Wisconsin Department of Natural Resources
Bureau of Watershed Management

Sediment TMDL for Gills Coulee Creek

INTRODUCTION

Gills Coulee Creek is a tributary stream to the La Crosse River, located in La Crosse County in west central Wisconsin. (Figure A-1) The Wisconsin Department of Natural Resources (WDNR) placed the entire length of Gills Coulee Creek on the state's 303(d) impaired waters list as low priority due to degraded habitat caused by excessive sedimentation. The Clean Water Act and US EPA regulations require that each state develop Total Maximum Daily Loads (TMDLs) for waters on the Section 303(d) list. The purpose of this TMDL is to identify load allocations and management actions that will help restore the biological integrity of the stream.

Waterbody Name	WBIC	TMDL ID	Impaired Stream Miles	Existing Use	Codified Use	Pollutant	Impairment	Priority
Gills Coulee Creek	1652300	168	0-1 1-5	WWFF	Cold II Cold III	Sediment	Degraded Habitat	High

Table 1. Gills Coulee use designations, pollutants, and impairments

PROBLEM STATEMENT

Due to excessive sedimentation, Gills Coulee Creek is currently not meeting applicable **narrative water quality criterion** as defined in NR 102.04 (1); Wisconsin Administrative Code:

"To preserve and enhance the quality of waters, standards are established to govern water management decisions. Practices attributable to municipal, industrial, commercial, domestic, agricultural, land development, or other activities shall be controlled so that all waters including mixing zone and effluent channels meet the following conditions at all times and under all flow conditions:

(a) Substances that will cause objectionable deposits on the shore or in the bed of a body of water, shall not be present in such amounts as to interfere with public rights in waters of the state.

Excessive sedimentation is considered an objectionable deposit.

In addition, Gills Coulee is currently listed as a warm water forage fishery and is not supporting its codified use as a coldwater fish community. The designated uses applicable to this stream are as follows:

S. NR 102.04 (3) intro, (a) and (c), Wisconsin Administrative Code:

"FISH AND OTHER AQUATIC LIFE USES. The department shall classify all surface waters into one of the fish and other aquatic life subcategories described in this subsection. Only those use subcategories identified in pars. (a) to (c) shall be considered suitable for the protection and propagation of a balanced fish and other aquatic life community as provided in federal water pollution control act amendments of 1972, P.L. 92-500; 33 USC 1251 et.seq.

"(a) Cold water communities. This subcategory includes surface waters capable of supporting a community of cold water fish and aquatic life, or serving as a spawning area for cold water fish species. This subcategory includes, but is not restricted to, surface waters identified as trout waters by the department of natural resources (Wisconsin Trout Streams, publication 6-6300 (80))."

"(c) Warm water forage fish communities. This subcategory includes surface waters capable of supporting an abundant diverse community of forage fish and other aquatic life."

GILLS COULEE CREEK

Gills Coulee is a five mile stream in central La Crosse County that flows southeast before reaching the La Crosse River near West Salem, Wisconsin. It has a moderate gradient of 44.4 feet per mile and drains an area of approximately 5.9 square miles. Gills Coulee is codified as a Class III coldwater trout stream from its mouth upstream for one mile, and as a Class II coldwater trout stream for the remaining length (Table A-2). The existing use for Gills Coulee is currently listed as warm water forage fishery (Table A-1).

Land Use	Acres	%
Forest	1957.5	51.00%
Grass	196.2	5.11%
Water	1.8	0.05%
Wetland	6.9	0.18%
Alfalfa	840.7	21.90%
Barren	23.4	0.61%
Corn	541.5	14.11%
Soybeans	270.4	7.05%
Total	3838	100

Table 2. Watershed land use. WISCLAND

Land use in the watershed is dominated by upland forest with steep wooded hills and some lowland pasture and agricultural cropland (Table 2). In many cases agricultural practices occur adjacent to the stream banks, causing immediate sediment runoff to the stream. This is especially evident during high precipitation or snowmelt events.

Habitat surveys dating back to 1972 note severe bank erosion caused by cattle access to the stream. The bank erosion that currently exists is likely a result of past agricultural practices, as more recent watershed surveys did not observe overgrazed pastures. Water chemistry data collected by the La Crosse County Department of Land Conservation (LCD) was compiled and reviewed to characterize water quality conditions at several locations along the stream (Figure A-2). Data collected include grab samples for phosphorus, temperature, and dissolved oxygen, taken between the years of 2003 and 2005. Biological surveys were conducted by WDNR between the years of 1972 to

2004, and include habitat assessments, fish surveys, and macroinvertebrate surveys. (Appendix, Section A-3).

SOURCE ASSESSMENT

Point Sources

There are no point sources located on or discharging to Gills Coulee Creek.

Nonpoint Sources

Two methods were used to assess the nonpoint sources of sediment in the Gills Coulee watershed: the Natural Resources Conservation Service (NRCS) Streambank Erosion Calculation method, and the Revised Universal Soil Loss Equation 2 (RUSLE2). The total sediment load generated from streambank erosion was calculated by determining eroding area, lateral recession rate, and dry density of the soil. Eroding streambank lengths were geo-located using GPS, and corresponding bank heights were measured. Lateral recession rate was determined by assessing digital photography of the measured stream sections and best professional judgment. Dry soil densities used in the calculations were 100 pounds per cubic foot, the average value for silt loam and sandy loam. Silt loam and sandy loam were determined to be the dominant soil types along the stream, according to the NRCS State Soil Geographic (STATSGO) database. Erosion (lbs/yr) was calculated for each landowner by multiplying average annual lateral

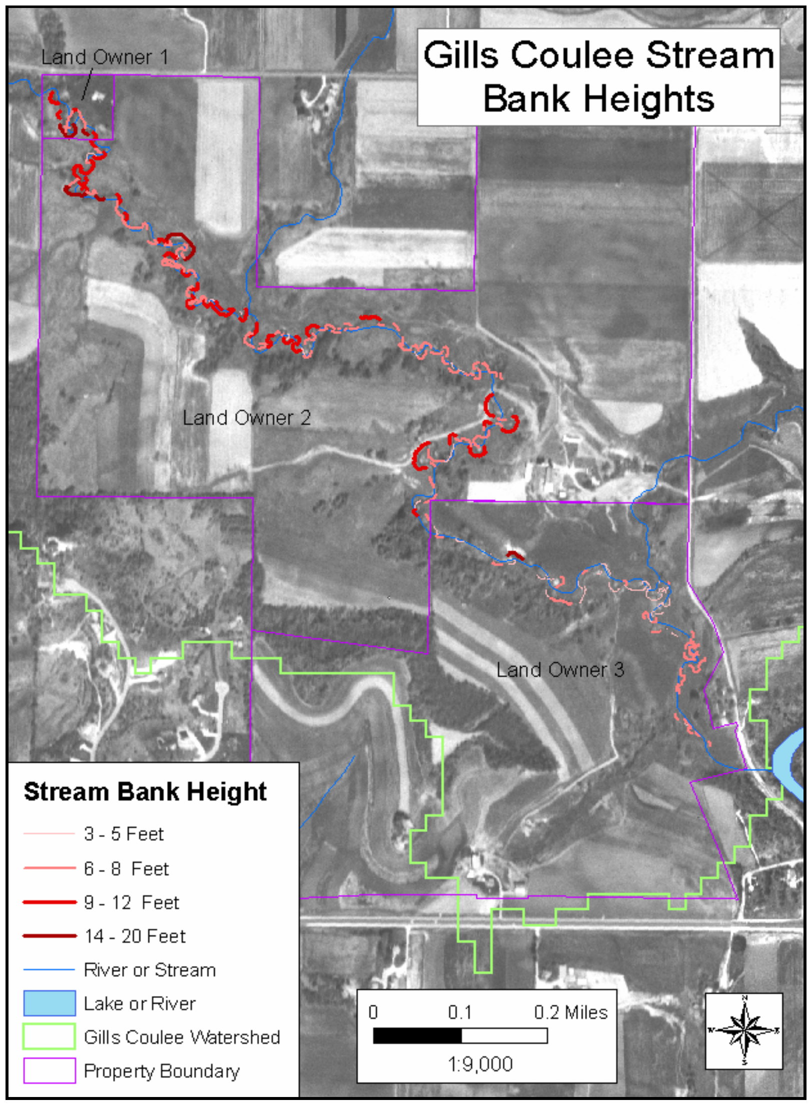

Figure 1. Streambank heights separated by landowner

recession rate, eroding area, and soil bulk density. Existing and target erosion values for each landowner are outlined in Tables B-1 and B-2.

The total existing sediment load contributed to Gill Coulee from streambank erosion is estimated to be 7.1 tons per day. This is an underestimate of what actual erosion rates may be currently because some severely eroded sections assigned rates of 0.5+ feet/year were calculated at a rate of 0.5 feet/year but may in fact be receding at a higher rate.

The target sediment load for eroding streambanks is 0.78 tons per day. Target recession rates were set at 0.05, which falls in the upper end of the NRCS "Slight" erosion category. This category includes "some bare bank but active erosion not readily apparent…some rills but no vegetative overhang…no exposed tree roots". It is expected that once streambanks are stabilized, there will be some naturally occurring erosion and a 0.05 recession rate reflects a reasonable target to achieve and is consistent with a stable bank.

Non-point sediment sources from agricultural activities in the watershed were estimated using the NRCS Revised Universal Soil Loss Equation 2 (RUSLE2). RUSLE2 evolved from a series of previous erosion prediction technologies, mainly USLE and RUSLE. The USLE was entirely an empirically based equation and was limited in its application to conditions where experimental data were available for deriving factor values. A major advancement of RUSLE was the use of sub-factor relationships to compute C-factor values from basic features of cover-management systems. While RUSLE retained the basic structure of the USLE, process-based relationships were added where empirical data and relationships were inadequate, such as computing the effect of strip cropping for modern conservation tillage systems. RUSLE2 was developed primarily to guide conservation planning, inventory erosion rates, and estimate sediment delivery. Values computed by RUSLE2 are supported by accepted scientific knowledge and technical judgment, are consistent with sound principles of conservation planning, and result in good conservation plans. RUSLE2 is also based on additional analyses and knowledge that were not available when RUSLE was developed. While RUSLE2 uses the USLE basic foundation of the unit plot, the soils loss calculations of RUSLE2 are performed on a daily basis. The use of RUSLE2 had additional benefits in that implementation of erosion reduction methods in the agricultural areas will be conducted through state and county programs that rely on field scale models. NRCS has adopted RUSLE2 for its programs and as such the results from this study can be directly used by field staff when conducting field scale planning and evaluation of farm plans.

The major inputs to the RUSLE2 model include information on land use, cropping practices, soil, slope, and climate data. This data was compiled using GIS software to help generate discrete input files or conditions for RUSLE2. The WISCLAND grid was combined with the slope grid and soils grid to produce unique combinations of the three variables. This data was then entered into a database and sorted into cropping practices based on local NRCS recommendations representing dominant and typical regional cropping practices. A statistical system was then created to generate the rotations based on the WISCLAND coverage, USDA statistics, and typical cropping rotations as specified by local NRCS and county staff. The WISCLAND coverage distinguishes between corn, forage, pasture, and other row crops. The land use was combined with the slope grid and resulting distribution of land use and slope was examined for incorporation into rotations.

Based on the RUSLE2 analysis, it was determined that the average existing sediment load to Gills Coulee from the watershed is 0.84 tons/acre/year. An evaluation utilizing future trends in increased cash cropping (corn-soybean rotation) and tillage reduction through increases in use of no-till shows additional load reductions can be expected. With implementation of no-till on just the slopes above 5%, the average estimated sediment load drops to 0.63 tons/acre/year.

LINKAGE ANALYSIS

Establishing the link between watershed characteristics and resulting water quality is a crucial step in TMDL development. By striving to return watershed characteristics closer to natural conditions, improvements in overall stream health can be achieved. Determining the natural stream bank conditions of this stream is challenging because of a lack of historical data to represent conditions prior to human disturbance. It is believed that stream bank instability was initially caused by heavy pasturing and overgrazing of the hillsides in the early 20th century. Removal of trees and compaction of the soils due to the grazing of hillsides caused gullies to form. Tons of sediment moved from the hillsides during rain events via gullies to the valley floor. In parts of La Crosse County, 12 to 15 feet of sediment transported from the hillsides can be documented at the streambank. Currently, during high velocity runoff events, sediment is carved out from severely exposed banks, contributing further to sedimentation and stream bank instability. Some portions of streambank are eroding due to livestock trampling (See photographs in Appendix, Section A-4).

Sedimentation from stream bank erosion and runoff from upland practices is the suspected cause of habitat degradation in Gills Coulee Creek. Fine sediments covering the stream substrate reduce suitable habitat for fish and other biological communities by filling in pools and reducing available cover for juvenile and adult fish. Sedimentation of riffle areas compromises reproductive success of fish communities by covering the gravel substrate necessary for spawning conditions. The filling in of riffle areas also affects the fish communities' food source, macroinvertebrates, which have difficulty thriving in areas with predominately sand substrate as opposed to a substrate composed of gravel, cobble/rubble, and sand mixture. In addition, sedimentation can increase turbidity in the water column, causing reduced light penetration necessary for photosynthesis in aquatic plants, reduced feeding efficiency of visual predators and filter feeders, and a lower respiratory capacity of aquatic macroinvertebrates due to clogged gill surfaces. Sedimentation of the substrate can also cause an increase in other contaminant levels, such as nutrients, which are attached to sediment particles and transported into the stream during runoff events.

Habitat scores and biotic integrity scores for fish and macroinvertebrate communities are expected to increase as measures are taken to reduce sedimentation and embeddedness of the substrate, and increase stability of exposed banks.

TMDL DEVELOPMENT

A TMDL is a plan to reduce the amount of specific pollutants reaching an impaired lake or stream to the extent that water quality standards will be met. As part of a TMDL, the amount of pollutant that the water can tolerate and still meet water quality standards must be identified. Gills Coulee Creek habitat has been impaired by a combination of flashy flow conditions during runoff events, severe bank erosion, runoff from upland agricultural practices, and excessive sedimentation of the stream substrate. The goal of this TMDL is to reduce sediment loads throughout the Gills Coulee watershed to a level that narrative water quality standards will be met and the stream's biological communities will be restored.

In addition to identification of pollutant loading, a TMDL also identifies critical environmental conditions used when defining allowable pollutant levels. However, in this circumstance there is no critical condition in the sedimentation of this stream. Sediment is a "conservative" pollutant and does not degrade over time or during different critical periods of the year. EPA acknowledges this in its 1999 Protocol for Developing Sediment TMDLs , "the critical flow approach might be less useful for the sediment TMDLs because sediment impacts can occur long after the time of discharge and sediment delivery and transport can occur under many flow conditions". The excessive sedimentation is a year round situation. This is not to say that there is no variation in the sediment carried via run-off to a stream. (Refer to Seasonal Variation section below)

ALLOCATIONS

The total annual loading capacity for sediment is the sum of the wasteload allocations for permitted sources, the load allocations for non-point sources, and the margin of safety, as generally expressed in the following equation:

$$\text{TMDL Load Capacity} = \text{WLA} + \text{LA} + \text{MOS}$$

WLA = Wasteload Allocation = 0 tons/year (no point sources)
LA = Load Allocation

MOS = Margin of Safety

WLA

Since there are no point sources in the watershed, the wasteload allocation is zero. If a point discharge were proposed, one of the following would need to occur:

- An effluent limit of zero sediment load would be included in the WPDES permit
- An offset would need to be created through some means, such as pollutant trading.
- A re-allocation of sediment load would need to be developed and approved by EPA.

TOTAL LOAD CAPACITY

To determine the total load capacity for Gills Coulee Creek, a reference stream approach was used. Two similar streams, Syftestad Creek and German Valley Branch, located in Dane County, Wisconsin, have shown considerable improvement in water quality from a similar impaired condition. The modeling results depicting the loads for these two streams under their improved condition were used to identify a total load capacity for Gills Coulee. Specifically, the total load capacity for each stream corresponds to a unit area load of 0.9 tons/acre/year.

This unit area load was then extrapolated to the Gills Coulee Creek watershed because, like Syftestad Creek and German Valley Branch, Gills Coulee is also in the driftless region of Wisconsin and has similar soils, land use, gradient, and topography. The successful reduction of sediment load in the reference streams of Syftestad Creek and German Valley Branch is a result of implementation of the following practices: stream channel stabilization, enrollment of CRP, improvement in agricultural practices to reduce soil loss, and the stabilization of forested hill slopes. All of these management practices are applicable to Gills Coulee; however, control of eroding stream banks needs to be emphasized in Gills Coulee as upland practices have already been fairly well implemented. The modeling results clearly support this. For more information regarding the reference streams used in this TMDL, refer to the WDNR document Sediment Impaired Streams in the Sugar-Pecatonica River Basin.

Based on the results of the NRCS RUSLE2 and stream bank erosion calculations, the existing sediment load to Gills Coulee Creek is 0.67 tons/acre/year from stream banks and 0.84 tons/acre/year from the upland watershed, for a total existing sediment load of 1.51 tons/acre/year. Based on modeling results, the goal, or recommended target load is 0.07 tons/acre/year from stream banks and 0.63 tons/acre/year from the watershed, for a total target load of 0.70 tons/acre/year. This target load could be achieved with implementation of bank stabilization practices and conservation tillage practices in the watershed. To meet the Total Maximum Daily Load of 0.9 ton/acre/year, or 0.002 tons/acre/day, a 40.4% reduction in sediment loading should be achieved. To meet the recommended target load, a 53.6% reduction should be achieved.

Sediment Loads	Tons/acre/year	Tons/acre/day	Percent Reduction
Existing Load	1.51	0.0041	0%
Total Maximum Daily Load	0.9	0.0024	40.4%
Target Load (MOS)	0.7	0.0019	53.6%

Table 3. Sediment loads and percent load reduction for Gills Coulee

If the load reduction is sufficient to achieve the load capacity and the stream has not adequately responded, the load capacity will be reviewed and lowered appropriately. In the event that the stream adequately responds with a load reduction that is still above the load capacity, the WDNR will either pursue “de-listing” of the stream or will revise (upward) the load capacity.

LA

The load allocation corresponds to the total load capacity because the waste load allocation is zero.

Load Capacity	**=**	***WLA***	**+**	***LA***	**+**	***MOS***
0.9 tons/yr	=	*0 tons/year*	+	*0.7tons/yr*	+	*0.2 tons/yr*
0.0024 tons/day	=	*0 tons/day*	+	*0.0019 tons/day*	+	*0.0005 tons/day*

MOS

The margin of safety (MOS) accounts for the uncertainty about the relationship between the sediment loads and the response in the waterbody. For this TMDL, the MOS is accounted for both implicitly and explicitly through several steps of the modeling and loading allocation.

The MOS approaches used for this TMDL include:

1. Using the lower recommended target of 0.7 tons/acre/year provides a 20% margin of safety.

2. The sediment load produced by RUSLE2 for this TMDL represents edge of field numbers and does not account for a reduction in sediment delivery due to deposition and infiltration loss in the drainage system. This means the numeric targets set for these TMDLs represent the worst case scenario in which all sediment eroding from agricultural fields is delivered to the receiving water body.

SEASONALITY

There is no seasonal variation in the sedimentation of this stream. Sediment is a "conservative" pollutant and does not degrade over time or during different critical periods of the year. The extensive sedimentation occurs year-round. Under some flow regimes, sediment is deposited, and at other times, sediment is scoured and transported downstream. Much of the sediment in this system remains within the confines of the stream until major floods scour some of the accumulated sediment. Over time the net result has been an accumulation of sediments in and along the stream under the current amounts of sediment reaching the stream.

Undoubtedly, the amount of sediment reaching Gills Coulee Creek through major rainfall and snowmelt runoff events varies throughout the year[1]. However, most of the sediment enters during the spring runoff and intense summer rainstorms. Considerable sediment also enters the stream from eroding stream banks during runoff events. The best management practices to achieve the load allocation are selected and designed to function for 10-year or 25-year, 24-hour design storms, providing substantial control for the major rainfall events.

MONITORING

The WDNR intends to monitor Gills Coulee Creek based on the rate of implementation of the TMDL, including the sites where implementations of Targeted Runoff Management (TRM) grants are aimed at removing the stream from the impaired waters list. Monitoring will continue until it is deemed that the stream has responded to the point where it is meeting its codified use or until funding for these studies are discontinued. In addition, the stream will be monitored on a 5 to 6 year interval as part of a baseline monitoring strategy to assess temporary conditions and note trends in overall stream quality. The monitoring will consist of metrics contained in WDNR's baseline protocol for wadeable streams, such as the Index of Biotic Integrity (IBI), the Hilsenhoff Biotic Index (HBI), the current habitat assessment tool, and sampling of water quality parameters at a subset of sites.

REASONABLE ASSURANCE

No new or additional enforcement authorities are provided under this TMDL. There are currently no point sources discharging to Gills Coulee Creek. However, future enforcement of non-point source performance standards and prohibitions will likely take place in the watershed. It is also anticipated that regulatory agricultural and non-agricultural performance standards called for in

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[1] The reader should clearly differentiate between sedimentation-the deposition of sediment-and the sediment as a pollutant reaching the stream. The first is a year-round situation where the depth of the sediment deposition may vary in response to flood flows in the stream. The second is the pollutant itself, which reaches the stream during storm events.

Wisconsin Statutes will be implemented in the watersheds for impaired waters. Currently, enforcement is based on the opportunity to provide landowners in violation of performance standards with cost-share dollars. If cost-share money is offered, those in violation are obligated to comply. Administrative rules passed by the Natural Resources Board identify that watersheds with impaired waters will have the highest priority for enforcement. In addition to the implementation of enforceable non-point source performance standards, there are a number of voluntary programs that will assist in implementing this TMDL.

Farmers may enroll in the Conservation Reserve Enhancement Program (CREP) or similar programs to establish vegetated buffers on cropland and marginal pastures. As of March 1st, 2005, farmers enrolled in CREP in La Crosse County maintained 68.4 acres of grass filter strips and 40.9 acres of forest riparian buffers. Riparian buffers assist in making CREP a viable program for this impaired stream. A similar program available to farmers is the Conservation Reserve Program (CRP) which takes highly erodible land out of agricultural use.

The Environmental Quality Incentive Program (EQIP) is another option available to farmers. EQIP is a federal cost-share program administered by the Natural Resources Conservation Service (NRCS) that provides farmers with technical and financial assistance. Farmers may receive up to 75 percent reimbursement for installing and implementing runoff management practices. Projects include terraces, waterways, diversions, and contour strips to manage agricultural waste, promote stream buffers, and control erosion on agricultural lands.

The La Crosse County LCD may also apply for TRM grants through WDNR. TRM grants are competitive financial awards to support small-scale, short term projects (24 months) completed locally to reduce runoff pollution. Both urban and agricultural projects can be funded through a TRM grant; the grants require a local contribution to the project. The state share is capped at $150,000 per grant.

In January of 2005, the La Crosse County LCD was awarded a TRM grant for implementation of better upland management practices in the watershed. A state share of $126,000 and a local share of $56,000 were used for the following practices in the upper portion of the watershed:

- Installation of stream bank stabilization practices
- Stream crossings
- Exclusionary livestock fencing along approximately 4,000 feet of stream in the upper section of Gills Coulee
- Associated upland runoff management practices

More practices are scheduled to be installed in 2006. The Gills Coulee TRM grant is scheduled to expire December 31st, 2006.

In the event that the La Crosse County LCD receives additional TRM grants, substantial improvements to habitat in the lower sections of Gills Coulee Creek could take place. Installation of stream bank stabilization practices in this section will greatly benefit stream health and reduce sedimentation, as the lower stream reaches experience the most severe instances of bank erosion.

PUBLIC PARTICIPATION

This section will be completed after review of the draft.

This TMDL was subject for public review from July 25th, 2006 through August 25th, 2006. On July 25th, 2006 a news release was sent to: newspapers, television stations, radio stations, interest groups, and interested individuals. The news release indicated the public comment period and how to obtain copies of the public notice and the draft TMDL. The news release, public notice, and draft TMDL were also placed on the DNR's website. A total of ten comments were received.

APPENDIX A

SECTION A-1. WATERSHED AND SAMPLING MAPS

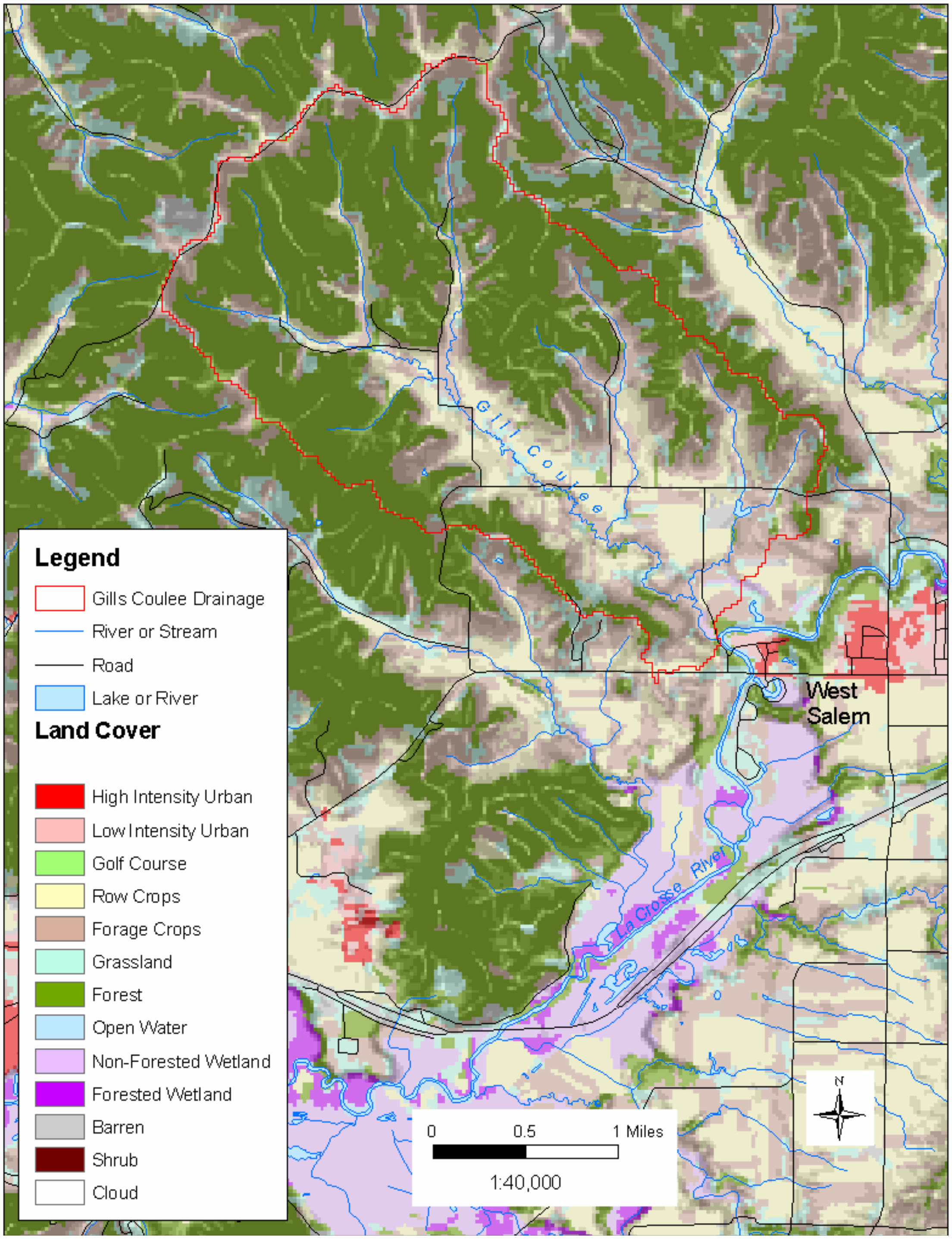

Figure A-1. Gills Coulee Creek watershed and surrounding area.

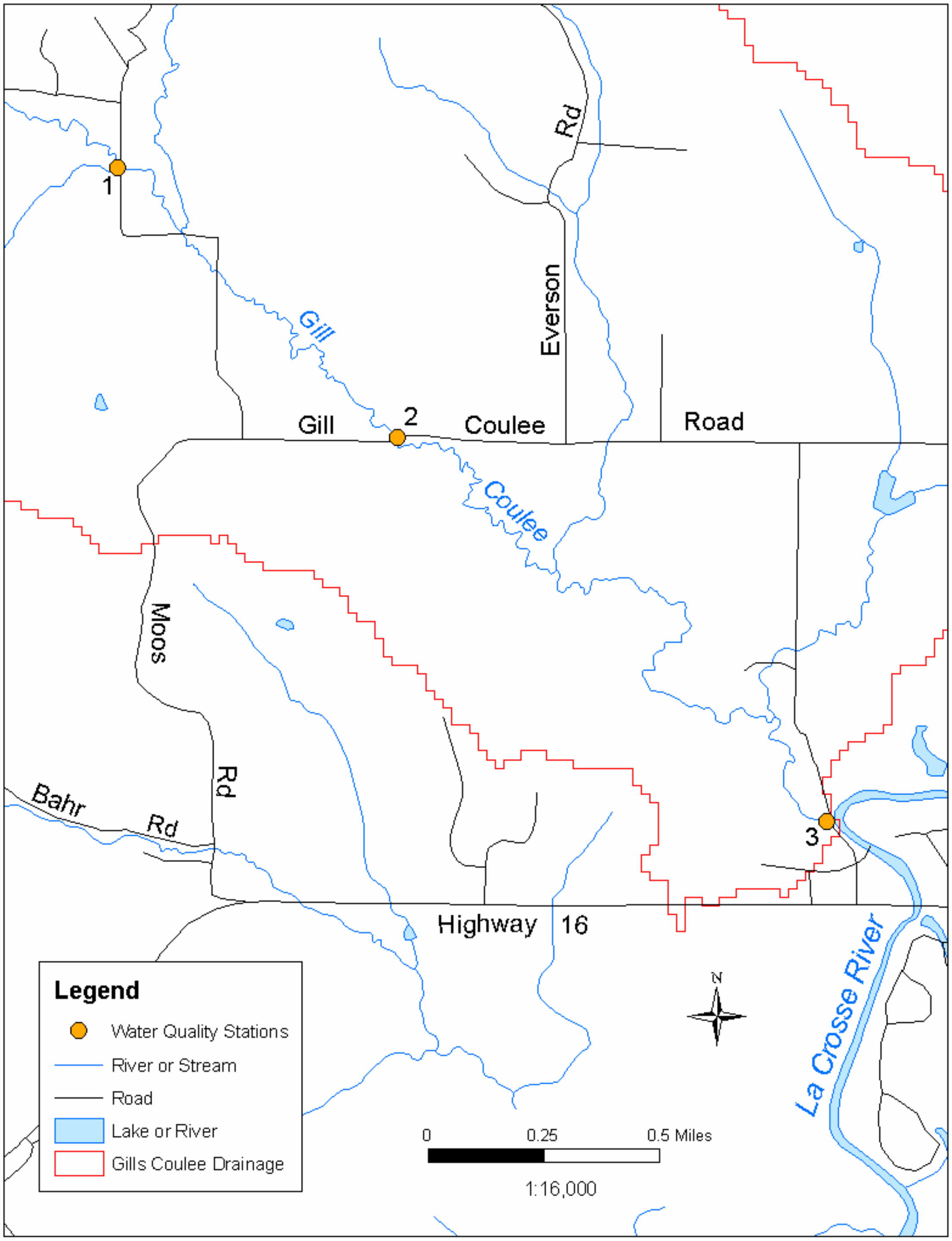

Figure A-2. La Crosse County LCD sampling sites 2003-2005.

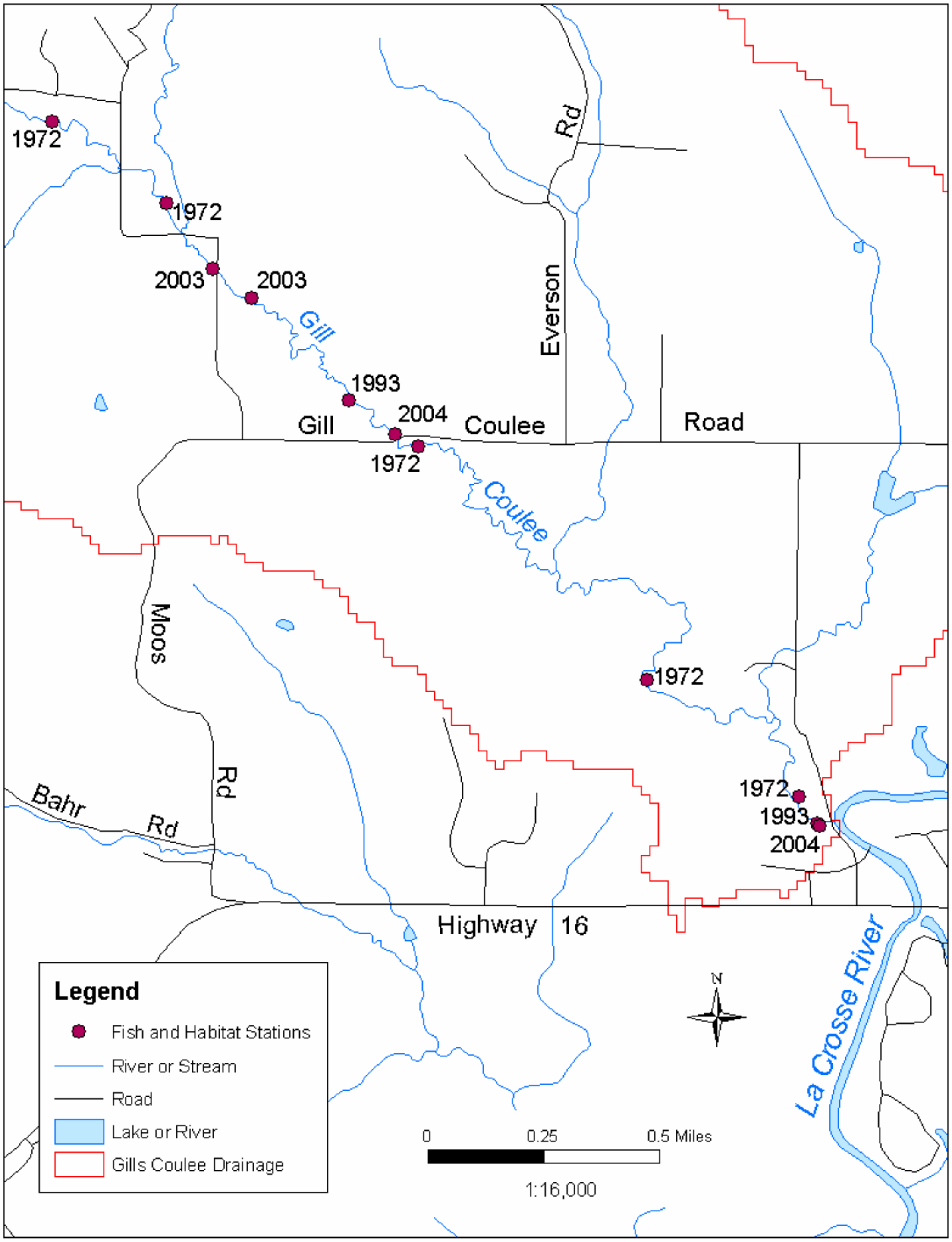

Figure A-3. WDNR fish and habitat survey sites, 1972-2004.

SECTION A-2. STREAM CLASSIFICATION AND DESCRIPTION

Stream Use Classification	Description
Cold	Cold water community; includes surface waters that are capable of supporting a cold water fishery and other aquatic life and serving as a spawning area for cold water species. This includes three levels of cold water classification (Class I, II, or III).
WWSF	Warm water sport fish communities; includes surface waters capable of supporting a community of warm water sport fish or serving as a spawning or nursery for warm water sport fish.
WWFF	Warm water forage fish communities; includes surface waters capable of supporting an abundant and diverse community of forage fish and other aquatic life.
LFF	Limited forage fishery; (intermediate surface waters (INT-D) includes surface water of limited capacity because of low stream flow, naturally poor water quality or poor habitat. These surface waters are capable of supporting only a limited community of tolerant forage fish and aquatic life.

Table A-1. Stream use classifications. The existing use of Gills Coulee Creek is a warm water forage fishery.

Trout Stream Classification	Description
Class I	These are high quality trout waters, having sufficient natural reproduction to sustain populations of wild trout at or near carrying capacity. Consequently, streams in this category require no stocking of hatchery trout. These streams or stream sections are often small and may contain small or slow-growing trout, especially in the headwaters.
Class II	Streams having this classification may have some natural reproduction but not enough to utilize available food and space. Therefore, stocking is sometimes required to maintain a desirable sport fishery. These streams show good survival and carryover of adult trout often producing some fish of better than average size.
Class III	These waters are marginal trout habitat with no natural reproduction occurring. They require annual stocking of legal-size fish to provide trout fishing. Generally, there is no carryover of trout from one year to the next.

Table A-2. Trout stream classifications. Gills Coulee is codified as a Class II and Class III trout stream.

SECTION A-3. WATER QUALITY, FISH, AND HABITAT DATA

Fish surveys conducted in 1971 and 1972 noted large numbers of brook trout and spawning areas evidenced by the occurrence of fingerlings. Specifically, a series of fish surveys completed at Gills Coulee by WNDR in 1971 estimated a standing crop of 471 brook trout per acre compared to only 29 rough fish per acre. Spawning areas were also noted as available as evidenced by the occurrence of fingerlings. Major limitations to the fishery at this time were noted as lack of in stream cover, lack of bank cover, and runoff from cattle grazing areas and feedlot areas.

Fish Species	Station	Station	Station	Station	Station	Station
Brook Trout	0	0	95	160	5	4
White Sucker	3	3	0	0	0	0
Common Carp	7	3	0	0	0	0
Central Mudminnow	P	P	0	0	0	0
Central Stoneroller	P	P	P	0	0	0
Southern Redbelly Dace	A	A	0	0	0	0
Spottail Shiner	C	C	0	0	0	0
Sand Shiner	A	A	0	0	0	0
Blacknose Dace	A	A	P	0	0	0
Longnose Dace	P	P	P	0	0	0
Creek Chub	P	P	0	0	0	0
Fantail Darter	P	P	0	0	0	0
Johnny Darter	C	C	0	0	0	0

Table A-3. WDNR Fish Survey, 1972 P=Present C=Common A=Abundant

A baseline monitoring stream survey conducted in the lower mile of the stream in 1993 captured few forage fish, and three sport fish which likely swam upstream from the La Crosse River. The second station of the survey conducted upstream from Gills Coulee Rd captured 0 fish, but did observe 4 minnow sized fish in the stream. This station was noted as having a sand bottom with large amounts of silt.

Fish Species	# Captured
Northern Pike	3
Green Sunfish	1
Blacknose Dace	1
Johnny Darter	1
Longnose Dace	1
Brook Lamprey	1
Central Mudminnow	1

Table A-4. WDNR Fish Survey, 1993

More recently, a fish survey conducted for a WDNR special study in July, 2003 south of Gills Coulee road found 25 brook trout at both stations, a single brown trout at the upstream station, but no forage species.

Species Found	2003 (Downstream)	2003(Upstream)
Brook Trout	25	25
Brown Trout	0	1
IBI Value	90=Excellent	90=Excellent

Table A-5. WDNR Fish Survey, 2003

A baseline monitoring stream survey was conducted in May of 2004. Similar to the 1993 survey, the 2004 survey conducted at the downstream station captured a variety of forage fish species and two trout species. The survey results in the upstream portion differed from 1993, with nineteen brook trout but no forage fish species.

Species Captured	2004 (Downstream)	2004 (Upstream)
Brook Trout	1	19
Brown Trout	1	0
White Sucker	9	0
Longnose Dace	14	0
Johnny Darter	11	0
Brook Stickleback	2	0
Spotfin Shiner	5	0
Green Sunfish	5	0
IBI Value	20=Poor	90= Excellent

Table A-6. WDNR Fish Survey, May 2004

Additionally, brook trout have been successfully stocked in Gills Coulee Creek in the past.

Year	Species	Age Class	# Fish Stocked
1987	Brown Trout	Yearling	900
1990	Brook Trout	Yearling	500
1991	Brook Trout	Yearling	500
1992	Brook Trout	Yearling	300
1993	Brook Trout	Yearling	422
1994	Brook Trout	Yearling	300
1995	Brook Trout	Yearling	300
1996	Brook Trout	Yearling	350

Table A-7. WDNR Fish Stocking Records for Gills Coulee

Habitat Assessments were conducted using WDNR's current habitat assessment tool for wadeable streams at two locations in July, 2003 and one location in May, 2004.

The WDNR habitat assessment conducted south of Gills Coulee Road (south of Quackenbush Road) in July of 2003 found a width to depth ratio of 10.24. According to WDNR habitat ratings, this is considered "good". However, the substrate consisted of predominantly silt, sand, and gravel. This section of the stream was documented as having extensive (greater than 60 percent) fines covering the substrate. According to the Department's habitat rating guidelines, this is considered poor habitat. The habitat station generally consisted of pools and runs, with an average depth of .21 meters. Riparian land use was noted as meadow and pasture.

A second habitat assessment conducted north of Gills Coulee Road (south of Quackenbush Road) in July 2003 found a width to depth ratio of 10.22. According to WDNR habitat ratings, this is considered "good". However, the substrate consisted of predominantly gravel and rubble/cobble covered in sand. WDNR staff believe the habitat is considered poor due to fine (or soft) sediment covering more than 60 percent of the stream bed.

The most recent habitat assessment conducted at Gills Coulee Road in May 2004 found a width to depth ratio of 11.41 (good) with a substrate primarily composed of sand (66.8%), clay (11.4%), and silt (7.3%). Again, habitat is rated as poor where there are excessive (greater than 60 percent) fines in pools, riffles, and runs.

In May 1998, a macroinvertebrate sample at Gills Coulee Road was taken and analyzed using the Hilsenhoff Biotic Index (HBI). This index represents the average weighted pollution tolerance value of all arthropods present in the stream sample. The sample received a score of 4.638, which indicates good water quality with some organic pollution. A 2004 macroinvertebrate sample taken at the same location scored 4.326, which indicates very good water quality with possible slight organic pollution.

Background base flow water quality data was collected once per month by the La Crosse County Department of Land Conservation during the summer months of 2003-2005. Sampling locations are shown in Figure A-2. Sample results suggest phosphorus and temperature levels increase moving downstream from Site 1 to Site 3, and dissolved oxygen levels decrease moving downstream from Site 1 to Site 3.

		2003			2004			2005		
Site		P(mg/l)	Temp(C)	DO(mg/l)	P(mg/l)	Temp(C)	DO(mg/l)	P(mg/l)	Temp(C)	DO(mg/l)
1	Min	0.05	9.1	8.5	0.03	11.5	9.3	0.05	12.5	8.4
	Max	0.1	15.5	10.6	0.53	14.9	11.0	0.28	15.7	10
	Mean	**0.07**	**13.53**	**9.22**	**0.11**	**13.22**	**9.77**	**0.11**	**14.46**	**9.64**
	Count	10	12	12	19	22	22	21	14	14
2	Min	0.11	9.8	8.01	0.13	13.0	8.0	0.13	15	7.6
	Max	0.49	21.4	10.5	1.29	20.2	10.4	0.75	21.6	9.8
	Mean	**0.24**	**17.1**	**9.23**	**0.40**	**16.46**	**9.07**	**0.25**	**19.00**	**8.62**
	Count	13	12	12	19	22	22	21	14	14
3	Min	0.13	10	6.41	0.1	14.3	6.5	0.19	16.9	5.9
	Max	0.47	25.9	10.5	1.99	24.3	10.4	2.06	26.6	9.4
	Mean	**0.28**	**19.88**	**8.59**	**0.46**	**19.08**	**8.48**	**0.49**	**22.46**	**7.56**
	Count	13	12	12	19	22	22	21	14	14

Table A-8. Summary of La Crosse County LCD water quality sample data, 2003-2005.

SECTION A-4. PHOTOGRAPHS OF STREAMBANK EROSION

Figure A-4. Stream bank erosion located in upper third of stream.

Figure A-5. Stream bank erosion located in upper third of stream.

Figure A-6. Stream bank erosion located in middle section of stream.

Figure A-7. Stream bank erosion located in middle section of stream.

Figure A-8. Streambank erosion located in lower third of stream.

Figure A-9. Stream bank erosion located in lower third of stream.

Figure A-10. Stream bank erosion located in lower third of stream.

Figure A-11. Stream bank erosion located in lower third of stream.

Figure A-12. Stream bank erosion located in lower third of stream.

Figure A-13. Stream bank erosion located in lower third of stream.

APPENDIX B

SECTION B-1. STREAMBANK EROSION CALCULATIONS

Bank Height	Eroding Area (ft^2)	Lateral Recession Rate (ft/yr)	Soil Volume Weight (pcf)	Erosion (lbs/yr)	Erosion (tons/yr)	Erosion (tons/day)
6	246	0.4 (severe)	100	9,840	5	0.01
7	1,806	0.4 (severe)	100	72,240	36	0.1
10	280	0.5 + (very severe)	100	14,000	7	0.02
12	2,652	0.5 + (very severe)	100	132,600	66	0.18
14	3,976	0.5 + (very severe)	100	198,800	99	0.27
Landowner 1 Total	**8,960**			**427,480**	**213**	**0.58**
3	108	0.3 (moderate/severe)	100	3,240	2	0.01
4	1,132	0.3 (moderate/severe)	100	33,960	17	0.05
5	1,605	0.4 (severe)	100	64,200	32	0.09
6	5,046	0.4 (severe)	100	201,840	101	0.28
7	9,065	0.4 (severe)	100	362,600	181	0.50
8	19,176	0.5 + (very severe)	100	958,800	479	1.31
9	11,052	0.5 + (very severe)	100	552,600	276	0.76
10	10,990	0.5+ (very severe)	100	549,500	275	0.75
12	13,200	0.5+ (very severe)	100	660,000	330	0.90
14	3,584	0.5+ (very severe)	100	179,200	90	0.25
20	6,720	0.5+ (very severe)	100	336,000	168	0.46
Landowner 2 Total	**81,678**			**3,901,940**	**1,951**	**5.36**
3	84	0.3 (moderate/severe)	100	2,520	1	0.003
4	2,152	0.3 (moderate/severe)	100	64,560	32	0.09
5	6,240	0.3 (moderate/severe)	100	187,200	94	0.26
6	5,160	0.4 (severe)	100	206,400	103	0.28
7	4,676	0.4 (severe)	100	187,040	94	0.26
8	2,728	0.4 (severe)	100	109,120	55	0.15
16	1,824	0.5+ (very severe)	100	91,200	46	0.13
Landowner 3 Total	**22,864**			**848,040**	**425**	**1.173**
Existing Stream Totals	**113,502**			**5,177,460**	**2,589**	**7.113**

Table B-1. Existing conditions: streambank erosion calculations

Bank Height	Eroding Area (ft)	Lateral Recession Rate (ft/yr)	Soil Volume Weight (pcf)	Erosion (lbs/yr)	Erosion (tons/yr)	Erosion (tons/day)
6	246	0.05 (Slight)	100	1,230	0.62	0.002
7	1,806	0.05 (Slight)	100	9,030	4.52	0.012
10	280	0.05 (Slight)	100	1,400	0.70	0.002
12	2,652	0.05 (Slight)	100	13,260	6.63	0.018
14	3,976	0.05 (Slight)	100	19,880	9.94	0.027
Landowner 1 Total	**8,960**			**44,800**	**22.41**	**0.06**
3	108	0.05 (Slight)	100	540	0.27	0.001
4	1,132	0.05 (Slight)	100	5,660	2.83	0.008
5	1,605	0.05 (Slight)	100	8,025	4.01	0.011
6	5,046	0.05 (Slight)	100	25,230	12.62	0.035
7	9,065	0.05 (Slight)	100	45,325	22.66	0.062
8	19,176	0.05 (Slight)	100	95,880	47.94	0.131
9	11,052	0.05 (Slight)	100	55,260	27.63	0.076
10	10,990	0.05 (Slight)	100	54,950	27.48	0.075
12	13,200	0.05 (Slight)	100	66,000	33.00	0.090
14	3,584	0.05 (Slight)	100	17,920	8.96	0.025
20	6,720	0.05 (Slight)	100	33,600	16.80	0.046
Landowner 2 Total	**81,678**			**408,390**	**204.20**	**0.56**
3	84	0.05 (Slight)	100	420	0.21	0.001
4	2,152	0.05 (Slight)	100	10,760	5.38	0.015
5	6,240	0.05 (Slight)	100	31,200	15.60	0.043
6	5,160	0.05 (Slight)	100	25,800	12.90	0.035
7	4,676	0.05 (Slight)	100	23,380	11.69	0.032
8	2,728	0.05 (Slight)	100	13,640	6.82	0.019
16	1,824	0.05 (Slight)	100	9,120	4.56	0.012
Landowner 3 Totals	**22,864**			**114,320**	**57.16**	**0.16**
Target Stream Totals	**113,502**			**567,510**	**284**	**0.78**

Table B-2. Target conditions: streambank erosion calculations

Lateral Recession Rate	Category	Description
0.01-0.05	**Slight**	Some bare bank but active erosion not readily apparent. Some rills but no vegetative overhang. No exposed tree roots.
0.06-0.2	**Moderate**	Bank is predominantly bare with some rills and vegetative overhang. Some exposed tree roots but no slumps or slips.
0.3-0.5	**Severe**	Bank is bare with rills and severe vegetative overhang. Many exposed tree roots and some fallen trees and slumps or slips. Some changes in cultural features such as fence corners missing and realignment of roads or trails. Channel cross section becomes U-shaped as opposed to V-shaped.
0.5+	**Very Severe**	Bank is bare with gullies and severe vegetative overhang. Many fallen trees, drains, and culverts eroding out and changes in cultural features as above. Massive slips or washouts common. Channel cross section is U-shaped and stream course may be meandering.

Table B-3. NRCS Streambank erosion categories and descriptions

Gills Coulee Watershed Sediment Loading Analysis								
Scenario 1: Existing Conditions								
Land Use	Acres	Soil	Slope	Slope Length	Tillage	Load (tons/acre)	Tons (annual)	Tons (daily)
Corn-soybean rotation	270.0	SIL	5-10%	150	Spring Chisel	4.4	1188	3.255
Corn-soybean rotation	270.0	SL	0-4%	200	Spring Chisel	1	270	0.740
Dairy Rotation (CCOH3)	1135.5	SIL	5-10%	150	Chisel	1.3	1476	4.044
Forest	1957.5	SIL	>15%	100	NA	0.14	274	0.751
Grass	196.2	SIL	11-15%	125	NA	0.10	20	0.054
Water	1.8		0-4%	200	NA	0.00	0	0.000
Wetland	6.9	SL	0-4%	200	NA	0.00	0	0.000
Total acres	**3838**						**3228**	**8.844**
					tons/acre	**0.84**		
Scenario 2: Enhance Tillage Management of Cash Crops (BMP Scenario)								
Land Use	Acres	Soil	Slope	Slope Length	Tillage	Load (tons/acre)	Tons (annual)	Tons (daily)
Corn-soybean rotation	270.0	SIL	5-10%	150	No till	1.4	378	1.036
Corn-soybean rotation	270.0	SL	0-4%	200	Spring Chisel	1	270	0.740
Dairy Rotation (CCOH3)	1135.5	SIL	5-10%	150	Chisel	1.3	1476	4.044
Forest	1957.5	SIL	>15%	100	NA	0.14	274	0.751
Grass	196.2	SIL	11-15%	125	NA	0.10	20	0.054
Water	1.8		0-4%	200	NA	0.00	0	0.000
Wetland	6.9	SL	0-4%	200	NA	0.00	0	0.000
Total acres	**3838**						**2418**	**6.624**
					tons/acre	**0.63**		

Table B-4. Watershed sediment loading analysis