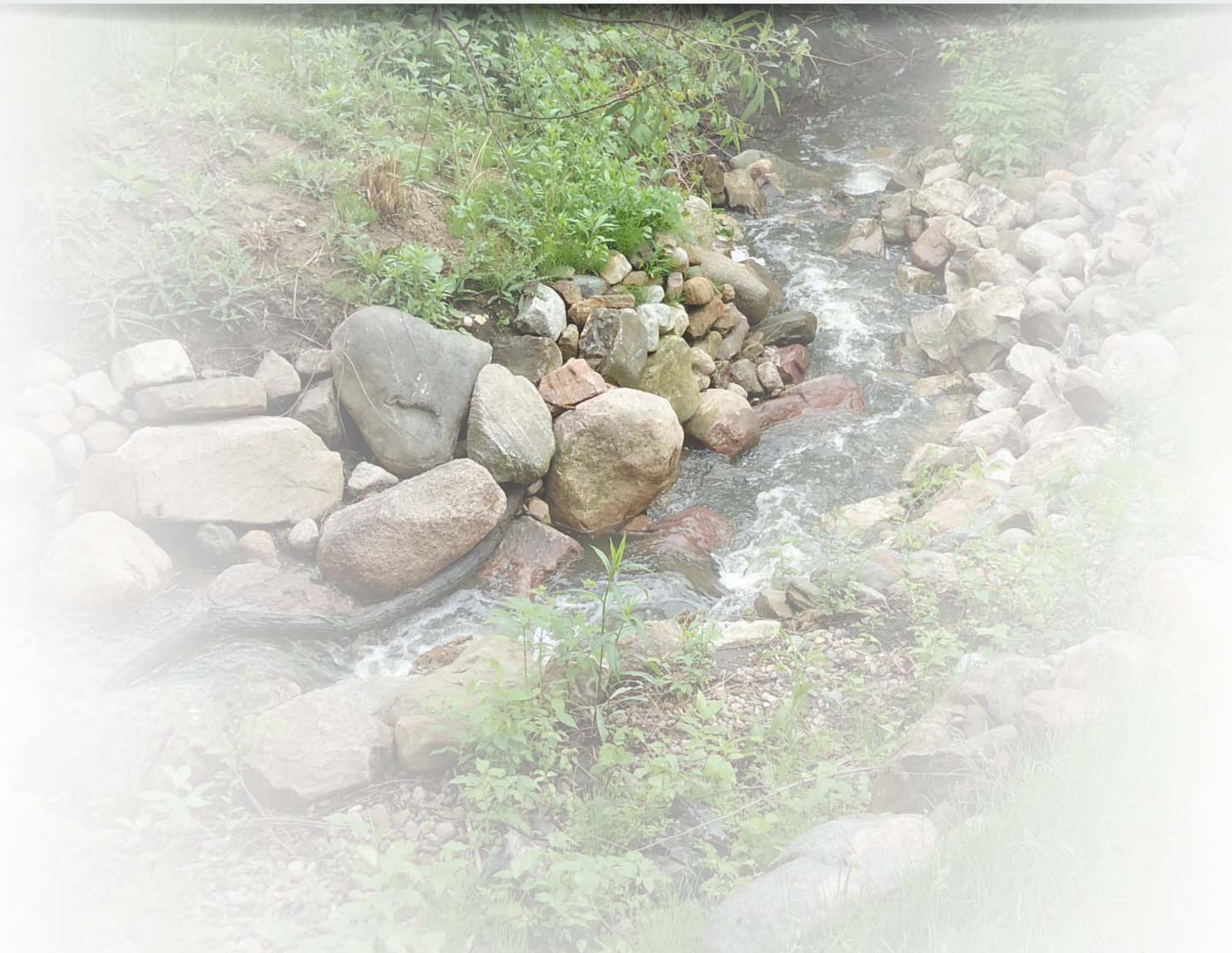
Fourmile Creek Watershed
Management Plan

April 2015



Fourmile Creek Watershed

Snyder & Associates
Engineers and Planners

Fourmile Creek Watershed Management Plan

April 2015

WMA Mission Statement: "To promote land stewardship and sustainable watershed management that reduces flood risk, improves water quality and supports socioeconomic and environmental functions."

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Acronyms

ACPF	Agricultural Conservation Planning Framework
BMP	Best Management Practice
CFS or cfs	Cubic Feet per Second
CFU	Colony-Forming Unit
CREP	Conservation Reserve Enhancement Program
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FCWMA	Fourmile Creek Watershed Management Authority
GIS	Geographic Information System
HSG	Hydrologic Soil Group
HUC	Hydrologic Unit Code
IAC	Iowa Administrative Code
IDALS	Iowa Department of Agriculture and Land Stewardship
IDNR	Iowa Department of Natural Resources
ISMM	Iowa Stormwater Management Manual
ISWEP	Iowa Storm Water Education Program
LiDAR	Light Detection and Ranging
N	Nitrogen
NAVD	North American Vertical Datum
NGVD	National Geodetic Vertical Datum
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service (formerly known as SCS)
NRS	Nutrient Reduction Strategy
NTU	Nephelometric Turbidity Unit
P	Phosphorous
PSWCD	Polk Soil and Water Conservation District
RASCAL	Rapid Assessment of Stream Condition Along Length
RUSLE	Revised Universal Soil Loss Equation
SCS	Soil Conservation Service
SUDAS	Statewide Urban Design and Specifications
SWCD	Soil and Water Conservation District
USACE	Unites States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WMA	Watershed Management Authority

Executive Summary

The Watershed Management Plan (WMP) for Fourmile Creek was developed with coordination from the Fourmile Creek Watershed Management Authority (FCWMA). The development of the WMP occurred over several meetings to discuss the concerns and challenges facing the watershed. Through the information gathered at the meetings, goals and tasks were appointed.

Watershed Characteristics
The watershed characteristics are described in this section, including general information, topography, land use, soils, groundwater, rainfall, and streamflow gage data. The land cover of the northern part of the watershed is primarily agricultural and the southern part is primarily urban, with a combination of the two in the central part. These characteristics are some of the many that define the features of the watershed. Figures throughout the section illustrate each characteristic.

Pollutants
Based on the recommendations of the Working Groups, the primary focus of this Watershed Management Plan is to develop a strategy to address the sediment and bacteria levels in the creek. The Watershed Management Plan also secondarily addresses the nitrogen and phosphorous loading in the creek. According to monitoring data collected as part of Iowa's volunteer-based water monitoring program, IOWATER, Fourmile Creek has typical urban stream pollutants, including high phosphorous, high *E. coli* bacteria, normal dissolved oxygen, normal to high nitrogen, and high water clarity.

Stream Assessment
A comprehensive stream assessment was completed by the Polk Soil & Water Conservation District (PSWCD) using the Rapid Assessment of Stream Conditions Along Length (RASCAL) tool. The tool is able to identify areas of varying stability in the stream. Overall, the assessment indicated that the stream has significant areas of erosion.

Stakeholder Involvement
The stakeholder involvement process involved assigning people to Working Groups, consisting of an Infrastructure Working Group and a Policy, Education, and Communication Working Group. Each group had three meetings independently and discussed their strategies to address issues in the Fourmile Creek Watershed. The goals that were identified are as follows:

- Goal 1: Monitor for Success
- Goal 2: Engage Rural & Urban Partners
- Goal 3: Adopt a Greenway System
- Goal 4: Promote Consistent Implementation
- Goal 5: Work to Establish Consistent Regional Guidelines and Standards
- Goal 6: Employ Performance Based Measures

- Goal 7: Identify and Implement Funding Alternatives
- Goal 8: Establish Effective Means of Education and Communication

Implementation Plan
In the Implementation Plan section, each goal is explained in detail with accompanying recommendations and strategies of how to achieve each one. Each goal was assigned subgoals and tasks to help track milestones and develop a schedule. See Appendix A for the complete schedule.

Implementation Plan Prioritization
The FCWMA met to discuss the Implementation Plan and prioritize Goals and Tasks under the categories of Funding Needs, Policy Modifications, and Education & Communication. The top priorities are listed in this section.

Budget/Funding
Various technical and financial opportunities that will be used to implement a successful plan are described in this section.

1. Introduction

Fourmile Creek has a history of flooding that has impacted property owners in the watershed. Flooding is the major concern expressed by property owners and citizens. Although there is minimal monitoring data from the watershed, available IOWATER data indicates water quality is an important element to address in this management plan. After community members expressed their concerns and jurisdictions desired to have a better collaboration mechanism, the Fourmile Creek Watershed Management Authority (FCWMA) was formed to address these and other challenges.

1.1 Watershed Management Authority

A Watershed Management Authority is formed when two or more eligible political subdivisions want to work together to engage in watershed planning and management. The political subdivisions can include a combination of cities, counties, and Soil and Water Conservation Districts. The FCWMA was formed in the fall of 2012 under a Chapter 28E Agreement (see Appendix B for complete agreement). This organization was established to provide a common voice and to facilitate inter-jurisdictional cooperation in working together on watershed issues and opportunities.

The WMA responsibilities may include:

- Assess the flood risk in the watershed
- Assess the water quality in the watershed
- Assess options for reducing flood risk and improving water quality in the watershed
- Monitor federal flood risk planning and activities
- Educate residents of the watershed area regarding water quality and flood risks
- Seek and allocate moneys made available to the Authority for purposes of water quality and flood risks
- Make and enter into contracts and agreements and execute all instruments necessary or incidental to the performance of the duties of the Authority. The Authority shall not have the power to acquire property by eminent domain or having taxing authority, per Iowa Code Chapter 466B.2. All interests in land shall be held in the name of the Party wherein said lands are located.

The requirements of a WMA include being located within a watershed no larger than an 8-digit Hydrologic Unit Code (HUC) watershed, notifying all eligible political subdivisions to participate within 30 days prior to establishing organization, a Chapter 28E agreement filed with the Secretary of State, and a Board of Directors. Membership in the FCWMA was established based on political boundaries in the watershed, which is shown in Table 1-1 and Figure 1-1.

Table 1-1: Members of FCWMA

Boone County, Iowa
Polk County, Iowa
Story County, Iowa
City of Ankeny, Iowa
City of Alleman, Iowa
City of Altoona, Iowa
City of Bondurant, Iowa
City of Des Moines, Iowa
City of Elkhart, Iowa
City of Pleasant Hill, Iowa
City of Sheldahl, Iowa
City of Slater, Iowa
Boone County Soil and Water Conservation District
Polk Soil and Water Conservation District
Story County Soil and Water Conservation District

Source: IA DNR NRGIS LIBRARY, USDA/ARS-NATIONAL LABORATORY FOR AGRICULTURE AND THE ENVIRONMENT

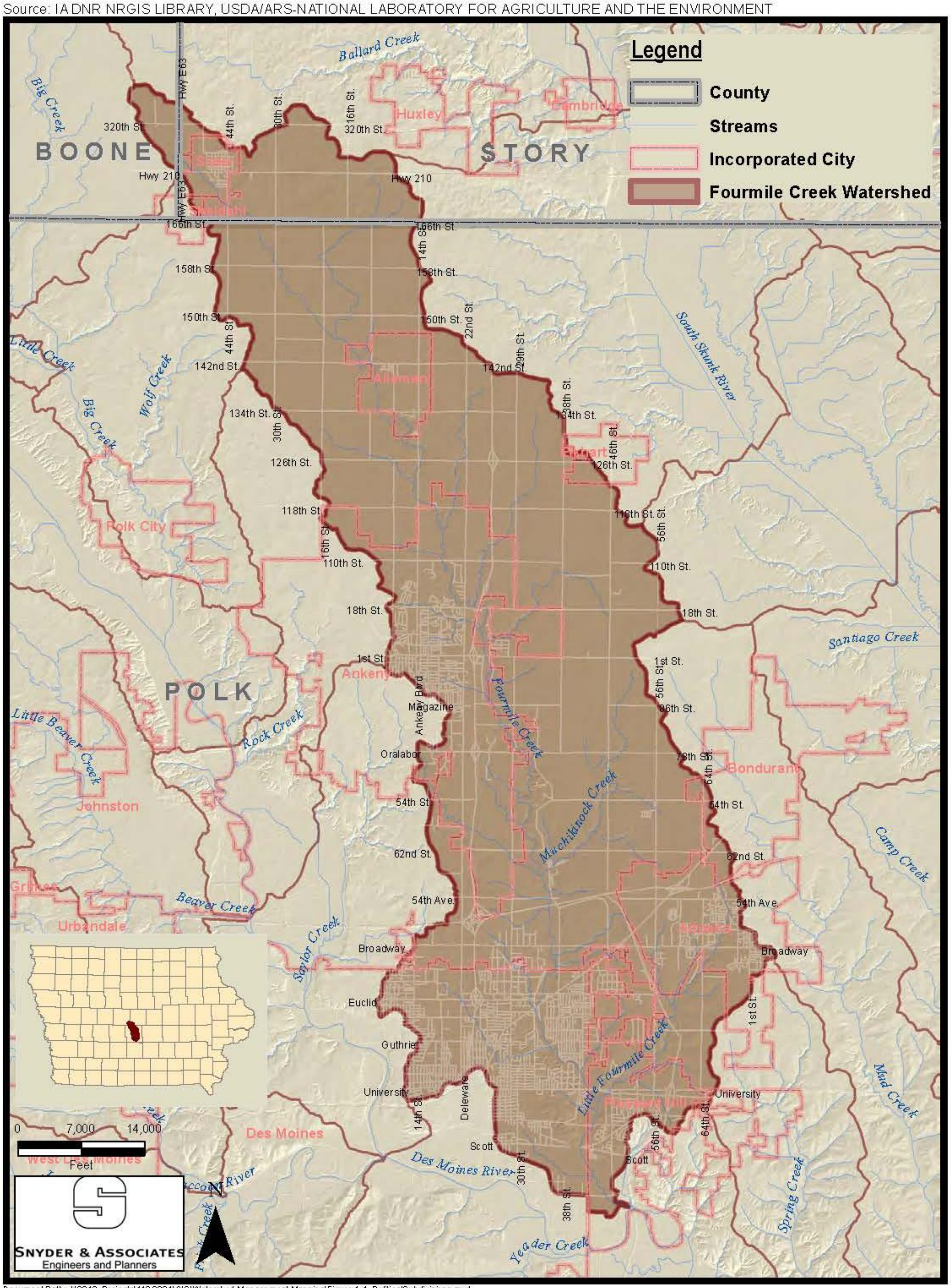

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Figure 1-1: Jurisdictions in the Fourmile Creek Watershed

2. Watershed Characteristics

2.1 Watershed Data

The Fourmile Creek Watershed is located in south central Iowa, as shown in Figure 2-1. The majority of the watershed is located in Polk County, with small areas in Boone and Story counties. The watershed is made up of both rural and urban areas, including the cities of Slater, Sheldahl, Alleman, Elkhart, Ankeny, Bondurant, Altoona, Des Moines, and Pleasant Hill.

Fourmile Creek is a tributary of the Des Moines River, which flows into the Mississippi River. The length of the main stem of the creek is approximately 38 miles. The watershed is approximately 23 miles long and 5 miles wide and has an approximate area of 119 square miles, based on natural topography, and 116 square miles when excluding the area that drains to Dean's Lake. The watershed is identified with a 10-digit HUC number, 0710000801. The watershed can be divided into three subwatersheds, as shown in Figure 2-2, including Upper Fourmile Creek, Middle Fourmile Creek, and Lower Fourmile Creek.

Fourmile Creek was broken up into a Stream Order system, which is also shown in Figure 2-2. Stream Order systems use stream size to rank portions of a stream from smallest to largest. Stream size is important for water management and understanding the characteristics of waterways. The rankings range from first order (smallest) to twelfth order (largest). The largest stream order in the Fourmile Creek is a fourth order stream, as shown in the Lower Fourmile Creek Watershed.

The Fourmile Creek Watershed consists of drainage districts within Polk, Boone, and Story counties. Drainage districts allow for proper drainage of wetlands for farming purposes where natural drainage outlets are not available or accessible. This is done by constructing and maintaining adequate drainage outlets and levees, including both underground tile systems and open channels. There are over 3,000 drainage districts in the State of Iowa. Figure 2-3 shows the drainage districts throughout the Fourmile Creek Watershed.

Each subwatershed was also analyzed using the Agricultural Conservation Planning Framework software. This software can be used for providing information on watersheds for watershed planning purposes using digital elevation models derived from LiDAR and spatial mapping algorithms. The assessments include potential grassed water and soil runoff risk, potential nutrient removal wetland sites, potential riparian buffers, and potential basin sites. The maps of these assessments can be found in Appendix C.

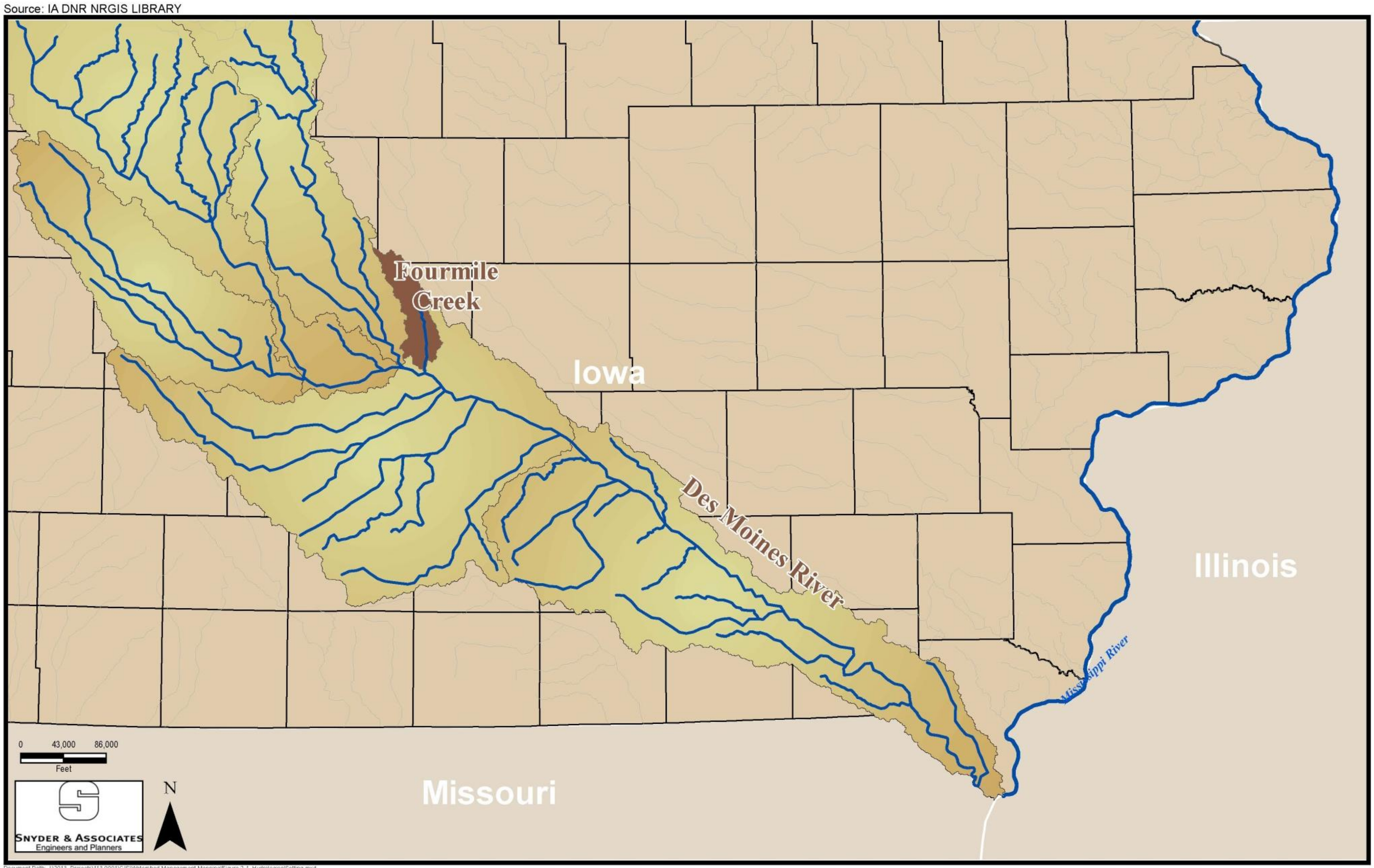

Figure 2-1: Fourmile Creek Watershed River System

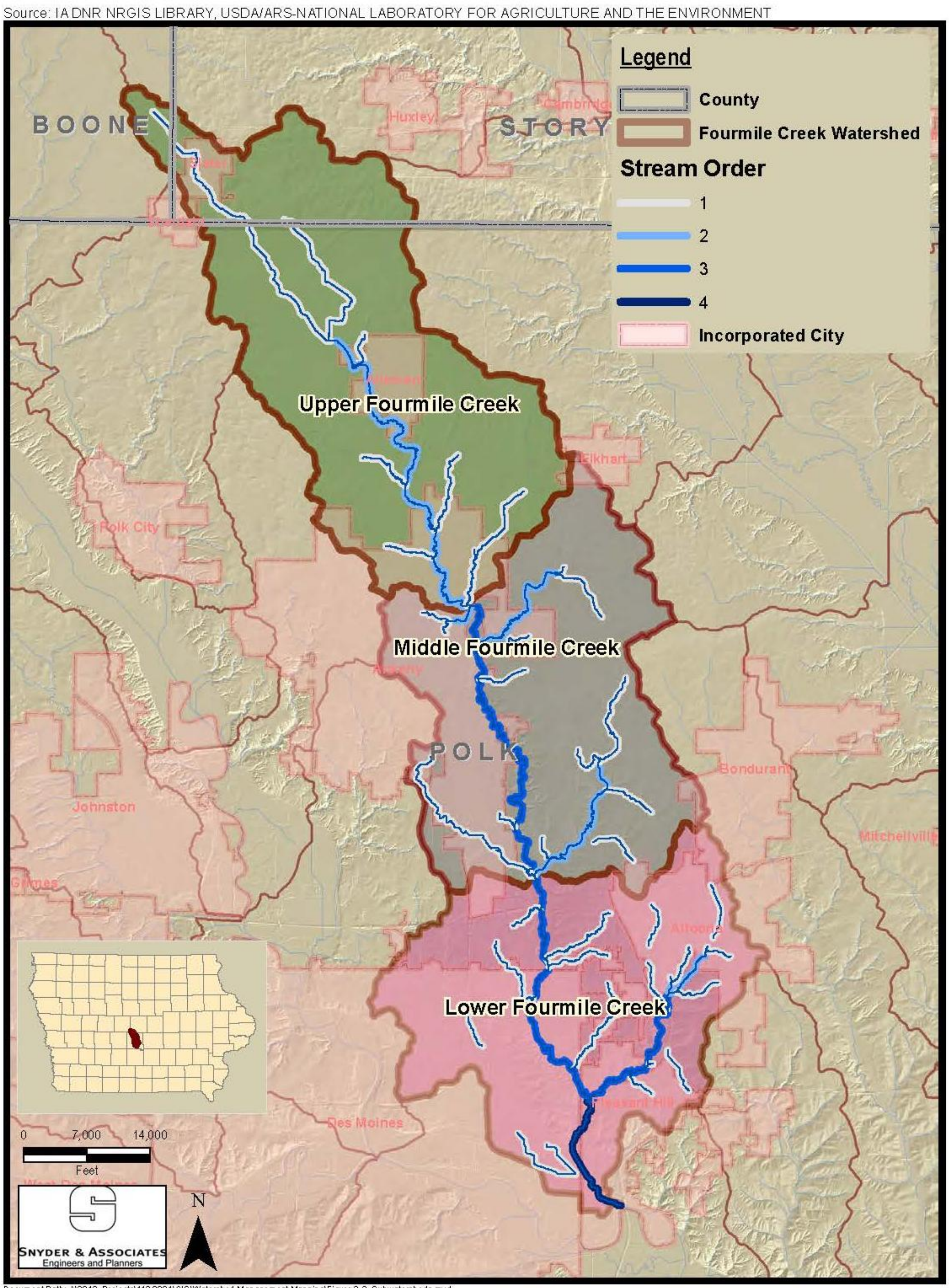

Figure 2-2: Fourmile Creek Subwatersheds

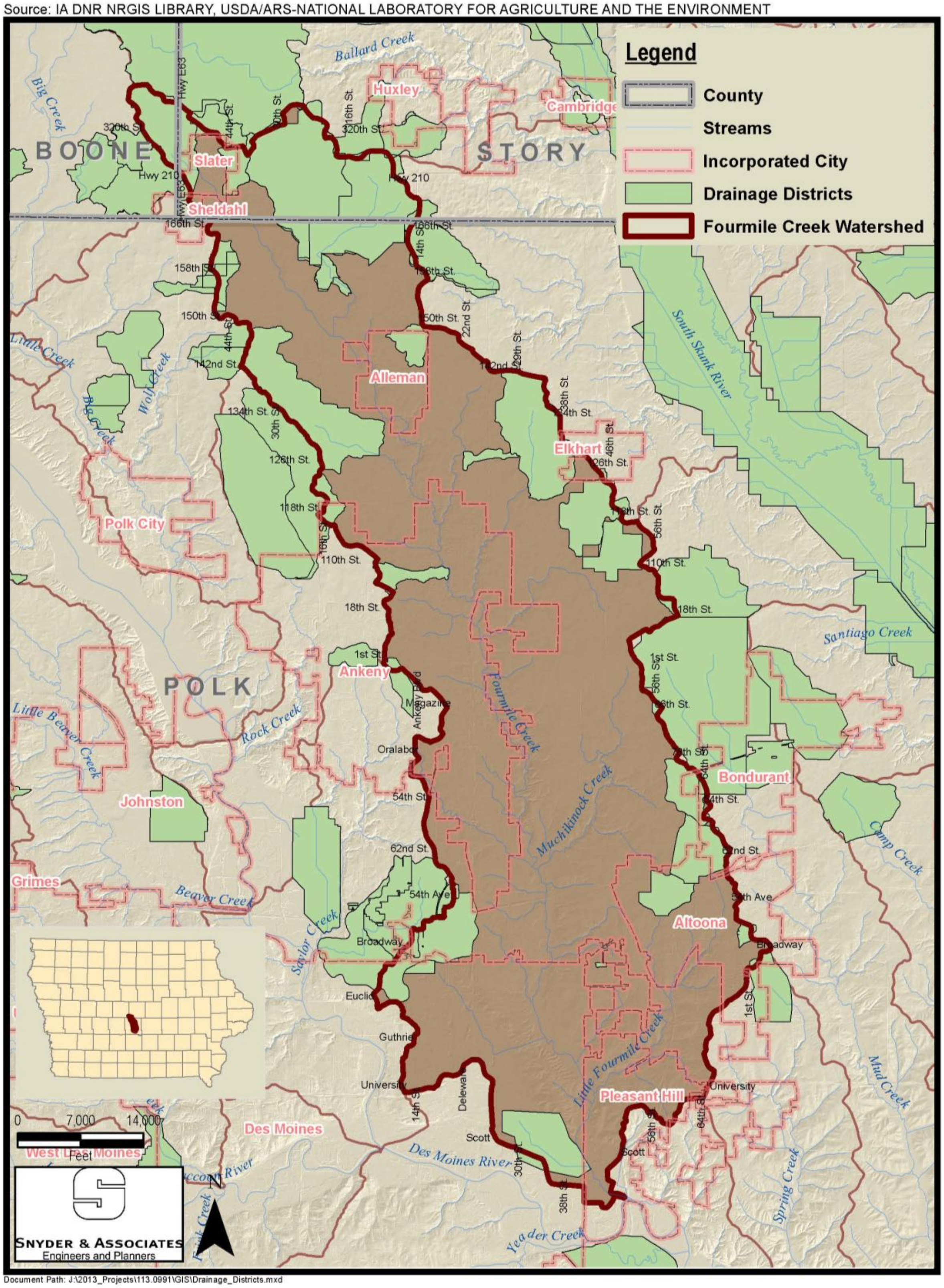

Figure 2-3: Fourmile Creek Watershed Drainage Districts

2.2 Topography

Figure 2-4 illustrates the topography of the watershed. As the figure demonstrates, the watershed becomes steeper when moving from upstream to downstream. The drop in elevation from the highest elevation, at Sheldahl, and the lowest elevation, at the Des Moines River, is greater than 300 feet.

The Fourmile Creek Watershed is located in the Des Moines Lobe landform region, near the southern terminus of this lobe that formed during the Wisconsin Glaciation between 12,000 and 15,000 years ago. Glacial activity, other climatic events, and land use practices that followed the last glaciations have shaped the landscape, contributing to carving a more defined Fourmile Creek stream channel. This region has mostly level terrain and occasional bands of crooked ridges. Marshes and ponds are found between these ridges and generally have no natural drainage outlets. The landforms found in the watershed are ground moraines on uplands, and flood plain and stream terraces. As a result, the upper portions of the watershed have pothole characteristics, which provide depressional areas that pool runoff and help regulate flows. The lower portion of the watershed is characterized by a gently to moderate rolling landscape, such as in the Des Moines, Altoona, and Pleasant Hill areas.

Source: IA DNR NRGIS LIBRARY, USDA/ARS-NATIONAL LABORATORY FOR AGRICULTURE AND THE ENVIRONMENT

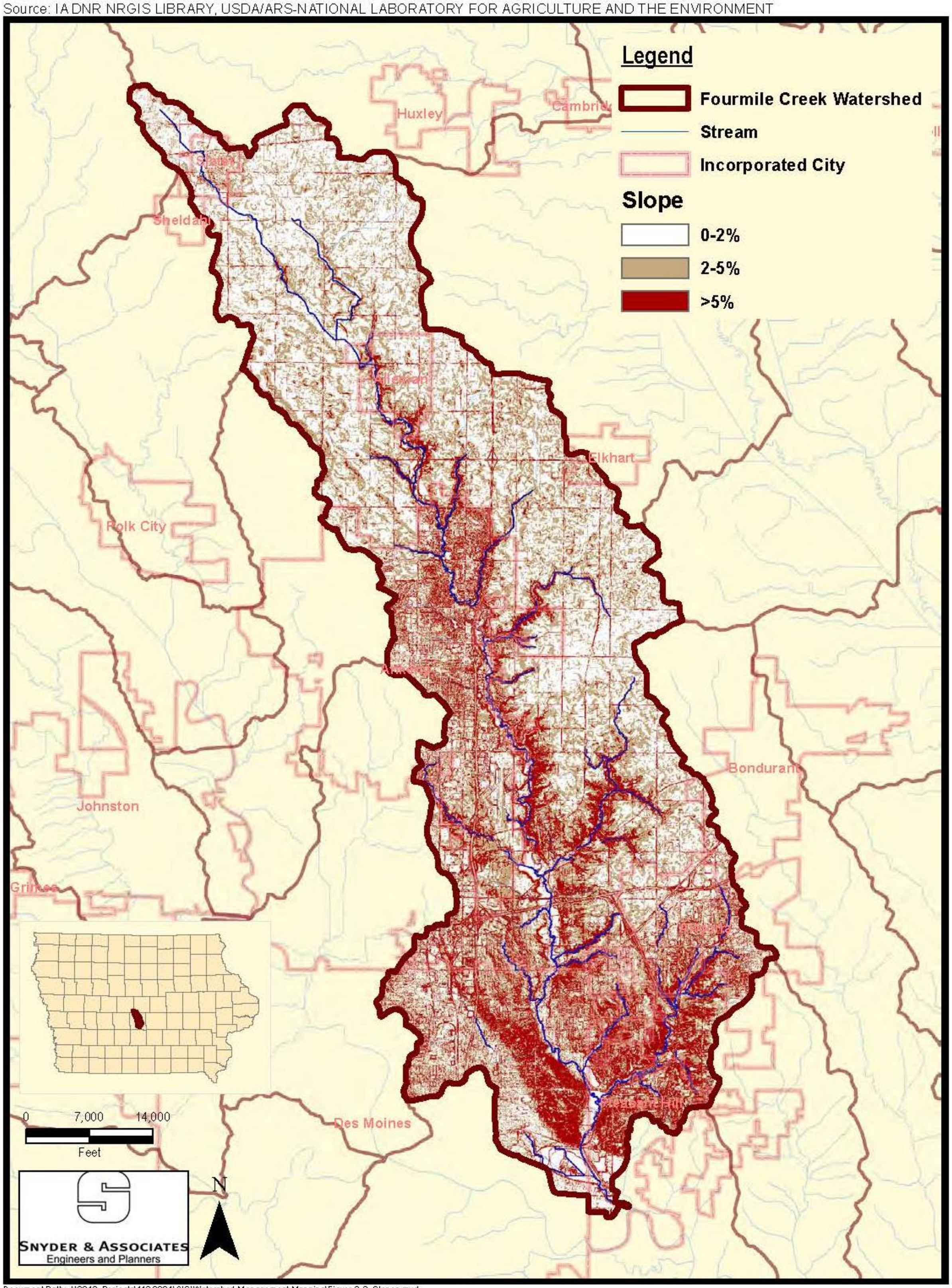

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Figure 2-4: Slopes within the Fourmile Creek Watershed

2.3 Land Use

Primary land use varies across the Fourmile Creek Watershed. Table 2-1 gives detail to the land use of the overall watershed. The list below demonstrates the land use within each of the subwatersheds.

- The upper, northern section of the watershed is primarily agricultural, consisting of cultivated row crops and small amounts of pasture and hay. The area is rural with a small amount of development.
- The middle section of the watershed is approximately half agricultural, cultivated crops, pasture, and hay. The other half of this portion of the watershed is urban with low, medium, and high density development.
- The lower, southern section of the watershed is primarily urban with low, medium, and high density development. It also consists of a small amount of deciduous woodland, pasture hay, and cultivated crops.

Table 2-1: Current Land Use of Fourmile Creek Watershed

Land Use	Area (Sq. Mi.)	Percentage
Alfalfa	0.3	0.3%
Corn	34.6	29.8%
Farmstead Active	1.7	1.5%
Grassland	4.8	4.1%
Oats	0.1	0.1%
Pasture	1.7	1.5%
Road	5.7	4.9%
Shrub/Scrub	0.8	0.7%
Soybeans	25.9	22.3%
Timber	5.3	4.6%
Urban/Residential	34.2	29.5%
Water	0.7	0.6%
Wetland	0.2	0.1%
Total	**116**	**100%**

Source: Polk Soil & Water Conservation District, 2014

Figure 2-5 shows the land cover in the watershed and Figure 2-6 shows the land use in the watershed.

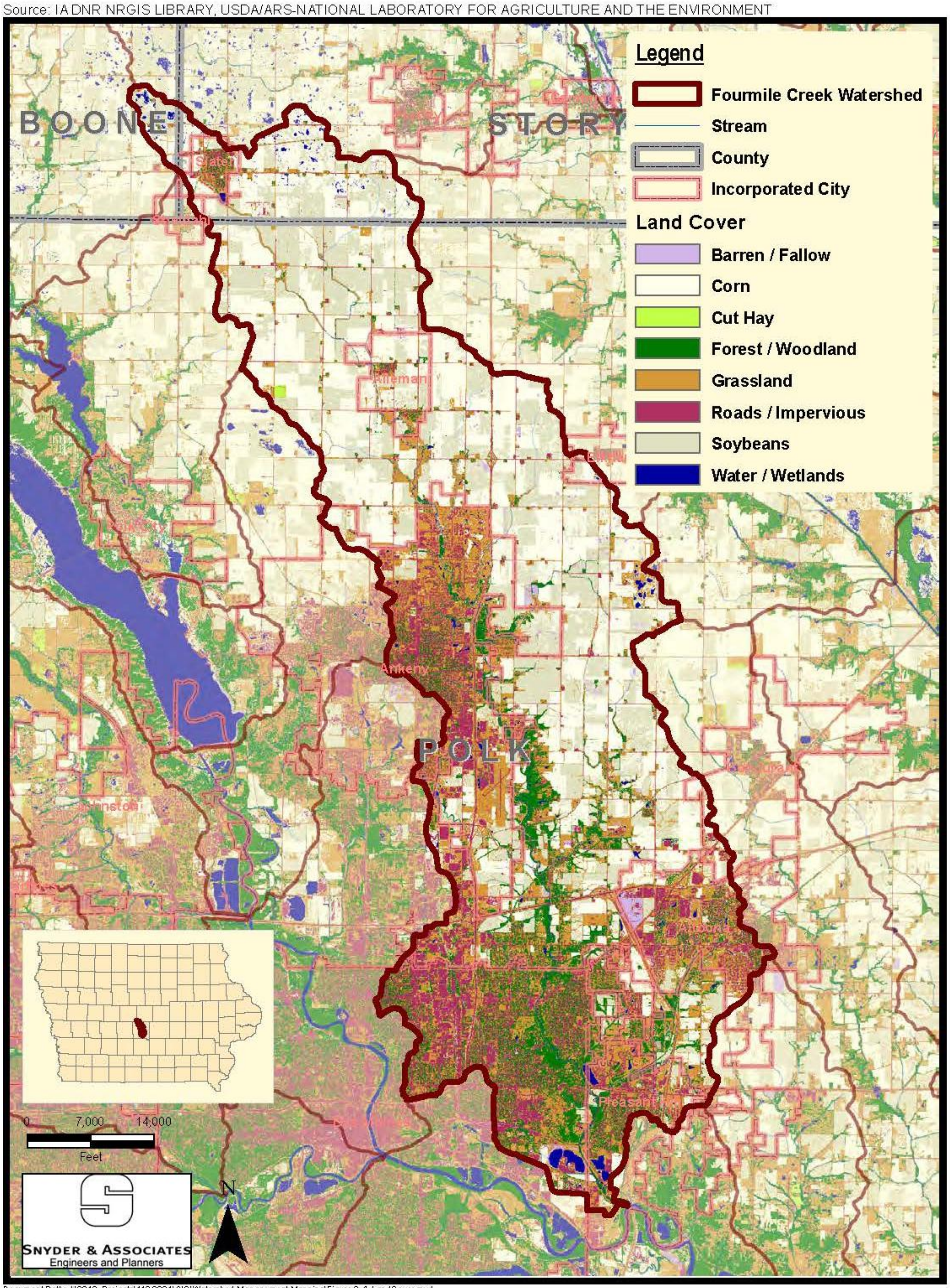

Figure 2-5: Land Cover Fourmile Creek Watershed

Source: IA DNR NRGIS LIBRARY, USDA/ARS-NATIONAL LABORATORY FOR AGRICULTURE AND THE ENVIRONMENT

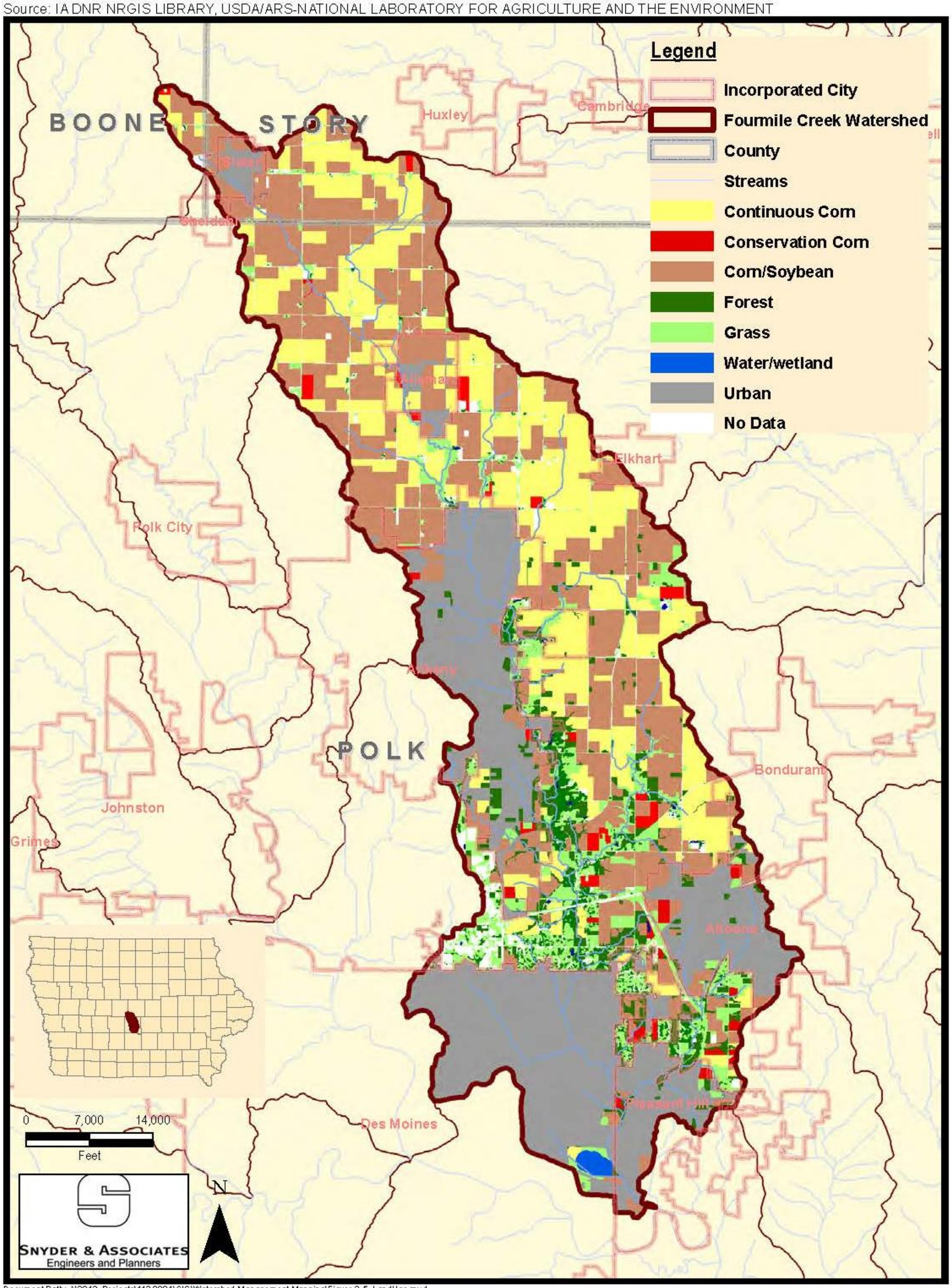

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Figure 2-6: Land Use Fourmile Creek Watershed

2.4 Soils

The primary soils in the Fourmile Creek Watershed are the Canisteo-Clarion-Nicollet Association. Other portions of the watershed are composed of the Hayden-Storden-Lester Association, the Downs-Fayette Association, and the Nodaway-Colo-Nevin Association. These soils range from silty clay loam to sandy loam. The majority of the watershed is used for cropland, woodland, pasture, and hay.

The primary hydrologic soil groups (HSG) are B and C/D, as shown by the distribution in Figure 2-7. Group C and D soils typically have the lowest infiltration rates, while group B soils have moderate infiltration rates and are generally well drained.

Group A soils have low runoff potential and high infiltration rates when thoroughly wet. These soils typically consist of deep, well to excessively drained sands or gravels and contain less than 10 percent clay.

Group B soils have moderately low runoff potential when thoroughly wet. These soils typically consist of 10 to 20 percent clay with loamy sand or sandy loam textures.

Group C soils have low infiltration rates when thoroughly wet and typically consist of soils with less than 50 percent sand and 20 to 40 percent clay. These soils have loam, sandy clay loam, silt loam, clay loam, and silty clay loam textures.

Group D soils have the highest runoff potential. These soils have very low infiltration rates when thoroughly wet and typically consist of greater than 40 percent clay and less than 50 percent sand with a clayey texture.

(USDA – NRCS)

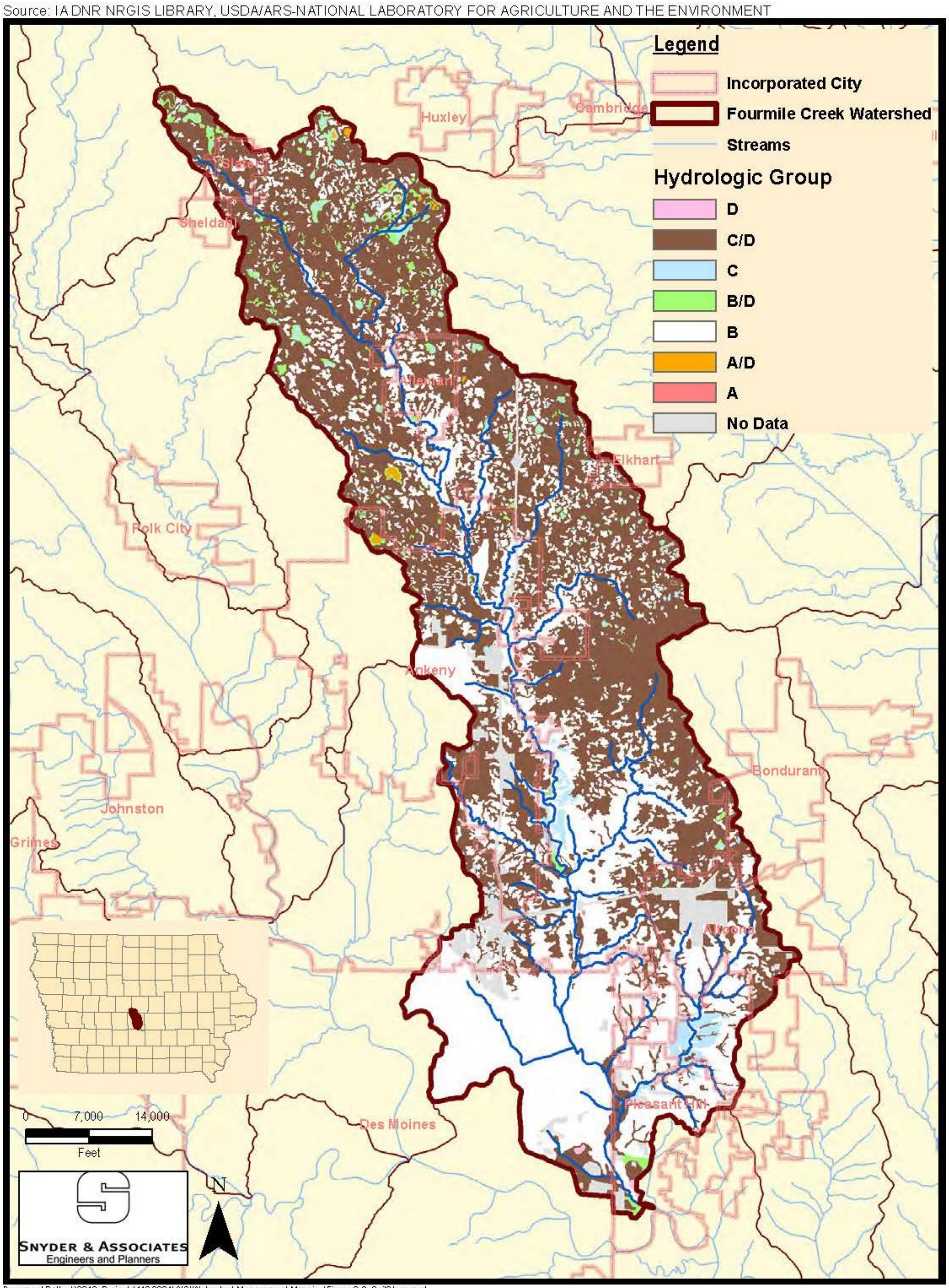


Figure 2-7: Fourmile Creek Watershed Soils by Hydrologic Soil Class

2.5 Hydrogeology

The bedrock of the Fourmile Creek Watershed consists of marine sedimentary rocks, including: sandstones, shales, mudstones, limestones, and dolomites. These rocks were deposited during the Carboniferous period, 354 to 290 million years ago. This period was further divided into two times periods: the Mississippian and the Pennsylvanian. Shallow seas covered the Midwest during the Mississippian and deposited clays, sands, and carbonate materials. The seas receded, allowing water and wind to erode the surfaces of the Mississippian rocks. The seas returned and again receded during the Pennsylvanian. For much of Polk County, Pennsylvanian bedrock is found (Polk County Comprehensive Plan, URS, February 2005).

According to an Iowa Department of Natural Resources (IDNR) geologic survey completed in 2008, the depth to bedrock in Polk County ranges from less than 50 feet to over 200 feet to the bedrock.

Figure 2-8 shows the water table depth in the watershed. As the figure illustrates, the majority of the watershed has a deep water table with a shallower water table prevalent in areas closer to the creek channel.

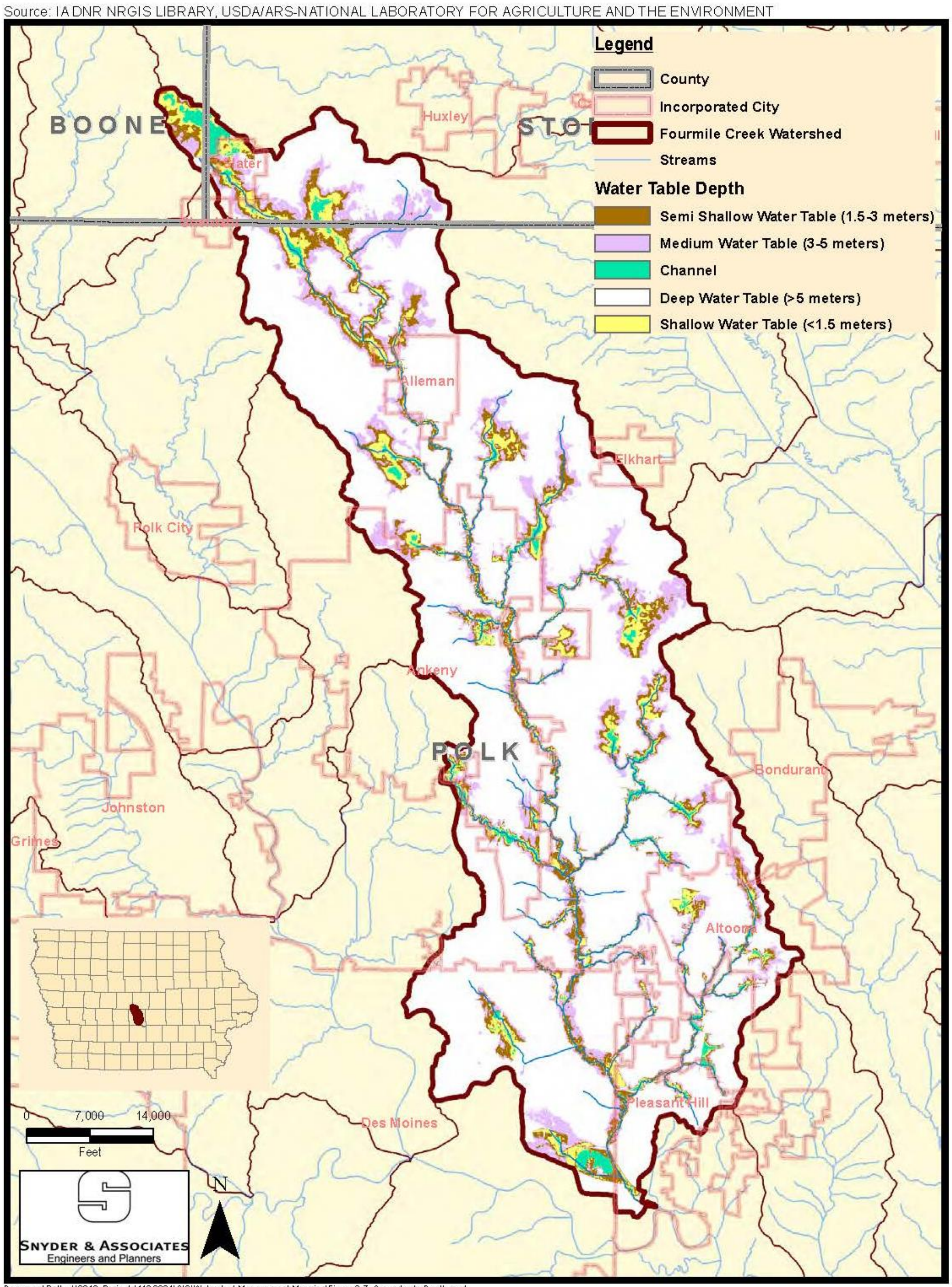
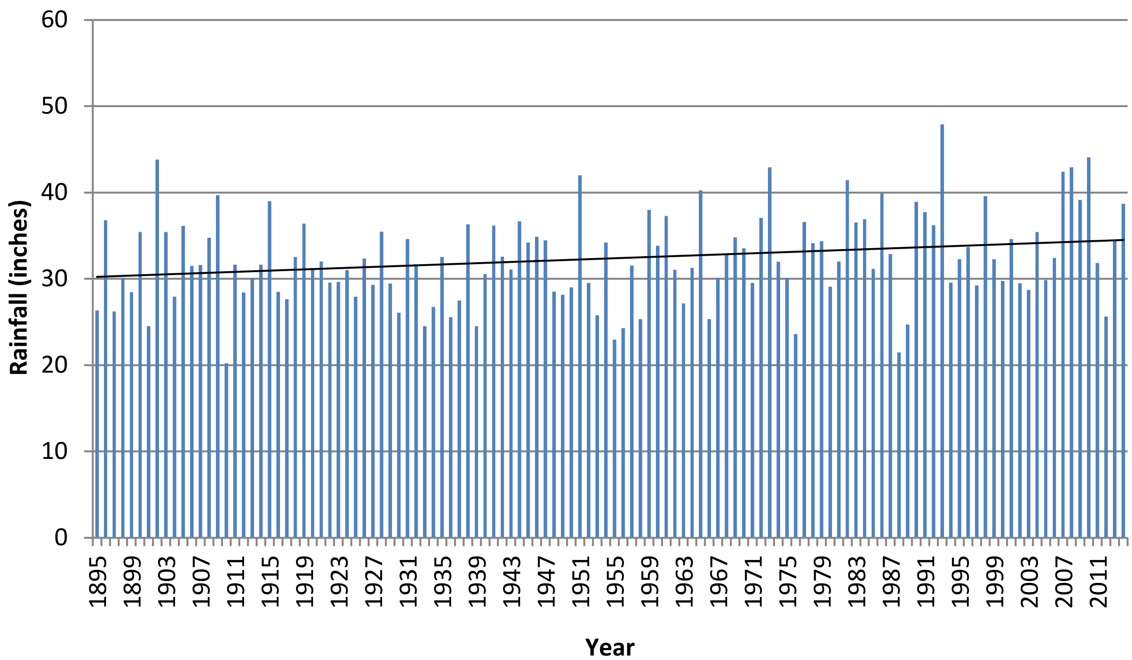


Figure 2-8: Fourmile Creek Watershed Depth to Groundwater

2.6 Rainfall

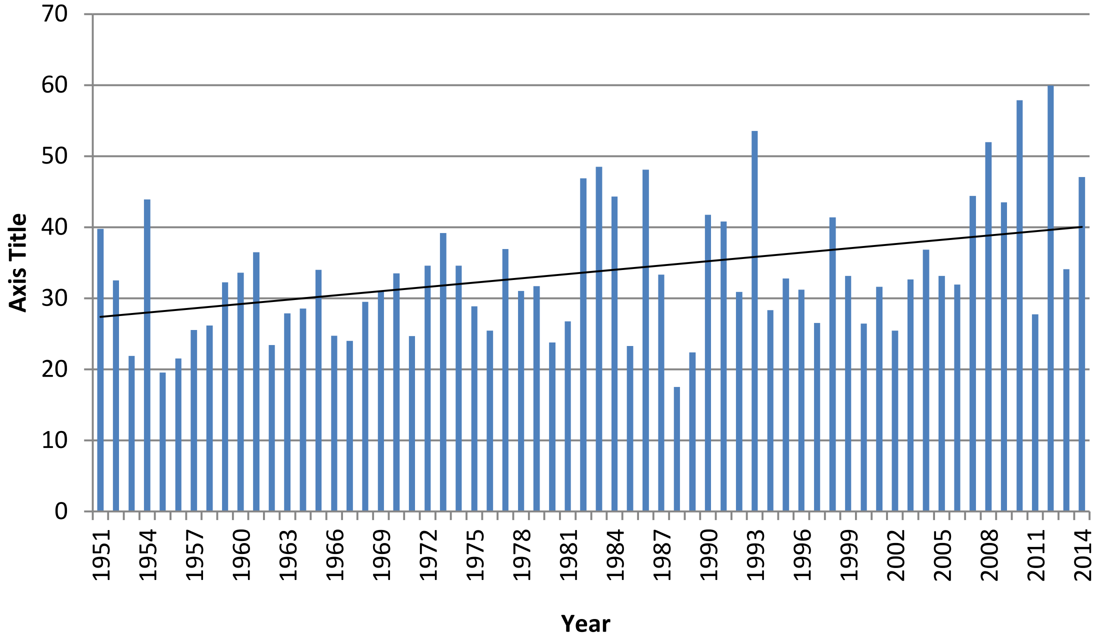
Annual precipitation in the state of Iowa averages approximately 34 inches. However, precipitation is highly variable across the state and averages have been recorded in areas as little as 26 inches per year to as much as 38 inches per year. Figure 2-9 displays the variability of the average annual rainfall in Iowa.



Source: National Climatic Data Center (NCDC) – National Oceanic and Atmospheric Administration (NOAA)

Figure 2-9: Iowa Average Yearly Rainfall

Ankeny, Iowa is located near the center of the Fourmile Creek Watershed and averages 33.12 inches of rainfall per year. Figure 2-10 depicts the variability of annual rainfall totals at the Ankeny Regional Airport. The gage at the Ankeny Regional Airport recorded over 50 inches of annual rainfall in the years 1993, 2008, 2010, and 2012 with the largest yearly rainfall in 2012 recording 59.92 inches. Table 2-2 ranks the top ten recorded daily rainfalls at the Ankeny airport between January 1951 and December 2014.



Source: http://mesonet.agron.iastate.edu/request/coop/fe.phtml

Figure 2-10: Ankeny Regional Airport Yearly Rainfall (1951-2014)

Table 2-2: Top Ten Daily Rainfalls in Ankeny Recorded Between Jan. 1951 – Dec. 2014

Rank	Date	Rain (inches)
1	6/20/1954	5.25
2	6/17/1990	4.63
3	8/28/1977	4.59
4	4/30/1986	4.50
5	7/28/2008	3.93
6	9/7/2007	3.92
7	6/28/1983	3.90
8	7/9/1993	3.70
9	9/12/1961	3.69
10	8/11/2010	3.66

Source: http://mesonet.agron.iastate.edu/request/coop/fe.phtml

Des Moines, Iowa, located in the southern part of the watershed, averages approximately 105 days of measurable rainfall per year (defined as at least 0.01 inches). Most rainfall events are small, as demonstrated by information presented in the Iowa Stormwater Management Manual, Section 2C-2, Table 1 (IDNR, 2009). The data shows that 90.60% of the measurable rainfall events were 1.25 inches or less. On average, Des Moines has 20 days per year in which rainfall exceeds 0.5 inches and 7 days per year in which rainfall exceeds 1 inch. However, large localized rainfall events do occur, on occasion, and amounts in excess of 12 inches per day have been recorded. Table 2-3 includes a few of Iowa's largest daily rainfall events.

Table 2-3: Iowa's Historic Rainfall Events

Daily Rainfall	Location	Date
13.18	Atlantic, IA	6/14/1998
12.53	Audubon, IA	7/2/1958
12.02	Castana, IA	7/17/1996
10.62	Dubuque, IA	7/27/2011-7/28/2011 (24 Hours)

Source: National Climatic Data Center (NCDC) – National Oceanic and Atmospheric Administration (NOAA)

2.7 Streamflow Gage Data

Streamflow data for Fourmile Creek is maintained by two United States Geological Survey (USGS) gages:

- NE 86th Avenue Gage (USGS 05485605 Fourmile Creek near Ankeny)
- Easton Boulevard Gage (USGS 05485640 Fourmile Creek at Des Moines)

Note that streamflow data has historically been collected at other gages, including gages at Interstate-80 in Altoona (National Weather Service (NWS) ID ATNI4 – no current information available) and US Highway 69 near Ankeny (NWS ID AKNI4 – out of service). Also, the Iowa Flood Center has stream stage sensors on bridges at 47th Street NE in Ankeny and NE 54th Avenue/County F52 in Altoona.

2.7.1 NE 86th Avenue Gage

USGS streamflow gage 05485605, also identified as NWS ID ANK14, is located along the right bank of Fourmile Creek at the bridge on NE 86th Avenue. According to the USGS National Water Information System, the gage is 1.0 mile southeast of Ankeny, 1.4 miles downstream from Deer Creek, 6.0 miles upstream from Muchikinock Creek, and 15.6 miles upstream from the mouth of Fourmile Creek, as shown in Figure 2-13. The drainage area at this gage station is 62.0 square miles and the datum is 864.91 ft above the National Geodetic Vertical Datum (NGVD) of 1929, which is equivalent to 865.01 feet in the North American Vertical Datum (NAVD) of 1988. The largest recorded peak flow occurred on August 11, 2010 in which the maximum gage height was 12.98 feet and the peak flow rate was 4,730 cubic feet per second (cfs). Table 2-4 and Figure 2-11 display the yearly peak flow data observed at the NE 86th Avenue gage.

Table 2-4: NE 86th Avenue gage (USGS 05485605) yearly peak flow data

Water Year	Date	Gage Height (ft)	Streamflow (cfs)
2004	May 23, 2004	10.60	1,720
2005	May 13, 2005	9.99	1,570
2006	Apr. 02, 2006	7.18	815
2007	Apr. 25, 2007	10.05	2,010
2008	Jul. 28, 2008	12.19	3,050
2009	Apr. 27, 2009	9.35	1,740
2010	Aug. 11, 2010	12.98	4,730
2011	Jun. 10, 2011	10.18	2,080
2012	Apr. 14. 2012	8.45	1,250
2013	May 30, 2013	9.41	1,680
2014	Jun. 30, 2014	10.36	2,180

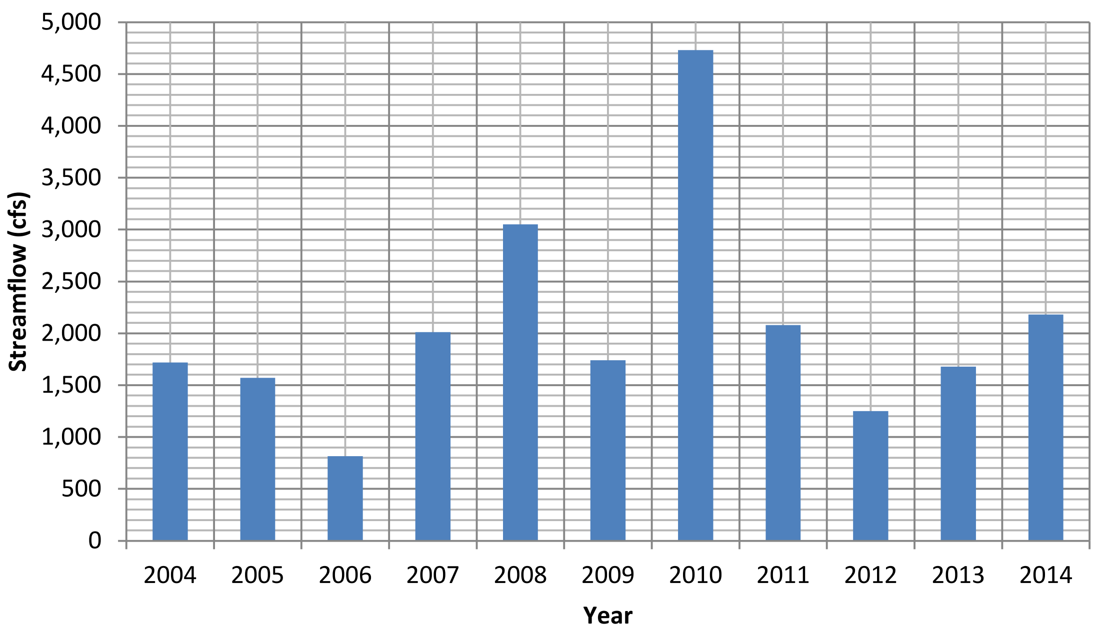


Figure 2-11: NE 86th Avenue gage (USGS 05485605) yearly peak flow data

2.7.2 Easton Boulevard Gage

USGS streamflow gage 05485640, also identified as NWS ID DFM14, is located on the right bank 20 ft downstream from the bridge on Easton Boulevard in the City of Des Moines. According to the USGS National Water Information System, the gage is 4.4 miles downstream from Muchikinock Creek and 5.2 miles upstream from mouth, as shown in Figure 2-13. The drainage area to the Easton Boulevard station is 92.7 square miles and the datum is 795.87 feet above NGVD of 1929, which is equivalent to 795.96 feet in the

NAVD of 1988. The largest recorded peak flow occurred on August 11, 2010, when the gage height was 16.14 feet and the streamflow was 9,620 cfs. Table 2-5 and Figure 2-12 display the yearly peak flow data observed at the Easton Boulevard gage.

Table 2-5: Easton Boulevard gage (USGS 05485640) yearly peak flow data

Water Year	Data	Gage Height (ft)	Streamflow (cfs)
1972	Jun. 20, 1972	9.54	1,440
1973	Feb. 01, 1973	12.71	2,600
1974	Jun. 09, 1974	14.84	5,340
1975	Jun. 18, 1975	10.95	1,820
1976	Apr. 18, 1976	14.20	4,440
1977	Aug. 28, 1977	14.64	5,380
1978	Mar. 19, 1978	11.43	1,900
1979	Mar. 19, 1979	10.00	1,470
1981	May 23, 1981	9.68	1,260
1982	Jul. 16, 1982	14.46	4,800
1983	Jun. 29, 1983	13.92	4,080
1984	Jul. 15, 1984	13.62	3,720
1985	Mar. 04, 1985	9.10	1,160
1986	Apr. 30, 1986	13.55	3,420
1987	Aug. 26, 1987	12.13	2,490
1988	Nov. 28, 1987	5.58	250
1989	May 24, 1989	7.80	731
1990	Jun. 16, 1990	14.18	4,410
1991	May 21, 1991	10.30	1,520
1992	Jul. 25, 1992	9.90	1,350
1993	Jul. 09, 1993	14.02	4,210
1994	Jun. 08, 1994	7.98	779
1995	May 09, 1995	10.15	1,540
1996	May 10, 1996	11.77	2,110
1997	Feb. 18, 1997	10.16	1,550
1998	Jun. 18, 1998	15.00	5,600
1999	May 21, 1991	12.39	2,440
2000	May 31, 2000	11.73	2,100
2001	Apr. 09, 2001	9.66	1,390
2002	Jun. 13, 2002	7.02	636
2003	May 04, 2003	11.41	1,980
2004	May 23, 2004	14.57	4,960
2005	May 13, 2005	13.19	3,230
2006	Apr. 03, 2006	8.90	1,210
2007	Apr. 25, 2007	13.80	3,950

2008	Jun. 06, 2008	15.14	6,810
2009	Apr. 27, 2009	12.54	2,550
2010	Aug. 11, 2010	16.14	9,620
2011	Jun. 14, 2011	11.89	2,640
2012	Apr. 15, 2012	10.54	1,620
2013	May 30, 2013	9.33	1,300
2014	Jul. 01, 2014	12.68	3,150

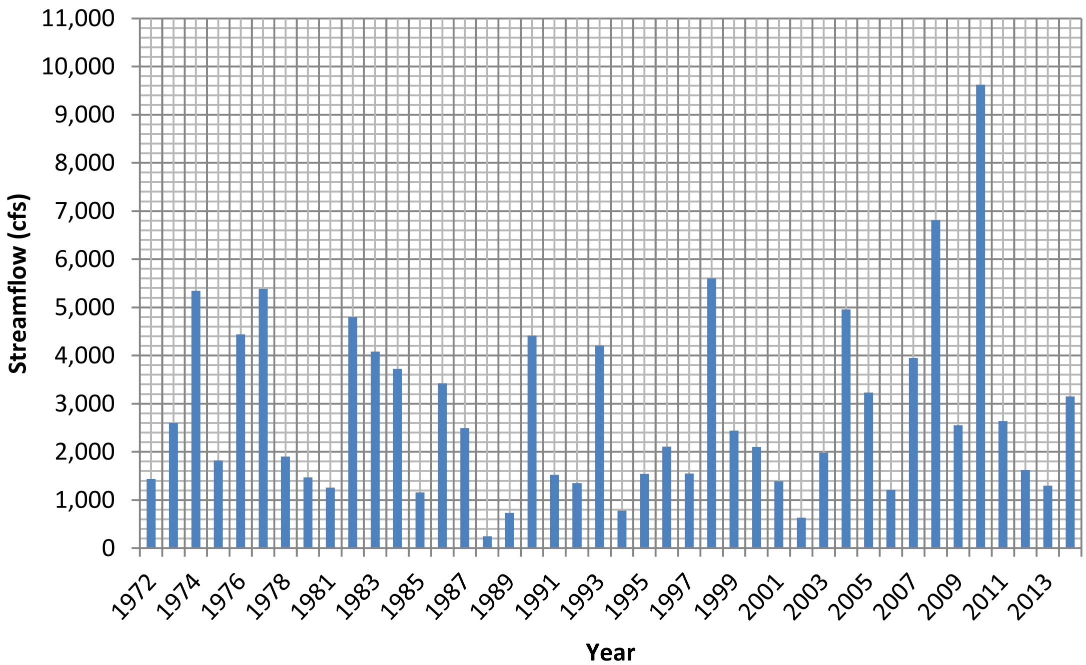


Figure 2-12: Easton Boulevard gage (USGS 05485640) yearly peak flow data

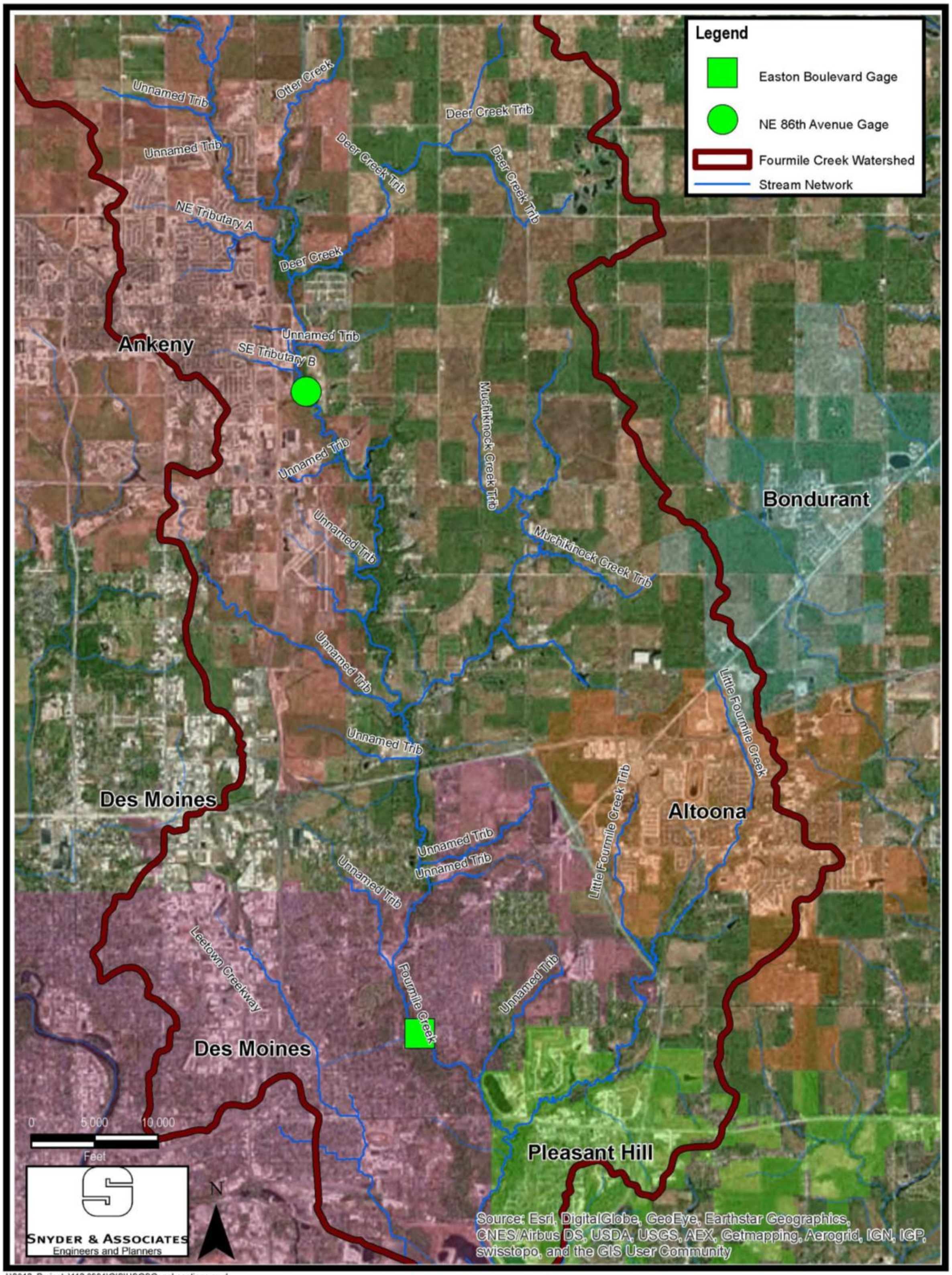


Figure 2-13: USGS Stream Gage Locations

2.8 Designated Use Classifications

Listed below are the definitions for the surface water classifications of designated use segments, according to Iowa Administrative Code 567, Chapter 61. The designated uses of Fourmile Creek are Classes A2, A3, and B(WW-2).

- **Primary contact recreational use (Class "A1"):** Waters in which recreational or other uses may result in prolonged and direct contact with the water, involving considerable risk of ingesting water in quantities sufficient to pose a health hazard, including swimming, diving, water skiing, and water contact recreational canoeing.
- **Secondary contact recreational use (Class "A2"):** Waters in which recreational or other uses may result in contact with the water that is either incidental or accidental, including fishing, commercial and recreational boating.
- **Children's recreational use (Class "A3"):** Waters in which recreational uses by children are common, which would primarily occur in urban or residential areas.
- **Cold water aquatic life – Type 1 (Class "B(CW1)"):** Waters in which the temperature and flow are suitable for the maintenance of a variety of cold water species.
- **Cold water aquatic life – Type 2 (Class "B(CW2)"):** Waters that include small, channeled streams, headwaters, and spring runs that possess natural cold water attributes of temperature and flow.
- **Warm water – Type 1 (Class "B(WW-1)"):** Waters in which temperature, flow and other habitat characteristics are suitable to maintain warm water game fish populations along with a resident aquatic community that includes a variety of native nongame fish and invertebrate species.
- **Warm water – Type 2 (Class "B(WW-2)"):** Waters in which flow or other physical characteristics are capable of supporting a resident aquatic community that includes a variety of native nongame fish and invertebrate species.
- **Warm water – Type 3 (Class "B(WW-3)"):** Waters in which flow persists during periods when antecedent soil moisture and groundwater discharge levels are adequate; however, aquatic habitat typically consists of nonflowing pools during dry periods of the year.
- **Lakes and wetlands (Class "B(LW)"):** Waters that are artificial and natural impoundments with hydraulic retention times and other physical and have chemical characteristics suitable to maintain a balanced community normally associated with lake-like conditions.
- **Human health (Class "HH"):** Waters in which fish are routinely harvested for human consumption or waters both designated as a drinking water supply and in which fish are routinely harvested for human consumption.
- **Drinking water supply (Class "C"):** Waters which are used as a raw water source of potable water supply.

3. Pollutants

3.1 Monitoring

Monitoring on Fourmile Creek was done through the IOWATER program, a voluntary water monitoring program supported with expertise and resources through the IDNR and local partners, and results were obtained from Mary Skopec, IOWATER Program Coordinator and Research Geologist. Field measurements were taken for nitrate, nitrite, phosphorous, chloride, dissolved oxygen, and water transparency. Laboratory tests were also run for nitrate, nitrite, orthophosphate as P, total phosphate as P, turbidity, *E. coli* bacteria, total kjeldahl nitrogen, bromide, fluoride, ammonia nitrogen as N, sulfate, and total coliform bacteria. There are 10 monitoring sites along Fourmile Creek and each was sampled one to two times per year from 2004 to 2009 and monthly starting in 2010.

The general findings of the analyzed data are as follows:

- phosphorous levels are high throughout the watershed, with lab data suggesting phosphorous is coming from wastewater discharges
- dissolved oxygen levels are generally normal
- transparency/water clarity measurements vary with season, but are typically high
- nitrate concentrations are typically normal to high
- chloride concentrations increase from upstream to downstream, due to larger road salt applications in the more urban areas downstream, but are typically low
- *E. coli* bacteria levels are high throughout the watershed
- turbidity measurements are low throughout the watershed

Monitoring data from the City of Ankeny can be found in Appendix D. The full report by Mary Skopec can be found in Appendix E. The combination of monitoring results from both sources is summarized in Table 3-1, which compares the Iowa Water Quality Standards to the Monitoring Data Averages.

Table 3-1: Monitoring Data Compared to Water Quality Standards

Parameter	Monitoring Data Averages	Iowa Water Quality Standard	Fourmile Creek Designated Use Classification(s)
Total Suspended Solids	5 to 30 mg/L	None	None
***Escherichia coli* Bacteria**	100 to 10000 CFU/100 ml (CFU = Colony-Forming Unit)	30-day geometric mean 126 organisms/100 ml**	A3[1]
		single-sample maximum 235 organisms/100 ml**	A3[1]
		30-day geometric mean 630 organisms/100 ml**	A2[2]
		single-sample maximum 2880 organisms/100 ml**	A2[2]
Total Phosphorus	0.1 to 5 mg/L	None	None
Nitrite + Nitrate as Nitrogen	5 to 20 mg/L	10 mg/L	C
Dissolved Oxygen	4 to 10 mg/L	5.0 mg/L[3] 4.0 mg/L[4]	B(WW-2)
Chloride	10 to 100 mg/L	389 mg/L (chronic) 629 mg/L (acute)	B(WW-2)
Turbidity	2 to 50 NTU (NTU = Nephelometric Turbidity Unit)	None	None
Transparency	20 to 60 cm	None	None

Source: Iowa Administrative Code [567], Chapter 61
** Depends on pH and temperature of water
[1] From Fourmile Creek mouth to NW 142nd Avenue
[2] Upstream of NW 142nd Avenue
[3] Minimum value for at least 16 hours of every 24-hour period
[4] Minimum value at any time during every 24-hour period

3.2 Sources

Based on the monitoring results, the pollutants of concern in the watershed were prioritized by stakeholders and the WMA. These include groups of both primary and secondary pollutants. Primary pollutants include sediment and bacteria and secondary pollutants include phosphorous and nitrogen. Although the Rapid Assessment of Stream Conditions Along Length (RASCAL) and Revised Universal Soil Loss Equation (RUSLE) assessments (discussed in detail in Section 4) provided ample information on a watershed level, monitoring data can provide targeted information on a local level for priority areas to implement water quality projects. Currently, there is inadequate monitoring data available for the needs of this plan. This proves difficult to determine the origin of the pollutants and quantities present. More robust monitoring of these parameters is addressed in a later section.

3.3.1 Priority Pollutants

Sediment loading and bacteria levels were prioritized as the primary pollutants in the Fourmile Creek Watershed because of the recreational contact concerns. Even though Fourmile Creek is not a drinking water source, there is still a pollutant concern due to human contact with the water.

Sources of sediment loading could be from any combination of streambank erosion and stormwater runoff from the surrounding rural and urban land uses. Excess amounts of sediment can cloud the stream and harm underwater organisms.

Sources of bacteria could be from any combination of pet waste, wildlife, agriculture, leaking or overflowing septic systems, and failing infrastructure. Bacteria levels can fluctuate greatly based on storm runoff, leaking sewage lines, the time of day, and the time of year. Elevated nutrients and water temperatures also have an effect on bacteria levels. Increased bacteria levels can cause health risks to anyone coming into contact with the water.

The next step would be to monitor the pollutants and determine mitigation actions from the results.

3.3.2 Secondary Pollutants

Phosphorous and nitrogen were set as secondary constituents of concern in the Fourmile Creek Watershed, since Fourmile Creek is not a drinking water source but high levels of these pollutants have a negative impact on the stream. These nutrients are essential for plant and animal growth and naturally abundant in the environment. Elevated nutrient levels can cause overstimulation of growth of plants and algae. Overgrowth can cause decrease dissolved oxygen in a stream, block light to deeper water, and clog water intakes. Both constituents are being considered for further monitoring and mitigation, if and when funding would be available.

3.3 Expected Reduction

The expected reduction of each pollutant is described in the Desired Outcome column under Goal 2 of the Implementation Schedule in Appendix A. Several tasks have been identified as reducing sediment loading, bacteria, phosphorous, and nitrogen.

4. Stream Assessment

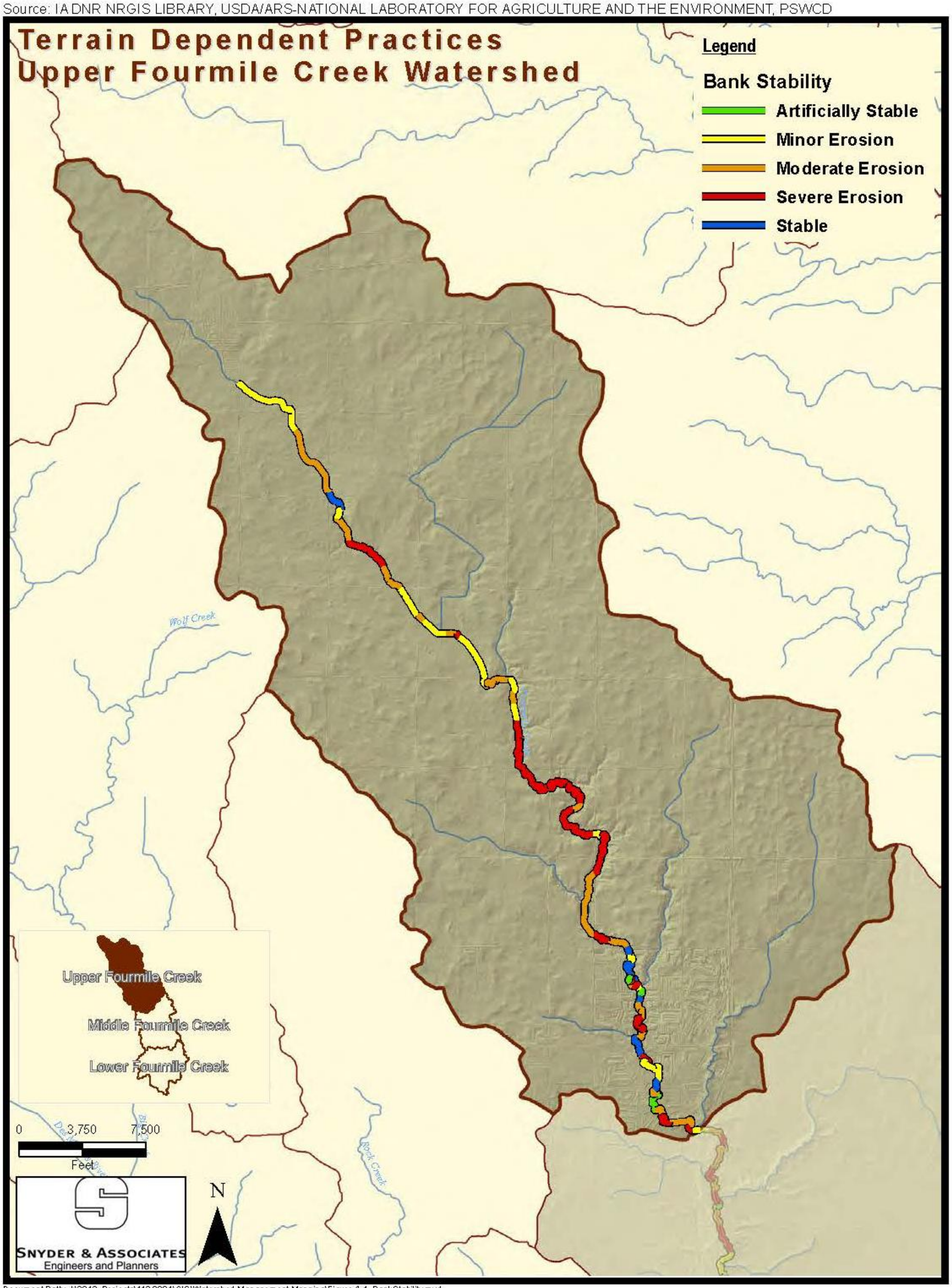
A comprehensive stream assessment was completed by the PSWCD using the Rapid Assessment of Stream Conditions Along Length (RASCAL) tool, which is one way to gain firsthand knowledge of the existing conditions in a stream. This tool allows priority areas in the stream to be identified for targeted conservation practices. These practices would reduce pollutant loading by amending adjacent land use, restoring habitat, and stabilizing banks. Data was collected including observed gullies, exposed utilities, tile outfalls, and storm sewers. A GPS camera was frequently used to document these points of interest and keep track of stream conditions.

The stream assessment was broken down into the three subwatersheds, as shown in Figures 4-1, 4-2, and 4-3. Each figure shows the portions of the stream that are stable or eroding and to what degree. All three subwatersheds show large portions of erosion and very few stable areas. The red areas, showing severe erosion, are the priority areas of concern. Section 6 discusses the implementation of the priority areas.

The PSWCD also conducted assessments on sediment delivery and Revised Universal Soil Loss Equation (RUSLE). These maps can be found in Appendix F.


Source: PSWCD

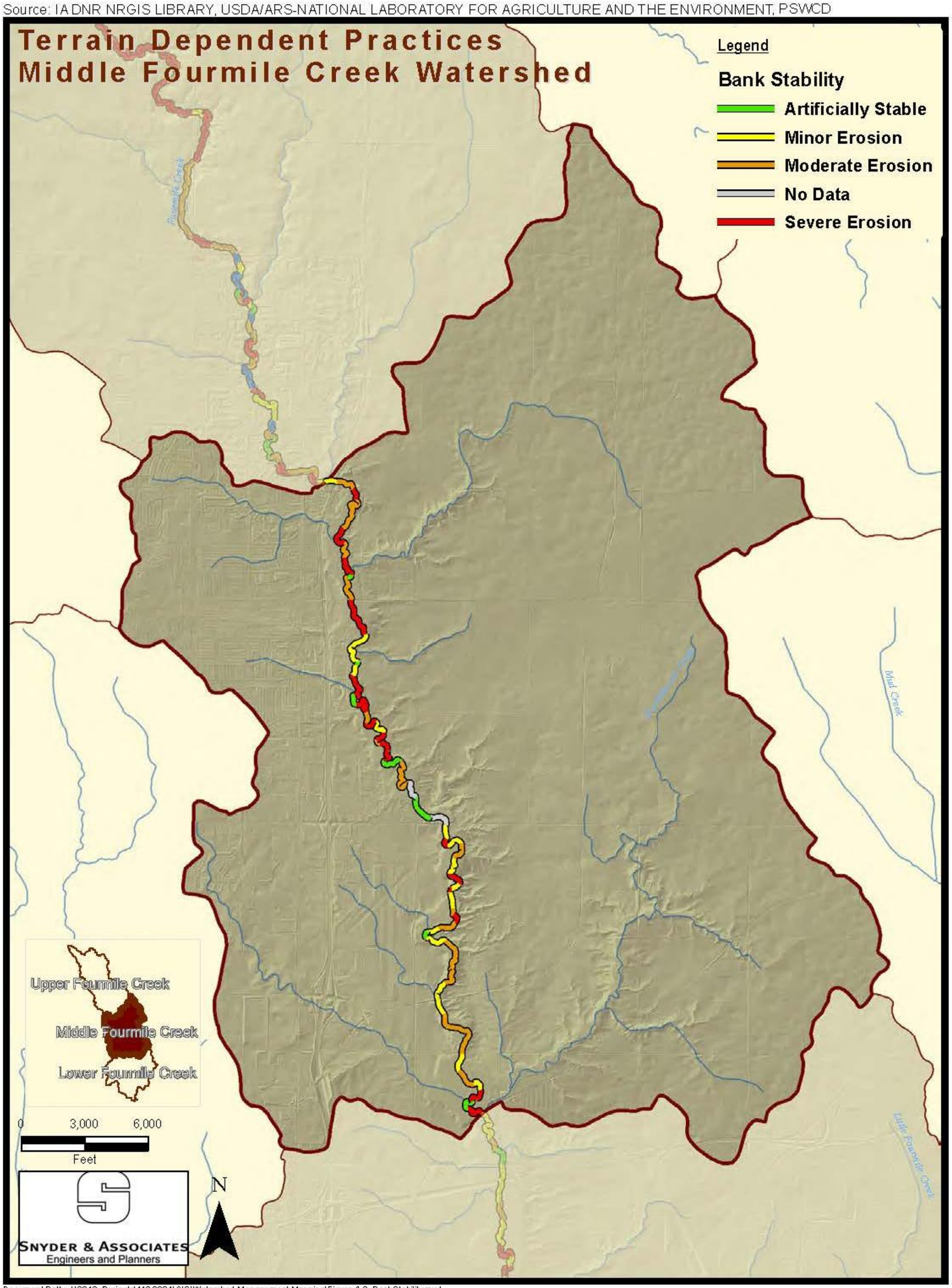
Source: IA DNR NRGIS LIBRARY, USDA/ARS-NATIONAL LABORATORY FOR AGRICULTURE AND THE ENVIRONMENT, PSWCD



Document Path: J:\2013_Projects\113.0991\GIS\Watershed Management Mapping\Figure 4-1_BankStability.mxd

Figure 4-1: Bank Stability on Upper Fourmile Creek Watershed

Source: IA DNR NRGIS LIBRARY, USDA/ARS-NATIONAL LABORATORY FOR AGRICULTURE AND THE ENVIRONMENT, PSWCD



Document Path: J:\2013_Projects\113.0991\GIS\Watershed Management Mapping\Figure 4-2_BankStability.mxd

Figure 4-2: Bank Stability on Middle Fourmile Creek Watershed

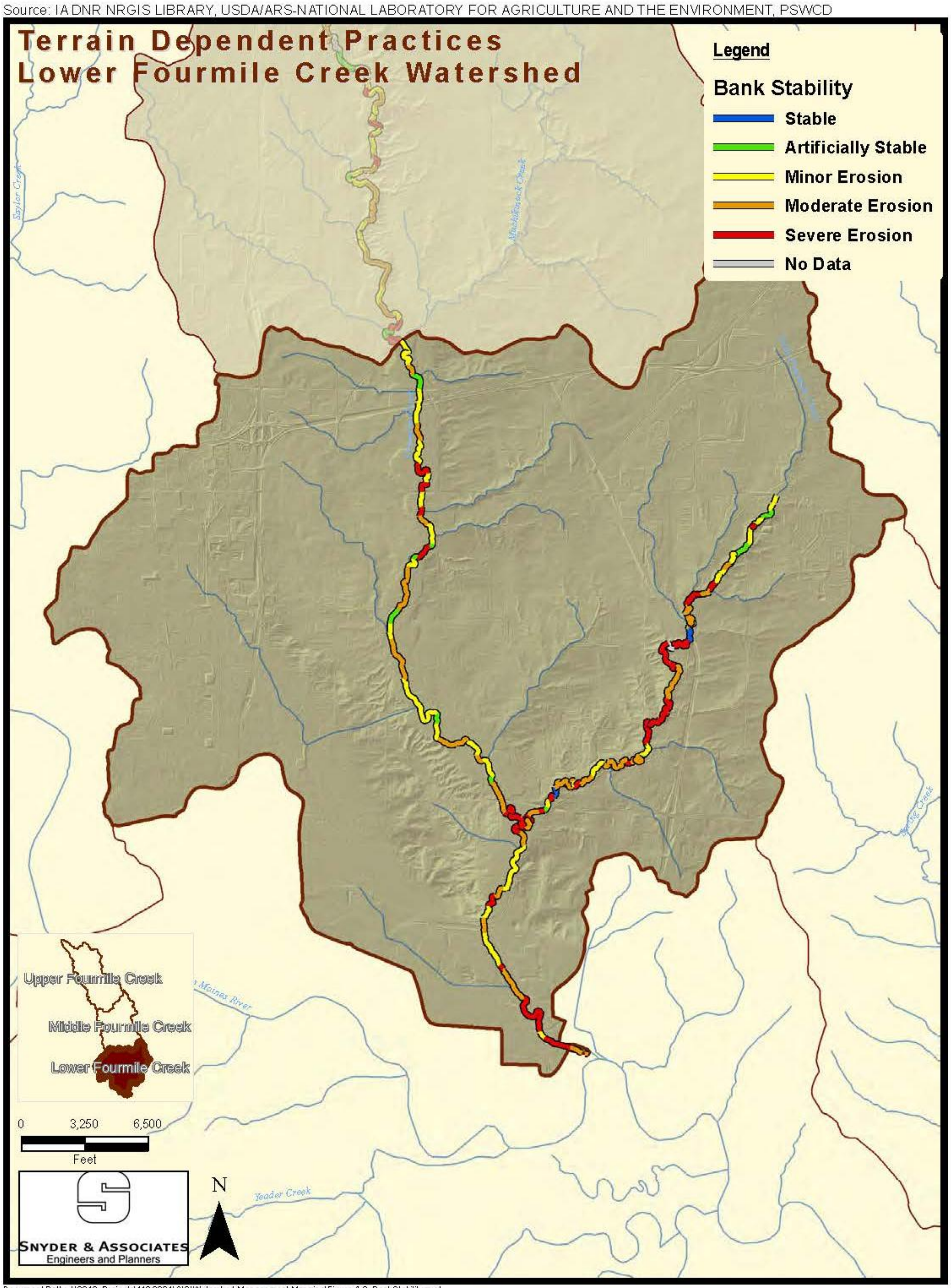


Figure 4-3: Bank Stability on Lower Fourmile Creek Watershed

5. Stakeholder & Public Involvement

An Initial Charrette was held with the WMA to develop the group's vision, mission, goals, and strategies moving forward.

A public open house was held to informally gather opinions from the community about the future of Fourmile Creek.

An Agriculture Focus Group meeting was held with agricultural producers within the watershed to discuss the formation of the FCWMA and the development of the Watershed Management Plan. The discussion was opened to the group to identify critical issues and opportunities to plan watershed management strategies within the watershed.

A Development Sector Focus Group meeting was held with development professionals from across the watershed to identify their concerns and opportunities to develop watershed management strategies and implementation.

The stakeholders were assigned Working Groups, consisting of an Infrastructure Working Group and a Policy, Education, and Communication Working Group. Each group had three meetings independently and discussed their strategies to address issues in the Fourmile Creek Watershed. The Infrastructure Working Group's focus was on developing best management practices to address both water quality and quantity issues in the watershed. The Policy, Education & Communication Working Group's focus was on developing consistency in guidelines across the watershed. A meeting was also held with Iowa State University members that were part of the both Working Groups to discuss their recommendations before being finalized. Their recommendations have been vetted through the Watershed Management Authority and are discussed in the Implementation Plan section.

Dates for Meetings

Initial Charrette:
October 10, 2013

Agriculture Focus Group:
April 2, 2014

Development Sector Focus Group:
April 17, 2014

Public Open House:
April 21, 2014

Infrastructure Working Group:
March 7, 2014
May 12, 2014
August 14, 2014

Policy, Education, and Communication Working Group:
March 5, 2014
May 29, 2014
August 18, 2014

Iowa State University Collaboration Session:
September 9, 2014

6. Implementation Plan

During the stakeholder involvement process, both of the initial groups developed recommendations that were brought to the FCWMA. The FCWMA, acting as the Implementation Working Group, finalized the recommendation documents from the stakeholder process and incorporated them into a final Implementation Plan. The following goals and tasks expand expound on the product developed through the Working Group process. A detailed plan, including target implementation dates for goals and tasks, follows.

6.1 Goal 1: Monitor for Success

An understanding of the current conditions is critical to assess the impact of future improvements. Currently, some monitoring data are available from IOWATER and the City of Ankeny, but they contain intermittent results for many of the constituents. This lack of monitoring data makes it difficult to verify the nature and extent of water quality concerns and to make recommendations on Best Management Practices (BMPs) and restoration activity investments. A more robust monitoring plan is needed to meet these ends and to help evaluate performance of current and future BMP installations and stream restoration activities.

A subcommittee of the FCWMA was formed to establish the ideal locations for monitoring and develop monitoring strategies. This includes developing a monitoring plan and properly submitting the data. The FCWMA will work with the IDNR and designate Polk County Conservation Board as the record keeper for all data. Appendix H includes examples of the IOWATER chemical, physical, and biological assessment documents.

6.1.1 Monitoring Site Locations

Monitoring sites were designated so as to divide the watershed into subwatersheds that are likely to demonstrate a measureable change in water quality as Watershed Plan elements are implemented. Site locations were chosen to meet access requirements and monitoring personnel safety. Fixed monitoring locations will be used to represent the condition of the waterway and to provide the ability to reassess the waterway for future reports. Some locations were given priority due to past monitoring data collection. There are 12 site locations that will be monitored on a regular basis. Table 6-1 shows the locations of the monitoring sites with coordinates, referenced to the Universal Transverse Mercator coordinate system, and the responsible jurisdictions.

Table 6-1: Monitoring Locations

Site	Location Description	X	Y	Responsible Jurisdiction
1	Fourmile Creek & 158th Ave	1461160	1520110	Polk County Conservation
2	Fourmile Creek & NE 54th St/NE 118th Ave	1478730	1517440	City of Ankeny
3	Otter Creek & NE 36th St	1483820	1516860	Polk County Conservation
4	Tributary A & NE Delaware Ave	1481910	1516210	City of Ankeny
5	Deer Creek & NE Frisk Dr	1484780	1515960	Polk County Conservation
6	Tributary B & SE Delaware Ave	1481830	1515460	City of Ankeny
7	Fourmile Creek & SE Oralabor Rd	1488680	1514740	City of Ankeny
8	Muchikinock Creek & NE Berwick Dr	1491260	1513440	Polk County Conservation
9	Fourmile Creek & NE 54th Ave	1491330	1513120	Polk County Conservation
10	Little Fourmile Creek & Little Fourmile Creek Dr	1498030	1511010	City of Pleasant Hill
11	Fourmile Creek and Dean Ave	1496000	1510630	Polk County Conservation
12	Fourmile Creek and Vandalia Rd	1497520	1509840	Polk County Conservation

6.1.2 Monitoring Frequency

Monitoring will be conducted on a monthly basis, during the first week of each month, to allow for a consistent sampling interval and allow the data from all sites to be directly compared. Monitoring locations are shown in Figure 6-1. Monitoring frequency will be assessed and modified, as needed, as the testing program progresses.

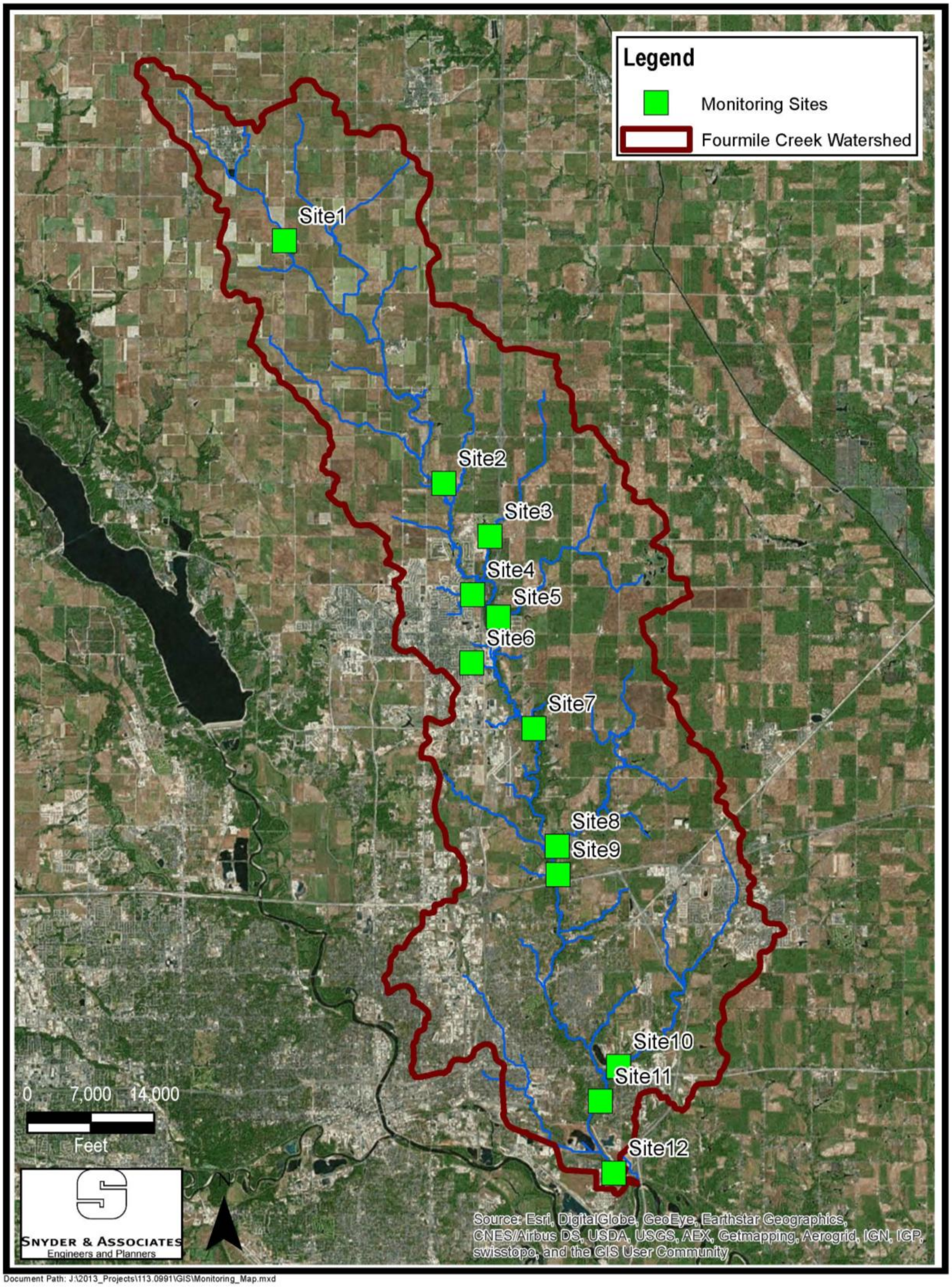


Figure 6-1: Fourmile Creek Water Quality Monitoring Sites

6.1.3 Monitored Constituents

The chemical and physical assessments will comprise of monitoring various characteristics of each site, including weather, water color, water odor, air temperature, precipitation, transparency, pH, nitrite as nitrogen, nitrate as nitrogen, dissolved oxygen, phosphate, chloride, water temperature, and stream flow. The FCWMA determined these constituents based on priority areas in the watershed.

6.1.4 Monitoring Protocol

The constituents described above will be monitored by staff within the designated responsible jurisdictions using field kits and practices developed by IOWATER. The monitoring results will be used to analyze trends within the watershed. A red flag network will also be used to alert monitoring personnel of any abnormal results requiring additional testing. The constituents to be monitored are specified in Table 6-2 below, as well as the Iowa Water Quality Standard, Designated Use Classifications, and Parameter Quantity limits.

Table 6-2: Water Quality Criteria for Monitored Constituents

Parameter	Iowa Water Quality Standard	Fourmile Creek Designated Use Classification(s)	Parameter Quantity Limit
Total Suspended Solids	None	None	1 mg/L
Nitrate as N	10 mg/L	None	0.05 mg/L
Nitrite as N	1 mg/L	None	0.05 mg/L
Total Phosphate as P	None	None	0.02 mg/L
Chloride	389 mg/l(chronic) 629 mg/l (acute)	B(WW-2)	
Dissolved Oxygen	5.0 mg/L[1] 4.0 mg/L[2]	B(WW-2)[3]	0.1 mg/L
pH	Minimum 6.5; Maximum 9.0	A, B	0.1 unit
Temperature	Maximum increase = 3°C not to exceed 32°C	B(WW-2)	0.5°C

Source: Iowa Administrative Code [567], Chapter 61
[1] Minimum value for at least 16 hours of every 24-hour period
[2] Minimum value at any time during every 24-hour period
[3] From Fourmile Creek mouth to NW 142nd Avenue

Stream flow data on the main stem of Fourmile Creek will be taken from USGS gages, Iowa Flood Center gages, or National Weather Service gages where applicable. Where gages are not available, the flow will be determined during each monitoring period by visually measuring the depth of water using a scale and utilizing a flow rating curve specific to the site. Flow rating curves correlate water depth to flow rate and will be developed for each site. Table 6-3 shows the method for which flow monitoring data will be gathered. Flow data for monitoring sites on tributaries will be determined as data becomes available.

Table 6-3: Flow Monitoring Information

Site	Location Description	X	Y	Method for Gathering Flow Monitoring Information
1	Fourmile Creek & 158th Ave	1461160	1520110	Depth scale on barrel of culvert
2	Fourmile Creek & NE 54th St/NE 118th Ave	1478730	1517440	Iowa Flood Center Sensor at 47th St. NE in Ankeny
7	Fourmile Creek & SE Oralabor Rd	1488680	1514740	USGS Gage at 86th St
9	Fourmile Creek & NE 54th Ave	1491330	1513120	Iowa Flood Center Sensor W of Berwick Dr. NE, County F52 in Altoona or National Weather Service Sensor at I-80 in Altoona
11	Fourmile Creek and Dean Ave	1496000	1510630	Depth scale on bridge pier
12	Fourmile Creek and Vandalia Rd	1497520	1509840	Depth scale on bridge pier

6.1.5 Biological Assessment

A biological assessment will be completed at each of the sites monitored by Polk County Conservation three times per year, in May, July, and September. The goal of this task is to assess trends in biological activity and stream health status, potentially resulting from land management and stormwater control practices implemented. The biological assessment uses key indicators to measure the health of a given stream, including indicators from the chemical and physical assessments. The key indicators of the biological assessment include benthic macroinvertebrates, microhabitats, aquatic plant cover, and invasive species.

6.1.6 Monitoring Committee

A monitoring committee will be formed to review the monitoring results. This may include members of the FCWMA and outside agencies or stakeholders. They will review the results on a quarterly basis and provide an annual report with a summary of the monitoring data. As the monitoring goals and objectives change with increased data collection, the monitoring process will be assessed and modified, as needed, by the monitoring committee and be presented for approval to the members of the FCWMA.

6.2 Goal 2: Engage Rural and Urban Partners

Owners and managers of both rural and urban land uses in the watershed have a role to play in the installation and maintenance of water quality and quantity improvement practices. If both demographic groups are effectively engaged, it will enable a holistic approach to implementation. Detailed descriptions are outlined below regarding tasks to be completed that will support desired accomplishments within rural and urban land uses. The recommendations are based largely on the experience of the working group members and the average/aggregate data contained in the Iowa Nutrient Reduction Strategy (NRS). The NRS is a science and technology-based framework that was developed to assess and reduce nutrients in Iowa's surface water. The recommendations also incorporate the five core components of the Stormwater Master Plan from the Fourmile Creek Watershed Study completed in December 2013 by Snyder & Associates, Inc, including sustainable rural land management, sustainable urban land management, sustainable land development, stormwater detention, and stream corridors. Education and communication goals are discussed in a later section.

Until a monitoring program compiles enough watershed specific data, initial goals will be consistent with those described in the NRS. The NRS has established specific goals of 45% reduction for both total nitrogen and total phosphorous exiting Iowa's lakes and rivers. NRS strategies for N and P will provide auxiliary water quality benefits to reduce bacteria and sediment loading. The NRS strategies address both point source (i.e. waste water treatment plant discharge) and non-point source (i.e. agricultural runoff) loading. As monitoring data becomes available, the goals for the Fourmile Creek Watershed can be reassessed based on actual field conditions. Based on NRS assessments and initial assessments of the watershed, the pollutant reduction goals are shown in Table 6-4.

Table 6-4: Desired Loading Reduction in Fourmile Creek Watershed

Monitoring	Total Reduction Goal (per NRS)	Maximum Point Source Reduction Anticipated	Non-Point Source Reduction Requirement
Nitrogen	45%	4%	41%
Phosphorous	45%	16%	29%

6.2.1 Sub-Goal A: Urban & Rural Strategies

These strategies need to be implemented within both rural and urban land areas. Some of the tasks described below require high levels of communication and collaboration between representatives associated with the two land use categories to ensure maximum effectiveness during and after final implementation. Many of the strategies described within the NRS are focused on rural (i.e. agriculture) practices, however, urban practices will also help meet the reduction goals. Urban practices also have a critical role for water quality and quantity improvements. If implemented in combination, these tasks will collectively benefit overall watershed health.

6.2.1.1 Task 1: Designate Watershed Coordinator

A full time Watershed Coordinator should be hired to oversee the implementation plan. This will ensure that goals and tasks are achieved and that proper communication is given for certain goals and tasks. A 28E agreement should be developed to split the costs associated with this position.

6.2.1.2 Task 2: Identify Strategy Champions

To ensure that practices are implemented throughout the watershed, there is a need to target individuals and groups as early adopters and advocates for each strategy. These individuals and groups will be effective stewards for targeted practices to thrive within the watershed. Not only can they provide one-on-one guidance and education for their peers, but they also can provide education and demonstration sites for the general public and other potential adopters within the same demographic. It will be the work of the Watershed Coordinator to facilitate identifying these champions.

6.2.1.3 Task 3: Wetland Restoration and Banking

As discussed in previous sections, wetlands can be a very effective treatment tool for a variety of runoff pollutants, as well as provide peak discharge attenuation and promote infiltration. However, a common practice during development of a parcel of land is to buy wetland "credits" at a wetland banking site to mitigate any losses of wetlands that may occur during and after development. These wetland credits are not required to stay within the Fourmile Creek watershed, nor is there an approved wetland banking site located within the watershed. When these credits are purchased outside of the Fourmile Creek watershed, the benefits of the wetland are completely removed and another watershed reaps the rewards.

During the Working Group process, there was a strong desire to identify areas of wetland restoration within the watershed for multiple reasons. Restoration of wetlands would allow end of field treatments to be identified, capitalize on the ability of wetlands to improve runoff quality and quantity, and potentially create a site(s) for an approved wetland bank to be established within the Fourmile Creek watershed. Once banking sites have been established, wetland credits, and the benefits that come with them, could then be required to stay within the watershed.

A wetland site assessment would need to take place to determine potential sites for banking. A Corps of Engineers permit will need to be submitted to ensure site construction eligibility. Once the site has been constructed, a mitigation cost per acre will be established.

The Conservation Reserve Enhancement Program (CREP) is a state and federal initiative that develops wetlands in areas that are targeted to remove nitrate from tile-drainage water in cropland areas. No CREP wetland sites are currently located in the watershed at this time. If funding becomes available, sites will be identified that meet the CREP criteria, including a 500 acre minimum drainage area with a wetland of at least 0.5% of the drainage area, viability, and landowner interest.

6.2.1.4 Task 4: Deep Rooted Native Plantings

Native vegetation typically has deeper roots and taller stands than non-native vegetation. The deeper roots enhance the soil profile and provide greater potential for runoff infiltration and nutrient absorption than turf grasses and other non-native landscaping. The deeper roots, coupled with the taller stand, also provide increased protection from erosion within waterways and on streambanks.

Native vegetation is currently being used in both rural and urban environments in the watershed, usually for different purposes, but yielding similar benefits. Although this practice is being used, there is the potential to realize greater benefits if planting and maintenance of native vegetation is more commonplace.

In the rural environment, native vegetation is being used within stream buffers, grassed waterways, and as a streambank stabilization measure. However, there are many areas within the watershed where turf grass is being grown where native vegetation could be established instead. In the urban environment, native vegetation is being used within infiltration ditches and basins, edge treatment and stabilization in detention basin designs, and for streambank stability. However, stormwater infiltration practices are not common and native vegetation is not typically used extensively at development sites in the watershed. Figures 6-3 and 6-4 illustrate conditions before and after implementation of native plantings for stream restoration.

6.2.1.5 Task 5: Streambank Restoration

As discussed in previous sections, streambank erosion is one of the leading causes of sediment transport and loading within Fourmile Creek. To combat this issue, the Working Groups targeted a need to develop a streambank restoration program. This program will use data already collected and collect additional data, if needed, to assess the condition of the streambanks throughout the watershed. As discussed in Section 4, a stream assessment was completed by the PSWCD to determine the existing conditions of bank stability and erosion on Fourmile Creek. This information was used to prioritize areas of concern along the stream for restoration. The areas were ranked based on various characteristics, including severity of erosion, condition of stream habitat, development of bank vegetation, bank height, and riparian width. The implementation of each project will be based on cost to reduce or eliminate erosion, funding availability, and stakeholder participation. The stream assessment and prioritization was completed on the main stem of Fourmile Creek and a portion of one tributary. This does not include known issues on other tributaries and urban stream, such as the Brook Run neighborhood, among others. Figure 6-2 shows the top ten areas of restoration along the main stem of Fourmile Creek, based on the results of the RASCAL assessment. Detailed figures of each area are in Appendix G. Figures 6-3 and 6-4 illustrate streambank conditions before and after a stream restoration project, respectively.

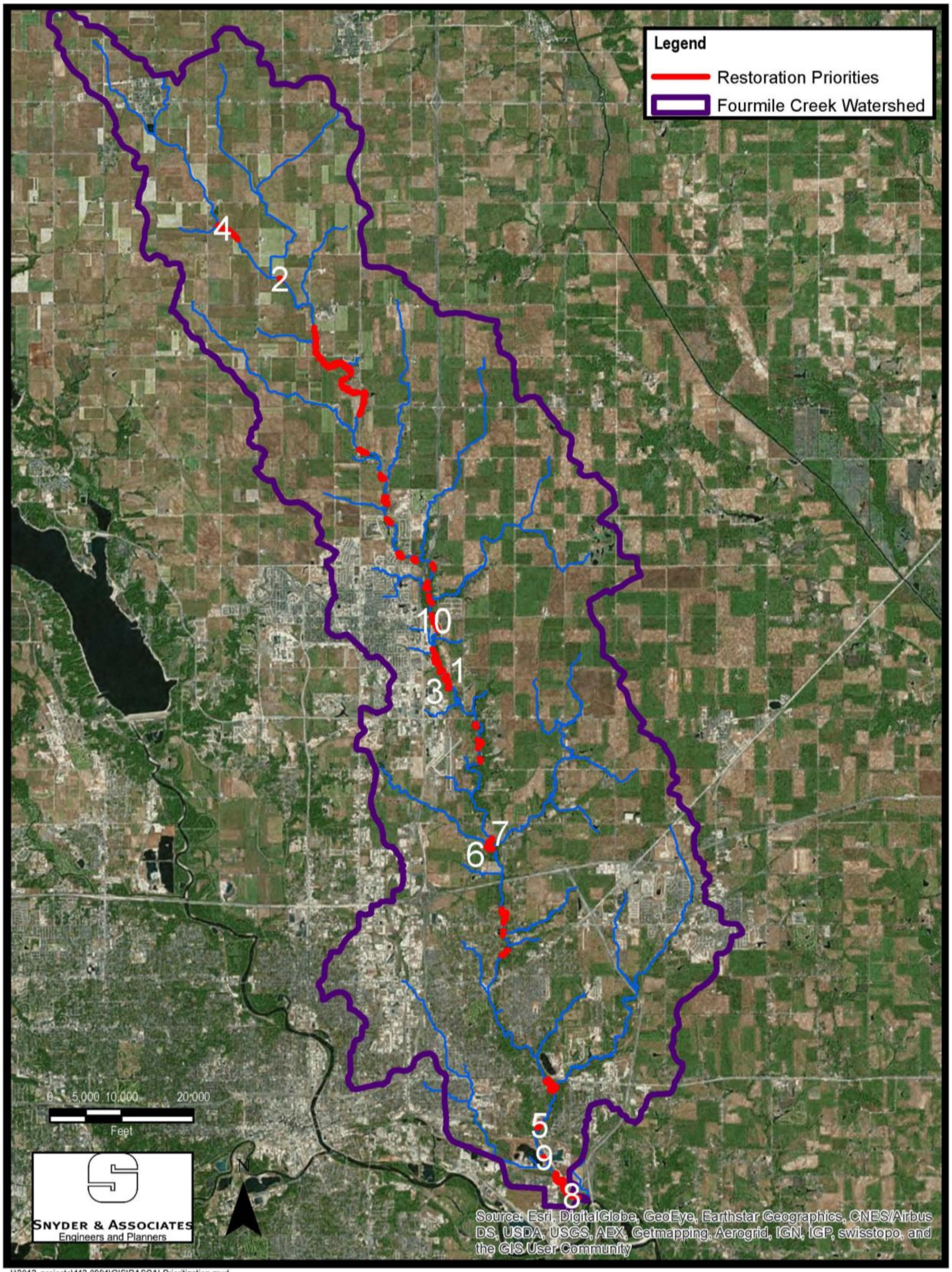


Figure 6-2: Top Ten Restoration Priorities Based on RASCAL Assessment

Figure 6-3: Eroding Bank before Stream Restoration

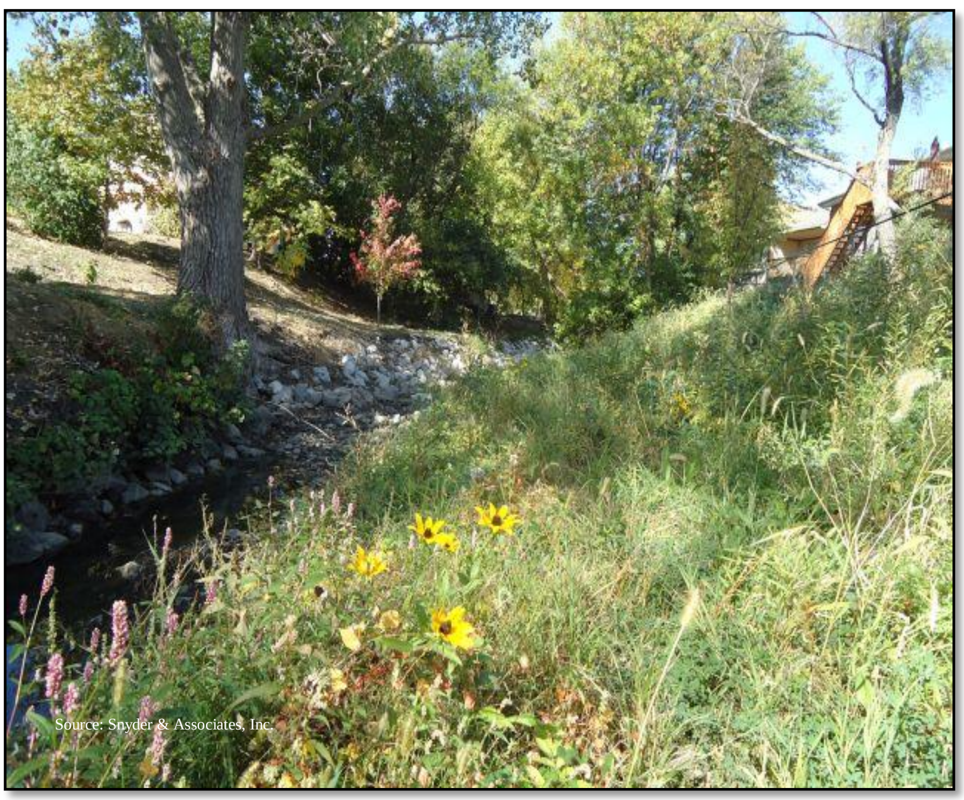


Figure 6-4: Stable Bank after Stream Restoration

6.2.1.6 Task 6: Bacteria Sources

The major sources of preventable bacteria in Fourmile Creek are from on-site wastewater system (septic system) discharges and from livestock grazing. The Environmental Health Division of Polk County Public Works provides a number of services to the public and business community relating to those affecting the health and safety of the environment. One of these services is permit issuing, inspection, and maintaining maintenance records of private on-site wastewater systems. The Environmental Health Division will be utilized to investigate on-site wastewater discharges within Polk County. The investigation areas will be prioritized based on data collected from stream monitoring, septic system permitting, and time of transfer septic system inspections. Polk County anticipates the development of a GIS database of on-site wastewater sites in Polk County to track their location, permitting, and maintenance. Over time, an understanding of on-site wastewater system locations can assist in assessing and correcting deficiencies which contribute to bacteria in Fourmile Creek.

Another possible source of bacteria in Fourmile Creek is the presence of livestock grazing adjacent to streams. Eliminating the direct access of livestock to Fourmile Creek and its tributaries can minimize or eliminate a source of bacteria. Livestock should be held at a buffered distance by fencing or other means to stop direct contact with water bodies. A watershed coordinator could work closely with affected property owners and producers to review options for separating livestock from the water bodies and look for cost sharing opportunities to implement these options.

Wildlife is another source of bacteria yet is more difficult to prevent. While the initial bacteria focus will be on-site wastewater systems and livestock, field reviews will note locations of high populations of wildlife, such as geese, to address in later years of the management plan.

6.2.2 Sub-Goal B: Urban Strategies

These strategies target urban and suburban land uses. Some strategies also work as community educational pieces. Even though these strategies are not explicitly outlined in the NRS Science Assessment, they will have direct effects on decreasing pollutant loading in the watershed. They emphasize reduction of impervious (hard) surfaces, increasing stormwater infiltration (water soaking through the soil), and slowing water through extended detention practices or other means. A regional coordinator may be needed to ensure urban strategies are consistent throughout. The education and communication of these strategies with urban land owners is discussed in Section 6.8.

6.2.2.1 Task 1: Water Quality and Quantity Management

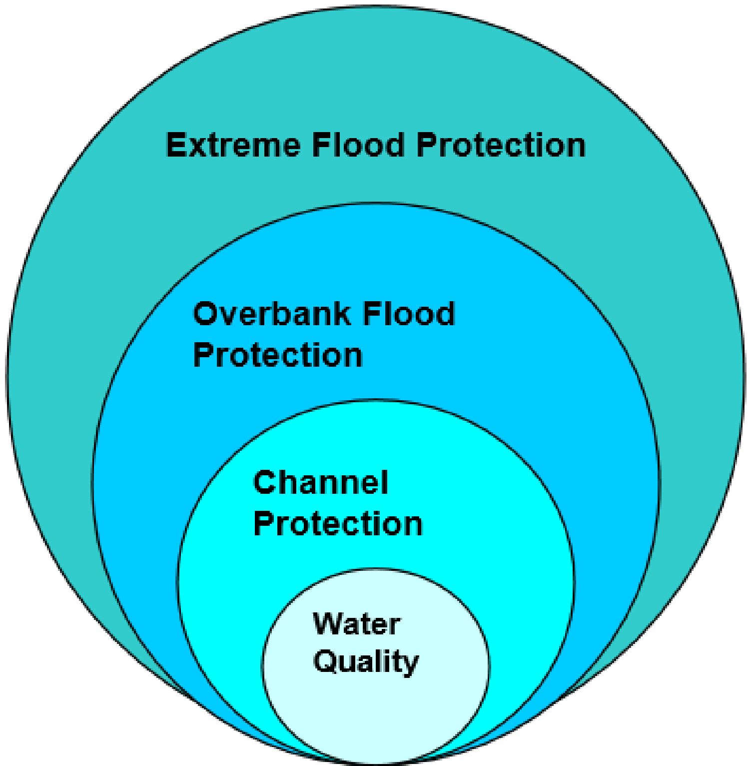
Ensure all communities within the Fourmile Creek Watershed adopt stormwater management requirements. These management requirements should address both water quality and quantity concerns to maximize benefits in the watershed as a whole.

6.2.2.2 Task 2: Water Quality Volume Management

Ensure all communities within the Fourmile Creek Watershed adopt standards that require infiltrating the water quality volume on site (as opposed to detaining and releasing that volume). The water quality volume in central Iowa is defined as the runoff that occurs during a 1.25" rainfall event. Infiltration practices have a high removal rate for suspended solids. This removal rate can be between 65%-100% depending on the practice as suggested in the Iowa Stormwater Management Manual (ISMM). Removal of suspended solids also helps remove metals, bacteria, hydrocarbons, and phosphorus that may be adhered or bonded to sediment particles suspended in stormwater.

6.2.2.3 Task 3: Channel Protection Volume Management

Ensure all communities within the Fourmile Creek Watershed adopt standards that require the detention of the channel protection runoff volume and release this volume slowly over a 24 hour period. The channel protection volume is defined as the runoff that occurs from a 2.4" rainfall event. Detaining this additional runoff volume and releasing it slowly allows for a reduced, although sustained, flow that would otherwise be released into a drainage way. This helps reduce the depth of flow in the channel. This, in turn, reduces the saturated condition of the channel banks and thereby decreases the likelihood of channel bank sloughing. In other words, this runoff control practice reduces stream bank erosion. Figure 6-5 below illustrates the various levels of stormwater detention that will benefit both water quality and quantity concerns.



Source: ISMM

Figure 6-5: Unified Sizing Criteria

6.2.2.4 Task 4: Green Street Strategy

A green streets strategy helps reduce runoff from impervious surfaces associated with urban and suburban streetscapes. This approach uses vegetation, soils, and other natural processes to manage stormwater via infiltration. Stormwater is managed and/or treated where it lands to create healthier urban environments. Practices such as permeable pavers, pervious asphalt, and infiltration ditches (installed in the street median or at the back of curb) help to reduce contaminants entering waterways with the street runoff. These practices also enhance the aesthetics of streetscapes and can often be integrated into other safety and traffic calming measures. Figures 6-6 and 6-7 illustrate some of these practices.

Figure 6-6: Bioretention Cell and Permeable Pavers

Figure 6-7: Permeable Pavers

6.2.2.5 Task 5: Prairie Pothole Preservation/Mitigation

Prairie potholes and other depressions occur naturally within the landscape and can serve as small detention basins for water quality and water quantity improvements. For example, during a 1.25" rainfall event, the same (or greater) runoff volume that would need to be infiltrated in an urban detention basin could be captured in a prairie pothole. This volume would then soak through the soil profile, feeding the native prairie vegetation surrounding the depression and filtering any contaminants present in the runoff entering the pothole. This naturally occurring process will also attenuate flow and lower peak discharges that reach streams and rivers until the depression is full and runoff begins to flow downstream. The volume of storage could be mitigated in a different location in the same watershed should the current location be unable to work.

As shown on previous figures, natural depressions are plentiful in the upper watershed. When a parcel of land is developed, these features are usually filled in and forgotten. This task helps to ensure the preservation of existing depression areas and incorporate the volume lost into the development design. This volume can be added to the water quality volume detention requirement, added to the development in other methods elsewhere in the development, or mitigated for this storage in a banking site within the Fourmile Creek Watershed.

6.2.2.6 Task 6: Regional Detention

Based on work done in the Fourmile Creek Watershed Study completed in December 2013 by Snyder & Associates, Inc., several strategies were recommended for maximizing the benefits of detention in the watershed. The study also recommended that high priority should be given to providing a minimum of 1,200 ac-ft of regional stormwater detention storage to reduce flood risk. Table 6-5 includes a recommendation for distributing the 1,200 ac-ft of detention storage in the watersheds. The suggested regional stormwater detention locations, shown in Figure 6-8, were placed with the intent to provide the highest downstream benefits. Further analysis of the sites will need to be completed to fully understand optimal locations based on topography, future development, and land ownership.

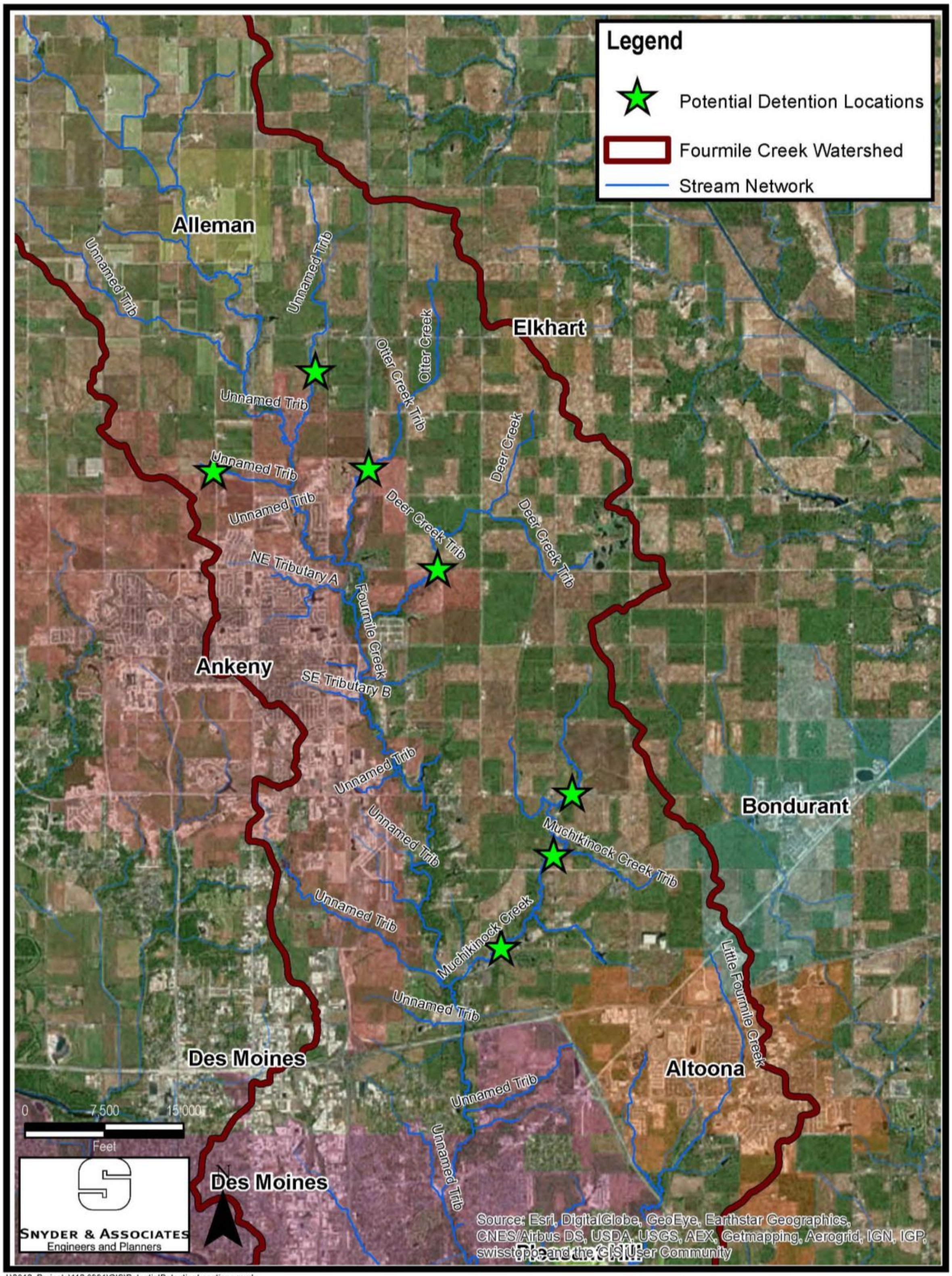
This task helps to ensure on-going efforts are pursued to plan, fund, and implement detention storage facilities. Each detention storage site will need an assessment of constraints and drainage area characteristics to determine the optimal flood risk reduction (e.g., dry and wet ponds, wetlands). The assessments would also need to involve coordination with adjacent property owners and the completion of a subwatershed concept plan.

Regional Detention Recommendations

- Establish multi-purpose stormwater detention facilities based on the site and water quality/quantity goals for the specific location.
- Integrate environmental and recreational amenities, such as lakes and wetlands, which can provide both stormwater storage and recreational amenities.
- Establish stormwater facilities that support water quality to flood protection objectives, reduce vulnerability to climate variability, and are maintainable/sustainable.
- Land for establishing stormwater detention facilities can be provided by any combination of maintaining current private land ownership, acquiring land for public ownership, using existing public land, and using existing easements.
- When deciding if private land ownership is to be maintained, consideration should be given to significant factors, such as establishing appropriate easements (e.g., floodplain/drainage easements) and defining monitoring, operation, and maintenance responsibilities (e.g., sediment removal).

Table 6-5: Recommended Storage

Region	Recommended Storage (ac-ft)
Otter Creek	120
Muchikinock Creek	370
Deer Creek	190
Upper Fourmile Creek	180
Other Tributaries	340
Total	**1,200**



J:\2013_Projects\113.0991\GIS\PotentialDetentionLocations.mxd

Figure 6-8: Potential Detention Locations

6.2.3 Sub-Goal C: Rural Strategies

These strategies are specifically targeted for rural land uses, and emphasize practices that are identified within the NRS. Specifically, priority is given to practices that are most likely to achieve higher reductions (as a percentage) of nutrients and sediment in rural area runoff. The education and communication of these strategies with rural land owners is discussed in Section 6.8.

6.2.3.1 Task 1: Enhance and Promote Vegetative Cover

Vegetative cover provides multiple benefits in the watershed and to the streams themselves. First, rainfall is intercepted by the vegetation, which reduces kinetic energy of the water before it contacts the soil. This increases the potential for infiltration and reduces the chance that soil particles are dislodged and suspended in stormwater runoff that exits a field. Second, the vegetative cover slows and filters any runoff as it leaves the field and before it reaches a waterway. This serves to enhance infiltration, attenuate peak flow rates, and reduce pollutant content in runoff entering nearby streams. Finally, vegetative cover uses excess nutrients that may be in the soil profile for its growth, further reducing the potential for those nutrients to reach a nearby stream or other water body.

Vegetative cover practices include cover crops, stream buffers, grassed waterways, prairie strips and perennial crops. Some of these practices are illustrated in Figures 6-9 and 6-10 below.

Figure 6-9: Cover Crops

Figure 6-10: Grassed Waterway

6.2.3.2 Task 2: Minimize Soil Disturbance

Minimizing soil disturbance reduces the opportunity for erosion and sediment loading to waterways. This keeps soil and organic matter upstream in the watershed, available for further valuable agricultural production. It also keeps nutrients and other pollutants attached to sediments from reaching waterways within the watershed.

These practices include reduced tillage, strip tillage, and no till. The Working Group emphasized the value of reduced tillage and strip tillage. Strip tillage is illustrated in Figure 6-11 below.

Figure 6-11: Soybean Field Following Strip Tillage

6.2.3.3 Task 3: End of Field Treatments

End of field treatments can be installed at the end of a field drainage way or at the end of a drain tile outlet. Each treatment has unique applications. At the end of a tile line, runoff treatment practices tend to reduce nitrogen. A bioreactor or saturated buffer at a tile outlet can accomplish high nitrogen reductions, according to the NRS. However, it will have little impact on sediment load, since water exiting tile lines does not usually have high turbidity. A wetland at the end of a field can allow sediment in the surface runoff to settle out, increase infiltration, and use excess nutrients contained within the runoff for vegetative growth. An end of tile bioreactor installation is illustrated in Figure 6-12 below.

Figure 6-12: Bioreactor Being Installed in a Field

6.3 Goal 3: Adopt a Greenway System

A greenway system allows for multiple benefits along the stream and in the watershed as a whole. It is being targeted by the FCWMA to reserve the 500 year (0.2% annual chance) floodplain as a greenway. This could be by acquisition, donation, or by overlay district. This will ensure that future property and life loss due to flooding will be lessened significantly. A greenway system also allows for the implementation of many practices presented in relation to other goals in this plan such as native vegetation, stream buffers, wetlands, etc. Additionally, greenways offer greater opportunity for recreation and aesthetic enhancement near a stream or river.

6.3.1 Task 1: Establish Main Channel Greenway Network

Establishment of the 500 year floodplain along the main channel as a greenway system will be easier and should be implemented before a similar strategy for the tributaries is developed. Flooding along the main channel of Fourmile Creek has been analyzed with detailed hydraulic methods as a part of the Fourmile Creek Watershed Study performed by Snyder & Associates, Inc. This study will also be used for the update of the Polk County FEMA Flood Insurance Rate Maps (FIRMs). Within this study, new hydrologic models and peak discharges were developed that are calibrated to gage data that included the 2008 and 2010 floods along Fourmile Creek. These peak discharges were then used in a detailed hydraulic model to develop flood profiles from Fourmile Creek's confluence with the Des Moines River to the northern corporate limits of Polk County. These updated flood profiles were used to map inundation extents in the 100 year and 500 year floodplains along the entire studied reach.

6.3.2 Task 2: Establish Tributary Greenway Network

After the establishment of a greenway system along the main channel, a greenway system adoption plan for the tributaries should be created. Most of the tributaries that have a confluence with Fourmile Creek have upwards of the first (lowermost) 500 feet of stream length mapped as backwater from the main channel. However, most of the tributaries have not been modeled with detailed hydrologic and/or hydraulic methods that accurately map the 500 year floodplain extents. Additionally, some of the tributaries have not been analyzed for even the 100 year floodplain.

The 100 year and/or the 500 year floodplain boundaries should be established over time for each major tributary to ensure consistent connectivity of the greenway system throughout the watershed. However, in instances where only the 100 year floodplain is mapped for a tributary or there is not an official floodplain that has been mapped, a Minimum Protection Elevation should be established. In instances where there has not been a floodplain that has been mapped, the 500 year floodplain should be established to ensure proper buffer width through proposed developments.

6.3.3 Task 3: Stream Corridor

Based on work done in the Fourmile Creek Watershed Study completed in December 2013 by Snyder & Associates, Inc., stream corridors were identified as a crucial component of stormwater management and flood hazard mitigation. Stream corridors have multiple functions, including reducing flood risk, improving water quality and other conditions, maintaining and improving aquatic and terrestrial habitats, filtering and treating runoff contaminants, and possible recreational and educational facilities.

The sustainable strategies that were identified in the study include property acquisition, stabilizing streambanks, and creating a multipurpose stream corridor.

Stream Corridor Recommendations

- **Acquire properties at risk for flooding**

The study determined that there is not an economical way to lower the flood elevation to protect certain structures from flooding. Many are simply located below flood elevations, which leaves acquisition of the property as the best alternative. The City of Des Moines has completed 160 voluntary buyouts within the watershed and will continue to remove vulnerable structures and establish a stream corridor, as funding becomes available.

- **Stabilize streambanks**

Flooding in 2008 and 2010 created extended periods of erosive flow in the creek, which caused creek channel deepening and widening in some areas. Based on available data, a plan should be developed and implemented to address targeted areas of streambank stabilization and protect existing streambanks.

- **Creation of a multipurpose stream corridor**

Stream corridors provide many benefits to a watershed, in addition to reducing flood risk. As development occurs adjacent to waterways within the watershed, the stream corridor should be acquired and protected and structures should be prevented from being built in the floodplain.

6.4 Goal 4: Promote Consistent Implementation

Implementation of strategies and practices within the Fourmile Creek watershed on a consistent basis is paramount to ensure a positive reception from citizens, jurisdictions, and other stakeholder groups.

6.4.1 Task 1: Incentives Programs

A clear path and plan needs to be developed for dissemination of proposed strategies to potential adopters under existing funding mechanisms. There are many existing programs that can help to fund establishment or maintenance of a strategy, but there is a lack of clear understanding regarding how to navigate some of the funding mechanisms. If this information is shared with potential adopters, the rate of strategy implementation would increase.

Additional incentive programs need to be developed at a watershed and regional level to ensure the viability of practices being adopted and ultimately implemented on a wide scale. This will involve communication between jurisdictions within the watershed and the region to target and develop the types of incentive programs needed. This will also create a great opportunity for jurisdictions to provide pooled resources to maximize adoption of practices throughout the entire watershed and region.

6.4.2 Task 2: Designate Outdoor Teaching Facilities

As discussed in a previous section, early adopters and advocates for a given practice need to be secured as champions for this work. Within this assessment and search, the practices that they are adopting need to be investigated for possible outdoor teaching and tour sites. Many individuals or organizations with interest in a particular practice may be hesitant to implement it. They may be unsure of how to install and/or maintain a particular practice. Teaching and model implementation sites would allow these interested parties to tour a practice in the field and interact with one or more advocates regarding installation procedures and actual (rather than perceived) maintenance requirements. Figure 6-13 shows Summerbrook Park in Ankeny which has already been developed into an outdoor teaching facility.

Figure 6-13: Summerbrook Park in Ankeny - Outdoor Teaching Facility

6.4.3 Task 3: Best Management Practice Documentation

Documentation of the best management practices being implemented within the watershed is a critical element in the implementation strategy. The jurisdictions are already executing many practices and the documentation of all of these practices in the watershed will provide opportunities for additional advocacy, as well as assist with future funding opportunities. If homeowners, land owners, or business entities see that a practice is being adopted on a wide scale by their peers, this would provide an environment of increased interest in a particular practice and may provide increased implementation. Also, oftentimes this information is critical in the application for grant funding for additional practices.

6.4.4 Task 4: Habitat Assessment Methodology

An appropriate and consistent habitat assessment methodology needs to be identified and adopted throughout the watershed and the region. This will ensure that consistent habitat quality and quantity measurements are being implemented throughout the region in support of shared goals. If different levels of habitat quality are desired in each individual watershed, wildlife and other biological elements may thrive in an individual watershed, but will not thrive as readily throughout the region. High communication levels will need to be sustained during the creation and adoption of this methodology.

6.5 Goal 5: Work to Establish Consistent Regional Guidelines and Standards

Some of the biggest resistance from developers for the adoption of different strategies and practices stems from inconsistency of stormwater guidelines and standards between jurisdictions within a watershed. Maximum stakeholder implementation can be achieved by the adoption of consistent stormwater standards on a watershed or region wide basis.

6.5.1 Task 1: Policy Review

Successful stormwater management ordinances and other policies and standards throughout the watershed and the region should be reviewed by a WMA subcommittee for possible inconsistencies and synergies. Many of the model ordinances that should be reviewed can be found on the Iowa Storm Water Education Program's website (www.iowastormwater.org). The City of Coralville's Post-Construction Stormwater Ordinance is one example on the website that aligns well with the FCWMA's approach to a model ordinance. A few items that would be applicable to the Fourmile Creek Watershed include the stormwater standards, approval of stormwater management concept plan and final plan, and maintenance and repair of stormwater BMPs. Once this review is complete, a model ordinance tailored for the Fourmile Creek Watershed should be presented to the full FCWMA for comment. Once a final ordinance has been drafted, it should be shared with member jurisdictions for adoption.

6.5.2 Task 2: Regional Collaboration

Due to the nature of the jurisdictional boundaries in Central Iowa, coordination on a regional basis is critical to the overall success of the adoption of consistent policies. The establishment of other watershed management authorities in the region provides a great opportunity for communication on a regional level. The Fourmile Creek Watershed Management Authority is slightly ahead in the planning process and can use the work completed to date to create model ordinances and approaches that can assist in the planning process for others.

6.5.3 Task 3: Natural Resources Overlay District

A natural resources overlay district would assist in the planning of transportation and development projects throughout the watershed. The Tomorrow Plan, as prepared by the Des Moines Area Metropolitan Planning Organization, provides outlines and examples of information that would be included in a proposed overlay district. The FCWMA needs to discuss any and all information that they and other stakeholders would like to see in this very important planning tool. Examples include: floodplains, prairies, wetland sites, archeological assets, etc. Once this overlay district is established, it can be updated frequently as new information is acquired. It can then be used during long term planning exercises within the watershed to avoid issues and concerns before they even arise. Additionally, a potential developer could consult the overlay district information to plan what mitigation strategies they may use or need to use during their project.

6.6 Goal 6: Employ Performance Based Measures

Developing performance based measures will be dependent on existing and future monitoring data. Targeted practices have projected reductions, but have not been installed on a large scale within Iowa or the Fourmile Creek Watershed. Once a monitoring program is established and practices are adopted, more direct performance measures that are specific to each practice within the Fourmile Creek Watershed can be created.

6.6.1 Task 1: Monitoring Program to Modify Future Approach

While some monitoring data exists, adequate levels of monitoring data are lacking in the Fourmile Creek Watershed to target long-term management approaches for some pollutants. Once a monitoring program is established and the results are analyzed, this data should be used to guide and modify watershed management priorities. During this process, some strategies may be found to be more effective than others within this watershed. This overall plan and implementation strategy should be revisited as monitoring data warrant doing so.

6.6.2 Task 2: Constituent Reduction Emphasis

The two primary water quality constituents of concern mentioned in the monitoring goal section are bacteria and sediment. Practice implementation will prioritize reductions for these constituents first, and monitoring for other constituents will be assessed as funding is available.

6.6.3 Task 3: Secondary Constituent Reduction

Some of the strategies being targeted can yield multiple benefits throughout the watershed. However, practices will not be implemented according to the priorities presented in this plan if the sole purpose is to reduce constituents other than bacteria and sediment, depending on funding options and practice impact. For example, funding may be available for practice implementation to reduce the secondary constituents of nitrogen or phosphorus. If these practices would also reduce bacteria or sediment, funding would be assessed at that time.

6.6.4 Task 4: Consistent Regional Monitoring Protocols

Standard monitoring practices throughout the region would ensure consistent, high quality data to assess the effectiveness of implementing different practices. The stakeholder involvement process virtually ensures each watershed management plan will have different priorities, especially early in the implementation phase. This means that different practices will be implemented at different times and to different extents in each watershed. If a consistent monitoring protocol is used in each watershed that allows high quality data to be collected throughout the region, each watershed management authority can at least start the learning process for a particular practice before it is implemented in their watershed.

6.7 Goal 7: Identify and Implement Funding Alternatives

Funding of the implementation is a critical element of the overall success of the management plan. As jurisdictional funding abilities are limited, innovative methods of cultivating funding is required. This section targets funding alternatives that will assist in generating the funding required for implementation of the management plan.

6.7.1 Task 1: Pooled Resources

Many of the costs associated with the goal implementation have watershed wide benefits. Pooling resources on a project by project basis or as an annual appropriation will allow the costs for all the priorities to be shared more equitably among the jurisdictions. This pool could also be used as a grant match in cases where that is required. This shows that jurisdictions are invested in the plan elements and improves opportunities for funding. Examples where this would assist include funding for a monitoring program, streambank restoration program, and the hiring of a watershed coordinator.

6.7.2 Task 2: Legislative Funding

The state level funding of water quality initiatives is relatively small, as compared to the overall needs. Obtaining grant funding to address many of the elements of this plan, in a timely fashion, is unlikely. There is currently an opportunity within the State of Iowa to increase funding for water quality. If the state sales tax is increased, the first 3/8 of one cent will be allocated to the Natural Resources and Outdoor Recreation Trust Fund. This funding would not be solely for the purpose of water quality, but it would "move the needle" toward having a steady funding stream to watershed management authorities for water quality improvement within Iowa. Actively advocating for the sales tax increase will assist in making this funding stream a reality.

6.8 Goal 8: Establish Effective Means of Education and Communication

This goal has been broken up into three stakeholder groups that were targeted by the Working Group. Each stakeholder group needs to be approached in different ways to gain support for targeted strategies. Any similarities between these groups in either the education plan or the implementation plan should be used to build partnerships and efficiencies that will enable faster implementation of the recommendations in this plan.

6.8.1 Sub-Goal A: Reaching Agricultural and Rural Land Owners

This group consists of agricultural producers, mostly in the upper watershed, tenants, and rural land owners.

6.8.1.1 Task 1: Education Plan

The education plan for agriculture and rural land identifies the following key messages for this audience:

1. Resources – There are extensive existing informational and teaching resources to ensure that practices are implemented correctly. There are also existing financial resources that can be utilized to address cost concerns.

2. Concerns with Land – The strategies targeted in this watershed management plan will ensure that soil and nutrients will remain in the upper watershed. This supports sustainable land use practices and agricultural yield potentials in the near term and for the following generations.

3. Partnerships & Collaboration – Partnerships with other producers or land owners allows cost sharing and efficiency for the implementation of certain practices.

4. Range of Solutions – There are a range of solutions available to mitigate certain concerns. A "one size fits all" approach does not apply. Given a range of potentially

effective options, each land owner can find and decide upon which practice(s) they are most comfortable with for implementation.

5. Why to Care – What is the legacy you are leaving for the future generation of producers?

6. Opportunities for Partnership Using Existing Entities – Agencies and trade groups, such as the NRCS or the Iowa Soybean Association, already have the infrastructure for building partnerships with individuals or groups of producers.

6.8.1.2 Task 2: Implementation of Education Plan

The watershed coordinator would be the lead on implementing the education plan, i.e., reaching the agricultural and rural landowner audience with the key messages highlighted above. Tactics to employ for message delivery include:

1. Direct Mail
2. Informational Meetings
3. Focus Groups
4. Outreach via Agricultural Retail – USDA, SWCD, etc.
5. Field Days
6. Surveys
7. Website/Social Media
8. Workshops
9. Speaker Series
10. On Farm Learning Network

6.8.2 Sub-Goal B: City and County Officials

This group consists of city council members, county board members, and other civic officials.

6.8.2.1 Task 1: Education Plan

Brief descriptions of the education messages for delivery to this group are presented below.

1. Cost Savings with Potential Return on Investment – If policy changes, or even dollar investments on certain practices, are made now, the cost of future losses, maintenance, and repairs can be mitigated.

2. Impacts on Other Community Systems – Recognition and mitigation of flood and water quality issues can reduce the resource commitment required to address impacts to utility systems, transportation systems, and public health.

3. Community Collaboration Opportunities – Some practices provide opportunities for collaboration among different departments within a jurisdiction to ensure the most benefit for the community and its residents. There is also the possibility for talent collaboration with other jurisdictions on joint projects.

4. What is in the Water = Public Health – If the concentrations of contaminants entering Fourmile Creek are reduced, the public health of users of the creek and greenway system will be enhanced.

5. Cost Sharing and Grants – Projects that may span multiple jurisdictions or are located at the border of more than one jurisdiction, provide opportunities for cost sharing and to implement a practice that may not otherwise be executed.

6. WMA Education – Educate these individuals on what a WMA is and what it is not, how the WMA process works, and how it will ultimately benefit their community.

6.8.2.2 Task 2: Implementation of Education Plan

The watershed coordinator’s approaches for message delivery are listed below.

1. Work Sessions

2. Field Days

3. “Speed Dating” Sessions with Farmer, Elected Official, Developers, etc.

4. Tap Into Current Staff

5. Incentives to Try Practices on Their Own

6. Local Television/Media

7. Panel of Experts

6.8.3 Sub-Goal C: Developers and Business Community

6.8.3.1 Task 1: Education Plan

Brief descriptions of the education elements applicable to this group are presented below. In this instance, these elements present a mix of key messages and long term strategies. These elements will assist in establishing greater consistency in the ordinances/guidelines throughout the WMA jurisdictions.

1. Resources – There is extensive informational and teaching resources to ensure that practices are implemented correctly. Additionally, once consistency in implementation throughout the watershed is achieved, developers will enjoy an increased efficiency when navigating standards and submittals.

2. Potential to Streamline the Review Process – Consistent standards will assist with streamlining the review process.

3. Review of Current Policies – Reviewing current policies while getting the business community involved will educate this group, as well as give ownership and involvement to the overall process.

4. Public Health – Making a connection between the health of the waterways and overall public health will help make a connection to the public, which builds advocacy. The developer and business community will have this information to take into consideration as they move forward with developments.

5. Why Regulations Exist – Educate regarding the negative effects that would result if regulations did not exist. Visual representations will be the strongest with this group.

6. Demonstration Opportunities – If practices are implemented within the property, it allows the owner to demonstrate their practice and get recognition throughout the community.

7. Previous Studies – Educate regarding the positive outcomes of previous studies performed with certain practices.

8. Partnership Opportunities and Outreach to Clients – This will allow partnerships between businesses for shared costs and provide another avenue to connect with potential clients and customers.

9. Triple Bottom Line – The triple bottom line consists of three P's: profit, people and planet. Education on effective watershed management practices aims to demonstrate that the financial, social and environmental performance of the corporation can improve over a period of time.

6.8.3.2 Task 2: Implementation of Education Plan

Implementing the educational elements listed above should be done using the same types of techniques described in sections 6.8.1.2 and 6.8.2.2.

6.9 Schedule

Milestones and outcomes were applied to each task discussed above to develop the Implementation Schedule. See Appendix A for the complete schedule.

7. Implementation Plan Prioritization

The FCWMA met on January 29, 2015 to discuss the priorities of the Implementation Plan. Exercises were developed for the members of the WMA to determine their priorities in three categories: Funding Needs, Policy Modification, and Education/Communication. Every exercise presented each member in attendance with a list of the tasks and goals of the Implementation Plan and they were asked to anonymously rank them. The results are presented below.

Top Priorities List

Funding Needs

1. Hire Watershed Coordinator
2. Streambank Restoration (Fourmile)
3. Water Quality Monitoring
4. Fourmile Creek Greenway (Land Acquisition)
5. Streambank Restoration (Tributaries)

Policy Modification

1. Adopt Stormwater Management Manual
2. Fourmile Creek Greenway (Property Dedication/Preservation Requirements)
3. Develop Consistent Regional Water Quality Monitoring Protocols
4. Create Regional WMA Collaboration Committee
5. Review Central Iowa Jurisdiction Development Requirements for Consistency/Conflicts and Create Model Ordinance

Education/Communication

1. City and County Officials
    a. Updates on WMA activities
    b. Watershed impact education
2. Agricultural and Rural
    a. Updates on WMA activities
    b. Watershed impact education
3. Developers and Business Communities
    a. Watershed impact education
    b. Updates on WMA activities
    c. Review model ordinance
4. Identify Strategy Champions
5. Communication with Legislators on Water Quality

A collaboration discussion was conducted to get an overall top five ranking. The top five rank in descending order is as follows: Hire Watershed Coordinator, Water Quality Monitoring, Establish Greenway, Create Model Ordinance, and Streambank Restoration (Fourmile).

8. Funding Sources

The following list includes resources made available to implement a successful Watershed Management Plan. Due to being in the early stages of implementation, the sources of funding could vary.

- **Iowa Department of Agriculture and Land Stewardship (IDALS)**

  IDALS offers several grants for projects related to water quality and watershed improvements. They offer Development and Planning Assistance grants and support the Watershed Improvement Review Board, which awards grants to eligible applicants.

- **Iowa Department of Natural Resources (IDNR)**

  The IDNR provides technical and financial assistance to eligible applicants. They offer grants for developing and implementing Watershed Management Plans, such as Section 319 grants, Land and Water Conservation Fund, and Resource Enhancement and Protection (REAP) funding. The IDNR is also one of the supervisors of the Clean Water State Revolving Fund, along with other state loan programs, including the Storm Water Loan Program and the Water Resource Restoration Sponsored Projects Program. The IDNR also facilitates IOWATER volunteer services to provide monitoring data on Fourmile Creek.

- **Iowa Economic Development Authority**

  The Iowa Economic Development Authority offers financial assistance through Vision Iowa and Community Development Block Grants, which can be used for water and sewer facilities.

- **Non-Governmental Organizations (NGOs)**

  NGOs are organizations that are neither a part of a for-profit business nor a government entity. They may be funded in a variety of ways and can offer their services and/or funding to organizations. Some examples include Ducks Unlimited, Keep Iowa Beautiful, Pheasants Forever, and Trees Forever.

- **Private Donors**

  Private donations will provide financial assistance to any projects related to the Fourmile Creek Watershed.

- **United States Army Corps of Engineers (USACE)**

  The USACE provides technical and financial assistance on wetland, stream bank stabilization, and certain watershed projects.

- **United States Environmental Protection Agency (USEPA)**

  The USEPA leads Clean Water Act related initiatives and offers grants and support for projects related to solving environmental problems. Examples of these grants include Environmental Education Sub-Grants, Environmental Justice Grants, and Urban Waters.

- **United States Department of Agriculture (USDA)**

  The USDA offers technical and financial assistance to both the rural and urban land uses for implementing conservation practices related to water, soil, and wildlife.

- **WMA/Jurisdictions**

  Each jurisdiction that is a member of the FCWMA will provide funding, as needed for each project, and the funding will be allocated appropriately. This funding can be sourced from stormwater utilities, public works funds, etc.

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Appendix A: Implementation Schedule

Goal/Task	Milestone	Desired Outcome	Phase 1 1 to 5 Years	Phase 1 Cost	Phase 2 6 to 10 Years	Phase 2 Cost	Phase 3 11 to 20 Years	Phase 3 Cost	Funding Source	Responsible Party
Goal 1: Monitor for Success										
Task 1: Monthly sampling at 12 Locations	Operational monitoring program	Total Suspended Solids , Nitrate+Nitrite as N , Total Phosphate as P, DO, Chloride, pH, Temperature	Designate record keeper, investigate continuous monitoring at sites	N/A	Continue implementation of monitoring program	N/A	Continue implementation of monitoring program	N/A	WMA Members, Grants, Donors, Agriculture Group Partnering	Polk County Conservation
Task 2: Tri-annual Biological Assessment	Biological Assessment completed in May, July, & September at each monitoring location	Watershed Coordinate coordinate with Polk County Conservation	Assessment every May, July, & September	N/A	Assessment every May, July, & September	N/A	Assessment every May, July, & September	N/A	N/A	Polk County Conservation
Goal 2A: Engage Rural & Urban Partners										
Task 1: Ensure Implementation Throughout Watershed	Designate Watershed Coordinator	Hire full-time employee to oversee implementation plan.	Develop 28E for Funding split, Hire Coordinator	$50,000/yr plus benefits	Maintain full-time employee	$60,000/yr plus benefits	Maintain full-time employee	$70,000/yr plus benefits	WMA, Grants, Donors, Agriculture Group Partnering	WMA/Jurisdictions
Task 2: Identify Strategy Champions	Identify Champion for each of the 8 Goals	To ensure efficient and sustained implementation of management plan	Create an organization of champions for each goal.	N/A	Maintain List or designate new as needed	N/A	Maintain List or designate new as needed	N/A	N/A	WMA/Jurisdictions
Task 3: Wetland Mitigation Bank	Establish wetland banking sites	Reduce sediment transport, bacteria, up to 52% reduction in N, up to 85% reduction in P for the portion of watershed upstream of wetland site	Complete site assessments to determine sites, Complete Corps permitting, set mitigation cost	$100,000	1 - 50 ac wetland site	$2,000,000	1 - 50 ac wetland site	$2,500,000	Initially: WMA, Grants, Donors, Agriculture Group Partnering, Long Term: Wetland Banking Fees, Long Term Maintenance: Jurisdictions/Polk County Conservation	WMA/Jurisdictions
Task 4: Native Prairie Plantings	Establish or require 100 acres of native plantings	Create promotional material on native plantings, watershed coordinator & jurisdictions work with owners to integrate into properties and crops. Surface reduction of sediment (95%), P (90%), N (84%) from treated fields.	10 acres	$10,000	20 acres	$20,000	70 acres	$70,000	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	STRIPS Program - Jennifer Welch
Task 5A: Streambank Restoration (Fourmile Creek)	Restore/Stabilize (see report) priority stream miles of the main channel (approx 10 miles)	Reduction of sediment loading by 0.25 ton/year/ft of channel. Total for 10 miles = 11,000-12,000 ton/year	5 stream miles	$5,000,000 (estimate for rural - both banks)	5 stream miles	$5,000,000 (estimate for rural - both banks)	Reassess need	$30,000	WMA, Grants, Donors, Agriculture Group Partnering, Developers	WMA/Jurisdictions
Task 5B: Streambank Restoration (Tributaries)	Restore/Stabilize priority stream miles of tributary channels (approx 10 miles)	Reduction of sediment loading by 0.25 ton/year/ft of channel. Total for 10 miles = 11,000-12,000 ton/year	2 stream miles	$2,000,000 (estimate for rural - both banks)	2 stream miles	$2,000,000 (estimate for rural - both banks)	6 stream miles	$6,000,000 (estimate for rural - both banks)	WMA, Grants, Donors, Agriculture Group Partnering, Developers	WMA/Jurisdictions
Task 6A: Bacteria Sources	Investigate and inspect systems to locate source problems thoughout watershed.	100% reduction of bacteria from those systems, Develop GIS Database, Coordinate Education Meetings with Sanitarian Trainings, Test for caffeine to determine human vs. animal.	25 inspections per year. Start GIS Database.	Owner	25 inspections per year.	Owner	25 inspections per year.	Owner	Owner, Iowa DNR, Polk County	Polk County
Task 6B: Bacteria Sources	Reduce bacteria input from pasture land. Offer incentive to 3 landowners for creating and implementing conservation plans.	100% reduction of bacteria from this source	3 property owners (125 acres)	$9,000/year	3 property owners (125 acres)	$9,000/year	3 property owners (125 acres)	$9,000/year	Cost Share: WMA, Grants, Donors, Agriculture Group Partnering	WMA/Jurisdictions
Goal 2B: Engage Urban Partners - Note: Regional Coordinator Needed										
Task 1: Stormwater management requirements	100% Adoption	All eligible jurisdictions adopt stormwater management requirements	100% of Jurisdictions adopt	No funding needed	N/A	N/A	N/A	N/A	N/A	WMA/Jurisdictions
Task 2: Require infiltration of water quality volume	100% Adoption	Up to 100% sediment reduction: filter bacteria, phosphorus, and hydrocarbons	50% Jurisdictions Adopt	No funding needed	25% Jurisdictions Adopt	No funding needed	25% Jurisdictions Adopt	No funding needed	N/A	WMA/Jurisdictions
Task 3: Require extended detention of channel protection volume	100% Adoption	Reduction of channel erosion, increased filtration and infiltration	50% Jurisdictions Adopt	No funding needed	25% Jurisdictions Adopt	No funding needed	25% Jurisdictions Adopt	No funding needed	N/A	WMA/Jurisdictions
Task 4: Install/Retrofit for green street strategies	10,000 Linear Feet of permeable pavers, back of curb infiltration, etc.	Coordinate with MPO on Tomorrow Plan, Reduction of channel erosion and urban sediment transport	1,000 linear feet	$100,000	4,000 linear feet	$450,000	5,000 linear feet	$550,000	Implementation Grants/Jurisdictions/SW Utility/Streetscape Funding	WMA/Jurisdictions
Task 5: Prairie pothole preservation during development	100 ac-ft	Up to 100% sediment reduction: Mitigate flooding, channel erosion, and increase infiltration	20 ac-ft	No funding needed	30 ac-ft	No funding needed	50 ac-ft	No funding needed	N/A	WMA/Jurisdictions
Task 6: Regional detention	600 ac-ft total detention from regional projects	Reduce flooding more effectively, reduce maintenance costs, recreational opportunities	200 ac-ft of storage	$4,000,000	200 ac-ft of storage	$4,000,000	200 ac-ft of storage	$4,000,000	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Goal 2C: Engage Rural Partners - Note: Regional Coordinator Needed										
Task 1A: Cover Crops	7,000 acres (10% of watershed)	Reduction in sediment transport, up to 31% N reduction, up to 31% reduction in P on treated fields.	2,000 acres	$60,000/yr	2,000 acres	add'l $60,000/yr	3,000 acres	add'l $90,000/yr	USDA/Implementation Grants/Jurisdictions/State/Land Owners	WMA/Jurisdictions
Task 1B: Grassed waterways	10 stream miles	Reduction in sediment transport, up to 43% N reduction, up to 58% reduction in P on treated fields.	2.5 stream miles	$15,000	2.5 stream miles	$15,000	5 stream miles	$30,000	USDA/Implementation Grants/Jurisdictions/State/Land Owners	WMA/Jurisdictions
Task 1C: Stream Buffers	10 stream miles (50 ft on each side)	Reduction in sediment transport, up to 43% N reduction, up to 58% reduction in P on treated stream segements.	2.5 stream miles	$30,000	2.5 stream miles	$30,000	5 stream miles	$60,000	USDA/Implementation Grants/Jurisdictions/State/Land Owners	WMA/Jurisdictions
Task 2A: Strip Tillage	Reduce Conventional tillage to strip till by 25% (2500 acres) in corn	Reduction in sediment transport, up to 33% reduction in P compared to chisel plow on affected field.	625 acres	Owner Adoption	625 acres	Owner Adoption	1250 acres	Owner Adoption	UDSA, PSWCD, WMA education	WMA/Jurisdictions

Goal/Task	Milestone	Desired Outcome	Phase 1 1 to 5 Years	Phase 1 Cost	Phase 2 6 to 10 Years	Phase 2 Cost	Phase 3 11 to 20 Years	Phase 3 Cost	Funding Source	Responsible Party
Task 2B: No Tillage	Increase no till by 10% (250 acres) in soybeans	Reduction in sediment transport, up to 90% reduction in P compared to chisel plow on affected field.	50 acres	Owner Adoption	50 acres	Owner Adoption	150 acres	Owner Adoption	UDSA, PSWCD, WMA education	WMA/Jurisdictions
Task 3: Edge of Field/Tile Treatments	Install bioreactors, saturated buffers, etc. at 100 (or 10%) of outlets	Reduction in sediment transport, up to 52% N reduction, up to 85% reduction in P upstream of treatment.	20 outlets	$200,000	20 outlets	$200,000	60 outlets	$600,000	USDA/Implementation Grants/Jurisdictions/State/Land Owners	WMA/Jurisdictions
Goal 3: Adopt a Greenway System										
Task 1: Main Channel Greenway	Reserve the 0.2% Floodplain (500 Year), Purchase, easement, or dedication	Stream stability, reduce streambank erosion, flood loss mitigation, habitat restoration	0.2% floodplain on 12.5% of area	$9M if all land has to be purchased (Approx. 450 acres at $20K/ac)	0.2% floodplain on 12.5% of area	$9M if all land has to be purchased (Approx. 450 acres at $20K/ac)	0.2% floodplain on 25% of area	$18M if all land has to be purchased (Approx. 900 acres at $20K/ac)	When needed: WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Task 2: Tributary Greenway Network	Reserve the 0.2% Floodplain (500 Year) on main tributaries, Purchase or dedication	Stream stability, reduce streambank erosion, flood loss mitigation, habitat restoration	Map 0.2% Floodplain on large tributaries up to 1 sq mi. of drainage area	$100,000	Reserve 0.2% floodplain on 20% of main tributary area	$5M if all land has to be purchased (Approx. 250 acres at $20K/ac)	Reserve 0.2% floodplain on 20% of main tributary area	$5M if all land has to be purchased (Approx. 250 acres at $20K/ac)	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Task 3: Stream Corridor	Continue to buy parcels located in the mapped floodplain	Stream stability, reduce streambank erosion, flood loss mitigation, habitat restoration	Purchase properties as funding is available and owners are willing	$3,500,000 (Approx. 20 properties)	Purchase properties as funding is available and owners are willing	$3,500,000 (Approx. 20 properties)	Purchase properties as funding is available and owners are willing	$7,000,000 (Approx. 40 properties)	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Goal 4: Promote Consistent Implementation										
Task 1: Develop Incentives Programs	Enhance or provide incentives programs at $50,000/yr	Approve incentives for best management practices with an emphasis on Total Suspended Solids and Bacteria reductions.	Incentives Program - reduce TSS and bacteria by depending on practices employed	$50,000/yr	Incentives Program - reduce TSS and bacteria by depending on practices employed	$50,000/yr	Incentives Program - reduce TSS and bacteria by depending on practices employed	$50,000/yr	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Task 2: Designate Outdoor Teaching Facilities	Designate Outdoor Teaching Facilities for all 8 Goals	Coordinate outdoor teaching facilities with goal champions so potential adopters can see practices in action	8 outdoor facilities	N/A	Revisit teaching facilities every year for removal or additions	N/A	Revisit teaching facilities every year for removal or additions	N/A	N/A	Goal Champions
Task 3: Best Management Practice Documentation	Develop BMP Database	Publish BMP practices on Fourmile Creek Watershed website	Develop database and publish	$10,000, $3,000/yr maintenance	Database monitoring and maintenance	$3,000/yr	Database monitoring and maintenance	$3,000/yr	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Task 4: Habitat Assessment Methodology	Habitat Assessment Methodology for Fourmile Creek	Align and coordinate Fourmile Creek Habitat Assessment methodology with regional & state standards	Develop Habitat Assessment Methodology for Fourmile Creek	N/A	Revisit Habitat Assessment Methodology for Fourmile Creek for new priorities and monitoring data	N/A	Revisit Habitat Assessment Methodology for Fourmile Creek for new priorities and monitoring data	N/A	N/A	WMA/Jurisdictions
Goal 5: Work to Establish Consistent Regional Guidelines and Standards - Coordinate with Goal 2B Elements										
Task 1: Existing Policy Review	Existing policy summary from the region.	This will be used to ensure consistent policy building throughout the region	Complete policy review, ordinance adoption	N/A	Adjust policies as neded	N/A	Adjust policies as neded	N/A	N/A	WMA/Jurisdictions
Task 2: Regional Collaboration Mechanism	Regional WMA Collaboration Committee	This will be used to ensure consistent implementation throughout the region	Establish Regional WMA Collaboration Committee	N/A	Maintain Regional WMA Collaboration Committee	N/A	Maintain Regional WMA Collaboration Committee	N/A	N/A	WMA/Jurisdictions
Task 3: Natural Resources Overlay District	Natural Resources Overlay District for Planning Purposes	This will be used to ensure consistent implementation throughout the region	N/A	N/A	Establish Natural Resources Overlay District	$50,000	N/A	N/A	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Goal 6: Employ Performance Based Measures										
Task 1: Modify Approach based on Monitoring Data	Revised Watershed Plan	To ensure the practices being implemented throughout the watershed are meeting goals	N/A	N/A	Modify Management Plan based on monitoring data	$40,000	2nd & 3rd Modifications to Management Plan based on monitoring data	$80,000	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Task 2: Constituent Reduction Emphasis	Prioritize practices that will reduce sediment and bacteria	This will ensure Fourmile Creek is not impaired based on designated use	N/A	N/A	N/A	N/A	N/A	N/A	N/A	WMA/Jurisdictions
Task 3: Secondary Reduction Emphasis	If funding is advantageous, target practices that will reduce N and P	This will allow the priority constituents to be reduced and go above and beyond the main mission	N/A	N/A	N/A	N/A	N/A	N/A	N/A	WMA/Jurisdictions
Task 4: Consistent Regional Monitoring Protocols	Monitoring Protocol for Fourmile Creek	Align and coordinate Fourmile Creek monitoring protocol with regional & state standards	Develop Monitoring Protocol for Fourmile Creek	N/A	Revisit Monitoring Protocol for Fourmile Creek for new priorities and monitoring data	N/A	Revisit Monitoring Protocol for Fourmile Creek for new priorities and monitoring data	N/A	N/A	WMA/Jurisdictions
Goal 7: Identify and Implement Funding Alternatives										
Task 1: Pooled Resources	Enhance or provide pooled resources for WMA.	Utilize pooled resources for implementing priority tasks	Pooled Resources	As available	Pooled Resources	As available	Pooled Resources	As available	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions

Goal/Task	Milestone	Desired Outcome	Phase 1 1 to 5 Years	Phase 1 Cost	Phase 2 6 to 10 Years	Phase 2 Cost	Phase 3 11 to 20 Years	Phase 3 Cost	Funding Source	Responsible Party
Task 2: Legislative Funding	State Land & Water Legacy Funding	Develop alternative funding sources for priority projects.	Legislative direct mail campaign, Capital Visit Day	$1,000/yr	Reassess need	N/A	Reassess need	N/A	N/A	WMA/Jurisdictions
Goal 8A: Establish Effective Means of Education and Communication with Agriculture and Rural Land Owners and Tenants										
Task 1: Education Plan	Education Plan	Inform watershed residents of the WMA, its plan, and ways they can contribute.	Develop tailored education plan	N/A	Refine education plan based on feedback, new priorities, and monitoring data	N/A	Refine education plan based on feedback, new priorities, and monitoring data	N/A	N/A	WMA/Jurisdictions
Task 2A: Implementation	Direct Mail Campaign	Inform watershed residents of the WMA, its plan, and ways they can contribute.	Direct mail campaign for 1 practice a year	$5,000/yr	Direct mail campaign for 1 practice a year	$5,000/yr	Direct mail campaign for 1 practice a year	$5,000/yr	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Task 2B: Implementation	Information Meetings	Inform watershed residents of the WMA, its plan, and ways they can contribute.	1 information meeting per year	$1,000/yr	1 information meeting per year	$1,000/yr	1 information meeting per year	$1,000/yr	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Task 2C: Implementation	Focus Groups	Inform watershed residents of the WMA, its plan, and ways they can contribute.	1 focus group meeting every year	$1,000/yr	1 focus group meeting every year	$1,000/yr	1 focus group meeting every year	$1,000/yr	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Task 2D: Implementation	Agricultural Retail Outreach	Inform watershed residents of the WMA, its plan, and ways they can contribute.	Provide information from direct mail campaign at this locations	$500/yr	Provide information from direct mail campaign at this locations	$500/yr	Provide information from direct mail campaign at this locations	$500/yr	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Task 2E: Implementation	Field Days	Inform watershed residents of the WMA, its plan, and ways they can contribute.	1 Ag Field Day per year	$500/yr	1 Ag Field Day per year	$500/yr	1 Ag Field Day per year	$500/yr	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Task 2F: Implementation	Surveys	Inform watershed residents of the WMA, its plan, and ways they can contribute.	1 online survey per year	$1,000/yr	1 online survey per year	$1,000/yr	1 online survey per year	$1,000/yr	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Task 2G: Implementation	Website	Inform watershed residents of the WMA, its plan, and ways they can contribute.	Enhance website presence	$20,000, $5,000/yr maintenance	Website maintenance	$5,000/yr	Website maintenance	$5,000/yr	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Task 2H: Implementation	Workshops	Inform watershed residents of the WMA, its plan, and ways they can contribute.	1 practitioner type workshop per year	$1,000/yr	1 practitioner type workshop per year	$1,000/yr	1 practitioner type workshop per year	$1,000/yr	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Task 2I: Implementation	Speaker Series	Inform watershed residents of the WMA, its plan, and ways they can contribute.	Speakers in conjunction with one of the other activities (Field Days, Workshops, etc.)	N/A	Speakers in conjunction with one of the other activities (Field Days, Workshops, etc.)	N/A	Speakers in conjunction with one of the other activities (Field Days, Workshops, etc.)	N/A	N/A	WMA/Jurisdictions
Task 2J: Implementation	On Farm Learning Network	Inform watershed residents of the WMA, its plan, and ways they can contribute.	Develop a network of farms as learning farms for potential adopters	N/A	Revisit network of farms to remove or add	N/A	Revisit network of farms to remove or add	N/A	N/A	WMA/Jurisdictions
Goal 8B: Establish Effective Means of Education and Communication with City and County Officials										
Task 1: Education Plan	Education Plan	Inform watershed residents of the WMA, its plan, and ways they can contribute.	Develop tailored education plan	N/A	Refine education plan based on feedback, new priorities, and monitoring data	N/A	Refine education plan based on feedback, new priorities, and monitoring data	N/A	N/A	WMA/Jurisdictions
Task 2A: Implementation	Work Sessions	Inform watershed residents of the WMA, its plan, and ways they can contribute.	Visit council and board work sessions to educate and inform	N/A	Visit council and board work sessions to educate and inform	N/A	Visit council and board work sessions to educate and inform	N/A	N/A	WMA/Jurisdictions
Task 2B: Implementation	Field Days	Inform watershed residents of the WMA, its plan, and ways they can contribute.	1 Urban Field Day per year	$500/yr	1 Urban Field Day per year	$500/yr	1 Urban Field Day per year	$500/yr	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Task 2C: Implementation	"Speed Dating" Sessions	Inform watershed residents of the WMA, its plan, and ways they can contribute.	1 Session every 5 years	$500	1 Session every 5 years	$500	1 Session every 5 years	$1,000	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Task 2E: Implementation	Current Staff Utilization	Inform watershed residents of the WMA, its plan, and ways they can contribute.	WMA members should establish relationships with officials	N/A	WMA members should establish relationships with officials as they turn over	N/A	WMA members should establish relationships with officials as they turn over	N/A	N/A	WMA/Jurisdictions
Task 2F: Implementation	Incentives for officials to implement practices personally	This will give the indivduals a chance to try practices and personally promote them	Incentives program of $10,000 over a 5 year period	$10,000	Incentives program of $10,000 over a 5 year period	$10,000	Incentives program of $10,000 over a 5 year period	$20,000	WMA, Grants, Donors, Agriculture Group Partnering, Property Owners	WMA/Jurisdictions
Task 2G: Implementation	Local Media/TV	To promote accomplishments in a light worthy for a human interest story for media realtions	1 Feature every 2 years	N/A	1 Feature every 2 years	N/A	1 Feature every 2 years	N/A	N/A	WMA/Jurisdictions
Task 2H: Implementation	Panel of Experts	Experts to guide and inform from the field regarding the effectiveness of practices.	Coordinate with work session, field day, and "Speed Dating" tasks	N/A	Coordinate with work session, field day, and "Speed Dating" tasks	N/A	Coordinate with work session, field day, and "Speed Dating" tasks	N/A	N/A	WMA/Jurisdictions
Goal 8C: Establish Effective Means of Education and Communication with Developers and Business Community										
Task 1: Education Plan	Education Plan	Inform watershed residents of the WMA, its plan, and ways they can contribute.	Develop tailored education plan	N/A	Refine education plan based on feedback, new priorities, and monitoring data	N/A	Refine education plan based on feedback, new priorities, and monitoring data	N/A	N/A	WMA/Jurisdictions
Task 2: Implementation	Consult Previous Implementation Tasks	Consult Previous Implementation Tasks	N/A	N/A	N/A	N/A	N/A	N/A	N/A	WMA/Jurisdictions
ESTIMATED COST										
Total Estimated Cost				$26,034,000		$32,509,000		$43,679,000		
Average Cost Per Year - By Phase				$5,206,800		$6,501,800		$4,367,900		
Average Cost Per Year - Entire Plan								$5,111,100		

Appendix B: Fourmile Creek Watershed Management Authority Chapter 28E Agreement

Matt Schultz
Secretary of State
State of Iowa

28E Agreement

FOR OFFICE USE ONLY:

FILED

M505489

9/24/2012 9:03:13 AM

PLEASE READ INSTRUCTIONS ON BACK BEFORE COMPLETING THIS FORM

Item 1. The full legal name, organization type and county of each participant to this agreement are:

	Full Legal Name	Organization Type	*County
Party 1	Polk County	County	Polk
Party 2	Various	Other	Other
Party 3			
Party 4			
Party 5			

Enter "Other" if not in Iowa

Item 2. The type of Public Service included in this agreement is: 310 (Code Number) Water System (Service Description)
(Enter only one Service Code and Description)

Item 3. The purpose of this agreement is: *(please be specific)*
Fourmile Creek Watershed Management Authority 28E with
Story County, Boone County, Ankeny, Des Moines, Pleasant Hill, Altoona, Bondurant, Slater, Alleman, Elkhart, Sheldahl, Story Boone & Polk County Soil & Water Conservation

Item 4. The duration of this agreement is: *(check one)* ☐ Agreement Expires ____________ [mm/dd/yyyy] ☑ Indefinite Duration

Item 5. Does this agreement amend or renew an existing agreement? *(check one)*
☑ **NO**
☐ **YES** Filing # of the agreement: ____________
(Use the filing number of the most recent version filed for this agreement)
The filing number of the agreement may be found by searching the 28E database at: www.sos.state.ia.us/28E.

Item 6. Attach two copies of the agreement to this form if not filing online.

Item 7. The primary contact for further information regarding this agreement is: *(optional)*

LAST Name Rice **FIRST** Name Robert

Title ____________ Department ____________

Email ____________ Phone 286-3705

Doc ID: 026463770028 Type: GEN
Kind: 28E AGREEMENT
Recorded: 09/21/2012 at 03:13:55 PM
Fee Amt: $0.00 Page 1 of 28
Revenue Tax: $0.00
Polk County Iowa
JULIE M. HAGGERTY RECORDER
File# 2013-00027505
BK 14451 PG 225-252

Preparer
Information: N/A

Individual Name	Address	City	Phone

Address Tax
Statement: N/A

Name	Address	City	Zip

RETURN TO:

Return to: **After Recording Return to:**
Becky Dewey, Auditor's Office

Description: **Fourmile Creek Watershed Management Authority Agreement between Polk County, Story County, Boone County, Cities of Ankeny, Des Moines, Pleasant Hill, Altoona, Bondurant, Slater, Alleman, Elkhart, Sheldahl, Story County Soil & Water Conservation, Boone County Soil & Water Conservation, Polk County Soil & Water Conservation**

Julie Haggerty
Polk County Recorder
111 Court Ave, Room 250
Des Moines IA 50309-2251

Fourmile Creek Watershed Management Authority Agreement
Between Polk County, Story County, Boone County, City of Ankeny, City of Des Moines, City of Pleasant Hill, City of Altoona, City of Bondurant, City of Slater, City of Alleman, City of Elkhart, City of Sheldahl, Story County Soil and Water Conservation, Boone County Soil and Water Conservation District, and
Polk County Soil and Water Conservation District.

This Joint and Cooperative Agreement (hereinafter referred to as the "Agreement") is entered into pursuant to the authority of the *Code of Iowa*, Chapter 28E on this day of , 2012 by and between Story County, Iowa; Boone County, Iowa; Polk County, Iowa; the City of Ankeny Iowa; the City of Des Moines, Iowa; the City of Pleasant Hill, Iowa; the City of Alleman, Iowa; the City of Slater, Iowa; the City of Bondurant, Iowa; the City of Altoona, Iowa; the City of Elkhart, Iowa; the City of Sheldahl, Iowa; the Story County Soil and Water Conservation District; the Boone County Soil and Water Conservation District; and the Polk County Soil and Water Conservation District. All entities shall be referred to hereinafter as the Parties.

WHEREAS, Iowa Code section 466B of the *Code of Iowa* authorizes two (2) or more political subdivisions, defined as including cities, counties and/or soil and water conservation districts, all of which must be located within the same United States Geological Survey Hydrologic Unit Code 10 watershed, to enter into agreement under Chapter 28E of the *Code of Iowa* to establish a watershed management authority to enable cooperation in supporting watershed planning and improvements for the mutual advantage of the political subdivisions involved; and

WHEREAS, pursuant to *Code of Iowa* Section 466B.22, a watershed management authority may perform all of the following duties:

1. Assess the flood risks in the watershed.
2. Assess the water quality in the watershed.
3. Assess options for reducing flood risk and improving water quality in the watershed.
4. Monitor federal flood risk planning and activities.
5. Educate residents of the watershed area regarding water quality and flood risks.
6. Seek and allocate moneys made available to the Authority for purposes of water quality and flood mitigation.
7. Make and enter into contracts and agreements and execute all instruments necessary or incidental to the performance of the duties of the Authority; and;

WHEREAS, the Parties deem establishment of the Fourmile Creek Watershed Management Authority (hereinafter referred to as the "Authority"), a watershed management authority encompassing all of the Fourmile Creek watershed, a Hydrologic Unit Code 10 (HUC 10) watershed, to be of mutual advantage; and

WHEREAS, it is mutually desired to enter into this Agreement pursuant to *Code of Iowa* Chapter 28E for the purpose of establishing the Authority to carry out watershed planning and improvements in the Fourmile Creek Watershed.

NOW THEREFORE, it is agreed by and between the parties as follows:

SECTION 1. IDENTITY OF THE PARTIES.

1.1 The Counties of Polk, Story, and Boone are each a municipality of the State of Iowa, organized and operating pursuant to *Code of Iowa* Chapter 331. Their respective addresses are:

Polk County
111 Court Avenue
Des Moines, Iowa 50309

Story County
900 Sixth Street
Nevada, Iowa 50201

Boone County
201 State Street
Boone, Iowa 50036

1.2 The Cities of Ankeny, Des Moines, Pleasant Hill, Altoona, Bondurant, Slater, Alleman, Sheldahl, and Elkhart are each a municipality of the State of Iowa, organized and operating pursuant to *Code of Iowa* Chapters 364 and 372. Their respective addresses are:

City of Ankeny
410 W. 1st Street
Ankeny, Iowa 50023

City of Des Moines
400 Robert D. Ray Drive
Des Moines, Iowa 50309

City of Pleasant Hill
5160 Maple Drive, Suite A
Pleasant Hill, Iowa 50327

City of Altoona
407 8th Street SE
Altoona, Iowa 50009

City of Bondurant
200 2nd Street NE
P.O. Box 37
Bondurant, Iowa 50035

City of Slater
101 Story Street
P. O. Box 538
Slater, Iowa 50244-0538

City of Alleman
14000 NE 6th Street
P.O. Box 86
Alleman, Iowa 50007

City of Elkhart
260 NW Main Street
P.O. Box 77
Elkhart, Iowa 50073

City of Sheldahl
803 2nd Avenue
Sheldahl, Iowa 50243

1.3 The Soil and Water Conservation Districts of Polk, Story, and Boone are each a governmental division of the State of Iowa as defined in *Code of Iowa* Section 161A.3(6) and a soil and water conservation district established pursuant to *Code of Iowa* Section 161A.5(1). Their respective addresses are:

Polk County SWCD
1513 North Ankeny Blvd. Suite 3
Ankeny, Iowa 50023-4167

Story County SWCD
510 South 11th Street
Nevada, Iowa 50201

Boone County SWCD
1602 Snedden Drive
Boone, Iowa 50036

SECTION 2. FOURMILE CREEK WATERSHED BOUNDARY.

The area within this Agreement shall be known as the Fourmile Creek Watershed Boundary. This Boundary is shown in Attachment A.

SECTION 3. PURPOSE.

3.1 The purpose of this Agreement is to provide for the manner in which the parties shall cooperate with one another to successfully encourage, plan for, and implement watershed activities within the Fourmile Creek watershed, including but not limited to the following activities authorized pursuant to *Code of Iowa* Section 466B.22:

3.1.1 Assess the flood risks in the watershed.

3.1.2 Assess the water quality in the watershed.

3.1.3 Assess options for reducing flood risk and improving water quality in the watershed.

3.1.4 Monitor federal flood risk planning and activities.

3.1.5 Educate residents of the watershed area regarding water quality and flood risks.

3.1.6 Seek and allocate moneys made available to the Authority for purposes of water quality and flood mitigation.

3.1.7 Make and enter into contracts and agreements and execute all instruments necessary or incidental to the performance of the duties of the Authority. The Authority shall not have the power to acquire property by eminent domain. All interests in lands shall be held in the name of the Party wherein said lands are located.

SECTION 4. GOVERNANCE.

4.1 It is the intention of this Agreement the inherent governmental powers of any Party not be affected in any way beyond the terms of this Agreement.

4.2 A joint board of the Parties known as the Fourmile Creek Watershed Management Authority Board (herein after referred to as the "Board") shall be responsible for coordinating watershed planning and improvements. The Board shall be comprised of one appointee from each county, city, and district participating in this Agreement.

4.3 The Board shall comply with the Open Meeting Law (Iowa Code Chapter 21), Open Records Law (Iowa Code Chapter 22) and gender balance requirements (Iowa Code Section 69.16A).

4.4 Once established, the Board will develop governing bylaws.

SECTION 5. DURATION.

This Agreement shall be in effect in perpetuity until terminated pursuant to Section 12.

SECTION 6. POWERS AND DUTIES.

6.1 The parties to this Agreement shall retain all powers and duties conferred by law but shall work together in the exercise of such powers and the performance of this Agreement. These powers shall not be transferred to the Watershed Management Authority. Each party shall be responsible for:

6.1.1 identifying opportunities for funding and in-kind support for the undertaking of watershed planning and improvements within the Fourmile Creek watershed boundary;

6.1.2 identifying opportunities for infrastructure development and planning capable of assessing and mitigating flood risks in the watershed;

6.1.3 identifying the most effective best management practices for water quantity and water quality improvements in the watershed;

6.1.4 participating in educational/outreach programs regarding water quality and flood risks;

6.1.5 identifying opportunities for infrastructure development and planning to assess and mitigate water quality in the watershed;

6.1.6 providing support for the administration of any projects, including technical, financial and clerical, as agreed to by the Parties;

6.1.7 securing such financing, including grants, loans and the issuance of bonds of loan agreements, as determined by the respective party to be necessary or desirable to achieve the objectives of the agreement;

6.1.8 designing and bidding of projects;

6.1.9 administering contracts; and

6.1.10 observing construction.

SECTION 7. MANNER OF FINANCING.

7.1 The Board may solicit, accept and receive donations, endowments, gifts, grants, reimbursements and other such funds as necessary to support work pursuant to this Agreement. It is agreed and understood by the parties hereto that no financial obligations upon any party are intended to be created hereby.

7.2 No action to contribute funds by a Board member of the Authority is binding on the Party that he or she represents without official approval by the governing body of that Party. No Party may be required to contribute funds to the Authority.

7.3 The Board will review each opportunity for funding or in-kind support. After review of the opportunity, a fiscal agent will be nominated. The fiscal agent would be a Party or other organization meeting the fiscal agent standards outlined in the bylaws.

7.4 All funds received for use by the Authority shall be held in a special fund by one of the Parties who shall act the fiscal agent, pursuant to a written Fiscal Agent Agreement between the fiscal agent and the Authority. When funds are provided as a grant or loan directed to a Party of the Authority for a project administered by that Party, the funds shall be retained and administered by that Party.

SECTION 8. SEVERABILITY/INVALIDITY.

If any term, provision or condition of this Agreement shall be determined to be invalid by a court of law, such invalidity shall in no way effect the validity of any other term, provision or condition of this Agreement, and the remainder of the Agreement shall survive in full force and effect unless to do so would substantially impair the rights and obligations of the Parties to this Agreement or substantially frustrate the attainment of the purposes of this Agreement.

SECTION 9. GOVERNING LAW.

This Agreement shall by governed by and interpreted under the laws of the State of Iowa.

SECTION 10. AMENDMENTS.

10.1 This Agreement may be amended at any time by the Parties. All amendments shall be in writing, signed by all of the parties, and filed in an electronic format with the Iowa Secretary of State as required by Iowa Code section 28E.8 (2011).

10.2 Any Party desiring an amendment to this Agreement shall notify the other Parties of its desire, and the reasons for the request. Such a request shall be in writing to the other governing bodies of the Parties, and shall be considered by their governing body without unreasonable delay and within no more than ninety (90) days of receipt.

10.3 If the request is agreed to by the other Parties, each Party shall prepare and submit to the others a certified resolution confirming the affirmative vote of the Party's governing body.

10.4 The Amendment shall take effect ten (10) days following receipt of the last such resolution by the other Parties. Amendments shall be filled and recorded as required by Section 15 hereof.

SECTION 11. ADDITIONAL PARTIES.

11.1 A City, County, or Soil and Water Conservation District within the Fourmile Creek Watershed who is not a Party, may request, in writing to all Parties, to become a Party.

11.2 Such a request shall be considered an Amendment and shall follow the steps outlined in Section 10 hereof.

SECTION 12. TERMINATION OF AGREEMENT.

This agreement shall terminate upon the mutual agreement of the governing bodies of all Parties in the Authority. Upon termination, all property and money then owned by the Authority shall be distributed equally among its members after payment of all debts. Any funds donated under a stipulation limiting their use shall be dispersed consistent with the owner's direction. The governing body of each jurisdiction may individually terminate their participation in the agreement after providing the Authority a written 90 notice of intent.

SECTION 13. EFFECTIVE DATE.

This Agreement shall take effect upon execution by the Parties as required by law, and filing with the Secretary of State in an electronic format.

SECTION 14. NOTICES.

Notices under this Agreement shall be in writing and delivered to the representative of the party to receive notice (identified below) at the address of the representative designated to receive notice for each Party as set forth in this Agreement. The effective date of any notice under this Agreement shall be the date of actual delivery of such notice and not the date of dispatch. The preferred means of notice shall be either actual hand delivery, certified US Mail, return receipt requested with postage prepaid thereon, or by recognized overnight delivery service, such as FedEx or UPS.

Notices shall be delivered to the following persons regarding each Party:

County:	Chairperson, Polk County Board of Supervisors Polk County Administration 111 Court Avenue Des Moines, Iowa 50309
County:	Chairperson, Story County Board of Supervisors Story County Administration 900 6th Street Nevada, Iowa 50201
County:	Chairperson, Boone County Board of Supervisors Boone County Administration 201 State Street Boone, Iowa 50036
Ankeny:	Mayor, City of Ankeny 410 W. 1st Street Ankeny, Iowa 50023
Des Moines:	Mayor, City of Des Moines 400 Robert D. Ray Drive Des Moines, Iowa 50309
Pleasant Hill:	Mayor, City of Pleasant Hill 5160 Maple Drive, Suite A Pleasant Hill, Iowa 50327
Altoona:	Mayor, City of Altoona 407 8th Street SE Altoona, Iowa 50009
Bondurant:	Mayor, City of Bondurant 200 2nd St. NE P.O. Box 37 Bondurant, Iowa 50035
Slater:	Mayor, City of Slater 101 Story Street P. O. Box 538 Slater, Iowa 50244-0538
Alleman:	Mayor, City of Alleman 14000 NE 6th Street P.O. Box 86 Alleman, Iowa 50007

Elkhart: Mayor, City of Elkhart
260 NW Main Street
P.O. Box 77
Elkhart, Iowa 50073

Sheldahl: Mayor, City of Sheldahl
803 2nd Avenue
Sheldahl, Iowa 50243

Polk County Soil and Water Conservation District:
Chairperson, Polk County SWCD
1513 North Ankeny Blvd. Suite 3
Ankeny, Iowa 50023-4167

Story County Soil and Water Conservation District:
Chairperson, Story County SWCD
510 South 11th Street
Nevada, Iowa 50201

Boone County Soil and Water Conservation District:
Chairperson, Boone County SWCD
1602 Snedden Drive
Boone, Iowa 50036

SECTION 15. RECORDATION.

This Agreement shall be recorded pursuant to the requirements of *Code of Iowa,* Chapter 28E.

SECTION 16. ENTIRE AGREEMENT.

This Agreement and attachments hereto constitute the entire Agreement among the Parties and supersedes or replaces any prior agreements among the Parties relating to its subject matter.

SECTION 17. NO WAIVER.

The waiver or acceptance by any Party of a breach or violation of any provisions of this Agreement by another Party shall not operate as, or be construed to be, a waiver of any subsequent breach.

SECTION 18. NO ASSIGNMENT OR DELEGATION.

Neither this Agreement, nor any right or obligation under it, may be assigned, transferred or delegated in whole or in part to any outside entity without the prior written consent of all the Parties.

SECTION 19. AUTHORITY AND AUTHORIZATION.

Each party to this Agreement shall supply a copy to the Authority of the resolution by the governing body of each party as evidence of the power and authority of each party to enter into this agreement.

SECTION 20. HEADINGS AND CAPTIONS.

The paragraph headings and captions set forth in this Agreement are for identification purposes only and do not limit or construe the contents of the paragraphs.

SECTION 21. SIGNATURE PAGES.

The Parties agree that this Agreement has attached to it signature pages which shall be assembled and filed together with the Agreement and shall together constitute one and the same instrument. A completed copy of the agreement with executed signature pages shall be sent to each Party.

Dated this 4TH day of SEPT, , 2012.

POLK COUNTY, IOWA

BY: [signature]
Board of Supervisors Chair

ATTEST: [signature]
County Auditor

Dated this 18 day of September, 2012.

STORY COUNTY, IOWA

BY: Wayne E. Clinton
Board of Supervisors Chair

ATTEST: [signature]
County Auditor

Dated this 12 day of Sept, 2012.

BOONE COUNTY, IOWA

BY: ______________________________
Board of Supervisors Chair

ATTEST: ______________________________
County Auditor

Dated this 6th day of August, 2012.

ANKENY, IOWA

BY: ______________________
Mayor

ATTEST: ______________________
City Clerk

Dated this 27th day of August, 2012.

DES MOINES, IOWA

BY: ______________________
Mayor

ATTEST: ______________________
City Clerk

Dated this 14th day of August, 2012.

PLEASANT HILL, IOWA

BY: ______________________________
Mayor

ATTEST: ______________________________
City Clerk

Dated this 17th day of September, 2012.

ALTOONA, IOWA

BY: ______________________
Mayor

ATTEST: ______________________
City Clerk

Dated this 6th day of September, 2012.

BONDURANT, IOWA

BY: ______________________
Mayor

ATTEST: ______________________
City Clerk

Dated this 10th day of September, 2012.

SLATER, IOWA

BY: Gary Halverson
Mayor

ATTEST: Mary E. Sprouse
City Clerk

Dated this 18 day of September, 2012.

ALLEMAN, IOWA

BY: William M. Bowlwat
Mayor

ATTEST: Kathleen a. Larson
City Clerk

Dated this 17th day of September, 2012.

ELKHART, IOWA

BY: ______________________
Mayor

ATTEST: Jeanne M. Uhl
City Clerk

Dated this 10th day of September, 2012.

SHELDAHL, IOWA

BY: ______________________________
Mayor

ATTEST: ______________________________
City Clerk

Dated this 6th day of September, 2012.

POLK COUNTY SOIL AND WATER CONSERVATION DISTRICT
POLK COUNTY, IOWA

BY: Chip Mathis
Chairperson

ATTEST: Pamela Schwartz
Secretary

Dated this 6th day of September, 2012.

STORY COUNTY SOIL AND WATER CONSERVATION DISTRICT
STORY COUNTY, IOWA

BY: Erwin E. Klaas
Chairperson

ATTEST: Claudia Dalbey
Secretary

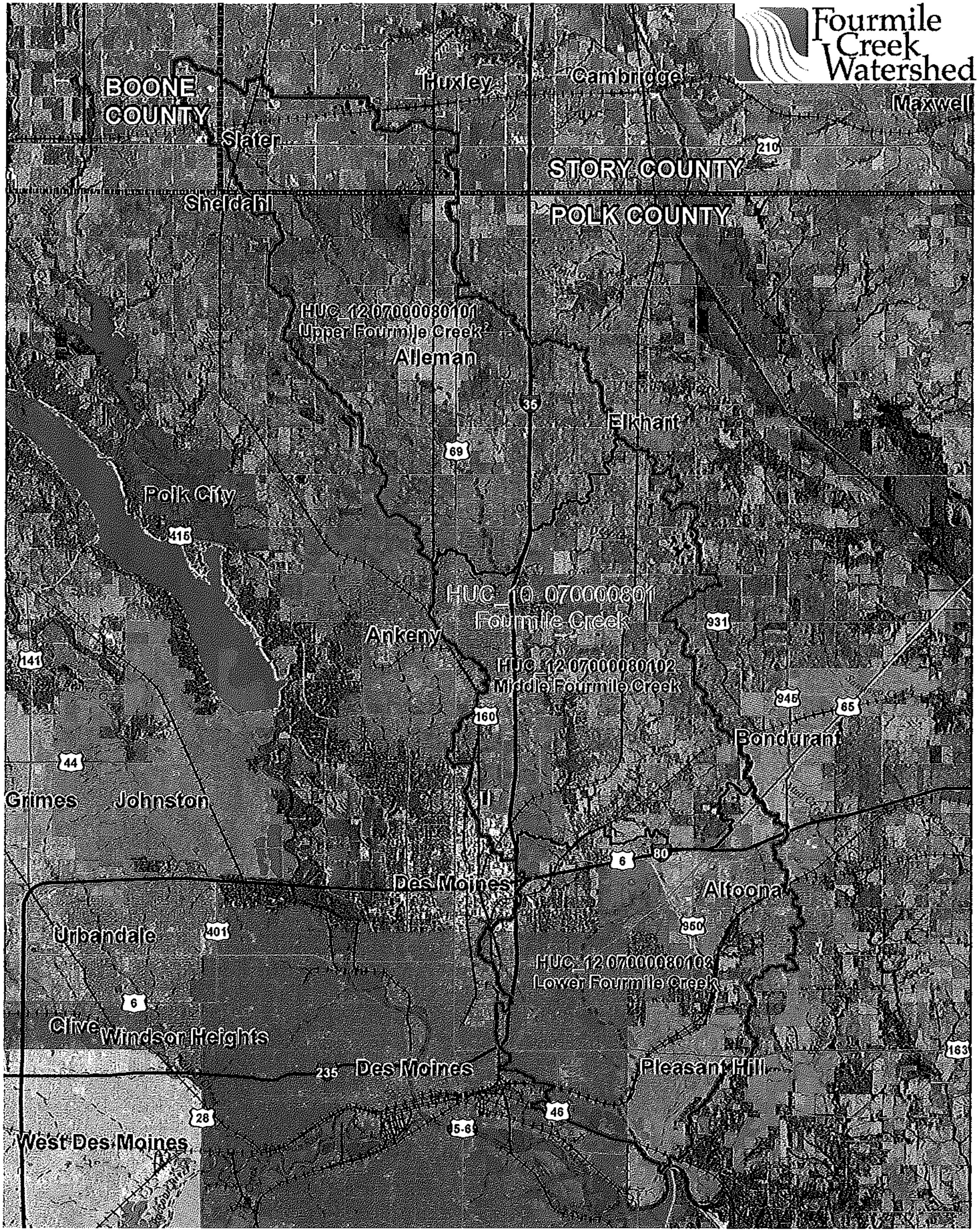
Dated this 26th day of July, 2012.

BOONE COUNTY SOIL AND WATER CONSERVATION DISTRICT
BOONE COUNTY, IOWA

BY: Kevin M Griggs
Chairperson

ATTEST: Jayne C. Smith
Secretary

Attachment A



SNYDER & ASSOCIATES
Engineers and Planners

0 1.5 3 Miles

Fourmile Creek Watershed

J:\2011_Projects\111.0076\Correspondence\IowaFloodCenter\Fourmile_Study_Area.mxd

Res. No. 133-12
September 4, 2012

RESOLUTION

Moved by Hockensmith, Seconded by Giovannetti that the following resolution be adopted:

WHEREAS, under Chapter 28E of the Code of Iowa, the Polk County Board of Supervisors as a public agency, may enter into an agreement with a public or private agency authorized under the laws of this state to cooperate in such a way as to provide joint services and facilities with other agencies, and to cooperate in other ways to mutual advantage; and

WHEREAS, in response to record setting flooding that occurred in 2008 and 2010 in the Fourmile Creek Watershed, the Board of Supervisors approved Resolution 1-11 dated January 11, 2011, which included approval of a Cooperative Services Agreement with the Cities of Ankeny, Des Moines, and Pleasant Hill to complete a comprehensive study of the Fourmile Creek watershed so possible flood reduction measures can be identified and implemented; and

WHEREAS, the findings of this study included a recommendation that a watershed management authority be established to enable cooperation in supporting watershed planning and improvements that are to the mutual advantage of the political subdivisions involved; and

WHEREAS, the Public Works Department has developed a 28E Agreement with the Cities of Alleman, Altoona, Ankeny, Bondurant, Des Moines, Elkhart, Pleasant Hill, Sheldahl, Slater, the Counties of Boone and Story, the Boone County Soil and Water Conservation District, the Story County Soil and Water Conservation District, and the Polk County Soil and Water Conservation District, to establish the Fourmile Creek Watershed Management Authority whose primary purpose will be to carry out watershed planning and improvements in the Fourmile Creek Watershed.

NOW, THEREFORE, BE IT RESOLVED that the Director of Public Works be authorized to process the "Joint and Cooperative Agreement" with the parties involved and complete the project as follows:

1) Chairperson of the Polk County Board of Supervisors to sign agreement.
2) Agreement to be recorded with the Polk County Recorder.
3) Agreement to be filed with the Secretary of State.
4) Return a copy of agreement to all Parties of the Agreement.
5) Provide planning and administration needed to implement the Agreement

POLK COUNTY BOARD OF SUPERVISORS:

Angela Connolly
Chairperson

RECOMMENDED FOR APPROVAL:

Robert Rice
Robert Rice, Director
Polk County Public Works

APPROVED AS TO FORM:

[signature]
Assistant County Attorney
Fiscal Impact: None

ROLL CALL
FOR ALLOWANCE

E.J. Giovannetti	Yea	Nay
Robert Brownell	Yea	Nay
John F. Mauro	Yea	Nay
Tom Hockensmith	Yea	Nay
Angela Connolly	Yea	Nay

SEP - 4 2012

ALLOWED BY VOTE OF BOARD
Angela Connolly
CHAIRPERSON

Yea 5 Nay 0
Above tabulation made by BD

#13

Appendix C: Agricultural Conservation Planning Framework Findings

Each subwatershed was analyzed using the Agricultural Conservation Planning Framework software. The attached figures are in the following order:

Upper Fourmile Creek

- Potential Grassed Waterway and Soil Runoff Risk: Figure C-1
- Potential Nutrient Removal Wetland Sites: Figure C-2
- Potential Riparian Buffers: Figure C-3
- Potential Sediment Basin Sites: Figure C-4

Middle Fourmile Creek

- Potential Grassed Waterway and Soil Runoff Risk: Figure C-5
- Potential Nutrient Removal Wetland Sites: Figure C-6
- Potential Riparian Buffers: Figure C-7
- Potential Sediment Basin Sites: Figure C-8

Lower Fourmile Creek

- Potential Grassed Waterway and Soil Runoff Risk: Figure C-9
- Potential Nutrient Removal Wetland Sites: Figure C-10
- Potential Riparian Buffers: Figure C-11
- Potential Sediment Basin Sites: Figure C-12

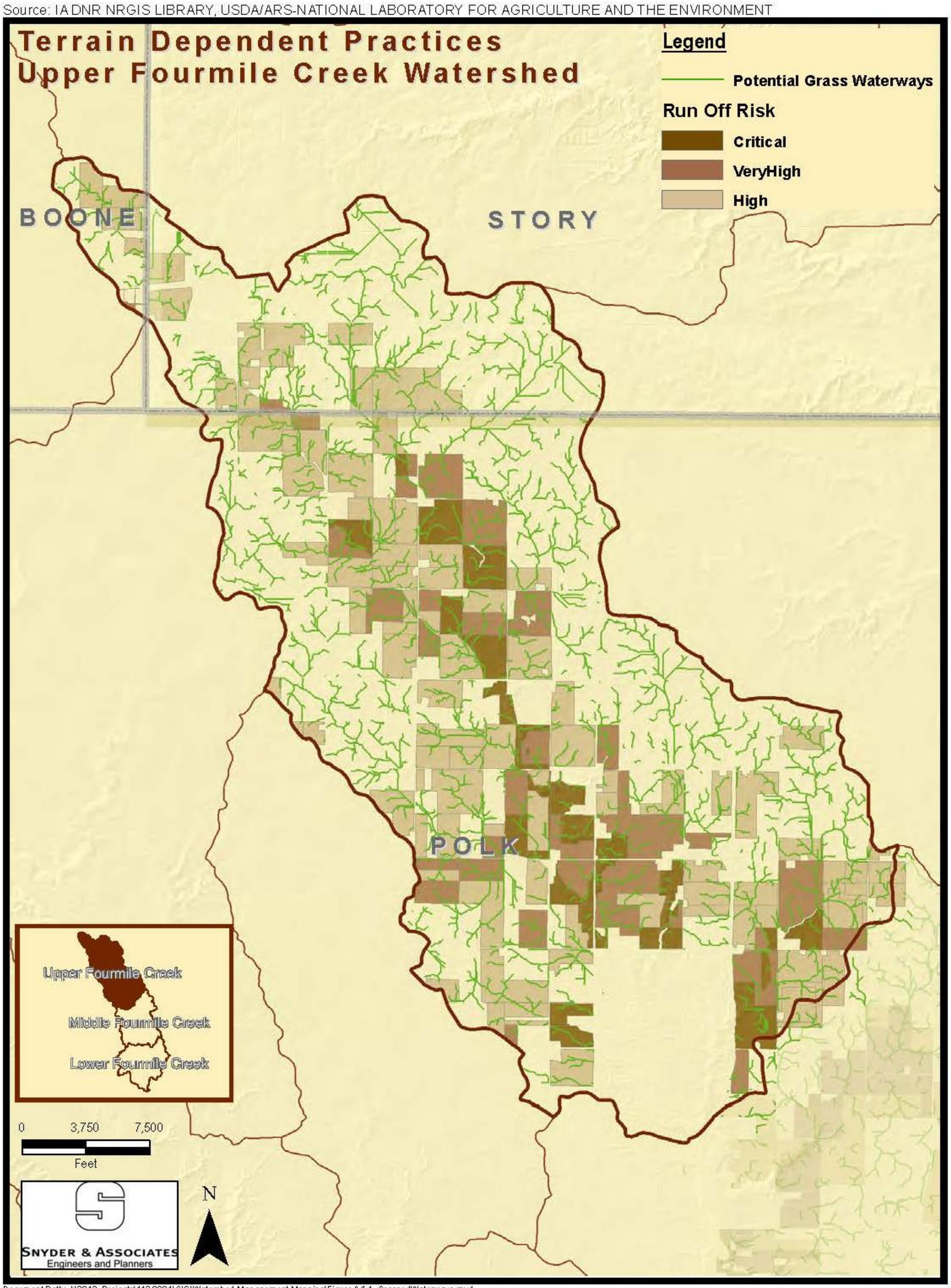


Figure C-1: Upper Fourmile Creek Watershed Potential Grassed Waterway and Soil Runoff Risk

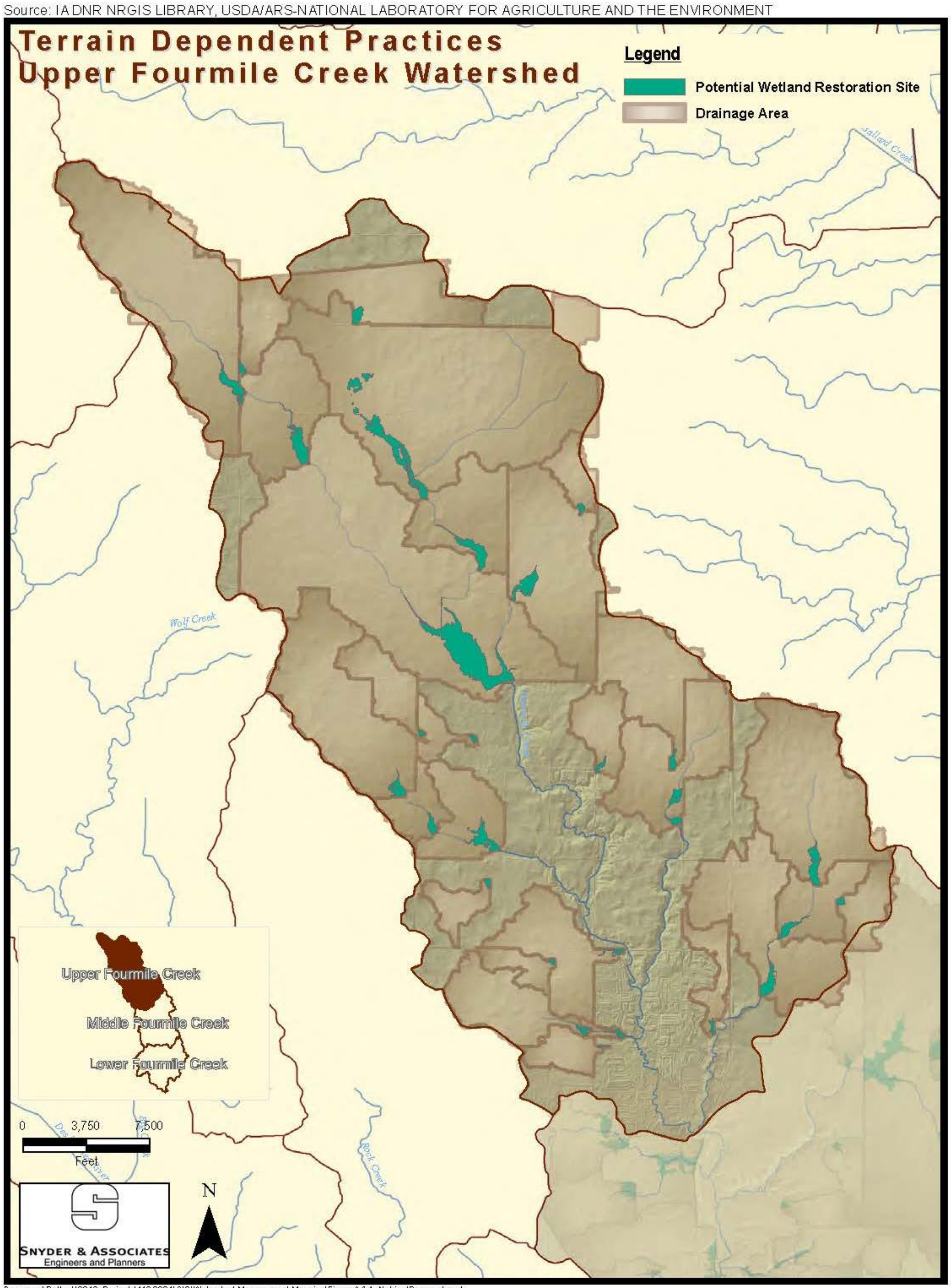


Figure C-2: Upper Fourmile Creek Watershed Potential Nutrient Removal Wetland Sites

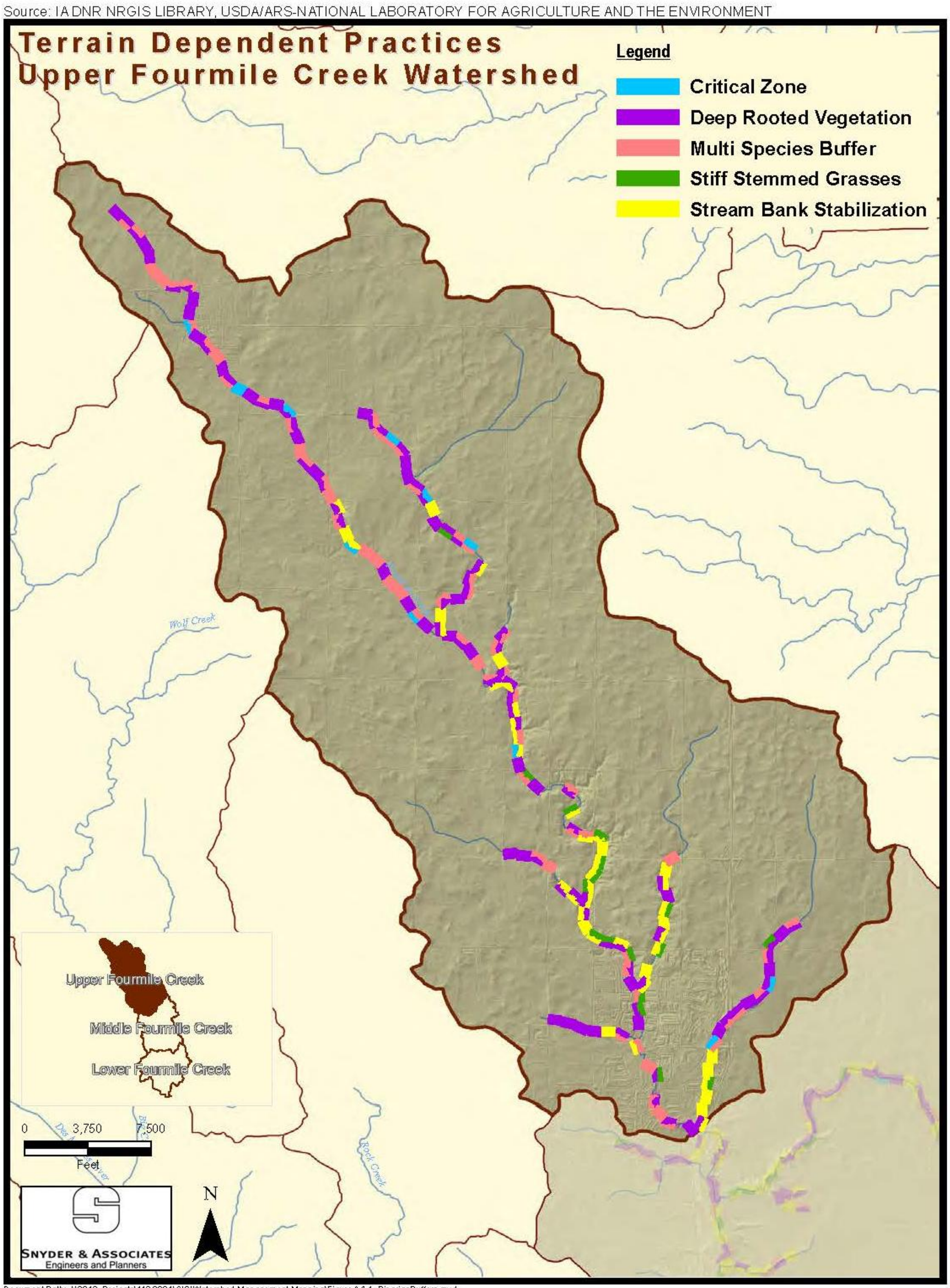
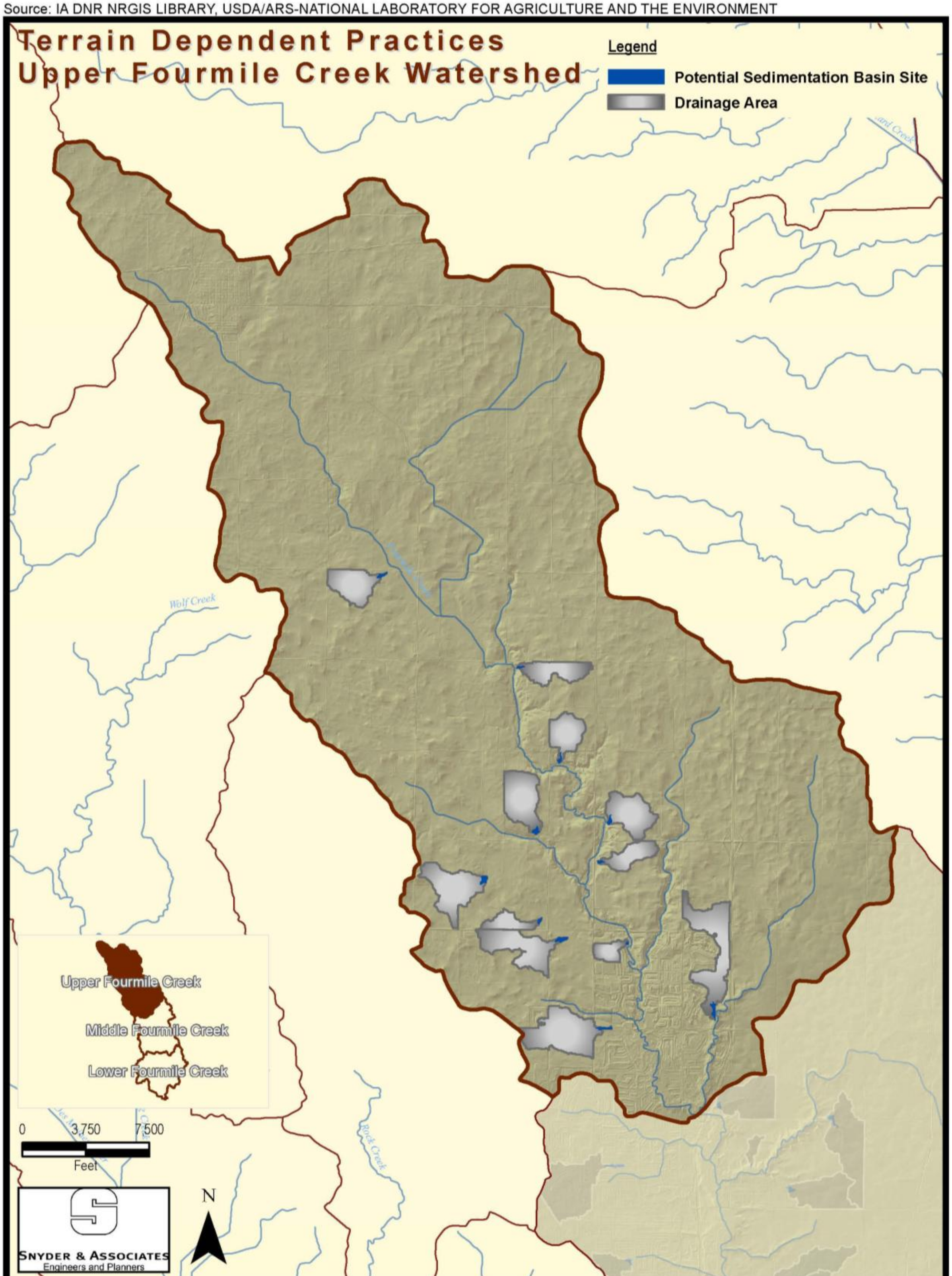


Figure C-3: Upper Fourmile Creek Watershed Potential Riparian Buffers

Source: IA DNR NRGIS LIBRARY, USDA/ARS-NATIONAL LABORATORY FOR AGRICULTURE AND THE ENVIRONMENT



Document Path: J:\2013_Projects\113.0991\GIS\Watershed Management Mapping\Figure A4-1_SedimentBasins.mxd

Figure C-4: Upper Fourmile Creek Watershed Potential Sediment Basin Sites

Source: IA DNR NRGIS LIBRARY, USDA/ARS-NATIONAL LABORATORY FOR AGRICULTURE AND THE ENVIRONMENT

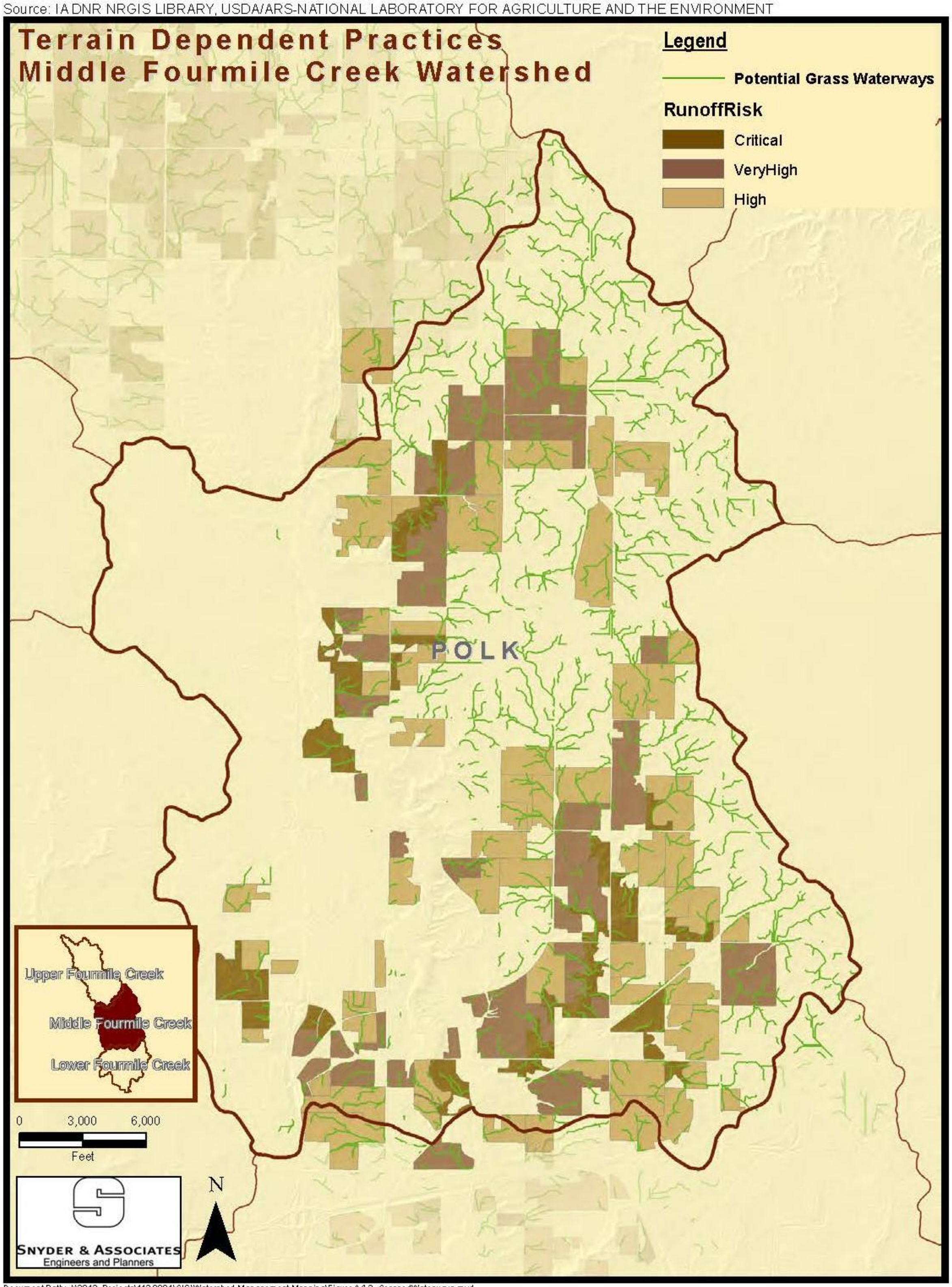


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Figure C-5: Middle Fourmile Creek Watershed Potential Grassed Waterway and Soil Runoff Risk

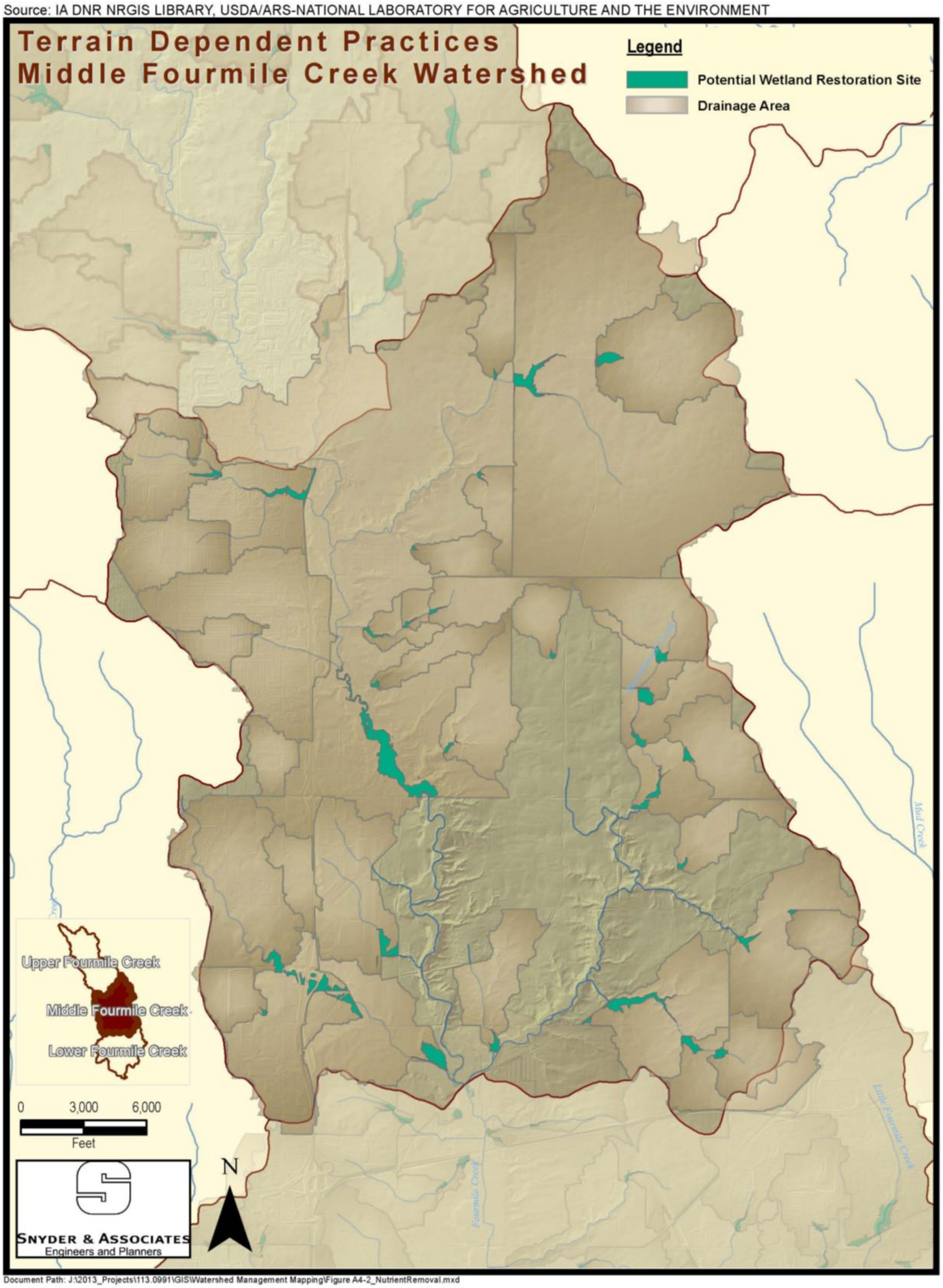

Figure C-6: Middle Fourmile Creek Watershed Potential Nutrient Removal Wetland Sites

Source: IA DNR NRGIS LIBRARY, USDA/ARS-NATIONAL LABORATORY FOR AGRICULTURE AND THE ENVIRONMENT

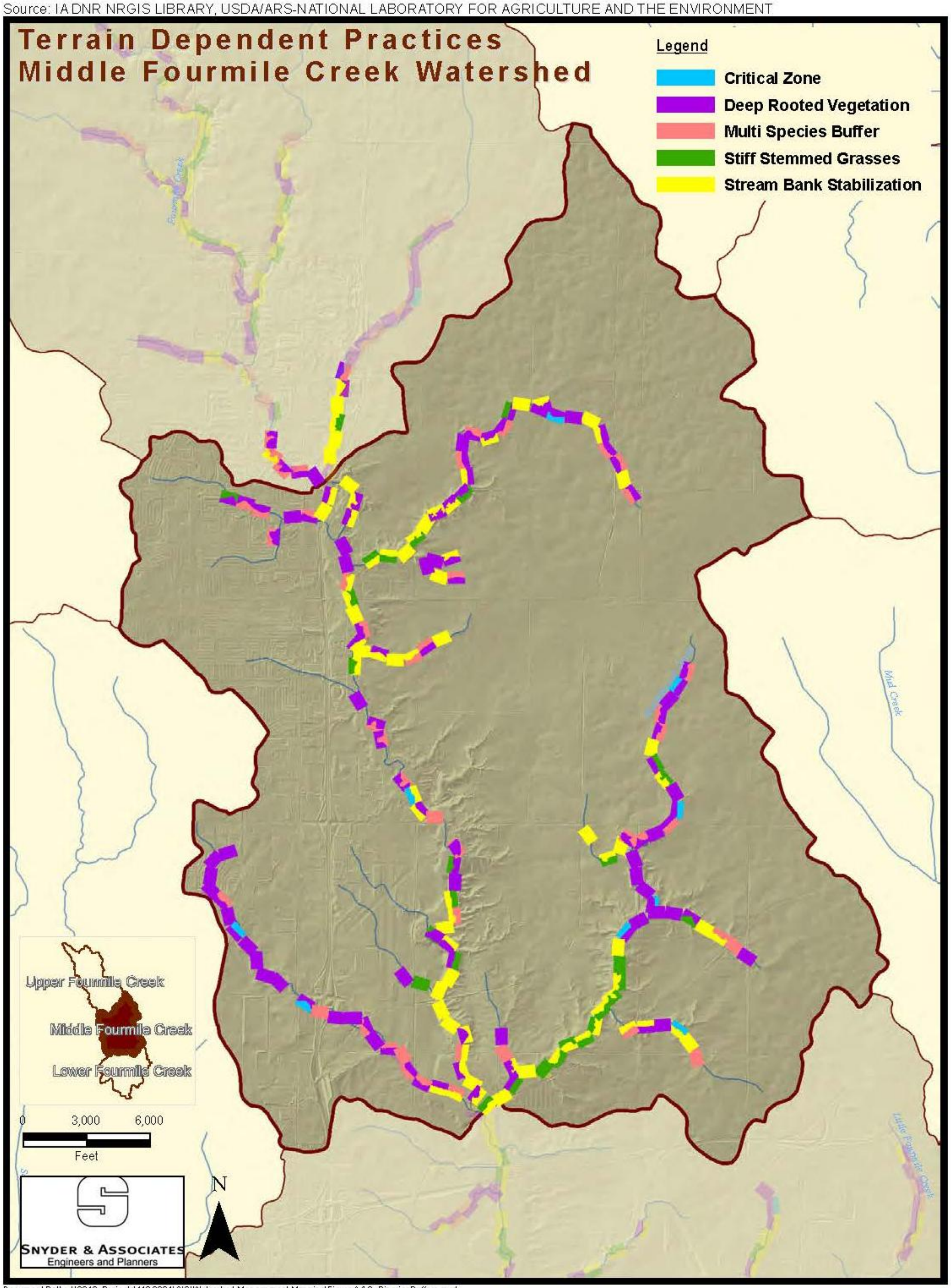

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Figure C-7: Middle Fourmile Creek Watershed Potential Riparian Buffers

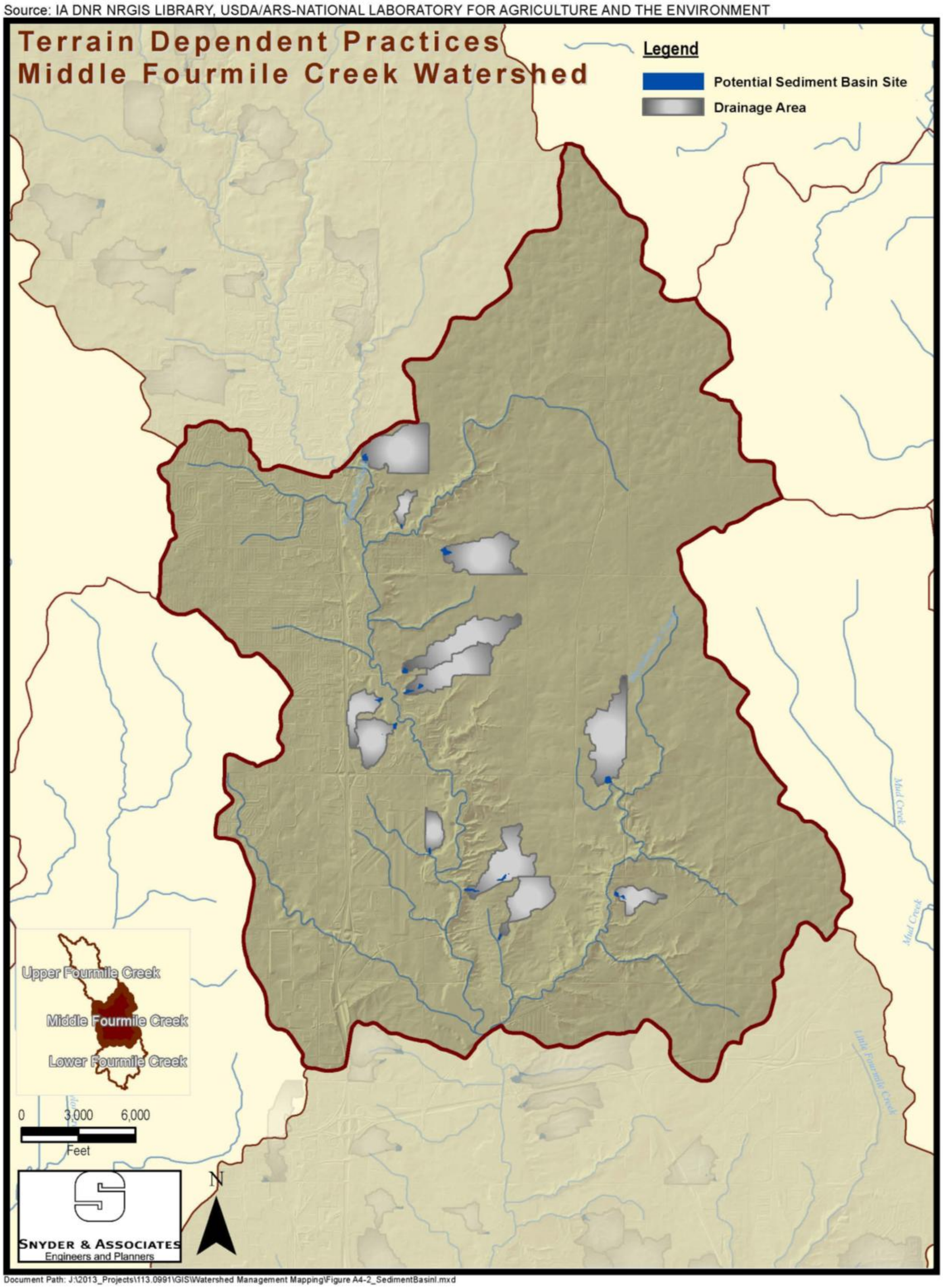

Figure C-8: Middle Fourmile Creek Watershed Potential Sediment Basin Sites

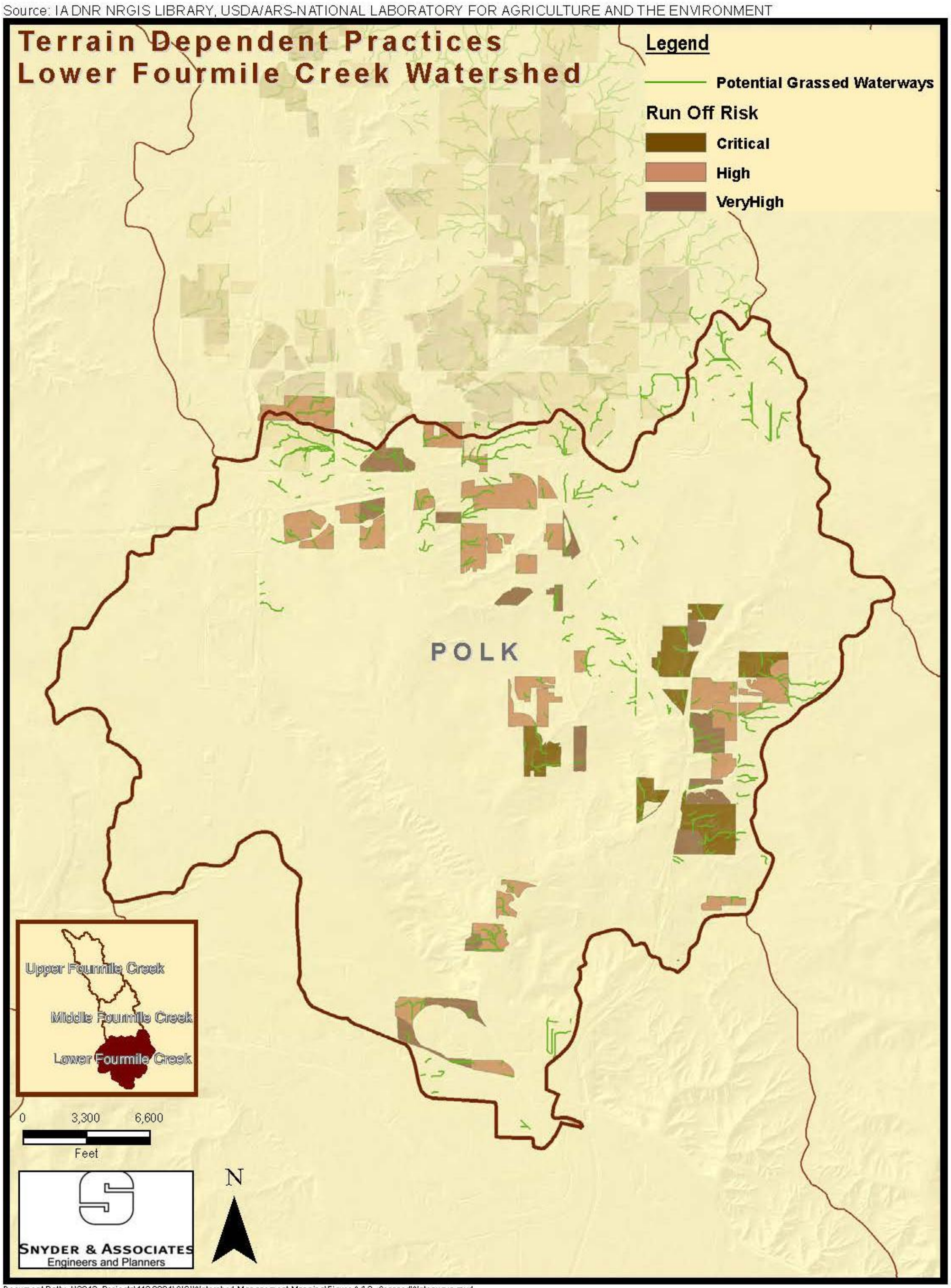

Figure C-9: Lower Fourmile Creek Watershed Potential Grassed Waterway and Soil Runoff Risk

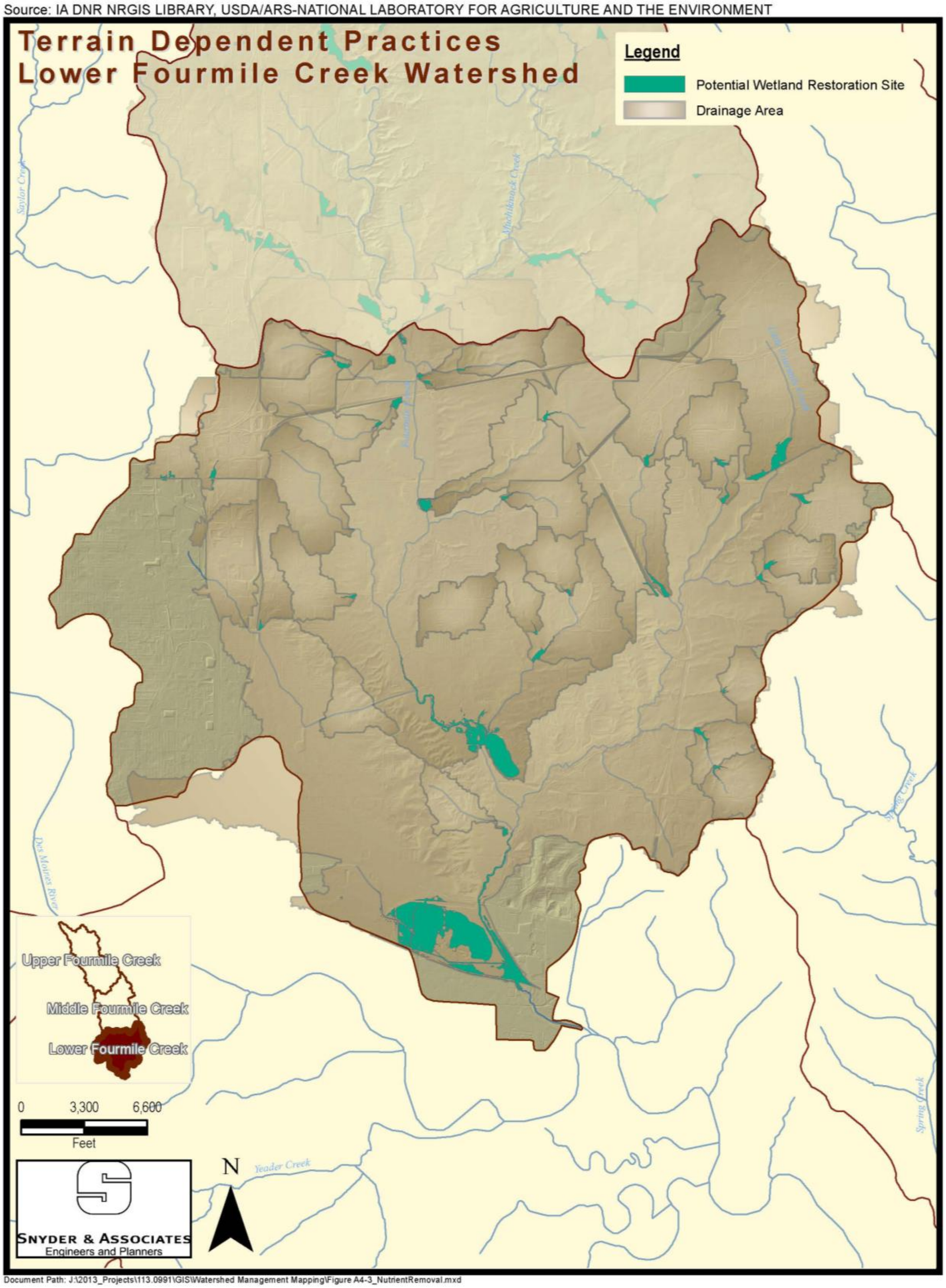

Figure C-10: Lower Fourmile Creek Watershed Potential Nutrient Removal Wetland Sites

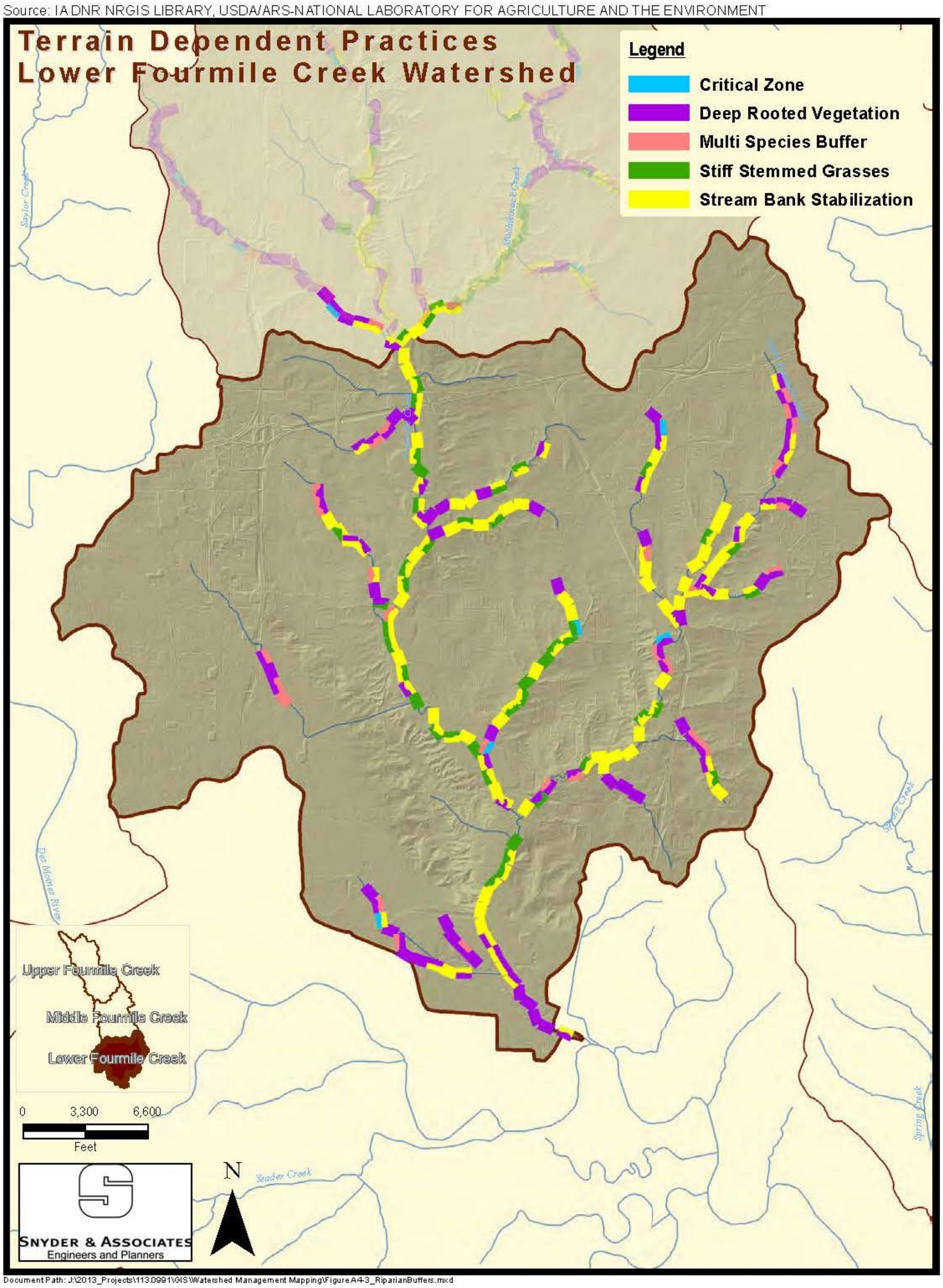

Figure C-11: Lower Fourmile Creek Watershed Potential Riparian Buffers

Source: IA DNR NRGIS LIBRARY, USDA/ARS-NATIONAL LABORATORY FOR AGRICULTURE AND THE ENVIRONMENT

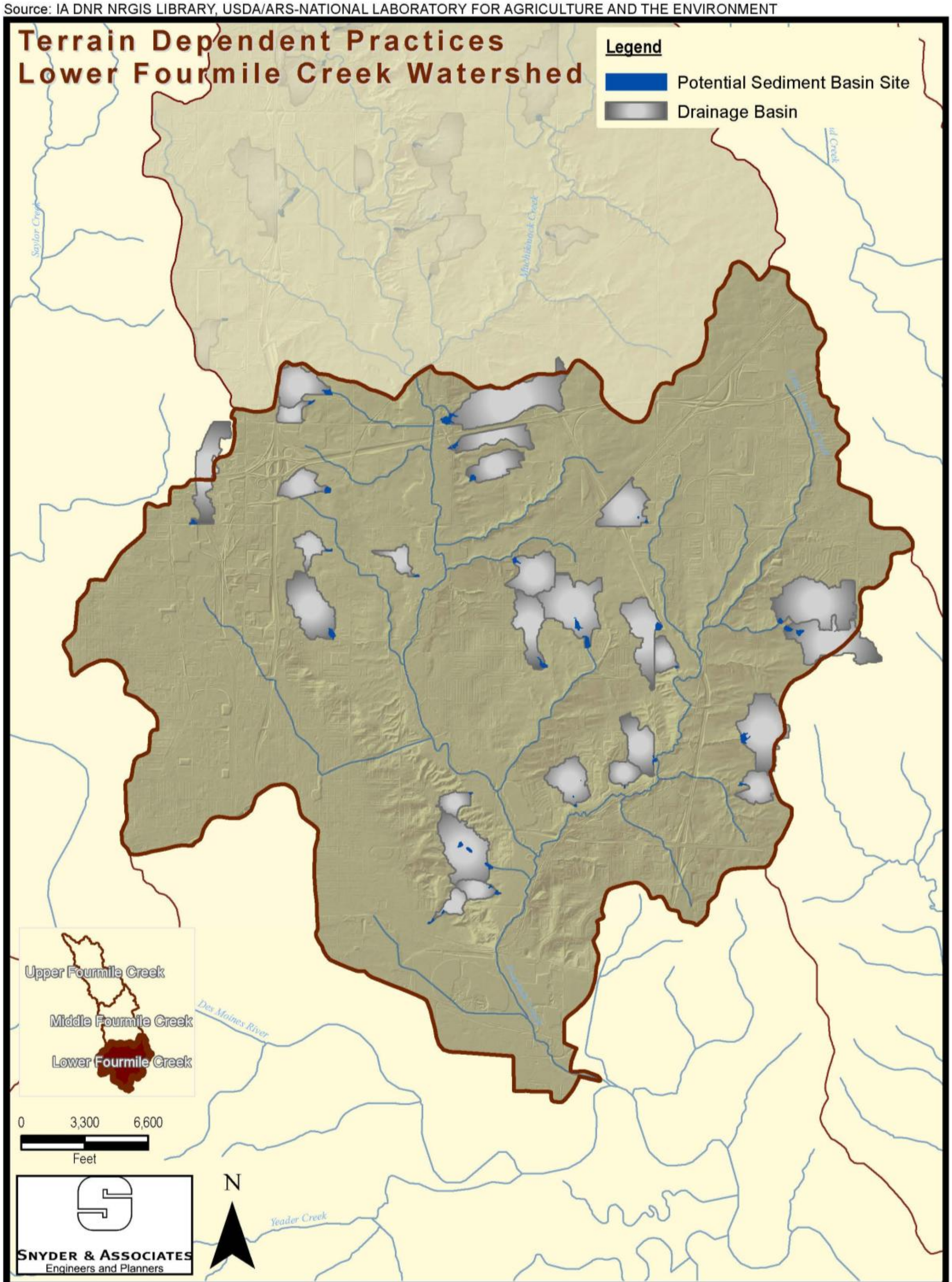

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Figure C-12: Lower Fourmile Creek Watershed Potential Sediment Basin Sites

Appendix D: Available Monitoring Data from the City of Ankeny

977075 - 54th Street
Fourmile Creek

	Field/Meter Analyzed Samples								Laboratory Analyzed Samples				
	Chloride	DO	pH	Water Temp	Transparency	Nitrite	Nitrate	Phosphate	TSS	NH-3	COD	CBOD	Fecal
Date	mg/L	mg/L	SU	Celsius	cm	(field)	(field)	(field)	mg/L	mg/L	mg/L	mg/L	cfu/dL
11/18/2009	NS	11.5	9.0	8.4	NS	NS	NS	NS	13	<1	7	0.9	87
12/17/2009	Could not sample, water frozen												
1/28/2010	29	14.55	7.8	0.3	NS	NS	NS	NS	11	<1	7.6	5	TNTC
2/25/2010	29	13.1	8.6	0.2	NS	NS	NS	NS	5	<1	6	2	
3/18/2010	<29	11.96	7.6	4.7	17	0	2	1	87	<1		2	<10,000
4/15/2010	<29	9.4	8.2	10.7	60	0	2	0	13	<1	43	2.5	
5/27/2010	29	10.45	8.5	14.7	36	0	5	0.6	13	<1	46	1.6	
6/24/2010	<29	9.37	8.0	17.6	37	0	2	0.7	29	<1	3	3	
7/15/2010	<36	9.49	8.1	23.1	43	0	0	NS	20	<1	13	1	
9/2/2010	<32	7.7	8	21.3	18	0	2	0.4	66	<1	18	5.2	
9/16/2010	<32	9.35	8.1	17.4	46	0	5	0.6	15	<1	11.4	1.3	2400
10/21/2010	<32	10.37	8.5	10.5	60	0	2	0	8	<1	4	0.8	800
11/19/2010	<32	11.77	8	6.1	60	0	0	0	13	0.3	4	3	
12/16/2010	Could not sample, water frozen												
1/20/2011	Could not sample, water frozen												
2/17/2011	<32	11.58	7	4.6	10	0.15	2	0.8					
3/17/2011	<33	10.62	8.5	9.8	60	0	2	0	11	<1	15.1	3	175
4/21/2011	<33	11.98	8.2	6.7	23	0	5	0					
5/16/2011	<33	11.22	8.6	9.2	23	0	10	0	79	<1	7.7	1.9	1400
6/16/2011	<33	9.33	8.2	15.4	18	0	20	0.2	67	<1	16.8	2	900
7/21/2011	<32	7.44	8.3	24.4	39	0.15	2	0.2	17	<1	9.4	2	6200
8/18/2011	<32	7.17	8.2	22.4	60	0.15	0	0	8	<1	13.5	4	
9/15/2011	48	12.9	8.6	15.3	28	0	0	0	19	<1	32.6	7	500
10/27/2011	125	8.06	7	7.1	27	0	0	0	23	<1	44.3	8.6	200
11/18/2011	<32	13.7	8	1.3	60	0	5	0.2	7	<1	9	0	
12/15/2011	<32	12.4	7.9	3.3	30	0	2	0.2	26	<1	22	0.1	
1/24/2012	Unable to sample, water frozen												
2/16/2012	<33	15.5	8.6	0.2	60	0	5	0					
3/15/2012	33	10.6	8.3	10.7	60	0.15	5	0.1					
4/19/2012	<33	10	8.7	10.9	26	0	10	0.3					
5/17/2012	<33	10.6	8.4	14.4	60	0	10	0.2					
6/21/2012	<32	8.2	8.5	20.4	13	0	10	0.8	86	<1	30.1	2	300
7/25/2012	Unable to sample, creek completely dry												
8/16/2012	Unable to sample, no flow, only puddles												
9/20/2012	Unable to sample, creek completely dry												
10/18/2012	Unable to sample, creek completely dry												
11/20/2012	261	11.4	8.8	6.2	60	0	0	1					
12/18/2012	303	12.5	8.4	1.0	60	0	0	0.2					
1/24/2013	Frozen, unable to sample												
3/7/2013	Frozen, unable to sample												
3/28/2013	137	12.3	8.4	4.7	42	0	5	0	17	0.72	32.7	4.1	<100
4/24/2013	38	13.0	8.3	4.0	60	0	20	0.6					
5/16/2013	Unable to sample, pavement being installed												
6/27/2013	<32	8.6	8	19.5	31	0	10	0.2	47	<1	28	0.5	3480
7/18/2013	35	6.1	8	25.2	58	0.3	2	No strips					
8/16/2013	48	6.8	8.1	19.7	60	0	0	0					
9/11/2013	Stream completely dry; did not sample												
10/18/2013	48	8.1	8.2	7.9	41	0	0	0					
11/22/2013	96	13.1	no meter	0.2	38	0	0	0.2					
12/18/2013	Frozen, unable to sample												

NS = Not sampled
NA = Not analyzed
TNTC = Too numerous to count

AVERAGE	89.92857	10.6003	8.2111	10.7972973	41.88235294	0.026471	4.264706	0.265625	29.16667	0.51	18.44348	2.645833	1494.727

977076- NE Delaware
Sampling Results

Date	TSS mg/L	pH SU	NH-3 mg/L	Nitrite (field)	Nitrate (field)	COD mg/L	CBOD mg/L	NO3 mg/L	DO mg/L	Fecal cfu/dL	e. coli mg/L	Chloride mg/L	Transparency cm	Phosphate (field)	P mg/L	Water Temp Celsius
11/18/2009	6	8.5	<1	NS	NS	0	0.3	8.2	11.2	48	12	NS	NS	NS	4.9	7.5
12/17/2009	Could not sample, water frozen															
1/28/2010	10	8.2	<1	NS	NS	0.0	4	7.8	13.96	TNTC	TNTC	29	NS	NS	0.96	0.7
2/25/2010	Could not sample, water frozen															
3/18/2010	78	7.7	<1	0	2	NA	2	NA	11.92	<10,000	NA	<29	15	1	NA	4.6
4/15/2010	15	8.2	<1	0	2	27	1.5	NA	9.03	NA	NA	<29	55	0	NA	11.8
5/27/2010	16	7.8	<1	0	2	132	2.4	NA	9.73	NA	NA	<29	30	0.4	NA	15.1
6/24/2010	34	8.0	<1	0	5	7	3	NA	9.07	NA	NA	<29	28	1.0	NA	17.6
7/15/2010	34	8.2	<1	0	2	13	2	NA	8.13	NA	NA	<36	27	NS	NA	23.1
9/2/2010	106	7.9	<1	0	2	22	2.9	NA	7.80	NA	NA	<32	17	0.6	NA	20.6
9/16/2010	21	8.2	<1	0	5	11.3	1.9	NA	9.01	2100	NA	<32	42	0.8	NA	17.9
10/21/2010	4	8.4	<1	0	2	11	1.3	NA	10.36	800	NA	<32	60	0	NA	10.6
11/19/2010	11	8.1	0.5	0	2	5.3	3	NA	11.79	NA	NA	<32	60	0	NA	5.3
12/16/2010	Could not sample, water frozen															
1/20/2011	Could not sample, water frozen															
2/17/2011	NA	7	NA	0.15	1	NA	NA	NA	11.81	NA	NA	<32	9	0.1	NA	2.5
3/17/2011	14	8.4	<1	0	10	7.3	3	NA	9.7	25	NA	<33	60	0	NA	9.7
4/21/2011	NS	8.2	NS	0	5	NS	NS	NA	11.9	NS	NS	<33	23	0	NA	6.1
5/16/2011	59	8.3	<1	0	5	14.8	2.1	NA	10.91	1300	NA	<33	21	0	NA	9.1
6/16/2011	76	8	<1	0	20	19.1	1	NA	9.24	1800	NA	<33	17	0.2	NA	15
7/21/2011	12	8.2	<1	0	2	0	2	NA	6.69	700	NA	<32	47	0.1	NA	26.2
8/18/2011	20	8.2	<1	0	0	21.4	3	NA	7.19	NA	NA	<32	37	0	NA	22.7
9/15/2011	13	8.3	<1	NS	NS	31.2	6	NA	11.06	200	NA	<32	45	0	NA	14.1
10/27/2011	8	7	<1	0	0	27.7	5.1	NA	8.88	100	NA	<32	60	0	NA	8.2
11/18/2011	6	8.3	<1	0	2	22	1	NA	12.3	NA	NA	32	60	0.1	NA	2.9
12/15/2011	13	8.2	<1	0	2	19	0.7	NA	11.9	NA	NA	39	41	0.4	NA	3.7
AVERAGE	27.8	8.059091	0.5	0.007895	3.736842	20.58421	2.41	8	10.16273	785.8889	12	33.33333	37.7	0.2473684	2.93	11.59090909

NS = Not sampled
NA = Not analyzed
TNTC = Too numerous to count

977239 - First Street
Fourmile Creek

	Field/Meter Analyzed Samples								Laboratory Analyzed Samples				
Date	Chloride mg/L	DO mg/L	pH SU	Water Temp Celsius	Transparency cm	Nitrite (field)	Nitrate (field)	Phosphate (field)	TSS mg/L	NH-3 mg/L	COD mg/L	CBOD mg/L	Fecal cfu/dL
11/18/2009	NS	11.0	8.4	7.6	NS	NS	NS	NS	5	<1	0	0.1	24
12/17/2009	Not sampled, very small amount of water open, but snow makes sampling conditions unsafe.												
1/28/2010	42	13.99	8.0	1.0	NS	NS	NS	NS	8	<1	4.3	4	TNTC
2/25/2010	42	13.0	8.1	0.3	NS	NS	NS	NS	6	<1	4	2	
3/18/2010	<29	11.95	7.8	5.0	17	0	2	1	69	<1		2	<10,000
4/15/2010	<29	9.41	8.2	12.3	60	0	2	0	16	<1	51	2.1	
5/27/2010	<29	9.78	8.4	16.3	32	0	2	0.2	15	<1	24	1.5	
6/24/2010	<32	9.12	7.8	19.3	28	0.15	5	1	34	<1	5	4	
7/15/2010	<36	8.09	8.2	23.2	30	0	5	NS	25	<1	17	1	
9/2/2010	NS	NS	NS	NS	NS	NS	NS	NS	76	<1	18	2.8	
9/16/2010	<32	9.33	8.2	18.2	48	0	2	0.6	12	<1	10.5	2	2100
10/21/2010	<32	10.72	8.2	11.2	60	0	2	0	4	<1	11	1.8	700
11/19/2010	<32	11.6	7.9	5.9	60	0	2	0	9	0.3	7.3	3	
12/16/2010	Could not sample, water frozen												
1/20/2011	Could not sample, water frozen												
2/17/2011	<32	11.52	7	1.9	9	0.15	2	1					
3/17/2011	<33	10.58	8.2	10.3	60	0	5	0	11	<1	19.2	2	125
4/21/2011	<33	12.04	8.2	6	60	0	5	0					
5/16/2011	<33	10.9	8.3	10.4	19	0	10	NS	65	<1	15.2	2	300
6/16/2011	<33	9.09	7.9	16.2	16	0	10	0.6	87	<1	12.9	2	1000
7/21/2011	<32	7.55	8.3	26.8	52	0	2	0.1	15	<1	7.3	2	500
8/18/2011	32	6.77	8.1	23.7	22	0	0	0	28	<1	11.5	4	
9/15/2011	39	7.56	8.2	13.4	40	0	0	0	15	<1	23.3	4	0
10/27/2011	39	7.48	7	9.3	60	0	0	0.1	7	<1	23.7	2.7	<20
11/18/2011	39	12.5	8.3	3.7	60	0	2	0.1	4	<1	14	1.2	
12/15/2011	32	12.5	8.3	3.1	52	0	2	0.1	10	<1	19	0.2	
AVERAGE	37.85714	10.295	8.045	11.14090909	41.31578947	0.015789	3.157895	0.282353	24.80952	0.3	14.91	2.209524	593.625

NS = Not sampled
NA = Not analyzed
TNTC = Too numerous to count

977077 - 86th Street
Sampling Results

Date	TSS mg/L	pH SU	NH-3 mg/L	Nitrite (field)	Nitrate (field)	COD mg/L	CBOD mg/L	NO3 mg/L	DO mg/L	Fecal cfu/dL	e. coli mg/L	Chloride mg/L	Transparency cm	Phosphate (field)	P mg/L	Water Temp Celsius
11/18/2009	6	8.1	<1	NS	NS	2	1.7	8.9	10.6	1,158	965	ns	NS	NS	4.8	9.4
12/17/2009	5	7.8	<1	NS	NS	1.4	2.2	8.2	11.68	772	NA	65	NS	NS	8.2	4.1
1/28/2010	8	7.5	<1	NS	NS	5.4	4	7.3	13.03	TNTC	TNTC	49	NS	NS	2.72	3.5
2/25/2010	11	7.6	<1	NS	NS	6	2	NA	11.20	NA	NA	65	NS	NS	NS	3.7
3/18/2010	77	7.7	<1	0	2	NA	2	NA	11.75	<10,000	NA	<29	17	1	NA	5.3
4/15/2010	17	8	<1	0.15	2	53	3.6	NA	8.46	NA	NA	35	59	1	NA	13.0
5/27/2010	11	8.2	<1	0	2	52	2.7	NA	9.59	NA	NA	35	34	2	NA	18.0
6/24/2010	35	7.8	<1	0	5	5	4	NA	8.95	NA	NA	<32	28	2	NA	18.7
7/15/2010	29	8.1	<1	0	5	20	2	NA	7.77	NA	NA	<36	34	NS	NA	23
9/2/2010	80	NS	<1	NS	NS	18	3.1	NS	NS	NS	NS	NS	NS	NS	NS	NS
9/16/2010	16	8.2	<1	0	5	15.8	2.3	NA	8.78	2,000	NA	<32	56	3	NA	18.8
10/21/2010	5	8.1	<1	0	2	10	1.9	NA	10.09	500	NA	<32	60	2	NA	12.9
11/19/2010	9	7.9	0.3	0	2	4.3	4	NA	11.23	NA	NA	<32	60+	2	NA	7.2
12/16/2010	6	8	<1	0	2	18	4	NA	11.32	NA	NA	40	60	2	NA	4.2
1/20/2011	11	7.9	<1	0.15	2	25	3.6	NA	11.39	NA	NA	57	60	3	NA	4.5
2/17/2011	NA	7	NA	0.3	2	NA	NA	NA	11.04	NA	NA	32	10	2	NA	2.7
3/17/2011	9	8	<1	0	10	18.9	3	NA	10.13	275	NA	40	60	5	NA	11.2
4/21/2011	NS	8.2	NS	0	10	NS	NS	NA	11.54	NS	NS	<33	28	1	NA	8.2
5/16/2011	63	8.2	<1	0	10	8.6	2.3	NA	10.58	1,000	NA	<33	18	0.2	NA	10.7
6/16/2011	78	8.1	<1	0	10	8.6	2	NA	13	600	NA	<33	15	0.3	NA	16
7/21/2011	13	8	<1	0	2	19.1	3	NA	7.37	4,700	NA	45	54	2	NA	24.3
8/18/2011	11	7.4	<1	0.15	0	16	5	NA	7.41	NA	NA	88	50	6	NA	21.2
9/15/2011	8	7.8	<1	0.15	1	24.5	4	NA	7.84	200	NA	88	60	10	NA	17.7
10/27/2011	17	7	10.2	1.5	10	61.2	>9.6	NA	4.42	10,100	NA	112	43	10	NA	17.2
11/18/2011	9	7.6	<1	0.15	10	29	3	NA	12.2	NA	NA	77	60	6	NA	8.5
12/15/2011	9	7.9	<1	0	2	29	2.4	NA	11.4	NA	NA	48	60	2	NA	6.1
AVERAGE	22.625	7.844	5.25	0.121429	4.571429	19.6	2.947826	8.133333	10.1108	2130.5	965	58.4	43.3	3.125	5.24	11.604

NS = Not sampled
NA = Not analyzed
TNTC = Too numerous to count

977078 - Oralabor
Fourmile Creek

	Field/Meter Analyzed Samples								Laboratory Analyzed Samples				
	Chloride	DO	pH	Water Temp	Transparency	Nitrite	Nitrate	Phosphate	TSS	NH-3	COD	CBOD	Fecal
Date	mg/L	mg/L	SU	Celsius	cm	(field)	(field)	(field)	mg/L	mg/L	mg/L	mg/L	cfu/dL
11/18/2009	ns	11.3	8.2	9.4	NS	NS	NS	NS	6	<1	1	0.9	1351
12/17/2009	42	13.55	8.0	2.0	NS	NS	NS	NS	19	<1	3.9	3.2	58
1/28/2010	49	14.0	7.8	3.6	NS	NS	NS	NS	15	<1	7.4	3	TNTC
2/25/2010	57	14.00	8.0	0.2	NS	NS	NS	NS	13	<1	5	2	NA
3/18/2010	<29	11.67	7.7	5.9	14	0	2+	1	93	<1	NA	3	<10,000
4/15/2010	29	8.67	8.1	13.8	48	0	5	1	20	<1	33	2.4	NA
5/27/2010	<29	9.63	8.2	17.9	29	0	2	2	12	<1	13	2	NA
6/24/2010	<32	8.90	7.98	18.9	27	0	5	2	36	<1	8	5	NA
7/15/2010	<32	7.7	8.2	24	34	0	5	NS	25	<1	17	2	NA
9/2/2010	NS	NS	NS	NS	NS	NS	NS	NS	9	<1	23	3	NS
9/16/2010	<32	8.98	8.2	19.5	43	0	2	2	15	<1	10.7	2.3	2800
10/21/2010	<32	10.19	8.3	12.2	60	0	2	2	4	<1	8	1.7	600
11/19/2010	<32	11.59	8.1	7.1	60	0	2	1	9	0.3	4.3	4	NA
12/16/2010	<33	12.83	8.2	1.6	25	0	1	1	37	<1	14	2	NA
1/20/2011	48	12.95	8.2	0.6	53	0.15	2	2	16	<1	16	3.3	NA
2/17/2011	40	11.17	8	4.1	10	0.15	1	1	NA	NA	NA	NA	NA
3/17/2011	47	11.56	8.3	11.2	60	0	10	3	9	<1	10.1	4	138
4/21/2011	<33	11.66	8.1	6.6	24	0	5	1	NS	NS	NS	NS	NS
5/16/2011	<33	10.6	8.3	10.8	20	0	10	0.2	63	<1	11.9	2.5	1500
6/16/2011	<33	9.09	7.9	16.2	16	0	10	0.6	97	<1	11.6	2	1900
7/21/2011	39	7.19	8.2	25.4	52	0	2	3	14	<1	2.6	2	300
8/18/2011	88	8.21	7.8	22.5	35	0.15	0	7	16	<1	28.5	4	NA
9/15/2011	100	7.41	7.7	13.3	60	0.15	1	10	7	3	21.5	3	1000
10/27/2011	125	4.94	7	11.6	60	0.3	5	10	3	10.3	38.1	4.2	300
11/18/2011	88	9.7	7.9	7.2	60	0.15	5	6	4	<1	25	1	NA
12/15/2011	39	11.7	8.1	4.6	54	0	1	0.8	9	<1	22	0.6	NA
1/24/2012	200	10.9	8	4.2	43	0.15	5	5	NA	NA	NA	NA	NA
2/16/2012	134	11.2	8.2	4.5	47	0.15	5	6	NA	NA	NA	NA	NA
3/15/2012	33	10.6	8.3	10.7	60	0.15	5	0.1	NA	NA	NA	NA	NA
3/15/2012	66	7.3	7.8	10.9	60	1	5	4	NA	NA	NA	NA	NA
4/19/2012	33	8.25	8.2	13	24	1	10	2	NA	NA	NA	NA	NA
5/17/2012	39	9.1	8.2	17.5	45	NS	NS	2	NA	NA	NA	NA	NA
6/21/2012	<32	7.6	8.2	22.4	21	0	10	1	9	NA	27.4	2	0
7/25/2012	94	5.5	7.6	26.5	60	0.15	20	10+	NA	NA	NA	NA	NA
8/16/2012	85	6	7.7	20.8	28	0.15	10	8	NA	NA	NA	NA	NA
9/20/2012	94	6.4	7.6	16	60	1	10	7	3	0.83	25.5	2	400
10/18/2012	94	5.4	7.6	12.2	60	1	5	4	NA	NA	NA	NA	NA
11/20/2012	94	9.8	7.7	11.5	60	0.15	10	6	NA	NA	NA	NA	NA
12/18/2012	94	8.1	7.7	8.6	60	0.15	5	6	NA	NA	NA	NA	NA
1/24/2013	94	11.6	7.8	0.1	49	3	20	1	12	0.8	23.6	4.4	22000
3/7/2013	261	11.6	8.0	3.5	47	1	10	3					
3/28/2013	137	11.8	8.0	8.8	60	0	5	3	6	<1	14.5	2.5	<100
4/24/2013	52	12.0	8.1	6.8	60	0	10	1					
5/16/2013	52	9.2	8.1	17	60	0	20	1					
6/27/2013	<32	8	8.1	22.2	33	0	10	2	44	<1	35.0	0.3	4680
7/18/2013	78	6.5	7.9	23.6	60	0	2	10+					
8/16/2013	96	4.8	7.4	18	60	0.3	20	8					
9/11/2013	116	5.5	7.3	23.4	60	1	20	6	2	<1	82.0	2	142
10/18/2013	87	7.5	7.4	11.9	60	0.15	10	6					
11/22/2013	70	12.8	no meter	0.4	60	0	1	0.1					
12/19/2013	Frozen, unable to sample												

NS = Not sampled
NA = Not analyzed
TNTC = Too numerous to count

	Chloride	DO	pH	Water Temp	Transparency	Nitrite	Nitrate	Phosphate	TSS	NH-3	COD	CBOD	Fecal
AVERAGE	82.68571	9.5233	7.94542	11.93265306	46.24444444	0.2625	7.069767	3.304762	20.9	3.046	18.74483	2.543333	2477.933

977237 - Tributary A
Fourmile Creek

	Field/Meter Analyzed Samples								Laboratory Analyzed Samples				
	Chloride	**DO**	**pH**	**Water Temp**	**Transparency**	**Nitrite**	**Nitrate**	**Phosphate**	**TSS**	**NH-3**	**COD**	**CBOD**	**Fecal**
Date	**mg/L**	**mg/L**	**SU**	**Celsius**	**cm**	**(field)**	**(field)**	**(field)**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**cfu/dL**
11/18/2009	NS	11.7	8.2	7.9	NS	NS	NS	NS	3	<1	8	1.2	56
12/17/2009	192	12.51	7.8	1.1	NS	NS	NS	NS	2	<1	4.4	1.5	1448
1/28/2010	124	13.07	8.0	1.5	NS	NS	NS	NS	2	<1	0.0	4	TNTC
2/25/2010	Could not sample, water frozen												
3/18/2010	102	13.08	7.8	4.8	60	0	1	0	14	<1		2	<10,000
4/15/2010	113	8.16	8	13.5	60	0	2	0	4	<1	44	2.6	
5/27/2010	102	7.83	8.0	17.3	60	0	0	0	2	<1	34	2	
6/24/2010	138	8.35	8.0	21.0	60	0	0	0	5	<1	5	5	
7/15/2010	39	6.80	7.9	23.9	60	0	1	NS	3	<1	18	2	
9/2/2010	39	7.85	8.0	22.2	60	0	1	0.1	1	<1	14	3.2	
9/16/2010	88	7.00	8.2	17.4	60	0	0	0	1	<1	11.1	1.6	700
10/21/2010	88	5.72	7.8	10.4	60	0	0	0	0	<1	12	1.4	900
11/19/2010	48	11.60	8.0	5.1	60	0	0	0	2	0.3	10.2	4	
12/16/2010	100	10.45	7.5	3.9	60	0	0	0	<1	<1	7	1	
1/20/2011	463	12.28	8.0	1.6	60	0	0	0	2	<1	10	2.3	
2/17/2011	180	10.73	7.0	5.8	43	0	0	0.1					
3/17/2011	174	10.34	8.0	9.7	60	0	1	0	10	<1	11.4	4	163
4/21/2011	80	11.97	8.2	7.7	60	0	1	0					
5/16/2011	54	9.42	8.2	11.5	60	0	1	0	8	<1	8.3	2.4	700
6/16/2011	54	8.27	8.1	17.7	60	0	2	0.2	14	<1	13.5	2	1600
7/21/2011	100	6.23	8	23	60	0	1	0.1	4	<1	4.4	1	4300
8/18/2011	88	5.71	7.7	19.7	60	0	0	0	3	<1	7.7	3	
9/15/2011	112	7.79	7.8	11.9	60	NS	NS	0	0	<1	6.7	2	100
10/27/2011	112	5.7	7	9.4	60	0	0	0	3	<1	6.3	2.2	200
11/18/2011	125	11.9	8.1	4.4	60	0	0	0	6	<1	7	1	
12/15/2011	57	11.5	7.9	4.1	60	0	0	0	3	<1	27	0.4	
1/24/2012	**614**	12	8.6	1.3	60	0	0	0.1					
2/16/2012	233	13	8.2	1.8	30	0	0	0					
3/15/2012	122	8.4	7.8	10.7	60	0	0	0					
4/19/2012	75	8.35	8.1	13	38	0	1	NS					
5/17/2012	112	8	7.9	14.6	60	NS	NS	0.1					
6/21/2012	38	7.2	8.2	22.3	60	0	0	0.1	4	<1	22.4	1	0
7/25/2012	Unable to sample, no flow												
8/16/2012	<32	7.7	8.3	21.4	49	0	0	0.1					
9/20/2012	45	5.0	7.8	14.5	60	0	0	0	5	0.05	12.8	2	1500
10/18/2012	115	4.4	7.7	10.9	60	0	0	0					
11/20/2012	52	10.0	7.9	7.7	60	0	0	0.1					
12/18/2012	94	10.4	7.9	3.6	60	0	0	0					
1/24/2013	192	12.5	7.4	1	60+	0	0	0	1.5	<1	26.2	1.1	0
3/7/2013	>634	14.0	8.9	0.9	60	0	0	0					
3/28/2013	281	15.4	8.0	5.0	60	0	1	0	5	<1	30.0	0.8	400
4/24/2013	115	13.2	8.2	6.2	60	0	2	0					
5/16/2013	52	9.4	8.1	14.7	60	0	5	0					
6/27/2013	70	7.3	8	21.7	60	0	2	0.2	5	<1	21.0	0.7	4720
7/18/2013	105	4.3	7.7	22.7	60	0	1	No strips					
8/16/2013	96	5.1	7.6	16.8	60	0	1	0.1					
9/11/2013	55	3.6	7.6	22.0	27	0	1	0	24	<1	94	16	<1
10/18/2013	78	7.1	7.8	10.0	60	0	0	0					
11/22/2013	96	10.3	no meter	2.3	60	0	1	0					
12/19/2013	Frozen, unable to sample												

NS = Not sampled
NA = Not analyzed
TNTC = Too numerous to count

AVERAGE	123	9.2045	7.9326	11.09787234	57.37209302	0	0.619048	0.0317073	4.875	0.175	17.01429	2.531034	1119.133

977238 - Tributary B
Fourmile Creek

	Field/Meter Analyzed Samples								Laboratory Analyzed Samples				
	Chloride	**DO**	**pH**	**Water Temp**	**Transparency**	**Nitrite**	**Nitrate**	**Phosphate**	**TSS**	**NH-3**	**COD**	**CBOD**	**Fecal**
Date	**mg/L**	**mg/L**	**SU**	**Celsius**	**cm**	**(field)**	**(field)**	**(field)**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**cfu/dL**
11/18/2009	NS	10.8	8.1	8.1	NS	NS	NS	NS	1	<1	2	1.1	13
12/17/2009	65	11.36	7.6	0.5	NS	NS	NS	NS	4	<1	0.0	1.7	820
1/28/2010	65	12.47	7.9	2.0	NS	NS	NS	NS	74	<1	6.3	11	40,000
2/25/2010	Could not sample, water frozen												
3/18/2010	65	11.04	7.7	6.8	60	0	2	0	14	<1		1	<10,000
4/15/2010	65	8.35	7.9	12.6	60	0	2	0	4	<1	45	2.1	
5/27/2010	65	7.82	7.9	15.7	60	0	1	0.2	5	<1	45	2.2	
6/24/2010	39	8.81	7.9	17.5	60	0	2	0	6	<1	1	4	
7/15/2010	32	7.43	7.6	20.2	60	0	2	NS	3	<1	14	1	
9/2/2010	32	7.15	7.7	20.7	60	0	2	0.2	3	<1	14	2.2	
9/16/2010	32	5	7.4	16.5	60	0	0	0.2	2	<1	7.4	2	500
10/21/2010	39	5.47	7.5	10.8	60	0	0	0	0	<1	10	3.1	600
11/19/2010	32	9.83	7.6	6.3	60	0	1	0	1	0.3	10.2	4	
12/16/2010	Could not sample, water frozen												
1/20/2011	Could not sample, water frozen												
2/17/2011	110	10.46	7	7.0	38	0	0	0.2					
3/17/2011	71	9.8	7.8	9.7	60	0	2	0	5	<1	6	4	88
4/21/2011	40	12.34	8.5	8.5	60	0	5	0					
5/16/2011	40	11.1	8	10.9	23	0	1	0	27	<1	13.5	2.6	1,200
6/16/2011	33	8.8	8	15.7	60	0	5	0.1	12	<1	10.2	2	2,900
7/21/2011	39	5.43	7.6	21.6	60	0	0	0.2	4	<1	3.5	2	9,000
8/18/2011	39	3.6	7.7	20.9	3	0	0	0	217	<1	25.2	3	
9/15/2011	39	4.0	7.8	10.8	60	NS	NS	0	17	<1	13.1	3	600
10/27/2011	Water level too low to collect sample												
11/18/2011	32	4.4	7.6	3.4	60	0	0	0.2	6	<1	0	1	
12/15/2011	57	8.8	7.7	4.4	60	0	0	0	2	<1	2	0.6	
1/24/2012	**614+**	8.4	7.9	0.1	60	0	0	0					
2/16/2012	270	10.6	8	1.7	60	0	0	0					
3/15/2012	66	6.6	7.7	10.3	60	0	0	0					
4/19/2012	<33	8.3	8	12.6	33	0	1	0.1					
5/17/2012	45	6.1	7.8	15.9	60	NS	NS	0.1					
6/21/2012	<32	8.2	7.8	22.3	60	0	0	0.1	9	<1	34.2	1	100
7/25/2012	32	5.6	8	26.1	60	0	0	0.4					
8/16/2012	<32	5.1	8	20.5	44	0	0	0.1					
9/20/2012	32	4.0	7.6	13.7	60	0	0	0.2	5	0.06	20.9	2	500
10/18/2012	<32	3.5	7.6	10.9	60	0	0	0					
11/20/2012	38	6.2	7.5	7.4	60	0	0	0.1					
12/18/2012	52	7.0	7.6	7.6	60	0	0	0					
1/24/2013	Frozen, unable to sample												
3/7/2013	Frozen, unable to sample												
3/28/2013	406	13.2	7.6	6.5	57	0	2	0	9	<1	27.5	0.5	<100
4/24/2013	52	13.1	8.1	7.8	60	0	5	0.1					
5/16/2013	68	10.3	8.1	13.9	60	0	5	0.1					
6/27/2013	41	6.5	7.7	19.7	60	0	5	0.2	1	<1	8.0	0.2	7520
7/18/2013	Completely algae-covered; did not sample												
8/16/2013	41	5.4	7.5	17.6	30	0	0	0.1					
9/11/2013	Stagnant water, level extremely low; did not sample												
10/18/2013	Stagnant water, level extremely low; did not sample												
11/22/2013	Stream covered in ice, low water; unable to sample												
12/19/2013	Frozen, unable to sample												

NS = Not sampled
NA = Not analyzed
TNTC = Too numerous to count

AVERAGE	65.87879	8.0087	7.7692	11.92820513	54.66666667	0	1.264706	0.082857	17.95833	0.18	13.86957	2.3875	4910.846

Appendix E: Monitoring Data Report from Mary Skopec at IOWATER

Four Mile Creek Summarization and Interpretation

Monitoring on Four Mile Creek began in June of 2004 to assess the quality of the creek and to understand the changes created by the cessation of wastewater inputs from the City of Ankeny and have continued to the present time. Monitoring activities have been conducted as part of the regular Polk County Snapshots (one to two times a year) and as part of the IOWATER citizen monitoring program. Initially the IOWATER testing was conducted one to two times a year, but starting in 2010, was increased to approximately monthly testing. Data collected as part of the Polk County Snapshot includes both laboratory testing methods for nitrate, nitrite, orthophosphate as P, total phosphate as P, turbidity, *E. coli* bacteria, total kjeldahl nitrogen, bromide, fluoride, ammonia nitrogen as N, sulfate, total coliform bacteria and IOWATER field kit methods. Data collected as part of the IOWATER program includes field measurements for nitrate, nitrite, phosphorus, chloride, dissolved oxygen and water transparency.

Sites sampled as part of the monitoring were FMC1, FMC2, FMC3, FMC4, FMC5, FMC6, FMC7, FMC8, FMC9, and FMC10. Sites were ordered from the headwaters (FMC1) to the lower stretches of Four Mile Creek near it's confluence with the Des Moines River (FMC10, See Table 1). For purposes of graphing and interpretation, results that fell below the method reporting limit were standardized to ½ of the method reporting limit (for example, if a nitrate result was reported as <0.5 mg/L, the result was standardized to 0.25 mg/L for graphing).

Station Name	Station Type	UTMX	UTMY	Latitude	Longitude
Site FMC1 - Fourmile Creek	River/Stream	445380	4633292	41.84965	-93.658
Site FMC10 - Fourmile Creek	River/Stream	455987	4604378	41.58989	-93.5281
Site FMC2 - Fourmile Creek	River/Stream	448132	4630020	41.82036	-93.6245
Site FMC3 - Fourmile Creek	River/Stream	450708	4625158	41.77674	-93.5931
Site FMC4 - Fourmile Creek	River/Stream	451690	4621989	41.74826	-93.581
Site FMC5 - Fourmile Creek	River/Stream	452617	4618529	41.71715	-93.5696
Site FMC6 - Fourmile Creek	River/Stream	453750	4616908	41.70262	-93.5559
Site FMC7 - Fourmile Creek	River/Stream	454563	4612016	41.6586	-93.5457
Site FMC8 - Fourmile Creek	River/Stream	454347	4608786	41.6295	-93.5481
Site FMC9 - Fourmile Creek	River/Stream	454556	4607047	41.61385	-93.5454

Table1. Four Mile Creek Sites

Figure 1 shows the box plot graphs for phosphorus, transparency and dissolved oxygen using the IOWATER field methods. The data show very high levels of phosphorus throughout the entire Four Mile Creek watershed. Iowa currently lacks a water quality standard for phosphorus, but the scientific literature indicates that at levels above 0.1 mg/L adverse impacts to aquatic life occur including frequent and severe algal blooms. Based on the IOWATER field methods, phosphorus rarely occurs below 0.1 mg/L. Median levels of phosphorus in Four Mile Creek are above 1 mg/L and at times reach nearly 10 mg/L, particularly in the lower stretches. The wastewater discharge for the City of Ankeny enters Four Mile Creek downstream of FMC4 and just upstream of FMC5. The large increase in phosphorus between these two sites is a direct result of municipal wastewater. Municipal wastewater contains large amounts of phosphorus and since these facilities are not currently required to remove phosphorus, streams often experience significant increases in phosphorus, especially if the stream flow is typically low. Phosphorus levels above the City of Ankeny are impacted by wastewater discharges from the town of Slater that occurs above sites FMC1 and FMC2 and Alleman that occurs before site FMC3. Phosphorus levels show some variability suggesting that the amount of water in the stream may provide for some dilution and processing when flows are higher (Figure 2). The increases in phosphorus levels during the latter part of 2011 and 2012 document the impact of the extreme drought conditions on phosphorus in Four Mile Creek.

Dissolved Oxygen levels in Four Mile Creek generally meet Iowa's water quality standard for warm water streams (5 mg/L); however several of the sites recorded dissolved oxygen levels below the standard occasionally (FMC1, FMC2, FMC5) and all of the sites had 10% or greater of dissolved oxygen readings below 6 mg/L. The low oxygen readings suggest that the stream is having difficulty assimilating all the nutrients discharged to it through the wastewater systems. Given that the oxygen readings are taken during the day, it is reasonable to assume that the oxygen levels may be much lower at night when aquatic plants are no longer providing oxygen to the stream through photosynthesis.

Transparency measurements for the ten Four Mile Creek sites indicate that water clarity is typically pretty high with median transparency levels above 40 cm for all of the sites except for FMC3 and FMC4 (Figure 1). It is unknown why the water clarity is lower at these two sites, although it may be related to algae growth in response to the high phosphorus levels coming from further upstream in the creek. As is expected, transparency values show extreme variability throughout the season ranging from 10 cm to 60 cm (Figure 3). These changes in transparency are likely related to rainfall runoff events that cause erosion in the watershed and within the creek banks. Further analysis to correlate transparency values to rainfall needs to be conducted to document the impact of erosion on transparency in the watershed.

Nitrate plus nitrite as N concentrations in Four Mile Creek are typically low with median concentrations between 2 and 5 mg/L (Figure 4). The statewide median concentration for nitrate plus nitrite as N for Iowa's ambient stream network is 5.5 mg/L (DNR Water Fact Sheet 2013-1). Iowa currently does not have an aquatic life standard for nitrate, but the drinking water standard is 10 mg/L for waters designated as drinking water sources. Four Mile Creek is not a drinking water source, but the 10 mg/L standard is provided as a frame of reference on the graphs below. Four Mile Creek is largely urban stream, particularly in the lower stretches (below FMC3). Data collected from around the State of Iowa demonstrate that urban streams typically have lower nitrate levels than agricultural streams due to lower inputs of nitrogen and because runoff in urban areas is dominated by overland flow that is delivered to the creek through storm sewers. Since nitrate forms in the soil profile, water that doesn't infiltrate the soil before being delivered to the stream does not have the opportunity to leach nitrate from the soil and deliver it to local creeks and streams. The time series data in Figure 5 show that nitrate levels in most of Four Mile Creek were below 10 mg/L from 2004 and into 2011. However, levels jump in late 2012 and 2013. Some of the increase in 2013 can be explained by the hydrologic response to the end of the drought that occurred in late 2011 and 2012. Nitrate is water soluble and the lack of rainfall prevented mobilization of nitrate to streams. Statewide, nitrate levels were much higher in 2013 than in 2011 and 2012. However, nitrate levels in Four Mile Creek did appear to have fairly large spikes during 2012 that are not understood at this time. Further analysis to determine the reasoning for these spikes is needed.

Chloride levels in Four Mile Creek also depict an urban stream. Chloride levels steadily increase from the upstream sites to the downstream sites (Figure 4). This increase is expected as the heavily urbanized segments of Four Mile Creek undoubtedly receive higher road salt applications than the more rural segments of the watershed. The sudden increase in chloride above FMC5 and the very large spike in chloride at Site FMC6 may be also be related to the wastewater discharges above FMC5.

E. coli bacteria levels in Four Mile Creek show very high levels at the majority of the sites (Figure 6). The one-time sample maximum standard for *E. coli* is 235 CFU/100ml (show with a blue line on Figure 6). All of the Four Mile Creek sites exceed this standard more than 50% of the time as indicated by the median line in the box plots. Several of the sites exceed this standard more than 75% of the time (FMC3, FMC4, FMC6, FMC7, FMC8 and FMC9). Additionally, the State of Iowa uses a geomean standard of 126 CFU/100ml to determine bacteria based impairments. The majority of the Four Mile Creek sites also exceed this standard the majority of the time. Unlike other parameters, the *E. coli* values do not have a strong upstream to downstream component, which suggests that wastewater discharges may not be the biggest contributor to *E. coli* levels in Four Mile Creek. Figure 7 shows the temporal variability in *E. coli* levels throughout the watershed. Based on the time series graphs, there does not seem to be an overall increase or decrease in *E. coli* during the period of record and the values show extreme variability likely based on rainfall events that flush bacteria into the system.

The laboratory total phosphorus and orthophosphorus data (analyzed by Des Moines Water Works) correlate well with the IOWATER field kit data (Figure 6 and 8). The laboratory data also reflect the significant impact wastewater discharges are having on Four Mile Creek and show highly elevated levels throughout the watershed. The laboratory data also show that the fraction of total phosphorus comprised by orthophosphorus (largely dissolved form) is very high, which also is an indication that the phosphorus in Four Mile Creek is coming from wastewater. If the total phosphorus were coming from sediment sources, we would expect the fraction of total P comprised by ortho P to be much lower. Laboratory nitrate plus nitrite as N values are also similar to the IOWATER field kit values and also show an increase in nitrate levels during the drought of 2012 that are currently unexplained (Figure 9 and 10).

Turbidity values in Four Mile Creek are similar to transparency values discussed earlier. While transparency records the clarity of water, turbidity readings record the lack of water clarity. Figure 10 shows that turbidity levels are fairly low throughout the watershed (medians below 10 NTU) with period increases to 100 NTU. Figure 10 also shows that Four Mile Creek has turbidity levels that are generally below the statewide median for all streams of 16 NTU. The time series plots for Four Mile Creek also demonstrate a significant temporal variability in turbidity readings, which is to be expected based on rainfall runoff events.

In summary, Four Mile Creek is a highly urbanized stream with significant wastewater inputs and impacts from the City of Ankeny, Slater and Alleman. Documenting changes in water quality as the Ankeny discharge goes off-line will show the improvements that can be made by altering the amount of phosphorus discharged to a small stream. Chloride values are likely to continue to be elevated in the near term, unless changes are made to road salt applications in the urban environment.

FFigure
1

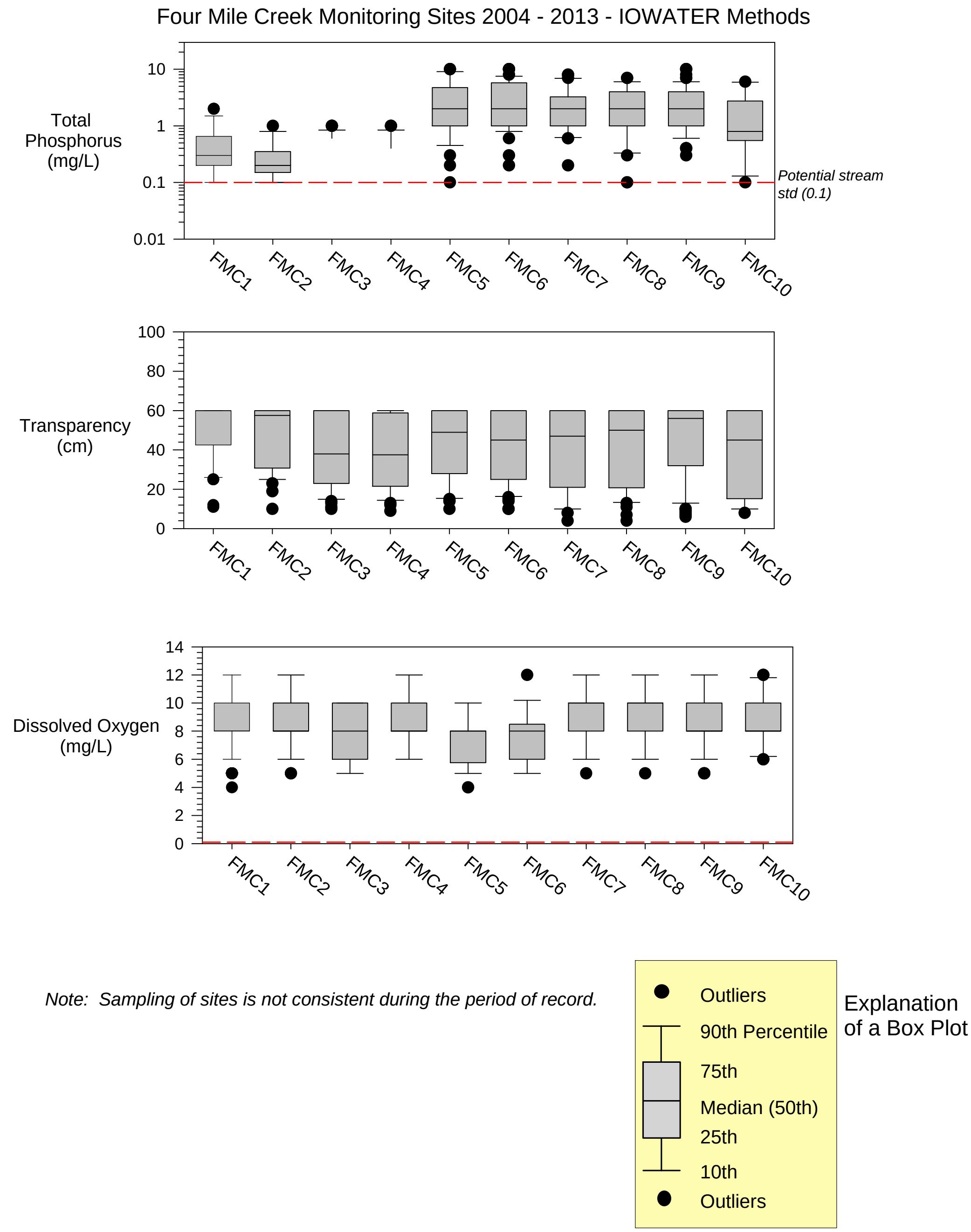


Figure 1. Four Mile Creek Box Plots of Total Phosphorus, Transparency and Dissolved Oxygen.

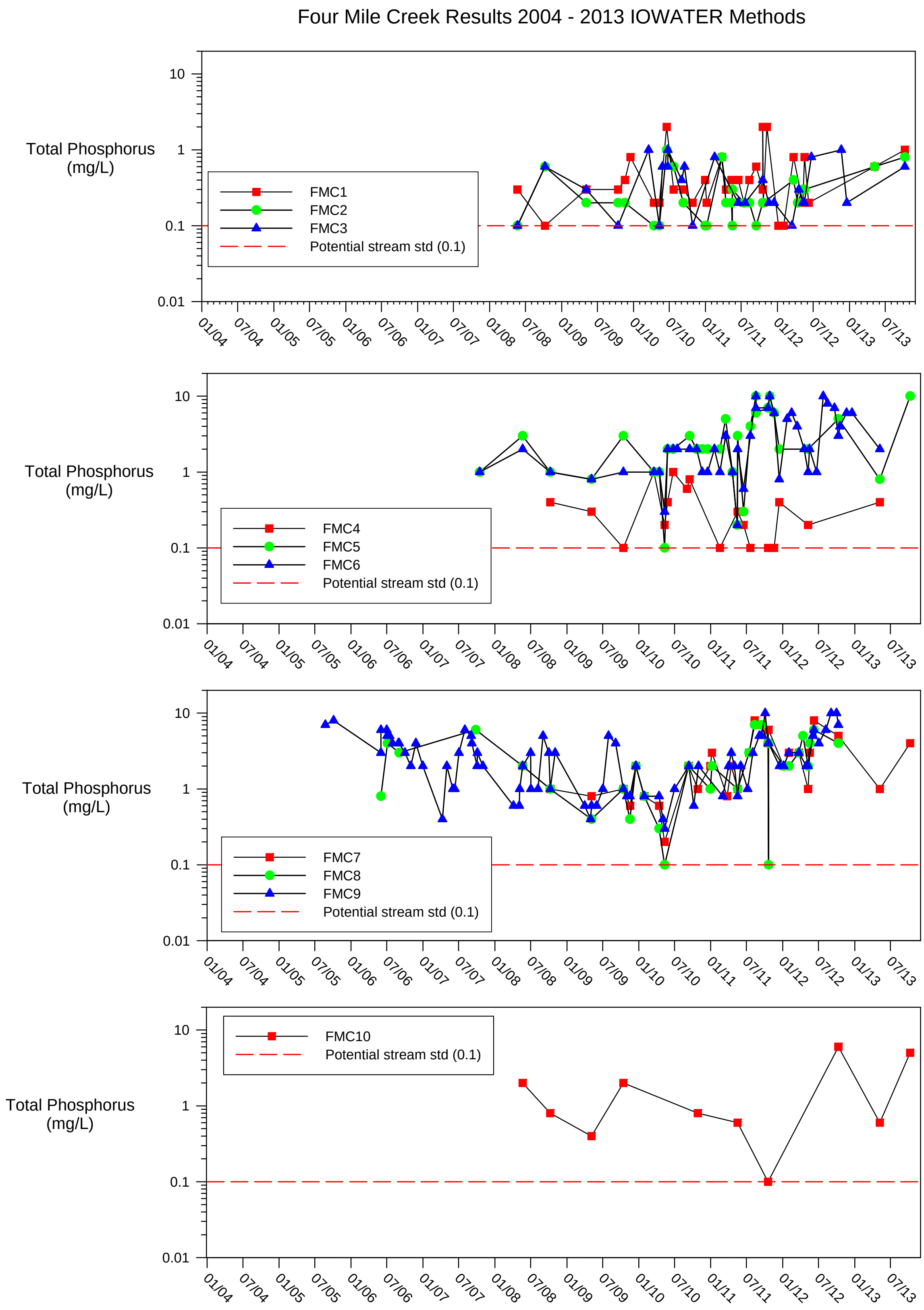


Figure 2. Four Mile Creek Phosphorus Time Series Graphs

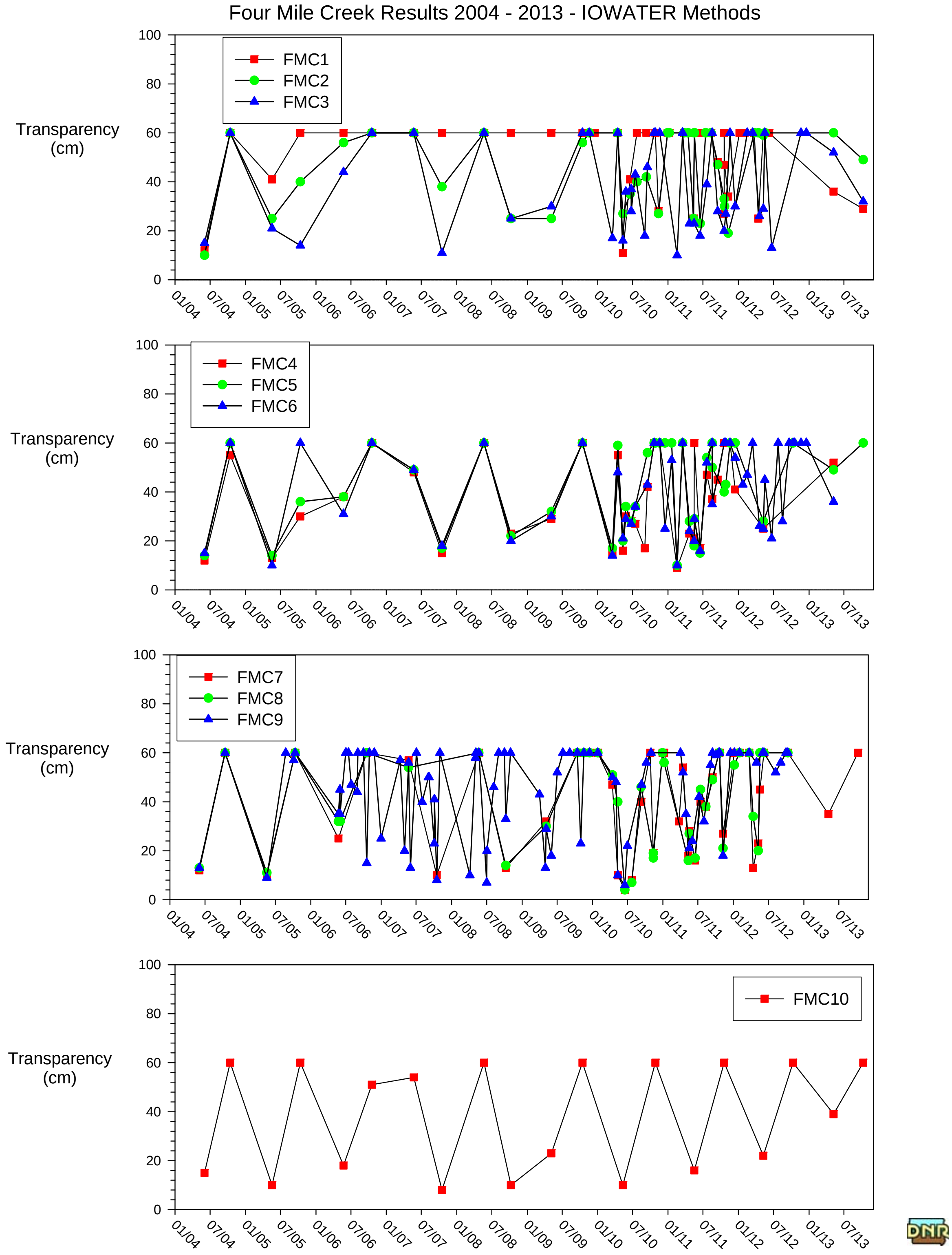


Figure 3. Four Mile Creek Transparency Time Series.

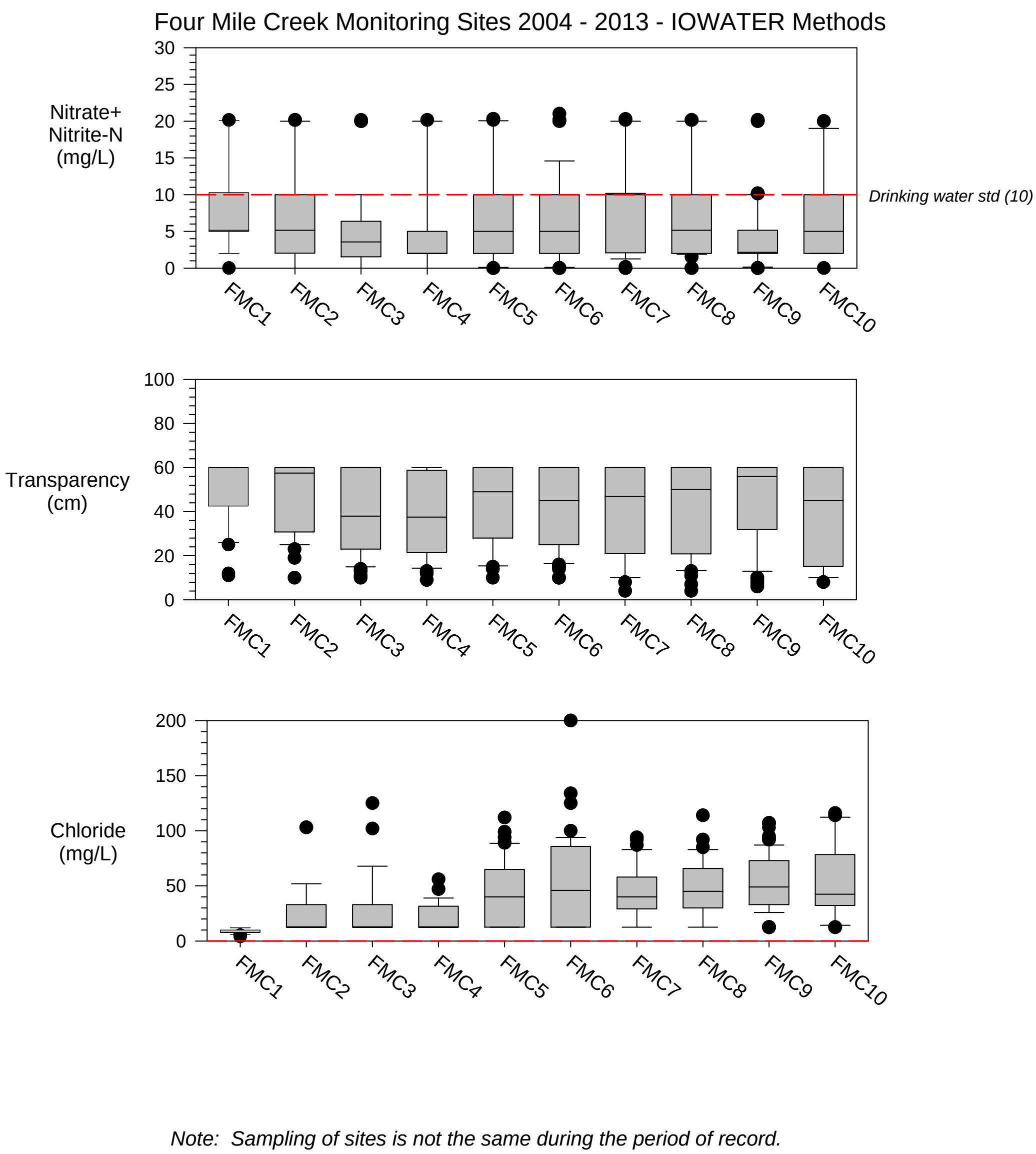


Figure 4. Box plot graphs of Nitrate, Transparency and Chloride for Four Mile Creek.

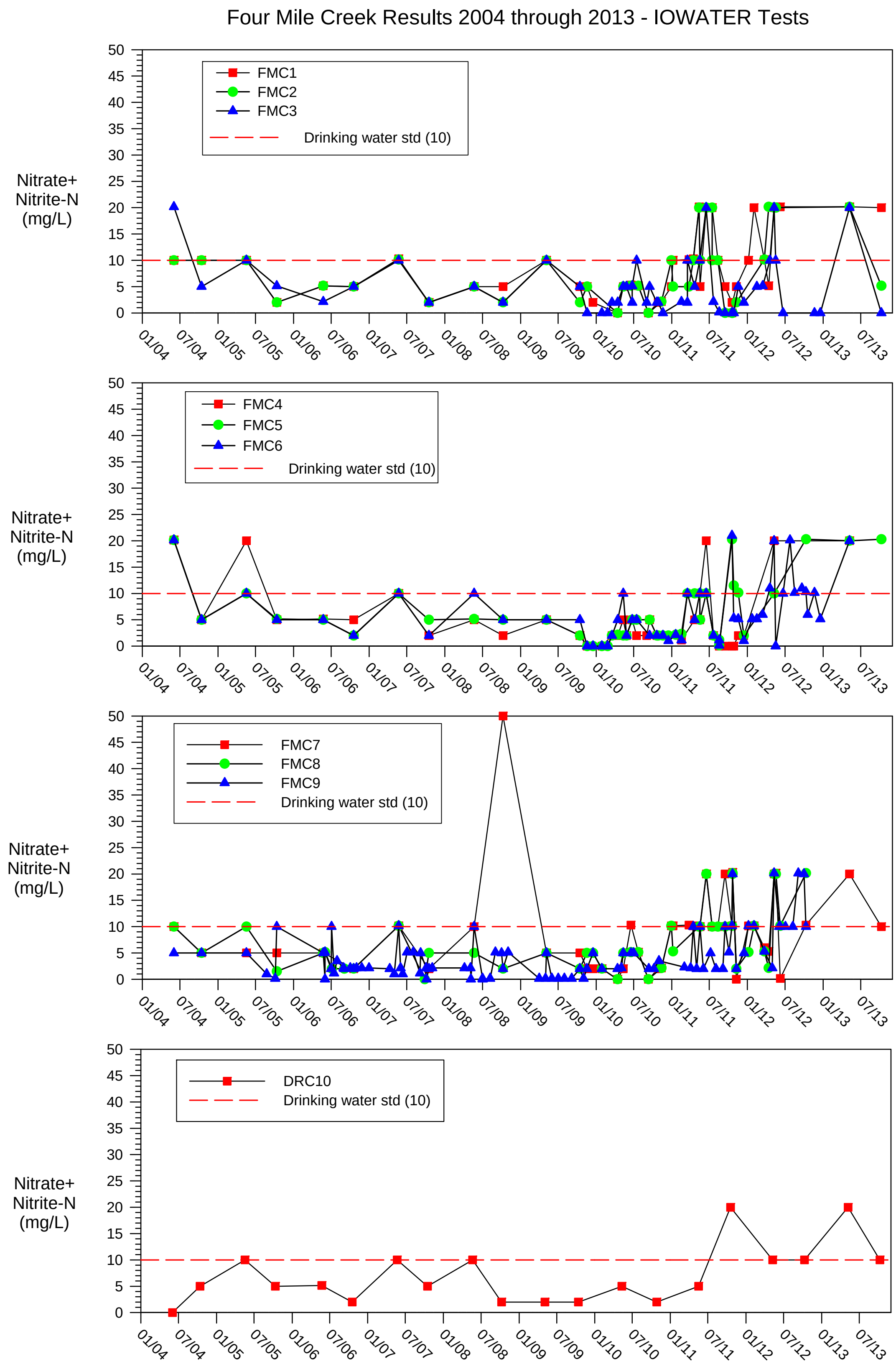


Figure 5. Four Mile Creek Nitrate plus Nitrite as N Time Series.

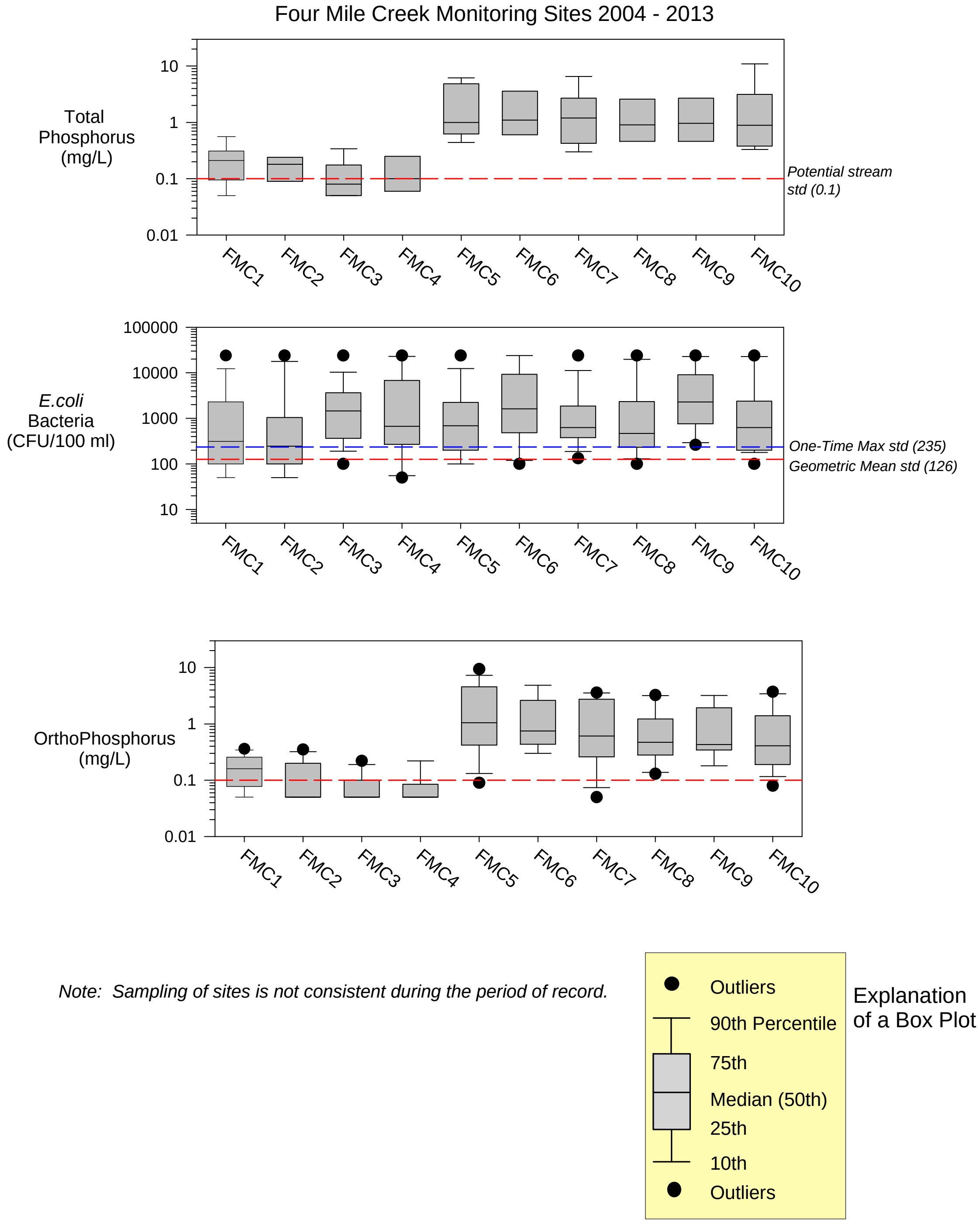


Figure 6. Four Mile Creek Box Plots of E. coli, Total phosphorus and Orthphosphorus.

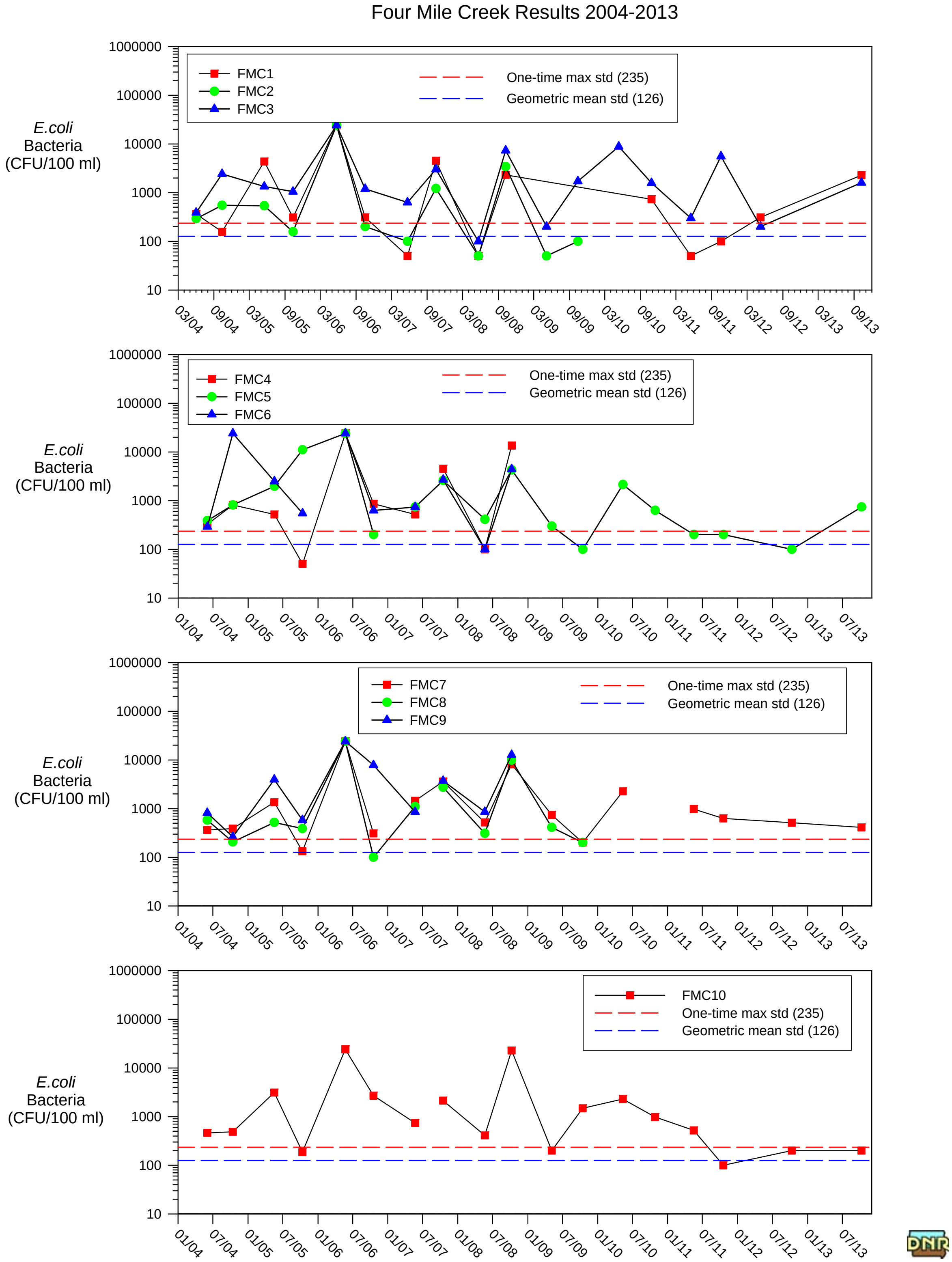


Figure 7. Four Mile Creek *E. coli* Time Series.

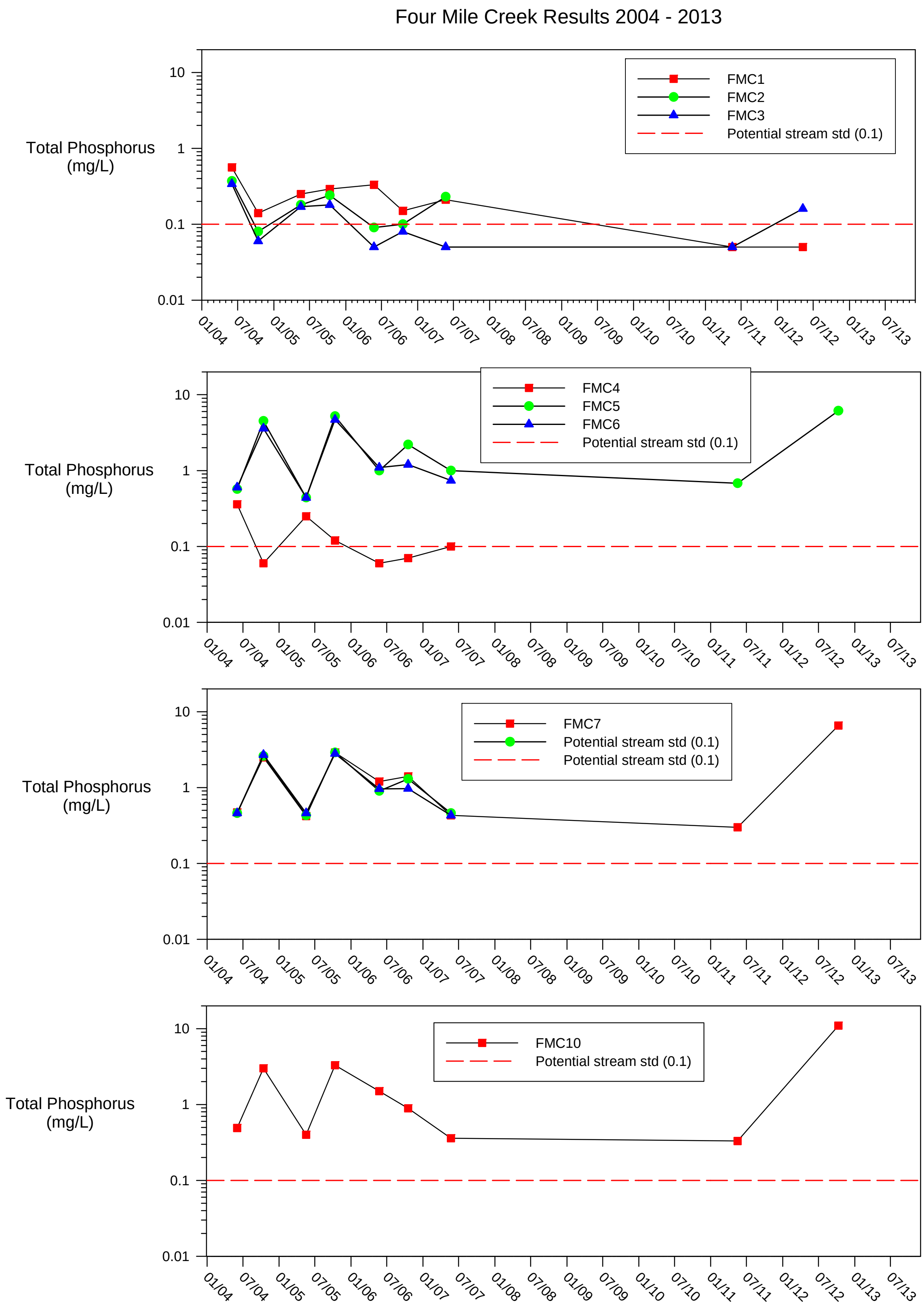


Figure 8. Four Mile Creek Total Phosphorus (Laboratory Methods) Time Series.

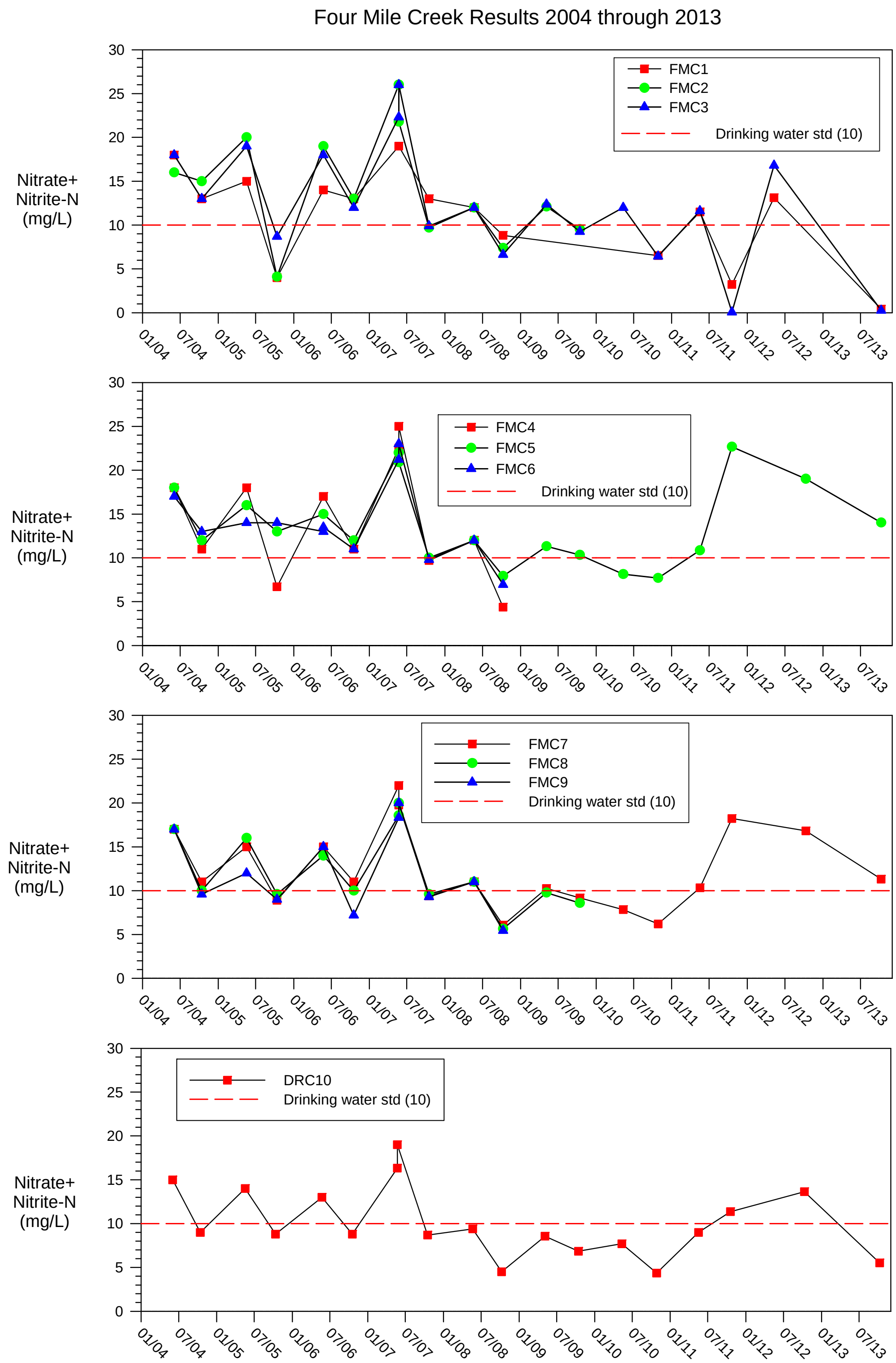
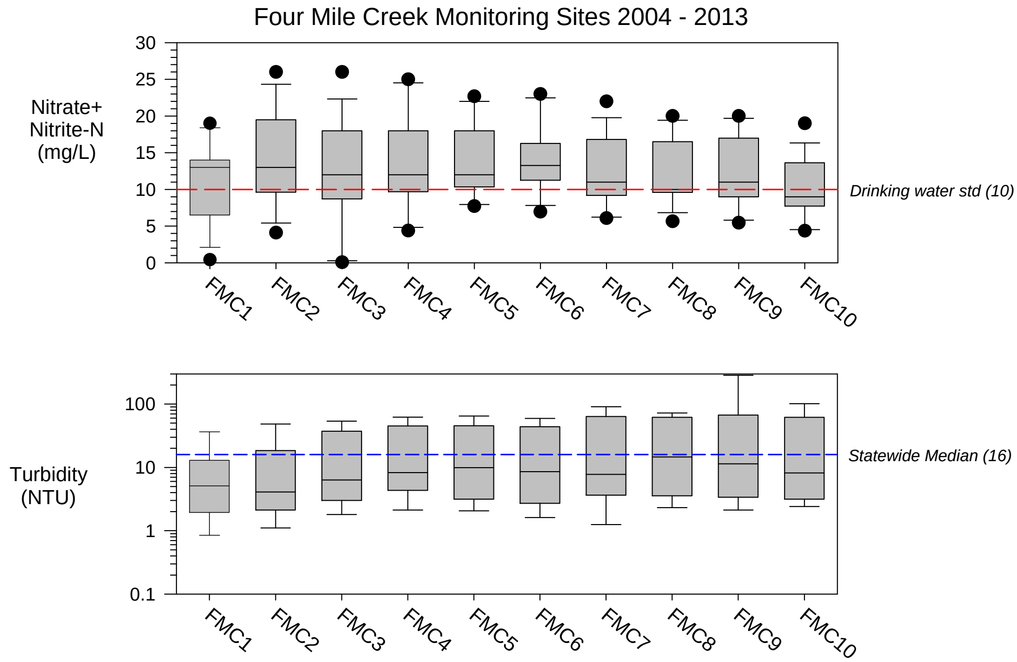


Figure 9. Four Mile Creek Nitrate plus Nitrite as N (Laboratory Methods) Time Series.



Note: Sampling of sites is not the same during the period of record.

Figure 10. Four Mile Creek Box Plots of Nitrate and Turbidity (Laboratory Methods).

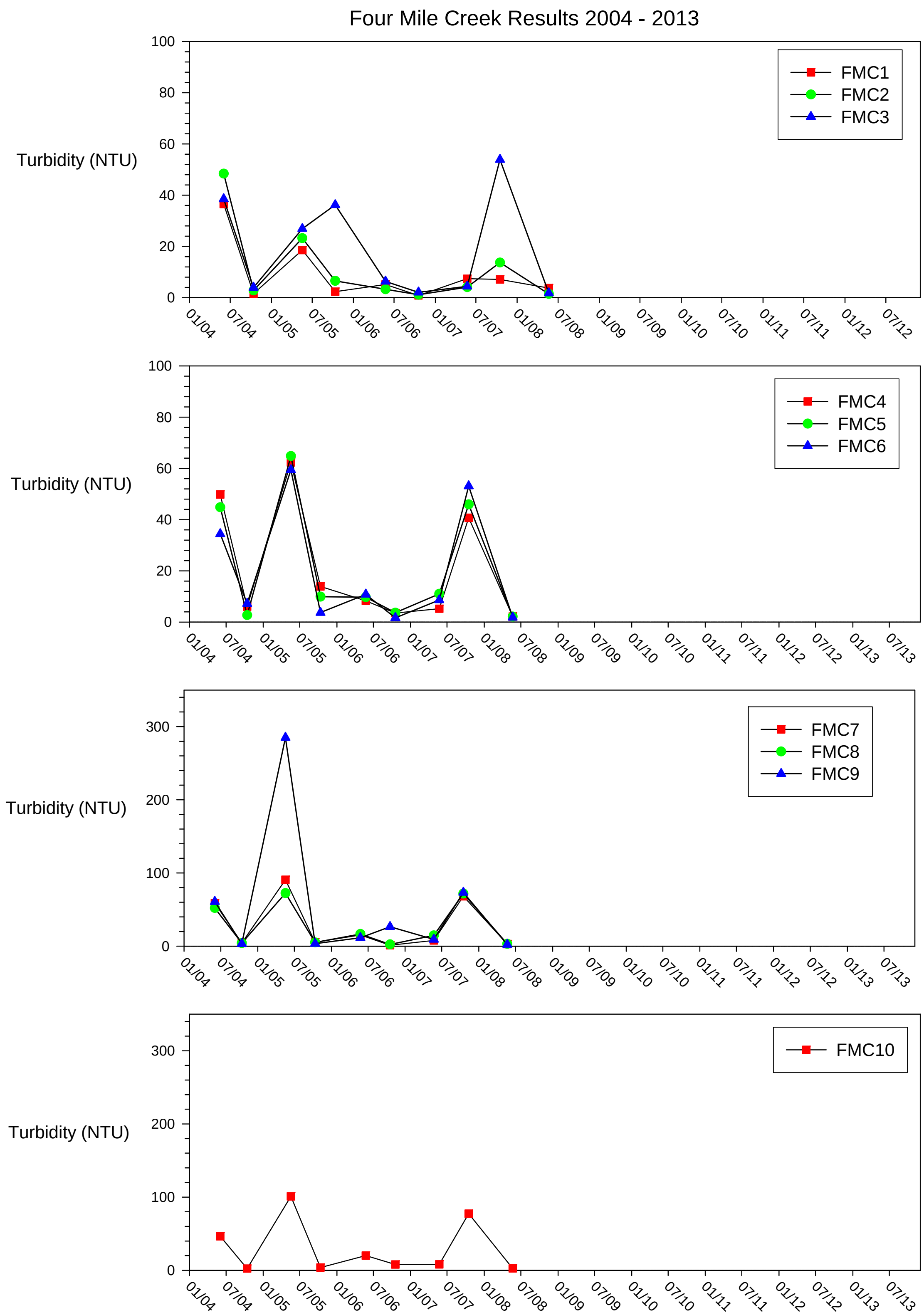
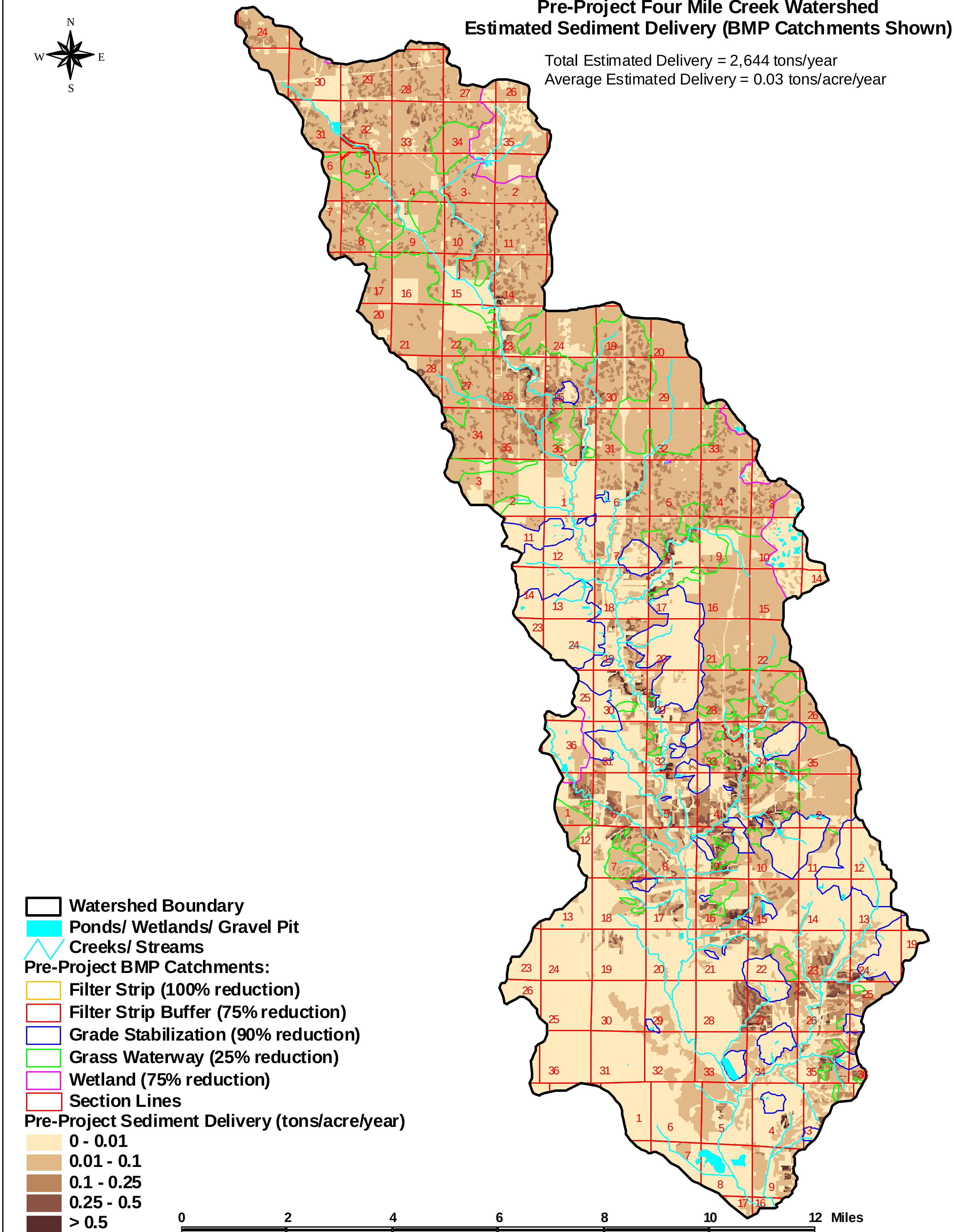


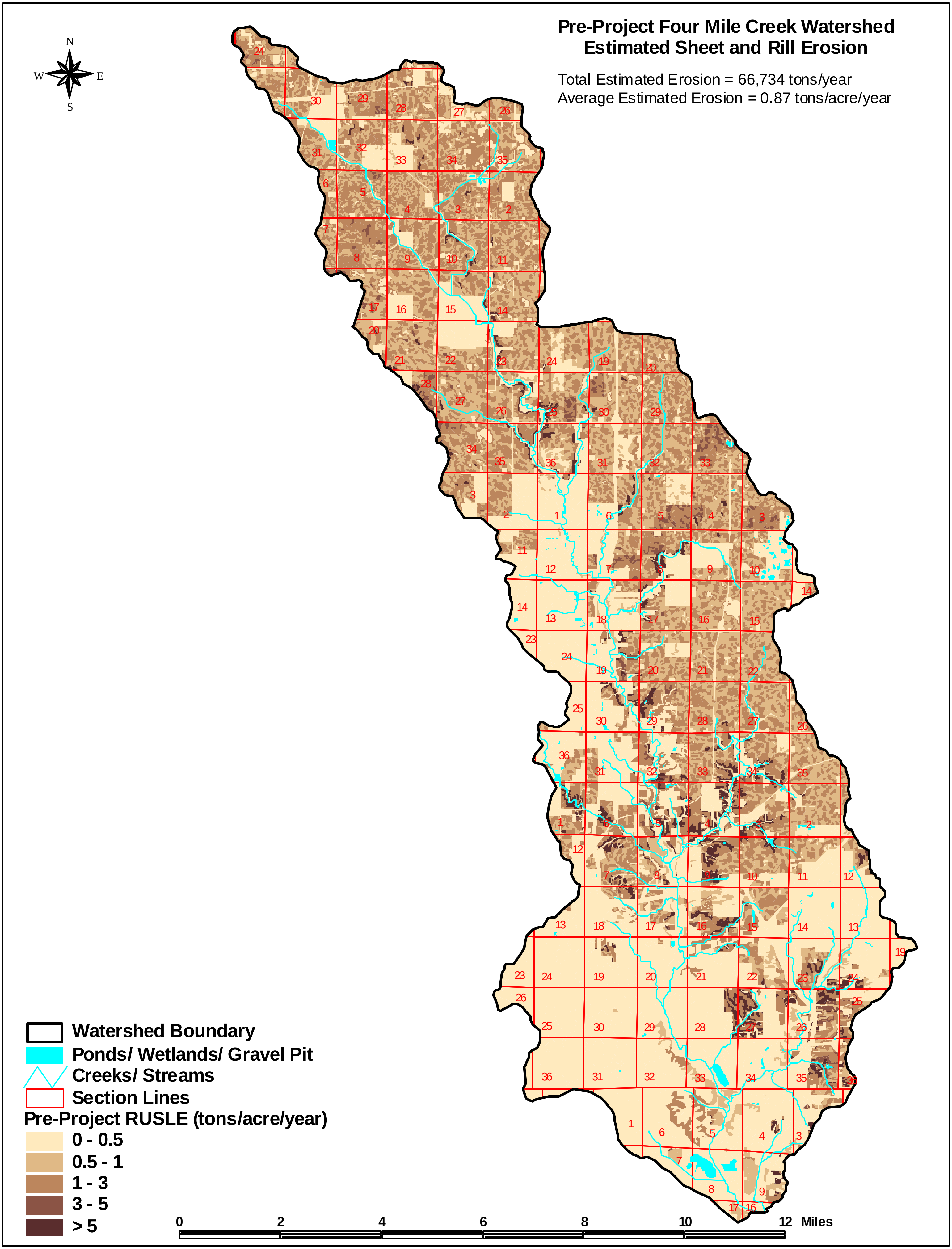
Figure 11. Four Mile Creek Turbidity Time Series.

Appendix F: Sediment Delivery and RUSLE Assessment Maps

Pre-Project Four Mile Creek Watershed
Estimated Sediment Delivery (BMP Catchments Shown)

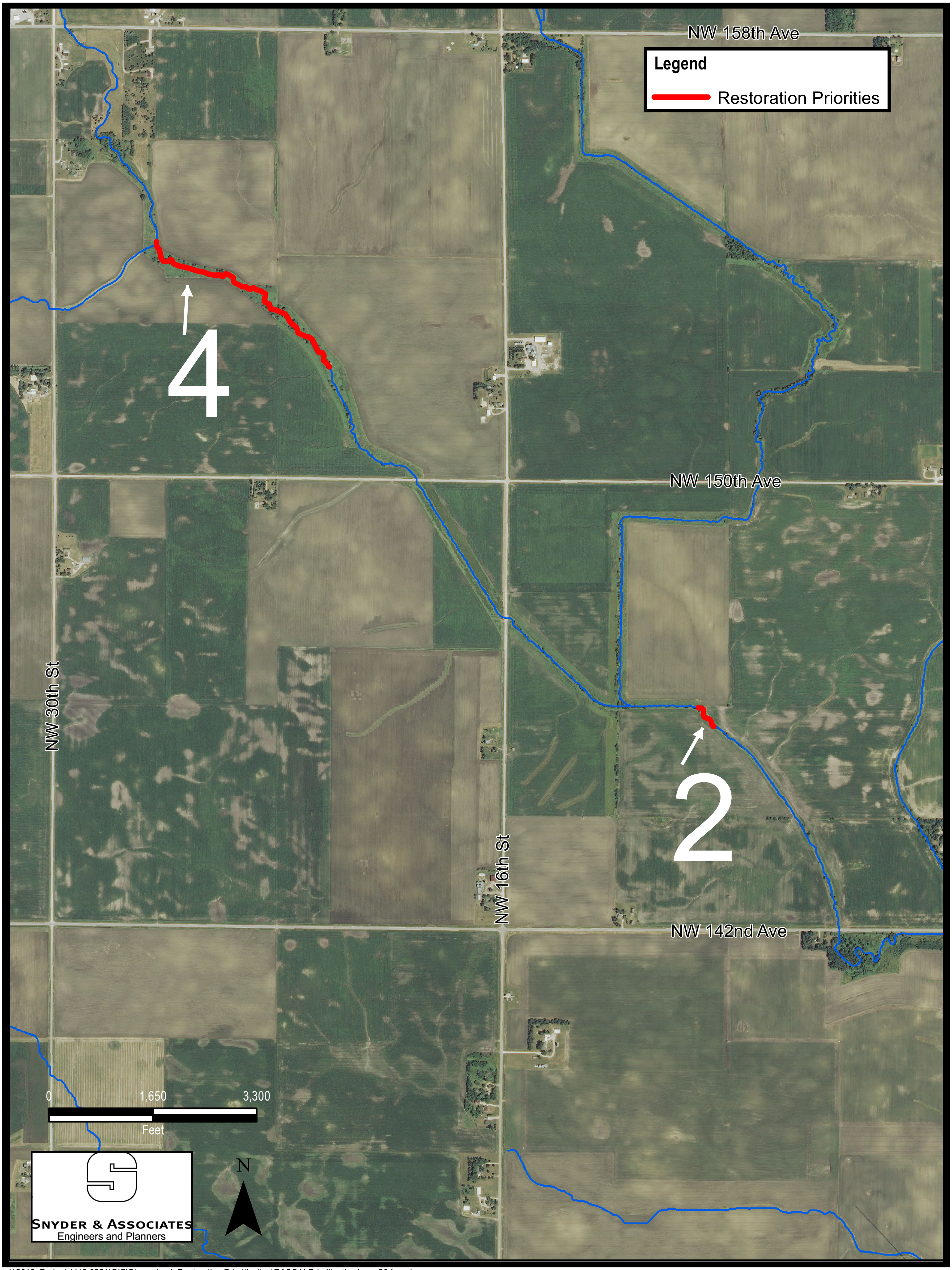
Total Estimated Delivery = 2,644 tons/year
Average Estimated Delivery = 0.03 tons/acre/year

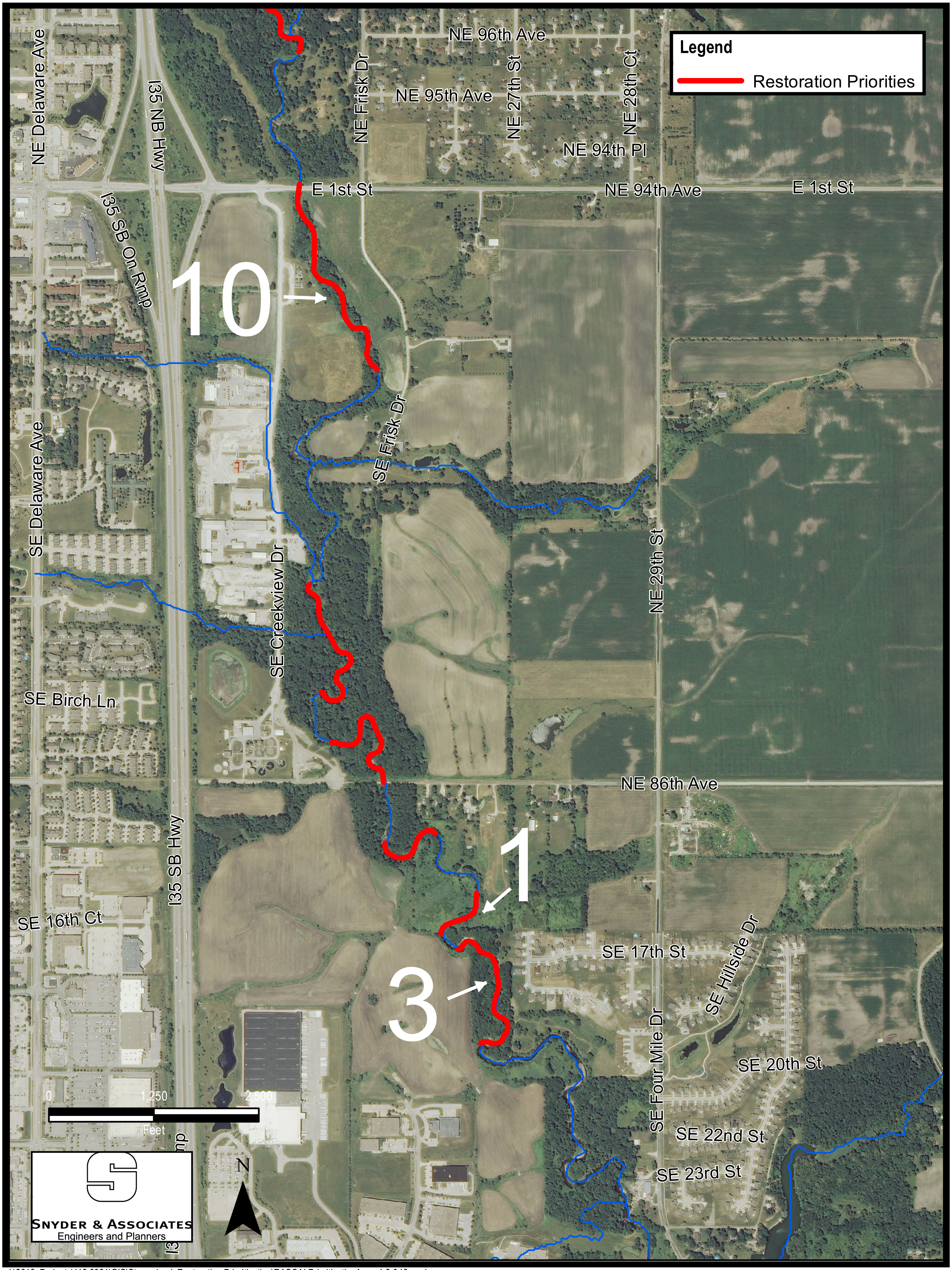




Pre-Project Four Mile Creek Watershed
Estimated Sheet and Rill Erosion
Total Estimated Erosion = 66,734 tons/year
Average Estimated Erosion = 0.87 tons/acre/year
N
W
E
S
Watershed Boundary
Ponds/ Wetlands/ Gravel Pit
Creeks/ Streams
Section Lines
Pre-Project RUSLE (tons/acre/year)
0 - 0.5
0.5 - 1
1 - 3
3 - 5
> 5
0
2
4
6
8
10
12
Miles

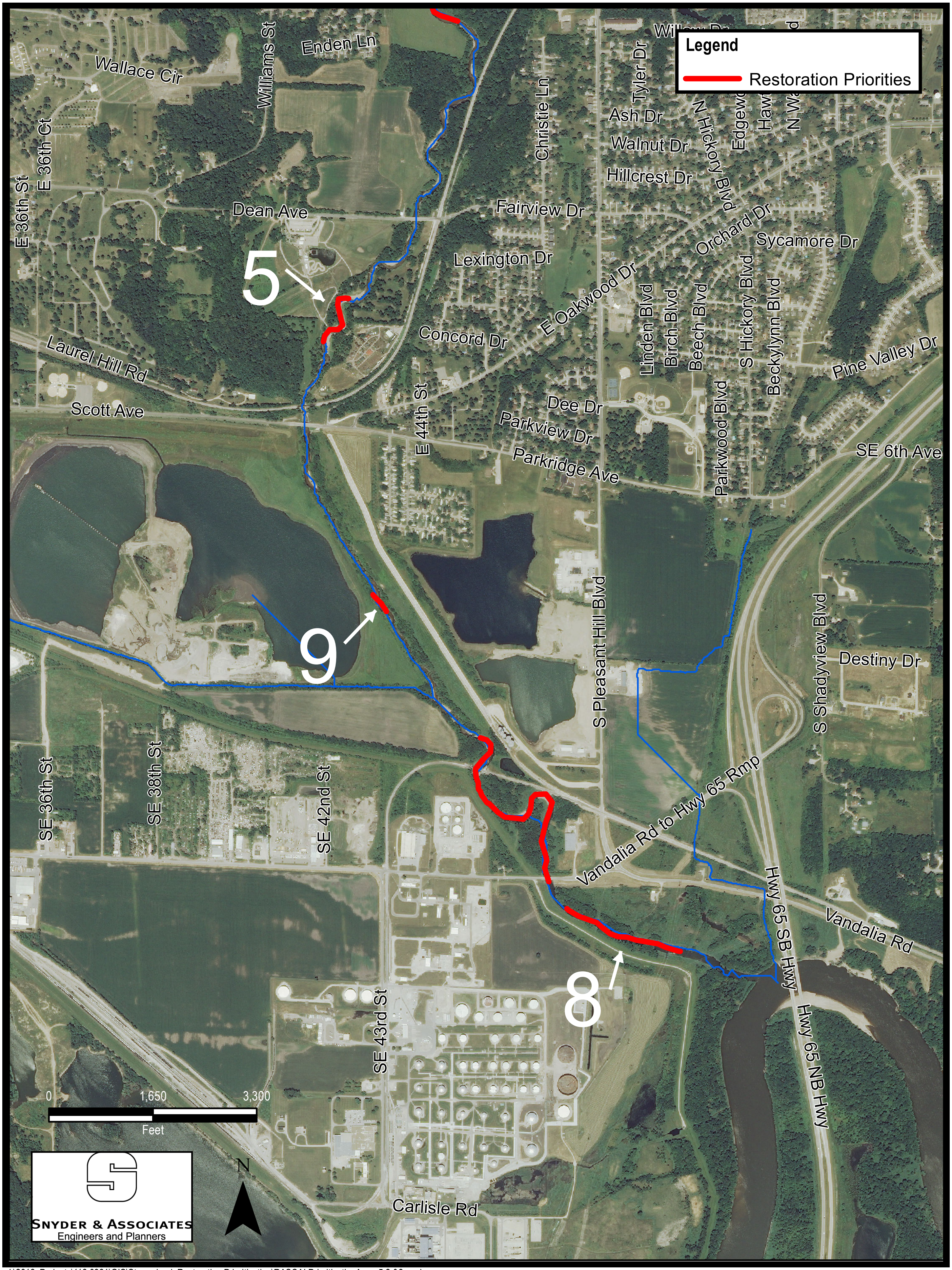
Appendix G: Streambank Restoration Priority Maps


NW 158th Ave
Legend
Restoration Priorities
4
NW 150th Ave
NW 30th St
2
NW 16th St
NW 142nd Ave
0
1,650
3,300
Feet
Snyder & Associates
Engineers and Planners
N



J:\2013_Projects\113.0991\GIS\Streambank Restoration Prioritization\RASCALPrioritizationAreas1,3,&10.mxd

J:\2013_Projects\113.0991\GIS\Streambank Restoration Prioritization\RASCALPrioritizationAreas6&7.mxd



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Appendix H: Examples of the IOWATER Assessment Forms

IOWATER
Volunteer Water Quality Monitoring

Chemical / Physical Assessment

*** Recommended frequency – monthly ***

Date __________ **Time ___________**

IOWATER Monitor ____________________ **# of Adults** (*incl. you*) ______

Site Number _________________________ **# of under 18** ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ No _____

Weather (*check all that apply*)
Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

Water Color (*check all that apply*)
Clear ___ Brown ___ Green ___ Oily ___ Reddish ___ Blackish ___ Milky ___ Gray ___

Water Odor (*check all that apply*)
None ___ Sewage/Manure ___ Rotten Eggs ___ Petroleum ___ Musky ___

Air Temperature _______ °Fahrenheit

Precipitation _______ inches over the last 24 hours

Transparency (*record whole numbers only – no tenths*)
________ centimeters

pH
Expiration date on bottom of bottle _______
check one – **4** ____ **5** ____ **6** ____ **7** ____ **8** ____ **9** ____

Nitrite-N (*mg/l*)
Expiration date on bottom of bottle _______
check one – **0** ____ **0.15** ____ **0.3** ____ **1.0** ____ **1.5** ____ **3** ____

Nitrate-N (*mg/l*)
Expiration date on bottom of bottle _______
check one – **0** ___ **1** ___ **2** ___ **5** ___ **10** ___ **20** ___ **50** ___

Dissolved Oxygen (*mg/l*)
Expiration date on back of color comparator _______
check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

Phosphate (*mg/l*)
Expiration date on back of color comparator _______
Expiration date on round color comparator _______
Expiration date on activator solution _______
check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**
1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

Chloride
Expiration date on bottom of bottle _______
____________ mg/l – *Convert Quantab Units to mg/L using the chart provided on the bottle*

Water Temperature
_______ °Fahrenheit

Stream Width
____._____ meters

Maximum Stream Depth (*along your transect*)
____.________ meters

Stream Flow (*along your transect*)
_______ high _______ normal _______ low _______ not sure

Stream Depth (*in meters*)

1st Spot ____.______	5th Spot ____.______	9th Spot ____.______	13th Spot ____.______
2nd Spot ____.______	6th Spot ____.______	10th Spot ____.______	14th Spot ____.______
3rd Spot ____.______	7th Spot ____.______	11th Spot ____.______	15th Spot ____.______
4th Spot ____.______	8h Spot ____.______	12th Spot ____.______	

Stream Velocity (*in seconds*)

1st Spot ______	5th Spot ______	9th Spot ______	13th Spot ______
2nd Spot ______	6th Spot ______	10th Spot ______	14th Spot ______
3rd Spot ______	7th Spot ______	11th Spot ______	15th Spot ______
4th Spot ______	8th Spot ______	12th Spot ______	

Other Stream Assessment Observations and Notes

____
____
____
____

IOWATER

Volunteer Water Quality Monitoring

Biological Assessment

*** Recommended frequency – no more than 3 times a year, preferably between mid-July to mid-Oct***

Date __________ **Time ___________**

IOWATER Monitor _________________ **# of Adults (incl. you) ______**

Site Number _______________________ **# of under 18 ______**

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ No _____

___ Were Benthic Macroinvertebrates Found? (*If no, please provide any relevant comments in the "Other Assessment Observations and Notes" section at the end of this form*)

Benthic Macroinvertebrates (*record the number of each collected, then total each group*)

High Quality Group (*pollution intolerant*)			**Middle Quality Group** (*somewhat pollution tolerant*)			**Low Quality Group** (*pollution tolerant*)		
Tally Column	**Total # found**	**HQ BMI**	**Tally Column**	**Total # found**	**MQ BMI**	**Tally Column**	**Total # found**	**LQ BMI**
		Caddisfly			**Alderfly**			**Aquatic Worm**
		Dobsonfly			**Backswimmer**			**Black Fly**
		Mayfly			**Crane Fly**			**Bloodworm**
		Riffle Beetle			**Crawdad**			**Flatworm**
		Snail (not pouch)			**Crawling Water Beetle**			**Leech**
		Stonefly			**Damselfly**			**Midge Fly**
		Water Penny Beetle			**Dragonfly**			**Mosquito**
TOTAL		**(A)**			**Giant Water Bug**			**Pouch Snail**
					Limpet			**Rat-tailed Maggot**
					Mussels/Clams			**Water Scavenger Beetle**
					Orbsnail	**TOTAL**		**(C)**
					Predaceous Diving Beetle			
					Scud			
					Sowbug			
					Water Boatman			
					Water Mite			
					Water Scorpion			
					Water Strider			
					Whirligig Beetle			
			TOTAL		**(B)**			

___ Other ____ (no tolerance group assigned)

Index of Biotic Integrity (IBI) $= \dfrac{(AX3)+(BX2)+(CX1)}{A+B+C} =$ ___________

(Over)

Revised March 2010

Benthic Macroinvertebrate Collection Time (*check one*)
0-15 min. _____ 15-30 min. _____ 30-45 min. _____ More than 45 min. _____

Collection Nets (*How many nets are you using to collect critters?*)
1 ____ 2 ____ 3 ____ 4 ____ 5 ____ 6+ ___

Identification Confidence Level (*Are you confident that your identification is correct?*)
_____ I'm not sure
_____ I think they've been identified correctly
_____ Some are definitely correct, I'm not sure about others (*Please clarify in "Other Assessment Observations and Notes" section at the end of this form*)
_____ I'm fairly confident they've all been correctly identified
_____ I guarantee they have been identified correctly

Stream Reach Length (*How far along the stream did you search?*)
___ 0-25 meters ___ 25-50 meters ___ 50-75 meters ___ 75-100 meters ___ 100+ meters

Microhabitats (*check all present in stream reach, check if sampled*)

Algae Mats	Present __	Sampled __	**Leaf Packs**	Present __	Sampled __
Logjams	Present __	Sampled __	**Rocks**	Present __	Sampled __
Root Wads	Present __	Sampled __	**Weed Beds**	Present __	Sampled __
Fallen Trees	Present __	Sampled __	**Undercut Banks**	Present __	Sampled __
Silt/Muck	Present __	Sampled __	**Rip Rap**	Present __	Sampled __
Sand	Present __	Sampled __	**Overhanging Vegetation**	Present __	Sampled __

Junk (*tires, garbage, etc.*) Present __ Sampled __
Other (*describe*) ____ Present __ Sampled __

Stream Habitat Type (*check all types sampled in stream reach*)
Riffle _____ Run _____ Pool _____

Aquatic Plant Cover of Streambed (*at transect – check one*)
0-25% _____ 25-50% _____ 50-75% _____ 75-100% _____

Algae Cover of Stream Streambed (*at transect – check one*)
0-25% _____ 25-50% _____ 50-75% _____ 75-100% _____

Is sewage algae present in the stream?
No ______ Yes ______ *If yes, please submit a photographic record & contact IOWATER.*

Invasive Species (*check all found*)
___ Eurasian water milfoil ___ Curly-leaf pondweed ___ Zebra mussels
___ Brittle naiad ___ Purple Loosestrife ___ Chinese mystery snails
___ Bighead Carp ___ Silver Carp ___ Rusty Crawfish

Other Assessment Observations and Notes
____
____
____
____