Report for

Village of Winnetka, Illinois

Stormwater Alternatives Study for Western and Southwestern Winnetka

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STRAND ASSOCIATES®

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APPENDICES

EXECUTIVE SUMMARY

In October 2015, the Village of Winnetka, Illinois (Village), engaged Strand Associates, Inc.® to provide stormwater and flood control study services for the western and southwestern areas of the Village shown within the red line boundary on Figure ES-1. The intent of the study was to identify creative and cost-effective "westward looking" improvements for stormwater and flood control, taking into account the Village's overall goals and objectives. This study took a holistic view of the western watershed, shown in the blue boundary on Figure ES-1, with evaluation of a variety of grey and green approaches including conveyance, detention, infiltration, property acquisition, and individual property protections.

The Vision that has come out of this study represents a concept level plan for the Village to meet its Target Level of Service. Because it is still a concept, there are questions, concerns, and details that will need to be resolved before any single project can be implemented. However, the Vision lays a strong foundation for the Village to make decisions moving forward with stormwater and flood control in western and southwestern Winnetka.

The study was performed in three phases:

AWARENESS PHASE

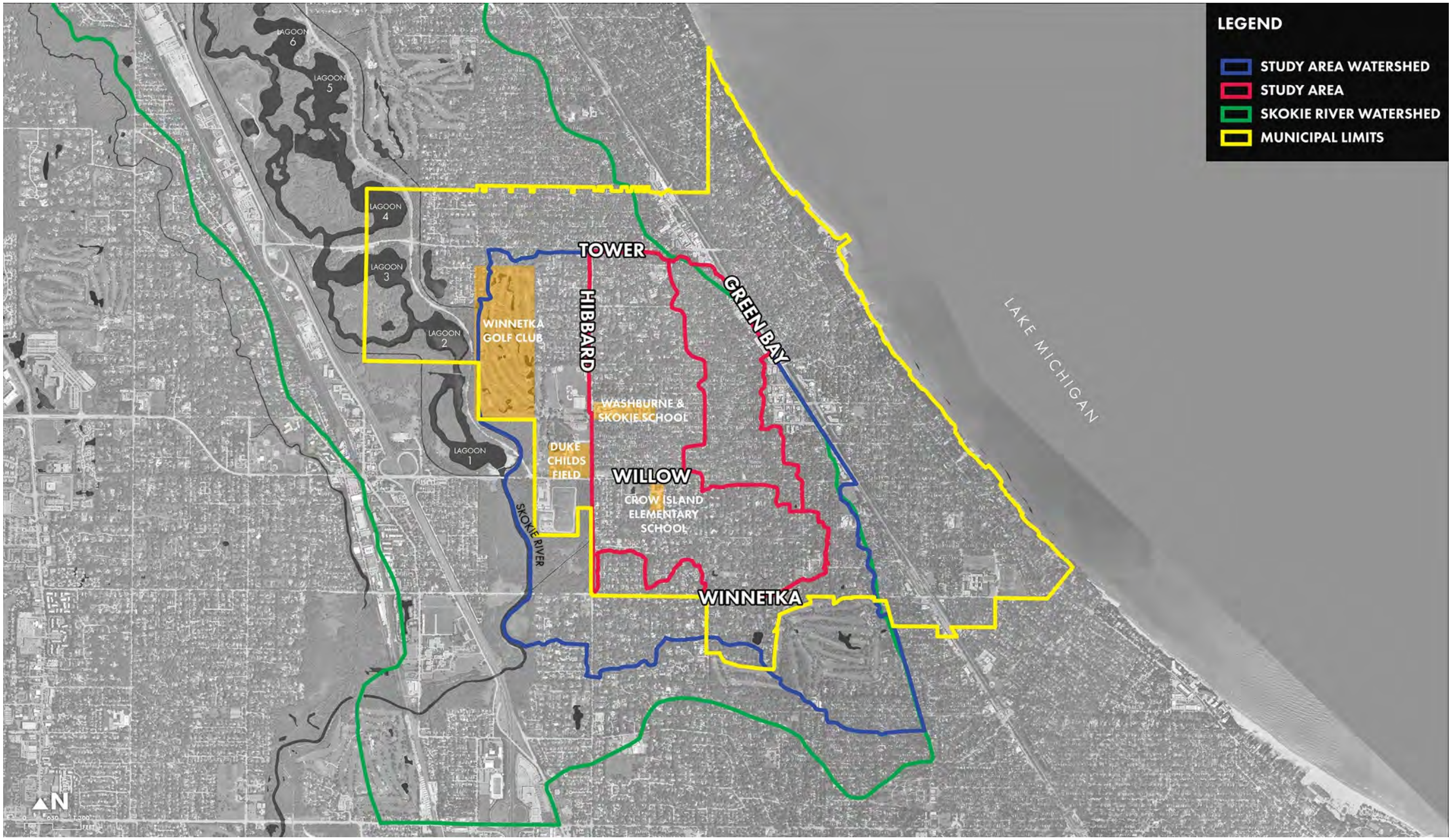
The Awareness Phase of this study gathered background information, studied watershed characteristics, created hydrologic and hydraulic models, and developed an understanding of the existing watershed conditions. From this understanding, the following key issues were identified that contribute to the study area's current stormwater and flood control issues.

1. Historical development in western Winnetka was influenced by construction of the Skokie Lagoons and a levee system built between the Village and the Skokie River. This allowed development to take place in areas that were prior marshlands but are now protected from the river by the levee.

2. The topography of study area watershed falls from northeast to southwest toward the levee system. So while the levee protects the study area from the river, the levee also cuts off natural overland drainage that used to flow into the Skokie River. This has created a "bath tub" effect in western and southwestern Winnetka with runoff from higher elevations into lower elevations trapped behind the levee.

3. The "bath tub" does have a drain, but this drain requires pumping of stormwater runoff from low areas, as shown in Figure ES-2, and has very limited capacity. When a storm event exceeds the capacity of the system, stormwater runoff is trapped in low areas and floods until flow in the system recedes and it can take in the ponded water. Additionally, the quantity of water that can be pumped into the Skokie River is limited by Illinois Department of Natural Resources regulatory requirements.

Figure ES-1 Study Area



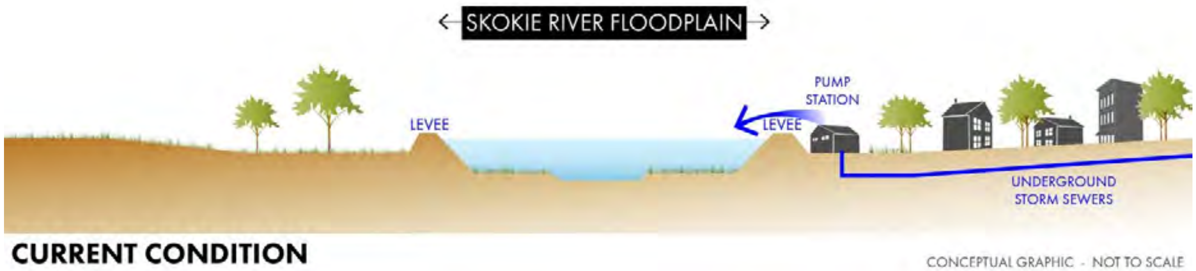


Figure ES-2 Current Condition Skokie River Floodplain

4. The magnitude of this problem is further compounded by the fact that about 30 percent of the total watershed is impervious surface, which is a relatively high impervious surface coverage resulting in increased stormwater runoff within the watershed.

   Only 18 percent of the study area is in open space, none of it is owned by the Village, and most it is in active community use, which severely limits opportunities to place excess stormwater storage.

   The Village is dominated by soils that are very poorly drained, meaning the ability of the soils to infiltrate runoff is extremely limited. Additionally, the dominant clay and clay-mix soils extend as much as 100 feet or deeper.

5. All these factors contribute to the hydrology of the watershed in which approximately 3,095 parcels produce 17,700 gallons of stormwater that is overtaxing to the existing drainage infrastructure and is trapped in the neighborhoods, creating significant stormwater and flood issues in the western and southwestern portions of the Village.

To support the investigations of this study, significant hydrologic and hydraulic modeling efforts were performed. Seven existing stormwater models were combined to create one single model for the entire watershed using the XP-SWMM (2d) package. which allowed for more accurately defined limits and volumes of surface flooding, better representation of overland flood routes, and generation of visually understandable and relatable exhibits. The results of the existing conditions modeling efforts can be seen in Appendix B.

Not surprisingly, the areas exhibiting the greatest flooding extents and depths are in the Tree Streets neighborhood and along DeWindt Road, Sunset Road, Higginson Lane, White Oak Lane, and Birch Street. It was also noted that widespread flooding begins to occur for as little as a 2-year recurrence interval storm event and the period of time it takes to draw down flooding levels in some areas ranges from 20 and 68 hours.

The Awareness Phase of the study concluded with two public meetings in January 2016. The public meetings shared an understanding of the study watershed characteristics and the current Village conveyance system capacity and limitations. But most importantly, the public provided the Village and consultant team a perspective on the types of flooding experienced by those in attendance and confirmed the stormwater modeling accurately reflects the actual flooding conditions in the study area.

EXPLORATION PHASE

The Exploration Phase of this study determined the Village's goals for protection during storm events, otherwise known as the Target Level of Service. Based on the Target Level of Service, various strategies were considered and a matrix of opportunities for stormwater and flood control were identified and evaluated. In that evaluation, significant community partners and the general public were also engaged for their comments and input. Through these exploratory activities the following determinations were made in pursuit of effective opportunities for stormwater and flood control in the study area.

1. The target level of service established for this study has two components. The first component is the magnitude of rainfall for which protection from flooding will be provided. For this study, it was determined that the target level of service storm will be a 100-year, three-hour duration storm event that produces 4.85 inches of rainfall as shown in Figure ES-3.

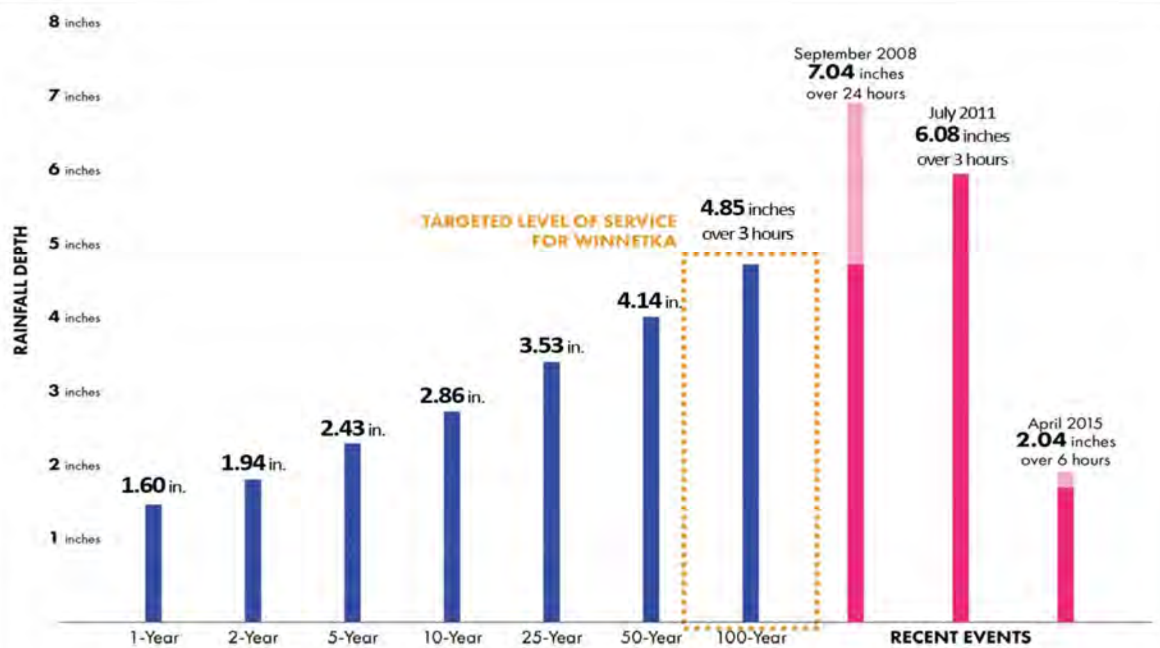


Figure ES-3 Target Level of Service Storm

The second component is the level of protection or the extent of flooding that will be allowed during the target level of service storm. For this study, it was determined that the target level of service for protection would allow for street flooding that maintains access by emergency and first-response vehicles; generally a maximum of 6 inches of flood depth at the centerline of roadways. Additionally, the target level of service for protection would allow flooding of private property but no closer than 20 feet to a primary structure and no greater than 24 inches in depth, and any street or private property flooding should be drained within 24 hours of the end of the storm event.

2. The sustainable watershed evaluation process used for this study considered a wide range of stormwater and flood control strategies. Traditional stormwater management opportunities, such as conveyance and storage, were considered alongside and, in some cases, were blended with more natural opportunities like green infrastructure and natural habitat restoration. More progressive opportunities and smart technologies were also considered. This wide view implemented numerous stormwater tools to overcome constraints in the watershed that previously were impeding the Village's progress.

3. The results of the sustainable watershed evaluation process were accounted for in an Opportunity Matrix provided in Appendix C and described in Section 2.03.A. This matrix itemizes 44 individual opportunities of various types and purposes. Many of these opportunities are interdependent, meaning their effectiveness depends on other opportunities being implemented. However, the evaluation of each opportunity in the matrix starts from an assumption that all other dependent opportunities have been implemented.

4. Section 2.03.B provides a detailed description of each identified opportunity and Section 2.03.C provides an explanation of the evaluation performed and the conclusions made regarding viability of each identified opportunity for meeting the Village's stormwater and flood control needs.

It was made clear through the Exploration Phase that successful stormwater management and flood control will require partnerships with key agencies within the community. A series of meetings and discussions were held with the Winnetka Park District, the Forest Preserve District of Cook County (FPDCC), the New Trier High School District (NTHSD), and School District 36. Section 2.04 describes the results of these discussions and the current status of the partnerships being developed.

The Exploration Phase of the study concluded with two more public meetings in March 2016. These public meetings explained the study progress through the Exploration Phase and the identification and shortlisting of potential stormwater and flood control opportunities. The public meetings also allowed the Village and study team to hear from the public and its support, suggestions, or reservations relative to the various potential opportunities being considered, generally summarized in Figure ES-4.

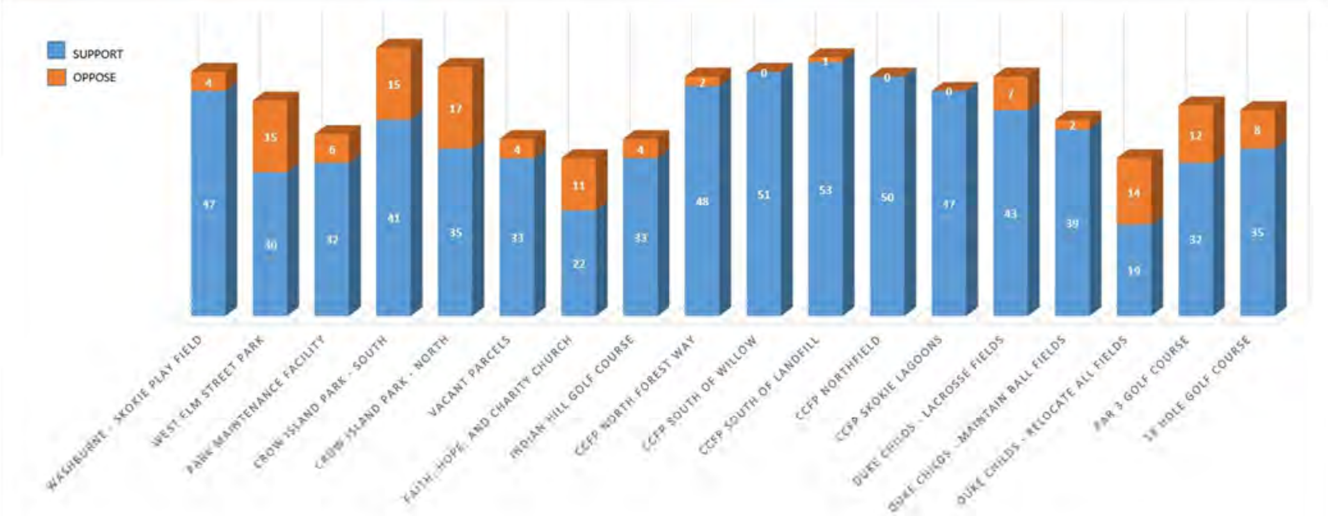


Figure ES-4 Opportunity Support or Opposition by Exploration Phase Public Comment

VISION PHASE

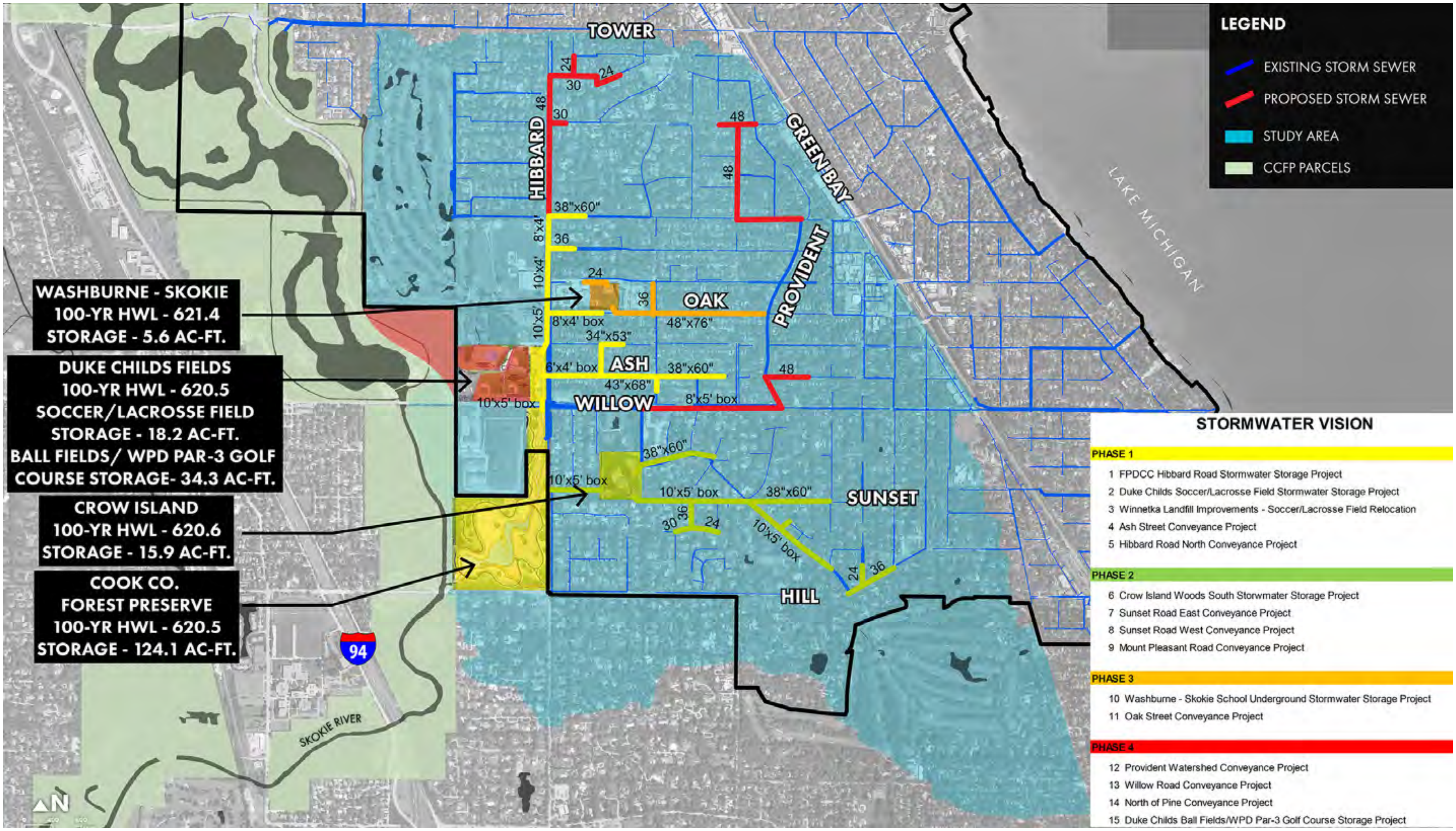
The Vision Phase of this study identified a program of fifteen individual projects for stormwater and flood control that when fully implemented would meet the Village's Target Level of Service. A timeline or phasing for implementation of this Stormwater Vision was determined with estimates of cost for the individual projects that make up the Vision. Unresolved issues related to the individual projects were also identified as well as potential alternatives to some of the key projects.

Figure ES-5 presents a graphic of the full Stormwater Vision, which has been broken down into four phases indicted by the four colors on the figure. These colors correlate with Table ES-1 which details the projected phased implementation of the fifteen individual projects as well as the estimated cost for each project.

The Stormwater Vision has been developed to provide the Village with flexibility to distribute over time both the financial impacts and construction-related impacts to Village residents and affected stakeholders. Much like the Stormwater Vision itself, this phasing plan should not be considered "etched in stone" as it will also continue to evolve as planning and design activities are advanced.

The estimated cost in 2016 dollars to implement all four phases of the Stormwater Vision is $57,717,000, which includes anticipated project contingencies, permitting, design and construction engineering. Detailed cost estimates are provided within Appendix J.

Figure ES-5 Stormwater Management and Flood Control Vision



• Phase 1	Cost	
○ FPDCC Hibbard Road Stormwater Storage Project	$	8,582,000
○ Duke Childs Soccer/Lacrosse Field Stormwater Storage Project	$	1,005,000
○ Winnetka Landfill Improvements - Soccer/Lacrosse Field Relocation	$	2,331,000
○ Ash Street Conveyance Project	$	5,107,000
○ Hibbard Road North Conveyance Project	$	6,553,000
Phase 1 Total	**$**	**23,578,000**
• Phase 2	**Cost**	
○ Crow Island Woods South Stormwater Storage Project	$	1,841,000
○ Sunset Road East Conveyance Project	$	10,356,000
○ Sunset Road West Conveyance Project	$	2,821,000
○ Mount Pleasant Road Conveyance Project	$	1,362,000
Phase 2 Total	**$**	**16,380,000**
• Phase 3	**Cost**	
○ Washburne-Skokie School Underground Stormwater Storage Project	$	1,381,000
○ Oak Street Conveyance Project	$	3,294,000
Phase 3 Total	**$**	**4,675,000**
• Phase 4	**Cost**	
○ Provident Watershed Conveyance Project	$	2,930,000
○ Willow Road Conveyance Project	$	5,284,000
○ North of Pine Conveyance Project	$	2,408,000
○ Duke Childs Ball Fields/WPD Par-3 Golf Course Storage Project	$	2,461,000
Phase 4 Total	**$**	**13,084,000**
Stormwater Vision Total	**$**	**57,717,000**

Table ES-1 Stormwater Vision Project Implementation Phasing Plan and Cost Estimates

The Vision Phase of the study concluded with a public meeting in April 2016, followed by public presentation of this study to the Village Council in May 2016. The public meetings presented the results of this study and the Vision for stormwater and flood control improvements in western and southwestern Winnetka. The public presentations also allowed the public opportunity to further express their views and ask questions concerning the presented Vision.

Conclusion of the Vision Phase of this study culminated with the next steps the Village needs to take in consideration of the Vision presented for stormwater and flood control in western and southwestern Winnetka.

NEXT STEPS

This report and the Vision it presents is not the end of the Village's study. There are still many questions that need to be answered, comments and concerns that need to be addressed, and partnerships that need to be solidified. These are the next steps in the Village's stormwater and flood control program for western and southwestern Winnetka. They represent the actions that need to begin before the Village can move forward with implementing the physical aspects of the Vision.

Details of the next steps are provided in **Section 4** and are summarized as follows:

A. FPDCC

1. Schedule and conduct a meeting with FPDCC to discuss the land use request process and establish a firm understanding of the milestones and expectations.
2. Engage the Village's local County Board Commissioner.
3. Engage the stakeholder groups that have a stake in FPDCC lands.
4. Determine with the FPDCC the scope of the proposed improvements to be advanced through the District's land use process.
5. Perform a tree inventory, wetland delineation, and floristic quality assessment for the lands included in the scope of the proposed improvements.
6. Begin coordination with the US Army Corps of Engineers regarding potential wetland impacts associated with the proposed improvements.
7. Begin advanced concept engineering plans for the site.
8. Longer-term next steps are anticipated to include, determination of a cost-sharing program, if any; development of a restoration plan; development of a maintenance plan; and development of a long-term operation.

B. New Trier High School District

1. Engage representatives of the NTHSD Board to determine their position relative to potential opportunities on high school lands.
2. Begin advanced concept engineering for the landfill redevelopment plan.

3. Determine the scope of potential alternative stormwater storage on Duke Childs soccer/lacrosse fields.

4. Proceed with advanced concept engineering plans for the storage facilities.

5. Keep the FPDCC informed of the status of the Duke Childs opportunities.

C. <u>Winnetka Park District</u>

1. Perform a tree inventory, wetland delineation (if needed), and a floristic quality assessment of the Crow Island Woods site.

2. Develop more advanced site engineering that refines the current Vision within the context of maintaining as much of the existing quality features of the property as possible.

3. Revise the hydraulic modeling based on the advanced concept to determine how it changes the balance of the Vision.

4. Conduct a site walking tour to provide one-on-one interaction and increased education to the public concerning the current value of Crow Island Woods.

5. Re-engage the public in an open house presentation of the Vision and work towards a more acceptable and less disruptive vision for the Crow Island Woods site.

6. Meet with the Winnetka Park District to discuss intentions for moving forward.

7. Keep the Winnetka Park District informed of the status of the Crow Island Woods opportunities.

D. <u>School District 36.</u>

1. Engage representatives of the School Board to present the Vision as it applies to the School District and determine their position on the proposed Vision.

2. Revise the Vision as needed to address School Board concerns.

E. <u>Sunset Road or Alternative Conveyance Routing</u>

1. Perform a tree inventory along the corridors to determine type, size, and condition, as well as exact location.

2. Develop more advanced site engineering along the corridors to better determine constructability, disturbance, and restoration issues.

3. Meet with the affected property owners to discuss the improvements and plans and begin negotiations for access and approvals as necessary.

4. Develop updated modeling reflecting results of the engineering and any changes.

SECTION 1
AWARENESS PHASE

1.01 INTRODUCTION

In October 2015, the Village of Winnetka, Illinois (Village), engaged Strand Associates, Inc.® to provide stormwater and flood control study services for the western and southwestern areas of the Village shown within the red line boundary on Figure 1.01-1. The intent of the study was to identify creative and cost-effective “westward looking” improvements for stormwater and flood control, taking into account the Village’s overall goals and objectives. This study was structured to be different from prior stormwater studies undertaken by the Village in that a holistic view was taken of the study area within the western watershed with evaluation of a variety of grey and green approaches including conveyance, detention, infiltration, property acquisition, and individual property protections.

The study was performed in three phases:

1. The Awareness Phase gathered background information, studied watershed characteristics, created hydrologic and hydraulic models, and developed an understanding of the existing watershed conditions leading to the area’s current stormwater and flood control issues.

2. The Exploration Phase determined the Village’s goals for protection during storm events, otherwise known as the Target Level of Service. Based on the Target Level of Service various strategies were considered and a matrix of opportunities for stormwater and flood control were identified and evaluated. In that evaluation, significant community partners known as Stakeholders as well as the public were engaged for their comments and input.

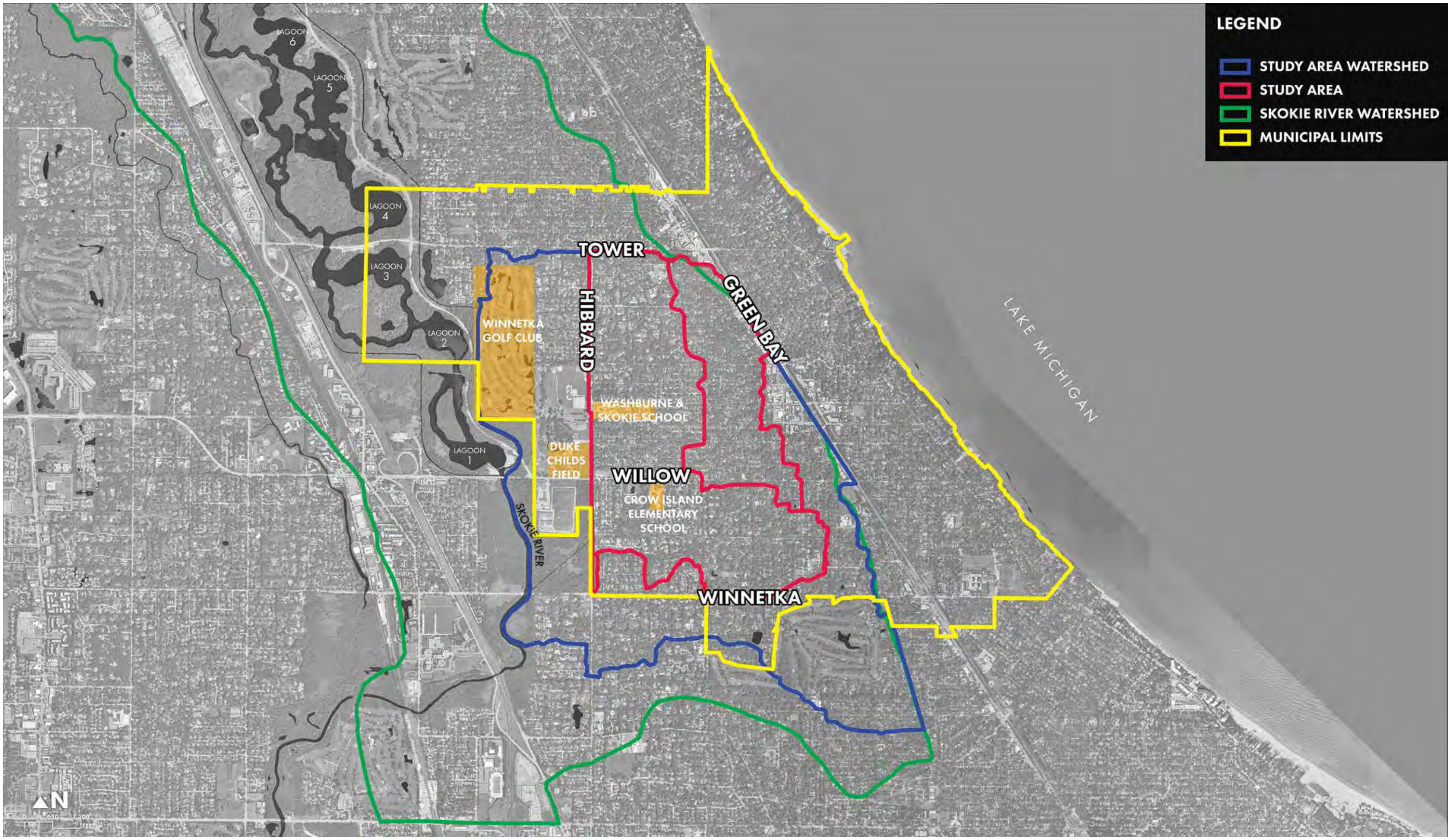
3. The Vision Phase identified a program of individual opportunities for stormwater and flood control that when fully implemented would meet the Village’s Target Level of Service. A timeline or phasing for implementation of this Vision was determined along with estimates of cost for the individual projects that make up the Vision. Unresolved issues related to the individual projects were also identified along with potential alternatives to some of the key projects.

The Vision that has come out of this study represents a concept level plan for the Village to meet its Target Level of Service. Because it is still a concept there are questions, concerns, and details that will need to be resolved before any single project can be implemented. However, the Vision lays a strong foundation for the Village to make decisions moving forward with stormwater and flood control in western and southwestern Winnetka.

1.02 BACKGROUND

For over a decade Winnetka has been concertedly pursuing solutions to recurring stormwater management and flooding issues across the entire Village. There are neighborhoods in Winnetka that are impacted by flooding on an annual basis. Even more daunting is the fact that the Village has been burdened with multiple historic rainfalls in less than a 10-year span resulting in significant property damage and losses.

Figure 1.01-1 Study Area



In 2008, following the influence of Hurricane Ike that dropped over 8 inches of rain on the Village in 36 hours, the Village moved forward to evaluate its stormwater management systems. The two studies that resulted from the 2008 storm showed that the Village was still vulnerable and made recommendations to spend over $14 million to achieve a 10-year storm level of protection.

Subsequently in July 2011, once again the Village received over 8 inches of rain; 6.5 inches falling in just over 3 hours. This event took a massive toll on Village residents. A survey of damage estimated 1,000 or more homes incurred some level of damage from the event and standing water burdened parts of the community for more than a week following the event. The Village suffered through a third damaging rainfall event in April 2013 that resulted in almost 5 inches of rain. Clearly, with three historic rainfall events in less than 5 years, a 10-year level of protection did not seem sufficient, and the Village pushed to identify solutions to provide residents with a greater level of protection.

Figure 1.01-2 Cherry Street Flooding on July 23, 2011

A Flood Risk Reduction Assessment was performed in October 2011 that recommended several stormwater management improvement projects across the entire Village. Many of these projects have been implemented. However, viable solutions for the western and southwestern portions of the Village have proven extremely challenging to find, and those pursued to date have experienced significant barriers impeding their progress and success. Because of these challenges in western and southwestern Winnetka, the Village decided to reassess the prior studies and pursue a more holistic approach to studying effective and sustainable stormwater and flood relief opportunities. The intent of this approach was to give the Village confidence that it has considered all the opportunities, called upon all potential community partners, and leveraged all available resources in support of its stormwater management and flood reduction program.

This study approach included the following key aspects:

A. <u>Sustainable Watershed Evaluation</u>

A sustainable watershed evaluation is based on data and understanding, which supports holistic thinking in the watershed. Because the Village has been studying its stormwater issues for many years, there was a significant amount of background data that was available for this study. That background information led to a thorough understanding of the watershed characteristics and why the western and southwestern portions of the Village continue to struggle with stormwater issues. That understanding was supported by robust hydrologic and hydraulic modeling that accurately simulated existing conditions in the watershed and afforded confident assessment of the sizing and efficacy of potential stormwater management opportunities.

Building on that understanding, the sustainable watershed evaluation process went beyond the prior studies by evaluating both traditional stormwater management opportunities and more natural and sustainable opportunities. This wider view implemented numerous stormwater tools to overcome constraints in the watershed that previously were impeding the Village's progress. It also brought water quality improvements to the stormwater strategies, which is a critical aspect of any stormwater management program. This holistic approach generated scores of potential opportunities that were compiled in a matrix, assessed through various criteria, and shortlisted to be part of a final vision for stormwater management and flood control.

B. Establishment of Community Partnerships

It was recognized at the start of the study that successful stormwater management and flood control requires a partnership with key entities within the community; namely the Winnetka Park District, the Forest Preserve District of Cook County (FPDCC), New Trier High School District, and School District 36. These potential community partners manage valuable open land areas that represent key opportunities in the Village's stormwater program. An open dialogue with these community entities was pursued through discussions of how a mutually beneficial partnership would advance the goals and objectives for the use of property and aid the Village in providing stormwater protection to the community.

C. Public Engagement

It was also recognized that engaging the general public in the study process was necessary to not only promote public acceptance of the study, but to help build the watershed evaluation process through understanding the experiences of the people living and working in the community. Furthermore, the technical aspects of stormwater management can be complicated and confusing, so engaging the public allowed for sharing of the concepts in an understandable and relatable manner.

The extensive public engagement aspect of the study helped to educate the public in the causes of the recurring flooding issues, confirm the existing flooding conditions as experienced by the public, explain the process and reasoning for identifying and evaluating potential stormwater and flood control strategies, and afford the public an opportunity to be part of the final vision for stormwater management and flood control.

D. Identification of a Viable Stormwater Program

The entire study process culminated in creation of the vision for stormwater management and flood control presented in this report. This vision was created to provide the Village with a conceptual direction to move forward with implementing improvements that will reduce stormwater and flood impacts in the community. The vision was crafted to provide flexibility through interdependent components that could be implemented over time on a schedule and budget as determined by the Village with a knowledge of the resultant benefits. The holistic nature of the study also provides the Village with an understanding of some key alternatives to the vision that could be considered in light of the remaining unknowns and potential conflicts identified for some of the vision components.

1.03 STUDY AREA CHARACTERISTICS

The Awareness Phase of this study gathered background information, studied the watershed characteristics, created hydrologic and hydraulic models, and developed an understanding of the existing watershed conditions leading to the study area's current stormwater and flood control issues.

A. Definition of Study Area

Figure 1.01-1 shows a map of the study area and its various components within the Village's municipal limits. This study investigates potential stormwater and flood control improvements for the area bounded in red (Study Area), generally between Tower Road and Winnetka Avenue from north to south and between Green Bay Road and Hibbard Road from east to west. However, it was recognized that this focus study area is located in a larger watershed bounded in dark blue (Study Watershed). Therefore, this study considered the impacts from and potential benefits within the larger study area watershed when searching for opportunities to help the focus study area.

This study also recognizes the study area watershed's location within the regional Skokie River Watershed, bounded in green and established from the point of confluence with the North Branch of the Chicago River. This regional watershed is important because the opportunities for stormwater and flood control identified within the study area need to consider their impacts on this larger watershed, which directly impacts neighboring communities, property owners, and regulatory agencies

B. Background Study Data

The Village has been gathering data and studying stormwater in the Village for several years so there was a significant amount of background data available to support the study efforts. Appendix A contains much of the data used in and created by this study including an information log of the data compiled in support of this study.

In addition to this information other data was gathered such as past stormwater and flood risk studies, wetland and floodplain mapping, soils data, various internet available historical study area data, and public comments, as well as many on-site observation notes.

C. Study Area Characteristics

All the background data gathered and studied provided an understanding of the historical and current characteristics of the study area watershed.

1. Historical Conditions

a. Historical Development Patterns

Aerial documentation of development conditions in and around the Village was available back to the 1930s. Figure 1.03-1 provides an aerial view from 1938, which is generally around the time when the drainage patterns in the study area underwent significant change as discussed further below.

Figure 1.03-1 1938 Aerial Photograph of Study Area

From this figure it can be seen that a significant amount of the study area has been developed leaving open lands to the south and west, most likely because development moving west was encroaching on low elevation lands susceptible to wet and flooded conditions. Figure 1.03-2 is a photo taken from Hibbard Road looking west showing the character of this marsh land area around the same time. At the time, official policies to

Figure 1.03-2 1930 Era Photograph at Hibbard Road Looking West

keep development out of flood-prone areas were weak, if existent at all, so development continued to move into what we today recognize as the floodplain of the Skokie River.

b. Skokie River Levee System

When Franklin Delano Roosevelt was inaugurated in 1933, more than 25 percent of the United States population was unemployed. As part of President Roosevelt's New Deal programs, the Civilian Conservation Corps (CCC) was instituted to provide jobs for young men to relieve families who had difficulty finding jobs during the Great Depression, while at the same time implementing a general natural resource conservation program across the country. The CCC is recognized as the single greatest conservation program in America.

Figure 1.03-3 Skokie Lagoons and River Channel Construction

Figure 1.03-4 Skokie River and Levee System

The Skokie Lagoons located immediately west of the Village were constructed as part of the CCC initiative between 1935 and 193*8* (see Figure 1.03-3). At the same time, the Skokie River was rechanneled and a levee was constructed along the east edge separating the river from the developing Village. Figure 1.03-4 shows a recent photograph taken from the west bank of the Skokie River looking east at the levee along the Winnetka Golf Course north of Willow Road. The levee system was intended to protect the Village from overbank flooding of the Skokie River. Available historical flood data seems to indicate that it effectively does that. From discussions with representatives of the Winnetka Park District and Village staff, the only recorded overtopping of the levee system occurred during the September 2008 storm event, which exceeded a 100-year storm event, (see Section 1.05 B below for a definition of 100-year storm event), and only at a small portion of the levy on the Winnetka Golf Course property.

The effect of the Skokie River levee system was to allow for development in the Village to continue west into what had been wet overbank areas of the Skokie River. These areas, now protected from the river, were considered dry enough to build in. A secondary effect of the levee system was to effectively cut off natural overland drainage that used to flow into the Skokie River. This effect is discussed further below relative to study area topography.

b. Skokie River Flood Plain

The National Flood Insurance Program was created in 1968, so official flood plain mapping didn't begin until the 1970s, well after development in the study area had encroached into what had been flood prone areas. Figure 1.03-5 shows the mapped extent of the Skokie River flood plain, which represents the limits of flooding anticipated during a 100-year storm event. Although it appears the levee system is effective in protecting Winnetka from overbank flooding of the Skokie River up to the 100-year storm event, it must be noted that the Federal Emergency Management Agency (FEMA), which oversees the national flood plain mapping system, does not recognize the Skokie River levee system as a certified levee - the levee was built prior to such certifications. Therefore, the flood plain mapping was developed assuming the levee system does not exist. Figure 1.03-6 shows the historical condition of the Skokie River flood plain as mapped by current FEMA floodplain mapping.

Figure 1.03-6 Historical Condition of Skokie River Floodplain

The historical circumstances under which development took place in the Village provides important clues to existing conditions in the study area that are influencing stormwater and flood issues in the Village today.

2. Topography

Figure 1.03-5 provides ground elevation ranges represented in color; greens and yellows are at higher elevations, falling into oranges and reds at lower elevations. From these color ranges it can be seen that the general direction of surface runoff in the watershed is northeast (green) to southwest (orange and red) toward the Skokie River.

Interestingly, the historic ground elevations within the study area do not appear to have changed much since 1938. Therefore, much of the development of today is still situated at low elevations that had been floodplain and are lower than the levee system separating the Village from the Skokie River. In fact, some portions of the study area are only a few feet higher in elevation than normal water levels in the Skokie River and actually several feet lower than the 100-year flood levels in the Skokie River. Thus, the western and southwestern area of the Village is like a bath tub with runoff from higher elevations into lower elevations trapped behind the levee.

Figure 1.03-5 Elevation Ranges and Skokie River Floodplain

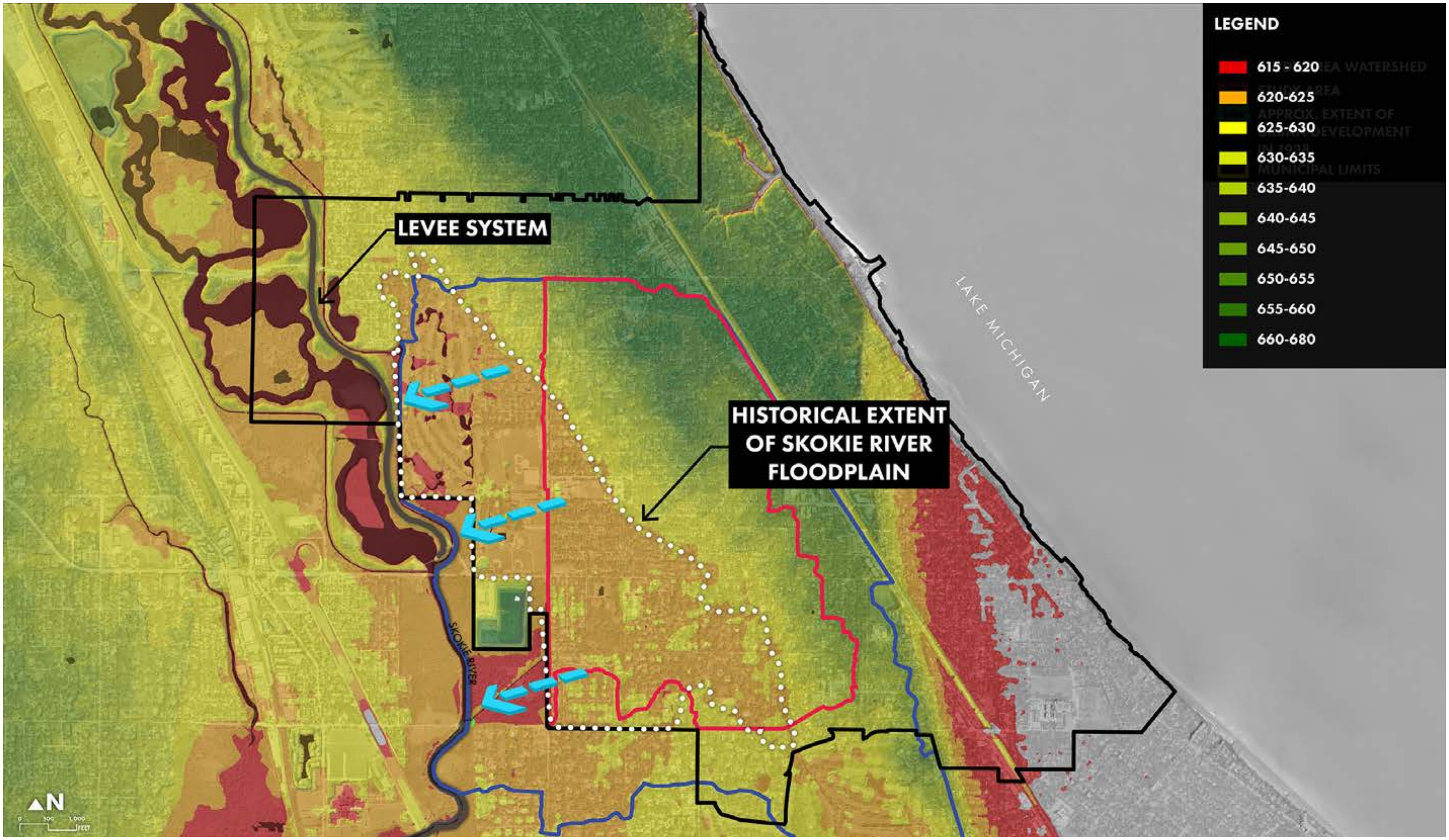


Figure 1.03-7 graphically shows the bath tub effect. The bath tub does have a drain, but this drain requires pumping of stormwater runoff from low areas and it has very limited capacity. Essentially, a restricted bath tub drain as discussed further below.

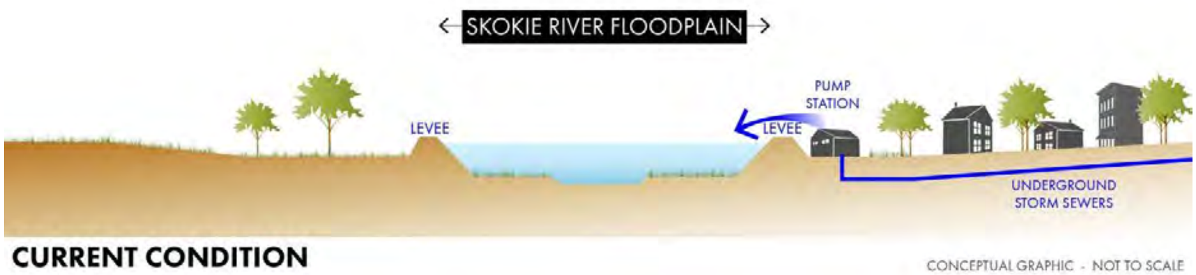


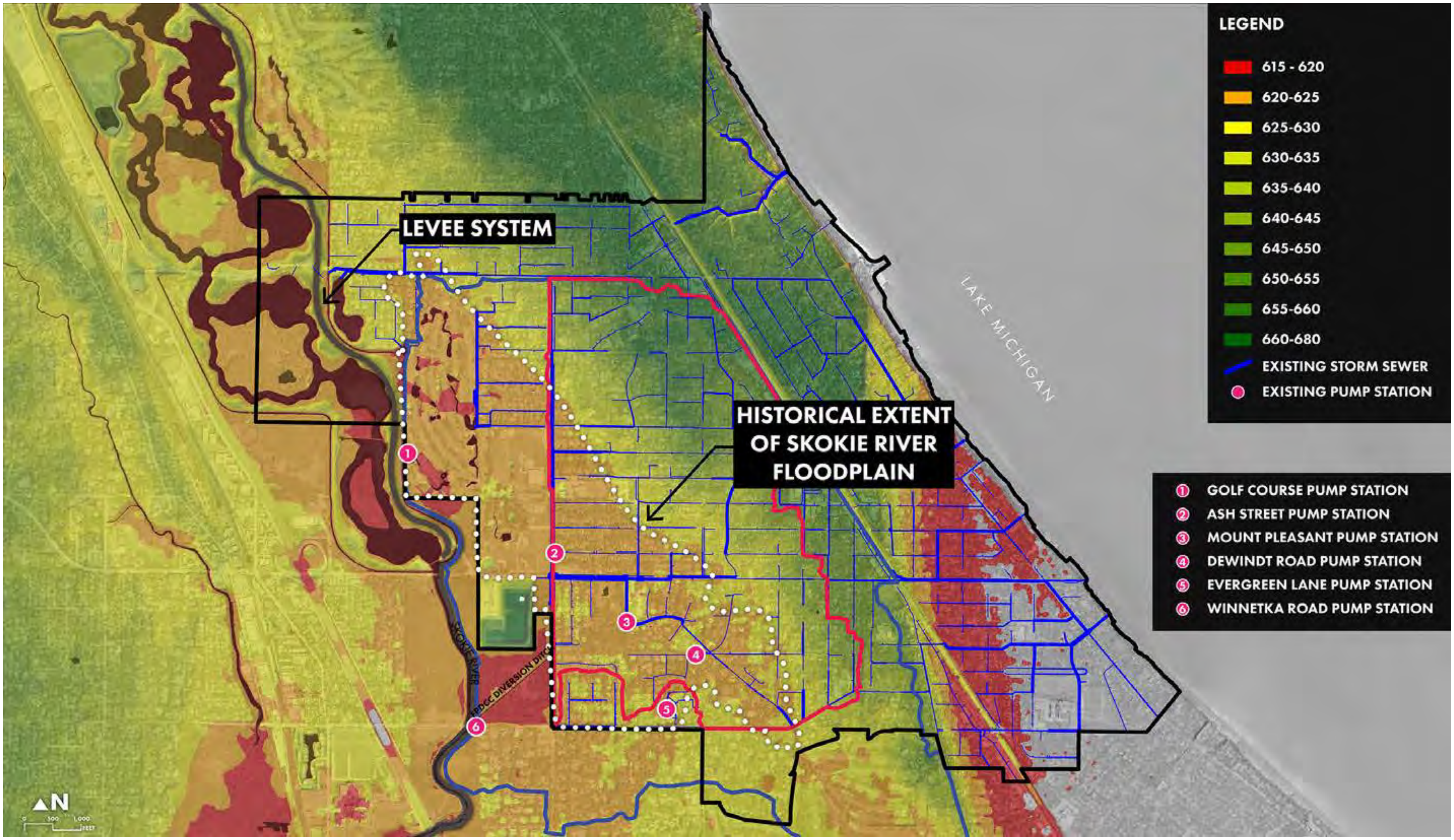
Figure 1.03-7 Current Condition Skokie River Floodplain

3. Drainage Infrastructure

The study area is drained through a series of storm sewers and stormwater pumping stations as shown in Figure 1.03-8. The storm sewer system captures runoff and conveys it toward one of five neighborhood pumping stations; Winnetka Golf Course, Ash Street, Mount Pleasant, DeWindt, or Evergreen Lane. When the capacity of the storm sewer system or the neighborhood pumping stations is exceeded, runoff flows overland into low areas where it ponds and floods until flow in the storm sewer system recedes and can take in the ponded water.

The Winnetka Golf Course pumping station pumps stormwater directly into the Skokie River. However, the other four neighborhood pumping stations indirectly pump to the Winnetka Avenue pump station located immediately east of the Skokie River on the north side of Winnetka Avenue on FPDCC property. Approximately 83 percent of the entire study area watershed runoff is conveyed through a diversion ditch on FPDCC property to this pumping station where it is pumped directly into the Skokie River. Regulatory requirements for the Skokie River set by the Illinois Department of Natural Resources control discharge of stormwater to the river from the Winnetka Avenue pumping station through a requirement that the pumping station be shut off when a specified flood level (elevation 624.0) in the Skokie River is reached.

Figure 1.03-8 Stormwater Drainage Infrastructure Schematic



The Village's stormwater drainage infrastructure is discussed in further detail below. However, the stormwater and flood control issues experienced in western and southwestern Winnetka can generally be summed up as a drainage infrastructure system with limited capacity resulting in excess stormwater runoff being trapped in the neighborhoods where the flat topography does not provide any significant overland flood routes. The magnitude of this problem is further compounded by the following watershed characteristics.

4. Land Use

The study area watershed is approximately 1,627 total acres in size. The land use within that area is predominantly residential with approximately 72 percent single-family residential and 2 percent multi-family or townhome residential. Also within the study watershed is approximately 6 percent public use (schools, administration, etc.) and approximately 2 percent mixed-use/commercial land use. The remaining 18 percent is open space in parks, school yards, and forest preserve.

This land use coverage includes about 500 acres of impervious surface or about 30 percent of the total watershed. The United States Geological Survey terms this percentage of impervious surface coverage as medium-density development (20 to 35 percent). This is a relatively high impervious surface coverage resulting in increased stormwater runoff within the watershed, which places additional burden on the Village's existing stormwater drainage system.

The limited 18 percent of open space poses another challenge within the study area. Most of this open space is maintained by the Park District (189 acres), the FPDCC (86 acres), or the two school districts (36 acres), and none of it is owned by the Village. Additionally, with the exception of the FPDCC lands, most of the open space is in active community use. Open space is a critical component to any community's stormwater management system. If the Village's drainage infrastructure had sufficient capacity to convey stormwater out of the neighborhoods, a place would still be needed to store that stormwater and control its release to the Skokie River. Open space often provides that stormwater storage place, which makes community partnerships a critical component of the Village stormwater and flood control program.

5. Soils

The Village is dominated by soils that are very poorly drained, meaning the ability of the soils to infiltrate runoff is extremely limited. Soils are generally categorized by hydrologic soil groups which, among other things, describe a soil's ability to infiltrate water. Class A soils are highly permeable or well-drained compared to Class D soils that are highly impermeable or poorly drained.

Approximately 72 percent of the Village's soils are Class D soils, characterized by clay soils or soils with a shallow permanent water table. Another 15 percent of the Village's soils are Class B/D soils, which means these soils act as Class D soils because of a variable high water table that, when lowered, the soils act more like Class B soils that are moderately permeable and moderate to well-drained. The Class B/D soils are generally found on the open space parks and forest preserve areas and not within the developed areas of the Village.

Classification of soils is generally limited to the top 5 feet of ground, but review of soil boring and well drilling logs from various locations across the study area generally showed that the dominant clay and clay-mix soils in the Village extend as much as 100 feet or deeper. The shallowest sand and gravel layers identified were at 80 feet deep. This means that the pervious surfaces in the study area are themselves limited in permeability and stormwater runoff reduction benefits.

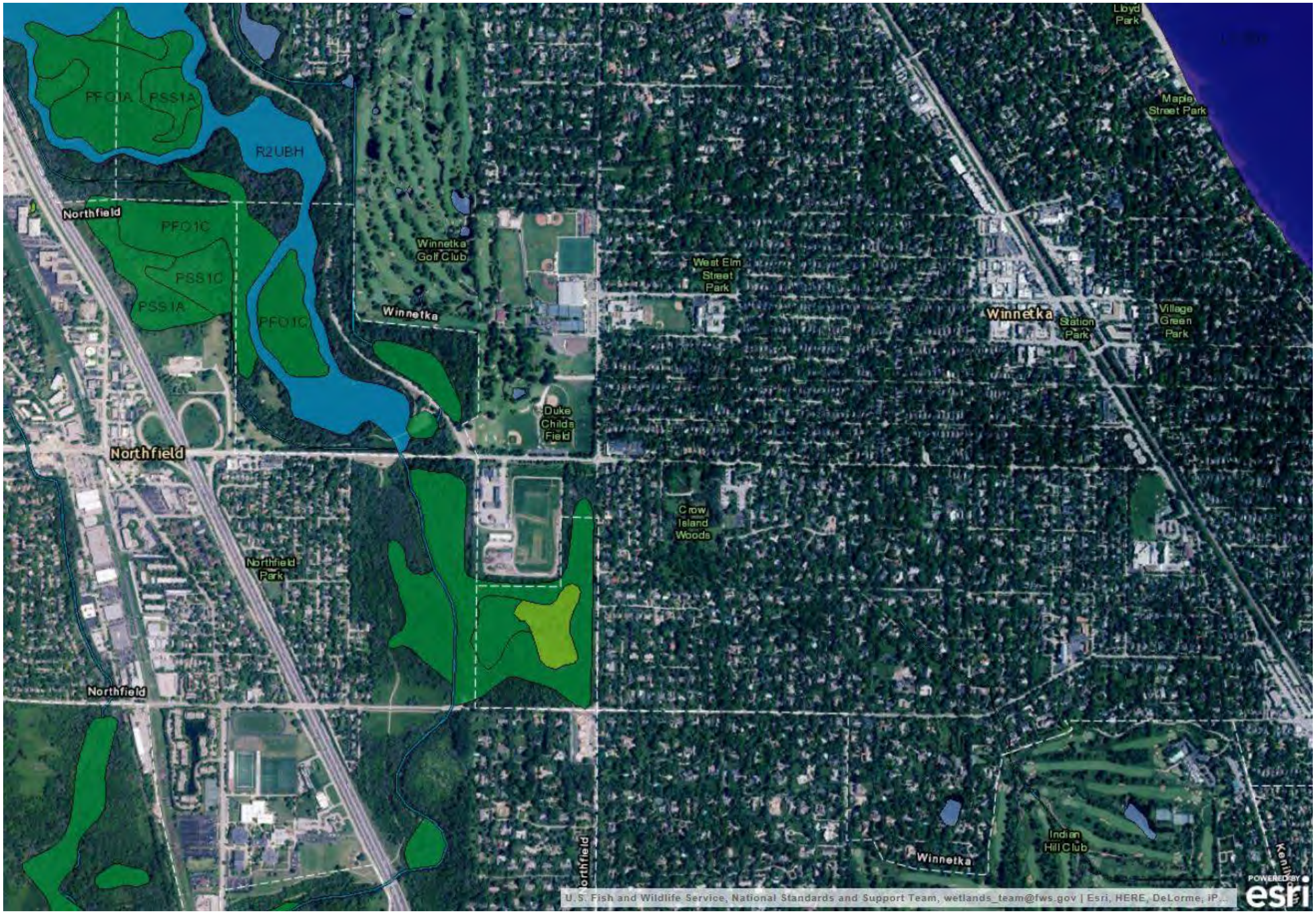
7. Wetlands

There are very limited delineated wetlands in the watershed study area as shown in Figure 1.03-9. According to the National Wetland Inventory mapping the majority of the wetlands in the study area are on Forest Preserve District lands. This issues will impact stormwater opportunities identified for these lands because mitigation (replacement) of disturbed wetlands will need to be considered in planning and cost estimating of the opportunity.

6. Hydrology

Topography, infrastructure, land use, and soils all contribute to the hydrology of the watershed. There are approximately 3,095 single-family residential parcels in the study area with an average parcel size of 24,111 square feet or about one-half acre. The approximate volume of stormwater runoff generated by a single parcel for various three-hour duration storm events is shown in Table 1.03-2.

Figure 1.03-9 National Wetland Inventory Mapping



Storm Event	Volume of Runoff (gallons)	Volume of Runoff (cubic feet)
2-year	9,000	1,200
10-year	14,000	1,870
50-year	20,000	2,670
100-year	23,000	3,070

Table 1.03-2 Stormwater Runoff Volumes from a Typical Winnetka Residential Parcel

The residential parcels alone produce almost 28 million gallons (3.7 million cubic feet) of stormwater runoff in a 2-year, three-hour duration storm event. In a 100-year, three-hour duration storm event, the runoff volumes increase to 71 million gallons (9.5 million cubic feet). The significant impervious surface coverage and poorly drained soils do little to reduce the runoff volume that is overtaxing to the existing drainage infrastructure and is trapped in the neighborhoods, creating significant stormwater and flood issues in the western and southwestern portions of the Village.

1.04 HYDROLOGIC AND HYDRAULIC MODELING

A. Existing Hydrologic and Hydraulic Models

The Village commissioned several stormwater studies in the past within the study watershed that involved development of hydrologic and hydraulic (H&H) models that simulated flooding conditions and allowed potential flood control improvement projects to be evaluated. One of the primary objectives of this study was to obtain, review, and to the greatest extent possible, build upon past H&H models to develop a single comprehensive H&H model of the study watershed. The majority of the H&H models created in the past by Christopher B. Burke Engineering, Ltd. (CBBEL) and Baxter and Woodman, Inc. (B&W) utilized the XP-SWMM (1d) modeling program. The only exception to this was H&H modeling done by Montgomery, Watson, Harza, Inc. (MWH), which utilized the MWH InfoWorks CS hydraulic modeling software package for analyzing the Willow Road Stormwater Tunnel and Area Drainage Improvements (STADI) project. Below is a listing of the various existing conditions H&H models that had previously been developed within the study watershed.

1. South of Willow Watershed (Area L) by CBBEL
2. Indian Hill Country Club Watershed by CBBEL
3. North of Willow Watershed (Area J) by CBBEL
4. North of Pine Watershed (Area G) by CBBEL
5. Provident Watershed (Area H) by CBBEL
6. Area N Watershed by B&W
7. Area O Watershed by B&W

Existing conditions stormwater models for the watersheds listed in items 1 through 5 were developed as part of CBBEL's October 2011 *Flood Risk Reduction Assessment*. The Area N and O Watersheds were studied as part of B&W's April 2014 *Village of Winnetka Stormwater Master Plan*. A brief discussion of each of these watersheds follows.

1. South of Willow Watershed (Area L)

This 255.5-acre watershed is generally bounded by Willow Road to the north, Ridge Avenue to the east, Hill Road to the south, and Hibbard Road to the west (refer to Figure 1.04-1). Stormwater runoff southeast of Hill Road from the 281.5-acre Indian Hill Country Club Watershed can enter the South of Willow Watershed via an existing restrictive 36-inch-diameter cross culvert. Further discussion regarding drainage in this area is provided in Subsection 2 below. Because of flat topography and a lack of overland flood routes, stormwater drainage from the majority of the South of Willow watershed must ultimately be pumped to the west via the Village's Mount Pleasant Road Pump Station, which has a pumping capacity of approximately 21.6 cubic feet per second (CFS). The 22-inch-diameter discharge force main from the pump station crosses through Crow Island Woods to the west and outlets into a 36-inch-diameter gravity storm sewer located at the east end of (West) Sunset Road. This 36-inch storm sewer pipe outlets into the FPDCC diversion ditch immediately west of Hibbard Road. Note that the DeWindt Road Pump Station, which is located near the intersection of (East) Sunset Road and DeWindt Road, is a privately-owned facility with limited hydraulic capacity (~1.6 CFS) that pumps stormwater runoff from a 26.7-acre subwatershed (SW-16) to a gravity storm sewer that ultimately outlets to the Mt. Pleasant Road Pump Station. Repetitive severe flooding has been reported throughout this watershed.

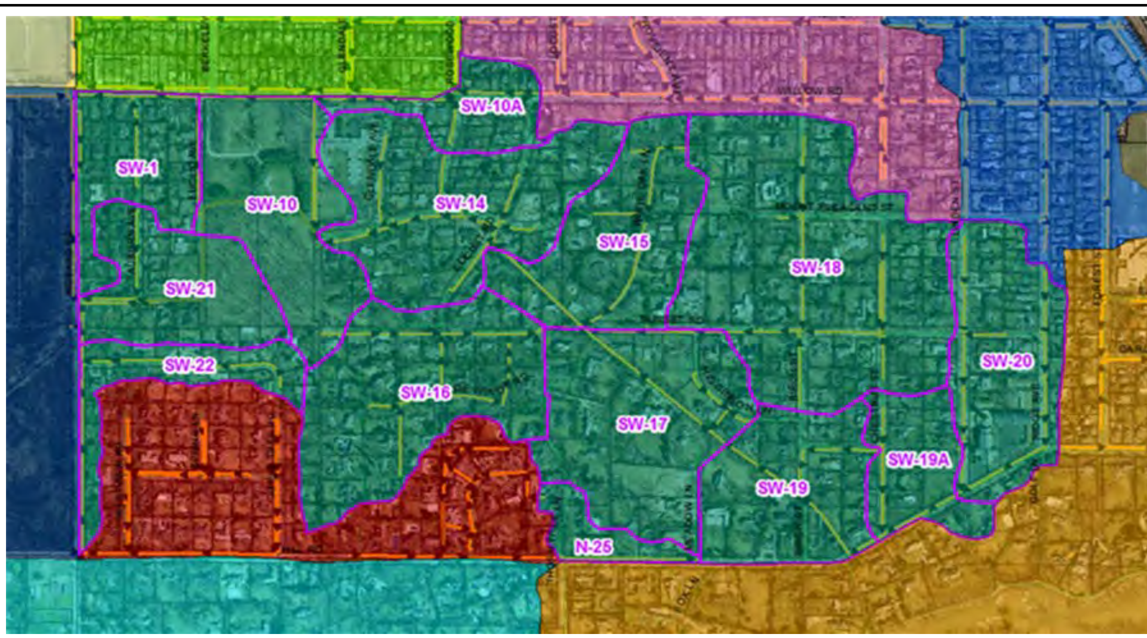


Figure 1.04-1 South of Willow Watershed (Area L)

2. Indian Hill Country Club Watershed

This 281.5-acre watershed is generally bounded by Hill Road to the north, Locust Road to the west, Ridge Road to the east, and Chestnut Avenue to the south in the Village (refer to Figure 1.04-2). Field reconnaissance and review of available topographic mapping within the watershed indicated that the following characteristics needed to be reflected in our updated stormwater model:

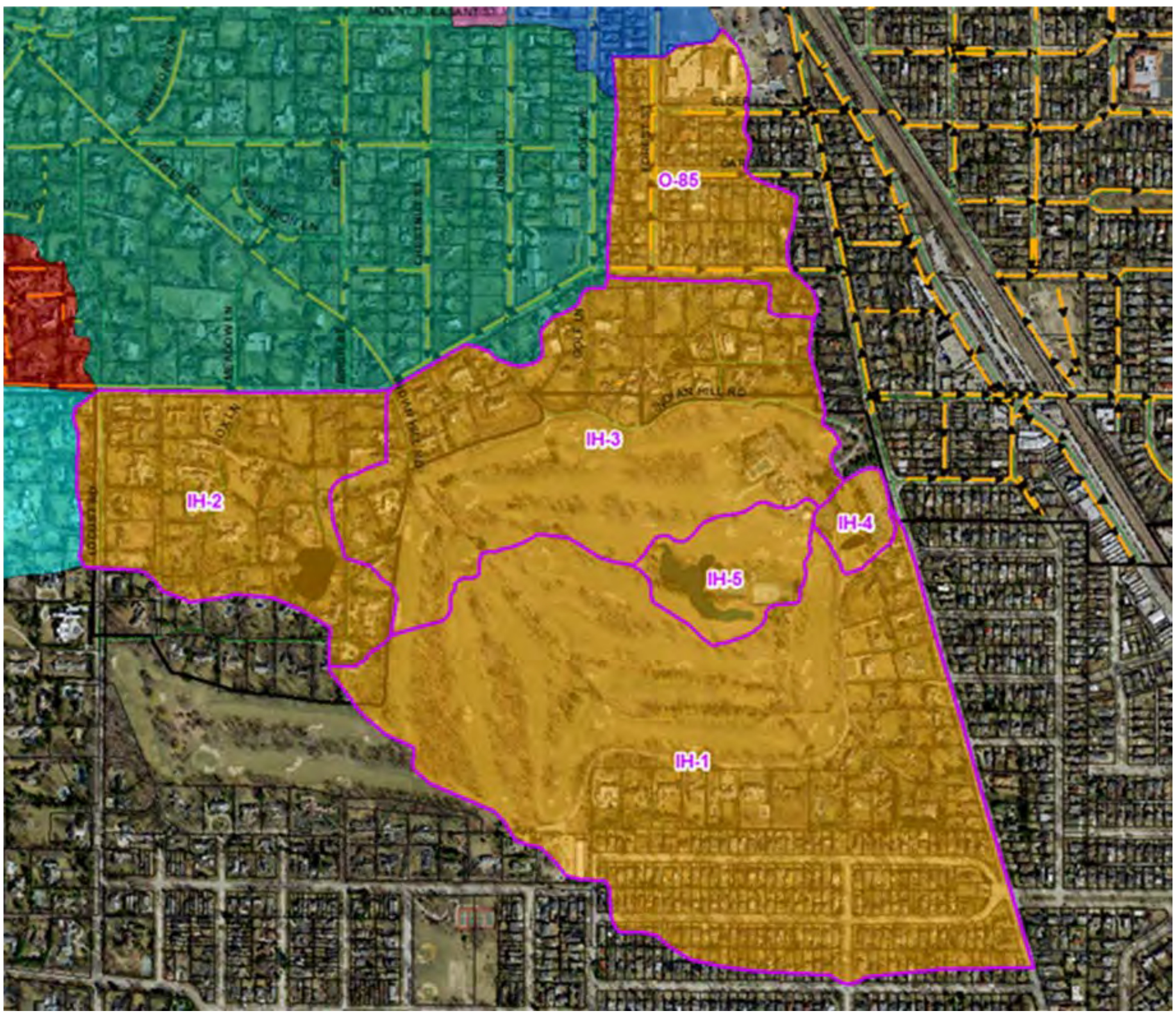


Figure 1.04-2 Indian Hill Country Club Watershed

a. There is a significant amount of existing depressional flood storage that is present within the Indian Hill Country Club.

b. The Skokie Ditch, which crosses the Indian Hill Country Club, has two primary pipe outlets. In addition to the 36-inch cross culvert at Hill Road, there is a 36-inch storm sewer near Ridge Road where the Skokie Ditch terminates to the east. This storm sewer system is then directed through neighborhoods within the Village of Kenilworth. Ultimately, this storm sewer connects to the Metropolitan Water Reclamation District (MWRD) combined sewer interceptor at Sheridan Road. We obtained a stormwater management study developed by the Village of Kenilworth that evaluated the hydraulic capacity and performance of this outfall storm sewer system. The discharge performance curve of the storm sewer system was input into the new model.

c. The opening of the 36-inch cross culvert at Hill Road is partially silted in, so the full hydraulic capacity of this culvert is not currently realized.

d. Several restrictive driveway cross culverts are located within the Skokie Ditch upstream (southeast) of the 36-inch Hill Road culvert, along Indian Hill Road.

e. The total drainage area of this watershed is approximately 281.5 acres. We separated this watershed into several smaller subwatersheds, as depicted in Figure 1.04-2. Subwatershed IH-2, located in the far westerly limits of the watershed, is tributary to an existing wet stormwater detention pond that outlets to the Skokie Ditch within the Indian Hill Country Club. Subwatersheds IH-4 and IH-5 are both internally drained to lakes that are assumed not to contribute runoff to Skokie Ditch. Stormwater runoff from subwatershed O-85 is drained by storm sewers that are directed to the east to the MWRD interceptor sewer. However, flows that exceed the capacity of these storm sewers are directed to the south into the Indian Hill Country Club.

3. North of Willow Watershed (Area J)

This 154.4-acre watershed is generally bounded by Hibbard Road to the west, Willow Road to the south, Locust Street to the east and Pine Street to the north (refer to Figure 1.04-3). This watershed encompasses what is commonly known as the Tree Streets Neighborhood, which include Oak Street, Cherry Street, and Ash Street. Stormwater runoff in this watershed is generally directed to the south and west via storm sewers. The focal point of this storm sewer drainage is the Village's Ash Street Pump Station located near the intersection of Ash Street and Hibbard Road. The Ash Street Pump Station, which has limited hydraulic capacity (~8.0 CFS), discharges into the 36-inch by 46-inch trunk storm sewer main along Hibbard Road. When the capacity of the Hibbard Road storm sewer main is exceeded, this further limits the pumping capacity of the Ash Street Pump Station. As with the South of Willow Road watershed, surface topography in the watershed is very flat and there does not exist a positive overland flood route once the capacity of the Ash Street Pump Station is exceeded. The elevation of Hibbard Road to the west and Willow Road to the south is generally higher than the tree streets area. During heavy rainfall events, stormwater runoff ponds within the tree streets area for prolonged periods until the Ash Street Pump Station can draw the flood levels down.

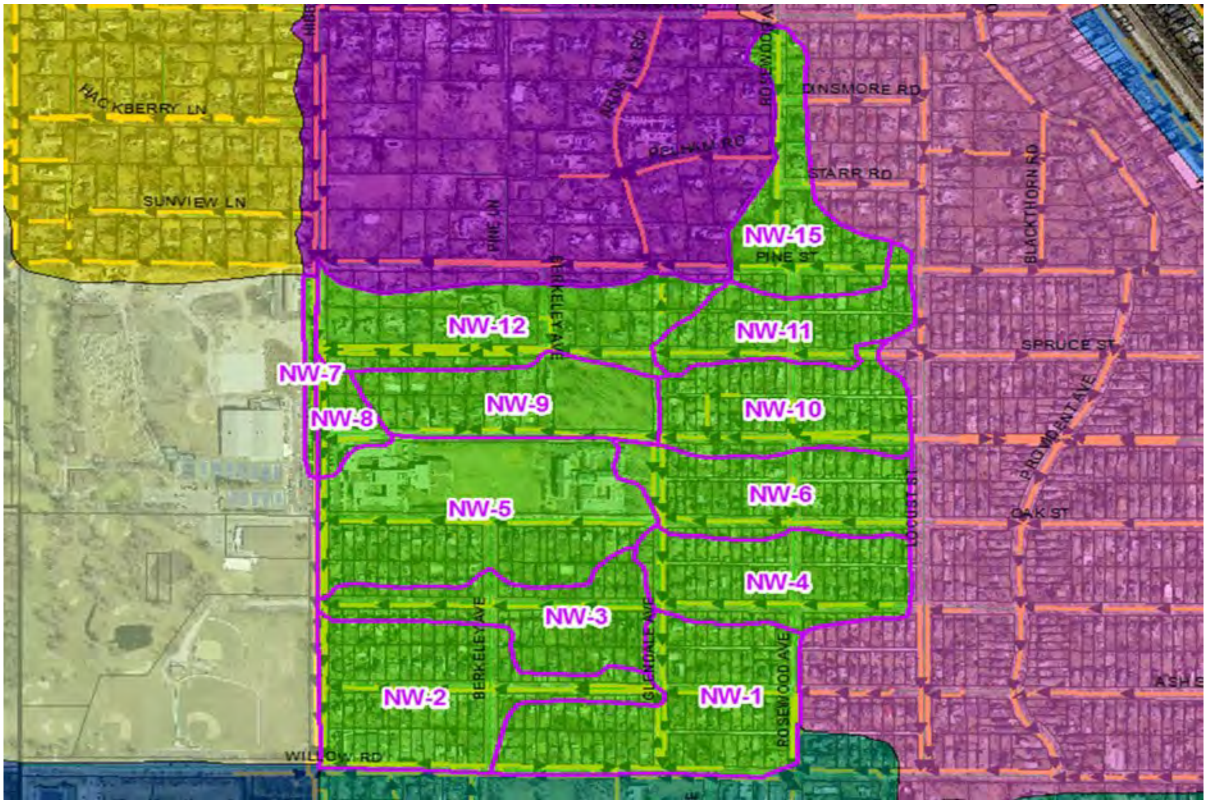


Figure 1.04-3 North of Willow Watershed (Area J)

4. North of Pine Watershed

This 121.6-acre watershed is generally bounded by Hibbard Road to the west, Tower Road to the north, Rosewood Avenue to the east, and Pine Street to the south (refer to Figure 1.04-4). This watershed was originally included in the modeling analyses for the October 2011 *Flood Risk Reduction Assessment*. However, flood control improvements were not evaluated as part of this effort. Subsequently, a detailed flood control evaluation was performed as part of the Village's 2014 *Stormwater Master Plan*. Surface topography in the watershed is relatively steep and generally directs drainage from east to west. There are three primary storm sewers in the watershed that eventually connect into a trunk line storm sewer that runs to the south along Hibbard Road. The north branch storm sewer main, providing drainage for Hamptondale Road, Auburn Road, Chatfield Road, and Kent Road, connects into the 24-inch Hibbard Road trunk sewer at Kent Road. The central branch storm sewer main, providing drainage for Laurel Avenue and Westmoor Road, ties into the 30-inch Hibbard Road trunk sewer at Westmoor Road. The southern branch storm sewer main, providing drainage for Ardsley Road, Pelham Road, and Pine Street, connects into the 30-inch Hibbard Road trunk sewer at Pine Street. Generally speaking, flooding in this watershed is because of insufficient storm sewer capacity, both in the trunk line sewer along Hibbard Road and the three east-west storm sewer branches.

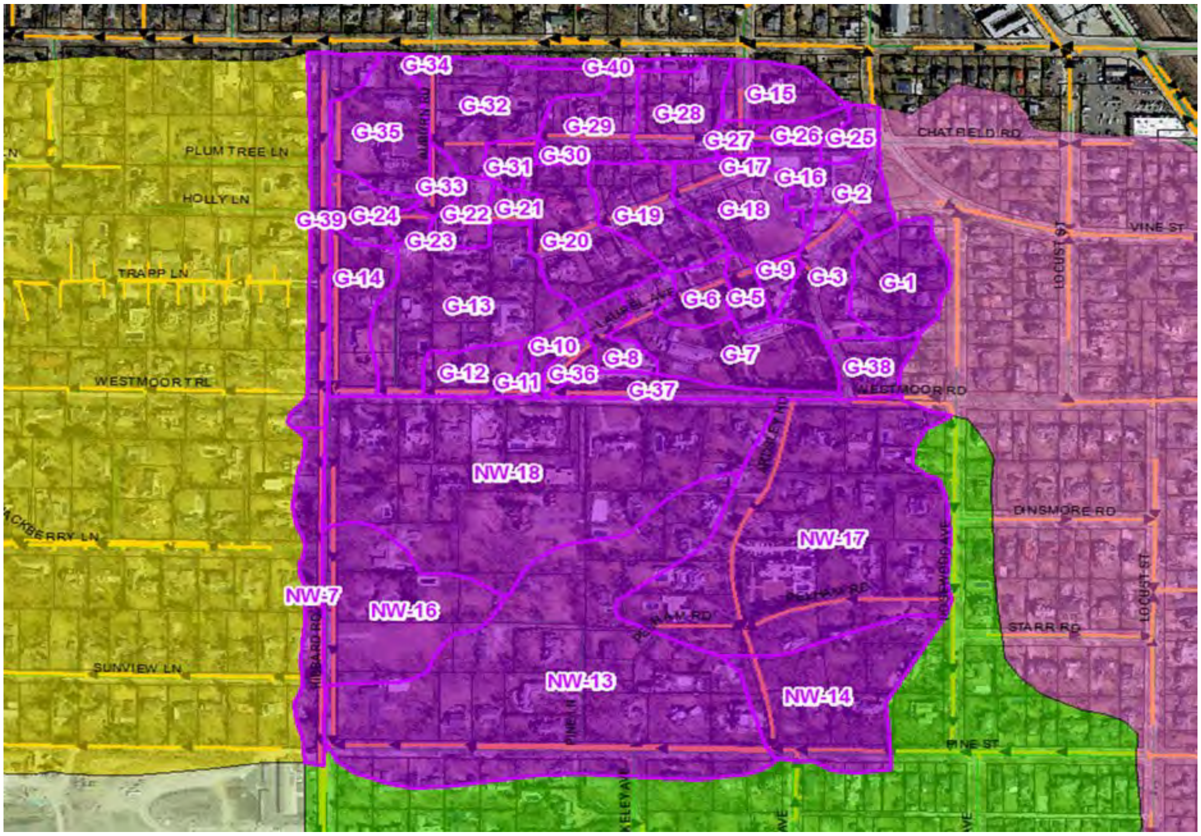


Figure 1.04-4 North of Pine Watershed

5. Provident Watershed

This 198.1-acre watershed is generally bounded by Locust Street to the west, Willow Road to the south, Chatfield Road to the north, and Birch Street to the east (refer to Figure 1.04-5). Surface drainage is predominantly from north to south and is directed to a 4-foot by 3-foot trunk sewer main located along Provident Avenue that connects into the Willow Road trunk storm sewer main. Approximately 40 feet of topographic relief is present from Chatfield Road to Willow Road. There are two locations within the upland (north) portion of the watershed that experience localized flooding because of depressional areas that lack a positive overland flood route. These areas include the intersection of Westmoor Road and Locust Street and rear yard flooding that occurs within a neighborhood that is bounded by Locust Street to the west, Walden Road to the east, and Pine Street to the south. Because the surface topography flattens out in the lower (southerly) portions of the watershed, there are several locations that experience street flooding, particularly at low points that lack sufficient overland flood routes. These areas include the intersection of Provident Avenue and Oak Street, low points in Ash Street between Birch Street and Provident Avenue and also between Rosewood Avenue and Locust Street, and flooding along Willow Road between Provident Avenue and Rosewood Avenue. Stormwater flows that exceed the capacity of the Provident Avenue trunk line storm sewer generally flow over the ground to the south on Provident Avenue to Willow

Road. This flow then is directed to the west along Willow Road where, during extreme storm events, it will flow both north to the North of Willow Watershed and south to the South of Willow Watershed, thereby exacerbating flooding in both of these watersheds.

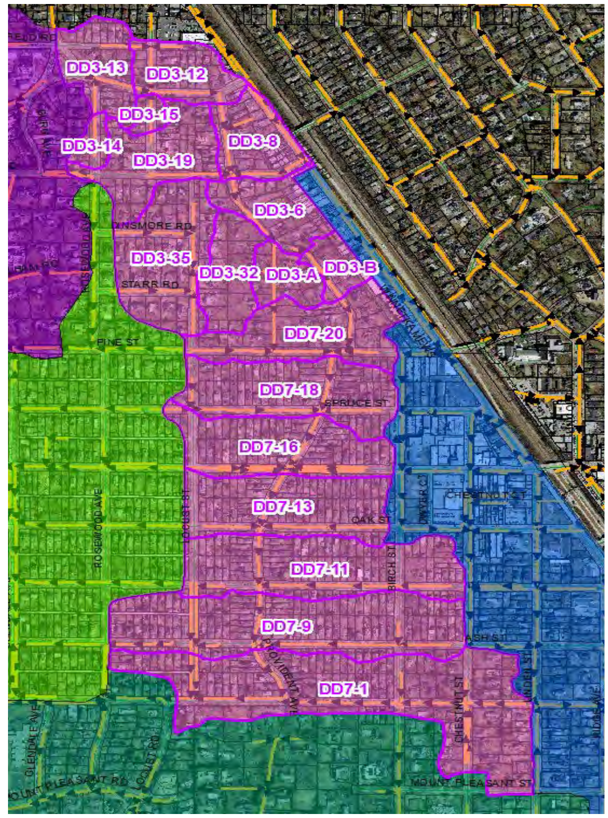


Figure 1.04-5 Provident Watershed

6. Area N Watershed

This 40.6-acre watershed is generally bounded by Hill Road to the south, Hibbard Road to the west, Lindenwood Drive to the north, and Thorntree Lane to the east (refer to Figure 1.04-6). Area N had originally not been included in the October 2011 *Flood Risk Reduction Assessment*. However, the western 25.2 acres of this watershed was later studied as part of the Village's *Stormwater Master Plan* in April 2014. Drainage within this watershed is generally directed to the south and connects into the 24-inch-diameter storm sewer main along Hill Road that outlets into an existing drainageway located on FPDCC lands near the intersection of Hill Road and Hibbard Road. The easterly 15.4 acres of the Area N watershed is directed to a small detention pond within the Evergreen Lane neighborhood. This pond is drained by a small private pump station that discharges to the south into the Hill Road storm sewer system.

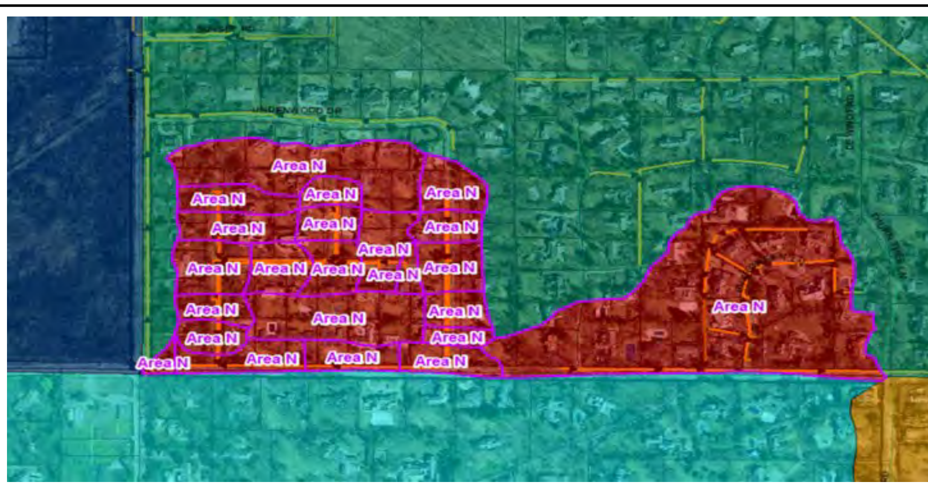


Figure 1.04-6 Area N Watershed

7. Area O Watershed

This elongated 56.7-acre watershed is generally bounded by Green Bay Road to the east and the Provident Watershed boundary to the west (refer to Figure 1.04-7). This watershed was not originally included in the October 2011 *Flood Risk Reduction Assessment*. However, a detailed stormwater model was later developed as part of the Village's *Stormwater Master Plan* in April 2014. It was noted in the 30 percent design of the Willow Road STADI project that while storm sewer drainage serving this watershed is directed to the east into the MWRD interceptor, runoff that exceeds the capacity of the local storm sewer system flows overland to the west, further contributing to flooding issues in the North and South of Willow Watersheds. For this reason, the Area O watershed was included in the overall stormwater model. One particular area of flooding identified in this watershed is the low point of Chestnut Street between Cherry Street and Oak Street.

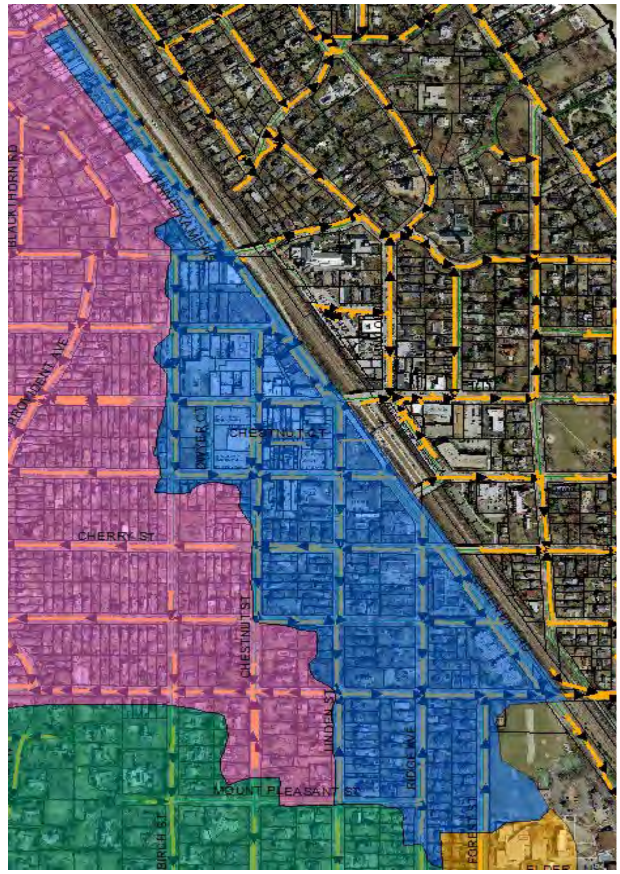


Figure 1.04-7 Area O Watershed

B. <u>Hydrologic and Hydraulic Model Conversion</u>

After performing appropriate model revisions, each H&H model was combined into a single master watershed model using XP-SWMM (2d) package. Past modeling efforts have used the XP-SWMM (1d) platform. The 2d modeling platform allows for integrating available surface topographic data (Cook County LIDAR topographic data) into the model to more accurately define limits and volumes of surface flooding, better represent overland flood routes, and most importantly, allow the modeling results to be generated in a visual format. The visual modeling output depicts specific flooding limit extents and depths for a range of storm events. This modeling output was an invaluable tool during the Awareness Phase public meetings, because it allowed the modeling results to be clearly seen by the public in order to confirm that flooding extents and depths modeled were consistent with their observations and experiences for historical flood events (particularly the most recent July 2011 flood event).

C. Additional Watershed Areas Modeled

In addition to the watershed areas that were modeled previously, there were other portions of the overall study watershed added to the new model. These subwatershed areas are discussed below.

1. West of Hibbard Road North (Area F) Watershed

This 84.7-acre area is generally located west of Hibbard Road, north of Pine Street, south of Tower Road and east of the Winnetka Golf Club (refer to Figure 1.04-8). This watershed was originally modeled in 2000 to support study and design of stormwater conveyance improvements that were later implemented. The stormwater model for this watershed was obtained and incorporated into the overall watershed model.

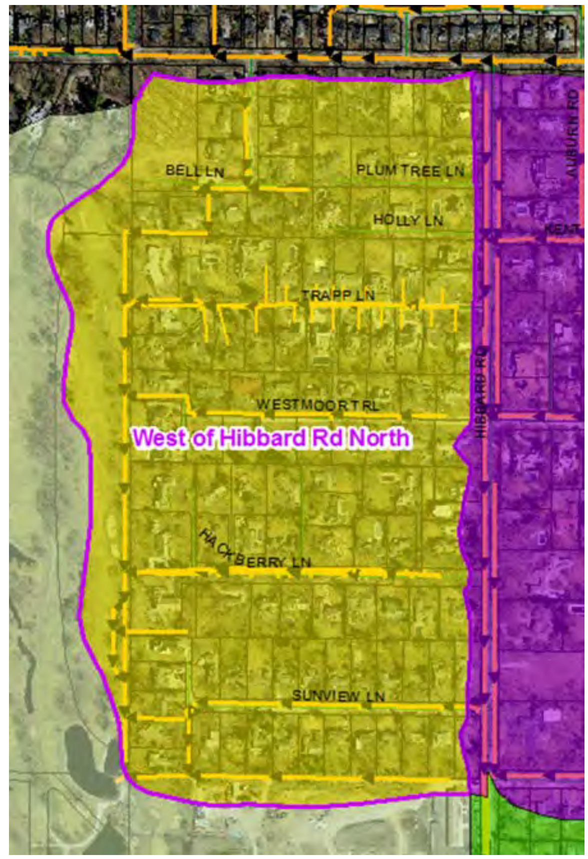


Figure 1.04-8 West of Hibbard Road North Watershed

Drainage from this watershed is generally directed to the southwest and outlets to an existing stormwater pumping station within the Winnetka Golf Club. While this watershed does not contribute runoff to areas that flood east of Hibbard Road, it does drain to the Winnetka Golf Club, an area that needed to be evaluated for potential creation of flood storage improvements. Additionally, when significant rainfall events occur that exceed the capacity of the Hibbard Road storm sewer systems, overland flow is directed to the west into this neighborhood.

Stormwater conveyance improvements along Hibbard Road north of Pine Street likely will help reduce the amount of overland drainage directed into this neighborhood.

2. Winnetka Golf Club Watershed

This 194.6-acre watershed is generally bounded by Hibbard Road to the east, Willow Road to the south, the Skokie River levee to the west, and Tower Road to the north (refer to Figure 1.04-9).

This watershed includes the entire Winnetka Golf Club, Skokie Playfields, and Duke Childs Field. Similar to the West of Hibbard Road North Watershed, the Winnetka Golf Club Watershed does not directly contribute stormwater runoff to areas east of Hibbard Road that currently flood. However, because areas within this watershed have been considered for potential flood storage creation improvements, it is important to include this area in the overall model.

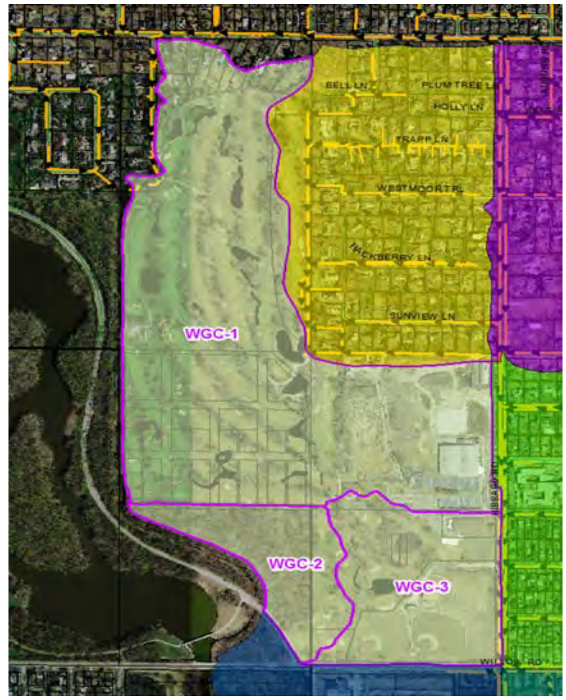


Figure 1.04-9 Winnetka Golf Club Watershed

3. West of Hibbard Road South Watershed

This 98.8-acre watershed is generally bounded by Hibbard Road to the east, Winnetka Avenue to the south, Willow Road to the north, and the Skokie River levee to the west (refer to Figure 1.04-10).

This watershed includes the Village's landfill, the Village's public works facilities, and lands owned by the FPDCC (including the FPDCC diversion ditch and the Village's Winnetka Avenue stormwater pump station). Once again, stormwater runoff from this watershed does not directly contribute to flooding in areas east of Hibbard Road, but the flooding conditions along the FPDCC diversion ditch does have significant hydraulic impact on how existing upstream gravity conveyance systems function and perform. Further discussion regarding this topic is provided later in this section.

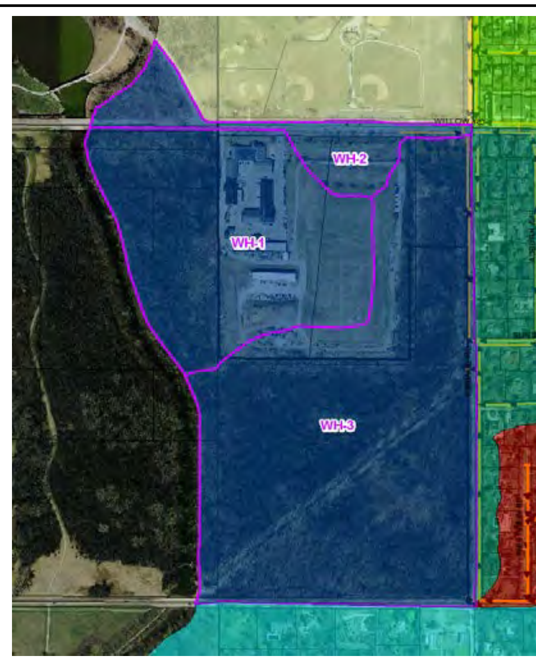


Figure 1.04-10 West of Hibbard Road South Watershed

4. Northfield/Unincorporated Watershed

This 122.3-acre watershed consists primarily of Village of Northfield and Unincorporated Cook County lands and is generally bounded by Hill Road (Winnetka Avenue) to the north, Locust Road to the east, and the Skokie River levee to the west (refer to Figure 1.04-11).

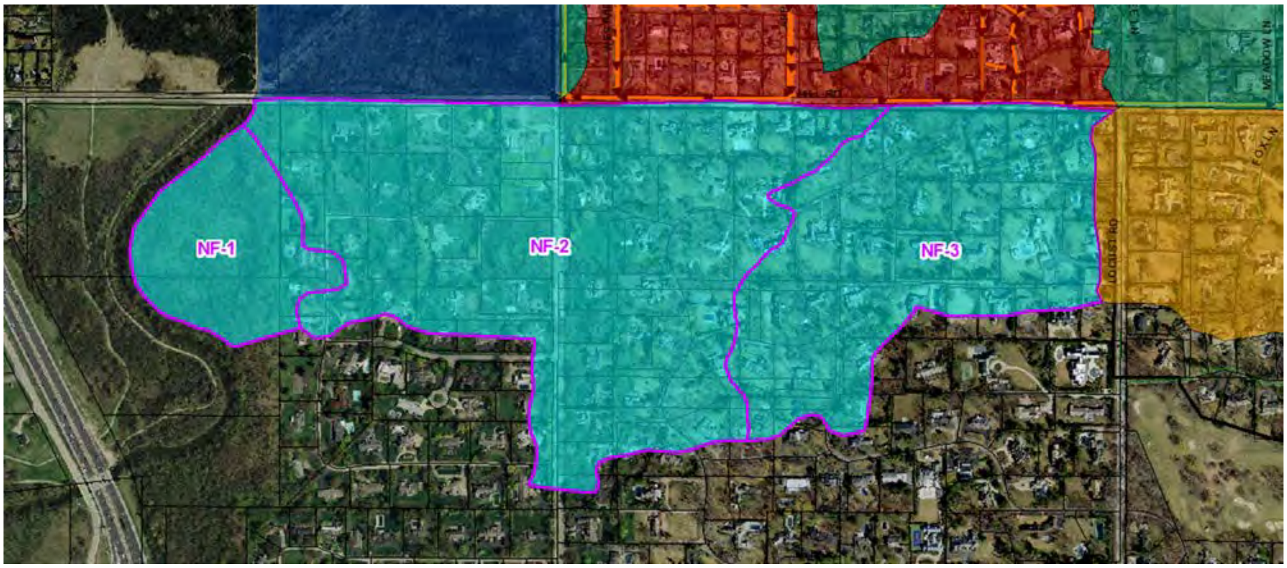


Figure 1.04-11 Northfield/Unincorporated Watershed

Stormwater drainage within this watershed is generally directed to the northwest and is conveyed via the existing Hill Road storm sewer system to an existing open ditch on the FPDCC property located immediately north of Hill Road. This ditch ultimately outlets to the Village's Winnetka Avenue Pump Station.

Available stormwater modeling did not include evaluation of the existing Hill Road Storm Sewer System that extends west from Meadow Lane approximately 3,400 feet and outlets into an open channel located immediately northwest of the intersection of Hill Road and Hibbard Road on FPDCC lands. Supplemental field survey data collected by Village staff was used to develop this portion of the storm sewer system model.

C. <u>Additional Modifications to Stormwater Models</u>

Additional modifications were made to the new study watershed model to incorporate important watershed features.

1. Winnetka Avenue Pump Station

Existing stormwater models included a discharge rating curve for the pump station that does not appear to match the current pump operating protocol. The existing models indicate that full capacity of the pump station is realized immediately with a pump-on elevation of 615.6.

Current operating protocol indicates that the pump-on elevation is 617.5. Because there is limited storage volume within the upstream diversion ditch in the FPDCC, this discrepancy likely has no significant impact on the modeling results. However, if additional upstream flood storage is introduced, it will be important to accurately reflect the pump station operating protocol.

It was also noted that review of the MWH *Basis of Design Memorandum* created as part of the prior STADI design effort, indicated that credit was taken for flow via the three 48-inch-diameter gravity outlet pipes that drain to the Skokie River through the levee at the Winnetka Avenue Pump Station. These existing pipes are each equipped with cast iron flap gates that prevents Skokie River floodwaters from backing up into the FPDCC diversion ditch and FPDCC property.

Based on review of available data, the water levels within the Skokie River and FPDCC diversion ditch typically equalize during dry weather conditions near elevation 615.0. During wet weather events, the rate at which water levels interior to the levee increase versus the Skokie River depends on the type and characteristics of storm event encountered. For instance, if a high intensity, more localized storm event occurs that is primarily confined to the study watershed, it is likely that interior water levels will rise faster than receiving Skokie River levels.

However, if a significant storm event occurs that is of longer duration and is more widely distributed over the region, including both the study watershed and the 18,688-acre (29.2 square mile) watershed of the Skokie River, it is likely that water levels of the Skokie River will rise as fast or faster than flood levels interior to the levee (similar to the September 2008 storm event). Note that while flows are attenuated within the Skokie Lagoons upstream of Willow Road, the Skokie River floodplain between the Willow Road Dam and points south of Winnetka Avenue is confined on both sides of the river with earthen levees. The confined nature of the Skokie River floodplain at the outlet of the Winnetka Avenue Pump Station likely results in high tailwater conditions that limit or preclude gravity discharge, thereby placing greater reliance on the pumping capacity of the Winnetka Avenue Pump Station.

Furthermore, the 10-year base flood elevation of the Skokie River based on the current Flood Insurance Study (FIS) is elevation 624 at the Winnetka Avenue Pump Station. The estimated 100-Year base flood elevation of the FPDCC diversion ditch is approximately 1.5 feet lower at 622.5. This data seems to indicate that conditions for positive gravity outlet in which flood levels are higher on FPDCC property interior to the levee versus on the Skokie River exterior to the levee are likely not available. It is understood that storm events that produce 100-year storm flood levels within the study watershed likely don't coincide with events that produce 100-year storm flood levels of the Skokie River. However, it is reasonable to assume that when significant storm events occur within the study watershed, receiving flood levels within the Skokie River will still be elevated.

2. Hydrologic Input Parameter Updates

Previous modeling efforts relied on development of runoff curve numbers that were based on standard land-use types, (i.e., low density residential, commercial, etc.) and hydrologic soil groups within each watershed evaluated. Since the completion of past modeling efforts, detailed impervious area geographic information systems (GIS) datasets are now available that include streets, parking lots, sidewalks, and rooftops. Availability of these datasets allowed for calculation of runoff curve numbers that are no longer based on standard land use types, but measured impervious areas present in each watershed. GIS shapefiles of remaining pervious surface areas in each subwatershed were then intersected with hydrologic soil groups to develop more appropriate runoff curve numbers. A summary of the estimated pervious and impervious areas within each watershed and the resultant computed RCNs is presented in Appendix A.

1.05 EXISTING STORMWATER AND FLOODING CONDITIONS

A. Model Calibration to Historical Rainfall Events

A key step to confirm the accuracy of the stormwater model was to compare the predicted flooding depths and extents to measured and observed flooding conditions for historical rainfall events. The historical rainfall events that were evaluated with the model included the September 2008 and the July 2011 rainfall events.

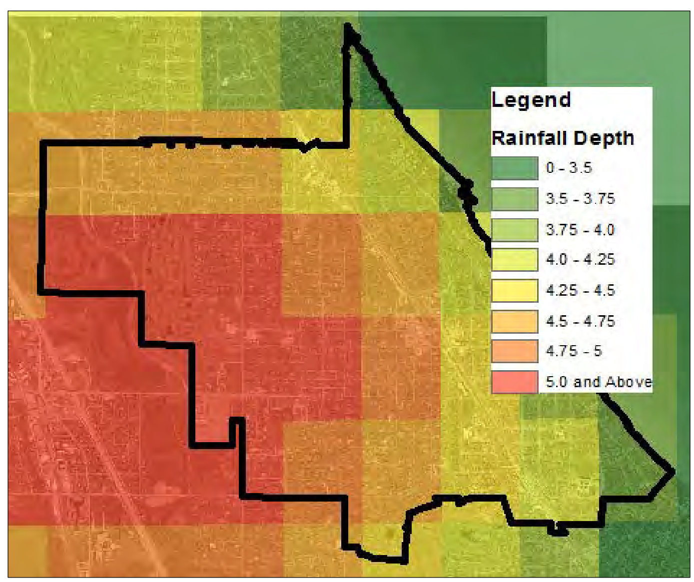


Figure 1.05-1 ***NEXRAD imagery of the July 2011 event over Winnetka.***

Cook County Precipitation Network rain gage data was obtained for both the September 2008 and July 2011 rainfall events. This rainfall gage is currently located within Winnetka Golf Club property and records incremental rainfall amounts in 10-minute intervals. Unfortunately, no other reliable rain gages exist within or near the study watershed. In cases like this, the National Weather Service's (NWS) Next Generation Weather Radar (NEXRAD) program generates gridded precipitation estimates. This NEXRAD data was obtained for the July 2011 rainfall event and used to appropriately adjust the rain gage data over the study watershed. The XP-SWMM model has the capability to further spatially distribute historical rainfall data over the study watershed. Based on review of the NEXRAD data for the July 2011 rainfall event, greater rainfall intensity and depths were experienced in the western portion of the watershed.

Estimated flooding extents and depths from the September 2008 and July 2011 storm events were generated with the XP-SWMM 2d model (refer to Figure B-7 and B-8 in Appendix B). The July 2011 storm event had the best availability of anecdotal flooding documentation, including photographs, video, high water marks, and debris lines. Areas that were evaluated included the Tree Street Neighborhood in the North of Willow Watershed and widespread areas of flooding in the South of Willow Watershed. Based on a comparison of the model predicted flooding extents and depths and available flooding documentation from the July 2011 event, the model results appeared to provide an accurate representation of flooding conditions experienced. Detailed flood depth and extent mapping generated from our stormwater model was presented to the public at the January 21 and 23, 2016, Awareness Phase Meetings. Generally speaking, the feedback received from area residents was that the July 2011 flooding conditions predicted by the stormwater model were consistent with what they had observed and experienced.

B. Existing Conditions Modeling Results

Following completion of the model calibration step, existing condition models were run for a range of recurrence interval storm events (2-, 5-, 10-, 25-, 50-, and 100-Year recurrence intervals). The storm recurrence interval is a simplified term explaining the probability that a given storm event will be equaled or exceeded in any given year. For example, a 100-year recurrence interval design storm has a one-percent chance of occurring in any given year. It is a probability, which is why it's possible to have two 100-year storm events in a period of time less than 100 years. Similarly, a 50-year recurrence interval storm event has a two-percent chance of occurring in any given year, and so forth. This concept is shown in Table 1.05-1.

Recurrence Interval, In Years	Probability Of Occurrence In Any Given Year	Percent Chance Of Occurrence In Any Given Year
100	1 in 100	1
50	1 in 50	2
25	1 in 25	4
10	1 in 10	10
5	1 in 5	20
2	1 in 2	50

Table 1.05-1 Recurrence Intervals and Probabilities of Occurrence

Rainfall amounts used in the model are representative values of the northeast region of Illinois published in the Bulletin 70 publication titled *Frequency Distributions and Hydroclimatic Characteristics of Heavy Rainstorms in Illinois*, Illinois State Water Survey (ISWS).

Recurrence Interval (Years)	Rainfall Depth (inches)
100	4.85
50	4.14
25	3.53
10	2.86
5	2.43
2	1.94

Table 1.05-2 Recurrence Storm Rainfall Amounts Three-Hour Duration

Results of previous stormwater modeling efforts for Winnetka indicated that the critical duration rainfall event (the rainfall event that produces the greatest depth of flooding), is a three-hour duration event. We performed a critical duration analysis for the study watershed and confirmed that the critical duration event is indeed a three-hour duration storm event. Three-hour duration Bulletin 70 rainfall amounts used in the model are summarized in Table 1.05-2.

Graphical results of the existing conditions stormwater modeling that depict estimated flooding extents and depths for a range of recurrence interval design storms are shown on Figures B-1 through B-6 in Appendix B.

C. Locations Exhibiting Greatest Flooding Extents, Depths, and Causes

As expected, the areas exhibiting the greatest flooding extents and depths are in the Tree Streets neighborhood in the North Willow Watershed and in widespread portions of the South Willow Watershed, primarily along DeWindt Road, Sunset Road, Higginson Lane, White Oak Lane, and Birch Street.

Physical characteristics common to these two areas that contribute most heavily to the high frequency and extent of flooding experienced include very flat topography, inadequate stormwater conveyance capacity primarily due to undersized stormwater pumping facilities, and a lack of positive overland flood routes once capacities of the stormwater conveyance systems are exceeded.

In both the North and the South Willow Watersheds widespread flooding begins to occur for as little as a 2-year recurrence interval storm event. Furthermore, during some storm events, when the capacity of upstream storm sewer systems in the Provident, North of Pine, and Area O Watersheds is exceeded, overland drainage contributes additional stormwater runoff to the Tree Streets and South of Willow areas that must be conveyed out of the North and South of Willow Watersheds, further exacerbating flooding conditions.

Areas of flooding in the North and South of Willow Watersheds not only exhibit significant extents and depths of flooding, they also experienced prolonged durations of flooding. Based on the 100-year storm event modeling results, the period of time it takes to draw down flooding levels in the North and South of Willow Watersheds is approximately 20 and 68 hours, respectively. These prolonged periods of flood water inundation likely contribute to inflow and infiltration (I&I) issues in the sanitary sewer system through manhole covers that are submerged and leaky sanitary sewer pipes under saturated groundwater conditions. These I&I issues can influence surcharging in the sanitary sewer systems and cause basement backups. While the primary goal of this stormwater and flood control study is to provide relief from overland flood damage, flood control efforts that achieve this goal will likely also benefit basement backup issues.

As mentioned previously, the majority of areas experiencing surface flooding conditions when conveyance system capacities are exceeded cannot be effectively drained overland because the ground elevations in these areas are too low to achieve a positive overland flow route to downstream receiving areas. Additionally, if sufficient conveyance were provided from these areas they would still experience significant flooding because sufficient flood storage volume does not exist at lower downstream elevations to receive the conveyed stormwater. This lack of storage creates a surcharge condition that further influences flooding in upstream areas. Although hydraulic capacity improvements that were made in the past few years at the Winnetka Avenue pump station (station capacity was increased by approximately 50 percent) have helped mitigate this surcharge situation somewhat, sufficient storage capacity is still not available to receive excess stormwater from the upstream areas. As a result, significant amounts of downstream flood storage volume must be created to enable gravity stormwater conveyance system improvements that can provide flood reduction benefits in the upstream areas.

SECTION 2
EXPLORATION PHASE

The Exploration Phase of this study determined the Village's goals for protection during storm events, otherwise known as the Target Level of Service. Based on the Target Level of Service, various strategies were considered and a matrix of opportunities for stormwater and flood control were identified and evaluated. In that evaluation, significant community partners and the general public were engaged for their comments and input.

2.01 TARGET LEVEL OF SERVICE

The target level of service is the standard by which the effectiveness of identified opportunities for stormwater and flood control would be judged. The target level of service established for this study has two components. The first component is the magnitude of rainfall for which protection from flooding will be provided. The second component is the level of protection or the extent of flooding that will be allowed during that magnitude of rainfall.

In April 2014, the Village Council formally adopted the *Village of Winnetka Stormwater Master Plan*. This plan documents the Village's stormwater-related goals and objectives and was intended as a guide for Village policy and decision-making over the following five- to ten-year period.

Section 3 of the *Stormwater Master Plan* presents the Village's goal to pursue stormwater capital improvements to reduce the risk of flooding throughout the Village, and generally establishes Village policy to provide protection from a 100-year storm event. A number of capital improvement projects were identified in the plan, some of which are currently underway or have already been completed, such as the Spruce Street Outlet Area Improvement and the Northwest Winnetka Improvements. These projects were designed to uphold the established policy to provide protection from the 100-year storm event. Based on Village policy and the precedent established by recent capital improvement projects, this study focuses on providing flood protection from a 100-year storm event (see Section 1.05 B for an explanation of storm recurrence intervals).

When considering storm events, it is also important to identify the duration of storm that has the greatest impact on the watershed. Some watersheds are more impacted by large volumes of rainfall over an extended period of time, while others are more impacted by short duration, heavy rainfalls. The hydraulic modeling created to analyze the study watershed's existing conditions was used to determine the most critical or impactful duration of 100-year storm event.

For this study, it was determined that the target level of service storm will be a 100-year, three-hour duration storm event that produces 4.85 inches of rainfall. Figure 2.01-1 shows the magnitude of various three-hour duration storm events and a comparison of the target level of service storm to some of the recent storms experienced by the Village.

Determining the target level of service also needs to consider the extent of flooding that will be allowed during the 100-year storm event. Flooding of streets and private property during intense storm events is not unusual and to a point is acceptable. The roadway system is intended to be part of the stormwater drainage system as are swales and ditches on private property. However, flooding of streets that renders them impassable to emergency and first-response vehicles and flooding on private property that results in structural damage or impedes reasonable access to a home or building is generally not acceptable. Additionally, flooding that persists for extended periods of time (generally more than 24 hours) after rainfall has ceased is also unacceptable.

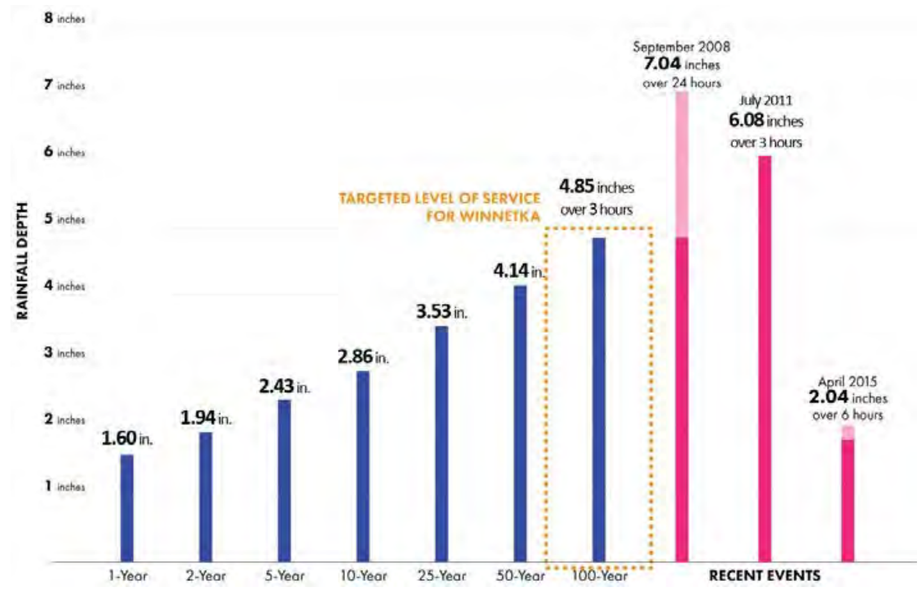


Figure 2.01-1 Target Level of Service Storm

For this study, it was determined that the target level of service for protection would allow for street flooding that maintains access by emergency and first-response vehicles; generally a maximum of 6 inches of flood depth at the centerline of roadways. Additionally, the target level of service would allow flooding of private property but no closer than 20 feet to a primary structure and no greater than 24 inches in depth, and any street or private property flooding should be drained within 24 hours of the end of the storm event.

These target level of service components were applied throughout this study to identify and evaluate potential opportunities for stormwater and flood control in western and southwestern Winnetka.

2.02 STORMWATER MANAGEMENT AND FLOOD CONTROL STRATEGIES

The sustainable watershed evaluation process used for this study considered a wide range of stormwater and flood control strategies. Traditional stormwater management opportunities, such as conveyance and storage, were considered alongside and, in some cases, were blended with more natural opportunities like green infrastructure and natural habitat restoration. More progressive opportunities and smart technologies were also considered. This wide view implemented numerous stormwater tools to overcome constraints in the watershed that previously were impeding the Village's progress.

It is important to recognize that not all strategies are viable in all situations and various strategies have varying degrees of effectiveness. The holistic nature of stormwater management means that for some strategies to work other strategies must be implemented. For instance, a program that depends solely on stormwater conveyance, like pumping or big pipes, will not be viable if there isn't a location to place the stormwater. And conversely, a program of stormwater storage is not viable without conveyance to get the stormwater there. In all cases, green infrastructure is a valuable strategy but is insufficient to handle the magnitude of most urban stormwater and flooding issues.

Figure 2.02-1 shows a spectrum of strategies for stormwater management and flood control that illustrates how various strategies find their effectiveness for varying intensities of storm events. A viable and sustainable stormwater management and flood control program requires all of these strategies to play their part, but also a recognition that no single strategy is effective without the others.

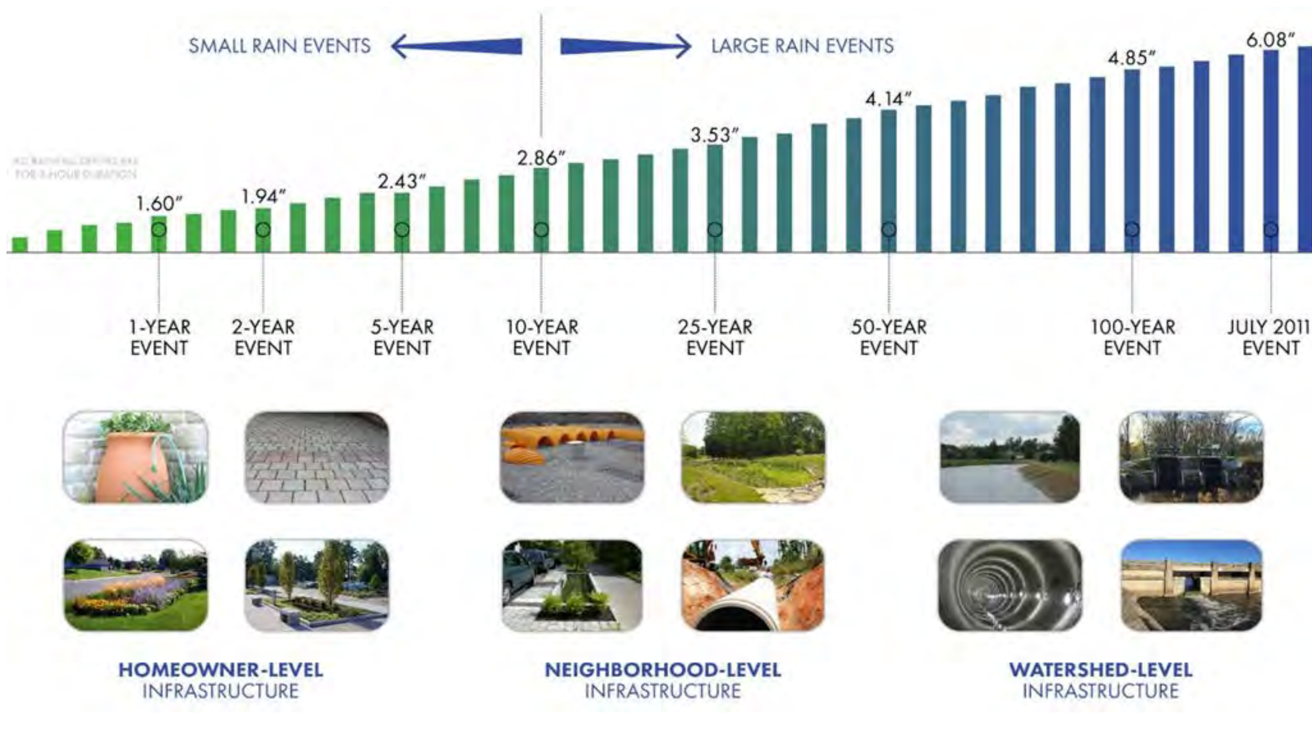


Figure 2.02-1 A Spectrum of Stormwater Strategies

The following section provides details of these various strategies and specifically the opportunities to employ these strategies in the Village.

2.03 STORMWATER MANAGEMENT AND FLOOD CONTROL OPPORTUNITIES

Following describes the results of the sustainable watershed evaluation process and the various opportunities identified.

A. <u>Opportunity Matrix</u>

The results of the sustainable watershed evaluation process are presented in an Opportunity Matrix provided in Appendix C. This matrix itemizes 44 individual opportunities of various types and purposes.

Many of these opportunities are interdependent, meaning their effectiveness depends on other opportunities being implemented. However, the evaluation of each opportunity in the matrix starts from an assumption that all other dependent opportunities have been implemented.

The matrix presents the pros and cons of each identified opportunity. The merits of these pro and con determinations draw upon acceptable industry practices, understanding of basic design principles, established regulatory policies, modeling, and engineering experience and judgement. However, it is important that some level of measurable metrics be applied to each opportunity to further support the preference of one opportunity over another. The following basic measures were used to objectively and consistently judge the viability of the identified opportunities.

1. Land Acquisition

Preference (indicated by a '**+**' symbol in the matrix) was given to those opportunities that can be performed on Village-owned property or within existing applicable easements. Preference (indicated by a **blank** entry in the matrix) is then given to opportunities that can be performed on public-owned property, such as parks and preserves, understanding that these bring with them an added requirement to obtain a partnership with the public landowner. Last preference (indicated by a '**–**' symbol in the matrix) is for projects on private property, and condemnation is considered a last resort.

2. Reliance on Mechanical Facilities

Preference (**+**) is given to opportunities that do not require human intervention for their means and methods. Facilities like pumping stations and mechanical water quality structures (**–**) primarily depend on electricity or at least some type of mechanical feature that is subject to failure and reduced dependability. Additionally, mechanical facilities are often significantly more expensive to implement and come with increased long-term maintenance and operation costs and a limited life cycle. Natural features and the use of gravity are the highest preferred opportunity because of their reliability and their sustainable value to the entire community.

3. Maintenance of Existing Drainage Patterns

Preference (**+**) was given to opportunities that generally maintain existing drainage patterns. Redirecting flows and volumes of stormwater runoff from one watershed or subwatershed to another (**–**) often results in transferring flooding problems to the receiving watershed. This crossing of watersheds is also objectionable to most regulatory agencies like the MWRD and the Illinois Department of Natural Resources (IDNR) and will run up against their disapproval.

4. Regulatory Authority Acceptance

The Village will be required to gain various regulatory authority approvals prior to implementing any identified stormwater and flood control improvement opportunity. Based on the adopted policies of and past experience with regulatory agencies, the probability of gaining approval of any given improvement opportunity can be predicted with a fairly high level of certainty.

In evaluating the identified opportunities, preference (**+**) is given to those that are felt to be in line with applicable regulatory policies and requirements and are anticipated to gain regulatory approval. Those that are anticipated to receive some level of additional scrutiny from a regulatory agency but are anticipated to be approvable are indicated by a blank entry. Those opportunities that are certain to be rejected by a regulatory agency are indicated by a **–** symbol.

5. Property Owner Acceptance

Opportunities that propose use of property not owned by the Village require a partnership between the property owner and the Village. This partnership is predicated on the property owner being amenable to the proposed use of their property. This study endeavored to begin discussions with every potential property owner of land needed for the identified opportunities and, as noted earlier, those contacted expressed a willingness to work with the Village in finding solutions to the stormwater and flooding issues in the community. But some identified opportunities were clearly not acceptable to some property owners. These opportunities often ran contrary to the owner's goals and objectives for their property or directly violated the owner's policies for use of the property. The relative level of acceptability expressed by the impacted property owners was used to judge the viability of identified opportunities with a **+** for those opportunities deemed acceptable, a blank for those deemed acceptable but with reservations, and a **–** for those that were deemed unacceptable.

6. Overall Effectiveness

Many opportunities are perceived to have great potential but when run through the stormwater model actually do not result in significant benefit or effectiveness. As an example, it is clear from the study area characteristics that there is a deficiency of available storage volume, so any opportunity to provide volume seems to be worthwhile. But many of the opportunities for storage volume that were identified when placed in the model resulted in little to no benefit to those areas that actually flood. Similarly, some of the green infrastructure opportunities individually do not provide much storage benefit but they provide great water quality benefits and community participation. Each storage opportunity was modeled and their relative effectiveness judged to determine viability. Those that had significant benefit are indicated with a **+**, a blank for those that were mildly effective, and a **–** for those that were not effective.

7. Relative Cost

It was not possible in the scope of this study to run detailed cost assessments on every opportunity identified. However, engineering judgement and experience as well as similar recent local projects provide a perspective on the relative cost of the various opportunities. For example, it is known from experience and recently completed stormwater storage projects that underground storage facilities can cost up to five times as much as aboveground facilities even before consideration of any special surface restoration features above the underground facility. Engineering judgement and experience was used to evaluate each opportunity identified as to the magnitude of cost taking the relative effectiveness of the opportunity into account. A **+** indicates an opportunity with a perceived reasonable cost, a blank indicates a moderate cost, and a **-** indicates a perceived unreasonable cost.

B. Opportunity Descriptions and Evaluations

1. Distributed and Local Green Infrastructure

a. Private Property: Rain Barrels

Rain barrels are fairly common property level stormwater management practices that allow collection and storage of rainwater from rooftop downspouts for non-potable exterior uses, such as irrigation. The typical volume of a rain barrel varies between 55 and 90 gallons and generally costs between $120 and $200. However, MWRD currently has a rain barrel program that allows residents that live in communities that are currently enrolled in the program to get 55 gallon rain barrels free of charge. Winnetka is currently not enrolled in the program, but still can purchase 55 gallon rain barrels at a discounted price of around $50.

Figure 2.03-1 Residential Rain Barrel

In an effort to estimate the amount of storage volume that could be generated through the use of rain barrels, we needed to make some reasonable assumptions regarding percentage of participation. The estimated number of properties in the watershed study area is 3,095, so if there is an assumed level of participation of 30 percent, this equates to 928 participants. If each participant uses two 55 gallon rain barrels, this amounts to approximately 102,000 gallons or 0.31 acre-feet of storage volume. Obviously, if the percentage of participation and the number of rain barrels per property increases, the storage volume that can be achieved will similarly increase and provide greater benefits. Regardless, the relative amount of storage provided is fairly limited when compared to the overall storage volumes needed in the study watershed.

b. Private Property: Pervious Driveways

Pervious driveways are a private property-level stormwater control technique that involves construction of permeable pavements over an underlying base and subbase that allows stormwater storage, thus reducing runoff volume. These measures can include pervious concrete, porous asphalt, or paving stones. Pervious driveways are generally more effective at reducing runoff when underlying soils are conducive for infiltration.

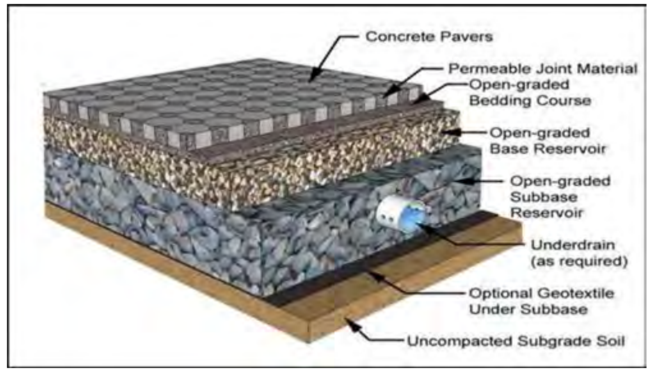


Figure 2.03-2 Pervious Driveway

To calculate the estimated cumulative storage volume that could result in the study watershed, we need to make a percent participation assumption. In this case, a reasonable assumption is five percent, which equates to 155 participants in the study watershed. Assuming the typical driveway size for each participant is 1,200 square feet, a 2-foot average depth, and porosity of 40 percent, this results in about 7,190 gallons for each pervious driveway. The potential storage volume for the study watershed under this scenario is 1,114,450 gallons or 3.40 acre-feet.

c. Private Property: Rain Gardens

Figure 2.03-3 Rain Garden

Rain gardens are typically private property-level stormwater control measures that involve establishment of specially-designed gardens that collect, store, and infiltrate stormwater from impervious surfaces such as rooftops, driveways, and heavily-compacted lawns. Rain gardens are typically planted with deep rooted native wet tolerant or wetland-type vegetation such as wildflowers, sedges, rushes, ferns and shrubs.

Estimated participation for implementation of rain gardens was assumed at 15 percent, equating to 464 properties. Using an average rain garden surface area of 500 square feet and a typical ponding depth of one foot, this results in 500 cubic feet or 3,745 gallons per rain garden. The cumulative volume within the study watershed would be 5.33 acre-feet.

d. Street Curb Bump-Out Bioretention Basins

Figure 2.03-4 Street Curb Bump-Out Bioretention Basin

Street curb bump-out bioretention basins are distributed green infrastructure measures that would likely be implemented by the Village and involve construction of a vegetated curb extension into the street near intersections. The bump-out typically receives street runoff through curb openings and has a ponding depth of about one to two feet. The bottom of the storage area generally consists of an engineered soil layer underlain by a coarse granular stone storage area that is drained by perforated underdrain directed to the storm sewer system. Typical vegetation types are similar to the wet tolerant plantings used in rain gardens. Because curb bump-outs receive stormwater from source areas that generate significant pollutants, these devices also provide important stormwater treatment benefits.

Assuming a typical curb bump-out is 30 feet in length, 7 feet wide and has 1 foot of ponding depth, this equates to 1,575 gallons per bump-out. If there are four curb bump outs at each intersection, the potential volume per intersection is 6,300 gallons or 0.02 acre-feet. Assuming that between 20 and 30 percent of the Village's intersections in the study watershed (50 to 70 intersections) receive curb bump-outs, the cumulative storage volume that could be realized is between 1.0 and 1.4 acre-feet.

As noted above, the significant benefit and importance of these opportunities is not as much for the volume stored as it is for the water quality benefits realized.

e. Street Intersection Bioretention Basins

Street intersection bioretention basins would entail closing select street intersections and constructing bioretention facilities in their place. This option would require permanent disruption to the Village's current road network and likely would involve some utility relocations. Assuming implementation of this practice at one street intersection, between 0.5 and 0.8 acre-feet of storage volume could be gained. Preliminary evaluation of the Village's roadway network indicates the viability of this opportunity in the neighborhoods with a gridded street network. Potentially five or six total intersections could be implemented.

The importance of these opportunities is in the water quality benefits realized through treatment of stormwater from source areas that generate significant pollutants as well as the neighborhood aesthetic and park area created.

f. Parkway Bioretention Basins

Parkway bioretention basins would be constructed mid-block between the curb and sidewalk at locations where storm sewer conveyance improvement projects are proposed within the study watershed. In many of these cases, street parkways and existing parkway trees will already be impacted by storm sewer conveyance improvements.

Figure 2.03-5 Parkway Bioretention Basin

Assuming each parkway bioretention basin is 50 feet in length, 7 feet in width and has an average ponding depth of 1 foot, each basin would have 2,620 gallons of storage volume. Based on review of anticipated conveyance projects within the study watershed and assuming one bioretention basin would be provided for each street block, this results in about 90 bioretention basins. The total anticipated storage volume within the study watershed is estimated to be 235,800 gallons or 0.72 acre-feet. Similar to the other street-related green infrastructure discussed above, the benefit and importance of these opportunities is not as much for the volume stored as it is for water quality benefits through treatment of stormwater from source areas that generate significant pollutants.

g. Induced Infiltration Structures

In 2009, the United States Geological Survey (USGS), in cooperation with MWRD performed a study to evaluate the potential for induced infiltration structures in Cook County as a means to reduce stormwater runoff volumes that could provide flood relief (*Preliminary Assessment of the Potential for Inducing Stormwater Infiltration in Cook County, Illinois*). Artificial or induced recharge can typically be provided with passive-induced structures such as surface infiltration basins or with active-induced structures such as injection wells.

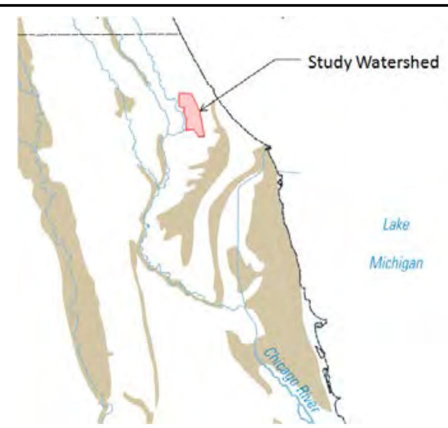


Figure 2.03-6 USGS Induced Infiltration Study

One of the goals of the assessment was to identify areas in Cook County that have favorable hydrogeological and land cover conditions for induced infiltration practices. This includes areas of permeable glacial deposits that would be located beneath infiltration measures that can sufficiently accept surface stormwater. Figure 2.03-6 is a map from the USGS report showing that only about 12.4 percent of the land area within Cook County exhibits these favorable conditions, which are shaded in brown. This map depicts areas with permeable glacial deposits 20 feet or greater in thickness and within 50 feet of land surface in relation to the study watershed limits. As seen in the figure, suitable areas for passive-induced infiltration within the study watershed do not appear to be available.

h. Infiltration Wells

Infiltration wells are designed to extend through impermeable layers to access permeable glacial deposit layers that are located at greater depths, but there is uncertainty of regulatory agency (IEPA and IDNR) acceptability of this concept and difficulty to predict the stormwater volume reduction effectiveness that could be realized.

Figure 2.03-7 Deep Infiltration Well Installation

2. Washburne-Skokie Play Field

The existing 3.4-acre playground located between Carleton Washburne Middle School and the Skokie (Elementary) School was identified as open space that could potentially be used for creation of stormwater detention storage. This site is located immediately adjacent to the “Tree Streets” neighborhood in the North of Willow Watershed, which has experienced frequent and severe flooding in the past, so creation of detention in this area could potentially provide immediate and effective flood relief.

Based on initial discussions with Winnetka School District 36 staff, they communicated that maintaining the current recreational uses, including daily use by the adjacent schools and significant use by a local soccer club (Scottish Soccer Academy), is a very important consideration. To limit impacts to current recreational uses of the play fields, implementation of surface storage likely is not a feasible alternative. However, creation of underground storage volume appears to be a viable option, as long as the construction schedule of the project does not conflict with usage of the play fields during the school year.

Figure 2.03-8 Washburne Skokie Play Fields

Potential physical constraints on the site include the presence of an existing 33-inch-diameter MWRD combined sewer interceptor that diagonally crosses through the middle of the play fields. However, this interceptor is approximately 20 feet below existing grade and would not conflict with placement of underground storage improvements that likely would be located a maximum of 10 feet below existing ground.

3. West Elm Street Park

West Elm Street Park is a 3.7-acre park located immediately north of the Skokie School and west of Glendale Avenue that is owned and maintained by the Winnetka Park District. The park is heavily used by residents of the surrounding neighborhoods and also has School District 36 partnerships that center around educational programs and activities. The park currently has an established grove of high quality mature trees that are located on relatively steeply sloped terrain (elevation drops approximately 10 feet from the northeast corner of the park to the southwest corner). The steep topography at the park would likely involve significantly more earthwork to create storage at optimal elevations (generally 10 to 15 feet below existing ground). Surface storage volume that could be created ranges between 8 and 12 acre-feet. However, creation of this storage volume would be costly because of the steep topography and likely would impact many of the high quality mature trees on the property.

Figure 2.03-9 West Elm Park

4. Winnetka Park District Maintenance Facility

The existing Winnetka Park District Maintenance Facility is located on a 1.2-acre site located at the southwest corner of Hibbard Road and Pine Street. Based on discussions with Winnetka Park District staff in November 2015, they indicated they had immediate plans to improve the existing building at the site. However, because the existing building is located within regulatory floodplain, costly floodproofing measures need to be implemented for the structure. They also indicated that the current location of the maintenance facility is not optimal and that they would prefer a location closer to the golf course. Based on a cursory review of the site, its relatively small size would only allow creation of between 2 and 3 acre-feet of surface storage volume. A stormwater basin providing this amount of storage volume would provide minimal benefit in terms of

Figure 2.03-10 Winnetka Park District Maintenance Facility

flood control and would be better equipped to provide water quality treatment for stormwater runoff conveyed along the Hibbard Road conveyance systems. To use this parcel, the Village would need to make accommodations for relocation of the existing maintenance facility, which would likely be a very costly endeavor.

5. Crow Island Woods–South

Crow Island Woods is a 17.9-acre park located immediately west of Crow Island School and south of Willow Road that is owned and maintained by the Winnetka Park District. In terms of evaluating opportunities for implementing stormwater management measures, the park was separated into the north and south portions. The north portion of the park is discussed in the following section.

Figure 2.03-11 Crow Island Woods–South

The southerly 9.2 acres of the park is a natural woodland consisting of many mature trees, a network of mulched pathways that connect to the adjacent neighborhoods and Crow Island School, and several interpretive signs and benches. Crow Island Woods suffered a microburst storm event in 2007 that resulted in widespread damage and loss to many mature trees, some of which have recently been removed by the district. Many of the ash trees in the woods are affected by Emerald Ash Borer (EAB) disease, so the district has an ongoing effort to identify and remove infested ash trees. Note that the Village's Mount Pleasant Road Pump Station, which is located at the west end of Mount Pleasant Road, has a 22-inch-diameter force main that crosses Crow Island Woods just north of the woodlands, extends to Euclid Avenue, and is then directed to the south along the west property line of Crow Island Woods to the east end of Sunset Road (west). This 22-inch storm sewer force main then discharges into a gravity 36-inch-diameter storm sewer main that runs to the west along Sunset Road (west), crosses Hibbard Road, and outlets into the FPDCC diversion ditch. As stated in Section 1.04, the only means of draining the South of Willow Watershed is via the Mount Pleasant Road Pump Station.

One of the primary east-west conveyance routes that has been identified to provide flood relief for the South of Willow Watershed extends along Sunset Road from the intersection of White Oak Lane and would ultimately outlet to the FPDCC diversion ditch west of Hibbard Road. This route would require conveying stormwater from the west end of Sunset Road (east) through Crow Island Woods to the east end of Sunset Road (west). Additionally, we have identified that if this primary gravity storm sewer outlet can be established, there may be an opportunity to eliminate the Village's Mount Pleasant Road Pump Station. A north-south gravity discharge could potentially be established from the current location of the Mount Pleasant Road Pump Station and tie into the primary east-west stormwater conveyance system along the south end of Crow Island Woods. Initial options considered for establishing conveyance of stormwater across Crow Island Woods included either storm sewer or potentially open ditching.

Given that any stormwater conveyance improvements providing flood relief to the South of Willow Watershed could potentially be directed to downstream FPDCC lands, water quality treatment measures will likely need to be considered. There is further discussion later in this section regarding FPDCC staff recommendations for providing upstream water quality improvement measures if receiving downstream FPDCC lands are to be part of the Village's overall flood risk reduction strategy.

Because Crow Island Woods is located near the downstream end of the South of Willow Watershed, it is an optimal location for potential implementation of regional water quality measures such as wet detention or constructed wetlands. However, any stormwater quality, storage, and conveyance measures to occur within Crow Island Woods will need to consider potential impacts to existing natural areas, preservation of the network of paths passing through the woods, and potential safety concerns related to placement of open water features near adjacent neighborhoods and Crow Island School. Conducting a detailed tree inventory of the woods to identify mature trees to avoid is recommended if planning efforts are further advanced.

6. Crow Island Woods - North

The northerly 8.7 acres of Crow Island Woods includes the historic Schmidt-Burnham Log House located at the northeast corner of the site (managed by the Winnetka Historical Society), a wet sedge meadow restoration and boardwalk at the northwest corner of the site, a pavilion structure with restrooms, and a recreated Native American Council Circle using 23 native oak trees. Construction of the restored wetland was funded through an IDNR grant that helped remove buried cinders that were disposed of in the early 1900s. Based on discussions with Winnetka Park District staff, residual cinder waste within this portion of site may still be present. The north half of Crow Island Woods is heavily used by residents of the surrounding neighborhoods and through partnerships with Crow Island School that center around educational/stewardship activities and programs.

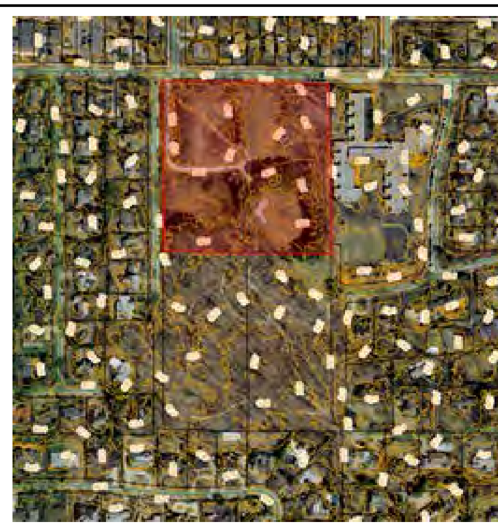


Figure 2.03-12 Crow Island Woods–North

Although significant amounts of stormwater detention volume could potentially be realized within the north half of Crow Island Woods (estimated between 15 and 25 acre-feet), it would create significant impacts to several active recreational uses at the site. Furthermore, the potential presence of cinder contamination at the site could result in significant earth excavation and disposal costs.

7. Vacant Private Parcels

Three vacant private parcels were identified within the study watershed that could potentially be acquired and used for creation of stormwater detention volume.

a. Meadow Lane appears to have a 1.9-acre residential lot located within the South of Willow Watershed. Current listing price is $2.5 million. Approximate storage volume that could be realized is between 2 to 3 acre-feet.

b. Dewindt Road appears to have a 1.06-acre residential lot located in the South of Willow Watershed. Current listing price $1.75 million. Approximate storage volume that could be realized is between 1 and 2 acre-feet.

c. Hibbard Road appears to have a 1.5-acre lot located north of Sunview Lane within the North of Pine Watershed. Current listing price $1.5 million. Approximate storage volume that could be realized is between 1.5 and 2.5 acre-feet.

While each of these available vacant parcels are located within areas that currently experience flooding issues, clearly acquisition of these parcels is cost prohibitive.

8. Hope, Faith, and Charity Church

The Hope, Faith, and Charity Church is located on the north side of Hill Road between Ridge Avenue and Linden Street. The church recently indicated plans for facility improvements that could create opportunities for creating detention storage at the 1.2-acre church playground site located at the northwest corner of Linden Street and Hill Road (refer to Figure 2.03-13). This parcel is located within an upland portion of the South of Willow Road Watershed that drains to an existing undersized storm sewer system along Hill Road. Because the site is actively used for recreational purposes by the church, implementation of surface flood storage likely is not practical. Construction of underground detention that could provide between 2 and 3 acre-feet of storage appears to be a viable option. However, the high construction costs for underground detention at this location likely cannot be justified.

Figure 2.03-13 Hope, Faith, and Charity Church

9. Indian Hill Country Club

The Indian Hill Country Club is an 18-hole private golf course located in unincorporated Cook County south of Indian Hill Road, west of Ridge Road, north of North Indian Hill Road, and east of Locust Road. The golf course is located within the 281.5-acre Indian Hill Country Club Watershed. The Skokie Ditch, a manmade ditch that was reportedly built in the late 1800s as an attempt to drain the Skokie Marsh, crosses through the middle of the golf course. The east end of the ditch terminates at North Indian Hill Road and discharges into the 36-inch diameter Kenilworth storm sewer system. The northwest end of the ditch exits the golf course immediately northwest of the tee box of the 8th hole and passes under several restrictive driveway culverts on the east side of Indian Hill Road where it ultimately connects to a partially silted in 36-inch diameter culvert at Hill Road. Based on review of available topographic data of the Skokie Ditch the grade of the ditch through the golf course is very flat.

Existing conditions stormwater modeling results indicate that during extreme storm events, both pipe discharges at either end of the Skokie Ditch have limited hydraulic capacity and cause the ditch to come out of its banks into the golf course. The 36-inch-diameter Kenilworth storm sewer system has significantly greater capacity than the Hill Road outlet. Existing condition modeling results indicate that the relative contribution of stormwater runoff from the Indian Hill Country Club is limited by the restrictive Hill Road culvert and upstream driveway culverts. During a 100-year storm event, the peak flow exiting the Indian Hill Country Club via the partially silted-in 36-inch Hill Road culvert into Winnetka is only about 2.1 CFS. The estimated peak 100-year flow discharging into the 36-inch-diameter Kenilworth storm sewer is approximately 40 CFS. Note that review of the hydrograph at this location indicates that there is a short period at the beginning of the storm event where flow actually exits the Village into Indian Hill Country Club.

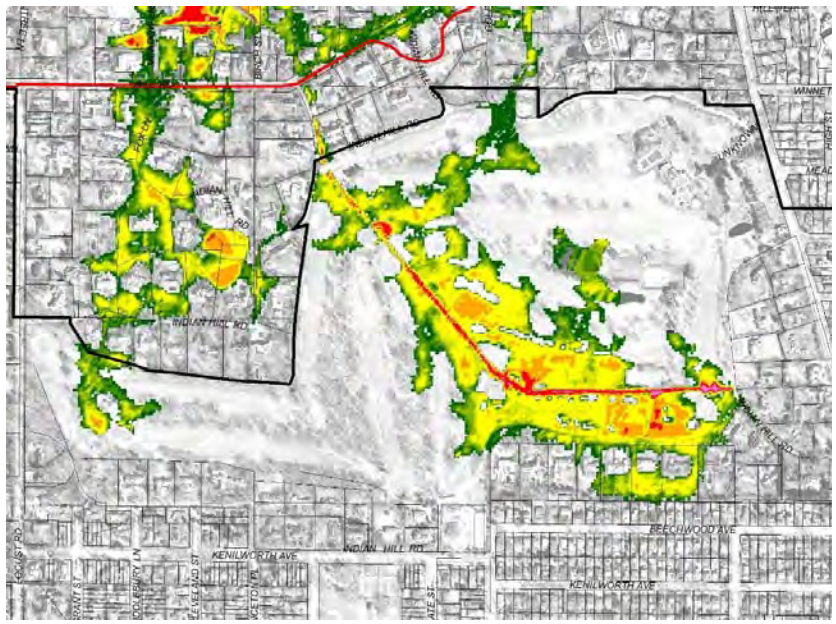


Figure 2.03-14 Existing Flooding Extents at Indian Hill Golf Course

Furthermore, when the capacity of each these culverts is exceeded, there is significant flood volume available within the golf course to store excess runoff (100-year storage volume ~37 acre-feet). Model results indicate a peak 100-year flood elevation within the golf course of 624.4 which does not result in surface overtopping of Hill Road into the Village. Estimated existing condition flooding extents and depths are shown in Figure 2.03-14. Because the peak flow rates that enter the Village via the Skokie Ditch out of the northwest side of the Indian Hill Country Club are highly restricted, providing additional detention volume likely will have very little benefit. An existing conditions modeling run that entirely removed the 281.5-acre Indian Hill Country Club Watershed from discharging across Hill Road was performed. The modeling results indicated less than a 0.1-foot drop in 100-year base flood elevation within flood-prone areas of the South of Willow Road Watershed. Flood control options that would involve redirecting flows from the Village southeast into the Indian Hill Golf Course were considered, but given that the Indian Hill Country Club already experiences significant flooding issues, it is unlikely that taking more water from the Village would be acceptable.

<u>FPDCC Sites</u>

Several FPDCC parcels (Sites 10 through 14) were identified as potential sites for creation of flood storage volume. Appendix E provides figures that depict the location of each of these sites (Zones A through E) and photographs documenting the existing conditions. Each site is described in further detail below.

10. FPDCC–North Forest Way Site (Zone A)

Figure 2.03-15 FPDCC Zone A

The North Forest Way Site is an approximate 13.2-acre parcel located immediately west of the Winnetka Park District's par 3 course, immediately south of the Winnetka Park District's 18-hole golf course, and east of the earthen levee that is adjacent to the Skokie River East Diversion Ditch and North Forest Way. Generally speaking, this parcel has relatively flat topography with existing ground elevations around 620. Given that the optimum elevation range to provide flood storage at this location is between elevation 615 and 621, removal of overburden soil to get to this elevation range would not be necessary, which translates to lower construction costs. While the parcel is densely wooded and vegetated, low quality invasive species such as cottonwoods, buckthorn and honeysuckle dominate the landscape. Review of National Wetland Inventory (NWI) maps indicates the potential presence of wetlands. However, it appears that sufficient hydrology is currently not available to enable wetland habitat.

As part of the Village's October 2011 *Flood Risk Reduction Assessment*, this site indicated a proposed 10-foot-deep, dry-bottomed detention basin providing 60 acre-feet of storage volume that was to primarily serve the North Willow Watershed. To drain the basin, a pump station with similar capacity to the Ash Street Pump Station was being proposed to pump directly to the Skokie River East Diversion Ditch. Placement of storage volume at this site appears to be a feasible option. However, if this site is pursued further, it is recommended that the 10-foot-deep dry detention basin concept be revised to instead provide shallower detention volume up to 5 feet deep that can be gravity drained. This configuration could result in approximately 20 to 30 acre-feet of flood storage volume. Placement of a 10-foot-deep dry basin that would be immediately adjacent to an earthen levee is not recommended because of potential seepage issues, high water table, and possible instability of the existing earthen levee that was likely not constructed to meet modern geotechnical standards. Furthermore, a shallower storage area would present opportunities to establish constructed wetlands and intermittent open water pools to improve water quality and enhance wetland habitat. Note that the proximity of the site is geographically distant from primary conveyance systems, such as Hibbard Road and Willow Road. There likely would be significant construction cost to extend primary conveyance systems to drain to this site.

11. FPDCC–South of Willow and West of Village Public Works Site (Zone B)

The South of Willow and West of Village Public Works Site is a 14.8-acre parcel that is densely wooded and vegetated with much of the same types of invasive species present at the North Forest Way site (including many large sycamore trees). Review of NWI maps, the majority of the site appears to be regulatory wetlands. However, it also appears that these wetlands have been deprived of the needed hydrology to support a functional wetland environment. The site is bounded on the west by the Skokie River earthen levee, which includes a gravel multi-use path at the top of the levee.

Figure 2.03-16 FPDCC Zone B

This site is topographically at a higher elevation than the North Forest Way site, with grades generally varying between 622 and 624. Establishment of flood storage volume between the optimal elevations of 615 and 621 would require the removal of an additional one to three feet of overburden soils, which translates to potentially higher excavation and excess soil disposal costs. Similar to the North Forest Way Site, this parcel is geographically distant from primary conveyance systems that would need to drain to a basin. If surface storage volume were created between elevations of 615 and 621 at the site, it appears that approximately 20 to 35 acre-feet of flood storage volume could be realized and could be gravity drained. This type of storage concept presents opportunities to create improved water quality and enhanced wetland habitat through implementation of constructed wetlands and open water features.

12. FPDCC - South and East of Landfill Site (Zones C and D)

Figure 2.03-17 FPDCC Zones C and D

The South and East of Landfill Site is a 49.0-acre parcel that is located immediately west of Hibbard Road, north of Winnetka Avenue, south and east of the Village's existing landfill, and east of the Skokie River levee. The FPDCC diversion ditch daylights from the Willow Road storm sewer interceptor approximately 400 feet south of Willow Road and immediately west of Hibbard Road. The diversion ditch then extends approximately 1,000 feet to the south where the alignment shifts to run diagonally to the southwest toward the Village's Winnetka Avenue Pump Station. The FPDCC diversion ditch is a manmade channel that is approximately 30 feet wide measured from top of bank to top of bank. Further discussion of the stormwater hydraulic conditions related to the Winnetka Avenue Pump Station and FPDCC diversion ditch are provided within Section 1.04, but it should be noted that the majority of the runoff generated within the study watershed is directed to this parcel and ultimately to the Winnetka Avenue Pump Station. This is an important factor when considering the goal of not diverting drainage outside current watershed boundaries and maintaining existing drainage patterns.

Existing topography at the site beyond the limits of the diversion ditch banks and the Skokie River levee is relatively flat, with grades generally ranging between elevations 620 and 621. Given that the optimum elevation range to provide flood storage at this location is between elevations 615 and 621, removal of overburden soil to get to this elevation range would not be necessary, which translates to lower construction costs. Furthermore, there exists potential for reuse of excess excavated soil both at the site and on the Village's adjacent closed landfill site. The potential for on-site soil reuse is a sustainable approach for management and disposal of excess excavated material. This also directly correlates to significant earthwork cost savings when compared to hauling and disposal of excess excavated materials to geographically distant fill sites.

The site is densely wooded and vegetated with similar invasive species described previously (cottonwood, buckthorn, box elder, etc.). These tree species were able to establish in what was once wet meadow that was connected to the Skokie River floodplain. Review of NWI maps indicates the potential presence of wetlands throughout the site, so wetland permitting through the Army Corps of Engineers (ACOE) will be required to mitigate wetland impacts. Similar to the other FPDCC sites evaluated, the hydrology of the Skokie River floodplain was essentially cut off when the Skokie River flood control levee was constructed in the 1930s. With the change in hydrology, change in vegetation to succession forest and introduction of invasive species, many of these natural areas do not demonstrate the functional wetlands, marsh, and wet meadow plant communities that once existed.

Figure 2.03-18 Winnetka Avenue Pumping Station

Figure 2.03-19 FPDCC Diversion Ditch

As part of the Village's October 2011 *Flood Risk Reduction Assessment*, a 15-foot-deep underground detention basin containing 65 acre-feet of storage volume was to be located immediately east of the landfill, south of Willow Road, and west of Hibbard Road. This underground basin was to receive runoff from a large gravity storm sewer main draining the South Willow Watershed. To drain the basin, a stormwater pump station discharging to the FPDCC diversion ditch was proposed. This underground storage concept was not considered a feasible alternative because of excessive construction cost and several physical constraints including the potential for high groundwater, challenges in accommodating the influent pipe passing under the existing diversion ditch, and difficulties getting FPDCC approval for a project that did not align with its core goals and objectives.

Opportunities do appear to exist to create surface storage by lowering the grade of the site and reconnecting stormwater flowing in the diversion ditch to adjacent floodplain. Concepts initially developed and presented to the FPDCC included creating open water features and constructed wetlands to enhance aquatic habitat and improve stormwater quality. Perimeter soil reuse areas on the site and at the Village's landfill can be restored to upland forested groves to mimic historical conditions. In terms of flood storage volume, between 60 and 100 acre-feet of flood storage can be created at this location, which is a significant share of the total anticipated volume to be provided.

13. FPDCC–Northfield Site (Zone E)

The Northfield Site is a 15.0-acre parcel located immediately south of Winnetka Avenue, east of the Skokie River levee and west of single family residential lots along Meadowview Drive in the Village of Northfield. The residential neighborhood immediately to the east has experienced drainage and flooding issues in the past. Stormwater drainage from this neighborhood is not directed to the west onto the FPDCC Northfield site, but is generally directed to the north onto the FPDCC property north of Winnetka Avenue. The 15.0 acre parcel is sparsely forested, with the exception of the far northeast corner of the site. This northeast corner contains a mature oak savannah that should be protected.

Figure 2.03-20 FPDCC Zone E

The remainder of the site is dominated by non-native species such as buckthorn. The topography of the site is relatively flat with surface elevations that vary between 622 and 625. Given that the optimal range of elevations to provide flood storage is generally between 615 and 621, an additional 1 to 4 feet of soil overburden would need to be excavated, translating to potentially higher earthwork costs. Review of NWI mapping does not indicate the presence of wetlands; however, this would need to be field verified.

The site is located immediately adjacent to a residential neighborhood, so the potential for disruption during construction does exist. Initial concept plans developed for the site included creating a range of open water features, constructed wetlands, and upland sedge meadows that could create enhanced aquatic habitat and improved water quality. It appears that between 15 and 25 acre-feet of flood storage volume could be created at this location, and could be hydraulically interconnected to created flood storage areas located on FPDCC lands north of Winnetka Avenue. While not located within the Village limits, flood storage improvements could result in stormwater management benefits for the adjacent neighborhood in the Village of Northfield.

14. Skokie Lagoons Upstream of Willow Road Dam

Figure 2.03-21 Willow Road Dam

The Skokie Lagoons, which are owned and managed by the FPDCC, consist of seven interconnected lagoons that total approximately 190 acres. The normal pool level in the lagoons is controlled by the Willow Road Dam, which includes an eight-foot wide rectangular low flow spillway with an invert elevation 619.0 and a 167-foot auxiliary spillway at an elevation of 626.0. Installation of the 8-foot-wide low flow weir was constructed in 2008 to replace three, 36-inch-diameter pipe conduits at the same elevation that were historically prone to debris blockage. Two diversion ditches exist on either side of the lagoons to collect local drainage that flowed into the former marsh area from the east and west and conveys it below the Willow Road Dam. The construction of the lagoons and the dam was originally done by the CCC to provide flood relief from the Skokie River in the 1930s. However, today the lagoons are a prime destination for recreational uses such as boating, kayaking, fishing, biking, and hiking.

It is noteworthy that no portion of the study watershed is currently tributary to the Skokie Lagoons. Approximately 279 acres within the study watershed (West of Hibbard North and Winnetka Golf Club Watersheds) are drained by an existing pump station that outlets to the Skokie River West Diversion Ditch. Potential concepts to create additional flood storage within the Skokie Lagoons to offset impacts of increased stormwater pumping from the study watershed have included lowering the elevation of the 8-foot-wide spillway elevation at the Willow Road Dam or to potentially increase the height of the 167-foot-wide auxiliary spillway. Each of these potential concepts was initially discussed with FPDCC in December 2015 and it was clear that any project proposal that would result in changes or impacts to the Skokie Lagoons could not be supported. FPDCC indicated that currently surface water quality within the lagoons is highly impaired from eutrophication and that modifications to the dam that would reduce the permanent pool depths of the lagoons would likely further impair water quality. Additionally, diversion of runoff from urban watersheds that do not currently drain to the lagoons was also viewed as a project proposal that would not be supported. Given the outcome of these initial discussions with FPDCC staff, use of the Skokie Lagoons as a potential location for placement or creation of additional flood storage to provide flood relief benefits for the Village does not appear to be feasible.

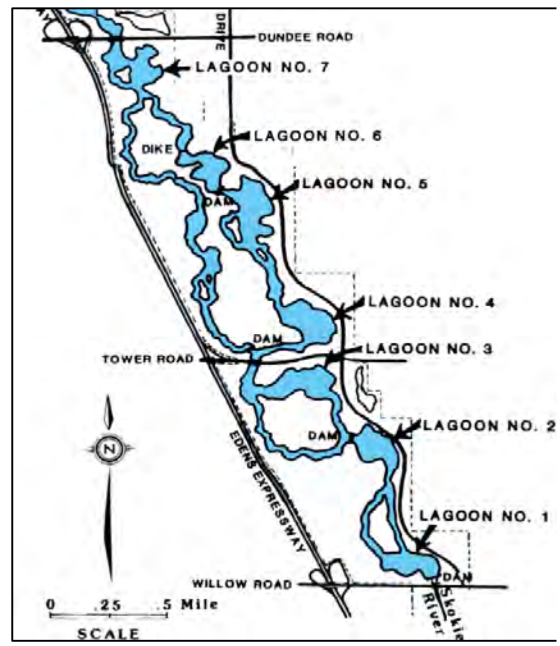


Figure 2.03-22 Skokie Lagoons System

15. Duke Childs Fields–Soccer/Lacrosse Fields

The soccer and lacrosse fields at Duke Childs Fields occupy an approximate 3.6-acre area located immediately north of Willow Road and west of Hibbard Road and are owned and maintained by the New Trier High School District (NTHSD). Proximity of this site to flood-prone areas within the North of Willow Watershed make this site a good candidate for creation of flood storage.

Additionally, placement of water quality treatment measures (i.e., wet detention and/or bioretention basins) would satisfy the FPDCC request to treat stormwater prior to discharging to FPDCC lands. Placement of surface storage at this location could generate between 12 and 18 acre-feet of storage volume while also providing water quality treatment. Excess excavated soil could potentially be reused at the Village's landfill site, thereby also allowing for relocation of the soccer and lacrosse fields at the top of the landfill. Conceptual layouts of the fields at this location indicate that sufficient land area is available to replicate the existing playing fields and also provide sufficient access and parking. The NTHSD has expressed several concerns related to this concept including playability during windy conditions, the fields not being immediately contiguous to the ball fields, the need for providing rest rooms, and potential issues resulting from settlement and loss of use of the fields during construction. Further review of this concept and engagement with the NTHSD would be required to satisfactorily address these concerns. Underground detention volume was also considered at the site and likely could provide a similar amount of storage volume (~18 acre-feet) while allowing the soccer and lacrosse fields to remain at their current locations. However, the cost of providing underground storage volume is significantly more expensive, with an estimated increase in cost of approximately $2.5 million. This option reduces the capability of providing water quality treatment prior to discharging flow to the FPDCC.

Figure 2.03-23 Soccer/Lacrosse Fields At Duke Childs Field

16. Duke Childs Fields–Baseball/Softball Fields Lowered

The baseball and softball fields located at Duke Childs Field occupy approximately 10.8 acres and are owned and maintained by the NTHSD. Creation of surface flood storage at this location could be accomplished by lowering the fields to an elevation that, during most rainfall events, would not be inundated and would still be playable (~10-year storm events and less). For larger storm events greater than a 10-year storm event, floodwater would temporarily inundate the fields. The dry basin would be constructed immediately adjacent to the soccer and lacrosse field basin and would provide between 24 and 32 acre-feet of additional surface storage volume.

Figure 2.03-24 Baseball/Softball Fields At Duke Childs Field

17. Duke Childs Fields–Baseball/Softball Fields Relocated

Relocation of the baseball and softball fields would allow surface detention to be provided at a greater depth and would allow for creation of an additional 30 acre-feet of storage volume. This option would require selection of a suitable site to relocate the fields within the NTHS District.

18. Winnetka Golf Club–Par 3 Course

The Winnetka Golf Club Par 3 course resides on an approximately 18.2-acre site located immediately north of Duke Childs Fields. The course is owned and maintained by the Winnetka Park District and serves as a valuable asset for teaching and developing young golfers. Discussions with Winnetka Park District staff indicated that options considered should limit impacts such that a portion of the golf holes could still maintained for use. Note that the green located at the far southwest corner of the site is located above an existing aboveground water storage tank, so this is an area that cannot be impacted. Also, immediately south of the ice arena is an approximate 1.0-acre playing field that is heavily used for recreational purposes. For this reason, use of this field for stormwater management purposes likely is not a feasible option unless underground storage is implemented that would maintain the current recreational uses at the site. One concept for use of the Par 3 course would be maintaining six of the existing golf holes, allowing for creation of approximately 7 acre-feet of dry-bottomed surface storage volume. If this same area would be used for wet detention at a lower elevation, approximately 15 acre-feet of storage volume could be created.

19. Winnetka Golf Club–18-hole Course

The Winnetka Golf Club 18-hole golf course resides on a 109-acre site located immediately north of the par 3 course, east of Skokie River East Diversion Ditch levee, and south of residential lots located along Tower Road. Initial discussions with Winnetka Park District staff indicated that any options considered for stormwater detention would need to keep all 18 holes maintained and playable. They indicated that northerly portions of the course are prone to flooding and prolonged standing water during heavy rainfall events. Given that the golf course is geographically distant from flood-prone areas, conveyance of stormwater to the golf course would likely be cost prohibitive. Furthermore, to keep all 18 golf holes intact, limited amounts of detention volume could be realized (between 4 and 6 acre-feet of storage). Suggestions were made to acquire the 18-hole course and convert it to a large regional stormwater basin that could be done in-lieu of storage improvements on FPDCC lands. It is estimated that approximately 40 to 50 acre-feet of

Figure 2.03-25 Winnetka Golf Club 18-Hole Course

storage could be provided to benefit the North of Willow Watershed. Additional detention volume could be created to potentially serve the South of Willow Watershed, but this option would likely require pumping of stormwater from the South of Willow Watershed a significant distance.

20. Ash Street Pump Station

The existing Ash Street Pump Station is owned and operated by the Village and is located near the intersection of Ash Street and Hibbard Road. This pump station is responsible for pumping stormwater from topographically low areas in the "Tree Streets" neighborhood into the Hibbard Road storm sewer interceptor. The capacity of the existing pump station of 8 CFS is insufficient and would need to be significantly increased (estimated required pumping rate of 125 CFS) to provide a 100-year storm level of protection for the "Tree Streets" neighborhood. Furthermore, this pump station discharge would need to be directed to a location where there is sufficient storage volume. As stated earlier, pumping to the Skokie Lagoons is not a feasible option. Pumping directly to the Skokie River is likely also not a feasible option because of increases in peak discharges to the Skokie River and the resultant downstream increases in Skokie River and North Branch Chicago River flood stages.

21. Lower Hibbard Road and Connecting Tree Streets

One of the physical challenges that must be overcome in the Tree Streets neighborhood is the lack of an overland flood route once the storm sewer and pump station capacities are exceeded. As stated previously, Hibbard Road is approximately 1 to 2 feet higher than the connecting Tree Streets (Ash Street, Cherry Street, and Oak Street), which causes stormwater to pond to excessive depths for prolonged periods until flood levels recede. One potential option that could provide relief in the Tree Streets neighborhood would be to lower the road profile 1 to 2 feet to facilitate a positive overland flood route to the west. This option assumes that stormwater detention improvements at Duke Childs Field would be in place to receive this overland drainage. For Hibbard Road to be lowered, the westerly portions of Ash Street, Cherry Street, and Oak Street would also need to be lowered to match grade at the intersections. While there do not appear to be driveways along Hibbard Road that would be impacted along either side, profile changes of Ash Street, Cherry Street, and Oak Street would likely impact several driveways. Additionally, this option would likely require relocation of impacted utilities. Furthermore, this configuration may introduce excessive flood depths that would extend across an arterial roadway that receives high traffic volumes that would be disrupted.

22. Increase Mount Pleasant Road Pump Station Capacity

The existing Mount Pleasant Road Pump Station is owned and operated by the Village of Winnetka and is located near at the west end of Mount Pleasant Road near Crow Island School. This pump station is responsible for pumping stormwater from topographically low areas within the South of Willow Watershed into an existing 36-inch storm sewer along Sunset Road (west) that outlets into FPDCC lands located west of Hibbard Road. The capacity of the existing pump station of about 22 CFS is insufficient and would need to be significantly increased (estimated required pumping rate of 319 CFS to provide the 100-year storm level of protection for the South of Willow Watershed. Furthermore, this pump station discharge would need to be directed to a location where there is sufficient storage volume available that would offset potential flooding impacts. As stated previously, directly pumping to the Skokie River likely is not a project proposal that would be accepted by regulatory agencies such as IDNR and MWRD because it means transferring higher flood peaks downstream to areas that already experience flooding issues. In lieu of pumping directly to the Skokie River, storage volume would likely need to be created at a location interior to the Skokie River levee.

23. Sunset Road Conveyance Route for South of Willow Watershed

As previously discussed in the Crow Island Woods section, establishing a gravity stormwater conveyance system to provide flood relief to the South of Willow Watershed is a feasible option as long as sufficient downstream flood storage volume is created to keep tailwater elevations at the outlet below an approximate elevation 620.5 for a 100-year storm, three-hour storm event. Maintaining the tailwater at this lowered elevation allows for sufficient hydraulic slope through the gravity conveyance system to provide adequate 100-year storm flood protection for the South of Willow Watershed (i.e., limiting flood elevations in the Sunset neighborhood to approximately 622).

Figure 2.03-26 Sunset Road Conveyance

One conveyance system route evaluated is along Sunset Road beginning at the intersection of White Oak Lane and ultimately outletting to the FPDCC diversion ditch west of Hibbard Road. This route would require conveying stormwater from the west end of Sunset Road (east) through Crow Island Woods to the east end of Sunset Road (west). This conveyance route is clearly the shortest distance, but there are several existing physical constraints that would be challenging. Based on current stormwater modeling results, it is estimated that a 10-foot wide by 5-foot high reinforced concrete box culvert (10’x5’ box) would be required along this route, including placement of a 10’x5’ box along the existing Skokie Ditch from Birch Street to the intersection of White Oak Lane and Sunset Road. Construction of the 10’x5’ box between along Sunset Road between White Oak Lane and Crow Island Woods will be especially challenging because of a very narrow private roadway corridor (as little as 12 feet wide in some places) and potential impacts to adjacent mature trees and landscaping.

Maintaining access through this corridor during construction will also be a significant challenge given the narrow width of the existing private street. Construction of the 10'x5' box along the existing Skokie Ditch, as shown in Figure 2.03-27, will also likely result in significant impacts to private property owners along the route. If the Sunset Road Conveyance route is pursued, significant coordination and engagement with potentially impacted private property owners along the conveyance route will be required as planning and design efforts are advanced.

24. Hill Road Conveyance Route for South of Willow Watershed

A potential alternative conveyance route to provide flood relief in the South of Willow Road Watershed is generally along Hill Road between Hibbard Road and Birch Street. This route presents fewer challenges in terms of construction impacts to private property owners because the majority of the route is within public right-of-way. The exceptions to this would be construction of a 6-foot by 4-foot box along the Skokie Ditch between the intersection of White Oak Lane and Sunset Road and extending southeast to Birch Street (note that flow direction is reversed for this option). However, this 6-foot by 4-foot box is smaller than the 10-foot by 5-foot box size for the Sunset Road Conveyance option so there would be fewer impacts to adjacent private properties. The Hill Road Conveyance option does limit opportunities for providing regional water quality improvements within Crow Island Woods for the entire watershed (the only portion of South of Willow Watershed that would drain to Crow Island Woods would be the watershed draining to the 38-inch by 60-inch Mount Pleasant Road storm sewer system). Clearly, the Hill Road Conveyance Route is significantly longer than the Sunset Road Conveyance Route, which translates to additional construction cost. Based on a comparison of cost opinions for the two conveyance routes evaluated, the Hill Road Conveyance Route results in an additional construction cost of approximately $7.3 million.

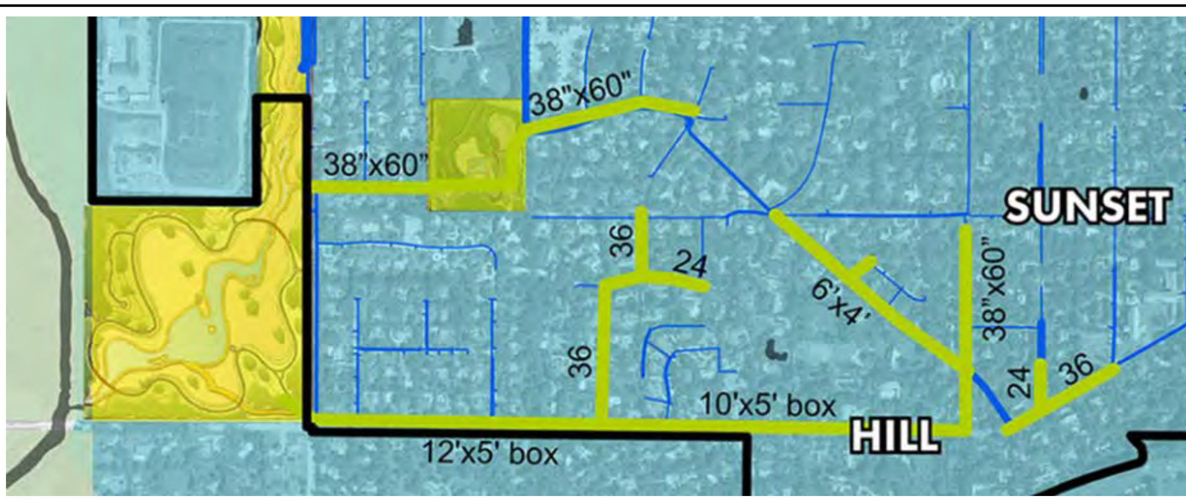


Figure 2.03-27 Hill Road Conveyance

An additional conveyance route that was considered is a slight modification of the Sunset Road Conveyance Project Route (refer to Figure 2.03-28). However, instead of the 10-foot by 5-foot box culvert continuing west along Sunset Road from Locust Street, the 10-foot by 5-foot box would be realigned to continue to the northeast along Locust Street (which is Village right-of-way) and continue to the west along Mount Pleasant Road where it would outlet into the Crow Island Woods Storage Project. This alternative alignment is approximately $2.0 million more costly than Sunset Road Conveyance Project option.

Figure 2.03-28 Locust Street/Mount Pleasant Road Conveyance

25. Winnetka Avenue Pump Station Capacity Upgrades

The current pumping capacity of the Winnetka Avenue Pump Station is 134 CFS. If implementation of storage improvements is not pursued within the study watershed, it is estimated that the capacity of the Winnetka Avenue Pump Station would need to be increased to 525 CFS. As previously stated, any further increase in peak discharge to the Skokie River and the North Branch Chicago River further downstream without providing sufficient offsetting flood storage volume would not be allowed or permitted by regulatory agencies such as IDNR. Downstream areas along the Skokie River and North Branch Chicago River currently experience significant flooding issues, so any increase in peak flows would likely exacerbate these flooding issues.

Additionally, the magnitude of the increased capacity pumping station would require several acres of additional FPDCC property to construct at a significant expense and with little take away value to the community. This course of action would continue to make the Village rely on mechanical facilities for protection, does not provide a sustainable solution, and would most likely not be acceptable to the FPDCC.

26. Gravity Pressure Storm Sewer Main Implementation

Because there exist areas within the study watershed that are at a higher elevation than the Skokie River levee (portions of the Provident Watershed, North of Pine Watershed, and Area O Watershed), pressure gravity storm sewer mains could drain these areas to the Skokie River without the need to use pumping conveyance systems. However, there would be similar approval and permitting challenges as previously indicated for any of the opportunities to pump directly to or increase discharge into the Skokie River. Additionally, this conveyance concept would not allow for providing downstream regional water quality treatment prior to discharging to the Skokie River.

27. Regulation Changes for Community Redevelopment and Infill Projects

The Village's current stormwater management ordinance was adopted in 2014 and closely follows the Cook County Watershed Management Ordinance (WMO). Stormwater detention requirements for new development projects on undeveloped lands require that sufficient detention volume be provided to reduce 100-year storm peak flows from a site that will not exceed predevelopment rates of runoff from the site for a three-year return interval storm event using a runoff coefficient of 0.15 (essentially a runoff coefficient of 0.15 represents grassed pervious ground cover). For redevelopment sites, the Village's ordinance requires sufficient stormwater detention volume to account for the increase in impervious surface on a particular lot. For instance if a one-acre redevelopment site increases its impervious surface from 0.5 acre to 0.7 acre, detention would be computed for the 0.2-acre area of increase only. If this methodology is used for this example, approximately 0.09 acre-feet of detention volume would be required.

One option to consider is to require detention for redevelopment sites using the new development stormwater management standards. For this same one-acre site, approximately 0.28 acre-feet of detention volume would be required. While the current ordinance does limit release rates off of redevelopment sites to current conditions, it limits opportunities for improving stormwater conditions in already flood prone watersheds. Adopting more stringent stormwater detention regulations for redevelopment projects could potentially improve flooding conditions if a policy described above were enacted. However, more stringent regulations should be balanced with potential hindrance of land redevelopment and economic growth.

Other regulatory control opportunities exist that could increase implementation of stormwater detention measures on either redevelopment sites or existing developed sites. One approach would be to modify the Village's current stormwater utility credit policy to allow for greater fee reduction incentives for either exceeding minimum stormwater detention requirements for redevelopments or voluntarily implementing stormwater controls on existing sites. Note that stormwater utility credit policy changes such as this would likely result in greater Village staff administrative demands to review, process, and enforce stormwater utility credit applications.

28. Zoning Regulation Modifications

The Village's current zoning code does establish maximum percentages of impervious surface for residential and multi-family residential districts (maximum values are 50- and 60-percent, respectively). It does not appear there are intensity of development standards for commercial and industrial districts. A potential opportunity to limit stormwater runoff from new developments and redevelopments is to lower the maximum percent impervious thresholds for residential districts and establish thresholds for commercial and industrial districts. As stated in the previous section, implementation of stricter lot intensity zoning regulations would need to balance with potential impacts to future land development and economic growth.

C. Opportunity Shortlist and Evaluation

Review of the opportunity matrix indicates there are several stormwater management opportunities that were judged as not viable to further pursue as components of the overall stormwater and flood control vision. This judgment is based on how each identified stormwater management opportunity measures up for each of the seven primary evaluation criterion (i.e., land acquisition, reliance on mechanical facilities, maintaining existing drainage patterns, regulatory authority acceptance, property owner acceptance, overall effectiveness, and relative cost). In many cases, there are one or more of these evaluation factors that eliminated a particular option from further consideration.

Based on the results of the opportunity matrix evaluation, the following conclusions were made.

1. Property-level green infrastructure measures can be an effective component of the overall stormwater and flood control vision, but their effectiveness is closely tied to private property owner’s willingness to participate. The Village can improve private property owner’s willingness to participate by establishing incentive-based green infrastructure programs. But even with high levels of participation, relative amounts of flood storage provided versus what is needed for the target level of service will still require significant large-scale flood control infrastructure improvements.

2. Potential neighborhood-level green infrastructure measures that appear to have the most promise are those that can be done in conjunction with major conveyance improvement projects, such as parkway bioretention basins. This approach will limit impacting areas that would otherwise not be disturbed. Similarly, the Village should also consider integrating these green infrastructure improvements into other capital improvement projects such as roadway and significant utility replacement projects.

   Similar to the property-level green infrastructure measures, the benefits of these opportunities are for smaller intensity and more frequent storm events. Flood control benefits are fairly minimal for the target level of service; approximately 0.8 acre-feet of storage volume provided. However, the significant benefit that does make this opportunity important to the vision are the water quality improvements realized across the watershed.

3. Given the current market property values in the Village, acquisition of vacant private property or property buyouts within the study watershed is likely cost prohibitive. Additionally, the storage volume provided is relatively small for the cost. For this reason, greater reliance on large-scale conveyance projects will be required.

4. Large scale conveyance projects will be an integral part of the overall stormwater management and flood control vision, regardless of which watershed-based stormwater

storage opportunities are chosen. In most cases, these conveyance projects will involve construction of large-diameter storm sewer pipes and box culverts to effectively and safely carry stormwater flows away from currently flood-prone private properties. In some cases, alternative conveyance routes exist to accomplish the same stormwater conveyance goals, such as the Hill Road Conveyance Route versus the Sunset Road Conveyance Route in the South of Willow Watershed. But in most cases, viable alternative conveyance routes are not available (i.e., conveyance improvements in the North of Willow Watershed, North of Pine Watershed, and Provident Watershed).

5. Stormwater management opportunities that do not mimic current drainage patterns or that result in increased stormwater peak discharges and/or stormwater runoff volumes to the Skokie River, Skokie Lagoons, and Skokie Ditch (within the Indian Hill Country Club) likely would not be acceptable or approved by affected landholders (FPDCC and Indian Hill Country Club), regulatory agencies (IDNR and MWRD), or impacted downstream municipalities currently experiencing flooding along the Skokie River and North Branch Chicago River (Northfield, Wilmette, Morton Grove, and Glenview).

6. The stormwater management and flood control vision should attempt to minimize reliance on mechanical pumping conveyance systems. Currently, the existing stormwater conveyance system in the study watershed is heavily dependent on multiple pump stations that are undersized and oftentimes unreliable because of mechanical or power failures. It was determined through stormwater modeling that gravity stormwater conveyance systems replacing the existing pumped systems could be viable in several drainage areas (Tree Streets in the North of Willow Watershed and the Sunset, DeWindt, and Mount Pleasant neighborhoods in the South of Willow Watershed). This presents a feasible and cost-effective flood conveyance solution that also provides the Village and residents with peace of mind that a mechanical system failure won't lead to potential damage to property.

7. To enable a gravity stormwater conveyance approach for flood relief, significant amounts of flood storage volume must be created in downstream areas hydraulically contiguous to the Winnetka Avenue Pump Station, which is the ultimate discharge point of the entire study watershed. Doing so allows the receiving tailwater elevations of the primary gravity conveyance systems in the Village (both existing and proposed) to have sufficient hydraulic slope to positively drain and achieve adequate hydraulic performance. Simply put, instead of storing stormwater runoff within upstream flood-prone neighborhoods, it will be stored in downstream large-scale storage facilities.

8. Assuming that the existing hydraulic capacity of the Winnetka Avenue Pump Station (134 CFS) is not increased, it is estimated that approximately 200 acre-feet of downstream large-scale storage improvements will be necessary. To get a feel for the relationship between the pumping capacity of the Winnetka Avenue Pump Station and storage volume needs, 134 CFS is equivalent to 11.1 acre-feet of stormwater pumped per hour. The estimated amount of stormwater runoff generated during the 100-year, three-hour duration design storm that must pass through the Winnetka Avenue Pump Station is approximately 250 acre-feet. Knowing that the rate of runoff delivered to the Winnetka Avenue Pump

Station will greatly increase with upstream conveyance improvements, 200 acre-feet of downstream detention volume is needed to store the difference in stormwater volume being delivered to and leaving from the Winnetka Avenue Pump Station.

9. The approximate 200 acre-feet of study area watershed-based stormwater storage volume can be provided at a number of locations on publicly-owned lands that are controlled by a variety of landholders (FPDCC, NTHSD, School District No. 36, and WPD). Selecting the most cost-effective combination of stormwater storage opportunities at these locations must strike a balance between many important decision-making factors including flood control performance, stormwater quality, construction and long-term maintenance costs, constructability and impacts during construction, land usage changes and associated impacts, and aligning proposed land usage with each landholder's core goals and missions.

   The most beneficial and important storage opportunity evaluated is the FPDCC site south of the landfill west of Hibbard Road (Zones C and D). Approximately 124.1 acre-feet of stormwater storage volume can be created at this location, which accounts for about 62 percent of the total 200 acre-feet storage volume goal. However, the message from FPDCC staff was very clear that every attempt must be made to maximize creation of storage at locations upstream in the watershed so that the burden does not fall solely on them. Along these same lines, the FPDCC indicated that upstream stormwater quality measures need to be implemented within the watershed prior to discharging to any new facilities on their lands. This is not to say that stormwater quality treatment measures will not be provided at the FPDCC site, but the sole burden cannot fall on the FPDCC to do so.

The other three FPDCC district storage opportunity sites are feasible options that were also strongly considered. However, each of these three sites had certain physical constraints and limitations that resulted in dropping them from consideration as part of the overall vision. All three sites are geographically more distant from the primary conveyance systems that would need to deliver runoff to the respective site, resulting in greater infrastructure cost and, in some cases, more dependence on pumping and mechanical facilities. Furthermore, two of the three sites (Northfield Site Zone E and West of Public Works Zone B) have higher existing ground elevations, which translates to greater earthmoving costs. Two of the three sites (North Forest Way Site Zone A and West of Village Public Works Zone B) indicate the potential presence of wetlands that would result in additional wetland mitigation costs.

Storage opportunities evaluated at Duke Childs Field are an important component of the vision, both in terms of flood storage benefits and stormwater quality improvements. Providing 18.2 acre-feet of storage volume consisting of extended wet detention and constructed wetlands at the current soccer and lacrosse fields is at an optimal location to provide much-needed flood control for the North of Willow watershed and valuable stormwater quality improvements. A potentially viable solution for the NTHSD's need to maintain the existing soccer and lacrosse field use appears to be available at the Village's landfill site, which is discussed further in the following section. This concept presents unique win-win opportunities to put the landfill open space to valuable community use and for cost-effective disposal or reuse of excess excavated soil from other storage volume construction projects, all while meeting the NTHSD's programming needs. Creation of shallower flood storage at the current baseball/softball field locations at Duke Childs Field presents a good opportunity to create approximately 27.7 acre-feet of additional flood storage volume and allows the current recreational usage at the site to remain intact.

Use of the Park District's existing Par-3 golf course would allow creation of an additional 6.6 acre-feet of storage volume and may allow the use of the par 3 course to remain intact.

Similarly, concepts developed to create constructed wetlands, open water features, and recreational enhancements within the south portion of Crow Island Woods achieves multiple stormwater management planning objectives including providing daylighted flood conveyance through Crow Island Woods, approximately 15.9 acre-feet of flood storage benefits, stormwater quality treatment improvements through implementation of constructed wetlands and open water features, and establishment of improved ecological habitat.

Establishment of underground storage at Skokie-Washburne School was chosen as a viable storage component for the stormwater and flood control vision. It provides approximately 5.6 acre-feet of flood storage volume in an area already prone to flooding and borders the most flood-prone residential properties in the North of Willow Watershed, so immediate flood relief will be realized from this project.

The selected flood storage opportunities identified to be included within the stormwater and flood control vision total 199.1 acre-feet of storage volume as detailed in Table 2.03-1). Each flood storage opportunity project is presented in further detail in Section 3 of this report, including concept drawings and renderings, cost estimates, and discussion of potential impacts to the public and affected stakeholders.

Storage Opportunity	Volume (acre-ft)	100-Year, 3-Hour HWL Elevation (Feet)
Parkway Bioretention Storage	0.7	NA
FPDCC–South of Willow, West of Hibbard, North of Winnetka Avenue and East of Landfill Site–Constructed Wetlands	124.1	620.5
Duke Childs–Soccer/Lacrosse Fields Wet Basin and Constructed Wetland	18.2	620.5
Duke Childs–Ball Fields Lowered Dry Basin	27.7	620.5
WPD Par 3 Course–Dry Basin	6.6	620.5
Skokie - Washburne School–Underground Storage	5.9	621.4
Crow Island Woods South–Wet Basin and Constructed Wetlands	15.9	620.6
Total Volume =	**199.1**	

Table 2.03-1 Summary of Storage Opportunity Design Storm Flood Volumes

2.04 COMMUNITY PARTNER ENGAGEMENT

It was recognized at the start of this study that successful stormwater management and flood control improvements would most likely require a partnership with key agencies within the community, namely the Winnetka Park District, the FPDCC, NTHSD, and School District 36. From evaluation of the study watershed land use characteristics, it was quickly noted that these potential community partners manage valuable open land areas that represent key opportunities for stormwater and flood control.

Introductory meetings were held with representatives of each agency to open a dialogue starting with an explanation of the study purpose and anticipated process, the stormwater and flood control issues the Village is facing, and how each agency is seen as a potential partner with the Village (see Figure 2.04-1). The introductory meetings were also important to hear from each agency as to their particular needs, their vision for the use of their property, and any limitations they saw to the potential partnership. Although the introductory meetings were held at the beginning stages of the study, ideas of how each agency's property could aid in the Village's stormwater and flood control purposes were presented to each agency for consideration.

Subsequent meetings were held with each of the agencies to continue the dialogue and discuss more conceptual proposals for mutually beneficial partnerships that would advance the goals and objectives for the use of each agency's property and provide improved stormwater and flood control protections to the community. Each agency has their particular needs and concerns, but all agencies expressed a general willingness to work with the Village. Following are details of the discussions and the status of engagement with each community partner.

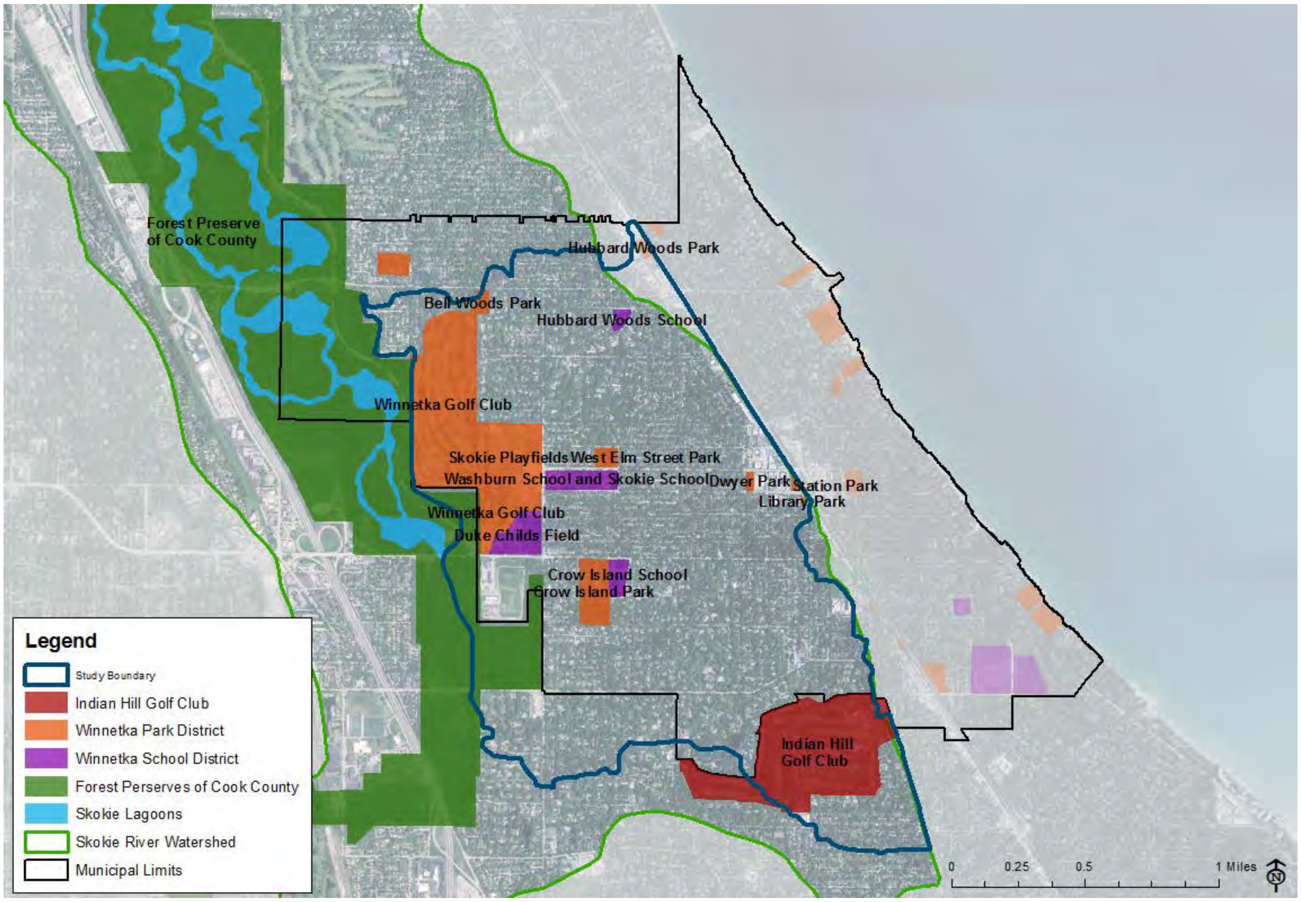


Figure 2.04-1 Potential Community Partner Lands in the Study Watershed

A. Winnetka Park District

An introductory meeting was held on November 17, 2015, with representatives of the Winnetka Park District. At that meeting the various properties owned by the District were discussed and thoughts on stormwater management were shared. Park District staff recognized the need for stormwater and flood controls in the community having experienced their own issues and damages from recent storm events, and expressed willingness to work with the Village to identify mutually beneficial improvements. Through the Exploration Phase of the project, opportunities in the golf courses and Crow Island Woods-South were shortlisted for further investigation with Crow Island Woods-South being identified as a key location in the vision.

The Park District stated that they have made some improvements to Crow Island Woods including a new boardwalk, picnic shelter renovation, council ring, and addition of an historic log cabin, all on the northern portion of the site. At the time of this study the District was also performing woodland restoration work on the southern portion of the site to clear out dead trees from a microburst storm that hit the area in 2007 and to address Elm Tree impacts due to the Emerald Ash Borer. The Park District stated that they have no formal land use plan for the Crow Island Woods but they did share a woodland and wetland habitat plan used by Park District staff as part of a stewardship program for implementation over time.

With information gathered, a second meeting with District staff was held on April 7, 2016, at which time a conceptual vision for stormwater improvements on Crow Island Woods-South was presented and discussed. Potential use of the Par-3 course was also briefly discussed. District staff expressed an interest in the proposed vision for Crow Island Woods-South, but stated that approval of a partnership will be subject to approval by their Board.

Since the April 7, 2016, meeting with the District and the April 14, 2016, Vision Phase presentation to the public, the Village and Park District have continued discussions concerning the appropriate next steps with an understanding that a partnership and some form of the vision for Crow Island Woods-South would be mutually beneficial to both parties.

Appendix D includes documentation of meetings, correspondence, and exhibits for the engagement process with the Winnetka Park District.

B. Forest Preserve District of Cook County

An introductory meeting was held on November 18, 2015, with representatives of the Forest Preserve District of Cook County. Following the introductory meeting, exhibits and supporting information were provided by the Village to the FPDCC to prompt discussion of a potential vision for stormwater management and habitat restoration at the various FPDCC properties within the study watershed. The key to the vision presented was a return of the properties to their historic condition of providing stormwater storage to the watershed. This vision builds upon the Skokie Lagoon system immediately upstream and provides significant opportunity to draw the public into active use of the properties that are currently inaccessible and unappreciated.

A follow up meeting was held on February 24, 2016, to discuss the proposed vision. At that meeting District staff and Administration expressed their interest in a potential partnership but also indicated that there are significant design, operation, and funding issues that would need to be resolved before any partnership or agreement could be established.

On March 14, 2016, FPDCC staff provided the Village with a nine item questionnaire concerning the Village's proposal. A response was provided by the Village to the District on April 1, 2016, and a third meeting was held on April 7, 2016, to review the response and further discuss a potential partnership. At that meeting the District again expressed their interest in working with the Village on the proposed vision and recognized the mutually beneficial stormwater storage and habitat restoration on the FPDCC parcels, particularly in Zones C and D. They also expressed an interest in potential improvements in Zone A.

An important message expressed throughout this engagement process from FPDCC staff and Administration to the Village was that every attempt needs to be made to maximize creation of storage at locations in the watershed upstream of FPDCC property so that the Village's stormwater management and flood control burden does not fall solely on the District. Similarly, the FPDCC stressed the importance that upstream stormwater quality measures be implemented within the watershed prior to discharging to FPDCC lands. This was not to say that stormwater quality measures would not be provided on FPDCC property, but that the sole burden cannot fall on the FPDCC.

Engagement with the FPDCC was extremely positive and now needs to proceed into more detailed planning and crafting of agreements between the Village and the District.

Appendix E includes documentation of meetings, correspondence, and exhibits for the engagement process with the Forest Preserve District of Cook County.

C. New Trier High School District

An introductory meeting was held on November 18, 2015, with representatives of the New Trier High School District. At that meeting the focus was on Duke Childs Field and gaining an understanding of the park's uses and limitations as well as the needs of the High School District. The NTHSD acknowledged the stormwater issues in Winnetka and expressed their willingness to explore ideas. However, the criteria stated by NTHSD throughout the engagement process was that any use of their property must come at no cost to the High School District and there must be no loss of current High School property use programming.

Through the Exploration Phase of the project, opportunities on the soccer/lacrosse fields on Duke Childs Field were of most interest, with potential modifications to the baseball/softball fields also being of interest longer term. A second meeting with the High School was held on February 25, 2016, at which time a vision for the use of Duke Childs Field were presented and discussed. The NTHSD representative again stated the importance of their available space for sports programming and the need to maintain their current uses. Concept exhibits for use of Duke Childs Field soccer/lacrosse fields as well as baseball and softball fields were presented and discussed. The High School representative inquired about providing underground storage at the soccer and lacrosse fields and expressed concern about whether the landfill development would work within their operational needs. The representative also expressed concern with lowering the baseball and softball fields recognizing that they are currently vulnerable to flooding but questioning how the work can be performed and still maintain their sports programming needs.

Subsequent to the February 25, 2016, meeting the vision was modified and additional information gathered and provided to NTHSD representatives at a third meeting held April 11, 2016. The District agreed to provide the Village with information on field needs and dimensions so the Village could advance the conceptual layout for replacing the soccer/lacrosse fields to the landfill so this opportunity can be further considered by the High School. The NTHSD representatives again stated their earlier concerns, but also added that separation of their soccer and lacrosse uses to the landfill would be challenging for their sports medicine operations that are performed during sporting events.

Through engagement with the NTHSD staff, the Village has identified viable, mutually beneficial opportunities on High School property that comply with the High School District's message while bringing stormwater and flood control relief to the community. But there has been some hesitation expressed by NTHSD staff and administration to these opportunities. Further engagement will require discussions with NTHSD governing officials as well as more detailed planning to support the viability of the identified vision for improvements on District lands.

Appendix F includes documentation of meetings, correspondence, and exhibits for the engagement process with the New Trier High School District.

D. School District 36

An introductory meeting was held on November 18, 2015, with a representative of School District 36. At that meeting both the Crow Island Woods school and Washburne-Skokie school properties were discussed with Washburne-Skokie rising to the top of the discussion. The opportunity to provide stormwater storage on the Washburne-Skokie play fields was recognized by both the Village and School as a mutually beneficial improvement since both the adjacent neighborhoods and the playfields themselves are subject to frequent stormwater flooding. However, the School District's message was that the current use must be maintained and limitations as to timing during any given year when improvements to the site can be performed must be addressed as part of the vision.

The School District was very helpful throughout the study process providing a venue for public engagement as well as support for the proposed vision. Next steps would be to develop more detailed vision planning for Washburne-Skokie play fields and work towards an agreement between the Village and School District.

Appendix G includes documentation of meetings, correspondence, and exhibits for the engagement process with the School District 36.

2.05 PUBLIC ENGAGEMENT

The purpose and results of this study are directly connected to the citizens who live and work in the Village. Therefore, it was key to engage the general public in the study process to not only promote public acceptance of the study, but to help build the watershed evaluation process through understanding the experiences of the people in the community. Furthermore, the technical aspects of stormwater management and flood control are multidimensional and often complicated and confusing, so engaging the public allowed for sharing of the technical watershed issues, planning concepts, and evaluation process in an understandable and relatable manner.

The extensive public engagement aspect of this study helped to educate the public in the causes of the recurring flooding issues, to confirm the existing flooding conditions as experienced by the public, to explain the process and reasoning for identifying and evaluating potential stormwater and flood control strategies, and to afford the public an opportunity to be part of the final vision for stormwater management and flood control in the community.

The public engagement process set the pace of the study through a series of public meeting/open house programs that presented the results of the study in the same progression as the format of this report, with three main chapters.

A. Awareness Phase

On Thursday evening, January 21, 2016, and again on Saturday morning, January 23, 2016, a public presentation was made in the Washburne Middle School auditorium followed by an open house in the Washburne gymnasium. The purpose of the presentation was to share with the public important information about the study and the study watershed including the following key points:

1. Study Purpose. The purpose and process of the study were presented.

2. Study Watershed Characteristics. The history of the study watershed and the course of development and changes that impact the current day stormwater issues were explained.

3. Stormwater Conveyance System. The current Village conveyance system, its capacity, and limitations were explained.

4. Stormwater Modeling. The advanced stormwater modeling program, supporting data, and process were explained. Exhibits were presented that showed what the model indicated as the extents of flooding for various storm events from 2-year to 100-year return intervals, as well as historical events from September 2008, July 2011, and April 2013, which played an important role in the open house component of this phase of public engagement discussed further below.

   Another key aspect was presentation of a real-time flood model video of the July 2011 storm that showed where and how flood waters rose and receded from the start of the storm to the peak of the storm. This was the benefit of the advanced stormwater modeling performed for the study to share and confirm with a strong visual reference the community's experience during this historical recent event.

5. Stormwater Strategies. A brief introduction into stormwater strategies that would be considered moving forward in the study were also presented to allow the public to begin thinking about ways to approach the stormwater problems and stimulate their participation in identification of potential opportunities and solutions.

A copy of the Awareness Phase presentation and the July 2011 storm video was posted on the Village website following the Saturday event for those individuals unable to attend either of the events. A copy of the presentation is provided in Appendix H for reference.

Immediately following the 30-minute public presentation was a brief question and answer period followed by an open house held in the Washburne gymnasium. There were four individual stations in the room representing the four neighborhood watersheds; North of Willow, South of Willow, North of Pine, and Provident. Each station presented full-size mapping of the neighborhood watershed, flood mapping for the July 2011 storm event, and a computer terminal with GIS, stormwater modeling, and storm video for reference.

The result of the open house was valuable one-on-one interaction between the Village and consultant team and the public. This interaction allowed the public to mark up the mapping with experiences and accounts, to discuss their perspective on flooding and potential flooding solutions, and, most importantly, to confirm that the flood model and resultant mapping reflects their experience. This was key to providing confidence in the modeling to be used to identify and determine the effectiveness of opportunities identified in the next phase of the study.

The Awareness Phase public meeting was attended by 54 individuals (according to sign-in sheets) representing 38 households from five different neighborhoods. A comment card was provided to those in attendance to document their input and comments. This comment card was posted to the Village website following the meeting to continue to solicit public comment. A copy of the comment card is provided in Appendix H, with the results of all comments received shown in Figure 2.05-1.

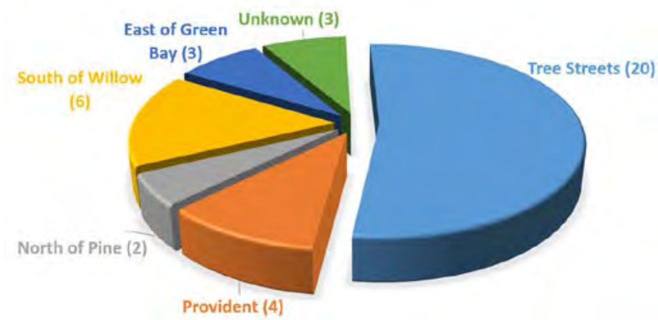


Figure 2.05-1 Awareness Phase Comments Received by Neighborhood

All comments received following the Awareness Phase public meeting confirmed the modeling results and gave the Village confidence in the accuracy of the model.

Additionally, important information relative to the types of flooding experienced by those attending and commenting was gathered as shown in Figure 2.05-2. This information gave the study team additional insight into flooding characteristics of the study watershed and an understanding of how identified opportunities may reduce each type of flooding impact.

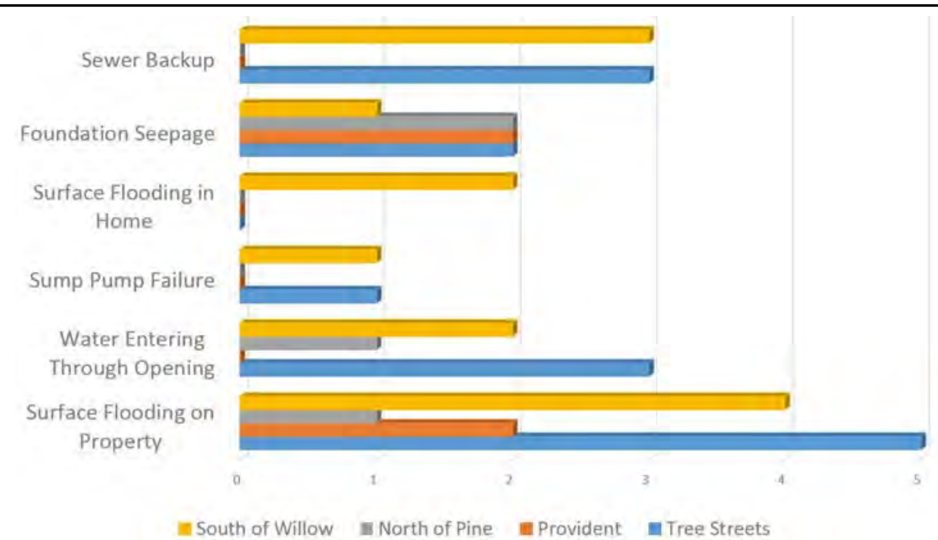


Figure 2.05-2 Flooding Experiences Reported by Awareness Phase Public Comments

B. Exploration Phase

On Thursday evening, March 3, 2016, and again on Saturday morning, March 5, 2016, a public presentation was made in Matz Hall of the Winnetka Community House at 620 Lincoln Avenue, followed by an open house in the same venue. The purpose of the presentation was to share with the public the study progress through the Exploration Phase and the identification and shortlisting of potential stormwater and flood control opportunities. The event included the following key points:

1. Study Progress to Date. The watershed characteristics and findings were briefly revisited to bring all in attendance up to date through the Awareness Phase of the project.

2. Responses to Awareness Phase Comments. General comments and questions posed as part of the Awareness Phase public outreach were addressed.

3. Target Level of Service. The target level of service established for the study was explained.

4. Opportunity Matrix. The opportunity matrix was presented and explained to reinforce the "no stone unturned" approach to the study.

5. Potential Opportunities. A cross section of opportunities identified during the Exploration Phase of the study were individually presented. These opportunities represented distributed green, local- and watershed-level storage, and conveyance strategies. The importance of this aspect of the public presentation was to share not only the shortlisted opportunities but also more controversial and less viable opportunities so that the public could understand the breadth of the exploration that had been performed and the theory behind the evaluation process.

A copy of the Exploration Phase presentation and a video of the actual presentation (recorded without an audience at Village Hall on March 8, 2016) was posted on the Village website following the event for those individuals unable to attend either event. A copy of the presentation is provided in Appendix H for reference.

Immediately following the 40-minute public presentation was a brief question and answer period followed by an open house also held in Matz Hall. There were three individual stations in the room; one represented the four neighborhood watersheds, a second provided details on distributed green opportunities, and a third provided details of the storage and conveyance opportunities. Each station presented full-size mapping of the various identified opportunities and computer terminal support to review GIS, stormwater modeling, and other information.

The result of the open house was valuable one-on-one interaction between the Village/consultant team and the public allowing the public to express their support, variations, and reservations relative to the various potential opportunities.

The public meeting provided important information to the public to better understand the benefits and limitations of various strategies and individual opportunities. It provided the study team with perspective on opportunities that would not gain public support and places where modifications or variations of particular opportunities might be necessary to make them more successful. It also reinforced the importance of public partnership.

The Exploration Phase public meeting was attended by 82 individuals (according to sign-in sheets). A comment card was provided to those in attendance to document their input and comments. This comment card was also posted to the Village website following the meeting to continue to solicit public comment. A copy of the comment card is provided in Appendix H. As of April 12, 2016, 72 comments and comment cards were submitted to the Village representing five different neighborhoods as shown in Figure 2.05-3.

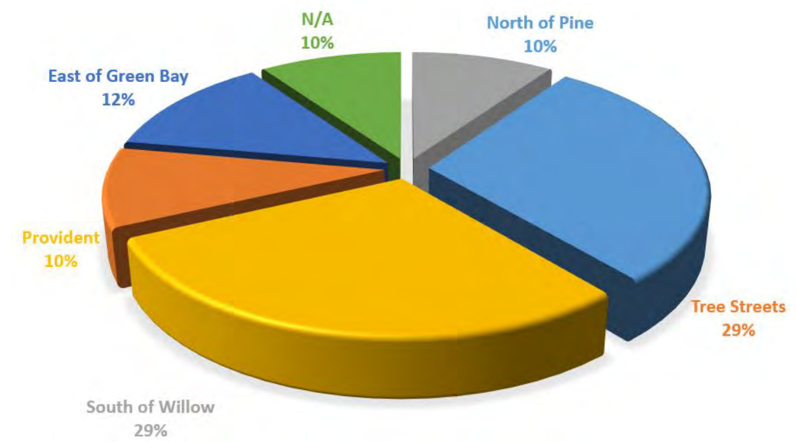


Figure 2.05-3 Exploration Phase Comments Received by Neighborhood

The value of the comment cards and comments received was in measuring general public support or opposition to the various strategies and opportunities presented up to this phase of the project. Regarding the various distributed green infrastructure opportunities presented, 56 percent of respondents indicated they would be willing to implement green infrastructure improvements on their property as compared to 18 percent who were unwilling and 26 percent non-responsive. To the question posed whether they would be willing to lose parkway trees to implement green infrastructure in the public right-of-way, 49 percent said “no”, 22 percent said “yes”, and 29 percent were non-responsive.

Regarding opinions relative to the storage and conveyance opportunities presented, Figure 2.05-4 provides a summary graphic of the responses received. All comments received gave the study team additional insight into the tolerance those in attendance had to various strategies and a feel for the direction to take moving forward with further shortlisting and evaluating opportunities to make up the Village’s vision for providing stormwater and flood control relief to the community.

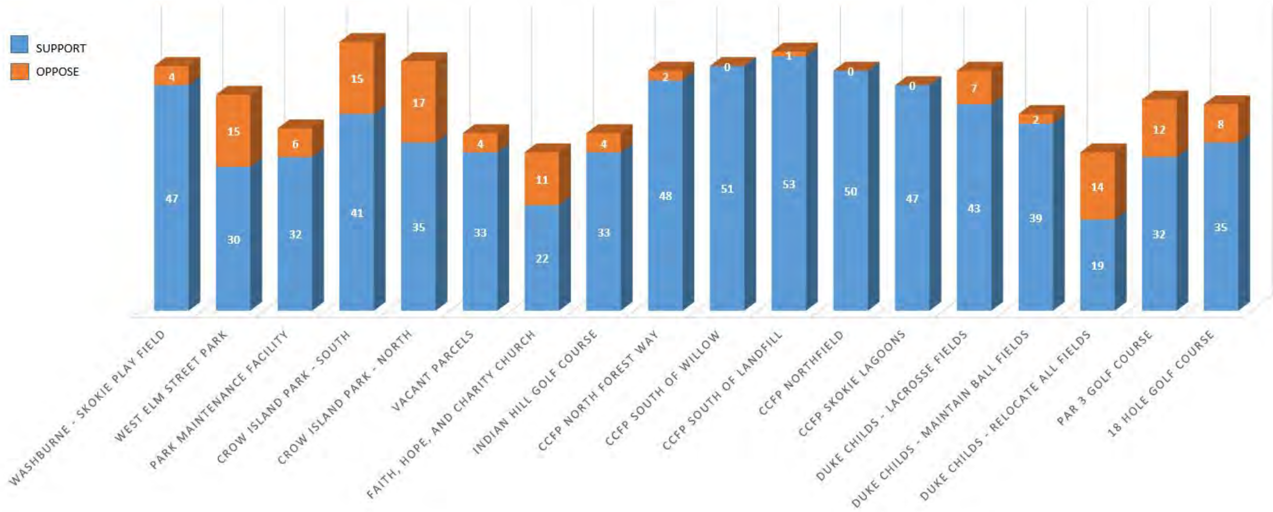


Figure 2.05-4 Opportunity Support or Opposition by Exploration Phase Public Comment

C. <u>Vision Phase</u>

On Thursday evening, April 12, 2016, a public presentation was made in the Washburne Middle School auditorium followed by an open house in the Washburne cafeteria. The purpose of the presentation was to present the results of this study and the vision for stormwater and flood control improvements in western and southwestern Winnetka. The event included the following key points:

1. Study Progress to Date. Information shared in the Awareness Phase and Exploration Phase public meetings concerning watershed characteristics, target level of service, the opportunity matrix, and the opportunity evaluation process were presented again to bring all in attendance up to date.

2. Responses to Exploration Phase Comments. General comments and questions posed as part of the Exploration Phase public outreach were addressed.

3. Vision Presentation. The vision for stormwater and flood control was presented including individual descriptions of each vision component ranging from distributed green infrastructure to stormwater conveyance to stormwater storage. The phasing and projected cost of the vision and its components were also presented.

A copy of the Vision Phase public presentation and a video of the actual presentation (recorded live) was posted on the Village website following the event for those individuals unable to attend. A copy of the presentation is provided in Appendix H for reference.

Questions and answers were often provided during the 75-minute public presentation that was followed by an extensive question and answer session and an informal open house held in the school cafeteria. There were three individual tables in the cafeteria with full-size prints of the various vision components.

The open house allowed one-on-one interaction between the Village/consultant team and the public allowing the public to further express their support or opposition and their questions concerning the presented vision.

The Vision Phase public meeting was attended by 109 individuals (according to sign-in sheets). A comment card was provided to those in attendance to document their input and comments. This comment card was also posted to the Village website following the meeting to continue to solicit public comment. A copy of the comment card is provided in Appendix H. The Village also created an email response card on the website to solicit general comments from the public. Only four comment cards were provided on the evening of the presentation. However, eighteen comment cards or emails were received by the Village through the website following the presentation.

The value of the comment cards and comments received was in measuring public support or opposition to the overall vision and its individual components. In general, support for the overall vision was positive. The main questions were in regard to the estimated cost of the overall vision and individual components of the vision. In particular, there was significant opposition to the flood storage component on Crow Island Woods–South, mainly from residents around Crow Island Woods, but also residents from other parts of the Village. There was also some opposition expressed regarding the flood storage component on Duke Childs Fields. The issues related to these comments are discussed further in Section 3.09.

SECTION 3
VISION PHASE

The Vision Phase of this study identified a program of individual projects for stormwater and flood control that when fully implemented would meet the Village's Target Level of Service. A timeline or phasing for implementation of this Vision was determined with estimates of cost for the individual projects that make up the Vision. Unresolved issues related to the individual projects were also identified with potential alternatives to some of the key projects.

3.01 VISION FOR STORMWATER AND FLOOD CONTROL

Based on the outcome of a robust public participation and community partner engagement process, the findings of a sustainable watershed evaluation process (SWEP) that sought to gain a thorough understanding of watershed characteristics to develop a matrix of flood control opportunities and the results of detailed stormwater modeling analyses used to predict potential flood risk reduction benefits, we have developed a Stormwater Vision that represents a concept level plan consisting of 15 distinct stormwater and flood control projects that, when fully implemented, will substantially reduce the risk of structural flood damage currently experienced in western and southwestern Winnetka (Refer to Figure 3.01-1).

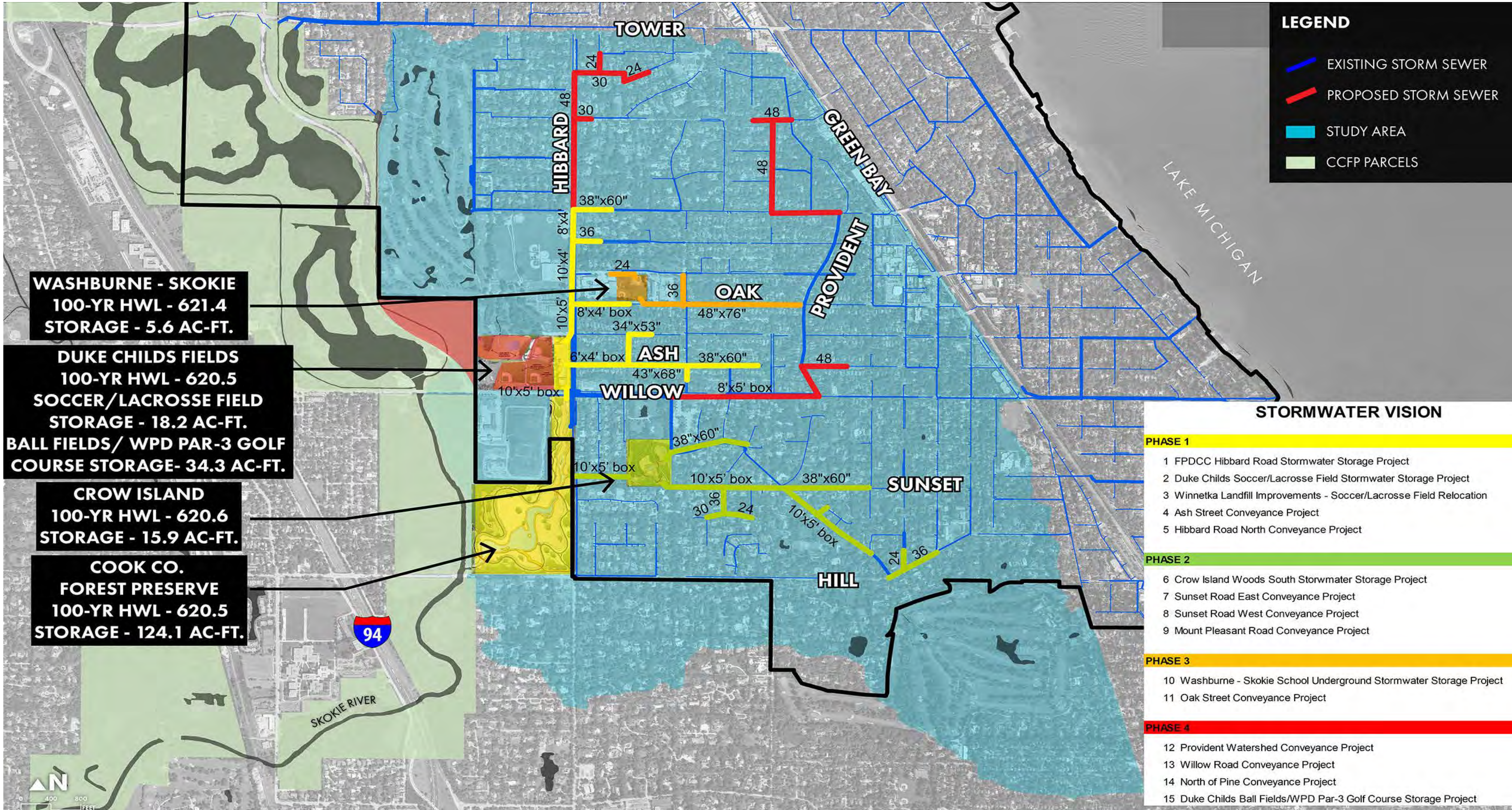
The Stormwater Vision was presented at the April 12, 2016, Vision Phase Workshop. Since that time, the Village has been gathering feedback from citizens, affected public agency stakeholders, and other interested parties so that comments and issues raised may be addressed and the Stormwater Vision can continue to be developed and refined. Note the Stormwater Vision presented in this report reflects what was presented at the April 12, 2016, Vision Phase Workshop. This version of the Stormwater Vision should not be considered the "final draft," as many components of the Stormwater Vision will continue to evolve through the same public and stakeholder engagement process that has guided this project to date.

The sections that follow provide detailed descriptions of each of the 15 projects in the program that range from large-scale stormwater conveyance projects, regional stormwater storage improvements, stormwater quality management improvements, and distributed property-level and neighborhood-level green infrastructure projects.

A projected timeline for phased implementation of the 15 projects has been developed that allows the Village flexibility to distribute over time both the financial impacts and construction-related impacts to Village residents and affected stakeholders. The 15 projects in the Vision have been broken up into four project implementation phases, as shown in Table 3.01-1. Much like the Stormwater Vision, this phasing plan should not be considered "etched in stone" as it will also continue to evolve as planning and design activities are advanced.

The estimated cost in 2016 dollars to implement all four phases of the Stormwater Vision is $57,717,000, which includes anticipated project contingencies, permitting, design and construction engineering. Table 3.01-1 indicates a summary of the estimated costs for each project and detailed cost estimates are provided within Appendix I. Further discussion on how the costs were developed is provided in Section 3.08.

Figure 3.01-1 Stormwater Management and Flood Control Vision



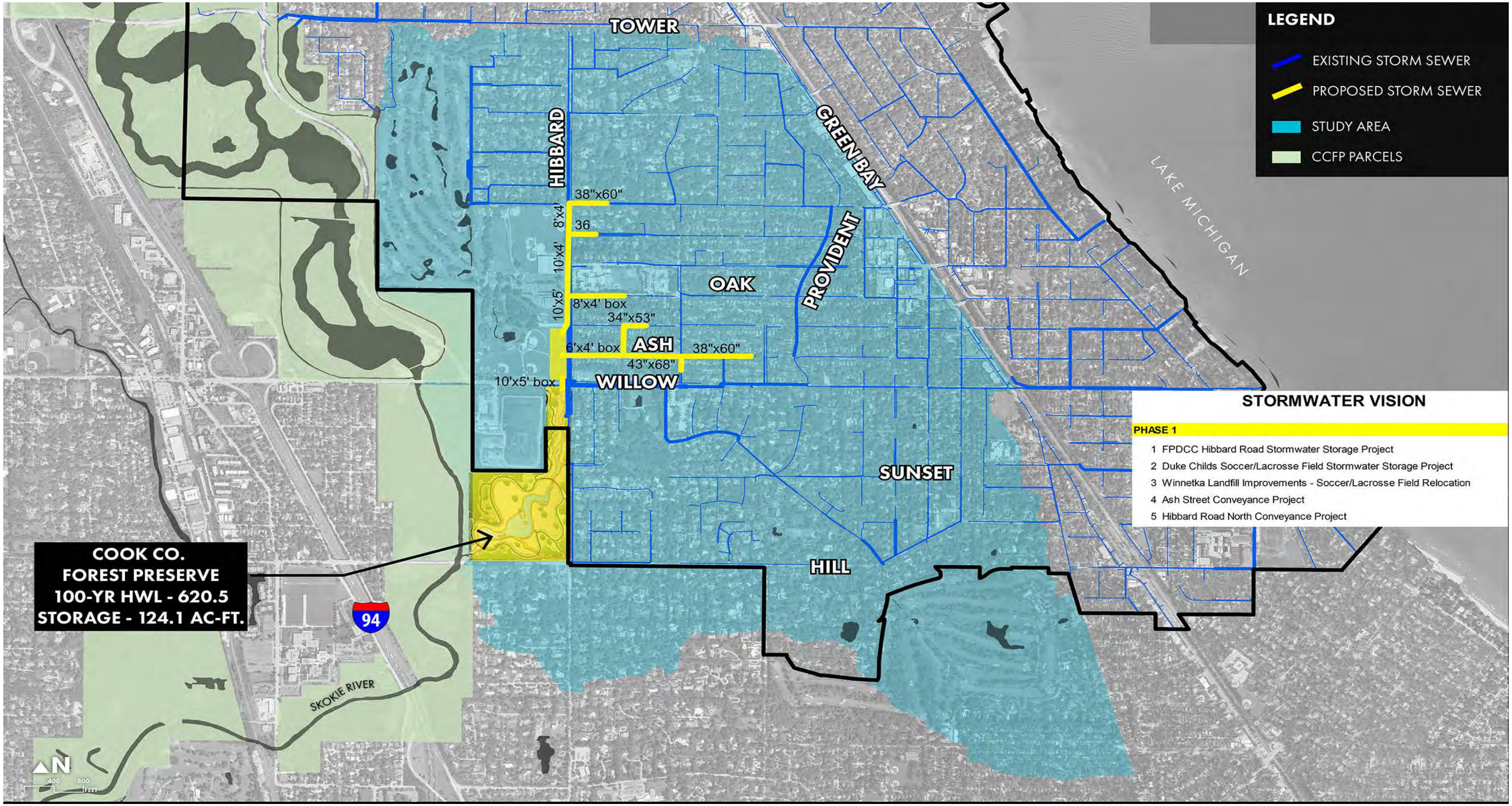
• Phase 1	Cost	
o FPDCC Hibbard Road Stormwater Storage Project	$	8,582,000
o Duke Childs Soccer/Lacrosse Field Stormwater Storage Project	$	1,005,000
o Winnetka Landfill Improvements - Soccer/Lacrosse Field Relocation	$	2,331,000
o Ash Street Conveyance Project	$	5,107,000
o Hibbard Road North Conveyance Project	$	6,553,000
Phase 1 Total	**$**	**23,578,000**
• Phase 2	**Cost**	
o Crow Island Woods South Stormwater Storage Project	$	1,841,000
o Sunset Road East Conveyance Project	$	10,356,000
o Sunset Road West Conveyance Project	$	2,821,000
o Mount Pleasant Road Conveyance Project	$	1,362,000
Phase 2 Total	**$**	**16,380,000**
• Phase 3	**Cost**	
o Washburne-Skokie School Underground Stormwater Storage Project	$	1,381,000
o Oak Street Conveyance Project	$	3,294,000
Phase 3 Total	**$**	**4,675,000**
• Phase 4	**Cost**	
o Provident Watershed Conveyance Project	$	2,930,000
o Willow Road Conveyance Project	$	5,284,000
o North of Pine Conveyance Project	$	2,408,000
o Duke Childs Ball Fields/WPD Par-3 Golf Course Storage Project	$	2,461,000
Phase 4 Total	**$**	**13,084,000**
Stormwater Vision Total	**$**	**57,717,000**

Table 3.01-1 Stormwater Vision Project Implementation Phasing Plan and Cost Estimates

3.02 PHASE 1 PROJECTS

Figure 3.02-1 depicts the five Phase 1 projects that consist of two large-scale regional stormwater storage projects at the Duke Childs soccer/lacrosse fields and the FPDCC Hibbard Road site, relocation of the Duke Childs soccer/lacrosse fields to the Winnetka landfill site, and the Ash Street and Hibbard Road North conveyance projects.

Figure 3.02-1 Phase 1 Projects



These stormwater improvement projects will provide immediate flood relief to the North of Willow Watershed (Tree Streets Neighborhood) and will implement the largest and most important stormwater storage project of the Stormwater Vision, the 124.1 acre-foot FPDCC project, which will establish the groundwork for future flood control improvement projects in the study watershed. The Duke Childs Soccer/Lacrosse field storage project will contribute approximately 18.2 acre-feet of flood storage volume and provide critically important stormwater quality improvement benefits. The total estimated Phase 1 project cost is $23,578,000.

A. FPDCC Hibbard Road Stormwater Storage Project

As previously stated, one of the most important project components of the Stormwater Vision is implementation of 124.1 acre-foot regional stormwater storage and constructed wetland enhancement project on FPDCC lands (Refer to Figure 3.02-2 and additional FPDCC concept drawings and renderings in Appendix E. The project would be located on a 49.0 acre site west of Hibbard Road, south of Willow Road, north of Winnetka Avenue, and south and east of the Village landfill. The conceptual plan developed for this project contributes significant flood storage volume within optimal elevation ranges (between elevation 615 and 620.5) that enable efficient gravity stormwater drainage from primary upstream conveyance systems. The concept plan also results in a created habitat improvement that consists of open water features, constructed wetlands, seasonally wet sedge meadows, upland mesic prairies, and upland hardwood forest ecosystems (refer to Figure 3.02-3). Looped gravel recreational walking paths will be constructed that include three pedestrian bridges spanning a network of created wetlands and waterways, and interpretive signage and entry/directional signage will be implemented for educational purposes.

Figure 3.02-2 FPDCC Storage Project Concept Drawing

There is very good potential for reuse of excess excavated soil, approximately 174,000 cubic yards (CY), from the project to form perimeter berms and embankments that can be restored as upland hardwood forest. Concept grading plans have been developed that allow embankment slopes to extend to the south and east slopes of the Village's landfill. This grading may allow the existing steep slopes along the landfill to be reduced, and it allows for more gradual transitioning of the slopes to look more natural. It should be understood that to accomplish this project, significant clearing of trees and vegetation at the 49.0-acre site and also extending to the Village's landfill site would need to occur. While there are robust plans to plant new trees and revegetate these areas, there will be an interim period where the visual appearance of the property will drastically change to a denuded landscape. This will be particularly visually apparent for residents living immediately adjacent to the site along Hibbard Road and Winnetka Avenue. It will be important to engage and inform area residents of these potential changes in landscape so their expectations are properly managed.

The Village has had preliminary discussions with FPDCC staff related to this project and, while they have generally been receptive to the concept, there are many review comments and details that must be addressed. Because this project is located on FPDCC-owned property, the FPDCC land-use request process must be followed, which requires initial staff approval and, ultimately, Cook County Board of Commissioners' approval.

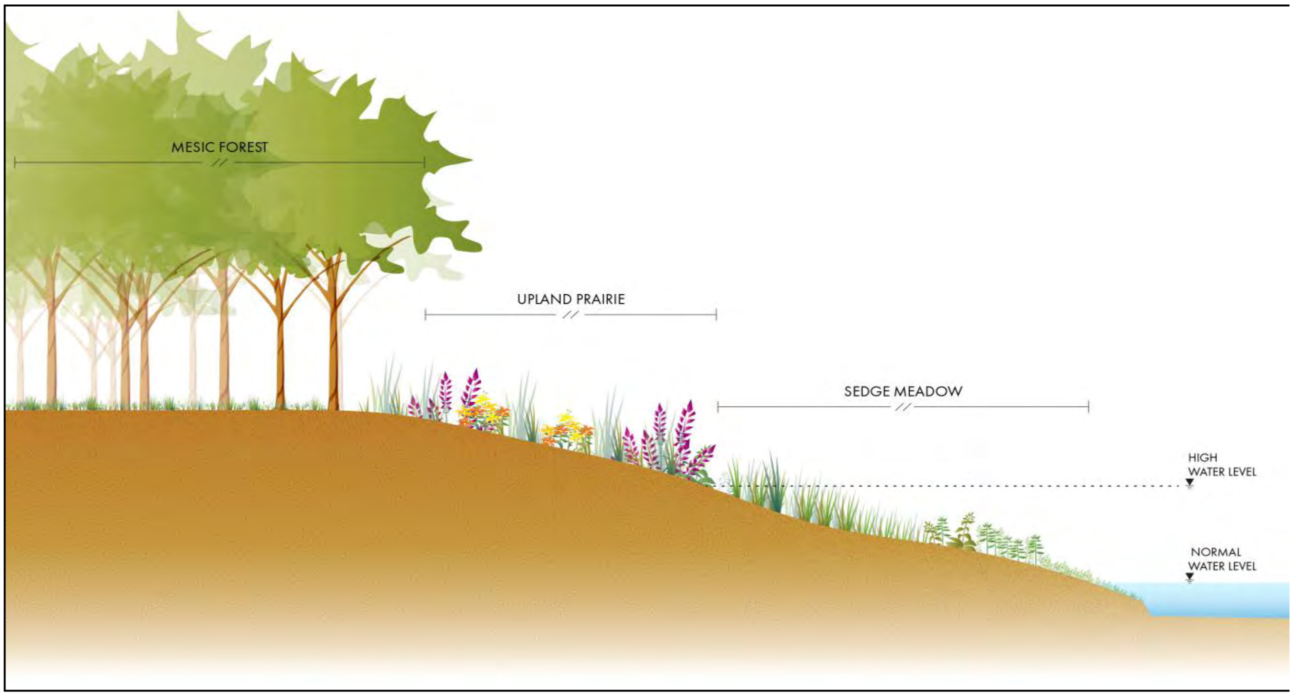


Figure 3.02-3 Representative Cross Section Transitional Zones FPDCC Storage Project

FPDCC staff developed a list of nine initial review comments and questions, dated March 14, 2016, for Village consideration and response. Listed below is a brief synopsis of each review comment and questions.

1. Inquiries related to project funding responsibility.

2. Requests that the Village maximize stormwater storage and stormwater treatment options on properties outside FPDCC lands.

3. Request for depth, duration, and limits/extents of flood storage above the normal water level for a range of recurrence interval storms and how this inundation

impacts native planting survivability. Also inquired about soil erosion and sediment control practices.

4. Concerns about inability to establish a diverse range of native species and having natural areas revert to only a few types.

5. Inquiries about the anticipated seed source for plugs and native plantings and how this relates to a high probability of robust establishment and persistence.

6. Concerns relative to invasive species control practices and long-term maintenance planning for natural areas.

7. Request for confirmation that no changes are being proposed to the Skokie Lagoons proper.

8. Asked what the sources of project funding will be (local, federal, or grants) and the Village's willingness to support other restoration efforts at nearby sites.

9. Request to preserve an existing 77-inch-diameter cottonwood tree at the site, the largest measured in the North Branch region.

The Village prepared written responses to each of the FPDCC's review comments and inquiries in an April 1, 2016, letter (a copy of letter, including the original FPDCC staff comments is included in Appendix E) and later met FPDCC staff on April 7, 2016, for further discussions. These initial discussions have been very positive and constructive in terms of the Village gaining an informed understanding of what of what FPDCC's primary concerns are related to the project and how this project can best meet its core goals and missions. It is understood that ongoing engagement discussions will need to continue, sharing additional project details and information as the planning and design process advances. Site information and evaluations that are anticipated moving forward are as follows:

1. Tree inventory and flora and fauna surveys/assessments.

2. Field wetland delineation.

3. Geotechnical investigations, including groundwater monitoring.

4. Installation of surface water level gauges and periodic monitoring.

5. Surface water quality sampling and monitoring.

The estimated construction cost for this project, including approximately $2,300,000 in anticipated wetland mitigation costs, is approximately $8,582,000.

B. Duke Childs Soccer/Lacrosse Field Stormwater Storage Project

Figure 3.02-4 Rendering of Duke Childs Field Wet Basin From the Hibbard/Willow Road Intersection

A second large-scale regional stormwater storage project entails implementation of a wet detention basin and constructed wetland on an approximate 3.6-acre site located at Duke Childs Field immediately north of Willow Road and west of Hibbard Road. The site is currently owned by the NTHSD and is used as a soccer and lacrosse field. The fields are important and valued assets to the NTHSD so it may deliver the quality athletic programming expected by the communities in its district. The conceptual plan for this stormwater storage project seeks to maintain the NTHSD's ability to provide the athletic programming currently at the project site by relocating the two existing fields to a regraded and reconfigured area on top of the Village's existing landfill across Willow Road from the existing fields. Further discussion of this project is provided in the following section.

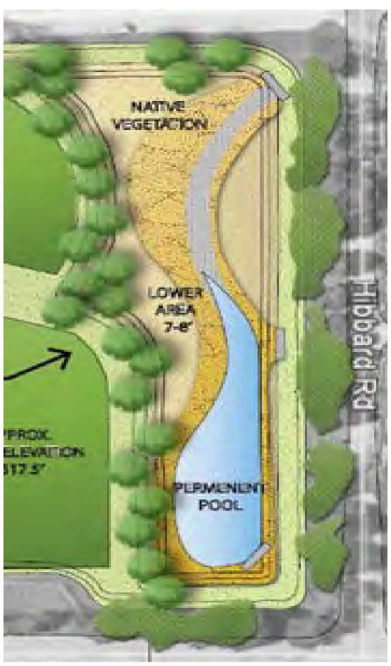


Figure 3.02-5 Duke Childs Wet Basin Concept

The conceptual plan developed for this project creates 18.2 acre-feet of surface flood storage volume that will provide immediate flood relief to the "Tree Streets" neighborhood in the North of Willow Watershed. The basin includes a 0.7-acre wet basin area that will have a permanent pool depth of 5 feet, including a 10-foot-wide safety shelf around the perimeter of the wet pool. A constructed wetland that includes shallow permanent pool depths and native wet emergent vegetation will encompass approximately the remaining 1.8 acres of the bottom of the basin, which is anticipated to have a permanent water surface elevation of 615.0 and a 100-year high water elevation of 620.5. The basin would receive stormwater runoff from two Phase I stormwater conveyance projects; the Hibbard Road Conveyance system, which would outlet into the northeast corner of the basin, and the Ash Street Conveyance Project, which would enter the east side of the basin from Ash Street extended. Estimated excess excavated soil from the basin is estimated to be approximately 40,000 CY that could potentially be reused at the Village's landfill just south of Willow Road and will allow the ground surface to be regraded to relocate the soccer and lacrosse fields.

Total estimated construction cost for this project is approximately $1,005,000 (does not include soccer and lacrosse field relocation).

C. Winnetka Landfill Improvements–Soccer/Lacrosse Field Relocation

As stated in the previous section, a concept that has been developed to allow for relocation of NTHSD's existing soccer and lacrosse fields currently located at Duke Childs Field, is placement of the fields at the top of the Village's existing landfill on the south side of Willow Road. Preliminary grading and site layout plans have been developed indicating that this is a feasible option. The conceptual plan (refer to Figure 3.02-5) provides for parking immediately south of Willow Road and a vehicular access road to the east of the reconstructed fields. Estimated construction costs for this project, including borrow earth excavation (~149,000 CY), reconstruction and restoration of the athletic fields, parking and access drive improvements, potential landfill modifications (gas vents and monitoring wells), and landscaping is approximately $2,331,000.

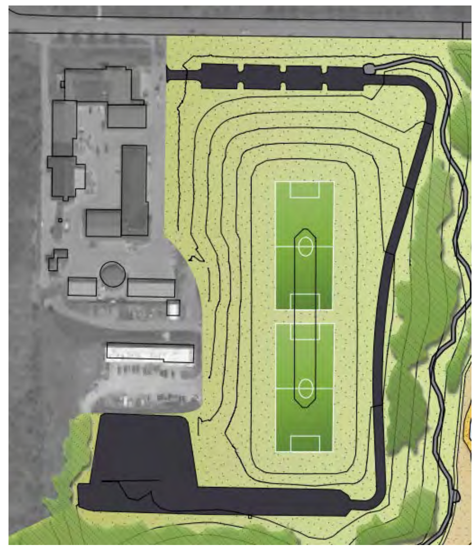


Figure 3.02-6 Soccer/Lacrosse Field Relocation Concept

While the Village has had preliminary discussions about this field relocation concept with NTHSD, there are still many details and questions to be addressed to determine if the fields can be relocated in a way that will be acceptable to the NTHSD. Additionally, the NTHSD Board of Education had preliminary discussions on the suitability of this concept field relocation plan at a recent board meeting and expressed several reservations and concerns. A memorandum, dated April 14, 2016, that was prepared by NTHSD Superintendent Dr. Linda Yonke for the NTHSD Board summarizes many of the reservations and concerns that have been expressed about the field relocation concept that were discussed at the April 18, 2016, Board meeting (copy of memorandum is included in Appendix _). Further discussions and engagement between Village and NTHSD representatives, including Village Council members and the New Trier Board of Education, will be necessary to determine whether the proposed field relocation concept can feasibly be implemented.

D. Ash Street Conveyance Project

The Ash Street Conveyance Project consists of implementation of large-diameter storm sewer and box culvert (largest size is 6'x4' box) to provide immediate flood relief in the "Tree Streets" neighborhood in the North of Willow Watershed. The primary trunk line storm sewer runs along Ash Street from midblock between Rosewood Avenue and Locust Street and extends approximately 2,500 feet to the west and would discharge into the proposed Duke Childs soccer/lacrosse field wet basin. Storm sewer trunk laterals will extend north along Berkley Avenue and south along Glendale Avenue to provide flood relief to existing low points at the intersection of Cherry Street and Berkley Avenue and a low point at Glendale Avenue located mid-block between

Ash Street and Willow Road, respectively. Water main and sanitary sewer main relocations likely will be required (approximately 1,500 and 760 lineal feet, respectively). The total estimated construction for the project is $5,107,000.

E. Hibbard Road North Conveyance Project

The Hibbard Road North Conveyance Project consists of implementation of large diameter storm sewer and box culvert (largest size is 10-foot x 5-foot box) to provide immediate flood relief in the "Tree Streets" neighborhood in the North of Willow Watershed. The primary trunk line storm sewer runs along Hibbard Road from the intersection of Pine Street, extends approximately 1,900 feet to the south near the intersection of Cherry Street, and would discharge into the northeast corner of the proposed Duke Childs soccer/lacrosse field wet basin. Storm sewer trunk laterals will extend east at three locations along Oak Street, Spruce Street, and Pine Street to drain low points along each of these streets. The total estimated construction for the project is $6,553,000.

3.03 PHASE 2 PROJECTS

Figure 3.03-1 depicts the four Phase 2 projects, which consist of one large-scale regional stormwater storage project located in the south half of Crow Island Woods and the Sunset Road East and West conveyance projects and the Mount Pleasant Road conveyance project. These stormwater improvement projects will provide immediate flood relief to the South of Willow Watershed (Areas near Sunset Road, Dewindt Road, and Mount Pleasant Road). The Crow Island Woods storage project is an important component of the South of Willow Watershed flood control plan because it provides vitally important regional stormwater quality benefits, contributes 15.9 acre-feet of flood storage volume, and facilitates a daylighted open channel conveyance system through the woods. The total estimated Phase 2 project cost is $16,380,000.

A. Crow Island Woods Stormwater Storage Project

The conceptual plan for the Crow Island Woods Stormwater Storage Project (refer to Figure 3.03-2) involves implementation of a 15.9 acre-feet stormwater storage and water quality enhancement project that is located within the southerly portion of Crow Island Woods. Crow Island Woods is currently owned and maintained by the Winnetka Park District (WPD). Two upstream stormwater conveyance projects (Sunset Road East and Mount Pleasant Road Conveyance Projects) are currently programmed within Phase 2 of the Village's Stormwater Vision that will provide significant flood relief to neighborhoods within the South of Willow Watershed. The outlets of these two stormwater conveyance projects are currently planned to be located near the westerly terminus of Sunset Road (East) and Mount Pleasant Road (10-foot by 5-foot box culvert and 38-inch by 60-inch elliptical pipe).

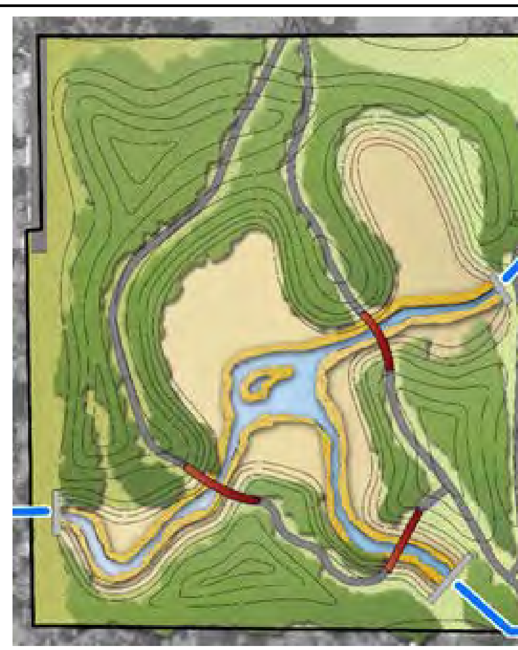
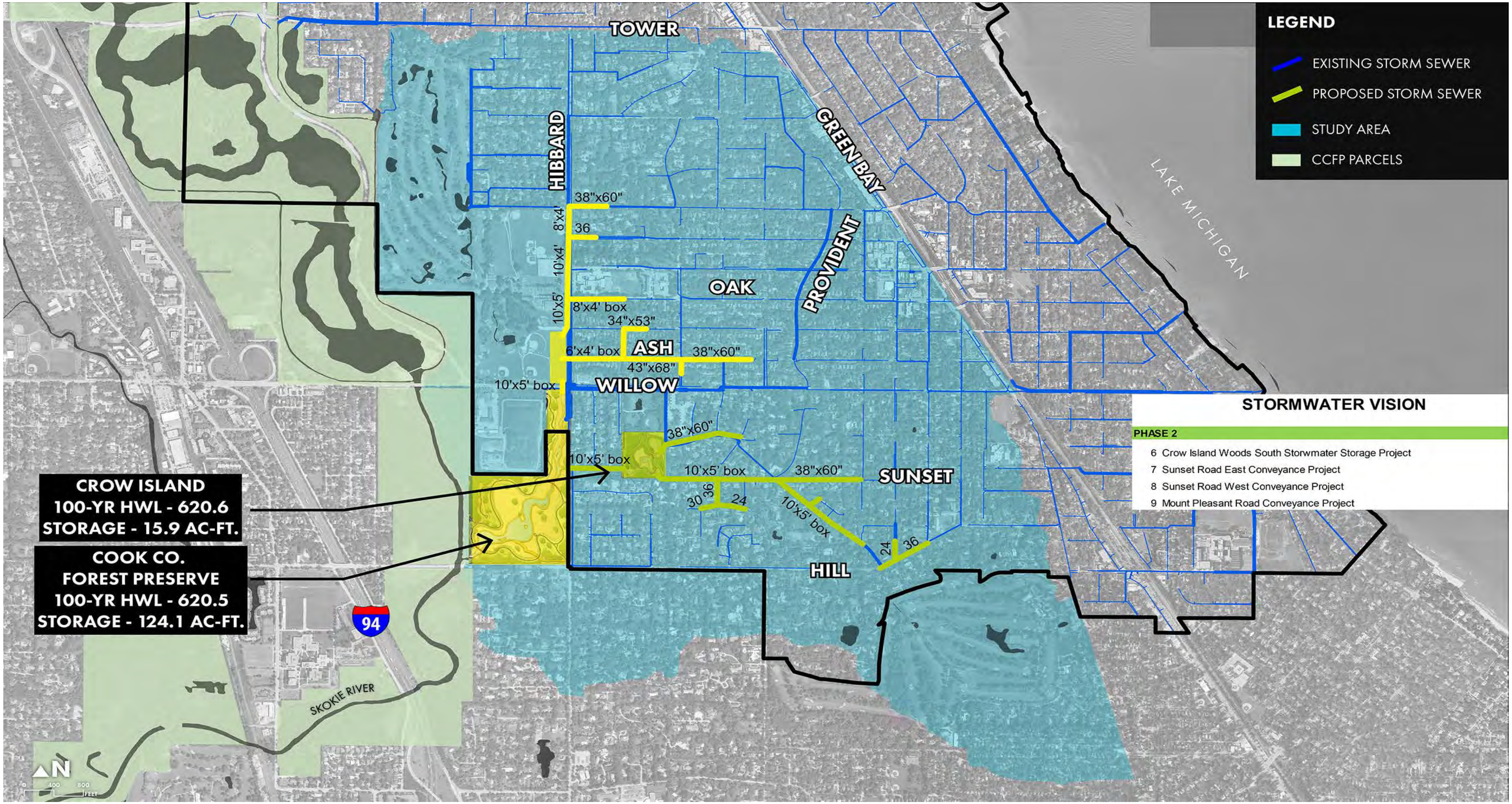


Figure 3.03-2 Crow Island Woods-South Concept

Figure 3.03-1 Phase 2 Projects



Stormwater runoff from these two outfalls must be conveyed to the west through Crow Island Woods and continue to the west via a planned 10-foot by 5-foot box culvert along Sunset Road (West) that ultimately will outlet to the FPDCC Hibbard Road stormwater basin located immediately west of Hibbard Road.

The current concept would implement daylighted open waterways that would extend to the southwest from the Mount Pleasant Road storm sewer outfall and extend northwest from the Sunset Road (East) outfall. At the confluence of these two open waterways would be a 10,000 square foot (0.23 acre) open water feature that is surrounded by a 1-acre emergent wetland zone that will be suitable for establishment of native wetland vegetation. A smaller 0.5 acre emergent wetland zone would also be provided near the proposed Mount Pleasant Road storm sewer outfall at the same location of an existing low wet area at the property. These water features and emergent wetland areas will be able to provide stormwater quality treatment by removal of pollutants from stormwater runoff through settling and natural processes such as uptake and filtering by native wetland vegetation. Beyond the central open water feature and wetland, an open waterway will meander to the southwest to the proposed intake of the Sunset Road (west) storm sewer. The anticipated normal water surface elevations of the waterways, open water feature, and wetlands would be set near elevation 615.5.

Permanent pool depths within the open water feature would be between four and five feet in depth to allow for settling and storage of sediment. Permanent pool depths within the open waterways and emergent wetland areas would likely vary between zero and one foot. Estimated peak elevations in the basin for the design 100-year, 3-hour event would be 620.6. The estimated cost of the project including earth excavation and disposal, restoration improvements, pedestrian paths and bridges is $1,840,000.

Many questions and concerns have been voiced by the public, including neighboring residents and park users regarding the perceived negative impacts this project may create. Below is a brief summary of these concerns.

1. Safety concerns related to the presence of deeper permanent water pools and the potential hazards they pose given the proximity of the project to Crow Island School and neighboring residential areas.

2. Potential hazards related to concentrating stormwater pollution from urban runoff to the new storage area at Crow Island Woods.

3. Constructed wetlands could promote mosquito breeding.

4. Potential impacts to mature high quality trees and other natural areas in the woods. Loss of existing trees and vegetation would also remove natural screening and privacy to neighboring residences and could detract from the public enjoyment of the woods.

5. Loss of access via the existing network of walking paths through the woods.

Many of these concerns can effectively be addressed by applying proven stormwater planning and design techniques. For instance, the deeper permanent pools could be reduced and access to standing water discouraged by establishing a dense vegetation buffer such as thick shrubs and tall grasses within shallower ledges around the perimeter of the water feature.

Considering the majority of the land usage tributary to the Crow Island Woods stormwater project is primarily residential, the most effective means to limit the public's exposure to stormwater pollutants (both at the source and at regional storage basins) is to place application restrictions to fertilizers and pesticides and implement other responsible land management practices. However, the wet areas of the site can be separated and buffered from human contact as noted above.

Also, the quality, functional wetland habitat proposed can actually reduce mosquito populations by promoting creatures that are predators that will keep mosquito populations low.

It is acknowledged that there exists many high quality mature trees within Crow Island Woods that should be identified and protected. A key next step will be to have a tree inventory survey done at the site to identify and locate these trees or stands of trees to preserve. It is important to note that the wooded portion of Crow Island Woods is approximately 9.2 acres. The current concept plan indicates that approximately 3.5 acres of the site (less than 40 percent) would be occupied by proposed stormwater practices. The planned alignments and locations of these stormwater practices is conceptual in nature at this point and can be refined to avoid and preserve sensitive natural areas of the site. Furthermore, one of the objectives of the current plan is minimize disturbance of perimeter areas of the woods that are adjacent to neighboring residents, and within the areas that will be disturbed, planting of new trees will be introduced to maintain a similar level of screening and privacy.

Finally, the current vision maintains a network of walking paths that is very similar to what exists in the woods. Pedestrian bridges over wet areas will be provided and the potential exists for creating educational opportunities by establishing overlooks with interpretive signage.

Because there are multiple Crow Island Woods stakeholder groups, the vision for this component will continue to require persistent public engagement and discourse with the Winnetka Park District, including their board members, School District 36 and Crow Island School representatives, neighboring residents, park users, residents that experience flood damage that would benefit from this project, and other stakeholders that have an interest in the project. Further discussion regarding this continued engagement process is provided within Section 4 of this report.

B. Sunset Road East Conveyance Project

The Sunset Road East Conveyance Project is a significant flood conveyance improvement project that will provide considerable flood relief benefit to flood prone areas within the South of Willow Watershed. The main trunk line of the storm sewer system will consist primarily of a 10-foot x 5-foot box culvert that will extend along the existing Skokie Ditch between Birch Street and the intersection of Sunset Road and White Oak Lane. Note that two segments of the existing Skokie Ditch are currently open daylighted channels. For the purposes of this study, it was assumed that these two segments of the Skokie Ditch would remain open channels. The open channel typical cross section would have a 10-foot bottom width and 2:1 side slopes that would be armored with creek rock to match existing surrounding grades. Because these conveyance improvements would be located on private property, significant interaction and coordination affected property owners will be necessary. There may be potential to establish greater limits of open channel section through this corridor if adjacent property owners are amenable to this concept. The 10-foot by 5-foot trunk box culvert then extends to the west along Sunset Road from the intersection of White Oak Lane to the west end of Sunset Road at Crow Island Woods. The outlet of the 10-foot by 5-foot box would discharge into the proposed Crow Island Woods storage project. Because the portion of Sunset Road between White Oak Lane and Crow Island Woods is very narrow (12 feet wide in certain areas) and is privately owned, construction of the storm sewer will present many challenges during construction. These challenges include the ability to maintain property access during construction and potential impacts to trees and landscaping abutting the street. Further property owner engagement will need to be conducted with affected property owners to discuss these issues. A 36-inch storm sewer trunk line lateral is proposed to extend to the south of the 10-foot x 5-foot box from the intersection of Locust Street and Sunset Road and provide flood relief to the Dewindt neighborhood. This storm sewer improvement would likely allow the existing private Dewindt stormwater pumping station to be discontinued, if desired. A 38-inch by 60-inch elliptical storm sewer trunk lateral would extend from the 10-foot by 5-foot box at the intersection of White Oak Lane and Sunset Road and extend to the intersection of Locust Road of Sunset Road. Additional upstream storm sewer improvements include upgrading storm sewers along Hill Road between Linden Street and just east of Birch Street. The total estimated construction of the Sunset Road (East) Conveyance Project is $10,356,000.

C. <u>Sunset Road West Conveyance Project</u>

The Sunset Road West Conveyance Project consists of implementation of 10-foot x 5-foot box culvert improvements that will run from the proposed Crow Island Woods stormwater storage project to the west along Sunset Road (West) approximately 800 feet and discharge into the proposed FPDCC Hibbard Road storage project located immediately west of Hibbard Road. Significant physical challenges exist in constructing the portion of box culvert between the two private residences located at the east end of Sunset Road (West). This narrow corridor is further complicated by the presence of an existing water main and sanitary sewer, both of which will likely need to be relocated to accommodate the box culvert. Based on initial research, there appear to be available recorded utility easements that will allow this construction work to occur. However, this construction work will result in significant impact to trees, landscaping, hardscaping, and access disruption to these two property owners, so further discussions and engagement will be required. The estimated construction cost for the project, which includes approximately 1,260 feet of sanitary sewer reconstruction and 300 feet of water main replacement is $2,821,000.

D. <u>Mount Pleasant Road Conveyance Project</u>

The Mount Pleasant Road Conveyance Project consists of 38-inch x 60-inch elliptical storm sewer that will run along Mount Pleasant Road from the intersection of Locust Road to the proposed

Crow Island Woods stormwater storage project. This project will provide flood relief to areas near the intersection of Mount Pleasant Road and Locust Street and the intersection of Mount Pleasant Road and Rosewood Avenue. Implementation of this project, in combination the other Phase 2 improvement projects, will allow the Village to discontinue use of the Mount Pleasant Stormwater Pumping Station. The estimated construction cost for this project is $1,362,000.

3.04 PHASE 3 PROJECTS

Figure 3.04-1 depicts the two Phase 3 projects, which consist of one regional underground stormwater storage project located at the playfields between Skokie and Washburne Schools and the Oak Street conveyance project. The underground storage project at Skokie-Washburne School will contribute 5.9 acre-feet of flood storage volume and will provide supplemental flood relief within the North of Willow Watershed. The Oak Street Conveyance Project will provide flood relief within portions of the Provident Watershed. The total estimated Phase 3 project cost is $4,675,000.

A. Washburne-Skokie School Underground Stormwater Storage Project

The Washburne-Skokie School Underground Stormwater Storage Project will result in the potential implementation of an underground flood storage chamber that will provide 5.6 acre-feet of detention volume. The project site is located on a 3.4 acre play area located between Carleton Washburne Middle School and the Skokie (Elementary) School and is owned by Winnetka School District 36.

Figure 3.04-2 - Typical Underground Storage Chamber Installation

The basin would connect into the Phase 1 Oak Street storm sewer that extends to the intersection of Oak Street and Berkley Avenue. The Oak Street Conveyance Project described below will outlet into the southeast corner of the storage basin. A 24-inch storm sewer main along Elm Street that will be constructed as part of the Oak Street Conveyance project will also discharge into the north side of the detention basin. The conceptual plan for the basin assumes construction of precast concrete storage chambers (i.e. StormTrap, refer to Figure 3.04-2) that would have a bottom elevation near elevation 615.5 and store approximately six feet of stormwater for a 100-year storm event. Preliminary layout of the chamber units provides a horizontal buffer from the underlying existing 33-inch MWRD interceptor sewer that diagonally crosses the site (note the depth of the sewer does not present vertical conflict issues). The play fields over the storage chambers would be restored to maintain the current recreational use. Initial discussions with School District 36 staff indicates that this project appeared to be an acceptable concept, so long as the construction schedule does not disrupt the usage of the play fields during the school year. The total estimated construction cost for the project is $1,381,000.

Figure 3.04-1 Phase 3 Projects

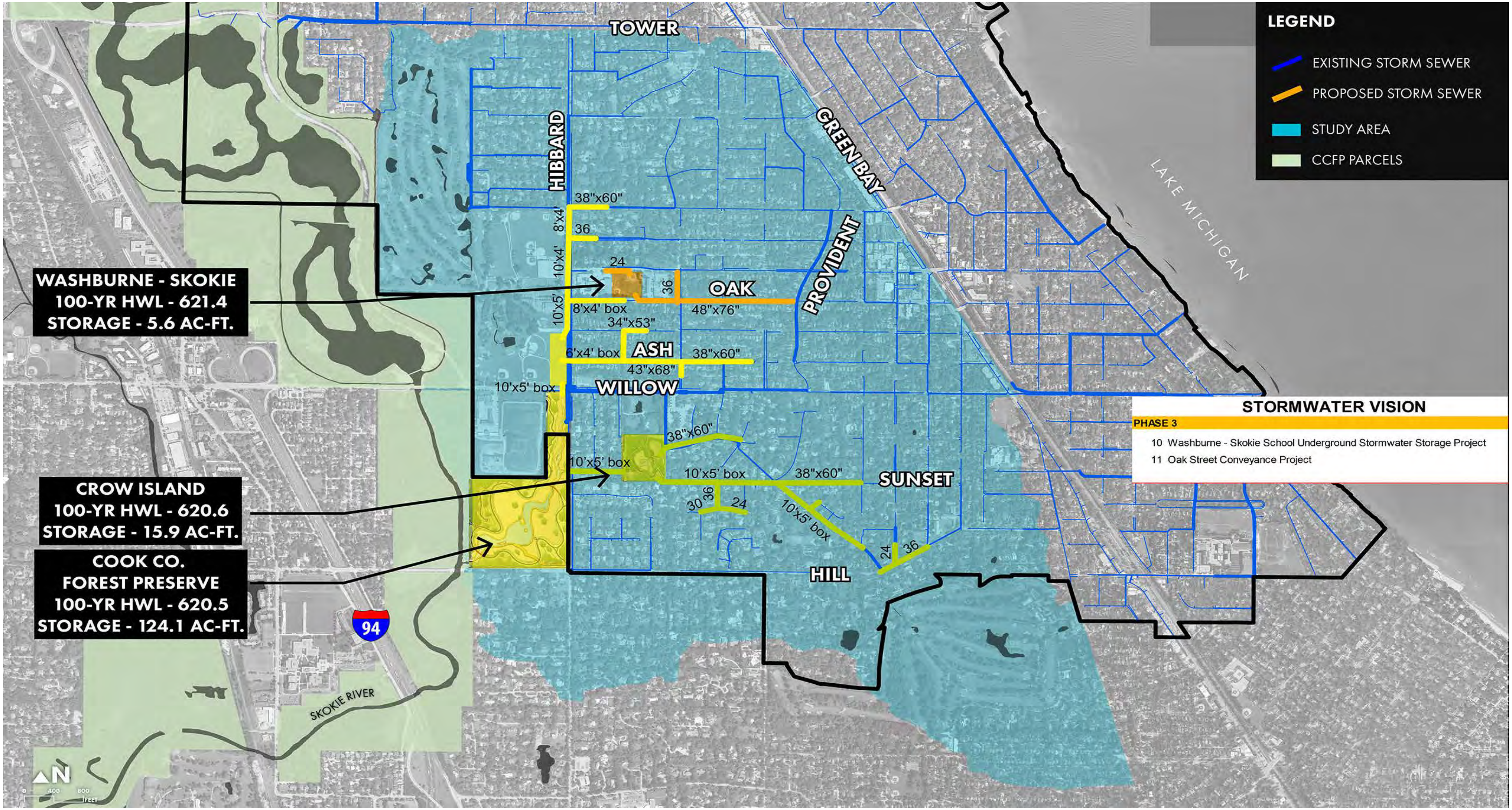
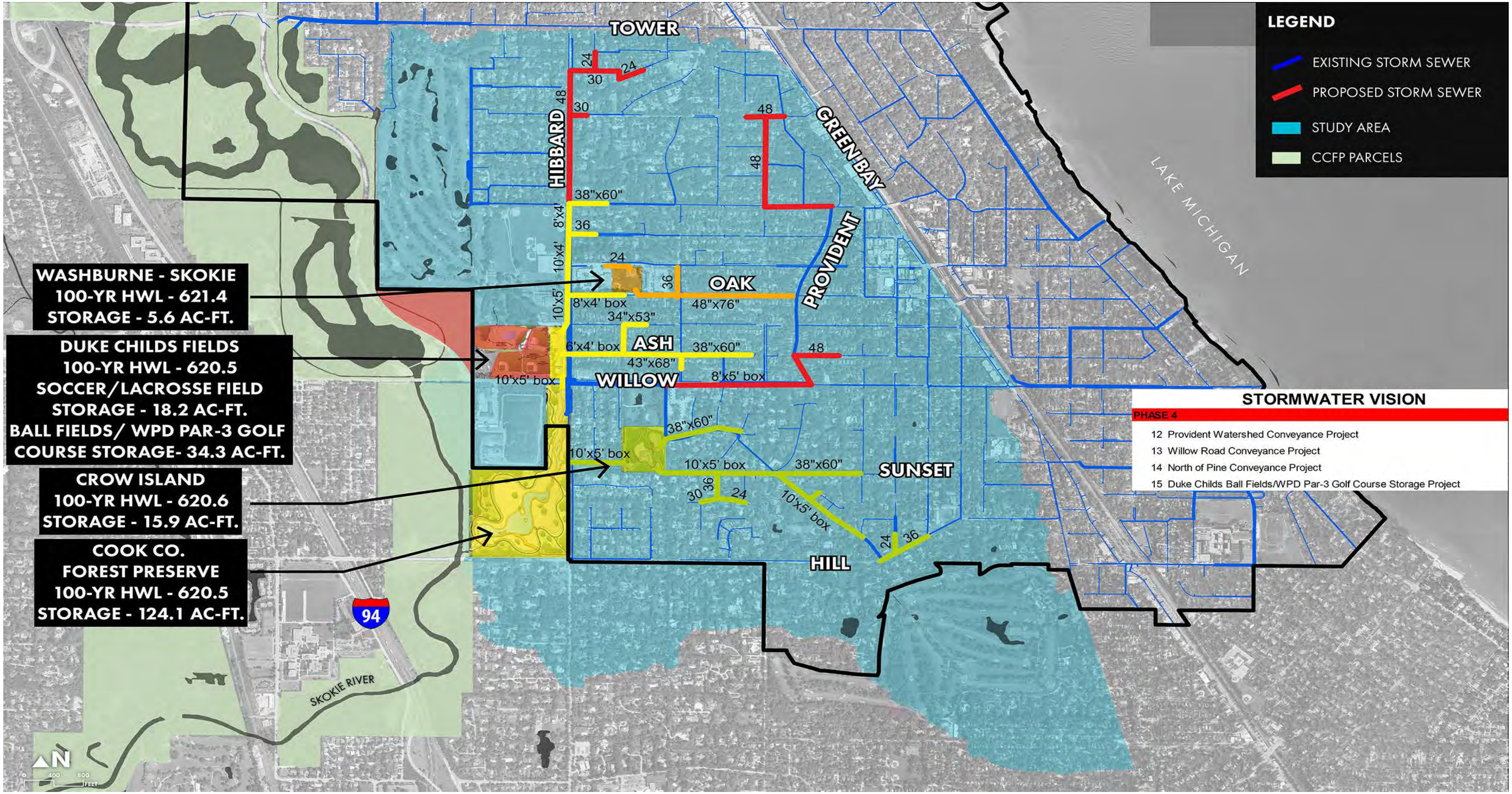


Figure 3.05-1 Phase 4 Projects



B. Oak Street Conveyance Project

The Oak Street Conveyance Project consists of a 48-inch x 76-inch elliptical storm sewer main that would extend west along Oak Street from Provident Avenue to near Berkley Avenue and ultimately outlet into the Washburne-Skokie underground detention basin. This storm sewer conveyance project provides flood relief in both the Provident Watershed and North of Willow Watershed. A 36-inch trunk lateral is also proposed to extend along Glendale Avenue to the intersection of Elm Street. The total estimated cost for the project is $3,294,000.

3.05 PHASE 4 PROJECTS

Figure 3.05-1 depicts the remaining four Phase 4 projects, which consist of three stormwater conveyance projects and one regional large-scale stormwater storage project located at the Duke Childs ball fields and portions of the WPD par 3 golf courseThe surface stormwater projects at the Duke Childs ball fields and the WPD par 3 golf course will contribute 34.3 acre-feet of flood storage volume and will provide supplemental flood relief within the North of Willow Watershed and North of Pine Watershed. The Provident Watershed Conveyance Project will provide additional flood relief in the Provident Watershed, particularly local areas of flooding in the northerly portions of the watershed. The Willow Road Conveyance Project will provide flood relief to areas near the intersection of Willow Road and Provident Street, but will also provide supplement flood relief benefits to both the South and North of Willow Watersheds. The North of Pine Street Conveyance Project will provide flood relief within the North of Pine Watershed and also within the West of Hibbard North Watershed. The total estimated Phase 4 project cost is $13,084,000.

A. Provident Watershed Conveyance Project

The Provident Watershed Conveyance Project involves implementing 48-inch trunk line storm sewer main that extends along Pine Street to the west from the intersection of Provident Avenue to the intersection of Locust Street. The storm sewer main then extends along Locust Street from Pine Street up to Westmoor Road. Additional storm sewer laterals along Westmoor Road that extend to existing low points are proposed. This project will address long-standing local flooding issues in the area. The estimated construction cost for this project is $2,930,000.

B. Willow Road Conveyance Project

The Willow Road Conveyance Project will implement an 8-foot by 5-foot box culvert that will extend east along Willow Road from just west of Glendale Avenue up to Provident Avenue. The 8-foot by 5-foot box will then extend to the north along Provident Avenue up to Ash Street. A 48-inch trunk lateral will extend along Ash Street from Provident Avenue up to a mid-block low point located between Provident Avenue and Birch Street. This project will provide significant flood relief to the southern portion of the Provident Watershed, but will also provide supplemental flood relief to both the North and South of Willow Watersheds by intercepting runoff that would otherwise be directed overland to these flood prone areas. The portion of the project along Willow Road is located within Illinois Department of Transportation (IDOT) right-of-way, so close coordination with IDOT staff will be required. The estimated construction cost for this project is $5,284,000.

C. North of Pine Conveyance Project

The North of Pine Conveyance Project will consist of large diameter storm sewer improvements that will extend from the upstream end of the Phase 1 Hibbard Road Stormwater Conveyance Project near the intersection of Hibbard Road and Pine Street. A 48-inch storm sewer main will run to the north along Hibbard Road from Pine Street up to Kent Road. Local storm sewer improvements will be implemented along Kent Road, Hamptondale Road, and Auburn Road ranging in size from 24-inches to 30-inches. A 30-inch storm sewer lateral will run to the east from the 48-inch main along Hibbard Road along Westmoor Road.

D. Duke Childs Ball Fields/WPD Par-3 Golf Course Storage Project

The Duke Childs Ball Fields/WPD Par-3 Golf Course Storage Project proposes to build upon flood storage created as part of the Phase 1 Duke Childs Soccer/Lacrosse Field Storage Project. This project would create an additional 34.3 acre-feet of storage volume that would be contiguous to the 18.2 acre-feet of flood storage volume provided by the Duke Childs Soccer/Lacrosse Storage Project. Approximately 27.7 acre-feet of storage volume would be provided by lowering the three existing Duke Childs ball fields to an elevation near elevation 618.0. The ball fields would be entirely reconstructed at their current location and likely would be equipped with an underdrain system that would promote efficient drainage of the fields. With the exception of very large storm events (i.e. greater than a 10-year return interval event, the fields would not be inundated and would be playable). For larger storm events, the fields would become temporarily inundated, but would become playable again once floodwaters recede. This concept has been presented to NTHSD staff and they have communicated several concerns and reservations related to this concept. Because this project is programmed to be implemented in Phase 4, there is time to look at other more acceptable options that may involve creating similar amounts of flood storage volume creation at other locations that are adjacent to the site (more storage at the WPD par 3 course or potentially the FPDCC North Forest Way site). The current concept for creating storage at the WPD par 3 course would similarly involve lowering the grade of three of the par 3 holes to an average elevation near 618.0. The tees and greens could be elevated higher, while fairways and rough could be at a lower elevation. This concept would generate approximately 6.6 acre-feet

Figure 3.05-2 Conceptual Plan for Detention at Duke Childs Ball Fields and WPD Par 3 Course

of additional flood storage volume. The total estimated construction cost for this project is $2,461,000.

3.06 GREEN INFRASTRUCTURE MEASURES

Green infrastructure practices are an important component of the overall Stormwater Vision, both in terms of effectively managing stormwater runoff from less intense more frequent storm events, reducing the impacts of larger less frequent storm events, and providing both distributed and regional stormwater quality treatment. Based on an evaluation of property-level green infrastructure measures such as private rain barrels, rain gardens (refer to Figure 3.06-1), and pervious driveways, the amount of storage volume provided is closely tied to private property owner's willingness to participate. While this level of participation can be increased through incentive-based policies, significant large-scale stormwater conveyance and storage infrastructure projects will still be required to meet the Village's target level of service. Because the level of private property participation is difficult to predict, implementation of property-level green infrastructure measures was not reflected in the Stormwater Vision proposed conditions stormwater modeling.

Figure 3.06-1 Typical Private Rain Garden

Potential neighborhood-level green infrastructure measures (Figure 3.06-2) such as parkway and intersection bump-out bioretention basins are programmed as part of each stormwater conveyance project and associated costs have been included in the cost estimates provided (estimated to be approximately $1,400,000). The implementation approach for these bioretention basins is to place them at locations that are already anticipated to be disturbed as part of conveyance infrastructure construction, thereby not expanding potential impacts to areas that would otherwise not be disturbed.

Figure 3.06-2 Typical Bioretention Basin

Many of the regional large-scale stormwater storage projects have been designed to implement constructed wetlands that will establish native plantings and habitat. Costs related to creation of native planting and restorative enhancements for the FPDCC Hibbard Road Storage Project, the Crow Island Woods Storage Project, and the Duke Childs Soccer/Lacrosse Fields Storage Projects have been included in their respective cost estimates and total approximately $2,500,000.

The cumulative green infrastructure-related expenditures programmed in the Stormwater Vision is approximately $3,900,000 or about seven percent of the overall project cost.

3.07 PROPOSED CONDITIONS MODELING RESULTS

In order to confirm that the Stormwater Vision meets the Village's Target Level of Service (100-year, 3-hour storm event or 4.85-inches of rainfall over a 3-hour period), we performed proposed conditions stormwater modeling using the XP-SWMM 2d model. The existing conditions XP-SWMM 2d model was updated to reflect implementation of the 15 stormwater and flood control projects that make up the Stormwater Vision. A side-by-side comparison of the model-simulated existing versus proposed conditions flooding extents and depths is shown on Figure 3.07-1 and Figure 3.07-2. Comparison of these two figures indicates significant reductions in flooding extents and depths, and shows that once the Stormwater Vision is fully implemented, the Village's Target Level of Service will be met throughout the majority of the study area. Note that the 100-year, 3-hour event proposed conditions flooding extents and depths mapping still indicates some areas within the study area that will have some degree of flooding, which should be expected. The Village's Target Level of Service is to protect structures from overland flooding and to minimize street flooding to allow safe vehicular access (especially emergency vehicle access).

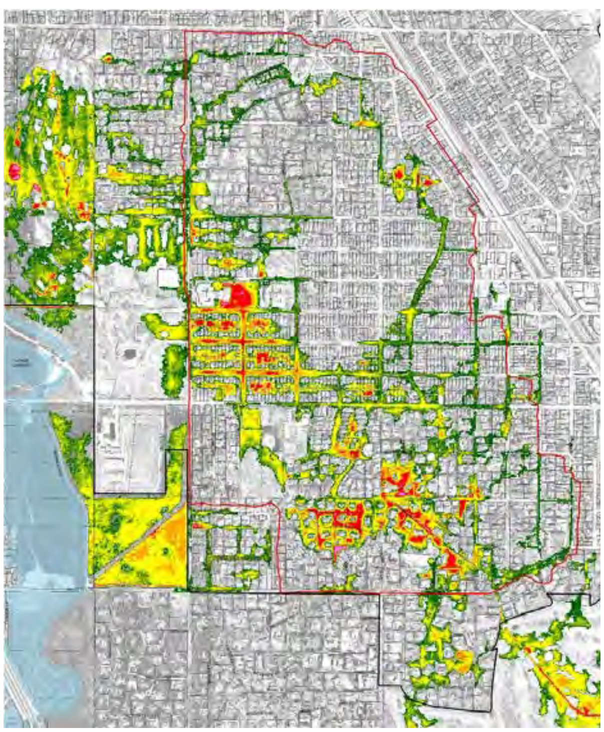


Figure 3.07-1 Existing Conditions Flooding Extents and Depths, 100-year, Three-Hour Event

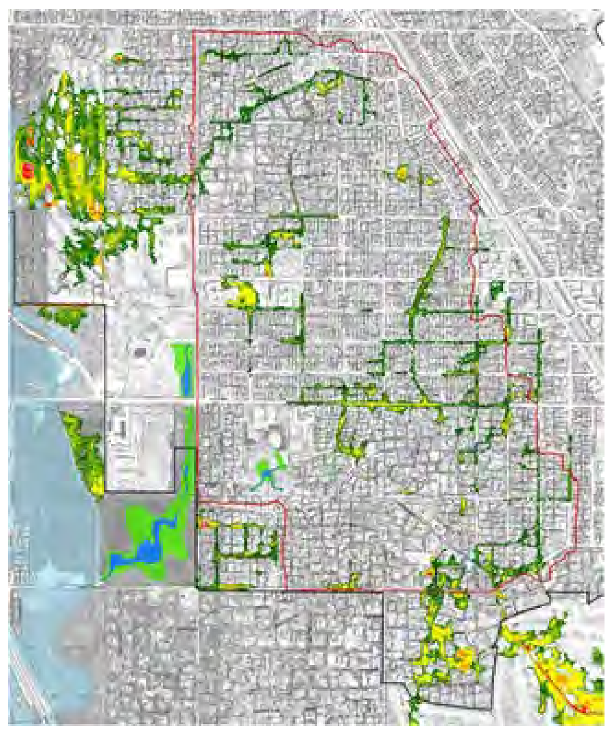


Figure 3.07-2 Proposed Conditions Flooding Extents and Depths, 100-year, Three-hour Event

11”x17” exhibits that depict the XP-SWMM model simulated flooding extents and depths within the study watershed for proposed conditions (Stormwater Vision fully implemented) for a 2-, 5-, 10-, 25-, 50-, and 100-year, 3-hour storm event are provided within Appendix I.

3.08 PROPOSED STRUCTURE FLOOD RISK REDUCTION

The existing and proposed conditions flooding depth and extent mapping that was generated for a range of recurrence interval storm events (2-, 10-, 50- and 100-year) was used to evaluate the structure flood risk reduction performance realized following implementation of the Stormwater Vision. Determination of whether a particular structure was at risk of flooding was done by first creating a polygon in GIS around the primary structure footprint that represented a five-foot horizontal buffer. Note that detached accessory buildings were not included. The five-foot buffer polygon was then intersected with the predicted flooding extents polygons. If the two polygons overlapped, the structure was identified as being at risk of flooding. Note that the results of this evaluation do relies heavily on LIDAR topographic data, which does have certain accuracy limitations. However, short of performing detailed field topographic surveys of every at risk structure in the Village, this exercise provides a very good indication of structure flood risk reduction results. Based on the results of this evaluation, the number of structures at risk of flooding for the 100-year, 3-hour design storm event will be reduced from 474 properties in the existing condition to 61 properties in the proposed condition (refer to Figure 3.08-1). This equates to an 87 percent reduction of the 474 structures in the study area for a 100-year storm event.

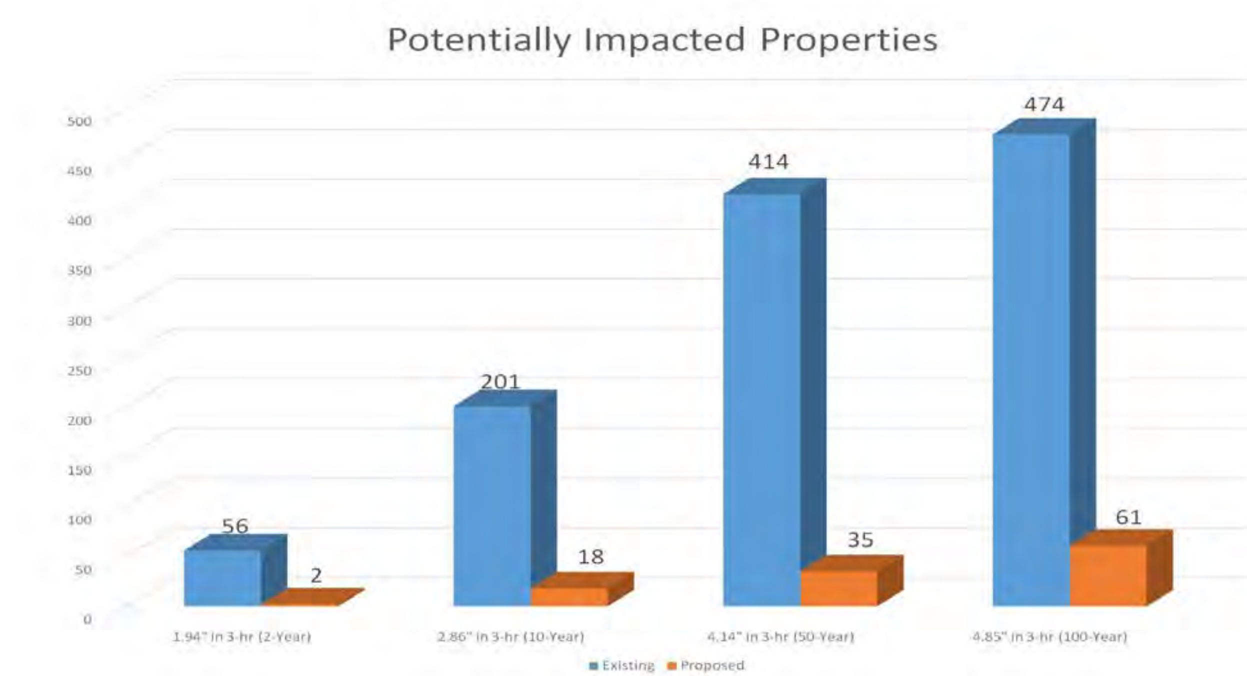


Figure 3.08-1 Proposed vs. Existing Conditions Impacted Parcels (2-, 10-, 50- and 100-Year Events

Taking this evaluation a step further, we performed a Benefit-Cost Analysis (BCA) to validate the cost effectiveness of the proposed Stormwater Vision. BCA is the methodology by which the future benefits of a flood risk reduction project are compared to its overall cost. The end result is a benefit-cost ratio (BCR), which is derived from a project's total net benefits divided by it total project cost. The flood risk reduction project is considered to cost effective when the BCR is 1.0 or greater, indicating the flood reduction benefits of the project are sufficient to justify the costs.

In order to determine the estimated benefits realized, it is necessary to first determine what the potential damage or cost of flooding is to a particular structure. In order to do this, it is necessary to compute the average depth of flooding for a particular impacted structure for a specified return interval storm event. This information was developed from our XP-SWMM 2d modeling. Damage estimates (structure and contents only) are derived from damage curves that have been developed by the Federal Emergency Management Agency (FEMA) for typical residential structures (2,000 sf footprint) in the US for various depths of flooding.

If the return interval storm event is 2-year storm event, there is a 50-percent chance that the computed flood damage will occur in a given year. If the flood damage predicted for a structure for a 2-year storm event is $40,000, the annualized cost is $20,000.

The goal is to reflect the flood damage in annual costs and then convert the annual costs to the projected design life of the flood risk reduction project. Typical standard practice is to assume that the design life of a flood risk reduction project is 50-years. Taking the annual "cost of flooding" of $20,000 times the design life of 50 years equals $1,000,000.

Table 3.08-1 represents the results of the BCR evaluation for the Village's Stormwater Vision. Because the computed BCR of 1.72 is greater than 1.0, the cost of the flood risk reduction project can reasonably be justified as cost-effective. Note that the damage estimates only include structure and contents. Other potential damages not quantified include auto damage, exterior property damage (i.e. yard, landscaping, trees, etc.), public works costs, road detour costs, and basement backup damage that occurs to structures that don't necessarily encounter surface water flooding). Furthermore, there are many ancillary project benefits and community assets that extend beyond just flood damage reduction such as utility replacements, road reconstruction, establishment of recreational facilities and uses, stormwater quality improvements, and maybe most importantly limiting reductions in property values.

Storm	Estimated Annual Cost of Flooding (2016 $)		
	Existing	Proposed	Reduction
2-Year	$1,096,196	$39,150	$1,057,046
10-Year	$648,171	$65,515	$582,657
50-Year	$260,652	$19,775	$240,877
100-Year	$130,436	$20,391	$110,045
		Total	**$1,990,624**
		X Project Life (50 Years)	$99,531,221
		Estimated Project Cost	$57,717,000
		BCR =	**1.72**

Table 3.08-1 Stormwater Vision BCR Analysis Results

3.09 MITIGATION ZONES

As stated in section 3.08, if the Stormwater Vision is fully implemented, it is anticipated that there will be an 87 percent reduction to 474 properties that are currently at risk of structural flooding for the design 100-year storm event. The remaining 61 properties that are potentially still at risk of flooding would need to be addressed by a process of individual property mitigation. The mitigation zones that have been identified are depicted on Figure 3.09-1. The first step of this process would involve additional data gathering to confirm if these 61 properties are indeed at risk of structural flooding. Note that the flood risk reduction estimates that were prepared were based primarily on available LIDAR topographic data. It is suggested that detailed field topographic survey be collected for the 61 at risk properties to determine low entry, finished floor, and lowest adjacent grade elevations. These elevations can then be compared to the regional predicted proposed conditions flood elevations to determine if the surveyed structures are flood-prone. It is assumed that some of the 61 estimated structures may not need further flood

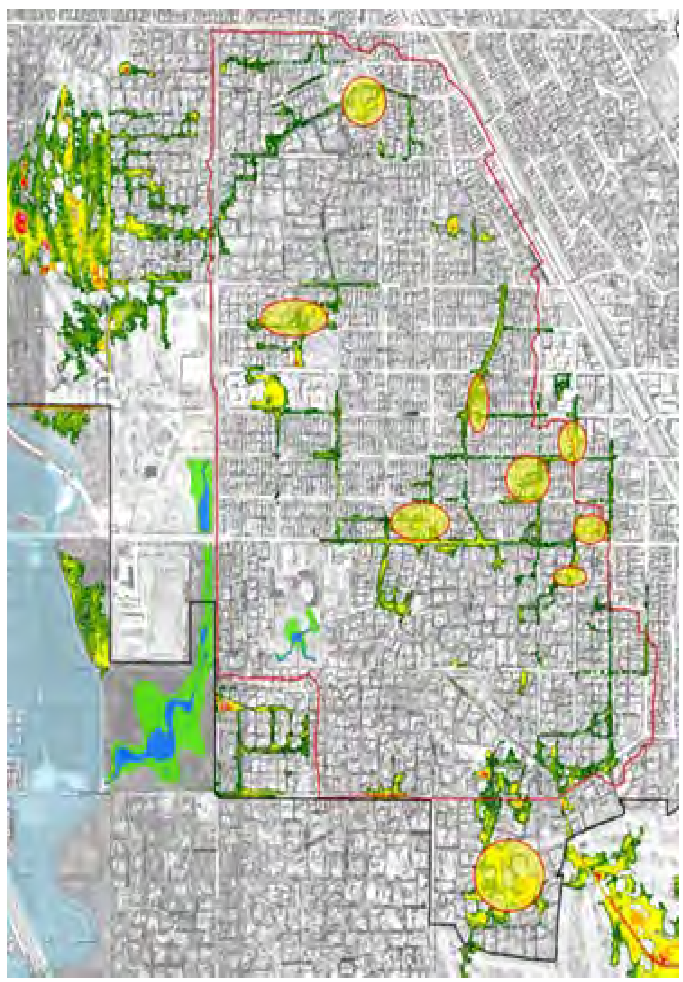


Figure 3.09-1 Mitigation Zones

protections. Those properties and specific buildings that are determined to still be at risk of flooding for the design storm can then be further evaluated for individual or group property flood protection activities

3.10 COST ESTIMATE

Planning-level cost estimates for each of the stormwater and flood control improvement projects that make up the Stormwater Vision are based on conceptual plans and designs presented in this report. Summaries of these estimates are provided in Appendix J. Given the high level of uncertainty for many of the project details that could impact design, appropriate levels of design contingencies were assigned. A 30-percent design contingency was assigned to conveyance-related stormwater improvements, while a 20-percent design contingency was assigned for storage-related stormwater improvements. In developing cost estimates for each stormwater improvement project, the level of design detail was advanced much further than what is typically customary for a concept or planning study such as this. Factors such as defining utility conflicts, performing detailed earthwork calculations, developing restoration quantities, and quantifying wetland mitigation costs were each considered in developing the individual project cost estimates. Note that unit prices for each element of construction were selected based on review of historic bid tabulations of similar projects done by the Village, IDOT bid tabulations, and past stormwater studies provided by the Village.

3.11 ALTERNATIVES EVALUATIONS

Based on the results of the opportunities matrix evaluation that was summarized in Section 2 of this report, there were several potential alternative components to the Stormwater Vision that were developed. Two of the component alternatives contemplated stormwater conveyance alignments that would minimize impacts to portions of Sunset Road (Hill Road Conveyance and Locust Street/Mount Pleasant Road Conveyance). A third alternative involved providing stormwater storage improvements at the Duke-Childs Field soccer/lacrosse fields in underground chambers rather than on the surface in a wet basin and constructed wetland. A brief discussion of each of these design alternatives is provide below, including estimated construction cost implications when compared to the Stormwater Vision.

A. Hill Road Conveyance Route

The Hill Road Conveyance system option that was discussed in Section 2 would redirect the main trunk line box culvert to Hill Road between Hibbard Road and Birch Street. While this route presents fewer challenges with private property owners along Sunset Road, the overall length of storm sewer is greatly increased. This conveyance route also limits opportunities for managing stormwater quality regionally, which is currently proposed with the Crow Island Woods Storage Project. In order to provide a similar levels of stormwater quality treatment, the Hill Road Conveyance alternative would likely involve expanding the scope of distributed green infrastructure provided within the South of Willow Watershed. The Hill Road Conveyance Route would result in an additional estimated construction cost of $7.3 million when compared to the Sunset Road Conveyance Route.

B. Locust Street/Mount Pleasant Road Conveyance Route

The Locust Street/Mount Pleasant Road Conveyance Route that was discussed in Section 2 is fairly similar to the Sunset Road Conveyance Route, but would redirect the main trunk 10-foot by 5-foot box culvert to run to the northeast along Locust Street and west along Mount Pleasant Road. The segment of 10-foot by 5-foot box culvert for the Sunset Road Conveyance Route that runs between Locust Street and Crow Island Woods could then be eliminated. This option does involve a greater overall length of storm sewer that would result in an additional estimated construction cost of $2.0 million when compared to the Sunset Road Conveyance Route.

C. Duke-Childs Soccer/Lacrosse Field Underground Storage

An additional component alternative that was evaluated included implementation of underground storage at the Duke-Childs soccer/lacrosse fields in lieu of the surface wet storage basin that is currently included in the Stormwater Vision. The primary benefit realized from this alternative is to eliminate the need to permanently relocate the NTHSD's existing soccer and lacrosse fields. The current proposal in the Stormwater Vision is to relocate the fields to the top of the Village's landfill site on the south side of Willow Road. The underground detention concept could provide a similar amount of storage volume when compared to the surface storage option (~18.2 acre-feet). However, this concept would result in an estimated construction cost increase of approximately $2.5 million when compared to the Duke-Childs soccer/lacrosse field surface storage option and field relocation concept. Furthermore, the underground storage concept limits the ability to provide stormwater quality treatment prior to discharging to FPDCC lands south of Willow Road.

SECTION 4
NEXT STEPS

4.01 NEXT STEPS

This report and the vision it presents is not the end of the Village's study. As discussed in Section 3, there are still many questions that need to be answered, comments and concerns that need to be addressed, and partnerships that need to be solidified. These are the next steps in the Village's stormwater and flood control program for western and southwestern Winnetka. They represent the actions that need to begin before the Village can move forward with implementing the physical aspects of the vision.

Following is a narrative of the anticipated next steps as identified at the conclusion of this study.

A. <u>Forest Preserve District of Cook County</u>

The opportunity to construct stormwater storage on the FPDCC lands south of the landfill west of Hibbard Road represents the most important aspect of the Village's vision for its stormwater and flood control program. This opportunity directly impacts almost every other opportunity in the vision. As such, the tasks associated with progressing this opportunity are the top priority for Village consideration.

Progressing this opportunity will eventually require the Village to complete the District's land use request process, which includes a series of project review and approval milestones with District staff, orchestration of public hearings and public comment solicitations, and ultimately creation of an intergovernmental agreement between the District and the Village that needs to gain approval by the FPDCC's Board. The uniqueness of this opportunity to establish such a partnership between the Village and FPDCC raises questions about the exact details and timing of this process, and an anticipated description of the next steps follows.

1. Schedule and conduct a meeting with District staff to discuss the land use request process and establish a firm understanding of the milestones and expectations. This meeting will be the most critical next step for the Village because it establishes not only the road map for progressing this opportunity, but the majority of the rest of the vision opportunities.

   The effort to successfully satisfy the District's land use process is extensive and requires significant investment on the part of the Village. It will be important for the Village in this initial meeting to establish with the District its expectations that it will not expend this effort only to be told "no" in the end, especially on the grounds of issues that could have been addressed or brought to the Village's attention earlier in the process.

2. Engage the Village's local County Board Commissioner.

3. Engage the stakeholder groups that have a stake in FPDCC lands. These groups include Friends of the Forest Preserve, Forest Preserve Volunteer Stewards, Friends of the Chicago River, and the Chicago Botanic Garden. Meetings should be scheduled with these groups to share the vision, particularly for FPDCC lands, gather comments and thoughts, and establish a communication plan to keep them informed as the process moves forward.

4. As part of the initial meeting with FPDCC staff, the scope of the proposed improvement will need to be determined. A series of concepts were shared with the District early in this study and, while the opportunity south of the landfill west of Hibbard Road has been identified as the desired project, the District showed interest in partnering on improvements in some of the other FPDCC lands, such as the triangle along Forest Way Drive. The exact scope of the improvements needs to be agreed upon.

5. Following the initial meeting and establishment of an understanding with the FPDCC, a tree inventory and floristic quality assessment should be undertaken for the property. This information will be required for moving forward with the FPDCC review process and ultimately will be required for any design work of the project.

Figure 4.01-1 Next Step–Tree Inventory and Wetland Delineation

6. A wetland delineation should be performed to identify the limits and quality of the wetlands on the site. This will be required for FPDCC review and design, and it will also be important to begin coordination with the US Army Corps of Engineers. The vision cost estimate includes a significant cost component for wetland mitigation. Getting this coordination moving will help to assess actual costs and the impacts existing wetlands will have on the project.

7. Begin advanced concept engineering plans for the site. This level of engineering will entail more detailed site grading, restoration, modeling, and amenities that conceivably will allow for more detailed discussions with FPDCC staff and further solidify the approval of staff and Board. This task will also include sharing of FPDCC design and material standards.

8. From this point, the remainder of the land use process working towards implementation (start of construction) should be clear and the remaining steps revisited by the Village. However, within this process the following tasks are anticipated:

    a. Determination of a cost-sharing program, if any. It is anticipated that the majority of the improvement will be funded by the Village, but it is also anticipated that there may be aspects or amenities requested by the FPDCC that may warrant investment by the FPDCC.

    b. Development of a restoration plan to include specific planting materials, planting material sources, installation specifications, and an establishment program.

c. Development of a maintenance plan to establish who and how the landscaping, amenities, and facilities will be maintained.

d. Development of a long-term operation plan to establish who and how more significant maintenance such as silt removal/dredging, controlled burns, and damage repair will be performed.

B. New Trier High School District

The opportunities to construct stormwater storage on Duke Childs Field represent another important aspect of the Village's vision for its stormwater and flood control program. As noted in Section 3, there are questions and reservations from NTHSD staff and administration about the form stormwater storage will take and how it would be implemented in the constraints of the NTHSD's needs and operations. The following next steps are recommended regarding NTHSD:

Figure 4.01-2 Next Step–Landfill Concept Plan Development

1. Concerns of NTHSD staff and administration have been expressed, but it will be important to also engage representatives of the NTHSD Board to determine their concerns and be sure there is full understanding of what lies ahead for these opportunities.

2. Begin advanced concept engineering for the landfill redevelopment plan. It seems the viability of this improvement is still in question but may provide important information to the NTHSD and help in finalizing the form and extent of stormwater storage on the Duke Childs lacrosse fields. Planning for the landfill may also be valuable for the Park District, which may turn out to be a valuable resource when it comes to programming sports activities. If the landfill can be redeveloped it, may allow for programing to be moved from NTHSD or Park District property permanently if aboveground storage is provided on Duke Childs lacrosse fields or temporarily during construction of underground storage.

3. Continue discussions with NTHSD staff and Board regarding the vision for above ground storage and the alternative for below ground storage as well as timing of the improvements to determine the scope of potential alternative stormwater storage on Duke Childs soccer and lacrosse fields.

4. Upon determination of the form of stormwater storage on Duke Childs lacrosse fields, proceed with advanced concept engineering plans for the storage facilities.

5. Depending on the form of stormwater storage on Duke Childs lacrosse field, the Village will need to incorporate this into its discussions with the FPDCC.

C. Winnetka Park District

The opportunity to construct stormwater storage on Crow Island Woods represents another important aspect of the Village's vision for its stormwater and flood control program. As noted in Section 3, there are questions and reservations from the public concerning stormwater storage on this Winnetka Park District land. Although the Park District expressed interest in the opportunity and it generally fits into the goals and objectives of the property, it will be important that the Village endeavor to address the questions and concerns raised by the public. The following next steps are recommended regarding the Winnetka Park District:

1. Perform a tree inventory and floristic quality assessment of the Crow Island Woods site. This will be required for any future design work on the property, but will immediately help to educate the public as to the actual condition and value of the property.

2. Perform a wetland delineation of the Crow Island Woods site. This may or may not be an extensive delineation, but it is recommended based on the history of the site and some documentation of potential wetland conditions on the site.

3. Based on the inventories and delineations, develop more advanced site engineering that refines the current vision within the context of maintaining as much of the existing quality features of the property as possible. This should be performed in conjunction with the Park District's own consultant who can provide an additional level of merit to the advanced concept.

4. Revise the hydraulic modeling based on the advanced concept to determine how it changes the balance of the vision.

5. Conduct a site walking tour to provide one-on-one interaction and increased education to the public concerning the current value of Crow Island Woods. This is a critical step in promoting the benefits of the Village's vision to the Crow Island site. This tour should be conducted by the Park District and its consultant to provide an independent aspect for the public to hear from.

6. Following the walking tour, re-engage the public in an open house presentation of the vision and work towards a more acceptable and less disruptive vision for the Crow Island Woods site.

7. Following the public open house, meet with the Park District to discuss intentions for moving forward based on whether there is still public concern or if an acceptable level of tolerance has been obtained.

Figure 4.01-3 Next Step–Revisit Concept for Crow Island Woods

8. From this meeting with the Park District, it is anticipated that the model and vision will need to be revisited to determine changes and any potential revisions for the South of Willow vision.

D. <u>School District 36.</u>

The opportunities to construct stormwater storage on the Washburne-Skokie School site provides immediate relief to the Tree Streets Neighborhood. From our meetings with the School District, it appears the School District is supportive of the proposed improvement. It will be important to progress this project to be sure the School District governing board does not have questions or reservations to the improvement. The following next steps are recommended regarding the School District:

1. Engage representatives of the School Board, possibly in a presentation at their regularly scheduled Board meeting, to present the vision as it applies to the School District and solicit any concerns or questions they may have.

2. Revise the vision as needed to address any School Board concerns.

3. Since this project is anticipated to take place in a later phase of the vision, no further action is recommended.

E. <u>Sunset Road or Alternative Conveyance Routing</u>

The opportunities to construct stormwater conveyance improvements along the Sunset Road corridor represents an important relief to the Sunset and Dewindt neighborhoods and surrounding area. From the public engagement meetings, there are concerns about the disturbance that construction of these facilities may cause as well as the final condition of Sunset Road and the adjoining households upon completion of the project. Alternative routing corridors on Locust Street and Mt. Pleasant Road have also been investigated and appear feasible, but more costly. The vision for stormwater management and flood control in the South of Willow area hinges on some form of conveyance opportunity, so it is recommended that these proposed improvements be progressed to address concerns and gain impacted property owner buy-in. The following next steps are recommended regarding conveyance within the South of Willow watershed:

Figure 4.01-4 Next Step–Advance Conveyance Concepts for South of Willow

1. Perform a tree inventory along the corridors to determine type, size and condition, as well as exact location.

2. Develop more advanced site engineering along the corridors to develop to-scale drawings of the facilities and the corridor features and identify more detailed constructability, disturbance, and restoration information.

3. Meet with the affected property owners individually to discuss the improvements and plans and begin negotiations for access and approvals as necessary.

4. Develop updated modeling reflecting results of the engineering and any changes due to the negotiations.

5. Remaining tasks will be dependent upon other tasks within the South of Willow area.