Stressor Identification for Assessment Unit # ID17010104PN027_03

Lower Kootenai River Subbasin

March 11, 2009

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Summary

Assessment Unit #ID17010104PN027_03 includes the lowest portion of Brown Creek from the confluence with Twentymile Creek to Deep Creek. Stressor identification for Assessment Unit #ID17010104PN027_03 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 #ID17010104PN027_03 was listed in the Idaho DEQ 2002 Integrated Report Section 5 as impaired for reasons associated with temperature. In the Idaho DEQ 2008 Integrated Report Section 5, this assessment unit was listed as impaired for reasons associated with benthic macroinvertebrate bio-assessments and temperature. This stressor identification analysis was initiated to elucidate the causes of the bio-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 lower portion of Brown Creek to some extent would be expected to be a depositional area with high sediment bedload. However, there is only minor evidence that Brown Creek in this lowland section has had channel alterations leading to bank instability, partial removal and replacement of natural tree/shrub riparian vegetation, and some sedimentation issues. The most common stressor at all sites visited in the watershed, including the dry site, is a lack of flow. Thus, flow alteration appears to be the leading causes of macroinvertebrate loss. Therefore, the most likely causes of low biological/habitat scores in lower Brown Creek are flow alteration and possibly some habitat alteration and excess sediment.

Section 1.0 Scope of Investigation

Assessment Unit #ID17010104PN027_03 includes the lowest portion of Brown Creek flowing north from the Twentymile Creek confluence to Deep Creek (see Figures 1 & 2). This portion of the Brown Creek watershed runs through a narrow, forested canyon along a railroad track.

The Brown Creek watershed contains Brown Creek and Twentymile Creek, drainages that flow east to west until their confluence north of the town of Naples, Idaho. The watershed is largely a forested watershed that is mostly state and privately owned, although portions of the headwaters of Brown and Twentymile Creeks are within Kaniksu National Forest (see Figure 1). The middle portion of Brown Creek and a small portion of lower Twentymile Creek are found in the Paradise Valley area of mixed use, agricultural and woodlands.

Stressor identification for Assessment Unit #ID17010104PN027_03 was completed with aid from the CADDIS (Causal Analysis/Diagnosis Decision Information System) program (http://cfpub.epa.gov/caddis/), EPA's *Stressor Identification Guidance Document* (EPA, 2000), and from physical, chemical and biological data collected by Idaho DEQ, Idaho Department of Lands (IDL), U.S. Forest Service (USFS) and others.

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 #ID17010104PN027_03.

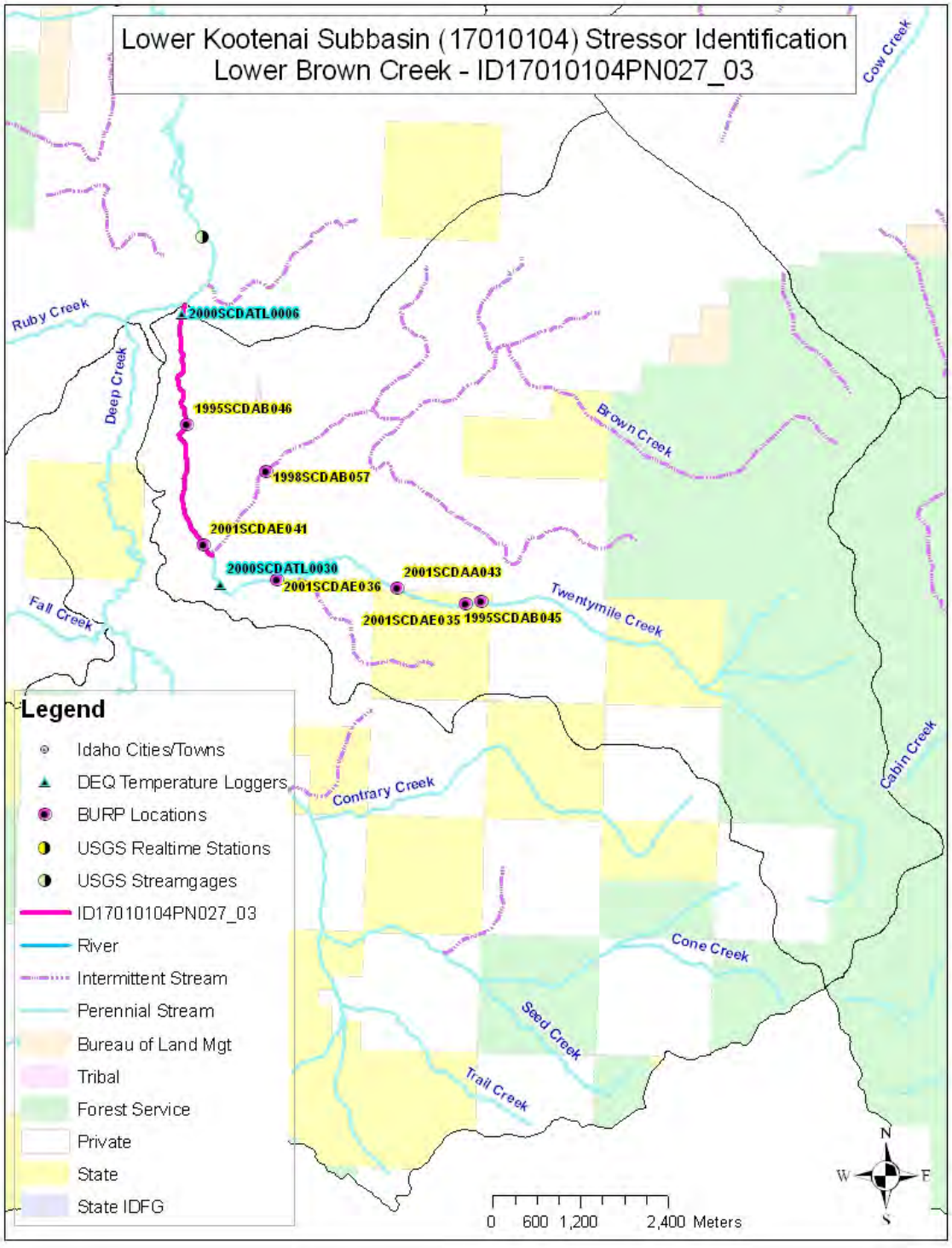
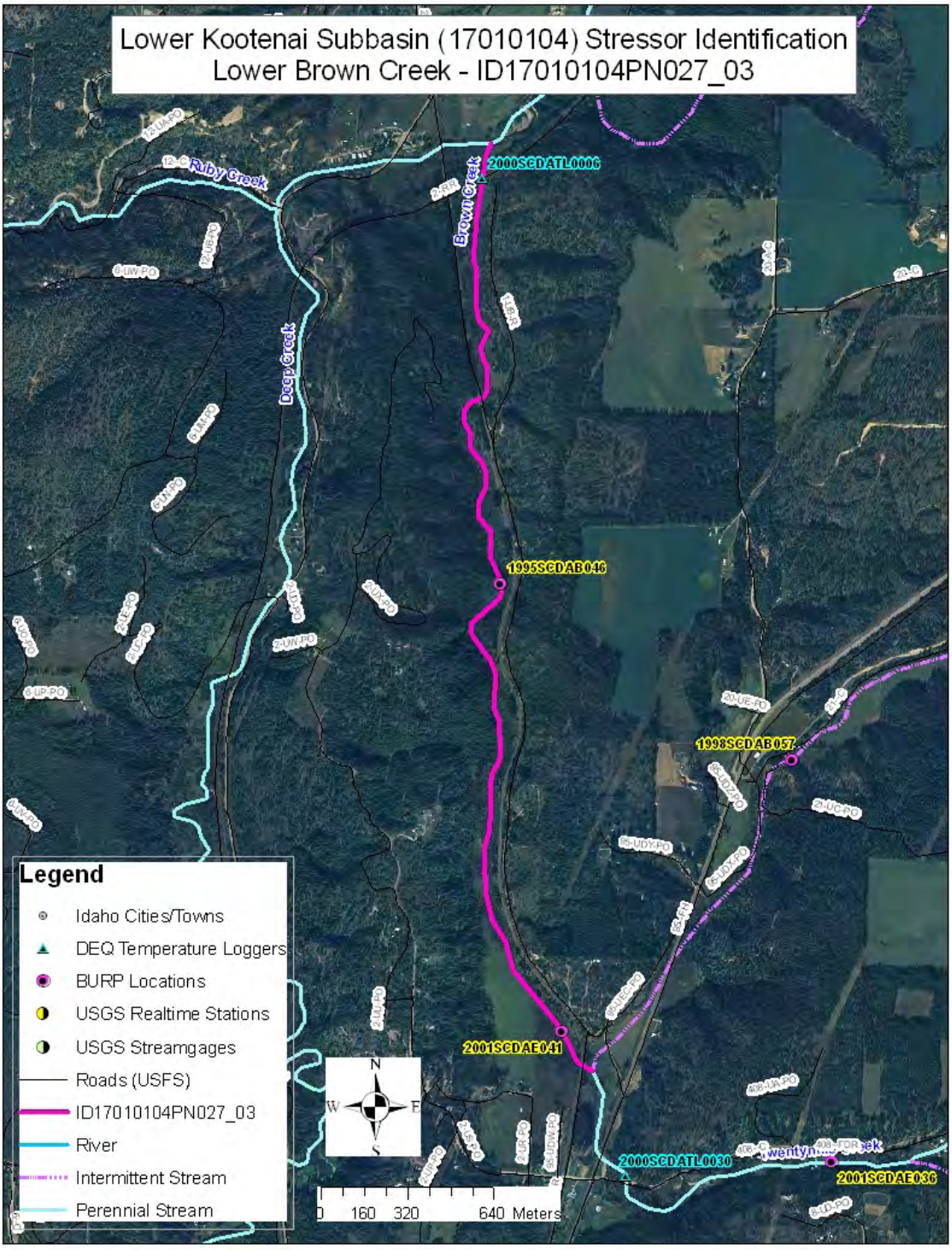


Figure 2. Aerial View of Assessment Unit #ID17010104PN027_03.



Section 2.0 Description of the Impairment

Assessment Unit #ID17010104PN027_03 was listed in the Idaho DEQ 2008 Integrated Report Section 5 as impaired for temperature and for reasons associated with benthic macroinvertebrate assessment scores. Essentially, this second listing indicates that BURP sampling in the assessment unit revealed that streams failed to pass assessment tests conducted on biological data.

Table 1 shows the index scores for the BURP sites in the assessment unit (2001SCDAE041 & 1995SCDAB046), as well as for several sites in the upper portion of the watershed. 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 #ID17010104PN027_03.

Assessment Unit	Stream	BURP ID	SMI (rating)	SFI (rating)	SHI (rating)	Overall Rating
ID17010104PN027_03	Brown Creek	2001SCDAE041	62.43 (2)	64.83 (1)	23 (1)	1.67
ID17010104PN027_03	Brown Creek	1995SCDAB046	36.8 (0)	N/A	48 (1)	0
ID17010104PN027_02	Brown Creek	1998SCDAB057	N/A	N/A	N/A	N/A
ID17010104PN028_02	Twentymile Cr	2001SCDAE036	64.9 (2)	66.91 (1)	57 (1)	1.67
ID17010104PN028_02	Twentymile Cr	2001SCDAA043	74.98 (3)	99.34 (3)	68 (3)	3
ID17010104PN028_02	Twentymile Cr	2001SCDAE035	71.94 (3)	97.27 (3)	78 (3)	3
ID17010104PN028_02	Twentymile Cr	1995SCDAB045	63.42 (2)	82.34 (3)	60 (2)	2.67

Note that in this assessment unit only two BURP sites on Brown Creek, one in the middle of the railroad canyon (1995SCDAB046, Photo 1) and the other near the confluence with Twentymile Creek (2001SCDAE041, Photos 2 & 3), were involved in the assessment. Other BURP sites in the watershed are on Twentymile Creek and are in a separate assessment unit. The 1998SCDAB057 BURP site on Brown Creek was further upstream in another assessment unit; however, this site was dry and produced no assessment scores. Therefore, the ID17010104PN027_03 assessment unit's biological impairment rating is solely based on results obtained from the first two sites in Table 1. Both sites had insufficient scores to pass the impairment test. Most of the Twentymile Creek sites in the next assessment unit did have sufficient scores. Electrofishing did not take place at 1995 site on Brown Creek, thus there are no fish (SFI) scores available for that site.

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 1995SCDAB046. .Looking downstream from sampled reach.

Note: photo misidentifies Brown Creek as Twentymile Creek.

Photo 2. BURP Site 2001SCDAE041. Looking upstream through sampled reach.

Photo 3. BURP Site 2001SCDAE041. Looking upstream from sampled reach.

Section 3.0 Candidate Causes

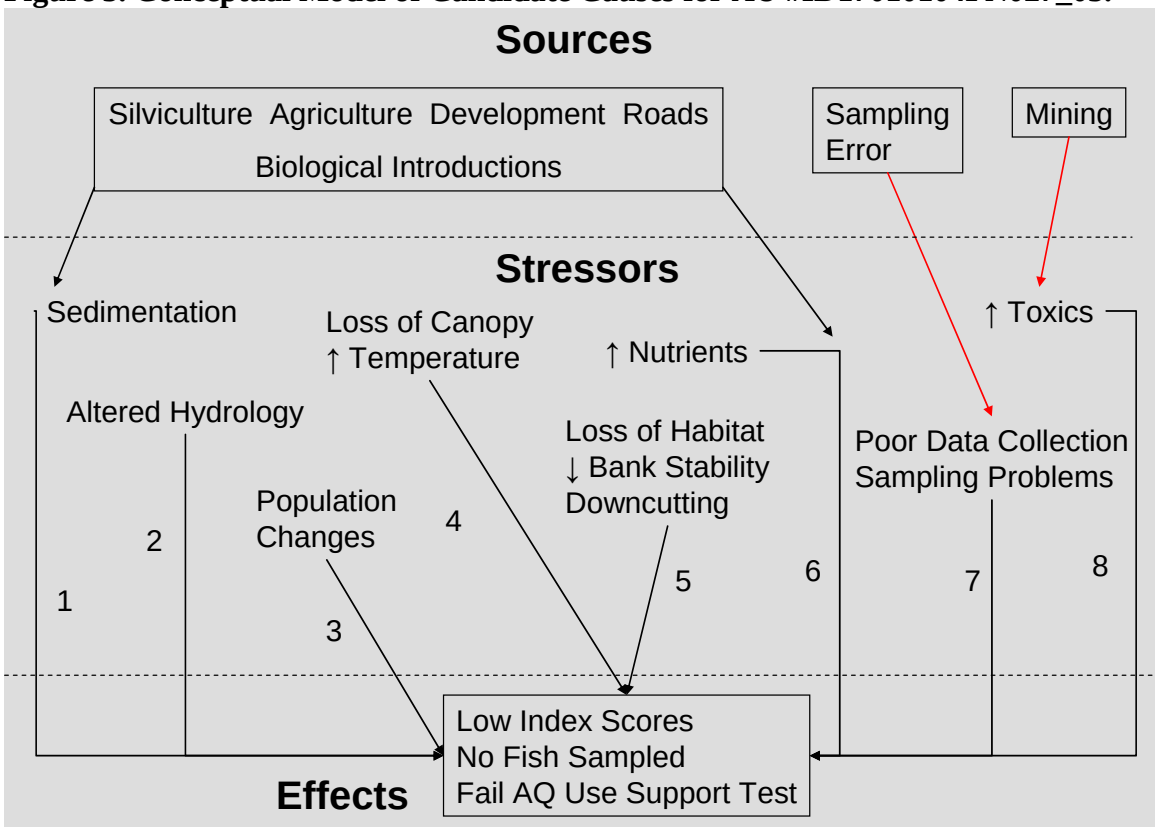
In order to suggest what may affect index scores for the assessment unit in question, a list of possible causes needs to be constructed. Figure 3 presents a simple conceptual model of candidate causes that may lead to poor biological/habitat scoring. The model presents eight candidate causes as stressors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

process where data were incorrectly interpreted or reported resulting in an incorrect assessment call.

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 #ID17010104PN027_03.



Section 4.0 Existing Data

Existing data for AU #ID17010104PN027_03 are very limited. No data have been acquired from USGS, Idaho Department of Lands, Idaho Fish and Game or U.S. Forest Service. Existing data for the assessment unit are solely based on BURP sites.

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 two BURP sites (2001SCDAE041 & 1995SCDAB046) in the assessment unit. Note that both sites had SHI scores insufficient to pass the assessment test. The lower site (1995SCDAB046) had metric values that showed low bank stability and a low embeddedness score when compared to the average of all BURP sites in the Lower Kootenai subbasin with passing SHI scores (Ave Supporting). The upper site (2001SCDAE041) had reduced canopy cover and somewhat high percent fines. Channel shape and embeddedness scores were very poor for the upper site.

Table 3. Habitat Metrics for BURP Sites in AU #ID17010104PN027_03.

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
2001SCDAE041	80	100	33	27.8	0	0	1.78	2.3	0.12	19.7	0.01	23
1995SCDAB046	85	50	N/A	N/A	2	7	0.47	5	N/A	N/A	1.7	48
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

The upper site in the assessment unit was the only site to be electrofished on Brown Creek by BURP crews (Table 4). Rainbow trout, brook trout and torrent sculpin were sampled at that site, thus cold water taxa and age class metrics look good. However, the site was dominated by brook trout which reduced the sensitive species percentage to produce a lower than average SFI score. Macroinvertebrate metrics (Table 5) for the upper site (2001SCDAE041) were generally similar to the average of all BURP sites in the Lower Kootenai subbasin with passing SMI scores (Ave Supporting), although Plecoptera (stonefly) taxa numbers were low. The lower site (1995SCDAB046) in the assessment unit showed a lack of species especially mayfly, stonefly and caddis fly (EPT) taxa when compared to the subbasin average supporting scores. Hilsenhoff Biotic Index (HBI) was also higher than the average supporting sites in the subbasin suggesting that pollution tolerant organisms were dominating the lower system. The loss of EPT taxa suggests that impacts have occurred on the lower portion of Brown Creek and are the driving mechanism inflicting macroinvertebrate impairment.

Table 4. Fish Metrics for BURP Sites in AU #ID17010104PN027_03.

BURP ID	Cold Water Taxa	% Cold Water	% Sensitive	Sculpin Age Classes	Salmonid Age Classes	CPUE	SFI
2001SCDAE041	2	100	14.3	2	4	1.49	64.8
Ave Supporting	1.97	93.9	59.3	1.1	3.1	8.7	81.1

Table 5. Macroinvertebrate Metrics for BURP Sites in AU #ID17010104PN027_03.

BURP ID	Total Taxa	Ephemeroptera Taxa	Plecoptera Taxa	Trichoptera Taxa	% Plecoptera	HBI	% Dominance of top 5 taxa	% Scraper	% Clinger	SMI
2001SCDAE041	43	7	3	10	9.5	5.84	66.7	23.4	51.3	62.4
1995SCDAB046	21	3	5	2	13.3	6.24	83.5	26	47.1	36.8
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 Brown Creek within and Twentymile Creek above the assessment unit are limited to temperature and one coliform bacteria sampling event. E. coli sample results are essentially not detected and, thus below Idaho WQS action levels. A temperature logger deployed on Brown Creek near the confluence with Deep Creek in 2000 showed numerous violations of the spring and fall salmonid spawning criteria as temperatures exceeded 13 °C from August 1st to September 19th. General cold water aquatic life criteria were never exceeded at this site. A temperature logger that was deployed in Twentymile Creek above the confluence with Brown Creek also during the year 2000 produced unreliable data as the logger went dry during deployment.

Table 6. Water Chemistry Data Collected in AU #ID17010104PN027_03.

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)	Suspended Sediment (mg/L)	Turbidity (JTU)
9/20/2001	Brown Creek	13.5(3:30pm)								0.01		
8/1/2000	Brown Creek	20.59(MDMT)										
9/10/2001	Twentymile Cr.	10.3(2pm)								0.15		
9/13/2001	Twentymile Cr.							<1	170			
9/17/2001	Twentymile Cr.	11.7(12pm)								0.42		
9/17/2001	Twentymile Cr.	19.1(4pm)								0.1		

*Temperatures are instantaneous readings unless otherwise noted.

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 some evidence that sedimentation is occurring in the lower reaches of Brown Creek. Habitat metrics such as percent fines and embeddedness scores at one site suggest that the assessment unit has been affected directly. The loss of EPT taxa that are generally sensitive to excess sediment may have resulted form sedimentation in the assessment reach. Low macroinvertebrate scores at the lower BURP site may indicate excess sediment has moved through this system and eliminated sensitive taxa.
2. Hydrological alteration cannot be ruled out. There was evidence of timber harvest activities in aerial photo (Figure 2) that could have led to changes in runoff characteristics and increased hydrologic loading. Changes in land use in the lower portion of the watershed that result from agricultural activities may also influence hydrologic characteristics. BURP site comments suggest that diversion of water for agricultural purposes may be taking place in the watershed. Measured flow is very low in most instances. A culvert photographed at the 2001SCDAE041 BURP site suggests this lack of flow (Photo 3).
3. Although it is a possible cause, there is no evidence of biological invasions that maybe affecting macroinvertebrate populations. Fish species include rainbow trout and brook trout, both of which may have been introduced. The culvert in Photo 3 maybe acting as a fish migration barrier as well.
4. Water temperature maybe a problem in the lower portion of the Brown Creek watershed. Measured temperature did exceed salmonid spawning criteria in spring and early fall.
5. There is evidence of loss of habitat through riparian alteration and possibly channel morphological changes. It has been noted that bank instability and low canopy cover has occurred in the lower reaches. These changes can lead to loss of habitat and a reduction in biological communities.
6. There is no evidence that nutrients are in excess in this assessment unit. To our knowledge visible slime growth, excess algae and other macrophytes have not been reported for streams in the assessment unit. However, no data have been collected on water chemistry to confirm normal nutrient status.
7. To our knowledge, BURP sampling occurred in an appropriate manner and there were no problems, sample mishandling nor loss of data. There were problems with the assessment process as originally the lack of fish data may have been

interpreted as a lack of fish in the stream. However, after review of the assessment data, it was discovered that the impairment call would likely result from a low macroinvertebrate score at one of the two BURP sites.

8. To our knowledge, there are no current or legacy mining activities in the assessment unit other than sand and gravel. There is one unknown entity that may have been exploration for uranium in the woodland north of site 2001SCDAA043. However, no water chemistry sampling has taken place to confirm a lack of toxic pollutants. The introduction of accidental spills cannot be ruled out.

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 excess nutrients, sampling error and toxic pollutants are not causing the problems associated with low biological scores in this assessment unit. It is likely that biological invasion by alien species is not prominent enough to cause low scores either. Temperature does appear to be playing a role in Brown Creek watershed as recognized by DEQ temperature data. There is some minor evidence that excess sediment and channel/habitat alteration have occurred. However, the most common stressor at all sites visited in the watershed, including the dry site, is a lack of flow. Thus, flow alteration appears to be the leading causes of macroinvertebrate loss.

Section 6.0 Conclusions

It is difficult to draw conclusions about the Assessment Unit # ID17010104PN027_03. Most of what we know about lower Brown Creek is from two BURP sites that revealed low macroinvertebrate, fish and habitat scores to fail assessment tests.

The lower portion of Brown Creek to some extent would be expected to be a depositional area with higher sediment bedload. However, there is only minor evidence that Brown Creek in this lowland section has had channel alterations leading to bank instability, partial removal and replacement of natural tree/shrub riparian vegetation, and some sedimentation issues. Therefore, the most likely causes of low biological/habitat scores in lower Brown Creek are flow alteration and possibly some habitat alteration and excess sediment.

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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