



Deer Creek Watershed

Ottawa and Muskegon
Counties, MI

Field Surveys
performed by DEQ staff
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SUMMARY OF DEER CREEK WATERSHED ASSESSMENT OTTAWA, MICHIGAN

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INTRODUCTION

The Deer Creek Watershed is located in the northeastern portion of Ottawa County. It originates in the agricultural fields near Conklin and the area south of Wilson Avenue and flows south to its convergence with the Grand River between Eastmanville and Lamont. The majority of the watershed drains a predominantly agricultural area with low density residential use. The only urban area is located along the mid reaches of Deer Creek within the City of Coopersville. 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 Deer 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, twenty-five road/stream crossing locations were surveyed during the assessment of the Deer Creek Watershed. Refer to Attachment A, Road Stream Crossings Inventory, for a summary of the survey locations conducted during October 2003 as well as survey location maps. Site identification codes were developed using three 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 in two days 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). Twenty locations, including ten along the main stem of Deer Creek, were measured for temperature and pH. pH values ranged from 7.39 to 7.95, which are not outside of the normal range for streams within Michigan. Overall the average temperature was 46.5° F, with most stations at either 45 or 46° F. One location, at Hayes Road east of 40th Avenue, was 56°F which was the highest recorded temperature within the watershed. This comparatively high reading was due to unknown sources.

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 containing 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 appear cool because the survey was conducted

during the fall. Maximum air temperatures during the two field days of this survey ranged from 54°F (on October 17) to 57°F (on October 24). 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, 50 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 are 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 Deer Creek Watershed approximately 26% were dominated (80 to 100% covered by) with sand and 22% dominated by silt, detritus or muck. 20% of the sites were unable to be categorized due to turbidity. 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 always less than 20%). Refer to Figures 3 through 6 for substrate data for each of the subwatersheds separately. Refer to Figure 7, in Attachment B, for a graph depicting the substrate composition for those survey locations located along the main channel of Deer 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 50 observations made, 82% of the sites had overhanging vegetation and 58% of the sites had woody debris. Undercut banks, deep pools and aquatic plant cover were each found in approximately 18%, 6% and 12% of the remaining 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 sheens, turbidity, oil sheen, foam and/or trash. In all, 50 physical appearance observations were recorded and rated as either present or abundant. No oil sheens were observed at any of the sites. In general foam, bacterial sheens and trash were the least common. Approximately 42% of the sites exhibited aquatic plants (including duckweed) while 10% exhibited floating algae, 14% of the sites exhibited filamentous algae and 16% of the sites exhibited turbidity. 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. Twenty five survey locations were assessed, resulting in 100 observations of riparian vegetation width recorded. The following three width classes accounted for a majority of the observations made: 29% in less than 10 feet, 30% between 10 and 30 feet and 26% with over 100 feet of riparian vegetation. The width class of 30 to 100 feet was the least common and was observed at only 15% of the sites.

The streamside land cover, estimated bank erosion and percent stream canopy were evaluated at each of the twenty-five survey locations for both the upstream and downstream stretches. In all, 50 observations were made for each of the above listed characteristics. Of the survey locations, 10% were recorded as having streamside land cover predominantly shrubs, 14% predominantly grasses, 25% dominated by trees, and one site was listed as having bare riparian vegetation. 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 Deer Creek Watershed with approximately 90% 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 help keep dissolved oxygen levels from depleting, an important habitat requirement for many fish species and other aquatic organisms. Of the 24 sites assessed, 24% had less than 25% cover, 30% had between 25 and 50% cover and 46% 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 8 for a summary of all the adjacent land uses recorded within the watershed. The most common adjacent land uses were crop land, forest and shrub/old field followed by a lesser number of observations for pasture, impervious surfaces, maintained lawns, disturbed ground and wetlands.

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 9, 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, crop related sources and urban residential runoff were the most serious while streambank erosion and grazing related sources were also considered common 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 West Subwatershed (Unnamed Tributary and Deer Creek headwaters)

Deer Creek originates in the agricultural fields to the south of Wilson Avenue. Four survey locations were evaluated on this portion of Deer Creek before the inlet of Beaver Creek tributary. Stations in the Upper West subwatershed are denoted by UWDC prefixes. The land use in this area is 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:

UWDC-01: Taft west of 68th

Due to very little flow, water temperature and pH were not collected at this site; substrate observations were impaired due to extensive leaf litter. Some overhanging vegetation and woody debris was noted along with aquatic plants and turbidity. Directly at the road stream crossing the land use was heavily agricultural. Approximately 10 feet (ft) of riparian vegetation was recorded for the upstream direction which consisted of grasses and flowed through cropland, while the downstream side had approximately 10-30 ft of riparian vegetation characterized by trees (although this portion was still located in cropland). Potential non point source pollution (NPS) is high for crop related activities and slight for transportation related NPS. Comments were: *Heavily agricultural area, very turbid and stagnant.*

UIWDC-02: Taft west of 64th

Water temperature was ~47°F and pH was measured at 7.95. Substrate appeared to be dominated by silt, detritus and muck with some sand. Overhanging vegetation and woody debris was available for in-stream cover. No algae, turbidity or aquatic plants were observed. 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 forest. A moderate potential for NPS pollutants was recognized from transportation and the gravel/sand road. *No specific comments were made regarding this site.*

UWDC-03: Roosevelt east of 64th

Water temperature was ~45°F and pH was measured at 7.85. Substrate was dominated by sand with lesser but equal amounts of gravel and silt present. Overhanging vegetation, deep pools and woody debris was available for in-stream cover. No algae, turbidity or aquatic plants were observed, however some trash was noted on the upstream side. 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 forest. A high potential for NPS pollutants was recognized from transportation and the gravel/sand road and bridge erosion. Comments were: *Site looks relatively good except for severely eroding bridge and gravel road.*

UWDC-04: 64th north of Cleveland

The water temperature remained at ~45°F with pH at 7.81. Silt, detritus and muck accounted for 100% of the bottom substrates with some overhanging vegetation, undercut banks and woody debris available for in-stream cover. No algae, turbidity or aquatic plants were observed. While abundant forest riparian vegetation (more than 100 ft) was available on the upstream side, only less than 10 to 30 ft of shrubs and trees was available on the downstream side. Adjoining land uses included forest, shrub/old field and pasture. Potential NPS pollution is slight for urban residential runoff, transportation and animal feeding operations and moderate for grazing related activities. Comments were: *Downstream banks looks highly eroded, stream is meandering through an area grazed by llamas.*

The majority of the impacts to the stream in this area seem to result from transportation erosion or erosion due to the road stream crossing (sand/gravel roads, road washout). In a few areas inadequate riparian buffer and possible nutrient runoff from adjoining crops, pasture could also potentially impact the stream.

Upper East Subwatershed (Beaver Creek flowing into Deer Creek)

Beaver Creek is the major tributary to Deer Creek with its headwaters originating near the small village of Conklin. It drains a heavily agricultural area and converges with Deer Creek just north of Cleveland Street. Nine survey locations were completed along Beaver Creek. Stations in the Upper East subwatershed are denoted by UEDC prefixes. The following conditions and comments were recorded on the survey forms:

UEDC-01: 32nd north of Wilson

Due to very little flow, water temperature and pH were not collected at this site. Substrate observations for the upstream side were impaired because of the small size of the channel and the fact that the channel itself was obstructed from view by thick grassy vegetation. Substrate on the downstream side was dominated by sand with lesser amounts of silt present. Only overhanging vegetation was available for in-stream cover. Although no algae, turbidity or aquatic plants were observed, some trash was noted on the downstream side. Riparian vegetation was 10-30 ft wide on the right bank and 30-100 ft on the left bank, characterized by grasses and shrubs. Adjoining land uses were mainly agricultural crop land. Potential NPS pollution was slight for channelization, moderate for transportation and high for crop related activities. Comments were: *Although highly agricultural, both the u/s and d/s have good riparian buffers and canopy cover.*

UEDC-02: Sehler west of 32nd

The water temperature here was slightly elevated to ~51°F with a pH of 7.46. Due to low flow and the abundance of grassy vegetation, substrate observations could not be made for the upstream side, however silt, detritus and muck accounted for 100% of the bottom substrates on the downstream side. Only overhanging vegetation and aquatic plant cover was available for in-stream habitat. Filamentous algae and duckweed was abundant on the downstream side. In general, riparian vegetation was less than 10 feet wide and consisted of grasses and small shrubs. Adjoining land uses included crop land on both banks, as well as shrub/old field on the right bank and impervious surfaces on the left. Potential NPS pollution is slight for urban residential runoff and channelization, moderate for transportation and high for crop related activities. Comments were: *Highly agricultural, field underdrains outlet here, lots of algae, some riprap in place.*

UEDC-03: 40th north of Wilson

The water temperature here had decreased from the previous site to ~41°F with pH at 7.41. Due to stagnant flow and the abundance of duckweed floating on the surface of the water on the upstream side, substrate observations were impaired, however silt, detritus and muck accounted for 100% of the bottom substrates on the downstream side. Although abundant in stream cover was noted including overhanging vegetation, undercut banks,

deep pools and aquatic plant cover, the lack of flow in this area, high nutrients and eroding streambanks probably prohibit most sensitive aquatic life. Riparian vegetation extended less than 10 feet and was dominated by grasses and small shrubs on the upstream side with only short grasses on the downstream side. Adjoining land uses included cropland, maintained lawns, pasture and a small area of disturbed ground. The disturbed ground was due to an area of unrestricted cattle access in the adjoining pasture. Potential NPS pollution is slight for channelization and urban residential runoff, moderate for transportation, streambank erosion and crop related activities and high for grazing related activities. Comments were: *D/s pasture where cattle have approx. 250ft unrestricted access, moderate bank erosion, area of road washout, u/s has tons of duckweed.*

Note: DEQ field staff referred the farm to the Michigan Department of Agriculture for follow up work.

UEDC-04: Elder south of Wilson

Due to little flow and thick vegetation near the culvert on the downstream, side, water temperature and pH were not collected at this site. Silt, detritus and muck accounted for 100% of the bottom substrate on both the downstream and upstream sides. Some aquatic plant cover and woody debris were available for in-stream cover. In general riparian vegetation extended 10-30 ft from the stream and consisted of mostly grasses on the upstream side and shrubs and small trees on the downstream side. Adjoining land uses consisted of cropland and pasture. Potential NPS pollution is slight for transportation and moderate to high for crop related activities. Comments were: *Choked with aquatic plants, lots of nutrients, almost no flow, gully from road erosion forming.*

UEDC-05: Taft east of Squires

The water temperature here was the second highest measured for all sites at ~53°F with a pH of 7.75. Silt, detritus and muck dominated the substrate of the both the upstream and downstream sides. Only some overhanging vegetation and woody debris were available for in-stream cover on the upstream side. Aquatic plants and filamentous algae were abundant with lesser degree of turbidity also noted. In general riparian vegetation, mainly grasses, extended less than 10 feet from the stream with the exception of the left bank on the upstream side which had more than 100 feet of riparian vegetation. Adjoining land uses consisted of cropland on the left banks and pasture and old/field on both banks. At this site Beaver Creek flows through an area grazed by cattle with no evidence of any fences to keep cattle out of the stream. Potential NPS pollution is slight to moderate for transportation, moderate for crop relate activities and high for streambank erosion and grazing related activities. Comments were: *severe bank erosion and devegetation from unrestricted cattle access on the d/s side, also gully erosion from road.*

Note: DEQ field staff referred the farm to the Michigan Department of Agriculture for follow up work.

UEDC-06: 48th south of Taft

This site was located on a small unnamed tributary to Beaver Creek that is not displayed on the site map. The tributary joins the main channel of Beaver Creek in the middle of the pasture described above. The water temperature at this site was ~51°F with a pH of 7.66. Sand dominated the substrate at this location with smaller amounts of silt, detritus, muck and gravel. Only some overhanging vegetation on the upstream side was available for in-stream cover. No turbidity or algae was noted for this site although aquatic plants were observed and the potential for turbidity exists based on cattle use and sandy substrate. Riparian vegetation ranged in width from less than 10 feet to between 10-30 feet, and consisted of shrubs on the upstream side and grasses on the downstream side. Adjoining land uses include pasture, cropland, disturbed ground and shrub/old field. Potential NPS pollution is slight to moderate for transportation and high for crop and grazing related activities as well as streambank erosion. Comments were: *Areas of road washout, culvert not aligned with stream, perched ~3 inches.*

UEDC-07: 48th north of Roosevelt

The water temperature here had decreased to ~44°F with a pH of 7.94. Once again silt, detritus, and muck dominated the substrate. Overhanging vegetation, and woody debris were available for in-stream cover. Aquatic plants and turbidity were also observed. Riparian vegetation was variable and ranged in width from less than 10 ft to over 100 ft in some areas, and consisted of mainly shrubs and trees. Adjoining land uses were cropland and forest. Potential NPS pollution ranged from slight to high for crop related activities and was moderate for transportation. Comments were: *Three round culverts not aligned well with stream, receiving direct runoff from road.*

UEDC-08: Roosevelt west of 48th

The water temperature here was ~45°F with a pH of 7.92. Sand dominated the substrate with lesser amounts of silt, detritus and muck also present. Overhanging vegetation, undercut banks and woody debris were available for in-stream cover. Aquatic plants and some turbidity were observed. Riparian vegetation was less than 10 ft for both banks on the upstream side while on the downstream side it ranged from 30 ft to more than 100 ft. Riparian vegetation consisted of mainly grasses with some shrubs and small trees. Adjoining land uses were maintained lawns and shrub/old field. Potential NPS pollution is slight for crop related activities, moderate for transportation and moderate to high for urban residential runoff. Comments were: *newly paved roads with extremely steep slopes and no vegetation stopping anything from getting into the stream, maintained lawns right up to stream edge*

UEDC-09: 56th south of Roosevelt

This site was the farthest downstream location on Beaver Creek surveyed before it empties into the main channel of Deer Creek. The water temperature here was ~46°F with a pH of 7.90. Sand dominates the substrate with lesser amounts of silt, detritus, and muck also present. Some overhanging vegetation and woody debris were available for in-stream cover. Aquatic plants and filamentous algae were observed in abundant quantities. Riparian vegetation ranged in width from 10- 30 ft on the left bank to over 100 ft on the right bank, and consisted of mainly grasses with some shrubs. Adjoining land uses included maintained lawns, crop land and shrub/old field. Potential NPS pollution is moderate for transportation, urban residential runoff and crop related activities. Comments were: *lots of filamentous algae where ditches drain into stream, very bad odor here, riprap from drainage area stained green.*

The majority of the impacts to the stream in this area seem to result from inadequate riparian buffers, grazing related activities and subsequent streambank erosion, nutrient runoff from cropland, and transportation non point source pollution. Two farmsteads were referred to the Michigan Department of Agriculture for providing unrestricted cattle access to Beaver Creek which resulted in moderate to severe streambank erosion and the potential input of e-coli bacteria to the stream. Many of the residential landowners near the road stream crossings appeared to have almost no buffer between their lawns and the stream. 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 possibly gravel/sand roads could be contributing to the sediment load within the stream.

Mid Subwatershed (main channel of Deer Creek as it passes through Coopersville)

The mid subwatershed refers to the portion of Deer Creek that flows south from its convergence with Beaver Creek, through the town of Coopersville to the area just before the mouth of the next largest tributary, Little Deer Creek. Five survey locations were completed along the main stem of Deer Creek including MDC-01, MDC-02, MDC-03, MDC-06 and MDC-08. Three survey locations were completed for unnamed tributaries flowing into Deer Creek including, MDC-04, MDC-05 and MDC-07. The majority of the land use in this area is agricultural with some low density to medium density residential areas. Land use becomes moderately urban near the city of Coopersville. The following conditions and comments were recorded on the survey forms:

MDC-01: Cleveland east of 64th

This site was the first station surveyed after Beaver Creek converges with Deer Creek. The water temperature here was ~46°F with a pH of 7.86. Due to turbidity, the substrate of the upstream side was not able to be determined, however sand dominated the downstream side substrate with lesser amount of silt, detritus, and muck. Overhanging vegetation, undercut banks, deep pools and woody debris were available for in-stream cover. No aquatic plants

or algae was observed. Riparian vegetation was abundant, extended more than 100 ft from the stream, and consisted of mainly trees and understory shrubs. Adjoining land uses included forest and shrub/old field (both banks), cropland and maintained lawns (right bank) and impervious surfaces (left bank). Potential non point source pollution was slight for transportation and crop related activities while it was moderate for urban residential runoff. Comments were: *looks pretty good, has some deep pools, good buffer and canopy.*

MDC-02: Grove Street east of Lawton

The water temperature here remained ~46°F with a pH of 7.76. Substrate conditions for both the upstream and downstream sides were varied and included mostly sand with varying amounts of silt and gravel also present. Overhanging vegetation and woody debris were available for in-stream cover. No aquatic plants, algae or turbidity were observed. Riparian vegetation was highly varied, ranging from less than 10 feet in some areas to more than 100 feet in others. Trees and understory shrubs were the dominant vegetation type within the riparian zone. In this residential area the adjoining land uses were forest and maintained lawns. A recreational baseball field was located on the banks of the stream and was included in the maintained lawns category. Potential non point source pollution is slight for transportation and moderate for urban residential runoff and recreational non point source pollution. Comments were: *Residential area, baseball field on downstream side.*

MDC-03: Arthur (Randall) west of 60th

The water temperature here had decreased to ~44°F with a pH of 7.56. The substrate was an even mix of silt and sand. Overhanging vegetation, undercut banks and woody debris were available for in-stream cover. Although no aquatic plants, algae or turbidity were observed, some foam and trash was noted. Riparian vegetation was highly varied, ranging from less than 10 feet in some areas to more than 100 feet in others. Trees and understory shrubs were the dominant vegetation type within the riparian zone. Adjoining land uses included forest, maintained lawns and impervious surfaces. Potential non point source pollution is slight for streambank erosion and debris in water, moderate for transportation and urban residential runoff. Comments were: *unknown source of foam, some erosion evident.*

MDC-04: 48th north of Garfield

This site was located on a small tributary to Deer Creek flowing in from the east and draining an area south of I-96 near the sewage disposal facility. The water temperature was ~46°F with a pH of 7.39. Sand dominated the substrate with very small amounts of silt, detritus and muck. Very little overhanging vegetation was available for in-stream cover. Aquatic plants and floating and filamentous algae were observed. Riparian vegetation extended

10-30 feet (upstream banks) and 30-100 feet (downstream banks) and consisted of grasses and shrubs. Adjoining land uses included maintained lawns, shrub/old field and cropland. Potential non point source pollution is moderate for crop related activities, urban residential runoff and transportation. Comments were: *good buffer although excess nutrients evident, gets a lot of grass clippings from roadside.*

MDC-05: Garfield west of 48th

The site was also located on the same tributary as described above (MDC-04). The water temperature here had decreased to 43°F with a pH of 7.78. Silt, detritus and muck accounted for most of the bottom substrates with some sand present. Only overhanging vegetation was available for in-stream cover. Although no aquatic plants, turbidity, or floating or filamentous algae were observed a bacterial sheen was noted. Very little riparian vegetation (less than 10 feet) was present and it consisted of mostly grasses. Adjoining land uses included pasture, maintained lawns and an animal feeding operation. Potential non point source pollution is slight for urban residential runoff and grazing related activities. *No specific comments were listed for this site.*

MDC-06: Garfield east of 60th

This site was located on the main channel of Deer Creek. The water temperature here was 46°F with a pH of 7.73. Silt, detritus and muck accounted for most of the bottom substrates with some sand also present. Overhanging vegetation, woody debris and undercut banks were available for in-stream cover. No aquatic plants, algae or turbidity were observed. In general riparian vegetation extended 10-30 feet from the stream and was dominated by small trees. Adjoining land uses included maintained lawns, shrub/old field and impervious surfaces. Potential non point source pollution is moderate for urban residential runoff and transportation. *No specific comments were listed for this site.*

MDC-07: 60th south of Garfield

This site was located on an unnamed tributary to Deer Creek, flowing from the west that drains a predominantly agricultural area. The water temperature and pH was not collected here due to very steep slopes and nearly stagnant waters. Due to the abundance of aquatic plants (duckweed) and floating algae substrate observations could not be made. Some overhanging vegetation and woody debris was available for in-stream cover. Riparian vegetation ranged from 10-100 feet and consisted of mainly trees, grasses and shrubs. Adjoining land uses included shrub/old field, wetlands and an animal feeding operation. Potential non point source pollution is slight for grazing and crop related activities, urban residential runoff and transportation. Comments were: *Lots of duckweed, very steep bank up to cattle feeding operation.*

MDC-08: Brucker

The site was the last survey location on the main channel of Deer Creek before the mouth of Little Deer Creek, the second largest tributary. The water temperature was recorded at ~46°F with a pH of 7.81. Silt, detritus and muck accounted for most of the bottom substrates with some sand present as well as areas with unknown substrate. Overhanging vegetation, undercut banks and woody debris were available for in-stream cover. No aquatic plants, algae or turbidity were observed. Riparian vegetation ranged from 10-100 feet and consisted mainly of grasses and shrubs. Adjoining land uses included maintained lawns and forest. Potential non point source pollution is slight for transportation, urban residential runoff and streambank erosion. *No specific comments were listed 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. Grazing and crop related activities are still a concern in some areas in the mid watershed.

Lower Subwatershed (Deer Creek converges with the Grand River)

The lower subwatershed includes Deer Creek's second largest tributary, Little Deer Creek as well as the main channel of Deer Creek as it flows south from its convergence with Little Deer Creek to the Grand River. Three survey locations were completed along the main stem of Little Deer Creek including LDC-01, LDC-02 and LDC-03, with one final station on Deer Creek, LDC-04. The majority of the land use in this area is somewhat agricultural with low to medium density residential as well. The following conditions and comments were recorded on the survey forms:

LDC-01: Berlin Fair

Due to very little flow at this crossing located near the headwaters of Little Deer Creek, the water temperature and pH were not recorded. Due to the abundance of leaf litter and low water conditions, substrate observations were prohibited. Some overhanging vegetation was noted and if the water level would have been greater undercut banks would have existed for in-stream cover. Aquatic plants were also observed. Riparian vegetation was less than 10 to 10-30 feet of mainly shrubs and trees. Adjoining land uses included forest and crop land. Potential non point source pollution slight for urban residential runoff and transportation. Comments were: *Stream was predominantly dry at this point.*

LDC-02: Hayes east of 40th

The water temperature here was recorded at ~56°F (the highest recorded temperature throughout the watershed) with a pH of 7.52. Silt, detritus and muck accounted for most of the bottom substrates with some sand present on the upstream side. Overhanging vegetation and woody debris were available for in-stream cover. Aquatic plants were observed. In general riparian vegetation extended 10-30 feet from the stream and consisted of shrubs and trees. Adjoining land uses were forest and cropland. Potential non point source pollution is slight for transportation and crop related activities. Comments were: *Slight bacterial sheen upstream and downstream.*

LDC-03: 48th south of Hayes

The water temperature here was recorded at ~44°F with a pH of 7.97. Bottom substrate was dominated by silt by also contained lesser amounts of gravel. Only overhanging vegetation was available for in-stream cover. Some floating algae was observed. Riparian vegetation generally extended 10-30 feet from the stream channel and consisted primarily of grasses and shrubs. Adjoining land uses were categorized as shrub/old field. Potential non point source pollution was slight for transportation. *No specific comments were listed for this site.*

LDC-04: Leonard west of 48th

The site was the farthest downstream location surveyed before Deer Creek meets the Grand River. The water temperature here was recorded at ~47°F with a pH of 7.60. Due to the level of turbidity and water depth, substrate observations were prohibited. Overhanging vegetation, undercut banks and woody debris were available for in-stream cover. A slight bacterial sheen was also noted. Riparian vegetation generally exceeded 100 feet with the exception of left bank on the downstream side which had less than 10 feet of riparian vegetation. Adjoining land uses included forest and shrub/old field. Potential non point source pollution was slight for transportation. Comments were: *Bacterial sheen present.*

Little Deer Creek is predominantly agricultural with interspersed old fields and forests. Riparian vegetation conditions were relatively good in this sub watershed, although potential still exists for possible pollution from transportation related issues. An unknown source of bacteria was evident at LDC-04, the furthest downstream location.

Attachment A

Road Stream Crossing Inventory and Maps

Road Stream Crossing Inventory for Deer Creek Watershed 2003

Count	Site ID	Sub-Watershed Name	Location	Township/County	Stream Name	Inventory Date
1	UWDC-01	Upper West Deer Creek	Taft west of 68th	Polkton/Ottawa	Trib to Deer Creek	10/17/2003
2	UWDC-02	Upper West Deer Creek	Taft west of 64th	Polkton/Ottawa	Deer Creek	10/17/2003
3	UWDC-03	Upper West Deer Creek	Roosevelt east of 68th	Polkton/Ottawa	Deer Creek	10/17/2003
4	UWDC-04	Upper West Deer Creek	64th north of Cleveland	Polkton/Ottawa	Deer Creek	10/17/2003
5	UEDC-01	Upper East Deer Creek	32nd north of Wilson	Chester/Ottawa	Beaver Creek	10/17/2003
6	UEDC-02	Upper East Deer Creek	Sehler west of 32nd	Chester/Ottawa	Beaver Creek	10/17/2003
7	UEDC-03	Upper East Deer Creek	40th north of Wilson	Chester/Ottawa	Beaver Creek	10/17/2003
8	UEDC-04	Upper East Deer Creek	Elder south of Wilson	Wright/Ottawa	Beaver Creek	10/17/2003
9	UEDC-05	Upper East Deer Creek	Taft east of Squires	Wright/Ottawa	Beaver Creek	10/17/2003
10	UEDC-06	Upper East Deer Creek	48th south of Taft	Wright/Ottawa	Beaver Creek	10/17/2003
11	UEDC-07	Upper East Deer Creek	48th north of Roosevelt	Polkton/Ottawa	Beaver Creek	10/17/2003
12	UEDC-08	Upper East Deer Creek	Roosevelt west of 48th	Polkton/Ottawa	Beaver Creek	10/17/2003
13	UEDC-09	Upper East Deer Creek	56th south of Roosevelt	Polkton/Ottawa	Beaver Creek	10/17/2003
14	MDC-01	Mid Deer Creek	Cleveland east of 64th	Polkton/Ottawa	Deer Creek	10/17/2003
15	MDC-02	Mid Deer Creek	Grove St. east of Lawton	Coopersville/Ottawa	Deer Creek	10/17/2003
16	MDC-03	Mid Deer Creek	Arthur west of 60th	Coopersville/Ottawa	Deer Creek	10/24/2003
17	MDC-04	Mid Deer Creek	48th north of Garfield	Polkton/Ottawa	Trib to Deer Creek	10/24/2003
18	MDC-05	Mid Deer Creek	Garfield west of 48th	Polkton/Ottawa	Trib to Deer Creek	10/24/2003
19	MDC-06	Mid Deer Creek	Garfield east of 60th	Polkton/Ottawa	Deer Creek	10/24/2003
20	MDC-07	Mid Deer Creek	60th south of Garfield	Polkton/Ottawa	Trib to Deer Creek	10/24/2003
21	MDC-08	Mid Deer Creek	Brucker	Polkton/Ottawa	Deer Creek	10/24/2003
22	LDC-01	Lower Deer Creek	Berlin Fair	Wright/Ottawa	Little Deer Creek	10/24/2003
23	LDC-02	Lower Deer Creek	Hayes east of 40th	Tallmadge/Ottawa	Little Deer Creek	10/24/2003
24	LDC-03	Lower Deer Creek	48th south of Hayes	Tallmadge/Ottawa	Little Deer Creek	10/24/2003
25	LDC-04	Lower Deer Creek	Leonard west of 48th	Polkton/Ottawa	Deer Creek	10/24/2003

Note: For Deer Creek Maps please see attached excel file

Attachment B
Figures and Tables

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

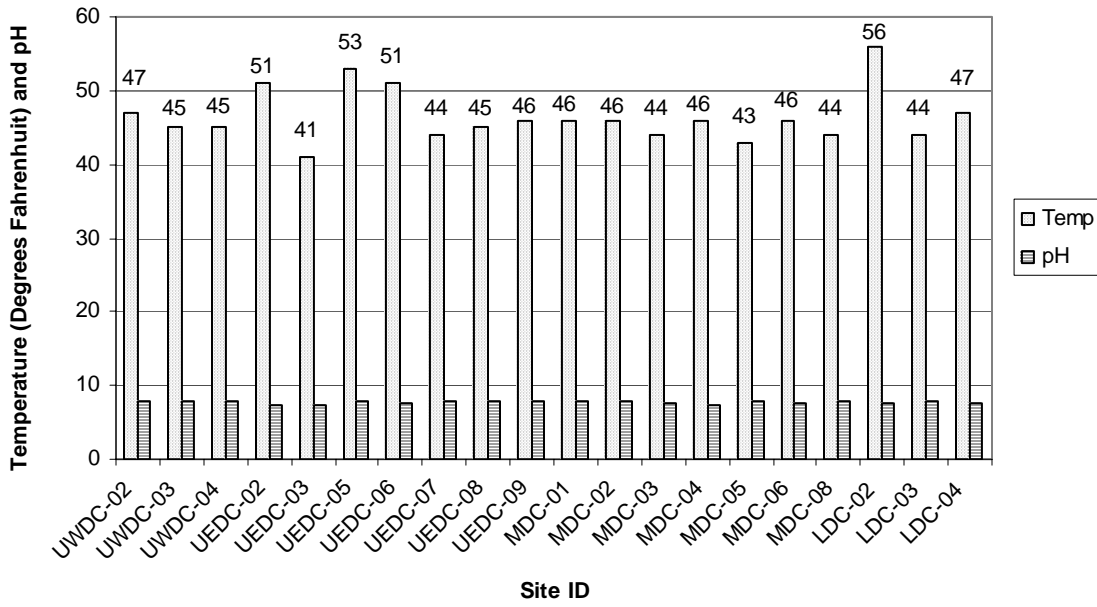


Figure 2. Temperature and pH summary for the mainstem sample locations from the headwaters to the mouth of Deer Creek

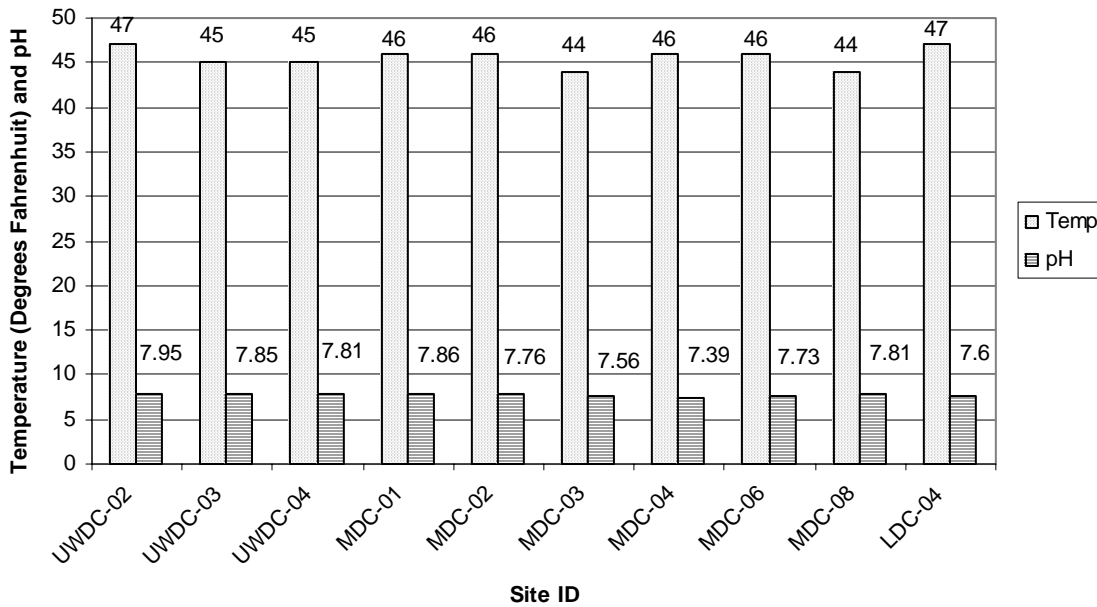


Figure 3. Percent substrate observations for each sample location in the Upper West Deer Creek Watershed

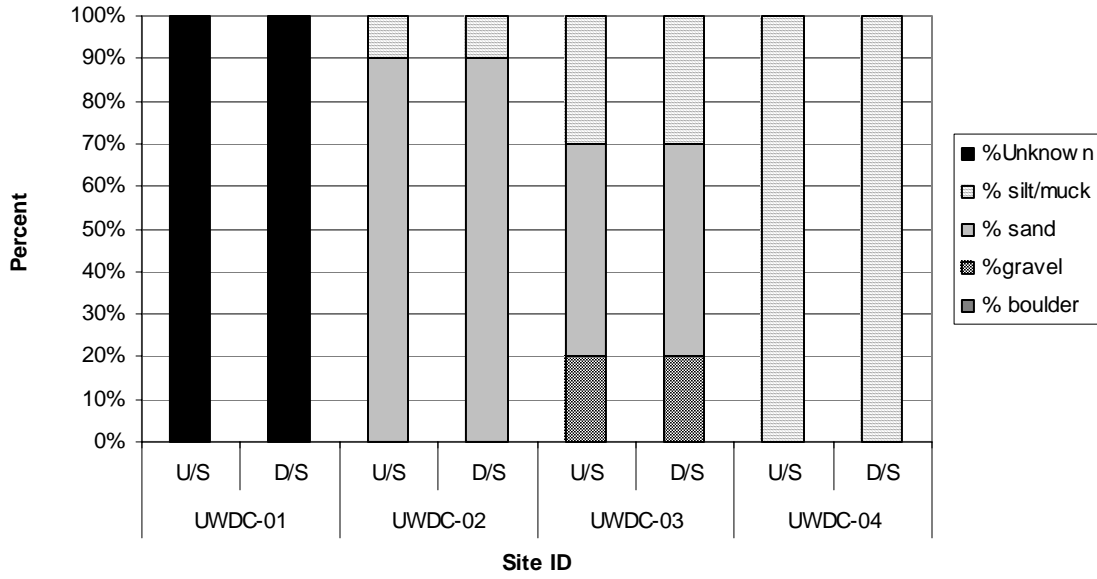


Figure 4. Percent substrate observations for each sample location in the Upper East Deer Creek Watershed

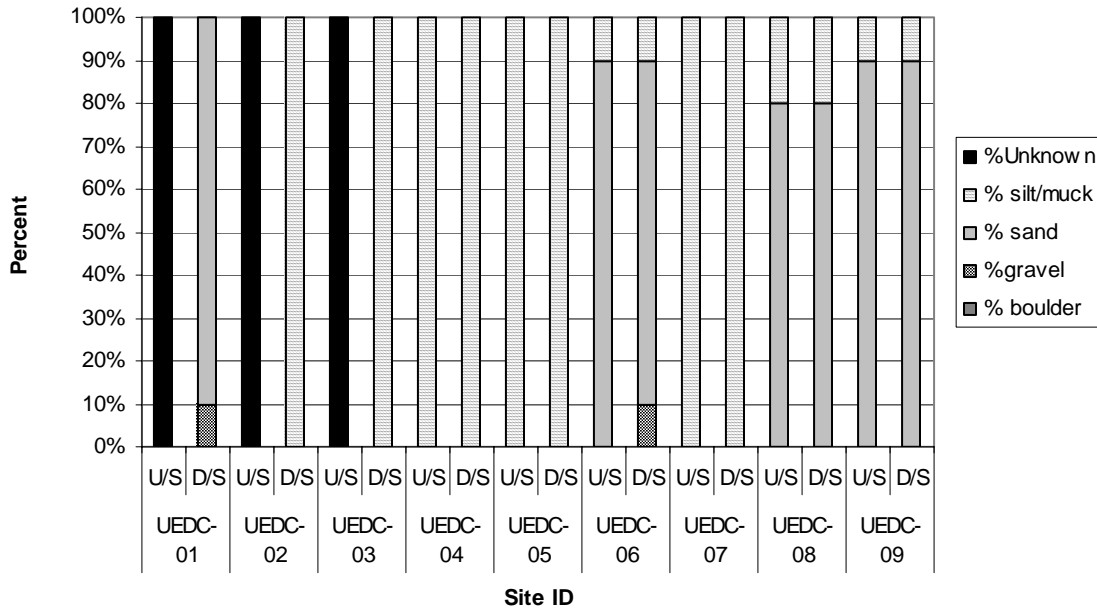


Figure 5. percent substrate observations for each sample location in the Mid Deer Creek Watershed

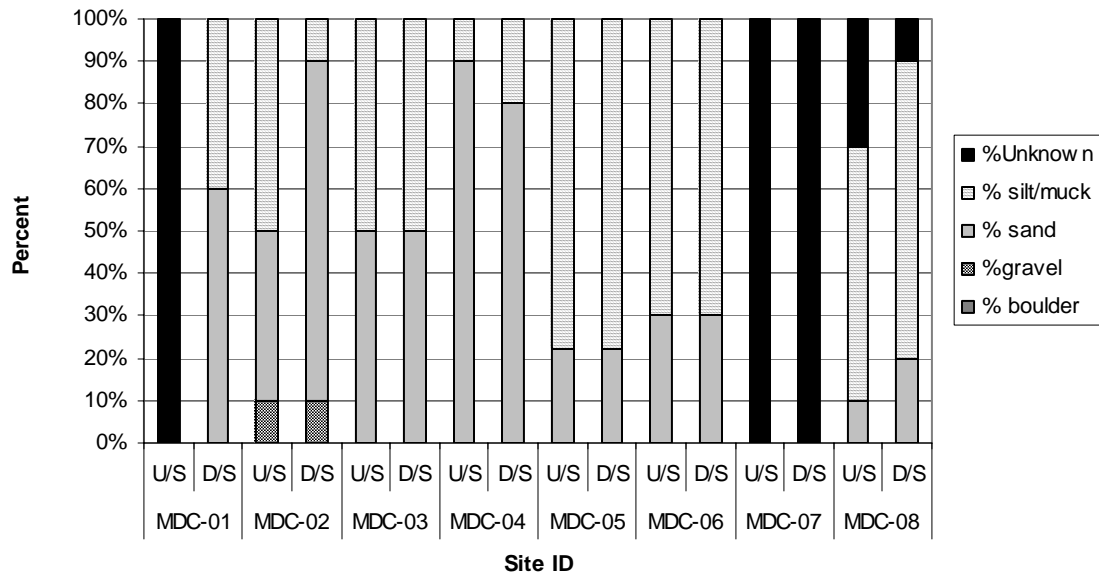


Figure 6. Percent substrate observation for each sample location on Lower Deer Creek

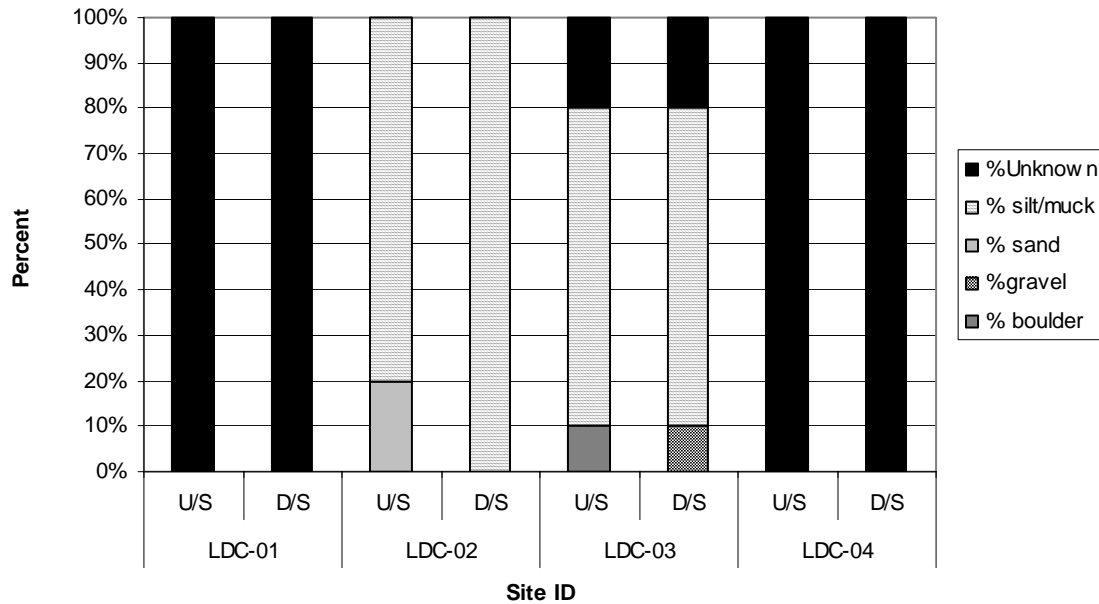


Figure 7. Percent substrate observation for the mainstem sample locations from the headwaters to the mouth

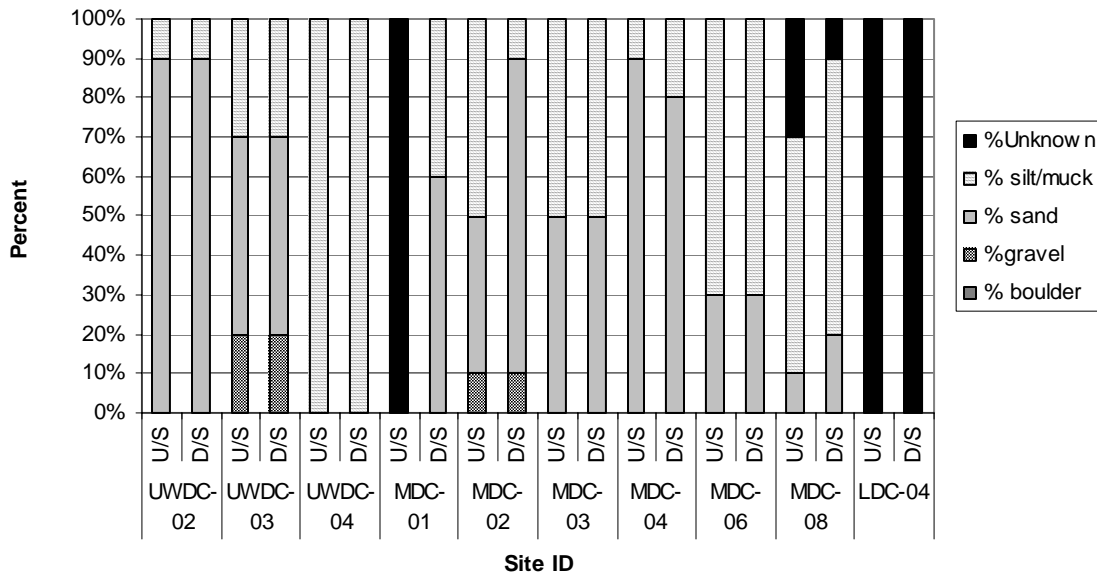
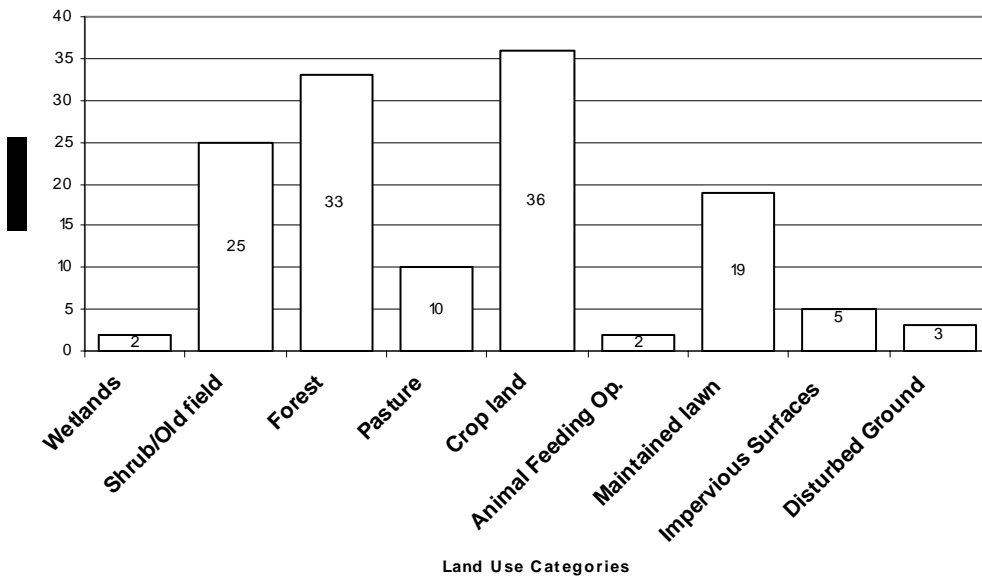


Figure 8. Summary of adjacent land uses



**Figure 9. Weighted values for possible sources of non point source pollution
(cumulative score for all locations)**

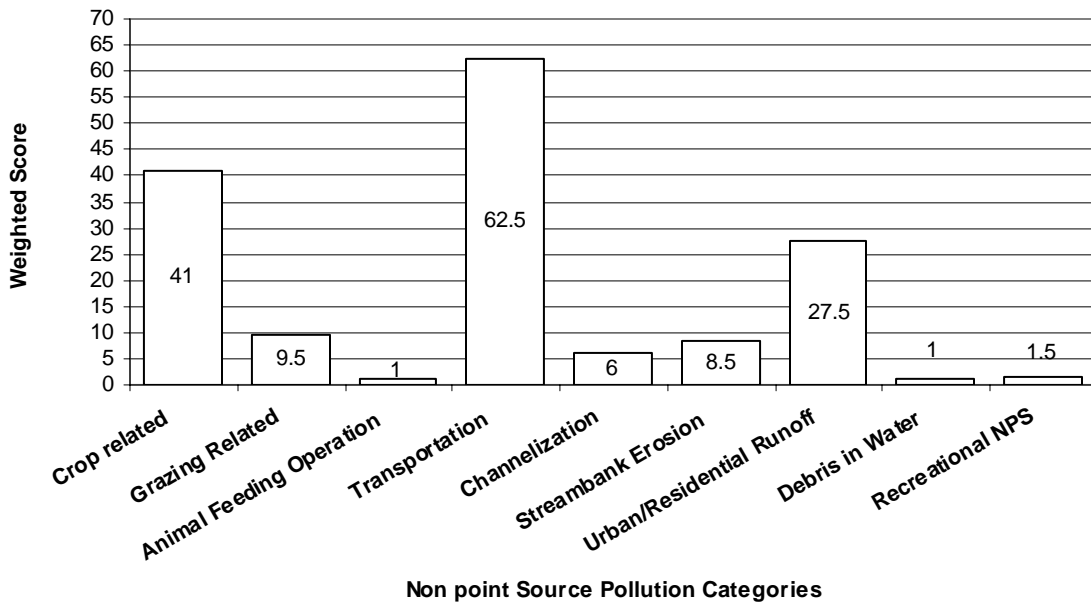


Table 1. Summary of observations made for in stream habitat and cover

SITE ID		Undercut Banks	Overhanging Vegetation	Deep Pools	Boulders	Aquatic Plant Cover	Logs/Woody Debris
UWDC-01	U/S		X				
	D/S		X				X
UWDC-02	U/S		X				X
	D/S		X				X
UWDC-03	U/S		X	X			X
	D/S		X	X			X
UWDC-04	U/S		X				X
	D/S	X	X				X
UEDC-01	U/S		X				
	D/S		X				
UEDC-02	U/S		X			X	
	D/S					X	
UEDC-03	U/S	X				X	
	D/S		X	X			
UEDC-04	U/S					X	
	D/S					X	X
UEDC-05	U/S		X				X
	D/S						
UEDC-06	U/S		X				
	D/S						
UEDC-07	U/S		X				X
	D/S		X				X
UEDC-08	U/S		X				
	D/S	X	X				X
UEDC-09	U/S		X				X
	D/S		X				
MDC-01	U/S		X				X
	D/S	X	X				X
MDC-02	U/S		X				X
	D/S		X				X
MDC-03	U/S		X				X
	D/S	X	X				X
MDC-04	U/S		X				
	D/S						
MDC-05	U/S		X				
	D/S		X				

Table 1. Continued

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

Table 2. Continued

SITE ID		Aquatic Plants	Floating Algae	Filamentous Algae	Turbidity	Bacterial Sheen	Foam	Trash
MDC-06	U/S							
	D/S							
MDC-07	U/S	A	P					
	D/S	A	P					
MDC-08	U/S							
	D/S							
LDC-01	U/S							
	D/S							
LDC-02	U/S	P						
	D/S	P						
LDC-03	U/S		P					
	D/S							
LDC-04	U/S				P	P		
	D/S				P	P		

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

A denotes abundance

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	
UWDC-01	U/S	X				X				grasses
	D/S		X				X			trees
UWDC-02	U/S				X				X	trees
	D/S				X				X	trees
UWDC-03	U/S				X				X	trees
	D/S				X				X	trees
UWDC-04	U/S				X				X	trees
	D/S	X					X			trees
UEDC-01	U/S			X			X			grasses
	D/S			X			X			shrubs
UEDC-02	U/S	X					X			shrubs
	D/S	X				X				grasses
UEDC-03	U/S	X				X				shrubs
	D/S	X				X				grasses
UEDC-04	U/S		X			X				grasses
	D/S		X				X			trees
UEDC-05	U/S				X	X				shrubs
	D/S	X				X				bare
UEDC-06	U/S		X				X			grasses
	D/S	X				X				grasses
UEDC-07	U/S				X	X				shrubs
	D/S			X				X		trees
UEDC-08	U/S	X				X				grasses
	D/S			X					X	trees
UEDC-09	U/S		X						X	shrubs
	D/S	X							X	grasses
MDC-01	U/S				X				X	trees
	D/S				X				X	trees
MDC-02	U/S				X		X			trees
	D/S			X		X				trees
MDC-03	U/S				X		X			trees
	D/S			X		X				trees
MDC-04	U/S		X				X			grasses
	D/S			X				X		grasses

Table 3. Continued

SITE ID		Left Bank				Right bank				Streamside land cover
		< 10	10-30	30-100	>100	< 10	10-30	30-100	>100	
MDC-05	U/S	X				X				grasses
	D/S	X				X				grasses
MDC-06	U/S				X		X			trees
	D/S		X				X			trees
MDC-07	U/S		X				X			trees
	D/S			X				X		grasses
MDC-08	U/S		X				X			shrubs
	D/S			X				X		shrubs
LDC-01	U/S		X				X			trees
	D/S	X				X				trees
LDC-02	U/S		X						X	trees
	D/S		X				X			trees
LDC-03	U/S		X				X			shrubs
	D/S			X				X		shrubs
LDC-04	U/S				X				X	trees
	D/S	X							X	trees

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
UWDC-01	U/S					B				
	D/S					B				
UWDC-02	U/S			B						
	D/S			B						
UWDC-03	U/S			B						
	D/S			B						
UWDC-04	U/S			B						
	D/S		B	R				L		
UEDC-01	U/S					B				
	D/S					B				
UEDC-02	U/S		R			R		R	L	
	D/S					B				
UEDC-03	U/S					B		L		
	D/S				B	B				L
UEDC-04	U/S				R	L				
	D/S					B				
UEDC-05	U/S	R	B			L				
	D/S				B	L				
UEDC-06	U/S		R			B				
	D/S				B					B
UEDC-07	U/S			R		B				
	D/S			B		B				
UEDC-08	U/S							B		
	D/S		R					L		
UEDC-09	U/S		R			L				
	D/S		R			B		L		
MDC-01	U/S		B	L		R				
	D/S			B				R	L	
MDC-02	U/S			R				L		
	D/S			R				B		
MDC-03	U/S			B					R	
	D/S			L				R	R	

Table 4. Continued

Site ID		Wetlands	Shrub/Old field	Forest	Pasture	Crop land	Animal Feeding Op.	Maintained lawn	Impervious Surfaces	Disturbed Ground
MDC-04	U/S		B			R		L		
	D/S		B			L				
MDC-05	U/S				B		R			
	D/S				L			B		
MDC-06	U/S		L					R		
	D/S		L					R	L	
MDC-07	U/S	L	L				R			
	D/S		B							
MDC-08	U/S			B				R		
	D/S			B						
LDC-01	U/S					B				
	D/S					R		L		
LDC-02	U/S			B		L				
	D/S			B						
LDC-03	U/S		B							
	D/S		B							
LDC-04	U/S			B						
	D/S		R	L						

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 are always assigned looking downstream for each survey location.

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

Site ID		Crop related	Grazing Related	Animal Feeding Operation	Transportation	Channelization	Streambank Erosion	Urban/Residential Runoff	Debris in Water	Recreational NPS
UWDC-01	U/S	H			S					
	D/S	H			S					
UWDC-02	U/S				M					
	D/S				M					
UWDC-03	U/S				H					
	D/S				H			S		
UWDC-04	U/S				S					
	D/S		M	S				S		
UEDC-01	U/S	H			H	S				
	D/S	H			M	S				
UEDC-02	U/S	M			M	S		S		
	D/S	H			M	S				
UEDC-03	U/S	M			M	S		S		
	D/S	M	H		M	S	M	S		
UEDC-04	U/S	M			S					
	D/S	H			S					
UEDC-05	U/S	M			M					
	D/S	M	H		S		H			
UEDC-06	U/S	H			M					
	D/S	S	H		S		H			
UEDC-07	U/S	H			M					
	D/S	S			M					
UEDC-08	U/S				M			H		
	D/S	S			M			M		
UEDC-09	U/S	M			M			S		
	D/S	M			M			M		
MDC-01	U/S	S			S					
	D/S				S			M		
MDC-02	U/S				S			M		
	D/S				S			M		M
MDC-03	U/S				M		S	S		
	D/S				M		S	M	S	

Table 5. Continued

Site ID		Crop related	Grazing Related	Animal Feeding Operation	Transportation	Channelization	Streambank Erosion	Urban/Residential Runoff	Debris in Water	Recreational NPS
MDC-04	U/S	M			M			M		
	D/S	M			M			M		
MDC-05	U/S		S		S					
	D/S				S					
MDC-06	U/S				M			M		
	D/S				M			M		
MDC-07	U/S		S		S			S		
	D/S	S			S					
MDC-08	U/S				S		S	S		
	D/S				S					
LDC-01	U/S	M			S					
	D/S	M			S					
LDC-02	U/S	S			S					
	D/S	S			S					
LDC-03	U/S				S					
	D/S				S					
LDC-04	U/S				S					
	D/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)**