

# Stormwater Master Plan – August 2014



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## Town of Merrillville

This Document Contains:

- *Project Overview*
- *Study Delineation and Methodology*
- *Drainage Studies: Nine Subwatersheds*
- *Identification of Problem Areas*
- *Proposed Recommendations and Cost*
  - *Infrastructure*
  - *Water Quality Improvements*
- *Prioritization Matrix*



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Appendix 1 – Cost Estimates

Appendix 2 – Hydrologic and Hydraulic Model Input/Output

Rank	Subwatershed	% of Total Area Studied	% Stormwater Fee Contribution within Study Area	Number of Residential Parcels	% of Residential Parcels in Study Area	Number of Structures in FEMA Regulatory Floodplain				Town and CBBEL Identified Problems and Concerns						Construction Cost Proposed Improvements **
						Floodway	Zone AE	Zone A	Total Number of Structures (FEMA)	Structures in CBBEL 100-Yr Inundation Area	Repetitive Loss	Major Public Roadway	Minor Public Roadway	Erodible Velocity (ft)	Water Quality Hot Spots	
		%	%	#	%	#	#	#	#	#	#	#	#	LF	#	
1	Meadowdale Lateral*	26	20	2,998	93	9	135	0	144	439	4	4	49	0	3	3.9–13.9M
2	Kaiser Ditch*	15	19	2,290	90	0	1	2	3	73	0	9	13	9,600	10	8.8M
3	Chapel Manor	19	32	1,958	74	18	21	7	46	50	4	3	15	3,700	18	8.7M
4	North Central TC*	6	3	257	73	0	0	0	0	4	0	0	1	250	7	1.7M
5	Northeast Turkey Creek	4	6	758	88	0	0	0	0	8	0	1	7	0	5	2.3M
6	Broadfield*	6	3	153	57	0	2	0	2	2	0	2	5	0	2	R-Map <sup>A</sup>
7	Turkey Meadows	4	7	1,041	97	0	0	0	0	0	0	0	9	0	0	Ditch <sup>C</sup>
8	Turkey Creek*	9	6	852	87	3	8	0	11	7	0	4	10	0	12 <sup>B</sup>	Monitor <sup>D</sup>
9	West	11	5	795	89	0	0	0	0	20	0	0	9	1,500	1	R-Map <sup>A</sup>

**Table 1. Summary of Problem Areas and Concerns by Subwatershed**

<sup>A</sup> The construction cost of proposed improvement does not include remapping projects. R-Map in the table indicates a remapping project.

<sup>B</sup> Mainstem Turkey Creek through the Town is on the 303d list for E. Coli.

<sup>C</sup> Ditch indicates the need for ditch maintenance.

<sup>D</sup> Monitor indicates the need for water quality monitoring at outfalls into Turkey Creek.

\* Indicates a regulated drain under LCSO jurisdiction.

\*\*Cost estimates do not include land acquisition, easements, or 252 acre-ft of flood storage for Meadowdale Lateral ultimate watershed improvements

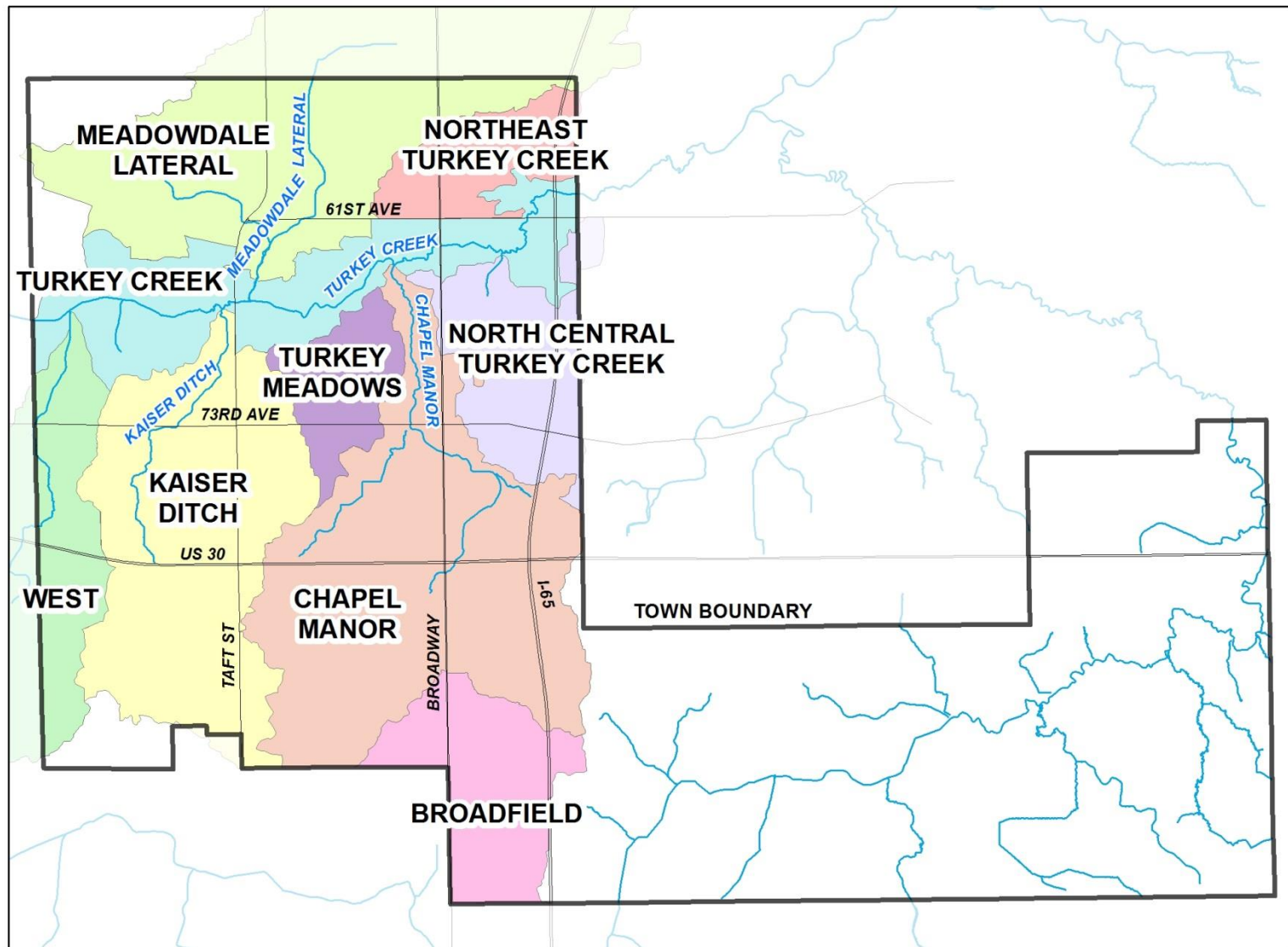


Figure 1. Subwatersheds in the Town of Merrillville Studied in this Stormwater Master Plan

## EXECUTIVE SUMMARY

The Town of Merrillville (Town) has become a leader among Northwest Indiana communities for managing stormwater quality and quantity. To effectively address stormwater management needs, the Town of Merrillville's Stormwater Management Utility retained Christopher B. Burke Engineering, Ltd. (CBBEL) to develop this Stormwater Master Plan (SWMP). The purpose of this SWMP is to present the findings of detailed analyses, provide justification for capital improvement projects in a prioritized manor and provide recommended improvement projects. This SWMP is an update to the 1987 Stormwater Master Plan and includes detailed hydrologic and hydraulic modeling of the developed portions of the Town to identify existing flood damage areas and water quality problem areas, verify adequacy of existing hydraulic structures and pinpoint areas of channel erosion.

The SWMP provides identification of proposed improvement projects to be used for reference when grant or funding opportunities become available. Chapters of this SWMP can be used to supplement grant applications in short order for previously identified projects should a funding opportunity become available. The scope of the SWMP includes the development of an all-inclusive Geographic Information System (GIS) database for the Town. This SWMP is to be used as the handbook or guidebook accompanying the comprehensive GIS database.

The following is an executive summary of the results of the analyses for each of the subwatersheds studied within the Town limits.

**Meadowdale Lateral Subwatershed:** CBBEL developed several levels of drainage improvements to reduce the risk of future flooding within the subwatershed. The improvements increase the size of restrictive culvert crossings, isolate the Grant Street & 57<sup>th</sup> Avenue detention basin from Meadowdale Lateral backwater, and create approximately 26.5 acre-feet (ac-ft) of additional storage volume within the subwatershed. The engineer's estimate of probable cost for the improvements is \$3.9 million. Funding for projects in this subwatershed could become available through collaboration with the Little Calumet River Basin Development Commission (LCRBDC) and the Lake County Surveyor's Office (LCSO). Meadowdale Lateral is also known as Griffith Lateral #6 and is a regulated drain under LCSO jurisdiction. These improvements remove 74 of the 439 structures from the 100-year CBBEL delineated inundation area, and the culvert system in the subwatershed remains restrictive. The restriction cannot be removed without offsetting the impacts of the increased flow rates.

An additional analysis was performed to explore possibilities to remove more structures from the 100-year CBBEL delineated inundation area. This includes an additional relief sewer along 61<sup>st</sup> Avenue, combined with additional storage (252 ac-ft) to remove 247 of 439 structures from the inundation area. The additional storage component of the proposed improvements is required to offset increased flowrates to Turkey Creek. The engineer's estimate of probable cost for the additional improvements is \$10 million and does not include the cost of additional flood storage in the Turkey Creek Watershed that would be required to mitigate for the increase in flowrates to the creek. Due to the limited open space in the subwatershed, the location of the additional flood storage has not been identified and may require property acquisition and/or easements. The \$10 million for relief culverts is in addition to the \$3.9 million of improvements for the 74 structures to be removed. The cost of the additional \$10 million should be

compared to the average cost of the structures in the subwatershed to be protected.

The potential does exist for stream re-meandering projects along with a constructed wetland to occur on the Merrillville Community School Corporation property associated with the school south of 57<sup>th</sup> Avenue. These improvements would benefit water quality through reduction of nutrients and suspended solids in the subwatershed.

The future project benefits and costs are summarized as follows:

- Future Flood Storage: 26.5 – 250 acre-ft
- Residential Structures Protected: 79 – 247
- Cost: \$3.9M - \$13.9M\*

\*Only includes cost of 26.5 acre-ft of flood storage, remaining flood storage locations not yet identified

**Kaiser Ditch Subwatershed:** The proposed improvements increase the size of restrictive culverts and employ an additional 62 ac-ft of storage to offset increased flowrates from negative downstream impacts. The location of flood storage is under Town and private ownership, and additional property acquisition may be required. The proposed improvements provide significant flood reductions to the east & west tributary (west of Taft Street) flooding areas removing 66 structures and 14 public roadway overtopping locations from the existing CBBEL 100-year inundation area. The estimated cost to construct these improvements is \$8.4 million. A small pump station at Independence Street is also proposed for the depressional area draining to the Taft Street drainage system and is estimated to cost \$400,000. For most channel banks south of 73<sup>rd</sup> Avenue, manicured residential lawn with no riparian zone is the predominant land use. These sections of open channel also show erodible velocities and would expect to show signs of being impacted by runoff and non-supporting of a healthy stream ecosystem from stormwater runoff. The main stem of Kaiser Ditch is a regulated drain and is under LCSO jurisdiction. The east tributary to Kaiser Ditch, west of Taft Street and south of 73<sup>rd</sup> Avenue is not. The enforcement of a riparian buffer or easement in this area could be used as a method to establish habitat restoration in these areas.

The future project benefits and costs are summarized as follows:

- Future Flood Storage: 62 acre-ft
- Residential Structures Protected: 66
- Cost: \$8.8M

**Chapel Manor Subwatershed:** The proposed improvements consist of three projects including a flood storage reservoir at the northwest corner of Broadway and 67<sup>th</sup> Avenue, culvert construction at Chapel Drive, storm sewer improvements combined with additional storage in the subdivision at 69<sup>th</sup> Place and floodplain remapping. Removal of the restrictive 36-inch CMPs and continuation of the 5 ft x 9 ft RCBC along 78<sup>th</sup> Avenue will prevent the crossing from overtopping and subsequently remove the four (4) repetitive loss structures from the floodplain. The estimated cost to construct the culvert extension is approximately \$1.2 million. A proposed location for flood control storage as suggested by the Town is currently vacant commercial land (northwest corner of Broadway and 67<sup>th</sup> Avenue) and could be used to provide approximately 100 ac-ft of flood regional storage. This could benefit the overall Turkey Creek Subwatershed and could be combined with proposed improvements in other subwatersheds. The benefit



of the reservoir is approximately a 100 cubic feet per second (cfs) reduction or 6% of the peak 100-year flowrate entering Turkey Creek from the Chapel Manor Subwatershed. The estimated cost to construct the 100 ac-ft flood control reservoir in the Chapel Manor Subwatershed is approximately \$5.2 million, which does not include property acquisition costs. The enforcement of a riparian buffer or easement could be used as a method to establish habitat restoration in areas shown to have erodible velocities. The Chapel Manor watercourse is not a regulated drain under LCSO jurisdiction. Therefore the establishment of a buffer along the watercourse through residential areas would be beneficial.

The future project benefits and costs are summarized as follows:

- Future Flood Storage: 100 acre-ft
- Residential Structures Protected: 18
- Cost: \$8.7M

**Broadfield Subwatershed:** The current aerial photography shows that the 1-foot aerial topography does not reflect the current land use or recent construction south of 93<sup>rd</sup> Avenue. The LCSO is in the process of compiling new 1-foot aerial topography. The existing condition CBBEL delineated 100-year inundation area in the Broadfield Subwatershed should be remapped based on the new aerial topographic information and the analysis created for this SWMP. Drainage improvements were completed within the Broadfield Subdivision and along 93<sup>rd</sup> Avenue in 2009. As part of these improvements, it was noted that the existing 18-inch outlet pipe from the Broadfield ponds should be regularly maintained. This includes regular inspections, installation of measures to prevent clogging and animal control. The farm field property located immediately west of Broadway is located in the City of Crown Point (Crown Point) and is almost entirely within the regulatory Zone AE floodplain. A proposed flood control reservoir on the 45 acre property could provide flood risk reduction to an area with known flooding problems.

The future projects for the watershed include updated flood mapping and a proposed flood control project within the City of Crown Point. It is anticipated that these will be completed by the City of Crown Point, and the specific benefits and costs were not quantified.

**Turkey Creek Subwatershed:** Turkey Creek has been documented by governmental agencies as an impaired watercourse through the Town limits. Although other watercourses within the Town are not as well documented for specific impairments, the water quality in those subwatersheds tributary to Turkey Creek can contribute to impaired water quality and degradation of biotic communities. The prevention of further water quality impairment and habitat loss in each subwatershed can only benefit water quality problems within the Town's subwatersheds and subsequently Turkey Creek. The construction of green infrastructure, including constructed wetlands for storage areas, bio-swales and vegetated buffers, use of water quality treatment structures for first flush at point sources and the establishment of riparian habitat as discussed in any of the subwatershed will help reduce water quality impairments. The construction of green infrastructure within any of the subwatersheds draining to Turkey Creek will contribute to the improvement of water quality in Turkey Creek. This ongoing effort is the basis for the Town's current water quality protection program where funds could be allocated to monitoring efforts, construction of green infrastructure and enforcement.

The proposed projects in this subwatershed include water quality monitoring. The specific monitoring program will be up to the discretion of the Town and therefore the benefits and costs were not quantified.

**North Central Turkey Creek Subwatershed:** CBBEL evaluated improvements including additional stormwater storage at Skinner Pond and storm sewer conveyance improvements along Delaware Street. There is additional space available on the Ross Township property to expand the existing pond (Skinner Pond) and provide approximately 20 ac-ft of storage. The additional 20 ac-ft of storage removes four (4) structures at the northeast corner of the pond from the existing condition CBBEL delineated 100-year inundation area. The estimated cost to construct the additional storage is approximately \$1.4 million. Based on preliminary discussions with Ross Township, it is anticipated that the flood easements for Skinner Pond would be provided to the Town. As noted by Town staff, localized street flood along Delaware Street has been addressed with storm sewer improvements to increase the existing outlet pipe from a 36-inch to a 42-inch diameter storm sewer draining into the existing pond. This will reduce the risk of flooding along Delaware Street for the 100-year design storm. The estimated cost to construct the culvert extension is approximately \$250,000. Water quality and channel bank monitoring could be implemented at this location in a partnership with Ross Township along the open channel discharging into Hidden Lake.

The future project benefits and costs are summarized as follows:

- Future Flood Storage: 20 acre-ft
- Residential Structures Protected: 4
- Cost: \$1.4M\*

\*Assumes Ross Township would provide flood easements for Skinner Pond Expansion

**Turkey Meadows Subwatershed:** There are currently no structures with the regulatory SFHA or the CBBEL delineated 100-year inundation area based on the 1-foot aerial topography. There are a number of roadway overtoppings however, this is consistent with current design standards where runoff generated from storm events in excess of the storm sewer system capacity is conveyed in overland flow routes in both backyards and roadways. Maintenance on the existing drainage system in the subwatershed should continue. The potential exists for a water quality sampling location at the downstream end of this open channel to represent baseline constituent levels from a subwatershed area consisting of entirely residential land use. The open channel presents an opportunity for a pilot project to construct a green street, which would replace the manicured lawn with native species to create a more naturalized area. This pilot green street project is the proposed improvement for the subwatershed. Pre and post-construction water quality sampling in the channel could be used to verify the effectiveness of the use of native species versus manicured lawn land uses.

The proposed projects for this subwatershed include re-mapping and a pilot program for water quality improvements. The extent of this work will be at the discretion of the Town and therefore benefits and costs were not quantified.

**Northeast Turkey Creek Subwatershed:** There are currently no structures within a regulatory SFHA in the Northeast Turkey Creek Subwatershed. As part of this SWMP, CBBEL delineated the 100-year inundation

area based on the 1-foot aerial topography and found eight (8) structures within the CBBEL delineated existing condition inundation area located along Jefferson Street, Adams Street and Broadway all in the vicinity of 60<sup>th</sup> Avenue. CBBEL evaluated improvements including increasing storm sewer sizes along Broadway, storm sewer conveyance improvements along Jefferson Street and additional stormwater storage on properties east of Broadway. The proposed condition project removes six structures from the existing condition CBBEL delineated inundation area. The estimated cost to construct the relief sewer and storage is approximately \$2.3 million.

Backwater from Turkey Creek also inundates or overtops Vermont Street extending from just north of 61<sup>st</sup> Avenue to East 85<sup>th</sup> Place. There is approximately 1,500 feet of Vermont Street that is below elevation 614 feet (regulatory 100-year floodplain elevation of Turkey Creek). Raising the roadway pavement above this elevation will allow access and reduce the frequency of overtopping during large storm events.

The future project benefits and costs are summarized as follows:

- Future Flood Storage: 25 acre-ft
- Residential Structures Protected: 6
- Cost: \$2.3M\*

\*Does not include flood easement or property acquisition

**West Subwatershed:** The west unnamed watercourse in the West Subwatershed is tributary to Turkey Creek and is not a regulated drain under LCSO jurisdiction. Therefore the establishment of a buffer along the watercourse through the residential area would be most beneficial. There are currently no structures with the regulatory SFHA. As part of this study, CBBEL delineated the 100-year inundation area based on the 1-foot aerial topography and found 20 structures within the CBBEL delineated existing condition inundation area. The current aerial photography shows that the 1-foot aerial topography does not reflect the current land use or recent construction. The LCSO is in the process of compiling new 1-foot aerial topography. The existing condition CBBEL delineated 100-year inundation area in the West Subwatershed should be remapped based on the new aerial topographic information. This will likely remove the 20 structures located in the CBBEL delineated 100-year existing condition inundation area.

The proposed projects for this subwatershed include re-mapping based on updated topographic information from Lake County. The extent of this work will be at the discretion of the Town and therefore benefits and costs were not quantified.

**Summary of Benefits and Costs:** The overall benefits and costs from across all subwatersheds are as follows:

- Future Flood Storage: 457 acre-ft
- Residential Structures Protected: 341
- Cost: \$25.1M – 35.1M\*

\*Does not include flood easement or property acquisition

## CHAPTER 1 PROJECT OVERVIEW

### 1.1 INTRODUCTION

The Town of Merrillville (Town) has become a leader among Northwest Indiana communities for managing stormwater quality and quantity. Stormwater management falls under the Town's Stormwater Utility (Utility) that oversees the operation and enforcement of stormwater regulations and future planning of the Town's stormwater drainage system. The Utility encourages progressive engineering design to manage stormwater quantity while enforcing pollution prevention to improve stormwater quality. The grand opening of the Town's Stormwater Resource Center in December, 2013, is a testament of the Town's dedication and commitment to the management of stormwater quality and quantity. The numerous awards and recognitions from Indiana Department of Environmental Management (IDEM) and the Indiana Association for Floodplain and Stormwater Management (INAFSM) demonstrate the leadership and innovation of the Utility as compared to other municipalities in the state.

To effectively address these priorities, the Town of Merrillville's Stormwater Utility retained Christopher B. Burke Engineering, Ltd. (CBBEL) to develop this Stormwater Master Plan (SWMP). This SWMP reflects the updated priorities for stormwater management in the Town of Merrillville and supersedes the former SWMP developed in September 1987. The current SWMP addresses existing and anticipated problems related to stormwater runoff, localized flooding, and highlights water quality priorities while focusing on the Town's responsibilities as a Municipal Separate Storm Sewer System (MS4) community.

### 1.2 PURPOSE AND SCOPE

The purpose of this SWMP is to present the findings of detailed analyses, provide justification for capital improvement projects in a prioritized manner and provide recommended improvement projects that will:

- Reduce existing flood/drainage problems,
- Prevent an increase in existing flood/drainage problems as growth occurs,
- Prevent or minimize future flood damages,
- Help preserve the natural and beneficial function of the drainage system, and
- Help preserve and enhance stormwater quality.

This SWMP is an update to the 1987 Stormwater Master Plan and includes detailed hydrologic and hydraulic modeling of the developed portions of the Town to identify existing flood damage areas and water quality problem areas, verify adequacy of existing hydraulic structures and pinpoint areas of riverine erosion. The detailed modeling will be used to identify optimal locations and sizes for drainage improvements and stormwater quantity/quality Best Management Practices (BMPs) to reduce flood damages. The SWMP provides identification of proposed improvement projects in advance to be used for reference when grant or funding opportunities become available. Chapters of this SWMP can be used to supplement grant applications in short order for previously identified projects should a funding opportunity become available.

The scope of the SWMP includes the development of an all-inclusive Geographic Information System (GIS)

database for the Town. The GIS database will serve as the central location for all of the information collected and developed as part or a result of this SWMP. The database has been developed with the intended use as a tool in the decision-making process for future capital improvements, funding requests and grant opportunities, regulation of future development, FEMA's Community Rating System (CRS) compliance and overall monitoring of the Town's stormwater infrastructure. The compilation of the GIS master database is one of the main products resulting from the master plan and is intended to be used interactively with the information presented in this SWMP. This SWMP is to be used as the handbook or guidebook accompanying the comprehensive GIS database.

### 1.3 TOWN STAFF AND PUBLIC INVOLVEMENT

Participation from Town staff, decision-makers and the public is essential to understanding the flooding and drainage issues and to craft solutions to effectively address these problems. The primary role of the project team was to provide input identifying drainage issues and complaints experienced throughout the Town. The extent and nature of known existing stormwater conditions and concerns in the Town were identified through various means including: discussions with the Town's Stormwater Utility, Stormwater Management Board Executive Director, Town staff, Town Supervisors, Public Works, the Police Department, Fire Department, Councilmen, Lake County Surveyor's Office staff, public meetings; review of applicable Town plans, codes, GIS data, projects, previous studies, construction documents; and review of relevant data and studies from the Indiana Department of Natural Resources (IDNR), the United States Geological Survey (USGS), the United States Army Corps of Engineers (USACE), etc. **Table 2** is a list of known problem areas resulting from information collected from the Police Department. Public notice was also posted to promote residents to review, identify and explain problem areas on maps and exhibits throughout the Town. Additional information included input from CBBEL project management staff. CBBEL's extensive experience with on-going construction projects throughout the Town also assisted with the identification of drainage concerns. Each member of the team provided information based on their knowledge of stormwater issues, access to the tools necessary to mitigate stormwater problems, and/or represent stakeholders for successful implementation of stormwater practices.

Location	Concern
7315 E. 93rd Ave	Creek overflows the public roadway
8885 E. 93rd Ave	Creek overflows the public roadway
7700 E. 97th Ave	Low area floods the public roadway
5400 E. 97th Ave	Creek overflows the public roadway
9715 Clay Street	Low area floods the public roadway
9919 Clay Street	Low area floods the public roadway
3800 E. 97th Ave	Low area floods the public roadway
3700 E. 101st Ave	Low area floods the public roadway
8600 Randolph Street	Creek overflows the public roadway

**Table 2. Problem Areas Identified by Merrillville Police Department**

## 1.4 TOWN PROGRAMS, POLICIES & PROJECTS

There are a number of entities and regulations that govern floodplain and stormwater management in the Town. These entities include: the Town of Merrillville Stormwater Utility, the Lake County Surveyor's Office (LCSO), the IDEM, Federal Emergency Management Agency (FEMA), IDNR, and USACE, which have been given authority through local, state and federal regulations. The Little Calumet River Basin Development Commission (LCRBDC) is also responsible for identifying and implementing flood control projects within the Little Calumet River Watershed and is made up of representatives of the communities and counties within the Watershed. The LCRBDC serves as the required local sponsor for the federally funded Little Calumet River, Indiana Flood Control and Recreation Project.

### 1.4.1 Stormwater Management

In the Town, stormwater issues are handled by the Stormwater Utility adopted in accordance with statutory authority granted to the Town of Merrillville under "Home Rule" as well as the "Indiana Drainage Code" IC 36-9-28.5 and IC 36-9-27-69.5. The purpose of these ordinances is to provide authority and is further required based on Phase II of the National Pollution Discharge Elimination System (NPDES) program (FR Doc. 99-29181). The NPDES program was authorized by the 1972 amendments to the Clean Water Act, IDEM Rule 13 (327 IAC 15-13), and IDEM Rule 5 (327 IAC 15-5). The ordinances cover all stormwater management related projects or properties located within the jurisdiction of the Town. The Town now includes additional requirements to implement low impact development to improve stormwater quality and quantity. These ordinances regulate:

- Discharges of prohibited non-stormwater flows into the stormwater drainage system.
- Stormwater drainage improvements related to development of lands located in the Town of Merrillville.
- Drainage control systems installed during new construction and grading of lots and other parcels of land.
- Stormwater Pollution Prevention Plans implemented during new construction and grading of lots and other parcels of land.
- The design, construction and maintenance of stormwater drainage facilities and systems.
- The design, construction and maintenance of stormwater quality facilities and systems.
- Land-disturbing activities affecting wetlands.

As a requirement of the NPDES Phase II program, the Town has prepared a Stormwater Quality Management Plan (SWQMP) to improve the water quality that enters receiving streams from the Town. The six (6) minimum control measures identified by EPA and IDEM have been addressed in this document and include:

- Public education and outreach.
- Public involvement and participation.
- Illicit discharge detection and elimination (IDDE).
- Construction site stormwater runoff control.
- Post-construction stormwater management in development and redevelopment.
- Pollution prevention and good housekeeping for municipal operations.

### 1.4.2 Floodplain Management

Floodplain management is governed locally through the Town's Stormwater Utility and governed through the local Stormwater Management Ordinance (Ordinance 10-22, Manual 1) combined with the accompanying Stormwater Technical Standards Manual (Manual 2).

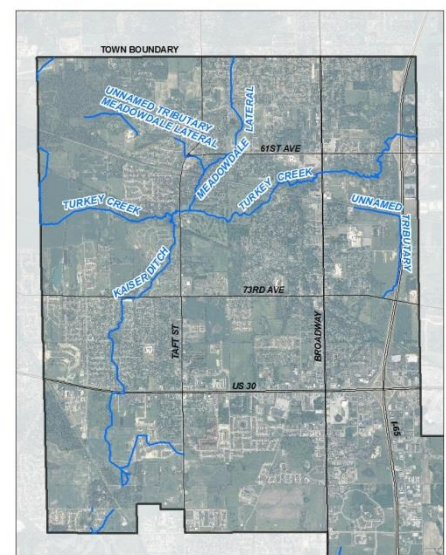
The purpose of this ordinance is to guide development in the special flood hazard areas (SFHA) in order to reduce the potential for loss of life and property, reduce the potential for health and safety hazards, and to reduce the potential for extraordinary public expenditures for flood protection and relief. The intent of this ordinance as it relates to floodplain management is to:

- To prevent unwise developments from increasing flood or drainage hazards to others.
- To protect new buildings and major improvements to buildings from flood damage.
- To protect human life and health from the hazards of flooding.
- To lessen the burden on the taxpayer for flood control project repairs to flood-damaged public facilities and utilities, and flood rescue and relief operations.
- To maintain property values and a stable tax base by minimizing the potential for creating flood blighted areas.
- To make federally subsidized flood insurance available for structures and their contents in the Town by fulfilling the requirements of the National Flood Insurance Program (NFIP).

The Town's consulting engineer administers the Ordinance as it relates to floodplain based on the regulatory floodplains delineated on FEMA's 2012 Flood Insurance Rate Maps (FIRMs) for the Town. As a result of the Town's commitment to ongoing floodplain management and regulation, the Town is part of FEMA's Community Rating System (CRS) program. The CRS program is a voluntary program for recognizing and encouraging community floodplain management activities that exceed the NFIP's minimum standards. A community receives points for engaging in any of 19 creditable activities, organized under four categories including, public information, mapping and regulations, flood damage reduction, warning and response. The benefit from this work is the eligibility for lower cost flood insurance rates. Town staff has recently and successfully completed efforts to increase the Town's CRS. This effort is ongoing as new information is developed and becomes available.

### 1.4.3 Regulated Drains

The Lake County Surveyor's Office (LCSO) maintains and manages Lake County's 600-mile legal drain (stormwater drainage) system. The land within 75 feet of the centerline to each bank of any ditch or drain tile within the Lake County Regulated Drainage System is regulated and maintained by the LCSO. For projects directly impacting or discharging to a Lake County Regulated Drain, both the Town's engineer and the



**Figure 2. Regulated Drains on the West Side of the Town of Merrillville**



Lake County Plan Commission are responsible to administer, implement and enforce the provisions of the Town's or County Ordinance. There are five (5) Regulated Drains (**Figure 2**) on the west side of Town within the Town's municipal boundary that were studied in this SWMP including:

- Turkey Creek
- Kaiser Ditch
- Meadowdale Lateral
- Unnamed Tributary to Meadowdale Lateral
- Beaver Dam Ditch (Lateral 2)

#### 1.4.4 Waters of the State

In Indiana, the USACE, IDEM and IDNR have jurisdiction over the Waters of the State. These entities administer a variety of federal and state regulations for wetlands, lakes, rivers, ponds, streams, creeks and other regulated water bodies. IDEM has prepared a Waterways Permitting Handbook to guide local decision-makers, developers and citizens through the regulatory process.

The USACE has jurisdiction over all navigable waters of the United States under the Rivers and Harbors Act of 1899. The USACE also regulated the placement of dredge or fill materials into the waters of the United States under Section 404 of the Clean Water Act. As a result, no person may deposit or fill materials into the wetlands or waters of the United States without a permit from the USACE.

IDEM is responsible for maintaining, protecting and improving the physical, chemical and biological integrity of Indiana's waters. IDEM administers the Section 401 Water Quality Certification Program, and draws its authority from the federal Clean Water Act and from Indiana's Water Quality Standards. Any person who wishes to place fill materials, excavate or dredge, or mechanically clear (use of heavy equipment) within a wetland, lake, river, stream or other Water of the State must first apply to the USACE for a Clean Waters Act Section 404 permit. If the USACE determines that a permit is necessary, then the person must also apply for, and obtain, a Section 401 Water Quality Certification from IDEM. A Section 404 permit cannot be granted without a Section 401 permit.

IDNR is charged by the State of Indiana to serve as stewards of Indiana's surface and ground water resources by overseeing construction of activities within, over and/or under the state's waterways. These statutes were enacted to allow the state's water related resources to be utilized in a prudent manner while simultaneously minimizing induced flood related damages and protecting Indiana's environmental and cultural resources. IDNR regulatory programs include: Lakes Preservation Act, Lowering of Ten Acre Lakes Act, Flood Control Act, Navigable Waterways Act, Sand and Gravel Permits Act and Construction of Channels Act. Construction in the floodway of a water body or navigable water, channel, or public freshwater lake must receive a permit from IDNR.

#### 1.4.5 Stormwater Utility

A local stormwater user fee has been established where each parcel within the Town is assessed and billed a flat monthly fee based on the property class code. Select property class codes are assessed by acreage or square footage beyond predetermined thresholds depending on property type. In addition to



NPDES compliance, the revenue generated from the stormwater user fee is used for activities including:

- Supplement public roadway drainage improvement projects.
- Long term maintenance for existing stormwater detention facilities.
- Minimizing sediment from construction sites and sediment from waterways.
- Provide water quality education.
- Routine testing of stormwater outfalls.
- Illicit discharge enforcement.
- Shoreline and ditch bank stabilization and ditch conveyance maintenance.
- Fish, wildlife and habitat enhancement.
- Flood assessment and reduction.
- Wetland enhancement and protection.

As discussed in forthcoming chapters, the developed areas within the Town limits have been divided into subwatersheds (**Figure 3**). CBBEL has quantified the contribution of utility fee from each subwatershed discussed in this SWMP. The subwatersheds include the developed areas (largely west of I-65) within the Town limits. The total contribution to the stormwater utility fee is based on the Town's stormwater utility fees assessed for 2013, assuming a 100% collection rate. The contribution from each subwatershed is reported as a percentage of the total utility fee contribution from all areas analyzed and is shown in **Table 3** and in the following chapters.

Subwatershed Name	%
Kaiser Ditch	19
Meadowdale Lateral	20
Chapel Manor	32
West	5
Turkey Meadows	6
North Central Turkey Creek	3
Broadfield	3
Turkey Creek	6
Northeast Turkey Creek	6
<sup>1</sup> Total	100%

<sup>1</sup>Total represents 100% of area studied on the west side of Town.

**Table 3. Percent Contribution to Stormwater Utility Fee by Subwatershed**

#### 1.4.6 Land Use Planning

Stormwater quality and quantity is impacted by land development practices. Areas with greater impervious cover (roads, rooftops, parking, etc.) have greater volumes of runoff and pollutant loading to receiving streams. Integrating stormwater management into planning and zoning decision-making can minimize stormwater problems once the project is built. Growth and development in the Town is guided by the Merrillville Planning & Building Department, who is responsible for the enforcement of the Town's building codes and zoning ordinance (Ordinance No. 13-07, enacted June 11, 2013).

## 1.5 APPROACH

The Town of Merrillville's SWMP has been prepared using a screening-level analysis of flooding, drainage and stormwater quality issues on a subwatershed basis. This includes the compilation of the GIS master database, a characterization of the base conditions, identification of existing and anticipated problems and/or concerns, a grouping of problem areas and proposed conditions for each subwatershed. Following the identification of problem areas, a detailed evaluation of the proposed condition or plan identified within each subwatershed was examined and the benefits were documented. The benefits documented include the number of structures removed from both the regulatory FEMA flood zones and CBBEL delineated 100-year inundation area, reduction of major and minor public roadway overtopping, reduction of erosive velocities in open channels and the identification other water quality hotspots. An implementation plan, complete with a conceptual layout and cost estimate for each recommended plan component, is the end result. As problem areas and potential projects are identified, the hydrologic and hydraulic analyses created for this SWMP can be used as the starting point for more detailed analyses of specific problems within a particular subwatershed.



**Figure 3. Taft Street Drainage Improvement Project – Ground Breaking Ceremony**

The outcome of this approach is an overall understanding of the problems and a detailed analysis of targeted study areas within the subwatersheds, resulting in plan components that would effectively address stormwater quality and quantity problems/concerns in a prioritized approach. The tangible result of this approach is the compilation of the GIS master database and this SWMP, which is to be used as the handbook or guidebook accompanying the master GIS database. The detailed plan components in forthcoming chapters of this SWMP can also be used to supplement grant applications in short order for identified projects should a funding opportunity become available. **Figure 3** demonstrates the results of one of the Town's drainage collaborative drainage projects where agency coordination between the Town, LCSO and INDOT resulted in the construction of an identified drainage project through multiple funding sources.

## CHAPTER 2 STUDY DEVELOPMENT AND METHODOLOGY

The scope of this SWMP focuses primarily on the western portion of the Town extending from just east of I-65, west to the Town limits. There are nine (9) major subwatersheds in in this area (**Figure 4**) tributary to two (2) main watercourses. A majority of the subwatersheds are tributary to Turkey Creek, which flows west to east across the northern portion of Town. A small portion of the southern area of Town drains south to Beaver Dam Ditch. Both Turkey Creek and Beaver Dam Ditch drain to the Little Calumet River. Forthcoming chapters and the discussion on existing and proposed conditions in this SWMP have been organized by these major subwatersheds.

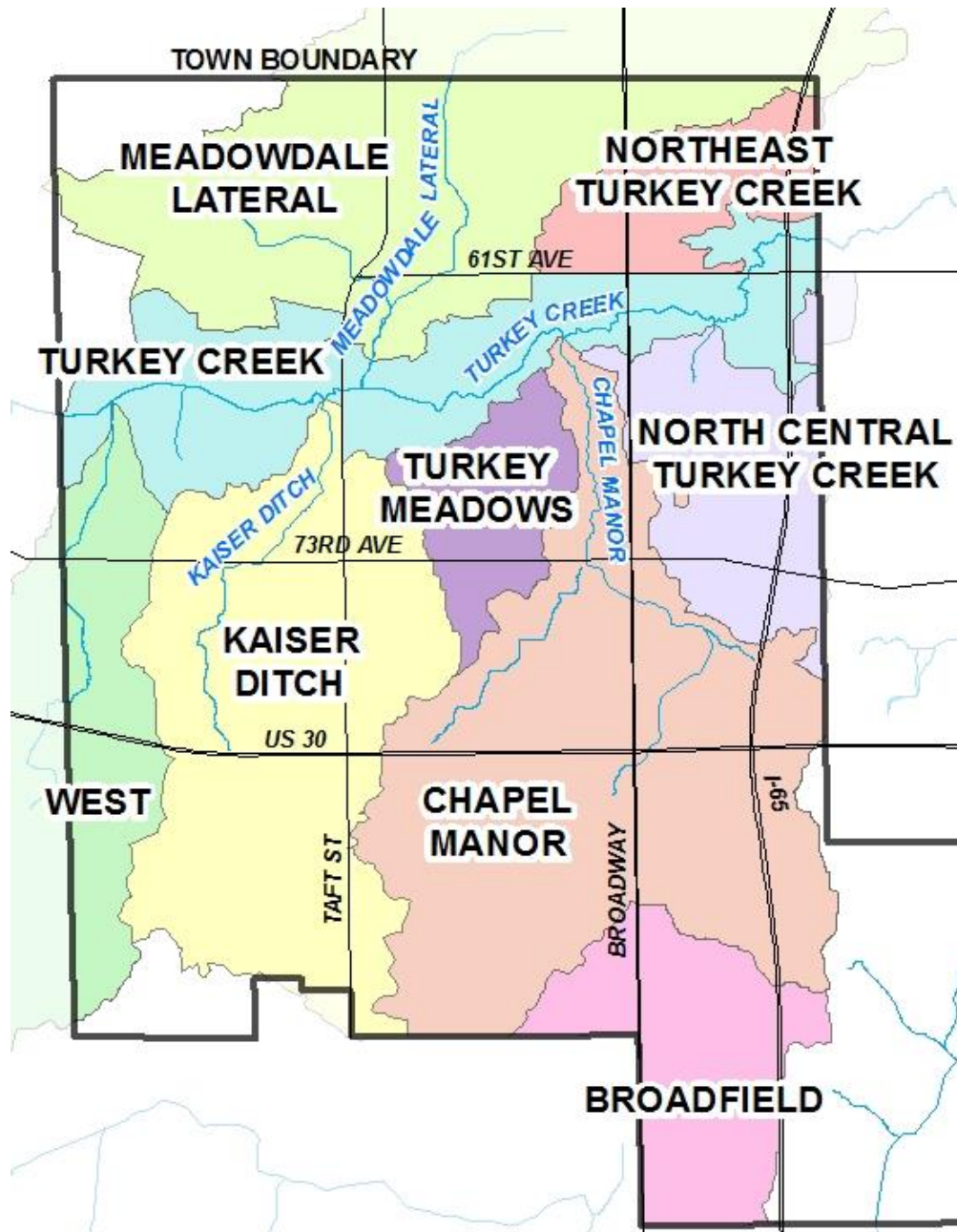


Figure 4. Study Areas by Subwatershed

Each subwatershed will have a chapter that will include a description of the flood risk areas, an assessment of the regulatory floodplain boundary areas, identification of structures in the regulatory floodplain or special flood hazard areas (SFHA), identification of structures in the CBBEL delineated 100-year inundation area and flood-related studies and projects.

## 2.1 SUBWATERSHED DELINEATION

Each subwatershed has been delineated by drainage boundaries defined by 1-foot Lake County aerial topography. A unique name based on the name of the watercourse draining the subwatershed or the relevant subdivision has been given to each subwatershed where applicable (**Figure 4**) throughout this study. In addition to the SWMP and GIS database, detailed hydrologic and hydraulic modeling has been created for each subwatershed analyzed.

## 2.2 HYDROLOGIC AND HYDRAULIC MODELING

Each major subwatershed was further delineated into subbasins based on both topography and storm sewer data and hydrologic and hydraulic modeling was conducted for each subwatershed. In subwatersheds where a regulatory model was available, additional information including detailed storm sewer data, storage areas, recent construction projects and information for known problem areas was incorporated. An XP-Software Stormwater and Wastewater Management Model (XP-SWMM) was created using this method for each study area. The XP-SWMM software is a dynamic modeling program that determines the hydrologic response (runoff mode) from a storm event and routes the runoff through a storm sewer network (hydraulic mode). The available regulatory information includes either HEC-RAS or HEC-2 hydraulic modeling for studied watercourses. In subwatersheds where no regulatory model was available, an XP-SWMM analysis was created based on subbasins, storm sewers, overland flow paths and depressional storage areas. The XP-SWMM software was chosen for the analyses in this SWMP for the ability to simulate open channel and overland flows combined with a storm sewer network to identify localized and regional flooding problems. **Table 4** lists each subwatershed, available regulatory modeling and the analysis created for the subwatershed in this SWMP.

Subwatershed	Regulatory Model	SWMP Model
Kaiser Ditch	HEC-2	XP-SWMM
Meadowdale Lateral	HEC-2	HEC-RAS
Chapel Manor	HEC-2	XP-SWMM
West	Unstudied	XP-SWMM
Turkey Meadows	Unstudied	XP-SWMM
North Central Turkey Creek	Unstudied	XP-SWMM
Broadfield	Unstudied	XP-SWMM
<sup>1</sup> Turkey Creek	HEC-RAS	HEC-RAS
Northeast Turkey Creek	Unstudied	XP-SWMM

<sup>1</sup>Modeling has not been modified as part of this SWMP.

**Table 4. Analysis by Subwatershed**

## 2.3 MODEL PARAMETER DEVELOPMENT

The first step in analyzing each subwatershed was to divide it into subbasins based on a review of the drainage system. On average, the subbasins were approximately 100 acres in size. Hydrologic parameters including area, Runoff Curve Number (RCN) and Time of Concentration (Tc) were calculated based on topography and current land use using aerial photography for each of the subbasins. The RCN value calculated for each subbasin is based on the ratio of impervious to pervious area in the subbasin. The land use was characterized using a combined land use cover shapefile created from shapefiles provided by the Town, LCSO and the Indiana Geological Survey. The land use classifications used in the analysis are shown in **Table 5** and can be accessed under the **Land Use and Cover** group layer in the master GIS database. The hydrologic parameters were then entered into the runoff mode of the XP-SWMM model for each subwatershed. A delineation of each subbasin within each subwatershed can be accessed under the **Subwatershed Subbasins** group layer in the master GIS database.

Land Use	Hydrologic Soil Group			
	A	B	C	D
Agricultural	62	71	78	81
Commercial	89	92	94	95
High Density Residential	70	85	90	92
Institutional	70	85	90	92
Light Industrial	81	88	91	93
Low Density Residential	51	68	79	84
Medium Density Residential	61	75	83	87
Mixed Use	70	85	90	92
Office	81	88	91	93
Park/Open Space	49	69	79	84
Woody Wetlands	25	55	70	77
Vacant	49	69	79	84

**Table 5. Land Use and RCN Summary**

The storm sewer system draining each area is defined using the Town's storm sewer database in the master GIS database for the Town created as part of the SWMP. The storm sewer database includes storm sewer elevations, locations, sizes, lengths and connections, as well as all recently constructed storm sewer improvement projects. The storm sewer database can be accessed under the **Survey Data** group layer in the master GIS database. The storm sewer network for each subwatershed was entered into the hydraulic phase of the XP-SWMM for each study area. In addition to the storm sewer network data, overland flow paths and depressional storage areas were entered into the model using aerial topography. When the capacity of a storm sewer has been exceeded during a storm event, the runoff begins to flow overland along the street, through drainage ways, or fills a depressional storage area. Overland flow paths and depressional storage areas were included in the hydraulic phase of the XP-SWMM analysis. CBBEL also field verified overland flow paths and depressional storage areas during storm events as these areas are generally associated with flood areas. Known problem areas were identified and discussed with Town staff.



## 2.4 CRITICAL DURATION DESIGN STORMS

The critical duration was determined for each subwatershed utilizing rainfall depths published in the Rainfall Frequency Atlas of the Midwest, by the Midwestern Climate Center and the Illinois State Water Survey (Bulletin 71). The critical duration refers to the duration of a storm that produces maximum water surface elevations, flood depths or flow rates. For example, the 100-year critical duration analysis included executing the XP-SWMM for the 1-hour through 48-hour duration storm events. The storm event producing the highest flood elevation is the critical duration storm event, and all proposed improvements are then designed for the critical duration storm. In some subwatersheds, the XP-SWMM was also executed for the September, 2008, storm event to verify the accuracy of the modeling compared to observed water surface elevations obtained by Town and CBBEL staff during the storm events. The 10-year design storm event was also executed for each subwatershed. Should additional analyses be required for a particular subwatershed or problem area in the future, results for design storm events less than the 100-year storm are readily accessible in the XP-SWMM modeling for each subwatershed.

## 2.5 EXISTING CONDITION MODEL RESULTS

The existing condition storm sewer systems, overland flow paths and depressional areas for each subwatershed were evaluated for the 100-year critical duration design storm events. Delineation of the existing 100-year flood inundation area was created and is shown for each subwatershed. Following the delineation, a number of problems were quantified or identified including structures in the FEMA regulatory floodplain and CBBEL delineated 100-year inundation area, major and minor public roadway overtopping, storage basin overtopping, erosive velocities and the identification of additional localized problem areas. These are described in detail in the following chapters. To determine the number of structures in each inundation area, a desktop GIS analysis was used to compare the CBBEL delineated 100-year inundation area, regulatory floodplain and the building footprint shapefile provided by the LCSO. The building shapefile can be accessed under the **Merrillville Structures 2011** layer in the master GIS database. Additional demographic data was also quantified for each subwatershed including land use/cover percentages, total stormwater utility fees generated and percentage of each ward within a particular subwatershed.

Where available, the existing condition, CBBEL delineated 100-year flood inundation area has been compared to the regulatory 100-year FEMA floodplain boundary. The comparison was done to determine if the FEMA floodplain included ground above the BFE or if ground below the BFE was missed by the floodplain limits and if the channel delineation was contained within the regulatory floodway. These factors can be good indicators of whether or not the regulatory modeling and floodplain delineations provide a good representation of the flood risk. If the comparison of BFE and topography shows areas where the regulatory floodplain limits are incorrectly noted, that indicates that at least a re-delineation of the regulatory floodplain limits may be appropriate. If the channel is not contained within the floodway, it can be an indication that the modeling does not accurately reflect the topography. The flood profiles were also reviewed to identify locations where BFEs would change if bridges had been replaced since survey data that was used in the Flood Insurance Study (FIS) was obtained. Based on this data, the potential for only minor changes due to bridge replacements was found. The regulatory FEMA

delineations can be accessed under the FEMA Data layer and the CBBEL delineations can be accessed under the CBBEL Inundation Area Shapefiles layer in the master GIS database.

## 2.6 PROPOSED CONDITION MODEL RESULTS

A series of proposed drainage improvements to reduce the risk of flooding were identified for each subwatershed. Where applicable, the flood reduction benefits from each proposed alternative were analyzed using the XP-SWMM model for the subwatershed to determine benefits. A delineation of the proposed 100-year flood inundation area was created to quantify the structures removed, reduction in public roadway overtoppings and overall reduction in flood depths throughout the subwatershed. The proposed condition delineations can be accessed under the CBBEL Inundation Area Shapefiles layer in the master GIS database. The proposed improvements analyzed in this SWMP include increasing storm sewer sizes, adding relief storm sewers, increasing culvert and outfall sizes, incorporating flood storage and ditch maintenance. Improvements were analyzed for each subwatershed to determine the effect on peak water surface elevations through entire subwatersheds and to ensure the proposed drainage projects did not negatively impact downstream areas.

### 2.6.1 Assumptions for Cost Estimates

This SWMP is based on conceptual plans and best available information. Because of this, there are many unknowns including soil conditions, utility conflicts and right-of-limits that will affect the ultimate design and cost of the improvements. CBBEL has provided an engineer's estimate of probable cost for many alternatives based on the conceptual designs and limited information. The engineer's estimate of probable cost includes a 20% contingency. Permitting and design engineering for each project has also been included in the estimates and is a percentage depending on the total cost of the project.

The following chapters of this SWMP have been organized by study area where each section describes the existing and proposed condition study area in detail and provides the engineer's estimate of probable cost for proposed alternatives.

## 2.7 WATER QUALITY

Stormwater runoff from urban areas can contain significant concentrations of pollutants that contribute to adverse water quality impacts in receiving streams. The concentrations of pollutants found in urban runoff are directly related to degree of development within the subwatershed. Urban runoff increases directly with imperviousness and the degree of subwatershed development. Contaminants in urban stormwater runoff can come from a variety of land use sources including residential, commercial, industrial activities, construction, streets and parking lots, and atmospheric deposition. **Table 6** shows contaminants commonly found in urban stormwater runoff and the typical loadings by urban land uses per acre, per year. As a point of reference, a comparison can be made of concentrations in runoff from parks and open space to the concentrations resulting from other land use types.

Land Use	TSS	TP	TKN	NH3-N	BOD	COD	Lead	Zinc	Cu
Commercial	1000	1.5	6.7	1.9	62	420	2.7	2.1	0.4
Parking Lot	400	0.7	5.1	2.0	47	270	0.8	0.8	0.04
High Density Residential	420	1.0	4.2	0.8	27	170	0.8	0.7	0.03
Medium Density Residential	190	0.5	2.5	0.5	13	72	0.2	0.2	0.14
Low Density Residential	10	0.04	0.03	0.02	NA	NA	0.01	0.04	0.01
Freeway/Interstate	880	0.9	7.9	1.5	NA	NA	4.5	2.1	0.37
Industrial	860	1.3	3.8	0.2	NA	NA	2.4	7.3	0.50
Park/Open Space	3	0.03	1.5	NA	NA	2.0	0.0	NA	NA
Construction	6000	80	NA	NA	NA	NA	NA	NA	NA

**Table 6. Pollutant Loadings from Runoff by Urban Land Use (lbs/acre-yr) EPA, Honer et al, 1994**

The EPA generally classifies adverse impacts to receiving waters as follows:

- Short-term changes in water quality during and after storm events including temporary increases in the concentration of one or more pollutants, toxics or bacteria levels.
- Long-term water quality impacts caused by the cumulative effects associated with repeated storm water discharges from a number of sources.
- Physical impacts due to erosion, scour and deposition associated with increased frequency and volume of runoff that alters aquatic habitat.

As development occurs, receiving streams are forced to accommodate larger volumes of stormwater runoff on a more frequent basis causing channel instability. The change in subwatershed hydrology associated with urban development causes increased velocities, erosion, channel widening and scouring, alteration of riparian corridors and sedimentation. This leads to adverse long term water quality impacts, the degradation and loss of aquatic habitat. Previous studies suggest that the elimination of riparian areas and habitat reduction negatively impacts the integrity of aquatic ecosystems. These impacts include the elimination or reduction in the numbers and diversity of fish and macroinvertebrates. Adverse habitat impact can be seen within the Town's extensive network of open channels, waterways and receiving streams used for drainage. Visible impacts include eroded and exposed stream banks, poor substrate, sedimentation and turbid conditions.

Stormwater management traditionally focused on flood control rather than quality control in the past. The Town's progressive ordinance not only has implemented an allowable release rate designed to regulate runoff volumes and velocities from new or redevelopment projects, but has incorporated the use of Best Management Practices (BMPs). BMPs include minimizing directly connected impervious surfaces, promoting on-site infiltration, implementing stream buffers and restoring riparian cover along urban streams. The Town's ordinance promotes the creation of the lost habitat through the use of BMPs.

Similar to the development of the Little Calumet River Basin Development Commission (LCRBDC) for flood control and flood reduction, the development of subwatershed workshop groups in recent years has led to a holistic approach for improving or creating habitat which subsequently improves water quality. These groups have shown that restoration of habitat promotes water quality more effectively than simply targeting constituent concentrations to receiving stream. Habitat improvement projects include stream re-meandering, riparian restoration, channel bank stabilization, dam removal, etc. Riparian zones are



widely recognized as functionally unique and dynamic systems that provide a suite of essential ecosystem services. Healthy riparian buffers can function to provide pollutant removal, protection from stream bank erosion, slowing of floodwaters, increased groundwater infiltration, temperature buffering, carbon sequestration and plant and animal habitat. Therefore, riparian zone restoration is a commonly applied method for improving the ecological function of a degraded site.

### 2.7.1 Subwatershed Water Quality Analysis

As part of this SWMP, potentially erosive velocities (greater than 3 feet/sec) within watercourses throughout the Town were analyzed and quantified. This information can be combined with the impervious cover analysis completed for each subwatershed to relate land use in the subwatershed to the health and future requirements of the receiving streams. Additional water quality parameters and database sets from regulatory agencies were added to the master GIS database for completion of a desktop GIS analysis for each subwatershed (**Table 7**). A water quality exhibit was created for each subwatershed in the following chapters and can be accessed under the **Water Quality Hot Spots** layer in the master GIS database.

Dataset	Agency
303D Impaired Waters	EPA
Active Solid Waste Site	EPA
Confined Feeding Operations	IDEM
Corrective Action Site	IDEM
Dams	IDNR
Impaired Lakes	IDEM
Leaky Underground Storage Tank	IDEM
NPDES Discharge Pipe	EPA
NPDES Facility	EPA
Open Dumps	IDEM
Sediment Inventory	EPA
Superfund Sites	EPA
Industrial Waste Site	IDEM
Waste Seepage Sites	IDEM
Waste Tire Sites	IDEM
Water Quality Monitoring Points	IGS
Water Quality Observations	EPA
Water Quality Statistics	EPA

**Table 7. Water Quality Datasets**

The information included in the datasets includes various hotspots, water quality testing locations, sediment inventories, etc. Agencies collect this information to provide general information on water quality statistics at monitoring stations in Indiana. The data is extracted from the U.S. EPA Storage and Retrieval of US Waters Parametric Data, which is contributed by a number of organizations including federal, state, interstate agencies, universities, contractors, individuals and water laboratories. The information also includes impaired waters listed under 303(d) used to track non-point source pollutants, and is used to aid in the development of Total Maximum Daily Loadings (TMDLs).

Overall, the coverage of the best available water quality sampling and testing data for Merrillville is limited to Turkey Creek. Throughout the following chapters for each subwatershed, the data for smaller receiving streams is sparse. The lack of coverage would suggest more monitoring within the MS4 program, specifically in subwatersheds where larger portions of imperviousness commercial or industrial land uses exists. The lack of available water quality data for smaller streams provides support for new programs and prompts the need for both pre and post-construction water quality monitoring, and the potential for additional staff.

## 2.8 FUNDING OPPORTUNITIES

The results of this SWMP offer a many potential solutions to reduce the risk of flooding and improve stormwater quality. As such, the identified solutions require funding. Many funding opportunities are available through government agencies on a cost sharing basis. Many grant programs require an approved plan, for which this SWMP has been developed. Potential funding sources, programs, agencies and opportunities include:

- Little Calumet River Basin Development Commission (LCRBDC)
- Lake County Surveyor's Office (LCSO)
- Indiana Department of Transportation (INDOT)
- Tax Increment Financing (TIF) districts – Broadway, Mississippi Street and other TIF districts
  - US Army Corps of Engineers (Section 205) – Flood Damage Reduction Projects
- Natural Resource Conservation Service (NRCS)
  - Wildlife Habitat Incentives Program (WHIP)
  - Wetland Reserve Program (WRP)
  - Conservation Stewardship Program (CSP)
  - Environmental Quality Incentives Program (EQIP)
- Indiana Department of Natural Resources (IDNR)
  - Division of Forestry
  - Land and Water Conservation Fund
    - Parks and recreation board must be established
- FEMA Programs
  - Hazard Mitigation Grant Program (HMGP)
    - Disaster area must be declared
  - Pre-Disaster Mitigation (PDM)
  - Flood Mitigation Assistance (FMA)
- IDEM
  - Section 319 Program
  - Section 205(j) Program – Non-Point Source Management Grant Program
- National Fish and Wildlife Foundation
  - Five Star/Urban Waters Restoration Program

## 2.9 MAINTENANCE OF EXISTING INFRASTRUCTURE AND CONSTRUCTION OF NEW GREEN INFRASTRUCTURE

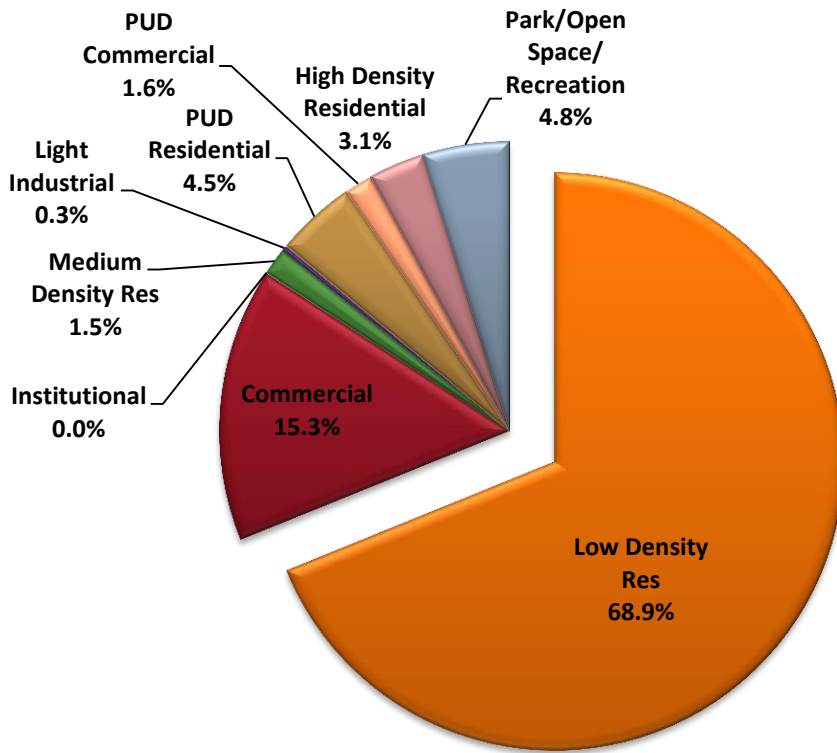
Much of the Town is drained by storm sewers, open channels, drainage swales and detention facilities. Maintenance of these drainage systems and facilities is imperative to the successful operation of the intended design of the drainage system. A regular maintenance plan should be established on a subwatershed basis with Town staff to assess, identify and plan maintenance activities. The Stormwater Resource Center and Utility equipment is well equipped to track and maintain the Town's stormwater infrastructure.

Turkey Creek represents the largest impaired watercourse to have been documented by governmental agencies through the Town limits. Turkey Creek drains all subwatersheds in this SWMP, with the exception of the Broadfield Subwatershed. The prevention of further water quality impairment and habitat loss in each subwatershed can only benefit water quality problems within the Town's subwatersheds and subsequently Turkey Creek. The construction of new green infrastructure, including constructed wetlands for storage areas, bio-swales and vegetated buffers, green streets, use of water quality treatment structures for first flush at point sources and the establishment of riparian habitat as discussed in any of the subwatershed will help reduce water quality impairments. Improvements in a particular subwatershed will help water quality and provides justification for green infrastructure projects in all subwatersheds.



regulated drain and is under the LCSO jurisdiction.

### 3.2 KAISER DITCH EXISTING CONDITIONS



**Figure 6. Kaiser Ditch Subwatershed Land Use**

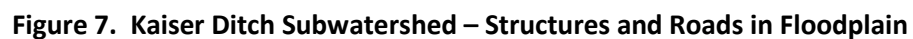
storm for the upper (south of 73<sup>rd</sup> Avenue) portion of the subwatershed, while the 12-hour storm event is the critical design storm for the portion north of 73<sup>rd</sup> Avenue.

A GIS analysis of the **Merrillville Structures 2011** layer compared to both the regulatory floodplain (**FEMA Data**) layer and the **CBBEL Delineated 100-year Inundation Area** layer identified 3 and 73 structures, respectively, in the SFHA and the CBBEL delineated inundation area (**Table 8**). **Figure 7** shows the number of structures in the regulatory and CBBEL delineated 100-year flood inundation area created for this SWMP associated with Kaiser Ditch. The number of total structures within the CBBEL delineated 100-year flood inundation area is larger than the number in the regulatory SFHA. This is due to the updated study methodology for Kaiser Ditch south of 73<sup>rd</sup> Avenue. **Figure 7** is intended to be used for reference. The GIS master database should be accessed for more detailed information regarding structures within the SFHA, public roadway overtoppings etc.

Structures in Regulatory 100-year Floodplain			Structures in CBBEL 100-year Inundation Area	Total Structures in Inundation Area
Floodway	Zone AE	Zone A		
0	1	2	73	73

**Table 8. Kaiser Ditch Subwatershed - Structures in Floodplain**





A comparison of the elevations used in the CBBEL delineated 100-year Inundation Area to the public roadway overtopping elevations from Lake County aerial topography showed nine (9) major roadway overtoppings and 13 minor roadway overtoppings (Figure 7). The minor versus major public roadway overtopping classification refers to the capacity of the public roadway or if the public roadway is arterial and crucial to emergency vehicle traffic during storm events. The public roadway overtoppings are due to restrictive culvert crossings and are responsible



**Figure 8. Restrictive Culvert at 79<sup>th</sup> Place**

for backing water upstream leading to street flooding and subsequent structure flooding. In some cases, the problem areas created by a restrictive culvert crossing are compounded by silt and/or debris combined with either a failing or collapsed pipe. In addition to public roadway overtoppings, main areas of significant flooding were identified and are shown in Table 9.

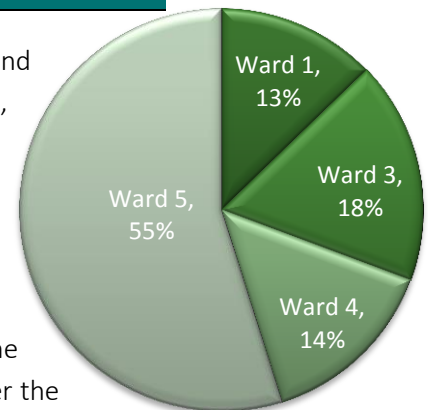
Location
West tributary between US 30 and Jennings Place
East tributary between US 30 and 79 <sup>th</sup> Place,
Restrictive culverts along east tributary at 79 <sup>th</sup> , 78 <sup>th</sup> , 77 <sup>th</sup> and 73 <sup>rd</sup>
Along Taney Place, 77 <sup>th</sup> Avenue to 79 <sup>th</sup> Place
Kaiser Ditch immediately upstream of 73 <sup>rd</sup> Avenue
Independence Street near 75 <sup>th</sup> Place west of Taft Street (localized low area)
Between US 30 and 78 <sup>th</sup> Avenue
Taft Street south of 85 <sup>th</sup> Avenue
Areas of erosion downstream of 79 <sup>th</sup> Place (eastern) downstream of 78 <sup>th</sup> (western)

**Table 9. Kaiser Ditch Subwatershed – Existing Problem Areas of Note**



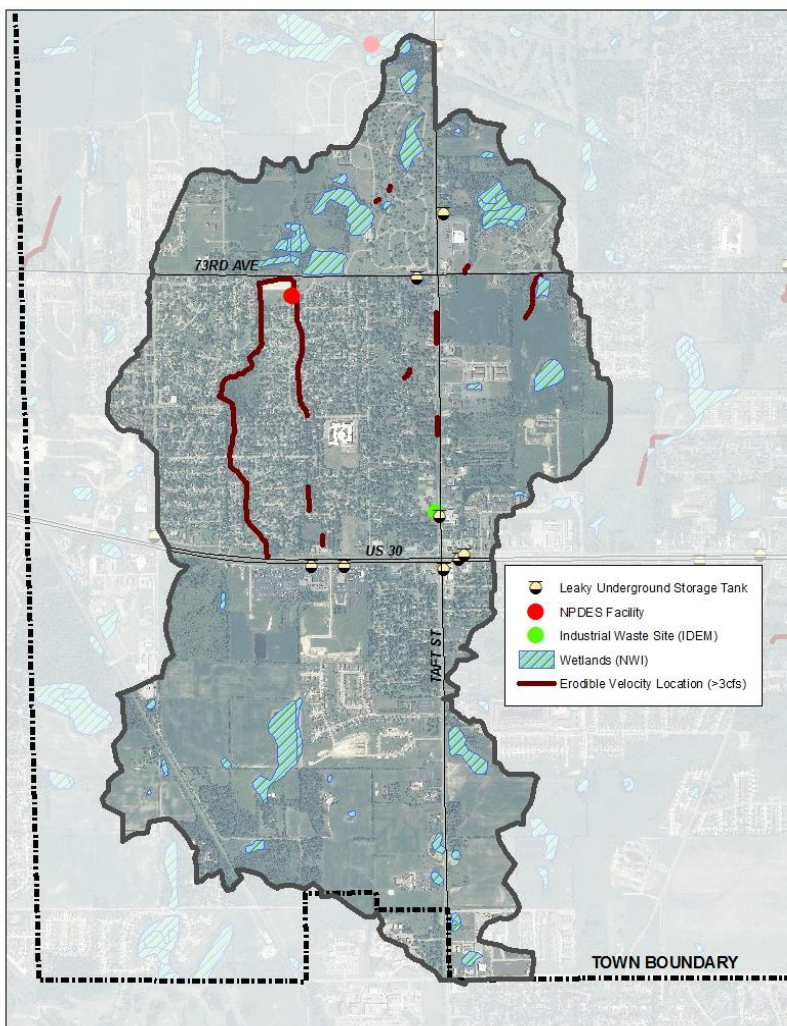
### 3.3 KAISER DITCH BY WARD AND UTILITY FEE

The Kaiser Ditch subwatershed consists of four (4) Wards (**Figure 9**) and contributes 19% of the Town's yearly stormwater utility fee, respectively. This percentage is of the total contribution from the subwatersheds studied in this SWMP. This does not include the unstudied portions of Town. This information is based on the Town's 2013 stormwater utility fee and is a function of the land use within the subwatershed. There are approximately 2,290 residential parcels within the Kaiser Ditch Subwatershed (89% of all parcels in the subwatershed are residential). This information can be accessed under the **Land Use and Cover** group layer in the master GIS database.



**Figure 9. Kaiser Ditch Subwatershed by Ward**

### 3.4 KAISER DITCH EXISTING WATER QUALITY CONCERNS



**Figure 10. Kaiser Ditch Subwatershed Environmental Concerns**

A water quality exhibit was created for the Kaiser Ditch Subwatershed using the database combined with stream flow velocities from the XP-SWMM modeling (**Figure 10**). This information can be accessed under the **Water Quality Hot Spots** layer in the master GIS database. From the XP-SWMM modeling analysis, erodible velocities were shown in the eastern and western tributaries south of 73rd Avenue (**Figure 10**). This data corresponds well, suggesting that erodible velocities are associated with the portion of the subwatershed with dense residential development. Likewise, erodible velocities are not associated with the undeveloped areas south of 73<sup>rd</sup> Avenue. Individual metrics for riparian zone, pool/glide quality and riffle/run quality were not specifically determined for these open channels; however, it is noted that the substrate is dominated by muck and silt and there is little to zero overall instream structure suggesting a history of vegetative control and disturbance. For most channel banks south of 73<sup>rd</sup> Avenue, manicured residential lawn with no riparian zone is



the predominant land use for the two western tributaries. These streams would expect to show signs of being impacted by runoff and non-supporting of a healthy stream ecosystem level from stormwater runoff and would impact aquatic organisms and the overall health of the stream. The enforcement of a riparian buffer or easement could be used as a method to establish habitat restoration in these areas.

According to the master dataset (Water Quality Hotspots), there are multiple leaky underground storage tanks along the US 30 and Taft Street corridors, as well as an industrial waste site on Taft Street. **Figure 10** also does not show areas within the subwatershed that were part of an EPA or IDEM water quality monitoring study and publically available data for the subwatershed is relatively limited. This suggests the need for a potential water quality program within the subwatershed following the establishment of baseline levels of water quality constituents.

### 3.5 KAISER DITCH PROPOSED CONDITIONS

CBBEL evaluated several improvements to stormwater storage and conveyance along the two (2) tributaries south of 73<sup>rd</sup> Avenue to alleviate flooding. Combinations of culvert improvements with storage basins were designed to maintain existing conditions flowrates north (downstream) of 73<sup>rd</sup> Avenue for the 100-year critical duration storm event while providing maximum benefits for identified problem areas. The XP-SWMM model was used as the baseline for analysis. The proposed improvements are shown on **Figure 11** and can be accessed under the Proposed Improvements layer in the master GIS database. The proposed improvements are listed in **Table 10**.

	Location	Improvement
1	South of US 30	20 ac-ft storage basin
2	73 <sup>rd</sup> Avenue	Replace existing 96" CMP with 2 – 6'x6' RCBC
3	North of US 30 - Trinity Memorial Lutheran Church	7 ac-ft storage basin
4	Along Taney Place, 77 <sup>th</sup> Avenue to 79 <sup>th</sup> Place	24" relief sewer
5	79 <sup>th</sup> Place	Replace 25"x17" CMP with 68"x43" ERCP
6	77 <sup>th</sup> Place	Restore section of existing 30" to open channel
7	Between US 30 and 78 <sup>th</sup> Avenue	Channel bank stabilization (east channel)
8	78 <sup>th</sup> Avenue	Replace elliptical culvert with 1 – 3'x5' RCBC
9	77 <sup>th</sup> Avenue	Replace elliptical culvert with 2 – 3'x5' RCBCs
10	73 <sup>rd</sup> Place	Replace 4 – 24" CPP culvert with 3 – 3'x5' RCBCs
11	Riparian buffer throughout	Enforcement of an easement
12	Jennings Place	Replace 56"x84" CMP culvert with 2 – 5'x4' RCBCs
13	West of 76 <sup>th</sup> Place	35 ac-ft storage basin

**Table 10. Kaiser Ditch Subwatershed – Proposed Improvements**

The proposed improvements increase the size of restrictive culverts and employ additional storage to offset increased flowrates from negative downstream impacts. The proposed improvements provide

significant flood reductions to the east & west tributary flooding areas removing 66 structures and 14 public roadway overtopping locations from the existing CBBEL 100-year inundation area. The proposed CBBEL 100-year inundation area resulting from the proposed improvements is shown on **Figure 12** and can be accessed under the **Proposed Improvements** layer in the master GIS database. Overtopping locations not completely removed have been reduced, with shorter durations during storm events. The following additional recommendations and conclusions have been made for the Kaiser Ditch Subwatershed:

- The Town should require all future development south of US 30 to provide stormwater detention storage and a field tile inventory.
- Improvement #1 is the expansion of the existing storage basin south of US 30 on the property currently known as the Schepel property and is private.
- Storage components should be constructed first to avoid increased downstream flowrates. Further investigation may be required if culvert replacement projects are to be constructed prior to the construction of additional storage.
- Channel bank stabilization and channel clearing and snagging along the east tributary is located on private property. A dedicated easement will assist to establish habitat restoration.
- The west tributary is a regulated drain and contains an easement for this work. The LCSO has begun and completed some of this work. Future coordination with LCSO should be pursued for on-going maintenance of this channel.
- The estimated cost to construct all of the improvements is \$8.4 million and is included in **Appendix 1**.



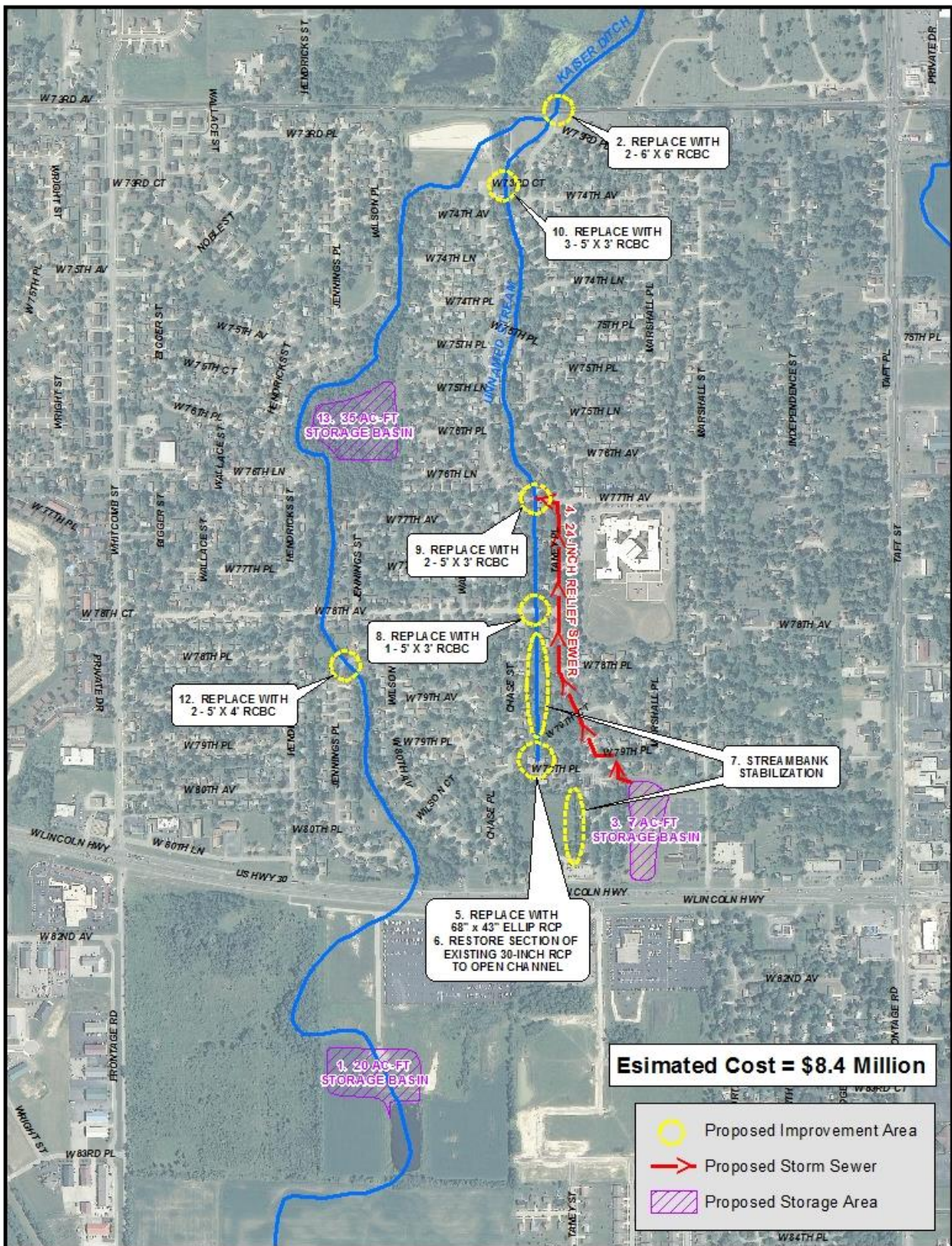


Figure 11. Kaiser Ditch Subwatershed Proposed Improvements and Storage Areas





### 3.6 ON-GOING CONSTRUCTION PROJECTS AND CONSIDERATIONS

#### 3.6.1 Kaiser Ditch Maintenance – North of 73<sup>rd</sup> Avenue

Kaiser Ditch is a regulated drain under LCSO jurisdiction through the Calumet Park Cemetery and the west tributary south of 73<sup>rd</sup> Avenue. Discussions with Town and LCSO staff indicate that clearing and snagging is to be completed through the Calumet Park Cemetery and stream restoration has been completed along the west tributary upstream of Jennings Place.

#### 3.6.2 Rosenbaum Park and Independence Park

Rosenbaum Park located south of 73<sup>rd</sup> Avenue was considered for additional storage; however, this parcel is largely located within the FEMA floodplain with floodway and wetland implications and is downstream of the damages. This parcel provides little benefit given the permitting requirements and location. Independence Park (Ross Township property) located north of 73<sup>rd</sup> Avenue was also considered for storage; however, this location shares the same constraints as Rosenbaum Park. Other parcels were considered for storage within the subwatershed but have been ruled out through discussion with the Town due to ownership, site constraints and proximity to flood problems.

#### 3.6.3 Taft Street Drainage Improvement Project

In 2012, the Town was awarded a grant from the Indiana Department of Transportation (INDOT) to construct proposed improvements along Taft Street designed to reduce structure and public roadway flooding. Construction of the improvements began in Fall 2012, and has been largely completed at the time of this SWMP. The current subwatershed analysis has assumed that the Taft Street Drainage Improvement Project has been completed.

#### 3.6.4 Independence Street West of Taft Street

A known problem area with localized flooding is located on Independence Street and is due to a depressional area with a 12" outlet intended to discharge east, to the open channel along Taft Street (**Figure 13**). The outlet at the open channel is in poor condition and is below the channel invert, preventing the low area on Independence from draining by gravity. A small pump station in this area is the proposed solution for this area and is estimated to cost \$400,000. The existing storm sewer outlet should be televised to verify condition and may lead to the replacement of the sewer and additional cost.



**Figure 13. Independence Street Problem Area**



### 3.6.5 Taft Street overtopping – South of 95<sup>th</sup> Avenue

An additional analysis and field visit was performed for the potential overtopping location on Taft Street near 95<sup>th</sup> Avenue. CBBEL staff verified that storm sewers convey flow north to US 30 and that the 30-inch storm sewer continuing west does not convey stormwater west, away from Taft Street. According to the field survey, it was assumed that this storm sewer conveyed drainage west from Taft Street through the subdivision drainage system and detention facility. CBBEL found that the manhole on the north side of 95<sup>th</sup> Avenue along the 30-inch storm sewer line was filled with debris (**Figure 14**). The manhole on the east side of Taft Street was conveying substantial flow north and was in poor shape (**Figure 14**). In addition, two other manholes were discovered that were not included with the survey data. It is unknown where the manhole on the west side of Taft Street drains. The existing condition CBBEL delineated inundation area has been based on the findings of the CBBEL field investigation. We recommend that the manholes in this area be further investigated or uncovered to verify flow direction and condition.



Figure 14. Taft Street South of 95<sup>th</sup> Avenue



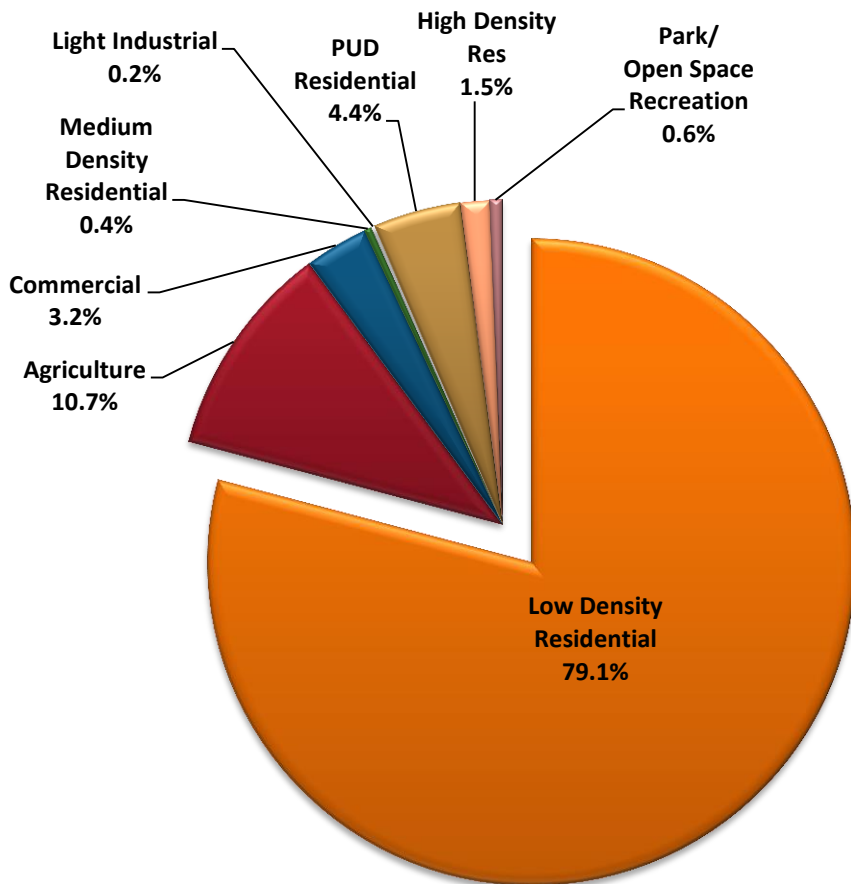
The Meadowdale Lateral Subwatershed is tributary to Turkey Creek and is generally located north of the Canadian National Railroad (Railroad) on the north side of Turkey Creek (**Figure 15**). Meadowdale Lateral consists of two tributaries north of the railroad where the east flows from north to south before its confluence with the west tributary just upstream of the Railroad. Approximately 7.1 square miles is tributary to the Railroad culvert crossing and approximately 60% of this tributary area is located outside the Town's municipal boundary. There is mapped regulatory Zone AE floodplain and floodway in the section from the confluence with Turkey Creek, north to 61<sup>st</sup> Avenue along the Meadowdale Lateral. The mapped regulatory floodplain associated with the west tributary represents backwater from the main lateral and extends upstream to Bon Aire Lake at a constant elevation. Meadowdale Lateral is named as such in the FIS, however the watercourse is referred to as Griffith Lateral #6 and the west tributary is referred to as Griffith Lateral #7 by the LCSO. Meadowdale Lateral (Griffith Lateral #6) and the west tributary (Griffith Lateral #7) are regulated drains and under the jurisdiction of the LCSO.





## 4.2 MEADOWDALE LATERAL EXISTING CONDITIONS

The total tributary area to Meadowdale Lateral is 4,636 acres of which 2,683 acres are located outside the Town's limits. The subwatershed land use within the Town limits is mostly low density residential and agricultural (Figure 16). Following the delineation of the tributary areas to large diameter storm sewers and drainage ways, CBBEL created an HEC-HMS hydrologic and unsteady HEC-RAS hydraulic analysis of the



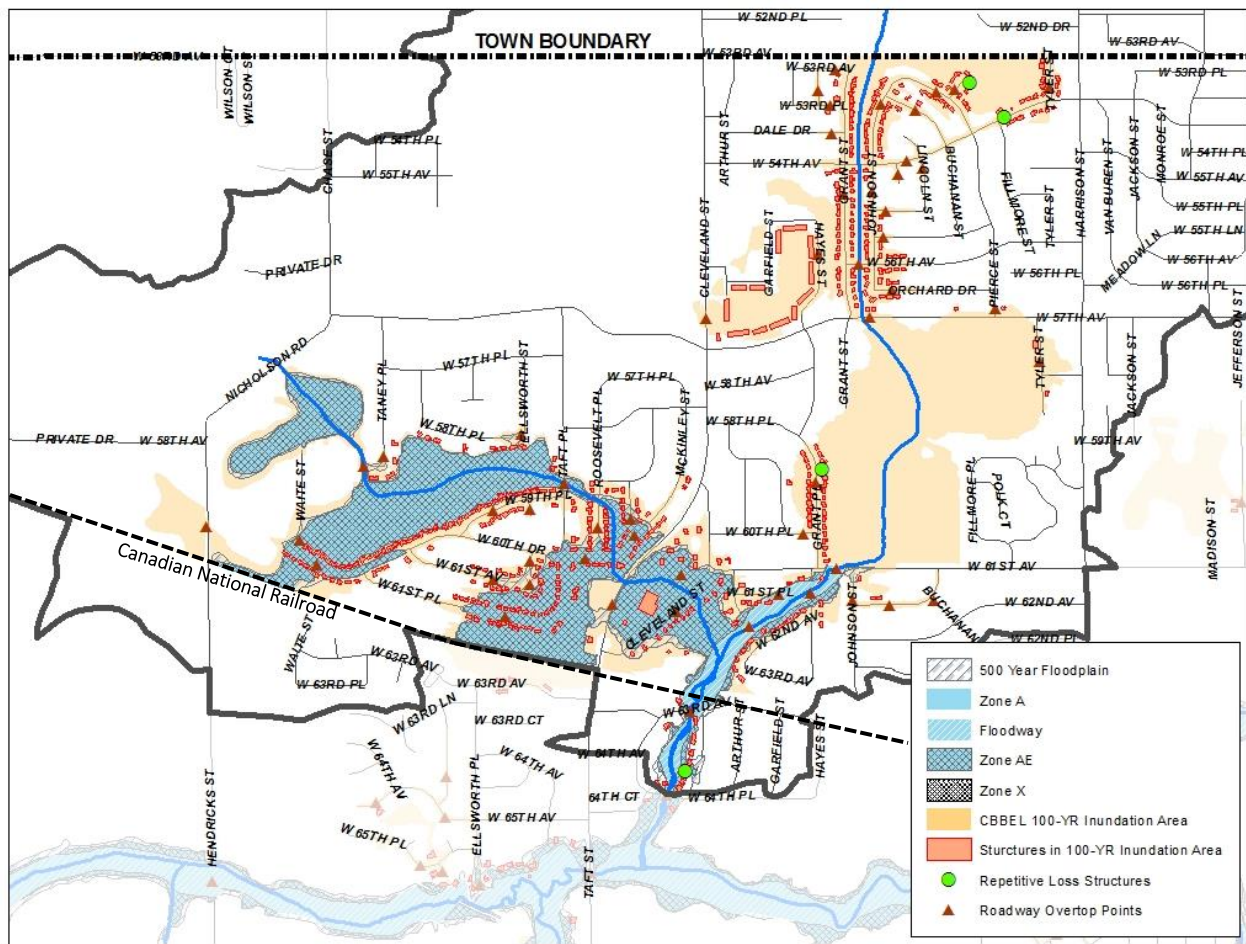
**Figure 16. Meadowdale Lateral Subwatershed Land Use**

subwatershed as the HEC-2 hydraulic model was not available. The analysis combines information from the field survey data and the Lake County 1-foot aerial topography including depressional storage areas and large diameter sewers through the use of rating curves and lateral structures. CBBEL created the unsteady HEC-RAS hydraulic model incorporating the output hydrographs from the HEC-HMS modeling. The modeling has been calibrated to the September 2008 storm event using USGS precipitation gage data and known specific areas of flooding.

Following the hydrologic and hydraulic analysis, CBBEL delineated the 100-year floodplain elevations using the Lake County topography. Based on the existing conditions and HEC-RAS modeling results, a restrictive 6 ft x 7.5 ft CMP arch culvert crossing under the Railroad significantly contributes to flooding conditions. The Railroad embankment is several feet higher than

the surrounding area which forces stormwater runoff to pond to the embankment elevation before overtopping. The Railroad is shown to be overtopped for the 100-year design storm event. A 60-inch relief sewer conveys stormwater upstream of the 61<sup>st</sup> Avenue crossing at Johnson Street, east along 61<sup>st</sup> Avenue and south along Harrison Street, outletting to Turkey Creek downstream of the restrictive Railroad crossing. This storm sewer provides relief, however it does not significantly reduce water surface elevations for the 100-year year inundation area upstream of the Railroad.

Flooding of the apartment buildings surrounding the detention basin located northwest of Grant Street and 57<sup>th</sup> Avenue is caused by stormwater runoff backing up from Meadowdale Lateral through the outlet pipe and overtopping of Grant Street. Based on Lake County 1-foot topographic mapping, the elevations



**Figure 17. Meadowdale Lateral Subwatershed - Structures and Roads in Floodplain**

of the residences appear to be below the Railroad embankment elevation. The existing conditions 100-year flood inundation area according to the calibrated HEC-RAS model is shown in **Figure 17**.

A GIS analysis of the **Merrillville Structures 2011** layer compared to both the regulatory floodplain (FEMA Data) layer and the CBBEL Delineated 100-year Inundation Area layer identified 144 and 439 structures in the SFHA and the CBBEL delineated inundation area (**Table 11**). Four of these structures are repetitive loss structures (Repetitive Loss Structures layer). **Figure 17** shows the number of structures in the regulatory and CBBEL delineated 100-year flood inundation area created for this SWMP associated with Meadowdale Lateral. The number of total structures within the CBBEL delineated SFHA is larger than the number in the regulatory SFHA. This is due to the unstudied portion of Meadowdale Lateral north of 61<sup>st</sup> Avenue. **Figure 17** is intended to be used for reference. The GIS master database should be accessed for more detailed information regarding structures within the SFHA, public roadway overtoppings, etc.

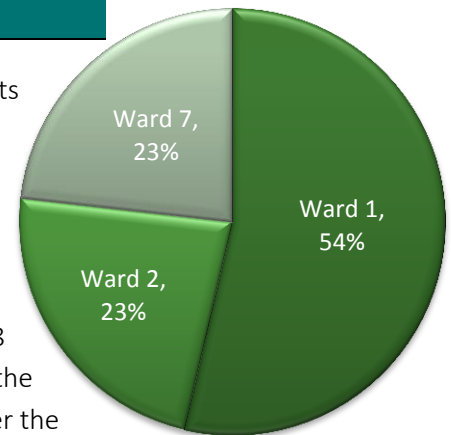
A comparison of the elevations used in the CBBEL 100-year Inundation Area to the public roadway overtopping elevations from Lake County aerial topography showed four (4) major roadway overtoppings and 49 minor roadway overtoppings (**Figure 17**). The public roadway overtoppings are due to restrictive culvert crossings and are responsible for backing water up, upstream leading to street flooding and subsequent structure flooding. In some cases, the problem areas created by a restrictive culvert crossing are compounded by silt and/or debris combined with either a failing or collapsed pipe.

Structures in Regulatory 100-year Floodplain			Structures in CBBEL 100-year Inundation	Total Structures in Inundation Area
Floodway	Zone AE	Zone A		
9	135	0	439	439

**Table 11. Meadowdale Lateral Subwatershed - Structures in Floodplain**

#### 4.3 MEADOWDALE LATERAL BY WARD AND UTILITY FEE

The Meadowdale Lateral Subwatershed within the Town limits consists of 3 Wards (**Figure 18**) and contributes 20% of the Town's yearly stormwater Utility fee. This percentage is of the total contribution from the subwatersheds studied in this SWMP. This does not include the unstudied portions of Town. This information is based on the Town's 2013 stormwater utility fee and is a function of the land use within the subwatershed. There are approximately 2,998 residential parcels in the subwatershed (93% of all parcels in the subwatershed are residential). This information can be accessed under the Land Use and Cover group layer in the master GIS database.



**Figure 18. Meadowdale Lateral Subwatershed by Ward**

#### 4.4 MEADOWDALE LATERAL EXISTING WATER QUALITY CONCERNS

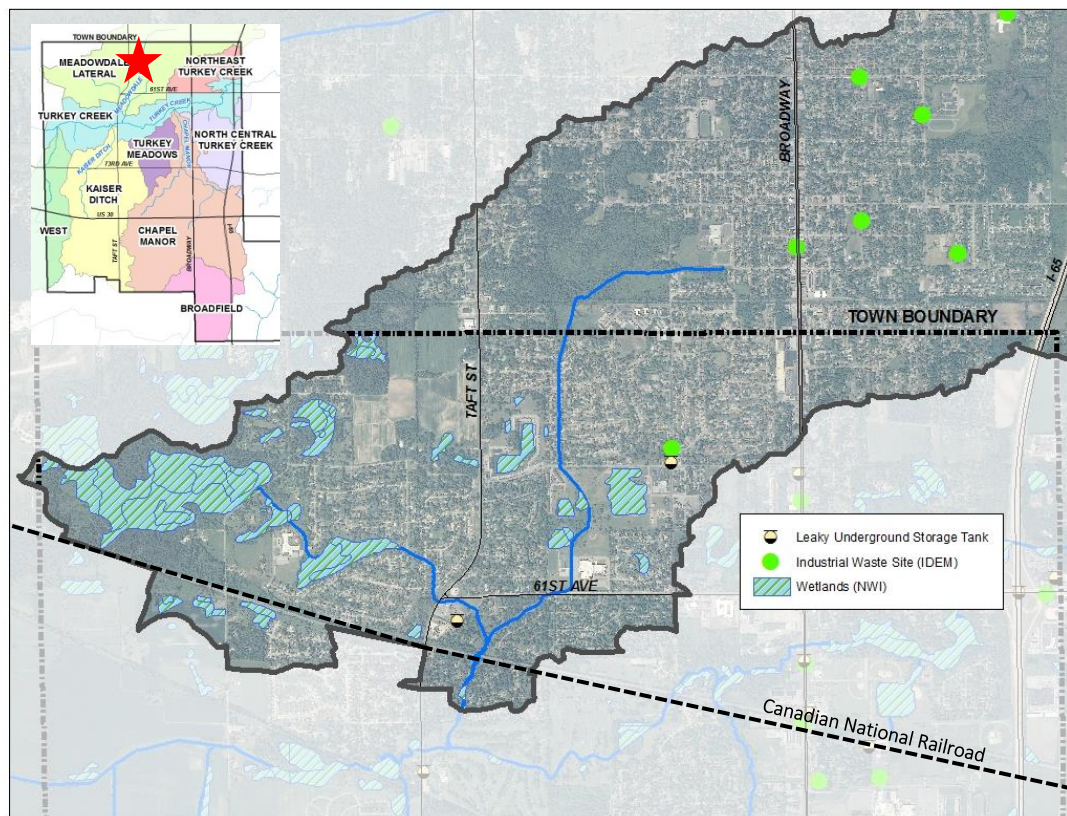
A water quality exhibit was created for the Meadowdale Lateral Subwatershed (**Figure 19**) using the database Water Quality Hot Spots layer in the master GIS database. The subwatershed figure does not indicate a large number of water quality hotspots, and data from IDEM and EPA is somewhat limited. One industrial waste site has been identified by IDEM and is associated with a vacated dry cleaning business on the northwest corner of the intersection of 57<sup>th</sup> Avenue and Harrison Street.

The lack of detailed information in the subwatershed does prompt the need for the establishment of baseline water quality constituent levels. A good point of reference for this testing could be located at the railroad crossing. It should be noted that water quality testing at this location will not be specific to the subwatershed located within the Town limits. Water quality testing at the Railroad crossing will reflect constituent levels in the upstream portion of the subwatershed located outside the Town's limits. Water quality testing may also be beneficial along the west tributary draining from Bon Aire Lake.



Water course velocities were analyzed using the HEC-RAS hydraulic modeling and found to be largely non-erosive or less than 3 feet/second throughout the majority of the subwatershed. This is likely due to the restrictive culvert crossing at the Railroad, which is preventing flows from exceeding erosive velocities given the lack of natural meandering. While land use along Meadowdale Lateral is residential with manicured lawns, a desktop GIS analysis showed the existence of a riparian zone along the lateral south of 57<sup>th</sup> Avenue extending to the Railroad.

There is a small existing riparian corridor north of 57<sup>th</sup> Avenue, and the potential for expansion of this area is limited due to site constraints. However, the potential does exist for stream re-meandering projects, along with a constructed wetland to occur on the Merrillville Community School Corporation property associated with the school south of 57<sup>th</sup> Avenue. The location of a stream re-meandering project, combined with a wetland downstream of the residential area, would greatly benefit water quality through the reduction of nutrients and sediment. Wetlands have been shown to be an effective way of removing water pollutants by absorbing excess inorganic and organic nutrients (including nitrogen and phosphorus). While individual metrics for water quality constituents were not measured, the existence of the residential area north of 57<sup>th</sup> Avenue could suggest elevated nutrient levels resulting from residential fertilization applications. The close proximity to the school also offers a possible outreach opportunity for education of water quality in stormwater runoff, wetland ecology and wetland biodiversity. Possible funding for this type of project could come from the NRCS Section 319 Program for constructed wetlands.



**Figure 19. Meadowdale Lateral Subwatershed Environmental Concerns**

## 4.5 MEADOWDALE LATERAL PROPOSED CONDITIONS

CBBEL evaluated improvements to stormwater storage and conveyance along Meadowdale Lateral to alleviate flooding. The proposed improvements that were considered included culvert replacements, flood storage and storm sewers at multiple locations throughout the subwatershed. The recommended combination of improvements was designed to allow a maximum Water Surface Elevation (WSEL) increase of 0.14 feet downstream of the Railroad for the critical design storm event while providing the maximum flood reduction benefits for identified problem areas upstream of the Railroad. The calibrated September, 2008, HEC-RAS hydraulic model was used as the baseline for the analysis. The proposed improvements are shown on **Figure 21** and can be accessed under the **Proposed Improvements** layer in the master GIS database. The proposed improvements are listed in **Table 12**.

	Location	Improvement
1	South of 57 <sup>th</sup> Avenue	19 ac-ft storage basin
2	South of 57 <sup>th</sup> Avenue	7.5 ac-ft storage basin
3&4	Northwest of Grant Street & 57 <sup>th</sup> Avenue (Hickory Ridge Apartments)	Create a berm at elevation 627.8 feet around the north and east sides of the apartment complex and existing detention basin. Upgrade pump station and flap gate on the outlet pipe
5	State Highway 55 (Cleveland Street)	Replace 24" CMP with a 2'x6' RCBC;
6	Taft Place – Bon Aire Lake outlet	Replace outlet with a 4'x4' RCBC and lower NWL
7	Restrictive Railroad crossing east of Taft Street	Additional 36" RCP under the Railroad parallel to the existing 6'x7.5' CMP arch
8	63 <sup>rd</sup> Avenue	Replace 84" CMP with 2 – 6'x6' RCBC
9	61 <sup>st</sup> Avenue	Replace 72" CMP with 2 – 5'x5' RCBC

**Table 12. Meadowdale Lateral Subwatershed – Proposed Improvements**

The improvements increase the size of four restrictive culvert crossings, isolate the apartment complex (Hickory Ridge Lake Apartments) and detention basin at Grant Street and 57<sup>th</sup> Avenue from Meadowdale Lateral backwater, and create approximately 26.5 ac-ft of additional storage volume within the subwatershed. The proposed improvements provide significant flood reductions removing 74 structures and five (5) roadway overtopping locations from the CBBEL 100-year inundation area. Overtopping locations not completely removed have been reduced, with shorter duration during storm events. The proposed CBBEL 100-year inundation area resulting from the proposed improvements is shown on **Figure 22** and can be accessed under the **Proposed Improvements** layer in the master GIS database. The estimated cost to construct the improvements is approximately \$3.9 million and a conceptual cost estimate is included in Appendix 1.

The following additional conclusions have been made for the Meadowdale Lateral Subwatershed:

- The Railroad culvert crossing significantly restricts stormwater conveyance and contributes to flooding conditions. Stormwater backs up behind this crossing to an elevation that causes upstream flooding. Safely increasing the capacity of this culvert crossing is a priority solution for flooding in the area. Railroad approval and permitting through the IDNR will be necessary for the proposed improvements.

- It should be noted that these improvements do not remove all structures from the proposed condition inundation area. **According to the proposed condition 100-year CBEL delineated inundation area, 365 structures will remain in the inundation area.** The restrictive culvert system both at the Railroad and on the school property at 61<sup>st</sup> Avenue and Grant Place contribute to the flooding problem (**Figure 20**).
- Building a berm and upgrading the pump station and flap gate at the Grant Street & 57th Avenue detention basin will significantly lower flood elevations for all design storm events in that area. These proposed improvements would effectively isolate the pond and apartments from Meadowdale Lateral backwater, which greatly reduces the risk of flooding in this area. CBEL also recommends upgrading the pump station to alleviate possible flooding during heavy rain events since there will effectively be no outlet.



**Figure 20. Intersection of Grant Street and 61<sup>st</sup> Avenue – September, 2008**



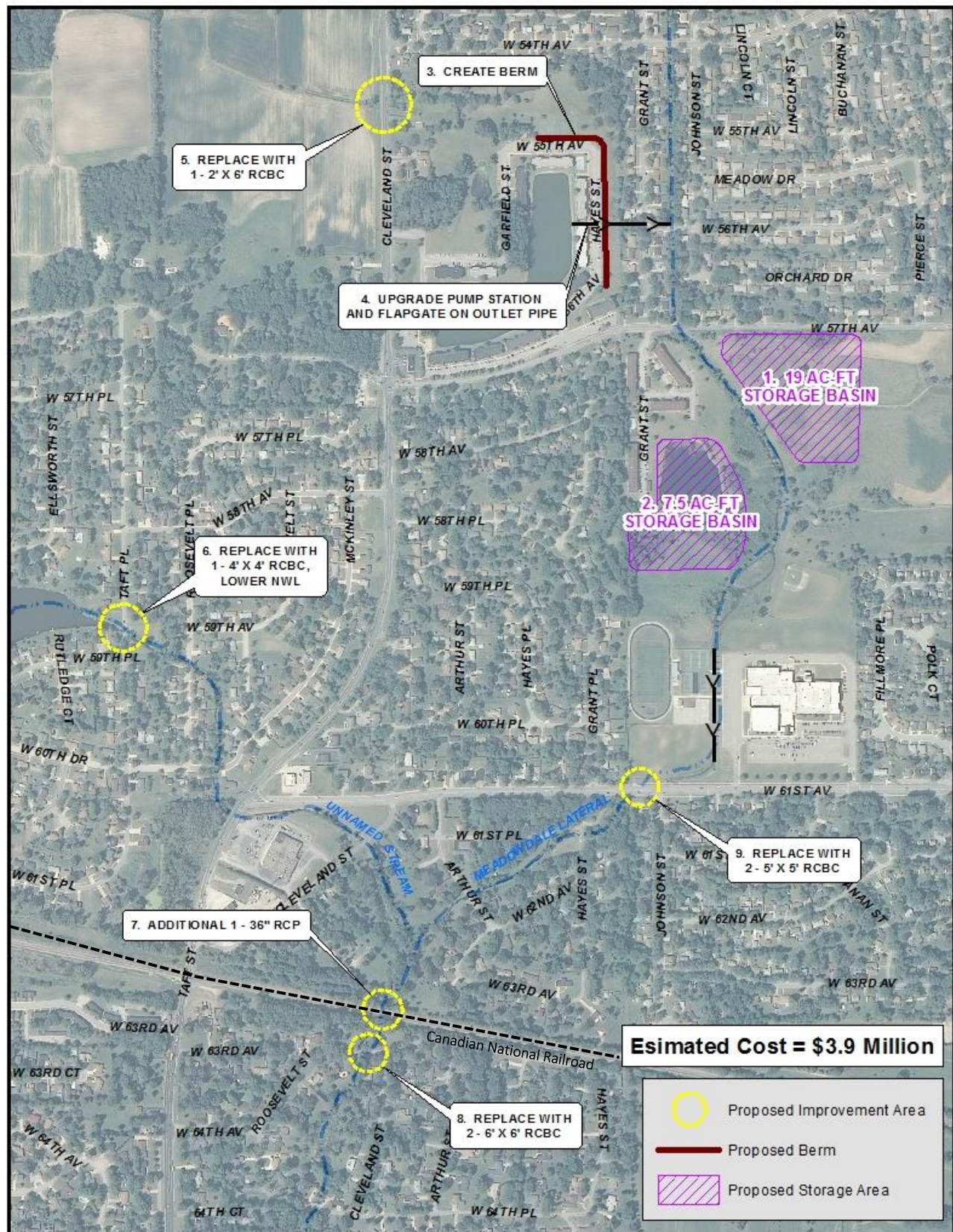


Figure 21. Meadowdale Lateral Subwatershed Proposed Improvements and Storage Areas



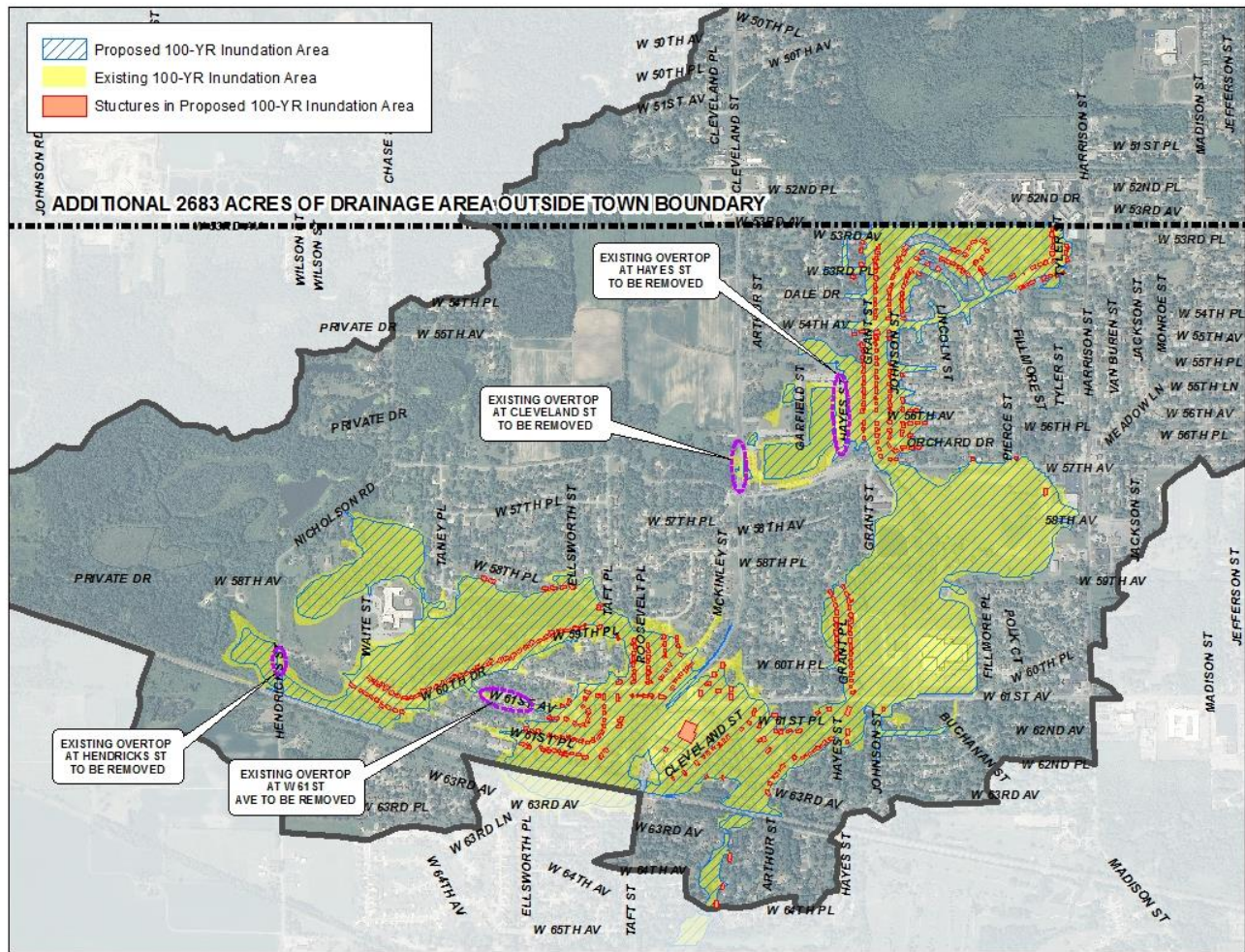


Figure 22. Meadowdale Lateral Subwatershed Proposed CBBEL 100-year Inundation Area

## 4.6 ON-GOING PROJECTS AND CONSIDERATIONS

### 4.6.1 Mississippi Street Wetland Creation

The Town is currently engaged in a wetland mitigation project in the upstream portion of the subwatershed located north of 54<sup>th</sup> Avenue between Cleveland and Harrison Streets. The required wetland mitigation is 2.25 acres as required by IDEM. The wetland mitigation results from the widening of Mississippi Street north of US 30 in 2002. Instead of using a wetland bank, the Town will convert an old baseball field into 1.25 acres of forested and scrub-shrub wetland and another 1.07 acres of emergent wetland. In addition, 1.56 acres of existing wetland at the site will be enhanced with additional plantings.

### 4.6.2 Ultimate Improvement Considerations

The improvements as previously proposed create approximately 26.5 ac-ft of additional storage volume and allow for an additional 36-inch diameter pipe to be installed at the Railroad crossing. While this improvement removes 74 structures from the 100-year CBBEL delineated inundation area, the culvert system in the subwatershed remains restrictive and 365 structures remain in the CBBEL delineated

inundation area. To increase one culvert size to a 42-inch diameter pipe at the Railroad would require approximately 160 ac-ft of storage volume, which may not be feasible given land use in the subwatershed. The storage component of the proposed improvements is required to offset increased flowrates downstream. The 36-inch pipe is the largest diameter that could be installed without increasing water surface elevations downstream.

An additional analysis was performed to explore possibilities to remove more structures from the 100-year CBBEL delineated inundation area. The proposed improvements include the following:

- Relief sewer along school property north of 61st Avenue – 600 feet of 6 feet x 12 feet RCBC
- Relief sewer along 61st Avenue to Turkey Creek – 4000 feet of 6 feet x 12 feet RCBC
- Culvert replacements at 57th Avenue and 56th Avenue – twin 6 feet x 10 feet RCBCs at each location

These improvements provide the following **reductions** in the CBBEL delineated 100-year water surface elevations:

- **Up to 1.5 feet** along West Tributary
- **Up to 2.2 feet** between 61<sup>st</sup> and 57<sup>th</sup> Avenue
- **Up to 1.0 feet** upstream of 57<sup>th</sup> Avenue

The proposed improvements remove 247 of the 439 structures, including the school at 61<sup>st</sup> Avenue from the CBBEL delineated inundation area. The reduction of storage in the subwatershed is approximately 252 ac-ft as a result of the reduced water surface elevation. Of the 192 structures remaining in the CBBEL delineated inundation area, flood protection is possible through berming or floodwalls for two (2) of the areas. These two areas include the low areas at 56<sup>th</sup> Avenue along Grant and Johnson Streets (29 structures) and along Grant Place north of 61<sup>st</sup> Avenue (17 structures). Additional storage is required if berming of these areas is constructed. The cost to construct the culvert replacements and additional relief culverts **only** is \$10 million (**Figure 23**). The cost of constructing 252 ac-ft of storage or the cost of floodwalls or berms in the two areas of note **is not included** in the \$10 million. The \$10 million for relief culverts is in addition to the \$3.9 million of improvements for the 74 structures to be removed as previously discussed.

Additional storage is possible in the subwatershed, however this will be difficult due to property constraints at the scale required to achieve the reduction in water surface elevations. The increased flow to Turkey Creek resulting from the relief sewer could be offset by reducing flowrates to Turkey Creek from a different subwatershed within the Town. For example, flood control storage could be constructed in the Chapel Manor Subwatershed which is tributary to Turkey Creek further downstream. This concept is discussed in further detail under the Chapel Manor Subwatershed discussion.



A larger relief sewer along 61<sup>st</sup> Avenue and extra storage is required to remove all structures from the CBEL delineated inundation area. The analysis was not taken further due to constructability and site constraints along 61<sup>st</sup> Avenue. The 6-foot x 12-foot RCBC is the largest and most reasonable conveyance system that can be constructed along 61<sup>st</sup> Avenue. The cost of the additional \$10 million should also be compared to the average cost of the structures in the subwatershed to be protected. The average home value in the area ranges from \$50,000 to \$125,000, according to current reality listings.

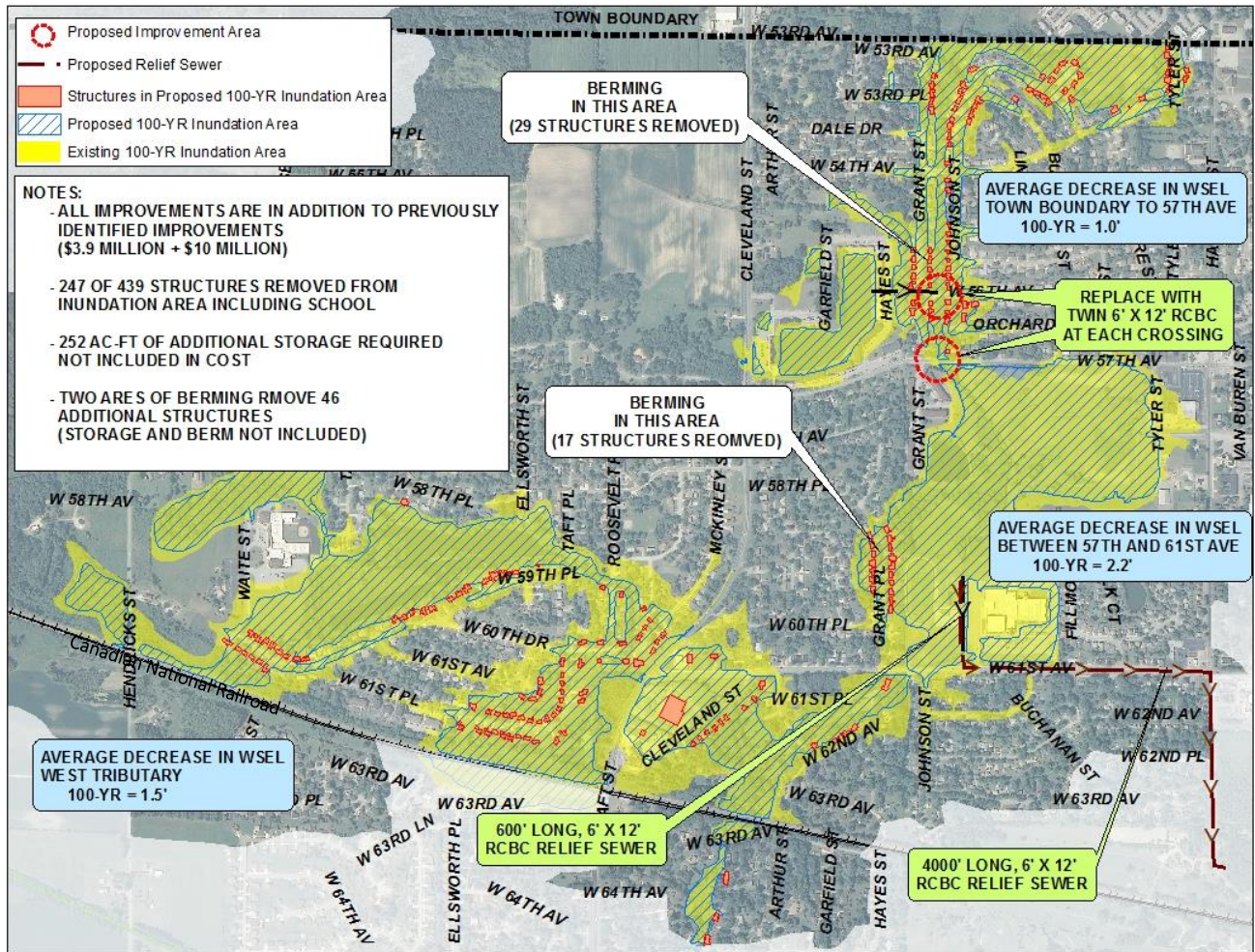


Figure 23. Meadowdale Lateral Subwatershed Ultimate Proposed CBEL 100-year Inundation Area



## CHAPTER 5 CHAPEL MANOR SUBWATERSHED

### 5.1 GENERAL OVERVIEW

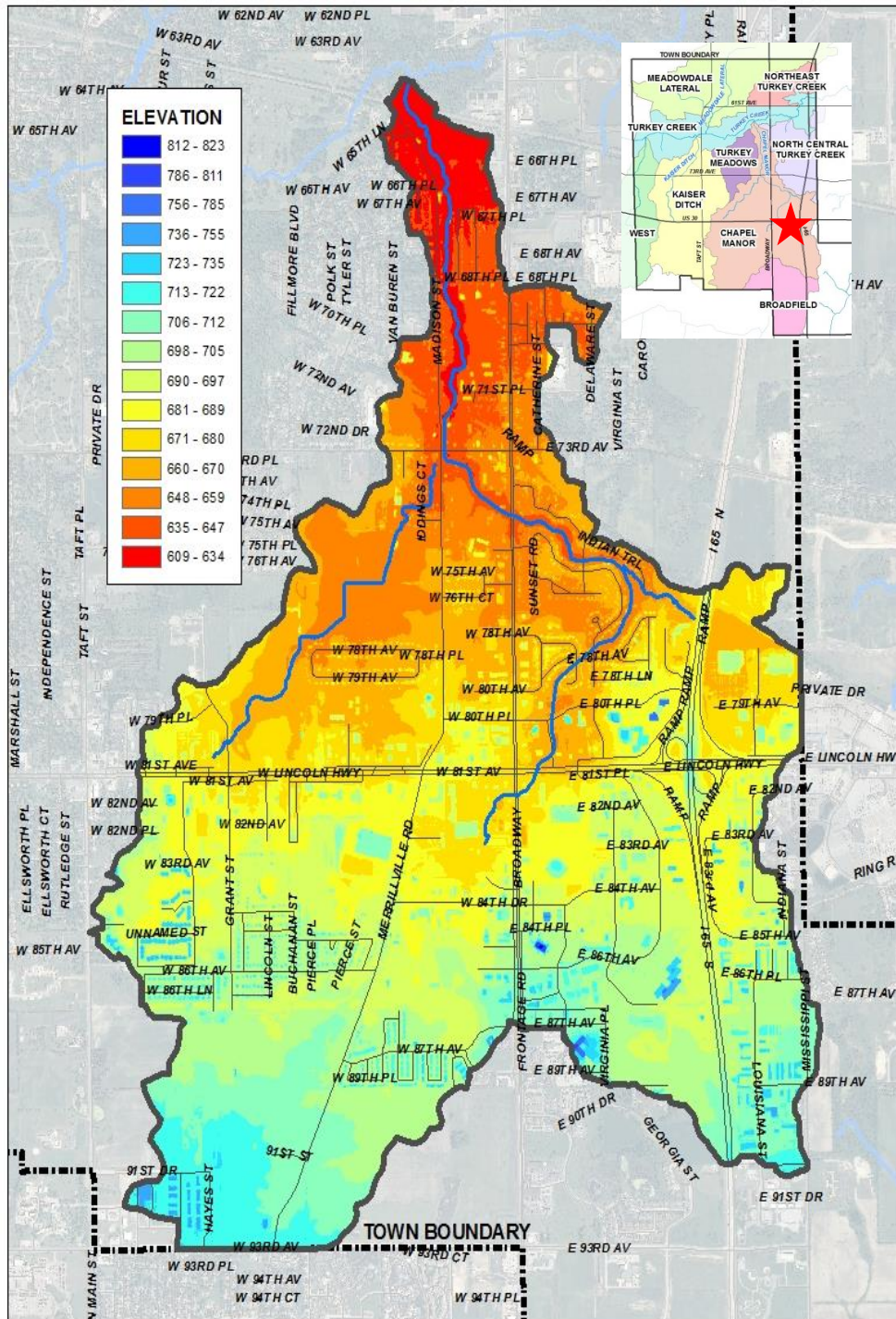
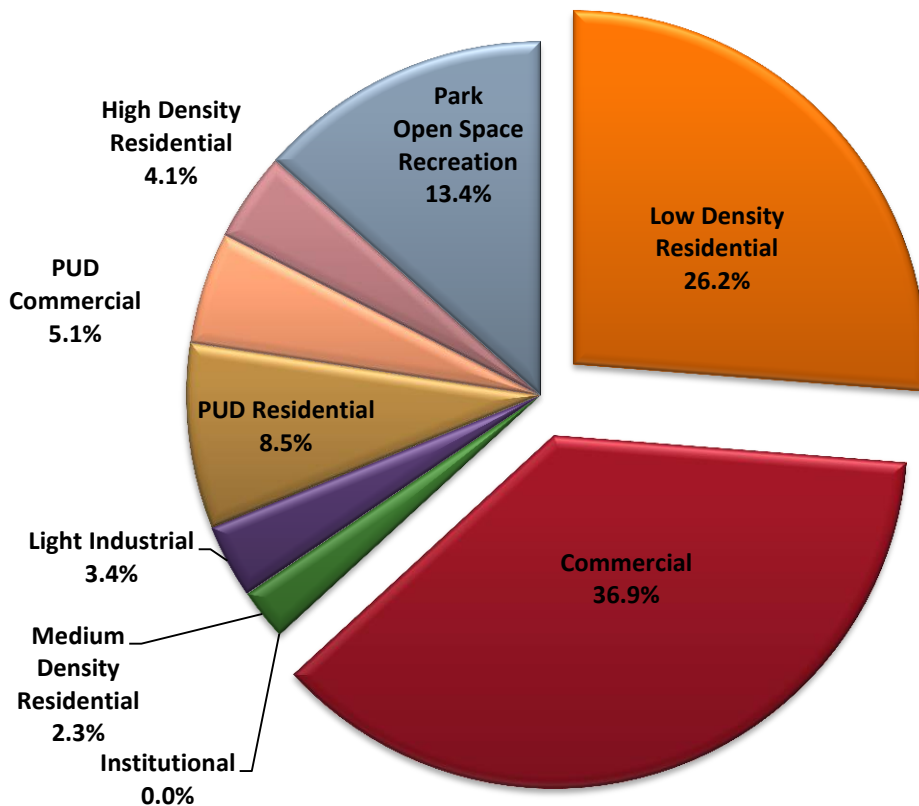


Figure 24. Chapel Manor Subwatershed by Elevation

The Chapel Manor Subwatershed consists of two tributaries flowing south to north, draining the I-65 and US 30 corridors and is tributary to Turkey Creek (Figure 24). The confluence of the two tributaries is located south of 73<sup>rd</sup> Avenue near Madison Street. The east tributary is mapped as regulatory Zone AE floodplain with a delineated floodway in the section of watercourse from the confluence with Turkey Creek, north to US 30. The western tributary is mapped as Zone A floodplain without an elevation or delineated floodway.

## 5.2 CHAPEL MANOR EXISTING CONDITIONS

The total tributary area in the Chapel Manor Subwatershed is 3,075 acres located completely within the Town's limits. The subwatershed land use is mostly commercial and low density residential with a notable portion of open space (Figure 25). The southwestern portion of the subwatershed consists of large undeveloped areas in the upper portions of the subwatershed. Following the delineation of the tributary areas to large diameter storm sewers and drainage ways, CBBEL created an XP-SWMM analysis of the subwatershed. The analysis combines information from the regulatory HEC-2 hydraulic modeling for Chapel Manor with field survey data and the Lake County 1-foot aerial topography. The regulatory model was obtained from the IDNR-Division of Water and was used for the sections of watercourse and culvert crossings



**Figure 25. Chapel Manor Subwatershed Land Use**

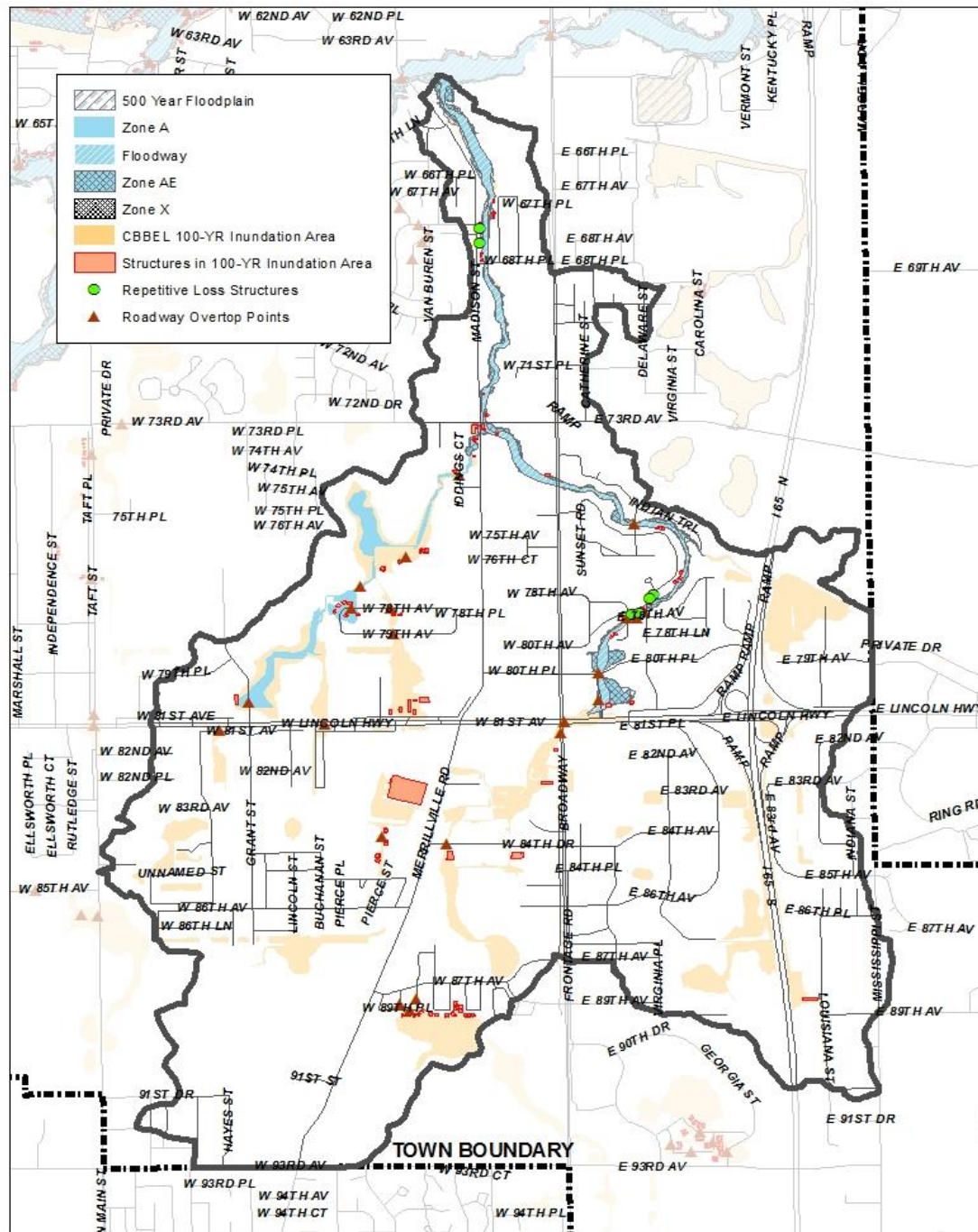
throughout the east tributary watercourse north of US 30. The analysis was extended south of US 30 to include the portion of the subwatershed throughout the eastern commercial areas and the residential areas to the west. An 18-hour storm event is the critical design storm for the subwatershed. Following the hydrologic and hydraulic analysis, CBBEL delineated the 100-year floodplain elevations using the Lake County topography. An analysis of the CBBEL proposed 100-year inundation delineation and the 1-foot aerial topographic data indicates that some areas with higher ground (above the base flood elevation) are erroneously included in the regulatory SFHA, and some areas with lower ground are erroneously shown as excluded. There are also some areas where the centerline as indicated by the aerial topography of the channel is shown outside the regulatory floodway.

### 5.2.1 Chapel Drive Problem Area

Based on the existing conditions XP-SWMM modeling results, one problem area of note is at the intersection of Chapel Drive and 79<sup>th</sup> Avenue where the eastern tributary enters a 5-ft x 9-ft RCBC. According to the GIS survey data layer (Survey Data), the 5-ft x 9-ft RCBC extends 80 feet to the upstream



side of Chapel Drive before entering two 36-inch CMPs. The two 36-inch CMPs continue downstream along 78<sup>th</sup> Avenue and outlet to the open channel downstream of Delaware Place and are restrictive. There are four (4) repetitive loss structures in this area (**Figure 26** and Repetitive Loss Structures layer). There are also two (2) additional repetitive loss structures located downstream of 68<sup>th</sup> Place. The information from the Survey Data layer was cross-referenced and confirmed with the plans for the construction of the RCBC dated September 13, 2010.



**Figure 26. Chapel Manor Subwatershed - Structures and Roads in Floodplain**

Two other additional problem areas of note include flooding in the subdivision between 78<sup>th</sup> And 79<sup>th</sup> Avenue west of Madison Street and backyard flooding in the subdivision along 89<sup>th</sup> Place east of Merrillville Road. The GIS analysis of the **Merrillville Structures 2011** layer compared to both the regulatory floodplain (**FEMA Data**) layer and the **CBBEL Delineated 100-year Inundation Area** layer identified 28 and 50 structures in the SFHA and the CBBEL delineated inundation area (**Table 13**). **Figure 26** shows the number of structures in the regulatory and CBBEL delineated 100-year flood inundation area created for this SWMP associated with Chapel Manor Subwatershed. The number of total structures within the CBBEL delineated SFHA is larger than the number in the regulatory SFHA. This is due to the unstudied portions of Chapel Manor Subwatershed along the western tributary south of 73<sup>rd</sup> Avenue and south of US 30. **Figure 26** is intended to be used for reference. The GIS master database should be accessed for more detailed information regarding structures within the SFHA, public roadway overtoppings, etc.

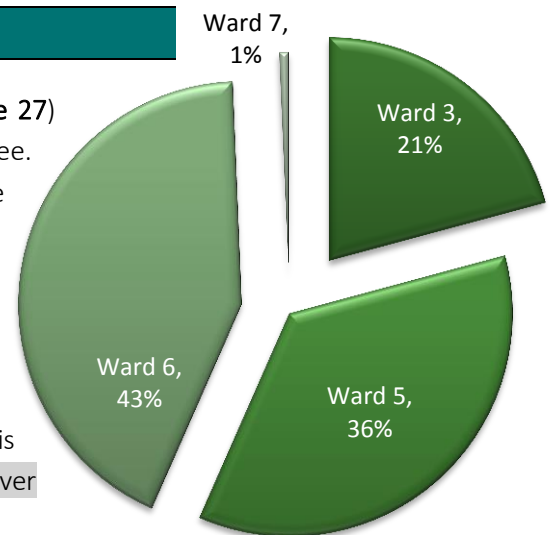
Structures in Regulatory 100-year Floodplain			Structures in CBBEL 100-year Inundation	Total Structures in Inundation Area
Floodway	Zone AE	Zone A		
18	21	7	50	50

**Table 13. Chapel Manor Subwatershed – Structures in Floodplain**

A comparison of the elevations used in the **CBBEL 100-year Inundation Area** to the public roadway overtopping elevations from Lake County aerial topography showed three (3) major roadway overtoppings and 19 minor roadway overtoppings (**Figure 26**). The public roadway overtoppings are due to restrictive culvert crossings and are responsible for backing water up, upstream leading to street flooding and subsequent structure flooding. In some cases, the problem areas created by a restrictive culvert crossing are compounded by silt and/or debris combined with either a failing or collapsed pipe.

### 5.3 CHAPEL MANOR BY WARD AND UTILITY FEE

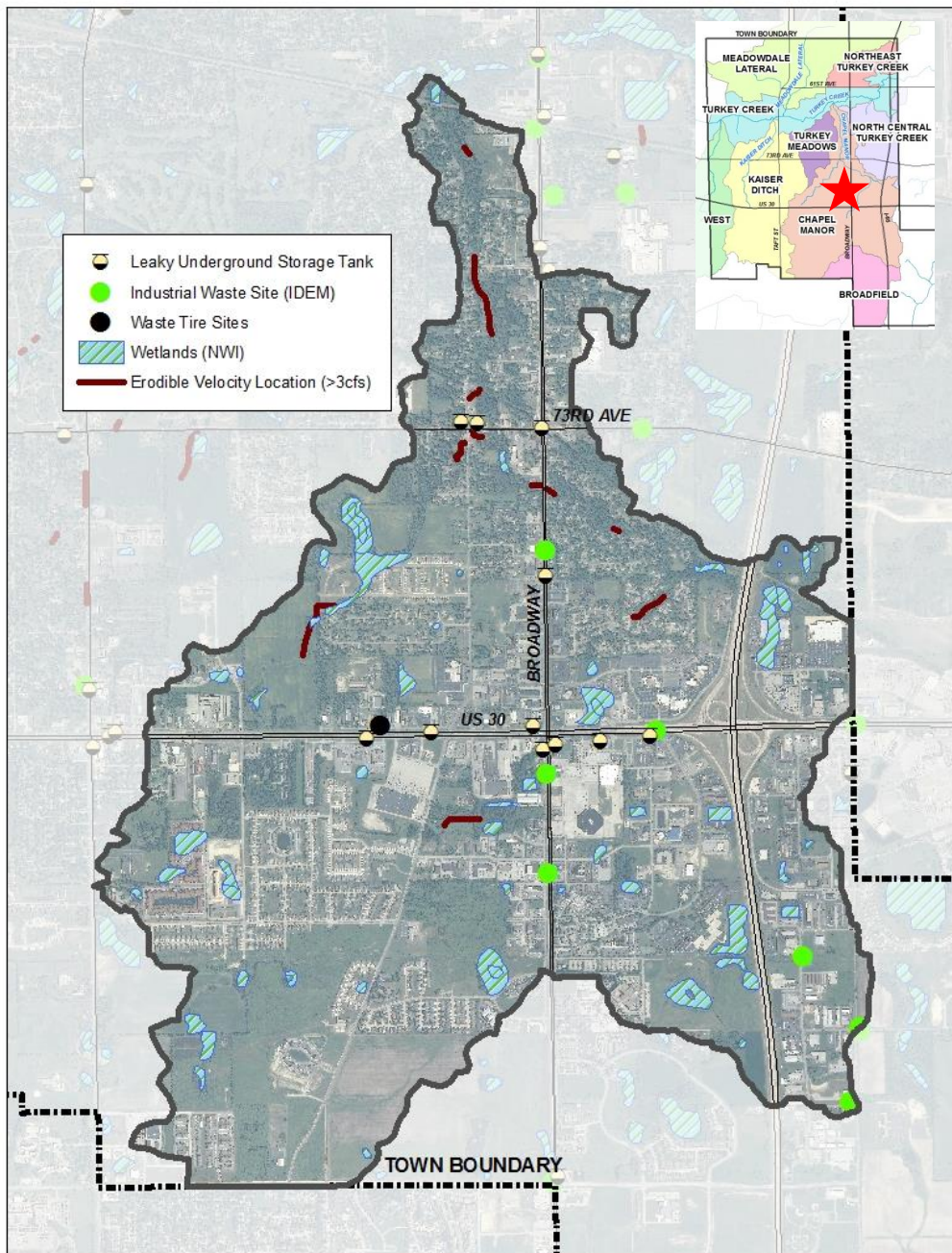
The Chapel Manor Subwatershed consists of 4 Wards (**Figure 27**) and contributes 32% of the Town's yearly stormwater utility fee. This percentage is of the total contribution from the subwatersheds studied in this SWMP. This does not include the unstudied portions of Town. This information is based on the Town's 2013 stormwater utility fee and is a function of the land use within the subwatershed. There are approximately 1,958 residential parcels in the subwatershed (74% of the parcels in the subwatershed are residential). This information can be accessed under the **Land Use and Cover** group layer in the master GIS database.



**Figure 27. Chapel Manor Subwatershed by Ward**



## 5.4 CHAPEL MANOR EXISTING WATER QUALITY CONCERNS



**Figure 28. Chapel Manor Subwatershed Environmental Concerns**

baseline levels of water quality constituents. A good point of reference for this testing could be located at the confluence between the east and west tributaries and at the confluence with Turkey Creek.

From the XP-SWMM modeling analysis, erodible velocities were shown in the eastern and western tributaries both north and south of 73rd Avenue (Figure 28). This data corresponds well, suggesting that erodible velocities are associated with the portion of the subwatershed with dense residential

A water quality exhibit was created for the Chapel Manor Subwatershed (Figure 28) using the database Water Quality Hot Spots layer in the master GIS database. The subwatershed figure does not indicate a large number of water quality hotspots, and data from IDEM and EPA is somewhat limited. There are multiple leaky underground storage tanks along the US 30 and Taft Street corridors, as well as multiple industrial waste sites along Taft Street. Figure 28 also does not show areas within the subwatershed that were part of an EPA or IDEM water quality monitoring study and publicly available data for the subwatershed is relatively limited. This suggests the need for a potential water quality program within the subwatershed following the establishment of

development. Likewise, erodible velocities are not associated with the undeveloped areas south of 73<sup>rd</sup> Avenue or within the headwaters of the subwatershed.

For most channel banks in the erodible velocity zone, manicured residential lawns with no riparian zone is the predominant land use for the two tributaries. These streams would expect to show signs of being impacted by runoff and non-supporting of healthy stream ecosystem levels from stormwater runoff and would impact aquatic organisms and the overall health of the stream. The enforcement of a riparian buffer or easement could be used as a method to establish habitat restoration in these areas. Chapel Manor is not a regulated drain under LCSO jurisdiction. Therefore, the establishment of a buffer along the watercourse through residential areas would be most beneficial.

## 5.5 CHAPEL MANOR PROPOSED CONDITIONS

CBBEL evaluated improvements including additional stormwater storage and conveyance along the western tributary of Chapel Manor to alleviate flooding. The proposed improvements consist of three projects (**Figure 29**) including a flood storage reservoir at the northwest corner of Broadway and 67<sup>th</sup> Avenue, culvert construction at Chapel Drive, storm sewer improvements combined with additional storage in the subdivision at 69<sup>th</sup> Place and floodplain remapping.

### 5.5.1 Flood Control Storage – (Broadway and 67<sup>th</sup> Avenue)

A proposed location for flood control storage as suggested by the Town is currently vacant commercial land and could be used to provide approximately 100 ac-ft of flood storage. The location, northwest corner of Broadway and 67<sup>th</sup> Avenue, would be considered regional storage for the Chapel Manor and Turkey Creek Subwatersheds. Regional storage at this location could be combined with proposed improvements in other subwatersheds. The benefit of the reservoir is approximately 100 cfs reduction or 6% of the peak 100-year flowrate entering Turkey Creek from the Chapel Manor Subwatershed. This reduction could be used to offset increased flowrates from other subwatersheds resulting from the removal of restrictive culverts; for example, the restrictive Railroad culvert in the Meadowdale Subwatershed. Removal of the restrictive culvert will cause downstream increases in water surface elevations and flowrates along Turkey Creek. The increases along Turkey Creek could be offset by reducing flowrates from a downstream subwatershed within the Town.

As previously discussed for the Meadowdale Subwatershed, the ultimate proposed plan requires additional storage in the subwatershed if restrictive culverts are removed or relief sewers are constructed. We have determined that storage is possible in the subwatershed, however this will be difficult due to property constraints at the scale required to achieve the water surface elevations required to remove structures from the inundations areas at lower elevations. A combined subwatershed approach is more likely and presents an opportunity to apply funding from the Little Calumet River Basin Development Commission. The estimated cost to construct the 100 ac-ft flood control reservoir in the Chapel Manor Subwatershed (northwest corner of Broadway and 67<sup>th</sup> Avenue) is approximately \$5.2 million (**Appendix 1**).





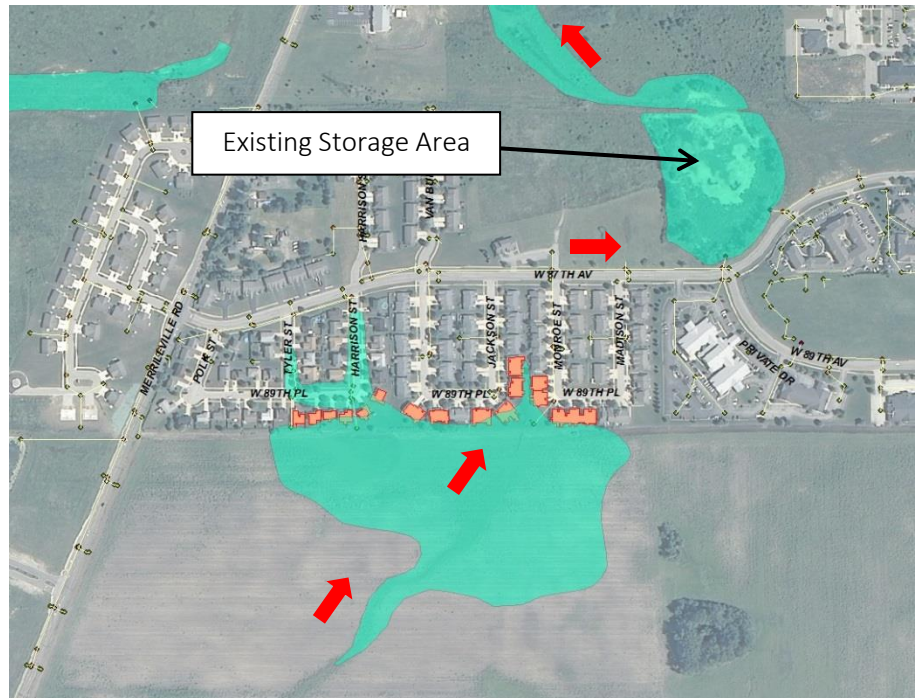


### 5.5.2 Chapel Drive - Culvert Reconstruction

Removal of the restrictive 36-inch CMPs and continuation of the 5 ft x 9 ft RCBC along 78<sup>th</sup> Avenue will prevent the crossing from overtopping and subsequently remove the four (4) repetitive loss structures from the floodplain. According to the proposed condition XP-SWMM analysis, flow rates are not increased as a result of removing the restriction. The increase in flow is offset in this case by the timing difference in peak flowrates from the inflow hydrographs. The estimated cost to construct the culvert extension is approximately \$1.2 million (**Appendix 1**).

### 5.5.3 Backyard Flooding – 89<sup>th</sup> Place

A large undeveloped off-site tributary area is bypassed through the backyards of the subdivision along 89<sup>th</sup> Place east of Merrillville Road. The runoff from the area is picked up by a 36-inch RCP and routed through the existing storage area on the north side of 87<sup>th</sup> Avenue (**Figure 30**). This pipe restricts the bypass flow and causes backyard flooding. There are 14 structures shown in the CBBEL delineated 100-year inundation area. The

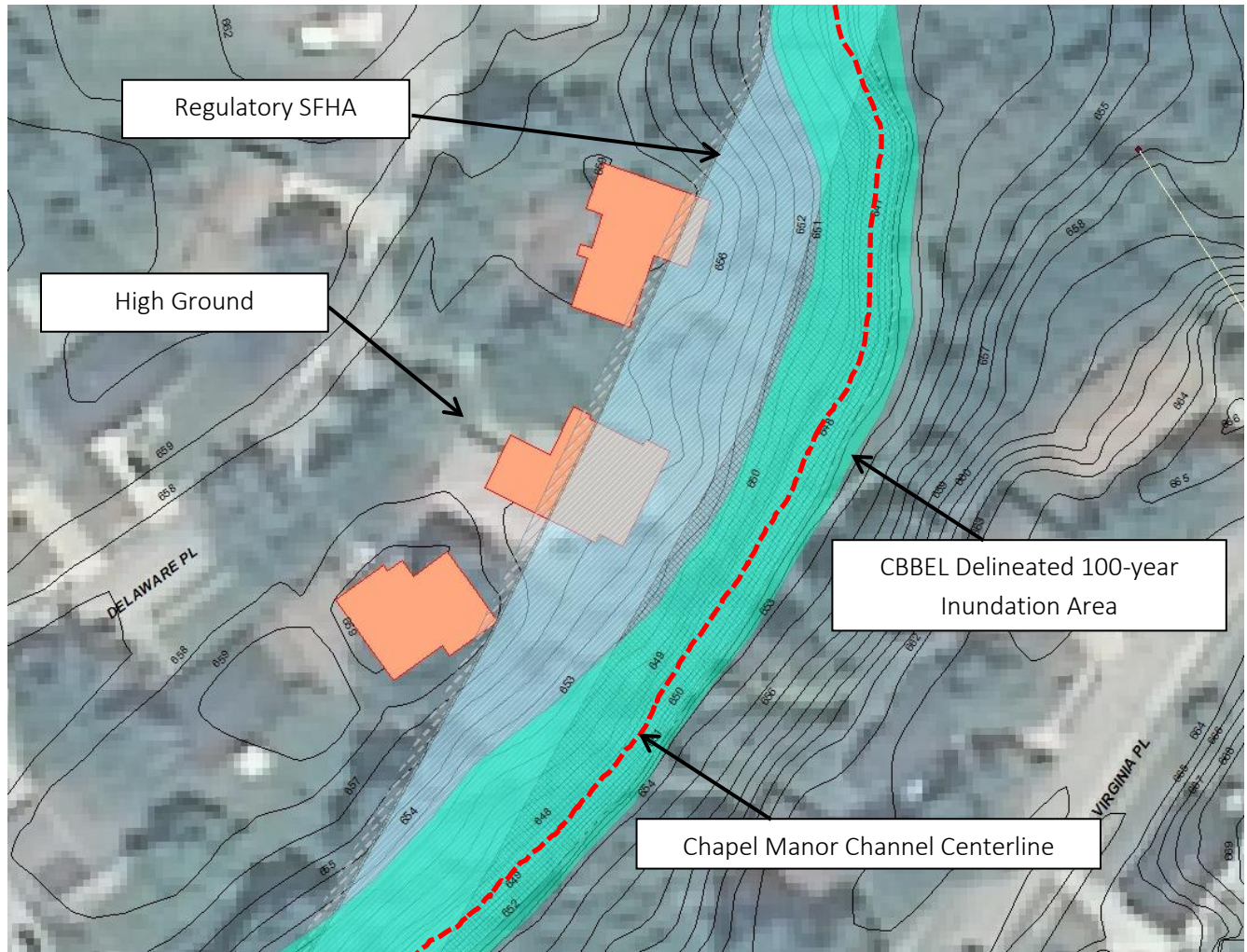


**Figure 30. Chapel Manor - 89<sup>th</sup> Place - CBBEL Delineated 100-year Inundation Area**

The proposed condition includes upsizing the bypass pipe from a 36- and 42-inch to a 42- and 54-inch line, combined with approximately 20 ac-ft of additional storage. The enlargement of the existing storage area is required to offset the increased downstream flowrates. The proposed storm sewer improvements combined with 20 ac-ft of storage, removes 13 of the 14 structures from the CBBEL delineated 100-year inundation area. The estimated cost to construct these improvements is \$2.3 million and does not include land acquisition costs. Maintenance of the existing storm sewer system along the backyards and 87<sup>th</sup> Avenue to the existing storage basin is recommended proper conveyance of the bypass flow from the south. A further detailed analysis of the area for pre- and post-construction of the subdivision could be used to show that the existing off-site bypass flow from the south has not been increased as a result of the development. This would eliminate the need for the storage component of the proposed improvements. This would reduce the cost of the proposed improvements from \$2.3 million to \$720,000 for this area if the storage component is eliminated.

### 5.5.4 Floodplain Re-Mapping

An analysis of the 1-foot aerial topography reveals several locations where the channel is shown outside the floodway. There are also locations where high ground is included in the floodplain and places where low ground has been excluded. The regulatory hydraulic model for Chapel Manor is dated October, 1981, and includes minimal cross sections and may have missed topography that impacts the water surface elevations. LCSO is in the process of compiling new 1-foot aerial topography. Using the analysis created for this SWMP, the floodplain should be remapped based on current information.



**Figure 31. Chapel Manor Subwatershed Regulatory SFHA versus CBEL 100-year Inundation Area**

### 5.5.5 Subdivision at 78<sup>th</sup> and 79<sup>th</sup> Avenue west of Madison Street

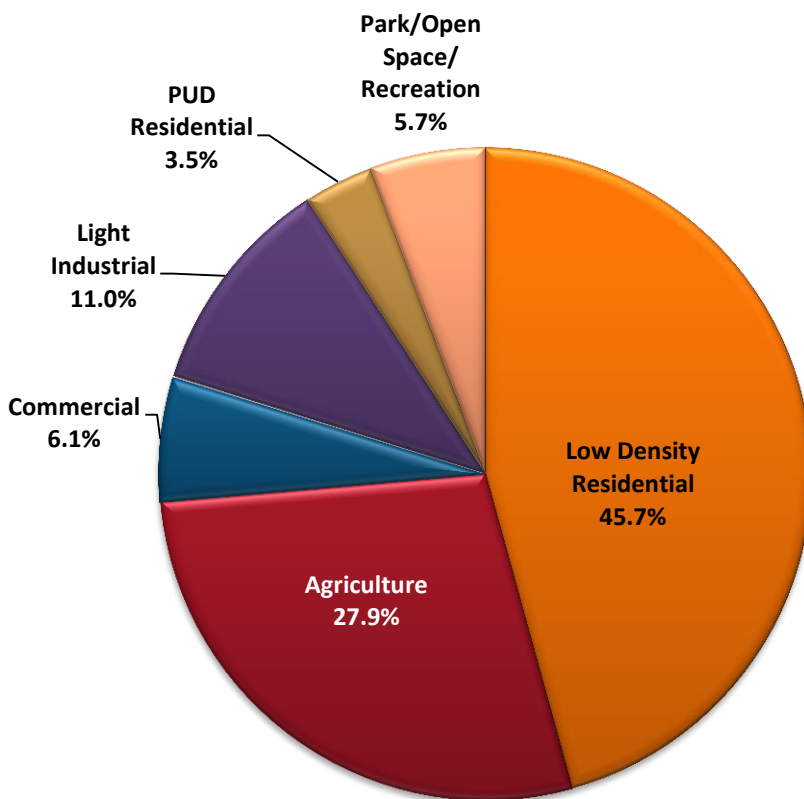
The Town is currently engaged in a drainage improvement project in the upstream portion of the subwatershed in the subdivision located west Madison Street between 78<sup>th</sup> and 79<sup>th</sup> Avenue to resolve on-going drainage issues.







## 6.2 WEST SUBWATERSHED EXISTING CONDITIONS



**Figure 33. West Subwatershed Land Use**

The total tributary area in the West Subwatershed is 1877 acres where 749 acres is located within the Town limits. The subwatershed land use is mostly agriculture and low density residential with a notable portion of commercial/light industrial use located predominantly along the US 30 corridor (**Figure 33**). The northern portion of the subwatershed consists of two (2) large depressions or former sand quarries located on either side of the main channel of the tributary.

Following the delineation of the tributary areas to large diameter storm sewers and drainage ways, CBBEL created an XP-SWMM analysis of the subwatershed. There is no regulatory hydraulic modeling available for the unnamed tributary. The XP-SWMM analysis is based on field survey data and the Lake County 1-foot aerial topography. The 12-hour storm

event is the critical design storm for the subwatershed. CBBEL delineated the 100-year floodplain elevations using the Lake County topography. An analysis of the current aerial photography, existing CBBEL delineated 100-year inundation area and the 1-foot aerial topographic data indicates that some areas are included in the inundation areas that do not reflect current development in the area. This is the case for two (2) recently constructed subdivisions located between 73<sup>rd</sup> Avenue and US 30 west of Whitcomb Street. The GIS analysis of the **Merrillville Structures 2011** layer compared to both the regulatory floodplain (**FEMA Data**) layer and the **CBBEL Delineated 100-year Inundation Area** layer identified no structures in the SFHA and 20 structures in the CBBEL delineated inundation area (**Table 14**). **Figure 34** shows the number of structures in the CBBEL delineated 100-year flood inundation area created for this SWMP. The GIS master database should be accessed for more detailed information regarding structures within the SFHA, public roadway overtoppings, etc.

Structures in Regulatory 100-year Floodplain			Structures in CBBEL 100-year Inundation	Total Structures in Inundation Area
Floodway	Zone AE	Zone A		
0	0	0	20	20

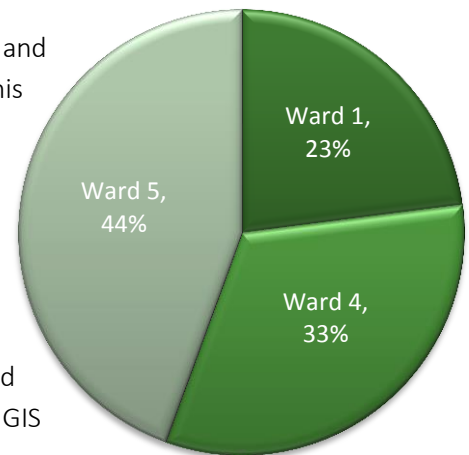
**Table 14. West Subwatershed – Structures in Floodplain**



A comparison of the elevations used in the **CBBEL 100-year Inundation Area** to the public roadway overtopping elevations from Lake County aerial topography showed no major roadway overtoppings and nine (9) minor roadway overtoppings (**Figure 34**). The public roadway overtoppings are due to restrictive culvert crossings and are responsible for backing water up, upstream leading to street flooding and subsequent structure flooding. In some cases, the problem areas created by a restrictive culvert crossing are compounded by silt and/or debris combined with either a failing or collapsed pipe.

### 6.3 WEST SUBWATERSHED BY WARD AND UTILITY FEE

The West Subwatershed consists of three (3) Wards (**Figure 35**) and contributes 5% of the Town's yearly stormwater utility fee. This percentage is of the total contribution from the subwatersheds studied in this SWMP. This does not include the unstudied portions of Town. This information is based on the Town's 2013 stormwater utility fee and is a function of the land use within the subwatershed. There are approximately 795 residential parcels in the subwatershed (89% of all parcels in the subwatershed are residential). This information can be accessed under the **Land Use and Cover** group layer in the master GIS database.



**Figure 35. West Subwatershed by Ward**

### 6.4 WEST SUBWATERSHED EXISTING WATER QUALITY CONCERNS

A water quality exhibit was created for the West Subwatershed (**Figure 36**) using the database **Water Quality Hot Spots** layer in the master GIS database. The subwatershed figure does not indicate that a large number of water quality hotspots exist. Data from IDEM and EPA is also limited. This is to be expected given the low land use density of the subwatershed. From the XP-SWMM modeling analysis, erodible velocities were shown north of 73<sup>rd</sup> Avenue (**Figure 36**) up through the former sand mine location.

While the channel is relatively straight through the newly constructed subdivisions between US 30 and 73<sup>rd</sup> Avenue, there were no erodible velocities through this area. An analysis of current aerial photography shows that the infrastructure for the new subdivisions has been constructed while homes in the subdivision are not complete. The lack of established residential development in this area corresponds well, suggesting that erodible velocities are associated with the portion of the subwatershed with dense residential development. If left unprotected, manicured residential lawns with no riparian zone is likely the future land use in this area. The enforcement of a riparian buffer or easement could be used as a method to protect the relative health of the stream in this area prior to full build-out of the subdivision. The unnamed tributary is not a regulated drain under LCSO jurisdiction. Therefore, the establishment of a buffer along the watercourse through the residential area would be beneficial.



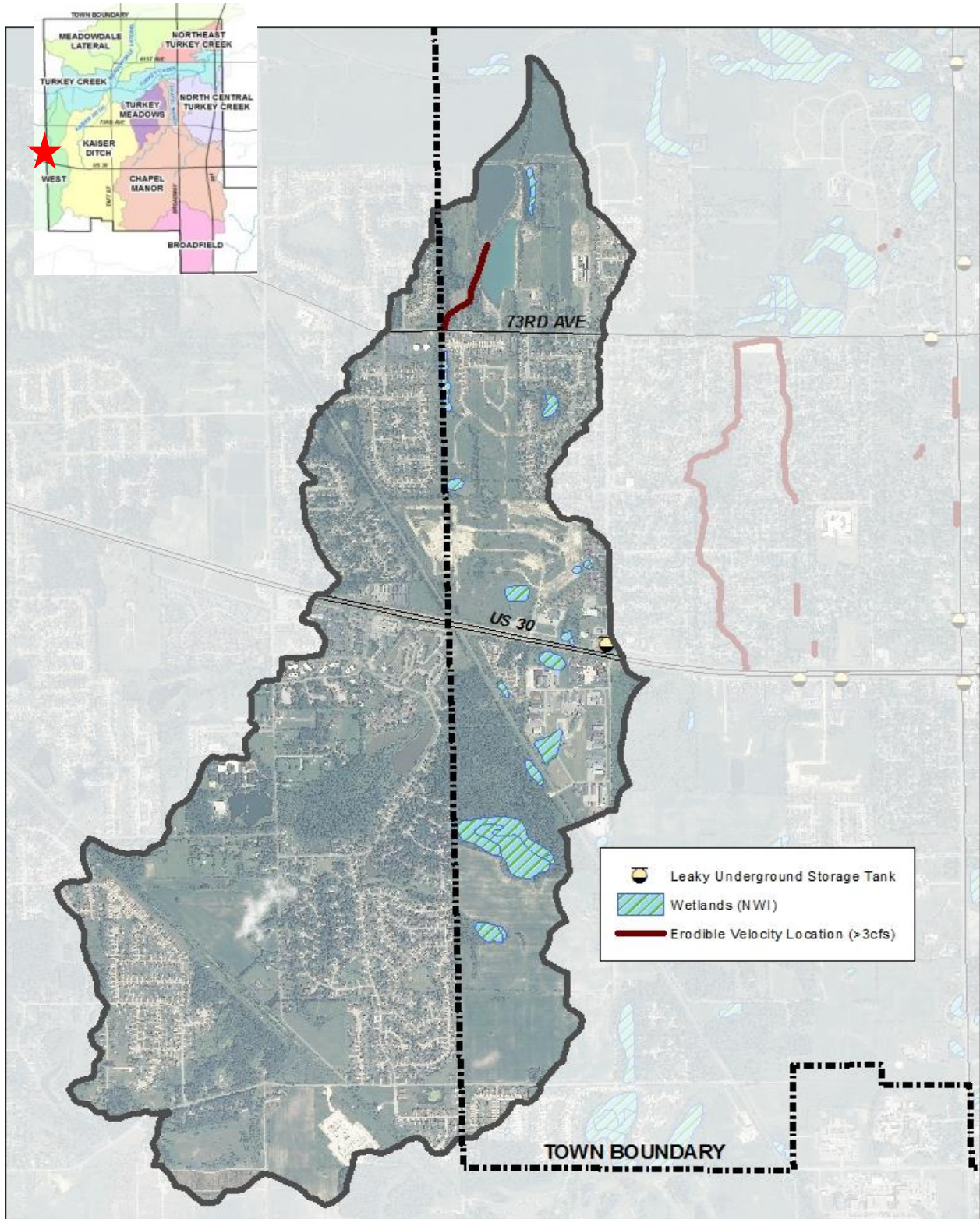


Figure 36. West Subwatershed Environmental Concerns

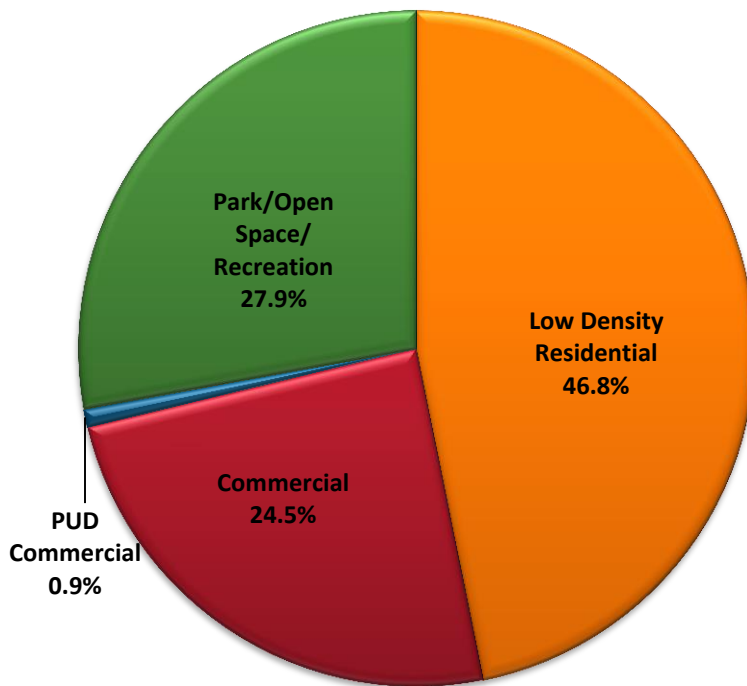


## 6.5 SUBWATERSHED PROPOSED CONDITIONS

There are currently no structures with the regulatory SFHA. As part of this study, CBBEL delineated the 100-year inundation area based on the 1-foot aerial topography and found 20 structures within the CBBEL delineated existing condition inundation area. The current aerial photography shows that the 1-foot aerial topography does not reflect the current land use or recent construction. The LCSO is in the process of compiling new 1-foot aerial topography. The existing condition CBBEL delineated 100-year inundation area in the West Subwatershed should be remapped based on the new aerial topographic information and the analysis created for this SWMP. This will likely remove the 20 structures located in the CBBEL delineated 100-year existing condition inundation area.



## 7.2 NORTH CENTRAL TURKEY CREEK EXISTING CONDITIONS



**Figure 38. North Central Turkey Creek Subwatershed Land Use**

The total tributary area in the North Central Turkey Creek Subwatershed is 931 acres of which 56 acres are located outside the Town's limits. The subwatershed land use within the Town limits is low density residential, commercial and open space (**Figure 38**). The northern portion of the subwatershed consists of open space and recreation including Hidden Lake Park and the Ross Township pond (Skinner Pond). Skinner Pond is located between 69<sup>th</sup> and 70<sup>th</sup> Place east of Clifford Peirce Middle School on Ross Township property.

Following the delineation of the tributary areas to large diameter storm sewers and drainage ways, CBBEL created an XP-SWMM analysis of the subwatershed. There is no regulatory hydraulic modeling available for the subwatershed. The XP-SWMM analysis is based on field survey data and the Lake County 1-foot aerial topography. The 18-hour storm event is the critical design storm for the subwatershed. CBBEL delineated the 100-year floodplain elevations using the Lake County 1-foot aerial topography.

The GIS analysis of the **Merrillville Structures 2011** layer compared to the **CBBEL Delineated 100-year Inundation Area** layer identified four (4) structures in the CBBEL delineated inundation area (**Table 15**). **Figure 39** shows the number of structures in the CBBEL delineated 100-year flood inundation area created for this SWMP. The GIS master database should be accessed for more detailed information regarding structures within the CBBEL delineated inundation areas and public roadway overtoppings.

Structures in Regulatory 100-year Floodplain			Structures in CBBEL 100-year Inundation	Total Structures in Inundation Area
Floodway	Zone AE	Zone A		
0	0	0	4	4

**Table 15. North Central Turkey Creek Subwatershed – Structures in Floodplain**

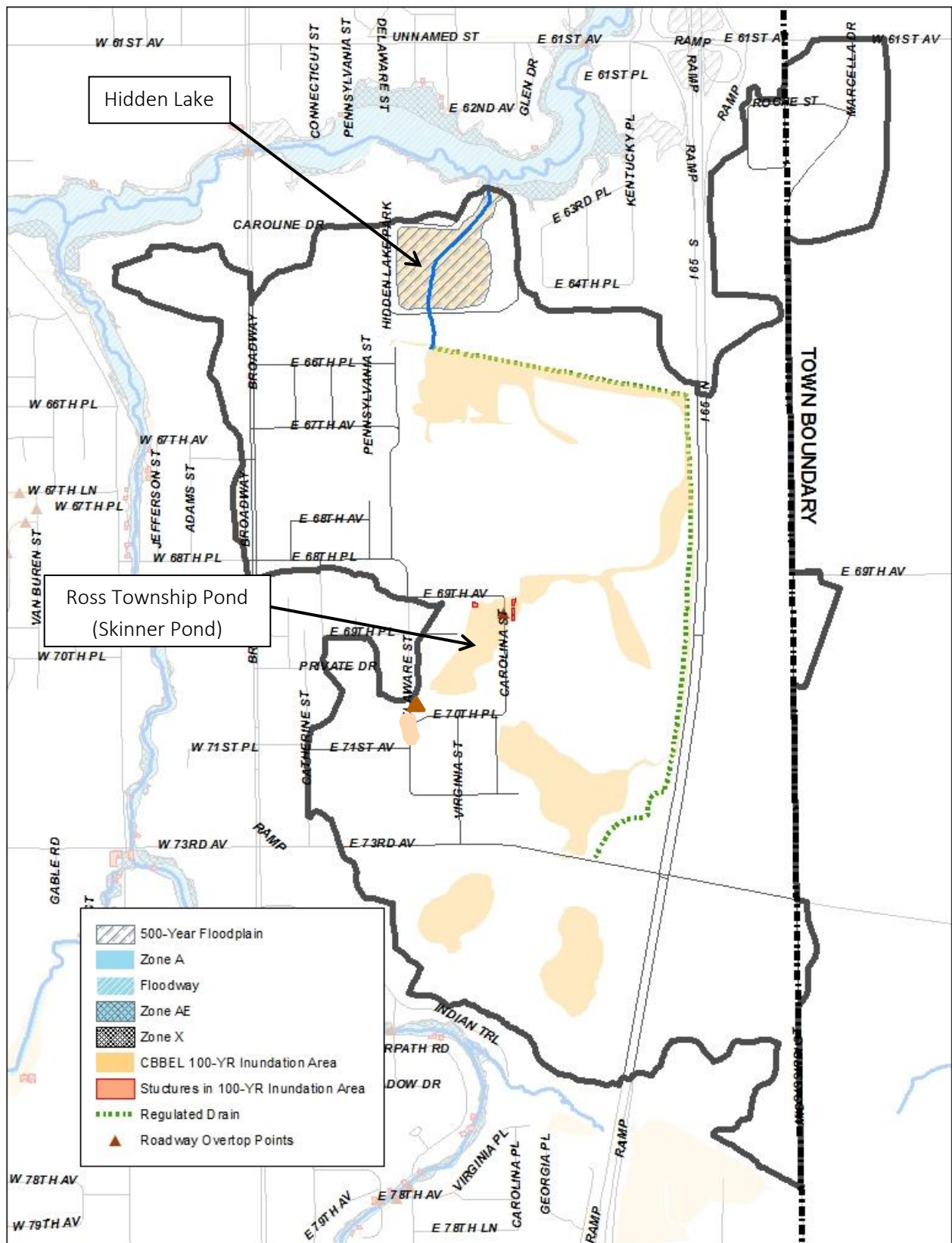


Figure 39. North Central Turkey Creek Watershed - Structures and Roads in Floodplain



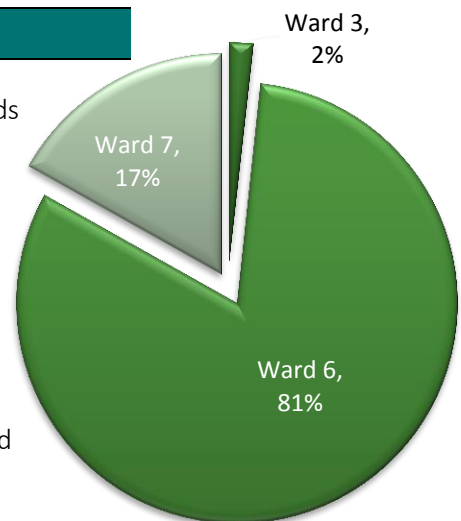
Two problem areas of note in the North Central Turkey Creek Subwatershed are located at the northeast corner of Skinner Pond (Figure 40) and the intersection of Delaware Street and 70<sup>th</sup> Place. Localized street ponding occurs along Delaware Street when the storm sewers in the area reach capacity. According to the existing condition XP-SWMM analysis, Skinner Pond overtops to the northeast upon reaching capacity. The overtopping to the northeast continues north toward the Merrillville High School property and could inundate structures in the immediate areas around the northeast corner of the pond.



**Figure 40. Skinner Pond (Ross Township) North Central Turkey Creek Subwatershed**

### 7.3 NORTH CENTRAL TURKEY CREEK BY WARD AND UTILITY FEE

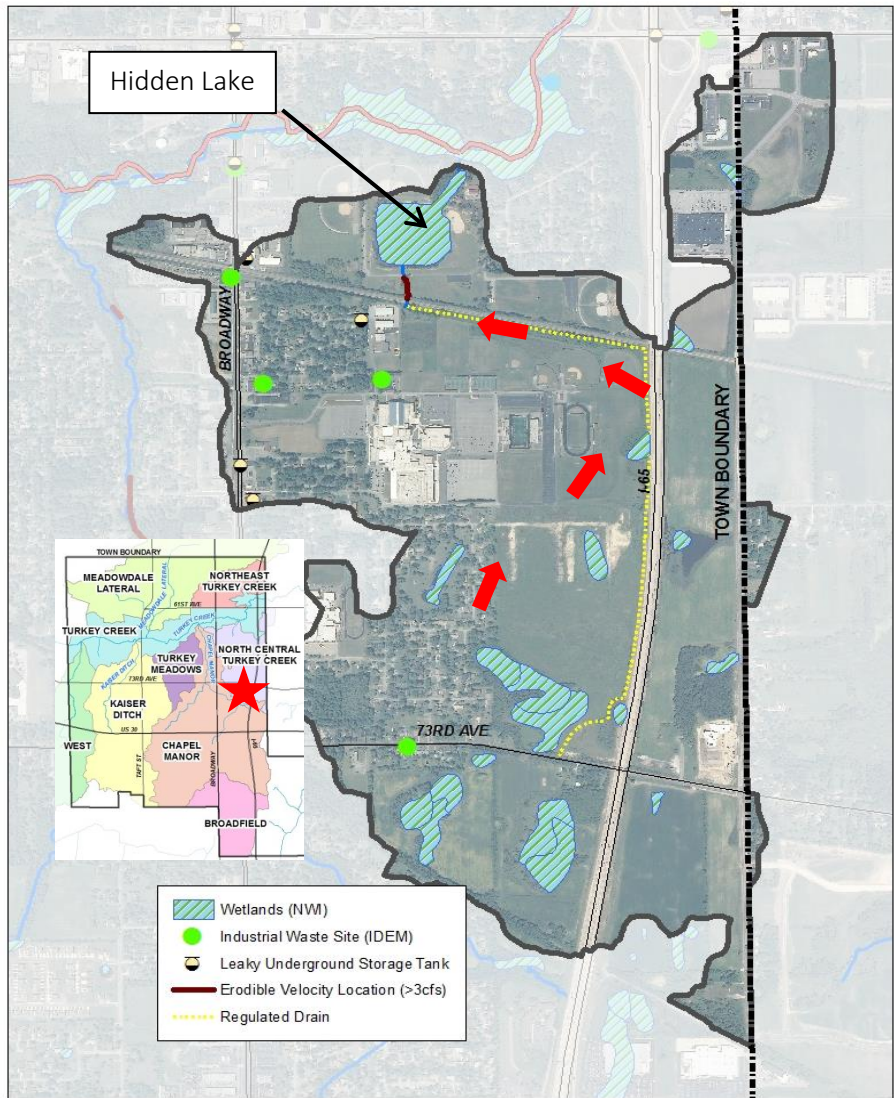
The North Central Creek Subwatershed consists of three (3) Wards (Figure 41) and contributes 3% of the Town's yearly stormwater utility fee. This percentage is of the total contribution from the subwatersheds studied in this SWMP. This does not include the unstudied portions of Town. This information is based on the Town's 2013 stormwater utility fee and is a function of the land use within the subwatershed. There are approximately 257 residential parcels in the subwatershed (73% of all parcels in the subwatershed are residential). This information can be accessed under the **Land Use** and **Cover** group layer in the master GIS database.



**Figure 41. North Central Turkey Creek Subwatershed by Ward**

## 7.4 NORTH CENTRAL TURKEY CREEK EXISTING WATER QUALITY CONCERNS

A water quality exhibit was created for the North Central Turkey Creek Subwatershed (Figure 42) using the Water Quality Hot Spots layer in the master GIS database. There are approximately seven (7) water quality hot spots mainly associated with the Merrillville High School bus garage and along Broadway. The subwatershed figure does not indicate a large number of water quality hotspots, and data from IDEM and EPA is somewhat limited. This is consistent with the large amount of open space and undeveloped areas within the subwatershed. The subwatershed also consists of three (3) large wetlands in addition to the open water associated with Hidden Lake and the Skinner Pond.



**Figure 42. North Central Turkey Creek Subwatershed Environmental Concerns**

While there is no major watercourse draining upper portions of the subwatershed, a drainage way along the west side of I-65 conveys runoff around the northeast portion of the Merrillville High School property north to Hidden Lake. Runoff that is tributary to this drainage way meanders across natural open space, which acts as a naturalized buffer before it is channelized into Hidden Lake north of the Railroad and continues to its confluence with Turkey Creek (Figure 42). The unnamed tributary is a regulated drain and is under the jurisdiction of the LCSO. A small section of the unnamed tributary is shown to have erodible

velocity in the channel as it enters Hidden Lake. Water quality testing at Hidden Lake where the channel enters the lake would be an ideal location for baseline testing of constituent levels and would provide a good representation of the water quality health of the subwatershed under existing conditions.

Future development is likely to occur on the parcels east of Carolina Street and south of the high school property, as well as the on the properties south of 73<sup>rd</sup> Avenue. These areas will continue to drain north to the unnamed tributary. The open space in the subwatershed should be maintained to the greatest extent possible. Likewise, best management practices should be enforced during development of these areas. Water quality testing at Hidden Lake should be established before the remaining portions of the subwatershed are developed to form a baseline constituent level for comparison under pre- and post-construction activities. The North Central Turkey Creek Subwatershed is very good candidate for water quality testing programs that monitor best management practices, as all future development in the relatively undeveloped subwatershed will be subject to the provisions in the Town's Ordinance.

## 7.5 NORTH CENTRAL TURKEY CREEK PROPOSED CONDITIONS

CBBEL evaluated improvements including additional stormwater storage at Skinner Pond and storm sewer conveyance improvements along Delaware Street. Additional storage at Hidden Lake was investigated; however this is not possible due to site constraints and was not further investigated.

### 7.5.1 Additional Storage at Skinner Pond

There are currently no structures within a regulatory SFHA in the North Central Turkey Creek Subwatershed. As part of this SWMP, CBBEL delineated the 100-year inundation area based on the 1-foot aerial topography and found four (4) structures within the CBBEL delineated existing condition inundation area at the northeast corner of Skinner Pond. There is additional space available on the Ross Township property to expand the existing pond and provide approximately 20 ac-ft of storage (**Figure 43**). According to the proposed condition XP-SWMM analysis, the additional 20 ac-ft of storage removes four (4) structures at the northeast corner of the pond from the existing condition CBBEL delineated 100-year inundation area. The estimated cost to construct the additional storage is approximately \$1.4 million (**Appendix 1**). Expansion of the existing storage area presents an opportunity to collaborate efforts with Ross Township and will reduce the costs incurred by the Town.

### 7.5.2 Delaware Street Storm Sewer Improvements

As noted by Town staff, localized street flood along Delaware Street has been addressed with storm sewer improvements to increase the existing outlet pipe from a 36-inch to a 42-inch diameter storm sewer draining into the existing pond. This will reduce the risk of flooding along Delaware Street for the 100-year design storm. The estimated cost to construct the culvert extension is approximately \$250,000 (**Appendix 1**).

### 7.5.3 Additional Improvements

The small stretch (approximately 370 feet) of open channel from the downstream face of the Railroad to the outlet at Hidden Lake is shown to have erodible velocities (**Figure 43**). Water quality and channel bank monitoring could be implemented at this location in a partnership with Ross Township.







## CHAPTER 8 BROADFIELD SUBWATERSHED – UNNAMED TRIBUTARY TO MAIN BEAVER DAM DITCH

### 8.1 GENERAL OVERVIEW

The Broadfield Subwatershed is named after the Broadfield Subdivision located in the upstream portion of the subwatershed north of 93<sup>rd</sup> Avenue and east of Broadway (Figure 44). The portion of the subwatershed located within the Town limits generally drains in the southwest direction and is tributary to an unnamed tributary to Main Beaver Dam Ditch according to the regulatory FIRM. A small section of this watercourse is also known as Beaver Dam Ditch (Lateral #2) and is a regulated drain under LCSO jurisdiction (Figure 44). The drainage system in the subwatershed consists of a series of constructed detention ponds connected through storm sewers and overland flow paths. The subwatershed does not consist of a channelized watercourse until runoff reaches the downstream or west side of Broadway where the watercourse is known as an unnamed tributary to Main Beaver Dam Ditch. The unnamed tributary in the vicinity of Broadway south of 97<sup>th</sup> Avenue is mapped as regulatory Zone AE floodplain with no delineated floodway (Figure 46).

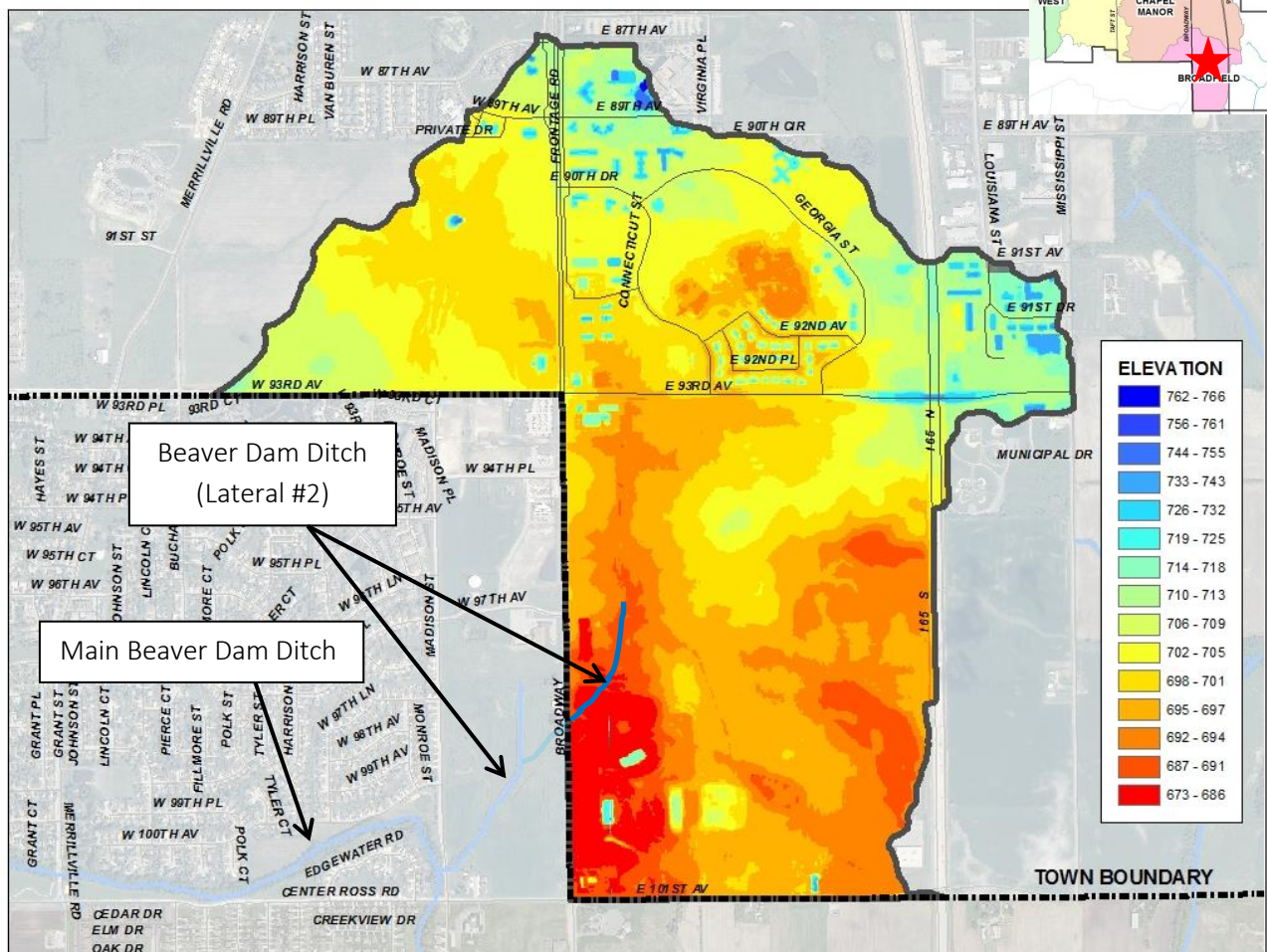
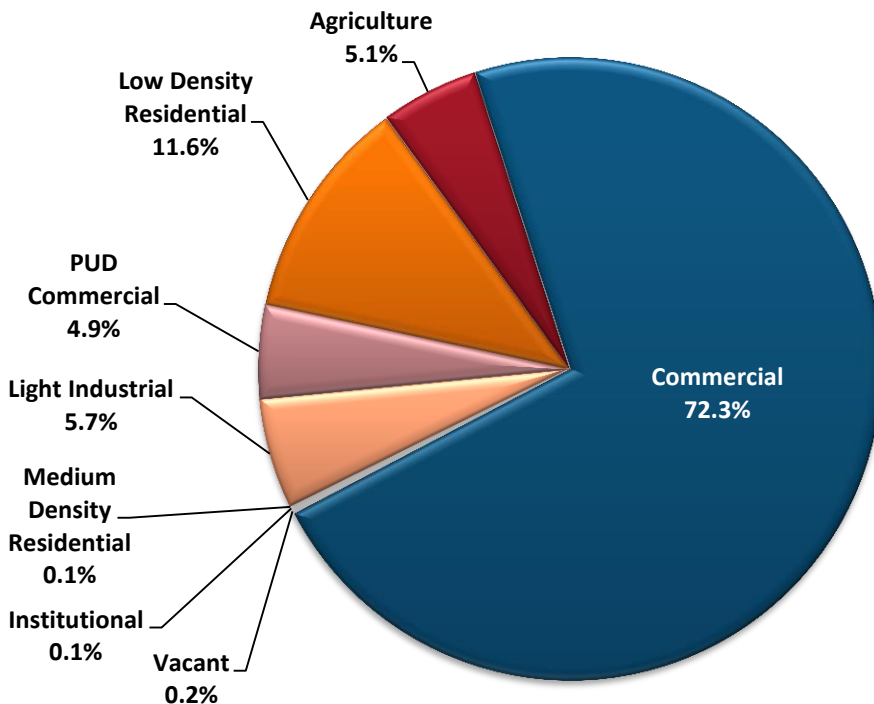


Figure 44. Broadfield Subwatershed by Elevation

## 8.2 BROADFIELD SUBWATERSHED EXISTING CONDITIONS



**Figure 45. Broadfield Subwatershed Land Use**

The total tributary area in the Broadfield Subwatershed is 913 acres within the Town limits. The subwatershed land use is mostly commercial and low density residential with a notable portion of commercial/light industrial use located predominantly along the Broadway corridor (**Figure 45**). The majority of the residential portion of the subwatershed is associated with the Broadfield Subdivision north of 93<sup>rd</sup> Avenue.

The area downstream of the Broadfield Subdivision consists of commercial development including the Ace Hardware development, the Pinnacle Hospital (Pinnacle), AmeriPlex at the Crossroads (AmeriPlex), and the Purdue Technology Center. The Ace Hardware development, Pinnacle and

the Purdue Technology Center have been constructed with detention ponds. A system of connected detention storage basins has been constructed, and the site has been mass graded, but the AmeriPlex lots, as well as majority of the subwatershed, have not been fully developed.

Stormwater from the Broadfield Subdivision is conveyed west along 93<sup>rd</sup> Avenue and ultimately to the Ace Hardware detention pond. Outflow from the Ace Hardware Pond and the Pinnacle Pond drain to the system of connected detention ponds for the AmeriPlex development. The AmeriPlex Ponds drain to the Purdue Technology Center ponds and finally through a culvert under Broadway to Main Beaver Dam Ditch. The stormwater route is identified in **Figure 46**. Main Beaver Dam Ditch ultimately drains to Deep River.

Following the delineation of the tributary areas to large diameter storm sewers and drainage ways, CBBEL created an XP-SWMM analysis of the subwatershed. There is no regulatory hydraulic modeling available for the subwatershed. The XP-SWMM analysis is based on field survey data and the Lake County 1-foot aerial topography. The 24-hour storm event is the critical design storm for the subwatershed. CBBEL delineated the 100-year floodplain elevations using the Lake County topography. An analysis of the current aerial photography, existing CBBEL delineated 100-year inundation area and the 1-foot aerial topographic data indicates that some areas are included in the inundation areas that do not reflect current development in the area. Therefore, the existing condition CBBEL delineated 100-year inundation area shown in **Figure 46** has been delineated based on a combination of materials including construction

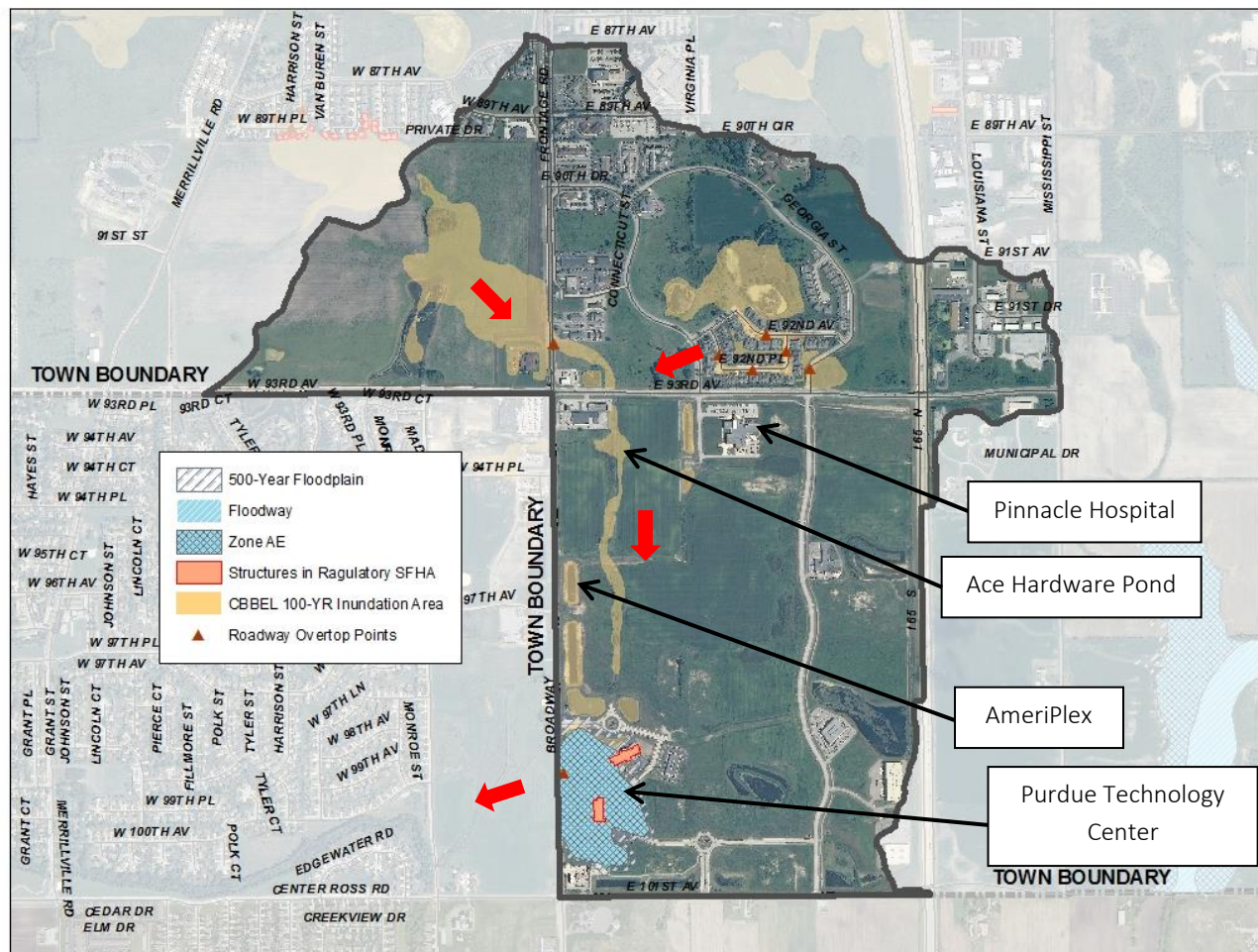


plans for recent developments from the LCSO, current aerial photography, aerial topography and our experience with the subwatershed drainage system.

The GIS analysis of the Merrillville Structures 2011 layer compared to both the regulatory floodplain (FEMA Data) layer and the CBBEL Delineated 100-year Inundation Area layer identified two (2) structures in the SFHA and two (2) structures in the CBBEL delineated inundation area (Table 16). Figure 46 shows the number of structures in the CBBEL delineated 100-year flood inundation area created for this SWMP. The GIS master database should be accessed for more detailed information regarding structures within the SFHA, public roadway overtoppings etc.

Structures in Regulatory 100-year Floodplain			Structures in CBBEL 100-year Inundation	Total Structures in Inundation Area
Floodway	Zone AE	Zone A		
0	2	0	2	2

**Table 16. Broadfield Subwatershed – Structures in Floodplain**

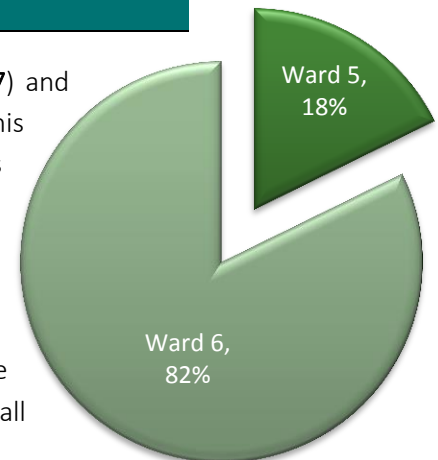


**Figure 46. Broadfield Subwatershed - Structures and Roads in Floodplain**

A comparison of the elevations used in the **CBBEL 100-year Inundation Area** to the public roadway overtopping elevations from Lake County aerial topography showed two (2) locations where Broadway is overtopped (**Figure 46**). The public roadway overtoppings are due to restrictive culvert crossings and are responsible for backing water up. The two (2) areas are located at the Purdue Technology Center and an undeveloped farm field north of 93<sup>rd</sup> Avenue. These two (2) problem areas are created by the restrictive culvert crossings which are compounded by silt and/or debris.

### 8.3 BROADFIELD SUBWATERSHED BY WARD AND UTILITY FEE

The Broadfield Subwatershed consists of two (2) Wards (**Figure 47**) and contributes 3% of the Town's yearly stormwater utility fee. This percentage is of the total contribution from the subwatersheds studied in this SWMP. This does not include the unstudied portions of Town. This information is based on the Town's 2013 stormwater utility fee and is a function of the land use within the subwatershed. There are approximately 153 residential parcels in the subwatershed (57% of all parcels in the subwatershed). The Broadfield Subwatershed contains the most commercial land use of all subwatersheds studies in this SWMP. This information can be accessed under the **Land Use and Cover** group layer in the master GIS database.



**Figure 47. Broadfield Subwatershed by Ward**

### 8.4 BROADFIELD SUBWATERSHED EXISTING WATER QUALITY CONCERNS

A water quality exhibit was created for the Broadfield Subwatershed (**Figure 48**) using the database **Water Quality Hot Spots** layer in the master GIS database. The subwatershed figure does not indicate that a large number of water quality hotspots and data from IDEM and EPA exist. This is to be expected, given the current land use density and lack of full development of the subwatershed. There were no instances of erodible velocities from the XP-SWMM analysis (**Figure 48**).

Given the lack of final development in the subwatershed, the enforcement of the Town's Ordinance in this subwatershed is crucial for the health of future water quality in the subwatershed. The use of best management practices to remove pollutants in runoff resulting from the first flush (the first 0.5 – 0.75 inches of precipitation) during a storm event should be implemented during final development. The large amount of impervious surfaces has the potential to generate pollutants typical of that from commercial development (oil, grease, heavy metals, etc.) The Broadfield Subwatershed presents an opportunity to use BMPs in a commercial application where it is anticipated the future land use will be largely impervious surfaces. The system of open ditches along 93<sup>rd</sup> Avenue should be maintained as to not allow restrictions resulting from vegetation and debris blockages to back water up into the Broadfield subdivision. Efficiency of the swale system will have an effect on the upstream Broadfield Subdivision drainage system.



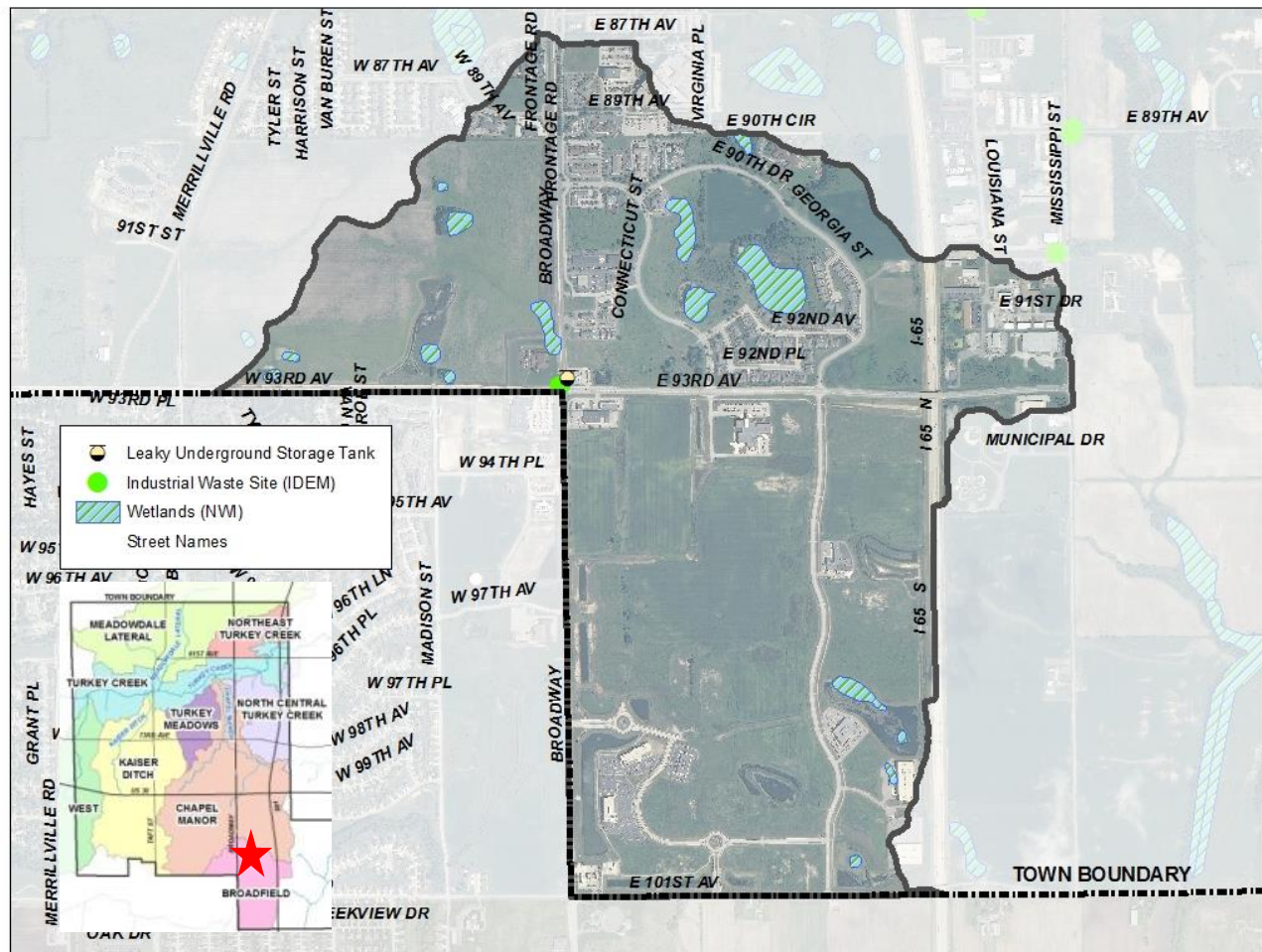


Figure 48. Broadfield Subwatershed Environmental Concerns

## 8.5 BROADFIELD SUBWATERSHED PROPOSED CONDITIONS

### 8.5.1 Previous Study for Broadfield Subdivision

On behalf of the LCSO, CBBEL performed a drainage investigation in 2007 for the Broadfield Subdivision where residents experienced significant flooding during the rain events of August, 2007, and January, 2008. The findings of that study revealed that recent development of downstream areas (south of 93<sup>rd</sup> Avenue) of the subdivision did not have an effect on the flooding within the subdivision. The findings in the study resulted in the construction of a new outlet to the existing ditch along the south side of 93<sup>rd</sup> Avenue and the re-routing of outflow from the wetland area located immediately east of Georgia Street. These improvements were constructed in 2008, and the existing condition 100-year CBBEL delineated inundation area reflects these improvements (**Figure 46**). In addition to these improvements, it was noted that the Town should require all future development tributary to the Broadfield detention ponds to provide additional detention storage as the Broadfield detention ponds are undersized for the current development. The existing 18-inch outlet pipe from the Broadfield detention ponds should be regularly maintained including regular inspections, installation of measures to prevent clogging and animal control.

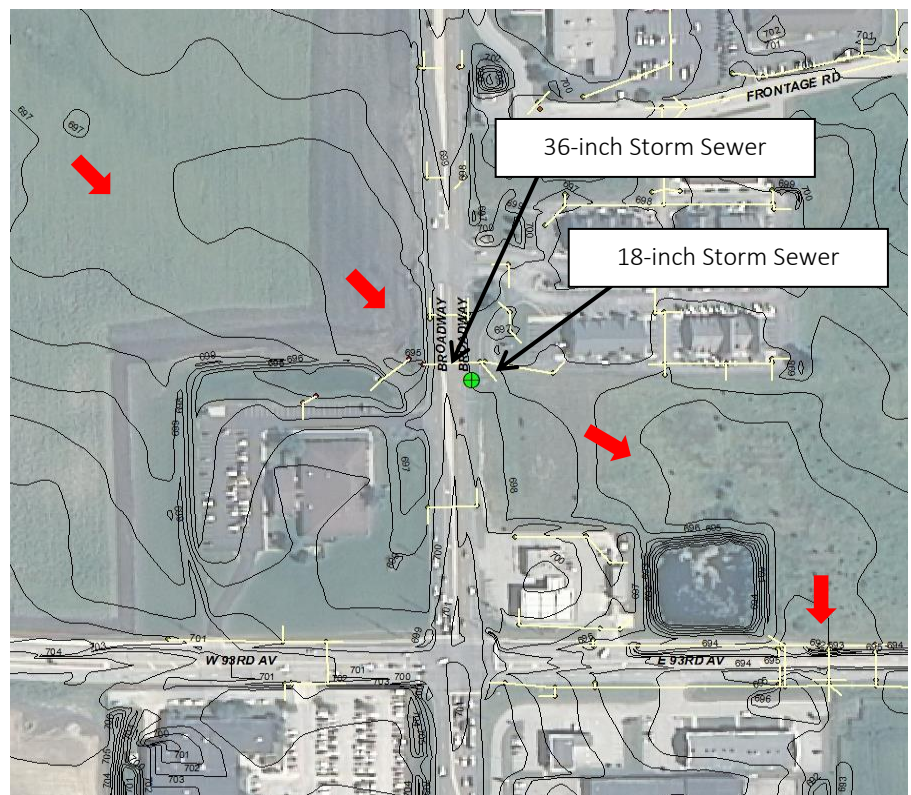


### 8.5.2 Inundation Area Re-Mapping

There are currently two (2) structures with the regulatory SFHA in the Broadfield Subwatershed. As part of this study, CBBEL delineated the 100-year inundation area based on the 1-foot aerial topography and found two (2) structures within the CBBEL delineated existing condition inundation area. The current aerial photography shows that the 1-foot aerial topography does not reflect the current land use or recent construction. The LCSO is in the process of compiling new 1-foot aerial topography. The existing condition CBBEL delineated 100-year inundation area in the Broadfield Subwatershed should be remapped based on the new aerial topographic information and the analysis created for this SWMP. This will likely remove the two (2) structures located in the regulatory SFHA CBBEL delineated 100-year existing condition inundation area.

### 8.5.3 Broadway Overtopping – North and South of 93<sup>rd</sup> Avenue

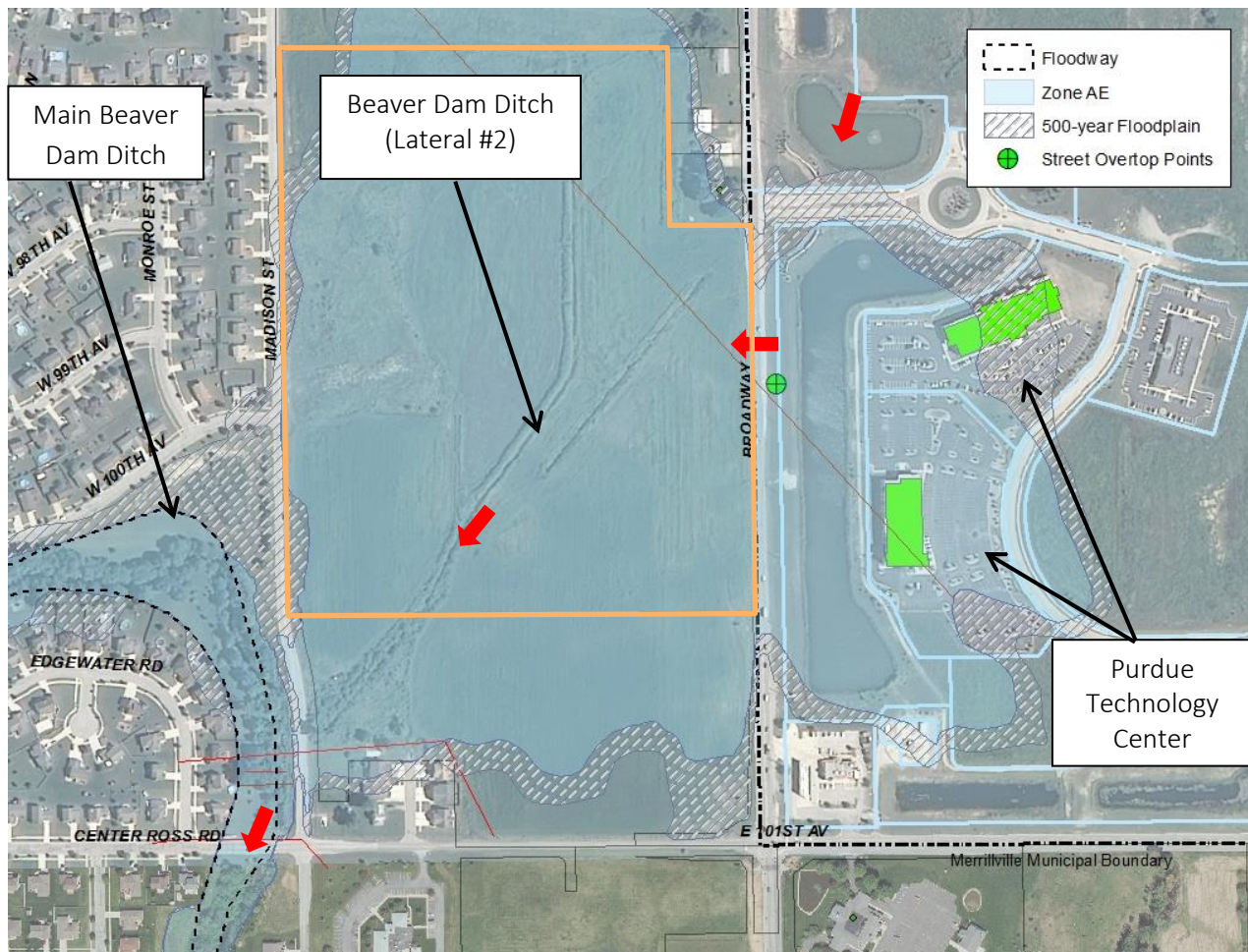
Broadway overtops in two (2) locations for the 100-year design storm event. The first location is north of 93<sup>rd</sup> Avenue just north of the Catholic Diocese of Gary property where runoff from the undeveloped farm field flows west to east. According to the Survey Data layer in the master GIS database, a 36-inch storm sewer conveys runoff to the east side of 93<sup>rd</sup> Avenue (**Figure 49**). The 36-inch storm sewer is restricted by a 15-inch storm sewer west of Broadway. It is assumed that the 15-inch storm sewer ties into the 93<sup>rd</sup> Avenue storm sewer system and continues to flow south through the commercial area. The exact location of the 15-inch tie-in should be field verified.



**Figure 49. Broadway Overtop Location 1 – Broadfield Subwatershed**

Increasing the size of the 15-inch tie-in will prevent 93<sup>rd</sup> Avenue from overtopping; however, this will increase the flow into the downstream receiving system through the commercial area. The overtopping elevation of 93<sup>rd</sup> Avenue at this location is 698.5 feet, and there is approximately 41 ac-ft of existing upstream storage on the farm field at this elevation. Additional upland storage at this location is required to prevent overtopping and increased flows downstream. Future development of the farm field parcel west of Broadway must maintain the existing storage as to not worsen problems downstream.

The second overtopping of Broadway is located near the Purdue Technology Center detention pond just north of 101<sup>st</sup> Avenue and flows east to west over Broadway (**Figure 50**). The Purdue Technology Center detention pond is restricted and outlets west to the Broadway right of way. Runoff from the Broadway right of way and additional upstream areas is conveyed under Broadway through a 24-inch storm sewer to the open channel west of 93<sup>rd</sup> Avenue in the City of Crown Point. The open channel west of Broadway is known as an unnamed tributary to Main Beaver Dam Ditch and is shown as Zone AE floodplain on the regulatory FIRM. The floodplain elevation of the unnamed tributary is at elevation 684 feet, and the overtopping elevation of Broadway at this location is approximately 681.5 feet. Flow in the unnamed tributary to Main Beaver Dam Ditch is subject to tailwater effects from Main Beaver Dam Ditch, which backs up into the farm field property west of Broadway.



**Figure 50. Broadway Overtop Location 2 – Broadfield Subwatershed**

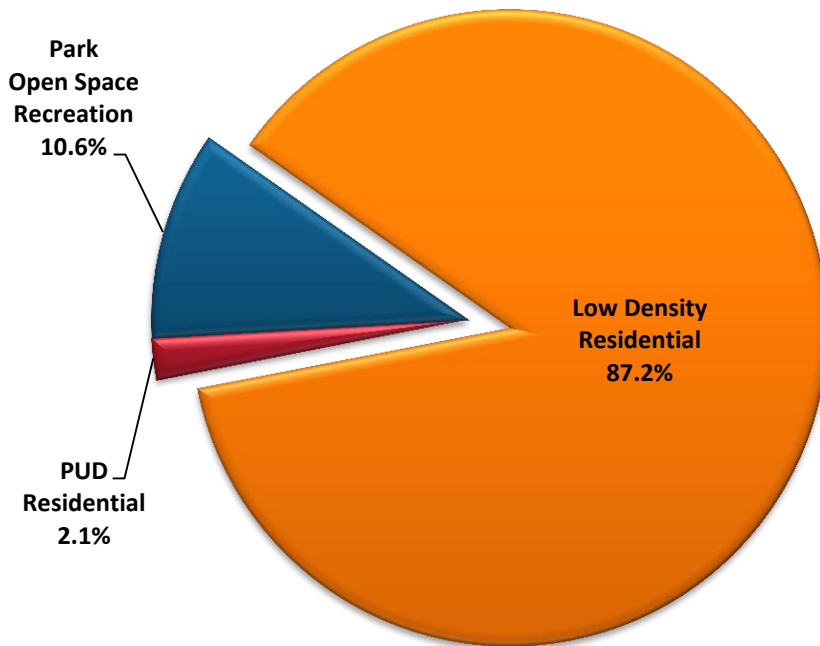
#### 8.5.4 Regional Storage with the City of Crown Point

The downstream end of the Broadfield Subwatershed within the Town limits is subject to tailwater effects from Main Beaver Dam Ditch. The farm field property (45 acre) located immediately west of Broadway (**Figure 50**) is located in the City of Crown Point (Crown Point) and is almost entirely within the regulatory Zone AE floodplain. The regulatory floodplain elevation on the property is 684 feet, and the existing grade on the property ranges from 675 to 684 feet. While flood problems in this area of Crown Point are unknown, this location presents the potential for the construction of a pump evacuated flood control reservoir.





## 9.2 TURKEY MEADOWS SUBWATERSHED EXISTING CONDITIONS



**Figure 52. Turkey Meadows Subwatershed Land Use**

The total tributary area in the Turkey Meadows Subwatershed is 483 acres, which are entirely located within the Town limits. The subwatershed land use is residential with park and open space. The subwatershed is mostly developed with the exception of the area near the abandon railway. (Figure 52).

Following the delineation of the tributary areas to large diameter storm sewers and drainage ways, CBBEL created an XP-SWMM analysis of the subwatershed. There is no regulatory hydraulic modeling available for the subwatershed. The XP-SWMM analysis is based on field survey data and the Lake County 1-foot aerial topography. The 18-hour storm event is the critical design storm for the subwatershed.

CBBEL delineated the 100-year floodplain elevations using the Lake County topography. The GIS analysis of the Merrillville Structures 2011 layer compared to the CBBEL Delineated 100-year Inundation Area layer identified no structures in the CBBEL delineated inundation area (Table 17). Figure 53 shows the number of structures in the CBBEL delineated 100-year flood inundation area created for this SWMP. The GIS master database should be accessed for more detailed information regarding structures within the SFHA, public roadway overtoppings etc.

Structures in Regulatory 100-year Floodplain			Structures in CBBEL 100-year Inundation	Total Structures in Inundation Area
Floodway	Zone AE	Zone A		
0	0	0	0	0

**Table 17. Turkey Meadows Subwatershed Number of Structures in SFHA and CBBEL Delineated 100-year Inundation Area**

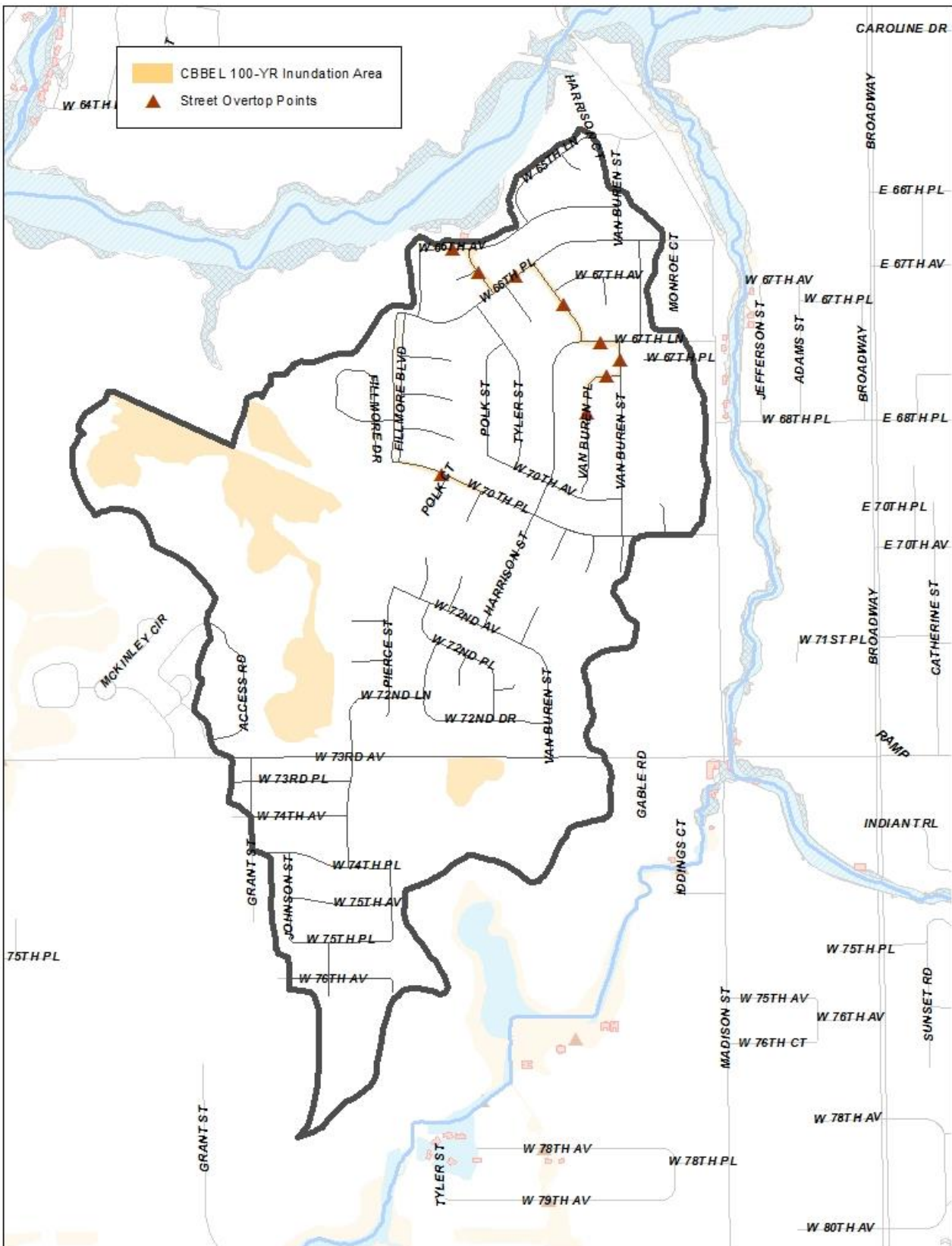


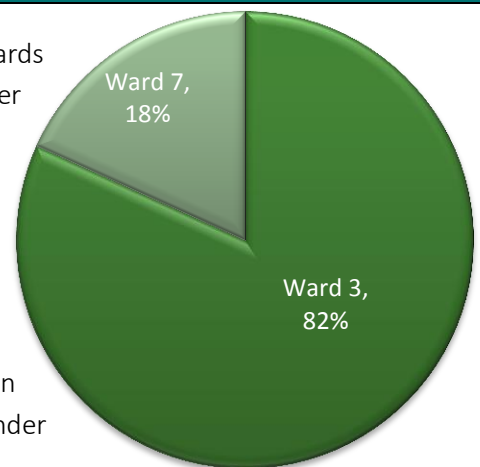
Figure 53. Turkey Meadows Subwatershed - Structures and Roads in Floodplain



A comparison of the elevations used in the **CBBEL 100-year Inundation Area** to the public roadway overtopping elevations from Lake County aerial topography showed no major roadway overtoppings and nine (9) minor roadway overtoppings (**Figure 53**). All of the roadway overtoppings identified in Turkey Meadows Subwatershed are located in the Turkey Creek Meadows Subdivision and are considered minor roadways. These overtoppings were identified for the 100-year design storm event. This is consistent with current design standards where runoff generated from storm events in excess of the storm sewer system capacity is conveyed in overland flow routes in both backyards and roadways. The roadway overtoppings in the subwatershed were identified using the XP-SWMM analysis for the subwatershed, not through Town staff or resident complaints. The development of the XP-SWMM analysis for the subwatershed is the baseline analysis of the drainage system and can be used to explicitly analyze the system should a specific drainage problem occur in the future.

### 9.3 TURKEY MEADOWS SUBWATERSHED BY WARD AND UTILITY FEE

The Turkey Meadows Subwatershed consists of two (2) Wards (**Figure 54**) and contributes 7% of the Town's yearly stormwater utility fee. This percentage is of the total contribution from the subwatersheds studied in this SWMP. This does not include the unstudied portions of Town. This information is based on the Town's 2013 stormwater utility fee and is a function of the land use within the watershed. There are approximately 1,041 residential parcels in the subwatershed (97% of all parcels in the subwatershed are residential). The remaining 3% of the parcels in this analysis are open space. This information can be accessed under the **Land Use and Cover** group layer in the master GIS database.



**Figure 54. Turkey Meadows Subwatershed by Ward**

### 9.4 TURKEY MEADOWS SUBWATERSHED EXISTING WATER QUALITY CONCERNS

The subwatershed does not consist of a main watercourse and is almost entirely drained by storm sewers and overland flow paths. There is a section of open channel along Fillmore Boulevard in the Turkey Creek Meadows Subdivision; however no erodible velocities were shown in the channel (**Figure 55**) from the XP-SWMM analysis. A buffer has been established along the channel due to the configuration of roadway. The potential exists for a water quality sampling location at the downstream end of this open channel to represent baseline constituent levels from a subwatershed area consisting of entirely residential land use. This open channel also presents an opportunity for a pilot project to construct a “green street” or environmental roadway section with curb cuts and a native vegetated swale, which would replace the manicured lawns with native species to create a more naturalized area (**Figure 55**). Pre- and post-construction water quality sampling in the channel could be used to verify the effectiveness of the use of native species versus manicured lawns and the effect on water quality constituents from residential runoff. Continued maintenance on the open channel should remain in effect from a water quantity point of view to maintain conveyance.



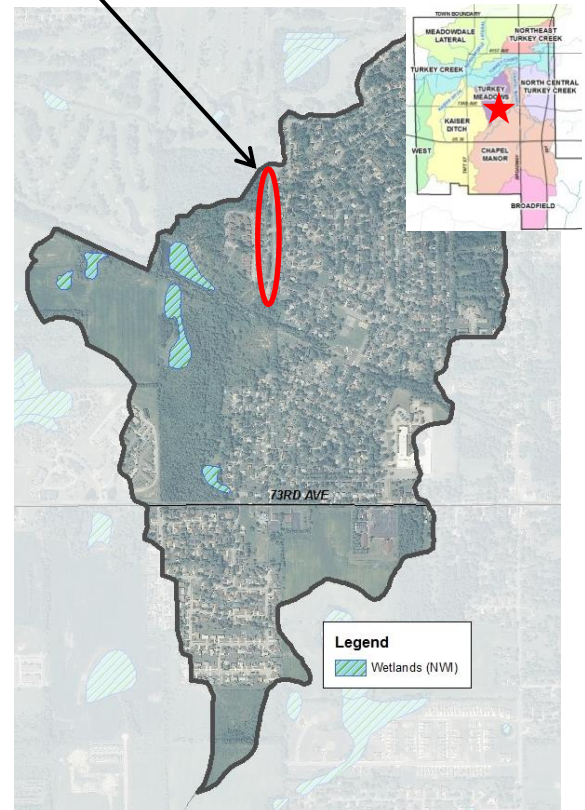
**Figure 55. Fillmore Boulevard Swale**

A water quality exhibit was created for the Turkey Meadows Subwatershed (**Figure 56**) using the database Water Quality Hot Spots layer in the master GIS database. The subwatershed figure does not indicate any instances of water quality hotspots, and data from IDEM and EPA exists. There are multiple wetland complexes in the areas near the abandoned railway in the west portion of the subwatershed. These complexes likely exist due to the depressional storage created from the railway embankment. This area also consists of forested areas and is currently undeveloped.

## 9.5 TURKEY MEADOWS SUBWATERSHED PROPOSED CONDITIONS

There are currently no structures with the regulatory SFHA or the CBBEL delineated the 100-year inundation area based on the 1-foot aerial topography. There are a number of roadway overtoppings however this is consistent with current design standards where runoff generated from storm events in excess of the storm sewer system capacity is conveyed in overland flow routes in both backyards and roadways. Maintenance on the existing drainage system in the subwatershed should continue.


The Turkey Meadows Subwatershed presents a very encouraging location for a pilot green street project as shown in **Figures 55 and 56**. This pilot green street project is the proposed improvement for the subwatershed.



**Figure 56. Turkey Meadows Subwatershed Environmental Concerns**



## 10.1 GENERAL OVERVIEW

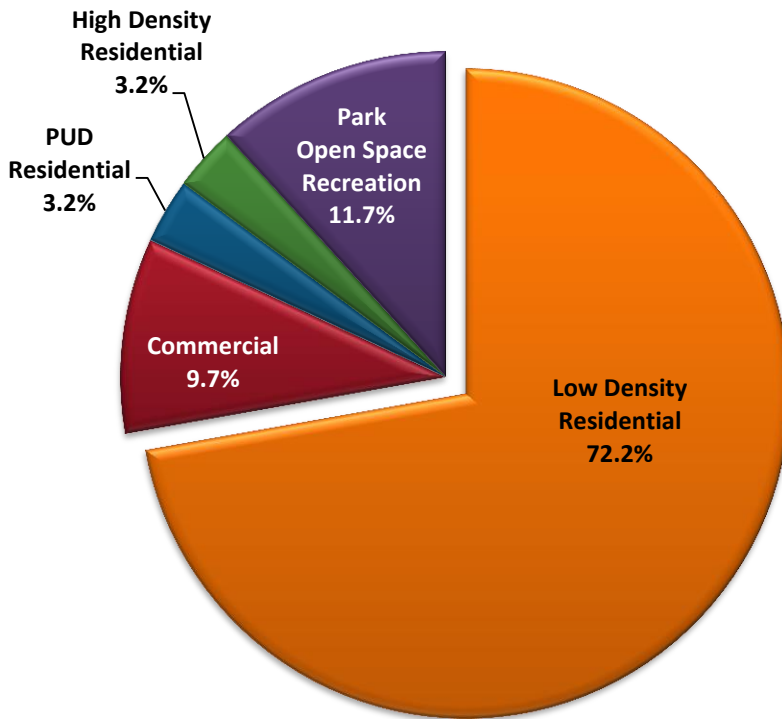


Christopher B. Burke Engineering, Ltd.



Vermont Street is studied Zone AE floodplain.

## 10.2 NORTHEAST TURKEY CREEK EXISTING CONDITIONS



**Figure 58. Northeast Turkey Creek Subwatershed Land Use**

The total tributary area in the Northeast Turkey Creek Subwatershed is 566 acres of which six (6) acres are located outside the Town's limits. The subwatershed land use within the Town limits is low density residential, commercial and open space (Figure 58). The Broadway and 61<sup>st</sup> Avenue corridors in the subwatershed consist of the commercial areas with locations of high density residential areas. The northeast and west portion of the subwatershed is largely undeveloped.

Following the delineation of the tributary areas to large diameter storm sewers and drainage ways, CBBEL created an XP-SWMM analysis of the subwatershed. There is no regulatory hydraulic modeling available for the subwatershed. The XP-SWMM analysis is based on field survey data and the

Lake County 1-foot aerial topography. The 18-hour storm event is the critical design storm for the subwatershed. CBBEL delineated the 100-year floodplain elevations using the Lake County 1-foot aerial topography.

A GIS analysis of the Merrillville Structures 2011 layer compared to both the regulatory floodplain (FEMA Data) layer and the CBBEL Delineated 100-year Inundation Area layer identified zero structures in the regulatory SFHA and eight (8) structures in the CBBEL delineated inundation area (Table 18). Figure 59 shows the number of structures in the CBBEL delineated 100-year flood inundation area created for this SWMP. A comparison of the elevations used in the CBBEL 100-year Inundation Area to the public roadway overtopping elevations from Lake County aerial topography showed 1 major roadway overtopping and 7 minor roadway overtoppings (Figure 59).

Structures in Regulatory 100-year Floodplain			Structures in CBBEL 100-year Inundation	Total Structures in Inundation Area
Floodway	Zone AE	Zone A		
0	0	0	8	8

**Table 18. Northeast Turkey Creek Subwatershed – Structures in Floodplain**

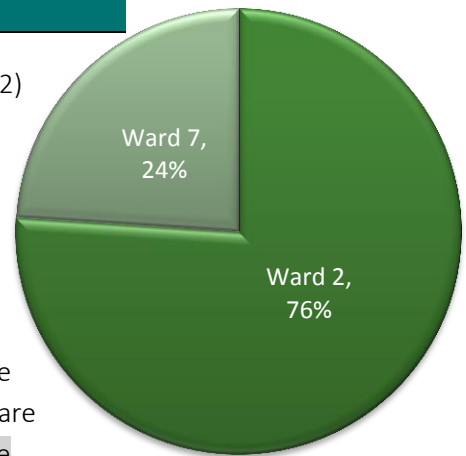


Backwater from Turkey Creek at Vermont Street is also a problem identified by Town staff. The regulatory 100-year floodplain elevation in Turkey Creek in the area north of 61<sup>st</sup> Avenue and west of Turkey Creek is at 614 feet. According to the Lake County 1-foot aerial topography, portions of the roadway range from elevation 611 – 614 feet heading north on Vermont Street from where the roadway begins to meander to

East 58<sup>th</sup> Place. The roadway inundation in this location prevents access to the properties along Vermont Street during large storm events.

### 10.3 NORTHEAST TURKEY CREEK BY WARD AND UTILITY FEE

The Northeast Turkey Creek Subwatershed consists of two (2) Wards (**Figure 60**) and contributes 6% of the Town's yearly stormwater utility fee. This percentage is of the total contribution from the subwatersheds studied in this SWMP. This does not include the unstudied portions of Town. This information is based on the Town's 2013 stormwater utility fee and is a function of the land use within the subwatershed. There are approximately 758 residential parcels in the subwatershed (88% of all parcels in the subwatershed are residential). This information can be accessed under the **Land Use and Cover** group layer in the master GIS database.



**Figure 60. Northeast Turkey Creek Subwatershed by Ward**

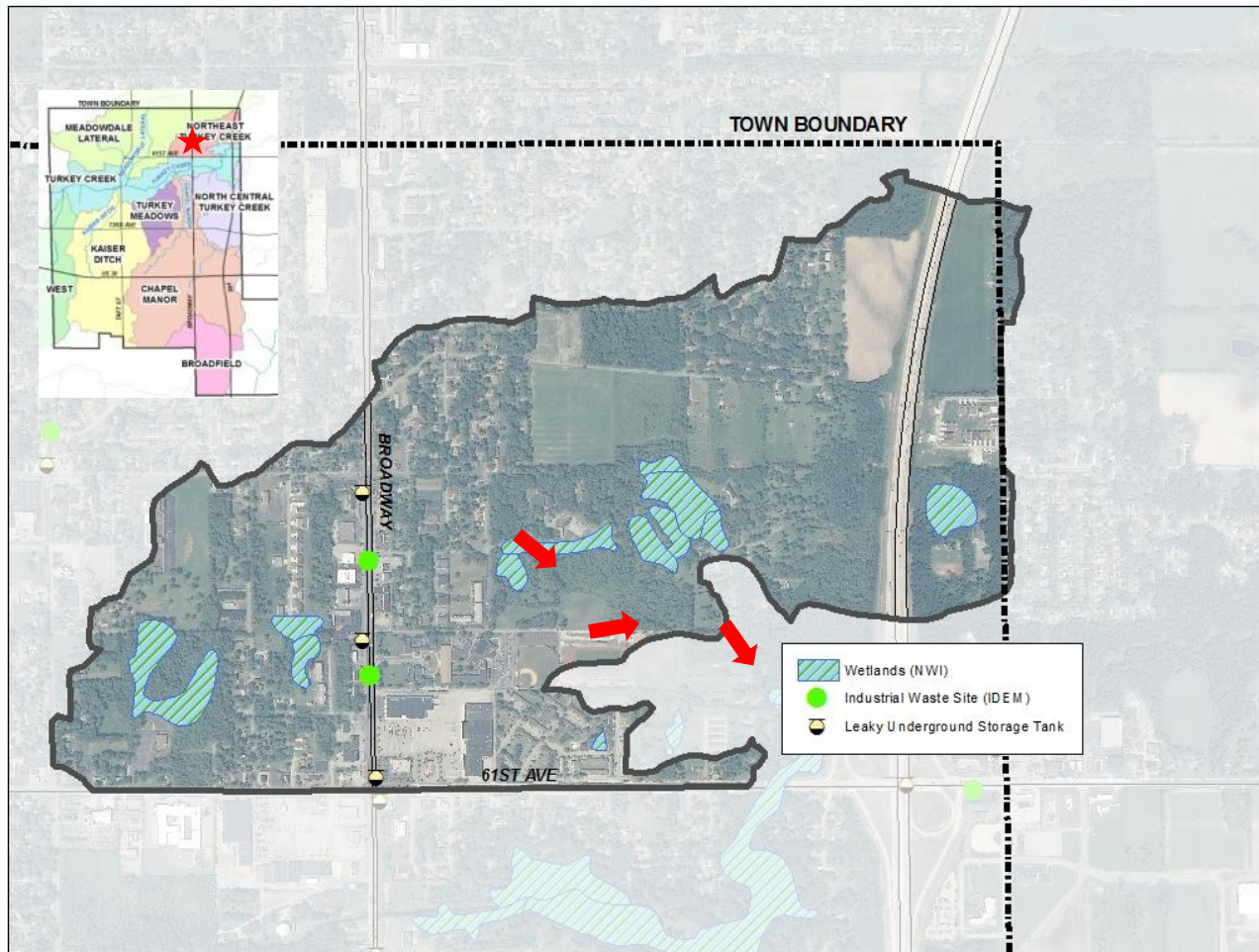
### 10.4 NORTHEAST TURKEY CREEK EXISTING WATER QUALITY CONCERNS

A water quality exhibit was created for the Northeast Turkey Creek Subwatershed (**Figure 61**) using the **Water Quality Hot Spots** layer in the master GIS database. There are four (4) water quality hot spots in the database associated with Broadway north of 61<sup>st</sup> Avenue. The subwatershed figure does not indicate a large number of water quality hotspots, and data from IDEM and EPA is limited. There are two (2) large wetland complexes located east and west of Broadway.

There is no major watercourse draining the western portion of the subwatershed, and runoff is conveyed to Turkey Creek through storm sewers along Broadway and 61<sup>st</sup> Avenue in this area. The storm sewer outfalls at Turkey Creek could be potential point sources for water quality concerns in Turkey Creek. Turkey Creek through the Town limits is on IDEM's 303(d) List of Impaired Waters for E. coli. The configuration of the storm sewer outlets at Turkey Creek presents the possibility for a water quality sampling location. Sampling stormwater at the outfalls will represent baseline constituent levels from a subwatershed with a larger commercial and residential area drained by storm sewers. Based on the results of the water quality sampling locations, the storm sewer outfalls at Turkey Creek could be outfitted with water quality treatment structures.

Pre and post construction water quality sampling at the outfalls could be used to verify the effectiveness of the water quality treatment structures and the effect on water quality constituents from commercial land use runoff. Runoff tributary to the depressional areas east of 61<sup>st</sup> Avenue meanders across the large wetland areas before flowing south along Vermont Street and outletting to Turkey Creek. There are no regulated drains in the subwatershed, and no erodible velocities were found in the subwatershed.



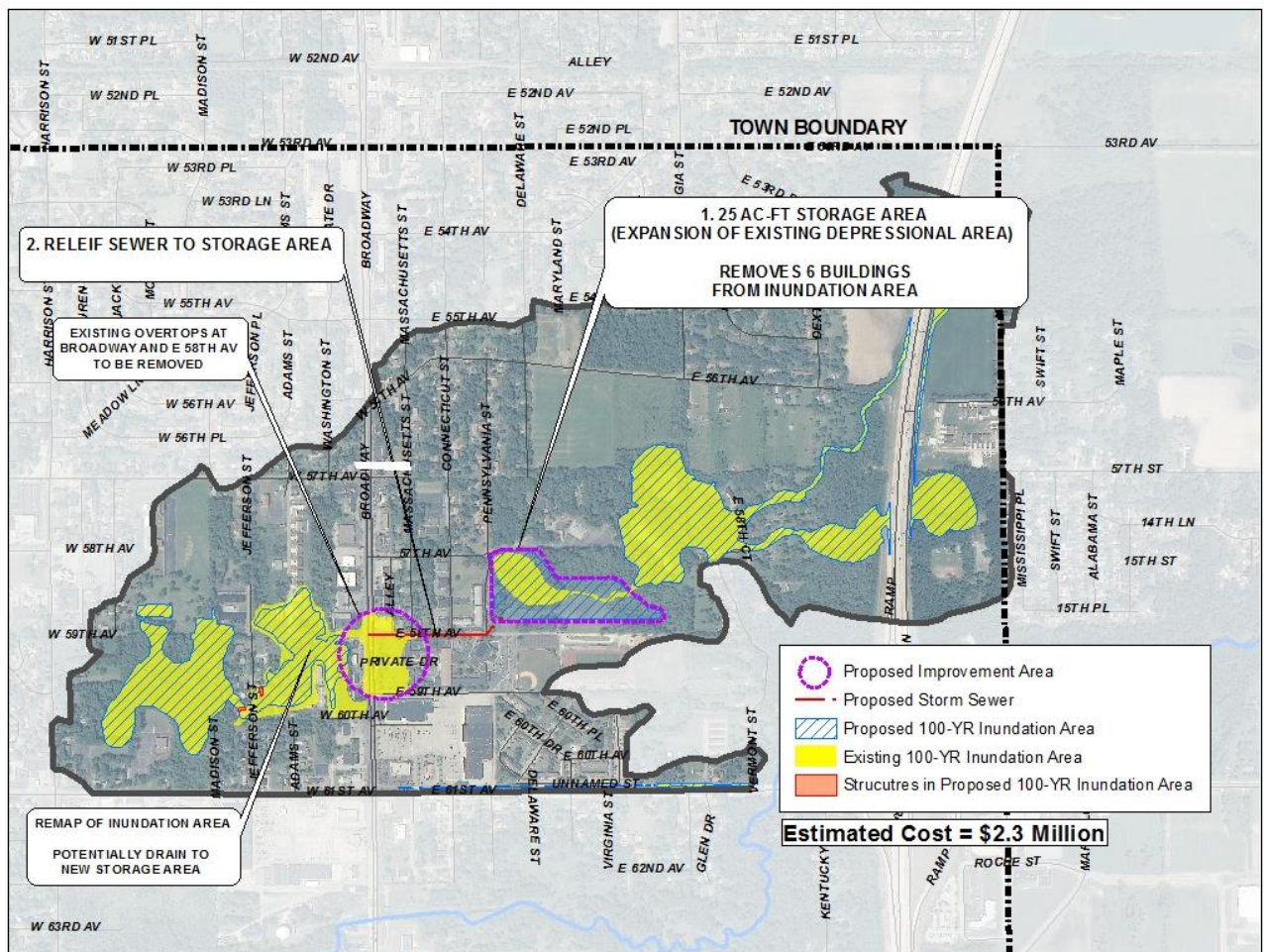


**Figure 61. Northeast Turkey Creek Subwatershed Environmental Concerns**

## 10.5 NORTHEAST TURKEY CREEK PROPOSED CONDITIONS

CBBEL evaluated improvements including increasing storm sewer sizes along Broadway, storm sewer conveyance improvements along Jefferson Street and additional stormwater storage on properties east of Broadway (**Figure 62**). Increasing storm sewer conveyance south directly to Turkey Creek provides a benefit for the area, however, this also increases the flow rates outletting to Turkey Creek for all storm events. Therefore, CBBEL investigated increasing storage in the existing depressional area on the Diocese of Gary (Diocese) property east of Broadway (**Figure 62**). CBBEL analyzed providing an additional 25 ac-ft of storage on the Diocese property combined with a 42-inch relief storm sewer along 58<sup>th</sup> Avenue between Broadway and the new storage area (**Figure 62**). Conveying storm water east will free up existing capacity in the existing storm sewer system. This will reduce inundation areas depths along Adams Street without increasing flow rates to Turkey Creek. The proposed condition project removes six (6) structures from the existing condition CBBEL delineated inundation area (**Figure 62**). The construction of additional storage in excess of 25 ac-ft is possible on the Church property, however not necessary to achieve the benefits shown. Should use of the property become a viable option in the future, additional storage and benefits could be explored at this location. This location is also shown in the SFHA (500-year floodplain)

and portions of the site are shown to be wetlands. The estimated cost to construct the relief sewer and storage is approximately \$2.3 million (**Appendix 1**). Expansion of the existing depressional storage area will require collaboration efforts with the Diocese of Gary and easement or property acquisition.



**Figure 62. Northeast Turkey Creek Subwatershed Proposed Improvements**

### 10.5.1 Inundation Area Re-Mapping

The current aerial photography shows that the 1-foot aerial topography does not reflect recent construction of the south portion of the town house development along Adams Street near 58<sup>th</sup> Avenue. There are four (4) structures or units shown in the existing condition CBBEL delineated inundation area. It is likely that these structures are not within the inundation area and should be remapped based on the new LCSO aerial topographic information and the analysis created for this SWMP.

### 10.5.2 Vermont Street

The existing depressional areas in the east portion of the subwatershed outlet at the north end of Vermont Street and continue south through the open channel along the east side of Vermont Street. The open channel outlets to Turkey Creek north of 61<sup>st</sup> Avenue and is a hydraulic connection to Turkey Creek. The proposed storage on the Diocese property could reduce runoff outletting from the upstream depressional areas south along Vermont Street. Backwater from Turkey Creek also inundates or overtops Vermont Street extending from just north of 61<sup>st</sup> Avenue to East 85<sup>th</sup> Place. There is approximately 1,500 feet of Vermont Street that is below elevation 614 feet (regulatory 100-year floodplain elevation of Turkey Creek). Raising the roadway pavement above this elevation will allow access and reduce the frequency of overtopping during large storm events.

### 10.5.3 Jefferson Street Storm Sewer Improvements

As noted by Town staff, localized flooding along Jefferson near the Cloisters Apartment complex has been recently addressed through the connection of an additional outlet on Jefferson Street. The proposed improvements identified for this subwatershed will further reduce the risk of flooding in this area.



## CHAPTER 11 TURKEY CREEK SUBWATERSHED

### 11.1 GENERAL OVERVIEW

The Turkey Creek Subwatershed flows west to east through the northern portion of the Town (Figure 63). Turkey Creek continues east into the City of Hobart and is tributary to Deep River which is tributary to the Little Calumet River. Turkey Creek is the receiving watercourse for all the Subwatersheds in this SWMP with the exception of the Broadfield Subwatershed, which is tributary to Main Beaver Dam Ditch. For the purposes of this SWMP, Turkey Creek is split into three (3) sections separated by two (2) railroad embankments (Figure 63), where the first railroad embankment is located upstream of the confluence with Kaiser Ditch and second embankment is located upstream of the confluence with Chapel Manor. Turkey Creek is Zone AE floodplain with a delineated floodway according to the regulatory FIRM. Turkey Creek is a regulated drain and under the jurisdiction of the LCSO.

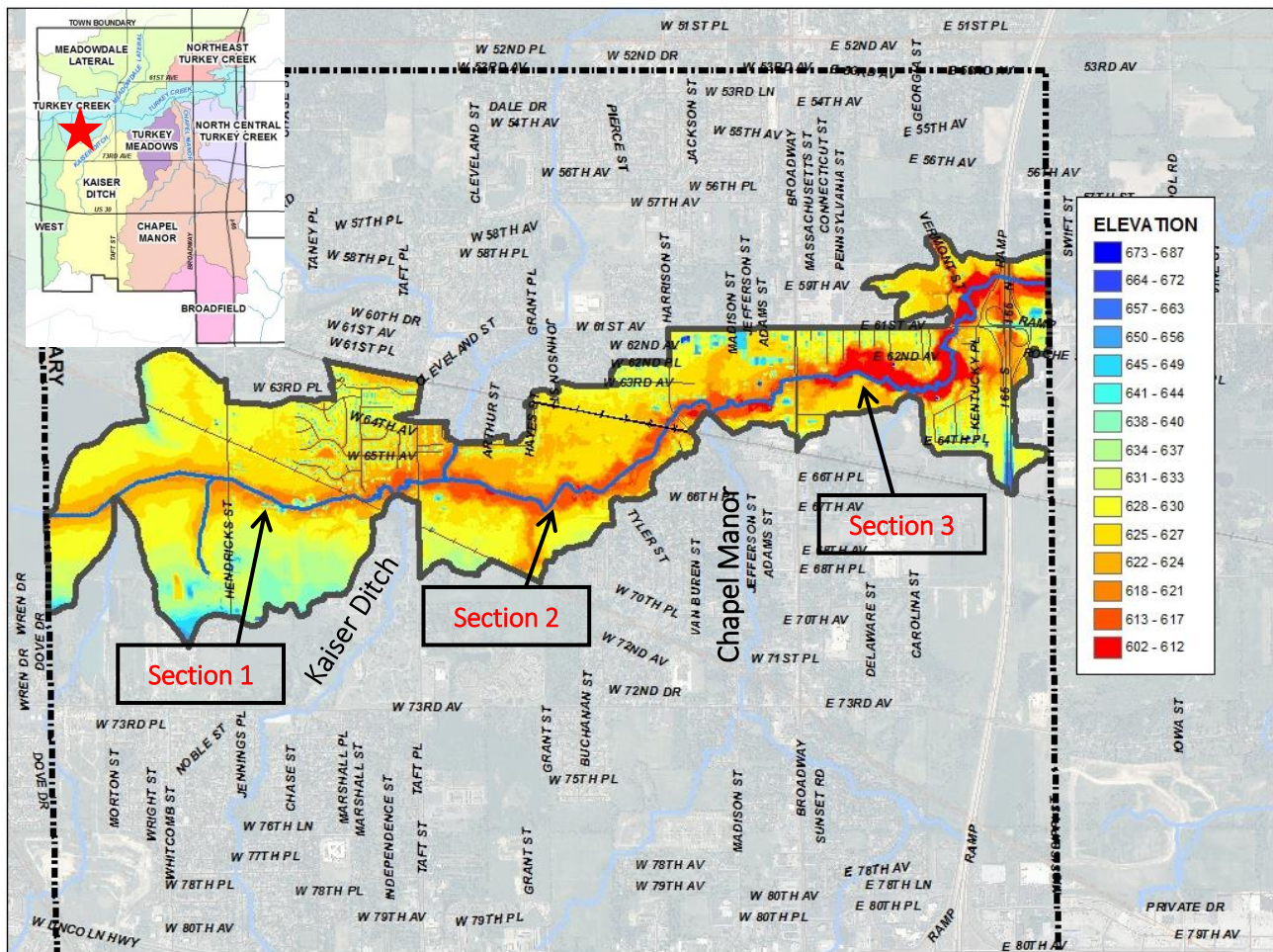
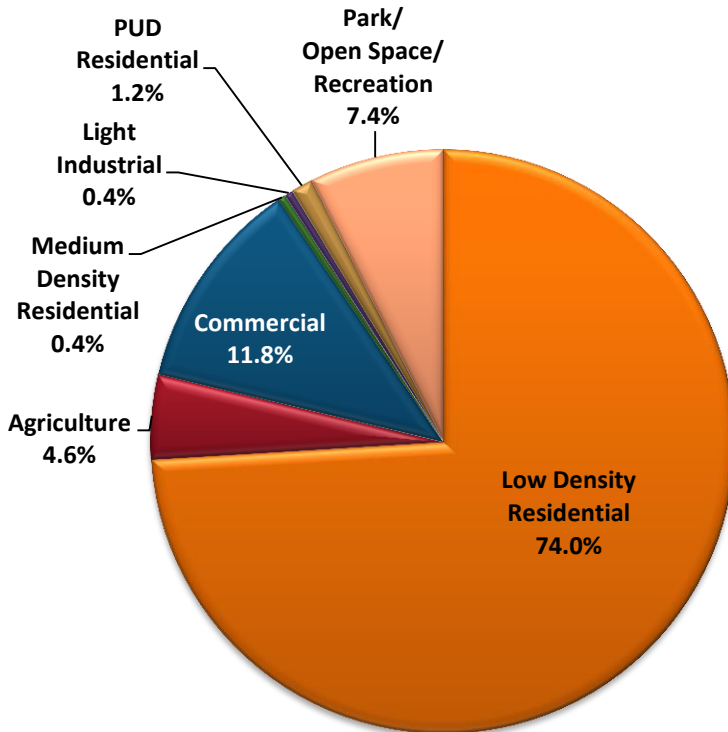


Figure 63. Turkey Creek Subwatershed by Elevation

## 11.2 TURKEY CREEK SUBWATERSHED EXISTING CONDITIONS



**Figure 64. Turkey Creek Subwatershed Land Use**

The total tributary area in the Turkey Creek Subwatershed is 1,584 acres. This is the total tributary area to this subwatershed as delineated for the purposes of the SWMP, within the Town. The total tributary area to Turkey Creek within the Town limits includes all of the subwatersheds in this SWMP with the exception of the Broadfield Subwatershed. The land use in the subwatershed is mostly residential and includes the Innsbrook Subdivision, Innsbrook Country Club and the Turkey Creek Golf Course.

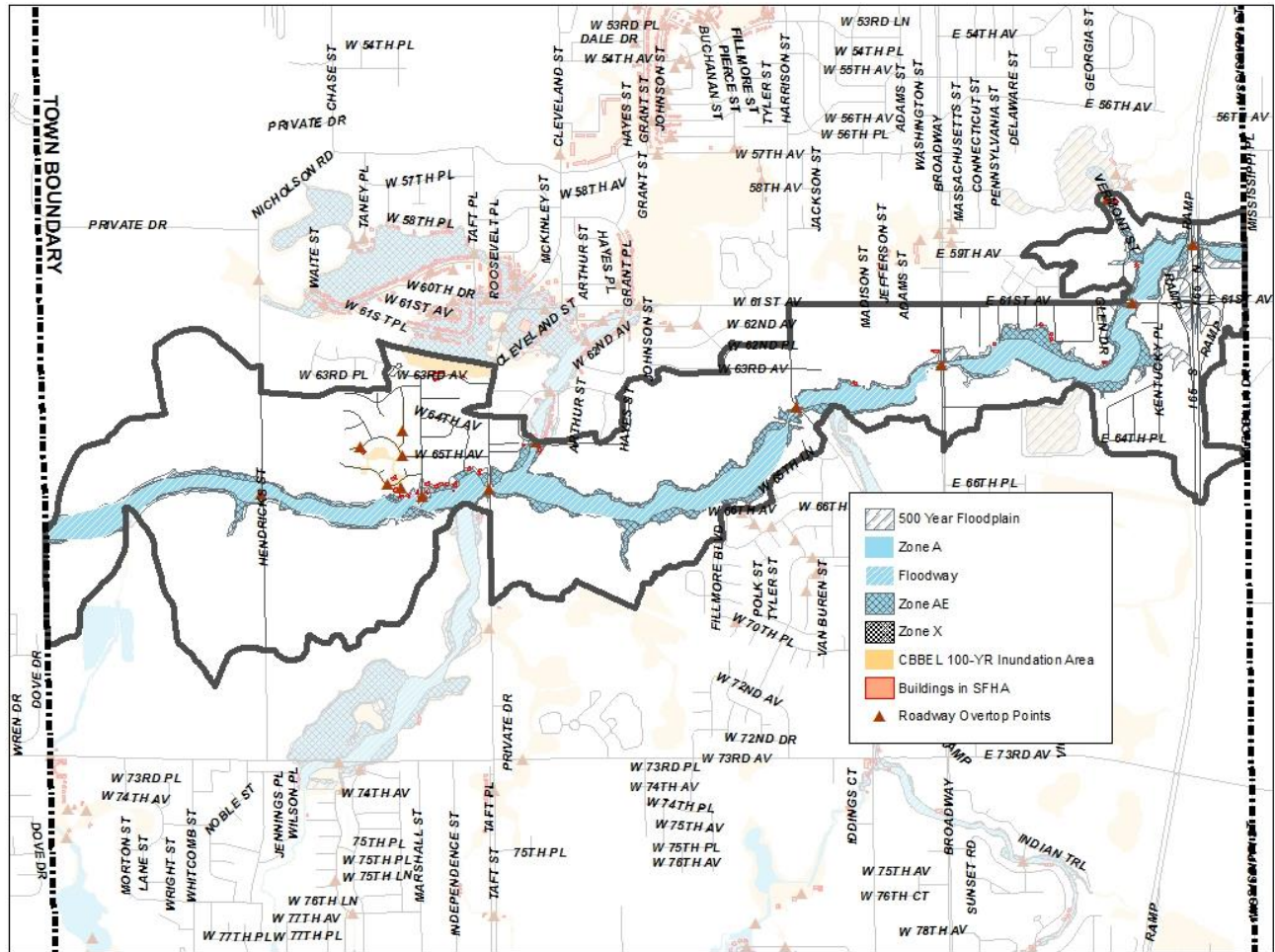
The regulatory hydraulic modeling available for Turkey Creek is a HEC-RAS hydraulic model which began as a HEC-2 hydraulic model dating back to 1977. To date, sections of the HEC-2 hydraulic modeling has been revised to include various projects and improvements. For this SWMP, the Turkey Creek Subwatershed was delineated

based on the boundaries of the other subwatershed and the main Turkey Creek watercourse. Therefore, an XP-SWMM analysis was not created for the Turkey Creek Subwatershed. The Innsbrook Subdivision is also included within this Subwatershed.

The 100-year floodplain delineation for Turkey Creek is the SFHA delineation as published by FEMA and is based on the Lake County topography 1-foot aerial topography. The existing condition CBBEL delineated inundation area in the Innsbrook Subdivision is based on our past experience and previous hydrologic and hydraulic analyses of the subdivision. The GIS analysis of the **Merrillville Structures 2011** layer compared to the **FEMA Data** layer identified three (3) structures in the floodway and eight (8) structures in the Zone AE SFHA (**Table 19**). **Figure 65** shows the number of structures in the CBBEL delineated 100-year flood inundation area created for this SWMP. The GIS master database should be accessed for more detailed information regarding structures within the SFHA, public roadway overtoppings, etc.

Structures in Regulatory 100-year Floodplain			Total Structures in Inundation Area
Floodway	Zone AE	Zone A	
3	8	0	8

**Table 19. Turkey Creek Subwatershed Number of Structures in Floodplain**



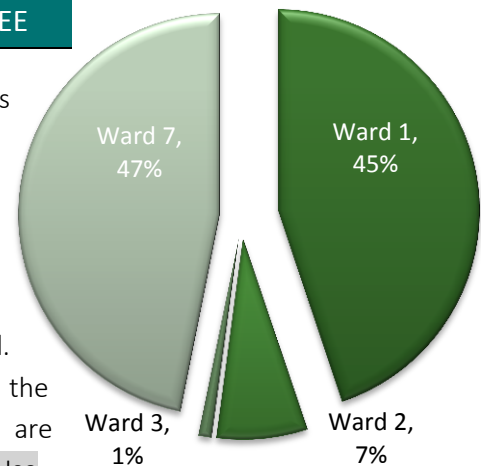
**Figure 65. Turkey Creek Subwatershed - Structures and Roadways in Floodplain**

A comparison of the regulatory floodplain elevations to the public roadway overtopping elevations from Lake County aerial topography shows overtopping at Hendricks Street and Vermont Street and five (5) minor roadway overtoppings in the Innsbrook Subdivision (**Figure 65**). Taft Street, Madison Street and Broadway are not shown to overtop according to the 1-foot aerial topography and the regulatory 100-year water surface elevations. All of the roadway overtoppings identified in Innsbrook Subdivision were identified for the 100-year design storm event. This is consistent with current design standards where runoff generated from storm events in excess of the storm sewer system capacity is conveyed in overland flow routes in both backyards and roadways.



### 11.3 TURKEY CREEK SUBWATERSHED BY WARD AND UTILITY FEE

The Turkey Creek Subwatershed consists of four (4) Wards (Figure 66) and contributes 6% of the Town's yearly stormwater utility fee. This percentage is of the total contribution from the subwatersheds studied in this SWMP. This does not include the unstudied portions of Town. This information is based on the Town's 2013 stormwater utility fee and is a function of the land use within the subwatershed. There are approximately 852 residential parcels in the subwatershed (87% of all parcels in the subwatershed are residential). This information can be accessed under the **Land Use and Cover** group layer in the master GIS database.



**Figure 66. Turkey Creek Subwatershed by Ward**

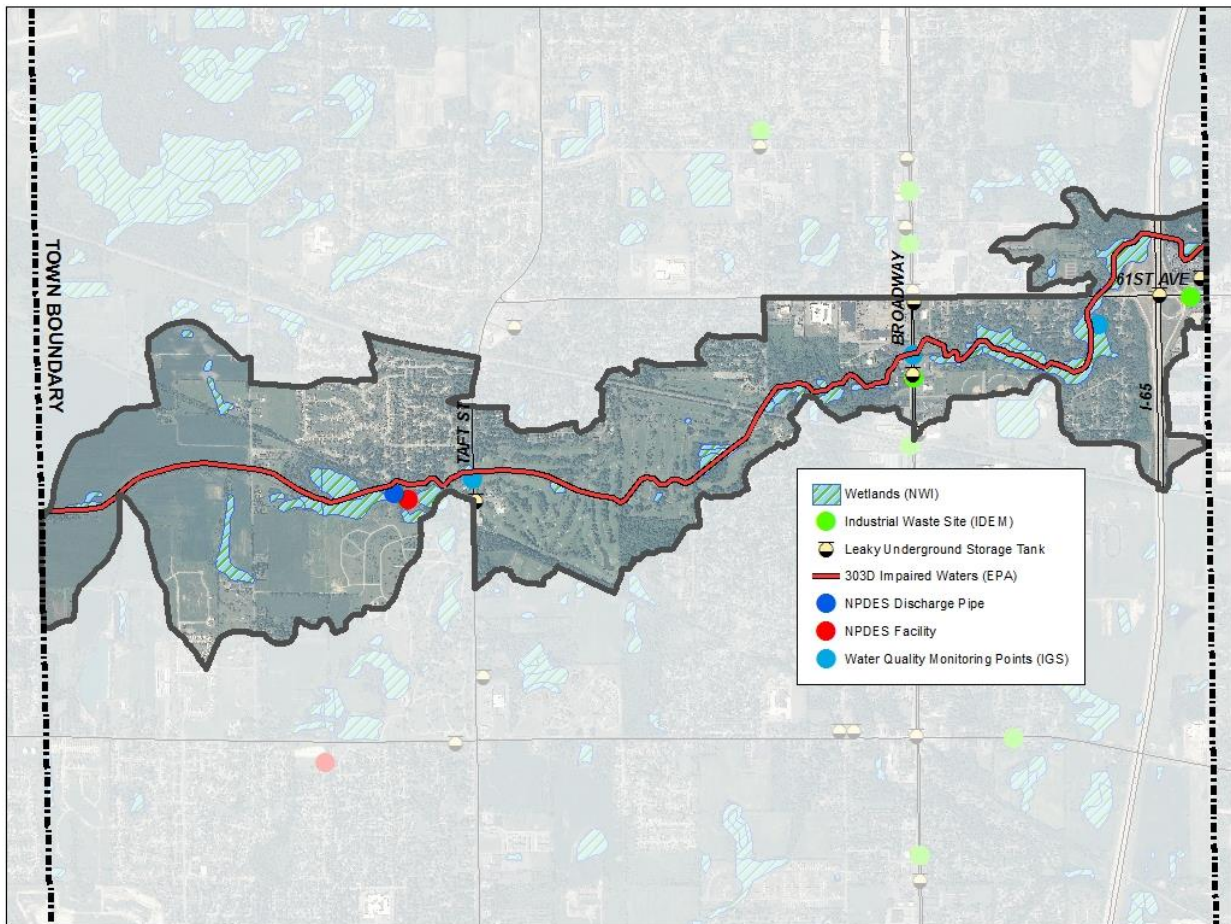
### 11.4 TURKEY CREEK SUBWATERSHED EXISTING WATER QUALITY CONCERNS

A water quality exhibit was created for the Turkey Creek Subwatershed (Figure 67) using the database **Water Quality Hot Spots** layer in the master GIS database. The subwatershed figure shows multiple water quality hot spots including NPDES discharge locations, NPDES facility locations and water quality monitoring points.

The NPDES database of discharge locations and facilities depicts all available information on regulated discharge sites. This data is a subset of the Permit Compliance System database focusing in on "active" state regulated wastewater facilities and permit discharge points discharging into surface water bodies under the NPDES program. It does include both "active" and "inactive" pipes for those actively permitted sites. The data set provides an important map layer for the Indiana Department of Environmental Management staff in conducting environmental assessments. Point locations generally reflect the sampling site which most often is where the discharge enters a surface water body but may reflect a manhole or other sample point.

The water quality monitoring location data was assembled by the Indiana Geological Survey (IGS) using data collected at sampling sites from 1973 through 2004 by four (4) agencies. These agencies include the Indiana Department of Environmental Management (IDEM) the Indiana Department of Natural Resources (IDNR), the United States Geological Survey (USGS) and the Interagency E. coli Task Force. The shapefile was compiled in order to conduct spatial analyses on the station locations, as well as to perform an assessment of data gaps. This data was used to develop and to identify impairments for which a total maximum daily load (TMDL) study is needed. A TMDL identifies the maximum amount of pollutant that a waterbody can receive and still meet water quality standards. The TMDL is used to allocate pollutant loadings among point and non-point sources. **Figure 67** shows that Turkey Creek is on IDEM's 303(d) List of Impaired Waters for E. coli through the Town limits.

Turkey Creek represents the largest impaired watercourse to have been documented by governmental agencies through the Town limits. Although other watercourses within the Town are not as well documented for specific impairments, the water quality in those subwatersheds tributary to Turkey Creek can contribute to poor water quality and degradation of biotic communities regardless of what is tributary to Turkey Creek upstream outside the Town's limits. Likewise, poor water quality within the Town limits has poor water quality implications further downstream in the City of Hobart.



**Figure 67. Turkey Creek Subwatershed Environmental Concerns**

The prevention of further water quality impairment and habitat loss in each subwatershed can only benefit water quality problems within the Town's subwatersheds and subsequently Turkey Creek. The construction of green infrastructure, including constructed wetlands for storage areas, bio-swales and vegetated buffers, use of water quality treatment structures for first flush at point sources and the establishment of riparian habitat as discussed in any of the subwatershed will help reduce water quality impairments. We recommend the Town supports water quality improvement projects and storage efforts in the overall Turkey Creek Watershed.

## Appendix 1 – Cost Estimates