



Lake Creek Watershed

Ionia County, MI

Field Surveys
performed by DEQ staff
August 2003

SUMMARY OF LAKE CREEK WATERSHED ASSESSMENT IONIA COUNTY, MICHIGAN

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INTRODUCTION

The Lake Creek watershed is located in the west central portion of Ionia County. It originates from Morrison Lake and flows north to its convergence with the Grand River in City of Saranac. The majority of the watershed drains a predominantly agricultural area with low density residential use. Department of Environmental Quality (DEQ) field staff surveyed road/stream crossings within the watershed to quickly assess the health of the watershed. The survey combined both qualitative and quantitative assessment of Lake Creek and its tributaries and provided a basis upon which to identify any potential sources of non point source pollution negatively affecting the watershed. In total, twelve road/stream crossing locations were surveyed during the assessment of the Lake Creek Watershed. Refer to Attachment A, Road Stream Crossings Inventory, for a summary of the survey locations conducted on August 14, 2003 as well as survey location maps. Site identification codes were developed using the first three letters of the township followed by the section number. The section number was followed by a two digit number indicating how many sites were assessed in that same township and section number.

METHODS

The DEQ's stream crossing watershed 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 DEQ staff or trained volunteers. Only observations that can be made from the road stream crossings are recorded; recording "educated guesses" or suspicions is prohibited. Because this assessment is based on visual observations, designed to be conducted quickly and by many different types of people and knowledge backgrounds, the survey results are only qualitative in nature.

A minimum of 30% of the road stream crossings within a watershed are to be surveyed with attention given to balanced geographical coverage and assessment across major land use changes and possible pollutant sources. Surveys are always conducted in one general direction (either upstream to downstream OR downstream to upstream), and the attempt is made to keep the surveyors and weather conditions consistent to limit bias and subjectivity between surveyors and field days. This survey was conducted from the upstream to downstream direction in one day by two DEQ field staff. The right and left bank designations were always assigned based on looking downstream at each road stream crossing location.

At each survey location the following stream conditions are visually assessed:

- Weather and any rain event conditions
- Culvert/bridge conditions
- Channel conditions (width, depth, high water mark, riffles, pools, natural, maintained, recovering)
- Stream appearance (color, turbidity, algae, aquatic plants, trash, oil sheen, bacteria, foam)
- Substrate composition (boulder, gravel, silt, sand, unknown)
- In-stream Cover (undercut banks, overhanging vegetation, woody debris, pools, boulders, plants)
- Stream corridor (riparian vegetation type and width, bank erosion, canopy cover, adjacent land use)
- Potential Pollutant Sources (source and pathway identification)

At each survey location the following stream conditions are directly measured:

- Water temperature
- Dissolved oxygen content
- pH
- flow velocity
- latitude and longitude coordinates (GPS)

In addition each site was photo-documented with a digital picture taken in the downstream direction, upstream direction and of the road crossing itself. Refer to the DEQ's *Stream Crossing Watershed Survey Procedure* for further information and a complete description of the above conditions. Please note that although some dissolved oxygen levels were collected at some sites and recorded on the survey sheets, they will not be summarized here due to unstable readings and unreliable calibrations of the dissolved oxygen meter.

OBSERVATIONS

Water Temperature and pH

Survey locations were assessed in the order of upstream sites (in the headwaters) to downstream sites (towards the mouth). Nine locations, including five on the main stem of Lake Creek, were measured for temperature and pH. pH values ranged from 7.0 to 8.35, and were not outside of the normal range for streams in Michigan. Overall the average temperature was 67.5° F, with most stations at either 63° or 65° F. One location, at Portland Road, near the Morrison Lake Country club golf course was 88°F. This comparatively high reading was evidently the result of thermal pollution resulting from nearly stagnant waters flowing through a golf course which provided no riparian vegetation, and therefore no stream canopy shading the channel.

Normal stream temperatures capable of supporting a coldwater fishery with few diseases are below 57°F. Walleye, northern pike and some trout are adapted to temperatures between 57° to 68°F while temperatures over 68°F are characteristic of fish communities containing bass, crappie, bluegill, carp and sucker, with occurrence of fish disease high. Note that the maximum air temperature on the day the survey was conducted was 86°F. Refer to Figure 1 in Attachment B, which depicts the temperature and pH levels at all

locations surveyed and to Figure 2, for only those temperatures and pH measurements for the mainstem locations.

Substrate

Substrate was observed and quantified for both the upstream and downstream stretch at each survey location. In all, 22 substrate observations were recorded. Substrate type is important when considering habitat suitability for desired species within the system (i.e. trout and other fish species). Cobble and gravel substrates with a low degree of embeddedness are the most suitable for reproduction in many fish species. Evidence of silt and sand dominated substrate could indicate problems within the watershed such as erosion and sedimentation. Among the survey locations within the Lake Creek Watershed approximately 18% were dominated (80 to 100% covered by) sand and 41% were dominated by silt, detritus or muck. None of the sites observed appeared to be dominated by cobble or gravel, however 40% of the sites had some amount of gravel present. Refer to Figure 3, in Attachment B, for a graph depicting the substrate composition at each survey location.

In-Stream Cover

The presence of in-stream cover was assessed at each location for both the upstream and downstream stretches. In-stream cover, such as overhanging vegetation, undercut banks, deep pools, boulders, plant cover and large woody debris provide habitat for macroinvertebrates and aquatic organisms such as amphibians and fish. Of the 22 observations made, 86% of the sites had overhanging vegetation and 27% of the sites had undercut banks. Deep pools, aquatic plant cover, boulders and large woody debris were each found in approximately 18% of the remaining sites. Refer to Table 1, in Attachment B for a summary of the in-stream cover observations made at each survey location.

Physical Appearance

The physical appearance of the stream at each survey location was assessed based on the presence or absence of aquatic plants, floating algae, filamentous algae, bacterial sheens, turbidity, oil sheen, foam and/or trash. In all, 22 physical appearance observations were recorded and rated as either present or abundant. No foam, bacterial or oil sheens were observed at any of the survey locations. Approximately 50% of the sites exhibited aquatic plants and floating algae, 41% of the sites exhibited filamentous algae, 36% of the sites exhibited turbidity and 5% of the sites exhibited trash. Refer to Table 2, in Attachment B for a summary of the physical appearance observations made for each survey location.

Stream Corridor

The riparian vegetation was assessed at each survey location for both the right and left banks of the upstream and downstream stretches. The presence of riparian vegetation reduces the amount of surface water runoff to streams, provides a filter strip for nutrients within runoff waters, provides overhanging vegetation for stream habitat, provides a source of woody debris, stabilizes stream banks against erosion and determines the

availability of sufficient stream canopy cover for temperature regulation. Twelve survey locations were assessed, resulting in 48 observations of riparian vegetation width recorded. The observations were evenly divided among the following width categories at 33% each, less than 10 feet, between 10 and 30 feet and over 100 feet.

The streamside land cover, estimated bank erosion and percent stream canopy were evaluated at each of the twelve survey locations for both the upstream and downstream stretches. In all, 24 observations were made for each of the above listed characteristics. Of the survey locations, 63% were recorded as having streamside land cover predominantly shrubs, 30% predominantly grasses and 8% (2 sites) dominated by trees. Overall erosion of the banks was not a major problem in the Lake Creek Watershed with approximately 95% of the sites described as having none or low bank erosion. In general, vegetation such as grasses and shrubs and residential and agricultural land uses, are associated with narrow riparian widths. More extensive riparian vegetation is usually associated with forests and old fields. Refer to Table 3, in Attachment B for the distribution of riparian width and vegetation observations made for both the right and left bank at each survey location.

Stream canopy cover is important for providing shade and maintaining cool temperatures within the stream. Cooler temperatures also help keep dissolved oxygen levels from depleting, an important habitat requirement for many fish species and other aquatic organisms. Of the 24 sites assessed, 12% had less than 25% cover, 29% had between 25 and 50% cover and 58% had over 50% cover.

Adjacent Land Uses

Adjacent land uses were recorded at each survey location for both the upstream and downstream stretches as well as both the right and left banks. Because the entire section of stream that can be seen from the road crossing is evaluated, multiple land uses can be recorded for each site. Land uses within the watershed play an important role in nutrient input, erosion, and in-stream conditions that affect water quality, quantity and habitat. Refer to Attachment B, Table 4 and Figure 4 for a summary of all the adjacent land uses recorded within the watershed. The most common land uses were maintained lawn and forest followed by an equal number of observations for shrub/old field, cropland and impervious surfaces.

Potential pathways of non-point source pollution

During the completion of the road stream crossing surveys, field staff also evaluated the *potential* for non point source pollution. This assessment focuses on the severity of *potential* pollutant *inputs*, not pollutant *impacts*. As part of this evaluation process field staff looks for 1.) a possible pollutant source, 2.) a potential pathway to the waterbody and 3.) potential severity of the input. Because each potential source was given a ranking of slight, moderate and high for potential severity, the values that were recorded were weighted before they were summed for each category (Refer to Figure 5, Attachment B). Observations recorded as slight were considered to be the basis for comparison, therefore observations recorded as moderate were multiplied by 1.5 and observations recorded as high were multiplied by 2. Potential non point source pollution from urban residential

runoff and crop related sources were the most serious while streambank erosion, transportation NPS, and channelization were also considered common sources of NPS pollution. Refer to Figure 5 in Attachment B for a summary of the non point source pollution observations identified for each survey location.

RESULTS

Upper Subwatershed (Unnamed Tributary and Leary Drain flowing into Morrison Lake)

Two, small tributaries flow into Morrison Lake. Five survey locations were evaluated on these tributaries including stations CAM0101, CAM0102, BOS3601, BOS3602 and BER3201. One survey point (CAM0101) was dry at the time of the evaluation. The surrounding area was dominated by agriculture and low density residential. Refer to Attachment C for site photos and to Attachment D for site survey forms. The following conditions and comments were recorded on the survey forms:

CAM0102: Clarksville Road west of Jackson

Water temperature was average (~65°F) with a neutral pH of 7 in this highly channelized portion of the stream. Due to abundant green algae, substrate observations were impaired. Some overhanging vegetation and aquatic plant cover was noted. Approximately 10 feet of riparian vegetation was observed which consisted of grasses; however the stream canopy was only 25-50 %. Directly at the road stream crossing the land use was heavily agricultural, however forest was also recorded on the survey sheets because forested areas could be seen from the survey location. Potential non point source pollution was slight for urban residential runoff and high for crop related sources and channelization. Comments were: *Adjoining sod farms obtain irrigation water from this flow, stagnant water apparently high in nutrients.*

BOS3601: Goodemote Road east of Elm

Water temperature was the same as previous site (~65°F) although pH had increased to 7.91. Turbidity on the upstream side prohibited substrate observations while the downstream side was dominated by silt, detritus and muck substrate. Floating algae, aquatic plants and turbidity were noted along with the presence of some overhanging vegetation. Abundant riparian vegetation was observed (more than 100 ft) which consisted of shrubs and small trees. The land cover in this area could be categorized as hardwood wetlands. Potential non point source pollution was slight for transportation and the gravel road. Comments were: *Culvert opening on the downstream side completely submerged indicating some type of blockage downstream, turbidity probably from observed carp and agricultural uses noted upstream.*

BER3201: Portland Road east of Bliss

Temperature and pH data were not collected for this site. Silt, detritus and muck accounted for 100% of the bottom substrates with some overhanging vegetation and boulders available for in-stream cover. Slight turbidity was noted on the downstream side. Riparian vegetation extended 10-30 feet from the stream and consisted mainly of shrubs with some small trees. Adjacent land uses consist of crops, pasture, forest and impervious surfaces. Potential non point source pollution is high for crop related activities, moderate for grazing related activities and slight for streambank erosion. Comments were: *Underdrain from adjoining sod fields discharges here, some streambank stabilization has occurred*

BOS3602: Jackson Road south of Portland

The water temperature here was slightly elevated to ~68°F with pH normal at 7.42. Silt, detritus and muck accounted for 100% of the bottom substrates with some overhanging vegetation, deep pools and aquatic plants available for in-stream cover. Abundant aquatic plants and floating algae were observed with a lesser degree of turbidity present. Riparian vegetation was 10-30 feet of grasses and shrubs. Adjoining land uses included maintained lawns (the golf course), impervious surfaces and shrub/old field. Potential non point source pollution is high for golf course related activities, moderate for grazing related activities and urban residential runoff and slight for transportation and streambank erosion. Comments were: *Completely stagnant and covered in duckweed, Morrison Lake Country Club golf course adjacent on the downstream side*

The majority of the impacts to the stream in this area seem to result from inadequate riparian buffer and stream canopy in some locations, as well as nutrient runoff from adjoining crops, the sod farm and especially the Morrison Lake Country Club golf course. While the impacts from the golf course were apparent and well documented the impacts from the sod farm might have been less apparent. Although the map of the survey locations depicts CAM0102, near the sod farm along a portion of stream not connected to Morrison Lake, the map does not include many of the drainage ditches that exist along the farms in the area that have connected this area with the Lake Creek Watershed. Before flowing into Morrison Lake the unnamed tributary flows through a wetland area near BOS3601. This area may be very important in filtering out excess sediments and nutrients from the upstream farms.

Lower Subwatershed (Lake Creek and all tributaries flowing into Lake Creek)

Lake Creek flows north from Morrison Lake to the City of Saranac where it converges with the Grand River. Five survey locations were completed along the main stem of Lake Creek including BOS3603, BOS2501, BOS2301, BOS1401 and BOS1101. Two survey locations were completed for unnamed tributaries flowing into Lake Creek including, BOS2502 and BOS1301. The majority of the land use in this area is agricultural and low density residential to medium residential nearing Saranac. The following conditions and comments were recorded on the survey forms:

BOS3603: Portland road west of Jackson Road

The water temperature here was the highest recorded at ~88°F with an elevated pH of 8.12. Silt, detritus and muck accounted for most of the bottom substrates with some gravel and sand present on the downstream side. Only overhanging vegetation was available for in-stream cover. Aquatic plants and floating and filamentous algae were observed. Riparian vegetation consisted of 10-30 feet of grasses and shrubs. Adjoining land uses included maintained lawns (the golf course and residential) and shrub/old field. Potential non point source pollution is high for golf course related activities, moderate for channelization and slight for urban residential runoff and transportation. Comments were: *Heavily impacted from upstream golf course.*

BOS2502: Jackson Road south of Grand River Avenue

The site was located near the mouth of a tributary flowing into Lake Creek from the east which drains an agricultural area. The water temperature here was ~63°F with a pH of 8.06. Silt, detritus, muck and sand accounted for most of the bottom substrates with some gravel also present. Only overhanging vegetation was available for in-stream cover. Filamentous algae were abundant while floating algae and aquatic plants were also observed. Riparian vegetation consisted of 10-30 feet of grasses and shrubs. Adjoining land uses were maintained lawns (residential), forest, and impervious surfaces. Potential non point source pollution is slight for urban residential runoff and transportation. *No comments were specifically listed for this site.*

BOS2501: Grand River Avenue east of Morrison Lake Road

The water temperature here had returned to ~68°F with pH elevated to 8.28. The inflow of water from the cooler tributary (described above) and the thick canopy cover probably helps in cooling heated water flowing from the golf course site. Bottom substrates improved to being mostly gravel with some sand and boulders. In-stream cover was also improved with overhanging vegetation, undercut banks, deep pools, boulders and woody debris noted. No turbidity or algae was noted for this site. Riparian vegetation extended more than 100 feet and was dominated by mature trees and understory shrubs. Adjoining land was mostly forested with one residential maintained lawn.

Potential non point source pollution is slight for urban residential runoff. Comments were: *Water flow, stream canopy, nutrient and sediment load greatly improved from upstream site near golf course.*

BOS2301: Morrison Lake Road south of Peck Lake Road

The water temperature here was ~63°F with a pH of 8.25. Silt, detritus, and muck dominated the substrate of the upstream side while gravel and sand accounted for most of the bottom substrates on the downstream side. Overhanging vegetation, undercut banks and woody debris were available for in-stream cover. Abundant floating algae with only some aquatic plants, turbidity and trash were observed. Riparian vegetation consisted of 30-100 feet of mostly shrubs and small trees. Adjoining land uses consisted of maintained lawns (residential), shrub/old field, and forest. Potential non point source pollution is slight for urban residential runoff, streambank erosion and debris in water. Comments were: *Stream appears to have larger sediment load then at Grand River Avenue crossing upstream (BOS2501).*

BOS1401: Maccarthur Road

The water temperature here remained ~63°F with a pH of 8.3. Sand dominated the substrate of the both the upstream and downstream sides. Overhanging vegetation and woody debris were available for in-stream cover. Abundant filamentous algae and only some aquatic plants, turbidity and floating algae were observed. Riparian vegetation ranged from less than 10 feet to over 100 ft and consisted of mostly shrubs and grasses and small trees. Adjoining land uses consisted of maintained lawns (residential), shrub/old field, and forest. Potential non point source pollution is slight for urban residential runoff and streambank erosion. Comments were: *Water cascades over concrete impoundment under the bridge, perched approximately 6 feet high and creating plunge pool.*

BOS1301: Jackson and Bennett Roads

The site was located on the mid reaches of a tributary flowing into Lake Creek from the east which drains a heavily agricultural area. The water temperature and pH was not measured at this site. Sand dominated the substrate at this location with smaller amounts of silt, detritus and muck. Only overhanging vegetation and undercut banks were available for in-stream cover. No turbidity or algae was noted for this site. Riparian vegetation ranged in width from between 10-30 feet to over 100 feet, and consisted of mainly shrubs. Adjoining land uses included forest, shrub/old field and impervious surfaces. Potential non point source pollution is slight for transportation due to the gravel/sand road. Comments were: *Culvert not aligned with stream although some streambank stabilization is present.*

BOS1101: Morrison Lake Road south of David Hwy

This site was the farthest downstream location surveyed before Lake Creek meets the Grand River. The water temperature here was ~65°F with a pH of 8.35. Once again silt, detritus, and muck dominated the substrate. Overhanging vegetation, undercut banks and deep pools were available for in-stream cover. Aquatic plants and filamentous and floating algae were observed. Riparian vegetation ranged in width from less than 10 feet to between 10-30 feet, and consisted of mainly grasses with some shrubs. Adjoining land uses included forest, maintained lawns and impervious surfaces. Potential non point source pollution is slight for transportation, streambank erosion and urban residential runoff. *No comments were specifically listed for this site.*

The majority of the impacts to the stream in this area seem to result from inadequate riparian buffer and stream canopy in some locations as well as nutrient runoff from adjoining crops and especially the Morrison Lake Country Club golf course. The water near the golf course was 88°F, a temperature detrimental to most aquatic organisms. Many of the residential landowners near the road stream crossings surveyed appeared to have almost no buffer between their lawns and the stream. Limited to nonexistent riparian vegetation was also a problem in downtown Saranac. In addition, since a majority of the survey locations were not listed as having problems with erosion but a high amount of sand and silt dominated substrate was observed, runoff from agricultural fields and residential lawns could be contributing to the sediment load within the stream.

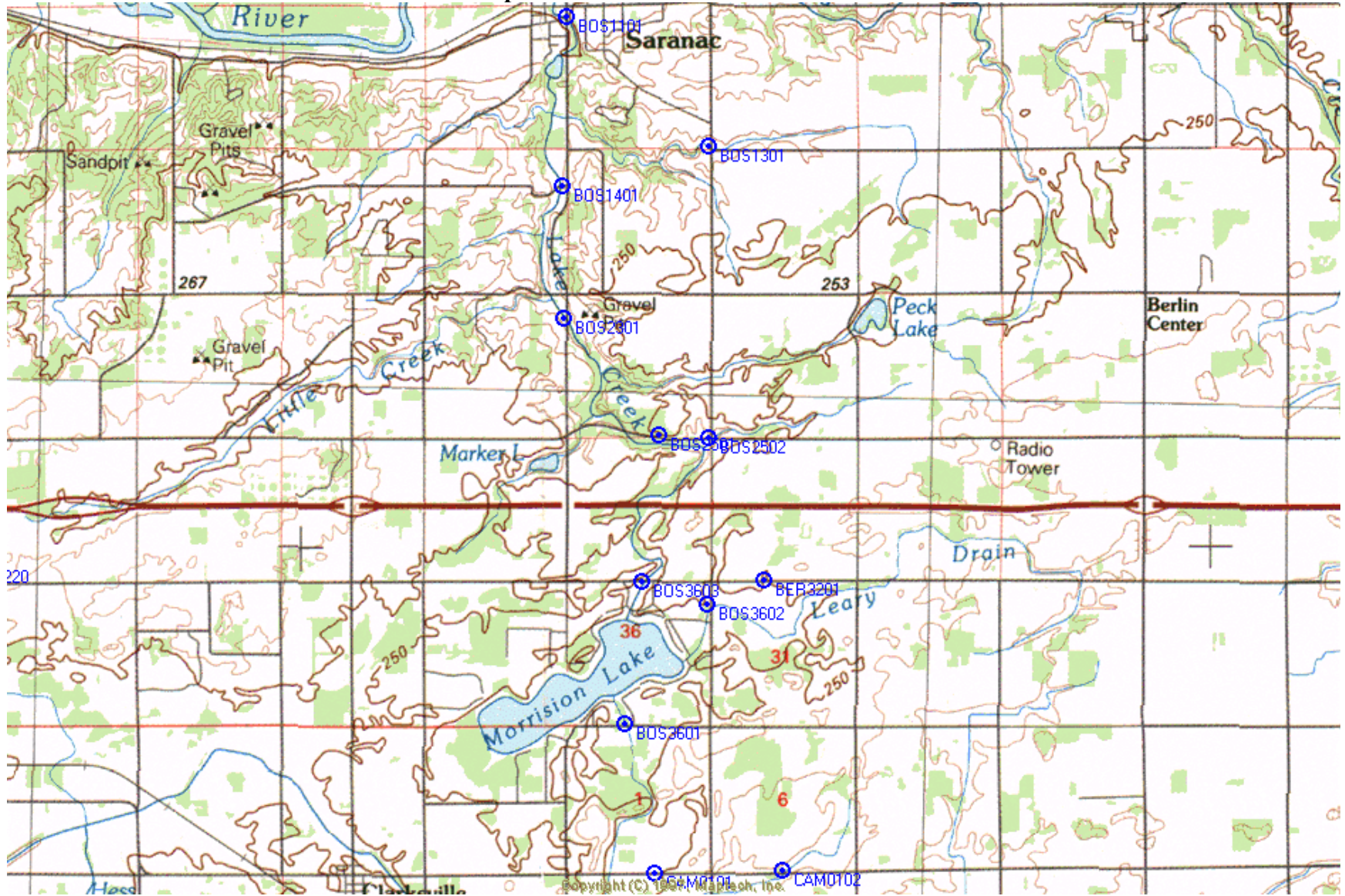
Attachment A

Road Stream Crossing Inventory and Maps

Road Stream Crossing Inventory for Lake Creek Watershed 2003

Count	Site ID	Sub-Watershed Name	Location	Township/County	Stream Name	Inventory Date
1	CAM0102	Lake Creek	Clarksville Road east of Jackson	Campbell/Ionia	Unnamed tributary to Morrison Lk.	8/14/2003
2	CAM0101	Lake Creek	Clarksville Road east of Elm	Campbell/Ionia	Unnamed tributary to Morrison Lk.	8/14/2003
3	BOS3601	Lake Creek	Goodemote Road east of Elm	Boston/Ionia	Unnamed tributary to Morrison Lk.	8/14/2003
4	BER3201	Lake Creek	Portland Road east of Bliss	Berlin/Ionia	Leary Drain	8/14/2003
5	BOS3602	Lake Creek	Jackson Road south of Portland	Boston/Ionia	Leary Drain	8/14/2003
6	BOS3603	Lake Creek	Portland Road west of Jackson	Boston/Ionia	Lake Creek	8/14/2003
7	BOS2502	Lake Creek	Jackson Road south of Grand River Ave.	Boston/Ionia	Unnamed Tributary to Lake Creek	8/14/2003
8	BOS2501	Lake Creek	Grand River Ave east of Morrison Lake Rd	Boston/Ionia	Lake Creek	8/14/2003
9	BOS2301	Lake Creek	Morrison Lake Rd. south of Peck Lake Road	Boston/Ionia	Lake Creek	8/14/2003
10	BOS1401	Lake Creek	Maccarthur Road	Boston/Ionia	Lake Creek	8/14/2003
11	BOS1301	Lake Creek	Jackson and Bennett Roads	Boston/Ionia	Unnmaed Tributary to Lake Creek	8/14/2003
12	BOS1101	Lake Creek	Morrison Lake Rd. south of David Hwy	Boston/Ionia	Lake Creek	8/14/2003

Map1. Lake Creek Watershed Stations



Attachment B
Figures and Tables

Figure 1. Temperature and pH summary for the Lake Creek Watershed

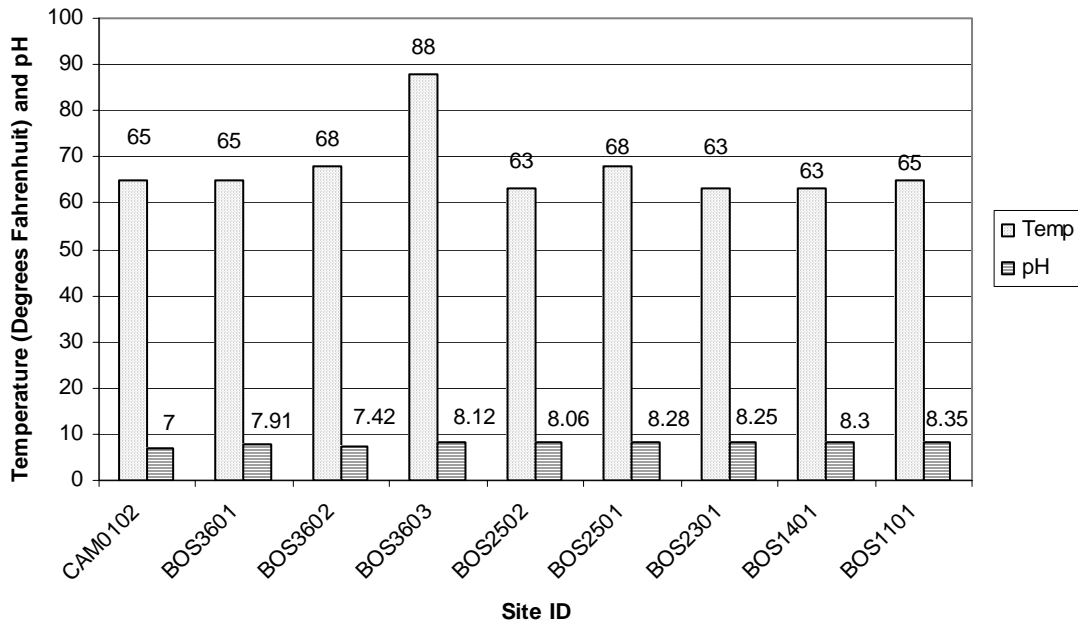


Figure 2. Temperature and pH summary for the mainstem sample locations from the headwaters to the mouth

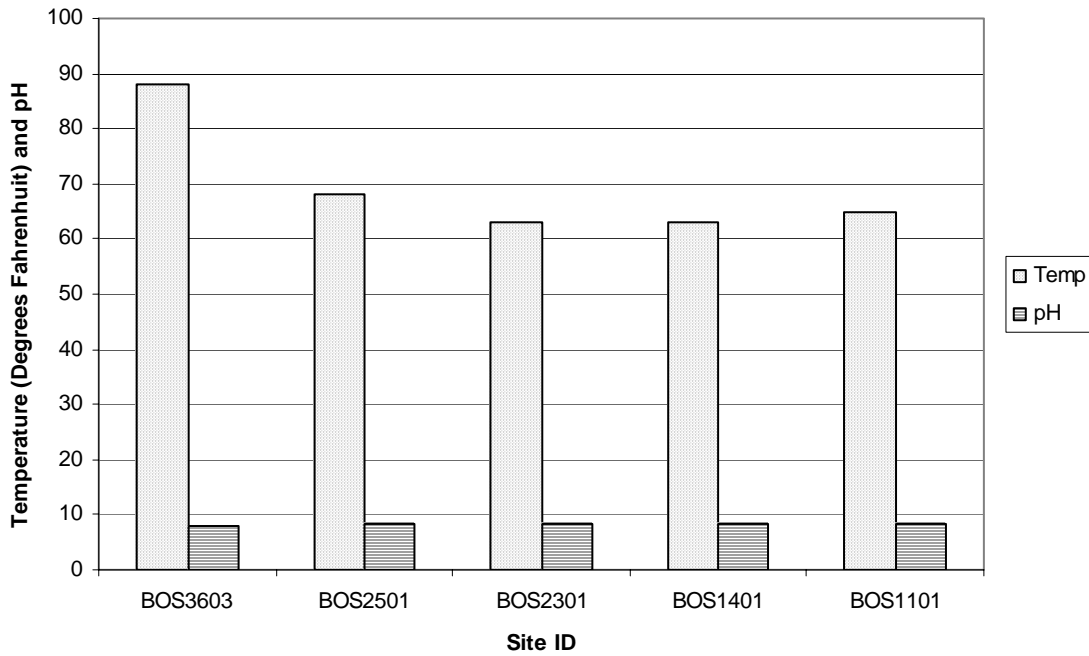


Figure 3. Percent substrate observation for each sample location

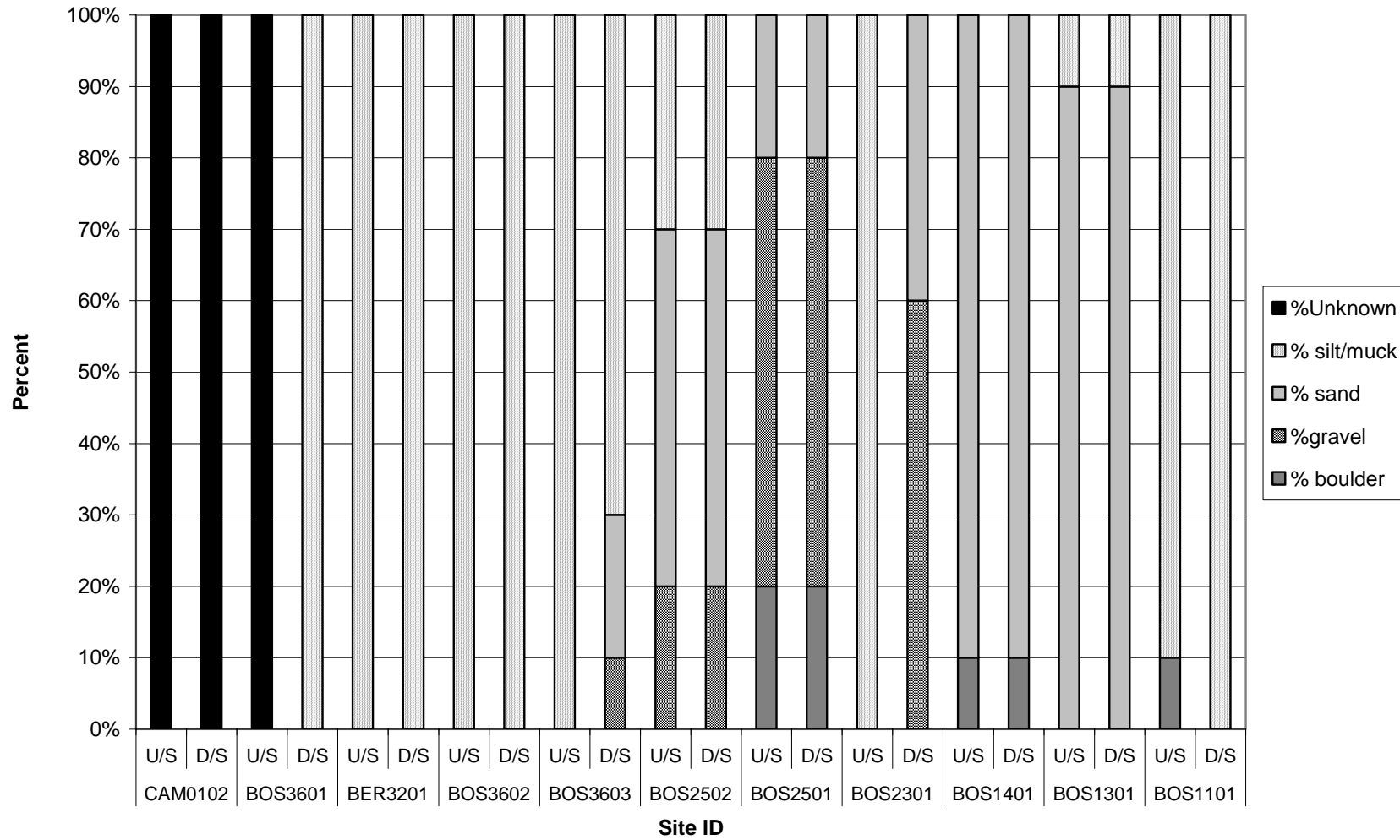


Figure 4. Summary of adjacent land uses

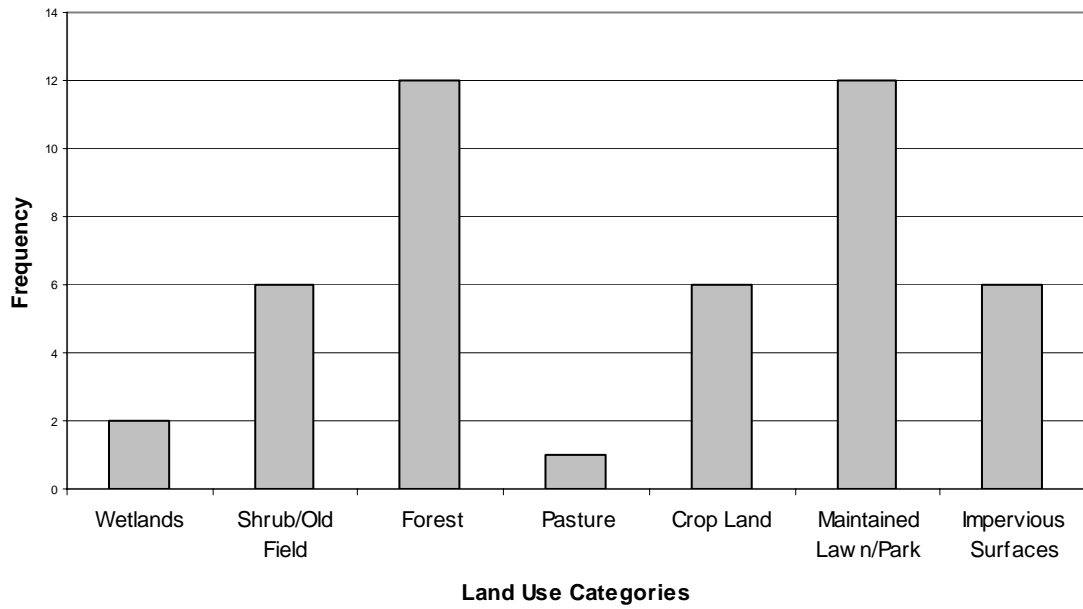


Figure 5. Weighted Values for Possible Sources of NPS Pollution

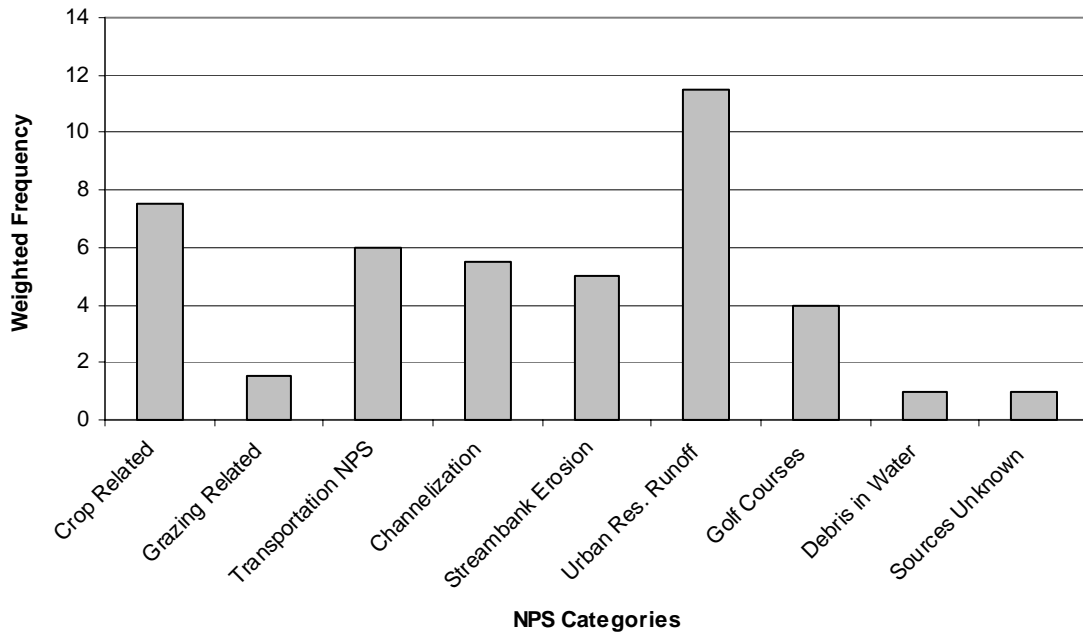


Table 1. Summary of observations made for in stream habitat and cover

SITE ID		Undercut Banks	Overhanging Vegetation	Deep Pools	Boulders	Aquatic Plant Cover	Logs/Woody Debris
CAM0102	U/S		X			X	
	D/S		X			X	
BOS3601	U/S		X				
	D/S		X				
BER3201	U/S		X				
	D/S		X		X		
BOS3602	U/S		X	X		X	
	D/S					X	
BOS3603	U/S						
	D/S		X				
BOS2502	U/S		X				
	D/S		X				
BOS2501	U/S	X	X		X		X
	D/S		X	X	X		X
BOS2301	U/S	X	X				
	D/S	X	X				X
BOS1401	U/S		X				X
	D/S		X				
BOS1301	U/S						
	D/S	X	X				
BOS1101	U/S	X	X	X			
	D/S	X	X	X			

U/S= upstream direction

D/S= downstream direction

X denotes presence but does not indicate abundance

Table 2. Summary of observations made for physical appearance

SITE ID		Aquatic Plants	Floating Algae	Filamentous Algae	Turbidity	Trash
CAM0102	U/S		A			
	D/S		A		P	
BOS3601	U/S	P	P		P	
	D/S	P	P		P	
BER3201	U/S					
	D/S				P	
BOS3602	U/S	A	A		P	
	D/S	A	A		P	
BOS3603	U/S	P	A	P		
	D/S	P	P	P		
BOS2502	U/S		P	A		
	D/S	P		A		
BOS2501	U/S					
	D/S					
BOS2301	U/S	P	A		P	P
	D/S					
BOS1401	U/S	P	P	A	P	
	D/S	P		P		
BOS1301	U/S					
	D/S					
BOS1101	U/S			P		
	D/S	P	P	P		

U/S= upstream direction

D/S= downstream direction

A denotes abundance

P denoted presence

Table 3. Summary of observations made for riparian width (ft) and vegetation

SITE ID		Left Bank				Right bank				Streamside land cover
		< 10	10-30	30-100	>100	< 10	10-30	30-100	>100	
CAM0101	U/S		X				X			shrubs
	D/S	X				X				shrubs
CAM0102	U/S	X				X				grasses
	D/S	X				X				grasses
BOS3601	U/S				X				X	shrubs
	D/S				X				X	shrubs
BER3201	U/S		X				X			shrubs
	D/S	X				X				shrubs
BOS3602	U/S		X				X			grasses
	D/S	X					X			grasses
BOS3603	U/S	X				X				grasses
	D/S		X				X			shrubs
BOS2502	U/S		X				X			shrubs
	D/S	X					X			shrubs
BOS2501	U/S				X				X	trees
	D/S				X				X	trees
BOS2301	U/S				X		X			shrubs
	D/S				X				X	shrubs
BOS1401	U/S				X				X	shrubs
	D/S	X							X	grasses
BOS1301	U/S		X				X			shrubs
	D/S				X				X	shrubs
BOS1101	U/S	X				X				grasses
	D/S	X					X			shrubs

U/S= upstream direction
D/S= downstream
direction

Table 4. Summary of adjacent land uses

Site ID		Wetlands	Shrub/Old field	Forest	Pasture	Crop land	Animal Feeding Op.	Maintained lawn	Impervious Surfaces	Disturbed Ground
CAM0101	U/S		R	L		R		L		
	D/S			B				B		
CAM0102	U/S			L		B				
	D/S			B		B				
BOS3601	U/S	B								
	D/S	B								
BER3201	U/S				L	R				
	D/S			R		L			R	
BOS3602	U/S		R			L				
	D/S							R	L	
BOS3603	U/S							B		
	D/S		B					B		
BOS2502	U/S							B		
	D/S			B				L	R	
BOS2501	U/S			B						
	D/S			B				L		
BOS2301	U/S		B					L		
	D/S			B						
BOS1401	U/S		B	B						
	D/S			L				R		
BOS1301	U/S		B						B	
	D/S		B	B						
BOS1101	U/S							B	B	
	D/S			B				L	R	

U/S= upstream direction

D/S= downstream direction

R denotes the land use was located on the right bank

L denoted the land use was located on the left bank

B denoted the land use was located on both banks

Note: Right and left bank designations were always assigned looking downstream for each survey direction.

Table 5. Summary of potential sources of non-point source pollution identified for each location

Site ID		Crop related	Grazing Related	Transportation	Channelization	Streambank Erosion	Urban/Residential Runoff	Golf courses	Debris in Water	Sources Unknown
CAM0101	U/S						S			
	D/S						S			
CAM0102	U/S	H			H					
	D/S	H			H		S			
BOS3601	U/S			S						
	D/S			S						
BER3201	U/S		M							
	D/S	H				S				
BOS3602	U/S		M							
	D/S			S		S	M	H		
BOS3603	U/S				M			H		
	D/S			S			S			
BOS2502	U/S			S			S			
	D/S						S			
BOS2501	U/S									
	D/S						S			S
BOS2301	U/S					S	S		S	
	D/S									
BOS1401	U/S									
	D/S					S	S			
BOS1301	U/S			S						
	D/S									
BOS1101	U/S			S		S	S			
	D/S			S		S	S			

U/S= upstream direction

D/S= downstream direction

S denotes the potential source was slight

M denotes the potential source was moderate

H denotes potential source was heavy

Note: Observations made in these categories indicate a potential for pollution from the source to occur not a confirmed source of pollution

Attachment C

**Site Photographs
(refer to attached powerpoint file)**