

Use Impairment	International Joint Commission Listing Guideline
Restrictions on fish and wildlife consumption	When contaminant levels in fish or wildlife populations exceed current standards, objectives or guidelines or public health advisories are in effect for human consumption of fish or wildlife. Contaminant levels in fish and wildlife must be due to contaminant input from the watershed.
Tainting of fish and wildlife flavor	When ambient water quality standards, objectives or guidelines for anthropogenic substances known to cause tainting are being exceeded or survey results have identified tainting of fish and wildlife flavor.
Degradation of fish and wildlife populations	When fish and wildlife management programs have identified degraded fish or wildlife populations due to cause within the watershed. In addition, this use will be considered impaired when relevant, field validated fish or wildlife bioassays with appropriate quality assurance/quality controls confirm significant toxicity from water column or sediment contaminants.
Fish tumors or other deformities	When incidence rates of fish tumors or other deformities exceed rates at unimpacted control sites or when survey data confirm presence of neoplastic or pre-neoplastic liver tumors in bullheads or suckers.
Bird or animal deformities or reproductive problems	When wildlife survey data confirm presence of deformities (e.g. cross-bill syndrome) or other reproductive problems (e.g. egg-shell thinning) in sentinel wildlife species.
Degradation of benthos	When the benthic macro-invertebrate community structure significantly diverges from unimpacted control sites of comparable physical and chemical characteristics. In addition, this use will be considered impaired when toxicity of sediment-associated contaminants is significantly higher than controls.
Restrictions on dredging activities	When contaminants in sediments exceed standards, criteria, or guidelines such that there are restrictions on dredging or disposal activities.
Eutrophication or undesirable algae	When there are persistent water quality problems attributed to cultural eutrophication.
Restrictions on drinking water consumption or taste and odor problems.	When treated drinking water: 1) exceeds standards, objectives, or guidelines for disease organisms, hazardous/toxic chemicals, or radioactive/toxic substances, 2) taste and odor problems are present, 3) treatment required for raw water is beyond standard treatment for the Great Lakes area.
Restrictions on body contact	When waters commonly used for full or partial body contact recreation exceed standards, objectives or guidelines for such use.
Degradation of aesthetics	When any substance in water produces a persistent objectionable deposit, color, turbidity, or odor.
Added cost to industry or agriculture.	When additional treatment is required prior to use.
Degradation of plankton populations.	When populations significantly differ from unimpacted control sites.
Loss of fish and wildlife habitat.	When fish and wildlife management goals have not been met as a result of loss of habitat due to perturbations of physical, chemical, or biological integrity.

Watershed Survey Data Sheet - Gun River Watershed

	Site ID#					
Water Odor	None	Musty	Rotten Eggs	Chemical	Oil	Sewage
Riparian Habitat	Trees	Shrubs	Herbaceous plants		Grass	Bare
Buffer/Filter Strip	Y / N	Width	<1'	1' - 3'	3' - 10'	>10'

Pollutant Source (choose only one, complete section)

SECTION 1. DEBRIS/TRASH/OBSTRUCTIONS

Description

Amount	Slight	Moderate	Extensive Amount		
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SECTION 2. CONSTRUCTION SITE RUNOFF

Location	Left Bank	Right Bank			
Construction type	road	residential	industrial	other	
Soil erosion measures	not installed	needs repair	not adequate		
Sedimentation control measures	not installed	needs repair	not adequate		
Extent of erosion/sedimentation	slight	moderate	severe		

SECTION 3. STREAM CROSSING

Type of Crossing	Bridge	Single Culvert	Double Culvert	Other	
Construction material	Concrete	Galvanized	Plastic	Other	
Condition	Good	Fair	Poor		
Flow	Clean	> 1/4 full of Sediment	Obstructed		
Road Surface	Paved	Gravel	Unimproved		
Erosion Location	Streambank	Embankment	Culvert outlet	Shoulder/Ditch	
Extent of Erosion	Minor	Moderate	Severe		

SECTION 4. RILL, GULLY, OR SURFACE DITCH EROSION

Location	Left Bank	Right Bank			
Average Width	_____ feet	(Top width + Bottom width)/2			
Depth	_____ feet				
Length	_____ feet				
Height of streambank	< 3'	3' - 6'	> 6'		
Land use at location	Wooded	Wetland	Agricultural	Residential	Commercial

SECTION 5. LIVESTOCK ACCESS

Location	Left Bank	Right Bank			
Length of erosion	< 10'	10' - 25'	26' - 100'	> 100'	
Height of streambank	< 3'	3' - 6'	> 6'		
Vegetation cover	Bare	Sparse vegetation	Stable vegetation		

SECTION 6. UPLAND NUTRIENT SOURCES

Location	Left Bank	Right Bank			
Cropland Erosion/Runoff		Conventional Tillage	Manure Spreading	Plowing perpendicular to stream	
Manure in Stream	None	Some Evident	Extensive Amount		
Manure Storage	Y / N	How far from top of streambank?			_____ feet
Feedlot Area	_____ acres		Paved	_____ %	
Animal Operation Type	Dairy	Hog	Beef	Other	

SECTION 7. TILE OUTLETS

Location	Left Bank	Right Bank	Erosion	Y / N	
Pipe diameter	_____ inches				
Pipe Material	Plastic	Clay	Metal	Concrete	Other
Height above Stream Botto	0" - 6"	6" - 12"	12" - 36"	> 36"	
Discharge Color	Clear	Green	Cloudy/Milky	Very Muddy	Black
Discharge Odor	None	Musty	Ammonia/eggs	Chemical/oil	Sewage

SECTION 8. STREAMBANK EROSION

Location	Left Bank	Right Bank			
Length of erosion	< 10'	10' - 25'	26' - 100'	> 100'	
Height of streambank	< 3'	3' - 6'	> 6'		
Severity of Erosion	Some Bare Bank	Mostly Bare Bank	Bare bank w/ Rills	Washout	
Location of Erosion	Toe	High Water Mark	Top of Bank	Entire Bank	

**Watershed Survey Data Sheet
Gun River Watershed**

Date
Technician
Waterbody Name **Site ID#** _____
Site Reference

Pollutant Source (choose only one, complete section)

- | | | | |
|---------------------|-----------------------------|--------------------|--------------------------|
| 1. Debris/Trash | 2. Construction Site Runoff | 3. Stream Crossing | 4. Rill or Gully Erosion |
| 5. Livestock Access | 6. Upland Source | 7. Tile Outlet | 8. Streambank Erosion |
| | | | 9. Other _____ |

County	A / B	Township	Section #	1/4	1/4	
Tract #(s)		Owner				
Current precipitation	None	Light	Moderate	Heavy		
Days since last rain	1 or less	2	3 or more	How much?	inches	
Water Color	Clear	Green	Cloudy/Milky	Very Muddy	Black	
Water Odor	None	Musty	Rotten Eggs	Chemical	Oil	Sewage
Stream flow type	Dry	Stagnant	Slow Flow	Rapid Flow		
Average Stream Width	10' or less	11' - 25'	25' - 50'	50' or more		
Average Stream Depth	<1'	1' - 3'	>3'	Don't know		
Riparian Habitat	Trees	Shrubs	Herbaceous plants	Grass	Bare	
Buffer/Filter Strip	Y / N	Width	<1'	1' - 3'	3' - 10'	>10'
Land Use (facing u/s)	Left Bank	Woodland	Wetland	Idle	Agricultural	Res/Comm
	Right Bank	Woodland	Wetland	Idle	Agricultural	Res/Comm

SECTION 1. DEBRIS/TRASH/OBSTRUCTIONS

Description			
Amount	Slight	Moderate	Extensive Amount

SECTION 2. CONSTRUCTION SITE RUNOFF

Location	Left Bank	Right Bank		
Construction type	road	residential	industrial	other
Soil erosion measures	not installed	needs repair	not adequate	
Sedimentation control measures	not installed	needs repair	not adequate	
Extent of erosion/sedimentation	slight	moderate	severe	

Date:
 Waterbody Name:
 Location:
 Investigator:

Watershed Survey Data Sheet

County:
 Township:
 Lat:

Time:
 Station #:
 Sec T R ¼ ¼
 Long:

Coordinate Determination Method (check the one that applies):
 ___ GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)
 Map Scale (if known _____)

PHYSICAL HABITAT																				
BACKGROUND INFORMATION - pg. 18							PHYSICAL APPEARANCE - pg. 20													
							U/S (Check all that apply)		D/S (Check all that apply)											
Event Conditions noted at site	None		Light		Moderate		Heavy		Aquatic Plants	Present	Abundant	Present	Abundant							
	≤ 1		2		≥ 3		Unknown		Floating Algae	Present	Abundant	Present	Abundant							
Days since Rain									Filamentous Algae	Present	Abundant	Present	Abundant							
Water Temp./D.O./pH *									Bacterial Sheen/Slimes	Present	Abundant	Present	Abundant							
Water Color	Clear	Gray	Brown	Black	Green				Turbidity	Present	Abundant	Present	Abundant							
Waterbody Type-u/s	Stream		Lake		Impd		Wetland		Oil Sheen	Present	Abundant	Present	Abundant							
Waterbody Type-d/s	Stream		Lake		Impd		Wetland		Foam	Present	Abundant	Present	Abundant							
Stream Width (ft.)	<10		10-25		25-50		>50		Trash	Present	Abundant	Present	Abundant							
Avg. Stream Depth (ft.)	<1		1-3		>3		Unknown													
Water Velocity (ft./sec) *																				
Stream Flow Type	Dry	Stagnant	L	M	H															
SUBSTRATE (add to 100%) - pg. 22							INSTREAM COVER - pg. 23													
							U/S (%)	D/S (%)						U/S (X)	D/S (X)					
Boulder - 10 in. diam.										Undercut Banks										
Cobble/Gravel - 10 to .08 in. diam.										Overhanging Veg.										
Sand - coarse grain										Deep Pools										
Silt/Detritus/Muck - fine grain/organic matter										Boulders										
Hardpan/Bedrock - solid clay/rock surface										Aquatic Plants										
Artificial - manmade										Logs or Woody Debris										
Unknown																				
RIVER MORPHOLOGY - pg. 23							STREAM CORRIDOR - pg. 26													
							U/S		D/S							U/S		D/S		
Riffle	Present		Abundant		Present		Abundant		Riparian Veg. Width ft.(L)	< 10	10-30	30-100	>100	< 10	10-30	30-100	>100			
Pool	Present		Abundant		Present		Abundant		Riparian Veg. Width ft.(R)	< 10	10-30	30-100	>100	< 10	10-30	30-100	>100			
Channel	Natr	Recv	Maintn d		Natr	Recv	Maintn d		Bank Erosion	0	L	M	H	0	L	M	H			
Designated Drain	?	Y	N		?	Y	N		Streamside Land Cover	B	G	S	T	B	G	S	T			
Highest Water Mark (ft.)	?	<1	1-3	3-5	5-10	>10		Stream Canopy %	<25	25-50	> 50		<25	25-50	> 50					
Stream Cross Section							Adjacent Land Uses													
							Wetlands	L	R		L	R								
							Shrub or Old Field	L	R		L	R								
							Forest	L	R		L	R								
							Pasture	L	R		L	R								
							Crop Land	L	R		L	R								
							Animal Feeding Operation	L	R		L	R								
							Maintained Lawns/Parks	L	R		L	R								
							Impervious Surfaces	L	R		L	R								
							Disturbed Ground	L	R		L	R								
							No Vegetation	L	R		L	R								

Date:

Watershed Survey Data Sheet (pg. 2)

Station #:

ROAD CROSSING INFORMATION								
Crossing Type	Bridge	Round Culvert(s)	Box Culvert(s)	Arch Culvert(s)	Other:			
Road Surface	Paved	Gravel	Sand	Clay	Grass	Other:		
Road Ownership	MDOT	County	USFS	MDNR	Municipal	Priv/Corp	Unknown	Other:
Culvert Problems	Poor Alignment	Inadequate Armoring	Impounding Water	Obstructed	Structural Integrity	Other:		
Perched Culvert	< 3"	3-12"	> 12"	Plunge Pool				
Crossing Erosion	Crossing Embankment	Road Approaches	Road Ditches					

POTENTIAL SOURCES (Severity: S - slight; M - moderate; H - high) - pg. 28

	U/S			D/S				U/S			D/S		
	S	M	H	S	M	H		S	M	H	S	M	H
Crop Related Sources	S	M	H	S	M	H	Land Disposal	S	M	H	S	M	H
Grazing Related Sources	S	M	H	S	M	H	On-site Wastewater Systems	S	M	H	S	M	H
Intensive Animal Feeding Operations	S	M	H	S	M	H	Silviculture (Forestry NPS)	S	M	H	S	M	H
Highway/Road/Bridge Maintenance and Runoff (Transportation NPS)	S	M	H	S	M	H	Resource Extraction (Mining NPS)	S	M	H	S	M	H
Channelization	S	M	H	S	M	H	Recreational/Tourism Activities (general)	S	M	H	S	M	H
Dredging	S	M	H	S	M	H	• Golf Courses	S	M	H	S	M	H
Removal of Riparian Vegetation	S	M	H	S	M	H	• Marinas/Recr. Boating (water releases)	S	M	H	S	M	H
Bank and Shoreline Erosion/Modification/Destruction	S	M	H	S	M	H	• Marinas/Recr. Boating (bank or shoreline erosion)	S	M	H	S	M	H
Flow Regulation/Modification (Hydrology)	S	M	H	S	M	H	Debris in Water	S	M	H	S	M	H
Upstream Impoundment	S	M	H	S	M	H	Industrial Pt. Source	S	M	H	S	M	H
Construction: Highway/Road/Bridge/Culvert	S	M	H	S	M	H	Municipal Pt. Source	S	M	H	S	M	H
Construction: Land Development	S	M	H	S	M	H	Natural Sources	S	M	H	S	M	H
Urban Runoff (Residential/Urban NPS)	S	M	H	S	M	H	Source(s) Unknown	S	M	H	S	M	H

SITE SUMMARY INFORMATION - pg. 33			
SURVEY DIRECTION	N/A	U/S	D/S
SITE SIMILARITY	?	Y	N
OVERALL SITE RANKING	Good	Fair	Poor
FOLLOW UP	L	M	H

COMMENTS: _____

Project Title: Gun River Watershed Management Plan
Job Number: G01339
Engineer: DF2
Date: 1/21/2004

Template Title: Gun River Watershed - Sediment Reduction (Agricultural Fields)

Sub District	Contributing Area (acres)	Soil Loss Before Treatment (tons/yr)	Area of Conservation Tillage (acres)	Filter Strip Area of Influence (acres)	Soil Loss After Treatment (tons/yr)	Delivery Ratio	Sediment Reduction (tons/yr)
Gregg's Brook	3666	4448	80	280	4234	0.50	107
Orangeville Drain	4444	9295	0	120	9171	0.50	62
Fenner Creek	3097	4920	0	80	4837	0.50	41
Reno Drain	1448	2302	0	0	2302	0.50	0
Culver Drain	2571	9372	400	400	8361	0.50	505
Sutherland Drain	1757	2871	0	240	2492	0.50	190
Monteith Drain	2919	3522	80	0	3510	0.50	6
Along US-131	1110	1011	0	0	1011	0.50	0
Bellingham Drain	1258	2000	0	320	1669	0.50	165
Otsego Plainwell	1882	1576	80	80	1524	0.50	26
Scott Whitcomb	1583	2136	80	80	2092	0.50	22
Gun River Corridor							
Total	25735	43452	720	1600	41204		1124

Notes:

- **Contributing Area** is based upon the amount of Agricultural Land within each Sub District.
- **Soil Loss Before Treatment** was calculated using *Michigan State University's "RUSLE - On Line Soil Assessment Tool"* and assumes an Existing Tillage condition of "*Mulch with 10% Cover*" except along waterways with poorly drained soils, in which case, a *Cover Management "C" Factor* of 0.50 was assumed. **Soil Loss Before Treatment** assumes **No Filter Strips!**
- **Area of Conservation Tillage** ("*Mulch with 30% Cover*") was obtained from *Table 5.1: Agricultural BMP Cost* of the Gun River WMP.
- **Filter Strip Area of Influence** includes all land that drains through a Filter Strip (obtained from *Table 5.1* of the Gun River WMP).
- **Soil Loss After Treatment** accounts for the implementation of BMP's such as Conservation Tillage and Filter Strips.
- **Delivery Ratio** accounts for the amount of eroded soil that actually reaches a water body.
- **Sediment Reduction** was calculated using the method prescribed by the *MDEQ - Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual*. (= ((**Soil Loss Before Treatment** - **Soil Loss After Treatment**) * **Delivery Ratio**))

Project Title: Gun River Watershed Management Plan
Job Number: G01339
Engineer: DF2
Date: 1/21/2004

Template Title: Gun River Watershed - Nutrient Loading (Agricultural Fields)

Sub District	Sediment Delivery Before Treatment (tons/ac/yr)	Soil Type	Before Phosphorous Content (lbs/ac/yr)	Before Phosphorous Content (lbs/yr)	Before Nitrogen Content (lbs/ac/yr)	Before Nitrogen Content (lbs/yr)
Gregg's Brook	0.61	Peat	1.60	5880	3.22	11797
Orangeville Drain	1.05	Silt	1.65	7351	3.31	14703
Fenner Creek	0.79	Silt	1.33	4125	2.65	8222
Reno Drain	0.79	Peat	2.00	2895	3.99	5776
Culver Drain	1.82	Silt	2.57	6609	5.15	13239
Sutherland Drain	0.82	Peat	2.04	3588	4.08	7165
Monteith Drain	0.60	Silt	1.06	3108	2.13	6215
Along US-131	0.46	Silt	0.85	947	1.71	1894
Bellingham Drain	0.79	Peat	2.00	2515	3.99	5018
Otsego Plainwell	0.42	Silt	0.80	1502	1.60	3003
Scott Whitcomb	0.67	Peat	1.75	2765	3.50	5545
Gun River Corridor						
Total	8.83		17.66	41284	35.32	82579

- Notes:**
- The terms "**Before**" or "**Before Treatment**" refer to the Existing State of the Sub District, Before any BMP's, such as **Conservation Tillage** or **Filter Strips**, have been implemented.
 - **Sediment Delivery Before Treatment** was calculated using the method prescribed by the *MDEQ - Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual*. (= ((**Soil Loss Before Treatment / Contributing Area**) * **Delivery Ratio**))
 - **Soil Type** is based upon the Predominate Soil of each Sub District.
 - **Phosphorous & Nitrogen Contents** were determined using *figure 5* from the *MDEQ - Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual*. Phosphorous & Nitrogen Contents are a function of **Sediment Delivery** and **Soil Type**.

Project Title: Gun River Watershed Management Plan
Job Number: G01339
Engineer: DF2
Date: 1/21/2004

Template Title: Gun River Watershed - Nutrient Reduction (Agricultural Fields)

Sub District	Sediment Delivery After Treatment - P (tons/ac/yr)	Sediment Delivery After Treatment - N (tons/ac/yr)	Soil Type	After Phosphorous Content (lbs/ac/yr)	After Phosphorous Content (lbs/yr)	After Nitrogen Content (lbs/ac/yr)	After Nitrogen Content (lbs/yr)	Phosphorous Reduction (lbs/yr)	Nitrogen Reduction (lbs/yr)
Gregg's Brook	0.57	0.58	Peat	1.53	5622	3.08	11297	258	501
Orangeville Drain	1.03	1.03	Silt	1.64	7266	3.27	14545	84	158
Fenner Creek	0.78	0.78	Silt	1.31	4059	2.62	8101	67	120
Reno Drain	0.79	0.79	Peat	2.00	2895	3.99	5776	0	0
Culver Drain	1.60	1.61	Silt	2.31	5938	4.65	11966	672	1273
Sutherland Drain	0.69	0.70	Peat	1.78	3135	3.61	6349	453	817
Monteith Drain	0.60	0.60	Silt	1.06	3099	2.12	6198	8	17
Along US-131	0.46	0.46	Silt	0.85	947	1.71	1894	0	0
Bellingham Drain	0.64	0.65	Peat	1.68	2114	3.41	4294	401	724
Otsego Plainwell	0.40	0.40	Silt	0.77	1458	1.55	2921	44	83
Scott Whitcomb	0.66	0.66	Peat	1.71	2713	3.44	5448	52	98
Gun River Corridor									
Total	8.23	8.27		16.66	39246	33.46	78790	2039	3790

Notes:

- The terms "After" or "After Treatment" refer to the State of the Sub District After BMP's, such as **Conservation Tillage** or **Filter Strips**, have been implemented.
- **Sediment Delivery After Treatment** was calculated using the method prescribed by the *MDEQ - Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual*. (= (((**Soil Loss After Treatment** (Neglecting Effects of Filter Strips on Soil Loss) / **Contributing Area**) * **Filter Strip Reduction Factor** * **Delivery Ratio**))
- **Filter Strip Reduction Factor** = 0.25 for *Phosphorous* and 0.30 for *Nitrogen*.
- **Soil Type** is based upon the Predominate Soil of each Sub District.
- **Phosphorous & Nitrogen Contents** were determined using *figure 5* from the *MDEQ - Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual*. Phosphorous & Nitrogen Contents are a function of **Sediment Delivery** and **Soil Type**.
- **Phosphorous / Nitrogen Reduction** was calculated using the method prescribed by the *MDEQ - Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual*. (= (**Before Content** - **After Content**))

Project Title: Gun River Watershed Management Plan
Job Number: G01339
Engineer: DF2
Date: 1/21/2004

Template Title: Gun River Watershed - Sediment and Nutrient Loading (NPS Pollution Sites)

Sub District	Sediment Loading (tons/yr)					Total	Correct Factor	Phosphorous Content (lbs/yr)	Nitrogen Content (lbs/yr)
	Streambank Erosion	Rill & Gully Erosion	Tile Outlet	Road / Stream Crossing	Livestock Access				
Gregg's Brook	5.3	1.4	0.3	3.1	0.2	10.2	1.50	15	31
Orangeville Drain	21.0	0.3	0.0	10.7	0.0	32.0	1.00	32	64
Fenner Creek	8.7	1.3	0.1	0.0	0.0	10.1	1.00	10	20
Reno Drain	7.4	3.3	0.1	1.5	0.0	12.2	1.50	18	37
Culver Drain	9.1	0.0	0.0	0.2	0.0	9.3	1.00	9	19
Sutherland Drain	0.7	0.0	0.0	3.6	0.0	4.3	1.50	6	13
Monteith Drain	1.7	0.0	0.0	0.0	0.0	1.7	1.00	2	3
Along US-131	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0	0
Bellingham Drain	26.7	3.4	0.2	2.2	0.0	32.4	1.50	49	97
Otsego Plainwell	1.7	0.0	0.0	0.2	0.0	1.8	1.00	2	4
Scott Whitcomb	6.8	0.2	0.0	1.1	0.0	8.0	1.50	12	24
Gun River Corridor	39.8	2.6	0.2	3.5	0.0	46.1	1.50	69	138
Total	88.9	9.8	0.7	22.5	0.2	122.0		156	311

Notes:

- This Table summarizes the Existing Sediment and Nutrient Loading from NPS Pollution Sites. These values are assumed to be Completely Reduced once site specific BMP's have been implemented.
- **Correction Factor** for Silt = 1, Sand =0.85 and Peat =1.5
- **Phosphorous Content** was calculated using the method prescribed in the *MDEQ - Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual*. (= (**Sediment Loading** (tons/yr) * 0.0005 (lb/lb) * 2000 (lb/ton) * **Correction Factor**))
- **Nitrogen Content** was calculated using the method prescribed in the *MDEQ - Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual*. (= (**Sediment Loading** (tons/yr) * 0.001 (lb/lb) * 2000 (lb/ton) * **Correction Factor**))
- **Gun River Corridor** = Summation of NPS Pollution Site Data located along the Gun River from various Sub Districts. This Information is for *Reference Purposes Only* and does not contribute to the Overall Totals!

Project Title: Gun River Watershed Management Plan

Job Number: G01339

Engineer: DF2

Date: 1/21/2004

Template Title: Gun River Watershed - Overall Sediment and Nutrient Reduction

Sub District	Before Sediment Delivery (tons/yr)	After Sediment Delivery (tons/yr)	Total Sediment Reduction (tons/yr)	Before Phosphorous Content (lbs/yr)	Before Nitrogen Content (lbs/yr)	After Phosphorous Content (lbs/yr)	After Nitrogen Content (lbs/yr)	Total Phosphorous Reduction (lbs/yr)	Total Nitrogen Reduction (lbs/yr)
Gregg's Brook	2234	2117	117	5896	11828	5622	11297	273	531
Orangeville Drain	4680	4586	94	7383	14767	7266	14545	116	222
Fenner Creek	2470	2419	51	4135	8242	4059	8101	77	140
Reno Drain	1163	1151	12	2913	5813	2895	5776	18	37
Culver Drain	4695	4181	515	6618	13258	5938	11966	681	1292
Sutherland Drain	1440	1246	194	3595	7178	3135	6349	460	830
Monteith Drain	1763	1755	8	3109	6218	3099	6198	10	20
Along US-131	506	506	0	947	1894	947	1894	0	0
Bellingham Drain	1032	834	198	2563	5115	2114	4294	449	821
Otsego Plainwell	790	762	28	1503	3007	1458	2921	46	86
Scott Whitcomb	1076	1046	30	2777	5569	2713	5448	64	122
Gun River Corridor	46	0	46	69	138	0	0	69	138
Total	21848	20602	1246	41440	82891	39246	78790	2194	4101

Notes:

- This Table summarizes the Overall or "**Total**" (Agricultural Fields and NPS Pollution Sites) Sediment and Nutrient Reductions.
- **Before Sediment Delivery** = Existing Sediment Loading, Before any BMP's have been implemented.
- **After Sediment Delivery** = Sediment Loading, After BMP's have been implemented.
- **Total Sediment Reduction** = Reduction in Sediment Loading as a result of BMP Implementation. **Delivery Ratio** was Factored into Agricultural Fields portion of Total Sediment Reduction.
- **Before Phosphorous Content** = Existing Phosphorous Loading, Before any BMP's have been implemented.
- **Before Nitrogen Content** = Existing Nitrogen Loading, Before any BMP's have been implemented.
- **After Phosphorous Content** = Phosphorous Loading, After BMP's have been implemented.
- **After Nitrogen Content** = Nitrogen Loading, After BMP's have been implemented.
- **Total Phosphorous Reduction** = Reduction in Phosphorous Loading as a result of BMP implementation.
- **Total Nitrogen Reduction** = Reduction in Nitrogen Loading as a result of BMP implementation.

Project Title: Gun River Watershed Management Plan

Job Number: G01339

Engineer: DF2

Date: 1/21/2004

Template Title: Gun River Watershed - RUSLE Input Data ("Before Treatment") for Agricultural Fields

Sub-District	Route Number	Area (Acres)	Slope Length (ft)	Soil Type	% of Soil	Slope (%)	Soil Loss	Soil Type	% of Soil	Slope (%)	Soil Loss	Soil Type	% of Soil	Slope (%)	Soil Loss	Weighted Soil Loss (tons/yr)
Gregg's Brook (3666 Acres)	GR	1833	300	11B	100%	3%	1535									1535
	GR Cor	1833	300	39	100%	1%	2914									2914
Orangeville Drain (4444 Acres)	OR	2222	300	57B	50%	6%	3844	31C	50%	8%	7683					5763
	OR Cor	2222	300	74	100%	1%	3532									3532
Fenner Creek (3097 Acres)	FE	2323	300	12B	65%	3%	4233	11B	20%	3%	1945	75B	15%	3%	3661	3689
	FE Cor	774	300	39	100%	1%	1231									1231
Reno Drain	RE Cor	1448	300	39	100%	1%	2302									2302
Culver Drain	CU	2571	300	11C	70%	8%	6927	12C	30%	8%	15076					9372
Sutherland Drain (1757 Acres)	SU	879	300	11B	100%	3%	735									735
	SU Cor	879	300	23	50%	1%	1971	30	50%	1%	2300					2136
Monteith Drain	MO	2919	300	44B	60%	3%	2444	12B	30%	3%	5319	16B	10%	3%	4600	3522
Along US-131	US	1110	300	44B	80%	3%	929	75B	10%	3%	1749	27B	10%	3%	929	1011
Bellingham Drain	BE Cor	1258	300	39	100%	1%	2000									2000
Otsego - Plainwell	OT	1882	300	44B	100%	3%	1576									1576
Scott Whitcomb Drain (1583 Acres)	SW	475	300	11B	50%	3%	398	10B	50%	3%	351					374
	SW Cor	1108	300	39	100%	1%	1761									1761
Total															43452	

Notes:

- **Route Numbers** containing the word "**Cor**" account for areas along waterways with poorly drained soils. These areas were evaluated assuming a *Cover Management (C) Factor of 0.50*. All other Route Numbers were evaluated assuming an average *"Before Treatment" C - Factor of 0.0814*.
- **Soil Loss'** were calculated for each Soil Type within a Sub-District using the *RUSLE* equation. A weighted average was then used to determine the Total Soil Loss in each Sub-District.

Project Title: Gun River Watershed Management Plan
Job Number: G01339
Engineer: DF2
Date: 1/21/2004

Template Title: Gun River Watershed - After BMP Implementation ("After Treatment") Input Data for Agricultural Fields

Sub-District	Route Number	Area (Acres)	Area of <u>Only</u> Conservation Tillage (acres)	Filter Strip <u>Only</u> Area of Influence (acres)	Area of Tillage & Filter Strip (acres)	Conservation Tillage Reduction Factor	Soil Loss After Treatment (tons/yr)	Sediment Delivery After Treatment - P (tons/ac/yr)	Sediment Delivery After Treatment - N (tons/ac/yr)
Gregg's Brook (3666 Acres)	GR GR Cor	1833 1833		80 120	80	0.877	1445 2790	0.78 1.51	0.78 1.52
Orangeville Drain (4444 Acres)	OR OR Cor	2222 2222		120		0.877	5763 3408	2.59 1.53	2.59 1.53
Fenner Creek (3097 Acres)	FE FE Cor	2323 774		80		0.877	3689 1148	1.59 1.47	1.59 1.47
Reno Drain	RE Cor	1448					2302	1.59	1.59
Culver Drain	CU	2571			400	0.877	8361	3.20	3.23
Sutherland Drain (1757 Acres)	SU SU Cor	879 879		240		0.877	735 1756	0.84 1.93	0.84 1.97
Monteith Drain	MO	2919	80			0.877	3510	1.20	1.20
Along US-131	US	1110				0.877	1011	0.91	0.91
Bellingham Drain	BE Cor	1258		320			1669	1.29	1.31
Otsego - Plainwell	OT	1882	80	80		0.877	1524	0.81	0.81
Scott Whitcomb Drain (1583 Acres)	SW SW Cor	475 1108			80	0.877	331 1761	0.68 1.59	0.69 1.59
			160	1040	560		41204		

Notes:

- **Area of Only Conservation Tillage** includes land where Conservation Tillage is the only BMP being Implemented.
- **Filter Strip Only Area of Influence** includes land where Filter Strips are the only BMPs being Implemented. This area includes all land that drains through a Filter Strip!
- **Area of Tillage & Filter Strip** includes land where Conservation Tillage and Filter Strips are being Implemented.
- **Conservation Tillage Reduction Factor** adjusts the C - Factor in the RUSLE equation to obtain a Soil Loss value for a Tillage Condition of "Mulch with 30% Cover" ($C\text{-Factor} = 0.0714$). It is a Ratio of the C-Factors for "Mulch with 30% Cover" to that of "Mulch with 10% Cover" = $(0.0714 / 0.0814)$
- **Soil Loss After Treatment** = $((\text{Area of Conservation Tillage Only} / \text{Contributing Area}) * (\text{Before Soil Loss} * \text{Conservation Tillage Reduction Factor})) + ((\text{Filter Strip Area Only} / \text{Contributing Area}) * (\text{Before Soil Loss} * 0.35)) + ((\text{Area of Tillage \& Filter} / \text{Contributing Area}) * ((\text{Before Soil Loss} * \text{Conservation Tillage Reduction Factor}) * 0.35)) + (((\text{Contributing Area} - \text{Total Area of BMP's}) / \text{Contributing Area}) * \text{Before Soil Loss})$
- **Sediment Delivery After Treatment** = Same as above except replace the Filter Strip Reduction Value of 0.35 with 0.25 for Phosphorous and 0.30 for Nitrogen; then divide the entire sum by the Contributing Area.

STREAMBANK EROSION

Site ID	Waterbody	Location	Severity of Erosion	Length (ft)	Height (ft)	Lateral Recession Rate (ft/yr)	Soil Weight (tons/ft ³)	Sediment Reduction (tons/yr)
407GUN0103	GUN RIVER	BOTH	WASHOUT	125	10	0.5	0.011	13.750
40GUN0201	GUN RIVER	RIGHT BANK	WASHOUT	125	10	0.5	0.011	6.875
40GUN1801C	GUN RIVER	LEFT BANK	MOSTLY BARE BANK	125	5	0.2	0.011	1.375
1059GUN1101	1059	BOTH	MOSTLY BARE BANK	125	5	0.2	0.011	2.750
1061ORA0901	1061	BOTH	MOSTLY BARE BANK	125	5	0.2	0.055	13.750
1071MAR1410	FENNER DRAIN	LEFT BANK	MOSTLY BARE BANK	125	10	0.2	0.011	2.750
1059MAR2514	1059	RIGHT BANK	MOSTLY BARE BANK	125	10	0.2	0.011	2.750
571MAR2401	571	RIGHT BANK	MOSTLY BARE BANK	125	10	0.2	0.011	2.750
408MAR3601B	408	RIGHT BANK	WASHOUT	75	5	0.5	0.011	2.063
40MAR2308	GUN RIVER	LEFT BANK	WASHOUT	75	10	0.5	0.011	4.125
RDWAY3401	ROAD DITCH	BOTH	MOSTLY BARE BANK	75	5	0.2	0.033	4.950
40MAR1301C	GUN RIVER	RIGHT BANK	MOSTLY BARE BANK	75	5	0.2	0.011	0.825
40GUN105	GUN RIVER	LEFT BANK	MOSTLY BARE BANK	75	10	0.2	0.011	1.650
40MAR2307	GUN RIVER	LEFT BANK	WASHOUT	18	10	0.5	0.011	0.990
40MAR2606	GUN RIVER	LEFT BANK	WASHOUT	18	10	0.5	0.011	0.990
40GUN0208	GUN RIVER	RIGHT BANK	WASHOUT	18	10	0.5	0.011	0.990
40GUN0204	GUN RIVER	RIGHT BANK	WASHOUT	18	10	0.5	0.011	0.990
40MAR2303	GUN RIVER	LEFT BANK	WASHOUT	18	10	0.5	0.011	0.990
1071MAR1002	FENNER DRAIN	BOTH	MOSTLY BARE BANK	18	5	0.2	0.033	1.188
1058GUN1102	1058	BOTH	MOSTLY BARE BANK	18	5	0.2	0.011	0.396
1071MAR1413	FENNER DRAIN	LEFT BANK	MOSTLY BARE BANK	18	5	0.2	0.011	0.198
40MAR3606	GUN RIVER	LEFT BANK	MOSTLY BARE BANK	18	5	0.2	0.011	0.198
5721MAR3602	5721	RIGHT BANK	MOSTLY BARE BANK	18	5	0.2	0.011	0.198
1058GUN1101	1058	RIGHT BANK	MOSTLY BARE BANK	18	5	0.2	0.011	0.198
40MAR2607	GUN RIVER	RIGHT BANK	MOSTLY BARE BANK	18	10	0.2	0.011	0.396
1071MAR1408	FENNER DRAIN	RIGHT BANK	MOSTLY BARE BANK	18	10	0.2	0.011	0.396
1060ORA1801	ORANGEVILLE DRAIN	RIGHT BANK	MOSTLY BARE BANK	18	10	0.2	0.011	0.396
40GUN0207	GUN RIVER	LEFT BANK	MOSTLY BARE BANK	18	10	0.2	0.011	0.396
1071MAR1504	FENNER DRAIN	BOTH	MOSTLY BARE BANK	18	10	0.2	0.033	2.376
1058MAR2501	1058	RIGHT BANK	SOME BARE BANK	18	10	0.05	0.011	0.099
1071MAR1405	FENNER DRAIN	LEFT BANK	MOSTLY BARE BANK	5	5	0.2	0.011	0.055
1060ORA1804	1060	RIGHT BANK	MOSTLY BARE BANK	5	10	0.2	0.011	0.110

STREAMBANK EROSION

Site ID	Waterbody	Location	Severity of Erosion	Length (ft)	Height (ft)	Lateral Recession Rate (ft/yr)	Soil Weight (tons/ft ³)	Sediment Reduction (tons/yr)
1071MAR1503	1071	RIGHT BANK	MOSTLY BARE BANK	5	10	0.2	0.033	0.330
1076MAR2301	1076	LEFT BANK	SOME BARE BANK	5	5	0.05	0.011	0.014
571MAR2402	571	LEFT BANK	SOME BARE/MOSTLY BARE	125	10	0.1	0.011	1.375
40GUN0103B	GUN RIVER	RIGHT BANK	SOME BARE BANK	125	5	0.05	0.011	0.344
407GUN0101	407	BOTH	SOME BARE BANK	125	10	0.05	0.011	1.375
40MAR2302B	GUN RIVER	LEFT BANK	SOME BARE BANK	125	10	0.05	0.011	0.688
1071MAR1415	FENNER DRAIN	LEFT BANK	MOSTLY BARE BANK	75	5	0.2	0.011	0.825
1060ORA1803	1060	BOTH	SOME BARE/MOSTLY BARE	75	10	0.1	0.011	1.650
1071MAR1407	FENNER DRAIN	RIGHT BANK	SOME BARE BANK	75	10	0.05	0.011	0.413
570MAR2601	CULVER DRAIN	LEFT BANK	MOSTLY BARE BANK	18	10	0.2	0.033	1.188
40GUN0104B	GUN RIVER	LEFT BANK	SOME BARE BANK	18	10	0.05	0.011	0.099
40MAR2603B	GUN RIVER	LEFT BANK	SOME BARE BANK	18	10	0.05	0.011	0.099
1071MAR1409	FENNER DRAIN	LEFT BANK	SOME BARE BANK	18	10	0.05	0.011	0.099
40GUN1702C	GUN RIVER	LEFT BANK	WASHOUT	5	10	0.5	0.011	0.275
59MAR1003	GREGG BROOK	LEFT BANK	MOSTLY BARE BANK	5	5	0.2	0.033	0.165
407GUN0102	407	LEFT BANK	MOSTLY BARE BANK	5	10	0.2	0.011	0.110
1071MAR1404	FENNER DRAIN	LEFT BANK	SOME BARE BANK	5	10	0.05	0.011	0.028
572MAR3601	572	LEFT BANK	SOME BARE BANK	5	5	0.05	0.011	0.014
40GUN1001C	GUN RIVER	LEFT BANK	SOME BARE BANK	5	10	0.05	0.011	0.028
403GUN1602B	GUN RIVER	RIGHT BANK	WASHOUT	125	5	0.5	0.011	3.438
40ORA0601C	GUN RIVER	BOTH	WASHOUT	5	5	0.5	0.011	0.275
1060ORA1802	ORANGEVILLE DRAIN	BOTH	WASHOUT	75	5	0.5	0.011	4.125
							Total	88.866

RILL AND GULLY EROSION

Site ID	Waterbody	Location	Avg. Width (ft)	Depth (ft)	Length (ft)	Volume (ft ³)	Soil Weight (tons/ft ³)	Number of Years	Annual Sediment (tons/yr)
5721MAR3601	5721	LEFT BANK	2	2	2	8	0.011	1	0.088
1071MAR1402	FENNER DRAIN	RIGHT BANK	2	2	7	28	0.011	3	0.103
1058GUN1103	1058	RIGHT BANK	2	1	8	16	0.011	3	0.059
572MAR3605	572	LEFT BANK	3	2	8	48	0.011	3	0.176
1059MAR2501	1059	LEFT BANK	3	2	8	48	0.011	3	0.176
1071MAR1505	FENNER DRAIN	LEFT BANK	2	2	10	40	0.033	3	0.440
1071MAR1501	FENNER DRAIN	RIGHT BANK	2	8	10	160	0.033	10	0.528
1059MAR2515	1059	LEFT BANK	1	1	12	12	0.011	3	0.044
1071MAR1001	FENNER DRAIN	LEFT BANK	2	1	12	24	0.033	3	0.264
1059GUN1104	1059	LEFT BANK	3	2	12	72	0.011	7	0.113
1060ORA1806	ORANGEVILLE DRAIN	LEFT & RIGHT	4	2	12	96	0.011	7	0.302
575MAR0201	N. TOWN LINE DRAIN	RIGHT BANK	1.5	2	15	45	0.011	3	0.165
1059MAR2511	1059	RIGHT BANK	3	2	15	90	0.011	7	0.141
59MAR1002	GREGG BROOK	LEFT BANK	6	4	15	360	0.033	10	1.188
1059MAR2503	1059	RIGHT BANK	2	3	20	120	0.011	10	0.132
1059MAR2506	1059	LEFT BANK	5	5	20	500	0.011	10	0.550
1059MAR2513	1059	LEFT BANK	6	3	20	360	0.011	10	0.396
572MAR3602	572	LEFT BANK	2	1	25	50	0.011	3	0.183
1059MAR2509A	1059	RIGHT BANK	2	3	25	150	0.011	10	0.165
572MAR3604	572	LEFT BANK	3	1	25	75	0.011	7	0.118
1059MAR2505	1059	LEFT BANK	10	5	30	1500	0.011	10	1.650
5721MAR3603	5721	LEFT BANK	1	1	40	40	0.011	3	0.147
RDGUN0101A	GUN RIVER	RIGHT BANK	8	3	100	2400	0.011	10	2.640
								Total	9.767

TILE OUTLET EROSION

Site ID	Waterbody	Location	Erosion Area (ft ²)	Lateral Recession Rate (ft/yr)	Soil Weight (tons/ft ³)	Sediment Reduction (tons/yr)
59MAR0305	GREGG BROOK	RIGHT BANK	20	0.2	0.033	0.132
1059MAR2502	1059	LEFT BANK	40	0.2	0.011	0.088
1071MAR1406	FENNER DRAIN	RIGHT BANK	20	0.2	0.011	0.044
1071MAR1401	FENNER DRAIN	RIGHT BANK	20	0.2	0.011	0.044
59WAY3401	GREGG BROOK	LEFT BANK	15	0.2	0.033	0.099
40GUN0207	GUN RIVER	LEFT BANK	15	0.2	0.011	0.033
572MAR3606	572	RIGHT BANK	15	0.2	0.011	0.033
1059MAR2517	1059	RIGHT BANK	10	0.2	0.011	0.022
40GUN0203	GUN RIVER	RIGHT BANK	10	0.2	0.011	0.022
407GUN0104	GUN RIVER	RIGHT BANK	15	0.2	0.011	0.033
408MAR3601A	408	RIGHT BANK	15	0.2	0.011	0.033
40MAR1201C	GUN RIVER	LEFT BANK	10	0.2	0.011	0.022
40MAR3603	GUN RIVER	RIGHT BANK	10	0.2	0.011	0.022
572MAR3603	572	LEFT BANK	10	0.2	0.011	0.022
40GUN0209	GUN RIVER		10	0.2	0.011	0.022
					Total	0.671

ROAD/STREAM CROSSING EROSION

Site ID	Waterbody	Severity of Erosion	Length (ft)	Height (ft)	Lateral Recession Rate (ft/yr)	Soil Weight (tons/ft ³)	Sediment Reduction (tons/yr)
407GUN0106	GUN RIVER	SEVERE	96	3	0.3	0.011	0.9504
406GUN1102	GUN RIVER	SEVERE	96	3	0.3	0.011	0.9504
575MAR0202	575	SEVERE	96	3	0.3	0.011	0.9504
59MAR1101	GREGG BROOK	SEVERE	96	3	0.3	0.011	0.9504
402GUN2101	402	SEVERE	96	3	0.3	0.011	0.9504
40ORA0601A	GUN RIVER	SEVERE	96	3	0.3	0.011	0.9504
573MAR2601	573	SEVERE	96	3	0.3	0.033	2.8512
1060ORA1701	ORANGEVILLE DRAIN	SEVERE	96	3	0.3	0.055	4.752
1059MAR2501B	1059	SEVERE	96	3	0.3	0.011	0.9504
1060ORA1807	ORANGEVILLE DRAIN	SEVERE	96	3	0.3	0.055	4.752
575WAY3501	575	MODERATE	48	3	0.15	0.011	0.2376
571ORA1901	571	MODERATE	48	3	0.15	0.011	0.2376
40MAR1301A	GUN RIVER	MODERATE	48	3	0.15	0.011	0.2376
573MAR2701	573	MODERATE	48	3	0.15	0.033	0.7128
577MAR0101	577	MODERATE	48	3	0.15	0.011	0.2376
59MAR0304A	GREGG BROOK	MODERATE	48	3	0.15	0.033	0.7128
4061GUN1101	406	MODERATE	48	3	0.15	0.011	0.2376
1059MAR2516	1059	MODERATE	48	3	0.15	0.011	0.2376
40GUN1101	GUN RIVER	MINOR	24	3	0.05	0.011	0.0396
407GUN0105A	GUN RIVER	MINOR	24	3	0.05	0.011	0.0396
570MAR2604	CULVER DRAIN	MINOR	24	3	0.05	0.033	0.1188
403GUN1604A	GUN RIVER	MINOR	24	3	0.05	0.011	0.0396
40GUN1801A	GUN RIVER	MINOR	24	3	0.05	0.011	0.0396
40MAR2601	GUN RIVER	MINOR	24	3	0.05	0.011	0.0396
40GUN1701	GUN RIVER	MINOR	24	3	0.05	0.011	0.0396
40GUN1801	GUN RIVER	MINOR	24	3	0.05	0.011	0.0396
40GUN1001A	GUN RIVER	MINOR	24	3	0.05	0.011	0.0396
40MAR2301	GUN RIVER	MINOR	24	3	0.05	0.011	0.0396
570MAR2605	CULVER DRAIN	MINOR	24	3	0.05	0.033	0.1188
40GUN1702B	GUN RIVER	MINOR	24	3	0.05	0.011	0.0396
Total							22.4928

LIVESTOCK ACCESS

Site ID	Waterbody	Location	Cover	Length (ft)	Height (ft)	Lateral Recession Rate (ft/yr)	Soil Weight (tons/ft ³)	Sediment Reduction (tons/yr)
59MAR0304B	GREGG BROOK	RIGHT BANK	BARE	18	2	0.2	0.033	0.2376