GALENA RIVER WATERSHED
HYDROLOGIC UNIT CODE 070600050307

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GALENA RIVER WATERSHED

RESOURCE INVENTORY

GALENA RIVER WATERSHED PLAN

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GALENA RIVER WATERSHED RESOURCE INVENTORY

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Cover photos (*from left to right*): Rotary Roundtable, Galena Gazette; Paddle Boarder, Deb Malone; Kayakers, Deb Malone

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1.0 EXECUTIVE SUMMARY

The larger Galena River Watershed (HUC10- 0706000503) drains approximately 200 square miles and covers portions of Northwest Illinois and Southwest Wisconsin. The lowest portion of this watershed, which receives waters from this entire watershed and covers the area of land in which the Galena River confluences with the Mississippi River, is also called the Galena River Watershed (HUC12- 070600050307). The waters draining this area of land have been classified as impaired by the Illinois Environmental Protection Agency for zinc, sedimentation/siltation, total suspended solids, polychlorinated biphenyls, bottom deposits, and fecal coliform. This resource inventory and watershed planning effort are funded in part by Clean Water Act Section 319 funding directed through the Illinois Environmental Protection Agency to plan remediation for these impairments in this area.

The conditions leading to the impairment originate with the natural conditions in the watershed. The Galena River Watershed has an average slope of 16.7%, one of the highest in Illinois. Forty percent of the watershed is forested and 27% is grassland and pasture. Row cropped corn and soybeans account for approximately 13% of the watershed. Another 8% is developed.

The lower Galena River Watershed covers the City of Galena and spans the townships of Rawlins, East Galena, West Galena, and Vinegar Hill Townships. U.S. Highway 20 is maintained by the Illinois Department of Transportation. This area can be further subdivided into six subwatersheds. A majority of the development in the watershed is contained within one subwatershed. Similarly, agriculture is concentrated in upper reaches of the Hughlett Branch and Mainstem subwatersheds. Deciduous forest is present in all areas.

The watershed is home to approximately 4,700 people, 3,400 of which (~73%) live within the City of Galena. The watershed's population is 52% female and 48% male, and 93% Caucasian (7% Hispanic). Twenty-four percent of the population is aged 65 and over; youth aged 17 years and younger compose 13% of the population. The average income for the watershed is between \$50,000 - \$74,999, and 6% of the households (10% of families) are below the poverty line.

Five Illinois Natural Areas Inventory sites are in the proximity of the watershed. The Illinois Natural Heritage Database lists the Indiana bat, Northern long-eared bat, and the pallid shiner as endangered and/or threatened species in the watershed. Additionally, three conservation areas are managed by the Jo Daviess Conservation Foundation.

The soils in the watershed are generally highly erodible, well drained, silt loam, and have high limitations for septic systems. The bedrock underlying the soils are primarily fractured calcium carbonate which tends to dissolve, and creates a porous connection between surface water and ground water, leaving the underlying aquifer highly sensitive to pollution.

Given these conditions, the corridors feeding the rivers are highly eroded. It is not a question of eroded or not eroded, but rather to what extent is it eroded. Further, the channelization of streams is extensive, where sediments from adjacent hills have deposited layers of sediment, in some cases as much as 12 – 16 feet, onto the floodplains. Modern development, in areas of the watershed in which it occurs, has led to further impact as natural processes have been interrupted by human manipulation. The improvement of degradations in the watershed rests on restoration of these impacts. To restore these areas, not only must physical metrics be improved, but also biological impacts, such as the loss of beaver and proliferation of deer, must be addressed. Restoration does not simply mean replacing historic items of significance. True restoration occurs when natural ecosystem services are restored.

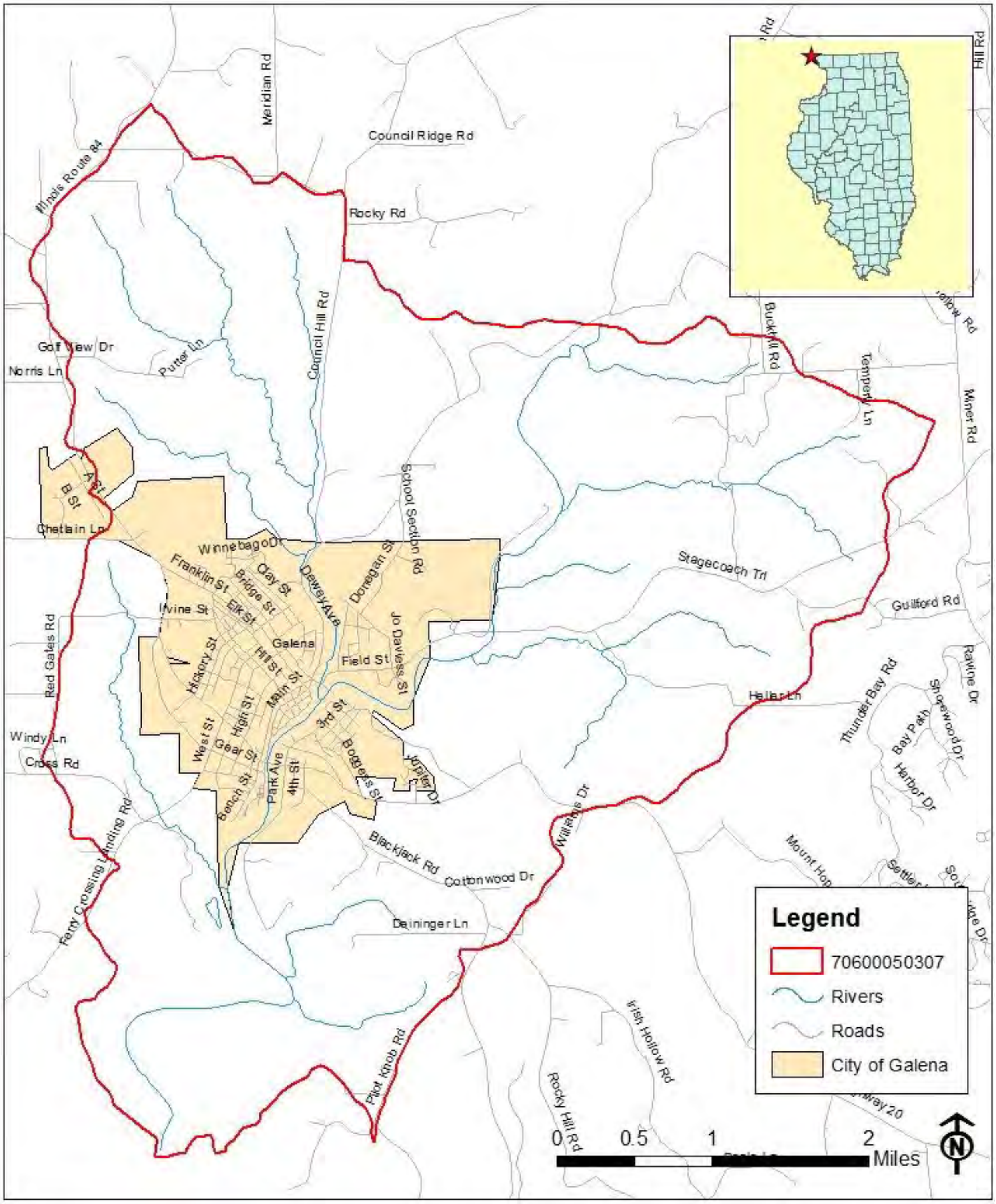

Figure 1-1. The boundaries of the lower Galena River Watershed (HUC12 070600050307).

2.0 INTRODUCTION

This document was created to provide a foundation to aid in the development of the Galena River Comprehensive Watershed Based Management Plan. The resource inventory completes the first two of nine necessary steps to complete EPA approved watershed plans. The resource inventory purposefully documents the human and natural resources within the planning area, and facilitates the remainder of watershed plan development.

The Galena River is a large water system spanning portions of Illinois and Wisconsin, and draining 200 square miles. This resource inventory and the planning effort associated with the inventory are the first planning efforts for the watershed, but focused on the lowest 20 square miles of drainage where the Galena River meets the Mississippi River. A single plan for the entire Galena River is not feasible at the level of detail provided in this inventory. A similar effort for the entire drainage would only be possible after smaller planning efforts were completed for the watersheds at the 12-digit hydrologic unit code which together compose the larger basin.

Jo Daviess County, IL, and the Galena River Watershed, contain a great deal of unique natural and anthropogenic features. The natural history of the area begins with the permeable features of the Cambrian and Ordovician bedrock, and moves through human induced landscape manipulation over the last 10,000 years, beginning with Native Americans clearing and burning the native hardwood forests, and even more intensive management in the last 200 years caused by European settlers. The more recent changes taking place in the late 1800s-to-present saw the most extreme changes in the landscape. These changes were largely caused by mining and the need for timber for fuel. This had a profound impact on soil loss, changes in natural hydrology caused by erosion, loss of native species diversity, and contamination of surface and groundwater caused by mine waste. Moving forward still, the industrial revolution increased the impact of modern humans, causing interrelated issues such as greater demand for energy intensive agriculture and a shift towards modern commerce and agribusiness.

The unique features of this area have also brought a long history of documentation of the landscape, and with development, community health have improved dramatically. In the early 1900s extensive mapping was done by the United States Geographical Survey (USGS). In the late 1930s and early 1940s the ground conditions were heavily studied by the USGS, the University of Iowa, and University of Chicago. The 1980s brought the Soil Survey by the United States Department of Agriculture. The 2000s have brought extensive field surveys by numerous universities, the Intensive Basin Survey conducted in joint effort by the Illinois Department of Natural Resources and the Illinois Environmental Protection Agency, and restoration work by volunteer and non-governmental organizations. It was not until all these field assessments were completed that we began to understand the extent of change which has been endured. Further study in collaboration with the long history of documentation is combined in this resource inventory to guide the path the watershed will take in the future.

Because the earth's surface is not flat, every map contains some discrepancy from the actual condition of the three-dimensional landscape. Cartographers use different methods of transforming the features of earth's surface on to a flat sheet depending on the age of the source of the data, the range in which the data was corrected, and size of the geographic area being studied. Due to this, the reader may find that there are some minor variations in land areas (square miles or acres) contained in this document depending on the source in which the data was gathered. Data sources are listed throughout and the reader is encouraged to refer to the original data sets for more information.

The resource inventory is used by the planning committee to determine how to most effectively move forward. Watershed planning has been conducted on a massive scale around the globe. The results of this work have led to the consensus that voluntary adoption of change in the watershed is most effective. However, local governing authorities still play a major role in providing the leadership, infrastructure, and guidance to implement changes. This resource inventory allows the planning committee to identify the inter-relationships between watershed problems, which allows for the development of multi-purpose implementation strategies and the design of best management practices which address multiple objectives.

3.0 WATERSHED BOUNDARIES AND JURISDICTIONS

The Galena River Watershed is referenced by the ten-digit hydrologic unit code (HUC10) 0706000503, and the Galena River has been given the assessment unit identification (AUID) IL-MQ by the Illinois EPA. This large watershed is composed of seven smaller watersheds at the Twelve-digit hydrologic unit code (HUC12), as shown in figure 3-3, which together capture 129,057 acres (201.65 mi.^{2}) of land area and direct its surface water flow into the Mississippi River at river mile 565.0. The watershed spans portions of two states, northwest Illinois, and southwest Wisconsin. It is located in a unique portion of the Midwest known as the Driftless Region (*Figure 3-2*). The Driftless Region contains parts of Illinois, Iowa, Minnesota, and Wisconsin. The Driftless Region escaped glaciation during the last two ice ages and therefore has remained a rugged and scenic area with great topographic relief, whereas the surrounding area was leveled by the glaciers and today remains largely flat.

Figure 3-2. The Driftless Area (NRCS, 2013).

The remainder of this resource inventory pertains to the smaller Galena River Watershed (HUC12 070600050307). This watershed is 13,911.3 acres (21.74 mi.^{2}). It receives water from its own land area, as well as from the inflow of the Galena River draining the remaining 115,146 acres (179.91 mi.^{2}) of the upper Galena River Watershed (HUC10 0706000503). The boundaries of the Galena River Watershed (HUC12 070600050307) are shown in figure 1-1.

Two streams within the watershed are identified by the Illinois EPA (AUID IL_MQ-01 and IL_MQA). The 8.64 miles of the Galena River within the boundaries of the watershed have been designated with the AUID IL_MQ-01. The Hughlett Branch, a 4.59-mile tributary to the Galena River within the Galena River Watershed, has been designated by the IL EPA with the AUID IL_MQA. Other tributaries have been identified in this resource inventory and are discussed in Section 5.0.

The smaller Galena River Watershed is located entirely in Jo Daviess County, IL. The watershed contains portions of four townships within the county; East Galena, Rawlins, Vinegar Hill, and West Galena (*see Figure 3-4*). Within the watershed lies the City of Galena, almost in its entirety. The City of Galena spreads across East Galena and West Galena townships, and also a small portion of Rawlins Township. Jo Daviess County governs zoning and planning in unincorporated areas, water quality protection, non-point source pollution control, health department authority over the entire watershed area, and maintains the county roads in the watershed. Roads in unincorporated areas are maintained by their corresponding township road commissioners, and by the City of Galena within its corporate limits. U.S. Highway 20 bisects the watershed and is maintained by the Illinois Department of Transportation.

The City of Galena holds jurisdiction over matters of planning and zoning within the corporate boundaries. On county matters within 1.5 miles of the Galena city limits, the City can

provide a recommendation to the County Board. If the City formally objects to the request and the County Board wants to override the objection, it must be done by a ¾ majority vote instead of the standard majority vote. (Ord. O-93-01 §153.04, 01/25/93; Ord. O-05-04 §154.009, 04/11/05). Whenever the requirements of these regulations are not in correlation with the requirements of any other lawfully adopted rules, regulations, ordinances or resolutions, the most restrictive or that imposing the higher standard shall govern (Ord. O-93-01, §153.05, passed 1-25-93). Stormwater within the City of Galena falls under the jurisdiction of the "*Storm Water Detention Regulations of the City of Galena, Illinois*" ('69 Code, § 5-18(a)) (Ord. O-83-1, passed 15/09/83). Additional natural resource protection is mandated in the City of Galena under "Article 5. Natural Resource Protection Standards" (Ord. O-05-04, §154.5, passed 04/11/05). Article 7, "General Performance Standards" sets forth standards for smoke, particulate matter, airborne hazardous matter, vibration, glare and heat, sewage waste, combustible storage, noise, odors, electromagnetic radiation, and hazardous or noxious material in the City of Galena jurisdictional area (Ord. O-05-04, §154.7, passed 04/11/05). Permitting for the City's jurisdictional area is regulated under §154.9. Further preservation of natural conditions outside of permitted areas are further regulated under
§ 154.914 (C)(5)(b).

Watershed planning efforts have, to-date, been led by the League of Women Voters of Illinois (LMV). The LMV spearheaded the production of the stakeholder based Jo Daviess County Water Resource Management Plan, which has been approved by the Jo Daviess County Board, the City of Galena, East Galena Township, West Galena Township, and 11 other jurisdictions outside of the Galena River watershed but located in Jo Daviess County. Their efforts have also coordinated a surface water sampling effort in 2017 which is conducted by the Illinois State Geological Survey and Illinois State Water Survey. Results from this effort are not yet available. Long-term monitoring of the Galena River takes place at MQ-01 by the IL EPA and the Illinois Department of Natural Resources. From the data collected through these efforts stream segment impairment is determined.

Non-point source pollution control is generally under the jurisdiction of the IL EPA, and best management practices assisting in the reduction of non-point source pollution are supplemented by efforts by the USDA Natural Resource Conservation Service, Jo Daviess County Soil and Water Conservation District, and Jo Daviess County Health Department.

The entire watershed area is under the jurisdiction of the U.S. Army Corps of Engineers (USACE), Rock Island District, and falls within the USACE Clinton Floodzone.

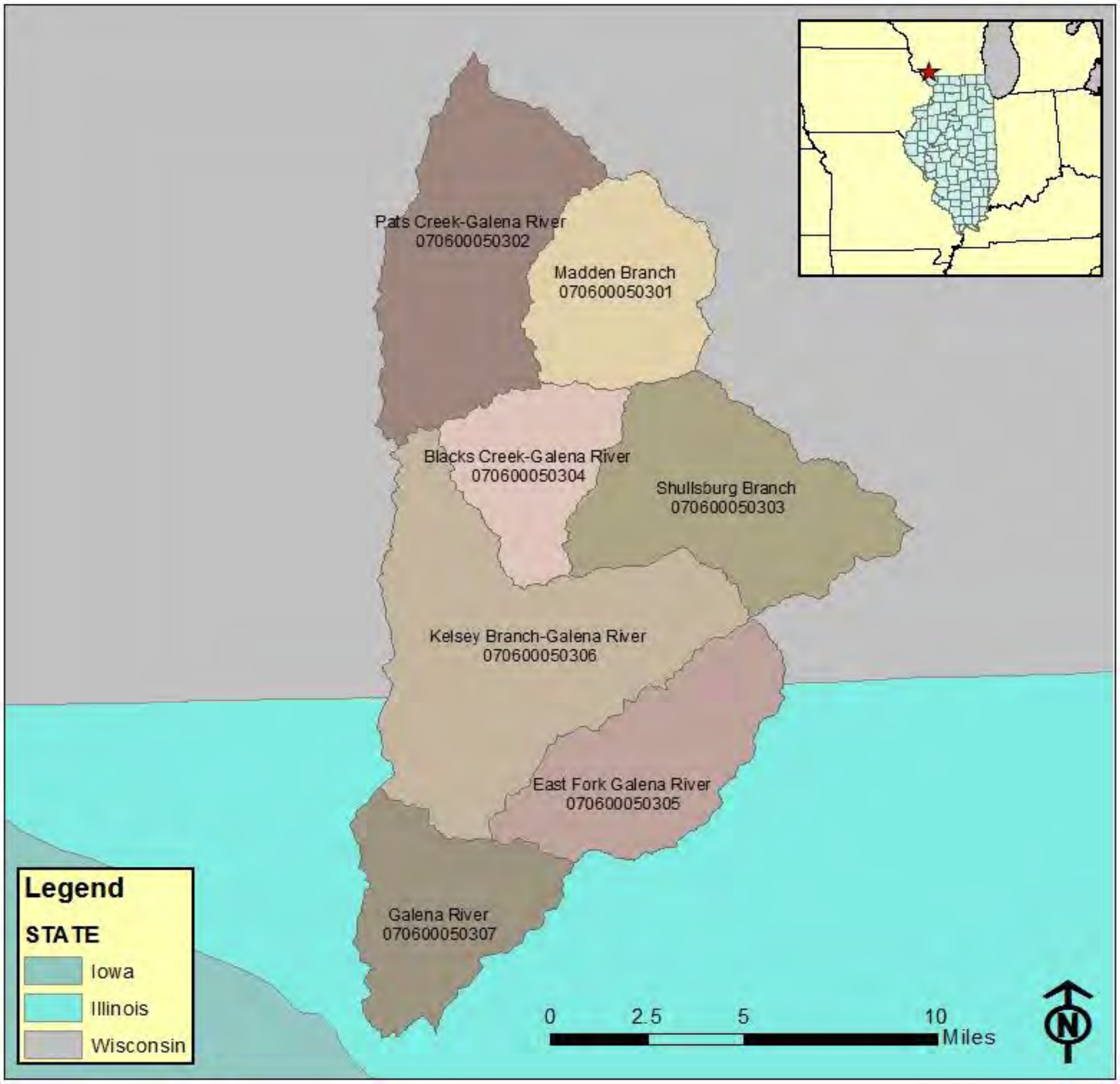

Figure 3-3. The Galena River Watershed (HUC10 0706000503) has its headwaters in Wisconsin and empties into the Mississippi River in Illinois. It is composed of seven smaller watersheds at the HUC12 level.

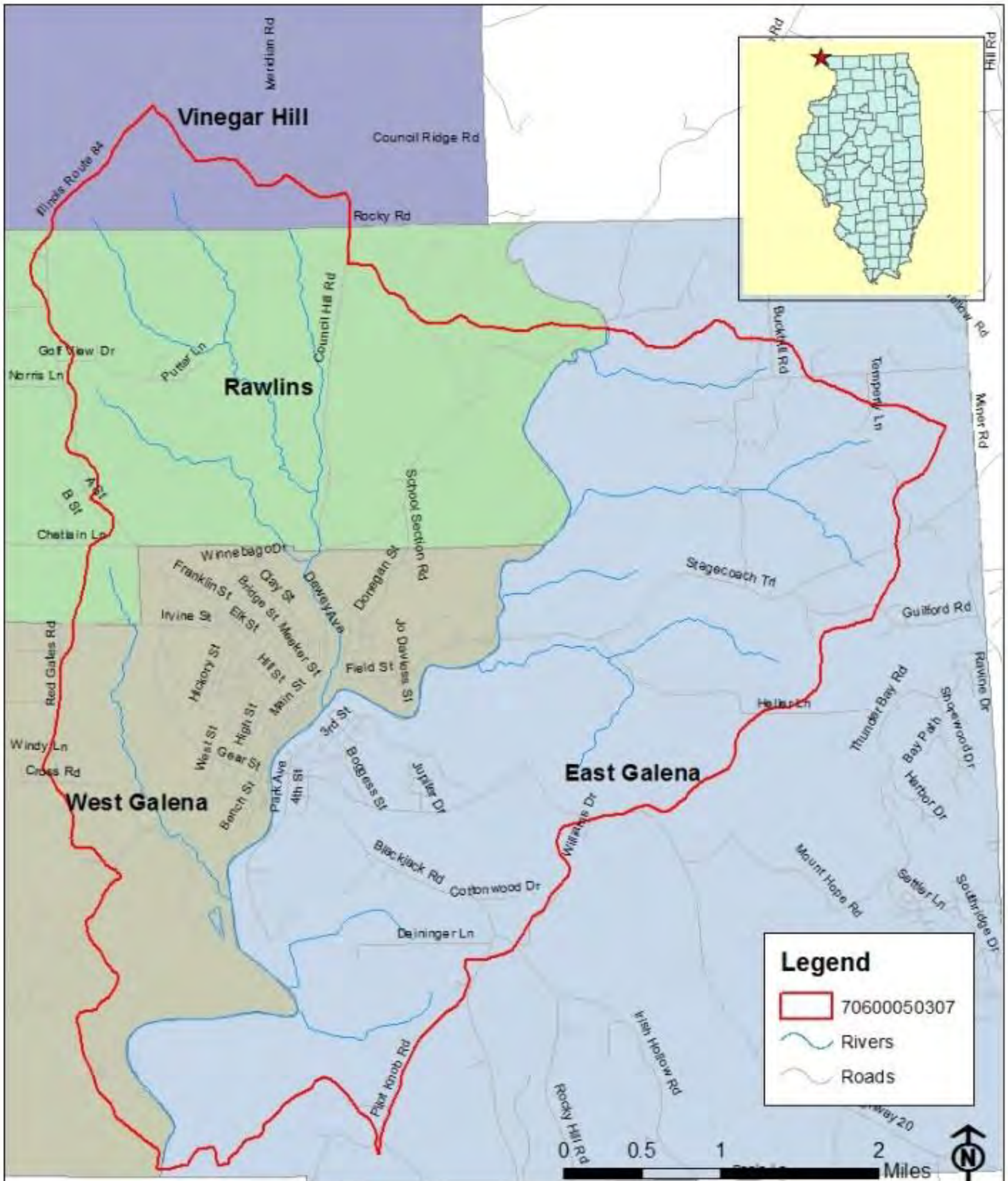

Figure 3-4. The Galena River Watershed (HUC12 070600050307) spans across portions of four townships: East Galena, Rawlins, Vinegar Hill, and West Galena.

Table 3-1. Jurisdictions within the Galena River Watershed.

Entity	Watershed Acres	Percent of Watershed	Authority
Jo Daviess County	13,909.8	100.00%	County Zoning (special use and rezoning outside of the City of Galena), County Roads and Bridges, Public Health, Water Quality Protection, Non-Point Source Pollution Prevention.
City of Galena	2406.1	3.47%	City codes, streets, stormwater and sewer systems, subdivisions and zoning within 1.5 miles of the city.
Vinegar Hill Twp.	482.4	3.47%	Township Roads and Bridges
Rawlins Twp.	3,636.30	26.14%	Township Roads and Bridges
West Galena Twp.	3,152.20	22.66%	Township Roads, Park, and Bridges
East Galena Twp.	6,638.90	47.73%	Township Roads and Bridges

4.0 TOPOGRAPHY

The topography of the watershed is rugged, characteristic of the Driftless Area landscape, with almost 500 feet of elevation change in the watershed. The highest hilltops containing remnants of Silurian dolomite reach 1,091.5 ft. above sea level. At the terminus of the watershed, the Galena River empties into the Mississippi River backwater sloughs at 595.6 ft. above sea level.

Due to its location in the Driftless Region, the topographic relief is quite varied. Along the Galena River in the valley bottoms near its confluence with the Mississippi River, watershed slopes can be as little as five feet per mile (0.1%), while in the uplands of the watershed the rugged hillsides and deeply eroded gullies can be more than 60%, with channel slopes of 170 feet per mile (3.2%). From the highest point to the lowest point in the watershed, a distance of approximately 8.8 miles is covered. Topographical elevations are shown in Figure 4-5 and percent slope is shown in Figure 4-6. Table 4-2 tabulates the slope classes by acres and percentage in the watershed. The implications of this topography mean that water runs off the surface at an increased rate, infiltration of storm water is less, and concern for erosion is magnified. The average slope for Illinois is 1.2 %. Jo Daviess County has the highest average slope of any counties in Illinois at 11.4%. The Galena River Watershed's average slope is 16.7%.

Table 4-2. Characterization of slopes in the watershed, summary of acres of classification, and percentage of watershed for each group.

Slope	Acres	Percent
A 0 - 2%	1,542.1	11.1%
B 2 - 5%	1,170.1	8.4%
C 5 - 10%	2,940.2	21.1%
D 10 - 18%	3,090.4	22.2%
E 18 - 25%	1,618.8	11.6%
F 25 - 35%	2,207.0	15.9%
G 35 - 60%	1,261.6	9.1%
Other 0%	80.9	0.6%
Total	13,911.1	100.0%

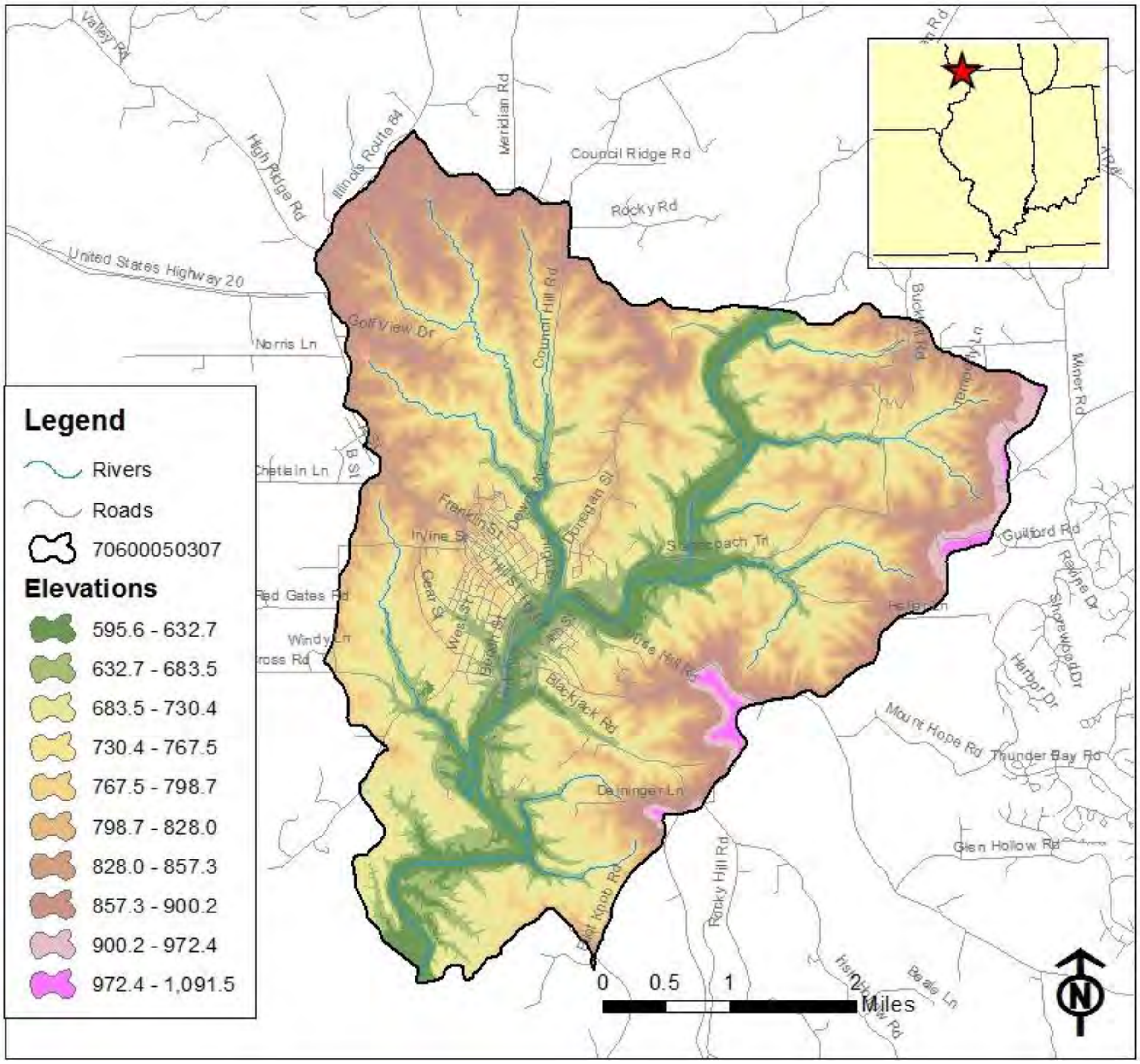

Figure 4-5. Topographic features of the Galena River Watershed. There is almost 500 feet of elevation change in the 13,911.3-acre watershed.

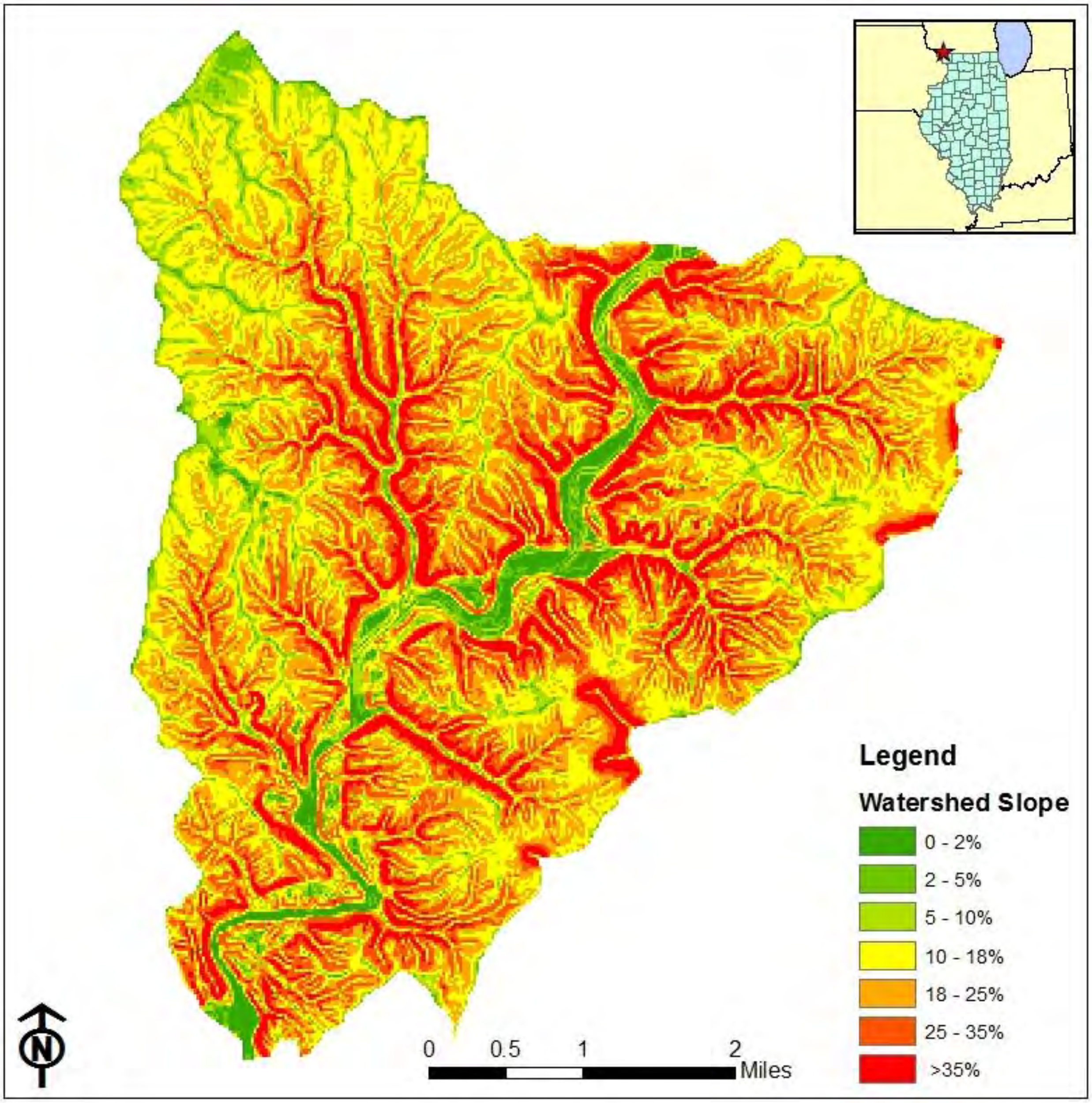

Figure 4-6. Slopes in the watershed classified by percent slope.

5.0 LAND USE, LAND COVER, AND DEVELOPMENT

Land use in the Galena River Watershed falls into 25 different classification groups. The five highest categories are deciduous forest, grass/pasture, corn, developed/open space, and developed/low intensity. These five categories, when added together, account for 87.8% of the watershed. The remaining 20 categories are 3.4% of the watershed or less each. Deciduous forest comprises 39.0% of the watershed. These forests are largely oak-hickory forests common to this part of the U.S. Much of the area containing these forests is steeply sloped, and challenging to develop. Erosion is a concern. Historic aerial imagery and local historical accounts from the area coincide, showing that much of this forest land was cleared in the late 19th and early 20th century and used for fuel and lumber. Due to this, much of this forest land today is composed of younger trees, approximately 100 years old or less. These areas are dominated by oaks and hickories today, interspersed with black walnut, black cherry, maple, cottonwood, and basswood, as well as some other species to a lesser extent. The invasive bush honeysuckle (*Lonicera sp.*) is an ongoing problem. Using the rate of change from 2011 to 2016, future predictions for deciduous forest is 4071.2 acres (29.3%) if the trend continues.

Grass and pastureland account for 26.6% of the watershed. This land is primarily either pastured with cattle, harvested as grass hay, or was previously cropland that has been enrolled in a grass practice in the federal Conservation Reserve Program (CRP). Corn is planted on approximately 9.5% of the land in the watershed. When all categories are combined, agricultural land uses account for 42.1% of the watershed. Table 5-3 lists categories for land use. The agricultural categories used for this calculation include grass/pasture, corn, alfalfa, soybeans, winter wheat, oats, other hay/non-alfalfa, rye, walnuts, and pop or ornamental corn. Row cropped fields in the watershed are primarily in the upland areas (*for more information on row cropping practices see Section 8.0*). Future predictions for grass and pastureland are 5,709.2 acres (41%) based on changes in the past five years. Future corn estimates are 844.4 acres (6.1%), and total agricultural land expecting to change to 7,061.3 acres (50.8%), although the large percentage of grass and pastureland may consist of conservation land (CRP or prairie) which may not accurately reflect agricultural use.

Low intensity development and open spaces in the watershed make up 5.8% of the watershed. Medium intensity development accounts for 1.5% of the watershed by area (206.2 acres). High intensity development accounts for 0.4% of the watershed by area (52.3 acres). Medium and high intensity development can be combined to determine impervious surface amount. In 2016 these two categories together equate to 1.9% of the watershed (258.5 acres). Because a majority of this area is directly along the Galena River in the downtown area of the City of Galena, the effects of the impervious surfaces and concentration of runoff effluent may be more detrimental to water quality in the Galena River than if it were to be concentrated further upland or spread into isolated areas throughout the watershed. The levee adjacent to the downtown portion of the City of Galena protects the city but also creates detrimental constriction to the Galena River's channel. Using the change in medium and high intensity development from 2011 to 2016, impervious surfaces estimated for 2021 assuming the same growth, totaling 347.4 acres or 2.5% of the watershed, an increase of 45.0%.

Descriptions of the land classifications are taken directly from the National Land Cover Database (2017), and are as follows. "Open water" is areas of open water, generally with less than 25% cover of vegetation or soil. "Developed, Open Space" is areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes. "Developed, Low Intensity" is areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units. "Developed, Medium Intensity" is described as areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units. Areas with the description "Developed, High Intensity" are described as highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover. "Barren" land consists of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover. "Deciduous Forests" are those areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change. "Evergreen Forests" are dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage. "Mixed Forests" are dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage. "Shrublands" are areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions. "Herbaceous" and "Grassland" areas are areas dominated by gramanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing. These differ from "Hay/Pasture", as depicted in *Figure 5-7*, which are areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation. "Cultivated Crops" are areas used to produce annual crops, such as corn, soybeans, vegetables, tobacco, and cotton; as well as perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled. "Woody Wetlands" are areas where forest or shrub land vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water. "Herbaceous Wetlands" are areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water. Specific crop descriptions listed in *Table 5-3* are specific statistics taken from the National Agricultural Statistics Service which describes specific acreages planted to specific crops, such as "Sorghum", "Sweet Corn", or "Rye".

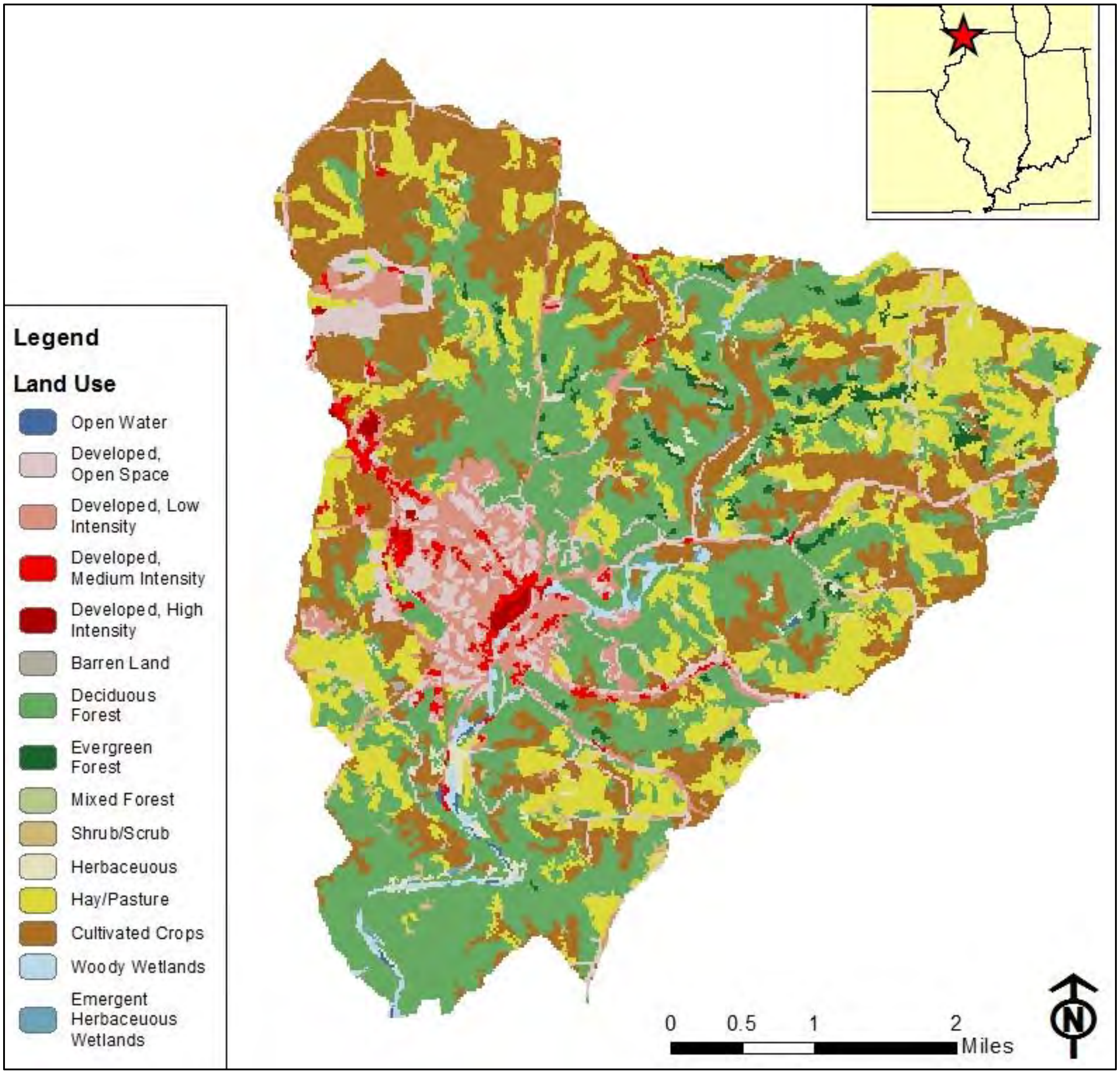

Figure 5-7. The land use composition of the Galena River Watershed. The majority is deciduous forest, with the second largest area being grass/pasture.

Table 5-3. Land categories within Galena River Watershed from 2016 and 2011, shown in acres and calculated as percentages (USDA-NASS, 2017). Predicted acres and percentage of watershed estimated for 2021 are shown on the far-right columns.

Category	Acres (2016)	Percentage (2016)	Acres (2011)	Percentage (2011)	Change (Acres)	Change (%)	Predicted Acres (2021)	Predicted Percentage (2021)
Deciduous Forest	5,421.3	39.0%	6,725.9	48.4%	-1,304.6	-19.4%	4,071.2	29.3%
Grass/Pasture	3,698.2	26.6%	1,268.5	9.1%	2,429.7	191.5%	5,709.2	41.0%
Corn	1,318.8	9.5%	1,919.0	13.8%	-600.2	-31.3%	844.4	6.1%
Developed/Open Space	963.4	6.9%	878.9	6.3%	84.5	9.6%	983.9	7.1%
Developed/Low Intensity	810.0	5.8%	648.9	4.7%	161.1	24.8%	942.0	6.8%
Soybeans	473.5	3.4%	537.8	3.9%	-64.3	-12.0%	388.4	2.8%
Alfalfa	336.9	2.4%	968.1	7.0%	-631.2	-65.2%	109.2	0.8%
Woody Wetlands	314.0	2.3%	76.5	0.5%	237.5	310.5%	292.5	2.1%
Developed/Medium Intensity	206.2	1.5%	143.4	1.0%	62.8	43.8%	276.2	2.0%
Evergreen Forest	97.4	0.7%	72.1	0.5%	25.3	35.1%	90.7	0.7%
Open Water	92.5	0.7%	73.2	0.5%	19.3	26.4%	86.2	0.6%
Shrubland	83.2	0.6%	246.2	1.8%	-163.0	-66.2%	26.2	0.2%
Developed/High Intensity	52.3	0.4%	35.8	0.3%	16.5	46.1%	71.2	0.5%
Other Hay/Non Alfalfa	12.2	0.1%	234.8	1.7%	-222.6	-94.8%	0.6	0.0%
Barren	9.8	0.1%	18.4	0.1%	-8.6	-46.7%	4.9	0.0%
Herbaceous Wetlands	6.4	0.0%	22.7	0.2%	-16.3	-71.8%	1.7	0.0%
Oats	4.7	0.0%	4.4	0.0%	0.3	6.8%	4.7	0.0%
Rye	4.4	0.0%	0.0	0.0%	4.4	0.1%	4.1	0.0%
Winter Wheat	2.0	0.0%	33.4	0.2%	-31.4	-94.0%	0.1	0.0%
Walnuts	0.9	0.0%	0.7	0.0%	0.2	0.0%	0.8	0.0%
Mixed Forest	0.9	0.0%	0.7	0.0%	0.2	0.0%	0.8	0.0%
Pop or Orn Corn	0.4	0.0%	0.0	0.0%	0.4	0.0%	0.4	0.0%
Total	13,909.4	100.0%	13,909.4	100.0%			13,909.4	100.0%

6.0 SUBWATERSHEDS

Within the Galena River Watershed (HUC12 070600050307), six subwatersheds were identified through a GIS analysis (*see Figure 6-9*). A digital elevation model (Figure 6-8) was accessed for the watershed and sub-basins were identified using a watershed delineation tool. Each subwatershed is unique in its land use as well as its drainage area size. For this reason, it may be most beneficial to analyze each subwatershed individually during the planning process. Table 6-4 lists the names and abbreviations used to label each of the subwatersheds, along with each sub-basin's area in acres and percentage by area of the Galena River Watershed. Tables 6-5 and 6-6 list the individual land uses for each subwatershed. Table 6-5 contains the area of each land use in acres, and table 6-6 provides the percentage of this area for the whole subwatershed. Because the information in these tables is so complex, figure 6-10 was developed to provide a graphic representation of the data to assist in data comprehension. This graphic helps to clearly depict and identify trends among the land uses and subwatersheds. It becomes evident that development is primarily concentrated in the Downtown, Hughlett Branch, and Main Stem subwatersheds. Forests, hay/pasture, and cultivated crops envelope a large portion of the subwatersheds by area. The Lower River is primarily forested. Rural agricultural areas compose a majority of the Hughlett Branch and Main Stem.

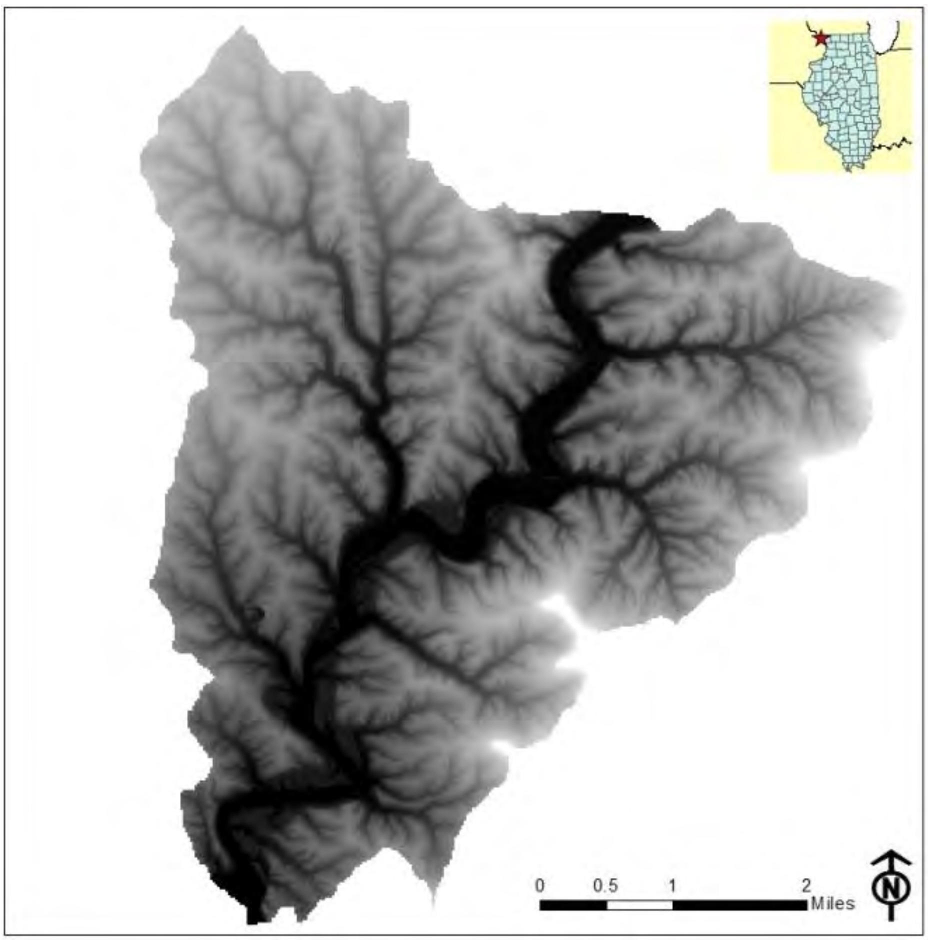

Figure 6-8. Digital elevation model of the Galena River Watershed developed from LIDAR imagery used to determine sub-watershed basins.

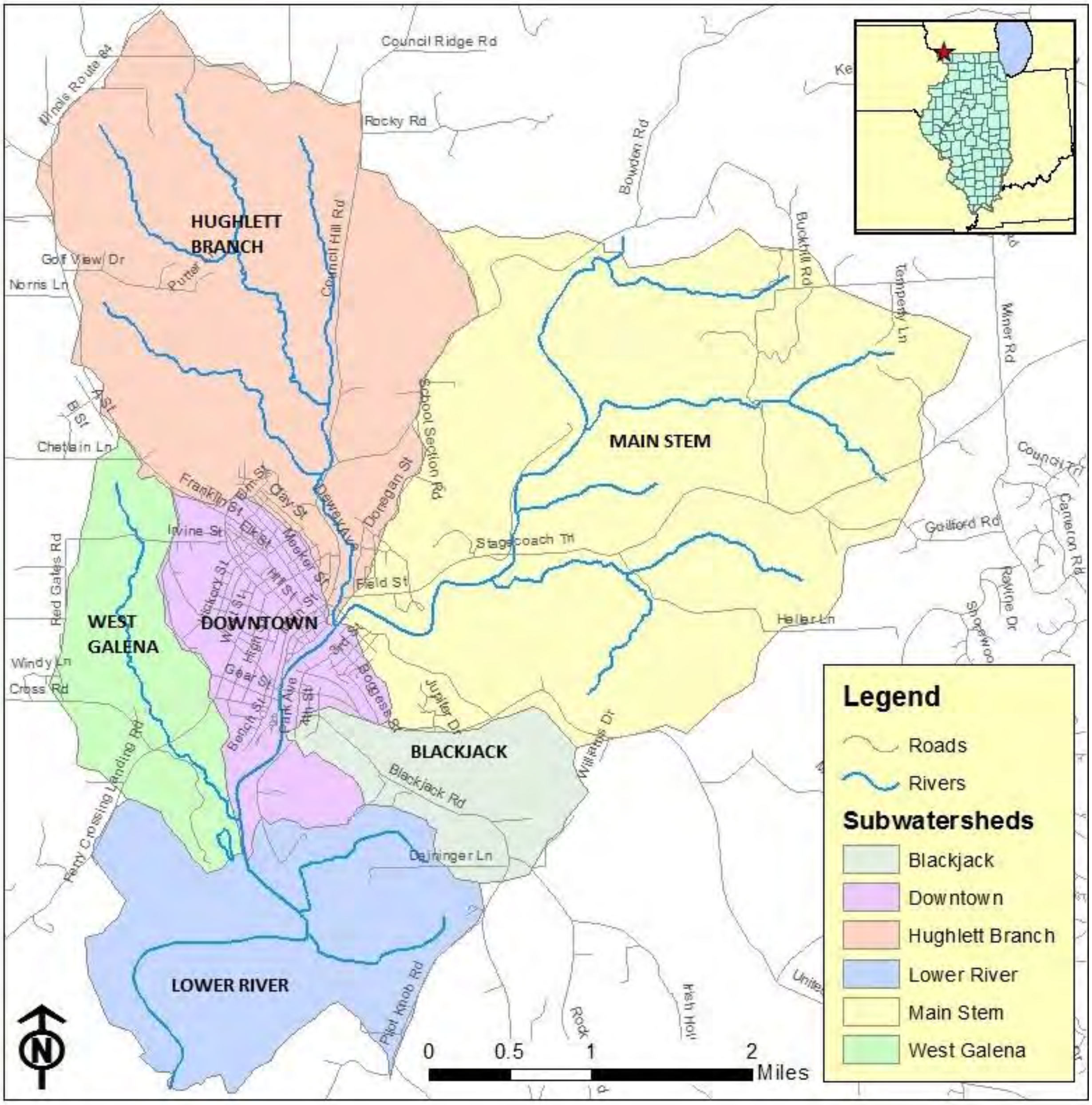

Figure 6-9. Subwatersheds within the Galena River Watershed.

As discussed in Section 5.0, medium and high intensity development can be combined to determine impervious surface amount. Predicting future imperviousness for smaller areas can be difficult. For the entire watershed, Section 5.0 predicted future imperviousness by analyzing change in land use from 2011 data to 2016 data. Using this same methodology to predict imperviousness at the sub-watershed level may not be as accurate due to local zoning regulations and site-specific constrictions. Using this method predicts 2021 impervious surfaces in the Mainstem Subwatershed to raise to 88.8 acres from 25.8 acres. The Hughlett Branch subwatershed raises to 81.2 acres from 60.3 acres. The Blackjack Subwatershed raises to 10.2 acres from 9.5 acres. The Downtown Subwatershed is predicted to raise to 176.6 acres from 139.0 acres. This increase is unlikely due to spatial constraints and City of Galena stormwater policies (Section 3.0). The West Galena Subwatershed is predicted to raise from 23.1 acres to 53.6 acres. This may be feasible because this is an area of heavy development in the watershed, but is a large increase that may be more affected by economics than regulation. Finally, the Lower River subwatershed is predicted to raise from 0.9 acres to 2.0 acres.

Table 6-4. Subwatersheds of the Galena River Watershed, area in acres, and percentage by area.

Label	Abbreviation	Acres	Percentage
Hughlett Branch	GRHB	3,709.1	26.8%
Main Stem	GRMS	5,394.8	38.9%
Downtown	GRDT	1,100.0	7.9%
West Galena	GRWG	1,052.8	7.6%
Blackjack Rd.	GRBJ	733.5	5.3%
Lower River	GRLR	1,868.0	13.5%
	Total	13,858.2	100.0%

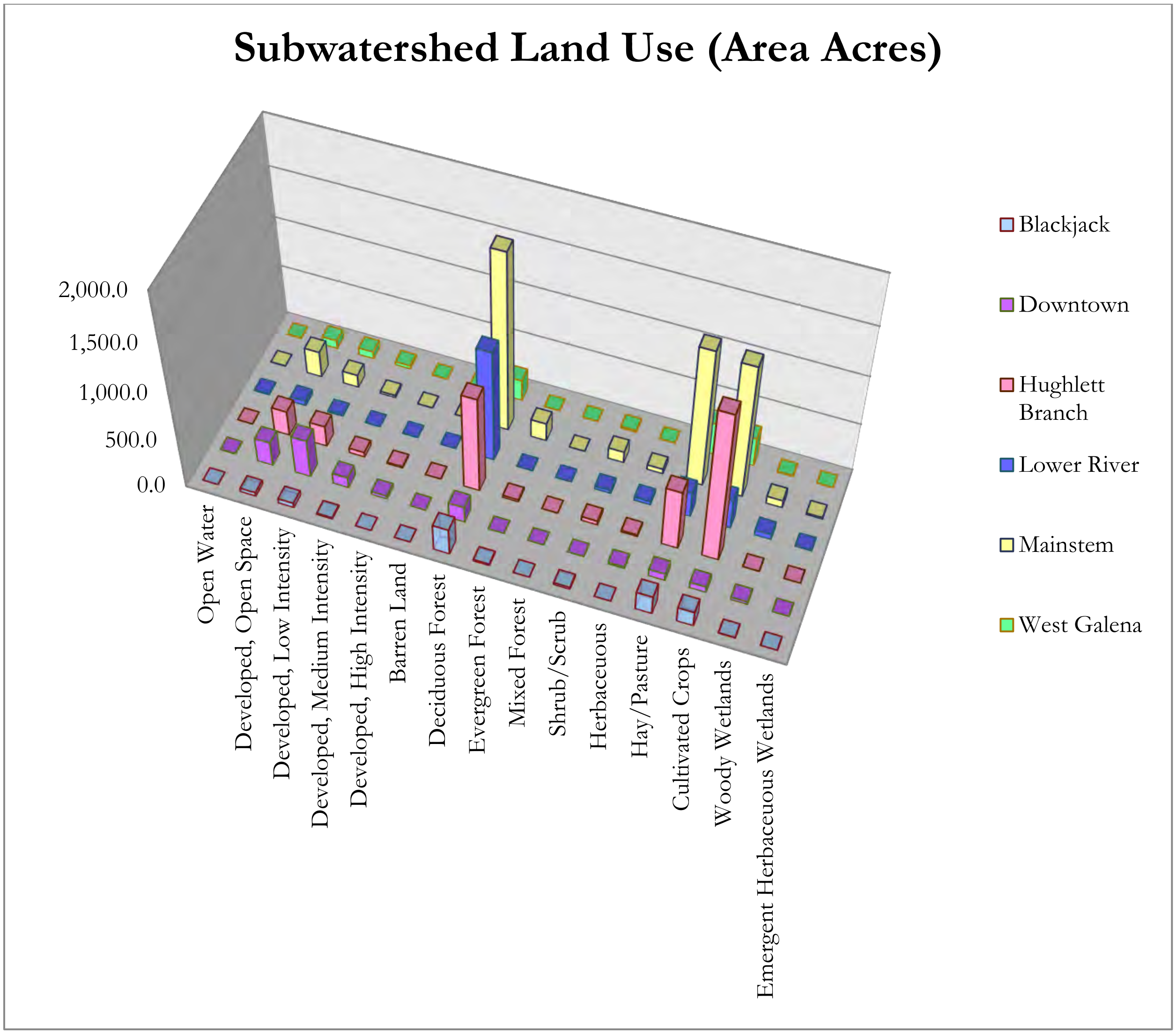

Figure 6-10. Graphic display of 2016 subwatershed land use by area (acres).

Table 6-5. Subwatershed land use by area (acres).

Land Cover (acres)	Lower River	West Galena	Blackjack	Downtown	Hughlett Branch	Mainstem
Open Water	8.7	2.9	0.0	4.5	0.9	2.9
Developed, Open Space	47.5	81.8	36.1	245.4	251.9	262.9
Developed, Low Intensity	8.3	71.0	45.5	387.3	210.0	126.0
Developed, Medium Intensity	0.7	32.1	11.9	107.1	46.4	20.4
Developed, High Intensity	0.0	0.0	0.0	30.5	12.1	0.9
Barren Land	0.0	4.3	0.0	0.0	0.0	1.1
Deciduous Forest	1,136.6	211.4	269.0	159.4	977.2	1,813.9
Evergreen Forest	1.3	0.0	13.4	0.0	19.3	181.3
Mixed Forest	1.8	0.0	0.0	0.0	0.0	0.0
Shrub/Scrub	29.1	17.3	19.5	0.9	39.4	112.3
Herbaceuous	34.3	0.0	0.0	17.0	15.2	46.2
Hay/Pasture	255.3	329.5	188.5	70.8	614.1	1,405.7
Cultivated Crops	301.2	290.9	152.0	59.2	1,540.7	1,363.8
Woody Wetlands	51.8	6.1	3.1	25.6	0.0	74.2
Emergent Herbaceuous Wetlands	4.7	0.0	0.0	0.0	0.0	14.1
Total	1,881.3	1,047.1	739.0	1,107.6	3,727.3	5,425.7

Table 6-6. Subwatershed land use by percentage of entire Galena River Watershed.

Land Cover (%)	Lower River	West Galena	Blackjack	Downtown	Hughlett Branch	Mainstem
Open Water	0.5%	0.3%	0.0%	0.4%	0.0%	0.1%
Developed, Open Space	2.5%	7.8%	4.9%	22.2%	6.8%	4.8%
Developed, Low Intensity	0.4%	6.8%	6.2%	35.0%	5.6%	2.3%
Developed, Medium Intensity	0.0%	3.1%	1.6%	9.7%	1.2%	0.4%
Developed, High Intensity	0.0%	0.0%	0.0%	2.8%	0.3%	0.0%
Barren Land	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%
Deciduous Forest	60.4%	20.2%	36.4%	14.4%	26.2%	33.4%
Evergreen Forest	0.1%	0.0%	1.8%	0.0%	0.5%	3.3%
Mixed Forest	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Shrub/Scrub	1.5%	1.6%	2.6%	0.1%	1.1%	2.1%
Herbaceuous	1.8%	0.0%	0.0%	1.5%	0.4%	0.9%
Hay/Pasture	13.6%	31.5%	25.5%	6.4%	16.5%	25.9%
Cultivated Crops	16.0%	27.8%	20.6%	5.3%	41.3%	25.1%
Woody Wetlands	2.8%	0.6%	0.4%	2.3%	0.0%	1.4%
Emergent Herbaceuous Wetlands	0.3%	0.0%	0.0%	0.0%	0.0%	0.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

7.0 DEMOGRAPHICS

Watershed boundaries do not conform to political and social boundaries. Because of this, relating demographic data specific to the watershed is challenging. Demographic information can be loosely interpreted from data retrieved by the U.S. Census Bureau (U.S. Department of Commerce, 2010), available for Jo Daviess County, as U.S. Census Bureau census blocks, and for the City of Galena. The population in Jo Daviess County has remained fairly constant since 1900. Similarly, the population for the City of Galena has not had a significant change from 2000 to 2010. County estimates show an increase of approximately 2%, while City of Galena shows a population decline of approximately 3.8% for the same period.

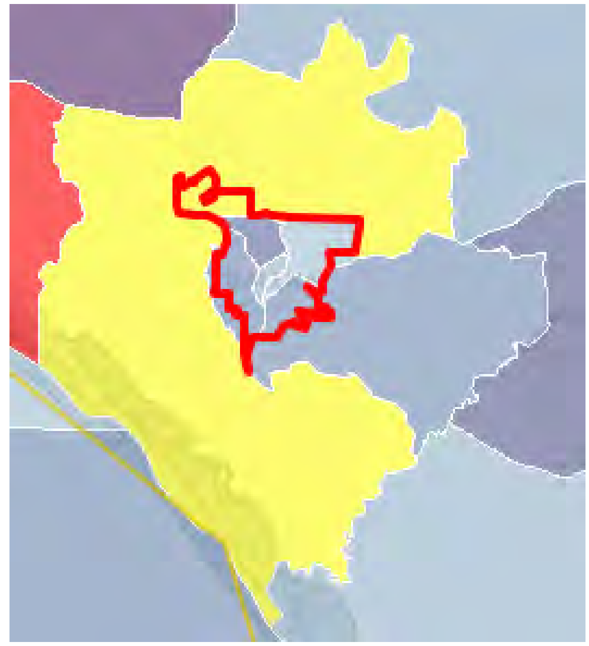

Figure 7-11. Census Blocks showing the city limits of Galena outlined in red.

Census block data includes the City of Galena and portions of the watershed, though area and boundaries are not the same. Because of the size and shape of this information, population data taken from census blocks may be the closest estimate to watershed population because the population center, the City of Galena, is contained within the various blocks, and areas outside of the city are sparsely populated. The combined populations for census blocks intersecting the watershed are 4,695 people. This compares with the City of Galena's 2010 population of 3,429, insinuating that the City of Galena may account for approximately 73% of the watershed's population. It is also observed from aerial photography that the City of Galena is experiencing some urban sprawl through the development of subdivisions just outside of the city limits which accounts for approximately half of the remaining estimated population, and would be included in the watershed. Because the City of Galena encompasses such a high percentage of the population for the area, the detailed data for the city is considered representative of the entire watershed and is primarily used to describe many factors in the watershed population.

The City of Galena is primarily Caucasian, or of white European decent (93.6%). The Latino population has been on a steady increase, consisting of 4.9% of the population in 2000 and rising to 8.3% by 2010. Some of these people are of mixed Hispanic backgrounds, which accounts for the discrepancy between the number of Caucasian people in the City and number of people listing a Hispanic background. The City's population is relatively balanced with 52% being female and 48% being male.

In 2010, persons aged 65 and over accounted for 24.1% of the total population, a 6.2% increase from 2000 to 2010. The group of persons of four years of age and younger stayed relatively stable at just under 5% of the total population, while persons aged 5 – 17 dropped between 2000 and 2010, from 14.1% to 12.8% of the total population. The estimated average household size was 2.0 in 2010. Population statistics for the City of Galena are shown in Table 7-7.

Financially, the largest percentage of families (25%) and households (21%) make between \$50,000 and \$74,999 per year. The Federal poverty guideline for a household of two persons is approximately \$16,000, and for a family \$22,050. Approximately 6% of households and 10% of families in the City of Galena are in this range. Financial data for the City of Galena is shown in Table 7-8.

The percentage of Hispanic residents as well as the percentage of families and households below the poverty threshold create special considerations in the watershed planning effort to ensure that all individuals are reached appropriately and that individuals are not inadvertently excluded or discriminated against in planning.

Table 7-7. Demographic data for the City of Galena.

Population	**2010**		**2000**		**2000-2010 change**	
	Number	Percentage	Number	Percentage	Number	Percentage
Population	3,429	100.00%	3,565	100.00%	-136	-3.81%
Population by Race	**2010**		**2000**		**2000-2010 change**	
	Number	Percentage	Number	Percentage	Number	Percentage
American Indian and Native Alaskan	23	0.67%	3	0.08%	20	666.67%
Asian	20	0.58%	11	0.31%	9	81.82%
Black or African American	16	0.47%	11	0.31%	5	45.45%
Some other race	127	3.70%	40	1.12%	87	217.50%
Two or more races	34	0.99%	20	0.56%	14	70.00%
White	3,209	93.58%	3,480	97.62%	-271	-7.79%
Population by Hispanic or Latino Origin (of any race)						
	2010		**2000**		**2000-2010 change**	
	Number	Percentage	Number	Percentage	Number	Percentage
Persons not of Hispanic or Latino Origin	3,145	91.72%	3,390	95.09%	-245	-7.23%
Persons of Hispanic or Latino Origin	284	8.28%	175	4.91%	109	62.29%
Population by Gender	**2010**		**2000**		**2000-2010 change**	
	Number	Percentage	Number	Percentage	Number	Percentage
Female	1,771	51.65%	1,825	51.19%	-54	-2.96%
Male	1,658	48.35%	1,740	48.81%	-82	-4.71%
Population by Age	**2010**		**2000**		**2000-2010 change**	
	Number	Percentage	Number	Percentage	Number	Percentage
Persons 0 - 4 years	168	4.90%	168	4.71%	0	0.00%
Persons 5 - 17 years	440	12.83%	504	14.14%	-64	-12.70%
Persons 18 - 64 years	1,995	58.18%	2,115	59.33%	-120	-5.67%
Persons 65 years and over	826	24.09%	778	21.82%	48	6.17%

Table 7-8. Financial statistics for the City of Galena.

2010 Financial Data by Family		2010 Financial Data by Household	
$10,000 - $14,999 Families	1% - 2%	$10,000 - $14,999 Households	5% - 6%
$15,000 - $24,999 Families	8% - 9%	$15,000 - $24,999 Households	11% - 12%
$25,000 - $34,999 Families	10% - 11%	$25,000 - $34,999 Households	13% - 14%
$35,000 - $49,999 Families	15% - 16%	$35,000 - $49,999 Households	16% - 17%
$50,000 - $74,999 Families	25% - 26%	$50,000 - $74,999 Households	21% - 22%
$75,000 - $99,999 Families	17% - 18%	$75,000 - $99,999 Households	13% - 14%
$100,000 - $149,999 Families	13% - 14%	$100,000 - $149,999 Households	9% - 10%
$150,000 - $199,999 Families	3% - 4%	$150,000 - $199,999 Households	2% - 3%
$200,000 + Families	2% - 3%	$200,000 + Households	1% - 2%

The U.S. Census Bureau reports 89.4% of Galena residents are high school graduates. This is above the U.S. average of 86.3%. However, the City average of those persons aged 25 or older who have completed a bachelor's degree or higher is 26.7%, below the U.S. average of 29.3%.

Employment statistics in Jo Daviess County are shown in Table 7-9. Management and professional occupations lead in Jo Daviess County with 27.8% of jobs falling into this category. Sales and office occupations are 21.1%, and production, transportation, and material moving are 19.5%. The service industry is also a strong component of employment in the county, accounting for 17.9% of the jobs. Construction and maintenance account for 11.4% of jobs. Farming jobs account for 2.3% of the county's reported occupations when classified by occupation. This number is slightly higher when classified by industry at 6.9%, possibly due to an anomaly in the data collection and classification methods. Unemployment averages 4.5%, slightly lower than the Illinois average of 5.1%.

Development statistics for Jo Daviess County are shown in Table 7-10. Development in the county gradually rose and peaked around 2005, and has been trailing off since. It has been relatively stable with the 2005 peak similar to much of the United States and correlating loosely to the housing boom which preceding the 2008 financial crisis. City of Galena data shows the average sale price of a home to be approximately $135,000 with an average annual property tax of $2,932 for homes with a mortgage and $1,605 for homes without a mortgage. Construction costs for new homes in the City of Galena averaged $143,093.8 from 1997 to 2013. For this period, the development rate for the City of Galena is behind the Illinois average.

Table 7-9. Employment statistics for Jo Daviess County (U.S. Census Bureau Website, 2016).

OCCUPATION	Number	%
Management, professional, and related occupations	3,200	27.8
Sales and office occupations	2,436	21.1
Production, transportation, and material moving occupations	2,253	19.5
Service occupations	2,060	17.9
Construction, extraction, and maintenance occupations	1,317	11.4
Farming, fishing, and forestry occupations	262	2.3
Total	11,528	100
INDUSTRY		
Manufacturing	2,023	17.5
Educational, health and social services	1,994	17.3
Arts, entertainment, recreation, accommodation and food services	1,383	12.0
Retail trade	1,264	11.0
Construction	990	8.6
Agriculture, forestry, fishing and hunting, and mining	798	6.9
Professional, scientific, management, administrative, and waste management services	700	6.1
Finance, insurance, real estate, and rental and leasing	584	5.1
Transportation and warehousing, and utilities	537	4.7
Other services (except public administration)	537	4.7
Wholesale trade	280	2.4
Public administration	280	2.4
Information	158	1.4
Total	11,528	100.1

Table 7-10. Development statistics for Jo Daviess County from 1995 – 2014.

Year	New Homes	Mobile Homes	Accessory Buildings	Additions	Decks	Towers	Commercial	Total Value
1995	187	12	47	21	2	1	7	$29,496,322
1996	145	5	46	24	1	0	0	$22,001,055
1997	148	2	33	17	1	0	0	$26,508,801
1998	131	9	28	36	1	2	2	$22,525,951
1999	137	2	42	30	1	0	0	$20,276,768
2000	130	3	48	38	1	1	0	$27,068,805
2001	135	5	88	40	9	4	4	$28,149,735
2002	182	4	69	45	6	0	1	$32,826,025
2003	178	1	81	32	11	0	3	$36,634,355
2004	172	3	78	39	5	0	4	$47,563,900
2005	184	6	80	40	3	5	0	$57,158,300
2006	125	4	84	46	6	2	3	$36,687,543
2007	115	1	68	52	12	13	5	$36,037,489
2008	62	0	74	51	7	3	10	$23,150,854
2009	37	0	60	35	15	12	12	$18,050,528
2010	33	0	52	26	14	10	0	$12,305,627
2011	31	0	47	22	18	6	0	$18,142,819
2012	43	1	67	44	17	16	0	$17,469,360
2013	37	0	84	52	13	14	22	$16,128,444
2014	27	0	72	58	15	3	38	$14,723,028

Figure 7-12. Development in Jo Daviess County by value of construction.

8.0 TILLAGE PRACTICES

Corn and soybeans are the primary crops in the watershed. In many operations, these crops are rotated from year to year, with soybeans providing a nitrogen source for future corn crops. Due to the high slope of the watershed these crops experience a much greater increase in erosion than in many parts of the US which grow these crops. The producers in the watershed have been proactive over the years at adopting best management practices (BMPs, *see Section 11*). Due to changes in weather patterns and increased intensity of rainfall events many of these BMPs may no longer be effective and/or may not meet current design standards.

A tillage transect survey is conducted every two years by the Illinois Department of Agriculture to assess the cropland practices in the watershed. A tillage transect survey is a roadside survey method designed to gather information on various agricultural practices, primarily tillage and crop residue management systems. The transect lines only intersect two points in the Galena River Watershed, requiring the need for additional data to determine tillage practices in the watershed. Out of the more than 450 data points used for the Jo Daviess County transect survey, less than 1% of the data points are within the Galena River Watershed. County-wide data shows that 23% of fields experience ephemeral erosion. Approximately 53% of fields are in a no-till system of field management, with another 42% being managed in mulch-till or reduced tillage. Conventional tillage accounts for 4% of total fields by number in the report. While tillage is reduced or non-existent in 96% of the fields from the 2015 survey report, even a complete no-till system may still experience high erosion rates on steep slopes, characteristic of both Jo Daviess County and especially the Galena River Watershed.

No-till farming (also called zero tillage or direct drilling) is a way of growing crops or pasture from year to year without disturbing the soil through tillage. Mulch tillage is a seeding method where a hundred percent of the soil surface is disturbed by tillage; crop residues are mixed with the soil and some residues remain on the soil surface. Reduced tillage is a cropping practice which involves fewer cultivations than used in conventional tillage. Conventional tillage is where stubble is burnt, harvested, or grazed, and weeds are controlled by cultivation.

Table 8-11. 2015 Soil Transect Survey data for Jo Daviess County taken from the IDOA (2015) report.

Total Transects	Avg. Soil Loss (ton/ac)	Avg. Soil Loss if all fields Conventionally Tilled (ton/ac)	No Till			Mulch Till			Reduced Till			Conventional Tillage		
			No.	%	Avg. Soil Loss (ton/ac)	No.	%	Avg. Soil Loss (ton/ac)	No.	%	Avg. Soil Loss (ton/ac)	No.	%	Avg. Soil Loss (ton/ac)
306	2.7	9.5	145	47.4%	1.6	138	45.1%	3.2	9	2.9%	3.9	14	4.6%	9.8
65	1.5	9.2	49	75.4%	1.4	15	23.1%	1.7	0	0.0%	NA	1	1.5%	4.6
8	1.0	2.7	7	87.5%	0.5	0	0.0%	NA	0	0.0%	NA	1	12.5%	4.1
58	0.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	0.5	19.8	1	50%	1.0	0	0%	NA	0	0%	NA	0	0%	NA
22	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
464			202	53%		153	40%		9	2%		16	4%	

9.0 ANIMAL OPERATIONS

Information on commercial animal operations is available from the National Agricultural Statistics Service. Detailed livestock data for the 12-digit hydrologic unit code is not available. Data for Jo Daviess County is presented in Table 9-12. Remote sensing using 2015 aerial imagery estimates approximately 19 livestock operations in the watershed. These are primarily cattle operations with summer feeding on pasture and supplemental winter feeding.

Table 9-12. Commercial animal operations in Jo Daviess County, number of animals. (USDA-NASS, 2014)

Livestock Type	2002	2007	2012	2015
Cattle and Calves	57,276	57,254	53,057	54,000
Hogs and Pigs	18,983	18,860	14,146	No Data
Poultry	510	1,273	802	No Data
Sheep and Lambs	1,998	796	1,312	No Data
Goats	No Data	No Data	447	No Data
Horses and Ponies	838	2,214	926	No Data

10.0 THREATENED AND ENDANGERED SPECIES

The Illinois Natural Heritage Database shows the following protected resources are in the vicinity:

Casper Bluff Illinois Natural Areas Inventory (INAI) Site
Horseshoe Mound Geological Area INAI Site
Keough Effigy Mounds INAI Site
Mississippi River Backwaters - Jo Daviess County INAI Site
Pilot Knob Geological Area INAI Site
Casper Bluff Land and Water Reserve
Keough Effigy Mounds Land and Water Reserve
Indiana Bat (*Myotis sodalis*)
Northern Long-Eared Bat (*Myotis septentrionalis*)
Pallid Shiner (*Hybopsis amnis*)

The Illinois Natural Areas Inventory (INAI) provides a set of information about high quality natural areas, habitats of endangered species, and other significant natural features. Information from the INAI is used to guide and support land acquisition and protection programs by all levels of government as well as by private landowners and conservation organizations. The original Illinois Natural Areas Inventory was carried out in 1975–78, and it has been maintained by the Illinois Department of Natural Resources since then.

Indiana bats are a federally endangered species and are endangered on the IUCN Red List. They are mostly threatened by habitat loss, and their numbers are monitored (FWS, 2007).The Indiana bat is small, weighing approximately 7 grams with a forearm range of 35 to 41 mm. They are dark grey or brown in color and their fur is considered soft. They are distinguished from other, similar, co-occuring members of *M. myotis* by their distinctly keeled calcar, a small cartilage projection from the foot, giving added stability to the wing. Indiana bats hibernate predominantly in limestone caves, though some hibernate under the bark of dead trees. During the summer, Indiana bats roost under the bark of large trees, under bridges, and sometimes in buildings. Trees in which Indiana bats are known to roost include hickories (*Carya sp.*), oaks (*Quercus sp.*), elms (*Ulmus sp.*), pines (*Pinus* sp.), American sycamore (*Platanus occidentalis*), and eastern cottonwood (*Populus deltoides*).

The northern long-eared bat is found in the United States from Maine to North Carolina on the Atlantic Coast, westward to eastern Oklahoma, and north through the Dakotas, even reaching into eastern Montana and Wyoming. In Canada, it is found from the Atlantic Coast westward to the southern Yukon Territory and eastern British Columbia. The bat hibernates in caves and mines, swarming in surrounding wooded areas in autumn. During late spring and summer, the bat roosts and forages in upland forests. The northern long-eared bat is one of the species of bats most impacted by the disease white-nose syndrome. Due to declines caused by white-nose syndrome, as well as continued spread of the disease, the northern long-eared bat received protection as a threatened species under the Endangered Species Act.

The pallid shiner (*Hybopsis amnis*) inhabits large rivers and streams, often at the end of sand and gravel bars. The shiner is found over sand and mud in shallow, slow-moving, moderately clear, warm and well-oxygenated waters in impoundments with little or no current. Distribution in the state includes the Mississippi River and the lower portions of major tributaries. The pallid shiner prefers the quiet to sluggish flows of large lowland rivers and their sloughs and impoundments, over substrates of sand or mud. Spawning occurs from late May through July. The body is slender and fragile, back pale olive yellow, sides silvery, belly silvery white, and fins unpigmented. Length of adult fish is 2 inches (51 mm).

Virtually nothing is known about the phenology of this species except that they most likely spawn in March. Access to the floodplains for spawning may be essential for the reproduction and survival of the pallid shiner. Rivera (2015) identifies pallid shiner individuals in the 2015 Basin Survey Conducted by the Illinois Department of Natural Resources and the Illinois Environmental Protection Agency at the Galena River (MQ-01) site. Rivera writes:

> "The Galena River was sampled at two locations. This station was located within the city limits of Galena using the public boat launch to access the stream. The electrofishing boat was used to sample a stretch of approximately 1/2 mile in length for a total sample time of 90 minutes, both upstream and downstream of the ramp. Despite the turbid water which limited visibility, a good sample was obtained. Thirty species of fish were collected including the state endangered Pallid shiner [*Table 10-13*]. In addition, 8 other native minnow species, 7 native sucker species, Walleye, Smallmouth Bass, Largemouth Bass, and Rock Bass were collected. Three of the species collected were on the list of SGNC [*Species in Greatest Need of Conservation*]. The habitat in this area was degraded so the large diversity was surprising. The Galena River from the city of Galena to the Mississippi River has been channelized, with bank erosion common and muddy bottom substrates. Habitat is provided by downed trees, brush piles and aquatic vegetation. However, just upstream of the city the gradient is steeper and the stream bottom is sandy with better habitat for fishes. The area upstream has not been channelized and is more of a natural pool/riffle/run which probably attracts the fish and likely results in the increased diversity seen downstream."

Table 10-13. Results from 2015 Basin survey in Galena River (MQ-01).

Water body	GALENA RIVER (MQ-01)
Date	07/07/2015
Station code	MQ-01
Species	28
Total fish	422
Electrode minutes	90
White sucker	29
Emerald shiner	171
Central stoneroller	3
Smallmouth bass	10
Bluntnose minnow	32
Spotfin shiner	45
Mimic shiner	9
Johnny darter	18
Bluegill	10
River shiner	10
Golden redhorse	3
Largemouth bass	22
Shorthead redhorse	1
Green sunfish	16
Pallid shiner *E*	9
Spotted sucker	13
Channel catfish	1
Yellow perch	1
Rock bass	6
Walleye	3
Black crappie	1
Sand shiner	1
Pumpkinseed	1
Bullhead minnow	2
Brook silverside	2
Quillback	1
River carpsucker	1
Highfin carpsucker	1

E- Denotes endangered status.

11.0 EXISTING BEST MANAGEMENT PRACTICES

Best Management Practices are *non-structural* practices, such as site planning and design aimed to reduce stormwater runoff, and avoid adverse development impacts, or *structural* practices that are designed to store or treat stormwater runoff to mitigate flood damage and reduce pollution. Some BMPs used in urban areas may include stormwater detention ponds, restored wetlands, vegetative filter strips, porous pavement, silt fences and biotechnical streambank stabilization. The watershed was surveyed using high-resolution aerial imagery, flown in 2015, and existing best management practices (BMP) were identified in the landscape. These practices include terracing in fields, grassed waterways, retention ponds and basins, dry-dams, rain gardens, and stream stabilization practices. Figure 11-13 identifies points where existing BMPs were identified in the watershed. Table 11-14 provides corresponding identification for the points labeled in figure 11-13. A majority of these BMPs were installed in the 1990s and early 2000s when the Illinois Department of Agriculture's C-2000 program was heavily funded. These BMPs were designed with a 10-year lifespan and are now beyond the design lifespan and may be in need of maintenance. Additional BMPs were identified at a smaller scale within the City of Galena. These BMPs are depicted graphically in figure 11-14, with descriptions identified in Table 11-15.

Figure 11-13. Map of the subwatersheds with identified BMPs numbered to correspond to Table 11-14.

Table 11-14. Subwatersheds with associated best management practices identified.

Subwatershed	ID	Practice
Lower River	1	Pond
Lower River	2	Grassed Waterways
Lower River	3	Grassed Waterways
Lower River	4	Ponds
West Galena	5	Grassed Waterways
West Galena	6	Grassed Waterways
West Galena	7	Grassed Waterways
West Galena	8	Grassed Waterways
West Galena	9	Grassed Waterways
Black Jack	10	Pond
Hughlett Branch	11	Grassed Waterways
Hughlett Branch	12	Grassed Waterways
Hughlett Branch	13	Grassed Waterways
Hughlett Branch	14	Grassed Waterways
Hughlett Branch	15	Grassed Waterways
Hughlett Branch	16	Grassed Waterways
Hughlett Branch	17	Grassed Waterways
Hughlett Branch	18	Grassed Waterways
Hughlett Branch	19	Contour Farming
Hughlett Branch	20	Grassed Waterways
Hughlett Branch	21	Contour Farming
Main Stem	22	Grassed Waterways
Main Stem	23	Grassed Waterways
Main Stem	24	Grassed Waterways
Main Stem	25	Contour Farming
Main Stem	26	Grassed Waterways
Main Stem	27	Pond
Main Stem	28	Pond
Main Stem	29	Contour Farming
Main Stem	30	Grassed Waterways
Main Stem	31	Contour Farming
Main Stem	32	Pond
Main Stem	33	Grassed Waterways
Main Stem	34	Grassed Waterways

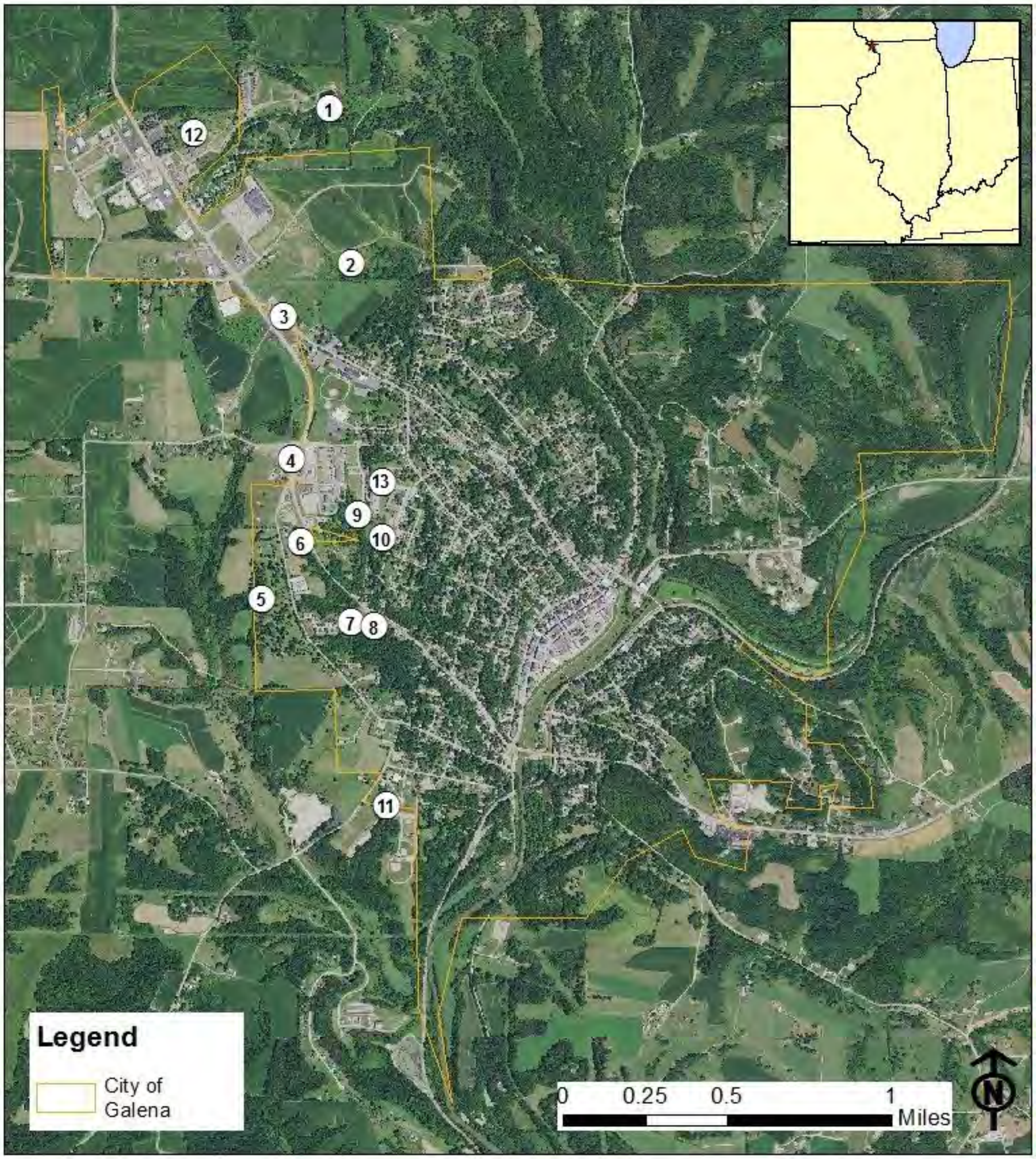

Figure 11-14. BMPs in the City of Galena.

Table 11-15. Table of descriptions referencing figure 11-14.

Reference Number	Description
1	Retention Basin
2	Retention Basin
3	Water catchment under parking lot
4	Water catchment under parking lot
5	Retention Basin (breached)
6	Retention Basin
7	Retention Basin
8	Retention Basin
9	Retention Basin
10	Retention Basin
11	Retention Basin/Wetland
12	Retention Basin
13	Retention Basin

12.0 WATERSHED DRAINAGE SYSTEM

The streams in the watershed flow generally in a north to south direction. Incoming waters from the larger HUC10 watershed enter the Galena River Watershed at the north end in the Main Stem subwatershed and continue in a southerly direction to where the Lower Galena subwatershed meets the Mississippi River backwaters. The Hughlett Branch and West Galena subwatersheds flow in a southeast direction towards their confluence with the Galena River, and the Blackjack subwatershed flows in a westerly direction towards its confluence with the Galena River.

There is one gauge on the Galena River located off Beebe Rd. in Buncombe, Wisconsin (05415000). This stream gage was operated by the United States Geological Survey from 1939 – 1992. The gage is currently active and maintained by the National Weather Service in conjunction with the U.S. Army Corps of Engineers hydrology section. This gage is outside of the target area for this resource inventory. The Buncombe gage measures a drainage area of 125 $mi.^2$ (61.6% of the study area in this report). Although it may roughly capture hydrograph changes in the basin which could be extrapolated to the larger size, the overall changes in watershed topography from headwaters to lowland floodplains is not accurately captured.

For this inventory, active stream flow for the Galena watershed was estimated using comparison data from the USGS Apple River Gage (05419000), located at Hanover, IL, which records real-time data from the Apple River watershed (*see Figure 12-16*). The discharge data is available from 1967 – present. Average monthly flows in the Apple range from 129.2 cubic feet per second (cfs) in September to 343.8 cfs in March. The gage drains 246.3 square miles. This data was used to estimate flow values for the Galena River at the lowest-most point in the watershed using the drainage area ratio method:

$$\mathbf{Q_{gaged}\left(\frac{Area_{ungaged}}{Area_{gaged}}\right) = Q_{un-gaged}}$$

Where Q_{gaged} = Streamflow of the gaged basin
$Q_{un\text{-}gaged}$ = Streamflow of the ungaged basin
$Area_{gaged}$ = Area of the gaged basin
$Area_{ungaged}$ = Area of the un-gaged basin

This assumes that the flow per unit area is equivalent in watersheds with similar characteristics, and the flow per unit area in the gaged watershed multiplied by the area of the un-gaged watershed estimates the flow for the un-gaged watershed. This calculation estimates an average flow of 179.9 cubic feet per second (cfs) where the Galena River flows into the Mississippi River. This model is appropriate for this watershed because the parameters between watersheds are very similar. Table 12-16 compares parameters for each watershed generated by the USGS (2016, November 22). Although these drainages are for the larger watersheds (HUC10), this is necessary for this analysis because the Galena River Watershed (HUC12) receives water from the entire HUC10 area. Therefore, this comparison accurately reflects the conditions and volume of water which would likely be documented through the area of interest. Using this data, a flow duration curve estimate was developed for the Galena River Watershed (Figures *12-17 & 12-18*).

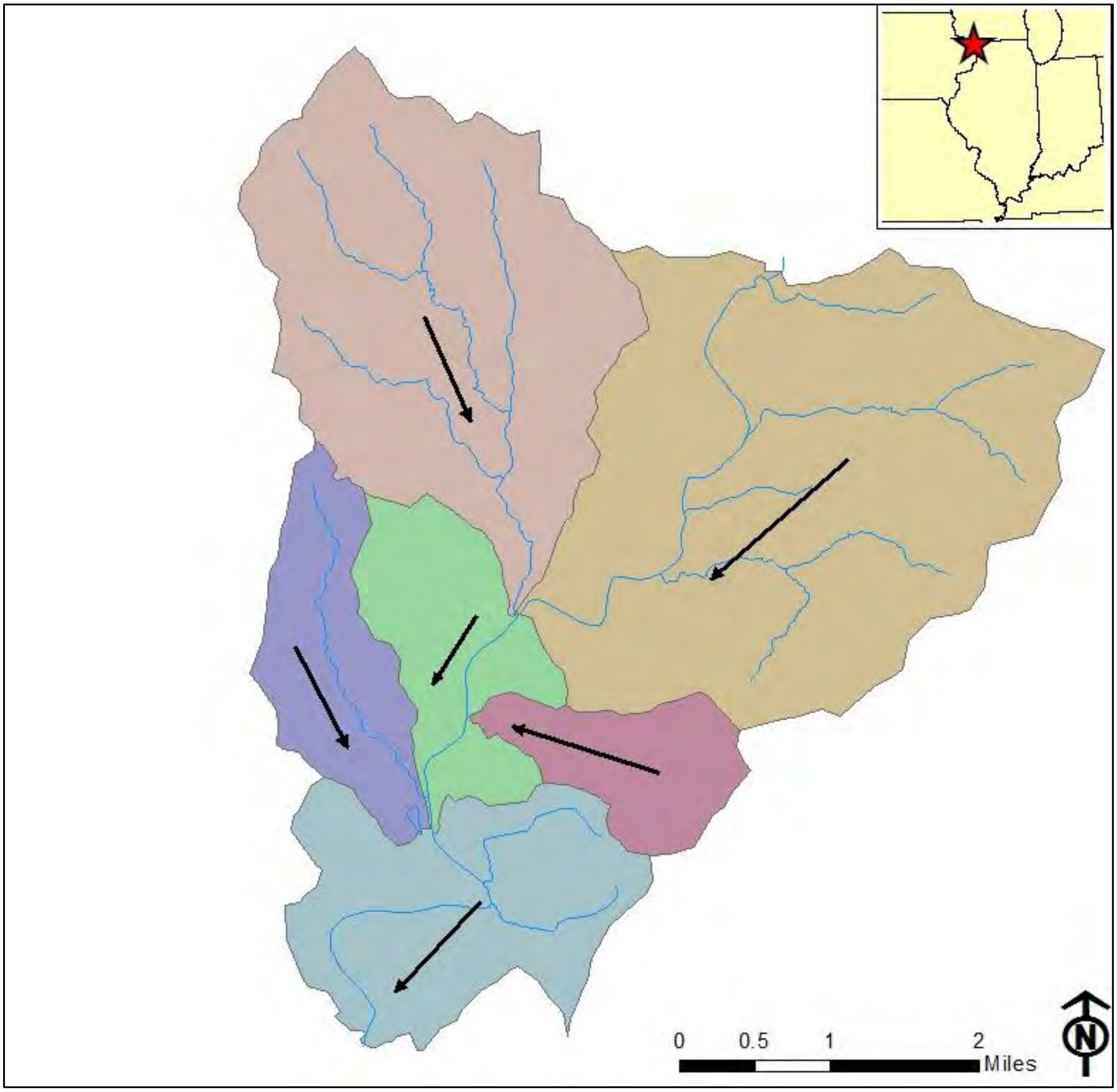

Figure 12-15. The direction of stream flow through the Galena River Watershed.

Table 12-16. Comparison between Apple River and Galena River stream data.

Parameters	Apple River	Galena River	Unit
Drainage Area	246.33	203.17	square miles
Soil Permeability	1.294	1.321	inches per hour
Channel Slope	10.483	7.742	feet per mi
Surface Water	0.339	0.155	percent
Impervious Surfaces	0.94	1.25	percent
Watershed Development	5.79	6.54	percent
Channel Length	24.65	30.24	miles
Maximum Elevation	1,250	1,250	feet
Watershed Relief	656	655	feet
2 Year Peak Flood	4,877	3,721	ft^3/sec.
5 Year Peak Flood	8,406	6,352	ft^3/sec.
10 Year Peak Flood	10,994	8,262	ft^3/sec.
25 Year Peak Flood	14,467	10,807	ft^3/sec.
50 Year Peak Flood	17,162	12,773	ft^3/sec.
100 Year Peak Flood	19,894	14,756	ft^3/sec.
500 Year Peak Flood	26,658	19,634	ft^3/sec.

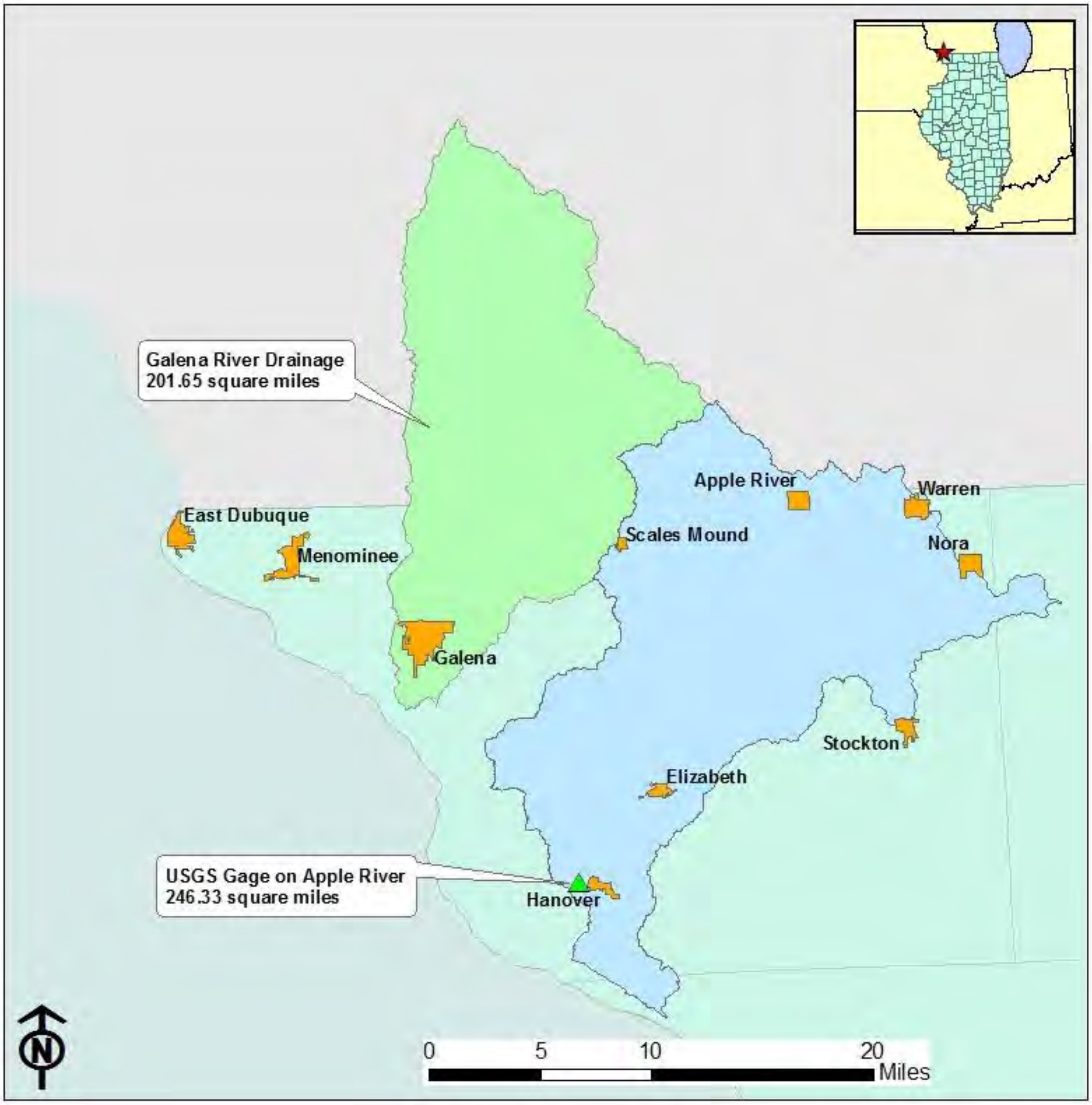

Figure 12-16. Geographic size and location comparison of drainage areas feeding USGS gage sites.

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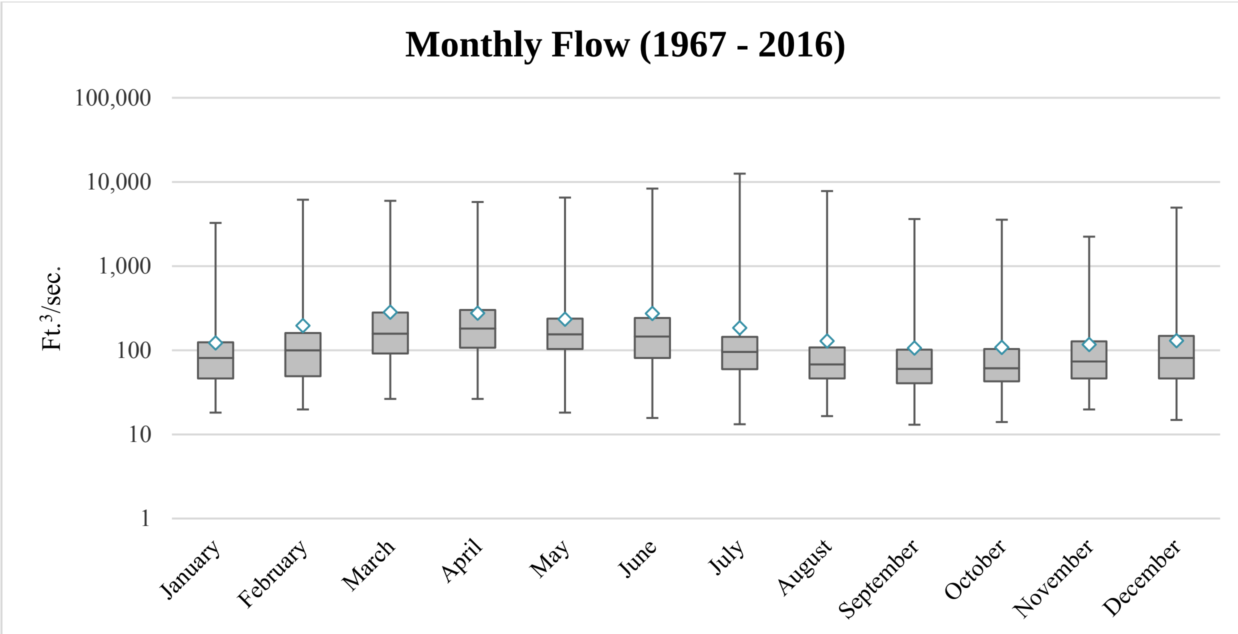

Figure 12-17. Estimated discharge calculations for the Galena River Watershed (HUC10 0706000503) based on USGS flow data for the Apple River (Gage 05419000, HUC10 0706000506) from 1967-2016. Whiskers show the range of flows on record while boxes indicate 25%, median, and 75% flow values. Diamonds indicate mean flow.

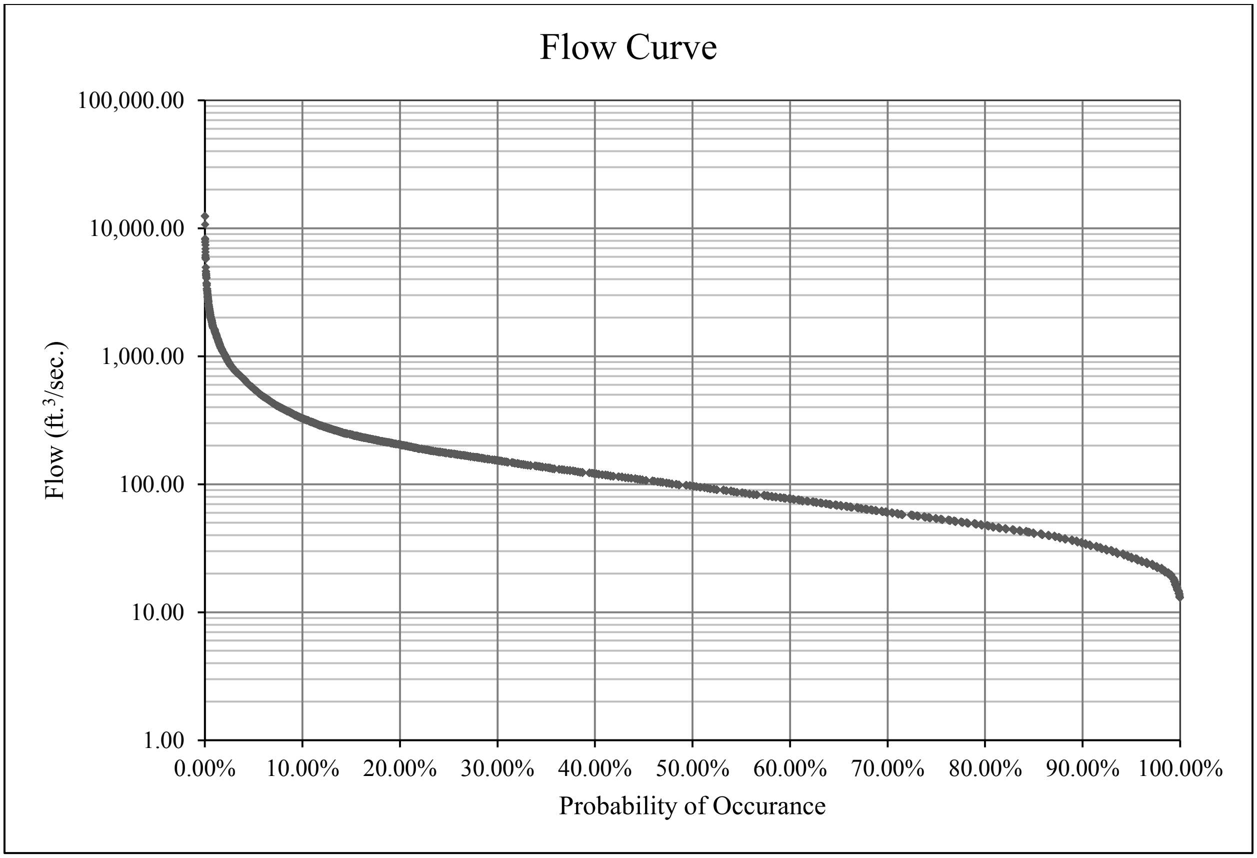

Figure 12-18. Flow curve developed for the Galena River Watershed shows the estimated probability of occurrence of a given flow.

13.0 FLOODZONE

Flood zones are geographic areas that the Federal Emergency Management Agency (FEMA) has defined according to varying levels of flood risk. These zones are depicted on a community's Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map. Adams (1940) identifies the width of the channel at Galena as 70 ft. wide, while even more historic accounts (circa 1880) tell of a channel as much as 400 ft. wide, allowing historic steamboat traffic. The siltation of the river has reduced the flooding capacity by over an estimated 80%.

A 100-year flood is a flood event that has a 1% probability of occurring in any given year. The 100-year flood is also referred to as the 1% flood, since its annual exceedance probability is 1%. Based on the expected 100-year flood flow rate, the flood water level can be mapped as an area of inundation. The resulting floodplain map is referred to as the 100-year floodplain. FEMA floodplain designations are limited to larger watersheds, although bottomland areas of smaller creeks are still subject to flooding, so local knowledge and common sense apply. The 100-year floodplain is shown in figure 13-19 for the Galena River Watershed.

A total of 512.4 acres are designated as floodplain in the Galena River Watershed. This equates to approximately 3.7% of the watershed. This area is primarily located in bottomlands along the Galena River. The deep channelization of the tributaries feeding the Galena River from the subwatersheds make frequent flooding unlikely, though these areas are also small enough that FEMA designations are unlikely.

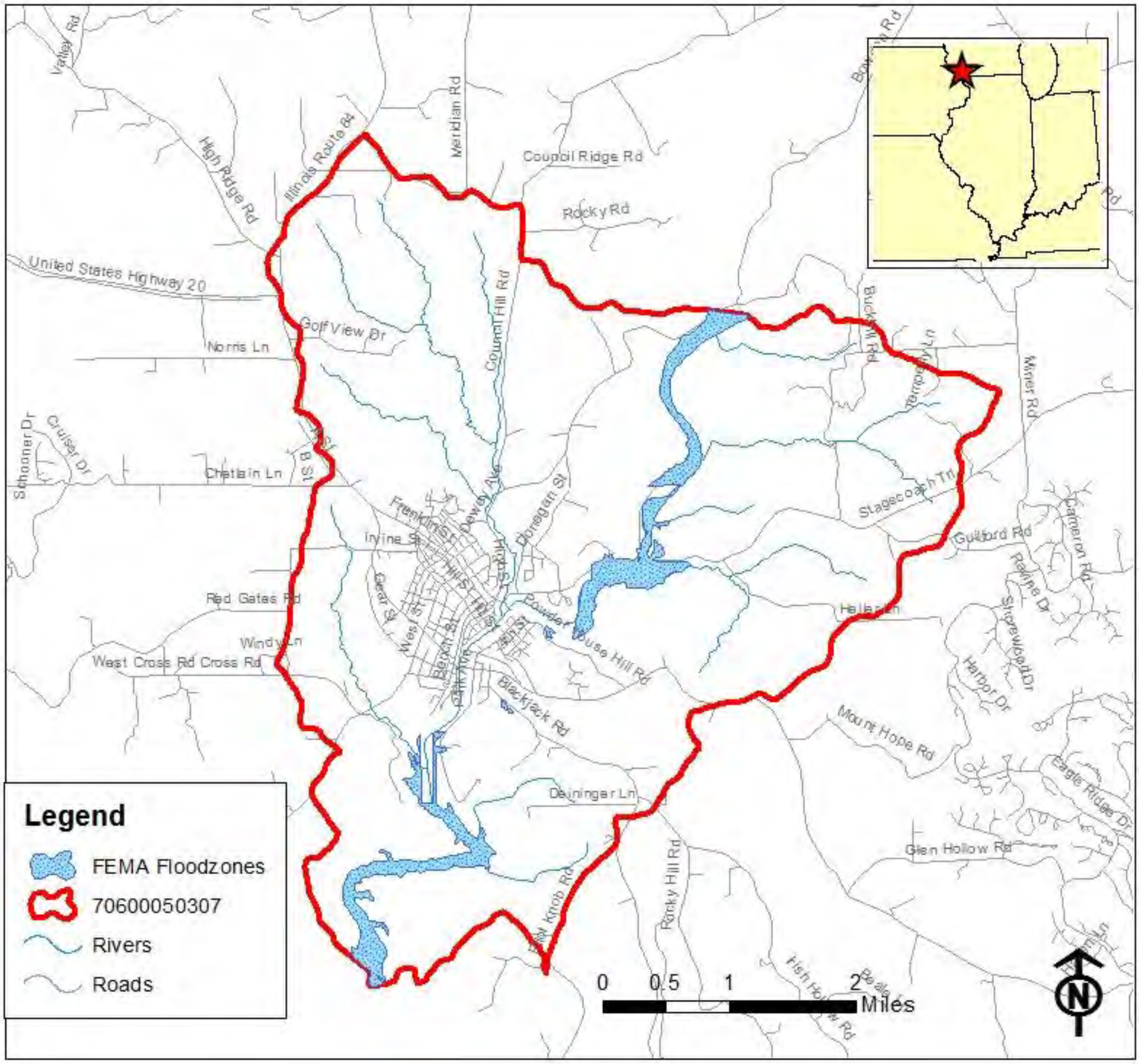

Figure 13-19. FEMA 100-year flood map for the Galena River Watershed.

14.0 AQUIFER SENSITIVITY

Much of Jo Daviess County, Illinois, has a very high aquifer sensitivity because fractured dolomite bedrock aquifers lie beneath thin glacial drift or loess. Areas where dolomite bedrock is exposed are most sensitive. In addition, a high potential for contamination exists where thick coarse-grained unconsolidated sediments occur. In contrast, areas underlain by shale bedrock have a low sensitivity to aquifer contamination. A more moderate sensitivity to aquifer contamination exists in areas where fine- grained unconsolidated deposits overlie dolomite bedrock (such as till- covered landscapes in the east- central portion of the county) or where thin coarse- grained unconsolidated deposits overlie shale (McGarry & Riggs, 2000).

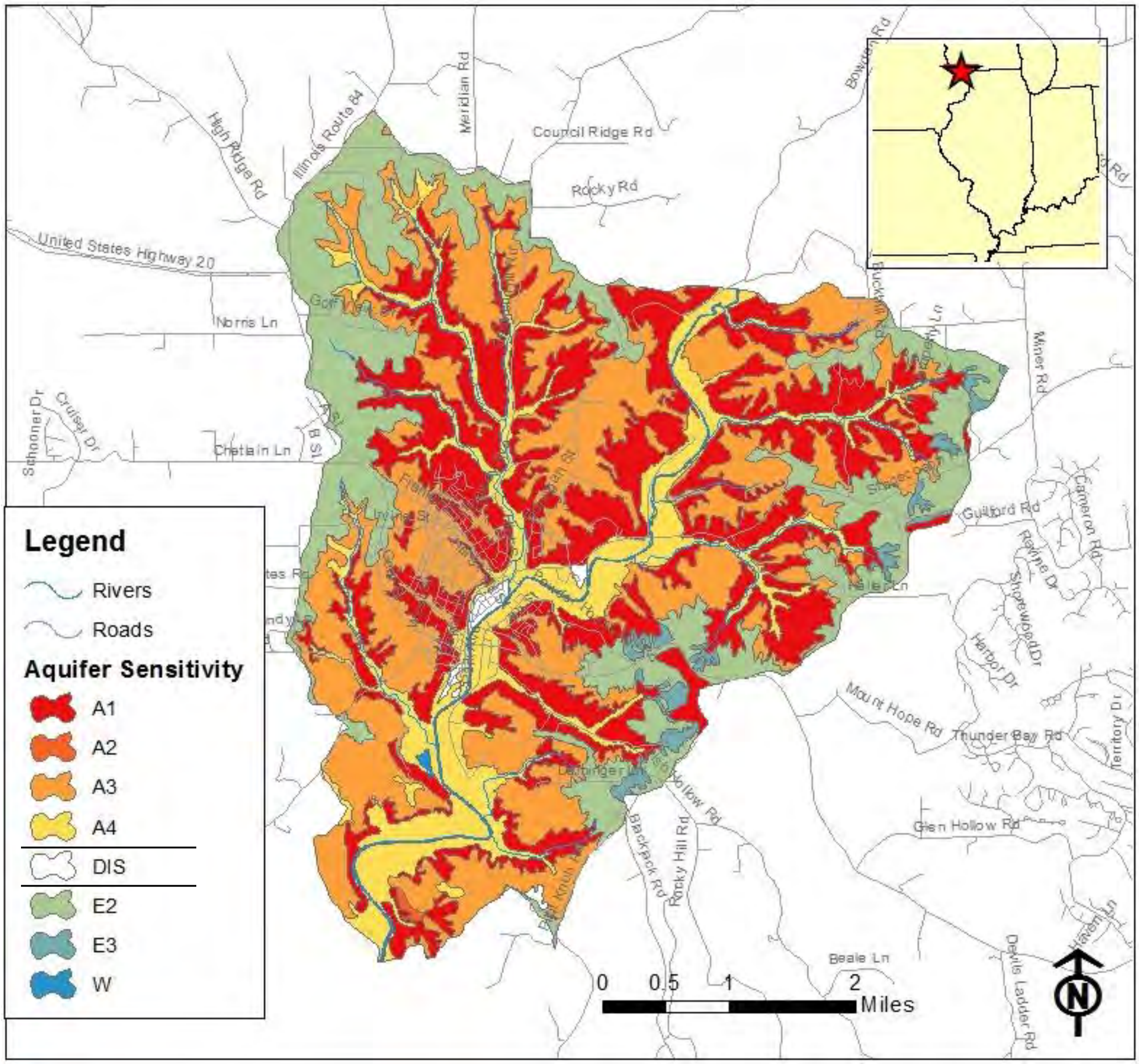

Figure 14-20. Aquifer sensitivity for the Galena River Watershed.

Table 14-17. Aquifer sensitivity details for the Galena River Watershed.

Category	Acres	Percent	Description
			Very High Sensitivity
A1	4,158.0	30.1%	Bedrock aquifer, >50 ft. thick, 0 - 5 ft. below the surface.
A2	14.5	0.1%	Sand & Gravel and/or bedrock aquifer, >50 thick, 0 - 5 ft. below the surface.
A3	4,469.4	32.4%	Bedrock aquifer, >50 ft. thick, 5 - 25 ft. below surface.
A4	2,031.5	14.7%	Sand & Gravel and/or bedrock aquifer, 5 - 25 ft. thick, 0 - 5 ft. below surface.
			Moderate Sensitivity
D	62.1	0.5%	Sand & Gravel and/or bedrock aquifer, >50 thick, >50 ft. below surface.
			Low Sensitvity
E2	2,781.6	20.2%	Bedrock aquifer, >50 ft capped with shale, >50 below surface.
E3	211.2	1.5%	Bedrock aquifer, 0 - 10 ft capped with shale, >50 below surface.
W	68.4	0.5%	Surface waters are highly prone to contamination.
Total	**13,796.8**	**100.0%**	

A report covering the extensive sensitivity of the aquifer of Jo Daviess County, including the Galena River Watershed, was published by Panno *et al.* (2017). This report officially classifies the carbonate bedrock features of the county as a karst geography and emphasizes the high degree of integration between surface and ground waters in these conditions. The report focuses in two areas; the karst features observed in the carbonate bedrock, and an assessment of the groundwater quality within these carbonate bedrock features. The karst investigation yielded a multitude of solution-enlarged crevices, cover-collapse sinkholes, springs, caves, conduits, and solution-enlarged bedding planes. Also documented were color-saturated crop lines which emerged during the drought of 2012, aligning with other fracture planes identified in the study. Results from sampling domestic wells indicated rapid recharge and an open aquifer system which is consistent with karst geography and its features. Surface-borne contaminants were found to stratify in the aquifer at depths of up to 210 feet. These findings are consistent with the categories A1 through A4 and D shown in Figure 14-20 and Table 14-17, and further emphasize the high degree of surface and ground water interaction which may likely be much higher than other watersheds in the State of Illinois.

15.0 GEOLOGY

The watershed is predominantly underlain with bedrock of the Ordovician Galena-Platteville formation (11,504.2 acres or 82.7%, *see figure 15-22*). Much of the uplands are underlain with Maquoketa shale of Ordovician age (2,327.8 acres or 16.7%). A small percentage of the highest points in the watershed are undifferentiated Silurian dolomite (79.3 acres or 0.6%). Stratigraphy for Jo Daviess County is shown in Figure 15-21.

The Galena-Platteville Unit, consisting of the Ordovician aged (488.3 – 433.7 million years ago) Platteville and Galena Groups, is predominantly pure limestone and dolomite. The Maquoketa Unit consists of dolomitic shale, argillaceous dolomite, and limestone assigned to the Ordovician Maquoketa Group. Shale is compacted or cemented silt and/or clay with fine laminations along which rock easily splits. Where present within about 25-125 ft. of the bedrock surface, weathering and dissolution of the carbonate rocks (limestone and dolomite) of the Galena-Platteville and Maquoketa Units has resulted in enough secondary porosity and permeability that water may easily penetrate the rock and part or all the units may be included in the shallow bedrock aquifer. The combined thickness of the Galena-Platteville and Maquoketa Units ranges from 100-610 ft., increasing eastward. The Platteville unit is exposed farther north in Wisconsin but is covered by Galena dolomite within the watershed. Galena dolomite is the most significant formation in the watershed with extensive outcrops. The Galena unit averages 240 ft. in thickness. This formation once had significant economic importance in the production of lead and zinc ores.

The Maquoketa Group is composed of silty, dolomitic shale to silty, argillaceous (rocks or sediment containing clay) dolomite. This uppermost Ordovician unit ranges in thickness from zero feet (where eroded) to about 150 feet (Adams, 1940). Outcrops of Maquoketa Shale are observed on the divides separating the Galena River Watershed from the adjacent Sinsinawa River and Smallpox Creek watersheds, or at elevations between approximately 857 ft. to 900 ft. in the watershed. Most gullying is observed in the Maquoketa layer where streams have cut down through eroded shale. The Maquoketa Group has been differentiated into four formations in northeastern Illinois but lithologic distinctions are not readily identifiable or able to be mapped in northwestern Illinois.

Silurian (443.7 – 416 million years ago) dolomite is of limited surface extent in Jo Daviess County and forms in the highlands, and is rarely used as a groundwater source. It is possible for large blocks of Silurian-age dolomite on ridges to separate along crevices and migrate downhill

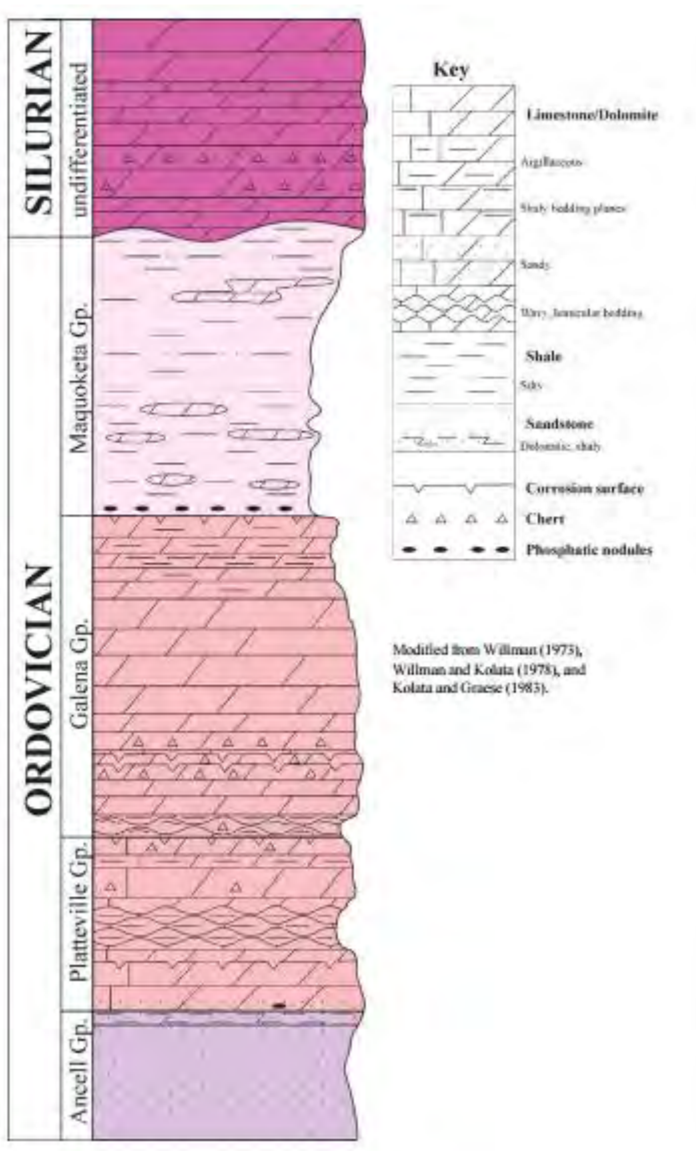

Figure 15-21. Cross section of bedrock stratification in Jo Daviess County (McGarry, 2000).

on the underlying shale, which causes linear collapse features. The lower ten feet has brown iron and pyrite content (Edgewood dolomite), above which lies about thirty feet of thin-bedded, brown, and extremely cherty layers (Kankakee dolomite). Both formations are Alexandrian (earliest Silurian) in age. The overlying strata are Joliet dolomite, cherty, buff to dark gray and Niagaran in age (Ordovician – Silurian). Carbonate rocks deposited during the Silurian and lower to middle Devonian Periods are included in the Silurian-Devonian Carbonate Unit. The Silurian System consists largely of dolomite, but lesser amounts of shale are present, and the dolomites may be argillaceous, silty, or clean. Within about 25 to 125 ft. of the bedrock surface, the Silurian Unit is extremely permeable and is included in the Shallow Bedrock Aquifer. Silurian and Devonian rocks consist mainly of dolomite and limestone. Although the Silurian and Devonian rocks overlap some Ordovician rocks, they are more accurately Ordovician than with Mississippian (360 – 325 million years ago) rocks. The Silurian system falls to the southwest at approximately 20 feet per mile.

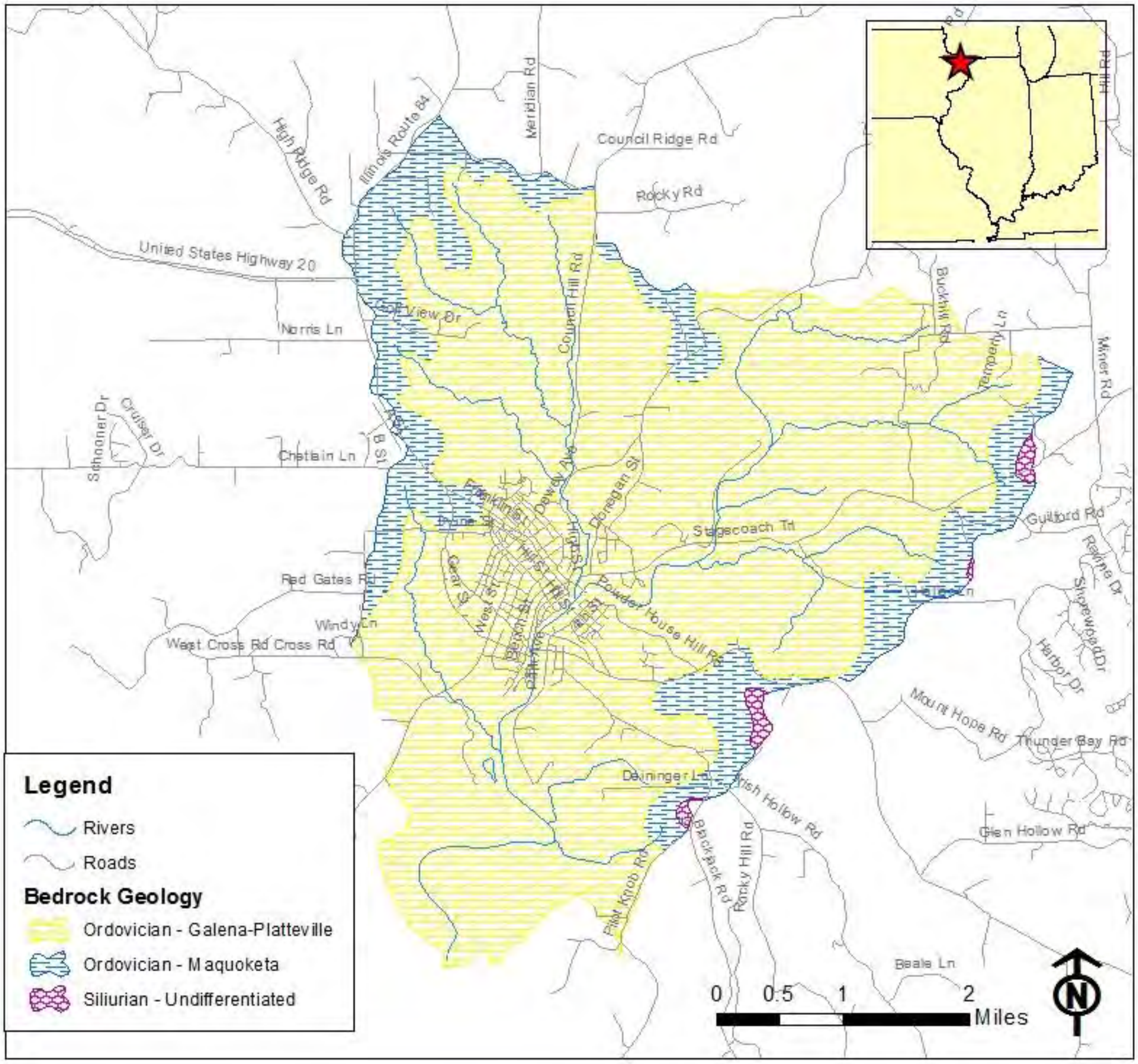

Figure 15-22. Bedrock geology of the Galena River Watershed.

16.0 CLIMATE

The Galena River Watershed experiences a common Upper-Midwestern temperate climate with four distinct seasons, and consistent variability in temperature, precipitation, and wind. A humid continental climate is a climatic region typified by large seasonal temperature differences, with warm to hot (and often humid) summers and cold (sometimes severely cold) winters. Precipitation is relatively well distributed year-round in many areas with this climate, while others may see a marked reduction in wintry precipitation and even a wintertime drought. Snowfall, regardless of average seasonal totals, occurs in all areas with a humid continental climate and in many such places is more common than rain during the height of winter. In places with sufficient wintertime precipitation, the snow cover is often deep. Most summer rainfall occurs during thunderstorms and a very occasional tropical system. Though humidity levels are often high in locations with humid continental climates, it is important to note that the "humid" designation does not mean that the humidity levels are necessarily high, but that the climate is not dry enough to be classified as semi-arid or arid. The Köppen Climate Classification subtype for this climate is "Dfa" (Hot Summer Continental Climate).

Weather station data was accessed from the National Climate Data Center Galena, IL, station (NCDC, 2016), and shown in Table 16-18. Weather indices are created for insurance ratings. These indices are based on reported weather events across the nation. The United States is given the mean reported event value of 100. Areas with above average weather events are proportionally graded above 100 and those with below average weather even numbers are graded below 100 based proportionally on the specific number of weather events. In general, Illinois' index is 90, slightly below the United States average. The overall weather index for Galena is 33. Illinois is above the national average for the hail index (139/100), and Galena is slightly below (75/100). Hurricane events are low in Illinois (14/100), and primarily concern rainfall that is centered in the southern portion of the state. Galena scores 2 on the hurricane index, likely due to rainfall received in September 2012 with the dissipation of Hurricane Isaac. Illinois is above the national average in the tornado index (172/100), and Galena is below the national average (58/100). Illinois is above the national average in the wind index (143/100). Galena is slightly above the national average in the wind index but below Illinois' value (103/100).

Average annual temperatures in the watershed are 49.8°F. Average winters see highs in the 30s and lows in the teens, with an average of 142 days at or below 32°F and 16 days at or below 0°F. The coldest day on record is -28°F. Average summers have highs in the 80s and lows in the 60s with 24 days at or above 90°F and one day over 100°F occurring about every other year. The warmest month, on average, is July with an average temperature of 73.5°F (23.1°C). The coolest month on average is February, with an average temperature of 20.1°F (-6.6°C). The highest recorded temperature in Galena is 108.0°F (42.2°C), which was recorded in July. The lowest recorded temperature in Galena is -27.0°F (-32.8°C), which was recorded in February. Spring and fall have moderate temperatures, with spring highs around 57°F and lows of 36°F and fall highs of 60°F and lows of 40°F. The average length of the frost-free growing season is 165 days. The last occurrence of 32°F in the spring is on average April 28 and the first occurrence of this temperature in the fall is on average October 7. April, May and June are typically the wettest months and January and February are the driest months. Average annual precipitation is 37.00". Once per year on average, the area may experience a snowfall of six inches or more. Average annual snowfall is 33.00". The average amount of precipitation for the year in Galena is 37.14" (943.4 mm). The month with the most precipitation on average is June with 4.6" (116.8 mm) of precipitation. The month with the least precipitation on average is February with an average of 1.2" (30.5 mm). There is an average of 111 days of precipitation, with the most precipitation days occurring in May (11.0 days), and the least number of precipitation days occurring in February (6.0 days). In Galena, there's an average of 33.3" of snow (845.8 mm). The month with the most snow is January, with 8.9" of snow (22.6 cm).

Table 16-18. Climate summary for Galena, IL, Illinois, and the United States.

Summary	Galena, IL	Illinois	United States
Weather Index	33	90	100
Hail Index	75	139	100
Hurricane Index	2	14	100
Tornado Index	58	172	100
Wind Index	103	143	100
Annual Maximum Avg. Temperature	57.7° F	61.0° F	N/A
Annual Minimum Avg. Temperature	36.2° F	42.0° F	N/A
Annual Avg. Temperature	49.8° F	51.1° F	N/A
Percent of Possible Sunshine	52	57	N/A
Mean Sky Cover (Sunrise to Sunset - Out of 10)	6	6	N/A
Mean Number of Days Clear (Out of 365 Days)	93	99	N/A
Mean Number of Days Rain (Out of 365 Days)	101	115	102
Mean Number of Days Snow (Out of 365 Days)	22.6	8	N/A
Avg. Annual Precipitation (Total Inches)	37.14"	36.00"	39.2
Avg. Annual Snowfall (Total Inches)	33.3"	27.00"	N/A

17.0 SEPTIC SYSTEMS

Due to the high sensitivity of the aquifer in the Galena River Watershed (77.3%, *see section 14*) the condition of septic control systems is extremely important. Many of the homes in the Galena River Watershed are connected to the Galena municipal sewer system as part of the City of Galena. The City of Galena's sewage treatment plant is a modern system under the jurisdiction of city, county, and state regulations. Rural homes and homes on the periphery of the city are served by private individual septic systems. The Jo Daviess County Health Department and the Jo Daviess County GIS department overlaid addresses within the Galena River Watershed and identified 462 total septic systems within the watershed. These septic systems within the watershed can be categorized as: 156 systems in East Galena Township, 105 systems within Rawlins Township, 69 systems within West Galena Township, 10 systems within Vinegar Hill Township, and 122 systems separate from these township numbers within the City of Galena boundaries,

Septic systems were originally used to serve individual homes in rural areas where population densities were too low to economically justify sanitary sewers. Septic systems are a household feature that is often forgotten unless obvious failure has occurred. A properly functioning septic system will remove most disease-causing organisms and some nutrients and chemicals from wastewater. However, it will not remove or treat many water-soluble pollutants such as solvents, drain cleaners, and many household chemicals. Consequently, the proper location, design, construction, operation, and maintenance of septic systems are critical in areas close to waterways, as well as in shallow groundwater zones.

Soil limitations for septic drainage fields are depicted graphically in Figure 17-23, and statistics for these classifications are shown in Table 17-19. Over 95% of the soils in the watershed have limitations for nutrient removal. Additionally, the underlying bedrock in the watershed is known to be extensively fractured. In the event of septic system failure, effluent can seep into bedrock fractures and into the aquifer instead of appearing at the soil surface. Many of the septic systems in the watershed were installed prior to 1985 and significant changes have taken place in county and state codes, as well as changes in septic design, and septic technology.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 60 inches is evaluated. The ratings are based on the soil properties that affect absorption of the effluent, construction and maintenance of the system, and public health. Factors such as hydraulic conductivity (Ksat, *see section 18.6)*, depth to a water table, ponding, depth to bedrock or presence of shale, and flooding all affect absorption of the effluent. Stones and boulders, ice, and bedrock or shale soils interfere with installation. Subsidence interferes with installation and maintenance. Excessive slope may cause lateral seepage and surfacing of the effluent in downslope areas.

Some soils are underlain by loose sand and gravel or fractured bedrock at a depth of less than 4 feet below the distribution lines. In these soils, the absorption field may not adequately filter the effluent, particularly when the system is new. As a result, the ground water may become contaminated.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected. None of the soils in the watershed fall into the “not limited” category, but 80.8 acres (0.6%) are not rated in the database and the conditions of these soils are therefore unknown.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Important in this discussion is the application of human septage to land in the watershed. The federal EPA has policy and guidelines set forth to the application of human septage to land (EPA, 1993). Because of aquifer sensitivity and soil limitations, the issue is just as pertinent to animal manure application to fields. The servicing, cleaning, transporting, and disposal of sewage system waste is regulated under 77 Illinois Administrative Code 905 (October 2013), Section 905.170. Under this ruling, disposal sites must be annually reported with location information, estimate of gallons disposed of at the site, and a description of disposal methods. Under this legislation, waste from portable toilets may not be disposed of on agricultural lands.

Table 17-19. Nutrient removal occurs in septic fields. The degree of nutrient removal is limited by soils as well as system upkeep and maintenance. Watershed soil limitations for septic drainage fields are displayed in this table.

Rating	Acres	Percent
Not rated	80.8	0.6%
Somewhat limited	5,749.0	41.3%
Very limited	8,084.7	58.1%
Total	13,914.5	100.0%

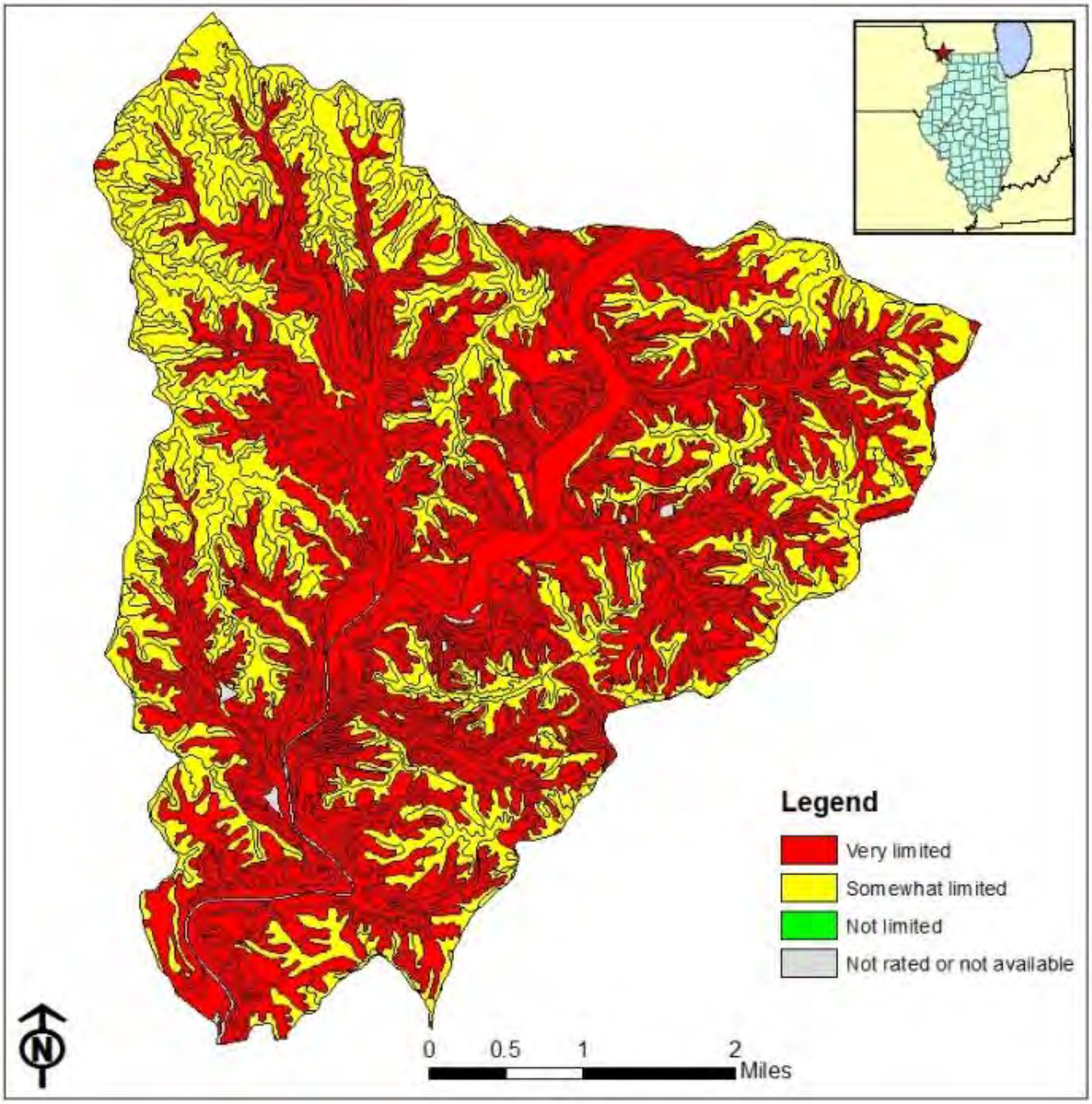

Figure 17-23. Septic soil limitations for the watershed.

18.0 SOILS

Soil conditions were referenced from the USDA-NRCS Soil Survey of Jo Daviess County, last updated 09/16/2016 (Tabular Data v.11; Spatial Data v.9).

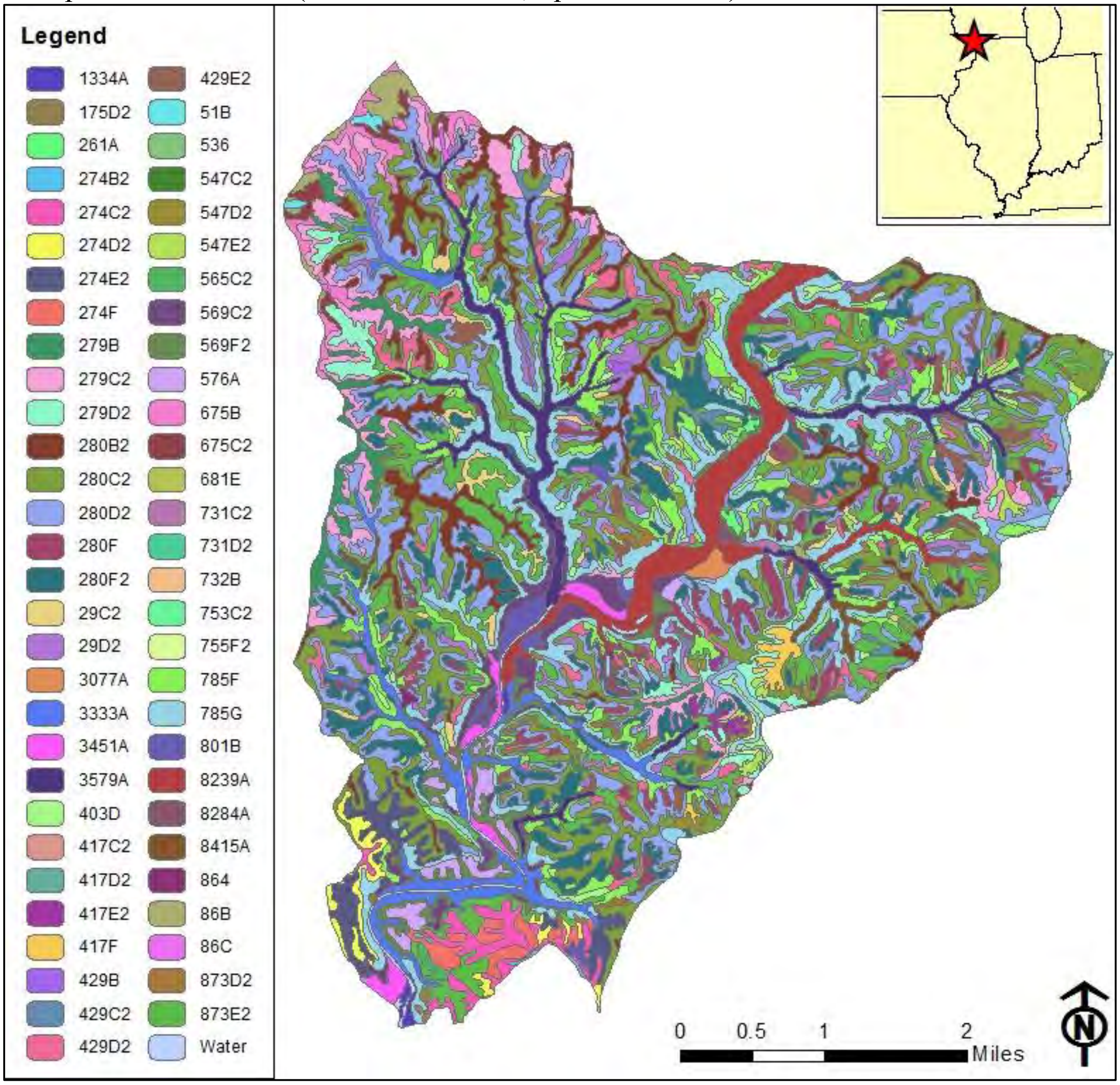

Figure 17-24. Soils map for the Galena River Watershed.

Erosion factor indicates the susceptibility of a soil to sheet and rill erosion by water. K-Factor is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter, and on soil structure and saturated hydraulic conductivity (sat, *see Section 18.60*). Values range from 0.02 to 0.9. Other factors being equal, the bigger the value, the more susceptible the soil is to sheet and rill erosion by water. Soil slope groups are shown in Figure 17-25 and aggregated in Table 17-20. Class A soils are 0-2% slope, B are 3-6% slope, C are 7-12% slope, D are 13-18% slope, E are 19-25% slope, F are 26-35% slope, and G are greater than 35% slope.

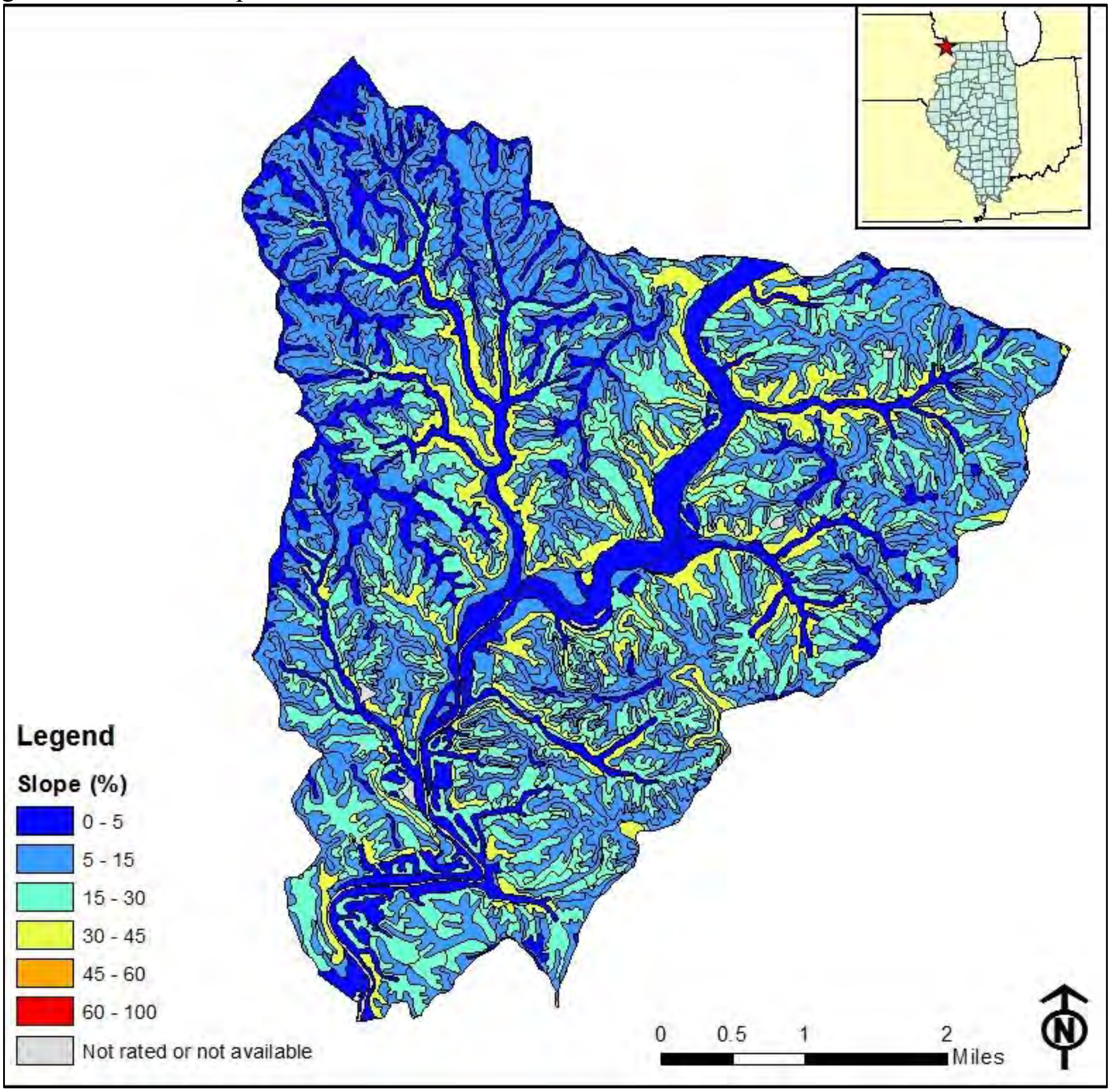

Figure 17-25. Geographic locations of soil slopes in Galena River Watershed.

Table 17-20. Area coverage of soil slopes within Galena River Watershed.

Soil Slopes	Acres	% of Watershed
A (0 - 2%)	1,542.50	11.09%
B (2 - 6%)	1,185.50	8.52%
C (6 – 12%)	3,751.60	26.96%
D (12 – 18%)	2,267.60	16.30%
E (18 – 25%)	1,616.70	11.62%
F (25 – 35%)	2,207.30	15.86%
G (>35%)	1,262.50	9.07%
Surface Water	80.80	0.58%
Total	**13,914.50**	**100.00%**

18.1 Highly Erodible Soils

In the United States agriculture policy, highly erodible land (HEL) refers to land that is very susceptible to erosion, including fields that have at least 1/3 or 50 acres of soils with a natural erosion potential of at least eight times their tolerable soil loss value. Natural Resources Conservation Service soil scientists and soil conservationists determine if a soil, or soil map unit, is "highly erodible" or "potentially highly erodible" due to sheet and rill erosion. This determination is done by using the Universal Soil Loss Equation (USLE). The USLE relates the effects of rainfall, soil characteristics, and the length and steepness of slope to the soil's tolerable sheet and rill erosion rate. The maximum erosion potential is calculated without consideration to crop management or conservation practices, which can markedly lower the actual erosion rate on a given field. Highly erodible land comprises approximately 78.3% (10,901 acres) of the watershed while non-highly erodible land comprises approximately 21.7% (3,013 acres). Table 18-20 displays HEL soils for the Galena River Watershed. The geographic location of such soils are shown in Figure 18-26. These soils are related to conservation compliance and tied to the 1985 Farm Bill.

Table 18-21. HEL Soils in Galena River Watershed.

Symbol	Acres	Percent
29C2	122.9	0.88%
29D2	260.1	1.87%
274C2	140.7	1.01%
274D2	92.7	0.67%
274E2	195.9	1.41%
274F	90	0.65%
279C2	502.3	3.61%
279D2	193.4	1.39%
280C2	1776	12.76%
280D2	1924.8	13.83%
280F	299.2	2.15%
280F2	879.9	6.32%
417C2	1.8	0.01%
417D2	11.1	0.08%
417E2	33	0.24%
417F	47.9	0.34%
429C2	87.9	0.63%
429D2	314.4	2.26%
429E2	220.4	1.58%
547C2	2.8	0.02%
547D2	32.2	0.23%
547E2	41.3	0.30%
565C2	14.2	0.10%
569C2	220.3	1.58%
569F2	190.3	1.37%
681E	2	0.01%
731C2	7.6	0.05%
731D2	1.3	0.01%
753C2	7.4	0.05%
755F2	10.1	0.07%
785F	689.9	4.96%
785G	1262.5	9.07%
873D2	98.8	0.71%
873E2	1126.1	8.09%
Total	**10,901.20**	**78.34%**

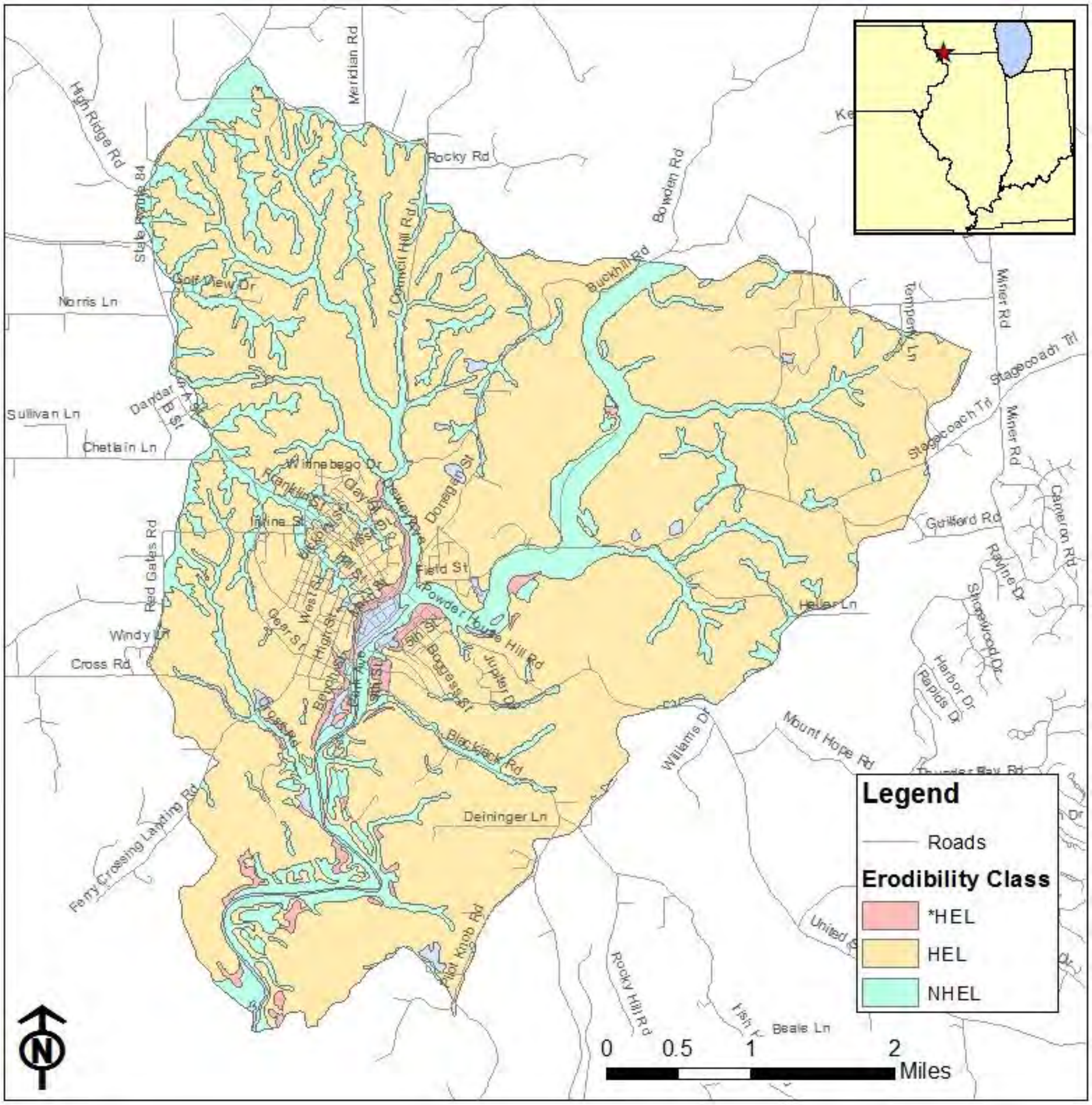

Figure 18-26. Highly erodible soils within Galena River Watershed. HEL is highly erodible land; NHEL is non-highly erodible land; *HEL is not assessed as highly erodible or non-highly erodible.

18.2 K Factor

K factor is a soil erodibility factor which represents both susceptibility of soil to erosion and the rate of runoff, as measured under the standard unit plot condition. Soils high in clay have low K values, about 0.05 to 0.15, because they are resistant to detachment. Coarse textured soils, such as sandy soils, also have low K values, about 0.05 to 0.2, because of low runoff even though these soils are easily detached. Medium textured soils, such as the silt loam soils, have a moderate K values, about 0.25 to 0.4, because they are moderately susceptible to detachment and they produce moderate runoff. Soils having high silt content are most erodible of all soils. They are easily detached; tend to crust and produce high rates of runoff. Values of K for these soils tend to be greater than 0.4.

Organic matter reduces erodibility because it reduces the susceptibility of soil particles to detach, and it increases infiltration which reduces runoff and erosion. Addition or accumulation of organic matter through management practices such as incorporation of manure is represented in the C factor rather than the K Factor.

Table 18-22. K-factor by area and percentage within the Galena River Watershed area, 80.8 acres (0.6%) is water.

K-Factor	Acres	Percent
Water	80.8	0.6%
0.2 – 0.24	2,113.5	15.2%
0.24 – 0.28	420.6	3.0%
0.28 – 0.32	17.2	0.1%
0.32 – 0.37	1,447.7	10.4%
0.37 – 0.43	4,971.0	35.7%
0.43 – 0.64	4,863.7	35.0%
Total	13,914.5	100.0%

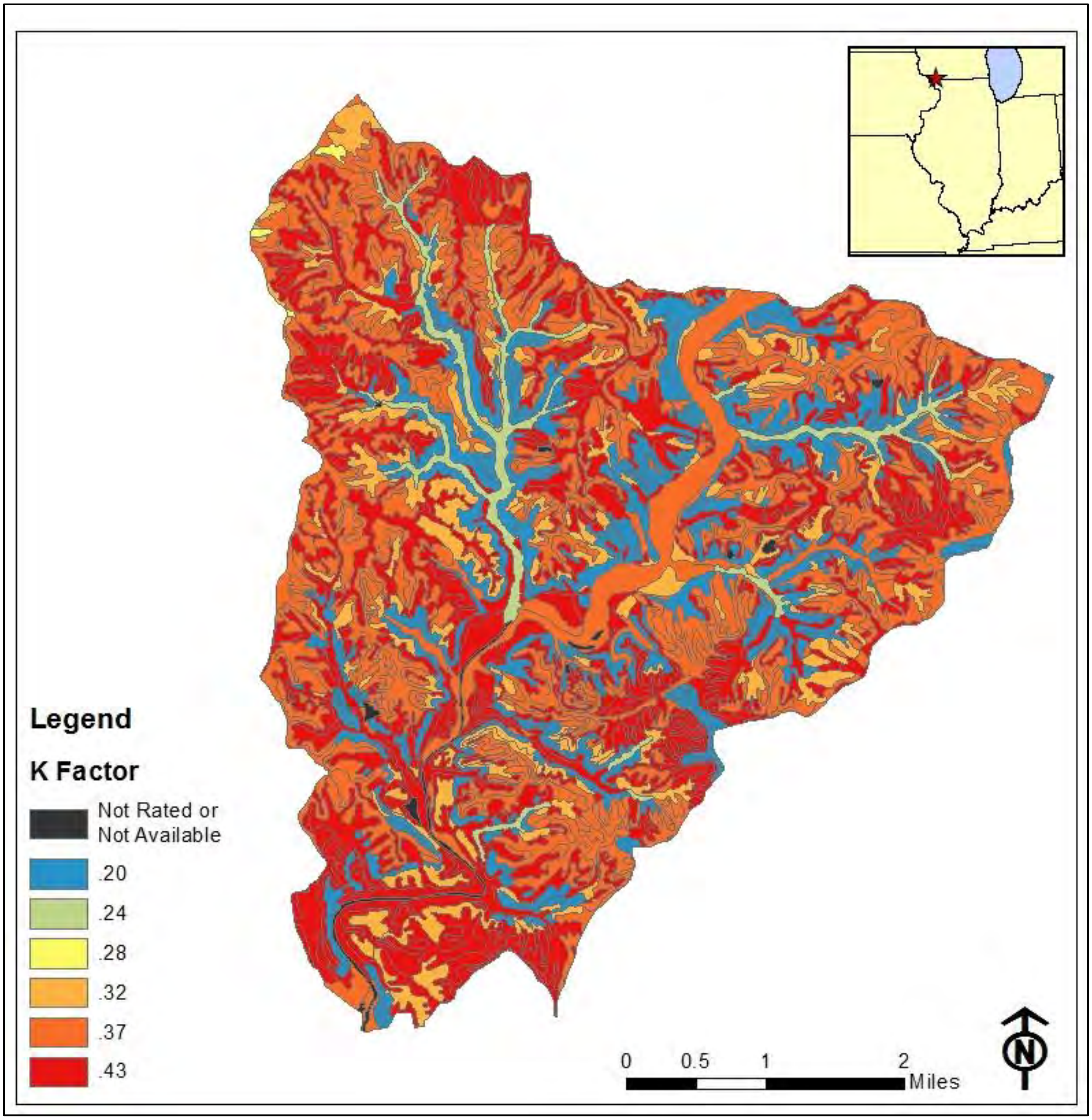

Figure 18-27. K-factor geographic dispersion within the Galena River watershed area.

18.3 Hydrologic Soil Groups

Hydrologic soil groups are based on estimates of runoff potential. Soils are grouped according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan, or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that, in their natural condition, are in group D, are assigned to dual classes. Hydrologic soil groups are summarized in Table 18-22.

Table 18-22. Hydrologic soil groups and the area of coverage in the watershed.

Class	Acres	Percent
A	420.60	3.4%
B	9,342.70	76.3%
B/D	500.50	4.1%
C	426.70	3.5%
C/D	1.10	0.0%
D	1,469.70	12.0%
W	78.40	0.6%
Total	12,239.70	100.0%

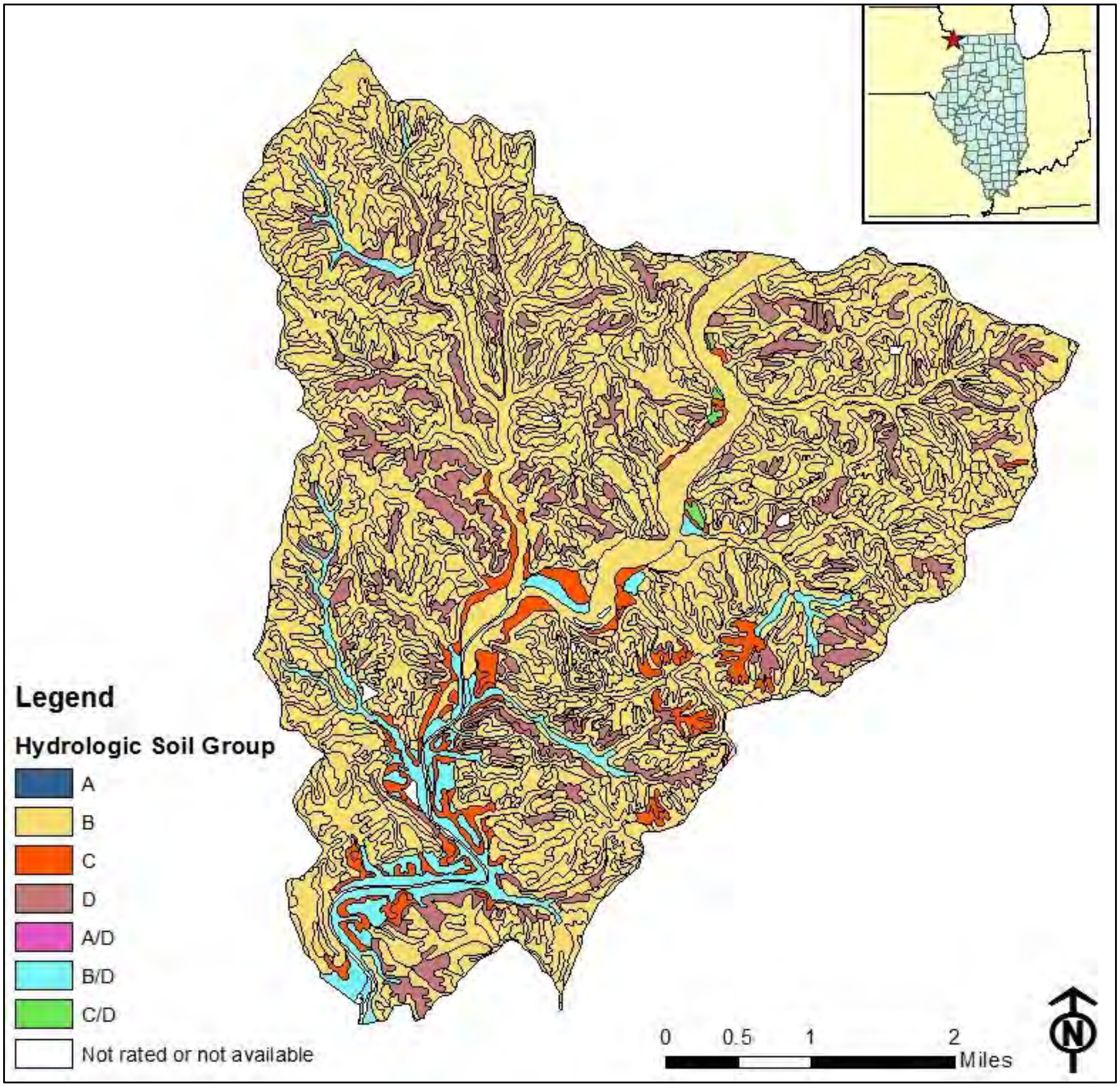

Figure 18-28. Hydrologic soil groups in the watershed.

18.4 Texture

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 % clay, 28 to 50 % silt, and less than 52 % sand. If the content of particles coarser than sand is 15 % or more an appropriate modifier is added, for example, "gravelly." The Galena River Watershed is primarily silt-loam, with some areas of cobbly silt-loam in low lying floodplains through stream corridors. Silty clay loam is common on shale bedrock on some of the ridges and hill slopes in the watershed. Figure 18-29 depicts soil texture and Table 18-23 shows these values for the watershed.

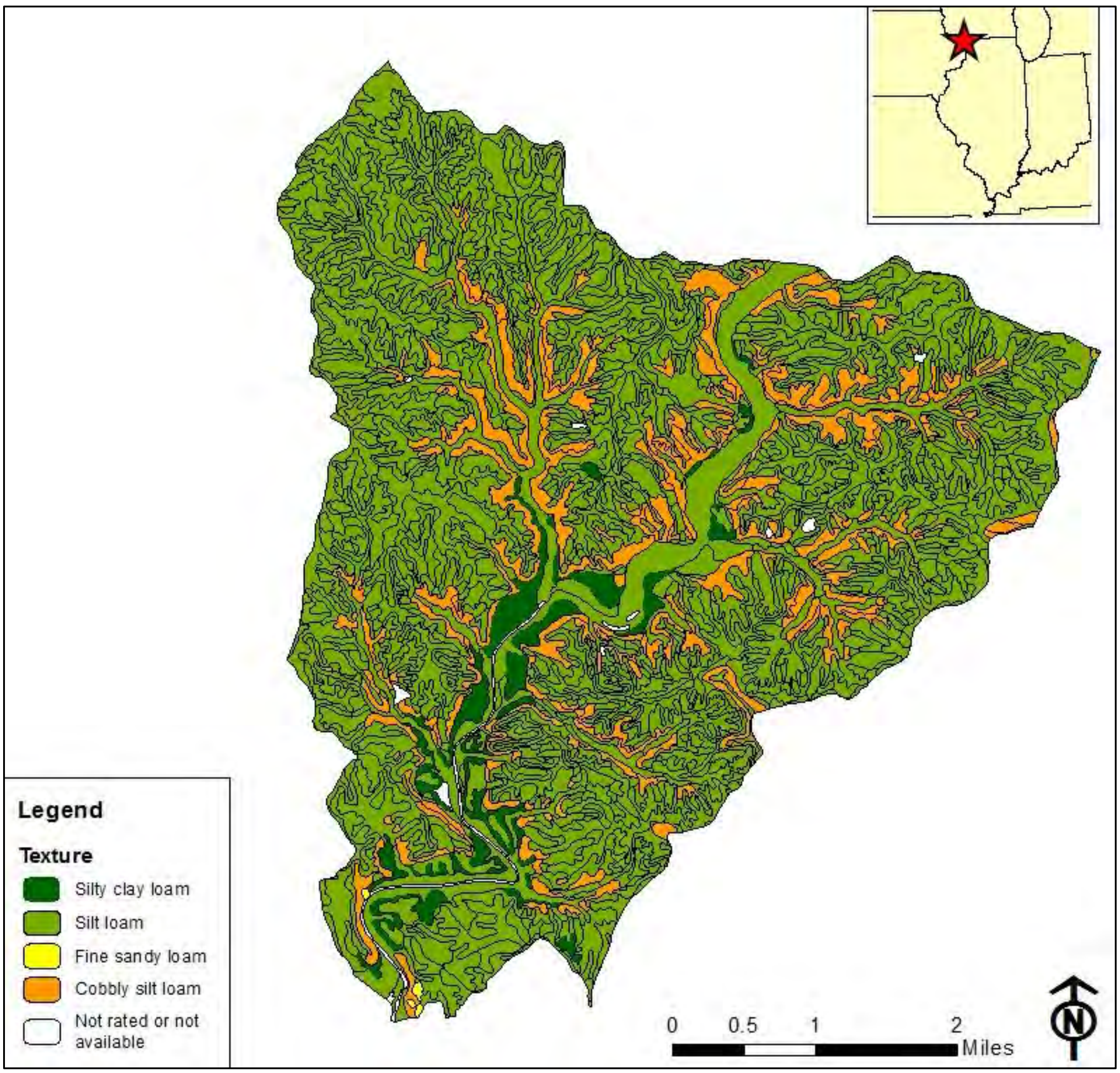

Figure 18-29. Representative texture class of the surface horizon.

Table 18-23. Summary of textures for the soils in the watershed and their corresponding acreages and percentage of the total watershed.

Texture	Acres	Percent of Watershed
Cobbly silt loam	1,952.4	14.0%
Fine sandy loam	10.1	0.1%
Silt loam	11,367.3	81.7%
Silty clay loam	503.9	3.6%
Total	**13,833.7**	**100.0%**

18.5 Drainage Class

"Drainage class" refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized-excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained. These classes are defined in the "Soil Survey Manual." Soils in the Galena River Watershed are primarily well drained (89.1%) and to a lesser extent, moderately well drained (4.5%). A smaller part is somewhat poorly drained (3.7%). Poorly drained soils are typically in valley bottoms near the water table. Drainage is listed in Table 18-24 and depicted in Figure 18-30.

Table 18-24. Summary of the drainage ratings for the soils in the watershed.

Drainage	Acres	Percent of Watershed
Well drained	12,396.9	89.61%
Moderately well drained	623.4	4.51%
Somewhat poorly drained	509.9	3.69%
Poorly drained	152.5	1.10%
Somewhat excessively drained	151.0	1.09%
Total	**13,833.7**	**100.00%**

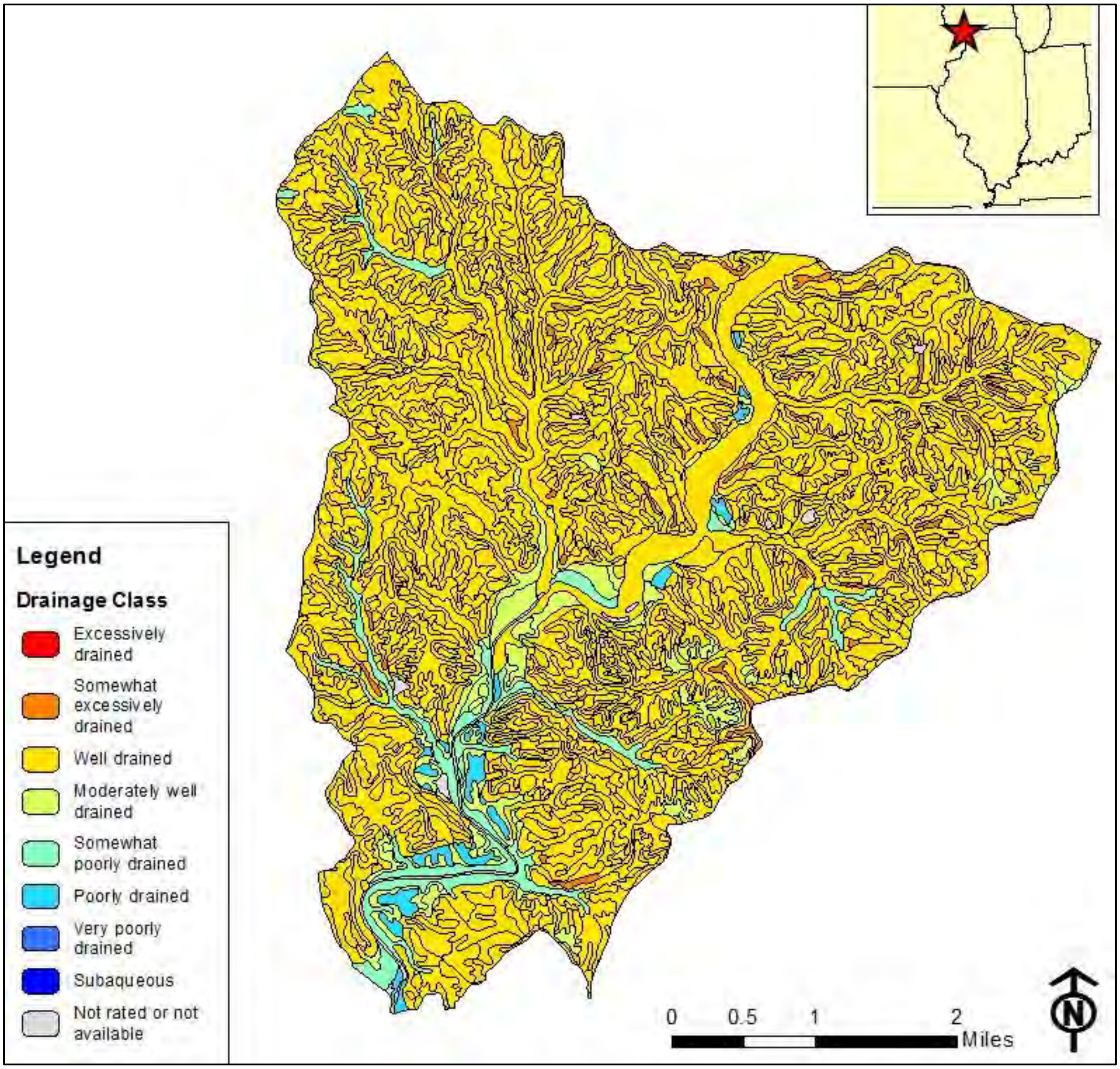

Figure 18-30. Drainage classes in the watershed.

18.6 Hydraulic Conductivity

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields. For each soil layer, this attribute is recorded as three separate values. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used. The soils in the watershed primarily fall into the average range of greater than 8.09 and less than or equal to 9.17. Variances from this occur primarily on side slopes and bottom drainage areas. Ksat values for the Galena River Watershed are shown in Figure 18-31 and categorical statistics are shown in Table 18-24.

Table 18-25. Ksat values for the Galena River Watershed.

Ksat	Acres	Percentage of Watershed
≤ 2.2191	520.5	3.74%
> 2.2191 - ≤ 4.1766	198.3	1.43%
> 4.1766 - ≤ 8.0845	1,585.8	11.40%
> 8.0845 - ≤ 9.170	9,226.8	66.31%
> 9.170 - ≤ 28.230	2,383.1	17.13%
Total	**13,914.5**	**100.00%**

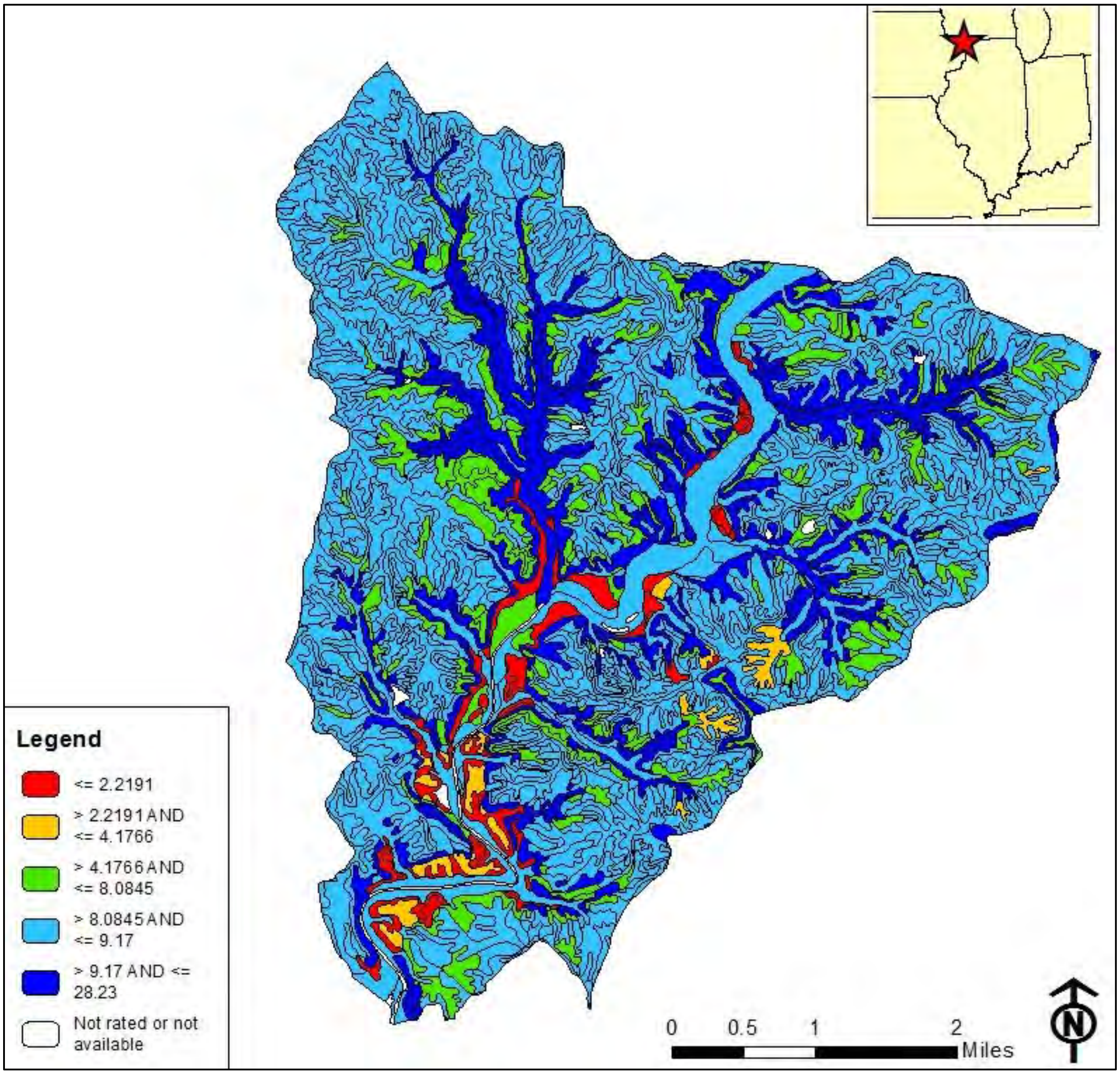

Figure 18-31. The numeric saturated hydraulic conductivity (Ksat) values for the Galena River Watershed. Ksat values have been grouped according to standard Ksat class limits.

18.7 Hydric Soils

Illinois once contained more than 8,000,000 acres of wetlands (IWQR, 2016). Community development and agriculture have caused the conversion of many of Illinois' wetlands leaving only approximately 920,000 acres of wetlands in the State today. Wetlands are typically found in Illinois along the margins of lakes and ponds, throughout river floodplains, and as isolated depressions. Although seemingly "useless" land to the general public, wetlands provide valuable habitat for 40% of the state's threatened and endangered species, flood storage, water quality improvement and groundwater recharge.

The Galena River Watershed has very few delineated wetlands. Many soil types within the watershed have hydric inclusions requiring field investigation to make the final determination. While field visits were not made to these sites to make wetland determinations, the hydric inclusion category is broad for soils in the county and state and most are unlikely to be wetlands in the topography existing in the watershed. Figure 18-32 shows the extent of hydric soils as mapped. Approximately 99% of the watershed is non-hydric soil and 1% hydric. The hydric extents are on the floodplain adjacent to the Galena River. The lack of wetlands today in the Galena River Watershed are partly due to the steep slopes and porous characteristics of both the bedrock and soils. Another factor is likely conversion of the few wetlands which existed in the watershed historically into lands more suitable for agriculture and development.

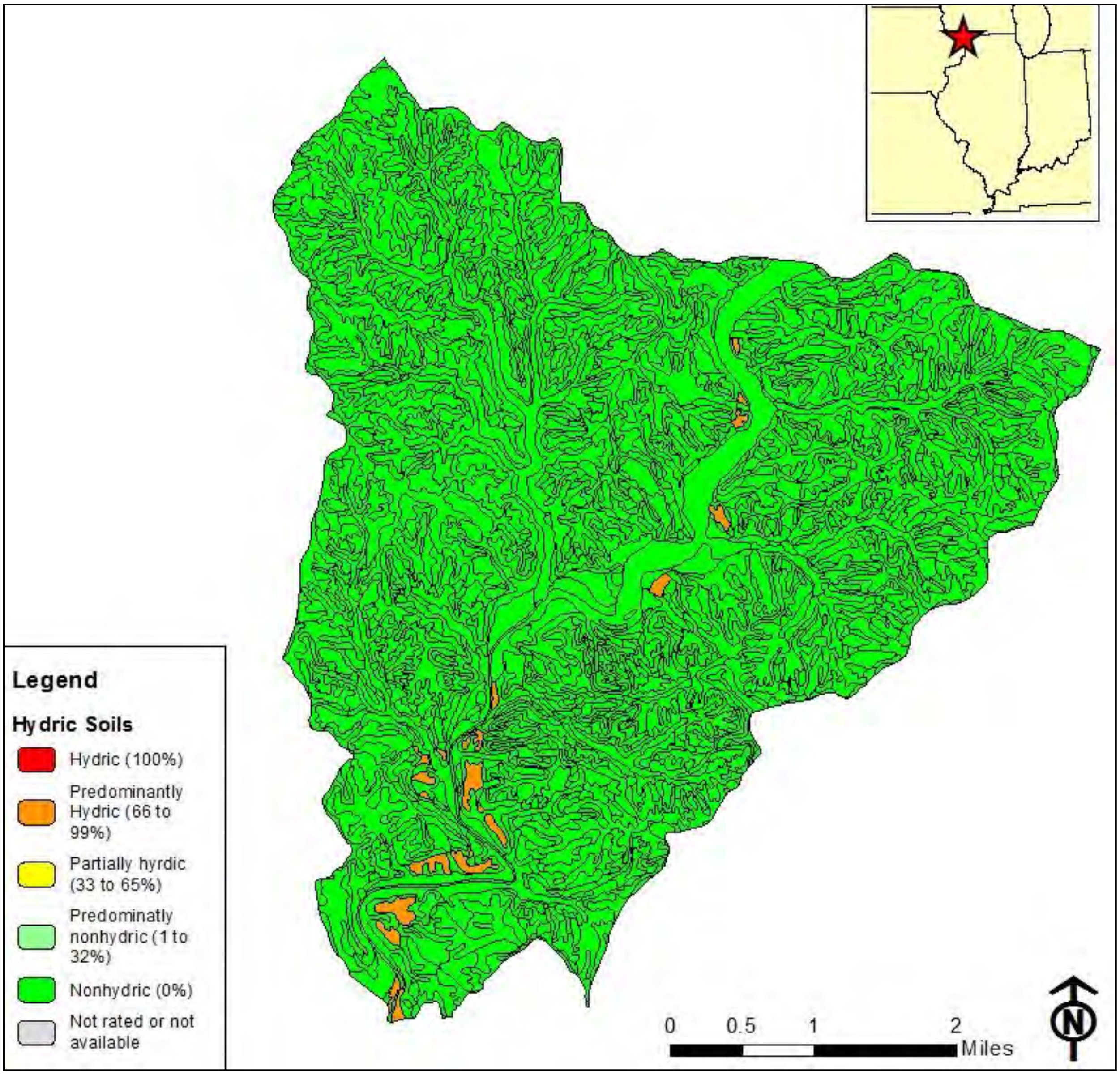

Figure 18-32. Hydric soils and hydric inclusions in the watershed.

19.0 STREAM CORRIDOR ASSESSMENTS

19.1 Valley Cross Sections

To better understand the character of stream segments and variation in subwatersheds valley cross sections were taken. Locations of these cross-sections are depicted in Figure 19-33, with cross-sections shown in Figures 19-34 through 19-39. On the x-axis, the distance across the valley is shown. On the y-axis, the elevation above sea level is shown. Cross sections are located closely to those by Adams (1942) wherever feasible. Because of the scale of the valley width, the actual river surface is not readily apparent on the cross section, and the location has been demarcated on figures 19-34 through 19-39 with a red arrow. On the Downtown cross section the levee location is shown with a blue arrow, and the downtown area with a yellow arrow.

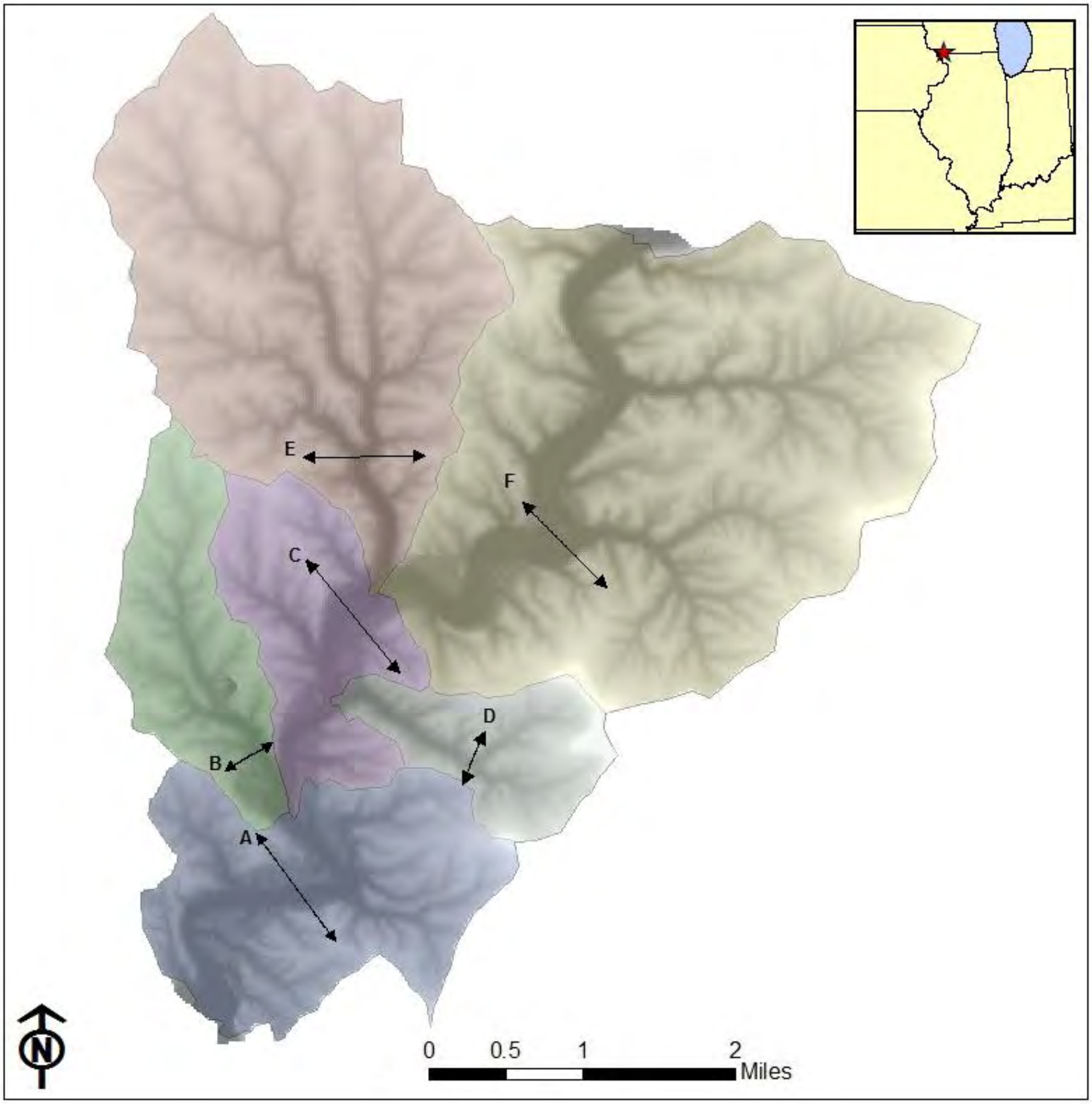

Figure 19-33. Location of valley cross-sections taken throughout the Galena River Watershed. Subwatersheds are depicted in colored shading.

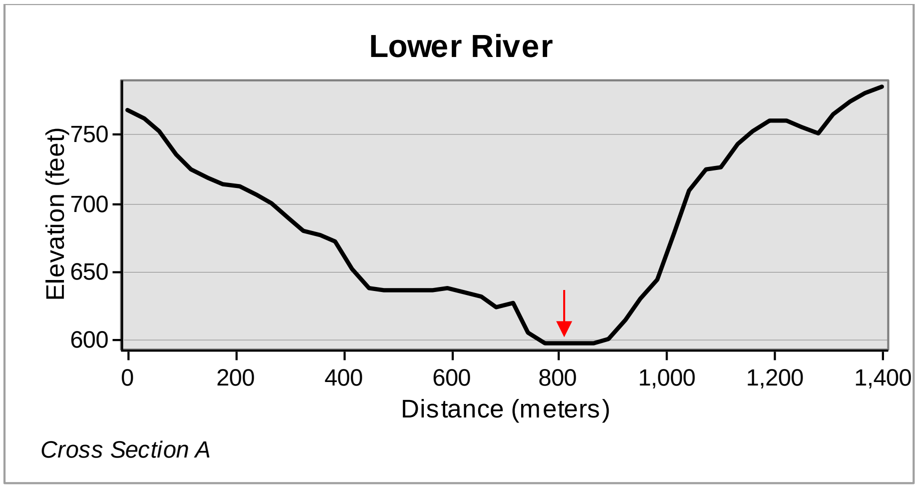

Figure 19-34. Lower River subwatershed valley cross-section (A).

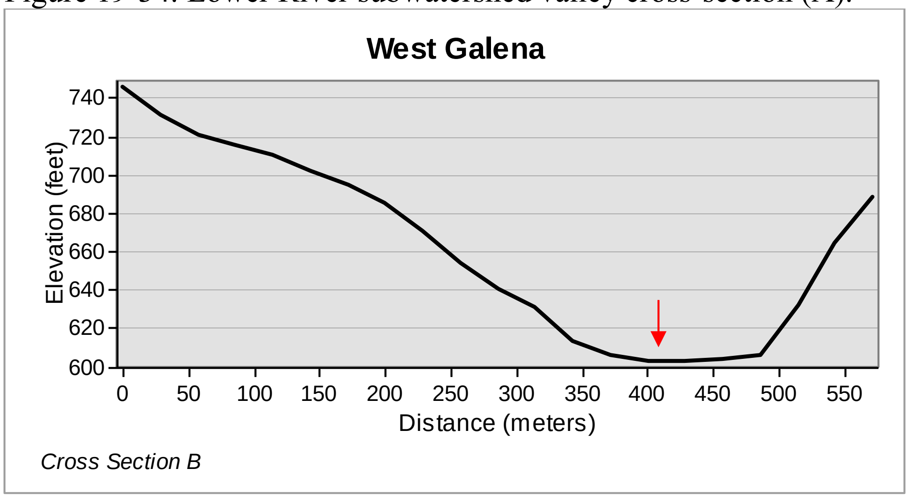

Figure 19-35. West Galena subwatershed valley cross-section (B).

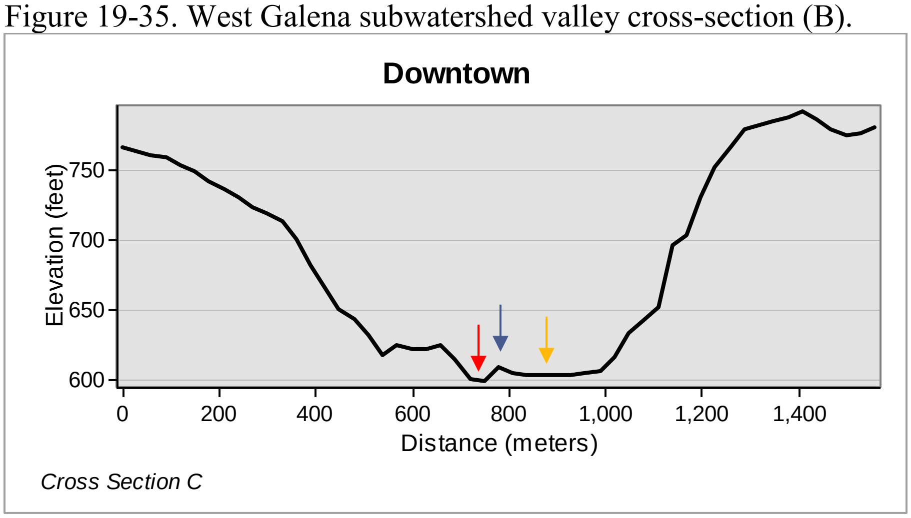

Figure 19-36. Downtown subwatershed valley cross-section (C). The levee protecting the downtown area is located at approximate distance 785 meters, with the urban center of downtown located approximately between 800 – 1000 meters.

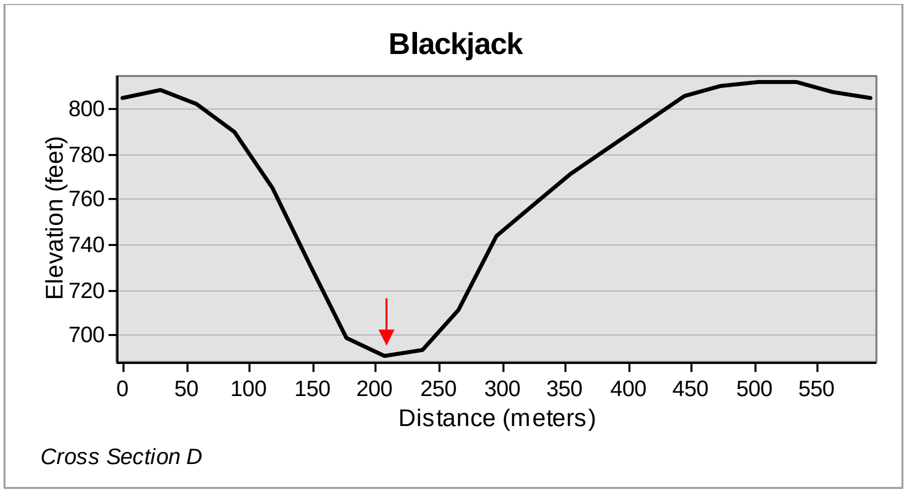

Figure 19-37. The Blackjack subwatershed valley cross-section (D).

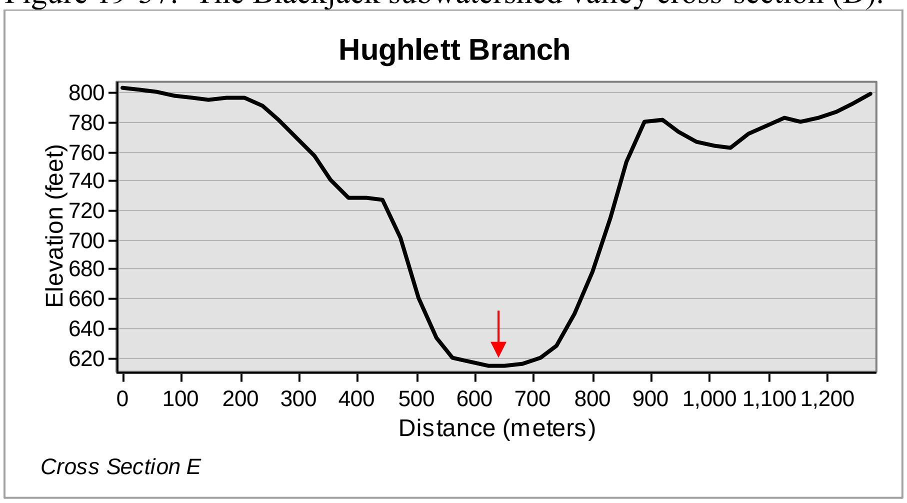

Figure 19-38. Hughlett Branch subwatershed valley cross-section (E).

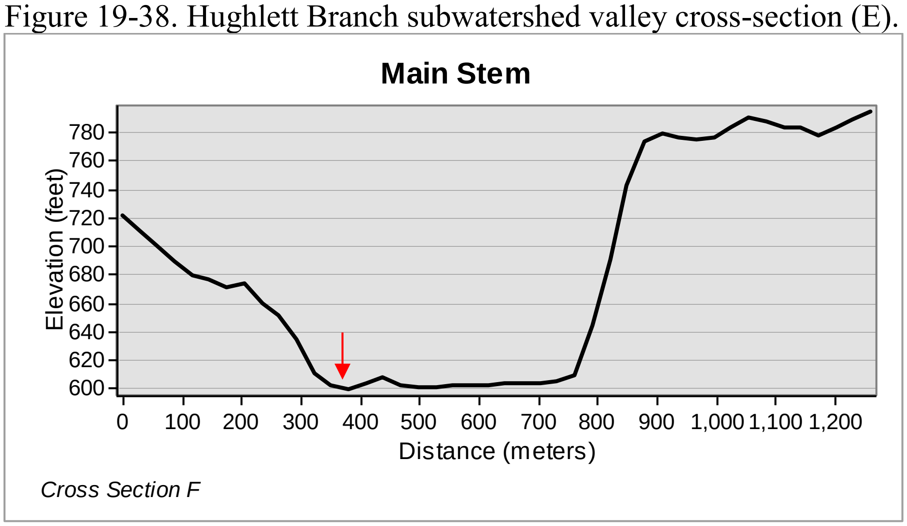

Figure 19-39. Main Stem subwatershed valley cross-section (F). Note the broad, flat flood plain.

19.2 Stream Corridors

The elaborate network of surface waters in the Galena River Watershed were broken out into individual reaches where consistent conditions would be expected throughout the reach, and variability would be expected outside of the reach (Figure 19-40). Stream corridors were assessed between January and June 2017. A total of 20 stream reaches were identified and assessed, with a total length of 136,376 ft. (25.83 miles). Streambank erosion and channelization was conducted using U.S. Forest Service stream inventory protocol (U.S. Forest Service, 2008). Streambank erosion was measured for length and height, and linear regression rate (LRR) was estimated. This data was then used to calculate nutrient and sediment erosion rates based on Steffen (1982). Channel erosion and channelization were classified as none or low if no or very minor erosion or channelization were visible. Moderate was classified when erosion or channelization were noted as being recent or minor events, with the assumption that this situation is only starting to occur. High erosion and channelization were designated when the channelization was physically manipulated (straightened streams with dug channels), or is evident that it has been occurring regularly, and sediment is actively being delivered to the stream under regular flows.

Riparian conditions were assessed using the NRCS SVAP2 methodology (NRCS, 2009). Throughout the assessment area, riparian conditions were noted, in addition to the presence of aquatic organisms and resource concerns. This information was tabulated to create the tables in Section 19.3. Riparian areas were classified as “good”, “fair”, or “poor”. Good condition was scored when vegetation was entirely native trees and plants and a functioning riparian buffer was observed. Fair conditions were identified when non-native or invasive plants were evident, or when the riparian area was showing some signs of being affected by cropping, livestock, or mowed lawns. Poor conditions were identified when the riparian area was thick with non-native and invasive species, vegetative cover was removed by more than 30% by livestock or agriculture, or when lawns were kept mowed to less than three inches in length. The average width of 50 feet was considered for the riparian buffer area.

The streams were assessed from their confluence with their next largest waterbody to the top of their watershed or identified stream segment. In the case where streams are extremely small, assessments were conducted up to the point where visible surface water started to appear.

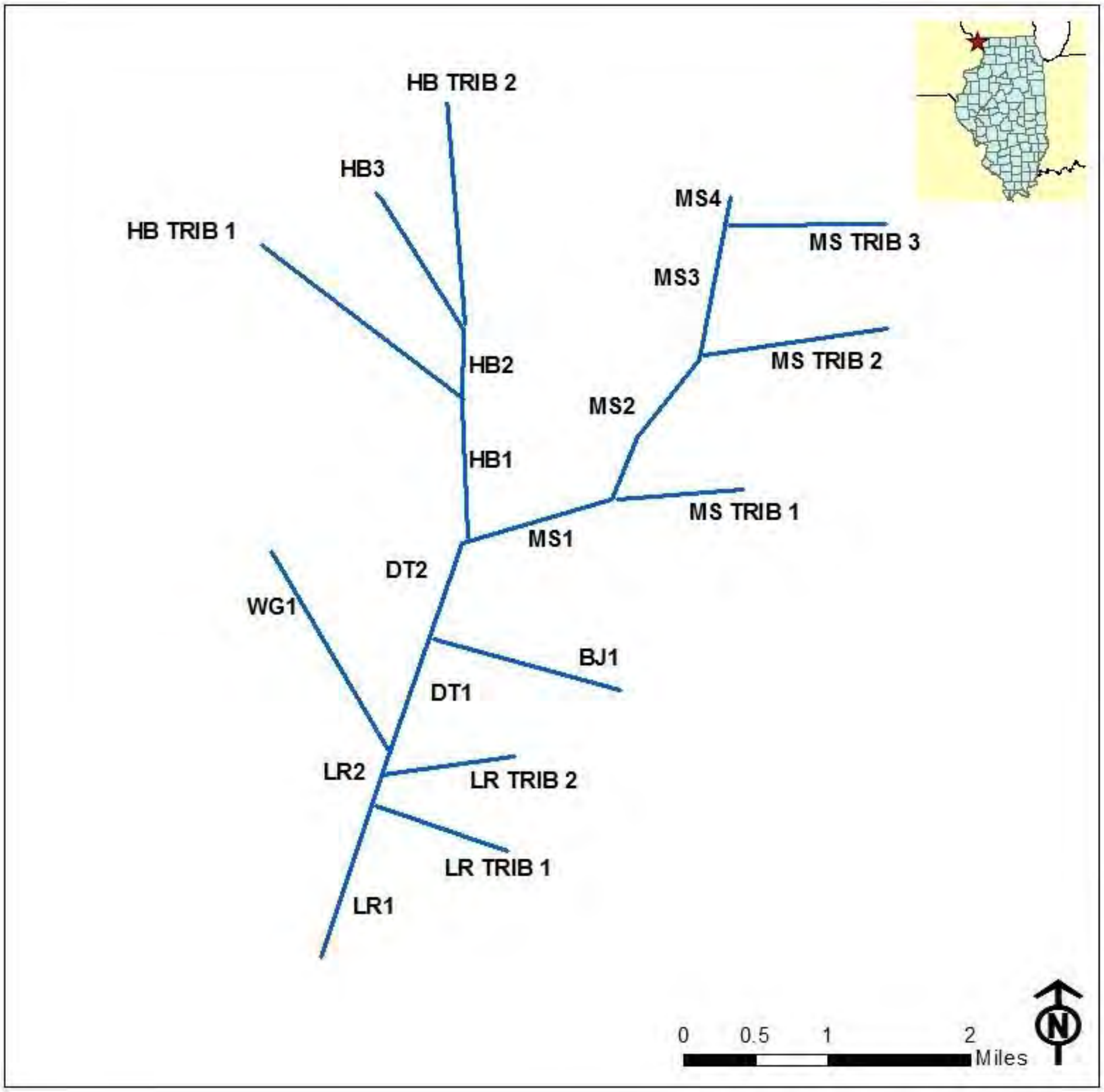

Figure 19-40. Delineation of watershed streams segments.

19.2.1 Lower River 1 (LR1)

The lower river is within the pool of the Mississippi River and therefore fluctuates with the stage of the Mississippi River. This reach is primarily undeveloped with thick forests of boxelder and maple lining the banks. Much of this bottomland floods. The substrate is mud through this reach. This reach is easily accessed by boat from the Mississippi River via Ferry Landing, and is often used by pleasure boaters migrating between the City of Galena and the Mississippi River. When water levels are lower, the heavily scoured banks are visible. Like much of the Galena River in this report, the banks are eroded for the entirety of the reach. The severity of the erosion is subjective. The large floodplain allows some relief from high storm flows and dissipates some of the energy which it receives. At the upper end of the reach a railway bed lies adjacent to the channel and significantly constricts the floodplain. During the inventory, one debris jam was observed congregating among the railroad bridge piers at the mouth of the river. Although thick with logs, passage was still possible along the left descending bank.

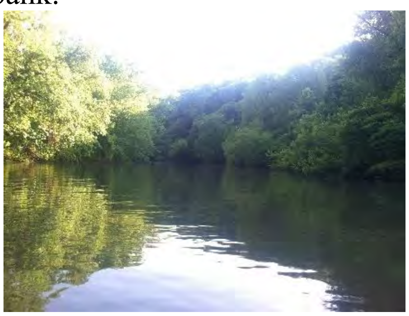

Figure 19-41. Secluded lower reach of the Galena River.

Figure 19-42. Eroded bank below adjacent railroad bed.

Figure 19-43. Railroad bridge at the mouth of the river and debris jam below.

19.2.2 Lower River 2 (LR2)

LR2 differs little from LR1. This reach is slightly more constricted due to the presence of the adjacent railroad bed for the entire course on the right descending bank, as well as the former railroad grade which today facilitates the Galena Bike Trail on the left descending bank. No debris jams were observed within this reach, but several trees are leaning into the river or have fallen in along the banks.

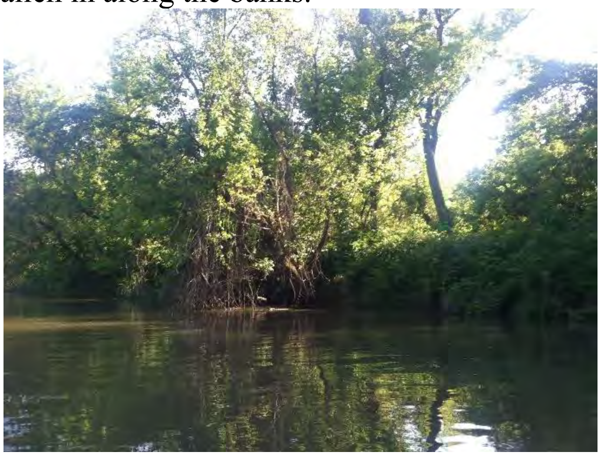

Figure 19-44. Elevated floodplain and eroded banks, observed even when visited during flood conditions.

Figure 19-45. Conditions at LR2 closely resemble LR1.

19.2.3 Lower River Tributary 1 (LR TRIB 1)

A majority of LR TRIB 1 is ephemeral. The system contained running water for the first 120 ft. when assessed during a period of heavy rain in the spring 2017. The substrate is silt loam soil which has eroded from upstream. The channel is heavily laden with sediment slugs, situated like rock riffles, which have been deposited by upstream erosion. These slugs are distinctly piled and easily discernable from the extensive sediment which lines the channel for much of its course. As the steady water disappears about 120 feet from its confluence with the Galena River, the sediment slugs turn into deposits of cobble, creek gravel, and in some cases, small boulders. Most erosion is limited to the lower reaches of the drainage. It appears that eroded sediment feeds primarily in areas that constantly flow, and in the area where the drainage changes from perennial stream to ephemeral, some sediment loading occurs, but to a much lesser extent. Six debris jams were observed, all composed of logs and branches, ranging from three to eight inches in diameter. These jams were all observed in the perennial areas and not in the lower reaches.

Figure 19-46. Channelization and erosion.

Figure 19-47. Sediment deposition.

Figure 19-48. Debris jam.

Figure 19-49. Bank erosion.

19.2.4 Lower River Tributary 2 (LR TRIB 2)

The LR TRIB 2 contains a sand bottom from its confluence with the Galena River to the culvert passing under the bike trail (approximately 640ft.). The extent of water in the tributary exists from the Galena River to this culvert, and approximately 105 ft. above the culvert. A head cut has formed from the improper inlet elevation of the culvert forming an eroded channel approximately 75 ft. long and four ft. deep. Above this scar no discernible channel is found for another 1000 ft., which appears to be a wetland field filled with vegetation rooted in sediment which has been deposited from upstream. Above this area, a small ephemeral channel can be found, which only flows during heavy rain. Evidence of stream features (riffle crests, eroded sediment slugs, and debris) can be found, but is not transporting material or contributing sediments on any consistent basis. Only one debris jam was observed in this corridor.

Figure 19-50. Stream running through sand substrate.

Figure 19-51. Headcut from low culvert elevation.

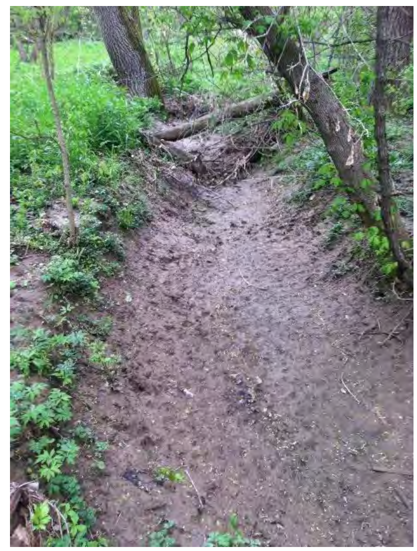

Figure 19-52. Ephemeral channel.

19.2.5 West Galena (WG1)

The West Galena corridor is extremely degraded, with channelization and erosion lining almost the entire corridor. From its confluence with the Galena River, this corridor travels past the sewage treatment plant, where the stream is narrow and deep, and the water level relatively consistent with the elevation of the pool of the Galena River. The banks are eroded and five debris jams were observed. A sixth jam was observed in this area created by beaver. Multiple trees lay fallen on the banks and could be added to the existing jams as weather events or deterioration exists. This area encompasses approximately 1000 ft., where a grassy wetland area emerges. In some places, the channel is braided into multiple channels coming from different directions. This area exists today largely as a sediment slug created by the extensive erosion upstream; likely close to 30,000 yd.^{3} of material. The channel bottom is primarily mud through this reach.

Moving upstream north of Ferry Landing road, the channel remains highly eroded and channelized, with 23 debris jams observed. An approximately 400 ft. length of stream was straightened in this area which is causing extensive downcutting and erosion which is affecting the upstream reaches of stream behind Greenwood Cemetery, as well as forming large gullies into the back yards along Red Gates Road. The straightening shows up on aerial imagery approximately 2012. Although this straightening is causing extensive damage, the erosion was likely existent long before the stream was straightened. These is a low degree of downward cutting of the stream through the floodplain, and what is more likely is that an extensive amount of sediment has been deposited into the floodplain from upslope over the more than 100 years of development and farming in this subwatershed. In this area, there is a high sand content in the soils and present in the streambed. Below Casey's gas station, the stream bed runs directly on bedrock for more than 800 feet, indicating that no further downcutting can occur in this reach.

Above Red Gates Road this stream returns to a mixed cobble stream bed, while the erosion and channelization remain extensive. This section of stream runs through a grass/pasture area for approximately 2,300 ft. Although land use in this area is not helping prevent erosion, some of the degradation is caused by improper culvert elevations under Red Gates Road.


Figure 19-53. Deep narrow stream in lower reach of corridor.


Figure 19-54. Beaver dam observed near sewage treatment plant.


Figure 19-55. Extensive braided erosion observed in wetland floodplain.


Figure 19-56. Extensive erosion throughout corridor.


Figure 19-57. Extensive erosion. Note grade rod for scale.

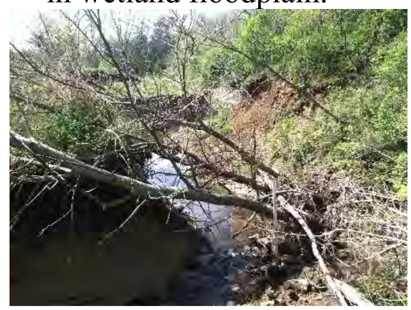
Figure 19-58. Extensive erosion. Note grade rod for scale.


Figure 19-59. Section of straightened stream; not grade rod for scale.


Figure 19-60. Stream running on bedrock.


Figure 19-61. Stream with mixed cobble substrate and sections of bedrock.

19.2.6 Down Town 1 (DT1)

DT1 encompasses the mainstem of the Galena River between the outlet of the Blackjack corridor and the lower river tributaries. This section is much like the lower river in its low development, deep water, muddy sediment, and constriction from railroad grades. In this reach is the former power plant, which is believed by many to be the source of PCBs in the river. Most of the banks in this reach are eroded and the riparian vegetation is dense through the growing season. In two areas, cattle pastures can be seen along the left descending bank butting directly up to the river. The adjacent floodplain is high enough that it rarely sees flooding. The relatively young ages of the trees in the riparian area indicate that the floodplain has likely built up from sediments deposited from eroded hillsides adjacent to the floodplain. The construction of the railroad grades as well as the extensive mining in the area are also contributing factors to the changes in natural flood regime.

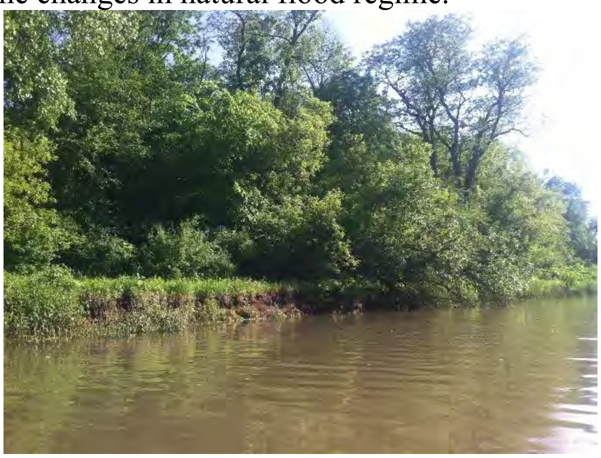

Figure 19-62. Eroded bank visible above flood waters.

Figure 19-63. One of two areas in this reach cleared up to the river's edge.

19.2.7 Down Town 2 (DT2)

The Galena River is a landmark in the downtown Galena area, and has become a recreational attraction for kayaking, walking, and biking. The river has changed drastically over the years due primarily to mining and logging. The DT2 reach of the river is highly channelized and is most affected by the levee protecting downtown. For the entire river within the watershed, the floodplain has naturally become elevated due to soil eroding from ridgetops and hillsides. This natural aggradation constricts the river, and the presence of the flood levee in Galena further impedes flood flows. The downtown area itself was built in what would be the natural floodplain of the river. Although infeasible to move the culturally rich and important historic downtown area of Galena, it is also infeasible to expect such a large impact on natural processes to not affect river conditions downstream.

DT2 is a slow-moving reach of river with a muddy substrate. Portions of the banks have been stabilized with rock, or rock blocks. The riparian vegetation matches upper and lower reaches with boxelder and silver maple primarily dominating the overstory and cool season grasses mixed with weedy forbs in the understory. No debris jams were observed in this reach.

Figure 19-64. The downtown reach with the levee on the right.

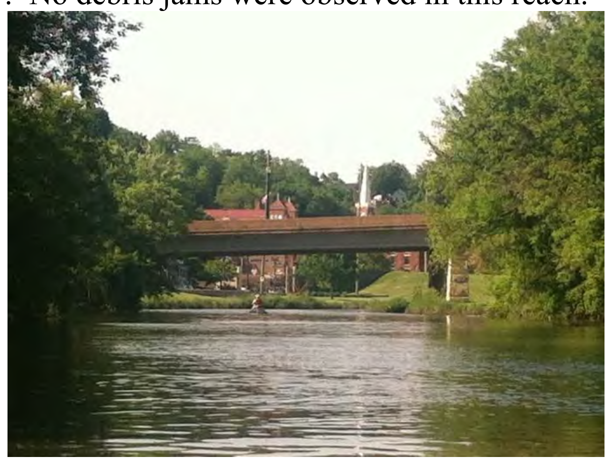

Figure 19-65. The Highway 20 bridge with recreational boater at the boat ramp.

19.2.8 Blackjack (BJ1)

The BJ1 corridor is extensively eroded from its confluence with the Galena River to the point where it breaks into several small drainages feeding from different directions approximately one and a half miles from downtown. The only exception to this is that approximately 2700 feet of road ditch has been armored with large cobble (≥RR5). Highly channelized, this system is no longer natural, but would provide some aquatic habitat if it saw continuous water flow. The road ditch sits wet on the lower end, but perennial stream flow only occurs in this corridor from between Blackjack Road and the Galena River. Six debris jams were observed in the corridor; four below the armored road ditch, and two in fields above the ditch.

Figure 19-66. Erosion and channelization as observed in lower reaches of the BJ1 corridor.

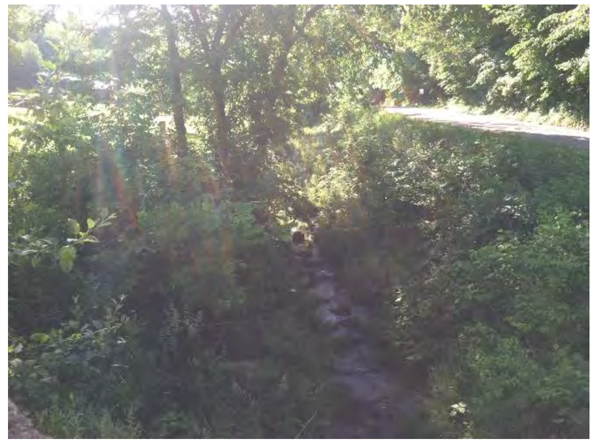

Figure 19-67. Rock lined channel parallel to Blackjack Rd.

19.2.9 Mainstem 1 (MS1)

MS1 is the first reach of the Galena upstream of the downtown Galena area before the Hughlett Branch joins the Galena River. The river is deep and slow moving through this section. Upstream reaches of the Galena River have some riffle-pool intervals, which have completely disappeared by MS1. The banks are lower in this reach than in more northerly reaches, but still eroded. The riparian vegetation is consistent with much of the Galena River corridor, with overhanging boxelder trees, and weedy forbs such as stinging nettle, poison parsnip, and giant ragweed.

Figure 19-68. Shorter eroded banks in MS 1.

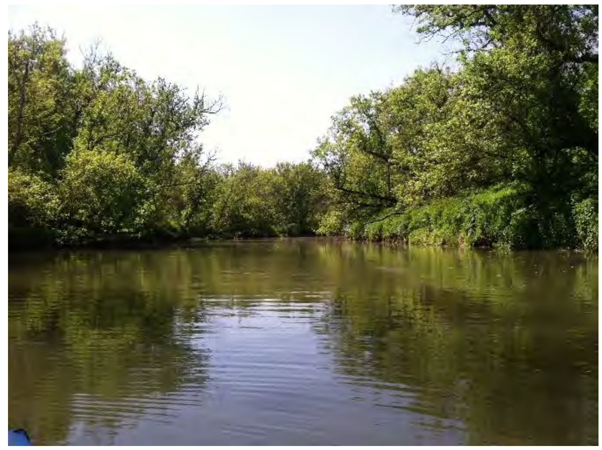

Figure 19-69. Typical riparian vegetation in the Galena River.

19.2.10 Mainstem 2 (MS2)

MS2 is the reach of the Galena River between MS Trib 1 and MS Trib 2, and constricted on its left bank by a railroad bed grade for approximately half of its length. The West Stagecoach Trail bridge spans this reach. The river is deep and slow moving through this reach, with a muddy bottom. The banks appear less eroded here during higher waters such as those experienced when surveyed during spring flow conditions, but as the water levels recede to normal flow conditions, deteriorated banks actively contributing sediment begin to appear. The riparian vegetation is primarily composed of overhanging boxelder, with bush honeysuckle and weeds typical of waste areas. Two gated storm discharge pipes were observed in this reach, both on the left bank.

Figure 19-70. Railroad grade on left bank constricting channel.

Figure 19-71. Some bank erosion can be observed on the left of this photo, but most erosion is hidden below the high water.

Figure 19-72. One of two gated storm discharge pipes.

19.2.11 Mainstem 3 (MS3)

This reach contains extremely eroded banks on one or both sides, except for an approximately 2000 ft. section of curve that has been protected with rip rap. In this section, the rip rap is working and could be a model for future protection. In other areas, the banks are heavily scoured and creating excessive slumping which contributes large amounts of sediment to the river. This active process is natural degradation in which the floodplain has received so much top soil eroded from the adjacent hillsides that it has built up more than 12 feet high in some sections. This is evident from the distinct stratigraphic layers observed in the cut banks where natural deposits of creek gravel are found in the lower one-to-two feet and the next 10 feet of deposit on top of this gravel is rich black topsoil, not normally found in layers this thick under natural conditions. The river is now trying to reach a natural equilibrium by scouring the banks until a normal connection between floodplain and river exists. The steep banks have created a highly-channelized condition, and the adjacent railroad grade adds to this constriction. The eroded banks contain many nests for bank swallows, so any restoration efforts should take this habitat into consideration while still relieving the sediment loading. The adjacent vegetation is consistent with upper and lower reaches; boxelder dominates the upper canopy and nettle and reeds canarygrass dominate the lower cover. No debris jams were observed in this reach.

Figure 19-73. Eroded banks on both sides of river.

Figure 19-74. Active slumping on eroded bank. Note adjacent hole in bank with swallow nest.

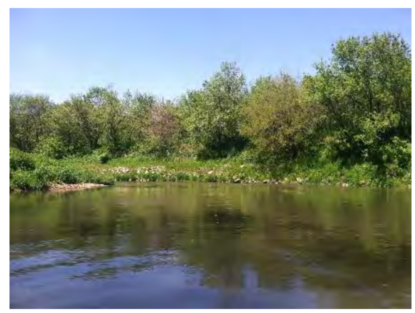

Figure 19-75. Riprap protection on stream bend.

19.2.12 Mainstem 4 (MS4)

Incoming flow of the Galena River enters the watershed at MS4, approximately 200 feet south (and downstream) of the West Buckhill Road bridge. MS4 is low to moderately channelized and the riparian vegetation is moderate with mixed silver maple and boxelder overstory and an understory of common forbs and reeds canarygrass. The river in this section is a series of pools broken up by cascading riffles. The banks are highly eroded with heights of 10 – 12 feet in some areas. No debris jams were observed in this reach.

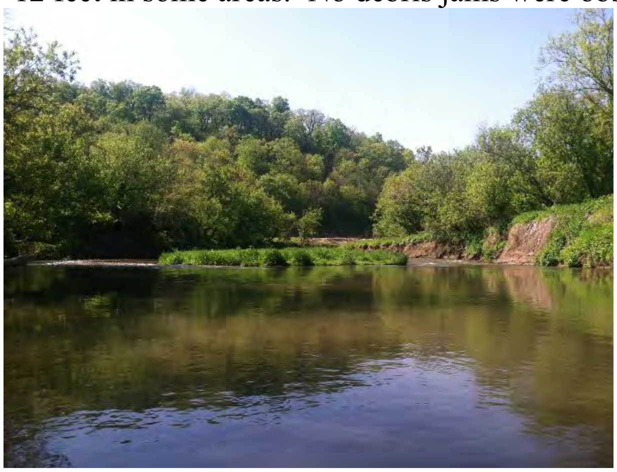

Figure 19-76. Top of MS 4. Note vegetated sediment slug in center of riffle and highly eroded banks.

Figure 19-77. Highly eroded banks on both sides of channel.

19.2.13 Mainstem Tributary 1 (MS TRIB 1)

MS Trib 1 runs in the valley parallel to West Stagecoach Trail, turning south along West Heller Lane, and has its headwaters below Highway 20's "Horseshoe Bend", east of Galena. The lower section of this reach shows multiple scars through the valley bottom indicating many different courses historically. The lowest section where the tributary meets the Galena river still shows some sinuosity, but above this section the tributary borders the valley wall on one side and crop land on the other side. In this area, the stream runs very straight and would have historically crisscrossed the valley bottom. This straightening has increased velocity and stream energy, and causes erosion. Part of the manipulation of this stream reach can be traced back to the old mill on Stagecoach trail, which had a raceway directing flow to the mill's wheels for power. Upstream from the old mill portions of a stone dam remain. This dam was breached at some point in history, and the remains today direct the flow of the stream into a tall eroded bank. Four debris jams were observed in this reach, primarily composed of smaller limbs (3" – 4" in diameter).

Figure 19-78. Eroded banks in MS Trib 1. Some natural stream sinuosity can be observed.

Figure 19-79. Eroded bank where flow is diverted by remains of mill dam. Adjacent vegetation indicates that recent out of bank flow occurred.

Figure 19-80. Remains of rock dam from former mill.

19.2.14 Mainstem Tributary 2 (MS TRIB 2)

This tributary runs through bottomland cropland and former pastures. Some of this former pasture has been converted to riparian forest plantings. Where the tributary meets the Galena River, it appears that it acts as a nursery for smallmouth bass. Larger bass were observed in the transition from the larger pool of the Galena into the tributary, and smallmouth fry were observed just upstream in the bottom of the tributary. Also in this nursery area, springs were found in the banks feeding the stream. The rest of the tributary is consistent, with approximately three foot eroded banks bordering a sinuous stream through open bottomlands. The floodplain has aggraded from sediment eroding off the hillsides and added approximately two feet of material. Pools throughout the reach are laden with mud. Minnows were observed in many of the pools of the reach. Two debris jams were observed in this tributary, which were primarily composed of smaller sticks (< 3 in.).

Figure 19-81. Springs contributing to stream reach.

Figure 19-82. Eroded banks showing soil stratifications.

Figure 19-83. Natural sinuosity of the stream relieves erosive energy.

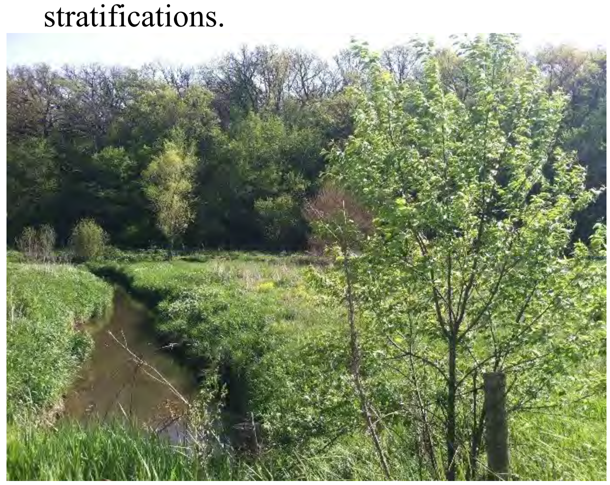

Figure 19-84. Upper portion of reach near NW Miner Rd.

19.2.15 Mainstem Tributary 3 (MS TRIB 3)

MS Trib 3 is an extremely eroded channel with extraordinary features. The channel becomes dry approximately 110 feet upstream of its confluence with the Galena River. For much of the remainder of the channel the substrate is coarse broken boulders for most of the course of the lower half of the reach. This channel runs through rich mature hardwood forest. The channel conveys a high amount of water when rain events occur, but the substrate is coarse and fractured enough that any base flow likely runs below surface. Approximately 1,600 feet upstream from the confluence with the Galena River, this tributary channel has a major split, with one branch feeding from the north, and the other continuing up the long narrow valley from the east. In the lower 1600 feet, 11 debris jams were observed, primarily composed of a single fallen tree which collected smaller sticks and cobble until a blockage occurred. Near the split in the channels, the riparian vegetation changes from mature forest to a dense stand of young prickly ash. Aside from this stand, the vegetation improves again upstream in both directions. A sand layer was observed in the channel banks in both directions upstream from the split. Periodically, a small pool of standing water was observed, with no flow in or out being evident. The channel feeding from the north contains metal cans, broken glass, and larger waste, which is evident through the entire channel. Almost the entire length of this reach is highly eroded, although because the channel only flows during rain events, this tributary is not likely a high contributor of sediment to the larger watershed. At the far eastern upstream end, the channel is in pasture and fed by grassed waterways from the adjacent crop fields. A large headcut can be seen at the top of the channel near the intersections of West Miner Road and West Buckhill Road.

Figure 19-85. Representative channel with eroded banks.

Figure 19-86. Eroded bank with debris.

Figure 19-87. Dry channel with eroded banks.

Figure 19-88. Small pool from previous flow below a bedrock channel bottom.

19.2.16 Hughlett Branch 1 (HB1)

HB1 flows into the pool of the Galena River and is therefore slow moving. Its course is roughly parallel to Dewey Avenue, and can be seen clearly from the bridge which crosses it at Dewey Ave., and the bridge crossing it at Meeker Street. This reach ends a short distance upstream from the Dewey bridge where Hughlett Branch confluences with HB TRIB 1. HB1 has an eroded bank for most of its course. Upstream from the Meeker Street bridge the banks are very high (four to six feet), where soils have eroded from the adjacent hilltops and filled the floodplain. The presence of young trees and few mature trees indicates that the floodplain is filling with soil rather than the other frequent condition where the stream is cutting down into the soil. No debris jams were observed in this reach.

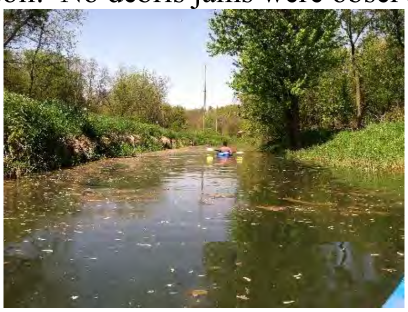

Figure 19-89. HB1 near its confluence with the Galena River.

Figure 19-90. HB1 near the Meeker Street Bridge; its eroded banks are submerged under high water.

Figure 19-91. HB1 looking downstream from the Dewey Ave. bridge.

19.2.17 Hughlett Branch 2 (HB2)

HB2 is a highly degraded system with eroded banks for a majority of its length. Large cobble is seen throughout this reach in the flow path. The high energy required to transport this large sized material is an indication of the intensity of the flows during large rain events, and the mobilization of this large material is understandably destructive and tears away at the banks and stream bed. Despite this destructive environment, very small minnows were observed in several of the pools of this reach during the survey. These fish are likely swept away during storms and migrate back up when conditions are more favorable. Most of this reach is down cutting, further channelizing the corridor and intensifying flows. One small 400 ft. section of this reach was observed to be stable, where the stream runs directly on bedrock and cannot downcut further. This bedrock section was markedly different than the rest of the reach, measuring approximately 18.5 ft. across, with 1.5 – 2 ft. banks. This broad area with low banks would be a useful model for restoration efforts in this corridor. No debris jams were observed in this reach.

Figure 19-92. Eroded banks and large cobble substrate.

Figure 19-93. Eroded bank adjacent to Council Hill Rd. measures more than 12 ft. high.

Figure 19-94. Short stable section of stream where course runs on bedrock.

19.2.18 Hughlett Branch 3 (HB3)

The valley feeding HB3 is over two miles long, and the stream at the valley bottom is highly sinuous, frequently carving back and forth from one side of the valley to the other, adding as much as 50% more length to the stream than that of the valley. This is the natural condition of a stream unaffected by human manipulation. The high sinuosity typically accommodates high water flows and reduces both stream energy and erosion. Despite the high sinuosity of HB3, the banks are eroded to some extent for almost the entire length of its course. Several oxbows can be found throughout the valley bottom where former paths of the stream have flowed, the stream has meandered, and former pools have been cut off. The stream originates from the outflow of grassed waterways in croplands. Once surface flow appears the stream flows through a broad valley floor for two miles. The valley bottom is open and not pastured, and the adjacent hills are mature oak hickory forest. Near its confluence with HB Trib 2, more than half a mile of the valley floor has matured to a riparian forest buffer, where the land owner has taken care of the land and many tree plantings are reaching a size to have deep root systems which are intended to provide stability to the banks. Four debris jams were observed in this reach, all in the lowest portion of the reach and composed of small trees and limbs. In the upper and open sections of the reach, debris was found scattered across the floodplain indicating frequent out-of-bank flows. The overall good health of the corridor of this reach leaves a perplexing case of why the stream is so degraded. At first look, it appears that it should be a model for stream restoration. There is little to no grazing in the stream. Many eroded corners have been stabilized with rock. Nuisance invasive species have been removed. Yet, the banks are eroded for almost the entire length, and the water runs a muddy brown color.

In most of the Galena River watershed it is assumed that mining and deforestation have destroyed the soil integrity of the hilltops and side slopes, and left a layer of topsoil on the valley floor which the stream now actively discharges trying to again gain equilibrium with its floodplain. There are conflicting indications in this reach that add another layer of complexity to this diagnosis. Throughout the reach very large mature trees can be seed on the floodplain. While it is possible that these trees have adapted to a constant supply of sediment to their roots and raised five to ten feet over the last 150 – 200 years as the hills have degraded, this is not typically the case. The stream itself does not give an indication that it is downcutting into the valley, leaving these trees dry. And the tree species themselves, oaks and walnuts, are not typical of a floodplain environment in which one might expect to see boxelders, cottonwoods, and willows. Further perplexing is that through much of the valley, mature sedges as much as five feet tall often dominate the vegetation, indicating moist environments not typical to oak-hickory environments.

One small pool, three-quarters of a mile up the valley may hold the answer. While surveying this corridor, the typical riffle-pool-riffle-pool sequence followed with five to eight-foot eroded bends and cobbly riffles breaking up elevation changes from pool to pool. One pool is different. It holds noticeably more water than any of the others. The banks are neatly grassed over, and no more than one and a half feet high. The pool is 20 feet across and filled with fish, who likely overwinter and spawn here. This pool, in its wide valley and highly sinuous stream, looked like it would be just as easily found in the remote backcountry of Wyoming or Montana, and could very well be what much of Jo Daviess County looked like prior to European settlement. What makes this one lonely pool different? This is the question the surveyors asked. Analyzing the pool for more than an hour, every facet of hydrology came into question. Finally, the answer appeared: a beaver swam across the pool, from one side to the other. The depletion of the beaver population falls right in line with history in the watershed; with settlement, mining, and logging the forests for timber. We are making tremendous strides towards many best management practices, such as bank stabilization, grassed waterways, and riparian buffers, but perhaps restoring nature's engineer has been dramatically overlooked- and perhaps the BMP needed most.


Figure 19-95. Grassed waterway in crop field in the headlands of the Hughlett Branch.


Figure 19-96. Five-foot-high eroded bank in planted riparian forest.


Figure 19-97. Stone toe bank protection installed in 2016.

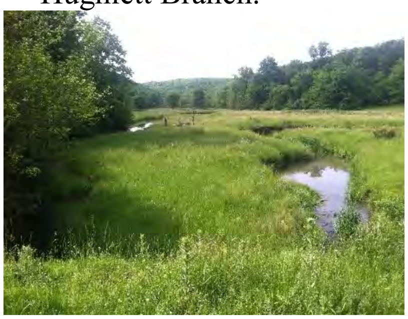
Figure 19-98. This highly sinuous reach meanders back and forth across the valley floor.


Figure 19-99. Eroded banks with actively slumping material. The soil layers visible in the bank indicate less legacy sediment than seen in other reaches of the watershed.


Figure 19-100. This one beaver pond may hold the answer to restoration in the watershed.

19.2.19 Hughlett Branch Tributary 1 (HB TRIB 1)

This stream reach is relatively isolated and difficult to access. It is small in length but drains a significant portion of land lying between US Highway 20 and developments on the lower portion of Council Hill Road. Like much of the watershed, almost the entirety of the bank is eroded. The watershed for this reach is primarily forested and mixed scrubland with some cool season grasses mixed into the floodplain in the bottom of the valley, and a very small amount of cropland in the headlands. At the headlands, a large erosional ditch has emerged and has recently been lined with rock check dams. The channelization of this stream continues for its entirety, varying from low to high. Near its confluence with the Hughlett Branch the drainage has been dug into a deeper channel and the spoils are piled on the adjacent bank, further disconnecting the stream from the floodplain. The stream bed is primarily cobble and gravel with little remaining sediment. No debris jams were observed in this reach.

Figure 19-101. Eroded channel of HB Trib 1.

Figure 19-102. HB Trib 1 lies in the back of this photo below the overstory vegetation; in the foreground, the material dug from the channel can be seen piled adjacent to the stream.

Figure 19-103. The headlands of HB Trib 1, with a scoured channel in the center of the photo.

19.2.20 Hughlett Branch Tributary 2 (HB TRIB 2)

HB Trib 2 starts in the headlands near the Wisconsin line and flows south roughly parallel to North Council Hill Rd. This stream reach has been channelized and pushed against the hillside to allow for cropping in some areas. Much of the stream runs through V-shaped valley bottom with some access to the floodplain. Aside from areas with adjacent cropland, the riparian vegetation is favorable overall, with mixed cool season grasses in the bottom areas and upland hills dominated by young oak-hickory forest. The headlands are cropped, and headwaters originate in grassed-waterways within crop fields. The stream bed is extremely rocky with almost no presence of soil or small material whatsoever. In several cases, the rock riffles between pools are formed from such large cobble that the interstices between rocks does not plug, and the riffle itself has no flow over it, but rather only through it. This impedes passage for all but the smallest of aquatic organisms, and makes these riffles very unstable. The water runs very clear in this reach and is noticeably less turbid than that of the Hughlett Branch where it convenes. Despite the degradation of the stream, numerous minnows and darters were observed in the pools at the lower end of this reach. In the center of the reach, the stream flows through a cattle pasture. All bends of the stream have eroded banks. One tributary flows into this stream with a large box culvert under Council Hill Rd. This tributary does not show much flow contribution during base flow conditions but does drain a significant portion of land, and likely has high flows during storm conditions. One debris jam was observed in this reach, which consisted of a fallen tree that does not block flow. Copious amounts of debris, including large rocks and logs, were observed up on the floodplain, indicating frequent out-of-bank flows.

Figure 19-104. Headland crop fields and grassed waterway at the start of the stream.

Figure 19-105. Cobbly stream bed adjacent to Council Hill Rd.

Figure 19-106. Eroded banks in pasture.

Figure 19-107. Box culvert under Council Hill Rd.

Figure 19-108. Cobble outwash forming permeable riffle.

Figure 19-109. All bends in this reach are eroded. This bank measures five feet high.

19.3 Stream Corridor Summary Tables

The field surveys conducted on surface waters throughout the watershed were used to populate the following tables:

Table 19-26. Summary of channelization in the Galena River Watershed.

Stream or Tributary Name	Reach Code	Stream Length Assessed (ft)	None or Low Channelization (ft/%)		Moderate Channelization (ft/%)		High Channelization (ft/%)	
Lower River	LR 1	10,675	3,770	35%	5,218	49%	1,687	16%
Lower River	LR 2	3,500	0	0%	2,434	70%	1,066	30%
Lower River	LR TRIB 1	5,750	4,177	73%	872	15%	701	12%
Lower River	LR TRIB 2	6,813	2,727	40%	3,065	45%	1,021	15%
Lower River Totals		**26,738**	**10,674**	**40%**	**11,589**	**43%**	**4,475**	**17%**
West Galena	WG 1	13,457	0	0%	6,473	48%	6,984	52%
West Galena Totals		**13,457**	**0**	**0%**	**6,473**	**48%**	**6,984**	**52%**
Down Town	DT 1	5,023	0	0%	845	17%	4,178	83%
Down Town	DT 2	4,045	0	0%	0	0%	4,045	100%
Down Town Totals		**9,068**	**0**	**0%**	**845**	**9%**	**8,223**	**91%**
Blackjack	BJ 1	6,683	0	0%	2,275	34%	4,408	66%
Blackjack Totals		**6,683**	**0**	**0%**	**2,275**	**34%**	**4,408**	**66%**
Mainstem	MS 1	6,974	0	0%	5,091	73%	1,883	27%
Mainstem	MS 2	8,123	0	0%	5,315	65%	2,808	35%
Mainstem	MS 3	8,323	1,271	15%	0	0%	7,052	85%
Mainstem	MS 4	2,444	1,318	54%	1,126	46%	0	0%
Mainstem	MS TRIB 1	8,675	792	9%	4,742	55%	3,141	36%
Mainstem	MS TRIB 2	8,019	1,123	14%	4,342	54%	2,554	32%
Mainstem	MS TRIB 3	6,255	1,439	23%	1,439	23%	3,315	53%
Mainstem Totals		**48,813**	**5,943**	**12%**	**22,055**	**45%**	**20,753**	**43%**
Hughlett Branch	HB 1	5,954	1,044	18%	3,096	52%	1,814	30%
Hughlett Branch	HB 2	3,188	400	13%	110	3%	2,678	84%
Hughlett Branch	HB 3	8,898	2,937	33%	3,381	38%	2,580	29%
Hughlett Branch	HB TRIB 1	6,906	202	3%	2,762	40%	3,942	57%
Hughlett Branch	HB TRIB 2	7,474	1,719	23%	2,840	38%	2,915	39%
Hughlett Brach Totals		**32,420**	**6,302**	**19%**	**12,189**	**38%**	**13,929**	**43%**
Totals		**137,179**	**22,919**	17%	**55,426**	40%	**58,772**	43%

Table 19-27. Summary of riparian buffer condition in the Galena River Watershed.

Stream or Tributary Name	Reach Code	Stream Length Assessed (ft)	Good Condition (ft/%)		Fair Condition (ft/%)		Poor Condition (ft/%)	
Lower River	LR 1	10,675	1,662	16%	9,013	84%	0	0%
Lower River	LR 2	3,500	735	21%	2,450	70%	315	9%
Lower River	LR TRIB 1	5,750	747	13%	4,140	72%	863	15%
Lower River	LR TRIB 2	6,813	2,668	39%	3,820	56%	325	5%
Lower River Totals		**26,738**	**5,812**	**22%**	**19,423**	**73%**	**1,503**	**6%**
West Galena	WG 1	13,457	1,800	13%	4,837	36%	6,820	51%
West Galena Totals		**13,457**	**1,800**	**13%**	**4,837**	**36%**	**6,820**	**51%**
Down Town	DT 1	5,023	1,808	36%	2,287	46%	928	18%
Down Town	DT 2	4,045	728	18%	2,734	68%	583	14%
Down Town Totals		**9,068**	**2,536**	**28%**	**5,021**	**55%**	**1,511**	**17%**
Blackjack	BJ 1	6,683	160	2%	2,579	39%	3,944	59%
Blackjack Totals		**6,683**	**160**	**2%**	**2,579**	**39%**	**3,944**	**59%**
Mainstem	MS 1	6,974	5,440	78%	349	5%	1,186	17%
Mainstem	MS 2	8,123	0	0%	1,470	18%	6,635	82%
Mainstem	MS 3	8,323	3,958	48%	502	6%	3,863	46%
Mainstem	MS 4	2,444	214	9%	1,318	54%	912	37%
Mainstem	MS TRIB 1	8,675	3,528	41%	1,760	20%	3,387	39%
Mainstem	MS TRIB 2	8,019	4,985	62%	2,121	26%	1,003	13%
Mainstem	MS TRIB 3	6,255	1,251	20%	3,378	54%	1,626	26%
Mainstem Totals		**48,813**	**19,376**	**40%**	**10,897**	**22%**	**18,612**	**38%**
Hughlett Branch	HB 1	5,954	0	0%	5,754	97%	200	3%
Hughlett Branch	HB 2	3,188	824	26%	1,351	42%	1,013	32%
Hughlett Branch	HB 3	8,898	2,957	33%	2,405	27%	3,536	40%
Hughlett Branch	HB TRIB 1	6,906	1,807	26%	1,099	16%	4,000	58%
Hughlett Branch	HB TRIB 2	7,474	3,065	41%	1,644	22%	2,765	37%
Hughlett Brach Totals		**32,420**	**8,653**	**27%**	**12,253**	**38%**	**11,514**	**36%**
Totals		**137,179**	**38,337**	**28%**	**55,010**	**40%**	**43,904**	**32%**

Table 19-28. Summary of stream channel erosion in the Galena River Watershed.

Stream or Tributary Name	Reach Code	Stream Length Assessed (ft)	None or Low Erosion (ft/%)		Moderate Erosion (ft/%)		High Erosion (ft/%)	
Lower River	LR 1	10,675	1,388	13%	6,298	59%	2,989	28%
Lower River	LR 2	3,500	850	24%	2,135	61%	515	15%
Lower River	LR TRIB 1	5,750	3,596	63%	782	14%	1,372	24%
Lower River	LR TRIB 2	6,813	6,004	88%	289	4%	520	8%
Lower River Totals		**26,738**	**11,838**	**44%**	**9,504**	**36%**	**5,396**	**20%**
West Galena	WG 1	13,457	128	1%	1,480	11%	11,849	88%
West Galena Totals		**13,457**	**128**	**1%**	**1,480**	**11%**	**11,849**	**88%**
Down Town	DT 1	5,023	402	8%	3,616	72%	1,005	20%
Down Town	DT 2	4,045	2,671	66%	769	19%	605	15%
Down Town Totals		**9,068**	**2,671**	**29%**	**769**	**8%**	**605**	**7%**
Blackjack	BJ 1	6,683	3,701	55%	1260	19%	1,722	26%
Blackjack Totals		**6,683**	**3,701**	**55%**	**1,260**	**19%**	**1,722**	**26%**
Mainstem	MS 1	6,974	4,802	69%	1,433	21%	739	11%
Mainstem	MS 2	8,123	1,706	21%	5,241	65%	1,126	14%
Mainstem	MS 3	8,323	2000	24%	1,388	17%	4,935	59%
Mainstem	MS 4	2,444	131	5%	452	18%	1,861	76%
Mainstem	MS TRIB 1	8,675	2,761	32%	3,602	42%	2,312	27%
Mainstem	MS TRIB 2	8,019	882	11%	4,817	60%	2,320	29%
Mainstem	MS TRIB 3	6,255	438	7%	2,002	32%	3,816	61%
Mainstem Totals		**48,813**	**12,720**	**26%**	**18,935**	**39%**	**17,109**	**35%**
Hughlett Branch	HB 1	5,954	2,262	38%	2,264	38%	1,428	24%
Hughlett Branch	HB 2	3,188	522	16%	2,040	64%	626	20%
Hughlett Branch	HB 3	8,898	5,854	66%	1,940	22%	1,104	12%
Hughlett Branch	HB TRIB 1	6,906	1,946	28%	2,900	42%	2,060	30%
Hughlett Branch	HB TRIB 2	7,474	1,270	17%	2,691	36%	3,513	47%
Hughlett Brach Totals		**32,420**	**11,854**	**37%**	**11,835**	**37%**	**8,731**	**27%**
Totals		**137,179**	**42,912**	**2**	**43,783**	**1**	**45,412**	**2**

Table 19-29. Summary of debris jams observed during the stream corridor assessments.

Stream or Tributary Name	Reach Code	Stream Length Assessed (ft)	Debris Jams (number)
Lower River	LR 1	10,675	1
Lower River	LR 2	3,500	0
Lower River	LR TRIB 1	5,750	6
Lower River	LR TRIB 2	6,813	1
Lower River Totals		**26,738**	**8**
West Galena	WG 1	13,457	30*
West Galena Totals		**13,457**	**0**
Down Town	DT 1	5,023	0
Down Town	DT 2	4,045	0
Down Town Totals		**9,068**	**0**
Blackjack	BJ 1	6,683	6
Blackjack Totals		**6,683**	**6**
Mainstem	MS 1	6,974	0
Mainstem	MS 2	8,123	0
Mainstem	MS 3	8,323	0
Mainstem	MS 4	1,126	0
Mainstem	MS TRIB 1	8,675	3
Mainstem	MS TRIB 2	8,019	2
Mainstem	MS TRIB 3	6,255	19
Mainstem Totals		**47,495**	**24**
Hughlett Branch	HB 1	5,954	0
Hughlett Branch	HB 2	3,188	1
Hughlett Branch	HB 3	8,898	4
Hughlett Branch	HB TRIB 1	6,906	0
Hughlett Branch	HB TRIB 2	7,474	0
Hughlett Brach Totals		**32,420**	**5**
Totals		**135,861**	**43**

*- Note: This debris jam is a beaver dam.

19.4 Stream Hydrology Statistics

The following table was derived from the Streamstats model developed by the United States Geological Society (Ishii, Soong, & Sharpe, 2010). For each reach the drainage area (square miles) and stream slope (feet per mile) is given. Discharge predictions are given for two-year and ten-year storm events. The two-year storm event is generally accepted as the channel forming discharge, or the storm events which dictate the shape of the channel within the floodplain. Stream stabilization best management practices are generally designed to consider the ten-year storm event, accommodating a frequent out of bank flow. A particular note of interest is that storm flows should be expected to increase as drainage area increases. However, flows at the bottom of the watershed are roughly equal to flows predicted above the downtown area, despite the addition of more than 5% of drainage area, and flows greatly increase in the constriction of the downtown area and directly below downtown, indicating that this area receives the brunt of energy from the levee constriction.

Table 19-30. Statistics for river reaches in the Galena River Watershed.

Stream or Tributary Name	Reach Code	Watershed Size (sq.mi.)	2-Year Storm Flow (ft^3/sec.)	10-Year Storm Flow (ft^3/sec.)	Stream Slope (ft/mi.)
Lower River	LR 1	203	3,720	8,270	7.8
Lower River	LR 2	201	3,780	8,410	8.2
Lower River	LR TRIB 1	0.74	143	398	166.5
Lower River	LR TRIB 2	0.44	122	338	151.0
West Galena	WG 1	1.66	242	632	68.9
Down Town	DT 1	199	3,790	8,450	8.0
Down Town	DT 2	197	3,810	8,510	9.0
Blackjack	BJ 1	1.14	224	604	108.5
Mainstem	MS 1	190	3,720	8,320	8.7
Mainstem	MS 2	187	3,660	8,170	8.7
Mainstem	MS 3	183	3,620	8,110	8.8
Mainstem	MS 4	182	3,600	8,050	8.7
Mainstem	MS TRIB 1	2.29	332	876	82.0
Mainstem	MS TRIB 2	2.21	342	912	96.3
Mainstem	MS TRIB 3	0.52	127	346	121.7
Hughlett Branch	HB 1	5.79	555	1,420	53.3
Hughlett Branch	HB 2	4.07	459	1,190	64.0
Hughlett Branch	HB 3	2.24	300	781	66.7
Hughlett Branch	HB TRIB 1	1.29	216	572	83.0
Hughlett Branch	HB TRIB 2	1.55	234	610	73.6

19.5 STEP-L Results

The data from land use in the watershed was combined with Best Management Practices (BMPs) identified in the watershed and the data returned from the stream corridor assesments and entered into the Spreadsheet Tool for Estimating Pollutant Loads (STEP-L). The results from this tool follow.

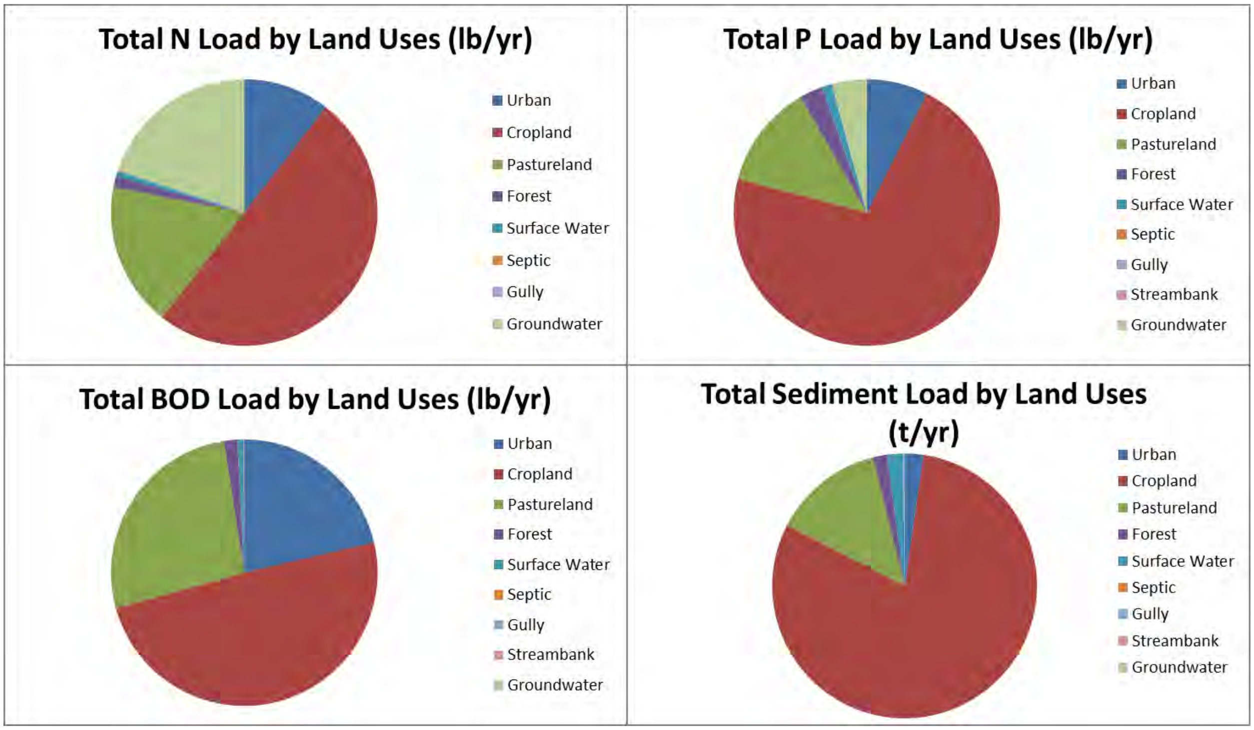

Figure 19-110. Charts showing loads modeled by the STEP-L method.

Table 19-31. Table summarizing the loads shown Figure 19-110.

Subwatershed	**N Load (lb/yr)**	**P Load (lb/yr)**	**BOD (lb/yr)**	**Sediment Load (ton/yr)**
Lower River	6,374.0	1,534.0	8,813.0	1,075.0
West Galena	6,486.0	1,452.0	9,730.0	978.0
Blackjack	3,523.0	781.0	5,155.0	524.0
Downtown	4,843.0	763.0	11,057.0	302.0
Hughlett Branch	25,683.0	6,393.0	39,078.0	4,489.0
Mainstem	32,144.0	7,690.0	45,761.0	5,392.0
Total	**79,053.0**	**18,613.0**	**119,595.0**	**12,760.0**

Table 19-32. Loads shown by source as estimated by STEP-L model.

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	8,290.5	1,387.3	25,541.2	288.4
Cropland	39,624.0	13,325.7	58,998.9	10,251.2
Pastureland	13,788.4	2,353.6	32,109.7	1,729.0
Forest	1,070.8	524.4	1,952.1	217.9
Surface Water	535.4	224.1	854.3	253.7
Septic	30.9	13.1	100.5	0.0
Gully	20.7	8.7	33.1	17.1
Streambank	3.3	1.4	5.2	2.7
Groundwater	15,689.0	774.7	0.0	0.0
Total	**79,053.0**	**18,613.0**	**119,595.0**	**12,760.0**

20.0 WATER QUALITY ASSESSMENT

The Illinois Environmental Protection Agency's 2016 Integrated Water Quality Report and 303d List (IWQR) identifies the Galena River (AUID MQ-01) and lists it as impaired for zinc, sedimentation / siltation, total suspended solids, bottom deposits, polychlorinated biphenols, and fecal coliform. The sources listed for these impairments are channelization, livestock (grazing or feeding operations), urban runoff / storm sewers, impacts from inactive abandoned mine lands, and unknown sources. The designated uses for the Galena River (MQ-01) are listed as aesthetic quality, aquatic life, fish consumption, and primary contact recreation. The following table summarizes the Illinois Environmental Protection Agency's (EPA) listed causes associated with these designated uses.

Table 20-33. Illinois EPA's Designated Uses and Causes from the 2016 Integrated Water Quality Report and 303d List.

Designated Use	Associated Cause	Listed Sources of Impairment
Aesthetic Quality	Bottom Deposits	Channelization, Livestock (Grazing or Feeding Operations), Urban Runoff / Storm Sewers, Impacts from Abandoned Mine Lands (Inactive), and Source Unknown.
Aquatic Life	Sedimentation / Siltation Total Suspended Solids (TSS) Zinc	
Fish Consumption	Polychlorinated Biphenols	
Primary Contact Recreation	Fecal Coliform	

The Galena/Sinsinawa Rivers Watershed TMDL Report prepared for the Illinois EPA by CDM Smith (2016) provides an analysis of zinc, sedimentation/siltation, total suspended solids, and fecal coliform. This report takes information from the 2014 IWQR, however, the 2016 IWQR also includes bottom deposits and polychlorinated biphenols (PCBs). The Illinois EPA is not currently developing TMDLs for sediment and PCBs (A. Haile, personal communication, January 19, 2017).

In addition to the IWQR, sampling is also conducted by the Illinois EPA in conjunction with the Illinois Department of Natural Resources (IDNR) through the Basin Survey; sampling conducted on a five-year basis throughout the Jo Daviess County Area (Vidales, 2016). This survey includes a sampling site on the Galena River at MQ-01 at the Route 20 Highway bridge in Galena (sample date 07/07/2015, 3:45pm), as well as upstream at MQ-02 3.5 miles north of Galena on Council Hill Rd. (sample date 07/06/2015, 3:50pm), and on the East Fork Galena River (MQB-01) at Council Hill Station on North Ford Rd. (sample date 07/07/2015, 8:25 am).

These identification parameters are the amalgamation of field sampling performed by trained biologists. By nature, stream conditions are generally of the lowest quality during the heaviest of rain storms, and field samples are not taken at these times. While field sampling may be perceived as random snapshots of a stream's condition, it is generally accepted that sampling results tend to favor conditions on the average to good, while the lowest quality samples are usually not obtained. However, the lowest quality conditions often persist for a very short duration, as flushes of a pollutant occur and then either precipitate out or are flushed downstream. Because of this, when samples exceed water quality targets it is often the case that the general state of the waterbody exceeds the target a majority of the time, and becomes even worse during storm conditions.

20.1 Bottom Deposits

The associated cause *bottom deposits* for 303d listing for the designated use aesthetic quality is a qualitative observation made by Illinois EPA biologists during intensive basin survey sampling based on the presence of silt and/or mud when compared to natural or expected conditions (IWQR, 2016). This is one of few Illinois water quality standards which is exclusively narrative and has no explicit numeric component in the standard. This stems from the standard at 35 Ill. Adm. Code 302.203 which prohibits "sludge or bottom deposits, floating debris, visible oil, odor, plant or algal growth, color or turbidity of other than natural origin" in all "general use" waters of the state. Revisions made to 35 Ill. Adm. Code 302.203, 302.403 and 302.515 by the Illinois Pollution Control Board in 1990 and 1997 make these exclusively narrative standards apply only to the protection of aesthetic quality in Illinois waters (IWQR, 2016).

20.2 Sedimentation/Siltation

Erosion is a natural process under which soils and sediments are detached from earth's surface and are transported downstream where they are deposited where slope angle decreases and/or water slows. However, the natural rate of erosion and sedimentation can be greatly accelerated by human influence, destabilizing the ground surface.

Sedimentation in the Galena River Watershed is well known. Academic study of the condition likely first took place by Clifford Adams in his Masters and Doctoral research (1940 & 1942) at Iowa State University. Adams attributes sedimentation in the Galena River Watershed to European settlement in the area which cleared the land for mining and agriculture, with mining being the most detrimental. Adams (1942) notes that top soil on slopes has been eroded away to bedrock while in valley bottoms the topsoil has been buried under several feet of deposited sediment. The combination of disturbed soil and vegetation, along with the steep slopes in the watershed, and increased frequency and intensity of extreme rainfall events have led to extreme erosional issues in the Galena River Watershed.

The Galena River listing for impairment due to sedimentation and siltation is due to the impacts of sedimentation and siltation to aquatic life. Sedimentation in aquatic ecosystems affects light penetration, temperature adjustment, electrolytes, bottom conditions, and retention of organic matter (Castro & Reckendorf, 1995). Numerous volumes of scientific research have documented the impacts of sediments to native mussel species and fish spawning habitat, not to mention numerous other aquatic life groups. Like other environmental contaminants, aquatic life responds to both the amount of sediments and duration of exposure (Newcombe & MacDonald, 1991).

The Galena/Sinsinawa Rivers Watershed TMDL (CDM Smith, 2016) covers sedimentation and siltation data for the Galena River (AUID MQ-01) identified by the Illinois EPA during field investigations. In 2006, 24 inches of sediment was documented on the streambed, which is greater than 34% of the stream depth at the sampling site. During the 2010 assessment, a column of sediment equal to 90% of the stream depth was observed at MQ-1 (CDM Smith, 2016). The 2015 Basin Survey data from the Illinois EPA does not contain information on the sediment conditions. Similarly, the 2015 Basin Survey data from the Illinois Department of Natural Resources does not specifically list the sediment depth, but does note MQ-1 with channelization, eroded banks, and a muddy bottom substrate (Rivera, 2016). Rivera's (2016) report describes MQ-2:

> "Average depth at this station was 1.5' with an average width of 75'. The stream in this area was flowing through a cow pasture so the riparian corridor was mostly grass and weeds

with few trees. Bottom sediments consisted of 5% sand, 10% gravel, 80% cobble, and 5% boulders."

This record suggests that extenuating bottom sediments are less present upstream (MQ-02) than in the lower reaches of the river (MQ-01). This may be explained by the fact that the slopes are steeper in headwater areas and flatter in bottomland areas. This natural hydrologic condition causes suspended sediment to precipitate in slow moving areas, typical of lower watershed reaches. Another factor is that the modified channel restriction created by the levee in the city of Galena speeds waters and removes sediments within the constriction, moving sediment to the lower reaches of the watershed.

20.3 Total Suspended Solids

Total suspended solids (TSS) rank highly as an overall impairment for Illinois streams and lakes. According to the IWQR (2016), TSS affects 1,004 miles of streams and 117,388 acres of lakes in Illinois. This impairment can be loosely correlated to the presence of bottom sediments, as TSS often settle to become sediment. TSS are all particles suspended in water which will not pass through a filter. TSS can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage. These conditions may be caused by nonpoint source pollution, such as erosion, as well as by sanitary wastewater and many types of industrial wastewater. Also, the presence of some fish species, such as common carp (*Cyprinus carpio*), can stir up existing bottom sediments and raise them back into suspension. When TSS levels increase, a water body begins to lose its ability to support a diversity of aquatic life. As with sedimentation and siltation, suspended solids absorb heat from sunlight, which increases water temperature and subsequently decreases levels of dissolved oxygen (warmer water holds less oxygen than cooler water). Some cold-water species, such as trout and stoneflies, are especially sensitive to changes in dissolved oxygen. Photosynthesis also decreases, since less light penetrates the water. As less oxygen is produced by plants and algae, there is a further drop in dissolved oxygen levels. TSS can also destroy fish habitat because suspended solids settle to the bottom and can eventually blanket the river bed. Suspended solids can smother the eggs of fish and aquatic insects, and can suffocate newly-hatched insect larvae. Suspended solids can also harm fish directly by clogging gills, reducing growth rates, and lowering resistance to disease (Mitchell & Stapp, 1992). Changes to the aquatic environment may result in a diminished food sources, and increased difficulties in finding food.

TSS impairment for the aquatic life use in the Galena River has been listed for the lower Galena River (MQ-01) but not tested in any of the other subwatersheds identified in this document. The Illinois EPA TSS target for the Galena River Watershed is ≤ 24.1 mg/L (CDM Smith, 2016). Sampling averages identified in the Galena/Sinsinawa Rivers Watershed TMDL (CDM Smith, 2016) show a mean value of 37.59 mg/L, with a maximum field sampling value identified as 440 mg/L, and a total of 40 samples since 1999 exceeding target TSS value. This report does not include 2015 Basin Survey data, which reported a TSS value of 21 mg/L.

20.4 Zinc

Zinc is a naturally occurring element essential to numerous aspects of cellular metabolism. However, the free zinc ion in solution is highly toxic to bacteria, plants, invertebrates, and vertebrate fish. Zinc is most harmful to aquatic life during early life stages, in soft water, under conditions of low pH, low alkalinity, low dissolved oxygen, and elevated temperatures (USDOI, 1998). Zinc introduced into aquatic environments eventually becomes partitioned into sediments. Because zinc is highly reactive, a straightforward measurement of zinc concentration does not reflect the nature of the toxicity of zinc in solution. The zinc ion occurs in the Zn^{2+} state, and in natural waters dissolved zinc speciates into the toxic ion $[Zn(H_2O)_6]^{2+}$ between pH 4 and 7.

Zinc is naturally occurring in the environment, and occurs in high levels in the Galena River Watershed from tailings of the lead and zinc mining industry (Adams, 1944). Modern testing for zinc in the Galena River is documented in the Galena Sinsinawa Rivers Watershed TMDL (CDM Smith, 2016), showing a sampling period from 1999 – 2014 with 103 samples taken. These samples are adjusted to account for water hardness. The Illinois EPA water quality criteria for zinc related to aquatic life in Illinois streams and Lake Calumet is hardness dependent and has two standards based on acute and chronic toxicity.

The formula for acute and chronic toxicity is:

Acute	$e^{A+B\ \ln(H)}$ x 0.978*	Chronic	$e^{A+B\ \ln(H)}$ x 0.986*
Where:	A = 0.5173 B = 0.8473		A = -0.4456 B = 0.8473

Ln(H) = natural logarithm of hardness

- = conversion multiplier for dissolved metals. (IEPA, 1978)

According to the CDM Smith report (2016), 23 of the 103 samples exceeded the chronic toxicity standard. The mean sample in the Galena River is 82 µg/L and the maximum sample reached 200 µg/L. The 2015 Intensive Basin Survey data shows MQ-01 with a zinc level of 86.6 µg/L. When adjusted for water hardness (Essig, 2005) the acute toxicity standard becomes 420.91 µg/L and the chronic toxicity standard becomes 110.11, both above the sample taken at the site. However, knowing the dynamic nature of zinc in solution, the toxicity of this sample could change drastically with changes in pH, temperature, or hardness.

20.5 Polychlorinated Biphenyls

The Galena River (MQ-01) is considered impaired by the Illinois EPA when assessed for fish consumption due to elevated levels of polychlorinated biphenyls (PCBs). PCBs are considered a bio-accumulative chemical of concern. Bioaccumulation is a condition which harmful chemicals are accumulated in biological organisms at higher and higher levels as they move up the food chain. Additionally, PCBs are persistent in the environment. The half-life of PCBs in the water column, sediment, or biota ranges from two to six years (Ogura, 2004; Phillips et al., 1989; Shirai & Kissel, 1996).

PCB exposure is linked to infant development problems in children whose mothers were exposed to PCBs before becoming pregnant. Continuous high-level doses of PCBs have been shown to cause cancer in laboratory animals (Abelson, 1991) and may cause cancer in humans (Pavuk et al., 2004; Robertson & Hansen, 2015; Stellman et al., 2000). Remediation of sediments containing high levels of PCBs has shown declines in PCB levels in biota in as little as one year (Kemble et al., 2000).

The human health standard for PCBs is 26 picograms per liter (pg/L) and the wildlife standard is 120 pg/L (IEPA, 1978). However, the fate of PCBs in the environment is complex. Because tissue tests are performed for PCB levels in an organism, the unit "pg/L" is not readily convertible to tissue test results which are reported in “mg/kg” of tissue. Further complicating the issue, the effects of PCBs can vary based on body weight, portion size, age of fish, species of fish, consumer’s age, dose interval, and cancer risk level. The Illinois Department of Public Health (IDPH, 2017) has listed a fish consumption advisory for the Galena River pertaining to common carp (*Cyprinus carpio*) and channel catfish (*Ictalurus punctatus*). For common carp, the public is advised to eat only one meal per week for fish lengths less than 20 inches and no more than one meal per month for fish between 20 and 24 inches. Common carp above 24 inches in length are not recommended for consumption at all. For all sizes of channel catfish, the public are advised to eat no more than one meal per month. These advisories are primarily based on protecting sensitive populations, such as women who are pregnant, nursing, or of childbearing age, fetuses, and children under 15 years of age. Because PCBs are lipophilic (accumulate in fatty tissue), trimming fatty tissue from fish is recommended. Additional measures to reduce PCB levels in fish at the table include broiling, grilling, or baking skinned and trimmed fish on a rack so the fat drips away. Using the drippings to prepare sauces or gravies is not recommended.

Illinois EPA data for PCBs at the Galena River (AUID MQ-01) are shown in Table 20-34. A total of six species of fish have been sampled between 2000 and 2009 during intensive basin survey sampling. These fish ranged in average weight from 0.23 – 7.52 pounds, with positive PCB results ranging from 0.034 mg/kg to 4 mg/kg. Two samples resulted in non-detectable reports, or levels below the test method identifiable range. These results may possibly be explained by capture of fish that have moved through the sampling area in the recent past and not resided in an area of PCB contamination for any significant length of time when captured.

Table 20-34. PCB data from the Galena River (MQ-01).

Sampling Date	Fish Species	Sample Location	Number of Individuals	Average Fish Weight (lbs)	Average Fish Length (in)	PCB_Result (mg/kg)
08/03/00	Common carp	Galena	4	3.46	19.7	0.2
07/25/01	Common carp	Galena	5	3.82	19.7	0.1
07/25/01	Common carp	Galena	5	6.92	23.4	0.41
06/20/05	Common carp	Galena Boat Ramp	3	4.77	21.3	0.44
06/20/05	Largemouth bass	Galena Boat Ramp	3	0.57	11	Not Detected
07/30/07	Bluegill	downstream of Route 20 Bridge	4	0.23	6.32	Not Detected
07/30/07	Channel catfish	downstream of Galena Boat Ramp	2	2.54	19.8	1.4
07/30/07	Common carp	downstream of US 20 Bridge	3	7.52	25.6	0.24
07/30/07	Common carp	downstream of Galena Boat Ramp	5	3.53	20.2	0.26
07/30/07	Largemouth bass	downstream	5	1.19	12.7	0.086
07/30/07	Walleye	downstream of boat ramp	2	2.47	19.7	0.034
06/03/09	Channel catfish		3	2.35	18.2	0.47
06/03/09	Common carp		3	4.62	21.4	0.42
06/03/09	Common carp		3	7.31	24	4
06/03/09	Rock bass		3	0.23	6.54	0.042

Two historic electrical substations in the area have been identified as potential sources of PCB contamination (Figure 20-111). The southernmost station is located within proximity to the MQ-01 sampling site. No known testing has been completed near the historic station to the north. In the future, sampling at a site near the northern site may be beneficial, although its distance from surface water make it less of a contamination concern than the southern station which is located directly on the river.

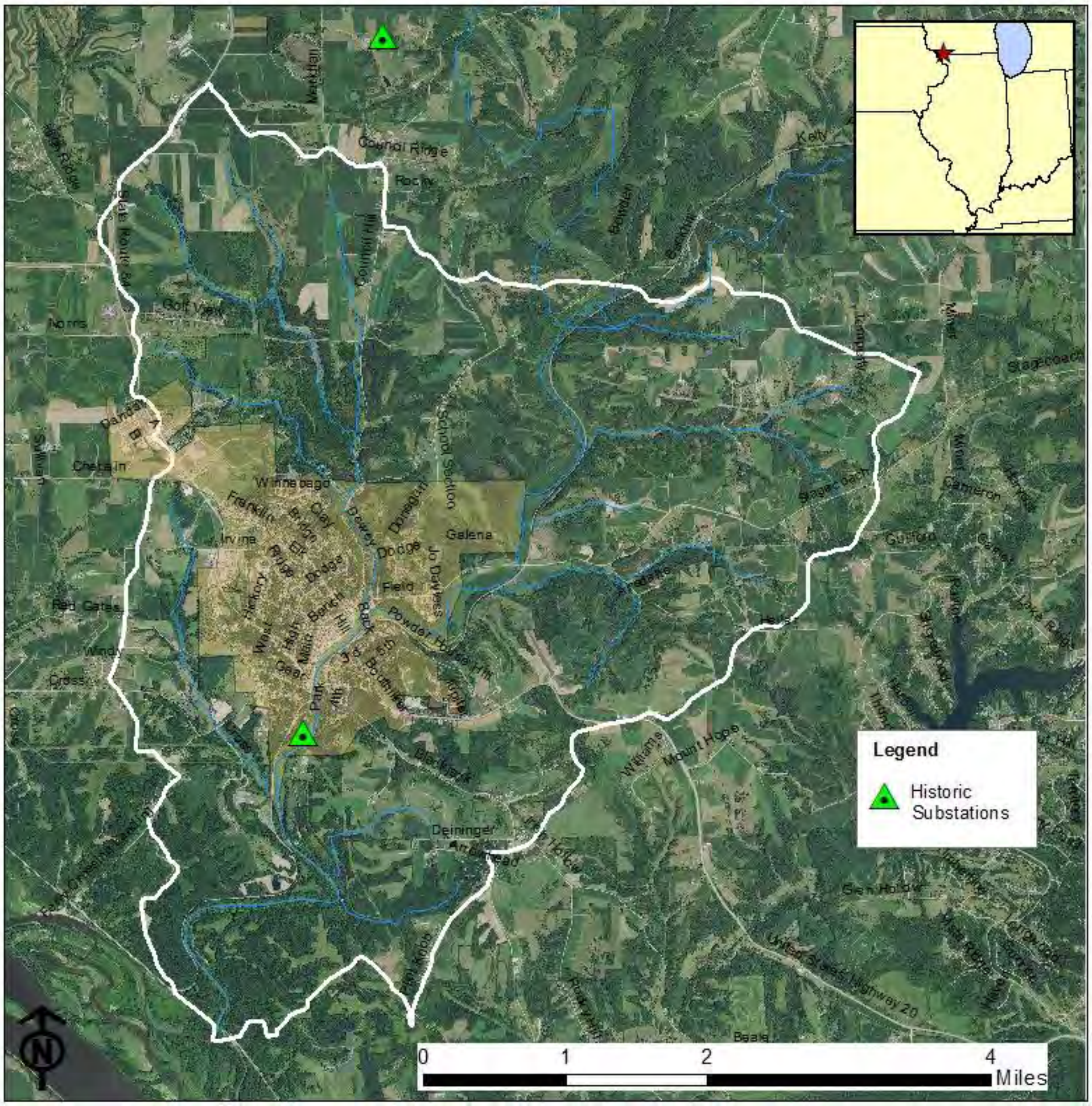

Figure 20-111. The Galena River Watershed with locations of two known historic substations indicated with green triangles.

20.6 Fecal Coliform

The Galena River (AUID MQ-01) is considered impaired by the Illinois EPA when assessed for primary contact recreation due to fecal coliform. Illinois water quality standards define primary contact as "any recreational or other water use in which there is prolonged and intimate contact with the water involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard, such as swimming and water skiing" (35 Ill. Adm. Code 301.355). Most bacteria in surface waters perform vital ecosystem functions and do not cause illness to humans. Most cases of water borne illness come from specific short-lived outbreaks of bacteria that live in the lower intestines of warm and cold-blooded animals, such as wildlife, farm animals, pets, and humans. These bacteria aid in digestion and are excreted in their feces. *Escherichia coli* and fecal coliform are not usually pathogenic, but their presence can indicate fecal contamination. If fecal coliform counts are high in a surface water, a person swimming in that water has a greater chance of getting sick from swallowing the water, or from pathogens entering the body through cuts in the skin, nose, mouth or ears. Diseases such as typhoid fever, hepatitis, gastroenteritis, dysentery, and ear infections can be contracted from waters with a high fecal-coliform count. These outbreaks can be caused by wastewater and septic system effluent, animal wastes, or sediment loads. High sediment loads and high-water temperatures can extenuate blooms.

The General Use Water Quality Standard for fecal coliform bacteria specifies that during the months of May through October, based on a minimum of five samples taken over not more than a 30-day period, fecal coliform bacteria counts shall not exceed a geometric mean of 200 colony forming units (cfu) per 100 ml, nor shall more than 10 percent of the samples during any 30-day period exceed 400 cfu per 100 ml (35 Ill. Adm. Code 302.209). Fecal coliform bacteria is not usually sampled at this frequency due to limited state resources (IWQR, 2016). Due to this, assessment guidelines are based on the data that is available. Fecal coliform data has been collected 42 times between 2000 – 2014. The average of these samples is 453 cfu per100 mL, with a maximum sample of 6880 cfu per 100mL, and a minimum of 1 cfu per 100 mL. Of these total samples, 33 samples were greater than 200 cfu per 100 mL, and 20 samples were greater than 400 cfu per 100 mL.

20.7 Needed Load Reductions

The only available information available on loading in the Galena River Watershed is in the Galena/Sinsinawa Rivers Watershed TMDL Stage 3 Draft Report (CDM Smith, July 2017). This report develops TMDL load reduction needs for the impaired reach of the Galena River (MQ-01), addressing fecal coliform, zinc, and TSS (total suspended solids) and sedimentation/siltation. A more extensive testing effort is required to develop load reduction needs at the subwatershed scale for the watershed.

The TMDL creates load reduction needs which vary based on flow. The fecal coliform TMDL lists a needed reduction ranging from 31% to 96% based on the standard of 200 colony forming units per 100mL, with an average reduction of 71.9%. The zinc TMDL lists a needed reduction ranging from 43% to 63%, with an average reduction need of 54.4%. The Illinois EPA set a numeric target of 24.1mg/L for TSS. The estimated TSS reductions needed range from no reduction to an 81% reduction, depending on flow, with an average reduction of 52.4%.

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22.0 GLOSSARY

100-year floodplain: A 100-year flood is a flood that has a 1-percent chance of being equaled or exceeded in any given year. A base flood may also be referred to as a 100-year storm and the area inundated during the base flood is called the 100-year floodplain.

303(d): The Federal Clean Water Act requires states to submit a list of impaired waters to the USEPA for review and approval using water quality assessment data from the Section 305(b) Water Quality Report. States are then required to develop total maximum daily load analyses (TMDLs) for waterbodies on the 303(d) list.

305(b): The Illinois 305(b) report is a water quality assessment of the state's surface and groundwater resources that is compiled by the Illinois EPA as a report to the USEPA as required under Section 305(b) of the Clean Water Act.

Aquatic habitat: Structures such as stream substrate, woody debris, aquatic vegetation, and overhanging vegetation that is important to the survival of fish and macroinvertebrates.

Base flow: The flow that a perennially flowing stream reduces to during the dry season. It is often supported by groundwater seepage into the channel.

Bedrock: The solid rock that underlies loose material, such as soil, sand, clay, or gravel.

Best Management Practices (BMPs): Best Management Practices (BMPs) are non-structural practices such as site planning and design aimed to reduce stormwater runoff and avoid adverse development impacts - or structural practices that are designed to store or treat stormwater runoff to mitigate flood damage and reduce pollution. Some BMPs used in urban areas may include stormwater detention ponds, restored wetlands, vegetative filter strips, porous pavement, silt fences and biotechnical streambank stabilization.

Biodiversity: The variety of organisms (plants, animals and other life forms) that includes the totality of genes, species and ecosystems in a region.

Bio-infiltration (rain gardens): Excavated depressional areas where stormwater runoff is directed and allowed to infiltrate back into groundwater rather than allowing to runoff. Infiltration areas are planted with appropriate vegetation.

Biological Oxygen Demand (BOD): The amount of dissolved oxygen that is required by microscopic organism (e.g. bacteria) to decompose organic matter in waterbodies.

Biological Stream Characterization (BSC): A multi-tiered stream quality classification based primarily on the attributes of lotic (living in moving water) fish communities. The predominant stream quality indicator used in this process is the Index of Biotic Integrity (IBI), comprised of 12 metrics, which form a basis for describing the health or integrity of the fish community.

When insufficient fishery data are available for calculating an IBI value, BSC criteria allow the use of sport fishing information or macroinvertebrate data to rate streams. BSC provides a uniform process of characterizing streams statewide and is used by a variety of sources for stream protection, restoration and planning efforts.

Bioengineering (or Soil Bioengineering): Techniques for stabilizing eroding or slumping stream banks that rely on the use of plants and plant materials such as live willow posts, brush layering, coconut logs and other "greener" or "softer" techniques. This is in contrast to techniques that rely on creating “hard” edges with riprap, concrete and sheet piling (metal and plastic).

Channelized stream: A stream that has been artificially straightened, deepened, or widened to accommodate increased stormwater flows, to increase the amount of adjacent land that can be developed or used for urban development, agriculture or for navigation purposes. In addition to being unsightly, channelized streams have a uniform gradient, no riffle and pool development, no meanders (curves) and very steep banks. The vegetation is frequently removed and replaced with riprap, concrete or other hard surfaces. During low flow periods in the summer, many channelized streams have low dissolved oxygen levels, in part due to shallow, slow-moving water. Under these conditions, they provide poor habitat for fish or other stream organisms such as benthic macroinvertebrates.

Channel: Any river, stream, creek, brook, branch, natural or artificial depression, ponded area, lakes, flowage, slough, ditch, conduit, culvert, gully, ravine, swale, wash, or natural or man-made drainageway, in or into which surface or groundwater flows, either perennially or intermittently.

Conservation easement: The transfer of land use rights without the transfer of land ownership.

Conservation easements can be attractive to property owners who do not want to sell their land now, but would support perpetual protection from further development. Conservation easements can be donated or purchased.

Clean Water Act (CWA): The CWA is the basic framework for federal water pollution control and has been amended in subsequent years to focus on controlling toxics and improving water quality in areas where compliance with nationwide minimum discharge standards is insufficient to meet the CWA’s water quality goals.

Debris Jam: Natural and man-made debris in a stream channel including leaves, logs, lumber, trash and sediment.

Designated Use: EPA requirements that states and authorized Indian Tribes specify appropriate water uses to be achieved and protected. Appropriate uses are identified by taking into consideration the use and value of the water body for public water supply, for protection of fish, shellfish, and wildlife, and for recreational, agricultural, industrial, and navigational purposes. In designating uses for a water body, States and Tribes examine the suitability of a water body for the uses based on the physical, chemical, and biological characteristics of the water body, its geographical setting and scenic qualities, and economic considerations. Each water body does not necessarily require a unique set of uses. Instead, the characteristics necessary to support a use can be identified so that water bodies having those characteristics can be grouped together as supporting specific uses.

Detention basin: A man-made structure for the temporary storage of stormwater runoff with controlled release during or immediately following a storm.

Discharge (streamflow): The volume of water passing through a channel during a given time, usually measured in cubic feet per second.

Digital Elevation Model (DEM): Regularly spaced grid of elevation points used to produce elevation maps.

Dissolved oxygen (DO): The amount of oxygen in water, usually measured in milligrams/liter.

Downcutting: The action of a stream to deepen itself, often as a result from channelization.

Drainage basin: Land surface region drained by a length of stream channel; usually 1,000 to 10,000 square miles in size.

Ecosystem: An ecological community together with its environment, functioning as a unit.

Erosion: Displacement of soil particles on the land surface due to water or wind action.

European settlement: A period in the early 1800s when European settlers moved across the United States in search of better lives. During this movement, much of the historical communities were altered for farming and other types of development.

Eutrophic: A waterbody having a high level of biological productivity. A typical eutrophic waterbody either has many aquatic plants and is clear or has few plants and is less clear. Both situations have potentially to support many fish and wildlife.

Federal Emergency Management Agency (FEMA): Government agency within the Department of Homeland Security that responds to, plans for, recovers from, and mitigates against disasters/emergencies, both natural and man-made.

Fee in lieu: Defined by the USACE and EPA as a payment "to a natural resource management entity for implementation of either specific or general wetland or other aquatic resource development projects" for projects that "do not typically provide compensatory mitigation in advance of project impacts."

Filter strip: A long narrow portion of vegetation used to retard water flow and collect sediment for the protection of watercourses, reservoirs or adjacent properties.

Flash flooding: A quickly rising and falling overflow of water in stream channels that is usually the result of increased amounts of impervious surface in the watershed.

Flood Insurance Rate Map (FIRM): A map prepared by the Federal Emergency Management Agency that depicts the special flood hazard area (SFHA) within a community. The FIRM includes zones for the 100-year and 500-year floodplains and may or may not depict Regulatory Floodways.

Floodplain (100-year): Land adjoining the channel of a river, stream, watercourse, lake or wetland that has been or may be inundated by floodwater during periods of high water that exceed normal bank-full elevations. The 100-year floodplain has a probability of 1% chance per year of being flooded.

Floodway: The floodway is the portion of the stream or river channel that includes the adjacent land areas to that must be reserved to discharge the 100-year flood without increasing the water surface.

General Use Water Quality Standards (State): The Illinois Pollution Control Board (IPCB), a sister Agency to the Illinois EPA, develops water quality standards in Illinois. These standards serve to protect aquatic life, human health or wildlife, although wildlife based criteria have not yet been derived.

Geographic Information System (GIS): A computer system for capturing, storing, querying, analyzing, and displaying geospatial data.

Geospatial Data: Describes both the locations and characteristics of spatial features.

Glacial Drift: Earth and rocks which have been transported by moving ice or land ice.

Global Positioning System (GPS): Satellite mapping systems that enable locators and mapping to be created via satellite.

Grassland: An area such as a prairie or a meadow dominated by grass or grass-like vegetation.

Green infrastructure: An interconnected network of waterways, wetlands, woodlands, wildlife habitats, and other natural areas; greenways, parks and other conservation lands, farms, and forests of conservation value; and wilderness and other open spaces that support native species, maintain natural ecological processes, sustain air and water resources and contribute to the health and quality of life.

Greenways: A protected linear open space area that is either landscaped or left in its natural condition. It may follow a natural feature of the landscape such as a river or stream, or it may occur along an unused railway line or some other right of way. Greenways also provide wildlife corridors and recreational trails.

Groundwater recharge: Primary mechanism for aquifer replenishment which ensures future sources of groundwater for commercial and residential use.

Headwaters: Upper reaches of tributaries in a drainage basin.

Hydraulic and Hydrologic modeling: Engineering analysis that predicts expected flood flows and flood elevations based on land characteristics and rainfall events.

Hydraulic structures: Low head dams, weirs, bridges, levees, and any other structures along the course of the river.

Hydric inclusion soil: A soil unit (usually adjacent to hydric soils) that are not wet enough to form hydric properties but do have some hydric properties.

Hydric soil: Soil units that are wet frequently enough to periodically produce anaerobic conditions, thereby influencing the species composition or growth, or both, of plants on those soils.

Hydrograph: A way of measuring and graphing stream flow, or discharge, as it varies with time.

Hydrologic Soil Groups (HSG): Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups based on the soil's runoff potential. The four Hydrologic Soils Groups are A, B, C and D. A's generally have the smallest runoff potential and D’s the greatest.

Hydrology: The scientific study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Illinois Department of Natural Resources (IDNR): A government agency established to manage, protect and sustain Illinois' natural and cultural resources; provide resource-compatible recreational opportunities and to promote natural resource-related issues for the public's safety and education.

Illinois Department of Transportation (IDOT): The Illinois Department of Transportation focuses primarily on the state's policies, goals and objectives for Illinois' transportation system and provides an overview of the department's direction for the future.

Illinois Environmental Protection Agency (Illinois EPA): Government agency established to safeguard environmental quality, consistent with the social and economic needs of the State, so as to protect health, welfare, property and the quality of life.

Illinois Natural Areas Inventory (INAI): A survey conducted by the Illinois Department of Natural Resources to catalogue high quality natural areas, threatened and endangered species and unique plant, animal and geologic communities for the purpose of maintaining biodiversity.

Illinois Pollution Control Board (IPCB): An independent agency created in 1970 by the Environmental Protection Act. The Board is responsible for adopting Illinois' environmental regulations and deciding contested environmental cases.

Impervious cover/surface: An area covered with solid material or that is compacted to the point where water cannot infiltrate underlying soils (e.g. parking lots, roads, houses, patios, swimming pools, tennis courts, etc.). Stormwater runoff velocity and volume can increase in areas covered by impervious surfaces.

Incised channel: A stream that has degraded and cut its bed into the valley bottom. Indicates accelerated and often destructive erosion.

Index of Biotic Integrity (IBI): The IBI is based on fish surveys with the rating dependent on the abundance and composition of the fish species in a stream. Fish communities are useful for assessing stream quality because fish represent the upper level of the aquatic food chain and therefore reflect conditions in the lower levels of the food chain. Fish population characteristics are dependent on the physical habitat, hydrologic and chemical conditions of the stream, and are considered good indicators of overall stream quality because they reflect stress from both chemical pollution and habitat perturbations. For example, the presence of fish species that are intolerant of pollution are an indicator that water quality is good. The IBI is calculated on a scale of 12 to 60, the higher the score the better the stream quality.

Infiltration: That portion of rainfall or surface runoff that moves downward into the subsurface soil.

Invasive vegetation/plant: Plant species that are not native to an area and tend to out-compete native species and dominate an area (e.g. European buckthorn or garlic mustard).

Loess: A fine-grained, unstratified accumulation of clay and silt deposited by wind.

Macroinvertebrates: Invertebrates that can be seen by the unaided eye (macro). Most benthic invertebrates in flowing water are aquatic insects or the aquatic stage of insects, such as stonefly nymphs, mayfly nymphs, caddisfly larvae, dragonfly nymphs and midge larvae. They also include such things as clams and worms. The presence of benthic macroinvertebrates that are intolerant of pollutants is a good indicator of good water quality.

Macroinvertebrate Biotic Index (MBI): Method used to rate water quality using macroinvertebrate taxa tolerance to organic pollution in streams. The method detects change in biological systems that result from the actions of human society. The MBI is very similar to the IBI except it is based on sampling macroinvertebrates (insects, worms etc.) that live in the stream rather than fish. The MBI scale is from 1 to 10, with 1 being the highest stream quality indicator and 10 being the worst. A MBI less than 5 on the 2004 revised scale indicates a good macroinvertebrate population. As with fish, the presence of pollution-intolerant macroinvertebrate species is an indicator of good water quality. Since macroinvertebrates are less mobile than fish, the MBI is a good index to evaluate upstream/downstream impacts of point source discharges.

Marsh: An area of soft, wet, low-lying land, characterized by grassy vegetation and often forming a transition zone between water and land.

Meander (stream): A sinuous channel form in flatter river grades formed by the erosion on one side of the channel (pools) and deposition on the other (point bars).

Mitigation: Measures taken to eliminate or minimize damage from development activities, such as construction in wetlands or Regulatory Floodplain filling, by replacement of the resource.

National Flood Insurance Program (NFIP): Managed by the Mitigation Division within the Federal Emergency Management Agency (FEMA), participants in the NFIP adopt and enforce floodplain management ordinances to reduce future flood damage and in exchange are eligible to receive federally funded flood insurance.

National Wetland Inventory (NWI): U.S. Fish and Wildlife Service study that provides information on the characteristics, extent, and status of U.S. wetlands and deep-water habitats and other wildlife habitats.

Native vegetation/plants: Plant species that have historically been found in an area.

Natural community: An assemblage of plants and animals interacting with one another in a particular ecosystem.

Natural divisions: Large land areas that are distinguished from each other by bedrock, glacial history, topography, soils, and distribution of plants and animals.

Nonpoint source pollution (NPS or NPSP): Refers to pollutants that accumulate in waterbodies from a variety of sources including runoff from the land, impervious surfaces, the drainage system and deposition of air pollutants.

Nutrients: Substances needed for the growth of aquatic plants and animals such as phosphorous and nitrogen. The addition of too many nutrients (such as from sewage dumping and over fertilization) will cause problems in the aquatic ecosystem through excess algae growth and other nuisance vegetation.

Open space: Any land that is not developed and is often set aside for conservation or recreation purposes. It can be either protected or unprotected. Protected open space differs from unprotected in that it is permanently preserved by outright ownership by a body chartered to permanently save land, or by a permanent deed restriction such as a conservation easement. Open space is important to a watershed’s hydrology, habitat, water quality, and biodiversity.

Point source pollution: Refers to discharges from a single source such as an outfall pipe conveying wastewater from an industrial plant or wastewater treatment facility.

Pollutant load: The amount of any pollutant deposited into waterbodies from point source discharges, combined sewer overflows, and/or stormwater runoff.

Pool: A location in an active stream channel usually located on the outside bends of meanders, where the water is deepest and has reduced current velocities.

Prairie: A type of grassland characterized by low annual moisture and rich black soil characteristics.

Preventative measures: Actions that reduce the likelihood that new watershed problems such as flooding or pollution will arise, or that those existing problems will worsen. Preventative techniques generally target new development in the watershed and are geared toward protecting existing resources and preventing degradation.

Rain gage station: Point along a stream where the amount of water flowing in an open channel is measured. The USGS makes most streamflow measurements by current meter. A current meter is an instrument used to measure the velocity of flowing water. By placing a current meter at a point in a stream and counting the number of revolutions of the rotor during a measured interval of time, the velocity of water at that point is determined.

Regulatory floodplain: Regulatory Floodplains may be either riverine or non-riverine depressional areas. Projecting the base flood elevation onto the best available topography delineates floodplain boundaries. A flood prone area is Regulatory Floodplain if it meets any of the following descriptions:

Any riverine area inundated by the base flood where there is at least 640 acres of tributary drainage area.

Any non-riverine area with a storage volume of 0.75 acre-foot or more when inundated by the base flood.

Any area indicated as a Special Flood Hazard Area on the FEMA Flood Insurance Rate Map expected to be inundated by the base flood located using best available topography.

Remnant: A small fragmented portion of the former dominant vegetation or landscape which once covered the area before being cleared for human land use.

Ridge: A line connecting the highest points along a landscape and separating drainage basins or small-scale drainage systems from one another.

Riffle: Shallow rapids, usually located at the crossover in a meander of the active channel.

Riparian: Referring to the riverside or riverine environment next to the stream channel, e.g., riparian, or streamside, vegetation.

Runoff: The portion of rain or snow that does not percolate into the ground and is discharged into streams by flowing over the ground instead.

Savanna: A type of woodland characterized by open spacing between its trees and by intervening grassland.

Sediment: Soil particles that have been transported from their natural location by wind or water action.

Sedimentation: The process that deposits soils, debris and other materials either on other ground surfaces or in bodies of water or watercourses.

Silt: Fine mineral particles intermediate in size between clay and sand.

Stakeholders: Individuals, organizations, or enterprises that have an interest or a share in a project. (see also Watershed Stakeholders).

Stormwater management: A set of actions taken to control stormwater runoff with the objectives of providing controlled surface drainage, flood control and pollutant reduction in runoff.

Stream corridor: The area of land that runs parallel to a stream.

Stream reach: A stream segment having fairly homogenous hydraulic, geomorphic and riparian cover and land use characteristics (such as all ditched agriculture or all natural and wooded).

Streambank stabilization: Techniques used for stabilizing eroding streambanks.

Stream monitoring: Chemical, biological and physical monitoring used to identify the causes and sources of pollution in the river and to determine the needs for reduction in pollutant loads, streambank stabilization, debris removal and habitat improvement.

Substrate (stream): The composition of the bottom of a stream such as clay, silt or sand.

Subwatershed: Any drainage basin within a larger drainage basin or watershed.

Threatened and Endangered Species (T&E): An "endangered" species is one that is in danger of extinction throughout all or a significant portion of its range. A "threatened" species is one that is likely to become endangered in the foreseeable future.

Topography: The relative elevations of a landscape describing the configuration of its surface.

Total dissolved solids (TDS): A measure of the dissolved solids in water sample.

Total suspended solids (TSS): The organic and inorganic material suspended in the water column and greater than 0.45 micron in size.

Total Maximum Daily Load (TMDL): A TMDL is the highest amount of a particular pollutant discharge a waterbody can handle safely per day.

Trophic State Index (TSI): Trophic State is a measure of the degree of plant material in of a body of water. It is usually measured using one of several indices (TSI) of algal weight (biomass): water transparency (Secchi Depth), algal chlorophyll, and total phosphorus.

Turbidity: Refers to the clarity of the water, which is a function of how much material including sediment is suspended in the water.

United States Environmental Protection Agency Section 319 (Section 319): Section 319 of the Clean Water Act encourages and funds nonpoint source pollution control projects (any indirect pollution, like runoff, stormwater discharge, road salt, sediment, etc.) or NPS reduction at the source.

United States Geological Survey (USGS): Government agency established in 1879 with the responsibility to serve the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters;

manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

United States Army Corps of Engineers (USACE): Federal group of civilian and military engineers and scientists that provide services to the nation including planning, designing, building and operating water resources and other Civil Works projects. These also include navigation, flood control, environmental protection, and disaster response.

Urban runoff: Water from rain or snow events that runs over surfaces such as streets, lawns, parking lots and directly into storm sewers before entering the river rather than infiltrating the land upon which it falls.

Vegetated buffer: An area of vegetated land to be left open adjacent to drainageways, wetlands, lakes, ponds or other such surface waters for the purpose of eliminating or minimizing adverse impacts to such areas from adjacent land areas.

Velocity (of water in a stream): The distance that water can travel in a given direction during a period of time expressed in feet per second.

Watershed: An area confined by topographic divides that drains to a given stream or river. The land area above a given point on a waterbody (river, stream, lake, wetland) that contributes runoff to that point is considered the watershed.

Watershed stakeholder: A person who has a personal, professional, legal or economic interest in the watershed and the outcome of the watershed planning process.

Waters of the United States (WOUS): For the purpose of this Ordinance the term Waters of the United States refers to those water bodies and wetland areas that are under the U. S. Army Corps of Engineers jurisdiction.

Wetland: A wetland is considered a subset of the definition of the Waters of the United States.

Wetlands are land that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, under normal conditions, a prevalence of vegetation adapted for life in saturated soil conditions (known as hydrophytic vegetation). A wetland is identified based upon the three attributes: 1) hydrology, 2) hydric soils and 3) hydrophytic vegetation.

Wet meadow: A type of wetland away from stream or river influence with water made available by general drainage and consisting of non-woody vegetation growing in saturated or occasionally flooded soils.