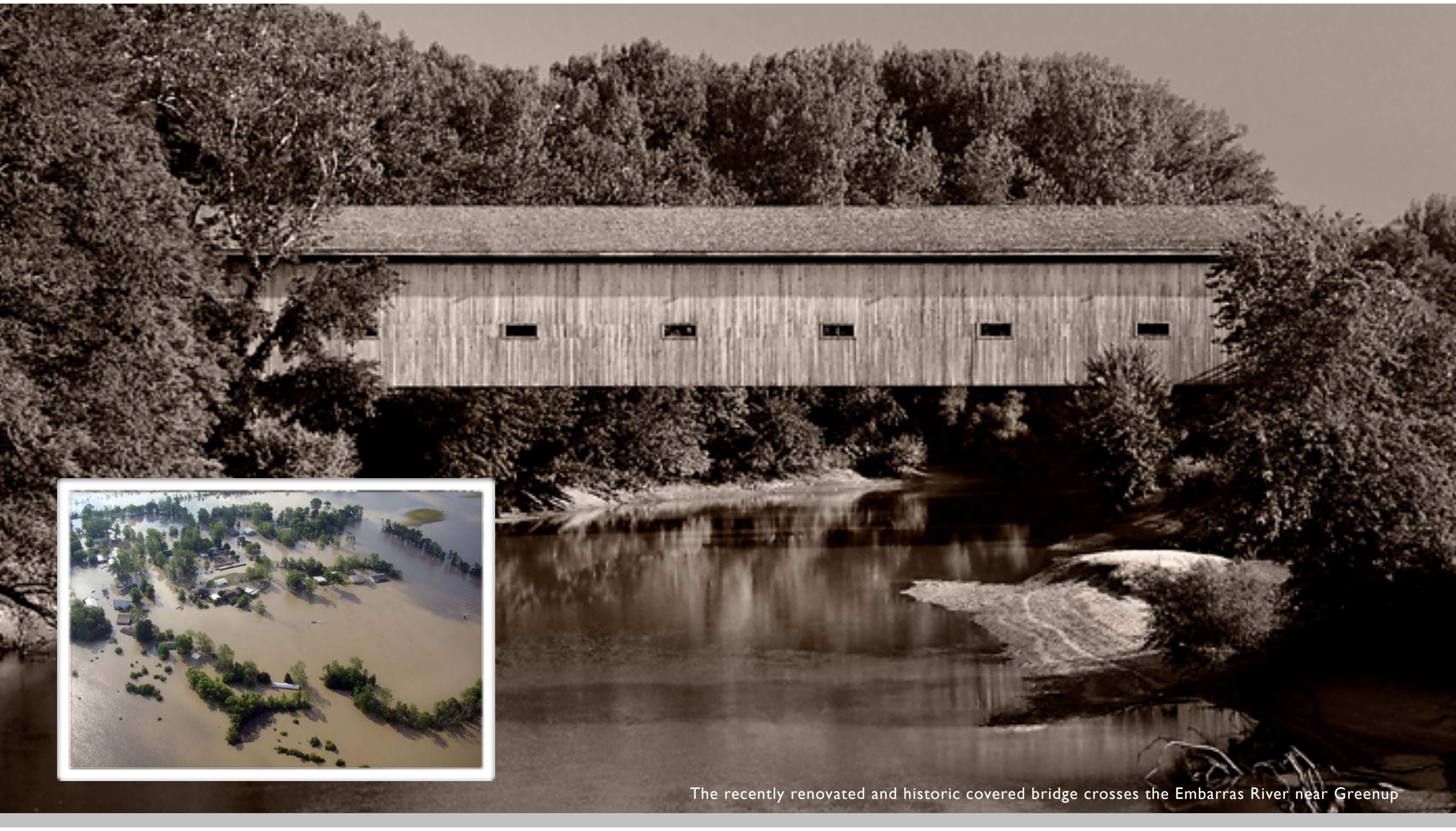
Embarras River Watershed Management Plan



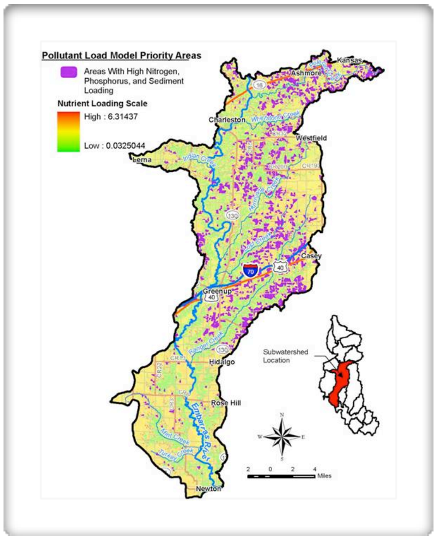
The recently renovated and historic covered bridge crosses the Embarras River near Greenup

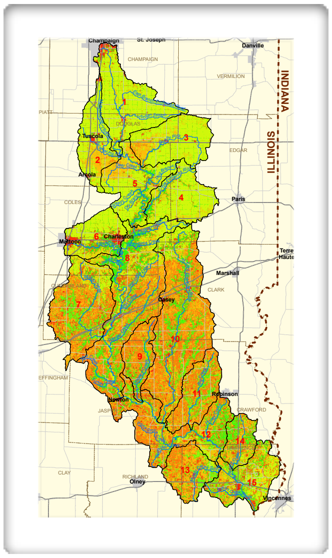
Champaign, Clark, Coles, Crawford, Cumberland, Douglas, Edgar, Effingham, Jasper, Lawrence, Richland and Vermillion Counties

Illinois

FINAL

Oct. 2011





Prepared By:

V3 Companies, Ltd

With Support from:

Northwater Consulting

This project was funded by the Illinois Environmental Protection Agency

Table of Contents

EXHIBITS

TABLES

FIGURES (REPORT INSETS)

Section 1 – Executive Summary

The Embarras River is located in southeast Illinois and has its origins on the University of Illinois campus in the City of Champaign. The river flows generally south through primarily rural and agricultural land for approximately 189.5 miles until in converges with the Wabash River in Lawrence County. The Embarras River Watershed consists of approximately 1,558,063 acres (2,435 square miles) of mixed land use and encompasses portions of Champaign, Clark, Coles, Crawford, Cumberland, Douglas, Edgar, Effingham, Jasper, Lawrence, Richland, and Vermilion Counties.

Since 1993, the non-profit Embarras River Management Association (ERMA) has been working to preserve and restore the natural character and resources of the Embarras River Watershed. The organization operates a number of conservation, education, and research projects in the Embarras Watershed. In 1996, the ERMA, in conjunction with many partner agencies, developed a comprehensive Embarras River Basin Resource Management Plan. This comprehensive plan provided long-term solutions to the existing resource concerns, guided the group’s work to preserve and restore the natural character and resources of the watershed region.

The City of Charleston has taken an active leadership role in developing a watershed plan for the Embarras River watershed. Working in conjunction with ERMA, the city received funding from the Illinois Environmental Protection Agency (IEPA) to develop the plan.

A Watershed Management Plan (WMP) funded through IEPA funding is required to meet nine minimum elements to ensure that the projects make progress towards restoring waters impaired by nonpoint source pollution. This updated plan incorporates information from the 1996 plan and incorporates the required nine minimum elements.

The Embarras River Watershed Management Plan (WMP) is intended as a guide for the protection and enhancement of the environment and quality of the watershed while balancing the different uses and demands of the community on this natural resource. This plan will address items such as:

- education and outreach;
- increasing preservation, restoration and protection of this vital system;
- increasing cooperation, coordination and collaboration among all stakeholders in the watershed; and
- maintaining a solid organization to look to the welfare of this important natural resource.

The WMP follows the IEPA requirements for watershed management plans, including sections on: watershed inventory, pollutant load analysis, watershed impairment and problem identification, source identification, priority watershed areas, setting goals and indicator selection for performance assessment, calculating load reductions, implementation of planned measures, monitoring indicators, and plan evaluation and adaptation.

Embarras River WMP Highlights

Watershed Inventory

- The watershed inventory is a comprehensive inventory that quantifies, describes, and summarizes available watershed data.
- The Embarras River Watershed is approximately 2,435 square miles and the river flows generally south for approximately 189.5 miles until in converges with the Wabash River in Lawrence County.
- The Embarras River has several major tributaries including North Fork Embarras River, Muddy Creek, Brushy Fork, Crooked Creek, Big Creek, and Range Creek, as well as several smaller tributaries, totaling approximately 482.4 river miles.
- The Embarras River Watershed is generally a rural area and sparsely populated. There are nine primary urban areas with all or portions of their limits located within the Embarras River Watershed. The most significant urban area located entirely within the watershed is Charleston, with a population of 20,889 in 2000.
- Overall, the total population within the watershed increased between the 1990 and 2000 Census by 2.4%. The largest increase was seen in the Range Creek – Embarras River Subwatershed at 24.1%; and the largest decrease was seen in the Brushy Fork Subwatershed at -23.8%.
- With approximately 81.8% of the watershed covered by agriculture and forest, the Embarras River watershed still remains primarily rural and agricultural. The developed areas (approximately 10.4%) are concentrated inside or on the fringe of established urban areas.
- Illinois Natural Area Inventory Sites (INAI) are natural landscape features and communities of the highest quality still remaining in Illinois. 34 INAI sites are located within the Embarras River Watershed.
- The Embarras River Watershed contains 40 Conservation and Recreation Land sites totaling approximately 7,250 acres.
- The surficial geology of the Embarras River drainage basin includes: (1) Illinois-age Glasford Formation in the southern part, and (2) Late Wisconsin-age Wedron Group in the northern part. The Glasford Formation is dominantly composed of glacial till and outwash sand and gravel deposits. Late Wisconsin-age deposits in the basin are composed of glacial tills, lacustrine silts and clays, outwash sand and gravels, and loess.
- Approximately 55.2% of the basin area is composed of three soil associations. The Catlin-Flanagan-Drummer series is prevalent in the northern portion of the watershed, while the Hoyleton-Cisne-Huey and Ava-Bluford-Wynoose series are predominantly found in the southern portion of the watershed.
- Within the Embarras River Watershed, all hydrologic soil groups can be found, however the majority of the soils fall within hydrologic soil group B (45.2%).
- A total of approximately 78,822 acres or 5.1% of the watershed is considered highly erodible or potentially highly erodible.
- Approximately 664,713 acres or 42.7% of the soils in the Embarras River Watershed are considered hydric.
- The United States Geological Survey (USGS) maintains four active stream gages within the Embarras River. These gages provide real-time data on gage height and discharge, as well as historical daily, monthly and annual statistics.

- The 100-year floodplain which is defined as an area inundated by 100-year flooding comprises 187,849 acres (12.1% of the watershed). The 500-year floodplain (0.2% chance of annual flooding) comprises only 235 acres (0.02% of the watershed).
- There are 41,252 acres (2.6% of the watershed) of wetlands scattered throughout the Embarras River Watershed. Among the three wetland classifications, 1,322 acres are considered lacustrine, 37,647 acres are palustrine, and 2,283 acres are riverine.
- Available biological data from IEPA for the Embarras River Watershed was obtained and evaluated to determine where water-quality problems were noted in the watershed. Data included macroinvertebrate and fisheries data where available.
- Macroinvertebrate stations ranged from moderately impaired to no impairment.
- A majority of the population within the watershed relies on groundwater for potable water supply. The Embarras River is also used as water supply; therefore the entire contributing watershed of the Embarras River affects the water supply quality.
- The 303(d) list indicates that approximately 240.31 miles of streams within the Embarras River Watershed were impaired at the time of the 2008 listing.
- Available water quality data from the United States Geological Survey (USGS) and the Illinois Environmental Protection Agency (IEPA) for the Embarras River Watershed was obtained and evaluated to determine where water-quality problems were noted within the watershed.
- A total of 57 NPDES permits (81 discharge points) and 49 landfills are located within the Embarras River Watershed.
- According to the NRCS Soil Reports for the Counties within the Embarras River Watershed, approximately 98.3% of the soils are rated as very limited for septic systems. An approximate total of 60,643 septic systems are possible within the Embarras River Watershed

Pollutant Load Analysis

- Pollutant loading within the watershed is the sum of point sources and nonpoint sources. Due to the large size and rural nature of the Embarras River watershed, non-point source pollutants are the primary concern.
- Total nitrogen, total phosphorus, total suspended sediment and fecal coliform bacteria were identified as the priority pollutants.
- A customized GIS based model was used to calculate nonpoint source pollutant loads to assess the nonpoint source pollution of the priority pollutants.
- Total nitrogen nonpoint source loading in the watershed is 6,632,514 lbs/year, averaging 4.30 lbs/acre per year for the entire watershed.
- Total phosphorus nonpoint source loading in the watershed is 1,336,411 lbs/year, averaging 0.86 lbs/acre per year over the entire watershed.
- Total suspended sediment loading is 612,684 tons per year, average 0.40 tons/acre per year for the entire watershed.
- Fecal coliform bacteria nonpoint source loading in the watershed is 3.115×10^9 coliform units per year. This averages 2.02×10^9 coliform units per acre/year.

Identification of Watershed Impairments and Problems

- The results of the Watershed Inventory and analysis of the stakeholder concerns indicate that the group concerns can be described in six general areas: soil, water, air, plants, animals, and human factors.

- The stakeholder concerns that were identified during the public meetings were prioritized by the planning committee. 18 of the concerns were identified as priority resource concerns and are included as part of this WMP.
- These concerns were listed into four categories to aid understanding of the issues: flooding; erosion/water quality; wetland, wildlife, and natural character; and information and public communication.
- The category and priority concerns that fall within that category are as follows. Flooding: Flooding, Log Jams/Obstructions, Drainage, Small Bridge Outlets. Erosion/Water Quality: Water Quality, Erosion, Sediment (Sand Deposits). Wetland, Wildlife, and Natural Character: Beaver, Deer and Turkey related problems, Loss of Natural Character, Bends in the Channel, Wetlands, Wildlife, and Recreation Opportunities. Information and Public Communication: Lack of Accountability – Communication, Private Property Rights, Economic Costs (Funding Solutions), Water Usage and Supply, Land Use Changes, Lack of Education.
- Problem statements were developed during the planning process in an effort to link the watershed concerns with existing and historical water quality data and the four major concern categories.
- Flooding Problem Statement: Excessive flow rates and volumes of water are causing damage and loss within the Embarras River Watershed.
- Erosion/Water Quality Problem Statement: Soil erosion and sedimentation within the watershed is degrading the water quality/quantity and limiting the aesthetics, wildlife habitat, and aquatic health of the streams within the watershed. Agriculture and typical urban area practices within the watershed contribute a significant amount of pollutants, thereby contributing to the frequent exceedances of water quality targets.
- Wetland, Wildlife and Natural Character Problem Statement: Impacts to the natural resources of the watershed are degrading the quality and amount of wetlands, wildlife habitat and recreational opportunities.
- Information and Public Communication Problem Statement: Stakeholders in the Embarras River Watershed are not knowledgeable about their daily impact on the watershed and its water quality.

<u>Identification of Sources and Priority Areas</u>

- Potential sources were identified for each problem statement based on the information analyzed in the Watershed Inventory.
- The priority areas within the Embarras River watershed were identified based on the watershed Inventory, the identified problems and the goals of the WMP, GIS analysis and stakeholder input
- Stakeholder identified project priority locations: a series of one-on-one meetings were held with selected stakeholders in December of 2009. A total of 68 specific projects were identified.
- Priority areas based on pollutant load analysis were identified by utilizing a statistical GIS analysis was applied to identify areas within the watershed that contributed the highest combined load of nitrogen, phosphorus and sediment collectively.
- Priority areas based on wetland restoration potential: Eastern Illinois University (EIU) performed a detailed soils analysis for the entire watershed to identify ideal locations within the watershed for wetland and bottomland restoration.

- Priority areas based on fecal coliform loading and septic density: a statistical GIS analysis was applied to identify the highest statistically significant areas in the watershed contributing fecal Coliform.
- Priority areas based on hydric soils under agricultural land cover: using GIS analysis hydric soils within the watershed that are currently under agricultural land cover were identified. These areas are important locations for wetland restoration that will reduce flooding problems and pollutant loading.
- Priority areas based on highly erodible soils under agricultural or pasture land cover: Using GIS analysis priority areas based on agricultural and pasture land uses that are on highly erodible soils were identified. These areas are important focus areas because project implementation will have the highest bang for the buck and contribute significant load reductions.
- Pasture land near streams: Using GIS analysis all pasture land area near streams in the watershed was identified. These areas are important areas that can be evaluated for project implementation for EQIP programs that would significantly reduce nutrient loading and fecal coliform bacteria loading.

Set Goals and Load Reductions

- Load reduction goals are utilized in the watershed planning process to provide a numeric reference goal for a watershed plan.
- Sediment, nitrogen and phosphorus have recommended water quality target ranges based on US EPA guidance documents and statistical analyses that have been performed for the region to meet water quality standards. The fecal coliform target concentration was set at 50% of the water quality.
- Target load reductions of sediment, nitrogen, phosphorus, and fecal coliform are 32%, 17%, 73%, and 11% respectively.
- Based on the identified concerns and pollutant loading analysis, goal statements were developed for each priority resource concern category.
- Flooding Goal Statement: Reduce flood damage in the Embarras River Watershed.
- Erosion/Water Quality Goal Statement: Protect and improve water quality in the Embarras River Watershed.
- Wetland, Wildlife and Natural Character Goal Statement: Protect and enhance natural resources and provide associated recreational opportunities.
- Information and Public Communication Goal Statement: Develop and implement an education and outreach program within the watershed.

Watershed Wide Implementation

- Although the watershed planning committee chose eight priority subwatersheds to focus in on due to the large scale of the watershed, implementation is needed and encouraged for the entire watershed.
- The selected measures and BMPs for improvement are categorized as Agricultural/Rural and Urban BMPs as well as Preventative Measures.
- Load reduction calculations were estimated for nitrogen, phosphorus and sediment based on the potential BMPs to be implemented within the Embarras River Watershed.

Subwatershed Based Implementation Plan

- Several factors went into selecting these priority subwatersheds which include: Level of stakeholder interest and involvement potential, Results from watershed inventory, modeling and GIS analysis, and IEPA 303(d) list.
- The priority subwatersheds include: East Branch Embarras River, Scattering Fork, Deer Creek – Embarras River, Kickapoo Creek, Range Creek – Embarras River, Big Creek, Honey Creek – Embarras River, and Paul Creek – Muddy River.
- A subwatershed inventory, analysis of data, and implementation plan is provided for each priority subwatershed.

Implementation Costs

- Cost estimates of BMPs needed to be implemented within each of the critical areas in order to accomplish the five, ten, and twenty-year targets were determined using the lowest cost BMPs for each landcover.
- Cost estimates are generalized for watershed-scale planning purposes and these estimates should not be used to estimate costs for individual projects, as costs will range significantly. The estimates also do not account for load reductions from Education and Outreach and Policy/Regulation BMPs since direct impacts are not easily determined.
- 5-year target loading estimated costs - $13,297,636. 10-year target loading estimated costs (total) - $53,190,405. 20-year target loading estimated costs (total) - $107,710,628. The high costs associated with phosphorus removal are the limiting factor in the cost estimates.
- Implementation costs of stakeholder-identified projects are estimated at $25,000,000 to $55,000,000.

Implementation Schedule

- An implementation schedule for years 1-10 of the watershed plan has been provided.

Measuring Success

- Indicators are measurable parameters or criteria which can used to determine the progress being made toward achieving a goal. Indicators were developed for each goal and objective.
- The WMP will be evaluated by assessing the progress made on each of the four goals.
- The plan should be evaluated every five years to assess the progress made as well as to revise the plan, if appropriate, based on the progress achieved. The plan will also have a comprehensive review every 15 years.
- To further measure progress and success, the planning committee will ask each county in the watershed to provide a brief annual update on project implementation.

Financing Resources

- There are a number of financing resources to implement BMP projects.
- A list of several fund sources is included in the WMP.

Section 2 – Watershed Community Initiative

Embarras River Management Association

Since 1993, the non-profit Embarras River Management Association (ERMA) has been working to preserve and restore the natural character and resources of the Embarras River Watershed. The organization operates a number of conservation, education, and research projects in the Embarras Watershed. In 1996, ERMA, in conjunction with many partner agencies, developed a comprehensive Embarras River Basin Resource Management Plan. This comprehensive plan provided long-term solutions to the existing resource concerns, guided the group's work to preserve and restore the natural character and resources of the watershed region.

The City of Charleston has taken an active leadership role in developing a watershed plan for the Embarras River watershed. Working in conjunction with ERMA, the city received funding from the Illinois Environmental Protection Agency (IEPA) to develop the plan.

A Watershed Management Plan (WMP) funded through IEPA funding is required to meet nine minimum elements to ensure that the projects make progress towards restoring waters impaired by nonpoint source pollution. This updated plan incorporates information from the 1996 plan and incorporates the required nine minimum elements.

Intentions of the Watershed Management Plan

The Embarras River Watershed Management Plan (WMP) is intended as a guide for the protection and enhancement of the environment and quality of the watershed while balancing the different uses and demands of the community on this natural resource. This plan will address items such as:

- education and outreach;
- increasing preservation, restoration and protection of this vital system;
- increasing cooperation, coordination and collaboration among all stakeholders in the watershed; and
- maintaining a solid organization to look to the welfare of this important natural resource.

The WMP follows the IEPA requirements for watershed management plans, including sections on: watershed inventory, pollutant load analysis, watershed impairment and problem identification, source identification, priority watershed areas, setting goals and indicator selection for performance assessment, calculating load reductions, implementation of planned measures, monitoring indicators, and plan evaluation and adaptation.

Public input is essential for the sustainability and success of the watershed improvement effort. Stakeholder input was sought and included during all aspects of the planning process. This local input was essential for developing a plan that would have broad appeal throughout the watershed and continued support.

As mentioned previously, the Embarras River WMP is intended to be comprehensive, identifying problem areas and suggesting improvement measures for both water quality and other concerns identified by watershed stakeholders. The watershed is large and diverse, and thus has a variety of issues and concerns that need to be addressed. To address some of these issues, the City of Charleston and ERMA will work with local stakeholder groups to pursue Best Management Practices (BMPs) that will result in the improvement of water quality within the watershed. Because of the size of the task at hand, this plan will also be used as a platform upon which to pursue additional grants and other funding for implementation of the many different improvement measures recommended in the plan.

Stakeholder Involvement

The stakeholders of the Embarras River Watershed include many important partners in conservation including:

- Embarras River Management Association (ERMA)
- Natural Resources Conservation Service (NRCS)
- Champaign County SWCD
- City of Charleston
- City of Newton
- City of Tuscola
- City of Villa Grove
- Clark County SWCD
- Coles County SWCD
- Crawford County SWCD
- Cumberland County SWCD
- Douglas County SWCD
- Edgar County SWCD
- Jasper County SWCD
- Lawrence County SWCD
- Richland County SWCD
- Upper Embarras Planning Committee
- North Fork Conservancy District
- Illinois Department of Natural Resources
- Illinois Department of Agriculture
- Illinois Environmental Protection Agency
- US Fish and Wildlife Service
- US Forest Service
- University of IL, Cooperative Extension Service
- Eastern IL University

The Embarras River Watershed Planning Committee comprises of representatives from ERMA, the City of Charleston, and Eastern IL University. The committee's purpose is to review the concerns from the public meetings, facilitate work group meetings, guide the development of the management plan, and provide additional data as requested. It is anticipated that ERMA will take a leadership role in the implementation of the plan. The work group meeting agendas and minutes are available in Appendix C.

Planning Process

Plan Development

The planning committee was directly involved in all aspects of the development of the plan, including input at public meetings, work group meetings, and data collection. The following steps were used in the development of the plan for the Embarras River Watershed.

- Outreach to stakeholders
- Develop watershed management partnership with relevant stakeholders and staff a planning committee
- Solicit public input on watershed problems and opportunities
- Formulate project goals and objectives for watershed plan
- Identify and collect existing studies and other watershed data
- Synthesize and summarize existing watershed data
- Collect new data where needed
- Complete assessment of watershed conditions
- Identify best management practices and policies appropriate for the watershed
- Develop an action plan recommending watershed improvement projects and policies
- Identify potential funding sources for watershed improvements
- Obtain public official and general public input from review of draft watershed plan
- Develop implementation schedule and complete final watershed management plan

Public and Stakeholder Participation

It should be recognized that ERMA has been leading watershed efforts throughout the watershed for over a decade. ERMA has a recognized role in the watershed and has held numerous public meetings, outreach events and community initiatives since it started in 1993. They are very active in implementing watershed-monitoring programs in close collaboration with Eastern Illinois University (EIU). They also have an outreach newsletter that informs the community of developments and opportunities for watershed management and conservation.

Public Notice Meetings

Public work group meetings were held throughout the watershed to introduce the planning process and hear the concerns of the public and stakeholders within the watershed. Meeting notices were posted publically in local papers, email distribution and on the website. At the meetings, the public and stakeholders were informed of the purpose of a WMP, informed on the planning process, updated on the planning committee progress, and given the opportunity to evaluate the priority resource concerns for the Embarras River Watershed. The meetings were held between August 4 – 6, 2009 and held in Tuscola, Greenup and Newton, respectively. Further details of these meetings can be found in Appendix C. These meetings were important for identifying the concerns of which this plan was designed to address.

County Stakeholder Priority Resource Concern Meetings

The Natural Resource Conservation Service (NRCS) and Soil & Water Conservation Districts (SWCDs) from each county in the watershed held special focused meetings to identify priority resource concerns. These meetings identified and ranked key priority concerns and some counties identified specific project opportunities to address issues. The details of these meetings are included in Appendix C and the highest ranked concerns and project recommendations are included in this plan.

Stakeholder Project Identification Outreach Workshops

Due to the large size of the watershed, the planning committee identified eight priority subwatersheds to focus on in terms of identifying specific on-the ground implementation opportunities to improve conditions in those subwatersheds.

One-on-one workshops were held with several counties and municipalities in the priority subwatersheds to identify specific project opportunities based on local knowledge or known issues and impairments. Large, detailed plotted maps showing aerial imagery and parcel ID information were used to facilitate effective discussion. The meetings were held in December of 2009 with the stakeholders shown on Table 2-1. Exhibit 22 also illustrates the project locations and additional details. These implementation projects are further detailed in Sections 8 & 9 of this plan. In total 68 potential projects were identified in this process, which are the recommended projects for the first stage of implementation.

Table 2-1: Project Identification Workshops

Entity	# Projects Identified	Project Types
Champaign County SWCD/NRCS	16	Runoff control at dairy farm; wetland restoration; filter strips
Coles County SWCD/NRCS	8	Terrace, grassed waterway, streambank stabilization
Douglas County SWCD/NRCS	5	Agricultural BMPs, wetland restoration, streambank stabilization
Jasper County SWCD/NRCS	5	floodplain easements, streambank stabilization, waste management and runoff BMPs from livestock operations
City of Charleston	8	Shoreline stabilization, runoff control BMPs, wetland restoration
City of Newton	6	Urban runoff BMPs, streambank stabilization, wetland restoration (acquisition)
City of Tuscola	6	Urban runoff control, stream restoration to improve flood issues, flood mitigation
City of Villa Grove	7	Urban runoff control, wetland restoration, stream maintenance to prevent flooding
Crawford County SWCD/NRCS	2	WASCB/Waterway, boat access to reduce erosion
Cumberland County SWCD/NRCS	5	WASCB, grassed waterway, agricultural BMPs, streambank stabilization
Total	**68**	

Top Priority Resource Concerns

The priority resource concerns that were identified during the planning process and plan development are listed in Section 5 with the top 18 listed below. Specific concerns were taken from the stakeholders and later listed in categories to aid understanding of the issues. The information will be used to prioritize watershed issues and aid in the planning and implementation process.

Priority Resource Concerns:

- Flooding
- Log Jams/Obstructions
- Water Quality
- Erosion
- Drainage
- Beaver, Deer and Turkey related problems
- Lack of Accountability – Communication
- Loss of Natural Character
- Private Property Rights
- Sediment (sand deposits)
- Bends in the Channel
- Wetlands
- Wildlife/Recreation Opportunities
- Economic Costs (funding solutions)
- Water Usage and Supply
- Land Use Changes
- Small Bridge Outlets
- Lack of Education

Section 3 – Watershed Inventory

The watershed inventory is a comprehensive inventory that quantifies, describes, and summarizes available watershed data. This inventory will be used to determine the current conditions of the watershed and identify the link between the stakeholder concerns and those watershed conditions.

Location and Characteristics of the Embarras River Watershed

The Embarras River is located in southeast Illinois and has its origins on the University of Illinois campus in the City of Champaign. The river flows generally south through primarily rural and agricultural land for approximately 189.5 miles until in converges with the Wabash River in Lawrence County (Exhibit 1). The Embarras River has several major tributaries including North Fork Embarras River, Muddy Creek, Brushy Fork, Crooked Creek, Big Creek, and Range Creek, as well as several smaller tributaries, totaling approximately 482.4 river miles.

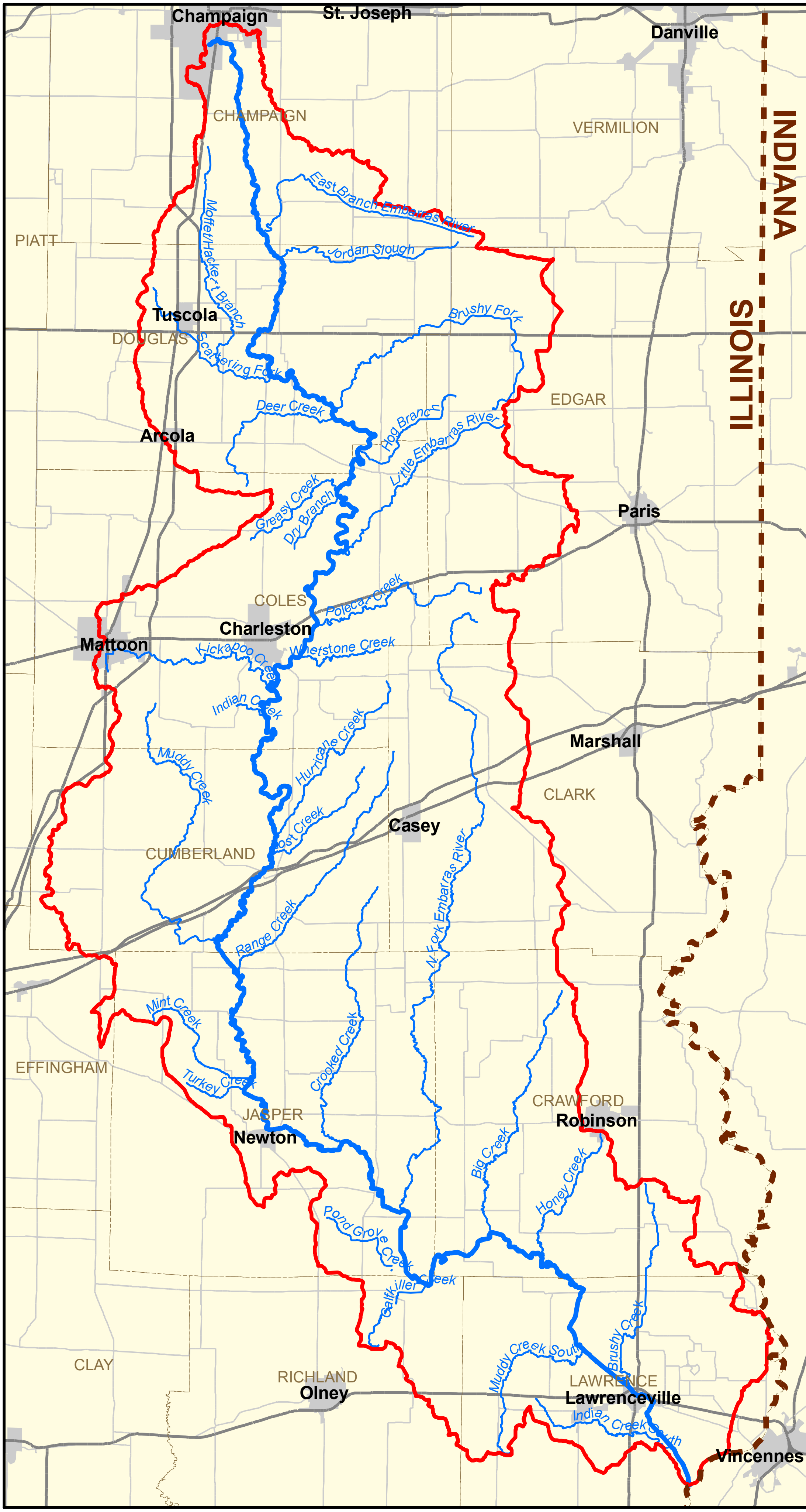
The Embarras River Watershed consists of approximately 1,558,063 acres (2,435 square miles) of mixed land use and encompasses portions of Champaign, Clark, Coles, Crawford, Cumberland, Douglas, Edgar, Effingham, Jasper, Lawrence, Richland, and Vermilion Counties. The distribution of watershed area within each county is shown in Table 3-1.

Table 3-1: Counties Within the Watershed		
County	**Acres**	**Percentage**
Champaign	92,795	6.0%
Clark	137,073	8.8%
Coles	225,678	14.5%
Crawford	179,956	11.6%
Cumberland	200,438	12.9%
Douglas	192,595	12.4%
Edgar	123,745	7.9%
Effingham	2,247	0.1%
Jasper	215,774	13.9%
Lawrence	152,522	9.8%
Richland	33,603	2.2%
Vermilion	1,637	0.1%
Total	1,558,063	100.2%*
*Note – Percent totals do not add to 100% due to rounding		

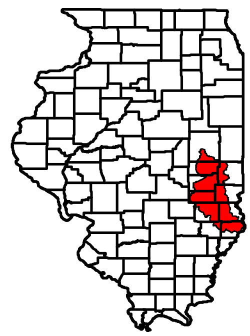
Hydrologic unit codes (HUCs) were developed by the United States Geological Survey (USGS) in cooperation with the United States Water Resource Council (USWRC) and United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). Most federal and state agencies use this coding system. HUCs are a way of cataloguing portions of the landscape according to their drainage. Landscape units are nested within each other and described as successively smaller units. The hydrologic code attached to a specific

Exhibit 1

EMBARRAS RIVER MANAGEMENT ASSOCIATION



Embarras River Watershed



Town	Popoulation (2000)
Arcola	2,634
Casey	3,154
Champaign	123,669
Charleston	20,899
Lawrenceville	7,802
Mattoon	19,105
Newton	3,110
Robinson	8,297
Tuscola	4,482

Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed

N W E S

5 0 5 10 Miles

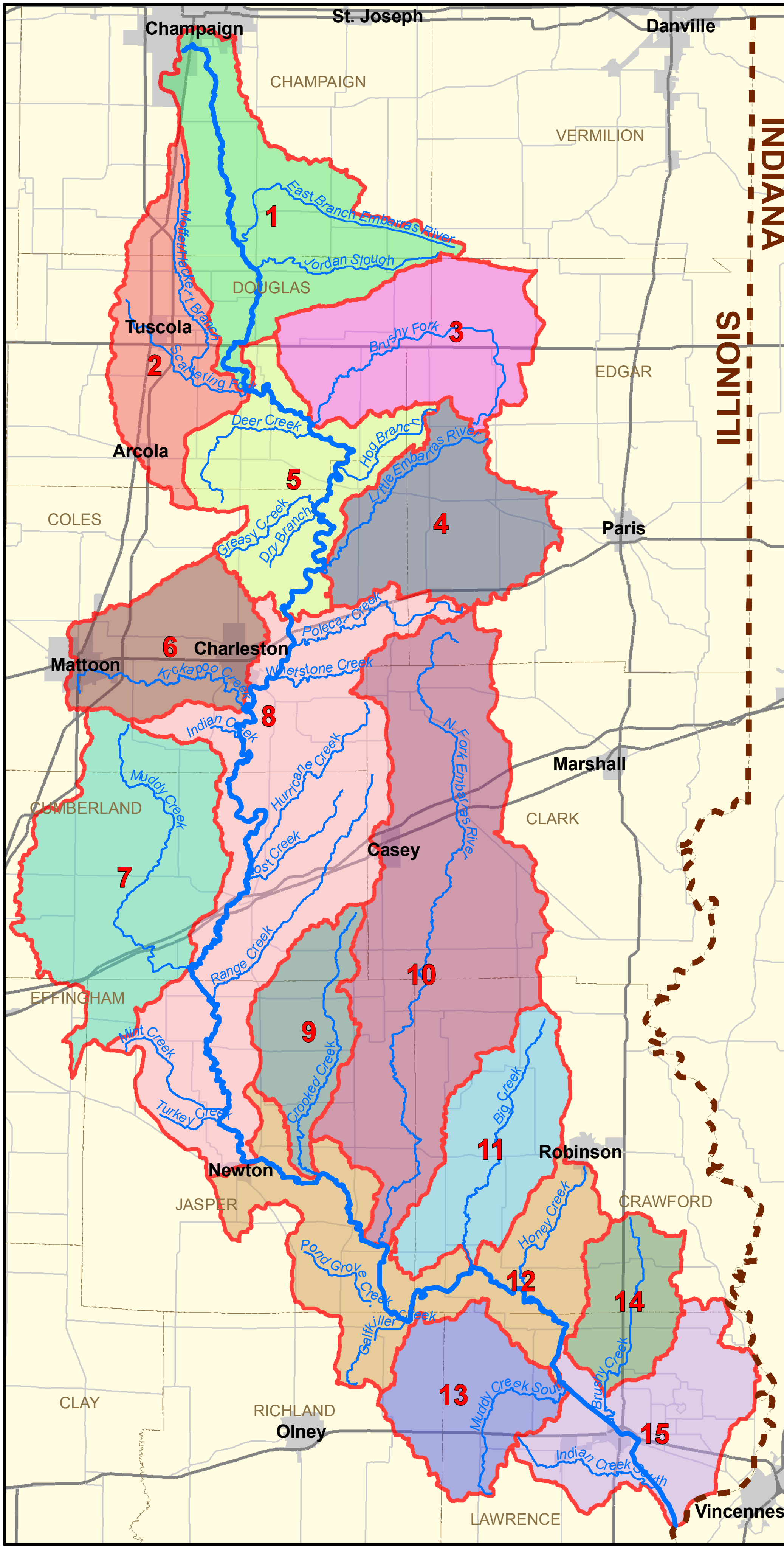
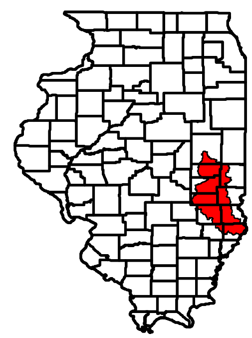


Exhibit 2

Embarras River Watershed

Subwatershed Location Map



Sub-watershed #	Subwatershed Name	Acres
1	East Branch Embarras River	122,219
2	Scattering Fork	69,875
3	Brushy Fork	94,410
4	Little Embarras River	83,744
5	Deer Creek-Embarras River	94,017
6	Kickapoo Creek	65,461
7	Muddy Creek	135,559
8	Range Creek-Embarras River	222,342
9	East Crooked Creek	49,974
10	North Fork Embarras River	229,692
11	Big Creek	72,143
12	Honey Creek-Embarras River	130,554
13	Paul Creek-Muddy River	63,468
14	Brushy Creek	41,508
15	Indian Creek-Embarras River	83,097

Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed & Subwatersheds

N W E S

5 0 5 10 Miles

Watershed is unique, enabling different agencies to have common terms of reference and agree on the boundaries of the watershed. These commonly understood boundaries foster understanding of how landscapes function, where water quality problems should be addressed, and who needs to be involved in the planning process.

The Embarras River Watershed is an 8-digit HUC watershed (05120112) and consists of fifteen 10-digit HUCs (Table 3-2, Exhibit 2). It should be noted that the Charleston Side Channel Reservoir is located within the Range Creek – Embarras River subwatershed. The drainage area to the reservoir has been included as a high priority subwatershed in Section 9; however information in the watershed inventory refers to the entire subwatershed of Range Creek – Embarras River.

Table 3-2: Subwatersheds

Number	HUC Code	Name	Acres	Percentage
1	0512011201	East Branch Embarras River	122,219	7.8%
2	0512011202	Scattering Fork	69,875	4.5%
3	0512011203	Brushy Fork	94,410	6.1%
4	0512011204	Little Embarras River	83,744	5.4%
5	0512011205	Deer Creek-Embarras River	94,017	6.0%
6	0512011206	Kickapoo Creek	65,461	4.2%
7	0512011207	Muddy Creek	135,559	8.7%
8	0512011208	Range Creek-Embarras River	222,342	14.3%
9	0512011209	East Crooked Creek	49,974	3.2%
10	0512011210	North Fork Embarras River	229,692	14.7%
11	0512011211	Big Creek	72,143	4.6%
12	0512011212	Honey Creek-Embarras River	130,554	8.4%
13	0512011213	Paul Creek-Muddy River	63,468	4.1%
14	0512011214	Brushy Creek	41,508	2.7%
15	0512011215	Indian Creek-Embarras River	83,097	5.3%
Total			1,558,063	100.0%

Population Characteristics

Human Geography and Economy

There is a direct correlation between the number and location of people living within the watershed and the impacts to water quality. The Embarras River Watershed is generally a rural area and sparsely populated. There are nine primary urban areas with all or portions of their limits located within the Embarras River Watershed (Table 3-3, Exhibit 1). The table includes population information for the entire urban area and is not limited to only the population living within the watershed boundaries. The most significant urban area located entirely within the watershed is Charleston, with a population of 20,889 in 2000, which is located adjacent to the Embarras River.

Table 3-3: Urban Areas Within the Watershed	
Urban Area	**Population in 2000**
Arcola	2,652
Casey	2,942
Champaign	67,518
Charleston	21,039
Lawrenceville	4,745
Mattoon	18,291
Newton	3,069
Robinson	6,822
Tuscola	4,448

With over 65% of the land within the Embarras River Watershed devoted to agriculture, agriculture plays a major role in the economy of the Embarras River Watershed. Information from the 2002 and 2007 Census of Agriculture was analyzed to determine the average size of each farm and the economic value of agricultural production in the watershed (Tables 3-4 and 3-5). Information was only available on a county wide scale, therefore this analysis pertains to the entire county and not only the portions located within the Embarras River Watershed.

Table 3-4: Average Farm Size									
County	**Number of Farms**			**Total Farm Acreage**			**Average Acreage/Farm**		
	2002	**2007**	**% Chg**	**2002**	**2007**	**% Chg**	**2002**	**2007**	**% Chg**
Champaign	1,285	1,389	8.1%	577,066	550,481	-4.6%	449.1	396.3	-11.7%
Clark	581	588	1.2%	275,318	238,706	-13.3%	473.9	406.0	-14.3%
Coles	684	729	6.6%	261,138	254,869	-2.4%	381.8	349.6	-8.4%
Crawford	567	615	8.5%	213,661	205,356	-3.9%	376.8	333.9	-11.4%
Cumberland	583	654	12.2%	173,363	144,981	-16.4%	297.4	221.7	-25.5%
Douglas	576	657	14.1%	232,690	261,513	12.4%	404.0	398.0	-1.5%
Edgar	667	670	0.4%	355,035	352,535	-0.7%	532.3	526.2	-1.1%
Effingham	1,134	1,150	1.4%	278,199	242,009	-13.0%	435.3	210.4	-14.2%
Jasper	791	882	11.5%	271,329	243,451	-10.3%	343.0	276.0	-19.5%
Lawrence	355	421	18.6%	192,048	194,035	1.0%	541.0	460.9	-14.8%
Richland	506	579	14.4%	209,273	202,860	-3.1%	413.6	350.4	-15.3%
Vermilion	909	1,014	11.6%	449,964	457,375	1.6%	495.0	451.1	-8.9%
Total	8,638	9,348	8.2%	3,489,084	3,348,171	-4.0%	403.9	358.2	-11.3%

Table 3-5: Average Agricultural Production Value									
County	**Number of Farms**			**Total Value of Agriculture Production**			**Average Production/Farm**		
	2002	**2007**	**% Chg**	**2002**	**2007**	**% Chg**	**2002**	**2007**	**% Chg**
Champaign	1,285	1,389	8.1%	$168,243,000	$311,463,000	85.1%	$130,928	$224,265	71.3%
Clark	581	588	1.2%	$59,622,000	$103,451,000	73.5%	$102,620	$175,937	71.4%
Coles	684	729	6.6%	$60,989,000	$123,862,000	103.1%	$89,165	$169,907	90.6%
Crawford	567	615	8.5%	$45,637,000	$74,665,000	63.6%	$80,489	$121,407	50.8%
Cumberland	583	654	12.2%	$50,778,000	$71,817,000	41.4%	$87,098	$109,812	26.1%
Douglas	576	657	14.1%	$62,612,000	$133,949,000	113.9%	$108,701	$203,880	87.6%
Edgar	667	670	0.4%	$139,648,000	$189,946,000	36.0%	$209,367	$283,501	35.4%
Effingham	1,134	1,150	1.4%	$72,294,000	$127,316,000	76.1%	$63,751	$110,710	73.7%
Jasper	791	882	11.5%	$68,898,000	$112,946,000	63.9%	$87,102	$128,057	47.0%
Lawrence	355	421	18.6%	$56,442,000	$90,058,000	59.6%	$158,992	$213,914	34.5%
Richland	506	579	14.4%	$53,020,000	$82,821,000	56.2%	$104,783	$143,041	36.5%
Vermilion	909	1,014	11.6%	$124,716,000	$223,968,000	79.6%	$137,201	$220,876	61.0%
Total	8,638	9,348	8.2%	$962,899,000	$1,646,262,000	71.0%	$111,472	$176,108	58.0%

Between 2002 and 2007 the total land devoted to agricultural production in the twelve counties decreased by approximately 4.0%. Even with this decrease in acreage, the total value of the agricultural production increased by approximately 71.0% in the same timeframe.

Population Trends

As discussed previously, the Embarras River Watershed is considered a rural area and is relatively sparsely populated. Census information from 1990 and 2000 Census was analyzed to determine population trends within the watershed. Table 3-6 shows the changes in population for each subwatershed. The analysis was completed at the county census tract level and only accounts for the portion of the tract located within the Embarras River Watershed.

Table 3-6: Population Trends				
Number	Subwatershed	1990 Population	2000 Population	Percent Change
1	East Branch Embarras River	19,398	22,187	14.4%
2	Scattering Fork	9,574	9,902	3.4%
3	Brushy Fork	1,974	1,505	-23.8%
4	Little Embarras River	2,181	1,784	-18.2%
5	Deer Creek- Embarras River	2,564	2,534	-1.1%
6	Kickapoo Creek	30,216	28,193	-6.7%
7	Muddy Creek	6,525	7,170	9.9%
8	Range Creek- Embarras River	14,052	17,436	24.1%
9	East Crooked Creek	1,262	1,244	-1.4%
10	North Fork Embarras River	10,082	10,292	2.1%
11	Big Creek	5,089	4,603	-9.5%
12	Honey Creek- Embarras River	8,408	7,605	-9.6%
13	Paul Creek- Muddy River	2,188	2,102	-3.9%
14	Brushy Creek	1,246	1,246	0.0%
15	Indian Creek- Embarras River	10,489	10,453	-0.3%
Total		125,247	128,256	2.4%

Overall, the total population within the watershed increased between the 1990 and 2000 Census by 2.4%. The largest increase was seen in the Range Creek – Embarras River Subwatershed at 24.1%; and the largest decrease was seen in the Brushy Fork Subwatershed at -23.8%.

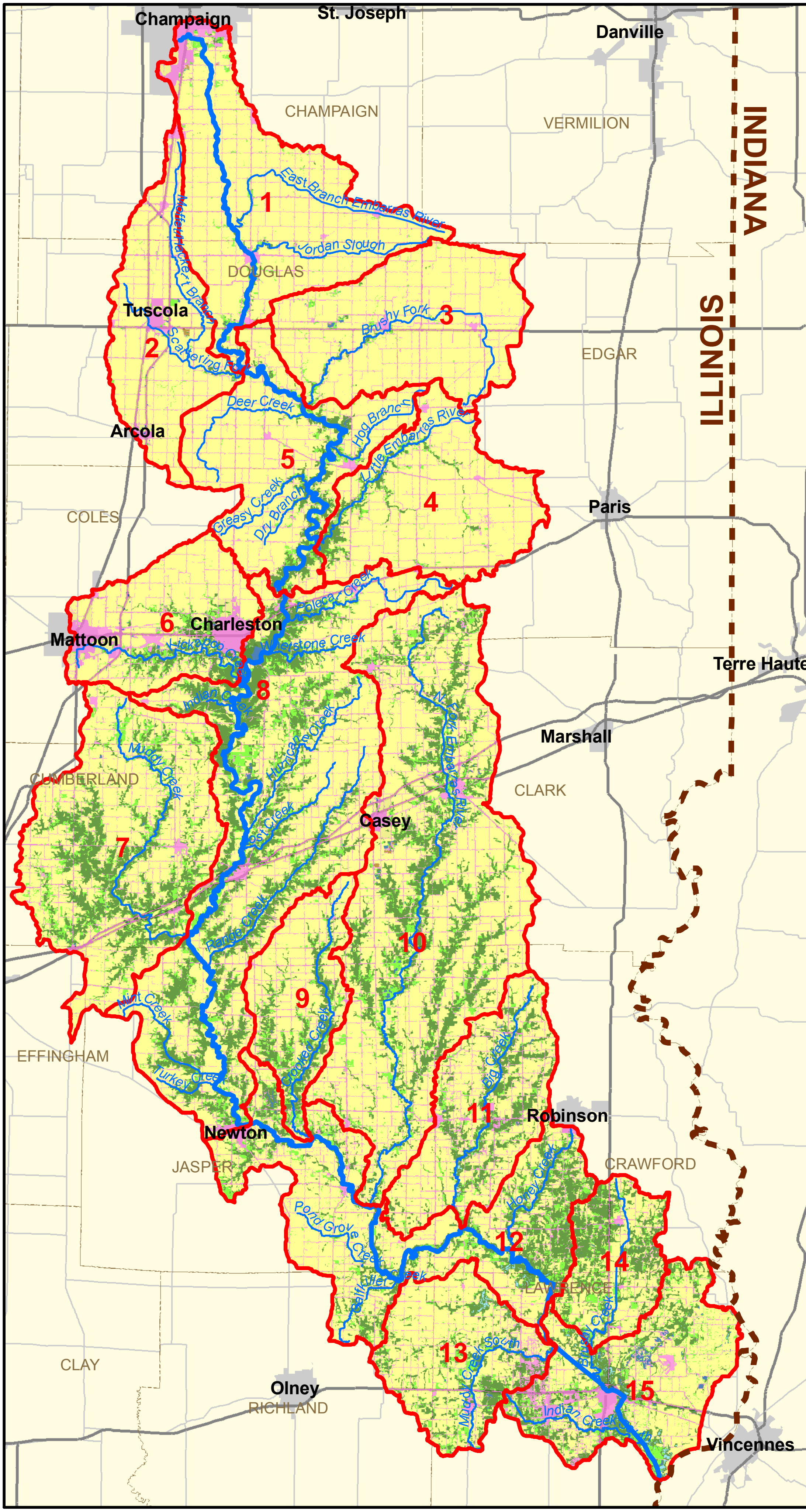
Land Cover

Land Cover and Pre-Settlement Vegetation

The Embarras River Watershed consists of approximately 1,558,063 acres of mixed land use, according to the 2007 Cropland Data Layer (CDL) for Illinois published by the United State Department of Agriculture, National Agriculture Statistics Service (USDA-NASS) (Exhibit 3; Table 3-7). From 1999-2006, the emphasis of the CDL data product was agricultural land cover, however beginning in 2007 a new classification protocol for both agricultural and non-agricultural lands was instituted. The resulting Illinois 2007 CDL layer is a comprehensive view of the land cover within Illinois. Table 3-7 and Exhibit 3 illustrate the distribution of land cover within the Embarras River Watershed.

Exhibit 3

ERMA
EMBARRAS RIVER MANAGEMENT ASSOCIATION



Embarras River Watershed

Landcover Map

Type	Acres	Percent
Agricultural	1,026,704	65.90%
Barren	500	0.03%
Developed	161,238	10.35%
Forest	247,152	15.86%
Grassland	113,914	7.31%
Open Water	6,151	0.39%
Wetlands	2,403	0.15%

Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed & Subwatersheds

Landcover

- Agricultural
- Barren
- Developed
- Forest
- Grassland
- Open Water
- Wetlands

N S E W

5 0 5 10 Miles

Table 3-7: Watershed Land Cover		
Landuse Classification	**Acres**	**Percentage**
Agricultural	1,026,704	65.9%
Barren	500	0.0%
Developed	161,238	10.4%
Forest	247,152	15.9%
Grassland	113,914	7.3%
Open Water	6,151	0.4%
Wetlands	2,403	0.2%
Total	1,558,062	100.1%*
*Note – Percent totals do not add to 100% due to rounding		

With approximately 81.8% of the watershed covered by agriculture and forest, the Embarras River watershed still remains primarily rural and agricultural. The developed areas (approximately 10.4%) are concentrated inside or on the fringe of established urban areas.

Out of the 15 subwatersheds included within the Embarras River basin (Table 3-8), the Kickapoo Creek subwatershed has the highest percentage of developed land (21.2%) associated with the Cities of Mattoon and Charleston, while the Deer Creek-Embarras River subwatershed had the lowest percentage of developed area (8.1%). The highest percentage of agricultural land among all the subwatersheds was Brushy Fork with 88.3% compared to the Brushy Creek subwatershed which had the lowest percentage at 44.9%.

Table 3-8: Watershed Land Cover by Subwatershed								
Number	**Subwatershed**	**Agricul-tural**	**Barren**	**Developed**	**Forest**	**Grass-land**	**Open Water**	**Wetlands**
1	East Branch Embarras River	82.4%	0.0%	12.3%	1.7%	3.3%	0.1%	0.1%
2	Scattering Fork	83.1%	0.2%	14.4%	0.5%	1.7%	0.2%	0.0%
3	Brushy Fork	88.3%	0.0%	8.7%	1.1%	1.7%	0.1%	0.1%
4	Little Embarras River	83.0%	0.0%	8.3%	5.8%	2.9%	0.0%	0.0%
5	Deer Creek- Embarras River	76.3%	0.0%	8.1%	10.7%	4.5%	0.2%	0.1%
6	Kickapoo Creek	61.8%	0.1%	21.2%	10.4%	6.3%	0.2%	0.0%
7	Muddy Creek	60.7%	0.0%	8.6%	19.8%	10.7%	0.1%	0.0%
8	Range Creek- Embarras River	54.7%	0.0%	9.1%	25.2%	10.2%	0.7%	0.0%
9	East Crooked Creek	61.6%	0.0%	9.0%	20.3%	9.0%	0.1%	0.0%
10	North Fork Embarras River	62.9%	0.1%	9.4%	19.2%	8.1%	0.3%	0.0%
11	Big Creek	61.6%	0.0%	11.2%	20.0%	6.7%	0.2%	0.3%
12	Honey Creek- Embarras River	58.3%	0.0%	9.1%	22.1%	9.4%	0.8%	0.3%
13	Paul Creek- Muddy River	63.9%	0.0%	9.9%	17.6%	7.9%	0.3%	0.4%
14	Brushy Creek	44.9%	0.0%	8.9%	33.4%	12.2%	0.3%	0.2%
15	Indian Creek-Embarras River	52.7%	0.0%	13.9%	19.9%	10.6%	1.9%	1.1%

Knowledge of pre-settlement conditions in a watershed is useful for interpreting the past and identifying appropriate restoration activities that can mimic historical landscape characteristics. During the establishment of the Public Land Survey System (PLSS) in Illinois (1804 through 1843), the surveyors were required to keep field notebooks with details about the survey and landscape. In the 1850's, these notebooks along with the original maps were compiled by the General Land Office (GLO) to create a more complete map of each township surveyed. The Illinois Natural History Survey used these maps to create the Early 1800's Land Cover Map which can be used as a guide to the pre-settlement vegetation. Table 3-9 and Exhibit 4 illustrate the distribution of pre-settlement vegetation within the Embarras River Watershed.

Table 3-9: Watershed Pre-Settlement Vegetation

Classification	Acres	Percentage
Barrens	1,126	0.1%
Bottomland	6,661	0.4%
Cultural	107	0.0%
Forest	655,152	42.0%
Marsh	304	0.0%
Other Wetland	401	0.0%
Prairie	872,560	56.0%
Slough	31	0.0%
Swamp	2,308	0.1%
Topo/geo	62	0.0%
Water	19,030	1.2%
Wet Prairie	319	0.0%
Total	1,558,061	99.8%*
*Note – Percent totals do not add to 100% due to rounding		

Prior to European settlement in the 1830's, the Embarras River watershed was predominantly comprised of prairie and forest lands. These forests, largely comprised of oak/hickory species, were found in the central and southern parts of the watershed with a majority along the tributaries of the Embarras River.

Significant Natural Areas

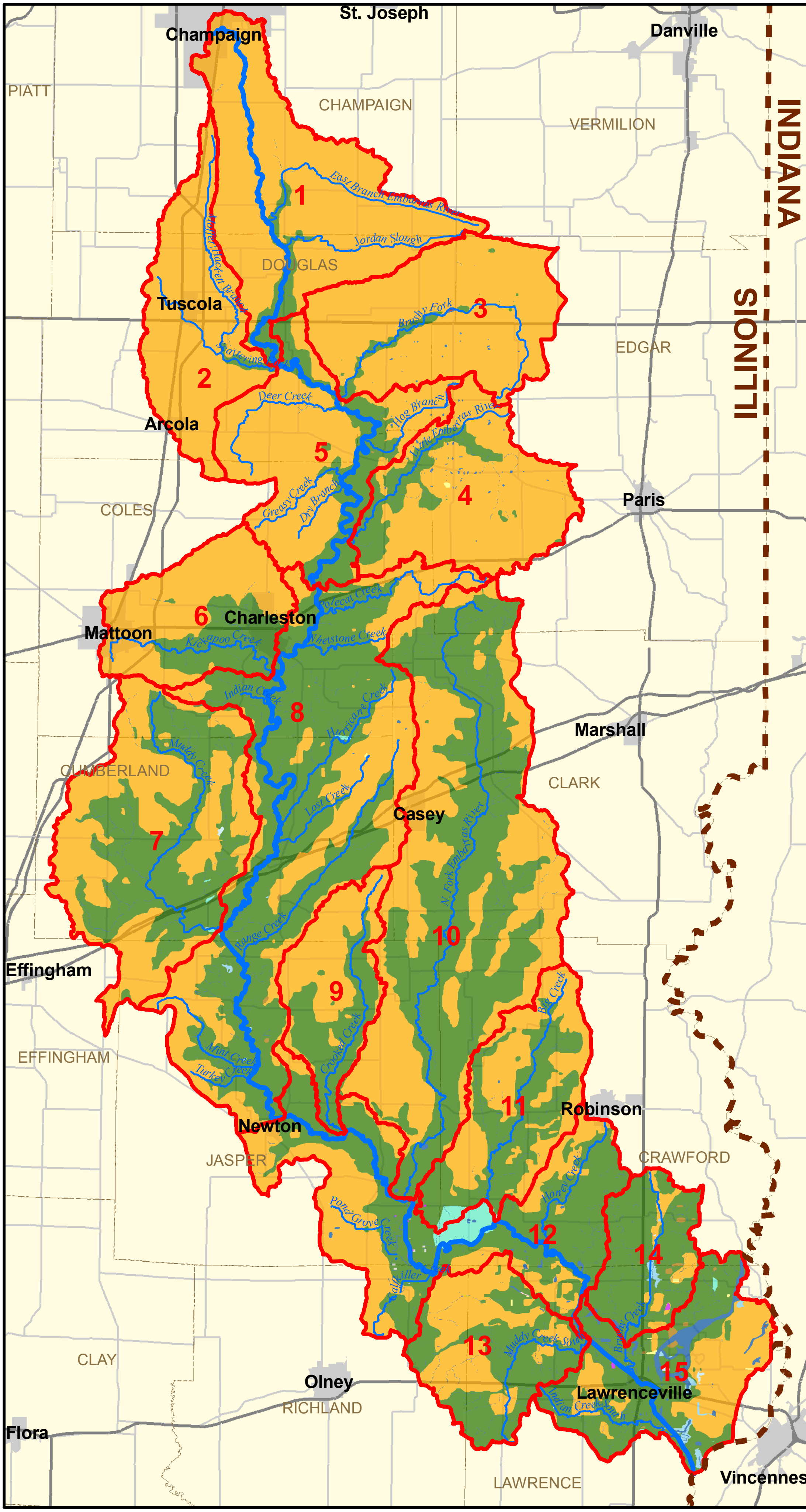
Illinois Natural Area Inventory Sites (INAI) are natural landscape features and communities of the highest quality still remaining in Illinois. In most cases, these sites are also where State and/or Federally listed Threatened and Endangered species have been found. As of August 2009, there were approximately 1,350 INAI sites, of which 34 can be found in the Embarras River Watershed. Table 3-10 summarizes the INAI sites found within the Embarras River Watershed.

Exhibit 4

ERMA
EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

Pre Settlement Vegetation Map



Type	Acres	Percent
Barrens	1,126	0.07%
Bottomland	6,661	0.43%
Cultural	107	0.01%
Forest	655,152	42.05%
Marsh	304	0.02%
Other Wetland	401	0.03%
Prairie	872,560	56.00%
Slough	31	0.00%
Swamp	2,308	0.15%
Topo/geo	62	0.00%
Water	19,030	1.22%
Wet Prairie	319	0.02%

Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed & Subwatersheds

Pre Settlement Vegetation

- Barrens
- Cultural
- Forest
- Marsh
- Wet prairie
- Other wetland
- Prairie
- Water
- Slough
- Swamp
- Topo/geo
- Bottomland

N
W E
S

5 0 5 10
Miles

Table 3-10: INAI Sites		
INAI Site Name	**INAI Category**	**Subwatershed (Number)**
Allison Ditch	II	Indian Creek-Embarras River (15)
Allison Gravel Prairie	II-R	Indian Creek-Embarras River (15)
Baber Woods	I, III	North Fork Embarras River (10)
Barnhart Prairie	II, III	East Branch Embarras River (1)
Center School Geological Area	IV	Range Creek-Embarras River (8)
Centerville Cemetery	II	Indian Creek-Embarras River (15)
Chauncey Marsh	I, II, II-R, III	Honey Creek-Embarras River (12)
Edward V. Price Woods	III	Big Creek (11), Honey Creek-Embarras River (12)
Embarras River-Camargo	II, III, VI	Brushy Fork (3), Deer Creek-Embarras River (5), East Branch Embarras River (1), Range Creek-Embarras River (8), Scattering Fork (2)
Embarras River Land and Water Reserve	III	Range Creek-Embarras River (8)
Emma Vance Woods	I	North Fork Embarras River (10)
Five-Mile Hill Prairie	I	Range Creek-Embarras River (8)
Grandville Woods	I, II, III	North Fork Embarras River (10)
Green Prairie	I, III	Range Creek-Embarras River (8)
Hillside Marsh	I, III	Range Creek-Embarras River (8)
Huddlestun Woods	I, III	East Crooked Creek (9)
Hutton Geological Area	IV	Range Creek-Embarras River (8)
Jewett Geological Area	IV	Muddy Creek (7)
Lawrenceville Airport	II	Indian Creek-Embarras River (15)
Miller Pond	I	Indian Creek-Embarras River (15)
Murdock Railroad Prairie	I	Brushy Fork (3)
Prairie Ridge-Jasper County	II, III	Honey Creek-Embarras River (12)
Red Hills Seep Springs	II, III	Paul Creek-Muddy River (13)
Red Hills Woods	I, III	Paul Creek-Muddy River (13)
Riley Creek	VI	Kickapoo Creek (6)
Sargent's Woods	I, III	Range Creek-Embarras River (8)
Shellbark Bottoms	III	Indian Creek-Embarras River (15)
Stevens Hill Prairie	I	Range Creek-Embarras River (8)
Thacker-Pauly Marsh	II	Paul Creek-Muddy River (13)
Wabash River-Mount Carmel	II, III, VI	Indian Creek-Embarras River (15)
Walnut Point	I, II, III	Deer Creek-Embarras River (5)
Warbler Woods	I, II, III	Range Creek-Embarras River (8)
Water Works Hill Prairie	I, III	Range Creek-Embarras River (8)
Woodyard Memorial Conservation Area	III	Range Creek-Embarras River (8)

INAI sites are categorized based on habitat and/or ownership status. Descriptions of the INAI categories are provided below.

- Category I – High quality natural community and natural community restorations,
- Category II – Specific suitable habitat for stat-listed species or state-listed species relocations,

- Category III – State dedicated Nature Preserves, Land and Water Reserves, and Natural Heritage Landmarks,
- Category IV – Outstanding geological features,
- Category V – Not used at this time, and
- Category VI – Unusual concentration of flora or fauna and high quality streams.

Conservation and Recreation Lands (CARL)

The Embarras River Watershed contains a number of significant natural resources that are worthy of protection. To a large extent, sustaining biodiversity in the watershed will depend on how well future decisions related to land use. Habitats such as wetlands, and remnant savanna, prairies and forest will have to be maintained in order ensure the survival of threatened and endangered species and the natural communities.

Knowing where existing conservation and recreation lands are located and what level of protection exists can have a profound impact the ability of organizations that own land to plan and implement conservation activities. The Conservation and Recreation Lands (CARL) GIS layer contains information on conservation and recreation lands in the Great Lakes region. It can be used in conjunction with other GIS layers for developing landscape and long-term planning perspectives for conservation activities. CARL was developed by Duck's Unlimited by incorporating existing GIS layers with hard-copy maps and online information.

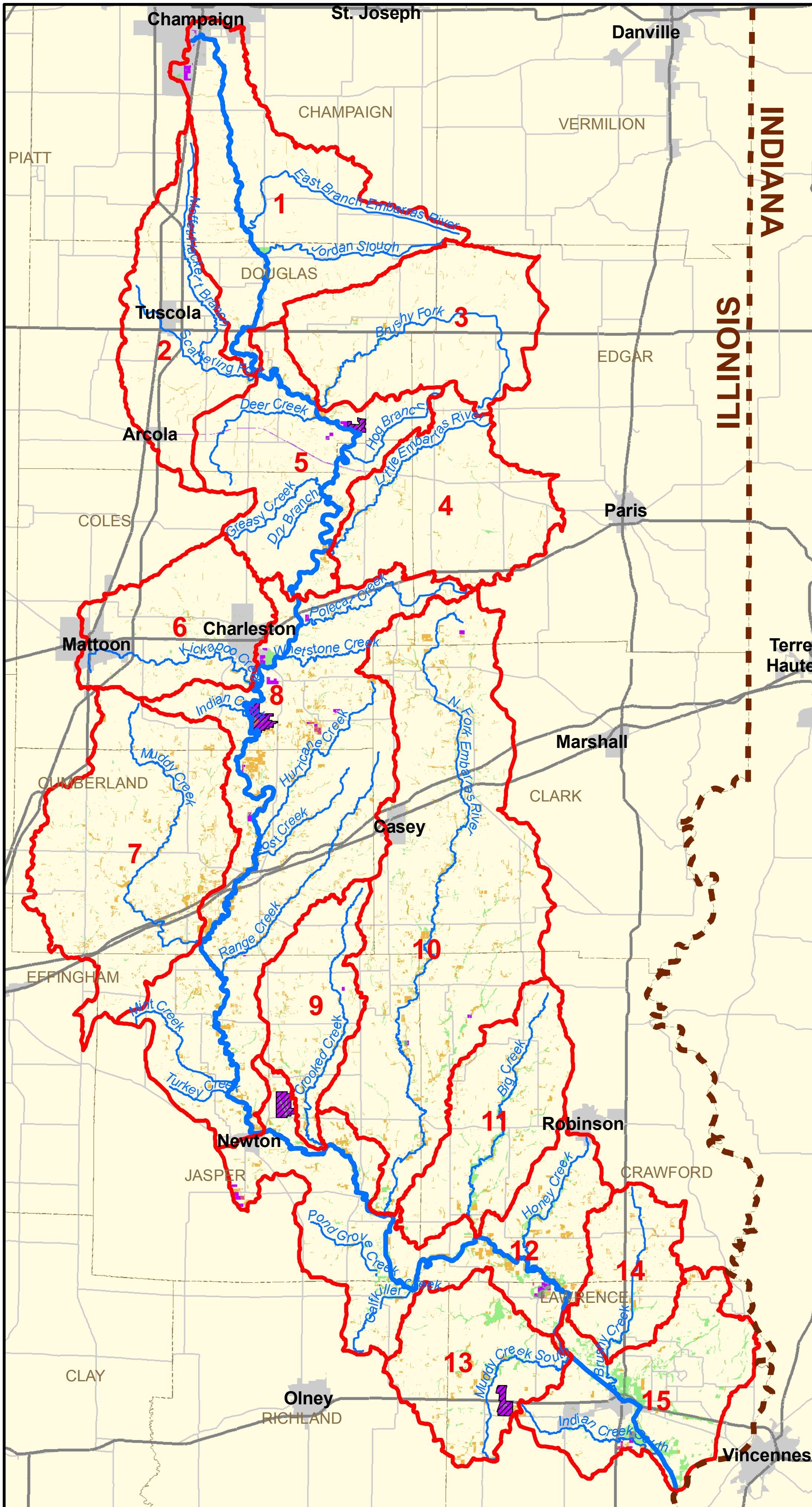
The Embarras River Watershed contains 40 CARL sites totaling approximately 7,250 acres. Table 3-11 and Exhibit 5 summarize the CARL sites located within the watershed.

Exhibit 5

EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

National Wetland Inventory and Conservation Map



Type of Wetland	Acres	Percent
Bottomland Forest	30,005	72.22%
Deep Marsh	327	0.79%
Deepwater Lake	1,319	3.17%
Lake Shore	3	0.01%
Open Water Wetlands	4,243	10.21%
Perennial Deepwater River	2,194	5.28%
Perennial Riverine	89	0.21%
Shallow Marsh/Wet Meadow	2,222	5.35%
Shrub-Scrub Wetlands	656	1.58%
Swamp	194	0.47%
Other	296	0.71%

Legend

- Urban Area
- Wetlands
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed & Subwatersheds
- CARL
- Conservation Reserve Program
- State Parks

N S E W

5 0 5 10 Miles

Table 3-11: CARL Sites		
CARL Site Name	**Ownership**	**Subwatershed**
Red Hills Woods Nature Preserve	State	Paul Creek – Muddy River
Red Hills State Park	State	Paul Creek – Muddy River
Richard and Jean Graber Grassland and Water R.	Local	Honey Creek – Embarras River
Sam Parr State Park	State	Honey Creek – Embarras River
Grandville Woods Nat. Heritage Landmark	Federal	North Fork Embarras River
Cox Timber Nat. Heritage Landmark	Federal	North Fork Embarras River
Emma Vance Woods Nat. Heritage Landmark	Federal	North Fork Embarras River
Huddlestun Nat. Heritage Landmark	Federal	East Crooked Creek
Huddleston Woods - Leon Tract NHL	Local	East Crooked Creek
Huddleston Woods Nat. Heritage Landmark	Federal	East Crooked Creek
Cecil E. Meeker	State	Range Creek – Embarras River
Grissom Farm Nat. Heritage Landmark	Federal	Range Creek – Embarras River
Sholem Farm Nat. Heritage Landmark	Federal	Range Creek – Embarras River
Wady / Cutright Farm Nat. Heritage Landmark	Local	Range Creek – Embarras River
Burris	State	Range Creek – Embarras River
Sargent's Woods Land and Water R.	Local	Range Creek – Embarras River
Fox Ridge State Park	State	Range Creek – Embarras River
Warbler Woods	Private	Range Creek – Embarras River
Baber Woods Nature Preserve	NGO	North Fork Embarras River
Fishel Hillside Marsh Nat. Heritage Landmark	Federal	Range Creek – Embarras River
Upper Embarras Woods Nature Preserve	State	Deer Creek – Embarras River
Walnut Point State Park	State	Deer Creek – Embarras River
Prairie Wind Trail	State	Scattering Fork, Deer Creek – Embarras River
Hazen Park	Local	East Branch Embarras River
Hale Park	Local	East Branch Embarras River
University of Illinois Public Golf Course	Private	East Branch Embarras River
Jones Park	Local	East Branch Embarras River
Burwash Park	Local	East Branch Embarras River
Noel Park	Local	East Branch Embarras River
Moore Park	Local	East Branch Embarras River
Mattis Park	Local	East Branch Embarras River
Hessel Park	Local	East Branch Embarras River
Jasper County Prairie Chicken Sanctuary Nature Pre.	State	Honey Creek – Embarras River
Shellbark Bottoms Nat. Heritage Landmark	Federal	Indian Creek – Embarras River
Hindsboro Habitat Area	State	Deer Creek – Embarras River
Fox Ridge	State	Range Creek – Embarras River
Green Prairie	State	Range Creek – Embarras River
Green Prairie Nat. Heritage Landmark	Federal	Range Creek – Embarras River
Woodyard Mem. Cons. Area Land and Water R.	Local	Range Creek – Embarras River
Chauncey Marsh Nature Preserve	State	Honey Creek – Embarras River

Climate

The Embarras River Watershed is within a humid continental climate region. The humid continental climate is marked by variable weather patterns and a large seasonal variance.

Summers are often warm and humid with frequent thunderstorms and winters can be very cold with frequent snowfall and persistent snow cover.

The National Oceanic and Atmospheric Administration, National Climatic Data Center publishes the normals of average monthly and annual maximum, minimum, and mean temperature, monthly and annual total precipitation (inches), and heating and cooling degree days (base 65 degrees F) for individual locations throughout the United States, Puerto Rico, Virgin Islands, and Pacific Islands.

The monthly precipitation and temperature normals were obtained for Illinois for the time period of 1971 – 2000. Out of the 186 climate stations within Illinois, 9 fall within the Embarras River Watershed. All nine of the stations recorded precipitation values, while only four stations maintained temperature data (Tables 3-12 and 3-13).

Table 3-12: Average Temperature (^oF), 1971- 2000

Month	Charleston	Mattoon	Tuscola	Urbana
January	26.9	24.8	26.2	24.1
February	32.3	29.9	31.7	29.4
March	42.8	41.0	42.7	40.0
April	53.8	52.3	53.9	51.1
May	63.9	63.3	64.8	62.4
June	72.8	72.8	73.9	71.5
July	76.4	76.2	77.0	74.8
August	74.5	74.2	74.9	72.8
September	67.6	67.1	68.4	66.0
October	56.3	55.4	56.8	54.0
November	43.5	41.9	43.4	41.4
December	31.8	30.3	31.6	29.4

Table 3-13: Average Precipitation (in.), 1971- 2000

Month	Casey	Charleston	Greenup	Lawrenceville	Mattoon	Newman	Ste Marie	Tuscola	Urbana
January	2.53	2.20	2.27	2.73	2.03	1.81	2.61	2.29	1.90
February	2.38	2.40	2.30	2.68	2.08	1.64	2.44	2.12	2.01
March	3.41	3.35	3.71	4.18	3.06	2.95	3.90	3.14	3.21
April	4.30	3.98	3.84	4.24	3.84	4.25	4.13	3.84	3.65
May	4.09	4.23	4.30	5.19	3.95	3.85	4.63	3.96	4.80
June	3.60	3.94	3.97	4.27	4.21	3.66	4.05	4.15	4.21
July	4.58	4.65	4.22	4.45	4.16	3.27	4.30	4.64	4.67
August	3.80	3.46	3.54	3.66	3.25	4.57	3.59	3.73	4.37
September	3.02	3.17	3.13	3.12	3.06	3.07	3.38	3.14	3.22
October	3.22	3.25	2.97	3.20	3.02	3.45	2.85	2.86	2.81
November	3.69	3.87	4.08	4.20	3.71	3.52	4.11	3.74	3.45
December	3.05	3.23	2.83	3.42	2.84	2.40	3.21	3.05	2.76

Physical Geography and Geomorphology

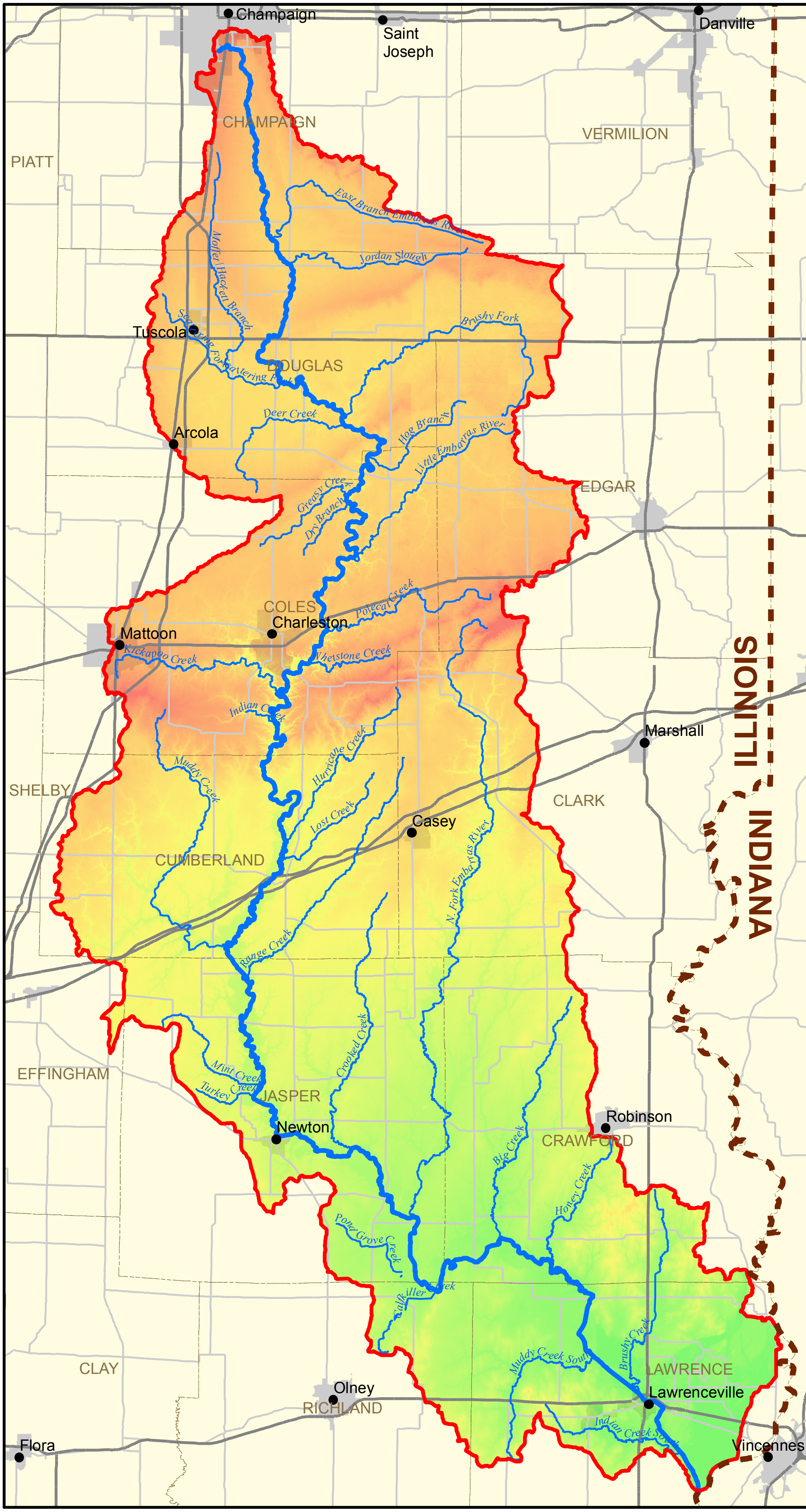
The topography of the Embarras River basin is the result of recent modification of glacial activity during the Wisconsinan and Illinoian glacial periods (exhibit 7). The northern part of the basin, above the Cumberland -Coles County line, is within the Bloomington Ridged Plain

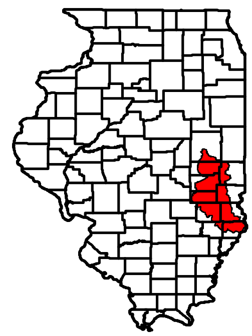
Exhibit 6

ERMA
EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

Shaded Relief Map



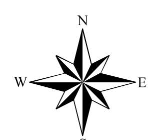


Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed

Elevation

- High
- Low



5 0 5 10
Miles

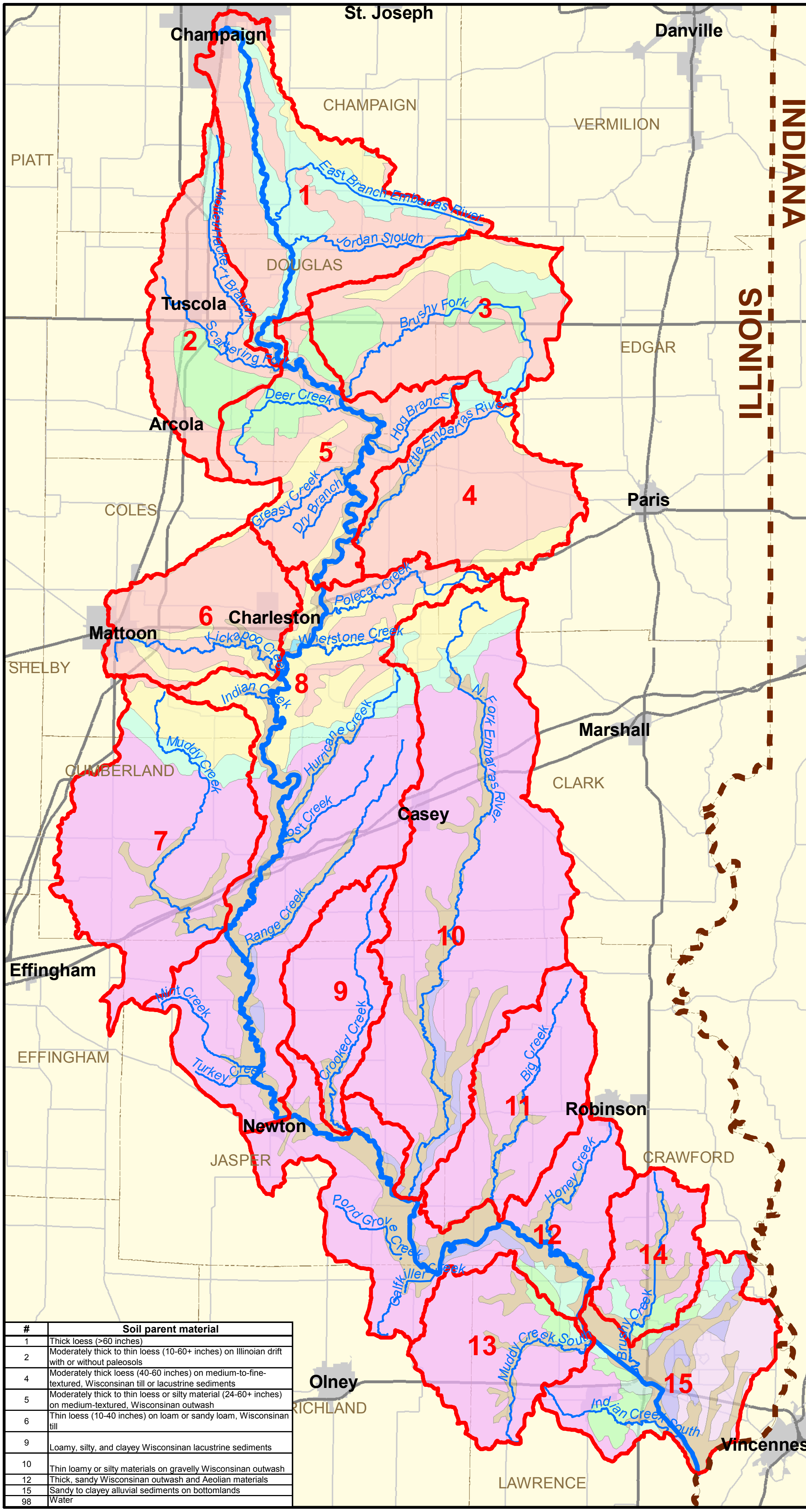
Exhibit 7

EMBARRAS RIVER MANAGEMENT ASSOCIATION

ERMA

Embarras River Watershed

Surficial Geology Map



#	Soil parent material
1	Thick loess (>60 inches)
2	Moderately thick to thin loess (10-60+ inches) on Illinoian drift with or without paleosols
4	Moderately thick loess (40-60 inches) on medium-to-fine-textured, Wisconsinan till or lacustrine sediments
5	Moderately thick to thin loess or silty material (24-60+ inches) on medium-textured, Wisconsinan outwash
6	Thin loess (10-40 inches) on loam or sandy loam, Wisconsinan till
9	Loamy, silty, and clayey Wisconsinan lacustrine sediments
10	Thin loamy or silty materials on gravelly Wisconsinan outwash
12	Thick, sandy Wisconsinan outwash and Aeolian materials
15	Sandy to clayey alluvial sediments on bottomlands
98	Water

Soil Parent Material #	Acres	Percent
1	4,729	0.30%
2	669,436	42.97%
4	381,087	24.46%
5	91,244	5.86%
6	126,392	8.11%
9	66,145	4.25%
10	19,954	1.28%
12	21,285	1.37%
15	177,380	11.38%
98	368	0.02%

Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed & Subwatersheds

Soil Parent Material #

1, 2, 4, 5, 6, 9, 10, 12, 15, 98

and described as depositional plains of low relief underlain by thick till and modified only slightly by post glacial stream erosion. The plains are nearly flat to gently rolling and are crossed by several low and poorly developed end moraines. The flatness of the plains is broken by low eskers, esker troughs, and melt water drainage ways that trend southeast.

The central portion of the basin is within the Springfield Plain and extends approximately from the Cumberland -Coles County line on the north to the Richland -Jasper County line. The glacial material in this area is Illinoian in age and was not subjected to the more recent Wisconsinan glacial activity. It is underlain by lacustrine, outwash, and alluvial sediments and till and is characterized by extensively aggraded valleys. The lowlands are broad plains with low rolling hills. The northern part of the plain has less relief than the southern end.

Downstream from the Richland -Jasper County line the basin is within the Mt. Vernon Hill Country which has gently rolling topographic features that are controlled chiefly by the underlying bedrock. The uplands are well dissected, and the lowlands are broad and have low-gradient alluvial river plains.

Elevation in the Embarras River basin varies from 715 feet Mean Sea Level at its source near Urbana to 405 feet Mean Sea Level at its confluence with the Wabash River, a total fall of 310 feet. With a total river distance of approximately 190 stream miles, this results in an average slope of 1.6 feet per mile. Headwater slopes of the main stem are relatively steep with a value of approximately 4.4 feet per mile while the middle reaches average 1.6 feet per mile. Finally, the outlet reach between the Wabash River and the USGS stream gauge at St. Marie averages only 1.2 feet per mile.

Geology

The surficial geology of the Embarras River drainage basin consists of a mantle of weakly consolidated to unconsolidated sediments of Pleistocene and recent age overlying Pennsylvanian-age bedrock. Bedrock exposures are relatively few in number and of limited areal extent. The near surface Pleistocene glacial deposits of the drainage basin include: (1) Illinois-age Glasford Formation in the southern part, and (2) Late Wisconsin-age Wedron Group in the northern part. The mapped boundary between these two subdivisions is along the southern margin of the Shelbyville and Westfield terminal moraines, which were formed about 18,000 years ago (Exhibit 6).

The Glasford Formation is dominantly composed of glacial till and outwash sand and gravel deposits. In a few areas, Illinois-age eskers, kames and crevasse-filling deposits occur above the Glasford. Late Wisconsin-age deposits in the basin are composed of glacial tills, lacustrine silts and clays, outwash sand and gravels, and loess. Glacial till, which is mostly poorly sorted clay, silt, sand, and gravel, is thickest in moraines.

The location and form of Wedron Group deposits influences the configuration of the northern part of the drainage basin. Drainage divides generally occur along moraines. The headwater area of the Embarras River is on the southwest side of the Champaign moraine. The basin's western divide, from north to south, obliquely crosses the Pesotum and West Ridge moraines and parallels the Arcola and Cerro Gordo moraines before cutting across the Paris and Shelbyville moraines, cuts across the West Ridge moraine, and over flat landscapes underlain by lacustrine deposits to the Arcola moraine. After following a portion of the Arcola moraine, the divide cuts across the Paris, Nevins, and Westfield moraines. Like the Glasford, the Wedron is dominantly composed of glacial till and outwash sand and gravel deposits.

In south-central Champaign and eastern Douglas Counties, clayey lacustrine deposits of the late Wisconsin-age Equality Formation were deposited in lakes ponded behind the West Ridge and Arcola moraines. At the southernmost part of the basin, slackwater lacustrine deposits, also mapped as Equality Formation, overlie the Glasford within the Embarras River valley.

Sand and gravel outwash deposits of late Wisconsin-age (Henry Formation) generally occur along the outer margins of the moraines where glacial ice stagnated during gradual retreat northward. Outwash deposits are significantly larger just south of the Wisconsin terminal moraines and where glacial meltwater eroded channels through moraines. Wisconsin-age outwash also is abundant at the southern end of the basin, occurring as terrace deposits along the Wabash River.

Late Wisconsin-age silt-size loess, deposited by the wind, blankets most of the Wisconsin and older sediments. Wind blown sand deposits (Parkland Sand) occur sporadically along the main branches of the Embarras River on the east side of the channel and south of the terminal Wisconsin-age moraine. Late Wisconsin-age and recent Cahokia Alluvium occurs throughout the drainage basin along streams and floodplains. The alluvium ranges from well to poorly sorted and consists of variable amounts of clay, silt, sand, and gravel derived from the loess, glacial till, and outwash sediments.

Exhibit 7 illustrates the surficial geology of the watershed.

Exhibit 8 illustrates the thickness of unconsolidated materials that lie above bedrock throughout the watershed.

Soil Characteristics

Soil Associations

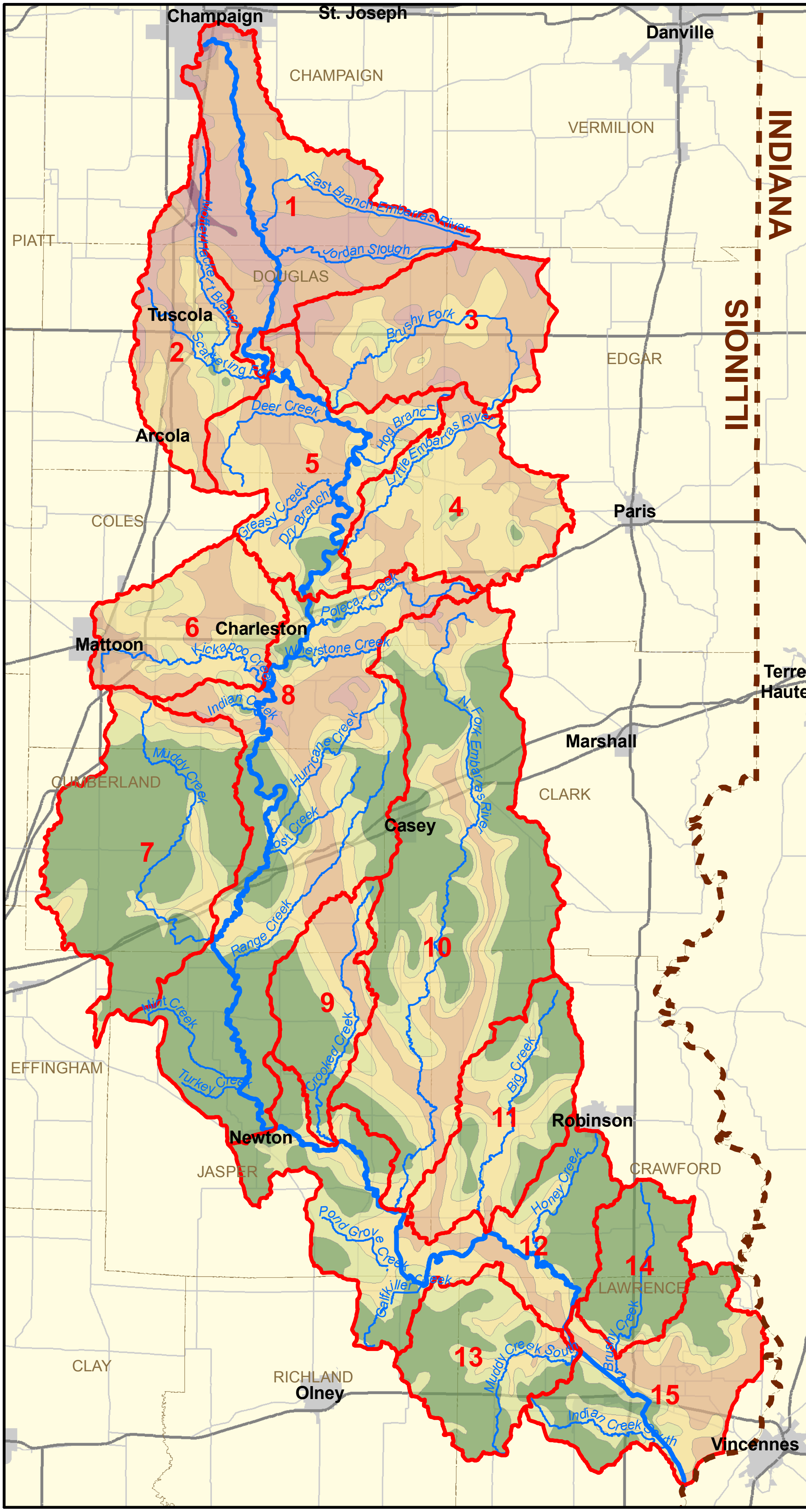
Soil associations are groups of soil types that generally share one or more common characteristics; such as parent material or drainage capability. These soil associations provide general characteristics for the specific soil association, but should not be used at the decision making level. There are 19 soil associations within the Embarras River Watershed (Table 3-14 and Exhibit 9). Approximately 55.2% of the basin area is composed of three soil associations, with the remaining 16 soil associations each comprising 0.0-6.6% of the watershed. The Catlin-Flanagan-Drummer series is prevalent in the northern portion of the watershed, while the Hoyleton-Cisne-Huey and Ava-Bluford-Wynoose series are predominantly found in the southern portion of the watershed.

Exhibit 8

EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

Drift Thickness Above Bedrock Map



Range (feet)	Acres	Percent
< 25	519,503	33.34%
25 - 50	211,152	13.55%
50 - 100	366,140	23.50%
100 - 200	381,148	24.46%
200 - 300	77,826	5.00%
300 - 400	2,293	0.15%

Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed & Subwatersheds

Drift Thickness Range (ft.)

- < 25
- 25 - 50
- 50 - 100
- 100 - 200
- 200 - 300
- 300 - 400

N W E S

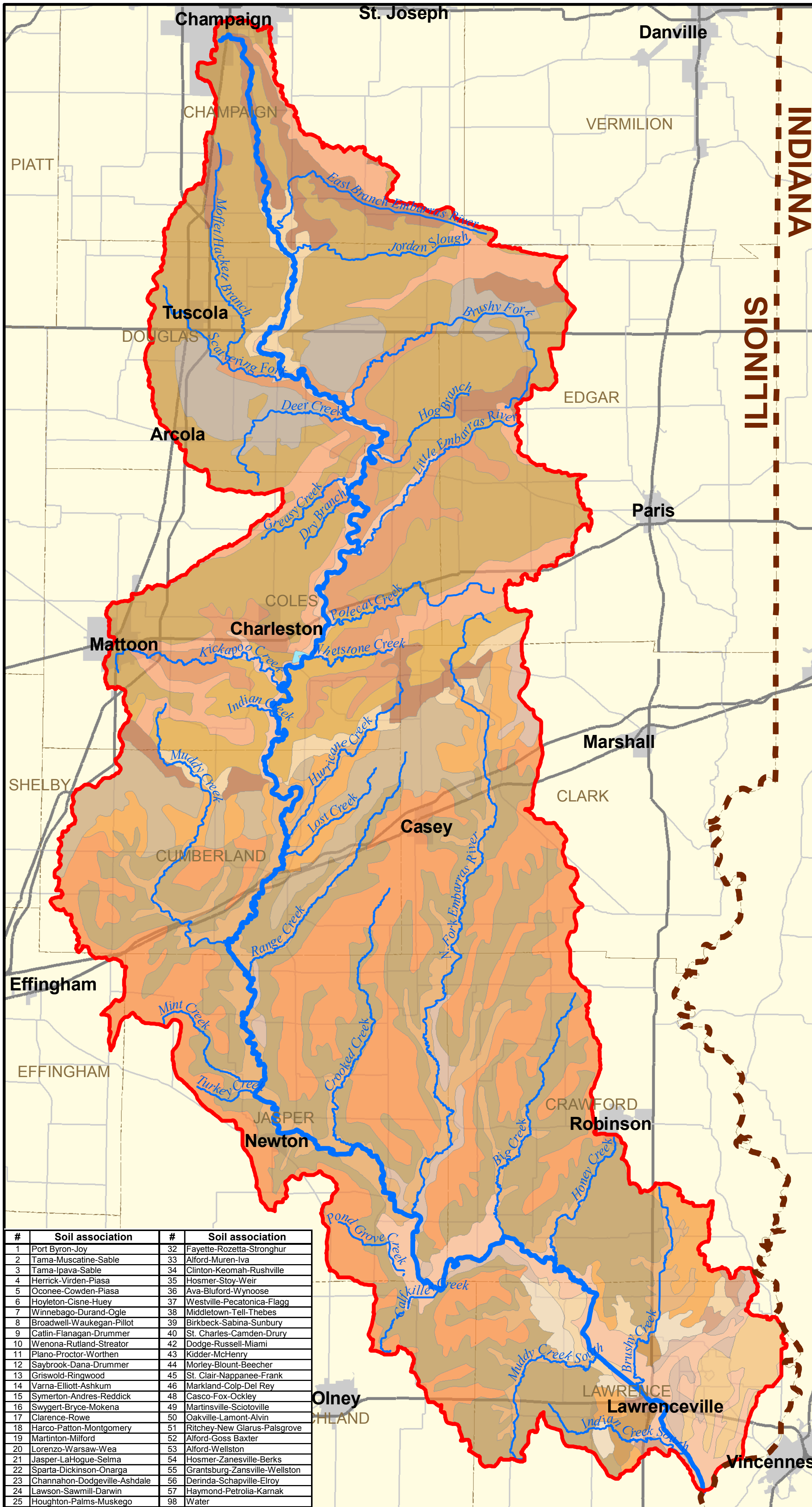
5 0 5 10 Miles

Exhibit 9

EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

Soils Map



#	Soil association	#	Soil association
1	Port Byron-Joy	32	Fayette-Rozetta-Stronghur
2	Tama-Muscatine-Sable	33	Alford-Muren-Iva
3	Tama-Ipava-Sable	34	Clinton-Keomah-Rushville
4	Herrick-Virden-Piasa	35	Hosmer-Stoy-Weir
5	Oconee-Cowden-Piasa	36	Ava-Bluford-Wynoose
6	Hoyleton-Cisne-Huey	37	Westville-Pecatonica-Flagg
7	Winnebago-Durand-Ogle	38	Middletown-Tell-Thebes
8	Broadwell-Waukegan-Pillot	39	Birkbeck-Sabina-Sunbury
9	Catlin-Flanagan-Drummer	40	St. Charles-Camden-Drury
10	Wenona-Rutland-Streator	42	Dodge-Russell-Miami
11	Plano-Proctor-Worthen	43	Kidder-McHenry
12	Saybrook-Dana-Drummer	44	Morley-Blount-Beecher
13	Griswold-Ringwood	45	St. Clair-Nappanee-Frank
14	Varna-Elliott-Ashkum	46	Markland-Colp-Del Rey
15	Symerton-Andres-Reddick	48	Casco-Fox-Ockley
16	Swygert-Bryce-Mokena	49	Martinsville-Sciotoville
17	Clarence-Rowe	50	Oakville-Lamont-Alvin
18	Harco-Patton-Montgomery	51	Ritchey-New Glarus-Palsgrove
19	Martinton-Milford	52	Alford-Goss Baxter
20	Lorenzo-Warsaw-Wea	53	Alford-Wellston
21	Jasper-LaHogue-Selma	54	Hosmer-Zanesville-Berks
22	Sparta-Dickinson-Onarga	55	Grantsburg-Zansville-Wellston
23	Channahon-Dodgeville-Ashdale	56	Derinda-Schapville-Elroy
24	Lawson-Sawmill-Darwin	57	Haymond-Petrolia-Karnak
25	Houghton-Palms-Muskego	98	Water
31	Seaton-Timula		

Soil Association #	Acres	Percent
5	58,926	3.78%
6	241,942	15.53%
9	310,552	19.93%
11	57,319	3.68%
12	69,519	4.46%
18	11,832	0.76%
19	48,686	3.12%
20	19,954	1.28%
24	74,367	4.77%
33	4,729	0.30%
35	56,126	3.60%
36	307,265	19.72%
39	70,535	4.53%
41	33,925	2.18%
42	56,873	3.65%
46	5,628	0.36%
50	26,463	1.70%
57	103,013	6.61%
98	368	0.02%

Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed & Subwatersheds

Soil Association #

5, 6, 9, 11, 12, 18, 19, 20, 24, 33, 35, 36, 39, 41, 42, 46, 50, 57, 98

N S W E

5 0 5 10 Miles

Table 3-14: Soil Associations		
Association	**Acres**	**Percentage**
Oconee-Cowden-Piasa	58,926	3.8%
Hoyleton-Cisne-Huey	241,942	15.5%
Catlin-Flanagan-Drummer	310,552	19.9%
Plano-Proctor-Worthen	57,319	3.7%
Saybrook-Dana-Drummer	69,519	4.5%
Harco-Patton-Montgomery	11,832	0.8%
Martinton-Milford	48,686	3.1%
Lorenzo-Warsaw-Wea	19,954	1.3%
Lawson-Sawmill-Darwin	74,367	4.8%
Alford-Muren-Iva	4,729	0.3%
Hosmer-Stoy-Weir	56,126	3.6%
Ava-Bluford-Wynoose	307,265	19.7%
Birkbeck-Sabina-Sunbury	70,535	4.5%
St. Charles-Camden-Drury	33,925	2.2%
Sodge-Russell-Miami	56,873	3.6%
Markland-Colp-Del Ray	5,628	0.4%
Oakville-Lamont-Alvin	26,463	1.7%
Haymond-Petrolia-Karnak	103,013	6.6%
Water	368	0.0%
Total	1,558,022	100.0%

The Catlin-Flanagan-Drummer association consists of nearly level to gently sloping silty soils formed in loess and the underlying glacial till or outwash on till plains of Wisconsinan age. Flanagan soils are somewhat poorly drained, Drummer soils are poorly drained, and Catlin soils are moderately well drained. They formed under prairie vegetation and are characterized by a thick, black or very dark grayish brown surface layer that is high in organic matter. Most of this association is used for cultivated crops. The soils are well suited to all of the crops commonly grown in the basin.

The Ava-Bluford-Wynoose association consists of nearly level to very steep silty and loamy soils formed in loess and the underlying glacial till or entirely in glacial till on till plains of Illinoian age. This association occurs in sloping upland areas adjacent to the Embarras River and its tributaries. Bluford soils are somewhat poorly drained, Ava soils are moderately well drained, and Wynoose soils are poorly drained. They formed under forest vegetation. Most of the nearly level to moderately sloping areas are used for cultivated crops. The soils in these areas are well suited or moderately suited to cultivated crops depending on the amount of slope. Steeper areas are mostly used for pasture, hay, and woodland. The soils are well suited or moderately suited to these uses.

The Hoyleton-Cisne-Huey association consists of nearly level to gently sloping silty soils formed in loess and the underlying glacial till on till plains of Illinoian age. They formed mostly under prairie vegetation but have been influenced by forest vegetation at some time during their development. Hoyleton soils are somewhat poorly drained, Cisne soils are poorly drained, and Huey soils are poorly drained. Most of this association is used for

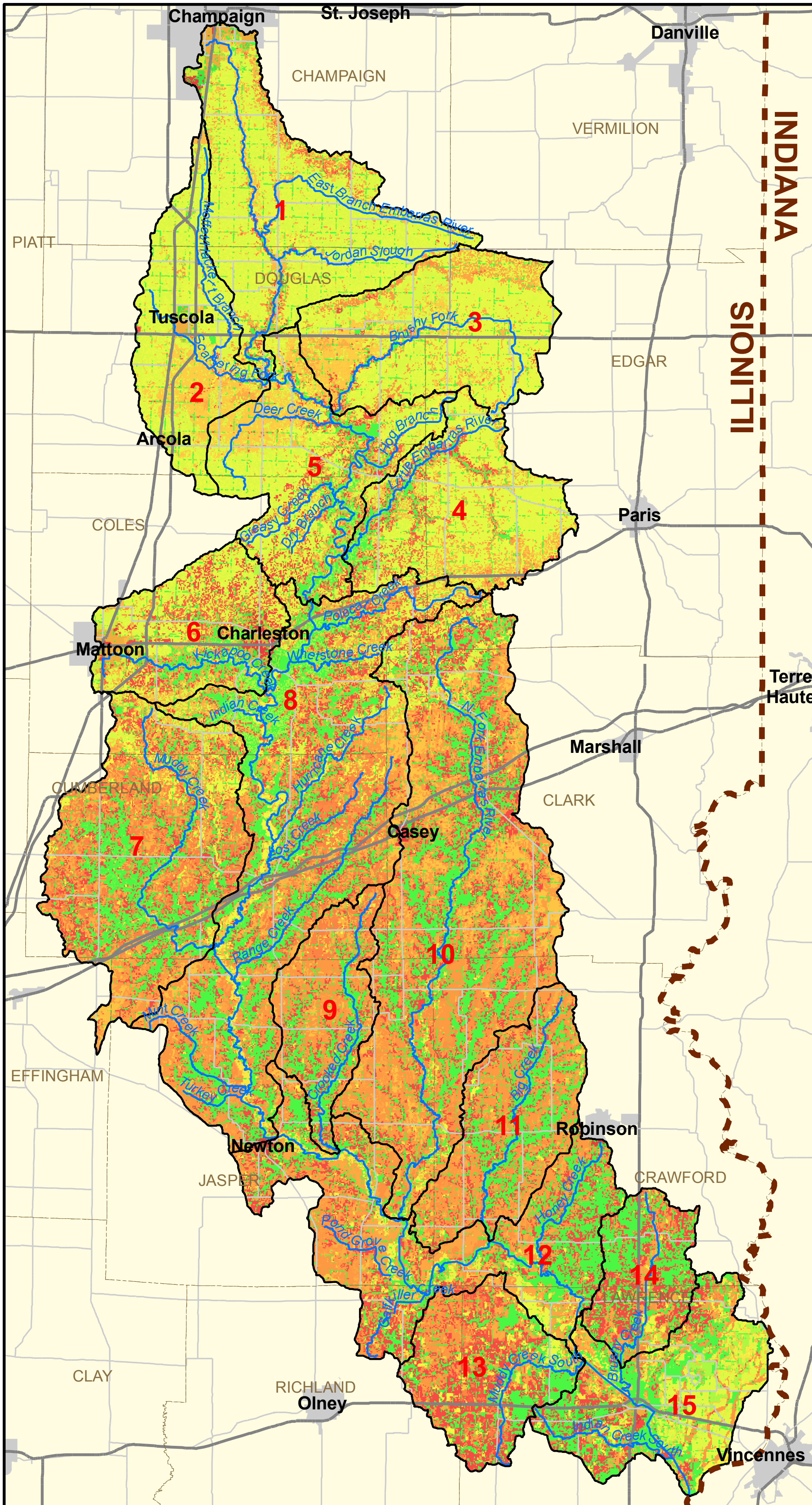
Exhibit 17

Embarras River Management Association

Seal of Charleston, Illinois

Embarras River Watershed

Total Nitrogen Non Point Source Loading



ID	Name	Total Nitrogen (lbs) Total	lbs/acre
1	East Branch Embarras River	472,026	3.90
2	Scattering Fork	277,057	4.01
3	Brushy Fork	382,942	4.10
4	Little Embarras River	339,618	4.10
5	Deer Creek-Embarras River	376,918	4.05
6	Kickapoo Creek	276,055	4.26
7	Muddy Creek	621,847	4.64
8	Range Creek-Embarras River	932,377	4.24
9	East Crooked Creek	231,990	4.69
10	North Fork Embarras River	1,047,551	4.61
11	Big Creek	324,351	4.54
12	Honey Creek-Embarras River	576,448	4.46
13	Paul Creek-Muddy River	306,067	4.87
14	Brushy Creek	170,693	4.15
15	Indian Creek-Embarras River	296,575	3.61

Legend

Embarras River

Embarras River Tributaries

County Line

Embarras River Watershed & Subwatersheds

Total Nitrogen Loading

High : 18.172

Low : 0.0628204

N S E W

5 0 5 10 Miles

cultivated crops. The soils are moderately suited or well suited to all of the crops commonly grown in the basin.

Hydrologic Soil Groups

Soils are classified into hydrologic soil groups to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The groups are designated as A, B, C, and D.

Group A soils have low runoff potential and high infiltration rates when thoroughly wetted and consist mainly of well to excessively drained soils. Group B soils have moderate infiltration rates and consist mainly of moderately well to well drained soils. Group C soils have low infiltration rates, and group D soils have high runoff potential.

Within the Embarras River Watershed, all soil groups can be found, however the majority of the soils fall within hydrologic soil group B (45.2%). Table 3-15 and Exhibit 10 summarize the hydrologic soil group information for the watershed.

Table 3-15: Hydrologic Soil Groups Within the Watershed

Soil Group	Acres	Percentage
A	2,575	0.2%
B	703,519	45.2%
C	541,493	34.8%
D	310,475	19.9%
Total	1,558,062	100.1%*

*Note – Percent totals do not add to 100% due to rounding

Highly Erodible Land

Erosion is a natural process within stream ecosystems; however excessive erosion negatively impacts the health of the watershed. Erosion throughout the watershed increases sedimentation of the streambeds which impacts the quality of habitat for fish and other organisms. Erosion also impacts water quality as it increases nutrients and decreases water clarity. Highly erodible soils and potentially highly erodible soils in the Embarras River Watershed are mapped in Exhibit 11. The data used to create this exhibit was extracted from the Soil Survey Geographic (SSURGO) Database. It was assumed that soils with K-factors greater than or equal to 0.4 and slope gradients greater than or equal to 6 were highly erodible. A total of approximately 78,822 acres or 5.1% of the watershed is considered highly erodible or potentially highly erodible.

Highly erodible soils are especially susceptible to the erosional forces of wind and water. Wind erosion is common in flat areas where vegetation is sparse or where soil is loose, dry, and finely granulated. Wind erosion damages land and natural vegetation by removing productive top soil from one place and depositing it in another. Heavy rainfall increases flow rates within streams as the volume and velocity of water moving through the stream channels increases. Velocity of water also increases as streambank steepness increases.

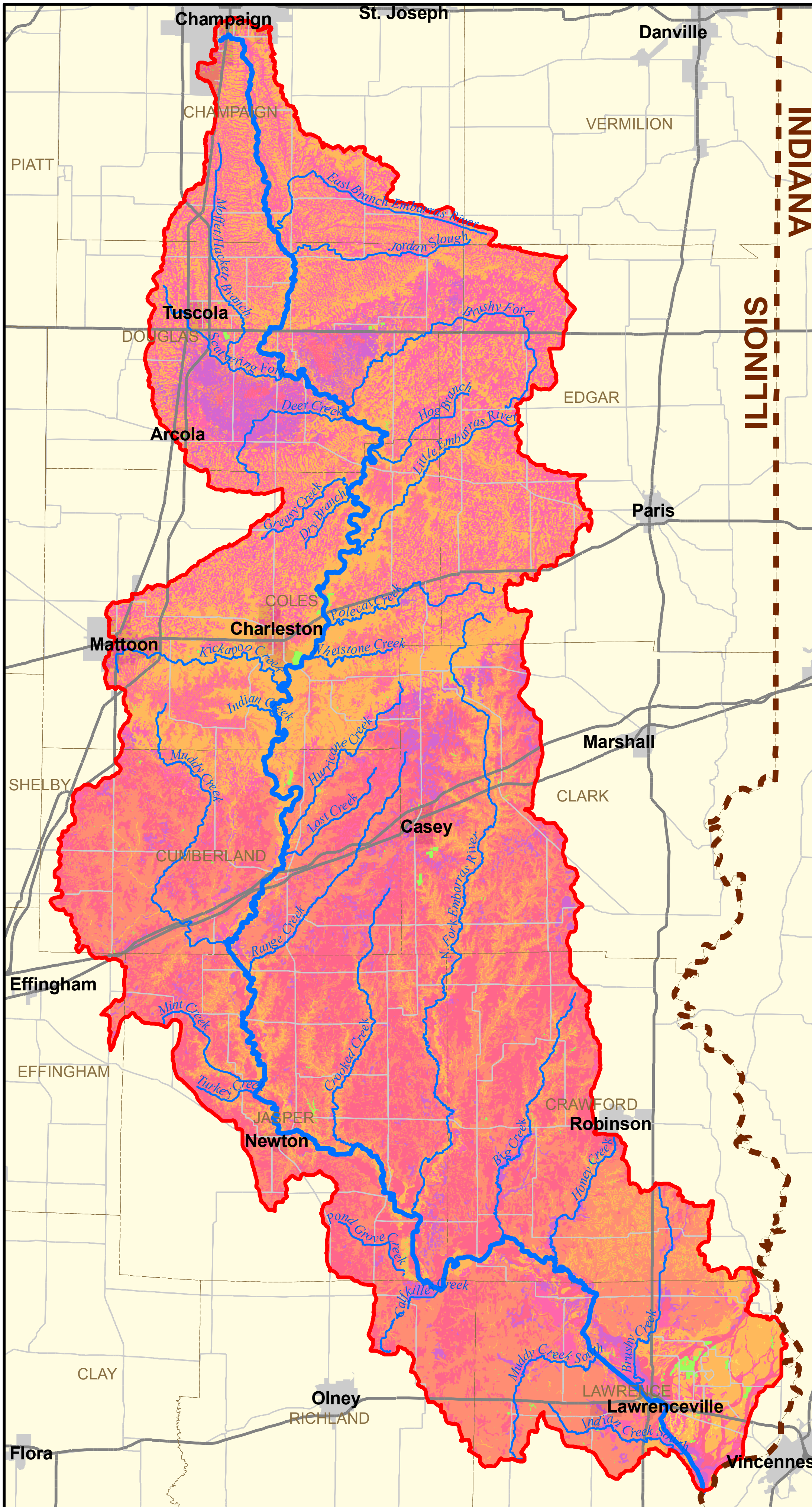
In areas with highly erodible soils special care must be taken to insure that land use practices do not result in severe wind or water erosion. Although natural erosion cannot be

Exhibit 10

ERMA
EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

Hydrologic Soil Groups



Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed & Subwatersheds

Hydrologic Soil Groups

- A - High Infiltration Rate
- B - Moderate Infiltration Rate
- C - Slow Infiltration Rate
- D - Very Slow Infiltration Rate
- B/D*
- C/D*
- Unclassified

*If a soil is assigned to a dual hydrologic group, the first letter is for drained areas and the second is for undrained areas

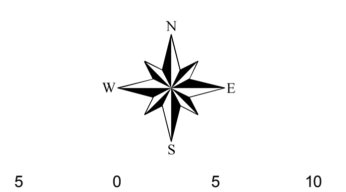
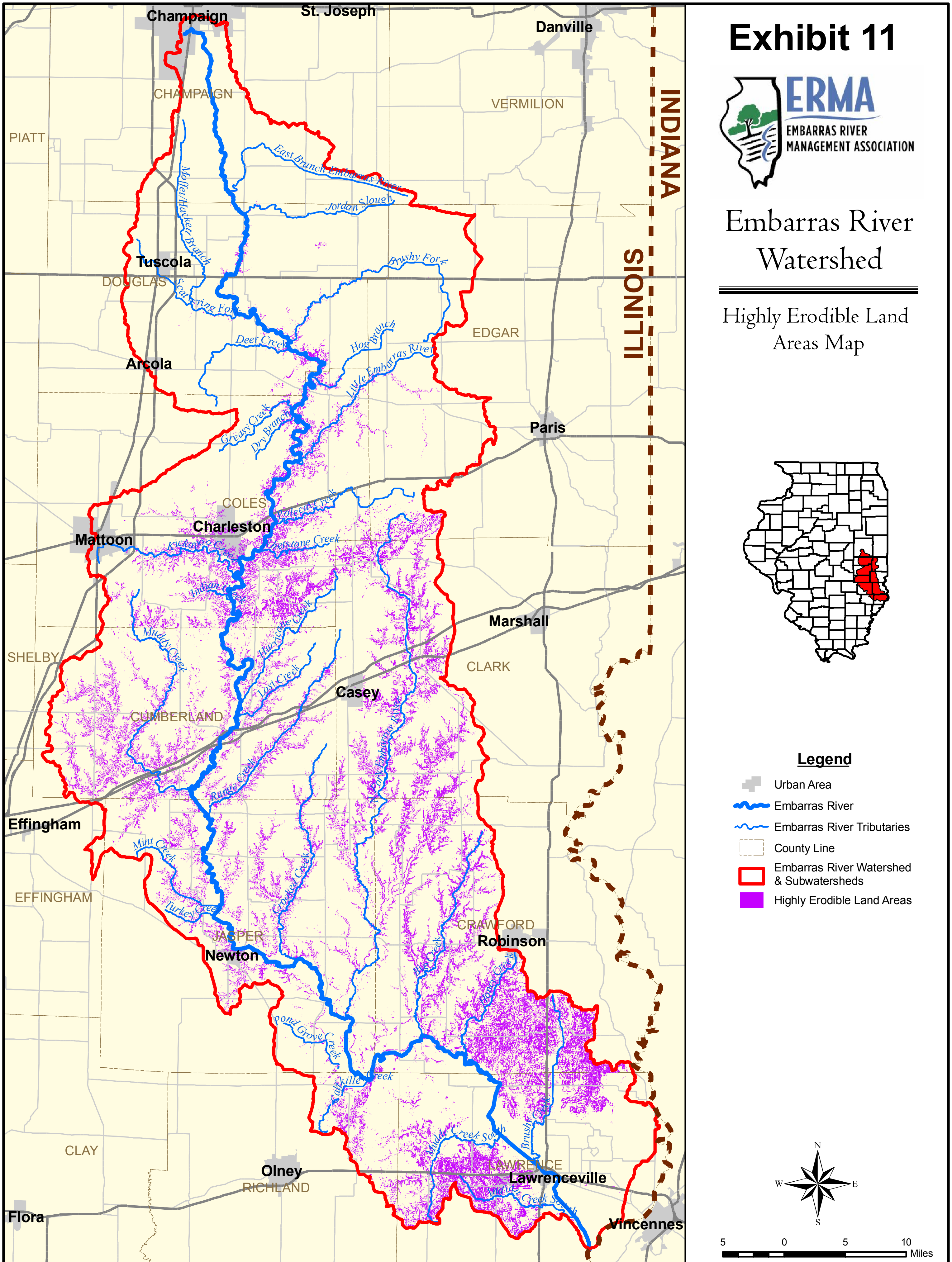


Exhibit 11

EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

Highly Erodible Land Areas Map



prevented, the effects of runoff can be moderated so that it does not diminish the health of the watershed.

Exhibit 11 illustrates highly erodible lands throughout the watershed, in addition the map illustrates highly erodible lands that are currently under agriculture or pasture land-use.

Hydric Soils

Soils that remain saturated or inundated with water for a sufficient length of time become hydric through a series of chemical, physical, and biological processes. Once a soil takes on hydric characteristics, it retains those characteristics even after the soil is drained. Approximately 664,713 acres or 42.7% of the soils in the Embarras River Watershed are considered hydric (Exhibit 12). However, a large majority of these soils have been drained for either agricultural production or urban development and would no longer support a wetland. The location of remaining hydric soils can be used to consider possible locations of wetland creation or enhancement. Wetland creation involves many components in addition to soil type that must be considered before moving forward with wetland design and creation.

Exhibit 12 shows the areas within the watershed that are classified as hydric soils that are currently under agricultural production. These areas should be given high priority for restoration as they would reduce flooding impacts, pollutant loading and create ecological habitat.

Hydrology

Stream Flow Characteristics

The United States Geological Survey (USGS) maintains four active stream gages within the Embarras River Watershed which are shown along with other hydrologic details in exhibit 13. These gages provide real-time data on gage height and discharge, as well as historical daily, monthly and annual statistics. Table 3-16 shows the stream flow characteristics for the Embarras River at these gaging stations.

Table 3-16: USGS Stream Flow Characteristics

Gage	Drainage Area (sq mi)	Average Daily Flow (cfs)	Peak Flow (cfs)	Period of Records
3343400 Embarras River near Camargo	186	171	8,040 4/12/94	1961-2009
3345500 Embarras River at Ste. Marie	1516	1,273	60,400 6/7/08	1910-2008
3346000 North Fork Embarras River near Oblong	318	279	46,200 6/7/08	1910-2008
3346500 Embarras River at Lawrenceville	2333	2,484	42,100 6/10/08	2002-2008

The Federal Emergency Management Agency (FEMA) also provides a source for stream flow information. Flood Insurance Studies (FIS) are produced for each county. Peak discharges at specific locations along a river are determined as part of the FIS process. Table 3-17

Exhibit 12

EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

Hydric Soils Map

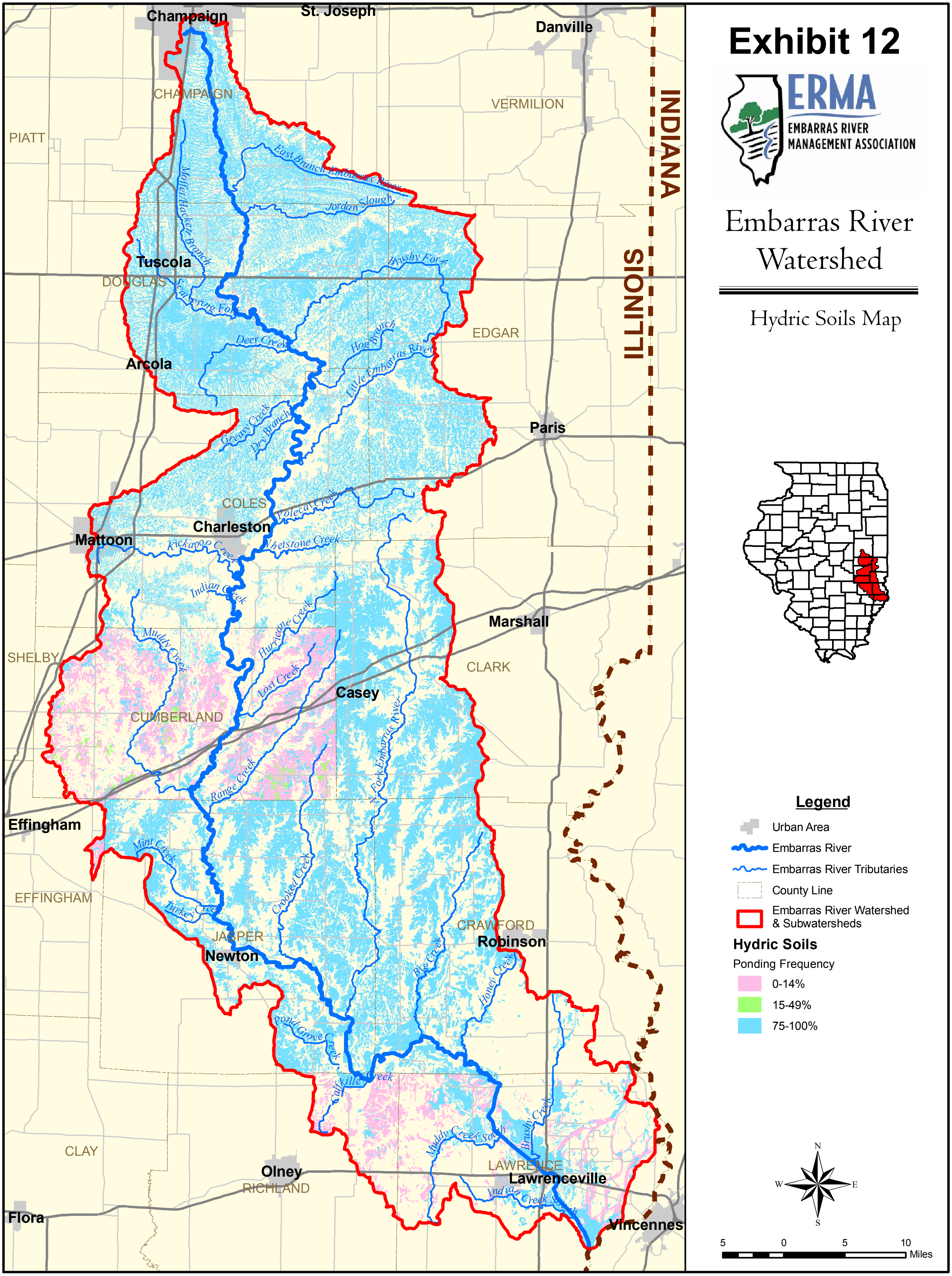
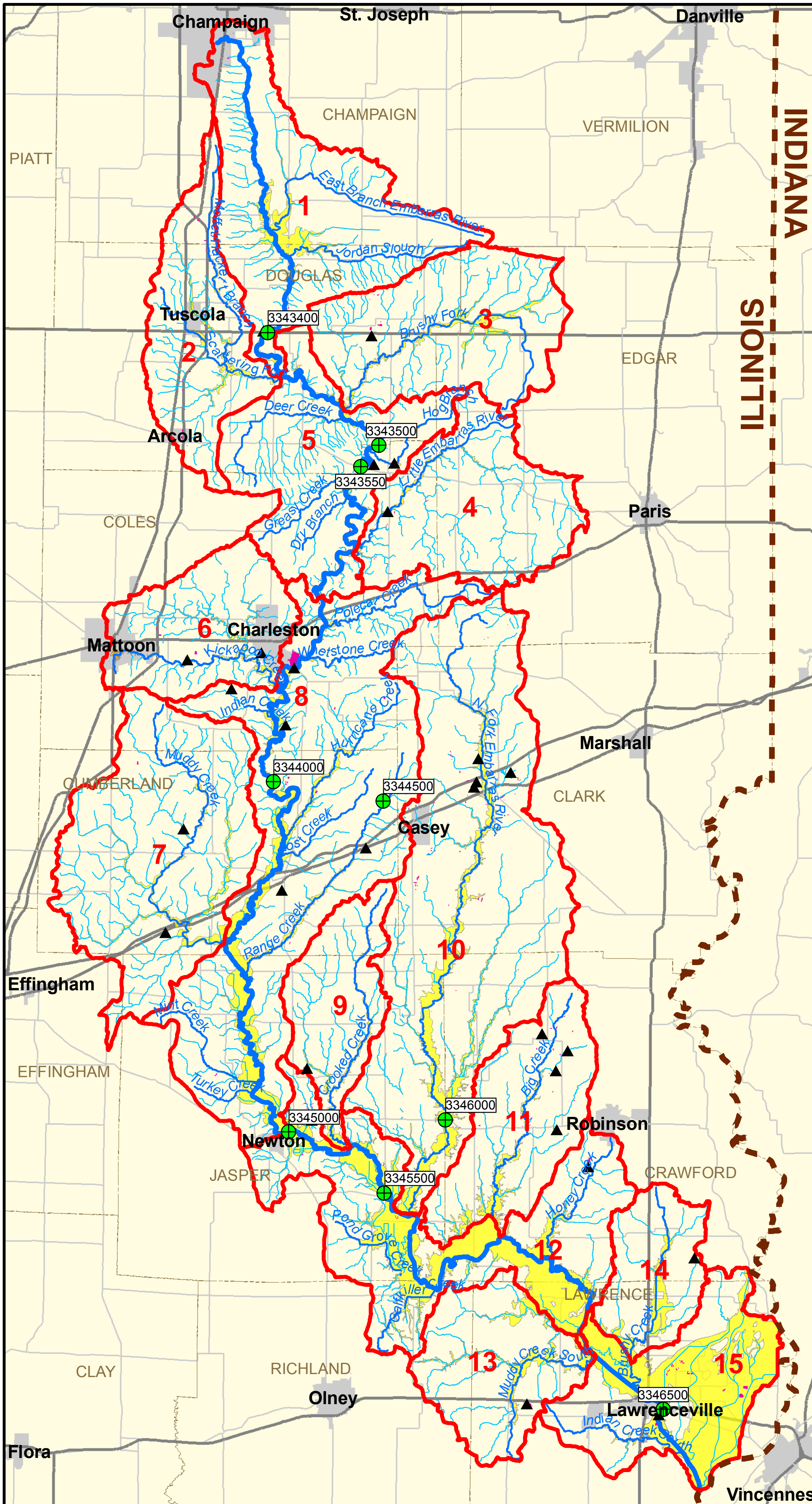


Exhibit 13

EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

Hydrologic Map



Legend

- Dams
- USGS Streamflow Stations
- Lakes
- Urban Area
- Embarras River
- Embarras River Tributaries
- Streams
- County Line
- Embarras River Watershed & Subwatersheds

Floodzones

- 100 Year
- 500 Year

N E S W

5 0 5 10 Miles

includes the peak discharges for two locations along the Embarras River based on FIS information.

Table 3-17: FEMA FIS Stream Flow Characteristics				
Location	**Drainage Area (sq mi)**	**10-year Peak Flow (cfs)**	**100-year Peak Flow (cfs)**	**Source**
U/S of confluence with Jordan Slough	122	4,486	7,183	Preliminary Douglas County FIS, 12/18/09
At mouth	2,440	48,000	69,000	Preliminary Lawrence County FIS, 2/8/10

Regulatory Floodplain

The Federal Emergency Management Agency (FEMA) has developed Flood Insurance Rate Maps (FIRMs) for many parts of the country in order for individuals and governments to assess the risk of flooding in specific areas. These maps also indicate what insurance rates property owners may need to pay to develop property in these areas.

Illinois is currently in the process of updating all of the FIRM panels for the state as part of the Map Modernization Project (MapMod). Many of Illinois' floodplain maps are outdated, some as much as 20 years. MapMod was undertaken in an effort to update and develop fully digital floodplain maps statewide. Only one county (Clark) within the Embarras River Watershed has completed the update with the updated maps being effective. Table 3-18 summarizes the status of the FIRM panels within the Embarras River Watershed.

Table 3-18: FEMA FIRM Status		
County	**Current Effective Date**	**MapMod Status**
Champaign	March 1, 1984	In Progress
Clark	August 2, 2007	Effective
Coles	August 5, 1985	Final Maps will be effective July 18, 2011
Crawford	June 6, 1986	Final Maps will be effective June 2, 2011
Cumberland	February 4, 2011	Effective
Douglas	March 4, 1985	Final Maps will be effective May 24, 2011
Edgar	January 19, 2011	Effective
Effingham	December 23, 1977	Not Funded
Jasper	January 17, 1985	Not Funded
Lawrence	February 1, 1985	Final Maps will be effective July 18, 2011
Richland	November 1, 1984	Not Funded
Vermilion	June 1, 1995	Preliminary Maps released

The floodplain boundaries based on the current effective FIRMs for the Embarras River Watershed are shown on Exhibit 13. The 100-year floodplain which is defined as an area inundated by 100-year flooding comprises 187,849 acres (12.1% of the watershed). In this zone there is a 1% chance of annual flooding, and a 26% chance that the area will be inundated at sometime during the life of a 30-year mortgage.

The 500-year floodplain (0.2% chance of annual flooding) comprises only 235 acres (0.02% of the watershed). These areas are considered to have a moderate or minimal risk of flooding, and the purchase of flood insurance is available but not required.

Wetlands

Wetland classifications are based on attributes which can be measured and when combined, help to define the nature of a specific wetland and distinguish it from others. The National Wetland Inventory (NWI) classified wetlands into five major groups or systems. The three wetland classifications identified within the Embarras River Watershed include lacustrine, palustrine, and riverine.

Lacustrine wetlands are associated with lakes and are characterized by a lack of trees and a dominance of emergent and submersed aquatic vegetation. Lacustrine wetlands typically extend from the shoreline to depths of 6.5 feet or until emergent vegetation no longer persists. Lacustrine wetlands are important in removing sediment and nutrients as well as providing habitat for fish and macroinvertebrates which are a vital food source within a lake ecosystem. Palustrine wetlands are related to marshes, swamps and bogs. Palustrine habitats are wetlands dominated by trees, shrubs, persistent emergents, and emergent mosses or lichens. Palustrine habitats have structural features that provide feeding, breeding, nesting, over wintering and migration habitat for wildlife in addition to their natural filtration properties. Riverine wetlands occur in floodplains and riparian corridors in association with stream channels. Riverine wetlands are directly affected by streamflow including overbank and backwater conditions. Riverine wetlands are very important in sediment retention as well as pollutant removal.

There are 41,252 acres (2.6% of the watershed) of wetlands scattered throughout the Embarras River Watershed. Among the three wetland classifications, 1,322 acres are considered lacustrine, 37,647 acres are palustrine, and 2,283 acres are riverine. Exhibit 5 and Table 3-19 show the distribution of the three classifications and the habitats found within each system.

Table 3-19: NWI Wetland Classifications

System	Habitat	Acres	Percentage
Lacustrine	Deep Water Lake	1,319	3.2%
	Lake Shore	3	0.0%
Palustrine	Open Water Wetlands	4,243	10.3%
	Shallow Marsh/Wet Meadow	2,222	5.4%
	Deep Marsh	327	0.8%
	Bottomland Forest	30,005	72.7%
	Swamp	194	0.5%
	Shrub-Scrub Wetlands	656	1.6%
Riverine	Perennial Deep Water River	2,194	5.3%
	Perennial Riverine	89	0.2%
Total		41,252	100.0%

Fish and Wildlife

Macroinvertebrates and Fish

Available biological data from IEPA for the Embarras River Watershed was obtained and evaluated to determine where water-quality problems were noted in the watershed. Data included macroinvertebrate and fisheries data where available. Any biological community assessment is a measurement of an ecosystem and how it responds to environmental stresses and gives an overall picture of the conditions, at the point being assessed. When conducted in conjunction with chemical analysis of specific water quality parameters and aquatic habitat quality, this information can provide a complete and comprehensive understanding of the ecological quality of the watershed.

Macroinvertebrate data was analyzed based on the Macroinvertebrate Index of Biotic Integrity (mIBI). Macroinvertebrate monitoring followed the US EPA Rapid Bioassessment Protocol single habitat, family level approach method. The mIBI is designed to assess biotic integrity directly through ten metrics which evaluate a macroinvertebrate community's species richness, evenness, composition, and density within the stream. These metrics include the family-level HBI (Hilsenhoff's Family Biotic Index), number of taxa, number of individuals, Percent Dominant Taxa, EPT index, EPT count, EPT count to total number of individuals, EPT count to Chironomid count, Chironomid count, and number of individuals per number of squares sorted. A final score of >41.8 indicates no impairment, <41.8 but >20.9 indicates moderate impairment, and <20.9 indicates severe impairment.

Fisheries data was analyzed based on the 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.

Table 3-20 summarizes the available macroinvertebrate and fish data for the Embarras River Watershed.

Table 3-20: Macroinvertebrate and Fisheries Data

Station	Date	mIBI	Fish-IBI
BE-07	08/2001	59.2	Not available
	08/2006	21.8	51
BE-09	07/2001	74.6	Not available
BE-30	07/2006	78.6	48
BE-14	08/2001	52.6	Not available
	07/2006	60.6	42
BEF-03	08/2001	61.2	Not available
	08/2006	39.4	54

Threatened or Endangered Species

The Illinois Department of Natural Resources was contacted to provide any Natural Heritage Data or related records for all listed threatened, endangered or rare species, high quality natural communities or natural areas documented within the Embarras River Watershed. Their response indicated that the watershed is home to several Threatened or Endangered Species as shown in Table 3-21.

Table 3-21: Threatened or Endangered Species

Name	Scientific Name	Common Name	Number of Occurrences
East Branch Embarras River	Clonophis kirtlandi	Kirtland's Snake	2
	Lanius ludovicianus	Loggerhead Shrike	1
	Bartramia longicauda	Upland Sandpiper	1
	Spermophilus franklinii	Franklin's Ground Squirrel	3
	Villosa lienosa	Little Spectaclecase	2
Scattering Fork	None Identified		
Brushy Fork	None Identified		
Little Embarras River	Notropis boops	Bigeye Shiner	1
Deer Creek-Embarras River	Carex arkansana	Arkansas Sedge	1
	Ptychobranchus fasciolaris	Kidneyshell	6
	Clonophis kirtlandi	Kirtland's Snake	1
	Villosa lienosa	Little Spectaclecase	5
	Alasmidonta viridis	Slippershell	2
	Epioblasma triquetra	Snuffbox	3
Kickapoo Creek	Ammocrypta pellucidum	Eastern Sand Darter	2
	Clonophis kirtlandi	Kirtland's Snake	1
	Bartramia longicauda	Upland Sandpiper	1
Muddy Creek	Emydoidea blandingii	Blanding's Turtle	1
	Ammocrypta pellucidum	Eastern Sand Darter	1
	Lanius ludovicianus	Loggerhead Shrike	1
Range Creek-Embarras River	Tyto alba	Barn Owl	1
	Hybopsis amblops	Bigeye Chub	1
	Orobanche ludoviciana	Broomrape	2
	Pleurobema clava	Clubshell	1
	Ammocrypta pellucidum	Eastern Sand Darter	15
	Carex communis	Fibrous-rooted Sedge	1
	Etheostoma histrio	Harlequin Darter	9
	Clonophis kirtlandi	Kirtland's Snake	2
	Ixobrychus exilis	Least Bittern	1
	Lanius ludovicianus	Loggerhead Shrike	1
	Calephelis muticum	Swamp Metalmark	1
East Crooked Creek	Lanius ludovicianus	Loggerhead Shrike	1
North Fork Embarras River	Ammocrypta pellucidum	Eastern Sand Darter	2
	Polygonum arifolium	Halbred-leaved Tearthumb	1
	Ambystoma jeffersonianum	Jefferson Salamander	1
Big Creek	Thamnophis sauritus	Eastern Ribbon Snake	1
	Styrax americana	Storax	1
Honey Creek-Embarras	Botaurus lentiginosus	American Bittern	2

River	Dendroica cerulea	Cerulean Warbler	8
	Nerodia erythrogaster neglecta	Copperbelly Water Snake	3
	Thamnophis sauritus	Eastern Ribbon Snake	2
	Ammocrypta pellucidum	Eastern Sand Darter	6
	Tympanuchus cupido	Greater Prairie-Chicken	17
	Lanius ludovicianus	Loggerhead Shrike	10
	Circus cyaneus	Northern Harrier	1
	Terrapene ornata	Ornate Box Turtle	8
	Sabatia campestris	Prairie Rose Gentian	2
	Silene regia	Royal Catchfly	3
	Bartramia longicauda	Upland Sandpiper	12
Paul Creek-Muddy River	Dendroica cerulea	Cerulean Warbler	2
	Carex prasina	Drooping Sedge	5
	Hemidactylium scutatum	Four-toed Salamander	7
	Polygonum arifolium	Halbred-leaved Tearthumb	8
	Lycopodium clavatum	Running Pine	1
	Carex bromoides	Sedge	7
	Styrax americana	Storax	1
Brushy Creek	Myotis sodalis	Indiana Bat	1
Indian Creek-Embarras River	Gallinula chloropus	Common Moorhen	2
	Nerodia erythrogaster neglecta	Copperbelly Water Snake	3
	Thamnophis sauritus	Eastern Ribbon Snake	2
	Ixobrychus exilis	Least Bittern	2
	Clematis viorna	Leatherflower	1
	Silene regia	Royal Catchfly	2
	Lithasia obovata	Shawnee Rocksnail	1
	Penstemon tubaeflorus	Tube Beard Tongue	1
	Bartramia longicauda	Upland Sandpiper	1
	Nyctanassa violacea	Yellow-crowned Night-Heron	2

Water Quality

Water Supply

A majority of the population within the watershed relies on groundwater for potable water supply. The City of Charleston is the largest urban area entirely within the watershed and this city relies on the Embarras River for its water supply.

The Charleston Side Channel Reservoir (CSCR) a water supply and recreational reservoir located in Coles County and is located three kilometers south of the city of Charleston, and it is the sole drinking water source for the city's approximately 23,000 residents. Many residents and outsiders also use the CSCR for sport fishing and boating activities. The CSCR was created in 1981 when Lake Charleston, an impoundment on the Embarras River, was divided by the building of a dike. Water from the Embarras River is now pumped into the CSCR for eventual intake to the Charleston drinking water treatment plant. The land that drains directly into the CSCR is only a few square kilometers in size, is steeply sloped, and is primarily forested. Since water from the Embarras River is also pumped directly into the CSCR, the entire contributing watershed of the Embarras River affects the water quality of the lake and is a significant resource concern to the City of Charleston and its residents.

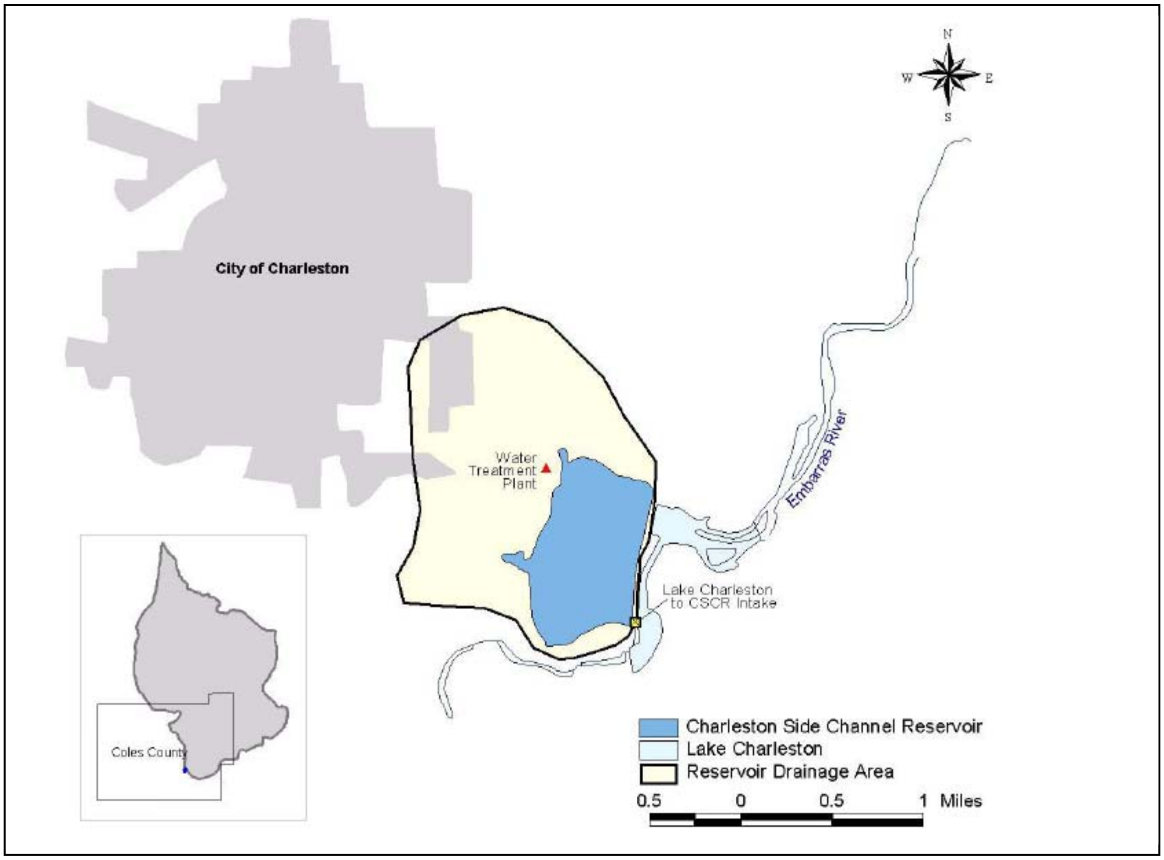
As part of the Section 303(d) listing process, the IEPA has identified the CSCR as impaired water. The potential causes of impairment are phosphorus, nitrogen, total suspended solids (TSS), and excessive algal growth/chlorophyll a (Illinois EPA, 2001). These impairments result in the CSCR's being in partial support of its primary contact (swimming) and secondary contact (recreation) designated uses and in partial support of its aquatic life designated use.

The drinking water supply and fish consumption designated uses of the CSCR are not impaired. It should also be noted that swimming is prohibited in the CSCR due to concerns about safety. The Illinois Pollution Control Board has designated the CSCR with a swimming use; therefore, Illinois EPA monitors this use even though the city of Charleston prohibits swimming in the CSCR.

A TMDL report was developed by Tetra Tech for the CSCR to investigate the causes of impairments and make recommendations to improve water quality. The body of this report is included in Appendix E; the information provided in this section of the plan is derived from that TMDL report.

Rank	29
Watershed Identifier	ILBE09
Waterbody Segment	RBC
Waterbody Name	Charleston Side Channel Reservoir
Size	137 hectares (339 acres)
Designated Uses and Support Status	Fish Consumption (Full), Drinking Water Supply (Full), Overall (Partial), Aquatic Life (Partial), Primary Contact/Swimming (Partial), Secondary Contact/Recreation (Partial)
Causes of Impairment[1]	Nutrients (Phosphorus, Total Ammonia-N), Suspended Solids, Excessive Algae Growth
Potential Sources of Impairment	Agriculture (Crop Related Sources-Non-irrigated Crop Production), Habitat Modification (Streambank Modification/Stabilization), Forest/Grassland/Parkland

Figure 3-1 – Location map of the Charleston Side Channel Reservoir, from TMDL report



303(d) List

Section 303(d) of the 1972 Federal Clean Water Act (CWA) requires each state to identify those waters that do not meet the state's water quality standards for designated uses. These streams are to be listed on the State's 303(d) list of impaired waters. For such waters, the State is required to establish total maximum daily loads (TMDLs) to meet the state water quality standards.

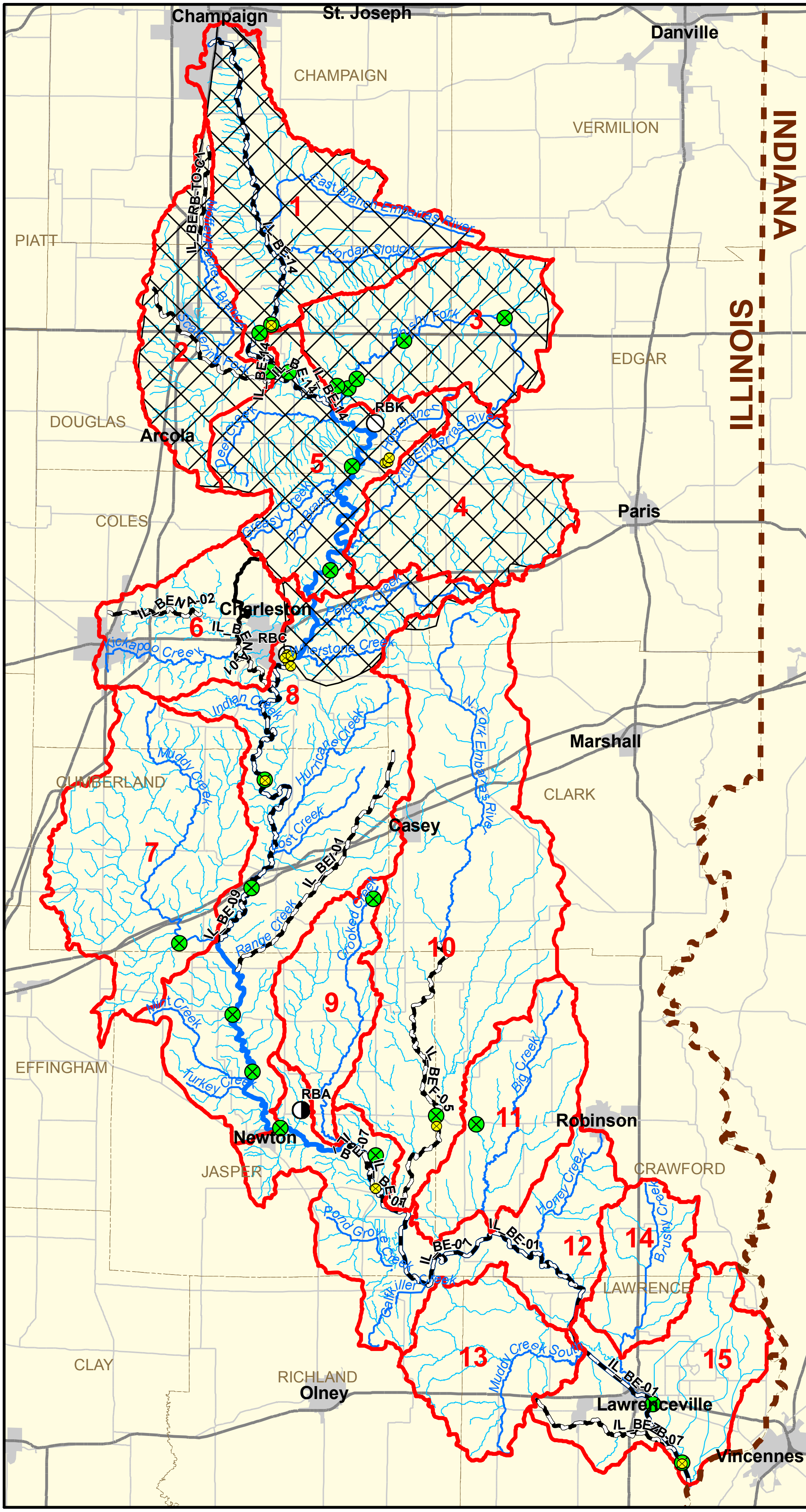
The 303(d) list indicates that approximately 240.31 miles of streams within the Embarras River Watershed were impaired at the time of the 2008 listing (Table 3-22; Exhibit 14). It should be noted that if a stream is not listed on the 303(d) list it may be impaired; however the data (or lack there of) does not indicate the impairment at the time of publication.

Exhibit 14

EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

Water Quality Map



Legend

- IEPA Station
- USGS Sample
- 2006 Impaired Waterbody
- 2008 Impaired Waterbody
- 2006-2008 Impaired Waterbody
- Urban Area
- Embarras River
- Embarras River Tributary
- 2006 Impaired Stream
- 2008 Impaired Stream
- 2006-2008 Impaired Stream
- Stream
- County Line
- Embarras River Watershed & Subwatersheds
- TMDL Under Development

N
W E
S

5 0 5 10 Miles

Table 3-22: 2008 303(d) Impairments				
Subwatershed	**Waterbody Name**	**Miles**	**Designated Use**	**Potential Causes**
East Branch Embarras River	Embarras River	39.87	Aquatic Life, Primary Contact Recreation	pH, Phosphorus (Total) Sedimentation/ Siltation, Total Suspended Solids (TSS), Fecal Coliform
Scattering Fork	Scattering Fork	13.37	Aquatic Life	Phosphorus (Total)
	Hackett Branch	6.72	Aquatic Life	Phosphorus (Total)
	Hackett Branch	0.33	Aquatic Life	Phosphorus (Total)
Brushy Fork	None Listed			
Little Embarras River	None Listed			
Deer Creek-Embarras River	None Listed			
Kickapoo Creek	Kickapoo Creek	5.25	Aquatic Life	Phosphorus (Total)
	Riley Creek	1.32	Aquatic Life	pH
	Riley Creek	8.05	Aquatic Life	Cause Unknown
	Cassel Creek	8.15	Aquatic Life	Cause Unknown
Muddy Creek	None Listed			
Range Creek-Embarras River	Embarras River	36.30	Primary Contact Recreation	Fecal Coliform
	Range Creek	22.41	Aquatic Life	Cause Unknown
East Crooked Creek	None Listed			
North Fork Embarras River	North Fork Embarras River	28.87	Primary Contact Recreation	Fecal Coliform
Big Creek	None Listed			
Honey Creek-Embarras River	Embarras River	26.47	Primary Contact Recreation	Fecal Coliform
Paul Creek-Muddy River	None Listed			
Brushy Creek	None Listed			
Indian Creek-Embarras River	Embarras River	28.79	Primary Contact Recreation	Fecal Coliform
	Indian Creek	14.41	Aquatic Life	Manganese

Water Quality Sampling

Available water quality data from the United States Geological Survey (USGS) and the Illinois Environmental Protection Agency (IEPA) for the Embarras River Watershed was obtained and evaluated to determine where water-quality problems were noted within the watershed. The water sampling locations are shown on exhibit 14.

Several water quality parameters which have standard targets associated with them were screened to determine which subwatersheds demonstrated impairments or degradations. The water quality parameters evaluated from the data set included Dissolved Oxygen (DO), Total Suspended Solids (TSS), Nitrate+ Nitrite (N+N), Total Phosphorus (P), and Fecal Coliform (FC).

Tables 3-23 and 3-24, indicated the available data for each station and the dates from which the data was available. Table 3-25 summarizes the available data for each subwatershed.

All parameters were summarized as means for comparison to water quality limits and other subwatersheds.

Table 3-23: USGS Water Quality Stations			
Subwatershed	Station ID	Available Data	
		Date	Water Quality Parameters
East Branch Embarras River	03343395	1978-1997	Dissolved Oxygen, Total Suspended Solids, Nitrate+ Nitrite, Total Phosphorus, Fecal Coliform
	03343400	1965-1983	N/A – screened parameters not available
	03343420	1971-1976	N/A – screened parameters not available
Scattering Fork	No USGS Water Quality Stations		
Brushy Fork	03343455	1979-1980	Dissolved Oxygen, Total Suspended Solids
	03343460	1971-1977	N/A – screened parameters not available
	03343470	1971-1976	N/A – screened parameters not available
	03343490	1971-1976	N/A – screened parameters not available
	03343450	2004	Dissolved Oxygen, Nitrate+ Nitrite, Total Phosphorus
Little Embarras River	No USGS Water Quality Stations		
Deer Creek- Embarras River	03343550	1978-1982	Total Suspended Solids
	03343700	1963-1977	N/A – screened parameters not available
	03343440	1971-1977	N/A – screened parameters not available
Kickapoo Creek	No USGS Water Quality Stations		
Muddy Creek	0344435	2004	Dissolved Oxygen, Nitrate+ Nitrite, Total Phosphorus
Range Creek- Embarras River	03344000	1963-1997	Dissolved Oxygen, Total Suspended Solids, Nitrate+ Nitrite, Total Phosphorus, Fecal Coliform
	03344200	1980	N/A – screened parameters not available
	03344600	1980	N/A – screened parameters not available
	03344680	1980	N/A – screened parameters not available
East Crooked Creek	03344500	1964-1982	N/A – screened parameters not available
North Fork Embarras River	03346000	1974-1997	Dissolved Oxygen, Total Suspended Solids, Nitrate+ Nitrite, Total Phosphorus, Fecal Coliform
Big Creek	03346180	1975	Dissolved Oxygen
Honey Creek- Embarras River	03345000	1980	N/A – screened parameters not available
	03345500	1963-1997	Dissolved Oxygen, Total Suspended Solids, Nitrate+ Nitrite, Total Phosphorus, Fecal Coliform
Paul Creek- Muddy River	No USGS Water Quality Stations		
Brushy Creek	No USGS Water Quality Stations		
Indian Creek-Embarras River	03346500	1985	N/A – screened parameters not available
	03346550	1977-1997	Dissolved Oxygen, Total Suspended Solids, Nitrate+ Nitrite, Total Phosphorus, Fecal Coliform

Table 3-24: IEPA Water Quality Stations			
Subwatershed	**Station ID**	**Available Data**	
		Date	**Water Quality Parameters**
East Branch Embarras River	BE-14	2005	Nitrate+ Nitrite, Total Suspended Solids, Total Phosphorus
Scattering Fork	No IEPA Water Quality Stations		
Brushy Fork	No IEPA Water Quality Stations		
Little Embarras River	No IEPA Water Quality Stations		
Deer Creek- Embarras River	RBP-1	2001	Nitrate+ Nitrite, Total Suspended Solids, Total Phosphorus
	RBP-2	2001	Nitrate+ Nitrite, Total Suspended Solids, Total Phosphorus
	RBP-3	2001	Nitrate+ Nitrite, Total Suspended Solids, Total Phosphorus
Kickapoo Creek	No IEPA Water Quality Stations		
Muddy Creek	No IEPA Water Quality Stations		
Range Creek- Embarras River	RBC-1	2001-2003	Nitrate+ Nitrite, Total Suspended Solids, Total Phosphorus
	RBC-2	2001	Nitrate+ Nitrite, Total Suspended Solids, Total Phosphorus
	RBC-3	2001	Nitrate+ Nitrite, Total Suspended Solids, Total Phosphorus
	RBH-1	2003	Nitrate+ Nitrite, Total Suspended Solids, Total Phosphorus
	RBH-2	2003	Nitrate+ Nitrite, Total Suspended Solids, Total Phosphorus
	RBH-3	2003	Nitrate+ Nitrite, Total Suspended Solids, Total Phosphorus
	BE-09	2005	Nitrate+ Nitrite, Total Suspended Solids, Total Phosphorus
East Crooked Creek	No IEPA Water Quality Stations		
North Fork Embarras River	BEF-05	2005	Nitrate+ Nitrite, Total Suspended Solids, Total Phosphorus
Big Creek	No IEPA Water Quality Stations		
Honey Creek- Embarras River	BE-07	2005	Nitrate+ Nitrite, Total Suspended Solids, Total Phosphorus
Paul Creek- Muddy River	No IEPA Water Quality Stations		
Brushy Creek	No IEPA Water Quality Stations		
Indian Creek-Embarras River	BE-01	2005	Nitrate+ Nitrite, Total Suspended Solids, Total Phosphorus

Table 3-25: Water Quality Sampling Summary										
Subwatershed	**Dissolved Oxygen (mg/L)**		**Total Suspended Solids (mg/L)**		**Nitrate+ Nitrite (mg/L)**		**Total Phosphorus (mg/L)**		**Fecal Coliform (CFU/100mL)**	
	USGS	**IEPA**	**USGS**	**IEPA**	**USGS**	**IEPA**	**USGS**	**IEPA**	**USGS**	**IEPA**
East Branch Embarras River	9.0	--	46.2	42.0	8.2	3.8	0.125	0.159	887	--
Scattering Fork	--	--	--	--	--	--	--	--	--	--
Brushy Fork	8.6	--	57.7	--	0.1	--	0.030	--	--	--
Little Embarras River	--	--	--	--	--	--	--	--	--	--
Deer Creek- Embarras River	--	--	288.9	37.7	--	1.1	--	0.234	--	--
Kickapoo Creek	--	--	--	--	--	--	--	--	--	--
Muddy Creek	7.5	--	--	--	0.1	--	0.070	--	--	--
Range Creek- Embarras River	10.1	--	74.5	32.0	6.4	2.9	0.265	0.147	599	--
East Crooked Creek	--	--	--	--	--	--	--	--	--	--
North Fork Embarras River	9.3	--	80.3	28.0	1.3	0.03	0.204	0.122	1110	--
Big Creek	6.4	--	--	--	--	--	--	--	--	--
Honey Creek- Embarras River	9.9	--	118.0	38.0	4.5	0.2	0.245	0.196	1029	--
Paul Creek- Muddy River	--	--	--	--	--	--	--	--	--	--
Brushy Creek	--	--	--	--	--	--	--	--	--	--
Indian Creek-Embarras River	9.6	--	129.4	27.5	3.4	0.7	0.262	0.193	2561	--

NPDES Permits and Landfills

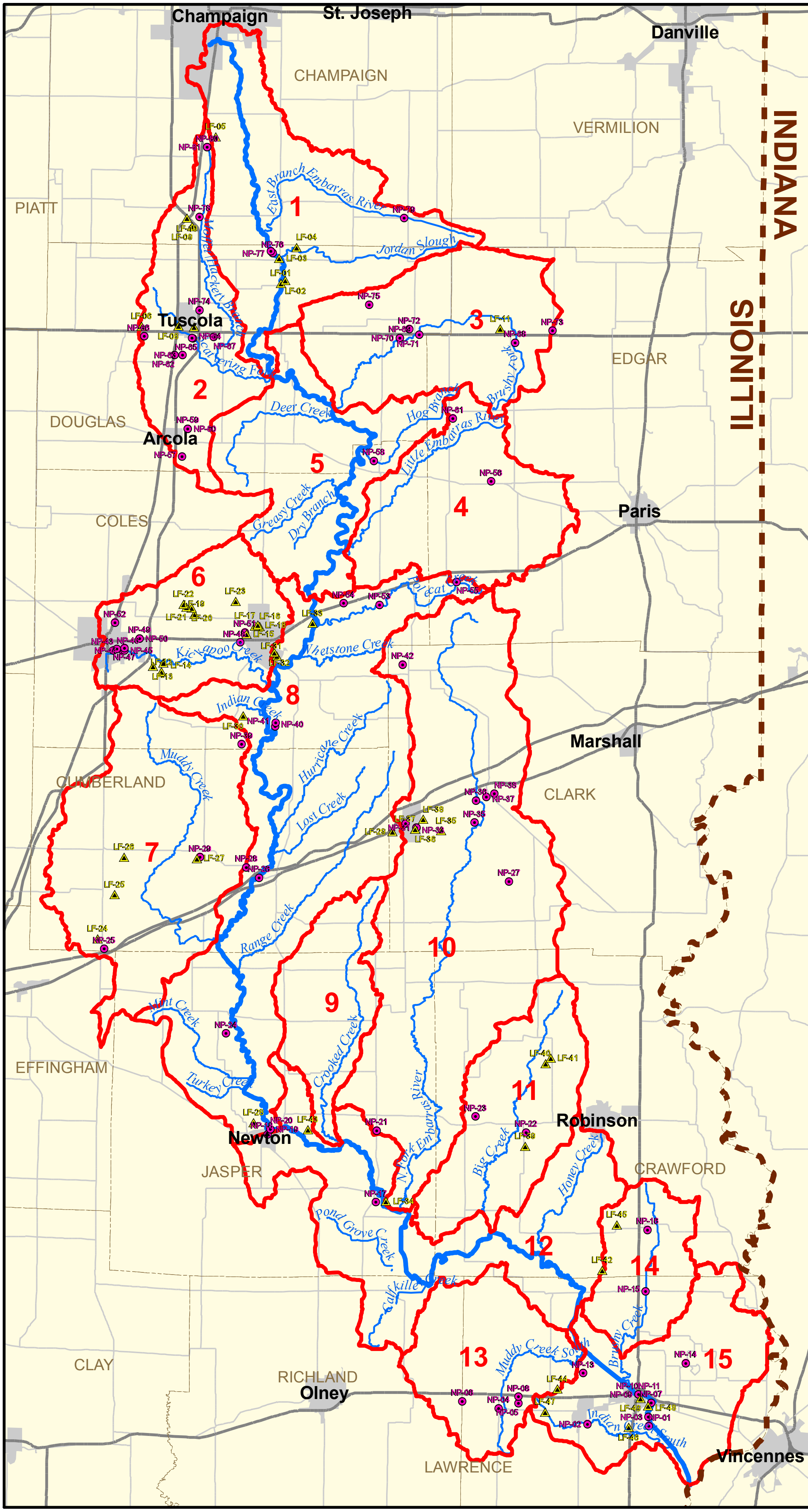
The National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. A total of 57 NPDES permits (81 discharge points) are located within the Embarras River Watershed (Exhibit 15 and Table 3-26). Compliance records for the NPDES facilities within the watershed were analyzed for the past three years. Although a formal violation may not have been noted, several facilities indicated effluent exceedances for water quality parameters. Effluent exceedances were noted based on the number of times in the past three years the permit allowed discharge was exceeded. The water quality parameters screened in this analysis included Dissolved Oxygen (DO), Total Suspended Solids (TSS), Nitrogen (N) and Fecal Coliform (FC).

Exhibit 15

ERMA
EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

Landfills and NPDES Permits Map



Legend

- Landfills
- NPDES Permits
- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed & Subwatersheds

N
W E
S

5 0 5 10 Miles

Table 3-26: NPDES Permits				
Subwatershed	**NPDES Permit Number**	**Location Identifier**	**Facility Name**	**Effluent Exceedances**
East Branch Embarras River	IL0059005	NP-01, NP-02	City of Villa Grove STP	DO-2, TSS-5
	IL0051900	NP-03	Village of Broadlands WTP	None reported
Scattering Fork	IL0027499	NP-04, NP-05, NP-06	City of Arcola STP	DO-6, TSS-1
	IL0060119	NP-07	Parkview MHP-STP	N-4, TSS-2
	IL0004375	NP-08, NP-11	Cabot Corporation	None reported
	IL0026107	NP-09,NP-10	City of Tuscola Southside STP	DO-2, TSS-1
	ILG840095	NP-12	Tuscola Stone	None reported
	IL0071617	NP-13	City of Tuscola STP	DO-1, TSS-1
	IL0023981	NP-14	Pesotum WTP	No records available
	IL0031453	NP-15, NP-16	Village of Tolono STP	N-3, DO-1
Brushy Fork	IL0042757	NP-17	Shiloh School STP	N-3, TSS-4
	IL0066532	NP-18, NP-19	Hydromet Environmental (USA)	None reported
	IL0066974	NP-20	Newman Rehab and Health Care Center	FC-8, N-10, TSS-3
	IL0069159	NP-21	Newman WTP	No records available
	IL0072222	NP-22	Metcalf WTP	No records available
	IL0075485	NP-23	Veolia ES Valley View Landfill	N-1, TSS-9
Little Embarras River	IL0054861	NP-24	Redman Waterworks, Inc WTP	No records available
	IL0047210	NP-25	Village of Brocton	TSS-3
Deer Creek-Embarras River	ILG580001	NP-26	City of Oakland STP	None reported
Kickapoo Creek	IL0029831	NP-27, NP-28, NP-29, NP-30, NP-31, NP-36	City of Mattoon STP	FC-6, TSS-2
	IL0021644	NP-32, NP-35	City of Charleston STP	FC-3
	IL0004049	NP-33, NP-34	Anamet Electrical	None reported
Muddy Creek	IL0063096	NP-37	Village of Montrose STP	N-10, DO-10, TSS-6
	ILG580158	NP-38	Village of Toledo STP	TSS-1
	IL0049361	NP-39	HPA-Lincoln Log Cabin Historical Site	N-7, DO-3, TSS-3
Range Creek-Embarras River	IL0030121	NP-40, NP-41	City of Newton STP	None reported
	IL0069574	NP-42	EJ Water Corporation Treat Plt	No records available
	ILG580065	NP-43	Village of Greenup STP	None reported
	IL0049212	NP-44	Cumberland Comm Sch Dist 77	N-4, TSS-1
	IL0055514	NP-45	IL DNR-Fox Ridge State Park	No records available
	IL0051250	NP-46	IL DNR-Fox Ridge State Park STP	None reported
	IL0004537	NP-47	Ashmore WTP	No records available
	IL0060585	NP-48	Marathon Pipeline Company	None reported
	IL0020991	NP-49	Kansas WTP	No records available
East Crooked Creek	No NPDES Permits			
North Fork Embarras River	ILG580092	NP-50	Village of Willow Hill STP	None reported
	IL0060585	NP-51, NP-58	Marathon Pipeline Company	None reported
	IL0035084	NP-52, NP-53, NP-54, NP-55	City of Casey North STP	N-5, TSS-1

	IL0020435	NP-56	Vulcan Materials Casey North	No records available
	ILG640103	NP-57	City of Casey WTP	None reported
	IL0055417	NP-59	E. Rowe Foundry	None reported
	ILG580269	NP-60	City of Martinsville STP	None reported
	IL0051462	NP-61	Village of Westfield WTP	None reported
Big Creek	IL0060585	NP-62	Marathon Pipeline Company	None reported
	ILG582017	NP-63	Village of Oblong WWTP	TSS-3
Honey Creek-Embarras River	ILG580058	NP-64	Village of Saint Marie STP	TSS-5
	IL0004561	NP-65	Newton WTP	No records available
Paul Creek-Muddy River	ILG580118	NP-66	City of Sumner STP	TSS-6
	IL0051829	NP-67	IL DNR-Red Hills State Park	N-6, TSS-3
	IL0073610	NP-68	Lawrence Correctional Center	N-1
	IL0051837	NP-69	IL DNR-Red Hills State Park	N-6, TSS-3
Brushy Creek	ILG640153	NP-70	Birds-Pinkstaff WTP	TSS-2
	ILG580224	NP-71	Village of Flatrock STP	None reported
Indian Creek-Embarras River	ILG582001	NP-73	City of Bridgeport STP	TSS-4
	IL0004219	NP-74	AWR Liquidating Trust	FC-1, TSS-3
	IL0029467	NP-72, NP-75, NP-76, NP-77, NP-78, NP-79	City of Lawrenceville WWTP	TSS-1
	IL0055948	NP-80	City of Mount Carmel WTP	TSS-3
	IL0051209	NP-81	Lawrenceville-Vincennes Airport	None reported

No records were available for ten of the NPDES facilities. Out of the 47 permits with compliance records available, 19 had no reported exceedances of the four water quality parameters screened. Of the water quality parameters, Total Suspended Solids (TSS) was exceeded the most with 76 instances reported; Nitrogen (N) was exceeded second most with 60 instances reported; followed by Dissolved Oxygen (DO) with 25 instances reported; and Fecal Coliform with 18 instances reported.

Landfill locations were also identified within the Embarras River Watershed. Landfills are often viewed as potential contamination sources. A total of 49 landfills were identified within the watershed (Table 3-27). Exhibit 15 shows the location of the landfills.

Table 3-27: Landfills			
Subwatershed	**Facility ID Number**	**Location Identifier**	**Facility Name**
East Branch Embarras River	0418030002	LF-01	Phipps, Harold
	0418030003	LF-02	Bade, Herman #1
	0418030004	LF-03	Bade, Herman #2
	0418030001	LF-04	Multi-County Landfill
	0198260001	LF-05	Tolono Municipal
Scattering Fork	0418080001	LF-06	Cabot Corp
	0410300001	LF-07	Tuscola Municipal
	0410300002	LF-08	Universal Asphalt Co Inc
	0198150001	LF-09	Illinois Central Gulf Railroad
	0198150002	LF-10	Harrel, Wally
Brushy Fork	0450150001	LF-11	Hume Municipal
Little Embarras River	No landfills		
Deer Creek- Embarras River	No landfills		
Kickapoo Creek	0298060002	LF-12	Alexander-Gilbert Inc
	0298050003	LF-13	Farrier, Francis L.
	0298050002	LF-14	Young
	0290100002	LF-15	Pearcy, Elmer
	0290100005	LF-16	Craig, Floyd
	0290100003	LF-17	Nielsen, Leif
	0290100001	LF-18	H & B Ready Mix Inc
	0298050007	LF-19	Coles County Landfill
	0298050001	LF-20	Service Disposal #1
	0298050005	LF-21	Service Disposal #2
	0298050006	LF-22	Western Lion LTD
	0290100004	LF-23	Midstate Foundry Co
Muddy Creek	0358040001	LF-24	Montrose Municipal
	0358040002	LF-25	Derrickson, Elza
	0418080002	LF-26	Quantum Chemical Company
	0358050001	LF-27	Toledo Municipal
Range Creek- Embarras River	0798090001	LF-28	Newton Sewage & Treatment Plant
	0230050001	LF-29	Casey Fertilizer Company
	0298100002	LF-30	Heath, William E#
	0298010002	LF-31	Farrier, James H#
	0298010001	LF-32	Woodyard
	0298000003	LF-33	Wright, Max
East Crooked Creek	No landfills		
North Fork Embarras River	0798060001	LF-34	St Marie Municipal
	0230050002	LF-35	Casey Municipal #2
	0238020001	LF-36	Casey Municipal
	0238020002	LF-37	Casey Municipal TBS
	0238020003	LF-38	Hickox
Big Creek	0330150001	LF-39	Curry, Frank
	0338080004	LF-40	Wilder #2
	0338080001	LF-41	Wilder #1

Honey Creek- Embarras River	0338000004	LF-42	Wilson
	0798090002	LF-43	Bergbower
Paul Creek- Muddy River	1018020001	LF-44	Dowty
Brushy Creek	0338000003	LF-45	Flat Rock Municipal
Indian Creek-Embarras River	1018040002	LF-46	Siddens #2
	1018020002	LF-47	Dowty
	1010150002	LF-48	Lawrenceville Municipal #3
	1010150001	LF-49	Siddens #1

Septic Density

In rural areas, households and businesses often depend on septic tank absorption fields. These waste treatment systems require soil characteristics and geology that allow gradual seepage of wastewater into the surrounding soils. Seasonal high water tables, shallow compact till and coarse soils present limitations for septic systems. While system design can often overcome these limitations (i.e. perimeter drains, mound systems or pressure distribution), sometimes the soil characteristics prove to be unsuitable for any type of traditional septic system or maintenance practices (or lack thereof) contribute to a failing septic system. Failing septic systems are often linked to water quality issues.

According to the NRCS Soil Reports for the Counties within the Embarras River Watershed, approximately 98.3% of the soils are rated as very limited for septic systems. A rating of very limited indicates that the soil has at least one feature that is unfavorable for septic systems.

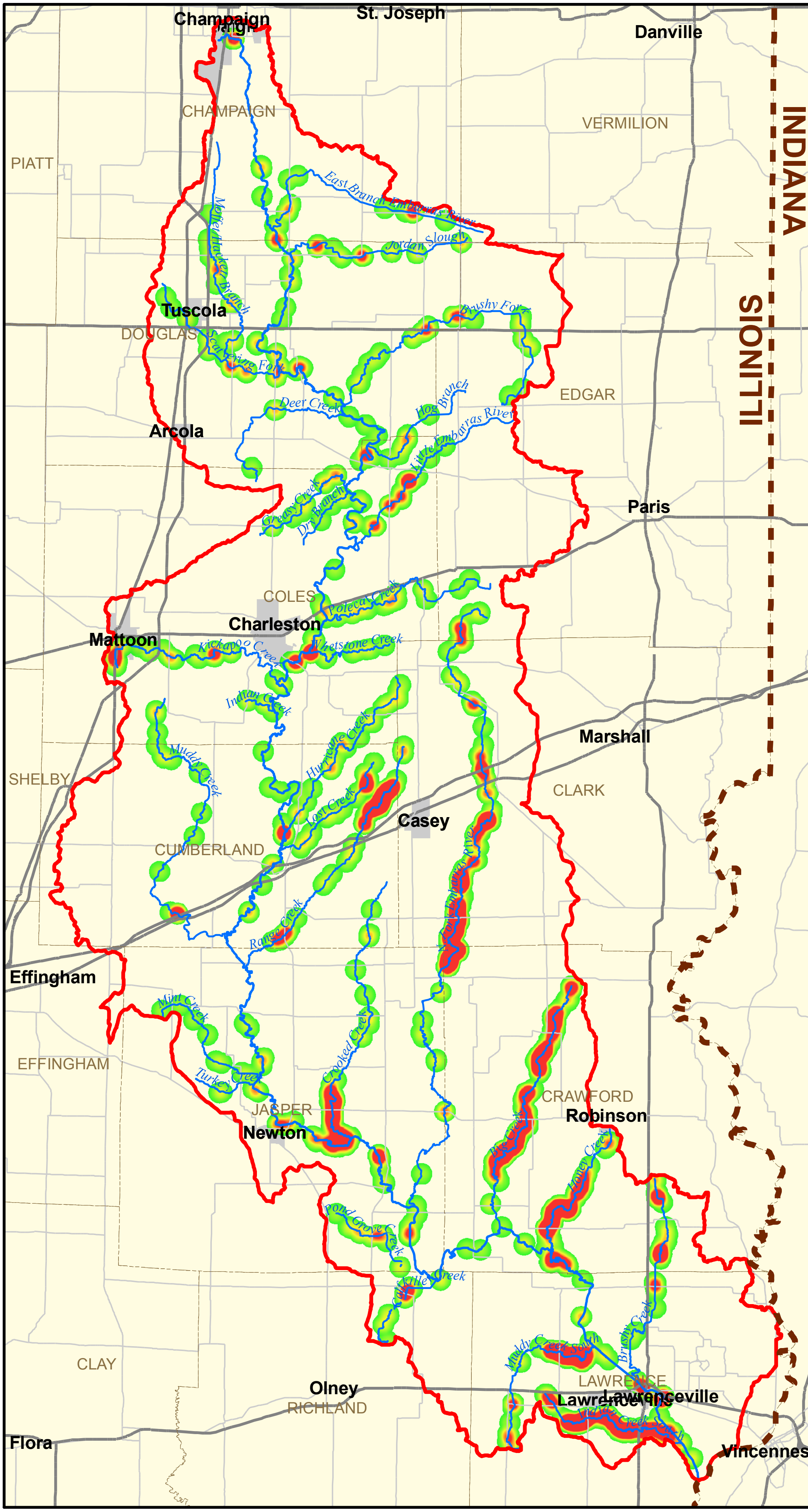
Possible locations of septic systems were identified by using well permit records, well records typically are good indicators of septic systems because there is a water supply that requires treatment. Table 3-28 shows the estimated number of septic systems and density for each subwatershed. It should be noted that this analysis is not ideal in urban areas because often times there is a wastewater treatment service even for areas that use private wells for water supply.

Exhibit 16 illustrates septic density analysis for within 800 feet of a perennial waterway; this analysis is valuable as it shows areas that varying ranges of probabilities of contributing to direct pollution to the streams. It is an important planning tool to help focus on priority areas to reduce fecal coliform bacteria loading.

Exhibit 16

Embarras River Watershed

Septic Density Map



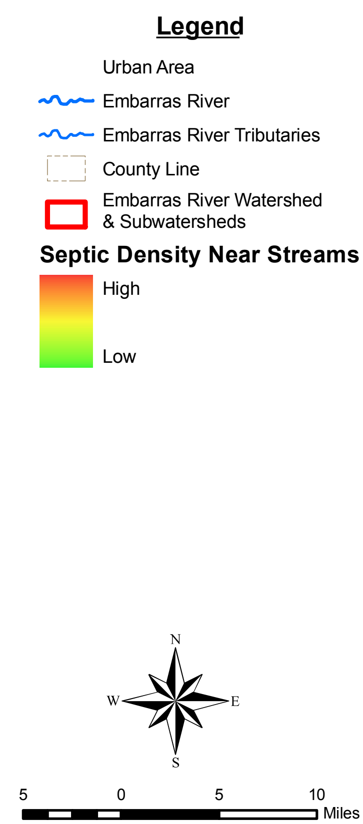


Table 3-28: Possible Septic Locations		
Subwatershed	**Number of Possible Septic Systems**	**Density (#/sq mi)**
East Branch Embarras River	886	4.6
Scattering Fork	748	6.9
Brushy Fork	522	3.5
Little Embarras River	1,110	8.5
Deer Creek- Embarras River	524	3.6
Kickapoo Creek	922	9.0
Muddy Creek	981	4.6
Range Creek- Embarras River	6,318	18.2
East Crooked Creek	1,035	13.3
North Fork Embarras River	10,835	30.2
Big Creek	15,801	140.2
Honey Creek- Embarras River	7,058	34.6
Paul Creek- Muddy River	4,275	43.1
Brushy Creek	2,721	42.0
Indian Creek-Embarras River	6,907	53.2

Section 4 – Pollutant Load Analysis

Overview of Watershed Pollutant Loading

Pollutant loading within the watershed is the sum of point sources and nonpoint sources. Due to the large size and rural nature of the Embarras River watershed, non-point source pollutants are the primary concern as it relates to addressing water quality at a watershed scale. The Embarras River watershed stakeholders identified total nitrogen, total phosphorus, total suspended sediment and fecal coliform bacteria as the priority pollutants to address in the watershed plan to accomplish their goals of improving the water quality of the watershed. These pollutants were identified based on first-hand experiences in the watershed, land-use activities in the watershed and water quality impairments identified by the Illinois Environmental Protection Agency (IEPA).

As defined by EPA, the pollution from nonpoint sources originates from urban runoff, construction activities, manmade modification of hydrologic regime of a watercourse (e.g. retention, detention, channelization, etc.), silviculture, mining, agriculture, irrigation return flows, solid waste disposal, atmospheric deposition, stream bank erosion, and individual or zonal sewage disposal. Nonpoint source pollution originates in a wide spectrum of public and private activities and, when not known or properly controlled, affects, in a large percentage, the water quality in a certain area.

Since runoff from the rainfall flows over or through the land and collects pollutants and nutrients prior to entering waterways, the overall characteristics of the land use within a watershed greatly influences water quality. Land use types have diverse effects on water quality, by contributing different pollutants with varying amounts and concentrations. The cumulative effect of this pollution throughout the watershed represents the contribution of nonpoint source pollution.

Point sources, or permitted facilities, are contributors to the overall watershed pollutant loading but due to the size of the watershed the primary focus of this plan is to address non point source pollutant loading. The premise of not focusing in detail on point source loading is that it is handled by existing regulatory processes and enforcement. The permitted point source facilities within the Embarras watershed include municipal wastewater treatment plants, mining operations, manufacturing facilities and private utility operations. All permitted facilities are subject to regulation through the IEPA and annual discharge volume estimates and permitted pollutant concentration of the applicable constituents are publically available.

Non Point Source Pollution Load Model

Nonpoint source pollution management is highly dependent on hydrologic simulation models and the use of computer modeling is often the only viable means of providing useful input information for adopting the best management decisions. As previously mentioned, the nonpoint pollution sources are generated by activities that are spatially distributed on the analyzed watershed or study area. Due to this spatial distribution of nonpoint pollution sources, the computation models used to study pollutant transport and stream bank erosion require large amounts of data for analysis in even a small watershed.

For the Embarras Watershed, a customized GIS based model was used to calculate nonpoint source pollutant loads to assess the nonpoint source pollution of the four identified pollutant parameters (Total Nitrogen, Total Phosphorus, Sediment and Fecal Coliform Bacteria) that have been identified as elements of concern by both the stakeholders and the land uses present in the watershed.

The GIS based model was executed for each HUC 10 subwatershed within the watershed. It should be noted that all computation models have assumptions and limitations. Therefore, the provided analytical results may not represent the exact pollution loads due to calibration and model limitations. In these conditions, even if the results are relative, they still can provide very useful information for targeting and prioritizing subwatersheds for Best Management Practices (BMPs).

Methodology and Calibration

The GIS based model was developed for the watershed, which compiled using land-cover data and SSURGO soils data for the entire watershed. Using these layers and regional climate data, average annual runoff volumes were estimated for the entire watershed. Following the runoff calculations, event mean pollutant concentrations (EMCs) were applied to the runoff based on each type of land use practice in the watershed. The EMCs were established based on literature sources, water quality studies and professional experience, the EMCs used in the model can be found in Appendix D.

For open and agricultural areas the model incorporates a Universal Soil Loss Equation (USLE) with a delivery ratio based on the soil types and land practices. The USLE portion of the model allows for more accurate sediment, nitrogen and phosphorus loading for individual land parcels based on soil types and topography, Appendix D outlines the details of the USLE equation.

Formulas and selected variables were derived from Spreadsheet Tool for Estimation of Pollutant Load (STEPL) Version 3, Tetra Tech, 2004. For Fecal Coliform, Schueler's Simple Method (1987) was modified for calculating bacterial loads (refer to Appendix D for further citations and details).

Model calibration was performed for the runoff by comparing values to published literature and established USGS stream gages in the watershed. Water quality was cross-referenced with existing IEPA and USGS water quality data from the watershed as outlined in the watershed inventory.

Existing Pollutant Loading Conditions

Exhibits 17 through 20 and Tables 4-1 through 4-2 below illustrate the modeling results for the existing land use conditions of the watershed. Exhibits 17, 18, 19 and 20 illustrate the existing condition pollution loads for total nitrogen, total phosphorus, total suspended sediment and fecal coliform bacteria (respectively).

These maps are valuable planning and implementation tools to identify specific locations and areas that are contributing significant loading to the watershed.

Table 4-1: Existing Conditions Annual Nonpoint Source Pollutant Loading *		
Parameter	**Total NPS Loading**	**Per Acre**
Total Suspended Sediment – (ton/yr)	612,951	0.40
Total Nitrogen (lb/yr)	6,632,514	4.30
Total Phosphorus (lb/yr)	1,336,411	0.86
Fecal Coliform (CFU in billions/yr)	3,115,237	2.02
Total Annual Storm Runoff (AC-Feet)	1,126,240	0.73

*the total suspended sediment estimate includes delivered sheet/rill erosion and streambank erosion.

Table 4-2: Existing Conditions Nonpoint Source Pollutant Loading*					
Land-Use Type	**Acres**	**Total Suspended Sediment (tons/acre)**	**Total Nitrogen (lbs/acre)**	**Total Phosphorus (lbs/acre)**	**Fecal Coliform (billions-cfu/acre)**
Soybeans	*506,165*	*0.421*	*5.38*	*1.16*	*2.2*
Corn	*475,520*	*0.415*	*5.20*	*1.13*	*2.1*
Forest	*236,344*	*0.089*	*0.48*	*0.22*	*0.3*
Pasture/Grass	*124,090*	*0.106*	*7.57*	*0.67*	*4.7*
Open Space	*120,034*	*0.017*	*0.33*	*0.17*	*0.4*
Urban	*38,301*	*0.155*	*6.20*	*0.96*	*6.1*
Wheat	*22,339*	*0.043*	*4.07*	*0.67*	*2.6*
Water	*10,855*	*0.000*	*1.01*	*0.54*	*1.3*
Wetland	*3,933*	*0.008*	*0.43*	*0.22*	*0.9*
Grassland	*2,009*	*0.047*	*0.41*	*0.20*	*0.3*
Gravel/Quarries	*1,778*	*0.150*	*0.47*	*0.25*	*2.9*
Other Ag	*473*	*0.551*	*5.23*	*1.23*	*1.9*
Barren	*237*	*0.023*	*0.56*	*0.29*	*0.7*
Aquaculture	*1*	*0.000*	*1.01*	*0.54*	*17.3*

*this suspended sediment estimate does not include streambank erosion

As illustrated in Exhibits 17 - 20; the highest loading per land area occurs in the southern portion of the watershed. This is primarily due to the soils and land slopes that are more highly erodible; these land areas are also more commonly used for livestock production and grazing which is a land use that contributes higher loading. The upper portion of the watershed also has nutrient loading primarily due to agricultural practices, however, the gentle slopes and less erodible soils in the upper watershed reduce the severity.

Nitrogen – Exhibit 17

Total nitrogen nonpoint source loading in the watershed is 6,632,514 lbs/year, averaging 4.30 lbs/acre per year for the entire watershed (Exhibit 17). Certain areas of the watershed, identified on Exhibit 17 contribute upwards of 18 lbs/acre per year. The total loading in the watershed is predominantly attributed to agricultural and livestock land practices (exhibits 17 and table 4-2). The North Fork watershed (Subwatershed 10) is the largest contributor of

Exhibit 18

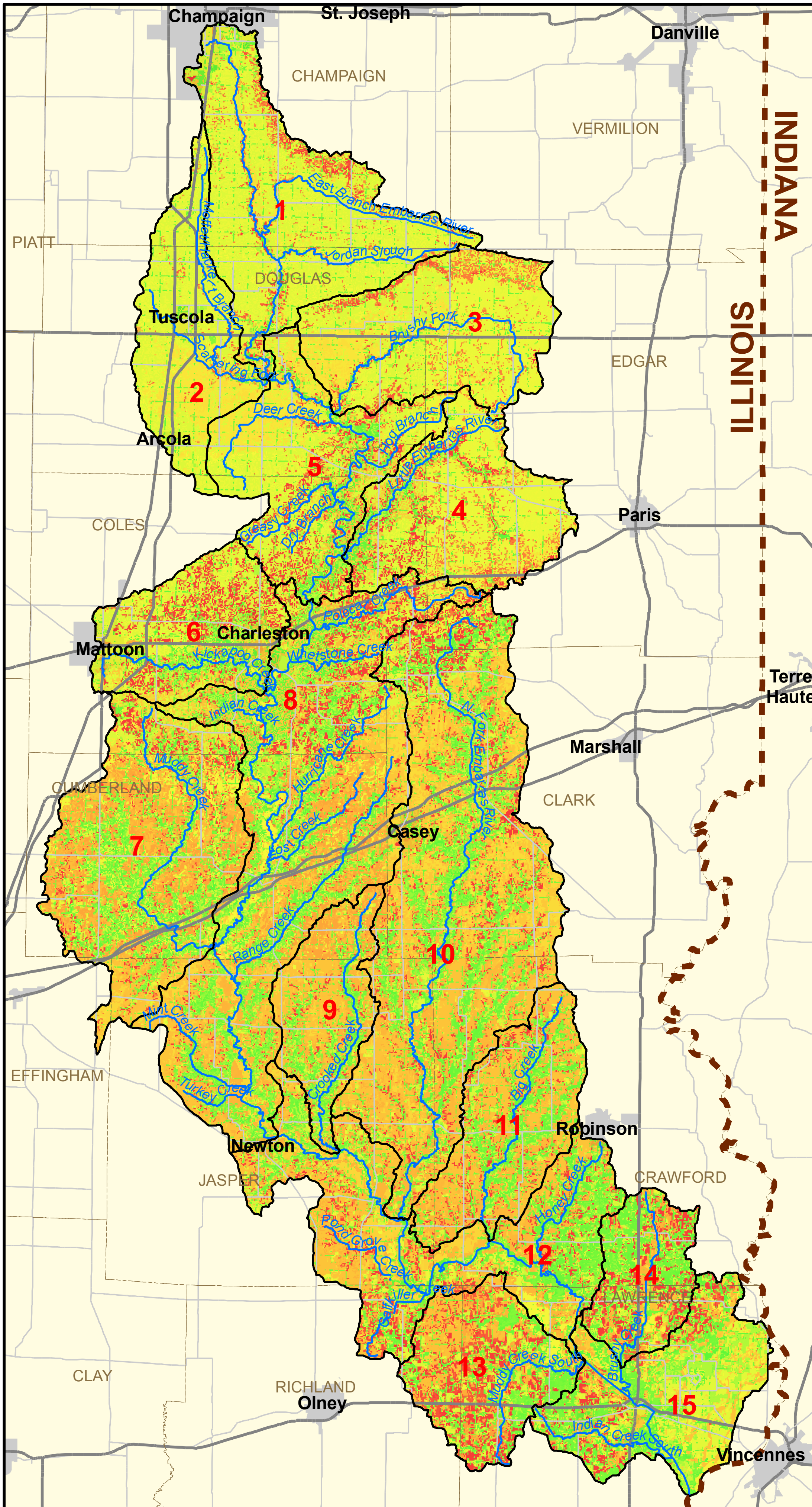
ERMA
EMBARRAS RIVER MANAGEMENT ASSOCIATION

SEAL OF CHARLESTON, ILLINOIS

Embarras River Watershed

Total Phosphorus Non Point Source Loading

ID	Name	Total Phosphorus (lbs)	
		Total	lbs/acre
1	**East Branch Embarras River**	94,859	0.78
2	**Scattering Fork**	53,170	0.77
3	Brushy Fork	79,335	0.85
4	Little Embarras River	73,907	0.89
5	**Deer Creek-Embarras River**	80,286	0.86
6	**Kickapoo Creek**	58,417	0.90
7	Muddy Creek	122,153	0.91
8	Range Creek-Embarras River	189,380	0.86
9	East Crooked Creek	44,055	0.89
10	North Fork Embarras River	207,859	0.91
11	**Big Creek**	64,503	0.90
12	**Honey Creek-Embarras River**	112,220	0.87
13	**Paul Creek-Muddy River**	63,975	1.02
14	Brushy Creek	35,340	0.86
15	Indian Creek-Embarras River	56,953	0.69



Legend

Embarras River
Embarras River Tributaries
County Line
Embarras River Watershed & Subwatersheds

Phosphorus Loading (lbs/ac)

High : 6.3
Low : 0.03

N S E W

5 0 5 10 Miles

nitrogen, primarily due to the subwatershed size and the agricultural land practices that dominate that subwatershed (table 4-2). Table 4-4 also indicates that the top four nitrogen loading subwatersheds per unit land area are:

Paul Creek- Muddy River (Subwatershed 13)
East Crooked Creek (Subwatershed 9)
Muddy Creek (Subwatershed 7)
North Fork (Subwatershed 10)

The primary nonpoint sources of nitrogen loading in the watershed are related to agricultural production, fertilizer application and common septic/sanitary infrastructure issues in developed areas.

Phosphorus – Exhibit 18

Total phosphorus nonpoint source loading in the watershed is 1,336,411 lbs/year, averaging 0.86 lbs/acre per year over the entire watershed (Table 4-1, exhibit 18). Certain areas of the watershed, identified in exhibit 18 contribute up to 6.31 lbs/acre/year. The total phosphorus loading is dominated by the soybeans, corn, pasture, other ag and urban land use categories (table 4-2). The Paul Creek-Muddy River subwatershed (subwatershed 13) is the largest contributor of phosphorus per unit area, whilst the North Fork subwatershed (subwatershed 10) is the largest overall contributor but this is primarily due to the large size of this subwatershed. Table 4-4 indicates the loading per subwatershed, the top four subwatersheds for phosphorus loading are:

Paul Creek – Muddy River (Subwatershed 13)
Muddy Creek (Subwatershed 7)
North Fork Embarras (Subwatershed 10)
East Crooked (Subwatershed 9) & Little Embarras River (Subwatershed 4)

The dominant typical nonpoint sources of phosphorus loading in the watershed are related to agricultural production, livestock, fertilizer application and common sanitary infrastructure issues.

Sediment – Exhibit 19

Total suspended sediment loading is 612,684 tons per year, average 0.40 tons/acre per year for the entire watershed (Table 4-1, exhibit 19). This overall loading is somewhat lower in comparison to other watersheds in the Midwest and Great Lakes areas primarily due to the fact that most of the Embarras watershed was not glaciated during the latest Wisconsin episode. As a result, this watershed is more mature in terms of recovering from the mass amount of sediment deposited during the Wisconsin event.

It is estimated that approximately 25% of total loading; 158,844 tons of sediment delivery are attributed to bank erosion. Most of this bank erosion occurs in the lower portion of the watershed where there are higher stream flows and more highly erodible soils and slopes. The remainder of sediment is sourced from sheet/rill and gully erosion throughout the watershed. Agriculture, pastureland and urban land uses are the largest contributors of sediment (Table 4-2). The sediment loading per subwatershed is shown in Table 4-4; the top four contributing subwatersheds per land area are:

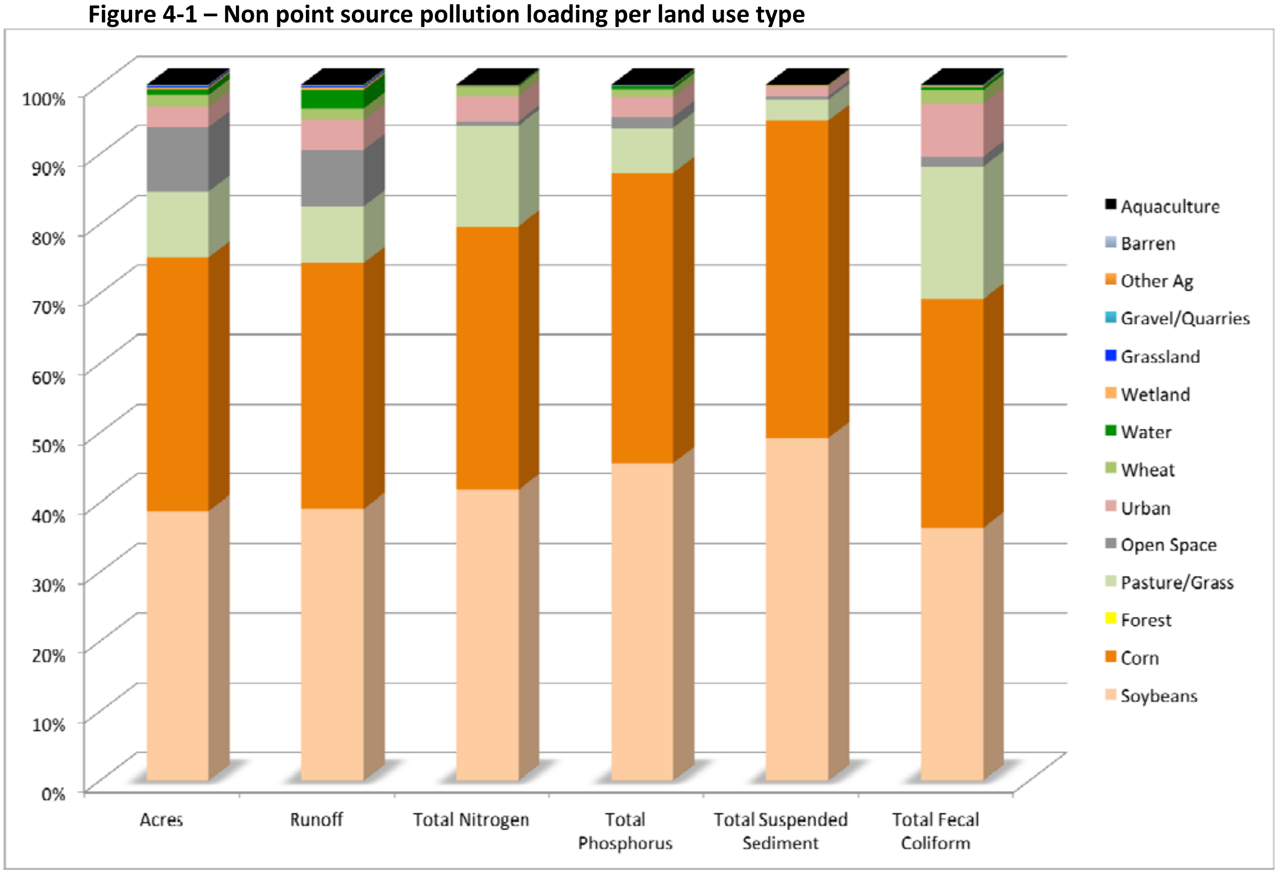
Paul Creek – Muddy River (Subwatershed 13)
Kickapoo Creek (Subwatershed 6)
Brushy Creek (Subwatershed 14)
Little Embarras River (Subwatershed 4)

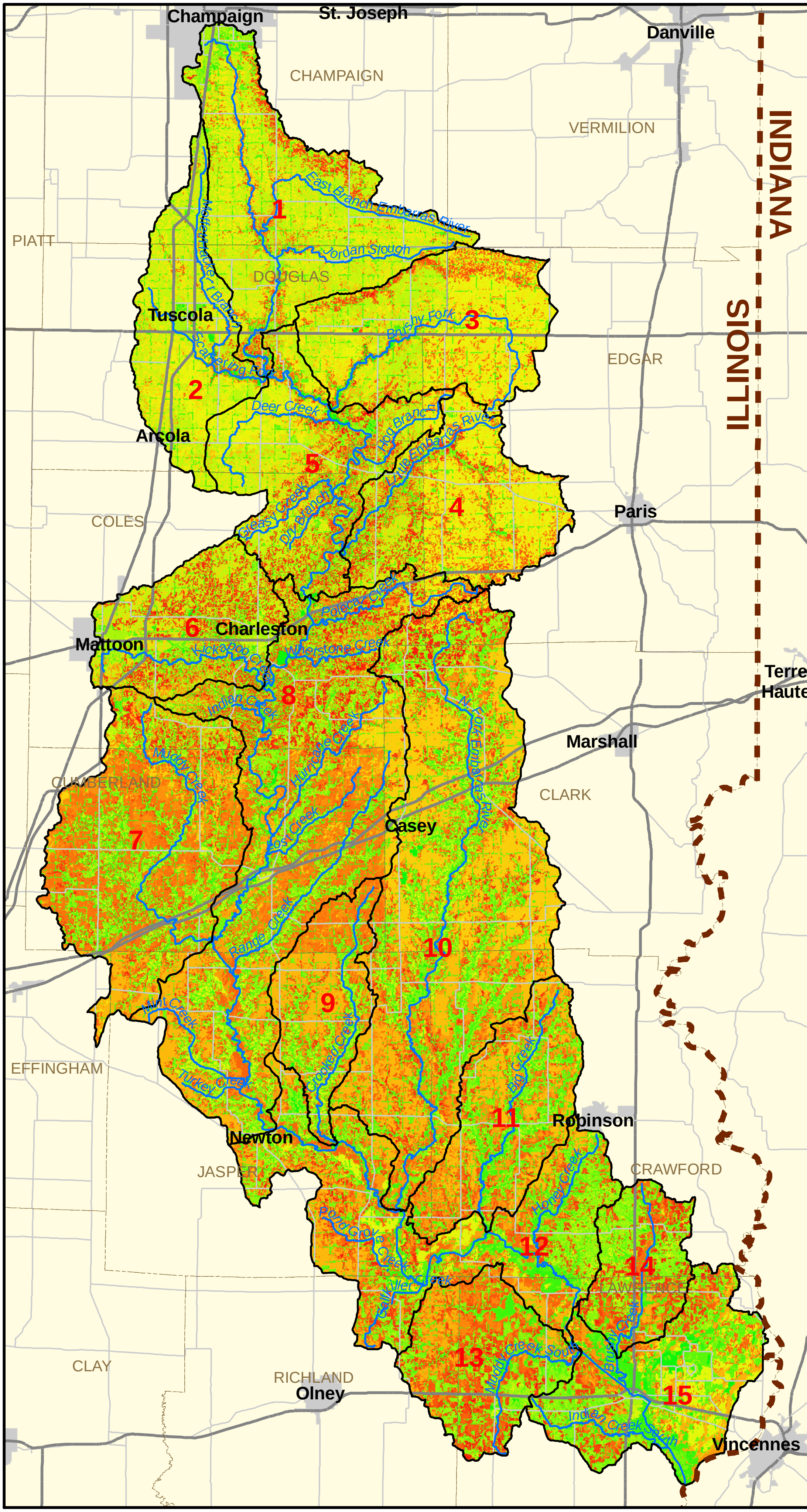
Table 4-3: Total Suspended Sediment Loading Breakdown *		
Parameter	Total Delivered Sediment	Per Acre
Sheet and Rill – (ton/yr)	453,840	0.30
Stream bank and Gully – (ton/yr)	158,844	0.10
Total	612,684	0.40

Fecal Coliform – Exhibit 20

Fecal coliform bacteria nonpoint source loading in the watershed is 3.115 x 10^9 coliform units per year (exhibit 20). This averages 2.02 x 10^9 coliform units per acre/year. This loading is fairly low overall for the watershed when compared to areas in the northwest part of Illinois; however, there is a large dichotomy between areas with high loading and low loading. For example, there is a lot of forested land area in the watershed which has low fecal coliform loading which helps depress the overall loading for the watershed. Urban and pasture areas have the highest loading in the watershed reaching over 6 X10^9 coliform units per year.

Figure 4-1 – Non point source pollution loading per land use type





ERMA
EMBARRAS RIVER MANAGEMENT ASSOCIATION

SEAL OF CHARLESTON, ILLINOIS

Embarras River Watershed

Sediment Non Point Source Pollutant Loading

ID	Name	Total Suspended Sediment (tons)	
		Total	tons/acre
1	**East Branch Embarras River**	40,431	0.33
2	**Scattering Fork**	18,545	0.27
3	Brushy Fork	35,350	0.38
4	Little Embarras River	38,524	0.46
5	**Deer Creek-Embarras River**	40,028	0.43
6	**Kickapoo Creek**	31,232	0.48
7	Muddy Creek	56,154	0.42
8	Range Creek-Embarras River	93,338	0.42
9	East Crooked Creek	17,603	0.36
10	North Fork Embarras River	91,996	0.40
11	**Big Creek**	26,812	0.38
12	**Honey Creek-Embarras River**	47,610	0.37
13	**Paul Creek-Muddy River**	32,407	0.52
14	Brushy Creek	19,481	0.47
15	Indian Creek-Embarras River	23,174	0.28

Legend

Sediment (ton/ac/yr)

High : 1.25

Low : 0.001

Embarras River

Embarras River Tributaries

County Line

Embarras River Watershed & Subwatersheds

5 0 5 10 Miles

Exhibit 20

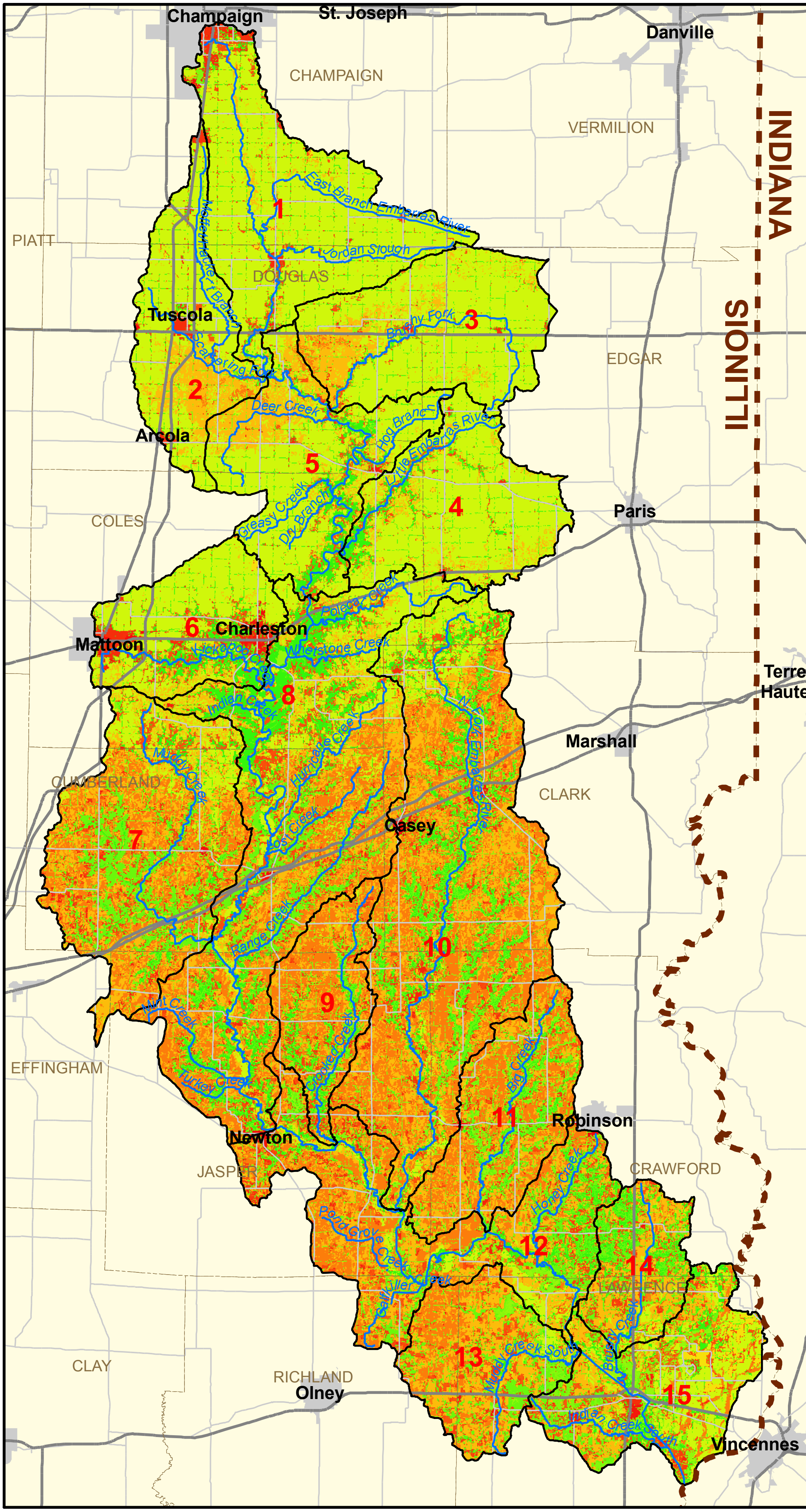
ERMA
EMBARRAS RIVER MANAGEMENT ASSOCIATION

SEAL OF CHARLESTON, ILLINOIS

Embarras River Watershed

Fecal Coliform
Non Point Source
Pollutant Loading

ID	Name	Fecal Coliform (cfu in billions)	
		Total	per acre
1	**East Branch Embarras River**	226,427	1.87
2	**Scattering Fork**	143,017	2.07
3	Brushy Fork	169,805	1.82
4	Little Embarras River	141,147	1.70
5	**Deer Creek-Embarras River**	163,654	1.76
6	**Kickapoo Creek**	138,215	2.13
7	Muddy Creek	290,251	2.16
8	Range Creek-Embarras River	432,019	1.96
9	East Crooked Creek	111,957	2.26
10	North Fork Embarras River	492,290	2.17
11	**Big Creek**	154,228	2.16
12	**Honey Creek-Embarras River**	279,956	2.17
13	**Paul Creek-Muddy River**	137,117	2.18
14	Brushy Creek	77,062	1.88
15	Indian Creek-Embarras River	158,093	1.92



Legend

- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed & Subwatersheds

Fecal Loading (bill fcu/ac/yr)

High : 8.2

Low : 0.074

N S E W

5 0 5 10 Miles

Table 4-4: Existing Conditions Nonpoint Source Loading by Subwatershed*									
ID	Name	Total Suspended Sediment (tons)		Total Nitrogen (lbs)		Total Phosphorus (lbs)		Fecal Coliform (cfu in billions)	
		Total	tons/acre	Total	lbs/acre	Total	lbs/acre	Total	per acre
1	**East Branch Embarras River**	40,431	0.33	472,026	3.90	94,859	0.78	226,427	1.87
2	**Scattering Fork**	18,545	0.27	277,057	4.01	53,170	0.77	143,017	2.07
3	Brushy Fork	35,350	0.38	382,942	4.10	79,335	0.85	169,805	1.82
4	Little Embarras River	38,524	0.46	339,618	4.10	73,907	0.89	141,147	1.70
5	**Deer Creek-Embarras River**	40,028	0.43	376,918	4.05	80,286	0.86	163,654	1.76
6	**Kickapoo Creek**	31,232	0.48	276,055	4.26	58,417	0.90	138,215	2.13
7	Muddy Creek	56,154	0.42	621,847	4.64	122,153	0.91	290,251	2.16
8	**Range Creek-Embarras River**	93,338	0.42	932,377	4.24	189,380	0.86	432,019	1.96
9	East Crooked Creek	17,603	0.36	231,990	4.69	44,055	0.89	111,957	2.26
10	North Fork Embarras River	91,996	0.40	1,047,551	4.61	207,859	0.91	492,290	2.17
11	**Big Creek**	26,812	0.38	324,351	4.54	64,503	0.90	154,228	2.16
12	**Honey Creek-Embarras River**	47,610	0.37	576,448	4.46	112,220	0.87	279,956	2.17
13	**Paul Creek-Muddy River**	32,407	0.52	306,067	4.87	63,975	1.02	137,117	2.18
14	Brushy Creek	19,481	0.47	170,693	4.15	35,340	0.86	77,062	1.88
15	Indian Creek-Embarras River	23,174	0.28	296,575	3.61	56,953	0.69	158,093	1.92

*bold = priority subwatershed

Section 5 – Identification of Watershed Impairments and Problems

Group Concerns

As discussed in Section 2, stakeholder concerns were gathered during the planning process. The Watershed Inventory provided a means of verifying these concerns or in some cases developing additional concerns. The results of the Watershed Inventory and analysis of the stakeholder concerns indicate that the group concerns can be described in six general areas: soil, water, air, plants, animals, and human factors.

Table 5-1 lists the concerns that were identified during the work group meetings and the problem category associated with each concern. Some concerns are listed in several problem groups as they cover a wide variety of issues.

Table 5-1: Concerns and Associated Problems

Concern	Problem Category
- Humus loss as biomass is removed - Emphemeral erosion - Gully erosion - Streambank erosion - Control soil erosion - Conservation tillage - Too much tillage - Sheet and rill erosion - Nutrient management – application of proper rates - Funding for existing waterway repair - Maintenance of conservation practices - Prime farmland preservation - Wind erosion - Maintaining the productivity of the soil	Soil
- Littering in rural areas - Nutrients in water - Water quality due to TMDL impediments - Nutrient management - Too much fall application of fertilizer - Log jam removal - Maintenance of conservation practices - Flooding - Streambank stabilization - Siltation - Point source protection of ground water (abandoned wells, irrigators, etc) - Aquifer management - Urban water management (stormwater and retention ponds, parking lots with oil and salt runoff) - Proper management of tile drainage - Livestock exclusion - Protection of wetlands - Runoff is too fast	Water

- Lack of maintenance on road side ditches and culverts - Lack of rural water supply systems - Urban fertilization of lawns	
- Wind turbines for energy production - Windbreaks around swine facilities to reduce odor problems - Off target chemical application/spray drift - Wind erosion - Livestock odor - Education of sequestration carbon credits - Soybean rust potential	Air
- Market for biofuels - Tree diseases - Herbicide (Roundup) resistant weeds - Insect problems - Chemical resistance - Quality of woodlands/exotic and invasive species - Forestry management - Control of emerald ash borer - Establishment of alternative crops - livestock overgrazing - Lack of management for native grasses - Lack of CRP mid-management practices	Plants
- Research into biofolters for swine confinement facilities - Windbreaks around swine facilities to reduce odor problems - Deer and turkey overpopulation - Livestock waste management - Develop and maintain proper habitat - Wastewater concerns - Lack of animal waste storage management - Nuisance wildlife - Lack of quality wildlife - Proper livestock exclusion - Lack of proper management of geese - Declining bobwhite quail population	Animals
- Low income - Health care for low income wage earners - Lack of assisted living facilities in the county - Littering in rural areas - More recycling - Zoning/Land Use planning - Lack of local control - Lack of education - Fertilizer costs – price differences in fall vs. spring - CRP/rental rates are not keeping up – CRP will go back into production - Education on wildlife habitat and management of wildlife - Outreach education on availability of USDA programs - Maintenance of conservation practices - Abandoned wells - Fire protection - Resource needs to complete watershed plan, including technical assistance - Cash leases that will work with USDA programs	Human Factors

- Ownership trends (including land exchanges) - Equipment costs - Urban sprawl - Equitable allocation between livestock and non-livestock - Too much paperwork for USDA programs - Fully fund CSP - Create coordination ability between drainage districts and USDA - Education on drainage law and wetland regulations - Lack of funding - Lack of youth education	

Priority Resource Concerns

The priority resource concerns that were identified during the public meetings were prioritized by the planning committee. 18 of the concerns were identified as priority resource concerns and are included as part of this WMP. These concerns were listed into four categories to aid understanding of the issues: flooding; erosion/water quality; wetland, wildlife, and natural character; and information and public communication. An explanation of each priority resource concern is listed below.

Flooding

Flooding

A flood is an overflow of an expanse of water that submerges land. Floods occur in rivers when flow exceeds the capacity of the river channel, particularly at bends or meanders. Floods often cause damage to homes and agricultural fields if they are placed in natural flood plains of rivers. According to the State of Illinois Hydrologic Units report (1987) estimated flood damages within the Embarras River basin can exceed $4,000,000 and the area in the basin subject to flood damage is 149,900 acres.

Log Jams/Obstructions

Log jams and sediment bars cause problems in the river that forces it to change the normal channel flow. Small log jams form restrictions in the channel widen the channel through bank erosion. Larger log jams divert flow onto adjacent land, change the direction of the normal channel flow and are potential safety hazards to private and public resources. Sedimentation is the result of normal stream channel dynamics and "bed load" conditions. As the river meanders, sediment bars are deposited on the inside of meander curves where the velocity of water flow is lower. In March 1995, a helicopter was used to video tape the Embarras River and its major tributaries to inventory the extent of the log jam and obstruction situation. Nine major log jams were recorded that appear to be causing extensive flow alterations.

Drainage

Drainage has been and will continue to be a major requirement for agricultural production in the basin. Surface and subsurface drains have been installed in the basin by individual landowners since 1850 and by mutual or organized groups of landowners beginning in 1895. Maintenance and replacement of the drainage improvements are continuing at the present time and will be important economic and environmental action items in the future.

Small Bridge Outlets

The planning committee concerns included small bridge outlets. Small bridge outlets can create restrictions for flow if not sized properly and can aid in the accumulation of debris around the bridge openings. In March 1995, a helicopter was used to video tape the Embarras River and its major tributaries. Approximately 59 bridges crossing the Embarras River were identified in the video.

Erosion/Water Quality

Water Quality

Water quality is the measure of the condition of water relative to the requirements of the biotic species or to any human need or purpose. Water quality can impact many aspects of the river system from aquatic habitats to recreational opportunities. The Embarras River is also a source of water supply, therefore protecting the quality of the water is important to the communities along the river.

Erosion

Soil erosion is a problem in almost all Illinois watersheds. Erosion is a natural process, but it has been increased dramatically by human land use. Excessive erosion can cause serious problems, such as receiving water sedimentation, ecosystem damage and loss of soil.

Sediment (Sand Deposits)

Sedimentation is an on-going natural process that occurs in all watersheds. Sediment deposition occurs throughout the basin in low spots and depressions, along field borders, on flood plains, in stream channels, and wherever slight variations in the velocity of silt-laden water takes place.

Wetland, Wildlife, and Natural Character

Beaver, Deer and Turkey related problems

The planning committee identified beaver, deer, and turkey as three wildlife species causing some problems with landowners in the watershed. Flooding of crops caused by beaver dams on tributaries and erosion of streambanks have been cited by some landowners. Wildlife have caused some crop damage, been an enticement to trespass hunters, and caused some vehicle accidents.

Loss of Natural Character

A significant segment of the Embarras River is on the State Natural Areas Inventory, and also qualifies for National Scenic River designation. This Scenic River area extends from Lake Charleston to the Old Mill at Newton. This Scenic River area has been listed because of the natural character, scenic beauty and wildlife habitat. It is frequently used for canoeing, fishing, hunting and other recreational activities. The natural character has intrinsic, biological, and physical importance for threatened and endangered species.

Bends in the Channel

As the Embarras River flows through the basin, it tends to meander, creating numerous bends. In the lower half the grade flattens out, and the meandering of the river increases which is typical of a river this size. The bends move back and forth over time across the floodplain. Landowners and operators farming along the river reported losses of up to 10 rows of crop (25 feet) as the river bend advances. Eventually the river jumps across the neck of the bend leaving isolated sloughs or oxbows. Activities of people and their structures in the floodplain come into conflict with the river as it moves. It is estimated that 57 miles of streambanks along the Embarras are actively eroding enough to need treatment.

Wetlands
For regulatory purposes under the Clean Water Act, the term wetlands means "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetland functions include water quality improvement, floodwater storage, fish and wildlife habitat, aesthetics and biological productivity. Restoring wetlands will slow stormwater runoff, filter excess nutrients from the runoff, recharge groundwater supplies, decrease flooding, and increase habitat for threatened and endangered species.

Wildlife, Recreation Opportunities
Fishing, canoeing, hunting, sightseeing, photography, biking, bird watching and environmental studies are major recreation activities within the Embarras River Watershed. The recreational value of this basin contributes significantly to the economic resources of the area. An IDNR fishery biologist has estimated that sport fishing on the Embarras River is $8,000,000 annually. Damages to the river channel and natural flood plain area reduce its scenic beauty.

Information and Public Communication

Lack of Accountability – Communication
Communication and coordination needs to be aggressively pursued to strengthen and maintain the cooperative relationship among the planning groups involved with this project (ERMA, Upper Embarras, and North Fork). In addition, communication among state and federal agencies that can provide financial and technical assistance needs to be facilitated so planning and implementation efforts will not be duplicated.

Private Property Rights
Landowners throughout the Embarras River basin have apprehension about any plan that affects freedom to use their land as well as any potential liability. Landowners may view any resource problem solution that restricts the land use as an infringement on private property rights. In the same manner, solutions to resource problems involving actual or perceived public access to private property raise unresolved questions about landowner liability in cases of accidental injury.

Economic Costs (Funding Solutions)
Landowners are concerned about the cost of implementing solutions to resource problems such as flooding, soil erosion and water quality. Without financial assistance, many treatment practices are not economical for the individual landowner to implement. Offsite benefits should be considered for overall economic justification. Alternatives such as property tax credit, income tax credit and other "green ticket" proposals such as the Illinois Vegetative Filter Strip Bill that amends the property tax code have been suggested. These alternatives are being researched by the planning committee.

Water Usage and Supply

The Embarras River is a source of water supply. Protecting the quality and quantity are important to the communities along the Embarras. Charleston draws one half of its water from the river through a side channel reservoir. Other towns and villages draw water from shallow and deep wells in the river bottom floodplain.

Land Use Changes

Although landuse within the watershed has remained virtually unchanged, growth and change may be inevitable in the future. The way in which growth takes place affects its impact on water quality. With careful planning and a commitment to protect streams, rivers, and ground water, land use practices can be implemented that balance the need for jobs and economic development with protection of the natural environment.

Lack of Education

Lack of education about the river basin, and stream channel dynamics were suggested as the reason that citizens take actions that were detrimental to the basin in general.

Problem Statements

Problem statements were developed during the planning process in an effort to link the watershed concerns with existing and historical water quality data and the four major concern categories.

Flooding

Excessive flow rates and volumes of water are causing damage and loss within the Embarras River Watershed.

Erosion/Water Quality

Soil erosion and sedimentation within the watershed is degrading the water quality/quantity and limiting the aesthetics, wildlife habitat, and aquatic health of the streams within the watershed. Agriculture and typical urban area practices within the watershed contribute a significant amount of pollutants, thereby contributing to the frequent exceedances of water quality targets.

Wetland, Wildlife and Natural Character

Impacts to the natural resources of the watershed are degrading the quality and amount of wetlands, wildlife habitat and recreational opportunities.

Information and Public Communication

Stakeholders in the Embarras River Watershed are not knowledgeable about their daily impact on the watershed and its water quality.

Section 6 – Identification of Sources and Priority Areas

Potential Sources

A source is an activity, material or structure that results in nonpoint source pollution. Potential sources were identified for each problem statement based on the information analyzed in the Watershed Inventory in Section 3. Table 6-1 lists the potential sources for each problem. For sources that did not have collected data as backup, the information was obtained during the work group meetings.

Table 6-1: Potential Causes and Sources

Problem Statement	Potential Sources
Excessive flow rates and volumes of water are causing damage and loss within the Embarras River Watershed.	-Alterations to flood storage and flow conveyance through the impacts of log jams and beaver activities or improperly sized crossings -Urban encroachment on the floodplains -Loss of wetlands -Land use changes
Soil erosion and sedimentation within the watershed is degrading the water quality/quantity and limiting the aesthetics, wildlife habitat, and aquatic health of the streams within the watershed. Agriculture and typical urban area practices within the watershed contribute a significant amount of pollutants, thereby contributing to the frequent exceedances of water quality targets.	-Conventionally tilled agricultural fields that drain directly to ditches/streams with no or inadequate buffers -Bank erosion due to changes in hydrology -Areas where live stock have direct access to streams -Areas with inadequate buffers -Combined Sewers and Overflows into ditches/streams -Communities with no sewer systems and direct discharges to ditches/streams -Over application of fertilizers for its specific use -Timing of application of fertilizers -Lack of septic maintenance -Lack of manure management
Impacts to the natural resources of the watershed are degrading the quality and amount of wetlands, wildlife habitat and recreational opportunities.	-Areas with inadequate buffers -Loss of wetlands -Urban encroachment on the floodplains -Water quality degradation
Stakeholders in the Embarras River Watershed are not knowledgeable about their daily impact on the watershed and its water quality.	-Lack of public awareness -Lack of unified approach -Lack of perceived benefits/ impacts -Lack of interest -Lack of time and commitment -Lack of media coverage/ educational material

Priority Areas and Priority Subwatersheds

Priority areas are defined as areas where project implementation focuses on remediating the most severe areas identified in the watershed with a goal to reduce the impact of future impairments. The priority areas within the Embarras River watershed were identified based on the watershed Inventory, the identified problems and the goals of the WMP, GIS analysis and stakeholder input. Priority areas throughout the entire watershed were mapped using

GIS spatial and statistical analyses; table 6-2 below illustrates the exhibits that illustrate the priority areas within the watershed. Table 6-2 below also illustrates the exhibits that display mapping analysis that can be used to prioritize areas within the watershed for the most effective implementation.

Also, understanding the size and scale of such a large watershed, the stakeholders selected eight (8) priority HUC-10 subwatersheds based on a range of criteria identified above to focus on for identifying specific priority areas and projects for implementation. In addition to the modeling results and identified regulatory water quality impairments, stakeholder participation and interest was weighed heavily in selecting the priority subwatersheds to identify specific implementation projects and opportunities. These subwatersheds are further detailed and inventoried in section 9 with sub-watershed specific mapping and load reduction implementation strategy. The selected strategic subwatersheds are shown in exhibit 21.

Priority Area Mapping and Project Identification

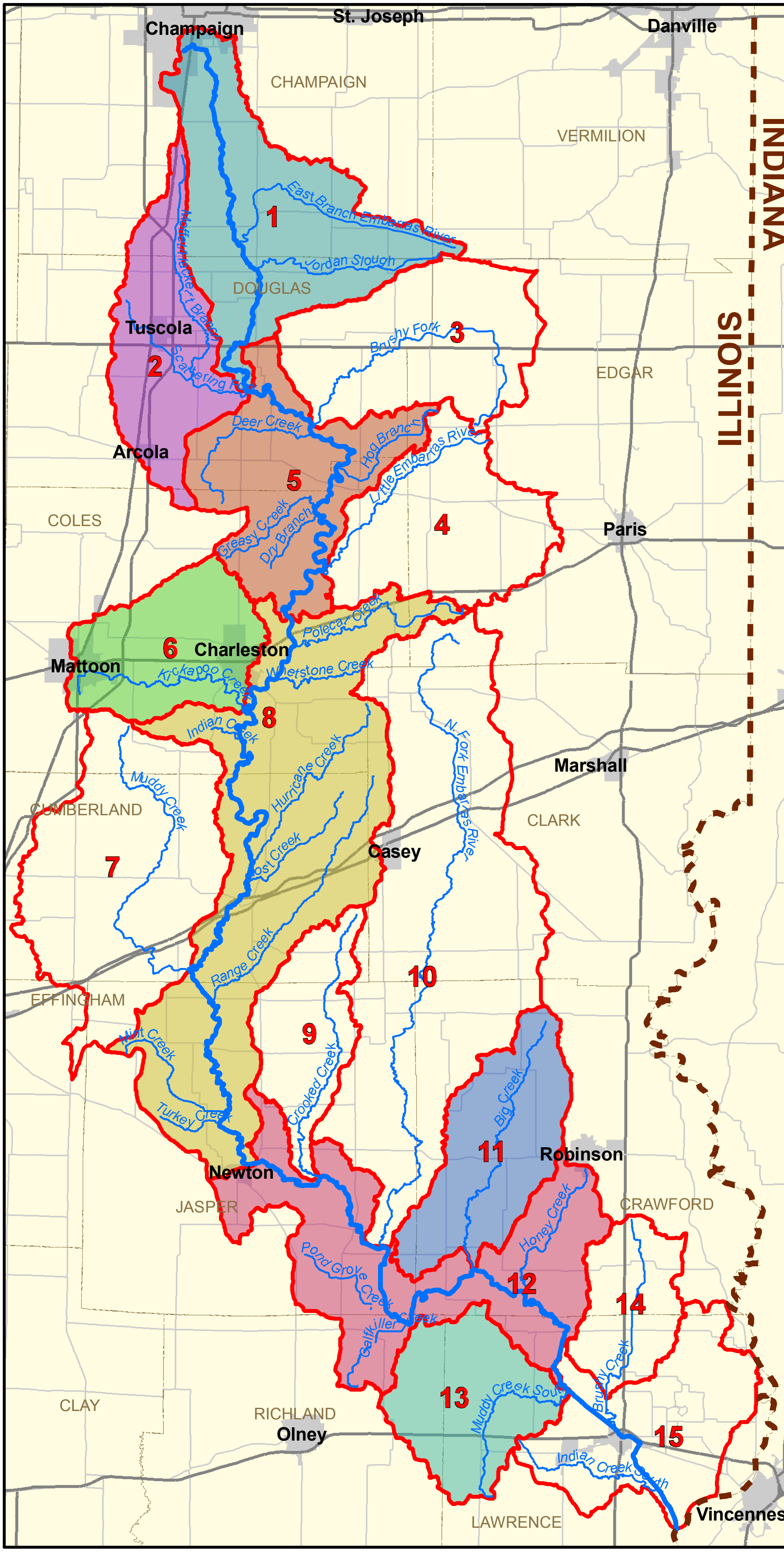
Mapping, modeling, stakeholder input and analysis were performed to identify project implementation priority areas that address the resource concerns identified for the watershed. These exhibits created are important tools that the watershed stakeholders can use to identify areas and sites within the watershed that are contributing to impairments and where significant watershed improvements can be applied. The following exhibits listed in table 6-2 are designed to be utilized as tools for project prioritization, many of these exhibits are provided in section 9 to show greater detail at a subwatershed level for the eight selected priority subwatersheds.

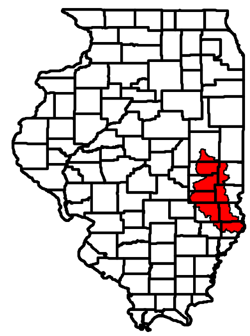
Exhibit 21

ERMA
EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

Priority Subwatersheds Map





Sub-watershed #	HUC Code	Subwatershed Name	Acres
1	0512011201	East Branch Embarras River	122,219
2	0512011202	Scattering Fork	69,875
5	0512011205	Deer Creek-Embarras River	94,017
6	0512011206	Kickapoo Creek	65,461
8	0512011208	Range Creek-Embarras River	222,342
11	0512011211	Big Creek	72,143
12	0512011212	Honey Creek-Embarras River	130,554
13	0512011213	Paul Creek-Muddy River	63,468

Legend

Urban Area
Embarras River
Embarras River Tributaries
County Line
Embarras River Watershed & Subwatersheds

Priority Subwatershed Basins

1
2
5
6
8
11
12
13

N
W
E
S

5 0 5 10 Miles

Table 6-2: Watershed-Wide Maps Designed for Prioritizing Project Areas and Locations		
Exhibit	**Name**	**Details**
28	Pasture Land Near Streams	Illustrates areas that have pasture land adjacent to streams where EQIP projects can be prioritized
27	Highly Erodible Lands	Illustrates highly erodible lands that are under agriculture or pasture/grazing land usage. These areas are high priority for reducing sediment and nutrient loads.
26	Hydric Soils	Illustrates hydric soils that are under agricultural production, these areas are great candidate sites to reduce nutrient loading, provide flood mitigation and enhance habitat
14	303 (d) List	Illustrates impaired stream segments, projects should prioritize improving the contributing watersheds to these stream segments as much as possible.
16	Septic Density	Illustrates potential septic density hotspots near streams and waterways throughout the watershed
17	Nitrogen Non Point Source Loading	Custom GIS model identifies ranges of nitrogen loading and hotspots throughout the watershed
18	Phosphorus Non Point Source Loading	Custom model identifies ranges of phosphorus loading and hotspots throughout the watershed
19	Sediment Non Point Source Loading	Custom model identifies ranges of sediment loading and hotspots throughout the watershed
20	Fecal Coliform Non Point Source Loading	Custom model identifies ranges of fecal coliform loading and hotspots throughout the watershed
22	Stakeholder Identified Project Locations	Shows 68 specific implementation projects identified by stakeholders during the plan development
23	Priority Areas Based on Non Point Source Loading	A spatial analysis to identify hotspots that contribute significant nitrogen, phosphorus and sediment loading
24	Priority Areas Based on Wetland Restoration and Flood Mitigation Potential	An analysis performed by Eastern Illinois University to identify potential implementation locations throughout the watershed
25	Priority Areas Based on Fecal Coliform Loading and Septic Density	A spatial analysis that identified hotspots that likely contribute to bacteria loading in the watershed

Stakeholder Identified Project Priority Locations

A series of one-on-one meetings were held with selected stakeholders in December of 2009 (see section 2). A total of 68 specific projects were identified. The meetings were held with selected counties and municipalities that were within the eight (8) strategic subwatersheds chosen by the planning committee. These projects are the recommended first stage of projects to be implemented, because the projects are identified and there are supporting stakeholders to lead them. Table 6-3 below summarizes the projects and exhibit 22 illustrates their locations on a map. These projects are further detailed for each strategic subwatershed in Section 9.

Exhibit 22

Embarras River Watershed

Stakeholder Identified Prioirty Projects Map

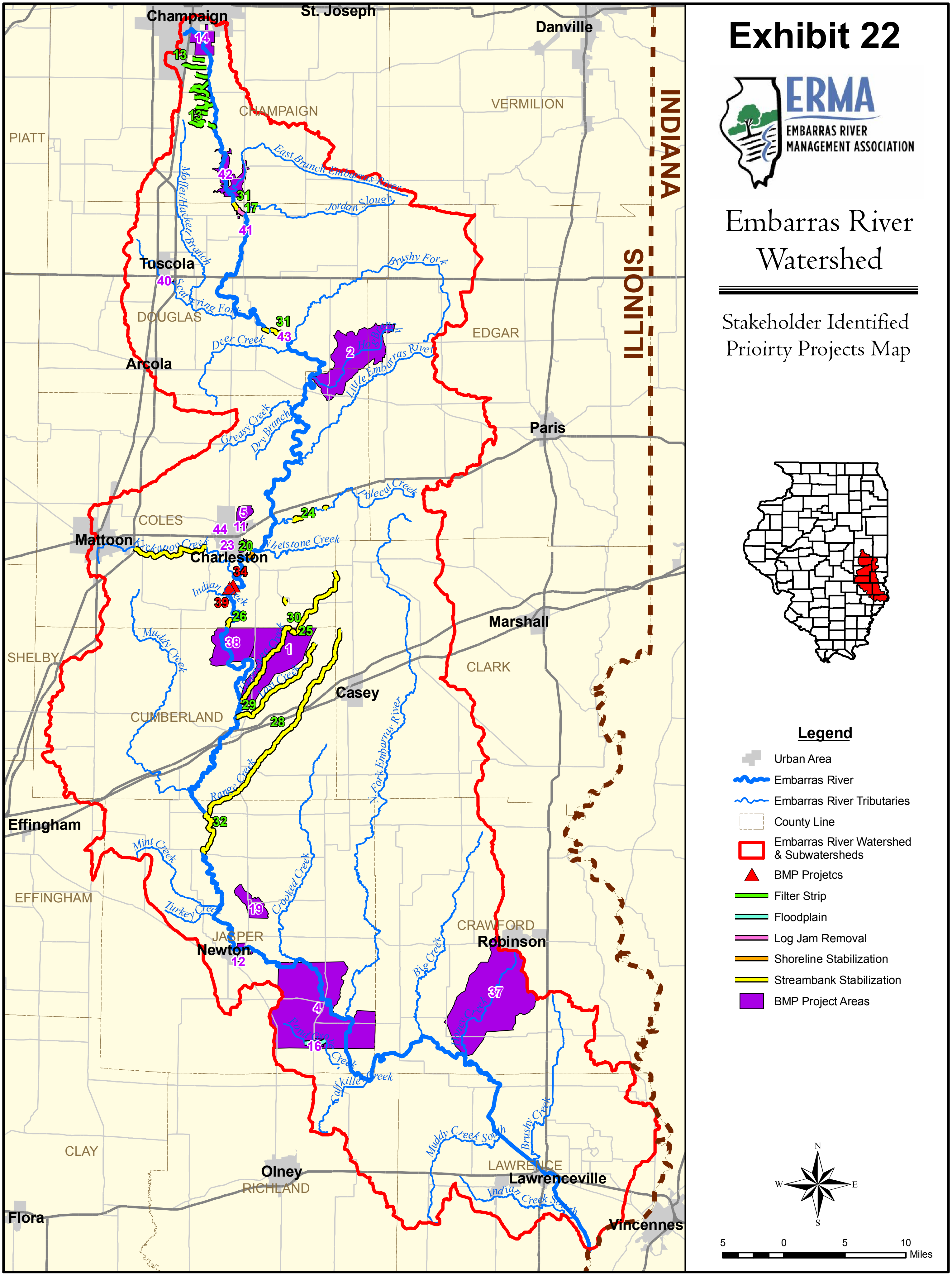


Table 6-3: Project Identification Workshops		
Entity	**# Projects Identified**	**Project Types**
Champaign County SWCD/NRCS	16	Runoff control at dairy farm; wetland restoration; filter strips
Coles County SWCD/NRCS	8	Terrace, grassed waterway, streambank stabilization
Douglas County SWCD/NRCS	5	Agricultural BMPs, wetland restoration, streambank stabilization
Jasper County SWCD/NRCS	5	floodplain easements, streambank stabilization, waste management and runoff BMPs from livestock operations
City of Charleston	8	Shoreline stabilization, runoff control BMPs, wetland restoration
City of Newton	6	Urban runoff BMPs, streambank stabilization, wetland restoration (acquisition)
City of Tuscola	6	Urban runoff control, stream restoration to improve flood issues, flood mitigation
City of Villa Grove	7	Urban runoff control, wetland restoration, stream maintenance to prevent flooding
Crawford County SWCD/NRCS	2	WASCB/Waterway, boat access to reduce erosion
Cumberland County SWCD/NRCS	5	WASCB, grassed waterway, agricultural BMPs, streambank stabilization
Total	**68**	

Priority Areas based on Pollutant Load Analysis

Exhibits 17 – 20 illustrate the pollutant load analysis for the entire watershed. These maps are created in a way to identify specific areas and land parcels that contribute high loads of nitrogen, phosphorus, sediment and fecal coliform. These maps are powerful tools to identify project opportunities and prioritize locations throughout the entire watershed.

This analysis was taken one step further and a statistical GIS analysis was applied to identify areas within the watershed that contributed the highest combined load of nitrogen, phosphorus and sediment collectively. These areas are illustrated on exhibit 23 and further detailed by subwatershed is section 9.

Priority Areas based on Wetland Restoration Potential

Eastern Illinois University (EIU) performed a detailed soils analysis for the entire watershed to identify ideal locations within the watershed for wetland and bottomland restoration. Implementation in these priority areas would lead to flood mitigation, creation of habitat and significant reductions in pollutant loading. Exhibit 24 details these areas for the entire watershed and section 9 further details them for each strategic subwatershed.

Priority Areas based on Fecal Coliform Loading and Septic Density

Exhibit 25 shows the non-point source pollutant load analysis for Fecal Coliform and septic density near waterways throughout the watershed.

This analysis was taken one step further to identify potential project areas to address fecal coliform loading. A statistical GIS analysis was applied to identify the highest statistically significant areas in the watershed and these are identified in exhibit 25 and further detailed by subwatershed in section 9.

Priority Areas based on Hydric Soils under Agricultural Land Cover

Using GIS analysis we identified hydric soils within the watershed that are currently under agricultural land cover. These areas are important locations for wetland restoration that will reduce flooding problems and pollutant loading. Implementation of projects in these areas will also reduce damage to crops and improve ecological habitat.

Exhibit 26 illustrates these areas of the watershed

Priority Areas based on Highly Erodible Soils under Agricultural or Pasture Land Cover

Using GIS analysis we identified priority areas based on agricultural and pasture land uses that are on highly erodible soils. These areas are important focus areas because project implementation will have the highest bang for the buck and contribute significant load reductions. Exhibit 27 illustrates all of the areas that met the criteria.

Pasture Land Near Streams

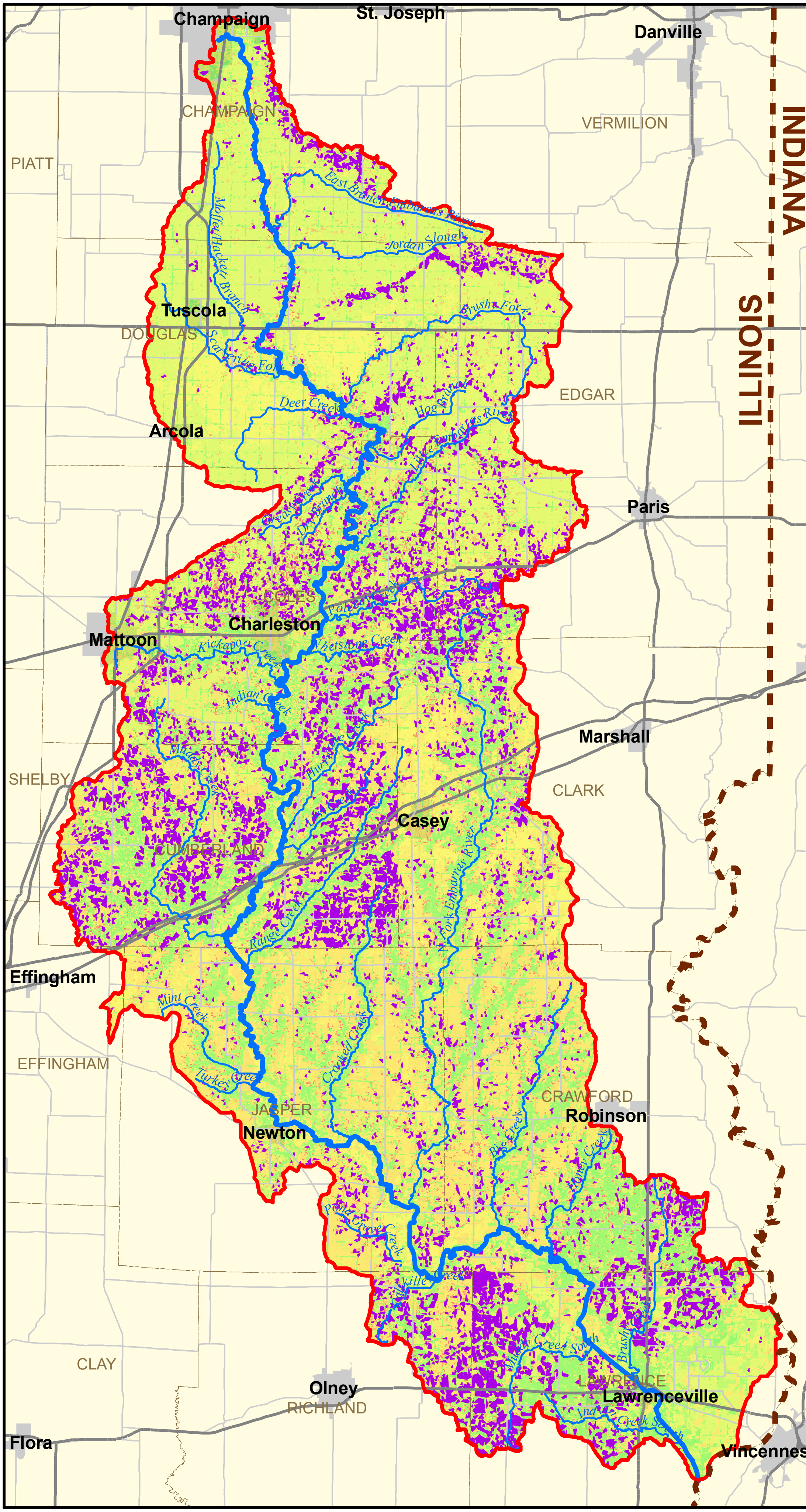
Using GIS analysis we identified all pasture land area near streams in the watershed. These areas are important areas that can be evaluated for project implementation for EQIP programs that would significantly reduce nutrient loading and fecal coliform bacteria loading. Exhibit 28 illustrates these areas.

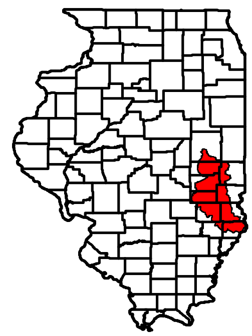
Exhibit 23

ERMA
EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

Pollutant Load Priority Areas Map





Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed & Subwatersheds
- Areas With High Nitrogen, Phosphorus, and Sediment Loading

Nutrient Loading Scale

High

Low

Exhibit 24

EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

Wetland Restoration and Flood Mitigation Potential

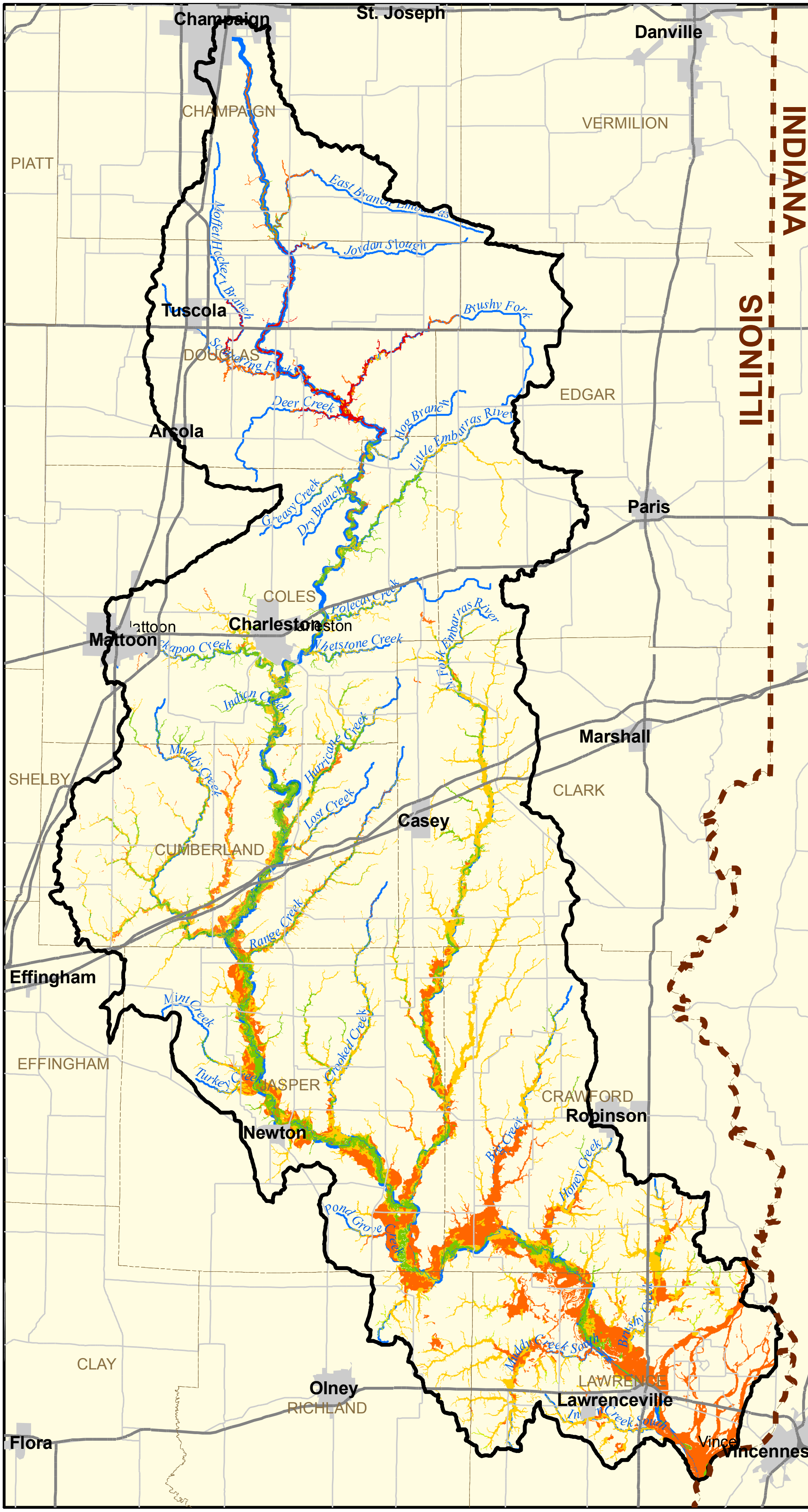
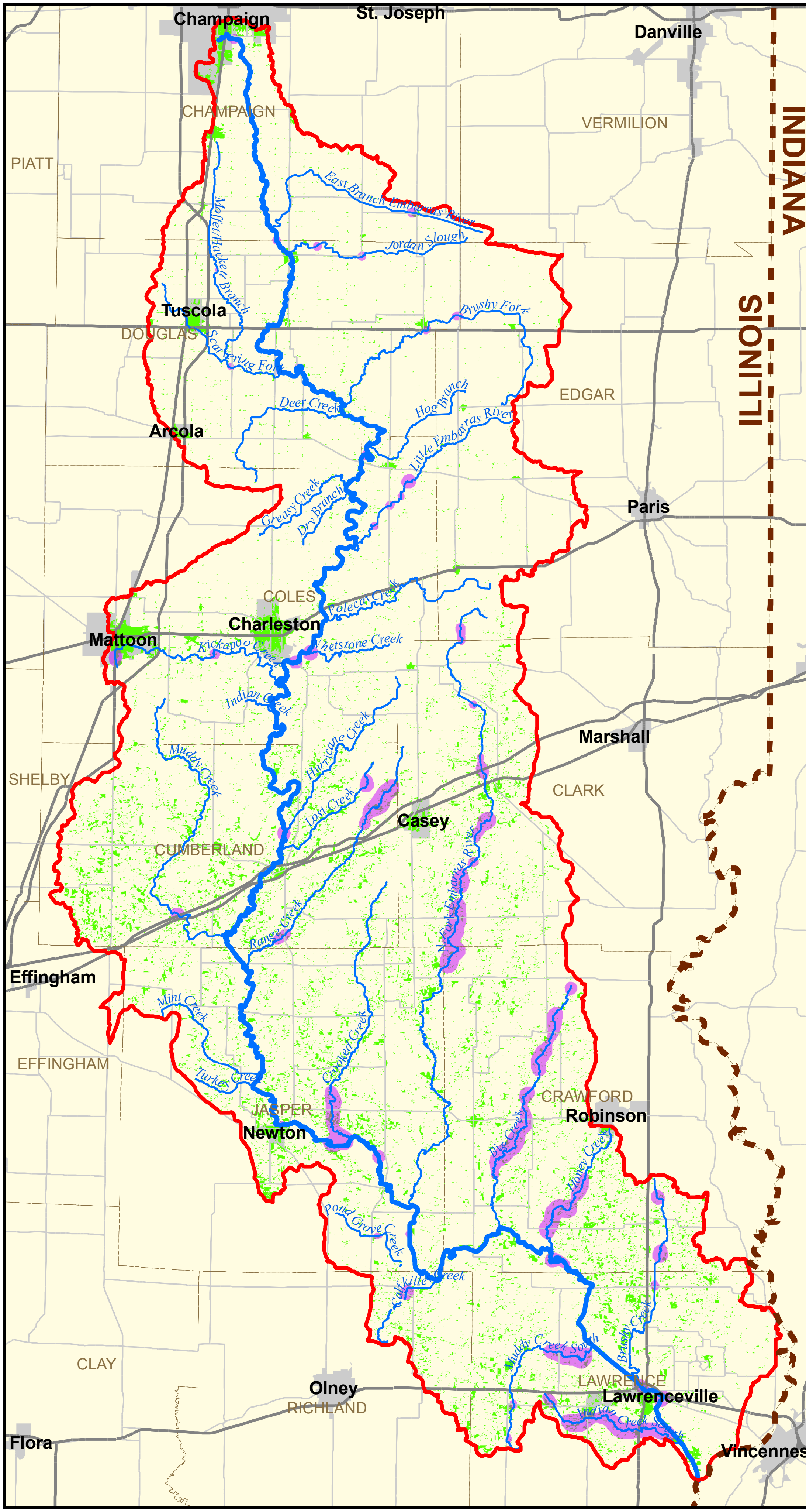
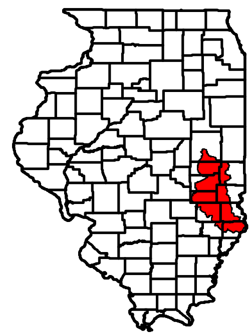


Exhibit 25



Embarras River Watershed

Septic and Fecal Coliform Priority Areas



Legend

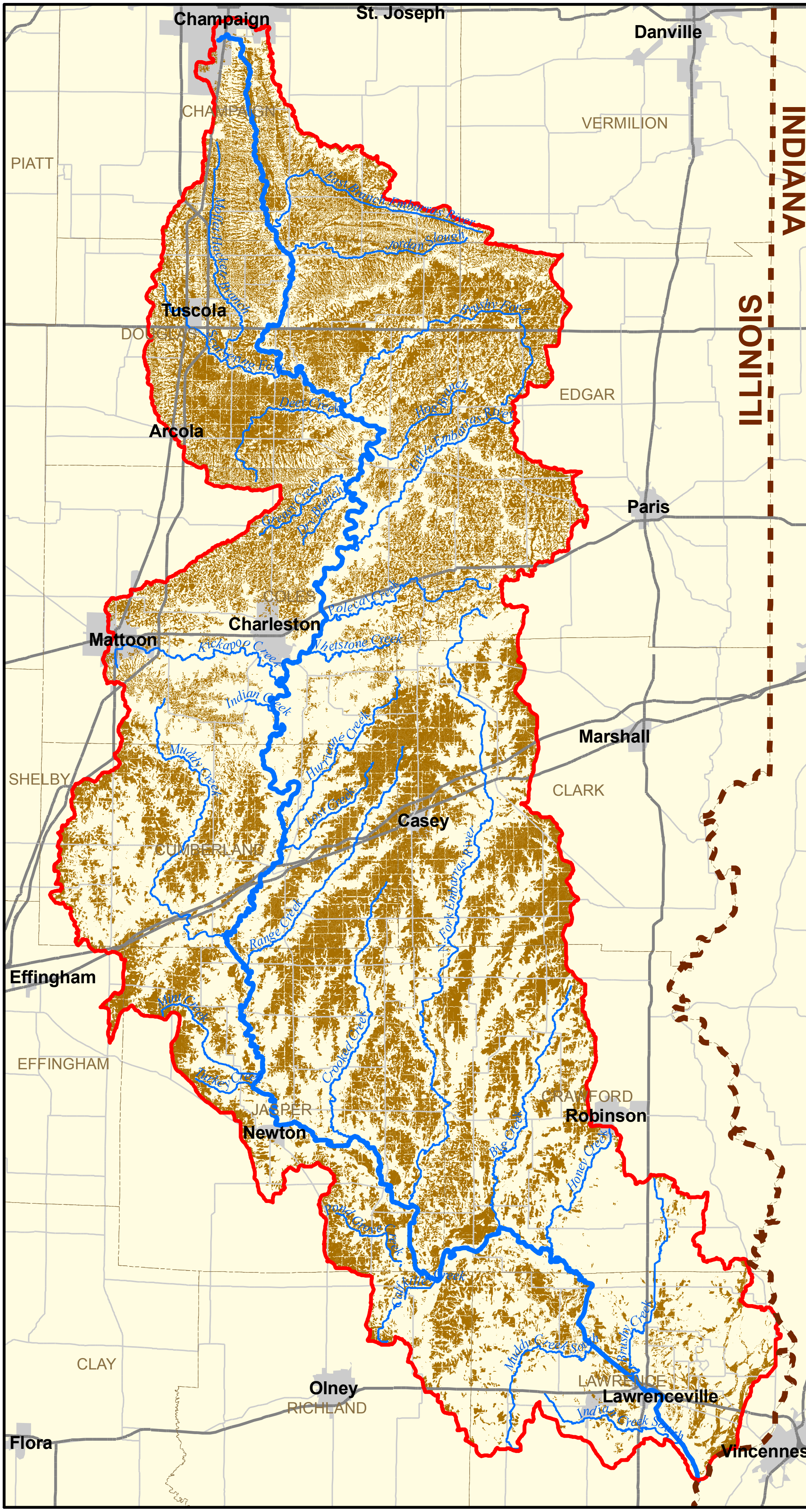
- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed & Subwatersheds
- Septic Density Priority Areas
- Load Model Priority Areas

Exhibit 26

EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

Farmed Hydric Soils Priority Areas



Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed & Subwatersheds
- Farmed Hydric Soils Priority Areas

N W E S

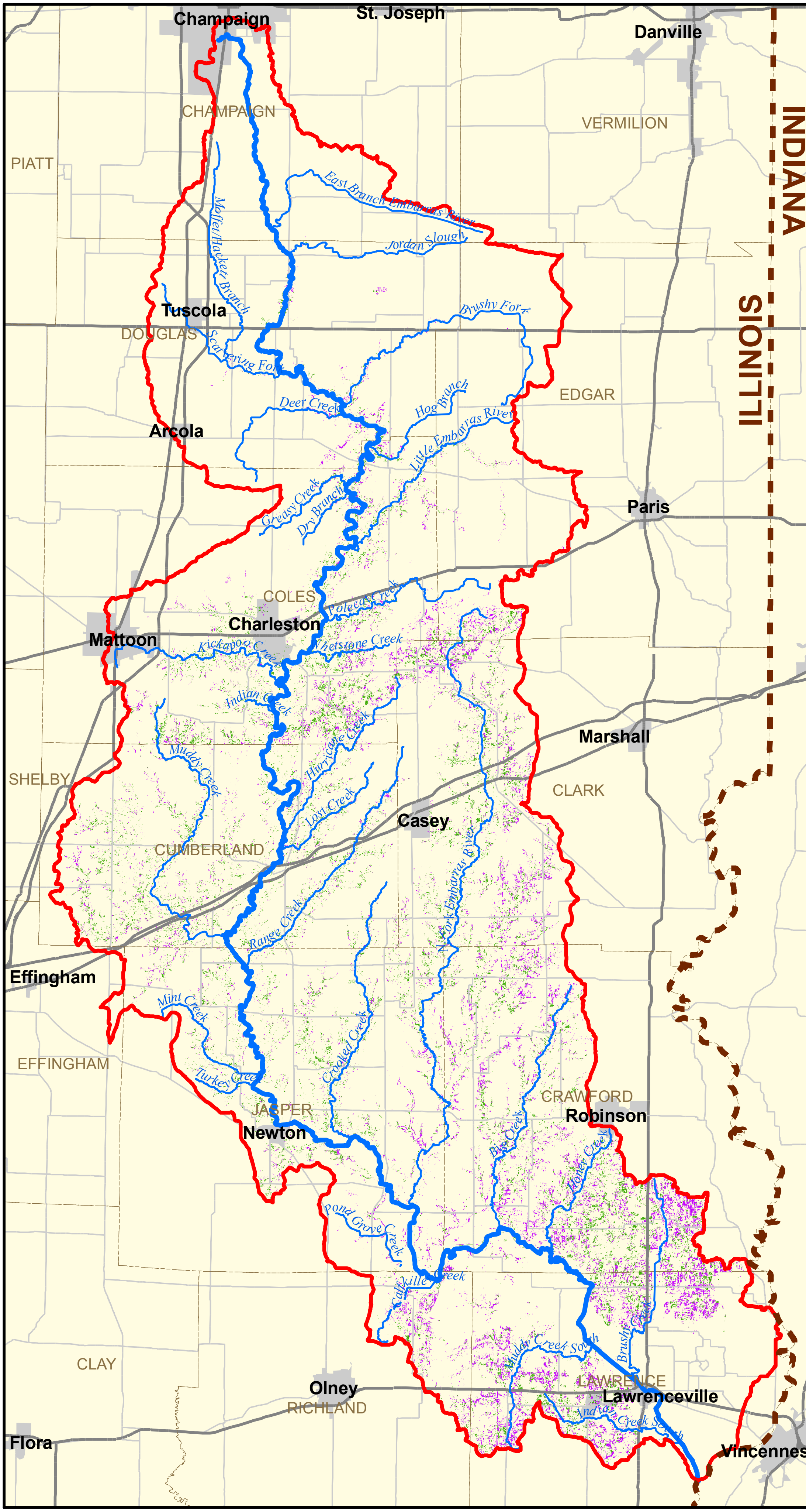
5 0 5 10 Miles

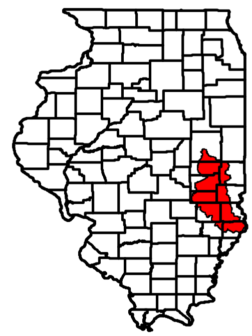
Exhibit 27

EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

Agriculture and Pasture Land Use on Highly Erodible Land Priority Areas





Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed & Subwatersheds
- Highly Erodible Land and Agriculture
- Highly Erodible Land and Pasture

N W E S

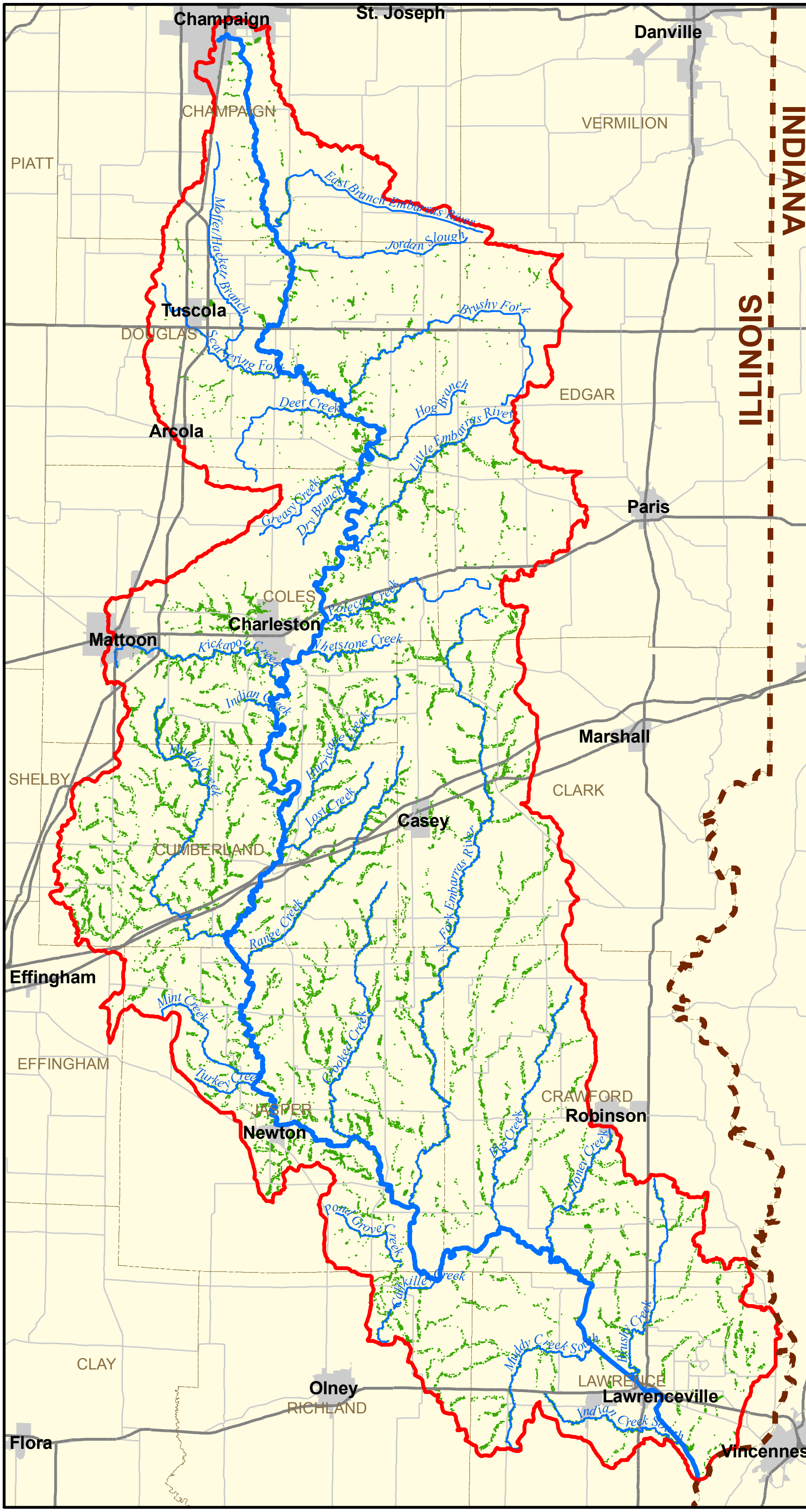
5 0 5 10 Miles

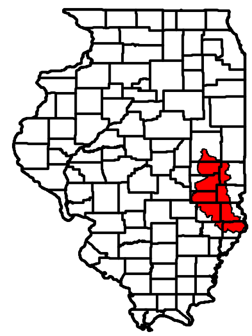
Exhibit 28

EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed

Pasture Land Near Streams Priority Areas





Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras River Watershed & Subwatersheds
- Pasture Land Near Streams Priority Areas

N
W
E
S

5 0 5 10 Miles

Section 7 – Set Goals and Load Reductions

Overview of Load Reduction Goals and Targets

Load reduction goals are utilized in the watershed planning process to provide a numeric reference goal for a watershed plan so that the plan works towards achieving water quality regulatory standards or other water quality standards through the diverse range of flows over the course of a year. Target loads can be set in several ways, including reduction of current loads by a defined percentage or basing the reduction on known water quality guidelines. For the Embarras River watershed, target loads were identified based on known water quality guidelines or standards for each pollutant.

Table 7-1 indicates the water quality targets identified and the source of the target concentration.

Table 7-1: Water Quality Targets

Parameter	Target	Source
Sediment	50 mg/L	US EPA recommendation for good to moderate fisheries for suspended sediment concentration (Range 25-80 mg/L)
Nitrogen	1.8 mg/L	US EPA Ambient Water Quality Recommendations for Nutrient Ecoregion VI (Range 1.16 – 3.26 mg/L)
Phosphorus	0.118 mg/L	US EPA Ambient Water Quality Recommendations for Nutrient Ecoregion VI (Range 0.062 – 0.118 mg/L)
Fecal Coliform	200 CFU/100mL	50% of the Illinois Water Quality Standards, Title 35: Environmental Protection (400 CFU/100mL)

Sediment, nitrogen and phosphorus have recommended water quality target ranges based on US EPA guidance documents and statistical analyses that have been performed for the region to meet water quality standards. The fecal coliform target concentration was set at 50% of the water quality standard based on the results of the existing annual loading as it established an achievable load reduction goal of 11%.

Pollutant Load Reductions

Target Load Reductions

The water quality targets chosen for the Embarras River watershed reference a concentration; therefore a flow rate was needed in order to convert the targets into either lb/year or ton/year for comparison to the calculated current pollutant loadings.

The target concentrations shown in table 7-1 were applied to an average annual flow from the watershed of 1,556 cubic feet per second (cfs). This average annual flow was developed using a GIS based hydrologic model. The estimate of annual flow was then verified with flow statistics from the USGS gaging station number 03346500, located in Lawrenceville.

Table 7-2 below shows the target loads that were calculated and the required reductions to meet these goals.

Table 7-2: Target Load Reductions				
Parameter	Total Current Loading	Target Loading Concentration	Load	Reduction
Sediment (ton/yr)	612,684	50 mg/L	419,379	193,305 (32%)
Nitrogen (lb/yr)	6,632,514	1.8 mg/L	5,510,641	1,121,873 (17%)
Phosphorus (lb/yr)	1,336,411	0.118 mg/L	361,253	975,158 (73%)
Fecal Coliform (CFU in billions/yr)	3,115,237	200 (CFU/100mL)	2,780,000	335,237 (11%)

Interim Load Reduction Goals

Since the overall reduction goals are significant, interim goals were also developed to aid in the progress measurement of plan implementation. The overall reduction goals represent a 20-year timeline; therefore interim goals were identified for the 5-year and 10-year timeframes. Table 7-3 identifies the interim load reduction goals.

Table 7-3: Interim Target Load Reductions				
Parameter	Total Current Loading	5-Year Target Load (10% of Total Reduction)	10-Year Target Load (40% of Total Reduction)	20-Year Target Load
Sediment (ton/yr)	612,684	593,354	535,362	419,379
Nitrogen (lb/yr)	6,632,514	6,520,327	6,183,765	5,510,641
Phosphorus (lb/yr)	1,336,411	1,238,895	946,348	361,253
Fecal Coliform (CFU in billions/yr)	3,115,237	3,081,713	2,981,142	2,780,000

Goal Statements

Based on the identified concerns and pollutant loading analysis, goal statements were developed for each problem statement. Implementation of policies and programs to meet these goal statements will improve watershed management in the Embarras River Watershed. The goal statements indicate the ultimate goal for a specific project. In some cases this goal may not be attainable in the short term; therefore there is also a list objectives included with each goal. The goal statements themselves are typically the overall long term goal. It should be noted that some objectives may relate to several goal statements, they are listed in each applicable category.

Flooding

Problem Statement: Excessive flow rates and volumes of water are causing damage and loss within the Embarras River Watershed.

Goal Statement: Reduce flood damage in the Embarras River Watershed.

Objectives:

- Protect and restore floodplain function.
- Maintain and manage the river corridor and other drainage ways to preserve conveyance of stormwater.
- Reduce flow rates and volumes from existing developed areas and prevent increases in flow rates and volumes from new development.
- Mitigate flood damages using both remedial and preventative measures.

Erosion/Water Quality

Problem Statement: Soil erosion and sedimentation within the watershed is degrading the water quality/quantity and limiting the aesthetics, wildlife habitat, and aquatic health of the streams within the watershed. Agriculture and typical urban area practices within the watershed contribute a significant amount of pollutants, thereby contributing to the frequent exceedances of water quality targets.

Goal Statement: Protect and improve water quality in the Embarras River Watershed.

Objectives:

- Reduce nonpoint pollutant loadings from runoff to meet load reduction targets.
- Reduce streambank and agricultural erosion.
- Protect and restore riparian greenways and buffers along water resources.
- Educate the stakeholders on the importance of reduced application or correct timing of fertilizer use
- Promote and implement agricultural BMPs that will reduce nutrient levels in the watershed (e.g. alternative watering systems, buffer/filter strips, exclusionary fencing, conservational tillage, reforestation, stream restoration, wetland restoration, etc.)
- Promote and implement urban BMPs that will reduce nutrient levels in the watershed (e.g. filtration basins, pervious pavement, bioretention practices, etc.)
- Educate and work with point discharges (CFOS, NPDES permitted facilities) to reduce their nutrient loads
- Establish a monitoring program or group to collect samples

Wetland, Wildlife and Natural Character

Problem Statement: Impacts to the natural resources of the watershed are degrading the quality and amount of wetlands, wildlife habitat and recreational opportunities.

Goal Statement: Protect and enhance natural resources and provide associated recreational opportunities.

Objectives:

- Protect and restore wetlands and streams to improve water quality and aquatic habitat.
- Protect and enhance plant communities and wildlife habitat and biodiversity.
- Identify potential wetland restoration areas.
- Protect and restore riparian greenways and buffers along water resources.

- Identify and develop potential areas for river-based recreational opportunities such as hiking, canoeing, fishing, running, biking, etc.

Information and Public Communication

Problem Statement: Stakeholders in the Embarras River Watershed are not knowledgeable about their daily impact on the watershed and its water quality.

Goal Statement: Develop and implement an education and outreach program within the watershed.

Objectives:

- Effectively share and communicate past, current and future activities within the watershed
- Educate stakeholders within the watershed on the function of a watershed and their impacts to water quality
- Coordinate efforts with local outreach groups and any other education and outreach efforts being conducted within the watershed
- Utilize examples or pilot programs/demonstration projects for educational purposes

Section 8 – Watershed Wide Implementation

Although the watershed planning committee chose eight priority subwatersheds (section 9) to focus in on due to the large scale of the watershed, implementation is needed and encouraged for the entire watershed. This section details some of the implementation and project type recommendations that can be applied to the diverse character of the watershed.

This WMP provides many tools and identified priority areas that can be used by watershed stakeholder to identify potential project locations and priority areas throughout the watershed. Section 6 identifies many of the exhibits and spatial analysis that have been performed to assist in implementing projects throughout the watershed.

Recommended Best Management Practice Types

Due to the significance of both nonpoint sources and point sources within the watershed, an implementation strategy needs be developed to address both sources of pollutants. This section addresses nonpoint sources through the application of watershed Best Management Practices (BMPs). Strategies to address reducing point source pollutant loads are addressed in section 4.

The watershed restoration and management techniques described in this section, when applied to the Embarras River watershed, can help achieve the watershed goals and objectives to decrease the concentrations of sediment, nutrient loads, and flooding identified in this plan. The selected measures and BMPs for improvement are categorized as Agricultural/Rural and Urban BMPs as well as Preventative Measures. While not all of the BMPs are being recommended at this point in the plan preparation, these BMPs may become important to have incorporated into the plan as the plan is updated and for future implementation opportunities.

The following BMP summaries are typical BMPs and are provided as a reference and generally describe each measure and its design components, it is not meant to be all inclusive list but only a guide. To choose an appropriate BMP, it is essential to determine in advance the objectives to be met by the BMP and to calculate the cost and related effectiveness of alternative BMPs. Once a BMP has been selected, expertise is needed to insure that the BMP is properly installed, monitored, and maintained over time.

Agricultural/Rural BMPs

Agricultural/Rural BMPs are implemented on agricultural lands for the purpose of protecting water resources, protecting aquatic wildlife habitat, and protecting the land resource from degradation. These practices control the delivery of nonpoint source pollutants to receiving water resources by first minimizing the pollutants available.

Agricultural/Rural BMPs include:

- Alternative Watering System
- Buffer/Filter Strips
- Cover Crops
- Grassed Waterways

- Infiltration Trenches
- No-Till/Reduced Till (Conservation Tillage)
- Nutrient/Waste Management
- Rotational Grazing/Exclusionary Fencing
- Two Stage Ditches
- Stream Restoration
- Wetland Restoration
- Reforestation

Alternative Watering System

Alternative watering systems (e.g. nose pumps or gravity flow systems) protect surface water by eliminating livestock's direct access to the stream. Providing an alternative watering source for livestock reduces soil erosion and sedimentation and improves surface water quality by reducing *E. coli* concentrations and nutrient loading. Alternative watering systems help to provide additional bank stabilization and assist in the preservation of riparian buffers through a reduction in compaction.

Buffer/Filter Strips

Creating and maintaining buffers along stream and river channels and lakeshores increases open space and can reduce some of the water quality and habitat degradation effects associated with increased imperviousness and runoff in the watershed. Buffers provide hydrologic, recreational, and aesthetic benefits as well as water quality functions, and wildlife habitat. TSS, phosphorus, and nitrogen are at least partly removed from water passing through a naturally vegetated buffer. *E. coli* concentrations are also reduced with buffers. The percentage of pollutants removed depends on the pollutant load, the type of vegetation, the amount of runoff, and the character of the buffer area. The most effective buffer width can vary along the length of a channel. Adjacent land uses, topography, runoff velocity, and soil and vegetation types are all factors used to determine the optimum buffer width. Buffers need to be a minimum of 30 feet wide to be eligible for most USDA programs. The greater the width of the buffer, the pollutant removal efficiency will be greater. Education is important in teaching farmers what options they have for funding. Several state and federal programs exist to provide incentives for maintaining riparian buffers. The Wetlands Reserve Program (WRP) makes funding available for the purchase and restoration of wetlands and riparian buffer connections between wetlands.

A filter strip is an area of permanent herbaceous vegetation situated between environmentally sensitive areas and cropland, grazing land, or otherwise disturbed land. Filter strips reduce TSS, particulate organic matter, sediment adsorbed contaminants, and dissolved contaminant loadings in runoff to improve water quality. Filter strips also restore or maintain sheet flow in support of a riparian forest buffer, and restore, create, and enhance herbaceous habitat for wildlife and beneficial insects.

Filter strips should be permanently designated plantings to treat runoff and should not be part of the adjacent cropland's rotation. Overland flow entering the filter strip should be primarily sheet flow. If there is concentrated flow, it should be dispersed so that it creates sheet flow. Filter strips cannot be installed on unstable channel banks that are eroding due to undercutting of the toe bank. Permanent herbaceous vegetation should consist of a single species or a mixture of grasses, legumes and/or other forbs (an herbaceous plant other than a grass) adapted to the soil, climate, and farm chemicals used in adjacent cropland. Filter strips must be properly maintained so that they function properly.

Filter strips should be located to reduce runoff and increase infiltration and groundwater recharge throughout the watershed. Filter strips should also be strategically placed to intercept contaminants, thereby enhancing the water quality in the watershed. Filter strip sizes should be adjusted to accommodate planting, harvesting, and maintenance equipment. Filter strip widths greater than that needed to achieve a 30 minute flow-through time at ½-inch depth will not likely improve the effectiveness of the strip in addressing water quality concerns created by TSS, particulate organics, and sediment adsorbed contaminants. Like buffers; filter strips decrease TSS and nutrient loading, reduce *E. coli* concentrations, and increase open space. Education will help to teach farmers where these practices should be applied and sources of possible funding. Implementation of filter strips is part of the Conservation Reserve Program and assistance may be provided to eligible projects.

Cover Crops

Cover crops can be legumes or grasses, including cereals, planted or volunteered vegetation established prior to or following a harvested crop primarily for seasonal soil protection and nutrient recovery. Cover crops protect soil from erosion decreasing sediment concentrations in the creek and recover/recycle phosphorus in the root zone. They are grown seasonally.

Cover crops are established during the non-crop period, usually after the crop is harvested, but can be interseeded into a crop before harvest by aerial application or cultivation. Cover crops reduce phosphorus transport by reducing soil erosion and runoff. Both wind and water erosion move soil particles that have phosphorus attached. Sediment that reaches water bodies may release phosphorus into the water. The cover crop vegetation recovers plant-available phosphorus in the soil and recycles it through the plant biomass for succeeding crops. The soil tilth also benefits from the increase of organic material added to the surface. Growing vegetation promotes infiltration, and roots enhance percolation of water supplied to the soil. This reduces surface runoff. Runoff water can wash soluble phosphorus from the surface soil and crop residue and carry it off the field.

Grassed Waterways

Grassed waterways are natural or constructed channels established for transport of concentrated flow at safe velocities using adequate channel dimensions and proper vegetation. They are generally broad and shallow by design to move surface water across farmland without causing soil erosion. Grassed waterways are used as outlets to prevent rill and gully formation. The vegetative cover slows the water flow, minimizing channel surface erosion. When properly constructed, grassed waterways can safely transport large water flows downslope. These waterways can also be used as outlets for water released from contoured and terraced systems and from diverted channels. This BMP can reduce sediment concentrations of nearby waterbodies and pollutants in runoff. The vegetation improves the soil aeration and water quality due to its nutrient removal through plant uptake and absorption by soil. The waterways can also provide wildlife corridors and allows more land to be natural areas.

Infiltration Trenches

Infiltration trenches are excavated trenches backfilled with a coarse stone aggregate and biologically active organic matter. Infiltration trenches allow temporary storage of runoff in the void space between the aggregate and help surface runoff infiltrate into the surrounding soil. Phosphorus from agricultural areas is primarily from animal manure either directly washing into streams and rivers or washing off from farm fields. Soil infiltration trenches can be especially beneficial as concrete feed-lots, barns, confined livestock areas, CFOs, and other agricultural areas can carry excess food and waste materials towards the adjacent stream through stormwater runoff. Installing soil infiltration trenches where runoff is concentrated will maximize the benefit of contaminant removal.

No-till/Reduced Till Conservation Practices

This practice manages the amount, orientation, and distribution of crop and other plant residues on the soil surface year-round, while growing crops planted in narrow slots or tilled, residue free strips previously untilled by full-width inversion implements. The purpose of this conservation practice is to reduce sheet and rill erosion thereby promoting improved water quality by reducing sediment and nutrient loading in the waterways. Additional benefits of this practice are to reduce wind erosion, to maintain or improve soil organic matter content and tilth, to conserve soil moisture, to manage snow, to increase plant available moisture or reduce plant damage from freezing or desiccation, and to provide food and escape cover for wildlife. This technique includes tillage and planting methods commonly referred to as no-till, zero till, slot plant, row till, direct seeding, or strip till.

Residue management is when loose residues are left on the field, and then uniformly distributed on the soil surface to minimize variability in planting depth, seed germination, and emergence of subsequently planted crops. When combines or similar machines are used for harvesting, they are equipped with spreaders capable of distributing residue over at least 80% of the working width. No-till or strip till may be practiced continuously throughout the crop sequence, or may be managed as part of a system which includes other tillage and planting methods such as mulch till. Production of adequate amounts of crop residues is necessary for the proper functioning of this conservation practice and can be enhanced by selection of high residue producing crops and crop varieties in the rotation, use of cover crops, and adjustment of plant populations and row spacing.

Maintaining a continuous no-till system will maximize the improvement of soil organic matter content. Also, when no-till is practiced continuously, soil reconsolidation provides additional resistance to sheet and rill erosion. The effectiveness of stubble to trap snow or reduce plant damage from freezing or desiccation increases with stubble height. Variable height stubble patterns may be created to further increase snow storage.

Nutrient/Waste Management

Nutrient management is the management of the amount, source, placement, form, and timing of the application of plant nutrients and soil amendments to minimize the transport of applied nutrients into surface water or groundwater. Nutrient management seeks to supply adequate nutrients for optimum crop yield and quantity, while also helping to sustain the physical, biological, and chemical properties of the soil.

Nutrient management plans are generally developed with assistance from NRCS. A nutrient budget for nitrogen, phosphorus, and potassium is developed considering all potential sources of nutrients including, but not limited to, animal manure, commercial fertilizer, crop residue, and legume credits. Realistic yields are based on soil productivity information, potential yield, or historical yield data based on a 5-year average. Nutrient management plans specify the form, source, amount, timing, and method of application of nutrients on each field in order to achieve realistic production levels while minimizing transport of nutrients to surface and/or groundwater.

Animal waste is a major source of pollution to waterbodies. To protect the health of aquatic ecosystems and meet water quality targets, manure must be safely managed. Good management of manure keeps livestock healthy, returns nutrients to the soil, improves pastures and gardens, and protects the environment, specifically water quality. Poor manure management may lead to sick livestock, unsanitary and unhealthy conditions for humans and other organisms, and increased insect and parasite populations. Proper management of animal waste can be done by implementing BMPs, through safe storage, by application as a fertilizer, and through composting. Proper manure management can effectively reduce *E. coli* concentrations, nutrient levels and sedimentation. Manure management can also be addressed in education and outreach to encourage farmers to participate in this BMP.

Rotational Grazing and Exclusionary Fencing

Rotational grazing management is the division of pastures into multiple cells that receive a short but intensive grazing period followed by a period of recovery of the vegetative cover. Pasture management practices that include the use of rotational grazing systems are beneficial for water and soil quality. Systems that include the riparian area as a separate pasture are beneficial because livestock access to these areas is controlled to limit the impact on the riparian plant communities.

The impacts of livestock grazing within riparian areas include manure and urine deposited directly into or near surface waters where leaching and runoff can transport nutrients and pathogens into the water. Unmanaged grazing may accelerate erosion and sedimentation into surface water, change stream flow, and destroy aquatic habitats. Improper grazing can reduce the capacity of riparian areas to filter contaminates, shade aquatic habitats, and stabilize stream banks.

A livestock exclusion system is a system of permanent fencing (board, barbed, etc) installed to exclude livestock from streams and areas, not intended for grazing. This will reduce erosion, sediment, and nutrient loading, and improve the quality of surface water. Education and outreach programs focusing on rotational grazing and exclusionary fencing are important in the success of this BMP.

Two Stage Ditches

Water, when confined to a channel such as a stream or ditch, has the potential to cause great destruction. If there is too much water moving through an undersized area of land, then there is nowhere for it to go but to rush out of its barriers. Bank erosion, scouring, and flooding are good indicators that there is a problem with how the water is drained from the soil. Researchers have been working on a type of in-stream restoration called the two-stage ditch that has proven to help solve these problems.

The design of a two-stage ditch incorporates a floodplain zone, called benches, into the ditch by removing the ditch banks roughly 2-3 feet about the bottom for a width of about 10 feet on each side. This allows the water to have more area to spread out on and decreases the velocity of the water. This not only improves the water quality, but also improves the biological conditions of the ditches where this is located.

The benefits of a two-stage ditch over the typical agricultural ditch include both improved drainage function and ecological function. The two-stage design improves ditch stability by reducing water flow and the need for maintenance, saving both labor and money. It also has the potential to create and maintain better habitat conditions. Better habitats for both terrestrial and marine species are a great plus when it comes to the two-stage ditch design. The transportation of sediment and nutrients is decreased considerably because the design allows the sorting of sediment, with finer silt depositing on the benches and courser material forming the bed.

Stream Restoration

Stream restoration techniques are used to improve stream conditions so they more closely mimic natural conditions. For urban stream reaches, restoration to natural conditions may not be possible or feasible. For instance, physical constraints due to adjacent development may limit the ability to re-meander a stream. In addition, the natural stream conditions may not be able to accommodate the increased volume of flow from the developed watershed.

Even in cases where restoring the stream to its natural condition is not possible, the stream can still be naturalized and improved by reestablishing riparian buffers, performing stream channel maintenance, stabilizing streambanks using bioengineering techniques, and, where appropriate, by removing manmade dams and installing pool/riffle complexes. Stream restoration projects may be one component of floodplain restoration projects, and can be supplemented with trails and interpretive signs, providing recreational and educational benefits to the community.

Wetland Restoration

Because agriculture and urbanization have degraded many of the wetlands in the Embarras River watershed, wetland enhancement projects are necessary to improve the diversity and function of these degraded wetlands. The term enhancement refers to improving the functions and values of an existing wetland. Converted wetland/field sites (or sites that were formerly wetlands but have now been converted to other uses) can also be restored to provide many of their former wetland benefits. Wetland restoration is the process of establishing a wetland on a site that is not currently a wetland, but once was prior to conversion. Wetlands have the ability to reduce *E. coli* concentrations, nutrient loading, TSS concentrations, and flood damage. Wetlands can be used to teach landowners about their importance with respect to plants and animals and also increases the amount of open space in the watershed.

Wetland functional values vary substantially from wetland to wetland; they receive special consideration because of the many roles they play. Because of the wetland protection laws currently in place, the greatest impact on wetlands from future development will likely be a shift in the types of wetlands. Often in mitigation projects, various types of marshes, wet prairies, and other wetlands are filled and replaced elsewhere, usually with existing open water wetlands. This replacement may lead to a shift in the values served by the wetland communities due to a lack of diversity of wetland types. The wetland restorations that are proposed should include a variety of different wetland types to increase the diversity of wetlands in the watershed. The restoration of wetlands can decrease flood damage by providing new stormwater storage areas, will improve water quality by treating stormwater runoff, and will create new plant and wildlife habitat. In addition to these values, wetlands can be part of regional greenways or trail networks. They can be constructed with trails to allow the public to explore them more easily, and they can be used to educate the public through signs, organized tours, and other techniques. Wetland restorations are an exceptional way to meet multiple objectives within a single project.

Reforestation

Reforestation is the restocking of existing forests and woodlands which have been depleted. Reforestation can be used to improve the quality of human life by soaking up pollution and dust from the air and rebuild natural habitats and ecosystems.

Urban BMPs

For the past two decades the rate of land development across the country has been more than two times greater than the rate of population growth. The increased impervious surface associated with this development will increase stormwater volume and degrade water quality, which will harm the overall watershed.

The best way to mitigate stormwater impacts from new developments is to use Urban BMPs to treat, store, and infiltrate runoff onsite before it can affect water bodies downstream. Innovative site designs that reduce imperviousness and smaller-scale low impact development practices dispersed throughout a site are excellent ways to achieve the goals of reducing flows and improving water quality.

The Urban BMPs include:

- Bioretention Practices
- Filtration Basin
- Naturalized Detention Basin
- Naturalized Stream Buffer
- Pervious Pavement
- Rain Barrels/Gardens
- Infiltration Trench
- Stream Restoration

Bioretention Practices

Bioretention practices (including bioinfiltration or biofiltration) are primarily used to filter runoff stored in shallow depressions by utilizing plant uptake and soil permeability. This practice utilizes combinations of flow regulation structures, a pretreatment grass channel or other filter strip, a sand bed, a pea gravel overflow treatment drain, a shallow ponding area, a surface organic mulch layer, a planting soil bed, plant material, a gravel underdrain system, and an overflow system to promote infiltration. Bioinfilitration systems such as swales are used to treat stormwater runoff from small sites such as driveways, parking lots, and roadways. They provide a place for stormwater to settle and infiltrate into the ground. Biofiltration swales are a relatively low cost means of treating stormwater runoff for small sites typifying much of the urban environment, such as parking, roadways, driveways, and similar impervious features. They provide areas for stormwater to slow down and pollutants to be filtered out. Careful attention to location and alignment of swales can lend a pleasing aesthetic quality to sites containing them.

In general, bioretention practices are highly applicable to residential uses in community open space or private lots. The bioretention system is very appropriate for treatment of parking lot runoff, roadways where sufficient space accommodates off-line implementation, and pervious areas such as golf courses. This BMP is not recommended for highly urbanized settings where impervious surfaces comprise 95% or more of the area due to high flow events and limited storage potential. This BMP can address most of the WMP goals including; reducing concentration of sediments and nutrients. Bioretention practices can also decrease flooding by storing stormwater and increase open space.

Filtration Basin

Filtration basins provide pollutant removal (including TSS, nutrients, and *E. coli*) and reduce volume of stormwater released from the basin. These basins utilize sand filters or engineered soils to filter stormwater runoff through a sand or engineered soil layer within an underdrain system that conveys the treated runoff to a detention facility or to the ultimate point of discharge. The filtration system consists of an inlet structure, sedimentation chamber, sand/engineered soil layer, underdrain piping, and liner to protect against infiltration.

Naturalized Detention Basins

Naturalized wet-bottom detention basins are used to temporarily store runoff and release it at a reduced rate. Naturalized wet-bottom detention basins are better than traditional detention basins because they encourage water infiltration, and thereby recharge groundwater tables. Native wetland and prairie vegetation also help to improve water quality by trapping sediment and other pollutants found in runoff, and are aesthetically pleasing. Naturalized wet-bottom detention basins can be designed as either shallow marsh systems with little or no open water or as open water ponds with a wetland fringe and prairie side slopes.

Naturalized Stream Buffer

Creating and maintaining buffers along stream and river channels and lakeshores increases open space and can reduce some of the water quality and habitat degradation effects associated with increased imperviousness and runoff in the watershed. Buffers provide hydrologic, recreational, and aesthetic benefits as well as water quality functions, and wildlife habitat. Sediment, phosphorus, and nitrogen are at least partly removed from water passing through a naturally vegetated buffer. The percentage of pollutants removed depends on the pollutant load, the type of vegetation, the amount of runoff, and the character of the buffer area. The most effective buffer width can vary along the length of a channel. Adjacent land uses, topography, runoff velocity, and soil and vegetation types are all factors used to determine the optimum buffer width. Buffers need to be a minimum of 30 feet wide to be eligible for most USDA programs. Other specific requirements for regulated drains should be determined during the feasibility stages of utilizing this practice.

Pervious Pavement

Pervious pavement has the approximate strength characteristics of traditional pavement but allows rainfall and runoff to percolate through it. This decreases sediment concentrations and flood damage in the watershed by slowing the water from entering the streams. The key to the design of these pavements is the elimination of most of the fine aggregate found in conventional paving materials. Pervious pavement options include porous asphalt and pervious concrete. Porous asphalt has coarse aggregate held together in the asphalt with sufficient interconnected voids to yield high permeability. Pervious concrete, in contrast, is a discontinuous mixture of Portland cement, coarse aggregate, admixtures, and water that also yields interconnected voids for the passage of air and water. Underlying the pervious pavement is a filter layer, a stone reservoir, and filter fabric. Stored runoff gradually drains out of the stone reservoir into the subsoil.

Modular pavement consists of individual blocks made of pervious material such as sand, gravel, or sod interspersed with strong structural material such as concrete. The blocks are typically placed on a sand or gravel base and designed to provide a load-bearing surface that is adequate to support personal vehicles, while allowing infiltration of surface water into the underlying soils. They usually are used in low-volume traffic areas such as overflow parking lots and lightly used access roads. An alternative to pervious and modular pavement for parking areas is a geotextile material installed as a framework to provide structural strength. Filled with sand and sodded, it provides a completely grassed parking area.

Rain Barrels/Gardens

A rain barrel is a container that collects and stores rainwater from your rooftop (via disconnected downspouts) for later use on lawn, garden, or other outdoor uses. Rainwater stored in rain barrels can be useful for watering landscapes, gardens, lawns, and trees. Rain is a naturally soft water and devoid of minerals, chlorine, fluoride, and other chemicals. In addition, rain barrels help to reduce peak volume and velocity of stormwater runoff to streams and storm sewer systems.

Rain gardens are small-scale bioretention systems that be can be used as landscape features and small-scale stormwater management systems for single-family homes, townhouse units, and some small commercial development. These units not only provide a landscape feature for the site and reduce the need for irrigation, but can also be used to provide stormwater depression storage and treatment near the point of generation. These systems can be integrated into the stormwater management system since the components can be optimized to maximize depression storage, pretreatment of the stormwater runoff, promote evapotranspiration, and facilitate groundwater recharge. The combination of these benefits can result in decreased flooding due to a decrease in the peak flow and total volume of runoff generated by a storm event. In addition, these features can be designed to provide a significant improvement in the quality of the stormwater runoff. These units can also be integrated into the design of parking lots and other large paved areas, in which case they are referred to as bioretention areas.

Infiltration Trenches

Infiltration trenches are excavated trenches backfilled with a coarse stone aggregate and biologically active organic matter. Infiltration trenches allow temporary storage of runoff in the void space between the aggregate and help surface runoff infiltrate into the surrounding soil. Infiltration trenches remove fine sediment and the pollutants associated with them. Soil infiltration trenches can be effective at reducing sediment concentrations and nutrient loading. Soluble pollutants can be effectively removed if detention time is maximized. The degree to which soluble pollutants are removed is dependent primarily on holding time, the degree of bacterial activity, and chemical bonding with the soil. The efficiency of the trench to remove pollutants can be increased by increasing the surface area of the trench bottom. Infiltration trenches can provide full control of peak discharges for small sites. They provide groundwater recharge and may augment base stream flow.

Stream Restoration

Stream restoration techniques are used to improve stream conditions so they more closely mimic natural conditions. For urban stream reaches, restoration to natural conditions may not be possible or feasible. For instance, physical constraints due to adjacent development may limit the ability to re-meander a stream. In addition, the natural stream conditions may not be able to accommodate the increased volume of flow from the developed watershed.

Even in cases where restoring the stream to its natural condition is not possible, the stream can still be naturalized and improved by reestablishing riparian buffers, performing stream channel maintenance, stabilizing streambanks using bioengineering techniques, and, where appropriate, by removing manmade dams and installing pool/riffle complexes. Stream restoration projects may be one component of floodplain restoration projects, and can be supplemented with trails and interpretive signs, providing recreational and educational benefits to the community.

Preventative Measures

The Preventative Measures section is provided as potential recommendations for education and outreach focused implementation. These BMPs encourage planning to reduce water quality impacts prior to the start of a project and ongoing maintenance/practices to reduce water quality impacts from municipal operations.

Conservation Design Developments

The goal of conservation design development is to protect open space and natural resources for people and wildlife, while at the same time allowing development to continue. Conservation design developments designate half or more of the buildable land area as undivided permanent open space. They are density neutral, allowing the same density as in conventional developments, but that density is realized on smaller areas of land by clustering buildings and infrastructure. In addition to clustering, conservation design developments incorporate natural riparian buffers and setbacks for streams, wetlands, other waterbodies, and adjacent agricultural.

The first and most important step in designing a conservation development is to identify the most essential lands to preserve in conservation areas. This will require coordination with local officials and the community as this practice is commonly added into ordinances and future planning efforts. Natural features including streams, wetlands, lakes, steep slopes, mature woodlands, native prairie, and meadow (as well as significant historical and cultural features) are included in conservation areas. Clustering is a method for preserving these areas. Clustered developments allow for increased densities on less sensitive portions of a site, while preserving the remainder of the site in open space for conservation and recreational uses (such as trails, soccer or ball fields).

Clustering can be achieved in a planned unit development (PUD) or planned residential development (PRD). PUDs contain a mix of zoning classifications that may include commercial, residential, and light industrial uses, all of which are blended together. Well-designed PUDs usually locate residences and offices within walking distance of each other to reduce traffic. Planned residential developments (PRDs) apply similar concepts to residential developments.

Greenways and Trails

Greenways can provide a large number of functions and benefits to nature and the public. For plants and animals, greenways provide habitat, a buffer from development, and a corridor for migration. Greenways located along streams include riparian buffers that protect water quality by filtering sediments and nutrients from surface runoff and stabilizing streambanks. By buffering the stream from adjacent developed land use, riparian greenways offset some of the impacts associated with increased impervious surface in a watershed. Maintaining a good riparian buffer can mitigate the negative impacts of approximately 5% additional impervious surface in the watershed.

Greenways also provide long, linear corridors with options for recreational trails. Trails along the river provide watershed stakeholders with an opportunity to exercise and enjoy the outdoors. Trails allow users to see and access the river, thereby connecting people to their river and the overall watershed. Trails can also be used to connect natural areas, cultural and historic sites and communities, and serve as a safe transportation corridor between work, school, and shopping destinations.

Techniques for establishing greenways and trails involve the development of a plan that proposes general locations for greenways and trails. In the case of trails, the plan also identifies who the users will be and provides direction on trail standards. Plans can be developed at the community and/or county level, as well as regionally, statewide, and in a few cases, at the national level. Public and stakeholder input are crucial for developing successful greenway and trail plans.

Several techniques can be used for establishing greenways and trails. Greenways can remain in private ownership, they can be purchased, or easements can be acquired for public use. If the lands remain in private ownership, greenway standards can be developed, adopted, and implemented at the local level through land use planning and regulation. Development rights for the greenway can be purchased from private landowners where regulations are unpopular or not feasible.

If the greenways will include trails for public use, the land for trails is usually purchased and held by a public agency such as a forest preserve district or local park system. In some cases, easements will be purchased rather than purchasing the land itself. Usually longer trail systems are built in segments, and completing connections between communities depends heavily on the level of public interest in those communities.

In new developing areas, the local planning authority can require trails. Either the developer or the community can build the trails. In some cases, the developer will voluntarily plan and build a trail connection through the development and use this as a marketing tool to future homebuyers. In other cases, the local planning authority may require the developer to donate an easement for the trail. To install trails through already developed areas, land can be purchased by a community agency with a combination of local, state, and federal funds. Impediments to land purchase can significantly slow up trail connections in already established areas.

Protected Ownership
There are several options for land transfer ranging from donation to fee simple land purchase. Donations can be solicited and encouraged through incentive programs. Unfortunately, while preferred by money-strapped conservation programs, land donations are often not adequate to protect high priority sites. A second option is outright purchase (or fee simple land purchase). Outright purchase is frequently the least complicated and most permanent protection technique, but is also the most costly. A conservation easement is a less expensive technique than outright purchase that does not require the transfer of land ownership but rather a transfer of use rights. Conservation easements might be attractive to property owners who do not want to sell their land at the present time, but would support perpetual protection from further development. Conservation easements can be donated or purchased.

Protecting Open Space and Natural Areas
Several techniques can be used for protecting natural areas and open space in both public and private ownership. The first step in the process is to identify and prioritize properties for protection. The highest priority natural areas should be permanently protected by the ownership or under the management of public agencies or private organizations dedicated to land conservation. Other open space can be protected using conservation design development techniques, and is more likely to be managed by homeowner associations.

Septic Tank Maintenance and Repair
Septic, or on-site waste disposal systems, are the primary means of sanitary flow treatment in the unincorporated parts of the Watershed. Because of the prohibitive cost of providing centralized sewer systems to many areas, septic tank systems will remain the primary means of treatment into the future. Annual maintenance of septic systems is crucial for their operation, particularly the annual removal of accumulated sludge. The cost of replacing failed septic tanks is about $5,000-$15,000 per unit based on industry standards.

Property owners are responsible for their septic systems. When septic systems fail, untreated sanitary flows are discharged into open watercourses that pollute the water and pose a potential public health risk. Septic systems discharging to the ground surface are a risk to public health directly through body contact or contamination of drinking water sources, provide conditions favorable to insect vectors such as flies and mosquitoes, and contribute significant amounts of nitrogen and phosphorus to the watershed. Therefore, it is imperative for homeowners not to ignore septic failures. If plumbing fixtures back up or will not drain, the system is failing. Funding for this practice is limited.

Threatened and Endangered (T&E) Species Protection
Threatened and endangered species are those plant and animal species whose survival is in peril. Both the federal government and the state of Illinois maintain lists of species that meet threatened or endangered criteria within their respective jurisdictions. Threatened species are those that are likely to become endangered in the foreseeable future. Federally endangered species are those that are in danger of extinction throughout all or a significant portion of their range. A state-endangered species is any species that is in danger of extinction as a breeding species in Illinois.

Considerations in protecting endangered species include making sure there is sufficient habitat available - food, water, and "living sites" (For animals, this means areas for making nests and dens and evading predators. For plants, it refers to availability of preferred substrate and other desirable growing conditions.); providing corridors for those species that need to move between sites; and protecting species from impacts due to urbanization.

Several techniques can be used to protect T&E species. One technique is to acquire sites where T&E species occur. Purchase and protection of the site where the species is located (with adequate surrounding buffer) may be sufficient to protect that population. In some instances it is not feasible or possible to buy the needed land. Where the site and buffer area is not available for purchase, where an animal's range is too large of an area (or migrates between sites), or where changes in hydrology or pollution from outside the site affect the species, other techniques must be used to protect the T&E species.

Developing a resource conservation or management plan for the species and habitat of concern is the next step. Resource plans consider the need for buffer areas and habitat corridors, and consider watershed impacts from hydrology changes or pollutant loadings. The conservation plan will include recommendations for management specific to the species and its habitat, whether located on private or public lands. The conservation plan will guide both the property owner and the local unit of government that plans and permits adjacent land uses and how to manage habitat to sustain the species.

Wetland Enhancement and Protection
Wetlands provide a multitude of benefits and functions. Wetlands improve water quality by removing suspended sediment and dissolved nutrients from runoff. They control the rate of runoff discharged from the watershed and reduce flooding by storing rainfall during storm events. Wetlands also provide habitat for plants and animals including many of those that are threatened and endangered.

Because agriculture and urbanization have degraded many of the remaining wetlands in the Watershed, wetland enhancement projects are necessary to improve the diversity and function of these degraded wetlands. The term enhancement refers to improving the functions and values of an existing wetland. Converted wetland/field sites (or sites that were formerly wetlands but have now been converted to other uses) can also be restored to provide many of their former wetland benefits. Wetland restoration is the process of establishing a wetland on a site that is not currently a wetland, but once was prior to conversion. Wetlands have the ability to reduce nutrient loading, sediment concentrations, and flood damage. Wetlands can be used to teach landowners about their importance with respect to plants and animals and also increases the amount of open space in the watershed.

Best Management Practices Load Reductions

Load reduction calculations were estimated for nitrogen, phosphorus and sediment based on the potential BMPs to be implemented within the Embarras River Watershed. The percent reductions for each BMP were based on the review of EPA’s Stormwater Menu of BMPs, EPAs National Management Measures to Control Nonpoint Source Pollution from Agriculture, The Nature Conservancy of Indiana, The Center for Watershed Protection and STEPL. The reductions for the Buffer/Filter strips were obtained from STEPL and the rest of the load reductions were obtained from the studies and information mentioned above.

The BMPs listed are typical BMPs and are provided as a reference, it is not meant to be all inclusive list but only a guide. The reductions only apply to the drainage area that is directly tributary to the BMP implemented. Meaning, a BMP is only effective for the drainage area tributary to it and not the areas of the entire subwatershed. Therefore, when trying to evaluate BMPs and their effectiveness for pollutant removal, the tributary drainage area needs to be evaluated as well.

The actual efficiency of each BMP is based on several variables making it difficult to accurately determine the number required to equal the reduction goals (e.g. the location in the watershed, tributary area, soils, etc), therefore specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind. Table 8-1 shows the expected load reductions and associated costs for each BMP.

The reductions shown in Table 8-1 are based on the tributary drainage area to the BMP. For example, if you have a tributary drainage area that is 1 acre and you install a buffer/filter strip that is 5 acres, you will reduce the loads for that 1 acre tributary drainage area by 65%, 75% and 70% for TSS, P and N respectively. And the approximate cost for the buffer/filter strip will be $25,000 to $50,000 (5 acres * $5,000/acre and $10,000/acre).

Table 8-1: Best Management Practice Load Reduction Summary					
Agricultural/Rural Best Management Practices					
	Estimated Load Reductions				
BMP/Measure	**Sediment**	**Phosphorus**	**Nitrogen**	***Bact***	**Cost**
Alternative Watering System	80%	78%	75%	N/A	$5,000/EA
Buffer/Filter Strips	65%	75%	70%	N/A	$5,000-$10,000/AC
Cover Crops	40%	45%	40%	N/A	$100/AC
Exclusionary Fencing	70%	60%	65%	90%	$50/Ft
Grassed Waterways	80%	30%	40%	N/A	$5,000-$10,000/AC
Nutrient/Waste Management	60%	90%	80%	85%	$5 - $30/AC
Infiltration Trench	100%	45%	45%	N/A	$10,000-$20,000/AC
No-Till/Reduced Till (Conventional Tillage)	75%	45%	55%	N/A	$20/AC
Reforestation	80%	42%	68%	N/A	$750/AC
Rotational Grazing	40%	20%	20%	N/A	N/A
Stream Restoration	75%	75%	75%	N/A	$100-$250/Ft
Two-Stage Ditches	38%	33%	17%	N/A	$15-$20/Ft
Wetland Restoration	80%	55%	45%	80%	$5,000-$10,000/AC
Urban Best Management Practices					
	Estimated Load Reductions				
BMP/Measure	**Sediment**	**Phosphorus**	**Nitrogen**	***Bact***	**Cost**
Bioretention Practices	40%	80%	65%	N/A	$10,000-$20,000/AC
Filtration Basin	75%	65%	60%	N/A	$10,000-$20,000/AC
Naturalized Detention Basin	80%	55%	35%	N/A	$10,000-$20,000/AC
Naturalized Stream Buffer	75%	45%	40%	N/A	$5,000-$20,000/AC
Pervious Pavement	95%	85%	85%	N/A	$2 - $7/Sq. Ft
Rain Barrels	N/A	N/A	N/A	N/A	$75-$300/Each
Rain Garden	80%	20%	20%	N/A	$10,000-$20,000/AC
Stream Restoration	75%	75%	75%	N/A	$100-$250/Ft
Infiltration Trench	100%	45%	45%	N/A	$10,000-$20,000/AC

Stakeholder Led Watershed-Wide Implementation Goals

As introduced in section 2, the Natural Resource Conservation Service (NRCS) and Soil & Water Conservation Districts (SWCDs) from most counties in the watershed held special focused meetings to identify priority resource concerns. These meetings identified and ranked key priority concerns and some counties identified specific project opportunities to address issues. The details of these meetings are included in Appendix C and the highest ranked concerns and project recommendations are included in this plan. Table 8-2 summarizes the watershed-wide implementation goals of the stakeholders.

Table 8-2a: Stakeholder Led Watershed-Wide Implementation Strategy

Parameter	Applications to Achieve Goals	Notes
Sheet/Rill Erosion	Conservation Tillage; Filter Strips; Terraces	Focus on highly erodible land, filter strips along water courses to filter sediment and pollutants
Gully Erosion	Grassed Waterways; Conservation Tillage; Check Dam Structures; WASCBs	Focus on highly erodible lands; pasture and agricultural land use
Livestock Management	Exclusionary fencing, alternate watering systems, waste/nutrient management	Priority should be given to CAFOs near streams and on highly erodible lands
Streambank Erosion	Standard stabilization practices and riparian restoration: Study required to develop prioritized implementation plan	Stakeholders have identified hundreds of miles of streams to be restored; a focused study is required to prioritize streambank erosion projects and develop an implementation plan
Crop Nutrient Management	Nutrient management plans	Approximately 20% of the agricultural land in the watershed targeted
Flood Mitigation and Wetland Restoration	Flood easements, wetland restoration	Measures that address taking cropland out of production to improve flood areas. Prioritize hydric soils and poorly drained areas.
Urban stormwater detention/retention	Detention/retention basins, WASCBs, urban stormwater BMPs	Goal to improve urban stormwater from 5 – 10% of the urban area in the watershed and encourage these practices for future urban development
Invasive Species	Woodland management	Reduce undergrowth in forests
Public Participation and Outreach	Meetings, events, websites, emails, workshops	Meetings/events to promote watershed implementation projects and efforts. Focus on urban areas and urban BMPs
CRP Enrollment	Conservation Reserve Program Enrollment	Increase CRP awareness and enrollment; push for CREP in the watershed
Water Supply	Shoreline stabilization, ravine stabilization, invasive species control, well abandonment	Intent to improve water quality of Charleston Side Channel Reservoir, which is an important water supply and recreational asset.

Table 8-2b: Stakeholder Led Watershed-Wide Implementation Goals (10-Year)									
					Estimated Load Reductions				
Category	Bmp	Amount	Unit	Estimated Costs	Sediment (tons/yr)	Phosphorus (lbs/yr)	Nitrogen (lbs/yr)	Fecal Coliform (CFU in billions/yr)	Priority
AG	Conservation Tillage	30,000	acre	600,000	7,500	21,000	57,000	13,650	High
AG	Cover Crops	2,500	acre	250,000	875	1,750	4,750	1,138	Med
AG	Filter Strip	1,500	acre	7,500,000	825	2,505	4,800	1,628	Low
AG	Grassed Waterway	4,000	acre	12,800,000	3,400	24,800	60,000	16,120	Med
AG	Nutrient Management	80,000	acre	1,760,000	12,000	32,000	224,000	20,800	High
AG	Terrace	45,000	feet	540,000	450	1,800	4,140	1,170	Med
AG	Water and Sediment Control Basin	12,000	feet	132,000	9,600	360	1,440	234	High
AG	Two-Stage Ditch	5,280	feet	105,600	1,584	1,901	4,752	1,236	High
HYDRO	Stream Channel Stabilization	300,000	feet	25,500,000	96,000	108,000	270,000	70,200	Med
HYDRO	Streambank and Shoreline Protection	16,000	feet	352,000	3,200	4,800	13,280	3,120	Med
HYDRO	Wetland Restoration	1,800	acre	3,283,200	3,240	28,800	99,000	18,720	High
LIVESTOCK	Fencing	18,000	feet	900,000	900	7,200	19,800	4,680	High
LIVESTOCK	Planned Grazing Systems	800	acre	16,000	8	480	880	312	Med
LIVESTOCK	Runoff Management System	12	#	60,000	90	360	1,260	234	Low
LIVESTOCK	Trough or Tank	12	#	18,000	0	0	0	0	Med
LIVESTOCK	Waste Management System	12	#	300,000	0	1,320	6,720	858	High
OTHER	septic system upgrade	100	#	150,000	0	1,600	5,600	1,040	Med
OTHER	buffer zone enhancement / installation	25	acre	125,000	0	38	125	24	Low
OTHER	Woodland Improvement	2,500	acre	1,875,000	75	6	13	4	Low
URBAN	Bio-retention Facility	12	acre	120,000	120	300	840	195	Med

URBAN	Porous Pavement	8	acre	696,000	0	20	48	13	Low
URBAN	Rain Garden	12	acre	115,200	0	150	360	98	Low
URBAN	Urban Stormwater Wetlands	5	acre	57,500	4	80	200	52	High
URBAN	Infiltration Trench	4	acre	40,800	5	64	160	42	Med

Specific Implementation Projects Identified by Stakeholders

Table 8-3 below summarizes 55 site specific projects within the priority subwatersheds that have been identified by the stakeholders during this planning process. The projects are further detailed in sections 9 and 10.

Table 8-3: Specific Implementation Projects Identified By Stakeholders

Project Type	Unit of Measure	Stakeholders	Total
Floodplain Easement	Acre	Jasper County SWCD/NRCS	299
Log Jam Removal	Feet	City of Villa Grove	4,798
Runoff Control	Acre	Champaign County SWCD/NRCS	81
Sediment Control; Retention	Acre	Jasper County SWCD/NRCS	2,219
Shoreline Stabilization	Feet	City of Charleston	3,697
Stabilization/Detention	Acre	City of Charleston	275
Streambank Stabilization	Feet	Jasper, Cumberland, Douglas and Coles SWCD/NRCS	445,897
Streambank Stabilization/retention	Acre	City of Newton	42
Two Stage Drainage Ditch	Acre	City of Tuscola	28
WASCB/Retention	Acre	Crawford County SWCD/NRCS	23,696
WASCB/Waterway	Acre	Cumberland County SWCD	5,939
Wetland Creation	Acre	City of Tuscola; City of Villa Grove	61
Wetland Restoration	Acre	Douglas and Champaign Counties SWCD/NRCS	3,370
Wetland/Floodplain Restoration	Acre	City of Charleston	46

Section 9 – Subwatershed Based Implementation Plan

The planning committee chose eight priority HUC-10 subwatersheds to focus on in further detail in terms of identifying project locations and initiating project implementation. This was done due to the expansive size of the watershed and the need to focus on smaller areas in further detail. The priority subwatersheds are shown on exhibit 21. Several factors went into selecting these priority subwatersheds which include:

- Level of stakeholder interest and involvement potential
- Results from watershed inventory, modeling and GIS analysis
- IEPA 303(d) list

It is important to note that it is not the intent of the planning committee to neglect any of the other subwatersheds. This plan was made to support watershed improvements and project implementation for the entire watershed, and it is the hope of the planning committee that this plan provides the tools and resources to help support all efforts throughout the watershed.

All load reduction estimates shown in this section are general estimates for planning purposes only, sites specific and detailed load reduction estimates will have to be calculated on an individual project basis.

East Branch Embarras River Subwatershed

Subwatershed Characteristics

Subwatershed Location

The East Branch Embarras River Subwatershed (HUC 10 – 0512011201) is located primarily in Champaign County with smaller portions in Douglas, Edgar and Vermilion Counties as shown in Exhibit 29. The subwatershed encompasses approximately 122,219 acres (7.8% of the watershed) and includes the Embarras River, East Branch Embarras River and Jordan Slough.

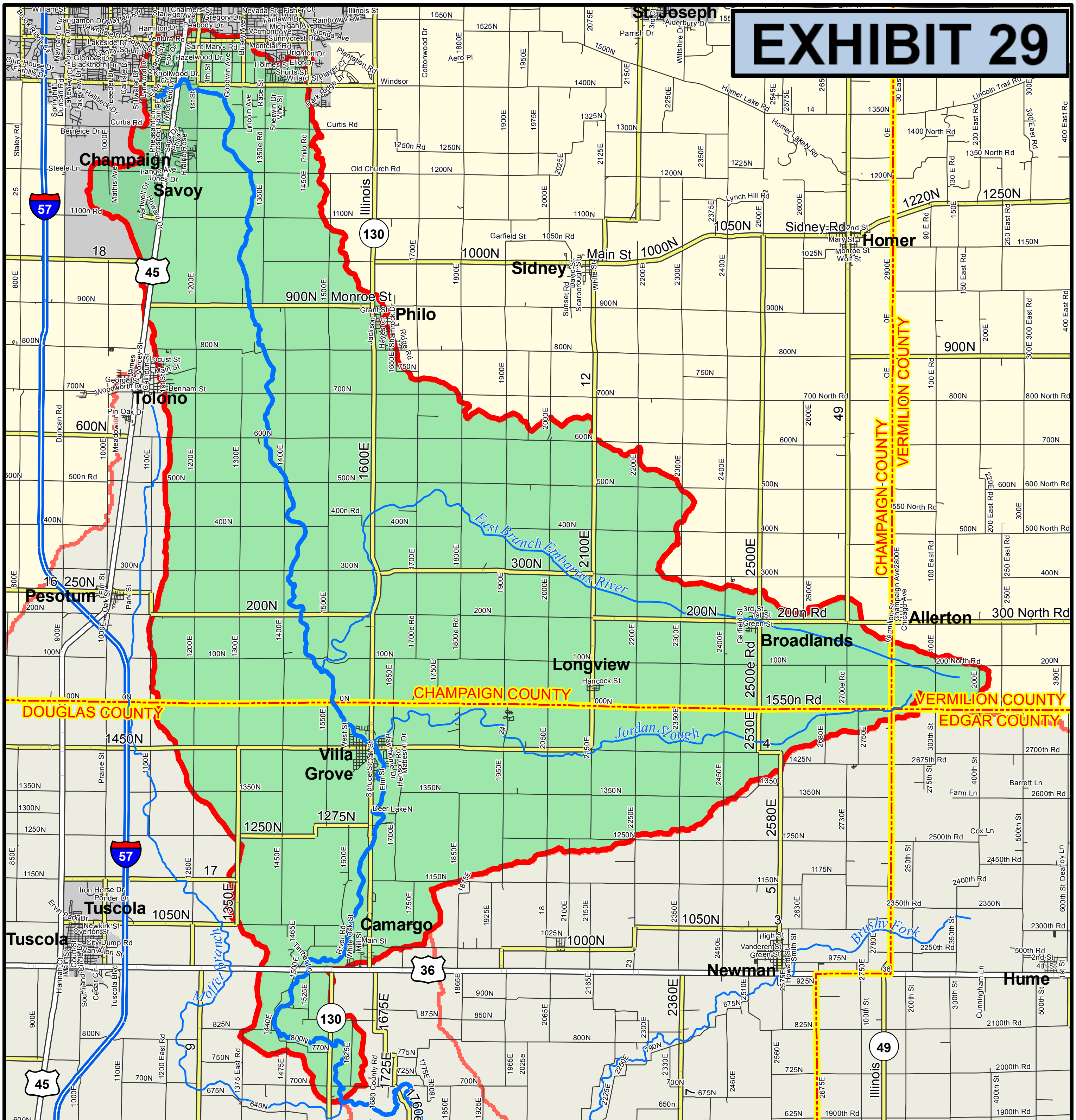
The Embarras River flows for approximately 32.3 miles generally north to south through the subwatershed. The East Branch Embarras River and Jordan Slough both flow east to west through the subwatershed to their confluence with the Embarras River. The East Branch Embarras River is approximately 19.9 miles long, while Jordan Slough is approximately 15.1 miles.

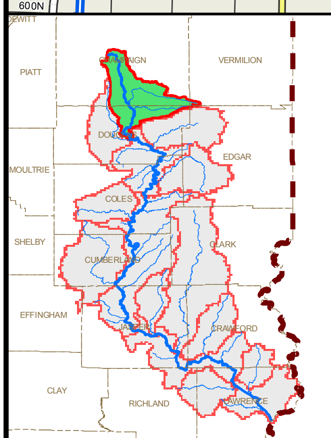
Population

According to the 1990 Census, the population within the East Branch Embarras River Subwatershed was approximately 19,398. In the 2000 Census, the population was approximately 22,187, an increase of 14.4%.

The majority of the subwatershed is relatively sparsely populated with population density averaging less than 0.2 people per acre. The most densely populated areas are located in the northern portion of the subwatershed and are associated with the City of Champaign.

EXHIBIT 29





East Branch Embarras River Subwatershed

HUC: 0512011201 Acres: 122,219

Embarras River Watershed Plan

Subwatershed Location Map

1 0 1 2 Miles

ERMA
EMBARRAS RIVER MANAGEMENT ASSOCIATION

Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- East Branch Embarras River Subwatershed
- Embarras Subwatersheds
- Interstate
- US Highway
- State Highway
- Local Road
- Minor Road
- Other Road
- Ramp

Land Cover

Land Use within the East Branch Embarras River Subwatershed was analyzed based on the 2007 Cropland Data Layer (CDL) for Illinois published by the United State Department of Agriculture, National Agriculture Statistics Service (USDA-NASS). With approximately 82.4% of the subwatershed covered by agriculture (Table 9-1), the East Branch Embarras River Subwatershed still remains primarily rural and agricultural. The developed areas (approximately 12.3%) are concentrated in the northern portion of the subwatershed and are associated with the City of Champaign.

Table 9-1: East Branch Embarras River Subwatershed Land Cover		
Landuse Classification	**Acres**	**Percentage**
Agricultural	100,736	82.4%
Barren	53	0.0%
Developed	15,068	12.3%
Forest	2,101	1.7%
Grassland	4,051	3.3%
Open Water	95	0.1%
Wetlands	115	0.1%
Total	122,219	99.9%*
*Note – Percent totals do not add to 100% due to rounding		

Soil Characteristics

The soils within the East Branch Embarras River Subwatershed fall into five major associations (Table 9-2). Over half of the subwatershed falls within the Catlin-Flanagan-Drummer association (58.0%) which consists of nearly level to gently sloping silty soils.

Table 9-2: East Branch Embarras River Subwatershed Soil Associations		
Association	**Acres**	**Percentage**
Catlin-Flanagan-Drummer	70,838	58.0%
Plano-Proctor-Worthen	26,543	21.7%
Saybrook-Dana-Drummer	12,440	10.2%
Lawson-Sawmill-Darwin	1,583	1.3%
St. Charles-Camden-Drury	10,815	8.8%
Total	122,219	100.0%

Highly erodible soils comprise approximately 754 acres (0.6%) of the subwatershed, while hydric soils consist of 49.1% (60,044 acres) of the subwatershed.

Natural Resources

Illinois Natural Area Inventory Sites (INAI) are natural landscape features and communities of the highest quality still remaining in Illinois. In most cases, these sites are also where State and/or Federally listed Threatened and Endangered species have been found. Two INAI sites are located within the East Branch Embarras River Subwatershed: Barnhart Prairie and Embarras River – Camargo.

Approximately 320 acres of land within the watershed is identified as conservation or recreational land, while 1610 acres are within the Conservation Reserve Program.

Wetland areas cover approximately 1507 acres of the watershed with Bottomland Forest being the predominant type at 44.6%

The Illinois Department of Natural Resources was contacted to provide any Natural Heritage Data or related records for all listed threatened, endangered or rare species, high quality natural communities or natural areas documented within the Embarras River Watershed. Five species were located within the East Branch Embarras River Subwatershed including: Kirkland's Snake, Loggerhead Snake, Upland Sandpiper, Franklin's Ground Squirrel, and Little Spectaclecase.

Analysis of Subwatershed Data

Water Quality Data and Identified Problems

The 303(d) list indicates that approximately 39.9 miles of the Embarras River within the East Branch Embarras River Subwatershed was impaired at the time of the 2008 listing. It should be noted that if a stream is not listed on the 303(d) list it may be impaired; however the data (or lack thereof) does not indicate the impairment at the time of publication. The potential causes of the impairment include pH, Phosphorus (Total), Sedimentation/Siltation, Total Suspended Solids (TSS), and Fecal Coliform.

Available water quality data from the United States Geological Survey (USGS) and the Illinois Environmental Protection Agency (IEPA) was analyzed based on screened water quality parameters. There are three USGS water quality stations within the East Branch Embarras River Subwatershed, however only one of these stations (03343395) contains data on the screened parameters. Only one IEPA station (BE-14) is located within the subwatershed. Table 9-3 below summarizes the USGS and IEPA sampling mean value of each parameter screened and the corresponding water quality target.

Table 9-3: East Branch Embarras River Water Quality Sampling Summary

Water Quality Parameter	USGS Mean Value	IEPA Mean Value	Water Quality Target
Dissolved Oxygen	9.0 mg/L	Not available	between 4.0 and 12.0 mg/L
Fecal Coliform	887 CFU/100mL	Not available	200 CFU/100mL
Nitrate + Nitrite	8.2 mg/L	3.8 mg/L	1.8 mg/L
Total Phosphorus	0.125 mg/L	0.159 mg/L	0.118 mg/L
TSS	46.2 mg/L	42.0 mg/L	50.0 mg/L

Based on the available water quality information, the East Branch Embarras River consistently tests higher than the water quality targets in Nitrate + Nitrite and Total Phosphorus. Fecal Coliform tested higher than the water quality target in the USGS sampling however Fecal Coliform data was not available for the IEPA station. Dissolved Oxygen falls within the acceptable ranges and TSS consistently tests lower that the target therefore these parameters are not a concern for this subwatershed.

NPDES permits are also indicative of the land use and water quality within a subwatershed. Compliance records for the NPDES facilities within the watershed were analyzed for the past three years Effluent exceedances were noted based on the number of times in the past three years the permit allowed discharge was exceeded. The water quality parameters screened in this analysis included Dissolved Oxygen (DO), Total Suspended Solids (TSS), Nitrogen (N) and Fecal Coliform (FC). There are 2 NPDES permits active within the East Branch Embarras River Subwatershed. According to compliance records, there have been no formal enforcement actions within the last 5 years; however there have been several noted effluent exceedances within the last 3 years. These exceedances included 2 reports of Dissolved Oxygen and 5 reports of Total Suspended Solids.

Five landfills were identified within the East Branch Embarras River Subwatershed.

Biological Data

IEPA has completed several habitat and biological studies within the Embarras River Watershed. Within the East Branch Embarras River Subwatershed, one IEPA site has biological information available. Sampling data was available from an August 2001 study and an August 2006 study. Table 9-4 summarizes the IEPA mean value for the Macroinvertebrate Index of Biotic Integrity (mIBI) and the Index of Biotic Integrity (IBI).

Table 9-4: East Branch Embarras River Subwatershed IEPA Biological Sampling Summary	
Habitat/Biological Parameter	**IEPA Mean Value**
mIBI	56.6
IBI	42

With a mIBI score of 56.6, the East Branch Embarras River Subwatershed shows no impairment for macroinvertebrate communities and an IBI score of 42 indicates that there is no impairment in the fish community.

Pollution Load Analysis

Nonpoint source modeling was completed for four water quality parameters including Total Suspended Solids (TSS), Total Nitrogen (N), Total Phosphorus (P), and Fecal Coliform. Table 9-5 summarized the modeling results for the East Branch Embarras River Subwatershed.

Table 9-5: East Branch Embarras River Subwatershed NPS Modeling Summary	
Parameter	**Loading**
Total Suspended Solids	0.33 ton/ac/yr
Nitrogen	3.90 lb/ac/yr
Phosphorus	0.78 lb/ac/yr
Fecal Coliform	1.87 CFU bill/ac/yr

Figure 9-1: Non Point Source Pollutant Load Priority Areas (Nitrogen, Phosphorus, Sediment)

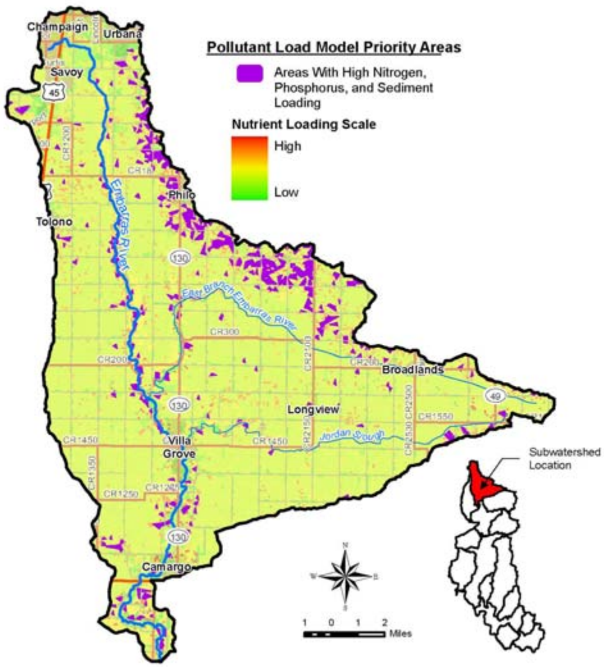


Table 9-6: East Branch Embarras River Subwatershed Pollutant Load Model Priority Areas		
Parameter	Acres	Percent in Watershed
Areas With High Nitrogen, Phosphorus, and Sediment Loading	4,204	3.44%

Figure 9 – 2: Fecal Coliform Bacteria Project & Priority Areas

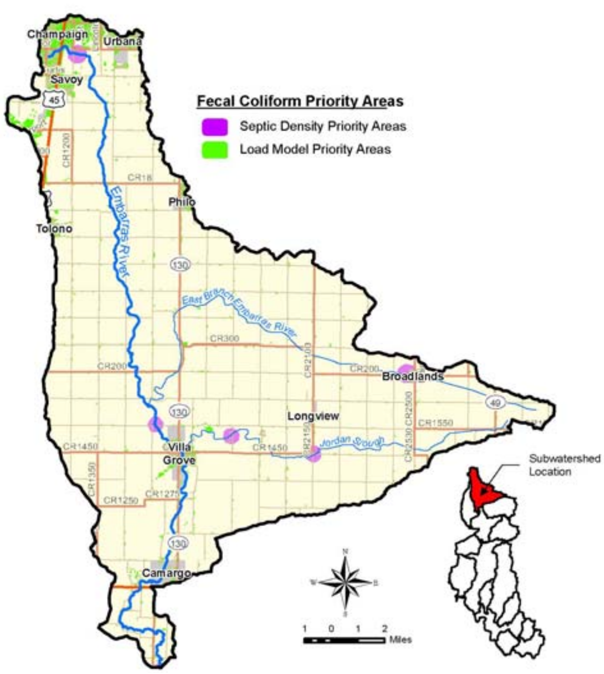


Table 9-7: East Branch Embarras River Subwatershed Fecal Coliform Bacteria Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Septic Density Priority Areas	1,119	0.92%
Load Model Priority Areas	5,951	4.87%

Figure 9-3: Highly Erodible Land Project & Priority Areas

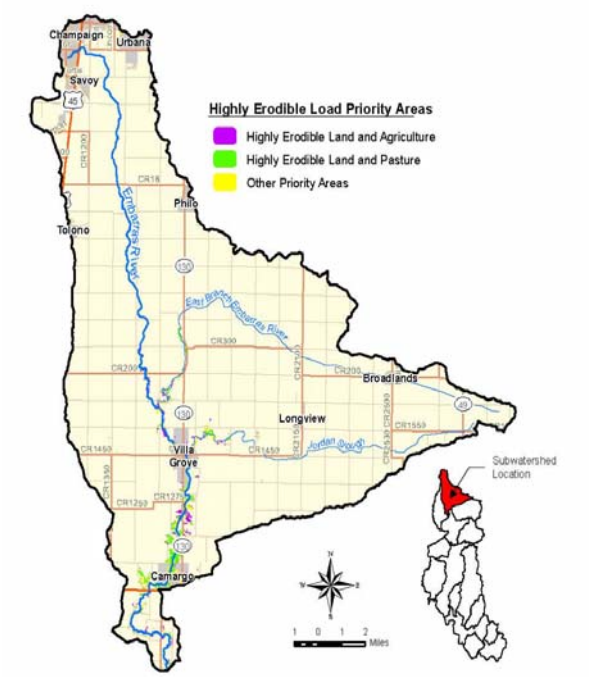


Table 9-8: East Branch Embarras River Subwatershed Highly Erodible Land Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Highly Erodible Land and Agriculture	89	0.07%
Highly Erodible Land and Pasture	213	0.17%
Other Priority Areas	678	0.55%

Figure 9-4: Wetland Restoration/Flood Mitigation Project & Priority Areas

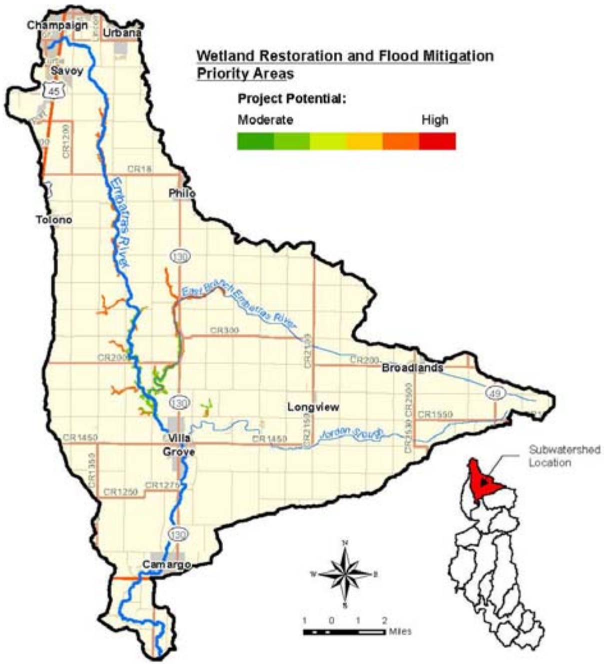


Figure 9-5: Stakeholder Identified Priority Projects

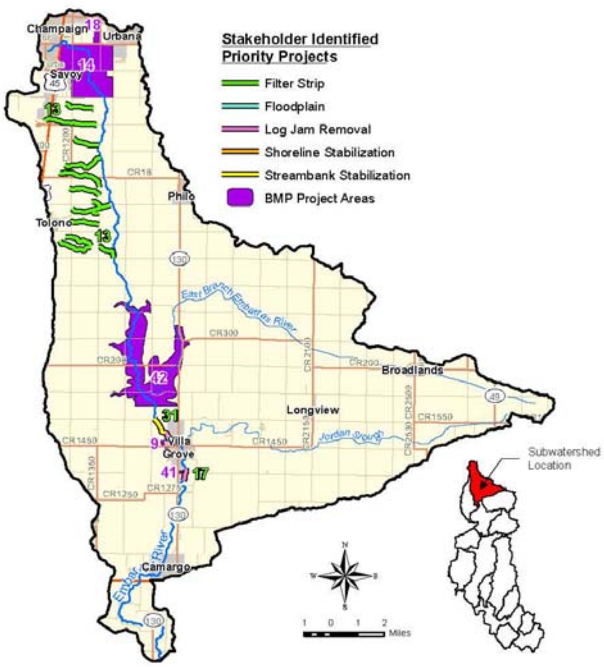


Table 9-9: East Branch Embarras River Subwatershed Estimated Load Reductions for Stakeholder Identified Priority Projects									
					Potential Annual Load Reductions				
Map ID	**Project Type**	**Stakeholder**	**Length (ft)**	**Area (Acres)**	**N (lbs)**	**P (lbs)**	**Sediment (tons)**	**Fecal Coliform (bill fcu)**	**Project Details**
37	WASCB/Retention	Crawford SWCD/NRCS		18	2	1	14	0	Focus work in this subwatershed
4	CNMP/Waste Utilization	Jasper SWCDD/NRCS		2,060	2,884	989	247	643	High Concentration of confined swine opps within 5mi radius of Ste. Marie; CNMPs
2	All BMP	Douglas SWCD/NRCS		11,437	13,724	4,575	1,144	2,974	Oakland/Hog Branch watershed; potential willing landowners, all BMPs
31	Streambank Stabilization	Douglas SWCD/NRCS	3,585		3,226	1,290	1,147	839	Main Stem
43	Wetland Restoration	Douglas SWCD/NRCS		205	11,255	3,274	368	2,128	Wetland WRP
13	Filter Strip	Champaign SWCD/NRCS	5,692		18,214	9,505	3,130	6,178	Filter strips where CRP does not exist
14	Filter Strips; Other BMP	Champaign SWCD/NRCS		0.33	13	5	0	3	Filter strips and other appropriate BMPs on UofI Property
14	Filter Strips; Other BMP	Champaign SWCD/NRCS		2,242	2,691	897	224	583	Filter strips and other appropriate BMPs on UofI Property
18	Runoff Control	Champaign SWCD/NRCS		0	13	5	0	3	Runoff control for UofI Dairy Farm; 319 was applied for in the past
18	Runoff Control	Champaign SWCD/NRCS		80	3,213	1,285	96	836	Runoff control for U of I Dairy Farm; 319 was applied for in the past
42	Wetland Restoration	Champaign SWCD/NRCS		3,166	174,11 3	50,651	5,698	32,923	Wetland restoration and flood storage in 100yr floodplain
9	Detention	City of Villa Grove		51	2,025	810	38	527	Detention of runoff entering city
17	Log Jam Removal	City of Villa Grove	4,798		0	0	0	0	Flood prevention
41	Wetland	City of Villa Grove		10	533	155	17	101	Detention of flood water
31	Streambank Stabilization	Douglas SWCD/NRCS	3,585		3,226	1,290	1,147	839	Main Stem

Scattering Fork Subwatershed

Subwatershed Characteristics

Subwatershed Location

The Scattering Fork Subwatershed (HUC 10 – 0512011202) is located primarily in Douglas County with smaller portions in Champaign and Coles Counties as shown in Exhibit 30. The subwatershed encompasses approximately 69,875 acres (4.5% of the watershed) and includes the Moffet/Hackett Branch and Scattering Fork.

The Moffet/Hackett Branch flows for approximately 18.3 miles generally north to south through the subwatershed to its confluence with Scattering Fork. Scattering Fork flows northwest to southeast through the subwatershed to its confluence with the Embarras River. Scattering Fork is approximately 13.4 miles long.

Population

According to the 1990 Census, the population within the Scattering Fork Subwatershed was approximately 9,574. In the 2000 Census, the population was approximately 9,902, an increase of 3.4%.

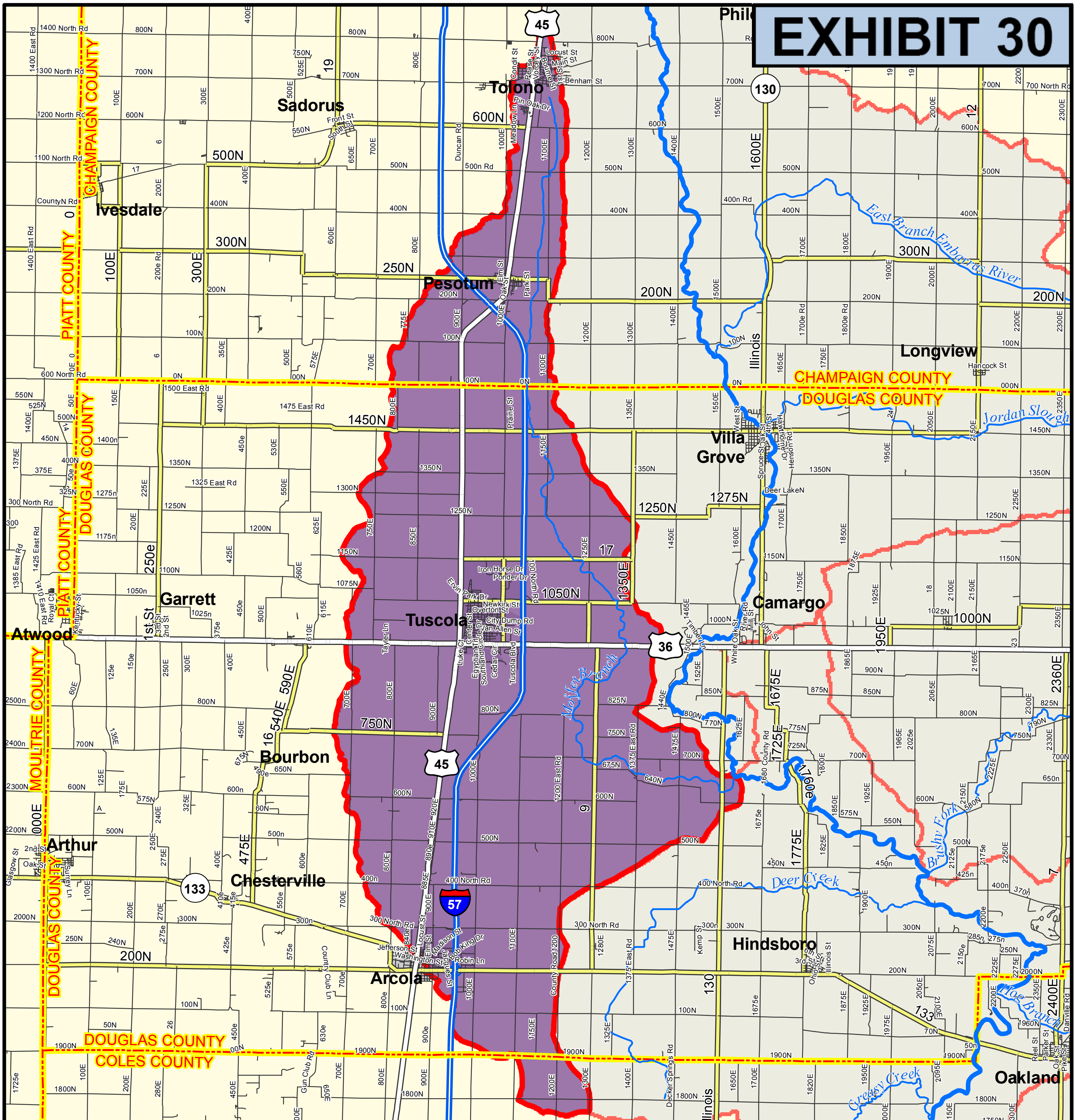
The majority of the subwatershed is relatively sparsely populated with population density averaging less than 0.2 people per acre. The most densely populated areas are located in the central portion of the subwatershed associated with the City of Tuscola and in the southern portion of the subwatershed associated with the City of Arcola.

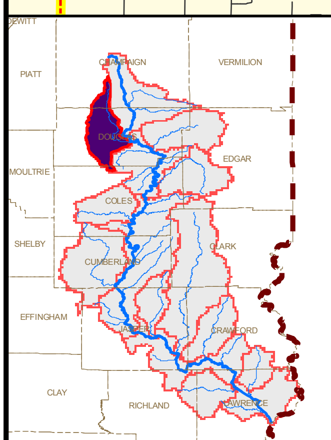
Land Cover

Land Use within the Scattering Fork Subwatershed was analyzed based on the 2007 Cropland Data Layer (CDL) for Illinois published by the United State Department of Agriculture, National Agriculture Statistics Service (USDA-NASS). With approximately 83.1% of the subwatershed covered by agriculture (Table 9-10), the Scattering Fork Subwatershed still remains primarily rural and agricultural. The developed areas (approximately 14.4%) are concentrated in the central portion of the subwatershed associated with the City of Tuscola and in the southern portion of the subwatershed associated with the City of Arcola.

Table 9-10: Scattering Fork Subwatershed Land Cover		
Landuse Classification	**Acres**	**Percentage**
Agricultural	58,061	83.1%
Barren	111	0.2%
Developed	10,037	14.4%
Forest	340	0.5%
Grassland	1,182	1.7%
Open Water	126	0.2%
Wetlands	18	0.0%
Total	69,875	100.1%*
*Note – Percent totals do not add to 100% due to rounding		

EXHIBIT 30





Scattering Fork Subwatershed

HUC: 0512011202 Acres: 69,875

Embarras River Watershed Plan

Subwatershed Location Map

N W E S

1 0 1 2 Miles

ERMA EMBARRAS RIVER MANAGEMENT ASSOCIATION

Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Scattering Fork Subwatershed
- Embarras Subwatersheds
- Interstate
- US Highway
- State Highway
- Local Road
- Minor Road
- Other Road
- Ramp

Soil Characteristics

The soils within the Scattering Fork Subwatershed fall into six major associations (Table 9-11). The majority of the subwatershed falls within the Catlin-Flanagan-Drummer association (69.2%) which consists of nearly level to gently sloping silty soils.

Table 9-11: Scattering Fork Subwatershed Soil Associations		
Association	**Acres**	**Percentage**
Catlin-Flanagan-Drummer	48,362	69.2%
Plano-Proctor-Worthen	3,890	5.6%
Martinton-Milford	14,456	20.7%
Lawson-Sawmill-Darwin	213	0.3%
Birkbeck-Sabina-Sunbury	2,495	3.6%
St. Charles-Camden-Drury	458	0.7%
Total	69,874	100.1%*
*Note – Percent totals do not add to 100% due to rounding		

Highly erodible soils comprise approximately 100 acres (0.1%) of the subwatershed, while hydric soils consist of 60.4% (42,172 acres) of the subwatershed.

Natural Resources

Illinois Natural Area Inventory Sites (INAI) are natural landscape features and communities of the highest quality still remaining in Illinois. In most cases, these sites are also where State and/or Federally listed Threatened and Endangered species have been found. Only one INAI site is located within the Scattering Fork Subwatershed: Embarras River – Camargo.

The Prairie Wind trail located at the southern end of the watershed is identified as conservation or recreational land, while 808 acres are within the Conservation Reserve Program.

Wetland areas cover approximately 222 acres of the watershed with Open Water Wetlands being the predominant type at 49.9%

The Illinois Department of Natural Resources was contacted to provide any Natural Heritage Data or related records for all listed threatened, endangered or rare species, high quality natural communities or natural areas documented within the Embarras River Watershed. There are no known threatened, endangered or rare species located within the Scattering Fork Subwatershed.

Analysis of Subwatershed Data

Water Quality Data and Identified Problems

The 303(d) list indicates that approximately 20.4 miles of the streams within the Scattering Fork Subwatershed was impaired at the time of the 2008 listing. It should be noted that if a stream is not listed on the 303(d) list it may be impaired; however the data (or lack thereof) does not indicate the impairment at the time of publication. The potential causes of the impairment include Phosphorus (Total).

Available water quality data from the United States Geological Survey (USGS) and the Illinois Environmental Protection Agency (IEPA) was analyzed based on screened water quality parameters. No USGS or IEPA stations are located with Scattering Fork Subwatershed.

NPDES permits are also indicative of the land use and water quality within a subwatershed. Compliance records for the NPDES facilities within the watershed were analyzed for the past three years. Effluent exceedances were noted based on the number of times in the past three years the permit allowed discharge was exceeded. The water quality parameters screened in this analysis included Dissolved Oxygen (DO), Total Suspended Solids (TSS), Nitrogen (N) and Fecal Coliform (FC). There are 8 NPDES permits active within the Scattering Fork Subwatershed. According to compliance records, there have been no formal enforcement actions within the last 5 years; however there have been several noted effluent exceedances within the last 3 years. These exceedances included 10 reports of Dissolved Oxygen, 5 reports of Total Suspended Solids, and 7 reports of Nitrogen.

Five landfills were identified within the Scattering Fork Subwatershed.

Biological Data
IEPA has completed several habitat and biological studies within the Embarras River Watershed. Within the Scattering Fork Subwatershed, no IEPA sites with biological data were available.

Pollution Load Analysis
Nonpoint source modeling was completed for four water quality parameters including Total Suspended Solids (TSS), Total Nitrogen (N), Total Phosphorus (P), and Fecal Coliform. Table 9-12 summarized the modeling results for the Scattering Fork Subwatershed.

Table 9-12: Scattering Fork Subwatershed NPS Modeling Summary

Parameter	Loading
Total Suspended Solids	0.27 ton/ac/yr
Nitrogen	4.01 lb/ac/yr
Phosphorus	0.77 lb/ac/yr
Fecal Coliform	2.07 CFU bill/ac/yr

Scattering Fork Subwatershed Implementation Plan

Figure 9-6: Non Point Source Pollutant Load Priority Areas (Nitrogen, Phosphorus, Sediment)

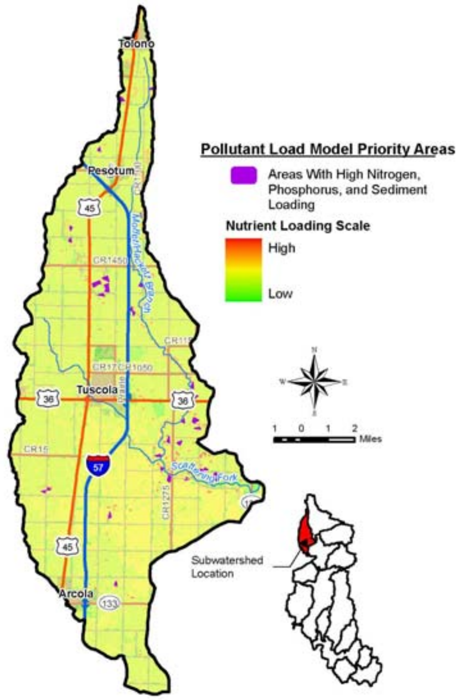


Table 9-13: Scattering Fork Subwatershed Pollutant Load Model Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Areas With High Nitrogen, Phosphorus, and Sediment Loading	319	0.46%

Figure 9-7: Fecal Coliform Bacteria Project & Priority Areas

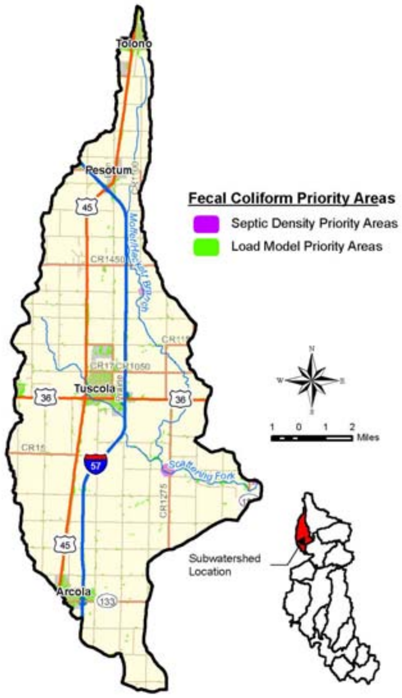


Table 9-14: Scattering Fork Subwatershed Fecal Coliform Bacteria Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Septic Density Priority Areas	176	0.25%
Load Model Priority Areas	4,949	7.08%

Figure 9-8: Highly Erodible Land Project & Priority Areas

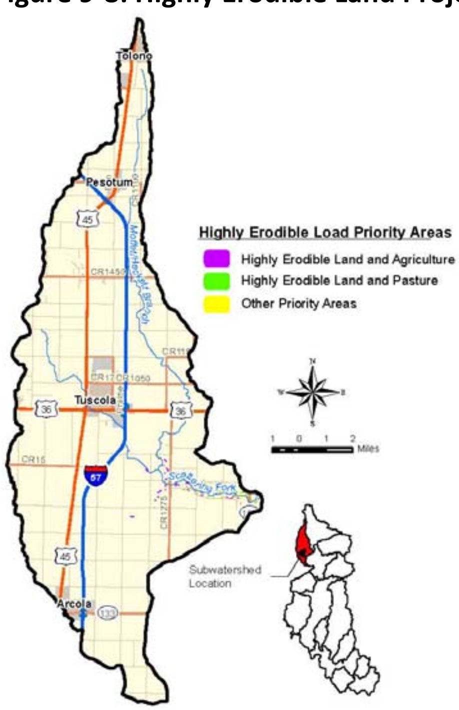


Table 9-15: Scattering Fork Subwatershed Highly Erodible Load Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Highly Erodible Land and Agriculture	23	0.03%
Highly Erodible Land and Pasture	10	0.01%
Other Priority Areas	98	0.14%

Figure 9-9: Wetland Restoration/Flood Mitigation Project & Priority Areas

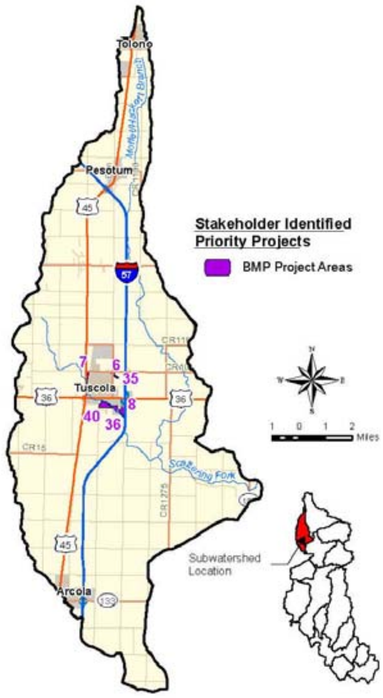


Figure 9-10: Stakeholder Identified Priority Projects

Table 9-16: Scattering Fork Subwatershed Estimated Load Reductions for Stakeholder Identified Priority Projects								
Map ID	**Project Type**	**Stakeholder**	**Area (Acres)**	**Nitrogen (lbs)**	**Phosphorus (lbs)**	**Sediment (tons)**	**Fecal Coliform (bill fcu)**	**Project Details**
8	Detention	City of Tuscola	0	3	1	0	1	Detention/Wetland; additional flood storage; part of other practices
8	Detention	City of Tuscola	54	2,156	862	40	561	Detention/Wetland; additional flood storage; part of other practices
35	Two Stage Drainage Ditch	City of Tuscola	12	10	4	3	3	Augment existing plan to deepend ditch; two stage ditch with wetlands
36	Two Stage Drainage Ditch	City of Tuscola	0	0	0	0	0	Stream channel improvement; 2 stage drainage ditch; part of other practices
36	Two Stage Drainage Ditch	City of Tuscola	16	15	6	5	4	Stream channel improvement; 2 stage drainage ditch; part of other practices
40	Wetland	City of Tuscola	51	2,795	813	91	529	Wetland creation for flood control; part of other practices; consider CREP

Deer Creek – Embarras River Subwatershed

Subwatershed Characteristics

Subwatershed Location

The Deer Creek – Embarras River Subwatershed (HUC 10 – 0512011205) is located primarily in Douglas and Coles Counties with a smaller portion in Edgar County as shown in Exhibit 31. The subwatershed encompasses approximately 94,017 acres (6.0% of the watershed) and includes the Embarras River, Deer Creek, Hog Branch, Greasy Creek and Dry Branch.

The Embarras River flows for approximately 33.3 miles generally north to south through the subwatershed. Greasy Creek and Dry Branch flow southwest to northeast; Deer Creek flows north and then turns east; and Hog Branch flows northeast to southwest through the watershed to their confluence with the Embarras River. Deer Creek is approximately 13.8 miles, Hog Branch is approximately 10.8 miles, Greasy Creek is approximately 10.1 miles and Dry Branch is approximately 5.6 miles long.

Population

According to the 1990 Census, the population within the Deer Creek – Embarras River Subwatershed was approximately 2,564. In the 2000 Census, the population was approximately 2,534, a decrease of 1.1%.

The majority of the subwatershed is relatively sparsely populated with population density averaging less than 0.1 people per acre.

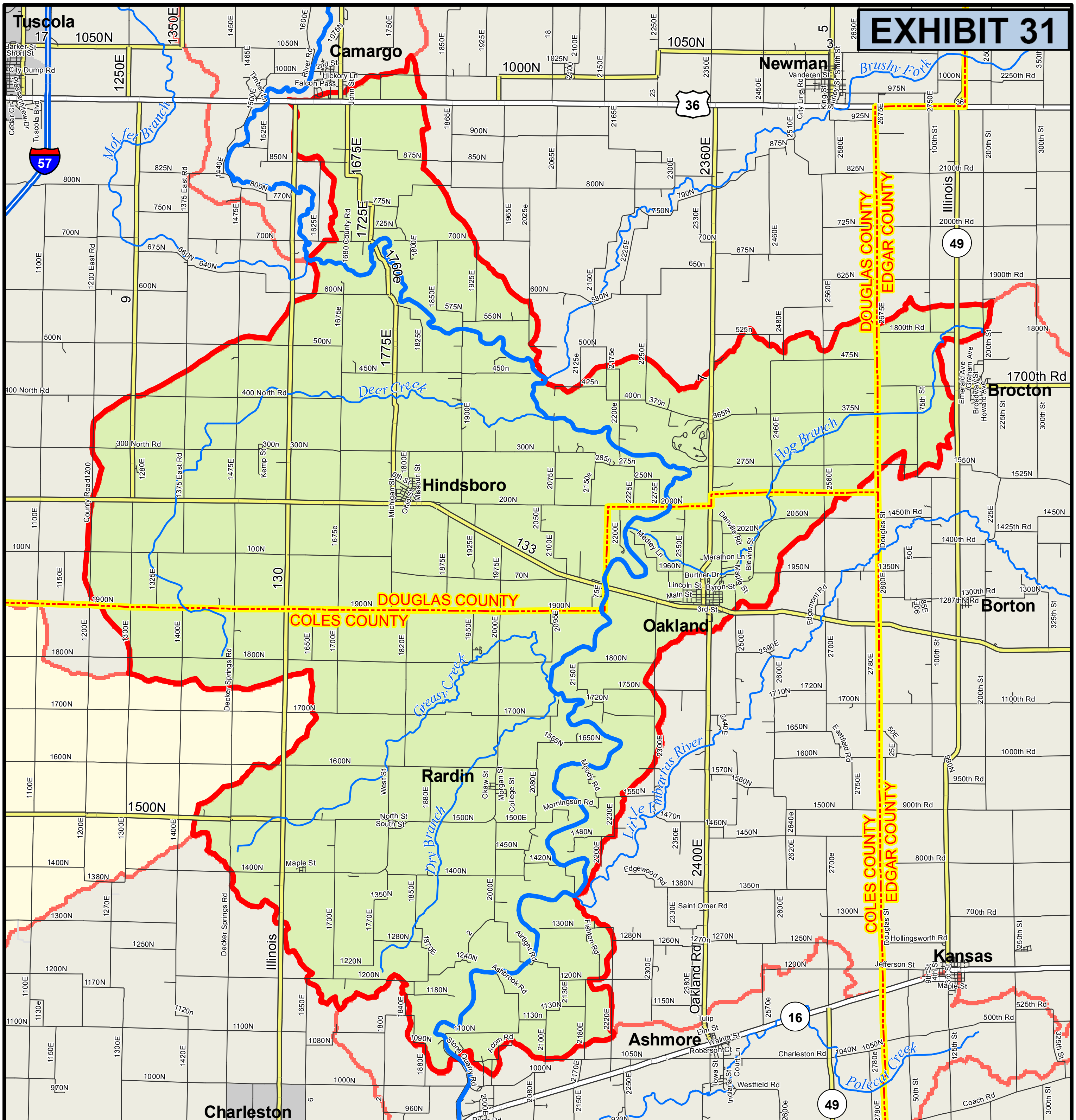
Land Cover

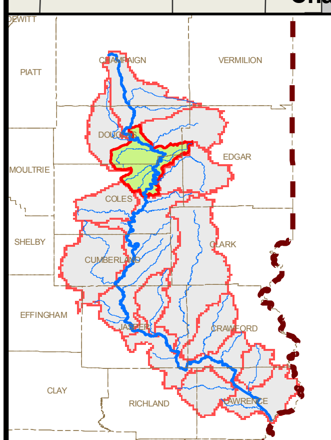
Land Use within the Deer Creek – Embarras River Subwatershed was analyzed based on the 2007 Cropland Data Layer (CDL) for Illinois published by the United State Department of Agriculture, National Agriculture Statistics Service (USDA-NASS). With approximately 76.3% of the subwatershed covered by agriculture (Table 9-17), the Deer Creek – Embarras River Subwatershed still remains primarily rural and agricultural.

Table 9-17: Deer Creek – Embarras River Subwatershed Land Cover

Landuse Classification	Acres	Percentage
Agricultural	71,690	76.3%
Barren	15	0.0%
Developed	7,660	8.1%
Forest	10,088	10.7%
Grassland	4,267	4.5%
Open Water	173	0.2%
Wetlands	125	0.1%
Total	94,018	99.9%*
*Note – Percent totals do not add to 100% due to rounding		

EXHIBIT 31





Deer Creek-Embarras River Subwatershed

HUC: 0512011205 Acres: 94,017

Embarras River Watershed Plan

Subwatershed Location Map

1 0 1 2 Miles

Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Deer Creek-Embarras River Subwatershed
- Embarras Subwatersheds
- Interstate
- US Highway
- State Highway
- Local Road
- Minor Road
- Other Road
- Ramp

Soil Characteristics

The soils within the Deer Creek – Embarras River Subwatershed fall into seven major associations (Table 9-18). Almost half of the subwatershed falls within the Catlin-Flanagan-Drummer association (44.7%) which consists of nearly level to gently sloping silty soils.

Table 9-18: Deer Creek - Embarras River Subwatershed Soil Associations		
Association	**Acres**	**Percentage**
Catlin-Flanagan-Drummer	42,040	44.7%
Plano-Proctor-Worthen	471	0.5%
Saybrook-Dana-Drummer	7,825	8.3%
Martinton-Milford	14,685	15.6%
Lawson-Sawmill-Darwin	10,267	10.9%
Birkbeck-Sabina-Sunbury	18,036	19.2%
St. Charles-Camden-Drury	693	0.7%
Total	94,017	99.9%*
*Note – Percent totals do not add to 100% due to rounding		

Highly erodible soils comprise approximately 3,578 acres (3.8%) of the subwatershed, while hydric soils consist of 48.2% (45,342 acres) of the subwatershed.

Natural Resources

Illinois Natural Area Inventory Sites (INAI) are natural landscape features and communities of the highest quality still remaining in Illinois. In most cases, these sites are also where State and/or Federally listed Threatened and Endangered species have been found. Two INAI sites are located within the Deer Creek – Embarras River Subwatershed: Walnut Point and Embarras River – Camargo.

Approximately 745 acres of land within the watershed is identified as conservation or recreational land not including the Prairie Wind Trail which runs from east to west through the middle of the subwatershed, while 2,275 acres are within the Conservation Reserve Program.

Wetland areas cover approximately 2,142 acres of the watershed with Bottomland Forest being the predominant type at 72.8%

The Illinois Department of Natural Resources was contacted to provide any Natural Heritage Data or related records for all listed threatened, endangered or rare species, high quality natural communities or natural areas documented within the Embarras River Watershed. Six species were located within the Deer Creek – Embarras River Subwatershed including: Arkansas Sedge, Kidneyshell, Kirkland's Snake, Little Spectaclecase, Slippershell and Snuffbox.

Analysis of Subwatershed Data

Water Quality Data and Identified Problems

The 303(d) list indicates that no streams within the Deer Creek – Embarras River Subwatershed were impaired at the time of the 2008 listing. It should be noted that if a stream is not listed on the 303(d) list it may be impaired; however the data (or lack thereof) does not indicate the impairment at the time of publication.

Available water quality data from the United States Geological Survey (USGS) and the Illinois Environmental Protection Agency (IEPA) was analyzed based on screened water quality parameters. There are three USGS water quality stations within the Deer Creek – Embarras River Subwatershed, however only one of these stations (03343550) contains data on the screened parameters. There are three IEPA stations (RBP-1, RBP-2, and RBP-3) are located within the subwatershed. Table 9-19 below summarizes the USGS and IEPA sampling mean value of each parameter screened and the corresponding water quality target.

Table 9-19: Deer Creek – Embarras River Water Quality Sampling Summary

Water Quality Parameter	USGS Mean Value	IEPA Mean Value	Water Quality Target
Dissolved Oxygen	Not available	Not available	between 4.0 and 12.0 mg/L
Fecal Coliform	Not available	Not available	200 CFU/100mL
Nitrate + Nitrite	Not available	1.1 mg/L	1.8 mg/L
Total Phosphorus	Not available	0.234 mg/L	0.118 mg/L
TSS	288.9 mg/L	37.7 mg/L	50.0 mg/L

Based on the available water quality information, the Deer Creek – Embarras River consistently tests higher than the water quality target in Total Phosphorus for the IEPA stations however Nitrate+Nitrite tested lower than the water quality target. TSS tested higher than the water quality target in the USGS sampling however it tested lower than the target at the IEPA station. Fecal Coliform and Dissolved Oxygen were not available in either data set.

NPDES permits are also indicative of the land use and water quality within a subwatershed. Compliance records for the NPDES facilities within the watershed were analyzed for the past three years Effluent exceedances were noted based on the number of times in the past three years the permit allowed discharge was exceeded. The water quality parameters screened in this analysis included Dissolved Oxygen (DO), Total Suspended Solids (TSS), Nitrogen (N) and Fecal Coliform (FC). There is one NPDES permit active within the Deer Creek – Embarras River Subwatershed. According to compliance records, there have been no formal enforcement actions within the last 5 years; there have also been no noted effluent exceedances within the last 3 years.

No landfills were identified within the Deer Creek – Embarras River Subwatershed.

Biological Data

IEPA has completed several habitat and biological studies within the Embarras River Watershed. Within the Deer Creek – Embarras River Subwatershed, no IEPA sites with biological data were available.

Pollution Load Analysis

Nonpoint source modeling was completed for four water quality parameters including Total Suspended Solids (TSS), Total Nitrogen (N), Total Phosphorus (P), and Fecal Coliform. Table 9-20 summarized the modeling results for the Deer Creek – Embarras River Subwatershed.

Table 9-20: Deer Creek – Embarras River Subwatershed NPS Modeling Summary	
Parameter	**Loading**
Total Suspended Solids	0.43 ton/ac/yr
Nitrogen	4.05 lb/ac/yr
Phosphorus	0.86 lb/ac/yr
Fecal Coliform	1.76 CFU bill/ac/yr

Deer Creek – Embarras River Subwatershed Implementation Plan

Figure 9-1: Non Point Source Pollutant Load Priority Areas (Nitrogen, Phosphorus, Sediment)

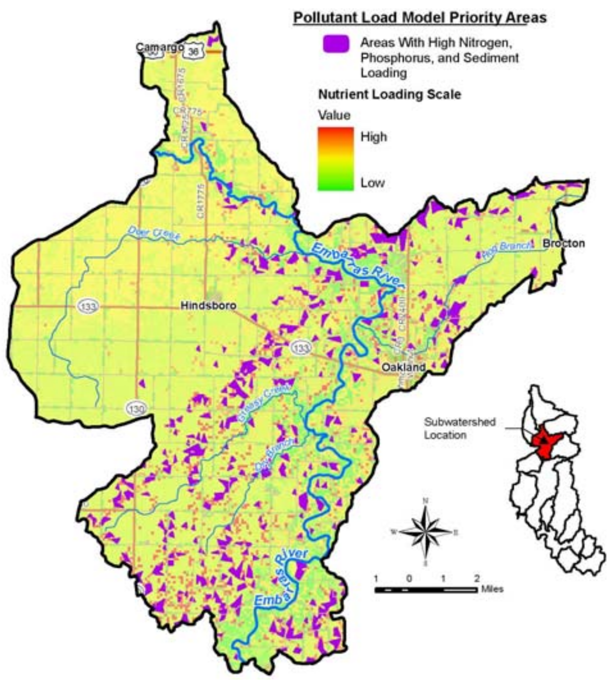


Table 9-21: Deer Creek – Embarras River Subwatershed Pollutant Load Model Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Areas With High Nitrogen, Phosphorus, and Sediment Loading	4,709	5.01%

Figure 9-12: Fecal Coliform Bacteria Project & Priority Areas

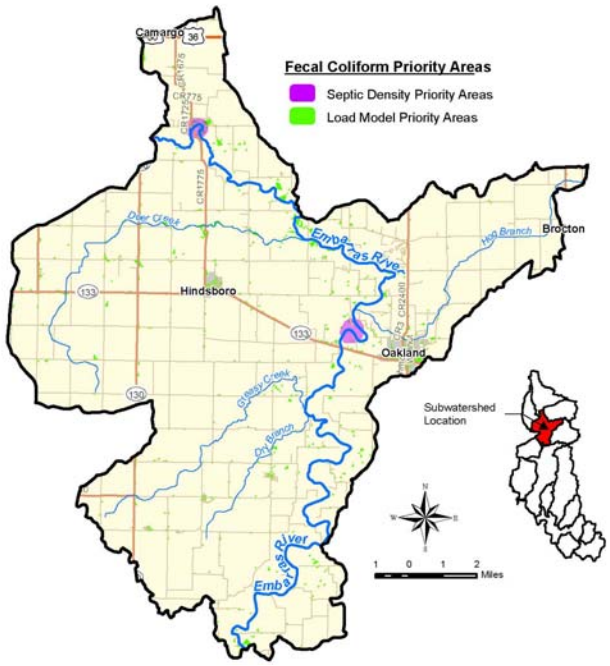


Table 9-22: Deer Creek – Embarras River Subwatershed Fecal Coliform Bacteria Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Septic Density Priority Areas	493	0.52%
Load Model Priority Areas	1,993	2.12%

Figure 9-13: Highly Erodible Land Project & Priority Areas

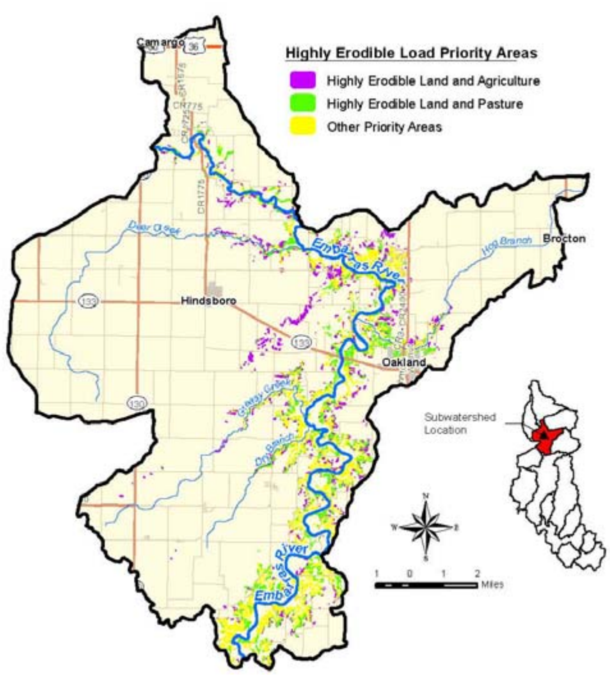


Table 9-23: Deer Creek – Embarras River Subwatershed Highly Erodible Load Priority Areas		
Parameter	Acres	Percent in Watershed
Highly Erodible Land and Agriculture	821	0.87%
Highly Erodible Land and Pasture	877	0.93%
Other Priority Areas	4,625	4.92%

Figure 9-14: Wetland Restoration/Flood Mitigation Project & Priority Areas

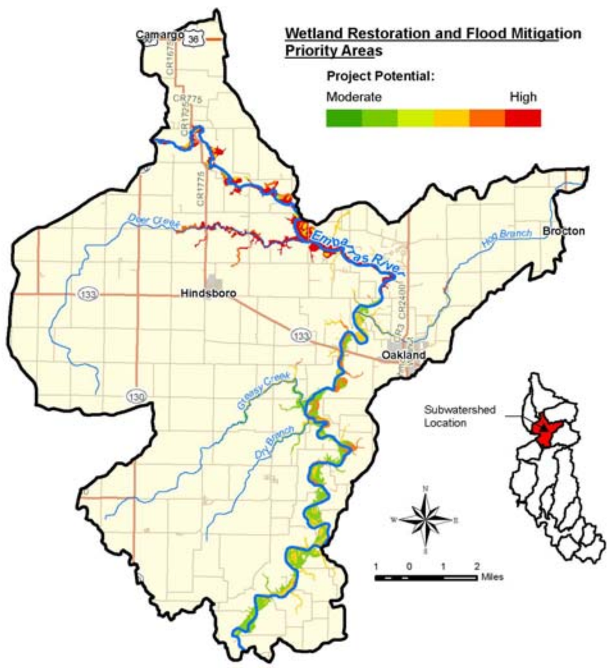


Figure 9-15: Stakeholder Identified Priority Projects

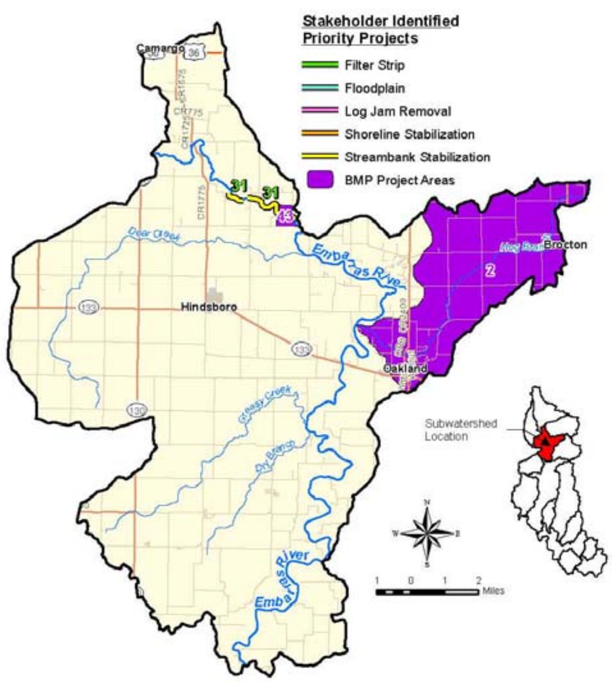


Table 9-24: Deer Creek – Embarras River Subwatershed Estimated Load Reductions for Stakeholder Identified Priority Projects									
Map ID	**Project Type**	**Stakeholder**	**Length (ft)**	**Area (Acres)**	**Nitrogen (lbs)**	**Phosphorus (lbs)**	**Sediment (tons)**	**Fecal Coliform (bill fcu)**	**Project Details**
2	All BMP	Douglas SWCD/NRCS		11437	13,724	4,575	1,144	2,974	Oakland/Hog Branch watershed; potential willing landowners, all BMPs
31	Streambank Stabilization	Douglas SWCD/NRCS	3,585		3,226	1,290	1,147	839	Main Stem

Kickapoo Creek Subwatershed

Subwatershed Characteristics

Subwatershed Location

The Kickapoo Creek Subwatershed (HUC 10 – 0512011206) is located within Coles County as shown in Exhibit 32. The subwatershed encompasses approximately 65,461 acres (4.2% of the watershed) and includes Kickapoo Creek.

Kickapoo Creek flows generally west to east through the subwatershed to its confluence with the Embarras River. Kickapoo Creek is approximately 18.9 miles long.

Population

According to the 1990 Census, the population within the Kickapoo Creek Subwatershed was approximately 30,216. In the 2000 Census, the population was approximately 28,193, a decrease of 6.7%.

The majority of the subwatershed is relatively sparsely populated with population density averaging approximately 0.4 people per acre. The most densely populated areas are located in the western portion of the subwatershed associated with the City of Matoon and in the eastern portion of the subwatershed associated with the City of Charleston.

Land Cover

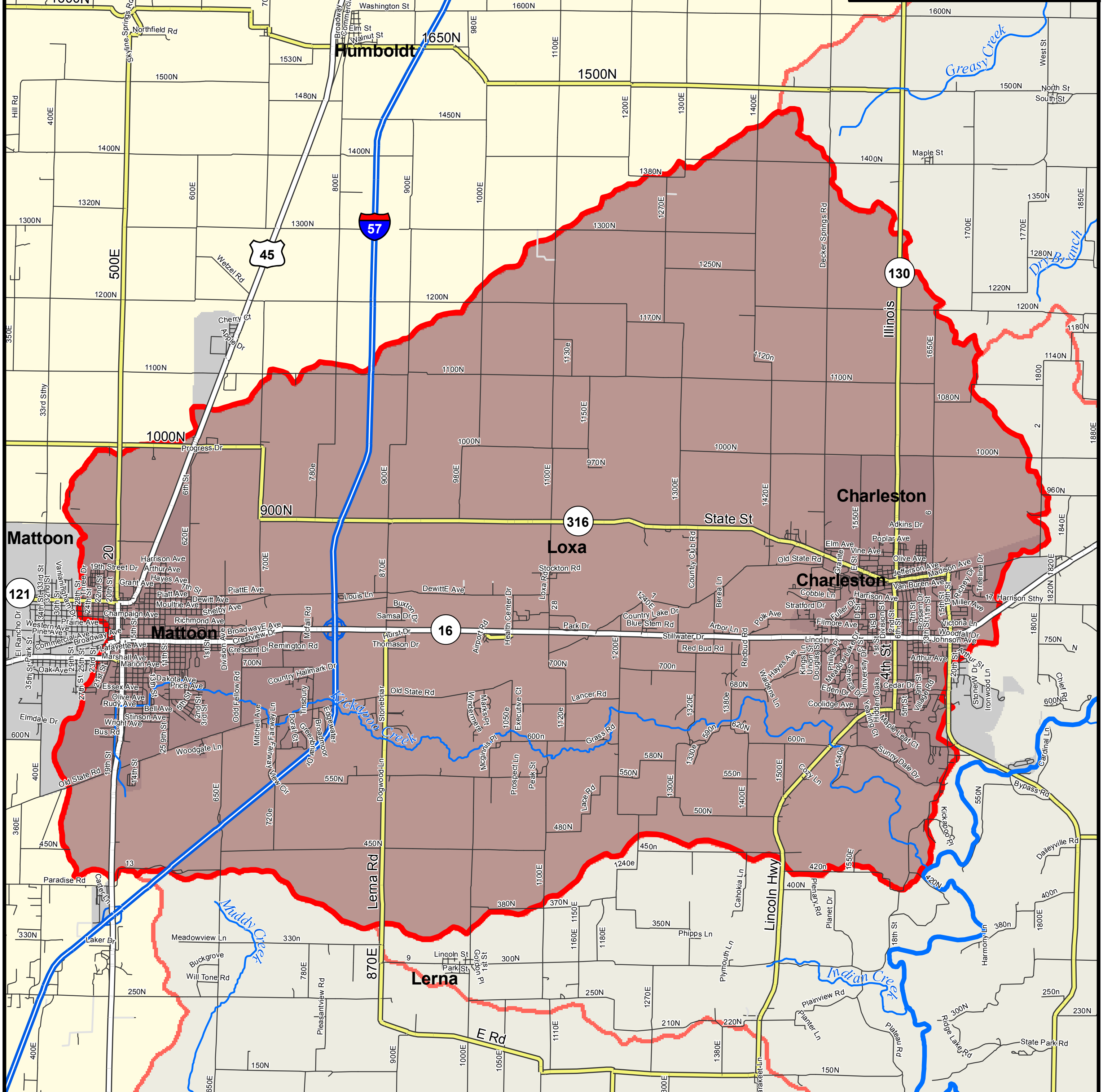
Land Use within the Kickapoo Creek Subwatershed was analyzed based on the 2007 Cropland Data Layer (CDL) for Illinois published by the United State Department of Agriculture, National Agriculture Statistics Service (USDA-NASS). With approximately 61.8% of the subwatershed covered by agriculture (Table 9-25), the Kickapoo Creek Subwatershed still remains primarily rural and agricultural. The developed areas (approximately 21.2%) are concentrated in the northern western portion of the subwatershed associated with the City of Matoon and in the eastern portion of the subwatershed associated with the City of Charleston.

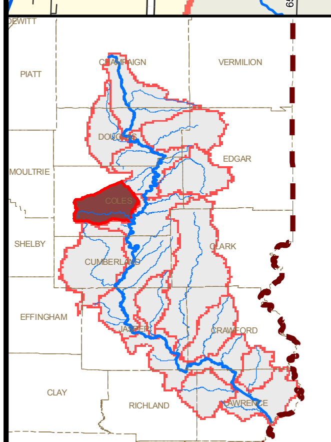
Table 9-25: Kickapoo Creek Subwatershed Land Cover		
Landuse Classification	**Acres**	**Percentage**
Agricultural	40,474	61.8%
Barren	40	0.1%
Developed	13,877	21.2%
Forest	6,800	10.4%
Grassland	4,107	6.3%
Open Water	155	0.2%
Wetlands	7	0.0%
Total	65,460	100.0%

Soil Characteristics

The soils within the Kickapoo Creek Subwatershed fall into five major associations (Table 9-26). Over half of the subwatershed falls within the Catlin-Flanagan-Drummer association (57.9%) which consists of nearly level to gently sloping silty soils.

EXHIBIT 32





Kickapoo Creek Subwatershed

HUC: 0512011206 Acres: 65,461

Embarras River Watershed Plan

Subwatershed Location Map

0.5 0 0.5 1 Miles

Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Kickapoo Creek Subwatershed
- Embarras Subwatersheds
- Interstate
- US Highway
- State Highway
- Local Road
- Minor Road
- Other Road
- Ramp

Table 9-26: Kickapoo Creek Subwatershed Soil Associations		
Association	**Acres**	**Percentage**
Catlin-Flanagan-Drummer	37,882	57.9%
Saybrook-Dana-Drummer	7,274	11.1%
Lawson-Sawmill-Darwin	2,468	3.8%
Birkbeck-Sabina-Sunbury	14,535	22.2%
Dodge-Russell-Miami	3,302	5.0%
Total	65,461	100.0%

Highly erodible soils comprise approximately 3,173 acres (4.8%) of the subwatershed, while hydric soils consist of 33.1% (21,679 acres) of the subwatershed.

Natural Resources
Illinois Natural Area Inventory Sites (INAI) are natural landscape features and communities of the highest quality still remaining in Illinois. In most cases, these sites are also where State and/or Federally listed Threatened and Endangered species have been found. One INAI site is located within the Kickapoo Creek Subwatershed: Riley Creek.

There is no land within the watershed identified as conservation or recreational land; however 720 acres are within the Conservation Reserve Program.

Wetland areas cover approximately 664 acres of the watershed with Bottomland Forest being the predominant type at 59.8%.

The Illinois Department of Natural Resources was contacted to provide any Natural Heritage Data or related records for all listed threatened, endangered or rare species, high quality natural communities or natural areas documented within the Embarras River Watershed. Three species were located within the Kickapoo Creek Subwatershed including: Eastern Sand Darter, Kirkland's Snake, and Upland Sandpiper.

The Douglas-Hart Nature Center is also located in the watershed and features more than 70 acres of prairie, wetland and forest habitat. The nature center provides the communities with a unique opportunity to learn and discover nature. The non-for-profit center is owned and maintained by the Douglas-Hart Foundation and governed by a board of directors.

Analysis of Subwatershed Data

Water Quality Data and Identified Problems
The 303(d) list indicates that approximately 22.8 miles of streams within the Kickapoo Creek Subwatershed were impaired at the time of the 2008 listing. It should be noted that if a stream is not listed on the 303(d) list it may be impaired; however the data (or lack thereof) does not indicate the impairment at the time of publication. The potential causes of the impairment include pH and Phosphorus (Total).

Available water quality data from the United States Geological Survey (USGS) and the Illinois Environmental Protection Agency (IEPA) was analyzed based on screened water quality parameters. No USGS or IEPA stations are located with Kickapoo Creek Subwatershed.

NPDES permits are also indicative of the land use and water quality within a subwatershed. Compliance records for the NPDES facilities within the watershed were analyzed for the past three years Effluent exceedances were noted based on the number of times in the past three years the permit allowed discharge was exceeded. The water quality parameters screened in this analysis included Dissolved Oxygen (DO), Total Suspended Solids (TSS), Nitrogen (N) and Fecal Coliform (FC). There are 3 NPDES permits active within the Kickapoo Creek Subwatershed. According to compliance records, there have been no formal enforcement actions within the last 5 years; however there have been several noted effluent exceedances within the last 3 years. These exceedances included 9 reports of Fecal Coliform and 2 reports of Total Suspended Solids.

Twelve landfills were identified within the Kickapoo Creek Subwatershed.

Biological Data

IEPA has completed several habitat and biological studies within the Embarras River Watershed. Within the Kickapoo Creek Subwatershed, no IEPA sites with biological data were available.

Pollution Load Analysis

Nonpoint source modeling was completed for four water quality parameters including Total Suspended Solids (TSS), Total Nitrogen (N), Total Phosphorus (P), and Fecal Coliform. Table 9-27 summarized the modeling results for the Kickapoo Creek Subwatershed.

Table 9-27: Kickapoo Creek Subwatershed NPS Modeling Summary

Parameter	Loading
Total Suspended Solids	0.48 ton/ac/yr
Nitrogen	4.26 lb/ac/yr
Phosphorus	0.90 lb/ac/yr
Fecal Coliform	2.13 CFU bill/ac/yr

Figure 9-16: Non Point Source Pollutant Load Priority Areas (Nitrogen, Phosphorus, Sediment)

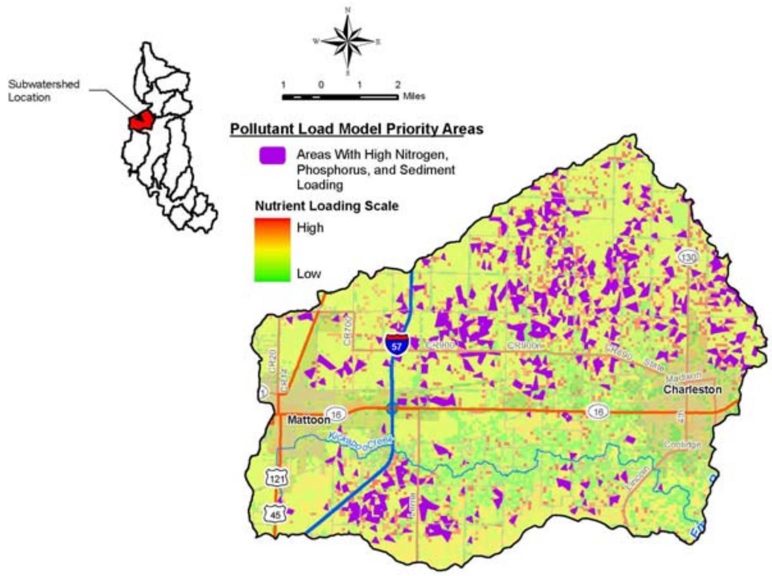


Table 9-28: Kickapoo Creek Subwatershed Pollutant Load Model Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Areas With High Nitrogen, Phosphorus, and Sediment Loading	5,436	8.30%

Figure 9-17: Fecal Coliform Bacteria Project & Priority Areas

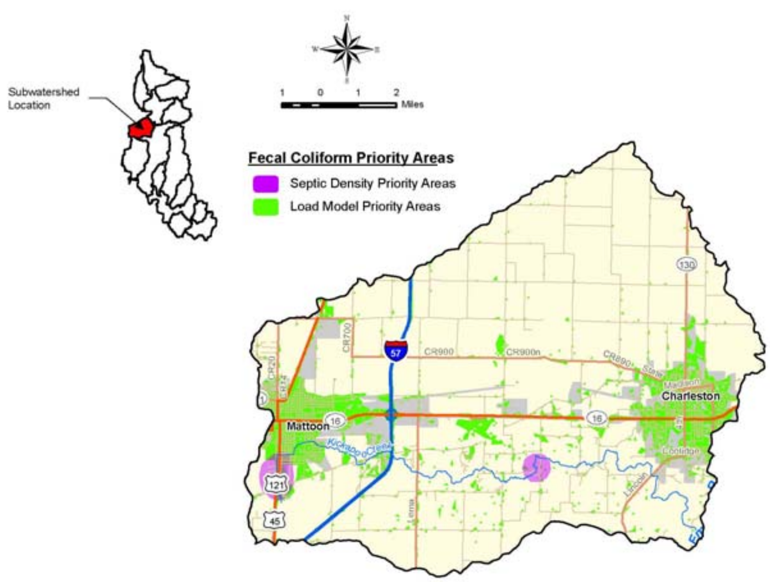


Table 9-29: Kickapoo Creek Subwatershed Fecal Coliform Bacteria Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Septic Density Priority Areas	863	1.32%
Load Model Priority Areas	8,422	12.87%

Figure 9-18: Highly Erodible Land Project & Priority Areas

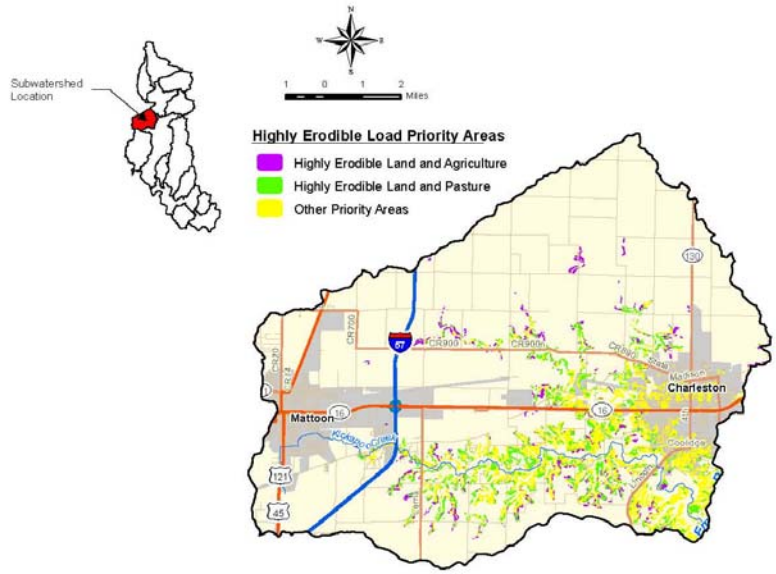


Table 9-30: Kickapoo Creek Subwatershed Highly Erodible Load Priority Areas		
Parameter	Acres	Percent in Watershed
Highly Erodible Land and Agriculture	348	0.53%
Highly Erodible Land and Pasture	778	1.19%
Other Priority Areas	4,101	6.26%

Figure 9-19: Wetland Restoration/Flood Mitigation Project & Priority Areas

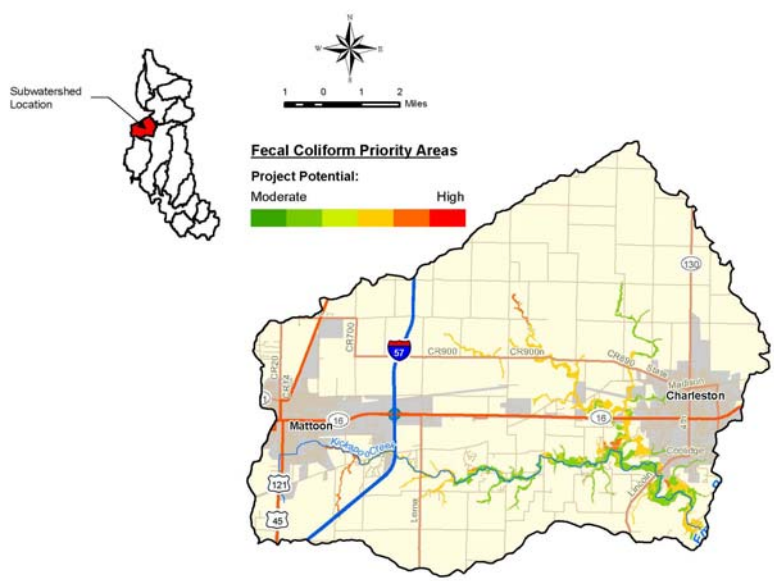


Figure 9-20: Stakeholder Identified Priority Projects

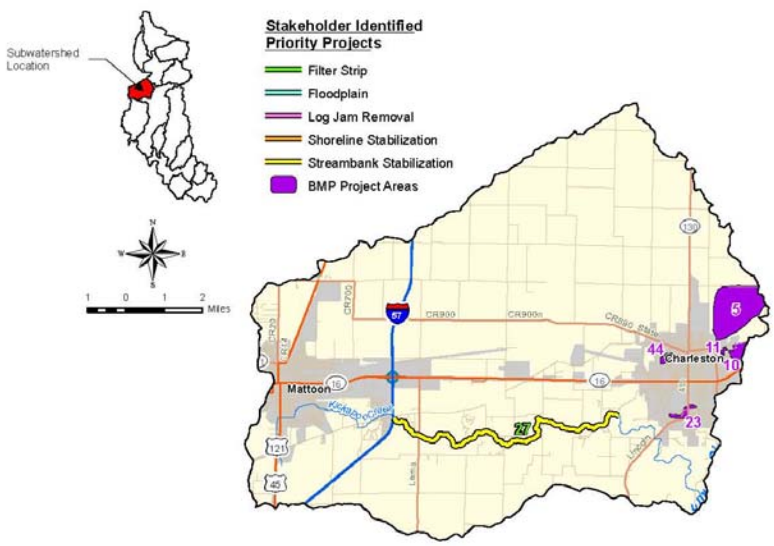


Table 9-31: Kickapoo Creek Subwatershed Estimated Load Reductions for Stakeholder Identified Priority Projects									
Map ID	**Project Type**	**Stakeholder**	**Length (ft)**	**Area (Acres)**	**Nitrogen (lbs)**	**Phosphorus (lbs)**	**Sediment (tons)**	**Fecal Coliform (bill fcu)**	**Project Details**
5	Detention	City of Charleston		876	35,041	14,016	657	9,111	Detention in crop field; High Priority
10	Detention Basin	City of Charleston		86	3,459	1,384	65	899	Detention in crop ground to alleviate flooding
11	Detention Basin	City of Charleston		12	464	185	9	121	Detention or floodplain restoration
23	Stabilization/Detention	City of Charleston		59	2,368	947	44	616	1 Ravine - Install detention structures and stabilize ravine; Low Priority
44	Wetland/Floodplain Restoration	City of Charleston		46	2,551	742	83	482	Floodplain restoration including wetlands; city property
27	Streambank Stabilization	Coles SWCD/NRCS	42,102		37,891	15,157	6,315	9,852	Kickapoo Creek

Range Creek – Embarras River Subwatershed

Subwatershed Characteristics

Subwatershed Location

The Range Creek – Embarras River Subwatershed (HUC 10 – 0512011208) is located in portions of Edgar, Coles, Cumberland and Jasper Counties as shown in Exhibit 33. The subwatershed encompasses approximately 222,342 acres (14.3% of the watershed) and includes the Embarras River, Polecat Creek, Whetstone Creek, Indian Creek, Hurricane Creek, Lost Creek, Range Creek, Mink Creek and Turkey Creek.

The Embarras River flows for approximately 64.5 miles generally north to south through the subwatershed. Polecat Creek and Whetstone Creek flow east to west; Hurricane Creek, Lost Creek and Range Creek flow northeast to southwest; and Mink Creek, Turkey Creek and Indian Creek flow northwest to southeast through the watershed to their confluence with the Embarras River. Polecat Creek is approximately 18.1 miles, Whetstone Creek is approximately 8.1 miles, Indian Creek is approximately 2.9 miles, Hurricane Creek is approximately 17.0 miles, Lost Creek is approximately 10.9 miles, Range Creek is approximately 22.5 miles, Mink Creek is approximately 11.7 miles and Turkey Creek is approximately 4.9 miles long.

Population

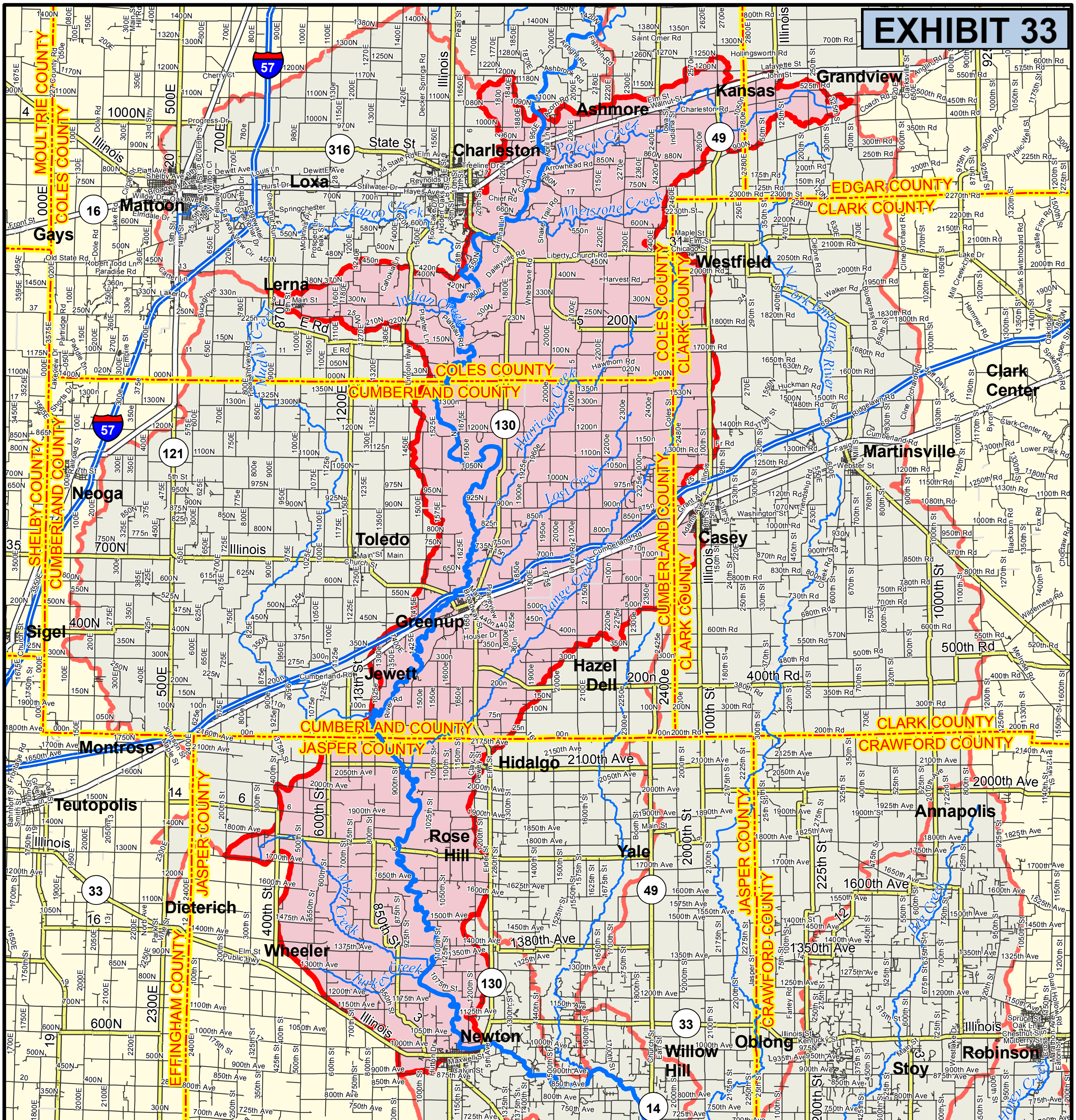
According to the 1990 Census, the population within the Range Creek – Embarras River Subwatershed was approximately 14,052. In the 2000 Census, the population was approximately 17,436, an increase of 24.1%.

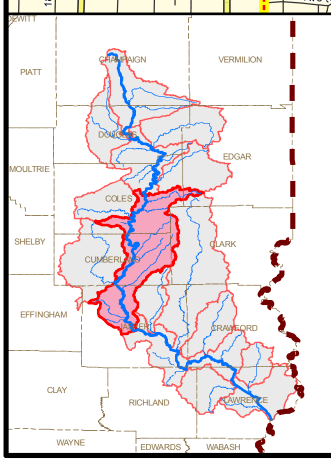
The majority of the subwatershed is relatively sparsely populated with population density averaging less than 0.1 people per acre. The most densely populated areas are located in the northwestern portion of the subwatershed associated with the City of Charleston, the east-central portion of the subwatershed associated with the City of Casey, and in the southern portion of the subwatershed associated with the City of Newton.

Land Cover

Land Use within the Range Creek – Embarras River Subwatershed was analyzed based on the 2007 Cropland Data Layer (CDL) for Illinois published by the United State Department of Agriculture, National Agriculture Statistics Service (USDA-NASS). With approximately 54.8% of the subwatershed covered by agriculture (Table 9-32), the Range Creek – Embarras River Subwatershed still remains primarily rural and agricultural. The developed areas (approximately 9.1%) are concentrated in the northwestern portion of the subwatershed associated with the City of Charleston, the east-central portion of the subwatershed associated with the City of Casey, and in the southern portion of the subwatershed associated with the City of Newton.

EXHIBIT 33





Range Creek-Embarras River Subwatershed

HUC: 0512011208 Acres: 222,342

Embarras River Watershed Plan

Subwatershed Location Map

2 0 2 4 Miles

ERMA Embarras River Management Association

Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Range Creek-Embarras River Subwatershed
- Embarras Subwatersheds
- Interstate
- US Highway
- State Highway
- Local Road
- Minor Road
- Other Road
- Ramp

Table 9-32: Range Creek – Embarras River Subwatershed Land Cover		
Landuse Classification	**Acres**	**Percentage**
Agricultural	121,731	54.8%
Barren	102	0.1%
Developed	20,164	9.1%
Forest	55,997	25.2%
Grassland	22,744	10.2%
Open Water	1,515	0.7%
Wetlands	89	0.0%
Total	222,342	100.1%*
*Note – Percent totals do not add to 100% due to rounding		

Soil Characteristics

The soils within the Range Creek – Embarras River Subwatershed fall into 14 major associations (Table 9-33). Approximately 70.3% of the basin area is composed of five soil associations, with the remaining nine soil associations each comprising 0.2-6.6% of the subwatershed.

Table 9-33: Range Creek – Embarras River Subwatershed Soil Associations		
Association	**Acres**	**Percentage**
Oconee-Cowden-Piasa	23,578	10.6%
Hoyleton-Cisne-Huey	31,125	14.0%
Catlin-Flanagan-Drummer	8,910	4.0%
Plano-Proctor-Worthen	4,069	1.8%
Saybrook-Dana-Drummer	10,407	4.7%
Lawson-Sawmill-Darwin	6,844	3.1%
Hosmer-Stoy-Weir	13,450	6.0%
Ava-Bluford-Wynoose	41,986	18.9%
Birkbeck-Sabina-Sunbury	14,650	6.6%
St. Charles-Camden-Drury	5,620	2.5%
Dodge-Russell-Miami	29,209	13.1%
Oakville-Lamont-Alvin	1,754	0.8%
Haymond-Petrolia-Karnak	30,372	13.7%
Water	368	0.2%
Total	222,342	100.0%

Highly erodible soils comprise approximately 13,365 acres (6.0%) of the subwatershed, while hydric soils consist of 36.0% (79,964 acres) of the subwatershed.

Natural Resources

Illinois Natural Area Inventory Sites (INAI) are natural landscape features and communities of the highest quality still remaining in Illinois. In most cases, these sites are also where State and/or Federally listed Threatened and Endangered species have been found. Twelve INAI sites are located within the Range Creek – Embarras River Subwatershed: Center

School Geological Area, Embarras River, Embarras River Land and Water Reserve, Five-Mile Hill Prairie, Green Prairie, Hillside Marsh, Hutton Geological Area, Sargent's Woods, Stevens Hill Prairie, Warbler Woods, Water Works Hill Prairie, and Woodyard Memorial Conservation Area.

Approximately 2,523 acres of land within the watershed is identified as conservation or recreational land, while 11,965 acres are within the Conservation Reserve Program.

Wetland areas cover approximately 6,564 acres of the watershed with Bottomland Forest being the predominant type at 61.1%

The Illinois Department of Natural Resources was contacted to provide any Natural Heritage Data or related records for all listed threatened, endangered or rare species, high quality natural communities or natural areas documented within the Embarras River Watershed. Eleven species were located within the Range Creek – Embarras River Subwatershed including: Barn Owl, Bigeye Chub, Broomrape, Clubshell, Eastern Sand Darter, Fibrous-rooted Sedge, Harlequin Darter, Kirkland's Snake, Least Bittern, Loggerhead Shrike, and Swamp Metalmark.

Analysis of Subwatershed Data

Water Quality Data and Identified Problems

The 303(d) list indicates that approximately 36.3 miles of the Embarras River within the Range Creek – Embarras River Subwatershed was impaired at the time of the 2008 listing. It should be noted that if a stream is not listed on the 303(d) list it may be impaired; however the data (or lack thereof) does not indicate the impairment at the time of publication. The potential cause of the impairment is Fecal Coliform.

Available water quality data from the United States Geological Survey (USGS) and the Illinois Environmental Protection Agency (IEPA) was analyzed based on screened water quality parameters. There are four USGS water quality stations within the Range Creek – Embarras River Subwatershed, however only one of these stations (03344000) contains data on the screened parameters. Seven IEPA stations (RBC-1, RBC-2, RBC-3, RBH-1, RBH-2, RBH-3, and BE-09) are located within the subwatershed and have water quality data. Table 9-34 below summarizes the USGS and IEPA sampling mean value of each parameter screened and the corresponding water quality target.

Table 9-34: Range Creek – Embarras River Water Quality Sampling Summary

Water Quality Parameter	USGS Mean Value	IEPA Mean Value	Water Quality Target
Dissolved Oxygen	10.1 mg/L	Not available	between 4.0 and 12.0 mg/L
Fecal Coliform	599 CFU/100mL	Not available	200 CFU/100mL
Nitrate + Nitrite	6.4 mg/L	2.9 mg/L	1.8 mg/L
Total Phosphorus	0.265 mg/L	0.147 mg/L	0.118 mg/L
TSS	74.5 mg/L	32.0 mg/L	50.0 mg/L

Based on the available water quality information, the Range Creek – Embarras River consistently tests higher than the water quality targets in Nitrate + Nitrite and Total Phosphorus. Fecal Coliform and TSS tested higher than the water quality target in the USGS sampling however this data was not available for the IEPA station. Dissolved Oxygen falls within the acceptable ranges of the target; therefore it is not a concern for this subwatershed in general. The data does not represent the Charleston Side Channel Reservoir which has had documented dissolved oxygen concerns.

NPDES permits are also indicative of the land use and water quality within a subwatershed. Compliance records for the NPDES facilities within the watershed were analyzed for the past three years Effluent exceedances were noted based on the number of times in the past three years the permit allowed discharge was exceeded. The water quality parameters screened in this analysis included Dissolved Oxygen (DO), Total Suspended Solids (TSS), Nitrogen (N) and Fecal Coliform (FC). There are 9 NPDES permits active within the Range Creek – Embarras River Subwatershed. According to compliance records, there have been no formal enforcement actions within the last 5 years; however there have been several noted effluent exceedances within the last 3 years. These exceedances included 1 report of Total Suspended Solids and 4 reports of Nitrogen.

Six landfills were identified within the Range Creek – Embarras River Subwatershed.

Biological Data

IEPA has completed several habitat and biological studies within the Embarras River Watershed. Within the Range Creek – Embarras River Subwatershed, two IEPA site have biological information available. Sampling data was available from a July 2001 study and a July 2006 study. Table 9-35 summarizes the IEPA mean value for the Macroinvertebrate Index of Biotic Integrity (mIBI) and the Index of Biotic Integrity (IBI).

Table 9-35: Range Creek – Embarras River Subwatershed IEPA Biological Sampling Summary	
Habitat/Biological Parameter	**IEPA Mean Value**
mIBI	76.6
IBI	48

With a mIBI score of 76.6, the Range Creek – Embarras River Subwatershed shows no impairment for macroinvertebrate communities and an IBI score of 48 indicates that the fish community is fair.

Pollution Load Analysis

Nonpoint source modeling was completed for four water quality parameters including Total Suspended Solids (TSS), Total Nitrogen (N), Total Phosphorus (P), and Fecal Coliform. Table 9-36 summarized the modeling results for the Range Creek- Embarras River Subwatershed.

Table 9-36: Range Creek – Embarras River Subwatershed NPS Modeling Summary	
Parameter	**Loading**
Total Suspended Solids	0.42 ton/ac/yr
Nitrogen	4.24 lb/ac/yr
Phosphorus	0.86 lb/ac/yr
Fecal Coliform	1.96 CFU bill/ac/yr

Range Creek Subwatershed Implementation Plan

Figure 9-21: Non Point Source Pollutant Load Priority Areas (Nitrogen, Phosphorus, Sediment)

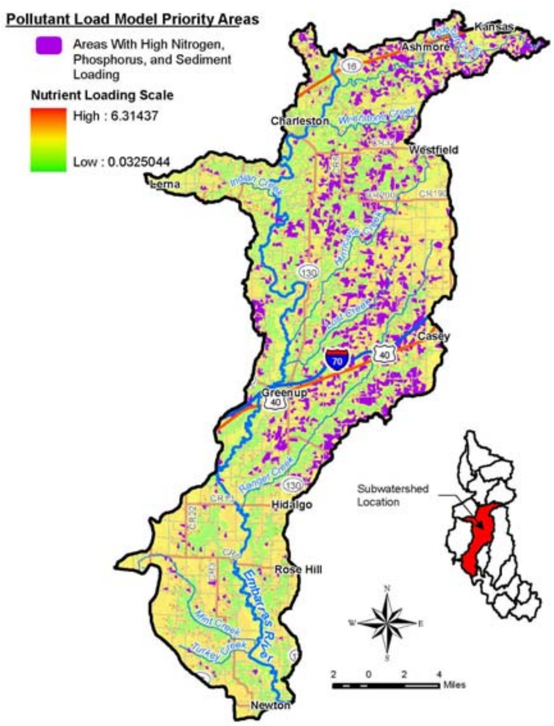


Table 9-37: Range Creek – Embarras River Subwatershed Pollutant Load Model Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Areas With High Nitrogen, Phosphorus, and Sediment Loading	17,834	8.02%

Figure 9-22: Fecal Coliform Bacteria Project & Priority Areas

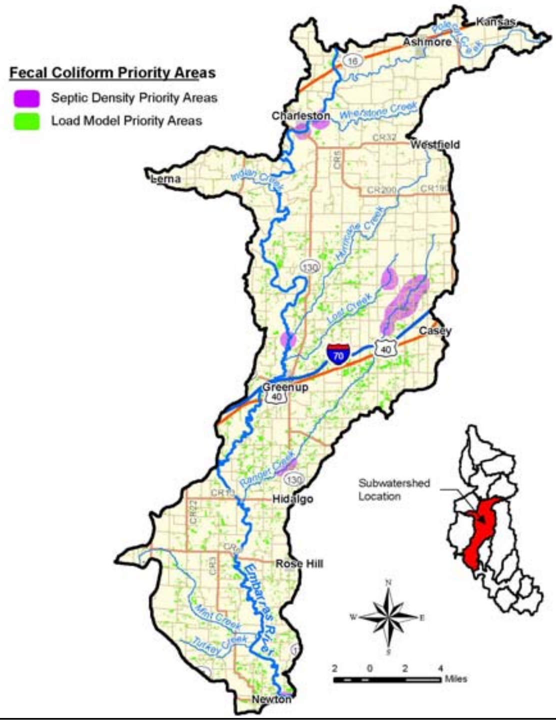


Table 9-38: Range Creek – Embarras River Subwatershed Fecal Coliform Bacteria Priority Areas		
Parameter	Acres	Percent in Watershed
Septic Density Priority Areas	5,608	2.52%
Load Model Priority Areas	14,596	6.56%

Figure 9-23: Highly Erodible Land Project & Priority Areas

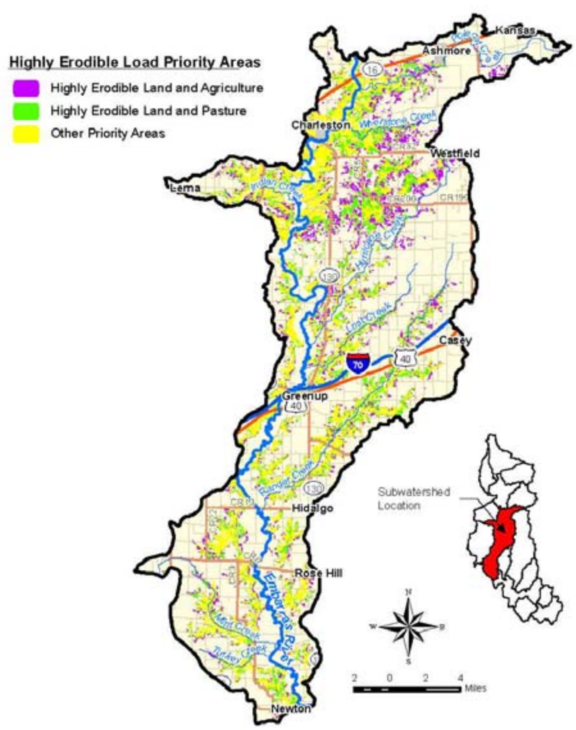


Table 9-39: Range Creek – Embarras River Subwatershed Highly Erodible Load Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Highly Erodible Land and Agriculture	2,711	1.22%
Highly Erodible Land and Pasture	5,126	2.31%
Other Priority Areas	26,116	11.75%

Figure 9 – 24: Wetland Restoration/Flood Mitigation Project & Priority Areas

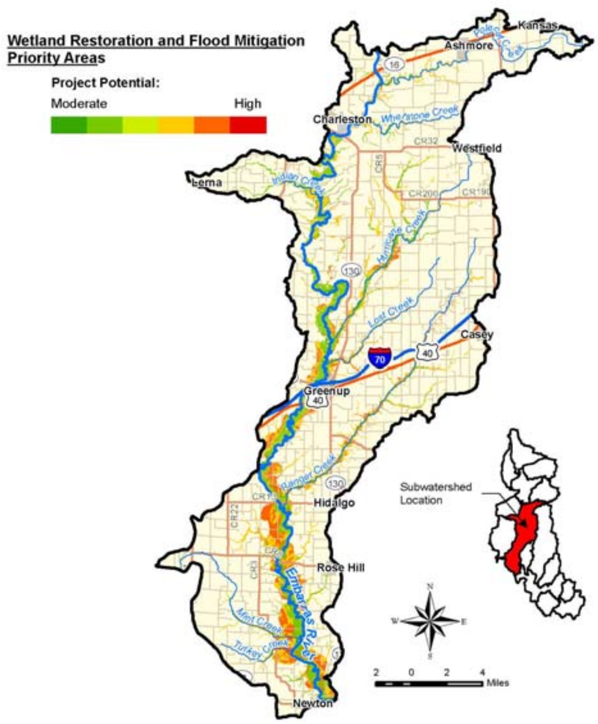


Figure 9-25: Stakeholder Identified Priority Projects

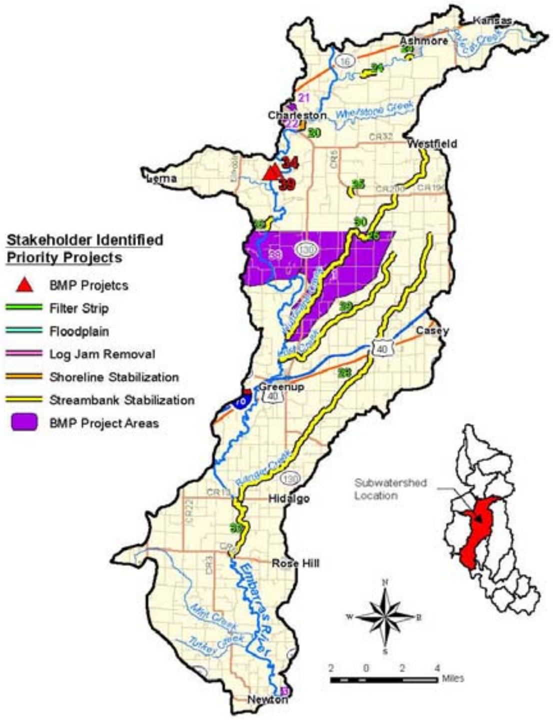


Table 9-40: Range Creek Subwatershed Estimated Load Reductions for Stakeholder Identified Priority Projects									
Map ID	**Project Type**	**Stakeholder**	**Length (ft)**	**Area (Acres)**	**Nitrogen (lbs)**	**Phosphorus (lbs)**	**Sediment (tons)**	**Fecal Coliform (bill fcu)**	**Project Details**
5	Detention	City of Charleston		0	7	3	0	2	Detention in crop field; High Priority
20	Shoreline Stabilization	City of Charleston	3,697		3,327	1,331	1,183	865	berm with wetlands to control bank erosion
21	Stabilization/ Detention	City of Charleston		113	4,520	1,808	85	1,175	2 Ravines - Install detention structures and stabilize ravines; INAI site - High Priority
22	Stabilization/ Detention	City of Charleston		102	4,093	1,637	77	1,064	4 Ravines - Install detention structures and stabilize ravines; High Priority
3	Acquisition/Wetland	City of Newton		170	9,326	2,713	305	1,764	Acquire property in floodplain and restore wetlands to mitigate flooding
24	Streambank Stabilization	Coles SWCD/NRCS	5,912		5,321	2,128	1,892	1,383	Polecat Creek
25	Streambank Stabilization	Coles SWCD/NRCS	3,038		2,734	1,094	972	711	Hurricane Creek
25	Streambank Stabilization	Coles SWCD/NRCS	3,038		2,734	1,094	972	711	Hurricane Creek
26	Streambank Stabilization	Coles SWCD/NRCS	4,342		3,908	1,563	1,389	1,016	Sand Pit
1	All BMPs	Cumberland SWCD/NRCS		12274	14,728	4,909	1,227	3,191	Priority shed for implementation; potential willing landowners
28	Streambank Stabilization	Cumberland SWCD/NRCS	118,300		106,470	42,588	17,745	27,682	Range Creek
29	Streambank Stabilization	Cumberland SWCD/NRCS	57,012		51,311	20,524	8,552	13,341	Lost Creek
30	Streambank Stabilization	Cumberland SWCD/NRCS	89,070		80,163	32,065	13,360	20,842	Hurricane Creek
30	Streambank Stabilization	Cumberland SWCD/NRCS	89,070		80,163	32,065	13,360	20,842	Hurricane Creek
38	WASCB/Waterway	Cumberland SWCD/NRCS		5939	713	178	4,751	116	Target BMPs on B slopes and greater between A slopes and floodways
19	Sediment Control; Retention	Jasper SWCD/NRCS		3	122	49	5	32	Sam Parr Lake; watershed plan in place; sediment reduction and retention
32	Streambank Stabilization	Jasper SWCD/NRCS	26,846		24,162	9,665	4,027	6,282	Main Stem

Big Creek Subwatershed

Subwatershed Characteristics

Subwatershed Location

The Big Creek Subwatershed (HUC 10 – 0512011211) is located primarily in Crawford County with a smaller portion in Jasper County as shown in Exhibit 34. The subwatershed encompasses approximately 72,143 acres (4.6% of the watershed) and includes Big Creek.

Big Creek flows generally north to south through the subwatershed to its confluence with the Embarras River. Big Creek is approximately 23.7 miles long.

Population

According to the 1990 Census, the population within the Big Creek Subwatershed was approximately 5,089. In the 2000 Census, the population was approximately 4,603, a decrease of 9.5%.

The majority of the subwatershed is relatively sparsely populated with population density averaging less than 0.1 people per acre. The most densely populated areas are located in the eastern portion of the subwatershed and are associated with the City of Robinson.

Land Cover

Land Use within the Big Creek Subwatershed was analyzed based on the 2007 Cropland Data Layer (CDL) for Illinois published by the United State Department of Agriculture, National Agriculture Statistics Service (USDA-NASS). With approximately 61.6% of the subwatershed covered by agriculture (Table 9-41) and approximately 26.7% covered by grassland or forest, the Big Creek Subwatershed still remains primarily rural and agricultural. The developed areas (approximately 11.2%) are concentrated primarily in the eastern portion of the subwatershed and are associated with the City of Robinson.

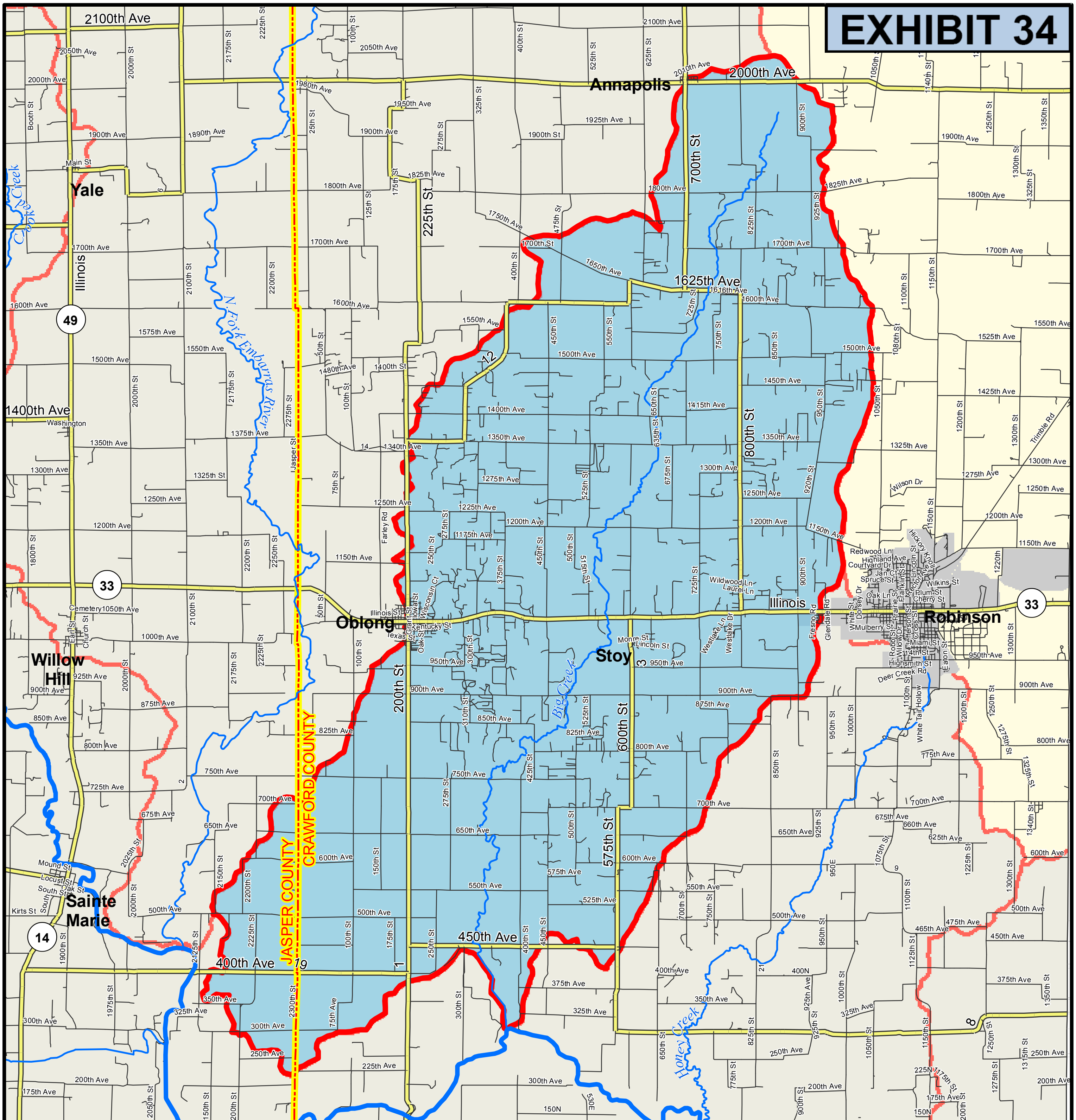
Table 9-41: Big Creek Subwatershed Land Cover

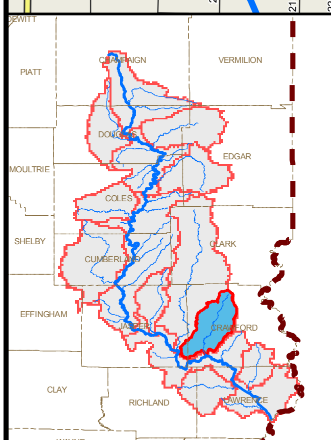
Landuse Classification	Acres	Percentage
Agricultural	44,417	61.6%
Barren	3	0.0%
Developed	8,095	11.2%
Forest	14,440	20.0%
Grassland	4,806	6.7%
Open Water	173	0.2%
Wetlands	210	0.3%
Total	72,144	100.0%

Soil Characteristics

The soils within the Big Creek Subwatershed fall into six major associations (Table 9-42). Over half of the subwatershed falls within the Ava-Bluford-Wynoose association (54.9%).

EXHIBIT 34





Big Creek Subwatershed

HUC: 0512011211 Acres: 72,143

Embarras River Watershed Plan

Subwatershed Location Map

1 0 1 2 Miles

ERMA
EMBARRAS RIVER MANAGEMENT ASSOCIATION

Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Big Creek Subwatershed
- Embarras Subwatersheds
- Interstate
- US Highway
- State Highway
- Local Road
- Minor Road
- Other Road
- Ramp

Table 9-42: Big Creek Subwatershed Soil Associations		
Association	**Acres**	**Percentage**
Hoyleton-Cisne-Huey	26,570	36.8%
Lawson-Sawmill-Darwin	1,195	1.7%
Hosmer-Stoy-Weir	17	0.0%
Ava-Bluford-Wynoose	39,588	54.9%
Oakville-Lamont-Alvin	14	0.0%
Haymond-Petrolia-Karnak	4,759	6.6%
Total	72,143	100.0%

Highly erodible soils comprise approximately 6,752 acres (9.4%) of the subwatershed, while hydric soils consist of 46.2% (33,347 acres) of the subwatershed.

Natural Resources

Illinois Natural Area Inventory Sites (INAI) are natural landscape features and communities of the highest quality still remaining in Illinois. In most cases, these sites are also where State and/or Federally listed Threatened and Endangered species have been found. One INAI site is located within the Big Creek Subwatershed: Edward V. Price Woods.

No land within the watershed is identified as conservation or recreational land; however 2,020 acres are within the Conservation Reserve Program.

Wetland areas cover approximately 2,836 acres of the watershed with Bottomland Forest being the predominant type at 88.2%

The Illinois Department of Natural Resources was contacted to provide any Natural Heritage Data or related records for all listed threatened, endangered or rare species, high quality natural communities or natural areas documented within the Embarras River Watershed. Two species were located within the Big Creek Subwatershed including: Eastern Ribbon Snake and Storax.

Analysis of Subwatershed Data

Water Quality Data and Identified Problems

The 303(d) list indicates that none of the streams within the Big Creek Subwatershed were impaired at the time of the 2008 listing. It should be noted that if a stream is not listed on the 303(d) list it may be impaired; however the data (or lack thereof) does not indicate the impairment at the time of publication.

Available water quality data from the United States Geological Survey (USGS) and the Illinois Environmental Protection Agency (IEPA) was analyzed based on screened water quality parameters. There is one USGS water quality station within the Big Creek Subwatershed and no IEPA stations. Table 9-43 below summarizes the USGS and IEPA sampling mean value of each parameter screened and the corresponding water quality target.

Table 9-43: Big Creek Water Quality Sampling Summary			
Water Quality Parameter	USGS Mean Value	IEPA Mean Value	Water Quality Target
Dissolved Oxygen	6.4 mg/L	Not available	between 4.0 and 12.0 mg/L
Fecal Coliform	Not available	Not available	200 CFU/100mL
Nitrate + Nitrite	Not available	Not available	1.8 mg/L
Total Phosphorus	Not available	Not available	0.118 mg/L
TSS	Not available	Not available	50.0 mg/L

Based on the available water quality information, Dissolved Oxygen falls within the acceptable range of the target therefore it is not a concern for this subwatershed. No other water quality data was available.

NPDES permits are also indicative of the land use and water quality within a subwatershed. Compliance records for the NPDES facilities within the watershed were analyzed for the past three years Effluent exceedances were noted based on the number of times in the past three years the permit allowed discharge was exceeded. The water quality parameters screened in this analysis included Dissolved Oxygen (DO), Total Suspended Solids (TSS), Nitrogen (N) and Fecal Coliform (FC). There are 2 NPDES permits active within the Big Creek Subwatershed. According to compliance records, there have been no formal enforcement actions within the last 5 years; however there have been several noted effluent exceedances within the last 3 years. These exceedances included 3 reports of Total Suspended Solids.

Three landfills were identified within the Big Creek Subwatershed.

Biological Data

IEPA has completed several habitat and biological studies within the Embarras River Watershed. Within the Big Creek Subwatershed, no IEPA sites with biological data were available.

Pollution Load Analysis

Nonpoint source modeling was completed for four water quality parameters including Total Suspended Solids (TSS), Total Nitrogen (N), Total Phosphorus (P), and Fecal Coliform. Table 9-44 summarized the modeling results for the Big Creek Subwatershed.

Table 9-44: Big Creek Subwatershed NPS Modeling Summary	
Parameter	Loading
Total Suspended Solids	0.38 ton/ac/yr
Nitrogen	4.54 lb/ac/yr
Phosphorus	0.90 lb/ac/yr
Fecal Coliform	2.16 CFU bill/ac/yr

Big Creek Subwatershed Implementation Plan

Figure 9-26: Non Point Source Pollutant Load Priority Areas (Nitrogen, Phosphorus, Sediment)

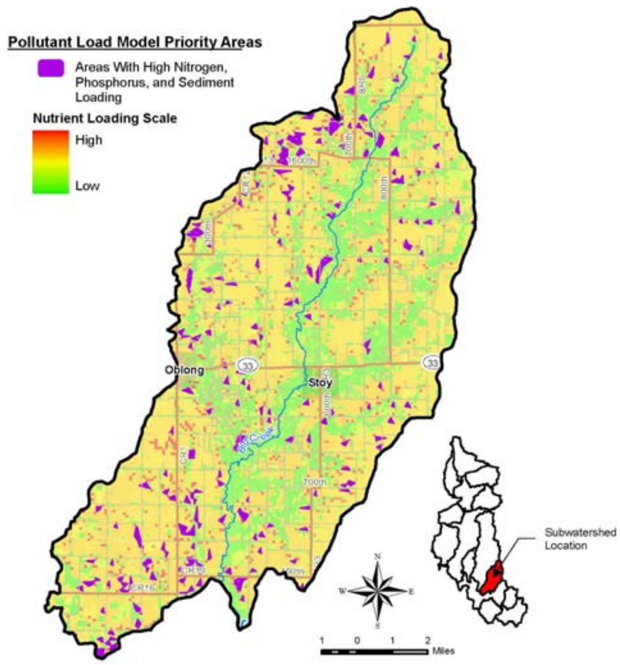


Table 9-45: Big Creek Subwatershed Pollutant Load Model Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Areas With High Nitrogen, Phosphorus, and Sediment Loading	2,113	2.93%

Figure 9-27: Fecal Coliform Bacteria Project & Priority Areas

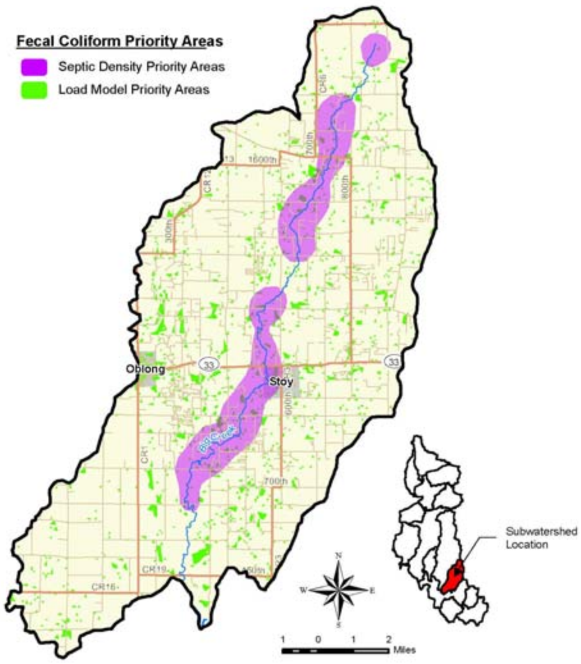


Table 9-46: Big Creek Subwatershed Fecal Coliform Bacteria Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Septic Density Priority Areas	7,599	10.53%
Load Model Priority Areas	4,132	5.73%

Figure 9-28: Highly Erodible Land Project & Priority Areas

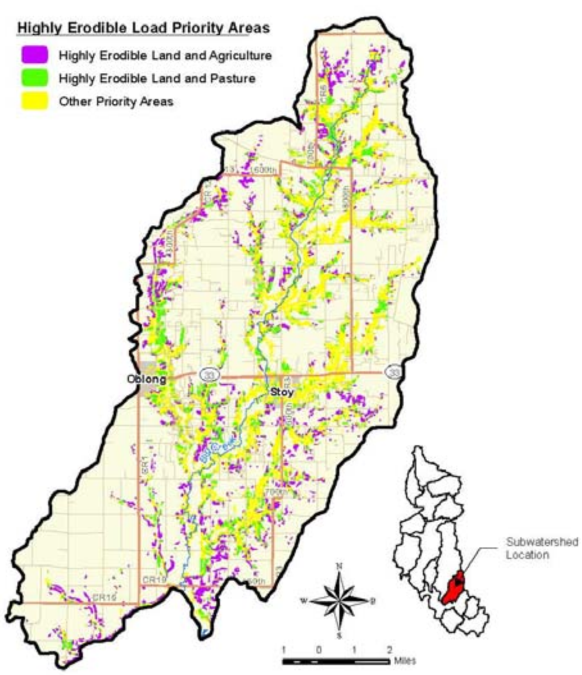


Table 9-47: Big Creek Subwatershed Highly Erodible Load Priority Areas		
Parameter	Acres	Percent in Watershed
Highly Erodible Land and Agriculture	1,979	2.74%
Highly Erodible Land and Pasture	1,453	2.01%
Other Priority Areas	9,770	13.54%

Figure 9-29: Wetland Restoration/Flood Mitigation Project & Priority Areas

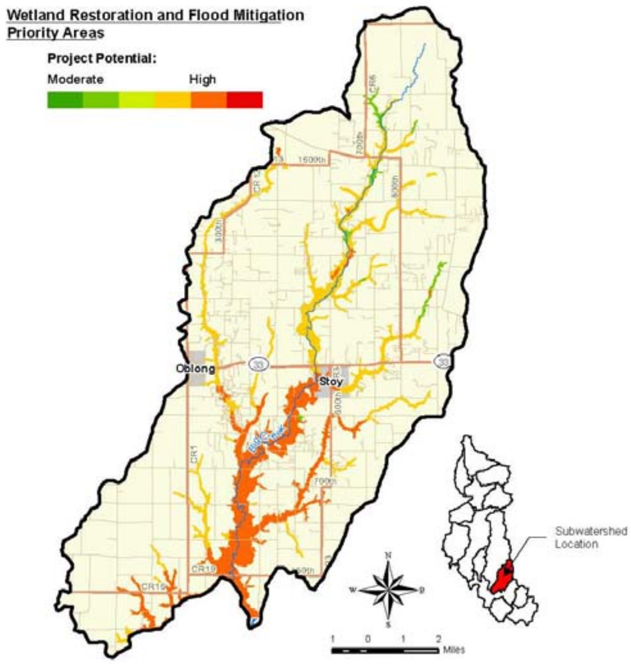


Figure 9-30: Stakeholder Identified Priority Projects

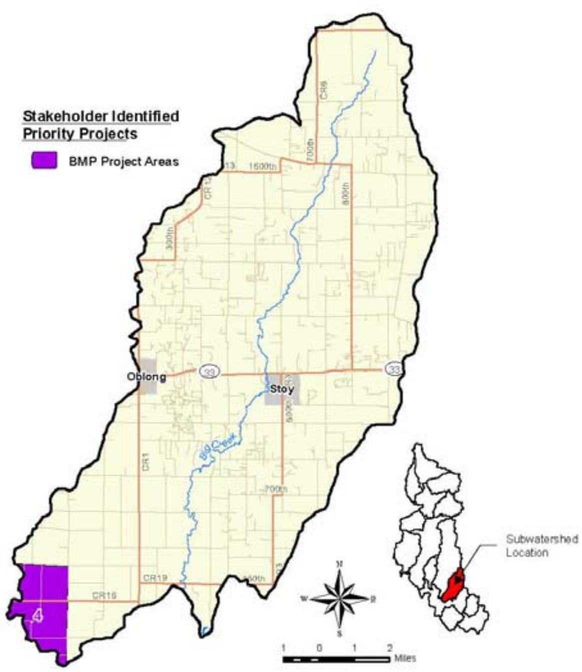


Table 9-48: Big Creek Subwatershed Estimated Load Reductions for Stakeholder Identified Priority Projects								
Map ID	Project Type	Stakeholder	Area (Acres)	Nitrogen (lbs)	Phosphorus (lbs)	Sediment (tons)	Fecal Coliform (bill fcu)	Project Details
37	WASCB/Retention	Crawford SWCD/NRCS	18	2	1	14	0	Focus work in this subwatershed
4	CNMP/Waste Utilization	Jasper SWCDD/NRCS	2060	2,884	989	247	643	High Concentration of confined swine opps within 5mi radius of Ste. Marie; CNMPs

Honey Creek – Embarras River Subwatershed

Subwatershed Characteristics

Subwatershed Location

The Honey Creek – Embarras River Subwatershed (HUC 10 – 0512011212) is located in portions of Jasper, Crawford, Richland and Lawrence Counties as shown in Exhibit 35. The subwatershed encompasses approximately 130,554 acres (8.4% of the watershed) and includes the Embarras River, Pond Grove Creek, Calfkiller Creek and Honey Creek.

The Embarras River flows for approximately 46.4 miles generally northwest to southeast through the subwatershed. Pond Grove Creek flows northwest to southeast, Calfkiller Creek flows southwest to northeast, and Honey Creek flows northeast to southwest through the watershed to their confluence with the Embarras River. Pond Grove Creek is approximately 7.2 miles long, Calfkiller Creek is approximately 7.5 miles, and Honey Creek is approximately 13.8 miles long.

Population

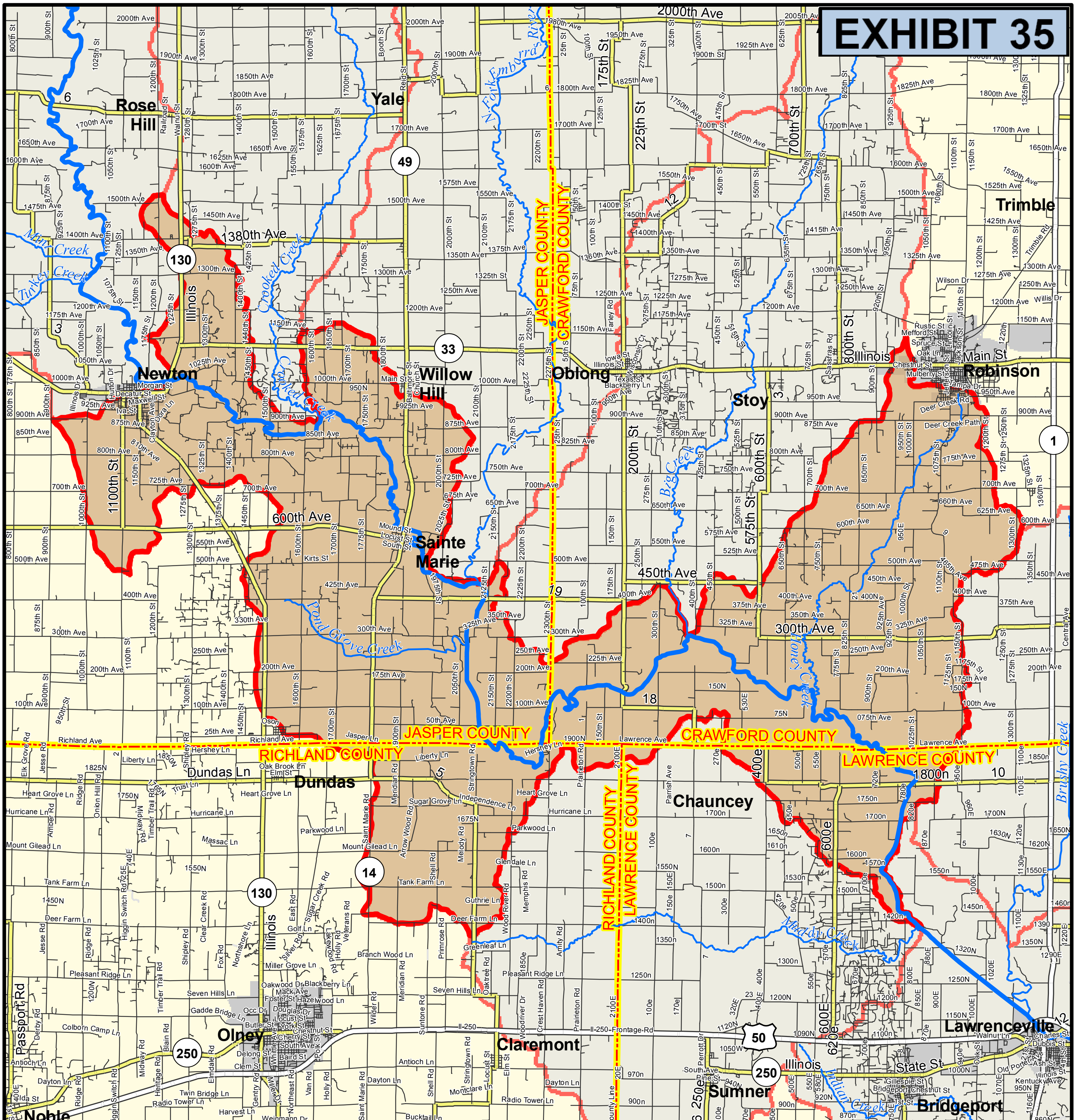
According to the 1990 Census, the population within the Honey Creek – Embarras River Subwatershed was approximately 8,408. In the 2000 Census, the population was approximately 7,605, a decrease of 9.6%.

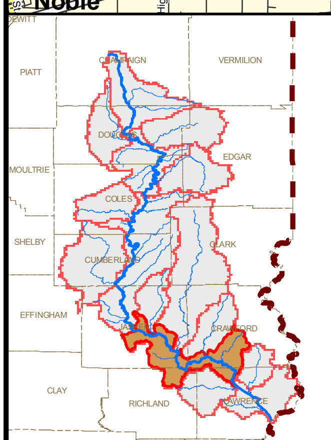
The majority of the subwatershed is relatively sparsely populated with population density averaging less than 0.1 people per acre. The most densely populated areas are located in the eastern portion of the subwatershed associated with the City of Newton and in the western portion associated with the City of Robinson.

Land Cover

Land Use within the Honey Creek – Embarras River Subwatershed was analyzed based on the 2007 Cropland Data Layer (CDL) for Illinois published by the United State Department of Agriculture, National Agriculture Statistics Service (USDA-NASS). With approximately 58.3% of the subwatershed covered by agriculture (Table 9-49) and approximately 31.5% covered by grassland or forest, the Honey Creek – Embarras River Subwatershed still remains primarily rural and agricultural. The developed areas (approximately 9.1%) are concentrated primarily in the eastern portion of the subwatershed associated with the City of Newton and in the western portion associated with the City of Robinson.

Table 9-49: Honey Creek – Embarras River Subwatershed Land Cover		
Landuse Classification	**Acres**	**Percentage**
Agricultural	76,168	58.3%
Barren	1	0.0%
Developed	11,919	9.1%
Forest	28,800	22.1%
Grassland	12,269	9.4%
Open Water	986	0.8%
Wetlands	411	0.3%
Total	130,554	100.0%





Honey Creek-Embarras River Subwatershed

HUC: 0512011212 Acres: 130,554

Embarras River Watershed Plan

Subwatershed Location Map

ERMA EMBARRAS RIVER MANAGEMENT ASSOCIATION

Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Honey Creek-Embarras River Subwatershed
- Embarras Subwatersheds
- Interstate
- US Highway
- State Highway
- Local Road
- Minor Road
- Other Road
- Ramp

Soil Characteristics
The soils within the Honey Creek – Embarras River Subwatershed fall into eight major associations (Table 9-50). Approximately 81.4% of the basin area is composed of three soil associations, with the remaining five soil associations each comprising 1.1-9.8% of the subwatershed.

Table 9-50: Honey Creek – Embarras River Subwatershed Soil Associations		
Association	**Acres**	**Percentage**
Hoyleton-Cisne-Huey	31,116	23.8%
Harco-Patton-Montgomery	2,374	1.8%
Lawson-Sawmill-Darwin	21,807	16.7%
Hosmer-Stoy-Weir	1,468	1.1%
Ava-Bluford-Wynoose	53,395	40.9%
St. Charles-Camden-Drury	2,954	2.3%
Oakville-Lamont-Alvin	4,673	3.6%
Haymond-Petrolia-Karnak	12,767	9.8%
Total	130,554	100.0%

Highly erodible soils comprise approximately 9,032 acres (6.9%) of the subwatershed, while hydric soils consist of 37.5% (48,970 acres) of the subwatershed.

Natural Resources
Illinois Natural Area Inventory Sites (INAI) are natural landscape features and communities of the highest quality still remaining in Illinois. In most cases, these sites are also where State and/or Federally listed Threatened and Endangered species have been found. Three INAI sites are located within the Honey Creek – Embarras River Subwatershed: Chauncey Marsh, Edward V. Price Woods, and Prairie Ridge-Jasper County.

Approximately 1,930 acres of land within the watershed is identified as conservation or recreational land, while 6,434 acres are within the Conservation Reserve Program.

Wetland areas cover approximately 6,887 acres of the watershed with Bottomland Forest being the predominant type at 69.6%

The Illinois Department of Natural Resources was contacted to provide any Natural Heritage Data or related records for all listed threatened, endangered or rare species, high quality natural communities or natural areas documented within the Honey Creek – Embarras River Watershed. Twelve species were located within the Honey Creek – Embarras River Subwatershed including: American Bittern, Cerulean Warbler, Copperbelly Water Snake, Eastern Ribbon Snake, Eastern Sand Darter, Greater Prairie-Chicken, Loggerhead Shrike, Northern Harrier, Ornate Box Turtle, Prairie Rose Gentian, Royal Catchfly, and Upland Sandpiper.

Analysis of Subwatershed Data

Water Quality Data and Identified Problems

The 303(d) list indicates that approximately 26.5 miles of the Embarras River within the Honey Creek – Embarras River Subwatershed was impaired at the time of the 2008 listing. It should be noted that if a stream is not listed on the 303(d) list it may be impaired; however the data (or lack thereof) does not indicate the impairment at the time of publication. The potential cause of the impairment includes Fecal Coliform.

Available water quality data from the United States Geological Survey (USGS) and the Illinois Environmental Protection Agency (IEPA) was analyzed based on screened water quality parameters. There are two USGS water quality stations within the Honey Creek – Embarras River Subwatershed, however only one of these stations (03345500) contains data on the screened parameters. Only one IEPA station (BE-01) is located within the subwatershed. Table 9-51 below summarizes the USGS and IEPA sampling mean value of each parameter screened and the corresponding water quality target.

Table 9-51: Honey Creek – Embarras River Water Quality Sampling Summary

Water Quality Parameter	USGS Mean Value	IEPA Mean Value	Water Quality Target
Dissolved Oxygen	9.9 mg/L	Not available	between 4.0 and 12.0 mg/L
Fecal Coliform	1029 CFU/100mL	Not available	200 CFU/100mL
Nitrate + Nitrite	4.5 mg/L	0.2 mg/L	1.8 mg/L
Total Phosphorus	0.245 mg/L	0.196 mg/L	0.118 mg/L
TSS	118.0 mg/L	38.0 mg/L	50.0 mg/L

Based on the available water quality information, the Honey Creek – Embarras River consistently tests higher than the water quality targets in Total Phosphorus. Fecal Coliform tested higher than the water quality target in the USGS sampling however Fecal Coliform data was not available for the IEPA station. Nitrate +Nitrite and TSS tested higher than the water quality target in the USGS sampling however these parameters tested lower than the water quality targets in the IEPA station. Dissolved Oxygen falls within the acceptable ranges of the water quality target; therefore it is not a concern for this subwatershed.

NPDES permits are also indicative of the land use and water quality within a subwatershed. Compliance records for the NPDES facilities within the watershed were analyzed for the past three years Effluent exceedances were noted based on the number of times in the past three years the permit allowed discharge was exceeded. The water quality parameters screened in this analysis included Dissolved Oxygen (DO), Total Suspended Solids (TSS), Nitrogen (N) and Fecal Coliform (FC). There are 2 NPDES permits active within the Honey Creek – Embarras River Subwatershed. According to compliance records, there have been no formal enforcement actions within the last 5 years; however there have been several noted effluent exceedances within the last 3 years. These exceedances included 5 reports of Total Suspended Solids.

Two landfills were identified within the Honey Creek – Embarras River Subwatershed.

Biological Data

IEPA has completed several habitat and biological studies within the Embarras River Watershed. Within the Honey Creek – Embarras River Subwatershed, one IEPA site has biological information available. Sampling data was available from an August 2001 study and an August 2006 study. Table 9-52 summarizes the IEPA mean value for the Macroinvertebrate Index of Biotic Integrity (mIBI) and the Index of Biotic Integrity (IBI).

Table 9-52: Honey Creek – Embarras River Subwatershed IEPA Biological Sampling Summary	
Habitat/Biological Parameter	**IEPA Mean Value**
mIBI	40.5
IBI	51

With a mIBI score of 40.5, the Honey Creek – Embarras River Subwatershed shows no impairment for macroinvertebrate communities and an IBI score of 51 indicates that the fish community is fair.

Pollution Load Analysis

Nonpoint source modeling was completed for four water quality parameters including Total Suspended Solids (TSS), Total Nitrogen (N), Total Phosphorus (P), and Fecal Coliform. Table 9-53 summarized the modeling results for the Honey Creek – Embarras River Subwatershed.

Table 9-53: Honey Creek – Embarras River Subwatershed NPS Modeling Summary	
Parameter	**Loading**
Total Suspended Solids	0.37 ton/ac/yr
Nitrogen	4.46 lb/ac/yr
Phosphorus	0.87 lb/ac/yr
Fecal Coliform	2.17 CFU bill/ac/yr

Honey Creek Subwatershed Implementation Plan

Figure 9-31: Non Point Source Pollutant Load Priority Areas (Nitrogen, Phosphorus, Sediment)

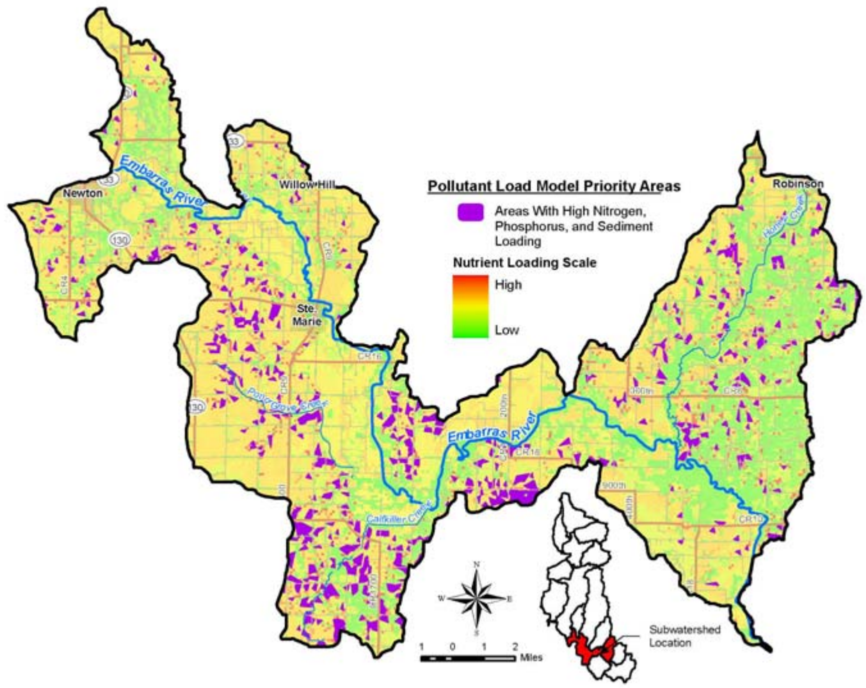


Table 9-54: Honey Creek – Embarras River Subwatershed Pollutant Load Model Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Areas With High Nitrogen, Phosphorus, and Sediment Loading	6,332	4.85%

Figure 9-32: Fecal Coliform Bacteria Project & Priority Areas

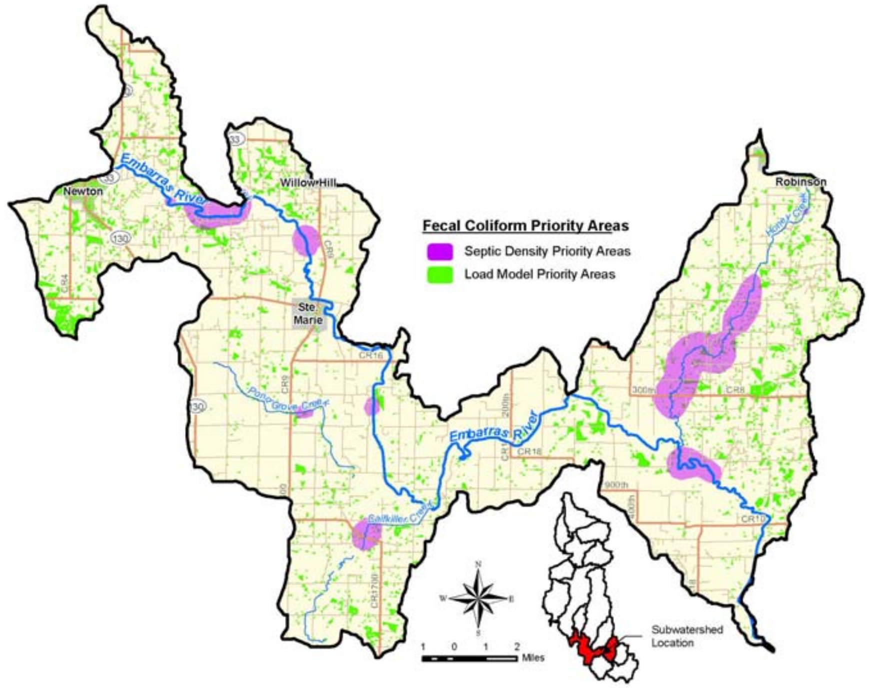


Table 9-55: Honey Creek – Embarras River Subwatershed Fecal Coliform Bacteria Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Septic Density Priority Areas	7,001	5.36%
Load Model Priority Areas	10,473	8.02%

Figure 9-33: Highly Erodible Land Project & Priority Areas

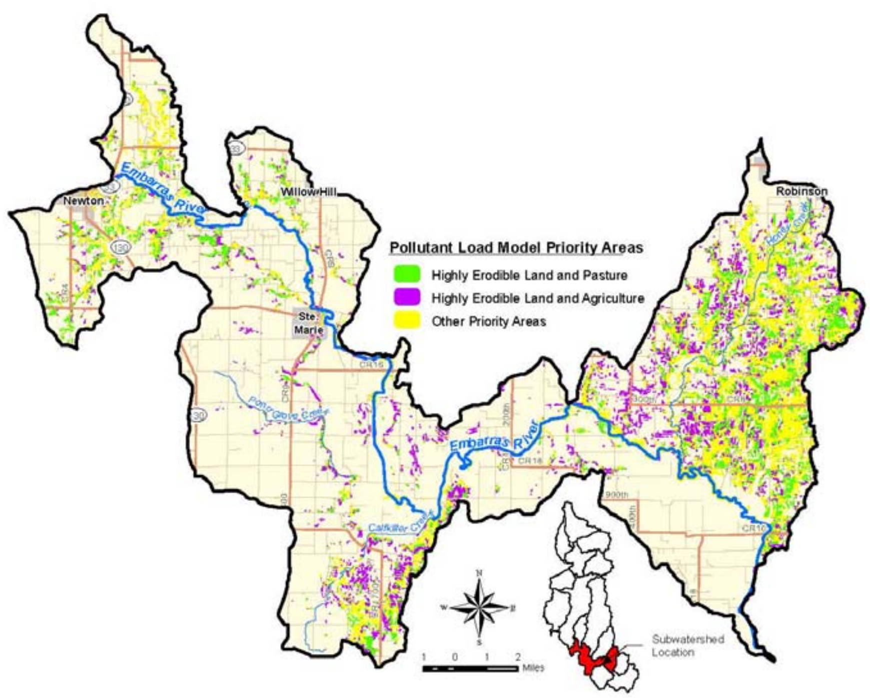


Table 9-56: Honey Creek – Embarras River Subwatershed Highly Erodible Load Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Highly Erodible Land and Agriculture	3,634	2.78%
Highly Erodible Land and Pasture	3,081	2.36%
Other Priority Areas	17,215	13.19%

Figure 9-34: Wetland Restoration/Flood Mitigation Project & Priority Areas

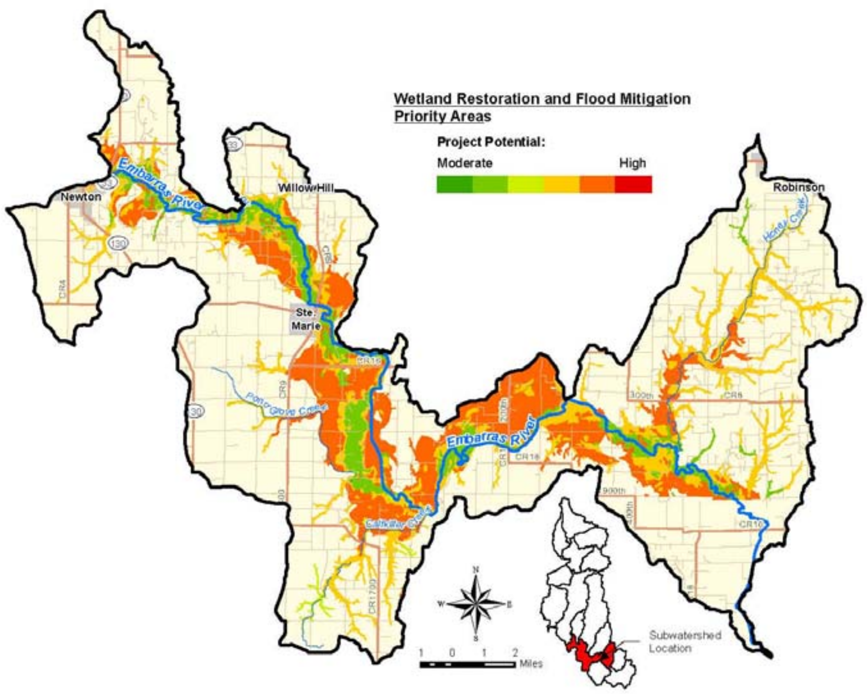


Figure 9-35: Stakeholder Identified Priority Projects

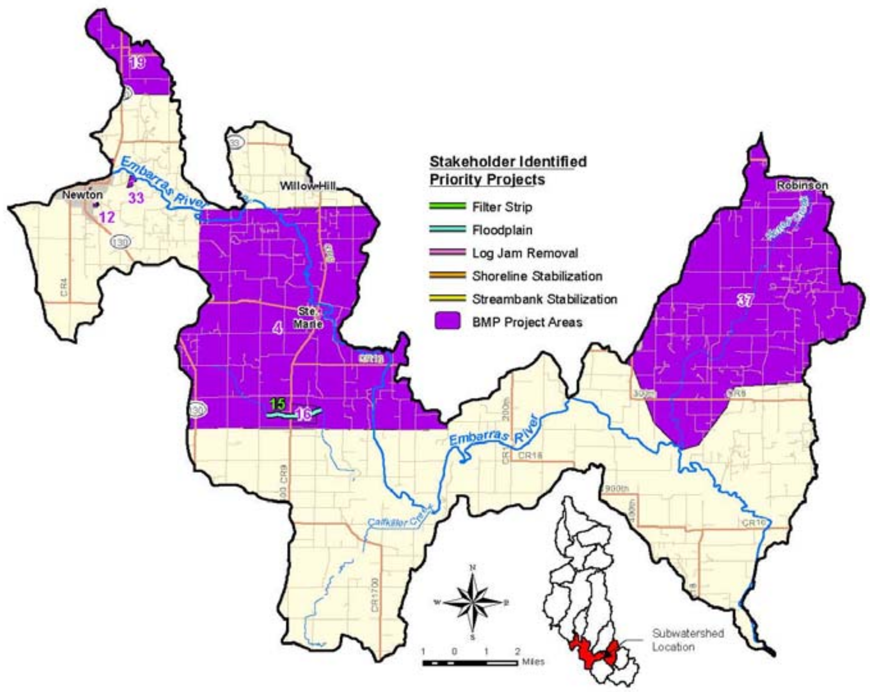


Table 9-57: Honey Creek – Embarras River Subwatershed Estimated Load Reductions for Stakeholder Identified Priority Projects									
Map ID	Project Type	Stakeholder	Length (ft)	Area (Acres)	Nitrogen (lbs)	Phosphorus (lbs)	Sediment (tons)	Fecal Coliform (bill fcu)	Project Details
3	Acquisition/Wetland	City of Newton		21	1,139	331	37	215	Acquire property in floodplain and restore wetlands to mitigate flooding
12	Detention/Bio Swale	City of Newton		19	748	299	14	194	Retention system of water flowing through city; filter strips in between detention areas
33	Streambank Stabilization/retention	City of Newton		42	38	15	14	10	Stabilize bend in river; develop wetland or retention areas to mitigate flooding
37	WASCB/Retention	Crawford SWCD/NRCS		23678	2,841	710	18,942	462	Focus work in this subwatershed
15	Floodplain	Jasper SWCD/NRCS	9,306		29,781	15,542	5,119	10,102	Floodplain Management; flooding Pond Grove Creek
16	Floodplain Easement	Jasper SWCD/NRCS		299	16,440	4,782	538	3,109	Easement/Wetland in Floodplain
19	Sediment Control; Retention	Jasper SWCD/NRCS		2216	7,090	3,700	222	2,405	Sam Parr Lake; watershed plan in place; sediment reduction and retention
4	CNMP/Waste Utilization	Jasper SWCDD/NRCS		299	418	143	36	93	High Concentration of confined swine opps within 5mi radius of Ste. Marie; CNMPs
4	CNMP/Waste Utilization	Jasper SWCDD/NRCS		26315	36,841	12,631	3,158	8,210	High Concentration of confined swine opps within 5mi radius of Ste. Marie; CNMPs

Paul Creek-Muddy River Subwatershed

Subwatershed Characteristics

Subwatershed Location

The Paul Creek – Muddy River Subwatershed (HUC 13 – 0512011213) is located in portions of Lawrence, Richland, and Robinson Counties as shown in Exhibit 36. The subwatershed encompasses approximately 63,468 acres (4.1% of the watershed) and includes Muddy Creek South.

Muddy Creek South flows generally south to northeast through the subwatershed to its confluence with the Embarras River. Muddy Creek South is approximately 15.6 miles long.

Population

According to the 1990 Census, the population within the Paul Creek – Muddy River Subwatershed was approximately 2,188. In the 2000 Census, the population was approximately 2,102, a decrease of 3.9%.

The majority of the subwatershed is relatively sparsely populated with population density averaging less than 0.1 people per acre.

Land Cover

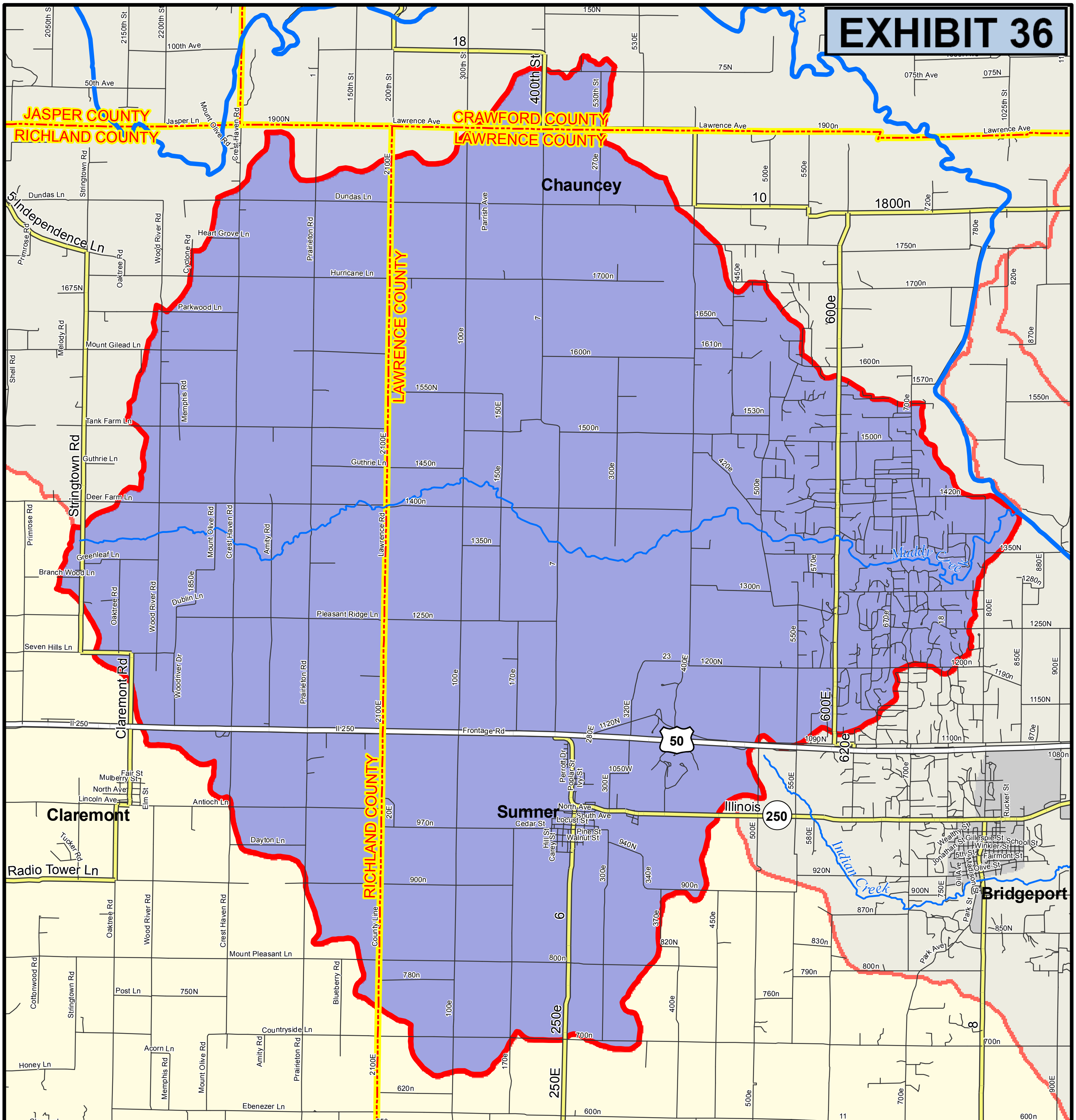
Land Use within the Paul Creek-Muddy River Subwatershed was analyzed based on the 2007 Cropland Data Layer (CDL) for Illinois published by the United State Department of Agriculture, National Agriculture Statistics Service (USDA-NASS). With approximately 63.9% of the subwatershed covered by agriculture (Table 9-58) and approximately 25.5% covered by grassland or forest, the Paul Creek – Muddy River Subwatershed still remains primarily rural and agricultural.

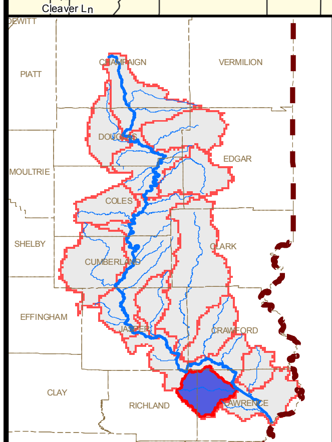
Table 9-58: Paul Creek – Muddy River Subwatershed Watershed Land Cover		
Landuse Classification	**Acres**	**Percentage**
Agricultural	40,563	63.9%
Barren	2	0.0%
Developed	6,259	9.9%
Forest	11,198	17.6%
Grassland	5,003	7.9%
Open Water	166	0.3%
Wetlands	277	0.4%
Total	63,468	100.0%

Soil Characteristics

The soils within the Paul Creek – Muddy River Subwatershed fall into six major associations (Table 9-59). Over half of the basin area (56.7%) is composed of one soil association: Ava-Bluford-Wynoose.

EXHIBIT 36





Paul Creek-Muddy River Subwatershed

HUC: 0512011213 Acres: 63,468

Embarras River Watershed Plan

Subwatershed Location Map

0.5 0 0.5 1 Miles

Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Paul Creek-Muddy River Subwatershed
- Embarras Subwatersheds
- Interstate
- US Highway
- State Highway
- Local Road
- Minor Road
- Other Road
- Ramp

Table 9-59: Paul Creek – Muddy River Subwatershed Soil Associations		
Association	**Acres**	**Percentage**
Hoyleton-Cisne-Huey	15,957	25.1%
Harco-Patton-Montgomery	3,219	5.1%
Lawson-Sawmill-Darwin	15	0.0%
Ava-Bluford-Wynoose	36,002	56.7%
St. Charles-Camden-Drury	987	1.6%
Haymond-Petrolia-Karnak	7,288	11.5%
Total	63,468	100.0%

Highly erodible soils comprise approximately 4,362 acres (6.9%) of the subwatershed, while hydric soils consist of 29.4% (18,668 acres) of the subwatershed.

Natural Resources

Illinois Natural Area Inventory Sites (INAI) are natural landscape features and communities of the highest quality still remaining in Illinois. In most cases, these sites are also where State and/or Federally listed Threatened and Endangered species have been found. Three INAI sites are located within the Paul Creek – Muddy River Subwatershed: Red Hills Seep Springs, Red Hills Woods, and Thacker- Pauly Marsh.

Approximately 979 acres of land within the watershed is identified as conservation or recreational land, while 2,209 acres are within the Conservation Reserve Program.

Wetland areas cover approximately 2,694 acres of the watershed with Bottomland Forest being the predominant type at 85.7%

The Illinois Department of Natural Resources was contacted to provide any Natural Heritage Data or related records for all listed threatened, endangered or rare species, high quality natural communities or natural areas documented within the Paul Creek – Muddy River Watershed. Seven species were located within the Subwatershed including: Cerulean Warbler, Drooping Sedge, Four-toed Salamander, Halbred-leaved Tearthumb, Running Pine, Sedge, and Storax.

Analysis of Subwatershed Data

Water Quality Data and Identified Problems

The 303(d) list indicates that none of the streams within the Paul Creek – Muddy River Subwatershed were impaired at the time of the 2008 listing. It should be noted that if a stream is not listed on the 303(d) list it may be impaired; however the data (or lack thereof) does not indicate the impairment at the time of publication.

Available water quality data from the United States Geological Survey (USGS) and the Illinois Environmental Protection Agency (IEPA) was analyzed based on screened water quality parameters. No USGS or IEPA stations are located with Paul Creek – Muddy River Subwatershed.

NPDES permits are also indicative of the land use and water quality within a subwatershed. Compliance records for the NPDES facilities within the watershed were analyzed for the past three years Effluent exceedances were noted based on the number of times in the past three years the permit allowed discharge was exceeded. The water quality parameters screened in this analysis included Dissolved Oxygen (DO), Total Suspended Solids (TSS), Nitrogen (N) and Fecal Coliform (FC). There are 4 NPDES permits active within the Paul Creek – Muddy River Subwatershed. According to compliance records, there have been no formal enforcement actions within the last 5 years; however there have been several noted effluent exceedances within the last 3 years. These exceedances included 12 reports of Total Suspended Solids and 13 reports of Nitrogen.

One landfill was identified within the Paul Creek – Muddy River Subwatershed.

Biological Data

IEPA has completed several habitat and biological studies within the Embarras River Watershed. Within the Paul Creek – Muddy River Subwatershed, no IEPA sites with biological data were available.

Pollution Load Analysis

Nonpoint source modeling was completed for four water quality parameters including Total Suspended Solids (TSS), Total Nitrogen (N), Total Phosphorus (P), and Fecal Coliform. Table 9-60 summarized the modeling results for the Paul Creek – Muddy River Subwatershed.

Table 9-60: Paul Creek – Muddy River Subwatershed NPS Modeling Summary

Parameter	Loading
Total Suspended Solids	0.52 ton/ac/yr
Nitrogen	4.87 lb/ac/yr
Phosphorus	1.02 lb/ac/yr
Fecal Coliform	2.18 CFU bill/ac/yr

Paul Creek-Muddy River Subwatershed Implementation Plan

Figure 9-36: Non Point Source Pollutant Load Priority Areas (Nitrogen, Phosphorus, Sediment)

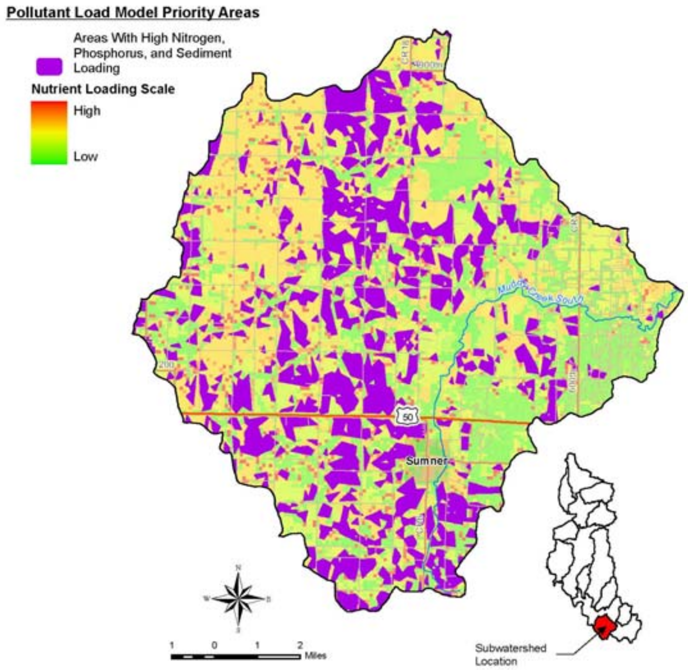


Table 9-61: Paul Creek – Muddy River Subwatershed Pollutant Load Model Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Areas With High Nitrogen, Phosphorus, and Sediment Loading	14,532	22.90%

Figure 9-37: Fecal Coliform Bacteria Project & Priority Areas

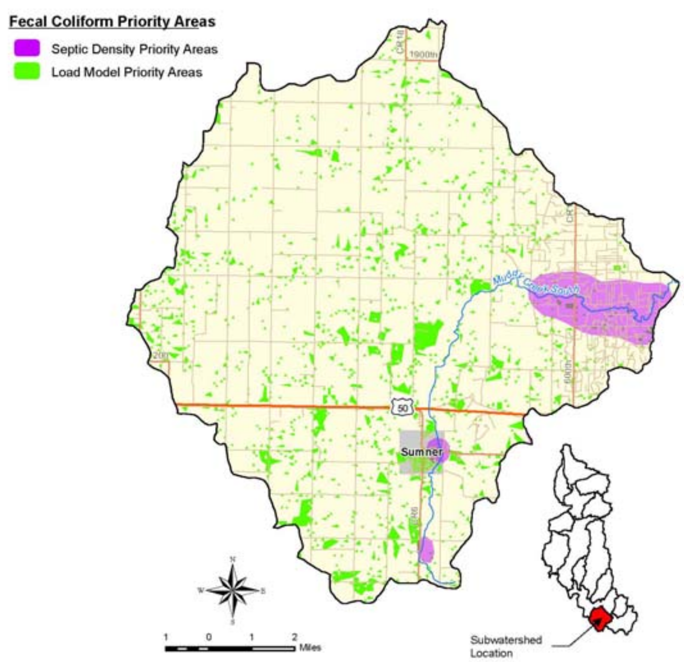


Table 9-62: Paul Creek – Muddy River Subwatershed Fecal Coliform Bacteria Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Septic Density Priority Areas	2,772	4.37%
Load Model Priority Areas	4,959	7.81%

Figure 9-38: Highly Erodible Land Project & Priority Areas

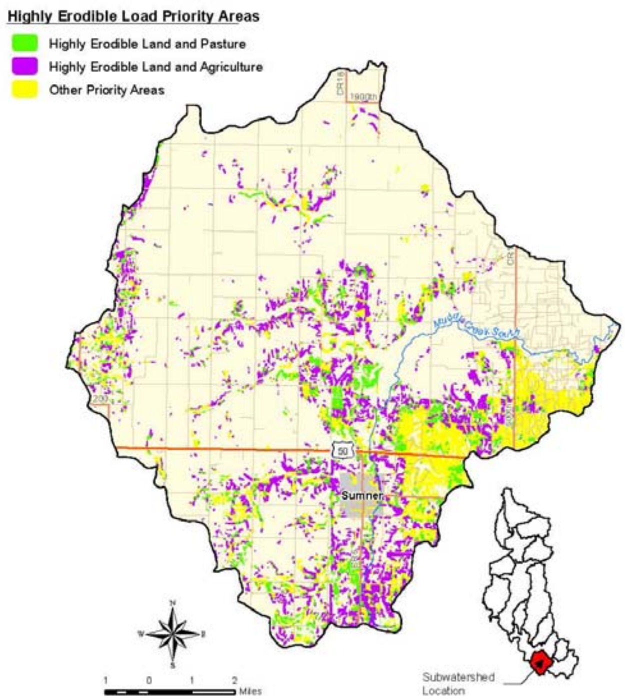
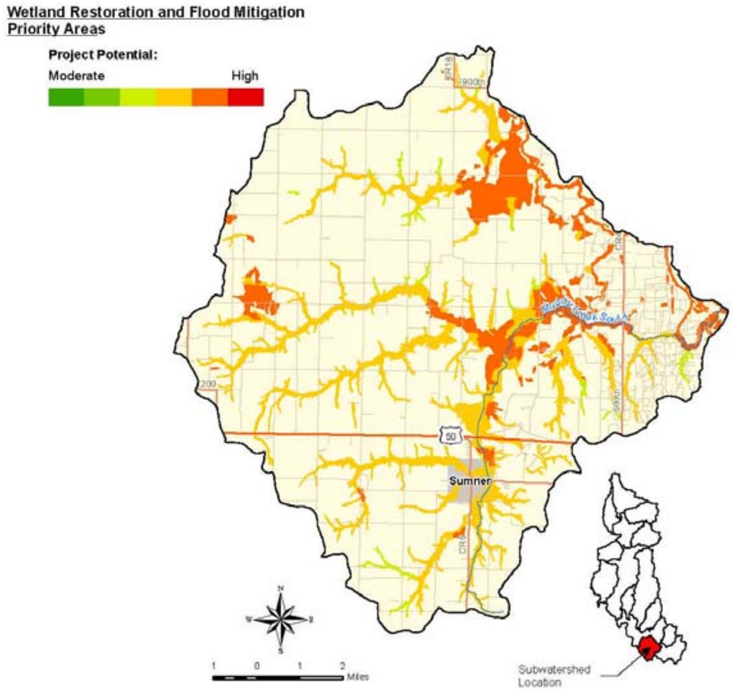


Table 9-63: Paul Creek – Muddy River Subwatershed Highly Erodible Load Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Highly Erodible Land and Agriculture	3,298	5.20%
Highly Erodible Land and Pasture	1,432	2.26%
Other Priority Areas	9,439	14.87%

Figure 9-39: Wetland Restoration/Flood Mitigation Project & Priority Areas



Charleston Side Channel Reservoir Drainage Area

Subwatershed Characteristics

Subwatershed Location

The Charleston Side Channel Reservoir (CSCR) a water supply and recreational reservoir is located approximately 2 miles south of the city of Charleston (as shown in Exhibit 37), and it is the sole drinking water source for the city's residents. The reservoir drainage area encompasses approximately 1,284 acres (0.1% of the watershed) and is included within the Range Creek – Embarras River Subwatershed.

The CSCR was created in 1981 when Lake Charleston, an impoundment on the Embarras River, was divided by the building of a dike. Water from the Embarras River is now pumped into the CSCR for eventual intake to the Charleston drinking water treatment plant.

Population

According to the 1990 Census, the population within the Charleston Side Channel Reservoir Drainage Area was approximately 1,771. In the 2000 Census, the population was approximately 2,112, an increase of 1.9%.

The majority of the drainage area is relatively densely populated compared to the rest of the watershed with population density averaging approximately 1.6 people per acre.

Land Cover

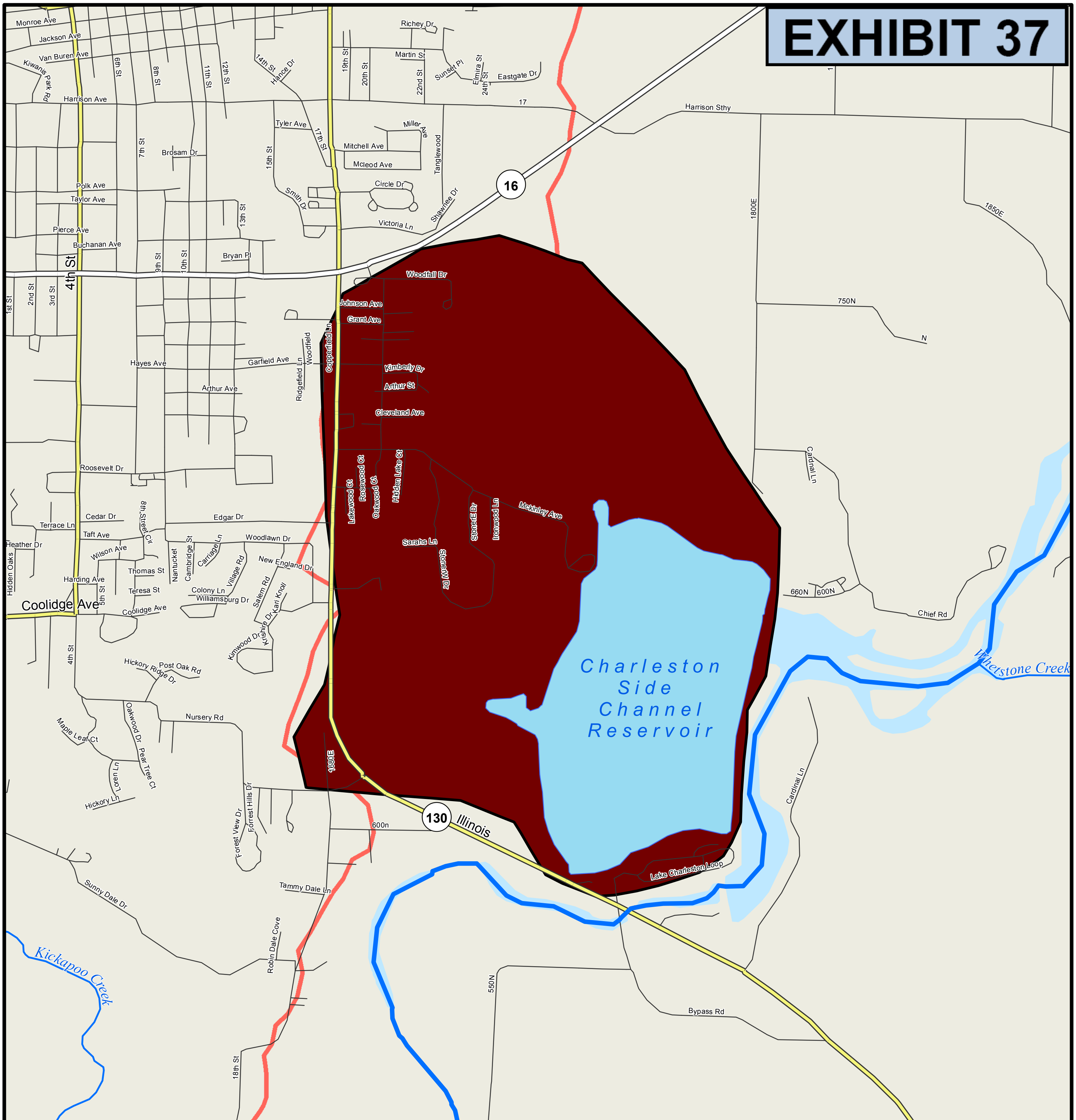
Land Use within the Charleston Side Channel Reservoir Drainage Area was analyzed based on the 2007 Cropland Data Layer (CDL) for Illinois published by the United State Department of Agriculture, National Agriculture Statistics Service (USDA-NASS). With approximately 44.6% of the drainage area covered by forest (Table 9-64) and approximately 26.8% covered by open water, the Charleston Side Channel Reservoir Drainage Area still remains primarily rural.

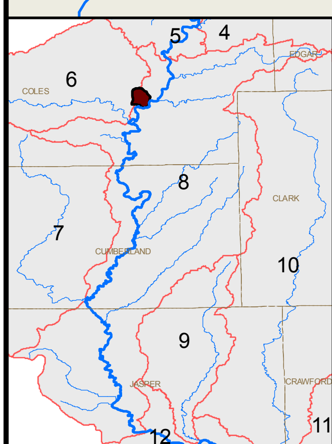
Table 9-64: Charleston Side Channel Reservoir Drainage Area Land Cover		
Landuse Classification	**Acres**	**Percentage**
Agricultural	92	7.2%
Barren	2	0.1%
Developed	243	18.9%
Forest	572	44.6%
Grassland	31	2.4%
Open Water	344	26.8%
Wetlands	1	0.0%
Total	1,284	100.0%

Soil Characteristics

The soils within the Charleston Side Channel Reservoir Drainage Area fall into six major associations (Table 9-65). Over half of the basin area is composed of soil association Saybrook-Dana-Drummer (26.8%) and water (20.8%).

EXHIBIT 37





Charleston Side Channel Reservoir Drainage Area

Acres: 1,284

Embarras River Watershed Plan

Drainage Area Location Map

600 0 600 1,200 Feet

ERMA EMBARRAS RIVER MANAGEMENT ASSOCIATION

Legend

- Urban Area
- Embarras River
- Embarras River Tributaries
- County Line
- Embarras Subwatersheds
- Charleston Side Channel Reservoir Drainage Area
- Interstate
- US Highway
- State Highway
- Local Road
- Minor Road
- Other Road
- Ramp

Table 9-65: Charleston Side Channel Reservoir Subwatershed Soil Associations		
Association	**Acres**	**Percentage**
Catlin-Flanagan-Drummer	59	4.6%
Saybrook-Dana-Drummer	344	26.8%
Lawson-Sawmill-Darwin	193	15.0%
Birkbeck-Sabina-Sunbury	188	14.7%
Dodge-Russell-Miami	233	18.1%
Water	267	20.8%
Total	1,284	100.0%

Highly erodible soils comprise approximately 253 acres (19.7%) of the subwatershed, while hydric soils consist of 5.1% (65 acres) of the reservoir drainage area.

Natural Resources
Approximately 157 acres of land within the watershed are identified as conservation or recreational land, while none are within the Conservation Reserve Program.

Wetland areas cover approximately 345 acres of the reservoir drainage area with Deepwater Lake being the predominant type at 93.6%

Analysis of Subwatershed Data

Water Quality Data and Identified Problems
The land that drains directly into the Charleston Side Channel Reservoir is only approximately 1,284 acres. However, water from the Embarras River is also pumped directly into the reservoir; therefore the entire contributing watershed of the Embarras River affects the water quality of the lake and is a significant resource concern to the City of Charleston and its residents.

As part of the Section 303(d) listing process, the IEPA has identified the Charleston Side Channel Reservoir as impaired water. The potential causes of impairment are phosphorus, nitrogen, total suspended solids (TSS), and excessive algal growth/chlorophyll a (Illinois EPA, 2001). These impairments result in the reservoir's being in partial support of its primary contact (swimming) and secondary contact (recreation) designated uses and in partial support of its aquatic life designated use. The drinking water supply and fish consumption designated uses of the reservoir are not impaired.

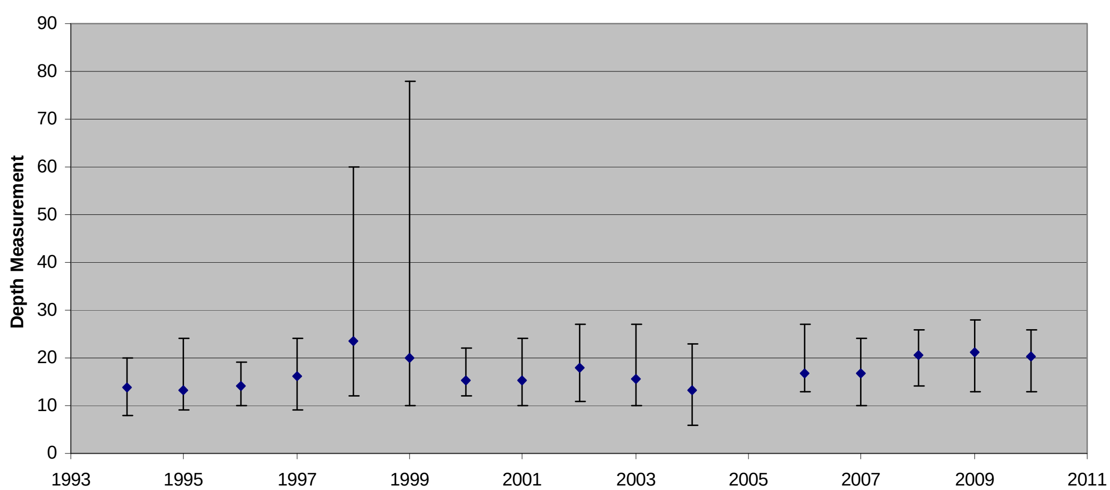
A TMDL report was developed by Tetra Tech for the Charleston Side Channel Reservoir to investigate the causes of impairments and make recommendations to improve water quality. The body of this report is included in Appendix E.

Since 1981, citizen volunteers, the Illinois EPA, and area-wide planning commissions have been working to monitor the quality of Illinois lakes through the Illinois Volunteer Lake Monitoring Program (VLMP). This cooperative effort provides information on many more lakes than could be otherwise monitored by the state agency staff. As part of the VLMP, water quality samples of Charleston Side Channel Reservoir were taken in 1994-2010. The data collected during these samplings included the Secchi disk transparency of the reservoir.

Secchi disk transparency refers to the depth to which the black and white disk can be seen in the lake water. Water clarity, as determined by a Secchi disk, is affected by two primary factors: algae and suspended particulate matter. Particulates (soil or dead leaves) may be introduced into the water by either runoff or sediments already on the bottom of the lake. Erosion from construction sites, agricultural lands, and riverbanks all lead to increased particulate content.

Figure 9-40 below shows the average and range of the Secchi disk readings from all sample events.

Figure 9-40: Secchi Disc Transparency



Pollution Load Analysis

Nonpoint source modeling was completed for four water quality parameters including Total Suspended Solids (TSS), Total Nitrogen (N), Total Phosphorus (P), and Fecal Coliform. Table 9-66 summarized the modeling results for the Charleston Side Channel Reservoir Drainage Area.

Table 9-66: Charleston Side Channel Reservoir Drainage Area NPS Modeling Summary

Parameter	Loading
Total Suspended Solids	0.43 ton/ac/yr
Nitrogen	4.59 lb/ac/yr
Phosphorus	1.14 lb/ac/yr
Fecal Coliform	1.58 CFU bill/ac/yr

Charleston Side Channel Reservoir Drainage Area Implementation Plan

Figure 9-41: Non Point Source Pollutant Load Priority Areas (Nitrogen, Phosphorus, Sediment)

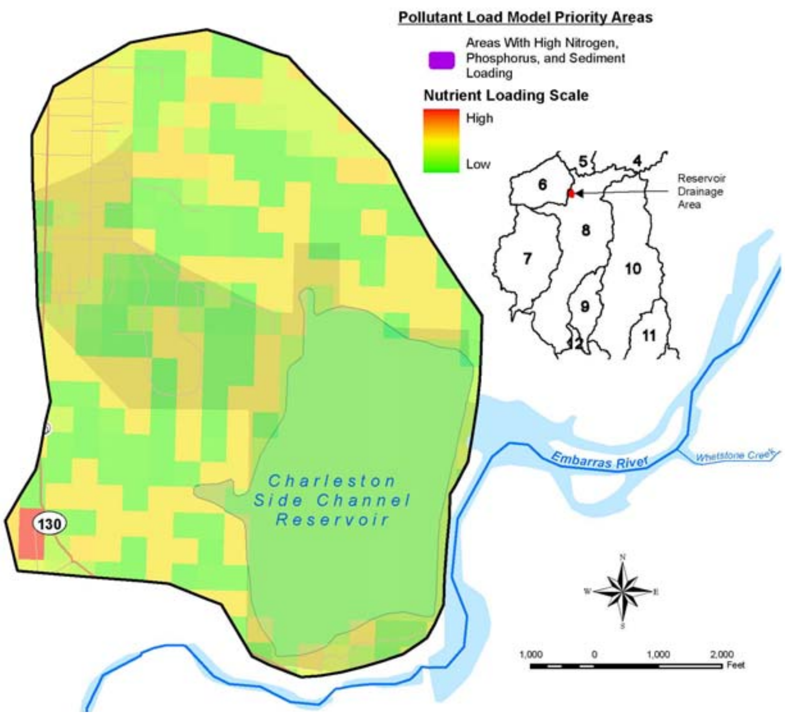


Table 9-67: Charleston Side Channel Reservoir Drainage Area Pollutant Load Model Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Areas With High Nitrogen, Phosphorus, and Sediment Loading	0	0%

Figure 9-42: Fecal Coliform Bacteria Project & Priority Areas

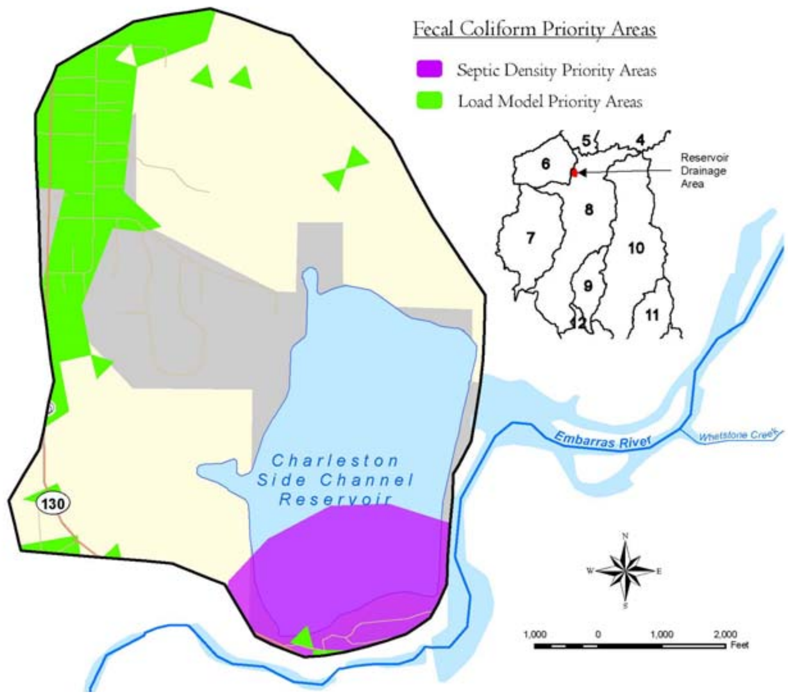


Table 9-68: Charleston Side Channel Reservoir Drainage Area Fecal Coliform Bacteria Priority Areas		
Parameter	**Acres**	**Percent in Reservoir Drainage Area**
Septic Density Priority Areas	145	11.30%
Load Model Priority Areas	162	12.62%

Figure 9-43: Highly Erodible Land Project & Priority Areas

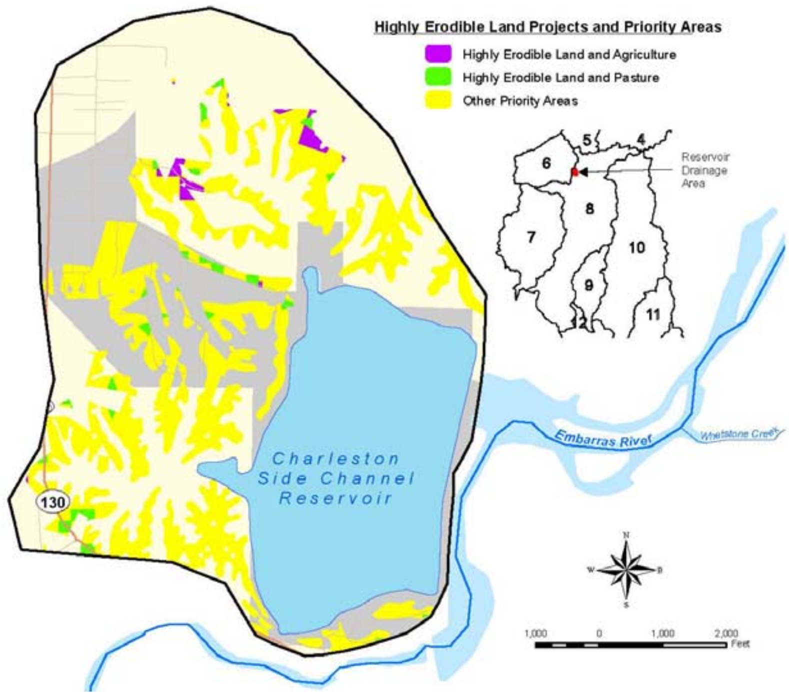


Table 9-69: Charleston Side Channel Reservoir Drainage Area Highly Erodible Load Priority Areas		
Parameter	**Acres**	**Percent in Watershed**
Highly Erodible Land and Agriculture	5	0.39%
Highly Erodible Land and Pasture	8	0.64%
Other Priority Areas	253	19.68%

Figure 9-44: Wetland Restoration/Flood Mitigation Project & Priority Areas

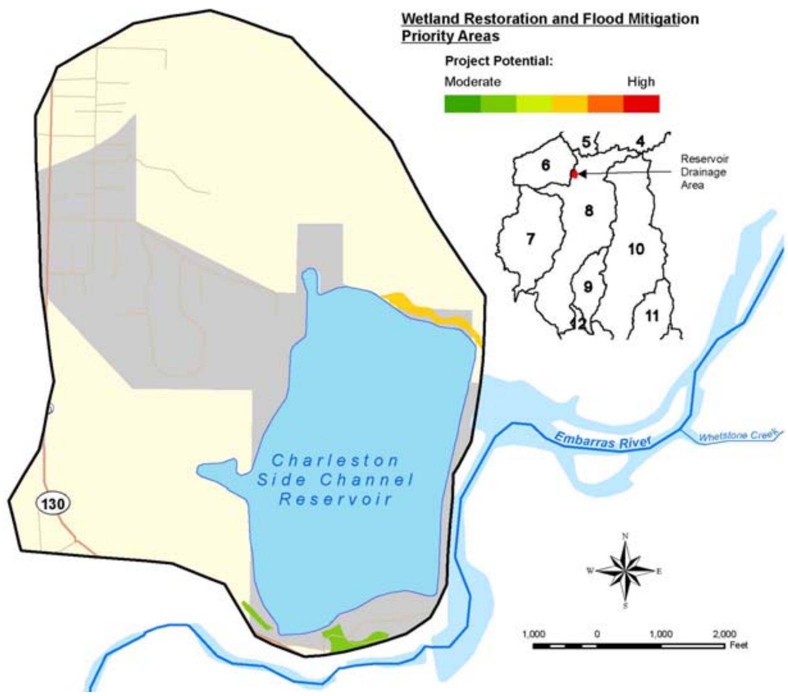


Figure 9-45: Stakeholder Identified Priority Projects

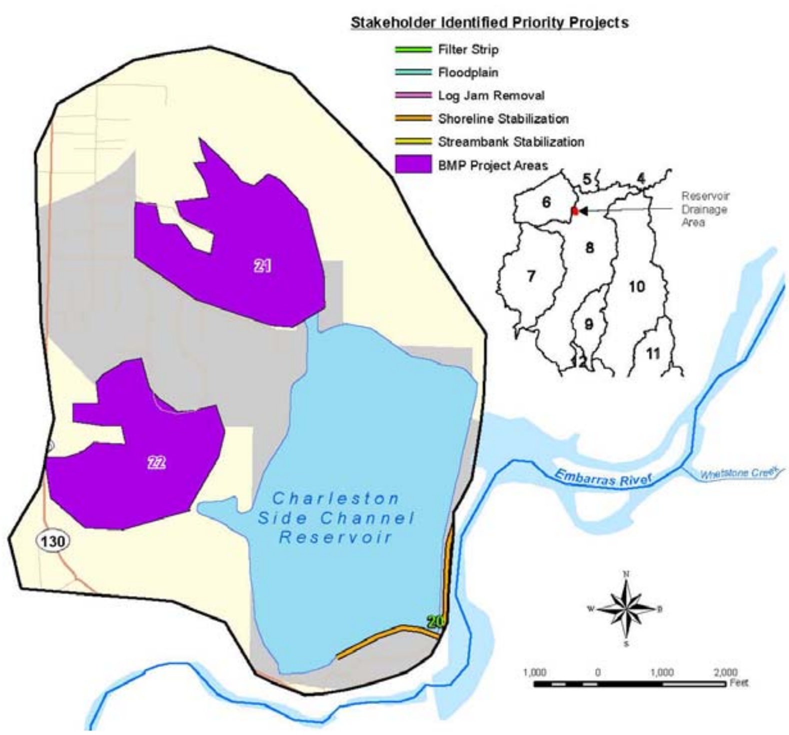


Table 9-70: Charleston Side Channel Reservoir Drainage Area Estimated Load Reductions for Stakeholder Identified Priority Projects									
Map ID	**Project Type**	**Stakeholder**	**Length (ft)**	**Area (Acres)**	**Nitrogen (lbs)**	**Phosphorus (lbs)**	**Sediment (tons)**	**Fecal Coliform (bill fcu)**	**Project Details**
5	Detention	City of Charleston		0	7	3	0	2	Detention in crop field; High Priority
20	Shoreline Stabilization	City of Charleston	3,697		3,327	1,331	1,183	865	Berm with wetlands to control bank erosion
21	Stabilization/ Detention	City of Charleston		113	4,520	1,808	85	1,175	2 Ravines - Install detention structures and stabilize ravines; INAI site - High Priority
22	Stabilization/ Detention	City of Charleston		102	4,093	1,637	77	1,064	4 Ravines - Install detention structures and stabilize ravines; High Priority

Section 10 – Implementation Costs and Schedule

Estimated Costs of BMPs to Achieve Load Reduction Targets

Cost Estimate Methodology

Tables 10-1 through 10-3 below portray the pollutant load reductions and approximate BMP costs to achieve the reductions for the Embarras River Watershed. The reductions were calculated by applying the urban and agricultural BMPs to the watershed. An average BMP reduction value was derived from the BMPs for each pollutant parameter. Cost estimates of BMPs needed to be implemented within each of the critical areas in order to accomplish the five, ten, and twenty year targets were determined using the lowest cost BMPs for each landcover; $400/acre for urban and $15/acre for cropland and then averaging these values relative to the proportion of each landuse within the watershed. Based on this analysis, the average cost per acre for BMP implementation was determined to be approximately $67.50. The costs and reductions were also calculated assuming that the applied BMPs benefit an upland drainage area.

Cost estimates are generalized for watershed-scale planning purposes and these estimates should not be used to estimate costs for individual projects, as costs will range significantly.

The estimates also do not account for load reductions from Education and Outreach and Policy/Regulation BMPs since direct impacts are not easily determined. Therefore these costs could vary significantly if extensive education and policy changes are implemented.

To determine the total cost required to meet the interim goals, the lowest efficiency BMP should be used. For example, the average BMP efficiency for phosphorus is 55% and the total cost to meet the 5-year target would be approximately $13,297,636. It can be assumed that the BMPs used to meet the phosphorus target will also reduce the loading of the other parameters and therefore the total cost to meet this target would be $13,297,636. Also, the costs provided below are cumulative between the goals. For example, the total cost to remove phosphorus to meet the 10-year target would be approximately $53,190,405. Assuming that the 5-year targets had been met, the additional cost to meet the 10-year target would only be $39,892,769.

5-Year Target Loading Estimated Costs

Table 10-1: Estimated Costs to Meet 5-Year Target Load Reductions

Parameter	Total Current Loading	5-Year Target Load Reduction	BMP Average Efficiency	Average Loading (per acre)	Treatment Acres Required	Total Cost ($67.50/ac)
Sediment (ton/yr)	612,684	19,330	70%	0.4	69,036	$4,659,930
Nitrogen (lb/yr)	6,632,514	112,187	50%	4.3	52,180	$3,522,150
Phosphorus (lb/yr)	1,336,411	97,516	55%	0.9	197,002	$13,297,636
Fecal Coliform (CFU in billions/yr)	3,115,237	33,524	50%	2.0	33,524	$2,262,870

10-Year Target Loading Estimated Costs

Table 10-2: Estimated Costs to Meet 10-Year Target Load Reductions						
Parameter	**Total Current Loading**	**10-Year Target Load Reduction**	**BMP Average Efficiency**	**Average Loading (per acre)**	**Treatment Acres Required**	**Total Cost ($67.50/ac)**
Sediment (ton/yr)	612,684	77,322	70%	0.4	276,150	$18,640,125
Nitrogen (lb/yr)	6,632,514	448,749	50%	4.3	208,720	$14,088,631
Phosphorus (lb/yr)	1,336,411	390,063	55%	0.9	788,006	$53,190,405
Fecal Coliform (CFU in billions/yr)	3,115,237	134,095	50%	2.0	134,095	$9,051,413

20-Year Target Loading Estimated Costs

Table 10-3: Estimated Costs to Meet 20-Year Target Load Reductions						
Parameter	**Total Current Loading**	**20-Year Target Load Reduction**	**BMP Average Efficiency**	**Average Loading (per acre)**	**Treatment Acres Required**	**Total Cost ($67.50/ac)**
Sediment (ton/yr)	612,684	193,305	70%	0.4	690,375	$46,600,312
Nitrogen (lb/yr)	6,632,514	1,121,873	50%	4.3	521,801	$35,221,568
Phosphorus (lb/yr)	1,336,411	975,158	55%	0.9	1,575,713	$107,710,628
Fecal Coliform (CFU in billions/yr)	3,115,237	335,237	50%	2.0	335,237	$22,627,498

Specific Stakeholder Identified Project Cost Estimates

Table 10-4: Load Reduction Estimates For Stakeholder Identified Implementation Projects				
Subwatershed	**Nitrogen (lbs)**	**Phosphorus (lbs)**	**Sediment (tons)**	**Fecal Coliform (b-fcu/yr)**
Big Creek	5,713	1,766	312	5,194
Deer Creek-Embarras River	32,194	9,931	1,961	29,111
East Branch Embarras	17,357	5,288	1,753	14,651
Honey Creek	83,417	18,604	4,282	59,092
Kickapoo Creek	5,074	1,339	2,688	2,783
Range Creek/Embarras River	71,605	19,949	26,833	29,325
Scattering Fork	1,119	346	47	615
Total Estimates	216,479	57,223	37,876	140,771
Estimated Implementation Cost	$25,000,000 - $55,000,000			

Implementation Schedule

Table 10-5: Implementation Schedule										
Task	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10
Seek funding and technical assistance	X	X								
Submit grant applications	X	X	X	X	X	X	X			
Coordinate available programs	X	X	X	X	X	X	X	X	X	
Secure funding through participation in existing programs and other mechanisms, such as market based conservation (i.e. conservation credits)	X	X	X	X	X	X	X	X	X	X
Project planning, site surveys and project design		X	X	X	X	X	X	X	X	
Implementation and construction			X	X	X	X	X	X	X	X
Report and monitor progress	X	X	X	X	X	X	X	X	X	X
Communicate success stories		X	X	X	X	X	X	X	X	X
Evaluate accomplishments			X			X				X

Section 11 –Measuring Success

Indicators of Success

The success of a WMP can be measured by how readily it is used by its intended audience and how well it is implemented. The Embarras River WMP is very ambitious and continued implementation of the plan will require an even greater degree of cooperation and coordination among partners and funding for projects.

Indicators are measurable parameters or criteria which can used to determine the progress being made toward achieving a goal. Indicators were developed for each goal and objective. Some indicators may be appropriate for several categories and are listed for each applicable goal. As the WMP is being implemented, it is anticipated that additional indicators will be identified; therefore this list is not intended to be comprehensive. Table 11-1 lists the indicators and the goals to which they are linked.

Table 11-1: Goals and Indicators

Goal	Indicators
Reduce flood damage in the Embarras River Watershed.	-Number of BMPs installed to reduce stormwater runoff -Number of wetland creation and restoration projects -Maintenance and management of drainage ways (debris/log jam removal) -Amount of property and crop damage tracked over time (comparing years with similar weather) -Trends in water levels, volume, and duration of flooding events
Protect and improve water quality in the Embarras River Watershed.	-Observed Total Nitrogen, Total Phosphorus, Total Suspended Solids and Fecal coliform concentrations -Number of agricultural fields utilizing conservation tillage, cover crops or other BMPs and associated load reductions -Number or stream miles of improved/created buffer zones and associated load reductions -Number of direct animal access points eliminated and associated load reductions -Number or stream miles of stabilized streambanks and associated load reductions -Nutrient loadings from point dischargers
Protect and enhance natural resources and provide associated recreational opportunities.	-Inventory of lands held within preservation and open space uses -Total acreage of restored uplands, wetlands, shoreline and stream channels -Number of identified recreational areas -Total acreage of sites managed for invasive species -Number of threatened or endangered species within the watershed
Develop and implement an education and outreach program within the watershed	-Number of brochures/educational materials distributed or field days organized -Number of programs and ideas utilized from the Education/Outreach Menu -Public involvement in volunteer programs

Evaluating Plan Performance

This Management Plan is meant to be a flexible tool to achieve water quality improvements within the Embarras River Watershed. The WMP will be evaluated by assessing the progress made on each of the six goals.

The plan should be evaluated every five years to assess the progress made as well as to revise the plan, if appropriate, based on the progress achieved. The plan will also have a comprehensive review every 15 years. Amendments and changes may be made more frequently as laws change or new information becomes available that will assist in providing a better outlook for the Watershed. As goals are accomplished and additional information is gathered, efforts may need to be shifted to watershed issues of higher priority.

In addition to the official 5 year evaluation and update, the Work Group will have a key role in evaluating implementation progress on an annual basis. The Work Group will review the status of actions recommended in the WMP, based on the indicators for success, at least once per year and then identify the top priority concerns and actions for the following years focus. The Work Group should identify how it will implement the plan (subcommittees, reporting structure, meeting schedule, etc.). Other opportunities for evaluating the status of plan implementation include the completion of quarterly project reports or work group meeting minutes. Since this plan is a flexible tool tracking changes/modifications are anticipated based on usability and changes in priority throughout the implementation of the WMP.

Recommendations for Measuring Success and Evaluating Plan Performance

This Management Plan is meant to be a flexible tool to achieve water quality improvements within the Embarras River Watershed. These recommendations are included below to help track success and achieve the goals of the plan.

Table 11-2: Recommended Actions For Increasing Public Participation, Measuring Success and Evaluating Performance

Recommendation	Estimated Cost	Description
Online BMP Tracking GIS System	$120,000: $10,000/year	Open on-line and administrative system for projects to be entered online and tracked in a database.
Watershed Certification System Incentive	$40,000	Public relations system to "certify" projects in the watershed that have water quality benefits. This certification would encourage the watershed planning committee to become aware of projects to keep track of them and also provide some quality assurance of the projects. Coordination with counties and municipalities should be implemented to encourage this certification.
Full-Time Watershed Coordinator/Administrator	$55,000/yr	Position to implement plan, administer online BMP tracking GIS system, certification program and quarterly outreach events.
Quarterly Outreach Events	$20,000/yr	Public events

Annual Update Report

To further measure progress and success, the planning committee will ask each county in the watershed to provide a brief annual update on project implementation. The annual update will include the following information on a subwatershed basis:

County Level NRCS/SWCD Updates

- Type and number of soil erosion control measures for upland treatment applied and acres benefitted.
- Soil loss reductions and nutrient loading reductions credited to the above conservation measures.
- Number of conservation tillage acres applied.
- Number of lineal feet of streambanks protected by structural measures and the corresponding nutrient load reductions.
- Number and acres of nutrient management plans developed and implemented and corresponding nutrient load reductions.
- Number and acres of pasture planning, prescribed grazing systems planned and applied.
- Number of use exclusions (cattle crossings and associated fencing) and livestock watering systems planned and applied.
- Status on the inventory of confined livestock operations in the watershed.
- Acres of filter/buffer strips planned and applied.
- A list of activities (workshops, tours, news articles, interviews, brochures) relating to resource concerns in the watershed plan.

Illinois Department of Natural Resources Updates

- Number and acres of forest management plans developed.
- Number and acres of timber stand improvement planned and applied.
- Number and acres of tree plantings.
- Acres of grassland/prairie planting/restoration planned/planted.
- Acres of bottomland forest restoration, wetland restoration planned and completed.

County Health Department Updates

- Number of septic inspections for existing, upgraded, and new systems resulting from property transfers or other situations.
- List of activities relating to public information on septic system construction, operation, and maintenance.

Communities within the Watershed Updates

- Results from any new runoff and hydrology studies.
- Number of retention basins and/or other stormwater management practices planned and installed.

Section 12 – Financing Resources

There are a number of financing resources to implement BMP projects. Fund sources for wetland protection and restoration, as well as technical assistance, are available from programs at the local, regional, state, and federal levels of government including USEPA Section 319 grants.

U.S. Army Corps of Engineers (USACE) Continuing Authorities Program

At the Federal level, the USACE Continuing Authorities Program (CAP) from Section 206 of the 1996 Water Resources Development Act targets wetland restoration. This section, also known as the "Aquatic Ecosystem Restoration" program gives the USACE the authority to carry out aquatic ecosystem restoration and protection if the projects will improve the quality of the environment, are in the public interest, and are cost effective. The objective of section 206 is to restore degraded ecosystem structure, function, and dynamic processes to a less degraded and more natural condition. The local sponsors of aquatic ecosystem restoration projects are required to contribute 35% towards the total project cost.

U.S Environmental Protection Agency (USEPA) Section 319 Grants

Section 319 of the Clean Water Act provides funding for projects that work to reduce nonpoint source water pollution. IEPA administers funds from the Section 319 program which are used to create watershed management plans, demonstrate new technology, provide education and outreach on pollution prevention, conduct assessments, develop and implement Total Maximum Daily Loads (TMDLs), provide cost share dollars for BMP implementation and provide technical assistance. Organizations that are eligible for funding include nonprofit organizations, universities, and local, State or Federal government agencies. An in-kind or cash match of the total project cost must be provided.

Farm Service Agency (FSA) Programs

Illinois Farm Service Agency (FSA) supports farmers through a variety of Credit and Commodity Programs designed to stabilize and enhance rural landscape. The FSA administers and manages farm commodity, credit, disaster and loan programs, and conservation as laid out by Congress through a network of federal, state and county offices. Programs are designed to improve economic stability of the agricultural industry and to help farmers adjust production to meet demand. Economically, the desired result of these programs is a steady price range for agricultural commodities for both farmers and consumers.

Conservation Reserve Program (CRP)

The CRP is a voluntary program encouraging landowners for long-term conservation of soils, water, and wildlife resources. CRP is the US Department of Agriculture's single largest environmental improvement program and is administered through the Farm Service Agency (FSA) with 10 to 15 year contracts. The goal of the CRP program (and CREP - Conservation Reserve Enhancement Program) is to give incentives to landowners who take frequently flooded and environmentally sensitive land out of crop production and plant specific types of vegetation. Participants earn annual rental payments and sign-up incentives. This program offers up to 90% cost share. Rental payments are boosted by 20% for projects such as installation of riparian buffers and filter strips. Windbreaks, contour buffer strips, and shallow water areas are additional funded practices. The WHIP program is available for private landowners to make improvements for wildlife on their property. This program offers up to 75% cost share. This grant program is competitive and funding depends on the project's ranking compared to others in the state.

Conservation Stewardship Program (CSP)

The Conservation Stewardship Program (CSP) is a voluntary program that encourages agricultural producers to improve conservation systems by improving, maintaining, and managing existing conservation activities and undertaking additional conservation activities. The Natural Resources Conservation Service administers this program and provides financial and technical assistance to eligible producers. CSP is available on Tribal and private agricultural lands and non-industrial private forestland (NIPF) on a continuous application basis.

CSP offers financial assistance to eligible participants through two possible types of payments:

- Annual payment for installing and adopting additional activities; and improving, maintaining, and managing existing activities.
- Supplemental payment for the adoption of resource-conserving crop rotations.

Environmental Quality Incentives Program (EQIP)

EQIP is accommodating to grass-roots conservation and is another voluntary USDA conservation program for farmers faced with threats to soil, water, and related natural resources. Typically EQIP monies will fund 75% of land improvements and installation of conservation practices such as grade stabilization structures, grassed waterways, and filter strips adjacent to water resources (including wetlands). The goal of WRP is to restore and protect degraded wetlands such as farmed wetlands. WRP provides technical and financial assistance to eligible landowners to restore, enhance and protect wetlands. At least 70% of each project area will be restored to natural site conditions to the extent practicable. WRP has three options available: permanent easements, 30-year easements and restoration agreements. The NRCS will reimburse the landowners for easements on the property plus a portion of the restoration costs based on the type of easement agreed to by the landowner. EQIP and WRP are only applicable to agricultural lands.

Wetlands Reserve Program (WRP)

The WRP is the Nation’s premier wetlands restoration program. It is a voluntary program that offers landowners the means and the opportunity to protect, restore, and enhance wetlands on their property. The USDA NRCS manages the program as well as provides technical and financial support to help landowners participate in WRP. Program objectives include: purchasing conservation easements from, or entering into cost-share agreements with willing owners of eligible land, helping eligible landowners, protect, restore, and enhance the original hydrology, native vegetation, and natural topography of eligible lands, restoring and protecting the functions and values of wetlands in the agricultural landscape, helping to achieve the national goal of no net loss of wetlands, and improving the general environment of the country.

The emphasis of the WRP program is to protect, restore and enhance the functions and values of wetland ecosystems to attain: 1) first and foremost, habitat for migratory birds and wetland dependent wildlife, including threatened and endangered species; 2) protection and improvement of water quality; 3) lessen water flows due to flooding; 4) recharge of ground water; 5) protection and enhancement of open space and aesthetic quality; 6) protection of native flora and fauna contributing to the Nation's natural heritage; and 7) contribute to educational and scholarship.

Wildlife Habitat Incentive Program (WHIP)
The Wildlife Habitat Incentive Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat primarily on private land. Through WHIP USDA's Natural Resources Conservation Service provides both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. WHIP agreements between NRCS and the participant generally last from 5 to 10 years from the date the agreement is signed.

In order to provide direction to the State and local levels for implementing WHIP to achieve its objective, NRCS has established the following national priorities:

- Promote the restoration of declining or important native fish and wildlife habitats.
- Protect, restore, develop or enhance fish and wildlife habitat to benefit at-risk species
- Reduce the impacts of invasive species on fish and wildlife habitats; and
- Protect, restore, develop or enhance declining or important aquatic wildlife species' habitats

WHIP has proven to be a highly effective and widely accepted program across the country. By targeting wildlife habitat projects on all lands and aquatic areas, WHIP provides assistance to conservation minded landowners that are unable to meet the specific eligibility requirements of other USDA conservation programs.

Conservation Reserve Enhancement Program (CREP)
CREP is a federal-state natural resources conservation program that addresses agricultural-related environmental concerns at the state and national level. CREP participants receive financial incentives to voluntarily enroll in CRP in contracts of 14 to 15 years. Participants remove cropland from agricultural production and convert the land to native grasses, trees and other vegetation.

The program will improve water quality by creating buffers and wetlands that will reduce agricultural runoff into the targeted watersheds. Installing buffer practices and wetlands will enhance habitat for wildlife, including State and Federally-listed threatened and endangered species. The program will also reduce nonpoint source nutrient losses.

Landowners may enroll any amount of eligible cropland in the federal program and voluntary state 14-15 year contract extensions. State permanent easements allow producers to offer non-cropped acreage when they enroll cropland. Installation of conservation practices must be completed within 12 months of the federal CREP contract effective date. Once enrolled in the CREP program the land cannot be developed (i.e. no permanent structures or roads may be built). Existing abandoned structures and roads may remain if approved by DNR. Landowners must follow the Conservation Plan of Operation and land cannot go back into row crops or agricultural uses. The landowners retain the right to recreational use of their property providing it does not negatively impact the practices or cover established. The state CREP contract is attached to the land deed; thus, a producer who purchases land enrolled in an active state CREP contract is required to participate in the program or refund state money paid to date and incur other penalties.

Natural Resource Credits, Corporate Responsibility & Private Sector Opportunities

Environmental stewardship and mitigation are common and critical issues that most private businesses deal with. Now more than ever are opportunities to encourage private enterprise to become involved with the watershed and assisting in achieving the goals of this plan. Businesses identified in the table below are already stakeholders in the watershed as they have permits that affect the water quality of the watershed. The watershed planning committee should attempt to develop partnerships with some of these entities and at least make them aware of this watershed plan and the partnership opportunities that are available.

Table 12-1: Stakeholder Opportunities for Partnerships

Subwatershed	Facility Name
East Branch Embarras River	City of Villa Grove STP
	Village of Broadlands WTP
Scattering Fork	City of Arcola STP
	Parkview MHP-STP
	Cabot Corporation
	City of Tuscola Southside STP
	Tuscola Stone
	City of Tuscola STP
	Pesotum WTP
	Village of Tolono STP
Brushy Fork	Shiloh School STP
	Hydromet Environmental (USA)
	Newman Rehab and Health Care Center
	Newman WTP
	Metcalf WTP
	Veolia ES Valley View Landfill
Little Embarras River	Redman Waterworks, Inc WTP
	Village of Brocton
Deer Creek-Embarras River	City of Oakland STP
Kickapoo Creek	City of Mattoon STP
	City of Charleston STP
	Anamet Electrical
Muddy Creek	Village of Montrose STP
	Village of Toledo STP
	HPA-Lincoln Log Cabin Historical Site

Table 12-1: Stakeholder Opportunities for Partnerships	
Range Creek-Embarras River	City of Newton STP
	EJ Water Corporation Treat Plt
	City of Charleston
	Village of Greenup STP
	Cumberland Comm Sch Dist 77
	IL DNR-Fox Ridge State Park
	IL DNR-Fox Ridge State Park STP
	Ashmore WTP
	Marathon Pipeline Company
	Kansas WTP
North Fork Embarras River	Village of Willow Hill STP
	Marathon Pipeline Company
	City of Casey North STP
	Vulcan Materials Casey North
	City of Casey WTP
	E. Rowe Foundry
	City of Martinsville STP
	Village of Westfield WTP
Big Creek	Marathon Pipeline Company
	Village of Oblong WWTP
Honey Creek-Embarras River	Village of Saint Marie STP
	Newton WTP
Paul Creek-Muddy River	City of Sumner STP
	IL DNR-Red Hills State Park
	Lawrence Correctional Center
	IL DNR-Red Hills State Park
Brushy Creek	Birds-Pinkstaff WTP
	Village of Flatrock STP
Indian Creek-Embarras River	City of Bridgeport STP
	AWR Liquidating Trust
	City of Lawrenceville WWTP
	City of Mount Carmel WTP
	Lawrenceville-Vincennes Airport

Section 13 – Appendices

Appendix A – Acronyms and Abbreviations

Appendix B – References

Appendix C – Public Participation and Stakeholder Meeting Details

Appendix D – Nonpoint Source Modeling Details

Appendix E – Supporting Reports

Appendix F – Original Embarras River Resource Plan

Appendix A – Acronyms and Abbreviations

BFE - Base Flood Elevation
BMP - Best Management Practices

CAP - Continuing Authorities Program
CARL - Conservation and Recreation Lands
CDL - Cropland Data Layer
CFO - Confined Feeding Operation
cfs - cubic feet per second
CFU - Colony Forming Units
CREP - Conservation Reserve Enhancement Program
CRP - Conservation Reserve Program
CSCR - Charleston Side Channel Reservoir
CSOs - Combined Sewer Overflows
CSP - Conservation Stewardship Program
CWA - Clean Water Act

DO - Dissolved Oxygen

EIU - Eastern Illinois University
EMC - Event Mean Pollutant Concentrations
EPT - Ephemeroptera, Plecotera, Trichoptera
EQIP - Environmental Quality Incentives Program
ERMA - Embarras River Management Association

FC - Fecal Coliform
FEMA - Federal Emergency Management Agency
FIRM- Flood Insurance Rate Maps
FIS - Flood Insurance Studies
FSA - Farm Service Agency

GIS - Geographic Information Systems
GLO - General Land Office

HBI - Hilsenhoff Family Biotic Index
HEL- Highly Erodible Land
HUC - Hydrologic Unit Code

IBC - Impaired Biotic Communities
IBI - Index of Biotic Integrity
IDNR- Illinois Department of Natural Resources
IDOT- Illinois Department of Transportation
IEPA - Illinois Environmental Protection Agency
INAI - Illinois Natural Areas Inventory

MapMod - Modernization Project
mg/L - milligrams per liter
MIBI - Macroinvertebrate Index of Biotic Integrity
MS4s - Municipal Separate Storm Sewer System

N - Total Nitrogen
(N+N) – Nitrate + Nitrite
NASS - National Agriculture Statistics Service
NLCD - National Land Cover Data
NH3 - Ammonia
NH4 - Ammonium
NO2 - Nitrite
NO3 - Nitrate
NOAA - National Oceanic and Atmospheric Administration
NPDES - National Pollutant Discharge Elimination System
NPS - Nonpoint Source
NRCS - Natural Resource Conservation Service
NTU - Nephelometric Turbidity Units
NWI – National Wetland Inventory

P - Total Phosphorus
PCB - Polychlorinated Biphenyls
PLSS - Public Land Survey System
PRD - Planned Residential Developments
PUD - Planned Unit Developments

QHEI - Qualitative Habitat Evaluation Index

STEPL - Spreadsheet Tool for Estimation of Pollutant Load
STP - Sewage Treatment Plant
SSURGO - Soil Survey Geographic Database
SWCD - Soil & Water Conservation District

T&E - Threatened and Endangered
TDS - Total Dissolved Solids
TKN - Total Kjeldahl Nitrogen
TMDL - Total Maximum Daily Load
TSS - Total Suspended Solids

ug/L - Micrograms per Liter
USACE - United States Army Corps of Engineers
USDA - United States Department of Agriculture
USEPA - United States Environmental Protection Agency
USGS - United States Geological Survey
USLE - Universal Soil Loss Equation

USWRC - United States Water Resources Council

WHIP - Wetland Habitat Incentive Program
WMP - Watershed Management Plan
WRP - Wetland Reserve Program
WTP - Water Treatment Plant
WWTP - Wastewater Treatment Plant

Appendix B – References

American Public Health Association, American Water Works Association and Water Environment Federation. 1995. Standard Methods for the Examination of Water and Wastewater. Nineteenth Edition.

Baird, C., and M. Jennings, 1996. Characterization of Nonpoint Sources and Loadings to the Corpus Christi Bay National Estuary Program Study Area, Texas Natural Resource Conservation Commission.

Baker, N.T., Stone, W.W., Frey, J.W., and Wilson, J.T., 2006, Water and Agricultural-Chemical Transport in a Midwestern, Tile-Drained Watershed: Implications of Conservation Practices: U.S. Geological Survey Fact Sheet 2007-3084, 6p.

Böhlke, J.K., J.W. Harvey., and M.A. Voytek. 2004. Reach-scale isotope tracer experiment to quantify denitrification and related processes in a nitrate-rich stream, midcontinent United States. Limnology and Oceanography 49: 821-838.

Capel, P.D., P.A. Hamilton, M.L. Erwin. 2004 Studies by the U.S Geological Survey on Sources, Transport, and Fate of Agricultural Chemicals: U.S Geological Survey Fact Sheet 2004-3098, 4p.

Carter, D. S. 1996. Determination of atrazine and its major degradation products in soil pore water by solid-phase extraction, chemical derivatization, and gas chromatography/mass spectrometry. U.S. Geological Survey Open-File Report 96-459, 12 p.

Center for Watershed Protection. 2007. National Pollutant Removal Performance Database, Version 3.

Chin, D.A. 2006. Water Resources Engineering. Prentice Hall.

Chow, Ven Te, 1959. Open-Channel Hydraulics. McGraw-Hill Book Company.

Geosyntec Consultants and Wright Water Engineers, Inc. 2008. Overview of Performance by BMP Category and Common Pollutant Type, International Stormwater Best Management Practices (BMP) Database.

Lal, R. 1999. Integrated Watershed Management in the Global Ecosystem.

Munn, M.D. and P.A. Hamilton 2003. New studies initiated by the U.S. Geological Survey-Effects of nutrient enrichment on stream ecosystems. U.S. Geological Survey Fact Sheet 118-03, 4p.

Tetra Tech, Inc. 2006. Users Guide Spreadsheet Tool for the Estimation of Pollutant Load (STEPL) Version 4.0, U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. 2002. National Management Measures for the Control of Nonpoint Pollution from Agriculture.

U.S. Environmental Protection Agency. 2005. National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of Nonpoint Source Pollution.

U.S. Environmental Protection Agency. 2010. Polluted Runoff (Nonpoint Source Pollution). http://www.epa.gov/nps.

U.S. Environmental Protection Agency. 2002. Urban Stormwater BMP Performance Monitoring: A Guidance Manual for Meeting the National Stormwater BMP Database Requirements.

U.S. Geological Survey. 2000. Pesticides in stream sediment and aquatic biota: current understanding of distribution and major influences. U.S. Geological Survey Fact Sheet 092-00, 4 p.

Vanoni, Vito. 1975. Sedimentation Engineering. American Society of Civil Engineers.

Wetzel, R.G. 1975. Limnology, Lake and River Ecosystems. W.B. Saunders Co.

Wetzel, R.G. and G.E. Likens. 1979. Limnological Analysis. W.B. Saunders Co.

Modeling References

Center for Watershed Protection. 2007. National Pollutant Removal Performance Database, Version 3.

Illinois Pollution Control Board. 2010. Title 35 of the Illinois Administrative Code: Environmental Protection Part 302 Water Quality Standards.

Indiana Department of Environmental Management, Office of Water Quality. 2010. Water Quality Targets. http://www.in.gov/idem/6242.htm.

Mitasova and Mitas: Modeling soil detachment with RUSLE3d using GIS, 1999; University of Illinois. http:/skagit.meas.ncsu.edu/~helena/gmslab/erosion/usle.html

Tetra Tech, Inc. 2006. Users Guide Spreadsheet Took for the Estimation of Pollutant Load (STEPL) Version 4.0, U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. 2000. Ambient Water Quality Criteria Recommendations Information Supporting the Development of State and Tribal Nutrient Criteria for Rivers and Streams in Nutrient Ecoregion VI.

U.S. Environmental Protection Agency. 2002. National Management Measures for the Control of Nonpoint Pollution from Agriculture.

U.S. Environmental Protection Agency. 2005. National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of Nonpoint Source Pollution.

U.S. Environmental Protection Agency. 2010. National Menu of Stormwater Best Management Practices. http://www.epa.gov/npdes/stormwater/menuofbmps.

U.S. Environmental Protection Agency. 2010. Polluted Runoff (Nonpoint Source Pollution). http://www.epa.gov/nps.

U.S. Environmental Protection Agency. 2002. Urban Stormwater BMP Performance Monitoring: A Guidance Manual for Meeting the National Stormwater BMP Database Requirements.

Schueler, T.R. 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Publ. No. 87703. Metropolitan Washington Council of Governments, Washington, DC.

Local Work Group
Notes from 12/17/07

Present:

Rich Stierwalt, FSA County Committee
Yvonne Odom, FSA CED
Steve Ayers, U of I Extension
Elliot Lagacy, IDOA
Kevin Donoho, NRCS
Paul Krone, NRCS
Steve Stierwalt, CCSWCD
Lennie Heiser, CCSWCD
Joe Rothermel, CCSWCD
Kenneth Kesler, CCSWCD
Bruce Stikkers, CCSWCD
Renee Weitekamp, CCSWCD

The meeting was called to order at 9:05 a.m.

The Local Work Group is a grass roots effort to identify conservation needs or agricultural resource concerns. The goal of this meeting is to start a list of concerns as they relate to Soil, Water, Air, Plants, Animals (livestock and wildlife), and Humans (SWAPA+H). Even though the focus is on agriculture, some issues may affect urban areas. This list will be distributed to FSA, U of I Extension and the Champaign County Soil and Water Conservation District, which are the core groups of the Local Work Group, so those not present may review and provide input. After the additional input is collected, a second meeting will be held in which additional organizations may review the list and voice their concerns. The core group will take the full list and prioritize the concerns. A plan to address the top 10-15 concerns will be written and submitted to the NRCS Assistant State Conservationist for Area 5; this plan must be submitted before March 30, 2008. Through this process the local work group has a voice in the USDA NRCS, which ultimately affects programs, funding, policy recommendations, local USDA program delivery, etc.

The concerns arose under the following categories:

Soil

- Sheet and rill erosion.
- Gully erosion.
- Prime farmland preservation.
- Wind erosion.
- Encouragement of conservation tillage practices (including strip-till).
- Maintaining the productivity of the soil.
- Streambank stabilization.

Water

- Management of nutrients, so nutrients are kept out of water.
- Streambank stabilization.
- Management of log jam removal.
- Siltation.
- Point source protection of ground water. (abandoned wells, irrigators, etc.)
- Aquifer management.
- Urban water management (stormwater and retention ponds)(parking lots with oil & salt runoff).
- Proper management of tile drainage.

Air

- Off target chemical application/Spray drift (fungicides, insecticides, herbicides).
- Wind erosion.
- Livestock odor.

Plants

- Invasive species (Reed Canary Grass, Garlic Mustard, Autumn Olive, etc.)
- Herbicide resistant species.
- Control of EAB (Emerald Ash Borer)
- Lack of windbreaks (farmstead and/or field)

Animals

- Nuisance wildlife.
- Livestock waste.
- Lack of quality wildlife.
- Proper livestock exclusion (cattle in creeks).
- Lack of windbreaks.

Human

- Resource needs to complete watershed plan, including technical assistance.
- Education.
- Cash leases that will work with USDA programs.
- Ownership trends (including land exchanges).
- Equipment costs.
- Urban sprawl.
- Proper management of tile drainage.
- Equitable allocation between livestock and non livestock.
- Too much paperwork for USDA programs.
- Fully fund CSP.

Along with additional input on the resource concerns, the local work group would like additional input on which groups should be invited to the next meeting. The following is a list of potential invites:

- Champaign County and/or CCRPC (Champaign County Regional Planning Commission)
- Cities representative
- ERMA (Embarras River Management Association)
- Farm Bureau
- IDNR (Illinois Dept. of Natural Resources)
- Illinois Natural History Survey
- Salt Fork Implementation Committee
- Road Commissioner
- Pheasants Forever
- Champaign County Forest Preserve
- Parkland

Please have comments submitted to Renee Weitekamp, 217-352-3536 ext 3 or renee.weitekamp@il.nacdnet.net by January 18, 2008.

Meeting adjourned at 10:38 a.m.

Table 1, Ranking of Resource Concerns, Champaign County, IL

No.	Rank	Possible Assistance	Resource	Specific Resource Concern	Total Acres Needing Treatment	FA ($) Needed	Explanation of units chosen and FA ($) Needed.
1	High	TA, EQIP, CPP, SWCD	Soil	Encouragement of conservation tillage practices (including strip-till)	Unknown	Unknown	Concern was identified as a concern which needs continued attention. Strip-Till is a common practice which will be used on both HEL and NHEL.
2	High	TA, EQIP, CPP, CRP	Soil & Water	Gully & Ephemeral Erosion and associated siltation problems	150 Structures	$1,050,000	Figured approximately 150 structures, at an average cost of $7,000.00
3	High	TA, EQIP, CPP	Soil & Water	Sheet & Rill erosion and associated siltation problems	22,000 ac	$4,300,000	Treating this concern with terraces, at a cost of about $200 per affected acre. 2006 Transect Survey puts 4% of cropland above "T".
4	High	TA, EQIP, SSRP	Soil, Water & Animals	Streambank stabilization (including livestock exclusion)	Inventory Needed	Not determined	There are 100's of miles of streams in Champaign County. Any estimate here would take a detailed inventory of needs.
5	High	TA, EQIP, CPP, FB, & Partners	Water	Management of nutrients, so nutrients are kept out of water (urban & agriculture)	100,000 ac	$1,000,000	Approximately 20% of all cropland is noted here, with an average payment for Nutrient Management of an estimated $10.00 per acre.
6				(Item combined w/ another)			Siltation was included in No. 2, 3 and 4 above
7				(Item combined w/ another)			Streambank "Water" resource was added to the Soil one above
8	High	TA, EQIP	Air	Wind erosion	5400 ac	Unknown	Estimated 1% of cropland
9	High	TA, EQIP	Animals	Livestock waste		Unknown	
10	High	TA, CSP	Humans	Fully fund CSP	(10% of Cropland acreage) 54,000 ac	Unknown	More funding for CSP will better insure, that our best producers continue to set the example for others.

11	High	TA, Watershed Planning	Humans	Resource needs to complete watershed plan, including technical assistance	300,000 ac needing to go to implementation phase	Unknown	Only the Salt Fork watershed has made it fully into the implementation phase. This leaves over 1/2 of the county to step up and fully develop plans, and move into the implementation phase.
12	Medium	TA, EQIP, CPP	Soil	Maintaining the productivity of the soil	540,000 ac	Unknown	Constant effort which will involve every acre of primarily cropland acres. Multiple practices and programs will be needed and utilized to insure that this happens.
13	Medium	TA, FRPP, F Bureau, SWCD	Soil	Prime farmland preservation	Inventory Needed	Not Determined	SWCD to continue with LE process for keeping the "Best" Prime farmland, as farmland.
14	Medium	TA, EQIP, CPP	Water	Point source protection of ground water (abandoned wells, irrigators, etc)	500 wells	$333,000	Estimate of Champaign County wells, based on past history of participation in well sealing program, and a presentation by the ISWS.
15	Medium	TA, EQIP - GSWC	Water & Humans	Proper management and protection of tile drainage systems	Countywide and 10 % of all tiled fields in county = 50,000 ac	Unknown amount of assistance needed	This item has two parts. 1 - maintaining tile, which are extensive and countywide. 2 - the DWM practice which is best suited to the flattest tiled areas, serving 20 or more acres per structure
16	Medium	TA, EQIP, WRP, WHIP, CRP	Water	Protection of wetland	10,000	Unknown	Includes cropland acres already converted to wetland, and naturally occurring wetlands.
17	Medium	SWCD, D Dist's	Water	River channel maintenance	Uncertain	Not Determined	Maintenance is done by those with current jurisdiction. Usually drainage districts.
18	Medium	SWCD	Water	Urban water management (stormwater and retention ponds)(parking lots with oil & salt runoff)	Uncertain	Not Determined	SWCD has been, and will continue to be actively involved in responses to requests for subdivision development, which includes provision for stormwater management.

19	Medium	TA, EQIP, CPP	Air	Off target chemical application/spray drift (fungicides, insecticides, herbicides)	Inventory Needed	Not Determined	This is an IPM practice which is incidental to other RMS planning activity, and is addressed in CSP contracts, and can be addressed in EQIP plans and contracts.
20	Medium	TA, EQIP, SWCD, IDOA	Plants	Invasive species (Reed Canary Grass, Garlic Mustard, Autumn Olive, etc)	Inventory Needed	Not Determined	Invasives are addressed in EQIP contracts (mainly Forestry Mgt), They are also addressed in all CSP contracts.
21	Medium	TA, EQIP, CRP, CPP, SWCD	Plants & Animals	Lack of windbreaks (farmstead and/or field)	Inventory Needed	Not Determined	Primarily utilized on farmsteads in the rural areas, but needs more promotion as a viable practice in crop fields as well.
22	Medium	TA, WHIP, EQIP, WRP, CPP	Animals	Lack of quality wildlife habitat	(5%Cropland ac.) = 27000	$4,590,000	Concentrated in a few areas with a already diverse habitat. Spreading throughout county will be a higher priority.
23				(Item Combined w/ another)			Windbreak "Animal" resource added to Plants resource above
24				(Item Combined w/ another)			Livestock exclusion included as part of no.4 above (streambank)
25	Medium	TA, SWCD	Humans	Cash leases that will work with USDA programs	Inventory Needed	Not Determined	Concern of many producers right now, especially with all costs rising. USDA to be mindful of this when developing cost lists for our planned practices.
26	Medium	SWCD	Humans	Create coordination ability between drainage districts and USDA (possibility for drainage districts to apply for USDA programs)	Uncertain	Not Determined	SWCD likely to be the main player in addressing this resource concern.
27	Medium	SWCD, IDOA	Humans	Education of Drainage Law and wetland regulations	Uncertain	Not Determined	SWCD also on the forefront for this item with assistance from the IDOA.

28	Medium	TA, SWCD	Humans	(of customers about programs and how we can solve their resource concerns)	Uncertain	Not Determined	Joint partner effort to get the word out about our programs by all means available. Plan to use TV, Radio, Newspaper print, newsletters, targeted mailings, as well as the SWCD website.
29				(Item Combined w/ another)			DWM added to No.15 above
30	Medium	TA, SWCD, Farm Bureau	Humans	Urban sprawl (minimize the impact and effect of development)	Uncertain	Not Determined	SWCD and CC Farm Bureau will remain leaders in continuing to insure that development happens in accordance with zoning and Land Use guidelines.

Cumberland County
Local Area Work Group Meeting
June 10, 2008
10:30 A.M.

The core group met on June 10, 2008 to put a dollar value on the ranked resource concerns and to indicate where the assistance may come from and the resource it affects.

We were to rank the high and medium concerns. We consolidated some of our concerns due to repetitiveness. We have compiled 13 concerns and have notes on how we came up with the values:

1. Sheet and Rill erosion. The County Transect Survey shows we are at 86% T. We took 14% of 170,000 acres of tillable ground in Cumberland county = 23,800 acres. 23,800 acres X $15 an acre = $347,000.
2. Streambank erosion and log jam removal along the Embarras River and tributaries. 633,600 ft. of river, tributaries and creeks times 30% needing treatment = 190,100 ft. at $50 per foot = $9,504,000.
3. Nutrient Management. 25% of 170,000 acres = 42,500 acres X $15 per acre = $637,500.
4. Education on Wildlife habitat and Management of Wildlife. We renamed it education to cover a wide range. We decided that it cost about $200 per meeting X 20 meetings = $4,000.
5. Outreach education on availability of USDA programs. Value not determined
6. Ephemerial gully erosion. 170,000 acres X 5% equals 8,500 acres X $100 an acres = $850,000.
7. Maintenance of Conservation Practices. 720 ac X $100 = $72,000.
8. Flooding. 10,000 acres at $144.00 = $1,444,000.
9. Abandoned Wells. (1000 wells) 10 wells a year at $250 per well X 10 years = $25,000.
10. Fire Protection. 10 dry hydrants X $700 per hydrant = $7,000.
11. Lack of Animal Waste storage management. 8 CAFO's over the next 10 years at $100,000 per facility = $800,000.
12. Invasive and exotic species. 43 projects X 20 acres per project = 860 acres. $187.50 an acre X 860 acres = $161,250.
13. Recycling Program to prevent littering and dumping. Value not determined.

Total money needed to complete this plan = $13,861,750.

Meeting adjourned at 11:55 a.m.

Cumberland County
Local Area Work Group Meeting
January 29, 2008
10 A.M.

Present for the meeting:
Kathy Dickerson, CED, Cumberland County FSA
Dean Dryden, Chairman, Cumberland County FSA County Committee
Don Frederick, Unit Leader, Cumberland/Jasper Extension Unit
Tom Benjamin, Coordinator, Lincoln Heritage RC & D
Paul Krone, NRCS Area Resource Specialist
Dan Osterman, DC, Cumberland County NRCS
Randy Hurt, RC, Cumberland County SWCD
Judy Meislahn, AC, Cumberland County SWCD

Members absent:
Robert Swearingen, Chairman, Cumberland County SWCD

The meeting was called to order by Randy Hurt, filling in for Robert Swearingen, at 9:55 a.m. There were 8 people present for the 1st meeting of the Cumberland County Local Area Work Group Meeting. Dan Osterman gave an explanation of the need for this meeting. It was mentioned by others at the meeting how this compared to past meetings when dockets were prepared for the ACP program. It was a locally led work group and was led by the SWCD and county committee. Dan then gave a power point presentation on Locally Led Conservation & Local Work Groups. It highlighted the point of how locally led conservation is where local stakeholders assess their natural resource conditions and needs, set goals, identify programs and other resources to solve their needs, develop proposals and recommendations, implement solutions, and measure their success. It was also pointed out the purpose of the local work group is to facilitate the USDA portion of locally led conservation, and provide advice to NRCS concerning the implementation of conservation programs in accordance with Federal Advisory Committee Act (FASA). This will all tie into how the dollars are needed to implement the programs and to let congress know what is needed to get conservation on the ground.

The group then identified some of the resource concerns for the county. They used SWAPAH as a guide, which stands for Soil, Water, Air, Plants Animals, and Humans.

Soil:

1. Sheet and rill erosion. The County Transect survey shows we are at 86% T.
2. Stream bank erosion and log jam removal
3. Ephemerial gully erosion
4. Lack of use of residue management being applied. Too much recreational tillage.
5. Lack of education on soil conditions
6. Maintenance of conservation practices both old and new.

7. Ponds – lack of pond construction, to reduce sedimentation, and for water supply for livestock.

Water:
1. Nutrient Management – water quality, chemicals, phosphorous, nitrogen
2. Flooding
3. Lack of rural water supply systems
4. Waste treatment, ground water contaminants – phosphorous
5. Log Jams
6. Stream bank erosion
7. Lack of good soil testing
8. Urban fertilization of lawns

Air:
1. Education on sequestration carbon credits
2. Lack of animal waste storage management which can cause air pollution
3. Lack of Forest Management
4. Soybean rust potential

Plants:
1. Lack of Forage and Forest management (education)
2. Forestland management is needed
3. Invasive and exotic species are a problem
4. Herbicide resistant plants
5. Education of alternative crops

Animals:
1. Animal Waste – excessive phosphorous and nitrogen, lack of storage management, and education is needed.
2. Education on Wildlife Habitat and Management of Wildlife
3. Education and outreach programs
4. Grazing

Human:
1. Nutrient management – prices, economic and financial cost of fertilizer - education is needed
2. Education for farm operation management – (costs) fertilizer, fuel etc.
3. Outreach Education on availability of USDA programs
4. Re-vamp programs such as EQIP and CRP – they have too many hoops – too many regulations

Other Concerns:
1. Keep USDA programs voluntary and do not turn them into regulatory programs.

A list of who to invite to the next meeting was discussed. The same 9 people that were to be at the first meeting should also try to attend the second meeting, along with the Village Maintenance Managers from Toledo, Greenup, and Neoga; Ben Bland, County Engineer; Rob Catey, Farm Bureau Chairman; Robert Wagoner, District Forester IDNR; Doug Brown, District Wildlife Biologist IDNR; Josh McKinney, Environmental Health Specialist Cumberland County Health Dept.; Greg Sherwood, Executive Director with ERMA; Dave Walk, county board member and pork producers member; Todd Padrick, Farm Bureau director and beef council; Tim Wente, member of the local dairy herd council; Mark Hemmen, Extension Council member and seed enterprise; and Sarah Layton, Executive Director Cumberland County Development Corporation. It was suggested to send a hard copy of the power point presentation to the invited members along with the minutes from this meeting.

The next meeting will be held on Tuesday, February 12, 2008 at 10 A.M., at the Toledo Village Hall, located on the south side of the square.

The meeting was adjourned at 11:30 a.m.

EDGAR COUNTY LOCALLY LED CONSERVATION
AND LOCAL WORK GROUP MEETING
January 7, 2008
USDA Service Center, Paris IL

Attendees:

Edgar County SWCD
- Phil Landes
- Warren Thomas
- Bob Webb
- Charla Coombe

FSA
- Dave Cornwell

Edgar County Extension
- Shaun Sullivan

City of Paris
- Paul Ruff

NRCS
- Ray Coombes
- Matt Sullivan

The Edgar County SWCD hosted the 2nd meeting of the Local Work Group at the USDA Service Center in Paris IL on January 7, 2008. Chairman Landes welcomed the group to the second meeting and made sure that everyone had received a copy of the list of concerns for prioritization.

Discussion took place and the group ranked them into the top 10 concerns for the county and placed number with them as to what needs were to be addressed.

10. Livestock Waste Management
    - 4 Comprehensive Nutrient Management Plans need developed
9. Lack of local control
    - Assist with Land Use Planning
8. Develop & Maintain Proper Habitat
    - 3,000 Acres of prairie habitat planted and properly maintained
    - 40 acres of shallow water/wetland restoration
7. Lack of Education
    - Hold 6 meetings/year
6. Chemical Resistance
    - County wide agriculture
5. Quality of Woodlands/Exotic & Invasive Species
    - 50,000 acres of woodlands to be better managed
    - County wide non agriculture fields
4. Control Soil Erosion
    - 50,000 acres of possible gully erosion
    - 8,000 acres of waterways needing treatment
3. Control of Streambank Erosion
    - 45 miles of streambank that need stabilized
2. Water Quality due to TMDL impediments
    - 3,000 acres of filterstrips and or riparian buffers need to be installed.
1. Conservation Tillage
    - 75,000 acres of HEL needs to be maintained or reduced to “T”.

These are to be presented at the SWCD annual Meeting on Feb. 5, 2008. At that time we will ask for public input and discussion. We will then assign programs available and utilize NRCS cost tracking to quantify in dollars the magnitude of the need.

<u>Effingham County Local Work Group Meeting Minutes</u>
February 19, 2008

The meeting of the Effingham County Local Work Group was called to order at 1:00pm by Dan Doedtman, chairman of the Soil and Water Conservation District board. There were 10 people present for the 1st meeting of the Effingham County Local Area Work Group Meeting.

Bart Pals, Effingham County District Conservationist, gave an explanation of the need for this meeting. Bart went over the "Locally Led Conservation & Local Work Groups" handout, which was presented to each member in attendance. It highlighted the point of how locally led conservation is where local stakeholders assess their natural resource conditions and needs, set goals, identify programs and other resources to solve their needs, develop proposals and recommendations, implement solutions, and measure their success. It was also pointed out the purpose of the local work group is to facilitate the USDA portion of locally led conservation, and provide advice to NRCS concerning the implementation of conservation programs in accordance with Federal Advisory Committee Act (FASA). This will all tie into how the dollars are needed to implement the programs and to let congress know what is needed to get conservation on the ground.

Those attending were:

- Tom Roepke — County Board Member
- Bart Pals — District Conservationist
- Jamie Houck — Soil Conservationist
- Sean Sherrod — SWCD Director
- Kenny Brummer — SWCD Director
- Stan Jansen — SWCD Director
- Merilyn Foster — SWCD Director
- Dan Doedtman — SWCD Chairman
- Randy Tillman — County Executive Director
- Paul Krone — NRCS Area Resource Specialist

Paul Krone continued by asking present members to identify Effingham County's resource concerns. They used SWAPAH as a guide, which stands for Soil, Water, Air, Plants Animals, and Humans. The resource concerns identified were:

<u>Soil:</u>
1. Sheet and rill erosion
2. Gully erosion
3. Scour erosion
4. Sedimentation in ditches and drains
5. Lack of education and repair of structural and conservation practices maintenance
6. Poor soil drainage
7. Stream bank erosion
8. Lack of proper road ditch education and maintenance
9. Log jam education
10. Ephemeral erosion

Water:
1. Nutrient management (excess nitrates, excess Phosphorus, animal manure)
2. Lack of water supply for humans (wells going dry)
3. Runoff is too fast
4. Road ditch culverts being plugged

Air:
1. Lack of animal waste storage management which can cause air pollution
2. Lack of Forest Management

Plants:
1. Johnson grass issues
2. Invasive and Exotic plant species issues (Lake Sara)
3. Livestock overgrazing (lack of education)
4. Lack of fertility management on pasture land
5. Lack of proper timber management (lack of education)
6. Lack of management for native grass species

Animals:
1. Manure, natural fertilizers (livestock)
2. Lack of waste storage (confinement) and application of manure
3. Management of geese (Lake Sara), deer, etc.
4. Declining Bobwhite quail population

Humans:
1. Need education of conservation programs that are available
2. Lack of participants' money and priorities
3. Complexity of federal programs (acronyms)
4. Lack of education of conservation and preservation of farmland
5. Need youth education

Other:
All issues lack education

The group then formed a list of individuals and agencies that will receive an invitation for the next meeting, which will be held on March 12th at 9:00am. The list included the following:

- County Highway Engineer
- Farm Bureau
- U of I Extension
- Effingham Water Authority
- County Board
- Little Wabash EcoPartnership
- Effingham Equity
- FS
- IDNR
  - District Forester
  - Wildlife Biologist
- Farmers Union
- City of Effingham Representative
- Council Board Member

The meeting adjourned at 2:15pm.

Effingham County Local Work Group Meeting Minutes
March 13, 2008

The meeting of the Effingham County Local Work Group was called to order at 9:15am by Dan Doedtman, chairman of the Soil and Water Conservation District board. There were 11 people present for the 2nd meeting of the Effingham County Local Area Work Group Meeting.

Bart Pals, Effingham County District Conservationist, gave an explanation of the need for this meeting. Bart briefly went over the "Locally Led Conservation & Local Work Groups" handout, since most of those in attendance had been through it before. It highlighted the point of how locally led conservation is where local stakeholders assess their natural resource conditions and needs, set goals, identify programs and other resources to solve their needs, develop proposals and recommendations, implement solutions, and measure their success. It was also pointed out the purpose of the local work group is to facilitate the USDA portion of locally led conservation, and provide advice to NRCS concerning the implementation of conservation programs in accordance with Federal Advisory Committee Act (FASA). This will all tie into how the dollars are needed to implement the programs and to let congress know what is needed to get conservation on the ground.

Those attending were:

- Tom Roepke — County Board Member
- Bart Pals — District Conservationist
- Jamie Houck — Soil Conservationist
- Sean Sherrod — SWCD Director
- Kenny Brummer — SWCD Director
- Stan Jansen — SWCD Director
- Merilyn Foster — SWCD Director
- Dan Doedtman — SWCD Chairman
- Rob Kiefer — SWCD Resource Conservationist
- Norbert Brauer — Farmers Union
- Paul Krone — NRCS Area Resource Specialist

Some of the invited representatives were unable to attend, so they voiced their resource concerns by phone.

Paul Krone continued by asking present members if there were any Resource Concerns that needed to be added to the current list of concerns.

They used SWAPAH as a guide, which stands for Soil, Water, Air, Plants Animals, and Humans. The resource concerns identified were:

****Additional Resource Concerns***

Soil:

1. Sheet and rill erosion
2. Gully erosion
3. Scour erosion
4. Sedimentation in ditches and drains

5. Lack of education and repair of structural and conservation practices maintenance
6. Poor soil drainage
7. Stream bank erosion
8. Lack of proper road ditch education and maintenance
9. Log jam education
10. Ephemeral erosion

Water:
1. Nutrient management (excess nitrates, excess Phosphorus, animal manure)
2. Lack of water supply for humans (wells going dry)
3. Runoff is too fast
4. Road ditch culverts being plugged

Air:
1. Lack of animal waste storage management which can cause air pollution
2. Lack of Forest Management

Plants:
1. Johnson grass issues
2. Invasive and Exotic plant species issues (Lake Sara)
3. Livestock overgrazing (lack of education)
4. Lack of fertility management on pasture land
5. Lack of proper timber management (lack of education)
6. Lack of management for native grass species
7. ***Lack of CRP Mid-management practices***

Animals:
1. Manure, natural fertilizers (livestock)
2. Lack of waste storage (confinement) and application of manure
3. Management of geese (Lake Sara), deer, etc.
4. Declining Bobwhite quail population
5. ***Need to increase wetlands and grasslands***

Humans:
1. Need education of conservation programs that are available
2. Lack of participants' money and priorities
3. Complexity of federal programs (acronyms)
4. Lack of education of conservation and preservation of farmland
5. Need youth education

Other:
All issues lack education

The meeting was adjourned at 9:45am.

<u>Effingham County Local Work Group Prioritizing Meeting Minutes</u>
March 13, 2008

The meeting of the Effingham County Local Work Group (for prioritization) was called to order at 9:45am by Dan Doedtman, chairman of the Soil and Water Conservation District board. There were 10 people present for the prioritization of resource concerns meeting.

Bart Pals, Effingham County District Conservationist, explained why we needed to prioritize the resource concerns. Rob Kiefer, Effingham County Resource Conservationist, gave options on ways to prioritize the resource concerns. Rob then handed out the resource concerns and the prioritizing began!

Those attending were:

- Tom Roepke — County Board Member
- Bart Pals — District Conservationist
- Jamie Houck — Soil Conservationist
- Sean Sherrod — SWCD Director
- Kenny Brummer — SWCD Director
- Stan Jansen — SWCD Director
- Merilyn Foster — SWCD Director
- Dan Doedtman — SWCD Chairman
- Rob Kiefer — SWCD Resource Conservationist
- Norbert Brauer — Farmers Union

Rob collected the results. The final results are on the attached page.
(located in an excel spreadsheet)

The resource concerns prioritization meeting adjourned at 10:00am.

Table 1, Ranking of HIGH Resource Concerns, Effingham County, IL					
Rank	**Possible Assistance**	**Resource**	**Specific Resource Concern**	**Total Acres Needing Treatment**	**FA ($) Needed**
H		SOIL	Sheet, Rill, Gully, Scour, and Ephemeral Erosion		
H		SOIL	Lack of education and repair of structural and conservation practices maintenance		
H		WATER	Nutrient Management (excessive nitrates, excess P, animal manure)		
H		ANIMALS	Manure, natural fertilizers (livestock)		
H		ANIMALS	Lack of waste storage (confinement) and application of manure		
H		HUMANS	Need education of conservation programs that are available		
H		HUMANS	Complexity of federal programs (acronyms)		
TOTALS:					

Table 1, Ranking of MEDIUM Resource Concerns, Effingham County, IL					
Rank	**Possible Assistance**	**Resource**	**Specific Resource Concern**	**Total Acres Needing Treatment**	**FA ($) Needed**
M		SOIL	Sedimentation in ditches and drains		
M		SOIL	Stream bank erosion		
M		SOIL	Lack of proper road ditch education and maintenance		
M		WATER	Runoff is too fast		
M		AIR	Lack of proper animal waste storage management (which can also cause air pollution)		
M		AIR	Lack of forest management		
M		PLANTS	Livestock overgrazing (lack of education)		
M		PLANTS	Lack of fertility management on pasture land		
M		PLANTS	Lack of proper timber management (lack of education)		
M		PLANTS	Lack of management for native grasses		
M		ANIMALS	Lack of proper management of geese (Lake Sara), deer, etc.		
M		HUMANS	Lack of participants' money and priorities		
M		HUMANS	Lack of education of conservation and preservation of farmland		
M		HUMANS	Lack of youth education		
TOTALS:					

Minutes of Vermilion County
Locally led Stakeholders Meeting

The locally led Stakeholder meeting was called to order at 8:30 a.m. by Cindy Johnston.

Resource concerns brought forward by the core group were reviewed.

Ken Konsis, representing the Vermilion County Conservation District (county park system) was unable to attend, but forwarded comments. Ken also voiced concern with the spread of invasive species. He further commented on forest management and tax assessment information that is available. Mr. Konsis felt there is more of a problem with dissemination of the information and people knowing where to get the information.

Mike Garthaus, IDNR District Fisheries Biologist, was also unable to attend and forwarded comments. He noted specifics of addressing the existing TMDL's which have been established for Vermilion County waters. Those areas where the TMDL's are being exceeded should be areas of focus. He further highlights the TMDL draft report as listing sources of impairments being largely due to excessive soil loss as a result of conventional tillage systems in use in areas of impaired waters.

It was noted that soil erosion due to too much tillage, as well as ephemeral and gully erosion, was listed as a resource concerns. An additional resource concern listed is the proper application rates of nitrogen and phosphorus.

Having no other resource concerns to be added to those generated by the core group of the local work group, the meeting adjourned at 9:25 a.m.

VERMILION COUNTY
Locally Led Conservation
and
Local Work Group

November 29, 2007

MEETING DATA

Location: USDA Agriculture Service Center

Time: 8:30 a.m.

NRCS District Conservationist – Glen Franke

USDA
Susan Hawkins – employee
Pat Marron – County Committee Member

SWCD
Richard Kentner - Chairman
Morris Chesnut - Director
Chris Elliott - Director
Kevin Green, Associate Director
John Maudlin, Associate Director
John Peverly – Watershed Coordinator
Cindy Johnston – Resource Conservationist
Sheila Lane – Administrator Coordinator

N.R.C.S.
Glen Franke
Amanda Grundy
Paul Krone

The Local Work Group meeting was called to order at 8:30 a.m. by Cindy Johnston. Cindy welcomed everyone to the meeting asked the members to share concerns, identify problems and set goals.

Glen Franke addressed the purpose a Locally Led Work Group. The results of the meetings will provide feedback to the NRCS State Technical Committee as recommendations to NRCS.

The following general categories were identified group headings:

Soil	Plants
Water Quality	Air
Animals	Human Factor

Category names in ( ) indicates problem could additionally be in another category.

<u>Soil</u>

(Water Quality) Gully Erosion

Waterways – existing / new

Too much tillage

(Water Quality) Streambank Erosion

(Water Quality) Sheet and Rill Erosion

1. Program for Surface Inlets - Lack of Filter strips around risers
2. Waste Water concerns – (manure) / (Animal concerns category)

Nutrient Management – application of proper rates (nitrogen, phosphorus, total maximum daily load pathogens)

Too much fall application of fertilizer

(Human Factor) Fertilizer costs – price difference - fall verses spring

<u>Animals</u>

Too many deer and turkey

(Human Factor) CRP / rental rates are not keeping up
Concern: CRP will go back into production

<u>Plants</u>

Exotic and invasive species

Autumn Olive, Multiflora Rose, Garlic Mustard, Bush Honeysuckle

Forestry Management – Lack of information and tax assessment

<u>Air</u>

<u>Human Factor</u>

Fertilizer Costs

County control is desired on handling level of funding allocation / county control of funding for cost share

Glen Franke asked Susan Hawkins (FSA) – What are the program questions that you hear most often?

Susan Hawkins – Funding for existing waterway repair, and gulleys

Paul Krone asked the group to priortize this list of ideas. Maybe some ideas were missed. This is the first opportunity to address these agriculture issues. A public meeting should be the next step for input.

Paul Krone suggested a) that the group ranks this list individually and send back
or
b) the top priorities that were discussed - rank now as a group

Ranking could be classed as High – Middle – Low

The Vermilion County Local Work Group prioritized the discussion of ideas as:

1. County control of funding to address Vermilion County issues
   1a. Streambank Stabilization
   1a. Erosion
2. Water Quality
3. Plants
4. Nutrient Management – waste water concerns
5. Animals
6. Lack of Information

The group stated that sometimes this process is redundant. Vermilion County has an active Water Quality Coalition and Ecosystem Partnership. Will any results be seen from these meetings?

The next step of the Work Group will be an action plan to address points of concern and scheduling meetings with other organizations and partners such as Farm Bureau and Pheasants Forever.

Paul encouraged public participation to get feedback. The key is sharing outside this group and develop a plan.

Refer to seps in the locally led conservation process.

Obtain public participation
Assess conservation needs
Identify and prioritize needs
Set Goals
Identify Programs and Funding Sources
Prepare Plan
Implement Plan (Conservation Action Plan)
Measure Performance

Other agencies to invite: Farm Managers, State Agencies, FSA county committee members.

A suggestion of other agencies to consider that were not represented in this group - Livestock, timber, ag retailer (fertilizer), elected people (County Board Chairman, Representative Black), road commissioners, and drainage districts.

Next meeting date

January 24, 2008
Time: 8:30 a.m.
Location to be decided

Kevin Green moved to adjourn the meeting. Morris Chesnut seconded the motion. The meeting was adjourned at 10:05 a.m.

Table 1, Ranking of Resource Concerns, _Douglas___County, IL					
Rank	Possible Assistance	Resource	Specific Resource Concern	Total Acres Needing Treatment	FA ($) Needed
H	EQIP/CRP/CPP	Soil	Sheet/Rill	12,100	544,500.00
H	EQIP/CRP/CPP	Soil	Ephemeral & Gully Erosion	24,200	1,085,000.00
H	EQIP/CPP	Soil	No-Till & Strip-Till Incentives	36,300	1,633,500.00
H	TA	Soil	Better Education of cons. practices	Hold Workshops	Unknown
H	EQIP/CPP	Water	Nutrient Management	96,800	2,904,000
H	EQIP	Soil/Air	Wind Erosion	170	51,000.00
H	All Programs	Human	Lack of Funding	Unknown	Unknown
H	RC&D	Human	Illegal Dumping	Unknown	Unknown
M	EQIP/CRP/CPP	Soil	Siltation in ditch banks & roads	Countywide	Unknown
M	EQIP/CPP	Soil	Streambank Erosion	150,000Ft.	4,500,000.00
M	TA	Soil	Pipeline Damage from Gas Pipeline	Unknown	Unknown
M	TA	Water	Proper use of herb/insect	Countywide	Unknown
M	WRP/CRP/CPP/EQIP	Soil & Water	Flooding from Kaskaskia & Embarras	Unknown	Unknown

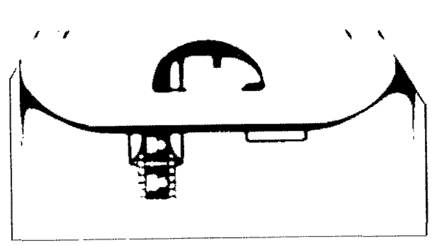


Table 1, Ranking of Resource Concerns, _Douglas___County, IL					
Rank	Possible Assistance	Resource	Specific Resource Concern	Total Acres Needing Treatment	FA ($) Needed
M	TA	Water	Log Jams	Countywide	Unknkown
M	CRP/WRP/EQIP	Water	Lack of Wetlands	Undetermined	Unknown
M	Lumpkin Foundation	Plants	Establishment of Alternative crops needed	400	Unknown
M	EQIP/TA	Animal	Proper animal waste manage	5 comp nutrient mgmt plans	50,000.00
M	EQIP/CRP/CPP/WHIP	Animal	Lack of wildlife habitat	Countywide 4840 AC	242,000.00
M	Lumpkin Foundation	Human	Preserve Heritage of Amish Comm.	Undetermined	Unknown
			TOTAL		11,010,000.00

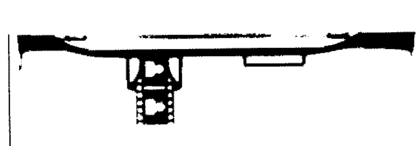


Table 1, Ranking of Resource Concerns, _JASPER_County, IL					
Rank	**Possible Assistance**	**Resource**	**Specific Resource Concern**	**Total Acres Needing Treatment**	**FA ($) Needed**
HIGH	EQIP, CSP, WRP, CRP, CPP	SOIL	EMPHEMERAL EROSION	49,200 acres @45 an acre	2,214,000
HIGH	EQIP, CSP, CPP, CRP	SOIL	GULLY EROSION	150 structures @$2492 ea. 150 structures @ $4748ea 50 structures @$5168ea. 56 structures @$1442 1230 acres of waterway @$2022 ea.	3,911,912
HIGH	UNKNOWN	ANIMALS	DEER OVER POPULATION		
HIGH	EQIP, CSP	WATER	NUTRIENTS IN WATER	WHOLE COUNTY	
HIGH	EQIP, IDNR	PLANTS	TREE DISEASES	INVENTORY NEEDED	
HIGH	UNKNOWN	PLANTS	ROUNDUP RESISTANT WEES	INVENTORY NEEDED	
HIGH	EQIP, IDNR	PLANTS	INSECT PROBLEMS	INVENTORY NEEDED	
HIGH	EQIP, AND STATE PROGRAMS FOR STREAM STABILIZATION	SOIL	STREAMBANK EROSION	438,768 FEET @ $54.62 PER FOOT FROM INVENTORY DONE IN 1997 BY VINCE GUTOWSKI AND STUDENTS FROM EIU	23,963,000

Table 1, Ranking of Resource Concerns, _Jasper County, IL					
Rank	**Possible Assistance**	**Resource**	**Specific Resource Concern**	**Total Acres Needing Treatment**	**FA ($) Needed**
MED	EQIP, CSP, CRP WRP, WHIP	SOIL	HUMUS LOSS AS BIOMASS IS REMOVED	INVENTORY NEEDED	
MED	UNKNOWN	PLANTS	MARKET FOR BIOFUELS		
MED	UNKNOWN	AIR	WIND TURBINES FOR ENERGY PRODUCTION		
MED	UNKNOWN	PEOPLE	LOW INCOME		
MED	UNKNOWN	PEOPLE	HEALTH CARE FOR LOW INCOME WAGE EARNERS		
MED	UNKNOWN	PEOPLE	LACK OF ASSISTED LIVING FACILITIES IN THE COUNTY		
MED	UNKNOWN	PEOPLE	LITTERING IN RURAL AREAS	INVENTORY NEEDED	
MED	UNKNOWN	PEOPLE	MORE RECYCLING		
MED	LESA	PEOPLE	ZONING/LAND USE PLANNING	WHOLE COUNTY	
MED	UNKNOWN	ANIMALS	RESERCH INTO BIOFILTERS FOR SWINE CONFINEMENT FACILITIES		
MED	EQIP, CSP, CRP,	ANIMALS	WINDBREAKS AROUND SWINE FACILITIES TO REDUCE ODOR PROBLEMS	INVENTORY TO DETERMINE FOOTAGE NEEDED	

EMBARRAS RIVER MANAGEMENT ASSOCIATION

6021 Development Drive; Suite 3
Charleston, IL 61920
Ph: (217) 345-3762
ERMA93@consolidated.net
www.ERMAWatershed.org

ERMA ANNOUNCEMENT

July 23, 2009

MEETING DATES SET FOR PUBLIC INPUT ON EMBARRAS RIVER BASIN RESOURCE MANAGEMENT PLAN REVIEW

The Embarras River Management Association (ERMA) is heading up the review and update of the 1996 Embarras River Basin Resource Management Plan. The Embarras (pronounced Ambraw) River starts at the southern end of the campus of the U of I in Champaign and flows generally south-southeast for 192 miles through the eight counties of Champaign, Douglas, Coles, Cumberland, Jasper, Richland, Crawford and Lawrence to its confluence with the Wabash River southeast of Lawrenceville, Illinois. The Embarras River Watershed is home to over 130,000 citizens and encompasses over 1.5 million acres with additional drainage area in the four counties of Vermilion, Edgar, Effingham and Clark.

ERMA has contracted with Eastern Illinois University and the V3 Companies for their services in research, data collection, GIS and mapping work, and publication of the new plan. This project is being carried out in cooperation with the Illinois Natural Resources Conservation Service, Illinois Department of Natural Resources, Illinois Environmental Protection Agency, Illinois Department of Agriculture, and the Soil and Water Conservation Districts in the counties of Champaign, Vermilion, Douglas, Edgar, Coles, Clark, Cumberland, Effingham, Jasper, Richland, Crawford, and Lawrence.

Public input is a very important part of the planning process. Hearing from the citizens who live and work within the boundaries of the Embarras River watershed is needed to make the plan current and relevant. Therefore, three public meetings have been set up in order to give citizens the opportunity to voice their ideas and concerns. Those meetings are as follows:

- **August 4, 2009 at 7:30 p.m. in Tuscola, IL in the meeting room of the USDA Service Center at the address of 900 South Washington Street. The building is located on the south side of Rt. 36 on the west side of town.**
- **August 5, 2009 at 7:00 p.m. in Greenup, IL in the Community Meeting Room located within City Hall, which is downtown in the middle of the town square.**
- **August 6, 2009 at 7:00 p.m. in Newton, IL at the Sunrise Community Center located south of town on Rt. 130, on the east side of the road, just north of the USDA Service Center.**

ERMA was established by concerned citizens in 1993 as a non-profit conservation group with the goal of promoting conservation projects and practices that improve water quality, reduce soil erosion and stream sedimentation, protect fish and wildlife habitat, alleviate flooding to communities and cropland, and improve economic and recreational opportunities within the Embarras River Watershed. Membership in ERMA is free and open to individuals, families, businesses, corporations, and organizations. ERMA's operations and projects are funded by grants and the generous donations of money, goods, and services from our members. Members also volunteer their time and many talents to our conservation cause. Interested parties should contact the ERMA office by phone at 217-345-3762; by mail at ERMA, 6021 Development Drive, Suite 3, Charleston, IL 61920; or by email at erma93@consolidated.net

Embarras River Watershed Plan – Public Meeting

August 5, 2009
City Hall
Greenup, Illinois

Meeting Agenda

7:00 – 7:05:	Introduction
7:05 – 7:35:	V3 & IDNR Presentation James Adamson, V3 Companies Jeff Boeckler, Illinois Department of Natural Resources
7:35 – 8:00:	Identify Watershed Concerns
8:00 – 8:15:	Prioritization Exercise & Closing

Embarras River Watershed Plan – Public Meeting

August 6, 2009
Sunrise Community Center
Newton, Illinois
7:00 PM

Meeting Agenda

7:00 – 7:05:	Introduction
7:05 – 7:35:	V3 & IDNR Presentation James Adamson, V3 Companies Jeff Boeckler, Illinois Department of Natural Resources
7:35 – 8:00:	Identify Watershed Concerns
8:00 – 8:15:	Prioritization Exercise & Closing

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

ERMA EMBARRAS RIVER MANAGEMENT ASSOCIATION

Embarras River Watershed Plan – Public Meeting

August 4, 2009
900 South Washington Street
Tuscola, Illinois

Meeting Agenda

7:30 – 7:35:	Introduction
7:35 – 8:05:	V3 & IDNR Presentation James Adamson, V3 Companies Jeff Boeckler, Illinois Department of Natural Resources
8:05 – 8:30:	Identify Watershed Concerns
8:30 – 8:45:	Prioritization Exercise & Closing

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

ERMA EMBARRAS RIVER MANAGEMENT ASSOCIATION

Champaign SWCD/NRCS	Dec-10
City of Charleston	Dec-10
City of Newton	Dec-10
City of Tuscola	Dec-10
City of Villa Grove	Dec-10
Coles SWCD/NRCS	Dec-10
Crawford SWCD/NRCS	Dec-10
Cumberland SWCD/NRCS	Dec-10
Douglas SWCD/NRCS	Dec-10
Jasper SWCDD/NRCS	Dec-10

Meetings were held with the above mentioned counties and municipalities in December of 2010, these counties and municipalities were chosen based on their position in the "priority subwatersheds" that were identified by the stakeholders. The purpose of the meetings was to better understand primary watershed concerns and to identify specific project implementation opportunities. As a result of these meetings we were able to identify over 60 specific implementation projects that work towards achieving the goals and objectives of the watershed plan.

APPENDIX D – Pollution Load Analysis

References

Center for Watershed Protection. 2007. National Pollutant Removal Performance Database, Version 3.

Illinois Pollution Control Board. 2010. Title 35 of the Illinois Administrative Code: Environmental Protection Part 302 Water Quality Standards.

Indiana Department of Environmental Management, Office of Water Quality. 2010. Water Quality Targets. http://www.in.gov/idem/6242.htm.

Mitasova and Mitas: Modeling soil detachment with RUSLE3d using GIS, 1999; University of Illinois. http:/skagit.meas.ncsu.edu/~helena/gmslab/erosion/usle.html

Tetra Tech, Inc. 2006. Users Guide Spreadsheet Took for the Estimation of Pollutant Load (STEPL) Version 4.0, U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. 2000. Ambient Water Quality Criteria Recommendations Information Supporting the Development of State and Tribal Nutrient Criteria for Rivers and Streams in Nutrient Ecoregion VI.

U.S. Environmental Protection Agency. 2002. National Management Measures for the Control of Nonpoint Pollution from Agriculture.

U.S. Environmental Protection Agency. 2005. National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of Nonpoint Source Pollution.

U.S. Environmental Protection Agency. 2010. National Menu of Stormwater Best Management Practices. http://www.epa.gov/npdes/stormwater/menuofbmps.

U.S. Environmental Protection Agency. 2010. Polluted Runoff (Nonpoint Source Pollution). http://www.epa.gov/nps.

U.S. Environmental Protection Agency. 2002. Urban Stormwater BMP Performance Monitoring: A Guidance Manual for Meeting the National Stormwater BMP Database Requirements.

Schueler, T.R. 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Publ. No. 87703. Metropolitan Washington Council of Governments, Washington, DC.

Supplemental Non-Point Source Model Details

RUSLE Soil Loss Model

Methodology modified by Jeff Boeckler from: Mitasova and Lubos Mitas: Modeling soil detachment with RUSLE3d using GIS, 1999; University of Illinois. http:/skagit.meas.ncsu.edu/~helena/gmslab/erosion/usle.html

The erosion model was run all ground except urban areas.

- Obtained 1:24,000 SSURGO Digital Soils.
- Appropriate soil types selected and relevant RUSLE factors identified and calculated from SSURGO soils dataset.

GIS procedure:

1) RUSLE factors calculated for agricultural ground

Landcover	C factor	K factor	LS factor	R factor	P factor	
Agriculture Crops including other Agriculture	A and B slopes = 0.21 C and D slopes = 0.1 E, F, G slopes = 0.001	Values included in SSURGO tabular data	Values included in SSURGO tabular data; calculated from slope and slope length values	USDA values for each county	1 used for all soil polygons	
Barren, Quarries, Pasture/Grass, and Wheat	All slopes = 0.01	Values included in SSURGO tabular data	Values included in SSURGO tabular data; calculated from slope and slope length values	USDA values for each county	1 used for all soil polygons	
All Grass, Forest, Open Space, and Wetland	All slopes = 0.003	Values included in SSURGO tabular data	Values included in SSURGO tabular data; calculated from slope and slope length values	USDA values for each county	1 used for all soil polygons	
Water	All slopes = 0.003	Values included in SSURGO tabular data	Values included in SSURGO tabular data; calculated from slope and slope length values	USDA values for each county	1 used for all soil polygons	

2) RUSLE equation was run on shapefiles multiplying LS, R, K, C, and P.
3) Applied Delivery Ratio; 0.21 and calculated total soil loss

Pollutant Load Model

Formulas and selected variables were derived from STEPL (Spreadsheet Tool for Estimation of Pollutant Load) Version 3, Tetra Tech, 2004. Total Nitrogen, Total Phosphorous, and Total Suspended Solids (Sediment) were calculated. Calculation for pollutant loads is as follows: Acre/Feet of annual Runoff X Nutrient Concentration X 4047 X 0.3048/454.

Pollutant Model Values:

Model	Rain days	Correction Factor (precipitation)	Curve Number (by soil hydrologic group)	Runoff (by soil hydrologic group in inches)	N	P	TSS
All landuse	99.27	0.511 from Newton Station	See table	Calculated using the following equation: $Q = \frac{((P - (Ia X S))^2}{P + 0.8 X S}$ $S = \frac{1000}{CN} - 10$ Q = Runoff (inches) P = Precipitation (inches S = Potential max retention (inches CN = Curve Number Ia = Initial abstraction factor (set to 0)	N concentration in sediment (all landuse) = 0.0016 %	P concentration in sediment (all landuse) = 0.00062 %	
					N Concentration Runoff; corn, beans, other Ag, Wheat = 1.9	P Concentration Runoff; corn, beans, other Ag, Wheat = 1.9	
					N Concentration Runoff; Pasture = 4	P Concentration Runoff; Pasture = 0.3	
					N Concentration Runoff; Urban = 2.01	P Concentration Runoff; Urban = 0.31	TSS Concentration Runoff; Urban = 100.2
					N Concentration Runoff; All other vegetation = 0.15	P Concentration Runoff; All other vegetation = 0.008	

Landuse	Hydrologic Group	Curve Number
Other Ag and Wheat	A	58
	B	72
	C	81
	D	85
Corn and Soybeans	A	64
	B	75
	C	82
	D	85
Water and Aquaculture	A	98
	B	98
	C	98
	D	98
Pasture/Grass, Grassland, and Open Space	A	49
	B	69
	C	79
	D	84
Urban	A	77
	B	85
	C	90
	D	92
Wetland	A	85
	B	85
	C	85
	D	85
All Forest/trees	A	36
	B	60
	C	73
	D	79
Barrens	A	76
	B	85
	C	90
	D	93

Charleston Side Channel Reservoir
Total Maximum Daily Load Report

Coles County, Illinois

Doc. No: IEPA/BOW/03-013

Submitted by:
Illinois Environmental Protection Agency
1021 North Grand Avenue East
Springfield, IL 62794-9276

Prepared by:
Tetra Tech, Inc.
1468 W. 9th Street
Suite 620
Cleveland, OH 44113

August 2003

CONTENTS

APPENDIX

FIGURES

TABLES

Executive Summary

The Charleston Side Channel Reservoir (CSCR) is a water supply and recreational reservoir located in Coles County in east central Illinois. The CSCR is located three kilometers south of the city of Charleston and is the sole drinking water source for the city's approximately 23,000 residents. Many residents and outsiders also use the CSCR for sportfishing and boating activities.

As part of the Section 303(d) listing process, the Illinois Environmental Protection Agency (Illinois EPA) has identified the CSCR as an impaired water. The potential causes of impairment are phosphorus, nitrogen, total suspended solids (TSS), and excessive algal growth/chlorophyll *a* (Illinois EPA, 2001). These impairments result in the CSCR's being in partial support of its primary contact (swimming) and secondary contact (recreation) designated uses and in partial support of its aquatic life designated use. The drinking water supply and fish consumption designated uses of the CSCR are not impaired. It should also be noted that swimming is prohibited in the CSCR due to concerns about safety. The Illinois Pollution Control Board has designated the CSCR with a swimming use, therefore, Illinois EPA monitors this use even though the city of Charleston prohibits swimming in the CSCR.

The Clean Water Act and U.S. Environmental Protection Agency (USEPA) regulations require that states develop Total Maximum Daily Loads (TMDLs) for waters on the Section 303(d) lists. Illinois EPA is currently developing TMDLs for pollutants that have numeric water quality standards. Of the potential pollutants impairing the CSCR, phosphorus is the only one with a water quality standard for lakes.

Potential sources of phosphorus to the CSCR include pumping from Lake Charleston, runoff from the direct drainage area, shoreline erosion, septic systems, and precipitation. The bottom sediments are also contributing phosphorus loadings during portions of the year. Loads from these sources were estimated using a variety of means, and it was determined that the primary sources are the bottom sediments, pumping, and shoreline erosion. The BATHTUB model was used to determine how much the loads must be reduced so that the phosphorus target is achieved. BATHTUB was determined to be appropriate for the modeling because it addresses the parameter of concern (phosphorus) and has been used previously for reservoir TMDLs in Illinois and elsewhere.

The results of this analysis indicate that phosphorus loads must be reduced approximately 90 percent from their current levels to meet the TMDL target. A draft project implementation plan discusses potential implementation activities to achieve the desired reductions in loading, and presents a range of alternatives along with their expected costs and ability to reduce loads. Additional discussion among key stakeholders must occur to better identify specific actions that can be taken, and to refine the cost analysis.

Phase II Storm Water Regulations were not addressed in this TMDL because municipal separate storm sewer systems (MS4s) were not identified as a contributor to the pollutant for which this TMDL was developed.

Confined Animal Feeding Operations (CAFOs) were not addressed in this TMDL because they were not identified as a contributor to the pollutant for which this TMDL was developed.

1.0 Introduction

The CSCR is a water supply and recreational reservoir located in Coles County in east central Illinois (Figure 1). The CSCR is located three kilometers south of the city of Charleston, and it is the sole drinking water source for the city's approximately 23,000 residents. Many residents and outsiders also use the CSCR for sportfishing and boating activities. The CSCR was created in 1981 when Lake Charleston, an impoundment on the Embarras River, was divided by the building of a dike. Water from Lake Charleston is now pumped into the CSCR for eventual intake to the Charleston drinking water treatment plant. The land that drains directly into the CSCR is only a few square kilometers in size, is steeply sloped, and is primarily forested.

Since the completion of the CSCR, the names of the resulting waterbodies have created some confusion. Different reports and maps use different names for these waters. Illinois EPA considers the large body of water to the west of the side-channel dike to be the CSCR (Figure 2). The body of the water on the east side of the dike from the Riverview Dam-spillway to the Route 16 bridge is considered Lake Charleston. The name of the river above and below Lake Charleston is the Embarras River.

As part of the Section 303(d) listing process, the Illinois Environmental Protection Agency (EPA) has identified the CSCR as an impaired water (Table 1). The potential causes of impairment are phosphorus, nitrogen, total suspended solids (TSS), and excessive algal growth/chlorophyll *a* (Illinois EPA, 2001). These impairments result in the CSCR's being in partial support of its primary contact (swimming) and secondary contact (recreation) designated uses and in partial support of its aquatic life designated use. The drinking water supply and fish consumption designated uses of the CSCR are not impaired. It should also be noted that swimming is prohibited in the CSCR due to concerns about safety. The Illinois Pollution Control Board has designated the CSCR with a swimming use, therefore, Illinois EPA monitors this use even though the city of Charleston prohibits swimming in the CSCR.

Several segments of the Embarras River upstream of Lake Charleston are also impaired and are identified below:

- Segment BE14 in Douglas County for habitat alteration (other than flow), nutrients, nitrate, and pathogens.
- Segment BE19 in Douglas County for habitat alteration (other than flow), nutrients, and nitrate.
- Segment BE20 in Champaign and Douglas counties for habitat alteration (other than flow), nutrients, and nitrate.

The waterbody known as Lake Charleston generally behaves as a river due to its riverine characteristics. However, at times, it acts like a lake due to the presence of a spillway on its downstream end. These characteristics are evident from the Lake Charleston water levels data recorded daily (Monday-Friday) from 1990 to 1999 by the City of Charleston Water Treatment Plant. These data suggest that in three out of the ten years, there were extended periods of no flow over the spillway; approximately two weeks in 1990, three months in 1991 and three months in 1994 (City of Charleston, 2003). Illinois EPA monitored Lake Charleston in 1976 but no longer monitors Lake Charleston as part of the Ambient Monitoring Program or Clean Lakes Program because of its riverine characteristics. Data that Illinois EPA has for Lake Charleston are not used to determine impairment because the data are more than 15 years old.

The Clean Water Act and USEPA regulations require that states develop TMDLs for waters on the Section 303(d) lists. Illinois EPA is currently developing TMDLs for pollutants that have water quality standards. Of the pollutants impairing the CSCR, phosphorus is the only one with a water quality standard for lakes. Illinois EPA believes that addressing the phosphorus impairment should lead to an

overall improvement in water quality due to the interrelated nature of the other listed pollutants. For example, reducing loads of phosphorus to the CSCR should result in less algal growth and some of the management measures taken to reduce phosphorus loads (e.g., reducing shoreline erosion) should also reduce loads of suspended solids. Also, if phosphorus is reduced the ability of nitrogen to contribute to excessive algal growth should be limited since both nutrients are required.

Table 1. Charleston Side Channel Reservoir Section 303(d) Listing Information.

Rank	29
Watershed Identifier	ILBE09
Waterbody Segment	RBC
Waterbody Name	Charleston Side Channel Reservoir
Size	137 hectares (339 acres)
Designated Uses and Support Status	Fish Consumption (Full), Drinking Water Supply (Full), Overall (Partial), Aquatic Life (Partial), Primary Contact/Swimming (Partial), Secondary Contact/Recreation (Partial)
Causes of Impairment[1]	Nutrients (Phosphorus, Total Ammonia-N), Suspended Solids, Excessive Algae Growth
Potential Sources of Impairment	Agriculture (Crop Related Sources-Non-irrigated Crop Production), Habitat Modification (Streambank Modification/Stabilization), Forest/Grassland/Parkland

[1]Ammonia appeared as a cause in the 2002 Water Quality Report, but was not a cause in the 1998 303(d) List for which the Illinois EPA developed the TMDL. The ammonia cause is being re-evaluated and Illinois EPA plans to monitor the CSCR in 2004.

Source: Illinois EPA, 2002a.

A TMDL is defined as "the sum of the individual wasteload allocations for point sources and load allocations for nonpoint sources and natural background" such that the capacity of the waterbody to assimilate pollutant loadings is not exceeded. A TMDL is also required to be developed with seasonal variations and must include a margin of safety that addresses the uncertainty in the analysis. The overall goals and objectives in developing the CSCR TMDL have been to:

- Further assess the water quality of the CSCR and identify key issues associated with the impairments and potential pollutant sources.
- Use the best available science and available data to determine the maximum load of phosphorus that the CSCR can receive and fully support all of its designated uses. Addressing the phosphorus impairment will also address the other causes of impairment.
- Use the best available science and available data to determine current loads of pollutants to the CSCR.
- If current loads exceed the maximum allowable load, determine the load reduction that is needed.
- Identify feasible and cost-effective actions that can be taken to reduce loads.
- Inform and involve the public throughout the project to ensure that key concerns are addressed and the best available information is used.
- Submit a final TMDL report to USEPA for review and approval.

Previous reports described the available water quality data, characterized the watershed, and described the modeling tools to be used in developing the TMDLs (Tetra Tech, 2001a, 2001b). This report incorporates all of the information from these previous reports, presents the findings of the modeling analysis, and describes the elements of the TMDL. It also includes a preliminary discussion of how the load reductions might be implemented.

Figure 1. Upper Embarras River Watershed and the Charleston Side Channel Reservoir.

2.0 Description of Waterbody and Associated Watersheds

2.1 Identification and Location of CSCR

The CSCR (watershed identifier ILBE09, waterbody segment RBC) is in Coles County, Illinois (Figure 2). It is adjacent to Lake Charleston, a 62-hectare (153-acre) artificial lake that was formed in 1947 by damming the Embarras River. The CSCR was constructed in 1981 when Lake Charleston (watershed identifier ILBE09, waterbody segment RBH) was separated by a dike (i.e., from 1947 to 1981 the CSCR was part of Lake Charleston). Although the area that surrounds the CSCR and the lake is forested, land use in the watershed that drains to Lake Charleston is predominantly agricultural.

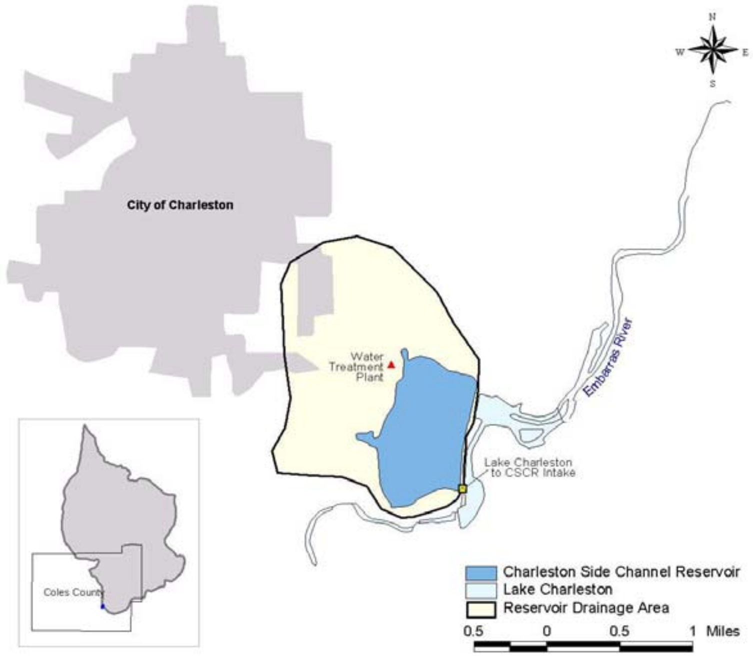
The CSCR is approximately 137 hectares (339 acres) in area. The estimated volume is 3.6 billion liters (923 million gallons). The average depth is 2.6 meters (8.6 feet) with a maximum of 4.6 meters (15 feet) near the water treatment plant (Alford, 2001). The intake from Lake Charleston to the CSCR is at the southeast end of the reservoir, while the output pump that leads from the CSCR to the water treatment plant is at the northwest end. The shoreline length is approximately 4,500 meters (14,800 feet) (City of Charleston, 1992).

The city of Charleston installed an aeration system in the CSCR in 1987 to address taste and odor problems associated with high algal populations. The purpose of an aeration system is to artificially increase dissolved oxygen concentrations to help the aquatic life and make it less likely that phosphorus will be released from the bottom sediments. The city installed the aeration system in the northwest corner of the CSCR, surrounding the raw water intake structure. Several problems were experienced with the initial system and it was replaced in the spring of 1996. The new system has performed better but still is incapable of keeping the entire CSCR from becoming anoxic during summer conditions. This is partly due to the unique hydrologic characteristics of the CSCR, such as the lack of flow associated with a typical reservoir.

The city of Charleston has also treated the CSCR with copper sulfate over the years in an attempt to control algae. The decision to treat with copper sulfate is made based on the results of algal analyses. The CSCR is treated with copper sulfate as many as three times in any one year, usually with some success. However, in some years the application is hampered by high winds that force all the copper sulfate to the north end of the CSCR (Alford, 2002).

The Embarras River upstream of Lake Charleston drains approximately 2,039 square kilometers (787 square miles) of land. The Embarras River begins just south of Champaign and Urbana, Illinois, and includes parts of five counties: Champaign, Edgar, Coles, Douglas, and a small corner of Vermillion. The entire Embarras River watershed (including downstream of Lake Charleston) drains 8,596 square kilometers (3,319 square miles) in 10 counties in east central Illinois.

Figure 2. Charleston Side Channel Reservoir and Lake Charleston.



2.2 Land Use

General land use and land cover data for the CSCR and Upper Embarras River watersheds were extracted from the Multi-Resolution Land Characteristics (MRLC) Consortium database for the state of Illinois. The following federal agencies formed the MRLC to acquire satellite-based remotely sensed data for their environmental monitoring programs: U.S. Geological Survey, EPA, National Oceanic and Atmospheric Administration, Forest Service, National Atmospheric and Space Administration, and the Bureau of Land Management. The land use data are derived from images acquired by Landsat's Thematic Mapper satellite during the early 1990s. These data categorize the land use for each 30-meter by 30-meter pixel of land in the watershed[1]. Each 30-meter by 30-meter pixel contained within the satellite image is classified according to its reflective characteristics. Land use in the area directly draining to the CSCR is

[1] A 1995 land cover database referenced by the Illinois Natural Resources Geospatial Data Clearinghouse is based on similar satellite data and was not available at the time of this report.

Illinois Environmental Protection Agency Charleston Side Channel Reservoir TMDL

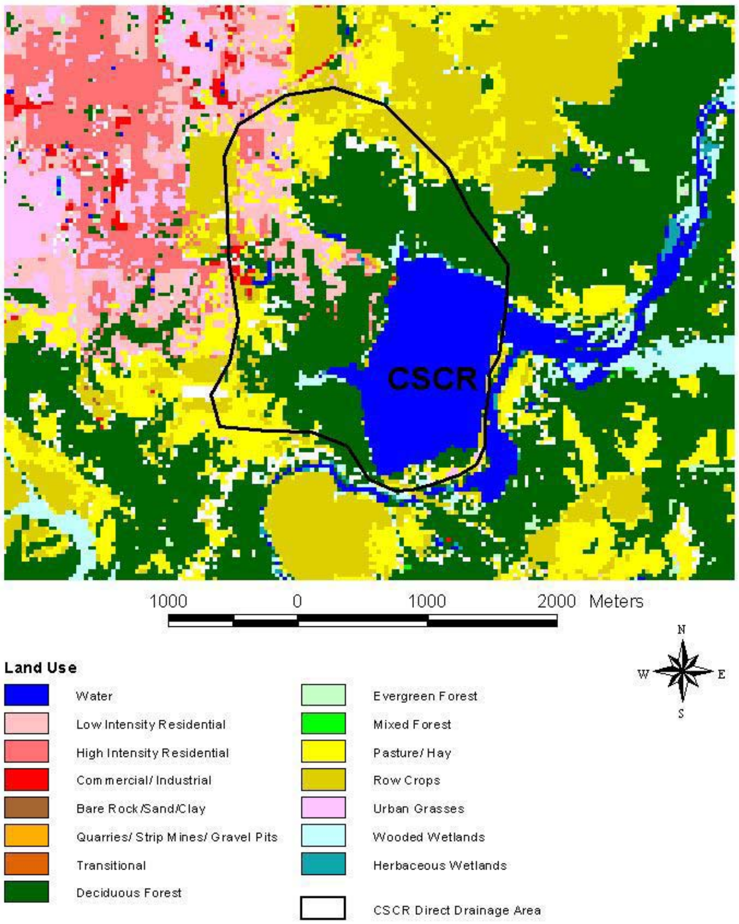
a mix of forest, agriculture, and urban areas (Table 2 and Figure 3). Table 3 and Figure 4 present the land use information for the Upper Embarras River watershed.

Table 2. Land Use Distribution in the Area Directly Draining to the Charleston Side Channel Reservoir.

Land Use	Hectares	Percentage
Deciduous Forest	197.4	37.7
Water	139.8	26.7
Pasture/Hay	60.8	11.6
Row Crops	43.4	8.3
Low-Intensity Residential	34.2	6.5
Grasslands/Herbaceous	12.0	2.3
High-Intensity Residential	11.3	2.2
Urban Grasses	8.5	1.6
Wooded Wetlands	8.0	1.5
Commercial/Industrial	2.7	0.5
Evergreen Forest	1.9	0.4
Small Grains	1.6	0.3
Herbaceous Wetlands	1.2	0.2
Bare Rock/Sand/Clay	0.3	0.1
Total	**523.1**	**99.9**

Source: MRLC, 1992.

Figure 3. Land Use in the Charleston Side Channel Reservoir Direct Drainage Area.



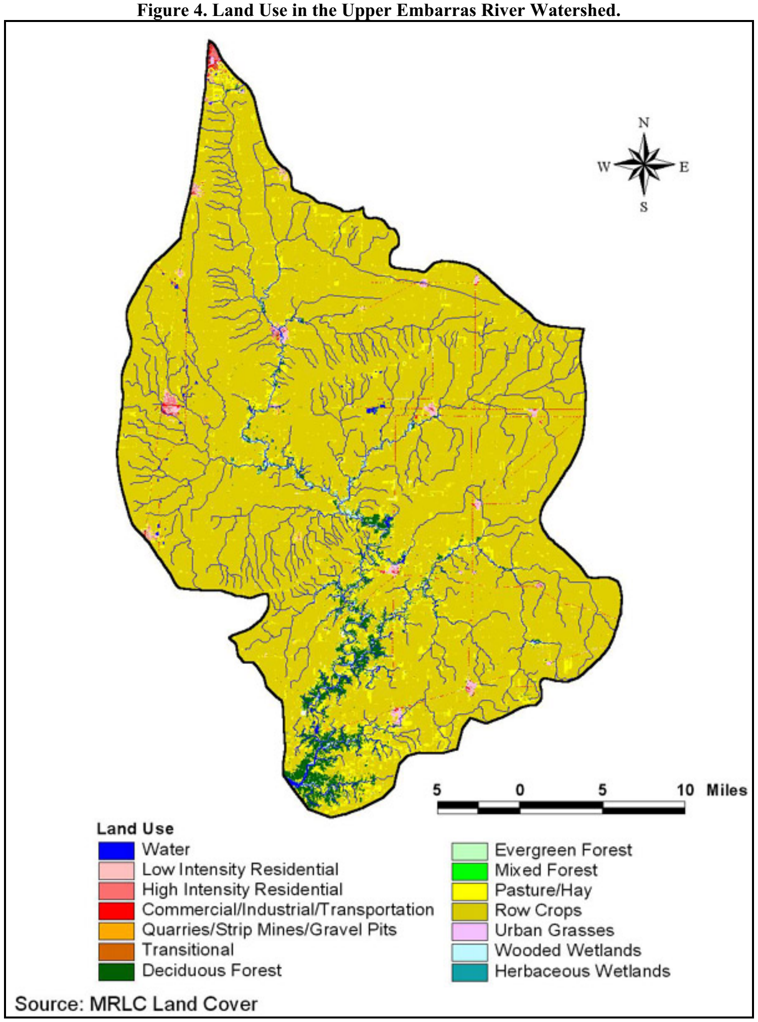
Illinois Environmental Protection Agency Charleston Side Channel Reservoir TMDL

Table 3. Land Use in the Upper Embarras River Watershed.

Land Use	Hectares	Percent
Row Crops	175,442	86.0
Pasture/Hay	15,274	7.5
Deciduous Forest	6,592	3.2
Wooded Wetlands	2,244	1.1
Commercial/Industrial/Transportation	985	0.5
Grasslands/Herbaceous	871	0.4
Low-Intensity Residential	802	0.4
Urban Grasses	635	0.3
High-Intensity Residential	366	0.2
Open Water	373	0.2
Evergreen Forest	112	0.1
Herbaceous Wetlands	103	0.1
Small Grains	83	0.0
Quarries/Strip Mines/Gravel Pits	54	0.0
Bare Rock/Sand/Clay	14	0.0
Mixed Forest	2	0.0
Total	**203,952**	**100.0**

Source: MRLC, 1992.

Figure 4. Land Use in the Upper Embarras River Watershed.



2.3 Topography and Soils

The CSCR is in the Embarras River Valley, which cuts through glacial till and some bedrock. The topography in the CSCR watershed is dominated by ridges and ravines with steep slopes, short lengths, and high-gradient tributaries. The maximum depth of the ravines is 27 meters (89 feet), and the slopes have a characteristic angle of approximately 27 degrees. Land on these slopes is predominantly forested. A portion of the watershed is flat uplands (City of Charleston, 1992).

The Upper Embarras River watershed is part of the Central-Corn Belt Plains Level III Ecoregion. Flat areas with little surface relief characterize this ecoregion. The maximum elevation in the upstream watershed is 244 meters (801 feet), and the minimum elevation is 171 meters (561 feet). The mean elevation is 208 meters (682 feet). Soils in the watershed are primarily Mollisols. Mollisols have a high native fertility making them some of the most important agricultural soils in the world (Brady, 1990).

2.4 Population

The Upper Embarras River watershed encompasses portions of five rural counties with small communities. The biggest cities in the area are Champaign-Urbana, with a population of approximately 170,000, and the city of Charleston, with a population of approximately 23,000 (U.S. Census Bureau, 2000). Nearly half of Charleston's population consists of students at Eastern Illinois University (EIU). The population of only the Upper Embarras River watershed is estimated to be 40,000 based on the 2000 Census data and a geographic information system (GIS) analysis.

Table 4 indicates that population growth in the area has been slow, with an increase of less than two percent for the five-county area between 1990 and 2000 (U.S. Census Bureau, 2000).

Table 4. Population for the Five Counties That Overlap the Upper Embarras River Watershed.

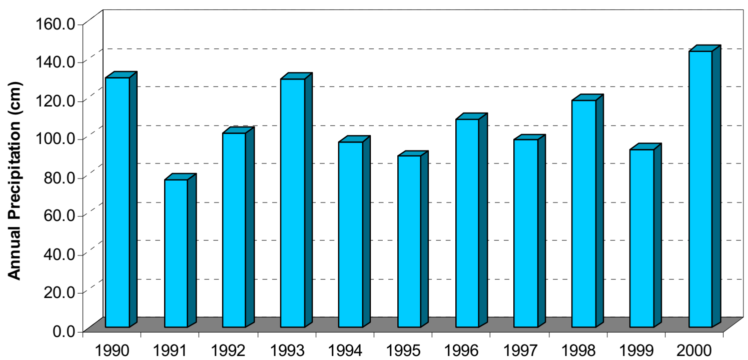
County	1990 Population	2000 Population
Champaign	173,025	179,669
Coles	51,644	53,196
Douglas	19,464	19,922
Edgar	19,595	19,704
Vermilion	88,257	83,919
Total	**351,985**	**356,410**

3.0 Climate and Hydrology

3.1 Climate

East central Illinois has a temperate climate with hot summers and cold, snowy winters. The average long-term annual precipitation is approximately 102 centimeters (40 inches). The maximum annual precipitation is 143.8 centimeters (56.6 inches) (2000); the minimum annual precipitations is 64.5 centimeters (25.4 inches) (1914). On average there are 107 days with precipitation of at least 0.03 centimeter, 26 days with precipitation of at least 1.3 centimeters, and 10 days with precipitation greater than 2.5 centimeters (MCC, 2001). Average snowfall is approximately 56 centimeters (22 inches) per year. The annual precipitation for the period 1990 to 2000 is shown in Figure 5. Average maximum and minimum temperatures in Charleston are 1.4 °C (34.6 °F) and –7.7 °C (18.1 °F), in January, and 30.3 °C (86.5 °F) and 18.9 °C (66.1°F) in July. The growing season typically lasts from April through October.

Figure 5. Annual Precipitation in Charleston, Illinois (1990–2000).



3.2 CSCR Hydrology

Inputs of water to the CSCR include precipitation, the water that the treatment plant pumps from Lake Charleston, direct runoff, and groundwater (including septic systems). A hydrologic budget for 1989 and 1990 (City of Charleston, 1992) showed that, of the contributions that could be accounted for, 51.3 percent of the flow input came from pumping. Pumping was greatest during the months of December and July, and least during May, September, and October (when no pumping occurred). The second largest input was from precipitation, which constituted 41.2 percent of the total input. Approximately 6 percent of the input came from direct runoff and less than 1 percent came from septic systems. Outputs include evaporation, groundwater discharges, and withdrawals for water supply. The water treatment plant withdrew 66.7 percent of the water, evaporation accounted for 31.2 percent, and groundwater loss accounted for the difference. Table 5 shows a comparison of Lake Charleston and CSCR pumping for the years 1981 to 2000.

Table 5. Pumping Records from 1981 to 2000 (million gallons) (City of Charleston, 2002).

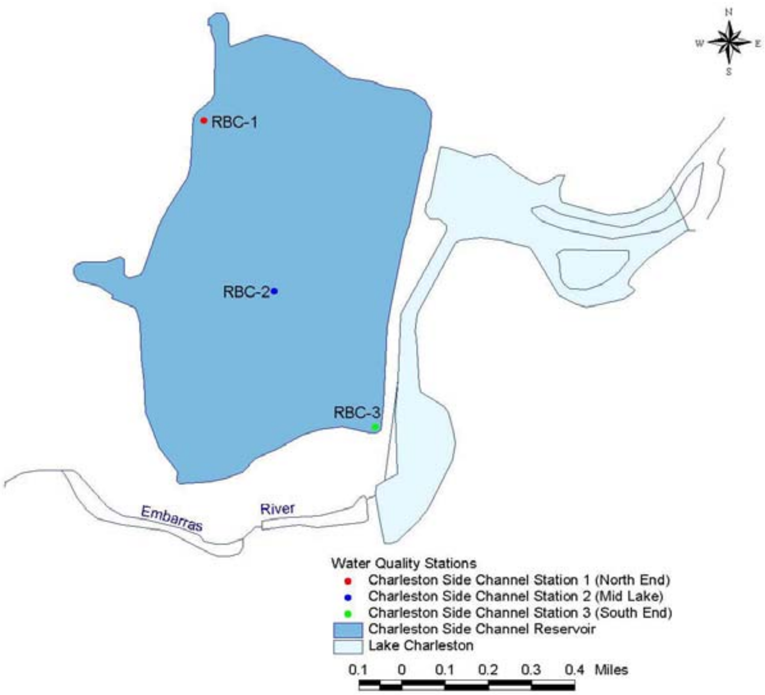
Year	Volume Pumped from Lake Charleston to CSCR	Volume Pumped from CSCR to Treatment Plant	Volume Pumped from Treatment Plant to City
1981	207.4	522.0	488.1
1982	297.3	525.4	560.6
1983	470.4	589.2	594.5
1984	397.5	629.4	614.9
1985	243.7	604.7	602.8
1986	541.3	604.6	606.8
1987	698.3	634.2	588.3
1988	590.4	630.0	601.1
1989	472.2	602.8	501.2
1990	322.6	557.6	489.5
1991	502.3	575.4	512.8
1992	559.5	680.2	577.6
1993	139.5	702.7	655.0
1994	311.9	800.2	691.4
1995	837.8	758.1	667.0
1996	633.7	821.4	673.9
1997	831.0	988.7	801.5
1998	503.1	831.0	705.5
1999	496.8	710.0	642.9
2000	720.8	657.3	609.7
Average	488.9	671.2	609.3

4.0 Water Quality

4.1 Monitoring Data

Illinois EPA has sampled water quality in the CSCR every three years since 1983. The location of the three sampling stations is shown in Figure 6. Parameters sampled include transparency, temperature, dissolved oxygen, nutrients, nonvolatile suspended solids, chlorophyll *a*, pH, and conductivity. Dissolved oxygen and temperature samples are taken at multiple depths in increments of 0.30 meters (1 foot). The results of the sampling for the parameters of interest to this TMDL are shown in Appendix A.

Figure 6. Location of Water Quality Monitoring Stations.



4.2 Water Quality Standards and TMDL Targets

States are responsible for setting water quality standards to protect the physical, biological, and chemical integrity of their waters. The Illinois Pollution Control Board establishes the water quality standards for all waters in the state, including the CSCR. The three components of water quality standards are:

- Designated uses (e.g., drinking water supply, aquatic life, secondary contact (recreation)).
- Narrative and numeric criteria designed to protect these uses.
- An antidegradation policy that provides a method of assessing activities that might affect the integrity of water bodies.

The purpose of the TMDL program is to ensure that waters that are not currently attaining water quality standards will meet them in the future.

Designated uses take into consideration the use and value of the CSCR for public water supply; for propagation of fish, shellfish, and wildlife; and for recreational, agricultural, industrial, and navigational purposes. General use standards protect aquatic life, wildlife, agricultural use, primary contact use (swimming), and secondary contact use (recreation). The public water supply use provides protection of potable water and culinary water. The general use standards are usually the principal restoration targets for water resource management efforts in Illinois.

Full support is achieved when the water body meets the designated use. Partial support means that the water body incompletely attains the designated use. Nonsupport means that the waterbody does not attain the designated use. Full/threatened means the waterbody attains the designated use, but a declining water quality related trend has been evidenced, and if continued, only partial use support may be attained in the future.

The assessment of the overall use support aggregates the support attained for each of the individual uses. The CSCR is currently rated as "partial" for its overall use support. Since the CSCR does not fully support all of its designated uses, it is considered impaired and is listed on the Section 303(d) list. The impaired designated uses are primary contact (swimming), secondary contact (recreation), and aquatic life. The fish consumption and drinking water supply uses are fully supported. This TMDL focuses only on phosphorus because it is the only listed parameter with a numeric water quality standard for lakes. However, Illinois EPA believes that addressing the phosphorus impairment should lead to an overall improvement in water quality due to the interrelated nature of the other listed pollutants. For example, reducing loads of phosphorus to the CSCR should result in less algal growth and some of the management measures taken to reduce phosphorus loads (e.g., reducing shoreline erosion) should also reduce loads of suspended solids. Also, if phosphorus is reduced the ability of nitrogen to contribute to excessive algal growth should be limited since both nutrients are required.

4.3 Evaluation of Water Quality Data in CSCR

The following sections describe the available water quality data in the CSCR related to the phosphorus impairment.

4.3.1 Eutrophication

Since the early part of the 20th century, lakes and reservoirs have been classified according to their trophic state. A eutrophic ("well-nourished") reservoir has high nutrients and high plant growth. An oligotrophic reservoir has low nutrient concentrations and low plant growth. Mesotrophic reservoirs fall somewhere in between.

Four main factors regulate trophic state:

- Availability of sunlight
- Climate
- Shape of the lake or reservoir
- Rate of nutrient supply

Of these factors, sunlight availability and the rate of nutrient supply are the two that are most temporally sensitive. Sunlight availability varies throughout the year and is one of the reasons algae concentrations are typically at their highest during the summer. Aeration systems such as the one in the CSCR can also stir up sediments and block sunlight from reaching plants attached to the bottom of the CSCR.

When nutrient loading to a reservoir is too high and sunlight is available, plant growth can be excessive and cause problems for the aquatic life, recreationists, and water supply use. For example, excessive algae can be aesthetically unattractive and can deplete dissolved oxygen concentrations. High growths of attached plants can also tangle boat propellers and be a nuisance to swimmers. The following sections of this report provide information on the degree of eutrophication in the CSCR.

4.3.2 Total Nitrogen (TN)-to-Total Phosphorus (TP) Ratio

Either nitrogen or phosphorus typically controls eutrophication in freshwater systems. The limiting nutrient is defined as the nutrient that limits plant growth when it is not available in sufficient quantities. Controlling this nutrient can often slow the rate of eutrophication and improve reservoir conditions.
An initial identification of the limiting nutrient can be made by comparing the levels of nutrients in the waterbody with the quantitative relationship between nutrients in the plant, known as its stoichiometry. The ratio of nitrogen to phosphorus in biomass is approximately 7.2:1. Therefore, a nitrogen:phosphorus ratio in water that is less than 7.2 suggests that nitrogen is limiting. Alternatively, higher ratios suggest that phosphorus is limiting (Chapra, 1997). The average TN-to-TP value for all samples for the CSCR is 16.04. This value was obtained for site RBC-1 using data collected during several years (Table 6). These data indicate that phosphorus is the limiting nutrient in the CSCR.

Table 6. TN:TP Ratios at Station RBC-1.

Year	TN:TP
1983	14.33
1984	10.65
1988	13.59
1989	25.75
1990	16.23
1992	14.88
1995	13.15
1998	19.72
Average	16.04

4.3.3 Total Phosphorus

The applicable water quality standard for TP in Illinois for lakes is 0.05 mg/L. Figure 7 presents the Illinois EPA TP data for 1998 in the CSCR. A review of these data shows that the water quality standard was routinely exceeded during the summer and fall months. The average concentration of TP for 1998 was 0.10 mg/L. All three stations have similar TP concentration values, with the station at the northwest end of the CSCR (RBC-1) presenting higher TP values (in particular during the fall months). For all stations a trend is noted: phosphorus values are least during the spring and increase during the summer reaching a maximum in the fall. No data are available for the months of November to March.

Figure 7. 1998 Total Phosphorus Observations.

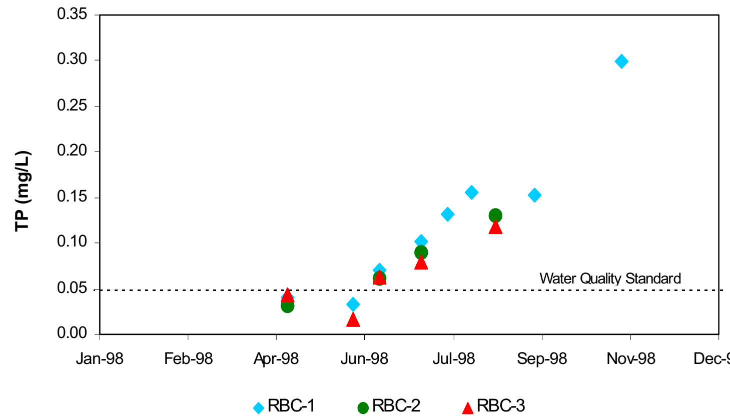
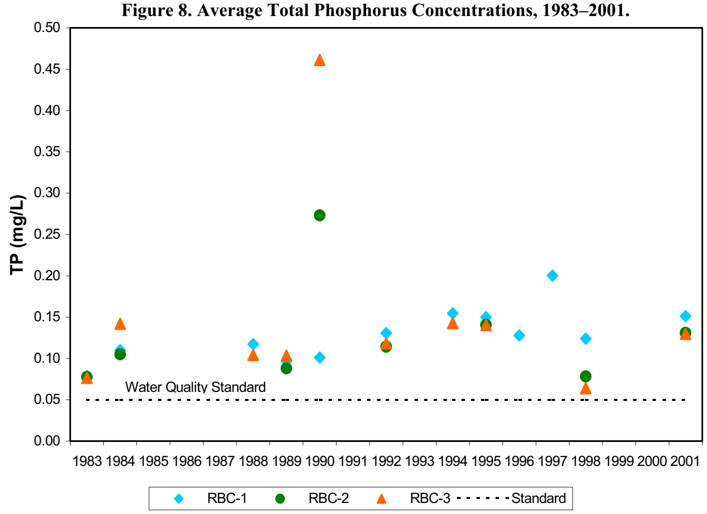


Figure 8 presents the annual averages of TP concentrations for several monitoring years between 1983 and 2001 (Illinois EPA data). Most values fall within the 0.05 to 0.15 mg/L range. The averages for 1990 are particularly notable because they were as high as 0.45 mg/L. A possible explanation might be that 1990 was a relatively wet year and therefore phosphorus loadings from nonpoint sources could have been greater than normal. The long-term average TP concentration for all samples for all dates at all depths is 0.13 mg/L.

Figure 8. Average Total Phosphorus Concentrations, 1983–2001.



4.3.4 Dissolved Phosphorus

The dissolved phosphorus component of TP is the form that is most readily available to plants. It consists of soluble phosphorus that is not bound to particulates. In waterbodies with relatively short residence times (such as fast-flowing streams), dissolved phosphorus is of greater interest than TP because it is the only form that is readily available to support algal growth. However, in lakes and reservoirs, where residence times are much longer, particulate phosphorus can be transformed to dissolved phosphorus through microbial action. TP is therefore considered an adequate estimation of bioavailable phosphorus (USEPA, 1999a).

Dissolved phosphorus concentrations at station RBC-1 averaged 0.025 mg/L for the period 1983 to 2001 (see Appendix A). This is 20 percent of the average TP concentration observed at the same station over the same period and indicates that particulate phosphorus constitutes the large majority of TP in the CSCR.

Table 7 shows the average monthly concentration of dissolved phosphorus and TP at RBC-1 for the period 1983 to 2001. It indicates that the ratio of dissolved phosphorus to TP is greatest in September and the least in April.

Table 7. Average Monthly Concentrations of Dissolved Phosphorus and TP at RBC-1 for the Period 1983 to 2001 (IEPA data).

Month	Average Total Phosphorus (mg/L)	Average Dissolved Phosphorus (mg/L)	Ratio of Dissolved Phosphorus to Total Phosphorus
April	0.06	0.01	0.17
May	0.08	0.02	0.25
June	0.11	0.02	0.18
July	0.14	0.04	0.29
August	0.15	0.03	0.20
September	0.13	0.04	0.31
October	0.17	0.03	0.18

4.3.5 Excessive Algal Growth/chlorophyll *a*

Chlorophyll *a*, the dominant pigment in algal cells, is fairly easy to measure and is a valuable surrogate for algal biomass. Chlorophyll *a* is desirable as an indicator because algae are either the direct (e.g., nuisance algal blooms) or indirect (e.g., high/low dissolved oxygen, pH, and high turbidity) cause of most problems related to excessive nutrient enrichment. Both seasonal mean and instantaneous maximum concentrations can be used to determine impairments. The Illinois water quality standard for general use states that "waters of the state shall be free from algal growth of other than natural origin" (Section 302.203).

Figure 9 depicts the observed chlorophyll *a* concentration values for 1998 (Illinois EPA data) and indicates a trend of increasing values from the spring to late summer and then decreasing values again in the fall. The annual means for sampling years between 1983 and 2001 are presented in Figure 10.

Figure 9. 1998 Observed Chlorophyll *a* Concentrations.

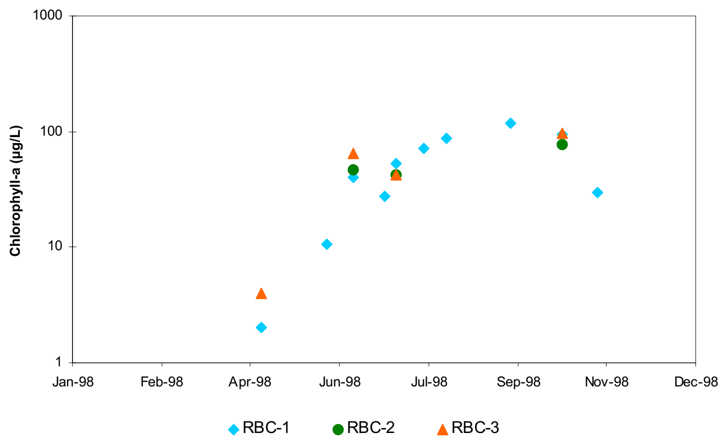
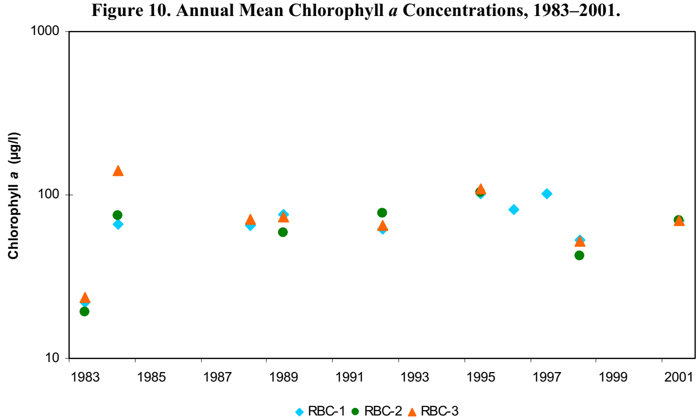


Figure 10. Annual Mean Chlorophyll *a* Concentrations, 1983–2001.



4.3.6 Trophic State

A frequently used biomass-related trophic status index was developed by Carlson in 1977. His trophic status index (TSI) uses Secchi depth (SD), chlorophyll *a* (Chl) and TP, each producing an independent measure of trophic state. Index values range from approximately 0 (ultraoligotrophic) to 100 (hypereutrophic). The index is scaled so that TSI = 0 represents SD transparency of 64 meters. Each halving of transparency represents an increase of 10 TSI units. For example, a TSI of 50 represents a transparency of 2 meters. A TSI is calculated from each of SD, chlorophyll *a* concentration, and TP concentration (Carlson, 1977; Carlson and Simpson, 1996). Each variable is used to estimate algal biomass independently, and the values should not be averaged.

Illinois EPA considers TSI values below 55 to be protective of swimming uses and values below 60 to be protective of aquatic life uses. TSI values above 60 suggest the presence of blue-green algae during the summer, algal scum, and a considerable macrophyte problem. Boating becomes difficult because of weeds and algal scum discourages swimming.

Average TSI values for the CSCR were calculated using available chlorophyll *a*, TP and SD data, and are presented in Table 8. All averages exceed the values Illinois EPA considers protective of swimming and recreational uses.

Table 8. Average Values of the TSI for the Charleston Side Channel Reservoir.

Location	TSI (Chl)	TSI (TP)	TSI (SD)
RBC-1	65.4	70.8	70.5
RBC-2	62.9	65.2	68.1
RBC-3	64.6	61.5	67.9
CSCR Average	64.3	**65.8**	**68.8**

Chl = chlorophyll *a*
TP = total phosphorus
SD = Secchi depth

4.4 Lake Charleston Water Quality Data

Table 9 presents the results of Lake Charleston sampling done by the city of Charleston in 2000. The sampling occurred near the point where water is pumped to the CSCR (Figure 2). It shows an average dissolved phosphorus concentration of 0.19 mg/L and an average TP concentration of 0.30 mg/L. Values fluctuate during the year, with TP concentrations greatest in June and August, and least in March and July. Xue et al. (1998) also report an average dissolved phosphorus concentration of 0.19 mg/L for the Embarras River upstream of Lake Charleston based on weekly or biweekly sampling during the period 1993 to 1996. Xue et al. did not report TP.

Table 9. Phosphorus Concentration in Lake Charleston (Sampling Done by City of Charleston in 2000). [1,2]

Month	Dissolved Phosphorus	Number of samples	Total Phosphorus	Number of Samples
January	0.06	1	0.40	1
February	0.06	4	0.22	2
March	0.13	23	0.04	1
April	0.13	14	0.31	2
May	0.16	4	0.40	2
June	0.49	7	0.46	2
July	0.26	4	0.08	2
August	0.15	2	0.46	1
September	NA	0	NA	0
October	0.21	2	0.23	1
November	NA	0	NA	0
December	0.36	2	0.34	2
Average (weighted)	0.19	NA	0.30	NA

[1]The sampling procedures and laboratory analysis used to collect these data do not meet the same level of quality assurance as data collected by the Illinois EPA. However, since they represent the only current data available for Lake Charleston, and since pumping from Lake Charleston is one of the major sources of nutrients to the CSCR, they were used.
[2]Note that in some cases the monthly values for dissolved phosphorus are greater than those for total phosphorus. This is a nonsensical result for an individual sample because dissolved phosphorus is a part of total phosphorus. However, in some months there were more samples of dissolved phosphorus than total phosphorus and therefore the average dissolved phosphorus could indeed be greater than the average total phosphorus.

5.0 Source Assessment

5.1 Point Sources

No point sources discharge directly to the CSCR. However, there are 12 facilities with National Pollutant Discharge Elimination System (NPDES) permits in the Embarras River watershed upstream of the CSCR (Illinois EPA, 2002b). Table 10 provides information on these facilities along with their annual TP loads for the period March 1998 to March 2002. The loads were estimated based on the reported average flow rates and an assumed discharge concentration of 4.0 mg/L TP (Litke, 1999). The literature value of 4.0 mg/L had to be used for the TP concentration in the effluent because all but one of the facilities do not report this parameter.[1]

5.2 Nonpoint Sources

Potential nonpoint sources of phosphorus to the CSCR include pumping from Lake Charleston, runoff from the direct drainage area, shoreline erosion, septic systems, the bottom sediments, and precipitation. Loads from these sources were measured or estimated by the city of Charleston during its preparation of the 1992 Clean Lakes Program Diagnostic/Feasibility Study (City of Charleston, 1992). These loads were used as the initial basis for estimating current loads to the CSCR but were modified in some cases to reflect new conditions.

5.2.1 Pumping from Lake Charleston

The Water Treatment Plant pumps on average 1.8 billion liters (488.9 million gallons) of water per year from the river to the CSCR (see Table 5). Annual loads of phosphorus from pumping are a function of the volume of water pumped and the concentration of pollutants in the water. A representative annual load of 554.5 kg has been estimated using the average pumping volume, and the 2000 sampling data for Lake Charleston, which indicate an average TP concentration of 0.30 mg/L (Table 9).

TP concentrations in Lake Charleston are a function of flows and loads coming from the Embarras River watershed upstream of Lake Charleston. To further evaluate these upstream loads, the Soil and Water Assessment Tool (SWAT) model was used. SWAT is a watershed model developed by the U.S. Department of Agriculture, Agricultural Research Service. It depicts the effects of land management practices on water, sediment, and agricultural chemical yields in large, complex watersheds. The watershed is divided into subwatersheds to assist in identification of potential sources of phosphorus (Figure 11). For more detailed information on SWAT modeling, refer to Appendix B.

The calibrated SWAT model was run for the 1993 to 2000 time period to determine annual average pollutant transport. The annual average load of TP for this time period was estimated to be 630,000 kg/yr. The majority of this load is attributed to row crop agriculture, which comprises more than 85 percent of the watershed area. Loads from other land uses, such as pasture, are less than 5 percent of the total load.

[1] The only facility to report TP concentrations for its effluent was the Villa Grove Sewage Treatment Plant. The reported value was 0.78 mg/L TP, and this value was used to estimate the average annual loads for this facility. It is not known why this value is so far below those typically reported in the literature.

Figure 11. Upper Embarras River Watershed Modeled Using SWAT2000, Divided into Subwatersheds.

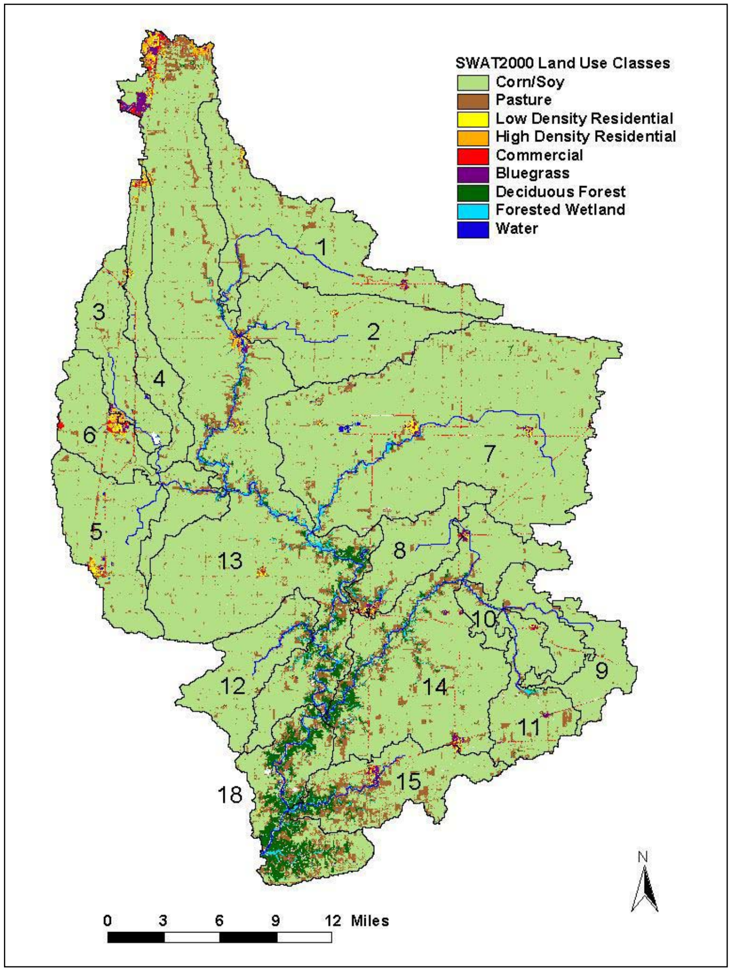


Table 10. NPDES Facilities in the Embarras River Watershed Upstream of the Charleston Side Channel Reservoir and Their Estimated Annual Discharge of Phosphorus (March 1998 to March 2002).

NPDES Permit No.	Facility Name	City	County	Description	Receiving Stream	Average Flow Rate (mgd)	TP (kg/yr)
IL0059005	Villa Grove Sewage Treatment Plant	Villa Grove	Douglas	Sewage Treatment Plant	Embarras River To Wabash River	0.3325	360
IL0027499	Arcola Sewage Treatment Plant	Arcola	Douglas	Sewage Treatment Plant	Unnamed Trib To Scattering Fork	0.4431	2,448
IL0071617	Tuscola Sewage Treatment Plant	Tuscola	Douglas	Sewage Treatment Plant	Hayes Branch	0.8208	4,536
IL0031453	Tolono Sewage Treatment Plant	Tolono	Champaign	Sewage Treatment Plant	Hackett Branch	0.1169	646
IL0055450	Newman Sewage Treatment Plant	Newman	Douglas	Sewage Treatment Plant	Embarras River	0.1220	674
IL0004375	Cabot Corporation	Tuscola	Douglas	Manufacturing	Scattering Fork Creek	0.0704	389
IL0066532	Hydromet Environmental (USA)	Newman	Douglas	Sewage Treatment Plant	Brushy Creek	0.0004	2
IL0042757	Shiloh County Community School	Hume	Edgar	School	Brushy Fork	0.0042	23
IL0055212	Unity High School	Tolono	Champaign	School	Embarras River	0.0012	7
IL0060119	Parkview Mobile Home Park	Tuscola	Douglas	Mobile Home Park	Scattering Fork	0.0100	55
IL0066974	Boxwood Health Care Center	Newman	Douglas	Health Services	Trib To Embarras River	0.0087	48
IL0034916	Rogers Mobile Home Park	Charleston	Coles	Mobile Home Park	Unnamed Trib To Embarras River	0.0059	33
					Total	**1.9361**	**9,221**

For each subbasin, SWAT produces reports that describe the total annual transport by runoff of sediment and associated pollutants into the subbasin stream reach from certain combinations of land use and soil type. Subbasin 7 generates the largest annual average loadings of TP, while Subbasins 13 and 14 contribute the second and third largest pollutant loadings. The large TP delivery from Subbasins 7, 13, and 14 is related to their large size and the dominance of corn/soybean agricultural activities within each subbasin.

The SWAT model does not include a component to estimate TP loads from septic systems. These loads were therefore estimated using the watershed population and assumptions for the performance of the systems (properly functioning systems should contribute very little TP because it will be adsorbed to the soil). Data from the 2000 U.S. Census indicate that the non-urban population of the watershed is approximately 14,000. Assuming that this entire population is served by septic systems with a per capita phosphorus load of 1.5 grams per day (Haith et. al, 1992), and a 15 percent failure rate, the estimated annual load of TP from failing septic systems is 1,150 kg/yr.

5.2.2 Direct Runoff

The only available TP data for tributaries draining directly to the CSCR are from sampling conducted in 1989 and 1990 as part of the Clean Lakes Study (City of Charleston, 1992). Loads were estimated based on monthly flows and observed phosphorus concentrations. Although several efforts have been made to control gully erosion since 1992, the observed loads from the Clean Lakes Study were used as an estimate of current loads in the absence of more current data. Table 11 provides the current estimated loads.

5.2.3 Precipitation

Phosphorus loads from precipitation were estimated using data from the National Atmospheric Deposition Program (NADP). Multiyear averages from three NADP sites were used to produce values for the CSCR. The estimated loads are shown in Table 11.

5.2.4 Shoreline Erosion

Shoreline erosion is another source of TP to the CSCR because phosphorus can be attached to the soil particles that erode. Shoreline erosion in the CSCR occurs when wave activity undercuts poorly consolidated soils and the higher slopes undergo mass movement into the CSCR. Shoreline erosion also occurs when large trees on the edge of the cliffs fall into the CSCR. This causes large masses of soil to be carried into the water and creates a large scar on the shore, which contributes significant sediment (City of Charleston, 1992).

An estimate of the loading from shoreline erosion was developed for the Clean Lakes Study with data supplied by Dr. Vince Gutowski and Dr. Ted Peck. The annual shoreline erosion rate was estimated to be between 944 cubic meters (33,330 cubic feet) and 1,573 cubic meters (55,556 cubic feet) per year based on measuring the eroding cliffs. The average density of the eroded material was estimated to be between 1.35 and 1.40 grams per cubic centimeter and the TP content was 0.45 to 0.91 kilograms (1 to 2 pounds) per short ton (2000 pounds). The most conservative values were used in the nutrient budget and this produced an annual shoreline TP load of 636.6 kg (1,403 lb) (City of Charleston, 1992).
Current loading from shoreline erosion is less than it was in 1992 due to the following (Alford, 2002):

- A 210-meter (700-foot) dike was built along the west shore in 1994 to contain a collapsing shoreline.
- More than 600 meters (2000 feet) of riprap was installed in 1999 and 2000 along the west shoreline.
- Approximately 120 meters (400 feet) of riprap were installed along the south shore.

Current loads were estimated to be approximately 40 percent less than the 1992 loads based on best professional judgment. A significant reduction in shoreline erosion is expected because the management measures focused on some of the most highly erodible areas of the shoreline. Table 11 provides the current estimated loads from shoreline erosion.

5.2.5 Internal Loading

Under certain conditions, bottom sediments can be important sources of phosphorus to the overlying waters of reservoirs, particularly if the reservoir is shallow or has an anaerobic hypolimnium (Chapra, 1997). Phosphorus flux from sediment deposits is strongly affected by sediment composition and oxygen levels in the water column; sediment release can contribute significant nutrient loadings during low-oxygen conditions. Under low-oxygen conditions, phosphorus may be released from the sediment layer, entering the water column and contributing to loading. Indicators of potential nutrient loading from sediment sources might include probable high concentrations of phosphorus in the sediment and known low-oxygen conditions in the waterbody, or evidence of algal blooms following turnover. The estimated internal loading for the CSCR is 944.1 kg/yr based on the results of the BATHTUB modeling. The phosphorus sedimentation term in BATHTUB is net sedimentation–that is, it represents the rate of phosphorus settling minus the rate of resuspension/regeneration from the sediment. The difference between an estimate of phosphorus deposition (1771 kg/yr) based on a phosphorus budget model (Chapra, 1997) and the BATHTUB net sedimentation rate was interpreted as internal loading.

5.2.6 Septic Systems

Several residences in the CSCR direct drainage area treat their household waste using septic systems. Septic systems provide an economically feasible way of disposing of household wastes where other means of waste treatment are unavailable (e.g., public or private treatment facilities). The basis for most septic systems involves the treatment and distribution of household wastes through a series of steps involving the following:

- A sewer line connecting the house to a septic tank
- A septic tank that allows solids to settle out of the effluent
- A distribution system that dispenses the effluent to a leach field
- A leaching system that allows the effluent to enter the soil

Phosphorus loads from properly functioning septic systems should be close to zero because the phosphorus is adsorbed by soil as the effluent passes through. Septic system failure occurs when one or more components of the septic system do not work properly and untreated waste or wastewater leaves the system. The waste may pond in the leach field and ultimately run off into nearby streams or percolate into the groundwater system. Untreated septic system waste is a potential source of nutrients (nitrogen and phosphorus), organic matter, suspended solids, and bacteria. Failure can occur for several reasons, the most common reason being improper maintenance. Other reasons for failure include improper installation, location, and choice of system. Harmful household chemicals can also cause failure by killing the bacteria that digest the waste.

No information is available on the performance of the septic systems in the CSCR direct drainage area. Assuming that 30 persons are served by these systems with a per capita daily phosphorus load of 1.5 g/day (Haith et. al, 1992), and a 15 percent failure rate, the estimated annual load is 2.5 kg/yr.

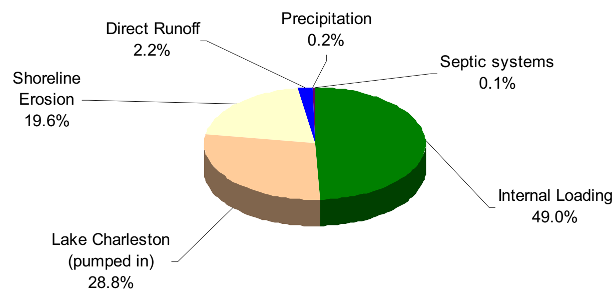
5.3 Source Summary

Table 11 and Figure 12 summarize the estimates of TP loading to the CSCR. They indicate that internal loading, pumping from Lake Charleston, and shoreline erosion are the largest sources of TP.

Table 11. Current Total Phosphorus Loads to the Charleston Side Channel Reservoir.

Source	TP Load (kg/yr)	Percent
Internal Loading	944.1	49.1
Lake Charleston (pumped in)	554.5	28.8
Shoreline Erosion	377.5	19.6
Direct Runoff	41.8	2.2
Precipitation	4.5	0.2
Septic systems	2.5	0.1
Total	1924.9	100.0

Figure 12. Phosphorus Loads to the Charleston Side Channel Reservoir.



6.0 Technical Analysis

Establishing the link between pollutant loads and resulting water quality is one of the most important steps in developing a TMDL. This link can be established through a variety of techniques ranging from simple mass balance analyses to sophisticated computer modeling. The objective of this section of the report is to describe the approach that was used to link the sources of phosphorus with the resulting concentrations in the CSCR.

6.1 Modeling Approach and Model Selection

BATHTUB was selected for modeling water quality in the CSCR. BATHTUB performs steady-state water and phosphorus balance calculations in a spatially segmented hydraulic network, which accounts for advective and diffusive transport, and nutrient sedimentation. In addition, the BATHUB model automatically incorporates internal phosphorus loadings into its calculations. Eutrophication-related water quality conditions are predicted using empirical relationships previously developed and tested for reservoir applications (Walker, 1985). BATHTUB was determined to be appropriate because it addresses the parameter of concern (phosphorus) and has been used previously for reservoir TMDLs in Illinois and elsewhere. USEPA also recommends the use of BATHTUB for phosphorus TMDLs (USEPA, 1999a).

6.2 Data to Support the Modeling Analysis

The BATHTUB model requires the following data to configure and calibrate: tributary flows and concentrations, reservoir bathymetry, in-lake water quality concentrations, and global parameters such as evaporation rates and annual average precipitation. Appendix C provides these values for the CSCR BATHTUB modeling.

The model was segmented into three sections to match the locations of the three sampling stations and to more accurately model the system and better understand the processes affecting water quality. The water quality associated with the station located in each segment was assumed representative of the water quality data of the whole segment. Available contour maps were digitized and used to obtain surface area, average depth, and average length for each segment.

Pumping records from the water treatment plant were used to obtain pumping rates and changes in storage. Average annual evaporation and precipitation values were obtained using the Illinois State Water Survey data for Urbana, Illinois.

The average and coefficients of variation for the sampling stations were determined by analysis of the available Illinois EPA data. These were summarized using statistical tools available with Microsoft Excel and Microsoft Access. Refer to Appendix C for details.

The BATHTUB model can compute average loads over one year or over the growing season. Since the CSCR has a residence time greater than one year, the appropriate averaging period is one year. (Note that the residence time for any one year varies depending on the volume of water pumped from Lake Charleston into the CSCR and the volume of water pumped to the treatment plant).

6.3 Model Calibration

The BATHTUB model was calibrated to observed conditions in 1992 by first checking and adjusting the water balances. The measured inflows and outflows reported in the Clean Lakes report were specified, and the storage term was adjusted to account for unmeasured or un-quantified inflow and outflows (seepage and groundwater contributions). Several of the phosphorus sedimentation routines available within BATHTUB were tested. These included the Canfield and Bachman, Vollenweider, Simple First Order, and Second Order Decay routines. The Second Order Decay routine was selected for the modeling because it provided the best calibration to the observed data. Table 12 shows the results of the calibration period.

Table 12. Results of BATHTUB Modeling (Calibration Period).

Component	Observed Area Weighted Mean	Estimated Area Weighted Mean	Observed vs Estimated Ratio
Total Phosphorus (mg/L)	0.1391	0.1379	1.01
Chlorophyll *a* (μg/L)	65.4	68.1	0.96
Secchi Depth (m)	0.4	0.4	1.00

6.4 Model Validation

The BATHTUB model was next validated to observed conditions in 1998 by adjusting loading and meteorological conditions to represent 1998 conditions and keeping all other model parameters the same. The results of the model validation are shown in Table 13.

Table 13. Results of BATHTUB Modeling (Validation Period).

Component	Observed Area Weighted Mean	Estimated Area Weighted Mean	Observed vs Estimated Ratio
Total Phosphorus (mg/L)	0.1048	0.1082	0.97
Chlorophyll *a* (μg/L)	52.8	52.2	1.01
Secchi Depth (m)	0.6	0.59	1.02

7.0 TMDL

7.1 Loading Capacity

The calibrated BATHTUB model was used to identify the load reductions necessary to achieve a target concentration of 0.05 mg/L phosphorus. An 87 percent reduction in loads is needed to meet the target. This corresponds to a loading capacity of 240.7 kg/yr. Table 14 displays the effect of this reduction.

Table 14. Predicted Impact of 87 Percent Reduction in Phosphorus Loads.

Parameter	Existing Concentration (mg/l)	TMDL Target Concentration (mg/L)	Post-TMDL Concentration (mg/L)
Total Phosphorus	0.1048	0.0500	0.0498
Chlorophyll *a*	0.0528	NA	0.0273

7.2 Allocations

The loading capacity and allocation of loads for the CSCR are summarized in Table 15. The wasteload allocations are 0.4 percent of the loading capacity because it is estimated that point sources currently contribute approximately 0.4 percent of the TP load to the CSCR. (They contribute approximately 1.5 percent of the TP load upstream of Lake Charleston which, in turn via pumping, is 28.8 percent of the load to the CSCR (see Table 11)). The margin of safety is set at ten percent of the loading capacity.

Table 15. TMDL Summary for Charleston Side Channel Reservoir.

Category	Phosphorus (kg/yr)
Existing Load	1924.9
Loading Capacity	240.7
Wasteload Allocation	1.0
Margin of Safety	24.0
Load Allocation	215.7

7.3 Seasonality

Section 303(d)(1)(C) of the Clean Water Act and USEPA's regulations at 40 CFR 130.7(c)(1) require that a TMDL be established that addresses seasonal variations normally found in natural systems. For the CSCR, the impact of seasonal and other short-term variability in loading is damped out by the fact that it is the long-term average TP concentrations that drives the biotic response. Since the residence time of the CSCR is greater than one year, the TMDL can be adequately expressed in terms of an annual average load.

7.4 Margin of Safety

Section 303(d) of the Clean Water Act and USEPA's regulations at 40 CFR 130.7 require that "TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality." Future growth is included in the margin of safety. The margin of safety can either be implicitly incorporated into conservative assumptions used to develop the TMDL or added as a separate explicit component of the TMDL (USEPA, 1991). A 10 percent explicit margin of safety has been incorporated into the CSCR TMDL by reserving a portion of the loading capacity. A relatively low margin of safety is justified because of the results of the BATHTUB modeling which indicate good representation of the relationship between source loading and water quality response.

Five percent of the margin of safety is for future growth. The relatively small percentage is based on the fact the city of Charleston is experiencing only moderate growth. Charleston's population increased from 20,398 in 1990 to 21,039 in 2000. Similarly, Table 4 shows that the five counties of which the Upper Embarras River watershed is a part grew by less than 2 percent between 1990 and 2000 (U.S. Census Bureau, 2000). The 5 percent will provide for continued growth but emphasizes that the impacts of all future growth must be fully addressed and TP loads minimized.

8.0 Implementation

A draft project implementation plan (Appendix D) discusses potential implementation activities to achieve the desired reductions in phosphorus loading, and a range of alternatives along with their expected costs and benefits. Additional discussion among key stakeholders must occur to better identify specific actions that can be taken.

9.0 Public Participation and Involvement

The public participation process for this TMDL was addressed through the use of a series of public meetings and progress reports made available on the Illinois EPA TMDL Web site <http://www.epa.state.il.us/water/tmdl/>. The Illinois EPA held public meetings to provide information and education on the TMDL process, and to take comments on the draft TMDL. The first meeting was held June 5, 2001, in Springfield, Illinois. A second meeting was held January 17, 2002, at the Charleston High School. The primary purpose of these meetings was to advise the public that a TMDL was being compiled, present the issues to be considered and addressed, and outline the timeframes for developing the TMDL. A final public hearing will be held to discuss and take comments on the draft TMDL.

10.0 References

Alford, A. 2001. City of Charleston. Personal communication, October 25, 2001.

Alford, A. 2002. City of Charleston. Personal communication, May 3, 2002 and December 13, 2002.

Brady, N. 1990. *The nature and property of soils.* MacMillan Publishing Company, New York, NY.

Carlson, R., 1977. A trophic state index for lakes*.* *Limnology and Oceanography*. 22:361:369.

Carlson, R. and J. Simpson. 1996. *A coordinator's guide to volunteer lake monitoring methods.* North American Lake Management Society and the Educational Foundation of America.

Chapra, S. 1997. *Surface water-quality modeling*. The McGraw-Hill Companies, Inc., Boston, MA.

City of Charleston. 1992. *Clean Lakes Program Phase I Diagnostic Feasibility Study of the Charleston Side Channel Reservoir.* City of Charleston in cooperation with Eastern Illinois University, Illinois EPA, and USEPA, Charleston, IL.

City of Charleston. 2001. Charleston Water Treatment Plant. Monthly Reports of Daily Test River Water. City of Charleston, Charleston, IL.

City of Charleston. 2002. Charleston Water Treatment Plant. Water Production Records. City of Charleston, Charleston, IL.

City of Charleston. 2003. Charleston Water Treatment Plant. Level and Discharge at Charleston Spillway. City of Charleston, Charleston, IL.

Haith, D. A., R. Mandel, and R. S. Wu. 1992 *Generalized watershed loading functions model. Version 2.0. User's Manual*. December 15, 1992.

Illinois EPA (Illinois Environmental Protection Agency). 1998. *Clean Water Act Section 303(d) List - Illinois' Submittal for 1998*. Illinois Environmental Protection Agency, Springfield, IL.

Illinois EPA (Illinois Environmental Protection Agency). 2000. *Illinois Water Quality Report 2000.* Illinois Environmental Protection Agency, Bureau of Water, Springfield, IL.

Illinois EPA (Illinois Environmental Protection Agency). 2001. Attachment 2 to Contract FWN-1305. Revised TMDL Scope of Work for Tetra Tech, Inc.

Illinois EPA (Illinois Environmental Protection Agency). 2002a. *Illinois Water Quality Report 2002*. Illinois EPA/BOW/02-006. Illinois Environmental Protection Agency, Springfield, IL. July 2002.

Illinois EPA (Illinois Environmental Protection Agency). 2002b. Point source discharge information forwarded to Tetra Tech, Inc. by Jennifer Clarke, Illinois Environmental Protection Agency. May 1, 2002.

Litke, D. 1999. Review of Phosphorus Control Measures in the United States. U.S. Geological Survey. Water-Resources Investigations Report 99-4007, Denver, CO.

McConkey, S., and K. P. Singh. 1996. *City of Charleston Public Water Supply: Analysis of Drought Yields from the Charleston Side-Channel Reservoir.* Illinois State Water Survey, Hydrology Division, Champaign, IL.

MCC (Midwestern Climate Center). 2001. Historical climate summaries for station 111436, Charleston, Illinois. Midwestern Climate Center. Available on the Internet at: <http://mcc.sws.uiuc.edu/>.

MRLC (Multi-Resolution Land Characteristics). 1992. Land use data for the Multi-Resolution Land Characteristics Consortium. Multi- Resolution Land Characteristics. Land use data produced mainly from the 1992 Landsat TM meter coverage (30 m resolution).

Tetra Tech, Inc. 2001a. Charleston Side Channel Reservoir TMDL. Report #1. Water Quality Analysis and Watershed Characterization. November 2001.

Tetra Tech, Inc. 2001b. Charleston Side Channel Reservoir TMDL. Report #2. Methodology. November 2001.

U.S. Census Bureau. 2000. *United States Census 2000.* < www.census.gov>. Accessed March 29, 2002 and November 25, 2002.

USEPA (U.S. Environmental Protection Agency). 1980. *Clean Lakes Program Guidance Manual* EPA440/5-81-003. U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, DC.

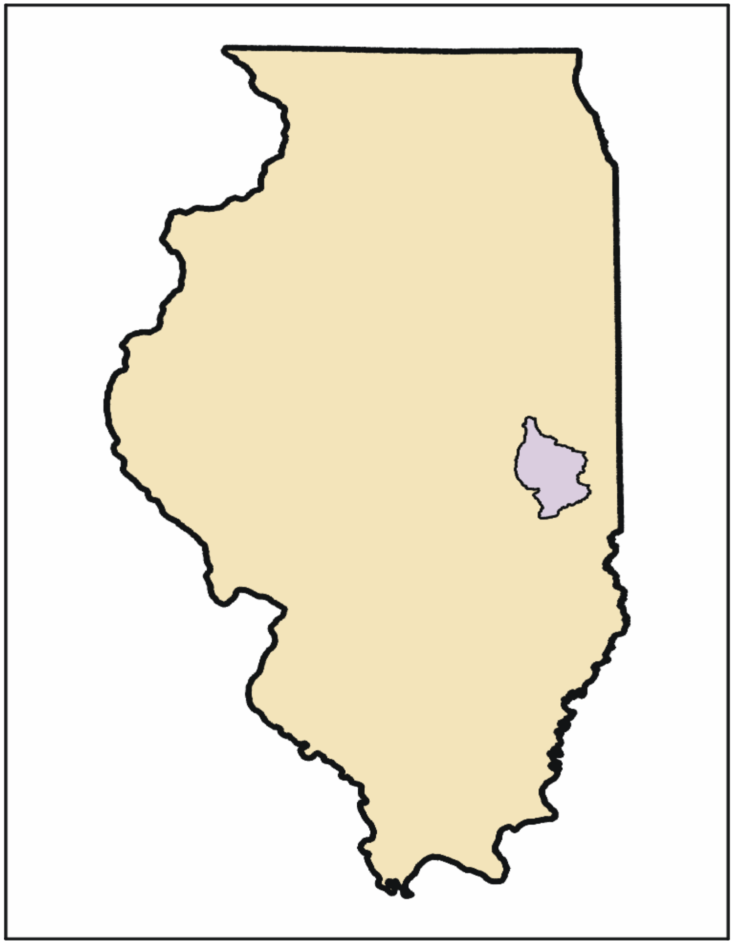
USEPA. (U.S. Environmental Protection Agency). 1991. *Guidance for water quality-based decisions: The TMDL process.* EPA 440/4-91-001. U.S. Environmental Protection Agency, Assessment and Watershed Protection Division, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 1999a. *Protocol for Developing Nutrient TMDLs. First Edition*. EPA 841-B-99-007. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 1999b. BASINS Version 2.0. Region 5 Data. U.S. Environmental Protection Agency, Washington, DC.

Walker, W. W. 1985. *Empirical Methods for Predicting Eutrophication in Impoundments; Report 3, Phase III: Model Refinements*. Technical Report E-81-9, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Xue, Y. 1998. Kinetics and modeling of dissolved phosphorus export from a tile-drained agricultural watershed. *Journal of Environmental Quality*. 27:917-922.



Aerial Assessment of Charleston Side Channel Reservoir (Embarras River) Champaign, Douglas and Coles Counties
July, 2005
Prepared by Wayne Kinney for IL. Dept. of Agriculture

In August 2003, Tetra-Tech, Inc. prepared a Total Maximum Daily Load Report on the Charleston Side Channel Reservoir (CSCR) for the Illinois Environmental Protection Agency. The CSCR is a water supply, recreational reservoir and the sole drinking water source for the city of Charleston, IL. This reservoir has been identified as an impaired water with potential causes of impairment being phosphorus, nitrogen, total suspended solids and excessive algae growth/chlorophyll "a" (Illinois EPA, 2001).

The CSCR TMDL Draft Implementation Plan contained in the August 2003 report indicates that the strategy adopted is to address the "phosphorus impairment which will lead to an overall improvement in water quality due to the interrelated nature of other listed pollutants.

Potential sources of TP to the CSCR include pumping from Lake Charleston, runoff from the direct drainage area, shoreline erosion, septic systems, and precipitation. The bottom sediments are also contributing TP loadings during portions of the year. Loads from these sources were estimated using a variety of means as part of the TMDL analysis, and it was determined that the primary sources are bottom sediments, pumping, and shoreline erosion. The BATHTUB model was used to determine how much the loads must be reduced so that the TP standard for lakes of 0.05 mg/L is achieved and the results indicate that loads must be reduced approximately 90 percent. Please refer to the full TMDL report for details regarding the analysis."
(Appendix D-1, May 2003 Implementation Plan)

The implementation plan cited suggests several alternative methods of addressing phosphorus in CSCR, one of those options is to reduce upstream loadings in Lake Charleston since an estimated 28.8% of phosphorus loads to CSCR are contributed by pumping from Lake Charleston to CSCR. The report also states that the TMDL analysis indicates that row crop production is the largest source of upstream TP and no mention is made of streambank erosion as a contributing source. The SWAT (Soil Water Assessment Tool, version 2000) developed by the USDA, Agricultural Resource Service was employed to model TP from the Upper Embarras River Watershed, however, this model does not include TP contributions from streambank or gully erosion.

This report will address the potential for contributions of TP from within the mainstem of the Embarras River from Lake Charleston to Villa Grove.

Assessment Procedure

Low level geo-referenced video was taken of the Embarras River in March, 2004. Video taping was completed by Fostaire Helicopters, Sauget, IL, using a camera mounted beneath a helicopter to record data from just above tree top level in DVD format for further evaluation and assessment. Video mapping began just below the Lake Charleston Dam downstream of IL. Rte 130 and progressed upstream to approx. 1 mile above Villa Grove on Jordan Slough. Aerial video of tributaries was not part of the project, regardless of the stream size or vegetation.

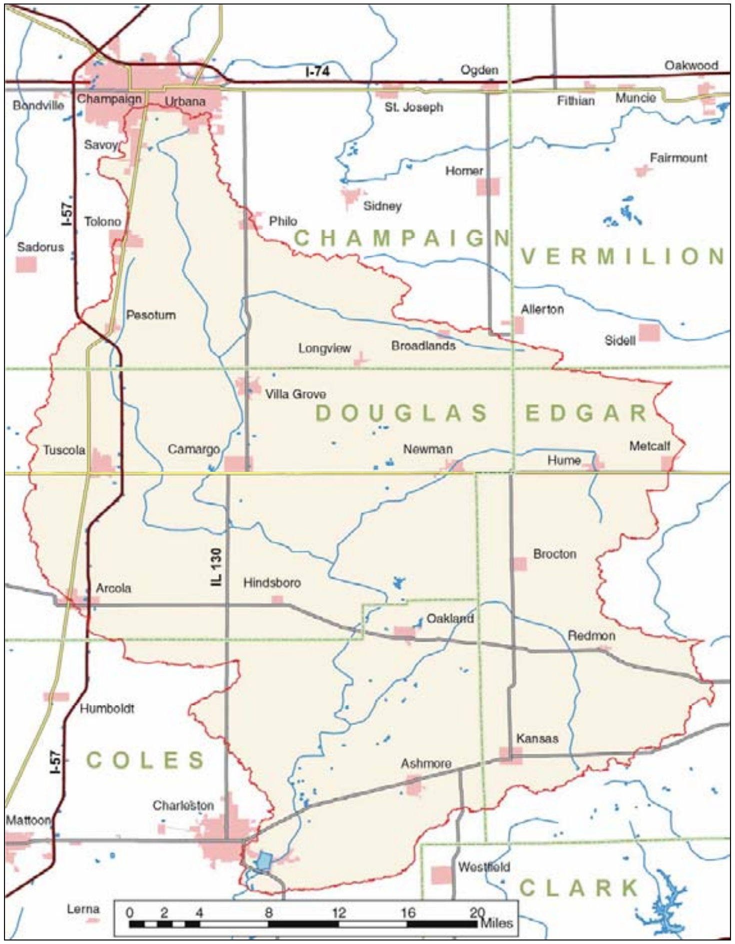


Fig. 1. Charleston Side Channel and Embarras River Watershed

After videotaping the stream, the DVD tapes were processed by USGS to produce a geo-referenced DVD showing flight data and location. Next, USGS identified features from the video and created shapefiles containing the GPS location, type of feature identified, and the time on the DVD to allow cross referencing. The shape-files along with the DVD were then used to identify and locate the points where ground investigations were needed to verify aerial assessment assumptions and gather additional data.

The ground investigations or "ground truthing" is intended to accomplish two primary functions. First, it provides those viewing videos the opportunity to verify the correct interpretation of the video. Second, the video allows the user to identify and gather field data at the most appropriate locations to more closely represent the entire study portion of the stream.

Detailed elevation data is not available; therefore the channel slope is calculated from USGS topo maps by measuring the channel length between contour lines (Fig. 2). The report refers to this as "valley profile" although a true valley profile would use a straight line distance down the floodplain rather than channel length. However, this method is used because it incorporates sinuosity into the calculation and allows the channel slope to be assume equal to "valley slope" in order to estimate channel capacity, velocity, etc., although there are short segments where the channel slope may differ significantly near roads, logjams, knickpoints, etc.

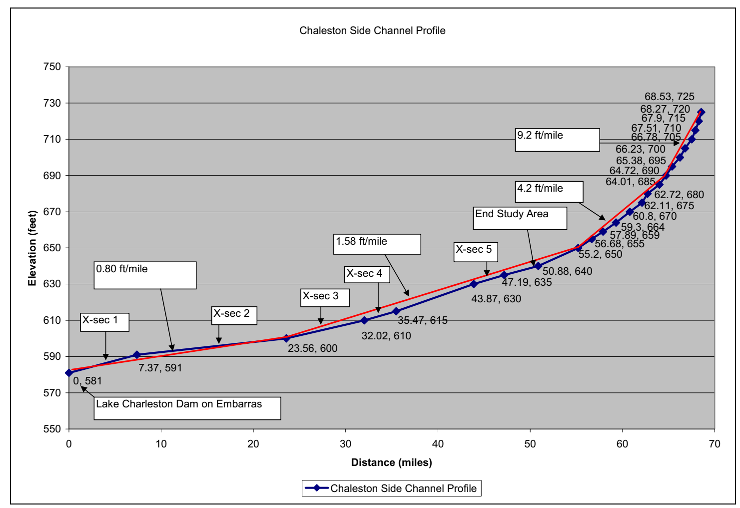


Fig. 2. Valley Profile Embarras River

The DVD has been divided in “chapters” of approximately five minutes of video (Fig. 3) to enhance the ability to navigate within the flight video and provide a simple way to identify and discuss different stream segments. Although the report will begin with a broader more general assessment of the entire study reach, it will also provide an assessment and treatment recommendations by chapter. The chapter divisions are clearly arbitrary and do not reflect “change points” in the stream characteristics or treatment recommendations. For clarity the conclusions and recommendations are presented for each stream “chapter”. There are 16 chapters on one DVD labeled Chapters 1 thru 16.

The major factors indicating channel condition identified from the aerial assessment have been totaled by DVD chapter in Table 1 below. This tabulation allows a general comparison of the relative dominance of features found in each chapter and provides a means of comparing stream characteristic between chapters. A discussion of the major differences will follow later in this report.

Features Identified by Chapter

Chapter	Rock Outcrop	Logjam	Geotech Failure	Deposition	Divided Channel	Erosion	Severe Erosion
1	1	0	1	1	4	9	0
2	4	0	5	0	1	6	0
3	3	0	2	0	3	17	0
4	1	2	3	0	0	15	0
5	0	2	2	0	1	12	1
6	0	1	2	0	0	10	0
7	0	3	2	0	0	7	1
8	0	1	4	0	0	13	0
9	0	4	2	1	2	6	0
10	0	5	2	0	3	13	0
11	0	5	1	0	2	10	0
12	0	8	2	0	6	7	0
13	0	6	1	0	2	3	0
14	0	6	0	0	0	0	0
15	0	7	0	4	0	5	0
16	0	7	0	7	0	9	0
Totals	**9**	**57**	**29**	**13**	**24**	**142**	**2**

Table 1. Features by Chapter Identified by Aerial Assessment

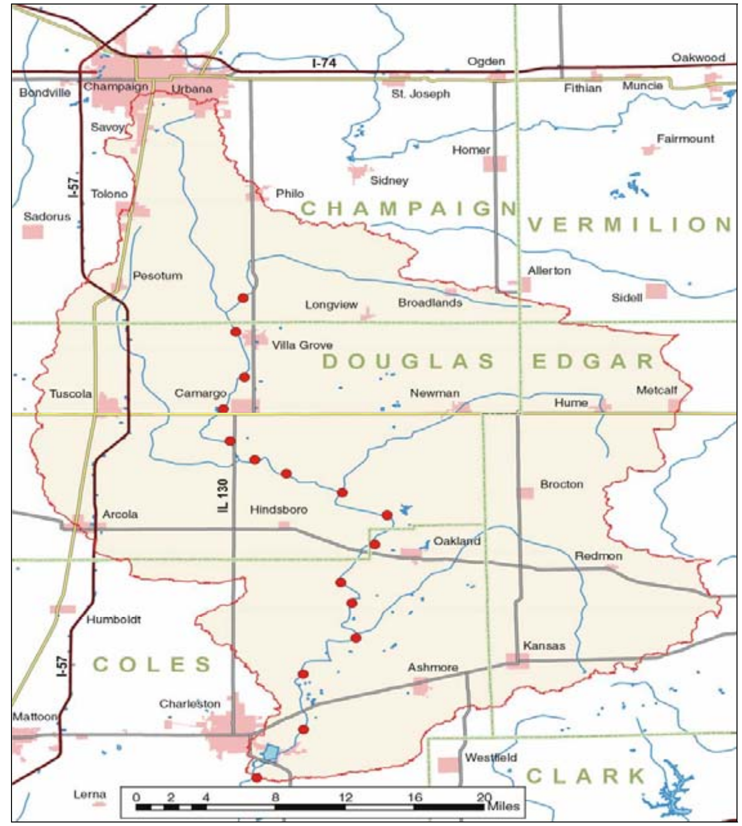


Fig. 3. DVD Chapter Division in Embarras River Study Area

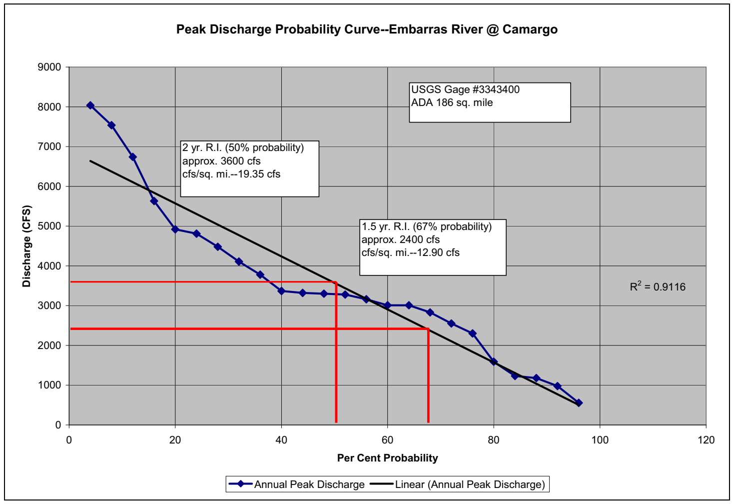


Figure 4. Annual Peak Discharge Probability Curve @ Camargo 1981-2004

The cross section data collected in the Embarras River is presented in Table 2. Bankfull discharges have been estimated by observing field indicators such as, flat depositional areas, washed root zones and change in bank angle. The field data has then been used with the Streambank Inventory and Evaluation data form developed by NRCS. This procedure allows for comparison of observed field conditions with “regional curve” predictions of channel dimensions, USGS Flood-Peak discharge predictions from Water-Resources Investigations Report 87-4207, and bedload material movement with velocity required for transport. Appendix A at the end of this report contains the NRCS Streambank Inventory and Evaluation of each cross section.

The probability plot of annual peak discharges for USGS Gage #03343400 has been developed for the period 1981 thru 2004, a more recent rainfall record than was used in WRI Report 87-4207. The more recent analysis shows a slight increase in the 2 yr. discharge from 3160 cfs to approx. 3600 cfs. This increase of 13.9% is not considered significant and may simply reflect increased rainfall during the years analyzed. A trendline of Annual Maximum Peak Discharges from this gage shows only a slight upward trend of 4% over the period 1967-2004. Therefore this report will assume the WRI Report 87-4207 figures to be an accurate reflection of long term peak discharges.

Five cross sections were taken at selected locations on the Embarras River after viewing the DVD’s. The cross sections are located at “riffle” locations to best represent the channel characteristics and to allow for comparison of width, depth, x-sec. area, etc. along the channel at similar geometric locations. The result of the hydraulic analysis at

each site is presented in summary form in Table 2 and each cross section is provided in more detail in Appendix A. Cross sections locations are shown in Figs. 5-20 showing aerial views of each chapter. Exact locations as Eastings and Northings can be found in Appendix A

CROSS SECTION SUMMARY –Embarras River

X-sec	ADA	Q2 cfs	BKF cfs	BKF/sq.mi.	BKF Width	Max D	Vel. FPS	W/D	Top Bk. Depth	BKF X-Area	Top Bk X-Area	BKF cfs/ Q2 cfs	Top Bk/ BKF area
1	719	6431	2205	3.06	235	10.8	1.5	38.27	10.9	1443	1467	0.34	1.02
2	541	5949	1559	2.88	93	11.4	1.9	10.57	11.5	819	828	0.26	1.01
3	513	6249	1500	2.92	106	10.3	2.2	16.43	10.3	684	684	0.24	1.00
4	317	4365	1277	4.02	83	8.7	2.3	12.24	8.8	563	571	0.29	1.01
5	179	3095	396	2.21	74	5.5	1.5	20.56	5.6	267	275	0.13	1.03

Table 2 Cross Section Summary

General Observations

1. Streambank erosion on the Upper Embarras above Lake Charleston is minimal with 173 sites identified in 56 miles of channel including the geotech failures. The average is about 3 sites per mile.
2. Both sides of the channel have mature woody vegetation on nearly the entire length with little to no point bar accumulation, suggesting very minimal lateral migration.
3. Lack of bar accumulations indicates sediment is primarily silt and clay with a high affinity for nutrients in a channel able to transport the sediment delivered from upland sources.
4. Mature woody vegetation on banks is sloughing off into channel at erosion sites contributing to the woody debris creating 57 identified logjams.
5. The channel x-sections taken show the Embarras to be very well connected to the floodplain with channel capacity only 13 to 34% of the predicted Q2. These discharges would equate to a range of “out-of-bank” frequencies of 1.04 yr. R.I to a 1.2 yr. R.I.
6. With no recent rains and the channel well within banks at the lower end of study area, the upper end near Villa Grove was near flood stage substantiating the findings at X-sec 5 of a channel only capable of carrying 13% of the 2 yr. discharge.

Conclusion and Recommendations

No assessment by chapter is being made for the Embarras River. Reviews of the aerial DVD’s and field investigations indicate there is no downcutting, the channel is well connected to floodplain and channel erosion appears to be minimal. There are 29 geotechnical failures where trees have slid vertically into the channel and the accumulation of woody debris and logjams in a major factor in many other erosion sites.
The recommendation is therefore to actively remove major logjams and large woody debris that is likely to form a logjam. The current erosion sites not associated with

woody debris could be successfully treated with stream barbs to stop the bank erosion and prevent additional trees from entering the channel through bank failure. It is estimated from the DVD that 40 to 50% of the erosion sites would be candidates for stabilization. The stone required for the average barb in the Embarras is estimated to be 150 tons at a cost of $4500 each. Each outside bend treated will require 4 to 5 barbs at an estimated cost of $18,000 to $22,500 per site. The total cost of treatment with streambarbs would then be approx. 70 sites at $20,000 each for a total of $1,400,000.

Figures 5 thru 20 show the location of eroding sites needing potential treatment, but no distinction is made for individual sites between those needing woody debris management only and those needing bank stabilization. No other treatment is recommended.

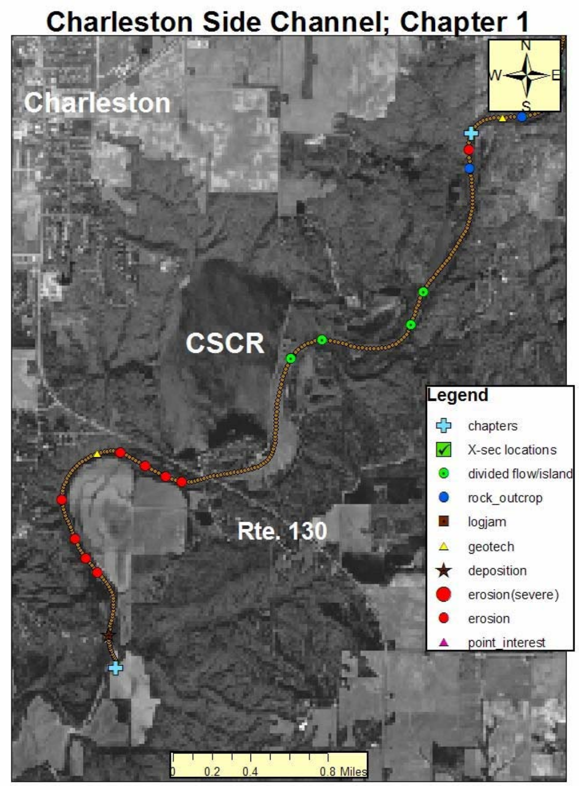


Fig. 5. Chapter 1 Aerial View

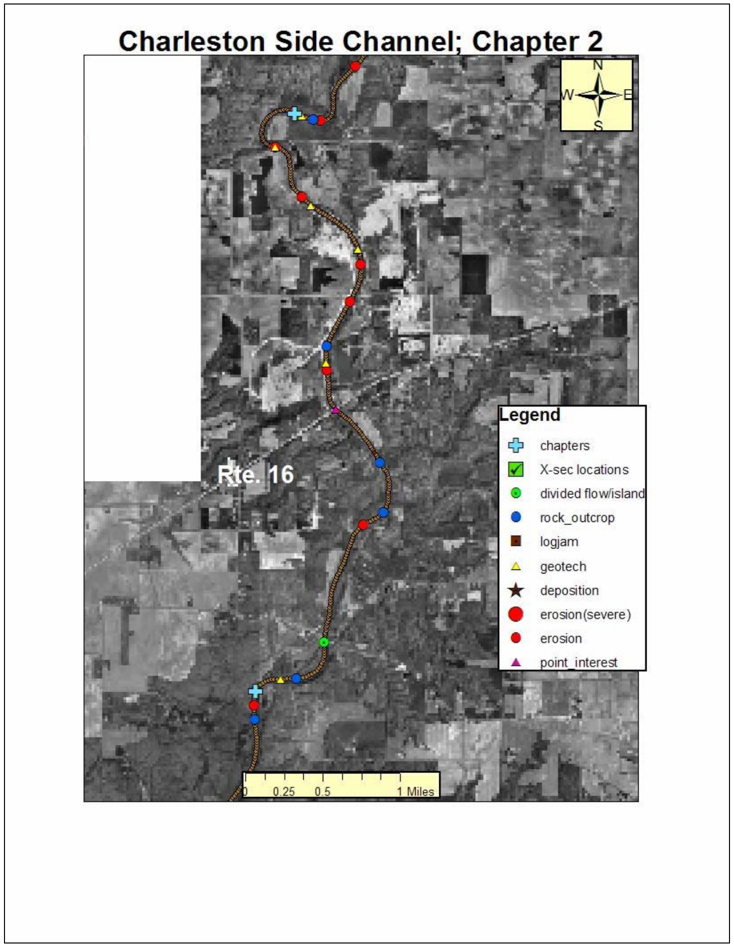


Fig. 6. Chapter 2 Aerial View

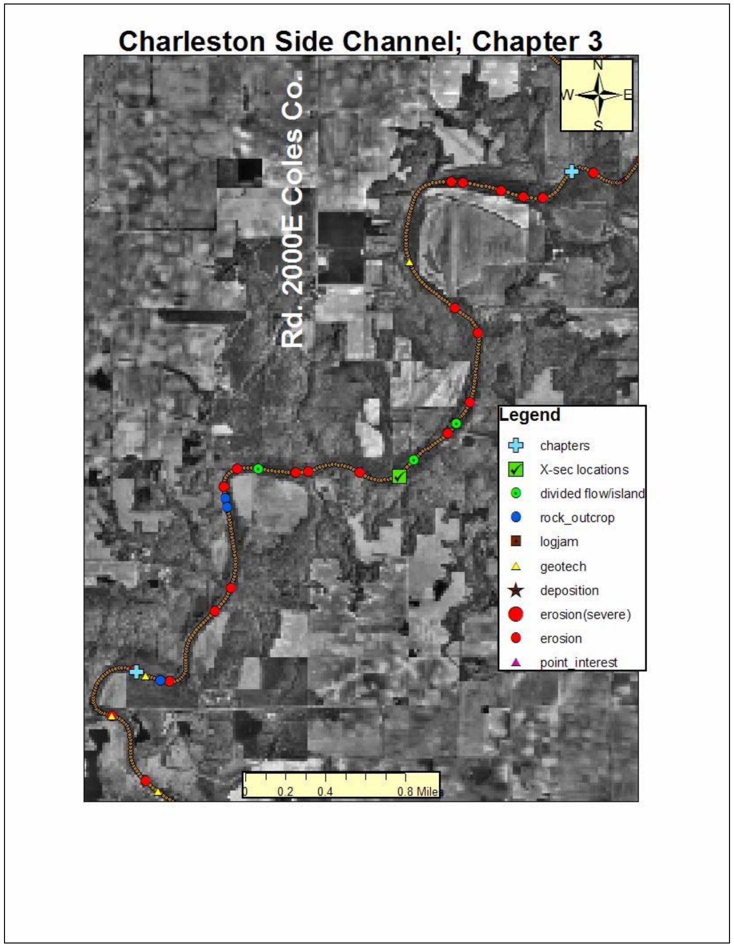


Fig. 7. Chapter 3 Aerial View

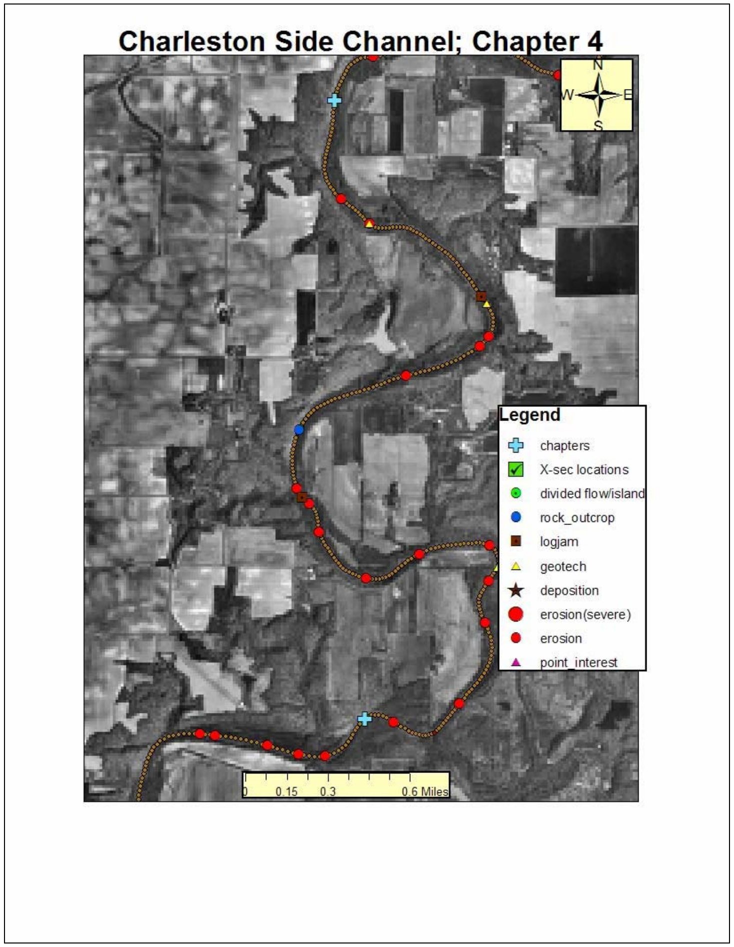


Fig. 8. Chapter 4 Aerial View

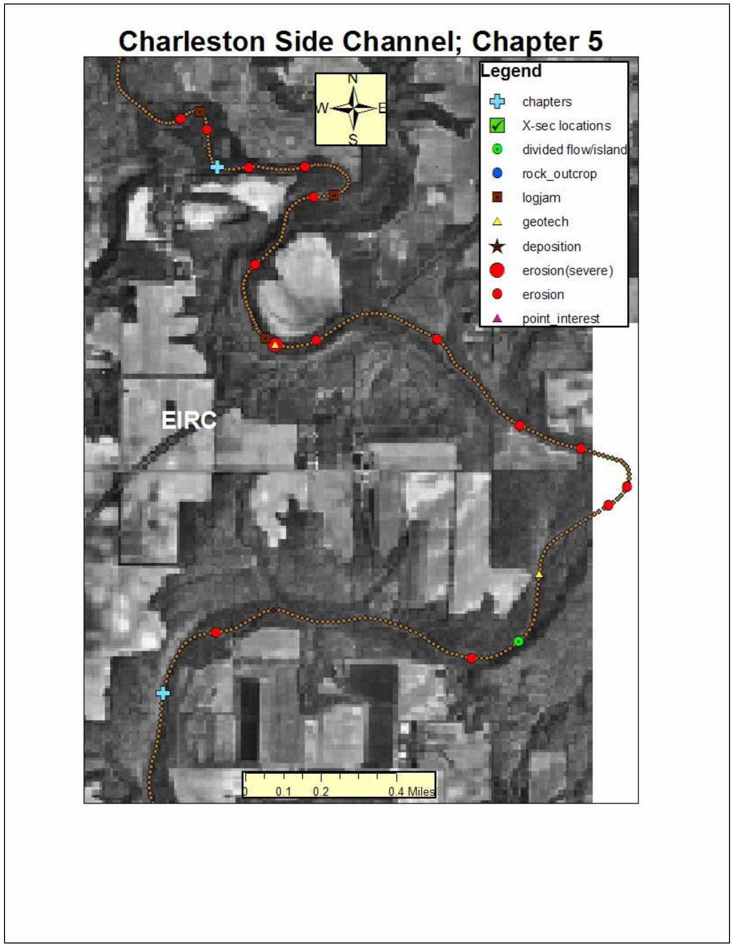


Fig. 9. Chapter 5 Aerial View

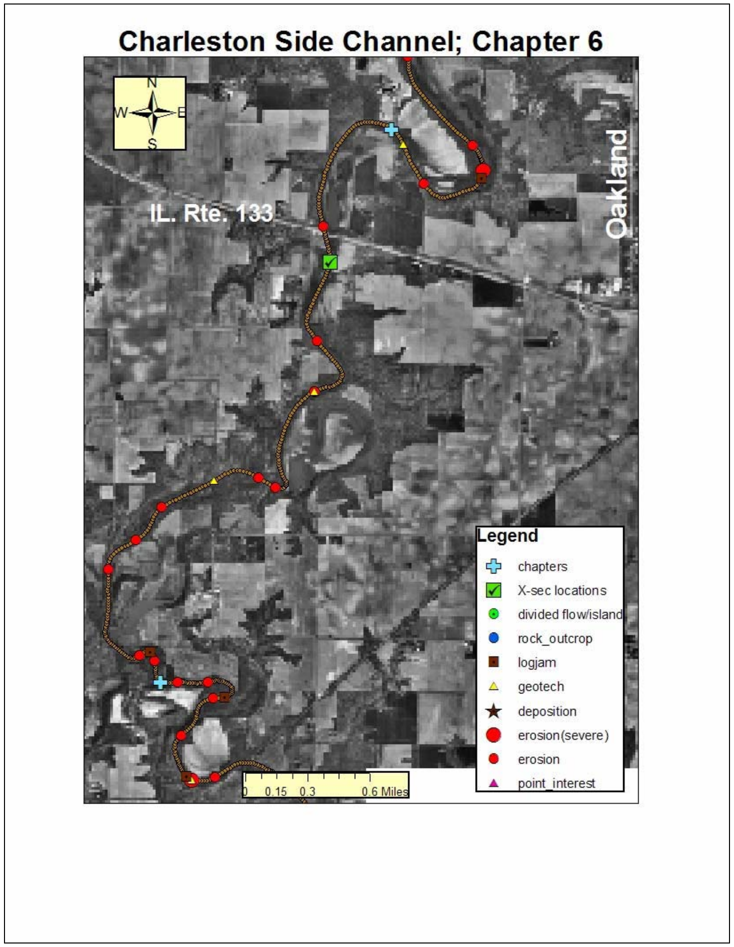


Fig. 10. Chapter 6 Aerial View

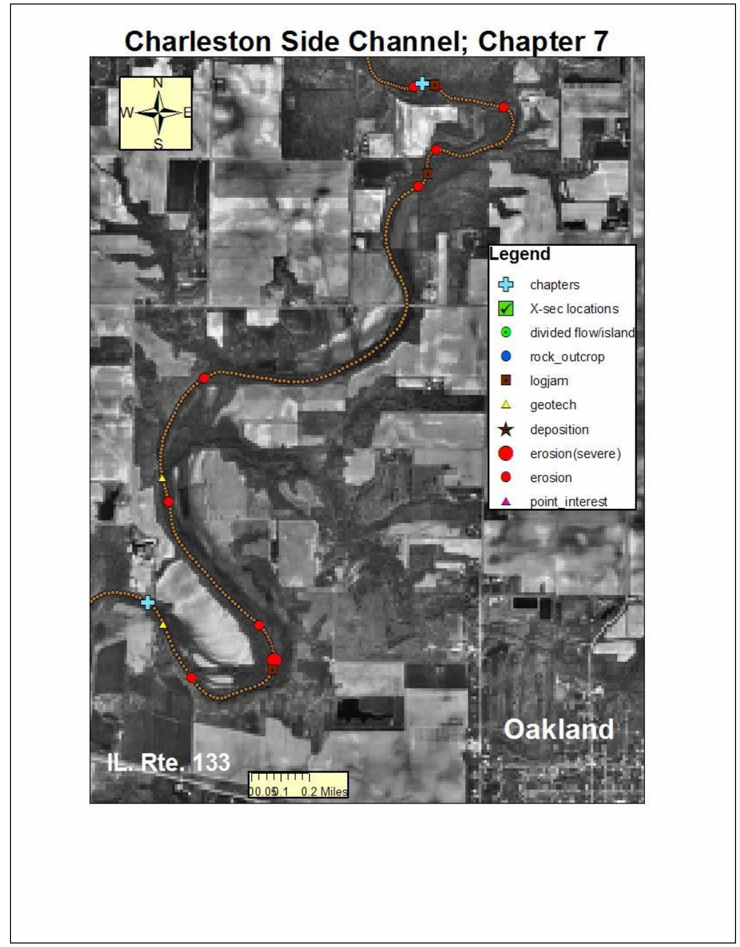


Fig. 11. Chapter 7 Aerial View

Charleston Side Channel; Chapter 8

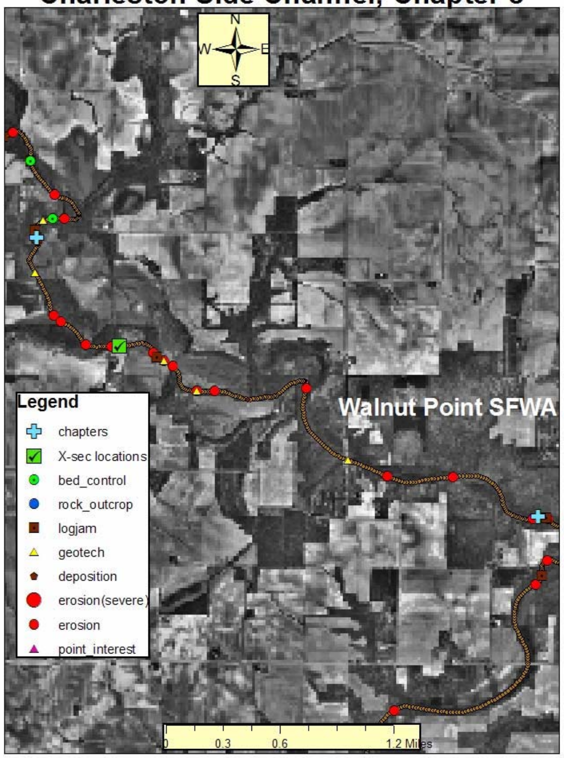


Fig. 12. Chapter 8 Aerial View

Charleston Side Channel; Chapter 9

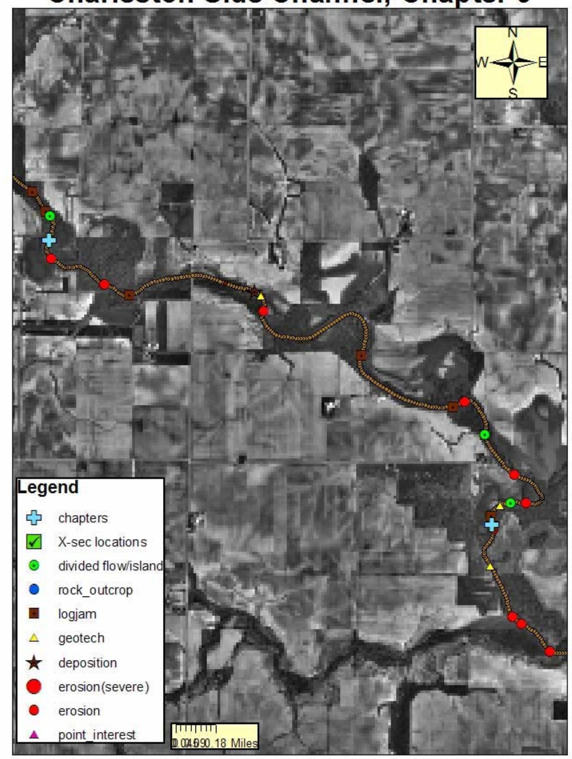


Fig. 13. Chapter 9 Aerial View

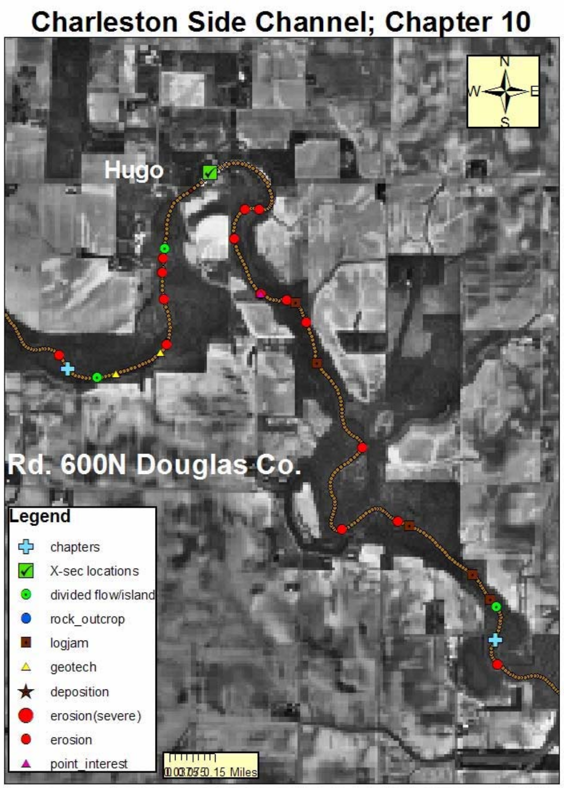


Fig. 14. Chapter 10 Aerial View

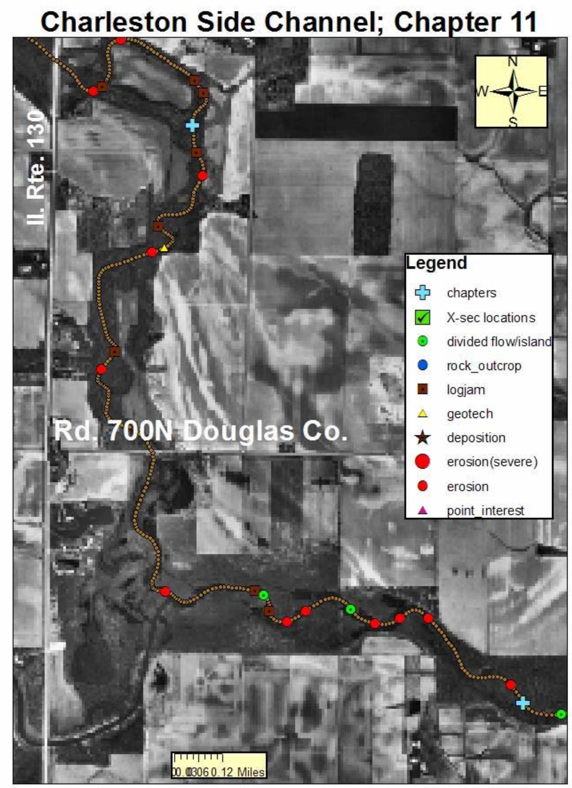


Fig. 15. Chapter 11 Aerial View

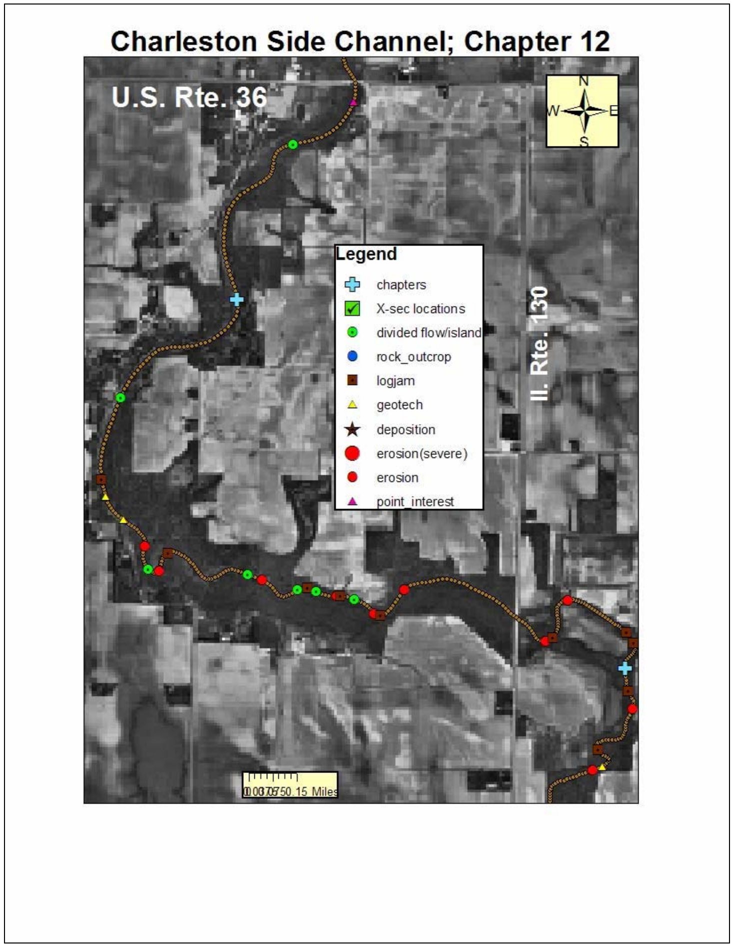


Fig. 16. Chapter 12 Aerial View

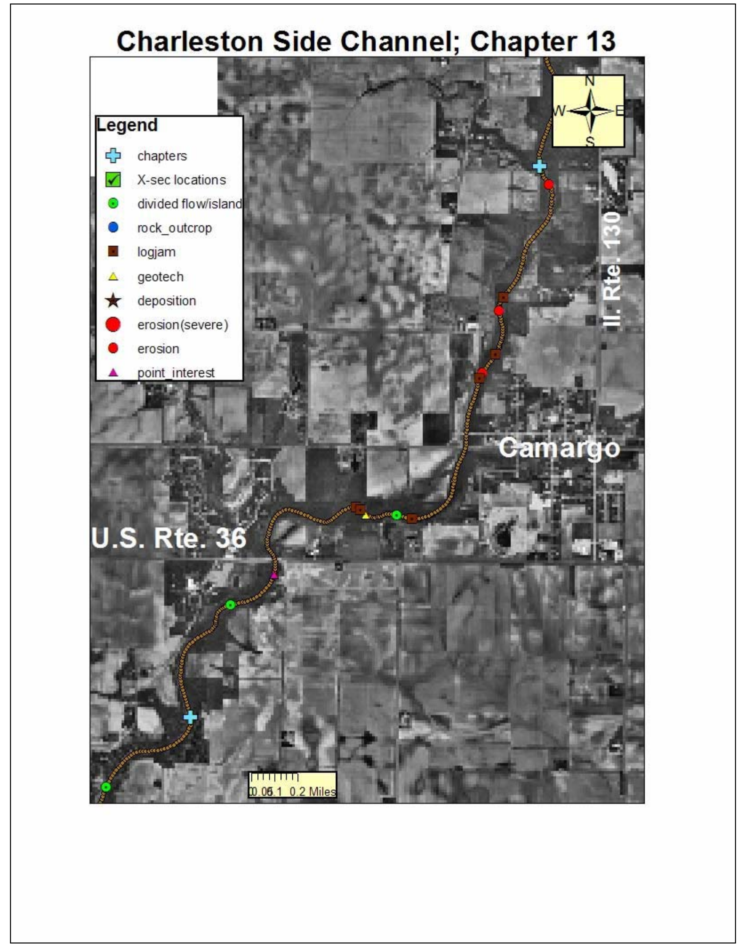


Fig. 17. Chapter 13 Aerial View

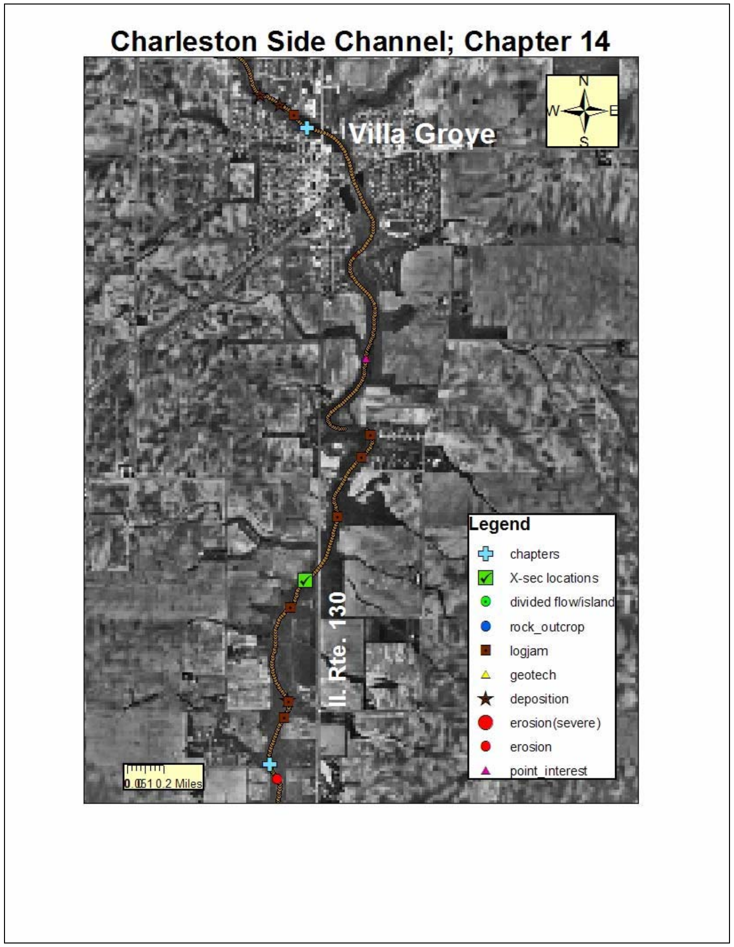


Fig. 18. Chapter 14 Aerial View

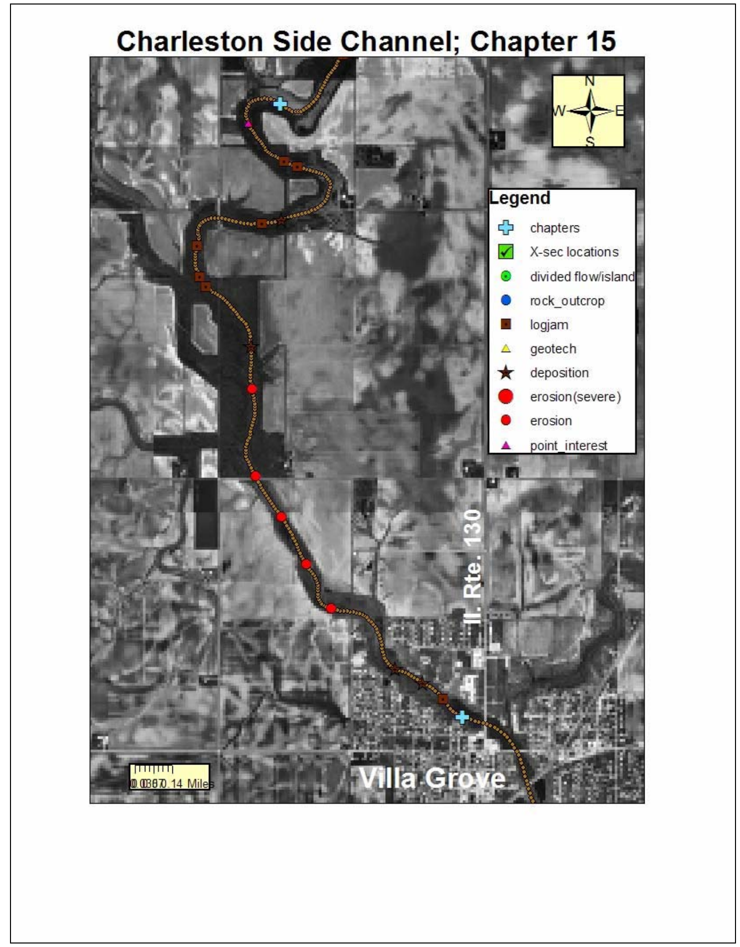


Fig. 19. Chapter 15 Aerial View

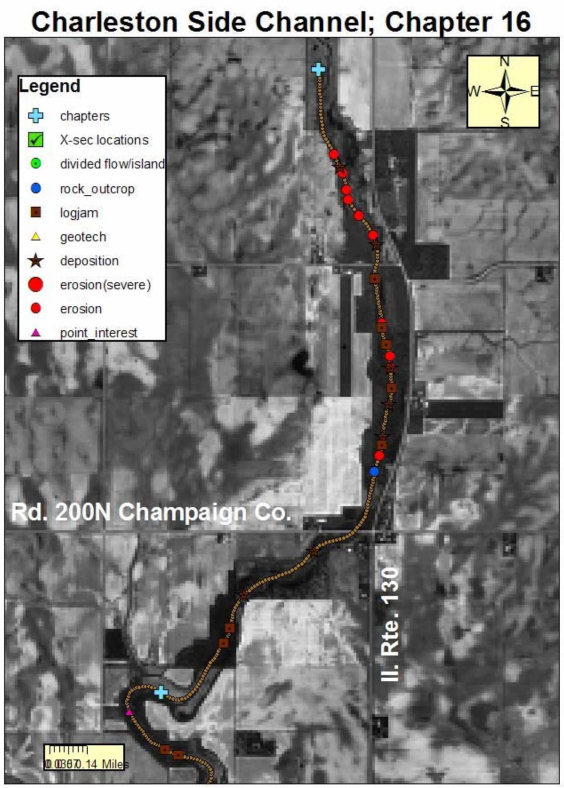


Fig. 20. Chapter 16 Aerial View

APPENDIX A

CROSS SECTION DATA

EMBARRAS RIVER

ERMA

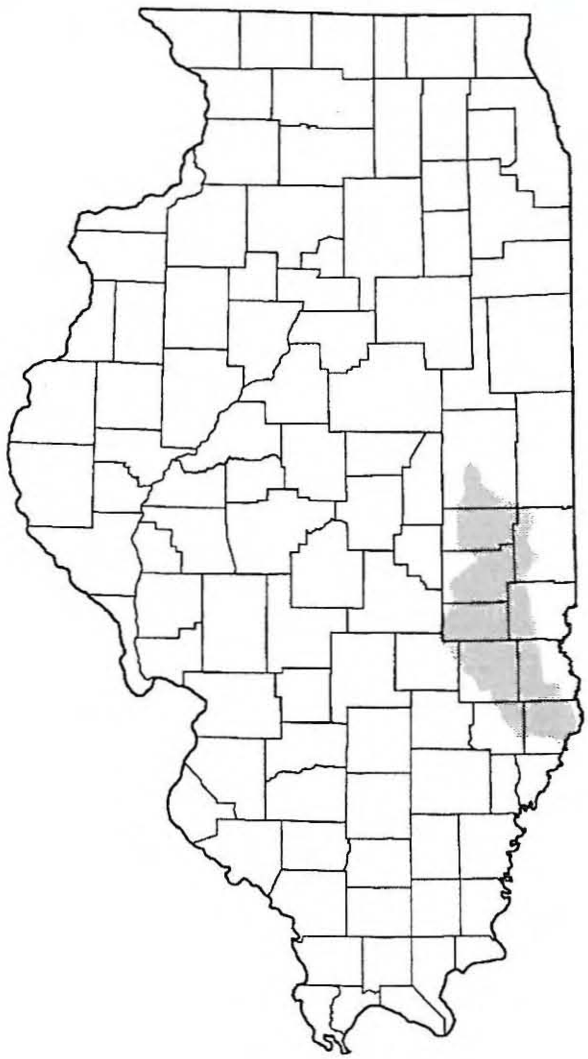
MANAGEMENT ASSOCIATION

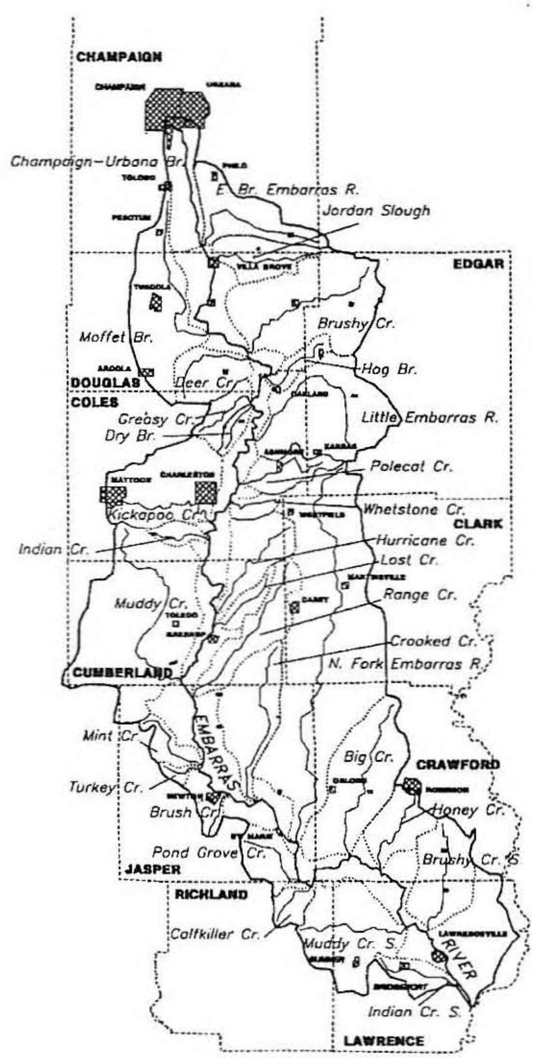
USDA

United States Department of Agriculture

Natural Resources Conservation Service

Champaign, Illinois





Embarras River Basin Resource Management Plan

October 1996

EMBARRAS RIVER BASIN REPORT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

SUMMARY
EMBARRAS RIVER BASIN

PROJECT: Embarras River Basin Resources Management Plan

STATE: Illinois

PREPARED BY: Embarras River Management Association (ERMA)
Natural Resources Conservation Service (NRCS)
Champaign County SWCD
Clark County SWCD
Coles County SWCD
Crawford County SWCD
Cumberland County SWCD
Douglas County SWCD
Edgar County SWCD
Jasper County SWCD
Lawrence County SWCD
Richland County SWCD
Upper Embarras Planning Committee
North Fork Conservancy District
Illinois Department of Natural Resources
Illinois Department of Agriculture
Illinois Environmental Protection Agency
US Fish and Wildlife Service
US Forest Service
University of IL, Cooperative Extension Service
Eastern IL University

DESCRIPTION OF RECOMMENDED PLAN

The recommended plan consists of a coordinated resource management plan for the Embarras river basin. This resource plan will:

- Promote/maintain the Embarras River's natural integrity
- Implement natural resource conservation planning
- Improve woodland management
- Identify, stabilize and restore wetlands
- Identify and implement streambank stabilization
- Create incentives for new practices

RESOURCE INFORMATION

Watershed size: 1,566,450 acres (2,440 sq. miles)

Land Use:

Cropland	77%
Forest land	11%
Grass land	4%
Rural transportation	3%
Urban land	2%
Water	1%
Miscellaneous	2%

Land Ownership: 97% Private 3% Public

Number of Farms: 4,140

Average Farm Size: 380 acres

Prime Farmland: 1,150,200 acres

Wetlands: 127,600 acres

Threatened and Endangered Species: 46 species identified in basin

Cultural Resources: Specific site reviews will determine if any cultural resources are impacted.

Locally Identified Resource Concerns:

1. Flooding
2. Log Jams/Obstructions
3. Water Quality
4. Erosion
5. Drainage
6. Beaver, Deer and Turkey related problems
7. Lack of Accountability-Communication
8. Loss of Natural Character
9. Private Property Rights
10. Sediment (sand deposits)
11. Bends in the Channel
12. Wetlands
13. Wildlife/Recreation Opportunities
14. Economic Costs (funding solutions)
15. Water Usage and Supply
16. Land Use Changes
17. Small Bridge Outlets
18. Lack of Education

PLAN PURPOSES

Improve drinking water quality.
Improve drinking water supply.
Reduce soil erosion on cropland, woodland, streambanks.
Provide flood control for communities and agricultural land.
Provide better fish and wildlife habitat.
Upgrade recreational activities and facilities.

ALTERNATIVES STUDIED

- No Action
- Purchase 10% of flooded cropland
- Build dams to control 30% of the basin
- Triple the amount of no-till cropland in the basin
- Identify sites and implement streambank stabilization
- Implement coordinated resource basin planning

The Coordinated Watershed Planning Alternative was selected as the best course of action to achieve ERMA goals.

ESTIMATED COSTS

Category	Cost	(% of Total Resource Needs) On-going Program	Implementation Rate
Conservation Land Treatment Practices	$34,000,000	5%	80%
Water Quality Improvement	$15,000,000	5%	80%
Wetland, Wildlife, Threatened and Endangered Species	$10,000,000	5%	80%
Flood Damage Reduction Features	$13,000,000	0%	100%
Technical Support	$ 5,000,000	-	-
Mitigation	$ 5,000,000	-	-
Total Estimated Cost	**$82,000,000**		

The estimated cost for land treatment for erosion and sediment reduction ($34,000,000), water quality improvement ($15,000,000) and wetland, wildlife, threatened and endangered species ($10,000,000) accounts for 80% anticipated acceptance and implementation rate. Flood damage reduction features ($13,000,000) accounts for 100% structure construction. Technical support ($5,000,000) accounts for planning, design and implementation assistance needed from field office and staff specialists. Mitigation ($5,000,000) accounts for replacement of forest and natural area values that may be disturbed or destroyed during construction of dry dams. See the Avoidance, Minimization, and Mitigation section for additional information about mitigation.

All Illinois Natural Area Inventory (INAI) sites will be avoided during site planning and construction. Unavoidable impacts to natural areas will be minimized and mitigated in conformance with National Environmental Policy Act (NEPA) provisions. See the Avoidance, Minimization, and Mitigation section for additional information about mitigation

IMPACTS

Reduce flood damages 25% through implementation of conservation practices and land use changes.

Reduce erosion on 500,000 acres of cropland by implementating planned conservation practices.

Reduce sediment load of the river and tributaries by reducing erosion.

Improve water quality on 194 miles of the Embarras River conditions from reduced sediment load, increased nutrient management, increased pesticide management and improved agricultural waste management.

Improve wildlife habitat on 40,000 acres from better woodland management, land use changes from cropland to riparian areas, buffer strips and filter strips.

Improve recreational opportunities by changing land use from cropland to woodland or riparian areas.

Convert 19,000 acres of cropland to riparian wetlands, bottom land and upland woods, or buffer/filter strips.

Improve management of flood plain cropland.

Improve management of woodland resources.

Restore bottomland wetlands on 660 acres.

Change 3,400 acres from woodland to grassland.

Improve pasture and hayland management on 10,000 acres.

A coordinated resource plan involving the implementation of restoration and protection of wetlands, structural measures, conservation land treatment, woodland management will have significant positive benefits to the natural, economic, and recreational resources of this basin.

AREAS OF CONTROVERSY

Communication and coordination need to be aggressively pursued to strengthen and maintain the cooperative relationship among the planning groups involved with this project (ERMA, Upper Embarras, and North Fork).

Communication among state and federal agencies providing financial and technical assistance should be coordinated so planning and implementation efforts will not be duplicated.

ISSUES TO BE RESOLVED

- Interagency involvement and coordination
- Implementation strategy
- Funding strategy and requests
- Administration of plan completion

INTRODUCTION

The Embarras River Basin is approximately 1,566,450 acres (2,440 square miles). The Embarras is located in southeast Illinois with drainage area in 12 counties. The basin starts on the University of Illinois campus, runs generally south through rural and agricultural land until it converges with the Wabash River in Lawrence County, Illinois (See Map 1). This plan includes parts of Champaign, Clark, Coles, Crawford, Cumberland, Douglas, Edgar, Jasper, Lawrence, and Richland Counties. Effingham and Vermilion Counties have only minor drainage area, and did not participate in the planning process.

The resource planning process was initiated by local landowners concerned about the quality of natural resources within the basin. These landowners approached the local Soil and Water Conservation Districts and the Natural Resources Conservation Service for assistance in developing long-term solutions to the resource problems that they were experiencing.

Two other earlier planning efforts in the watershed should be noted. One started within the Upper Embarras Watershed Area and involved landowners in Champaign and Douglas Counties. Another was in the North Fork tributary of the Embarras River. The efforts of these two groups is acknowledged. The current planning process seeks to assist local SWCD's in the coordination and implementation of this plan.

Planning Committee

The resource planning committee is made up of elected representatives from each county within the basin. Each county SWCD was contacted and sponsored an informational meeting about the planning process. A local steering committee was formed, and a representative was selected to serve on the Board of Directors of the Embarras River Management Association (ERMA).

ERMA is a not-for-profit corporation formed to give local landowners an organizational structure to carry on the development of a comprehensive resource plan. This effort represents a joint approach to management for the entire Embarras River Basin.

The ERMA Board of Directors are elected representatives from each county. These directors volunteer their time and talents by serving as the planning committee. They include:

Leroy Scott, President	Cumberland County
Bill Burgener, Vice-President	Richland County
Keith Donelson, Secretary	Champaign County
George Holsapple, Treasurer	Jasper County
Tom Kleiss	Champaign County
Alan Alford	Coles County
Rollie Spaniol	Coles County
Scott Finley	Crawford County
Blake Smith	Crawford County
Stan Holsapple	Cumberland County
Butch Fisher	Douglas County
Wayne Meyer	Douglas County
Joe Bergbower	Jasper County
John Probst	Jasper County
Jim Legg	Lawrence County
Dennis Williams	Lawrence County
Dave Kocher	Richland County

Objective

The objective of the Planning Committee is to develop a Comprehensive Management Plan for the natural resources in the entire Embarras River Basin. They hope to unite private citizens, public groups, and government agencies to address the resource problems related to watershed management.

Resource Concerns

The Planning Committee has identified the following priority resource concerns:

1. Flooding
2. Log Jams/Obstructions
3. Water Quality
4. Erosion
5. Drainage
6. Beaver, Deer and Turkey related problems
7. Lack of Accountability-Communication
8. Loss of Natural Character
9. Private Property Rights
10. Sediment (sand deposits)
11. Bends in the Channel
12. Wetlands
13. Wildlife/Recreation Opportunities
14. Economic Costs (funding solutions)
15. Water Usage and Supply
16. Land Use Changes
17. Small Bridge Outlets
18. Lack of Education.

Goals

The goals of the people, the public groups, and the government agencies involved in the planning process are to:

- Improve drinking water quality
- Maintain and protect drinking water supply
- Reduce erosion
- Provide flood control
- Provide better fish and wildlife habitat
- Upgrade recreational activities and facilities

Four technical advisory committees were established:

Flooding

Wayne Johanning, Facilitator
Butch Fisher
Mary Kay Solecki
Noble Brown
Lyle Wetzel
Bill Keyth
Vince Gutowski
Bill Boyd
Gary Zwilling
Diane McNaught
Karl Visser
Leroy Scott
Bob Cottingham
Pius Weibel

Erosion/Water Quality

Dennis Clancy, Facilitator
Bob Blair
Laura Keefer
Paul Terrio
Doug Brown
Rollie Spaniol
Randy Hurt
Michael Mounce
Ray Coombes
Bill Burgener
Al Coutant
Mary M. Adams
Mike Hirschi
Vince Gutowski
John Pearse
Gary Eicken
Alan Alford
Dave Shiley

Wetland, Wildlife, and Natural Character

Larry Esworthy, Facilitator
Jack Summers
Don O. Frederick
Paul A. Brewer
Kevin Woods
Keith Donelson
Bob Szafoni
Andy Cerven

Information and Public Communication

Paige Mitchell
Teresa Zimmer
Leroy Scott
Bob Wendt
Greg Carney
Kay Kitchen-Maran

RESOURCE CONDITIONS

Resources and Treatment Needs

To adequately address the resource concerns, minimum levels of treatment were identified during the planning process. This plan includes a comprehensive coordinated resource management system for the soil, water, air, plant, animal, and human resources of the watershed.

Soil

The soils of the river basin vary from flat to steeply sloping, from poorly drained to well drained, from not very erodible to very highly erodible.

Sheet, rill and gully erosion need to be treated on all land so that the average annual soil loss is at or below the "T" (Tolerable Soil Loss) value for the soil map unit. Streambank and scour erosion on bottomland need to be treated so that affected areas are stabilized. Soils disturbed by urban development and construction need to be protected so sediment does not leave the site.

Water

The stream channel of the Embarras River has an average width of 67 feet, although it varies from 122 feet to only 19 feet. The average water depth in the stream is 0.85 feet. Sand is the predominant substrate (41%) followed by gravel (21%) and silt (10%). The average Index of Biotic Integrity (IBI) for the main stem of the Embarras was 46.2 (IEPA-1987) indicating a highly valued aquatic resource. Of the 817 stream miles in the Embarras River System, 421 miles were rated as meeting full aquatic life use support.

Man's activities need to ensure that they have no negative affect on water quality. The impacts of flooding should be reduced to prevent scour erosion on bottomland areas and reduce streambank erosion. Nutrients and pesticides should be used in accordance with label instructions, plant requirements, soil characteristics, proven yield potential, and climatic factors.

Air

The quality is high during most of the year. Winter prevailing winds are from the west or north. Spring and summer prevailing winds are from the south. Occasionally odorous smoke or particulate matter moves from the urban centers. Some windstorms will carry soil particles throughout the river basin at planting time. At harvest time soil particles and dust from crops will permeate the air. Surface application of agri-chemicals may drift off-site. Offensive odors from animal waste utilization occurs frequently.

Wind blown particles of soil and smoke need to be controlled. Offensive odors from urban industrialization, livestock production facilities, and from animal waste needs to be controlled. Chemical drift during nutrient and pesticide application needs to be minimized to prevent damage to non-target plants, animals and humans or to adjacent lands and water bodies.

Plants

The river basin historically consisted of tall prairie grasses and native timber. Clearing, sodbusting, and drainage converted the area to an agri-ecosystem with crop production as the main plant cover.

Plants need to be suitable for the soil and climate conditions. Cropland, hayland and pastureland yields should be 75% or more of the high management yield potential for the soil map unit. Woodland management should meet or exceed 75% of the standard stocking guide recommended for the forest type and woodland suitability group. Adapted or native plants should be in sufficient quantity and quality to protect or improve wildlife land, recreation land and other land use.

Animals

Animals in the river basin fall into two categories: domestic and wild. Domestic livestock production is a contributor to nutrient overloads and odor problems. Several endangered species of wildlife have been identified in the river and wildlife habitat areas.

The quantity and quality of food sources for domestic and wild animals should be adequate to meet the nutritional requirements. Habitat should be managed to provide a medium to high level of quality, based on the Illinois Modified Evaluation Procedures. Endangered species are protected where appropriate through habitat protection and enhancement.

Human Factors

The total population of the river basin is 119,932 people. The rural population is declining slightly as urban areas continue to expand.

The quality of life for residents and visitors to the Embarras River Basin should be enhanced through improved diversity of environmental and economic conditions.

BASIN DESCRIPTION

Physiography (Ettinger, IEPA, 1987)

The topography of the Embarras River basin is the result of recent modification of glacial activity during the Wisconsinan and Illinoian glacial periods. The northern part of the basin, above the Cumberland - Coles County line, is within the Bloomington Ridged Plain and is described as depositional plains of low relief underlain by thick till and modified only slightly by post glacial stream erosion. The plains are nearly flat to gently rolling and are crossed by several low and poorly developed end moraines. The flatness of the plains is broken by low eskers, esker troughs, and melt water drainageways that trend southeast.

The central portion of the basin is within the Springfield Plain and extends approximately from the Cumberland - Coles County line on the north to the Richland - Jasper County line. The glacial material in this area is Illinoian in age and was not subjected to the more recent Wisconsinan glacial activity. It is underlain by lacustrine, outwash, and alluvial sediments and till and is characterized by extensively aggraded valleys. The lowlands are broad plains with low rolling hills. The northern part of the plain has less relief than the southern end.

Downstream from the Richland - Jasper County line the basin is within the Mt. Vernon Hill Country which has gently rolling topographic features that are controlled chiefly by the underlying bedrock. The uplands are well dissected, and the lowlands are broad and have low-gradient alluvial river plains.

Elevation in the Embarras River basin varies from 715 feet Mean Sea Level at its source near Urbana to 405 feet Mean Sea Level at its confluence with the Wabash River, a total fall of 310 feet. With a total river distance of 194 stream miles, this results in an average slope of 1.6 feet per mile. Headwater slopes of the main stem are relatively steep with a value of approximately 4.4 feet per mile while the middle reaches average 1.6 feet per mile. Finally, the outlet reach between the Wabash River and the USGS stream gauge at St. Marie averages only 1.2 feet per mile (See Map 2).

Geology

The surficial geology of the Embarras River drainage basin consists of a mantle of weakly consolidated to unconsolidated sediments of Pleistocene and recent age overlying Pennsylvanian-age bedrock. Bedrock exposures are relatively few in number and of limited areal extent. The nearsurface Pleistocene glacial deposits of the drainage basin include: (1) Illinois-age Glasford Formation in the southern part, and (2) Late Wisconsin-age Wedron Group in the northern part. The mapped boundary between these two subdivisions is along the southern margin of the Shelbyville and Westfield terminal moraines (SM and WM on Map 3), which were formed about 18,000 years ago.

The Glasford Formation is dominantly composed of glacial till and outwash sand and gravel deposits. In a few areas, Illinois-age eskers, kames and crevasse-filling deposits occur above the Glasford. Late Wisconsin-age deposits in the basin are composed of glacial tills, lacustrine silts and clays, outwash sand and gravels, and loess. Glacial till, which is mostly poorly sorted clay, silt, sand, and gravel, is thickest in moraines.

The location and form of Wedron Group deposits influences the configuration of the northern part of the drainage basin. Drainage divides generally occur along moraines. Map 3 depicts the surficial deposits of the basin overprinted by a pattern showing the glacial moraines in the area (abbreviations below refer to Map 3). The headwater area of the Embarras River is on the southwest side of the Champaign moraine (CM). The basin's western divide, from north to south, obliquely crosses the Pesotum (PM) and West Ridge (WRM) moraines and parallels the Arcola (AM) and Cerro Gordo (CGM) moraines before cutting across the Paris (PM) and Shelbyville (SM) moraines, cuts across the West Ridge (WRM) moraine, and over flat landscapes underlain by lacustrine deposits to the Arcola moraine (AM). After following a portion of the Arcola moraine, the divide cuts across the Paris (PM), Nevins (NM), and Westfield (WM) moraines. Like the Glasford, the Wedron is dominantly composed of glacial till and outwash sand and gravel deposits.

In south-central Champaign and eastern Douglas Counties, clayey lacustrine deposits of the late Wisconsin-age Equality Formation were deposited in lakes ponded behind the West Ridge and Arcola moraines. At the southernmost part of the basin, slackwater lacustrine deposits, also mapped as Equality Formation, overlie the Glasford within the Embarras River valley.

Sand and gravel outwash deposits of late Wisconsin-age (Henry Formation) generally occur along the outer margins of the moraines where glacial ice stagnated during gradual retreat northward. Outwash deposits are significantly larger just south of the Wisconsin terminal moraines and where glacial meltwater eroded channels through moraines. Wisconsin-age outwash also is abundant at the southern end of the basin, occurring as terrace deposits along the Wabash River.

Late Wisconsin-age silt-size loess, deposited by the wind, blankets most of the Wisconsin and older sediments (not shown in Map 3). Wind blown sand deposits (Parkland Sand) occur sporadically along the main branches of the Embarras River on the east side of the channel and south of the terminal Wisconsin-age moraine. Late Wisconsin-age and recent Cahokia Alluvium occurs throughout the drainage basin along streams and floodplains. The alluvium ranges from well to poorly sorted and consists of variable amounts of clay, silt, sand, and gravel derived from the loess, glacial till, and outwash sediments.

Soils

There are 19 soil associations within the basin (See Map 4). Approximately 70 percent of the basin area is composed of four soil associations. The Flanagan-Drummer-Catlin association and the Camden-Drummer-Starks association are dominant in the northern part of the basin (Champaign, Coles, Douglas, Edgar, and northern parts of Clark and Cumberland Counties). This part of the basin lies within Major Land Resource Area (MLRA) 108 (Illinois and Iowa Deep Loess and Drift) and MLRA 111 (Indiana and Ohio Till Plain). The Bluford-Ava-Hickory association and the Cisne-Hoyleton-Darmstadt association are dominant in the southern part of the basin. The southern part of the basin lies within MLRA 113 (Central Claypan Areas), MLRA 114 (Southern Illinois and Indiana Thin Loess and Till Plain), and MLRA 115 (Central Mississippi Valley Wooded Slopes).

The Flanagan-Drummer-Catlin association consists of nearly level to gently sloping silty soils formed in loess and the underlying glacial till or outwash on till plains of Wisconsinan age. Flanagan soils are somewhat poorly drained, Drummer soils are poorly drained, and Catlin soils are moderately well drained. They formed under prairie vegetation and are characterized by a thick, black or very dark grayish brown surface layer that is high in organic matter. Most of this association is used for cultivated crops. The soils are well suited to all of the crops commonly grown in the basin. The main management needs are measures that maintain the drainage system in areas of Drummer and Flanagan soils, control erosion in areas of Catlin soils, and maintain tilth and fertility.

The Camden-Drummer-Starks association consists of nearly level to gently sloping silty soils formed in loess and the underlying glacial outwash on outwash plains and terraces of Wisconsinan age. Camden soils are well drained, Drummer soils are poorly drained, and Starks soils are somewhat poorly drained. Camden and Starks soils formed under forest vegetation. They have a thinner, lighter colored surface layer than the Drummer soils which formed under prairie vegetation. Most of this association is used for cultivated crops. The soils are well suited to all of the crops commonly grown in the basin. The main management needs are measures that maintain the drainage system in areas of Drummer and Starks soils, control erosion in areas of Camden soils, and maintain tilth and fertility.

The Bluford-Ava-Hickory association consists of nearly level to very steep silty and loamy soils formed in loess and the underlying glacial till or entirely in glacial till on till plains of Illinoian age. This association occurs in sloping upland areas adjacent to the Embarras River and its tributaries. Bluford soils are somewhat poorly drained, Ava soils are moderately well drained, and Hickory soils are well drained. They formed under forest vegetation. Most of the nearly level to moderately sloping areas are used for cultivated crops. The soils in these areas are well suited or moderately suited to cultivated crops depending on the amount of slope. Steeper areas are mostly used for pasture, hay, and woodland. The soils are well suited or moderately suited to these uses. The main management needs in this association are measures that maintain the drainage system in areas of Bluford soils, control erosion in sloping areas, and maintain tilth and fertility,

The Cisne-Hoyleton-Darmstadt association consists of nearly level to gently sloping silty soils formed in loess and the underlying glacial till on till plains of Illinoian age. They formed mostly under prairie vegetation but have been influenced by forest vegetation at some time during their development. Cisne and Hoyleton soils are considered to be intergrades between prairie soils and forest soils and have a thin, very dark grayish brown surface layer that has moderate levels of organic matter. Darmstadt soils have a high content of exchangeable sodium in the subsoil. The exchangeable sodium restricts rooting depth and the uptake of water and nutrients. Crop yields on these soils are reduced as a result. Darmstadt soils are commonly intermingled on the landscape with the more productive Cisne and Hoyleton soils. Most of this association is used for cultivated crops. The soils are moderately suited or well suited to all of the crops commonly grown in the basin. The main management needs are measures that maintain the drainage system, control erosion in sloping areas of Hoyleton and Darmstadt soils, and maintain tilth and fertility.

Most of the major soils in these four associations that occur on nearly level to gently sloping landform positions qualify as prime farmland. Bluford, Cisne, Drummer, and Starks soils have a seasonal high water table and qualify as prime farmland only in areas where this limitation has been overcome by drainage measures. Ava, Camden, Catlin and Hickory soils that are moderately sloping or steeper are not considered to be prime farmland because of slope and the erosion hazard. Darmstadt soils are not prime farmland because of the high exchangeable sodium content in the subsoil.

Major flood plains comprise approximately 10 percent of the basin. The Beaucoup-Lawson-Darwin association occurs in the northern part and in the extreme southern part of the basin. Beaucoup and Darwin soils are poorly drained or very poorly drained. Lawson soils are somewhat poorly drained. These soils typically are silty clay loam in texture and have a thick, very dark gray or black surface layer.

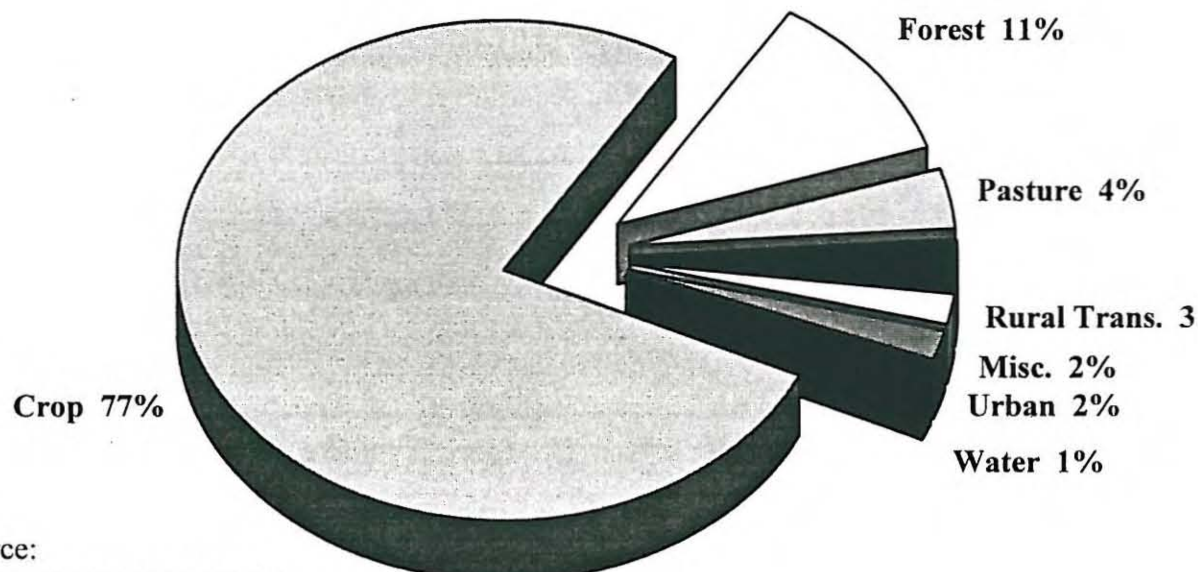
The Wakeland-Birds-Belknap association occurs in the southern part of the basin. Wakeland and Belknap Soils are somewhat poorly drained. Birds soils are poorly drained, typically are silt loam in texture and have a thin, brown or dark grayish brown surface layer.

Soils that occur on flood plains within the Embarras River Basin are subject to occasional or frequent flooding for brief to long periods between January and June of most years. Damage to crops can occur if flooding occurs after planting for extended periods. Most areas are used for cultivated crops. Some areas have been left in woodland. The main management needs are measures that maintain the drainage system, protect crops from floodwater, maintain tilth and fertility, and protect streambanks from erosion.

Land Use

Land use estimates in the Embarras River Basin from the USDA-NRCS National Resource Inventory by different categories is shown below:

Figure 1. 1992 Land Use



Source:
USDA-NRCS 1992 NRI data

Climate

The climate within the Embarras River Basin is humid continental, with the weather principally influenced by masses of cold polar air moving to the east across the basin and by warm moist gulf air masses crossing the basin from the south toward the east. Prevailing winds, in order of importance, are from the southwest, west, and northwest.

The average monthly temperature and precipitation is shown in the following graphs for Tuscola and Newton during the 30-year period, 1961 to 1990. Tuscola is in the northern end of the river basin and Newton is in the southern end.

Figure 2.

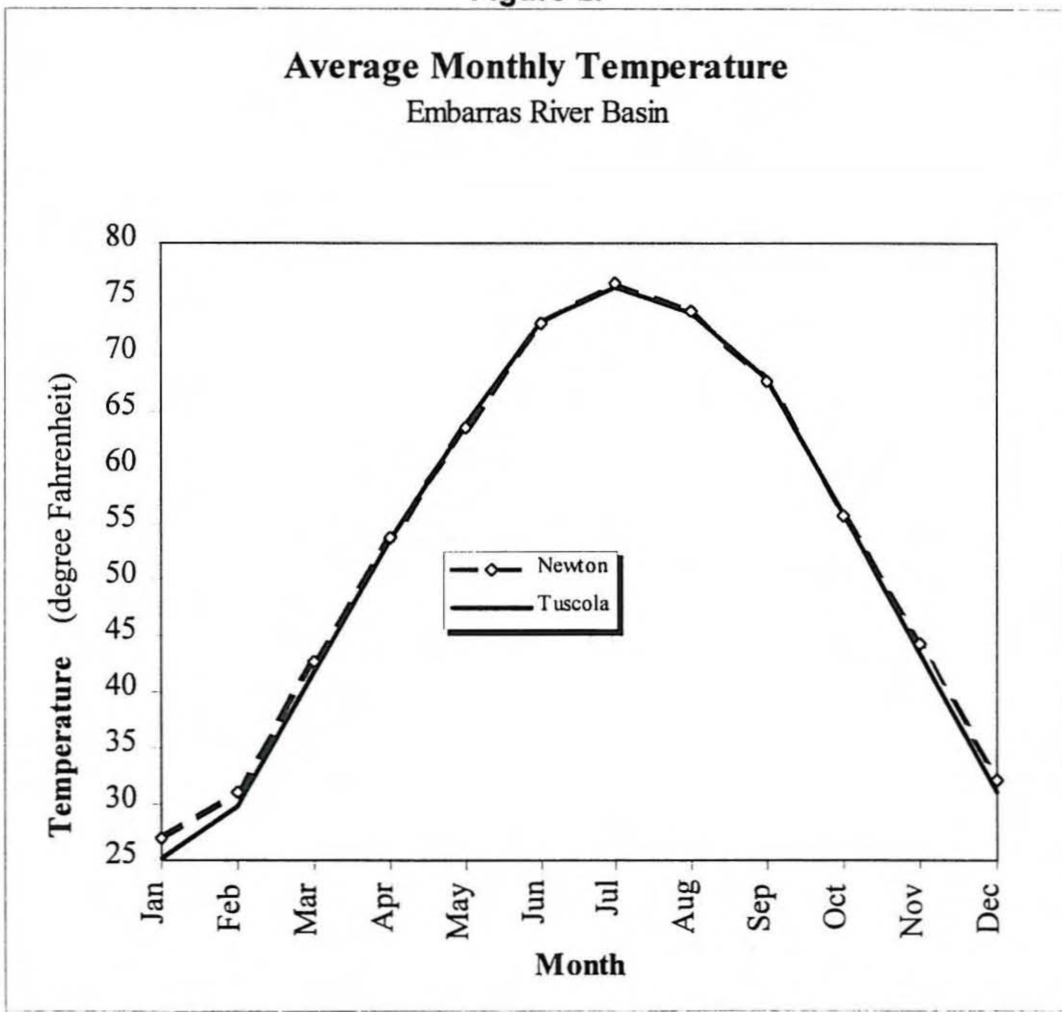
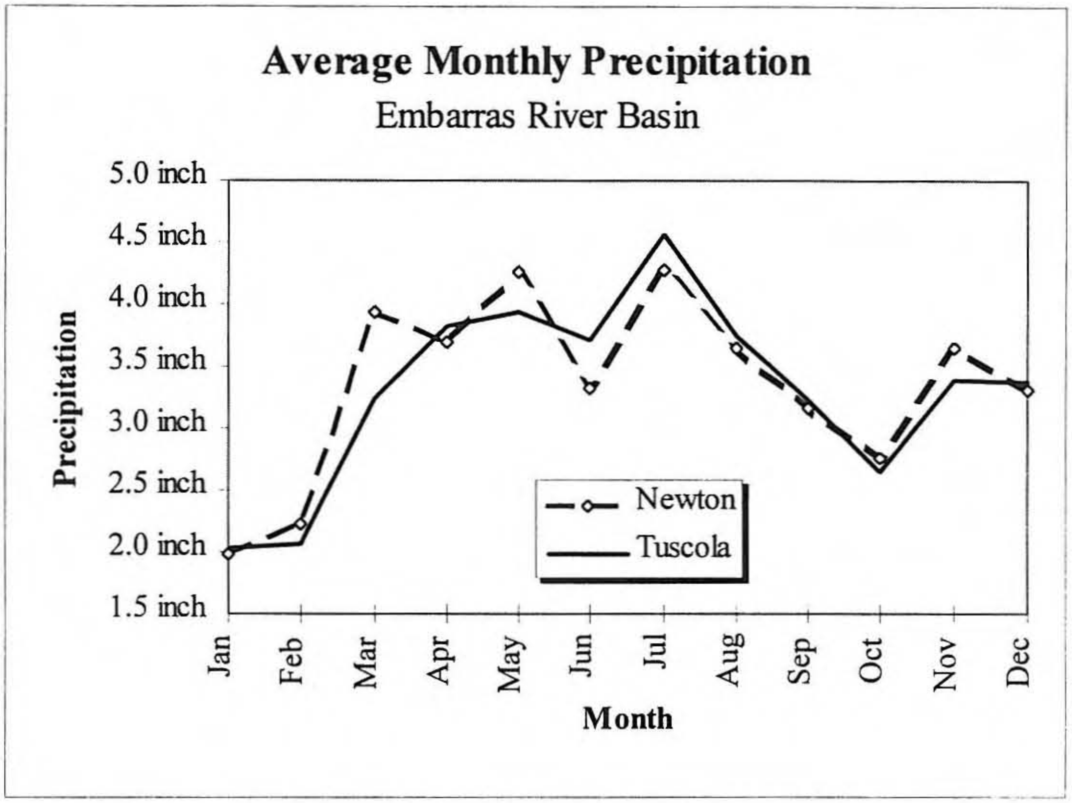


Figure 3.



During summertime, when gulf air masses control the precipitation pattern, there is wide variation in rainfall over the basin. Heavy thunderstorm rainfall may occur over a principal tributary causing main stem flooding in an area which may have experienced no rainfall. The combination of highly variable summer precipitation with poor moisture retention characteristics of the soil often produce very droughty areas when the actual rainfall is near the average value.

Hydrology

The Embarras River Basin is approximately 110 miles long (the Embarras *River* is 194 miles long due to meandering within the basin), but only about 25 miles wide. In addition, the main channel is relatively flat when compared to the steep tributary slopes. Thunderstorm precipitation, which may be very intense, but limited to a rather small area of the river basin, may be locally severe. However, flooding may not result on major portions of the main stem of the Embarras River because the basin is so long and narrow.

In general, it has been found that very heavy storms tend to have nearly west-to-east orientations. (*Illinois State Water Survey Bulletin 70*). This is fortunate, because the Embarras River Basin is oriented west-northwest to south-southeast. It is apparent that main stem flooding at Ste. Marie, where the drainage area is 1,516 square miles, is not principally associated with thunderstorm precipitation. The same conclusion may be stated for the points further downstream than Ste. Marie because of the increasing size of the drainage area. (Embarras River Basin Study Flood Control Report, Illinois Department of Transportation - Division of Water Resources, September 1976)

Stream flow characteristics for the Embarras River and the North Fork tributary at three different United States Geological Survey (USGS) gauging stations are shown in the following table:

Table 1. Stream Flow Characteristics				
Gauge	Drainage Area (square miles)	Average Daily Flow (cfs)	Maximum Daily Flow (cfs)	Period (years)
Camargo	186	168	6,150	1961-1994
Ste. Marie	1,516	1,253	38,200	1910-1994
Oblong (*North Fork*)	318	269	20,300	1941-1994

The following graph shows the estimated peak discharge of the Embarras River by frequency at three different USGS gauging stations. The Diona gauge has been discontinued and was not listed in the previous table. For purposes of clarity, the gauging station on the North Fork tributary (Oblong) is not shown. The 2-year, 10-year, and 100-year discharge estimates are the bottom, middle, and top lines in the graph.

The estimates shown above do not include the portion of the Embarras River below the mouth of the North Fork tributary. To show these estimates, the 1976 *Embarras River Basin Flood Control Report* (Illinois Department of Transportation - Division of Water Resources) listed estimates for drainage areas from 900 square miles to 2,440 square miles (mouth of the Embarras River). The 5-year, 10-year, 15-year, and 100-year estimates are shown in the following graph.

Figure 4.

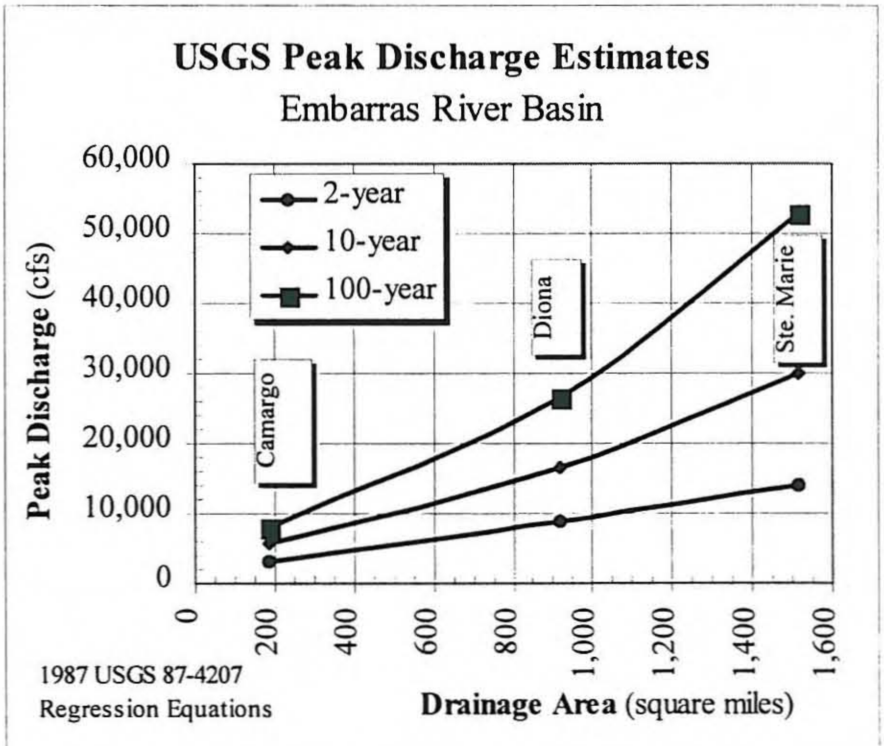
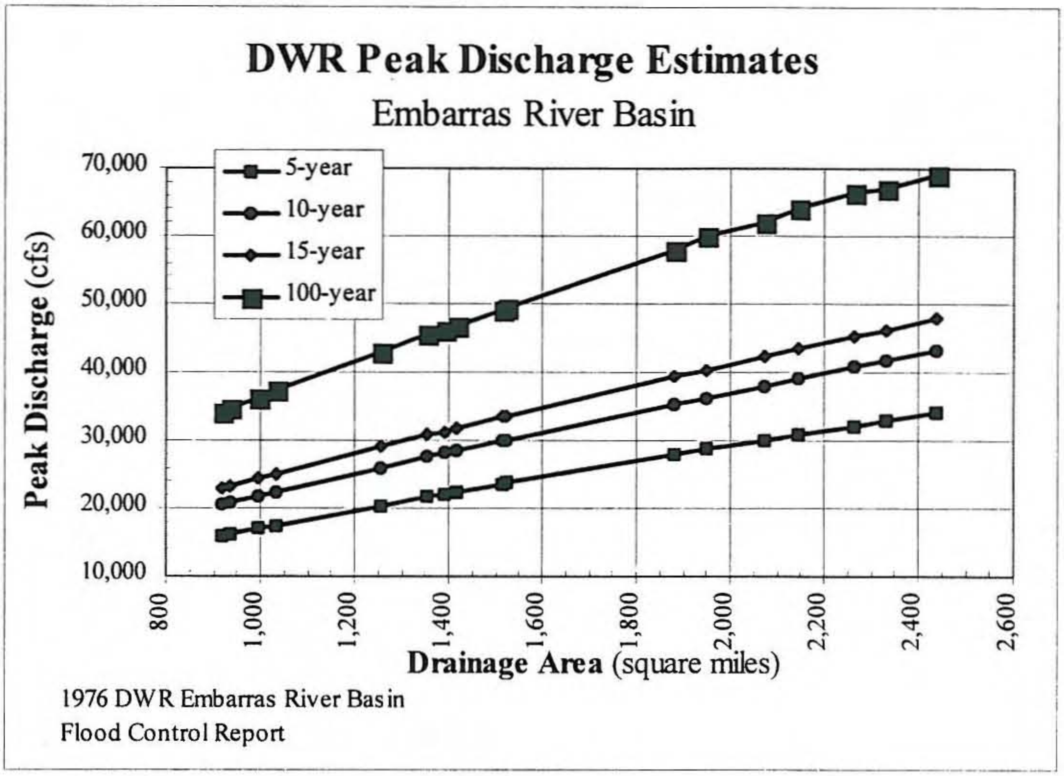


Figure 5.



Transportation Network

The Embarras River Basin has a well developed transportation system composed of federal interstate highways, state highways, main county roadways and farm to market roads. This road system blankets the river basin from its origin in Champaign County to the confluence in Lawrence County. There is also a network of passenger (AMTRAK) and freight railroads serving the area.

Major highways running north and south are: I-57 crosses the north and western part of the basin from Champaign to Mattoon; IL-130 crosses the central part of the river basin from Philo in Champaign County to near Dundas in Richland County; IL-49 crosses the eastern side of the basin from Highway 36 in Edgar County to Highway 33 in Jasper County; IL-1 crosses the basin in Lawrence County.

Major highways running east and west are: I-70 angles northeast across the central part of the basin from Montrose in Effingham County to Martinsville in Clark County; IL-36 crosses the northern part of the basin from Atwood in Douglas County to Hume, in Edgar County; IL-133 crosses the northern part of the basin from Arthur in Douglas County to Redmon in Edgar County; IL-16 crosses the north central part of the basin from Mattoon to Charleston in Coles County, to Kansas in Edgar County; IL-33 crosses the south central part of the basin from Wheeler in Jasper County to Oblong in Crawford County; IL-50 crosses the southern part of the basin from Sumner to Lawrenceville in Lawrence County.

Agriculture

Agriculture plays a role for the residents of the Embarras Basin. The major crops grown in the basin are corn and soybeans. Based on the 1992 Census of Agriculture, the market value of agriculture products sold in the counties in the basin are $717,357,000, with an average of $98,654 per farm as shown in the following table. Statistics are not available for portions of each county in the basin, so county-wide statistics are used.

Table 2. Number of Farms/Value of Agricultural Production

County	Number of Farms	Value of Ag. Produce	Average Value/Farm
Champaign	1,452	$160,064,000	$110,237
Clark	685	57,686,000	84,213
Coles	700	65,038,000	92,911
Crawford	543	52,961,000	97,535
Cumberland	645	50,833,000	78,810
Douglas	682	79,241,000	116,189
Edgar	823	92,146,000	111,963
Jasper	772	69,735,000	90,330
Lawrence	365	44,043,000	120,667
Richland	545	45,610,000	83,687
Totals/Average	**7,212**	**$717,357,000**	**$98,654**

Crops constitute 80% of the value of agricultural products sold while the sales from livestock is 20%.

Based upon Illinois Agricultural Statistics, crop yields in the study are some of the best in the state and illustrated as follows with 1994 yield averages for corn and soybeans. Again, statistics are not available for portions of each county in the basin, so county-wide statistics are used.

Table 3. 1994 Average Crop Yields

County	Corn	Soybeans
Champaign	161	51.0
Clark	146	43.0
Coles	166	47.0
Crawford	122	37.5
Cumberland	156	44.0
Douglas	161	51.5
Edgar	158	49.5
Jasper	140	41.5
Lawrence	120	40.5
Richland	121	40.0
State of Illinois	156	46.0

The following illustrates the unemployment rate trends for the basin as compared to the state and the U.S. Edgar and Lawrence counties are designated labor surplus areas due to their unemployment rates as determined by the Secretary of Labor. Note that statistics are not available for portions of each county in the basin, so county-wide statistics are used.

Table 4. Unemployment Rates (%) By County

County	1990	1991	1992	1993	1994	1995
Champaign	6.1%	4.5%	4.8%	5.4%	3.9%	3.4%
Coles	6.2%	6.5%	6.9%	6.2%	4.4%	4.3%
Clark	8.4%	8.4%	8.1%	7.0%	5.3%	4.6%
Crawford	9.2%	10.5%	8.7%	7.6%	8.2%	7.5%
Cumberland	10.0%	10.2%	9.5%	7.8%	5.9%	5.8%
Douglas	5.2%	6.5%	7.8%	7.2%	5.4%	4.5%
Edgar	8.6%	8.7%	9.4%	9.0%	6.5%	5.0%
Jasper	7.1%	8.8%	8.6%	8.2%	6.9%	6.2%
Lawrence	9.5%	10.4%	10.4%	9.1%	8.5%	8.5%
Richland	8.7%	8.0%	7.1%	6.0%	5.9%	4.7%
State of IL	6.2%	7.1%	7.5%	7.4%	5.7%	5.2%
U.S.	5.5%	6.7%	7.4%	6.8%	6.1%	5.6%

Population

The Embarras River Basin is considered a rural area and sparsely populated. Based upon the 1990 Census, the area experienced a decline since 1980. The following table shows the median age, population, and population density for the ten county area. The county-wide values for median age and population density are representative of the river basin. The population values are not county-wide, but only include census blocks in the basin.

Table 5. Median Age, Population, and Density

County	County-wide Median Age	1990 Population Within Embarras River Basin	County-wide Density People per sq. mi.
Champaign	27.8	14,544	173.5
Clark	37.0	7,158	31.7
Coles	29.8	41,071	101.6
Crawford	37.1	7,147	43.9
Cumberland	33.9	8,367	30.8
Douglas	34.5	14,389	46.7
Edgar	37.3	2,921	31.4
Jasper	34.4	9,303	21.5
Lawrence	38.0	13,789	42.9
Richland	35.6	1,243	45.9
Total		119,932	49.2

The following table shows the 1990 population diversity in the Embarras River Basin ten county study area. These values are not county-wide, but only include census blocks in the basin.

Table 6. Population Diversity

County	White	Black	American Indian Eskimo	Asian Pacific Islands	Other
Champaign	13,570	395	15	539	25
Clark	7,117	2	12	21	6
Coles	39,769	814	78	321	89
Crawford	7,113	10	11	8	5
Cumberland	8,341	3	5	14	4
Douglas	14,220	12	18	32	107
Edgar	2,909	1	8	1	2
Jasper	9,274	1	11	14	3
Lawrence	13,586	143	29	21	10
Richland	1,241	1	0	1	0
Total	117,140	1,382	187	972	251
Percent	97.7%	1.2%	0.2%	0.8%	0.2%

Note: Percent totals do not add to 100% due to rounding.

PROBLEMS AND OPPORTUNITIES

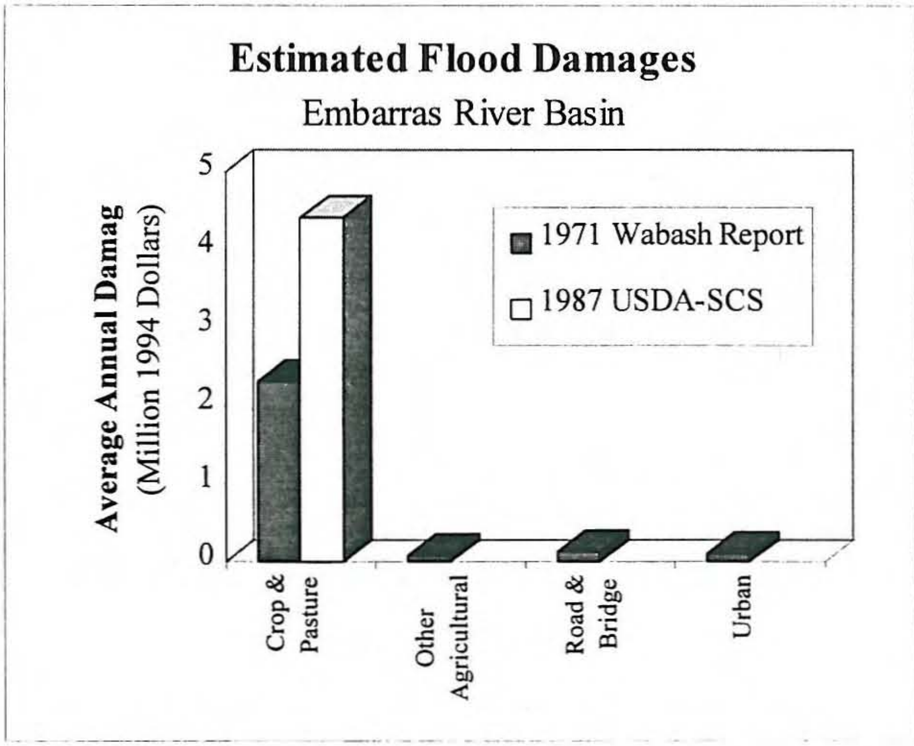
Priority Resource Concerns

Flooding

Two published sources estimate flood damages in the Embarras River Basin. The 1971 Wabash River Basin Comprehensive Study *(Wabash River Coordinating Committee; Volume IX - Appendix H Agriculture; June 1971)* reported the average annual flood damages in the basin for several categories including: crop and pasture, other agricultural damages, road and bridge, and urban. The cost basis for this report is 1966 dollars. It is clear that the primary flood damage is agricultural crops, not transportation or urban damages.

The State of Illinois Hydrologic Units report *(USDA - Soil Conservation Service, July 1987)* provides a single estimate for agricultural damages for the Embarras River Basin. The cost basis for this report is 1983 dollars. These estimates, updated to 1994 dollars, are shown in the graph below.

Figure 6.



The 1976 Illinois Department of Transportation Division of Water Resources report established the 15-year flood profile, but this area was not mapped. The 1987 State of Illinois Hydrologic Unit report estimates the area in the basin subject to flood damage is 149,900 acres.

Log Jams/Obstructions

Log jams and sediment bars cause problems in the river that forces it to change the normal channel flow. Small log jams form restrictions in the channel widen the channel through bank erosion. Larger log jams divert flow onto adjacent land, change the direction of the normal channel flow and are potential safety hazards to private and public resources. Sedimentation is the result of normal stream channel dynamics and "bed load" conditions. As the river meanders, sediment bars are deposited on the inside of meander curves where the velocity of water flow is lower. In March 1995, a helicopter was used to video tape the Embarras River and its major tributaries to inventory the extent of the log jam and obstruction situation (See Map 5). Nine major log jams were recorded that appear to be causing extensive flow alterations. These jams need to be evaluated.

A resource management team of professional scientists and public people needs to be established to evaluate log jam and obstruction situations. This team could determine criteria and evaluate the extent of damages caused by individual log jams and obstructions and determine appropriate action.

Water Quality

From April through October 1987, the Illinois Environmental Protection Agency (IEPA) conducted an intensive survey of the Embarras River, a seventh order tributary to the Wabash River, and several of its major tributaries to evaluate the aquatic resources of the basin. The following information is taken from the *1987 IEPA Intensive Survey of the Embarras River Basin.*

The Embarras River, in particular the section between the towns of Greenup and Newton has been characterized as one of the finest aquatic natural areas remaining in Illinois. Water chemistry, fish, macroinventebrate and habitat data were collected at 25 stations to assess the basin's biotic potential. An additional 31 stations were also sampled on smaller tributaries throughout the basin for all data except fish. From the data collected, environmental quality was summarized utilizing various indices including water quality index (WQI), macroinvertebrate biotic index (MBI), fish index of biotic integrity (IBI), and habitat potential index of biotic integrity (PIBI).

Water quality within the basin was in excellent to very good condition with only minor water quality problems. The mean of water quality index for the Embarras River was 31.4 and the tributaries were only slightly higher at 35.2. Total suspended solids and phosphorus were the primary causes of elevated WQI values. An impact from point source discharges was evident at only five stations. These stations had WQI's that indicated at least moderate water quality problems from ammonia, phosphorus and/or specific conductance. Violations or potential violations of the state's general use water quality standards occurred from iron (25 sites), phosphorus (14 sites), manganese (910 sites), dissolved oxygen (8 sites), total dissolved solids (3 sites), pH (1 site), and unionized ammonia (1 site).

A total of 79 macroinvertebrate taxa were collected from 15 Embarras River stations while 102 taxa were collected from the 41 tributary sites. Species richness was good with an average of 28 per station on the Embarras and only slightly fewer on the tributaries with 22. Only five sites had 10 or fewer macroinvertebrate taxa and all were associated with either a municipal wastewater treatment plant or with oil field brine problems. MBI values on the main stem ranged from a high of only 6.4 to a low of 4.3 with an average of 5.0 reflecting very good stream quality. For the tributaries, the MBI ranged from a high of 8.2 to a low of 4.4 with a mean of 5.6 indicating very good stream quality.

During 1986-87, the Illinois Natural History Survey conducted a study of the mussel populations in the Embarras River. This study which incorporated 25 main stem sites found that an 86% reduction in the total mussel population had occurred since 1956. Unfortunately, no cause for this decline was given. A further finding of the study was that of the 39 mussel species reported for the Embarras River, nine have been proposed for the state endangered species list and one (Cyprogenia stegaria) is also a candidate for federal endangered status.

Main stream width for the Embarras River was 67 feet although it varied from 122 feet near Newton to only 19 feet wide near Philo. Average water depth in the stream was 0.85 feet. Sand was the predominant substrate with 41% of the total followed by gravel (21%) and silt/mud (10%). The average predicted IBI for the main stem Embarras was 46.2 indicating a highly valued aquatic resource.

Individual station values ranged from 49.8 to 39.5. Tributary streams, which were all at least third order, varied greatly in size from 53 feet wide and 1.2 feet deep to only 9 feet wide and 0.2 feet deep. Tributary instream substrate was composed primarily of sand (25%), gravel (23%), silt/mud (20%) and plant detritus (15%). A total of 25 tributaries were rated as highly valued aquatic resources while the remaining 16 were rated as moderately valued aquatic resources.

A total of 62 fish species from 12 families were collected at 25 stations on the Embarras River and its tributaries in October 1987. IBI values on the main stem Embarras ranged from 28 to 50 with a mean of 38 placing the Embarras River in the moderately valued aquatic resource category overall. Only three stations were rated as highly valued and all three were located in the middle section below Lake Charleston and above St. Marie. The further downstream station at Billett was rated as a limited aquatic resource. With only three major dischargers in the basin and no known industrial or nonpoint runoff problems, the average IBI for the Embarras appears to be lower than expected especially since several respected authors have rated the Embarras, and in particular the middle section, one of the outstanding streams in Illinois. Several factors probably depressed the observed IBI's. Excessive stream width, particularly below Lake Charleston, was probably the main cause since it permitted fish to escape around the sampling area. Reduced visibility from disturbed silt may also have contributed to the lower IBI's. IBI values for the tributaries ranged from 32 to 50 with a mean of 41. Four of the ten sites were rated as moderate aquatic resources while the remaining six were highly valued aquatic resources.

According to a list of threatened and endangered species published by the Illinois Species Protection Board, there are three endangered fish species in the Embarras River including the bigeye chub, the harlequin darter, and the eastern sand darter. In addition, the bigeye shiner is on the state threatened list.

Of the 817.0 stream miles in the Embarras River System, 420.7 miles were rated as meeting full aquatic life support. With the exception of one Embarras River segment near Charleston, all fully supported river miles were tributaries. Approximately 354.0 miles were classified as achieving partial use support with minor impairment including 160.6 miles of the main stem Embarras along with a number of smaller tributaries. There were only three tributaries comprising 39.6 stream miles which provided partial use support with moderate impairment. Finally, Dogwood Creek was the only stream classified as non-supportive of aquatic life. Approximately 5.0 miles were impacted by the discharge from the Oblong municipal wastewater treatment facility.

See Map 6 and its legend indicating degree of overall use support for Wabash River Basin, which includes the Embarras River Basin. This map was taken from Volume I of the *1992-1993 IEPA Illinois Water Quality Report*. This report describes water quality conditions by the degree of designated use attained by the stream reach. For example:

Full Support - The water quality meets the needs of all designated uses protected by applicable water quality standards.

Full Threatened - Water Quality is presently adequate to maintain designated uses, but if a declining trend continues, only partial support may be attained in the future.

Partial Support/Minor Impairment - Water quality has been impaired, but only to a minor degree. There may be minor exceeds in applicable water quality standards or criteria for assessing the designated use attainment.

Partial Support/Moderate Impairment - Water quality conditions are impaired to a greater degree inhibiting the waterbody from meeting all needs for that designated use.

Nonsupport - Water quality is severely impaired and not capable of supporting the designated use to any degree.

A water quality report by Akambi and Demissie, Office of Sediment and Wetland Studies, Illinois State Water Survey, June 1994, indicated trends in suspended sediments and sedimentation in Illinois streams. According to this report, the distribution of sediment yield rates for the Embarras River Basin is moderate to low. The highest sediment yield rate occurs in Region 4, and lowest sediment yield rate occurs in Region 1. Embarras River Basin yield rate occurs in Region 2. See Map 7, indicating distribution of sediment yield rates in tributary drainage basins.

In the Upper Embarras River Basin, nitrates have been found to be high for normal stream flows. Nitrate is a matter of concern as a water contaminant because of its effects on health and because it stimulates algal growth. Nutrients and pesticides move to the river in runoff water or attached to sediment. The cropland, particularly cropland planted to corn, contributes most of the nutrients and pesticides that reduce water quality.

Although there is no state water quality standard for total suspended solids (TSS), a criterion of 25 mg/l is used in calculating the water quality index. It was an important parameter in the Embarras River Basin since elevated WQI values during the intensive survey were primarily caused by elevated TSS. Concentrations ranged from 338 mg/l on Cottonwood Creek near Jewett to only 3 mg/l on Polecat Creek near Ashmore. Mean concentration of TSS in the Embarras River was 53 mg/l and 51 mg/l was the mean for all tributary sites.

Total suspended solids are normally associated with sediment particles in the water column. These sediment particles can originate as non-point runoff from agricultural areas such as row crops and livestock feedlots. Other major nonpoint sources of sediment are streambank erosion, urban stormwater runoff and the activity of bottom feeding fish such as carp. During this study unicellular algae were also a major source of TSS, particularly during the summer when stream flow was reduced due to lack of rainfall and there was no runoff.

Erosion

Soil erosion is a problem in almost all Illinois watersheds. Sheet and rill erosion was evaluated on the entire Embarras basin. Estimated rates of erosion were established using the NRCS NRI data for 1992 and represent the midpoint of all six classes listed (See the following figures for cropland and pastureland). Totals for all erosion sources are listed in Table 7-Estimated Annual Erosion and Sedimentation in the Sedimentation section. Total gross erosion is estimated to be 6,725,980 tons, of which approximately 77 percent is from sheet and rill erosion.

Figure 7.

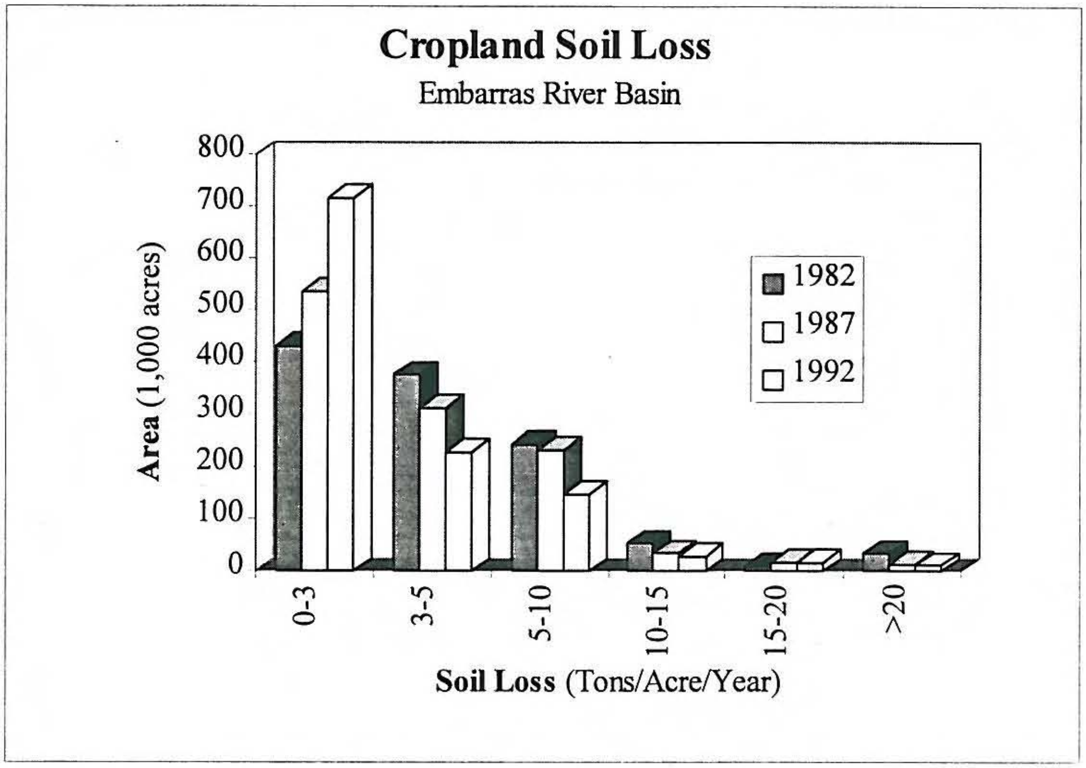
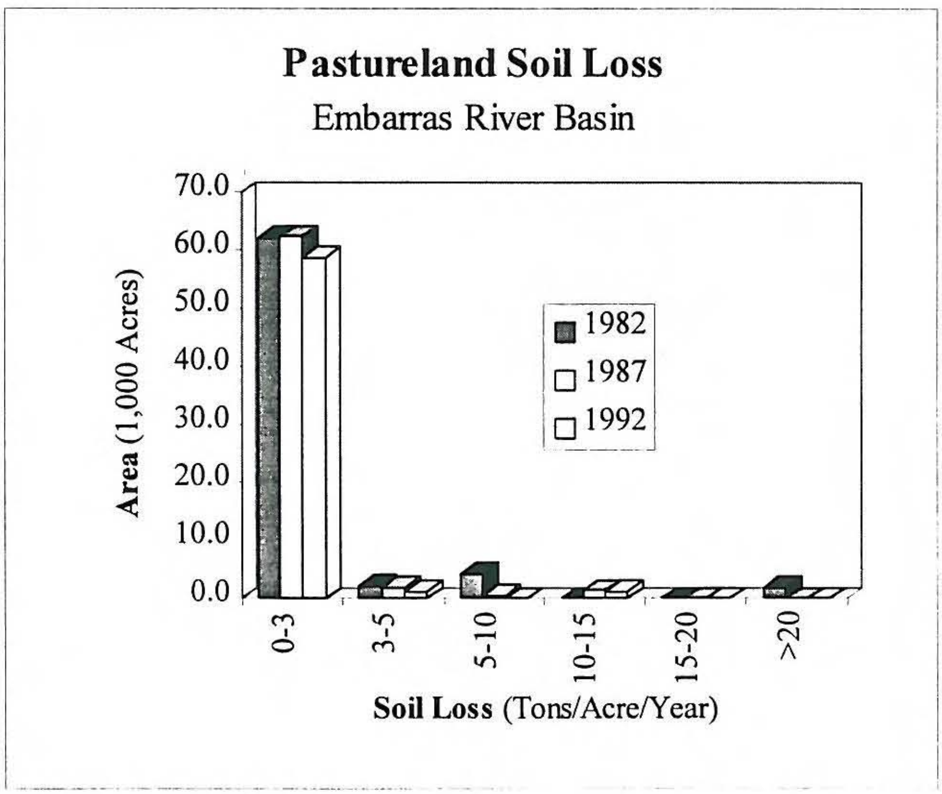


Figure 8.



Drainage

Some drainage concerns exist in the basin. Drainage has been and will continue to be a major requirement for agricultural production in the basin. Surface and subsurface drains have been installed in the basin by individual landowners since 1850 and by mutual or organized groups of landowners beginning in 1895. Maintenance and replacement of the drainage improvements are continuing at the present time and will be important economic and environmental action items in the future.

Drainage guidelines and general maintenance considerations for drainage systems are discussed in the Illinois Drainage Guide.

Appropriate wetland agencies should be contacted to ensure that the activities fully comply with the wetland regulations in effect.

Beaver, Deer, & Turkey Related Problems

The planning committee identified beaver, deer, and turkey as three wildlife species causing some problems with landowners in the watershed. Flooding of crops caused by beaver dams on tributaries and erosion of streambanks have been cited by some landowners. Wildlife have caused some crop damage, been an enticement to trespass hunters, and caused some vehicle accidents. These can be viewed as incidental situations, which can/should be handled by individual landowners in consultation with the Illinois Department of Natural Resources.

Practices in the plan that may lessen the effects of these damages are: buffer zones, restoring wetlands, and timber stand improvement (if good mast producers are favored). In addition, properly structured hunting and trapping programs may be of benefit. Contact the Illinois Department of Natural Resources for advice on how best to treat depredation cases

Lack of Accountability/Communication

Communication and coordination needs to be aggressively pursued to strengthen and maintain the cooperative relationship among the planning groups involved with this project (ERMA, Upper Embarras, and North Fork). In addition, communication among state and federal agencies that can provide financial and technical assistance needs to be facilitated so planning and implementation efforts will not be duplicated.

Loss of Natural Character

A significant segment of the Embarras River is on the State Natural Areas Inventory, and also qualifies for National Scenic River designation. This Scenic River area extends from Lake Charleston to the Old Mill at Newton. This Scenic River area has been listed because of the natural character, scenic beauty and wildlife habitat. It is frequently used for canoeing, fishing, hunting and other recreational activities. The natural character has intrinsic, biological, and physical importance for threatened and endangered species.

The recreational value of this area contributes significantly to the economic resources of the area. An IDNR fishery biologist has estimated that sport fishing on the Embarras River is $8,000,000 annually. Hunting, picnicking, bird watching and other recreation are tied to the natural character of the area.

The land in the Embarras River Basin is predominantly privately owned. Areas of state-owned land in the river basin are:

Walnut Point State Park	Chauncey Marsh INAI
Fox Ridge State Park	The Slough INAI
Sam Parr State Park	Robeson Hills Nature Preserve
Red Hills State Park	Robeson Hills INAI
Chauncey Marsh Nature Preserve	

Illinois Natural Area Inventory sites are listed in Appendix B. These sites may be state owned or privately owned.

As economic pressures increase, and as land units change ownership, the potential for land use changes from natural areas to cropland production will increase. Each year there is more pressure to change the natural character of this area.

Increased amounts of water flow, volume, and frequency is another threat to the natural character of the Embarras River. Damages to the river channel and natural flood plain area reduce its scenic beauty.

Private Property Rights

Landowners throughout the Embarras River basin have apprehension about any plan that affects freedom to use their land as well as any potential liability. The planning committee chose not to give this issue to a technical advisory committee for study.

Landowners may view any resource problem solution that restricts the land use as an infringement on private property rights. In the same manner, solutions to resource problems involving actual or perceived public access to private property raise unresolved questions about landowner liability in cases of accidental injury.

The resource treatments suggested in this plan are intended to be implemented on a voluntary basis either through landowner's private initiative or with the assistance of public cost-share assistance with funding. Suggested practices to resolve resource will meet the standards and specifications of the supervising agency and will not create public safety hazards.

This resource plan does not attempt to resolve issues of freedom or liability. However, the Embarras River Management Association is an organization that can set up an advisory team and make recommendations about private property rights and liabilities to landowners and public lawmakers.

Sedimentation

Sedimentation is an on-going natural process that occurs in all watersheds. Sediment deposition occurs throughout the basin in low spots and depressions, along field borders, on flood plains, in stream channels, and wherever slight variations in the velocity of silt-laden water takes place. Sediment deposited in one rainfall may be picked up and moved in another rainfall event. This process may be repeated many times.

A Sediment Delivery Rate (SDR) was applied to each type of erosion to calculate that portion that was "available for transport". Only a portion of the sediment produced by soil erosion actually reaches a stream or transport system. Much of the sediment produced by sheet and rill erosion is deposited before entering a stream. Conversely, literally all of the sediment produced by streambank erosion enters a watercourse directly.

A Sediment Transport Efficiency Factor accounts for the variation in the ability of streams and their tributaries to transport sediment. Generally, as watersheds become larger, the streams become more meandering, and the stream gradient flattens, the ability to transport sediment is significantly reduced. In the Embarras River Basin, approximately 5,180,000 tons of sediment enters the stream system on an annual basis. Of this total, about 1,295,000 tons is expected to move through the system.

Table 7. Estimated Annual Erosion and Sedimentation

Type	Erosion (tons)	Sediment Delivery Rate	Sedimentation (tons)
Sheet & Rill	5,172,800.[1]	0.75	3,879,600
Ephemeral	775,920.[2]	0.85	659,500
Gully	683,760.[3]	0.80	547,000
Streambank	93,500.[4]	1.00	93,000
Total	6,725,980		5,180,000

[1] National Resources Inventory Data-1992, average values within groups

[2] 15% of sheet and rill erosion totals

[3] Based on an estimated 7,400 miles of gullies in the entire watershed, using average rate of erosion from 5 similar watersheds.

[4] Based on 657 miles of direct tributaries to the Embarras River and 576 miles of secondary tributaries.

Bends in the Channel

As the Embarras River flows through the basin, it tends to meander, creating numerous bends. In the lower half the grade flattens out, and the meandering of the river increases which is typical of a river this size. The bends move back and forth over time across the floodplain. Landowners and operators farming along the river reported losses of up to 10 rows of crop (25 feet) as the river bend advances. Eventually the river jumps across the neck of the bend leaving isolated sloughs or oxbows. Activities of people and their structures in the floodplain come into conflict with the river as it moves. It is estimated that 57 miles of streambanks along the Embarras are actively eroding enough to need treatment.

The 1976 IDOT Study of the Embarras River Basin detailed some of the more restrictive bends.

Wetlands

The National Wetland Inventory completed by the U.S. Fish & Wildlife Service lists 100 different kinds of wetlands found along the Embarras River. These are broadly classified as:

Riverine (includes the river and its tributaries)
Palustrine (lowland areas that hold water)
Lacustrine (lakes, reservoirs, and impounded rivers)

They are further broken down by the type of bottom structure, dominant vegetation, frequency of flooding, and time period flooded. By far the most area was Palustrine with 120,194 acres. The single most common type of Palustrine wetlands is woodland that is temporarily flooded with 72,000 acres. Lacustrine was next with 3,881 acres, and Riverine had 3,524 acres. This totals almost 127,600 acres or 7.7% of the total land in the watershed (1,566,450 acres). The variety of wetlands in the Embarras River contributes to the variety of aquatic species found in the Embarras River Basin.

Practices from the plan will protect wetlands from further siltation, which will prolong their existence. Restoring wetlands will slow stormwater runoff, filter excess nutrients from the runoff, recharge groundwater supplies, decrease flooding and increase habitat for threatened and endangered species. Over 40% of Illinois' threatened and endangered species depend on wetlands. Of these species, the ones found in and around the Embarras River Basin are listed in the following table.

Table 8. Illinois Threatened and Endangered Species - Wetland Dependent

Birds	Mussels	Plants
Henslow's Sparrow	Spike	Running Pine Moss
Least Bittern	Elephant-ear	Water-pennywort
Pied-billed Grebe	White Warty-back Pearly	Drooping Sedge
King Rail	Kidneyshell	Broomrape
Short-eared Owl	Little Spectacle Case	Large-seeded Mercury
Bald Eagle	Rainbow	Halbred-leafed Tearthumb
Northern Harrier	Snuffbox	
Red-Shouldered Hawk	Purple Lilliput	
Common Moorhen	Rabbitsfoot	
	Ebonyshell	
	Sheepnose	
Fishes	**Butterflies**	**Reptiles**
Eastern Sand Darter	Swamp Metalmark	Kirtland's Snake
Harlequin Darter		
Bigeye Chub		
Bigeye Shiner	**Amphibians**	**Mammals**
	Four-toed Salamander	Indiana Bat
		River Otter

Wildlife Habitat

Most terrestrial plant communities display gross modification as a result of human disturbance including logging, grazing, cultivation, and residential development. The main existing plant communities and dominant species are as follows: cropland (corn, soybeans, wheat); roadsides (bluegrass, brome, fescue); permanent pasture (bluegrass, brome, fescue); forest (Upland-white oak, red oak, shagbark hickory and bottomland-cottonwood, silvermaple, sycamore, black walnut, bur oak); and farmsteads and urban areas (bluegrass, ornamental shrubs, conifers, and deciduous shade trees).

The wildlife resources of the watershed consist of species associated with previously described plant communities. Open water environments and wetlands provide habitat for many species of migrant and resident waterfowl, wading birds, shorebirds, and raptors. Representative species include great blue heron, green back heron, common snipe, spotted sandpiper, solitary sandpiper, wood duck, mallard , and greater yellowlegs. Mammals utilizing these areas include raccoon, mink, muskrat, and beaver.

Bottomland forest remnants along the streams in the area are the preferred habitat of mammals such as the raccoon, beaver and opossum. Avian species utilizing the bottomland forest include the great blue heron, wood duck, red-shouldered hawk, barred owl, brown creeper, prothonotory warbler and the American redstart.

Upland forests are typically occupied by mammals such as masked shrew, keen's bat, gray fox, fox squirrel, deer mouse, and white tailed deer. Birds representative of upland forest are the red tailed hawk, great horned owl, red-headed woodpecker, tufted titmouse, and yellow-breasted chat.

Grasslands, including prairie remnants, roadsides, hay fields, and pastures are relatively uncommon. Because of their general scarcity they are quite valuable for a variety of wildlife species. These include such birds as the savannah sparrow, grasshopper sparrow, dickcissel, meadowlark, kestrel, and even the state endangered upland sandpiper and prairie chicken. Mammals of the grasslands are the thirteen-lined ground squirrel, Franklin's ground squirrel, prairie vole, meadow mouse, deer mouse, red fox, and coyote.

Transitional plant communities consisting of interspersed cropland, waterways, permanent pastures, ditch banks, roadsides, and brush fencecrows are the primary habitat of the least shrew, meadow jumping mouse, striped skunk, coyote, red fox, woodchuck, and cottontail rabbit. Typical birds of these edge communities are the indigo bunting, woodcock, mourning dove, brown thrasher, song sparrow, cowbird, field sparrow, and the bobwhite quail.

Controlling erosion and enhancing wetlands in the river basin will improve wildlife habitat. The plan practices will improve habitat by widening available nesting and brood rearing areas for birds, increasing food supply, improving water quality, and increasing escape cover for all species. The practices having the most effect on these needs are buffer strips, no-till, tree planting, timber stand improvement, restoring wetlands and addressing point source pollutants.

Pheasants nest in wetlands, as do other species. It has been stated that over 40% of Illinois' threatened and endangered species depend on wetlands (USFWS-Illinois Wetlands). A study in Iowa showed 37 quail nests every 247 acres in no-till versus only 4 per 247 acres in conventionally tilled fields.

Recreation

Fishing, canoeing, hunting, sightseeing, photography, biking, bird watching and environmental studies are major recreation activities in the basin.

Current and proposed river access points exist at Walker's Ford, Fox Ridge (2), Lake Charleston, Lanman's Slough, Ryan Bridge, Newton, Greenup and Lawrenceville. In addition, there are other private access points. There are four State Parks in the basin (Walnut Point, Fox Ridge, Red Hills, and Sam Parr).

Economic Costs/Funding Solutions

Landowners are concerned about the cost of implementing solutions to resource problems such as flooding, soil erosion and water quality. Without financial assistance, many treatment practices are not economical for the individual landowner to implement. Offsite benefits should be considered for overall economic justification.

Alternatives such as property tax credit, income tax credit and other "green ticket" proposals such as the Illinois Vegetative Filter Strip Bill that amends the property tax code, have been suggested. These alternatives are being researched by the planning committee.

Water Usage and Supply

The Embarras River is a source of water supply. Protecting the quality and quantity are important to the communities along the Embarras. Charleston draws one half of its water from the river through a side channel reservoir. Other towns and villages draw water from shallow and deep wells in the river bottom flood plain.

The latest Mattoon water supply study indicates that the water supply is sufficient. Projections for Charleston up to the year 2030 show that the current supply is adequate with low to moderate growth. However, if large growth occurs and a 50-year drought occurs, Charleston may need more water. In addition to the cities of Mattoon and Charleston, E-J Water (a rural water system) draws its water from along the Embarras River.

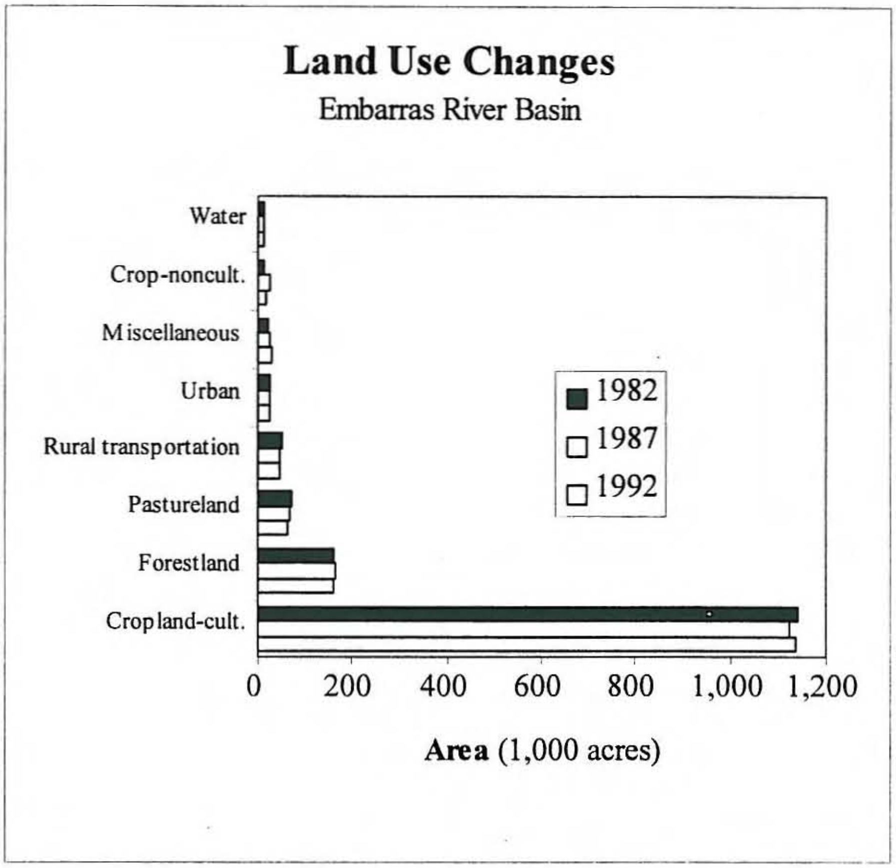
The quality of the surface water supply, although considered good, can easily be threatened by contamination from accidental chemical spills.

These issues need to be studied further and addressed by an interdisciplinary team of professionals and local citizens. This team can guide local officials to activities that protect the area's water resources.

Land Use Change

Land use has remained virtually unchanged from 1982 to 1992 as shown in the following graph.

Figure 9.



Small Bridge Outlets

The planning committee concerns included small bridge outlets. The 1976 Embarras River Basin Flood Control Study noted that 29 bridges over the Embarras River were included in the hydraulic model from the mouth of the Embarras upstream to the Coles-Cumberland county line. The March 1995 helicopter video included the Embarras and several tributaries. Approximately 59 bridges crossing the Embarras River have been seen on the video. The video includes the Embarras River from Villa Grove downstream to the Wabash River.

The table below shows the bridges noted on the video index for the tributaries (Vince Gutowski, 1995). This list represents approximately 25% to 50% of all the bridges on the tributary streams.

Table 9. Tributary Bridges

Stream	Number of Bridges Noted on Video Index
North Fork of the Embarras	5
Range Creek	6
Muddy Creek	5
Hurricane Creek	3
Whetstone Creek	1
Polecat Creek	2
Little Embarras River	7
Scattering Forks	4

The 1976 study also presented 21 minor channel improvements and seven major channel improvements. The minor channel improvements were primarily removal of logjams, drift accumulations, and sediment bars in the river. The major channel improvements related to three railroad bridges, three river cutoffs, and one sand-bar. Under current environmental considerations, the channel straightening (cutoffs) are not recommended, due to the impacts on the riparian ecosystems.

Two of the three railroad bridges noted on the 1976 study are still in use. One bridge is in Lawrenceville by the refinery and the other bridge is east of Newton. The remaining railroad bridge, at Greenup, has been abandoned.

Lawrenceville recently removed concrete piers of an abandoned railroad bridge (though this is **not** the bridge mentioned in the 1976 study). Details of their experience serves as a good case history of cooperation by local, state, and federal groups. Their work consisted of three phases:

1) Removing the logjam debris around the abandoned railroad bridge piers
2) Removing the steel railroad bridge
3) Removing the concrete bridge piers

The log jam against the abandoned railroad bridge piers was causing severe bank erosion, flooding upstream cropland, and threatening to expose a municipal water line serving the communities of Lawrenceville, Bridgeport, Sumner, and Petrolia. Local county, city, state and Federal officials, and local producers met to see what could be done to remove the log jam and raze the bridge piers. Congressman Glenn Poshard's aide was involved and updated through the entire process. Land ownership of the river beneath the bridge was never fully established. The new bridge owner did not respond to requests to remove the log jam.

NRCS provided Emergency Watershed Protection funds for the log jam removal. The Lawrence County SWCD acted as the local sponsor. Planning, started early in 1994, resulted in the log jam removal in August 1994. Lawrence County provided trucks and hauled part of the debris away to county property. Lawrenceville obtained the proper Corps of Engineers (COE) permits for placement of the majority of the logs and smaller debris.

After removing the log jam debris around the piers, the bridge owner took away the bridge steel in December 1994. While the river was low in February 1995, the Lawrenceville National Guard Unit removed the bridge piers. Two of the piers were then placed in the eroded north river bank. The Lawrence SWCD coordinated and facilitated this project. IDNR provided a machine and operator for a week. In addition, a local contractor donated a track hoe with jack hammer for one week. Lawrence County provided rock for an access road and fuel for the National Guard machinery. Lawrenceville provided funds to feed the National Guard members at a local restaurant and secured a COE permit for the placement of the pier material. Local producers also made a financial contribution to reimburse local expenses.

The eroded bank is filling back in and logs no longer accumulate at this point. To celebrate the project's successful completion in early spring of 1995, the Lawrence County Chamber of Commerce sponsored an official "river opening ceremony" for the local steering committee and others involved. A log draped with a ribbon was cut to officially "re-open" the river.

The ERMA directors, in conjunction with the Cumberland County Soil and Water Conservation District board, have asked the Illinois Department of Natural Resources (IDNR) to assist with the removal of the piers of the abandoned railroad in Greenup.

Lack of Education

Lack of education about the river basin, and stream channel dynamics were suggested as the reason that citizens take actions that were detrimental to the basin in general.

More opportunities for contact with resource planners and educators need to be made available so residents can gain the knowledge they need to effectively manage the basin resources.

OTHER PROBLEMS AND OPPORTUNITIES

Technical Advisory Committee and Institutional Concerns

In addition to the eighteen concerns identified by the local ERMA planning committee, there are other concerns that must be considered to ensure that regional and national concerns are addressed during planning. These concerns are:

Animal Resources - Livestock Waste Management
Threatened and Endangered Species
Cultural Resources
Natural Areas
Fisheries
Prime Farmland
Forestry
Civil Rights

It is important that any identified solutions to the local concerns do not negatively impact any of these concerns.

Animal Resources

Livestock operations are part of the agricultural activities in the basin. Illinois Census of Agriculture values for the number of livestock farms in each county are shown below. Statistics are not available for portions of each county in the basin, so county-wide values are used.

Table 10. Livestock Census Data

(1992 Census Of Agriculture)

	Number Of Farms			
County	**Swine**	**Beef Cattle**	**Dairy Cattle**	**Sheep**
Champaign	66	304	7	25
Clark	98	401	7	17
Coles	112	286	12	20
Crawford	77	293	10	16
Cumberland	125	311	30	8
Douglas	98	203	77	24
Edgar	111	505	6	28
Jasper	183	403	26	14
Lawrence	61	184	13	6
Richland	117	294	15	4

The primary effect of livestock operations within the basin will be on water quality when the animal waste is allowed to enter the river through the runoff water. This is not caused by all operations, only the ones that are not properly handling the waste produced. It is estimated that 81 more waste management systems are needed to reduce the nitrates, phosphates and other contaminants entering the river and its tributaries. These contaminants in the stream reduce water quality, increase the growth of aquatic vegetation, and can lead to reduced dissolved oxygen rates.

Threatened and Endangered Species

Threatened and endangered species information is included for the terrestrial, fresh water, and wetland habitats found in the river basin. The federal government as well as individual states, have identified endangered and threatened species. Federal Endangered Species are those in danger of extinction throughout all or a significant portion of its range. Federally Threatened Species are those which are likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. State Endangered Species are those species which are in danger of extinction as a breeding species in Illinois. State Threatened Species include any breeding species which are likely to become a State Endangered Species within the forseeable future. The major cause of species decline is loss of habitat. Threatened and endangered species that may be found in the 10-county region of the Embarras River Basin are shown in the following table.

Table 11. Federal and State Threatened and Endangered Species List 10-County Region Embarras River Basin

SCIENTIFIC NAME	COMMON NAME	FEDERAL	STATE	HABITAT
Tomanthera auriculata	EARLEAF FOXGLOVE	C2	LT	prairie, savanna
Platanthera leucophaea	EASTERN PRAIRIE FINGED ORCHID	PHLT		prairie remnant
Ammodramus henslowii	HENSLOW'S SPARROW	C2	LE	prairie, wetland
Ixobrychus exilis	LEAST BITTERN		LE	wetland
Lanius ludovicianus	LOGGERHEAD SHRIKE	C2	LT	prairie, savanna
Asclepias meadii	MEAD'S MILKWEED	PHLT		prairie remnant
Circus cyaneus	NORTHERN HARRIER		LE	wetland, prairie, savanna
Podilymbus podiceps	PIED-BILLED GREBE		LT	wetland, aquatic
Lespedeza leptostachya	PRAIRIE BUSH-CLOVER	PHLT		prairie remnant
Buteo lineatus	RED-SHOULDERED HAWK		LE	forest, wetland
Elliptio dilatata	SPIKE		LT	aquatic
Bartramia longicauda	UPLAND SANDPIPER		LE	prairie
Gallinula chloropus	COMMON MOORHEN		LT	wetland, aquatic
Ptychobranchus fasciolaris	KIDNEYSHELL MUSSEL		LE	aquatic
Clouophis kirtlandii	KIRTLAND'S SNAKE	C2	LT	forest, wetland, aquatic, prairie
Villosa lienosa	LITTLE SPECTACLE CASE MUSSEL		LE	aquatic
Toxolasma lividus	PURPLE LILLIPUT MUSSEL	C2	LE	aquatic
Villosa iris	RAINBOW MUSSEL		LE	aquatic
Epioblasma triquetra	SNUFFBOX MUSSEL	C2	LE	aquatic
Veratrum woodii	FALSE HELLEBORE	C3	LT	forest
Lynx rufus	BOBCAT		LT	forest, savanna, primary
Orobanche ludoviciana	BROOMRAPE		LE	prairie, wetland
Etheostoma histrio	HARLEQUIN DARTER		LE	aquatic
Acalypha deamii	LARGE-SEEDED MERCURY		LT	forest, wetland
Calephelis matica	SWAMP METALMARK		LE	forest, wetland
Etheostoma pellucidum	EASTERN SAND DARTER	C2	LE	aquatic
Elliptio crassidens	ELEPHANT-EAR MUSSEL		LT	aquatic
Myotis sodalis	INDIANA BAT	PHLE	PHLE	forest, wetland, aquatic, cave
Lutra canadensis	RIVER OTTER		LE	forest, aquatic
Silene regia	ROYAL CATCHFLY	C3	LE	prairie, savanna
Crotalus horridus	TIMBER RATTLESNAKE		LT	primary, forest
Plethobasus cicatricosus	WHITE WARTY-BACK PEARLY MUSSEL	PHLE	PHLE	rivers
Carex prasina	DROOPING SEDGE		LE	forest, wetland
Fusconaia ebena	EBONYSHELL		LT	aquatic

Table 11. Federal and State Threatened and Endangered Species List (continued)

SCIENTIFIC NAME	COMMON NAME	FEDERAL	STATE	HABITAT
Hemidactylium scutatum	FOUR-TOED SALAMANDER		LT	aquatic, forest, wetland
Polygonum arifolium	HALBRED-LEAVED TEARTHUMB		LE	wetland
Asio otus	LONG-EARED OWL		LE	forest
Lycopodium clavatum	RUNNING PINE		LE	wetland, forest, primary
Plethobasus cyphyus	SHEEPNOSE MUSSEL		LE	aquatic
Hydrocotyle ranunculoides	WATER-PENNYWORT		LE	wetland, aquatic
Haliaeetus leucocephalus	BALD EAGLE	LT	LE	wintering
Tyto alba	COMMON BARN-OWL		LE	forest, prairie, savanna, wetland
Tympanuchus cupido	GREATER PRAIRIE-CHICKEN		LE	prairie
Rallus elegans	KING RAIL		LT	wetland, prairie
Quadrula cylindrica	RABBITSFOOT MUSSEL		LE	aquatic
Thamnophis sauritus sauritus	EASTERN RIBBON SNAKE			
Notrophis amblops	BIGEYE CHUB			

The above list of threatened and endangered species is from a November, 1995 query of the Illinois Natural Heritage Database. The Federal Status was modified to be consistent with the U.S. Fish and Wildlife Service listing for Illinois which was revised July, 1995. Since this information changes frequently, an updated list for specific projects should be obtained from the Illinois Endangered Species Protection Board and the U.S. Fish and Wildlife Service.

LE = Endangered
LT = Threatened,
C1, C2, C3 = Candidate Species,
E/SA = Endangered/Similarity of Appearance (all subspecies and hybrids)
PH = Species not recorded in this 10-county region but search for species wherever potential habitat is present.

Cultural Resources

The Embarras River has been a major water resource for the eastern part of Illinois since pre-settlement times. There is much evidence that the Embarras River area and its major tributaries were used extensively by historic and pre-historic cultures. The NRCS is committed to protecting cultural resource sites.

Since the basin covers such a large area, over 2,440 square miles, a specific cultural resources study has not been completed. Site specific cultural resource reviews will be completed before any land disturbing project is approved for implementation.

NRCS has cultural resource coordinators located throughout the basin who are trained in recognizing cultural resources. They will complete site reviews and coordinate with the State Cultural Resources Coordinator who is a professional archaeologist. NRCS will consult with the State Historic Preservation Officer and the Advisory Council on Historic Preservation, as appropriate, to complete inventories and evaluate any cultural resources that may be affected by conservation practices.

Natural Areas

Natural areas provide critical habitat for native Illinois plants, animals and natural communities. Through the Illinois Natural Heritage database, Natural Heritage Division of the Illinois Department of Natural Resources, information can be retrieved about inventoried sites that possess the biological diversity of Illinois' pre-settlement conditions. These ecosystems are important as living repositories for use in science, medicine, industry, and agriculture, as well as for future generation to develop their own sense of nature and reverence for the land. Appendix B lists the Illinois Natural Areas Inventory sites within the Embarras River Basin. This list includes the county name, the site name, the township/range/section and a brief description of the area (when available).

Fisheries

Fish communities in the Embarras typically include small minnows, shiners, and small sunfish. In areas where depth conditions are suitable, larger species can be found.

The Embarras River, particularly the reach between Charleston and Newton, has an excellent variety of aquatic habitats and extremely rich species diversity, making the middle section potentially one of the outstanding streams in Illinois. At least 92 species of fish have been reported for the basin including several that are rare or limited elsewhere in the state, including the harlequin darter, dusky darter, eastern sand darter, spotted bass, mountain madtom, and greenside darter. Three are endangered - the eastern sand darter, harlequin darter, and bigeye chub. The bigeye shiner found in the 1987 study is on the state threatened list. Only six species - steelcolor shiner (35%), redfin shiner (12%), bluntnose minnow (10%), bullhead minnow (9%), silverjaw minnow (6%), and larger sunfish (4%), made up 76% of all fish collected during the study.

The Index of Biotic Integrity (IBI) is used to evaluate stream ecosystems. It can help point out areas needing improvement.

IBI values rated 51.9% (420.7 miles out of 817) of the entire Embarras River system achieving full aquatic life use support, 43.3% as partial/minor use support, 4.8% as partial/moderate use support, and 0.6% (5 miles on Dogwood Creek by Oblong) as nonsupportive of aquatic life. Channelization, nonpoint agriculture runoff, oil field runoff, urban and oil field runoff along Indian Creek, and municipal wastewater treatment discharge coming into Hayes Branch and Dogwood Creek are considered factors keeping the entire basin from reaching full aquatic life use support (*IEPA Intensive Survey of the Embarras River Basin*, Ettinger, 1989).

The value of the sport fishing on the Embarras and its tributaries has been estimated by an IDNR fisheries biologist to be nearly $8,000,000 annually.

Prime Farmland

Prime Farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses. It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed according to acceptable farming methods.

In general, Prime Farmland has an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks that interfere with tillage or rooting volume. It is permeable to water and air. It is not excessively erodible or saturated with water for a long period of time, and it does not flood frequently or it is protected from flooding by artificial means.

The majority of the soils in the Embarras River Basin are Prime Farmland. There are some soils that are naturally too wet to be adequately drained for farming or are on slopes that are too great to be safely farmed and protected from excessive erosion that meet the criteria of Additional Farmland of Statewide Importance. Generally, these soils are "nearly" Prime, and that economically will produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce yields as high as Prime Farmland if conditions are favorable.

Approximately 75 percent of the soils in the Embarras River Basin (1,150,200 acres) meet the Prime Farmland criteria. This includes soils in the relatively flat upland sections and also many of the alluvial soils on the floodplains. It is assumed that most of the soils that need artificial drainage to be considered Prime have had those systems installed, as is the case in much of central Illinois. Floodplain soils must not flood more often than once every two years to be considered Prime. Beaucoup, Belknap, Darwin, and Wakeland soils are considered to be Prime Farmland where drained and either protected from flooding by levees or flooding does not occur during the growing season. Lawson soils are considered to be Prime Farmland where protected from flooding or flooding is less often than once in two years during the growing season. In general, the soils that are not Prime are those that are greater than 5 percent slope, too high in sodium, or are too wet to drain properly.

Forest Resources

Forests cover 11%, approximately 165,000 acres, of the Embarras River Basin. Although historically forests occurred throughout the basin, there was a predominance of prairie in the north portions and deciduous hardwood forest in the south portions of the basin. Substantial conversion of both cover types to agricultural uses has fragmented blocks of forest cover and narrow riparian forest strips along major drainage ways.

Forest Types are very general categories of forest cover named for the dominant tree species of each category. Much of the forest cover today in the Embarras River floodplain is the Elm-Ash-Soft Maple Forest Type, a forest cover type consisting of species of trees that grow in the moist and wet parts of the landscape. Another type occurring primarily on dry upland sites is the Oak-Hickory Forest Type. There are some areas of the basin supporting small amounts of the Maple-Beech Forest Type, which is natural and Pine Forest Type, which is planted.

Although forests comprise a significant portion of the landscape throughout the basin, forestry is not currently a significant economic factor. There is opportunity for forestry to play an increased economic role in the basin. Many of the benefits provided by trees to watersheds are best provided when the trees are in an immature stage of aggressive growth. There are numerous arguments for the harvest of trees at economic maturity, before growth stagnates and the regeneration of new trees occurs in their place. There are standards to follow to preserve and maintain wildlife habitats and to improve water quality while aggressively practicing forestry. Existing incentive programs can be packaged and promoted to accomplish forestry goals in the Embarras River Basin.

Civil Rights

All landowners and residents within the area are effected by the condition and treatment of the soil, water, air, plant and animal resources of the river basin. Small farms, female owners, and limited resource farmers deserve special considerations in the implementation of plan components. Technical and financial services will be provided to all landowners and operators on a non-discriminatory basis (see the USDA Civil Rights/Equal Opportunity Statement, inside the front cover). Delivery of services by USDA agencies to these groups is an important part of implementation of this plan. Services may be provided by: Natural Resources Conservation Service; Farm Service Agency; Cooperative Extension Service; Forest Service; Rural Development; Agricultural Research Service; and state and local government entities.

FORMULATION PROCESS

Summary of Alternatives Developed

Recommendations were developed at the fall 1995 Technical Advisory Committee meeting. These recommendations were presented and refined at the December and January ERMA directors meetings. For the purposes of the individual ERMA county meetings during January 1996, the list presented to the public included 6 alternatives:

(1) No Action
(2) Purchase 10% of the flooded cropland
(3) Build dams to control 30% of the Embarras River Basin
(4) Triple the amount of no-till cropland in the basin
(5) Identify and implement streambank stabilization measures
(6) Implement coordinated river basin planning in the Embarras River Basin.

No Action

Nothing would be done to address the locally-identified concerns in the basin. All existing problems would continue.

Purchase 10% of the flooded cropland

It is estimated that 150,000 acres of cropland in the basin receive flood damage. It was assumed that 10% of this cropland would be purchased for wetlands and riparian areas. This alternative would reduce cropland flooding and scour erosion; improve water quality, wildlife habitat, and natural character; and establish additional wetland areas.

Build dams to control 30% of the Embarras River Basin

Build 1,000 to 2,500 dry dams of sufficient size to control 30% of the drainage area of the entire Embarras River Basin. These small dams would be designed for control of a 3-inch rainfall. The dams could either have a small permanent pool or be dry dams. This alternative would reduce cropland flooding and sedimentation in the river system.

Triple the amount of no-till cropland in the basin

It is estimated that approximately one-quarter of the cropland acres in the basin is no-till. This alternative would convert an additional 500,000 acres (approximately 50%) of cropland to no-till. Therefore, the total no-till would be 75% of the cropland in the basin. This would result in reduced soil erosion and sedimentation; improved water quality and wildlife habitat; and a slightly reduced cropland flooding.

Identify and implement streambank stabilization measures

This alternative would identify channel meanders damaging cropland fields. After each site is identified, the measures would be designed and implemented to stabilize the streambank. This would result in reduced streambank erosion, improved water quality, and improved wildlife habitat (if vegetative measures are used).

Implement coordinated river basin planning in the Embarras River Basin.

This is a broad alternative and would include these efforts:

Promote and maintain the natural integrity of the Embarras
Implement natural resource conservation planning
Improve woodland management
Identify, stabilize, and restore wetlands
Identify and implement streambank stabilization
Create incentives for new practices

The following treatment options are included in the coordinated resource plan but were not completely studied because of time constraints. They will need further planning to implement.

Promote stormwater detention (rural and urban areas)
Increase monitoring stations (quantity and quality)
Minimize floodplain development
Complete rural septic inventory and educate the public
Clean up dump sites
Address point-source pollution
Address water use issues

Consultation and Public Participation

On April 23, 1993, six farmers met in a farm shop west of Greenup, Illinois to form an organization to seek solutions for problems in and around the Embarras River. In the spring of 1993, the Embarrass River Management Association (ERMA) was named and the initial formation process began. Over 200 people gathered April 6, 1994 at the Jasper County Courthouse to collectively voice their concerns. This meeting gave the incentive to start a river basin planning program.

ERMA is a private organization funded by its members. It is a grassroots structure with eight county steering committees consisting of a Chairman, Vice-Chairman, Secretary, and two local Directors. The Directors make up ERMA's governing Board of Directors. The first official Board of Directors meeting was held May 3, 1994 at the USDA building in Newton, IL. Officers were elected, organizational by-laws were adopted, and a logo for promotional purposes was approved.

ERMA requested NRCS to assess needs and concerns in the river basin. Public meetings were sponsored throughout the spring and summer of 1994. Resource concerns and problems were identified through public meetings in Jasper, Lawrence, Cumberland, Crawford, Richland and Coles counties. The ERMA Board of Directors met after these public input meetings and prioritized the identified resource concerns as follows:

1. Flooding
2. Log Jams/Obstructions
3. Water Quality
4. Erosion
5. Drainage
6. Beaver, Deer and Turkey related problems
7. Lack of Accountability-Communication
8. Loss of Natural Character
9. Private Property Rights
10. Sediment (sand deposits)
11. Bends in the Channel
12. Wetlands
13. Wildlife/Recreation Opportunities
14. Economic Costs (funding solutions)
15. Water Usage and Supply
16. Land Use Changes
17. Small Bridge Outlets
18. Lack of Education.

Four Technical Advisory Committees were established:

1. Flooding
2. Water Quality and Erosion
3. Wetland, Wildlife, Recreation and Natural Character
4. Information and Public Communication

These committees inventoried and evaluated the resource concerns in the Embarras River Basin. Agencies and groups represented on the technical advisory committee include the following:

USDA-Natural Resources Conservation Service
Illinois Department of Agriculture, Bureau of Soil and Water Conservation
Illinois State Water Survey
Illinois Department of Natural Resources
Illinois Environmental Protection Agency
Illinois Nature Preserves Commission
Illinois Department of Transportation
U.S. Geological Survey
Illinois State Geological Survey
Eastern Illinois University
Local Soil and Water Conservation Districts
U.S. Fish and Wildlife Service
Illinois Cooperative Extension Service
Illinois Riverwatch Network
Farm Bureau
City of Charleston

The technical advisory committee provided their reports and recommendations to the ERMA Board of Directors at their December 14, 1995 meeting. During January 1996, ERMA sponsored public meetings in Cumberland, Lawrence, Crawford, Richland, Jasper, Coles, Champaign and Douglas Counties. These meetings were held to review the following six alternatives.

1. Implement a coordinated watershed planning program
2. Increase acreage of no-till to 75% of cropland acres in the basin
3. Build dams to control runoff from 30% of basin
4. Implement streambank stabilization on eroding channel banks
5. Purchase 10% of flooded cropland and convert to non-cropland
6. No action

The meetings allowed an opportunity for public input into the proposed solutions to the resource problems.

Table 12 is the ERMA Alternatives Priority Summary. See Appendix A for public input comments from local ERMA meetings held in January 1996.

Through the public participation process, county ERMA groups selected the coordinated resource planning program as their approach to resource management within the river basin.

On March 6, 1996, a meeting was held with ERMA Directors, Technical Advisory Committee members, and interagency personnel to review the draft Embarras River Resource Management Plan. Comments have been incorporated into this final version of the plan.

Future Public Participation

The Embarras River Management Association (ERMA) continues its commitment to promote the improvements within the river basin with the same enthusiasm it has shown throughout its first years. ERMA plans to promote the River Basin Resource Management Plan by using the ideas listed below:

Each steering committee will hold public educational meetings in their county to inform landowners and farmers about the River Basin Resource Management Plan.

A series of newspaper articles discussing the Plan will be published in the 28 newspapers within the basin.

The aerial video produced by NRCS will be made available to schools and civic groups.

The video now under production by NRCS on watershed planning and ERMA's efforts to help the basin will also be shown to schools, civic groups, and farm organizations.

Directors of ERMA will be speaking at civic groups and farm organizations meetings to explain the Plan.

Local television and radio farm shows will be used to promote ERMA and the River Basin Resource Management Plan.

Information on the Plan will be made available to Eastern Illinois University, University of Illinois, and the community colleges within the basin. This would include showing the videos and slides.

Table 12. ERMA Alternatives Priority Summary
February, 1996

County	Watershed planning program	Increase no-till to 75% cropland	Dams on 30% of basin	Streambank stabilization	Purchase 10% of Cropland	No Action	Number of Responses
Champaign/ Douglas	1	2	3	4	5	6	28
Coles	1	2	3.5	5	3.5	6	12
Crawford	1	4	3	2	5	6	6
Cumberland	1.5	4	1.5	3	5	6	17
Jasper	1	3.5	3.5	2	5	6	25
Lawrence	3	2	1	4	5	6	6
Richland	3	1	4	2	5	6	25
AVERAGE PRIORITY	**1.6**	**2.6**	**2.8**	**3.1**	**4.8**	**6.0**	

NOTE: Priority rankings are summary data from each county meeting.
Number 1 indicates **highest** priority and number 6 indicates **lowest** priority.
Clark and Edgar Counties did not conduct meetings.

EMBARRAS RIVER BASIN RESOURCE PLAN

Description of Plan Components

The planned treatment components can be grouped into four general categories:

- Conservation Land Treatment for Erosion and Sediment Reduction
- Water Quality Improvement
- Wetland, Wildlife, Threatened and Endangered Species
- Flood Damage Reduction

This grouping is somewhat arbitrary. For example, Conservation Cover could be placed into the any one of three categories: Conservation Land Treatment for Erosion and Sediment Reduction; Water Quality Improvement; or Wetland, Wildlife, Threatened and Endangered Species. For the purposes of this plan, Conservation Cover was placed in Conservation Land Treatment for Erosion and Sediment Reduction.

Conservation Land Treatment for Erosion and Sediment Reduction

Clearing and Snagging
Conservation Cover
Contour Farming
Cover and Green Manure
Critical Area Planting
Diversions
Grade Stabilization Structures
Grassed Waterways
Mulch Tillage
No-Till
Pasture/Hayland Management
Pasture/Hayland Planting
Ponds
Terraces
Water & Sediment Control Basins (WASCOB)

Land treatment in the Embarras River Basin will be installed to reduce sheet and rill erosion, trap sediment, improve water quality, and provide habitat for fish, fowl, and other wildlife. This plan provides improved recreational areas for hunting and fishing.

Water Quality Improvement

Agricultural Waste Management System
Critical Area Planting on Oil Brine Damaged Land
Filter Strips
Nutrient Management
Pesticide Management
Streambank Stabilization and Protection
Water Table Management Research Project

This plan provides for a water level management research project. This project is located in Champaign County to study how to manage tile drainage systems to increase infiltration, decrease runoff and control flooding. This is the only research project contained in the plan.

Wetland, Wildlife, Threatened and Endangered Species

Field Border Strips
Riparian Easements
Time-Share Wetlands
Tree Planting
Wetland Establishment
Wildlife Habitat
Windbreaks
Woodland Management

"Time-share" wetland establishment on 14,440 acres (Wildlife wetland habitat management) is designed to convert pothole areas of tile-drained, row crop fields to temporarily flooded wetlands. This practice is called "Time-Share Wetlands" because the area will be drained during the growing season, then flooded after the crops are harvested. A valve will have to be installed on the tile drainage system to allow the farmer to drain or flood the pothole. These areas will improve water quality through nitrate reduction. During the winter and early spring period of temporary flooding some benefit may accrue to wildlife. Full-time wetland establishment will be implemented on 660 acres.

Flood Damage Reduction Features

Dry dam structures to slow storm water runoff and reduce flooding impacts

It is important to note the difference between two terms used in this report: dams and ponds. The ERMA planning committee originally formulated the alternative of a multitude of upland dams distributed throughout the basin. During the planning process, these dams were considered to be in the 200 - 500 acre drainage area size. These dams will have flood control benefit. Cumberland and Clark County each have over 100 potential sites for dams of this size. These dry dams have only a temporary pool of water, approximately 10 to 15 acres. The number of dams needed includes the anticipated effects on runoff after the adoption of other plan components such as: land treatment for erosion and sediment reduction and wetland, wildlife, threatened and endangered species measures.

As NRCS employees determined the need for conservation measures within individual counties, it was determined that a need for dams of smaller size existed. These dams, each having a drainage area smaller than 200 acres in size, are called ponds. The flood control benefits of these ponds would be very localized. Clark, Crawford, and Lawrence Counties each have over 250 potential sites for ponds. These ponds would have a pool size of approximately 5 acres.

The dams will have earthfill embankments with a principal spillway pipe through it. Each structure will also have an earth vegetated emergency spillway. The dams will likely need to meet IDNR-OWR dam safety permitting criteria. These structures are most likely to be of the size Class III small. Therefore, the 25-year storm (approximately 5.4 inches) will be detained in the dam without flow in the emergency spillway. The flow depth of the emergency spillway will be determined using the 100-year storm (approximately 7.4 inches).

This criterion exceeds the goal expressed by the ERMA planning committee of controlling a 3-inch rainfall (2-year frequency). By using IDNR's permit criteria, additional flood control is realized at the medium frequency (25-year) storms as well as the more frequent storms (2-year).

These upland dry dams essentially replace the storage function of upland wetlands that formerly stored large volumes of water on the uplands and released it slowly to the stream systems. However, these dams will not replace the biological function of upland wetlands.

The following considerations will be utilized when siting dams and ponds to avoid or minimize environmental impacts. Wet-site tree species will be encouraged for planting in dry dam pools. Native grasses and forbs will be encouraged for grass plantings and alien cool season grasses will be discouraged. Breaks in the riparian forest corridors caused by construction of the dams will be replaced by tree plantings around the dam and up both sides of the pool. Siting will avoid high quality forest cover to enhance existing habitats, complement other habitats, and emulate natural systems whenever possible. In addition, the siting process will consider stream type (permanent or intermittent) and landscape position in order to avoid or minimize impacts on fish, mussels, and other aquatic organisms. See the Avoidance, Minimization, and Mitigation section for avoidance, minimization, and mitigation procedures for environmental impacts.

Technical Support

Assistance from field offices and staff specialists for planning and implementation will be available.

Avoidance, Minimization, and Mitigation

During the siting process of applying individual planned measures, these are the steps that will be followed in regard to environmental impacts.

1. Avoid any negative environmental impacts.

2. If it is not possible to completely avoid a negative environmental impact, then the negative impact will be minimized.

3. If a minimal negative impact is not possible, then the impact will be mitigated in consultation with appropriate federal, state, and local environmental agencies such as: US Fish and Wildlife Service and Illinois Department of Natural Resources.

The mitigation requirements for this project were developed through interagency consultation with divisions of the Illinois Department of Natural Resources, U.S. Forest Service, U.S. Fish & Wildlife Service, Illinois Department of Agriculture, and Illinois Nature Preserves Commission on March 6, 1996. All Illinois Natural Area Inventory (INAI) sites will be avoided during site planning and construction. Unavoidable impacts to natural areas will be minimized and mitigated in conformance with National Environmental Policy Act (NEPA) provisions.

The construction of dams may have an impact on native hardwoods, estimated to be around 3,400 acres, due to tree clearing for the construction sites. The following considerations will be utilized when siting dams and ponds to avoid or minimize environmental impacts. Wet-site tree species will be encouraged for planting in dry dam pools. Native grasses and forbs will be encouraged for grass plantings and alien cool season grasses will be discouraged. Breaks in the riparian forest corridors caused by construction of the dams will be replaced by plantings around the dam and up both sides of the pool. Siting will avoid high quality forest cover to enhance existing habitats, complement other habitats, and emulate natural systems whenever possible. In addition, the siting process will consider stream type (permanent or intermittent) and landscape position in order to avoid or minimize impacts on fish, mussels, and other aquatic organisms.

Permits and Compliance

Structural elements of the plan will require permits from U.S. Army Corps of Engineers; Illinois Department of Natural Resources-Office of Water Resources; and Illinois Environmental Protection Agency. Other state and local permits may be required. Other federal statutes with which the plan will comply are listed in the following table.

Table 13. Water Resources Council-Designated Environmental Statutes

Federal Statute	
Analysis of Impacts of Prime & Unique Farmland	CEQ Memorandum; August 11, 1980
Archaeological and Historic Preservation Act	16 U.S.C 469 et seq.
Clean Air Act, as amended	42 U.S.C. 1857h-7 et seq.
Clean Water Act	(Federal Water Pollution Control Act)
Coastal Zone Management Act	U.S.C. 1451 et seq.
Farmland Protection Act	
Federal Water Project Recreation Act	16 U.S.C. 460-1(12) et seq.
Fish & Wildlife Coordination Act	16 U.S.C. 661 et seq.
Flood Plain Management	Executive Order 11988
Land and Water Conservation Fund Act	16 U.S.C. 460/460/-11, et seq.
Marine Protection, Research and Sanctuary Act	33 U.S.C. 1401 et seq.
National Environmental Policy Act	42 U.S.C. 4321 et seq.
National Historic Preservation Act	16 U.S.C. 470a et seq.
Protection of Wetlands	Executive Order 11900
Rivers and Harbors Act	33 U.S.C. 403 et seq.
Watershed Protection and Flood Prevention Act	16 U.S.C. 1001 et seq.
Wild and Scenic Rivers Act	16 U.S.C. 1271 et seq.

Total Resource Needs

Table 14 shows the total resource needs for the Embarras River Basin. These total resource needs were estimated by local NRCS staff utilizing the following information:

- IDNR "T by 2,000" transect data
- USDA-NRCS National Resource Inventories
- Local resource planning efforts
- Onsite investigations
- County treatment trends
- Previous implementation trends

Table 14. Embarras River Basin Total Resource Needs

Practice/Systems	Units	Cham-paign	Clark	Coles	Crawford	Cumber-land	Douglas	Edgar	Jasper	Lawrence	Richland	**TOTAL**
CONSERVATION LAND TREATMENT FOR EROSION AND SEDIMENTATION												
Clearing and Snagging	Feet	40,000	15,000		27,000	6,600			10,000		10,000	108,600
Conservation Cover	Acres		3,500	1,000	25,000	2,000	950	4,000	3,300	5,000	500	45,250
Contour Farming	Acres		2,000		11,000							13,000
Cover and Green Manure	Acres		600		2,000	1,500			1,500	1,200	550	7,350
Critical Area Planting	Acres		40		1,000	100			263			1,403
Diversions	Feet		35,000	5,000	3,000	10,000	7,000	20,000				80,000
Grade Stabilization Structures	No.	20	420	150	512	150	50	70	214	250	32	1,868
Grassed Waterways	Acres	500	620	250	309	300	300	130	526		38	2,973
Mulch Tillage	Acres		17,000	50,000	21,000	20,000			46,000		1,500	155,500
No-Till	Acres	30,000	9,000	50,000	21,000	20,000	30,600	10,000	50,000	10,000	3,500	234,100
Pasture/Hayland Management	Acres		2,200	5,000	3,500	2,000	325					13,025
Pasture/Hayland Planting	Acres		150	5,000	600	200	325	2,000	2,500			10,775
Ponds	No.		350	50	521	50	12	36	75	250	25	1,369
Terraces	Feet		120,000	450,000	80,000	25,000	24,000	10,000	60,000	145,200	16,000	930,200
Water & Sediment Control Basins (WASCOB)	No.	20	400	50	480	200	22	50	200	500	100	2,022
FLOOD DAMAGE REDUCTION												
Dams	No.		129	60	81	312	17	22	34	12	5	672

Table 14. Embarras River Basin Total Resource Needs

Practice/Systems	Units	Cham-paign	Clark	Coles	Crawford	Cumber-land	Douglas	Edgar	Jasper	Lawrence	Richland	*TOTAL*
WATER QUALITY												
Agricultural Waste Management System	No.		10	7	15	20	5	4	20			81
Critical Area Planting - Oil Brine	Acres		60		2,100				356	675		3,191
Filter Strips	Acres	500	85	500	25	600	100	200	128	15	8	2,161
Nutrient Management	Acres	60,000	95,000	150,000	63,000	140,000	30,600	80,000	50,000	60,000	7,600	736,200
Pesticide Management	Acres	60,000	95,000	150,000	63,000	140,000	30,600	80,000	50,000	60,000	7,600	736,200
Streambank Stabilization and Protection	Feet		11,000	82,000	9,200	100,000	45,460	12,000	32,000	10,000	3,000	304,660
Water Table Management Research Project	Each	1										1
WETLANDS, WILDLIFE, AND THREATENED & ENDANGERED SPECIES												
Field Border Strips	Feet		45,000			75,000	22,600		15,000		10,000	167,600
Riparian Easements	Acres	900								3,312		4,212
Time-Share Wetlands	Acres	1,000		5,000			3,000	10,000				19,000
Tree Planting	Acres	500	100	2,000	320	200						3,120
Wetland Establishment	Acres		20	500		50	300					870
Wildlife Habitat	Acres	200	150	50,000	564	500	250	200			250	52,114
Windbreaks	Feet		12,000		15,000	60,000			15,000			102,000
Woodland Management	Acres	500	9,000	20,000	2,560	10,000	400		4,250			46,710

Costs

This resource plan covers a broad range of issues and concerns, and also contains a broad list of conservation treatments to address these issues and concerns. For treatment costs see Table 15.

		(% of Total Resource Needs)	
Category	**Cost**	**On-going Program**	**Implementation Rate**
Conservation Land Treatment Practices	$34,000,000	5%	80%
Water Quality Improvement	$15,000,000	5%	80%
Wetland, Wildlife, Threatened and Endangered Species	$10,000,000	5%	80%
Flood Damage Reduction Features	$13,000,000	0%	100%
Technical Support	$ 5,000,000	-	-
Mitigation	$ 5,000,000	-	-
Total Estimated Cost	**$82,000,000**		

The estimated cost for land treatment for erosion and sediment reduction ($34,000,000), water quality improvement ($15,000,000) and wetland, wildlife, threatened and endangered species ($10,000,000) accounts for 80% anticipated acceptance and implementation rate. Flood damage reduction features ($13,000,000) accounts for 100% structure construction. Technical support ($5,000,000) accounts for planning, design and implementation assistance needed from field office and staff specialists. Mitigation ($5,000,000) accounts for replacement of forest and natural area values that may be disturbed or destroyed during construction of dry dams. See the Avoidance, Minimization, and Mitigation section for additional information about mitigation.

Table 14. Total Resource Needs quantities have been reduced by the following formula to arrive at *Table 15. Quantities and Cost by Practice* quantities. It should be noted that this plan is a voluntary plan.

$$\text{Quantity}_{\text{Table 15}} = \text{Quantity}_{\text{Table 14}} \times \frac{(100 - \text{On-going Program \%})}{100} \times \frac{(\text{Implementation Rate})}{100}$$

Example: No-till Acres

$$\text{Quantity}_{\text{Table 15}} = 234{,}100 \text{ acres} \times (0.95) \times (0.80)$$

$$\text{Quantity}_{\text{Table 15}} = 177{,}916 \text{ acres}$$

Table 15. Quantities & Cost by Practice

Practice	Unit	Unit Cost	Quantity	Total Cost
Clearing and Snagging	Feet	$5	82,536	$412,680
Conservation Cover	Acres	$199	34,390	$6,843,610
Contour Farming	Acres	$10	9,880	$98,800
Cover and Green Manure Crops	Acres	$20	5,586	$111,720
Critical Area Planting	Acres	$1,917	1,066	$2,043,522
Diversions	Feet	$4	60,800	$243,200
Grade Stabilization Structures	Number	$3,520	1,420	$4,998,400
Grass Waterway	Acres	$1,776	2,259	$4,011,984
Mulch Tillage	Acres	$0	118,180	$0
No-till	Acres	$0	177,916	$0
Pasture and Hayland Management	Acres	$100	9,899	$989,900
Pasture and Hayland Planting	Acres	$182	8,189	$1,490,398
Ponds	Number	$7,503	1,040	$7,803,120
Terraces	Feet	$3	706,952	$2,120,856
Water and Sediment Control Basins	Number	$1,500	1,537	$2,305,500
Conservation Land Treatment Subtotal				*$33,473,690*
Dams	Number	$20,000	672	$13,440,000
Flood Damage Reduction Subtotal				*$13,440,000*
Agricultural Waste Management Systems	Number	$19,855	62	$1,231,010
Critical Area Planting (Oil Brine)	Acres	$1,766	2,425	$4,282,550
Filter Strips	Acres	$275	1,642	$451,550
Nutrient Management	Acres	$5	559,512	$2,797,560
Pesticide Management	Acres	$5	559,512	$2,797,560
Streambank Stabilization and Protection	Feet	$15	231,542	$3,473,130
Water Table Management Study	Each	$80,000	1	$80,000
Water Quality Subtotal				*$15,113,360*
Field Border Strips	Feet	$0.08	127,376	$10,190
Riparian Easements	Acres	$1,478	3,201	$4,731,078
Time-share Wetlands	Acres	$90	14,440	$1,299,600
Tree Planting	Acres	$300	2,371	$711,300
Wetland Establishment	Acres	$120	661	$79,320
Wildlife Habitat Management	Acres	$26	39,607	$1,029,782
Windbreaks	Feet	$1	77,520	$77,520
Woodland Management	Acres	$55	35,500	$1,952,500
Wetland, Wildlife, and T&E Subtotal				*$9,891,290*
Total				**$71,918,340**

Description of Plan Effects

Flooding

The estimated flood reduction benefits of the resource plan are shown in the table below:

Item	Flood Reduction Benefits
Land Treatment for Erosion & Sediment, Water Quality Improvement, Wetland, Wildlife, T&E Practices	10%
Flood Damage Reduction Features	15%
Total	**25%**

Most of the potential sites for dams are located in the lower two-thirds of the basin, from Coles County south. The majority of flood control benefits will be close to the dams and on tributary streams. The effect will not be as great on the main stem of the Embarras.

Log Jams/Obstructions

The plan includes improved woodland management and streambank stabilization. These practices will improve flood plain and streambank conditions and significantly reduce conditions that contribute to log jams and obstruction formation. Clearing and snagging of logs and debris along 83,000 feet of the river and its tributaries is also included. If carried out under the direction of the interdisciplinary team, this will improve water flow throughout the river basin. However, removal of log jams and obstructions could be detrimental to certain aquatic species that require the conditions created by the log jams and obstructions. Clearing and snagging operations need to be carried out under the direction of an interdisciplinary team of responsible agencies and private individuals. Habitat availability and nutrient cycling will be considered.

Water Quality

The plan components significantly reduce sediment, chemicals, and nutrients that will be delivered to the river. Dams, streambank stabilization measures, no-till farming, filter strips, agricultural waste management systems, wetland establishment, and other land treatment systems in this alternative will have a major impact on nonpoint source runoff from agricultural areas such as row crops and livestock feed lots. District Conservationists in these counties identified the need for 736,200 acres of nutrient and pesticide management in the river basin. This management would specify application rates and timing, and will have a beneficial effect on water quality in Embarras River Basin.

Erosion

The proposed land treatment practices for erosion and sediment reduction will reduce sheet and rill erosion by 33% in the Embarras River Basin.

Drainage

Drainage ditch maintenance is the responsibility of the drainage district or private individual. Maintenance will comply with local, state, and federal regulations.

Resource plan activities should not have an adverse impact on cropland drainage. Alterations (e.g. to create wetlands) to a crop drainage system will be voluntary.

Beaver, Deer, and Turkey Related Problems

Practices in the plan that may lessen the effects of these damages are buffer zones, restoring wetlands, and timber stand improvement (favoring good mast producers such as oak, hickory, and walnut). Contact the Illinois Department of Natural Resources for advice and/or permission to remove or relocate animals that cause a problem.

Lack of Accountability/Communication

The formation of the Embarras River Management Association has significantly improved communication throughout the basin area through its representation from participating counties. The Association has provided many opportunities for communication throughout the planning process. Continued communication will be the key to the success of this resource plan.

Loss of Natural Character

The coordinated resource plan contains an element specifically dealing with promoting and protecting the natural integrity of the river system. Educational features along with conservation practices and structural measures are intended to promote and protect the natural character.

The planned practices will not adversely impact the scenic beauty and functions of any Illinois Natural Inventory sites or state parks within the basin.

Private Property Rights

This resource plan, other than establishing the criterion that resource treatment practices be implemented on a voluntary basis, does not have an impact on private property rights issues.

Sedimentation

If the proposed 672 dams and 1,040 ponds are built, approximately 25% of the Embarras River Basin will be sediment controlled thus improving water quality.

Bends in the Channel

Under current environmental considerations, the channel straightening (cutoffs) are not recommended due to the impacts on the riparian ecosystems.

Wetlands

Practices from the plan will protect wetlands from further siltation, which will prolong their existence. Restoring wetlands will slow stormwater runoff, filter excess nutrients from the runoff, recharge groundwater supplies, decrease flooding, and increase habitat for threatened and endangered species. In addition, the plan encourages wet prairie restoration in the lower part of the basin. Long-term ecological maintenance of newly-constructed wetlands or restorations should be performed by qualified individuals and be designed to benefit both the flora and fauna of the basin.

Wildlife Habitat

The plan practices will improve habitat by widening available nesting and brood rearing areas for birds, increasing food supply, improving water quality, and increasing escape cover for all species. The practices having the most effect on these needs are buffer strips, no-till, tree planting, timber stand improvement, restoring wetlands, and addressing point source pollutants.

Recreation

Improved water quality will encourage greater fish production. Controlling pollution, maintaining flow for longer periods, and stabilizing streambank erosion will improve canoeing experiences. An education program on river management, combined with a Clean-Up Day and increased access will improve the public's appreciation for the river.

Economic Costs/Funding Solutions

The implementation of this resource plan is dependent on receiving funding assistance from all available sources, state and federal government, public groups and private organizations.

Water Usage and Supply

This plan does not provide for increased water supply, but does provide for protection of the quality of water in the Embarras River Basin.

Land Use Change

This plan includes converting 19,000 acres of cropland to riparian wetlands, bottomland and upland woods, or buffer/filter strips. Construction of small dams may require changing a maximum of 3,400 non-contiguous acres from woodland to grassland that will need to be mitigated. Avoidance of high quality habitat will be high priority.

Small Bridge Outlets

This plan does not directly address the concern of small bridge outlets. The responsible parties for the bridges, such as counties or railroads, are the only ones who can physically change the openings.

The Embarras River Management Association links groups across county lines. This fosters the exchange of ideas in the basin. For example, the successful removal of the railroad bridge piers at Lawrenceville can be shared with the group at Greenup.

In addition, the helicopter video serves as a quick overview of the major streams in the basin. This video enables anyone to see which bridges act as an obstruction by catching debris and logs.

Lack of Education

The resource management plan has many features that relate to educational opportunities for landowners, producers and residents. Many opportunities will involve "hands-on" learning experiences that will teach the methods of resource management.

Animal Resources

The primary effect of livestock operations on the basin will be on water quality when the animal waste is allowed to enter the river through the runoff water. This is not caused by all operations, only the ones that are not properly handling the waste produced. District Conservationists estimate that 81 waste management systems could be installed to reduce the nitrates and other contaminants entering the river and its tributaries. These contaminants in the stream reduce water quality, increase the growth of aquatic vegetation, and reduce dissolved oxygen rates.

Threatened and Endangered Species

Care must be taken to avoid adverse impacts to threatened and endangered species. Plan items such as ponds, water and sediment control basins, terraces, no-till, etc., are likely to produce desirable effects with little or no adverse impacts to resources of concern. When structural sites have been identified, check with Illinois Department of Natural Resources, Endangered Species Protection Manager, and U.S. Fish & Wildlife Service for potential impacts.

Cultural Resources

Cultural resources within the basin area will be protected. Site specific projects will be reviewed as implementation proceeds. Cultural resource sites will be avoided or mitigated, as deemed appropriate by the NRCS and the State Historic Preservation Officer.

Natural Areas

The Illinois Department of Natural Resources, Natural Heritage Division, must be consulted in regards to land treatment that might impact any natural area site in the basin. Structural measures that will be installed must not impact natural areas during construction.

Fisheries

Components of this plan will improve water quality. Buffer zones next to the streams, terraces, no-till, tree plantings, restoring wetlands, stabilizing streambanks, grade stabilization structures, minimizing development in the floodplains, use of detention basins to store urban and rural surface runoff, and shallow water wetland areas will all reduce sediment into the river basin. This will reduce siltation of the streambed which is thought to be the major factor causing the 86% drop in number of mussels documented between 1956-1987. Addressing point source pollution, industrial-residential pollution, rural septic systems, restoring wetlands, implementing Integrated Pest Management (IPM) and nutrient management programs will reduce the amounts of pollutants entering the Embarras River and its tributaries. This may enable the river system to reach full life use support.

Prime Farmland

The practices that are included in this plan protect or enhance prime farmland characteristics. Implementation of conservation land treatment measures will have a minimal impact on prime farmland. Construction of the dams may have an adverse impact on prime farmland.

Forestry

This resource plan will improve forestry resources in the basin by the following five methods:

1. Agroforestry

This concept involves the use of trees in conjunction with other agricultural practices. Agroforestry practices may provide income through forest-based crops. It may save money as the least expensive solution to other problems such as snow control, streambank or floodplain stabilization, energy conservation or water quality. Agroforestry may enhance agriculture production and create opportunities for additional income by providing wildlife habitat or recreational opportunities.

2. Upland Hardwood Forest Protection And Management

Protection from domestic livestock use will increase the capability of upland forests to infiltrate, store, utilize, and slowly release precipitation. These areas provide opportunities for the diversion of surface water flow from other areas. Because hardwood forests can be managed to regenerate naturally, trees can be perpetually grown and harvested from these areas with cultural practices that seldom involve replanting.

3. Riparian And Floodplain Forest Protection And Management

Trees of all sizes play a role in stabilizing stream banks and flood plain soils. Strategically placed stands of trees can substantially reduce the energy and damaging effects of flood waters. Through measurements of the stream and the nature of the landscape through which it flows, a belt width can be calculated which will accommodate stream meandering within a relatively stable area secured by trees. These areas can be managed aggressively for wood crops or a particular wildlife habitat. These sites also support nut producing trees such as black walnut and pecan, which create excellent income opportunities. Aggressive management of these areas can provide a reasonable number of trees to the stream for aquatic habitats while reducing the overall number of trees contributing to debris piles and log jams. Healthy vigorous riparian corridors provide a place to slow and trap logs and debris when streams flood.

4. Tree Planting

There are areas converted from native forest cover to other uses that would be best served by restoring forest cover. Sometimes the only means of reestablishing tree cover is through planting. Wet soils, stream borders, steep slopes, over-grazed pastures, odd corners, and extremely small fields are some examples of land that is difficult to use with the rest of the farming operation or has become uneconomical to manage. Forestry options can restore profitability and economic opportunity to these areas.

5. Urban and Community Forestry

Attention to trees and tree-covered areas in residential areas can contribute to river basin health, improve quality of life and provide economic benefits.

Civil Rights

The implementation of this plan can have significant positive impacts on the economic and cultural diversity of this area by providing opportunities for minority, female and limited resource persons.

Resource Treatment Effects

The resource treatment effects by each practice in four categories are summarized in Tables 16-19. In the tables, a "+" indicates a positive impact, a "-" indicates a negative impact, and a "0" indicates no impact.

Grouping of the practices is somewhat arbitrary. For example, Conservation Cover could be placed into the any one of three categories: Conservation Land Treatment for Erosion and Sediment Reduction; Water Quality Improvement; or Wetland, Wildlife, Threatened and Endangered Species. For the purposes of this plan, Conservation Cover was placed in Conservation Land Treatment for Erosion and Sediment Reduction.

Table 16. Resource Treatment Effects
Land Treatment Practices for Erosion and Sediment Reduction Practices

Practice	Locally Identified Resource Concerns								
	Flooding	Log Jams & Obstructions	Water Quality	Erosion	Drainage	Beaver Deer & Turkey Problems	Lack of Account. & Commun.	Loss of Natural Character	Private Property Rights
Clearing & Snagging	+	+	0	+	0	0	0	-	0
Conservation Cover	+	+	+	+	0	+	0	+	0
Contour Farming	+	0	+	+	+	+	0	+	0
Cover & Green Manure Crops	+	0	+	+	+	+	0	+	0
Critical Area Planting	+	0	+	+	+	+	0	+	0
Diversions	+	0	+	+	+	+	0	+	0
Grade Stabilization Structures	+	0	+	+	+	+	0	+	0
Grassed Waterways	+	0	+	+	+	+	0	+	0
Mulch Tillage	+	0	+	+	+	0	0	+	0
No-till	+	0	+	+	+	0	0	+	0
Pasture & Hayland	+	0	+	+	+	+	0	+	0
Ponds	+	0	+	+	+	0	0	0	0
Terraces	+	0	+	+	+	0	0	+	0
WASCOB	+	0	+	+	+	0	0	+	0

+ Positive Effect
- Negative Effect
0 No Effect

Table 16. Resource Treatment Effects
Land Treatment Practices for Erosion and Sediment Reduction Practices

Practice	Locally Identified Resource Concerns								
	Sediment	Bends in Channel	Wetlands	Wildlife & Rec.	Economic Cost	Water Use & Supply	Land Use Change	Small Bridge Outlets	Lack of Education
Clearing & Snagging	+	+	-	-	-	0	0	0	+
Conservation Cover	+	0	+	+	+	+	-	0	+
Contour Farming	+	0	+	+	+	+	+	0	+
Cover & Green Manure Crops	+	0	+	+	-	+	+	0	+
Critical Area Planting	+	+	0	+	-	+	0	0	+
Diversions	+	+	0	+	-	+	0	0	+
Grade Stabilization Structures	+	+	+	+	-	+	0	0	+
Grassed Waterways	+	0	+	+	-	+	-	0	+
Mulch Tillage	+	0	+	+	+	+	0	0	+
No-till	+	0	+	+	+	+	0	0	+
Pasture & Hayland	+	0	+	+	-	+	-	0	+
Ponds	+	0	+	+	-	+	-	0	+
Terraces	+	0	+	+	-	+	0	0	+
WASCOB	+	0	+	+	-	+	0	0	+

+ Positive Effect
- Negative Effect
0 No Effect

Table 17. Resource Treatment Effects
Water Quality Improvement Practices

Practice	Locally Identified Resource Concerns								
	Flooding	Log Jams & Obstructions	Water Quality	Erosion	Drainage	Beaver Deer & Turkey Problems	Lack of Account. & Commun.	Loss of Natural Character	Private Property Rights
Agric. Waste Mgt. System	0	0	+	0	0	0	0	+	0
Critical Area Planting - Oil Brine	0	0	+	+	0	+	0	0	0
Filter Strip	+	0	+	+	0	+	0	0	0
Nutrient Mgt.	0	0	+	+	+	0	0	0	0
Pest Mgt.	0	0	+	0	0	0	0	0	0
Streambank Stabiliz.	+	+	+	+	0	0	0	-	0
Water Table Mgt. Study	+	0	+	0	+	+	0	+	0

+ Positive Effect
- Negative Effect
0 No Effect

Table 17. Resource Treatment Effects
Water Quality Improvement Practices

Practice	Locally Identified Resource Concerns								
	Sediment	Bends in Channel	Wetlands	Wildlife & Rec.	Economic Cost	Water Use & Supply	Land Use Change	Small Bridge Outlets	Lack of Education
Agric. Waste Mgt. System	0	0	+	+	-	0	0	0	+
Critical Area Planting - Oil Brine	+	0	+	+	-	+	0	0	+
Filter Strip	+	0	+	+	-	+	-	0	+
Nutrient Mgt.	+	0	+	+	+	+	0	0	+
Pest Mgt.	0	0	+	+	+	+	0	0	+
Streambank Stabiliz.	+	+	+	+	-	+	+	0	+
Water Table Mgt. Study	+	0	+	+	+	+	0	0	+

+ Positive Effect
- Negative Effect
0 No Effect

Table 18. Resource Treatment Effects
Wetland, Wildlife, Threatened and Endangered Species

Practice	Locally Identified Resource Concerns								
	Flooding	Log Jams & Obstructions	Water Quality	Erosion	Drainage	Beaver Deer & Turkey Problems	Lack of Account. & Commun.	Loss of Natural Character	Private Property Rights
Field Border Strips	+	+	+	+	0	+	0	+	0
Riparian Easements	+	+	+	+	0	+	0	+	0
Time-Share Wetlands	+	+	+	+	0	+	0	+	0
Tree Planting	+	0	+	+	0	+	0	+	0
Wetland Estab.	+	+	+	+	-	+	0	+	0
Wildlife Habitat Mgt.	+	+	+	+	+	+	0	+	0
Windbreaks	0	0	+	+	0	+	0	+	0
Woodland Mgt.	+	+	+	+	0	+	0	+	0

+ Positive Effect
- Negative Effect
0 No Effect

Table 18. Resource Treatment Effects
Wetland, Wildlife, Threatened and Endangered Species

Practice	Locally Identified Resource Concerns								
	Sediment	Bends in Channel	Wetlands	Wildlife & Rec.	Economic Cost	Water Use & Supply	Land Use Change	Small Bridge Outlets	Lack of Education
Field Border Strips	+	0	+	+	-	+	-	0	+
Riparian Easements	+	0	+	+	-	+	-	0	+
Time-Share Wetlands	+	0	+	+	-	+	0	0	+
Tree Planting	+	0	+	+	-	+	-	0	+
Wetland Estab.	+	0	+	+	-	+	-	0	+
Wildlife Habitat Mgt.	+	0	+	+	-	+	-	0	+
Windbreaks	+	0	0	+	-	0	-	0	+
Woodland Mgt.	+	0	+	+	-	+	0	0	+

+ Positive Effect
- Negative Effect
0 No Effect

Table 19. Resource Treatment Effects
Flood Damage Reduction Practices

Practice	Locally Identified Resource Concerns								
	Flooding	Log Jams & Obstructions	Water Quality	Erosion	Drainage	Beaver Deer & Turkey Problems	Lack of Account. & Commun.	Loss of Natural Character	Private Property Rights
Dams	+	0	+	0	0	+	0	-	0

Table 19. Resource Treatment Effects
Flood Damage Reduction Practices

Practice	Locally Identified Resource Concerns								
	Sediment	Bends in Channel	Wetlands	Wildlife & Rec.	Economic Cost	Water Use & Supply	Land Use Change	Small Bridge Outlets	Lack of Education
Dams	+	0	0	+	-	+	-	+	+

\+ Positive Effect
\- Negative Effect
0 No Effect

List of Preparers

Tom Book
Planning Engineer
NRCS
Champaign, Illinois

Marvin Brown
Resource Planning Specialist
NRCS
Springfield, Illinois

Andrew Cerven
District Conservationist
NRCS
Charleston, Illinois

Dennis Clancy
District Conservationist
NRCS
Newton, Illinois

Raymond Coombes
District Conservationist
NRCS
Paris, Illinois

Tonie Endres
Soil Survey Project Leader
NRCS
Lawrenceville, IL

Larry Esworthy (retired)
District Conservationist
NRCS
Olney, Illinois

Vincent Gutowski
Professor
Eastern Illinois University
Charleston, Illinois

Frank Hershey
Forester
NRCS
Columbia, Missouri

Mary Ann Hoeffliger
Soil Conservationist
NRCS
Toledo, Illinois

Wayne Johanning
District Conservationist
NRCS
Toledo, Illinois

Paul Krone
Environmental Specialist
NRCS
Champaign, Illinois

William Lewis, Jr.
Resource Conservationist
NRCS
Champaign, Illinois

Kenton Macy
Biologist
NRCS
Charleston, Illinois

Harry Means
State Conservation Engr.
NRCS
Champaign, Illinois

Benard Mingo
District Conservationist
NRCS
Tuscola, Illinois

James Moye
District Conservationist
NRCS
Lawrenceville, Illinois

Steve Mozley
Ass't. St. Conservationist
NRCS
Springfield, Illinois

Daniel Mueller
District Conservationist
NRCS
Martinsville, Illinois

John Pearse
District Conservationist
NRCS
Robinson, Illinois

Karl Visser
Hydraulic Engineer
NRCS
Champaign, Illinois

Manuel Wei
Zone Engineer
NRCS
Louisville, Illinois

C. Pius Weibel
Geologist
ISGS
Champaign, Illinois

Leon Wendte
District Conservationist
NRCS
Champaign, Illinois

Roger Windhorn
Soil Scientist
NRCS
Champaign

APPENDIX A. Written Comments From Public Meetings

- Stress "education" as a key factor for success.
- Dams, filter strips, riprap & bendway weirs are good ideas, however, they need to be done on ALL creeks & ditches that flow into the Embarras River.
- Pinpoint one tributary in the watershed to use for an example of how the project will work.
- Incorporate aquaculture as an added incentive for building ponds.
- Install pipe outlets in main drainage ditches to slow the flow of runoff water.
- Need more awareness of problems among the upland farmers.
- Use woodland erosion control structures to slow runoff.
- Compile a neighbor-to-neighbor network on completed projects to make available to farmers.
- Use conservation tours and demonstration projects.
- Tax credits to get people involved money will get action.
- Communication and education to the public to get involvement and practices done.
- Alternatives given seem well-reasoned. Should complement each other and seem enough for now.
- Dam up the river.
- Buy 300-400 acres in bottoms and use as large retaining pond.
- Build a few small projects to show people how it helps, then take groups to show this on a tour. Need to do more than newspaper (articles) to get people's interest.
- Have the ERMA planning committee investigate or consider the potential of Conservation Credit initiatives as is being used in Wisconsin.
- Replace permanent easement of WRP (Wetland Reserve Program) to 15 years and give more priority points to the Embarras River Basin.
- Develop new modified crop alternatives suitable for large sediment retention basins (5-7 day storage).
- Create single or multi-county conservation district to direct/coordinate management and use or river/riparian resources.
- Long-term lease of cropland rather than purchase.

- Construct large ponds - combination of pond and dry dam capable of having large variations from water level to store water release into river. Would help to provide a more consistent water flow in river, better for fishing, boating, and quality.
- Controlling runoff with dams is likely to result in degraded wetlands.
- No-till, green buffers, restoration of woodlands by themselves ought to be enough to control runoff and reduce flooding efficiency.
- The Coordinated Watershed Planning Program alternative is good but building dams need not be part of this alternative to achieve better flood control.
- Plans that are developed should be voluntary and incentive driven.
- Landowners need to be made aware of the opportunities that can to derived through this program.
- "No Action" is NOT a viable option.
- Put an additional 500 head of cattle on every hillside; keep up the tradition!
- Need some cost-share incentive. Changes in tillage practices DO cost $$ for equipment. The tenant will bear all this cost.
- Real estate tax adjustments when projects are completed.
- Stop farmers from farming too close to ditches and streambanks
- Use of Jordan Slough and ditching to run flood water on east side of Villa Grove and back into Embarras River south of town.
- Set up annual maintenance on upper Embarrass to keep log jams cleared from river.
- County taxing bodies should be approached to give tax relief on acreage put into permanent filter strips, wetlands, grass buffers and reforestation.
- Use buffer strips along rivers & streams
- Increase no-till but with strict limitation on increased use of chemicals, i.e.. 1/3 of recommended rates by input suppliers.
- Alternate cover crops to increase soil fertility without fertilizer.
- Tax incentives for conservation tillage and highly erodible land.
- Long term set-aside acreage.
- Increase storage terraces.
- Increasing capacity of river by restoring the original depth plus streambank stabilization and no-till would help immensely.
- Do away with the worst areas of crooked river banks, dog legs, horseshoes, and switchbacks.

COUNTYNAME:.	SITENAME.....................................	TRS.ALL...	RATINGCOM..
Lawrence	ALLISON DITCH	004N011W24	
Edgar	BABER WOODS	012N013W18	Baber Woods is an Illinois Nature Preserve. The area includes 44 acres of very high quality upland forest.
Coles	CENTER SCHOOL GEOLOGICAL AREA	011N010E15	A streambank on the West Branch of the Embarras River displays an outstanding section of the Sangamon Soil in the Center School Geological Area.
Lawrence	CENTERVILLE CEMETERY	004N011W25	
Lawrence	CHAUNCEY MARSH	005N012W19	Chauncey Marsh is a large, diverse area on the Embarras River. The natural area includes a high quality marsh.
Crawford		005N012W30	
		005N013W25	
		005N013W36	
Jasper	EMBARRAS RIVER	005N014W04	The Embarras River from Lake Charleston to the Jasper/Richland county line is a large natural stream 25 to 75 feet in width. The substrate consists of sand and gravel with some bedrock, cobble, and silt present. Stream habitats include extensive stretches of sand bottom, deep pools, abrupt bends, fast riffles, sandy and gravelly raceways, and sand bars. A high diversity of mussels is also present. The tree lined riparian zone ranging from zero to 50 feet gives way to row crop agriculture.
Cumberland		005N014W05	
Coles		005N014W08	
		005N014W16	
		005N014W17	
		005N014W21	
		006N014W30	
		006N014W31	
		006N014W32	
		006N014W33	
		006N011E07	
		006N011E18	
		006N011E19	
		006N010E01	
		006N010E02	
		006N010E04	
		006N010E05	
		006N010E06	
		006N010E08	
		006N010E09	
		006N010E10	
		006N010E11	
		006N010E12	
		007N010E31	
		006N009E01	
		007N009E02	
		007N009E03	
		007N009E10	
		007N009E11	
		007N009E14	
		007N009E22	

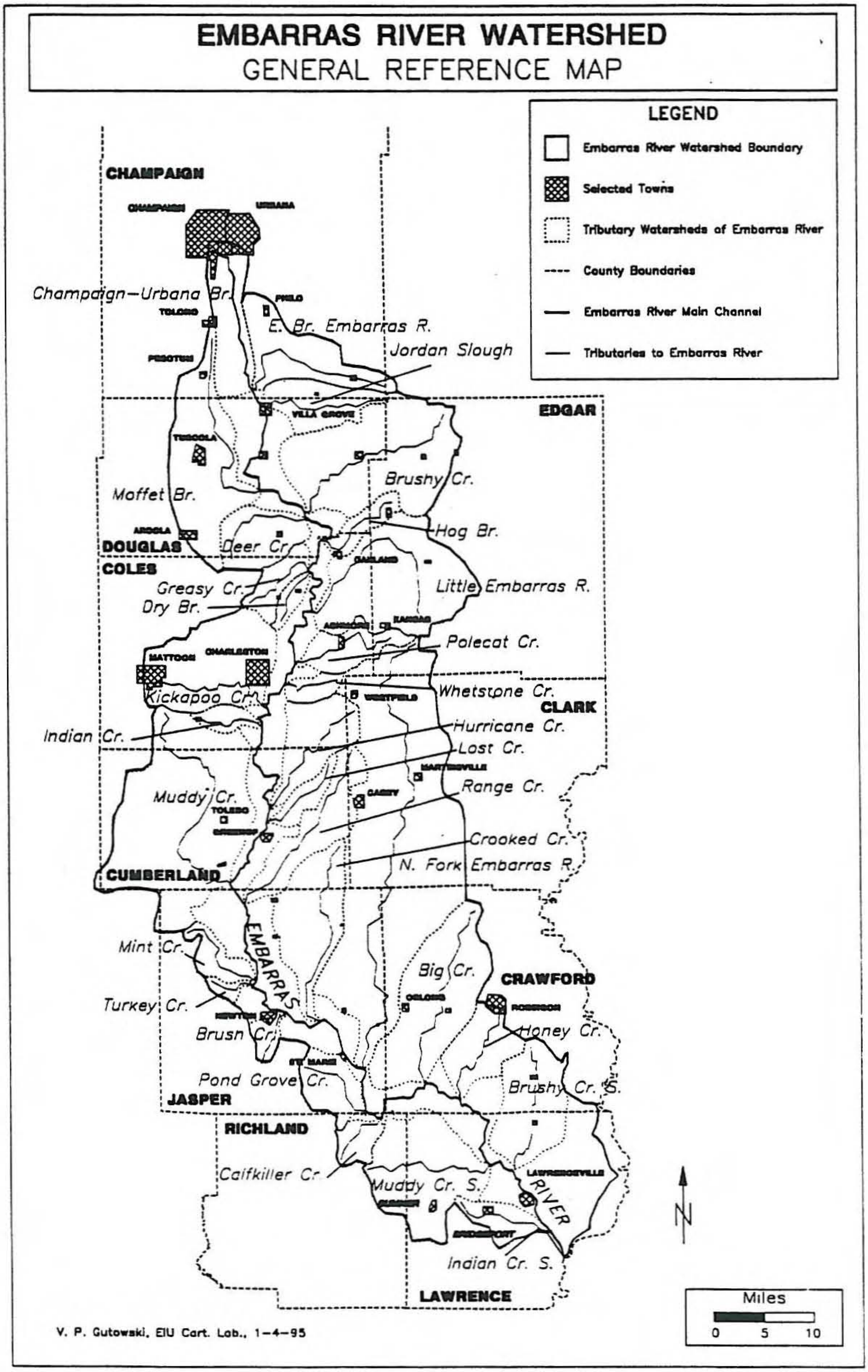
		007N009E23	
		007N009E25	
		007N009E36	
		008N009E03	
		008N009E04	
		008N009E10	
		008N009E15	
		008N009E21	
		008N009E22	
		008N009E27	
		008N009E28	
		008N009E34	
		009N009E02	
		009N009E03	
		009N009E10	
		009N009E16	
		009N009E20	
		009N009E21	
		009N009E28	
		009N009E29	
		009N009E30	
		009N009E31	
		009N009E32	
		010N009E01	
		010N009E02	
		010N009E11	
		010N009E12	
		010N009E13	
		010N009E14	
		010N009E23	
		010N009E24	
		010N009E25	
		010N009E26	
		010N009E35	
		010N010E06	
		010N010E07	
		011N009E01	
		011N009E02	
		011N009E11	
		011N009E13	
		011N009E14	
		011N009E22	
		011N009E23	
		011N009E26	
		011N009E27	
		011N009E34	
		011N009E35	
		012N009E25	
		012N009E26	
		012N009E35	
		012N009E36	
Douglas	EMBARRAS RIVER - CAMARGO	015N009E02	The Embarras River from U.S. Rt.36 to North of Charleston is a medium-sized natural stream 25 to 50 feet in width. The substrate consists of sand and gravel with some bedrock, cobble, and silt. A high diversity fo mussels are present. The tree lined riparian zone ranging from zero to 50 feet gives way to row crop agriculture.
Coles		015N009E03	

		015N009E04	
		015N009E10	
		015N009E11	
		015N009E12	
		015N009E13	
		015N009E14	
		015N010E18	
		015N010E19	
		015N010E20	
		015N010E21	
		015N010E28	
		015N010E29	
		015N010E33	
		015N010E34	
		015N010E35	
		014N010E01	
		014N010E02	
		014N010E11	
		014N010E12	
		014N010E14	
		014N010E15	
		014N010E22	
		014N010E23	
		014N010E27	
		014N010E28	
		014N010E34	
		014N010E35	
		013N010E03	
		013N010E09	
		013N010E10	
		013N010E15	
		013N010E16	
		013N010E20	
		013N010E21	
		013N010E29	
		013N010E30	
		013N010E31	
		013N010E32	
Coles	FIVE-MILE HILL PRAIRIE	011N009E01	Five-mile Hill Prairie is a very high quality prairie opening on a steep slope above the Embarras River.
Jasper	GRANDVILLE WOODS	008N014W34	Grandville Woods is a 67-acre forest in the bottomland of the North Fork of the Embarras River. The high and very high quality forest provides habitat for the endangered buckwheat vine Polygonum arifolium.
Clark	HAMMOND'S WOODS	011N013W07	Hammond's Woods includes three tracts of high to very high quality upland and bottomland forest, totaling 193 acres. This land, along the North Fork of the Embarras River and Doyles Creek, is protected in private ownership.
		011N014W12	
Coles	HILLSIDE MARSH	012N010E04	The Hillside Marsh is a group of natural seepage areas on a tributary to the Embarras River. The seep has many unusual plants, including some that are far from their normal range, such as poison sumac.
Jasper	HUDDLESTON WOODS	008N010E13	Huddleston Woods is a 40-acre woodlot with high quality

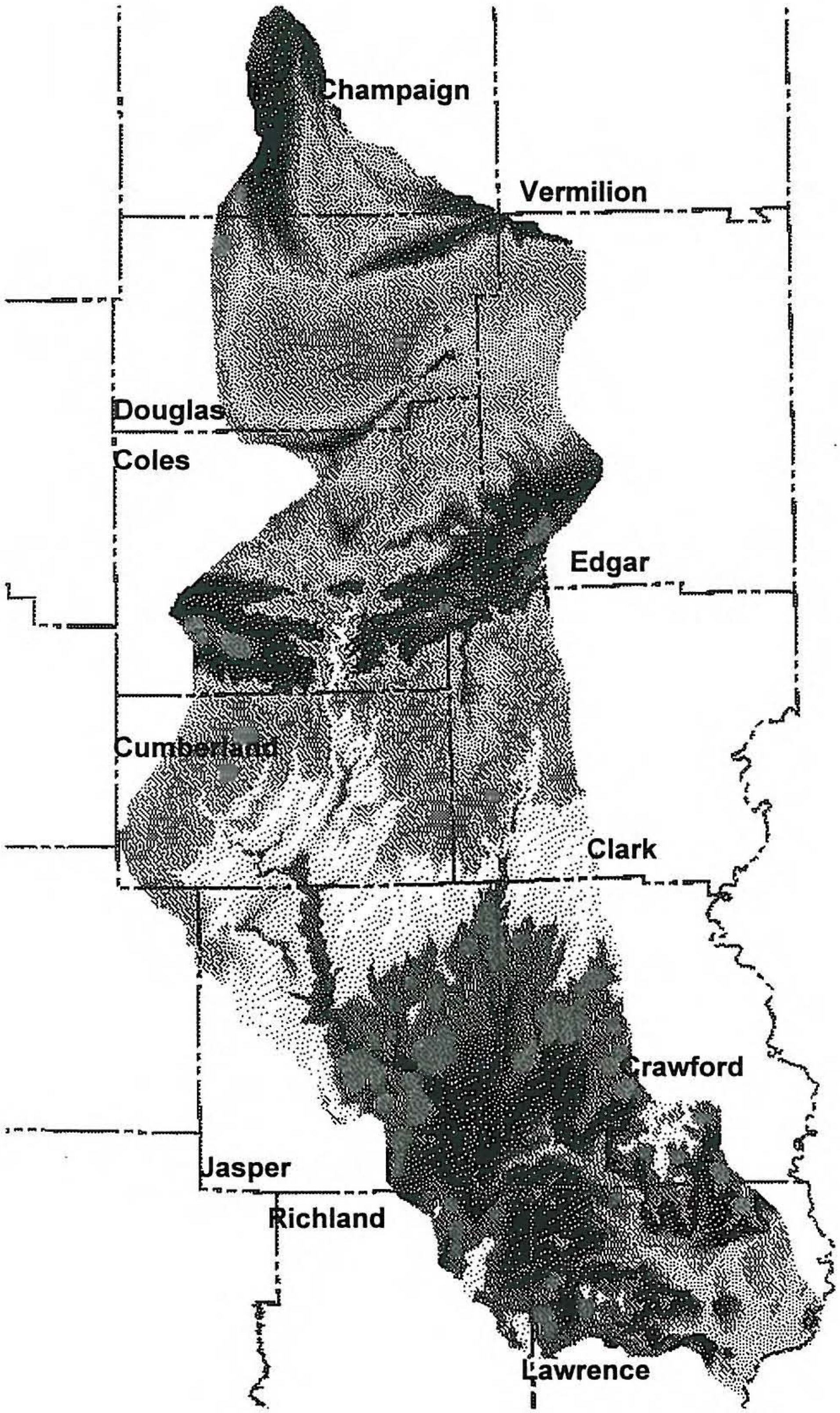
			upland forest.
Coles	HUTTON GEOLOGICAL AREA	011N010E22	A streambank in the Hutton Geological Area has an outstanding exposure of the Illinoian Till Plain formations.
Cumberland	JEWETT GEOLOGICAL AREA	009N009E31	A roadcut south of Jewett exposes an outstanding section of Illinoian and Kansan formations in this geological area.
Lawrence	LAWRENCEVILLE AIRPORT	004N011W22 004N011W23 004N011W26 004N011W27	
Douglas	MURDOCK RAILROAD PRAIRIE	016N010E36	The Baltimore and Ohio Railroad owns this only high quality railroad prairie in Douglas County.
Lawrence	RED HILLS SEEP SPRINGS	004N013W34	
Lawrence	RED HILLS WOODS	003N013W02	Red Hills Woods has a 26-acre area of high quality upland forest.
Clark	REDMAN'S FOREST	011N014W25	Redman's Forest is 23-acre, high quality forest on the banks of the North Fork of the Embarras River.
Coles	SARGENT'S WOODS	011N010E11	Sargent's Woods has 57 acres of high quality upland forest.
Jasper	STEBER'S WOODS	005N014W07	Steber's Woods is a 40-acre woodlot in the Embarras River bottomland with a high quality forest.
Coles	STEVENS HILL PRAIRIE	012N009E26	Stevens Hill Prairie is a very high quality hill prairie on a scenic overlook above the Embarras River.
Coles	STODDARD HILL PRAIRIE	012N010E06	Stoddard Hill Prairie is a very high quality prairie opening on the steep slope of a tributary to the Embarras River.
Lawrence	THACKER-PAULEY MARSH	005N013W33	The Thacker--Pauley Marsh is a very high quality marsh at the edge of the Slough in the Embarras River bottoms.
Douglas	WALNUT POINT	015N010E35 015N010E36 014N010E01 014N010E02	Walnut Point State Park has a large area of medium and high quality upland forest along the Embarras River.
Coles	WATER WORKS HILL PRAIRIE	012N009E24	The Water Works Hill Prairie is a very high quality prairie opening in a steep ravine leading to Lake Charleston.

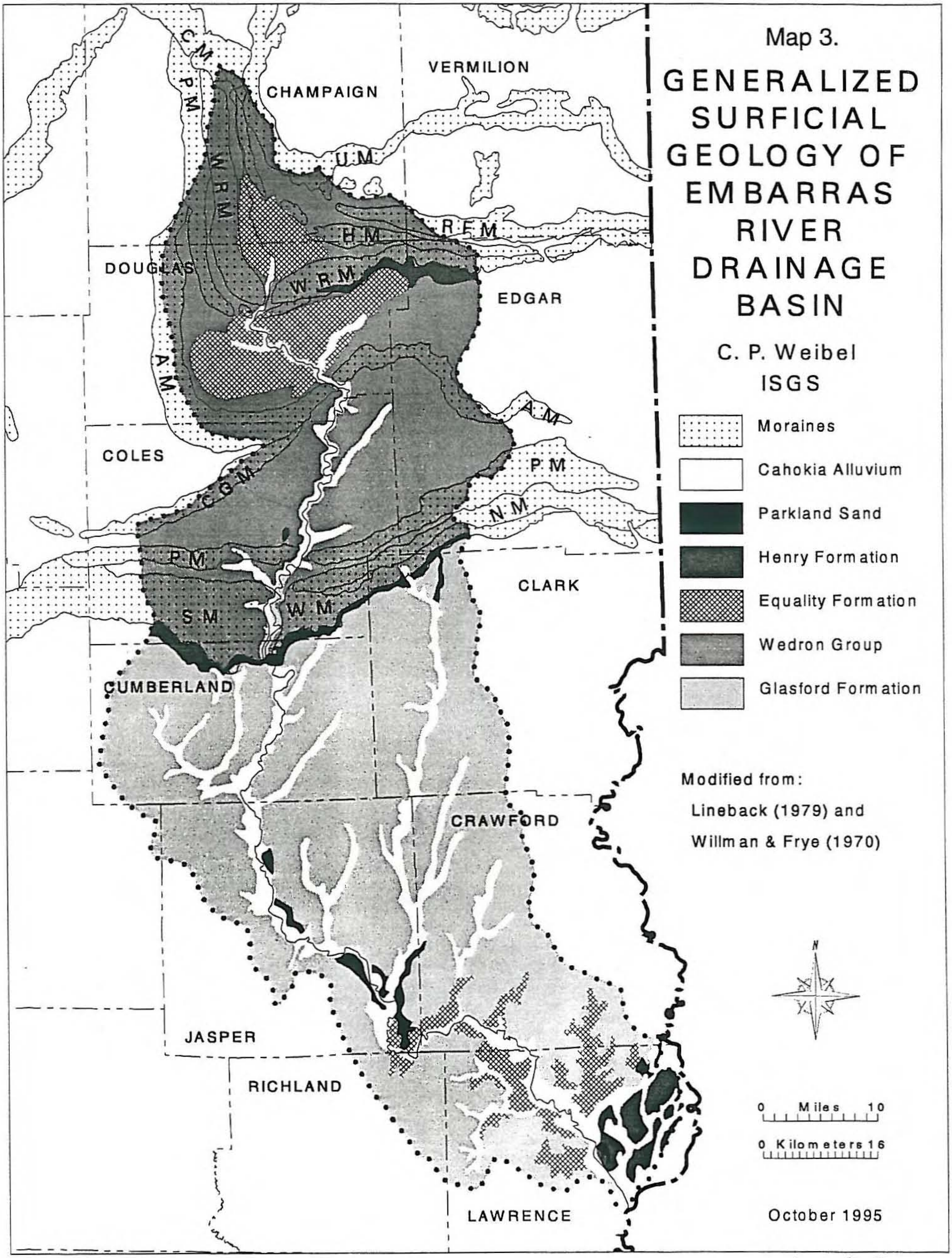
APPENDIX C. MAPS

Map 1.


EMBARRAS RIVER WATERSHED
GENERAL REFERENCE MAP
LEGEND
Embarras River Watershed Boundary
Selected Towns
Tributary Watersheds of Embarras River
County Boundaries
Embarras River Main Channel
Tributaries to Embarras River
CHAMPAIGN
Champaign–Urbana Br.
E. Br. Embarras R.
Jordan Slough
EDGAR
VILLA GROVE
Brushy Cr.
Moffet Br.
Hog Br.
DOUGLAS
Deer Cr.
COLES
Greasy Cr.
Dry Br.
Little Embarras R.
Polecat Cr.
MATTOON
CHARLESTON
Kickapoo Cr.
Whetstone Cr.
CLARK
Indian Cr.
Hurricane Cr.
Lost Cr.
Range Cr.
Muddy Cr.
TOLEDO
Crooked Cr.
N. Fork Embarras R.
CUMBERLAND
EMBARRAS
Mint Cr.
Big Cr.
CRAWFORD
Turkey Cr.
Brush Cr.
Honey Cr.
Pond Grove Cr.
Brushy Cr. S.
JASPER
RICHLAND
Calfkiller Cr.
Muddy Cr. S.
RIVER
Indian Cr. S.
LAWRENCE
N
Miles
0 5 10
V. P. Gutowski, EIU Cart. Lab., 1-4-95

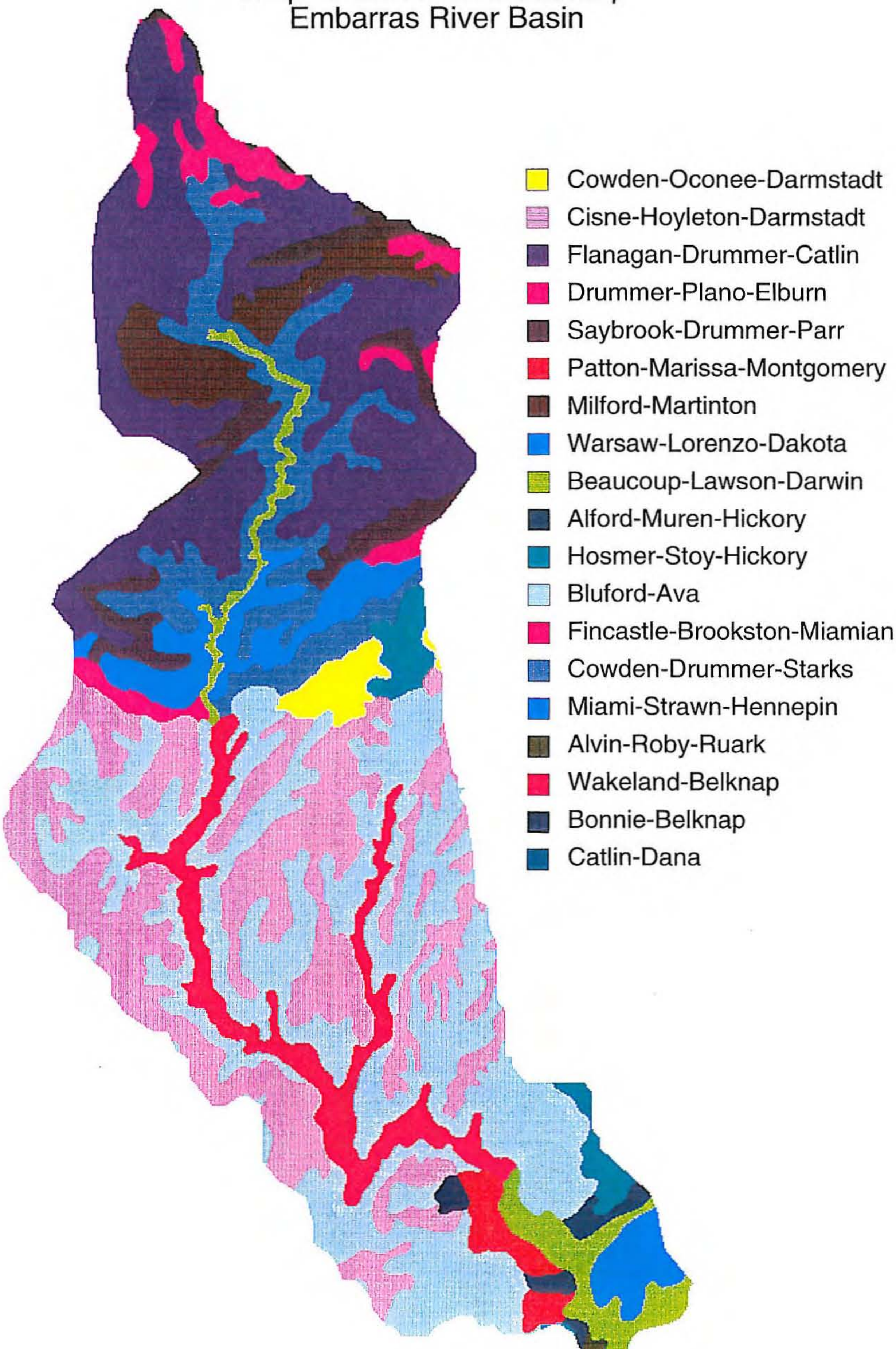
Map 2. Relief Map
Embarras River Basin



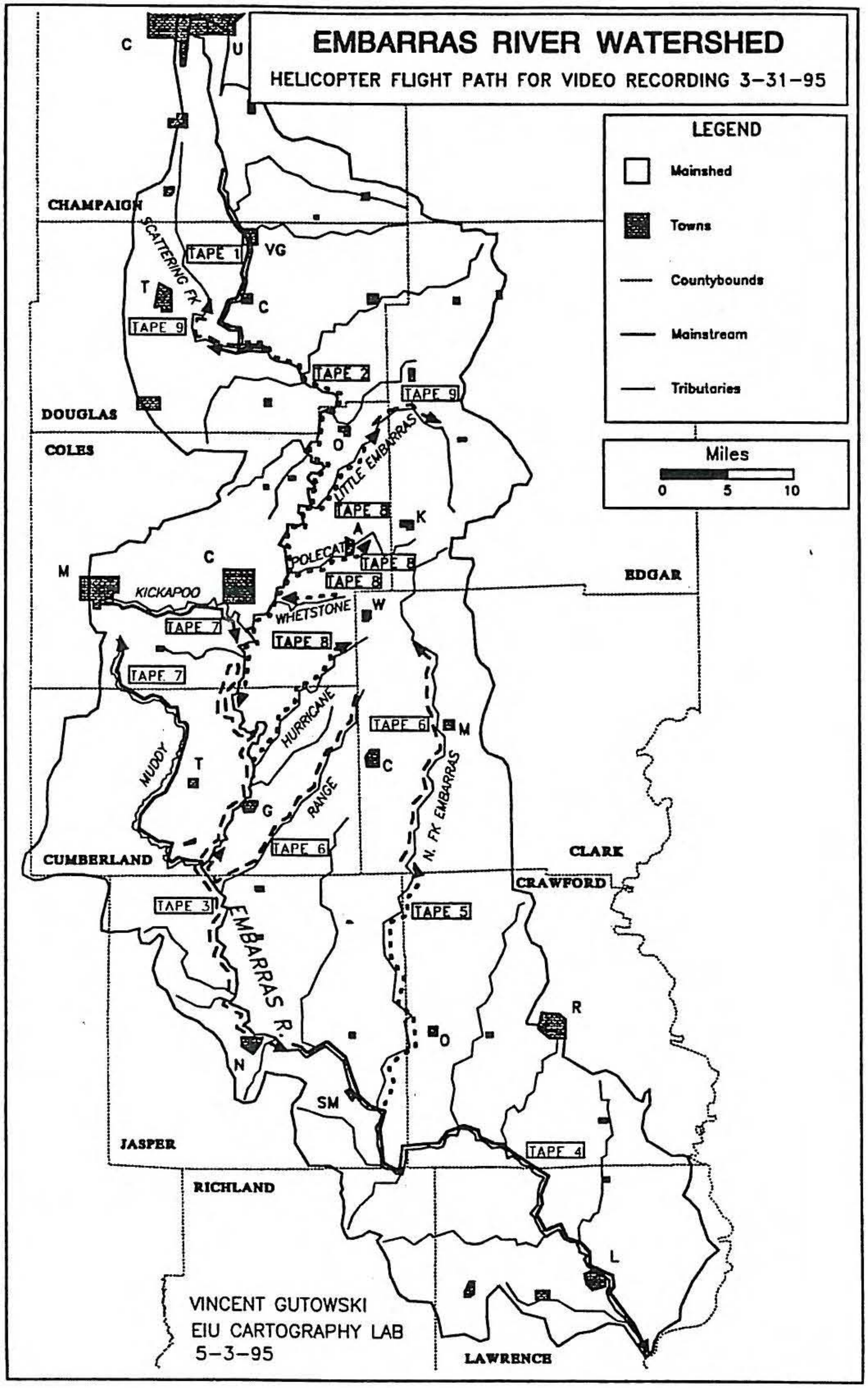


Map 3.
GENERALIZED SURFICIAL GEOLOGY OF EMBARRAS RIVER DRAINAGE BASIN
C. P. Weibel
ISGS
Moraines
Cahokia Alluvium
Parkland Sand
Henry Formation
Equality Formation
Wedron Group
Glasford Formation
Modified from:
Lineback (1979) and
Willman & Frye (1970)
0 Miles 10
0 Kilometers 16
October 1995
VERMILION
CHAMPAIGN
DOUGLAS
EDGAR
COLES
CLARK
CUMBERLAND
CRAWFORD
JASPER
RICHLAND
LAWRENCE
C M
P M
W R M
U M
R F M
H M
A M
C G M
N M
S M
W M

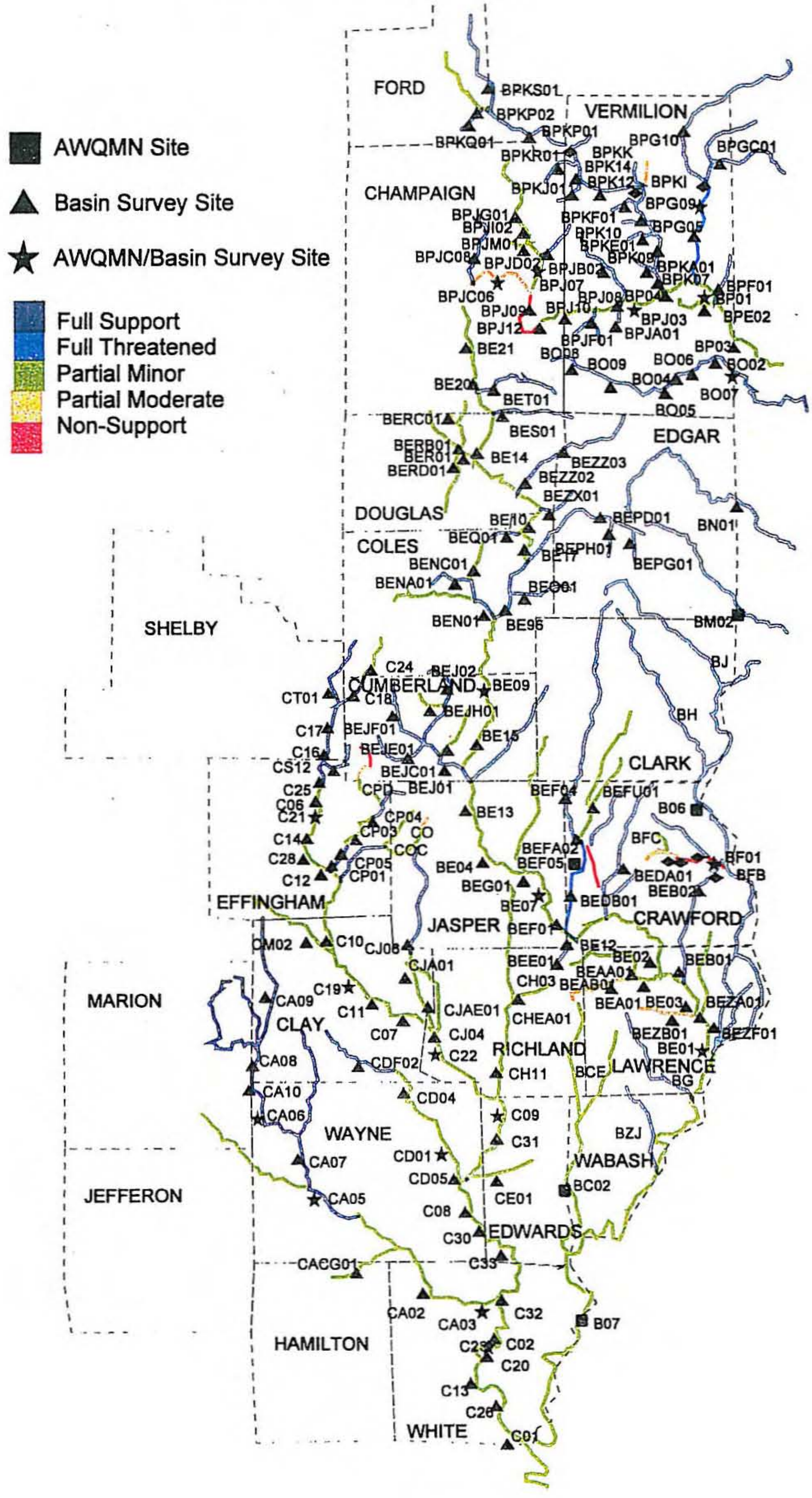
Map 4. Soil Association Map
Embarras River Basin



Map 5.


EMBARRAS RIVER WATERSHED
HELICOPTER FLIGHT PATH FOR VIDEO RECORDING 3-31-95
LEGEND
Mainshed
Towns
Countybounds
Mainstream
Tributaries
Miles
0
5
10
CHAMPAIGN
DOUGLAS
COLES
EDGAR
CLARK
CRAWFORD
CUMBERLAND
JASPER
RICHLAND
LAWRENCE
SCATTERING FK
LITTLE EMBARRAS
POLECAT
KICKAPOO
WHETSTONE
HURRICANE
MUDDY
RANGE
N. FK EMBARRAS
EMBARRAS R.
TAPE 1
TAPE 2
TAPE 3
TAPE 4
TAPE 5
TAPE 6
TAPE 7
TAPE 8
TAPE 9
C
U
VG
T
O
A
K
M
W
G
R
N
SM
L
VINCENT GUTOWSKI
EIU CARTOGRAPHY LAB
5-3-95

Map 6. Degree of Overall Use Support for the Wabash River Basin



Map 6.
Overall Use Support Legend

B	Wabash R.	BM	Sugar Cr.
BZJ	Crawfish Cr.	BN	Brouilletts Cr.
BC	Bonpas Cr.	BO	Little Vermilion R.
BCE	Little Bonpas Cr.	BP	Vermilion R.
BE	Embarras R.	BPE	Grape Cr.
BEA	Muddy Cr.	BPF	Stoney Cr.
BEAA	The Slough	BPG	N. Fk. Vermilion R.
BEAB	Paul Cr.	BPGC	Jordan Cr.
BEB	Brushy Cr.	BPJ	Salt Fk. Vermilion R.
BED	Big Cr.	BPJG	Upper Salt Fork
BEDA	Little Cr.	BPJA	Jordan Cr.
BEDB	Dogwood Cr.	BPJB	Stoney Cr
BEE	Calfkiller Cr.	BPJC	Saline Br.
BEF	N. Fk. Embarras R.	BPJD	Spoon Br.
BEFA	Willow Cr.	BPJF	Olive Branch
BEFU	Muddy Cr.	BPJI	Flatville Br.
BEG	Crooked Cr.	BPJM	Union Dr. Ditch
BEI	Range Cr.	BPK	Mid. Fk. Vermilion R.
BEJ	Muddy Cr.	BPKA	Glenburn Cr.
BEJC	Cottonwood Cr.	BPKE	Collison Br.
BEJE	Spring Point Cr.	BPKF	Knights Br.
BEJF	Mule Cr.	BPKI	Bluegrass Cr.
BEJH	Bear Cr.	BPKJ	Buck Cr.
BEN	Kickapoo Cr.	BPKK	Sugar Cr.
BENA	Riley Cr.	BPKP	Big Four Ditch
BENC	Cassel Cr.	BPKQ	Big Four Ditch trib.
BEO	Polecat Cr.	BPKR	Kerr Cr.
BEP	Little Embarras Cr.	BPKS	Wall Town Ditch
BEPD	Catfish Cr.	C	Little Wabash R.
BEPG	Drain Ditch #7	CZS	Blue Point Cr.
BEPH	Hickory Grove Cr.	CA	Skillet Fk.
BEQ	Greasy Cr.	CAGC	Auxier Ditch
BER	Scattering Fk.	CAN	Horse Cr.
BERB	Hackett Branch	CAR	Brush Cr.
BERC	Hayes Branch	CAW	Dums Cr.
BERD	Spoil Bank trib.	CAY	Lost Fk.
BES	Jordan Slough	CD	Elm R.
BET	E. Br. Embarras R.	CDF	Raccoon Cr.
BEZA	Beaver Pond Ditch	CE	Village Cr.
BEZB	Indian Cr.	CH	Fox R.
BEZF	Allison Ditch	CHEA	Big Cr.
BEZX	Hog Branch	CJ	Big Muddy Cr.
BEZZ	Brushy Fk.	CJA	Little Muddy Cr.
BF	Sugar Cr.	CM	Dismal Cr.
BFB	Lamotte Cr.	CO	Bishop Cr.
BFC	Robinson Cr.	COC	Dieterich Cr.
BFCB	Quail Cr.	CP	Salt Cr.
BG	Raccoon Cr.	CPD	Second Salt Cr.
BH	Mill Cr.	CS	Green Cr.
BJ	Big Cr.	CT	West Branch

Map 7.
Illinois Sediment Yield Rate Subareas