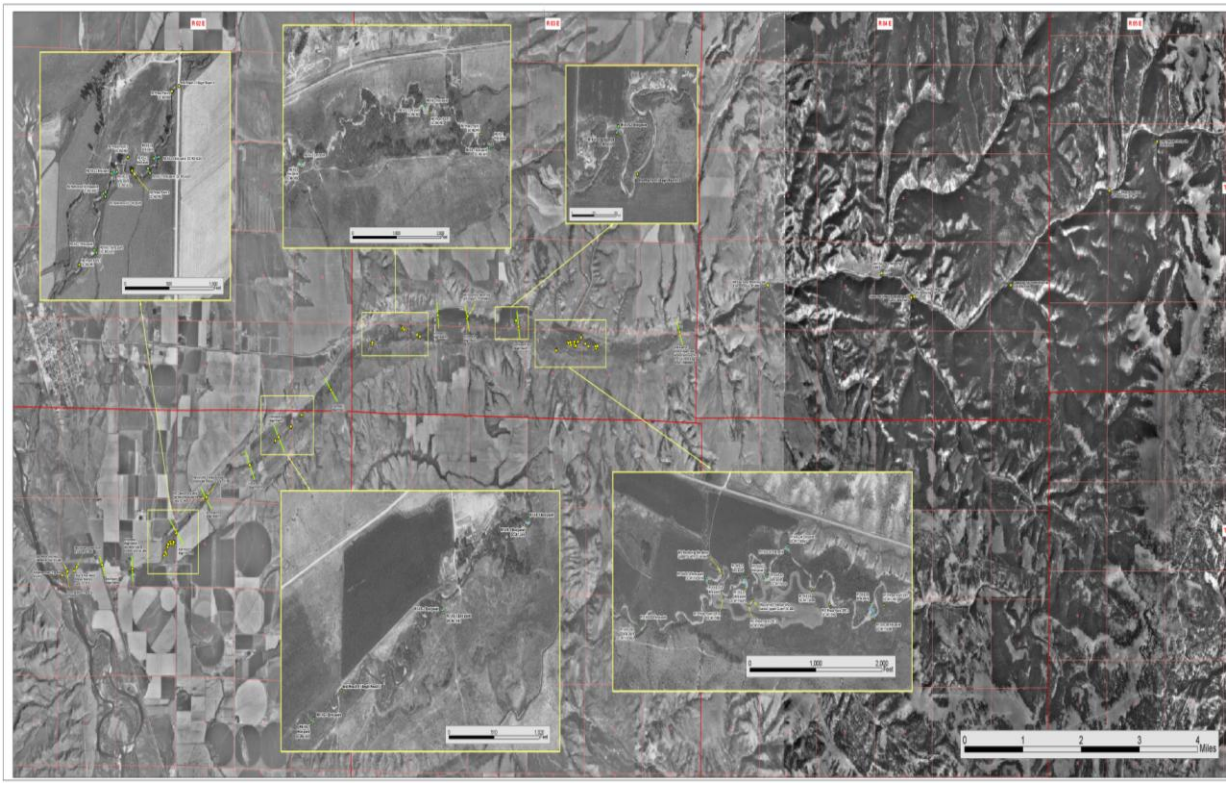
Montana Department of
ENVIRONMENTAL QUALITY

Deep Creek TMDL Implementation Evaluation



Aerial Photo of Deep Creek, near Townsend, Montana

November 2011

Brian Schweitzer, Governor
Richard Opper, Director DEQ

WQPBWPSER-003

Prepared by:
Water Quality Planning Bureau
Watershed Protection Section

Contributors:
Water Quality Planning Bureau
Water Quality Standards Section
Watershed Management Section

Montana Department of Environmental Quality
Water Quality Planning Bureau
1520 E. Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901

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ABSTRACT

The Deep Creek TMDL Implementation Evaluation (Deep Creek TIE or Evaluation) summarizes restoration and monitoring efforts to address identified water quality concerns since TMDL completion. The Broadwater Conservation District and the local Fish, Wildlife and Parks fisheries biologist are core members of an informal watershed group leading Deep Creek watershed restoration activities. A series of TMDL recommended sediment reduction practices, primarily riparian fencing and stream bank modification/revegetation, were completed in the middle sections of Deep Creek, above Clopton Lane, between 1997 and 2003. Since year 2004, there have been scattered watershed restoration activities, including recent Highway 12 improvement work, and local infrastructure protection and local bank restoration efforts. Since 2004, little systematic water quality monitoring has been completed.

Current conditions in Deep Creek indicate insufficient restoration progress has been achieved to warrant a reassessment of fishery and aquatic life beneficial use support. On-going and accelerated implementation of the existing voluntary reasonable land soil and water conservation practices are necessary to: reduce fine sediment production, increase woody vegetative to stabilize banks, increase pool depths, and routinely flush instream fine sediments. Two DEQ related sediment TMDL planning activities are recommended in this evaluation. It is recommended to update the TMDL sediment targets to reflect current DEQ methods, and to conduct an assessment of sediment loading sources. This evaluation also recommends that DEQ conduct a temperature standards assessment.

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ACRONYMS

Acronym	Definition
BLM	Bureau of Land Management (federal)
BMP	Best Management Practices
CWAIC	Clean Water Act Information Center (DEQ)
DEQ	Department of Environmental Quality (Montana)
EA	Environmental Assessment
EC	Electrical Conductance or Electrical Conductivity
EPA	Environmental Protection Agency (US)
FRS	Facility Registry System
HUC	Hydrologic Unit Code
MCA	Montana Codes Annotated
MDT	Montana Department of Transportation
PPA	Planning, Prevention and Assistance (DEQ)
SAR	Sodium Absorption Ratio
TIE	TMDL Implementation Evaluation
TMDL	Total Maximum Daily Load
TPA	TMDL Planning Area
TSS	Total Suspended Solids
WQPB	Water Quality Planning Bureau (DEQ)
WRP	Watershed Restoration Plans

EXECUTIVE SUMMARY

The document **"Development of a TMDL to Reduce Nonpoint Source Sediment Pollution in Deep Creek, Montana"** by the Montana Department of Environmental Quality (Montana Department of Environmental Quality, 1996) was completed in March 1996 and approved by EPA on October 16, 1997. This Deep Creek Implementation Evaluation (Deep Creek TIE or Evaluation) summarizes restoration and monitoring efforts to address identified water quality concerns since TMDL completion. The Broadwater Conservation District and the local Fish, Wildlife and Parks fisheries biologist are core members of an informal watershed group leading Deep Creek watershed restoration activities.

The TMDL identifies two causes of impairment currently on the state's list of impaired waters is sedimentation and dewatering, with the sediment TMDL addressing sediment problems. Impairment sources are identified as bank erosion, lack of riparian vegetation, and irrigation diversions. The Deep Creek TMDL restoration targets and goals address all restoration concerns, not only those linked to sediment. Targets focus on reducing instream fine sediment by increasing woody riparian vegetation, decreasing bank erosion, increasing suitable aquatic habitat (i.e. trout spawning and population recruitment), reducing summer dewatering, and decreasing peak summer water temperatures.

A series of TMDL recommended sediment reduction practices, primarily riparian fencing and streambank modification/revegetation, were completed in the middle sections of Deep Creek, above Clopton Lane, between 1997 and 2003. These restoration activities within the middle sections of Deep Creek reduced poor bank condition from 56% of all banks to 9% by year 2004. Approximately 50% of these bank improvements have degraded, resulting in current bank conditions similar to overall un-restored stream sections. Little restoration work or condition improvement has occurred in lower sections of Deep Creek. Since year 2004, there have been scattered watershed restoration activities, including recent Highway 12 improvement work, and local infrastructure protection and local bank restoration efforts. Recent flood flows have prompted increasing numbers of 310 and 401 permit requests to protect streamside infrastructure such as roads, bridges, irrigation diversion sites, and fields. Since the TMDL was approved, little systematic water quality monitoring has been completed.

Two DEQ related sediment TMDL planning activities recommended in this evaluation are to update the TMDL sediment targets to reflect current DEQ methods, and to conduct an assessment of sediment loading sources. This evaluation also recommends that DEQ conduct a temperature standards assessment. The TMDL sediment target update and temperature assessment recommendations could be conducted as part of the upcoming Canyon Ferry TMDL.

Current conditions in Deep Creek indicate insufficient restoration progress has been achieved to warrant a reassessment of fishery and aquatic life beneficial use support. On-going and accelerated implementation of the existing voluntary reasonable land soil and water conservation practices are necessary to: reduce fine sediment production, increase woody vegetative to stabilize banks, increase pool depths, and routinely flush instream fine sediments.

1.0 BACKGROUND

Deep Creek, a major tributary of the Missouri River, is located in central Broadwater County near Townsend, Montana and has a drainage area of 87.7 square miles. The watershed topography ranges

from steeply wooded slopes in the Helena National Forest portions of the eastern upper watershed to the flat irrigated farmlands along the Missouri River floodplain. The Deep Creek TMDL (Total Maximum Daily Loads) applies to the middle and lower sections of Deep Creek, specifically the lower 20.4 miles of the stream below the National Forest boundary.

The 1997 Deep Creek TMDL identifies the following pollution causes of concern:

- Sediment/Siltation. This is the only cause of impairment linked to a listed pollutant and therefore sediment is the only TMDL that DEQ recognizes within the original Deep Creek document.
- Low Flow Alterations. This form of pollution is not a pollutant and therefore does not have a TMDL developed for it; nevertheless the TMDL incorporates a restoration approach that includes problem identification and restoration consistent with the sediment TMDL approach.
- The document also identifies summer water temperature concerns.

The TMDL document identifies the main sources causing sediment and low flow impairments as:

- Loss of riparian habitat
- Streambank modifications/destabilization
- Flow alterations from water diversions or shoreline modification/destabilization

According to an inventory completed in 1993, approximately 9% (9,100 feet) of Deep Creek stream channel length has been lost since 1955, based on a survey of 106,000 feet of channel. Loss of stream sinuosity has increased stream hydraulic energy and led to increased channel steepness, bank erosion and downcutting in four of the lower five stream sections. Channel sinuosity losses are attributed to stream channelization and meander losses from bank erosion, and exacerbated by ongoing removal of woody riparian vegetation. The lower portions of Deep Creek (stream sections 4 and 5 on either side of the BM siphon located from stream mile 2.9 to 4.5) have the lowest sinuosity and most notable channel steepness. Surveys in the early 1990's determined that a total of 33,072 ft (6.3 miles or 33%) of the lower 19 miles of streambanks were actively eroding. Inventories of eroding banks show elevated eroding banks in these lower stream sections within the Missouri River floodplains where reference condition include high stream sinuosity and low bank erosion. These conditions create other impacts in the lower sections of Deep Creek, including lowering of the groundwater table, highly incised channels, and the inability of high flow events to effectively disperse into historic floodplains. These downcut channels also have difficulty sustaining protective woody riparian vegetation due to the lowered groundwater table.

Most of the watershed restoration activities in Deep Creek were conducted following TMDL development in 1996 and continuing through 2004. Restoration work in the upper sections of Deep Creek included riparian woody vegetation plantings, channel bank re-sloping, and sediment reduction work along Highway 12. These vegetation and channel sloping restoration efforts treated approximately 9,800 feet of the upper section's 11,800 feet of eroding banks.

2.0 TMDL-RECOMMENDED ACTIVITIES

The TMDL document recommends stream reach-specific restoration activities to address the sediment concerns in the Deep Creek TMDL. The reach-specific recommendations are summarized below:
Reach 1 (beginning at mouth on the Missouri River) - Riparian livestock fencing and bank restoration

Reach 2 - Increasing width of riparian area, bank shaping and willow plantings ("riparian BMPs") for incised channel with eroding banks
Reach 3 - Increase channel length, bank restoration and irrigation operation improvements for deeply incised channel banks with high erosion
Reach 4 – Increase channel length, riparian BMPs and willow plantings for incised channel with eroding banks (Broadwater-Missouri (B-M) Canal crossing)
Reach 5 - Increase channel length, riparian BMPs and willow plantings for incised channel with eroding banks
Reach 6 - Riparian BMPs and willow plantings for incised channel with eroding banks
Reach 7 - Protect existing channel meanders with riparian BMPs and willow plantings
Reach 8 - Riparian livestock fencing, protect existing channel meanders with riparian BMPs and willow plantings, increase channel length
Reach 9 - Riparian BMPs and willow plantings (Clopton Lane)
Reach 10 - Riparian BMPs and willow plantings for several incised and eroded banks (Lippert Gulch)
Reach 11 - Riparian BMPs and willow plantings for eroding banks

The TMDL document recommends the following types of monitoring activities:

- Riparian monitoring by landowners through the use of a questionnaire developed by the Montana Riparian Association.
- TSS concentrations and discharge through spring runoff
- Monitor water temperature. In addition to the site at Montana Ditch, temperature should be monitored throughout the 11 reaches.
- Substrate sediment cores
- Channel morphology transects
- Photopoints
- Spawning fish counts at the Montana Ditch siphon trap
- Rapid Bioassessment

3.0 INDICATORS OF PROGRESS

Indicators of progress towards achieving Deep Creek TMDL document targets and additional restoration goals generally fall into one of three major categories: Restoration, Monitoring, and Planning.

3.1 RESTORATION

- **Sediment: eroding banks** - Notable bank erosion work, approximately 18,500 feet of bank reshaping, vegetative plantings and riparian fencing, were accomplished between 1990 and 2003 to restore the nearly 33,100 feet of eroding banks (year 1992 stream data). This bank sloping and revegetation work has been countered by ongoing bank erosion and flood events (approximately 55% of inventoried restored banks have failed or are failing according to Montana Department of Fish, Wildlife, and Parks (Spoon, 2010). The 2011 floods were a major channel defining event with substantial bank scour and channel movement. This event increased the amount of eroded banks and has prompted increased irrigation and road protection activities. Other than Highway 12 sediment reduction work in 2009 and vegetative soil-lifts constructed in 2011, there is little recent restoration work on sediment sources.

- **Dewatering** – No progress identified

- **Temperature** – No progress identified

3.2 MONITORING

Monitoring data compiled in year 2003 and 2004 (Hydrotech Water Resource Consultants, 2004) indicate the following instream targets and conditions:

- TMDL target of slope of discharge versus TSS regression ratio (at Montana Ditch site) is < 0.26 in 4 of 5 years. This target was not achieved over any 5 year period of record (average of 2.30 between 1995 and 2003 (Hydrotech Water Resource Consultants, 2004).
- TMDL target of decreasing total eroding banks by 50% (from approximately 15% stream total to TMDL target of approximately 7%). An early 1990's estimate of eroding bank lengths totaled about 33,000 linear feet. Current estimates for the TMDL section of Deep Creek are not available. Inventories for Clopton Lane to Lippert Gulch bank restoration work indicate that of the 4,023 feet of the banks restored by year 2003, approximately 2,220 feet (55%) have failed (Spoon, 2010).
- TMDL target is to restore 25% of the stream channel length lost since 1955. The increase of 2,275 feet of channel would be accomplished through re-establishing meanders and channel sinuosity. Current estimates of stream channel length are not available.
- TMDL target of a reduction in sediment fines (<6.35mm) in spawning riffles from 50% to 30%. Current data for fine sediment (McNeil core or pebble counts) are not available.
- TMDL target for sensitive fish population spawning success is 3,000 female trout entering Deep Creek by 2005. This target was not achieved. Montana Fish, Wildlife and Parks observed an average of 941 female trout per year between 1997 and 2003 (Hydrotech Water Resource Consultants, 2004). Recent monitoring of brown trout redds above Clopton Lane in the upper 4 miles of the TMDL show roughly 20% increases in the number of redds between year 2000 and 2010 (Spoon, 2010).
- There has been little instream TMDL target monitoring since 2004.
- An additional target, not specific to the TMDL sediment target, for temperature is that instream summer maximum daily temperatures exceeding 73^{o}F will occur less than 10 days per year (in 4 of 5 years). This target was not achieved over any 5 year period. There were an average of 37 days of exceedances per year between 1998 and 2003 (Hydrotech Water Resource Consultants, 2004).

3.3 PLANNING

The Broadwater Conservation District has led restoration activities between 1996 and 2004. The primary planning framework for watershed restoration work was the Deep Creek TMDL document. The Conservation District led the preparation of a water quality progress report that was completed in year 2004 (Hydrotech Water Resource Consultants, 2004).

4.0 RECOMMENDATIONS FOR ADDITIONAL WORK

- Moderate bank restoration progress was made between years 1990 and 2003, but this progress has been partially offset by ongoing nonpoint sediment increases. There has been little recent coordinated work on historic and current sediment sources. A renewed effort to implement riparian BMPs is needed.

- Past and recent information indicates that a DEQ assessment for temperature standards attainment is needed.
- Several Deep Creek TMDL targets are incompatible with current DEQ assessment methodology. Specifically, the year 2004 Hydrotech Water Resource Consultants report concluded that there is "poor individual year correlation between discharge and TSS" and recommended that "perhaps the project TSS target using slope of regression between TSS and Discharge is no longer valid."
- The TMDL target value for sediment fines less than 6.35 mm in McNeil Core samples is useful, but this target is not expressed as an annual value or an average/median value over a specific multi-year period. A running average for several years is recommended to account for natural inter-annual variation and naturally occurring events such as floods, drought, fire, etc. Evaluating a two-to-five year running median for McNeil core values would smooth out inter-annual variations, more accurately portray data trends, better align with the time scales of trout spawning cycles, and better match the time scale of watershed management planning efforts. Development and implementation of a sediment monitoring program is recommended.
- The year 2004 Hydrotech Water Resource Consultants report recommends that the migrant female trout target be revised to 1,500 females annually. Justification for this recommendation should be explored.

5.0 CONCLUSIONS

- Modest riparian BMPs have been implemented in Deep Creek, with the cumulative effect of this work appearing to be insufficient to significantly improve stream sediment conditions.
- **Appendix A – Conclusions Spreadsheet** provides a detailed explanation of conclusions reached in this Deep Creek TMDL Implementation Evaluation. A brief summary is provided below:
  - Renewed efforts in implementing voluntary reasonable land soil and water conservation practices are necessary.
  - Deep Creek water quality trends are fluctuating, slightly improving or not improving; it is not possible to estimate a time frame to reach water quality standards, due to lack of information, planning and resources.
  - Updating the water quality sediment targets from the 1997 TMDL to be consistent with current DEQ targets would increase monitoring effectiveness and provide appropriate future assessment information.

6.0 SOURCES OF INFORMATION

A variety of information sources were consulted during the preparation of the Deep Creek Implementation Evaluation, including reports, databases, websites, and personal communications. A complete list can be found in **Section 7.0**.

Questions concerning the Deep Creek TMDL Implementation Evaluation should be directed to Robert Ray, Section Manager, Montana DEQ Watershed Protection Section, (406) 444-5319, or rray@mt.gov

7.0 REFERENCES

Hydrotech Water Resource Consultants. 2004. Deep Creek Watershed and Spawning Enhancement Project: 2003 Project Monitoring Report. S.l.: Hydrotech Water Resource Consultants. Report DEQ Contract #203076.

Montana Department of Environmental Quality. 1996. Development of a TMDL to Reduce Nonpoint Source Sediment Pollution in Deep Creek, MT. Helena, MT: Montana Department of Environmental Quality. http://deq.mt.gov/wqinfo/TMDL/pdf/DeepCrk.pdf. Accessed 8/26/11.

Spoon, Ron. 2010. Draft Deep Creek Watershed and Spawning Enhancement Project. Townsend, MT: Montana Department of Fish, Wildlife and Parks.

APPENDIX A – CONCLUSIONS SPREADSHEET

Table A-1. Conclusions

Waterbody Pollutant/Pollution Causes	**Conclusion***	**Justification/Recommendations**
Deep Creek *(National Forest Boundary to Mouth)* Low Flow Alterations	1	- Moderate amounts of riparian bank work has been completed, but the cumulative effects of this work appear to be insufficient in improving temperature particularly in the face of ongoing temperature sources.
Deep Creek *(National Forest Boundary to Mouth)* Sedimentation/ Siltation	1, 3	- Moderate bank restoration progress was made between years 1990 and 2003, but this progress has been offset by ongoing nonpoint sediment increases. Other than recent Highway 12 improvement work, there is very modest recent work on historic and current sediment sources. - The main pollutant/pollution sources include: • Loss of Riparian Habitat • Streambank Modifications/destabilization • Flow Alterations from Water Diversions or shoreline modification/ destabilization - Several TMDL targets are incompatible with current DEQ processes and are recommended for updating. Updating the type(s) of targets from the year TMDL to become consistent with current DEQ targets and target levels would simplify monitoring and progress assessment toward achieving water quality standards - Specifically, a 2004 report concluded that there is "poor individual year correlation between discharge and TSS" suggesting that the "TSS target using slope of regression between TSS and discharge is no longer valid." The TMDL target value for particles less than 6.35 mm in McNeil Core samples is highly useful, but this target is not expressed as an annual value or an average/median value over specific multi-year period target. It is recommended that an inter-annual evaluation period be used to account for natural year to year variations toward synchronizing with natural patterns of variability.

*****Conclusions are limited to the four options described below. Conclusions 1, 2 and 3 are the basic, 5-year review conclusions outlined in 75-5-703(9) MCA. "NA" is used as described below.

1 – The implementation of a new or renewed phase of voluntary reasonable land, soil, and water conservation practice is necessary.

2 – Water quality is improving but a specified time is needed for compliance with water quality standards.

3 – Revisions to the TMDL are necessary to achieve applicable water quality standards.

NA – In these instances, the typical three conclusions are superseded by complicating factors in statute, a lack of sufficient information in order to draw defensible conclusions, or some other circumstance.

APPENDIX B – DEEP CREEK TIE CONCLUSIONS SPREADSHEET

TOTAL MAXIMUM DAILY LOADS FOR THE DEEP CREEK TMDL PLANNING AREA IMPLEMENTATION EVALUATION – 2011

Executive Summary

The Development of a TMDL to Reduce Nonpoint Source Sediment Pollution in Deep Creek, Montana document was completed in March 1996 and approved by EPA in October 1997 (Montana Department of Environmental Quality, 1996). Deep Creek is in Hydrologic Unit Code (HUC) 10030101 – (Upper Missouri watershed) with a Montana water quality classification of B-1. The Deep Creek watershed has been impacted by sedimentation (a pollutant) and dewatering (pollution, and not subject to a TMDL). The details of this waterbody classification are listed in **Table B-1**.

Deep Creek, (waterbody: MT41I002_070) located east of Townsend, Montana, in central Broadwater County, is a notable tributary of the Missouri river, with a drainage area of 87.7 square miles. The length of Deep Creek from the Meagher County line to the confluence with the Missouri River is 24 miles, with the TMDL applying to the lower 20.4 miles of the stream (below the National Forest boundary). The watershed topography ranges from steeply wooded slopes in the Helena National Forest portion of the watershed to near level irrigated farm and ranchlands along the Missouri River floodplain.

The most quantifiable TMDL target is < 30% fines <6.35mm using McNeil core samples. Data gathered through 2004, did not include McNeil cores. Trout populations were estimated as stable to declining (trap year 1997/1998 average females of 1088 declining to the 2002/2003 average of 791) and are below TMDL biological indicator of 3,000. The slope of discharge (cfs) vs. TSS ratio averaged 3.67 in 2002/2003 (above the target of 0.26 in 4 of 5 years) (see **Table B-1**. for details).

Table B-1. Waterbody and Impairment Causes and Sources

Segment Name	Waterbody Number	Length (mi)	Probable Causes	Probable Sources
DEEP CREEK, (National Forest Boundary to mouth (at Missouri River nr. Townsend)	MT41I002_070	20.4	Sedimentation/Siltation Low flow alterations	Loss of Riparian Habitat Streambank Modifications/ destabilization Flow Alterations from Water Diversions or shoreline modification/ destabilization
Implementation of a new or improved phase of voluntary reasonable land soil and water conservation practices is necessary (Y/N)				Y
Water quality is improving but a specified time is needed for compliance with water quality standards (Y/N)				N
Revisions to the TMDL are necessary to achieve applicable water quality standards (Y/N)				Adjustments in target parameters and attainment analyses are warranted

APPENDIX C - TMDLS, TARGETS, AND LOAD/WASTELOAD ALLOCATIONS FROM TMDL TABLE 9

Table C-1. TMDL/Target Summary

Instream Targets for Deep Creek.		**Monitoring Data and Location** (when available)		
Sediment or Temperature Parameter	Target , or Surrogate Measure	Data	Year	Results
Slope of discharge vs. TSS regression (at Montana Ditch site)	Slope of discharge (cfs) vis TSS ratio: < 0.26 in 4 of 5 years	1.58 89 1.42 2.90 0.51 5.09 2.25	1995 1997 1998 1999 2000 2002 2003	Does not achieve target over 5 year period
Daily TSS load during runoff with reference stream (i.e. Sixteen Mile Creek)	TSS not significantly different (than reference stream) in 4 of 5 years		-	Not measured
Riffle sediments	< 30 % Fine sediments < 6.35 mm in substrate cores (McNeil cores)		-	Not measured
Instream Summer Water Temperatures	Maximum daily temperatures exceeding 73 ^{o}F < 10 days in 4 of 5 years	3 days 33 days 42 days 50 days 18 days 56 days	1998 1999 2000 2001 2002 2003	Does not achieve target over 5 year period
Performance-Based Stream Targets for Deep Creek.				
Performance indicator	Channel Stability, Fish Population and Stream Flow Targets	Data	Year	Results
Reestablishment of lost channel length	Channel length – add 2275 feet of channel length (recovering some of 9,100 feet lost since 1955)		-	Not measured
Reducing eroding bank percentages	Percent of erosive banks - Each reach has < 6 to 8 % eroding banks		-	Not measured, scattered indications of 12 to 20 %
Sensitive Spawning Fish Population Success	Number of rainbow trout captured at weir > 3,000 females within 10 years (i.e. by 2007)	730 1038 1139 963 950 917 683 898	Pre-year 1997 1997 1998 1999 2000 2001 2002 2003	Does not achieve performance target
Minimum stream flows	9 cfs Lowest flows measured on Reaches 1-4, 10-11		-	Not measured
Minimum stream flows	3 cfs Lowest flows measured on Reaches 5 – 9		-	Not measured
Load/Wasteload Allocations: No load allocations developed in TMDL – performance-based load reductions called for.				

APPENDIX D - RECOMMENDATIONS

Table D-1. Implementation Review Questions

Course of Action	Y/N	Rationale
I) Implementation of a new or improved phase of voluntary reasonable land soil and water conservation practices is necessary	Y	Moderate bank restoration progress was made between years 1990 and 2003, but this progress has been offset by ongoing nonpoint sediment increases. Other than recent Highway 12 improvement work, there is very modest recent work on historic and current sediment sources.
II) Water quality is improving but a specified time is needed for compliance with water quality standards	N	Water quality indications do not support a trend of notably improving water quality.
III) Revisions to the TMDL are necessary to achieve applicable water quality standards	N	Several TMDL targets are incompatible with current DEQ processes and are recommended to be updated to meet current TMDL target frameworks. Specifically, the 2004 report determined that there is "poor individual year correlation between discharge and TSS" concluding that the "TSS target using slope of regression between TSS and Discharge is no longer valid." The TMDL target value for particles less than 6.35 mm in McNeil Core samples is highly useful, but this target is not expressed as an annual value or an average/median value over specific multi-year period target. It is recommended that an inter-annual evaluation period be used to account for natural year to year variations toward appropriating natural variability patterns. The natural variability associated with floods, drought, and fire, etc. may cause year to year values to fluctuate slightly above and below the target value, which would cause inconsistent year-to-year impairment-non-impairment information, confusing evaluation of TMDL attainment. Evaluating a two to five year running median for McNeil core values would smooth out slight inter-annual variations, more accurately portray data trends, better align with the biological time scale for some biological uses (i.e. trout spawning cycles), and better match the time scale of watershed management planning efforts. The 2004 report also recommended that the performance target migrant female trout be revised to 1,500 female trout annually.
IV) Formal reassessment of one or more of the pollutant/waterbody impairment listings is now recommended	N	The basis for the listings are generally reasonable. A formal assessment for temperature impairment should be pursued.
V) More monitoring data is needed in order to determine whether or not progress has been made towards improving water quality	Y	Very modest ongoing monitoring of instream parameters. Ongoing systematic monitoring would be most helpful. Desirable to revise impairment listing and targets toward more current and focused DEQ parameters and targets. Some limited monitoring activities would help in developing priorities for more sustainable and cost efficient restoration work (i.e. a mini-WRP). Since 2004, most water quality and restoration monitoring has been opportunistic.

Table D-1. Implementation Review Questions

Course of Action	Y/N	Rationale
VI) Work is believed to have been done, but information on the nature and extent of the work is unavailable.	N	
VII) Little or no work has been completed to address one or more pollutant/waterbody combinations	N	Moderate amounts of work have been completed, but the cumulative effects of this work appear to be insufficient in improving sediment and temperature impairments. Recent flood effects are adding new sediment and temperature sources.
Specific Recommendations		
Moderate amounts of work have been completed but the cumulative effects of this work appear to be insufficient in improving sediment and low flow (temperature) causes, particularly in the face of new sediment and temperature sources. Reorganize the low flow listing, the types of targets and possible target levels to be congruent with current DEQ practices.		

APPENDIX E- DEEP CREEK TMDL TARGET SUMMARY FROM DEEP CREEK TMDL TABLE 9.

TMDL targets for Deep Creek. Targets are to be achieved within 5 years of implementation of restoration activities (i.e. by 2009).

Table E-1. Original Parameter Targets for Deep Creek

Parameter	Baseline Condition	Target Condition
Slope of discharge vs. TSS regression at Montana Ditch	0.51	0.26 in 4 of 5 years

Comparison of daily TSS load during spring runoff on Deep Creek with reference stream (i.e. Sixteen Mile Creek) unknown not significantly different in 4 of 5 years.

Table E-2. Original TMDL Targets for Erosive Banks in Deep Creek

Percent of reach consisting of erosive banks		
	Baseline Condition	**Target Condition**
Reach 1	17	8.5
Reach 2	4	2
Reach 3	20	10
Reach 4	14	7
Reach 5	10	5
Reach 6	15	7.5
Reach 7	13	6.5
Reach 8	16	8
Reach 9	12	6
Reach 10	8	4
Reach 11	12	6

Table E-3. Original TMDL Targets for Deep Creek

	Baseline Condition	**Target Condition**
Re-establishment of lost channel length	9,100 feet lost since 1955	add 2,275 feet
Fine sediments < 6.35 mm in substrate cores	50 %	30 %
Number of rainbow trout captured at weir	1,500 females	3,000 females*
Maximum daily temperatures exceeding 73^{o}F	50 days (1994)	≤ 10 days in 4 of 5 years
Lowest flows measured on Reaches 1-4, 10-11	Not available	9 cfs
Lowest flows measured on Reaches 5-9.	Not available	3 cfs

* within 10 years

APPENDIX F – YEAR 2010 DEEP CREEK WATERSHED CONDITION INDICATORS

Excerpts from: Montana Department of Fish, Wildlife, and Parks. 2010. Deep Creek Watershed and Spawning Enhancement Project. December 16, 2010 draft report by Ron Spoon to MFWP Future Fisheries Panel

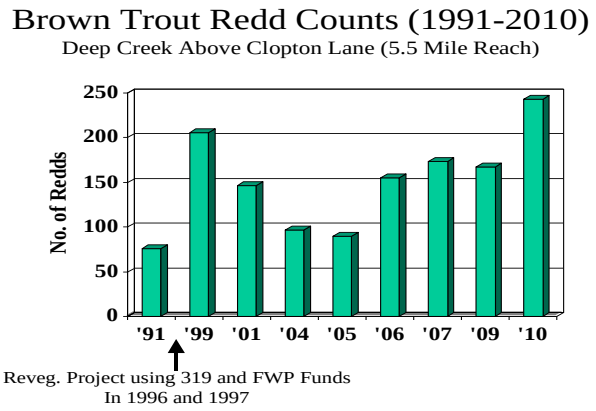

Figure F-1. Brown trout redd counts in Deep Creek above Clopton Lane (1991-2010)

The percentage of eroding bank in the treated area (15%) is similar to the percentage of eroding bank in the control reach (16%) (**Table F-1** and **F-2**).

Table F-1 DEEP CREEK (Clopton Upstream 3.96 Miles) Comparison: 1991-2010

	Total Distance	Eroding Bank 1991	Area Eroded Bank 1991	Length Treated 96-97	Area Treated 96-97	Eroding Bank 2010	Area Eroded Bank 2010
Clopton Lane to Top of Rehab	20909 ft 3.96 miles	11840 ft (56 %)	91512 sq ft	9830 ft	73370 sq ft	3204.75 ft (15 %)	32816.5 sq ft
Top of Rehab to Hwy Xing (no treatment)	8184 ft 1.55 miles	NO SURVEY	NO SURVEY	Not treated	Not treated	16 sites 1345 ft (16%)	16 sites 12370 sq ft

Table F-2 DEEP CREEK Comparison of Erosion in 1991 and 2010

	Total Distance	Eroded Bank 1991	Eroded Bank 2010	Length Treated 1996-97
Clopton Lane to Top of Rehab	20909 ft 3.96 miles	11840 ft (56 %)	3204.75 ft (15 %)	9830 ft (or 5593 ft??) (47 %)
Top of Rehab to Hwy Xing (no treatment)	8184 ft 1.55 miles		16 sites 1345 ft 12370 sq ft	none