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Little Calumet River Watershed Management Plan

The Little Calumet River Watershed (Group) exists to effectively and aggressively reduce pollutant loads in the subwatersheds of the Little Calumet River through coordinated planning, public education, and structural BMP implementation.

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Glossary of Terms

303(d) List - a list identifying waterbodies that are impaired by one or more water quality elements there by limiting the performance of designated beneficial uses.

Aquifer - Any geologic formation containing water, especially one that supplies water for wells, springs, etc.

Best Management Practice (BMP) - Practices implemented to control or reduce non-point source pollution.

Canopy Cover - The overhanging vegetation over a given area.

Channelization - Straightening of a stream; often the result of human activity.

Clean Water Act - The primary federal law in the United States governing water pollution. Commonly abbreviated as the CWA, the act established the symbolic goals of eliminating releases to water of high amounts of toxic substances and ensuring that surface waters would meet standards necessary for human sports and recreation.

Coliform - Intestinal waterborne bacteria that indicate fecal contamination. Exposure may lead to human health risks.

Combined sewer Overflow (CSO) - outlets that dump excess water from the sewers into streams and rivers, keeping the sewers from backing up into homes, business and streets when it rains.

Conservation Design - A development approach that seeks to protect natural resources from development impacts by taking existing landscape, drainage, and natural features into consideration.

Continental Divide - The name given to the North American portion of the mountainous ridge which separates the watersheds that drain into the Pacific Ocean from rivers which drain into the Atlantic Ocean and the Arctic Ocean.

Designated Uses - State-established uses that waters should support (e.g. fishing, swimming, acquatic life).

Detention Pond - A basin designed to slow the rate of stormwater run-off by temporary storing the run-off and releasing it at a specific rate.

Dissolved Oxygen (DO) - Oxygen dissolved in water that is available for aquatic organisms.

Downstream - In the direction of a stream's current.

Dredge - To clean, deepen, or widen a waterbody using a scoop, usually done to remove sediment from a streambed.

Easement - A right, such as a right of way, afforded an entity to make limited use of another's real property.

Ecoregion - A geographic area characterized by climate, soils, geology, and vegetation.

Ecosystem - A community of living organisms and their interrelated physical and chemical environment.

Erosion - The removal of soil particles by the action of water, wind, ice, or other agent.

Escherichia Coli (*E. coli*) - A type of coliform bacteria found in the intestines of warm-blooded organisms, including humans.

Exotic Species - An introduced species not native or endemic to the area in question.

Gradient - Measure of a degree of incline; the steepness of a slope.

Groundwater - Water that flows or seeps downward and saturates soil or rock.

Headwater - The origins of a stream.

Heavy Metals - The group of elements between copper and bismuth on the periodic table of the elements having specific gravities greater than 4.0. The most common ones in municipal permits are cadmium, chromium, copper, nickel, lead, mercury, and zinc.

Hydrologic Unit Code (HUC) - Unique numerical code created by the U.S. Geological Survey to indicate the size and location of a watershed within the United States. Based on four separate divisions ranging in size from regions, sub-regions, accounting units, and cataloging units.

Impervious Surface - Any material covering the ground that does not allow water to pass through or infiltrate (e.g. roads, driveways, roofs).

Infiltration - Downward movement of water through the uppermost layer of soil.

Low Impact Development (LID) - A development approach that utilizes a variety of natural or built features to promote sound management of stormwater.

Macroinvertebrates - Animals lacking a backbone that are large enough to see without a microscope.

Maximum Contaminant Level (MCL) - The highest level of a contaminant that is allowed in drinking water.

Moraine - any glacially formed accumulation of unconsolidated debris which can occur in currently glaciated and formerly glaciated regions.

National Pollutant Discharge Elimination System (NPDES) - National program in which pollutant discharges such as factories and treatment plants are given permits with set limits of discharge allowable.

Nonpoint Source Pollution (NPS) - Pollution generated from large areas with no identifiable source (e.g., stormwater run-off from streets, development, commercial and residential areas).

Permeable - Capable of conveying water (e.g., soil, porous materials).

Point Source Pollution - Pollution originating from a "point," such as a pipe, vent, or culvert.

Pollutant - As defined by the Clean Water Act (Section 502(6)): "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wreaked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water."

Polychlorinated Biphenyls (PCB's) - Any of a family of individual compounds produced by chlorination of biphenyl, noted primarily as an environmental pollutant that accumulates in animal tissue with resultant pathogenic and teratogenic effects.

Pool - An area of relatively deep, slow moving water in a stream.

Retention Pond - A basin designed to retain stormwater run-off so that a permanent pool is established.

Riffle - An area of shallow, swift moving water in a stream.

Riparian Zone - An area, adjacent to a water body, which is often vegetated and constitutes a buffer zone between the nearby land and water.

Run-off - Water from precipitation, snowmelt, or irrigation that flows over the ground to a waterbody. Run-off can pick up pollutants from the air or land and carry them into streams, lakes, and rivers.

Sediment - Soil, sand, and minerals washed from the land into a waterbody.

Sedimentation - The process by which soil particles (sediment) enter, accumulate, and settle to the bottom of a waterbody.

Septic System - A small scale sewage treatment system common in areas with no connection to main sewerage pipes.

Soil Association - A landscape that has a distinctive pattern of soils in defined proportions. Typically named for the major soils.

Steering Committee - Group of individuals responsible for the development of the procedures and policies to improve the overall water quality of the Little Calumet River and its tributaries.

Storm Drain - Constructed opening in a road system through which run-off from the road surface flows on its way to a waterbody.

Stormwater - The surface water run-off resulting from precipitation falling within a watershed.

Substrate - The material that makes up the bottom layer of a stream.

Topographic Map - Map that marks variations in elevation across a landscape.

Topography - The study of Earth's surface features, concerned with local detail in general, including not only relief but also vegetative and human-made features

Total Maximum Daily Load (TMDL) - Calculation of the maximum amount of a pollutant that a waterbody can receive before becoming unsafe and a plan to lower pollution to that identified safe level.

Tributary - A stream that contributes its water to another stream or waterbody.

Turbidity - Presence of sediment or other particles in water, making it unclear, murky, or opaque.

Upstream - Against the current.

Valparaiso Moraine -

Water Quality - The condition of water with regard to the presence or absence of pollution.

Water Quality Standard - Recommended or enforceable maximum containment levels of chemicals or materials in water.

Watershed - The area of land that water flows over or under on its way to a common point.

Wetlands - Lands were water saturation is the dominant factor in determining the nature of soil development and the types of plant and animal communities.

Zoning - To designate, by ordinance, areas of land reserved and regulated for specific uses, such as residential, industrial, or open space.

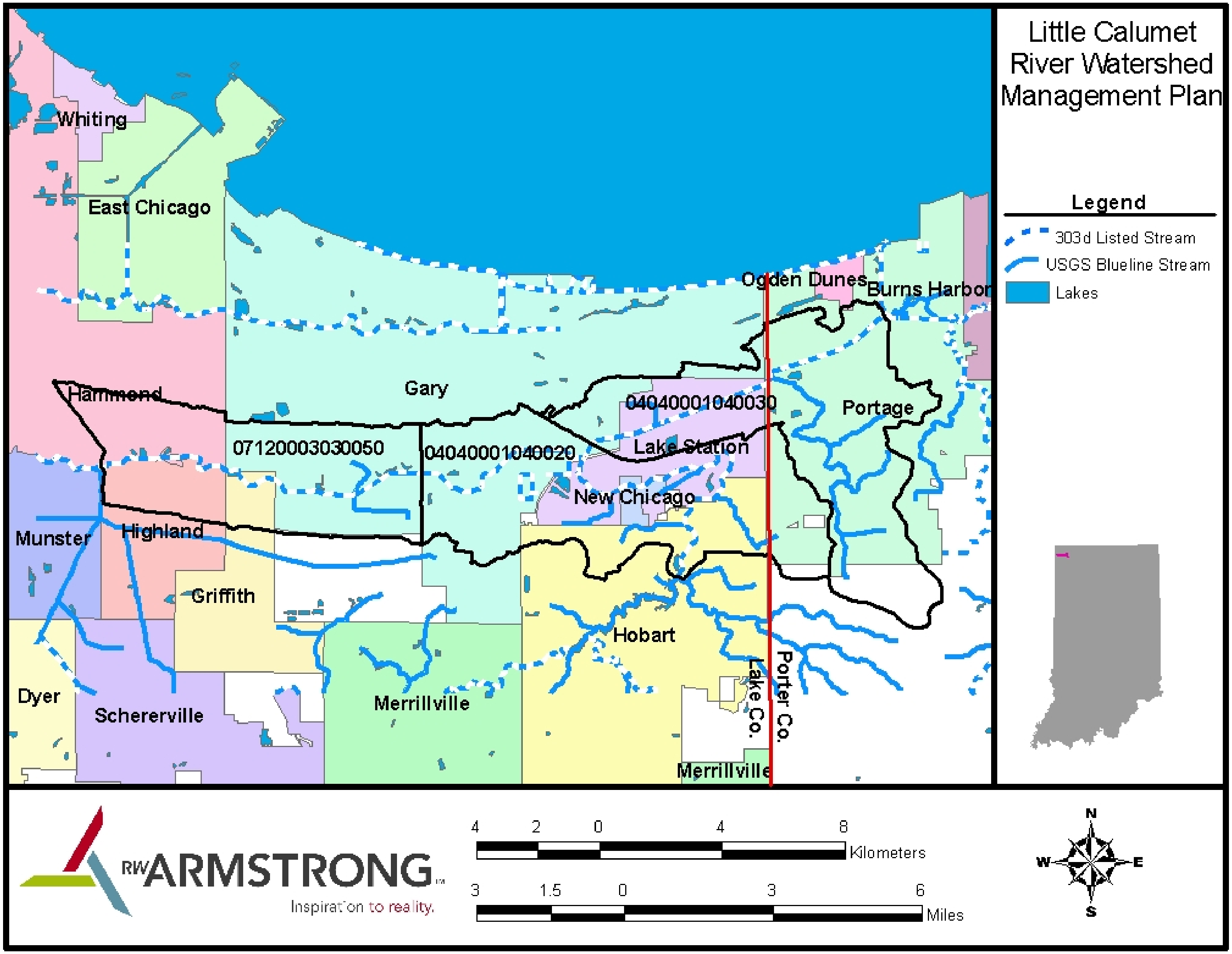
Acronyms

ACOE	Army Corps of Engineers
BMP	Best Management Practice
BOD	Biological (or Biochemical) Oxygen Demand
CWA	Clean Water Act
CWP	Center for Watershed Protection
EPA	Environmental Protection Agency
FCA	Fish Consumption Advisory
GAP	Gap Analysis Program
GIS	Geographic Information System
GPS	Global Positioning System
GSWMD	Gary Storm Water Management District
HUC	Hydrologic Unit Code
INDOT	Indiana Department of Transportation
IAC	Indiana Administrative Code
IDEM	Indiana Department of Environmental Management
IDNR	Indianan Department of Natural Resources
ISDA	Indiana State Department of Agriculture
ISS	Individual Septic System
LARE	Lake and River Enhancement
MRCC	Midwestern Regional Climate Center
NIRPC	Northwestern Indian Regional Planning Commission
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NRCS	Natural Resources Conservation Service
NWI	National Wetland Inventory
OSDS	On-site Sewage Disposal Systems
PCB	Polychlorinated Biphenyls
SSC	Suspended Sediment Concentration
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFW	United States Fish and Wildlife
USGS	United States Geological Survey
WWTP	Wastewater Treatment Plant
E.coli	Escherichia coli
NH3	Ammonia
NO3	Nitrate
TP	Total Phosphorus
Ortho-P	Ortho Phosphorus, TSS: Total Suspended Solids
TP	Total Phosphorus
TSS	Total Suspended Solids
TKN	Total Kjeldahl Nitrogen

Executive Summary

To be written later.

This plan has been developed over the course of 15 months by the Steering Committee and its consultants. Eight steering committee meetings have been held with two of them advertised to the public for public input. The overall process closely followed the Indiana Watershed Planning Guide.


Little Calumet River Watershed Management Plan
Legend
303d Listed Stream
USGS Blueline Stream
Lakes
Whiting
East Chicago
Gary
Hammond
07120003030050
04040001040020
04040001040030
Lake Station
New Chicago
Ogden Dunes
Burns Harbor
Portage
Munster
Highland
Griffith
Dyer
Schererville
Merrillville
Hobart
Lake Co.
Porter Co.
Merrillville
RW ARMSTRONG
Inspiration to reality.
4 2 0 4 8
Kilometers
3 1.5 0 3 6
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Section I: Project Introduction

The Gary Storm Water Management District (GSWMD) submitted an application for a Clean Water Act Section 319 grant for the Little Calumet River. After some negotiation with the Indiana Department of Environmental Management (IDEM), the grant was approved on _________________. The grant application stated the purpose was to identify pollutant contributions to the Western Branch of the Little Calumet River resulting from inappropriate or failed on-site sewage disposal systems, stream bank erosion and aquatic habitat degradation; and polluted runoff from land development. The approach required by IDEM as part of the grant negotiations included a watershed wide study of this problem.

The majority of the funding for this project came form a Section 319 grant in response to the previously mentioned application with the matching funds coming form the City of Gary.

Designating the Study Area

A watershed is an area of land that water flows over or under on its way to a common point. Watersheds can be extremely large, covering thousands of square miles, or they can be small, covering areas measured only in square feet. Larger watersheds contain many smaller watersheds within them.

In the United States, watersheds are identified using a hierarchical coding system, Hydrologic Unit Codes (HUC), developed in the mid-1970's by the U. S. Geological Survey (USGS). Based on topographical surface features, this system divided the country into successively smaller hydrologic units with the smaller units contained inside the larger units. These units are broken down into four levels from largest to smallest: regions, sub-regions, accounting units, and cataloging units. A unique number was assigned to identify each level by starting with the region level. To designate different sub-regions within each region, more digits were added to the region number.

The first level of classification divides the United States into 21 regions. Figure 1.1 shows these 21 regions as they are distributed over the country. Each region is then divided into sub-regions, totaling in the United States. The third level of classification divides the nation into 378 accounting units contained within the sub-regions. The fourth level of classification subdivides many of the accounting units into cataloguing units. There are 2,264 cataloguing units in the United States. The cataloguing unit is the smallest unit within this classification system and is commonly referred to as 14-digit watersheds; though efforts are underway to further subdivide the cataloguing units.

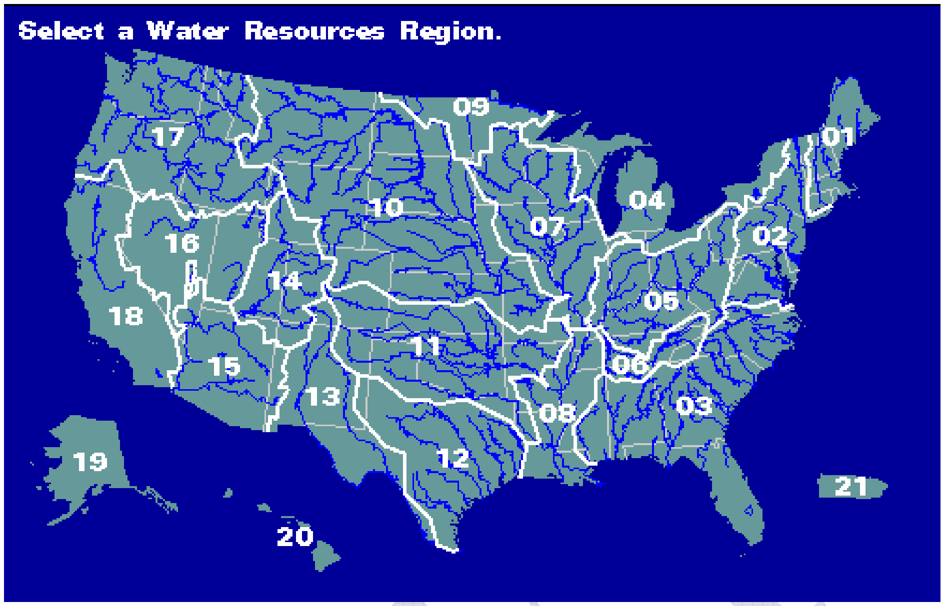

Figure 1.1 Hydrologic Unit Codes 21 regions over the United States.

The three 14 digit HUC watersheds specifically identified for consideration in the watershed management plan are:

071200003030050 – Little Calumet River East-West Split
04040001040020 – Deep River – Little Calumet River
04040001040030 –Burns Ditch - Willow Creek

The watersheds covered by this study consist of the West Branch Little Calumet River and Willow Creek. The Little Calumet River includes areas to the east in the City of Portage and west in the City of Hammond and the Town of Highland. Figure 1.2 shows the three HUC watersheds and how they fit into the local communities. The unique location of this river segment crosses the continental divide. It is at this point that the river flow splits and drains east towards the Great Lakes and west towards the Mississippi River.

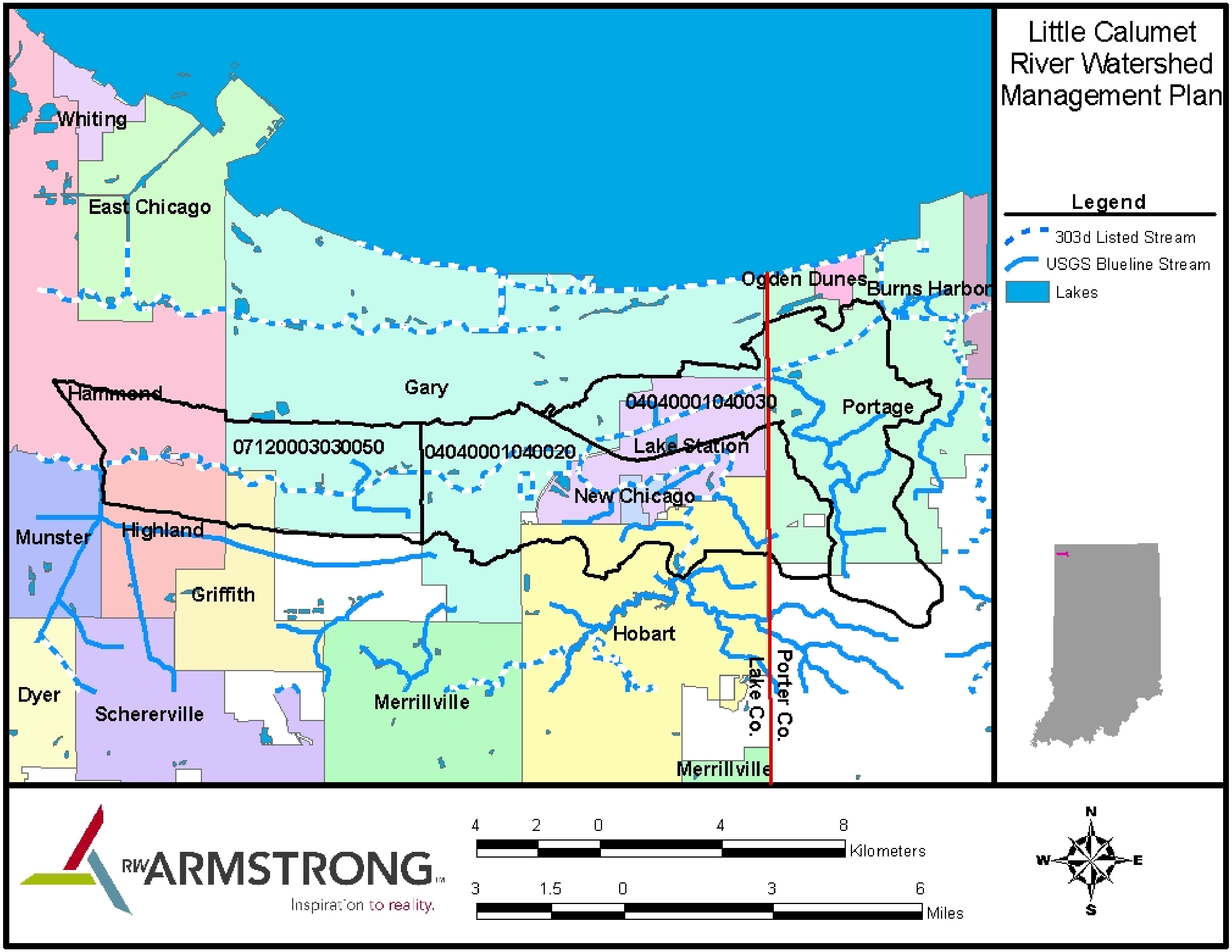

Figure 1.2: Watershed management study area with three 14-digit HUC watersheds delineated.

Building Partnerships

The Gary Storm Water Management District (GSWMD) invited all of the communities and a number of environmental groups located or effected by the watershed to participate in a steering committee. This invitation was in the form a letter sent via U.S. Mail in late summer 2006. A copy of this letter is included in Appendix 1: Stakeholders Invitation. This letter was sent to:

- City of Hammond
- Town of Munster
- Town of Highland
- Town of Griffith
- City of Hobart
- City of Lake Station
- City of Portage
- City of Crown Point
- Lake County
- Porter County
- Save the Dunes Council
- Little Calumet River Basin Development Committee
- Wildlife Habitat Council
- Northwestern Indiana Regional Planning Commission
- Lake Michigan Coastal Program
- Lake County Soil & Water Conservation District

The Steering Committee of the Little Calumet River Watershed Management Plan was ultimately composed of representatives from state and local agencies with jurisdiction over at least part of the watershed as well as local groups, businesses, and citizens concerned with the current condition of the river. Members who participated in developing this management plan are listed in Table 1.1.

Name	Organization
Doreen Carey	Gary Department of Environmental Affairs
Luci Horton	GSWMD
Tammi Davis	GSWMD
Martin J. Brown	GSWMD
Robert Perrine	Town of Burns Harbor
Bill Meeks	City of Crown Point
Mike Gulley	Town of Griffith
Stan Dostatni	City of Hammond
John Bach	Town of Highland
Steve Truchan	City of Hobart
Marshall Giliana	City of Lake Station
Roland Cloco	City of Lake Station
Howard Fink	Town of Merrillville
Jim Mandon	Town of Munster
	City of Portage
Kevin Breitzke	Porter County
Sky Schelle	IDEM
Steve West	IDEM
Joe Exl	Lake Michigan Coastal Program
Dan Gardner	LCRBDC
Mary Beth Wiseman	NIRPC
Phil Gralik	R.W. Armstrong & Assoc.
Arnie Muzumdar	North-West Engineering Co.
Debra Hammonds	Golden Recognition, Inc.
Jill Hoffmann	Empower Results, LLC
Tom Anderson	Save the Dunes Council
Rodney Littleton	Groundwork Gary
Ruth Mores	Hammond Southmoor Rd. Group
Dan Gossman	Lake County Surveyor's Office
Cecile Petro	Town of Highland
Spencer Cartwright	IU Northwest
Dan Vicari	CDM
Mark Gordish	Hammond
Jeff Jones	Portage Parks
Herb & Charlotte Read	Save the Dunes Council
Jenny Orsburn	IDNR Coastal Program
Jim Meyer	Meyer & Wyatt
Harlee Currie	GSWMD
Constance Maria Clay	Save the Dunes Council
Brenda Scott Henry	
Dorothy Robinson	
Dan Rieden	
Elizabeth McCloskey	U.S. Fish & Wild Life Service
Antwuan Clemmons	

Table 1.1: Watershed Management Plan Steering Committee members.

Mission Statement

The Mission Statement as developed by the Steering Committee is:

(The Little Calumet River Watershed Group) exists to effectively and aggressively reduce pollutant loads in the subwatersheds of the Little Calumet River through coordinated planning, public education, and structural BMP implementation.)

Plan Development Process

The Steering Committee, comprised of watershed stakeholders, met for the first time on November 30, 2006 at the offices of the Gary Sanitary District (GSD) in Gary, Indiana. The meeting started with introductions of those in attendance and a brief introduction of the project. A draft Mission Statement was developed as well as a list of the issues and concerns of the steering committee. The list of issues developed at this meeting is included in Appendix 2: Issues Identification, of this report. Full minutes of this meeting are located in Appendix 3: Steering Committee Meeting Minutes.

The second Steering Committee meeting was held on January 11, 2007, again at the GSD offices in Gary, Indiana. The draft Mission Statement was reviewed and a goal setting exercise was conducted. The date for the first public meeting was set for March 1, 2007. Full minutes of this meeting are located in Appendix 3: Steering Committee Meeting Minutes.

The first public meeting was held at the Indiana University Northwest Library on March 1, 2007. Local politicians, citizens, and steering committee members attended. A list of public concerns was developed and prioritized by those in attendance.

The third Steering Committee meeting was held on March 14, 2007, again at the GSD offices in Gary, Indiana. Sampling Plan alternatives were presented and can be found in Appendix 4: Sampling Plan Alternatives. Ultimately, the steering committee chose to take grab samples and test for specific water quality parameters and employ two rounds of long term *E.coli* sampling to determine "hot zones" where *E.coli* is the greater problem. Full minutes of this meeting are located in Appendix 3: Steering Committee Meeting Minutes.

Watershed Activity

To aid the Steering Committee in determining the level of knowledge the public had regarding the Little Calumet River Watershed and the concerns associated with it a Hoosier River Watch Day was held on Saturday, October 13, 2007. The event was held in the City of Gary along the Little Calumet River and had a number of activities that the public could participate in. Among these were a nature walk along the river using the levee system trails that allowed participants to identify different plant and animal species. Water quality testing was conducted by Joe Exl and a bike ride was led by Dorreen Carey. EmPower Results also had a game set up that allowed participants to roll a weighted die in an attempt to make their way through an ecological environment. Each station that was visited by a roll of the dice had a different color bead that was used to make a bracelet in order to show how difficult it was to get out of some environments along the river.

The water quality testing conducted by Joe Exl during the watershed activity included a chemical monitoring sheet, a biological monitoring sheet and qualitative habitat evaluation index. The results of this water testing were similar in value to the water quality results from this study and previous studies conducted on the Little Calumet River and can be seen in Appendix 5: Watershed Activity Event.

As part of the Hoosier River Watch Day participants were given a survey to complete regarding their knowledge of the Little Calumet River, the recreational features associated with the river and the pollutant and flood concerns. A total of 76 responses were received for the survey between the River Watch Day participants and a class of Indiana University Northwest environmental engineering class students. The survey results and answers to the question, "Regarding the river, my biggest concerns are:" can be found in Appendix 5: Watershed Activity Event.

Issues/Problems Identified

Two forums were utilized to identify issues within this watershed. The first was to conduct exercises at the steering committee meetings to list concerns in the watershed. The brainstorming session produced a long list of concerns that can be summarized in five categories.

The five categories and the associated statements made by the **steering committee** are:

1. Water Quality Concerns

- Low flow water quality
- Flood control impacts on water quality
- *E coli* sources
- CSOs (discharge & impacts on use)
- Sediment loads (TSS) & upstream erosion problems
- Increase in large rain events - flooding water quality
- Quantity & quality from east reach

2. "Other" Natural Resource Concerns

- Downstream impacts (Lake Michigan)
- Impact of altered hydrology
- Fishery condition – fish health
- Impacts on recreational uses
- Impacts on neighborhood's – aesthetic & habitat
- Preservation of waterways and riparian areas
- Restoration of natural areas/habitat

3. Public Involvement/Education Needs or Concerns

- Risk communication to community
- *E.coli* communication/education with public
- Who's in charge of what?
- Getting local buy-in or participation

4. Local Coordination Needs or Concerns

- Coordination with other watershed projects (DNR 6217 coordination)
- Coordination with flood control project
- TMDL coordination
- Septic systems and social issues
- Flood diversion away from Illinois
- Coordination with planning & zoning
- Communication with ACOE
- Development awareness
- Community cooperation and improved uniformity

5. Resource Needs or Concerns (data, financial, people)

- Planning tools to assess downstream impacts
- Public access

During the first public meeting, the public also went through an issue identification and prioritization exercise. A brainstorming session was first held with every issue mentioned added to a list on easels at the front of the room.

Ranking	Identified Issue	Red Dots	Yellow Dots	Green Dots	Total Points	% Points
1	Flooding	15	3	0	255	19.7%
2	Impact on Lake Michigan	7	4	0	145	11.2%
3	Watershed Education for Public*	8	1	2	140	10.8%
4	Erosion	6	1	2	110	8.5%
5	Connecting People to their Watersheds	6	0	0	90	7.0%
6	Increasing Recreational Uses	2	4	2	80	6.2%
7	Holistic Conservation Planning	2	3	3	75	5.8%
8	Coordination with Other Studies	0	6	2	70	5.4%
9	Fishery	3	1	2	65	5.0%
10	Brownfields	2	1	3	55	4.3%
11	Change in Impervious Areas	2	1	1	45	3.5%
12	Public Workshops	1	2	1	40	3.1%
13	Public Education - Who to Call*	1	1	2	35	2.7%
14	Coordination of Local Projects	0	2	2	30	2.3%
15	Map Parks, Land Trusts, & Natural Areas	1	1	1	30	2.3%
16	Interpretation Opportunities	1	0	1	20	1.5%
17	Diked areas in Watershed	0	0	2	10	0.8%
	Red Dot = 15 points Yellow Dot = 10 points Green Dot = 5 points * Both Issues are Public Education, but with a different focus					

Table 1.2: Issues presented and values given by Steering Committee Members.

Moderators of the exercise relied on the list of issues identified in the steering committee meeting to start the exercise. When all of the additional issues identified had been recorded, each person in the audience was given three stickers. The stickers were color coded by a red dot representing the most important issue, a yellow dot for the second most important issue and a green dot to be placed on the third most important issue in their opinion. The audience then placed the stickers on the easel pads. The issues and the prioritization are tabulated in Table 1.2.

No issue was left without some vote next to it at the completion of the exercise. Point values for each dot were assigned as noted in the table and summarized. Clearly, the most important issue was flooding which included areas outside the levee system and throughout the watershed.

Combining the issues identified by both groups under the five categories established yields the following list.

1. Water Quality Concerns

- Low flow water quality
- Flood control impacts on water quality
- *E.coli* sources

- CSOs (discharge & impacts on use)
- Sediment loads (TSS) & upstream erosion problems
- Increase in large rain events - flooding water quality
- Quantity & quality from east reach
- Impact on Lake Michigan

2. "Other" Natural Resource Concerns

- Downstream impacts (Lake Michigan)
- Impact of altered hydrology
- Fishery condition – fish health
- Impacts on recreational uses
- Impacts on neighborhood's – aesthetic & habitat
- Preservation of waterways and riparian areas
- Restoration of natural areas/habitat
- Flooding concerns
- Erosion concerns
- Change in impervious areas
- Diked areas in watershed

3. Public Involvement/Education Needs or Concerns

- Risk communication to community
- *E.coli* communication/education with public
- Who's in charge of what?
- Getting local buy-in or participation
- Watershed education for the public
- Connecting people to their watershed
- Need for public workshops
- Educating the public on whom to call with concerns or for information
- Interpretation opportunities

4. Local Coordination Needs or Concerns

- Coordination with other watershed projects (DNR 6217 coordination)
- Coordination with flood control project
- TMDL coordination
- Septic systems and social issues
- Flood diversion away from Illinois
- Coordination with planning & zoning
- Communication with ACOE
- Development awareness
- Community cooperation and improved uniformity
- Holistic conservation planning
- Coordination with other studies and projects
- Brownfield impacts
- Map parks, land trusts, and natural areas

5. Resource Needs or Concerns (data, financial, people)

- Planning tools to assess downstream impacts
- Public access
- Increasing recreational uses

Previous Work/Studies in the Watershed

Sampling

The Indiana Department of Environmental Management (IDEM) established a fixed monitoring station along the Little Calumet River in 1990 in the eastern portion of the project area. This location is sampled multiple times a year for physical and chemical water quality as well as bacterial (Fecal Coliform and *E.coli*). Four additional sampling locations (three along the Little Calumet River and one along Willow Creek) were established in 2000 as part of the IDEM *E.coli* Sampling Program. This data is included in Appendix 6: IDEM Fixed Station Data and is discussed further in Section IV of this report.

Sampling has also been performed by the United Sates Army Corps of Engineers, the Indiana Department of Natural Resources (Hoosier Riverwatch Program), local utilities, and universities. Also, Total Maximum Daily Loads (TMDL) were established for *E.coli* on the Little Calumet River and Potage Burns Waterway in 2004. Sampling was performed as part of the Data Report (December 2002).

U.S. Army Corp of Engineers Flood Control Project

The Little Calumet River Basin Development Commission (LCRBDC) is the local sponsor for a federal flood control project building levee systems along the west branch of the Little Calumet River.

As part of this project, earthen levees and I-walls are being constructed from the Illinois State line to the eastern boundary of the City of Gary. This line of protection limits the location of discharges to the river and allows storm water flows to enter the river only through XXX flood control gates and XXX pump stations. A map of the line of protection showing the location of these discharge points is shown in Figure 1.3 and a larger version of the same map is included in Appendix 7: ACOE Levee System.

Note the diversion structure shown in Figure 1.3 on the Little Calumet River just west of Hart Ditch. This diversion structure is planned to divert high flows to the east and limit the volume of flows traveling west toward the State of Illinois. This addition will change the western boundary of this watershed under high flow conditions.

XXX acres of wetlands have been constructed in the Hobart Marsh to mitigate XXX acres of wetlands impacted by the addition of the levee system. No storm water quality measures are currently being included by the Army Corp of Engineers. Trails, canoe launches, fishing piers, observation decks, and other amenities have been added along the river.

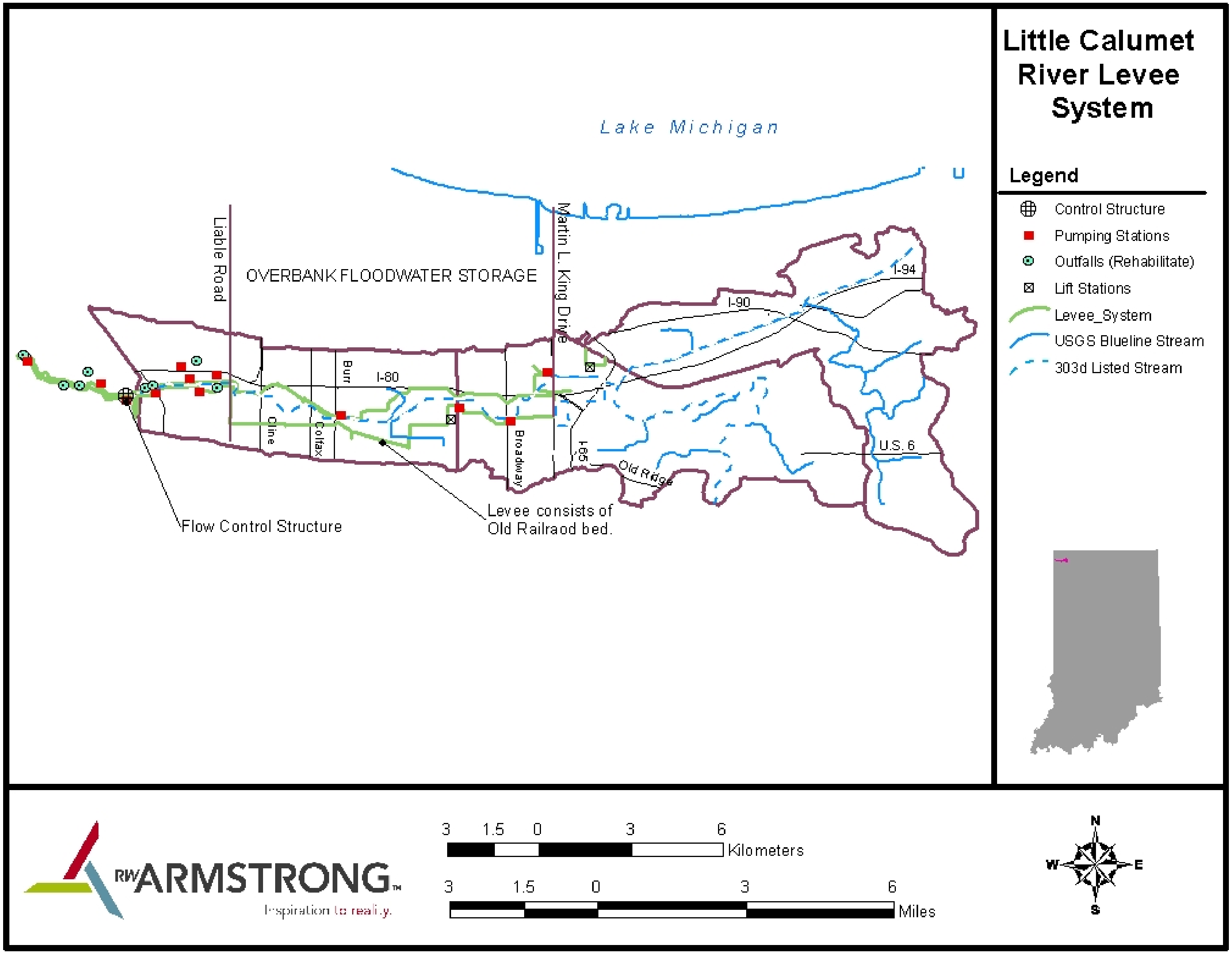

Figure 1.3: Levee system being completed by the Little Calumet River Basin Development Commission and the Army Corps of Engineers.

Operations and maintenance of the levee system is being negotiated with the local communities where construction is complete. Some form of organization will most likely continue to exist, even after construction is complete and the operations and maintenance is delegated to the proper parties, to centralize and maintain records as required by the Army Corp of Engineers.

The final completion of the system should occur around 2013.

Phase II - Combined Sewer Overflow Master – Little Calumet River Sampling Program – The Sanitary District of Hammond, Indiana (November 1995)

This study monitored pump station discharges and water quality during combined sewer overflow (CSO) events. CSO events on August 11, 1994, October 8, 1994, and October 31, 1994 were sampled and analyzed. Four of the eleven sampling sites, three water quality and one CSO discharge sampling site, provided information pertinent to this watershed plan. One significant piece of data was that the water quality sampling site on Hart Ditch showed significant amounts of *E.coli* and other pollutants. A map of the sample sites and the data collected is included in Appendix 8: CSO Master Plan Phase II for the Hammond Sanitary District and discussed further in Section IV of this plan.

The Watershed Diagnostic Study of the Little Calumet-Galien River Watershed prepared for the IDNR-Division of Water Resources (April 2001)

This study summarized the available existing data within the Little Calumet-Galien River Watershed. The goals and objectives of the study were to:

- Describe and map trends in water resources within the Little Calumet-Galien River Watershed.
- Identify potential non-point source water quality problems.
- Identify and prioritize watershed land treatment projects to address existing and potential problems.
- Project the probability of achieving program success and provide specific directions for future work to optimize success.

The study included two of the three watersheds included in this watershed management plan:
04040001040020 – Deep River – Little Calumet River
04040001040030 –Burns Ditch - Willow Creek

It did **not** include one of the three watersheds contained within this watershed management plan:
071200003030050 – Little Calumet River East-West Split

This study provides an excellent discussion of the history of this watershed and the timelines for its development. No specific, hard data was provided. However, a summary of potential sources of both point source and non-point source pollution is provided that was helpful.

A comparison of the locations where high levels of pollutants were encountered within the Little Calumet-Galien River watershed with the locations of EPA-permitted discharges was done to determine whether point sources or non-point sources were more likely responsible for high pollutant loads. None of the locations showing excessive concentrations of lead, copper, zinc, nitrogen, phosphorus, total suspended solids, low dissolved oxygen or pH were along the Little Calumet River or Willow Creek. Fecal Coliforms were located downstream from four (4) small waste water treatment plants with no location given.

This study also states that contaminated sediments are a serious issue in the Grand Calumet River and the Indiana Harbor and Ship Canal but does not discuss sediments within the Little Calumet River.

Little Calumet River Stream Reach Characterization and Evaluation Report (October 2002)

This study was completed in October 2002 by Greeley and Hansen for the Gary Sanitary District to identify the concentrations of pollutants in the West Branch of the Little Calumet River being generated by the Combined Sewer Overflows (CSOs). The study was conducted as part of a requirement within Attachment A, Part III, of the GSD National Pollutant Discharge Elimination System (NPDES) Permit No. IN 0022977. The results of the study were also used to assist in determination of a Long Term Control Plan.

The Little Calumet-Galien Watershed Restoration Action Strategy (WRAS) developed for IDEM (2002)

This study was reported in two parts. Part 1 provided a reference point and map to assist local citizens with improving water quality. The major water quality concerns and recommended management strategies were addressed in Part 2.

The strategy presented was not intended to dictate management and activities at the stream site or segment level. The report covered the watershed as a whole and water quality management decisions and activities for individual portions of the watershed are most effective and efficient when managed through subwatershed plans.

That being said, the summarizations of management strategies, funding sources, and superfund sites were useful in the preparation of the subwatershed plan being conducted now.

Gary Green Link Master Plan (2003-2005)

This study was completed in February 2005 with the goal to "develop, through a public process, a Master Plan for implementation and management of a natural resources greenway and recreation corridor, the Gary Green Link, which will ring the City of Gary, connecting the Grand Calumet River, Little Calumet River, and the Lake Michigan shoreline."

Some of the relevant objectives of this project were to:

- Identify, protect, and restore globally significant natural resources
- Identify, protect, and restore other locally significant natural resources, natural areas, and open spaces
- Extend the green corridor that is already part of the Indiana Dunes National Lakeshore and other protected public lands
- Provide recreational opportunity as a bicycle / pedestrian multi-use trail

This project produced useful land inventory maps of natural areas along the Little Calumet River in the City of Gary. The land inventory maps can be found in Appendix 9: Gary Green Link Master Plan.

Integrated Storm Water Drainage Plan for the Little Calumet River Watershed Study (2003-2004)

The goal of this project was to develop an integrated storm water drainage plan for the Little Calumet River Drainage Basin (LCRDB) and the remaining areas to the south within the Gary city limits. This integrated storm water plan had multiple objectives, including evaluation of the existing conditions, identification of storm water related issues and a recommended plan of action. This plan encompassed a comprehensive and holistic approach by looking at the river as a total system and not its individual parts. The end product of this project was a capital improvement plan for the City of Gary to implement to improve storm water drainage in the study area. The improvements proposed in this plan will impact flows to and in the Little Calumet River within and downstream from the City of Gary.

Little Calumet and Portage Burns Waterway TMDL for *E.coli* Bacteria (September 2004)

This report was prepared for the Indiana Department of Environmental Management in response to their listing of over 30 miles of the Little Calumet River and Portage Burns Waterway on the 303(d) list of impaired waters for *E.coli* bacteria. The intent of this report was to determine the Total Maximum Daily Load (TMDL) for this pollutant in these waters as required by the Clean Water Act. This report inventoried available data, evaluated the documented sources of *E.coli* within the study's boundaries, and modeled the river system to determine the TMDL.

The report was not designed to address CSO contributions to the Little Calumet River. It relies on the Long Term Control Plans prepared by the Hammond Sanitary District and the Gary Sanitary District to address these sources. It then noted that "There were no apparent patterns to the water quality violations relating to *E.coli* that would suggest that violations were more common during a certain time of year or under some critical flow or weather conditions. From the available data, one could not identify the magnitude of any single source of *E.coli*." It also noted "The major sources of the *E.coli* bacteria impairment in the Little Calumet-Portage Burns Waterway appears to be non-point sources. Non-point sources most likely to be contributing to the impairment of the water quality include: failing septic systems, unknown illicit discharges of sewage, wildlife, small agriculture operations, bacteria laden sediments, and urban runoff. Point sources are well below water quality standards. Therefore, point sources of *E.coli* make up such a small percent of the total load that further reductions would not significantly improve water quality. CSO's are a known source of *E.coli* and play a major role in the water quality impairment when they occur. However, CSO's did not coincide with the dates of the simulated events, indicating that the waterbody was impaired by other sources in addition to CSO's." The report also stated that "There is a strong correlation between impervious area in a watershed and bacteria concentrations in the receiving stream."

The report concluded that a reduction of over 90% in non-point source loads would be required to meet the water quality standards for the rivers' designated uses. The report states the designated use of the Little Calumet River is full-body contact recreation and is designated for warm water communities.

The report also states that flow from Hart Ditch travels east through the reach of the Little Calumet River covered by this watershed management plan. This is contrary to the observations of steering committee members that the east/west flow divide is east of that confluence. The TMDL report gives an estimated travel time from the Hart ditch confluence to Lake Michigan of four days.

NIRPC's Watershed Management Framework Plan (October 2005)

This study provided a broad framework for smaller watersheds in the Lake, Porter, and LaPorte Counties in northwest Indiana to develop and implement their own watershed plan.

Many of the participants in the development of the Regional Watershed Management Plan concurrently participated in the development of the Indiana Lake Michigan Coastal Program Non-point Pollution Control Plan (6217 Plan). Because many of the same issues were identified during both processes, the 6217 Plan was used as a foundation for this plan as adopted by the Watershed Advisory Group. Though the 6217 Plan addresses only the Little Calumet-Galien basin excluding the Chicago Watershed, the plan management measures are consistent with the issues identified in the Kankakee River Basin.

The goals and objectives of this plan were:

- Implement urban and rural non-point source practices in northwest Indiana to the extent practicable to achieve and maintain applicable water quality standards and improve quality of life.
- Implement agricultural non-point source practices in northwest Indiana to the extent practicable to achieve and maintain applicable water quality standards and improve quality of life.
- Ensure the protection of northwest Indiana's water bodies from further impacts of hydromodification and wetland loss to meet and maintain applicable water quality standards.

The plan did provide some useful historical information for this plan. Its findings did correspond to other studies and reports utilized in the production of this plan.

Lake Michigan Coastal Program Nonpoint Source Pollution Control Plan(6217 Plan)

The Indiana Lake Michigan Coastal Program (ILMCP) was required by the National Oceanic and Atmospheric Administration (NOAA) and the USEPA to complete a Coastal Non-point Source Pollution Management Plan (6217 plan) as part of becoming a Coastal Zone State. The plan will included a series of management measures for agricultural runoff; forestry runoff; marinas and recreational boating; channel modification; dams and erosion of stream banks and the shoreline; wetlands; riparian areas; and vegetated treatment systems.

The management measures for urban/rural areas, for agricultural sources, and those for wetlands, riparian areas, and vegetated treatment systems were applicable to this plan. The management measures for hydromodification and the management measures for marinas and recreational boating were not applicable to this plan. The list of potential sources for non-point source pollution was especially useful in identifying probable sources of non-point source pollutants in this watershed.

Section II: Physical Description of the Watersheds

Watershed Boundaries

The watersheds covered by this study consist of the West Branch Little Calumet River and Willow Creek. The Little Calumet River includes areas to the east in the City of Portage and west in the City of Hammond and the Town of Highland. This river segment is crossed by the continental divide. From this point, the river flows both east toward the Great Lakes and west toward the Mississippi River.

The Little Calumet River and its tributaries in this study flow through the borders of Hammond, Highland, Griffith, Gary, Hobart, Lake Station, and Portage in Indiana. Portions of this watershed are also located in unincorporated Lake and Porter Counties. Figure 2.1 shows the study area and how it fits into the local communities and unincorporated areas.

Physical Setting

The Little Calumet River E-W Split (07120003030050) and Willow Creek /Burns Ditch (04040001040030) Watersheds are densely populated areas. The two watersheds contain very little unincorporated county area. However, they contain little industrial area as majority of the industry is north of the watershed study area.

The west branch of the Little Calumet River is approximately 18 miles long, with 10 miles located within the City of Gary. The major tributaries to the Little Calumet River located within the study area are Turkey Creek, Deep River, and Salt Creek. Each tributary originates on the Valparaiso Moraine and flows north to the Little Calumet River.

The Little Calumet River has major tributaries but collects most of its waters from small streams and drainage ditches in northwest Indiana. The flow of the river is roughly parallel to the Lake Michigan shoreline and the direction may change depending on a number of factors. The eastward flow empties into Lake Michigan via Burns Ditch and the westward flow enters the Calumet Harbor in Illinois. A unique feature of the Little Calumet River is that its direction of flow corresponds with the water levels in Lake Michigan. The location in the river where the direction of flow splits between Indiana and Illinois, depends on the water levels in the lake and river and climate conditions throughout the year.

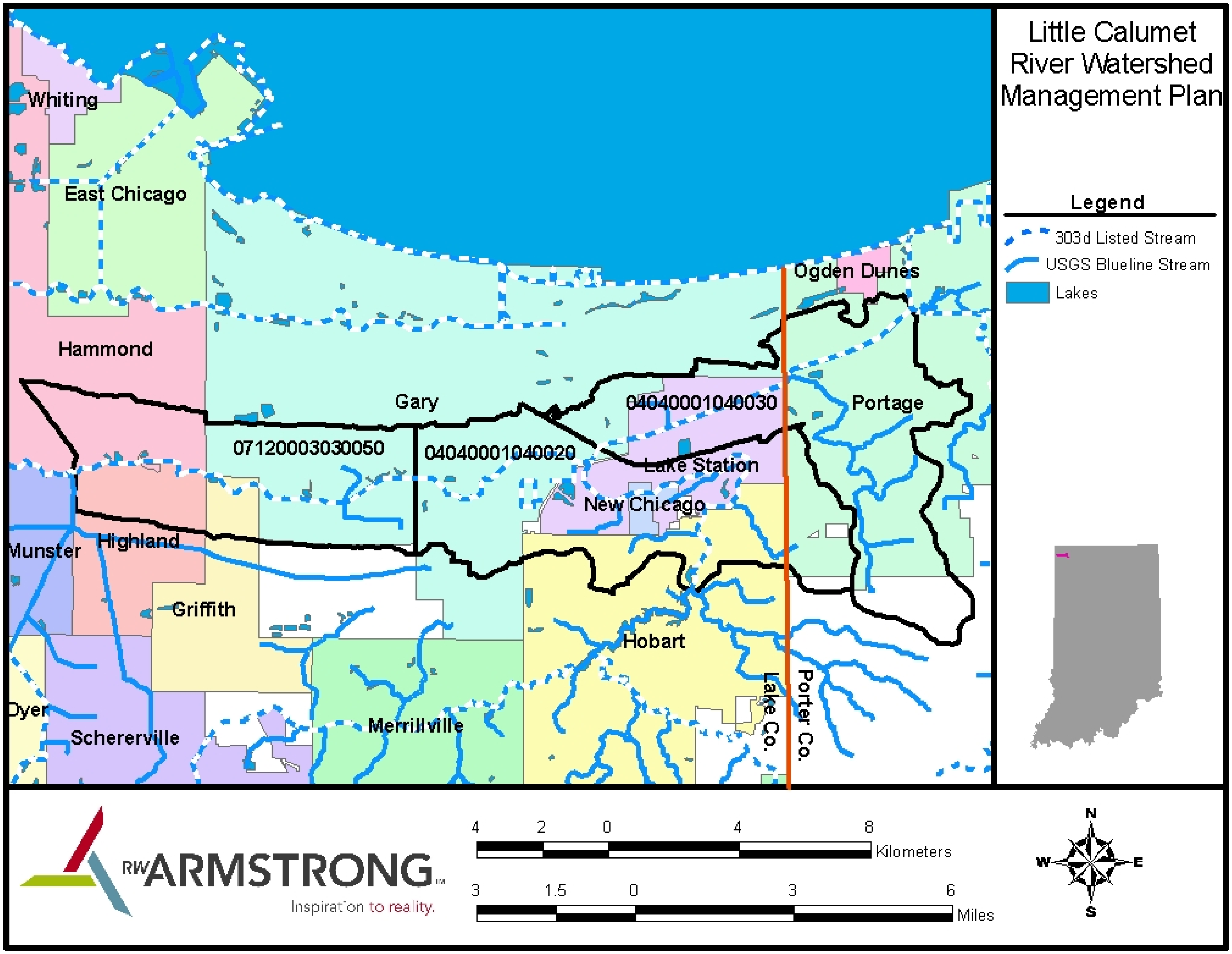

Figure 2.1: Little Calumet River Watershed Management Plan study area showing the local communities.

Slope and Elevation

The area encompassed by the watershed study area is extremely flat and many areas have little relief or elevation. This lack of difference between the normal flow elevation of the river and the surrounding communities makes flooding a serious concern. Open ditches designed for storm water drainage are an added problem as sedimentation eliminates the small amount of slope they are built with.

History

Thousands of years ago, the area was glaciated. The advancing and retreating of glaciers formed the geology and soils of this region. Advancing and retreating of glaciers leads to the creation of complex geological arrangements known as "moraines." Thus the soils, geology and topography of the region is not likely to be uniform and is more likely to be quite diverse, even within the same basin.

The Little Calumet River has gone through many changes since the glaciers melted away and reshaped the land. At one time the Little Calumet River and Grand Calumet River was one river. The Calumet River flowed westward into Illinois, made a hairpin turn at present-day Blue Island, and flowed back eastward into Indiana, where it eventually discharged into Lake Michigan at present-day Marquette Park Lagoon.

This area has been claimed by the Menomonee and Potawatomi, as well as by France, England, and the United States over its history. However, not much is known about the history of the Grand Calumet River (GCR) and Little Calumet River (LCR) before the 1800s, but the earliest known name for the rivers, given by the Native Americans, was the "Grand and Little Killainick Rivers".

The 1800's saw a variety of changes in this area. The war of 1812 saw the French expelled from the region. The 1830's saw the Native Americans forced from the area as well. European settlement in this area continued through these times and into the mid 1800's. The growth rate in the Chicago area though dwarfed the growth rate of northwest Indiana which was viewed as a "marshy hinterland" and not suitable for urbanization.

In the late 1800s, as Chicago became more of a transportation hub, the U.S. Congress delegated funds to allow construction of a "Harbor of Refuge" for Lake Michigan which was located in the Calumet area. Until this time, the Calumet Rivers were shown on maps only as a swamp area. This began the flow of the Calumet Rivers into Lake Michigan at Chicago. The Little Calumet River became the smaller river to the south discharging to Lake Michigan in Illinois, while the Grand Calumet River ran to the north and discharged to the east in Indiana. Soon after construction was completed, ships started to use this new channel.

In the early 1870s, after the great Chicago fire, many manufacturing companies that were destroyed relocated to and rebuilt in the Calumet area. The present outlet for the Grand Calumet River was constructed in the 1900s at the Indiana Harbor Ship Canal. A U.S. Topographic Bureau map from 1845 showed the Grand Calumet River no longer flowing into Lake Michigan because it was clogged with aquatic vegetation and sand (IDNR-ILMCP, 2001).

The late 1800's also saw the rise of the railroad industry and steel industry in this region. This industrialization brought a population boom to the area and led directly to the draining of the marshes through the installation of ditches and sewers to make the area more suitable to its residents.

Much of the region's sanitary sewage and garbage was dumped into the river systems. This dumping, combined with the ship and barge traffic, polluted both the river and Lake Michigan. The pollution in Lake Michigan was severe, especially by the early 1920s.

In the early 1960s, the Army Corps of Engineers (ACOE) designed the T.J. O'Brien Lock and Dam. This lock system reversed the flow of the LCR and GCR away from Chicago. Until this time, the LCR flowed into the GCR near the Illinois border. The LCR now combines with Deep River near the intersection of Interstate 80/94 and Interstate 65. As it flows east from its confluence with Deep River, the LCR is sometimes referred to as "Burns Ditch". Burns Ditch is a channelized section of the LCR that connects it to Burns Harbor. The LCR flows into Lake Michigan. The outlet to Lake Michigan at Burns Harbor is in Portage, Indiana. Burns Ditch is a man-made channel which allows the LCR and Deep River to flow into Lake Michigan.

According to the ACOE, the LCR still has a high point in its channel bed somewhere near Indianapolis Boulevard which is in the City of Hammond. The channel bed undulates but gradually slopes down to the east and west from this point.

The massive hydro-modifications to the river channel itself in addition to the development within the watershed have drastically changed the flow characteristics of the river. Reversing the flow direction left the river with just enough slope over its entire length to flow to the east. The minimal slope in that direction leaves the river prone to influence by the water levels in Lake Michigan. Flow direction can change based on lake levels and weather patterns.

Soils

The majority of the soil types in the watershed are sand or silt. These highly permeable and erodible soils allow relatively quick infiltration; however, the ground water table is very high throughout most of the watershed.

Much of the basin has been drained by ditches and buried drainage tiles to allow agricultural and development in this watershed. High ground water tables still hamper development in many areas though. The sandy soils are not well suited to on site sewage disposal facilities as little attenuation of the pollutants is achieved before the effluent reaches the ground water.

Soils on the low parts of the landscape have hydric morphology, periodically high water tables, redox depletions (gray colors), and supported hydrophytic vegetation. Soils on dunes have deep water tables, lack redox depletions and concentrations, and have upland vegetation.

Figures 2.2 and 2.3 show the soils in Lake and Porter Counties, respectively. A summarized breakdown of the soils types including a definition for the soil abbreviations can be found in Table 2.1 and 2.2 for Lake and Porter Counties, respectively.

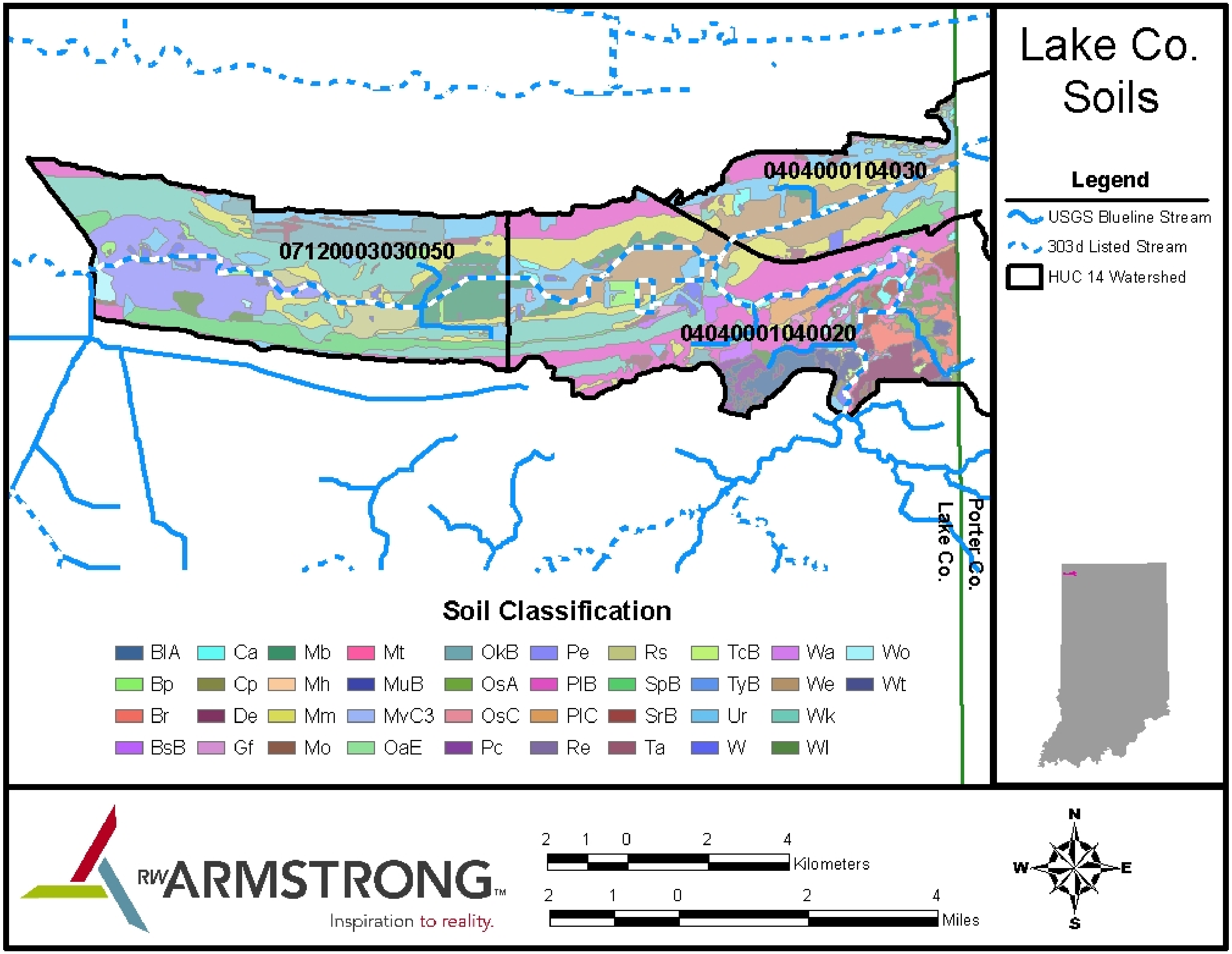

Figure 2.2: Lake County soil classifications.

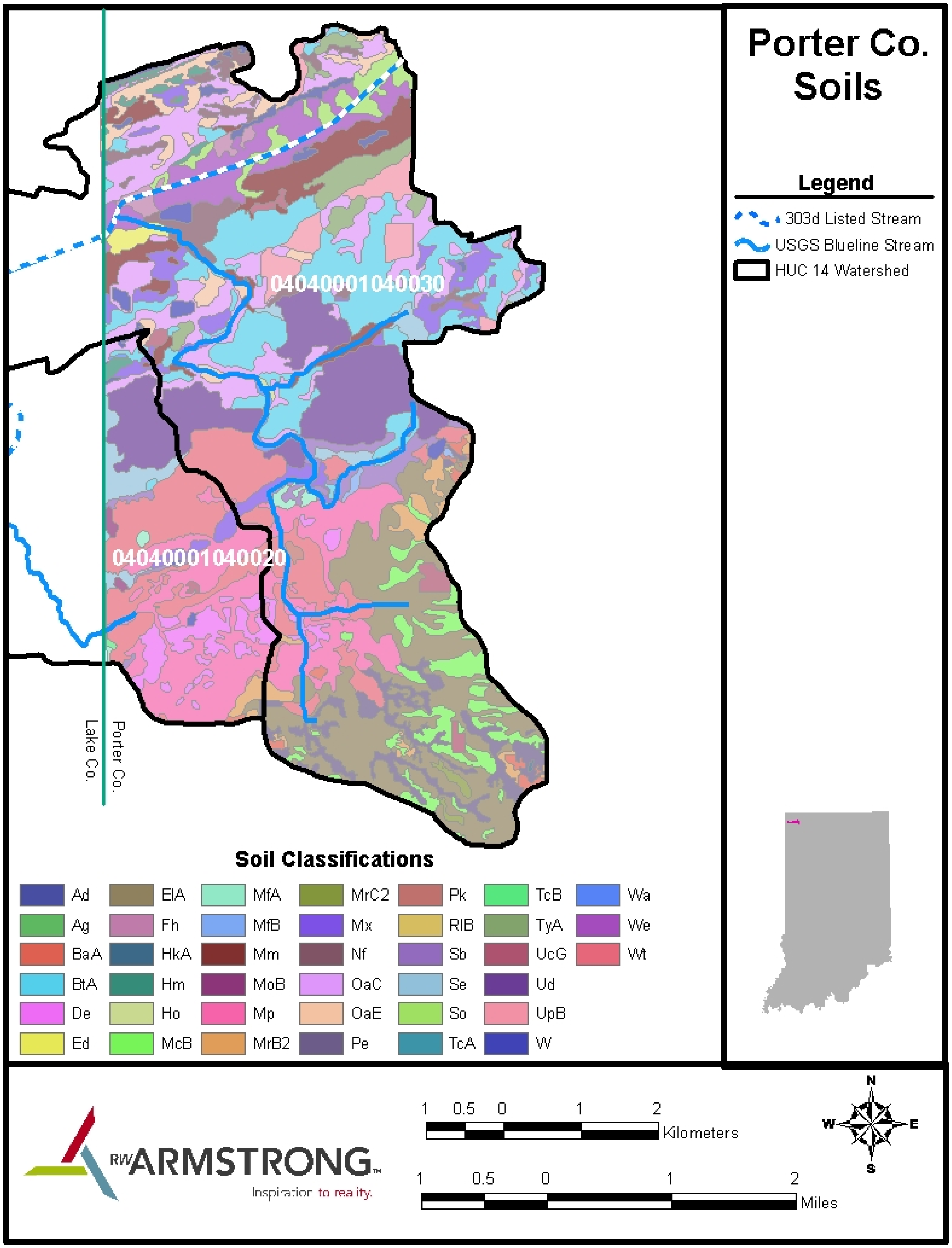

Figure 2.3: Porter County soil classifications.

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Map Unit Symbol	Lake County Description	Area (Acres)	Percentage
BlA	Blount silt loam, 0 to 2 percent slopes	343.9	1.42%
Bp	Borrow pits	211.5	0.87%
Br	Brady fine sandy loam	330.2	1.36%
BsB	Brems fine sand, 0 to 4 percent slopes	162.6	0.67%
Ca	Houghton muck, drained, 0 to 1 percent slopes	206.2	0.85%
Cp	Clay pits	13.9	0.06%
De	Del Rey silt loam	384.2	1.59%
Gf	Gilford mucky fine sandy loam	137.4	0.57%
Mb	Marl beds	981.4	4.05%
Mh	Marsh	11	0.05%
Mm	Maumee loamy fine sand	2760.8	11.40%
Mo	Milford silt loam, overwash	50.5	0.21%
Mt	Milford-Palms-Wallkill complex	254.2	1.05%
MuB	Morley silt loam, 2 to 6 percent slopes	30	0.12%
MvC3	Morley silty clay loam, 6 to 12 percent slopes, severely eroded	23.1	0.10%
OaE	oakville fine sand, 12 to 25 percent slopes	100.7	0.42%
OkB	Oakville-Adrian complex, 0 to 6 percent slopes	825.4	3.41%
OsA	Oshtemo fine sandy loam, 0 to 2 percent slopes	146	0.60%
OsC	Oshtemo fine sandy loam, 6 to 12 percent slopes	16.4	0.07%
Pc	Pewamo silty clay loam	208.4	0.86%
Pe	Pewamo silty clay loam, calcareous variant	1639.4	6.77%
PlB	Plainfield fine sand, 0 to 6 percent slopes	3570.8	14.75%
PlC	Plainfield fine sand, 6 to 12 percent slopes	275.5	1.14%
Re	Rensselaer loam	21.4	0.09%
Rs	Rensselaer loam, calcareous subsoil variant	390.1	1.61%
SpB	Sparta fine sand, 0 to 4 percent slopes	1156.4	4.78%
SrB	Sparta fine sand, silty clay loam substraatum, 0 to 4 percent slopes	236.2	0.98%
Ta	Adrian muck, drained, 0 to 1 percent slopes	398.6	1.65%
TcB	Tracy loam, 2 to 6 percent slopes	60.8	0.25%
TyB	Tyner loamy fine sand, 0 to 6 percent slopes	7.1	0.03%
Ur	Urban land	2163.9	8.94%
W	Water	569	2.35%
Wa	Wallkill silt loam	205.5	0.85%
We	Warners silt loam	2034.9	8.40%
Wk	Watseka loamy fine sand	3600.2	14.87%
Wl	Watseka loamy sand, moderately deep variant	318.8	1.32%
Wo	Wauseon fine sandy loam	150.8	0.62%
Wt	Whitaker loam	216.9	0.90%
	TOTALS	24214.2	100.00%

Table 2.1: Lake County soil descriptions and percentage of total area covered.

Map Unit Symbol	Porter County Description	Area (Acres)	Percentage
Ad	Adrian muck, drained	91.7	0.87%
Ag	Alida loam	0.7	0.01%
BaA	Blount silt loam, 0 to 3 percent slopes	58.4	0.56%
BtA	Brems sand, 0 to 3 percent slopes	1074.9	10.22%
De	Del Rey silt loam	254.6	2.42%
Ed	Edwards muck, drained	41.4	0.39%
ElA	Elliott silt loam, 0 to 3 percent slopes	1207.8	11.48%
Fh	Fluvaquents	51.5	0.49%
HkA	Haskins loam, 0 to 2 percent slopes	2.5	0.02%
Hm	Houghton muck, ponded	72.5	0.69%
Ho	Houghton muck, drained	9	0.09%
McB	Markham silt loam, 2 to 6 percent slopes	346	3.29%
MfA	Martinsville loam, 0 to 2 percent slopes	30.4	0.29%
MfB	Martinsville loam, 2 to 6 percent slopes	12.3	0.12%
Mm	Maumee loamy sand	433.2	4.12%
MoB	Metea loamy fine sand, 1 to 6 percent slopes	16.3	0.15%
Mp	Milford silty clay loam	1063.9	10.12%
MrB2	Morley silt loam, 2 to 6 percent slopes,eroded	155	1.47%
MrC2	Morley silt loam, 6 to 12 percent slopes, eroded	24.3	0.23%
Mx	Morocco loamy sand	372	3.54%
Nf	Newton loamy fine sand	227.7	2.16%
OaC	Oakville fine sand, 4 to 12 percent slopes	944.6	8.98%
OaE	Oakville fine sand, 18 to 40 percent slopes	256.8	2.44%
Pe	Pewamo silty clay loam	321.9	3.06%
Pk	Pits	9.6	0.09%
RlB	Riddles silt loam, 2 to 6 percent slopes	1.6	0.02%
Sb	Sebewa loam, shaly sand substratum	194.4	1.85%
Se	Selfridge loamy fine sand	191.5	1.82%
So	Suman silt loam	155.2	1.48%
TcA	Tracy sandy loam, 0 to 2 percent slopes	0.2	0.00%
TcB	Tracy sandy loam, 2 to 6 percent slopes	2.5	0.02%
TyA	Tyner loamy sand, 0 to 3 percent slopes	199.3	1.89%
UcG	Udorthents, loamy, 3 to 30 percent slopes	78.2	0.74%
Ud	Urban land-Brems complex	893.5	8.49%
UpB	Urban land-Psamments complex, 0 to 6 percent slopes	234.9	2.23%
W	Water	107.1	1.02%
Wa	Wallkill silt loam	29.9	0.28%
We	Warners silt loam	375.8	3.57%
Wt	Whitaker loam	974.6	9.27%
	TOTALS	10517.4	100.00%

Table 2.2: Porter County soil descriptions and percent of total area covered.

Topography

The watershed area covered in this study is extremely flat and has experienced both course and direction changes throughout the year. The low gradient gives the river only a small current. Before human alteration, water flowed westward from LaPorte County, Indiana along the Little Calumet River, made a complete turn, and flowed east along the Grand Calumet into Lake Michigan at the Miller section of Gary, Indiana.

As Figure 2.4 shows, most of the watershed is located in the flat areas along the Little Calumet River itself and is contained within the 605 contour line. Higher elevations are found in the Willow Creek watershed, especially as you move south, but fall off rapidly as the creek flows north.

Wetlands

The U.S. Fish and Wildlife Services wetlands are delineated in Figures 2.5 to 2.7, one map showing each HUC watershed. The vast majority of wetlands within the study area are located along the river channel and its tributaries. This is expected given the highly developed state of the watershed study area. Table 2.3 summarizes the wetland categories found in each watershed and the acreage they cover.

Once the ACOE has completed the levee system for the Little Calumet River large areas of land located between the lines of protection may present opportunities to increase the wetlands acreage in the study area.

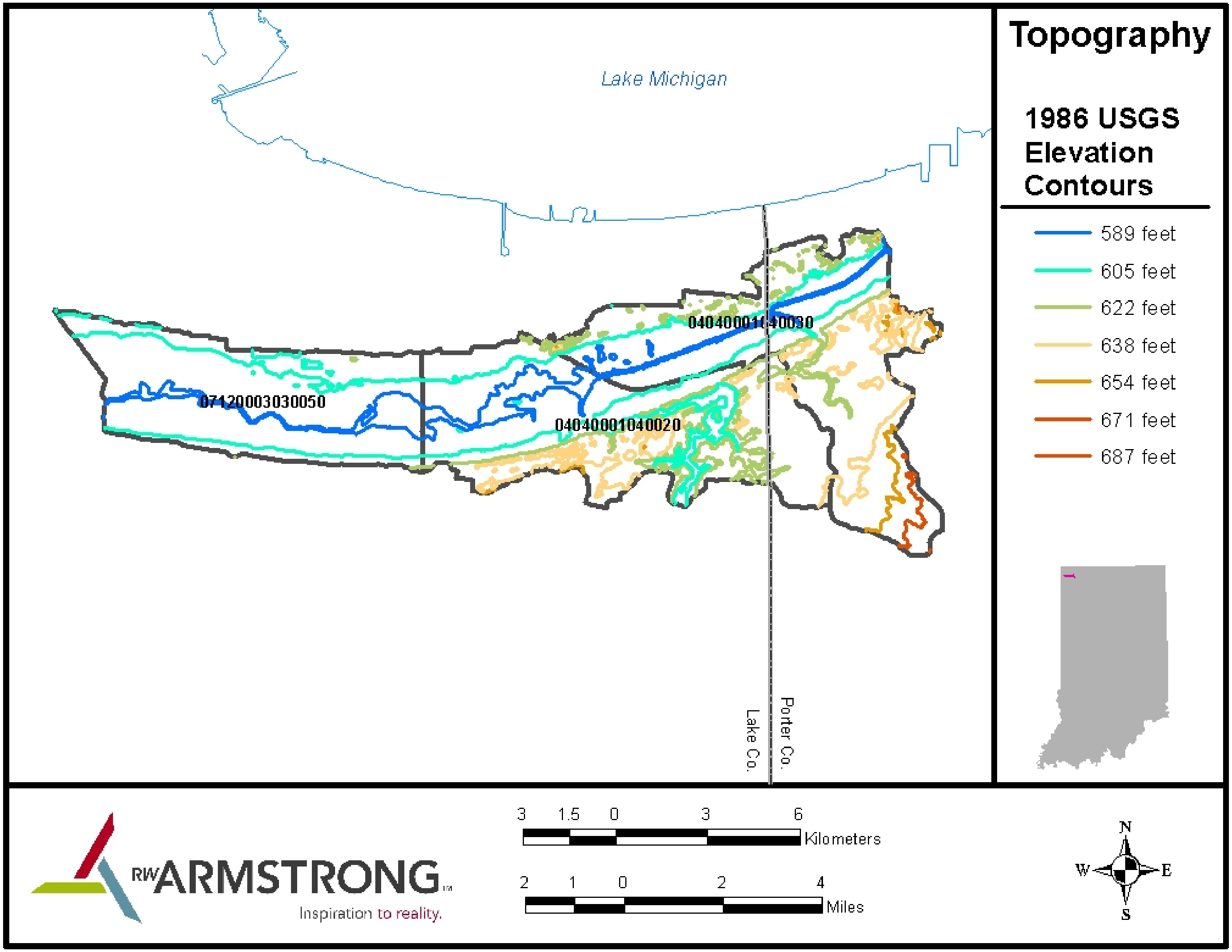


Figure 2.4: Topography for the study area, note the flat portions in the west and central portions.

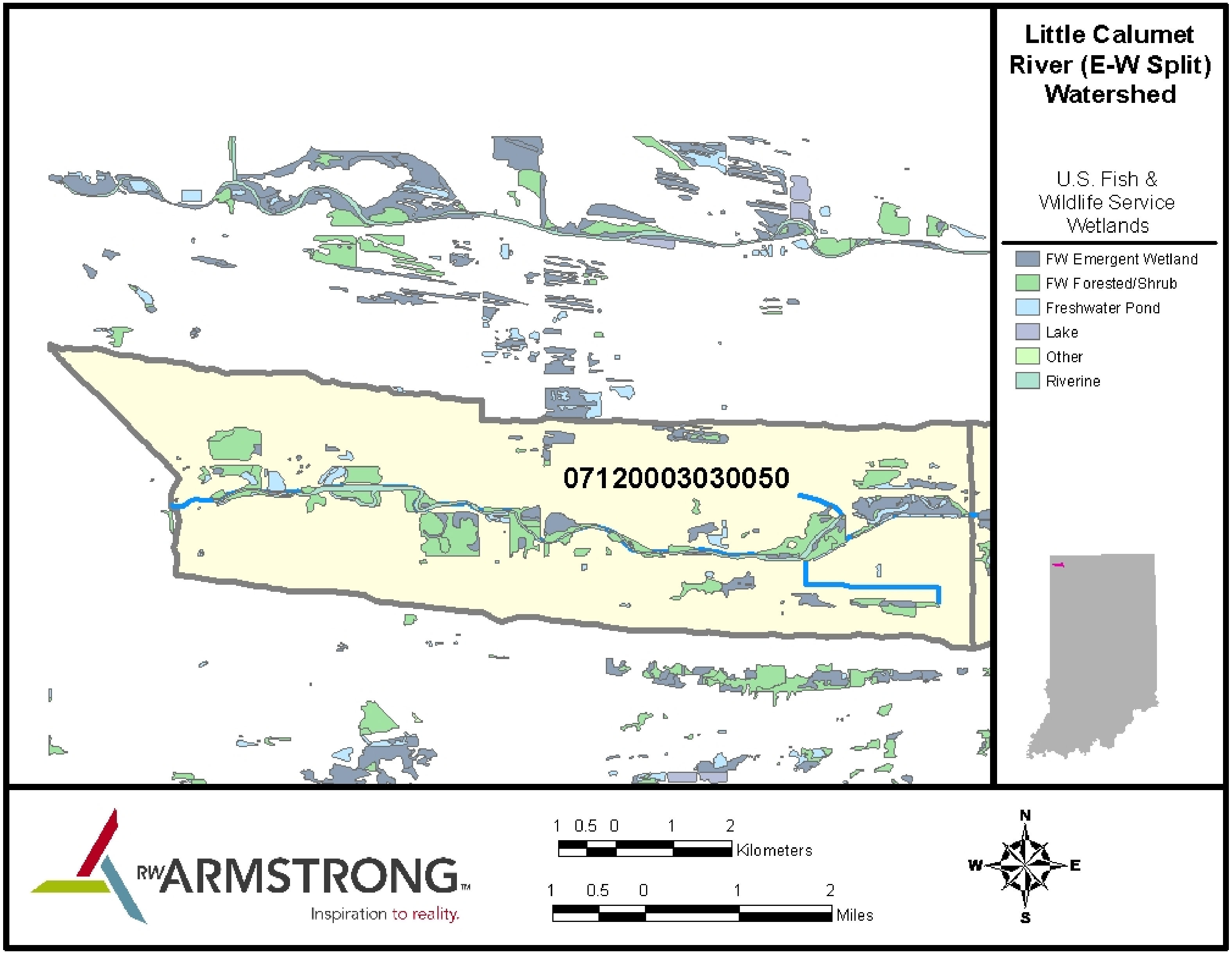


Figure 2.5: Little Calumet River (E-W Split) watershed wetlands.

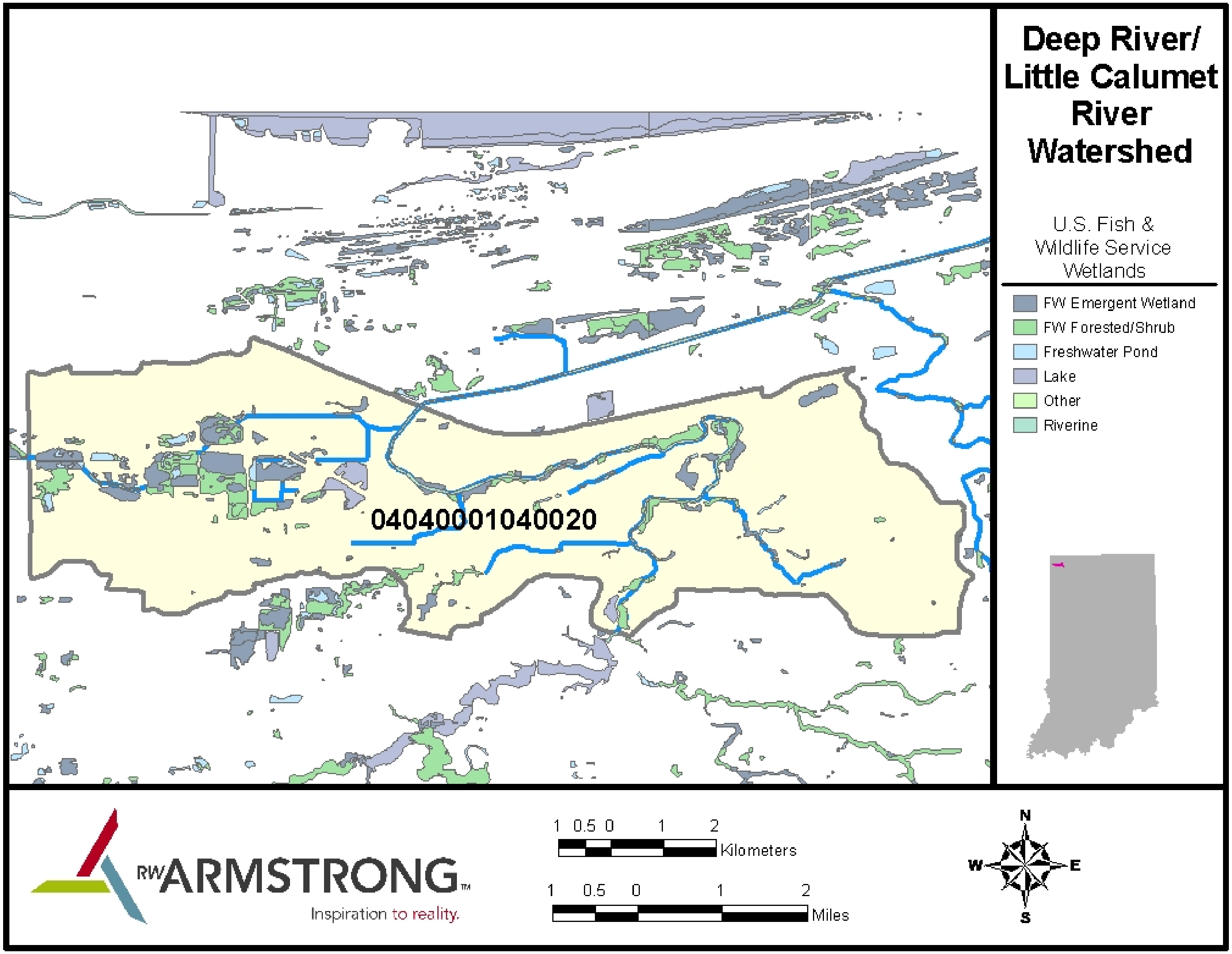


Figure 2.6: Little Calumet River and Deep River Watershed wetlands map.

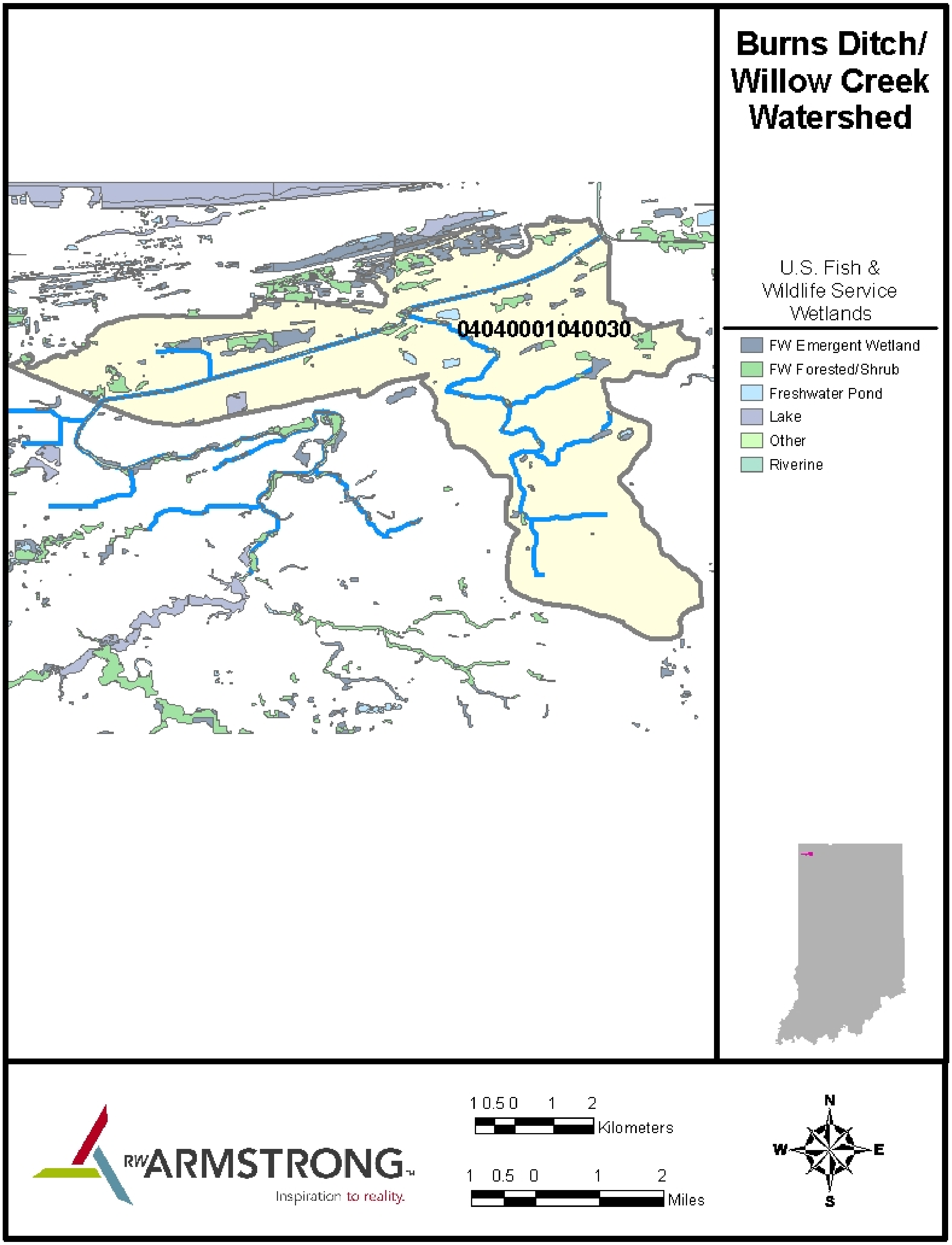


Figure 2.7: Willow Creek and Burns Ditch Watershed wetlands map.

Watershed		Area (acres)	% of Total Area
E-W Split Wetlands HUC 07120003030050	Freshwater Emergent Wetland	324.7	3.4
	Freshwater Forested/Shrub Wetland	643.3	6.6
	Riverine	115.3	1.2
		1083.3	11.2
Deep River Wetlands HUC 04040001040020	Freshwater Emergent Wetland	520	4.1
	Freshwater Forested/Shrub Wetland	463.6	3.7
	Riverine	314.8	2.5
		1298.4	10.4
Burns Ditch Wetlands HUC 04040001040030	Freshwater Emergent Wetland	593.8	4.7
	Freshwater Forested/Shrub Wetland	535.9	4.3
	Riverine	246.7	2
		1376.4	11

Table 2.3: Watershed study area wetlands classification and acreage.

Endangered Species

Appendix 10: NIRPC Watershed Management Framework Plan contains a listing of threatened and endangered species found within Lake, Porter, and LaPorte Counties taken from the Watershed Management Framework Plan produced by NIRPC in October of 2005. Appendix 9: Gary Green Link Master Plan also contains the reproduction of Table I and Figure I from the Gary Green Link Master Plan produced in February 2005 that lists endangered and threatened species within this area and maps their habitats in this vicinity.

Section III: Land Use Description of the Watershed

Land Use

The watershed study area is heavily populated and touches most of the urbanized communities in northern Lake and northwestern Porter counties. While the watershed area is primarily urban, land uses range from agricultural to industrial.

Due to the large variety of land uses in the watershed eleven (11) different land use categories were delineated. They include the following:

- High Density Urban
- Medium Density Urban
- Excavation
- Forest
- Grassland/Suburban land
- Agriculture
- Wetlands: Forest
- Wetlands: Other Vegetation
- Wetlands: Bare
- Open Water
- Roads

Many of the land use categories are self explanatory but others do need further definition. The difference between a high density urban area and a medium density urban area is the number of dwellings per acre. A high density area will have five (5) to seven (7) dwellings per acre of land while a medium density area will only have two (2) to four (4) dwellings per acre. All golf courses are included in the grassland/suburban land category and only major roads (i.e. interstates and U.S. Highways) are delineated for the road category. The wetlands were divided into three land use categories so that the quality could be noted. The forest wetlands include areas along the river and other bodies of water that are wooded. The other vegetation category includes the Heron Rookery and portions of the Oxbow Park while the bare category refers mostly to marshes and swamps.

The land use delineation for the three 14-digit HUC watersheds are shown in Figures 3.1 to 3.3 with a table included in each figure showing the total area, in acres, of each land use category. In all three watersheds the prevailing land use is Medium Density Urban. Table 3.1 summarizes the land use areas for the entire study area. The overall second most common land use was found to be High Density Urban. The three other major land use contributors are Forest, Grassland/Suburban land and Agriculture. These five land uses cover over 87% of the study area.

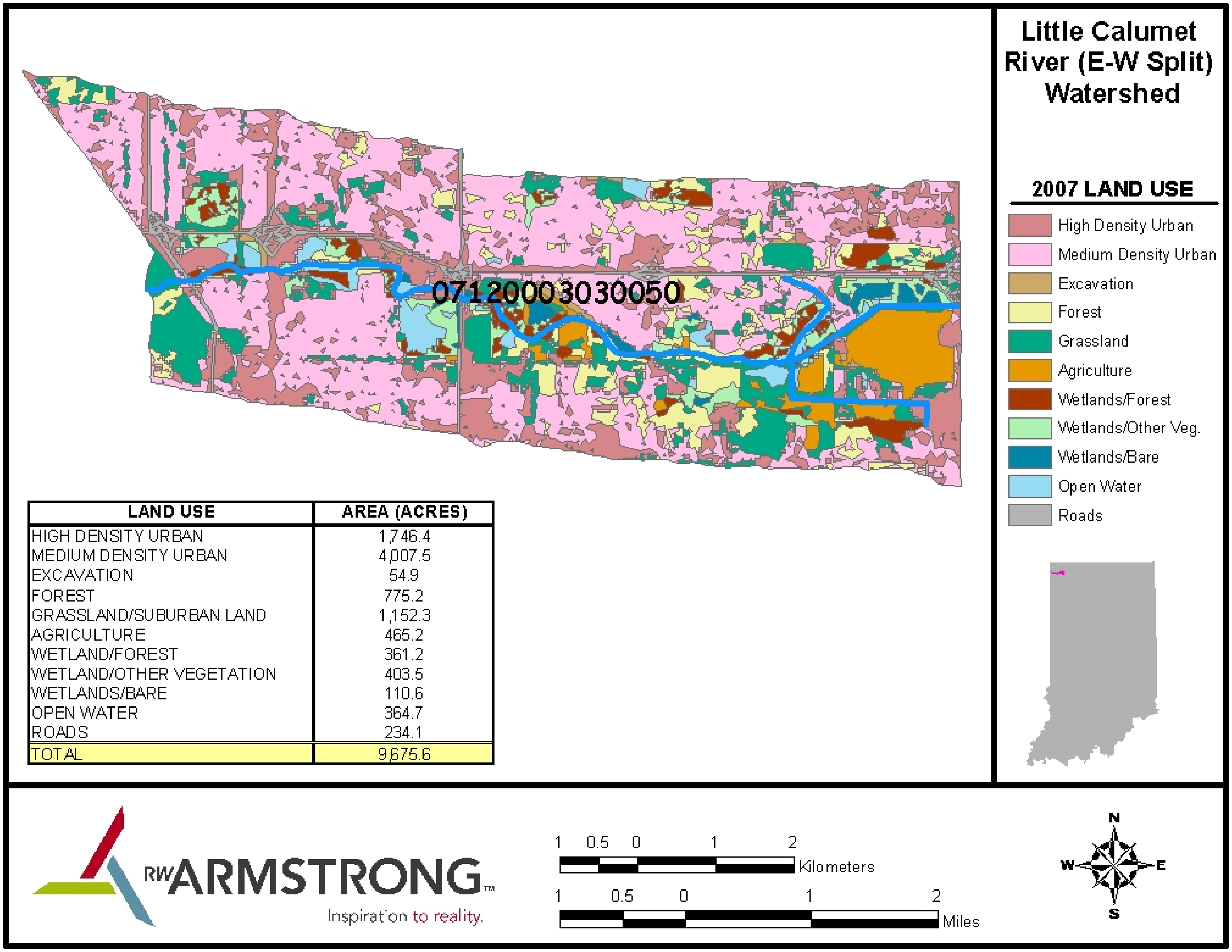
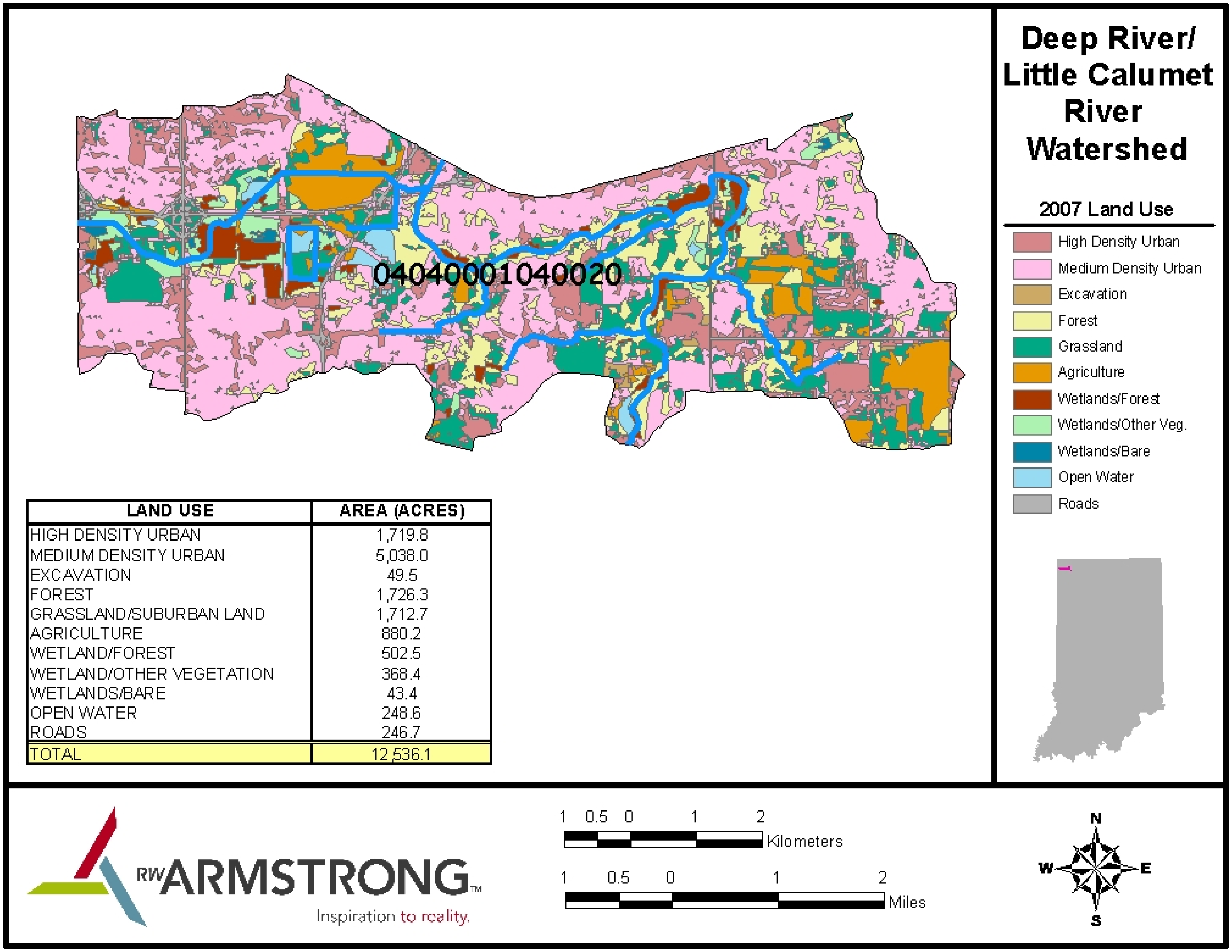
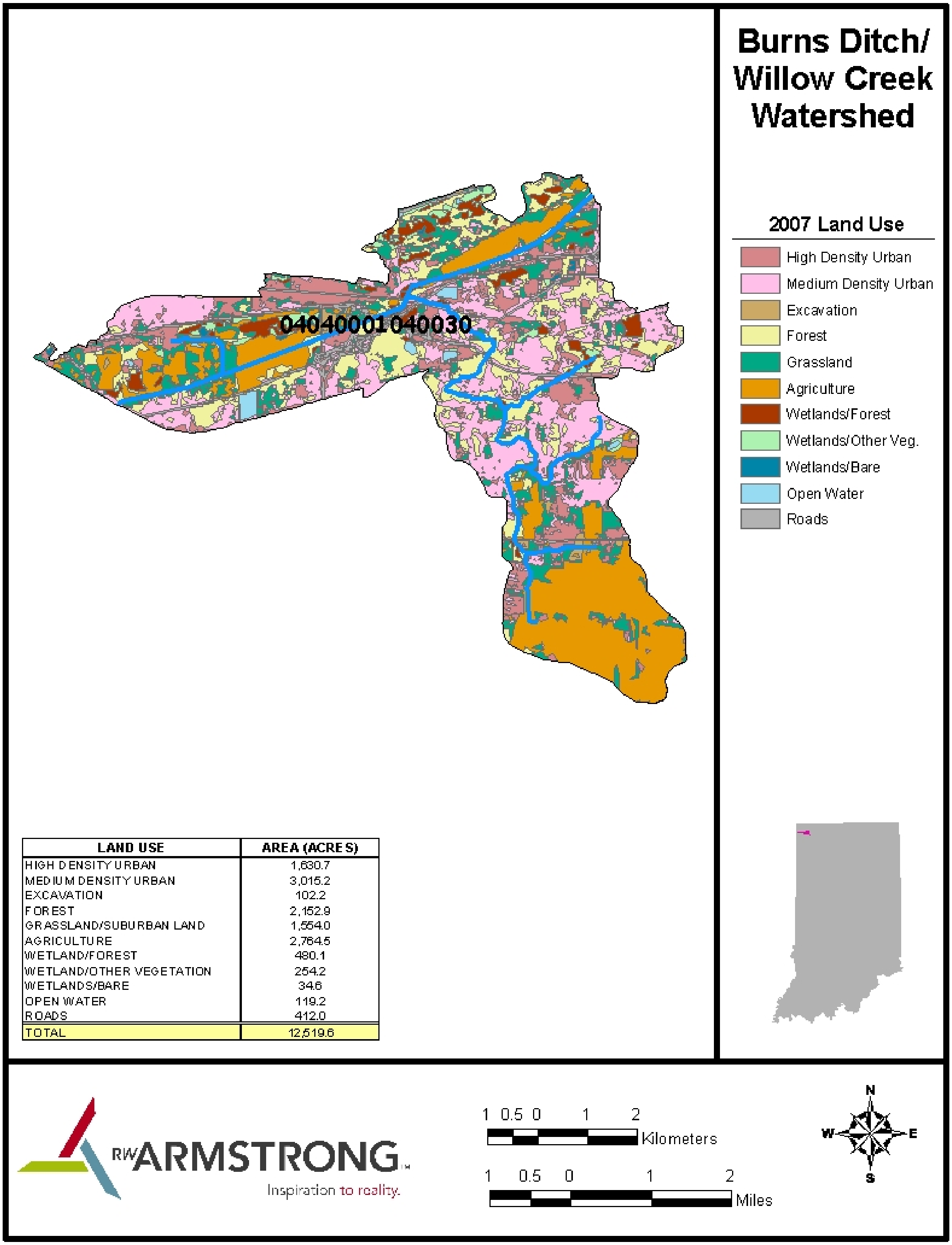


Figure 3.1: Land use map for HUC 07120003030050, Little Calumet River E-W Split Watershed.



LAND USE	AREA (ACRES)
HIGH DENSITY URBAN	1,719.8
MEDIUM DENSITY URBAN	5,038.0
EXCAVATION	49.5
FOREST	1,726.3
GRASSLAND/SUBURBAN LAND	1,712.7
AGRICULTURE	880.2
WETLAND/FOREST	502.5
WETLAND/OTHER VEGETATION	368.4
WETLANDS/BARE	43.4
OPEN WATER	248.6
ROADS	246.7
TOTAL	12,536.1

Figure 3.2: Land use map for HUC 04040001040020, Deep River & Little Calumet River Watershed.



LAND USE	AREA (ACRES)
HIGH DENSITY URBAN	1,630.7
MEDIUM DENSITY URBAN	3,015.2
EXCAVATION	102.2
FOREST	2,152.9
GRASSLAND/SUBURBAN LAND	1,554.0
AGRICULTURE	2,764.5
WETLAND/FOREST	480.1
WETLAND/OTHER VEGETATION	254.2
WETLANDS/BARE	34.6
OPEN WATER	119.2
ROADS	412.0
TOTAL	12,519.6

Figure 3.3: Land use map for HUC 04040001040030, Burns Ditch & Willow Creek Watershed.

LAND USE TYPE	AREA (ACRES)	% OF TOTAL AREA
HIGH DENSITY URBAN	5,097.0	14.68%
MEDIUM DENSITY URBAN	12,060.7	34.73%
EXCAVATION	206.6	0.59%
FOREST	4,654.4	13.40%
GRASSLAND/SUBURBAN LAND	4,419.0	12.72%
AGRICULTURE	4,109.9	11.83%
WETLANDS: FOREST	1,343.8	3.87%
WETLANDS: OTHER VEGETATION	1,026.1	2.95%
WETLANDS: BARE	188.6	0.54%
OPEN WATER	732.5	2.11%
ROADS	892.9	2.57%
TOTAL AREA =	**34,731.5**	**100.00%**

Table 3.1: Land use acreage for entire watershed study area.

Impervious Areas

Urbanization and the resulting impervious areas contained within them are one of the most significant factors affecting non-point source pollution.

Several studies have reported a direct relationship between the increase of impervious areas and the degradation of the receiving water bodies. Of these studies, most agree that once impervious cover exceeds 10% of the land in the watershed, the receiving waters will be negatively impacted. Watersheds with an impervious cover of 10% to 30% are often said to be "impacted" and watersheds with greater than 30% of the available land covered with an impervious surface are often categorized as seriously degraded.

Increases in impervious areas lead directly to increases in run off volume and reduction of surface water infiltration. This added runoff often leads to increased flow velocities, increased flooding severity and frequency, and a decrease in water quality.

The impervious area was calculated for all three HUC watersheds (Tables 3.2 to 3.4) according to their land use map category. Impervious area factors were used based on the land use type and a total area of 12,905 acres was found to be impervious. This acreage results in 37% of the study area being considered impervious and consequently puts the area in the seriously degraded category.

LITTLE CALUMET RIVER (E-W SPLIT) WATERSHED HUC 07120003030050				
LAND USE	AREA (ACRES)	IMPERVIOUS AREA FACTOR	IMPERVIOUS AREA (ACRES)	% OF HUC WATERSHED
HIGH DENSITY URBAN	1,746.4	75%	1,309.8	13.54%
MEDIUM DENSITY URBAN	4,007.5	65%	2,604.9	26.92%
EXCAVATION	54.9	2%	1.1	0.01%
FOREST	775.2	2%	15.5	0.16%
GRASSLAND/SUBURBAN LAND	1,152.3	2%	23.0	0.24%
AGRICULTURE	465.2	4%	18.6	0.19%
WETLAND/FOREST	361.2	0%	0.0	0.00%
WETLAND/OTHER VEGETATION	403.5	0%	0.0	0.00%
WELANDS/BARE	110.6	0%	0.0	0.00%
OPEN WATER	364.7	0%	0.0	0.00%
ROADS	234.1	100%	234.1	2.42%
TOTALS	**9,675.8**		**4,207.1**	**43.48%**

Table 3.2: Impervious area based on land use category for E-W Split Watershed.

LITTLE CALUMET RIVER & DEEP RIVER WATERSHED HUC 04040001040020				
LAND USE	AREA (ACRES)	IMPERVIOUS AREA FACTOR	IMPERVIOUS AREA (ACRES)	% OF HUC WATERSHED
HIGH DENSITY URBAN	1,719.8	75%	1,289.9	10.29%
MEDIUM DENSITY URBAN	5,038.0	65%	3,274.7	26.12%
EXCAVATION	49.5	2%	1.0	0.01%
FOREST	1,726.3	2%	34.5	0.28%
GRASSLAND/SUBURBAN LAND	1,712.7	2%	34.3	0.27%
AGRICULTURE	880.2	4%	35.2	0.28%
WETLAND/FOREST	502.2	0%	0.0	0.00%
WETLAND/OTHER VEGETATION	368.4	0%	0.0	0.00%
WELANDS/BARE	43.4	0%	0.0	0.00%
OPEN WATER	248.6	0%	0.0	0.00%
ROADS	246.7	100%	246.7	1.97%
TOTALS	**12,535.8**		**4,916.2**	**39.22%**

Table 3.3: Impervious area based on land use category for Little Calumet & Deep River Watershed.

BURNS DITCH & WILLOW CREEK WATERSHED HUC 04040001040030				
LAND USE	AREA (ACRES)	IMPERVIOUS AREA FACTOR	IMPERVIOUS AREA (ACRES)	% OF HUC WATERSHED
HIGH DENSITY URBAN	1,630.7	75%	1,223.0	9.77%
MEDIUM DENSITY URBAN	3,015.2	65%	1,959.9	15.65%
EXCAVATION	102.2	2%	2.0	0.02%
FOREST	2,152.9	2%	43.1	0.34%
GRASSLAND/SUBURBAN LAND	1,554.0	2%	31.1	0.25%
AGRICULTURE	2,764.5	4%	110.6	0.88%
WETLAND/FOREST	480.1	0%	0.0	0.00%
WETLAND/OTHER VEGETATION	254.2	0%	0.0	0.00%
WELANDS/BARE	34.6	0%	0.0	0.00%
OPEN WATER	119.2	0%	0.0	0.00%
ROADS	412.0	100%	412.0	3.29%
TOTALS	**12,519.6**		**3,781.7**	**30.21%**

Table 3.4: Impervious area based on land use category for Burns Ditch & Willow Creek Watershed.

Recreational Areas and Publicly Controlled Lands

As part of the Little Calumet River Basin Development Commission project being completed in conjunction with ACOE recreational features are being added along the river. These recreational features being included in the flood protection project include canoe launches, walking trails, and fishing piers.

In addition to the recreational features being added to the study area by the ACOE there are many other features in the watershed area currently that can be used for recreation. Figures 3.4 to 3.6 highlight the publicly controlled lands in each of the 14-digit HUC watersheds. Majority of the areas included are undeveloped and will remain that way, with the exception of schools and other government lands that were included. The maps created for the recreational features are the result of data taken from several sources, including aerial photographs, park foundation maps from Lake and Porter Counties, local street maps and information listed in other previous studies.

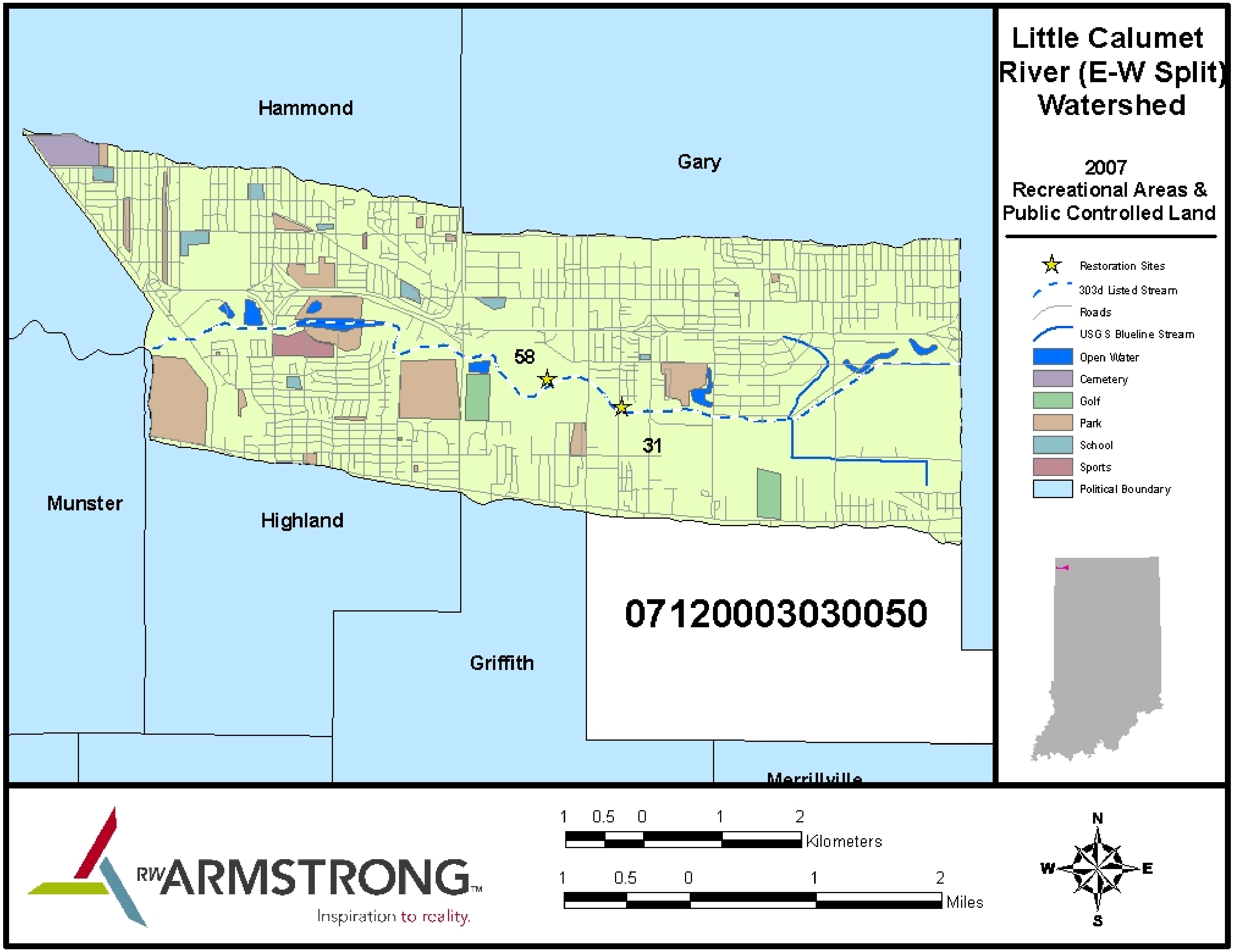


Figure 3.4: Publicly controlled lands for HUC 07120003030050, Little Calumet River E-W Split Watershed.

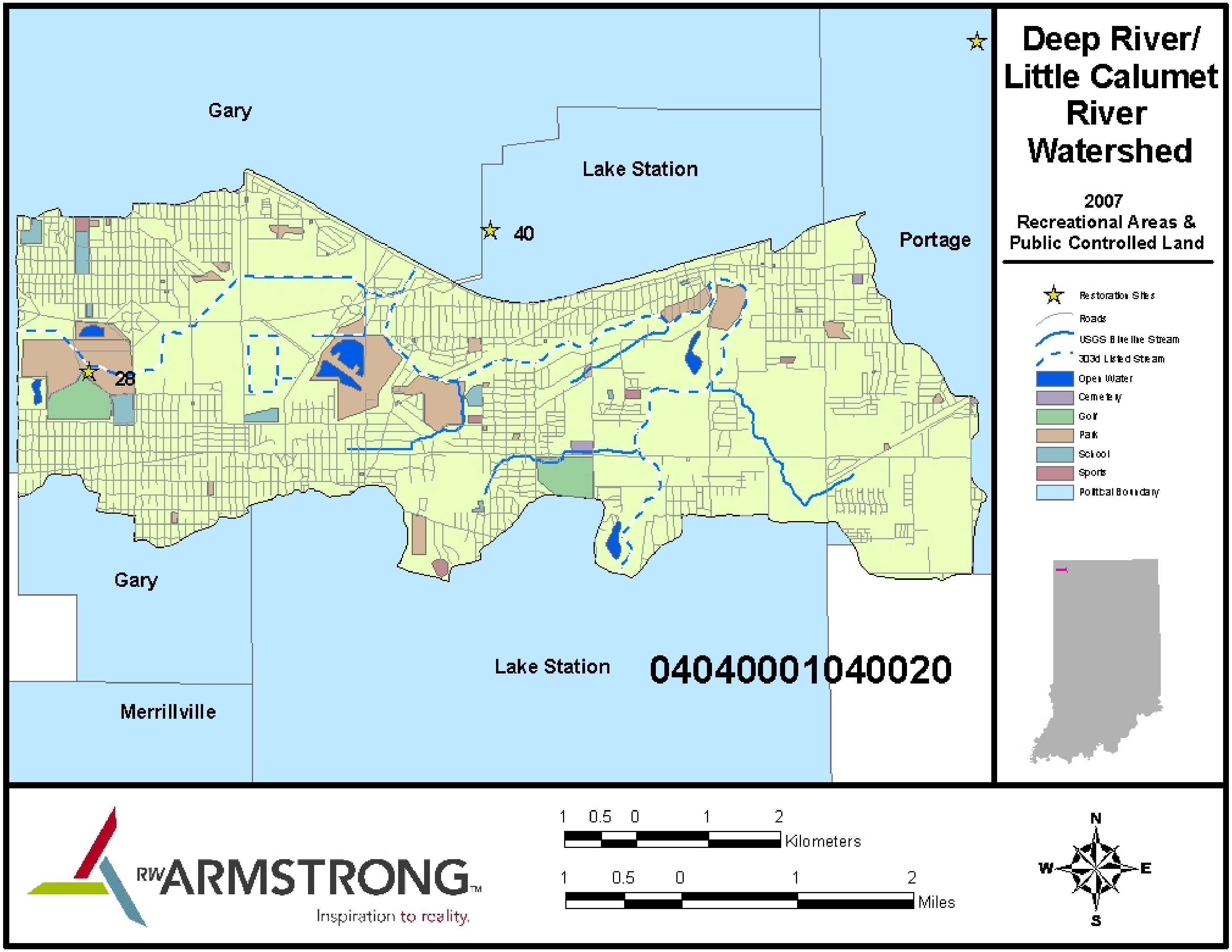


Figure 3.5: Publicly controlled lands for HUC 04040001040020, Little Calumet River and Deep River Watershed.

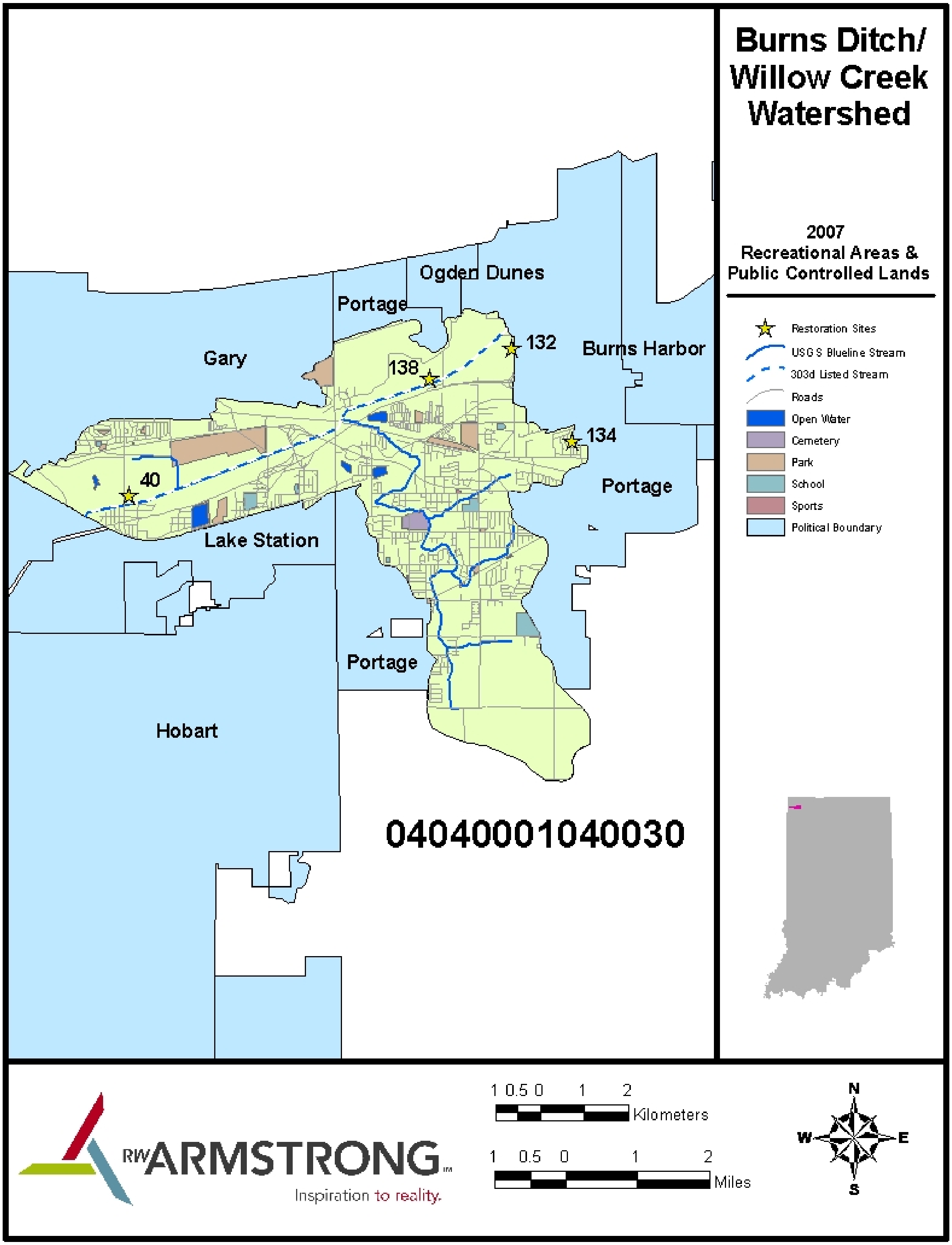


Figure 3.6: Publicly controlled lands in HUC 04040001040030, Burns Ditch and Willow Creek Watershed.

Riparian Buffer Areas

Natural areas currently exist along the river from the western boundary of the study area to approximately the Lake/Porter County Line. Once you enter the Burns Ditch and Willow Creek watershed though there is very little natural buffer along the Little Calumet River (Burns Ditch). Figure 3.7 to 3.9 show the natural buffer areas, as delineated using aerial photographs and previously conducted studies including the Gary Green Link Plan.

Projects are currently under way that will increase the natural buffer areas in the western portion of the study area but not in the eastern portion where it is perhaps needed the most. The riparian areas in the western portion of the study area are undergoing changes currently that will increase their size and hopefully their effectiveness. The Army Corp of Engineers is in the process of building a levee system along the Little Calumet River and the East Reach of this project includes the western portion of the study area being looked at for this report. Figure 3.10 shows the levee system that is currently being built. All of the area within the flood control project will remain as natural areas.

Large natural buffers along the river have multiple positive impacts to the water quality. They increase the stability of the slope due to the vegetation that will develop and have deeper root systems than those of crops or summer grass. The effect that floods will have on the local community will decrease in severity due to the water having a place to pool before reaching individual communities and homes. The wildlife habitat in the area will also improve as the non-point source pollution is reduced by slowing down the physical runoff and giving sufficient time for sediments to settle out before reaching the water.

Future Population and Development Trends

Population projections through 2030 show the population decreasing in the western portion of the study area while the eastern portion looks to have population increases, especially in the Porter County area. Figure 3.11 shows the breakdown of population trends, according to traffic analysis zones, created using population projection data from the Northern Indiana Regional Planning Commission (NIRPC). NIRPC is currently in the process of creating new future population data which will alter these projections. Infrastructure that was expected to be completed and therefore taken into account when creating these projections was not able to be constructed; resulting in lower population increase projections in some communities.

Comparison of the future population projections with the land use maps in this plan indicates that the areas projected to grow the fastest over the next 2o plus years will be areas that are currently shown as large agricultural tracks. The area shown in HUC 071200030050 that is delineated to increase between 701 to

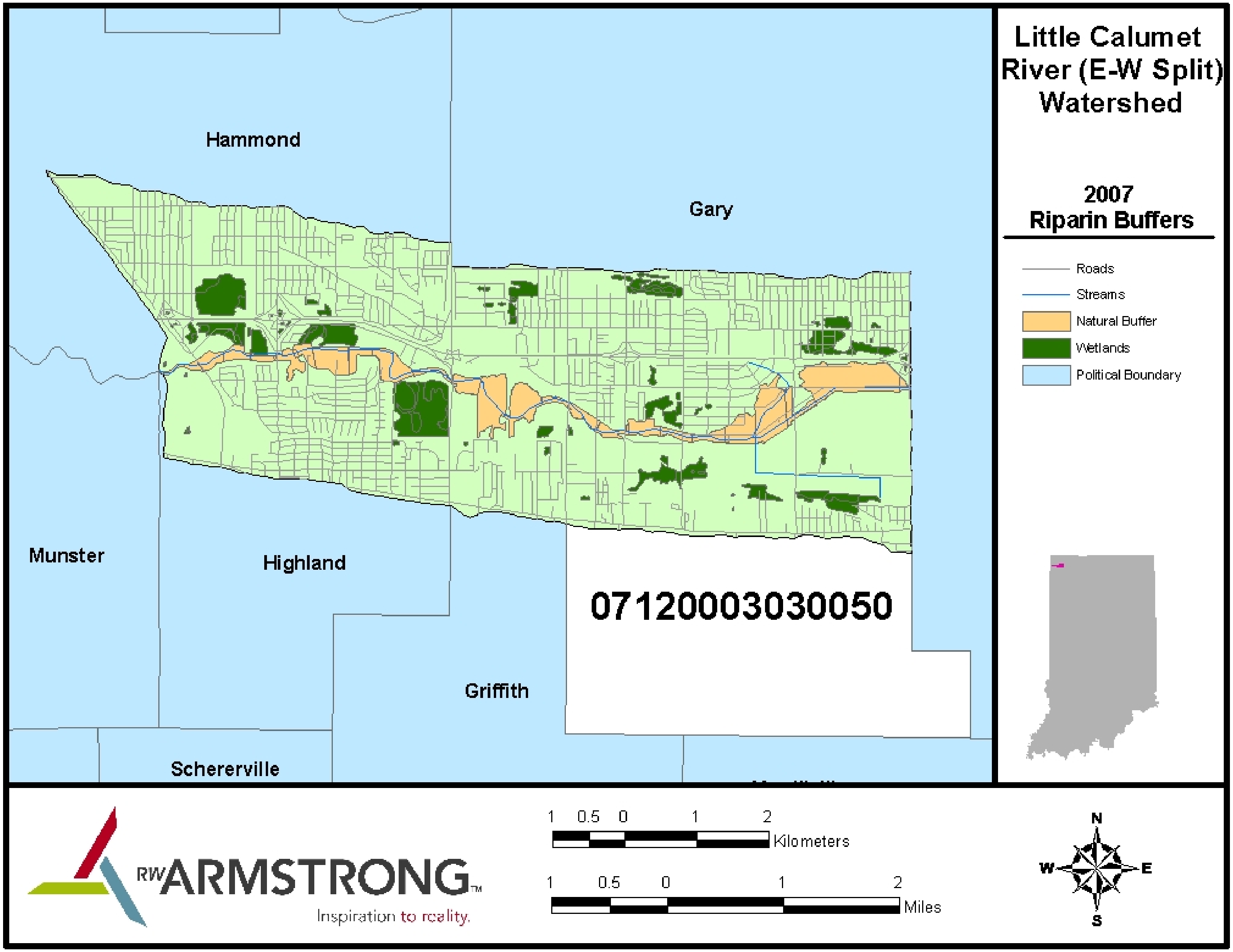


Figure 3.7: Riparian zones located along the Little Calumet River in the E-W Split Watershed, HUC 07120003030050.

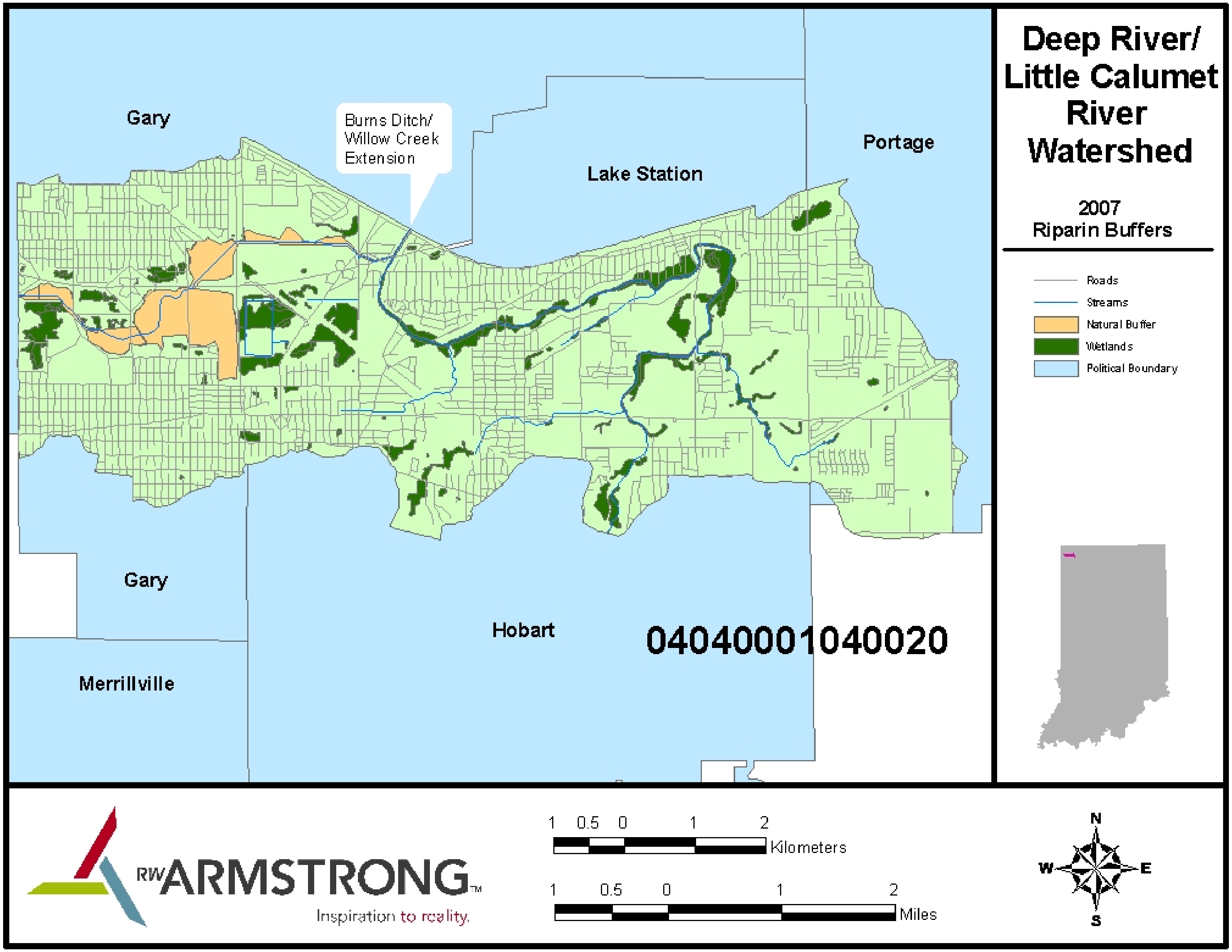


Figure 3.8: Riparian zones located along the Little Calumet River in the Little Calumet & Deep River Watershed, HUC 04040004040020.

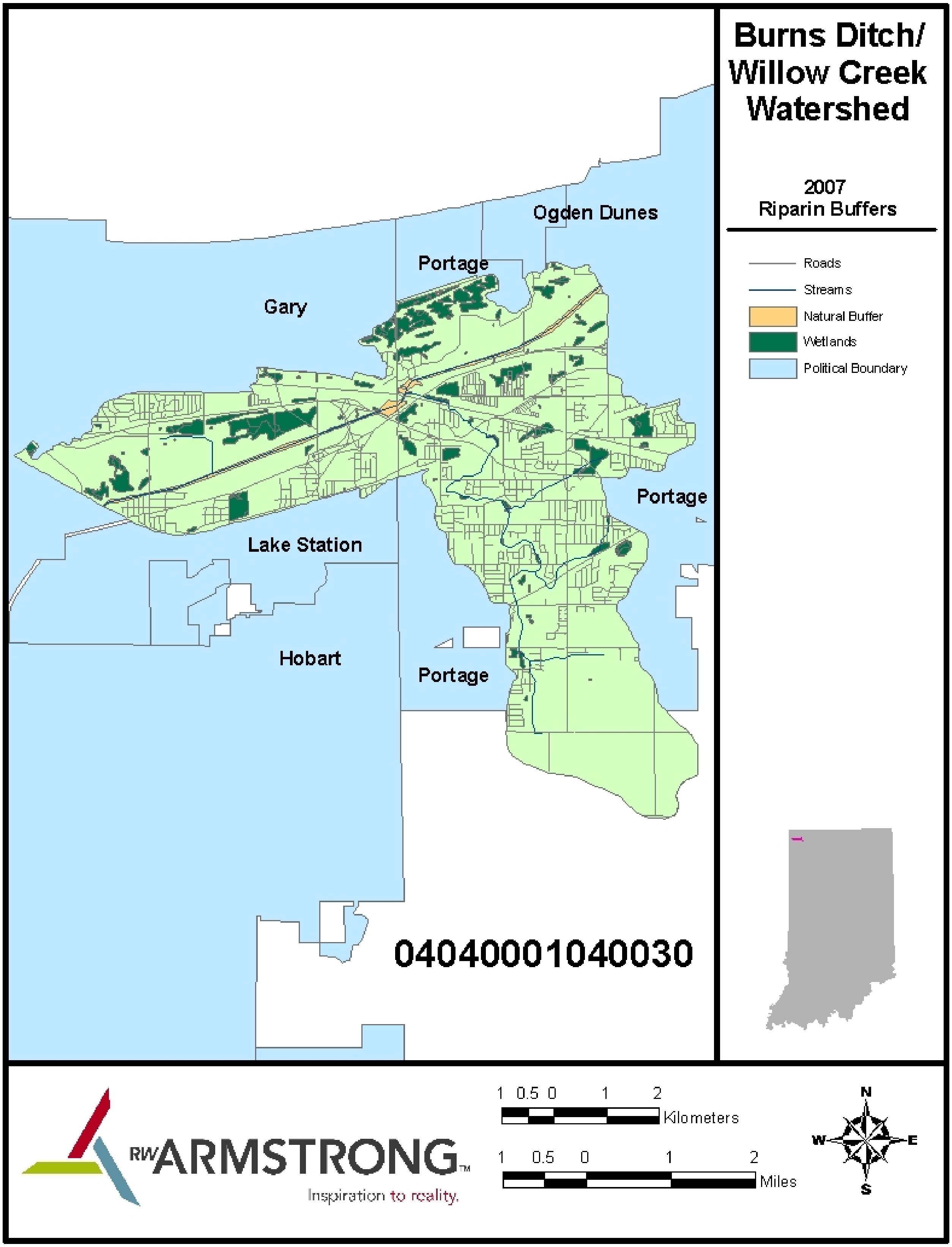


Figure 3.9: Riparian zones located along the Little Calumet River in the Burns River and Willow Creek watershed.

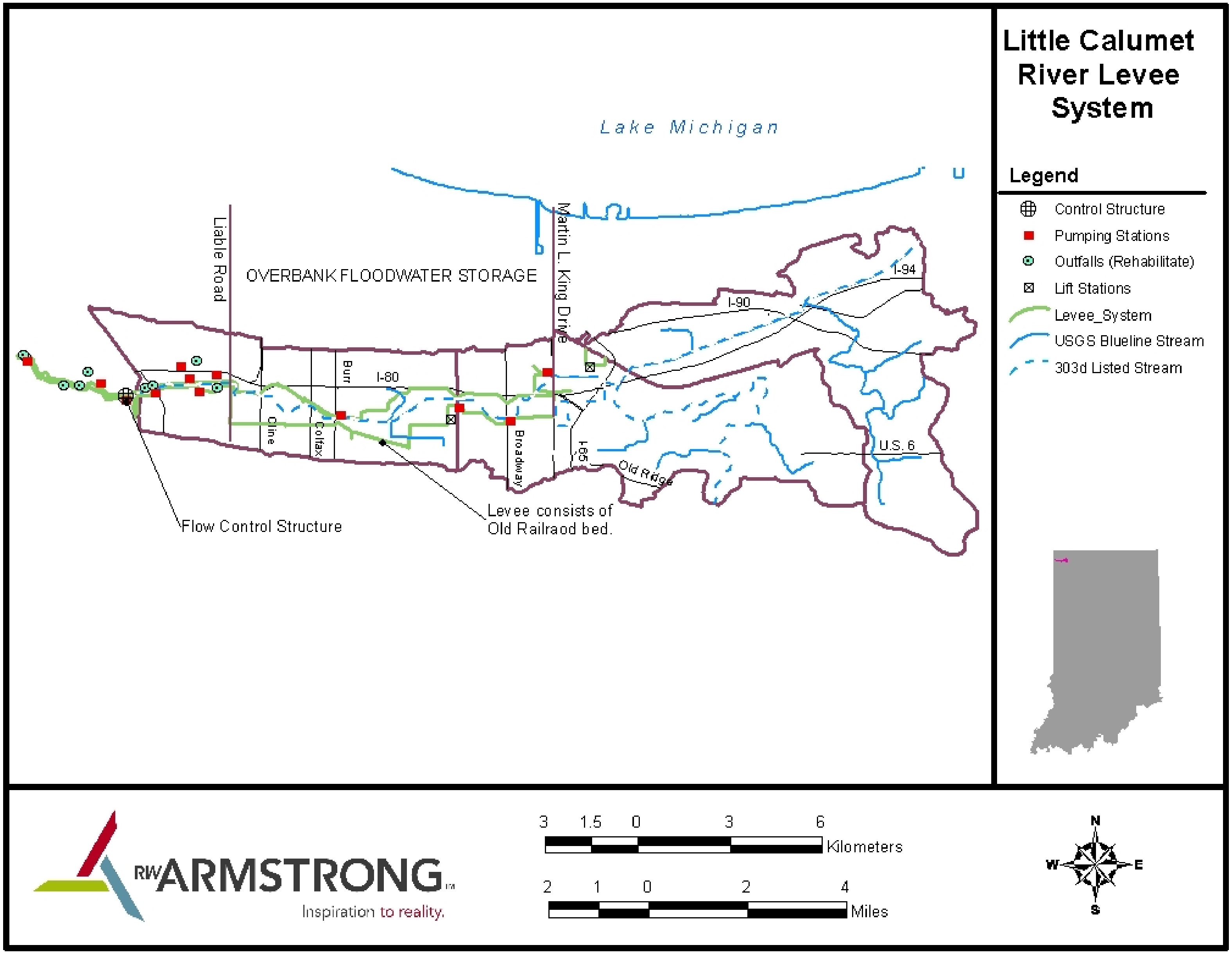


Figure 3.10: ACOE levee system currently being constructed for completion in 2013.

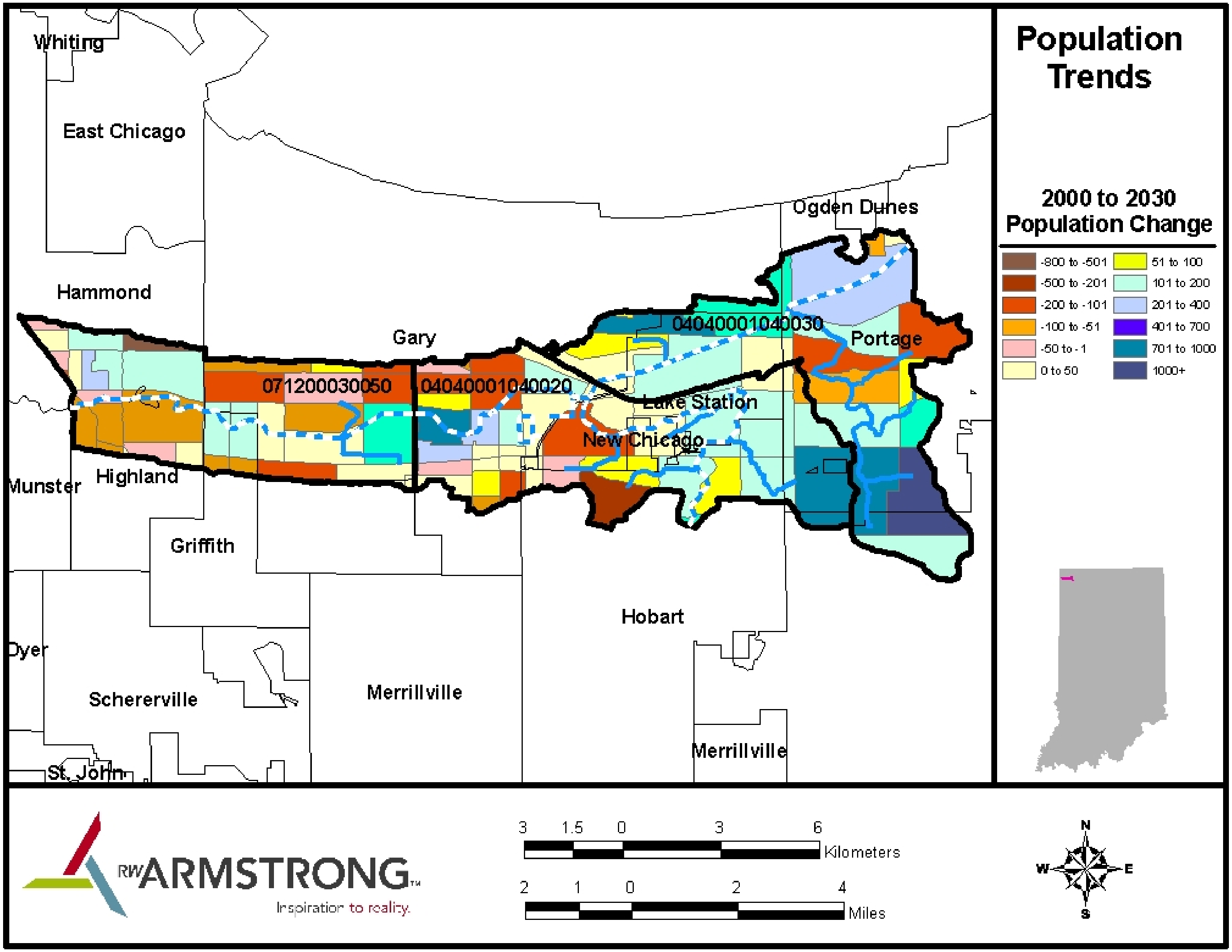


Figure 3.11: Population trends according to 2030 projections from the Northern Indiana Regional Planning Commission.

1,000 and the area in the southern tip of HUC 04040001040030 both average out to be growing at more than 741 people per square mile. These two areas encompass approximately 3,500 acres and development into Medium Density Urban will result in an increase of nearly 2,000 impervious acres; according to the impervious area factors used for the two land use categories. This development would not only increase the impervious area greatly but would also decrease the agricultural land use in the study area by approximately 50%.

Further development is expected around the interchanges of the Borman Expressway (I-80/I-94) due to the completion of the line of protection of the levee system. It is expected that this will be mostly in the form of commercial property. Other future development includes the current site of the Woodmar Country Club within the City of Hammond which is being developed as commercial property.

An increase in impervious area due to development has the possibility of creating higher TSS readings. As populations increase and development lowers the pervious area in the watershed the velocity of the Little Calumet River and its tributaries will increase. This increase in water velocity will be due to more runoff entering the water bodies as less will be capable of entering the soil. Increased water velocities are a leading cause of increased TSS readings as is the effluent produced from wastewater treatment plants which will also be increased due to larger loads being taken to the plants.

Porter and Lake County Legal Drains

All of the Little Calumet River within the three 14- digit HUC watersheds in this study is a legal/regulated drain in Lake and Porter Counties. However, portions of the tributary system, especially Deep River and Willow Creek, are not legal/regulated drains. Figure 3.12 show the legal/regulated drains according to information received from Lake and Porter counties.

Waterbody Use

The 2003 Recreational Use Surveys conducted by GSD as part of their CSO Long Term Control Plan indicated that residents currently access the river at several sites within the city for fishing.

As part of the Little Calumet River Flood Control Project, the U.S. Army Corp of Engineers has constructed trails, canoe ramps, and fishing piers along the Little Calumet River.

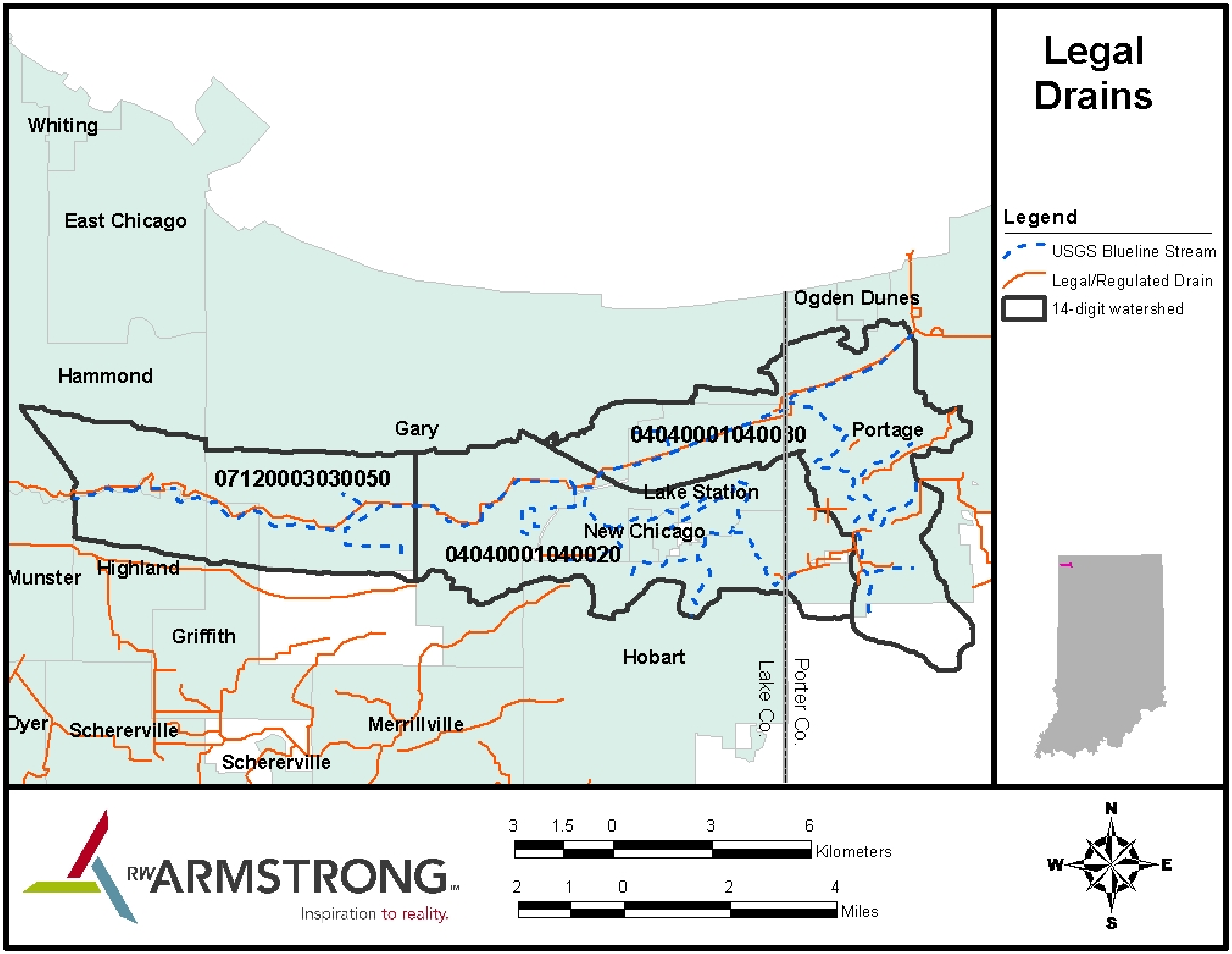


Figure 3.12: Legal/Regulated drains in Lake and Porter Counties.

Section IV: Water Quality Investigation

Designated Uses and Water Quality Standards

The State of Indiana specifies appropriate water uses to be achieved and protected for each water body as required by the US EPA. Appropriate uses are identified by taking into consideration the use and value of the water body for public water supply, for protection of fish, shellfish, and wildlife, and for recreational, agricultural, industrial, and navigational purposes.

According to Indiana Rule 327 IAC 2-1.5, the Little Calumet River is designated for full-body contact recreation and shall be capable of supporting a well-balanced, warm water aquatic community. The West Branch of the Little Calumet River is **not** designated as a Limited Use water or as an Outstanding State Resource Water.

The overall water quality goal for these watersheds, which includes the Little Calumet River, is that all water bodies meet the applicable water quality standards for their designated uses as determined by the State of Indiana, under the provisions of the Clean Water Act.

The following quantitative standards have been set for the Little Calumet River:

1. *E.coli* bacteria, using membrane filter (MF) count shall not exceed two hundred thirty-five (235) per one hundred (100) milliliters in any one (1) sample in a thirty (30) day period.
2. No pH values below six (6.0) or above nine (9.0) except daily fluctuations that exceed pH nine (9.0) and are correlated with photosynthetic activity, shall be permitted.
3. Concentrations of dissolved oxygen shall average at least five (5.0) milligrams per liter per calendar day and shall not be less than four (4.0) milligrams per liter at any time.
4. Total Cyanide is limited to 48,000 micrograms per liter for the protection of human health in non-drinking waters.
5. Temperatures in the river and its tributaries are limited to the following temperatures in degrees Fahrenheit (degrees Celsius):
    a. January 50 (10)
    b. February 50 (10)
    c. March 60 (15.6)
    d. April 70 (21.1)
    e. May 80 (26.7)
    f. June 90 (32.2)
    g. July 90 (32.2)
    h. August 90 (32.2)
    i. September 90 (32.2)

j.	October	78	(25.5)
k.	November	70	(21.1)
l.	December	57	(14.0)

Currently, there are no standards in place for nitrogen and phosphorus levels in this particular category of water bodies.

Water Quality Impairments and TMDLs

The West Branch of the Little Calumet River is currently listed for *E.coli* and Cyanide on the Indiana Department of Environmental Management (IDEM) Section 303(d) List of Impaired Water Bodies. A Fish Consumption Advisory is also in effect for the West Branch of the Little Calumet River for PCB's and Mercury. This river has also appeared on the United States Environmental Protection Agency's Indiana List of Impaired Waters for 1998 for Cyanide, *E.coli*, Mercury, PCB's, Pesticides, and Impaired Biotic Communities.

Aquatic ecosystems have suffered from the chronic effects of contaminated sediments and air deposition. In the early and mid-1960s, most streams in northwestern Lake County were affected by pollution. Water quality currently is characterized within the basin by low dissolved oxygen, high biochemical oxygen demand (BOD), pollutant tolerant aquatic biota that has replaced native species in the northern reaches of the basin, and fish consumption advisories. Oil, grease, floating debris and offensive odors have made most portions of the Grand Calumet and Little Calumet rivers unappealing to recreational boaters and fishermen. High bacteria counts also have made them unfit for full body contact. Causes of such pollution include a history of unregulated and poorly regulated discharges from industries and sewage treatment plants, combined sewer overflows, urban runoff carrying pesticides, nutrients and heavy metals, and sedimentation (IDNR 1994).

A Total Maximum Daily Load (TMDL) standard for *E.coli* bacteria has been developed for this watershed. This plan has been crafted to achieve the required pollutant reduction in the TMDL. Based on the 2004 TMDL report, a reduction of approximately 90% in the non-point source loads will be required.

Major causes of water quality impairment in the Little Calumet River watershed include:

- *E.coli* Bacteria.
- Cyanide
- PCBs
- Metals
- Pesticides

E.coli Pollution

E.coli is a significant source of pollution in the Little Calumet River. The federal standard set forth to ensure safe use of waters for water supplies and recreation (327 IAC 2-1-6 Section 6(d)) states that *E.coli* bacteria, shall not exceed 125 per 100 milliliters as a geometric mean based on not less than five samples equally spaced over a 30 day period. The bacteria are associated with the intestinal tract of warm blooded animals. The presence of *E.coli* in water is a strong indication of the presence of sewage or animal waste contamination. It may enter the water through combined sewer outlets during rainfalls or other types of precipitation, or it may come from poorly functioning septic systems or spills from lagoons containing animal wastes. *E.coli* is widely used as an indicator of the potential presence of waterborne disease causing (pathogenic) bacteria and viruses because they are easier to detect than these pathogenic organisms. The presence of waterborne disease-causing organisms can lead to outbreaks of such diseases as typhoid fever, dysentery, and cholera.

Cyanide

Hydrogen Cyanide is mainly used to make the compounds needed to make nylon and other synthetic fibers and resins. Other cyanides are used as fertilizers. Cyanide enters the water through the release of discharges from metal finishing industries, iron, and steel mills and organic chemical industries. Cyanide ties up the hemoglobin sites that bind oxygen to red blood cells, resulting in oxygen deprivation. This condition is known as cyanosis and is characterized by blue skin color. Cyanide also causes chronic effects on the thyroid and central nervous system.

PCBs

PCBs are organic chemicals that were once used in capacitors and transformers. PCBs enter water from runoff from landfills and from the discharge of waste chemicals. In 1977, production of PCBs in North America was halted. PCB contamination today is a result of historical waste disposal practices. All water bodies in Indiana are under a fish consumption advisory for PCBs.

Metals

Municipal and industrial dischargers and urban runoff are the main sources of metal contamination in surface water. Indiana has stream standards for many heavy metals, but the most common ones in municipal permits are cadmium, chromium, copper, nickel, lead, mercury, and zinc. Point source discharges of metals are controlled through the National Pollution Discharge Elimination System (NPDES) permit process. Non-point sources of metals are controlled through best management practices (BMPs).

Pesticides

Pesticides are used in agricultural and urban/residential settings to kill unwanted plants and animals. Pesticides enter surface waters primarily through non-point source runoff from agricultural lands and urban areas. Pesticide contamination is also due to legacy pesticides that are no longer being used but are still impairing the environment. Pesticides are a significant source of pollution in the Little Calumet-Galien watershed.

Existing Water Quality Data

Water quality data that had been previously gathered by governmental agencies and local communities was collected. Information that had been generated by the Department of Natural Resources (DNR), United States Geological Survey (USGS), and Indiana Department of Environmental Management (IDEM) for the three 14-digit HUC watersheds being studied was requested and received. The information is limited from these sources however, due to the fact that most of the water quality data collected in Northwest Indiana is along the Grand Calumet River.

Data that local communities had collected concerning the water quality of the Little Calumet River was also requested and reports were received from the Sanitary District of Hammond and from the Gary Sanitary District (GSD).

Fixed Station Data

Fixed station monitoring by the Indiana Department of Environmental Management in Portage at the Portage Boat Yard Dock was reviewed from 1990 to 2006. Samples were analyzed for Alkalinity, Chlorides, COD, Cyanide, *E.coli*, Hardness, Ammonia, Nitrates, Nitrites, pH, Total Phosphorus, TKN, and Total Suspended Solids. The fixed station data from IDEM that is referenced here can be found in Appendix 6: IDEM Fixed Station Data.

Three additional sampling locations were added along the Little Calumet River/Portage Burns Waterway for sampling in July and August of 2000. These additional locations were at Cline Avenue, Broadway Street and Ripley Street. The *E.coli* results of the five samples recorded can also be found in Appendix 6: IDEM Fixed Station Data.

E.coli Bacteria: Figure 4.1 shows the *E.coli* sampling results from 1996 through 2001, the most recent reading recorded. The highest reading in this time frame was 5,200 cfu/100mL on August 8, 2000. In this time frame, 28 of the 52 readings exceeded the 235 cfu/100mL standard set forth.

Earlier data shows much higher readings in 1990 and 1991. Higher readings also occurred from mid 1997 to mid 1999. The highest recorded reading for *E.coli* was 11,000 cfu/100mL and occurred on January 16, 1991.

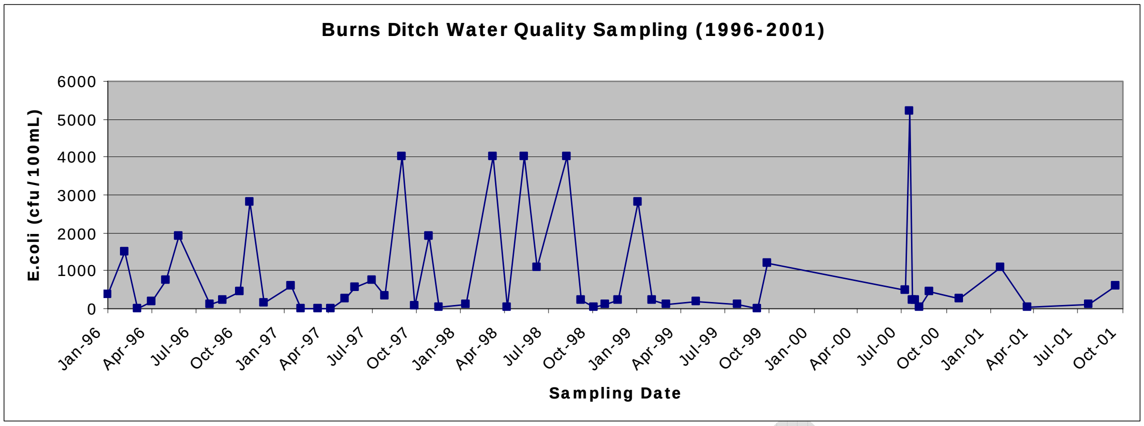


Figure 4.1: Portage Boat Yard fixed station *E.coli* data as recorded by IDEM.

Ammonia (NH_3): The level of Ammonia was determined at the Portage Boat Yard Dock on a monthly basis beginning in January of 1990. Figure 4.2 shows the sampling results from 2000 to 2006. The ammonia levels of the water were consistently around 0.1 mg/L with an average reading of 0.15 mg/L and the high level being found in February 2004 at 0.8 mg/L. This reading was also the high level for the 17 year sampling period. The ammonia levels have been consistent since 1990 with the 17 year average at 0.18 mg/L.

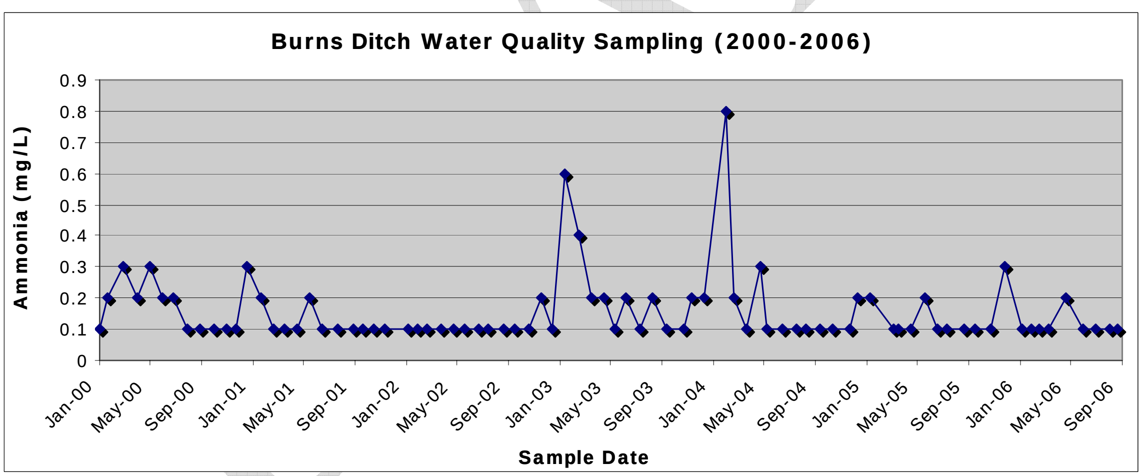


Figure 4.2: Portage Boat Yard fixed station ammonia (NH_3) data as recorded by IDEM.

Nitrogen: The nitrogen sampling results are comprised of the total nitrates and nitrites found each month over the 17 year period. Figure 4.3 shows the sampling data from 2000 to 2006. The high reading was found to be 4.6 mg/L in July 2005.

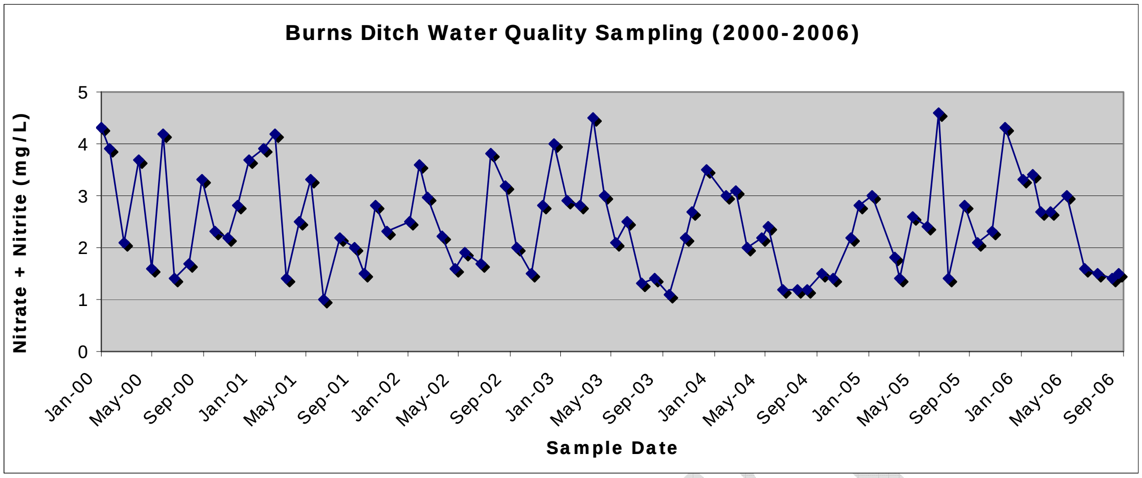


Figure 4.3: Portage Boat Yard fixed station nitrate and nitrite data as recorded by IDEM.

Total Phosphorous: The phosphorous levels can be found in Figure 4.4 for the Portage-Burns Waterway from 2000 to 2006. The levels vary from 0.05 to 0.38 mg/L for the 7 year sampling period. This period accurately reflects the overall 17 year trend where the levels vary from 0.05 to 0.45 mg/L. The high reading of 0.45 mg/L was found in November 1990 with the next highest reading being 0.38 mg/L in July 1999 and then again in July 2005, which is reflected in our sampling data.

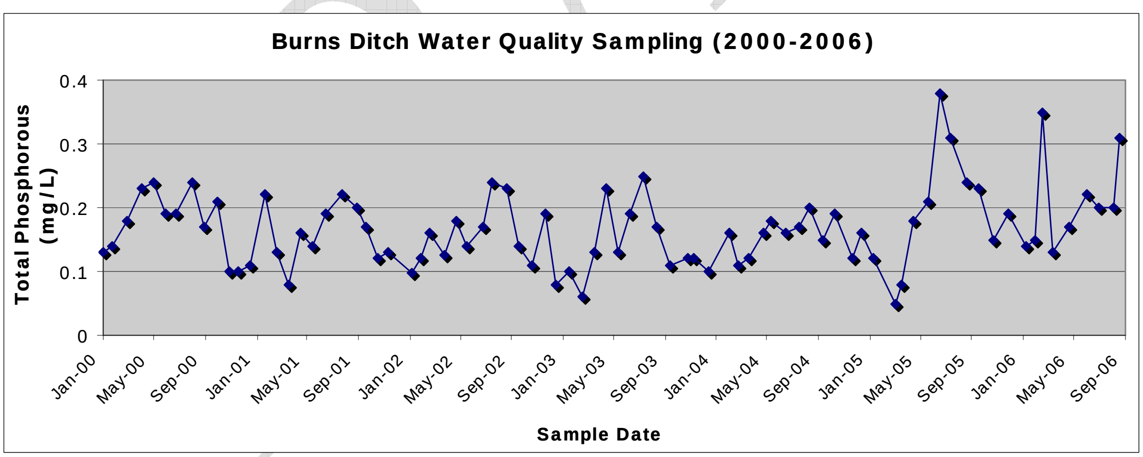


Figure 4.4: Portage Boat Yard fixed station total phosphorus data as recorded by IDEM.

Total Kjeldahl Nitrogen: The results of the water quality sampling conducted for the TKN levels showed a variance of 1.9 mg/L, with the low being 0.4 mg/L. There seems to be no consistent pattern in the TKN levels found. Figure 4.5, below, shows the results from 2000 through 2006 which accurately reflect the 17 year testing period in the variance shown and that there is no consistent pattern that can be found.

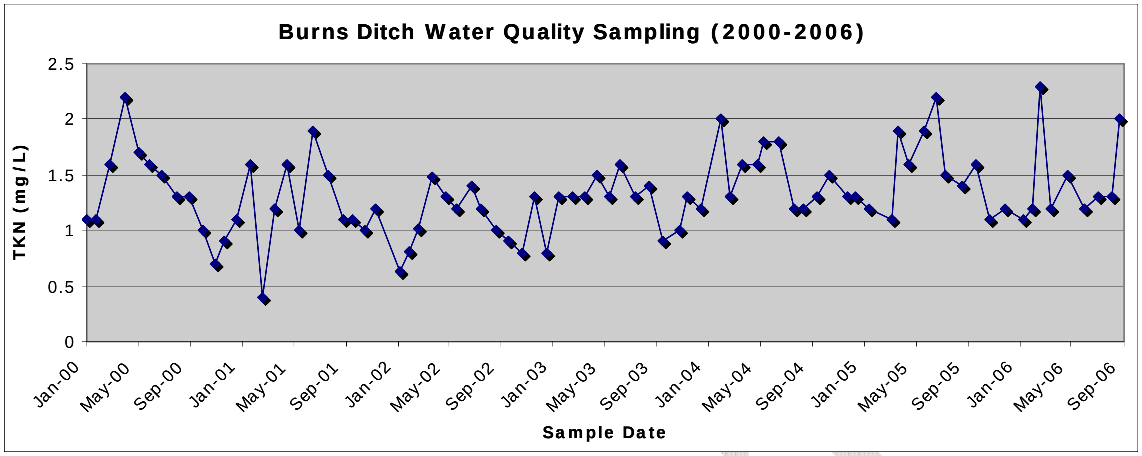


Figure 4.5: Portage Boat Yard fixed station total kjeldahl nitrogen data as recorded by IDEM.

Total Suspended Solids: The water quality sampling results for TSS showed levels that were consistently below 50 mg/L. While majority of the samples were found to be under 50 mg/L there were five samples over the 17 year sampling period that were above 150 mg/L. The first of these was the largest with a value of 240 mg/L. In the seven (7) year sampling period shown in Figure 4.6 there is only one of these spikes. It occurred on March 13, 2006 and was found to be 186 mg/L. The other three spikes all occurred before July 1997.

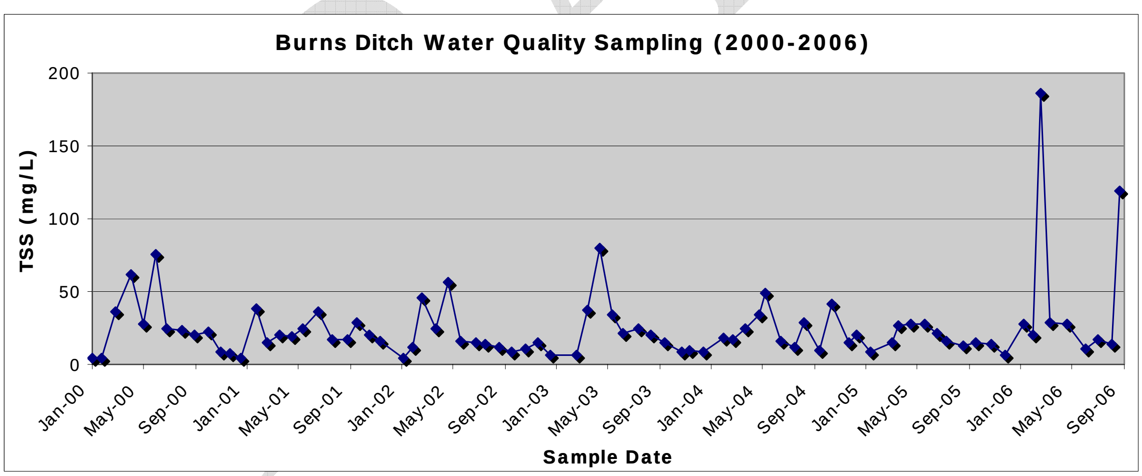


Figure 4.6: Portage Boat Yard fixed station total suspended solids data as recorded by IDEM.

Combined Sewer Overflow Master Plan Phase II – Little Calumet River Sampling Program for the Hammond Sanitary District – November 1995

This study was intended to characterize and model water quality in the Little Calumet River and the impact that Combined Sewer Overflows (CSO's) have on the river for the Hammond Sanitary District. The study was bounded by Cline Avenue on the east and Hohman Avenue on the West. The samples were analyzed for ammonia, *E.coli*, metals, phosphorus, cyanide, nitrates, and other pollutants of concern. Some baseline biological sampling was also conducted. The data collected as part of this study is included in Appendix 8: CSO Master Plan Phase II for the Hammond Sanitary District. Sampling was conducted at seven locations, shown in Figure 4.7, on August 11, 1994, October 8, 1994, and October 31, 1994.

Three of the seven sampling points were within the boundaries of the watershed being studied as part of this planning effort. A fourth point was located just outside of the watershed boundary along Hart Ditch, which flows north from the Munster area.

E.coli Bacteria: The *E.coli* concentrations found during this study far exceeded the state standard of 235 cfu/100mL. The lowest concentration recorded in this report was 3,000 cfu/100mL at the Kennedy Avenue sampling site on October 4, 1994. Figure 4.8 shows the *E.coli* concentrations recorded at Hart Ditch and the three sampling locations within the boundaries of our study area. The highest concentration levels were found west of these sites at the Hohman and Calumet sampling locations on October 31 and were recorded as being 260,000 and 400,000 cfu/100mL, respectively. While the highest concentration levels were found west of our watershed it can be seen that Hart Ditch also contributes high concentration levels. The east-west split of the river is just west of Hart Ditch therefore these high concentrations have a significant impact on our watershed study area. At the same time the high readings west of Hart Ditch should not affect our study area.

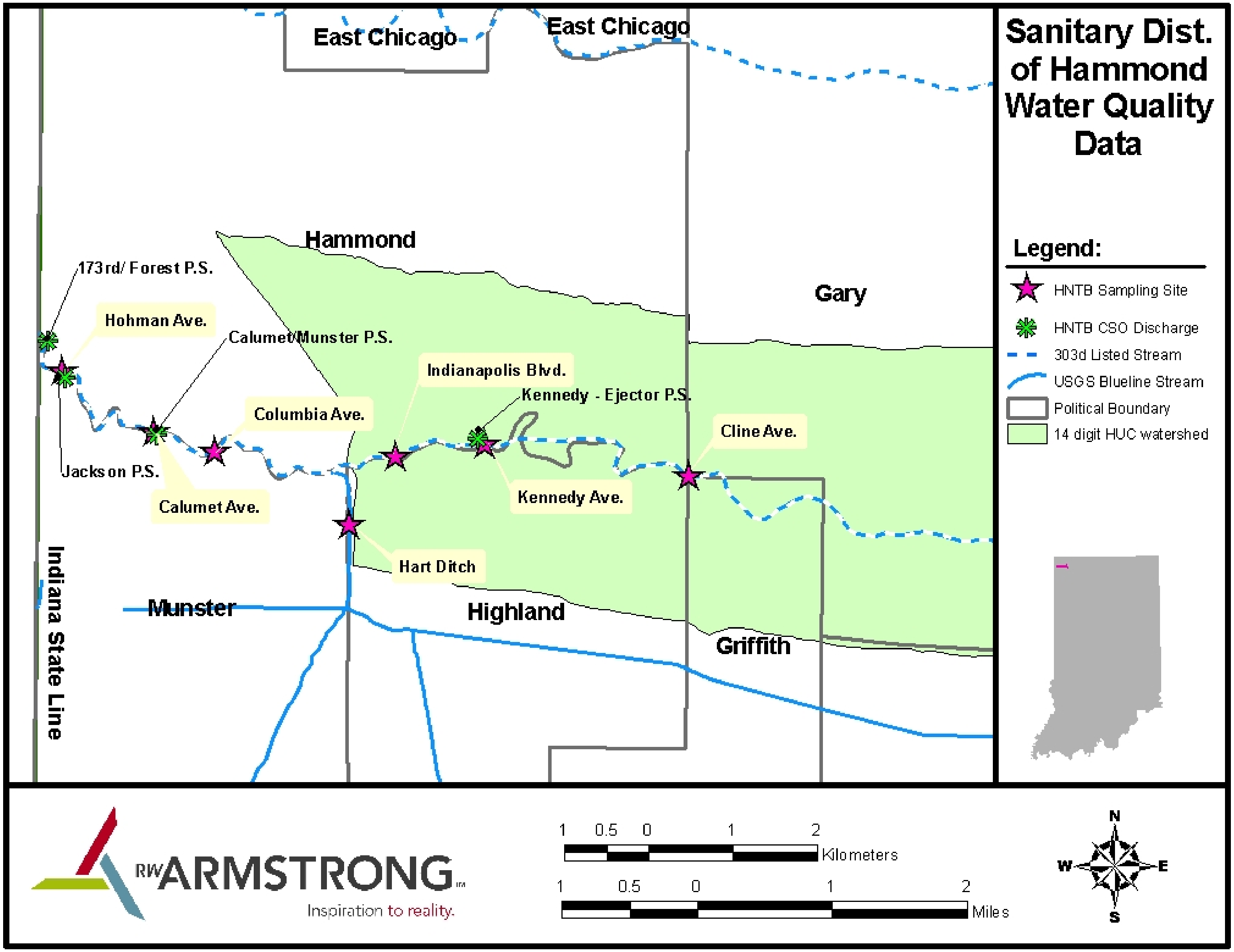


Figure 4.7: HNTB sampling locations for the 1995 Phase II Combined Sewer Overflow Master

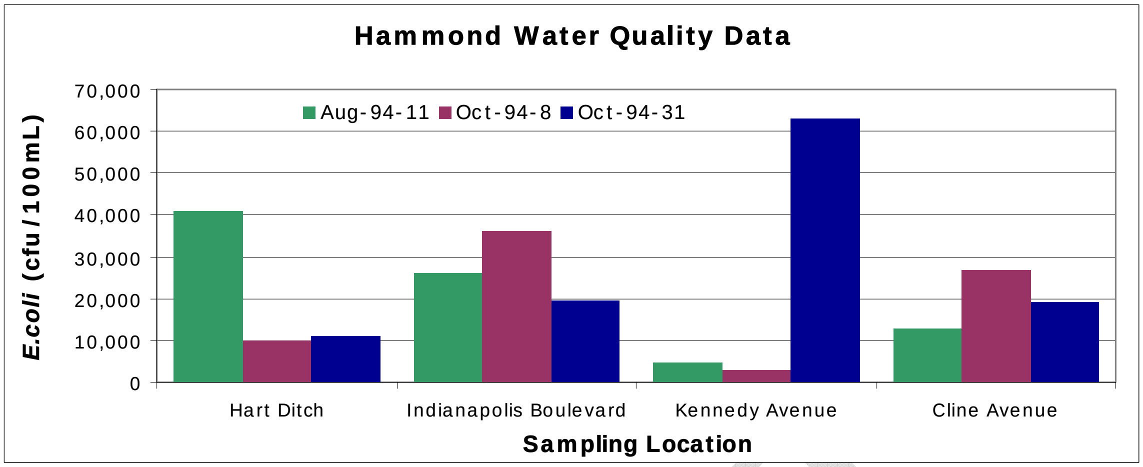


Figure 4.8: Hammond water quality data as recorded in Phase II Combined Sewer Overflow Master by HNTB completed in November 1995 for the Sanitary District of Hammond.

Ammonia: The concentrations of ammonia (NH_3) found during the sampling events ranged from 0.4 to 1.82 mg/L. The high and low value resulted from samples taken at Kennedy Avenue on the October 4th and 31st sampling dates, respectively. Figure 4.9 shows ammonia concentrations for the three sampling locations inside the study area watershed and along Hart Ditch.

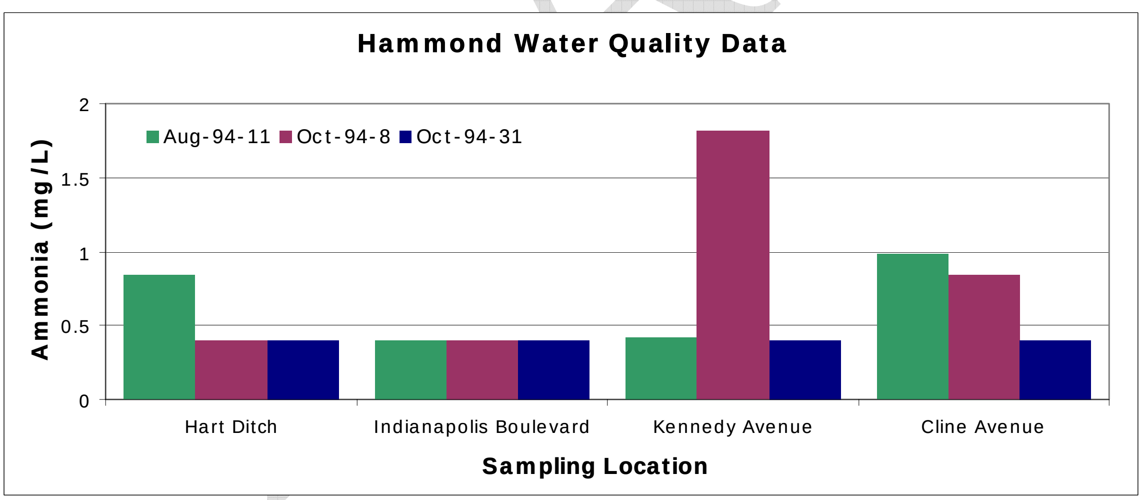


Figure 4.9: Hammond water quality data as recorded in Phase II Combined Sewer Overflow Master by HNTB completed in November 1995 for the Sanitary District of Hammond.

Total Phosphorus: The concentration level of total phosphorus found during the three sampling events was as high as 2.5 mg/L. This is significantly higher than the sampling results recorded by Greeley & Hansen for GSD, the fixed station data recorded by IDEM, and those recorded from the sampling data collected for this study. Figure 4.10 shows the concentration levels recorded by HNTB at the three sampling locations located inside the study area and along Hart Ditch.

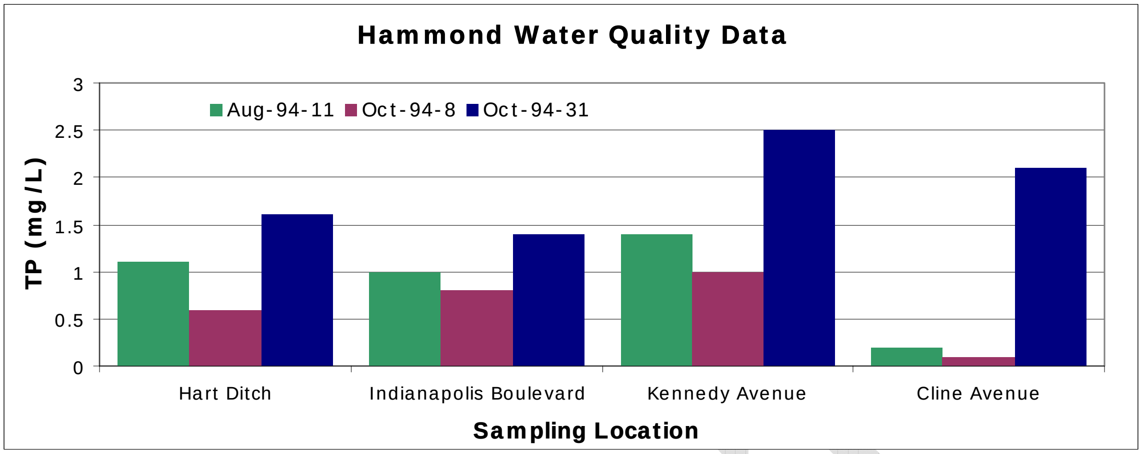


Figure 4.10: Hammond water quality data as recorded in Phase II Combined Sewer Overflow Master by HNTB completed in November 1995 for the Sanitary District of Hammond.

Nitrate: The concentrations of nitrate for the four sampling locations being used for comparison ranged from 0.35 to 9.44 mg/L. The three HNTB sampling locations not shown in Figure 4.11 also fall in this range.

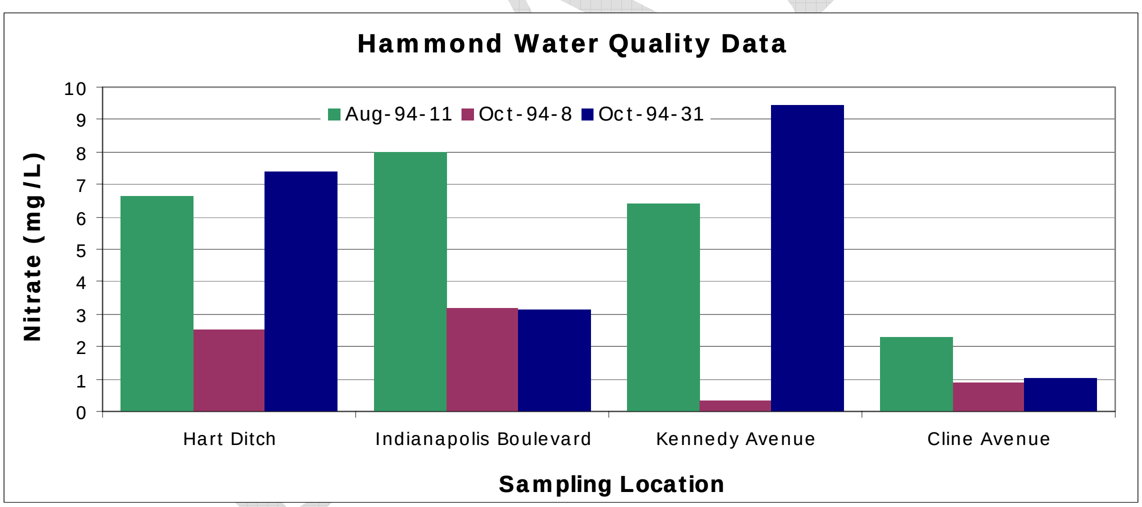


Figure 4.11: Hammond water quality data as recorded in Phase II Combined Sewer Overflow Master by HNTB completed in November 1995 for the Sanitary District of Hammond.

Little Calumet River Stream Reach Characterization and Evaluation Report – October 2002

This study attempted to identify the concentrations of pollutants in the West Branch of the Little Calumet River and in Combined Sewer Overflows (CSO's) during both dry and wet weather for the Gary Sanitary District (GSD). The dry weather samples were taken on April 27, 2001, June 25, 2001, December 11, 2001, and July 2, 2002. There were two wet weather sample taken, the first from September 18-21, 2001 and the second spanning April 27-30, 2002. Each sampling event tested 11 different sties throughout the City of Gary, these locations are shown in Figure 4.12. The samples were analyzed for a number of parameters, including: *E.coli*, Ammonia, Nitrogen, Total Phosphorus, Total Suspended Solids, and Dissolved Oxygen. Data for the four dry weather sampling events and two wet weather sampling events is included in Appendix 11: GSD Stream Reach Characterization and Evaluation Report.

E. coli Bacteria: The dry weather *E.coli* results collected in this study covered a large range of values. Two of the sample dates showed that all 11 sites met the state standard of 235 cfu/100mL. These two samples took place on April 27, 2001 and December 11, 2001. When comparing this to the dry weather sample taken on June 25, 2001, in which all sites exceeded the state standard, you can see a range in values from 30 to 2,000 cfu/100mL at the Martin Luther King Street Bridge. The fourth dry weather sampling date met the state standard at three (3) of the 11 sites. Figure 4.13 shows the dry weather sampling results.

The wet weather sampling results for *E.coli* bacteria in the Little Calumet River followed the unpredictability of the dry weather results. The first storm event in September 2001 showed large peeks in the *E.coli* concentrations at the Broadway and Martin Luther King Street bridges. These peeks were not found to occur again during the second storm event in April 2002. In order to better understand what may have caused these peeks the CSO data collected during these storm events were looked at, this information is included in Appendix 11: GSD Stream Reach Characterization and Evaluation Report. The CSO events did not account for the spikes in the *E.coli* concentrations during the first storm event. The CSO located directly before the Broadway Street Bridge overflowed during both storm events, however; during the first storm event the high *E.coli* concentrations were recorded starting four (4) hours before the storm while the overflow did not occur until five (5) hours after the start of the storm event. The CSO located before the Martin Luther King Street Bridge did not overflow during either storm event and therefore can not be the cause of the increased concentrations. The wet weather sampling results found at four (4), eight (8), and 12 hours after the start of each storm event are shown in Figure 4.14.

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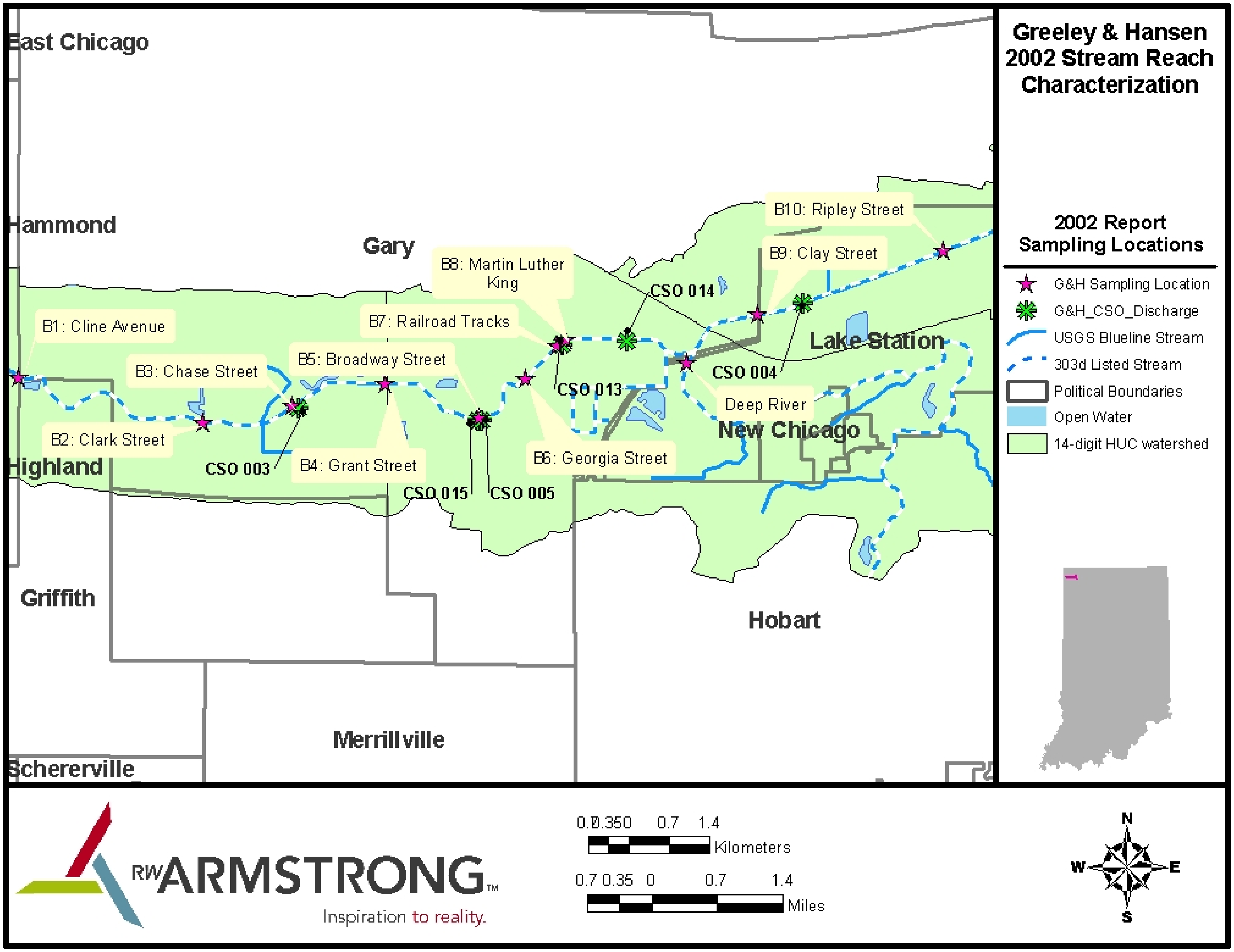

Figure 4.12: Greeley & Hansen sampling locations for the Little Calumet River Stream Reach Characterization and Evaluation Report.

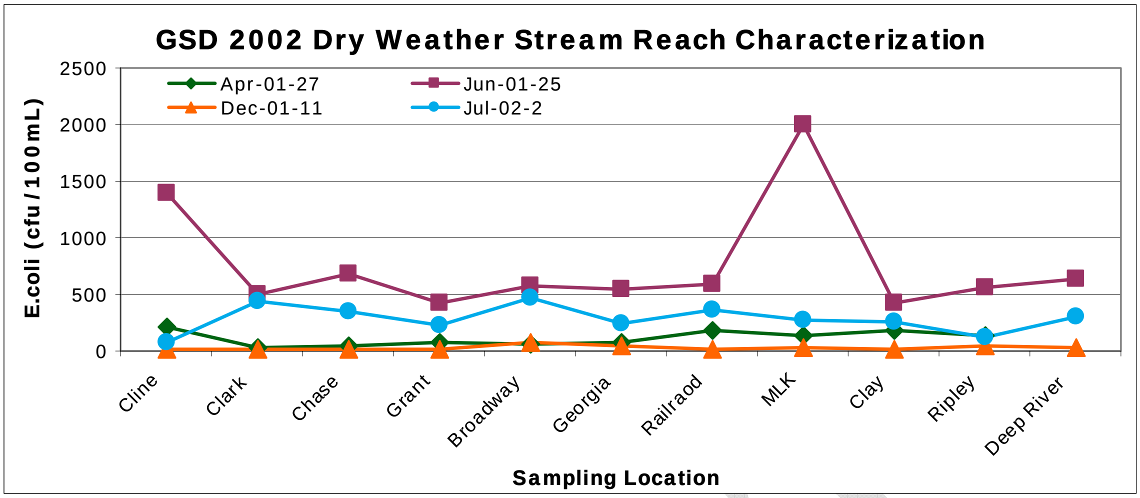

Figure 4.13: Dry weather *E.coli* concentrations as recorded in Greeley & Hansen's Little Calumet River Stream Reach Characterization and Evaluation Report completed in October 2002 for GSD.

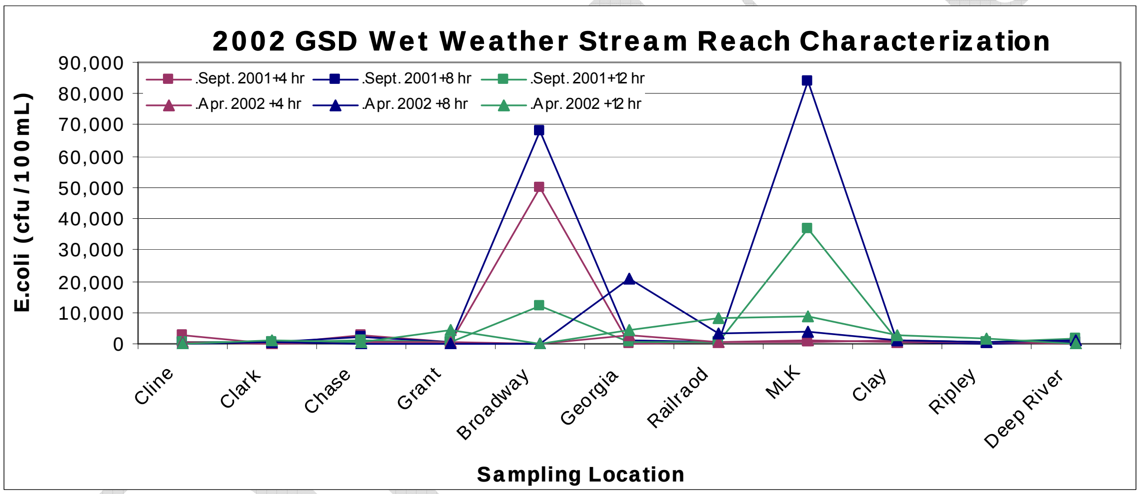

Figure 4.14: Wet weather *E.coli* concentrations as recorded in Greeley & Hansen's Little Calumet River Stream Reach Characterization and Evaluation Report completed in October 2002 for GSD.

Ammonia (NH_3): The ammonia concentrations were found at each sampling site for the four (4) dry weather events and the two (2) wet weather events. When looking at the dry weather events shown in Figure 4.15 it can be seen that the average ammonia concentration is highest from the Broadway Street Bridge to the Railraod Tracks. The first wet weather event shows higher concentration levels at the Broadway Street and Martin Luther King Street bridges, the same locations and storm event as the high *E.coli* readings. The second wet weather sampling event does not repeat these higher concentration levels as can be seen in Figure 4.16.

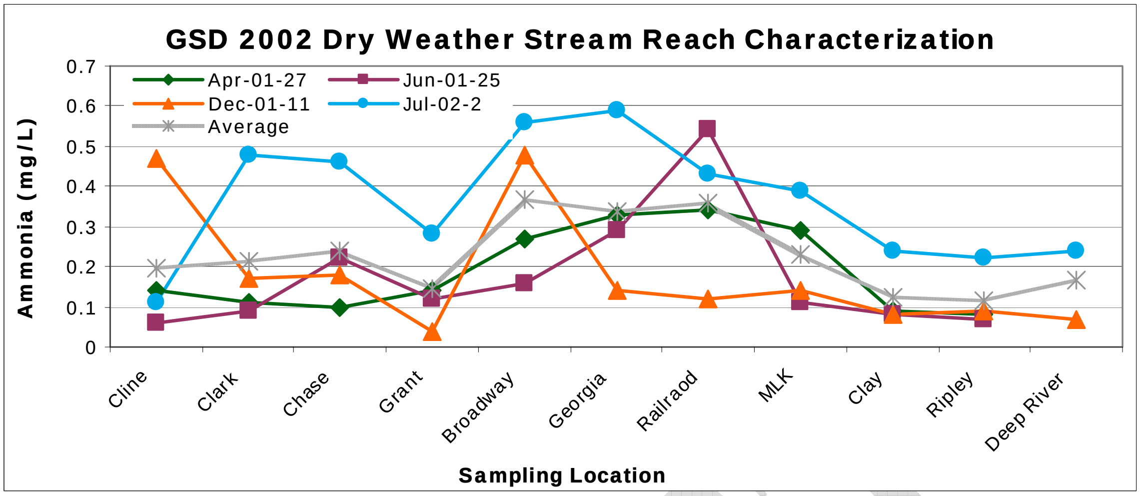

Figure 4.15: Dry weather Ammonia concentrations as reported in Greeley & Hansen's Little Calumet River Stream Reach Characterization and Evaluation completed in October 2002 for GSD.

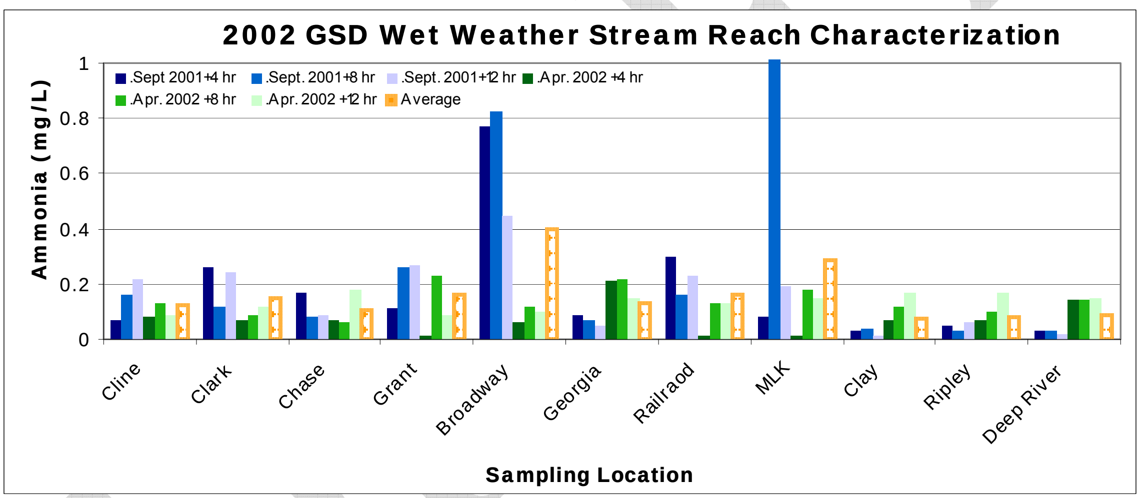

Figure 4.16: Wet weather Ammonia concentrations as reported in Greeley & Hansen's Little Calumet River Stream Reach Characterization and Evaluation completed in October 2002 for GSD.

Total Kjeldahl Nitrogen: Concentrations of TKN found during dry and wet weather sampling events were similar in numbers. Both set of events have an average concentration around two (2) mg/L. Figure 4.17 and 4.18 show the dry and wet weather sampling events concentrations, respectively.

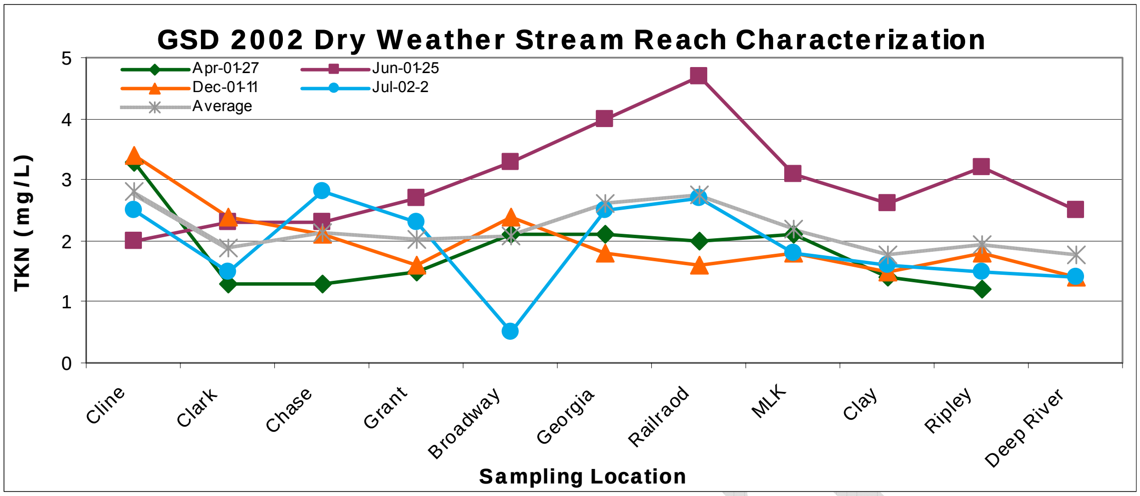

Figure 4.17: Dry weather TKN concentrations as recorded in Greeley & Hansen's Little Calumet River Stream Reach Characterization and Evaluation Report completed in October 2002 for GSD.

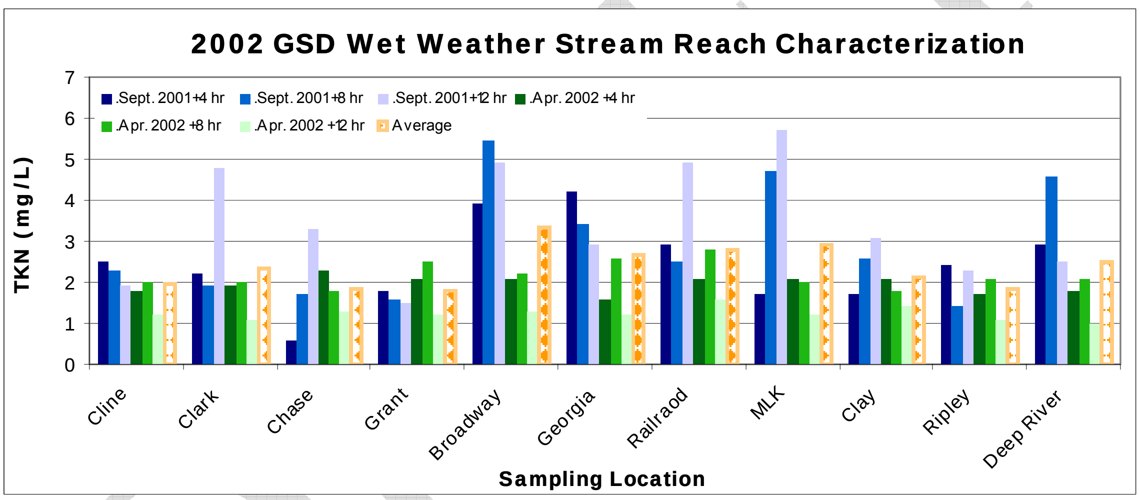

Figure 4.18: Wet weather TKN concentrations as recorded in Greeley & Hansen's Little Calumet River Stream Reach Characterization and Evaluation Report completed in October 2002 for GSD.

Total Phosphorus: The concentrations of phosphorus found in both the dry and wet weather samples appeared to be higher in the summer months when compared to the winter samplings. The dry weather samples taken in June 2001 and July 2002 were higher at every location than the concentrations found in April and December 2001, as can be seen in Figure 4.19. The wet weather concentrations followed the same pattern with the September concentrations being higher than the April concentrations for the same time period. This can be seen in Figure 4.20 with the only exception being the first sample taken at Cline Avenue. The concentrations found for the wet weather events are also lower in value than the dry weather events.

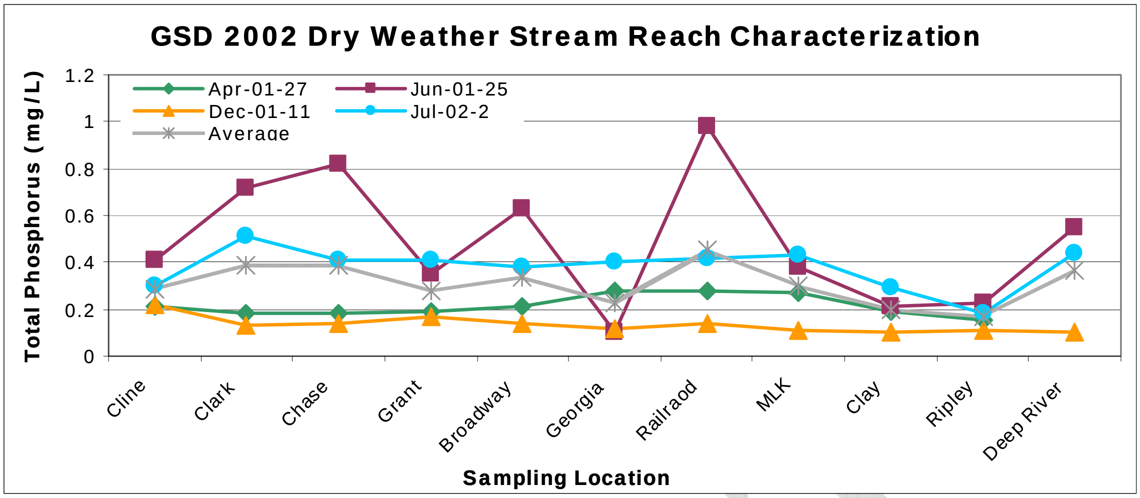

Figure 4.19: Dry weather phosphorus concentrations as recorded in Greeley & Hansen's Little Calumet River Stream Reach Characterization and Evaluation Report completed Oct. 2002 for GSD.

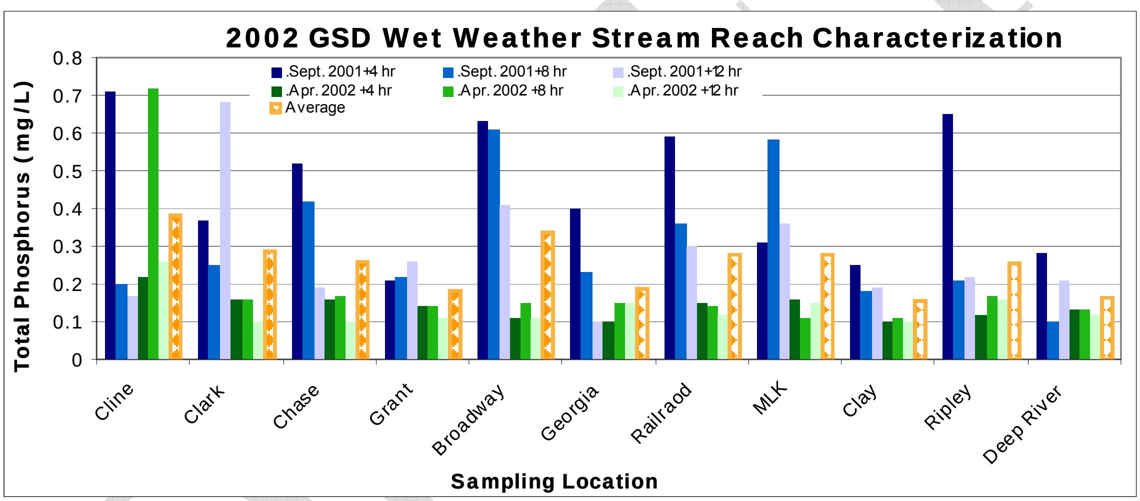

Figure 4.20: Wet weather phosphorus concentrations as recorded in Greeley & Hansen's Little Calumet River Stream Reach Characterization and Evaluation Report completed Oct. 2002 for GSD.

Total Suspended Solids: The concentration levels of suspended solids for the wet weather sampling events are consistently less than those found for the dry weather sampling events. The dry weather events can be seen in Figure 4.21with the average value for each sampling site shown by the gray line. Figure 4.22 shows the wet weather sampling events with the orange column representing the average values for each site.

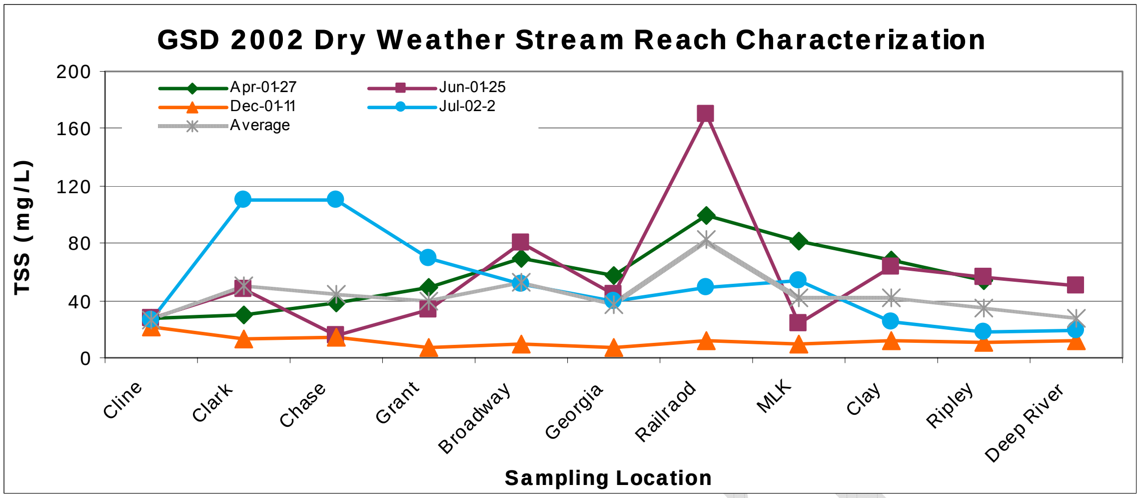

Figure 4.21: Dry weather TSS concentrations as reported in Greeley & Hansen's Little Calumet River Stream Reach Characterization and Evaluation Report completed October 2002 for GSD.

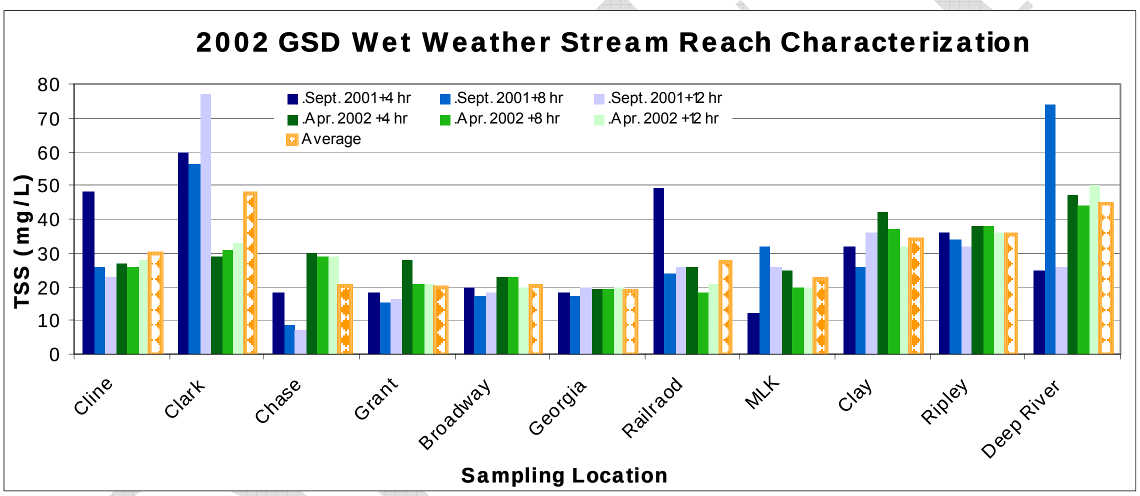

Figure 4.22: Wet weather TSS concentrations as reported in Greeley & Hansen's Little Calumet River Stream Reach Characterization and Evaluation Report completed October 2002 for GSD.

pH Units: The pH levels found during both the dry and wet weather sampling events met the state standard range. Figures 4.23 and 4.24 show the dry and wet weather sampling results, respectively, with the state standard range of a minimum six (6) and a maximum nine (9) being identified on the charts.

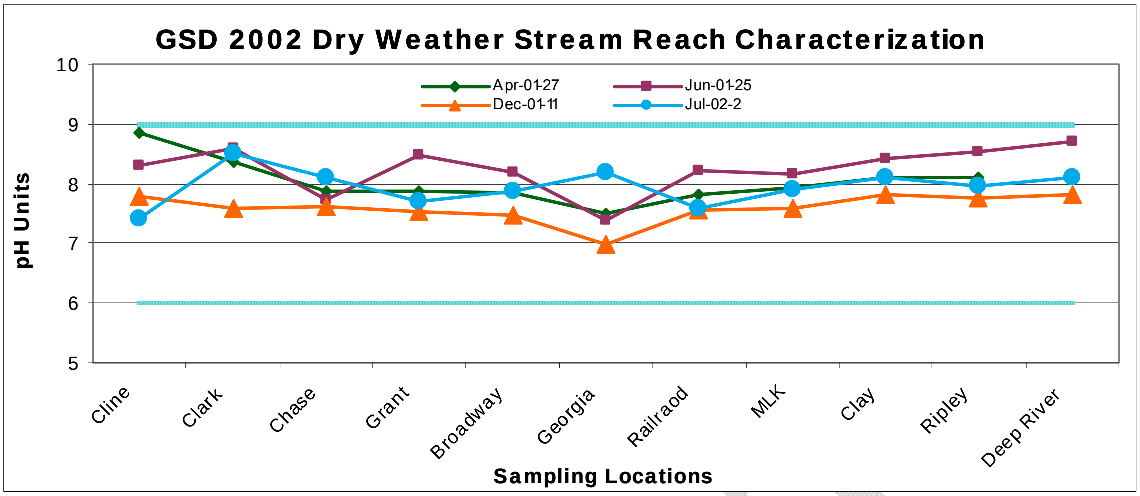

Figure 4.23: Dry weather pH units as recorded in Greeley & Hansen's Little Calumet River Stream Reach Characterization and Evaluation Report completed in October 2002 for GSD.

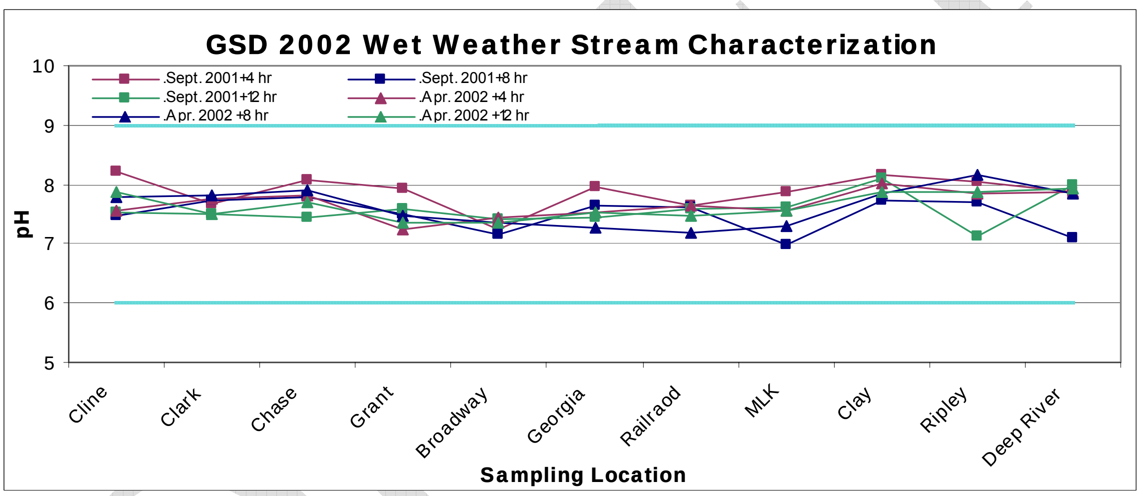

Figure 4.24: Wet weather pH units as recorded in Greeley & Hansen's Little Calumet River Stream Reach Characterization and Evaluation Report completed in October 2002 for GSD.

CDM Study for the Gary Sanitary District – 2003

In 2003 CDM completed a study for the City of Gary in which they conducted sampling at four hour intervals after three separate rain events. There were a total of eight (8) sampling locations; seven (7) along the Little Calumet River and one (1) on Deep River. Sampling locations and how they fit into our watershed study area can been seen in Figure 4.25. The four (4) locations located on the western end were tested at +4 and +8 hours after the storm event while the four on the eastern half were sampled at +8 and +12 hours. The wet weather sampling took place on May 20, June 18 and July 15, 2003. The eight sampling locations were also sampled on May 19, June 10 and June 25, 2003 for dry weather samples. Appendix 12: CDM Study for the Gary Sanitary District contains all of the sampling results.

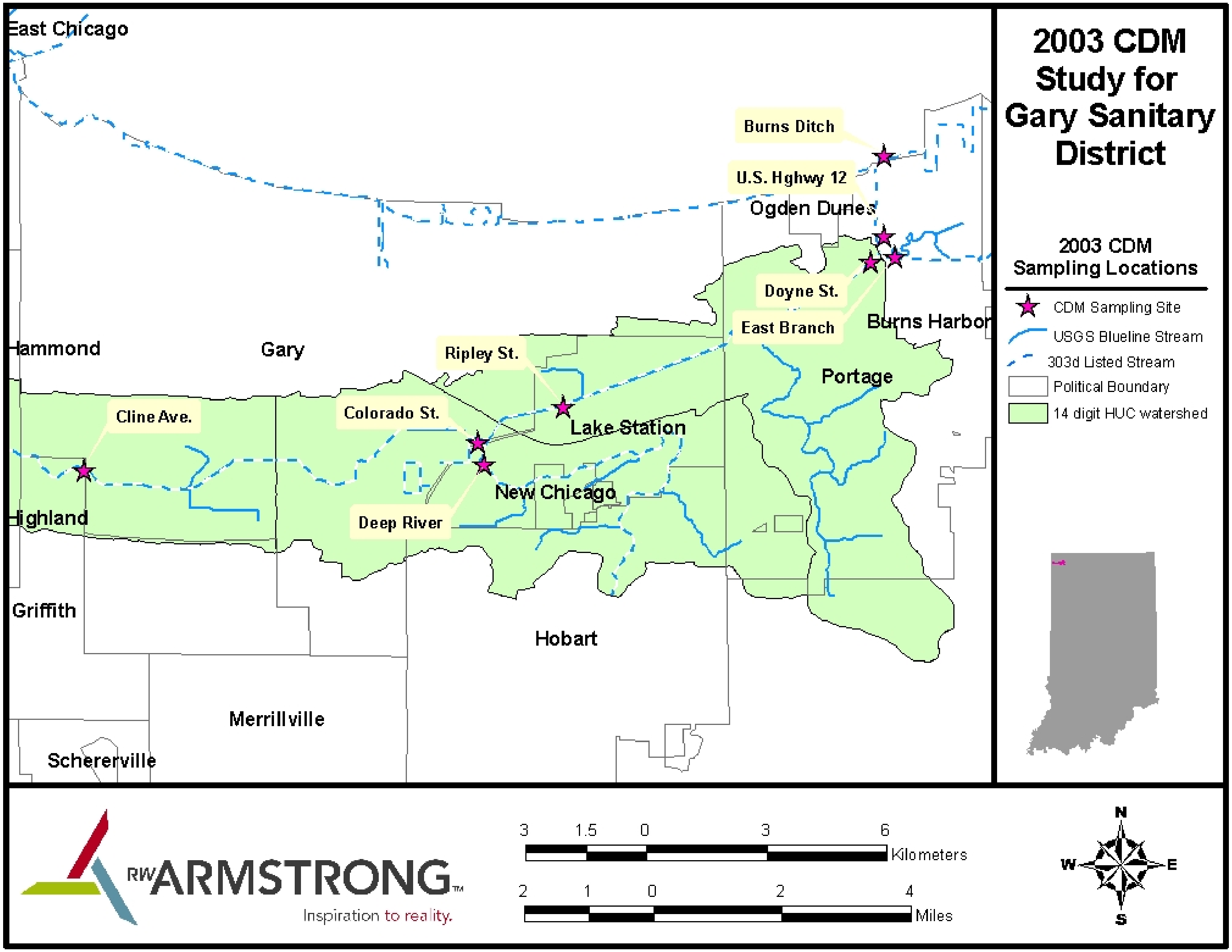

Figure 4.25: CDM sampling locations for the 2003 study completed for the Gary Sanitary District.

<u>*E.coli* Bacteria:</u> The wet weather sampling results found at the +8 hour storm interval is shown in Figure 4.26; the sampling locations at the far west and east ends met the state standard of 235 cfu per 100 mL. These two location met the standard for the +8 hour interval; however, neither one met the standards on the other interval sample. The sampling locations at Colorado Street and Ripley Street show elevated levels when compared to the other sampling locations at this sampling interval. This is an accurate reflection of the other sampling intervals results. The large peak shown at the Colorado Street sampling location is similar to the peak found in the sampling results recorded for this study. The Colorado Street peak is also close to the interchange of I-65 and I-80.

The dry weather *E.coli* sampling shows an elevated level along Deep River. Figure 4.27 shows the sampling results for the dry weather sampling events. The Deep River sample is the highest for the May 19th and June 25th sampling dates; however, for the June 10th sampling date it was found to be one of the lowest *E.coli* concentration levels.

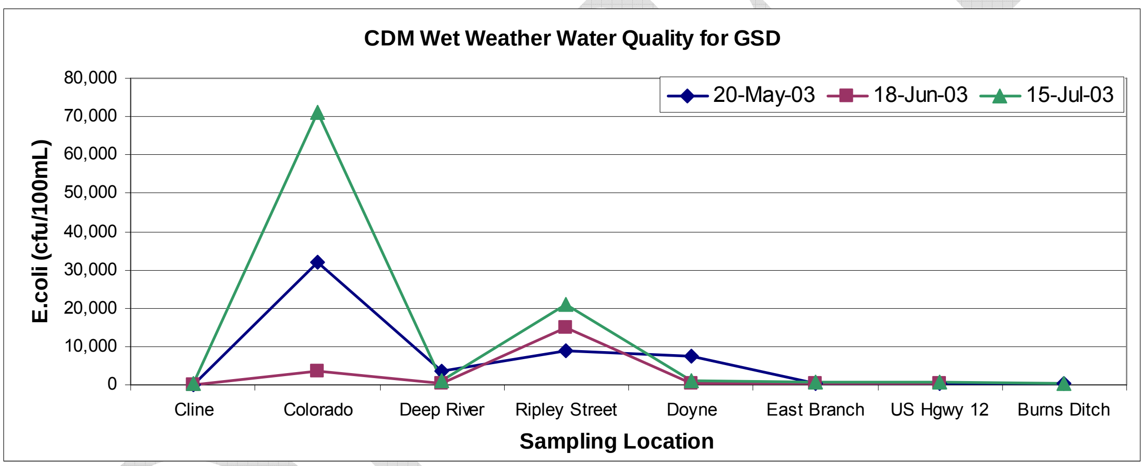

Figure 4.26: Wet weather *E.coli* sampling results recorded by CDM for the City of Gary.

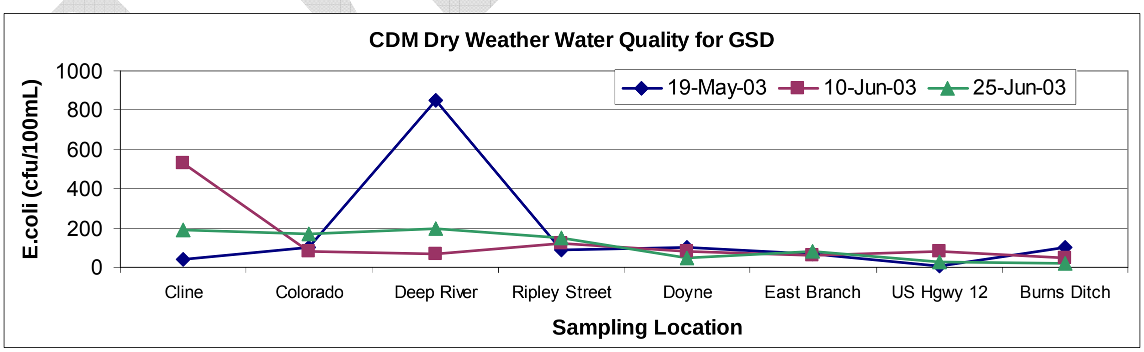

Figure 4.27: Dry weather *E.coli* sampling results recorded by CDM for the City of Gary.

Total Suspended Solids: Figures 4.28 and 4.29 show the total suspended solids sampling data results for the wet weather and dry weather sampling events, respectively. It can be seen from both sets of data that the western portion of the sampling area covered has higher TSS concentrations than the east. The sampling data recorded for this watershed management plan found the highest TSS concentrations to be around Grant Street which is between the Cline and Colorado Street sampling locations used here by CDM.

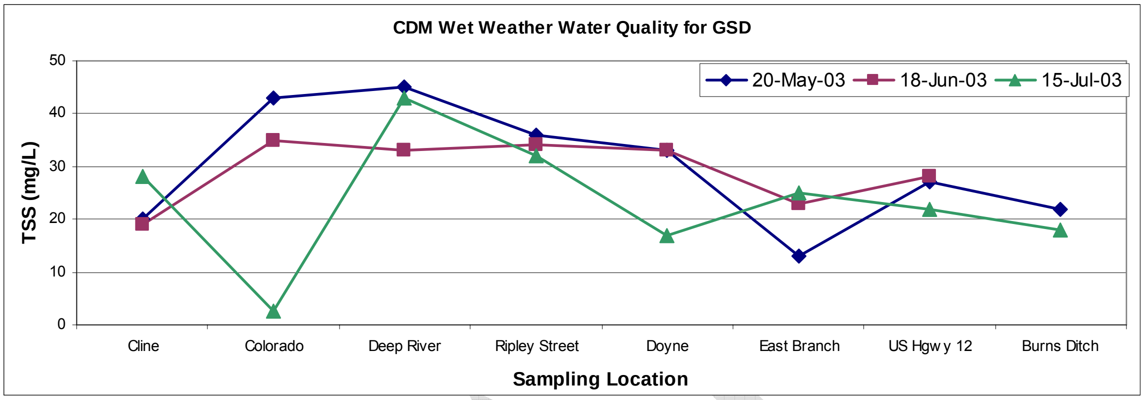

Figure 4.28: Wet weather TSS concentrations recorded by CDM for the City of Gary.

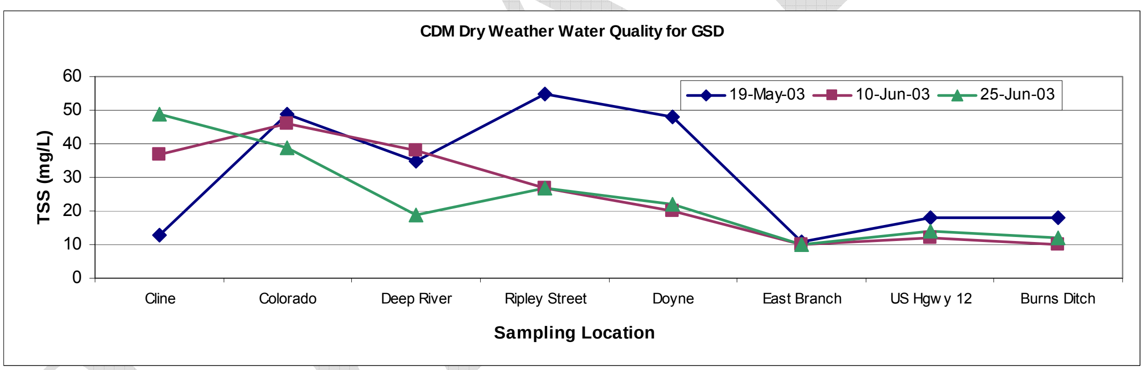

Figure 4.29: Dry weather TSS concentrations recorded by CDM for the City of Gary.

pH: The measured pH values met the state standards on all levels. They were all found to be within the minimum of six and the maximum of nine. Figure 4.30 and 4.31 show the pH values for the wet and dry weather sampling events, respectively. The blue lines represent the state standards for maximum and minimum.

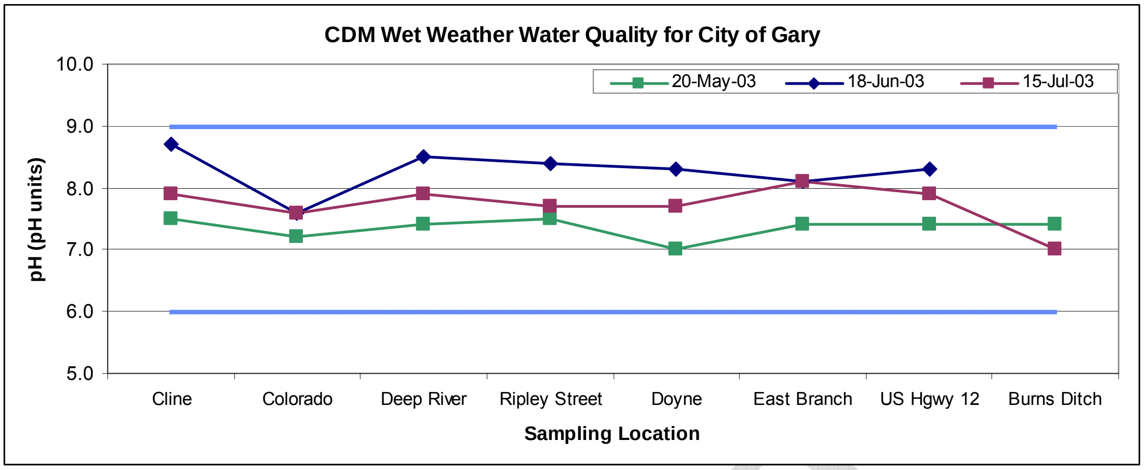

Figure 4.30: Wet weather pH values as recorded by CDM for the Gary Sanitary District.

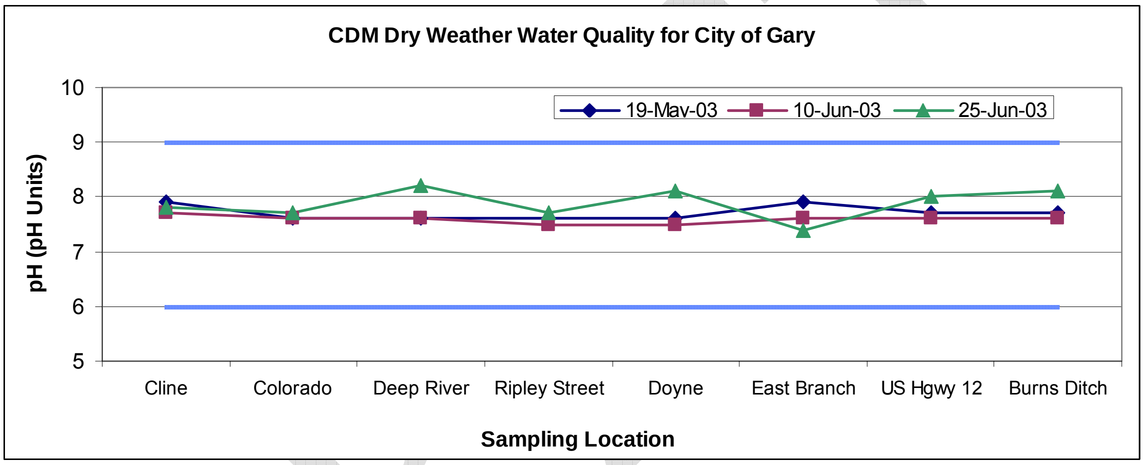

Figure 4.31: Dry weather pH values as recorded by CDM for the Gary Sanitary District.

Sampling Plan

Three sampling alternatives were presented to the Steering Committee on March 14, 2007. They were:

Alternative A

1.) 7 sites w/ grab samples for a full suite of water chemistry and physical parameters:
  - pH, temperature, dissolved oxygen,
  - nitrate+nitrite, organic nitrogen (TKN), ammonia nitrogen,
  - total and dissolved phosphorus,
  - turbidity, conductivity, and discharge (flow).
  - Fecal coliform as *E.coli*
  - Stormflow and baseflow samples collected once at each site.

2.) 40 long-term *E. coli* samplers
  - Samplers stay in via stakes for one month
  - Media removed and rinsed
  - Sub-sample of wash water cultured on Petri dish and enumerated

3.) Water Quality & *E.coli* Public Workshop
  - Focus on interpretation in lay persons terms
  - Public can view samples of bugs and bacteria samples
  - Approve understanding of *E.coli* threat and its status as an indicator organism
  - NOTE: may need approval from IDEM for workshop element to be part of sampling budget

Alternative B

1.) 7 sites w/ grab samples for a full suite of water chemistry and physical parameters:
  - pH, temperature, dissolved oxygen,
  - nitrate+nitrite, organic nitrogen (TKN), ammonia nitrogen,
  - total and dissolved phosphorus,
  - turbidity, conductivity, and discharge (flow).
  - Fecal coliform as *E.coli*
  - Stormflow and baseflow samples collected once at each site.

2.) 90 long-term *E.coli* samplers
  - Samplers stay in via stakes for one month
  - Media removed and rinsed

Sub-sample of wash water cultured on Petri dish and enumerated

Alternative C

1.) 7 sites w/ grab samples for a full suite of water chemistry and physical parameters:
    - pH, temperature, dissolved oxygen,
    - nitrate+nitrite, organic nitrogen (TKN), ammonia nitrogen,
    - total and dissolved phosphorus,
    - turbidity, conductivity, and discharge (flow).
    - Fecal coliform as *E.coli*
    - Stormflow and baseflow samples collected once at each site.
2.) 40 long-term *E.coli* samplers
    - Samplers stay in via stakes for one month
    - Media removed and rinsed
    - Sub-sample of wash water cultured on Petri dish and enumerated
3.) 5 Macroinvertebrate Sites
    - Will require Hester Dendy artificial substrate samplers due to lack of riffle habitat
    - <u>NOTE:</u> species diversity is affected by available habitat, therefore potential knowledge gained related to insect community health (re: surrogate for long-term water quality conditions) is some what limited since Hester Dendy samplers are only left in place a few weeks.

The creation and aim of alternative "A" was to respond to public concerns presented at the first public meeting. Alternative C was added based on a suggestion by steering committee members that believed some Macroinvertebrate data would be beneficial.

After much discussion, the Steering Committee selected Alternative B with the intent to provide two rounds of long-term *E.coli* samplers. The first round of grab samples and long-term *E.coli* samplers was planned for during high flows. The second round was planned for summer when only base flow is likely to be present in the river.

Macroinvertebrate data will be gathered by the Hoosier River Watch program, though the data may not be as useful as professionally gathered data.

The seven (7) sampling sites are shown in Figure 4.32 with their exact locations and sample streams noted in Table 4.1.

A Quality Assurance Project Plan (QAPP) was submitted to the Indiana Department of Environmental Management. The sampling plan was modified through this process to include 42 grab sample sites in lieu of the 90 long term samplers. The approved QAPP is included in Appendix 13: Quality Assurance Project Plan. The sampling sites are described in Appendix 14: Sampling Sites.

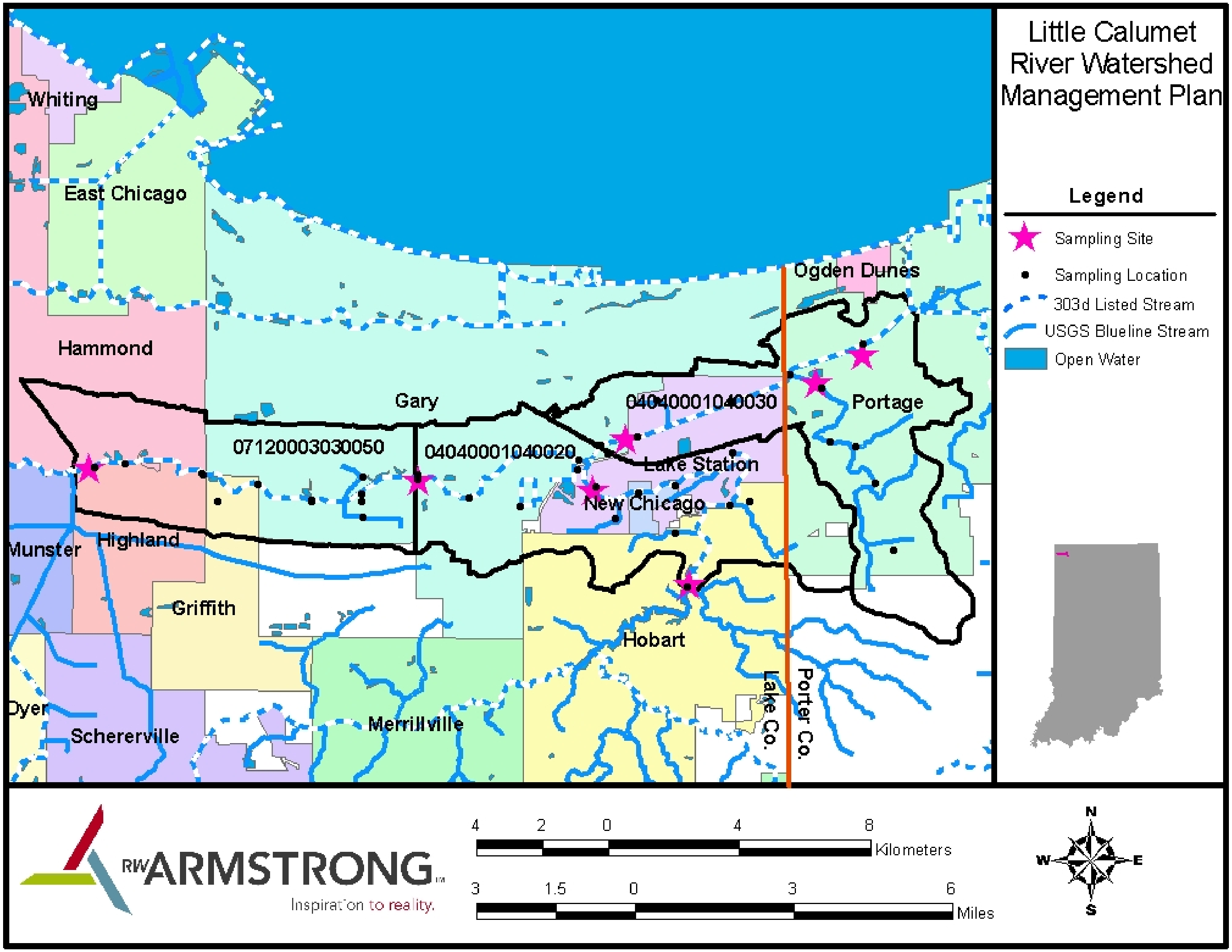

Figure 4.32: Sampling sites proposed and accepted by IDEM for a full suite of nutrient testing parameters.

Sampling Sites	Stream Name	Location	Latitude	Longitude
Site 1	Little Calumet	Indianapolis Blvd.	41.34.06	87.28.28
Site 2	Little Calumet	Grant Street	41.33.56	87.21.20
Site 3	Deep River	Upstream	41.32.14	87.15.18
Site 4	Deep River	Downstream	41.33.47	87.17.27
Site 5	Burns Ditch	Clay Street	41.34.37	87.16.45
Site 6	Willow Creek	Hwy 20	41.35.33	87.12.36
Site 7	Burns Ditch	Downstream	41.36.10	87.11.35

Table 4.1: Little Calumet River Watershed Management Plant sampling site locations.

Sampling Site Contributing Areas

The watershed area that is the focus of this study was divided into five (5) subwatersheds that were delineated by the site to which they drained. Figure 4.33 shows the five subwatersheds that the study area was broken into. The land use was summarized for each of the five (5) subwatersheds in the study area and can be found in Figures 4.34 to 4.38.

Pollutant Load Determination Based on Land Use

Expected pollutant loading rates were found based on the current land use summarized for each delineated subwatershed. The two sampling sites that do not have an associated watershed were used as baseline comparison points.

The watershed was separated into five subwatersheds, each contributing to a different sampling site, Sites 2, 4, 5, 6, and 7. Within each specific sampling sites watershed the land use areas were tabulated and the pollutant loads determined using the United States Environmental Protect Agency (U.S. EPA) Region V Watershed Treatment Model (WTM) Version 3.1. The WTM was created in an excel format by the Office of Wetlands, Oceans and Watersheds and can be found and downloaded via the internet on the EPA website.

The drawback to the model used is that it only calculates the Total Nitrogen, Total Phosphorus, Total Suspended Solids and Fecal Coliform. This does not cover the same parameters tested for as part of the water quality testing completed and the determination of fecal coliform does not allow a direct comparison to the data collected. It is estimated that the *E.coli* bacteria concentrations are about 80% of the fecal coliform concentrations according to the TMDL prepared for the Little Calumet River.

The results of the WTM are shown in Table 4.2

Summary of Expected Pollutant Loads		TN lb/year	TP lb/year	TSS lb/year	Bacteria billion/year
Sampling Site #2	Total	77634.72505	9626.678867	2215445.901	2881371.093
	Storm	67185.44355	9005.798767	2126249.801	2881371.093
	Non-Storm	10449.2815	620.8801	89196.1	0
Sampling Site #4	Total	49914.49127	6346.572785	1452197.602	1756754.933
	Storm	42668.37327	5838.227985	1403691.302	1756754.933
	Non-Storm	7246.118	508.3448	48506.3	0
Sampling Site #5	Total	46380.93083	5817.501848	1301459.691	1720582.641
	Storm	40444.85283	5441.529848	1254902.291	1720582.641
	Non-Storm	5936.078	375.972	46557.4	0
Sampling Site #6	Total	40357.62145	5327.227418	1200551.513	1310087.86
	Storm	33281.55695	4753.587418	1162953.263	1310087.86
	Non-Storm	7076.0645	573.64	37598.25	0
Sampling Site #7	Total	37165.85372	4686.047654	1139354.857	1175854.182
	Storm	29899.67322	4177.695454	1090435.657	1175854.182
	Non-Storm	7266.1805	508.3522	48919.2	0
TOTAL	Total	251453.6223	31804.02857	7309009.565	8844650.709
	Storm	213479.8998	29216.83947	7038232.315	8844650.709
	Non-Storm	37973.7225	2587.1891	270777.25	0

Table 4.2: Calculated pollutant loadings based on land use in subwatersheds using WTM.

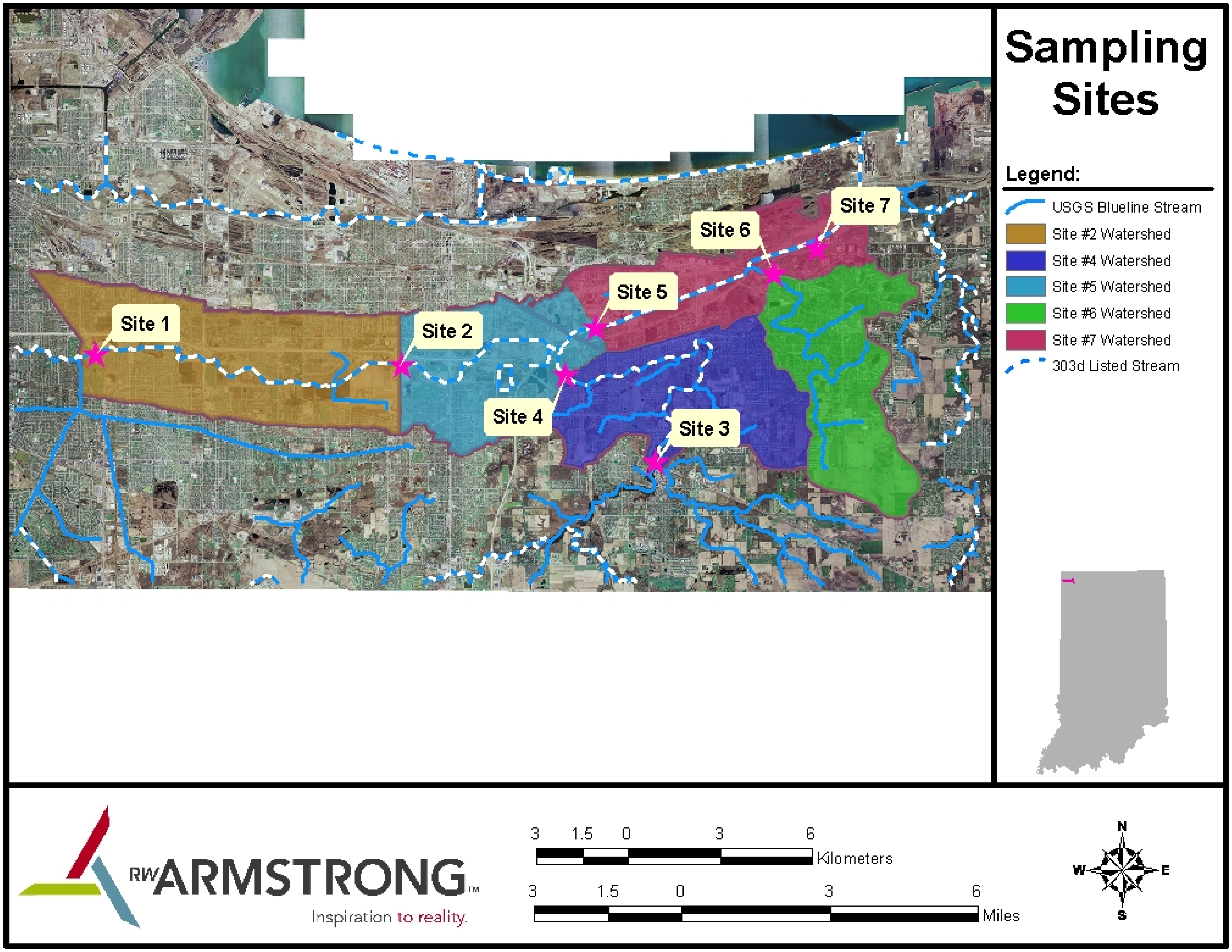

Figure 4.33:Delineation of sampling site watersheds.

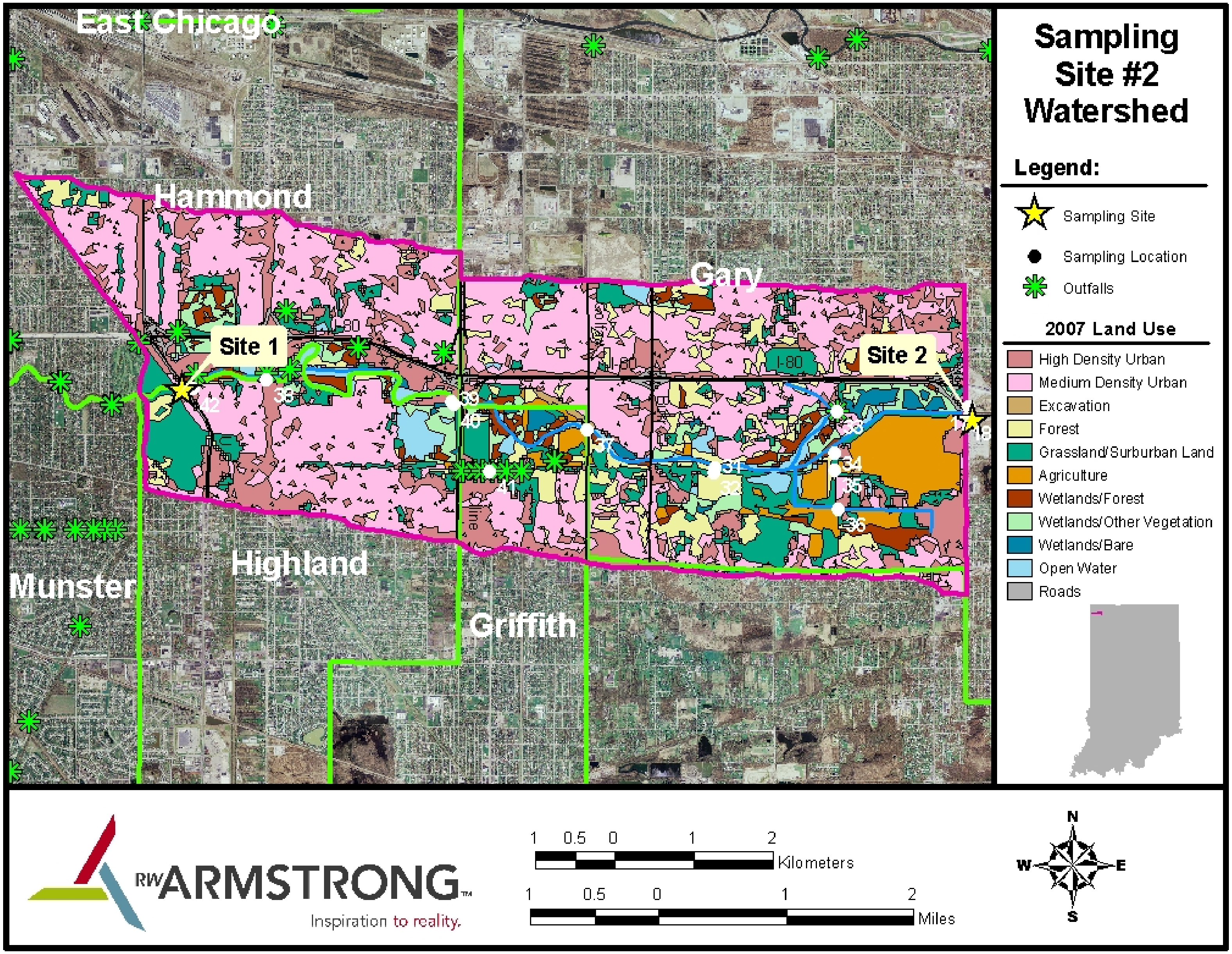

Figure 4.34: Sampling Site 2 subwatershed land use map.

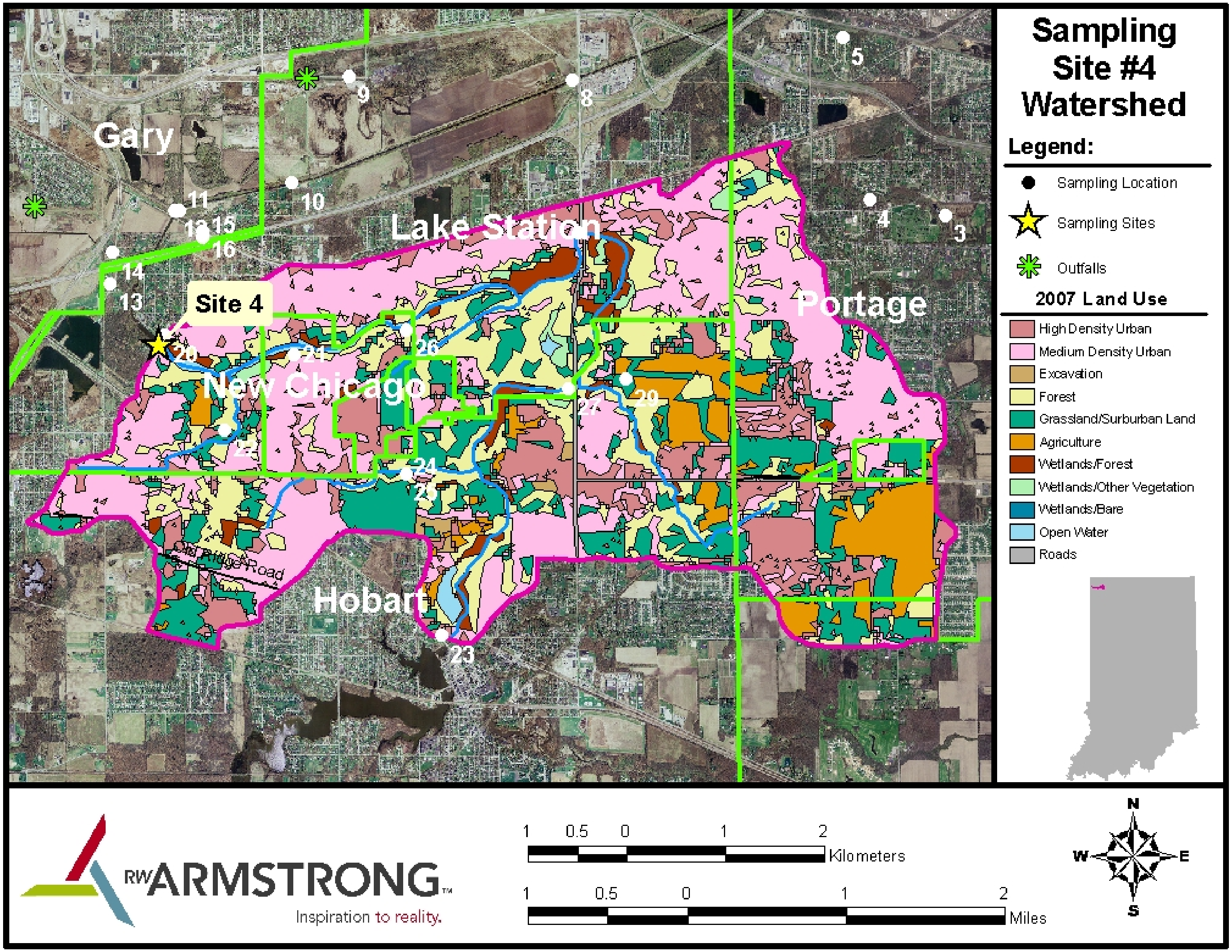

Figure 4.35: Sampling Site 4 subwatershed land use map.

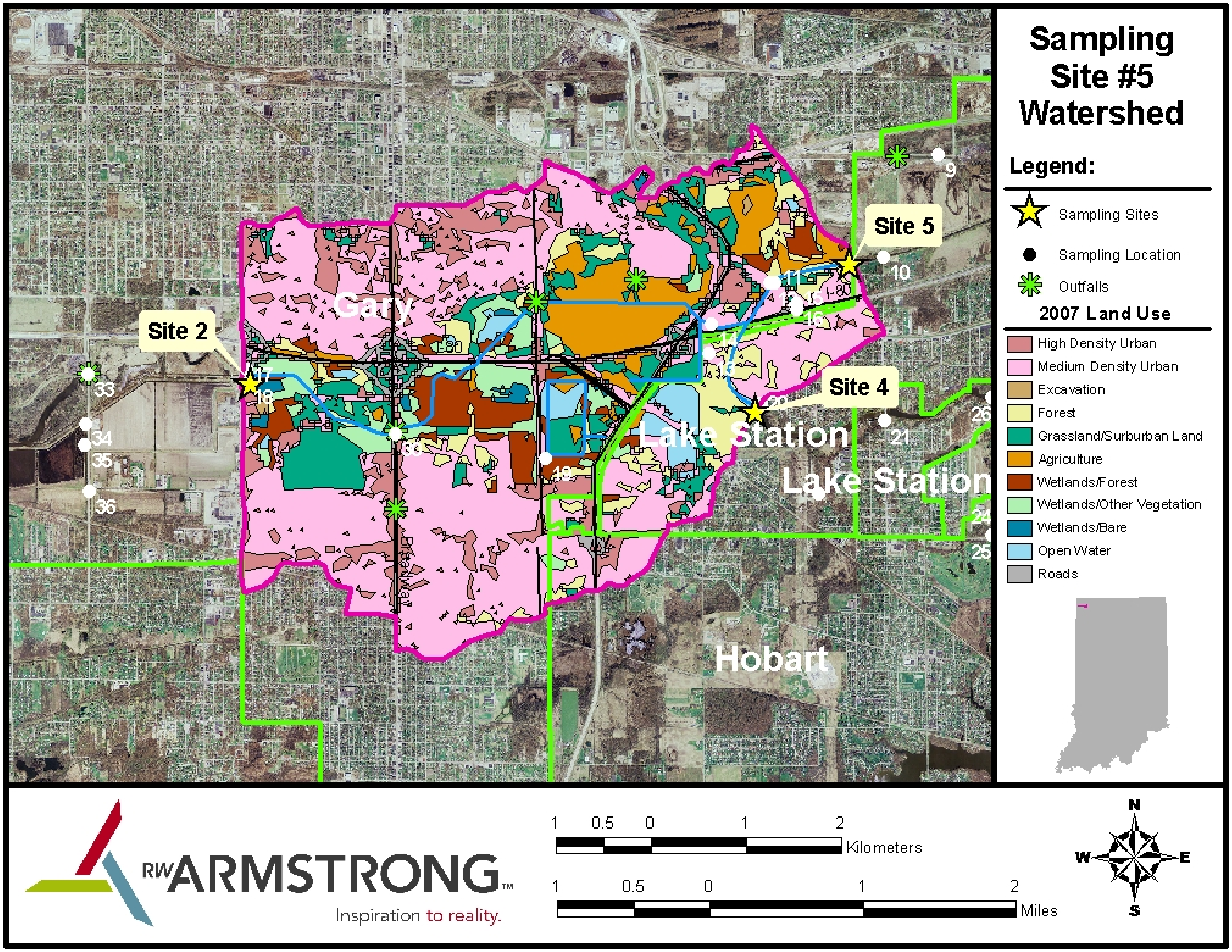

Figure 4.36: Sample Site 5 subwatershed land use map.

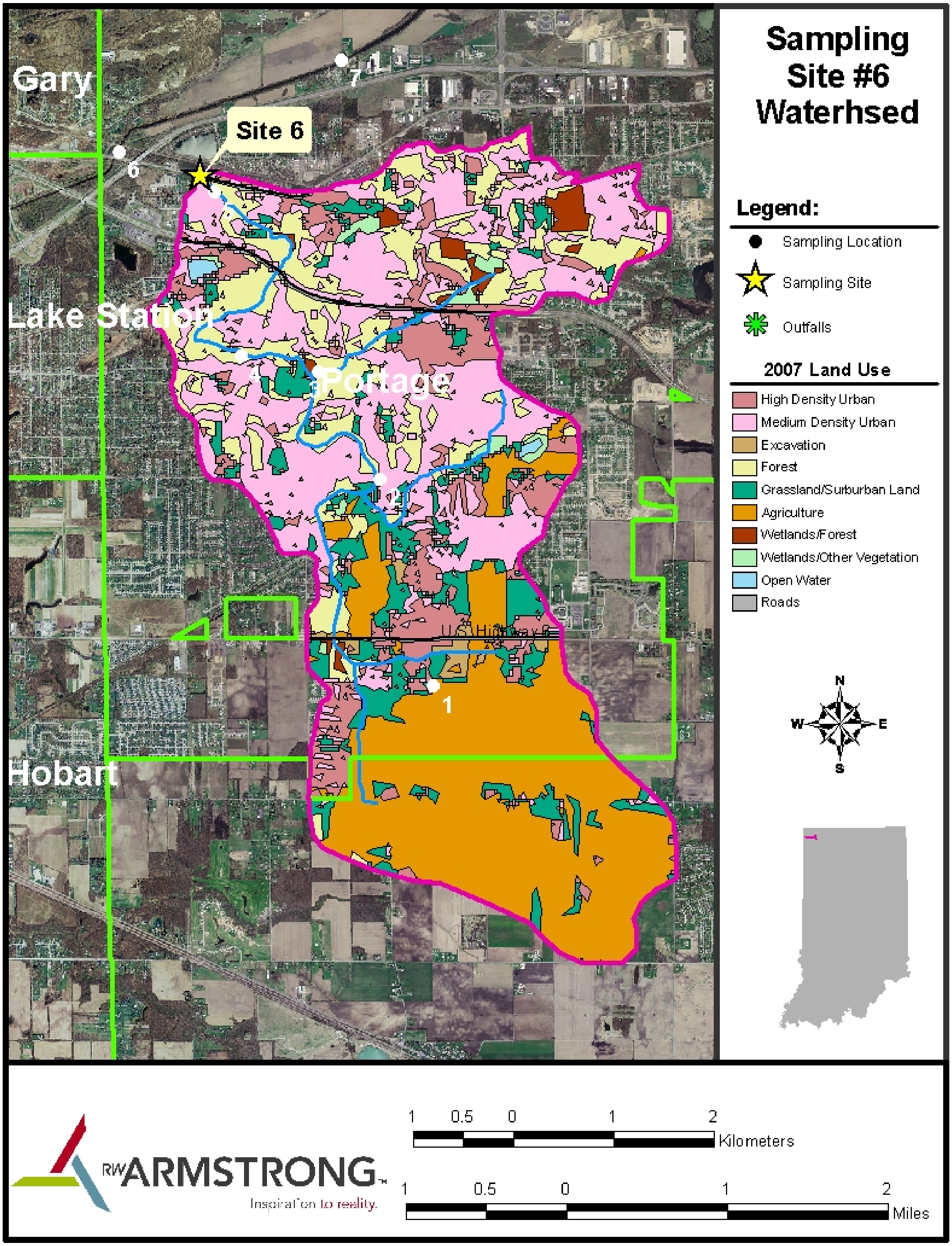

Figure 4.37: Sample Site 6 subwatershed land use map.

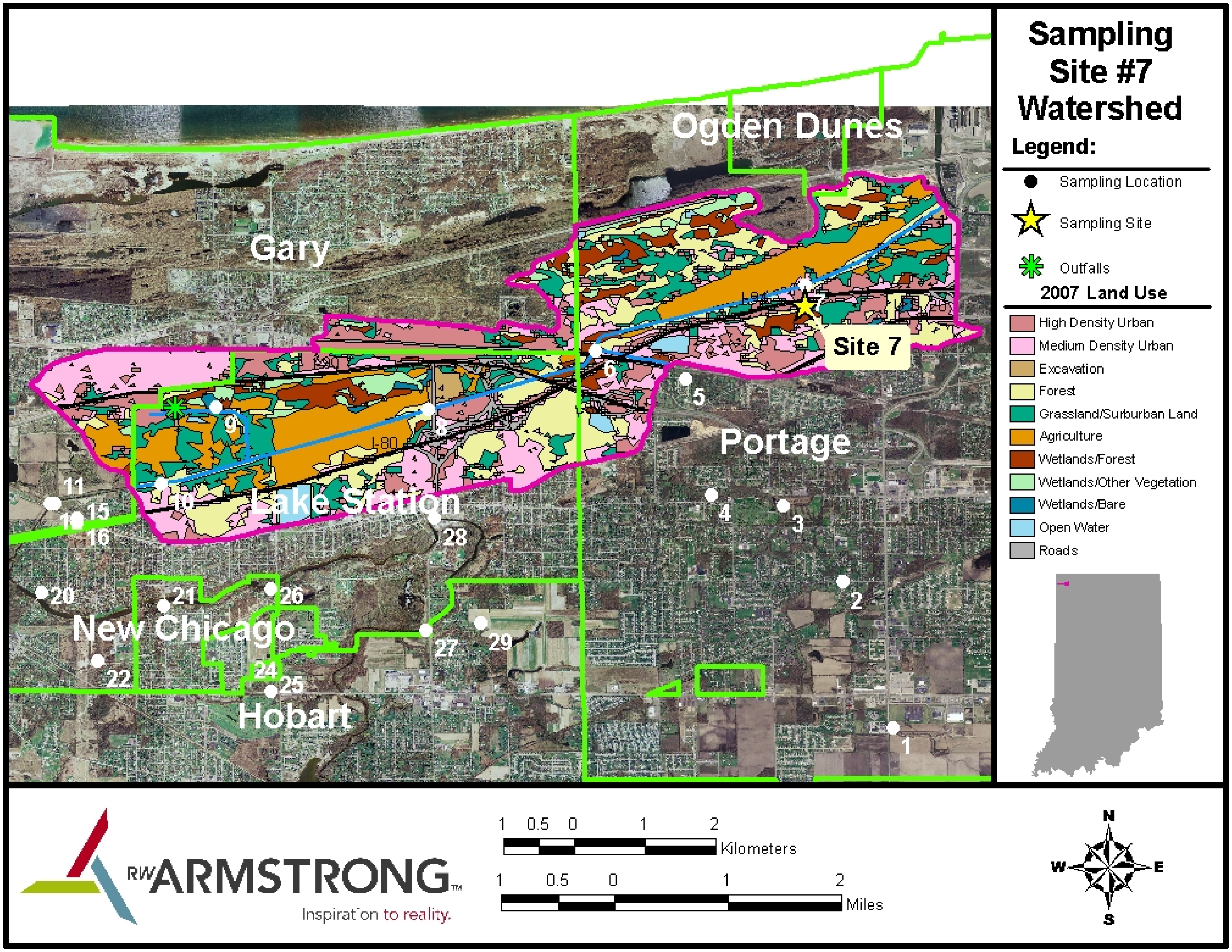

Figure 4.38: Sample Site 7 subwatershed land use map.

Sampling Results

Forty-two locations were sampled four (4) to six (6) times during the summer and late autumn of 2007 for *E.coli* bacteria. Fourteen of these sites were on the Little Calumet River itself, while the others were on tributaries. Sampling occurred under both storm flow and base flow conditions.

According to the modified QAPP plan, found in Appendix 13: Quality Assurance Project Plan, there were seven (7) sampling sites that were sampled twice, once for storm flow and once for base flow, for the full suite of chemical and physical parameters. The results of these samplings, converted to yearly loading rate from concentrations, can be found in Tables 4.3 and 4.4. There were also 42 sampling locations that had four (4) separate grab samples performed to find *E.coli* concentrations in the Little Calumet River and its tributaries. The sampling results for these grab samples can be found in Table 4.5. The sampling sites and location can be seen in Figures 4.34 to 4.38.

One sampling location at the uppermost end of the Little Calumet River (Indianapolis Blvd.) had 100% of its samples exceed the recreational standard for *E.coli*. Since contamination at this upstream site has the potential to negatively affect the entire river, finding and reducing sources of bacteria at this site are of the highest priority.

Other high priority sites include Willow Creek (67% of its samples exceeded the criteria for impairment by *E.coli*), the Little Calumet River at Grant Street (87% of the samples indicated impaired conditions), and a tributary of Deep River at Lake Park Avenue (75% of its samples showed impairment).

Two locations (one site on the lowermost end of the Little Calumet River at the Lake/Porter County Line and a tributary of the Little Calumet River at Three Rivers Park) fully supported their recreational uses. *E.coli* at these locations had a mean of less than 235 cfu/100 ml and no values higher than 576 cfu/100 ml. These two sites can be removed from the Indiana impaired waterbodies list.

Nitrate and phosphorus concentrations at seven monitored Little Calumet River sites were relatively low. A notable exception was at sampling site #1, Indianapolis Boulevard, during base flow conditions. This site had elevated nitrate and extremely high phosphorus values.

Dissolved oxygen levels fell below the state water quality standard (4 mg/l) at four sites during base flow and at two sites during storm flow. The lowest value occurred at Indianapolis Boulevard, indicating again the importance of finding and reducing pollutant sources in this area.

Sampling Site	Base Flow Pollutant Loads							
	DO (lbs/yr)	NH_3 (lbs/yr)	NO_3 (lbs/yr)	TP (lbs/yr)	Ortho-P (lbs/yr)	TSS (lbs/yr)	*E.coli* (cfu/100mL)	pH SU
1*	27,358	2,042	34,708	19,600	11,025	44,916	3,150	7.4
2	18,511	4,900	15,244	708	653	506,325	255	7.6
3**	173,539	17,014	40,833	8,167	5,104	748,598	501	7.9
4	135,871	20,586	37,056	10,705	5,352	1,070,496	61	7.5
5	144,703	14,004	56,014	6,068	4,201	606,821	118	7.5
6	18,102	2,144	3,335	429	357	14,291	927	7.7
7	303,795	24,500	146,998	11,760	10,780	440,993	125	7.5

* Water quality data entering into watershed on Little Calumet River

** Water quality data entering into watershed on Deep River

Table 4.3: Base flow pollutant loads for the seven sampling sites.

Sampling Site	Storm Flow Pollutant Loads							
	DO (lbs/yr)	NH_3 (lbs/yr)	NO_3 (lbs/yr)	TP (lbs/yr)	Ortho-P (lbs/yr)	TSS (lbs/yr)	E.coli (cfu/100mL)	pH SU
1*	31,345	104,484	156,725	18,807	15,673	2,455,363	1,820	7.1
2	404,003	125,380	195,036	13,931	12,538	2,228,982	1,320	7.3
3**	5,311,246	696,557	957,766	121,897	113,190	25,250,184	2,380	7.3
4	5,057,002	2,107,084	1,158,896	200,173	158,031	20,544,072	1,240	7.4
5	7,166,525	1,552,747	1,074,979	71,665	59,721	33,443,782	1,760	7.4
6	432,736	115,803	73,138	7,314	6,704	1,432,295	2,900	7.4
7	7,522,813	1,629,943	1,253,802	275,836	225,684	45,136,881	2,600	7.3

* Water quality data entering into watershed on Little Calumet River

** Water quality data entering into watershed on Deep River

Table 4.4: Storm flow pollutant loads for the seven sampling sites.

Sampling Location	E. coli (cfu/100ml)			
	Dry Weather (7/24/2007)	Wet Weather (8/21/2007)	Wet Weather (9/26/2007)	Dry Weather (10/30/2007)
1		695	2	225
2	1804	3890	0	341
3	448	465	4	190
4	25	1620	0	218
5	396	2570	6	174
6	94	220	2	52
7	2	200	0	3
8	3	1385	2	5
9	1	2775	0	32
10	228	910	6	15
11	207	11130	0	144
12	108	340	2	15
13	56	215	6	1
14	353	415	14	20
15	270	3760	0	46
16	692	2765	0	75
17	119	1010	982	78
18	345	695	0	58
19	1	345	0	428
20	88	310	0	113
21	51	720	0	79
22	111	130	6400	7
23	374	945	8	40
24	505	685	2	77
25	275	565	2540	48
26	68	2285	114	16
27	937	2145	182	445
28	375	1220	56	260
29	158	4120	170	5
30	168	735	6	18
31	5	2310	1030	72
32	72	1610	792	102
33	50	405	882	8
34	71	1065	110	19
35	129	1100	358	27
36	51	755	4	2
37	4	1600	654	92
38	3	4580	2700	79
39	36	4515	62	67
40	9	2375	292	2
41	86	105	2440	44
42	913	2040	3100	586

Table 4.5: *E.coli* concentrations of grab sample location during both storm and base flow.

Baseline Conclusions

E.coli Bacteria

E.coli bacteria is the major pollutant of concern in this watershed. Significant contributions enter the watershed on the west end where flow from Hart Ditch has been sampled as high as 10,000 cfu/100mL. (HNTB, 2003). These elevated levels can be seen in Figure 4.39 where the x-axis is based on a distance measurement. The distance represents how far away from the first sample location, located at Indianapolis Boulevard, each subsequent location is along the Little Calumet River. The sample location immediately downstream of Hart Ditch, distance is zero meters, was the only location to exceed the state standard of 235 cfu/100mL in all four grab samples taken.

There is a second peak that indicated a possible hotspot around the 18,000 meter mark. This location is downstream of the convergence of Deep River with the Little Calumet River. Figure 4.40 shows the CDM data collected for the Gary Sanitary District in which there are elevated levels of *E.coli* at the same location. The x-axis is based on the same zero point of distance as Figure 4.39, showing the peak happens in the same physical location.

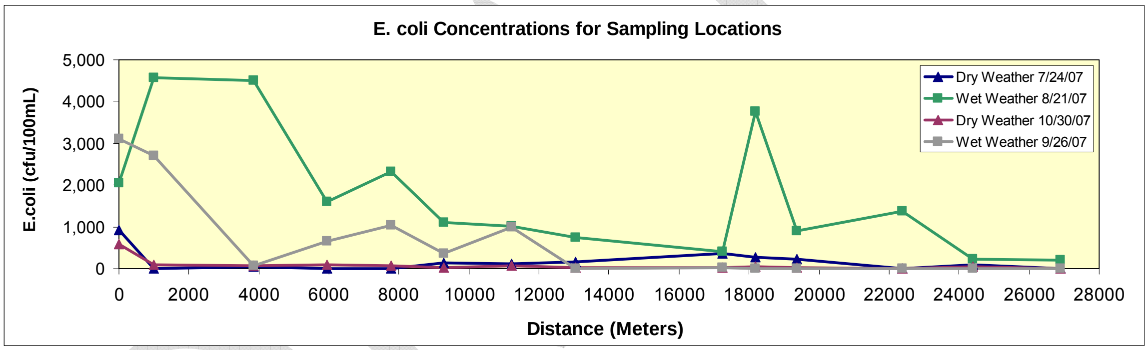

Figure 4.39: *E.coli* concentrations of sample locations along the Little Calumet River.

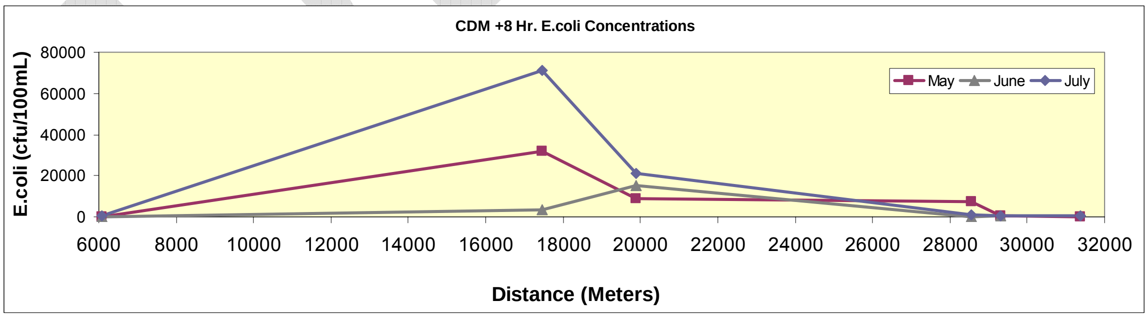

Figure 4.40: *E.coli* concentrations according to data reported in the 2003 CDM report to GSD.

Contributions from the watershed itself, even without CSO discharges, cause the river to exceed the state water quality standards for *E.coli* bacteria. Figure 4.41 visually summarizes the results of the *E.coli* sampling exceedance locations. Of

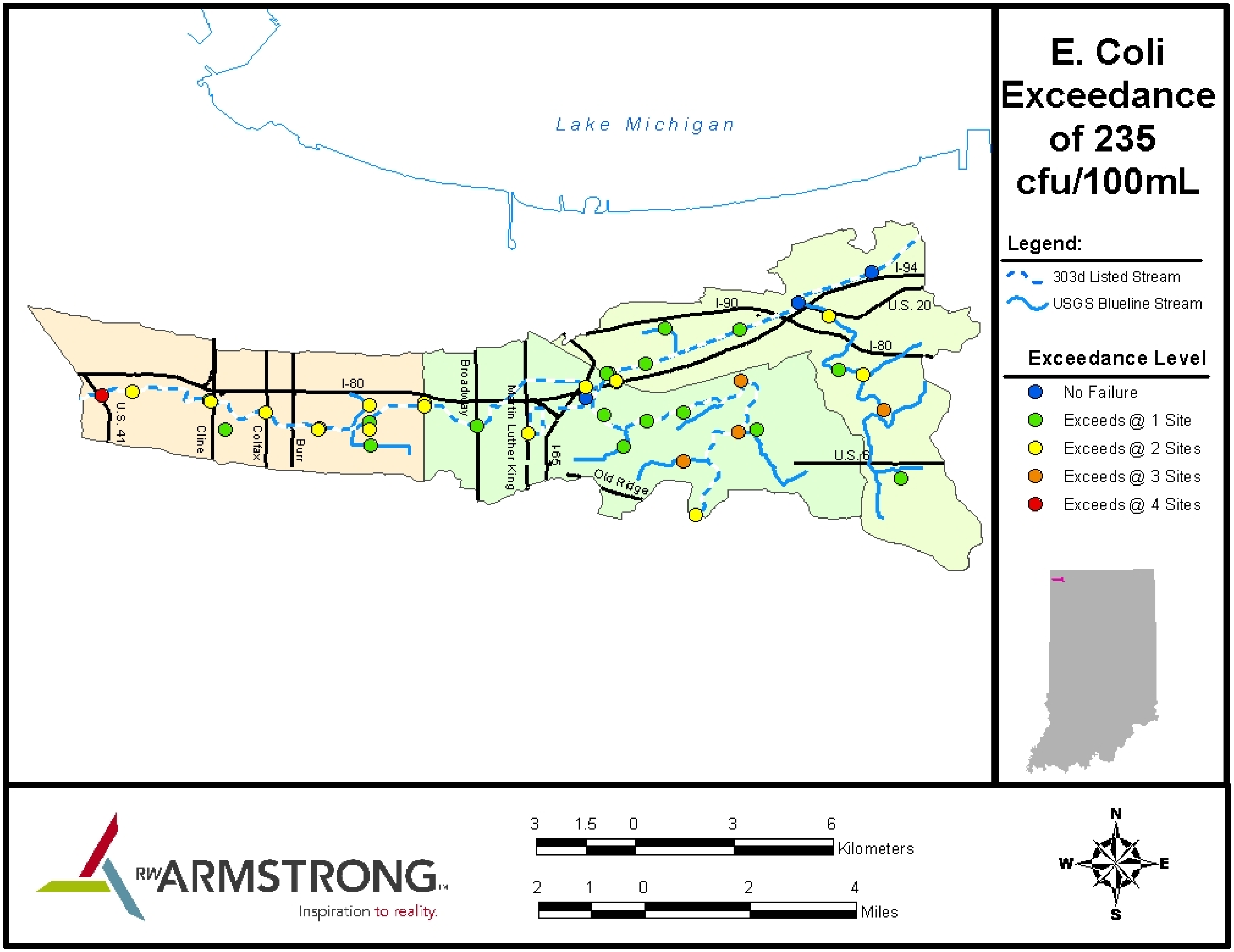

Figure 4.41: Sampling locations *E.coli* exceedance frequency and location.

the 42 sampling locations, only two never exceeded 235 cfu/100mL standard, 39 met the at least once in the four samples, and one was consistently above the 235 cfu/100mL mark.

As Figure 4.41 shows, all of the sampling sites that exceeded 235 cfu/100mL three times or more were on tributaries to the Little Calumet River or just down stream from their confluence with the Little Calumet River. The highest concentration of points exceeding the state standard on two of the four grab samples was located in the western most watershed near the east-west split and immediately downstream from Hart Ditch.

Total Nitrogen (TN)

The expected yearly loading rates for Total Nitrogen at each sampling site found using the Watershed Treatment Model (WTM) were greatly exceeded by the loads found during the water quality sampling conducted for this plan. Tables 4.2 to 4.4 show the expected pollutant loads, base flow pollutant loads, and storm flow pollutant loads, respectively. When looking at these numbers it can be seen that sample site #7, at the eastern edge of the watershed study area, had the highest values compared to the expected. The non-storm, or base flow, loads were more than 25 times the expected while the storm load was exceeded by nearly a factor of 100.

Total Phosphorus

Total Phosphorus in the sample results conducted for this plan exceeded the pollutant loads that were expected when looking at the land use. Sample sites # 2 and 6 were close in yearly loading rates: exceeding the expected loads by less than a factor of two (2). Sample site #7 was once again the worst site exceeding the expected loads (Table 4.2) by a factor of 23 for the non-storm or base flow (Table 4.3) and a factor of 66 for the storm flow (Table 4.4).

Total Suspended Solids

The sample results of the Total Suspended Solids compared to the expected loads found using the WTM followed the same pattern as the total nitrogen and total phosphorus. Sample site #7 exceeded the expected storm flow by the greatest factor (over 40). The non-storm or base flow had the greatest exceedance factor at sample site #4, at over 20. The expected total suspended solids yearly loads, the base flow pollutant loads and the storm flow pollutant loads can be found in Tables 4.2 to 4.4, respectively.

Overview

Figures 4.42 and 4.43 show the sites that had the worst base flow and storm flow nutrient loads, respectively. Sites that present problems both in base flow and storm flow are Sites one (1) and four (4). Site 4 is sampling the Deep River and while there do not seem to be *E.coli* bacteria problems, other nutrients are affecting the water quality here. Sampling Site 1 has a number of problems that differentiate between base flow and storm flow.

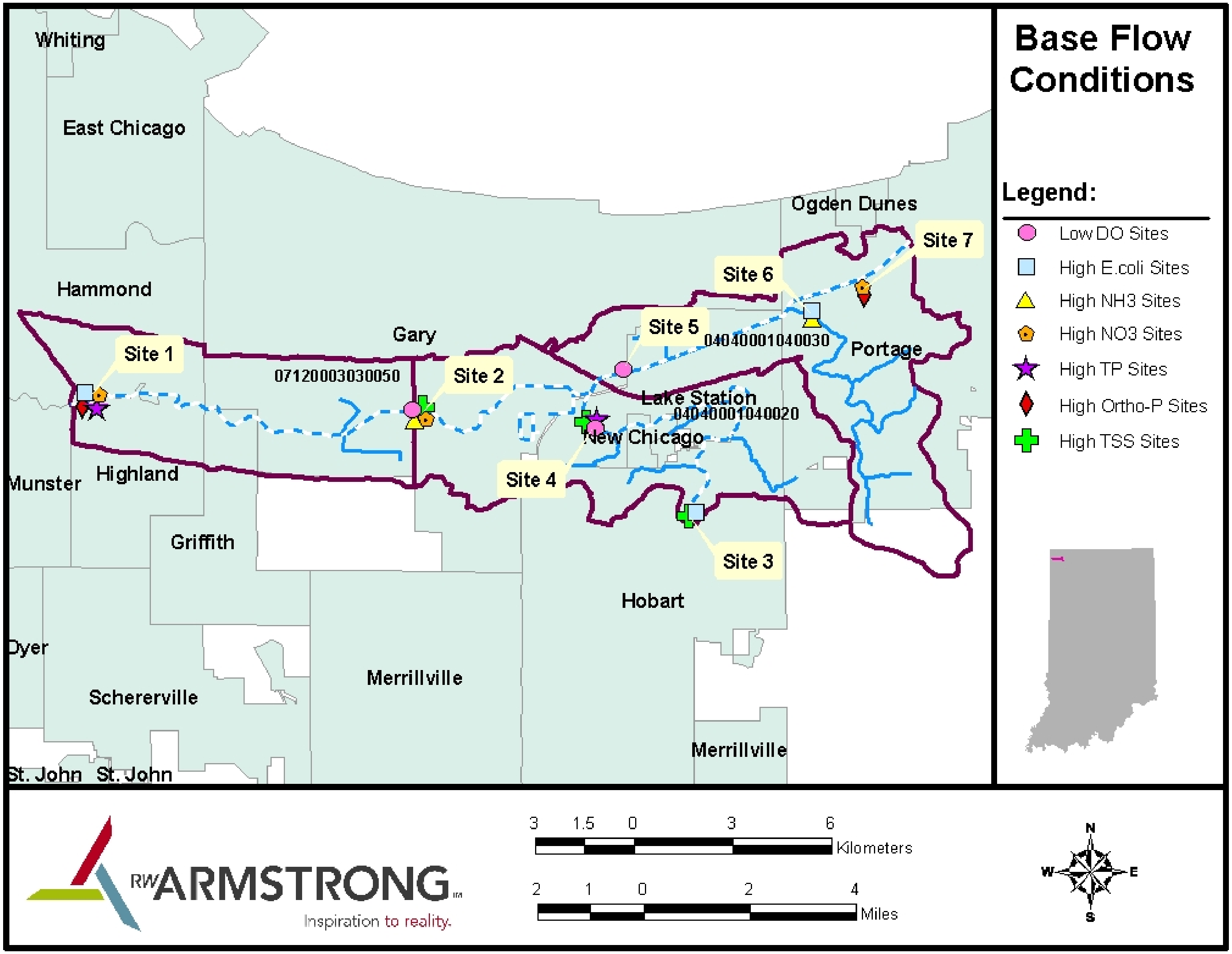

Figure 4.42: Base flow nutrient problems for the Little Calumet River Watershed Management Plan sampling sites.

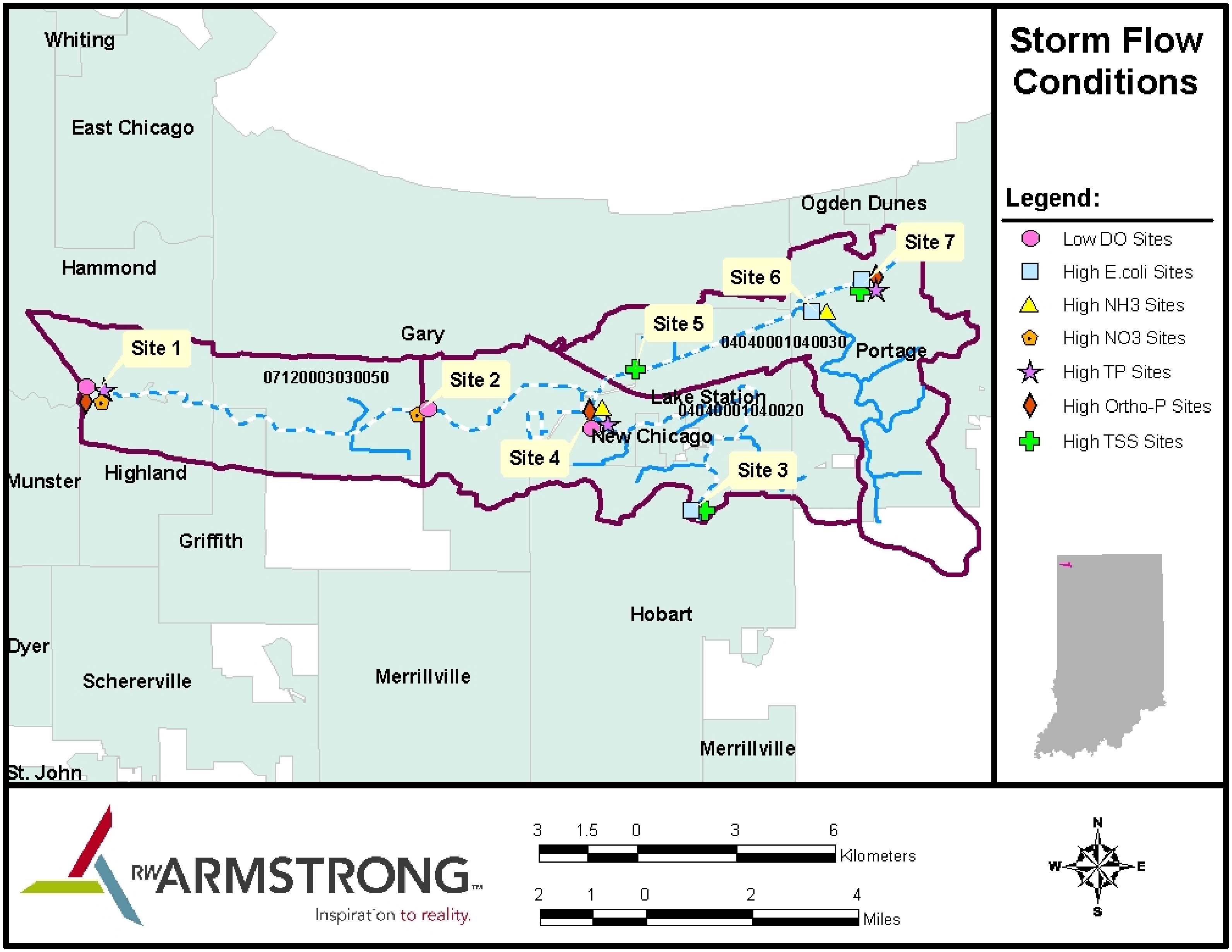

Figure 4.43: Storm flow nutrient loads for the Little Calumet River Watershed Management Plan sampling sites.

Stream Reach Survey

The Stream Reach Survey was conducted on October 31, 2007.

Methods

The Stream Reach Survey was conducted by a two-person team including an aquatic biologist and a plant ecologist. The Environmental Protection Agency's Rapid Biological Protocol (RBP) was conducted at 24 sites along the river (Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.). The RBP scores represent the general habitat quality of a particular stream reach visible to the surveyors from each survey location in either direction. The RBP habitat assessment looks at multiple key features including available cover, sediment deposition, channel flow status, channel sinuosity, bank stability, and riparian vegetative zone. Appendix 15: Rapid Bioassessment Protocols Data Sheets contains a habitat assessment field data sheet that was used to analyze the condition of the stream. RBP scores were recorded at locations where *E. coli* water quality sampling was also conducted to assist in the interpretation of physical factors on *E. coli*. A photo log was also conducted as part of the survey. Photo locations are shown in Figure 4.44 and Appendix 16: Stream Reach Survey Photos contains the photos.

The surveying scientists made every effort to collect habitat information and other scientific observations from as many accessible sites along the river as were possible to reach by car and by foot while respecting private property. The surveying team also canoed a few segments of the river; however, it was impractical to conduct on-stream evaluations in a number of areas given the number of culverts and available launch points. It is the professional judgment of the team that the number of sites assessed provides a comprehensive look at habitat along the Little Calumet River. While conducting formal RBP assessments, the surveying scientists also made observations and field notes regarding the following: invasive species, shoreline erosion, visible pollution hotspots, buffer widths, low-flow/stagnant areas, important natural area, and areas of notable human influence/degradation.

Findings

The Little Calumet River and associated waterways within this watershed have seen significant human alteration. As a result, public perception about the habitat and natural resource value of the stream tends to be negative. The stream reach survey results do not support this perception. In fact, some stretches of the stream provide important habitat and water quality function for this highly urbanized watershed. Other isolated stretches, do however; suffer from some narrow buffers and adjacent land use impacts (Figure 4.48).

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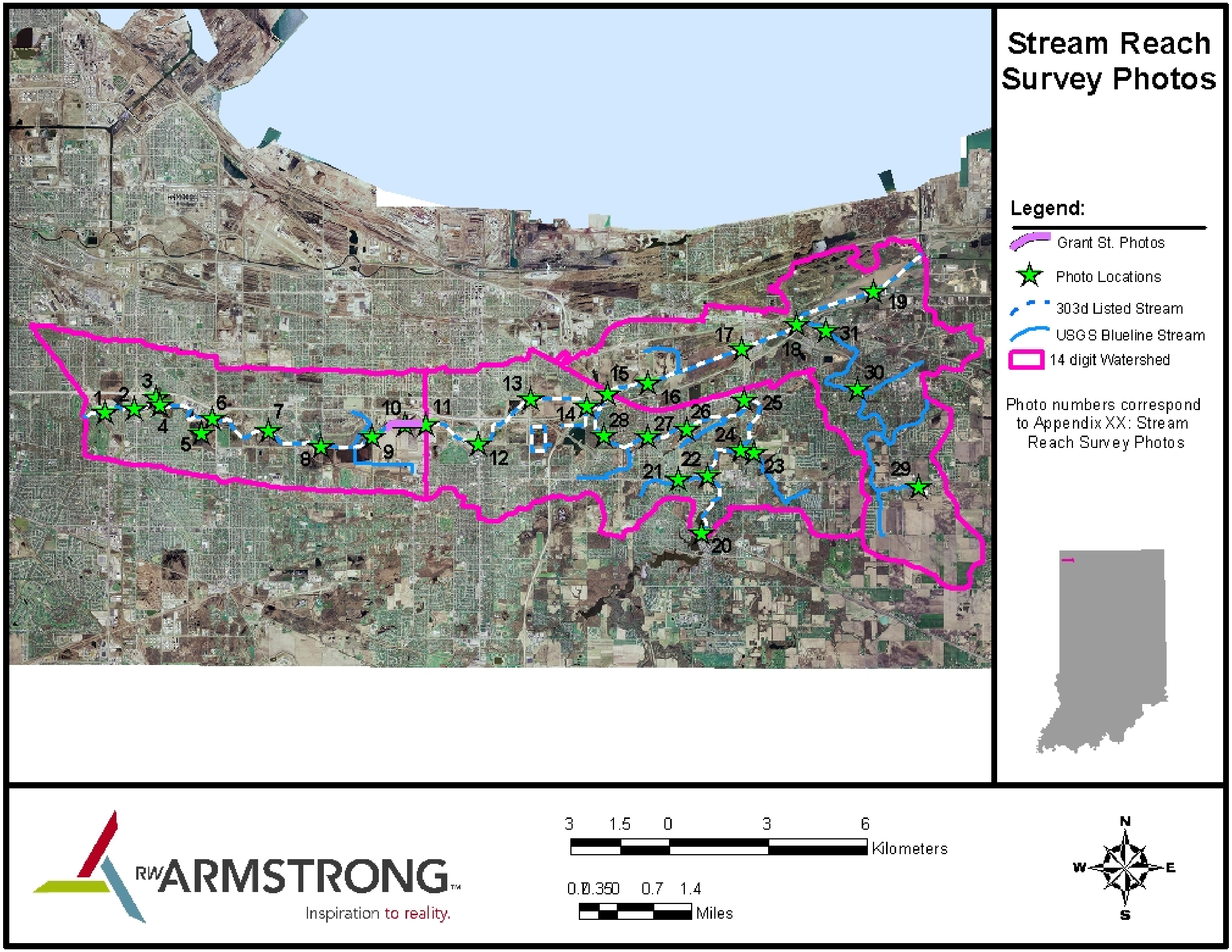

Figure 4.44: Locations of stream reach survey photos.

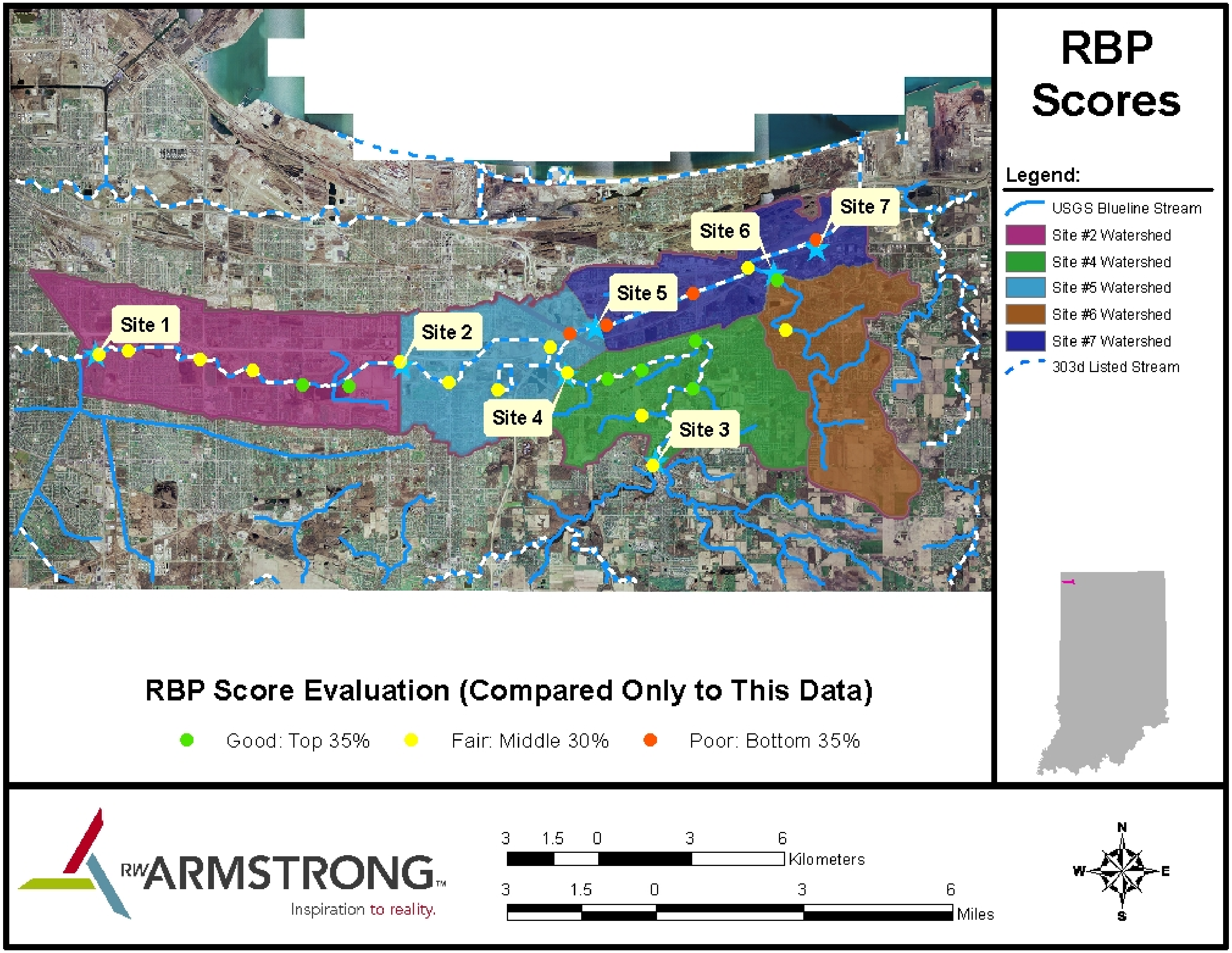

Figure 4.45: RBP scores throughout watershed and their corresponding grade(good, fair, poor)

RBP scores along the Little Calumet River and its tributaries ranged from 44 to 160, with the highest possible score being 200. The total number of sites and their associated scores were divided into three (3) categories based on appropriate breaks in the data set and the judgment of the survey team. Since the watershed study is designed to be a relative comparison of areas that may need protection or restoration, the scores were defined as good, fair, and poor (relative to one another), not necessarily compared to other streams in the state. These conclusions about habitat throughout the project area are shown in Figure 4.45. Data sheets can be found in Appendix 15: Rapid Bioassessment Protocols Data Sheets.

Little Calumet River

The Little Calumet River is for the most part a well buffered stream. Trees and floodplain wetlands line the majority of the stretch of the Little Calumet. The work done by the USACE building levees and creating flood control zones has resulted in a system of wetlands and floodplains that buffer both sides of the Little Calumet along a significant portion of its length. The stream itself is very channelized and turbid. Wood duck boxes have been placed along the stream in areas. Other than the constant roar of traffic, there are many times when you would not think you are in a highly urbanized area.

An important habitat location along the Little Calumet is the heron rookery (Figure 4.46). This large wetland complex contains large trees with numerous, giant heron nests. Other wetland and oxbow complexes along the Little Calumet provide water quality improvement via water filtration and attenuation of floodwaters. Many of these areas also provide habitat for fish, songbirds, and amphibians. Important wetland features are called out on Figure 4.47. Wetland habitat in the area is however negatively impacted by the presence and domination of invasive species. Habitat scores through this stretch ranged from 77 to 120.

Burns Ditch

Burns Ditch represents the most channelized section of the Little Calumet river system. Burns Ditch is a straight line segment of river designed to have a direct route to Lake Michigan. Buffers are minimal in this area as the adjacent land is used for agricultural production. Farming practices occur right up to the edge of the stream bank. Even though it is highly channelized, the waters of Burns Ditch are often hospitable enough for trout and many fishermen fish these waters. Fishermen were observed in this location numerous times throughout the watershed study. A number of marinas are located along Burns Ditch to support the many large boats that travel the waterway to get to Lake Michigan. Habitat scores through this stretch ranged from 44 to 66.

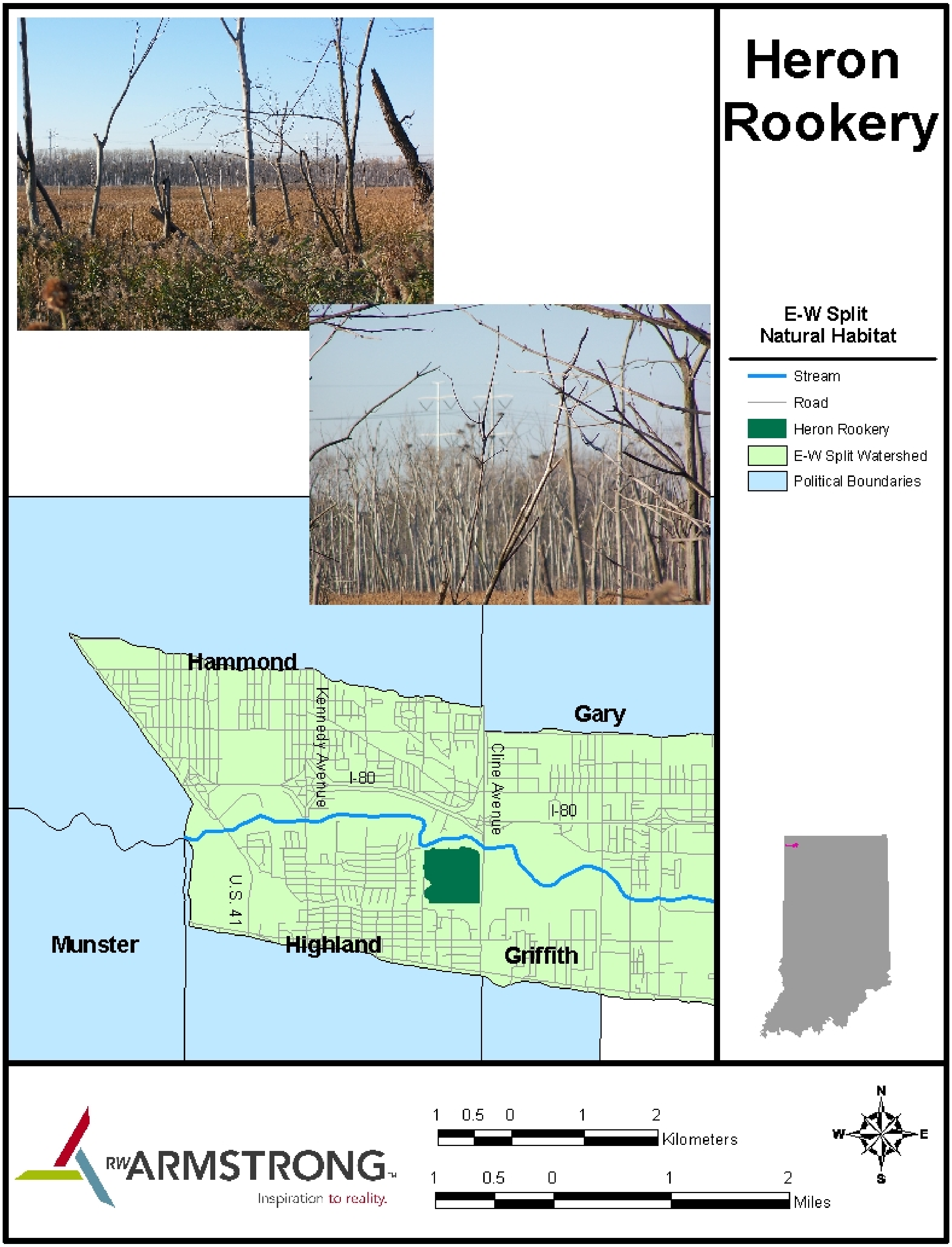

Figure 4.46: Location and condition of Heron Rookery located along Cline Avenue.

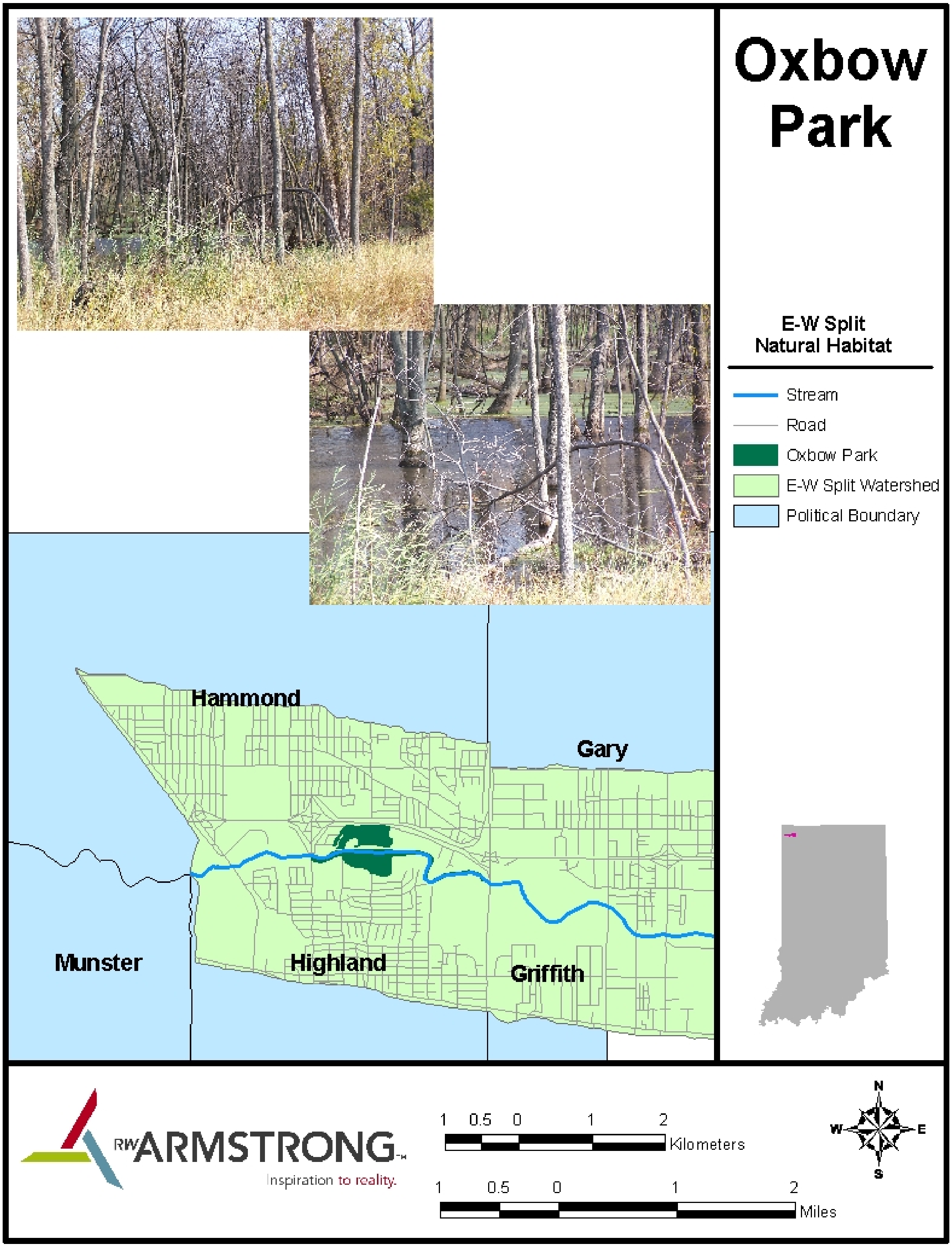

Figure 4.47: Oxbow Park location and wetland photos along the Little Calumet River.

Deep River

Of all the streams surveyed in this watershed, the Deep River provides the best habitat and has retained many of its natural features. Deep River has not been notably channelized and can be characterized as sinuous and complex in its structure. Stream banks are well buffered and large trees stabilize the bank providing shade and cover. Deep River has high recreational value and good fisheries habitat. The surrounding landscape provides good aesthetic value for river users. Habitat scores through this stretch ranged from 107 to 160

Willow Creek

Willow Creek also provides areas of good aquatic and riparian habitat and water quality features relative to other streams in the watershed. It was one of the few stream segments where riffle pool complexes can be found. The water in Willow Creek is much clearer than in other streams/segments inventoried in this survey. Stream cover, along with the riffle/pool complexes provide good habitat for fish and other macroinvertabrates. Habitat scores through this stretch ranged from 123 to 140.

Invasive species

The dominance of invasive species is a problem for habitat diversity throughout the watershed. The primary species of concern is *Phragmites australis*, also known as common reed. It is difficult to call out one location where this species is more of a problem than another. *Phragmites* has out-competed most other plants in the floodplain wetland areas. It lines the miles of roadside ditches and stream banks in the watershed. Its density, spacial distribution, and its likely seedbank strong hold, make whole-sale restoration of floodplain wetlands nearly impossible.

Cattails (*Typha sp.*) are also present and dominate emergent areas throughout the watershed. Cattails may or may not be considered invasive and therefore, can be an ecological concern. Many people consider the plant invasive as it is known to take over an area and limit diversity of other wetland plants; however, unlike the *Phragmites*, some cattails are native to the region. Cattails can provide some habitat value for birds and other animals; although, the biggest concern is the limited food supply value they offer by crowding out other flower and seed producing species. It is important to note that cattails can provide important soil stabilization and nutrient and metals attenuation along shorelines, thus positively affecting water quality.

Cattails are a dominant species of many of the floodplains and wetlands along the Little Calumet. At the location of the heron rookery (Figure 4.46), cattails cover the wetland complex for acres. Other than the trees that house the heron nests, cattails are the only visible species in this area.

<u>High Quality Natural Areas</u>
Aside from the challenges of invasive species, there are ecologically important natural areas within the Little Calumet River Watershed worthy of protection and/or restoration efforts. The first is the above mentioned heron rookery located west of Cline Avenue and south of the Little Calumet River. The rookery is important to all species of heron. The location of these trees in an undeveloped wetland complex allows for undisturbed nesting in close proximity to fishing and feeding areas.

Another natural area is the Cline Oxbow Park. The park contains an oxbow wetland complex where many ducks were observed feeding during the survey/evaluation. In addition to the physical habitat this park provides for wildlife, a diverse array of plant species such as touch-me-nots, sedges, and many others valuable wetland plants are also present. The park caters to visitors by providing several trails and an open shelter house and grill. The somewhat diverse community here is unusual among the wetlands and riparian areas in the watershed.

Across the river, on the south side, is another oxbow wetland complex. This area is not a park, but future planning and some restoration efforts could protect this area and provide a larger, opportunity for area wildlife to thrive, given its proximity to the above noted areas.

<u>"Hotspots"</u>
There are a number of locations where stream banks are non-existent along the Little Calumet River. These areas flow directly into floodplain wetland areas that are part of the USACE levee system. The floodplain wetlands adjacent to the stream are often littered with trash – old tires, plastic shopping bags, plastic pop bottles, and other trash. If volunteers picked up trash in these areas three to four times a year the aesthetics and wildlife safety of these areas could be greatly improved. Such clean-up efforts in these floodplain areas would also reduce the amount of pollution moving through the watershed and toward Lake Michigan.

Areas of limited buffer are also a water quality and erosion concern. These areas are somewhat concentrated along the Burns Ditch segment (Figure 4.48). Cost-share programs to restore buffers in this location are recommended. Given the urban nature of the watershed and its associated pollutant load, increased buffers along commercial and residential properties could result in water quality improvements, as well as improved habitat connectivity.

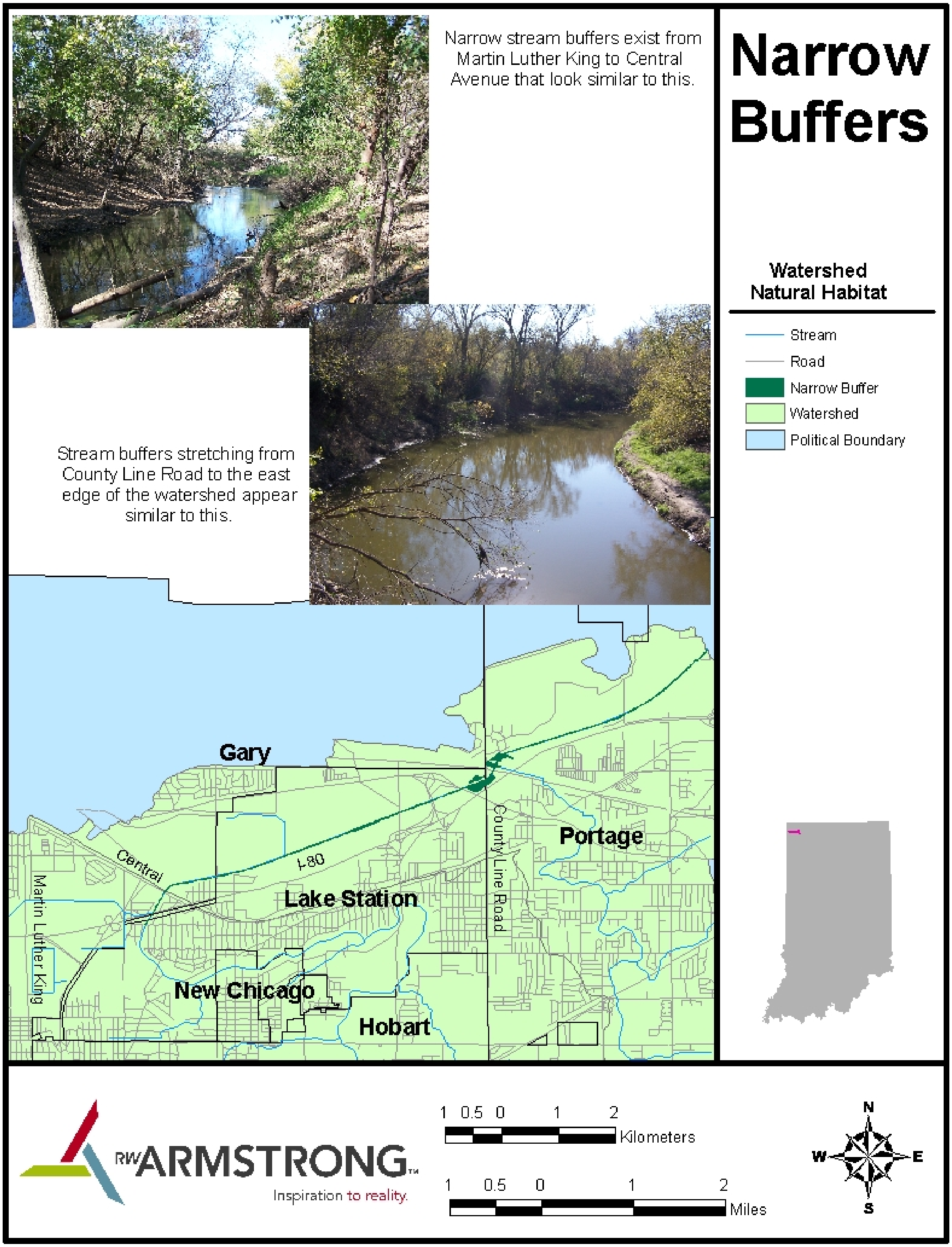

Figure 4.48: Narrow stream buffers from Martin Luther King to Central and County Line to eastern watershed edge.

Section V: Development of Problem Statements and Goals

Draft problem statements were presented to the Steering Committee. Input from the meeting participants suggested that Problem Statement No.2 be broken apart into a problem statement for each of the pollutants addressed by this plan. The presented problem statement was "Several non-point source pollutants such as sediment and nutrients are elevated to levels that can impact biological communities and overall river health." The revised problem statements are shown below with the concerns identified by the Steering Committee and the public. Under each list of concerns are one or more statements summarizing the problems around which the expressed concerns centered.

1. Water Quality Concerns

- Low flow water quality
- Flood control impacts on water quality
- *E.coli* sources
- CSOs (discharge & impacts on use)
- Sediment loads (TSS) & upstream erosion problems
- Increase in large rain events - flooding water quality
- Quantity & quality from east reach
- Impact on Lake Michigan

Problem 1: The Little Calumet River and its tributaries regularly exceed the Indiana single sample daily maximum of 235 colonies per 100 milliliters for *Escherichia coli* (*E.coli*) bacteria, thus limiting recreation, impacting downstream waters, and raising health concerns among the public.

Problem 2: Several non-point source pollutants such as sediment and nutrients are elevated to levels that can impact biological communities and overall river health.

2. "Other" Natural Resource Concerns

- Downstream impacts (Lake Michigan)
- Impact of altered hydrology
- Fishery condition – fish health
- Impacts on recreational uses
- Impacts on neighborhood's – aesthetic & habitat
- Preservation of waterways and riparian areas
- Restoration of natural areas/habitat
- Flooding concerns
- Erosion concerns
- Change in Impervious Areas
- Diked Areas in Watershed

Problem 3: Severe hydrologic manipulations have impacted the natural topography of the river and riparian areas resulting in disconnection from historic floodplains and wetlands, as well as the creation of extreme low-flow conditions in the river at certain locations.

3. Public Involvement/Education Needs or Concerns

- Risk communication to community
- *E.coli* communication/education w/ public
- Who's in charge of what?
- Getting local buy-in or participation
- Watershed Education for the Public
- Connecting People to their Watershed
- Need for Public Workshops
- Educating the Public on Whom to Call with Concerns or for Information
- Interpretation Opportunities

Problem 4: The residents in the Little Calumet River Watershed need more education on their role in maintaining the overall quality of the watershed.

4. Local Coordination Needs or Concerns

- Coordination w/other watershed projects (DNR 6217 coordination)
- Coordination w/ flood control project
- TMDL coordination
- Septic systems and social issues
- Flood diversion away from Illinois
- Coordination with planning & zoning
- Communication w/ ACOE
- Development awareness
- Community cooperation and improved uniformity
- Holistic Conservation Planning
- Coordination with other studies and projects
- Brownfield Impacts
- Map Parks, Land Trusts, and Natural Areas
- Planning tools to assess downstream impacts

Problem 5: A single point of contact is not in place to coordinate resources across political boundaries in the Little Calumet River Watershed.

5. Resource Needs or Concerns (data, financial, people)

- Public access
- Increasing Recreational Uses

Problem 6: Public access to the river is limited due to the highly developed state of the watershed.

Section VI: Pollutant Sources

Point Sources

Point sources are discharges that enter a water body through or from a well defined point of discharge. Point sources can include storm sewers, CSO's, culverts, ditches, waste water treatment plant discharges, concentrated animal feeding operations, etc.

As stated in Section II, the Watershed Diagnostic Study of the Little Calumet-Galien River Watershed noted no correlation between high pollutant loads detected as part of that effort and any permitted point sources along the Little Calumet River for a variety of pollutants.

Most point source discharges require an NPDES permit. The most notable exceptions to this are storm water discharges in rural areas or small communities. There are currently XXXXX active NPDES permits in this plan area. This number does not include un-permitted, illegal discharges that are most likely occurring in the watershed.

The Watershed Restoration Action Strategy for the Little Calumet-Galien Watershed states on page 19 that "Illegal discharges of residential waste water (septic tank effluent) to streams and ditches from straight pipe discharges and old inadequate systems are a problem within the watershed."

Municipal operators of a separate storm sewer system in this plan area are currently required by Rule 13 of the Indiana Department of Environmental Management to track down these illicit discharges and eliminate them.

Combined Sewer Overflows within the LCR Watershed

Combined sewers are a system of pipes designed to carry sanitary sewage and storm water together in the same pipe. Due to the variable nature of storm water flows and the tremendous capacity required in both the pipes and wastewater treatment facilities to deal with those flows, overflow points were constructed to prevent the system from backing up into buildings and homes connected to the sewers. When the volume of flow in the pipe exceeds the systems capacity, the excess flow is directed out the overflow point and into some form of receiving water or ditch. Construction of this type of system was stopped in Indiana in the 1960s. Current design practices require separate sanitary and storm water collection and treatment systems.

There are currently eight (8) combined sewer overflows within the three watersheds included in this study. Though often regarded as a source of *E.coli*, CSO's are a point source of many different pollutants. Anything flowing through the sanitary sewers can be released out a CSO under the right flow conditions. These pollutants can include *E.coli*, pathogens, solids, debris, and toxic pollutants including chemicals and heavy metals. Figures 6.1 and 6.2 show the locations of these CSO points.

Other Potential Point Sources

Other potential point sources of pollutants in these watersheds include landfills, industrial sites, underground storage tanks, super fund sites, junk yards, and other EPA permitted discharges. Figures 6.3 and 6.4 show the location of potential point sources and Appendix 17: Potential Point Sources list the locations and other available associated data for each potential source.

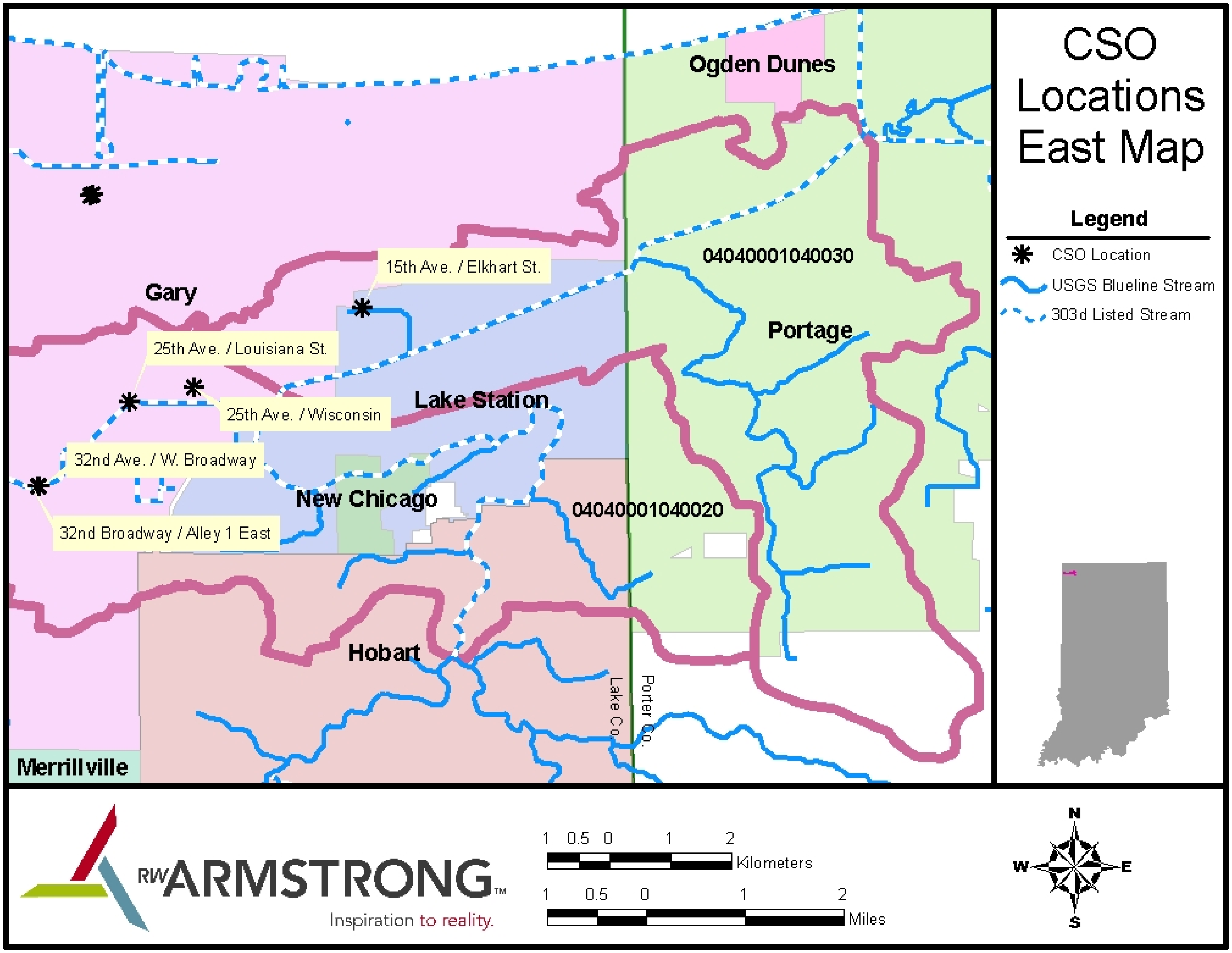

Figure 6.1: Combined Sewer Outfall locations for the eastern portion of the watershed study area.

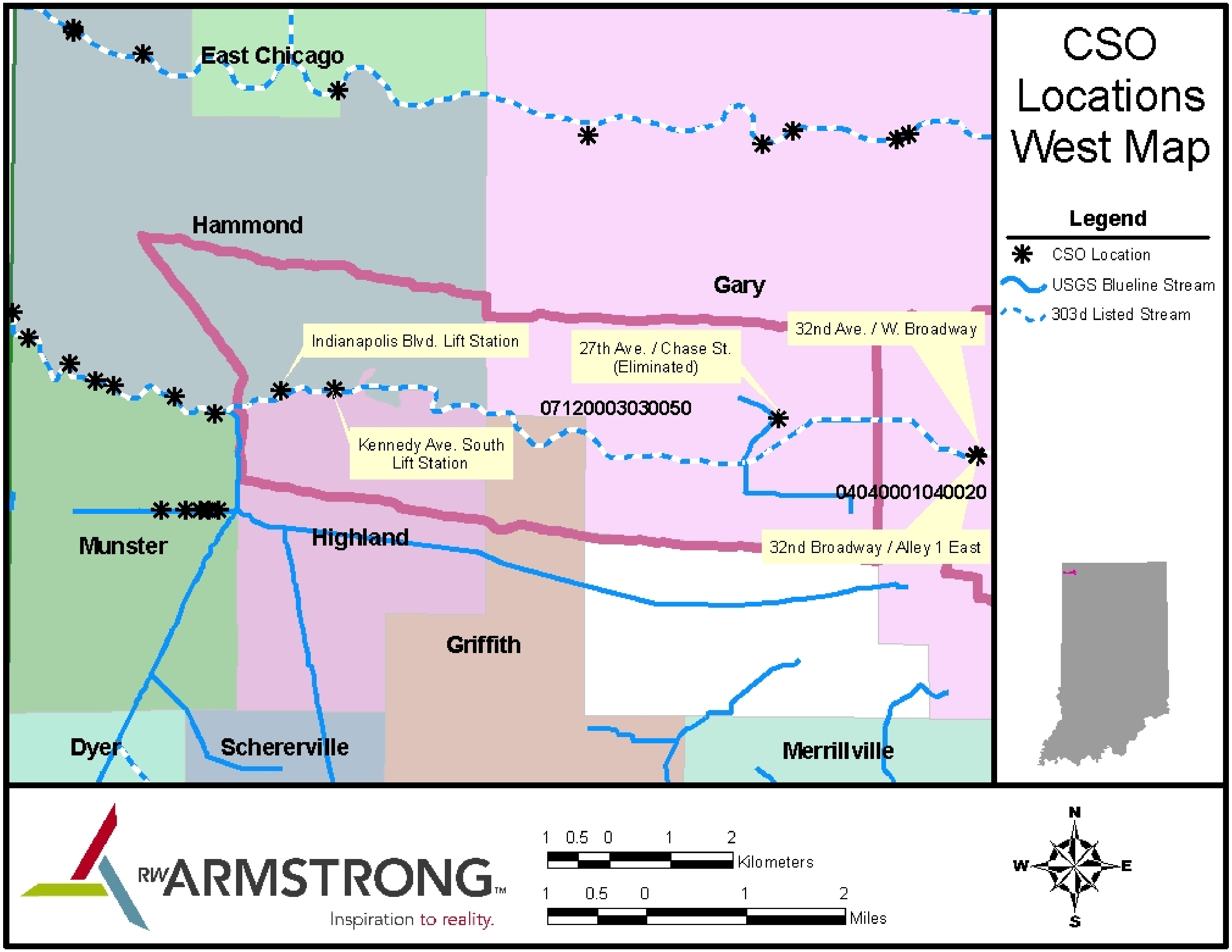

Figure 6.2: Combined Sewer Outfall locations for the western portion of the watershed study area.

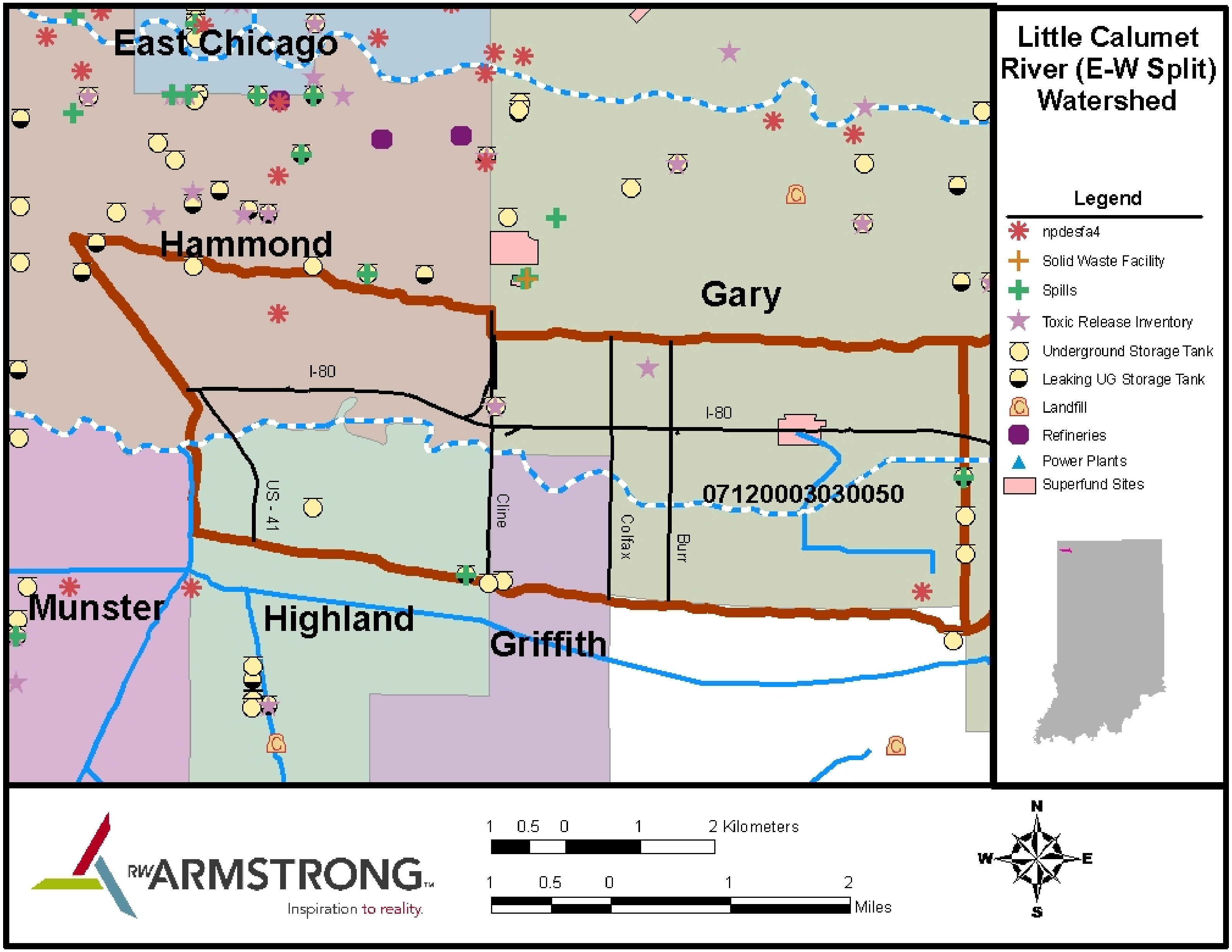

Figure 6.3: Potential point sources for the western portion of the watershed study area.

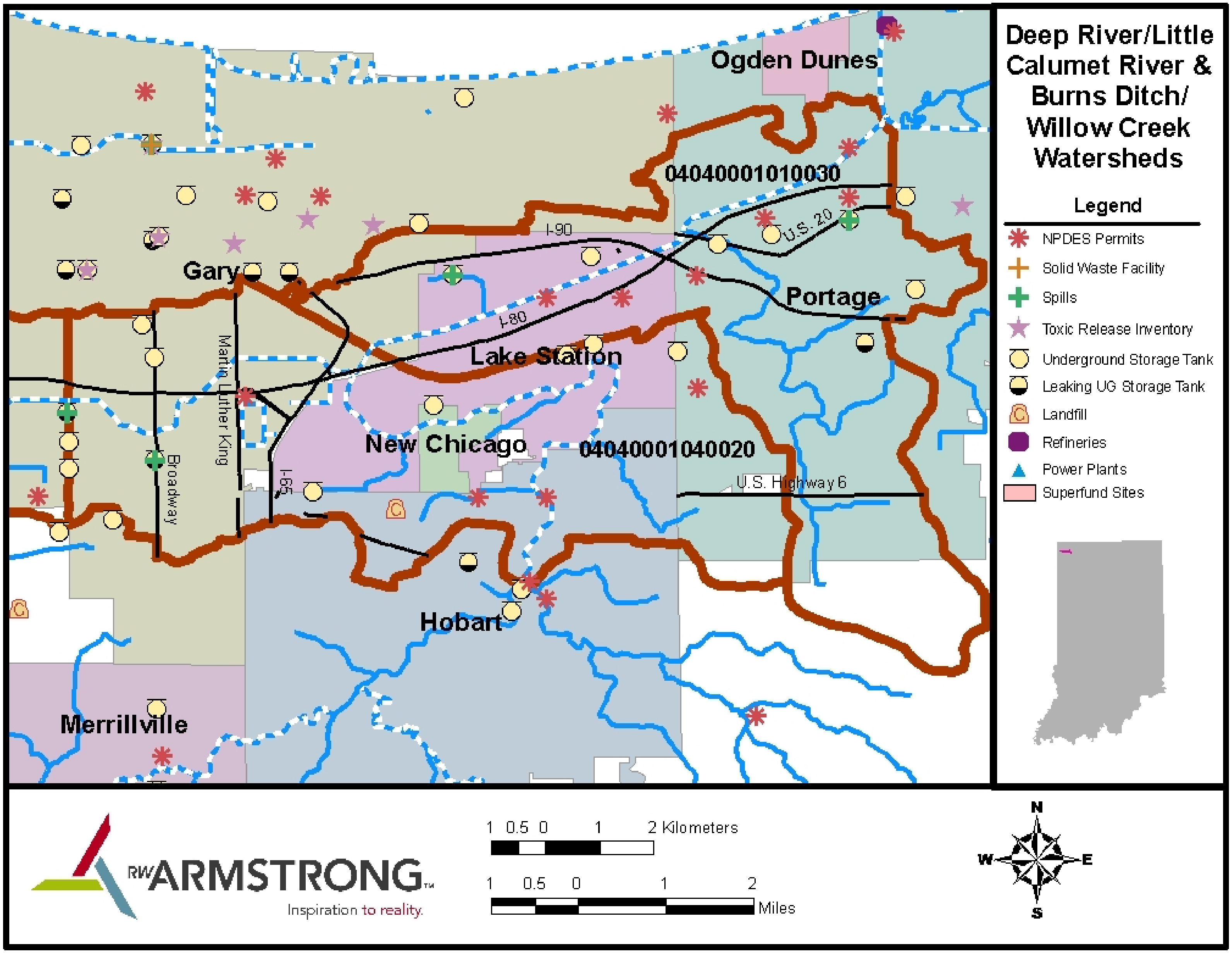

Figure 6.4: Potential point sources for the eastern portion of the watershed study area.

Non-Point Sources

Non-point source pollution refers to pollutants that enter the water body through storm water runoff, contaminated ground water, snowmelt, or atmospheric deposition. These sources tend to be more diffuse in nature and occur at random time intervals depending on weather patterns.

Non-point sources can, in some instances, provide larger pollutant loads than the point sources to the same water body. Sources of pollutants in this category tend to be related to land useage and are more spread out throughout the watershed. These sources can include roadways, parking areas, failing septic systems, animal wastes, fertilizers, detergents, etc.

With regard to *E.coli* pollution, the Little Calumet and Portage Burns Waterway TMDL for *E.coli* Bacteria discussed in Section II states:

"Based on the modeling and data analyzed, the allowable TMDLs for the Little Calumet – Portage Burns Waterway will require a reduction of over 90 percent in non-point source loads."

Onsite Wastewater Disposal

Because the TMDL states that a 90 percent reduction in non-point source *E.coli* bacteria is needed to meet current water quality standards, an attempt has been made to map existing septic systems within the three watersheds. Both the Lake and Porter County Health Departments were contacted and neither had adequate records to produce a map of active and abandoned septic systems. Once that was determined, a new strategy was developed and the City of Gary's Health Department was not contacted. The new strategy was to attempt to map un-sewered areas because the City of Gary had already produced such a map under their Integrated Storm Water Drainage Plan for the Little Calumet River Watershed Study (2003-2004).

While the map below attempts to locate un-sewered areas, not all communities were forthcoming with information needed to complete the map shown in Figure 6.5. Even in the areas shown as sewered, there may be enough active and/or abandoned septic systems to be a significant source of *E.coli* and other non-point source pollutants.

The TMDL report sites an Ohio Department of Environmental Quality 2001 study that estimated each failing septic system could generate a daily load of around 1.516 x 10^8 cfu/day. It then states that the non-point source load in the Black Oak area of the City of Gary would indicate 200 to 300 failing septic systems if 100 percent of the loading reached the river. It goes on to say that this scenario is unlikely and other non-point sources must exist in and around the Black Oak area to account for the loading observed in that area of the river.

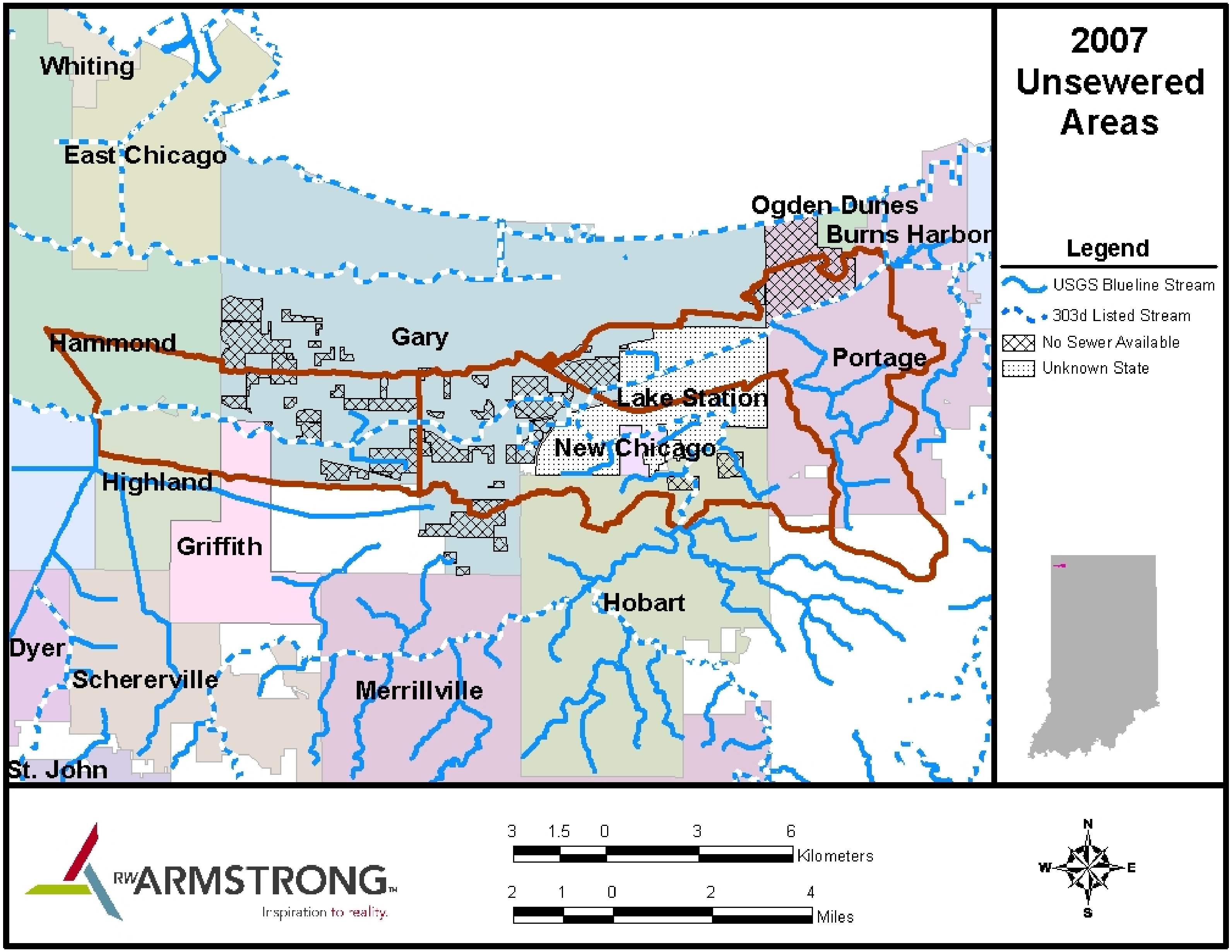

Figure 6.5: Un-sewered areas in the watershed study area according to information received from local sanitary districts.

Urban/Residential

Runoff from urban areas can be the most significant source of non-point source pollution in a watershed. Impervious surfaces can increase the volume of runoff, the rate of run off, and the temperature of runoff.

The additional flow can cause erosion and sedimentation in receiving channels. Impervious areas also allow detergents, auto fluids, deicing chemicals, household wastes, pesticides, fertilizers, animal wastes, and other pollutants to reach receiving waters with little or no filtering, often due to curb and guttered roadways. Atmospheric deposition on impervious surfaces is often washed away with the first rain or snowmelt.

Agriculture/Managed Lands

These lands include areas such as golf courses, agriculture, parks, etc. where fertilizers, pesticides, animal wastes, and other chemicals may be washed off the lands and into receiving waters. Land disturbance in these areas can also lead to pollutant loading in the river.

Land Disturbing Activities

Any type of land-disturbing activity such as clearing, tilling, excavation, filling, grading, or even vegetation degradation can result in increased pollutant loading. Increased erosion by wind and water ultimately reaches waterways. In addition to that, the removal or degradation

Natural Areas

While natural areas tend to be a sink for many pollutants, especially nutrients, they can be a significant source of *E.coli* depending on local animal types and populations. The TMDL report for this watershed sites potential bacteria contributions from geese, ducks, deer, beavers, and raccoons. It is interesting to note that the estimated daily bacteria production for each goose, duck, deer, and beaver exceeds the bacteria loading rate of a failing septic system. The bacteria production of each raccoon is slightly below (approximately 18%) the loading produced by each failing septic system.

Pollutant Specific Sources

E.coli Sources

Combined Sewer Overflows are the dominant source of *E.coli* bacteria. Previous testing of CSO discharges discussed earlier in this plan found discharges as high as 5,300,000 cfu/100mL. The locations of these discharges are shown in Figures 6.1 and 6.2. Because each CSO community is required to develop a Long Term

Control Plan (LRCP) to eliminate these discharges, they were not considered in the development of the TMDL discussed previously and do not need to be included in the goals of this plan, at this time.

Animal Life in this watershed, according to the TMDL, could contribute to the *E.coli* impairment in these waters. The TMDL report for this watershed sites potential *E.coli* contributions from geese, ducks, deer, beavers, and raccoons. Population estimates for wildlife in the natural areas in these watersheds would be needed to quantify this contribution. Previously presented land use maps indicate areas where wildlife is most likely concentrated, but wildlife is certainly not limited to these areas. In addition to wildlife, pets and livestock in this watershed are also sources of *E.coli*. The LCRBDC has found horse farms in the flood plains of the river, though most live stock along the Little Calumet River is located east of this study area. Pet waste in the high density and medium density urban areas could also contribute to the problem.

Failing Septic Systems are another source of *E.coli* pollution in this watershed. The quantity and location of septic systems within these watersheds is unknown. The un-sewered areas map, Figure 6.5, does not necessarily indicate that there are no septic systems in the sewered areas. Estimated bacteria release from failing septic systems is unlikely to be the sole source of *E.coli* impairment in this watershed based on estimated bacteria release from these systems as discussed previously.

Contaminated Sediments are also sited in the TMDL as a likely source of *E.coli* pollution. Years of CSO discharge and other sources may have contaminated sediments in and around the channels causing residual *E.coli* contamination during higher flows when these sedimets are agitated. Contaminated sediments may also be contained within storm sewers leading to the channels.

Impervious Areas are sited by the TMDL as likely sources of *E.coli*. Although impervious areas do not produce *E.coli* themselves, they are a conduit for *E.coli* bacteria from other sources to reach the river before they can die off. Runoff carrying *E.coli* from pet wastes, failing septic systems, etc. can be quickly routed to the creeks/rivers in this area via curb and gutter and storm sewer systems. Impervious areas also contribute to thermal pollution by raising the temperature of run off and may be responsible for making the flows more conducive to bacteria survival. Likely locations of impervious areas can be seen on the land use maps (Figure 4.34 to Figure 4.38).

Nitrogen and Phosphorus Sources

Combined Sewer Overflows were shown to be major sources of nitrogen and phosphorus in previously discussed studies on the Little Calumet River. The locations of these discharges are shown in Figures 6.1 and 6.2. Because each CSO community is required to develop a Long Term Control Plan (LRCP) to eliminate these discharges, they not need to be included in the goals of this plan, at this time.

Excessive Fertilizer Application is sited by the Watershed Diagnostic Study of the Little Calumet-Galien River Watershed as a source of nitrogen and phosphorus in this watershed. Managed lands such as golf courses, as well as urban areas which make up most of this watershed, are significant sources of excess fertilizer applications.

Animal Life in this watershed, according to the Watershed Diagnostic Study of the Little Calumet-Galien River Watershed, is also a source of nitrogen and phosphorus. Pets and livestock in this watershed are also sources of nitrogen and phosphorus. The LCRBDC has found horse farms in the flood plains of the river, though most live stock along the Little Calumet River is located east of this study area. Pet waste in the high density and medium density urban areas could also contribute to the problem. Wildlife contributions are most likely limited to bird droppings deposited directly into the waters or on impervious surfaces that carry to flows to the channels without any break in impervious surface connections.

Failing Septic Systems are another source of nitrogen and phosphorus pollution in this watershed according to the Watershed Diagnostic Study of the Little Calumet-Galien River Watershed. The quantity and location of septic systems within these watersheds is unknown. The un-sewered areas map (Figure 6.5) does not necessarily indicate that there are no septic systems in the sewered areas.

Total Suspended Solids

Impervious Areas are a major source of Total Suspended Solids in this watershed. Soil erosion and sedimentation are naturally occurring processes in all streams and rivers. However, as impervious areas increase so do runoff volumes and velocities. These increased volumes and velocities often directly relate to additional channel erosion in drainage ditches, streams, and rivers. This erosion in drainage ditches is a constant problem in this watershed due to highly erodible soils, the high ground water table, and almost flat slopes within the ditches themselves. Impervious areas also collect wind deposited sediments as well as deicing salt/sand mixtures that can then be carried directly to waterways, if there is no break in the connection of impervious areas.

Construction Practices within this highly urbanized area is also a source of total suspended solids via soil erosion by wind and water. The large amount of construction work in this watershed due to development, redevelopment, and replacement of aging infrastructure presents ample opportunity for soil erosion if careful planning and execution of preventive measures is not performed. While many standards are in place for dealing with erosion through storm water runoff, little is done to prevent wind erosion.

Agriculture can also contribute to total suspended solids when care is not taken to prevent soil loss. While agriculture is not the dominant land use in this watershed, its 4,100 plus acres make up almost 12% of the watershed area.

Section VII: Critical Areas

As previously discussed, the pollutant load calculations for these watersheds showed that the non-point sources within them are producing much greater amounts of the identified pollutants of concern for this plan than national averages for the current land uses would indicate. Therefore, critical areas have been identified based on the results of the stream reach survey, land use mapping, previous sampling and sampling conducted as part of this plan. Figure 7.1 identifies the location of each critical area within the study area. A note of caution though, the sampling for this plan was very limited and a more extensive sampling program may be needed to confirm these findings and further isolate sources and critical areas.

E.coli **Critical Areas**

Sampling conducted for this study found the highest areas of *E.coli* concentration near the confluence of Hart Ditch with the Little Calumet River and then near the confluence of Deep River and the Little Calumet River as shown in Figure 4.41. By focusing on reducing *E.coli* levels at these sites, overall *E.coli* levels can be lowered significantly. Therefore the two critical areas are:

Critical Area 1- Sample results show high levels of *E.coli* at Sample Location #38 and Sample Location #39. Sample Location #42 upstream of #38 is much lower and #37 downstream is significantly lower as well. This area is strongly influenced by contributions from Hart Ditch which is outside the areas covered by this plan. Source reduction in this critical area within this watershed will off set some of the *E.coli* inflow from the Hart Ditch watershed.

Critical Area 2- Graphs of the in stream pollutants yield a peak at Sampling Location #11 in both the sampling conducted as part of this plan and the sampling conducted in 2003. This peak is not found at Sample Location #20 where Deep River enters the watershed, therefore the *E.coli* appears to be coming from somewhere other than Deep River. Efforts are currently underway to locate the source of this spike in *E.coli* concentrations.

Nitrogen and Phosphorus Critical Areas

Critical Area 3 – Sampling Site 2 has shown elevated levels of Nitrates in both the base flow and storm flow samples. It has also shown levels of Ammonia higher than the other sites during base flow conditions. This area has opportunities for restoration between the levees that could mitigate these values. This sampling site is also influenced by flows from Hart Ditch.

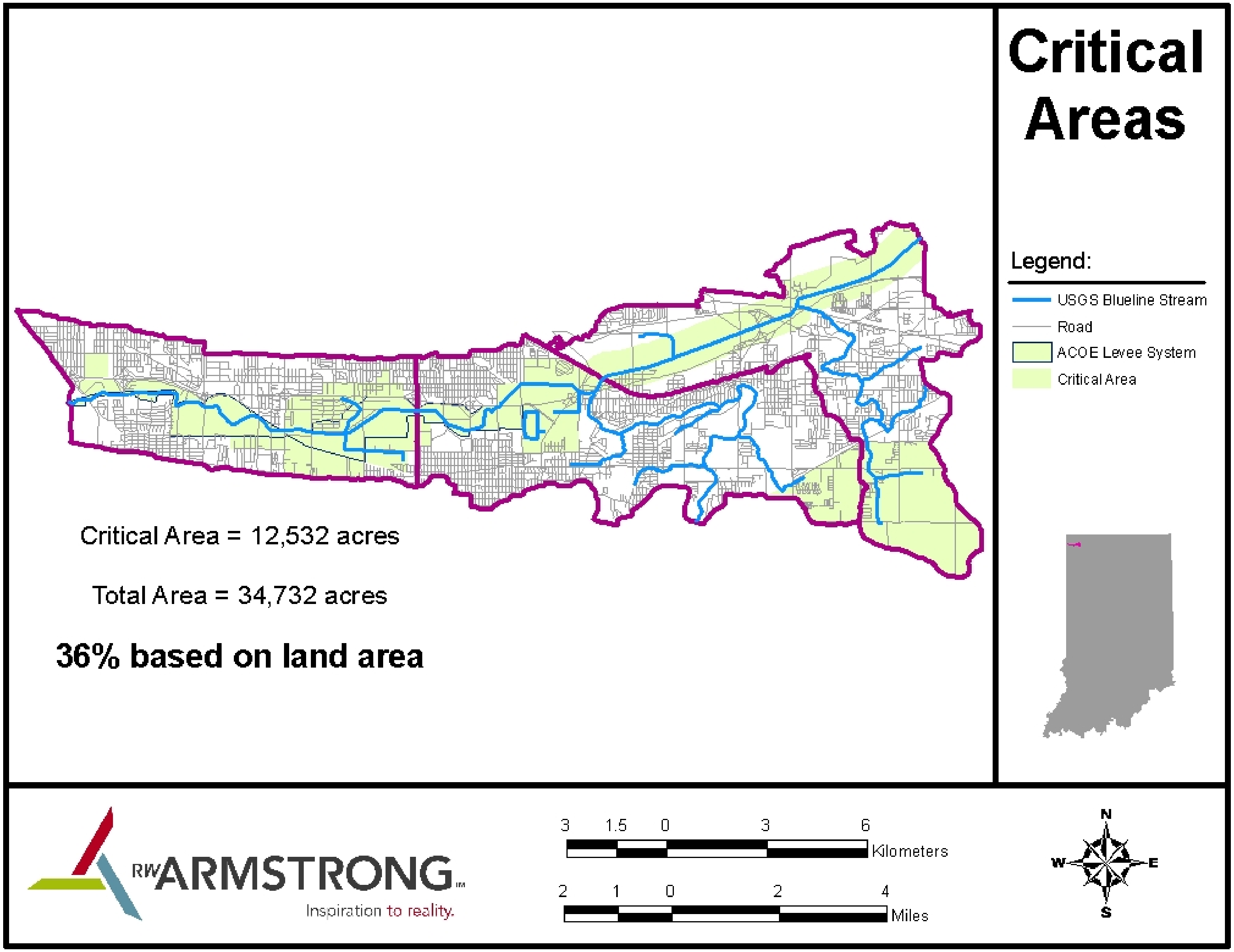

Figure 7.1: Critical pollutant areas and how they fit into the overall study area.

Critical Area 4 – Sampling Site 6 has shown almost double the base flow and storm flow concentrations of Ammonia when compared to the other sampling sites. Most of the pollutants found in the samples from this site are from the Willow Creek watershed.

Total Suspended Solids Critical Areas

Critical Area 5 – Sampling Site 2 showed a base flow concentration of TSS almost 400% higher than the second highest sample. This is also an area that has a large amount of publically controlled lands on both sides of the river that could be restored and utilized to reduce this loading.

Natural Habitat Critical Areas

Areas that present opportunities to preserve or restore some of the natural habitat along the river and its tributaries are important to the overall quality of this watershed.

Critical Area 6 – The land between the lines of protection along the Little Calumet River present a great opportunity to restore natural areas along the river. While this area may have a large impact on the water quality of the river, it is an area that needs little further protection due to the limits on the usage of this land already imposed.

Critical Area 7 - Natural areas not under public control along the Little Calumet River and its tributaries provide an excellent opportunity of preservation. These areas should be further analyzed to prioritize them based on location, cost, water quality value, etc.

Section VIII: Goals and Indicators

To determine the types of remediation projects which would result in the greatest benefit to these watersheds, goals and objectives were developed based on the Concerns and Problem Statement previously discussed. These goals are intended to address each of the specific problem statements presented in Section V.

Problem 1: The Little Calumet River and its tributaries regularly exceed the Indiana single sample daily maximum of 235 colonies per 100 milliliters for *Escherichia coli* (*E. coli*) bacteria, thus limiting recreation, impacting downstream waters and Lake Michigan, and raising health concerns among the public.

Goal 1: Reduce *E. coli* levels in the Little Calumet River by reducing loads to the River to meet beneficial uses.
Baseline Information: The Little Calumet River and its tributaries regularly exceed the Indiana single sample daily maximum of 235 colonies per 100 milliliters for *Escherichia coli* (*E. coli*) bacteria

Short Term Target: Lower *E.coli* levels, during dry weather flows, below 235 cfu/mL with less than 10% exceedance.
Target Date: 2018

Long Term Target: Lower *E.coli* levels below 235 cfu/mL per single sample with less than one (1) exceedance in any 30 day period.
Target Date: 2028

Indicators:

a. *E.coli* sampling results
b. Number of septic systems identified, inspected, rehabilitated, and/or eliminated.
c. Number of BMP's installed to reduce loading
d. Number of Educational Events Conducted
e. Number of Educational Fact Sheets and Brochures Distributed
f. Number of Ordinances enacted

Problem 2: Total Suspended Solids levels during high flow conditions are elevated to levels that can impact biological communities and overall river health.

Goal 2: Reduce sediment loads by source reduction strategies and, in priority subwatersheds, through the use of Best Management Practices (BMPs).

Baseline Information: Highly erodible soils through much of this watershed contribute large amounts of sediment during high flows.

Short Term Target: Reduce the amount of sediment being transported in the Little Calumet River by enacting, implementing, and enforcing ordinances to improve water quality in the subwatersheds.
Target Date: 2013

Long Term Target: Reduce sediment loading to the Little Calumet River Watershed to an accumulated 1,700 ton/year of TSS across the entire watershed to preserve and enhance aquatic habitats through the use of BMP's.
Target Date: 2018

Indicators:

a. Sampling Results
b. Number of erosion control enforcement actions
c. Number of communities with Low Impact Development (LID) Ordinances
d. Public Survey Results
e. Area of wetlands restored/constructed
f. Area of buffer strips installed
g. Number of infiltration BMP's installed to reduce storm flows

Problem 3: Nutrients levels that can impact biological communities and overall river health are present during both high and low flow conditions.

Goal 3: Reduce nutrient loads by source reduction strategies and, in priority subwatersheds, through the use of Best Management Practices (BMPs).

Baseline Information: The large amount of impervious surfaces do not allow nutrients to be filtered out before entering the receiving waters.

Short Term Target: Reduce the amount of nutrients being transported in the Little Calumet River through education and outreach efforts and Low Impact Development (LID) ordinances.
Target Date: 2013

Long Term Target: Reduce nutrient concentrations in the Little Calumet River Watershed such that Total P does not exceed an accumulated load of 12.7 ton/year and Total N does not exceed and accumulated load of 105 ton/year

across the entire watershed to preserve and enhance aquatic habitats through the use of BMP's.
Target Date: 2028

Indicators:
- a. Sampling Results
- b. Number of communities with Low Impact Development (LID) Ordinances
- c. Public Survey Results
- d. Area of wetlands restored/constructed
- e. Area of buffer strips installed
- f. Number of infiltration BMP's installed to reduce storm flows

Problem 4: Severe hydrologic manipulations have impacted the natural topography of the river and riparian areas resulting in disconnection from historic floodplains and wetlands, as well as the creation of extreme low-flow conditions in the river at certain locations.

Goal 4: Restore, improve, and/or protect floodplains, wetlands, natural areas, and riparian corridors.
Baseline Information: Many opportunities exist within these watersheds worth protecting, improving, and/or restoring. These areas can be used to meet other goals within this plan as well.

Short Term Target: Identify and prioritize areas to be protected, improved, and/or restored.
Target Date: 2010

Long Term Target: Protect, restore, and/or improve 4,780 acres of floodplains, wetlands, natural areas, and/or riparian corridors not already protected.
Target Date: 2018

Indicators:
- a. Acres of floodplains identified, protected, improved, and restored.
- b. Acres of wetlands identified, protected, improved, and restored.
- c. Acres of natural areas identified, protected, improved, and restored.
- d. Acres of riparian corridors identified, protected, improved, and restored.
- e. Acres of natural conveyances identified, protected, improved, and restored.

Problem 5: The residents and local leaders in the Little Calumet River Watershed need more information and education on their role in maintaining the overall quality of the watershed.

Goal 5: Improve public awareness/knowledge of pollutant loads, sources, and solutions, especially with regard to *E. coli*, and the impacts and risks associated with them.
Baseline Information: An adequate educational outreach program is not in place to inform the residents within these watersheds about their role in maintaining the overall quality of the watershed.

Short Term Target: Raise awareness of watershed and water quality issues, especially urban storm water management, *E.coli* sources and risks, and septic system maintenance.
Target Date: 2013

Long Term Target: Change attitude and behaviors to foster long term environmental stewardship.
Target Date: 2018

Indicators:
a. Public Survey Results
b. Number of educational events conducted
c. Attendance numbers from educational events
d. Number of outreach materials developed and distributed

Problem 6: A single point of contact is not in place to coordinate resources across political boundaries in the Little Calumet River Watershed.

Goal 6: Create an active watershed alliance or conservancy district that facilitates and implements information sharing including ordinances, projects/experiences, and educational materials in a central location.
Baseline Information: No one entity has the ability or authority to

Short Term Target: Identify the type and extent of entity needed to perform the necessary functions.
Target Date: 2010

Long Term Target: Establish the entity determined above.
Target Date: 2015

Indicators:

a. Establish Entity
b. Number of resolutions adopted by municipalities within the watersheds.
c. Number of meetings of new entity.
d. Number of communities participating
e. Number of web sites visits and downloads
f. Funding mechanism in place

Problem 7: Public access to the river is challenging due to the highly developed state of the watershed.

Goal 7: Increase river corridor connectivity, river navigability, and public access sites and make the public aware of them.

Baseline Information: Public Access Sites are being added as part of the Army Corp of Engineers Flood Control and Recreation Project. The sites as well as other know public access sites are shown in Figure X.XX. Opportunity for additional site exists in the areas outside

Short Term Target: Identify areas suitable for connectivity improvements and additional public access sites and promote existing sites.
Target Date: 2010

Long Term Target: Increase connectivity and public access sites and promote them within the communities.
Target Date:2018

Indicators:

a. Number of New Public Access Sites
b. Number of Connectivity Projects completed
c. Public Information survey results indicating increase in public awareness and usage.

Section IX: Implementation and Evaluation

Timeline (Start/Finish)	Description	Participants	Cost	Goal(s)
3/2009	▪ Develop septic maintenance awareness program (homeowners, realtors, health departments)	MS4, and Coastal Prgram	$1k	1
3/2009	▪ Showcase urban BMPs that reduce sediment loads		$1k	2
3/2009	▪ Showcase urban BMPs that reduce nutrient loads		$1k	3
3/2009	▪ Develop homeowner outreach strategy for yard maintenance activities	MS4 and NIRPC	$1k	3
3/2009	▪ Determine functional value and feasibility of existing wetlands		$50k	4
3/2009	▪ Identify funding programs/partners for restoration		-	4
3/2009	▪ Promote guidance document for land managers/owners (NIRPC's materials)		$1k	4
3/2009	▪ Develop and implement an operation and maintenance program that identifies opporutnities to mitigate and restore instream and riparian habitat.	Local planning and zoning, MS4s, IDEM, NIRPC, SWCDs	-	4
3/2009	▪ Develop consistent messages including cause and effect statements		-	5
3/2009	▪ Increase awareness of on-going watershed projects and home owner BMPs	MS4 and NIRPC	$5k	5
3/2009	▪ Conduct PSA announcement related to *E.coli* and recreation		$5k	5
3/2009	▪ Develop campaign to include educational inserts in utility bills, etc.	MS4 and NIRPC	-	5
3/2009	▪ Determine relevant players and stakeholder groups		-	6
3/2009	▪ Coordinate with NIRPC's resources		-	6
3/2009	▪ Approach public officials with idea, structure, etc. to gain buy-in		-	6
3/2009	▪ Incorporate (into public education materials) the finding from the pending Coastal Program study regarding significant gaps in public access on sections of the river	Coastal Program	$1k	7
3/2009	▪ Promote/incentivize low impact develolpment (LID) or redevelopment strategies	MS4 and NIRPC	Unknown	2 and 3
3/2009	▪ Identify funding programs/partners for BMPs		-	2 and 3
3/2009	▪ Coordinate regional Rule 5 enforcement	MS4s	-	2 and 3
3/2009	▪ Develop LID presentation that can travel - ID target audiences		$1k	2 and 3
3/2009	▪ Coordinate/train muncipalities on good housekeeping strategies	MS4 and NIRPC	$5k	2 and 3
3/2009	▪ Reach out, educate communicate with developers and consultants regarding erosion and sediment control plans.	MS4 and NIRPC	$5k	2 and 3
3/2008 - 3/2013	▪ Targeted communications toward municipal parks land and golf courses regarding nutrient management plans		$1k	3

3/2008-3/2013	▪ Cordinate with the Health Departments to develop more/better interactive signs regarding risk locations and times not to have contact with the water	Health Department	$10k	5
3/2008-3/2013	▪ Promote or assist in classroom programs such as Project WET	MS4 and NIRPC	$5k	5
3/2008-3/2013	▪ Appoint representation from each subwatershed		-	6
3/2008-3/2013	▪ Host regular meetings		-	6
3/2008-3/2013	▪ Develop contiguous mapping across boudaries	NIRPC	$100k	6
3/2008-3/2013	▪ Engage landowners in BMPs installation (buffers, wetlands, bioretention areas, etc.)		-	2 and 3
3/2009 - 3/2013	▪ Reduce stormwater volume leading to CSO events through infiltration BMPs and conservation measures	Local government ordinances	$5/ft^3 of runoff	1
3/2009 - 3/2013	▪ Accelerate/incentivize maintenance and/or replacement of malfunctioning septic systems.	Local government and county government	Unknown	1
3/2009 - 3/2013	▪ Research *E.coli* treatment strategies	EPA	-	1
3/2009 - 3/2013	▪ Develop pet waste campaign including pick-up stations with watershed/water quality information.	MS4 and NIRPC	$50k	1
3/2009 - 3/2013	▪ Create pond/lake management capaign to reduce nuisance wildlife habitat		$5k	1
3/2009 - 3/2013	▪ Develop and promote ordinanaces related to installation of new septic systems or resiting existing systems.	Local government and county government	$1k	1
3/2009 - 3/2013	▪ Implement animal waste management practices as defined by the IN NRCS FOTG to minimize storm water runoff impacts from small livestock operations.	Porter and Lake County NRCS and small livestock owners	-	1
3/2009 - 3/2013	▪ Develop and implement the pasture components of a Conservation Management System (CMS) as defined by the IN NRCS FOTG on grazing land adjacent to waterbodies.	Porter and Lake County NRCS and SWCD and agricultural landowners and operaters.	-	2
3/2009 - 3/2013	▪ Develop and implement nutrient management plans as defined by the IN NRCS Field Office Technical Guide on cropland adjacent to waterbodies.	Porter and Lake County NRCS and SWCD and agricultural landowners and operaters.	-	3
3/2009 - 3/2013	▪ Target restoration to certain soil types and locations and contact landowners		$1k	4
3/2009 - 3/2013	▪ Manage natural transition zones via regulation (zoning, ordinances, etc.)	Local government	-	4
3/2009 - 3/2013	▪ Identify key landowners and secure easements		Unknown	4
3/2009 - 3/2013	▪ Assimilate economic study of wetlands and floodplains into outreach approach (e.g. Des plains River)		$100k	4

3/2009 - 3/2013	▪	Develop funding strategy for easement purchase and restoration projects		-	4
3/2009 - 3/2013	▪	Conduct outdoor activities/workshops		$50k	5
3/2009 - 3/2013	▪	Work with realtors to educate homeowners about helpful homeowner BMPs upon purchase of new house		$10k	5
3/2009 - 3/2013	▪	Outreach to local pet stores to increase knowledge of sources	MS4 and NIRPC	$5k	5
3/2009 - 3/2013	▪	Develop organization structure alternatives		-	6
3/2009 - 3/2013	▪	Develop MOUs between jurisdictions		-	6
3/2009 - 3/2013	▪	Construct and maintain a website		$5k	6
3/2009 - 3/2013	▪	Develop locally relevant educational materials including clear watershed boundaries and homeowner programs	MS4 and NIRPC	$5k	6
3/2009 - 3/2013	▪	Develop a communication/outreach strategy for the Alliance at key meetings, etc.		-	6
3/2009 - 3/2013	▪	Coordinate landuse planning across planning jurisdictions	NIRPC	-	7
3/2009 - 3/2013	▪	Discuss culvert alternatives with state and federal highway authorities	Highway Departments	-	7
3/2009 - 3/2013	▪	Utilize new Coastal Program data and develop maps and web resources highlighting access sites	Coastal Program	$10k	7
3/2009 - 3/2013	▪	Develop informative resources about where hazzards are located, how long of a stretch between impediments, and key resources within a given stretch		$100k	7
3/2009 - 3/2013	▪	Develop and implement the erosion control component of a Conservation Management System (CMS) as defined by the IN NRCS Field Office Technical Guide on cropland adjacent to waterbodies.	Porter and Lake County NRCS and SWCD and agricultural landowners and operaters.	-	1,2, and 3
3/2009 - 3/2013	▪	Develop LID ordinances or policies to use in mulitple jurisdictions		$10k	2 and 3
3/2009 - 3/2013	▪	Targeted enforcement in priority subwatershed/areas	MS4s	Unknown	2 and 3
3/2009 - 3/2013	▪	Determine which protection mechanism for buffers, riparian areas, and natural conveyances best fits each jurisdiction and encourage appropriate officials to implement		-	2 and 3
3/2009 - 3/2013	▪	Evaluate the potential effects of proposed channel modifications on riparian and instream habitat and based on that informaiton plan and design propsed modificiations to reduce impacts.	Little Cal Commission, local communities, IDNR, NRCS, USACE, IDEM	$100k	2 and 4

3/2009 - 3/2013	▪	Develop a watershed protection program that guides new development and redevelopment (including roads and bridges) in a manner which protects areas susceptible to erosion and preserves areas that provide water quality benefits.	Local planning and zoning, MS4s, IDEM, NIRPC, SWCDs, IDNR, Planning w/POWER	-	2,3, and 4
3/2009 - 3/2028	▪	Use existing permitting process to develop better control over projects in sensitive areas	Local government and county government	-	2
3/2009 - 3/2028	▪	Stabilize eroding streambanks and protect them from impacts associated with adjacent land uses.	Little Cal Commission, local communities, IDNR, NRCS, USACE, IDEM	$500k	2
3/2009 - 3/2028	▪	Develop program to offset cost and availability of phosphorus free fertilizer		$50k	3
3/2009 - 3/2028	▪	Restore wetlands and riparian areas that provide a significant NPS pollution reduction function.	Local communities, IDNR, IDEM, USFWS	$50M	4
3/2009 - 3/2028	▪	Promote positive/healthy locations for reacreation		$10k	5
3/2009 - 3/2028	▪	Auto generated alerts upon CSO discharges and/or promote exiting venues for such alerts		$5k	5
3/2009 - 3/2028	▪	Implement meausres which stablize shorelines in marinas where erosion is contributing to sediment loading.	Marina owners, IDNR, and IDEM	$500k	2
3/2009 - 3/2028	▪	Implement structural practices that reduce the average annual E.coli, TSS, and nutrient loadings 50% or reduce the postdevelopment loadings so that the average annual loadings are no greater than predevelopment loadings	Local planning and zoning, MS4s, IDEM, NIRPC, SWCDs	$40M	2 and 3
3/2013 - 3/2028	▪	Explore nuisance wildlife harrassment strategies		-	1
3/2013 - 3/2028	▪	Find and develop partnerships with fertilizer industry		-	3
3/2013 - 3/2028	▪	Work with Ducks Unlimited and such groups to incorporate their conservation/restoration programs on public lands like golf courses		-	3
3/2013 - 3/2028	▪	Initiate a new local permit process to protect waterways and natural areas		$10k	4
3/2013 - 3/2028	▪	Promote river sports and access sites thorugh events and coordination with outfitters		$10k	7
3/2013 - 3/2028	▪	Create signs about recreational assets		$10k	7

Section X: Load Reduction Calculations

The expected loads for each subwatershed were determined using the Watershed Treatment Model (WTM) Version 3.1 produced by the United States Environmental Protection Agency's (EPA) Office of Wetlands, Oceans and Watersheds for Region V. This same WTM was used to find the expected pollutant load reductions according to the HUC 14-digit watershed from the implementation of Best Management Practices (BMPs) outlined in this Watershed Management Plan.

The WTM is comprised of a series of worksheets with data inputs for primary sources, secondary sources, existing management practices, future management practices, and future land use. Other worksheets are included in the model but these were the primary input sheets for the load reduction calculations. The only secondary source considered was stream erosion and the only existing management practice was the natural riparian areas along the river that currently exist.

The future management practices included all of the BMPs to be implemented in the critical areas of this plan along with the current areas identified as wetlands, but not within the critical areas, being included in the wetlands acreage used. The future land use worksheet reflected the change in land use types due to the implementation of the BMPs. Table 10.1 shows the acreage used for the future management practices for each HUC 14-digit watershed.

The structural BMPs outlined in Table 10.1 were figured into the calculation of the load reductions along with some soft practices that would promote load reductions. These practices include implementing lawn care and pet waste education via the radio to inform local residents as to the impact that these practices have on the river system. An erosion and sediment control program was also identified as being implemented by regulating building permits. Other practices included in the future management include street sweeping to be done monthly by the local communities and a septic system education program.

The resulting load reductions for each HUC 14-digit watershed and the combined total reduction is listed in Table 10.2. Appendix 18: Load Reductions contains the detailed listing of the existing and future loads with the reduction and percentages being shown. The only parameters calculated for the WTM are Total Phosphorus, Total Nitrogen, Total Suspended Solids, and Fecal Coliform. The reduction percentage found for the fecal coliform was used to find the new *E.coli* concentrations during dry weather. The new reduced concentrations are listed in Table 10.3 for each of the 42 sampling locations, which tested for *E.coli* alone. This percentage reduction was used because the relationship between fecal coliform concentrations and *E.coli* concentrations is a factor of 80%, with the *E.coli* concentrations being less.

	BMP Type	Acreage
E-W Split Watershed 07120003030050	Infiltration Strip	17
	Wet Pond	200
	Dry Extended Detention Pond	100
	Wetlands: Critical Areas	1857
	Wetlands: Current Land use	148
LC & DR Watershed 04040001040020	Infiltration Strip	21
	Wet Pond	200
	Dry Extended Detention Pond	151
	Wetlands: Critical Areas	970
	Wetlands: Current Land use	418
WC & BD Watershed 04040001040030	Infiltration Strip	54
	Wet Pond	200
	Dry Extended Detention Pond	256
	Wetlands: Critical Areas	1954
	Wetlands: Current Land use	454
COMBINED	Infiltration Strip	92
	Wet Pond	600
	Dry Extended Detention Pond	506
	Wetlands: Critical Areas	4780
	Wetlands: Current Land use	1020

Table 10.1: Future management practices used for WTM.

LOAD REDUCTIONS RESULTING FROM BMP IMPLEMENTATION					
		TN lb/year	TP lb/year	TSS lb/year	Bacteria billion/year
07120003030050	Total	14526	2344	4093108	1164171
	Percentage	18.63%	24.15%	84.61%	39.94%
04040001040020	Total	11538	1627	4353019	870303
	Percentage	12.44%	13.86%	69.45%	25.69%
04040001040030	Total	14653	2543	5552534	1420717
	Percentage	18.10%	24.24%	88.70%	54.63%
COMBINED	Total	40717	6513	13998660	3455191
	Percentage	16.18%	20.40%	80.61%	38.81%

Table 10.2: Load reduction totals and percentage for 14-digit watersheds.

Sampling Location	E. coli (cfu/100ml)			
	Dry Weather (7/24/2007)		Dry Weather (10/30/2007)	
	Sampling Results	38.81% Reduction	Sampling Results	38.81% Reduction
1		0	225	138
2	1804	1104	341	209
3	448	274	190	116
4	25	15	218	133
5	396	242	174	106
6	94	58	52	32
7	2	1	3	2
8	3	2	5	3
9	1	1	32	20
10	228	140	15	9
11	207	127	144	88
12	108	66	15	9
13	56	34	1	1
14	353	216	20	12
15	270	165	46	28
16	692	423	75	46
17	119	73	78	48
18	345	211	58	35
19	1	1	428	262
20	88	54	113	69
21	51	31	79	48
22	111	68	7	4
23	374	229	40	24
24	505	309	77	47
25	275	168	48	29
26	68	42	16	10
27	937	573	445	272
28	375	229	260	159
29	158	97	5	3
30	168	103	18	11
31	5	3	72	44
32	72	44	102	62
33	50	31	8	5
34	71	43	19	12
35	129	79	27	17
36	51	31	2	1
37	4	2	92	56
38	3	2	79	48
39	36	22	67	41
40	9	6	2	1
41	86	53	44	27
42	913	559	586	359

Yellow highlight represents a load reduction still exceeding the 235 standard.
Gray highlight represents a location that exceeds 235 standard on both load reductions and sampling.

Table 10.3: Sampling locations dry weather *E.coli* loads resulting from percentage load reduction.

Section XI: Implementing the Measures

Monitoring Plan

Future monitoring of the watershed will need to include further baseline data collection once the diversion structure is constructed as part of the flood control project. This structure will be located west of Hart Ditch and will divert high flows to the east by limiting the amount of flow that can travel west. This diversion will significantly alter water quantity and quality in the areas covered under this study by diverting storm flows from Hart Ditch through these watersheds. This additional baseline data collection is eligible for 319 grant funding and in targeted to be conducted in 2009.

Water quality sampling will be conducted to determine the status of indicators for the bacteria and nutrients as discussed under Goals #1, #2, and #3. The future sampling plan, including a QAPP, will have to be determined once the new baseline data has been collected and some of the BMP's outlined in this plan have been installed. At a minimum this sampling should include sampling the same seven sites that were sampled during the development of this plan for both base flows and high flows. Additional locations should be added between these locations to clarify pollutants levels and the effectiveness of BMP's in use at that time. Monitoring of indicators for Goals #1, #2, and #3 is planned for five (5) years after the next round of baseline data has been collected and then every five years after that. A consultant or laboratory will most likely be needed for this sampling to ensure uniformity.

At that time, the area, in acres, of floodplains, wetlands, natural areas, riparian corridors identified, protected, improved, and/or restored should be evaluated to determine progress under Goal #4. A public survey should be conducted with a representative sample in each municipality to determine progress under Goal #5. The number of new public access sites and connectivity projects completed should also be tallied at this time to measure the progress under goal #7. These tasks can be performed by the entity that is the end result of Goal #6 with volunteers from each municipality and should be repeated every five (5) years starting in 2014.

Goal	Indicator	Responsible Party	First Report	Second Report	Third Report	Fourth Report
1	E.coli sampling results	Entity from Goal #6	2014	2019	2024	2029
2	TSS sampling results	Entity from Goal #6	2014	2019	2024	2029
3	Nutrient sampling results	Entity from Goal #6	2014	2019	2024	2029
4	Acres identified, protected, improved, and/or restored.	Entity from Goal #6	2014	2019	2024	2029
5	Public survey results	Entity from Goal #6	2014	2019	2024	2029
6	Watershed entity established	Current Steering Committee and Municipalities	2014	N/A	N/A	N/A
7	Number of new public access sites and connectivity project completed.	Entity from Goal #6	2014	2019	2024	2029

Table 11.1: Goals and Indicators for watershed management plan.

Section XII: Evaluating and Adapting the Plan

As discussed in the previous section, the indicators for Goals #1, #2, #3, #4, #5, and #7 will be monitored every five (5) years under this plan by the entity formed under Goal #6. This planned should be evaluated and updated during at least every other monitoring period by the same watershed entity and the stakeholders in the watersheds. This would set the first evaluation of the plan and its goals for no later than 2019. The plan may be evaluated sooner once the entity is formed and begins to address the goals outlined in this plan.

The watershed entity created under Goal #6 will be responsible for coordinating this plan with the existing TMDL and updating this plan as needed.

Section XIII: References and Appendices

References
Appendix 1 – Letter to Stakeholders from Sponsor
Appendix 2 – Steering Committee Issues and Concerns 11-30-07
Appendix 3 – Minutes the First Steering Committee Meeting 11-30-06

Appendix 4 – Minutes the Second Steering Committee Meeting 01-11-07

Appendix 5 – Table of Prioritized Issues from 1st Public Meeting

Appendix 6 – Proposed Sampling Map and Alternatives Table

Appendix 7 – Minutes the Third Steering Committee Meeting 03-14-07

Appendix 8 –
Appendix 9 –

Appendix 10 –

Appendix 11 –

Appendix 12 –

Fact Sheets
Brochures
Grant Application and Contract