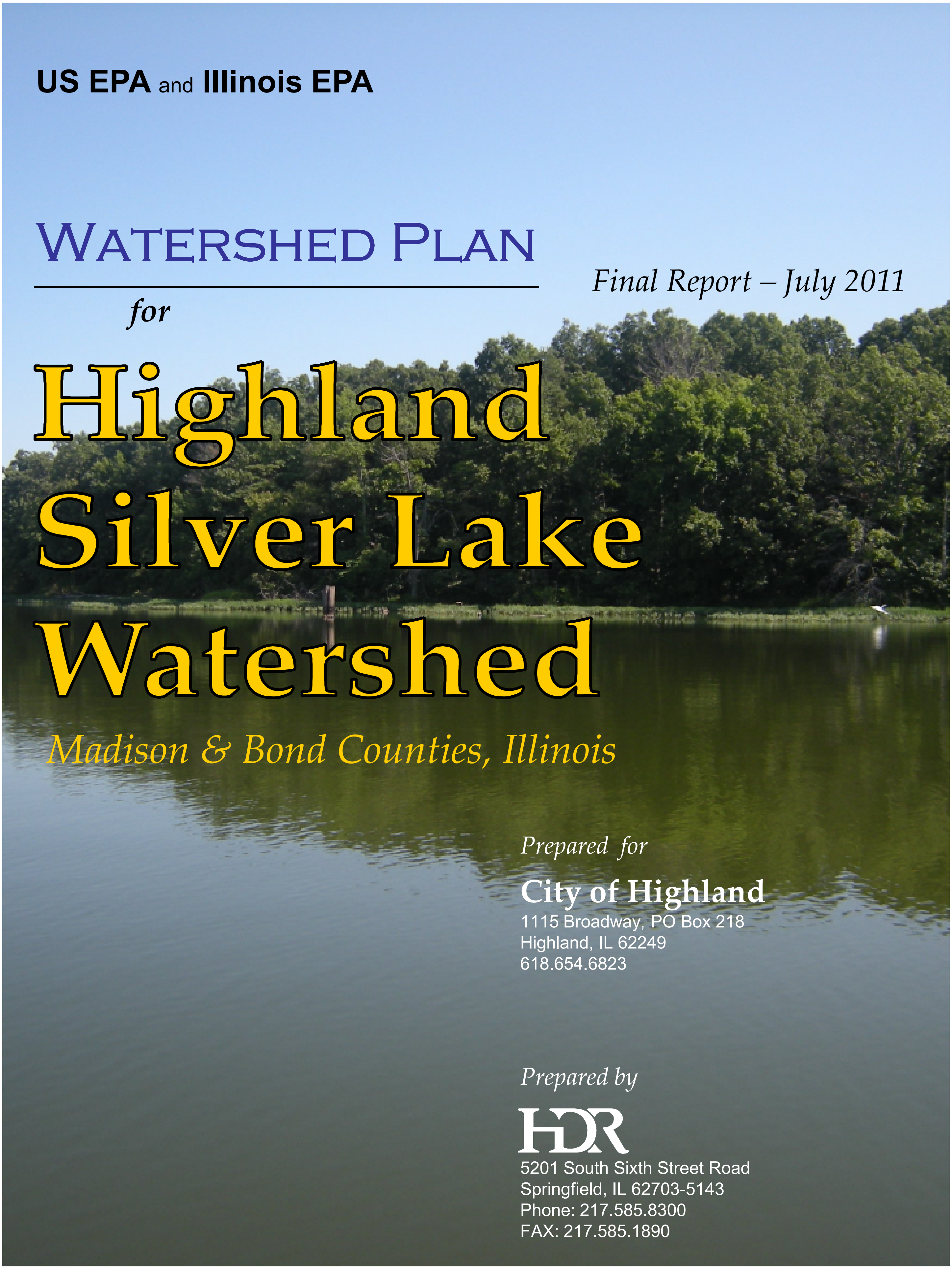


US EPA and **Illinois EPA**

Watershed Plan

for

Highland Silver Lake Watershed

Final Report – July 2011

Madison & Bond Counties, Illinois

Prepared for

City of Highland
1115 Broadway, PO Box 218
Highland, IL 62249
618.654.6823

Prepared by

HDR
5201 South Sixth Street Road
Springfield, IL 62703-5143
Phone: 217.585.8300
FAX: 217.585.1890

Watershed Plan for
Highland Silver Lake Watershed
Madison and Bond Counties, Illinois

July 2011

Prepared for:

City of Highland
1115 Broadway
P.O. Box 218
Highland, Illinois 62249
(618)-654-6823

Prepared by:

HDR Engineering, Inc.
5201 South Sixth Street Road
Springfield, Illinois 62703-5143
(217) 585-8300

Funding for this project was provided, in part, by the Governor of Illinois and the Illinois Environmental Protection Agency (Illinois EPA) through Section 319 of the Clean Water Act and the Partners for Conservation Fund. The matching funds for this project were provided by the City of Highland. The findings and recommendations herein are not necessarily those of the funding agencies.

Acknowledgements

The Watershed Plan for Highland Silver Lake was developed using a collaborative approach in order to incorporate a broad view of technical expertise and local opinions. This report was prepared in cooperation with the following organizations:

The City of Highland
US Environmental Protection Agency (USEPA)
US Department of Agriculture Natural Resources Conservation Service (USDA-NRCS)
Illinois Environmental Protection Agency (IEPA)
Madison and Bond County Farm Service Agencies (FSA)
Madison and Bond County Soil and Water Conservation Districts (SWCD)
Southwestern Illinois Resource Conservation and Development (SWIRCD)

Table of Contents

Tables

Figures

Appendices

I. Introduction

Highland Silver Lake is a 550-acre reservoir located in the eastern portion of Madison County, Illinois, approximately one mile northwest of the City of Highland (Figure I-1). The lake is used as a public water supply and for recreation. The Highland Silver Lake Watershed covers approximately 30,688 acres (48 square miles) in Madison and Bond Counties. The lake and watershed have been extensively studied and many small scale restoration projects have been implemented by the City of Highland and private landowners dating back to the 1970s. Despite these efforts, Highland Silver Lake appears on the 2010 Illinois Section 303(d) List of Impaired Waters (IEPA, 2010), which identifies water bodies that are not meeting their designated uses.

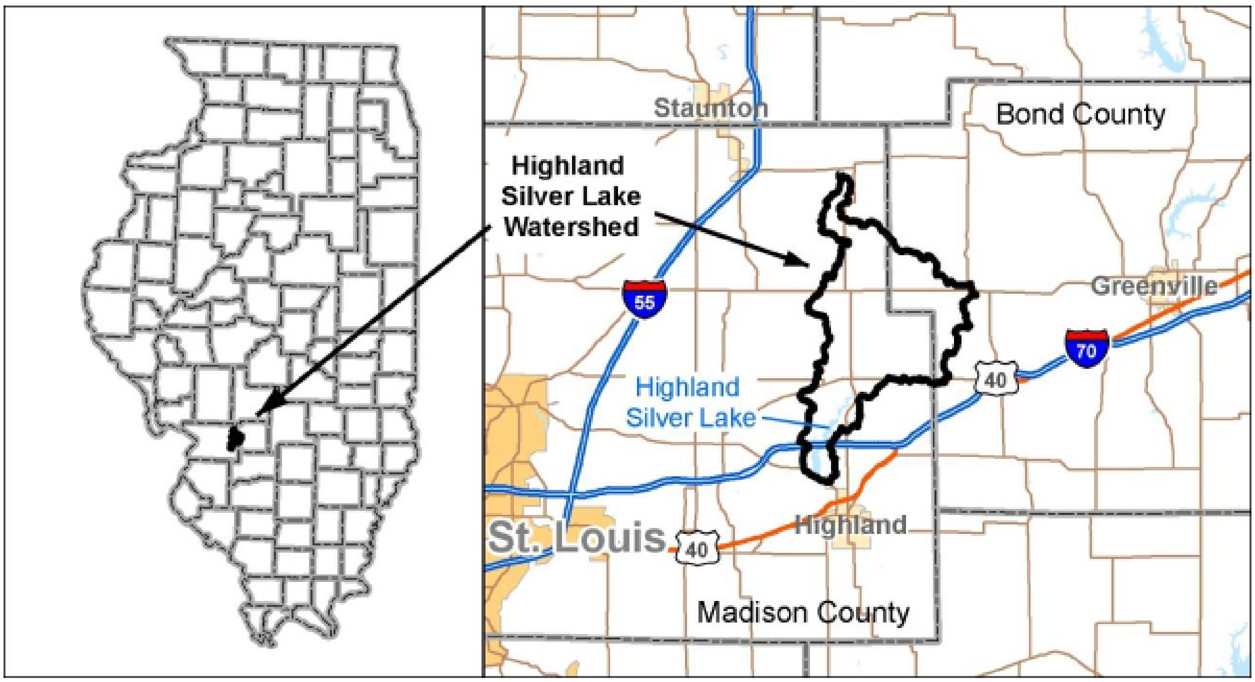


Figure I-1. General Location Map

Watershed planning is an effective means of addressing water quality issues because it is a holistic approach to management of streams, lakes, wetlands, flood plains, water supply, irrigation, stormwater, and wastewater throughout an entire watershed. The Highland Silver Lake Watershed Plan will establish long-term goals, describe objectives to meet those goals, and incorporate the nine components of a watershed plan required by the United States Environmental Protection Agency (USEPA). Completion of the Highland Silver Lake Watershed Plan according to USEPA guidelines will allow the City of Highland to leverage grant funding for future lake and watershed restoration projects. Funding for this project was provided, in part, by the Governor of Illinois and the Illinois Environmental Protection Agency (IEPA) through Section 319 of the Clean Water Act and the Partners for Conservation Fund. The matching funds for this project were provided by the City of Highland.

II. Natural Resource Assessment

The Highland Silver Lake Watershed has been extensively studied. Multiple reports were generated during the 1980s and several additional reports have been recently published. The data collected and generated for previous technical reports combined with several recent field surveys will serve as the framework for the natural resource assessment, which is divided into three categories as listed below.

- Highland Silver Lake Watershed
- Highland Silver Lake Tributaries
- Highland Silver Lake

A. Highland Silver Lake Watershed

The Highland Silver Lake Watershed is identified by hydrologic unit code (HUC 10) 0714020404 and covers approximately 30,688 acres (48 square miles) of primarily agricultural land in Madison and Bond Counties within the Lower Kaskaskia River Watershed (Figure II-1). The two main tributaries that drain the watershed are East Fork Silver Creek and Little Silver Creek. These tributaries originate in northeastern Madison County and each flows approximately five miles before entering Highland Silver Lake, a 550-acre reservoir located in Madison County. The two major tributaries and the lake are fed by multiple unnamed tributaries and a vast network of smaller inlet channels, concentrated flows and storm drains, as shown on the Hydrology Map (G3) in Appendix 1.

The Highland Silver Lake Watershed has been previously characterized in the Highland Silver Lake Watershed TMDL Report (LTI, 2006) and in the Phase 1 Diagnostic/Feasibility Study of Highland Silver Lake (HDR│CWI, 2008). These reports should be referred to for a description of soils, topology, hydrology, land use, sources of pollution, water quality, economics, urbanization, and lake conditions. A brief description of each report is provided within this section and maps depicting general watershed characteristics are provided in Appendix 1. Other information discussed within this section includes historical watershed management, tributary conditions, and observations of existing conditions via field surveys and GIS mapping.

1. Historical Watershed Management

The Highland Silver Lake Rural Clean Water Program (RCWP) was developed by the USDA in 1980 to identify critical areas within the watershed, recommend best management practices (BMPs) to reduce erosion of soil in these areas, aid landowners in implementing these practices, and evaluate the efficiency of these practices (Davenport, 1984). The purpose of this process was to improve water quality by reducing agricultural non-point source pollution. Specific goals included a 60 percent reduction in sediment yield, a target lake TSS level of less than 25 mg/L, and an increase of Secchi depth to more than 24 inches. Based on recent total suspended solids (TSS) levels and Secchi depths provided in Table II-1, it appears that these goals are still valid. These data were collected as part of the IEPA Ambient and Volunteer Lake Monitoring Programs. Secchi depths collected as part of the RCWP are also included as a reference point (Kelly and Davenport, 1986).

Table II-1. TSS and Secchi Depth Data

Sample Site	**Secchi Depth (in)** 1981 Average	**Secchi Depth (in)** 2010 Average	**TSS (mg/L)** 2009 Average
ROZA-1	18	21	11
ROZA-2	16	15	25
ROZA-3	8	9	57

As the program developed, critical areas were defined as agricultural land with natric soils and slopes exceeding two percent, or alfic soils with slopes exceeding five percent (SIMRPC, 1983). Maps depicting slopes and natric soils are included in Appendices 1 and 2, respectively. The following erosion rates were identified for different types of fields, which also helped to identify critical areas (Davenport, 1982).

- Feedlots: 17.36 tons/acre
- Corn/soybean fields: 7.56 tons/acre
- Crop rotations: 2.11- 4.08 tons/acre
- Forest (managed): 0.17 tons/acre
- Forest (unmanaged): 1.15 tons/acre
- Grassland: 0.44 tons/acre

The Comprehensive Monitoring and Evaluation Program was developed under the RCWP to monitor and evaluate the effect of BMPs on the reduction of non-point source pollution to Highland Silver Lake. The primary conclusion based on the RCWP implementation and monitoring efforts was that clay-sized particles must be kept in place because they tend to stay in suspension once disturbed. Permanent ground cover is most effective in controlling transport of these particles. The following goals were established in response to the findings (Makowski and Lee, 1985).

1. Reduce detachment and transport of soil particles by increasing ground cover
2. Maximize the opportunity for settling of the suspended particles before reaching a watercourse
3. Reduce nutrient input through better management of livestock wastes

2. Community Capacity in Silver Creek Watershed

Southern Illinois University at Carbondale, Illinois State University, and University of Minnesota collectively published a summary report of a three-year (2007-10) study entitled Water Quality and Community Capacity in Silver Creek Watershed, Illinois, in which water quality and community capacity were evaluated. The project study area encompassed the entire Lower Kaskaskia River Watershed but data and findings were reported for two major subwatersheds, one of which was the Silver Creek Watershed. Figure II-1 shows the relationship of the Highland Silver Lake Watershed to both of these watersheds. The East Fork Silver Creek, which drains Highland Silver Lake, is a major tributary to Silver Creek.

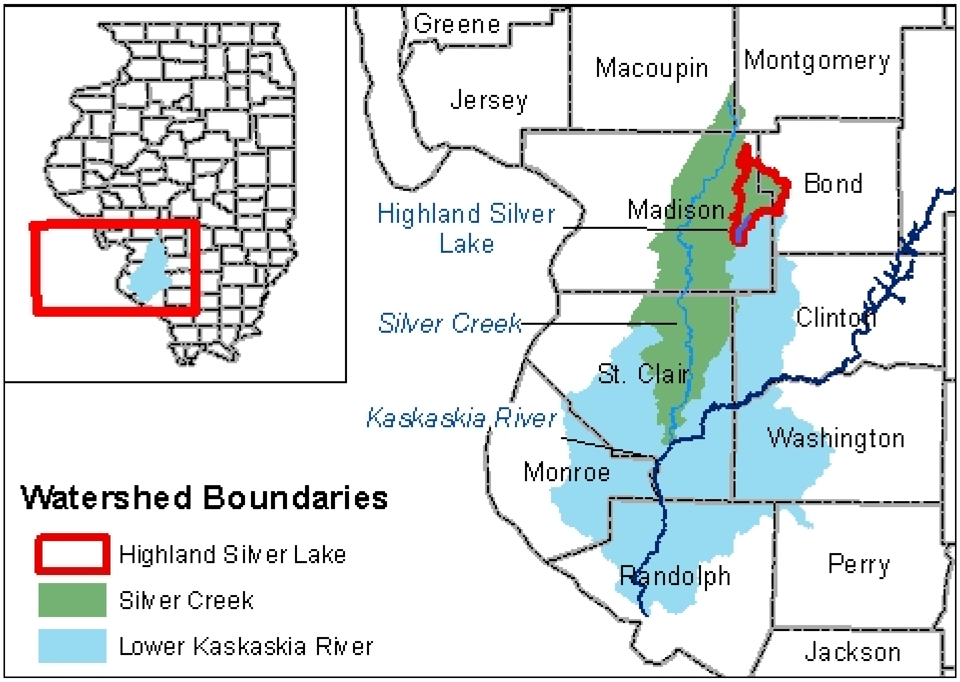


Figure II-1. Watershed Relationships

To assess community capacity, the project team gathered social data using three different techniques. Interviews were conducted with community stakeholders, focus groups were held with community leaders and concerned citizens, and a mail survey was conducted. The vast majority surveyed by mail believe that their quality of life depends on good water quality. Almost 86 percent of those residents agreed that using conservation practices on farms improves water quality (SIUC et al., 2010). Stakeholders participating in interviews and focus groups described a need for continued efforts to promote conservation practices on farms. The study found that citizens, organizations, villages and cities appear to be committed to protecting water resources, but it was also evident that many residents do not realize how their everyday choices affect water quality in their communities. The challenge is to share knowledge, adopt conservation practices, and coordinate watershed scale planning across boundaries between public and private property, as well as between communities.

3. Highland Silver Lake Watershed Total Daily Maximum Load (TMDL)

Section 303(d) of the 1972 Clean Water Act (CWA) requires states to define impaired waters and identify them on a list, which is referred to as the 303(d) list. In 1994, Highland Silver Lake was placed on the Illinois Section 303(d) List of Impaired Waters as a water body that was not meeting its designed uses (IEPA, 1996). It remains on the draft 2010 303(d) List (IEPA, 2010). The listing is summarized in Table II-2 below. The CWA requires that a TMDL be completed for each pollutant listed for an impaired waterbody. A TMDL establishes the maximum amount of a given pollutant that a waterbody can receive without violating water quality standards and designated uses, considering all known and potential sources. In response to the 303(d) listing, a TMDL was completed in October 2006 for Highland Silver Lake (LTI, 2006). This report will hereafter be referred to as the 2006 TMDL Report.

Table II-2. 303(d) Listing for Highland Silver Lake (IEPA, 2004, 2006, 2008, and 2010)

Designated Use Not Supported	Impairment Causes	Impairment Sources*
Aquatic Life Fish Consumption Public Water Supply Aesthetic Quality	Sedimentation/Siltation Total Suspended Solids (TSS) Total Phosphorus (TP) Aldrin Chlordane Mercury Dissolved Oxygen (DO) Manganese Excess Algal Growth	Contaminated Sediments Atmospheric Deposition Littoral/shore Area Modifications Livestock Operations Crop Production Runoff from forest/grassland/parkland

*Additional sources identified during the TMDL study included failing septic systems, lakeshore and streambank erosion, natural background sources, brine from oil wells, and runoff from lawns (LTI, 2006).

TMDLs were only developed for pollutants that have numerical water quality standards (Table II-3). However, attainment of the TP standard is expected to result in attainment of the manganese and DO standards since sources for these causes relate directly to excess phosphorus. For instance, exceedance of the DO standard is presumed to be due to the effects of nutrient enrichment, as there are no significant sources of oxygen demanding materials to the lake. The only controllable source of manganese to the lake is the release of manganese from lake sediments during anoxic conditions (no DO in lake bottom waters). Due to this direct relationship and lack of other sources, the TMDLs for dissolved oxygen and manganese were set as a total phosphorus concentration of 0.05 mg/L (LTI, 2006). Furthermore, many activities put in place to reduce phosphorus loads should also reduce TSS, sedimentation and algal growth in the lake.

The load allocation for total phosphorus represents a 90 percent reduction from the existing load. The existing loads for aldrin and chlordane cannot be calculated because the existing concentration of these parameters is below the laboratory detection limit. Thus, a load reduction cannot be determined. As of 2006, sediment and fish tissue data suggested that the concentration of these parameters in the lake was improving and should recover on its own (LTI, 2006).

Table II-3. Illinois Water Quality Standards and TMDL Allocations (LTI, 2006)

Impairment Cause	**WQ Standard**	**Load Allocation**
Total Phosphorus	0.05 mg/L	1,647 kg/year
Dissolved Oxygen	6.0 mg/L (min 5.0 mg/L)	NA
Manganese	150 µg/L	NA
Aldrin	0.00014 µg/L	3.29 g/year
Chlordane	0.0008 µg/L	18.6 g/year

An implementation plan for the Highland Silver Lake Watershed phosphorus TMDL was developed and included the following alternatives for implementation (LTI, 2006).

- Restrict livestock access
- Conservation buffers
- Shoreline enhancement & protection
- Streambank stabilization
- Sediment control basins
- Nutrient management plans
- Conservation tillage
- Grassed waterways
- Aeration/destratification
- Septic system inspection & maintenance
- Dredging
- Phosphorus inactivation

4. Field Surveys and GIS Mapping

During the course of this watershed planning process, the watershed was observed from public roads to identify critical areas of erosion. Photographs were taken and locations were documented during field visits in November 2009 and March 2010. An additional survey was conducted from the lake in April 2010 to assess the general condition of the forest surrounding the lake.

General Observations from Field Surveys:

- Field borders were greatly lacking; there was evidence of equipment plowing into roadway ditches on many fields (Figure II-2).
- Several fields had trenched drainage ways with no vegetation or grading (Figure II-2).
- Soil erosion was noted at many roadway culverts.
- Adequate stream buffers were noted in some locations but not in others.
- Cover crops were noted in multiple locations.

- Several areas that would benefit from wetlands were observed.
- Several livestock operations were noted.
- Land in the lower portion of the watershed is better protected from erosion.
- Gully erosion around the lake was not observed to be extensive.
- Shoreline erosion was extensive but not severe.
- Forest conditions ranged from poor to high quality and included honey suckle invasion.

Figure II-2. Examples of Existing Conditions

The watershed was also observed using electronic data in a geographic information system (GIS) format. Datasets reviewed included aerial imagery, topology, hydrology, soils, land cover, and land use. Data were used to generate multiple maps that highlight critical areas for protection or restoration. For example, areas with highly erodible land (HEL), steep slopes or hydric soils being used for crop production could be potential locations for conservation practices. Refer to Appendix 1 for general maps that display features within the Highland Silver Lake Watershed and Appendix 2 for maps that highlight critical areas.

General Observations from GIS Data:

- 83 % of the watershed is used for agriculture, primarily row crops
- 78 % of the watershed is classified as prime farmland
- 14 % of the watershed is steeply sloping (≥ 4 % slopes)
- 21 % of the watershed is classified as HEL
- 90 miles of streams have been identified on the USGS national hydrologic dataset
- 63 % of these streams have some type of buffer
- 23 % of streams are major tributaries (East Fork Silver Creek and Little Silver Creek)
- 77 % of streams are minor tributaries

B. Highland Silver Lake Tributaries

Two major tributaries exist within the Highland Silver Lake Watershed, namely, East Fork Silver Creek and Little Silver Creek. Numerous minor tributaries and small drainages also exist. Refer to Map G3 in Appendix 1 which displays hydrologic features within the watershed. Portions of East Fork Silver Creek and Little Silver Creek have been evaluated in previous studies. Water quality data collected as part of the Lower Kaskaskia River Watershed Study and observations collected for East Fork Silver Creek are described below.

1. Water Quality

Water samples were collected and analyzed from 43 subwatersheds of the Lower Kaskaskia River Watershed and analyzed for bacteria, nutrients, and TSS as part of a study previously mentioned (SIUC et al., 2010). Three of these subwatersheds (9, 11, and 12) were located within the Highland Silver Lake Watershed (Figure II-3). Based on water quality analyses, each subwatershed analyzed was given an overall stream rating of good, fair, or poor. Of the three subwatersheds within the Highland Silver Lake Watershed, one was rated as poor and two were rated as fair. The primary pollutants of concern were phosphorus and *E. coli*. These water quality findings correlate with the 2006 TMDL Report and the 2008 Lake Study. Maps showing the stream ratings for each of the water quality parameters analyzed are included in Appendix 3.

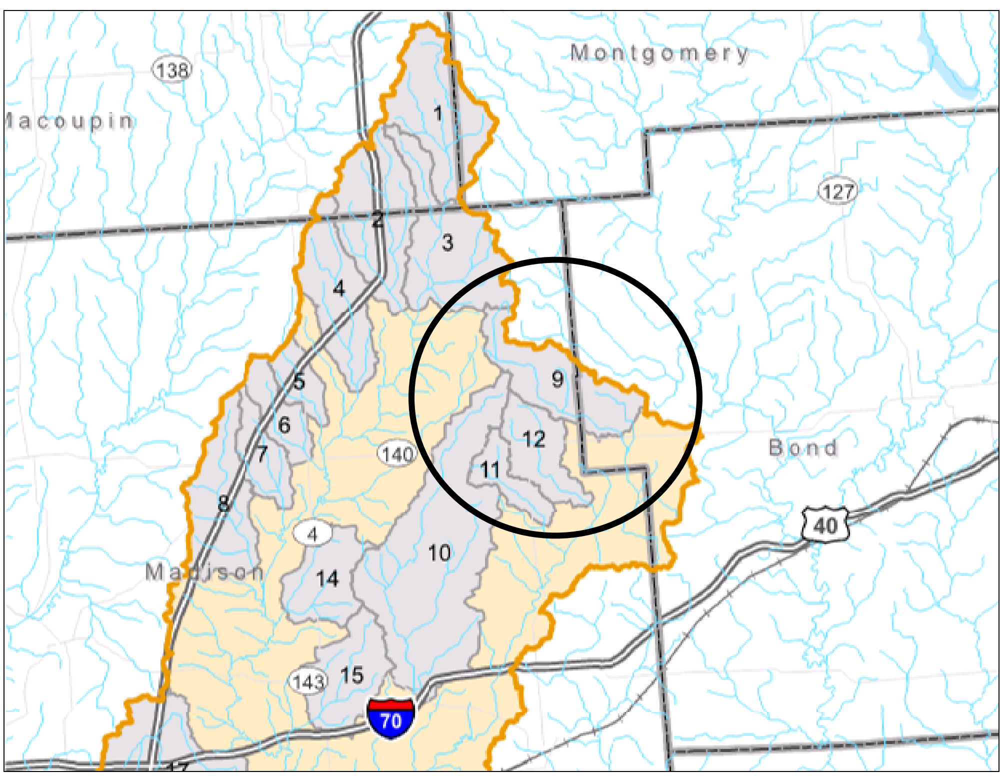


Figure II-3. Focus Subwatersheds within Highland Silver Lake Watershed (SIUC et al., 2010)

Table II-4. Summary of Water Quality Ratings (SIUC et al., 2010)

Focus Subwatershed	Watershed Name	E. coli Rating	Nitrate (NO_3)	Orthophosphate (PO_4)	TSS	Overall Stream Rankings
9	Little Silver Creek	Poor (>400.00)	Good (<0.99)	Poor (>0.40)	Poor (>80.00)	Poor
11	Coolwater Creek	Poor (>400.00)	Good (<0.99)	Poor (>0.40)	Good (<14.99)	Fair
12	East Fork Silver Creek	Fair (100.00-399.99)	Good (<0.99)	Poor (>0.40)	Fair (15.00-79.99)	Fair

2. Condition of East Fork Silver Creek and Little Silver Creek

The Aerial Assessment Report on Highland Silver Lake and East Fork of Silver Creek published by the USDA in 2005 examined streambed and bank conditions of the East Fork of Silver Creek and Little Silver Creek using aerial observations and ground investigations (Kinney, 2005). The study area encompassed East Fork Silver Creek, both upstream and downstream of Highland Silver Lake (Figure II-4). General observations from the report are listed below and data collected are shown on Maps S3a and S3b in Appendix 2.

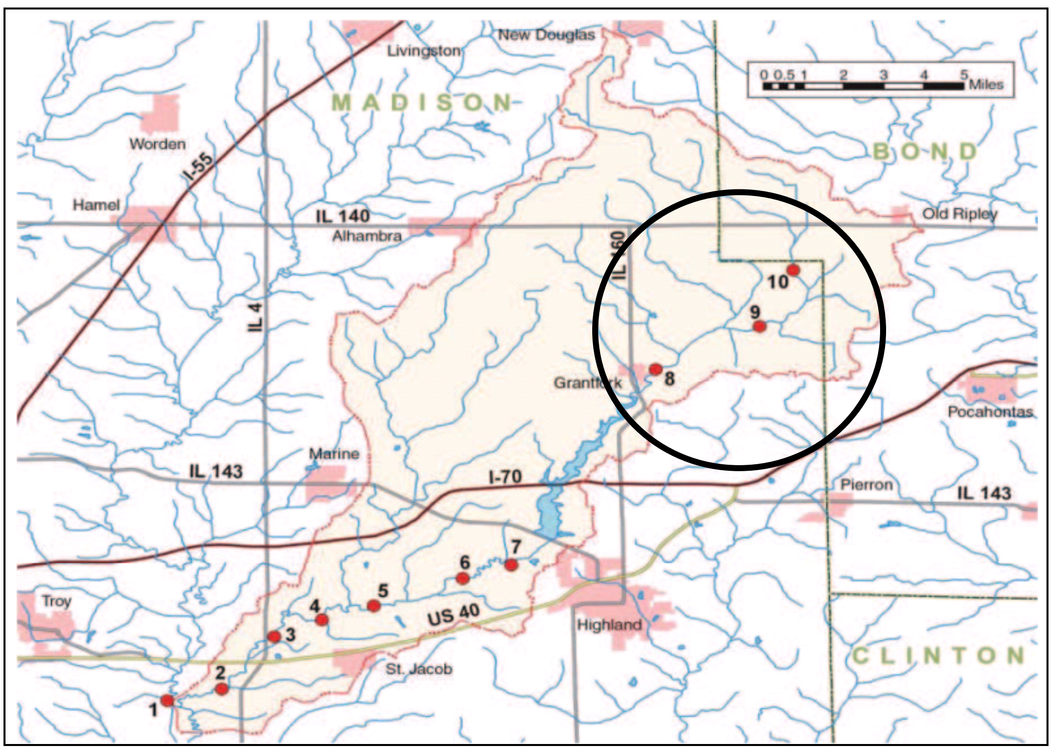


Figure II-4. Scope of Aerial Assessment (Kinney, 2005)

General Observations

1. The lower portion of East Fork Silver Creek below Highland Silver Lake is well connected to its floodplain and near an equilibrium condition with only minor streambank erosion.

2. The upper reaches of East Fork Silver Creek above Highland Silver Lake are influenced and controlled by the lake and by bedrock in the channel bottom for the lower 4 or 5 miles immediately above Highland Silver Lake.

3. The upper 10 miles of channel with the steepest gradient does not have grade control and has incised from 2.5 ft to 4 ft below "geomorphic bankfull" depths based on the Natural Resource Conservation Service (NRCS) Streambank Inventory and Evaluation procedures.

4. The increased frequency of logjams and depositional features upstream of the lake are the likely result of an increase in bank failure as a result of incision.

5. Bedload and depositional features are dominated by sand and silt with only minor deposits of larger material above the lake and almost none below the lake.

6. Installation of Rock Riffle Grade Controls along with some bank treatment above the lake would significantly reduce the quantity of sediments being generated from within the stream system. Initial hydraulic calculations indicate riffle heights of 2.0 ft or less would have no effect on the water surface profile at bankfull stage.

Summary of Recommendations

Chapter 8- Stone toe protection at 13 sites

Chapter 9- Installation of 22 to 25 rock riffle grade controls

Chapter 10- Installation of 52 rock riffle grade controls

C. Highland Silver Lake

Highland Silver Lake is a 550-acre reservoir located in the eastern portion of Madison County, Illinois, approximately one mile northwest of Highland (Figures I-1 and II-5). The lake was constructed in 1962 to provide a reliable water source to the City of Highland and surrounding communities including St. Jacob, Pierron, and Grantfork. It also provides recreational opportunities such as boating, hunting, and fishing. Select lake statistics are listed below.

<u>Highland Silver Lake Statistics</u>

Illinois EPA ID	ROZA
Normal Pool Elevation	500.0 feet
Hydraulic Retention Time	0.518 years
Shoreline Length	12 miles
Mean Depth (2005)	13.8 feet
Maximum Depth (2005)	25 feet
Storage Capacity (2005)	5,700 acre-feet

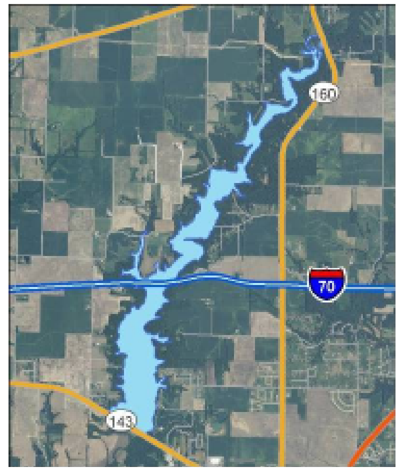


Figure II-5. Highland Silver Lake

A Phase 1 Diagnostic/Feasibility Study of Highland Silver Lake was completed in 2008 (HDR│CWI, 2008). This study should be referred to for additional lake characteristics. The major objective of the study was to assess the lake and develop a lake management plan. The diagnostic portion of the study was designed to delineate the existing lake conditions; to examine the causes of degradation; and to identify and quantify the sources of sediment and nutrients and any other pollutants flowing into the lake. On the basis of the findings of the diagnostic portion, water quality and use impairments were identified for the feasibility portion. Lake management plan objectives were established and subsequent alternatives for achieving those objectives were evaluated and recommended within the feasibility study. Study objectives and recommended alternatives are listed below.

<u>Lake Management Objectives</u>

1. Reduce the amount of sediment, nutrients, and fecal bacteria delivered to the lake
2. Remove accumulated sediment in the upper end of the lake
3. Improve water quality
4. Stabilize and protect eroded shoreline areas
5. Enhance fisheries population and habitat

<u>Lake and Watershed Restoration Alternatives</u>

1. Watershed protection
    a. Partner with NRCS and SWCD to identify and implement watershed BMPs
    b. In-lake sediment and nutrient control basin
    c. Lake livestock exclusion
2. In-lake sediment removal
3. In-lake aeration system
4. In-lake shoreline stabilization
5. Fisheries management

III. Findings and Recommendations

A natural resource assessment was provided in Section II in order to identify impairments and locate areas within the watershed that need either protection or restoration. Section III will describe general goals for the Highland Silver Lake Watershed; provide an overview of impairments, protection areas, and critical areas identified by the natural resource assessment; and provide a detailed description of recommended practices that will reduce non-point source pollution.

- Goals
- Overview of Impairments
- Protection Areas and Critical Areas
- Recommended Alternatives
- Summary of Recommendations

A. Goals

The primary goal of the Highland Silver Lake Watershed Plan is to improve water quality within Highland Silver Lake and throughout the watershed, including East Fork Silver Creek and Little Silver Creek. This can be achieved by reducing sediment and nutrient loads to all waterways within the watershed. Waterways include the lake, major tributaries, small tributaries, drainages (defined or undefined) and roadside ditches. General goals are listed below.

- Improve water quality
- Reduce sediment and nutrient loads
- Remove Highland Silver Lake from Illinois EPA 303(d) List of Impaired Waters
- Improve public drinking water source and minimize future treatment costs
- Improve and increase recreational opportunities within and around Highland Silver Lake
- Promote environmental stewardship and installation of conservation practices
- Protect natural waterways, wildlife habitat, and prime farmland

B. Overview of Impairments

Numerous impairments for the Highland Silver Lake Watershed have been identified by previous studies, water quality data, field surveys, GIS mapping, and conversations with the City of Highland and local technical experts. The major impairments include soil erosion, accumulated lake sediment, and poor water quality. Section II and previous studies should be referenced for a comprehensive discussion of the impairments briefly summarized below.

1. Soil Erosion

Soil erosion was identified as an impairment in the 2008 Lake Study and was identified as a source of water quality impairments in the 2006 TMDL Report. Furthermore, soil erosion was documented during the 2005 Stream Survey, 2005 Shoreline Erosion Survey and the 2009 Watershed Survey. Soil erosion translates to sediment loads entering Highland Silver Lake and its major tributaries. The prevailing land management practices dictate much of the soil erosion processes within the watershed and this is supported by findings of the 2010 Silver Creek Report, which identifies a correlation between TSS concentrations and agricultural land use (SIUC et al., 2010). The primary sources of soil erosion within the watershed are: sheet, rill and gully erosion from exposed soils on crop land and forested land; streambed and bank erosion along East Fork Silver Creek, Little Silver Creek and other tributaries; and shoreline erosion around the lake. The effects of sheet, rill, gully and streambed and bank erosion are amplified in the Highland Silver Lake Watershed due to the clay soils that stay in suspension. In other words, once soil erosion occurs, it is likely that only a small fraction of the eroded soil will settle in wetlands, grassed areas, ponds or stream beds before entering the lake.

Approximately 83 percent of the watershed is agricultural and 7 percent is forested. Sheet and rill erosion are very common on crop land with exposed, tilled soil. The forested slopes adjacent to the lake are also sources of sheet, rill and gully erosion. Conservation tillage practices are generally minimal and may change each year depending on the weather or production goals. Sheet and rill sediment delivery rates range from 20 to 45 percent (HDR│CWI, 2007). Gully erosion tends to occur at the transition area between fields and forests, where concentrated overland flows enter forested areas of the watershed. As overland flow continues, head cutting occurs and large erosional gullies are created. Gully erosion was also observed on crop land where overland flows enter culverts. Gully erosion sediment delivery rates range from 75 to 90 percent (HDR│CWI, 2007).

Another source of soil loss in the watershed is from streambed and bank erosion within East Fork Silver Creek and Little Silver Creek and shoreline erosion around Highland Silver Lake. Streambed and bank and lake shoreline erosion have high sediment delivery rates as nearly all of the eroded soils are deposited within the receiving waters. Some of the sediment from streambed and bank erosion will settle in depositional areas prior to reaching the lake.

2. Accumulated Lake Sedimentation

Excessive sedimentation can negatively impact any lake that serves as a public water supply or that is used for recreational purposes since there is the possibility of burying intake structures, reducing the lake's original water storage capacity, contributing to shallow water depths, and impacting aquatic habitat. Reservoir sedimentation is a natural process that can be accelerated or slowed by human activities in the watershed. In most cases, agricultural and developmental activities in the watershed increase sediment delivery to the lake due to increased exposure of the soil material to erosive forces. Thus, this impairment was created by the soil erosion previously described.

An estimated 2,977,502 cubic yards of sediment have been deposited in the lake between 1962 and 2011. This volume of accumulated sediment was extrapolated based on 1999 sediment survey results and the estimated annual sedimentation rate. Accumulated sediment has caused an approximate 33 percent water storage capacity loss for the entire lake over a 49-year period. Most of the accumulated sediment is located north of the I-70 Bridge as documented by the sediment survey completed in 1999 (Bogner, 2001). The upper end of the lake is inaccessible due to shallow depths. This sedimentation has already led to recreational use limitations and water quality impairments and will continue to degrade the lake.

3. Poor Water Quality

Soil erosion and excessive nutrient loads have caused poor water quality in the lake and its tributaries. Accumulated sediment within the lake has also contributed to poor lake water quality. As mentioned previously, Highland Silver Lake was placed on the Illinois Section 303(d) List of Impaired Waters in 1994 as a water body that was not meeting its designed uses and remains on the draft 2010 303(d) List (IEPA, 2004 and 2010). Multiple water quality impairments have been identified on the 303(d) List (Section II, Table II-2). The major water quality impairments and associated sources identified by the 303(d) List, the 2008 Lake Study, and the 2010 Silver Creek Report are listed below. Although this is not an all inclusive list of impairments, most of the impairments not listed below are either minor or uncontrollable and will be indirectly improved as a result of plan implementation.

<u>Water Quality Impairments</u>

- Total Phosphorus
- *E. coli*
- Total Suspended Solids (TSS)
- Turbidity

<u>Sources of Water Quality Impairments</u>

- Failing Septic Systems
- Livestock Operations
- Crop Production
- Streambank and Shoreline Erosion
- Runoff from Forestland
- Accumulated Sediments

Multiple sources have contributed to the current condition of Highland Silver Lake and its tributaries, as listed above. The Highland Silver Lake Watershed is highly agricultural, which often reflects higher gross soil erosion rates and excess nutrients in stormwater runoff from direct application of fertilizers. Compared to other land use types, agricultural fields tend to erode more easily due to their increased exposure to wind and precipitation. Streambed, streambank and shoreline erosion are also major contributors to the amount of sediment and nutrients being transferred to the lake. Fine-grained particles (i.e., silt and clay) from erosion can remain suspended in the water column for extended periods of time, especially with the presence of natric soils in the watershed. Once the sediment and nutrients are deposited in the lake, resuspended sediments may also release nutrients into the water column. Other direct sources of nutrients include livestock operations and failing septic systems. Livestock and human waste byproducts present significant solids, nutrient, and bacterial loads that impair water quality and lake aesthetics.

C. Protection Areas and Critical Areas

Protection areas can be defined as locations throughout the Highland Silver Lake Watershed that should be managed to avoid degradation of natural resources. These are generally waterways and adjacent land that would benefit by reduced sediment and nutrient loads. Critical areas can be defined as locations throughout the Highland Silver Lake Watershed that are most impaired. This means that one or more of the impairments listed above have been identified in this area. Sediment delivery ratios or the location relative to the nearest waterway are also taken into account when determining critical areas. As an example to further explain protection and critical areas, the lake would be considered a protection area and severely eroded shoreline would be considered a critical area. Both protection and critical areas within the watershed, tributaries and the lake are discussed below.

1. General Watershed

Protection areas throughout the watershed include waterways reported in the national hydrographic dataset as indicated on Map G3 within Appendix 1. Prime farmland is also a valued resource within the watershed and these areas are important to consider when implementing projects. In general, critical areas within the watershed consist of impaired waterways and areas susceptible to soil erosion. Critical areas for impaired waterways will be discussed below under tributaries and lake.

General areas susceptible to soil erosion include HEL, land with steep slopes (B slopes or greater, or $\geq 4\%$ slopes) and small drainages within or adjacent to land that is subject to routine soil disturbance. Compared to other land use types, agricultural fields tend to erode more easily due to their increased exposure to wind and precipitation. Soil slopes and land use are shown on Maps G4 and G6 in Appendix 1. In order to further identify critical erosion areas within the watershed, a field survey was conducted in 2009. The survey indicated that most roadside ditches in the upper end of the watershed should be considered a critical area due to lack of field borders. Select areas lacking field borders observed from public rights-of-way are shown on Maps S2a-f in Appendix 2. It is likely that there are many more locations that were not identified during the field survey.

2. Tributaries

Little Silver Creek, East Fork Silver Creek, and minor tributaries as defined by the USGS national hydrologic dataset are natural resources that should be protected. Protective areas for these waterways include buffer zones that should range from 50 to 100 feet from the banks at a minimum. Smaller buffer zones may be more practical for headwaters or small drainages. Aerial photography was used to estimate the level of protection or buffer that currently exists around major and minor tributaries. Unprotected and partially protected streams have been identified on Maps S2a-f in Appendix 2 and select statistics are listed below.

- 94% of East Fork Silver Creek has some type of riparian buffer, of which 82% forested.
- 82% of Little Silver Creek has some type of riparian buffer, of which 79% is forested.
- 55% of minor tributaries have some type of riparian buffer.

In 2010, the Silver Creek Report rated water quality for several subwatersheds in the Highland Silver Lake Watershed as part of a larger study for many subwatersheds in the Lower Kaskaskia River Watershed (SIUC et al., 2010). Based on this study, critical areas are considered streams with poor water quality ratings for orthophosphate, total suspended solids, *E. coli*, and nitrate; or an overall poor stream rating. A summary table of these areas was provided in Section II and copies of relevant maps included within this study are provided in Appendix 3. Although this characterization was not completed for the entire Highland Silver Lake Watershed, it is likely that most portions of stream located downstream of an impaired stream are also impaired.

In 2005, an aerial assessment of portions of East Fork Silver Creek and Little Silver Creek was conducted (Kinney, 2005). This assessment documented numerous points of bed cutting and bank erosion as shown on Maps S3a and b in Appendix 2. There is one critical area in particular located just above the confluence of East Fork Silver Creek and Little Silver Creek that is in very poor condition and in great need of stabilization. Although this characterization was not completed for stream reaches, it is likely that additional stream reaches are unstable and eroded.

3. Highland Silver Lake

Highland Silver Lake is a valuable natural resource that should be protected in order to preserve recreational activities and the public drinking water supply. The entire lake and adjacent land is considered a protection area since all actions within this area directly affect water quality. In general, the entire lake should be considered a critical area since lake water quality is impaired and designated uses for the lake are not being met. However, specific critical areas for Highland Silver Lake have been identified for three separate activities: forest management, shoreline stabilization and sediment removal.

The general condition of the forested areas surrounding the lake was characterized in April 2010. Observations of tree density and understory growth were utilized to create a data layer that identifies poor quality sections of forest. Approximately 116 acres have been classified as critical management areas as designated on Map S1 in Appendix 2.

A shoreline erosion survey was completed in 2005 as part of the 2008 Lake Study to characterize the degree of erosion around the lake. Critical areas are designated as moderately (bank height of 3 to 5 feet) or severely (bank height of greater than 8 feet) eroded shoreline as indicated on the 2005 shoreline erosion survey (HDR│CWI, 2008). An estimated 4,130 feet of those critical areas, including all severely eroded shoreline, have been stabilized since the 2005 survey. A copy of the 2005 shoreline erosion survey map and a map showing areas that have been stabilized since that survey are included in Appendix 3.

The most recent sedimentation survey for Highland Silver Lake was conducted by the ISWS in 1999. The results of the 1999 ISWS survey were used to estimate the amount of accumulated sediment that had been deposited annually within the lake between the 1999 survey and 2011. Based on the 1999 survey, extrapolated data and current observations of shallow water depth, moderately and highly impacted areas have been designated on Map S1 in Appendix 2.

D. Recommended Alternatives

Soil erosion, accumulated sediment, total phosphorus, *E. coli*, total suspended solids, turbidity, are the major impairments for Highland Silver Lake that require immediate attention. There are many lake and watershed restoration projects described within this section that will reduce sediment and nutrient loads, and collectively improve impairments listed above. Reduced loads will also indirectly improve water quality impairments such as manganese, low dissolved oxygen and excess algal growth identified on the 303(d) List. Community outreach activities for target groups are discussed below and recommended in order to facilitate implementation of lake and watershed restoration projects. Table III-1 at the end of Section III provides a summary of recommended alternatives.

The discussion below is divided into the following categories:

- Soil Conservation Practices
- Nutrient and Bacteria Conservation Practices
- Stream Protection and Restoration
- Lake Protection and Restoration
- Community Outreach Activities

1. Soil Conservation Practices

Soil erosion has been identified as an impairment for the entire watershed and it is contributing to additional impairments such as accumulated sediment and poor water quality. Sources of soil erosion include: stormwater runoff from cropland, gully erosion, unvegetated drainage ways and shoreline erosion, and streambed and bank erosion. Based on the composition of soils in the Highland Silver Lake Watershed, practices that promote soil cover will be the most effective in preventing soil erosion and reducing sediment loads to adjacent waterways. This was determined from installation and evaluation of BMPs during the RCWP as discussed Section II.

Conservation tillage and crop rotations would provide the biggest benefit but would be difficult to implement because many farmers feel that conventional tillage is the best method. Field borders and grassed waterways would provide good load reductions and have been identified as a wide spread need throughout the upper end of the watershed. Other practices that allow soil to settle out of suspension, such as sediment basins, wetlands, or ponds, can also be useful but would not be as beneficial. These practices are summarized below.

<u>Soil Conservation Practices</u>

- Field borders
- Grassed waterways
- Conservation tillage
- Crop rotations
- Water and Sediment Control Basins (WASCBs)
- Wetlands/Ponds

Field Borders

Field borders can be defined as a strip of native, perennial grasses or shrubs permanently established around the edge of an agricultural field. They act to slow water flow and allow sediment, fertilizers, and pesticides to collect in the vegetated buffer zone. The trapped nutrients are utilized by the vegetation, and cleaner filtered water is allowed to enter the stream and lake. According to the “Lake and Reservoir Restoration Guidance Manual,” properly installed and maintained filter strips or stream side buffer zones are capable of filtering or trapping from 67 to 84 percent of sediment and nutrients from sheet runoff on four percent slopes (HDR│CWI, 2007). This is highly dependent on the size of the filter strip and could be less for field borders.

As mentioned in Section II, many of the fields in the upper end of the watershed had no vegetated border between crops and ditches. This allows for a high degree of natural soil erosion because there is nothing to keep the soil from the field in place. The problem is exaggerated by the fact that tillage is performed right up to and within the ditch which is a direct waterway source to adjacent streams. This is a huge source of sediment and improving this impairment is very high priority. Based on field observations and GIS analysis, it is estimated that approximately 87,400 linear feet of roadway ditches need protection. Select problem areas observed in the field are shown on Maps S2a-f in Appendix 2 and account for an estimated 17 percent of the total roadway length within the watershed.

It is recommended that the City of Highland partner with the Bond and Madison County SWCDs to develop a field borders program for the Highland Silver Lake Watershed that would provide an incentive to landowners beyond what is traditionally provided in order to promote installation of field borders within the upper end of the watershed and especially on those parcels that are directly adjacent to tributaries. Based on 2011 costs provided by Madison County SWCD, installation of field borders cost approximately $380 per acre for cool season grasses and $525 per acre for warm season grasses. Field borders would provide a benefit to farmers by alleviating the need to dig out bordering ditches when they fill up with eroded soil. This will save time and money and also improve drainage by allowing a proper pathway for runoff during rain events and times of flooding.

Grassed Waterways

Grassed waterways can be very effective at preventing gully erosion. They force stormwater runoff to flow down the center of an established grass strip, while minimizing soil erosion during the process. Besides preventing gully erosion, grass waterways can be effective filters that trap sediment and nutrients. However, they can lose their effectiveness if too much sediment builds up in the waterway. In order to maintain optimal effectiveness, they should be implemented with other practices such as conservation tillage and filter strips.

Grassed waterways are abundant within the lower portion of the watershed around the lake but fewer are present within upper portions of the watershed. According to a local landowner, many of the grassed waterways installed as part of the RCWP in the 1970s and 1980s have been removed. Multiple fields are drained by creating a small surface channel right in the middle of the field as shown in Figure II-2. This provides a direct pathway for soil erosion and sediment transfer to adjacent waterways. In areas that are natural drainage ways but are not covered with vegetation, large gullies have formed. Unvegetated waterways or concentrated flow pathways have been designated as headwaters on Maps S2a-f in Appendix 2 and account for 544,194 linear feet. It is also important to note that some grassed waterways installed in the watershed are in need of maintenance. Grassed waterways cost approximately $2,500 per acre (NRCS, 2011) and have annual maintenance costs of roughly $25 per acre for mowing and $300 per acre for burning (NRCS, 2003).

Conservation tillage

The predominant land cover within the watershed is a consistent agricultural rotation of corn, soybeans, and with lesser amounts of winter wheat and other small grains. Due to the flat topography, the majority of the farmland within the watershed, especially corn fields, continues to be conventionally tilled (i.e., 0 to 10 percent residue left on the fields) (Madison Co. NRCS, 2005). Soil conservation tillage practices are generally only found in steeper sloping and highly erodible areas (LTI, 2006). The USDA requires that farmers have a conservation plan in place for fields that are classified as HEL in order to receive financial assistance. Soil slopes and HEL are shown on Map G4 in Appendix 1. Conservation tillage, also referred to as crop residue management, provides a mechanism to protect prime farmland and reduce sediment and nutrient loads by minimizing exposed soil and subsequent soil erosion. Conservation tillage/crop residue management systems were recommended as part of the 2006 TMDL Report and are recognized as cost-effective means of significantly reducing soil erosion and maintaining productivity (LTI, 2006).

Conservation tillage practices include any tillage and planting system that maintains at least 30 percent crop residue after planting and harvesting. Examples of conservation tillage include no till, ridge till, and mulch till. Advantages of conservation tillage over conventional systems can include fuel and labor savings, lower machinery investments and repair costs, and long-term benefits to soil structure and fertility (USDA, 1996). Conservation tillage is an important tool used to reduce sheet and rill erosion within agricultural fields. Using continuous no till methods can reduce soil loss by 75 percent over conventional methods. The NRCS (2003) recommends that row crops grown on slopes greater than five percent (i.e., B slopes or greater) should be continuously no tilled or terraced. Approximately 1,838 acres of cropland within the Highland Silver Lake Watershed have slopes of four percent or greater. Approximately 714 acres of cropland are classified as natric.

Conservation tillage is the best method to keep soil from migrating to adjacent waterways. It also provides a benefit to the farmer by retaining moisture and preserving good quality soil. As top soil erodes from the fields each year, any residual nutrients from previously applied fertilizer go right along with it and underlying clay becomes exposed which is poorly drained and more difficult to work with. If no till practices are adopted, operational expenses can be minimized.

Despite potential advantages and improved conservation tillage equipment, conventional tillage is still the most accepted practice. According to local SWCD staff, tillage practices can be highly dependent on climate and crop prices. These issues are uncontrollable and may prevent some farmers from adopting conservation tillage practices. However, it is recommended that these practices be promoted and educational opportunities be offered to help farmers gain knowledge about production rates, costs, and emerging equipment or methods.

A wide range of costs has been reported for conservation tillage practices, ranging from $12 per acre to $83 per acre (1998 dollars) in capital dollars (USEPA, 2003). For no till, the Illinois Agronomy Handbook for Machinery and Labor lists costs that range from $36 to $66 per acre (UIUC, 2005). Recent costs have been estimated at $15 per acre for no till or strip till practices (NRCS, 2011). Many of the initial capital costs associated with conservation tillage may be off set by reduced operating fuel costs (i.e., labor, lower machinery investments and repair costs).

Crop Rotations

Crop rotation is a soil conservation practice that keeps agricultural land under vegetative cover year round, or as much as possible. Crop rotation not only reduces erosion and subsequent soil and nutrient transport within the watershed but also increases water infiltration and decreases runoff. Rotating crops reduces water and wind erosion and can improve crop yields by recycling nutrients. Crop rotations include: pasture or hayland planting, cover crops, conservation cover, and planting warm or cool season grasses. Cover crops include grasses, legumes or small grains grown between regular grain crop production periods for the purpose of protecting and improving the soil. Legumes have an added benefit of adding nitrogen to the soil to reduce the need for commercial fertilizers.

Conservation cover, a type of land cover, establishes and maintains perennial vegetation on lands retired or removed from agricultural production. Conservation cover can be a variety of different species depending on long term objectives of the land user and the needs of target wildlife species. Conservation cover reduces soil erosion and sedimentation, improves water quality by acting as a filter to remove chemicals and other nutrients, and creates or enhances wildlife habitat (NRCS, 2005). Approximate costs to implement crop rotations are listed below (NRCS, 2011).

Crop Rotation Activities	Cost ($)
Pasture and hayland planting per acre	$70- $280
Fencing per linear foot	$1- $4
Cover crops per acre	$30- $50
Conservation cover per acre	$130- $330

Crop rotations were observed in some areas during the 2009 Watershed Survey; however, many other areas would benefit from this practice. It is recommended that all types of crop rotations be promoted throughout the watershed with educational materials. Conservation cover in particular is one of the best ways to reduce sediment and nutrient loads because it establishes perennial cover on lands that were previously exposed to sheet, rill and gully erosion. It is recommended that the City of Highland pursue purchase of agricultural parcels and establish conservation cover on these parcels. Critical areas described within this plan and shown on Map S4 in Appendix 2 should be targeted.

WASCBs

Water and sediment control basins (WASCBs), also referred to as dry dams, are earth embankments constructed across a slope and a minor waterway to form a sediment trap and water detention basin. They trap water and sediment runoff from cropland and reduce gully erosion by controlling flows within the drainage area. WASCBs have several benefits including reducing waterway and gully erosion, sediment trapping, reducing and managing on-site and downstream runoff, and improving downstream water quality. The sediment trapping efficiency has been reported as high as 75 percent but this may be lower for the Highland Silver Lake Watershed due to clay soils (LTI, 2006). These structures tend to work best when other practices such as conservation tillage and crop rotations are used concurrently because WASCBs do not address sheet and rill erosion.

A number of basins were constructed in the Highland Silver Lake Watershed during the 1970s and 1980s to reduce erosion and sedimentation. Installation of additional basins should be considered throughout the watershed in areas selected to minimize disruption to existing croplands. Depending on the site, grassed waterways may be more effective than WASCBs due to a higher surface area of vegetation which ultimately keeps the soil in place and allows for additional filtering. WASCBs are most beneficial in areas with steep and undulating topology where a grassed waterway may not be practical. However, WASCBs may be more accepted by farmers because land taken out of crop production can be minimized. This provides an advantage over some of the other soil conservation practices that may be more difficult to implement on a watershed-wide scale. Construction costs for WASCBs can vary widely depending on location and size but have been estimated at $20,000 to $45,000 based on recent project experience.

Wetlands/Ponds

The 2006 TMDL Report states that the finer portion of the suspended sediment load entering the lake may not be easily treated by sedimentation basins, but may be treatable through the use of constructed wetlands (LTI, 2006). Wetlands provide stormwater detention, which typically traps sediment and allows for nutrient uptake. Although this practice would be beneficial; it is a much

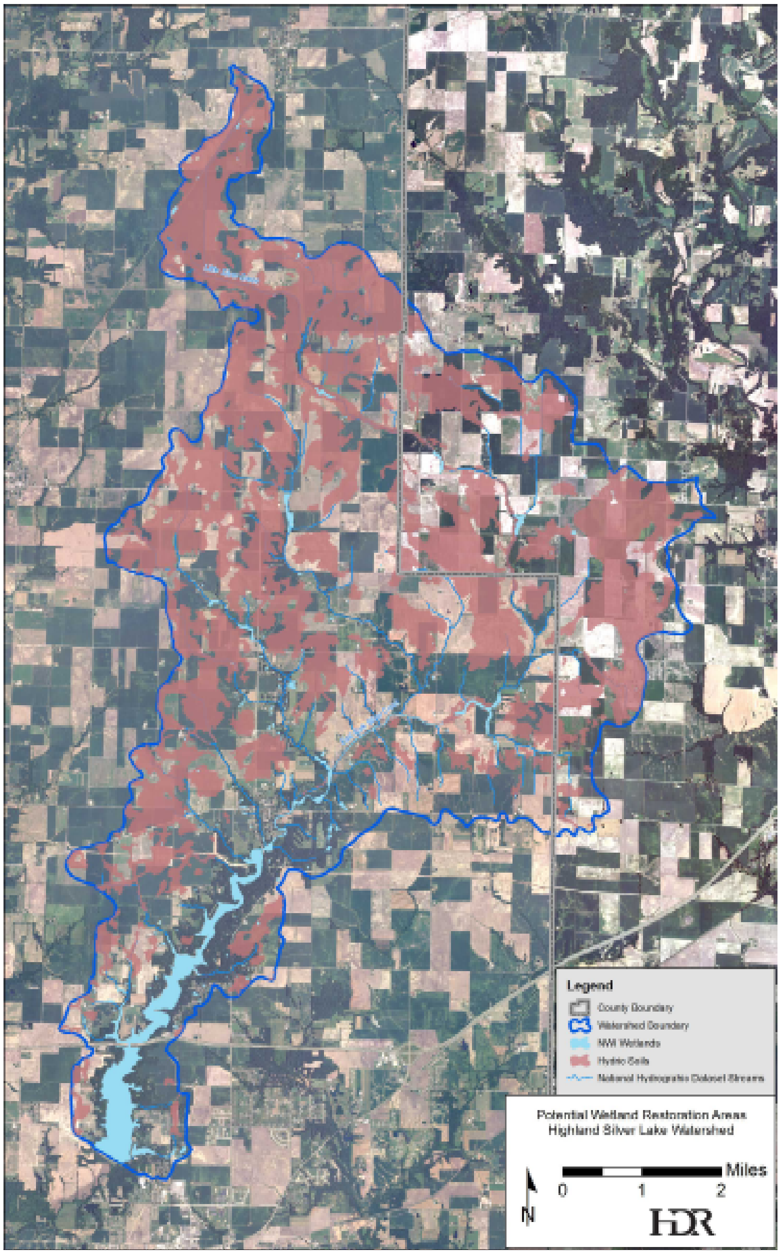


Figure III-1. Potential Wetland Restoration Areas

lower priority since the primary goal of recommended practices is to keep soil and nutrients in place prior to transport. Furthermore, this is not generally a favored practice by farmers and would be difficult to promote and implement. This is demonstrated by the fact that many of the pond features on the USGS topographic map are now farmed wetlands. Wetland creation and maintenance would therefore be most feasible on city-owned land. Potential wetland restoration areas, defined as areas with hydric soils, are shown in Figure III-1.

Ponds or small impoundments can be constructed along minor waterways and ravines, as an alternative to WASCBs. Ponds trap sediment and nutrients and can provide habitat and recreational opportunities. For the purposes of this study, the construction of ponds is estimated to cost approximately $50,000- $75,000 per acre (HDR Project Experience, 2007 and 2010). This cost includes clearing, earth work, discharge structure, riprap slope protection, and seeding. Pond construction is not a high priority because there are numerous ponds already present within the watershed as shown on Map G3 in Appendix 1. Furthermore, ponds reduce loads by allowing for settling which is not as beneficial as other practices described above.

2. Nutrient and Bacteria Conservation Practices

Nutrient conservation practices should be encouraged throughout the watershed in order to minimize the amount of nutrient delivery to adjacent waterways. As mentioned previously, phosphorus is listed by the state of Illinois as an impairment for Highland Silver Lake. Phosphorus and *E. coli* have been identified as impairments in several tributaries. Since the TMDL indicates that a 90 percent reduction in phosphorus is needed, any nutrient conservation practices implemented would be beneficial for the Highland Silver Lake Watershed. Furthermore, many organizations and government agencies are taking action on a regional level to reduce nitrogen loads to the Mississippi River and the Gulf of Mexico. Sources of nutrients listed in the 2006 TMDL Report include failing septic systems; animal feeding operations and pastureland runoff; crop fertilization with commercial fertilizers or manure; lake bottom sediments during anoxic conditions; lakeshore and streambank erosion; and runoff from fertilized lawns. The recommended practices listed below address these sources.

<u>Nutrient and Bacteria Conservation Practices</u>

- Septic system inspection and maintenance
- Livestock management
- Nutrient management plans
- Bioswales/rain gardens
- Soil conservation practices

Septic System Inspection and Maintenance

Inspecting and upgrading or repairing septic systems is a practice that ensures wastewater is properly treated and not discharged into adjacent streams or the lake. Septic systems are common in rural communities such as the Highland Silver Lake Watershed, where centralized wastewater treatment systems are not economical. Many of the residences and facilities within the watershed utilize septic systems to treat domestic wastewater from toilets, wash basins, bathtubs, washing machines, and other water consumptive items. Typical pollutants in household wastewater are nitrogen, phosphorus, and disease causing bacteria and viruses. Due to their widespread use and high volume discharges, septic systems have the potential to pollute groundwater, lakes, and streams. In 2004, the Illinois EPA estimated that between 20 and 60 percent of surface discharging systems statewide have failed or are in the process of failing (LTI, 2006).

The following is an excerpt from the Madison County Private Sewage Disposal Ordinance (Madison County Planning and Development, 1999).

> USEPA research shows that one of the biggest causes of pollution to waterways is septic systems that are not working as they should. When a septic system is not properly maintained or fails, untreated domestic wastewater can reach source water. Bacteria and viruses from human waste can cause dysentery, hepatitis, and typhoid fever and the cumulative effect of numerous failing

septic systems can become a major source of pollution on a waterway. And, the more polluted the source water, the more costly it is to clean for human consumption, resulting in higher treatment costs on the municipal level.

While the County Health Departments oversee the installation of new septic systems, inspections and routine maintenance on existing septic systems are voluntary and are the responsibility of homeowners, unless a complaint is received. The U.S. EPA (2001) recommends that septic systems should be inspected every three years. Routine inspections, maintenance, and replacement/upgrades of septic and holding systems would reduce nutrient and bacteria loads and should be encouraged via community outreach programs. Furthermore, it is recommended that the City of Highland work with Bond and Madison County Health Departments and the US EPA 319 Section to develop and fund a program that would minimize the potential for releases from private sewage disposal systems. This recommendation was included in the TMDL Implementation Plan and has been considered on a county-wide level by Madison County. The estimated cost of a septic system inspection ranges from $200 to $500.

Livestock Management

Livestock are a source of nutrients, oxygen demanding substances, bacteria, and in some cases soil erosion. Feed lots were identified as a critical area by the RCWP due to a very high rate of erosion (Davenport, 1982). Livestock have historically had access to Highland Silver Lake. In 2010, two ponds were constructed to serve as alternative watering sources and in 2011, existing fencing was set back to prevent livestock access to the lake. This project was funded by the City of Highland and will provide substantial load reductions for sediment, phosphorus, nitrogen, and *E. coli*.

Livestock may also have access to the tributaries at one or more locations but this has not been confirmed. In cases where this is occurring, fencing and alternate water sources should be installed to prevent access. In addition, planned grazing systems and maintaining pasture ground cover are recommended at locations of all livestock operations. Improving the distribution of grazing pressure by developing a planned grazing system or strategically locating water troughs, salt, or feeding areas to draw cattle away from riparian zones can result in improved utilization of existing forage, better water quality, and improved riparian habitat. Livestock exclusion and other grazing management measures have been shown to reduce phosphorus loads on the order of 49 percent (IEPA, 2003).

Development and maintaining comprehensive nutrient management plans (CNMPs) for livestock operations was one alterative recommended by Bond County NRCS staff in order to reduce phosphorus loads. The objective of a CNMP is to document the animal feeding operation's plan to manage manure and organic by-products by combining conservation practices and management activities into a conservation system that, when implemented, will achieve the goal of the producer and protect or improve water quality (Rowley, 2010). The cost of developing a CNMP ranges from $4,000 to $6,000 (NRCS, 2011). Although nutrient load reductions can be high for certain livestock management practices, there are few livestock operations within the watershed. Thus, livestock management practices should be encouraged but are not a high priority on a watershed scale.

Nutrient Management Plans

Nutrient management plans increase the efficiency with which nutrients are applied to crops, which reduces the amount available to be transported to both surface and ground waters. The majority of phosphorus lost from agricultural land is transported via surface runoff in particulate form attached to eroded soil particles. When a small loss of fertilizer is accounted for on a large scale, such as the 83 percent of agricultural land present within the Highland Silver Lake Watershed, water quality can be significantly impacted. A nutrient management plan identifies the amount, source, time of application, and placement of each nutrient needed to produce each crop grown on each field each year, to optimize efficient use of all sources of nutrients and minimize the potential for losses or transfer to waterways (UIUC, 2005). Increased efficiency of fertilizer applications will collectively decrease the amount of nitrogen and phosphorus transported to adjacent waterways.

A U.S. Department of Agriculture study reported that average annual phosphorus application rates were reduced by 36 lbs per acre when nutrient management practices were adopted (USEPA, 2003). This is supported by the fact that plans developed by the Madison County SWCD office typically recommend no phosphorus application based on the high background levels present in the soil. Costs of developing nutrient management plans have been estimated at $6 to $20 per acre but these costs are often offset by the savings associated with using less fertilizer. For example, a study in Iowa showed improved nutrient management on cornfields led to a savings of about $3.60 per acre (USEPA, 2003).

Local SWCD staff has indicated that most of the farmers in the area use soil testing to determine the amount and type of fertilizer to apply to their fields. Based on this information, it does not appear that development of nutrient management plans is a great need but the goal should be to have a nutrient management plan in place and maintained for every field. It is recommended that this practice be promoted via distribution of informational materials.

Bioswales/Rain Gardens

Bioswales can be defined as a vegetated drainage designed to slow stormwater and reduce sediment and nutrient loads by allowing for trapping and infiltration. A rain garden can be defined as a shallow depression that is planted with native wetland or wet prairie wildflowers and grasses. They are installed in residential areas to reduce stormwater runoff and non-point source pollution created by fertilizer application. They are typically an inexpensive and aesthetically pleasing way to reduce phosphorus loads to nearby waterways.

There are few residential areas within the Highland Silver Lake Watershed; however, most of them are very close to waterways. Installation of bioswales and rain gardens is a cost-effective method for reducing phosphorus and nitrogen loads from urban runoff and should be promoted via educational material or demonstration plots. Potential areas that would benefit from this practice are shown on Map S6 in Appendix 2.

Soil Conservation Practices

Since much of the phosphorus entering the lake is bound to sediment, any action that involves reducing sediment loads will also reduce phosphorus levels. These practices were described above but added information regarding load reductions is provided for select practices below. In general, practices that result in higher sediment load reductions will also provide higher nutrient load reductions. Many of these practices should be a high priority since they reduce sediment and nutrients.

Vegetative control methods such as field borders and stream buffers can be very effective in reducing nutrient transport. The relative gross effectiveness of filter strips in reducing total phosphorus has been reported as 75 percent (USEPA, 2003). Reduction of particulate phosphorus is moderate to high, while effectiveness for dissolved phosphorus is low to negative (NRCS, 2006). Conservation tillage practices have been reported to reduce total phosphorus loads by 45 percent (USEPA, 2003). In general, conservation tillage and no-till practices are moderate to highly effective at reducing particulate phosphorus, but exhibit low or even negative effectiveness in reducing dissolved phosphorus (NRCS, 2006). According to the 2006 TMDL Report, the rate of phosphorus removal via wetlands has been reported up to 45 percent but data are inconsistent when compared with other reports.

3. Stream Protection and Restoration Activities

The stability of a stream is directly linked to the quality of water within the downstream waterbody. Erosion is a natural and continual process affecting all stream channels. In limited amounts, erosion creates a stable stream with a diverse array of natural features such as riffles and pools that support aquatic life. Stream stability can further be described as an "equilibrium condition" where, over a period of time, the stream slope and channel characteristics have adjusted to accommodate the energy and velocity from water discharges. Destabilizing erosion produces accelerated stream widening and/or deepening. An unstable channel is defined as a channel in which its banks are collapsing, and/or the bed is cutting down.

Stream protection and restoration activities for major streams within the watershed seek to create a "stable channel" and should be considered a high priority in order to halt accelerated erosion and sediment loads to Highland Silver Lake. Activities, such as using rock riffle grade controls for streambed/grade stabilization, are designed to create a naturally stable channel and address multiple deficiencies. Based on 2005 survey data, grade stabilization requires over 100 grade control riffles and represents a significant financial commitment; however, stabilizing placement locations can be further prioritized and phased to spread the total cost over a longer period. Another important restoration element for creating a stable stream channel is providing an adequate riparian corridor to accommodate the stability requirements for the recovery the active channel, meanderbelt and terrace slopes. Stream buffer zones currently protected need to be managed and expanded for a stable channel to exist and to improve or preserve water quality. Comprehensive expansion and protection of the existing riparian corridors along East Fork of Silver and Little Silver Creek represents a significant financial commitment, but serves to increase the ability of the stream system to recover a stable channel and regain the functions of a natural riparian wetland.

<u>Stream Protection and Restoration Activities</u>

- Streambed and Streambank Stabilization
- Filter Strips
- Riparian Corridor Restoration
- Conservation Easements

Streambed and Streambank Stabilization

Streambed and streambank erosion are a significant contributor to the amount of sediment delivered into Highland Silver Lake. Recent evidence from a radionucleotide tracking study on an eroding Iowa stream indicates 76 percent of sediment transported to the stream is the result of bank failure, while only 24 percent is traced to terrestrial soil mobilization from sheet or rill erosion (Schilling, 2011). Results from this study clearly illustrate the importance of maintaining a stable channel and highlight the need to minimize stream bank erosion to the greatest extent possible throughout the watershed.

Valley profile estimates from USGS topographic maps indicate the East Fork of Silver Creek has a gradient of approximately 9.4 ft/mi for the upper 7.4 miles then dramatically reduces to 3.6 ft/mi for the remaining 5.6 mi immediately above Highland Silver Lake (Figure III-2). Approximately 3.5 miles upstream of the Lake, the stream maintains an extensive bedrock channel bed that is providing natural grade control and preventing a 3.5-foot head-cut from advancing upstream.

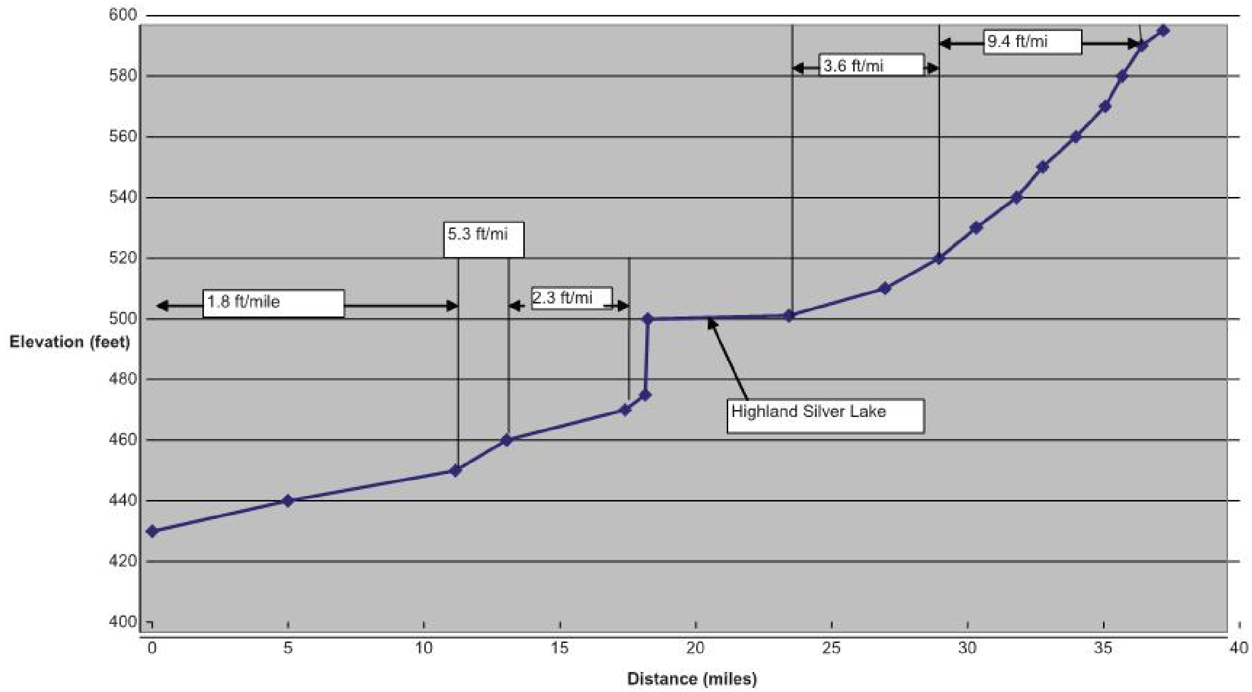


Figure III-2. East Fork Silver Creek Profile (Kinney, 2005)

The upper 10 miles of the survey area does not maintain any natural grade control and has incised 2.5 to 4.0 feet below bankfull depths. Significant erosional points, depositional areas, and log jams are numerous within the unstable reach and are likely the result of mass bank failure from streambed incision. Field reconnaissance was performed at multiple sites throughout the watershed during the 2009 Watershed Survey to confirm the findings reported by Kinney in 2005. Multiple stream banks were severely eroded and massive log and woody debris jams were also prevalent, indicating continued bank slope failure.

The 2005 Stream Survey recommended rock riffle grade controls to address streambed erosion (i.e., channel downcutting and channel widening) (Kinney, 2005). Rock riffle controls to raise the streambed profile and prevent further downcutting are constructed from large RR-6 stone and are placed across the channel and keyed into the banks. Riffles placed at intervals of one riffle for every 6 bankfull widths would serve to restore a natural “riffle” and “pool” sequence that enables a stable stream to efficiently transport water and sediment from the watershed. The approximate cost of $5,000 to $6,000 per structure including materials (RR-6 stone), trucking, and placement was used for estimation purposes (Kinney, 2005). Riffle construction costs will vary according to stream height and width. Streambank stabilization to limit lateral migration may also be necessary in some locations. Techniques such as installing riprap revetments for stone-toe protection, planting woody vegetation, or adding bendway weirs may be necessary in some areas.

Filter Strips

Vegetated buffer zones adjacent to stream systems provide numerous environmental protection and resource management benefits. A buffer zone for a stream system consists of a vegetated strip of land extending along both sides of a stream and its adjacent wetlands, floodplains and slopes. The buffer width should include contiguous sensitive areas, such as steep slopes or erodible soils, and must accommodate a stable channel. Depending on the stream order, optimum widths will vary throughout the watershed. Most buffer zones within the headwaters would consist of grasses, sedges and rushes but as the stream channels widen and become more defined, forested buffers should be maintained. Expansion and management of the existing buffer zones is a high priority. Areas of concentrated flow should be treated as streams and protected accordingly. Headwater streams account for a significant percentage of the drainage and should be set aside and buffered, instead of continually tilled and disturbed. These areas should be addressed with grassed waterways or WASCBs where appropriate.

Approximately 178,924 linear feet of unprotected or partially protected streams (minor tributaries) have been identified on Maps S2a- f in Appendix 2. This number was determine using observations of land cover on aerial photography for any waterway identified on the national hydrologic dataset, with the exception of the major tributaries. Partially protected generally refers to streams that have a buffer on only one side. Installation of grassed or forested buffers along these streams should be a high priority. It is recommended that the City of Highland partner with the Bond and Madison County SWCDs to develop a program for the Highland Silver Lake Watershed that would provide an incentive to landowners beyond what is traditionally provided in order to promote installation of stream buffers within the upper end of the watershed. Costs and load reductions for implementation would be similar to those discussed above for field borders since these practices are similar but installed in different locations.

Riparian Corridor Restoration

Restoration of the riparian corridor consists of re-establishing areas that were previously forested and have been cleared or altered due to human activities. Riparian corridors are ecosystems that border streams, lakes, and watercourses. Generally, they contain three major elements: a stream channel, a floodplain, and a transitional area to uplands. Riparian corridors provide critical functions such as the cycling of nutrients, filtering contaminants from runoff, absorbing and gradually releasing floodwaters, maintaining fish and wildlife habitats, recharging groundwater, and maintaining stream flows (LTI, 2006). Several riparian corridors have been cleared and are now used for agriculture. Most of these farmed areas are located on steeper slopes, which have increased sheet, rill, and gully erosion and subsequent nutrient and sediment loads to adjacent waterways. Restoring these forested natural buffer areas will help reduce sediment and nutrient loads within the Highland Silver Lake Watershed. Map S5 in Appendix 2 depicts the forested riparian corridor along the two major tributaries. Although the majority of both tributaries have a forested riparian corridor, many areas should be expanded. Based on a corridor width of 300 feet, approximately 63 percent of East Fork Silver Creek is unforested and approximately 56 percent of Little Silver Creek is unforested. Approximate costs to restore riparian corridors to native woodland range from $500 to $900 per acre (NRCS, 2011).

Conservation Easements

The Land Conservancy (TLC), a division of SWIRCD, defines a conservation easement as a perpetual legal agreement that permanently restricts harmful uses and development of the property. The land stays in private ownership and use, and the land trust sees that the restrictions are carried out. This is an alternative available in the Highland Silver Lake Watershed that should be considered but is not expected to generate a lot of interest. The City of Highland could create a conservation easement on city-owned land as a way to protect future development. A representative from TLC attended a Silver Lake Commission Meeting in 2009 to provide information regarding conservation easements.

Another form of conservation easements would be acquisition or rental of land in protection areas, such as stream corridors. The City of Highland would provide a financial incentive to landowners in order to obtain management rights over the area in need of protection. This would allow the City to maintain proper buffer zones for fertilizer application and soil disturbance.

4. Lake Protection and Restoration Activities

In general, lake protection and restoration activities should be a high priority in order to improve water quality and recreational opportunities for Highland Silver Lake. Activities such as shoreline stabilization and forest management are alternatives that are easy to implement, cost-effective and prevent or minimize a direct transfer of sediment and nutrients to the lake. Gully stabilization and shoreline buffers would provide high load reductions due to proximity to the lake but are needed in limited locations, many on private land. Dredging is greatly needed to increase water depths, increase storage capacity and minimize nutrient recycling but is substantial cost commitment. An in-lake sediment and nutrient control basin has a high cost and would not alleviate the need for dredging. Furthermore, it is possible that similar load reductions could be achieved by installing practices upstream of the lake.

<u>Lake Protection and Restoration Activities</u>

- Shoreline stabilization
- Dredging
- Forest management
- Gully stabilization
- Shoreline buffers
- In-lake sediment and nutrient control basin

Shoreline Stabilization

The uncontrolled erosion of shoreline areas is source of sediment and nutrient loads to the lake and shoreline stabilization has been previously recommended in multiple reports. Lake shoreline erosion can be caused by the following activities or actions: wind and boat generated wave action, water level fluctuations caused by either drought or periodic lake level draw downs, livestock traffic and a lack of near-shore vegetation. Shoreline erosion impairs lake usage and access by increasing lake turbidity, decreasing lake storage capacity, and damaging valuable lakeshore property. The loss of shoreline soils may also jeopardize the stability of infrastructure, such as bridges, roads, and docks.

As of 2011, approximately 10,260 feet of shoreline stabilization work has been completed at Highland Silver Lake, where either riprap and/or concrete blocks have been utilized. Based on the 2005 shoreline erosion survey data, there were approximately 1,030 linear feet of severe erosion, 9,784 linear feet of moderate erosion, and 20,687 linear feet of slight erosion. The typical form of erosion observed at these locations was an exposed and undercut bank that, throughout time, will gradually allow the upper reaches of the shoreline slope to collapse. After stabilizing approximately 4,130 feet of shoreline in 2009 and 2011, the remaining eroded shoreline is estimated to consist of 7,384 linear feet of moderate erosion, and 19,957 linear feet of slight erosion. A copy of the 2005 shoreline erosion survey is provided in Appendix 3. An updated shoreline erosion survey is recommended prior to any additional shoreline stabilization. The survey should be conducted when the lake level is low or normal and minimal vegetation is present in order to provide the most accurate data.

Rock riprap is a shoreline stabilization alternative that has proven to be very effective for reducing and preventing erosion. Installation of riprap with underlying geotextile filter fabric is recommended to address the remaining areas of moderate (3 to 8 ft bank heights) shoreline erosion and the majority of slight erosion. The advantages of riprap include its reliable longevity, ease of installation and relatively inexpensive cost over large areas. Costs for riprap shoreline stabilization are estimated to range from $65 to $70 per linear foot. For areas of shoreline with gentle slopes that have been categorized as having slight bank erosion, it is possible that emergent vegetation could be planted in shallow littoral areas as an alternative stabilization technique. This technique will only be suitable for select areas due to vulnerability of new plants to wind and wave action, animal destruction, and the need for proper lake bottom and upland slopes. In 2011, a demonstration project was conducted to evaluate the success of establishing aquatic plants from dormant cuttings of existing aquatic plants within the lake in areas currently exhibiting slight erosion. If this method is successful, additional areas of slight erosion should be stabilized using this method.

Dredging

Accumulated sediment has been documented as major impairment for Highland Silver Lake (HDR│CWI, 2008). It has resulted in shallow water depths and reduced water storage capacity, and contributes to poor water quality. An estimated 2,977,502 cubic yards of sediment have been deposited throughout the lake between 1962 and 2011. This volume of accumulated sediment represents an approximate 33 percent water storage capacity loss for the entire lake over the 49-year period and suggests that approximately 35,331 cubic yards of sediment have been deposited on an average annual basis. These numbers are only estimates and were calculated based on data collected during the 1999 Sediment Survey (Bogner, 2001).

The most critically impacted area is shown in Figure III-3 below. It is estimated that this critical area has lost more than 50 percent of its water storage capacity since 1962 and contains more than 750,000 cubic yards of sediment (HDR│CWI, 2008). Current water depths in the upper end are approximately two feet. Removing as much accumulated sediment as possible from within this critical area of the lake will help restore lake water quality by removing deposited materials and an internal nutrient source. It is estimated that the accumulated sediment accounts for approximately 32 percent of the nutrient load for the lake. In addition, water depths and storage capacity can be improved in the upper end of the lake.

It is recommended that a minimum of 400,000 cubic yards be hydraulically removed from the upper end of the lake, which is only a portion of the most critically impacted area as shown on Figure III-1. The removal of 400,000 cubic yards of accumulated sediment would restore nearly four percent of the lake's original volume and provide approximately a two-month water supply for the City and surrounding communities. An updated sedimentation survey is recommended prior to project initiation and will be necessary in order to more accurately determine the amount and distribution of accumulated sediment within the lake. This should be completed during the engineering design phase prior to bidding and implementation. It is anticipated that a higher volume of sediment removal will be recommended by the time a dredging project is initiated.

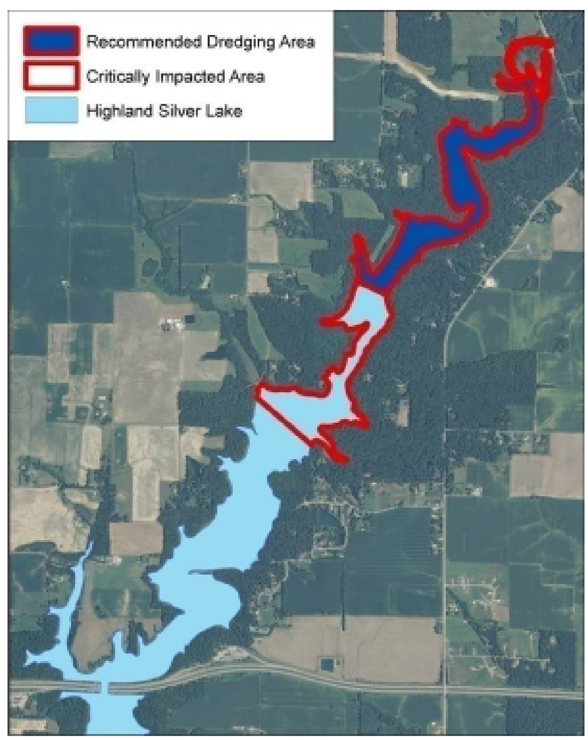


Figure III-3. Sediment Removal Area

Land will be required for the construction of a retention facility that will store and dewater dredged sediment. Based on the recommendation of removing 400,000 cubic yards of sediment, it is estimated that 33 to 50 acres will be required for a suitable retention and dewatering site. The site should be located within the watershed and no more than two miles from the upper end of the lake. Since cropland can be utilized, it is in the best interest of the City to acquire this land as soon as possible to take advantage of land management prior to initiation of the dredging project. This will also minimize costs due to the increasing price for land and could offset costs required at the time of project initiation. Additional details regarding the construction, cost and operation of a sediment retention and dewatering site can be found in the 2008 Lake Study.

An estimated total cost of over $3 million was provided for removal of almost 400,000 cubic yards of sediment from the upper end of Highland Silver Lake in the 2008 Lake Study. Dredging operation costs can range from $6 to $20 per cubic yard depending on the amount and distribution of accumulated sediment (HDR | CWI, 2008). Additional costs included in the total account for engineering, permitting and retention site construction.

Forest Management

Forest management includes a variety of activities aimed toward maintaining a high quality forest. Additionally a managed forest has greater species diversity and a greater ability to absorb stormwater to prevent erosion of slopes. Specifically, selective tree thinning and removal of invasive species has been identified to create a more open woodland type forest, primarily situated around the lake. The forested upland slopes surrounding Highland Silver Lake are generally closed canopy old growth forests composed of mix white, bur and red oak and hickory, while bottomland and transitional successional forests included silver maple, sycamore, cottonwood, American elm, and green ash. Protection of these existing resources using forest management is required to insure their natural ability to regenerate.

In general, oaks and hickories compete with faster growing exotic species and early successional species that can tolerate less sun light. As these species become more established within the understory, it becomes increasingly difficult for preferred canopy species, such as oaks and hickories, to regenerate naturally. Selective tree removal or thinning can promote regeneration and growth of preferable species by removing exotic shrubs and undesirable trees. This process can influence the growth and quality of the larger canopy layer trees and allow sun light to reach the underlying herbaceous and shrub layers that when fully vegetated, serve to stabilize soil on steep slopes. Selective tree thinning and management ensure that the forests will remain healthy and function to reduce erosion within the watershed for generations to come. Forest management will help sustain the lower gross erosion and subsequent sediment and nutrient delivery rates that are characteristic of forested land uses.

Forest management activities within the watershed should focus on all forested areas surrounding the Highland Silver Lake (1,400 acres). Critical areas for management have been identified for several large forested tracts as shown on Map S1 in Appendix 2. The critical areas identified account for eight percent and represent the most degraded forest sites around the lake, that contain a high density of invasive shrubs and bare soil slopes. Other forested sites should also be managed; however, their integrity is much more stable, and will require significantly less effort to manage. Previous studies within the Highland Silver Lake Watershed suggest that erosion rates can be reduced by up to 85 percent with forest management activities; however, erosion rates are low to begin with. Although overall load reductions may not be as high for forest management activities when compared to other recommended practices, this activity can be implemented on city-owned land and would prevent direct soil transfer to the lake.

Costs for forest management activities are dependent on the extent of activities proposed. A forest management plan would be helpful to determine site-specific activities and could be developed for approximately $400 (NRCS, 2011). Costs for invasive species removal have been estimated at $50 to $150 but would be minimal if volunteers could be used (NRCS, 2011). Some activities are already being implemented at no cost by adjacent landowners. Selective tree thinning projects have been initiated by the Medford District Bureau of Land Management (MDBLM) in the Elk Creek Watershed for an estimated cost ranging from $560 to $1000 per acre (MDBLM, 2003). This cost includes removing trees less than eight inches in diameter to reach a 50 percent canopy cover, piling, and burning. Other riparian restoration projects have been implemented along the Illinois River at a cost of approximately $4000 per acre (MDBLM, 2007).

Gully Stabilization

Structures can be installed to prevent gully erosion by controlling the grade in areas that have naturally or artificially formed a channel or are likely to form a channel if not stabilized. They are typically necessary in areas that receive concentrated runoff or have steep slopes, such as riparian areas adjacent to Highland Silver Lake. Several varieties of grade stabilization structures (i.e., stockade post structures; post, weir, and brush structures; post-weir structures; and rock grade stabilization structures) could be constructed to minimize gully erosion. Gully stabilization costs are estimated to range from $30 to $100 per linear foot based on recent project experience.

Approximately 78,476 linear feet of small drainages exist around the lake. There are several areas around the lake that would benefit from gully stabilization but gully erosion was not observed to be a widespread issue on City-owned land or in areas viewable from public right-of-ways. The City of Highland also agreed that gully erosion around the lake was not a major issue. However, the areas where gully erosion is occurring should be considered stabilization because gully erosion yields direct soil transfer to the lake.

Shoreline Buffers

Maintaining proper shoreline buffers or filter strips will reduce nutrient loads to the lake by preventing fertilizer application adjacent to the water's edge and allowing a small un-mowed strip of grass or shrubs to intercept runoff. Utilizing fertilizers that contain low or no phosphorus in these areas will also reduce loadings. The City of Highland owns the majority of property adjacent to the lake; however, there are some landowners that own shoreline property. Encouraging these few landowners to create a buffer zone as described would be beneficial. Costs for this practice would be minimal.

In-Lake Sediment and Nutrient Control Basin

A sediment and nutrient control basin, consisting of either a free floating sediment control boom or curtain or a low-head dam structure, could be constructed to reduce flow velocities and allow sediment to be deposited within the upper end of the lake. The exact positioning and location of the structure would be determined in the design phase of the project through further hydraulic and engineering design studies, although a preliminary site was suggested in the 2008 Lake Study (Figure III-4). Costs included for these locations ranged from $414,000 to $750,000 (HDR│CWI, 2008). Since an in-lake structure would temporarily increase the upstream lake elevation by several feet, the final design would minimize the maximum water surface elevation so as to reduce flooding potential and impacts to properties and structures. Low flows would pass through the structure, potentially through a concrete culvert or an opening within the dam structure, which could allow small boat to pass upstream. Larger flows would be temporarily impounded behind the dam allowing sediment and nutrients to be deposited and retained.

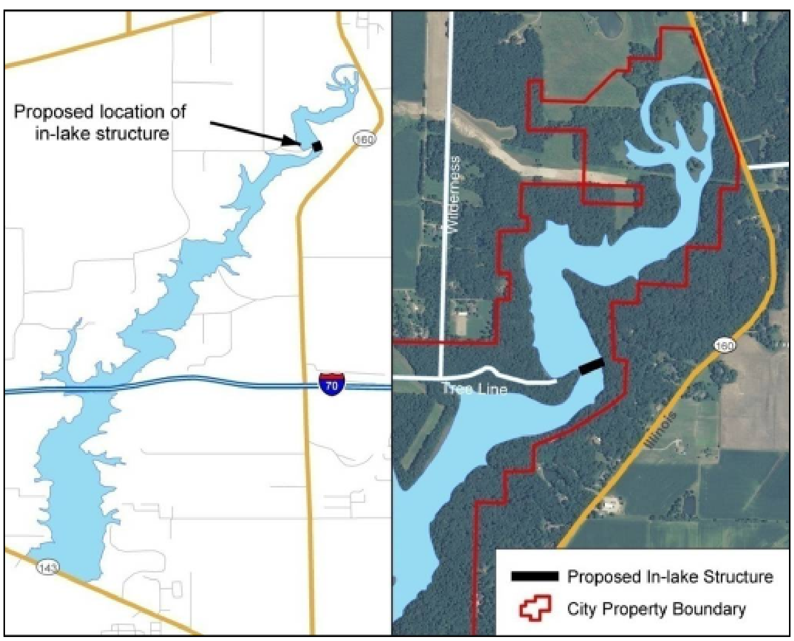


Figure III-4. Proposed Location of In-lake Sediment and Nutrient Control Basin

Load reductions for the sediment and nutrient control basin were estimated using the 1999 ISWS sedimentation survey results (35,331 cubic yards per year), the mean concentrations for sediment grab samples collected during the 2008 Lake Study, and the trapping efficiency of a sediment and nutrient basin with a similar design and application. The initial basin trapping efficiency was conservatively estimated at 50 percent. It should be noted that the basin's trapping efficiency was based on dredging prior to construction and would be reduced over time as accumulated material reduces its storage capacity. The sediment and phosphorus load reductions were estimated to be 11,924 tons and 6 tons per year, respectively (HDR | CWI, 2008).

Removing accumulated sediment within the lake is strongly recommended and a prerequisite to installation of an in-lake sediment and nutrient control basin. Dredging prior to installation would increase the effectiveness, longevity, and trapping capability of a sediment and nutrient control basin. Furthermore, dredging is the only alternative to remove accumulated sediment but there are multiple alternatives for reducing sediment and nutrients loads to the lake. There is a consistent trend in many Illinois watersheds demonstrating that sediment and nutrients loads to reservoirs are decreasing due to conservation practices throughout the watershed. If this trend continues and the other recommendations of this plan are carried out, it is possible that sediment and nutrient loads will continue to decrease in the Highland Silver Lake Watershed. With the combination of dredging and reduced loads, the need for a sediment and nutrient control basin will be minimal.

5. Community Outreach Activities

Community outreach activities, sometimes referred to as informational and educational (I/E) programs, can increase the public's awareness of various lake and watershed issues, educate stakeholders on the process of lake and watershed restoration, and promote future involvement. These activities should target different groups throughout the community in order to engage people with various ages, interests, ability to implement projects. Four audiences that should be targeted with public outreach materials and activities include children and organized youth groups, citizens interested in preserving the public drinking water supply, residential landowners around the lake and lake users, and agricultural landowners or operators that have the ability to implement projects in the watershed.

In general, outreach materials may be obtained through state and federal agencies that promote environmental awareness and stewardship, such as USDA, USEPA, Illinois EPA, Illinois DNR, NRCS, SWCD, and SWIRCD. The USEPA Guide for Conducting Watershed Outreach Campaigns entitled "Getting in Step" is an excellent resource that should be referenced for community outreach activities (USEPA, 2003). Alternatively, materials specific to the Highland Silver Lake Watershed can be created by a City representative, environmental consultant, or other local agency. A combination of general and watershed specific materials should be distributed. Additional programs and/or activities that could aid in public outreach for each target audience are described below.

Facilitate activities for children and youth

Providing teaching materials for science classrooms, conducting field trips to project sites, developing small projects that can be implemented by scouts or other youth groups (i.e., planting trees on Arbor Day or Earth Day), and demonstrations at a lake or watershed festival can be used in combination to target the younger generation. In order to encourage children to talk with their parents about the environment, flyers can be sent home from school with children. Contacting a classroom or youth group to develop an educational brochure would be one way to distribute information with a personal touch. The Illinois EPA sponsored Lake Education Assistance Program (LEAP) is a great resource to aid in getting children involved with lake and watershed educational activities.

Inform drinking water users about water quality issues

This target audience does not own land within the watershed and is mainly concerned about water quality issues that could affect their drinking water. Although they may not use the lake for recreational purposes and may have no interest in protecting the lake as a natural resource, they have a major interest in drinking water which is directly related to lake water quality. This message needs to be conveyed to local citizens. If there is a general understanding that improvements to lake water quality will improve drinking water quality and minimize water treatment costs, citizens are much more likely to support distribution of funds or added taxes for major lake and watershed restoration projects.

Educate lake users and residential landowners around the lake

This target audience values the lake not only as a public water supply but a valuable resource for recreational opportunities including boating, fishing and hunting. Educational materials to target this group may consist of signs around the lake, brochures specific to lake water quality issues, and activities to encourage protection and restoration activities. Typically, lake festivals can be good community outreach activities for this group; however, the City of Highland sponsored a lake festival in 2006 that was not well attended. This should be taken into consideration if another lake festival or similar activity is planned.

Separate from lake users, residential landowners close to the lake should be educated on landscape practices that would reduce sediment and especially phosphorus loads to the lake, and made aware that any actions on their property can affect the lake downstream. One example of a good awareness activity would be stenciling near stormwater drains that states "drains to the lake." This can make people think twice about the fertilizer, pesticides and other chemicals or natural materials that may be transferred to the lake via the drainage system. While this group is limited, it may also be useful to host workshops on topics such as shoreline management, forest management and urban stormwater practices that would reduce sediment and nutrient loads to the lake.

Educate and provide technical assistance for upper watershed landowners

This target audience is by far the most important because they can be encouraged to implement projects on their own land that would reduce sediment and phosphorus loads. Outreach activities recommended for this group include workshops, educational material, demonstration plots, and technical assistance. Local agencies such as NRCS, SWCD, Farm Service Agency, and the Farm Bureau will be great resources to aid in carrying out these activities. These agencies are a vital component in connecting with landowners and farm operators to increase awareness of practices that reduce soil erosion within the watershed and in turn can improve the water quality of Highland Silver Lake. The education and technical assistance would primarily be targeted to watershed residents who have soil, water, plant, and resource problems, as identified throughout this plan.

It is recommended that the City of Highland develop a select group of agricultural landowners to be placed on a distribution list. This can be coordinated through the Madison County Plats and Maps Division. The list could be developed based on geographic location, such as all landowners that have a major tributary on their property, or based on the size of property they own, such as all landowners that own more than 80 acres of property within the watershed. It may be more difficult to develop this type of list for landowners within Bond County. Educational material should be distributed to these landowners at least once per year, during non-peak production times and focus on various topics discussed within this plan. Alternatively, articles could be placed in local publications that are popular among farmers. Workshops should also be held to provide information on emerging technologies, current funding opportunities and resources for technical assistance. Workshops should be coordinated through local agencies previously listed and/or other conservation organizations such as the SWIRCD.

Other activities such as a barbeque or field trip to a demonstration plot could help to promote implementation of conservation practices. The City is encouraged to develop demonstration plots and place signs at these locations to show their commitment to lake and watershed restoration. Additional demonstration plots on private property would promote stakeholder participation. One way to increase awareness of the watershed boundary is to place signs on major roads to indicate where the boundary is.

During the watershed planning process, a brochure that summarized recent projects implemented by the City of Highland was developed and approximately 800 were distributed (Figure III-5). The brochure was mailed to all watershed landowners in Madison County and additional copies were distributed by the City of Highland, Madison County SWCD and Bond County SWCD.

The intent of the brochure was to inform landowners about water quality improvements as a result of shoreline stabilization and livestock exclusion, provide tips for improving water quality by reducing load reductions, and introduce the concept of a watershed plan. The brochure also announced a public meeting in which almost 30 landowners attended. This was evidence that mailings are an effective means of communication to reach watershed landowners.

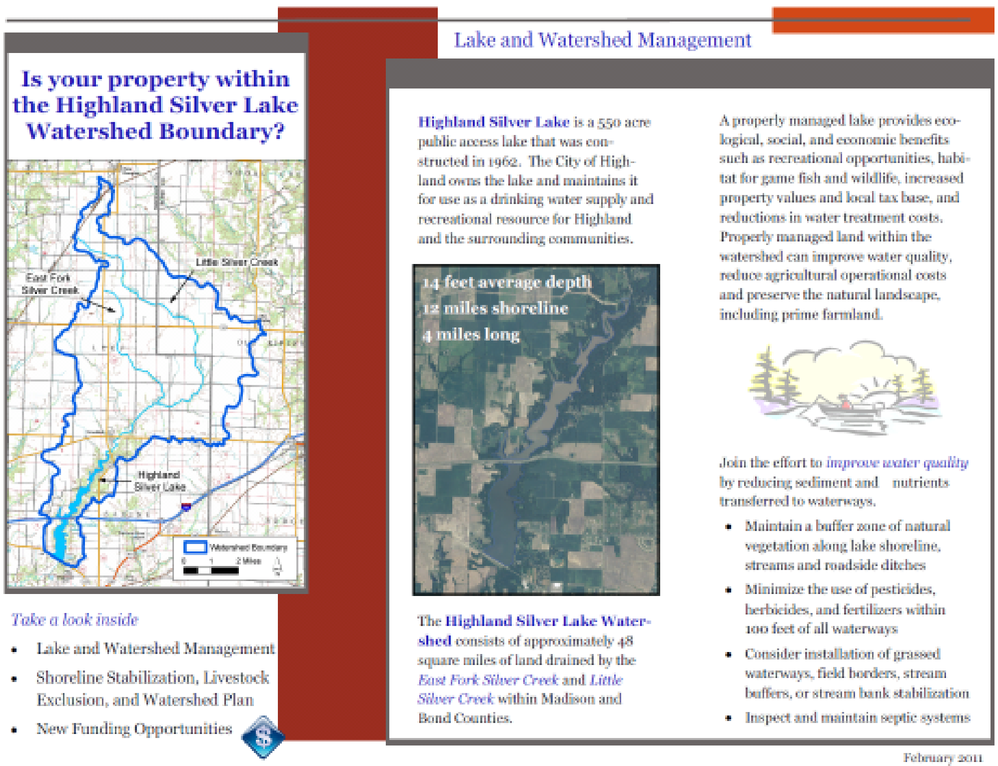


Figure III-5. Educational Brochure

E. Summary of Recommendations

The identified impairments for the Highland Silver Lake Watershed include soil erosion, sedimentation, and poor water quality (TP, TSS, *E. coli*, and turbidity). Recommended alternatives within this plan include a variety of soil, nutrient, and bacteria conservation practices; stream and lake protection and restoration practices; and community outreach activities. The alternatives will address identified impairments by reducing sediment and nutrient loads to all waterways within the watershed. Each recommendation has advantages and disadvantages related to cost, load reductions (or effectiveness), and feasibility. Thus, a combination of the recommended practices over a 10 to 20 year period will be the best approach to improving water quality and reducing non-point source pollution to Highland Silver Lake.

The following discussion provides a brief overview of the recommended alternatives in order to provide a better understanding of which practices should be the highest priorities in relation to reducing sediment and nutrient loads to the lake.

When evaluating alternatives for reducing sediment and nutrient loads, it is important to consider the location of the source of impairment in relation to adjacent waterways and more importantly, Highland Silver Lake. Sources of impairments that are further away from the lake contribute less non-point source pollution than those closer to the lake. For instance, the sediment delivery ratio for shoreline erosion is 100 percent, which the sediment delivery ratio for sheet and rill erosion within the watershed ranges from 20 to 45 percent. This means that 100 percent of eroded soil from the shoreline is directly deposited within the lake, while only 20 to 45 percent of eroded soil from fields is transferred to the lake. Alternatives such as dredging, shoreline stabilization and streambed and bank stabilization are strongly recommended as top priorities in order to address a major existing impairment within the lake and direct sources of sediment and nutrients.

It is also important to consider the need for a certain practice on a collective watershed scale. Alternatives such as field borders, filter strips (including conservation easements), and grassed waterways would not only address erosion directly adjacent to waterways, but have been identified as alternatives that can improve widespread erosion as identified through field observations and GIS analysis. Implementation of these practices should also be a high priority. Similarly, failure of septic systems is a widespread issue. Inspection and maintenance of these systems, especially those discharging directly to waterways, should be a high priority.

There are many alternatives discussed above that would reduce sediment and nutrient loads but provide limited benefits on a watershed scale for one of several reasons: there are few areas in need of these practices, they may be more difficult to implement due to lack of landowner interest, or projected load reductions would be low due to either low erosion rates or low sediment delivery rates. These include conservation tillage, crop rotations, wetlands, ponds, WASCBs, livestock management, nutrient management plans, bioswales/rain gardens, riparian corridor restoration, gully stabilization around the lake, and shoreline buffers. These practices are good alternatives but should be considered a lower priority than those listed above.

Due to the large financial commitment when considering the recommendations collectively, the only way for this plan to be successful is to engage private landowners and gain the support of local citizens. In other words, community outreach activities are strongly recommended as a top priority. Aside from encouraging landowner participation and gaining local support, it will also be important develop strong relationships with local agencies that can provide financial or technical assistance. This will be discussed further in Section IV.

Table III-1. Recommended Alternatives

Practice Category	Recommended Practice	Estimated Range of Unit Costs	Advantages/Disadvantages
Soil Conservation Practices	Field borders	$380 to $525 per acre	Widespread need, cost effective
	Conservation tillage	$12 to $83 per acre	Prevents suspension of soil, limited interest
	Cover crops	$30 to $50 per acre	Prevents suspension of soil, limited interest
	Conservation cover	$130 to $330	Prevents suspension of soil, high efficiency
	Grassed waterways	$1,500 to $2,500 per acre	Widespread need
	Wetland creation or restoration	$ 5,000 to $15,000 per acre	Limited interest
	Ponds	$50,000 to $75,000 per acre	Limited need, low efficiency, high cost
	WASCBs	$20,000 to $45,000 each	Limited need, high cost
Nutrient and Bacteria Conservation Practices	Septic system inspection and maintenance	$200 to $500 per unit	Widespread need, difficult to implement
	Livestock exclusion	$1 to $4 fencing, $90 to $800 watering trough	Limited need
	CNMP	$3,000 to $6,000 per area	Limited need
	Nutrient management plans	$5 to $20 per acre	Reduces direct source of nutrients
	Bioswales/rain gardens	$100 to $300 per area	Limited need, cost-effective
	Soil conservation practices	See above	See above; addresses multiple pollutants
Stream Protection and Restoration Activities	Streambed and grade stabilization	$5,000 to $10,000 per structure	Prevents direct load to waterway
	Streambank stabilization	$25 to $50 per linear foot	Prevents direct load to waterway
	Filter strips	$380 to $500 per acre	Widespread need, cost effective
	Riparian corridor restoration	$500 to $900 per acre	Limited need
	Conservation easements	$300 to $500 per acre	Limited interest without added financial incentive
Lake Protection and Restoration Activities	Shoreline stabilization	$70 to $80 per linear foot riprap	Prevents direct load to waterway
	Invasive species removal	$50 to $150 per acre	Cost-effective, easy to implement, low efficiency
	Forest management	$500 to $4,000 per acre	High cost, limited load reduction
	Dredging	$6 to $20 per cubic yard	High cost, addresses major impairment
	Gully stabilization	$30 to $100 per linear foot	Limited need, high efficiency
	Shoreline buffer zones	$100 to $300 per area	Limited need and interest, high efficiency, cost-effective
	In-lake basin	$350,000 to $750,000 lump sum	Need decreases as sediment and nutrient loads decrease

IV. Implementation

Recommended practices to reduce sediment and nutrient loads were presented in Section III. Section IV will complete the Highland Silver Lake Watershed Plan by providing a structure for implementing the recommended practices presented in Section III. Components of plan implementation discussed in Section IV are listed below.

- Coordination
- Schedule and Prioritization
- Financial Assistance
- Technical Assistance
- Monitoring and Evaluation

A. Coordination

The projects and conservation practices proposed as part of this plan will require prioritization, planning, funding, design, operation and maintenance, and oversight. The City of Highland and the Silver Lake Commission will need to take responsibility for completing these tasks or identifying resources to assist in completion of these tasks for proposed lake and watershed restoration activities. Currently, many of these responsibilities fall under the positions of the Natural Resource Manager and the Director of Parks and Recreation. Another option would include engaging the lake commission in planning, decision making and creating awareness, but also contracting a consultant to help secure funding and implement projects identified within this report. Since stakeholder participation was limited during the watershed planning process, it will be critical to have someone local and familiar with the area to assist in identifying cooperating stakeholders for future projects. It is recommended that the Natural Resource Manager act as a watershed coordinator in order to facilitate implementation of the watershed plan and seek assistance from the Director of Parks and Recreation, the Silver Lake Commission, local agencies or organizations with technical expertise, and a private consultant when needed. The components of watershed plan coordination are listed below.

- Develop and distribute educational materials and/or programs for target audiences
- Seek funding opportunities, prepare grant applications and oversee projects funded by grants to ensure all requirements are met
- Identify cooperative landowners and coordinate with landowners that will be implementing projects
- Aid in prioritizing and planning lake and watershed restoration projects, as well as project oversight during design and construction, and operation and maintenance after project completion

- Develop partnerships and routinely coordinate with the local representatives of federal and state agencies including the SWCD, IDNR, IEPA, FSA, and Farm Bureau
- Align projects with recommendations of other regional plans, such as the Madison County 2020 Land Use and Resource Management Plan and the City of Highland Natural Resource Plan, in order to facilitate implementation of projects on a larger scale with agencies or organizations that have a similar interest in protecting natural resources
- Observe the success of projects implemented and revise watershed plan as needed

B. Schedule and Prioritization

The Highland Silver Lake Watershed Plan contains more than 25 recommended alternatives, some more important than others. Rather than having a start and end date, plan implementation will be an on-going process in which projects are implemented as funding and cooperative landowners become available. Funding and public support will dictate initiation of projects implemented on city-owned land. Once a project is initiated, permitting, design and construction will dictate the schedule. Funding and landowner cooperation will dictate initiation of projects implemented on private land. Since funding, politics and landowner cooperation can be difficult to control, a specific schedule for each of the recommended practices would not be realistic. The implementation schedule is therefore based on interim milestones over the course of several years at a time, as listed below.

<u>Short-term Milestones (1- 3 years)</u>

- Establish funding options for a capital project to be completed within 5- 10 years
- Secure land for future sediment dewatering facility
    - Goal: Purchase a 50 acre agricultural parcel (explore funding through IDNR)
- Expand tributary water quality monitoring
    - Goal: Add at least 4 monitoring stations for TSS, total phosphorus, orthophosphate and *E. coli*
- Conduct forest management activities on city-owned property
    - Goal: Conduct invasive species removal once per year using volunteers
- Facilitate forest management activities on private property via outreach activities
    - Goal: Host 1 workshop for private landowners
- Increase awareness of water quality impairments and encourage implementation of urban conservation practices on private land through community outreach activities
    - Goal: Distribute 1 brochure and implement 1 project as a demonstration
- Develop relationships with state, county and federal agencies that can provide financial and technical assistance for project implementation
    - Goal: Meet with each agency annually

Mid-term Milestones (2-5 years)

- Complete shoreline erosion survey and additional shoreline stabilization
  - Goal: 4,000 feet of moderate or severe erosion (explore funding through USEPA)
- Encourage implementation of select conservation practices on private land through community outreach activities for the entire watershed: conservation tillage, crop rotations, nutrient management plans
  - Goal: Distribute at least one brochure or host one workshop per year
- Encourage implementation of conservation practices on private land through financial incentives for select practices: field borders, grassed waterways, filter strips, and streambed/streambank stabilization
  - Goal: Directly contact landowners in critical areas and implement at least 2 projects per year

  Note: This activity should be coordinated through the county agencies to receive financial and technical assistance
- Work with the Madison County Planning and Development Department and the Illinois Public Health Department to develop and implement a septic system inspection and maintenance program
- Increase awareness of water quality impairments and develop support for use of public funds for lake and watershed restoration projects
  - Goal: Distribute at least 1 brochure annually to drinking water consumers and publish articles in the Highland News Leader biannually
- Initiate planning for dredging the upper end of the lake
  - Goal: Complete sedimentation survey and secure funding for dredging project

Long-term Milestones (5- 10+ years)

- Complete shoreline erosion survey and additional shoreline stabilization
  - Goal: 4,000 feet of moderate or severe erosion
- Evaluate watershed plan success
  - Goal: Revise implementation plan if interim milestones are not being met
- Work with the Bond County and Illinois Public Health Departments to develop and implement a septic system inspection and maintenance program
- Continue to encourage implementation of conservation practices listed in Section III on private land through community outreach activities
  - Goal: Distribute at least one brochure or host one workshop per year
- Continue to encourage implementation of conservation practices on private land through financial incentives for select practices: field borders, grassed waterways, filter strips, and streambed/streambank stabilization

    - Goal: Directly contact landowners in critical areas and implement at least 2 projects per year

  Note: This activity should be coordinated through the county agencies to receive financial and technical assistance

- Complete hydraulic dredging project
    - Goal: Remove at least 400,000 cubic yards of sediment from the lake
- Evaluate the need for an in-lake sediment and nutrient control structure using sediment survey data and tributary water quality data to estimate loads

B. Financial Assistance

Implementing the recommendations outlined above will require multiple funding sources due to the large financial commitment. Many projects will not get off the ground without a financial commitment in the form of land, a monetary cost share and/or in kind services from the City of Highland, private landowners or select departments of Madison and Bond County. This local commitment will dictate the overall success of plan implementation. Multiple federal and state funding sources are available to supplement this local financial commitment, as listed in Table IV-1. This is not an all inclusive list and sources on the list may not have funding for these programs on an annual basis. Therefore, it will be important for the watershed coordinator and the Silver Lake Commission to consistently seek grant opportunities by coordinating with local government agencies and exploring the internet. For additional information regarding relevant grant programs, refer to the 2006 TMDL Report and the 2008 Lake Study.

C. Technical Assistance

In addition to capital resources, technical resources will also be required in the consultation, planning, permitting, bidding, implementation, and construction phases of the specific watershed and lake projects and action items outlined within the plan. Technical resources can be private (consultant) or public (federal, state, or municipal) and will vary depending on the complexity and scale of the project. Many of the recommended conservation practices will require technical assistance from Madison and Bond County SWCDs. Additional resources for technical assistance are listed below.

- Madison and Bond County NRCS, FSA, and Farm Bureau
- Madison County Planning and Development, and Plats and Maps Division
- Bond County Health Department
- Southwestern Illinois Resource Conservation and Development

- Illinois DNR and EPA
- USEPA, USDA, USACOE, USFWS

Table IV-1. Potential Resources for Financial Assistance

Grant Program Name	Funding Source
Section 319: Non-Point Source Management Program	USEPA
Partners in Conservation (formerly C2000)	IDNR
Land and Water Conservation Fund (LWCF)/ Open Space Lands Acquisition and Development (OSLAD)	IDNR
Illinois Conservation Reserve Enhancement Program (CREP)	NRCS
The Conservation Reserve Program (CRP)	NRCS
The Wetlands Reserve Program (WRP)	NRCS
Wildlife Habitat Incentive Program (WHIP)	NRCS
The Environmental Quality Incentives Program (EQIP)	NRCS
Grassland Reserve Program (GRP)	NRCS
Streambank Stabilization & Restoration (SSRP)	SWCD
Partners for Fish and Wildlife	USFWS
North American Wetlands Conservation	USFWS
Section 206: Aquatic Ecosystems Restoration	USACE
Sect. 1135: Project Modifications for Improvement of the Environ.	USACE
Watershed Assistance Grants Program	River Network

D. Monitoring

It is important to measure progress as projects are implemented within the watershed. Monitoring will help track watershed plan progress so that adjustments can be made, if necessary, and it will demonstrate progress toward meeting the proposed load reductions. Some grant programs also have monitoring and project reporting requirements to assess and document the effectiveness of implemented projects and conservation practices.

1. Indicators

Indicators such as the number or amount of conservation practices installed and water quality concentrations should both be used to monitor physical progress and determine the effectiveness of the watershed plan. General indicators for tracking installation of conservation practices and water quality indicators are listed below.

<u>Indicators Tracking Conservation Practices</u>

- Number of landowners installing practices
- Number of practices installed
- Acreage of practices installed
- Linear feet of practices installed
- Attendance at workshops

<u>Water Quality Indicators</u>

- Phosphorus concentrations and loads
- Total suspended solid concentrations and loads
- *E. coli* concentrations in streams
- Secchi transparency depth in lake
- Hypolimnetic dissolved oxygen in lake
- Raw water quality at drinking water intake
- Number of nuisance algal blooms

It should be noted that the rate in which water quality improvements are observed is often dependent on the nature of the pollutants. Unlike pathogens, which tend to die off quickly once the source is removed, management practices and erosion controls designed to reduce sediment and nutrient loadings often do not have immediate observed effects. Unfortunately, it may take multiple years to observe a response to conservation practices implemented. This demonstrates the need to track progress by the number or amount of conservation practices installed. As discussed previously, it is recommended that the City of Highland coordinate regularly with local county agencies overseeing implementation of conservation practices in order to track progress using the indicators listed above.

2. Water Quality Monitoring

In general, water quality data should be collected to document impairments and improvements not only in the lake but throughout the watershed. Highland Silver Lake is sampled monthly as part of the Illinois EPA Volunteer Lake Monitoring Program (VLMP) and every four years as part of the Illinois EPA Ambient Lake Monitoring Program (ALMP). It is recommended that tributary sampling be added to the current water quality monitoring efforts in order to provide more comprehensive data. This would include analysis of total suspended solids, total phosphorus, orthophosphate, and *E. coli* at locations shown in Figure IV-1. These locations represent most of the subwatersheds within the Highland Silver Lake Watershed.

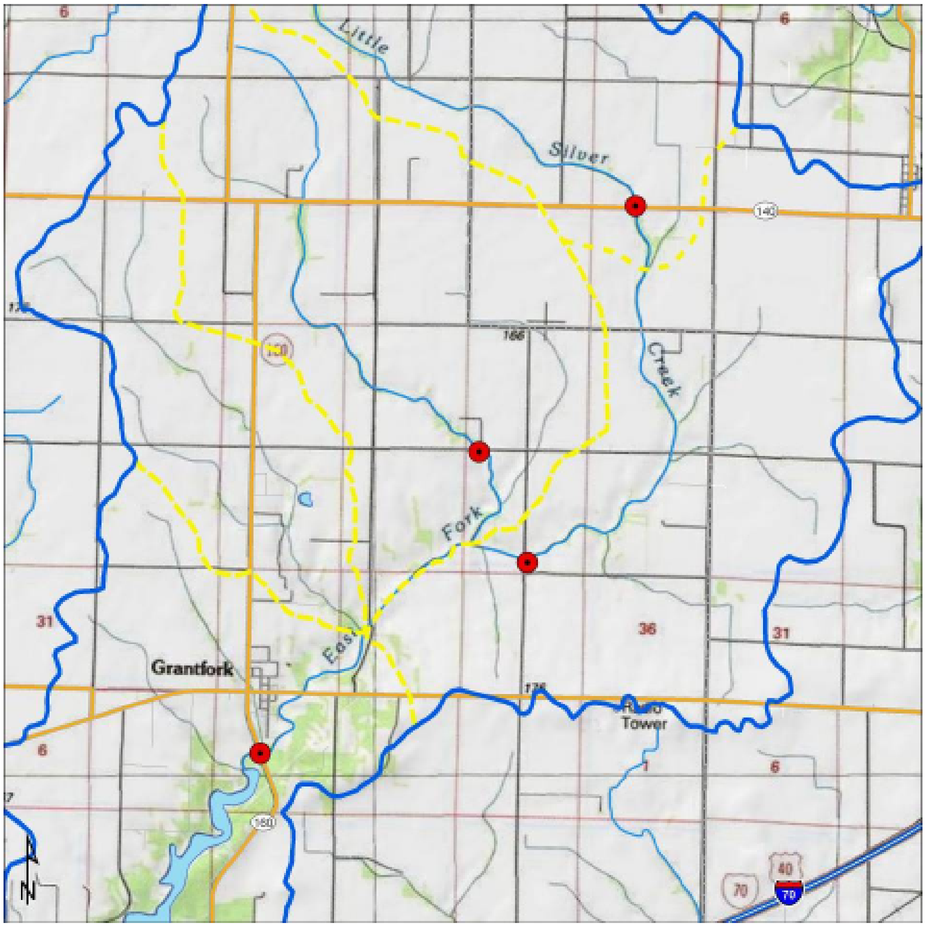


Figure IV-1. Proposed Locations for Additional Monitoring

Collectively the VLMP, AMLP, and supplemental water quality monitoring will provide data to assist in making future lake and watershed management decisions. While it will be difficult to use water quality data to assess specific conservation practices, general improvements in water quality will be used to document load reductions and progress toward achieving the phosphorus TMDL. Separately, data collected at specific locations throughout the watershed will be used to support future implementation of projects within subwatersheds or document any change in existing impairments. Water quality data is the basis for the Illinois 303(d) List of Impaired Waters and will determine if and when Highland Silver Lake can be removed from this list. Water quality data can also be used to determine critical areas within the watershed as demonstrated previously within this plan.

3. Load Reductions

The water quality impairments within the Highland Silver Lake are well documented. The TMDL proposed a 90 percent reduction in phosphorus loads (36,533 lbs/year) (LTI, 2006) and the RCWP proposed a sediment reduction of 60 percent (2,084 tons/year) (Davenport, 1984). A portion of the phosphorus loading can be attributed to internal release of phosphorus caused by resuspension of accumulated lake bottom sediment (HDR│CWI, 2008). When this amount is subtracted from existing load documented in the 2006 TMDL Report, the adjusted load reduction is estimated to be 59 percent. This translates to a load reduction of 23,683 lbs of phosphorus per year. Reducing the sediment and phosphorus loads by roughly 60 percent dictates that multiple watershed and lake protection and restoration projects are needed over a significant period of time to achieve attainment levels and to improve water quality. Since many of the measures needed require voluntary participation by private landowners, the proposed load reductions may not be attainable in the near future.

Projected load reductions based on project implementation and actual load reductions based on water quality data should be used in combination to measure progress toward achieving the proposed sediment and phosphorus load reductions. Numeric load reductions are typically required for those practices that are implemented through federal or state grants. These load reductions are often calculated by using reduction estimates reported in the literature or by spreadsheets that contain coefficients and variables. Calculated load reductions for several practices implemented after the 2006 TMDL Report are listed in Table IV-2. Projected load reductions for the recommended practices within this plan of highest priority are also included in Table IV-2. Load reductions are provided on a watershed-wide scale for estimating purposes only. Most load reductions were calculated using USEPA Region 5 worksheets for estimating pollutant load reductions for non-point source pollution control BMPs and should be recalculated for each practice and location as implementation occurs.

Determining load reductions can be challenging to ascertain, as they are often difficult to define or measure for all recommended practices. While load reduction data can be valuable, data such as the number of completed projects and/or public awareness of water quality issues may provide another useful approach for measuring progress of the watershed plan. Ultimately, a combination of the indicators and interim milestones listed above will allow the City of Highland to evaluate progress toward achieving the goals of the watershed plan.

Table IV-2. Load Reductions for Select Recommended Practices

		Estimated Load Reductions		
Implemented Practice	**Units**	**Sediment (tons/yr)**	**Nitrogen (lbs/yr)**	**Phosphorus (lbs/yr)**
Conservation Cover (Tree Planting)	5.5 acres	27	56	28
Streambank Stabilization	Unknown			
Shoreline Stabilization	4,130 feet	680	1,321	680
Livestock Exclusion	NA	7	894	289
Conservation Cover (Tree Planting)* **Proposed CREP Contract*	19 acres	80	170	85
Recommended Practice	**Proposed Units**	**Sediment (tons/yr)**	**Nitrogen (lbs/yr)**	**Phosphorus (lbs/yr)**
Field borders (30 feet wide) (50% of critical areas identified)	43,700 ft	69	211	113
Conservation tillage or crop rotations (50% of cropland with ≥ 4% slopes and 100% of cropland with natric soils)	1,633 acres	3,485	8,165	4,077
Grassed waterways or WASCBs (25% of identified headwaters)	116,429 ft	5,938	11,876	5,938
Streambed or streambank stabilization (75% of major tributaries)	82,598 ft	6,319	13,637	6,319
Streambed or streambank stabilization (25% of minor tributaries)	91,770 ft	1,170	2,340	1,170
Filter strips (50 feet wide) (75% of unprotected tributaries)	134,193 ft	280	898	482
Shoreline stabilization (100% of moderate erosion)	8,000 ft	204	408	204
Forest management (50% of critical areas identified)	60 acres	22	89	45
Gully stabilization around lake (10% of forested headwaters)	7,848 ft	3,169	6,337	3,169
Dredging (not annual reduction)	394,968 cy	266,603	78,656	17,341
In-lake sediment and nutrient basin	1 structure	11,924	23,848	11,924

References

Bogner, William C. 2001. *Sedimentation Survey of Highland Silver Lake, Madison County, Illinois.* Illinois State Water Survey. Champaign, IL.

Davenport, T. 1982. *Soil Erosion and Sediment Delivery in the Highland Silver Lake Watershed, Madison County, Illinois- Preliminary Analysis*. Illinois Environmental Protection Agency. Springfield, IL.

Davenport, T. 1984. *A Review of the Sediment Delivery Ratio Techniques Component of the Highland Silver Lake Watershed Project*. Illinois Environmental Protection Agency. Springfield, IL.

HDR│CWI. 2008. *Phase 1 Diagnostic/Feasibility Study of Highland Silver Lake, Madison and Bond Counties, Illinois.* Springfield, IL.

Illinois Environmental Protection Agency. 1990. Title 35: Environmental Protection, Subtitle C: Water Pollution, Part 302: Water Quality Standards. State of Illinois, Rules and Regulations, Springfield, IL.

Illinois Environmental Protection Agency (IEPA). 1996. *Illinois Water Quality Report*. 1994-IEPA/BOW/96-060b. Division of Water Pollution Control, Planning Section, Springfield, Illinois.

Illinois Environmental Protection Agency (IEPA). 2004. *Illinois Section 303(d) List.* Bureau of Water, Watershed Management Section. IEPA/BOW/04-005.

Illinois Environmental Protection Agency (IEPA). 2004. *Illinois Water Quality Report 2004.* Bureau of Water, May 2004. IEPA/BOW/04-006.

Illinois Environmental Protection Agency (IEPA). 2006. *Illinois Section 303(d) List.* Bureau of Water, Watershed Management Section. Springfield, IL.

Illinois Environmental Protection Agency (IEPA). 2008. *Illinois Section 303(d) List.* Bureau of Water, Watershed Management Section. Springfield, IL.

Illinois Environmental Protection Agency (IEPA). 2010. *Illinois Section 303(d) List.* Bureau of Water, Watershed Management Section. Springfield, IL.

Kelly, M. and Davenport, T. 1986. *Water Resource Data and Trend Analysis for the Highland Silver Lake Monitoring and Evaluation Project, Phase 4*. Illinois Environmental Protection Agency. Springfield, IL.

Limno-Tech, Inc. (LTI) 2006. *TMDL Report for Highland Silver Lake Watershed (ROZA).* Prepared for Illinois Environmental Protection Agency. Springfield, IL.

Makowski, P and Lee, M. 1985. *Hydrologic Investigation of the Highland Silver Lake Watershed: 1984 Progress Report.* Prepared for Illinois State Rural Clean Water Coordinating Committee. Champaign, IL.

Madison County Planning and Development. 1999. Madison County Private Sewage Disposal Ordinance. Edwardsville, IL.

Medford District Bureau of Land Management (MDBLM). 2003. Final Environmental Impact Statement – Timbered Rock Fire Salvage and Elk Creek Watershed Restoration.

Medford District Bureau of Land Management (MDBLM). 2007. Water Quality Restoration Plan – Illinois-Kerby Sub-Watershed. Available at www.blm.gov/or/districts/medford/plans/files/wqrpillkerby.pdf

Natural Resources Conservation Service (NRCS). 1999. *CORE4 Conservation Practices Training Guide. The Common Sense Approach to Natural Resource Conservation*. U.S. Department of Agriculture. Available at http://www.nrcs.usda.gov/technical/ECS/agronomy/core4.pdf

Natural Resources Conservation Service (NRCS). 2000. *Natural Resources Conservation Service Conservation Practice Standard, Grassed Waterway, Code 412*. Available at http://www.age.uiuc.edu/clmt/Workbook/WK_FILES/NRC_WATR.DOC

Natural Resources Conservation Service (NRCS). 2011. Estimated Costs for BMP Installation. Available at http://www.il.nrcs.usda.gov/programs/eqip/index.html.

Rowley. National Planning Procedures Handbook Parts. 2010. http://nutrientplan.com/id30.html

Schilling, Keith E., Thomas M. Isenhart, Jason A. Palmer, Calvin F. Wolter, and Jean Spooner, 2011. Impacts of Land-Cover Change on Suspended Sediment Transport in Two Agricultural Watersheds. *Journal of the American Water Resources Association* (JAWRA) 00(0):1-15.

Southwestern Illinois Metropolitan and Regional Planning Commission (SIMRPC). 1982. *Highland Silver Lake Comprehensive Monitoring and Evaluation Project– Economic Baseline*.

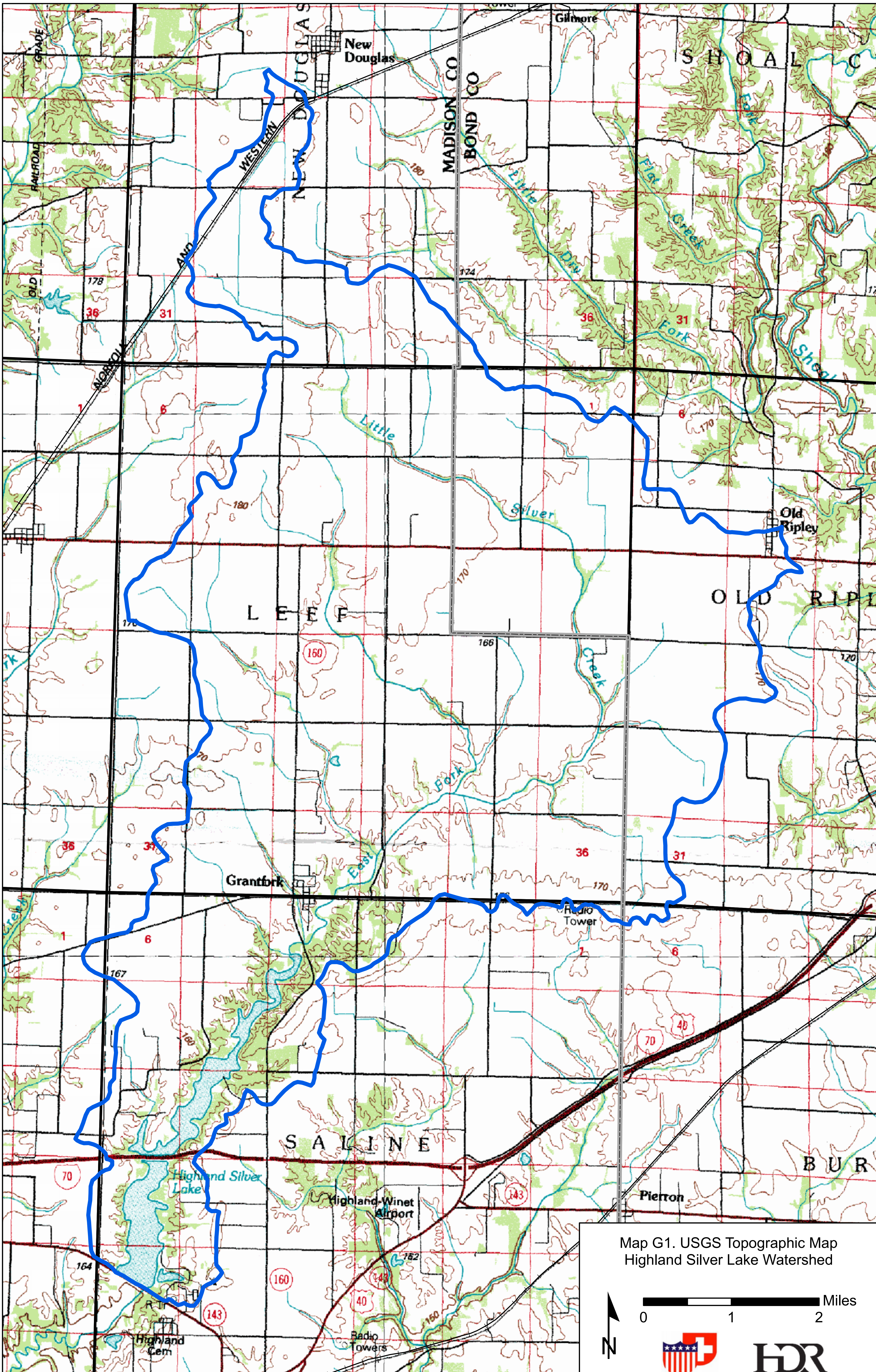
Southern Illinois University at Carbondale (SIUC), Illinois State University, and University of Minnesota. 2010. Water Quality and Community Capacity in Silver Creek Watershed, Illinois.

University of Illinois at Urbana-Champaign (UIUC). 2005. *Illinois Agronomy Handbook.*

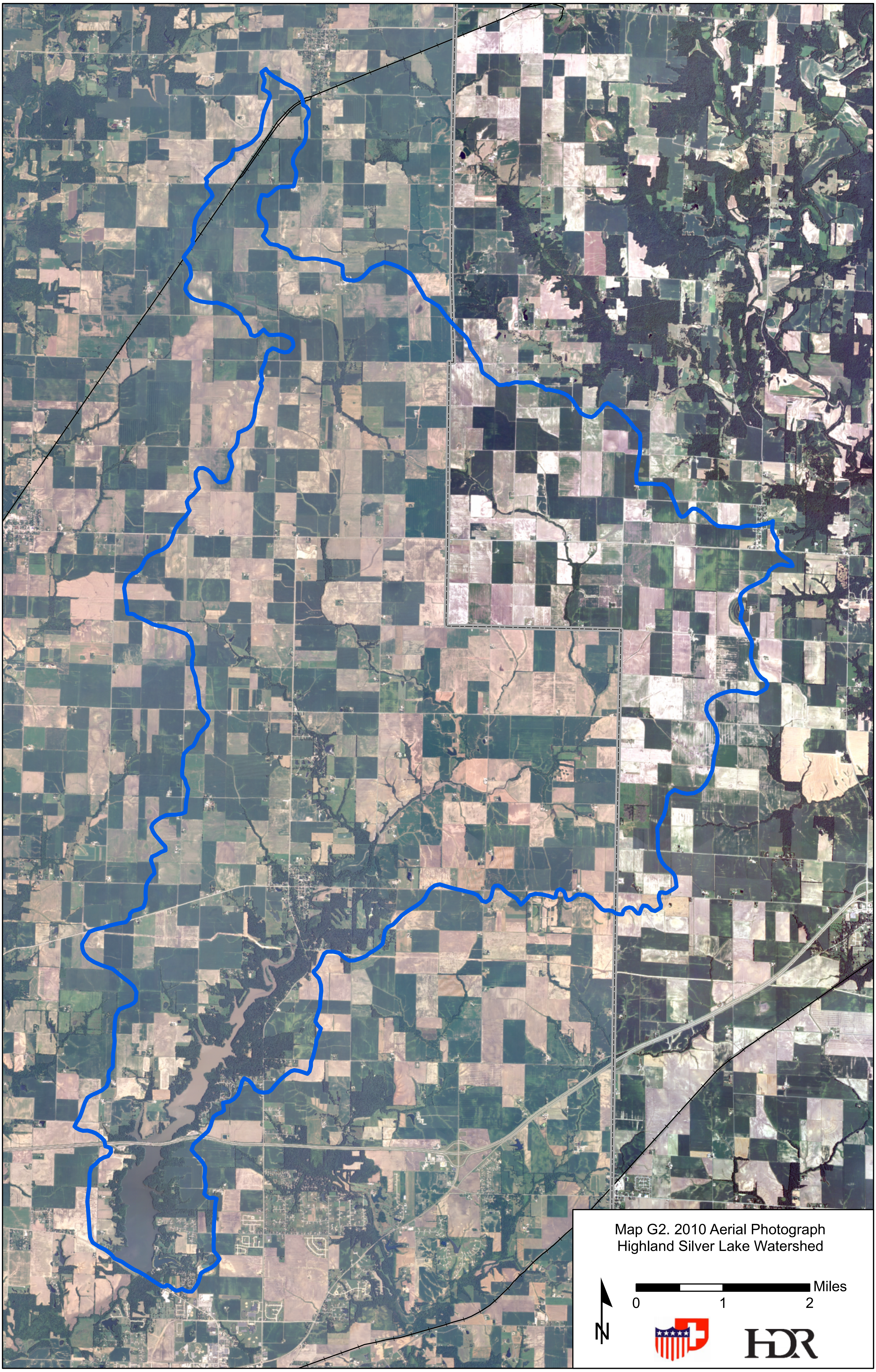
U.S. Environmental Protection Agency (USEPA). 2003. *National Management Measures to Control Nonpoint Source Pollution from Agriculture*. EPA 841-B-03-004. Office of Water, Washington, DC.

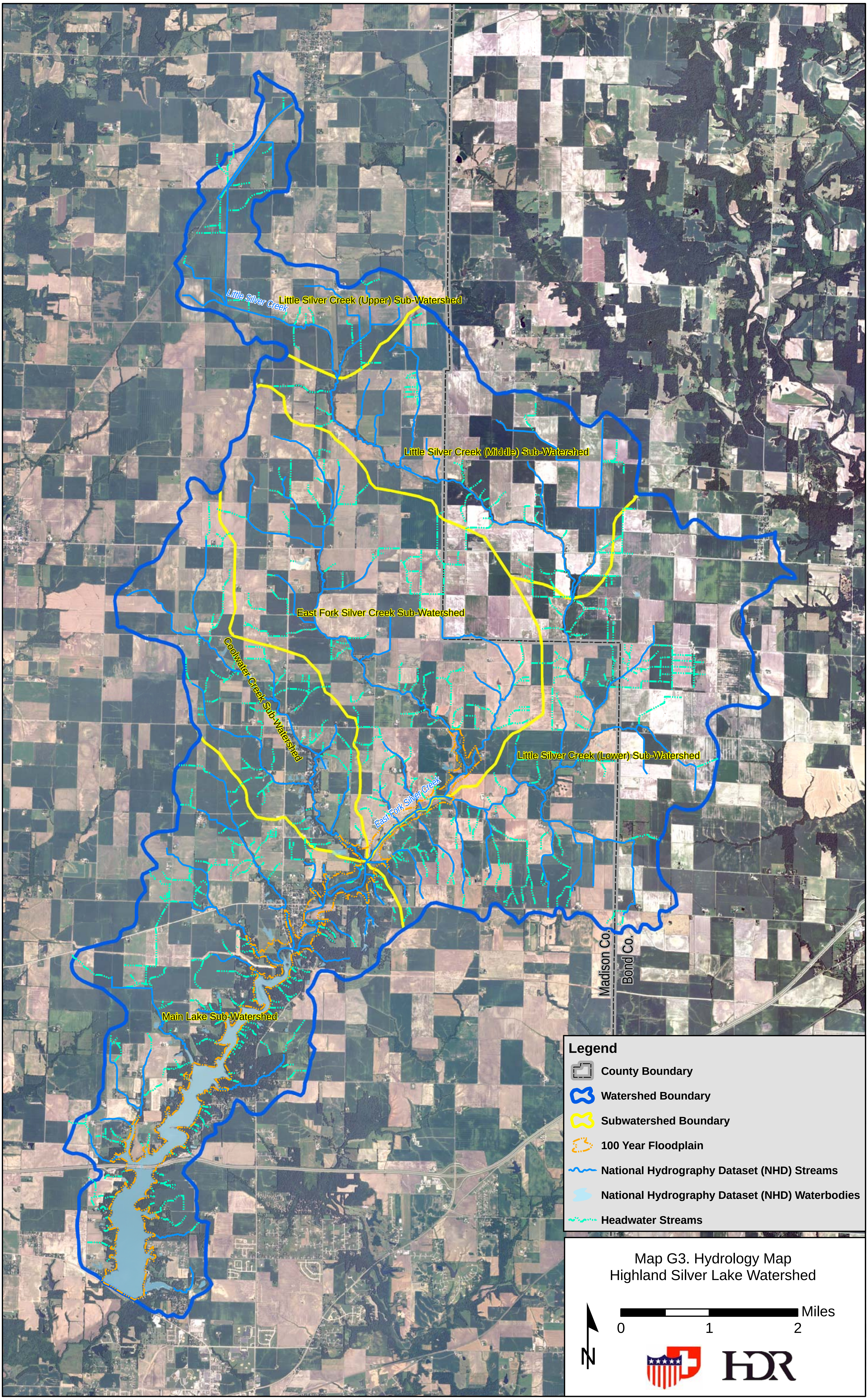
US Environmental Protection Agency (USEPA). 2003 Getting in Step: Guide for Conducting Watershed Outreach Campaigns. EPA 841-B-03-002.

Appendix 1: General Maps

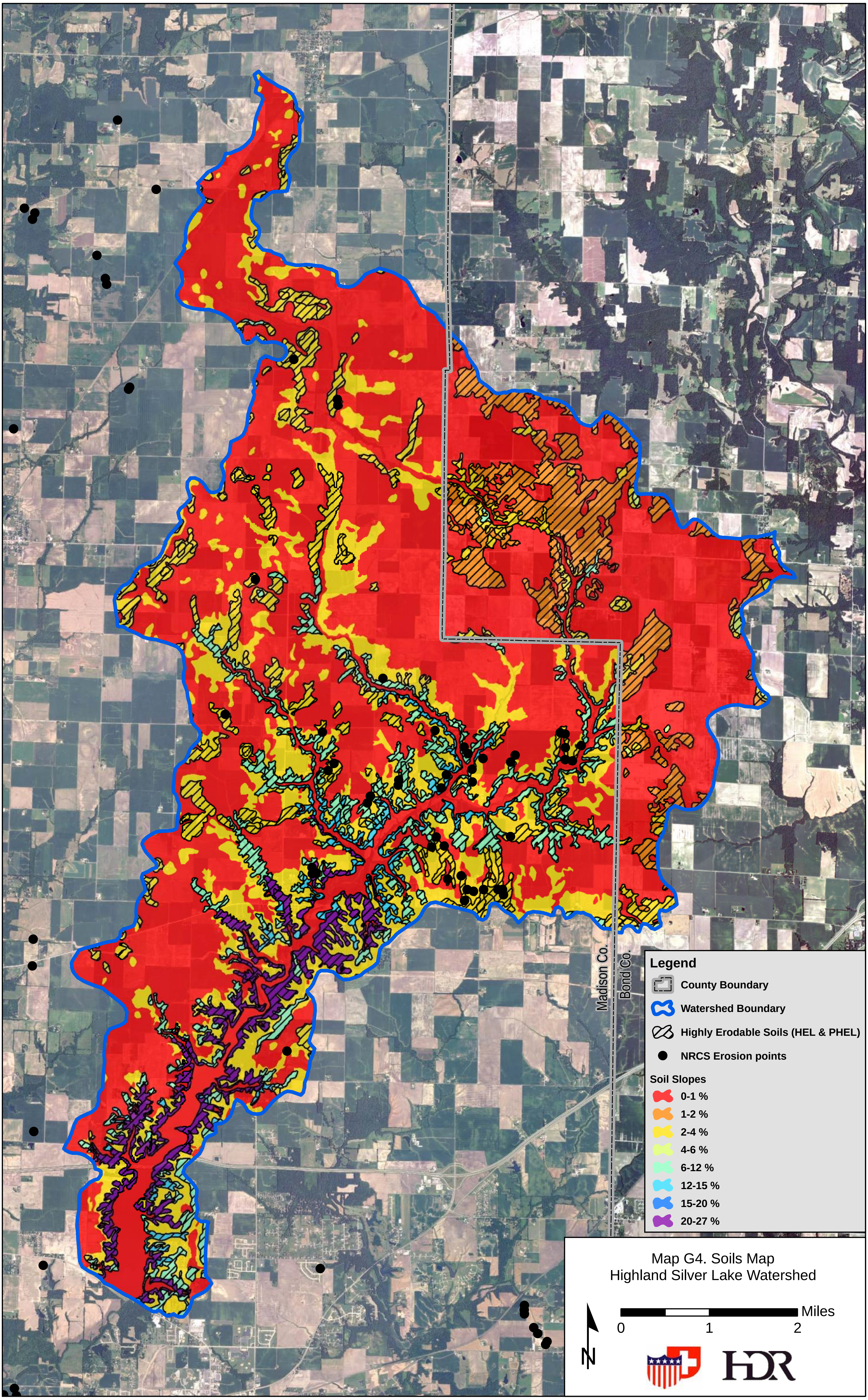


Map G1. USGS Topographic Map
Highland Silver Lake Watershed

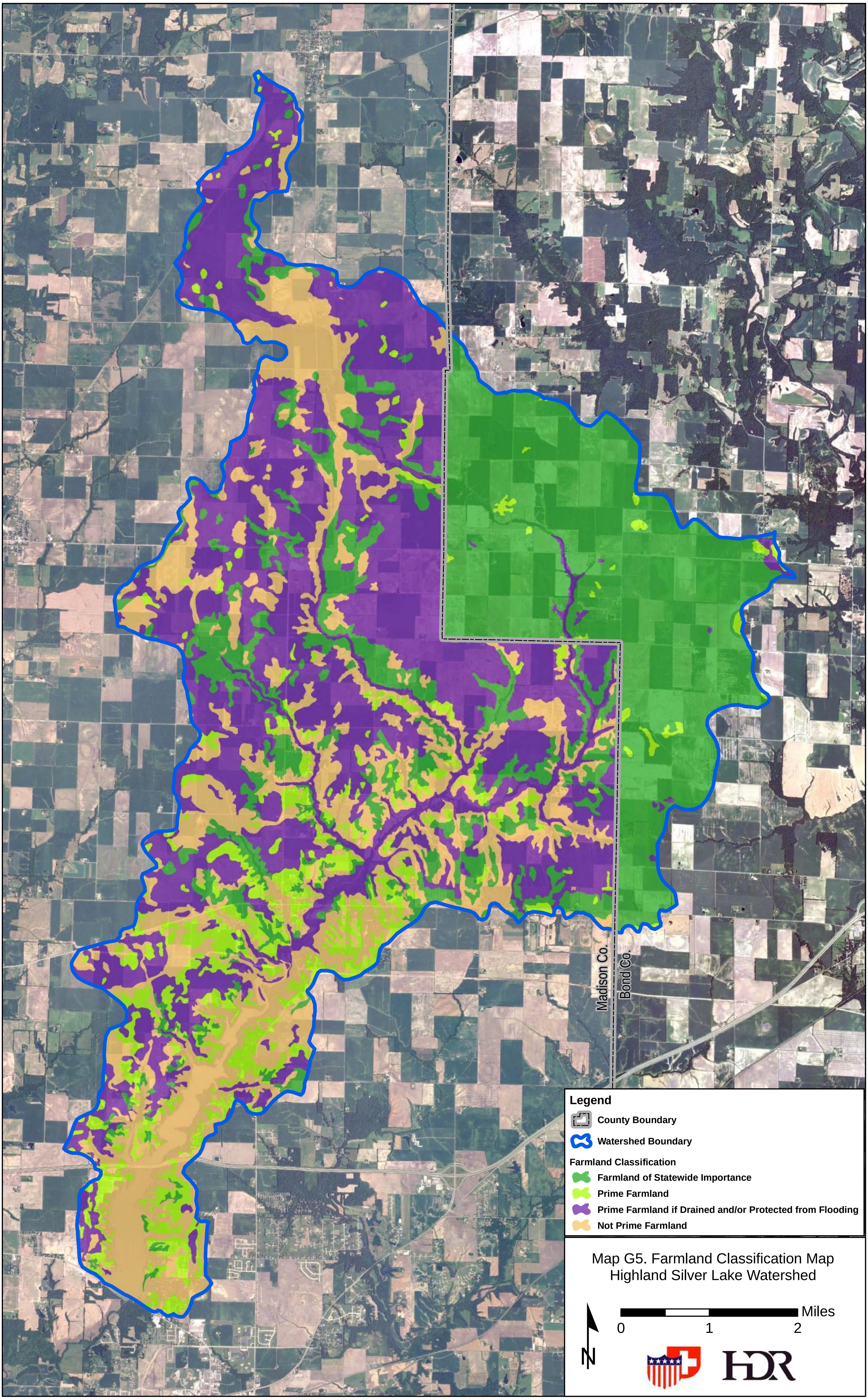

Map G2. 2010 Aerial Photograph
Highland Silver Lake Watershed
Miles
0
1
2
N
HDR



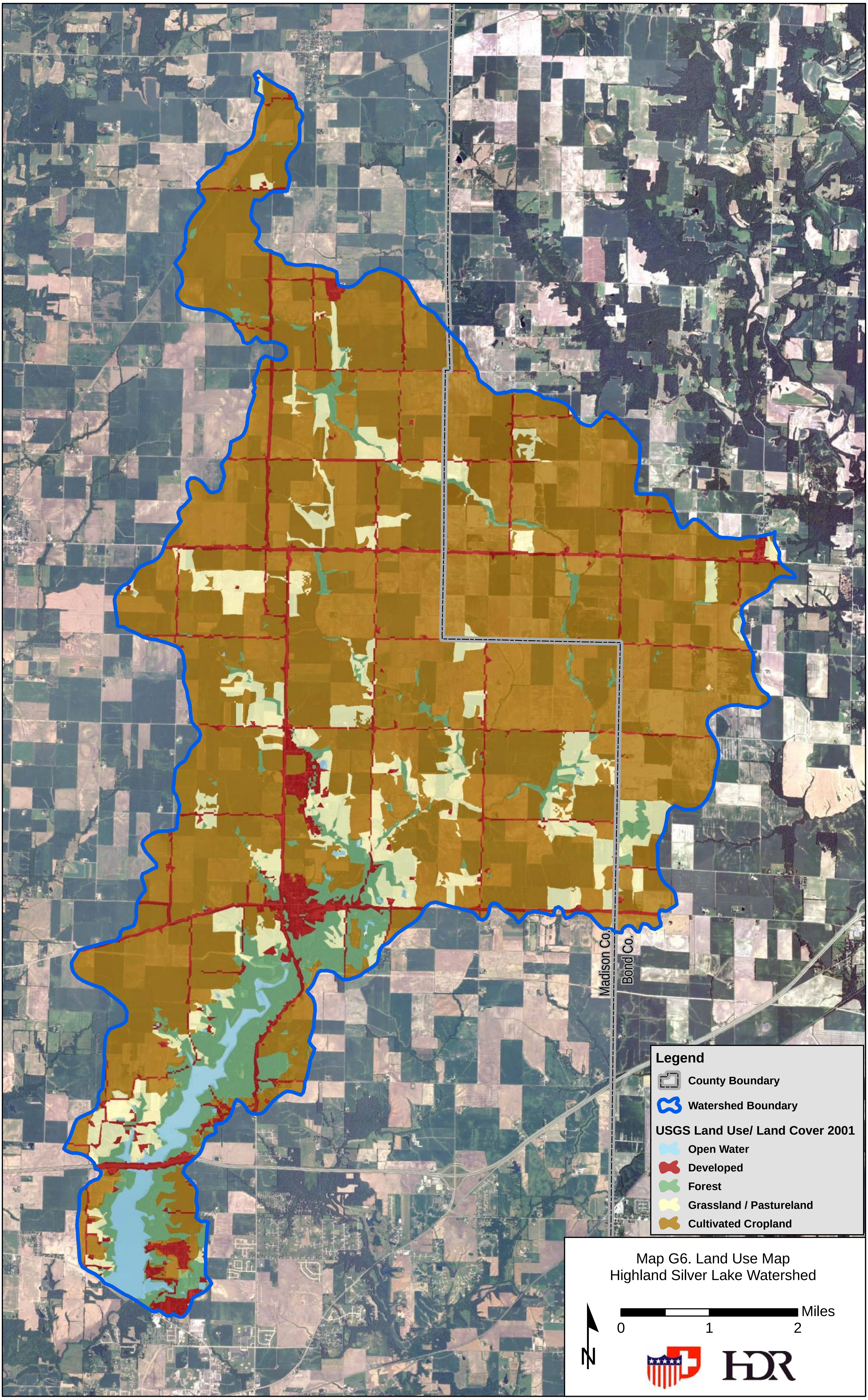
Map G3. Hydrology Map
Highland Silver Lake Watershed



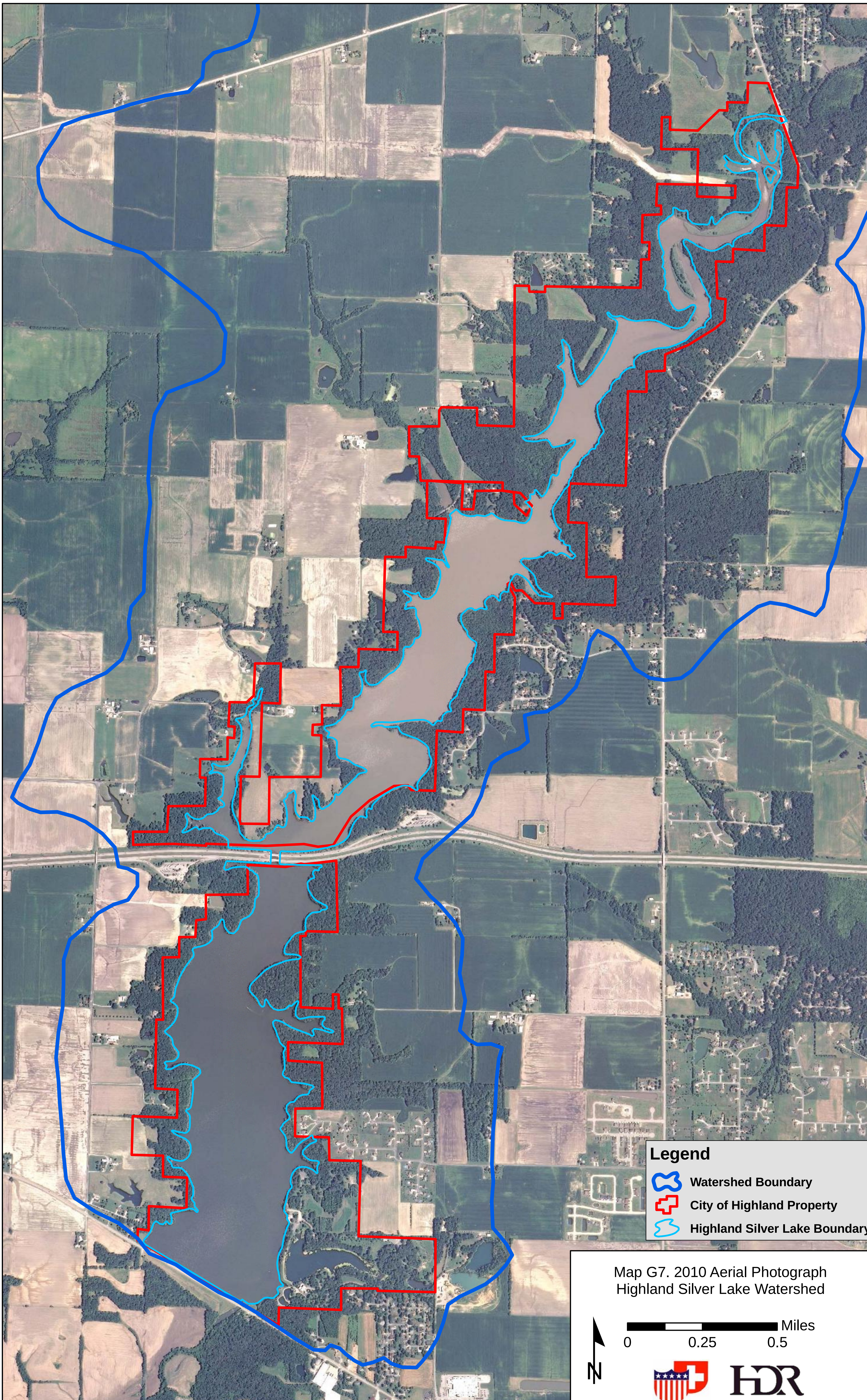
Map G4. Soils Map
Highland Silver Lake Watershed



Map G5. Farmland Classification Map
Highland Silver Lake Watershed

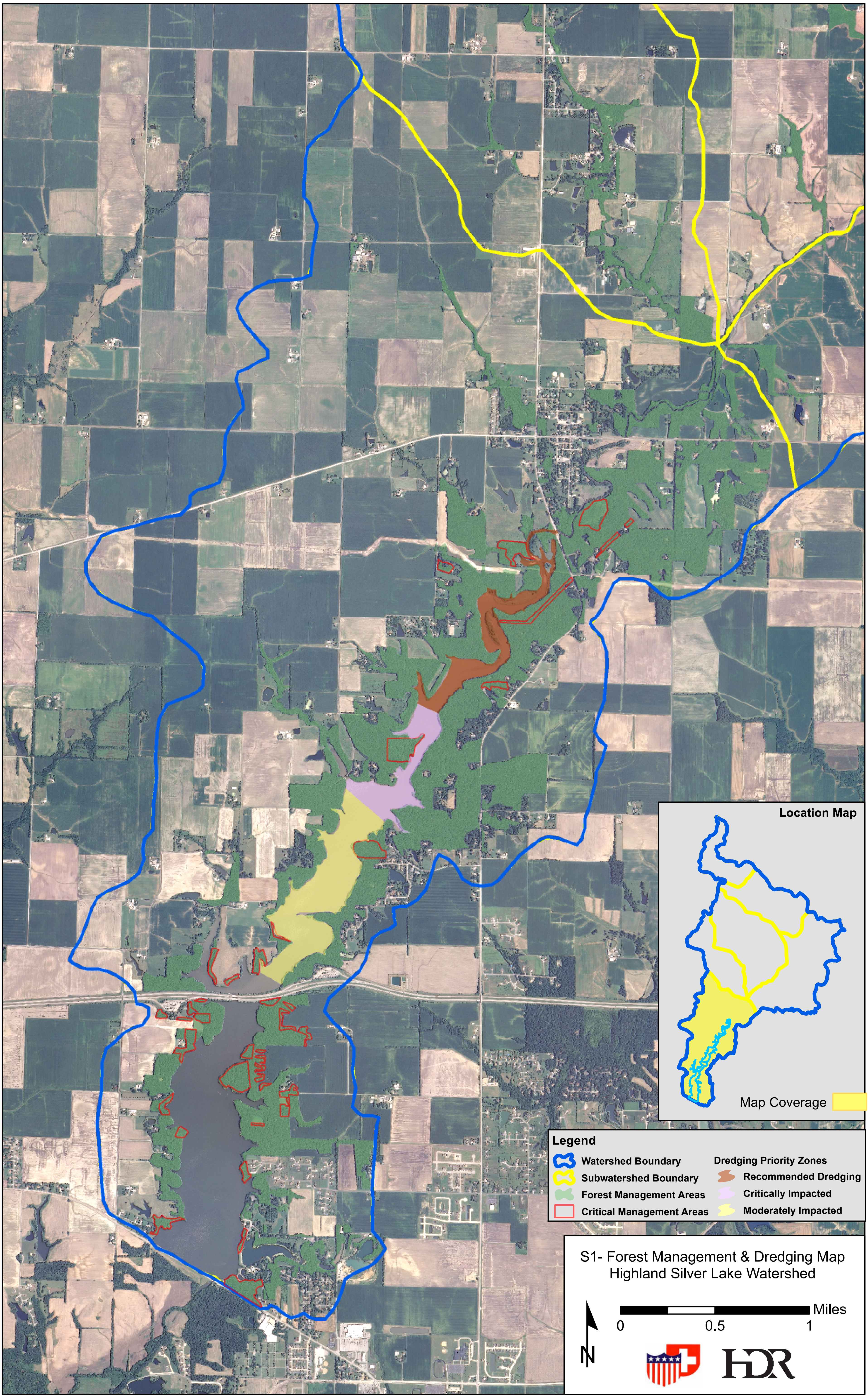


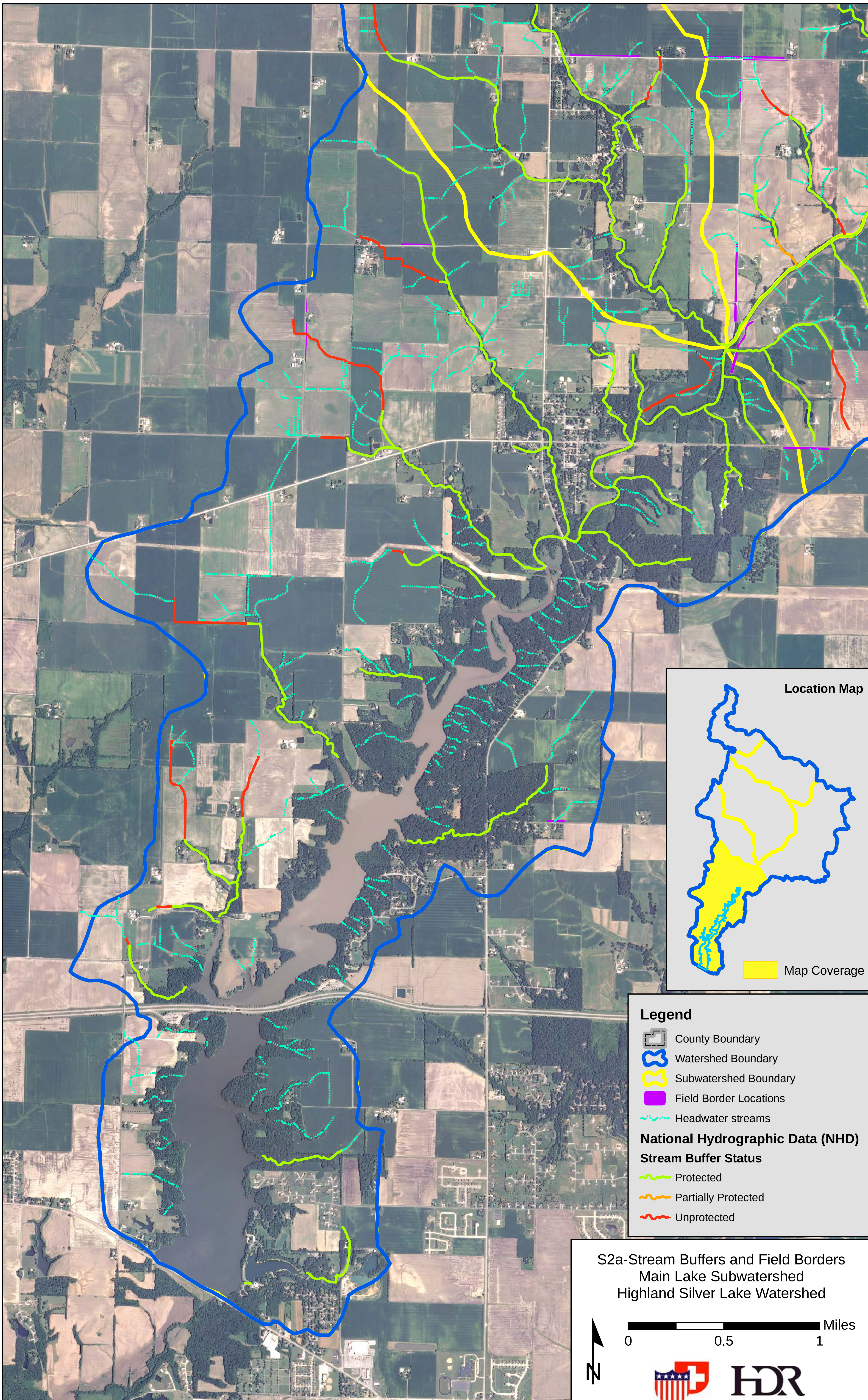
Map G6. Land Use Map
Highland Silver Lake Watershed

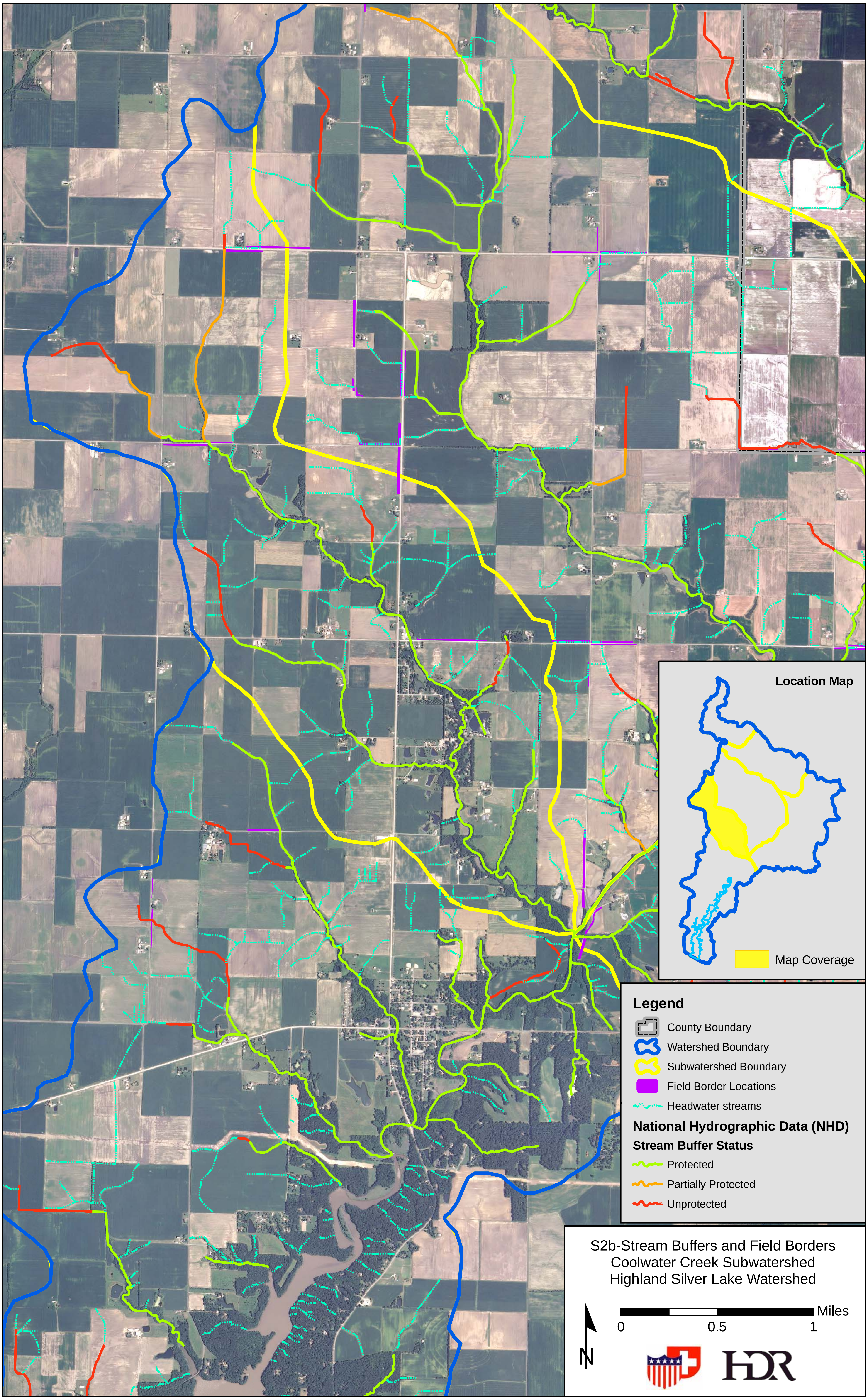


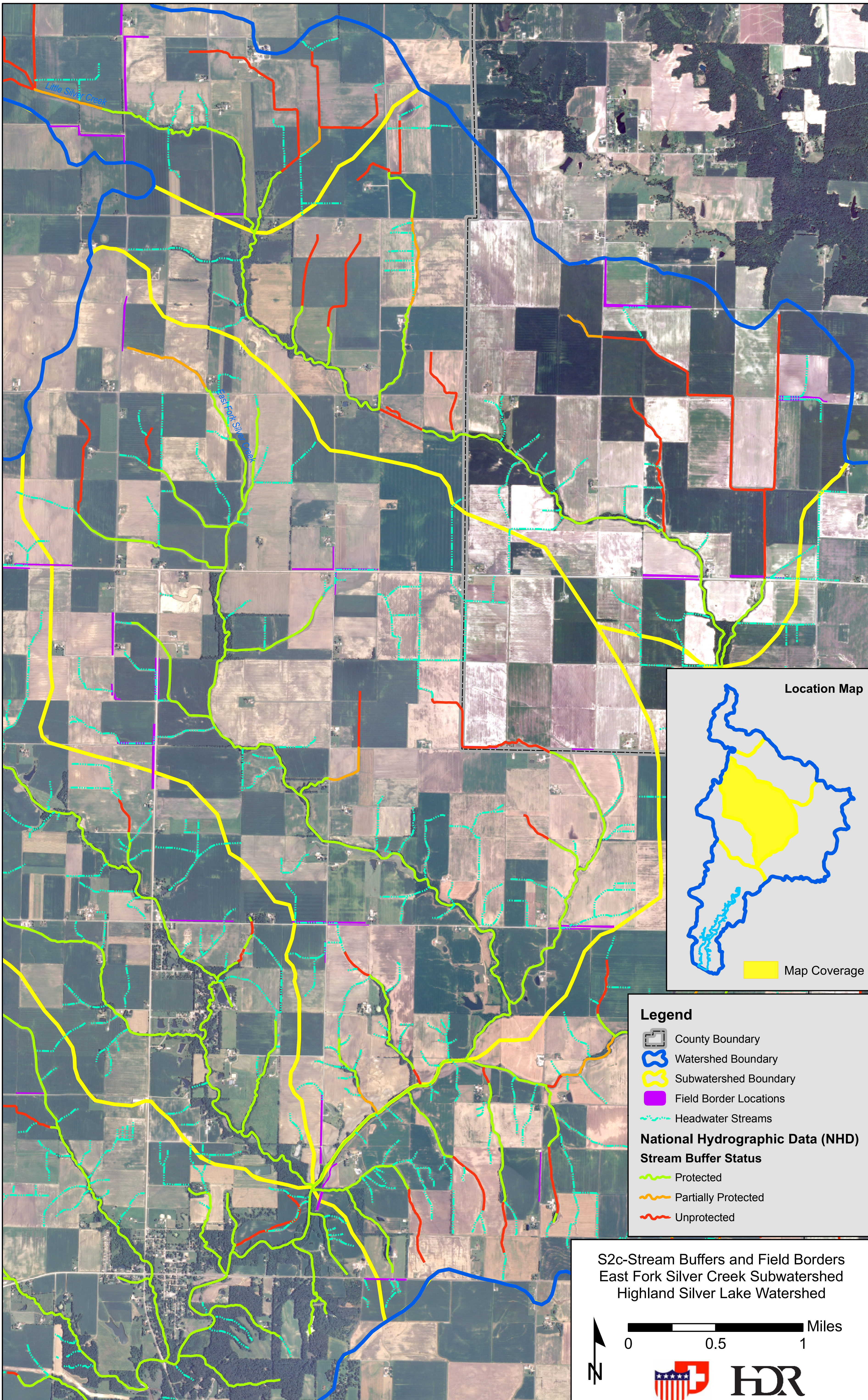
Legend
Watershed Boundary
City of Highland Property
Highland Silver Lake Boundary
Map G7. 2010 Aerial Photograph
Highland Silver Lake Watershed
Miles
0
0.25
0.5
N
HDR

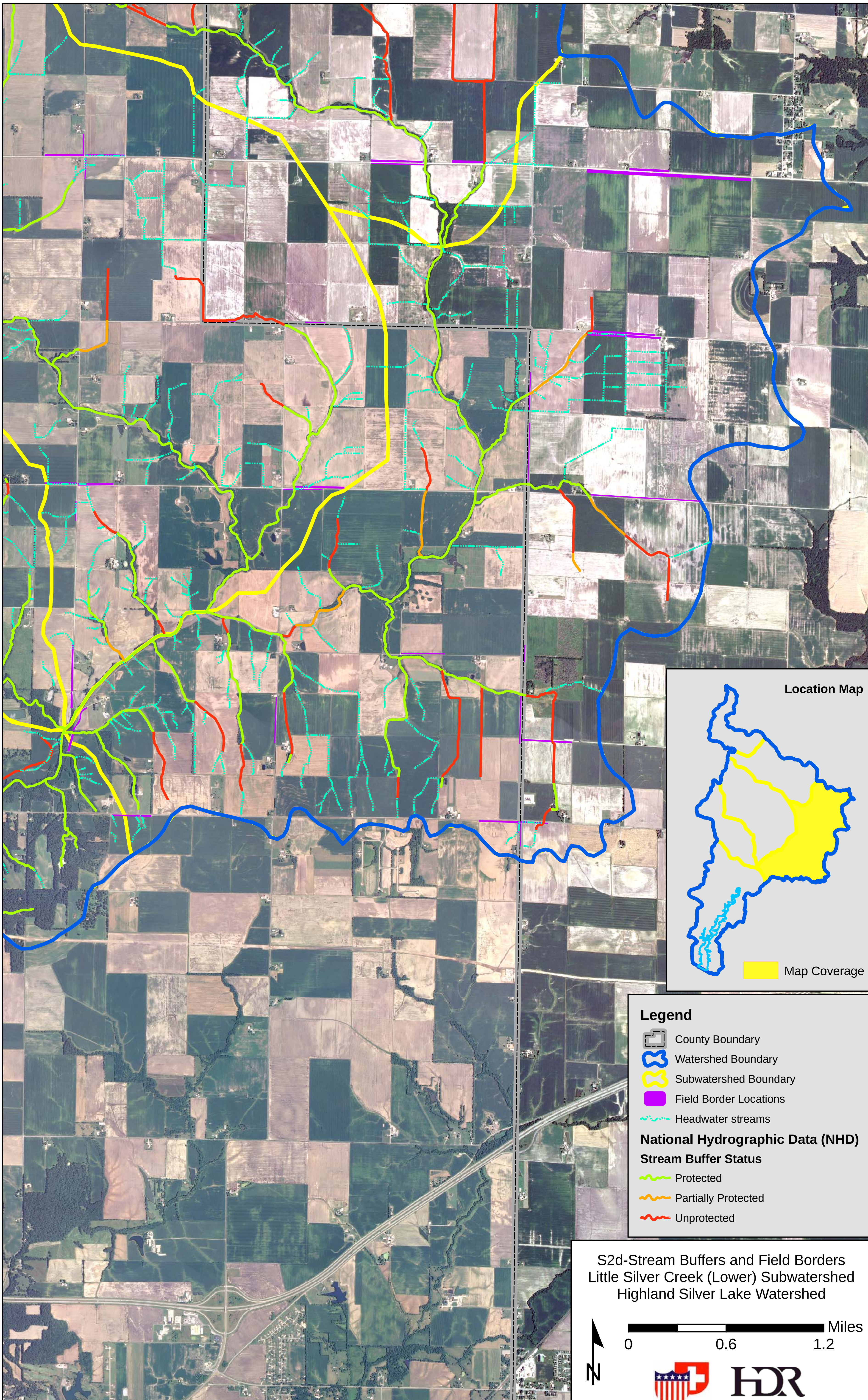
Appendix 2: Critical Area Maps

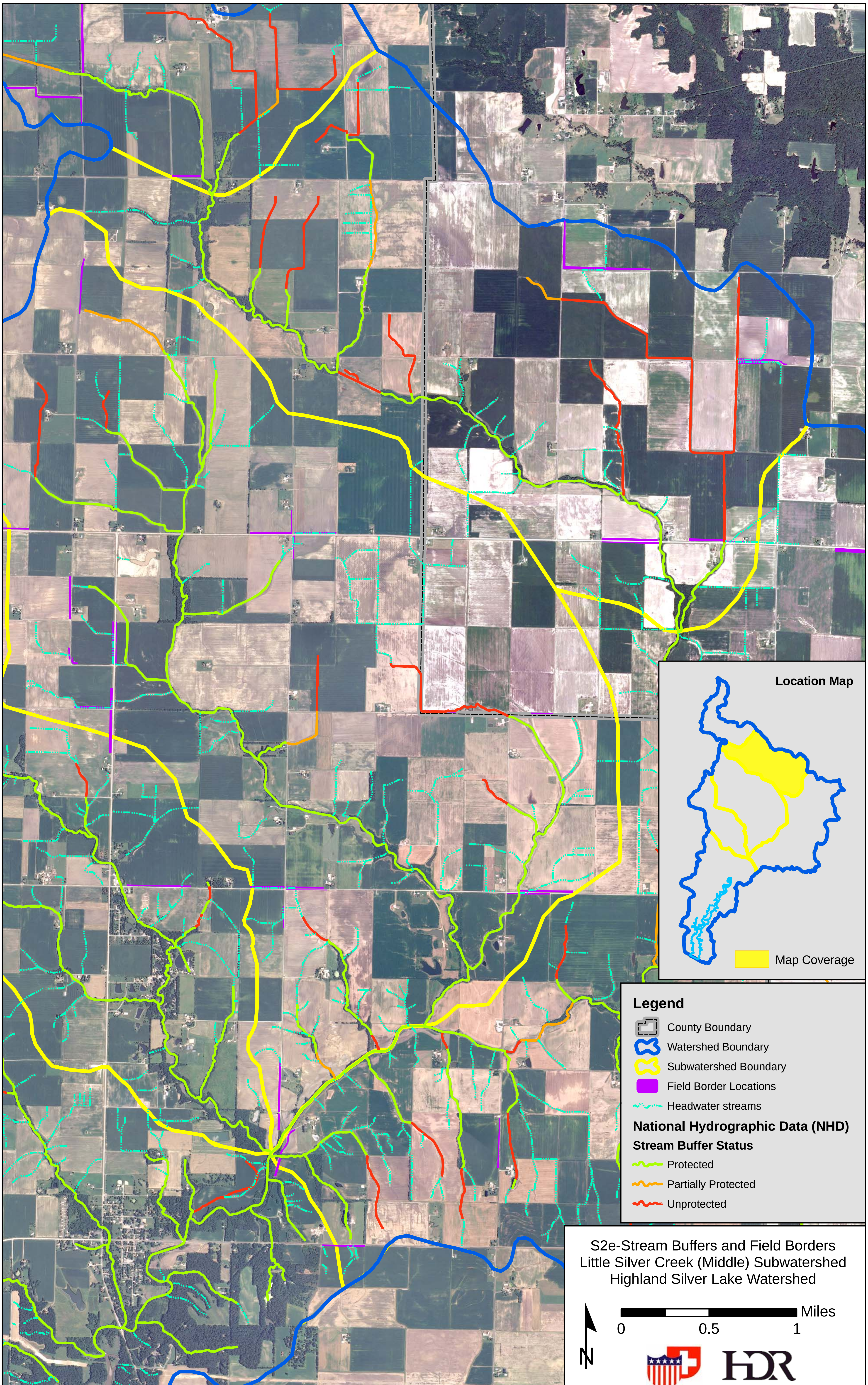

Location Map
Map Coverage
Legend
Watershed Boundary
Subwatershed Boundary
Forest Management Areas
Critical Management Areas
Dredging Priority Zones
Recommended Dredging
Critically Impacted
Moderately Impacted
S1- Forest Management & Dredging Map
Highland Silver Lake Watershed
Miles
0
0.5
1
N
HDR


Location Map
Map Coverage
Legend
County Boundary
Watershed Boundary
Subwatershed Boundary
Field Border Locations
Headwater streams
National Hydrographic Data (NHD)
Stream Buffer Status
Protected
Partially Protected
Unprotected
S2a-Stream Buffers and Field Borders
Main Lake Subwatershed
Highland Silver Lake Watershed
Miles
0
0.5
1
N
HDR

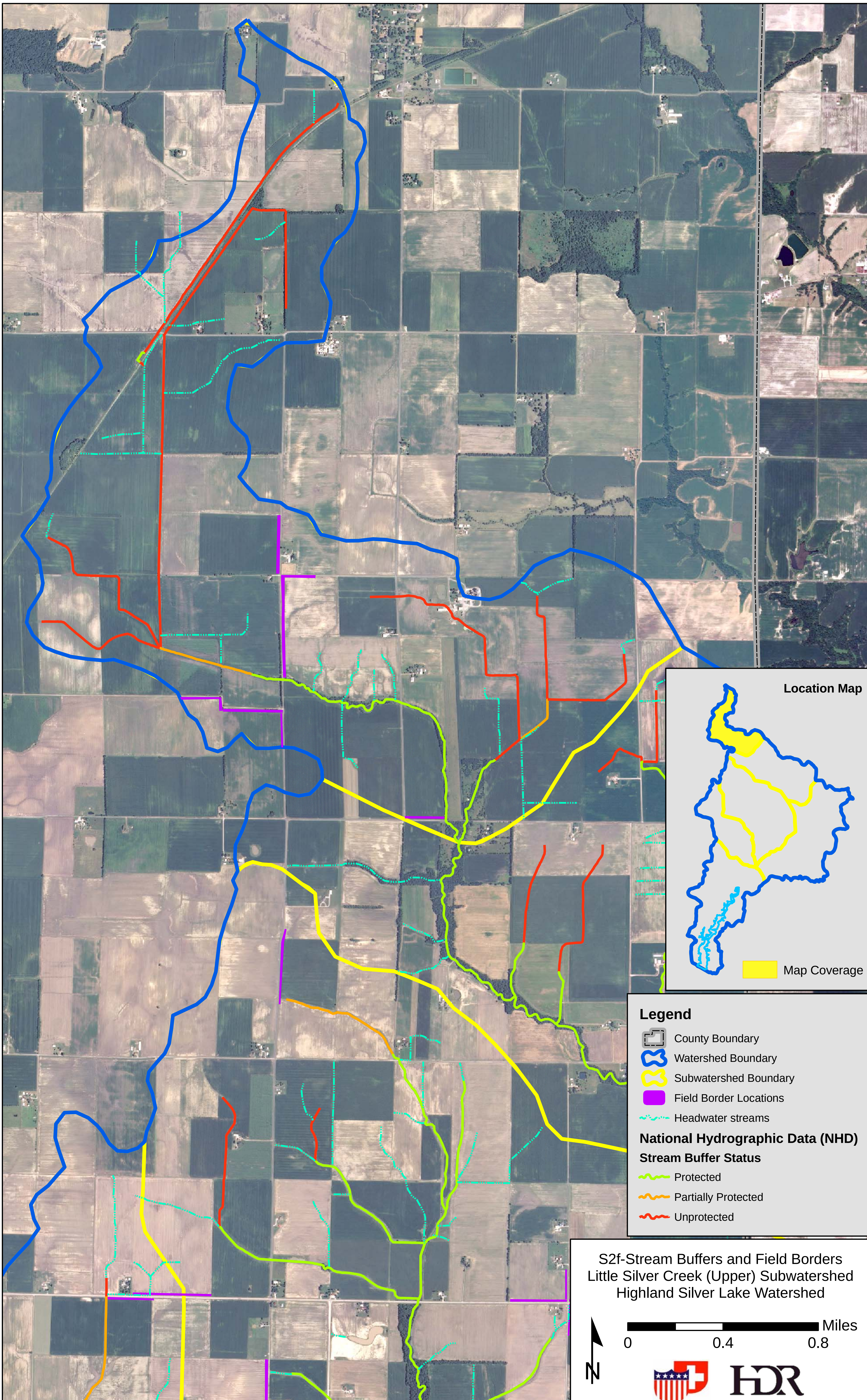

Location Map
Map Coverage
Legend
County Boundary
Watershed Boundary
Subwatershed Boundary
Field Border Locations
Headwater streams
National Hydrographic Data (NHD)
Stream Buffer Status
Protected
Partially Protected
Unprotected
S2b-Stream Buffers and Field Borders
Coolwater Creek Subwatershed
Highland Silver Lake Watershed
Miles
0
0.5
1
N

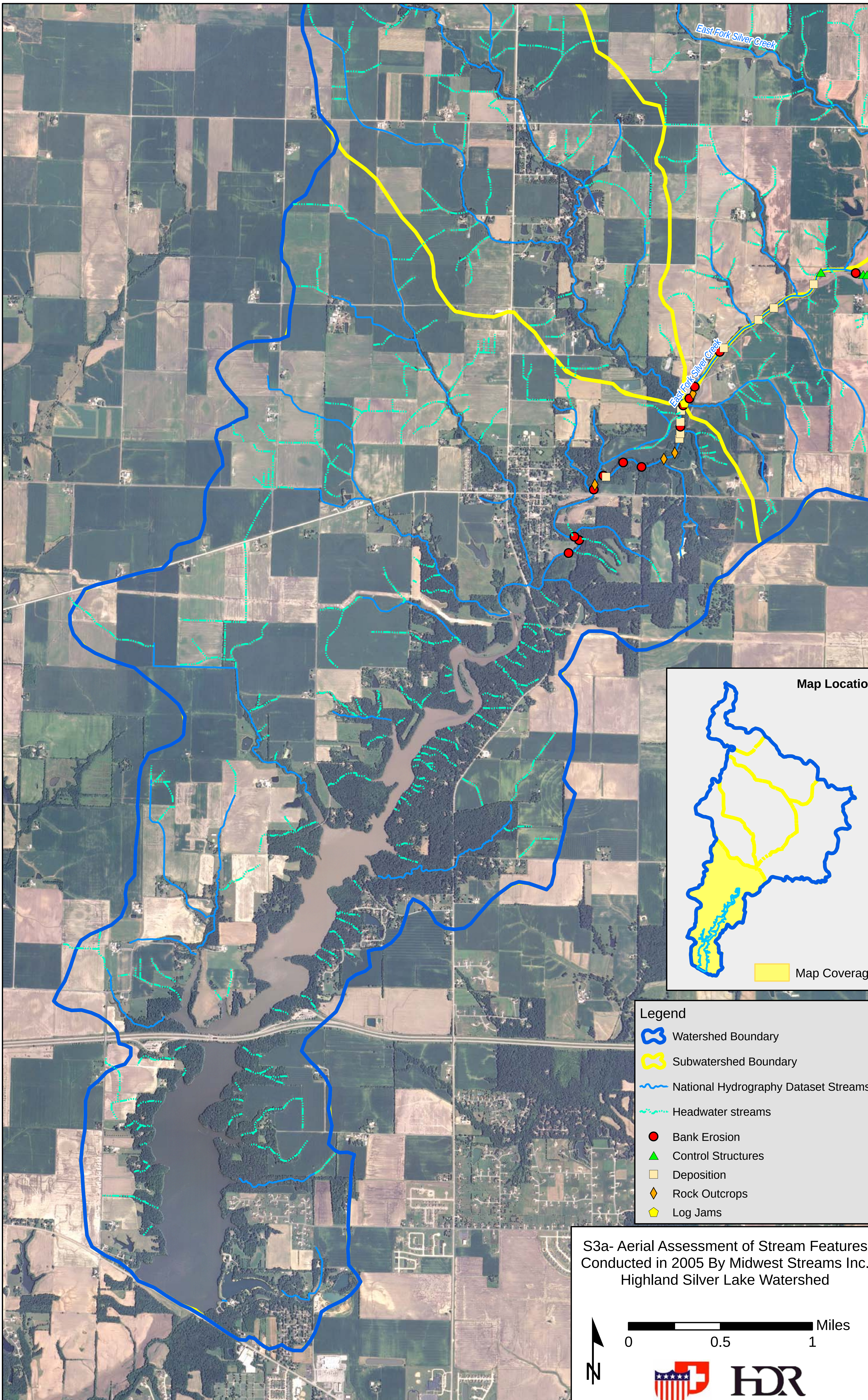

Little Silver Creek
East Fork Silver Creek
Location Map
Map Coverage
Legend
County Boundary
Watershed Boundary
Subwatershed Boundary
Field Border Locations
Headwater Streams
National Hydrographic Data (NHD)
Stream Buffer Status
Protected
Partially Protected
Unprotected
S2c-Stream Buffers and Field Borders
East Fork Silver Creek Subwatershed
Highland Silver Lake Watershed
Miles
0
0.5
1
N
HDR


Location Map
Map Coverage
Legend
County Boundary
Watershed Boundary
Subwatershed Boundary
Field Border Locations
Headwater streams
National Hydrographic Data (NHD)
Stream Buffer Status
Protected
Partially Protected
Unprotected
S2d-Stream Buffers and Field Borders
Little Silver Creek (Lower) Subwatershed
Highland Silver Lake Watershed
Miles
0
0.6
1.2
N

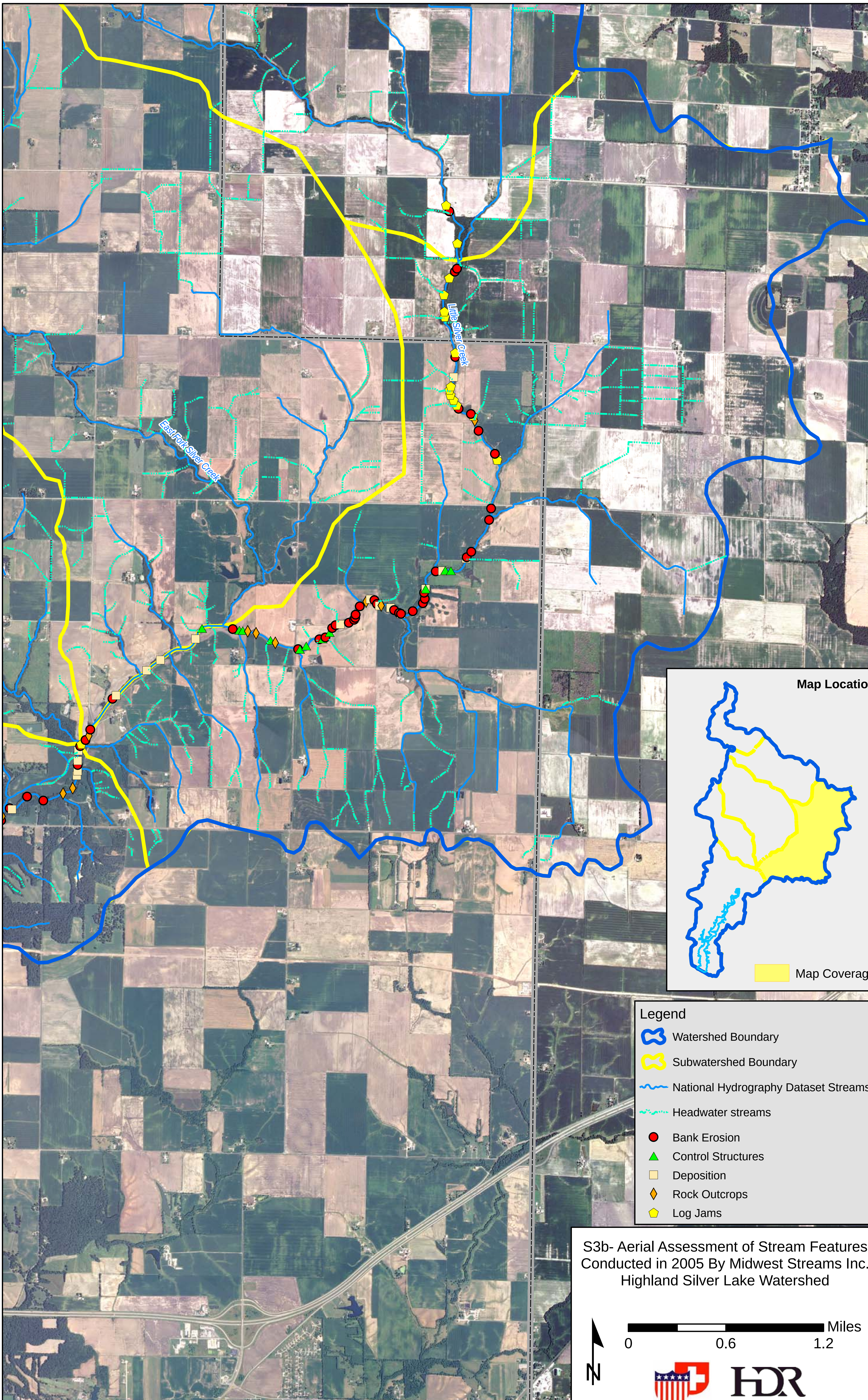


Location Map
Map Coverage
Legend
County Boundary
Watershed Boundary
Subwatershed Boundary
Field Border Locations
Headwater streams
National Hydrographic Data (NHD)
Stream Buffer Status
Protected
Partially Protected
Unprotected
S2e-Stream Buffers and Field Borders
Little Silver Creek (Middle) Subwatershed
Highland Silver Lake Watershed
Miles
0
0.5
1
N
HDR

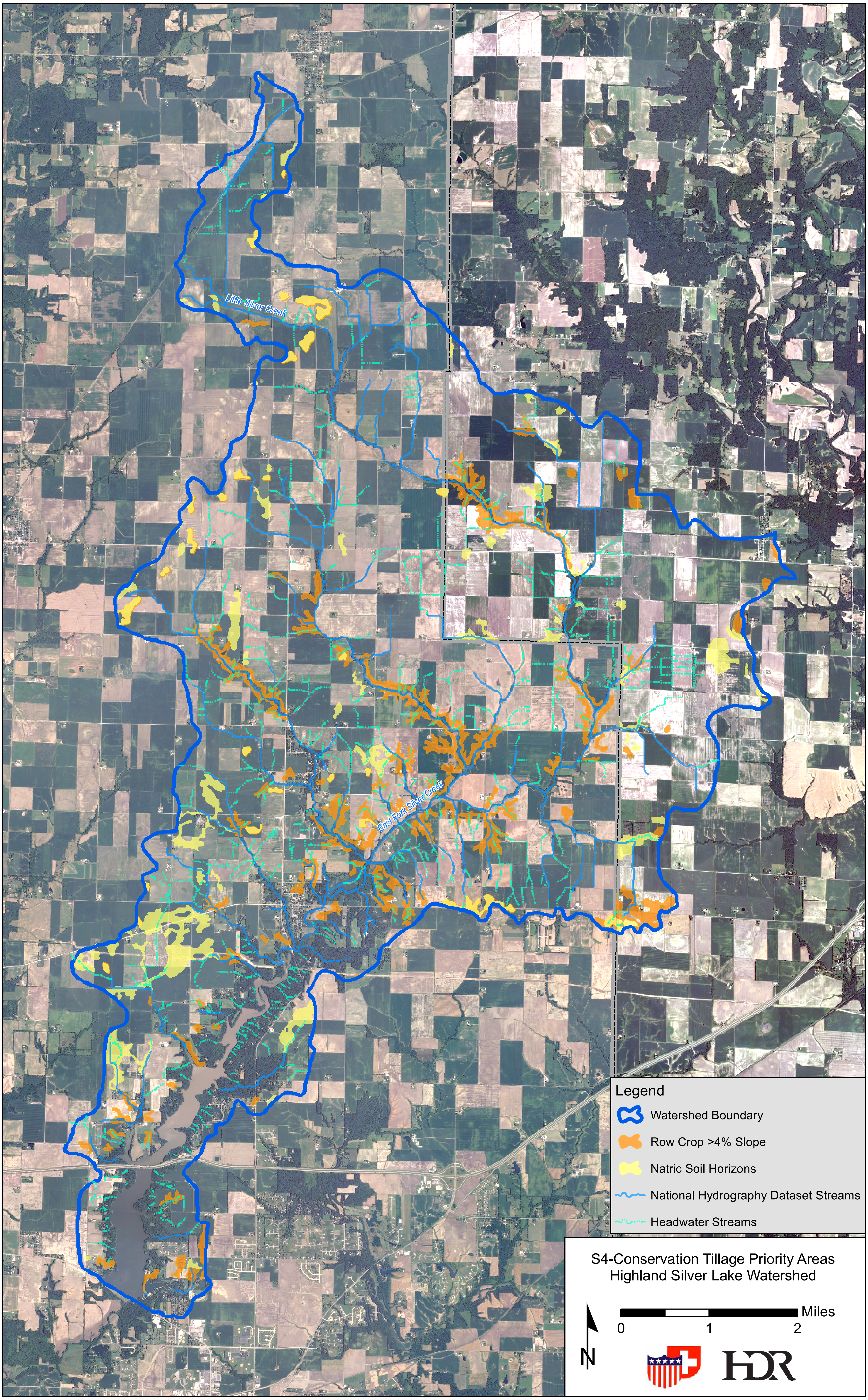

Location Map
Map Coverage
Legend
County Boundary
Watershed Boundary
Subwatershed Boundary
Field Border Locations
Headwater streams
National Hydrographic Data (NHD)
Stream Buffer Status
Protected
Partially Protected
Unprotected
S2f-Stream Buffers and Field Borders
Little Silver Creek (Upper) Subwatershed
Highland Silver Lake Watershed
Miles
0
0.4
0.8
N
HDR



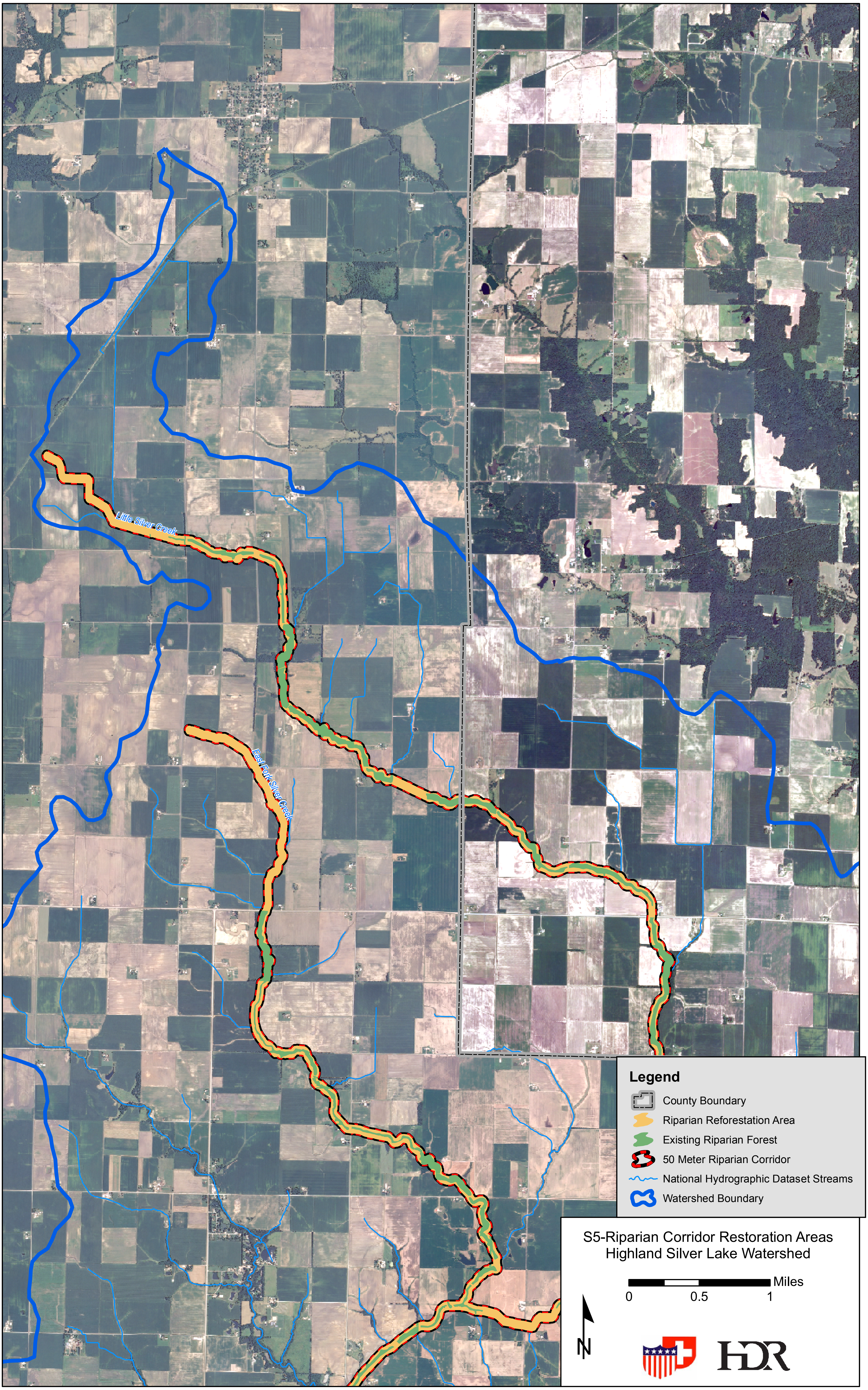
S3a- Aerial Assessment of Stream Features
Conducted in 2005 By Midwest Streams Inc.
Highland Silver Lake Watershed



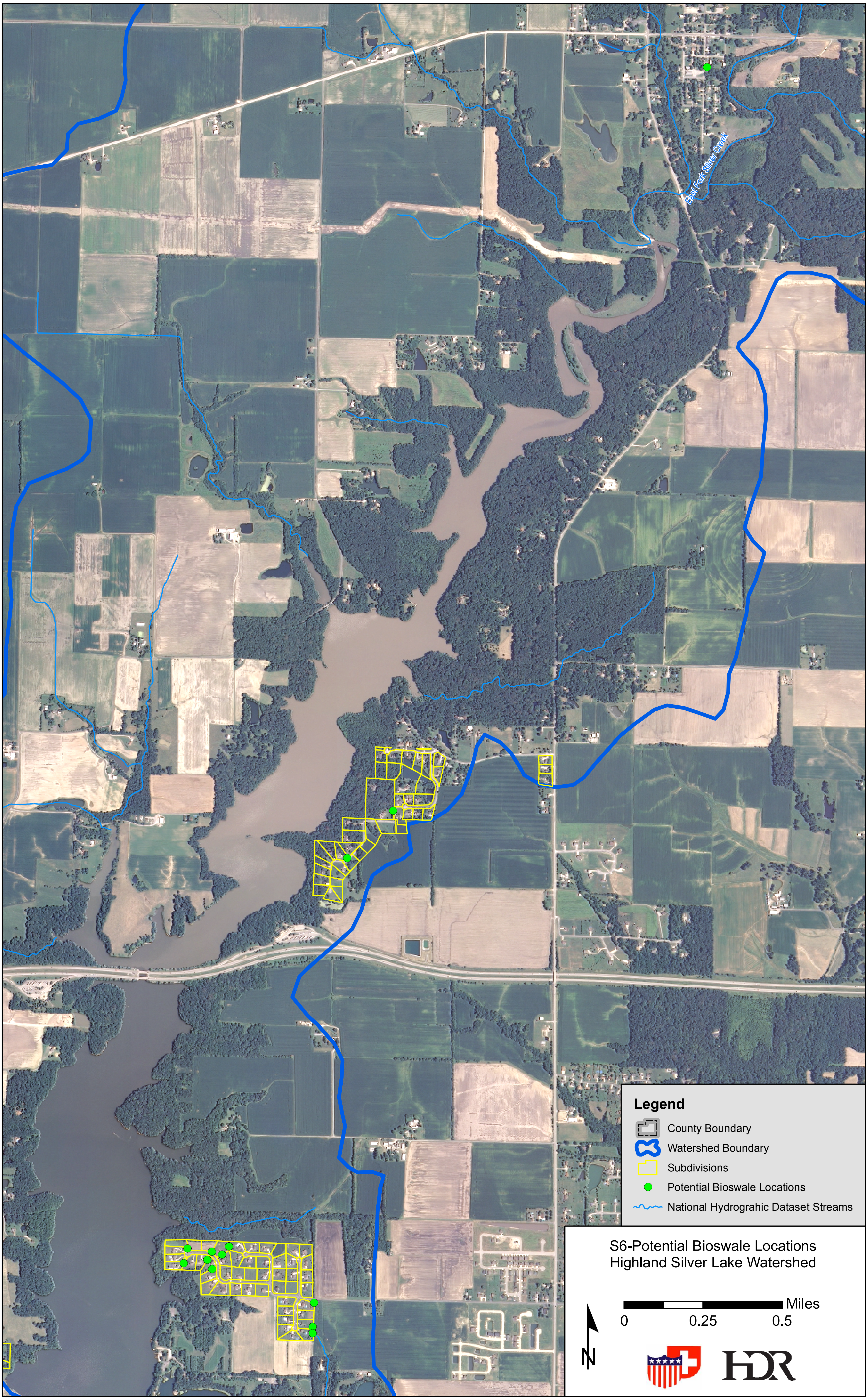
S3b- Aerial Assessment of Stream Features Conducted in 2005 By Midwest Streams Inc.
Highland Silver Lake Watershed



Little Silver Creek
East Fork Silver Creek
Legend
Watershed Boundary
Row Crop >4% Slope
Natric Soil Horizons
National Hydrography Dataset Streams
Headwater Streams
S4-Conservation Tillage Priority Areas
Highland Silver Lake Watershed
Miles
0
1
2
N
HDR



Little Silver Creek
East Fork Silver Creek
Legend
County Boundary
Riparian Reforestation Area
Existing Riparian Forest
50 Meter Riparian Corridor
National Hydrographic Dataset Streams
Watershed Boundary
S5-Riparian Corridor Restoration Areas
Highland Silver Lake Watershed
Miles
0
0.5
1
N
HDR



East Fork Silver Creek
Legend
County Boundary
Watershed Boundary
Subdivisions
Potential Bioswale Locations
National Hydrograhic Dataset Streams
S6-Potential Bioswale Locations
Highland Silver Lake Watershed
0
0.25
0.5
Miles
N
HDR

Appendix 3: Additional Maps

2005 Shoreline Erosion Survey (HDR | CWI, 2008)

2009- 2011 Shoreline Stabilization

2010 Lower Kaskaskia River Watershed Study Excerpts (SIUC et al., 2010)

- Overall Stream Rankings
- TSS Rankings
- Orthophosphate Rankings
- Nitrate Rankings
- *E. coli* Rankings

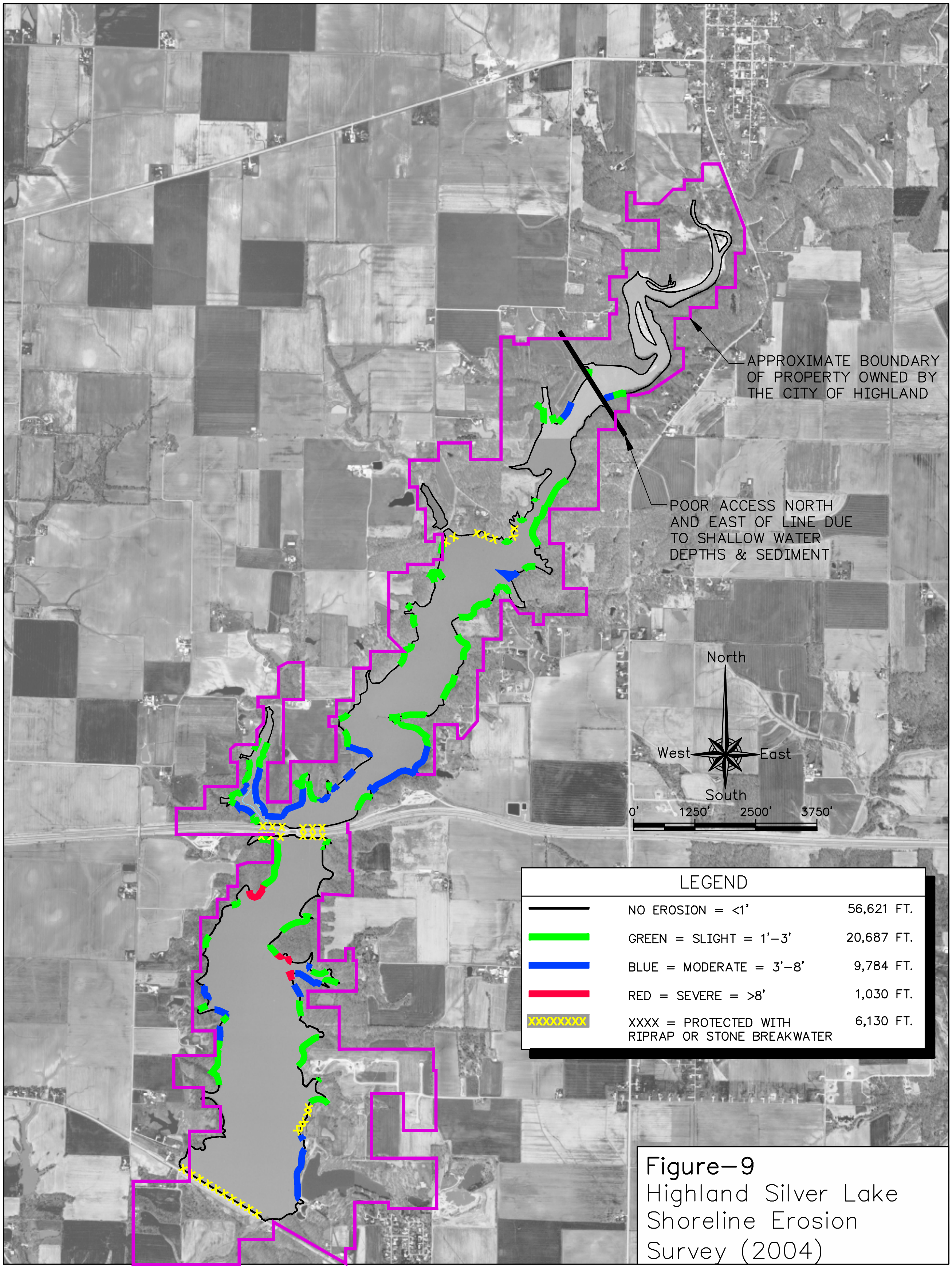
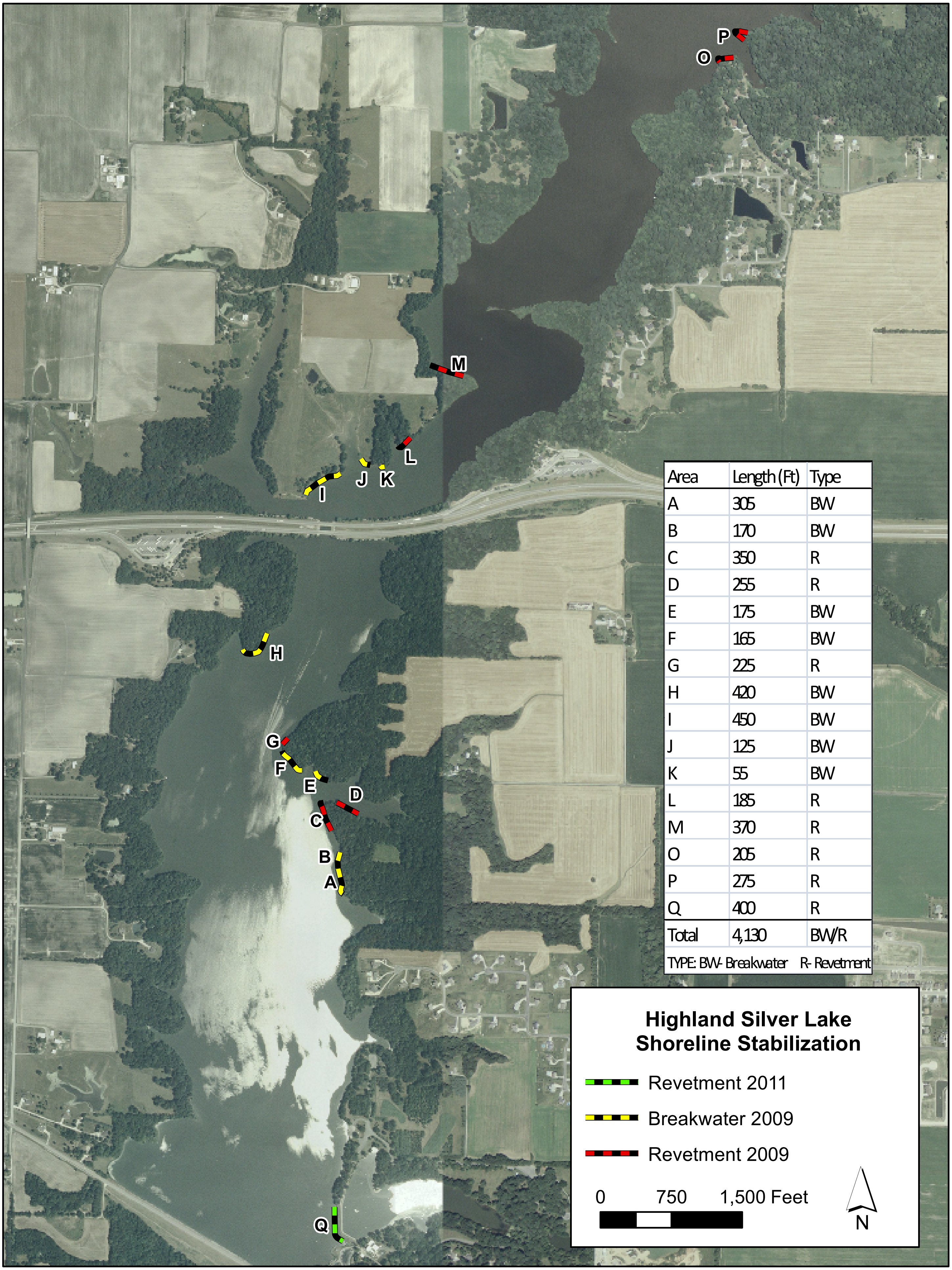


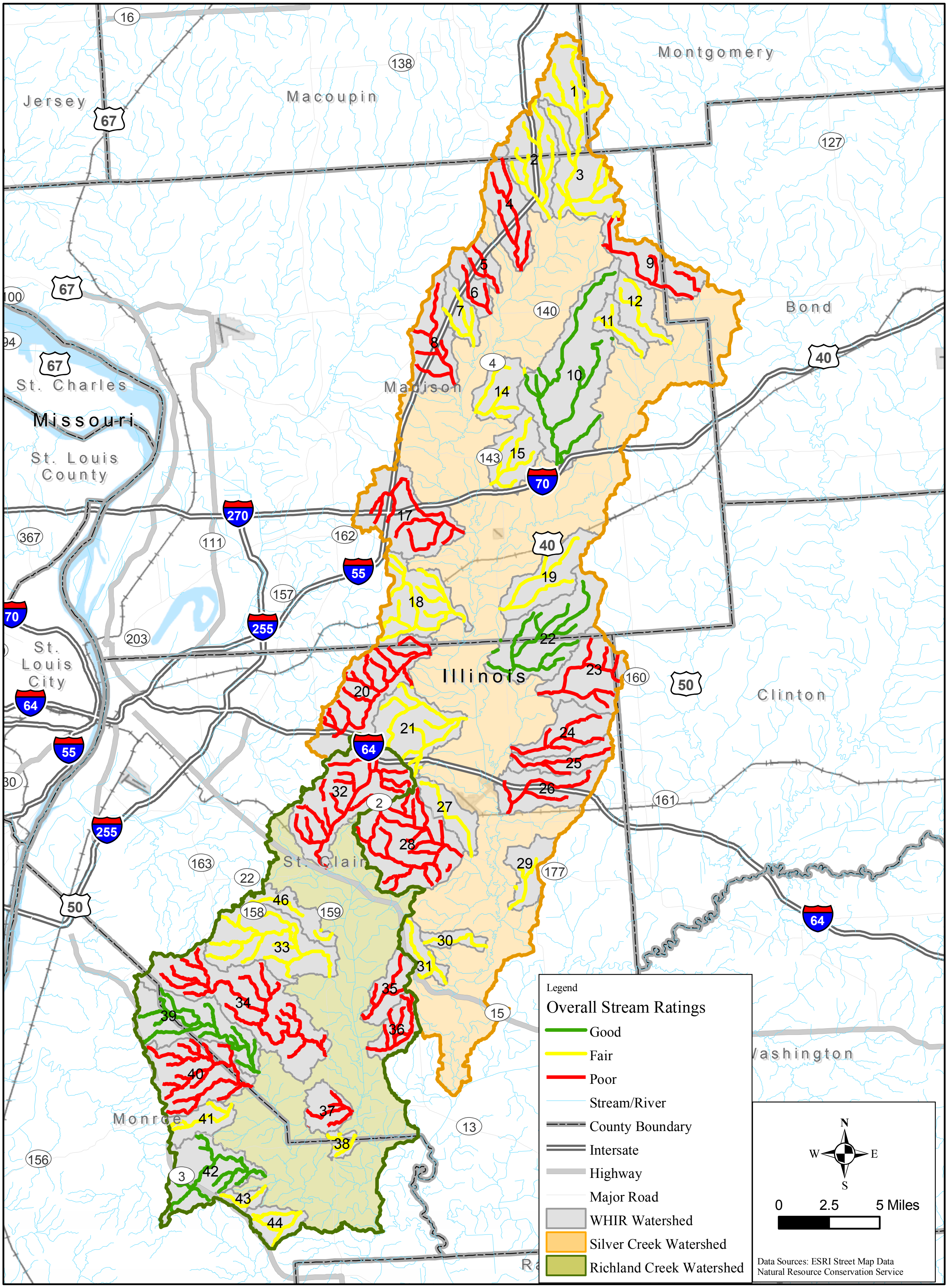
Figure-9
Highland Silver Lake
Shoreline Erosion
Survey (2004)



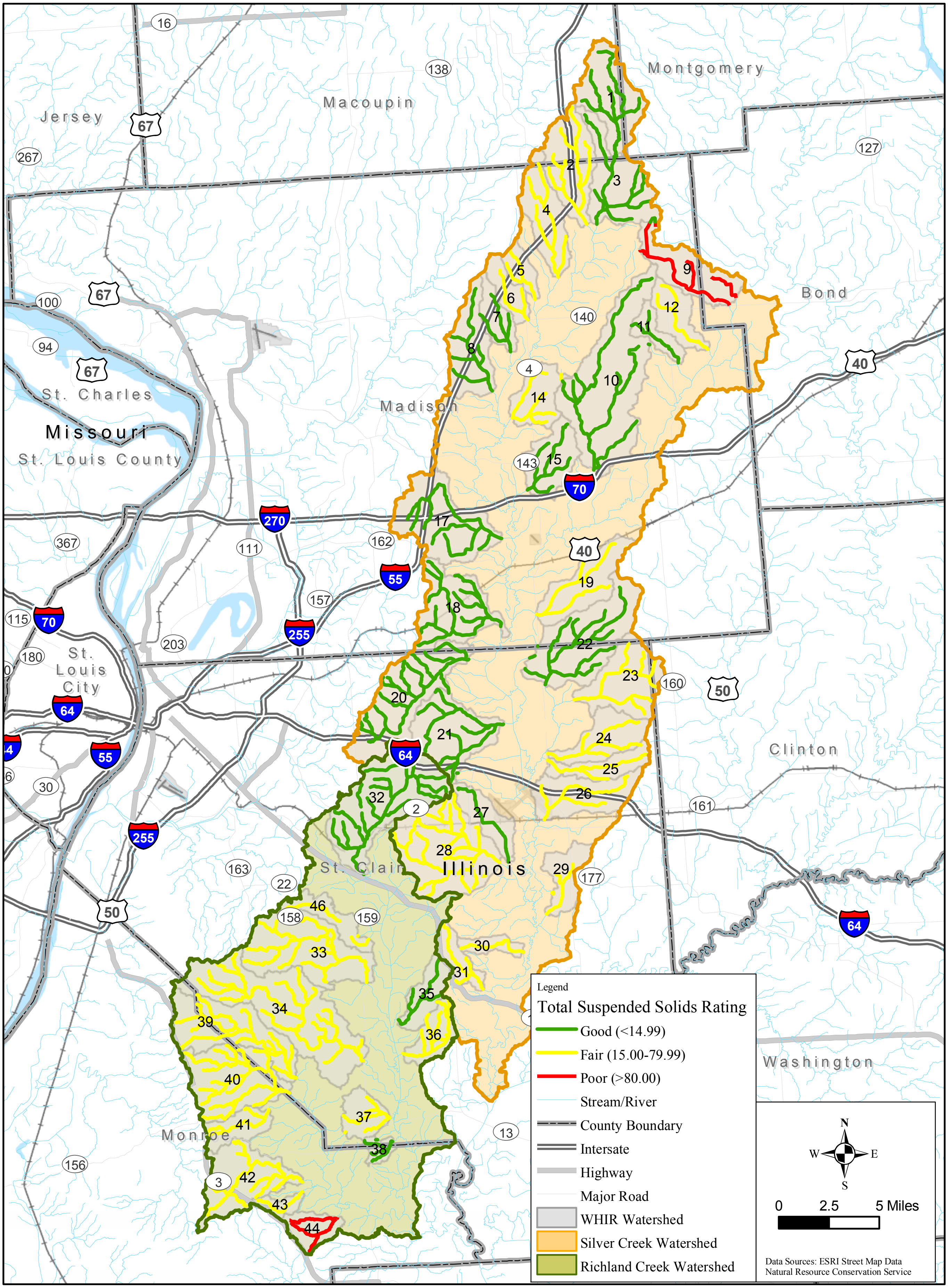
Area	Length (Ft)	Type
A	305	BW
B	170	BW
C	350	R
D	255	R
E	175	BW
F	165	BW
G	225	R
H	420	BW
I	450	BW
J	125	BW
K	55	BW
L	185	R
M	370	R
O	205	R
P	275	R
Q	400	R
Total	4,130	BW/R

TYPE: BW- Breakwater R- Revetment

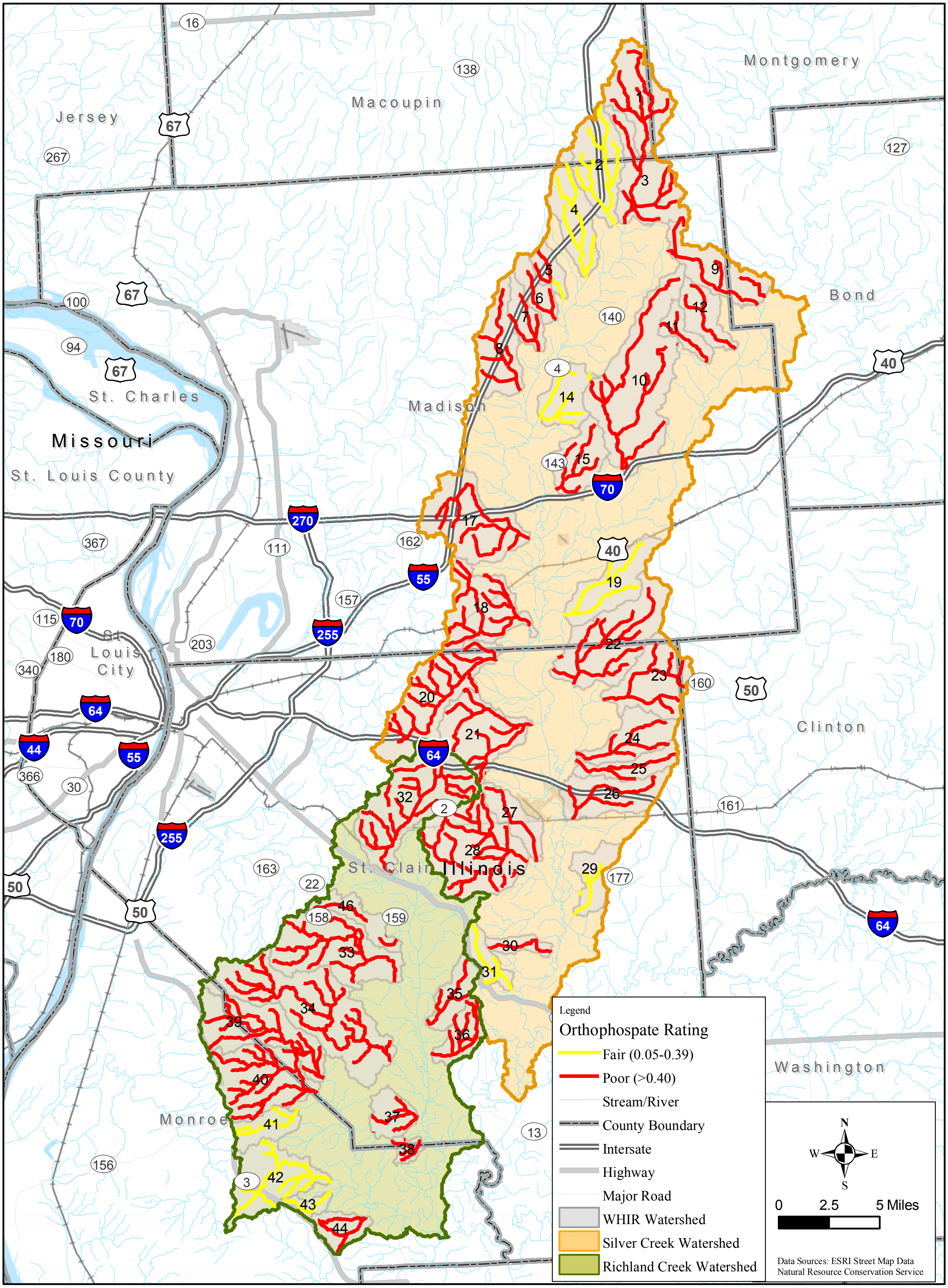
WHIR Study Watersheds
Overall Stream Ratings
Lower Kaskaskia River Basin in Illinois



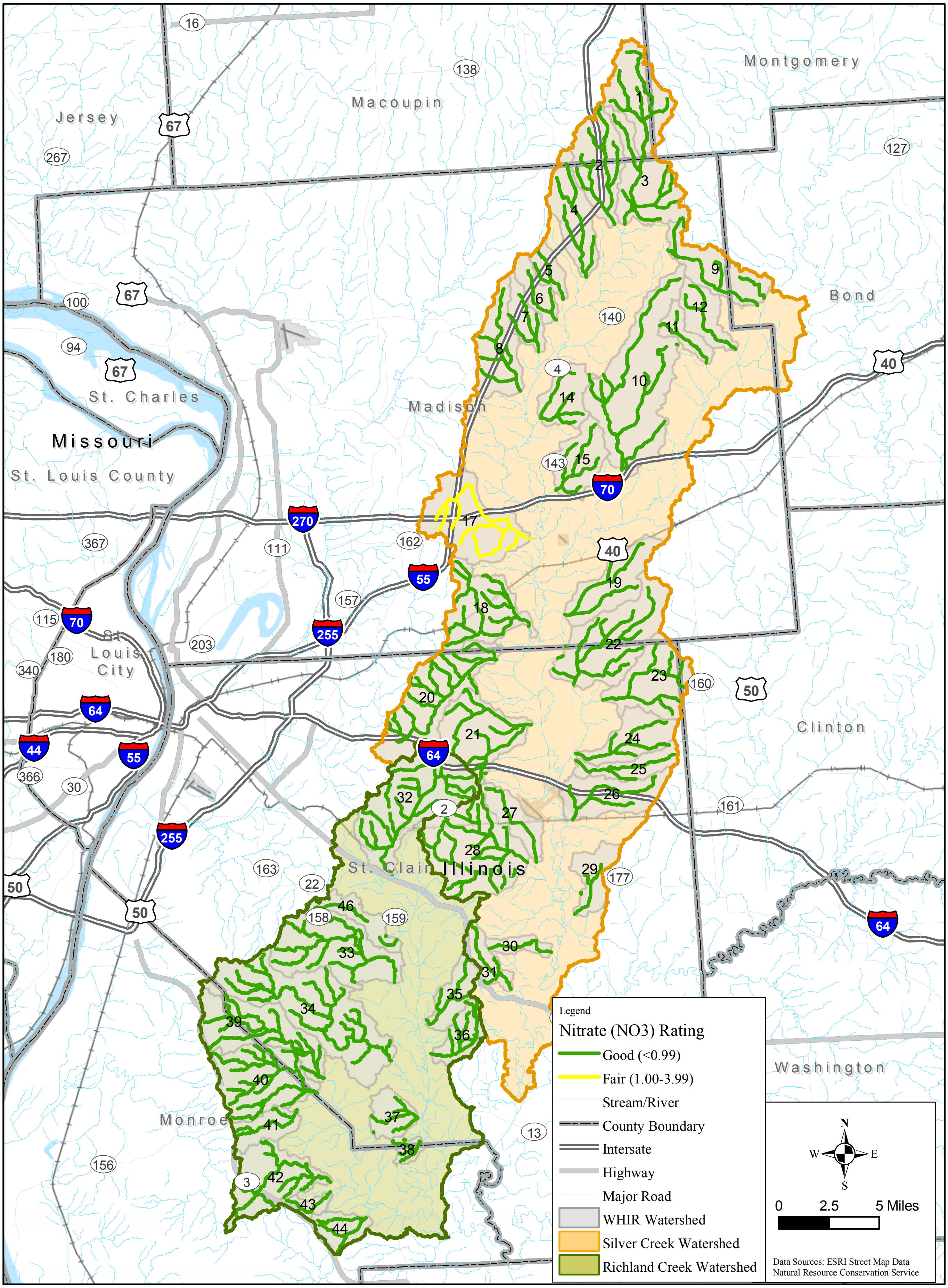
WHIR Study Watersheds
Total Suspended Solids Stream Ratings
Lower Kaskaskia River Basin in Illinois



WHIR Study Watersheds
Orthophospate Stream Ratings
Lower Kaskaskia River Basin in Illinois



WHIR Study Watersheds
Nitrate (NO3) Stream Ratings
Lower Kaskaskia River Basin in Illinois



WHIR Study Watersheds
E. coli Stream Ratings
Lower Kaskaskia River Basin in Illinois