BUCK CREEK

WATERSHED MANAGEMENT PLAN

ADDENDUM

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PREPARED FOR:
GRAND VALLEY METROPOLITAN COUNCIL
AS PART OF THE
LOWER GRAND RIVER WATERSHED IMPLEMENTATION PROJECT

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INTRODUCTION

This document is an addendum to the Buck Creek Watershed Management Plan (2003 WMP) submitted to the Michigan Department of Environmental Quality (MDEQ) in December 2003 by the Grand Valley Metropolitan Council. The 2003 WMP was written in compliance with the requirements specified in the Administrative Rules for the Clean Michigan Initiative Nonpoint Source Pollution Control Grants promulgated pursuant to Part 88, of the Natural Resources and Environmental Protection Act, 1994 Public Act 451, as amended, effective October 27, 1999. Development of the 2003 WMP was completed by stakeholders in the Lower Grand River Watershed (LGRW) to identify implementation actions needed to protect and restore designated uses and resolve water quality and quantity concerns in an urban watershed.

The Buck Creek Watershed (Watershed) drains approximately 51 square miles from its headwaters in southern Kent County, Michigan, to where it enters the Grand River. Many tributaries, and several sections of Buck Creek, are maintained as designated county drains. Land use in the Buck Creek Watershed is 2% agricultural, 23% urbanized, 74% residential, and 1% open space/water. Land use in the Watershed is primarily suburban/residential and commercial from outward growth of the City of Grand Rapids into southern Gaines and Byron Townships. In 1992, the MDEQ conducted a biological survey of Buck Creek, which revealed fair to poor water quality due to sedimentation and substantial flow fluctuations. The MDEQ has also determined that Buck Creek exceeds water quality standards for *E. coli*.

The information provided in this addendum follows U.S. Environmental Protection Agency (EPA) requirements specified by the Clean Water Act, Title III, Section 319(h). This addendum is to be used in conjunction with the 2003 WMP to maintain a complete watershed management strategy that addresses the concerns and water quality issues in the Watershed. Chapter and section numbers follow the 2003 WMP and are included only if updates or additions were made to that section; thus, the numbering is not always sequential.

3.3A POLLUTANT LOADINGS AND REDUCTIONS

Addendum Summary - Section 3.3A is an addition to Chapter 3 of the 2003 Watershed Management Plan and addresses several of the minimum elements required by the EPA:

Element A) extent of pollutant sources to be controlled,

Element B) estimate of the load reductions expected for management measures,

Element C) a description of management measures to achieve load reductions, and

Element D) amounts of technical and financial assistance needed and estimated costs.

3.3.1A EXTENT OF POLLUTANT SOURCES TO BE CONTROLLED

MODELING POLLUTANT LOADINGS FROM NONPOINT SOURCE SITES

An inventory of Buck Creek and its tributaries was completed in the summer of 2003. A total of 97 sites were identified as contributing nonpoint source (NPS) pollution to surface waters of the Watershed. The methods used to provide estimates of sediment and nutrient loadings from the identified NPS sites include:

- MDEQ's "*Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual" (MDEQ 1999)* for agricultural sites
- Michigan State University's "Revised Universal Soil Loss Equation (RUSLE) - Online Soil Erosion Assessment Tool" for construction sites
- Illinois Environmental Protection Agency's (IEPA) Environmental Management Watershed Management Section pollutant load reduction model for urban settings
- Penn State Agricultural and Biological Engineering Department's Fact Sheet *"Land Application of Leaves and Grass Clippings"* for yard waste.

The inventory data from the nonpoint source sites are included in Appendix 1. The estimated loadings for sediment, phosphorus, and nitrogen are presented by subwatershed in Table 3.1A. The estimated reductions for sediment, phosphorus, and nitrogen are presented by subwatershed in Table 3.2A. Worksheets and land use data used to calculate these estimates are included in Appendix 2. The subwatersheds are illustrated in Figure 4B.

Sediment originates from various types of erosion. Amounts of sedimentation from each of these erosion types can be estimated by accepted methods to determine total erosion. The RUSLE, the Gully Erosion Equation (GEE), and the Channel Erosion Equation (CEE) are used to calculate total erosion.

Soil loss, or erosion, is a naturally occurring process, which is defined as the wearing away or disintegration of earth material by the physical forces of moving water and wind. Using these calculations, the total sediment loss in the Watershed before implementation of best management practices (BMPs) was estimated. Controlling sediment loading requires the knowledge of the soil erosion and sedimentation. The difference between "soil loss," as measured by these erosion equations, and the sediment delivery to water bodies is important to recognize. A number of factors such as drainage area size, basin slope, climate, and land use/land cover may affect sediment delivery processes. The accurate prediction of a sediment delivery ratio is an important and effective approach to predicting sediment loading. Sediment delivery is the amount or fraction of soil that is actually delivered to a water body.

Nutrient loading is estimated by calculating total erosion at a site, then estimating the amount of nutrients attached to the amount of sediment (Charts 1 and 2). Sediment-borne nutrients originate from various types of erosion. Each of these erosion types can be estimated by accepted methods to determine total erosion. The RUSLE, GEE, and CEE are used to calculate total erosion, which enables an estimate of attached nutrients to be calculated.

Pathogen Contamination

Pathogens, specifically *Escherichia Coli* (*E. coli)* bacteria, have been measured at levels exceeding water quality standards (WQS) in reaches of Buck Creek. The WQS for the Buck Creek Watershed is 130 *E. coli* per 100 milliliters (ml) as a 30-day geometric mean and 300 *E. coli* per 100 ml as a daily geometric mean. In the document titled "*Total Maximum Daily Load for E. coli for Buck Creek, Kent County*," developed by MDEQ in January 2006, the data indicated that exceedances of the WQS were observed during both wet and dry weather events. Additional sampling is currently taking place at 11 sites in the Watershed (Figure 5A).The data generated from the current monthly sampling is presented in Table 3.5A. The monthly samples have ranged from 75 *E. coli* per 100 ml to >2,420 *E. coli* per 100 ml. Samples of *E. coli* during wet weather events have ranged from 500 *E. coli* per 100 ml to 25,000 *E. coli* per 100 ml.

3.3.2A ESTIMATE OF THE LOAD REDUCTIONS EXPECTED FOR MANAGEMENT MEASURE

MODELING POLLUTANT REDUCTIONS

The 2003 WMP recommends several BMPs to address nonpoint sources of pollution in the Buck Creek Watershed. Urban practices include soil erosion and sedimentation control on construction sites, porous pavement, extended wet detention, dry detention, and vegetative filter strips. Estimates of sediment and

nutrient load reductions from the implementation of these urban BMPs were calculated using reduction efficiencies and calculations developed by the IEPA. Pollutant removal efficiencies for each BMP, as determined by the pollutant load model developed by the IEPA, are identified in Table 3.2A.

The model uses many simplifying assumptions to provide a general estimate of pollutant reductions through BMP implementation. The land use data was extracted using Geographic Information System (GIS) information. The acreage of contributing area with storm sewers at each site was estimated to be 0.5 acre. More accurate results of pollutant reductions should be obtained through direct monitoring and/or a more detailed modeling application.

Pollutant reductions of other identified NPS sites were calculated using the CEE and GEE. The actions and systems of BMPs that have been identified to be implemented in the Watershed to achieve the estimated reductions were determined from the information collected during the Watershed inventory and previous studies.

As described in the MDEQ training manual, BMPs that address NPS sites are assumed to control 100% of the erosion, thus reduce the pollutants by 100%. The reductions are therefore the same amounts as the loadings. Pollutant reductions for phosphorus and nitrogen are based on the amount of sediment delivered (Chart 1 and 2), thus the calculations are dependent on the accuracy of the data collected at the site pertaining to soil loss. These estimates are based on limited field measurements, due to time and financial constraints. The results, therefore, are purely estimates of the pollutant removal capability of the actions and BMPs implemented.

Using these calculations, the total sediment loading for the entire Watershed before implementation of BMPs, or treatment, was estimated to be 46.95 tons per year. The total sediment reduction from BMPs installed at NPS sites is 42.45 tons per year.

The Total Phosphorus (TP) content before implementation of BMPs, or treatment, was estimated to be 47.68 pounds per year. The total reduction of phosphorus for treatment of NPS sites is 32.47 pounds per year.

The Nitrogen (N) content before implementation of BMPs, or treatment, was estimated to be 165.86 pounds per year. The total reduction of nitrogen for treatment of NPS sites is 112.27 pounds per year.

The IEPA method of calculating loadings has consistently resulted in very high levels of nitrogen. The reasons for these results are under investigation.

Pathogen Contamination

The Buck Creek total maximum daily load (TMDL) establishes allowable loadings of pollutants to meet WQS based on the relationship between pollution sources and in-stream water quality conditions. The TMDL allows stakeholders to develop controls to reduce pollution and restore the quality of the resource. TMDLs identify the allowable levels of *E. coli* that will result in the attainment of the applicable WQS. The TMDL is comprised of the sum of individual waste load allocations (WLAs) for point sources, load allocation (LAs) for nonpoint sources and natural background levels, and a margin of safety, as expressed in the following equation:

TMDL = ∑WLAs + ∑LAs + MOS

Michigan's WQS for total body contact recreation for *E. coli* is 130 ct/100ml (as a 30-day geometric mean) or 300 *E. coli* ct/100 ml (daily maximum during the same sampling event). Total body contact recreation is from May 1 to October 31.

WLA is equal to 130 ct/100ml (as a 30-day geometric mean) or 300 *E. coli* ct/100 ml (daily maximum during the same sampling event), since that is the WQS. An illicit connections WLA is 0, since it is illegal. Because the TMDL is concentration based, the LA is equal to 130, since all land should be required to meet the lowest standard, regardless of use.

The reductions, therefore, at each site must be enough to reduce the load to reach 130 ct/100ml (as a 30-day geometric mean). Consistent exceedances of WQS have been observed in the sampling programs, thus many sites would be nearing 100% reduction to meet water quality standards. As pollutant load reductions approach 100%, costs escalate exponentially. Many existing load allocations, such as those for pathogens in Michigan, call for nearly 100% pollution reduction without concern for implementation cost.

3.3.3A MANAGEMENT MEASURES TO ACHIEVE LOAD REDUCTIONS

To control urban runoff in the Watershed, several BMPs are recommended: porous pavement, extended wet detention, dry detention, and vegetated filter strips. Pollutant removal percentages of these practices should be considered by watershed managers when selecting a BMP, or combination of BMPs, to address a pollutant source.

Because the IEPA model does not provide information on the amount of each BMP needed to achieve pollutant removal efficiencies, pollutant reduction goals should be considered during BMP implementation in order to achieve long-term pollutant reduction goals for the Watershed. For example, the pollutant reduction goal for sediment is 25%; therefore, BMPs selected to address sediment at a particular site should be at least 25% efficient. By reducing sediment by 25%, or greater, at each known pollutant source in the Watershed, this pollutant reduction goal will eventually be met.

Table 3.5A summarizes the recommendations first presented in the 2003 WMP (Table 6.2) and lists the specific BMPs that will need to be implemented on the identified NPS sites to achieve the estimated load reductions stated above. Estimates of the technical and financial assistance are included that are required for implementing each BMP. The “Unit Costs” are consistent with those in the original 2003 tables. The “Number of Sites Affected” and “Total Cost” columns are summaries of the number of sites and costs for that particular BMP.

Many combinations of actions and BMPs can be implemented to realize pollutant reduction goals. The most effective combination will be the one that is most feasible for the stakeholders based on cost, acceptability, and sustainability. Local and national efforts are continuing to identify pollutant removal effectiveness of actions and BMPs, and estimated pollutant reductions expected. Not all of the answers to the question of which practices will meet the pollutant reduction goals are included in the Watershed Management Plan (WMP). However, the best available information has been referenced to estimate pollutant reduction predictions.

Table 3.1A - Sediment and Nutrient Loadings from Nonpoint Source Sites by Subwatershed

	Rill & Gully Stabilization			Bank Stabilization			Livestock Access			Construction Sites			Yard Waste		Urban Runoff			TOTAL		
Subshed #	Sediment Loading (ton/year)	Phosphorous Loading (lb/year)	Nitrogen Loading (lb/year)	Sediment Loading (ton/year)	Phosphorous Loading (lb/year)	Nitrogen Loading (lb/year)	Sediment Loading (ton/year)	Phosphorous Loading (lb/year)	Nitrogen Loading (lb/year)	Sediment Loading (ton/year)	Phosphorous Loading (lb/year)	Nitrogen Loading (lb/year)	Phosphorous Loading (lb/year)	Nitrogen Loading (lb/year)	Sediment Loading (ton/year)	Phosphorous Loading (lb/year)	Nitrogen Loading (lb/year)	Sediment Loading (ton/year)	Phosphorous Loading (lb/year)	Nitrogen Loading (lb/year)
1																		0.00	0.00	0.00
2	0.1	0.085	0.17										0.70	2.04				0.10	0.78	2.21
3	0.2	0.17	0.34	0.50	0.42	0.72				3.39	2.88	5.76	0.31	0.91	0.30	1.00	11.00	4.39	4.78	18.72
4				4.95	4.21	7.15				4.79	4.07	8.14	0.23	0.68				9.74	8.51	15.97
5																		0.00	0.00	0.00
6				7.01	5.96	10.13							0.16	0.45	1.63	5.00	61.00	8.64	11.12	71.59
7				0.33	0.28	0.48				11.18	9.50	19.01	0.23	0.68				11.51	10.01	20.17
8							6.60	5.61	9.54				0.31	0.91				6.60	5.92	10.45
9																		0.00	0.00	0.00
10				0.83	0.70	1.19												0.83	0.70	1.19
11				4.54	3.86	6.56									0.57	2.00	17.00	5.11	5.86	23.56
12															0.04	0.00	2.00	0.04	0.00	2.00
13																		0.00	0.00	0.00
TOTAL	**0.30**	**0.26**	**0.51**	**18.15**	**15.43**	**26.23**	**6.60**	**5.61**	**9.54**	**19.36**	**16.45**	**32.91**	**1.94**	**5.68**	**2.54**	**8.00**	**91.00**	**46.95**	**47.68**	**165.86**

Table 3.2A - Sediment and Nutrient Reductions from Nonpoint Source Sites by Subwatershed

	Rill & Gully Stabilization			Bank Stabilization			Livestock Access			Construction Sites			Yard Waste		Urban Runoff			TOTAL		
Subshed #	Sediment Reduction (ton/year)	Phosphorous Reduction (lb/year)	Nitrogen Reduction (lb/year)	Sediment Reduction (ton/year)	Phosphorous Reduction (lb/year)	Nitrogen Reduction (lb/year)	Sediment Reduction (ton/year)	Phosphorous Reduction (lb/year)	Nitrogen Reduction (lb/year)	Sediment Reduction (ton/year)	Phosphorous Reduction (lb/year)	Nitrogen Reduction (lb/year)	Phosphorous Reduction (lb/year)	Nitrogen Reduction (lb/year)	Sediment Loading (ton/year)	Phosphorous Loading (lb/year)	Nitrogen Loading (lb/year)	Sediment Loading (ton/year)	Phosphorous Loading (lb/year)	Nitrogen Loading (lb/year)
1																		0.00	0.00	0.00
2	0.1	0.085	0.17										0.70	2.04				0.10	0.78	2.21
3	0.2	0.17	0.34	0.50	0.42	0.72				2.71	0.68	4.61	0.31	0.91	0.27	0.00	9.00	3.68	1.58	15.57
4				4.95	4.21	7.15				3.83	0.96	6.51	0.23	0.68				8.78	5.40	14.34
5																		0.00	0.00	0.00
6				7.01	5.96	10.13							0.16	0.45	1.20	0.00	23.00	8.21	6.12	33.59
7				0.33	0.28	0.48				8.94	7.60	15.20	0.23	0.68				9.27	8.11	16.36
8							6.60	5.61	9.54				0.31	0.91				6.60	5.92	10.45
9																		0.00	0.00	0.00
10				0.83	0.70	1.19												0.83	0.70	1.19
11				4.54	3.86	6.56									0.42	0.00	11.00	4.96	3.86	17.56
12															0.03	0.00	1.00	0.03	0.00	1.00
13																		0.00	0.00	0.00
TOTAL	**0.30**	**0.26**	**0.51**	**18.15**	**15.43**	**26.23**	**6.60**	**5.61**	**9.54**	**15.48**	**9.24**	**26.32**	**1.94**	**5.68**	**1.92**	**0.00**	**44.00**	**42.45**	**32.47**	**112.27**

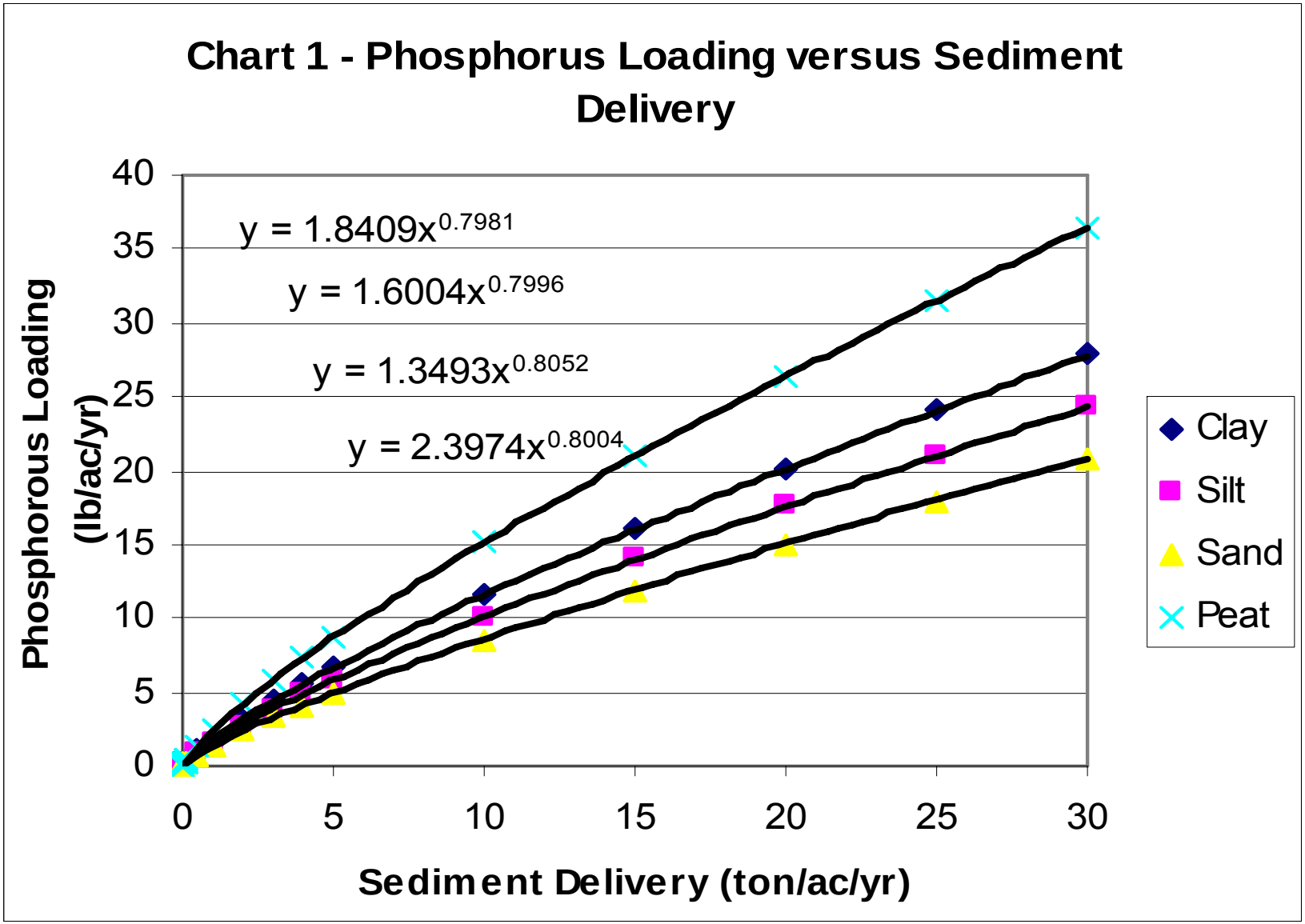


Chart 1 - Phosphorus Loading versus Sediment Delivery
Phosphorous Loading (lb/ac/yr)
Sediment Delivery (ton/ac/yr)
y = 1.8409x^0.7981
y = 1.6004x^0.7996
y = 1.3493x^0.8052
y = 2.3974x^0.8004
Clay
Silt
Sand
Peat
0
5
10
15
20
25
30
35
40

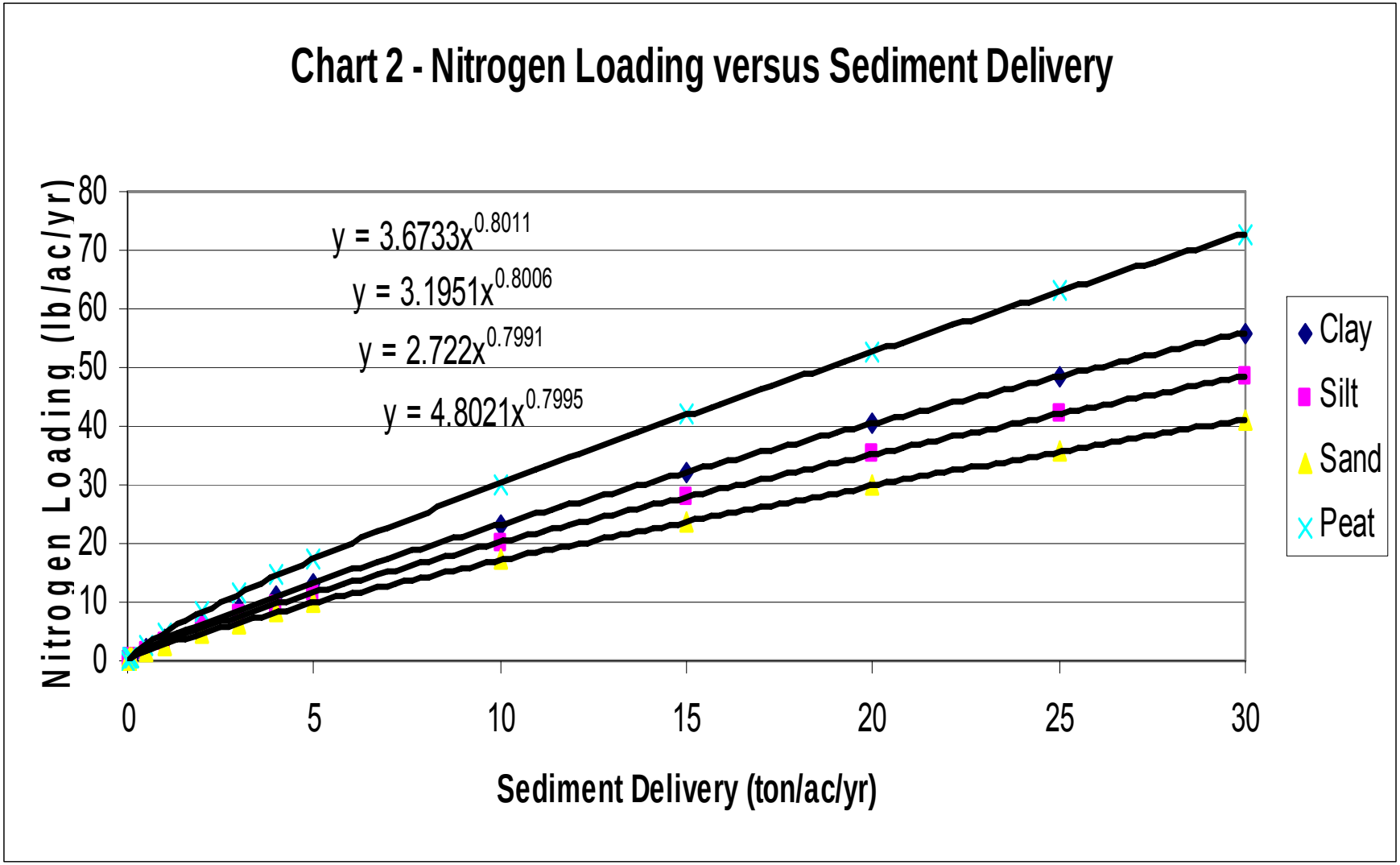


Chart 2 - Nitrogen Loading versus Sediment Delivery
Nitrogen Loading (lb/ac/yr)
0
10
20
30
40
50
60
70
80
0
5
10
15
20
25
30
Sediment Delivery (ton/ac/yr)
y = 3.6733x^0.8011
y = 3.1951x^0.8006
y = 2.722x^0.7991
y = 4.8021x^0.7995
Clay
Silt
Sand
Peat

Table 3.3A - Monthly *E.coli* Analytical Results – Buck Creek Watershed September 2005 to June 2006

		(*E.coli*/100 ml)	(*E.coli*/100 ml)	(*E.coli*/100 ml)	(*E.coli*/100 ml)
STATION_ID	***Subwatershed***	***9/13/2005***	***10/17/2005***	***5/9/2006***	***6/13/2006***
BCK01	13	192	89	75	1046
BCK02	12	2420	1414	111	1733
BCK03	11	1733	2420	179	196
BCK04	10	461	345	192	517
BCK05	8	727	236	248	1414
BCK06	7	1300	517	326	921
BCK07	5	1553	361	687	1414
BCK08	3	980	345	272	816
BCK09	2	579	219	162	649
BCK10	1	435	365	1046	727
BCK11	4	1046	387	921	1414
BCK12	6	2420	548	365	1733

Table 3.4A - Urban BMP Pollutant Removal Efficiencies (*Source – IEPA*)

Urban BMP	**TSS Removal Percentage**	**N Removal Percentage**	**TP Removal Percentage**
Porous Pavement	90	85	65
Infiltration Trench	75	55	60
Grass Swale	65	10	25
Extended Wet Detention	86	55	69
Oil/Grit Separator	15	5	5

Table 3.5A - BMP Implementation Detail

Pollutant Source	BMP	Technical Assistance	Unit Cost	Number of Affected Sites	Total Cost	Financial Assistance
Debris and obstructions	Manage woody debris	KCDC, MDEQ, MDNR, local governments	$10/foot - obstruction removal	Log jam (4 sites)	$200	Drain assessments, MDNR grants
	Organize creek clean-up event	WMEAC, LGRW Council, local governments	$60/day - trash removal by volunteers	Trash (35 sites)	$120	Stream clean up grants, WMEAC Adopt-a-stream program,
Yard waste	Mail information to landowners	LGRW Council, local governments	$4/mailing	Yard waste piles (22 sites)	$8	EPA Education grants, municipalities, LGRW Council
Streambank erosion	Filter strip	KCD, NRCS, land conservancies	$190-$350/acre	Erosion by agricultural runoff (2 sites)	<$400	USDA farm bill programs, 319 and CMI grants, land conservancy programs, private landowners
	Rain garden	WMEAC, Rain Gardens of West Michigan, KCDC	$5-$15/square foot	Erosion by residential/commercial runoff (7 sites)	$5,600 to $16,800	319 and CMI grants, drain assessments, local governments
	Exclusion fencing	KCD, NRCS	$2/linear foot	Horse access erosion (1 site)	$80	USDA farm bill programs, 319 or CMI grants, private landowners
	Riprap	Road Commission, KCDC	$70/square yard	Road/stream crossing erosion (2 sites)	$560	Road commission general fund, drain assessments
	SESC - proper use of existing silt fence	County or Municipal Enforcing Agent	$210-$840 6-month inspection fee	Construction site erosion (1 site)	$210 to $840	Developers
	Investigate pollution sources	KCD, NRCS, local governments	$65/hour	Unknown source of erosion (3 sites)	$195	319 grant, drain assessments, local governments

Table 3.5A - BMP Implementation Detail

Pollutant Source	BMP	Technical Assistance	Unit Cost	Number of Affected Sites	Total Cost	Financial Assistance
Urban runoff	Rain garden (extended wet detention)	WMEAC, Rain Gardens of West Michigan, KCDC	$5-$15/square foot	Residential/commercial runoff (3 sites)	$8,800 to $26,400	319 and CMI grants, drain assessments, local governments
	Dry detention	Consultants, manufacturers	$5-$15/square foot	Industrial runoff (1 site)	To be determined	319 or CMI grants, businesses, local governments
	Porous pavement	Consulting Engineers, DPW staffs, manufacturers	$7-$20 per sq foot	Commercial sites (2 sites)	To be determined	Drain assessments, local governments, local businesses, 319 and CMI grants
	Vegetated filter strips	Consulting Engineers, DPW staffs	$4-$10 per linear foot	Residential riparian (6 sites)	To be determined	319 and CMI grants, drain assessments, local governments
	Wildlife and pet waste management	MDNR, local officials	Site specific – to be determined	Pet waste stations	To be determined	MDNR, MDEQ grants, local park and recreation departments
Construction sites	SESC - silt fence	County or Municipal Enforcing Agent, Contractor	$2/linear foot	Residential/commercial construction (2 sites)	To be determined	Developers
	SESC - silt fence	County or Municipal Enforcing Agent, Contractor	$2/linear foot	Road construction (2 sites)	To be determined	Developers
Rill and gully erosion	Grade stabilization, grass waterways	KCD, NRCS	$70/square yard	Residential/commercial runoff (3 sites)	To be determined	319 and CMI grants, drain assessments, local governments
Livestock access	Exclusion fencing	KCD, NRCS	$2/linear foot	Livestock access (1 site) Ag reductions	$300	USDA farm bill programs, 319 or CMI grants, private landowners
Stream crossings	Obstruction removal	KCDC, Road Commission	$10/foot - obstruction removal	Obstructed flow (1 site) check site, cause of erosion, dam? Calculate deposition?	<$500	Road commission general funds, drain assessments

Table 3.5A - BMP Implementation Detail

Pollutant Source	BMP	Technical Assistance	Unit Cost	Number of Affected Sites	Total Cost	Financial Assistance

Notes:
SESC = Soil Erosion Sedimentation Control
KCDC = Kent County Drain Commissioner
NRCS = USDA Natural Resources Conservation Service
USDA - U.S. Department of Agriculture
MDNR - Michigan Department of Natural Resources
WMEAC - West Michigan Environmental Action Council
CMI = State of Michigan's Clean Michigan Initiative
DPW = Department of Public Works

CHAPTER 4A - DESIGNATED AND DESIRED USES

Addendum Summary - Table 4.1A further defines the reaches of water bodies that are impaired or threatened.

Table 4.1A - Status of Designated Uses

Designated Use	Status of Designated Use	Pollutants
High Priority		
Coldwater fishery	Moderately impaired north of 84th Street to limits of City of Grandville. Severely impaired in Lemery Park and Burlingame Avenue areas	Sediment (k)
	Moderately impaired north of 84th Street to limits of City of Grandville	Nutrients (k)
	Slightly threatened in the City of Grandville	Road salt (s)
	Might pose a threat	Temperature (s)
Partial body contact recreation	Fishing opportunities are impaired from creek mouth to 68th Street due to water quality exceedances for *E. coli*	Pathogens *(E. coli)* (k)
Total body contact recreation	Swimming (wading at Palmer Park) is impaired from creek mouth to 68th Street due to water quality exceedances for *E. coli*	Pathogens *(E. coli)* (k)
Coolwater fishery	Moderately impaired in the City of Grandville	Sediment (k)
	Moderately impaired in the City of Grandville	Nutrients (k)
	Slightly threatened in the City of Grandville	Road salt (s)
Medium Priority		
Warmwater fishery	Slightly to moderately impaired south of 84th Street	Sediment (k)
	Slightly to moderately impaired south of 84th Street	Nutrients (k)
Low Priority		
Other indigenous aquatic life and wildlife	Moderately to severely impaired habitats	Sediment (k)
Agriculture	WQS being met	
Industrial supply	WQS being met	
Navigation	Not a use	
Public water supply	Not a use	

(k) = known
(s) = suspected

CHAPTER 7A - EVALUATION

Addendum Summary - To meet the EPA required elements, substantial documentation of evaluation methods must be incorporated into the plan to assess the effectiveness of the activities and determine if progress is being made toward meeting the goals in the Watershed Management Plan (WMP). Table 7.2 in the 2003 WMP described the required elements for monitoring the overall success in reducing pollutants. Section 7.1.3A and Table 7.2A describe the evaluation criteria and monitoring components that will be used to evaluate the specific BMPs implemented to address the impairments identified in the 2003 Watershed inventory. Measurable goals and milestones are also explained in Table 7.2A. Table 7.3A outlines a monitoring program to evaluate long-term pollutant load reductions. This chapter addresses the following required elements:

Element F) a schedule for implementing measures,

Element G) a description of milestones,

Element H) a set of criteria to determine if load reductions are being met, and

Element I) monitoring components to evaluate effectiveness.

7.1.3A EVALUATION OF THE IMPLEMENTATION ACTIVITIES

Evaluation components to evaluate success of the implemented BMPs are provided in Table 7.2A. This information should be consulted by watershed managers of the Buck Creek Watershed prior to BMP implementation to ensure effective watershed management practices. The implementation schedule was originally submitted based on the severity of individual nonpoint source sites, as short-term (within five years), intermediate (within three to eight years), or long-term (within five to ten years). The updated schedule, in Table 7.2A, includes BMPs of education and policy, and sets milestones of three years and ten years in which to accomplish the tasks.

Table 7.3A provides evaluation methods to determine if pollutant reduction loads are being achieved over time for sediment, *E.coli*, nutrients, trash and debris, and other urban contaminants. Short-term goals and long-term pollutant reduction goals are identified.

The evaluation process is an important part of watershed planning that allows for a review of watershed conditions and impairments each time the evaluation is completed. It also establishes a mechanism for determining the success and usefulness of programs initiated within the Watershed in response to problems defined in the planning process. A well planned evaluation process measures the effectiveness of the Watershed plan by showing changes in the public's awareness of water quality issues, changes in attitudes or behavior, changes in conditions of the Watershed, and improvements in water quality. Local

counties, municipalities, and organizations within the Watershed will do much of the evaluation. Certain environmental measurements, however, are best conducted by the MDEQ and/or the MDNR.

The Lower Grand River Watershed Council is identified as the agency responsible for tracking the progress of pollution prevention efforts, as well as revising and updating the WMP when necessary. A review of the implementation process, effectiveness of pollution prevention activities, and tracking of these activities has been discussed at council meetings, and will be incorporated into the strategic plan for the council.

SUMMARY OF MONITORING COMPONENTS

Several parameters are currently being measured in the Watershed. Some are conducted at a local level, while others are administered at county and state levels. The establishment of targets, against which observed measurements are compared, is essential for the monitoring components to be successful in determining whether progress toward meeting the goals is being made. The targets set are not enforceable, just a measure that the council can use to gauge the implementation efforts. The monitoring components recommended in Table 7.2A and Table 7.3A that require explanation are summarized below.

MICHIGAN DEPARTMENT OF AGRICULTURE (MDA) CONSERVATION DISTRICT REVIEW

The MDA is responsible for overseeing the operations of the conservation districts around the state. Yearly reviews of the districts are conducted to determine if activities, programs, and funding sources that the districts use are effective to carry out their missions.

USDA - NRCS YEARLY STATUS REVIEWS

The NRCS District Office is required to report annually on the agricultural practices installed in the county under all Farm Bill Programs. Tracking the practices and the resource concerns which they address will assess water quality impacts from agricultural operations.

KCDC

The KCDC regularly conducts physical inventories and inspections of the county drains, investigating problems associated with soil erosion and sedimentation, high flows, habitat degradation, and agricultural practices impairing water quality.

MDEQ STREAM CROSSING SURVEYS

The MDEQ stream crossing survey procedure was developed as a quick screening tool to assess general water quality and possible pollutant sources, causes, and problems within the Watershed. The survey procedure provides standardized visual assessments that can be conducted by MDEQ staff or trained volunteers. Because this assessment is based on visual observations designed to be conducted quickly, the survey results are only qualitative in nature. In addition, each site is photo-documented with a digital picture taken in the downstream direction, upstream direction, and of the stream crossing. Examples of information collected at a site include: weather and any event conditions, culvert/bridge conditions, channel conditions, stream appearance, substrate composition, in-stream cover, stream corridor, and potential pollutant sources. MDEQ conducts these surveys on a 5-year cycle for each watershed.

POLLUTANT REDUCTION CALCULATIONS

The MDEQ provides instruction to calculate and document pollutant reduction from treatments to sources of sediment and nutrient pollutants using BMPs. The methods have standardized the progress reporting to systematically represent water quality impacts and statewide achievements. As BMPs are installed, pollutant reductions can be calculated to estimate the amount of pollutants prevented from entering the stream and compare the cost of BMPs to the amount of pollutants reduced.

7.3A MEASURABLE GOALS, CRITERIA, AND MILESTONES

An evaluation of the implementation of the WMP will provide the council an opportunity to assess the effectiveness of the activities that have been implemented to achieve the goals set forth in the WMP. This chapter will describe the set of criteria that will be used to determine if BMP implementation is successful, pollutant reductions are being achieved over time, and if substantial progress is being made toward attaining WQSs.

The evaluation criteria outlined in Table 7.2A provide an indication of how BMPs can be assessed to evaluate success. Some criteria are more appropriate for measuring progress on a watershed basis, such as public awareness surveys and fishery surveys. Other criteria are more appropriate for specific sites or small tributaries, such as pollutant reduction calculations or student monitoring results. Through this evaluation process, communities and agencies will be better informed about public response and the success of the project, what improvements are necessary to the project, and which BMPs need to continue as part of the project. The success of the BMPs, collectively and over time, is assumed to have a positive impact on the water quality, even though these evaluation criteria may not be directly tied to water quality measurements. Evaluation components described in Table 7.3A, however, are designed to directly evaluate changes in water quality.

Criteria have been established to determine whether the WMP will need to be revised if the pollution reductions are not being achieved or progress is not being made toward meeting water quality standards. The WMP will also need to be revised if the milestones are not being met or the BMPs being implemented are not adequately meeting the defined goal. If additional watershed concerns are discovered, the milestones, actions, and commitments would also need to be updated.

The evaluation of BMP effectiveness is outlined in Table 7.2A. The process is organized by matching a monitoring component to each BMP recommended and then describing the criteria and milestones for measuring progress toward meeting the goals and objectives. To determine whether the BMPs are being implemented and if the progress in meeting the goals is moving in the right direction, 3-year and 10-year milestones were developed. The parties responsible for working with the Council in evaluating the achievement of the milestones are also included in Table 7.2A.

The evaluation methods recommended for assessing pollutant reductions are described in Table 7.3A. Monitoring techniques are prioritized and are listed by pollutant. Short-term goals are identified along with long-term pollutant reduction goals. An evaluation schedule and potential partnering organizations are also listed.

7.4A MONITORING PLANS

GVMC was awarded a grant in 2004 to monitor *E. coli* in the Buck Creek, Plaster Creek, and Coldwater River Watersheds. A Quality Assurance Project Plan was developed for the water quality monitoring, and the project has almost completed its second year of monitoring. The monitoring plan is included in the Quality Assurance Project Plan (QAPP) previously submitted and approved by MDEQ. The sampling points in the Buck Creek Watershed are illustrated in Figure 5A.

Table 7.2 in the 2003 WMP describes the evaluation techniques that would be feasible and effective to measure success in the Buck Creek Watershed. The specifics of each technique should be developed into a QAPP during future projects to measure the targeted impairment.

Table 7.2A - Evaluation Components to Assess BMP Effectiveness

Pollutant Source	BMP	Monitoring Components (Conduct Monitoring)	Units of Measurement	Criteria	3-Year Milestone (2009)	10-Year Milestone (2016)	Evaluation Schedule	Responsible Parties and Partners to Conduct Evaluation
Nonpoint Source Sites								
Trash and debris	Manage woody debris	Drain Commissioner's inspections (KCDC)	Number of log jams	Fewer log jams	Remove obstructions identified during 2003 inventory. Begin a second assessment of creek and its tributaries for log jams.	Complete survey. Remove 50% of known obstructions according to accepted woody debris management practices.	Every 3 years	LGRW Council, MDNR
	Organize creek clean-up event	Assessment of clean-up event (WMEAC)	Amount of trash picked-up	Decrease in the amount of trash removed from creek.	Identify known areas with large amounts of trash. Remove trash and debris from sites identified in 2003 inventory.	Hold yearly clean-up events.	Yearly	LGRW Council, local governments
Yard waste	Mail information to landowners	Drain Commissioner's inspections (KCDC)	Number of yard waste piles on streambanks	Fewer yard waste piles on streambanks	Identify known areas with yard waste piles. Decrease yard waste dumping by 25%.	Decrease yard waste dumping by 35%.	Every 3 years	LGRW Council, Local governments
Streambank erosion	Filter Strip	Kent Conservation District (KCD) and NRCS records, pollutant reduction calculations (MDA, USDA)	Acres of planted filter strips	Increase acreage of planted filter strips	Identify existing filter strips. Increase total acreage of planted filter strips by 15%.	Increase acreage of filter strips planted by 25%.	Yearly	LGRW Council, KCD, NRCS
	Rain garden	WMEAC records (WMEAC)	Number of rain gardens installed	Increase in number of rain gardens installed	30 rain gardens installed.	60 rain gardens installed.	Every 3 years	LGRW Council, landowners
	Livestock exclusion fencing	KCD and NRCS records, pollutant reduction calculations (MDA, USDA)	Number of access sites	Decrease in number of access sites	Identify current access sites. Decrease total access sites by 15%.	Decrease access sites by 25%.	Yearly	LGRW Council, KCD, NRCS
	Riprap	Drain Commissioner's inspections (KCDC)	Number of streambank erosion sites	Fewer streambank erosion sites	Identify existing streambank erosion sites. Decrease streambank erosion sites by 15%.	Decrease streambank erosion sites by 25%.	Every 3 years	LGRW Council, KCDC
	SESC - proper use of existing silt fence	County records (SESC County Enforcing Agency)	Number of violations addressed	Fewer violations	Decrease violations by 10% based on past records.	Decrease violations by 20%.	Yearly	LGRW Council , County Enforcing Agent,
	Investigate pollution sources	Investigation assessment (LGRW Council)	Number of sites addressed	Fewer sites impacted by unknown pollution sources	Identify pollution sources of sites with unknown pollution sources according to the 2003 inventory.	Address pollution sources for all 3 sites.	Yearly	LGRW Council
Urban runoff	Rain garden	WMEAC records (WMEAC)	Number of rain gardens installed	Increase in number of rain gardens installed	30 rain gardens installed.	60 rain gardens installed.	Yearly	LGRW Council, landowners
	Oil/grit separators	DPW Inspections (Local governments, KCDC)	Number of oil/grit separators installed	Increase in number of oil/grit separators installed	10 oil/grit separators installed.	20 oil/grit separators installed.	Yearly	LGRW Council, developers

Table 7.2A - Evaluation Components to Assess BMP Effectiveness

Pollutant Source	BMP	Monitoring Components (Conduct Monitoring)	Units of Measurement	Criteria	3-Year Milestone (2009)	10-Year Milestone (2016)	Evaluation Schedule	Responsible Parties and Partners to Conduct Evaluation
Construction sites	SESC - silt fence	County records (SESC County Enforcing Agency)	Number of violations addressed	Fewer violations	Decrease in violations by 10% based on past records.	Decrease in violations by 20%.	Yearly	LGRW Council , County Enforcing Agent
Rill and gully erosion	Berm rain gardens	WMEAC records (WMEAC)	Number of berms and rain gardens installed	Increase in number of berms and rain gardens installed	30 rain gardens and associated berms installed (berms installed only where needed).	60 rain gardens and associated berms installed (berms installed only where needed).	Yearly	LGRW Council, landowners
Livestock access	Livestock exclusion fencing	KCD and NRCS records, pollutant reduction calculations (MDA, USDA)	Number of access sites	Decrease in number of access sites	Identify current access sites. Decrease total access sites by 15%.	Decrease access sites by 25%.	Yearly	LGRW Council, KCD, NRCS
Tile outlets	Riprap for outlet protection	Drain Commissioner's inspections (KCDC)	Number of tile outlets causing streambank erosion	Fewer tile outlets causing streambank erosion	Address tile outlets identified in 2003 inventory.	Riprap 25% of known tile outlets causing erosion based on new inventory results.	Every 3 years	LGRW Council, KCDC
Stream crossings	Obstruction removal	Drain Commissioner's inspections, MDEQ Road Stream Crossing Survey (KCDC, MDEQ)	Number of culvert obstructions	Fewer culvert obstructions	Remove obstructions identified during 2003 inventory. Begin an assessment of creek and its tributaries for culvert obstructions.	Complete survey. Remove 20% of known culvert obstructions.	Every 3 years	LGRW Council, KCDC

Table 7.3A - Evaluation Components to Determine Pollutant Load Reductions

Impairment	Evaluation Technique	Priority	Units of Measurement	2009 Short-Term Goals	2016 Long-Term Pollutant Reduction Goal	Evaluation Schedule	Partners in Evaluation
Sediment	Biological surveys	Medium	Habitat/water quality rankings	Increase biota abundance/diversity scores and quality rankings	25% reduction in sediment load	Annually	WMEAC (WMEAC), Grand Valley State University (GVSU), MDEQ
	Water quality monitoring - lab analysis	High	Suspended Solids Concentration (SSC) for long-term water quality	Reduce excessive pollutant inputs to surface waters		Annually	WMEAC (WMEAC), Grand Valley State University (GVSU), MDEQ
E. coli	Water quality monitoring - lab analysis	High	Pathogen counts per 100 ml	Meet water quality standards of 1,000 count *E.coli*/100 ml for partial body contact recreation and 130 count/100 ml in areas for total body contact recreation	Meet TMDL	Annually	Kent County Health Department (KCHC), MDEQ, Consultants
Nutrients	Biological surveys	Medium	Fish/macroinvertebrate abundance and diversity scores and habitat/water quality rankings	Increase biota abundance/diversity scores and quality rankings	15% reduction in nutrient load	Annually	West Michigan Environmental Action Council (WMEAC), Grand Valley State University (GVSU), MDEQ
	Water quality monitoring - lab analysis	High	N and TP Mg/L	Reduce excessive pollutant inputs to surface waters		Annually	WMEAC (WMEAC), Grand Valley State University (GVSU), MDEQ
Debris and Obstructions	Removal Activities	High	Amount of logjams and trash removed from stream and streambanks	Reduction in the amount of log jams and trash found from baseline data	15% reduction in the amount of trash and debris	Annually	KCDC, Municipalities, MDNR, MDEQ, consultants, Municipal DPWs, youth groups, community service programs
Yard Waste	Removal Activities	High	Amount of yard waste piles removed from stream and streambanks	Reduction in the amount of yard waste piles found from baseline data	15% reduction in the amount of yard waste piles	Annually	KCDC, Municipalities, Municipal DPWs, youth groups, community service programs
Other Urban Contaminants	Hydrologic analysis	Medium	Hydrographs of peak flows	Reduction of peak flows by limiting impervious cover, minimizing channelization of streams, and restoration of wetlands and storage areas	Stabilized flows	Every 5 Years	MDEQ, consultants
	Impervious cover calculations	Medium	Percentage of impervious cover in watershed	Changing development rules to limit amount of impervious cover in Watershed	No increase in amount of impervious surfaces	Every 5 Years	GVSU, REGIS, MDEQ, consultants

Notes: REGIS: Regional Geographic Information System

CHAPTER 9A - INFORMATION AND EDUCATION STRATEGY

Addendum Summary - EPA requires an information and education component that will be used to enhance public understanding of the project and encourage their early and continuous participation in selecting, designing, and implementing the BMPs that will be implemented. Table 9.2 in the 2003 WMP described the Information & Education Strategy recommended for the Buck Creek Watershed. Table 9.2A provides additional detail for the BMPs that are recommended to address the identified impairments.

Table 9.2A - Information and Education Implementation

Objectives	Information and Education Activity	Products	Estimated Costs	Hours	Evaluation Techniques
Stabilize stream flows to moderate hydrology and increase base flow	Tours of successful BMP sites	Yearly tour, in spring	$125 each	16 hours each	Follow-up questionnaires to participants
	Targeted workshop	2 workshops/year	$200 per workshop	40 hours/ workshop	Follow-up questionnaires to participants
	Lawn, garden, and landscape activities	Yearly activities, in summer	$125 each	16 hours each	Follow-up questionnaires to participants
	Media releases/articles	Develop 1 kit, update as needed	$500 to develop, $150 to update	40 hours to develop, 20 hours for update	Responses, requests, comments
Reduce soil erosion and sedimentation	Storm drain stenciling or marking	1 event/year	$250/event	30 hours each	Participation, comments
	Media releases/articles	Develop 1 kit, update as needed	$500 to develop, $150 to update	40 hours to develop, 20 hours for update	Responses, requests, comments
	Volunteer macroinvertebrate collection days	Seasonal reports	$1,000 to write and reproduce report	50 hours to write and print	Documentation of adherence to QAPP
	"Did you Know?" fact sheet	500 fact sheets with 30 factoids	$750 for development and printing	30 hours	Comments, times used
Encourage cover crops and no-till practices	Targeted workshop	2 workshops/year	$200 per workshop	40 hours/ workshop	Follow-up questionnaires to participants
Install livestock exclusion fencing	Fact sheets with examples of potential cost savings	30 fact sheets	$3 each	30 hours	Comments, times used
Install filter strips	Fact sheets with cost and savings examples	30 fact sheets	$20 each	30 hours	Comments, times used

Table 9.2A - Information and Education Implementation

Objectives	Information and Education Activity	Products	Estimated Costs	Hours	Evaluation Techniques
Determine TMDL for *E. coli* and reduce inputs to meet water quality standards of 1,000 count/100 ml for areas of partial body contact recreation and 130 count/100 ml for total body contact recreation	Media Releases/articles	Develop 1 kit, update as needed	$500 to develop, $150 to update	40 hours to develop, 20 hours for update	Responses, requests, comments
Encourage proper installation and maintenance of septic systems	Distribute Septic System Owner Guidebooks Presentations throughout Watershed	500 Guidebooks sent once/year and targeted to new home owners with septic systems 2 presentations/ year	$2,500 to develop mailing list and send out $20 each	25 hours 6 hrs each	Responses, requests, comments Q&A period at end of presentation, participation numbers
Encourage sanitary sewers in areas serviced by water utilities					
Exclude livestock access in high-risk areas	Targeted workshop	2 workshops/year	$200 per workshop	40 hours/ workshop	Follow-up questionnaires to participants
Reduce amount of pet waste entering waterways	Distribute materials on pet waste	500 pet waste booklets sent once/year and targeted to new home owners near parks	$2,500 to develop mailing list and send out	25 hours	Responses, requests, comments
	Storm drain stenciling	1 stenciling event/year	$250/event	30 hours each	Participation, comments
Control urban wildlife, such as geese and raccoon populations	Distribute landscaping for water quality booklets	25-100 booklets supplied to communities once/year and distribution plan reviewed.	$5,000 to reprint booklets, develop mailing list and send out	50 hours	Responses, requests, comments
Encourage composting and curbside collections of yard wastes	Mail composting information to landowners	500 composting brochures sent once/year and targeted to new riparian home owners	$2,500 to develop mailing list and send out	25 hours	Responses, requests, comments
Reduce the amount of trash and debris in the creek	Organize creek clean-up event	1 clean up/year in spring	$100 for supplies	50 hours	Amount of trash collected and number of volunteers
Encourage proper installation and maintenance of septic systems	Distribute septic system owner hand books	500 handbooks sent once/year and targeted to new home owners with septic systems	$2,500 to develop mailing list and send out	25 hours	Responses, requests, comments

Table 9.2A - Information and Education Implementation

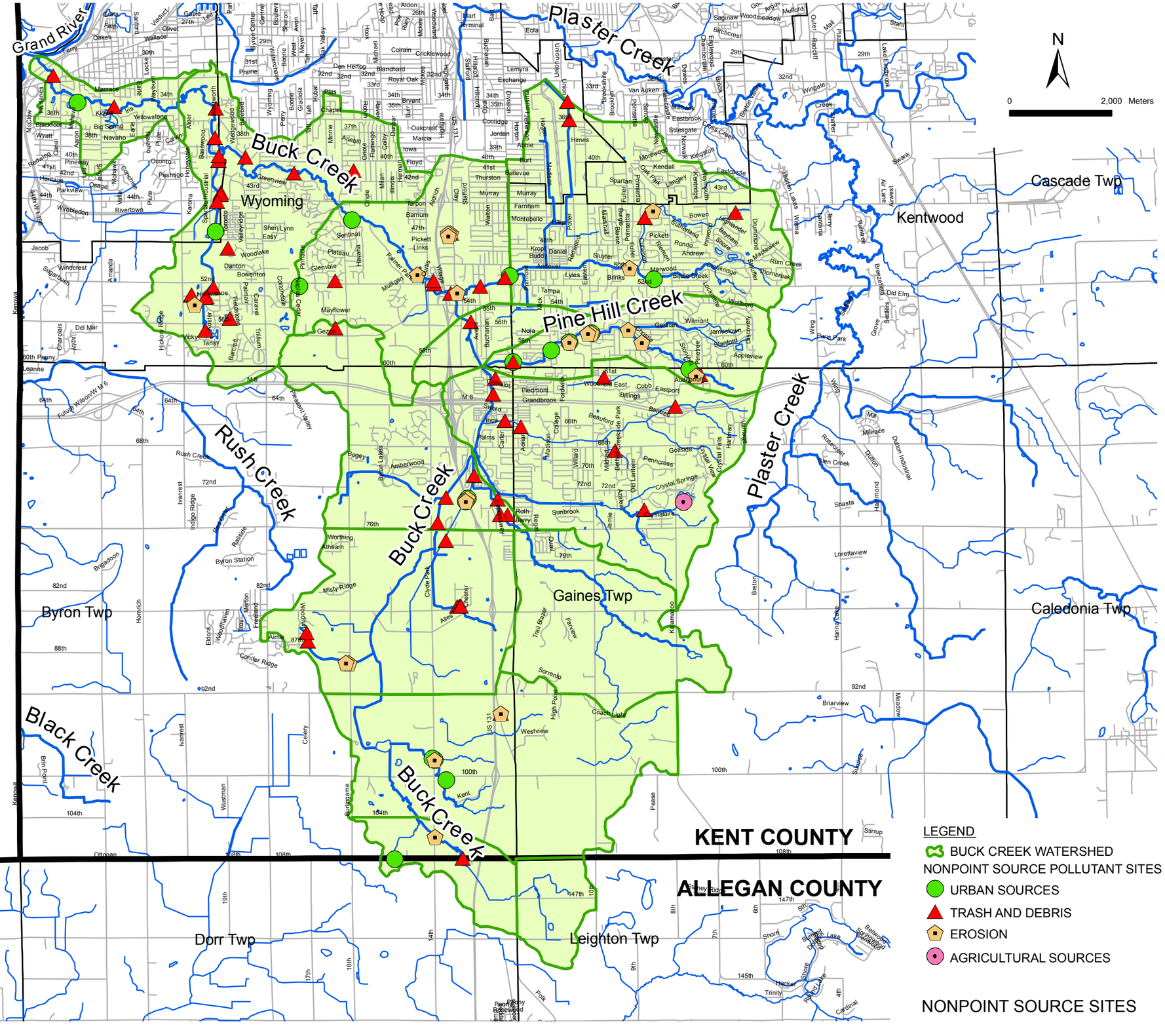
Objectives	Information and Education Activity	Products	Estimated Costs	Hours	Evaluation Techniques
	"Did You Know" lists	500 fact sheets with 30 factoids	$750 for development and printing	30 hours	Comments, times used
Encourage sanitary sewers in areas serviced by water utilities	Media releases/articles	Develop 1 kit, update as needed	$500 to develop, $150 to update	40 hours to develop, 20 hours for update	Responses, requests, comments
Install filter strips	Targeted workshop	2 workshops/year	$200 per workshop	40 hours/ workshop	Follow-up questionnaires to participants
Install livestock exclusion fencing	Targeted workshop	2 workshops/year	$200 per workshop	40 hours/ workshop	Follow-up questionnaires to participants
Calibrate salt application equipment and have proper salt storage	Grounds maintenance training	1 training/year in winter	$200 per training	40 hours/ training	Follow-up questionnaires to participants
	Fact sheets with cost and savings examples	500 fact sheets with examples	$750 for development and printing	30 hours	Comments, times used
	Targeted workshop	2 workshops/year	$200 per workshop	40 hours/ workshop	Follow-up questionnaires to participants
Encourage use of alternative de-icing techniques	De-icing alternatives demonstrations	1 demonstration/ year in fall	$200 per demonstration	40 hours/ demonstration	Follow-up questionnaires to participants
Reduce the amount of impervious surfaces	Targeted workshop	2 workshops/year	$200 per workshop	40 hours/ workshop	Follow-up questionnaires to participants
	Tours of successful BMP sites	Yearly tour	$125 each	16 hours each	Follow up questionnaires to participants
	Distribute materials on landscaping for water quality	25-100 booklets supplied to communities once/year and distribution plan reviewed.	$5,000 to reprint booklets, develop mailing list and send out	50 hours	Responses, requests, comments
	Distribute Riparian Homeowner Guidebooks	500 guidebooks sent once/year and targeted to new riparian home owners	$2,500 to develop mailing list and send out	25 hours	Responses, requests, comments
	Distribute materials on storm water education	500 mailings sent once/year and targeted to new home owners	$2,500 to develop mailing list and send out	25 hours	Responses, requests, comments
	Tours of successful BMP sites	Yearly tours	$125 each	16 hours each	Follow-up questionnaires to participants

Literature Cited

MDEQ. 1999. *Pollutants Controlled Calculation and Documentation for Section 319 Watersheds Training Manual.* Nonpoint Source Unit, Surface Water Quality Division, MDEQ, Lansing, Michigan

Jamieson, Rob, Doug M. Joy, Hung Lee, Ray Kostaschuk, Robert Gordon. 2005. Transport and deposition of sediment-associated *Escherichia coli* in natural streams. Water Research 39 (2005) 2665-2675.

Figures



LEGEND

BUCK CREEK WATERSHED

NONPOINT SOURCE POLLUTANT SITES

- URBAN SOURCES
- TRASH AND DEBRIS
- EROSION
- AGRICULTURAL SOURCES

NONPOINT SOURCE SITES

DATA SOURCES: MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION,FRAMEWORK V 2A, MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY, DIGITAL WATERSHEDS. NPS SITES, BUCK CREEK WATERSHED MANAGEMENT PLAN, 2003.

PLOT INFO: D:\work\G02408EC MapDocument\BUCK_WMPSAMPLEPNTS.mxd DATE: 8/2/2006 USER: MCL

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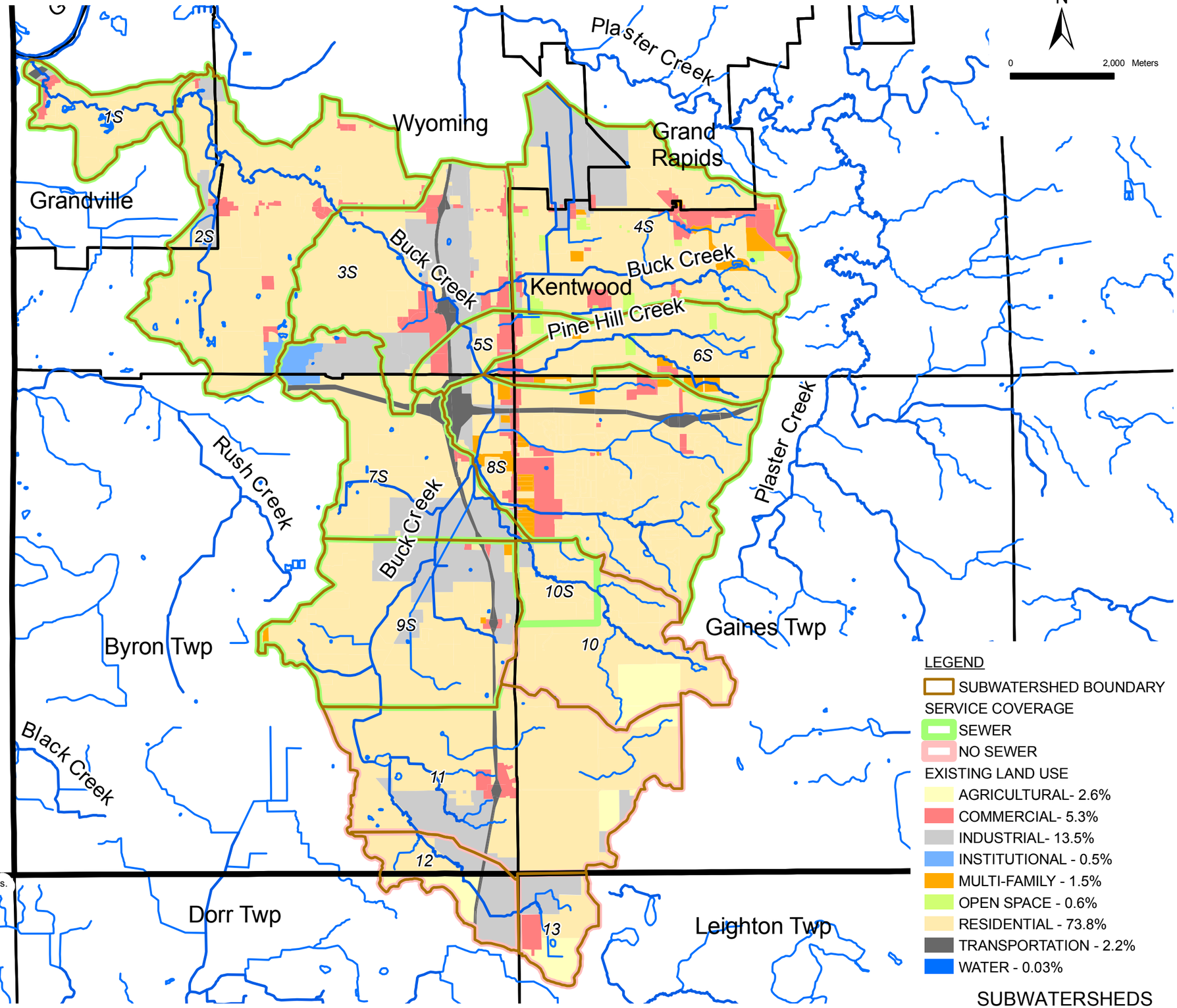
Muskegon, Ottawa, Kent, Montcalm, Ionia, Barry, and Eaton Counties, Michigan

Buck Creek
Watershed Management Plan Addendum

PROJECT NO.
G02408EC

FIGURE NO.
4A



SUBWATERSHEDS

DATA SOURCES: MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION FRAMEWORK V. 2A, MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY DIGITAL SHEDS, GVMC REGIS STORM SEWER AND ZONING.

PLOT INFO: D:\WORK\G2408EC\MAP_DOCUMENT\BUCK_EXLANDUSE.MXD DATE: 12/18/2006 USER: MCL

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PROJECT NO.
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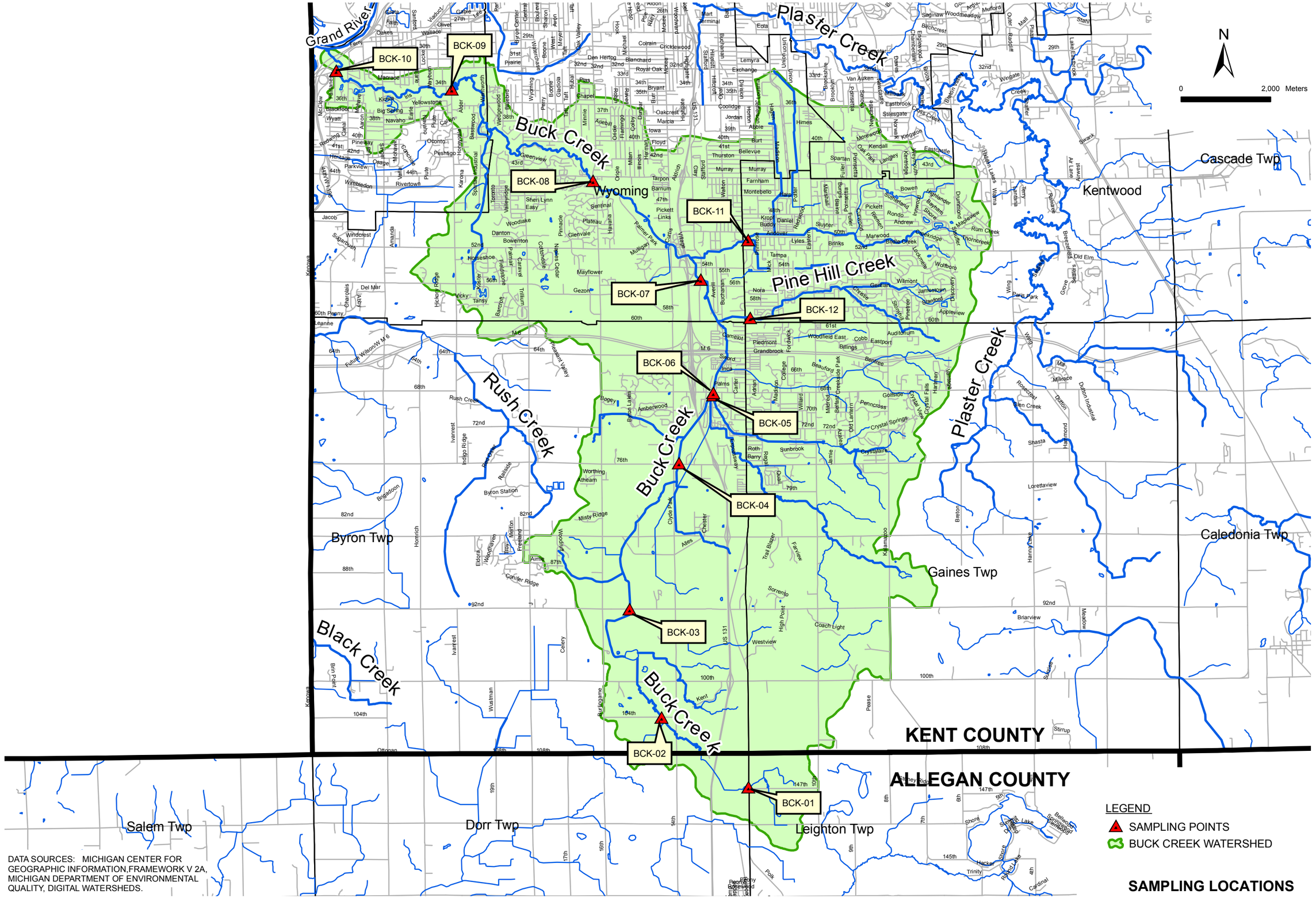
FIGURE NO.
4B



DATA SOURCES: MICHIGAN CENTER FOR GEOGRAPHIC INFORMATION,FRAMEWORK V 2A, MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY, DIGITAL WATERSHEDS.

LEGEND

- SAMPLING POINTS
- BUCK CREEK WATERSHED

SAMPLING LOCATIONS

PLOT INFO: D:\work\G02408EC MapDocument\BUCK_WMPSAMPLEPNTS.mxd DATE: 7/6/2006 USER: MCL

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PROJECT NO.
G02408EC

FIGURE NO.
5A

Appendix 1

Appendix 3.4 - Nonpoint Source Data

Trash and Debris

SITE ID NUMBER	DATE	Trash and	PHOTO	TOWNSHIP	LAND USE LEFT	LAND USE RIGHT	TYPE OF TRASH AND DEBRIS	AMOUNT	COMMENTS
08BYR3601	26-Jun-03	BUCK CREEK	NO	BYRON CENTER	IDLE	IDLE	LOG JAM OBSTRUCTING FLOW OF CREEK	SLIGHT	
1154GRC2107	22-Aug-03	BEMAN AND FOLEY DRAIN	YES	GRANDVILLE			PRESENT		EXCESSIVE SAND AND TREES, LEAVES, BRANCHES BLOCKING WATERWAY. ALSO, CHAIR AND MISC. TRASH.
1154GRC2110	22-Aug-03	BEMAN AND FOLEY DRAIN	YES	GRANDVILLE			PRESENT		LOOKS LIKE CAR OIL.
1154GRC2116	25-Aug-03	BEMAN AND FOLEY DRAIN	YES	GRANDVILLE			PRESENT		GRASS CLIPPINGS
1154GRC2117	25-Aug-03	BEMAN AND FOLEY DRAIN	YES	GRANDVILLE			PRESENT		GRASS CLIPPINGS
1154GRC2809	3-Jul-03		NO	GRANDVILLE			PRESENT		
1154WYO2116	21-Aug-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		
1154WYO3333	23-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
1154WYO3337	23-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
1154WYO3339	24-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GLASS CLIPPINGS ON THE BANK
1154WYO3347	24-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
1154WYO3348	24-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
1154WYO3357	25-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
1155BYR2217	30-Jun-03	TRIBUTARY (1155)	YES	BYRON CENTER			PRESENT		NOT COMPLETELY FULL...JUST BEHIND HOUSES
1155BYR2218	1-Jul-03	TRIBUTARY (1155)	YES	BYRON CENTER			PRESENT		
1157BYR1323	20-Jun-03	TRIBUTARY (1157)	YES	BYRON CENTER			PRESENT		
1157BYR1324	20-Jun-03	TRIBUTARY (1157)	YES	BYRON CENTER			PRESENT		
1157BYR1325	20-Jun-03	TRIBUTARY (1157)	YES	BYRON CENTER			PRESENT		
1157BYR1326	20-Jun-03	TRIBUTARY (1157)	YES	BYRON CENTER			PRESENT		
11601GAI0838	6-Jun-03	TRIBUTARY (11601)	YES	GAINES TWP			PRESENT		CRYSTAL SPRINGS, GRASS CLIPPINGS BY POND
11611GAI0859	9-Jun-03	CUTLERVILLE DRAIN (TRIBUTARY)	YES	GAINES TWP			PRESENT		
1161BYR0126	17-Jun-03	CUTLERVILLE DRAIN	YES	BYRON CENTER			PRESENT		YARD WASTE ON STREAM BANK
1161GAI0620	23-May-03	CUTLERVILLE DRAIN	YES	GAINES TWP			PRESENT		
11631KEN2801	6-Aug-03	TRIBUTARY (11631)	YES	KENTWOOD	RES/COMM	RES/COMM	PARKING LOT RUNOFF / TRASH IN STREAM	MODERATE	RETENTION BASIN UPSTREAM / TRASH IN STREAM
11631KEN2901	6-Aug-03	TRIBUTARY (11631)	NO	KENTWOOD	RES/COMM	RES/COMM	GRASS CLIPPINGS ALONG LEFT BANK	SLIGHT	
11632WYO1811	14-Aug-03	HEYBOER DRAIN #2	YES	WYOMING			PRESENT		TWO HUGE CULVERTS
11632WYO1815	14-Aug-03	HEYBOER DRAIN #2	YES	WYOMING			PRESENT		
1163WYO2505	5-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		
1163WYO3614	5-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		TRASH, TREES AND STICKS ALMOST COMPLETELY RESTRICTING WATERWAY
1163WYO3628	6-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		TRUCK DUMP(WATER OR SOME LIQUID). BANK IS ERODED & THERE IS A LOT OF CARDBOARD TRASH. ALGAE GROWING ON GROUND
59GAI0402	4-Aug-03	PINE HILL CREEK	NO	GAINES TWP	RES/COMM	RES/COMM	GRASS CLIPPINGS ALONG BOTH BANKS	SLIGHT	
59KEN3105	4-Aug-03	PINE HILL CREEK	YES	KENTWOOD	IDLE		DEBRIS IN WATER	EXTENSIVE	
59KEN3302	4-Aug-03	PINE HILL CREEK	YES	KENTWOOD		WOODLAND	DEBRIS IN WATER	EXTENSIVE	
6511BYR1316	19-Jun-03	NORFOLK SOUTHERN RAIL ROAD	YES	BYRON CENTER			PRESENT		
65BYR1227	3-Jul-03	76TH STREET INDUSTRIAL PARK DRAIN	YES	BYRON CENTER			PRESENT		TRUNED OVER TRUCK, BEEN THERE FOR QUITE A WHILE, RUSTED
65BYR1228	3-Jul-03	76TH STREET INDUSTRIAL PARK DRAIN	YES	BYRON CENTER			PRESENT		GRASS CLIPPINGS
65BYR1232	3-Jul-03	76TH STREET INDUSTRIAL PK. DRAIN	YES	BYRON CENTER			PRESENT		GRASS CLIPPINGS AND YARD WASTE
65BYR1261	9-Jul-03	TRIBUTARY (65)	YES	BYRON CENTER			PRESENT		CAGE/BED FRAME BLOCKING WATER WAY, THERE IS AN EXTREME AMOUNT OF SEDIMENT AND GROWTH IN CAGE
674BYR2501	17-Oct-03	UNKNOWN (674)	YES	BYRON CENTER	IDLE	RES/COMM	BROKEN PVC PIPES	EXTENSIVE	BROKEN PVC PIPES IMPEDING FLOW THROUGH CULVERT (WEST OF DIVISION - DOWN STREAM)
675GAI0514	10-Jun-03	WATERMAN DRAIN	YES	GAINES TWP			PRESENT		WOODCHIPS OVERFLOWING INTO CREEK, YARD WASTE NEXT TO IT
8BYR0118	17-Jun-03	BUCK CREEK	YES	BYRON CENTER			PRESENT		
8BYR0121	17-Jun-03	BUCK CREEK	YES	BYRON CENTER			PRESENT		WHOLE POND IS TRASHED.... FOAM INSULATION, 2X4'S, TRASH CANS, GRILLS, STEAL BEAMS, BED FRAMES, TIRES, ETC.
8BYR1236	7-Jul-03	BUCK CREEK	YES	BYRON CENTER			PRESENT		OTHER DEBRIS DOWNSTREAM--FROM HERE OR PROBABLY NEXT COMPANY TO THE NORTH
8BYR1255	8-Jul-03	BUCK CREEK	YES	BYRON CENTER			PRESENT		
8GRC1607	17-Jun-03		NO	GRANDVILLE			PRESENT		
8GRC1713	17-Jun-03		NO	GRANDVILLE			PRESENT		
8GRC1815	17-Jun-03		NO	GRANDVILLE			PRESENT		
8GRC2124	25-Aug-03	BUCK CREEK	YES	GRANDVILLE			PRESENT		GRASS CLIPPINGS
8WYO2112	21-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		YARD DEBRIS
8WYO2219	12-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		VARIOUS BITS OF TRASH--PROBABLY FROM UPSTREAM.
8WYO2301	22-Jul-03	UNKNOWN	YES	WYOMING			PRESENT		GRASS CLIPPINGS
8WYO2515	12-Aug-03	UNNAMED LAKE	YES	WYOMING			PRESENT		
8WYO2706	17-Jul-03	WETLAND	YES	WYOMING			PRESENT		GRASS CLIPPINGS
8WYO2816	31-Jul-03	UNKNOWN	YES	WYOMING			PRESENT		CAT LITTER
8WYO3386	29-Jul-03	UNNAMED LAKE	YES	WYOMING			PRESENT		GRASS CLIPPINGS
8WYO3413	17-Jul-03	UNNAMED LAKE	YES	WYOMING			PRESENT		DEBRIS AROUND AND IN LAKE FROM CONSTRUCTION AND BUSINESSES
8WYO3629	6-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		REASH (WATER BOTTLES, SPRAY CANS, CHIP BAGS)
8WYO3634	6-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		GRASS CLIPPINGS
8WYO3636	6-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		GRASS CHIPPINGS
8WYO3645	7-Aug-03	BUCK CREEK	YES	WYOMING			PRESENT		

Appendix 3.4 - Nonpoint Source Data

Construction Sites

SITE ID NUMBER	DATE	WATER BODY	PHOTO	TOWNSHIP	LAND USE LEFT	LAND USE RIGHT	CONSTRUCTION	TYPE	EROSION MEASURES	SEDIMENTATION MEASURES	EXTENT	COMMENTS
1163KEN2905	6-Aug-03	BUCK CREEK	YES	KENTWOOD	WOODLAND	RES/COMM	RIGHT BANK	OTHER - HYDROLOGIC	NOT ADEQUATE	NOT ADEQUATE	SEVERE	
6511BYR1256	9-Jul-03	NORFOLK SOUTHERN RAIL ROAD	YES	BYRON CENTER			PRESENT					131 CROSSING
6511BYR1257	9-Jul-03	NORFOLK SOUTHERN RAIL ROAD	YES	BYRON CENTER			PRESENT					131 CONSTRUCTION, SILT FENCE DOWN
8WYO3416	17-Jul-03	UNNAMED LAKE	YES	WYOMING			PRESENT					SMELLS LIKE SEWAGE BUT COULDN'T FIND PIPE NO SEDIMENT CONTROL

Appendix 3.4 - Nonpoint Source Data

Stream Crossings

SITE ID NUMBER	DATE	WATER BODY	PHOTO	LAND USE LEFT	LAND USE RIGHT	STREAM CROSSINGS	MATERIAL	CONDITION	FLOW RATE	SURFACE	LOCATION	EROSION EXTENT	COMMENTS
08BYR3602	26-Jun-03	BUCK CREEK	YES	IDLE	IDLE	DOUBLE CULVERT	CONCRETE	GOOD	OBSTRUCTED	PAVED			

Appendix 3.4 - Nonpoint Source Data

Rill and Gully Erosion

SITE ID NUMBER	DATE	WATER BODY	PHOTO	TOWNSHIP	RILL AND GULLY EROSION	WIDTH	DEPTH	LENGTH	HEIGHT	LAND USE	COMMENTS
1154WYO3338	23-Jul-03	BEAMAN AND FOLEY DRAIN	YES	WYOMING	PRESENT						
8WYO2517	12-Aug-03	UNNAMED LAKE	YES	WYOMING	PRESENT						
8WYO2519	12-Aug-03	UNNAMED LAKE	YES	WYOMING	PRESENT						

Appendix 3.4 - Nonpoint Source Data

Livestock Access

SITE ID NUMBER	DATE	WATER BODY	PHOTO	LIVESTOCK ACCESS	EROSION LENGTH	EROSION HEIGHT	COVER	COMMENTS
11601GAI0911	27-May-03	TRIBUTARY (11601)	YES	PRESENT				COWS AND HORSES IN STREAM/POND

Appendix 3.4 - Nonpoint Source Data

Tile Outlets

NUMBER	DATE	WATERBODY	PHOTO	TOWNSHIP	FLOW TYPE	WIDTH	DEPTH	LEFT	RIGHT	OUTLET	N	R	MATERIAL	HEIGHT	COLOR	GE ODOR	COMMENTS
1163WYO2501	6-Aug-03	BUCK CREEK	YES	WYOMING	SLOW FLOW	10' OR LESS	<1'	RES/COMM	RES/COMM	LEFT BANK			CLAY	6"-12"	CLOUDY/MILKY	NONE	BLUE / MILKY DISCHARGE NEAR CAR WASH
8WYO2618	12-Aug-03	BUCK CREEK	YES	WYOMING						PRESENT							WOODCHIPS AND OTHER TREE MATERIAL DUMPED INTO WETLAND AREA.

Appendix 3.4 - Nonpoint Source Data

Streambank Erosion

SITE ID NUMBER	DATE	WATER BODY	PHOTO	TOWNSHIP	FLOW TYPE	STREAM WIDTH	STREAM DEPTH	HABITAT	LEFT BUFFER	RIGHT BUFFER	LEFT WIDTH	RIGHT WIDTH	LAND USE LEFT	LAND USE RIGHT	STREAMBANK EROSION LOCATION	EROSION LENGTH	EROSION HEIGHT	SEVERITY	EROSION LOCATION	COMMENTS
1155BYR2201	26-Jun-03	TRIBUTARY (1155)	NO	BYRON CENTER	SLOW FLOW	11'-25'	<1'	TREES	YES	NO	>10'		AGRICULTUR	IDLE	LEFT BANK	10'-25'	3'-6'	SOME BARE BANK	TOE	
1155BYR2201	26-Jun-03	TRIBUTARY (1155)	YES	BYRON CENTER	SLOW FLOW	10' OR LESS	<1'	SHRUBS		YES		>10'	AGRICULTUR	RES/COMM	PRESENT			SOME BARE BANK		
1156BYR2501	26-Jun-03	TRIBUTARY (1156)	YES	BYRON CENTER	SLOW FLOW	10' OR LESS	<1'	GRASS					RES/COMM	RES/COMM	PRESENT			SOME BARE BANK		
11631KEN2902	6-Aug-03	TRIBUTARY (11631)	NO	KENTWOOD	SLOW FLOW	10' OR LESS	<1'	TREES / SHRUBS / GRASS					RES/COMM	RES/COMM	BOTH BANKS	26'-100'	>6'	SOME BARE BANK	TOE	PARKING LOT ON LEFT SIDE, SCHOOL ON RIGHT SIDE OF TRIBUTARY
1163KEN2902	6-Aug-03	HEYBOER CREEK	YES	KENTWOOD	SLOW FLOW	10' OR LESS	1'-3'	GRASS / SHRUBS	YES	YES	>10'	>10'		RES/COMM	PRESENT			MOSTLY BARE BANK		
1163WYO3629	6-Aug-03	BUCK CREEK	YES	WYOMING											PRESENT					TRUCK DUMP(WATER OR SOME LIQUID). BANK IS ERODED & THERE IS A LOT OF CARDBOARD TRASH. ALGAE GROWING ON GROUND
59GAI0401	4-Aug-03	PINE HILL CREEK	NO	GAINES TWP	SLOW FLOW	10' OR LESS	<1'	SHRUBS	YES	YES	3'-10'	3'-10'	RES/COMM	RES/COMM	LEFT BANK	10'-25'	3'-6'	WASHOUT	ENTIRE BANK	
59KEN3101	4-Aug-03	PINE HILL CREEK	YES	KENTWOOD	SLOW FLOW	10' OR LESS	1'-3'	GRASS / SHRUBS					RES/COMM	RES/COMM	PRESENT			SOME BARE BANK		
59KEN3104	4-Aug-03	PINE HILL CREEK	YES	KENTWOOD	SLOW FLOW			GRASS					RES/COMM	RES/COMM	PRESENT			MOSTLY BARE BANK		
59KEN3201	4-Aug-03	PINE HILL CREEK	YES	KENTWOOD	SLOW FLOW	10' OR LESS	<1'	SHRUBS / TREES	YES	YES	>10'	>10'	WOODLAND	WOODLAND	PRESENT			SOME BARE BANK		
59KEN3202	4-Aug-03	PINE HILL CREEK	YES	KENTWOOD	RAPID FLOW	10' OR LESS	<1'	SHRUBS	YES	YES	1'-3'	1'-3'	PARK	PARK	BOTH BANKS	10'-25'	3'-6'	SOME BARE BANK	TOE	LOTS OF EROSION / SEDIMENT (FOREST CANOPY INHIBITS GROWTH OF GROUND COVER)
6511BYR1258	9-Jul-03	NORFOLK SOUTHERN RAIL ROAD	YES	BYRON CENTER											PRESENT					131 CROSSING
6511BYR1259	9-Jul-03	NORFOLK SOUTHERN RAIL ROAD	YES	BYRON CENTER											PRESENT					131 CONSTRUCTION, SILT FENCE DOWN
674BYR2502	17-Oct-03	UNKNOWN (674)	YES	BYRON CENTER	MODERATE FL	10' OR LESS	<1'	SHRUBS	YES	YES	>10'	>10'	RES/COMM	ROAD	BOTH BANKS	10'-25'	3'-6'	WASHOUT	ENTIRE BANK	STREAM BANK IS ERODED AROUND CULVERT LOCATED ~ 200' EAST OF DIVISION
8WYO2516	12-Aug-03	UNNAMED LAKE	YES	WYOMING											PRESENT					
8WYO2619	11-Aug-03	BUCK CREEK	YES	WYOMING											PRESENT					HORSE ALLOWED TO ACCESS CREEK

Appendix 3.4 - Nonpoint Source Data

Urban Runoff

SITE ID NUMBER	DATE	WATER BODY	PHOTO	TOWNSHIP	FLOW TYPE	STREAM WIDTH	STREAM DEPTH	HABITAT	BUFFER LEFT	BUFFER RIGHT	LEFT BUFFER WIDTH	RIGHT BUFFER WIDTH	LAND USE LEFT	LAND USE RIGHT	URBAN RUNOFF SOURCE	SOURCE LOCATION	WASTE LOCATION	TYPE OF WASTE	COMMENTS
1156BYR2502	26-Jun-03	TRIBUTARY (1156)	YES	BYRON CENTER	SLOW FLOW	10' OR LESS	<1'	GRASS					RES/COMM	RES/COMM	PRESENT				
1156BYR2601	26-Jun-03	TRIBUTARY (1156)	NO	BYRON CENTER	SLOW FLOW	11'-25'	1'-3'	GRASS	NO	NO			RES/COMM	RES/COMM	RESIDENTIAL LAWN			TURF RUNOFF	
1156BYR3601	26-Jun-03	TRIBUTARY (1156)	NO	BYRON CENTER	SLOW FLOW	10' OR LESS	1'-3'	SHRUBS	YES	YES	3'-10'	3'-10'	INDUSTRIAL	RES/COMM	INDUSTRIAL / LANDFILL	LEFT BANK	LEFT BANK	LANDFILL RUNOFF	RUNOFF POSSIBLY FROM LANDFILL
1158BYR3501	26-Jun-03	UNKNOWN DRAIN	NO	BYRON CENTER	RAPID FLOW	10' OR LESS	<1'	GRASS	NO	NO			RES/COMM	RES/COMM	RESIDENTIAL LAWN	BOTH BANKS	BOTH BANKS	TURF RUNOFF	MAN MADE STREAMBED (GEOTEXTILE & COBBLE) / LAND OWNER IS REMOVING RIPARIAN VEGETATION
1163WYO2501	6-Aug-03	HEYBOER CREEK	NO	WYOMING	SLOW FLOW	10' OR LESS	<1'	GRASS / SHRUBS	YES	YES	>10'	>10'	RES/COMM	RES/COMM	PRESENT				
59GAI0402	4-Aug-03	PINE HILL CREEK	YES	GAINES TWP	SLOW FLOW	10' OR LESS	<1'						RES/COMM	RES/COMM	PRESENT				
59KEN3103	4-Aug-03	PINE HILL CREEK	NO	KENTWOOD	RAPID FLOW	10' OR LESS	1'-3'	GRASS	NO	NO			RES/COMM	RES/COMM	RESIDENTIAL LAWN	BOTH BANKS	BOTH BANKS	TURF RUNOFF	
59KEN3105	4-Aug-03	PINE HILL CREEK	YES	KENTWOOD	SLOW FLOW	10' OR LESS	1'-3'	GRASS / SHRUBS					RES/COMM	RES/COMM	PRESENT				
59KEN3106	4-Aug-03	PINE HILL CREEK	YES	KENTWOOD	SLOW FLOW	10' OR LESS	<1'	GRASS / SHRUBS / TREES	YES	YES	>10'	>10'	RES/COMM	RES/COMM	PRESENT				
59KEN3106	4-Aug-03	PINE HILL CREEK	YES	KENTWOOD	SLOW FLOW			GRASS					RES/COMM	RES/COMM	PRESENT				
59KEN3201	4-Aug-03	PINE HILL CREEK	NO	KENTWOOD	RAPID FLOW	10' OR LESS	<1'	GRASS	NO	NO			RES/COMM	RES/COMM	RESIDENTIAL LAWN	BOTH BANKS	BOTH BANKS		NO BUFFER - LAWNS BORDER STREAM
59KEN3301	4-Aug-03	PINE HILL CREEK	YES	KENTWOOD	SLOW FLOW	10' OR LESS	<1'	GRASS / SHRUBS					RES/COMM	RES/COMM	PRESENT				

Appendix 2

RILL & GULLY

Site ID	Subshed	Rill & Gully Length (ft)	Rill & Gully Depth (ft)	Rill & Gully Top Width (ft)	Rill & Gully Bottom Width (ft)	Rill & Gully Volume (ft^3)	Soil type	Soil Weight ($tons/ft^3$)	Number of Years	Annual Sediment Load (100% delivery) and Reduction (100% reduced) (tons/yr)	Phosphorus Loading and Reduction (lbs/yr)	Nitrogen Loading and Reduction (lbs/yr)	S	P	N
1154WYO3338	2	50	1.5	10	2	10	fine sandy loam	0.05	5	0.100	0.085	0.170	0.100	0.085	0.170
8WYO2517	3	50	1.5	10	2	10	fine sandy loam	0.05	5	0.100	0.085	0.170			
8WYO2519	3	50	1.5	10	2	10	fine sandy loam	0.05	5	0.100	0.085	0.170	0.200	0.170	0.340
									TOTAL	**0.300**	**0.255**	**0.510**			

BMPs:
Grade Stabilization Structure
Grassed Waterway
Critical Area Planting
Water and Sediment Control Basin

Estimate

Streambank Erosion

Site ID	Subshed	Buffer Width Right	Buffer Width Left	Streambank Erosion Length (ft)	Streambank Erosion Height (ft)	Erosion Severity	Streambank Erosion	Erosion Area (ft^2)	Lateral Recession Rate (ft/yr)	Soil Weight ($tons/ft^3$)	Sediment Loading (100% delivery) Reduction (100% reducton) (tons/yr)	Phosphorus Loading and Reduction (lbs/yr)	Nitrogen Loading and Reduction (lbs/yr)	S	P	N
1163WYO3629	3			10	6	SOME BARE BANK	PRESENT	60	0.05	0.055	0.165	0.14	0.24			
8WYO2516	3			10	6	SOME BARE BANK	PRESENT	60	0.05	0.055	0.165	0.14	0.24			
8WYO2619	3			10	6	SOME BARE BANK	PRESENT	60	0.05	0.055	0.165	0.14	0.24	0.50	0.42	0.72
11631KEN2902	4			100	12	SOME BARE BANK	BOTH BANKS	1200	0.05	0.055	3.3	2.81	4.77			
1163KEN2902	4	>10'	>10'	25	6	MOSTLY BARE BANK	PRESENT	150	0.20	0.055	1.65	1.40	2.38	4.95	4.21	7.15
59KEN3202	6	1'-3'	1'-3'	25	6	SOME BARE BANK	BOTH BANKS	150	0.05	0.055	0.4125	0.35	0.60			
59GAI0401	6	3'-10'	3'-10'	25	6	WASHOUT	LEFT BANK	150	0.50	0.055	4.125	3.51	5.96			
59KEN3104	6			25	6	MOSTLY BARE BANK	PRESENT	150	0.20	0.055	1.65	1.40	2.38			
59KEN3101	6			25	6	SOME BARE BANK	PRESENT	150	0.05	0.055	0.4125	0.35	0.60			
59KEN3201	6	>10'	>10'	25	6	SOME BARE BANK	PRESENT	150	0.05	0.055	0.4125	0.35	0.60	7.01	5.96	10.13
6511BYR1258	7			10	6	SOME BARE BANK	PRESENT	60	0.05	0.055	0.165	0.14	0.24			
6511BYR1259	7			10	6	SOME BARE BANK	PRESENT	60	0.05	0.055	0.165	0.14	0.24	0.33	0.28	0.48
1155BYR2201	10	>10'		25	6	SOME BARE BANK	LEFT BANK	150	0.05	0.055	0.4125	0.35	0.60			
1155BYR2201	10		>10'	25	6	SOME BARE BANK	PRESENT	150	0.05	0.055	0.4125	0.35	0.60	0.83	0.70	1.19
674BYR2502	11	>10'	>10'	25	6	WASHOUT	BOTH BANKS	150	0.50	0.055	4.125	3.51	5.96			
1156BYR2501	11			25	6	SOME BARE BANK	PRESENT	150	0.05	0.055	0.4125	0.35	0.60	4.54	3.86	6.56
										TOTAL	**18.15**	**15.43**	**26.23**			

Soil Type Loamy sand
Correction factor 0.85
Soil weight .055 Loamy Sand

BMPs
Stream Channel Stabilization
Streambank Protection

estimates

Livestock Access

Site ID	Subshed	Buffer Width Right	Buffer Width Left	Streambank Erosion Length (ft)	Streambank Erosion Height (ft)	Erosion Severity	Streambank Erosion	Erosion Area (ft^2)	Lateral Recession Rate (ft/yr)	Soil Weight ($tons/ft^3$)	Sediment Loading (100% delivery) Reduction (100% reducton) (tons/yr)	Phosphorus Loading and Reduction (lbs/yr)	Nitrogen Loading and Reduction (lbs/yr)	S	P	N
11601GAI0911	8	1'-3'	1'-3'	50	6	SOME BARE BANK	BOTH BANKS	300	0.40	0.055	6.60	5.61	9.54	6.60	5.61	9.54

Soil Type Loamy sand
Correction factor 0.85
Soil weight .055 Loamy Sand

BMPs
Exclusion Fencing

Estimates

Construction Sites

SITE ID NUMBER	Subshed	Before Soil Loss (tons/yr)	BMP Reduction	After Soil Loss (tons/yr)	Before Phosphorus Loading (lbs/yr)	BMP Reduction	After Phosphorus Loading (tons/yr)	Before Nitrogen Loading (lbs/yr)	BMP Reduction	After Nitrogen loading (tons/yr)	Loading S	Loading P	Loading N	Reduction S	Reduction P	Reduction N
8WYO3416	3	3.39	2.71	0.68	2.88	2.30	0.58	5.76	4.61	1.16	3.39	2.88	5.76	2.71	2.30	4.61
1163KEN2905	4	4.79	3.83	0.96	4.07	3.26	0.82	8.14	6.51	1.63	4.79	4.07	8.14	3.83	3.26	6.51
6511BYR1256	7	5.59	4.47	1.12	4.75	3.80	0.95	9.50	7.60	1.90						
6511BYR1257	7	5.59	4.47	1.12	4.75	3.80	0.95	9.50	7.60	1.90	11.18	9.50	19.01	8.94	7.60	15.20
		19.36	**15.48**	**3.88**	**16.456**	**13.158**	**3.298**	**32.912**	**26.316**	**6.596**						

Soil Type Loamy sand
Correction factor 0.85
Soil weight .055 Loamy Sand

BMPs
Mulch Type: Straw/hay
Mulch Rate: 1(tons/acre)

Estimates

Urban Runoff

SITE ID NUMBER	Subshed	Before TSS Loading (tons/yr)	BMP Reduction (tons/yr)	After TSS Loading (tons/yr)	Before Phosphorus Loading (lbs/yr)	BMP Reduction (lbs/yr)	After Phosphorus Loading (lbs/yr)	Before Nitrogen Loading (lbs/yr)	BMP Reduction (lbs/yr)	After Nitrogen Loading (lbs/yr)	Loading			Reduction		
											S	P	N	S	P	N
1163WYO2501	3	0.295	0.265	0.0295	1	0	0	11	9	2	0.30	1.00	11.00	0.27	0.00	9.00
59GAI0402	6	0.295	0.2155	0.0795	1	0	0	11	4	6						
59KEN3103	6	0.0775	0.0665	0.011	0	0	0	3	2	1						
59KEN3105	6	0.295	0.2155	0.0795	1	0	0	11	4	6						
59KEN3106A	6	0.295	0.2155	0.0795	1	0	0	11	4	6						
59KEN3106B	6	0.295	0.2155	0.0795	1	0	0	11	4	6						
59KEN3201	6	0.0775	0.0565	0.021	0	0	0	3	1	2						
59KEN3301	6	0.295	0.2155	0.0795	1	0	0	11	4	6	1.63	5.00	61.00	1.20	0.00	23.00
1156BYR2502	11	0.26	0.234	0.026	1	0	0	9	8	1						
1156BYR2601	11	0.0385	0.033	0.0055	0	0	0	2	1	1						
1156BYR3601	11	0.27	0.1555	0.115	1	0	0	6	2	4	0.57	2.00	17.00	0.42	0.00	11.00
1158BYR3501	12	0.0385	0.033	0.0055	0	0	0	2	1	1	0.04	0.00	2.00	0.03	0.00	1.00
	TOTAL	2.53	1.92	0.61	8.00	0.00	0.00	91.00	44.00	42.00	2.53	8.00	91.00	1.92	0.00	44.00

Assume all sites .5 acres

BMPs
Porous Pavement
Extended Wet Detention
Dry Detention
Vegetated Filter Strip

Estimates

Yard Waste

SITE ID NUMBER	Subshed	Waterbody	TOWNSHIP	YARD WASTE	AVE. AMOUNT (cft/yr)	Density (lb/cft)	Phosphorus (lbs/yr)	Nitrogen (lbs/yr)	P	N
1154WYO3339	2	BEAMAN AND FOLEY DRAIN	WYOMING	GLASS CLIPPINGS ON THE BANK	1	8.3	0.08	0.23		
1154WYO3333	2	BEAMAN AND FOLEY DRAIN	WYOMING	GRASS CLIPPINGS	1	8.3	0.08	0.23		
1154WYO3337	2	BEAMAN AND FOLEY DRAIN	WYOMING	GRASS CLIPPINGS	1	8.3	0.08	0.23		
1154WYO3347	2	BEAMAN AND FOLEY DRAIN	WYOMING	GRASS CLIPPINGS	1	8.3	0.08	0.23		
1154WYO3348	2	BEAMAN AND FOLEY DRAIN	WYOMING	GRASS CLIPPINGS	1	8.3	0.08	0.23		
1154WYO3357	2	BEAMAN AND FOLEY DRAIN	WYOMING	GRASS CLIPPINGS	1	8.3	0.08	0.23		
8WYO2301	2	UNKNOWN	WYOMING	GRASS CLIPPINGS	1	8.3	0.08	0.23		
8WYO3386	2	UNNAMED LAKE	WYOMING	GRASS CLIPPINGS	1	8.3	0.08	0.23		
8WYO2112	2	BUCK CREEK	WYOMING	YARD DEBRIS	1	8.3	0.08	0.23	0.70	2.04
8WYO3636	3	BUCK CREEK	WYOMING	GRASS CHIPPINGS	1	8.3	0.08	0.23		
8GRC2124	3	BUCK CREEK	GRANDVILLE	GRASS CLIPPINGS	1	8.3	0.08	0.23		
8WYO2706	3	WETLAND	WYOMING	GRASS CLIPPINGS	1	8.3	0.08	0.23		
8WYO3634	3	BUCK CREEK	WYOMING	GRASS CLIPPINGS	1	8.3	0.08	0.23	0.31	0.91
1154GRC2116	4	BEMAN AND FOLEY DRAIN	GRANDVILLE	GRASS CLIPPINGS	1	8.3	0.08	0.23		
1154GRC2117	4	BEMAN AND FOLEY DRAIN	GRANDVILLE	GRASS CLIPPINGS	1	8.3	0.08	0.23		
11631KEN2901	4	TRIBUTARY (11631)	KENTWOOD	GRASS CLIPPINGS ALONG LEFT BANK	1	8.3	0.08	0.23	0.23	0.68
59GAI0402	6	PINE HILL CREEK	GAINES TWP	GRASS CLIPPINGS ALONG BOTH BANKS	2	16.6	0.16	0.45	0.16	0.45
65BYR1232	7	76TH STREET INDUSTRIAL PK. DRAIN	BYRON CENTER	GRASS CLIPPINGS AND YARD WASTE	2	16.6	0.16	0.45		
65BYR1228	7	76TH STREET INDUSTRIAL PARK DRAIN	BYRON CENTER	GRASS CLIPPINGS	1	8.3	0.08	0.23	0.23	0.68
11601GAI0838	8	TRIBUTARY (11601)	GAINES TWP	CRYSTAL SPRINGS, GRASS CLIPPINGS BY POND	1	8.3	0.08	0.23		
675GAI0514	8	WATERMAN DRAIN	GAINES TWP	WOODCHIPS OVERFLOWING INTO CREEK, YARD WASTE NEXT TO IT	2	16.6	0.16	0.45		
1161BYR0126	8	CUTLERVILLE DRAIN	BYRON CENTER	YARD WASTE ON STREAM BANK	1	8.3	0.08	0.23	0.31	0.91
				TOTAL	**25.00**	**207.50**	**1.94**	**5.68**		

Source of method
http://www.abe.psu.edu/extension/factsheets/c/C2.pdf

BMPs:
Composting

SITE ID NUMBER	Subshed	DATE	WATERBODY	PHOTO	TOWNSHIP	LAND USE LEFT	LAND USE RIGHT	AMOUNT	TYPE OF TRASH AND DEBRIS
1154GRC2107	2	22-Aug-03	BEMAN AND FOLEY DRAIN	YES	GRANDVILLE				EXCESSIVE SAND AND TREES, LEAVES, BRANCHES BLOCKING WATERWAY. ALSO, CHAIR AND MISC. TRASH.
1163WYO3614	3	5-Aug-03	BUCK CREEK	YES	WYOMING				TRASH, TREES AND STICKS ALMOST COMPLETELY RESTRICTING WATERWAY
08BYR3601	12	26-Jun-03	BUCK CREEK	NO	BYRON CENTER	IDLE	IDLE	SLIGHT	LOG JAM OBSTRUCTING FLOW OF CREEK
08BYR3602	12	26-Jun-03	BUCK CREEK	YES	BYRON CENTER	IDLE	IDLE		OBSTRUCTED DOUBLE CONCRETE CULVERT

SITE ID NUMBER	AMOUNT	TYPE OF TRASH AND DEBRIS
674BYR2501	EXTENSIVE	BROKEN PVC PIPES IMPEDING FLOW THROUGH CULVERT (WEST OF DIVISION - DOWN STREAM)
65BYR1261		CAGE/BED FRAME BLOCKING WATER WAY, THERE IS AN EXTREME AMOUNT OF SEDIMENT AND GROWTH IN CAGE
8WYO2816		CAT LITTER
8WYO3413		DEBRIS AROUND AND IN LAKE FROM CONSTRUCTION AND BUSINESSES
59KEN3105	EXTENSIVE	DEBRIS IN WATER
59KEN3302	EXTENSIVE	DEBRIS IN WATER
1154GRC2110		LOOKS LIKE CAR OIL.
1155BYR2217		NOT COMPLETELY FULL...JUST BEHIND HOUSES
8BYR1236		OTHER DEBRIS DOWNSTREAM--FROM HERE OR PROBABLY NEXT COMPANY TO THE NORTH
11631KEN2801	MODERATE	PARKING LOT RUNOFF, RETENTION BASIN UPSTREAM / TRASH IN STREAM
1154GRC2809		TRASH
1154WYO2116		TRASH
1155BYR2218		TRASH
1157BYR1323		TRASH
1157BYR1324		TRASH
1157BYR1325		TRASH
1157BYR1326		TRASH
11611GAI0859		TRASH
1161GAI0620		TRASH
11632WYO1815		TRASH
1163WYO2505		TRASH
6511BYR1316		TRASH
8BYR0118		TRASH
8BYR1255		TRASH
8GRC1607		TRASH
8GRC1713		TRASH
8GRC1815		TRASH
8WYO2515		TRASH
8WYO3645		TRASH
8WYO3629		TRASH (WATER BOTTLES, SPRAY CANS, CHIP BAGS)
1163WYO3628		TRUCK DUMP(WATER OR SOME LIQUID). BANK IS ERODED & THERE IS A LOT OF CARDBOARD TRASH. ALGAE GROWING ON GROUND
65BYR1227		TURNED OVER TRUCK, BEEN THERE FOR QUITE A WHILE, RUSTED
11632WYO1811		TWO HUGE CULVERTS
8WYO2219		VARIOUS BITS OF TRASH--PROBABLY FROM UPSTREAM.
8BYR0121		WHOLE POND IS TRASHED.... FOAM INSULATION, 2X4'S, TRASH CANS, GRILLS, STEAL BEAMS, BED FRAMES, TIRES, ETC.

1158 BYR3501

8/9/2007

URBAN RUNOFF BMP POLLUTANT LOAD REDUCTION WORKSHEET

Please fill in the gray areas below.

Notes:
The methodology and efficiency values used in this worksheet were developed by the Illinois Environmental Protection Agency.

Please Select a Best Management Practice:

☐ Vegetated Filter Strips	☐ Sand Filters	☐ Sand Filter/Infiltration Basin
☐ Grass Swales	☐ WQ Inlets	☐ WQ Inlet w/ Sand Filter
☐ Infiltration Device	☐ Weekly Street Sweeping	☐ Oil/Grit Separator
◉ Extended Wet Detention	☐ Infiltration Basin	☐ Wet Pond
☐ Wetland Detention	☐ Infiltration Trench	
☐ Dry Detention	☐ Porous Pavement	
☐ Settling Basin	☐ Concrete Grid Pavement	

Please enter landuse of contributing/drainage area in acres:

	Sewered	Unsewered
Commercial		
Industrial		
Institutional		
Transportation		
Multi-Family		
Residential		0.5
Agriculture		
Vacant		
Open Space		

Note: Sewered and Unsewered refer to storm sewers.

Estimated Load and Load Reductions

	Load before BMP (lbs/yr)	Load after BMP (lbs/yr)	Load Reduction (lbs/yr)
BOD	6	2	4
COD	36	U	U
TSS	77	11	66
LEAD	0	0	0
COPPER	0	U	U
ZINC	0	0	0
TDS	109	U	U
TN	2	1	1
TKN	1	U	U
DP	0	U	U
TP	0	0	0
CADMIUM	0	U	U

tons/yr

.0385 .0055 .033

U = Removal Efficiency for the particular BMP and constituent unavailable.

59KEN3103

8/9/2007

URBAN RUNOFF BMP POLLUTANT LOAD REDUCTION WORKSHEET

Please fill in the gray areas below.

Notes:
The methodology and efficiency values used in this worksheet were developed by the Illinois Environmental Protection Agency.

Please Select a Best Management Practice:

☐ Vegetated Filter Strips	☐ Sand Filters	☐ Sand Filter/Infiltration Basin
☐ Grass Swales	☐ WQ Inlets	☐ WQ Inlet w/ Sand Filter
☐ Infiltration Device	☐ Weekly Street Sweeping	☐ Oil/Grit Separator
◉ Extended Wet Detention	☐ Infiltration Basin	☐ Wet Pond
☐ Wetland Detention	☐ Infiltration Trench	
☐ Dry Detention	☐ Porous Pavement	
☐ Settling Basin	☐ Concrete Grid Pavement	

Please enter landuse of contributing/drainage area in acres:

	Sewered	Unsewered
Commercial		
Industrial		
Institutional		
Transportation		
Multi-Family		
Residential	0.5	
Agriculture		
Vacant		
Open Space		

Note: Sewered and Unsewered refer to storm sewers.

Estimated Load and Load Reductions

	Load before BMP (lbs/yr)	Load after BMP (lbs/yr)	Load Reduction (lbs/yr)
BOD	11	3	8
COD	70	U	U
TSS	155	22	133
LEAD	0	0	0
COPPER	0	U	U
ZINC	0	0	0
TDS	218	U	U
TN	3	1	2
TKN	2	U	U
DP	0	U	U
TP	0	0	0
CADMIUM	0	U	U

tons/yr

.0775 .011 .0665

U = Removal Efficiency for the particular BMP and constituent unavailable.

11562BYR2601

8/9/2007

URBAN RUNOFF BMP POLLUTANT LOAD REDUCTION WORKSHEET

Please fill in the gray areas below.

Notes:
The methodology and efficiency values used in this worksheet were developed by the Illinois Environmental Protection Agency.

Please Select a Best Management Practice:

☐ Vegetated Filter Strips	☐ Sand Filters	☐ Sand Filter/Infiltration Basin
☐ Grass Swales	☐ WQ Inlets	☐ WQ Inlet w/ Sand Filter
☐ Infiltration Device	☐ Weekly Street Sweeping	☐ Oil/Grit Separator
◉ Extended Wet Detention	☐ Infiltration Basin	☐ Wet Pond
☐ Wetland Detention	☐ Infiltration Trench	
☐ Dry Detention	☐ Porous Pavement	
☐ Settling Basin	☐ Concrete Grid Pavement	

Please enter landuse of contributing/drainage area in acres:

	Sewered	Unsewered
Commercial		
Industrial		
Institutional		
Transportation		
Multi-Family		
Residential		0.5
Agriculture		
Vacant		
Open Space		

Note: Sewered and Unsewered refer to storm sewers.

Estimated Load and Load Reductions

	Load before BMP (lbs/yr)	Load after BMP (lbs/yr)	Load Reduction (lbs/yr)
BOD	6	2	4
COD	36	U	U
TSS	77	11	66
LEAD	0	0	0
COPPER	0	U	U
ZINC	0	0	0
TDS	109	U	U
TN	2	1	1
TKN	1	U	U
DP	0	U	U
TP	0	0	0
CADMIUM	0	U	U

tons/yr

.0385 .0055 .033

U = Removal Efficiency for the particular BMP and constituent unavailable.

1152BYR3601

8/9/2007

URBAN RUNOFF BMP POLLUTANT LOAD REDUCTION WORKSHEET

Please fill in the gray areas below.

Notes:
The methodology and efficiency values used in this worksheet were developed by the Illinois Environmental Protection Agency.

Please Select a Best Management Practice:

☐ Vegetated Filter Strips	☐ Sand Filters	☐ Sand Filter/Infiltration Basin
☐ Grass Swales	☐ WQ Inlets	☐ WQ Inlet w/ Sand Filter
☐ Infiltration Device	☐ Weekly Street Sweeping	☐ Oil/Grit Separator
☐ Extended Wet Detention	☐ Infiltration Basin	☐ Wet Pond
☐ Wetland Detention	☐ Infiltration Trench	
◉ Dry Detention	☐ Porous Pavement	
☐ Settling Basin	☐ Concrete Grid Pavement	

Please enter landuse of contributing/drainage area in acres:

	Sewered	Unsewered
Commercial		
Industrial		0.5
Institutional		
Transportation		
Multi-Family		
Residential		
Agriculture		
Vacant		
Open Space		

Note: Sewered and Unsewered refer to storm sewers.

Estimated Load and Load Reductions

	Load before BMP (lbs/yr)	Load after BMP (lbs/yr)	Load Reduction (lbs/yr)
BOD	20	15	5
COD	115	92	23
TSS	540	230	311
LEAD	1	0	0
COPPER	0	U	U
ZINC	1	0	0
TDS	565	U	U
TN	6	4	2
TKN	2	U	U
DP	0	U	U
TP	1	0	0
CADMIUM	0	U	U

tons/yr

.27 .115 .1555

U = Removal Efficiency for the particular BMP and constituent unavailable.

1163W402501

8/9/2007

URBAN RUNOFF BMP POLLUTANT LOAD REDUCTION WORKSHEET

Please fill in the gray areas below.

Notes:
The methodology and efficiency values used in this worksheet were developed by the Illinois Environmental Protection Agency.

Please Select a Best Management Practice:

○ Vegetated Filter Strips	○ Sand Filters	○ Sand Filter/Infiltration Basin
○ Grass Swales	○ WQ Inlets	○ WQ Inlet w/ Sand Filter
○ Infiltration Device	○ Weekly Street Sweeping	○ Oil/Grit Separator
○ Extended Wet Detention	○ Infiltration Basin	○ Wet Pond
○ Wetland Detention	○ Infiltration Trench	
○ Dry Detention	◉ Porous Pavement	
○ Settling Basin	○ Concrete Grid Pavement	

Please enter landuse of contributing/drainage area in acres:

	Sewered	Unsewered
Commercial	0.5	
Industrial		
Institutional		
Transportation		
Multi-Family		
Residential		
Agriculture		
Vacant		
Open Space		

Note: Sewered and Unsewered refer to storm sewers.

Estimated Load and Load Reductions

	Load before BMP (lbs/yr)	Load after BMP (lbs/yr)	Load Reduction (lbs/yr)
BOD	43	U	U
COD	295	59	236
TSS	590	59	531
LEAD	1	0	1
COPPER	0	U	U
ZINC	1	0	1
TDS	1,415	U	U
TN	11	2	9
TKN	3	U	U
DP	0	U	U
TP	1	0	0
CADMIUM	0	U	U

tons/yr

.295 .0295 .265

U = Removal Efficiency for the particular BMP and constituent unavailable.

11563YR2502

8/9/2007

URBAN RUNOFF BMP POLLUTANT LOAD REDUCTION WORKSHEET

Please fill in the gray areas below.

Notes:
The methodology and efficiency values used in this worksheet were developed by the Illinois Environmental Protection Agency.

Please Select a Best Management Practice:

○ Vegetated Filter Strips	○ Sand Filters	○ Sand Filter/Infiltration Basin
○ Grass Swales	○ WQ Inlets	○ WQ Inlet w/ Sand Filter
○ Infiltration Device	○ Weekly Street Sweeping	○ Oil/Grit Separator
○ Extended Wet Detention	○ Infiltration Basin	○ Wet Pond
○ Wetland Detention	○ Infiltration Trench	
○ Dry Detention	◉ Porous Pavement	
○ Settling Basin	○ Concrete Grid Pavement	

Please enter landuse of contributing/drainage area in acres:

	Sewered	Unsewered
Commercial		0.5
Industrial		
Institutional		
Transportation		
Multi-Family		
Residential		
Agriculture		
Vacant		
Open Space		

Note: Sewered and Unsewered refer to storm sewers.

Estimated Load and Load Reductions

	Load before BMP (lbs/yr)	Load after BMP (lbs/yr)	Load Reduction (lbs/yr)
BOD	38	U	U
COD	260	52	208
TSS	520	52	468
LEAD	0	0	0
COPPER	0	U	U
ZINC	1	0	1
TDS	1,250	U	U
TN	9	1	8
TKN	3	U	U
DP	0	U	U
TP	1	0	0
CADMIUM	0	U	U

tons/yr

.26 .026 .234

U = Removal Efficiency for the particular BMP and constituent unavailable.

59KEN330

8/9/2007

URBAN RUNOFF BMP POLLUTANT LOAD REDUCTION WORKSHEET

Please fill in the gray areas below.

Notes:
The methodology and efficiency values used in this worksheet were developed by the Illinois Environmental Protection Agency.

Please Select a Best Management Practice:

(•) Vegetated Filter Strips	( ) Sand Filters	( ) Sand Filter/Infiltration Basin
( ) Grass Swales	( ) WQ Inlets	( ) WQ Inlet w/ Sand Filter
( ) Infiltration Device	( ) Weekly Street Sweeping	( ) Oil/Grit Separator
( ) Extended Wet Detention	( ) Infiltration Basin	( ) Wet Pond
( ) Wetland Detention	( ) Infiltration Trench	
( ) Dry Detention	( ) Porous Pavement	
( ) Settling Basin	( ) Concrete Grid Pavement	

Please enter landuse of contributing/drainage area in acres:

	Sewered	Unsewered
Commercial	0.5	
Industrial		
Institutional		
Transportation		
Multi-Family		
Residential		
Agriculture		
Vacant		
Open Space		

Note: Sewered and Unsewered refer to storm sewers.

Estimated Load and Load Reductions

	Load before BMP (lbs/yr)	Load after BMP (lbs/yr)	Load Reduction (lbs/yr)
BOD	43	21	21
COD	295	177	118
TSS	590	159	431
LEAD	1	0	0
COPPER	0	U	U
ZINC	1	0	0
TDS	1,415	U	U
TN	11	6	4
TKN	3	U	U
DP	0	U	U
TP	1	0	0
CADMIUM	0	U	U

U = Removal Efficiency for the particular BMP and constituent unavailable.

59KEN3201

8/9/2007

URBAN RUNOFF BMP POLLUTANT LOAD REDUCTION WORKSHEET

Please fill in the gray areas below.

Notes:
The methodology and efficiency values used in this worksheet were developed by the Illinois Environmental Protection Agency.

Please Select a Best Management Practice:

(•) Vegetated Filter Strips	( ) Sand Filters	( ) Sand Filter/Infiltration Basin
( ) Grass Swales	( ) WQ Inlets	( ) WQ Inlet w/ Sand Filter
( ) Infiltration Device	( ) Weekly Street Sweeping	( ) Oil/Grit Separator
( ) Extended Wet Detention	( ) Infiltration Basin	( ) Wet Pond
( ) Wetland Detention	( ) Infiltration Trench	
( ) Dry Detention	( ) Porous Pavement	
( ) Settling Basin	( ) Concrete Grid Pavement	

Please enter landuse of contributing/drainage area in acres:

	Sewered	Unsewered
Commercial		
Industrial		
Institutional		
Transportation		
Multi-Family		
Residential	0.5	
Agriculture		
Vacant		
Open Space		

Note: Sewered and Unsewered refer to storm sewers.

Estimated Load and Load Reductions

	Load before BMP (lbs/yr)	Load after BMP (lbs/yr)	Load Reduction (lbs/yr)
BOD	11	5	6
COD	70	42	28
TSS	155	42	113
LEAD	0	0	0
COPPER	0	U	U
ZINC	0	0	0
TDS	218	U	U
TN	3	2	1
TKN	2	U	U
DP	0	U	U
TP	0	0	0
CADMIUM	0	U	U

tons/yr
.0775 .021 .0565

U = Removal Efficiency for the particular BMP and constituent unavailable.

59KEN3106B

8/9/2007

URBAN RUNOFF BMP POLLUTANT LOAD REDUCTION WORKSHEET

Please fill in the gray areas below.

Notes:
The methodology and efficiency values used in this worksheet were developed by the Illinois Environmental Protection Agency.

Please Select a Best Management Practice:

(•) Vegetated Filter Strips	( ) Sand Filters	( ) Sand Filter/Infiltration Basin
( ) Grass Swales	( ) WQ Inlets	( ) WQ Inlet w/ Sand Filter
( ) Infiltration Device	( ) Weekly Street Sweeping	( ) Oil/Grit Separator
( ) Extended Wet Detention	( ) Infiltration Basin	( ) Wet Pond
( ) Wetland Detention	( ) Infiltration Trench	
( ) Dry Detention	( ) Porous Pavement	
( ) Settling Basin	( ) Concrete Grid Pavement	

Please enter landuse of contributing/drainage area in acres:

	Sewered	Unsewered
Commercial	0.5	
Industrial		
Institutional		
Transportation		
Multi-Family		
Residential		
Agriculture		
Vacant		
Open Space		

Note: Sewered and Unsewered refer to storm sewers.

Estimated Load and Load Reductions

	Load before BMP (lbs/yr)	Load after BMP (lbs/yr)	Load Reduction (lbs/yr)
BOD	43	21	21
COD	295	177	118
TSS	590	159	431
LEAD	1	0	0
COPPER	0	U	U
ZINC	1	0	0
TDS	1,415	U	U
TN	11	6	4
TKN	3	U	U
DP	0	U	U
TP	1	0	0
CADMIUM	0	U	U

lbs/yr

.295 .0795 .2155

U = Removal Efficiency for the particular BMP and constituent unavailable.

59KEN3106A

8/9/2007

URBAN RUNOFF BMP POLLUTANT LOAD REDUCTION WORKSHEET

Please fill in the gray areas below.

Notes:
The methodology and efficiency values used in this worksheet were developed by the Illinois Environmental Protection Agency.

Please Select a Best Management Practice:

(•) Vegetated Filter Strips	( ) Sand Filters	( ) Sand Filter/Infiltration Basin
( ) Grass Swales	( ) WQ Inlets	( ) WQ Inlet w/ Sand Filter
( ) Infiltration Device	( ) Weekly Street Sweeping	( ) Oil/Grit Separator
( ) Extended Wet Detention	( ) Infiltration Basin	( ) Wet Pond
( ) Wetland Detention	( ) Infiltration Trench	
( ) Dry Detention	( ) Porous Pavement	
( ) Settling Basin	( ) Concrete Grid Pavement	

Please enter landuse of contributing/drainage area in acres:

	Sewered	Unsewered
Commercial	0.5	
Industrial		
Institutional		
Transportation		
Multi-Family		
Residential		
Agriculture		
Vacant		
Open Space		

Note: Sewered and Unsewered refer to storm sewers.

Estimated Load and Load Reductions

	Load before BMP (lbs/yr)	Load after BMP (lbs/yr)	Load Reduction (lbs/yr)
BOD	43	21	21
COD	295	177	118
TSS	590	159	431
LEAD	1	0	0
COPPER	0	U	U
ZINC	1	0	0
TDS	1,415	U	U
TN	11	6	4
TKN	3	U	U
DP	0	U	U
TP	1	0	0
CADMIUM	0	U	U

tons/yr

.295 .0795 .2155

U = Removal Efficiency for the particular BMP and constituent unavailable.

59KEN3105

8/9/2007

URBAN RUNOFF BMP POLLUTANT LOAD REDUCTION WORKSHEET

Please fill in the gray areas below.

Notes:
The methodology and efficiency values used in this worksheet were developed by the Illinois Environmental Protection Agency.

Please Select a Best Management Practice:

◉ Vegetated Filter Strips	○ Sand Filters	○ Sand Filter/Infiltration Basin
○ Grass Swales	○ WQ Inlets	○ WQ Inlet w/ Sand Filter
○ Infiltration Device	○ Weekly Street Sweeping	○ Oil/Grit Separator
○ Extended Wet Detention	○ Infiltration Basin	○ Wet Pond
○ Wetland Detention	○ Infiltration Trench	
○ Dry Detention	○ Porous Pavement	
○ Settling Basin	○ Concrete Grid Pavement	

Please enter landuse of contributing/drainage area in acres:

	Sewered	Unsewered
Commercial	0.5	
Industrial		
Institutional		
Transportation		
Multi-Family		
Residential		
Agriculture		
Vacant		
Open Space		

Note: Sewered and Unsewered refer to storm sewers.

Estimated Load and Load Reductions

	Load before BMP (lbs/yr)	Load after BMP (lbs/yr)	Load Reduction (lbs/yr)
BOD	43	21	21
COD	295	177	118
TSS	590	159	431
LEAD	1	0	0
COPPER	0	U	U
ZINC	1	0	0
TDS	1,415	U	U
TN	11	6	4
TKN	3	U	U
DP	0	U	U
TP	1	0	0
CADMIUM	0	U	U

tons/yr

.295 .0795 .2155

U = Removal Efficiency for the particular BMP and constituent unavailable.

59GA10402

8/9/2007

URBAN RUNOFF BMP POLLUTANT LOAD REDUCTION WORKSHEET

Please fill in the gray areas below.

Notes:
The methodology and efficiency values used in this worksheet were developed by the Illinois Environmental Protection Agency.

Please Select a Best Management Practice:

(•) Vegetated Filter Strips	( ) Sand Filters	( ) Sand Filter/Infiltration Basin
( ) Grass Swales	( ) WQ Inlets	( ) WQ Inlet w/ Sand Filter
( ) Infiltration Device	( ) Weekly Street Sweeping	( ) Oil/Grit Separator
( ) Extended Wet Detention	( ) Infiltration Basin	( ) Wet Pond
( ) Wetland Detention	( ) Infiltration Trench	
( ) Dry Detention	( ) Porous Pavement	
( ) Settling Basin	( ) Concrete Grid Pavement	

Please enter landuse of contributing/drainage area in acres:

	Sewered	Unsewered
Commercial	0.5	
Industrial		
Institutional		
Transportation		
Multi-Family		
Residential		
Agriculture		
Vacant		
Open Space		

Note: Sewered and Unsewered refer to storm sewers.

Estimated Load and Load Reductions

	Load before BMP (lbs/yr)	Load after BMP (lbs/yr)	Load Reduction (lbs/yr)
BOD	43	21	21
COD	295	177	118
TSS	590	159	431
LEAD	1	0	0
COPPER	0	U	U
ZINC	1	0	0
TDS	1,415	U	U
TN	11	6	4
TKN	3	U	U
DP	0	U	U
TP	1	0	0
CADMIUM	0	U	U

tons/yr

.295 .0795 .2155

U = Removal Efficiency for the particular BMP and constituent unavailable.

PENNSTATE

College of Agricultural Sciences Cooperative Extension

Agricultural and Biological Engineering

C-2

Land Application of Leaves and Grass Clippings

Timothy J. Fritz, Associate Extension Agent
Robert E. Graves, Professor of Agricultural Engineering

One of the simplest ways for communities to dispose of leaves and grass clippings is to apply them directly to crop land or use them for land reclamation purposes. Land applying these materials is sometimes referred to as leaf mulching. Composting leaves and grass is an alternative disposal method. Of the two choices, composting may be the best long-range solution, but land application or leaf mulching can provide an interim or permanent alternative that, in many cases, costs less. In the September 26, 1990 *Guidelines for Leaf Composting Facilities*, DER states: "In addition to leaf composting facilities, some municipalities provide leaves and grass clippings to farmers for use as soil nutrients or conditioners in normal farming operations, or use the leaves and grass clippings for land reclamation purposes."

Under most circumstances, contracting with local farmers to handle leaves and grass clippings can benefit both the community and the farmer. Tipping fees are necessary to ensure that the cooperating farmer(s) is being compensated for labor and equipment costs. If the farmers are not compensated adequately for their extra effort, the service they provide will probably end up being a low priority and, consequently, problems may arise. A contract that specifies what is expected of both parties is essential.

Benefits to farmers who accept leaves and grass clippings include:

- additional income
- nutritive material valuable for soil conditioning
- use of equipment that is already available.

Benefits to the community include:

- minimal start-up time and expense
- reasonable disposal costs
- eliminating the need for a composting site, equipment, and management
- less handling and hauling
- preserving local farms by providing farmers with extra income.

Two potential problems that farmers who handle leaves and grass clippings might face are:

- coordinating land availability and labor to deliver and spread material (Material must be spread within 7 days of delivery, so crop rotations might have to be altered to accommodate the timing of applications.)
- extraneous material mixed in with leaves and grass clippings.

Mutual Understanding

The community and farmer must recognize at the outset that each has different goals and constraints. Farmers must be prepared to take material as it is generated regardless of weather or field conditions. Storage areas, roads to storage areas, and modifications to crop planning may be necessary.

Municipalities should recognize the importance of providing leaves and grass that are free of trash. Truck drivers must respect the farmer's property, croplands, livestock, and family.

Environmental Benefits

Land application will keep leaves and grass clippings out of landfills and incinerators. The increased organic matter in the soil helps improve the condition of drought-prone or poorly drained soils. Odors, sometimes associated with composting, will not be a problem because spreading the material in a thin layer minimizes anaerobic odor.

DER Requirements

Any municipality or farmer considering land applying leaves or grass clippings should be familiar with the requirements set forth in *Guidelines for Leaf Composting Facilities,* which is available from DER regional or state offices. Some of the specific points that must be considered are:

- The farm should be located in the municipality where the material is collected unless special permission is granted from DER.
- DER must be notified of the intent to land apply leaves and grass clippings.

This notification should include:

- Sponsoring municipality
- Contact person
- Map showing location
- General site plan indicating access road(s), unloading area, surface water controls, farm conservation plan, and farm nutrient management plan.
- Operational narrative describing such things as: hours when material will be accepted, spreading and incorporation methods, spreading and incorporation frequency, plan for removing leaves and grass from bags.

- Leaves and grass clippings cannot be stockpiled or spread within 50 feet of property lines.
- Leaves and grass clippings cannot be stockpiled or spread on any wetlands.
- Leaves and grass clippings should be delivered to the farm in bulk. If they are in bags or containers, the bags or containers must be emptied on the day of delivery.
- Grass and leaves are to be spread 1) within 7 days of delivery to the farm, 2) according to the farm's nutrient management plan, and 3) no deeper than 6 inches.
- Grass and leaves should be incorporated into the soil no later than the following tilling season.

Contract Provisions

A contract between the municipality and the farmer(s) is necessary to ensure that both parties understand their responsibilities. Items that should be addressed include:

- tipping fee
- method for measuring material (cubic yards, truck loads, weight, moisture content)
- quality of acceptable material (amount and type of unacceptable materials, such as plastics, glass, metals, large tree limbs, chemical contaminants, etc.)
- responsibility for removing and disposing of unacceptable materials
- responsibility for damage to fields, equipment, livestock, or water resources from unacceptable materials delivered in leaves or grass clippings
- acceptable container for delivery, i.e. in bulk or in paper or plastic bags
- responsibility for emptying and disposing of plastic or paper bags
- time periods and location(s) leaves will be accepted
- provisions for regularly reviewing the contract
- provisions for arbitrating disputes
- terms for changing the contract.

Education of Public and Workers

The community and workers gathering the leaves and grass clippings must recognize that farming is a business. A farm can only accept leaves and grass clippings if they do not have a negative effect on the operation of the farm. If handling leaves and grass is too disruptive to normal farming operations, the farmer will probably not wish to participate. Material must be free of bottles, cans, plastics, large tree limbs, and other debris. All parties should be aware that contaminants have the potential to cause costly equipment damage and injury or possible death to livestock. The best way to provide a clean, quality product for the farmer is to keep extraneous material out of the leaves and grass clippings. This requires that citizens who rake the materials to the curb and crews that load and unload the delivery trucks be considerate. Sweeping streets before leaves fall in autumn will also reduce the amount of contaminants.

Storage of Leaves and Grass

The first step in handling leaves and grass clippings on the farm is locating a suitable place for stockpiling the material. This spot should be convenient to the road to receive deliveries and convenient to the fields where the material will be spread. Because collecting these materials will continue regardless of weather, an all-weather road to the stockpiling area is important for trouble-free delivery. The size and type of vehicles delivering leaves should be considered when planning roads. DER regulations require that stockpiles be at least 50 feet from boundary lines. All surface water should be diverted away from the site. Runoff water

from the site should flow onto vegetated areas and not directly into a stream or drainage ditch. A concrete barnyard, manure storage pad, or bunker silo that is not in use makes an excellent stockpiling area. A location within view of the farmstead will make it easier to monitor the site and control unauthorized dumping.

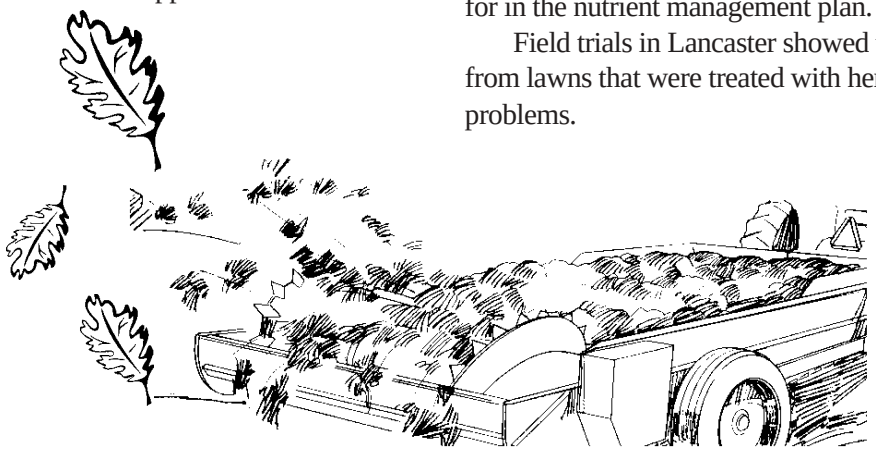
Application Methods and Equipment

Requirements for handling equipment on the farm are relatively simple. A conventional rear unloading beater-type manure spreader, a tractor to pull the spreader, and a tractor loader will be needed for loading and spreading the leaves or grass clippings.

Leaves will breakdown best if they are incorporated evenly within the top few inches of soil. Reports on the best equipment to use for incorporation vary. Incorporation will be affected by such things as soil type and vegetation, as well as the amount of material being spread, its moisture content, and how long it has laid on the ground. Most reports indicate that a mold board plow or offset disc do not work well to incorporate leaves. Farmers in New Jersey have reported good results with chisel plows (Kluchinski, New Jersey). Wisconsin studies have found that a rototiller worked well to break up and incorporate leaves (Peterson, Wisconsin). If possible, visit a farmer who is handling leaves or grass clippings. Be prepared to do some experimenting to see which tillage method works best. If additional tillage equipment or extra tillage steps are required, the economics of the operation will change considerably.

Nutrient Management Planning

A nutrient management plan is necessary for applying leaves and grass clippings. To avoid nutrient imbalances, the plan should balance the nutrients in the leaves or grass clippings against the nutrient needs of the crops. It is also recommended that field applications be rotated so that material is not applied to the same field year after year.



Limited data is available on the nutrient content of either leaves or grass clippings. A representative sample of the yard waste should be analyzed for its nutrient content. Manure analysis kits, available at your local extension office, can be used for this purpose. Generally leaves are higher in carbon than nitrogen. If leaves are applied immediately before planting a crop, they might cause a short-term nitrogen deficiency. It might be wise to plant a legume crop on land that has just received leaves. Leaves can be applied to a maximum depth of 6 inches according to DER guidelines. This will amount to about 800 cubic yards per acre. A more realistic amount to apply is 3 inches. It takes about 4 cubic yards of compacted leaves to make one ton.

Grass clippings are high in nitrogen and should be applied to land where a crop requiring high levels of nitrogen will be grown. The following analysis of fresh grass clippings is from a study done by the Lancaster County Solid Waste Authority.

Moisture content	16.7% (range 15.1% - 18.9%)
Density	8.3 pounds per cubic foot
Nitrogen	54.7 pounds / ton (range 47.5 - 60.8)

* approximately 30% of the nitrogen will be available the first year

Phosphorus	18.7 pounds per ton (range 16.5 - 21.6)
Potassium	45.9 pounds per ton (range 31.1 - 57.1)

*Data is based on analyses of 3 different samples.

Using the above averages, 10 tons of grass clippings applied per acre will provide about 164 pounds of available nitrogen, 187 pounds of phosphorus, and 460 pounds of potassium. This is similar to the nitrogen needs of a corn crop, but exceeds the phosphorus and potassium requirements. Also, the unavailable nitrogen will become available over time and must be accounted for in the nutrient management plan.

Field trials in Lancaster showed that grass clippings from lawns that were treated with herbicides pose no problems.

Summary

Leaves and grass clippings can be applied to crop land to provide additional organic matter and nutrients. Farmers can benefit from the nutritive value of the material and extra income. Municipalities gain a convenient, low-investment method for handling these waste products. Typical farm equipment can be used to apply and incorporate leaves and grass. Some experimentation may be necessary to determine the best application rates and incorporation methods. Both farmers and municipalities should be aware of the potential problems and be prepared to solve them and honor their sides of the agreement.

References and Additional Reading

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Peterson, A. E.,P. E. Speth, D. E. Schlough, T. H. Wright & T. B. Ginder. *Effect of Applying Leaves from Middletown, Wisconsin on Cropland*. 1989 Report.

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