# Sampling and Analysis Plan for Sediment TMDL Implementation Evaluation of Big Creek and Coal Creek, Tributaries to the North Fork of the Flathead River

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# 1.0 Introduction

This document constitutes the Sampling and Analysis Plan (SAP) for data collection efforts by Montana DEQ's Watershed Protection Section that will be used to evaluate the status of sediment impacts to the fishery and aquatic life beneficial uses of Big Creek and Coal Creek. Under the provisions of the Clean Water Act Section 303(d) these two tributaries to the North Fork of the Flathead River are considered to have water quality impaired by anthropogenic sources of sediment, for which Total Maximum Daily Loads have been established by the Montana Department of Environmental Quality and the U.S. Environmental Protection Agency.

The scope of this study is to assess the progress of TMDL implementation efforts. This evaluation of TMDL implementation effectiveness is not intended to assess the support of beneficial uses, but instead is intended to determine whether the TMDLs have been satisfied in Big Creek and to collect data for trend monitoring in Coal Creek. Attainment of the conditions established by the TMDLs provides a strong indication of compliance with water quality standards. Therefore, if it is determined that the TMDLs for Big Creek have been satisfied, the Watershed Protection Section will request a formal reassessment of beneficial use support by Montana DEQ's Monitoring and Assessment Section. If it is determined that the TMDLs have not been satisfied, as per MCA 75-5-703 Subsection (9), the Watershed Protection Section will make a recommendation that: 1) the implementation of a new or improved phase of voluntary reasonable land, soil, and water conservation practice is necessary; 2) water quality is improving but a specified time is needed for compliance with water quality standards; or 3) revisions to the TMDL are necessary to achieve applicable water quality standard.

The Montana water use classification for Big Creek and Coal Creek is B-1, which designates that their waters "…are to be maintained suitable for drinking, culinary, and food processing purposes, after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply." (ARM 17.30.623) The applicable State of Montana water quality standard that provides the evaluation context for this investigation will collect data to address is expressed in section (f) of ARM 17.30.623 which states that: "No increases are allowed above naturally occurring concentrations of sediment or suspended sediment (except as permitted in 75-5-318, MCA), settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife." Compliance with this narrative water quality standard in Big and Coal Creeks is achieved through the attainment of TMDL targets and/or other appropriate water quality measures that represent the current available science.

# 2.0 Background Information

## *2.1 Big Creek*

The Big Creek watershed drains approximately 207 $km^2$ of the eastern slope of the Whitefish mountain range in Flathead County. At the landscape level, the watershed is composed of the *Western Canadian Rockies ecoregion*, with a lesser proportion of the watershed rising into the *Crestal Alpine-Subalpine Zone ecoregion* (Woods et al. 2002). Big Creek is approximately 15.7 miles long and is a major tributary to the North Fork of the Flathead River. The Big Creek watershed is entirely within the jurisdiction of the United States Forest Service. The headwaters of Big Creek drain the north slope of Big Mountain where a recreational downhill ski area is maintained.

Big Creek, from headwaters to mouth (water body segment ID MT76Q002_050) has been identified by the State of Montana as being water quality limited. Big Creek was placed on the State of Montana's 1996 303(d) list due to the impairment of the fishery and aquatic life beneficial uses by habitat alterations and sedimentation, which was later confirmed through a review of sufficient and credible data during 1999. Sedimentation was listed as a cause of impairment due to impacts upon bull trout spawning habitat associated with historic logging practices. Habitat alterations were listed as a cause of impairment due to perceived channel morphology impacts from increased water and sediment supplies associated with historic logging practices. All other designated beneficial uses for Big Creek have been determined to be fully supporting, except for drinking water, which has not been assessed.

In accordance with the federal Clean Water Act a water quality restoration plan for Big Creek was completed in 2003 through a joint effort by MT DEQ and the USFS (MT DEQ, 2003). The water quality restoration plan for Big Creek can be described as a performance-based TMDL in that the plan called for the achievement of a substantial reduction in sediment loading to Big Creek through implementation of specific soil, land, and water conservation practices in order to achieve full support of Big Creek's fishery and aquatic life beneficial uses (MT DEQ, 2003), although no specific load allocations were identified for sediment- the pollutant of concern. In order to evaluate attainment of the narrative water quality standard for sediment, a number of water quality targets were identified in the watershed restoration plan. The water quality targets established for Big Creek as described in Section 3.0 of the watershed restoration plan (MT DEQ, 2003) state that:

- The channel substrate in fish spawning areas should contain less than 30% fine sediment (<6.35mm) as measured through McNeil core sampling.
- The estimated erosion rates in monitored reaches should not be significantly greater than 125% of erosion rates in reference reaches.
- Successful re-vegetation and/or protection of at least 75% of the identified sediment sources should occur.

The plan also called for monitoring of macroinvertebrate and periphyton communities in order to provide additional confirmation of beneficial use support. The plan for Big Creek stated that MT FWP was responsible for performing annual McNeil core sampling at one site within the watershed, that the USFS was responsible for annual monitoring of channel cross-sections &

bank profiles, annual performing pebble counts, and calculating bank erosion indices, and that MT DEQ was responsible for collecting macroinvertebrate and periphyton data once every five years.

The available McNeil core data from FWP (unpublished) collected between 2004 and 2008 subsequent to TMDL completion indicates a median percentage of subsurface fines sediment (<6.35mm) of 32.6% in the primary spawning area for migratory bull trout in Big Creek. This value is significantly lower than the maximum of 53.4% fines measured in 1990, but has not yet breached the 30% threshold established by the TMDL. However, the 32.6% fines value is lower than the 35% target used by the EPA and DEQ to assess sediment conditions in all other tributaries to the North Fork of the Flathead. FWP considers spawning areas to be threatened once subsurface fines exceed 35% (Weaver, 2005). Although it is clear that the Big Creek values have not attained the TMDL target value, there have been questions about whether the 30% subsurface fines value for Big Creek is too stringent and should be revised to 35%. Information from the USFS suggests that all reasonable land, soil, and water conservation practices have been enacted in the Big Creek watershed. In accordance with TMDL target #3 listed above, a memo information from the USFS indicates that successful re-vegetation and protection of at least 75% of the identified upland sediment sources has occurred (DeHerrera, 2009). However, there is insufficient data to evaluate whether these restoration activities have translated to reductions in in-stream sediment impacts. With regard to TMDL target #2 above, there is no data available to assess bank erosion rates in Big Creek since the USFS has determined that current bank erosion rates along Big Creek are naturally occurring. In-stream monitoring data that can be used to determine whether the conservation practices have been effective at reducing sediment and habitat impacts to fish and aquatic life is lacking. Bank erosion rates will not be analyzed since a rigorous assessment of instream sediment parameters will allow a determination of whether sediment from upland or anthropogenic bank erosion sources has been mitigated.

## *2.2 Coal Creek*

The Coal Creek watershed drains approximately 210 $km^2$ of the eastern slope of the Whitefish Mountain range in Flathead County. At the landscape level, the watershed is composed entirely of the *Western Canadian Rockies ecoregion* (Woods et al. 2002). Most of the Coal Creek watershed is within the jurisdiction of the United States Forest Service, however most of the Coal Creek water body segment is within the Coal Creek State Forest and there is a significant amount of private land in the lower watershed. The water body segment of primary concern in the Coal Creek watershed is identified by the State of Montana as *Coal Creek, from the confluence of the north and south forks to the mouth* (MT76Q002_080) and is approximately 10 miles in length.

The TMDL document for Coal Creek included an assessment to verify sediment impairment to Coal Creek which determined that the fishery beneficial use of Coal Creek was impaired by sedimentation (EPA, 2004). The fishery beneficial use was judged to be impaired by sedimentation associated with historic logging practices. A TMDL for sediment was established for Coal Creek by the U.S. Environmental Protection Agency during 2004. The TMDL targets established for Coal Creek provide thresholds through which the attainment of the narrative sediment water quality standard can be evaluated. The following sediment TMDL targets for

Coal Creek were listed in Table 4-6 in the Water Quality Assessment and TMDLs for Flathead River Headwaters Planning Area, Montana (EPA, 2004):

- The five-year mean McNeil Core Percent Subsurface Fines less than 6.35mm should not exceed 35%.
- The five-year mean substrate score (as per FWP methods) should equal or exceed a value of 10.
- The percentage of surface fines less than 2mm should be less than 20%.
- The macroinvertebrate clinger richness metric should be equal to or greater than 14.

The TMDL document for Coal Creek notes that Montana Fish, Wildlife, and Parks is responsible for performing McNeil core, "substrate score", bull trout population, and redd count monitoring in Coal Creek. MT DEQ will continue to rely upon MT FWP for the collection of these monitoring parameters and will incorporate the data into TMDL implementation evaluations and beneficial use impairment determinations. The TMDL document also recommends that monitoring of substrate surface fines and macroinvertebrate communities should occur approximately once every five years, as there are TMDL targets associated with these two parameters. Physical parameters and biological data for Coal Creek in accordance with the current DEQ protocols is lacking. The collection of monitoring data for surface fines and macroinvertebrate communities will be performed by DEQ as part of this study (in addition to other sediment-related parameters) and is addressed within the study design section below. The supplemental monitoring as recommended within Section 4.4.2 of the TMDL document (e.g. LWD inventories, temperature monitoring, etc.) is not within the scope of this study.

## *2.3 Reference data*

Given that DEQ has very little reference data applicable to the tributaries to the North Fork of the Flathead River, three different approaches will be used to establish reference conditions for sediment parameters in Big Creek and Coal Creek.

The first approach is to use DEQ reference site data to assess sediment related parameters for Big and Coal Creeks. DEQ is planning to perform the sediment assessment methodology during August 2010 for three candidate reference sites in the Flathead headwaters. The reference sites have been selected due to their similarity in ecoregion, watershed area, valley gradient, and valley confinement with the selected assessment sites on Big and Coal Creeks. The drawback to this approach is that even after the 2010 reference sites have been visited, there will be few sites in watersheds that are similar to Big and Coal Creeks. Most of the reference sites in western Montana are located in smaller watersheds with higher gradient channels.

The second approach is to compare the data from Big and Coal Creeks to the sediment TMDL targets established in the Flathead Headwaters TMDL document (EPA, 2004). Although this approach seems like the most applicable approach to assessing TMDL compliance, there is a considerable amount of uncertainty in this approach since most of the targets were not derived from local reference sites, but from studies conducted in Idaho and New Mexico with streams that may not be similar to the Big and Coal Creek watersheds.

The third approach for establishing a reference comparison is to use data from the Pacific Inland Fisheries Biological Opinion (PIBO) program used by the United States Forest Service to

compare in-stream parameters between managed and unmanaged watersheds. The PIBO data set includes parameters such as watershed area, channel gradient, pool frequency, residual pool depth, pebble count data, large woody debris counts, and macroinvertebrate IBI scores. Data for sites in unmanaged watersheds having similar landscape level attributes as the sites in Big Creek and Coal Creek will be utilized. Although the methods used in PIBO differ slightly from DEQ's sediment assessment methodology, the PIBO data can be used to strengthen decisions on whether the TMDL for Big Creek has been attained and whether conditions in Coal Creek are improving. Although the PIBO data set is very large, most of the sites are from smaller watersheds.

### *2.4 Threatened and Endangered Species*

The Big Creek and Coal Creek watersheds provide critical habitat for the federally threatened bull trout and are within the range of threatened grizzly bear and Canada lynx populations (USFWS, 2010). Furthermore, Westslope cutthroat trout, which inhabit both watersheds, have been a designated species of concern by Montana Fish, Wildlife, and Parks due to a decline in populations relative to historic conditions. Accordingly, issues surrounding the management of habitat for these species play a central role in the decision processes that the United States Forest Service completes with regards to its managing its land use within these watersheds. Due to their specific ecological requirements (USFWS 2010), bull trout populations are considered the most sensitive component of the designated fishery beneficial use. Therefore, evaluations of impairment to this designated use need to include an assessment of habitat and water quality data in relation to the environmental requirements of bull trout populations.

## 3.0 Goals, Objectives and Design of the Investigation

There are two primary goals for this study. The first goal is to collect data necessary to perform an evaluation of TMDL attainment in Big Creek. This will involve collecting data on several of the parameters established by DEQ's draft sediment assessment methodology for performing evaluations of sediment impairment to fishery and aquatic life beneficial uses.Nevertheless, note that a TMDL attainment evaluation determines whether a particular cause of impairment has been substantially mitigated, but does not determine whether the affected beneficial uses are impaired. In the event that the TMDL attainment evaluation by the Watershed Protection Section concludes that the sediment TMDL for Big Creek has resulted in successful mitigation of sediment impacts to the water body, compliance with Montana's narrative sediment standard will be assessed for the aquatic life and fishery beneficial uses by the Monitoring and Assessment Section. In this regard, the forthcoming TMDL attainment evaluation will serve as a screening assessment that will evaluate if improved water quality conditions in Big Creek warrant a re-assessment of sediment and habitat impairment to the aquatic life and fishery beneficial uses. The third goal of this study is to collect monitoring data for Coal Creek in order to evaluate current sediment related conditions in Coal Creek relative to the revised sediment assessment methodology. Completion of DEQ's draft sediment assessment methodology in Coal Creek will provide data that can also be used to address the percent fines TMDL target in Coal Creek. As recommended by in the Coal Creek sediment TMDL document, biological data (i.e.

macroinvertebrate and periphyton) will be collected in Coal Creek in accordance with DEQ's most current protocols.

The following objectives are intended to meet the goals described above:

- Objective #1: To perform DEQ sediment assessment methodology at two targeted sites on Big Creek during August 2010.

- Objective #2: To perform sampling of periphyton communities at two targeted sites on Big Creek during August 2010.

- Objective #3: To perform Riffle Stability Index measures at two targeted sites during August 2010. One site will be located on Big Creek and one on Hallowatt Creek.

- Objective #4: To perform DEQ sediment assessment methodology at two targeted sites on Coal Creek during September 2010.

- Objective #5: To perform sampling of periphyton and macroinvertebrate communities sampling at two targeted sites on Coal Creek during September 2010.

- Objective #6: To perform Riffle Stability Index measures at two targeted sites on Coal Creek during September 2010.

## *3.1 Sampling Design*

Assessment reach selection for Big Creek and Coal Creek was performed using a diagnostic approach for evaluating chronic increases in fine and/or coarse sediment. (Montgomery and MacDonald, 2002). The diagnostic approach to channel monitoring (Montgomery and MacDonald, 2002) indicates that reaches having pool-riffle channel morphology are the most appropriate places to measure the types of parameters established by the DEQ sediment methodology (Kusnierz and Welch, 2010). Reaches with valley gradients greater than 2% were not selected because they are classified as transport reaches in the M-B system and thus are less appropriate locations to detect excessive accumulations of fine sediment.

In the channel morphology classification system of by Montgomery & Buffington (1997), the typical slope of pool-riffle channels is less than 2%. Accordingly, stream reaches with a valley bottom gradient of 2% or less tend to have channel gradients less than 2%. Valley gradient was used rather than channel gradient in selecting assessment reaches because: 1) valley gradient provides an inherent geomorphic control on channel gradient; 2) valley gradient is relatively insensitive to anthropogenic impacts whereas channel gradient may be substantially altered; and 3) valley bottom gradient can be more accurately delineated than channel gradient using. In this respect, reaches with riffle-pool morphology having valley gradients less than 2% were considered for sampling.

In contrast, reaches with gradients between 2 and 4% are appropriate for performing measures associated with the Riffle Stability Index (Kapesser, 2002). Therefore reaches utilized for the

Riffle Stability Index (RSI) measurements will not be the same as those selected for the rest of the sediment assessment methodology.

Geomorphically distinct stream reaches were delineated using a 1:24,000 scale topographic map, a 30m digital elevation model, and aerial imagery with a GIS. The length of a distinct reach is designated by a length of channel having a relatively homogenous watershed area, valley gradient, and valley confinement whose combination of those three factors is different from that of adjacent reaches. Reaches were further segmented at the confluence of tributaries having a Strahler stream order greater than one. The resulting reaches that met the valley gradient criteria and had a length greater than the 20 bankfull channel width site length used in the DEQ sediment methodology were considered for field assessment.

A single reach with a valley gradient of approximately 0.5% was identified during the GIS analysis of Coal and Big Creeks. Although this reach meets the valley gradient criteria, sediment parameters will not be measured within it because it appears to be an exception to the general morphology of stream channels in the region. This low gradient valley segment in the Coal Creek watershed is bounded by higher gradient valley segments at its upstream and downstream extent and therefore act as a landscape scale sluice that is expected to accumulate relatively high levels of fine sediments. Currently, DEQ is not able to sufficiently define reference conditions for very low gradient reaches with naturally high levels of fine sediment. Monitoring such locations would be expected to show naturally higher levels of fine sediment with natural impacts to habitat and biological communities which would make it even more difficult to determine whether the anthropogenic sediment impacts were occurring.

One sample site per targeted assessment reach will be visited in the Big Creek and Coal Creek watersheds. For both Big and Coal Creeks, two low gradient reaches (i.e. using the general sediment assessment methodology) and two moderate reaches (using the RSI methods) will be sampled.

## *3.2 Sample Site Locations*

The sample site locations have been randomly assigned within each of the targeted assessment reaches. Random selection of sample location involved approximating the upper and lower elevations of the selected assessment reaches and then using a random number generator to select an elevation between the two reach endpoints that will determine the placement of the downstream endpoint of the sample site in the field. Additionally, the upper ends of reaches and areas around bridges are buffered such that sites are not permitted to cross reach boundaries or span through bridge crossings. In these cases a site is shifted away from the buffer just enough to ensure that the site will not extend into a buffer zone. Also, if a randomly determined elevation of the second sample site in a targeted reach is located within the estimated bounds of the first selected sample site, another random elevation value was generated to ensure that sample sites would not overlap.

### 3.2.1 Big Creek Sampling Locations

Seven reaches of Big Creek having a valley gradient less than 2% were identified through a GIS analysis. Two of these reaches were selected for the application of the general sediment assessment methodology. Two moderate gradient reaches within the Big Creek watershed were selected for performing Riffle Stability Index measurements. One site will occur within each reach. Table 1 below summarizes the samping locations that were selected for study in the Big Creek watershed.

**Big Creek Site 1**

The site selected for study is located within a reach of the mainstem Big Creek between the confluences of Hallowatt Creek and Elelehum Creek. This reach is the lowest gradient reach in the upper portion of the watershed and as such should also be the most geomorphically responsive reach to sediment supply in the upper watershed. This means that this is the most likely location in the upper watershed where sediment impacts would be detected. The geomorphology of this reach is heavily influenced by a large glacial outwash deposit associated with a tributary confluence at the lower end of the valley segment. The outwash deposit at the down gradient end of the valley segment serves as a control on the valley gradient of the upstream valley segment because it has induced a reach scale accumulation of sediments. This valley fill has resulted in a relatively low valley gradient (approximately 1%), resulting in an unconfined stream reach with relatively higher sinuosity than other reaches that are either steeper, more confined, or both.

The reach in which Site 1 is located provides the primary spawning habitat in the Big Creek watershed for the Flathead Lake migratory bull trout meta-population. The geomorphology of this reach (i.e. steep tributaries entering a flat aggraded valley bottom) probably results in substantial surface-groundwater interaction. Since bull trout have been shown to select spawning areas with upwelling groundwater, this might explain why migratory spawning bull trout select this reach for spawning. Since 1981 FWP has performed monitoring of the bull trout population and subsurface fine sediment in this spawning area using McNeil core samplers. The measurement of parameters in this reach will allow DEQ to make a more effective determination of whether the Big Creek bull trout populations continue to be significantly impacted by anthropogenic sedimentation.

**Big Creek Site 2**

Site 2 is located within a reach that occurs between the confluences of Lookout Creek and Vogt Creek with Big Creek. This reach is the lowest gradient reach in the lower portion of the watershed and as such should also be the most geomorphically responsive reach to sediment supply in the lower watershed. Similar to Reach 2, this reach also appears to be influenced by a large glacial outwash deposit. This reach appears to be the most likely location in the lower watershed where impacts from sediment accumulation would be detected. Monitoring this reach will allow an effective evaluation of whether excess sediment accumulations are impacting fish and aquatic life habitat.

**Big Creek Site 3**

This site is located within a moderate gradient reach (valley gradient of 2 to 4%) on Big Creek upstream of the confluence with Hallowatt Creek. Riffle Stability Index (RSI) measurements will be performed in this reach in order to help evaluate whether extensive historic timber harvesting in the upper Big Creek watershed is contributing to elevated sediment loading to the reach in which Big Creek Site 1 is located. A high RSI value would indicate that riffles are loaded with excessive sediment (Kapesser, 2002).

**Hallowatt Creek Site 1**

This site is located within a moderate gradient (valley gradient of 2 to 4%) reach on Hallowatt Creek just upstream of its confluence with Big Creek and just upstream of Big Creek assessment Reach 1. Riffle Stability Index (RSI) measurements will be performed in this reach in order to help evaluate whether extensive historic timber harvesting in the Hallowatt Creek watershed is contributing to elevated sediment loading to the reach in which Big Creek Site 1 is located. A high RSI value would indicate that riffles are loaded with excessive sediment (Kapesser, 2002).

### 3.2.2 Coal Creek Sampling Locations

Ten reaches of Big Creek having a valley gradient less than 2% were identified through a GIS analysis. Two of these reaches were selected for the application of the general sediment assessment methodology. The valley segment immediately upstream of Coal Creek's confluence with the North Fork of the Flathead River was considered for assessment, but was disqualified because it is bisected by the North Fork Road and has a geomorphology that is strongly influenced by its proximity to the North Fork Flathead River. It was therefore determined that the assessment of sediment parameters in this reach would not be sufficiently diagnostic of anthropogenic impacts to fish and aquatic life uses. Table 1 below summarizes the samping locations that were selected for study in the Coal Creek watershed.

**Coal Creek Site 1**

This site is located within a low gradient reach of Coal Creek approximately 3.5 kilometers downstream of the confluence of the North and South Forks of Coal Creek. The reach in which this site is located is upstream of the very low gradient valley segment that was disqualified from sampling due to its very low gradient.

The reach in which this site is located provides important spawning habitat in the Coal Creek watershed for the Flathead Lake migratory bull trout meta-population. Since 1981 FWP has performed monitoring of the bull trout population and subsurface fine sediment in this spawning area using McNeil core samplers. The measurement of parameters in this reach will allow DEQ to make more effective evaluations of the sediment impacts to the fish and associated aquatic life in Coal Creek.

**Coal Creek Site 2**

This site is located approximately one kilometer below the confluence of Cyclone Creek in the lower part of the watershed. The reach in which this site is located occurs in a low gradient valley segment bounded by steep canyon walls. This site is not located within a bull trout spawning reach, but is likely to contain important habitat for cutthroat trout and associated aquatic life.

**North Fork Coal Creek Site 1**

This site is located within a moderate gradient reach (valley gradient of 2 to 4%) on the North Fork of Coal Creek upstream of the confluence with the South Fork. Riffle Stability Index (RSI) measurements will be performed in this reach in order to help evaluate whether extensive historic timber harvesting in the upper Coal Creek watershed is contributing to elevated sediment loading to the reach in which Coal Creek Site 1 is located. A high RSI value would indicate that riffles are loaded with excessive sediment (Kapesser, 2002).

**South Fork Coal Creek Site 1**

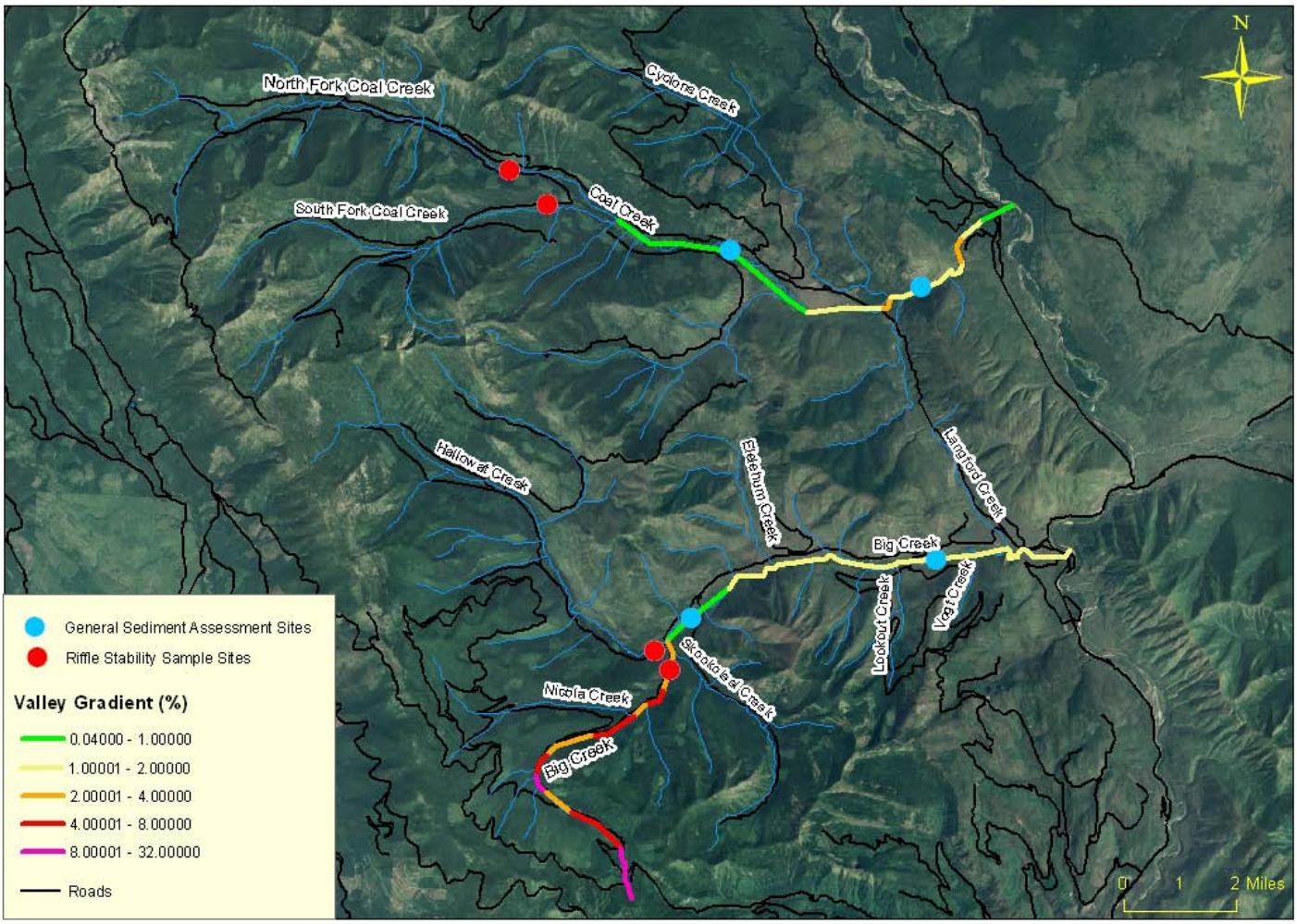
This is a moderate gradient reach (valley gradient of 2 to 4%) on the South Fork of Coal Creek upstream of the confluence with the North Fork. Riffle Stability Index (RSI) measurements will be performed in this reach in order to help evaluate whether extensive historic timber harvesting in the upper Coal Creek watershed is contributing to elevated sediment loading to the reach in which Coal Creek Site 1 is located. A high RSI value would indicate that riffles are loaded with excessive sediment (Kapesser, 2002).

## Table 1

| Assessment Site Name | Big Creek Site 1 | Big Creek Site 2 | Big Creek Site 3 | Hallowatt Creek Site 1 | Coal Creek Site 1 | Coal Creek Site 2 | N. Fork Coal Creek Site 1 | S. Fork Coal Creek Site 1 |
|---|---|---|---|---|---|---|---|---|
| Watershed area (sq. km) | 145 | 191 | 43 | 71 | 124 | 207 | 52 | 41 |
| Valley slope (%) | <1% | 1 to 2% | 2 to 4% | 2 to 4% | <1% | 1 to 2% | 2 to 4% | 2 to 4% |
| Sample Site Elevation (m) | 1180 | 1068 | 1219 | 1202 | 1172 | 1101 | 1295 | 1266 |
| Latitude | 48.581 | 48.599 | 48.567 | 48.572 | 48.674 | 48.668 | 48.691 | 48.683 |
| Longitude | 114.308 | 114.215 | 114.314 | 114.321 | 114.301 | 114.227 | 114.388 | 114.372 |

### *3.3 Sampling Location Map*

## 2010 Big and Coal Creek Samping Locations



# 4.0 Field Methodology

## *4.1 Physical Parameters*

A sediment assessment will be performed once at each site at base-flow conditions. The method is described in Appendix B of Kusnierz and Welch (2010). Riffle Stability Index (RSI) measurements will be performed within Reaches 3 and 4 in the Big Creek watershed and Reaches 7 and 8 within the Coal Creek watershed. The general procedure for performing the RSI measurements can be found in Kappesser (2002).

There are two exceptions to completing the sediment assessment methodology. The first exception is instead of having a fixed site length equivalent to twenty bankfull channel widths (which is intended to capture four or more riffles), the length of each site will encompass twenty bankfull width equivalents or a length of channel containing four riffles- whichever is greater. The reason is that in a large stream such as Big Creek, a site length equivalent to twenty bankfull widths may include less than four riffles. For the purposes of this study, the ability to describe the variability of substrate among at least four riffles at a single site is desirable since we do not currently know how variable substrate size distributions are from riffle to riffle (or site to site within a single reach). Rather than risk inadequately representing the substrate, this study will seek to increase accuracy and representativeness by ensuring that four riffles per site are sampled. The second exception to the sediment assessment methodology is that measurements associated with Rosgen channel classification will not be performed because such measurements would be overly time-consuming when considering that they will not result in information that will facilitate a determination of whether the conditions of the sediment TMDL have been satisfied. DEQ's sediment methodology (Kusnierz & Welch, 2010) indicates that Rosgen measurements are not used to assess impairment but rather to select reference sites that are similar to the assessment sites. The selection of appropriate references sites & reaches for making sediment parameter comparisons for the TMDL attainment evaluation will be made based on similarity in ecoregion, watershed area, valley gradient, and valley confinement between assessment and reference sites, not based on Rosgen channel type, which is readily altered by human activities. Geomorphologists have indicated that reference and assessment reaches should be matched based on the process-based geomorphic attributes that control potential channel types instead of structure-based Rosgen channel types, since channel types are more transitory in nature.

The evaluation of TMDL attainment will not assess all of the parameters involved with the DEQ sediment assessment methodology. Specifically, the TMDL attainment evaluation will not assess pool tail-out grid toss data and pool frequency data. Rather, if it is determined that TMDL attainment has been accomplished then staff from the Monitoring & Assessment Section will evaluate all the sediment parameters. The parameters from the DEQ sediment assessment methodology that will be used to evaluate TMDL attainment are: 1) riffle pebble count: % fines <2mm and % fines < 6.35mm; and 2) residual pool depths. In addition subsurface % fines as measured through McNeil core sampling (FWP data) will also be evaluated.

### *4.2 Biological Parameters*

Macroinvertebrate sampling using the EMAP reach-wide method was completed at four sites on Big Creek during 2009. The results of this sampling indicate that at all four sites were non-impacted relative to reference conditions. Therefore, further sampling of macroinvertebrate communities in Big Creek is not necessary.

The 2003 Flathead Headwaters TMDL identified clinger taxa richness as a primary target for evaluating sediment impacts, yet the clinger richness target of 14 for Coal Creek was already exceeded at both sites on Coal Creek prior to completion of the sediment. Nevertheless, this TMDL target will be addressed through semi-quantitative sampling of macroinvertebrate populations in Coal Creek using the targeted riffle method (Peck et al. 2001) as specified in DEQ's draft sediment assessment methodology (Kusnierz and Welch, 2010). Macroinvertebrate samples will be stored in 1 L bottles topped off with ethanol. The macroinvertebrate samples will be delivered by MT DEQ to Dave Stagliano of the Natural Heritage Program for taxonomic analysis. The taxonomic data will be provided to DEQ in hard copy and EDAS compatible) electronic formats. The targeted riffle data is comparable with the EMAP reach-wide sampling method (Dave Feldman, personal communication; Rehn et al.2007).Therefore, the taxonomic data analysis will be analyzed according to DEQ's current macroinvertebrate analysis procedures, i.e. O/E and MMI models (MT DEQ, 2006). Additionally, the targeted riffle method is currently being explored by DEQ as a potential method for establishing metrics that can be used to help identify sediment specific impacts to aquatic macroinvertebrates. In this regard, the results of the Coal Creek sampling will be compared to targeted riffle data that is being collected by DEQ from numerous reference sites during 2010.

Periphyton samples will be collected within Reach 1 and Reach 2 of Big Creek as well as Reach 7 and Reach 8 of Coal Creek. The sample will be placed in a 50 ml centrifuge tube and preserved with formalin. Detailed methodology can be found in MDEQ (2010).The National Academy of Sciences in Philadelphia, PA will perform the taxonomic analysis in accordance with MT DEQ protocols. Sediment impacts to periphyton will be evaluated using DEQ's periphyton siltation index.

## 5.0 Data Analysis: Decision Criteria for Big Creek Sediment TMDL Attainment

It is important to note that the decision criteria associated with TMDL effectiveness monitoring is not the same process for determining whether aquatic life and fishery beneficial uses are impaired since the TMDL effectiveness monitoring serves as a screening level assessment to determine whether a formal re-assessment of beneficial uses support is warranted.

The decision of whether attainment of the TMDL for Big Creek has been achieved will be based on a combination of compliance with the TMDL targets described in the Big Creek sediment TMDL (DEQ, 2003), Flathead Headwaters TMDL Planning Area (EPA, 2004), a comparison of the Big Creek data to DEQ reference site data, consideration of DEQ biological indices, and possibly (see discussion below) a comparison to the USFS PIBO data. The Big Creek TMDL established a target value for the percentage of subsurface fines in bull trout spawning areas, but did not establish targets for other in-stream sediment. The Flathead Headwaters TMDL

established a target for percent surface fine sediment <2mm for 303(d) listed streams in the Flathead Headwaters TMDL Planning Area. Although this TMDL did not include Big Creek, it is reasonable to assume that this sediment target can be used as a guideline for assessing sediment in Big Creek. Nevertheless, DEQ reference site data will also be applied for percent surface fines. Since neither TMDL document addressed parameters such as percent surface fines <6.35mm and residual pool depths data from DEQ's reference sites will be used to assess these parameters. In the event that the DEQ reference data set is found to be lacking sufficient comparable data from reference sites to make a reasonable scientific comparison to the Big Creek data, a comparison to the sediment parameters from the USFS PIBO data for unmanaged watersheds will also be incorporated into the analysis. In these regards, the following decision criteria will be used to evaluate attainment of the Big Creek sediment TMDL.

**Criterion 1:** The macroinvertebrate indices from all four samples collected during 2009 indicate non-impairment using DEQ's macroinvertebrate assessment metrics. As indicated in the report by Bollman (2010), this criterion has been met.

**Criterion 2:** The value for the percent sediment less than 2mm as measured by riffle pebble counts for Reaches 1 & 2 on Big Creek is below 20% (as per the Flathead Headwaters TMDL document) **and/or** the % <2mm values at each of the two assessment reaches Big Creek are less than the 75$^{th}$ percentile of the reference values (from DEQ and/or PIBO reference data).

**Criterion 3:** The value for the percent sediment less than 6.35mm as measured by riffle pebble counts for Reaches 1 & 2 on Big Creek from the riffle pebble counts is less than the 75$^{th}$ percentile of the reference values (from DEQ and/or PIBO reference data).

**Criterion 4:** The median values for the residual pool depths for Reaches 1 & 2 is above the 25$^{th}$ percentile of the reference values.

**Criterion 5:** The Riffle Stability Index for Assessment Reaches 3 & 4 watershed are both less than 85.

**Criterion 6:** The 2009 & 2010 McNeil core values for % fines < 6.35mm are both below 32% (as monitored by MT FWP). A graphical analysis indicates that if the 2009 & 2010 values meets this criterion, it would be consistent and further strengthen the strong observed trend (r = .81) of decreasing % fines since TMDL completion, but that if the 2009 & 2010 values are greater than 32%, it would result in a weakening of the trend in fine sediment since 2004.

A determination that the Sediment TMDL for Big Creek has been attained requires that Criterion 1 be met and that three of five of the physical decision criteria are met. If two of the physical criteria are not met they still must be considerably close to the decision thresholds. For example, the sediment TMDL would not be met if the RSI values were both greater than 100 and the McNeil core values were above 35%, but if the RSI values were both 86 and the 2009-2010 McNeil core values were both 32.1% an exception to those decision thresholds may be appropriate. Lastly, Criteria 2 through 4 depend upon having an appropriate reference data set. If appropriate reference data is lacking then these Criteria may need to be revised.

## 6.0 Quality Assurance and Quality Control Requirements

This project will follow the WQPB internal process for quality control and assurance. These requirements are described in MT DEQ (2005b).

## 7.0 Record Keeping and Reporting Requirements

This project will follow the WQPB internal process for record keeping, and reporting requirements. Site Visit & Chain of Custody forms, field forms, and digital photos will be processed by WQPB staff following QA/QC procedures. The GPS coordinate system datum used will be NAD 1983 State Plane Montana, in decimal degrees, to at least the third decimal.

## 8.0 Schedule

Four sites on Big Creek will be visited in a single trip during late August 2010. The timing of the Coal Creek visit will depend upon the availability of USFS Staff. Sampling of Coal Creek will likely take place during August 2011.

## 9.0 Project Team and Responsibilities

Patrick Lizon, Water Quality Specialist with Montana DEQ's Watershed Protection Section will coordinate and lead the monitoring activities. Dean Sirucek and Craig Kindle from the USFS Glacier View Ranger District will assist with the field data collection on Big Creek. Mark Kelley and Lauran Andersen of the WPS will assist with data collection on Coal Creek. DEQ's Monitoring and Assessment Section is in the process of collecting sediment reference data at established and candidate reference sites.

# 10.0 References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# 11.0 Appendix A

## *11.1 Field Equipment*

1. five 100 meter tape measures
2. two 50 meter tape measures
3. survey flagging
4. 1 set of TMDL Planner style bank pins (ones with clippies)
5. 3 pairs of the candy striped (i.e. red & white) bank pins
6. 1 small mallet
7. 1 dozen small wooden stakes
8. 1 can orange spray paint
9. 8 (1) Liter wide mouth Nalgene bottles
10. 4 Liters ethanol
11. D frame net, extra net, extra “hog rings”, two pairs of pliers
12. plastic sorting tray
13. 5 gallon bucket
14. 500 µm metal sieve
15. forceps
16. spray bottle
17. 8 AA batteries
18. digital camera
19. field forms packages for 10 sites- site visit forms and field forms for the sediment methodology(i.e. 24 pebble count forms). Q forms, X-section forms, Rosgen forms not needed
20. sediment field methodology on water resistant paper
21. 10 biological sample labels, 10 SVC labels, tape, pencils, markers, etc.
22. 1 roll of parafilm
23. calculator
24. stadia rod
25. metal grid for grid toss
26. *Kusnierz* pebble locator
27. 2 gravelometers
28. periphyton sampling supplies, including formalin and centrifuge tubes
29. backpack, if available
30. bear spray (2)
31. first aid kit