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5. Total Maximum Daily Loads

A load is fundamentally a quantity of a pollutant discharged over some period of time and is the product of concentration and flow. A TMDL prescribes an upper limit, called the load or load capacity (LC), on the pollutant load discharged from all sources so as to assure water quality standards are met. The load capacity is allocated among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a wasteload allocation (WLA); and nonpoint sources, which receive a load allocation (LA). Natural background (NB), when present, is considered part of the LA, but is often broken out on its own because it represents a part of the load not subject to control. The magnitude of the natural background load determines the amount of the LC that is available for allocation to human-made pollutant sources.

Because of uncertainties regarding quantification of loads and the relation of specific loads to attainment of water quality standards, the rules regarding TMDLs (40 CFR § 130) require that a margin of safety (MOS) be a part of the TMDL. The MOS may be implicit, as in conservative assumptions used in calculating the LC, WLA, and LAs. The MOS may also be explicitly stated as an added, separate, quantity in the TMDL calculation

The TMDL components presented above can be summarized symbolically as:

$$\mathbf{LC = MOS + NB + LA + WLA = TMDL}$$

The equation is written in this order because it represents the logical order in which a loading analysis is conducted. First the LC is determined. Then the LC is broken down into its components: taking into consideration the MOS and NB, the remaining portion of the LC is then allocated among point and nonpoint pollution sources.

Another step in a loading analysis is the quantification of current pollutant loads by source. This allows the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary in order for pollutant trading to occur. Also a required part of the loading analysis is that the LC be based on critical conditions – the conditions when water quality standards are most likely to be violated. If protective under critical conditions, a TMDL will be more than protective under other conditions. Because both LC and pollutant source loads vary, and not necessarily in concert, determination of critical conditions can be more complicated than it may appear.

Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, the federal rules allow for “other appropriate measures” to be used when necessary. These “other measures” must still be quantifiable, and relate to water quality standards, but they allow flexibility to deal with pollutant loading in more practical and tangible ways. The rules also recognize the particular difficulty of quantifying nonpoint loads and allow “gross allotment” as a LA where available data or appropriate predictive techniques limit more accurate estimates. For certain pollutants whose effects are long term, such as sediment and nutrients, seasonal or annual loads are allowed.

This document has four types of TMDLs: a bacteria TMDL for Threemile Creek, nutrient and associated dissolved oxygen TMDLs for Threemile Creek, a set of temperature TMDLs that cover all of the water bodies in the subbasin, and a set of sediment TMDLs for Threemile Creek, Butcher Creek and the main stem SF CWR. The Threemile Creek bacteria TMDL is presented in Section 5.1, the nutrient TMDLs for Threemile Creek in Section 5.2, the temperature TMDLs in Section 5.3, and the sediment TMDLs in Section 5.4.

5.1 Bacteria TMDL – Threemile Creek

Threemile Creek is listed for bacteria, and data discussed in Chapter 2 indicate that development of a bacteria TMDL is warranted. Threemile Creek has been designated by the state of Idaho for secondary contact recreation. A secondary contact recreation designation is for waters in which only incidental human contact with the water is expected. It is not likely that such water bodies would be used for swimming, but some water contact, such as from fishing or other activities may occur. Idaho WQS include criteria for *E. coli* that is intended to provide protection from microbiological illnesses that may be caused by incidental water contact. The purpose of this TMDL is to reduce bacteria levels in order to meet these criteria and fully support the secondary contact recreation beneficial use.

Design Conditions

Numeric criteria to protect recreational beneficial uses apply to all perennial reaches of Threemile Creek and to intermittent reaches of Threemile Creek during periods of optimum flow (defined as 5 cfs or greater in Idaho WQS). Four sampling points in Threemile Creek were monitored twice per month for one year to estimate bacteria concentrations. At all four of these locations (above the Grangeville WWTP outfall, at the outfall, below the outfall, and at the mouth), flow was measured throughout the year. While there may be locations in the headwaters and in the canyon reach of the Threemile Creek that are intermittent in nature, the locations sampled were all perennial. As a result, the numeric bacteria criteria are applicable at these locations, and the TMDL was developed based on flow and concentration data collected from these sites.

Data shown in Table 32 indicate that bacteria WQS are exceeded consistently from May through September, with fewer violations from October through January. Peak concentrations appear to occur in August and September, which is also the period of lowest flow. In order to address critical conditions, the LC and allocations were developed based on the flows and concentrations that occur during this time. It is expected that reductions driven by these allocations will be protective other times of the year when *E. coli* concentrations are lower.

Target Selection

The criteria for *E. coli* concentrations in Idaho WQS intended to protect the secondary contact recreation beneficial use are:

- not to exceed 576 cfu per 100 ml at any time, and
- not to exceed a geometric mean of 126 cfu per 100 ml based on a minimum of 5 samples taken every 3 to 5 days over a 30-day period.

These criteria are the targets of the TMDL and have been used to establish the LC and allocations.

Monitoring Points

A comprehensive monitoring plan for bacteria should be implemented to assure planners that mitigation practices are sufficiently addressing the pollution problems. It is recommended that additional sites be monitored and that more frequent monitoring occur during times when elevated concentrations are expected in order to evaluate compliance with the 126 cfu/100 ml monthly *E. coli* criteria. In addition to existing sites, a site near the headwaters would enable planners to determine the NB concentration of bacteria. Continued monitoring above the WWTP outfall, at the outfall, and below the outfall would enable planners to monitor the city improvements to the sewer lines and WWTP modifications. A site at the head of the canyon would identify contributions from farmland below the WWTP.

Load Capacity

The LC is the greatest amount of pollutant loading a water body can receive and still meet WQS. The LC will vary with flow, that is, at higher flows a water body can accept greater loading and still comply with criteria. The LCs were estimated for the four sampling locations using the average flow recorded during August and September multiplied by the monthly mean *E. coli* criteria of 126 cfu/100 ml. While elevated concentrations of *E. coli* occur during periods of high runoff (e.g., in May), the LC was established utilizing the low flow period because a much lower bacteria loading is necessary in order to remain in compliance with established criteria.

Table 32 lists LCs at the three sampling locations used to establish the monthly criteria. The loading is presented in terms of colony forming units per day. This is not a very practical measure as there is seldom information from which to estimate such daily loads. As a result, the allocations include the percent reduction in bacteria loading needed to achieve the LC in addition to the numeric criteria.

Table 32. *E. coli* load capacities for Threemile Creek.

Location	Target (cfu/100 ml)	Critical Flow (cfs)	Load Capacity (cfu/day)
Above Outfall	126	0.7	2.1E+12
Below Outfall	126	1.5	4.7E+12
Mouth	126	2.6	7.9E+12

Estimates of Existing *E. coli* Loads

Estimates of the current concentrations and loading are presented in Table 33. Concentration data were collected during the February 2000 through February 2001 time period, with two samples collected during most months. Flow, concentration, and loading are presented by month, and are averages of the two monthly measurements. As discussed in Chapter 2, flows during this time period were somewhat below average for the time period.

Table 33. Average monthly flow, *E. coli* concentration, and loading in Threemile Creek.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Above Outfall	Flow (cfs)[a]	1.8	1.4	2.2	3.4	5.3	2.0	0.7	0.2	1.3	0.7	0.3	0.7
	Measured *E. coli* (mg/L)[b]	28	86	95	82	903	370	710	1750	1350	300	400	41
	Measured load (cfu/day)[c]	1.13 E+12	5.07 E+12	7.52 E+12	7.18 E+12	5.44 E+13	1.13 E+13	1.33 E+13	2.84 E+13	2.30 E+13	5.65 E+12	9.03 E+12	1.35 E+12
Grange-ville WWTP (at outfall)	Flow (cfs)	1.4	1.9	2.5	1.8	1.2	1.5	3.8	3.3	2.7	2.0	1.9	1.7
	Measured *E. coli* (mg/L)	9	17	38	43	375	4	208	51	56	4	0	1
	Measured load (cfu/day)	1.97 E+11	3.73 E+11	8.34 E+11	9.44 E+11	8.23 E+12	8.78 E+10	4.56 E+12	1.12 E+12	1.23 E+12	8.78 E+10	0.00 E+00	2.19 E+10
Below Outfall	Flow (cfs)	2.9	1.5	3.4	4.6	7.0	2.6	1.3	1.0	1.7	1.4	1.3	1.1
	Measured *E. coli* (mg/L)	690	62	110	89	767	245	690	605	1201	130	20	1400
	Measured load (cfu/day)	4.39 E+13	5.24 E+12	1.18 E+13	1.03 E+13	6.59 E+13	1.29 E+13	2.74 E+13	2.23 E+13	4.54 E+13	5.17 E+12	8.80 E+11	7.78 E+13
At Mouth	Flow (cfs)	4.0	9.9	8.5	7.5	11.4	5.9	1.6	1.2	1.9	3.8	2.8	2.6
	Measured *E. coli* (mg/L)	5	17	6	6	38	67	200	77	691	120	26	38
	Measured load (cfu/day)	7.63 E+11	3.81 E+12	1.81 E+12	2.00 E+12	8.71 E+12	7.75 E+12	1.42 E+13	4.72 E+12	4.45 E+13	8.54 E+12	2.22 E+12	4.76 E+12

[a] cubic feet per second
[b] milligrams per liter
[c] colony forming units per day

Load and Wasteload Allocations

Nonpoint source allocations and WLAs are presented in Table 34, and include a WLA for the Grangeville WWTP and allocations for the other three monitoring stations. Because source-specific loading information was not available, the nonpoint allocations are gross allotments to all nonpoint sources within the reach upstream of each point, and include all sources, such as storm water runoff, animal feeding operations, septic systems, etc.

Allocations were established at the same loading and concentration as the LC in Table 32, without an explicit margin of safety. Due to the lack of sufficient information, it was not possible to differentiate background loading from anthropogenic loading, so background loading is included within the gross allocation to nonpoint sources. The percent reduction needed to achieve nonpoint source LAs is also shown, in order to provide some perspective on the magnitude of source control needed during the critical period.

The WLA for the Grangeville WWTP is established at the level of the applicable water quality criteria for *E. coli*. These limits are the same as proposed in draft NPDES permits for other wastewater facilities in the SF CWR Subbasin (USEPA 2002a-e) and are expected to be incorporated into Grangeville's permit when it is reissued.

Margin of Safety

An implicit MOS has been incorporated into the TMDL by utilizing conservative assumptions. The period of lowest flows was used to estimate the LC. This results in a LC far below that needed to achieve criteria during 10 months of the year. The LC is also somewhat conservative during the critical August and September period, since the flows measured during the year used to derive the allocations were somewhat below normal (Chapter 2). The resulting allocations range from 80% to 90% reductions for nonpoint sources and send a clear message that major reductions are needed in order to meet criteria.

Seasonal Variation/Critical Conditions

Although the TMDL does not include seasonal allocations, it does consider seasonal variations in loading. Table 33 lists concentrations and loading by month, and the annual variation and peak in concentration in August and September is apparent. The TMDL addresses critical conditions by deriving allocations from the period of highest concentration and lowest flow, which both occur in August and September.

Background

As discussed previously, it was not possible to differentiate background from anthropogenic loading, so background has been included with other sources in the gross nonpoint source allocation. This has been identified as a data gap, and in the future it may be possible to refine relative source contributions and refine allocations if more definitive monitoring is conducted.

Reserve

An explicit reserve for future growth has not been set aside within the TMDL. Any increased discharge from future growth or development within the Threemile Creek watershed would need to be consistent with these allocations. In other words, it could not increase *E. coli* concentrations above target criteria identified.

5.2 Nutrient TMDLs – Threemile Creek

Threemile Creek is listed for nutrients, and data discussed in Chapter 2 indicate that development of nutrient TMDLs for phosphorus and nitrogen is warranted. Because of the link between nutrients and DO, a TMDL for DO is also established.

Threemile Creek has been designated by the state of Idaho for salmonid spawning and secondary contact recreation. Idaho's narrative standard states: "surface waters shall be free from excess nutrients that can cause visible slime growth or other aquatic growths impairing beneficial uses" (IDAPA 58.01.02.200.06). Salmonid spawning aquatic life beneficial uses can be impaired when excess algae decompose, depleting DO in the water column. Primary and secondary contact recreation can be also impacted by visible slime and algae growth resulting from excess nutrients when temperature and sunlight are not limiting. The purpose of this TMDL is to reduce levels of phosphorus and nitrogen in order to meet the narrative standard and fully support the beneficial uses.

Design Conditions

Numeric criteria and narrative standards to protect salmonid spawning and recreational beneficial uses apply to all perennial reaches of Threemile Creek and to intermittent reaches of Threemile Creek during periods of optimum flow (defined as 5 cfs or greater in Idaho WQS). Four sampling points in Threemile Creek were monitored twice per month for one year to estimate phosphorus and nitrogen concentrations. At all four of these locations (above the Grangeville WWTP outfall, at the outfall, below the outfall, and at the mouth), flow was measured throughout the year. While there may be locations in the headwaters and in the canyon reach of the Threemile Creek that are intermittent in nature, the locations sampled were all perennial. As a result, the numeric salmonid spawning criteria and narrative nutrient standards are applicable at these locations, and the TMDL was developed based on flow and concentration data collected from these sites.

Data shown in Table 36 indicate that levels of TP consistently exceeded USEPA (2000) regional guidance of 0.030 mg/L TP at all sites in the Columbia Plateau and frequently exceeded USEPA guidance commonly known as the "Goldbook" (1986a) recommendations (0.1 mg/L). The headwaters had a consistent TP level of 0.056 mg/L. Above the WWTP outfall, TP ranged from 0.038 to 0.166 mg/L. Below the WWTP, TP ranged from 0.24 to 3.14 mg/L. The mouth had a fairly constant level of TP, ranging from 0.272 to 0.336 mg/L.

Table 34. *E. coli* nonpoint source allocations and wasteload allocations for Threemile Creek.

	Location	Target (cfu/100 ml)[a]	Critical Flow (cfs)[b]	Peak Conc. (cfu/100 ml)	Current Load (cfu/day)	Load Capacity (cfu/day)	Allocation (cfu/day)	Allocation (cfu/100 ml)	Reduction %
Nonpoint Source Allocations	Above Outfall	126	0.7	1,750	2.9E+13	2.1E+12	2.9E+13	126 – monthly geometric mean 576 – daily maximum	93%
	Below Outfall	126	1.5	1,201	4.5E+13	4.7E+12	4.5E+13	126 – monthly geometric mean 576 – daily maximum	90%
	At Mouth	126	2.6	691	4.3E+13	7.9E+12	4.3E+13	126 – monthly geometric mean 576 – daily maximum	82%
Wasteload Allocation	Grangeville WWTP[c] NPDES[d] Permit: ID-002003-6	126	1.4	375	8.2E+12	2.8E+12	8.2E+12	126 – monthly geometric mean 576 – daily maximum	

[a] cfu = colony forming units
[b] cfs = cubic feet per second
[c] WWTP = wastewater treatment plant,
[d] NPDES = National Pollution Discharge Elimination System

Data shown in Table 37 indicate levels of total nitrogen (TN) frequently exceeded USEPA (2000) regional guidance of 0.22-0.36 mg/L for the Columbia Plateau. The headwaters had a consistent TN level of 0.16 mg/L. Above the WWTP outfall, TN ranged from 0.17 to 1.16 mg/L. Below the WWTP, TN ranged from 2.47 to 22.22 mg/L. At the mouth, TN ranged from 0.23 to 8.33 mg/L. The critical time period for algae growth, and the time frame in which TMDL allocations have been typically applied in the Clearwater River basin, is April through September. However, within this window, it is expected that the most growth occurs from July through mid-September, which is also the period of lowest flow with increased risk of low DO levels. In order to address the critical time period for algae growth, the LC and allocations were developed based on the flows and concentrations which occur during this time. It is expected that reductions driven by these allocations will be protective of beneficial uses during other times of the year.

Target Selection

Targets were selected for TP based on site specific characteristics of the Threemile Creek watershed and regional guidance levels discussed above, which avoid promoting nuisance algae growth. Grangeville is considering land application of its wastewater during the critical time period for excessive algae growth (July through mid-September). This will facilitate meeting the target set for the segment immediately downstream from the WWTP outlet. The three TP and TN targets described below have been used to establish the LC and allocations of the TMDL.

A TP target of 0.08 mg/L was set for the segment of Threemile Creek upstream of the WWTP outfall. This target was selected based on averaging the level of TP (0.056 mg/L) in the headwaters with the USEPA “Goldbook” (1986) recommendation (0.1 mg/L) and is felt to be optimal for the upper watershed.

A TP target of 0.1 mg/L was selected for the segment beginning downstream of the WWTP and ending at the “Big Barn” site where the stream drops into the canyon. This target is based on the EPA “Goldbook” (1986) and reflects a slight increase from the upstream target due to natural enrichment anticipated with the change in soil type and the distance downstream from headwater areas.

A TP target of 0.3 mg/L was selected for the mouth. Monitoring has demonstrated that the TP concentration at the mouth does not vary substantially with flow, seasons, or WWTP influence and is consistently near 0.3 mg/L. The exact mechanism behind this observation is unknown, but it is suspected that phosphorous is taken up and released in an equilibrium reaction with soil particles as the stream flows subsurface through a large landslide for a distance of approximately 0.75 mile, 1 mile upstream from the mouth. Approximately 2 cfs continually flow subsurface at all flow levels. During the critical time period for which targets are designated, flows ranged from 1.2 cfs to 1.9 cfs at the mouth. Thus, during this interval, all flow was subsurface through the landslide.

A TN target of 0.3 mg/L was selected for above the WWTP outfall, below the WWTP outfall, and the mouth. This target is based on the range recommended in recent USEPA

(2000) nutrient criteria guidance (0.22-0.36 mg/L) specific to the Columbia Plateau ecoregion. This target has previously been applied in other local TMDLs, including Cottonwood Creek, based on work by Bauer and Burton (1993).

A DO target based on the state WQS of 6.0 mg/L was established.

Monitoring Points

A comprehensive monitoring plan for nutrients should be implemented to assure planners that mitigation practices are sufficiently addressing the pollution problems. It is recommended that three sites be monitored: above the WWTP outfall, the Big Barn site at the head of the canyon, and the mouth.

Load Capacity

The LC is the greatest amount of pollutant loading a water body can receive and still meet WQS. The LC will vary with flow, that is, at higher flows a water body can accept greater loading and still comply with standards. The LCs were estimated for the three segments (above the WWTP, from the WWTP to the top of the canyon, from the top of the canyon to the mouth) using the flows recorded during July, August, and September, multiplied by the TP or TN target for that site. While elevated concentrations of TP and TN occur during periods of high runoff (e.g., in May), the LC was established utilizing the critical growing season for aquatic vegetation. Nutrient levels greater than the LC at this time may result in excess algae growth and depleted oxygen in the water column, thus impairing beneficial uses. Table 35 lists the average LC for the critical time period at three sampling locations (not at the "at outfall" location) presented in kilograms per day. The LC for the "below outfall" site does not include WWTP loading.

Table 35. Average total phosphorus (TP) and total nitrogen (TN) load capacities for Threemile Creek.

Location	TP Target (mg/L)	TN Target (mg/L)	Critical Flow (cfs)[a]	TP Load Capacity (kg/day)[b]	TN Load Capacity (kg/day)
Above Outfall	0.08	0.3	0.4	0.14	0.52
Below Outfall	0.10	0.3	0.4	0.09	0.28
Mouth	0.30	0.3	1.4	1.13	1.13

[a] cubic feet per second
[b] kilograms per day

Estimates of Existing Total Phosphorus and Total Nitrogen Loads

Estimates of the current concentrations and loading are presented in Tables 36 and 37. Flow, concentration, and loading are presented by month, and are averages of the two monthly measurements. As discussed in Chapter 2, flows were somewhat below average for the time period.

Monthly variations in TP and TN concentrations and loading are shown in Tables 36and 37. Below the WWTP outfall, TP and TN concentrations vary considerably throughout the year, with the highest concentrations and lowest in-stream flows occurring in July and August

Above the outfall, concentrations and flows are highest in the spring (March, April, and May). Flows from the Grangeville WWTP are relatively stable year around. At the mouth, TN concentrations and loading are also highest during spring flows (February-May). While loading increases for TP at the mouth during the spring, concentrations remains fairly constant at 0.3 mg/L. This may be due to an interaction of P with soils in the landslide area described above.

Load and Wasteload Allocations

Nonpoint source allocations for TP and TN and a WLA for the Grangeville WWTP are presented in Tables 38 and 39. Because source-specific loading information was not available, the nonpoint allocations are gross allocations to all nonpoint sources within each reach, and include all sources, such as storm water runoff, farming practices, animal feeding operations, septic systems, etc.

Allocations were established at the same loading and concentration as the LC in Table 35, without an explicit margin of safety. Due to the lack of sufficient information, it was not possible to differentiate background loading from anthropogenic loading, so background loading is included within the gross allocation to nonpoint sources. The percent reduction needed to achieve nonpoint source load allocations is also shown, in order to provide some perspective on the magnitude of source control needed during the critical period.

The WLA for the Grangeville WWTP was established as 0 for both TP and TN, as the city has agreed to land apply effluent during the critical time period (July through mid-September). These limits are expected to be incorporated into Grangeville's NPDES permit when it is reissued. If further studies being conducted by DEQ and Grangeville indicate a DO or other nutrient impairment occurs earlier in the summer (i.e., June), then the Grangeville WWTP and nonpoint source allocations will be revised to include this new time period.

Margin of Safety

An implicit margin of safety has been incorporated into the TMDL by utilizing conservative assumptions. The period of greatest aquatic plant growth and lowest flows was used to estimate the LC. The LC is also somewhat conservative during the critical of July through mid-September, since the flows measured during the year used to derive the allocations were somewhat below normal (Chapter 2). The resulting TP allocations range from 32% to 90%

reductions for nonpoint sources. The TN allocations range from 32% to 95% reductions for nonpoint sources. These percentages indicate that major reductions are needed in order to meet targets set for standards attainment.

Seasonal Variation/Critical Conditions

The TP and TN TMDLs include seasonal allocations in order to address the growing season when nutrient enrichment may result in nuisance algae growth and lower DO levels. The period in which allocations apply is also believed to encompass critical conditions for nutrient impairments, because it includes the periods of lowest flows and highest stream temperatures, which are the most conducive to rapid algae growth and depressed DO levels.

Background

As discussed previously, it was not possible to differentiate background from anthropogenic loading, so background has been included with other sources in the gross nonpoint source allocation. This has been identified as a data gap, and in the future it may be possible to refine relative source contributions and refine allocations if more definitive monitoring is conducted.

Reserve

An explicit reserve for future growth has not been set aside within the TMDL. Discharge from future growth or development within the Threemile Creek watershed would need to be consistent with the allocations, and could not increase TP or TN concentrations above the target criteria identified.

Table 36. Average monthly flow, total phosphorus (TP) concentration, and loading in Threemile Creek.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Above Outfall	Flow (cfs)[a]	1.8	1.4	2.2	3.4	5.3	2.0	0.7	0.2	1.3	0.7	0.3	0.7
	Measured TP (mg/L)[b]	0.058	0.142	0.108	0.094	0.112	0.091	0.112	0.115	0.137	0.078	0.038	0.064
	Measured Load (kg/day)[c]	0.255	0.486	0.581	0.782	1.452	0.445	0.186	0.048	0.436	0.128	0.032	0.102
Grange-ville WWTP (at outfall)	Flow (cfs)	1.4	1.9	2.5	1.8	1.2	1.5	3.8	3.3	2.7	2.0	1.9	1.7
	Measured TP (mg/L)	0.896	0.741	0.876	0.799	1.100	0.99	0.737	0.876	1.056	0.869	0.735	0.740
	Measured Load (kg/day)	3.095	4.170	5.399	3.973	2.656	3.226	8.384	7.210	6.014	4.324	4.258	3.775
Below Outfall	Flow (cfs)	2.9	1.5	3.4	4.6	7.0	2.6	1.3	1.0	1.7	1.4	1.3	1.1
	Measured TP (mg/L)	0.922	0.909	0.985	0.482	0.369	0.591	2.130	2.820	16.69	12.84	7.01	1.82
	Measured Load (kg/day)	6.564	3.225	8.218	5.377	6.329	3.803	6.879	6.830	70.233	44.922	21.781	4.809
At Mouth	Flow (cfs)	4.0	9.9	8.5	7.5	11.4	5.9	1.6	1.2	1.9	3.8	2.8	2.6
	Measured TP (mg/L)	0.306	0.330	0.321	0.326	0.283	0.282	0.277	0.298	0.305	0.336	0.316	0.311
	Measured Load (kg/day)	2.957	8.017	6.699	5.974	7.879	4.078	1.071	0.860	1.388	3.148	2.165	1.955

[a] cubic feet per second
[b] milligrams per liter
[c] kilograms per day

Table 37. Average monthly flow, total nitrogen (TN) concentration, and loading in Threemile Creek.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Above Outfall	Flow (cfs)[a]	1.8	1.4	2.2	3.4	5.3	2.0	0.7	0.2	1.3	0.7	0.3	0.7
	Measured TN (mg/L)[b]	0.381	0.547	0.449	0.338	0.389	0.200	0.251	0.235	0.672	0.314	0.168	0.168
	Measured Load (kg/day)[c]	1.678	1.874	2.417	2.812	5.044	0.979	0.418	0.098	2.137	0.515	0.140	0.267
Grange-ville WWTP	Flow (cfs)	1.4	1.9	2.5	1.8	1.2	1.5	3.8	3.3	2.7	2.0	1.9	1.7
	Measured TN (mg/L)	15.83	18.19	17.69	19.76	14.34	16.06	22.02	21.02	15.24	12.37	16.44	18.60
	Measured Load (kg/day)	34.70	32.98	37.91	38.63	38.59	38.90	39.70	45.05	39.37	25.99	29.56	33.67
Below Outfall	Flow (cfs)	2.9	1.5	3.4	4.6	7.0	2.6	1.3	1.0	1.7	1.4	1.3	1.1
	Measured TN (mg/L)	9.55	8.21	6.49	4.58	3.74	5.88	12.33	18.69	9.30	8.55	10.78	11.55
	Measured Load (kg/day)	67.99	29.12	54.12	51.04	64.18	37.85	39.82	45.28	379.83	268.59	184.80	51.42
At Mouth	Flow (cfs)	4.0	9.9	8.5	7.5	11.4	5.9	1.6	1.2	1.9	3.8	2.8	2.6
	Measured TN (mg/L)	3.37	8.33	4.84	1.99	0.94	0.74	0.38	0.29	2.68	2.95	3.23	3.64
	Measured Load (kg/day)	32.52	202.25	100.90	36.49	26.22	10.71	1.46	0.83	12.20	27.61	22.12	22.86

[a] cubic feet per second
[b] milligrams per liter
[c] kilograms per day

Table 38. Total phosphorus (TP) nonpoint source allocations and wasteload allocations for Threemile Creek.

	Location	Target (mg/L)[a]	Critical Flow (cfs)[b]	Peak Concentration (mg/L)	Average Current Load (kg/day)[c]	Average Load Capacity (kg/day)	Average Allocation (kg/day)	Allocation (mg/L)	Reduction (%)
Nonpoint Source Allocations	Above Outfall	0.08	0.4	0.130	0.117	0.139	0.139	0.08	32
	At Mouth	0.30	1.4	0.306	0.965	1.130	1.130	0.30	0
Wasteload Allocation	Grangeville WWTP[d] NPDES[e] Permit: ID-002003-6	0	0	0	0	0	0	0	100
Applicable Period		July 1 – Sept 15							

[a] milligrams per liter
[b] cubic feet per second
[c] kilograms per day
[d] WWTP = wastewater treatment plant,
[e] NPDES = National Pollution Discharge Elimination System

Table 39. Total nitrogen (TN) nonpoint source allocations and wasteload allocations for Threemile Creek.

	Location	Target (mg/L)[a]	Critical Flow (cfs)[b]	Peak Concentration (mg/L)	Average Current Load (kg/day)[c]	Average Load Capacity (kg/day)	Average Allocation (kg/day)	Allocation (mg/L)	Reduction (%)
Nonpoint Source Allocations	Above Outfall	0.30	0.4	0.67	0.88	0.52	0.52	.30	0
	At Mouth	0.30	1.4	2.68	4.83	1.13	1.13	.30	32
Wasteload Allocation	Grangeville WWTP[d] NPDES[e] Permit: ID-002003-6	0	0	0	0	0	0	0	100
Applicable Period		July 1 – Sept 15							

[a] milligrams per liter
[b] cubic feet per second
[c] kilograms per day
[d] WWTP = wastewater treatment plant,
[e] NPDES = National Pollution Discharge Elimination System

5.3 Temperature TMDLs

In-Stream Water Quality Targets

Nine water bodies were identified in Chapter 2 (Table 10) as water quality limited due to temperature. In addition, all other streams in the subbasin that have been monitored have been found to exceed temperature criteria (Appendix J), even though they are not currently 303(d) listed for temperature. The goal of the temperature TMDLs is to achieve applicable temperature criteria and restore all of the temperature-impaired water bodies (listed or not) to "full support of designated beneficial uses" (Idaho Code 39.3611, 3615).

The five water bodies that make up the SF CWR main stem and Three Mile Creek have designated beneficial uses of cold water aquatic life, salmonid spawning. Little Elk Creek, Big Elk Creek and Butcher Creek have existing beneficial uses of cold water aquatic life, salmonid spawning. All these streams must meet the coldwater temperature criteria, and the salmonid spawning temperature criteria when spawning occurs (Table 40). In addition, USEPA has established temperature criteria for bull trout for a number of water bodies in the subbasin, including two that are 303(d) listed: Big Elk and Little Elk Creeks (Appendix B). These must meet the federally-promulgated bull trout temperature standard of 10°C (50°F) as an average of daily maximum temperatures over a seven-day period (MWMT).

Table 40. Applicable water temperature criteria.

Beneficial use	Criteria		Reference
Cold Water Aquatic Life	19°C (66.2^{o}F) daily average	22°C(71.6^{o}F) daily maximum	IDAPA 58.01.02.250.02.b
Salmonid Spawning	9°C (48.2^{o}F) daily average	13°C (55.4^{o}F) daily maximum	IDAPA58.01.02.250.02.e.ii
Bull Trout	10°C (50°F) MWMT[a]		40 CFR Part 131.33(a)

[a] maximum weekly maximum temperature

Idaho water quality standards include a provision (IDAPA 58.01.02.401.03.a.v) that addresses point source discharges in circumstances where natural temperature conditions exceed existing criteria, as follows:

> "If temperature criteria for the designated aquatic life use are exceeded in the receiving waters upstream of the discharge due to natural background conditions, then Subsections 401.03.a.iii. and 401.03.a.iv. do not apply and instead wastewater must not raise the receiving water temperatures by more than three tenths (0.3) degrees C."

This standard has not been approved by USEPA but has been used to develop wasteload allocations for WWTPs. Review of this standard by USEPA is ongoing, and approval of this portion of the TMDL will be contingent upon USEPA approval of the standard.

Design Conditions

Heat loading sources on the main stem SF CWR were evaluated through an assessment of measured temperature data with support from model analysis (Appendix I and J). Temperature data indicate that much of the excess heat loading in the upper main stem is the result of loading from the headwater tributaries, from both natural and human caused processes. Human caused heat loading measured in the tributaries is largely a result of the loss of shade from riparian vegetation from such activities as grazing, road construction, dredge mining, and timber harvest. The influence of shade on stream temperature is much more significant on smaller streams with smaller water volumes than larger streams. In addition, tributaries are often locations of lower observed stream temperatures within the SF CWR Subbasin; therefore, protecting these tributary source areas, even if they are currently above the criteria, will reduce the cumulative temperature effects on the main stem. The management of tributary conditions is the most effective method to reduce stream temperature in the main stem.

Analysis also showed that main stem heat loading conditions increased dramatically in lower reaches of the SF CWR main stem, which resulted in a large rise in stream temperatures. Once again, landuse activities occurring within this portion of the basin have resulted in very low shade conditions. Reach scale dynamics (aspect, width/depth ratio, flow, etc.) become more dominant components of the heat loading process in this section of the river, and when coupled with the low shade conditions, have resulted in very high water temperatures.

Although criteria are also exceeded at other times of the year, the critical time period for water temperature has been determined to be the months of July and August when air and water temperatures are at their peak and the most dramatic exceedances of criteria occur. As a result, the TMDLs focus on achieving temperature targets for these months. If the temperature standards are attained during July and August, when water flows are low and air temperatures are high, it is expected that temperature criteria will be met throughout the rest of the year.

The SF CWR Subbasin is predominantly forested and managed for various forest practices (Appendix A, Map 8). Under the auspices of the Idaho FPA (IDAPA 20.02.01), the Forest Practices Act Advisory Committee developed a methodology for assessing stream temperature problems on lands covered under the FPA (IDL 2000, Appendix G). This methodology, modified to a degree to receive approval from USEPA for use in a TMDL, is applied to the streams in the subbasin that are primarily influenced by forest practices. All other streams and rivers in the SF CWR Subbasin are assessed using a methodology developed by the USEPA (Appendix F). While the two methods have the same goals, the actual results in terms of TMDL development are somewhat different for the two parts of the SF CWR Subbasin.

Target Selection

The targets for the temperature TMDLs throughout the SF CWR Subbasin are the applicable temperature criteria. The cold water aquatic life criteria of 19 ^{o}C (66.2^{o}F) daily average and

22 ^{o}C (71.6^{o}F) as a daily maximum apply to all waters year around. In addition, more restrictive salmonid spawning criteria of 9 ^{o}C (48.2^{o}F) daily average and 13 ^{o}C (55.4^{o}F) daily maximum apply to most streams in the subbasin on a seasonal basis depending on which salmonid species are present (Table 41). The criterion for bull trout waters identified in federal regulations is 10°C (50°F) MWMT or less during the months of June through September (Appendix B includes a list of streams in the SF CWR Subbasin covered by the federal bull trout criteria). Using a conversion factor developed by Sugden et al. (1998) for northern Idaho and western Montana, 9°C (48.2^{o}F) daily average temperature is equivalent to 9.7^{o}C (49.5^{o}F) MWMT, such that the federal bull trout temperature standard and Idaho's salmonid standard are roughly equivalent in terms of MWMT. Therefore, we assume they are equivalent and use 10°C (50°F) MWMT for both standards in the FPA CWE analysis discussed in Appendix G. The cold water biota aquatic life standard of 19°C (66.2^{o}F) can be converted to 21°C (69.8^{o}F) MWMT.

The time periods when salmonid spawning criteria are applicable for different salmonid species found in the SF CWR are listed in Table 41, and are based on the findings of the Fish TAG (Appendix D) and federal regulations for bull trout. The distribution of salmonid species within the SF CWR Subbasin is listed in Table 42 (and shown in a series of maps at the end of Appendix D), which indicates that salmonids are present in all water bodies covered by the SF CWR TMDLs; hence, the salmonid spawning criteria are applicable in all these waterbodies. Reviewing the spawning and incubation windows in Table 41, if bull trout, cutthroat trout, spring/summer chinook salmon, brook trout or steelhead, (mid-upper reaches and tributaries) are present, the salmonid spawning window includes the critical July-August time period, and hence the salmonid spawning criteria are applicable for all the temperature TMDLs. Reviewing the species distribution information in Table 42, all streams included in the SF CWR Subbasin TMDL have one or more of these species present; therefore, the salmonid spawning criteria are applicable, and 10°C (50°F) MWMT will be used as the target of the temperature TMDLs throughout the subbasin.

Table 41. Time periods of salmonid spawning and incubation in the SF CWR Subbasin.

Salmonid Species	Dates Criteria Are Applicable
Bull Trout	June 1 – September 30
Cutthroat Trout	March 15 – August 15
Spring/Summer Chinook	August 15 – April 30
Steelhead/Rainbow Trout (lower SF CWR and tributaries)	February 1 – June 1
Steelhead/Rainbow Trout (middle and upper SF CWR and tributaries)	February 1 – July 15
Whitefish	October 1 – February 28
Brook Trout	August 15 – February 28

Table 42. Salmonid species distribution in the SF CWR Subbasin.

South Fork Clearwater River Subbasin																
WB ID[a]	Water Body Name	Acres	Current Fish Population Presence[b]					Current Habitat Condition[c]	Natural Inherent Conditions				Pollutant Problems[d]			Conservation Preservation Priority[e]
			BUT	CUT	SCH	ST RBT	BRT	Salmonids	BUT	CUT	SCH	ST RBT	SED	TEMP	NUTR	
1	Lower SF CWR	19,723	Y	Y	Y	Y	Y	P	F	F	F	F	Y	Y	Y?	M (main stem)
2	Lower Cottonwood Cr.	16,929	N	N	N	Y	N	P	P	P	P	G	Y	Y	N	L
3	Upper Cottonwood Cr.	21,223	N	N	N	Y	N	P	P	P	P	F	Y	N	N	L
4	Lower Red Rock Cr.	2,969	N	N	N	N	N	P	P	P	P	G	Y	N	N	L
5	Upper Red Rock Cr.	23,481	N	N	N	N	N	P	P	P	P	F	Y	N	N	L
6	Stockney Cr.	19,978	N	N	N	N	N	P	P	P	P	F	Y	N	N	L
7	Shebang Cr.	18,380	N	N	N	N	N	P	P	P	P	F	Y	N	N	L
8	S.F. Cottonwood Cr.	12,676	N	N	N	N	N	P	P	P	P	F	Y	N	N	L
9	Long Haul Cr.	8,812	N	N	N	N	N	P	P	P	P	F	Y	N	N	L
10	Threemile Cr.	21,475	N	N	Y	Y	N	P	P	P	P	F	Y	Y	Y	L
11	Butcher Cr.	10,723	N	N	Y	Y	N	P	P	P	P	F	Y	Y	Y	M
12	Mid-Lower SF CWR	56,691	Y	Y	Y+	Y	Y	P	F	F	F	F	Y	Y	N	M (main stem)
13	Mill Cr.	23,410	Y	Y	Y+	Y	N	F	F	G	F	G	Y	Y	N	M
14	Lower Johns Cr.	26,378	Y+	Y	Y	Y	N	G	G	G	F	G	N	N	N	C/H
15	Gospel Cr.	10,832	Y	Y	N	Y	N	G	G	G	P	G	N	N	N	C/H
16	W. F. Gospel Cr.	4,467	Y	Y	N	N	N	G	G	G	P	F	N	N	N	C/H
17	Middle Johns Cr.	10,200	Y+	Y	Y	Y	N	G	G	G	F	G	N	N	N	C/H

South Fork Clearwater River Subbasin																
WB ID[a]	Water Body Name	Acres	Current Fish Population Presence[b]					Current Habitat Condition[c]	Natural Inherent Conditions				Pollutant Problems[d]			Conservation Preservation Priority[e]
			BUT	CUT	SCH	ST RBT	BRT	Salmonids	BUT	CUT	SCH	ST RBT	SED	TEMP	NUTR	
18	Upper Johns Cr.	8,674	Y+	Y	N	Y	N	G	G	G	P	G	N	N	N	C/H
19	Moores Cr.	3,987	Y+	Y	N	Y	N	G	G	G	P	G	N	N	N	C/H
20	Square Mountain Cr.	2,289	Y	Y	N	Y	N	G	G	G	P	F	N	N	N	C/H
21	Hagen Cr.	5,537	Y	Y	N	Y	N	G	G	G	P	F	N	N	N	C/H
22	Middle SF CWR	18,952	Y	Y	Y+	Y	Y	F	F	F	F	G	Y	Y	N	M (main stem)
23	Wing Cr.	5,329	N	Y	N	N	N	F	P	F	P	F	N	N	N	L
24	Twentymile Cr.	14,641	Y	Y	N	Y	N	G	F	G	P	F	N	N	N	C/M
25	Lower Tenmile Cr.	2,447	Y+	Y	Y	Y	N	G	F	F	F	G	N	N	N	C/H
26	Middle Tenmile Cr.	7,227	Y+	Y	Y+	Y	N	G	G	G	F	G	N	N	N	C/H
27	Upper Tenmile Cr.	13,617	Y+	Y	Y	Y	N	G	G	G	F	G	N	N	N	C/H
28	Williams Cr.	5,891	Y	Y	N	Y	N	G	F	G	F	G	N	N	N	C/H
29	Sixmile Cr.	5,130	Y	Y	Y	Y	N	F	F	G	F	G	Y	N	N	M
30	Mid-Upper SF CWR	17,165	Y	Y	Y+	Y	Y	F	F	F	G	G	Y	Y	N	M
31	Lower Crooked R.	9,481	Y	Y	Y+	Y	Y	P	F	G	G	G	Y	Y	N	H
32	Upper Crooked R.	14,488	Y+	Y	Y+	Y	Y	F	G	G	G	G	Y	Y	N	H
33	W. F. Crooked R.	7,594	Y+	Y	Y	Y	Y+	G	G	G	G	G	N	N	N	C/H
34	E. F. Crooked R.	6,689	Y+	Y	Y	Y	N	G	G	G	G	G	N	N	N	C/H
35	Relief Cr.	7,484	Y	Y	Y+	Y	N	F	F	G	G	G	Y	Y	N	M

South Fork Clearwater River Subbasin																
WB ID[a]	Water Body Name	Acres	Current Fish Population Presence[b]					Current Habitat Condition[c]	Natural Inherent Conditions				Pollutant Problems[d]			Conservation Preservation Priority[e]
			BUT	CUT	SCH	ST RBT	BRT	Salmonids	BUT	CUT	SCH	ST RBT	SED	TEMP	NUTR	
36	Upper SF CWR	2,695	Y	Y	Y+	Y	Y	P	F	F	G	G	Y	Y	N	H
37	Lower Red R.	10,333	Y	Y	Y+	Y	Y	P	F	G	G	G	Y	Y	N	M
38	Middle Red R.	16,042	Y	Y	Y+	Y	Y	P	F	G	G	G	Y	Y	Y?	H
39	Moose Butte Cr.	7,087.55	Y	Y	Y+	Y	Y	F	F	G	G	G	Y	Y	N	H
40	Lower S.F. Red R.	3,154	Y+	Y	Y+	Y	Y	F	G	G	G	G	Y	Y	N	H
41	Middle S.F. Red R.	2,791	Y+	Y	Y+	Y	Y	F	G	G	G	G	Y	N	N	H
42	W. F. Red R.	6,406	Y+	Y	Y	Y	Y	G	G	G	G	G	N	N	N	C/H
43	Upper S.F. Red R.	4,744	Y+	Y	Y	Y	Y	F	G	G	G	G	Y	N	N	H
44	Trapper Cr.	7,077	Y	Y	N	Y	Y+	F	G	G	F	G	Y	N	N	H
45	Upper Red R.	19,250	Y	Y	Y+	Y	Y+	F	G	G	G	G	Y	Y	N	H
46	Soda Cr.	3,353	N	Y	N	N	Y+	F	F	G	F	G	Y	N	N	H
47	Bridge Cr.	2,380	N	Y	N	N	Y+	G	F	G	F	G	N	N	N	C/M
48	Otterson Cr.	2,488	Y	Y	Y	N	Y+	G	F	G	F	G	N	N	N	C/M
49	Trail Cr.	4,560	Y	Y	Y	N	Y+	F	F	G	F	G	Y	N	N	H
50	Siegel Cr.	7,784	Y	Y	Y	Y	Y+	F	F	G	G	G	Y	Y	N	H
51	Red Horse Cr.	5,806	Y	Y	Y	Y	Y+	F	F	G	G	G	Y	Y	N	H
52	Lower American R.	7,215	Y	Y	Y+	Y	Y	P	F	G	G	G	Y	Y	Y?	H
53	Kirks Fork	6,257	Y	Y	Y	Y	Y	F	F	G	G	G	Y	Y	N	H

South Fork Clearwater River Subbasin																
WB ID[a]	Water Body Name	Acres	Current Fish Population Presence[b]					Current Habitat Condition[c]	Natural Inherent Conditions				Pollutant Problems[d]			Conservation Preservation Priority[e]
			BUT	CUT	SCH	ST RBT	BRT	Salmonids	BUT	CUT	SCH	ST RBT	SED	TEMP	NUTR	
54	E.F. American R.	11,445	Y	Y	Y+	Y	Y+	F	G	G	G	G	Y	N	N	H
55	Upper American R.	15,275	Y	Y	Y+	Y	Y+	F	F	G	G	G	Y	Y	N	H
56	Elk Cr.	2,324	Y	Y	Y+	Y	Y+	P	F	G	G	G	Y	Y	Y	H
57	Little Elk Cr.	5,081	Y	Y	Y	Y	Y+	F	F	G	G	G	Y	Y	V	H
58	Big Elk Cr.	8,821	Y	Y	Y+	Y	Y+	F	F	G	G	G	Y	Y	V	H
59	Buffalo Gulch	2,139	N	Y	N	Y	N	P	P	G	F	G	Y	Y	N	M
60	Whiskey Cr.	1,659	Y	Y	Y	Y	Y	F	F	G	F	G	Y	Y	N	M
61	Maurice Cr.	1,094	N	Y	N	Y	N	P	P	G	F	G	Y	Y	N	M
62	Lower Newsome Cr.	4,145	Y	Y	Y+	Y	Y	P	F	G	G	G	Y	Y	N	H
63	Bear Cr.	3,832	Y	Y	Y	Y	N	F	F	G	G	G	Y	Y?	N	H
64	Nugget Cr.	1,451	Y	Y	N	N	N	F	F	G	F	G	Y	Y?	v	M
65	Beaver Cr.	3,733	Y	Y	N	Y	N	F	F	G	F	G	Y	Y?	v	H
66	Middle Newsome Cr.	1,135	Y	Y	Y+	Y	N	F	F	G	G	G	Y	Y	N	H
67	Mule Cr.	5,497	Y	Y	Y	Y	N	F	F	G	G	G	Y	Y?	N	H
68	Upper Newsome Cr.	6,356	Y	Y	Y+	Y	N	F	F	G	G	G	Y	Y	N	H
69	Haysfork Cr.	3,172	N	Y	Y	Y	N	F	F	G	G	G	Y	Y?	N	H
70	Baldy Cr.	2,724	Y+	Y	Y	Y	N	F	G	G	G	G	Y	Y?	N	H
71	Pilot Cr.	3,918	Y+	Y	Y	Y	N	G	G	G	G	G	N	Y?	N	C/H

South Fork Clearwater River Subbasin																
WB ID[a]	Water Body Name	Acres	Current Fish Population Presence[b]					Current Habitat Condition[c]	Natural Inherent Conditions				Pollutant Problems[d]			Conservation Preservation Priority[e]
			BUT	CUT	SCH	ST RBT	BRT	Salmonids	BUT	CUT	SCH	ST RBT	SED	TEMP	NUTR	
72	Sawmill Cr.	1,769	Y	Y	Y	Y	N	G	F	G	G	G	N	Y?	N	C/M
73	Sing Lee Cr.	1,556	N	Y	Y	Y	N	F	F	G	G	G	N	Y?	N	M
74	W.F. Newsome Cr.	3,305	Y	Y	Y	Y	N	F	F	G	G	G	N	Y	N	H
75	Leggett Cr.	4,992	N	Y	Y	Y	N	F	F	G	F	G	Y	Y	N	M
76	Fall Cr.	2,334	N	Y	N	N	N	F	P	F	P	G	Y	N	N	L
77	Silver Cr.	16,517	Y	N	N	Y	Y+	G	F	G	P	F	N	N	N	C/L
78	Peasley Cr.	9,093	N	Y	N	Y	N	F	F	G	F	G	Y	Y?	N	M
79	Cougar Cr.	7,737	N	Y	N	N	N	P	P	F	P	F	Y	Y?	N	L
80	Meadow Cr.	24,010	Y	Y	Y+	Y	Y+	P	F	G	F	G	Y	Y	N	M
81	Sally Ann Cr.	8,891	Y	Y	N	Y	N	P	F	F	P	F	Y	Y	N	M
82	Rabbit Cr.	6,191	Y	Y	N	Y	Y	P	F	F	P	F	Y	Y	N	L

[a] water body identification number
[b] Y+ = known spawning and rearing population
BUT = bull trout, CUT = cutthroat trout, SCH = spring chinook salmon, ST RBT = steelhead/rainbow trout, BRT = brook trout
[c] G = good, F = fair, P = poor
[d] SED = sediment, TEMP = temperature, NUTR = nutrients
[e] C/G or C/F or C/P = ratings for conservation rather than restoration. All other ratings in this column are priorities for restoration

Surrogate Water Temperature Targets

Shade is one of the most important factors effecting stream temperature. As mentioned previously, two approaches for evaluating shade were used to develop surrogate targets for the TMDL: CWE and System Potential Vegetation (SPV). While the appropriate temperature criteria are the ultimate goal of the TMDLs, percent effective shade and percent canopy closure have been identified as surrogate targets. Percent effective shade over a stream, or percent canopy closure, depending on the approach, are practical targets because they are the primary factors that can be managed to alter heat loading and stream temperature. Such targets also allow detailed monitoring of streamside conditions affected by management and progress towards target attainment.

While it is recognized that there are some technical differences between "percent effective shade" of the SPV method and "percent canopy closure" of the CWE method, both approaches address near-stream vegetation conditions, and the two terms are used interchangeably in the discussions to follow. The technical differences between the two do not translate into significant differences in the amount or location of vegetation needed to protect stream temperatures.

For the portions of the SF CWR Subbasin with the potential for a largely complete conifer canopy cover over the stream, the CWE temperature model developed for north Idaho under the auspices of the FPA (IDL 2000) is used. The CWE model is an empirical, reach-based model that predicts the amount of stream canopy closure required in a given 200-foot elevation range empirically predicted to maintain a given stream temperature. Each elevation reach has a predicted percent canopy closure target. Canopy closure requirements increase with decreasing elevation (as would be expected to account for cumulative effects) increased exposure times to energy inputs, and increased air temperatures at lower elevations. The CWE model and its results are discussed in more detail in Appendix G.

The CWE temperature model relationship was developed from data collected in north Idaho, where the MWMT is predicted by elevation and percent canopy closure. The model assumes that water temperature has been protected upstream. It accounts for three of the primary environmental factors affecting stream temperature: local air temperature as it varies by elevation, micro-environmental modification by the vegetation and its canopy, and shade of the stream surface by the riparian canopy. Thus, the CWE model predicts the amount of canopy closure required at a given elevation to maintain stream temperatures within the water quality standards. In applying the model, the amount of required shade has been limited to that determined to be the maximum possible for coniferous sites in the SF CWR Subbasin, or approximately 90% canopy closure.

In non-forested areas in the subbasin, and for large streams where the CWE approach is not applicable (e.g., SF CWR), an approach that estimates the effective shade produced by a mature native vegetation community (SPV) has been utilized.

"System potential land cover" is necessary to achieve "system potential effective shade," and is defined for purpose of the TMDL as "the potential near-stream vegetation that can grow

and reproduce on a site, given the climate, elevation, soil properties, plant biology, and hydrologic processes." System potential does not consider management or land use as limiting factors. In essence, system potential is the design condition used for TMDL analysis that meets the temperature standard by minimizing human-related warming.

System potential is an estimate of the condition where anthropogenic activities that cause stream warming are minimized. System potential is not an estimate of pre-settlement conditions. Although it is helpful to consider historic land cover patterns, channel conditions, and hydrology, many areas have been altered to the point that the historic condition is no longer attainable given drastic changes in stream location and hydrology (channel armoring, wetland draining, urbanization, etc.).

Loading capacity in the SF CWR Subbasin is largely controlled by nonpoint source influences of heat to the system. Heat accumulates through much of the watershed by direct solar radiation loading. System potential was estimated as August solar radiation levels that would reach the stream surface under conditions where anthropogenic activities would not measurably increase temperature. Similarly, the CWE model estimates percent canopy closure conditions required during the hottest time of the year, late July and early August, to protect stream temperatures.

Current effective shade conditions were modeled using Heat Source 6.5 (Boyd 1996; ODEQ 2002) using recently collected field data and other spatial data (i.e., bank full width, digital elevation models, digital orthophoto quads, and streamside vegetation). These features were measured on a fine scale using existing GIS databases and digital orthophoto quads (Chapter 3). Simulations were performed for all currently 303(d) listed streams including the SF CWR main stem, Big Elk Creek, Little Elk Creek, Butcher Creek, and Threemile Creek. The Red River was also analyzed because it is a meadow-dominated system that dramatically influences the temperature profile translated downstream.

"System potential effective shade" was simulated by increasing tree heights and densities to those expected at "system potential land cover." System potential land cover was calculated for various forested, non-forested, and wetland plant communities. The output of this effort is a series of curves and graphs that identify effective shade targets given different vegetation types, channel widths, and aspect (north, south, east, and west). The details of this approach may be found in Appendix F.

Using the CWE and the SPV methods, surrogate measures of percent stream shading have been developed. The target percent stream shading is the necessary percent stream shading needed to achieve temperature criteria during the period of the year with highest ambient air temperatures (late July and early August), which is the critical time period for stream temperatures.

Using the approach of percent shade targets distributed throughout the SF CWR Subbasin, shading conditions were established under which stream temperature criteria have the highest probability of being achieved throughout the subbasin. While it is recommended that progress towards attainment of stream temperature targets be monitored using continuous in-

stream temperature monitoring devices, evaluation by land managers of progress towards the reach-by-reach shade targets should help guide decisions regarding methods to increase stream shade.

Heat Loading Capacity

The heat load needed to achieve state and federal temperature criteria during the critical time of the year is used as the loading capacity for all water bodies. The actual heat loading, in Langleys per day or British thermal units (Btu) per day, needed to achieve temperature criteria in each waterbody can be derived. Examples of this are shown in graphs of shade levels and corresponding Langley loadings in Appendix F. Wastewater treatment plant heat loading in Btus per day which would achieve applicable temperature criteria are listed in a series of tables in Appendix O. Given that the heat energy (Langley or Btu) loading is not very useful in guiding nonpoint or point source management practices, we have instead focused on the temperature criteria and the surrogate target of percent shade in addressing point and nonpoint sources respectively.

Estimates of Existing Heat Loading

Increased stream temperatures in the SF CWR Subbasin are primarily the result of increased heat loading from increased solar radiation reaching the water surface and increased local environmental temperatures as a result of the removal of riparian shading. Logging, road building, mining, agriculture, livestock grazing, fire, and residential construction are the primary anthropogenic causes of riparian shade reduction over the last century. In some cases, lack of shade beyond that which will maintain stream temperatures within the applicable standard is natural and/or may be the result of forest fires and other natural disturbance processes. Solar radiation and resultant heat loading have also been increased in numerous locations around the SF CWR Subbasin through widening of the stream channel (an increase in the width-to-depth ratio). This is the result of dredge mining, deterioration and/or removal of the streamside vegetation, channelization, and sediment accumulation resulting in stream aggradation.

Increasing net heat loading to the surface of a stream segment will result in higher stream temperatures. Heat loading to a stream surface, however, has both temporal and spatial variability within the water bodies for which TMDLs are being developed. Predictingthe stream temperature at any location and time in a water body requires an understanding of how heat is distributed through space and time. In reality, it is most useful to describe heat loading throughout a water body in a way that provides information about maintaining water temperatures that supports the water body's beneficial uses.

In terms of timing, heat loading in the SF CWR Subbasin is at its greatest during late July and early August and is reflected in the high stream temperatures at this time (see Figure 13 and Appendix J stream temperature plots). July and August are the critical months for temperature exceedances, though exceedances can occur from April through October, depending on the water body. Water temperatures increase in April through June, but are consistently at their peaks during late July and early August. Water temperatures decrease

rapidly after the first wet cold fronts of late August or early September. Heat loading and stream temperature are analyzed for the critical period of July through August, and it is assumed that if stream temperatures are in compliance with the temperature WQS during this period, they will be in compliance throughout the rest of the year.

The effects of heat loading on stream temperature were evaluated using measured in-stream and remotely sensed water temperature data, calculated percent shade (the most significant factor influencing heat loading), and stream temperature. The in-stream temperature data in Section 2.3 and Appendix J show the stream temperatures for specific locations in each water body. These data are often collected near the mouth where temperatures are likely to be the highest and can be assumed to integrate all the heat loading and unloading occurring upstream from the monitoring site. These data indicate that all streams monitored exceeded applicable temperature criteria between 1999 through 2001. Exceedances of the criteria occurred as early as April in water bodies at lower elevations in the watershed (e.g., Threemile Creek) and continue into early October in some other water bodies (e.g., lower SF CWR). Standards are usually exceeded by the greatest amount in late July and early August, which corresponds with the highest air temperatures. An example of water temperature data, showing peaks in July and August, can be seen in Figure 47.

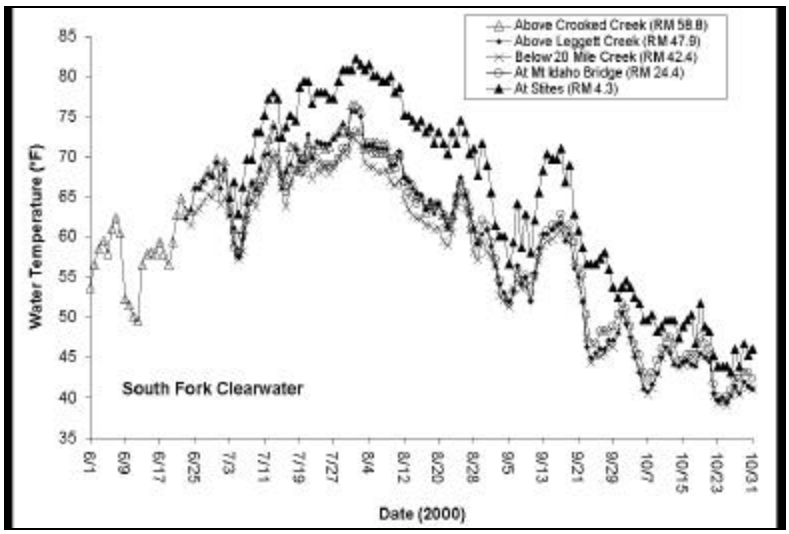


Figure 47. Seasonal Variation in Maximum Water Temperature at Various Locations along the SF CWR in 2000

Water temperature criteria apply throughout all water bodies and at all times. Spatial and temporal variations in heat loading can be evaluated using remotely sensed surface water temperatures or a series of in-stream temperature monitors. A number of factors influence these patterns (Appendix I), but in general, the common pattern is that stream temperatures increase in a downstream direction and significant diurnal fluctuations can occur. Section 2.3 discusses patterns of heat loading in the SF CWR and several tributaries in more detail. The main stem SF CWR temperatures are already significantly elevated at the confluence of the American and Red Rivers, but remain relatively stable until the Mt. Idaho bridge, where temperatures begin to increase dramatically. Similarly, an evaluation of data from Red

River, Big and Little Elk Creeks, and Threemile Creek indicate that temperatures increase dramatically in the lower reaches of these tributaries as well.

Figure 48 illustrates the diurnal temperature pattern in Big Elk Creek. The temperatures at the NPNF boundary, reflecting largely forested conditions, are much lower than temperatures at a point 5 miles downstream (RM 4.7). The primary difference between these two monitoring stations is that a series of meadows occur between the two, in which much of the riparian vegetation (shading) has been removed as a result of long-term grazing. Measured data for Big Elk Creek clearly show the effect of shade on heat loading and stream temperature that occurs in the SF CWR Subbasin.

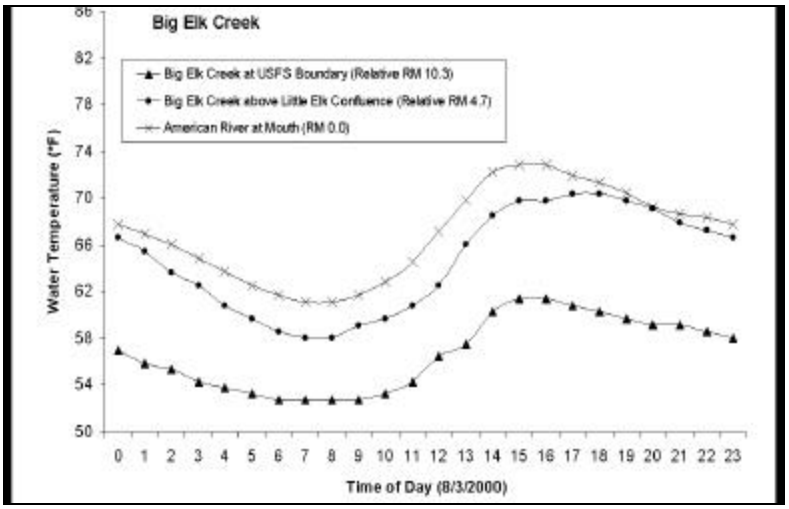


Figure 48. Diurnal Temperatures Measured Big Elk Creek and the American River (mouth) on August 3, 2000

Current shade conditions were estimated using CWE (percent canopy closure) and SPV (percent effective shade) methods for forested and non-forested areas, respectively (Appendices F and G). The CWE determination of current percent canopy closure for the SF CWR Subbasin is presented in Figure 49. Focusing on water bodies currently 303(d) listed for temperature, Figures 50 and 51 show current CWE percent canopy closure data for the Threemile Creek/Butcher Creek area and the Big Elk Creek/Little Elk Creek area. Figures 52 - 56 list current effective shade for Threemile Creek, Big and Little Elk Creeks (meadow areas), the main stem SF CWR, and Butcher Creek. The line presented on these figures represents the 0.25-mile moving average condition, which was calculated at 100-foot intervals along the stream segments.

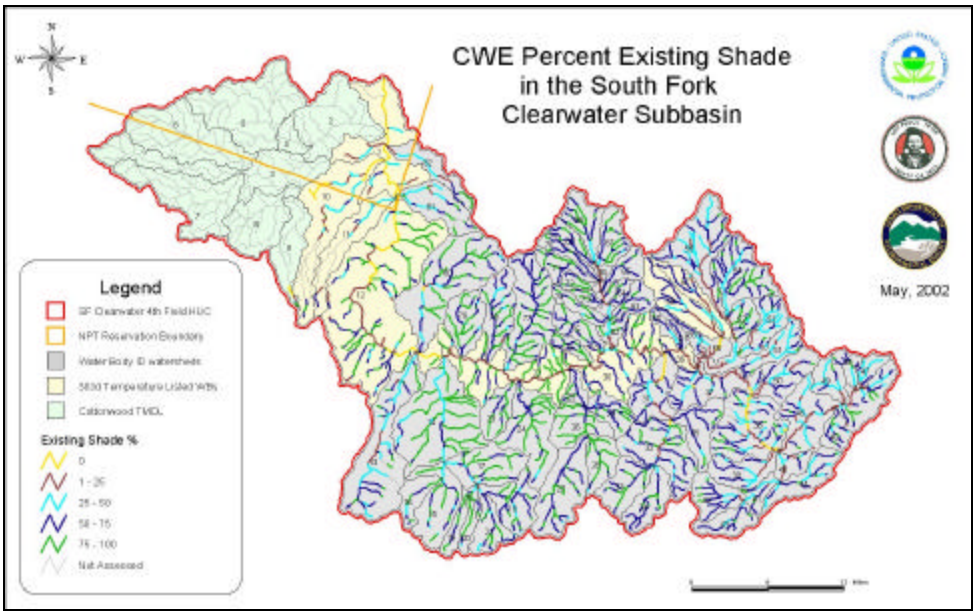


Figure 49. Current Percent Canopy Closure Determined by Aerial Photographic Interpretation of the SF CWR Subbasin

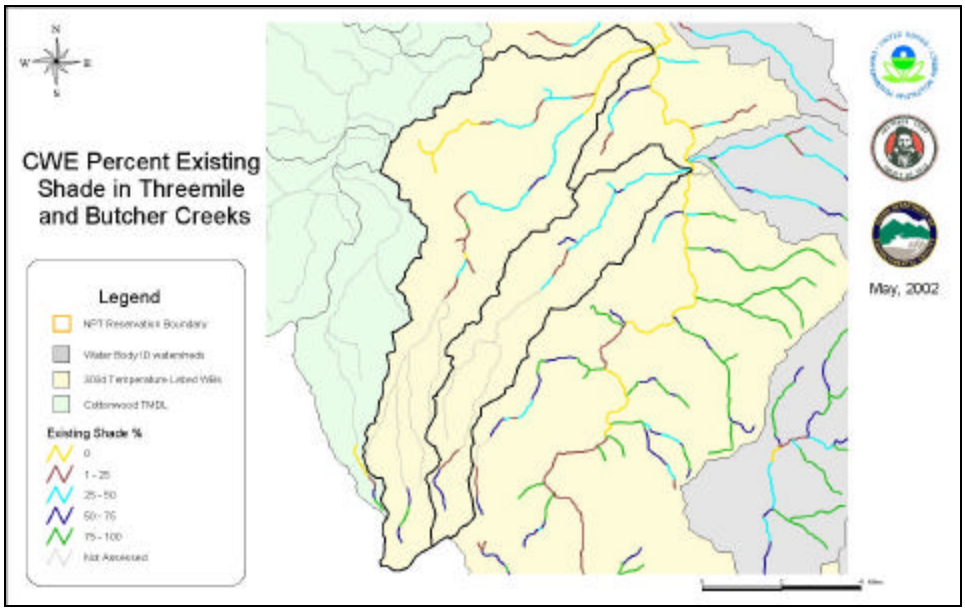


Figure 50. Current Canopy Closure of Threemile and Butcher Creeks

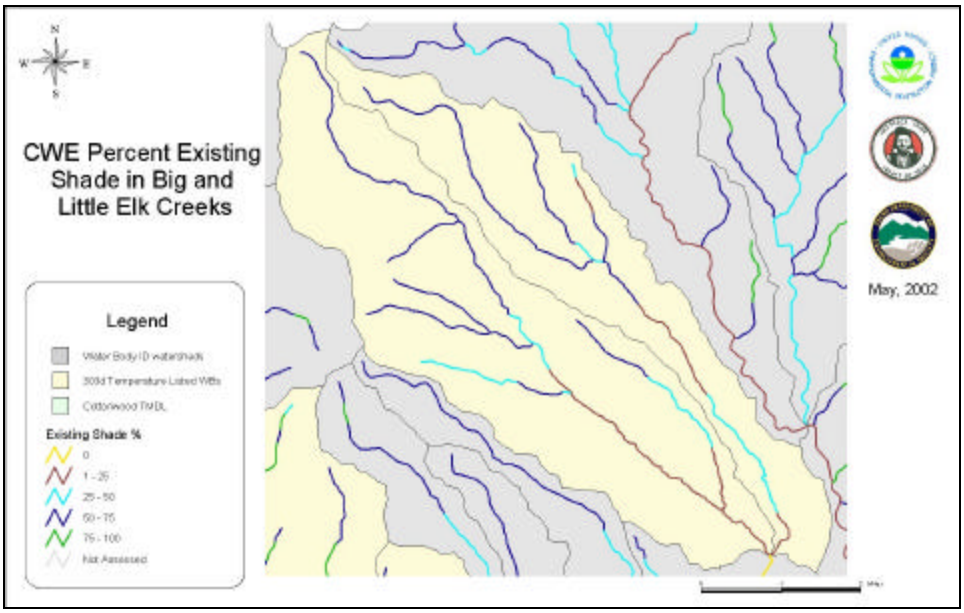


Figure 51. Current Canopy Closure of Big Elk and Little Elk Creeks

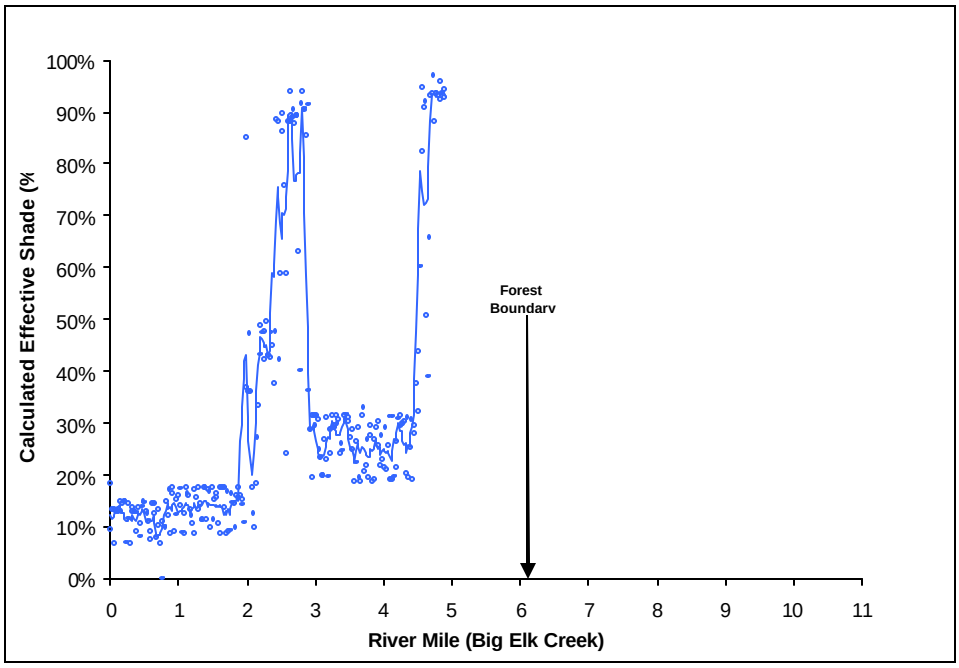


Figure 52. Big Elk Creek Current Effective Shade, Lower Reaches

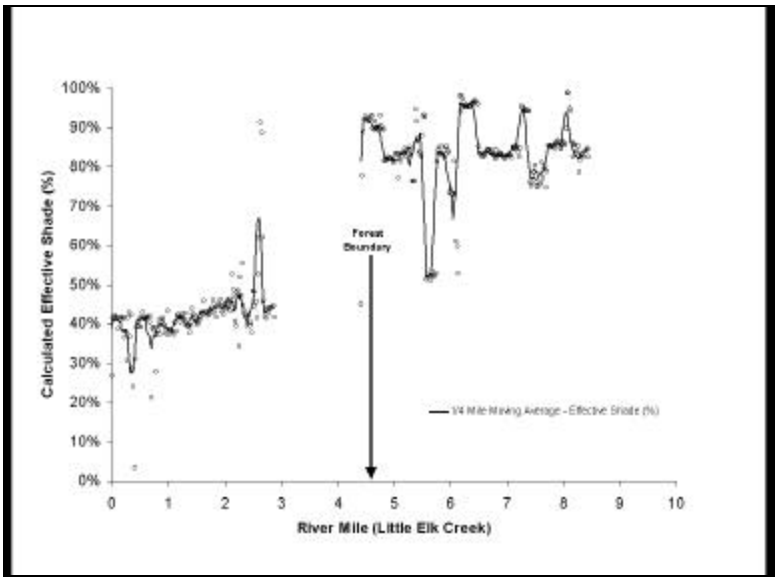


Figure 53. Little Elk Creek Current Effective Shade, Lower Reaches

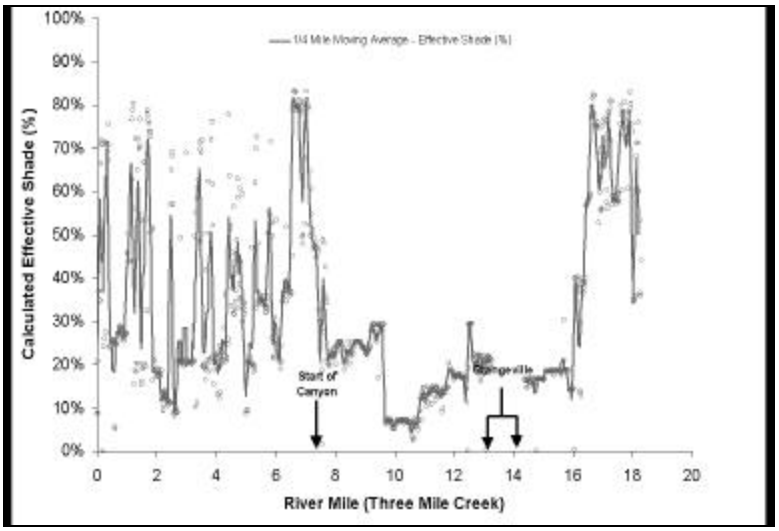


Figure 54. Threemile Creek Current Effective Shade

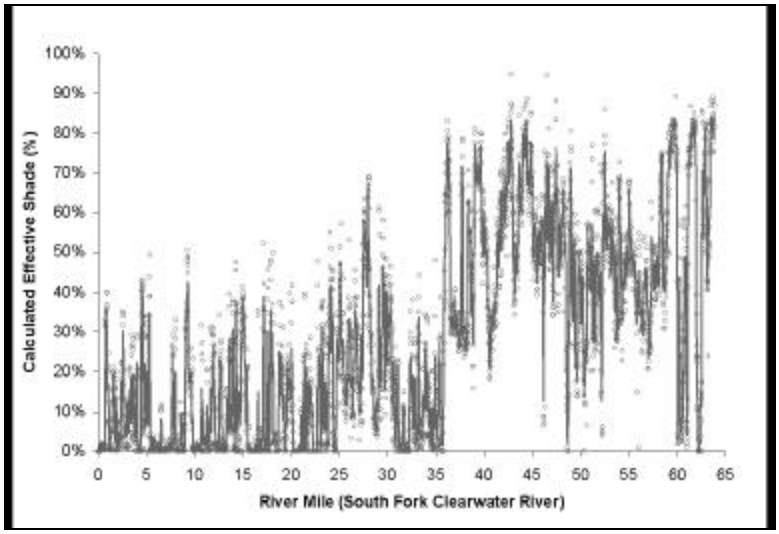


Figure 55. South Fork Clearwater River Current Effective Shade

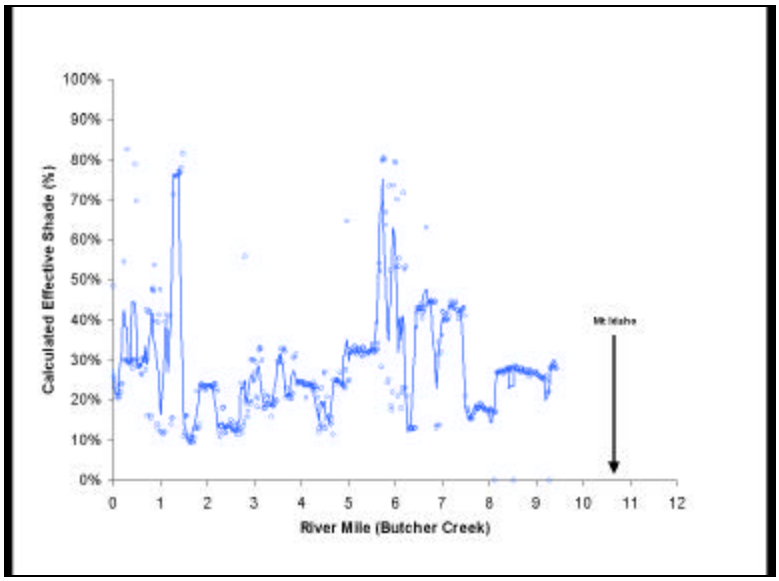


Figure 56. Butcher Creek Current Effective Shade

Point sources are another source of heat loading in the subbasin. While Section 3.1 identifies a number of point sources known to exist in the SF CWR Subbasin, only the five municipal WWTPs listed in Table 43 are expected to have any effect on stream temperature. Other point sources in the subbasin include suction dredge operations and industrial and construction related stormwater. None of these are believed to contribute to heat loading given the nature of the facilities. The heat of water and sediment is not believed to increase significantly as it passes through the pumps and piping of suction dredge operations, and stormwater runoff during the critical time period for temperature (July-August) is minimal, since precipitation during these months is the lowest for the year (WRCC 2003).

Table 43. Point sources that may affect stream temperature.

Facility Location	NPDES Permit Number[a]	Type of Facility	Receiving Water	Design Flow (MGD)[b]
Grangeville	ID-002003-6	Wastewater Treatment Plant	Threemile Creek	0.88
Kooskia	ID-002181-4	Wastewater Treatment Plant	South Fork Clearwater River	0.2
Stites	ID-002034-6	Wastewater Treatment Plant	South Fork Clearwater River	0.07
Elk City	ID-002201-2	Wastewater Treatment Plant	Elk Creek	0.12
Red River Ranger Station	ID-002069-9	Wastewater Treatment Plant	South Fork Red River	0.0063

[a] National Pollution Discharge Elimination system
[b] million gallons per day

Heat Load Allocation

Allocation of heat load is the process in which the heat loads necessary to achieve the load capacity (i.e., water temperature criteria) are assigned to the various nonpoint and point sources and background. Shade conditions for nonpoint sources are used as a surrogate to achieve in-stream temperature criteria in the SF CWR Subbasin. The allocation process for point sources must explicitly identify a heat load (i.e., a temperature or range of temperatures), also known as a WLA, which will be subsequently incorporated into NPDES permits.

Shade targets were established for the SF CWR and all tributaries, whether or not they are included on the current 303(d) list, for two reasons. First, the entire SF CWR main stem is 303(d) listed for temperature. As discussed in Section 2.3, a significant portion of heat loading to the SF CWR is from tributaries, and it is necessary to address elevated temperatures in the tributaries in order to reduce main stem SF CWR temperatures. Second, as also pointed out in Section 2.3, the applicable temperature criteria are exceeded at some time in all streams monitored within the SF CWR Subbasin. While most of these streams are not currently on the 303(d) list, including shade targets for them in the TMDL will address human-caused temperature problems measured in the main stem, as well as in these streams, and preclude the need to include them in future 303(d) lists and TMDLs.

To the extent possible, the allocation process should also identify what portion of the total load allocation is natural background. Clearly there is significant natural solar radiation loading to all SF CWR Subbasin streams. Some streams have significant human influences that have elevated stream temperature (e.g., Red River, Big Elk Creek). Also, as mentioned previously, some streams that have very little human influence, such as Johns and Silver Creeks, also exceed applicable temperature criteria. In all cases it is difficult to quantify what portion of the loading is from background and what portion is human caused. Rather

than attempting to identify the specific natural background heat load, it is assumed that by establishing and achieving shade targets, and correcting channel problems in some locations, the majority of human caused heat loading will be addressed What remains will largely be natural heat loading (background). Temperature in some streams may still exceed numeric criteria, but if human-caused sources of heat loading have been addressed, these streams will be in compliance with Idaho WQS (IDAPA 58.01.02.250.02).

Nonpoint source allocations (shade targets) have been assigned independent of land use or land ownership. Reductions in stream shade have occurred as a result of a variety of land use activities, and on private, state, and federal lands. In order to resolve temperature problems, improvements will need to be made across all land use and ownership categories. The location and degree of shade loss and channel alteration are the major factors that must be considered in restoration. As a result, allocations were established based on conditions at a given location, regardless of land use or land ownership.

Non-point source load allocation

Nonpoint source load allocations consist of a series of shade targets established for each stream in the SF CWR Subbasin. As discussed in Section 3.1 and Appendix G, shade targets for forested areas have been developed utilizing the CWE process. Specific percent canopy closure targets for each 200-foot elevation reach have been developed. Due to the sheer number of stream segments evaluated, these are included as a map in Appendix G accompanied by an ArcView shapefile on CD or diskette. For illustration, targets for forested areas in currently 303(d) listed streams are shown Figures 57, 58, and 59.

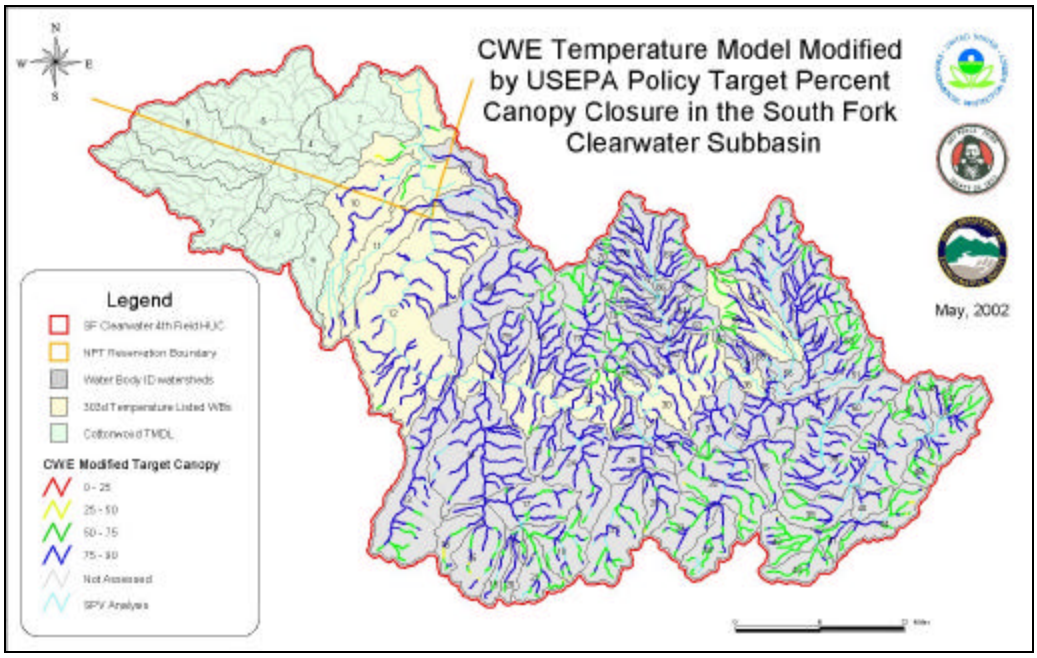


Figure 57. Cumulative Watershed Effects (CWE)-Based Target Percent Canopy Closure for the SF CWR Subbasin

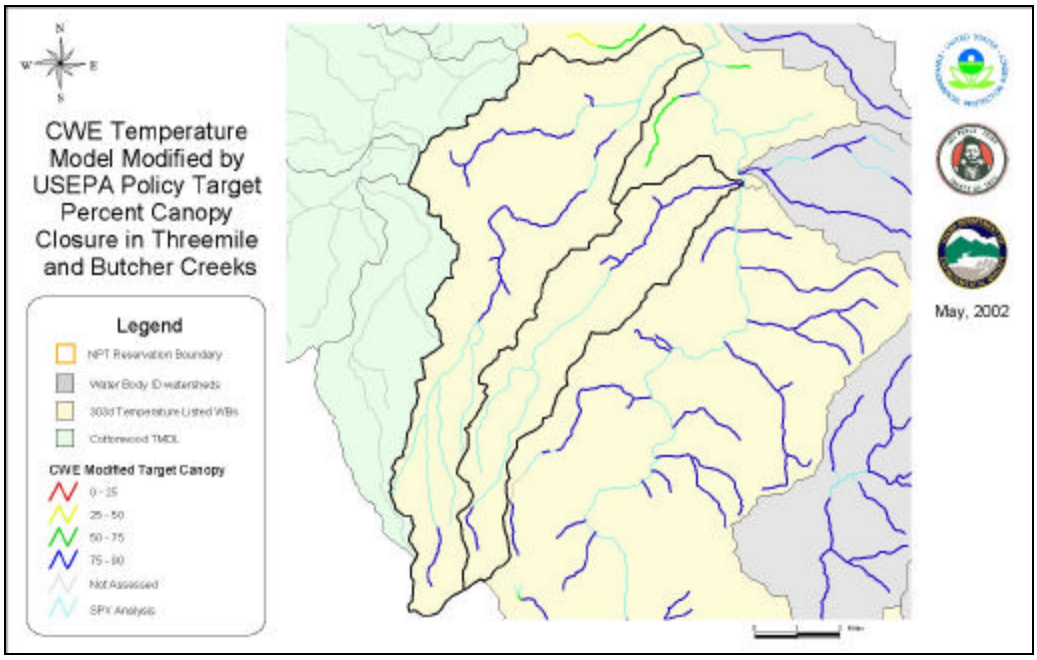


Figure 58. Cumulative Watershed Effects (CWE)-Based Target Percent Canopy Closure for the Threemile/Butcher Creeks Area

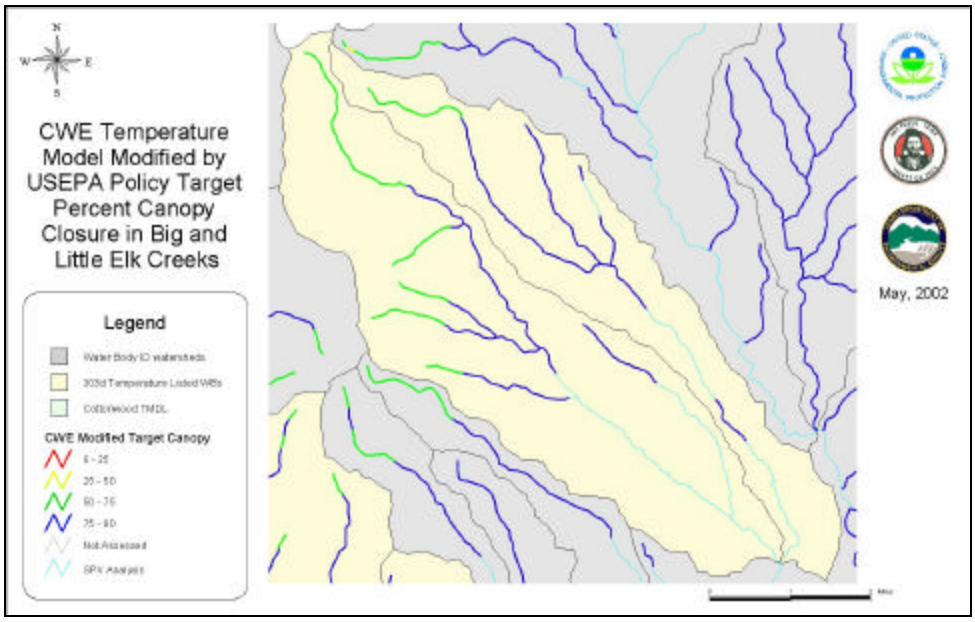


Figure 59. Cumulative Watershed Effects (CWE)-Based Target Percent Canopy Closure for the Big and Little Elk Creeks Area

In non-forested areas the allocation consists of effective shade targets established through the SPV process outlined in Appendix F. A series of curves has been developed for 12 different vegetative response units (VRUs) and three wetland types (Appendix F). Reach-specific targets may be derived from these curves using site-specific information on channel width and aspect. Effective shade targets for currently listed 303(d) streams based on existing vegetation and channel width information were estimated and are shown in Figures 60-64. Target conditions (gray lines) are plotted against the current shade conditions (dark lines).

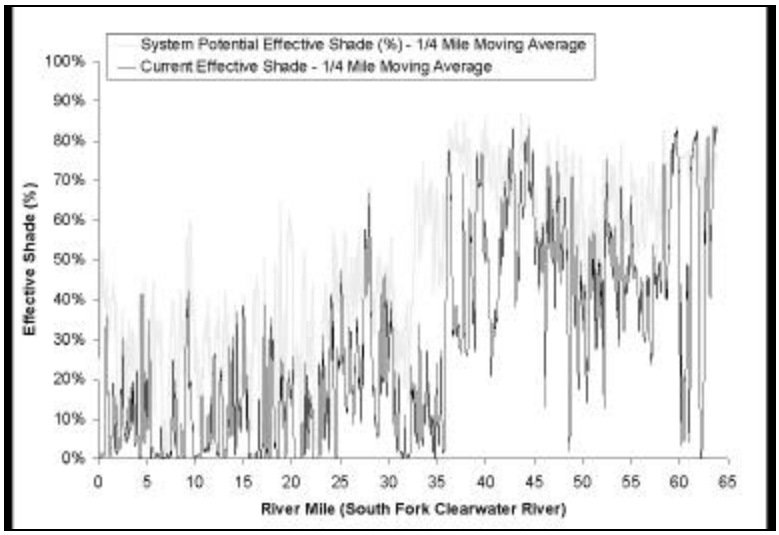


Figure 60. Current and System Potential Effective Shade Conditions for the SF CWR

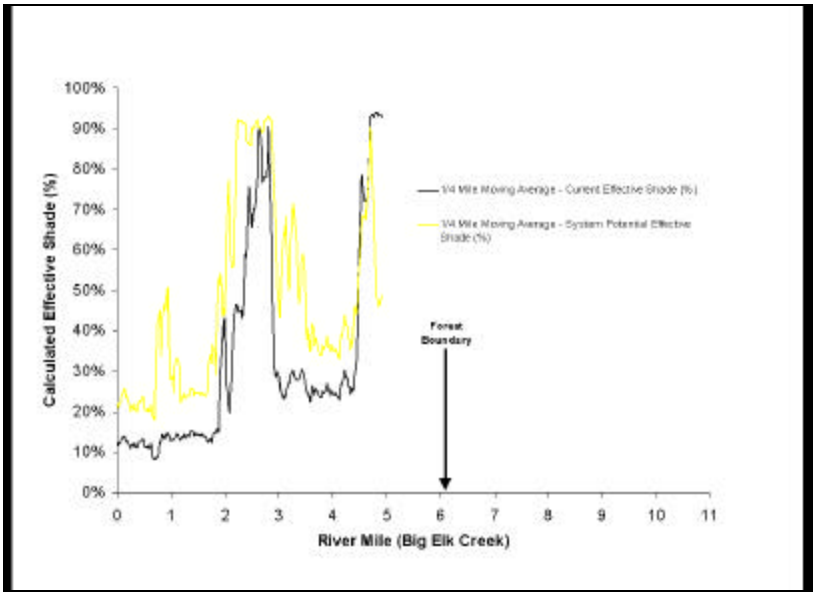


Figure 61. Current and System Potential Effective Shade Conditions for Big Elk Creek

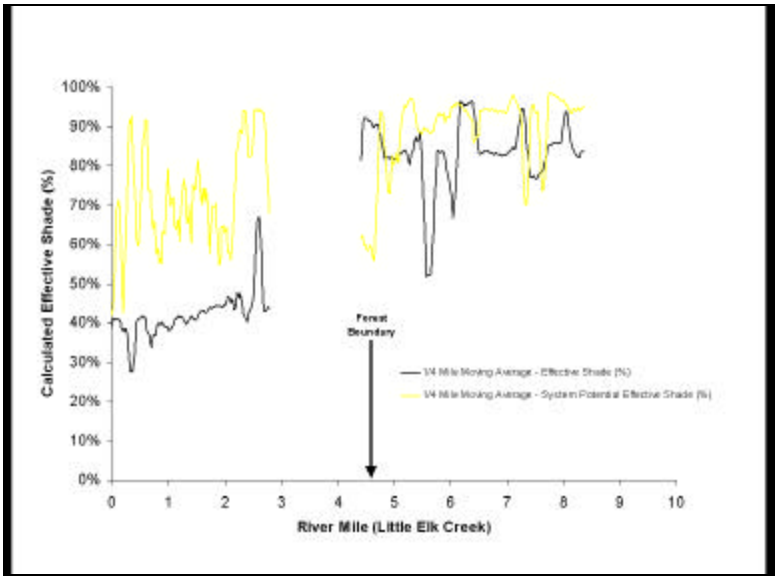


Figure 62. Current and System Potential Effective Shade Conditions for Little Elk Creek

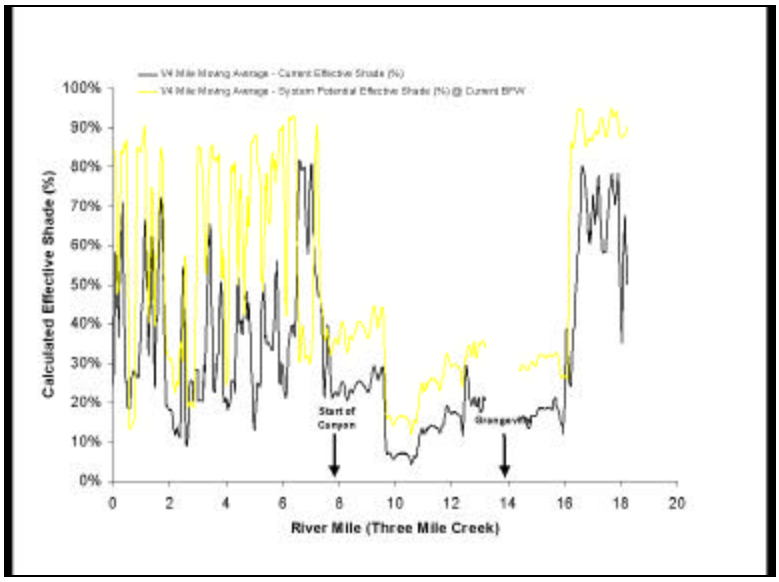


Figure 63. Current and System Potential Effective Shade Conditions for Threemile Creek

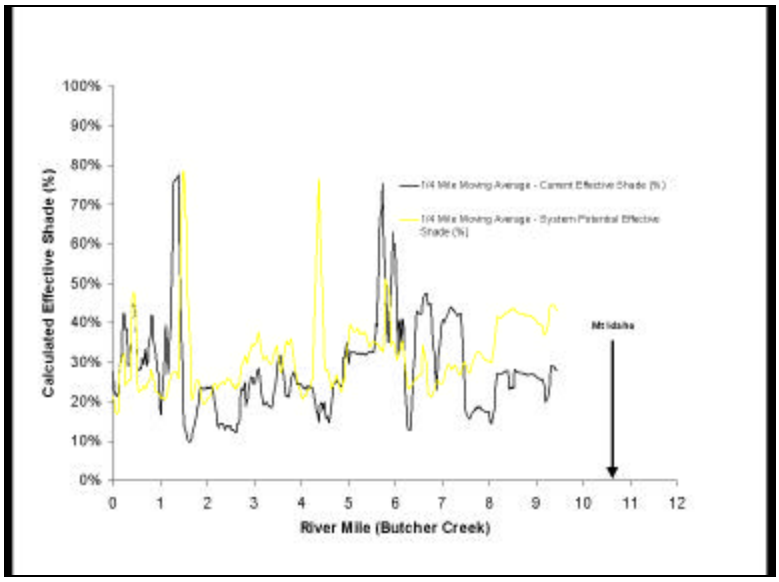


Figure 64. Current and System Potential Effective Shade Conditions for Butcher Creek

Point Source Wasteload Allocations

As indicated in Chapter 3, point sources in the SF CWR include WWTPs, storm water runoff, and suction dredging. Of these, only WWTPs are known to be contributors of heat to the SF CWR and are the focus of WLAs in this TMDL.

It has been established that temperatures in all SF CWR streams monitored in recent years exceed established water quality criteria, primarily during the summer months. Since even streams at high elevations with little or no human impact exceed temperature criteria, it has been concluded that streams temperatures naturally exceed criteria throughout the subbasin, primarily during the warmest months of the year. The recently adopted natural conditions provision in Idaho WQS (IDAPA 58.01.02.401.03.a.v) is intended to address how point source effluent limits for temperature are established in these circumstances. The standard provides that:

> "If temperature criteria for the designated aquatic life use are exceeded in the receiving waters upstream of the discharge due to natural background conditions, then Subsections 401.03.a.iii. and 401.03.a.iv. do not apply and instead wastewater must not raise the receiving water temperatures by more than three tenths (0.3) degrees C."

Although this standard has not yet been approved by USEPA, it has been used as the basis for establishing preliminary WLAs for all WWTPs, and approval/issuance of this portion of the TMDL will be contingent upon approval of this standard by USEPA. This standard is consistent with recently issued temperature guidance (USEPA 2003), which supports allowance of "de-minimis" increases.

In order to determine the maximum effluent temperature that will not increase the natural stream temperature by more than 0.3°C, it is necessary to know the natural background stream temperature, stream flow, and effluent flow. The natural stream temperature at each of the treatment facilities will vary daily, seasonally, and from year to year, and is clearly the most difficult of these variables to establish. Further, at each of the facilities, upstream human activities likely have increased stream temperature above background levels, so stream temperatures upstream of each outfall are not considered to be natural. Natural stream temperatures may be modeled, but such modeling is beyond the scope of this TMDL, and likely is not feasible for very small streams such as Elk Creek, Threemile Creek, and the South Fork Red River.

Given the lack of natural stream temperature data, for the purposes of calculating effluent limits, it has been conservatively assumed that the in-stream temperature upstream of a treatment facility does not exceed the applicable temperature criteria. Effluent temperatures that would increase the stream temperature by 0.3°C are then calculated using a mass balance equation and provisions in Idaho WQS which allow mixing zones of up to 25% by volume of the stream flow (IDAPA 58.01.02.060). This approach is consistent with recommendations in the USEPA temperature guidance (USEPA 2003). The mass balance equation is as follows:

$$T_E = \frac{[Q_E + (0.25 * Q_S)] * [T_C + 0.3C] - [(0.25 * Q_S) * T_C]}{Q_E}$$

Where:

T_E = effluent temperature (°C)
Q_E = effluent flow (cfs)

Q_S = stream flow (cfs)
T_C = applicable temperature criteria (cfs)
0.25 = 25% by volume mixing zone allowance (unitless)

Based on these calculations, very high effluent temperatures at Kooskia, Stites, Red River Ranger Station, and, to some degree, Elk City would not significantly increase in-stream temperatures below the mixing zone (See Appendix O). However, since all of the receiving waters for these facilities naturally exceed temperature criteria, and since other anthropogenic sources in these watersheds are also increasing stream temperatures, it does not seem reasonable to allow treatment facilities to further increase their effluent temperatures. Consequently, allocations for these facilities will be based on current maximum temperatures, as recommended in the temperature guidance (USEPA 2003).

Local data to estimate maximum effluent temperatures are sparse; only Grangeville has monitored and reported effluent temperatures historically. Effluent data collected between 1989 and 2001 were reviewed, and a maximum temperature of 23°C was reached during six different months (typically August) over the 12-year period. This is consistent with data reported in TMDLs in eastern Oregon for other small community WWTPs: Pendleton, OR – 22 °C; Hermiston, OR – 23°C; La Grande, OR – 23°C (ODEQ 2000, ODEQ 2001). Therefore, establishing a maximum daily limit of 23°C, which would apply at times when temperature criteria are expected to be exceeded, appears to be reasonable for Kooskia, Stites, Red River Ranger Station, and portions of the year for Elk City.

Effluent temperatures for Grangeville, and Elk City under low stream flow conditions, may have a significant impact on stream temperature. Wasteload allocations for these facilities will be based on mass balance calculations in Tables 44 - 46 to ensure that permit limits do not result in greater than a 0.3°C increase in stream temperature.

Table 44. Elk City wastewater treatment plant (WWTP) daily maximum effluent temperatures (°C)[a] that would not increase temperatures in Elk Creek by more than 0.3 °C between June 1 and September 30 when federal bull trout criteria apply.

Elk Creek Flow Above WWTP (cfs)[b]	WWTP Effluent Discharge (cfs)							
	0.01	0.02	0.03	0.04	0.05	0.10	0.15	0.20
3	23.0	20.6	16.8	14.9	13.8	11.6	10.8	10.4
5	23.0	23.0	21.8	18.7	16.8	13.1	11.8	11.2
10	23.0	23.0	23.0	23.0	23.0	16.8	14.3	13.1
15	23.0	23.0	23.0	23.0	23.0	20.6	16.8	14.9
20	23.0	23.0	23.0	23.0	23.0	23.0	19.3	16.8
25	23.0	23.0	23.0	23.0	23.0	23.0	23.0	18.7
30	23.0	23.0	23.0	23.0	23.0	23.0	23.0	20.6
35	23.0	23.0	23.0	23.0	23.0	23.0	23.0	22.4
>35	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0

[a] Applicable between June 1 and September 30 w13°C hen federal bull trout temperature criteria apply
[b] cubic feet per second

Table 45. Grangeville wastewater treatment plant (WWTP) daily maximum effluent temperatures (°C)[a] which would not increase temperatures in Threemile Creek by more than 0.3 °C between April 1 and May 31 when the salmonid spawning criteria is applicable.

Threemile Creek Flow Above WWTP Outfall (cfs)[b]	WWTP Effluent Discharge (cfs)				
	0.4	1.0	1.5	2.0	2.5
0.1	9.3	9.3	9.3	9.3	9.3
1	9.5	9.4	9.4	9.3	9.3
3	9.9	9.5	9.5	9.4	9.4
5	10.2	9.7	9.6	9.5	9.5
7	10.6	9.8	9.7	9.6	9.5
9	11.0	10.0	9.8	9.6	9.6
10	11.2	10.1	9.8	9.7	9.6

[a] Applicable between April 1 and May 31 when salmonid spawning temperature criteria apply
[b] cubic feet per second

Table 46. Grangeville wastewater treatment plant (WWTP) daily maximum effluent temperature (^oC) that would not increase Threemile Creek temperature more than 0.3 ^oC between July 15 and September 15 when coldwater aquatic life temperature criteria apply.

Threemile Creek Flow Above WWTP Outfall (cfs)	WWTP Effluent Discharge (cfs)				
	0.3	0.5	1.0	1.5	2.0
0.1	19.3	19.3	19.3	19.3	19.3
1.0	19.6	19.5	19.4	19.4	19.3
2.0	19.8	19.6	19.5	19.4	19.4
3.0	20.1	19.8	19.5	19.5	19.4

Specific WLAs for all WWTPs are listed in Table 47. Heat loads (Btu/day) that correspond to these allocations are listed in tables in Appendix O. These allocations are intended to apply only during times when it is expected that the receiving waters will exceed numeric temperature criteria, based on historic data in Appendix J. It is expected that these limits will be incorporated directly into NPDES permits, since a 25% mixing zone provision has already been included in WLAs for Grangeville and Elk City. For Kooskia, Stites, and Red River Ranger Station, the 23°C WLA should be interpreted as an end-of-pipe limit (i.e., no mixing zone), since it represents the reasonable maximum end-of-pipe temperature.

Table 47. Temperature wasteload allocations for wastewater treatment plants.

Facility	Wasteload Allocation	Applicable Period
Kooskia Wastewater Treatment Plant	23^oC, daily maximum	July 15 – August 31 October 1 – 15
Stites Wastewater Treatment Plant	23^oC, daily maximum	July 15 – August 31 October 1 – 15
Red River Ranger Station Wastewater Treatment Plant	23^oC, daily maximum	July 15 – August 31
Elk City Wastewater Treatment Plant	23^oC, daily maximum	May 15 – 31
	See Table 44	June 1 – September 30
Grangeville	See Table 45	April 1 – May 31
	See Table 46	July 15 – September 15

An evaluation of localized impacts of thermal plumes on salmonids, as recommended in the temperature guidance, was not conducted as part of this TMDL. The guidance describes potential adverse impacts from thermal plumes, which may occur at different temperatures ranging from 13°C to 32^oC, for different exposure periods. The evaluation in the TMDL supporting allocations for all facilities focused on achieving salmonid spawning (9^oC daily

average), bull trout (10°C MWMT), or the coldwater aquatic life criteria (19°C daily average) at the edge of a 25% by volume mixing zone. Given the nature of this evaluation, and the size and location of the WWTPs, the only scenario in the temperature guidance which would appear to warrant further impacts analysis is whether the WWTP effluent causes stream temperature to exceed 13°C, or cause increases in stream temperature of more than 0.25°C, in the vicinity of active salmonid spawning and egg incubation areas. Prior to issuing NPDES permits based on these WLAs, it is recommended that stream channels in the vicinity and downstream of these outfalls be surveyed by fisheries biologists to establish the nearest downstream spawning areas. Mixing zone calculations should then be conducted to determine if the wasteload allocations would cause stream temperature to exceed 13°C, or cause stream temperature to increase more than 0.25°C in these spawning areas. If so, wasteload allocations and NPDES permit limits should be adjusted to avoid these conditions.

Margin of Safety

The CWA requires that each TMDL be established with an MOS. The statutory requirement that TMDLs incorporate an MOS is intended to account for uncertainty in available data or in the actual effect controls will have on loading reductions and receiving water quality. An MOS is expressed as unallocated assimilative capacity or conservative analytical assumptions used in establishing the TMDL (e.g., derivation of numeric targets, modeling assumptions, or effectiveness of proposed management actions).

The MOS may be implicit, as in conservative assumptions used in calculating the LC, WLA, and LA. The MOS may also be explicitly stated as an added, separate quantity in the TMDL calculation. In any case, assumptions should be stated and the basis behind the MOS documented. The MOS is not meant to compensate for a failure to consider factors that affect water quality.

A TMDL and associated MOS, which result in an overall allocation, represent the best estimate of how standards can be achieved. The TMDL process accommodates the ability to track and ultimately refine assumptions within the TMDL implementation-planning component.

The following factors may be considered in evaluating and deriving an appropriate MOS:

- The analysis and techniques used in evaluating the components of the TMDL process and deriving an allocation scheme.
- The characterization and estimates of source loading (e.g., confidence regarding data limitation, analysis limitation, or assumptions).
- An analysis of relationships between the source loading and in-stream impact.
- The prediction of the response of receiving waters under various allocation scenarios (e.g., the predictive capability of the analysis and simplifications in the selected techniques).
- The implications of the MOS on the overall load reductions identified in terms of reduction feasibility and implementation time frames.

A number of areas of uncertainty exist in the SF CWR Subbasin temperature TMDL. Among the more significant are:

- The relationship between stream temperature and shade levels.
- Estimating CWE and system potential shade levels.
- Estimating point source effluent temperatures.

The TMDL accounts for these uncertainties by incorporating implicit MOS. The procedure to develop shade targets utilizing the CWE methodology is based on achieving existing temperature criteria. Analysis above indicates that temperatures naturally exceed criteria throughout the subbasin; therefore, shade targets and WLAs that are developed to meet the criteria are inherently conservative. In addition, by definition SPV targets represent riparian vegetation conditions absent human disturbance, and are therefore the best achievable.

Seasonal Variation/Critical Conditions

Temperature varies seasonally due to changes in solar radiation loading, air temperature, and other factors, as illustrated in Section 2.3. Water temperatures peak in the July – August time period, which coincides with spawning and incubation periods for key sensitive aquatic species including spring/summer chinook salmon, cutthroat trout, bull trout, and steelhead. Egg and larval stages of salmonids are the most sensitive to elevated temperatures, so the July – August time period, when the magnitude of temperature exceedances is the greatest and flows are the lowest, is the most critical period for temperature.

The TMDLs have addressed the seasonal nature and this critical time period by developing shade targets (CWE and SPV) and WLAs specifically for this period. The CWE analysis targets early August in deriving canopy closure targets that have been associated with water temperature compliance, and the heat loading resulting from system potential vegetation targets is estimated for the August time frame. Seasonal WLAs apply only during the time period when violations are expected to occur, and have been established to meet Idaho temperature criteria, including natural condition provisions, during the critical low flow summer months. By developing targets for the most critical time period, it is expected that shade targets will be protective at other times of the year as well.

Reasonable Assurance

Reasonable assurance of the implementation of nonpoint source control actions is required in a TMDL when point source WLAs are made less restrictive as a result of expected reductions from nonpoint source allocations. Where there are not reasonable assurances, the entire load reduction must be assigned to point sources (USEPA 1991). Wasteload allocations in the temperature TMDL are not made any less restrictive due to the expectation that nonpoint source controls will occur. In fact, WLAs are conservatively targeted at existing criteria, when in fact they could be targeted at natural temperatures that exceed these criteria.

The point source heat loading in the subbasin is very minor compared to nonpoint source loading, except in the Threemile Creek. As a result, assigning the entire load reduction to

point sources would result in essentially no improvement in temperature conditions throughout the SF CWR Subbasin and would likely not result in compliance with applicable standards, even in Threemile Creek where substantial riparian shade loss (a nonpoint source) has occurred. For these reasons, reasonable assurance of nonpoint source control actions is not relevant to this TMDL, nor would placing the burden entirely on the point sources result in substantial environmental improvement.

Background

The natural background heat loading is an important component of the TMDL, because temperatures throughout the subbasin appear to naturally exceed existing water quality criteria at certain times. The TMDL does not attempt to quantify the natural background heat loading or establish the natural thermal regime of individual water bodies. Rather, the TMDL allocations incorporate natural background by setting shade targets that are expected to achieve natural background temperatures. This is consistent with direction provided in Idaho WQS (IDAPA 58.01.02.200.09), which say that when natural background conditions exceed any applicable water quality criteria, the water quality criteria shall not apply; instead, pollutant levels shall not exceed natural background conditions.

Reserve

A reserve capacity for future growth has not been specifically identified or incorporated within these temperature TMDLs. Future management activities and growth of municipalities is expected to be possible within the allocations and WLAs established.

Implementation Strategies

Shade targets are established in the TMDL (CWE canopy closure and SPV effective shade) as surrogate measures necessary to achieve temperature criteria. While specific information and direction regarding how these targets are to be implemented will be established in the implementation plan, certain general considerations accompany these targets.

The overall intent of these TMDLs is to meet temperature criteria by increasing shade, or in areas where shade targets are already met, to maintain natural shade levels, including natural disturbance regimes (e.g., fire, mass wasting, insects, disease, etc). While these shade targets do not preclude all management within the riparian zone, only activities that result in negligible shade reduction, or through careful evaluation, result in long term benefits in terms of stream temperature, are consistent with the targets.

Application of these targets is expected to be carried out at a stream reach scale, as defined in the NPNF *Basinwide Survey Methodology* (USFS, 1995) or similar guidance. Typically the stream reaches are 0.5 mile in length, but this may vary considerably given the nature and size of the stream. In all cases (both SPV and CWE), a site evaluation will be essential in order to 1) confirm current shade conditions, 2) confirm channel conditions, 3) determine why shade is above or below target values, and 4) establish appropriate best management

practices (BMP). While the shade targets provide a useful goal for restoration, the key to implementation is to tailor management to the problems unique to each stream reach.

In much of the watershed it is expected that shade targets will be achieved through passive restoration, that is, allowing vegetation to grow to a mature state. In some locations (e.g., dredge mined areas), active restoration through plantings and channel alteration will likely be warranted.

There may be circumstances in which it is necessary to temporarily reduce shade in order to achieve increased shade and ecological health in the long term. For example, active channel restoration or prescribed fire may temporarily reduce existing shade, but lead to long-term temperature benefits. These activities would be consistent with TMDL targets, provided they are carefully evaluated to establish whether or not the long-term temperature benefits outweigh the short-term loss of shade.

In still other areas, it is recognized that it may not be possible to achieve the desired shade due to essentially irreversible human caused changes, such as roads or railroads adjacent to the stream. In these areas, it is expected that the implementation plan will identify local or other offsetting measures (e.g., plantings along the stream) that would minimize the effects of permanent human-caused shade loss.

Approach

The implementation plan will be developed jointly by the WAG, landowners, and resource agencies. Contents of the implementation plan are expected to generally include:

- A description of how targets are to be implemented (e.g., explains details of how to implement SPV and CWE targets).
- An identification of BMPs and BMP locations, to the extent possible.
- An identification of existing efforts that will help achieve TMDL goals.
- An implementation schedule with milestones based on restoration priorities (e.g., Fish TAG priority areas).
- Provisions to seek funding sources and sponsoring agencies.

Time Frame

Development of the implementation plan has already begun and is expected to be completed in time for submittal of nonpoint source projects for CWA Section 319 funding in 2004/2005. Wasteload allocations will be incorporated into NPDES permits when they are reissued or reopened. The Grangeville NPDES permit is expected to be reissued within the next 1-2 years, and the recently reissued permits for Kooskia, Stites, Elk City, and Red River Ranger Station will need to be reopened to incorporate revised limits.

Implementation of nonpoint source controls has already begun, but is expected to proceed in earnest once the implementation plan is complete and funds are available. A majority of the sources of temperature and sediment loading are nonpoint in origin, and realistically it may

take many years if not decades to fully achieve the goals of the TMDL. Certain improvements, such as controlling temperature and nutrients from the Grangeville WWTP or controlling nonpoint bacteria sources, are likely to occur fairly rapidly, within a few years. In order to substantially improve stream temperatures, mature riparian communities and a stable hydrologic regime and stream channel are needed. In smaller streams and watersheds, for example at an exclosure on Big Elk Creek, significant improvement may be seen in several years. Realistically though, it is likely to take decades to see such improvement throughout the watershed given the large scale of needed improvements and the time frame needed to for riparian vegetation to grow to maturity.

Participating Parties

Responsible agencies and interest groups expected to play an important role in developing and implementing restoration measures include: NPNF, NPT, IDL, Idaho County Soil and Water Conservation District, Soil Conservation Commission, BLM, ITD, IDWR, Idaho Department of Agriculture, WAG, NRCS, DEQ, NMFS, USEPA, IDFG, U.S. Fish and Wildlife Service, Idaho County, and local highway districts, municipalities, industries, and local landowners.

Monitoring Strategy

Monitoring needs include continued monitoring of in-stream temperatures, determining point source discharge temperatures, and monitoring to establish reach-specific shade targets. Monitoring for stream temperature trends and standards attainment should occur near the mouths of each of the water bodies 303(d) listed for temperature, as well as those other 303(d) listed streams that are protected for bull trout. A total of 13 monitoring points should be established in the SF CWR Subbasin: five on the main stem near the lower ends of the water bodies, and one each near the mouths of Threemile Creek, Butcher Creek, Newsome Creek, American River, Big Elk Creek, Little Elk Creek, Red River and Crooked River. Stream temperature should be monitored using a device that at a minimum can make hourly recordings over the course of six months, encompassing the critical months of July and August. Monitoring should occur every summer until such time as the WQS are attained, or until this TMDL is revised and another plan established.

Monitoring of point source temperatures is needed so that the facilities can verify compliance with WLAs using current operations or determine if treatment revisions will be necessary. Monitoring requirements will be included in revised NPDES permits, but point sources are encouraged to begin collecting data immediately.

Determining reach-specific channel width, aspect, and current effective shade is needed in order to verify SPV shade targets and determine whether increases in shade are needed. A systematic procedure and time frame for collecting these data across federal, state, and private land is needed.

5.4 Sediment TMDLs

Sediment TMDLs are developed below for seven water bodies in the SF CWR Subbasin: Threemile Creek, Butcher Creek, and the five water bodies of the main stem SF CWR. Point sources of sediment within the subbasin are relatively minor in relation to the nonpoint sources. However, all known point sources are evaluated and WLAs set.

The details of the data sets and some of the calculations for the nonpoint source of sediment are presented in Appendix M. A sediment budget (Appendix L) was developed for all the major nonpoint sediment sources in the SF CWR Subbasin; the results of which are used to calibrate and validate the sediment loadings calculations.

In-Stream Water Quality Targets for Sediment

The goal of a sediment TMDL is to restore "full support of designated beneficial uses" (Idaho Code 39.3611). A part of the analysis discussed herein uses a TSS target derived from the turbidity WQS based on equations found in Appendix M. Other parts of the analysis use the narrative sediment standard and are driven by reasoning processes rather than hard numbers. Setting the targets for the narrative-derived TMDLs involved the WAG and other interest groups to arrive at a method that would address the sediment impairment in the subbasin and not adversely affect one economic interest over another.

In general, in-stream TSS targets are set for Threemile Creek, Butcher Creek, and the lower main stem SF CWR at Stites. The sediment targets for the main stem SF CWR above Butcher Creek are set at the targeted percent sediment load reduction from the Stites location, (i.e., 25% of the total human-caused sediment load). The human-caused loads and targets for the locations upstream from Butcher Creek are based on the sediment budget presented in Appendix L.

Design Conditions

The 303(d) listed streams in the SF CWR Subbasin for which sediment TMDLs were developed are Threemile Creek and Butcher Creek in the lower end of the subbasin and the whole of the main stem SF CWR from Kooskia up to the confluence of the Red and American Rivers. The main stem SF CWR is divided into five water bodies in state code (IDAPA 58.01.02.120.07) and sediment TMDLs are developed for each one of them. Salmonid spawning aquatic life use is the most limiting designated or existing beneficial use for all of these water bodies.

Sediment loading to streams and rivers in the SF CWR Subbasin is dominated by spring runoff events, particularly those extreme events that have a recurrence of once every five years or longer. Sediment loadings for the SF CWR TMDLs are calculated on an annual basis. However, it is clear that only significant load reductions during the extreme events will result in attainment of the water quality targets. The majority of sediment load reductions for the SF CWR Subbasin must come from Cottonwood Creek if the subbasin is to meet WQS. The sediment TMDL for Cottonwood Creek has been written (DEQ, NPT,

USEPA 2000) and the SF CWR Subbasin TMDLs rely on some of its calculated loadings to balance the sediment budget.
The narrative sediment WQS states that sediment "shall not exceed quantities … which impair designated beneficial uses" (IDAPA 58.01.02.200.08). Sediment load reduction calculations for the main stem SF CWR above Butcher Creek are based on restoring beneficial uses that are impaired in this part of the river. DEQ's protocol for assessing beneficial use support status for large rivers has not been applied to the main stem SF CWR for lack of adequate data. However, sediment loading, coupled with the Fish TAG conclusions (Appendix D), cobble embeddedness data, and other reference watershed data (Appendix N) have led to the conclusion that beneficial uses are impaired in the main stem and that TMDLs are required. The requirement for load reductions in the main stem will likely result in load reductions from water bodies flowing into the main stem. Targets are set at four main stem SF CWR control points upstream from the mouth of Butcher Creek.

Bedload in the form of sand-sized particles is considered to be the primary pollutant of interest in the main stem SF CWR water bodies above Butcher Creek. Bedload is also considered to be a problem in Butcher Creek, Threemile Creek, and the lower reach of the main stem. While we do have some bedload data, there are insufficient data to calculate loads and set targets for bedload. Therefore, it is assumed that sediment load reductions to meet TSS-based targets will result in adequate bedload reductions as well. The basis for this assumption is discussed in the sections to follow.

Sediment loading calculations for these SF CWR TMDLs are based on daily average flows and monitoring results of associated in-stream TSS. The calculated results are then annualized so sediment LAs can be made. The following sections of this report present the calculations in the order they come into play: development of the stochastic flow models; development of the flow to TSS and bedload relationships; estimations of current sediment loading; estimations of the proportions of current sediment loading that are natural background; estimations of loading capacities based on the WQS, flow, and background; calculations of excess sediment loading from the current loading and loading capacities; determination of a MOS; and estimation of a required sediment load reduction to meet WQS. The summary results of all the calculations and estimations are presented for control locations for Butcher and Threemile Creeks and the main stem SF CWR at Stites and Harpster in Tables 48 through 51.

Table 48. Threemile Creek loading calculations.

Parameter[a]	Equation[b]	Minimum	Maximum	Average
Daily Flow for Last 10 Years (cfs)	Derived from Lapwai Creek and Lipscomb (1998) correction	0.19	394	16
Existing TSS, Daily Average (mg/L)	(flow) * (0.9779)	0.19	402	16
Existing TSS (t/day)	(TSS) * (flow) * (0.0027)	0.0001	446	3.0
Existing TSS, Yearly Average (t/y)		18	3,856	1,098
Existing Turbidity (NTU)	(flow) * (1.8182)	0.25	520	21
Background Ratio	(535 t/y/WB) / (6640 t/y/WB)			0.08 (8%)
Background TSS (mg/L)	(TSS daily average) * (background ratio)	0.02	31	1.3
Background TSS (t/day)	TSS (t/day) * background ratio	0	33	0.24
Load Capacity (t/day)	((17 mg/L) * daily flow * 0.0027) + background TSS (t/day)	0.008	51.1	1.0
Excess Load (t/day)	If load capacity > TSS (t/day) Else, TSS (t/day) – load capacity	0 0	0 360	0 2.1
Excess Load (t/y)				775
Load Reduction (%)	Excess load / TSS, yearly average			0.71 (71%)

[a] cfs = cubic feet per second, TSS = total suspended solids, mg/L – milligrams per liter, t/day = tons per day, t/y = tons per year, NTU = nephlometric turbidity units
[b] t/y/WB = tons per year per water body

Threemile Creek watershed area = 21, 478 acres or 33.5 square miles
Threemile Creek sediment yield equation: 25 NTU Idaho WQS standards = 17 mg/L = (25 NTU * 0.674)

Table 49. Butcher Creek loading calculations.

Parameter[a]	Equation[b]	Minimum	Maximum	Average
Daily Flow for Last 10 Years (cfs)	Derived from Lapwai Creek and Lipscomb (1998) correction	0.07	153	6.2
Existing TSS, Daily Average (mg/L)	(flow) * (2.381) + 5.89	6.1	369	20.6
Existing TSS (t/day)	(TSS) * (flow) * (0.0027)	0.001	152	1.2
Existing TSS, Yearly Average (t/y)		13.8	1,486	435.6
Existing Turbidity (NTU)	((flow) * (2.6118)) + 3.7317	3.9	402	19.9
Background Ratio	(303 t/y/WB) / (1,251 t/y/WB)			0.24 (24%)
Background TSS (mg/L)	(TSS daily average) * (background ratio)	1.5	89.1	5.0
Load Capacity (mg/L)	Background + 25.25 mg/L	26.7	114.8	30.2
Background TSS (t/day)	TSS (t/day) * background ratio	0.0003	36.7	0.29
Load Capacity (t/day)	((25.25 mg/L) * daily flow * (0.0027)) + background TSS (t/day)	0.005	47.7	0.71
Excess Load (t/day)	If load capacity > TSS (t/day) Else, TSS (t/day) – load capacity	0 0	0 105	0 0.55
Excess Load (t/y)				199.4
Load Reduction (%)	Excess load / TSS, yearlyaverage			0.46 (46%)

[a] cfs = cubic feet per second, TSS = total suspended solids, mg/L – milligrams per liter, t/day = tons per day, t/y = tons per year, NTU = nephlometric turbidity units
[b] t/y/WB = tons per year per water body

Butcher Creek watershed area = 10,723 acres or 16.8 square miles
Butcher Creek sediment yield equation: 25 NTU Idaho WQS standards = 25.25 mg/L = ((25 NTU) * 0.9056) + 2.6113

Table 50. Stites USGS station loading calculations.

Parameter[a]	Equation[b]	Minimum	Maximum	Average
Daily Flow for Last 10 Years (cfs)	Stites USGS station and Lipscomb (1998) correction	90	9140	1099
Existing TSS, Daily Average (mg/L)	(flow^1.953) * (0.00005)	0.03	272	9.7
Existing TSS (t/day)	TSS (mg/L) * flow * (0.0027)	.008	6715	104
Existing TSS, Yearly Average (t/y)		NA	NA	38,157
Existing Bedload, (t/y)	3 * (10^(-12)) * (flow^3.6237)	NA	NA	2,542
Existing Turbidity (NTU)	(flow) * (0.0058)	0.5	53	6.4
Background Ratio	(19,884 t/y/WB) / (91,052 t/y/WB)			0.22 (22%)
Background TSS (mg/L)	(TSS daily average) * (background ratio)	0.007	57.1	2
Load Capacity (mg/L)	Background TSS (mg/L) + 45 mg/L	45	102.1	47
Background TSS (t/day)	TSS (t/day) * background ratio	0.002	1409	22
Load Capacity (t/day)	((46.9 mg/L) * daily flow * (0.0027) + (background TSS (t/day))	11.4	2566	161
Excess Load (t/day)	If load capacity > TSS (t/day) Else, TSS (t/day) – load capacity	0 0	0 4149	0 49
Excess Load (t/y)				9,630
Load Reduction (%)	Excess load / TSS, yearly average			0.25 (25%)

[a] cfs = cubic feet per second, TSS = total suspended solids, mg/L – milligrams per liter, t/day = tons per day, t/y = tons per year, NTU = nephlometric turbidity units
[b] t/y/WB = tons per year per water body

Watershed area = 1,150 square miles
Stites sediment yield equation: 25 NTU Idaho WQS standards = 45 mg/L = (25 NTU) * 1.8074

Table 51. Harpster site loading calculations.

Parameter[a]	Equation[b]	Minimum	Maximum	Average
Daily Flow for Last 10 Years (cfs)	(Stites USGS station) – (Prairie flow) and Lipscomb (1998) correction	42	7,479	860
Existing TSS, Daily average (mg/L)	(Flow) * (0.0066) + 6.7219	7.0	56.1	13.6
Existing TSS (t/day)	(TSS) * (flow) * (0.0027)	0.8	1,132	52.2
Existing TSS, Yearly Average (t/y)		NA	NA	17,349
Existing Bedload, (t/y)	6 * (10^(-9)) * (flow^2.713)	NA	NA	1,212
Existing Turbidity (NTU)	(TSS-3.8524) / 2.0474	1.5	25.5	4.2
Background Ratio	(14,856 t/y/WB) / (20,621 t/y/WB)			0.72 (72%)
Background TSS (mg/L)	(TSS daily average) * (background ratio)	4.8	38.8	8.6
Load Capacity (mg/L)	(Background TSS) + (60 mg/L)	59.8	93.8	63.6
Background TSS (t/day)	TSS (t/day) * (background ratio)	0.5	784	32.9
Load Capacity (t/day)	(60 mg/L) * daily flow * (0.0027) + (background TSS (t/day))	6.7	1,896	161
Excess Load (t/day)	If load capacity > TSS (t/day) Else, TSS (t/day) – load capacity	0 0	0 0	0 0
Excess Load (t/y)				0
Load Reduction (%)	Excess load / TSS, yearly average			0

[a] cfs = cubic feet per second, TSS = total suspended solids, mg/L – milligrams per liter, t/day = tons per day, t/y = tons per year, NTU = nephlometric turbidity units
[b] t/y/WB = tons per year per water body

Watershed area = 880 square miles
Harpster sediment yield equation: 25 NTU Idaho WQS standards = 60 mg/L = ((25 NTU) * (2.4281)) - 0.3334

Discussion of Tables 48 through 51

For Threemile Creek, the sediment budget calculations (Appendix L) indicate that 6,640 t/y of sediment are produced, whereas these TSS data (Table 58) indicate that only about 1,098 t/y of TSS are being output at the mouth. If one adds in the estimate of bedload for Threemile Creek, 615 t/y, this results in an estimate of 1,713 t/y of sediment discharged from the mouth, or only about 26% of the total from the sediment budget calculations. This 74% discrepancy may be the result of much more storage in this watershed than we have accounted for in the routing coefficient. There is an old mass failure about 1 mile above the mouth, above which sediment is accumulating. At the lower flows over most of the year, the stream goes subsurface above the mass failure, which probably accounts for the consistently low TSS and turbidity at low flows. The effect of the mass failure on sediment throughput, however, is not well understood.

The sediment budget calculations (Appendix L) for Butcher Creek indicate that 1,251 t/y of sediment are produced, whereas these TSS data (Table 59) indicate that only about 435 t/y of TSS are being output at the mouth. If one adds in the estimate of bedload for Butcher Creek, 211 t/y, this results in an estimate of 646 t/y of sediment discharged from the mouth, which is only 52% of the sediment predicted by the sediment budget. This 48% discrepancy is consistent with the data from Stites and may be the result of more storage in the watershed than accounted for in the routing coefficient.

The sediment budget calculations (Appendix L) for the mouth of the SF CWR at Stites indicate that 91,052 t/y of sediment are produced in the SF CWR watershed, whereas the TSS data indicate that only about 38,157 t/y of TSS (Table 50) are being output at the mouth. If one adds in the estimate of bedload for the South Fork, 2,541 t/y, this results in an estimate of 40,698 t/y of sediment discharged from the mouth, which is only 45% of the calculated sediment budget. This 55% discrepancy may be the result of more storage in the watersheds than accounted for in the routing coefficient.

For the Harpster site, the sediment budget calculations (Appendix L) indicate that 19,624 t/y of sediment are produced in the SF CWR watershed above Harpster, whereas these TSS data (Table 51) indicate that about 17,349 t/y of TSS are being output. If one adds in the estimate of bedload at Harpster, 1,212 t/y, this results in an estimate of 18,561 t/year of sediment discharged from the mouth. This relatively minor discrepancy is somewhat surprising giving the level of reliability of the data and the relationships being used. However, it is noted that these numbers are very close to numbers generated in the past by the NPNF for sediment loading at the Mt. Idaho bridge (Kenny 1995).

Target Selection

The targets for Threemile Creek, Butcher Creek and lowest reach of the main stem SF CWR (water body #1) are derived using TSS data collected at bridges near the mouths of Threemile and Butcher Creeks and at the bridge at Stites over the SF CWR (near the USGS gaging station at Stites). Loading calculations and targets are set using the state WQS of 25 NTU over background with the assumption that the duration of excursions greater than 25 NTU is greater than 10 days.

The sediment targets for the four main stem water bodies upstream from the mouth of Butcher Creek (i.e., water bodies #12, #22, #30, and #36) are set based on the percent load reduction required at Stites, the pour point for the basin. The data suggest that bedload sediment in the SF CWR Subbasin above Butcher Creek is impacting the beneficial uses of the waters above this point. However, bedload data at hand are insufficient to set bedload targets. It is assumed that targets based on total sediment loads will address the bedload issue. Targets for the main stem above Butcher Creek are set as a percentage of the total human-caused sediment load. The percentage is the same as that calculated for the Stites

location. The human-caused sediment load is that calculated in the sediment budget in Appendix L.

Flow Data and Flow Estimation

Mean daily flow data recorded by the USGS are available for the lower main stem SF CWR ranging back to 1911. For the period of 1923-1963, the recording station was located at a location above the dam at Harpster. Since 1965, the recording station has been at Stites. Daily flow data from the USGS site at Stites are shown in Figure 65. The flow data for 10 years, from 1991 through 2001, were selected for the calculations. Examination of the flow chart shows that this is a reasonably representative time period. It includes the 1995 and 1996 high flow events, but as can be seen, these were not unusually high flow years. The USGS predicts that the 8,000 cfs flows of 1995 and 1996 have a return period of five years (see Table 21). The other major feature to note about the USGS plot is the variation in flow on an annual basis, almost two orders of magnitude.

Flow and loading calculations for each watershed were accomplished in a spreadsheet format with 3,658 records, one for each day of the 10 years of record used.

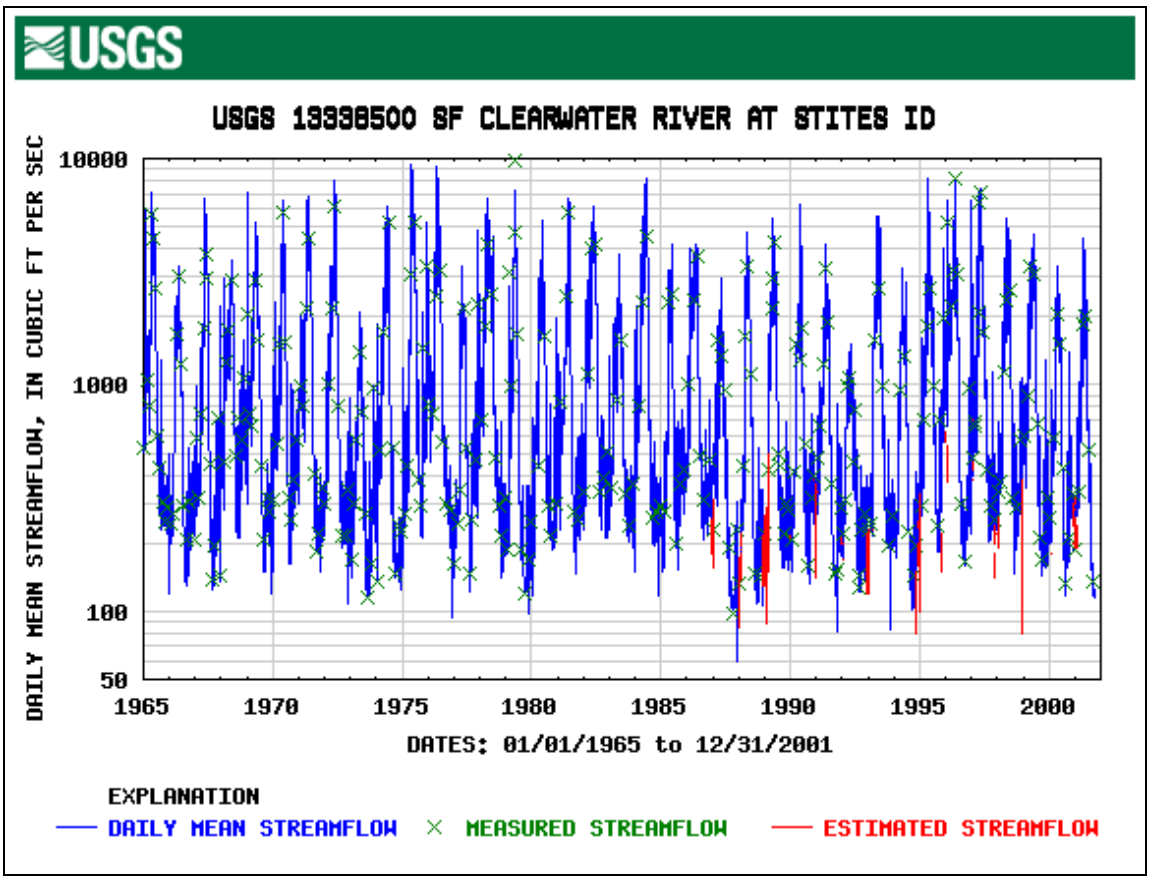


Figure 65. U.S. Geological Survey (USGS) Flow Record from Stites

It is generally recognized by local residents and hydrologists working in the area that the flow patterns from the watersheds in the lower subbasin, those watersheds to the west of the federal lands, are significantly different from those in the upper basin both in terms of the timing and duration of peak flows and the duration of minimum flows. The nearest USGS gaging station with similar flow patterns to the lower elevation streams flowing off the Camas Prairie is on Lapwai Creek. Of particular interest for the analyses are the flows of Cottonwood Creek, Threemile Creek, and Butcher Creek. Flows for Cottonwood Creek were calculated for the Cottonwood Creek TMDL based on flows from Lapwai Creek (DEQ, NPT, USEPA 2000). A similar procedure as used in the Cottonwood Creek TMDL using USGS measured flow from Lapwai Creek over the same 10-year time period from 1991 through 2001 was followed to calculate flows for Threemile Creek and Butcher Creek. The USGS chart of flows for Lapwai Creek is presented in Figure 66.

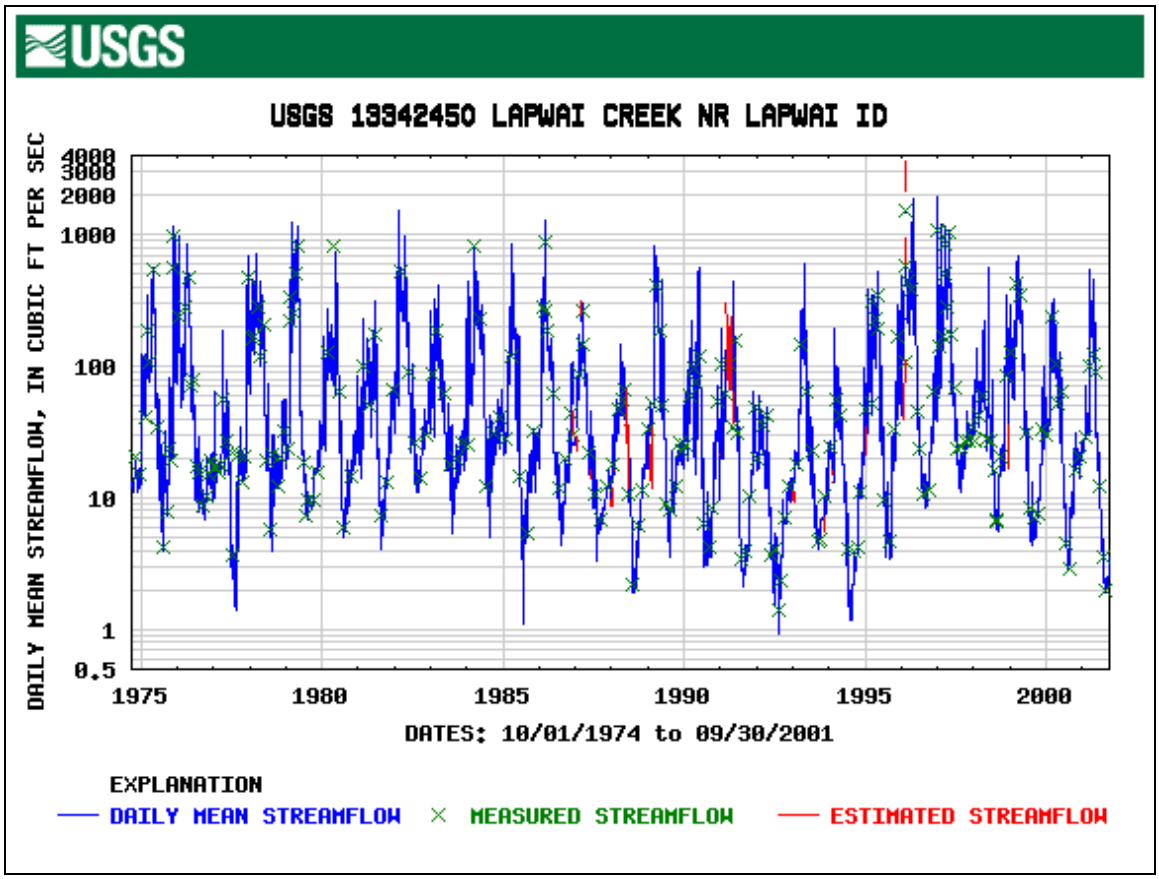


Figure 66. U.S. Geological Survey (USGS) Flow Data for Lapwai Creek

The flow at Lapwai Creek is much more variable from year to year compared to the flow at Stites, and the annual range of flow rates approaches three orders of magnitude.

Of particular concern about transposing the Lapwai Creek flow data to other watersheds is the single extreme flow event of February 1996. The flow rates for the three days when this flow occurred were reduced before using these flow data to calculate flows for Threemile, Cottonwood, and Butcher Creeks. It did not seem reasonable to extrapolate such an extreme

event from Lapwai Creek to other waterhseds where anecdotal evidence suggests that while the event was very large, it was not of the extreme nature as occurred in Lapwai Creek. In Figures 67 and 68 showing the graphs of the calculated flows for Threemile and Butcher Creeks, the February 1996 flows have been reduced to only slightly greater than other high flows that occurred in 1996 and 1997.

Daily flows for Threemile and Butcher Creeks were calculated in a two-step process. Since the volume of runoff from a watershed is proportional to the size of the watershed, everything else being equal, daily flow from Lapwai Creek was multiplied the values 33.5/235 for Threemile Creek and 16.8/235 for Butcher Creek (33.5, 16.8, and 235 are areas in square miles of Threemile, Butcher and Lapwai Creeks, respectively).

However, everything else is not equal between Threemile, and Butcher, and Lapwai Creeks, especially the precipitation. They all also have somewhat different geology, soils, physiography, land cover, and other features. Most notably, Threemile Creek and Butcher Creek receive more precipitation than Lapwai Creek. The USGS (Lipscomb 1998) provides statistically derived estimates of mean annual and mean monthly discharge for water bodies in central Idaho. The proportion of the mean annual flow from the USGS estimates were compared against the area adjusted mean annual flows to calculate daily flows over the 10 years, such that the mean annual flow over the 10 years equaled the USGS developed discharge rate for the two watersheds. This then is assumed to be a daily flow pattern representative of each watershed over the long term. The derived 10-year flow patterns for Threemile and Butcher Creeks are shown in Figures 67 and 68. The same calculations for were performed for Cottonwood Creek so the data would be available to calculate the flow pattern at Harpster, based on removal of high flows from these prairie streams.

For daily flow at Stites, the flow record from the USGS station was used and adjusted upwards to meet the long term annual discharge calculated by the USGS (Lipscomb 1998), resulting in a flow curve representative of the long term flow at the site. For daily flow at Harpster, the daily flows for Cottonwood, Threemile, and Butcher Creeks were subtracted from the Stites daily flow to account for the change in flow pattern as result of the different timing of peak flows from these three major tributaries. The flow was then adjusted to match the USGS estimate (Lipscomb 1998).

These calculations result in an estimate mean daily discharge based on the flow pattern over the last 10 years for Threemile Creek, Butcher Creek, and the Harpster site on the SF CWR (Figures 67, 68, and 69) and are assumed to be representative of long term flows in the respective watersheds. These flow estimates form the basis from which sediment movement in the basin can be calculated.

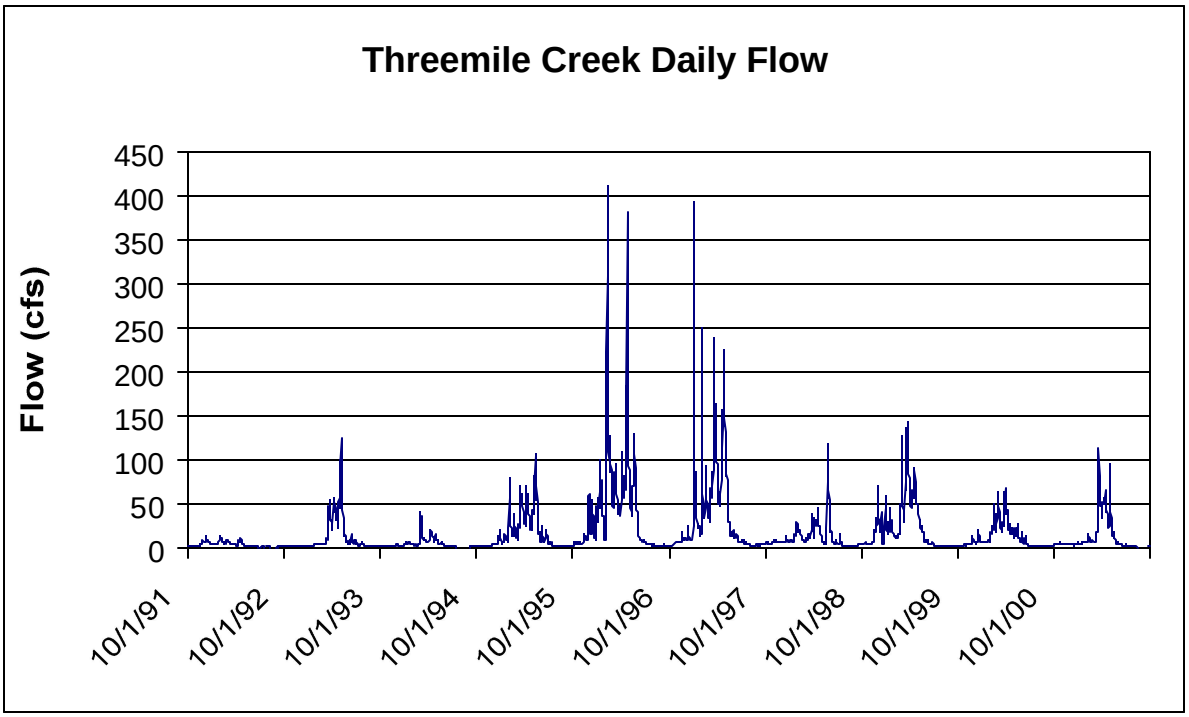


Figure 67. Derived 10-Year Flow for Threemile Creek

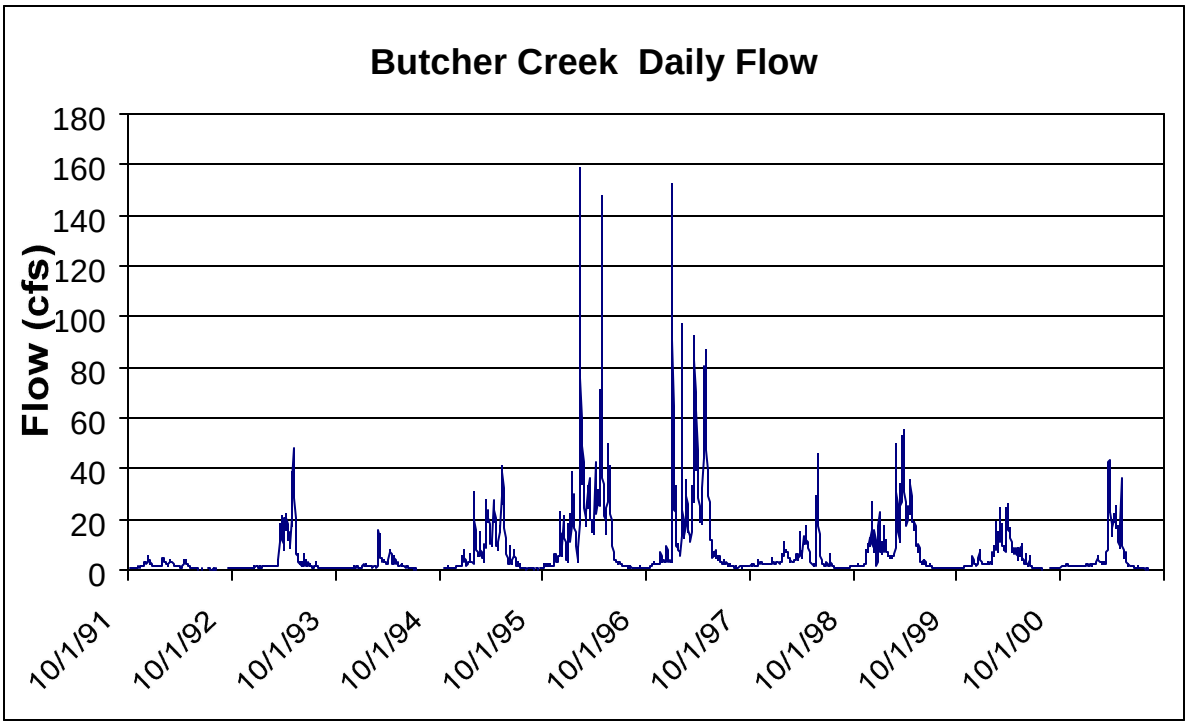


Figure 68. Derived 10-Year Flow for Butcher Creek

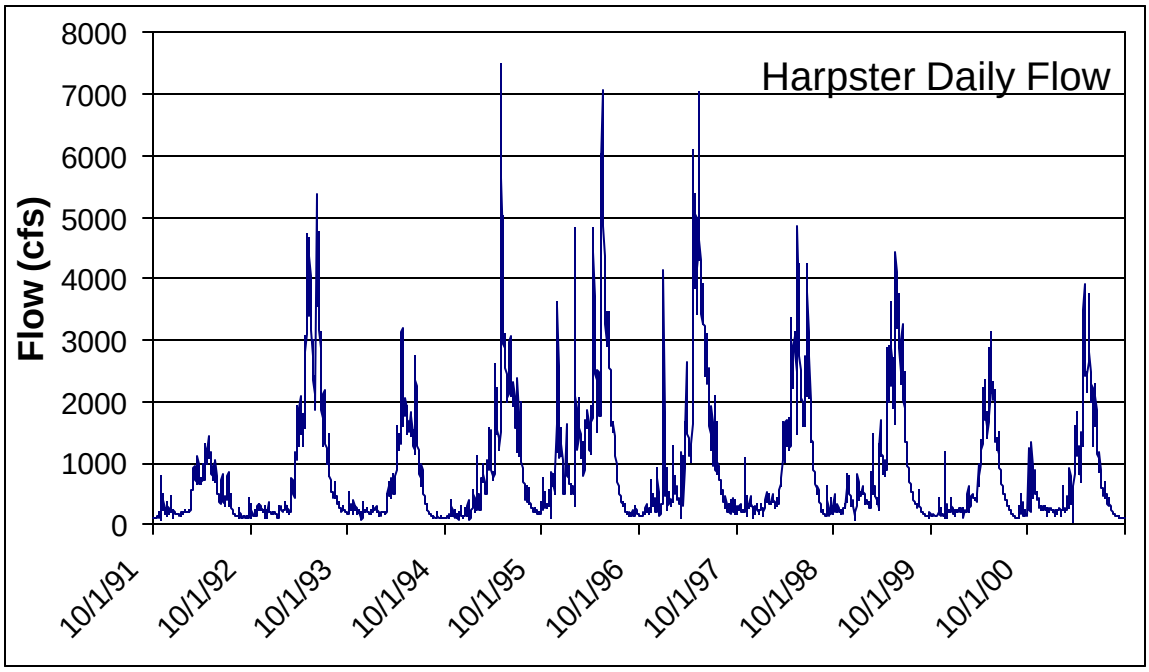


Figure 69. Derived 10-Year Flow for the Harpster Site on the SF CWR

TSS and Bedload Data

TSS and bedload data reported herein are the results of several different efforts on the part of DEQ, NPT, and USEPA. The USEPA provided funding for some of these efforts. DEQ collected instantaneous flow, TSS, and turbidity data for Threemile Creek as part of its detailed monitoring of that water body. The NPT collected instantaneous flow, TSS, turbidity, and bedload data for Butcher Creek as part of its monitoring of that water body. DEQ contracted with Western Watershed Analysts of Lewiston, Idaho, to provide flow and bedload data for the main stem SF CWR and Threemile Creek.

Unfortunately, flows in Threemile Creek and Butcher Creek over the sample period were below the level where significant bedload moved or could be sampled. Therefore, bedload for these streams is estimated from the sediment budget. Similarly, for the year when the contractor was to sample bedload in the upper main stem SF CWR, flows did not allow the bedload to be sampled. The result is that sampled bedload data exist only for the Stites and Harpster sites.

Other TSS and turbidity data exist for the SF CWR Subbasin, but come from such diverse locations and time periods as to make them difficult to use for a subbasin-wide analysis. DEQ collected turbidity and flow data for a number of streams in the SF CWR Subbasin (Thomas 1991) and these data provide a comparison for the results of the calculations. The NPNF collected TSS, turbidity, and flow data at the Mt. Idaho bridge from 1988-1992, analyzed these data, and extrapolated them using the data from Thomas (1991). These results were used to help validate the results from the 1991-2001 time frame of the analyses. Sediment yield curves are developed from the TSS and bedload data. The data and sediment yield curves for the Threemile, Butcher, Stites, and Harpster sites are presented in Appendix

M. The sediment yield curves for each site are presented in the summary sediment loading calculations Tables 48 through 51.

Estimates of Existing Sediment Loads

Regulations allow that loadings "…may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading," (Water quality planning and management, 40 CFR 130.2(I)). An estimate must be made for each point source. Nonpoint sources are typically estimated based on the type of sources (land use) and area (such as a subwatershed), but may be aggregated by type of source or land area. To the extent possible, background loads should be distinguished from human-caused increase in nonpoint loads.

Point Sources

Existing sediment loads from the point sources in the SF CWR Subbasin are presented in Table 52

Table 52. Sediment loads from point sources in the SF CWR Subbasin.

Facility	NPDES Permit[a]	Design Flow (MGD)[b]	Current Monthly TSS Permit Limit (mg/L)[c]	Current TSS Concentra-tion (mg/L)[d]	Current TSS Load (t/y)[d]
Kooskia Wastewater Treatment Plant	ID-002181-4	0.20	70	34	4.3
Grangeville Wastewater Treatment Plant	ID-002003-6	0.88	30	11	12.3
Elk City Wastewater Treatment Plant	ID-002201-2	0.12	70	21.6	1.5
Stites Wastewater Treatment Plant	ID-002034-6	0.07	70	45.6	3.0
Red River Ranger Station Wastewater Treatment Plant	ID-002069-9	0.0063	30	5.0	0.08
Storm water Sources	None currently	NA	None currently	Data not available	Data not available
Suction Dredge Industry	None currently	NA	None currently	Data not available	Unknown (see discussion)

[a] National Pollution Discharge Elimination Permit number
[b] million gallons per day
[c] TSS = total suspended solids, mg/L – milligrams per liter
[d] Based on data from March 1999 through February 2002, t/y = tons per year

Estimates of loading from WWTPs are averages based on flow and TSS monitoring data collected by each facility and reported to USEPA in monthly discharge monitoring reports for the period from March 1999 through February 2002.

Estimates for storm water and suction dredging are not available due to the lack of monitoring data from which to quantify annual loads. As explained in Section 3.1, sediment loading from these sources is expected to be minor when compared to nonpoint sources of sediment.

Nonpoint Sources

For Threemile Creek, Butcher Creek, and the Stites location on the lower main stem SF CWR, sediment loads are calculated from in-stream TSS and bedload data. The TSS and bedload yield curves (Appendix M) were coupled with daily flow data in a spreadsheet to predict TSS loads and bedloads on a daily basis. The average daily TSS sediment loads in mg/L were then converted to tons of sediment per day and tons of sediment per year. Average daily NTUs were calculated from a similarly developed relationship. The summaries of these results for the Threemile, Butcher, Stites, and Harpster locations are presented in Tables 48 through 51.

For the water bodies above Harpster, estimates of existing nonpoint source sediment loads are from the sediment budget presented in Appendix L. Table 30 in Section 3.1 summarizes the results from Appendix L. The TSS-based method for the downstream water bodies and the sediment budget-based method for the upstream water bodies are quite different and produce results that should only be compared in light of the different methods. When compared, the results of the two methods compare reasonably well, lending confidence to both methods.

Table 53 shows the total nonpoint source sediment load, the background sediment load, and the human-caused sediment load for each control location. Both methods include assessments of which parts of the loads are human-caused and which parts are estimated background loads. Each number is the sum of all the sediment yields upstream from that control location. Human-caused sediment is the total sediment load minus the background sediment load.

Table 53. Estimated cumulative sediment loads from nonpoint sources in the SF CWR Subbasin.[a]

Water Body Name	Water Body ID	Control Location	Total Load (ton/year)	Background Load (ton/year)	Human-Caused Load (ton/year)
Lower SF CWR	1	Stites Bridge	38,157	8,439	29,718
Threemile Creek	10	Mouth	1,112	97	1,015
Butcher Creek	11	Mouth	441	106	335
Mid-Lower SF CWR	12	Harpster Bridge	20,622	14,856	5,736
Middle SF CWR	22	Above Johns Creek	11,185	8,898	2,297
Mid-Upper SF CWR	30	Above Tenmile Creek	7,827	5,993	1,835
Upper SF CWR	36	Above Crooked River	4,527	3,279	1,248

[a] Loads presented for these sites are cumulative of all areas upstream of the control location. Loads for water bodies 1, 10, and 11 are total suspended solids loads, while loads for water bodies 12, 22, 30, and 36 are total sediment loads, calculated using different methods.

Estimates of Background Sediment Loading

The background sediment loading for each of the control locations in the subbasin (Table 53) is calculated from background loading rates for each of the water bodies or rates for groupings of water bodies. Background sediment loading was developed from the sediment budget (Appendix L). The background ratio for each control location was calculated using the routed background erosion for all areas upstream of the control location divided by the total tons of sediment routed from a watershed. The background loads in Table 53 are cumulative for all the water bodies upstream from the control locations.

Background erosion rates have been developed for all federally managed watersheds and range from 16 to 90 tons per square mile per year. After reviewing the range of background figures from the federally-managed lands, background figures used in other TMDLs, erosion studies at Washington State University, predictions by the RUSLE model, and best professional judgement, a background erosion rate of 30 tons per square mile per year was assigned for the non-federal lands. The routing coefficient was that used by the NPNF to route sediment using the NEZSED model (Roehl 1962) and that used throughout the sediment budget calculations in this TMDL. The background ratios developed from the sediment budget for the Threemile, Butcher, Stites, and Harpster sites are presented Tables 48 through 51.

For the Threemile, Butcher, and Stites locations, the amount of daily load that is attributed to background was calculated by multiplying the daily load by the background ratio. This results in different background loads depending on flow, as would be expected naturally, as higher flows naturally would have resulted in greater movement of sediment. For the control

locations upstream from Butcher Creek, including the Harpster site, the background loading rate is simply the yearly rate based on the sums from the sediment budget.

Results for the Stites, Threemile, and Butcher locations are not directly comparable to those of the other four water bodies because of different methods used for the calculations. This is especially noticeable in the background loads shown in Table 53. The background load for Stites would be approximately 20,000 t/y if calculated from the sediment budget, and the total sediment load would be in the range of 90,000 t/y if calculated from the sediment budget (the TSS-based estimates for Stites are 8,439 t/y background load and 38,157 t/y total load [Table 53]). This magnitude of difference between the TSS-based calculations and the sediment budget-based calculations is noticeable throughout these sediment loading calculations. Part of the difference is that TSS-based estimates do not include bedload, whereas the sediment budget does. More importantly, however, current sediment routing models do not adequately account for sediment storage in a watershed. The sediment budget adds up eroded sediment from numerous sources, but does not adequately account for where that sediment goes once detached from its location. It is likely that much more of it is being stored in floodplains, low slope areas, and other locations than is being moved through the active waterways.

Sediment Load Capacity

The goal of the sediment TMDLs is to achieve both the numeric turbidity standard and the narrative sediment standard. Calculations of the fine sediment load capacities needed to achieve the numeric turbidity WQS relate the turbidity to TSS levels at the Threemile, Butcher, Stites, Harpster, and Mt. Idaho monitoring locations. The fine sediment load capacity calculations are based on daily flow records coupled with sediment yield curves developed from TSS and bedload monitoring data collected at these sites. The load capacity for Cottonwood Creek as it empties into the SF CWR is quoted from the Cottonwood Creek TMDL (DEQ, NPT, USEPA 2000).

Total suspended solids sediment load capacity and excess load capacity were calculated based on the Idaho WQS of “turbidity … shall not exceed background turbidity by more than fifty NTU instantaneously or more than twenty-five NTU for more than ten consecutive days.” (IDAPA 58.01.02.250.02.d) Plots of the sediment loadings at Threemile Creek and Butcher Creek showed that turbidity is elevated for periods of considerably greater than 10 days. Loading calculations are based, therefore, on the 25 NTU above background WQS. As sediment loading reductions are accomplished, using this standard to make the loading calculations will result in a large MOS for loading reductions as turbidity begins to be reduced to less than 10 consecutive days of exceedances.

The load capacity was calculated based on the relationship between turbidity in NTUs and the TSS in milligrams per liter, resulting in a calculation of the amount of TSS in milligrams per liter that 25 NTUs from the state WQS represents. For example, in Threemile Creek, 25 NTUs is equivalent to 17 mg/L TSS. For each day then, the load capacity is the 17 mg/L plus the percentage of the load that is background. Since the background load varies with flow, the load capacity varies with flow as well.

The TSS load capacities for five locations are presented in Table 54. However, these numbers are relatively meaningless for loading calculations based on daily flows. They are shown here because they are expected as part of a TMDL. The useful numbers for calculations using the daily flow method are those for excess loading shown in the next section.

Table 54. Total suspended solids (TSS)-based load capacities for water bodies in the lower SF CWR Subbasin.

Water Body Name	Water Body ID	Sampling Location	TSS[a] (t/y)
Lower SF CWR	1	Stites Bridge	68,095
Cottonwood Creek	2	At the mouth	5,110
Threemile Creek	10	At the mouth	366
Butcher Creek	11	At the mouth	261
Mid-lower SF CWR	12	Harpster Bridge	61,631

[a]Based on daily flow calculations summed and averaged for 10 years.

In the absence of a numeric standard for coarse sediment, or any particular knowledge about the level of loading that might impair beneficial uses, the coarse sediment load capacities for these same sites are assumed to be proportional to the total coarse sediment loading for the lower main stem, or about 7%. This is consistent with USGS data for the Clearwater River indicating that bedload is in the range of 5-10% of total sediment load (Jones and Seitz 1980).

The load capacity for the five lower water bodies is dependant on flow on a day-to-day basis, or even hour-to-hour basis for extremely flashy streams like Threemile and Butcher Creeks. In general, the highest load capacities occur during the highest flows, which occur episodically January through May. The load capacities in Table 54 are based on load capacities calculated on a daily basis and averaged over 10 years to arrive at a yearly rate. Since on most days the existing load is less than the load capacity, the average load capacity may be far greater than the existing load over a year. However, load capacity exceedances also occur on a daily basis and when these are summed and averaged, load exceedances summed over a year occur even when yearly average load capacity is greater than yearly average existing load.

A good example of this can be found in the data set for Stites. The average annual load at Stites is about 38,000 t/y (Table 53). The average annual load capacity at Stites is 69,000 t/y (Table 54). However, the average annual load exceedance at Stites is about 7,500 t/y because there are days of high flow and heavy erosion every year when the actual loading on a daily basis exceeds the load capacity. It is during these few days of extreme high flows, such as the 1996 events, when excess loading adds up significantly. These are the sediment loading events that really exceed the capacity of the system to handle sediment, and these are the events that need to be managed for if sediment in the SF CWR system is to be reduced to meet WQS.

Figure 70 shows the variability of load capacity over the 10-year period that these calculations were based on. Also in Figure 70 is an associated graph for each one of the three sites showing the load capacity in more detail, for two years..

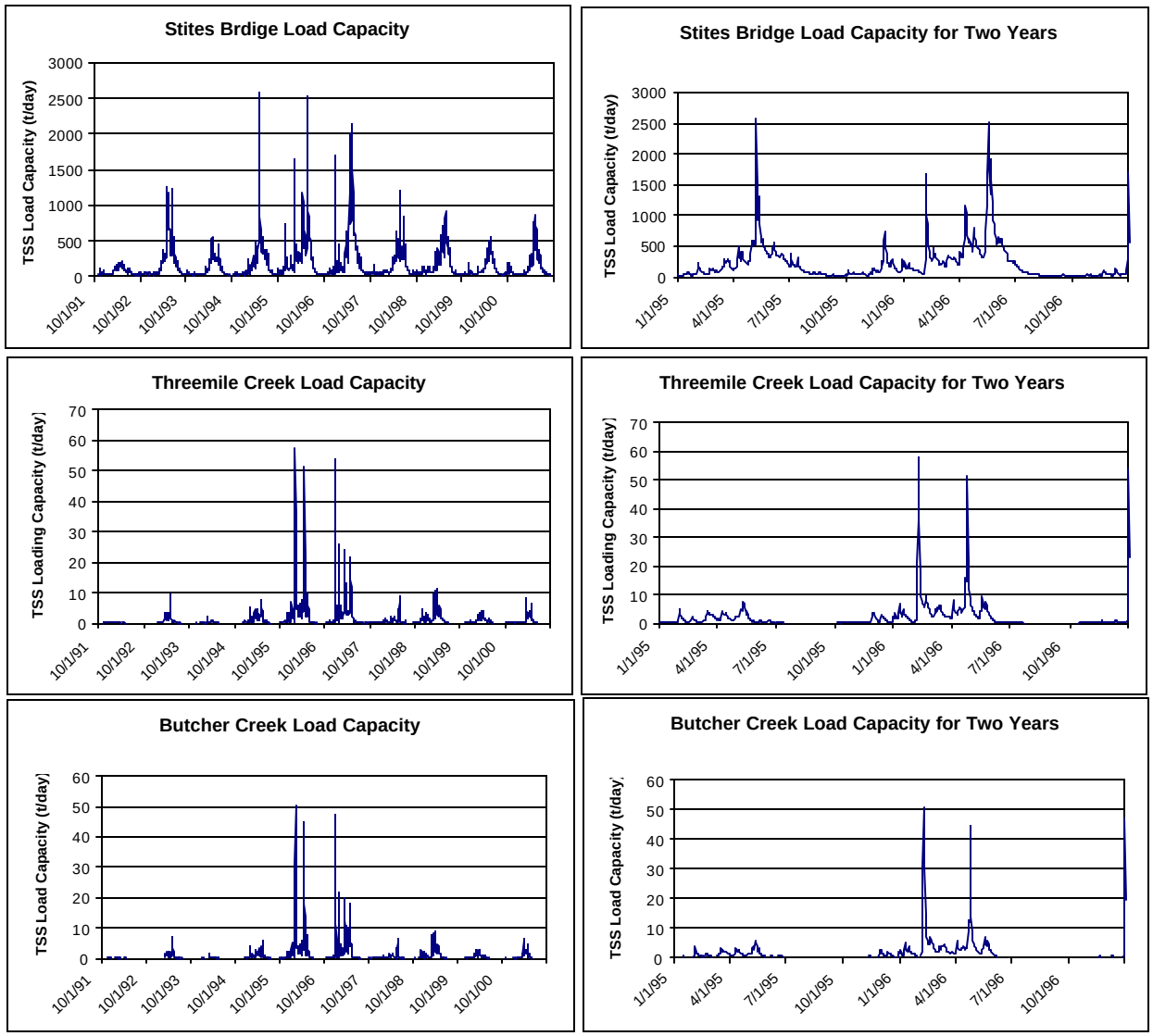


Figure 70. Average Daily Total Suspended Solids (TSS) Load Capacities for the Stites Site on the SF CWR, Threemile Creek, and Butcher Creek

Upstream from the mouth of Butcher Creek (water body #12 and upstream), from the control location called the Harpster site, load capacities are calculated in a different manner based on the available data. Below Harpster, load capacities were calculated on a daily basis, but above Harpster, they were calculated on an annual basis. The daily and annual load capacities are not very comparable. Above the Mt. Idaho bridge, TSS and flow coupled data for the rest the subbasin are not adequate to support making estimates of daily loading and daily loading exceedances. The private bridge above Harpster was set as the control location for the entire subbasin above the confluence of Butcher Creek with the main stem because it is a good sampling site.

Upstream from Harpster we do not differentiate between fine and coarse sediment. Nez Perce National Forest data show that bedload may represent anywhere from 2% to 60% of the total loading from any particular stream, depending on watershed area, geology, and stream type (Gloss 1995). Therefore, load capacity is based on total sediment load, with the assumption that load reductions will result in both fine and coarse sediment loading reductions proportional to the total load.

Lacking specific in-stream data to calculate load capacities for the 303(d) listed water bodies, load capacities are calculated based on the sediment budget and the target load reduction. For example, the load capacity for the control location on the main stem SF CWR above the mouth of Johns Creek is calculated from sum of total sediment for all the water bodies above Johns Creek (water bodies #22-79) minus 25% of the sum of the human-caused sediment for the same set of water bodies. This change from in-stream sediment estimates to sediment source estimates is partially justified by the fact that estimates of human caused in-stream and sediment sources at the Harpster control location are essentially equal, in the 19,000-20,000 t/y range. The NPNF came up with similar figures (16,100 t/y) with their analyses of NEZSED data (Kenny 1995) for the area above the Mt. Idaho bridge. The NPNF calculations did not include estimates for in-stream erosion, highway sediment, mining, or mass failures.

The loading capacities for the 303(d) listed water bodies above Harpster/Butcher Creek are presented in Table 55. Again, these numbers are not directly comparable to the numbers in Table 54 above because different calculation methods were used. The numbers in Table 55 are truly annually based, rather than daily data averaged over a year (Table 54). The load capacity at Harpster calculated using the sediment budget method is 19,180 t/day, vs. the 62,000 t/day shown in Table 54. The difference is as discussed above for the example at Stites. Numbers calculated for the table below (Table 55) correspond better to the conceptual framework for TMDL loading calculations presented earlier.

Excess Loading

Excess loading occurs when the current loading is greater than the load capacity. Excess loading on a daily basis is the current load minus the load capacity. The excess loads addressed by the TMDLs for Threemile Creek, Butcher Creek, and the Stites site are shown

Table 55. Total sediment loading capacity of water bodies in the upper SF CWR Subbasin.

Water Body Name	Water Body ID	Control Location	Load Capacity (t/y)
Mid-lower SF CWR (Johns Cr. to Butcher Cr.)	12	Harpster Bridge	19,180
Middle SF CWR (Tenmile Cr. to Johns Cr.)	22	Above mouth of Johns Cr.	10,621
Mid-upper SF CWR (Crooked R. to Tenmile Cr.)	30	Above mouth of Tenmile Cr.	7,369
Upper SF CWR (Confluence to Crooked R.)	36	Above mouth of Crooked R.	4,215

in Figures 71, 72, and 73. The first figure in each of these sets of figures shows the distribution and magnitude of excess loads over the10 years used in the calculations, and the subsequent figure shows more detail of only two years of those same data. The figures show that excess loading only occurs over short time frames, the same time frames as high flows, and that the episodes of excess loading are limited to January through May each year.

The excess load is summed over the 10 years of data and divided by 10 to calculate an average amount of excess loading on a yearly basis. When this figure is divided by the average annual human-caused TSS yield, the result is the percent reduction of human-caused TSS needed for a given water body. The summaries of these calculations are presented in Tables 48 through 51 and Table 56. These calculations indicate that significant load reductions in TSS are needed for Threemile Creek, Butcher Creek, and for the main stem SF CWR at Stites.

Table 56. Total suspended solids (TSS) excess loading for water bodies in the lower SF CWR Subbasin.

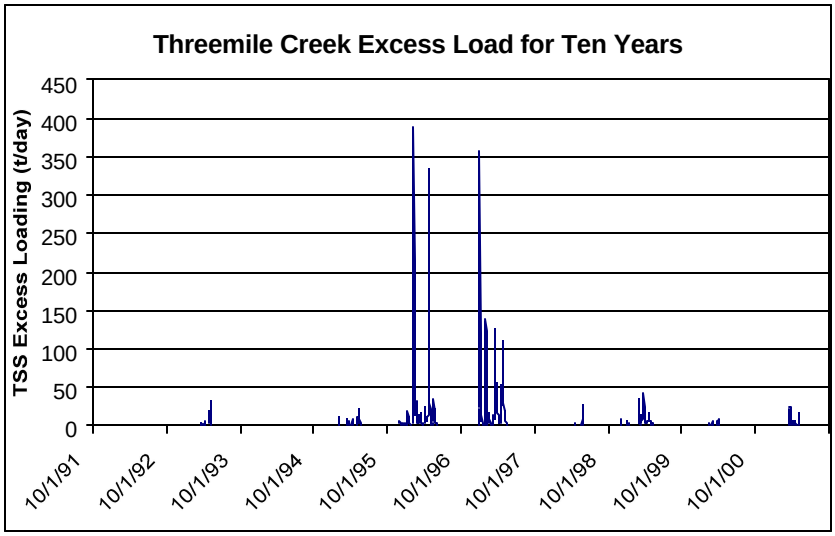
Water Body Name	Water Body ID	Control Location	Human Caused Loading (t/y)	Excess TSS Loading[a] (t/y)	Excess TSS Loading (%)
Lower SF CWR	1	Stites Bridge	29,718	7,574	25
Threemile Creek	10	At the mouth	1,015	780	77
Butcher Creek	11	At the mouth	335	203	61
Mid-lower SF CWR	12	Harpster Bridge	4,632	0	0

[a]Based on daily flow calculations summed and averaged for 10 years.

One could subtract the excess TSS loading from the human caused loading to arrive at another sort of estimate of load capacity on an annual basis. However, based on the daily

flow and loading approach used in these calculations, that figure does not have much meaning.

These data indicate that TSS does not exceed that state WQS at Harpster. However, application of the narrative standard, as discussed in Chapter 2, results in a conclusion that the four main stem water bodies above Butcher Creek are impaired by coarse sediment. For lack of any other data, the excess load for these water bodies is set at the 25% excess load calculated for the Stites location.



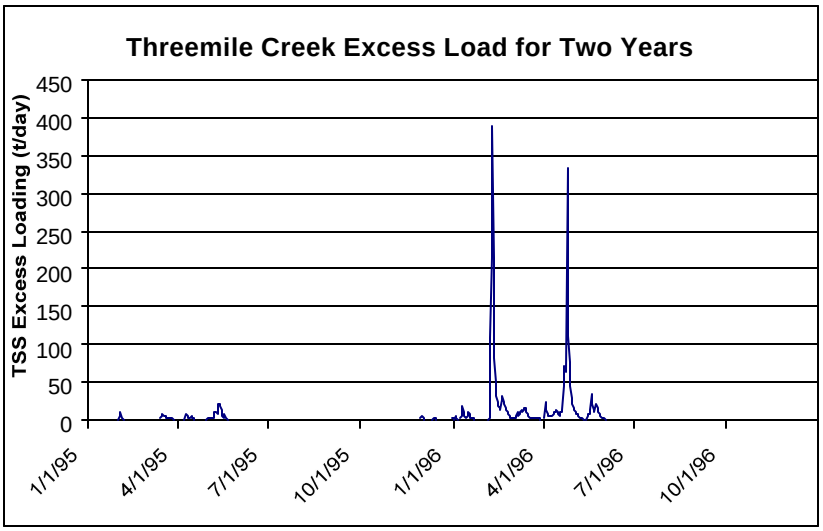
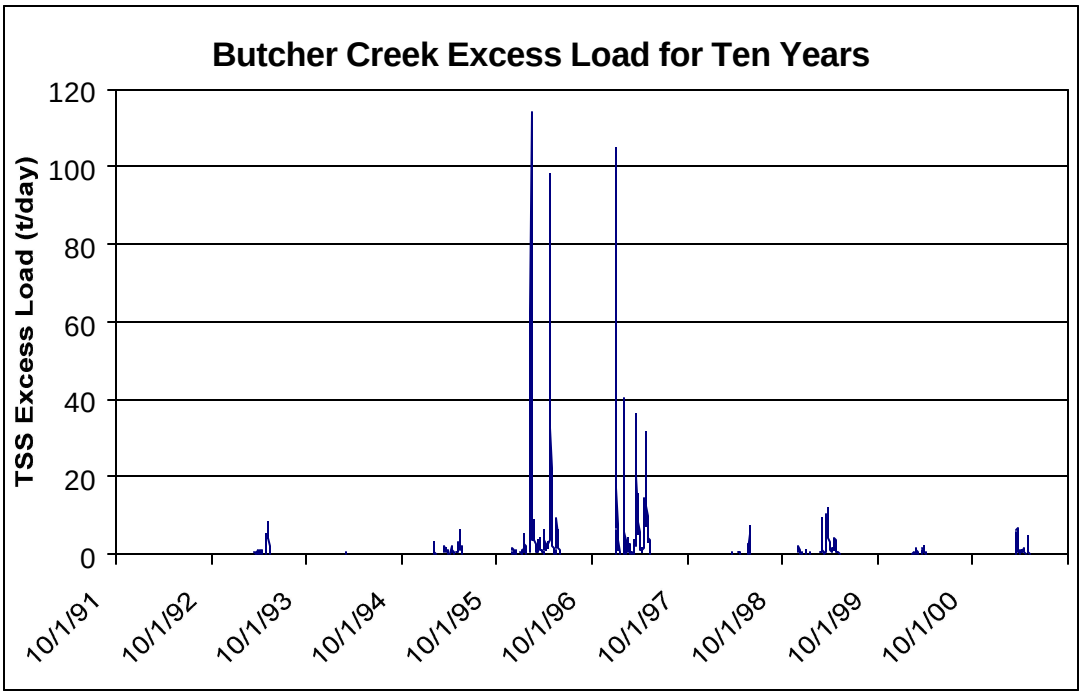


Figure 71. Excess Sediment Loading for Threemile Creek



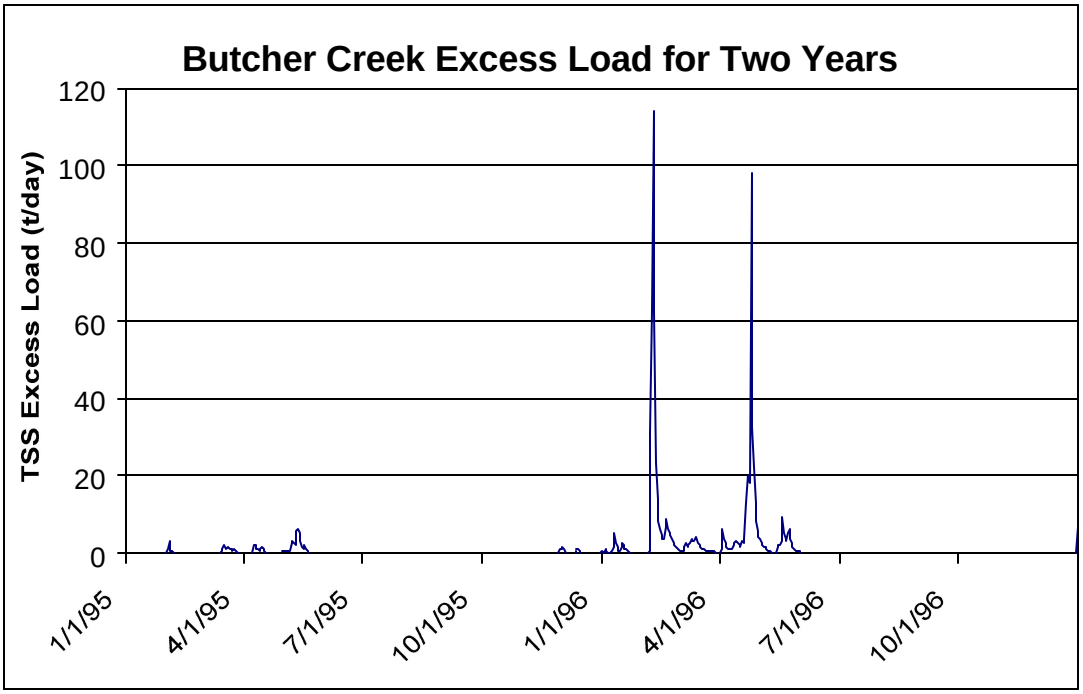
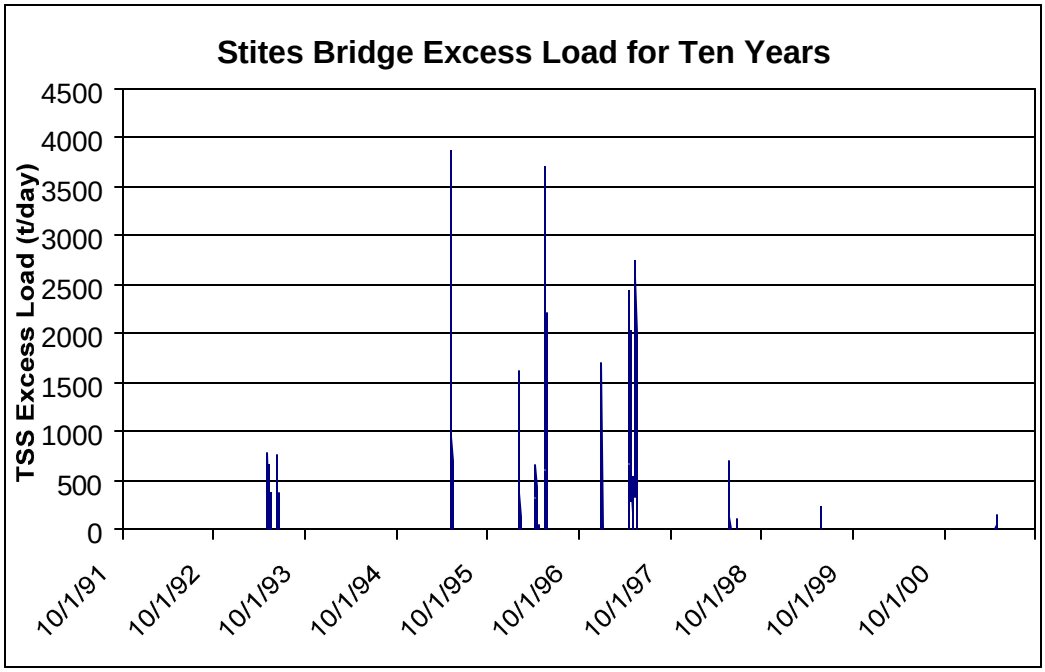


Figure 72. Excess Sediment Loading for Butcher Creek



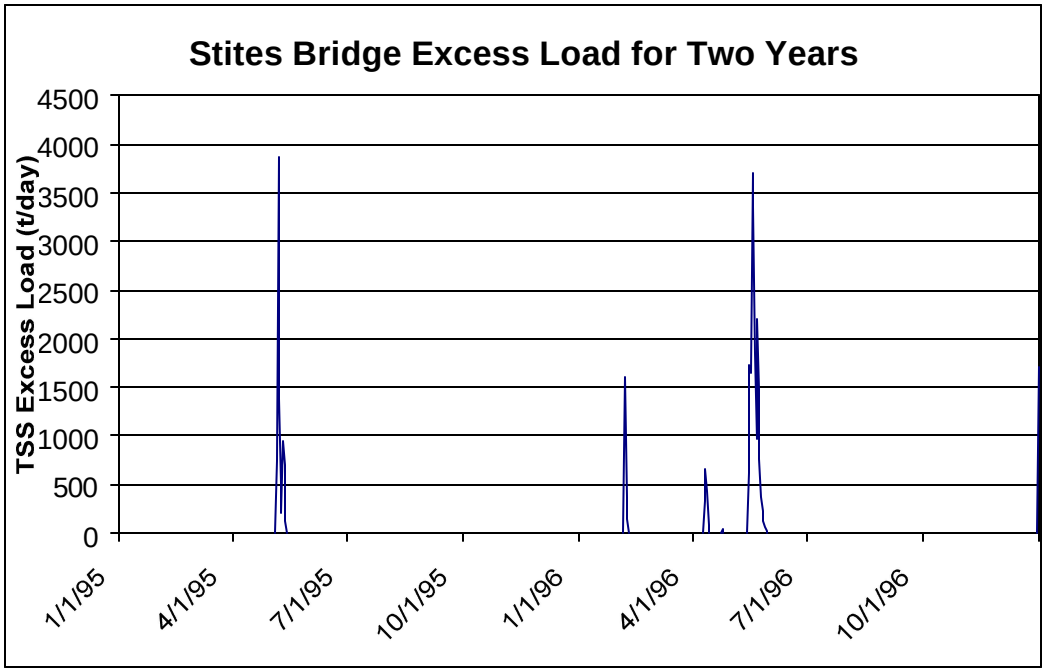


Figure 73. Excess Sediment Loading at Stites

Margin of Safety

Loading calculations using 25 NTU over background as the WQS above which loading is treated as an exceedance results in a significant MOS. As sediment reduction activities proceed to the point where the 25 NTU over background loadings no longer exceed 10 days, the standard becomes 50 NTU over background. All exceedance loading calculations for nonpoint source sediment in these TMDLs have this MOS built into them. Therefore, no further load allocation to MOS has been built into the TMDLs.

For example, at Stites, the 25 NTU over background for more than 10 days standard has only been exceeded during one event during the last 10 years. So, one can conclude that the Stites location is close to the threshold where the 50 NTU over background standard should be in effect. Using the 50 NTU over background standard in the same calculations as above, the excess load at Stites is only 3,578 t/y, compared to 9,356 t/y at 25 NTU, and the percent load reduction required would be 9% compared to 25%. Similar calculations could be done for Threemile Creek and Butcher Creek. However, the point is that use of the 25 NTU over background as the basis for the loading calculations provides a very large MOS in the loading calculations. The use of the 25 NTU standard in the loading calculations is justified because that is the standard that should be applied for the current situation, but as compliance with the TMDL is accomplished, the 50 NTU over background standard likely will become the appropriate standard.

Seasonal Variation

Calculations for sediment TMDLs of the SF CWR Subbasin have focused on the seasonality and episodic nature of sediment loading to the 303(d) water bodies. Clearly, almost all of the loading occurs between January and May (Figures 71, 72 and 73), but more importantly, the problem loadings occur during extreme, five-year (or longer) recurring episodic events. These episodic events are not predictable by nature, they have been accounted for by running the calculations over a 10-year period. An examination of the flow regime data indicated that a 10-year time frame for the calculations was adequate to capture the effects of these major sediment-producing episodes.

Sediment Load Allocations

Sediment loading in the SF CWR Subbasin is dominated by nonpoint sources. A number of nonpoint sources have been identified, coming from lands with a number of different owners and management agencies. While sediment from point sources is relatively insignificant in the overall picture of the subbasin, WLAs are set for the purposes of NPDES permitting.

Wasteload Allocations for Wastewater Treatment Plants.

As can be seen by comparing WWTP sediment loading in Table 57 with total sediment loading in the various watersheds in Table 58, WWTPs contribute only a very minor amount to the overall sediment loading, so it is not necessary to require load reductions from these facilities. Currently permitted facilities include the Kooskia, Stites, Grangeville, Elk City,

and Red River Ranger Station WWTPs. Federal technology standards outlined in 40 CFR 133.105 (Treatment Equivalent to Secondary Treatment) apply to facilities treating domestic sewage, and vary based on the type of treatment process used by that facility. For those facilities using stabilization ponds/lagoons (i.e., Kooskia, Stites, Elk City, and Red River Ranger Station), federal regulations specify monthly and weekly average TSS limits of 45 and 65 mg/L respectively. For other treatment types (i.e., Grangeville), the monthly and weekly average TSS limits are 30 and 45 mg/L respectively.

The state of Idaho also has technology standards for facilities that treat domestic sewage using stabilization ponds/lagoons of 70 and 105 mg/L as monthly and weekly averages, respectively. These limits have not been approved by USEPA, and therefore the federal requirements specified above apply.

In the case of Red River Ranger Station, federal regulations that address anti-backsliding prohibit new effluent limits from being less stringent than previous limits in an NPDES permit. The previous and current limits in the NPDES permit are 30 and 45 mg/L TSS as monthly and weekly averages. Therefore, the Red River Ranger Station limits must remain at 30 and 45 mg/L. After reviewing effluent data from Red River Ranger Station, the facility appears to be meeting the current limits.

Wasteload allocations for the Kooskia, Stites, Elk City, and Grangeville WWTPs will be the technology based TSS limits described above. The Red River Ranger Station WWTP's WLA will be based on the current NPDES limits and anti-backsliding provision (Table 57).

Wasteload Allocations for Storm Water Discharge.

Since storm water sources subject to NPDES permit requirements are not considered to be significant components of the anthropogenic sediment load (Section 3.1), yet are considered point sources when and if they occur, a single WLA for both the industrial and construction categories has been established. This WLA is general in nature, covering both industrial and construction categories of storm water discharges, rather than being category-specific.

The overall goal of the sediment TMDL in the mid-lower watershed, where most industrial and/or construction storm water discharges are likely to exist, is to achieve Idaho's 25 NTU above background turbidity criteria (50 NTU above background instantaneous)(IDAPA 58.01.02.250.02.d.). Therefore, the allocation for regulated industrial/construction storm water discharges is compliance with this turbidity criteria, or compliance with appropriate BMPs to control sediment as required by the applicable NPDES storm water permit. It is recognized that monitoring compliance with a turbidity allocation may be difficult or impossible. As a result, if during the course of applying for NPDES permit coverage, it is determined to be infeasible to conduct compliance monitoring for any facility, the allocation is to be interpreted to be the installation of appropriate storm water BMPs in lieu of monitoring and achieving the turbidity allocation.

Storm water sources that are not subject to NPDES permit requirements, including all municipal sources of storm water, are included within the general load allocation for nonpoint sources.

Wasteload Allocations for Suction Dredge Mining.

Due to the inability to establish a quantitative daily or annual sediment load for individual suction dredgers, or the industry as a whole, allocations must be based on other measures. Turbidity is a parameter that can be measured easily and reliably in the field and directly relates to the water column impacts of suction dredges, as well as to Idaho WQS. Therefore, a turbidity-based allocation will be established for the suction dredge operations discharging to waters of the United States in the upper SF CWR Subbasin.

The allocation is based on treatment requirements for point sources in the Idaho WQS (IDAPA 58.01.02.401.03.b). In essence, the standard requires that turbidity below any applicable mixing zone must not exceed background turbidity by more than 5 NTU or by more than 10% if background turbidity is 50 NTU or higher.

A turbidity-based allocation does not relate directly to excessive bedload movement that may be triggered by the operation. The effectiveness of the allocation in controlling bedload related problems is contingent upon several other factors. To ensure that the allocation effectively prevents all adverse sediment impacts from suction dredging, additional requirements to implement the WLA are as follows:

- Each facility should comply with all applicable permitting processes, including those of IDWR, USFS, BLM, ACOE, etc., which include important operational considerations to minimize substrate problems.
- Until information is available from which to evaluate the impacts of larger dredges, it is recommended that only dredges of 5 inches or less and 15 horsepower or less be permitted.
- The number of operations permitted to operate in the upper SF CWR Subbasin should not substantially exceed the number that have operated in recent years. It is recommended that no more than 15 operations be permitted annually until it can be established that the operation of a greater number of facilities will not impair beneficial uses or otherwise violate Idaho WQS.
- The location of permitted facilities should be such that mixing zones do not overlap, in order to avoid localized excessive impacts from suspended and bedload sediment mobilized by these operations.

It is expected that implementation of this allocation in this manner will adequately protect against effects from TSS and bedload which could violate the numeric turbidity criteria and narrative sediment criteria.

Suction dredge mining has historically occurred in the upper SF CWR and tributaries. Accordingly, the WLA will be established for the entire SF CWR watershed above the Harpster Bridge, including tributaries.

Wasteload Allocations for Other Point Sources.

No other point sources are known to exist within the SF CWR Subbasin. However, another category of point sources common in neighboring areas is CAFOs. If these facilities harbor enough animals under the right conditions, as spelled out in 40 CFR 122.23(b)(2), they are considered to be point sources. Federal regulations at 40 CFR 412, 413, and 415 prohibit discharge to surface water from these facilities, except under extreme climatic events. Given that discharge is not allowed from these facilities, and that it is possible that some of these operations may be established in the subbasin in the future, a WLA of zero is established for this industry as a whole.

Table 57. Sediment wasteload allocations for the SF CWR Subbasin.

Facility[a]	NPDES Permit Number	Design Flow (MGD)[b]	Wasteload Allocation[c]		
			Monthly Average TSS Concentration (mg/L)	Weekly Average TSS Concentration (mg/L)	Annual TSS Load (t/y)
Kooskia WWTP	ID-002181-4	0.20	45	60	13.7
Grangeville WWTP	ID-002003-6	0.88	30	45	40.3
Elk City WWTP	ID-002201-2	0.12	45	60	8.2
Stites WWTP	ID-002034-6	0.07	45	60	4.8
Red River Ranger Station WWTP	ID-002069-9	0.0063	30	45	0.29
Storm Water	None currently	NA	Turbidity shall not exceed background turbidity by more than 50 NTU instantaneously or by more than 25 NTU for more than 10 consecutive days. Appropriate BMPs should be implemented to control sediment if monitoring is determined to be infeasible.		
Recreational Suction Dredge Industry (<u>≤ 5 inch nozzle</u>)	None currently	<u>SF Clearwater River above Harpster Bridge, including tributaries[d,e,f]:</u> July 15 – August 15: - Turbidity shall not exceed background turbidity by more than 5 NTU when background turbidity is 50 NTU or less, and - Turbidity shall not exceed background turbidity by more than 10% when background turbidity is more than 50 NTU, and shall not to exceed a maximum increase of 25 NTU. August 16 – July 14: - Zero wasteload allocation <u>SF Clearwater River below Harpster Bridge:</u> - Zero wasteload allocation			
Suction Dredge Industry (> 5 inch nozzle)	None currently	<u>Zero wasteload allocation</u>			
CAFOs	None currently	<u>Zero wasteload allocation</u>			

[a] WWTP = wastewater treatment plant, CAFO = confined animal feeding operation
[b] MGD = million gallons per day
[c] TSS = total suspended solids, mg/L = milligrams per liter, t/y = tons per year, NTU = nephlometric turbidity unit, BMP = best management practice
[d] Each facility should comply with all other applicable permitting processes, including those of the Idaho Department of Water Resources, U.S. Forest Service, Bureau of Land Management, Army Corps of Engineers, etc., which include important operational considerations to minimize substrate problems.
[e] The number of operations permitted to operate in the upper SF CWR Subbasin should not substantially exceed the number which have operated in recent years. It is recommended that no more than 15 operations be permitted annually until it can be established that the operation of a greater number of facilities will not impair beneficial uses or otherwise violate Idaho water quality standards.
[f] The location of permitted facilities should be such that mixing zones do not overlap, in order to avoid localized excessive impacts from suspended and bedload sediment mobilized by these operations.

Nonpoint Source Sediment Load Allocations

The excess load of nonpoint source sediment in Table 58 is calculated using the two methods discussed above. The excess loads for the Stites, Threemile Creek, and Butcher Creek control locations are based on TSS daily loading calculations, while the excess loads for Harpster and upstream are based on yearly loading calculations from the sediment budget. In the case of the daily calculations, those days when the existing load exceeds the daily load capacity are summed and averaged over the 10 years. For Harpster and above, the excess load is calculated by subtracting the yearly background load from the load capacity and comparing the result to the activity load. For Harpster and above the load capacity was fixed based on the current activity load and the percent load reduction needed at Stites (the pour point for the basin). The discussion used to justify the 25% load reduction for all water bodies above Stites is presented in Appendix M, Loading Calculations.

Table 58. Sediment load allocations for nonpoint sources in the SF CWR Subbasin.[a]

Water Body Name	Water Body ID	Control Location	Total Load (t/y)[b]	Background Load (t/y)[b]	Human Caused Load (t/y)[b]	Excess Load (t/y)[b]	Target Load (t/y)[b]	Load Reduction (%)
Lower SF CWR	1	Stites Bridge	38,157	8,439	29,718	7,754	21,964	25
Threemile Creek	10	Mouth	1,112	97	1,015	780	235	77
Butcher Creek	11	Mouth	441	106	335	203	132	61
Mid-Lower SF CWR	12	Harpster Bridge	20,622	14,856	5,736	1,434	4,302	25
Middle SF CWR	22	Above Johns Creek	11,185	8,898	2,297	574	1,723	25
Mid-Upper SF CWR	30	Above Tenmile Creek	7,827	5,993	1,835	456	1,379	25
Upper SF CWR	36	Above Crooked River	4,527	3,279	1,248	312	936	25

[a] Loads presented for these sites are cumulative of all areas upstream of the control location. Loads for water bodies 1, 10, and 11 are total suspended solids loads, while loads for water bodies 12, 22, 30, and 36 are total sediment loads.

[b] t/y = tons per year

Reasonable Assurance

Reasonable assurance of the implementation of nonpoint source control actions is required in a TMDL when point source WLAs are made less restrictive as a result of expected reductions from nonpoint source allocations. Where there are not reasonable assurances, the entire load reduction must be assigned to point sources (USEPA 1991). Wasteload allocations in this sediment TMDL are not less restrictive than current NPDES limits, and in the case of the Kooskia, Elk City, and Stites WWTPs, are more restrictive than current effluent limits (45 mg/L TSS monthly average WLA vs. 70 mg/L TSS current monthly average limit). In addition, as pointed out above, point source loading compared to the overall load capacity is very minor: approximately 0.3 % of the load capacity at Stites. As a result, assigning the entire load reduction to point sources would result in essentially no improvement in sediment conditions in the SF CWR. For these reasons, reasonable assurance of nonpoint source control actions is not relevant to this TMDL.

Nonetheless, for forested areas in the SF CWR Subbasin, water quality problems caused by nonpoint sources of sediment are improving as a result of work by land managers, federal policies, and the Idaho's FPA. There is no reason to expect that the trend will not continue. The TMDLs identify areas of highest sediment input and should allow for prioritization of where further work needs to be done.

In the agricultural and grazing areas of the subbasin, no-till and minimum-till farming have been making an impact in the Cottonwood drainage, and there is reason to expect that farmers in the Threemile and Butcher Creek watersheds will adopt these practices as well. Similarly, there are programs being put in place by the Soil Conservation Commission (SCC)to limit livestock access to stream sides, which would allow vegetation to regrow along the streams. The Idaho Department of Agriculture has an active program working with CAFOs to eliminate water pollution from these operations.

Implementation Strategies

Implementation of the sediment TMDLs would be most efficient if it were based on the data that went into developing the TMDLs. Since implementation will be the responsibility of the WAG, numerous land managers, and various agencies, it seems reasonable to stratify the SF CWR Subbasin based on the data sets used to develop the TMDL. This should help in making decisions regarding implementation. The following is a list of data sets used in the TMDLs, and the agencies that could monitor them as implementation proceeds:

- Threemile and Butcher Creeks
  - Percent Eroding Banks
    - SCC, Soil and Water Conservation District (SWCD), NRCS, NPT
  - RUSLE model for changed farming practices
    - SCC, SWCD, NRCS
  - Road Erosion Buffering
    - ITD, Road District
- Main Stem SF CWR

In-Channel Habitat Conditions
NPT, NPNF, BLM
Highway Gravel
ITD
Percent Eroding Stream Banks
NPNF, BLM, SWCD, SCC, NRCS
NEZSED model results to track forest activity sediment reductions
NPNF, BLM

Since the sediment budget for the upper basin indicates that sediment is coming from numerous sources, it is expected that implementation of sediment reductions will come from throughout the upper basin as well.

Nonpoint source sediment load reductions are divided for each of the control locations by ownership (Table 58) and land use (Table 60). This division of loading to ownership and land use is informational in nature. As implementation progresses, actual sediment reductions may be accomplished in any number of ways at the 9discretion of the implementing landowners, managers, and agencies. In Table 61, methods are described by which implementation results could be measured.

Monitoring of sediment reduction for any land use or ownership, or just general sediment reduction, should be designed to measure either against the TSS-based targets or the sediment load-based targets. Since it is expected that most implementation will be planned and monitored against the sediment load-based targets, implementing agencies should be responsible for collecting data to track progress, as identified above.

The land has been divided by ownership: NPNF, BLM, the state (state highway), Idaho County (county roads), and private individuals. Small amounts of land owned by the NPT and IDL are too small to be broken out. Generally, the loading division by ownership used the following scheme: all RUSLE results were identified as private; all WEPP results were identified as county roads; mass failures were divided between the NPNF and private based on locations in the GIS, since we had no data that any occurred on BLM land; in-stream erosion results were divided between the NPNF, BLM, and private based on locations; and NEZSED results were divided between NPNF, BLM, and private based on percentage of ownership.

Land use is divided into forestry, grazing, county roads, state highway, in-stream erosion, and agriculture. An estimation is made for Cottonwood Creek based on the Cottonwood Creek TMDL (DEQ, NPT, USEPA 2000). The result is that total percentages for Stites do not equal 100% because of the different estimation methods used in the different TMDLs.

Table 59. Sediment excess loads by land ownership in the SF CWR Subbasin.

Location	Ownership[a]	Percentage (%)[b]	Human-Caused Load (ton/year)	Excess Load (ton/year)
Stites[c]	All	100	29,718	7,754
	NPNF	68	2,009	618
	State Highway	NA	1,151	288
	County Roads	NA	516	129
	BLM	2	250	63
	Private	12	11,006	2,752
	Cottonwood TMDL[d]	16	22,300	15,660
Threemile Creek[c]	All	100	1,015	780
	County Roads	NA	134	95
	Private	100	881	685
Butcher Creek[c]	All	100	335	203
	Private	97	325	197
	County Roads	NA	111	51
	BLM	1	6	3
Harpster (Johns Creek to Threemile Creek)[e]	All	100	5,736	1,434
	NPNF	72	1,658	415
	State Highway	NA	1,151	288
	County Roads	NA	98	25
	BLM	3	135	34
	Private	24	2,792	698
Tenmile Creek to Johns Creek[e]	All	100	2,297	574
	NPNF	76	1,168	292
	State Highway	NA	630	156
	BLM	6	135	34
	Private	17	306	77
Crooked River to Tenmile Creek[e]	All	100	1,835	459
	NPNF	73	1,003	251
	State Highway	NA	375	94
	BLM	6	135	34
	Private	19	301	75
Confluence to Crooked River[e]	All	100	1,248	312
	NPNF	66	708	177
	State Highway	NA	114	29
	BLM	8	135	34
	Private	25	284	71

[a] NPNF = Nez Perce National Forest, BLM = Bureau of Land Management

[b] Percentages for Stites do not equal 100% because of different estimation methods used in the Cottonwood Creek TMDL; other percentages do not all equal 100% due to rounding

[c] Total suspended solids (TSS)-based loading calculations

[d] Derived from the Cottonwood Creek TMDL

[e] Sediment budget-based calculations

Table 60. Sediment excess loads by land use in the SF CWR Subbasin.

Location	Land Use	Percentage (%)[a]	Human-Caused Load (ton/year)	Excess Load (ton/year)
Stites[b]	All	100	29,718	7,574
	Agriculture	23	6,835	1,742
	Grazing	3	891	227
	Forestry	5	1,486	379
	In-stream Erosion	2	594	151
	County Roads	1	297	72
	State Highway	3	891	227
	Cottonwood TMDL[c]	75	22,300	15,660
Threemile Creek[b]	All	100	1,015	780
	Agriculture	50	508	390
	Grazing	9	91	70
	Forestry	14	142	109
	County Roads	6	61	47
	In-stream Erosion	19	193	148
Butcher Creek[b]	All	100	335	203
	Agriculture	45	151	91
	Forestry	14	47	28
	Grazing	18	60	37
	County Roads	11	37	22
	In-stream Erosion	13	44	26
Harpster (Johns Creek to Threemile Creek)[d]	All	100	5,736	1,434
	Agriculture	3	144	36
	Forestry	57	3,285	821
	Grazing	11	653	164
	County Roads	2	98	25
	State Highway	20	1,151	288
	In-stream Erosion	7	405	101
Tenmile Creek to Johns Creek[d]	All	100	2,297	574
	Forestry	54	1,227	307
	Grazing	3	65	16
	State Highway	27	630	156
	In-stream Erosion	16	376	94
Crooked River to Tenmile Creek[d]	All	100	1,835	459
	Forestry	57	1,030	258
	Grazing	3	53	13
	State Highway	20	375	94
	In-stream Erosion	20	376	94
Confluence to Crooked River[d]	All	100	1,248	312
	Forestry	59	740	185
	Grazing	13	163	41
	State Highway	9	114	29
	In-stream Erosion	19	231	58

[a] Percentages for Stites do not equal 100% because of different estimation methods used in the Cottonwood Creek TMDL; other percentages do not all equal 100% due to rounding

[b] Total suspended solids (TSS)-based loading calculations

[c] Derived from the Cottonwood Creek TMDL

[d] Sediment budget-based calculations

For each of the control locations, one to several types of data are identified to monitor whether control measures are being put in place. Table 61 presents the targets for the different data types for the areas upstream from each of the control locations. The targets are the cumulative sediment from all portions of the subbasin upstream from the control locations. The current condition and targets are set based on the data type. As noted several times above, where both TSS and sediment budget methods of calculating the sediment loading are used, the sum of the different targets do not add to the total sediment load target at any particular control location.

Table 61. Sediment load targets by data type in the SF CWR Subbasin.

Location of Control Point	Data Type	Target Type[a]	Current Condition[b]	Target[b]
Stites[c]	Sediment Load	TSS tons/year	29,718	22,144
	Cottonwood TMDL[d]	TSS tons/year	22,300	6,640
Threemile Creek[c] (mouth)	Sediment Load	TSS tons/year	1,015	235
	In-stream Erosion Model	Tons/year	357	103
	RUSLE Model (ag and grazing)	Tons/year	5,632	1,633
	WEPP Model (roads)	Tons/year	134	39
Butcher Creek[c] (mouth)	Sediment Load	TSS tons/year	335	132
	RUSLE Model (ag and grazing)	Tons/year	723	390
	WEPP Model (roads)	Tons/year	111	60
	In-stream Erosion Model	Tons/year	131	71
Johns Creek to Threemile Creek[e] (Harpster Bridge)	Sediment Load	Tons/year	5,736	4,302
	RUSLE Model (ag and grazing)	Tons/year	2,268	1,701
	NEZSED (forestry and grazing)	Tons/year	1,439	1,079
	Highway Gravel	Tons/year	1,151	863
	In-stream Erosion Model	Tons/year	405	304
Tenmile Creek to Johns Creek[e]	Sediment Load	Tons/year	2,297	1,723
	NEZSED (forestry and grazing)	Tons/year	1,292	969
	Highway Gravel	Tons/year	630	474
Crooked River To Tenmile Creek[e]	Sediment Load	Tons/year	1,835	1,376
	NEZSED (forestry and grazing)	Tons/year	1,083	812
	Highway Gravel	Tons/year	375	281
	In-stream Erosion Model	Tons/year	376	282
Confluence to Crooked River[e]	Sediment Load	Tons/year	1,248	936
	NEZSED (forestry and grazing)	Tons/year	903	677
	Highway Gravel	Tons/year	114	85
	In-stream Erosion Model	Tons/year	231	173

[a] TSS = total suspended solids

[b] All numbers for the control locations on the main stem are cumulative for all areas upstream

[c] Total suspended sediment (TSS)-based loading calculations

[d] Derived from the Cottonwood Creek TMDL

[e] Sediment budget-based calculations