Monte Cristo Mining Area Remedial Investigation Phase 3 Characterization of Aquatic Sampling Reaches Reconnaissance Report

Prepared for
Washington State
Department of Ecology

March 29, 2013
17800-35

HARTCROWSER

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Prepared by
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RECONNAISSANCE REPORT

INTRODUCTION

Hart Crowser staff conducted a site reconnaissance in the Monte Cristo Mining Area (MCMA) near Granite Falls, Washington (Figure 1), from October 23 through October 25, 2012. Hart Crowser performed this initial investigation for the Washington State Department of Ecology (Ecology) under Contract No. C1100144. Work was conducted in general accordance with the Ecology Statement of Work (SOW) and project Sampling and Analysis Plan (SAP) prepared by Hart Crowser (Hart Crowser 2011). The purpose of the reconnaissance was to identify and characterize potential aquatic sampling reaches in the South Fork Sauk River (SFSR) and two of its headwater tributaries, Glacier Creek and Seventysix Gulch.

Aquatic sampling reaches were intended to coincide with surface water, pore water, and sediment sampling conducted by Cascade Earth Sciences (CES) as part of the Monte Cristo Mining Area Engineering Evaluation/Cost Analysis (EECA; CES 2010). At each location, Hart Crowser conducted a habitat characterization of an approximately 100-meter section of stream that included multiple habitats (e.g., riffles, pools). In addition, we documented riparian vegetation, flow velocity, took site photographs, and drew a sketch of the stream reach and its surroundings. Hart Crowser characterized a total of seven potential aquatic sampling stream reaches during the reconnaissance. This report summarizes the results of the initial site reconnaissance of potential aquatic stations.

The objectives of this initial investigation were to:

- Locate potential aquatic sampling stream reaches;
- Characterize the physical habitat conditions of the stream reach and document the riparian plants and any macroinvertebrates and animals present at and in the vicinity of the site; and
- Collect general water quality parameters at each site.

A site reconnaissance for aquatic sampling reaches was conducted from October 23 through October 25, 2012. Table 1 summarizes activities completed during this reconnaissance in chronological order.

Table 2 presents the project team members and their roles and responsibilities for this investigation.

Table 1 – Daily Activities Summary

Day	Activity	Observations
Day 1	■ Mobilization ■ Drove to Barlow Pass ■ Located and characterized the first aquatic station (HC-SFSR-07) approximately 3/4 mile northeast of Barlow Pass ■ Located and characterized an appropriate sampling reach for HC-SFSR-09 ■ Located and characterized HC-MCL-01 ■ Drove to Darrington to stay for the night	Macroinvertebrates observed at HC-SFSR-07 and HC-SFSR-09; not visible at HC-MCL-01
Day 2	■ Traveled to Monte Cristo Townsite via helicopter ■ Hiked to Glacier Creek Watershed ■ Located and characterized HC-GC-05 (lower Glacier Creek station) ■ Conditions too snowy to reach HC-GC-01 (upper Glacier Creek station) ■ Hiked to Seventysix Gulch Watershed ■ Located and characterized HC-76-02	Macroinvertebrates present at HC-GC-05 and HC-76-02
Day 3	■ Hiked down the South Fork Sauk River ■ Located and characterized HC-SFSR-03 ■ Picked up from the Townsite ■ Drove back to the stations visited on the first day to collect flow data ■ Identified and characterized an alternate sampling reach for HC-SFSR-07 ■ Demobilization	Macroinvertebrates present at HC-SFSR-03 and HC-SFSR-07 Alt

Table 2 – Project Team Roles and Responsibilities

Project Role	Personnel Assignment	Roles/Responsibilities
Ecology Project Manager	Mary Monahan Ecology (509) 454-7840	Client Project Manager
Program Manager	Mike Bailey Hart Crowser (206) 324-9530	Ensures that all work is carried out in accordance with contractual obligations and the Delivery Order statement of work. Assists the Project Manager as needed with technical decisions and in resolving issues. Final reviewer.
Project/Task Manager	Michelle Havey Hart Crowser (206) 324-9530	Overall responsibility for execution of the Work Plan. Coordinate with Client, Field Manager, and Program Manager as necessary to resolve issues.
Corporate Health and Safety Officer (HSO)	Echo Summers Hart Crowser (206) 324-9530	Overall responsibility for review and answering questions regarding health and safety.
Field Manager and Site Safety Coordinator (SSC)	Michelle Havey Hart Crowser (206) 324-9530	Ensures that field activities are conducted in accordance with project specifications. Coordinates field activities with Project and Program Managers.

SITE DESCRIPTION AND OPERATIONAL HISTORY

The MCMA is located at the headwaters of the South Fork Sauk River (SFSR) (Figure 1). Three smaller watersheds, Weden Creek, Glacier Creek, and Seventysix Gulch, form the headwaters of the SFSR approximately 6 miles upstream of Monte Cristo Lake. The MCMA is comprised of approximately 54 abandoned mines, facilities, and prospects scattered throughout the three watersheds. The principal commodities produced were gold and silver, with an estimated 310,000 tons of ore produced between 1889 and the closure of most of the mines in 1907. Today the area is a popular destination and is accessible to hikers by a washed-out dirt road which runs south from Barlow Pass on the Mountain Loop Highway; the road crosses over and follows along the SFSR to the Monte Cristo Townsite (Townsite). There is currently no vehicular access to the area. Each watershed is described in further detail below.

Glacier Creek Watershed

The Glacier Creek Watershed is characterized by rock, snow, and ice. The low elevation portions of the watershed contain forested areas with a shrub-dominated understory. Forested vegetation is dominated by grand fir (*Abies grandis*), subalpine fir (*Abies lasiocarpa*), and cedar (*Thuja plicata*), with understory vegetation consisting of blueberry (*Vaccinium* sp.) and huckleberry (*Vaccinium* sp.), with devil's club (*Oplopanax horridus*), vine maple (*Acer circinatum*), and salmonberry (*Rubus spectabilis*) being common near drainages and seeps. High-elevation areas are dominated by rock, snow (seasonally), and ice, with small forested stands and low-growing shrubs, such as mountain-heather (*Phyllodoce* sp. and *Cassiope* sp.), lichen, and moss. Talus slopes and rocky outcrops are common features in this watershed.

Glacier Creek flows in a northerly and westerly direction into the SFSR from its headwaters (Figure 1). Snowmelt serves as the primary water source for Glacier Creek. Some of the snowmelt likely enters the creek as groundwater base flow and seasonal seeps.

Mining activity in the Glacier Creek Watershed is described in the Monte Cristo Mining Area Remedial Investigation Phase 2 Summary Report (Hart Crowser 2012).

Seventysix Gulch Watershed

The Seventysix Gulch Watershed is characterized by a predominantly forested landscape interspersed with rock, snow, and ice. Dominant vegetation is similar to the Weden Creek and Glacier Creek watersheds, and consists of an overstory of Douglas-fir (*Pseudotsuga menziesii*), true firs (*Abies* sp.), hemlock (*Tsuga* sp.), and cedar within an understory of shrubs. Evidence of historical timber harvest can be observed near established trails. High elevation areas contain a combination of forest stands, talus slopes, and rocky outcrops.

Seventysix Gulch generally flows in a northerly direction into the South Fork Sauk River (Figure 1). Snowmelt serves as the primary water source for Seventysix Gulch, which is reported to go dry during the late summer months (personal communication, US Forest Service volunteer, July 2011). Groundwater base flow and seasonal seepage likely contribute to surface water flows during the spring and early summer. Silver Lake, a popular destination for recreational users, is located just west of Seventysix Gulch watershed, over Poodle Dog Pass.

Mining activity in the Seventysix Gulch Watershed is described in the Monte Cristo Mining Area Remedial Investigation Phase 2 Summary Report (Hart Crowser 2012).

Weden Creek Watershed

Weden Creek is the third component of the SFSR headwaters. The Weden Creek Watershed was not visited during this reconnaissance, so it is not discussed further in this report. In the event that future observations and sampling in Weden Creek are necessary to characterize water quality in the SFSR, we anticipate work would be similar to that discussed herein.

SITE INVESTIGATION ACTIVITIES

A site reconnaissance to identify aquatic sampling reaches was conducted from October 23 through October 25, 2012. Before the reconnaissance, locations of interest were identified based on elevated arsenic levels in surface water and sediment samples previously collected by CES for the Monte Cristo Mining Area EECA. The GPS coordinates for these point locations were loaded onto a handheld GPS and used by the field team for navigating to the intended sampling reaches. Once on site, the field team assessed the sampling location and identified an appropriate 100-meter sampling reach either near or including the original CES sampling location.

During the site reconnaissance, photographs and GPS data points were taken at the sample locations shown on Figure 1. Additionally, physical characterization/ water quality and Habitat Assessment datasheets from the EPA Rapid Bioassessment Protocol (RBP) were completed (Appendix A). The RBP is described in Barbour et al. (1999). We are using the RBP to characterize the MCMA sampling reaches because the protocols were designed to provide pertinent, cost-effective information for water quality management purposes.

During our site reconnaissance, we examined bank stability, instream features, riparian vegetation, on-site wildlife (macroinvertebrates, fish, reptiles, amphibians, birds, and mammals), or signs of wildlife in the area. We also observed proximity to human activities (i.e., trails, roads, or clear-cuts) and readily visible impacts on the stream reach. Photographs were taken at each location to document vegetation, wildlife use, and other relevant site features. Stream reach sketches are presented with the RBP datasheets in Appendix A, along with site photographs.

Because the reconnaissance occurred in late fall, the river level was higher and the flow much faster than we would expect to encounter for a late summer sampling trip. As shown in Figure 2, the USGS gage located on the Sauk River in Darrington, Washington, measured markedly higher flows in the latter half of October than in September and early October. Many of the locations we visited were not easily wadeable at the time of the reconnaissance, but we expect all of these sites to be easily accessible and wadeable during the 2013 field sampling.

South Fork Sauk River

HC-SFSR-07

On October 23, 2012, we identified and sampled HC-SFSR-07 as the first location on the site reconnaissance. After driving over Barlow Pass on the Mountain Loop Highway, the field team used a GPS to navigate to the CES station SFSR-07, which was located under a bridge approximately 0.5 miles northeast of the Pass along the highway. The RBP advises that locally modified sites (e.g., bridge areas) should be avoided, if possible, unless attempting to assess their effects. To avoid the bridge, we backtracked on the highway about 200 meters and parked in a small pullout on the east side of the road. We were able to access the left bank of the river from this location and set up a sampling reach just upstream of the bridge. Photographs, field datasheets, and site sketches for this site can be found on pages A-1 through A-8 in Appendix A.

First, we marked the upper and lower extent of the sampling reach with the Trimble GPS. Then, we measured the length, width (average), and slope of the stream reach using a laser rangefinder and slope inclinometer. Water quality measurements were collected using a Horiba U52 MultiMeter. A summary of all detailed location information, water quality, and instream feature measurements can be found in Table 3.

The riparian zone was dominated by western hemlock (*Tsuga heterophylla*), with some red alder (*Alnus rubra*) and devil's club (*Oplopanax horridus*) along the banks as well. There was only one piece of large woody debris (LWD) within the reach. We observed minimal aquatic vegetation (estimated 5 percent of the reach) in the form of attached algae on some of the larger boulders. The substrate was dominated by boulders and cobbles (Table 4), with very little gravel and sand.

Table 3 – Detailed Sampling Reach Measurements

	HC-SFSR-07	HC-SFSR-07-ALT	HC-SFSR-09	HC-MCL-01	HC-MCL-road	HC-SFSR-03	HC-GC-05	HC-76-02
Latitude	985454.57	986460.66	994798.89	993634.99		972878.32	968210.9	967630.98
Longitude	1410822.23	1411410.96	1414518.14	1412950.32		1415093.9	1423445.15	1422128.01
Altitude (ft)	2,142	2,172	1,800	1,954		2,448	2,873	2,931
Slope (deg)	5	4	6	0		3	9	13
Rivermile	7.2	7.4	9.7	9.1		3.9	2.0	1.2
Instream Features								
Length (m)	94	94	84	101		91	104	87
Width (m)	20	16	20	43		15	5	2
Area (m^2)	1,880	1,504	1,680	4,343		1,365	520	174
Depth (m)	1	0.3	0.5	0.3		0	0.2	0
Velocity (m/sec)	0.7	0.41	0.51	0.34		0	0.56	0.381
LWD (m^2)	0.4	2	0	3		8	30	20
LWD density (m^2/km^2)	0.21	1.33	0	0.68		5.86	57.69	115
High water (m)	2	0.3	5	0.25		1.5	4	1
Stream Morphology								
Riffle (%)	10	30	5	0		60	50	5
Run (%)	40	65	15	100		15	0	0
Pool (%)	10	0	15	0		25	20	35
Cascade (%)	40	5	65	0		0	30	60
Water Quality								
Temperature (deg C)	5.55	6.11	5.95	5.73	7.08	5.4	2.97	4.7
Specific Conductance (mS/cm)	0.031	0.034	0.034	0.03	0.034	0.023	0.022	0.021
Dissolved Oxygen (mg/L)	31.47 [a]	10.93	12.53	30.57 [a]	8.64	11.8	12.21	11.45
pH	7.29	7.28	6.94	6.96	6.82	7.07	7.4	6.92
Turbidity (NTU)	0.94	0.64	0.75	7.19	4.59	0.39	1.15	1.06

Note:

(a) Measurement is outside the expected range; likely an instrument error.

Table 4 – Inorganic Substrate Components for HC-SFSR-07

Substrate	Diameter	Percent Composition
Bedrock		0
Boulder	>256 mm (10")	50
Cobble	64–256 mm (2.5"–10")	40
Gravel	2–64 mm (0.1"–2.5")	9
Sand	0.06–2 mm (gritty)	1
Silt	0.004–0.06 mm	0
Clay	<0.004 mm (slick)	0

Based on the slope (5 percent) and the channel form, this reach can be classified as an A type stream (based on Rosgen 1994), which is considered high gradient. The high gradient habitat assessment field data sheet requires rating 10 habitat parameters based on four conditional categories: optimal, suboptimal, marginal, and poor. In general, this sampling reach would be considered optimal for habitat quality. The conditions assessed in the field for each habitat parameter are listed below:

1. Epifaunal Substrate/Available Cover: Optimal
2. Embeddedness: Optimal
3. Velocity/Depth Regime: Suboptimal
4. Sediment Deposition: Optimal
5. Channel Flow Status: Suboptimal
6. Channel Alteration: Optimal
7. Frequency of Riffles (or bends): Optimal
8. Bank Stability (each bank scored separately) Suboptimal (both banks)
9. Vegetative Protection (by bank): Optimal (both banks)
10. Riparian Vegetative Zone Width (by bank): Optimal (both banks)

In addition, we conducted a brief qualitative survey to determine the presence/absence of macroinvertebrates. By turning over 4 or 5 large cobbles along the left bank, we observed a number of mayflies (Ephemeroptera) and a few small casemaker caddisflies (Limnephilidae/Uenoidae).

This stream reach has several deep pools and fast water, making it unwadeable at the time of the reconnaissance. The narrow channel may, in fact, mean that this reach is not easily wadeable even in late-summer, low-flow conditions.

Therefore, we planned to identify and characterize an alternate reach nearby at the end of the reconnaissance, time permitting.

HC-SFSR-07 ALT

From the road, we identified a potential alternative location to HC-SFSR-07 just downstream of the bridge that appeared to be more suitable for the RBP field work planned in 2013. There was extra time on the last day of the reconnaissance, so we were able to complete a physical characterization and habitat assessment for this alternate location, HC-SFSR-07 Alt. This alternative reach is located approximately 230 meters downstream of the bridge. We were able to park on the side of the highway and scramble down a steep embankment down to the right bank of the river. Even with the higher flow conditions, we were still able to wade across the stream to access the left bank. Photographs, field datasheets, and site sketches for this site can be found on pages A-9 through A-18, in Appendix A.

First, we marked the upper and lower extent of the sampling reach with the Trimble GPS. Then, we measured the length, width (average), and slope of the stream reach using a laser rangefinder and slope inclinometer. Water quality measurements were collected using a Horiba U52 MultiMeter. A summary of all detailed location information, water quality, and instream feature measurements can be found in Table 3 (page 7).

As shown in Photographs 3 through 6 (Appendix A), the riparian zone was densely forested. The riparian zone was dominated by red alder, western hemlock, western redcedar (*Thuja plicata*), and subalpine fir (*Abies lasiocarpa*). There were a couple of pieces of LWD within the reach and minimal aquatic vegetation (3 percent of the reach) was observed in the form of attached algae on some of the larger boulders. The substrate was dominated by cobble, with boulders and gravel (Table 5).

Table 5 – Inorganic Substrate Components for HC-SFSR-07 Alt

Substrate	Diameter	Percent Composition
Bedrock		0
Boulder	>256 mm (10")	30
Cobble	64–256 mm (2.5"–10")	50
Gravel	2–64 mm (0.1"–2.5")	19
Sand	0.06–2 mm (gritty)	1
Silt	0.004–0.06 mm	0
Clay	<0.004 mm (slick)	0

Based on the slope (4 percent) and the channel form, this reach can be classified as an A type stream (based on Rosgen 1994), which is considered high gradient. In general, this sampling reach would be considered optimal for habitat quality. The conditions assessed in the field for each habitat parameter are listed below:

1. Epifaunal Substrate/Available Cover: Optimal
2. Embeddedness: Optimal
3. Velocity/Depth Regime: Suboptimal
4. Sediment Deposition: Suboptimal
5. Channel Flow Status: Optimal
6. Channel Alteration: Optimal
7. Frequency of Riffles (or bends): Optimal
8. Bank Stability (each bank scored separately): Optimal (both banks)
9. Vegetative Protection (by bank): Optimal (both banks)
10. Riparian Vegetative Zone Width (by bank): Optimal (both banks)

In addition, we conducted a brief qualitative survey to determine the presence/absence of macroinvertebrates. There were casemaker caddisflies and mayflies under every cobble we overturned.

Overall, this alternate sampling reach appears to be a better option for conducting the RBP near the CES sample location, SFSR-07. This reach should be easily wadeable, ideal for electrofishing and collection of macroinvertebrates, and accessible from the road.

HC-SFSR-09

From the road, we scoped out three or four potential reaches near the CES sample location, SFSR-09. Ultimately, we selected a reach approximately 300 meters downstream of the CES station based on access from the road and wadeability for ease of sampling in 2013. There was a pullout/roadside camping area where we were able to park and access the right bank of the river. Because of the high flow conditions, we were not able to wade across to the left bank, but lower flow conditions should allow for wading in this reach in late summer. Photographs, field datasheets, and site sketches for this site can be found on pages A-19 through A-28 in Appendix A. An orange staining was visible on many of the boulders and cobbles throughout this reach, especially in Photograph 7 (Appendix A).

First, we marked the upper and lower extent of the sampling reach with the Trimble GPS. Then, we measured the length, width (average), and slope of the stream reach using a laser rangefinder and slope inclinometer. Water quality measurements were collected using a Horiba U52 MultiMeter. A summary of all detailed location information, water quality, and instream feature measurements can be found in Table 3 (page 7).

As shown in Photographs 8 and 10 (Appendix A), the left bank showed signs of significant erosion. The riparian zone was dominated by deciduous trees and shrubs: red alder, big leaf maple (*Acer macrophyllum*), and black twinberry (*Lonicera involucrata*). There no LWD visible within the reach and minimal aquatic vegetation (3 percent of the reach) in the form of attached algae on some of the larger boulders. The substrate was dominated by cobble and boulders, but gravel, sand, and silt were present as well (Table 6).

Table 6 – Inorganic Substrate Components for HC-SFSR-09

Substrate	Diameter	Percent Composition
Bedrock		0
Boulder	>256 mm (10")	45
Cobble	64–256 mm (2.5"–10")	40
Gravel	2-64 mm (0.1"–2.5")	5
Sand	0.06–2 mm (gritty)	5
Silt	0.004–0.06 mm	5
Clay	<0.004 mm (slick)	0

Based on the slope (6 percent) and the channel form, this reach can be classified as an A type stream (based on Rosgen 1994), which is considered high gradient. In general, this sampling reach would be considered suboptimal for habitat quality. The conditions assessed in the field for each habitat parameter are listed below:

1. Epifaunal Substrate/Available Cover: Suboptimal
2. Embeddedness: Optimal
3. Velocity/Depth Regime: Suboptimal
4. Sediment Deposition: Optimal
5. Channel Flow Status: Marginal
6. Channel Alteration: Optimal
7. Frequency of Riffles (or bends): Marginal
8. Bank Stability (each bank scored separately): Marginal (left bank); Suboptimal (right bank)
9. Vegetative Protection (by bank): Suboptimal (both banks)
10. Riparian Vegetative Zone Width (by bank): Optimal (left bank); Suboptimal (right bank)

In addition, we conducted a brief qualitative survey to determine presence/ absence of macroinvertebrates. On the cobbles we overturned, we observed very few mayflies and no casemaker caddisflies, as seen at other sites.

HC-MCL-01

Driving south along the road from HC-SFSR-09, we were able to navigate to the approximate location of the CES sample station, MCL-01. This was the only Monte Cristo Lake locations where CES sampled sediment, surface water, and pore water. At the time of CES' sampling (August 2008), arsenic concentrations were 338 milligrams per kilogram (mg/Kg), 68.5 micrograms per liter (µg/L), and 2820 µg/L, respectively. Because the water level was elevated, we were unable to wade to the exact sample location, but were able to do a physical characterization and habitat assessment (with limited mobility) along the east shore of Monte Cristo Lake. The substrate of the lake is silt, so a boat or raft will be necessary for sampling in 2013. There was a small shoulder pullout on the road we were able to park in and access the east shore of the lake. Photographs, field datasheets, and site sketches for this site can be found on pages A-29 through A-38 in Appendix A. In addition to the main lake station, we measured water quality parameters in still water next to a submerged log by the

roadside. There appeared to be no measurable flow from the still water into the main lake through the channel (identified in Photographs 11, 12, and 14, Appendix A).

Because of the silty substrate, our mobility was very limited. Therefore, we were unable to collect GPS coordinates for the upper or lower extent of the intended sampling reach. Consequently, we were only able to estimate the length and width (average) of the sampling reach using a laser rangefinder; there was no measurable slope. Water quality measurements were collected using a Horiba U52 MultiMeter. A summary of all detailed location information, water quality (for both the main lake and the roadside station), and instream feature measurements can be found in Table 3 (page 7).

As shown in Photographs 11 and 12 (Appendix A), the riparian zone was dominated by shrubs: black twinberry (*Lonicera involucrata*), willow (probably Schouler's willow; *Salix scouleriana*), vine maple (*Acer circinatum*), and western redcedar. There were several submerged pieces of LWD visible within the reach and some rooted emergent aquatic vegetation in the form of scouring-rush (horsetail; *Equisetum hyemale*) along the east bank. From our vantage point, the substrate appeared to be solely comprised of silt (Table 7).

Table 7 – Inorganic Substrate Components for HC-MCL-01

Substrate	Diameter	Percent Composition
Bedrock		0
Boulder	>256 mm (10")	0
Cobble	64–256 mm (2.5"–10")	0
Gravel	2–64 mm (0.1"–2.5")	0
Sand	0.06–2 mm (gritty)	0
Silt	0.004–0.06 mm	100
Clay	<0.004 mm (slick)	0

Based on the slope (<1 percent) and the channel form, this reach can be classified as a DA type stream (based on Rosgen 1994), which is considered low gradient. In general, this sampling reach would be considered marginal for habitat quality. The conditions assessed in the field for each habitat parameter are listed below:

1. Epifaunal Substrate/Available Cover: Poor
2. Pool Substrate Characterization: Suboptimal
3. Pool Variability: Poor
4. Sediment Deposition: Poor
5. Channel Flow Status: Optimal
6. Channel Alteration: Optimal
7. Channel Sinuosity: Marginal
8. Bank Stability (each bank scored separately) Optimal (both banks)
9. Vegetative Protection (by bank): Optimal (both banks)
10. Riparian Vegetative Zone Width (by bank): Optimal (both banks)

There were no cobbles to overturn to look for macroinvertebrates, but we would expect to find macroinvertebrates within the sediment during future sampling.

HC-SFSR-03

On October 25, 2012, we hiked north along the old Forest Service road from the Townsite to the CES sample station, SFSR-03. Using the Trimble GPS, we were able to navigate to the CES sample station and establish our sampling reach right there. The sampling reach is located downstream of the Silvertip Campground and just upstream of the Hops Hill Campground and an eroding slope of the Forest Service road (Photograph 15, Appendix A). Photographs, field datasheets, and site sketches for this site can be found on pages A-39 through A-48 in Appendix A.

First, we marked the upper and lower extent of the sampling reach with the Trimble GPS. Then, we measured the length, width (average), and slope of the stream reach using a laser rangefinder and slope inclinometer. Water quality measurements were collected using a Horiba U52 MultiMeter. A summary of all detailed location information, water quality, and instream feature measurements can be found in Table 3 (page 7).

As shown in Photographs 15 and 17 (Appendix A), the right bank showed signs of erosion adjacent to the old Forest Service road. The riparian zone was dominated by deciduous trees and shrubs: red alder, black twinberry, and red-osier dogwood (*Cornus stolonifera*). There was LWD in the upstream portion of the reach along the left bank and in the pool on the right bank in the downstream portion of the reach. There was a notable amount of aquatic vegetation (40 percent of the reach) in the form of attached algae on the

submerged cobble. The substrate was dominated by cobble, followed by gravel, and few boulders (Table 8).

Table 8 – Inorganic Substrate Components for HC-SFSR-03

Substrate	Diameter	Percent Composition
Bedrock		0
Boulder	>256 mm (10")	5
Cobble	64–256 mm (2.5"–10")	74
Gravel	2–64 mm (0.1"–2.5")	20
Sand	0.06–2 mm (gritty)	1
Silt	0.004–0.06 mm	0
Clay	<0.004 mm (slick)	0

Based on the slope (3 percent) and the channel form, this reach can be classified as a B type stream (based on Rosgen 1994), which is considered high gradient. In general, this sampling reach would be considered optimal for habitat quality. In fact, there was a flag on the right bank in the upstream portion of the sample reach marking a bull trout (*Salvelinus confluentus*) redd that had been identified on October 23, 2012 (Photograph 19, Appendix A). The conditions assessed in the field for each habitat parameter are listed below:

1. Epifaunal Substrate/Available Cover: Optimal
2. Embeddedness: Optimal
3. Velocity/Depth Regime: Optimal
4. Sediment Deposition: Suboptimal
5. Channel Flow Status: Marginal
6. Channel Alteration: Optimal
7. Frequency of Riffles (or bends): Optimal
8. Bank Stability (each bank scored separately): Optimal (both banks)
9. Vegetative Protection (by bank): Optimal (both banks)
10. Riparian Vegetative Zone Width (by bank): Optimal (both banks)

In addition, we conducted a brief qualitative survey to determine presence/ absence of macroinvertebrates. On the cobbles we overturned, we observed a

mite (Hydracarina), a few casemaker caddisflies, and possibly a green rock worm (Rhyachophilidae) or net spinner caddisfly (Hydropsychidae).

Glacier Creek Watershed

HC-GC-05

On the morning of October 24, 2012, we planned to drive back to Barlow Pass and hike in to the Monte Cristo Townsite at daybreak so that we had most of the day to hike to the Glacier Creek and Seventysix Gulch sites. However, we experienced car trouble and ended up taking a helicopter in late morning from Darrington, WA, to the Townsite. From there, we hiked southeast on the Glacier Basin Trail until we were approximately even with the lowest Glacier Basin CES aquatic station, GC-05. We scrambled down the hillside and the steep bank to drop down onto the left stream bank. At the CES station, the stream consisted mostly of steep cascades with no visible sediment for sample collection, so we moved downstream approximately 100 meters and marked the sample reach moving downstream from that point (Photograph A20). Photographs, field datasheets, and site sketches for this site can be found on pages A49 through A58 in Appendix A.

First, we marked the upper and lower extent of the sampling reach with the Trimble GPS. Then, we measured the length, width (average), and slope of the stream reach using a laser rangefinder and slope inclinometer. Water quality measurements were collected using a Horiba U52 MultiMeter. A summary of all detailed location information, water quality, and instream feature measurements can be found in Table 3 (page 7).

As shown in Photographs 20, 22, and 23 (Appendix A), both banks have a wide band of boulders with no vegetation suggesting high flows move through this section of the stream. The riparian vegetation present (set back from the stream) is dominated by western hemlock, subalpine fir, and noble fir (*Abies procera*). It appears LWD is highly mobile and a dynamic feature in this portion of Glacier Creek. There was a LWD jam (shown in Photographs 21 and 22, Appendix A) in the upstream portion of the sampling reach, but virtually no aquatic vegetation (<1 percent of the reach) in the form of attached algae on boulders; further evidence that this stream is very dynamic and subject to significant debris and substrate transport most likely with seasonal storms. The substrate was dominated by cobble and boulders, with some gravel (Table 9).

Table 9 – Inorganic Substrate Components for HC-GC-05

Substrate	Diameter	Percent Composition
Bedrock		0
Boulder	>256 mm (10")	30
Cobble	64–256 mm (2.5"–10")	65
Gravel	2–64 mm (0.1"–2.5")	4
Sand	0.06–2 mm (gritty)	1
Silt	0.004–0.06 mm	0
Clay	<0.004 mm (slick)	0

Based on the slope (9 percent) and the channel form, this reach can be classified as an A type stream (based on Rosgen 1994), which is considered high gradient. In general, this sampling reach would be considered optimal for habitat quality. The conditions assessed in the field for each habitat parameter are listed below:

1. Epifaunal Substrate/Available Cover: Suboptimal
2. Embeddedness: Optimal
3. Velocity/Depth Regime: Marginal
4. Sediment Deposition: Optimal
5. Channel Flow Status: Suboptimal
6. Channel Alteration: Optimal
7. Frequency of Riffles (or bends): Optimal
8. Bank Stability (each bank scored separately): Suboptimal (both banks)
9. Vegetative Protection (by bank): Optimal (both banks)
10. Riparian Vegetative Zone Width (by bank): Optimal (both banks)

We neglected to conduct the qualitative survey to determine presence/absence of macroinvertebrates. Based on the presence of macroinvertebrates at all other sample locations, we would expect macroinvertebrates to be present at this location as well.

HC-GC-01

Originally, we had planned to continue up the Glacier Basin Trail to scope out the CES reference station, GC-01, at the very upstream extent of Glacier Creek.

However, the snowfall and limited daylight would have made it difficult to hike up to GC-01, do the reconnaissance, and make it back to the Forest Service cabin before dark. Therefore, we elected to skip reconnaissance of the reference site on that trip.

Seventysix Gulch Watershed

HC-76-02

After sampling HC-GC-05, we hiked back down the Glacier Basin Trail to where it cuts across to the Seventysix Gulch Watershed on the Sunday Falls Trail. We dropped down to the stream where the Sunday Falls bridge had collapsed into the creek. Using the Trimble GPS, we walked downstream and were able to navigate to the CES sample station and establish our sampling reach to include it. Photographs, field datasheets, and site sketches for this site can be found on pages A-59 through A-68 in Appendix A.

First, we marked the upper and lower extent of the sampling reach with the Trimble GPS. Then, we measured the length, width (average), and slope of the stream reach using a laser rangefinder and slope inclinometer. Water quality measurements were collected using a Horiba U52 MultiMeter. A summary of all detailed location information, water quality, and instream feature measurements can be found in Table 3 (page 7).

The stream is confined in a narrow valley with steep hillsides and a forested riparian zone (see Photographs 25 and 27, Appendix A). The riparian vegetation was dominated by western hemlock, subalpine fir, and devil's club. There was LWD across the channel and along the bank in several places (Photographs 24 and 26, Appendix A) in the upstream portion of the reach along the left bank and in the pool on the right bank in the downstream portion of the reach. There was a notable amount of moss on top of boulders and along the banks (Photographs 24, 25, and 27, Appendix A), but only modest coverage in the form of attached algae on the submerged cobble (10 percent of the reach). The substrate was dominated by boulders and cobble, with some gravel and a small deposit of sand in a pool at the downstream end of the reach (Table 10).

Table 10 – Inorganic Substrate Components for HC-76-02

Substrate	Diameter	Percent Composition
Bedrock		0
Boulder	>256 mm (10")	55
Cobble	64–256 mm (2.5"–10")	40
Gravel	2–64 mm (0.1"–2.5")	4
Sand	0.06–2 mm (gritty)	1
Silt	0.004–0.06 mm	0
Clay	<0.004 mm (slick)	0

Based on the slope (13 percent) and the channel form, this reach can be classified as an Aa+ type stream (based on Rosgen 1994), which is considered high gradient. In general, this sampling reach would be considered optimal for habitat quality. The conditions assessed in the field for each habitat parameter are listed below:

1. Epifaunal Substrate/Available Cover: Optimal
2. Embeddedness: Optimal
3. Velocity/Depth Regime: Suboptimal
4. Sediment Deposition: Optimal
5. Channel Flow Status: Optimal
6. Channel Alteration: Optimal
7. Frequency of Riffles (or bends): Optimal
8. Bank Stability (each bank scored separately): Suboptimal (both banks)
9. Vegetative Protection (by bank): Optimal (both banks)
10. Riparian Vegetative Zone Width (by bank): Optimal (both banks)

This stream may be ephemeral based on the narrow width (2 meters) and shallow depth (0.3 meters) at the time of sampling. If this stream goes dry during low-flow conditions in late summer that will affect the macroinvertebrate and fish communities present (personal communication, Karen Adams, November 9, 2012). An alternate site may need to be located to conduct RBP sampling in this watershed. We did, in fact, observe mayflies and casemaker caddisflies under every cobble we overturned during our qualitative macroinvertebrate survey.

DEBRIEF WITH ECOLOGY

Following our site reconnaissance, Hart Crowser (Michelle Havey) and Ecology managers (Jason Shira and Mary Monahan) met with Karen Adams, a stream ecologist with Ecology. During this meeting, Jason provided Karen with the Monte Cristo site background on the mining history, sampling and cleanup efforts to-date, and planned clean-up efforts for the near future. Karen provided a description of how her team uses the Ecology Quality Assurance Monitoring Plan (QAMP) protocols and some of the differences from the EPA RBP. After seeing photographs of the sample reaches from the aquatic site reconnaissance, she offered valuable suggestions for planning the upcoming 2013 aquatic sampling.

One objective of the QAMP is to provide baseline information from "reference condition" streams within a given ecoregion. In order to identify appropriate reference streams/conditions, the QAMP requires detailed physical habitat observations at numerous major and minor transects within a sample reach. Everyone present at the meeting agreed this level of detail is beyond the needs of the Monte Cristo monitoring because each site will primarily be monitored for changes in biological condition; the hydrology and physical habitat are not expected to change as a result of the removal action.

For macroinvertebrate sampling in Monte Cristo Lake, Karen suggested using a Petite Ponar grab sampler because the size is manageable and it can be deployed from the bank. Because it would be extremely time consuming, this method is only feasible if we do not need to sample an area equivalent to the stream samples (i.e., an area of 8 square feet [sf]).

For macroinvertebrate sampling in the stream reaches, she suggested using a 500 micron mesh kick net instead of a Serber sampler because they are easier to work with in streams with larger substrate. She recommended using the QAMP protocol, which consists of eight randomly selected sample locations starting at the downstream end of the sample reach and zigzagging from bank to bank to get an 8-sf composite sample for the reach.

Ecology uses the Rhithron lab to process macroinvertebrate samples, which is the lab Hart Crowser had identified. We should be able to request the same protocol and reporting requirements that Ecology uses for the QAMP, which is identification of individuals down to the lowest practical taxonomic level. She also suggested we may want to analyze the body burden on macroinvertebrates as a compliment to the sediment chemistry and sediment bioassays.

Karen recommended choosing a subset of the sites (one or two in the headwaters and one in the lower SFSR) to collect seasonal replicates to meet the QAMP replicate requirements in case these sites are ever compared to the QAMP ecoregion streams. Ideally, these sites would be monitored for 10 years with progress evaluation in Year 5 to discuss whether we are meeting our goals, any changes that need to be made to achieve those goals, and anticipated future progress.

LESSONS LEARNED FOR FUTURE SAMPLING

The site reconnaissance was successful in locating and characterizing six of the seven desired aquatic sampling reaches. During the reconnaissance, it became obvious that sampling will require a significant level of effort to complete all of the protocols at each aquatic station. The field crew needs to be 3 to 4 people, and each station will take a full day including transport to and from the site. We also identified certain sections of the RBP protocol that are not sufficient, where sections of the QAMP protocol are more appropriate. For example, the physical characterization, habitat quality assessment, and fish sampling protocols from the RBP are appropriate for the needs of this project, but in the future we will use the periphyton, benthic macroinvertebrate, sediment and water sampling protocols from the QAMP.

The remote nature of the MCMA watersheds is a challenge for conducting field work. Outlined below are some of the problems encountered and planned solutions for future sampling trips.

- Photo point locations should be established in Year 1 and revisited at each monitoring effort. In addition, GPS coordinates should be collected for significant instream features (i.e., large boulders, LWD, etc.) so we can monitor site changes over time.

- Sample handling times will be difficult to plan/schedule around. A schedule will need to be coordinated with the helicopter and personnel at Hart Crowser to ensure samples are shipped to the lab within the required holding time.

- For the three stations along the Mountain Loop Highway, we will want to be based out of Darrington, Washington, so we can transport samples each night and keep them on ice until shipping. The 45- to 60-minute drive each way is equivalent to the amount of time camping adds to field work (e.g., preparing meals and getting ready in the morning and evening). We will

camp at the Townsite campground for the other four stations and will need to arrange a sample pickup after two days.

- In Glacier Basin, the trail up to the reference station (HC-GC-01) has an elevation gain of approximately 2,000 feet over 2 miles, which will be challenging with all of the field sampling gear: Swoffer flow meter; water quality meter; electrofishing backpack; nets; and cooler bags for surface water, sediment, periphyton, and macroinvertebrate samples. Ideally, this should be the first or second site sampled because people will still be "fresh" for the challenging hike.

Based on the discussion with Karen Adams, we recommend sampling the following sites as early as possible in the 2013 field season:

- HC-SFSR-07 Alt;
- HC-GC-01; and
- HC-76-02.

To capture the peak of the macroinvertebrate community and wadeable flows, we recommend the full sampling of all seven aquatic stations in late August/early September.

A separate site reconnaissance trip was planned to establish sampling locations for both site-specific terrestrial exposure analysis and background. The purpose was to identify 8 to 10 waste rock sampling locations at the three mine sites: Justice Mine and Mystery Mine in Glacier Creek Watershed, and Sheridan Mine in Seventysix Gulch Watershed. In addition, we proposed to identify 8 to 10 background sampling locations with similar soil composition and plant communities as the waste rock samples. Due to the late season start, this trip was canceled for 2012 as a result of inclement weather. This reconnaissance is now tentatively planned to coincide with an early-season, truncated aquatic sampling trip in June, 2013.

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Hart Crowser 2011. Monte Cristo Mining Area Phase I Spatial Analysis Summary Report. Prepared for the Washington State Department of Ecology. April 20, 2011.

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Rosgen, D. L. 1994. A Classification of Natural Rivers. Catena Vol. 22: 169–199.

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FIGURES

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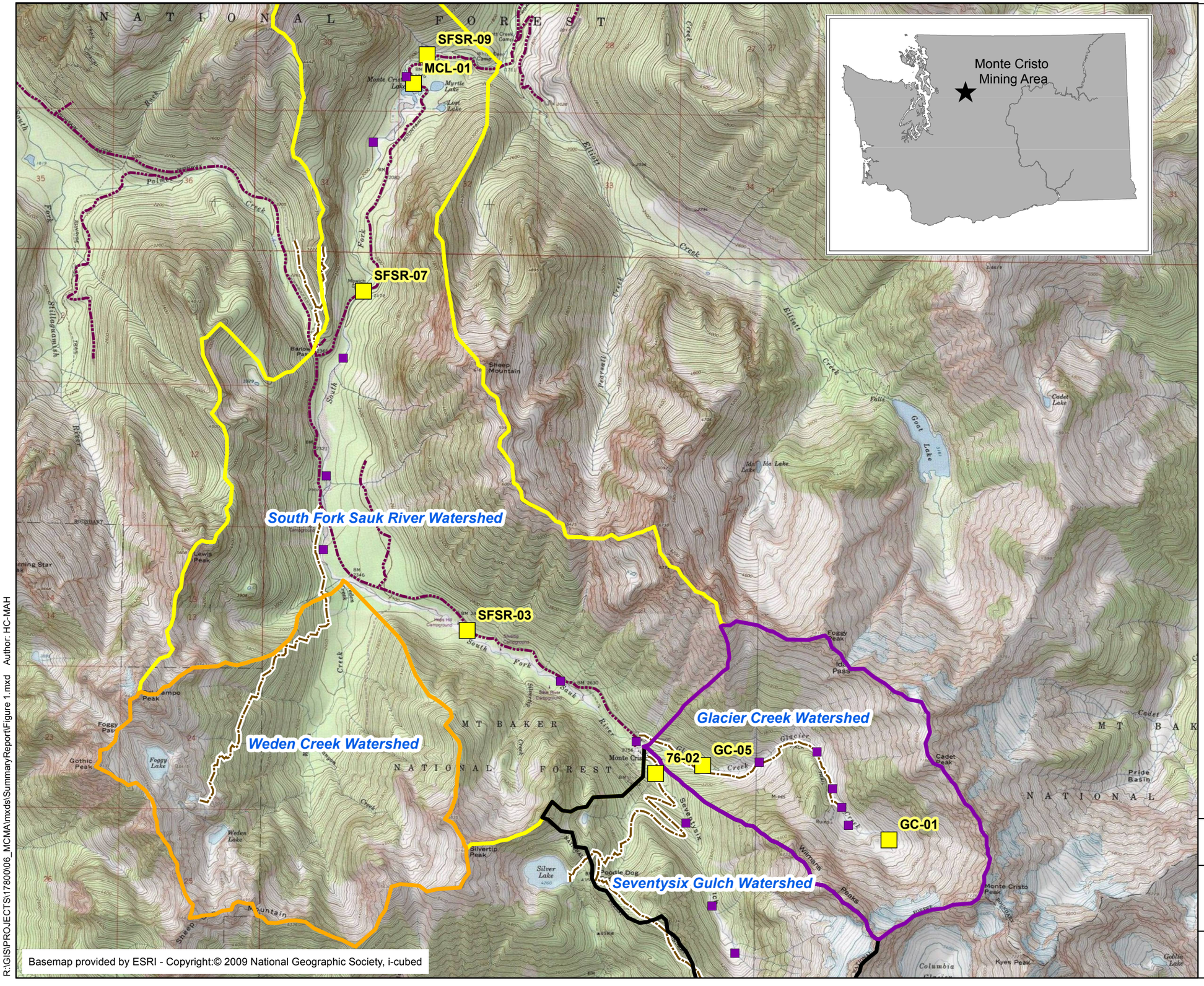

CES Aquatic Sampling Locations

- Sample - included in site reconnaissance
- Alternate - not visited by HC

Features

- Roads
- Trails

Watersheds

- South Fork Sauk River Watershed
- Weden Creek Watershed
- Seventysix Gulch Watershed
- Glacier Creek Watershed

N

1 inch = 3,500 feet

0 0.2 0.4 0.6 0.8 1 Miles

NAD 1983 HARN StatePlane Washington South FIPS 4602 Feet

Monte Cristo Mining Area Site Reconnaissance
Monte Cristo, Washington

Vicinity Map

17800-35 3/13

HARTCROWSER

Figure 1

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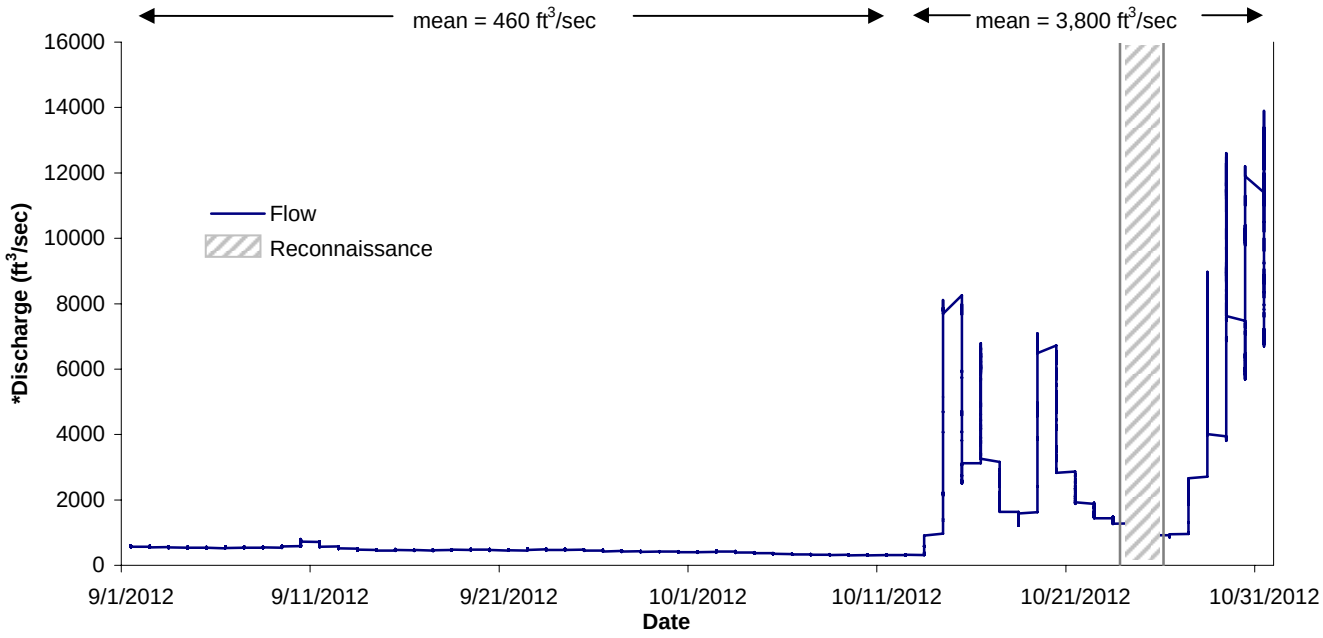

*Data obtained from the USGS database; they have not received Director's approval and are provisional and subject to revision

Monte Cristo Mining Area Site Reconnaissance
Monte Cristo, Washington

USGS Darrington, WA, Flow Data

17800-35 3/13

HARTCROWSER

Figure
2

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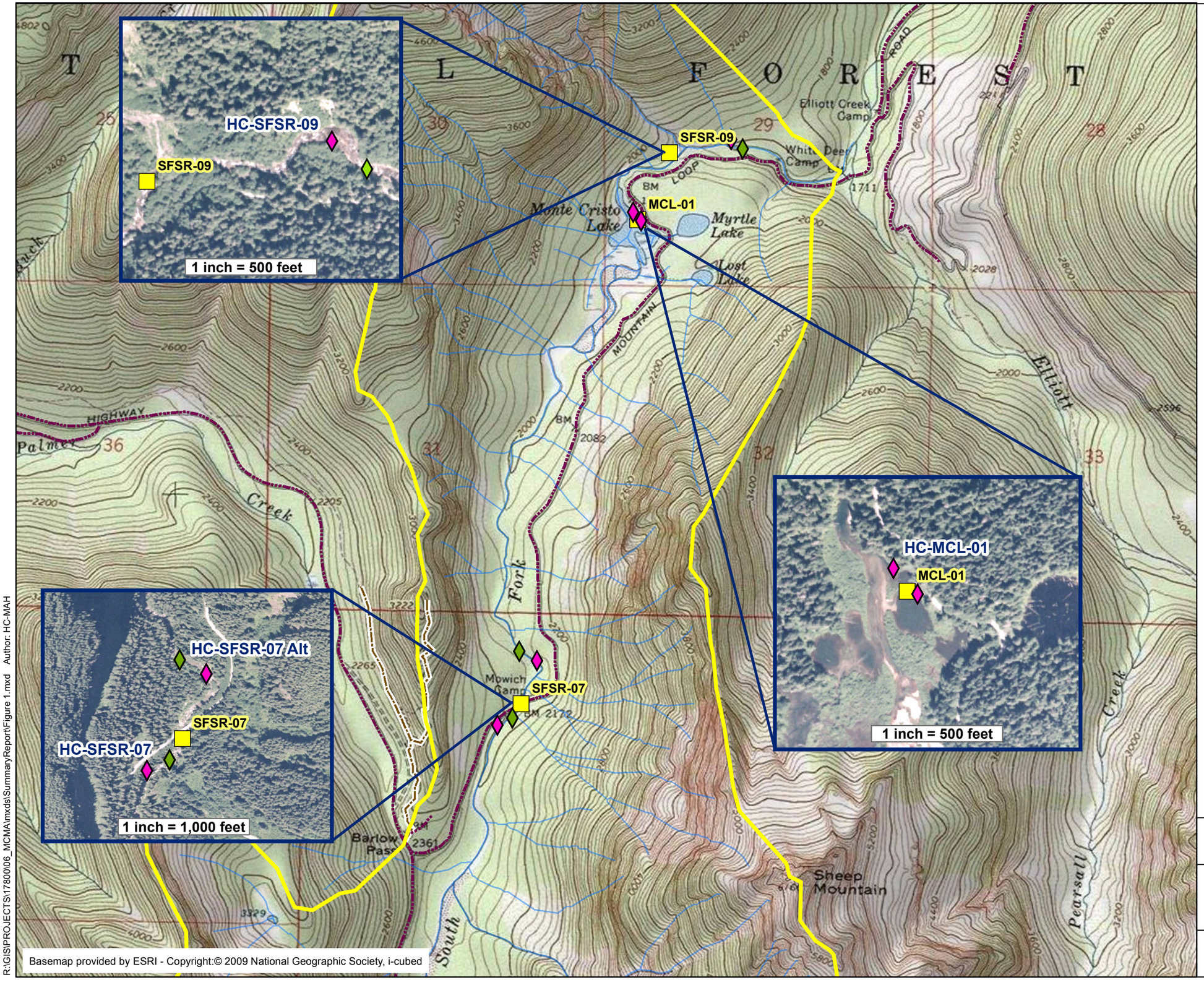

HC 2012 Aquatic Stations

- Upstream
- Downstream

CES Aquatic Sampling

- Sample location

Features

- Roads
- Trails
- Streams

Watersheds

- South Fork Sauk River Watershed
- Weden Creek Watershed
- Seventysix Gulch Watershed
- Glacier Creek Watershed

N

1 inch = 1,500 feet

0 0.2 0.4 0.6 Miles

NAD 1983 HARN StatePlane Washington South FIPS 4602 Feet

Monte Cristo Mining Area Site Reconnaissance
Monte Cristo, Washington

Downstream Aquatic Reconnaissance Stations

17800-35 3/13

HARTCROWSER

Figure 3

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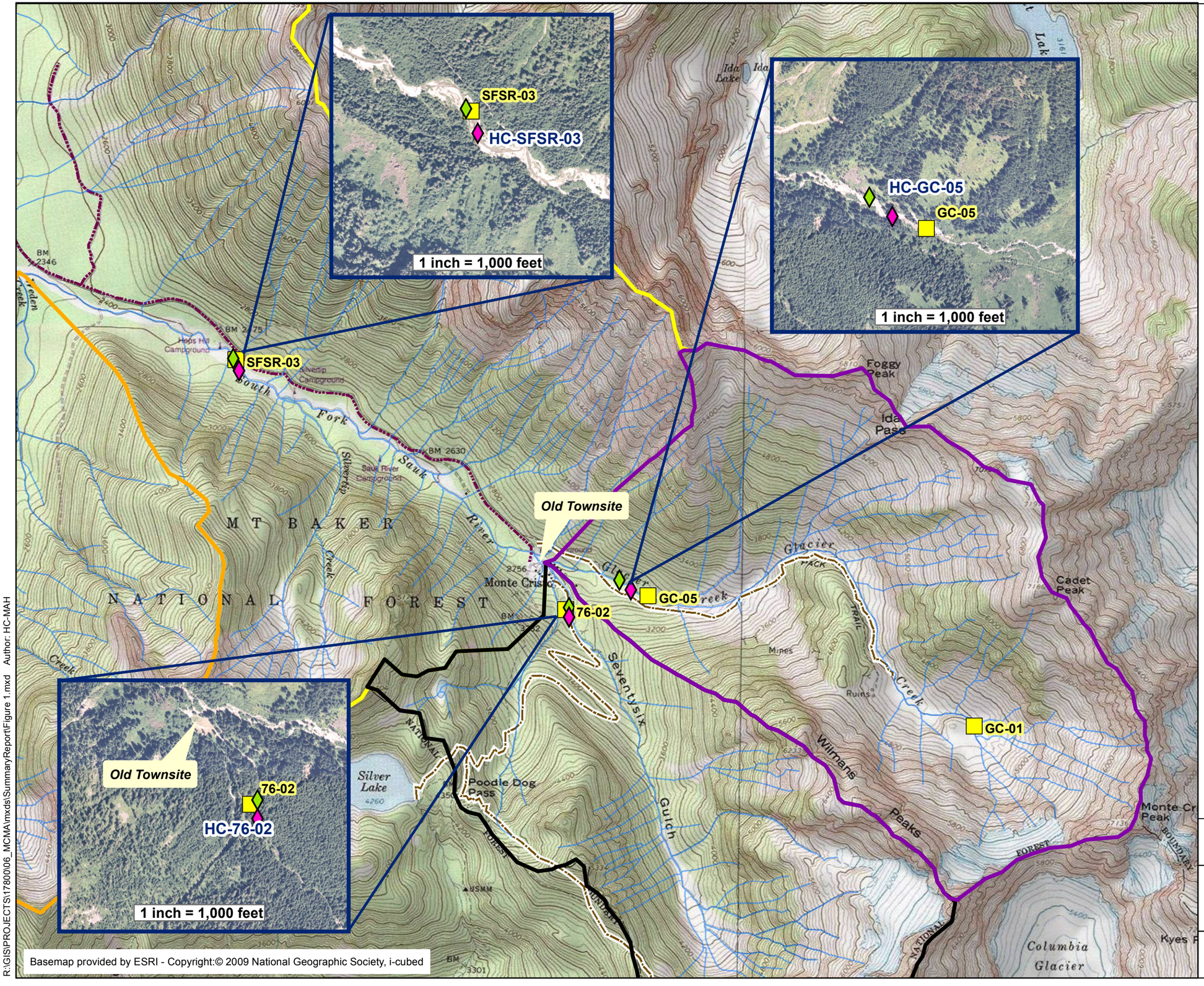

HC 2012 Aquatic Stations

- Upstream
- Downstream

CES Aquatic Sampling

- Sample location

Features

- Roads
- Trails
- Streams

Watersheds

- South Fork Sauk River Watershed
- Weden Creek Watershed
- Seventysix Gulch Watershed
- Glacier Creek Watershed

N

1 inch = 2,000 feet

0 0.2 0.4 0.6 Miles

NAD 1983 HARN StatePlane Washington South FIPS 4602 Feet

Monte Cristo Mining Area Site Reconnaissance
Monte Cristo, Washington

Upstream Aquatic Reconnaissance Stations

17800-35 3/13

HARTCROWSER

Figure 4

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APPENDIX A
SITE PHOTOGRAPHS AND RAPID BIOASSESSMENT PROTOCOL FORMS

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CONTENTS

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South Fork Sauk River
HC-SFSR-07

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PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

HC-SFSR-07
2,142.46ft N
56

STREAM NAME SFSR	LOCATION
STATION # HC-SFSR-07 RIVERMILE	STREAM CLASS A
LAT 98 5454.57 E LONG 1410822.23	RIVER BASIN SFSR
STORET #	AGENCY
INVESTIGATORS MAH/HLH	
FORM COMPLETED BY MAH	DATE 10/23/12 TIME 10:15 (AM) PM
REASON FOR SURVEY	

WEATHER CONDITIONS

Now:
- ☐ storm (heavy rain)
- ☐ rain (steady rain)
- ☐ showers (intermittent)
- ☒ 60 % cloud cover
- ☐ clear/sunny

Past 24 hours:
- ☐
- ☒
- ☐
- ☐ ___ %
- ☐

Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

Air Temperature 4 °C

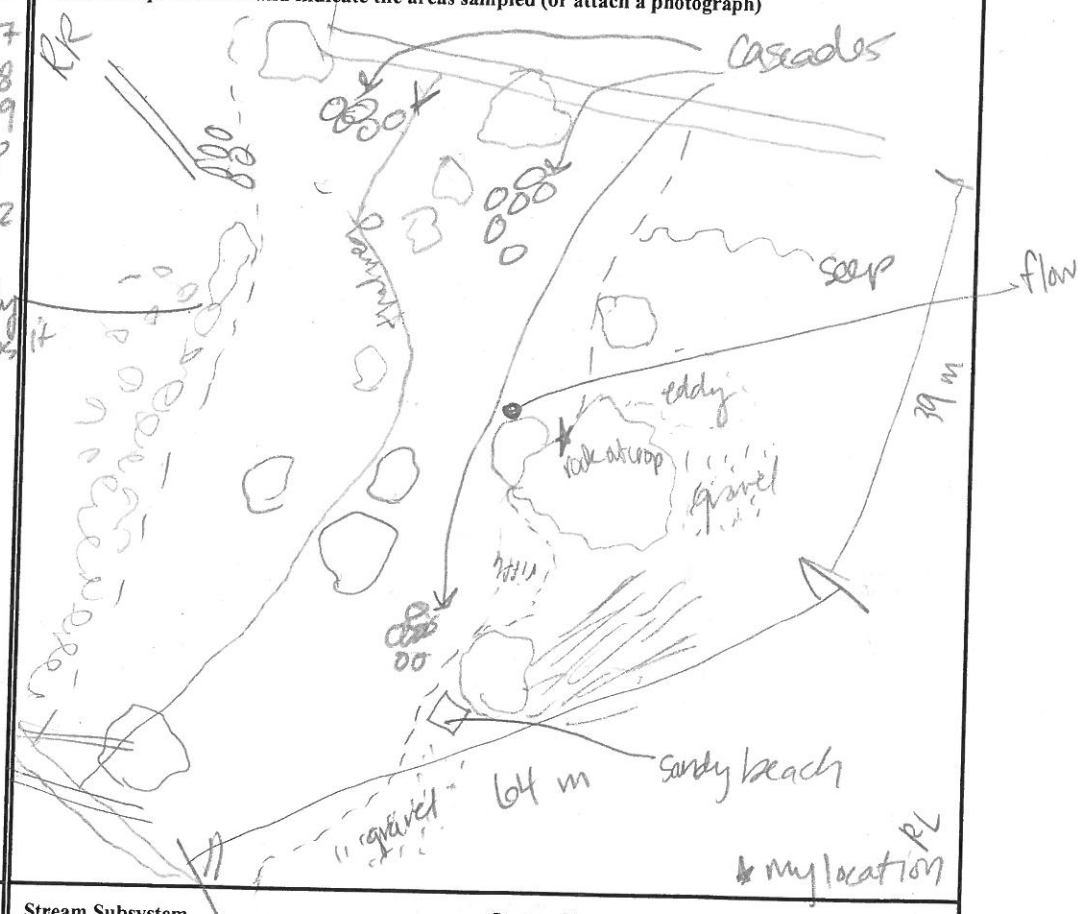
Other _____

SITE LOCATION/MAP

water flow R-L

pic US 100-5677
- US RR 5678
- US RL 5679
- DS 5680
- DS RR 5681
- DS RL 5682

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☒ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other _____

Catchment Area _____ km²

* lots of mayflies, some small casemakers

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other _____
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☒ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy BANK EROSION

100-5683

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present western hemlock, alder, devil's club, pic # 100-5686

INSTREAM FEATURES

23
16
27

Estimated Reach Length 103 ~~m~~ ft
Estimated Stream Width 22 ~~m~~ ft
Sampling Reach Area 2266 m²
Area in km² (m²x1000) 2.27 km²
Estimated Stream Depth 1 ~~m~~
Surface Velocity (at thalweg) 2.29 ~~m/sec~~ ft/sec in 2.9 ft

Canopy Cover
☒ Partly open ☐ Partly shaded ☐ Shaded
High Water Mark 2 m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 10 % ☐ Run 40 %
☐ Pool 10 % cascade 40 %

Channelized ☐ Yes ☒ No
Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 0.4 m² 0.25 m x 1.6 m long
Density of LWD 21 m²/km² (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae

dominant species present pic 100-5685

Portion of the reach with aquatic vegetation 5 % % cover

WATER QUALITY

Temperature 5.55 °C
Specific Conductance 0.031 mS/cm
Dissolved Oxygen 31.47 mg/L
pH 7.29
Turbidity 0.94 NTU
WQ Instrument Used Horiba U-52

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other _____

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other _____

SEDIMENT/ SUBSTRATE

100-5684

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☒ None
☐ Other _____

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☒ Sand
☐ Relict shells ☐ Other _____

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	5
Boulder	> 256 mm (10")	~~50~~ 50			
Cobble	64-256 mm (2.5"-10")	~~40~~ 40	Muck-Mud	black, very fine organic (FPOM)	—
Gravel	2-64 mm (0.1"-2.5")	9			
Sand	0.06-2mm (gritty)	1	Marl	grey, shell fragments	—
Silt	0.004-0.06 mm	0			
Clay	< 0.004 mm (slick)	0			

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION # 07 RIVERMILE	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 (7) 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0

Total Score _____

Photograph 1 – View of the upper portion of the sampling reach from the midpoint boulder.

Photograph 2 – View of the lower portion of the sampling reach from the midpoint boulder.

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for double-sided printing.

South Fork Sauk River
HC-SFSR-07 Alt

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PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

ALT: 2172

STREAM NAME HC-SFSR-07 ALT	LOCATION
STATION # _____ RIVERMILE _____	STREAM CLASS A 4% GRADE
~~N~~LAT 984660.66 ~~E~~LONG 1411410.96	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS MATI / HIH	
FORM COMPLETED BY HIH	DATE 10/25/12 TIME 1615 AM PM / REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☒
100% ☒	%cloud cover	☐ 100 %
☐	clear/sunny	☒

Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

Air Temperature 6.5 °C

Other _____

SITE LOCATION/MAP

SEE ATTACHED

Draw a map of the site and indicate the areas sampled (or attach a photograph)

PHOTOS

5812-5816: METHOD PHOTOS
5817: LOOKING D.S. FROM START BOULDER
5818: RB FROM START BOULDER
5819: LB " "
5820: START BOULDER AND ACROSS TO RB
5821: LOOKING D.S. FROM MIDPOINT
5822: RB " "
5823: LB " "
5824: LOOKING U.S. " "
5825: LOOKING U.S. @ LB " "
5826: LOOKING U.S. (END LOG IN BOTTOM PIC)
5827: LARGE CASEMAKER CADDIS

STREAM CHARACTERIZATION

SC

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☒ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other _____

Catchment Area _____ km²

CADDIS & MAYFLIES UNDER EVERY ROCK

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES WF

Predominant Surrounding Landuse
☒ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other _____
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☒ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☒ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer) RV

Indicate the dominant type and record the dominant species present
☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous
dominant species present ALDER, W. HEMLOCK, CEDAR, S.A. FIR

INSTREAM FEATURES IF

Estimated Reach Length 103 m
Estimated Stream Width 18 m
Sampling Reach Area _____ m²
Area in km² (m²x1000) _____ km²
Estimated Stream Depth 0.3 m
Surface Velocity (at thalweg) 1.36 ~~m/sec~~ ft/sec @ 31"

Canopy Cover
☐ Partly open ☒ Partly shaded ☐ Shaded
High Water Mark 1/3 m
Proportion of Reach Represented by Stream Morphology Types
☒ Riffle 30 % ☒ Run 65 %
☐ Pool _____ % XCASCADE: 5%
Channelized ☐ Yes ☒ No
Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS LWD

LWD 2 m²
Density of LWD _____ m²/km² (LWD/ reach area)

AQUATIC VEGETATION AV

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae
dominant species present _____
Portion of the reach with aquatic vegetation 3 %

WATER QUALITY WQ

Temperature 6.11 °C
Specific Conductance 0.034 mS/cm
Dissolved Oxygen 10.93 mg/L
pH 7.28
Turbidity 0.64 NTU
WQ Instrument Used Horiba U-52

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other _____

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other _____

SEDIMENT/ SUBSTRATE SS

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits NONE
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☒ No

IS

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%) OS		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		0	Detritus	sticks, wood, coarse plant materials (CPOM)	2
Boulder	> 256 mm (10")	~~30~~ 30			
Cobble	64-256 mm (2.5"-10")	50	Muck-Mud	black, very fine organic (FPOM)	2
Gravel	2-64 mm (0.1"-2.5")	20			
Sand	0.06-2mm (gritty)	<1	Marl	grey, shell fragments	0
Silt	0.004-0.06 mm	0			
Clay	< 0.004 mm (slick)	0			

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME HC-SFSR-07 ALT	LOCATION	
STATION # _____ RIVERMILE _____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

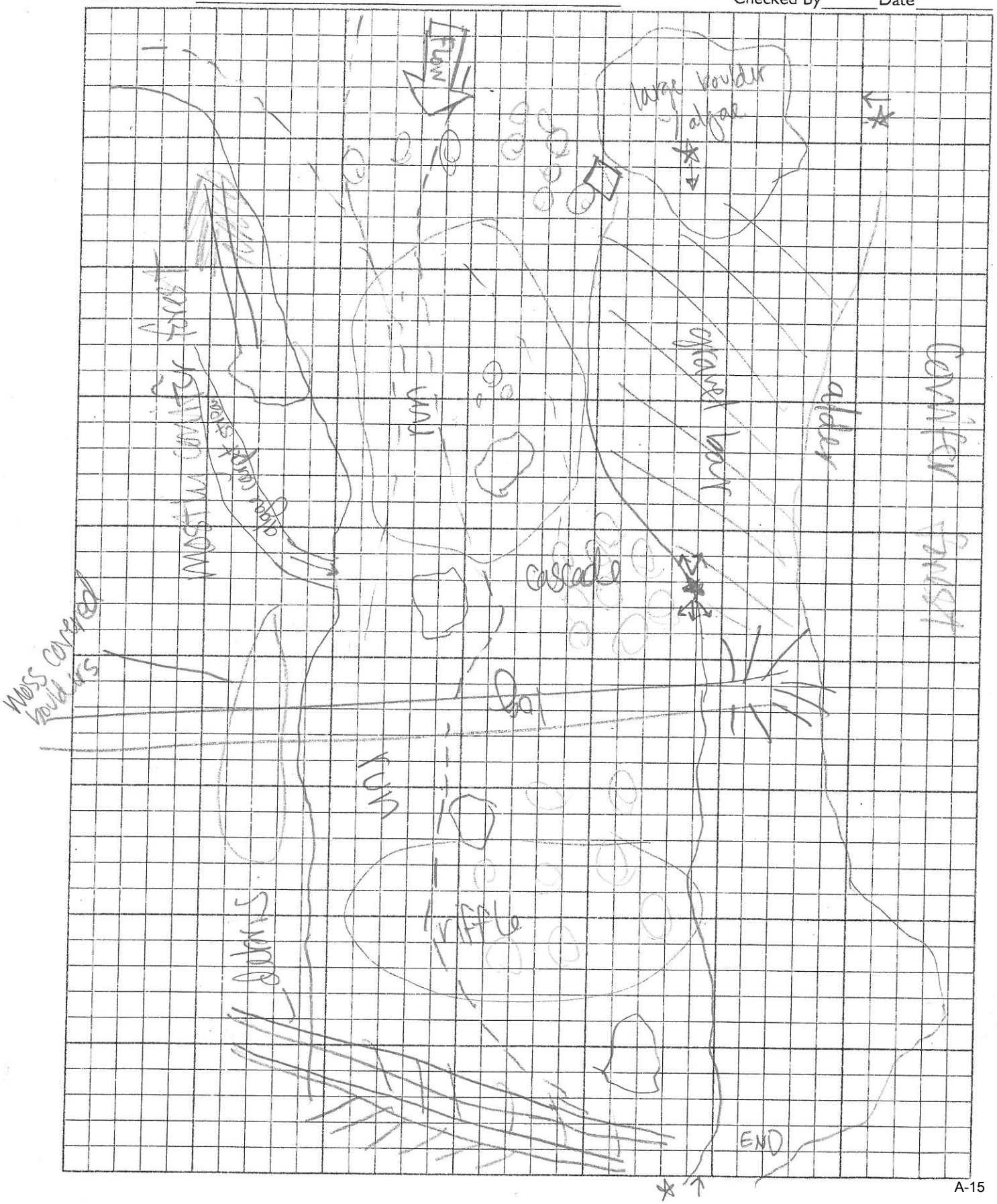
Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score _____


large boulder
algae
channel
alder
cascade
moss covered boulders
riffle
END

Photograph 3 – View of the upper portion of the sampling reach from the upstream end.

Photograph 4 – View of the upper portion of the sampling reach from the midpoint boulder.

Photograph 5 – View of the lower portion of the sampling reach from the midpoint boulder.

Photograph 6 – View of the lower portion of the sampling reach from the downstream end.

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South Fork Sauk River
HC-SFSR-09

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PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

HC-SFSK-09
1800 ft N

STREAM NAME	LOCATION
STATION # _____ RIVERMILE _____	STREAM CLASS A
~~LAT~~ 994798.89 ~~LONG~~ 1414518.14	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS MAH / HIH	
FORM COMPLETED BY MAH	DATE 10/23/12 TIME 1400 AM PM
	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☒
☐	showers (intermittent)	☐
75 % ☒	%cloud cover	☐ ___ %
☐	clear/sunny	☐

15
29
33
15
21

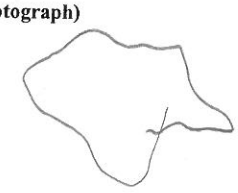
Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

Air Temperature 7.5 °C

Other _____

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



pics
from US RB 100-5697
across to LB
DS to LB 100-5698
DS to RB 100-5699
DS to RB 100-5700

see attached

water Flow L-R

from DS across to LB 100-5702
up to LB 100-5703
from DS to US 100-5703
DS up RB 5704

STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☒ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other _____

Catchment Area _____ km²

photo # 100-5696 large stained boulder @ US end of HC-SFSK-09
100-5701 boulder beach @ DS end

☆ only a couple of mayflies

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other _____
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☒ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous
dominant species present alder, big leaf maple, black twinberry

INSTREAM FEATURES

Estimated Reach Length 92 m crow
Estimated Stream Width 22 m
Sampling Reach Area _____ m²
Area in km² (m²x1000) _____ km²
Estimated Stream Depth 0.5 m
Surface Velocity (at thalweg) 1.66 ~~m/sec~~ ft/sec in 2 ft

Canopy Cover
☒ Partly open ☐ Partly shaded ☐ Shaded
High Water Mark 5 m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 5 % ☐ Run 15 %
☐ Pool 15 % cascade %, 65

Channelized ☐ Yes ☐ No
Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD Ø m²
Density of LWD Ø m²/km² **(LWD/ reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae
dominant species present ~~see~~ see SFSR-07 pic
Portion of the reach with aquatic vegetation 3 %

WATER QUALITY

Temperature 5.95 °C
Specific Conductance 0.034 mS/cm
Dissolved Oxygen 12.53 mg/L
pH 6.94
Turbidity 0.75 NTU
WQ Instrument Used Horiba U-52

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other _____

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other _____

SEDIMENT/ SUBSTRATE

Odors
☐ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☒ None
☐ Other _____

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☒ Other N4

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☐ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		0	Detritus	sticks, wood, coarse plant materials (CPOM)	2
Boulder	> 256 mm (10")	45			
Cobble	64-256 mm (2.5"-10")	40	Muck-Mud	black, very fine organic (FPOM)	Ø
Gravel	2-64 mm (0.1"-2.5")	5			
Sand	0.06-2mm (gritty)	5	Marl	grey, shell fragments	Ø
Silt	0.004-0.06 mm	5			
Clay	< 0.004 mm (slick)	0			

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #_____ RIVERMILE_____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

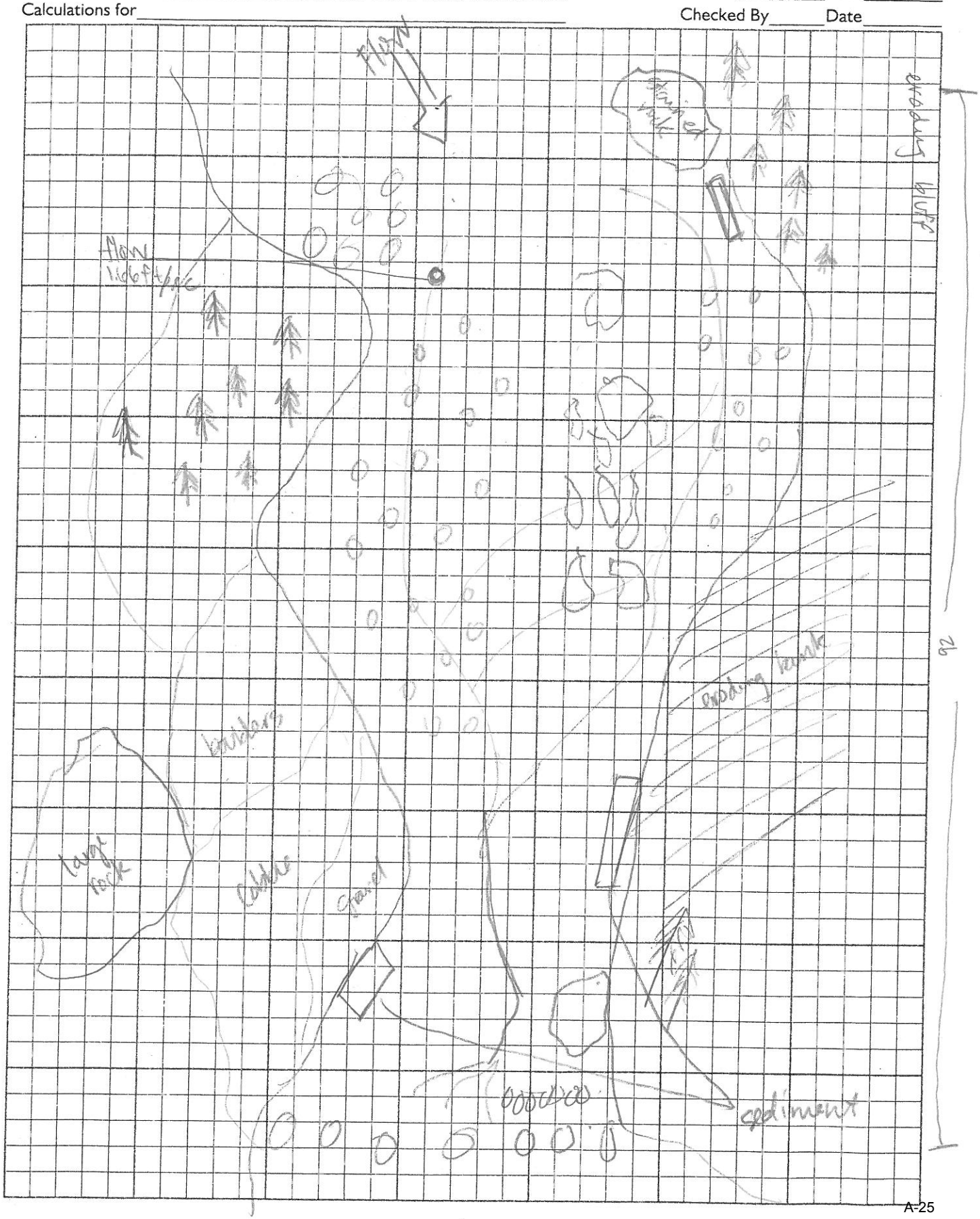
Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 (4) 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 (7) 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 (6)	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0

Total Score _____


flow
existing bluff
flow
1166ft/sec
boulders
large rock
cobble
gravel
existing bank
sediment
22

Photograph 7 – View across to the left bank from the upstream end of the sampling reach.

Photograph 8 – View of the large pool (along the left bank) at the upper end of the sampling reach.

Photograph 9 – View across to the left bank from the downstream end of the sampling reach.

Photograph 10 – View of the lower portion of the sampling reach from the downstream end; eroding slope along the left bank.

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Monte Cristo Lake
HC-MCL-01

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PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

HC - main lake - RB
RM54 ft N

0%

STREAM NAME	LOCATION	
STATION # _____ RIVERMILE _____	STREAM CLASS	
~~LAT~~ 9936499 ~~LONG~~ 1412950.32	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE 10/23/12 TIME 1000 AM PM	REASON FOR SURVEY

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
30 % ☒	%cloud cover	☐ ____ %
☐	clear/sunny	☐

Has there been a heavy rain in the last 7 days? ☐ Yes ☐ No

Air Temperature 6 °C

Other _____

SITE LOCATION/MAP

DS 5706
US 5707
US 5708
across 09

Draw a map of the site and indicate the areas sampled (or attach a photograph)

STREAM CHARACTERIZATION

Stream Subsystem
☐ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☒ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other _____

Catchment Area _____ km²

★ no evidence of invert; no cobble or suitable substrate

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other _____
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☒ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☒ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☐ Trees ☒ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present ~~horsetail~~ black huckleberry willow, vine maple, cedar

INSTREAM FEATURES

* no flow detectable in channel from roadside lake

Estimated Reach Length 111 m
Estimated Stream Width 47 m
Sampling Reach Area _____ m²
Area in km² (m²x1000) _____ km²
Estimated Stream Depth 0.3 ~~m~~
Surface Velocity (at thalweg) 1.12 ~~m/sec~~ ft/sec in main lake thalweg

Canopy Cover
☒ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark 0.25 m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle _____ % ☒ Run 100 %
☐ Pool _____ %

Channelized ☐ Yes ☒ No
Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 3 ~~100~~ m²
Density of LWD _____ m²/km² (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☒ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present horsetail

Portion of the reach with aquatic vegetation _____ %

WATER QUALITY

Temperature 6.11 °C (main lake RB)
Specific Conductance 0.040 ~~mS/cm~~
Dissolved Oxygen 12.76 mg/L
pH 6.97
Turbidity 101 — sediment kicked up
WQ Instrument Used _____

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other _____

Turbidity (if not measured)
☒ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other _____

SEDIMENT/ SUBSTRATE

Odors
☐ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☒ Anaerobic ☐ None
☐ Other _____

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits NONE
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		—	Detritus	sticks, wood, coarse plant materials (CPOM)	15
Boulder	> 256 mm (10")	—			
Cobble	64-256 mm (2.5"-10")	—	Muck-Mud	black, very fine organic (FPOM)	—
Gravel	2-64 mm (0.1"-2.5")	—			
Sand	0.06-2mm (gritty)	—	Marl	grey, shell fragments	—
Silt	0.004-0.06 mm	100			
Clay	< 0.004 mm (slick)	—			

redo @ roadside RB on 10/25/12

7.08	5.73°C
0.034	0.030 mS/cm
9.64	30.57 mg/L — questionable
6.82	6.96
4.59	7.19 NTU

* organic smell

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #_____ RIVERMILE_____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE 10/23/12 TIME 1016 AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 (2) 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 (2) 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 (6)	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0

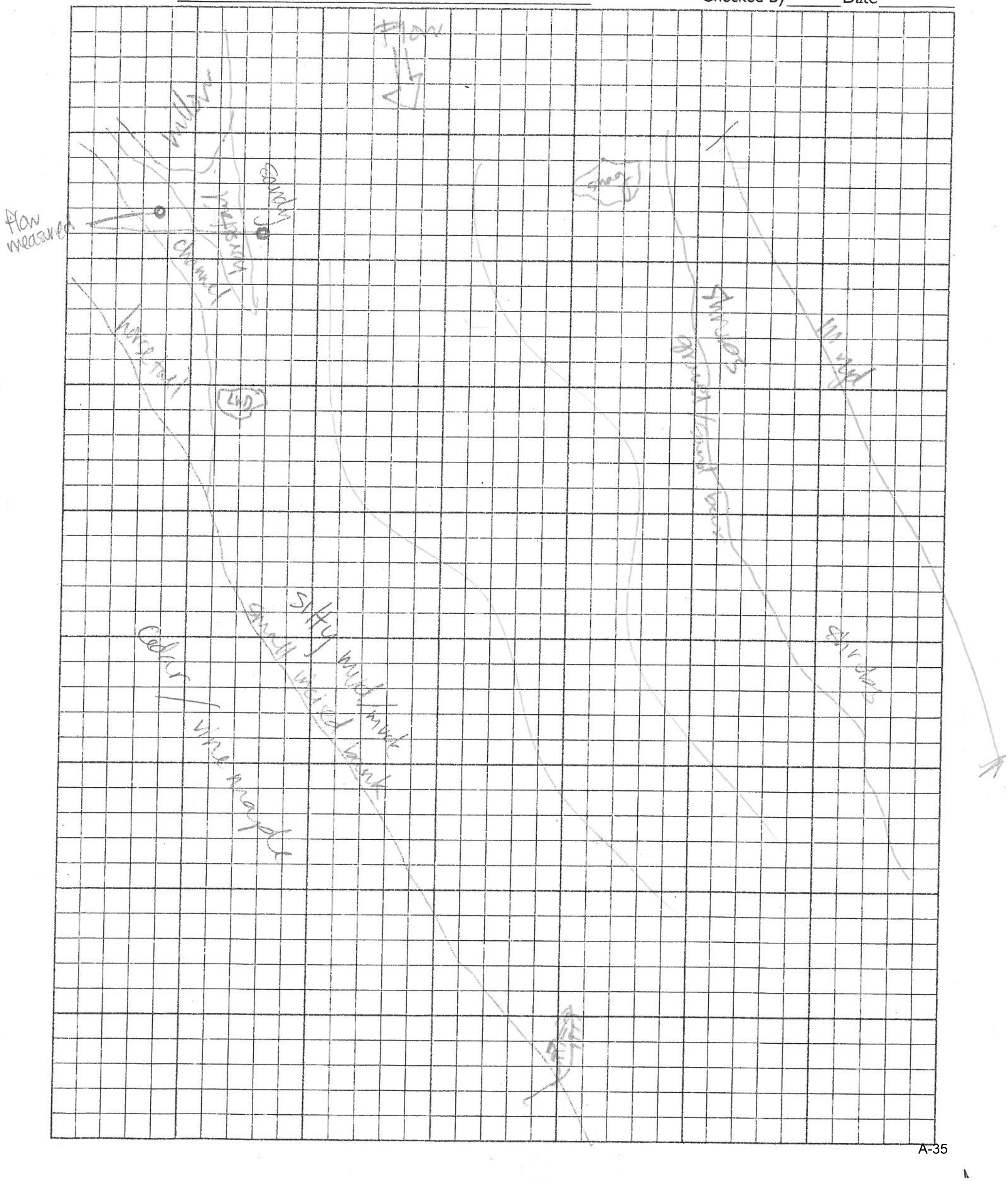
Total Score _____

HARTCROWSER
Delivering smarter solutions

Calculations

Project HC-MCL-01 (HC-main lake-RB)
Calculations for

Page ____ of ____
Job No. ____
Made By ____ Date ____
Checked By ____ Date ____



Photograph 11 – View of the upper portion of the main lake from the midpoint.

Photograph 12 – View of the left bank directly across from the midpoint.

Photograph 13 – View of the lower portion of the main lake from the midpoint; water quality collected on the right bank.

Photograph 14 – View of the roadside back-water just east of the main lake sampling reach; collected water quality on the far bank.

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South Fork Sauk River
HC-SFSR-03

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PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME	LOCATION
STATION # HC-SFSR-07 RIVERMILE	STREAM CLASS B 3% grade
~~LAT~~ 972878.32 ~~LONG~~ 1415093.90	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS MAH/HIH	
FORM COMPLETED BY MAH	DATE 10/25/12 TIME 1000 AM PM / REASON FOR SURVEY

2448 ft N

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☒
40 % ☒	%cloud cover	☐ ___ %
☐	clear/sunny	☐

Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

Air Temperature 4 °C

Other _____

SITE LOCATION/MAP

SEE ATTACHED SKETCH

Draw a map of the site and indicate the areas sampled (or attach a photograph)

PHOTOS

5761: FROM RB ACROSS TO START PT. (ORANGE GLOVE LOWER LEFT)
5762: DEBRIS PILE ON LB JUST D.S. OF START
5763: D.S. FROM START
5764: R.B. FROM START
5765: L.B. " "
5766: BULL TROUT REDD FLAG ≈ 10m DS. R.B.
5767: BULL TROUT REDD FROM RB
5768: LOOKING U.S. FROM R.B. / BT REDD MARKER
5769: LOOKING U.S FROM 20m mark
5770: LOOKING DS " "
5771: LB " "
5772: RB " "
5773: LOOKING DS FROM 80 m mark
5774: RB " "
5775: LB " "
5776: LOOKING US FROM 80 m mark
5777: " " LB
5778: " " RB
5779: LOOKING US FROM END
5780: LB END
5781: RB FROM END
5782: BT REDD

STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☒ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other _____

Catchment Area _____ km²

Saw caddis fly cases, green inchworm? or net spinner caddis? and a mite under a few rocks

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other _____
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☒ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☒ None ☐ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous
dominant species present ALDER, RED-OSIER DOGWOOD, BLACK RASPBERRY

INSTREAM FEATURES

Estimated Reach Length 100 m
Estimated Stream Width 16 m
Sampling Reach Area 1600 m²
Area in km² (m²x1000) _____ km²
Estimated Stream Depth 0.6 m
Surface Velocity (at thalweg) 2.3 m/sec

Canopy Cover
☒ Partly open ☐ Partly shaded ☐ Shaded
High Water Mark 1.5 m

Proportion of Reach Represented by Stream Morphology Types
☒ Riffle 60 % ☒ Run 15 %
☒ Pool 25 %

Channelized ☐ Yes ☒ No
Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 8 m²
Density of LWD _____ m²/km² (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae
dominant species present _____
Portion of the reach with aquatic vegetation 40 %

WATER QUALITY

Temperature 5.40 °C
Specific Conductance 0.023 mS/cm
Dissolved Oxygen 11.80 mg/L
pH 7.07
Turbidity 0.39 NTU
WQ Instrument Used HORIBA U-52

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other _____

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other _____

SEDIMENT/ SUBSTRATE

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits NONE
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		0	Detritus	sticks, wood, coarse plant materials (CPOM)	5
Boulder	> 256 mm (10")	5			
Cobble	64-256 mm (2.5"-10")	75	Muck-Mud	black, very fine organic (FPOM)	0
Gravel	2-64 mm (0.1"-2.5")	20			
Sand	0.06-2mm (gritty)	<1	Marl	grey, shell fragments	0
Silt	0.004-0.06 mm	0			
Clay	< 0.004 mm (slick)	0			

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #_____ RIVERMILE_____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0

Total Score _____

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Delivering smarter solutions

Calculations

Project HC-SFSK-03

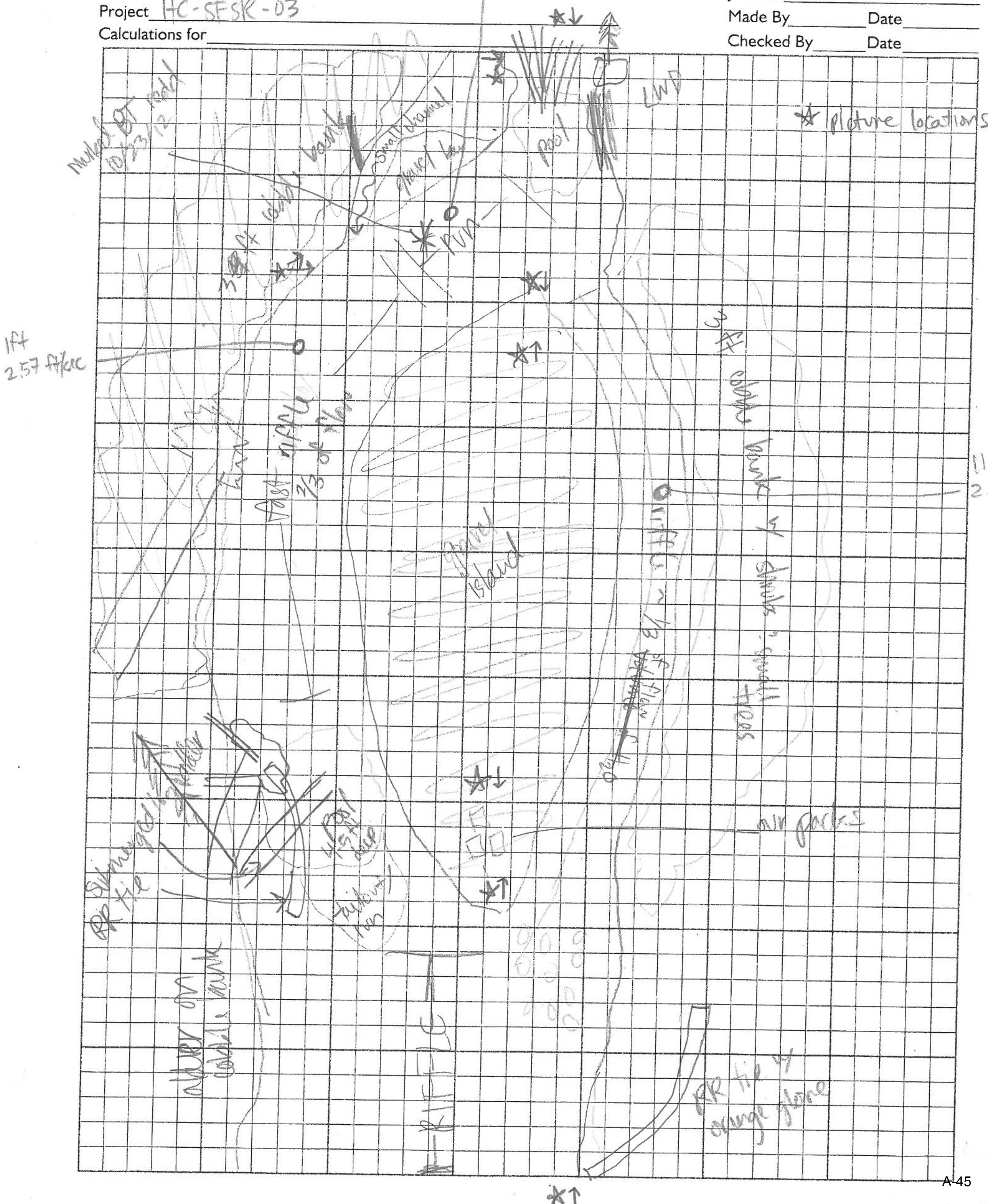
Calculations for

Page ____ of ____

Job No. ____

Made By ____ Date ____

Checked By ____ Date ____



Photograph 15 – View of the upper portion of the sampling reach from the upstream end.

Photograph 16 – View of the middle portion of the reach from the upstream end of the gravel island.

Photograph 17 – View of the middle portion of the sampling reach from the downstream end of the gravel island.

Photograph 18 – View of the lower portion of the sampling reach from the downstream end.

Photograph 19 – View of the bull trout red-flagged on 10/23/12; located on the right bank in the upper 30 meters of the sampling reach.

Glacier Creek
HC-GC-05

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PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME	LOCATION
STATION # HC-GC-05 RIVERMILE	STREAM CLASS A 9° grade
LAT 9682610.90 E LONG 1423445.15	RIVER BASIN Glacier Creek
STORET #	AGENCY
INVESTIGATORS MAH / HIH	
FORM COMPLETED BY MAH	DATE 10/24/12 TIME 1215 AM PM / REASON FOR SURVEY

2873 ft. N

9%

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☑	showers (intermittent)	☑
___% ☐	%cloud cover	☐ ___%
☐	clear/sunny	☐

Has there been a heavy rain in the last 7 days? ☑ Yes ☐ No

Air Temperature 4.5° C

Other _____

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

pic from DS end
looking US 5733
across to LB 34 *tree that denotes end
up the LB 35
RB 36
up the RB 5737

LOOKING U.S. 5738, 39
@ START BOULDER (LOWER RH CORNER)

LOOKING D.S. 5740
@ DAM FROM U.S. LOC

LOOKING D.S., LB 5741
D.S. RB 5742
D.S. FROM DAM 5743

STREAM CHARACTERIZATION

Stream Subsystem
☑ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☐ Warmwater

Stream Origin
☑ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other_____

Catchment Area_____km²

* forgot to check for inverts

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other _____
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☒ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous

dominant species present W. HEMLOCK, SUBALPINE FIR, NOBEL FIR

INSTREAM FEATURES

Estimated Reach Length 114 m
Estimated Stream Width 5 m
Sampling Reach Area _____ m²
Area in km² (m²x1000) _____ km²
Estimated Stream Depth .2 m
Surface Velocity (at thalweg) _____ m/sec

1.52
2.8K ft/s
1.11 →

Canopy Cover
☒ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark 4 m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 50 % ☐ Run ϕ %
☒ Pool 20 % 30 CASCADE

Channelized ☐ Yes ☒ No

Dam Present ☒ Yes ☐ No

LARGE WOODY DEBRIS

LWD 30 m²
Density of LWD _____ m²/km² (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae

dominant species present _____

Portion of the reach with aquatic vegetation <1 %

WATER QUALITY

Temperature 2.97 °C
Specific Conductance 0.072 mS/cm
Dissolved Oxygen 12.21 mg/L
pH 7.40
Turbidity 1.15 NTU
WQ Instrument Used Horiba U-52

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other _____

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other _____

SEDIMENT/ SUBSTRATE
BOULDERS/ COBBLES STAIN RED/BROWN

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits NONE
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		ϕ	Detritus	sticks, wood, coarse plant materials (CPOM)	8
Boulder	> 256 mm (10")	30			
Cobble	64-256 mm (2.5"-10")	65	Muck-Mud	black, very fine organic (FPOM)	ϕ
Gravel	2-64 mm (0.1"-2.5")	5			
Sand	0.06-2mm (gritty)	<1	Marl	grey, shell fragments	ϕ
Silt	0.004-0.06 mm				
Clay	< 0.004 mm (slick)	ϕ			

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #_____ RIVERMILE_____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low). FS, SS	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. HIGH ERosion SMALL AREA	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 (7) 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 (7) 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0

Total Score _____

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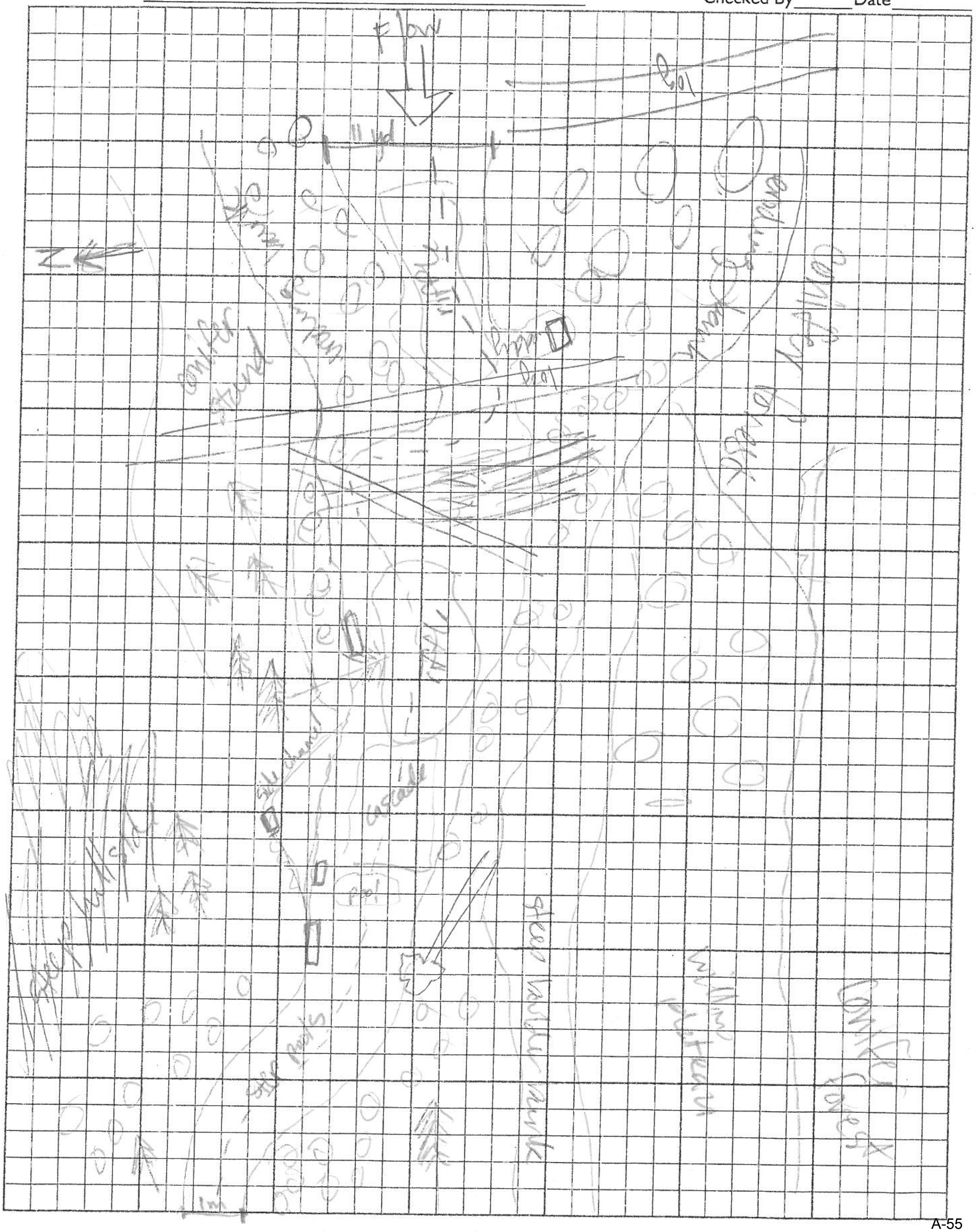
Delivering smarter solutions

Calculations

Page ______ of ______
Job No. ______
Made By ______ Date ______
Checked By ______ Date ______

Project HC-GC-05
Calculations for ______

2.85
1.11
1.52



Photograph 20 – View of the upstream end of the sampling reach from the right bank.

Photograph 21 – View of the large woody debris jam approximately 30 meters down from the upstream end of the reach.

Photograph 22 – View of the lower portion of the sampling reach from the large woody debris dam.

Photograph 23 – View of the lower portion of the sampling reach from the downstream end.

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for double-sided printing.

Seventysix Gulch
HC-76-02

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for double-sided printing.

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME	LOCATION
STATION # HC-76-02 RIVERMILE	STREAM CLASS Aa+ 13° grade
LAT 46°16'30.98" N LONG 142°12'8.01" E	RIVER BASIN Seventysix Gulch
STORET # 2931	AGENCY
INVESTIGATORS MAH / HLH	
FORM COMPLETED BY MAH	DATE 10/24/12 TIME 1500 AM (PM)
REASON FOR SURVEY	

WEATHER CONDITIONS

Now		Past 24 hours
☐	storm (heavy rain)	☐
☒	rain (steady rain)	☐
☐	showers (intermittent)	☒
___% ☐	%cloud cover	☐ ___%
☐	clear/sunny	☐

Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

Air Temperature 2.5 °C

Other _____

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)

ATTACHED

Pics
5745: LOOKING UP GLACIER BASIN TRAIL
5746: DEPOSITIONAL POOL @ D.S. END
5747: VIEW OF D.S. END FROM LB (GRAVEL BAR)
5748: VIEW U.S. FROM D.S END (HANS ON (L))
5749: VIEW D.S. FROM MIDREACH PT. ON LB
5750: VIEW U.S " "
5751+2: VIEW FROM LB TO BOULDER START (US)
5753: VIEW DS. FROM US END
5755: RB FROM U.S.
5758: LB FROM U.S.

5759: CADDIS
5760: MAYFLY

STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☒ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☐ Mixture of origins
☐ Other _____

Catchment Area _____ km²

* mayflies & casemaker caddis under every rock we overturned

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest ☐ Commercial
☐ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other _____
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☒ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous
dominant species present SAPLING FIR, W. HEMLOCK

INSTREAM FEATURES

Estimated Reach Length 95 ~~m~~ yd
Estimated Stream Width 2 m
Sampling Reach Area _____ m²
Area in km² (m²x1000) _____ km²
Estimated Stream Depth 0.3 m
Surface Velocity (at thalweg) 1.5 m/sec ft/sec

Canopy Cover
☐ Partly open ☐ Partly shaded ☒ Shaded
High Water Mark 1 m
Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 5 % ☐ Run 0 %
☐ Pool 35 % CASCADE 60
Channelized ☐ Yes ☒ No
Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 20 m²
Density of LWD _____ m²/km² (LWD/ reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae
dominant species present _____
Portion of the reach with aquatic vegetation 10 %

WATER QUALITY

Temperature 4.70 °C
Specific Conductance 0.021 mS/cm
Dissolved Oxygen 11.45 mg/L
pH 6.92
Turbidity 1.06 NTU
WQ Instrument Used Horiba

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other _____

Turbidity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other _____

SEDIMENT/ SUBSTRATE
RED/BRN STAINING

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits NONE
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	
Boulder	> 256 mm (10")	55			
Cobble	64-256 mm (2.5"-10")	40	Muck-Mud	black, very fine organic (FPOM)	0
Gravel	2-64 mm (0.1"-2.5")	5			
Sand	0.06-2mm (gritty)	<1%	Marl	grey, shell fragments	0
Silt	0.004-0.06 mm	0			
Clay	< 0.004 mm (slick)	0			

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #_____ RIVERMILE_____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends) BENDS	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 (7) 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0

Total Score _____

HARTCROWSER

Delivering smarter solutions

Calculations

Page ______ of ______

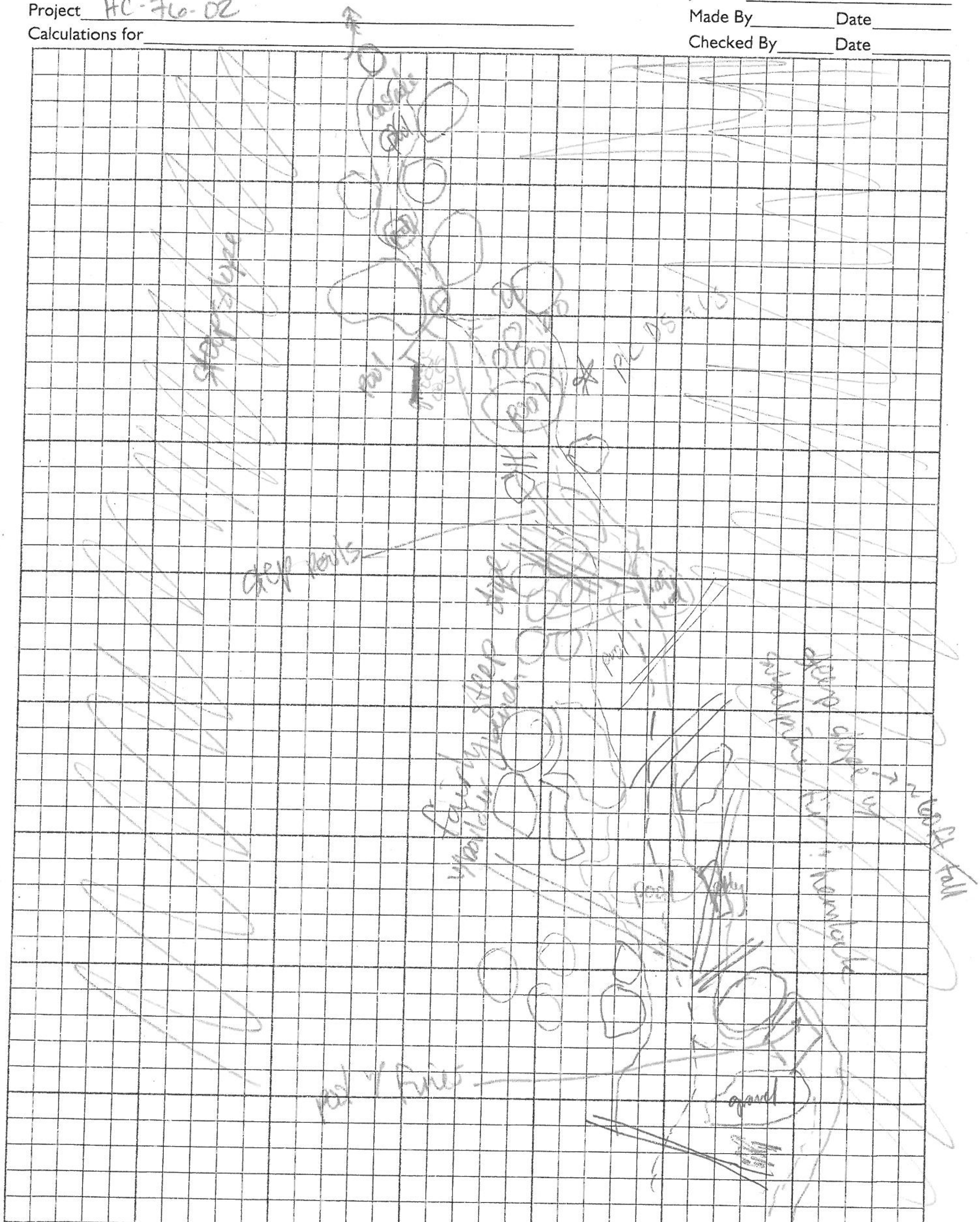
Job No. ______

Made By ______ Date ______

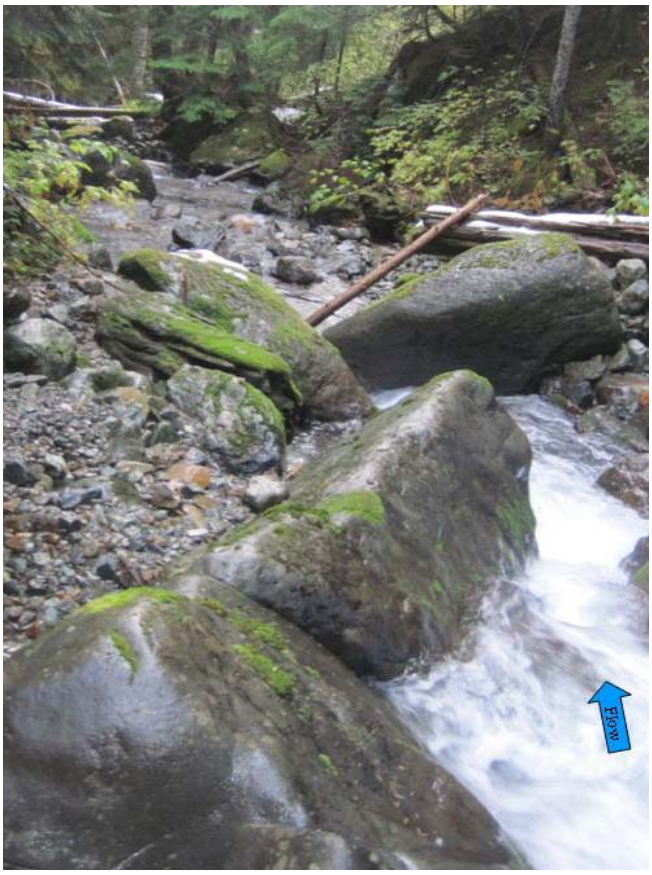
Checked By ______ Date ______

Project HC-76-02

Calculations for ______



hop under every rock!



Photograph 24 – View of the upper portion of the sampling reach from the upstream end.

Photograph 25 – View of the upper portion of the sampling reach from the midpoint.

Photograph 26 – View of the lower portion of the sampling reach from the midpoint.

Photograph 27 – View of the lower portion of the sampling reach from the downstream end.