A SUPPLEMENTAL ASSESSMENT OF USE SUPPORT IN THE TETON RIVER BASED ON PERIPHYTON COMPOSITION AND COMMUNITY STRUCTURE

Prepared for:

State of Montana
Department of Environmental Quality
Monitoring and Data Management Bureau
P.O. Box 200901
Helena, Montana 59620-0901

Project Officer: Carol Endicott
DEQ Contract No. 200012

Prepared by:

Loren L. Bahls, Ph.D.
Hannaea
1032 Twelfth Avenue
Helena, Montana 59601

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SUMMARY

Composite periphyton samples were collected from natural substrates at 17 sites on the Teton River and tributaries in the summer of 1998. All but 6 of these samples were evaluated in an earlier report (Bahls 1999). This report evaluates the support of aquatic life uses at the remaining 6 sites: 3 on the North and South Forks and 3 on the mainstem of the Teton River.

All 6 sites supported relatively small amounts of periphyton growth. Insufficient numbers of diatoms were available in the samples from the North and South Forks for conducting diatom proportional counts, probably because of low nutrients.

The site at the **Gaging Station** had good water quality and only minor impairment. Increasing diatom species richness and diversity values and decreasing pollution index values indicated increasing nutrient enrichment between the lower site on the North Fork and the site at Breen's above Choteau.

Diatom metrics at the site **near Collins** indicated full support of aquatic life uses when compared to criteria developed for mountain streams, but only **partial support and moderate impairment** when compared to criteria for prairie streams. The probable causes of impairment here were siltation and nutrient enrichment.

The sites at **Kelly Ranch** and **Dent Bridge** had very similar diatom floras and metrics that indicated **moderate impairment and partial support of aquatic life uses**. These sites had very low diatom diversity for prairie streams and were dominated by a single species of free-living diatom. The probable causes of impairment here were siltation and habitat homogeneity (lack of habitat diversity).

INTRODUCTION

Composite periphyton samples were collected at 2 sites on McDonald Creek and 15 sites on the Teton River in 1998. Analyses of the McDonald Creek samples and of 9 of the Teton River samples were reported earlier (Bahls 1999). This report addresses the 6 Teton River samples that were not included in the earlier report.

This report evaluates the support of aquatic life uses, and probable causes of impairment to those uses in the Teton River. This evaluation is part of a larger assessment that was conducted by staff of the Montana Department of Environmental Quality.

Evaluation of use support in this report is based on the species composition and community structure of periphyton (benthic algae) communities at 6 sites that were sampled in July and August of 1998. The periphyton or phytobenthos community is a basic biological component of all aquatic ecosystems. Periphyton accounts for much of the primary production and biological diversity of Montana streams (Bahls et al. 1992).

Plafkin et al. (1989) and Stevenson and Bahls (1999) list several advantages of using periphyton in biological assessments of streams:

- Algae are universally present in large numbers in all streams and unimpaired periphyton assemblages typically support a large number (>30) of species;
- Algae have rapid reproduction rates and short life cycles, making them useful indicators of short-term impacts;
- As primary producers, algae are most directly affected by physical and chemical factors, such as temperature, nutrients, and toxins;
- Sampling is quick, easy and inexpensive, and causes minimal damage to resident biota and their habitat;
- Standard methods and criteria exist for evaluating the composition, structure, and biomass of algal associations;

- Identification to species is straightforward for the diatoms, for which there is a large body of taxonomic and ecological literature;
- Excessive algae growth in streams is often correctly perceived as a problem by the public.
- Periphyton and other biological communities reflect the *biological integrity*[1] of waterbodies; restoring and maintaining the biological integrity of waterbodies is a goal of the federal Clean Water Act;
- Periphyton and other biological communities integrate the effects of different stressors and provide a measure of their aggregate impact; and
- Periphyton and other biological communities may be the only practical means of evaluating impacts from non-point sources of pollution where specific ambient criteria do not exist (e.g., impacts that degrade habitat or increase nutrients).

Periphyton is a diverse assortment of simple photosynthetic organisms called algae, and other microorganisms that live attached to or in close proximity of the stream bottom. Most algae, such as the diatoms, are microscopic. Diatoms are distinguished by having a cell wall composed of opaline glass--hydrated amorphous silica. Diatoms often carpet a stream bottom with a slippery brown film.

Some algae, such as the filamentous greens, are conspicuous and their excessive growth may be aesthetically displeasing, deplete dissolved oxygen, interfere with fishing and fish spawning, clog irrigation intakes, create tastes and odors in drinking water, and cause other problems.

The federal Clean Water Act directs states to develop water

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[1] *Biological integrity* is defined as "the ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitats within a region" (Karr and Dudley 1981).

pollution control plans (Total Maximum Daily Loads or TMDLs) that set limits on pollution loading to water-quality limited waters. Water-quality limited waters are lakes and stream segments that do not meet water-quality standards, that is, that do not fully support their beneficial uses. The Clean Water Act and EPA regulations require each state to (1) identify waters that are water-quality limited, (2) prioritize and target waters for TMDLs, and (3) develop TMDL plans to attain and maintain water-quality standards for all water-quality limited waters.

The purpose of this report is to provide information that will help the State of Montana to determine whether certain segments of the Teton River are water-quality limited and in need of TMDLs.

PROJECT AREA AND SAMPLING SITES

The project area is in Teton and Chouteau Counties in northcentral Montana. The Teton River is a tributary of the Marias River in the Missouri River Drainage.

The North and South Forks of the Teton River head in the Bob Marshall Wilderness and converge just east of the Rocky Mountain Front about 20 miles west of Choteau, Montana. The Teton River begins in the Northern Rockies Ecoregion, flows across the Montana Valley and Foothill Prairies Ecoregion, and ends near Fort Benton in the Northern Great Plains Ecoregion (Omernik and Gallant 1987).

The Teton River is classified B-1 above Deep Creek near Choteau, B-2 between Deep Creek and Interstate 15, and B-3 from I-15 to the mouth. The Teton River is stressed by dewatering for agricultural irrigation, salinization (mostly discharges from Freezeout Lake and Priest Butte Lakes), channel instability, habitat alteration, and sedimentation (MDEQ 1998; Carol Endicott, MDEQ, personal communication).

The headwaters of the Teton River begin in the Overthrust Belt of the Northern Rocky Mountains. Here the surface geology consists of faulted blocks of Madison limestone alternating with sandstones, shales, and mudstones of the Kootenai Formation. At the base of the Rocky Mountain Front the Teton River flows across a band of Bearpaw Shale that is about 20 miles wide. The lower reaches of the river are underlain by Colorado Shale (Taylor and Ashley, undated).

Vegetation in the headwaters is mostly mixed conifer forest dominated by douglas-fir and lodgepole pine, with mixed fescue and wheatgrass grassland in the foothills, and shorter grasses (e.g., needleandthread and related species) on the plains (USDA 1976). The main land uses in the watershed are recreation, waterfowl and wildlife production, livestock grazing, hay production, and dryland farming. Choteau (pop. 1,729) is the largest town in the watershed.

Periphyton samples were collected at 3 sites on the Forks of the Teton River and 3 sites on the mainstem Teton River in July and August 1998 (maps; Table 1). The 3 sites on the mainstem extend from just below the forks to near the mouth. Elevations at the sampling sites range from about 6,000 feet at the upper sites on the North and South Forks to about 3,000 feet near the mouth of the Teton River near Loma, Montana.

METHODS

Periphyton samples were collected following standard operating procedures of the MDEQ Planning, Prevention, and Assistance Division. Using appropriate tools, microalgae were scraped, brushed, or sucked from natural substrates in proportion to the rank of those substrates at the study site. Macroalgae were picked by hand in proportion to their abundance at the site. All collections of microalgae and macroalgae were pooled into a common container and preserved with Lugol's (IKI) solution.

Samples were examined to estimate the relative abundance and rank by biovolume of diatoms and genera of soft (non-diatom) algae according to the method described in Bahls (1993). Soft algae were identified using Prescott (1978), Smith (1950), and Whitford and Schumacher (1984). These books also served as the main references on the ecology of the soft algae.

After the identification of soft algae, raw periphyton samples were cleaned of organic matter using sulfuric acid, and permanent diatom slides were prepared in a high refractive index mounting medium following *Standard Methods for the Examination of Water and Wastewater* (APHA 1998). For each slide, between 400 and 441 diatom cells (800 to 882 valves) were counted at random and identified to species. The following were used as the main taxonomic and autecological references for the diatoms: Krammer and Lange-Bertalot 1986, 1988, 1991a, 1991b; Patrick and Reimer 1966, 1975. Lowe (1974) was also used extensively as an ecological reference for the diatoms.

The diatom proportional counts were used to generate an array of diatom association metrics (Table 2). A metric is a characteristic of the biota that changes in some predictable way with increased human influence (Barbour et al. 1999).

Metric values from the Teton River were compared to numeric biocriteria developed for Montana streams (Tables 3 and 4). These criteria are based on metric values measured in least-impaired reference streams (Bahls et al. 1992) and on metric values measured in streams that are known to be impaired by various sources and causes of pollution (Bahls 1993).

Because of inherent differences in periphyton composition and community structure between mountain streams and prairie streams, two different sets of criteria are provided (Tables 3 and 4). For the purpose of periphyton assessment, mountain streams are those located in the Rocky Mountain and Montana Valley and Foothill Prairies Ecoregions (Omernik and Gallant 1987). These streams are generally classified B-1 and B-2 in the Montana Surface Water Quality Standards. Prairie streams are those located in the Great Plains Ecoregions and are generally classified B-3 and C-3.

Of the 6 sites addressed in this report, periphyton metrics from the forks of the Teton River and from the site just below their confluence will be compared to criteria for mountain streams in Table 3. Metrics from the site near the mouth at Kelly Ranch will be compared to criteria for prairie streams in Table 4. Metrics from the remaining site near Collins will be compared to criteria for both mountain and prairie streams.

The criteria in Tables 3 and 4 distinguish among four levels of impairment and three levels of aquatic life use support: no impairment or only minor impairment (full support); moderate impairment (partial support); and severe impairment (nonsupport). These impairment levels correspond to excellent, good, fair, and poor *biological integrity*, respectively.

Only periphyton samples collected in summer (June 21-September 21) can be compared with confidence to reference stream samples because metric values change seasonally and summer is the season in which reference streams and impaired streams were sampled for the purpose of biocriteria development.

Quality Assurance. Several steps were taken to assure that the study results are accurate and reproducible. Upon receipt of the samples, station and sample information were recorded in a laboratory notebook and samples were assigned a unique number compatible with the Montana Diatom Database, e.g., 1056-06. The first part of this number (1056) designates the sampling site (North Fork Teton River at Trailhead); the second part of the number (06) designates the number of periphyton samples that have been collected at this site to date for which data have been entered into the Montana Diatom Database.

Sample observations and analyses of soft (non-diatom) algae were recorded in a lab notebook along with station and sample information provided by MDEQ. A portion of the raw sample was used to make duplicate diatom slides.

On completion of the project, station information, sample information, and diatom proportional count data will be entered into the Montana Diatom Database. One set of diatom slides will be deposited in the University of Montana Herbarium in Missoula. The other set of slides will be retained by ***Hannaea*** in Helena.

RESULTS AND DISCUSSION

Results are presented in Tables 5, 6, and 7, located near the end of this report following the Literature Cited section. Spreadsheets containing completed diatom proportional counts, with species pollution tolerance classes (PTC) and calculated percent abundances, are attached as Appendix A.

SAMPLE NOTES

All of the following samples were preserved with alcohol. Because of the small numbers of diatoms in these samples, the entire volume of each sample was processed for preparing diatom slides.

North Fork Teton River at Trailhead (#2). No diatoms were observed in this sample during a 10 minute scan. Diatom slides were not prepared for this sample. The *Calothrix* in this sample was colonial, lacked heterocysts, and had filaments that extended beyond the sheaths, ending in fine points. This is a reference site for the mountain ecoregions (Bahls et al. 1992).

South Fork Teton River above Trailhead (#3). Only three diatom cells were observed during a 10 minute scan.

South Fork Teton River at Abbott's (#4). Diatoms were very sparse in this sample.

Teton River at Gaging Station (#1). Diatoms were sparse.

Teton River near Collins (#13). This sample was silty and diatoms were sparse.

Teton River at Kelly Ranch ("new site"). The *Cladophora* in this sample was senescent. The sample was silty.

NON-DIATOM ALGAE

Algae were sparse in all of the samples (Table 5). Diatoms were rare to common and the only group present at all of the sites. Besides diatoms, only two genera of green algae and two genera of bluegreen algae were present.

Diatoms were rare in the samples from the North and South Forks. The small standing crops of algae here probably reflect low nutrient concentrations at these sites. The mainstem supported larger standing crops. *Phormidium*, a eurytopic cyanobacterium with many species, was the most abundant taxon at these Teton River sites. *Cladophora* was present (but not abundant) only at the farthest downstream site (Kelly Ranch).

DIATOMS

The sample from the North Fork at the trailhead did not have enough diatoms to warrant making diatom slides. Slides prepared from samples collected at the 2 South Fork sites did not have enough diatoms to allow for a proportional count of 800 valves. For these reasons, diatom metrics could not be generated for these 3 sites.

The site at the **Gaging Station** below the forks was dominated by the pollution sensitive diatoms *Achnanthes minutissima* and *Gomphonema bohemicum* (Table 6). The number of species counted, diatom species diversity, pollution and siltation index values all indicated excellent water quality. Only minor impairment was indicated by the disturbance index and percent dominant species. This stress causing this impairment was probably natural in origin.

The **Gaging Station** site had about half of its diatom flora in common with the North Fork site upstream (Table 6). This is to be expected where two co-equal tributaries (i.e., the North and South Forks) join and their floras are combined. A larger change occurred between the Gaging Station and the next site downstream at Breen's; these two sites shared less than a third of their diatom floras. These 3 upper sites show progressively increasing species richness and diversity (Table 6), which is probably caused by inorganic nutrient enrichment. The site at Breen's shows minor impairment by nutrient enrichment.

When assessed using criteria developed for mountain streams, the site **near Collins** shows minor impairment because of depressed diversity and species richness, and a large percentage of the dominant diatom *Amphora pediculus* (Table 6). Most species of *Amphora* are motile (Round et al. 1990). *Amphora pediculus* is an alkaliphilous species, prefers large concentrations of inorganic nutrients, and is indifferent to small amounts of salt (Lowe 1974). It is rarely abundant in stream samples (Patrick and Reimer 1975). Large numbers of this diatom near Collins are probably a response to siltation and nutrient enrichment.

When compared to criteria developed for prairie streams, the site **near Collins** exhibited **moderate impairment and only partial support of aquatic life uses** (Table 7). This is because prairie streams are typically richer in species and have higher species diversity values than mountain streams. The site near Collins had very little in common, floristically, with the closest sites upstream (Highway 221) and downstream (Interstate 15).

The site at **Kelly Ranch** had a diatom flora that was very similar to the one at **Dent Bridge** (Table 7). The two sites shared over 80% of their diatom floras. **Both sites suffered from moderate impairment and partial support of aquatic life uses** as indicated by low diversity and dominance by a single species. Kelly Ranch also had a very small number of species for a prairie stream. The causes of impairment at both sites were probably siltation and the homogeneity of microhabitats (lack of habitat diversity).

Both the Kelly Ranch and Dent Bridge sites were dominated by *Cymbella sinuata* (=*Reimeria sinuata*). This is a free-living species (Round et al. 1990) with ecological requirements that are very similar to those of *Amphora pediculus* (Lowe 1974). *Amphora pediculus* was the second most abundant diatom at Kelly Ranch. Both species probably tolerate siltation because of their motility and/or free-living lifestyles. They are not included in the siltation index because they are seldom abundant in streams. Also common at both sites was *Navicula tripunctata*, a motile species that **is** included in the siltation index.

The diatom flora changed considerably between Kelly Ranch and the site near the mouth of the Teton River. These sites had less than a third of their floras in common (Table 7). Habitat conditions were evidently much improved near the mouth over conditions at Dent Bridge and Kelly Ranch.

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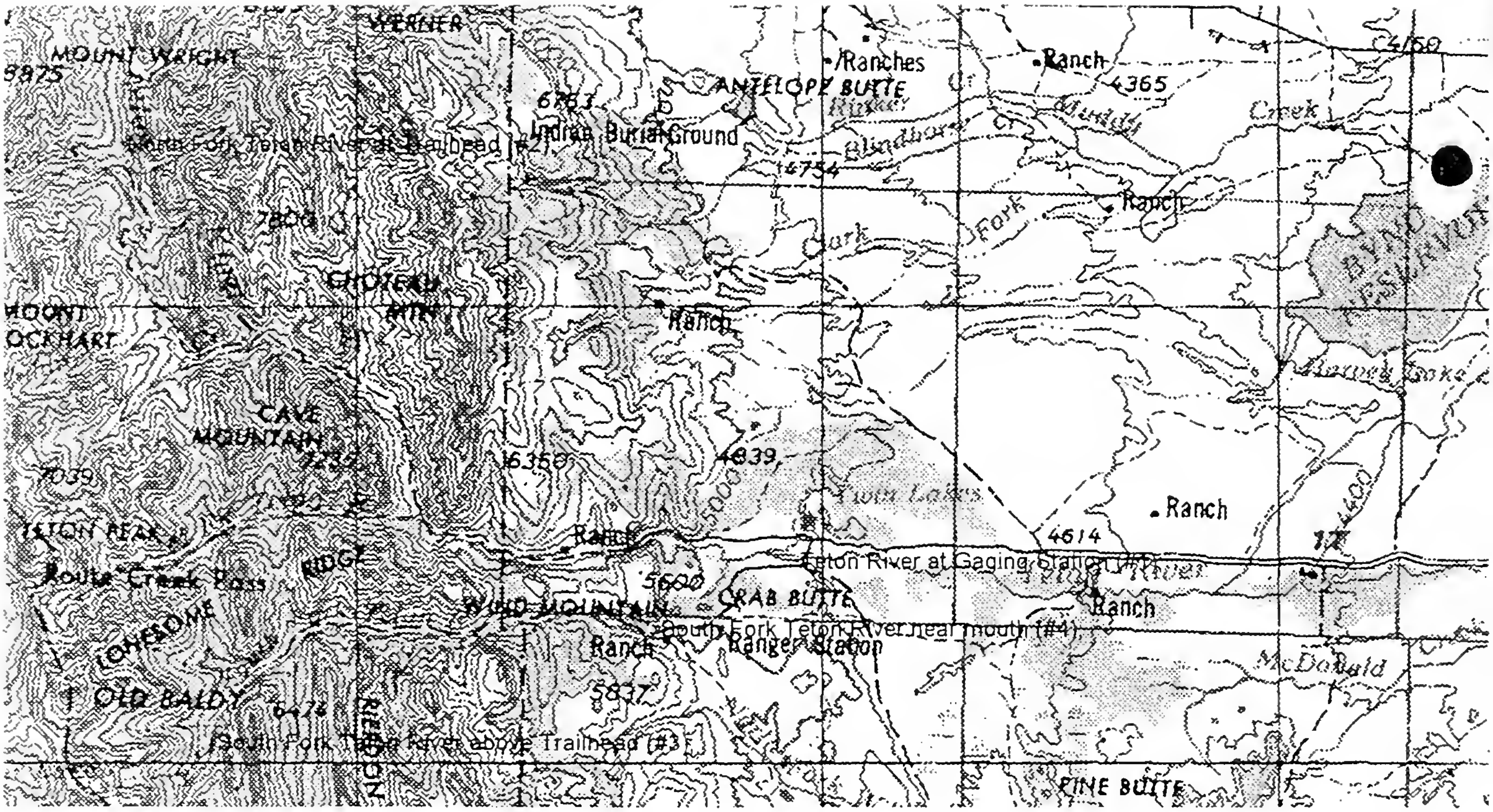
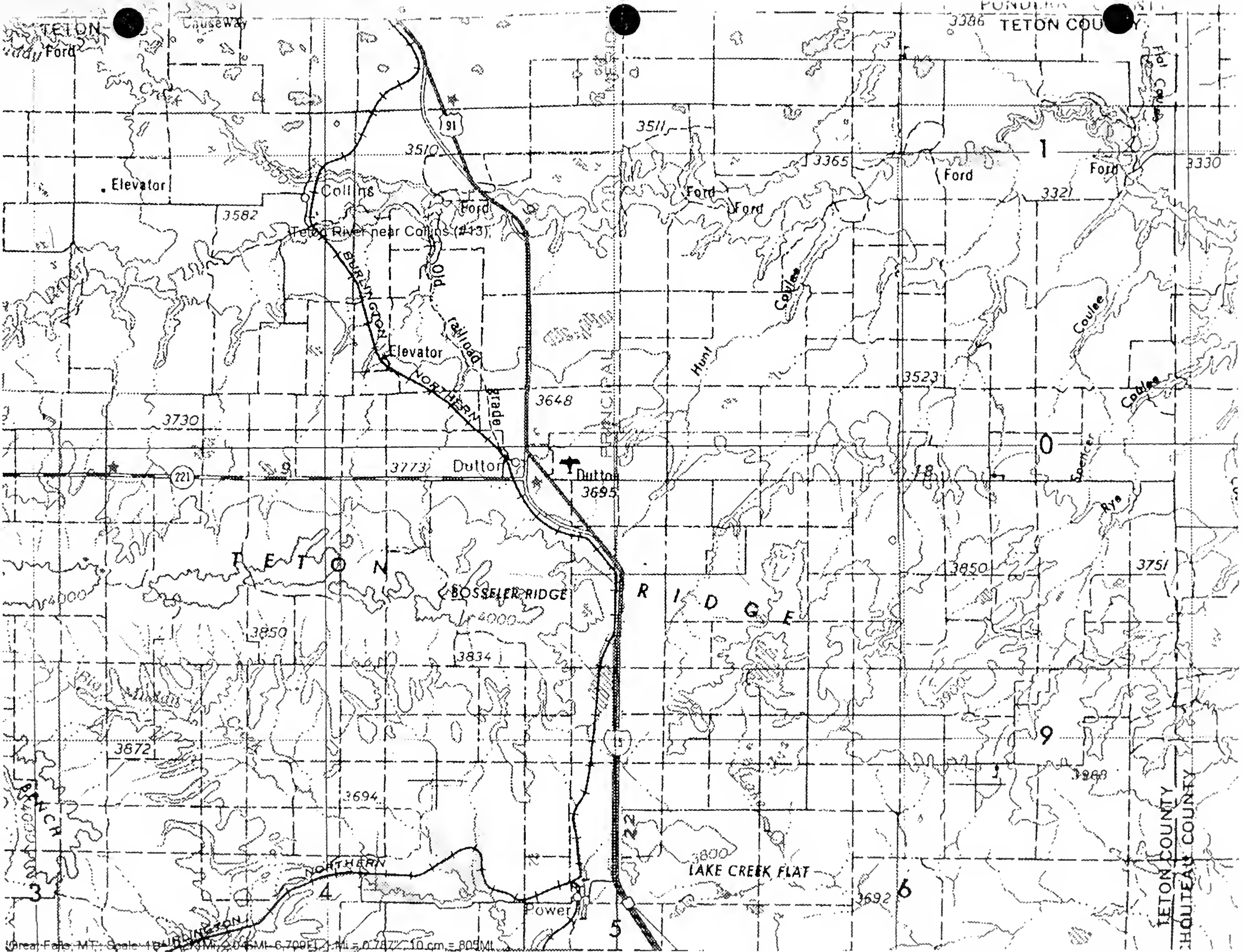
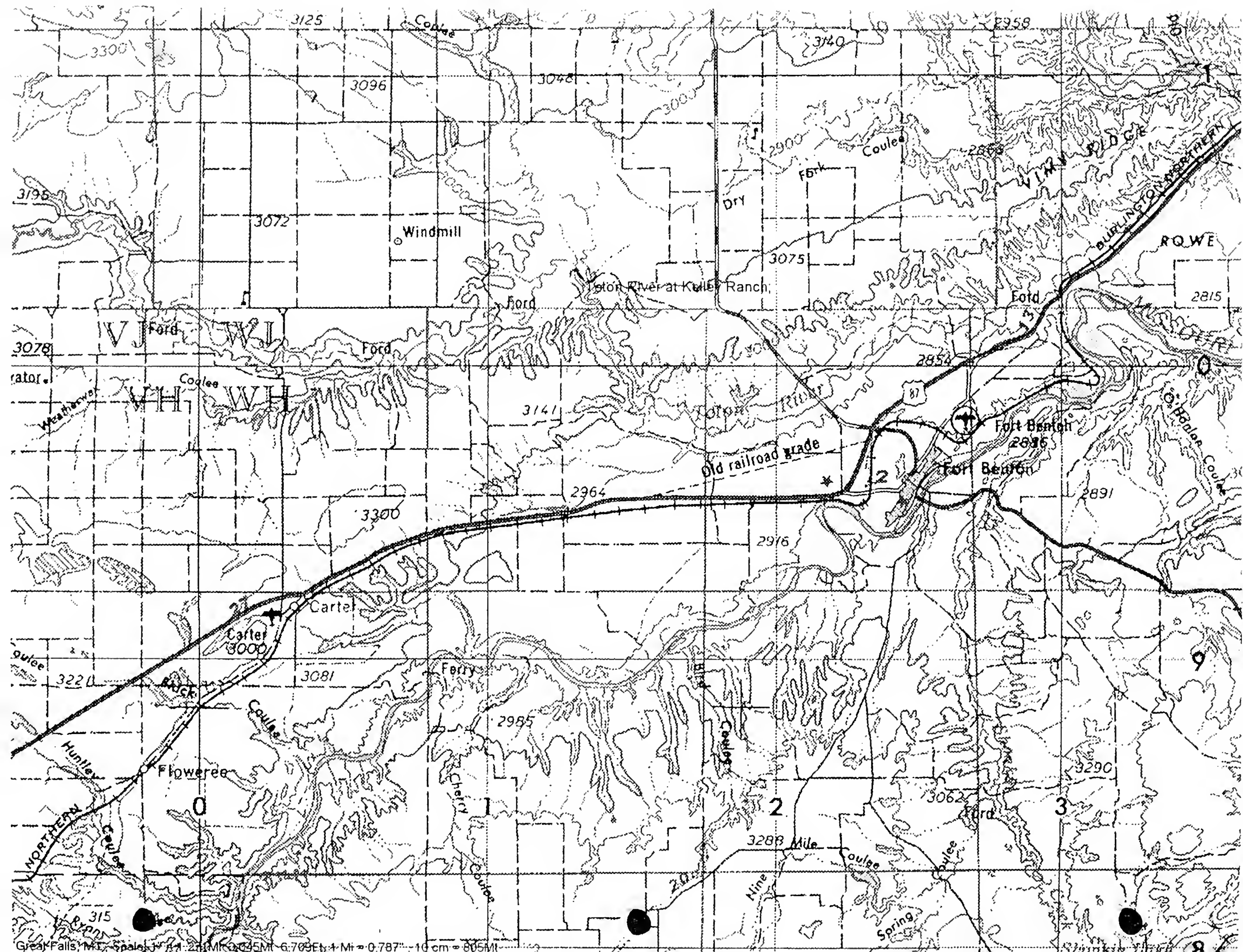


'Choteau, MT', Scale: 1" = 2.526Mi 4,064Mt 13,334Ft, 1 Mi = 0.396" , 10 cm = 1,600Mt




Fort Benton
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Fort Benton
Old railroad grade
Teton River at Kulley Ranch
Windmill
Dry Fork
Coulee
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Huntley
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Coulee
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Table 1. Location of periphyton sampling stations on the Teton River, MDEQ station code, sample number in the Montana Diatom Database, latitude/longitude, water quality classification, and sample date. Sites are listed in order from upstream to downstream.

Location	Station Code	Sample Number	Latitude/ Longitude	Water Quality Classification[1]	Sample Date
North Fork Teton River at Trailhead	#2	1056-06	47°57'49" N 112°48'31" W	B-1	07/21/98
South Fork Teton River above Trailhead	#3	1823-01	47°50'45" N 112°46'54" W	B-1	07/21/98
South Fork Teton River at Abbott's near mouth	#4	1824-01	47°52'06" N 112°39'05" W	B-1	07/21/98
Teton River at Gaging Station below North and South Forks	#1	0953-02	47°53'00" N 112°36'44" W	B-1	07/20/98
Teton River near Collins on Fuhringer's land	#13	1825-01	47°55'06" N 111°49'12" W	B-2	08/05/98
Teton River at Kelly Ranch	new station	1826-01	47°52'45" N 110°49'19" W	B-3	08/04/98

[1] Surface Water Quality Standards. Revised July 1994. Rule 16.20.607. Water-Use Classifications--Missouri River Drainage. Administrative Rules of Montana.

Table 2. Diatom association metrics used to evaluate biological integrity in Montana streams: reference, range of values in Montana streams, and expected direction of metric response to increasing anthropogenic perturbation or natural stress.

Metric	Reference	Range of Values	Expected Response
Shannon Species Diversity	Bahls 1979	0.00-5.00+	Decrease[1]
Pollution Index[2]	Bahls 1993	1.00-3.00	Decrease
Siltation Index[3]	Bahls 1993	0.00-90.0+	Increase
Disturbance Index[4]	Barbour *et al.* 1999	0.00-100.0	Increase
No. Species Counted	Bahls 1979, 1993	0-100+	Decrease[1]
Percent Dominant Species	Barbour *et al.* 1999	5.0-100.0	Increase
Percent Abnormal Cells	McFarland *et al.* 1997	0.0-20.0+	Increase
Similarity Index	Whittaker 1952	0.0-80.0+	Decrease

[1] Shannon diversity and species richness may increase somewhat in naturally nutrient-poor mountain streams in response to slight to moderate increases in nutrients or sediment.

[2] This is a composite numeric expression of the pollution tolerances assigned by Lange-Bertalot (1979) to the common diatom species.

[3] Computed as the sum of the percent abundances of all species in the genera *Navicula*, *Nitzschia*, and *Surirella*. These are common genera of predominantly motile taxa that are able to maintain their positions on the substrate surface in depositional environments.

[4] Computed as the percent abundance of *Achnanthes minutissima*. This attached taxon typically dominates early successional stages of benthic diatom associations and resists chemical, physical and biological disturbances in the form of metals toxicity, substrate scour by high flows and fast currents, and grazing by macroinvertebrates.

Table 3. Criteria for rating levels of biological integrity, environmental impairment or natural stress, and aquatic life use support in wadeable **mountain** streams of Montana using selected metrics for benthic diatom associations. The lowest rating for any one metric is the overall rating for the study site.

Biological Integrity/ Impairment or Natural Stress/Use Support	Diversity Index (Shannon)	Pollution Index	Siltation Index	Disturbance Index	Number of Species Counted	Percent Dominant Species	Percent Abnormal Cells	Similarity Index[1]
Excellent None/Full Support	>2.99	>2.50	<20.0	<25.0	>29	<25.0	0.0	>59.9
Good/Minor Full Support	2.00-2.99	2.01-2.50	20.0-39.9	25.0-49.9	20-29	25.0-49.9	>0.0-<1.0	40.0-59.9
Fair/Moderate Partial Support	1.00-1.99	1.50-2.00	40.0-59.9	50.0-74.9	10-19	50.0-74.9	1.0-9.9	20.0-39.9
Poor/Severe Nonsupport	<1.00	<1.50	>59.9	>74.9	<10	>74.9	>9.9	<20.0

[1] The Similarity Index or Percent Community Similarity (Whittaker 1952) may be used to compare a study site to an unimpaired upstream control site on the same stream. This metric measures the degree of floristic similarity between diatom associations at the two sites and is the sum of the smaller of the two percent abundance values for each species that is common to both sites. Adjacent riffles on the same stream, without intervening tributaries or environmental perturbations, will generally have at least 60% of their diatom floras in common (Bahls 1993). PCS may also be used to guage the relative amount of impairment or recovery that occurs between adjacent study sites: >59.9% = very similar floras, no change; 40.0-59.9% = somewhat similar floras, minor change; 20.0-39.9% = somewhat dissimilar floras, moderate change; <20.0% = very dissimilar floras, major change.

Table 4. Criteria for rating levels of biological integrity, environmental impairment or natural stress, and aquatic life use support in wadeable **plains** streams of Montana using selected metrics for benthic diatom associations. The lowest rating for any one metric is the overall rating for the study site.

Biological Integrity/ Impairment or Natural Stress/Use Support	Diversity Index (Shannon)	Pollution Index	Siltation Index	Disturbance Index	Number of Species Counted	Percent Dominant Species	Percent Abnormal Cells	Similarity Index[1]
Excellent None/Full Support	>3.99	>2.25	<50.0	<25.0	>39	<25.0	0.0	>59.9
Good/Minor Full Support	3.00-3.99	1.76-2.25	50.0-69.9	25.0-49.9	30-39	25.0 49.9	>0.0-<1.0	40.0-59.9
Fair/Moderate Partial Support	2.00-2.99	1.25-1.75	70.0-89.9	50.0-74.9	20-29	50.0-74.9	1.0-9.9	20.0-39.9
Poor/Severe Nonsupport	<2.00	<1.25	>89.9	>74.9	<20	>74.9	>9.9	<20.0

[1] The Similarity Index or Percent Community Similarity (Whittaker 1952) may be used to compare a study site to an unimpaired upstream control site on the same stream. This metric measures the degree of floristic similarity between diatom associations at the two sites and is the sum of the smaller of the two percent abundance values for each species that is common to both sites. Adjacent riffles on the same stream, without intervening tributaries or environmental perturbations, will generally have at least 60% of their diatom floras in common (Bahls 1993). PCS may also be used to guage the relative amount of impairment or recovery that occurs between adjacent study sites: >59.9% = very similar floras, no change; 40.0-59.9% = somewhat similar floras, minor change; 20.0-39.9% = somewhat dissimilar floras, moderate change; <20.0% = very dissimilar floras, major change.

Table 5. Estimated relative abundance of algal cells and rank by volume of diatoms and genera of non-diatom algae in periphyton samples collected from the Teton River in July and August 1998. R = rare, C = common, VC = very common, A = abundant, VA = very abundant.

Taxa	N. Fork Trailhead	S. Fork Trailhead	S. Fork near mouth	Gaging Station	Near Collins	Kelly Ranch
Chlorophyta						
Cladophora						C(2)
Mougeotia				R(3)		
Chrysophyta						
Diatoms	R(3)	R(1)	R(1)	C(2)	C(2)	C(3)
Cyanophyta						
Calothrix	VC(1)					
Phormidium	C(2)	R(2)		A(1)	A(1)	A(1)

Table 6. Percent abundance of major diatom species[1] and values of selected diatom association metrics for periphyton samples collected from upper Teton River sites in July and August 1998. Underlined values indicate full support of aquatic life uses with minor impairment; **bold values** indicate partial support of aquatic life uses with moderate impairment; **underlined and bold values** indicate nonsupport of aquatic life uses with severe impairment based on criteria for wadeable mountain streams in Table 3.

Species/Metric (Pollution Tolerance Class)	North Fork near mouth	Gaging Station	Breen's (above Choteau)	Near Collins
Achnanthes minutissima (3)	30.50	29.72	11.75	4.63
Amphora pediculus (3)		0.24	0.37	47.80
Cocconeis placentula (3)	10.12	1.77	0.50	0.35
Cymbella sinuata (3)	4.25	3.77		16.67
Gomphonema bohemicum (3)	0.75	12.62		
Gomphonema pumilum (3)	10.50		1.25	
Gomphonema subtile (3)	11.75	1.42	0.87	
Synedra ulna (2)	0.50	0.83	19.25	0.12
Number of Cells Counted	400	424	400	432
Shannon Species Diversity	3.57	4.11	4.49	2.59
Pollution Index	2.94	2.84	2.42	2.94
Siltation Index	0.62	3.68	2.73	9.14
Disturbance Index	30.50	29.72	11.75	4.63
Number of Species Counted	36	48	62	24
Percent Dominant Species	30.50	29.72	19.25	47.80
Percent Abnormal Cells	0.00	0.00	0.00	0.00
Similarity Index		50.89	31.63	

[1] A major diatom species is here defined as one that accounts for 10.0 percent or more of the diatom cells that were counted at one or more stations in a sample set.

Table 7. Percent abundance of major diatom species[1] and values of selected diatom association metrics for periphyton samples collected from the lower Teton River in August 1998. <u>Underlined values</u> indicate full support of aquatic life uses with minor impairment; **bold values** indicate partial support of aquatic life uses with moderate impairment; <u>**underlined and bold values**</u> indicate nonsupport of aquatic life uses with severe impairment based on criteria for wadeable prairie streams in Table 4.

Species/Metric (Pollution Tolerance Class)	Highway 221	Near Collins	Interstate 15	Dent Bridge	Kelly Ranch	Near Mouth
Achnanthes minutissima (3)	24.50	4.63	17.25	0.50	1.47	28.25
Amphora pediculus (3)	0.25	47.80	3.62	3.00	12.02	7.37
Cymbella minuta/silesiaca (2)	10.50		0.62	0.12	0.23	
Cymbella sinuata (3)	0.50	16.67	1.75	63.12	64.40	14.37
Diatoma tenue (2)	15.12		0.50			
Fragilaria vaucheriae (2)	18.12		0.87			1.25
Navicula cryptotenella (2)	1.37	0.23	12.00	0.25		6.37
Navicula tripunctata (3)	0.12	5.67	3.00	10.62	8.73	1.37
Nitzschia frustulum (2)	0.25	0.23	12.37		1.36	10.37
Number of Cells Counted	400	432	400	400	441	400
Shannon Species Diversity	<u>3.66</u>	**2.59**	4.60	**2.49**	**2.09**	<u>3.69</u>
Pollution Index	2.27	2.94	2.43	2.91	2.90	2.58
Siltation Index	12.70	9.14	<u>54.31</u>	15.08	12.25	27.09
Disturbance Index	24.50	4.63	17.25	0.50	1.47	<u>28.25</u>
Number of Species Counted	52	**24**	70	45	**23**	41
Percent Dominant Species	24.50	<u>47.80</u>	17.25	**63.12**	**64.40**	<u>28.25</u>
Percent Abnormal Cells	<u>0.50</u>	0.00	0.00	0.00	0.00	0.00
Similarity Index		9.21	17.77		81.03	28.58

[1] A major diatom species is here defined as one that accounts for 10.0 percent or more of the diatom cells that were counted at one or more stations in a sample set.

DIATOM PROPORTIONAL COUNTS

Sample	Genus/Species/Variety	PTC	Count	Percent
095302	Achnanthes biasolettiana	3	56	6.60
095302	Achnanthes laevis	3	7	0.83
095302	Achnanthes minutissima	3	252	29.72
095302	Amphora inariensis	3	2	0.24
095302	Amphora pediculus	3	2	0.24
095302	Caloneis bacillum	2	5	0.59
095302	Cocconeis placentula	3	15	1.77
095302	Cyclotella meneghiniana	2	2	0.24
095302	Cymbella affinis	3	52	6.13
095302	Cymbella cesatii	3	2	0.24
095302	Cymbella cymbiformis	3	6	0.71
095302	Cymbella delicatula	3	10	1.18
095302	Cymbella hebridica	3	8	0.94
095302	Cymbella microcephala	2	8	0.94
095302	Cymbella minuta	2	7	0.83
095302	Cymbella silesiaca	2	8	0.94
095302	Cymbella sinuata	3	32	3.77
095302	Denticula subtilis	2	9	1.06
095302	Diatoma hiemale	3	13	1.53
095302	Diatoma vulgare	3	3	0.35
095302	Diploneis oblongella	3	2	0.24
095302	Eunotia sp.	3	2	0.24
095302	Fragilaria brevistriata	3	4	0.47
095302	Fragilaria capucina	2	2	0.24
095302	Fragilaria construens	3	12	1.42
095302	Fragilaria leptostauron	3	13	1.53
095302	Fragilaria pinnata	3	28	3.30
095302	Fragilaria vaucheriae	2	27	3.18
095302	Gomphonema angustatum	2	4	0.47
095302	Gomphonema bohemicum	3	107	12.62
095302	Gomphonema minutum	3	43	5.07
095302	Gomphonema olivaceoides	3	14	1.65
095302	Gomphonema parvulum	1	9	1.06
095302	Gomphonema subtile	3	12	1.42
095302	Hannaea arcus	3	20	2.36
095302	Meridion circulare	3	2	0.24
095302	Navicula cryptotenella	2	5	0.59
095302	Navicula exilis	2	1	0.12
095302	Navicula gregaria	2	2	0.24
095302	Navicula subtilissima	3	2	0.24
095302	Navicula tripunctata	3	1	0.12
095302	Nitzschia amphibia	2	7	0.83
095302	Nitzschia dissipata	3	3	0.35
095302	Nitzschia fonticola	3	2	0.24
095302	Nitzschia linearis	2	2	0.24
095302	Nitzschia palea	1	6	0.71
095302	Synedra rumpens	2	10	1.18
095302	Synedra ulna	2	7	0.83

Sample	Genus/Species/Variety	PTC	Count	Percent
182501	Achnanthes biasolettiana	3	25	2.89
182501	Achnanthes minutissima	3	40	4.63
182501	Amphora inariensis	3	84	9.72
182501	Amphora libyca	3	1	0.12
182501	Amphora pediculus	3	413	47.80
182501	Caloneis bacillum	2	1	0.12
182501	Cocconeis placentula	3	3	0.35
182501	Cymatopleura solea	2	1	0.12
182501	Cymbella affinis	3	2	0.23
182501	Cymbella amphicephala	3	2	0.23
182501	Cymbella muelleri	2	6	0.69
182501	Cymbella sinuata	3	144	16.67
182501	Denticula kuetzingii	3	39	4.51
182501	Gomphonema olivaceum	3	5	0.58
182501	Gomphonema parvulum	1	4	0.46
182501	Navicula caterva	2	7	0.81
182501	Navicula cryptotenella	2	2	0.23
182501	Navicula reichardtiana	2	2	0.23
182501	Navicula tripunctata	3	49	5.67
182501	Nitzschia amphibia	2	15	1.74
182501	Nitzschia dissipata	3	2	0.23
182501	Nitzschia frustulum	2	2	0.23
182501	Rhopalodia gibba	2	4	0.46
182501	Synedra ulna	2	1	0.12

Sample	Genus/Species/Variety	PTC	Count	Percent
182601	Achnanthes minutissima	3	13	1.47
182601	Amphora fogediana	3	2	0.23
182601	Amphora inariensis	3	9	1.02
182601	Amphora pediculus	3	106	12.02
182601	Caloneis amphisbaena	2	3	0.34
182601	Caloneis bacillum	2	9	1.02
182601	Caloneis silicula	2	17	1.93
182601	Cymbella muelleri	2	8	0.91
182601	Cymbella silesiaca	2	2	0.23
182601	Cymbella sinuata	3	568	64.40
182601	Denticula kuetzingii	3	7	0.79
182601	Epithemia sorex	3	13	1.47
182601	Fragilaria construens	3	4	0.45
182601	Gomphonema parvulum	1	5	0.57
182601	Hantzschia amphioxys	2	3	0.34
182601	Navicula capitatoradiata	2	8	0.91
182601	Navicula tripunctata	3	77	8.73
182601	Nitzschia amphibia	2	6	0.68
182601	Nitzschia dissipata	3	3	0.34
182601	Nitzschia frustulum	2	12	1.36
182601	Nitzschia hungarica	2	2	0.23
182601	Pinnularia microstauron	2	2	0.23
182601	Rhopalodia operculata	1	3	0.34