



Indian Mill Creek Watershed

Kent County, MI

Field Surveys
performed by DEQ staff
October 2003

SUMMARY OF INDIAN MILL CREEK WATERSHED ASSESSMENT KENT, MICHIGAN

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INTRODUCTION

The Indian Mill Creek watershed is located in the west central portion of Kent County. It originates in the agricultural fields of Alpine Township in the area south of 8 Mile Avenue and flows south to its convergence with the Grand River in the city of Grand Rapids north of Leonard Street. The majority of the upper watershed drains a predominantly agricultural area with low density residential use, while the lower watershed drains a predominantly urban area. 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 Indian Mill 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, eighteen road/stream crossing locations were surveyed during the assessment of the Indian Mill Creek Watershed. Refer to Attachment A, Road Stream Crossings Inventory for a summary of the survey locations conducted during October 10, 2003 as well as survey location maps. Site identification codes were developed using four letter identifiers for the subwatershed followed by the two digit site location number. Sites were numbered successively from the headwaters to the mouth.

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 and was completed 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 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). Eighteen locations, including ten along the main stem of Indian Mill Creek, were measured for temperature and pH. pH values ranged from 7.77 to 8.35, which are outside of the normal range for streams within Michigan. Overall the average temperature was 54° F, with a range from 52 and 58° F. The location with the highest temperature was at Walker south of 5 Mile.

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 suitable for fish communities characterized by bass, crappie, bluegill, carp and sucker with occurrence of fish disease high. While temperatures recorded here seem low it is important to note that this survey was not conducted during the hottest summer months when temperature becomes a limiting factor to some species. Temperatures will appear cool because the survey was conducted during the fall although the maximum air temperature during this field survey was 77°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, 36 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 and is important for macroinvertebrates as well. Evidence of silt and sand dominated substrate could indicate problems within the watershed such as erosion and sedimentation. Among the survey locations within the Indian Mill Creek Watershed approximately 3 were dominated (80 to 100% covered) by sand and 7 were dominated silt, detritus or muck. 42% of the sites (15 sites) were unable to be categorized due to turbidity or inability to actually see the stream through overgrown vegetation. None of the sites observed appeared to be dominated by cobble or gravel however 14 of the sites had some amount of gravel present (although it was almost always less than 40%). Refer to Figures 3 and 4 for substrate data for each of the subwatersheds separately. Refer to Figure 5, in Attachment B, for a graph depicting the substrate composition for those survey locations located along the main channel of Indian Mill Creek.

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 36 observations made, 69% of the sites had overhanging vegetation and 31% of the sites had woody debris. Undercut banks, boulders and deep pools cover were each found in approximately 11%, 25% and 6% of the sites respectively. 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 slimes, turbidity, oil sheen, foam and/or trash. In all, 36 sites were assessed for physical appearance; observations were recorded and rated as either present or abundant. No oil or bacteria sheens or foam were observed at any of the sites. In general trash, turbidity and filamentous algae were the least common. Approximately 36% of the sites exhibited aquatic plants (including duckweed) while 11% exhibited floating algae. 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. Eighteen survey locations were assessed, resulting in 72 observations of riparian vegetation width recorded. Most of the observations fell almost evenly into the three width categories: 36% had less than 10 feet, 27% had between 10 and 30 feet and 30% had over 100 feet of riparian vegetation. The riparian width class of 30 to 100 feet was the least common and was observed at only 5% of the sites.

The streamside land cover, estimated bank erosion and percent stream canopy were evaluated at each of the eighteen survey locations for both the upstream and downstream stretches. In all, 36 observations were made for each of the above listed characteristics. Riparian vegetation dominated by shrubs was the most common, observed at 47% of the survey locations, followed by 36% dominated by grasses and 6% dominated by trees. 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. Overall erosion of the banks was not a major problem in the Indian Mill Creek Watershed with approximately 100% of the sites described as having none or low bank erosion. 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 helps keep dissolved oxygen levels from depleting, an important habitat requirement for many fish species and other aquatic organisms. Of the 36 sites assessed, 14 had less than 25% cover, 9 had between 25 and 50% cover and 13 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 6 for a summary of all the adjacent land uses recorded within the watershed. The most common adjacent land uses were maintained lawn and shrub/old field followed by a lesser number of observations for forest, cropland, pasture 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 look 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 severity, the values recorded were weighted before they were summed for each category (Refer to Figure 7, 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 transportation and urban residential runoff were the most serious while crop and grazing related sources, development construction and gold courses were also considered possible sources of NPS pollution. Refer to Table 5 in Attachment B for a summary of the non point source pollution observations identified for each survey location.

RESULTS

Upper Subwatershed (Unnamed Tributaries and Indian Mill creek headwaters)

The Upper Indian Mill Creek subwatershed originates in the agricultural fields in central Alpine Township south of 8 Mile Avenue and extends to the area near 3 Mile and Walker Avenue before Indian Mill Creek converges with Brandywine Creek. Twelve survey locations were evaluated on this portion of Indian Mill Creek and were denoted by UIMC prefixes. The land use in this area is dominated by agricultural use and low density residential in the headwaters to urban near Brandywine Creek. 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:

UIMC-01: Fruit Ridge north of 7 Mile

Due to dry conditions, water temperature, pH and substrate data were not collected at this site. No overhanging vegetation, undercut banks, woody debris, aquatic plant cover, boulders or deep pools were available for in-stream cover. No aquatic plants, floating algae, filamentous algae, turbidity, bacterial sheen/slime, oil sheen, foam or trash were observed. Riparian vegetation, consisting mainly of grasses, ranged from more than 100 feet (ft) on the downstream right bank to less than 10 feet (ft) on the downstream left bank. A moderate amount of riparian vegetation (10 to 30 ft) was observed on the both banks of the upstream side. Adjacent land uses included pasture and cropland on both banks. Potential non point source pollution (NPS) was categorized as high for crop related activities, moderate for grazing related activities and slight for transportation. Comments were: *Stream was dry at time of survey, cattle and orchards observed nearby, could not determine what type of access cattle had to the stream.*

UIMC-02: 7 Mile east of Fruit Ridge

Due to stagnant conditions and low visibility, water temperature, pH and substrate data were not collected at this site. Overhanging vegetation and aquatic plant cover were available for in-stream cover. Abundant aquatic plants and some floating algae were observed. Abundant riparian vegetation (more than 100 ft) was observed downstream, while a moderate amount of riparian vegetation (10 to 30 ft) was observed upstream. Vegetation consisted mainly of grasses and shrubs. Adjacent land uses included shrub/old field (both banks), impervious surfaces and maintained lawns. Potential NPS pollution was categorized slight to moderate for crop related activities, and slight for transportation. Comments were: *Abundant duckweed on upstream side, upstream farmer at 6300 Fruit Ridge could be a problem.*

UIMC-03: 7 Mile west of Peach Ridge

Due to dry conditions, water temperature, pH and substrate data were not collected at this site. No overhanging vegetation, undercut banks, woody debris, aquatic plant cover, boulders or deep pools were available for in-stream cover. No aquatic plants, floating algae, filamentous algae, turbidity, bacterial sheen/slime, oil sheen, foam or trash were observed. Riparian vegetation, consisting mainly of grasses and shrubs, ranged from more than 100 feet (ft) on the downstream right bank to less than 10 ft on the downstream left bank. A moderate amount of riparian vegetation (10 to 30 ft) was observed on the both banks of the upstream side. Adjacent land uses included cropland (both banks), shrub/old field, forest and maintained lawns. Potential NPS pollution was categorized as slight to high for crop related activities and slight for transportation. Comments were: *Dry at time of survey, potential impacts from agricultural.*

UIMC-04: 6 Mile west of Peach Ridge

Water temperature was ~52°F and pH was measured at 8.18. Silt, detritus and muck accounted for 100% of the bottom substrate both upstream and downstream. Only overhanging vegetation was available for in-stream cover. Some aquatic plants were observed upstream. In general a moderate amount of riparian vegetation (10 to 30 ft) was observed both upstream and downstream, which consisted of grasses and shrubs. Adjacent land uses included shrub/old field, cropland, forest, and maintained lawn. Potential NPS pollution was categorized as moderate to high for crop related activities and slight for transportation. Comments were: *No buffer on downstream side between lawn and stream, lawn looks fertilized, only one culvert is flowing.*

UIMC-05: Peach Ridge south of 6 Mile

Water temperature was ~52°F and pH was measured at 7.77. Silt, detritus and muck accounted for 100% of the bottom substrate both upstream and downstream. Only overhanging vegetation was available for in-stream cover. Some aquatic plants and floating algae were observed upstream while abundant plants and algae were observed downstream. A moderate amount of riparian vegetation (10 to 30 ft) was observed upstream consisting of mainly grasses. Downstream riparian vegetation was more variable and ranged from less than 10 ft on the right bank to between 30 and 100 ft on the left bank. Adjacent land uses included shrub/old field and cropland on both banks, upstream and downstream. Potential NPS pollution was categorized as high for crop related activities, moderate to high for transportation and slight for grazing related activities. Comments were: *many areas of road failure near culvert, abundant algae and duckweed, there is a direct channel from the road to the stream to carry runoff waters, cattle observed grazing near the Ed Dunneback farm.*

UIMC-06: 7 Mile east of Peach Ridge

Due to dry conditions, water temperature, pH and substrate data were not collected at this site. No overhanging vegetation, undercut banks, woody debris, aquatic plant cover, boulders or deep pools were available for in-stream cover. No aquatic plants, floating algae, filamentous algae, turbidity, bacterial sheen/slime, oil sheen, foam or trash were observed. Little riparian vegetation (less than 10 feet) was observed both upstream and downstream which consisted of grasses and shrubs. Adjacent land uses included cropland (both banks) and maintained lawn. Potential NPS pollution was categorized as moderate for crop related activities and slight for transportation. Comments were: *Adjacent lands consist of orchards and bean crops.*

UIMC-07: 6 Mile east of Peach Ridge

Due to dry conditions, water temperature, pH and substrate data were not collected at this site. No overhanging vegetation, undercut banks, woody debris, aquatic plant cover, boulders or deep pools were available for in-stream cover. No aquatic plants, floating algae, filamentous algae, turbidity, bacterial sheen/slime, oil sheen, foam or trash were observed. Abundant riparian vegetation (more than 100 ft) was observed upstream, which consisted of shrubs. A moderate amount of riparian vegetation (between 10 and 100 ft) was observed downstream. Adjacent land uses included shrub/old field, cropland, forest, and maintained lawn on both banks. Potential NPS pollution was categorized as moderate for crop related activities, slight to moderate for transportation, and slight for urban residential runoff. Comments were: *Stream dry at time of survey, good buffer.*

UIMC-08: Walker north of 5 Mile

Water temperature was ~54°F and pH was measured at 8.06. Silt, detritus, muck and sand appeared to dominate the substrate with lesser amounts of gravel present on the downstream side. Only overhanging vegetation was available for in-stream cover. Some aquatic plants were observed downstream. Abundant riparian vegetation (more than 100 ft) was observed downstream which consisted of shrubs and small trees. However, little riparian vegetation (less than 10 feet) was observed upstream. Adjacent land uses included shrub/old field, forest and maintained lawn on both banks. Potential NPS pollution was categorized as moderate for urban residential runoff, and slight to moderate for transportation. Comments were: *Some road runoff from road crossing, stream starting to look more natural, better canopy of shrub/tree mix.*

UIMC-09: Walker south of 5 Mile

Water temperature was ~58°F and pH was measured at 7.95. Sand and silt appeared to dominate the substrate with lesser amounts of gravel present upstream and downstream. Only overhanging vegetation was available for in-stream cover. Some aquatic plants were observed upstream and trash was observed downstream. Abundant riparian vegetation (more than 100 ft) was observed downstream which consisted of shrubs and small trees. However, little riparian vegetation (less than 10 feet) was observed upstream. Adjacent land uses included forest and maintained lawn on both banks. Potential NPS pollution was categorized as high for golf courses and slight for transportation. Comments were: *Golf course upstream, stream channel widens downstream, some transportation non point source pollution.*

UIMC-10: 4 Mile west of Walker

Water temperature was ~53°F and pH was measured at 8.04. Silt, detritus and muck appeared to dominate the substrate with lesser amounts of sand, gravel and boulders also present. Overhanging vegetation, undercut banks, and some boulders were available for in-stream cover. Some aquatic plants (upstream) and filamentous algae (downstream) were observed. Little riparian vegetation (less than 10 feet) was observed both upstream and downstream which consisted of grasses and shrubs. Adjacent land uses consisted of maintained lawn on both banks. Potential NPS pollution was categorized as high for golf courses and urban residential runoff, and moderate for transportation. Comments were: *Golf course upstream, maintained residential lawns downstream.*

UIMC-11: Walker north of I-96

Water temperature and pH were not collected at this site. Silt, detritus and muck dominated the upstream substrate while observations were unable to be made downstream. Overhanging vegetation and some boulders were

available for in-stream cover. Some aquatic plants and floating algae (upstream) were observed. A moderate amount of riparian vegetation (10 to 30 ft) was observed downstream while vegetation on the upstream ranged from less than 10 ft on the right bank to over 100 ft on the left bank. Vegetation consisted of shrubs and small trees. Adjacent land uses included shrub/old field, impervious surfaces, forest and maintained lawn. Potential NPS pollution was categorized as slight to moderate for transportation, and slight for urban residential runoff. Comments were: *No specific comments were recorded for this site.*

UIMC-12: 3 Mile west of Walker

Water temperature was ~54°F and pH was measured at 8.17. Silt and sand dominate the substrate with a lesser amount of gravel also present. Overhanging vegetation and some boulders were available for in-stream cover. Some trash was observed downstream. Abundant riparian vegetation (more than 100 ft) was observed upstream, while between 10 and 100 ft was observed downstream. Vegetation consisted mainly of shrubs and trees. Adjacent land uses included forest (both banks) and maintained lawns. Potential NPS pollution was categorized as moderate for transportation, and slight for urban residential runoff. Comments were: *Good riparian vegetation and canopy.*

The majority of the impacts to the stream in this area seem to result from inadequate riparian buffers and road crossing erosion. Potential non point source pollution impacts results from nutrient runoff from grazing and crop related activities, urban residential runoff and transportation. Many of the residential landowners near the road stream crossings surveyed appeared to have almost no buffer between their lawns and the stream. Although many sites were dry at the time of this survey, of the ones that were flowing a surprising amount of gravel was present for a stream in such an agricultural area.

Lower Subwatershed (mid reaches of Indian Mill Creek to the mouth in Grand Rapids)

The Lower Indian Mill Creek subwatershed drains a predominantly urban area and converges with Grand River just north of Leonard Street in the City of Grand Rapids. Six survey locations were completed along this portion of Indian Mill Creek and were denoted by LIMC prefixes. The following conditions and comments were recorded on the survey forms:

LIMC-01: Richmond east of Elm Ridge

Water temperature was ~55°F and pH was measured at 7.78. Sand appeared to dominate the substrate with lesser amounts of silt and gravel also present. Overhanging vegetation and deep pools (on the downstream side) were available for in-stream cover. Some turbidity was observed downstream. Abundant riparian vegetation (more than 100 ft) was observed on the left

banks while vegetation on the right banks ranged from less than 10 ft to over 100 ft, consisting of shrubs and small trees. Adjacent land uses included forest and maintained lawn. Potential NPS pollution was categorized as moderate to high for urban residential runoff and moderate for transportation. Comments were: *Some bank stabilization evident, however direct runoff from road and adjacent lawns still occurring, maintained lawns right up to the edge, lots of fish observed in pools.*

LIMC-02: Waldorf east of Walker

Due to dry conditions, water temperature, pH and substrate data were not collected at this site. No overhanging vegetation, undercut banks, woody debris, aquatic plant cover, boulders or deep pools were available for in-stream cover. No aquatic plants, floating algae, filamentous algae, turbidity, bacterial sheen/slime, oil sheen, foam or trash were observed. Riparian vegetation was variable and ranged from less than 10 ft on the upstream side to more than 100ft on the downstream side. Vegetation consisted mainly of grasses and shrubs. Adjacent land uses included shrub/old field, forest, and maintained lawn. Potential NPS pollution was categorized as high for development construction, slight to moderate for urban residential runoff, and slight for transportation. Comments were: *Even though stream was dry, sedimentation was evident presumably from upstream construction.*

LIMC-03: Walker north of Richmond

Water temperature was ~54°F and pH was measured at 7.96. Sand dominated the upstream substrate while observations were unable to be made downstream. Overhanging vegetation, undercut banks and woody debris were available for in-stream cover. Some turbidity was observed downstream. Abundant riparian vegetation (more than 100 ft) was observed on the left banks, while vegetation ranged from less than 10 ft to over 100 ft on the downstream side. Vegetation consisted mainly of shrubs and small trees. Adjacent land uses included shrub/old field and maintained lawn. Potential NPS pollution was categorized as moderate for transportation, and slight for urban residential runoff. Comments were: *No specific comments were recorded for this site.*

LIMC-04: Bristol north of Richmond

Water temperature was ~55°F and pH was measured at 8.01. Bottom substrates were varied with sand, silt, gravel and boulders observed. Habitat at this site was diverse and included overhanging vegetation, undercut banks, woody debris, boulders and deep pools. No aquatic plants, floating algae, filamentous algae, turbidity, bacterial sheen/slime, oil sheen, foam or trash were observed. Abundant riparian vegetation (more than 100 ft) was observed upstream, while downstream vegetation ranged from 10 to 100 ft. Shrubs and large trees generally characterized the vegetation. Adjacent land uses included shrub/old field, forest and maintained lawn. Potential NPS

pollution was categorized as slight to high for transportation and slight for urban residential runoff. Comments were: *Observed spawning salmon, good buffer and canopy.*

LIMC-05: Alpine north of Richmond

Water temperature was ~56°F and pH was measured at 8.20. Sand and gravel accounted for most of the bottom substrates; however some boulders were also present. Overhanging vegetation, woody debris, and some boulders were available for in-stream cover. Some aquatic plants and filamentous algae (upstream) were observed. In general, little riparian vegetation (less than 10 feet) was observed both upstream and downstream, which consisted of grasses and shrubs. Adjacent land uses included impervious surfaces on both banks. Potential NPS pollution was categorized as high for urban residential runoff and moderate for transportation. Comments were: *No riparian vegetation or canopy cover, lots of salmon.*

LIMC-06: Turner south of Ann Street

Water temperature was ~57°F and pH was measured at 8.35. Silt, sand, and gravel were observed downstream while observations were unable to be made upstream. Overhanging vegetation and woody debris were available for in-stream cover. Some aquatic plants and trash were observed upstream. In general, a moderate amount of riparian vegetation (10 to 30 ft) was observed both upstream and downstream, which consisted of shrubs. Adjacent land uses included shrub/old field and impervious surfaces. Potential NPS pollution was categorized as high for urban residential runoff and moderate for transportation. Comments were: *No specific comments were recorded for this site.*

Although conditions in this portion of the watershed seem to have improved from the headwaters, the potential for transportation and urban residential runoff pollution remains. In-stream habitat greatly improved from the headwaters regions and salmon observed near the lower reaches of this subwatershed indicates that temperatures and bottom substrates are still suitable for very sensitive species.

Attachment A

Road Stream Crossing Inventory and Maps

Road Stream Crossing Inventory for Indian Mill Creek Watershed 2003

Count	Site ID	Sub-Watershed Name	Location	Township/County	Stream Name	Inventory Date
1	UIMC-01	Upper Indian Mill Creek	Fruit Ridge north of 7 Mile	Alpine/Kent	Indian Mill Creek	10/10/2003
2	UIMC-02	Upper Indian Mill Creek	7 Mile east of Fruit Ridge	Alpine/Kent	Unnamed Trib to Indian Mill Creek	10/10/2003
3	UIMC-03	Upper Indian Mill Creek	7 Mile west of Peach Ridge	Alpine/Kent	Unnamed Trib to Indian Mill Creek	10/10/2003
4	UIMC-04	Upper Indian Mill Creek	6 Mile west of Peach Ridge	Alpine/Kent	Indian Mill Creek	10/10/2003
5	UIMC-05	Upper Indian Mill Creek	Peach Ridge south of 6 Mile	Alpine/Kent	Indian Mill Creek	10/10/2003
6	UIMC-06	Upper Indian Mill Creek	7 Mile east of Peach Ridge	Alpine/Kent	Unnamed Trib to Indian Mill Creek	10/10/2003
7	UIMC-07	Upper Indian Mill Creek	6 Mile east of Peach Ridge	Alpine/Kent	Unnamed Trib to Indian Mill Creek	10/10/2003
8	UIMC-08	Upper Indian Mill Creek	Walker north of 5 Mile	Alpine/Kent	Indian Mill Creek	10/10/2003
9	UIMC-09	Upper Indian Mill Creek	Walker south of 5 Mile	Alpine/Kent	Indian Mill Creek	10/10/2003
10	UIMC-10	Upper Indian Mill Creek	4 Mile west of Walker	Alpine/Kent	Indian Mill Creek	10/10/2003
11	UIMC-11	Upper Indian Mill Creek	Walker north of I-96	Walker/Kent	Unnamed Trib to Indian Mill Creek	10/10/2003
12	UIMC-12	Upper Indian Mill Creek	3 Mile west of Walker	Walker/Kent	Indian Mill Creek	10/10/2003
13	LIMC-01	Lower Indian Mill Creek	Richmond east of Elm Ridge	Grand Rapids/Kent	Brandywine Creek	10/10/2003
14	LIMC-02	Lower Indian Mill Creek	Waldorf east of Walker	Walker/Kent	Unnamed Trib to Indian Mill Creek	10/10/2003
15	LIMC-03	Lower Indian Mill Creek	Walker north of Richmond	Grand Rapids/Kent	Indian Mill Creek	10/10/2003
16	LIMC-04	Lower Indian Mill Creek	Bristol north of Richmond	Walker/Kent	Indian Mill Creek	10/10/2003
17	LIMC-05	Lower Indian Mill Creek	Alpine north of Richmond	Grand Rapids/Kent	Indian Mill Creek	10/10/2003
18	LIMC-06	Lower Indian Mill Creek	Turner south of Ann Street	Grand Rapids/Kent	Indian Mill Creek	10/10/2003

Note: To view Indian Mill Creek Maps please see attached Excel file

Attachment B
Figures and Tables

Figure 1. Temperature and pH summary for the Indian Mill Creek Watershed

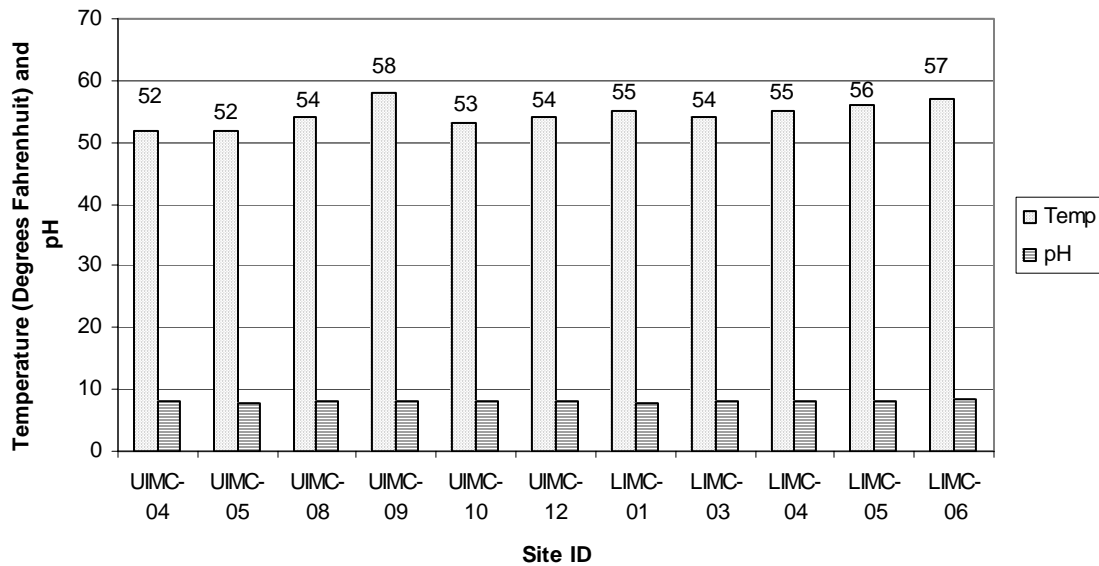


Figure 2. Temperature and pH summary for the mainstem sample locations from the headwaters to the mouth of Indian Mill Creek

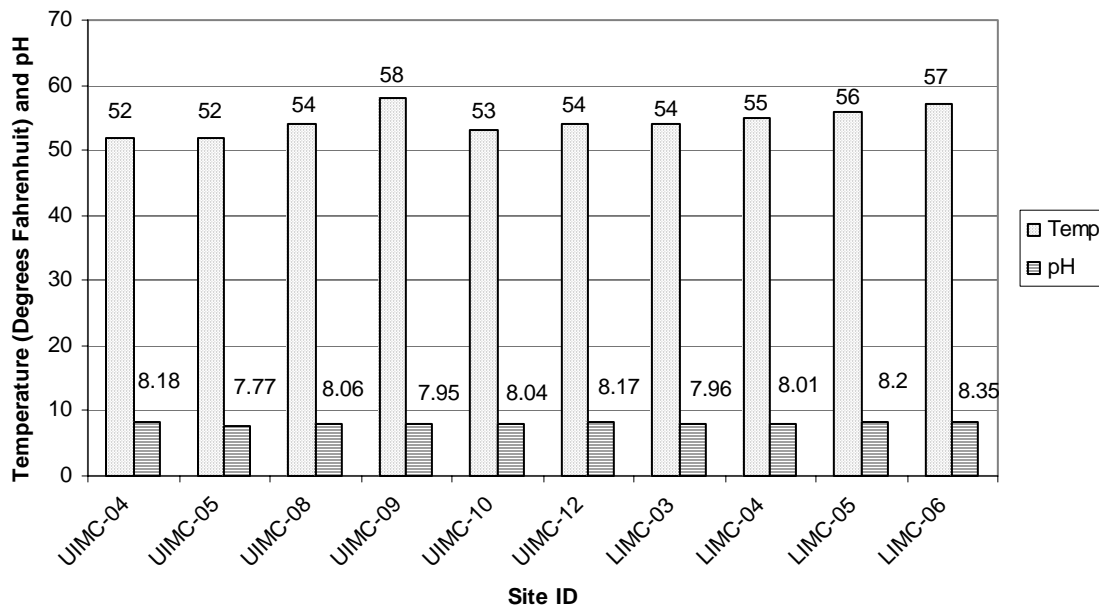


Figure 3. Percent substrate observations for each sample location in the Upper Indian Mill Creek Subwatershed

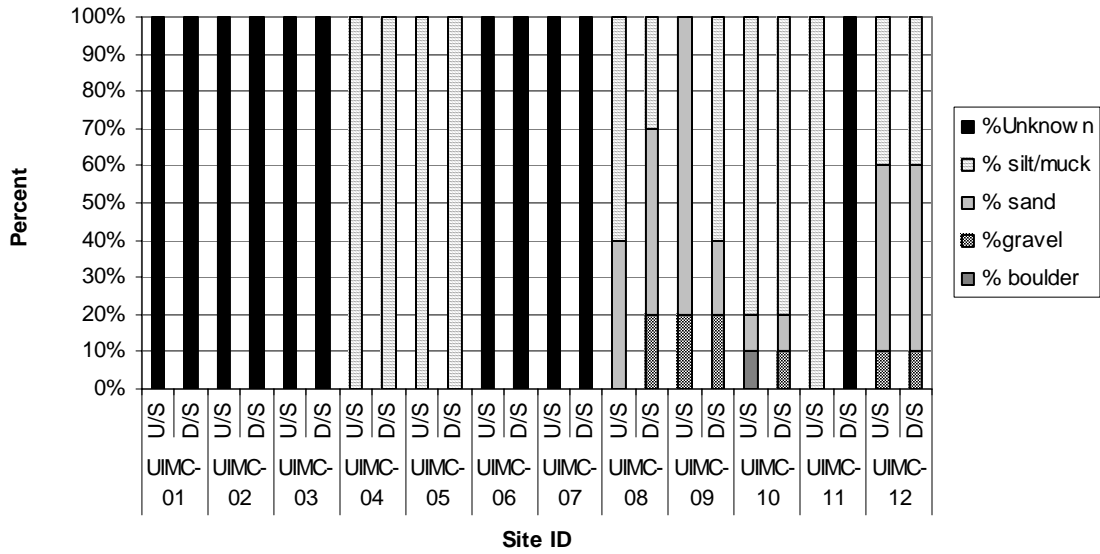


Figure 4. Percent substrate observations for each sample location in the Lower Indian Mill Creek Subwatershed

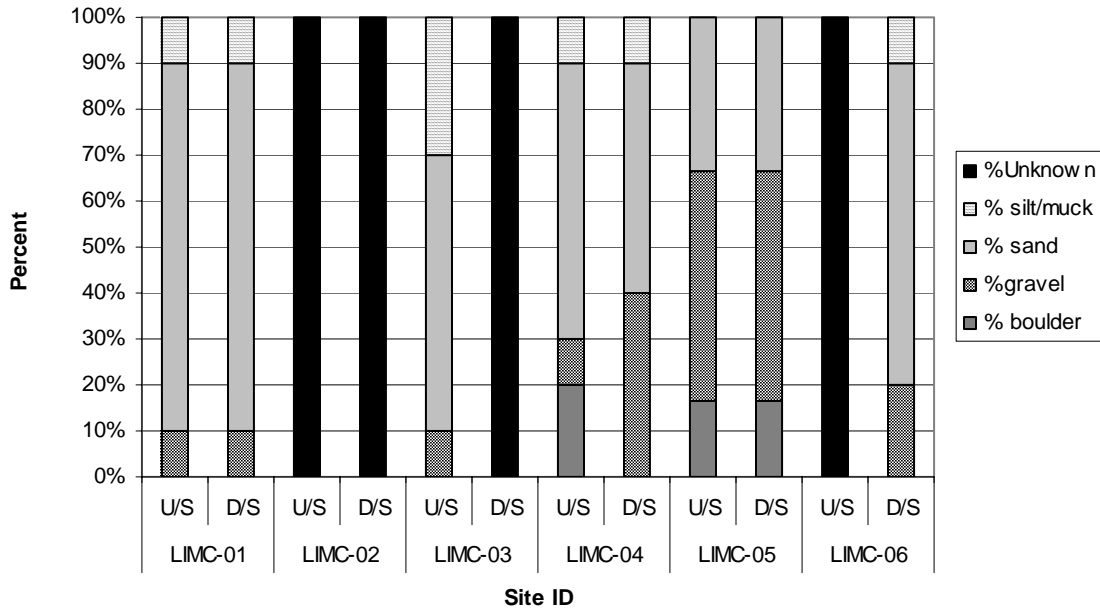


Figure 5. Percent substrate observation for the mainstem sample locations from the headwaters to the mouth of Indian Creek Mill

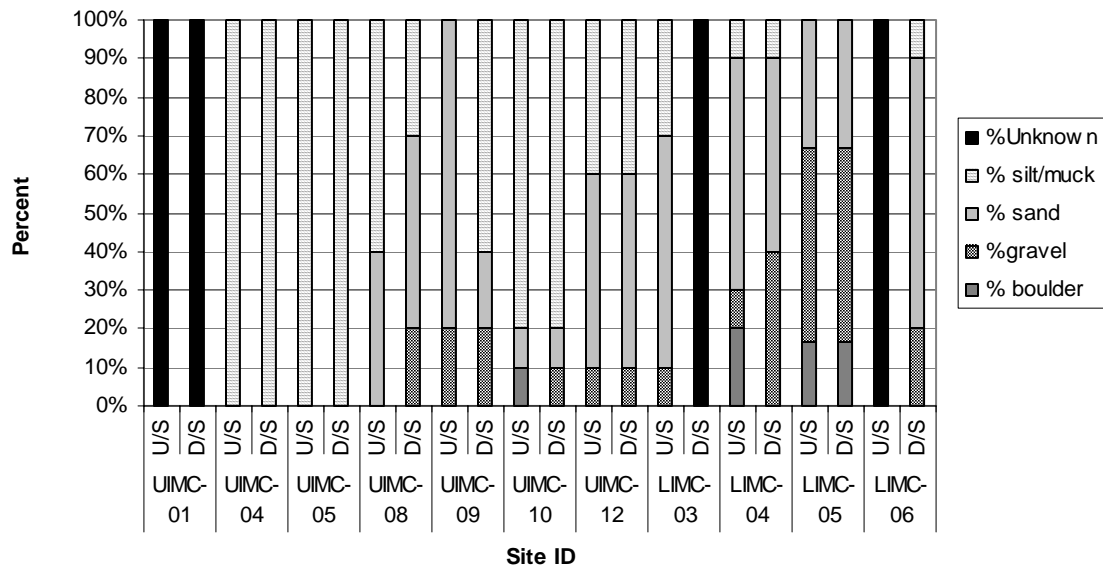


Figure 6. Summary of adjacent land uses

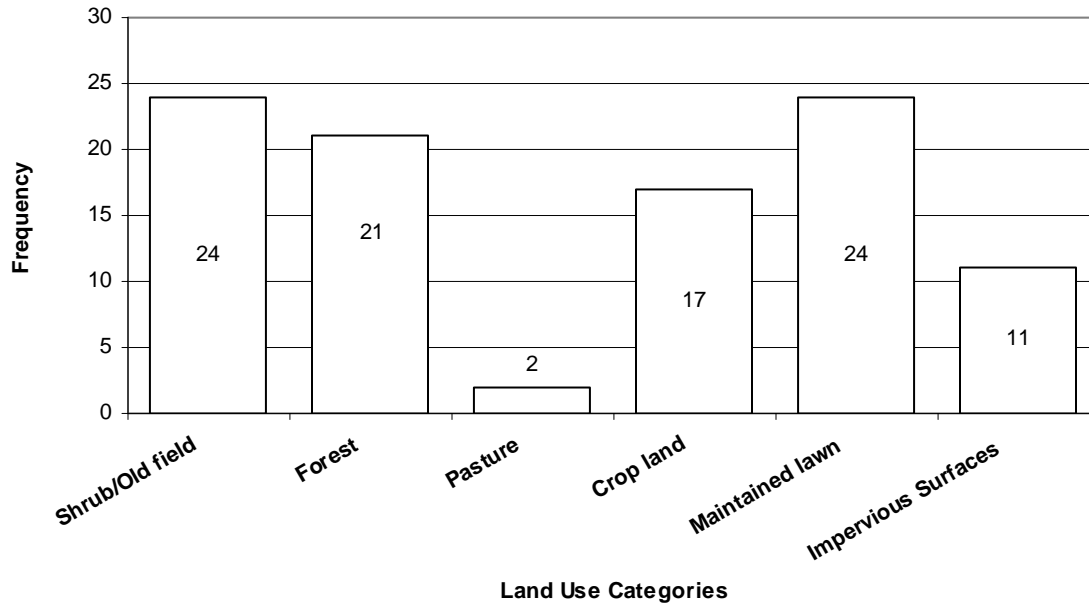


Figure 7. Weighted values for possible sources of non point source pollution (cumulative score for all locations)

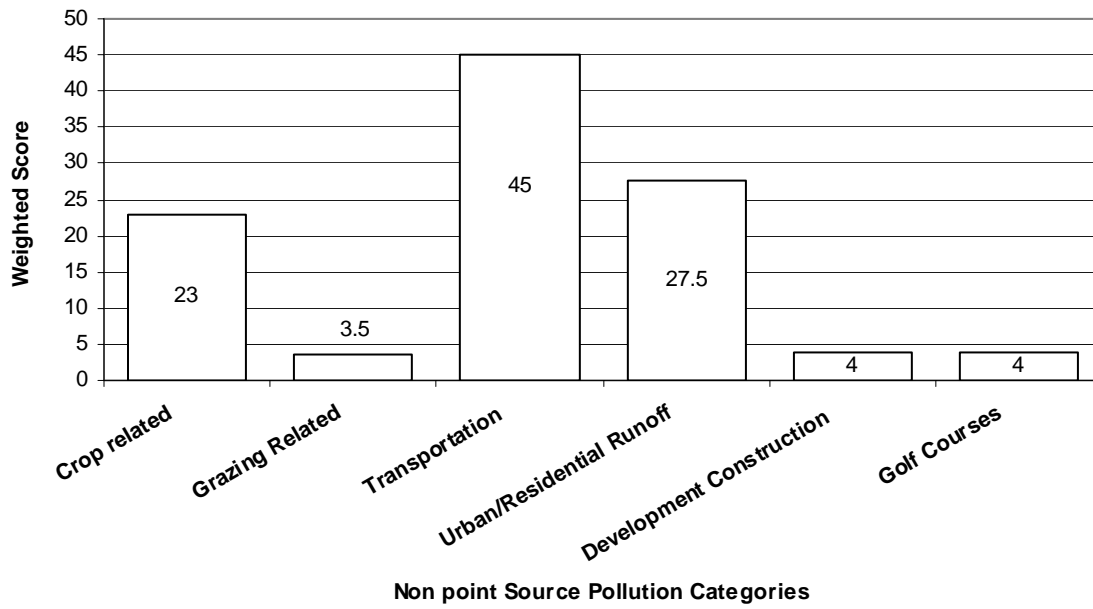


Table 1. Summary of observations made for in stream habitat and cover

SITE ID		Undercut Banks	Overhanging Vegetation	Deep Pools	Boulders	Aquatic Plant Cover	Logs/Woody Debris
UIMC-01	U/S						
	D/S						
UIMC-02	U/S					X	
	D/S		X			X	
UIMC-03	U/S						
	D/S						
UIMC-04	U/S		X				
	D/S		X				
UIMC-05	U/S		X				
	D/S		X				
UIMC-06	U/S						
	D/S						
UIMC-07	U/S						
	D/S						
UIMC-08	U/S		X				
	D/S		X				
UIMC-09	U/S		X				
	D/S		X				X
UIMC-10	U/S	X	X		X		
	D/S		X		X		
UIMC-11	U/S		X		X		
	D/S		X		X		
UIMC-12	U/S		X		X		X
	D/S		X		X		X
LIMC-01	U/S		X				X
	D/S		X	X			
LIMC-02	U/S						
	D/S						
LIMC-03	U/S		X				X
	D/S	X	X				X
LIMC-04	U/S	X	X		X		X
	D/S	X	X	X	X		X
LIMC-05	U/S		X				X
	D/S		X		X		
LIMC-06	U/S		X				X
	D/S		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	Bacterial Sheen	Foam	Trash
UIMC-01	U/S							
	D/S							
UIMC-02	U/S	A						
	D/S	P	P					
UIMC-03	U/S							
	D/S							
UIMC-04	U/S	P						
	D/S							
UIMC-05	U/S	P	P					
	D/S	A	A					
UIMC-06	U/S							
	D/S							
UIMC-07	U/S							
	D/S							
UIMC-08	U/S							
	D/S	P						
UIMC-09	U/S	P						
	D/S							P
UIMC-10	U/S	P						
	D/S			P				
UIMC-11	U/S	P	P					
	D/S	P						
UIMC-12	U/S							
	D/S							P
LIMC-01	U/S							
	D/S				P			
LIMC-02	U/S							
	D/S							
LIMC-03	U/S							
	D/S				P			
LIMC-04	U/S							
	D/S							
LIMC-05	U/S	P		P				
	D/S	P						
LIMC-06	U/S	P						P
	D/S							

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	
UIMC-01	U/S		X				X		grasses	
	D/S	X						X	grasses	
UIMC-02	U/S		X				X		grasses	
	D/S				X			X	grasses	
UIMC-03	U/S		X			X			grasses	
	D/S	X						X	shrubs	
UIMC-04	U/S		X				X		shrubs	
	D/S	X					X		grasses	
UIMC-05	U/S		X				X		grasses	
	D/S			X		X			grasses	
UIMC-06	U/S	X				X			grasses	
	D/S	X				X			grasses	
UIMC-07	U/S				X			X	shrubs	
	D/S		X				X		shrubs	
UIMC-08	U/S	X				X			grasses	
	D/S				X			X	shrubs	
UIMC-09	U/S	X				X			grasses	
	D/S				X			X	trees	
UIMC-10	U/S	X				X			shrubs	
	D/S	X				X			shrubs	
UIMC-11	U/S				X	X			trees	
	D/S		X				X		shrubs	
UIMC-12	U/S				X			X	trees	
	D/S			X			X		trees	
LIMC-01	U/S				X			X	shrubs	
	D/S				X	X			shrubs	
LIMC-02	U/S	X					X		grasses	
	D/S				X		X		shrubs	
LIMC-03	U/S				X			X	trees	
	D/S				X	X			shrubs	
LIMC-04	U/S				X			X	shrubs	
	D/S			X		X			trees	
LIMC-05	U/S	X				X			shrubs	
	D/S	X					X		shrubs	
LIMC-06	U/S		X			X			shrubs	
	D/S		X				X		shrubs	

U/S= upstream direction

D/S= downstream direction

Table 4. Summary of adjacent land uses

Site ID		Shrub/Old field	Forest	Pasture	Crop land	Maintained lawn	Impervious Surfaces
UIMC-01	U/S				B		
	D/S			B	B		
UIMC-02	U/S					R	L
	D/S	B					
UIMC-03	U/S				B		
	D/S	R	L			L	
UIMC-04	U/S		R		L	R	
	D/S	L	L			R	
UIMC-05	U/S	B			B		
	D/S	B			B		
UIMC-06	U/S				B	R	
	D/S				B		
UIMC-07	U/S	B	B				
	D/S	B			B	B	
UIMC-08	U/S	B				B	
	D/S	B	B				
UIMC-09	U/S					B	
	D/S		B				
UIMC-10	U/S					B	
	D/S					B	
UIMC-11	U/S	L	L				R
	D/S					R	L
UIMC-12	U/S		B				
	D/S		B			R	
LIMC-01	U/S		B			L	
	D/S		L			R	
LIMC-02	U/S					B	
	D/S	R	R			L	
LIMC-03	U/S	B					
	D/S	B				R	

Table 4. Continued

Site ID		Shrub/Old field	Forest	Pasture	Crop land	Maintained lawn	Impervious Surfaces
LIMC-04	U/S		B				
	D/S	R	L			R	
LIMC-05	U/S						B
	D/S						B
LIMC-06	U/S						B
	D/S	R					B

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

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

Site ID		Crop related	Grazing Related	Transportation	Urban/Residential Runoff	Development Construction	Golf Courses
UIMC-01	U/S	H		S			
	D/S	H	M	S			
UIMC-02	U/S	M		S			
	D/S	S		S			
UIMC-03	U/S	H		S			
	D/S	S		S			
UIMC-04	U/S	H		S			
	D/S	M		S			
UIMC-05	U/S	H	S	M			
	D/S	H	S	H			
UIMC-06	U/S	M					
	D/S	M		S			
UIMC-07	U/S	M		M			
	D/S	M		S	S		
UIMC-08	U/S			S	M		
	D/S			M			
UIMC-09	U/S			S			H
	D/S			S			
UIMC-10	U/S			M	H		H
	D/S			M	H		
UIMC-11	U/S			M	S		
	D/S			S	S		
UIMC-12	U/S			M	S		
	D/S			M	S		
LIMC-01	U/S			M	M		
	D/S			M	H		
LIMC-02	U/S			S	S	H	
	D/S			S	M	H	
LIMC-03	U/S			M			
	D/S			M	S		

Table 5. Continued

Site ID		Crop related	Grazing Related	Transportation	Urban/Residential Runoff	Development Construction	Golf Courses
LIMC-04	U/S			S	S		
	D/S			H	S		
LIMC-05	U/S			M	H		
	D/S			M	H		
LIMC-06	U/S			M	H		
	D/S			M	H		

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)**