Village of Oak Park, IL

Village of Oak Park
Combined Sewer System Master Plan Report

February 2014

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VILLAGE OF OAK PARK

COMBINED SEWER MASTER PLAN REPORT

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1 INTRODUCTION

The Village of Oak Park has historically suffered from basement flooding resulting from moderate to large rain events. In July 2011, the Village experienced a 50 year storm and received 281 reports of basement flooding. Since the most recent study of the Village system had been completed in 1994, this flooding prompted a request for a new study. The Village retained MWH to complete this study under the Combined Sewer Mapping and Modeling Project.

The goals of this study are:

- Propose a program to improve the level of protection against basement flooding in chronic flooding areas.
- Provide a more uniform level of protection against flooding across the Village.
- Investigate green infrastructure improvements within the Village and estimate their effectiveness in reducing basement flood risk.

The recommended program developed by MWH is included in the final section of this report. This program includes a combination of impervious surface reduction, inlet control, and local and relief sewer projects. In addition to the recommended program, this report also includes:

- An estimation of existing level of protection against basement flooding.
- A list of local and relief sewer improvements designed to improve protection against basement flooding.
- Description of a large-scale project designed to bring the entire Village to a 10 year level of protection.

2 STUDY SETTING

The Village of Oak Park, Illinois is a well-established suburban community of approximately 52,000 people located immediately west of the City of Chicago as shown in Figure 1. Covering an area of approximately 4.7 square miles, the Village extends from Austin Boulevard on the east to Harlem Avenue on the west, and from Roosevelt Road on the south to North Avenue on the north. In addition to the City of Chicago, which borders Oak Park to the east and north, other adjacent communities include Elmwood Park to the northwest, River Forest and Forest Park to the west and Berwyn and Cicero to the south. Figure 1 shows the location of the Village in relation to these communities.

Although portions of the area were settled as early as the mid-1800's, the Village was not incorporated as a municipality until near the turn of the century. Following incorporation, a relatively steady pattern of growth began within the Village and continued through the 1930's. By 1950, most of the available land in Oak Park had been developed and the population of the community had reached 63,529. Since 1950 the population within the Village has fluctuated with changes in demographic patterns.

At present, near build-out conditions exist throughout Oak Park. On-going development consists primarily of rehabilitation and/or redevelopment. With the exception of public parks and school properties, there are no large parcels of undeveloped land remaining within the Village's limits.

Land use within Oak Park is predominantly residential. Single family and multi-family dwellings account for the majority of the Village's land area. The remaining area includes a mix of commercial development, institutional properties, and public open space. Interstate 290 crosses Oak Park just south of Van Buren and Harrison Streets. Roughly one-third of the Village is located south of the I-290 alignment. The Illinois Department of Transportation operates and maintains separate drainage facilities for I-290, which conveys runoff to a pumped discharge at the Des Plaines River.

Lot sizes and dwelling density vary significantly within Oak Park. Single family densities throughout most of the Village range from about 3.5 to 6.8 homes per acre and are typical of those found in the City of Chicago and immediately adjacent communities. However, within the historic district, densities decrease to roughly 1.8 homes per acre. These large-lot low-density areas are concentrated primarily in the central and western sections of the Village bounded by Ridgeland Avenue, Ontario Street, and Augusta Street. High density multi-family developments are common throughout the area south of Ontario Street and north of Madison Street. Commercial and business properties are generally located along the major thoroughfares bounding and crossing the Village.

Oak Park is located on relatively level ground along a natural ridgeline between the Des Plaines River and the Chicago Sanitary and Ship Canal watersheds. Natural ground elevations within the area range from a maximum of about 61 feet Chicago City Datum (CCD) at the north end of the ridgeline to about 36 feet CCD near the southeast corner of the Village. Typical ground slopes are in the range of 0.6 to 1.1 feet per thousand feet throughout most of the study area. However, significantly steeper slopes do occur along the ridgeline where ground surface elevations differ by as much as 10 feet within a distance of about two blocks. Figure 2 provides an indication of approximate ground surface elevations within the Village.

Drainage of stormwater runoff resulting from rainfall in the Village is accomplished through a system of combined sewers. These sewers collect both normal sanitary wastewater flows from all buildings in the Village and surface runoff captured by street inlets and other storm water connections. All flow collected by the sewer system is conveyed across adjacent communities to the Stickney Water Reclamation Plant (WRP) operated by the Metropolitan Water Reclamation District of Greater Chicago (MWRD). A more detailed description of the Oak Park combined sewer system is presented in the next section.

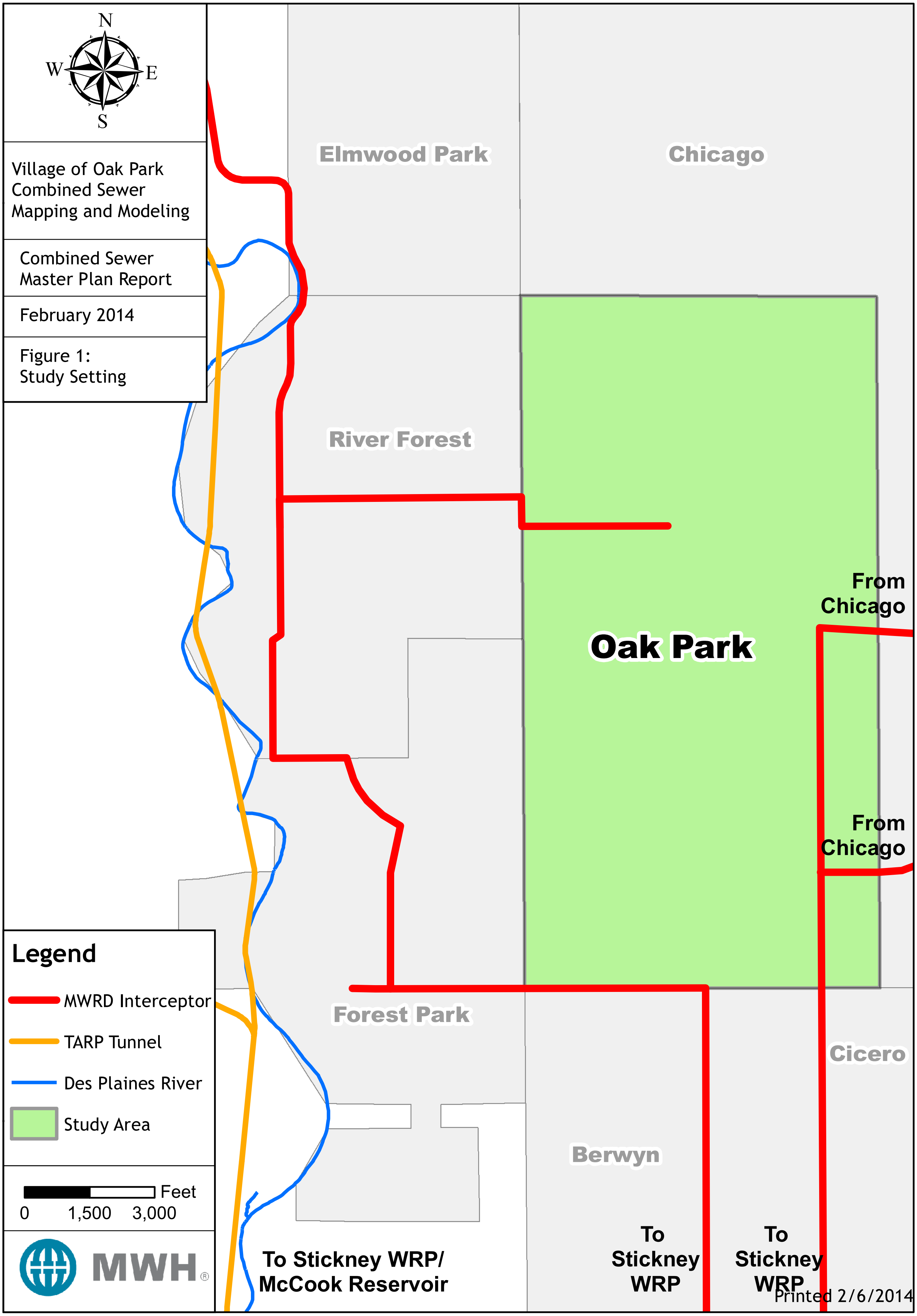

Figure 1:
Study Setting

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Village of Oak Park
Combined Sewer
Mapping and Modeling

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Figure 2:
Village of Oak Park
Existing Topography

Printed 2/4/2014

Legend

Ground Elevation (CCD)

- 34 - 37
- 38- 39
- 40 - 41
- 42 - 47
- 48 - 49
- 50 - 51
- 52 - 57
- 58 - 67

Feet
0 550 1,100

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3 EXISTING SYSTEM DESCRIPTION

Like the City of Chicago and many of the other older suburban communities in the Chicagoland area, Oak Park is served by a combined sewer system designed and constructed to collect and convey both sanitary wastewater and runoff from rainfall events in the same conduits. However, unlike most of the other communities in the Chicago area, Oak Park does not have direct access to any receiving stream. As a result, the rate at which flow can be conveyed away from Oak Park is constrained by the capacity of downstream sewers running from Oak Park to regional collection and treatment facilities.

OVERVIEW OF THE OAK PARK COMBINED SEWER SYSTEM

In a combined sewer service area all household drainage, including sanitary wastewater, runoff to roof drains and groundwater collected by foundation or footing drains, is conveyed to the combined sewer system. During non-rainfall periods the wastewater that must be conveyed by the sewer system is primarily sanitary sewage flows with a component of uncontrolled groundwater infiltration which enters the system through manhole and pipe joints. In Oak Park, flow monitoring data indicate that dry weather flow rates associated with these conditions are on the order of 120 gallons per day per person, or about 0.003 cfs/acre. These dry-weather flows can normally be accommodated by properly designed, constructed and maintained sewer facilities such as Oak Park's system.

In contrast, combined wastewater flows associated with severe rainfall events can result in peak flow rates of up to 1.0 cfs/acre, or more than 300 times normal dry weather rates. Thus, in order to perform properly, a combined sewer system such as Oak Park's would need to be sized to effectively accommodate peak flows that are significantly greater than normal dry weather flow rates.

The Oak Park combined sewer system is made up of sewers ranging from 6-inches to 108-inches in diameter as listed in Table 1. These sewers fall into the basic categories described below:

- Lateral Collector Sewers – Lateral collector sewers ranging from 6-inches to 15-inches in diameter account for more than 50% of the total length of the system. These small-diameter sewers collect sanitary wastewater flows, runoff from connected roof drains, and groundwater flows from footing and foundation drains from private sewer laterals. Typically, these lines also collect runoff from street inlets and catch basins. In Oak Park, these lateral collector sewers generally run north-south for one block to two blocks between connections with larger sewers.

- Branch Sewers – Branch sewers within the Oak Park system serve to collect and consolidate flows from lateral sewers before conveying the flows to major trunk lines. In many areas, these sewers are also connected to private sewer laterals and street inlets. Typically, Oak Park branch sewers range from 18-inches to 30-inches in diameter and are located in east-west streets throughout the Village. It is estimated that these lines account for roughly 25% of the total length of pipe in the existing system.

- Trunk Sewers – Large diameter trunk sewers make up roughly 25% of the pipe length in the Oak Park combined sewer system. These sewers range in size from 36-inches up to 110-inches and serve as the backbone of the conveyance system for the Village's combined wastewater. Typically, these trunk sewers do not collect flow directly from private laterals or street inlets, but serve only to convey flows collected by tributary branch and lateral sewers. The principal trunk sewers in the existing Oak Park system run north-south and are located in Euclid Street, East Avenue, Ridgeland Avenue, and Lombard Avenue. Trunk relief sewers constructed in the late 1960's include additional lines in Augusta, Erie, Harvey, Cuyler, Taylor and Harrison Streets.

- Interceptor Sewers – Three large-diameter, MWRD-owned interceptor sewers serve as the major outlets for the Village system, conveying flows to the Stickney WRP. These sewers range in diameter from 66 inches to 180 inches, are each built to serve multiple municipalities, and are generally designed only to match the existing local system capacity at the time of construction. These interceptors and their tributary trunk sewers are described in detail below.

Table 1: Summary of Existing Village-Owned Combined Sewers

Sewer Size (in)	Length (ft)
Less than 12	16,464
12	158,066
15	110,124
16 - 18	73,767
20 - 24	72,272
27 - 30	29,038
33 - 36	27,140
39 - 42	16,164
44 - 48	18,606
50 - 54	25,532
60	4,779
63 - 72	3,667
75 - 84	9,476
90 - 102	9,414
Greater than 102	5,303
Total	**579,811**

VILLAGE SYSTEM OUTLET DESCRIPTIONS

Due to its age and the number of modifications and improvements made over time, the Oak Park combined sewer system has developed into a complex, highly interconnected network of pipes, backconnections, diversion chambers, junction chambers, and manholes. As a result, elements of the system can best be described in relation to the outlet to which they drain. The location of the Village's combined sewer facilities and the outlets to which they are generally tributary are shown as inverted green triangles in Figure 3 and described below. Locations where flow from outside of Oak Park enters the Village's system or the interceptors to which it discharges are shown in Figure 3 as red triangles.

Ridgeland Avenue Outlet

About 530 acres of the Village are directly tributary to the 84-inch diameter Ridgeland Avenue trunk sewer. The shallow depth of this sewer reduces its effectiveness, as it is close to the elevation of private service lines and can cause basement flooding without backing up significantly. This trunk continues to serve as a principal outlet for flows from the section of the Village south of Lake Street and between East Avenue and Lombard Avenue. West central areas tributary to trunk sewers in Euclid and Madison Streets also drain to the Ridgeland outlet.

The southern section of the Ridgeland trunk sewer was last inspected before it was relined with concrete in the late 1980's to improve the structural integrity of the old brick sewer. The Ridgeland

Avenue siphon is scheduled to be inspected and cleaned in December 2013. The Ridgeland outlet is identified as Outlet 1 in Figure 3.

Oak Park Outfall Sewer

The MWRD Oak Park Outfall Sewer constructed along Chicago Avenue in the early 1920's served as one of the first major outlets for the Village combined sewer system. This interceptor runs west from the intersection of Chicago Avenue and Euclid Avenue to Harlem Avenue before shifting north one block and running through the Village of River Forest to a junction with the MWRD Upper Des Plaines Intercepting Sewer. The section of sewer located within Oak Park was originally constructed as a 72-inch diameter brick sewer in 1940, but was relined with concrete by MWRD as part of a rehabilitation effort. The relining project reduced the diameter of the line to about 60 inches.

Roughly 110 acres within the Village are tributary to the Oak Park Outfall Sewer. This area is located north of Chicago Avenue and west of Euclid Avenue and is tributary to the 48-inch trunk sewer in Grove Street. A stoplog weir located in the junction chamber at Chicago Avenue and Euclid Avenue controls the amount of flow from this line that enters the Oak Park Outfall Sewer. In addition, a connection to the Erie Street relief sewer at Chicago Avenue and Forest Avenue provides for diversion of wet weather flows from the outfall line to the newer relief sewer, and eventually to either the East Avenue trunk sewer or the MWRD Northwest Intercepting Sewer. The Oak Park Outfall Sewer is labeled as Outlet 2 in Figure 3.

Oak Park Avenue Outlet

The first sewer built in Oak Park was an elliptical brick sewer, flowing south to Berwyn. This shallow line is 32-inches by 48-inches and approximately 14 feet deep at the Berwyn connection. When the Upper Des Plaines Intercepting Sewer was built in 1937, MWRD built a structure to divert all flows below surcharge conditions from this outlet to the interceptor. The Oak Park Avenue outlet is labeled Outlet 3 in Figure 3.

City Of Chicago Outlets

Several small areas along the northern and eastern edge of Oak Park are tributary to sewers which flow through the City of Chicago system before discharging to one of the MWRD interceptors east of the Village. Overall, there are nearly 20 connections to the City of Chicago system, many of which are small diameter sewers at the upstream end of the Chicago system and do not contribute flow to the Village system. The largest of the Chicago outlet sewers is a 36-inch diameter pipe running east in North Avenue. At present, the total Oak Park area tributary to the Chicago outlets is estimated to be only about 11 acres. The North Avenue outlet to the City of Chicago system is labeled as Outlet 4 in Figure 3.

Elmwood Park Outfall Sewer

Prior to 1937, combined sewer flows from the extreme northwestern part of Oak Park discharged to the 72-inch semi-elliptical MWRD Elmwood Park Outfall Sewer running west in North Avenue to the Des Plaines River. Oak Park's outlet to this sewer was closed in 1937 with the construction of the East Avenue trunk sewer. The new connection to compensate for the closed outlet at Harlem and North Avenue consists of a 30-inch pipe relieving a 42-inch pipe, creating a bottleneck and potential for flooding issues. This historical outlet is not shown in Figure 3 as it is no longer functional.

MWRD INTERCEPTORS AND TRIBUTARY TRUNK SEWERS

As emphasized previously, Oak Park is entirely dependent on outlet capacity provided by downstream MWRD interceptor sewers. If capacity to accept flows is not available in these lines, there is no place for combined wastewater from within the Village to flow. Under such conditions, the Village system surcharges or backs up, potentially resulting in basement flooding.

Two major MWRD interceptor sewer systems serve as outlets for all of the combined wastewater generated within Oak Park, whether directly connected at the southern border of the Village or taken east or west through neighboring municipalities before discharging to the interceptor upstream.

East Avenue Trunk/Outlet

More than 1430 acres within the Village, or nearly 50 percent of the total Village is drained by the East Avenue trunk sewer. Areas tributary to this sewer include both the northern and southern portions of the Village located west of Ridgeland Avenue. Constructed in the late 1930's, this horseshoe shaped sewer runs from north to south through the Village, passing under I-290 before connecting to the MWRD West Town's Interceptor at East Avenue and Roosevelt Road. The East Avenue trunk ranges from 41 inches by 60 inches at the upstream end to 88 inches by 110 inches at its outlet. The invert of the East Avenue trunk ranges from 20 to 35 feet below grade.

Major trunk sewers tributary to the East Avenue trunk include the Augusta, Erie, and Harrison/Jackson relief sewers. In addition, a continuation of the 102-inch diameter Erie Street sewer provides a means for relief of the East Avenue system to the Northwest Intercepting Sewer in Lombard Avenue. The East Avenue outlet is labeled as Outlet 5 in Figure 3.

Upper Des Plaines/West Town Interceptor

The older interceptor system serving Oak Park consists of the West Town's Outlet Sewer and the Upper Des Plaines Intercepting Sewer. Constructed during the late 1930's, this system conveys sanitary and combined sewage flows to the Stickney WRP from communities as far north as Des Plaines. Immediately upstream of Oak Park, this interceptor flows through River Forest and Forest Park before turning eastward along Roosevelt Road. Discharges from the Oak Park East Avenue trunk sewer and the Ridgeland Avenue trunk sewer enter the Upper Des Plaines/West Town system via connections at East Avenue and Roosevelt Road and at East Avenue and 13th Street in Berwyn. At its connection with the East Avenue trunk sewer, the Upper Des Plaines/West Town's interceptor is semi-elliptical in shape with dimensions of 144 inches by 160 inches.

Lombard Avenue Trunk/Outlet

Approximately 870 acres within the eastern portion of Oak Park drain to the MWRD Northwest Intercepting Sewer located in Lombard Avenue. Constructed in the mid 1960's, this interceptor is currently the largest and deepest outlet sewer serving Oak Park. The existing pipe ranges in diameter from 132 inches at Lake Street to 180 inches at Roosevelt Road and is located about 45 to 50 feet below grade.

Major sewers tributary to the Lombard Avenue outlet include the Cuyler, Lombard, and Taylor trunk sewers draining the northeastern part of the Village. Connections along Lombard south of Lake Street also drain many of the smaller branch lines serving the eastern and southeastern sections of the Village. In addition, the 102 inch diameter Erie Street relief sewer conveys wet weather flows from the East Avenue trunk sewer and northwestern portions of the Village to the Lombard outlet. The Lombard Avenue outlet is labeled as Outlet 6 in Figure 3.

Northwest Intercepting Sewer

Constructed in the mid-1960’s, the Northwest Intercepting Sewer runs south along Lombard Avenue from Lake Street in Oak Park to the Stickney WRP. The primary connection between the Oak Park sewer system and the Northwest Intercepting Sewer is located at Lake Street and Lombard Avenue. However, a number of small drop connections deliver flow from Oak Park to the interceptor along its route through the Village. In addition, two 96-inch diameter upstream branches of the interceptor system collect flows from the west side of Chicago before joining the main section of the pipeline in Oak Park.

This interceptor was constructed specifically to provide additional outlet capacity to Chicago, Oak Park, and the downstream communities of Berwyn and Cicero. Along its route, the sewer ranges in diameter from 132 inches at Lake Street to 180 inches at Harrison Street. South of Oak Park, the diameter of the line increases again to 240 inches before reaching the Stickney WRP.

TARP SYSTEM

The MWRD completed construction of the Des Plaines branch of the Tunnel and Reservoir Plan (TARP) in 1999 including components along the Des Plaines River in Forest Park and River Forest. These facilities are part of the regional TARP Phase I system built to reduce combined sewer overflows (CSO’s) throughout the Chicago metropolitan area. Phase II of TARP includes the McCook Reservoir, which will provide storage for combined sewage from both the Des Plaines and Mainstream TARP tunnel systems.

In concept, TARP works by providing relief points near outfall locations for flows in excess of interceptor capacity. Storage for combined sewage is provided both in the tunnels and in the reservoir associated with each branch. In this way, the system is able to reduce the likelihood of overflows of combined sewage to area waterways. Combined sewage captured by TARP is stored for the duration of the storm event and then pumped gradually to facilities where it can be treated prior to discharge.

The southern section of the Des Plaines branch of the Phase I TARP system is intended to reduce CSO’s from the combined sewer communities located along the Des Plaines River south of Fullerton Avenue. With this Phase I system in operation, the frequency and duration of CSO’s from the interceptor system have been greatly reduced. Once the Phase II McCook Reservoir is completed, the impact of the TARP system to CSO prevention in the tributary Des Plaines area should increase. However, the Village’s only access to the TARP system is through the Oak Park Outfall Sewer in Chicago Avenue. Due to the age, depth, and limited capacity of this sewer, the direct impact to the Village from Phase II TARP completion without additional improvements should be minimal.

SUMMARY

The Oak Park combined system is a complex and aging network of pipelines constructed to collect and convey both sanitary and combined wastewater generated within the Village. Key facts concerning the system include the following:

- The Oak Park combined system includes 110 miles of sewer varying in diameter, material, age and condition.
- More than 50 percent of the combined sewers serving Oak Park are lateral collector sewers 15 inches in diameter and smaller.
- All major trunk sewers serving the Village are over 45 years old, and several sections are 75 – 90 years old.

- The Oak Park system relies completely on the MWRD interceptor system for outlet capacity.
- When completed, the McCook Reservoir will reduce the amount of combined sewer overflow to the Des Plaines River in communities upstream of Oak Park, but will not significantly improve the outlet capacity of the Village

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Village of Oak Park Combined Sewer Mapping and Modeling

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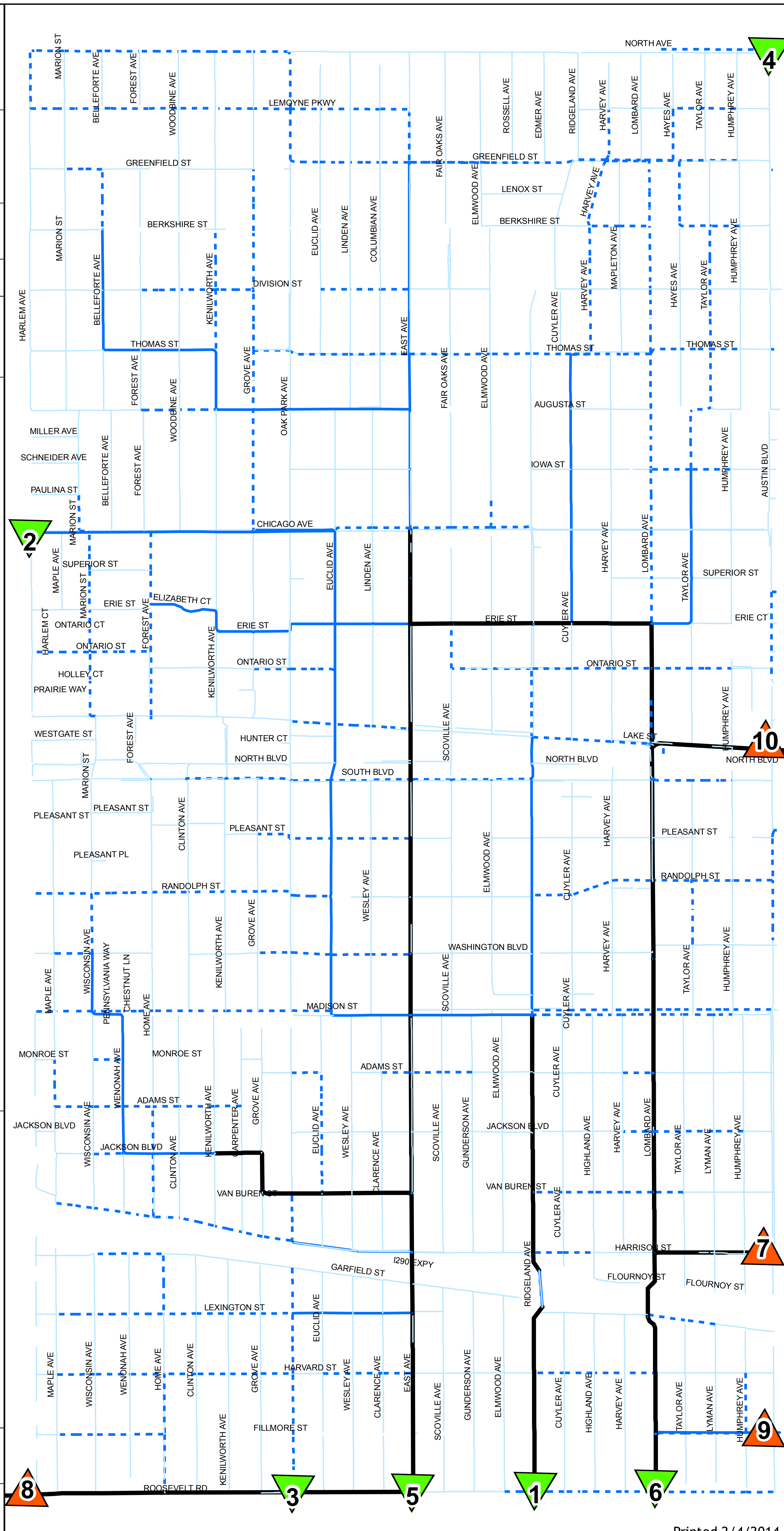
Figure 3: Existing System Inflows and Outlets



Legend

Outlet

External Inflow

Existing Sewer Diameter

- 6 - 22 in.
- 24 - 48 in.
- 50 - 82 in.
- 84 - 180 in.

Feet
0 550 1,100

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4 MODEL DEVELOPMENT

To evaluate existing and proposed sewer system capacity in the Village, an all-pipes model of the combined sewer system within the Village limits was created using InfoWorks CS software. InfoWorks has a powerful simulation engine which allows evaluation of many alternative scenarios to optimize potential improvement projects.

Model creation was based on the Village's GIS database of physical assets, which was updated by MWH reflecting more recent information provided by the Village. A hydrologic model of the Village was created using the Village's GIS data of impervious area, soil types, and census-derived population data. The hydrologic model was then added to the physical asset (pipe network) model and calibrated to recently acquired flow monitoring data. The calibrated model was used to assess the existing baseline flooding condition, and evaluate potential improvement projects for specific design storms.

PHYSICAL ASSET UPDATE

Before any hydraulic modeling could begin, the existing Village pipe network GIS database was updated to reflect current conditions. The output of this task was a correctly connected, complete, updated network database suitable for building a reliable sewer model.

Data included in the physical asset update was provided to MWH by the Village in different formats as described in the following sections. Sources were considered in the order of precedence listed below, which represents a ranking of the data based on quality and gives priority to more reliable data. At locations where conflicting data was found, this order of precedence was used as a guide to selecting the best available data source.

2003 – 2012 Village CIP Files

The Village CIP data is a compilation of as-built drawings in DGN format. This is the newest data processed in the GIS update, includes information that has been checked by Village staff, and is considered the most reliable data source for the existing sewer system.

1994 MWH Model Schematics

During the course of sewer modeling for the 1994 Combined Sewer System Evaluation Study by MWH, schematics were produced detailing hydraulically significant junctions at 47 locations throughout the Village. Since this data has previously undergone QA/QC and been incorporated into a successful computational model of the Village's trunk main sewer system, it is considered a very reliable compilation of the details needed to model these complex structures and was superseded only by the Village CIP data.

Existing Village GIS

The Village provided several layers of sewer data in ESRI geodatabase feature class format including pipes and manholes, which was used as the basis of the update. Pipe data was nearly complete including more than 99% of diameters and pipe ages, but required updates. Manhole data was incomplete containing less than 1/3 of invert elevations. While manhole invert data was lacking, the data and connectivity represented in the pipe database was considered to be reliable except where it conflicted with the data sources noted above.

Existing Village Survey

The Village has utility survey data in DGN, DWG, and PDF format. This data currently needs QA/QC of pipe sizes and layout configurations by the Village. Therefore, the survey data was only used to supplement missing invert fields in the GIS data that remained after incorporation of CIP data and the 1994 MWH model schematics.

Existing Sewer Atlas Sheets

The existing Village sewer atlas is available in a scanned electronic format and includes a set of 36 sheets covering the extents of the Village. It is estimated that there are only few locations that the sewer atlas has invert information where the survey and GIS data do not. However, the sewer atlas was used to supplement missing data as needed.

1992 – 2002 Village CIP Files

The Village has as-built drawings from sewer CIP projects completed during 1992-2002. Since the data in these sheets is of lower quality than other sources, it was used only to provide data for gaps remaining after above data sources had been exhausted.

Supplemental Survey

A survey to supplement missing invert elevations at critical manholes after incorporation of the data sources listed above was necessary at only a few locations, and was performed by Village staff.

Interpolation

Mid-block manholes with missing invert data were interpolated using a straight-line through known manholes upstream and downstream after exhaustion of the data sources listed above.

HYDROLOGIC MODEL

To properly represent flows entering the Village combined sewer system, a hydrologic model was built within InfoWorks. First, the Village was divided into 390 separate subcatchments representing individual sources of both dry weather flow (DWF) and surface runoff. DWF was calculated first as a per-capita rate based on flow monitoring as described below. Population density data was downloaded in a GIS format from the US Census website, and each subcatchment was assigned an appropriate population density. Total DWF from each subcatchment was then calculated based on this data.

Two GIS layers were available from the Village for estimation of impervious area; building footprints and curb lines. A third layer of impervious area was created by MWH by tracing major parking lots in GIS shown on aerial photography. The remaining impervious areas, mostly alleys and residential driveways, were estimated as a percentage of total pervious area.

To calculate infiltration through pervious areas, the soil type GIS data received from the Village was used to calculate the fraction of each soil type within each subcatchment. Soil infiltration parameters were estimated from Akan[1], and were applied to each soil type.

The ground slope in each subcatchment was calculated within Infoworks from 2-foot interval contour topography data provided by the Village and shown in Figure 2.

[1] Akan, A.O., "Horton Infiltration Formula Revisited," *Journal of Irrigation and Drainage Engineering*, ASCE, Vol. 118, No. 5, pp. 828-830, 1992.

FLOW MONITORING

The purpose of flow monitoring in this study was to record flow rates during both dry and wet weather conditions, so that assumed model parameters could be adjusted to more closely represent observed conditions. Flows were recorded from April 22, 2013 to June 3, 2013 in Village combined sewers at six locations shown in Figure 4. A detailed report on the flow monitoring can be found in Appendix C, with a summary of recorded events shown in Table 1. Although several distinct precipitation events occurred during this period, all were of less than a 2-month recurrence interval. Since none of the recorded events were representative of a significant design storm, outlet conditions for design storms were bracketed to represent a range of expected conditions.

Table 2: Summary of recorded precipitation events

	Depth (in)	*Duration (hr)*	*Avg. Intensity (in/hr)*
4/23/2013	0.62	12.7	0.05
5/9/2013	0.55	8.2	0.07
5/20/2013	1.00	3.6	0.28
5/21/2013	0.82	9.5	0.09
5/28/2013	0.62	1.5	0.41
5/30/2013	0.33	4.3	0.08
6/1/2013	0.60	3.4	0.18

MODEL CALIBRATION

Flow monitoring data was then used to perform a DWF calibration. First, a period of five consecutive days without rainfall was isolated so that a DWF pattern specific to the Village could be calculated. A per-capita DWF rate was then applied to that pattern and adjusted so that simulated and recorded flow rates at meter locations matched as closely as possible. The pattern and per-capita DWF rate was then used for all wet-weather simulations.

The results of the dry weather flow calibration are shown in Appendix A in Figures A1 – A6. Generally, average and peak flows compare well with a 10% difference or less between observed conditions and simulated results. The only meter location that shows a difference of greater than 10% is M3. However, this meter recorded a low average flow, and the absolute difference varies between only 0.1 to 0.2 cfs.

Wet weather calibration was performed by adjusting several parameters estimated during the development of the hydrologic model. The three parameters adjusted for wet weather calibration were initial losses, soil infiltration rate, and the fraction of impervious area represented by alleys and private driveways, which could not be measured directly as described above. Modest adjustments of these parameters resulted in a reasonable match between simulation results and observations.

Using flow monitoring data from the largest storm possible is considered good practice for model calibration. There are some connections in the Oak Park system, such as overflows into relief pipes, which may not be activated during smaller storms. As a result, system response may be different for large or small storms. In this study, the largest storm recorded was on May 20, 2013, and was used to perform wet weather calibration. This storm was only of a 3-month recurrence interval.

Results of the wet weather calibration are shown in Appendix A in Figures A7 – A12. The wet weather calibration resulted in a difference between simulated and observed peak flows of 10% or less at three of six meters, less than 25% at one meter, and less than 50% at the other two meters, with closer agreement at Village outlets, and lesser agreement at internal meters. One possible explanation for the internal (M1-M4) meters not matching simulation results as well as the outlets (M5-M6) is the assumption made for some impervious areas. Since a uniform average value for impervious area representing alleys, sidewalks, and driveways was used across the hydrologic model, meters with tributary area characteristics different than the average assumption may not match simulations. This effect becomes more pronounced in small, localized tributary areas such as meter M3, and less pronounced in large tributary areas such as meters M5 and M6. The effect is also more pronounced during smaller storms, such as the May 20 storm used in the calibration.

Two of the meters that matched peak flows within 10% are at the outlets at East Avenue and Ridgeland Avenue. Since the peak flows at these monitored outlets compare well, it suggests that the hydrologic inputs and overall performance of the Village system is represented well by the model and that the model calibration is appropriate for this study.

DESIGN STORM SELECTION

In this study, the model was used to predict combined sewer response to 1-hour duration design storms of 1-year, 2-year, 5-year, and 10-year recurrence intervals. Design storm data were obtained from Illinois State Water Survey Bulletin 71, using a Huff first quartile distribution to produce rainfall hyetographs.

A 1-hour duration was selected for all design storms. The short duration storm produces a higher intensity and is a more conservative design scenario compared to longer duration storms. Due to the conservative nature of this selection, model results reflecting existing conditions shown in Figures A5 and A6 indicate higher flood risk than records indicate for 1- to 10-year historical storms with longer durations. For example, a historical 10-year storm that occurred over a 12-hour duration would be expected to cause less flooding than the modeled 1-hour duration storm since it would have a lower intensity over a longer duration. The 1-hour duration storm is considered appropriate for the analysis completed for this study.

OUTLET CONDITIONS

Two outlet conditions were simulated in this study; base flow only and full outlets. Base flow outlet conditions are appropriate only for short duration storms where the outlets at the interceptors would not be expected to fill before the storm passes. Base flow outlet conditions are also useful to eliminate the effects of backwater effects from interceptors on the Village system. Elimination of flooding caused by backwater conditions at outlets allows identification of flooded areas that are caused by bottlenecks within the Village system and assessment of the capacity of the Village system itself.

Full outlet conditions represent a more conservative approach, setting the hydraulic grade line (HGL) elevations at the crown of each outlet pipe and simulating an outlet that is already operating near its maximum capacity. This situation as modeled with a 1-hour storm represents a high intensity storm preceded by another storm.

BASEMENT FLOODING CRITERION

The basement flooding criterion adopted for this analysis was defined as a simulated maximum instantaneous HGL elevation at less than 4 feet below grade. At locations where the crown of the local sewer is less than 4 feet below grade, the crown elevation is defined as the basement flooding criterion. Flood risk as discussed in this study refers to the most frequent storm violating the basement flooding criterion at a node as calculated by model simulations. Level of protection refers to the largest modeled storm in which a model node, building, or subcatchment is not predicted to be flooded.

A subcatchment and all buildings in it are considered to be at risk of basement flooding if it contains flooded nodes. Due to the lack of survey grade accuracy in the model, a minimum threshold was set to consider a subcatchment as flooded. For example, if a flooded node that should be within a few feet of the border of one subcatchment is slightly offset relative to another catchment, that catchment would be falsely considered flooded. To meet the flooding criteria threshold, subcatchments with 11-20 nodes must have at least two flooded nodes, and catchments with greater than 20 nodes must have at least three flooded nodes. No minimum threshold was set for catchments with 10 or less nodes.

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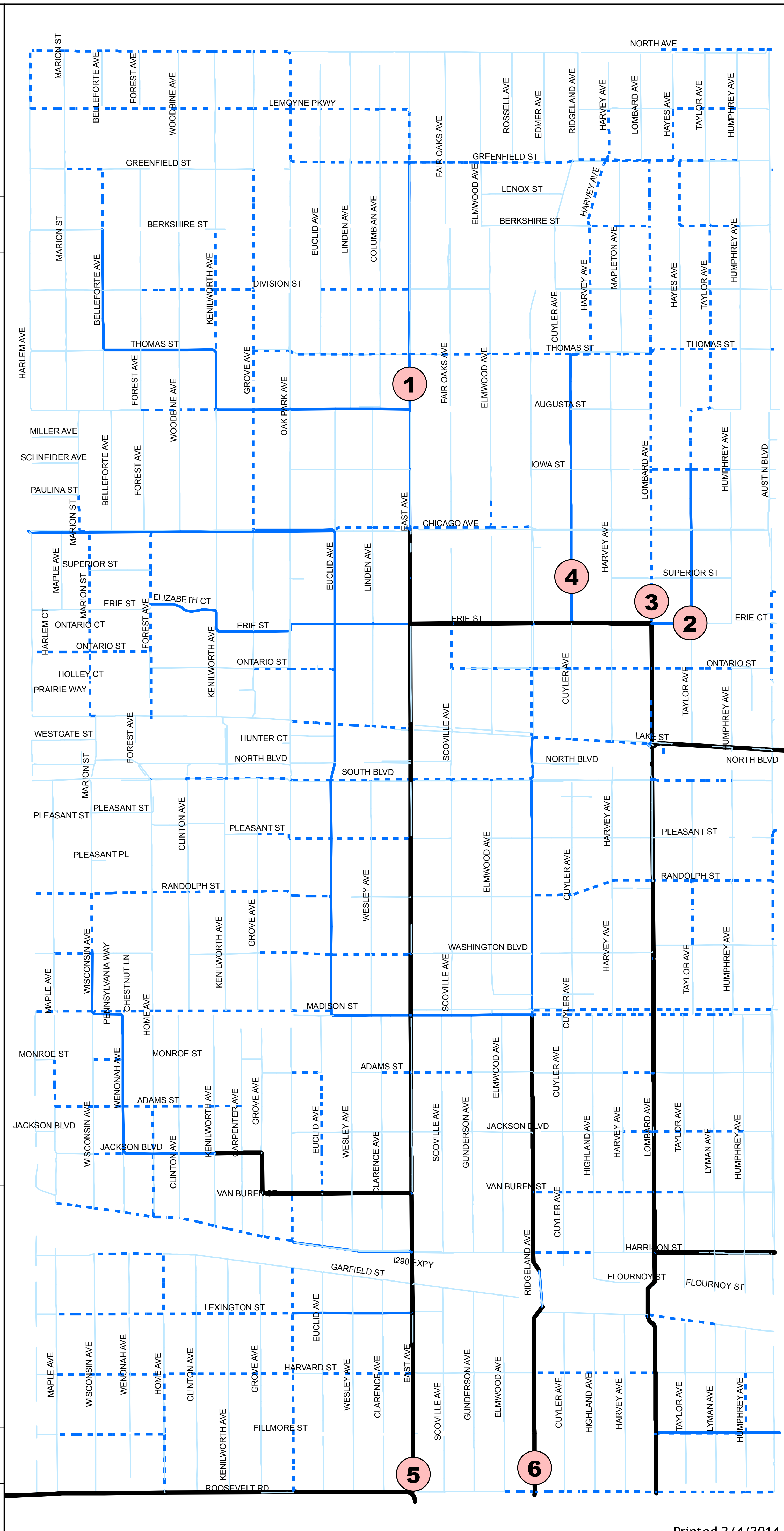
Figure 4: Flow Meter Locations



Legend

Meter Location

Existing Sewer Diameter

- 6 - 22 in.
- 24 - 48 in.
- 50 - 82 in.
- 84 - 180 in.

Feet
0 550 1,100

MWH®

5 ASSESSMENT OF EXISTING SYSTEM PERFORMANCE

The Village of Oak Park has a combined sewer system which conveys both sanitary flows and stormwater runoff to the MWRD interceptor system. The system is effective for dry weather flows (DWF), but the capacity of both the MWRD and Village systems can be exceeded during moderate to large storm events. When the capacity of either system is exceeded, the sewers may back up into private sewer laterals, causing basement flooding.

There are two primary situations which can cause basement flooding in Oak Park. The first is a lack of capacity in the Village's combined sewer system. This happens during short duration, intense events which exceed the capacity of the Village system to convey flows to the MWRD interceptors. In this situation, the storm is preceded by dry weather conditions so that interceptors are conveying base flow only, providing capacity for the interceptors to accept flows from the Village. However, storm water runoff cannot be effectively conveyed to these outlets. This problem can occur in both smaller local sewers and larger trunk sewers and can be addressed by improvements within the Village.

The second situation is a lack of available outlet capacity in the MWRD interceptors. This occurs during longer duration storms which generate runoff at rates that exceed the capacity of the MWRD interceptors. A short storm may also be preceded by another storm so that interceptors contain wet weather flow prior the second storm. In this situation, the ability for the interceptors to receive additional flow is reduced, along with the Village's overall protection from flooding.

In order to understand the flooding issues facing the Village, both of the scenarios described above were considered. Depending on when a storm arrives in Oak Park in relation to the previous storm there or in the region, MWRD interceptors may be flowing full or nearly empty regardless of the intensity, duration, or total volume of the current storm. Due to spatial and temporal variation of rainfall patterns, it could be possible for the level at any outlet to be on the rising or falling limb of a hydrograph, making the actual HGL elevation at the outlets difficult to predict. Additionally, the Village has no control over the level of service of the MWRD system. For these reasons, and because the Village is completely reliant on the available capacity in the receiving MWRD interceptor outlet sewers, it is logical to bracket the calculated level of service in the Village between full and dry weather flow only scenarios. Therefore, both of these conditions are considered in the assessment of the performance of the Village's existing system.

This assessment is of the Village's public local and trunk sewer system. The risk of flooding for individual basements may vary due to site-specific factors including installation of overhead sewer/backflow prevention devices or private laterals that are damaged or in excess of their capacity due to downspout connection. Since the condition of privately-owned sewer laterals was not assessed or modeled, only the risk of a basement flooding associated with the public sewer system surcharging could be assessed.

DESIGN CONDITIONS

Figures presented in this section show the modeled basement flood risk at manholes within the Village's existing system. In each figure, every manhole violating flood risk criteria for a 1-, 2-, 5-, and 10-year storm is identified. Manholes that are not shown do not violate the flood risk criteria for events up to and including the 10-year design storm.

Roughly 50% of the Village area has a level of protection of less than a 10-year storm when assuming base flow outlet conditions, as shown in Figure 5. All trunk sewers were found to be surcharged during the 10-year storm except Ridgeland Avenue south of the I-290 siphon. Most trunk sewers within the Village were at or near capacity during the 5-year storm, including East Avenue, Erie Street, Augusta Street up to Greenfield Street, Van Buren Street up to Grove/Jackson, Cuyler Avenue, and Taylor

Avenue. Older sewers were found to have some available capacity during the 5-year storm due to their higher elevation.

Roughly 85% of the Village area has a level of protection of less than 10 years when assuming full outlet conditions, as shown in Figure 6. Exceptions include the area along the ridgeline between the Des Plaines River and the Chicago Sanitary and Ship Canal watersheds due to the greater depth of sewers in this area, and the area east of Cuyler Avenue and south of South Boulevard due to the greater depth of the Lombard Avenue interceptor. Although basement flooding criteria are not violated in these areas, all trunk sewers in Oak Park are surcharged under the 10 year storm with full outlet conditions. Because the sewers are surcharged and have no additional conveyance capacity, it is not possible to significantly improve flooding conditions for this scenario without constructing an additional outlet for the Village.

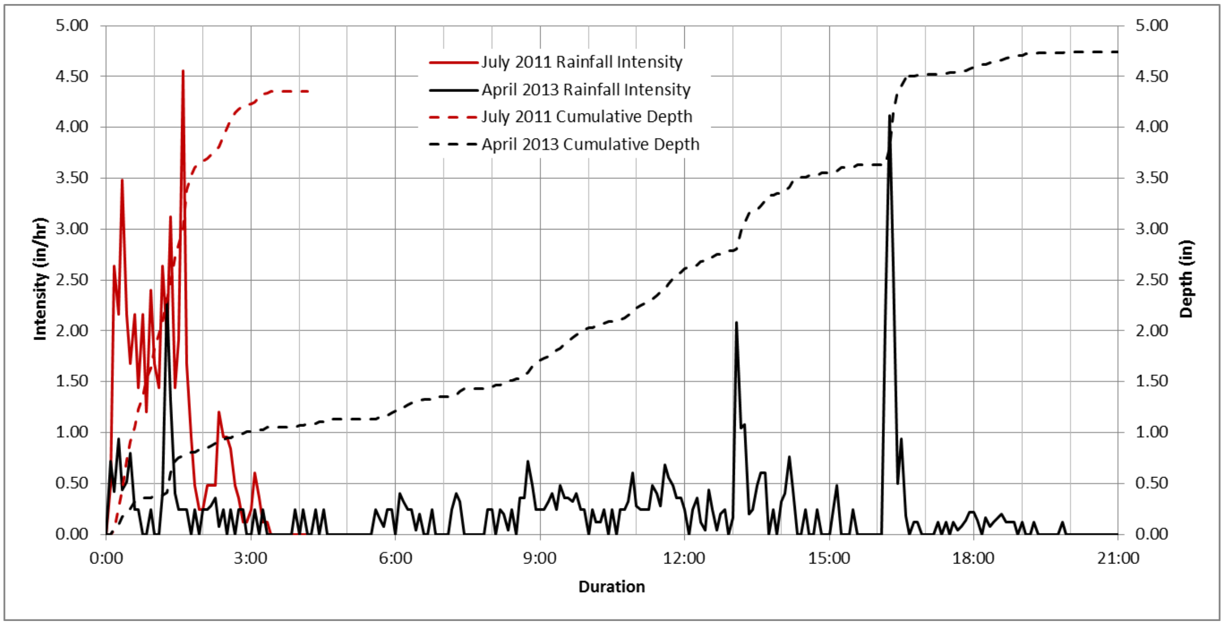
HISTORICAL RAINFALL SIMULATIONS

Two historical storm events (July 2011 and April 2013) were analyzed in this report. While both of these events caused basement flooding in the Village, the extent was different due to the nature of each event. These events represent different conditions causing flooding; July 2011 represents a short duration, intense event which exceeds the capacity of the Village system to convey flow to its outlets, and April 2013 represents a longer duration, less intense event which results in the outlets exceeding their own capacity and backing up into the Village system.

Historical flood complaints from July 2011 and April 2013 are shown in Figure 7 with the areas having the most significant flooding issues highlighted as focus areas. Focus areas were defined based on historical flooding complaints and modeling results, with more weight given to historical complaints. According to both historical complaints and modeling results, the Northeast Area is the most problematic. This area lacks a large dedicated trunk line to an MWRD interceptor that the other two focus areas have in the East Avenue trunk sewer. The northeast focus area does have two outlets serving the area, but both outlets are subject to upstream flows from the City of Chicago and depending on conditions there, may or may not have remaining capacity available to receive flow from the Village.

The south central and northwest focus areas have a similar historical density of flooding compared to the low distribution of basement flooding throughout the remainder of the Village. Modeling results suggest that flooding could be more extensive in these two focus areas under design conditions than the non-focus areas in the Village. In the northwest focus area, the area enclosed by Oak Park Avenue, Fair Oaks Avenue, Greenfield Street and Augusta Street has particularly shallow local sewers, which increases flood risk due to the reduced depth that a sewer must back up before potentially causing a problem. In the south central focus area, although the East Avenue trunk is nearby, there are no connections larger than 12 inches to take advantage of the trunk's proximity.

Figure 8: Rainfall intensity and cumulative depth for the July 2011 and April 2013 storms.



July 23, 2011

The July 2011 event was approximately a 50 year, 3hr storm, resulting in 281 reported flood incidents. As shown in Figure 8, this is an example of a short duration, intense event exceeding the capacity of the Village system. Figure 9 shows the modeled flood risk from the July 2011 event. The figure shows that nearly the entire Village is at risk of flooding, although flooding was not reported to be so widespread. Possible reasons that the simulated flood risk is not matching historical reported flooding include the installation of backflow prevention devices at homes, residents who choose not to report flooding, and likely more conservative assumptions of outlet conditions used in the simulation as compared to actual conditions.

April 17-18 2013

The April 2013 event was somewhere between a 10- and 25-year, 18-hour storm, resulting in 69 reported flooding incidents. Although the total depth of the storm is similar to July 2011, it was not nearly as intense, as shown in Figure 8. If only the most intense 30 minute period were examined, it would be considered less than a 1-year storm. This is an example of a storm that is easily conveyed by the Village system, but still causes flooding due to lack of outlet capacity. Figure 10 shows the modeled flood risk from the April 2013 event. The actual outlet conditions during this storm are unknown, but are assumed to be full because of the wide-spread rainfall both in time and in space.

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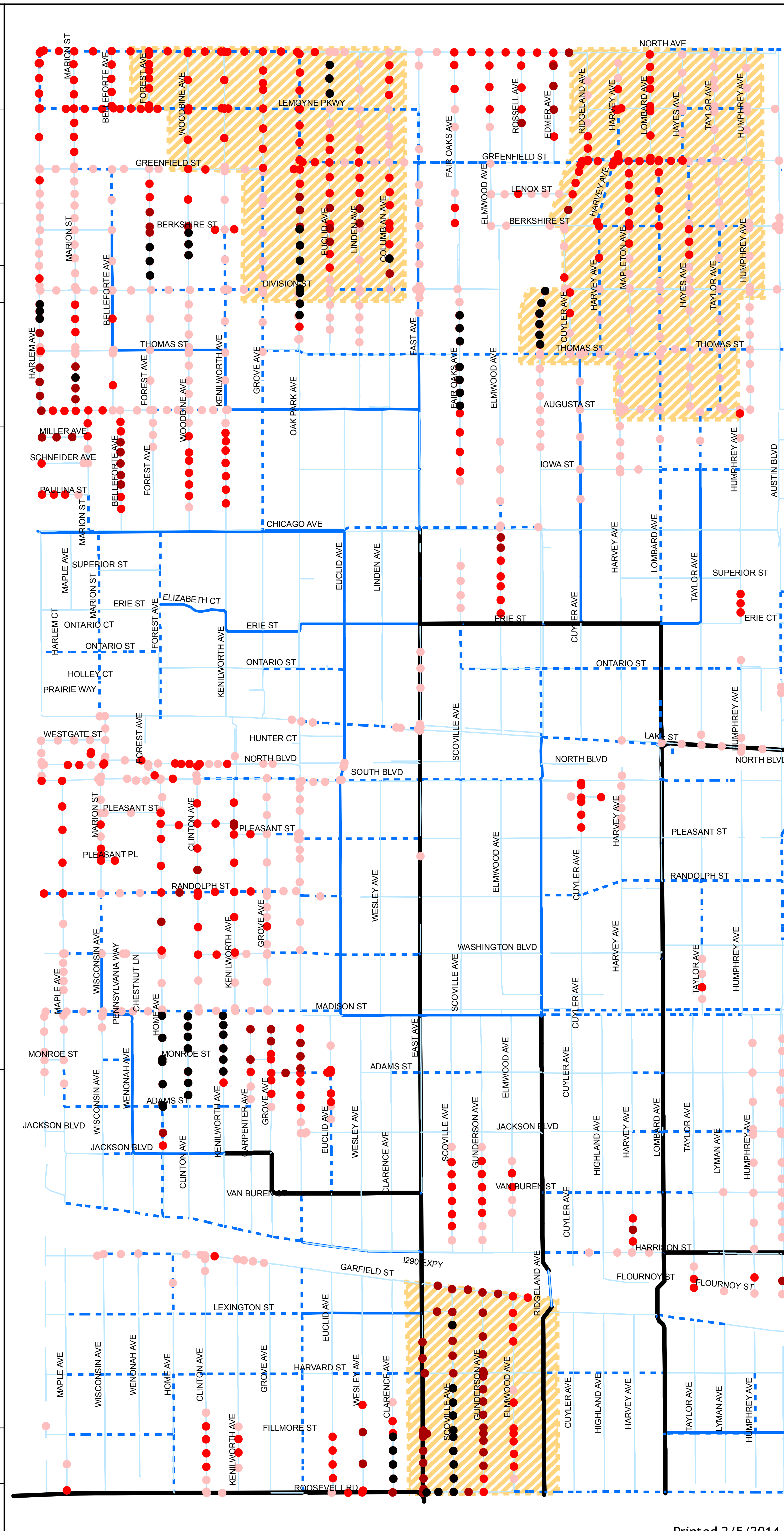
Figure 5:
Existing Level of Service with Base Flow Outlet Conditions



Legend

- 1yr Flood Risk
- 2yr Flood Risk
- 5yr Flood Risk
- 10yr Flood Risk
- Focus Areas

Existing Sewer Diameter

- 6 - 22 in.
- 24 - 48 in.
- 50 - 82 in.
- 84 - 180 in.

Feet
0 550 1,100

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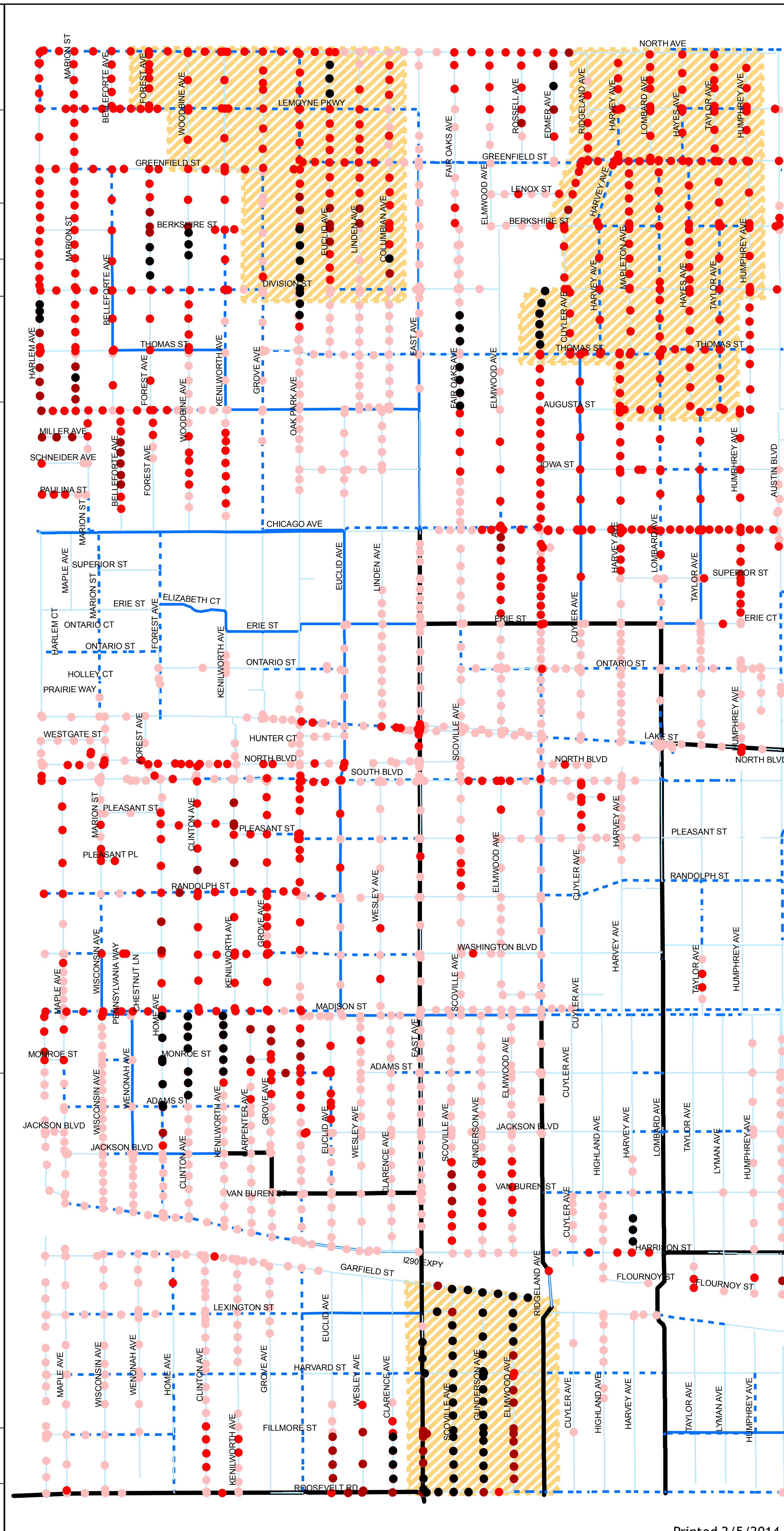
Figure 6:
Existing Level of Service with Full Outlet Conditions



Legend

- 1yr Flood Risk
- 2yr Flood Risk
- 5yr Flood Risk
- 10yr Flood Risk
- Focus Areas

Existing Sewer

- 6 - 22 in.
- 24 - 48 in.
- 50 - 82 in.
- 84 - 180 in.

Feet
0 550 1,100

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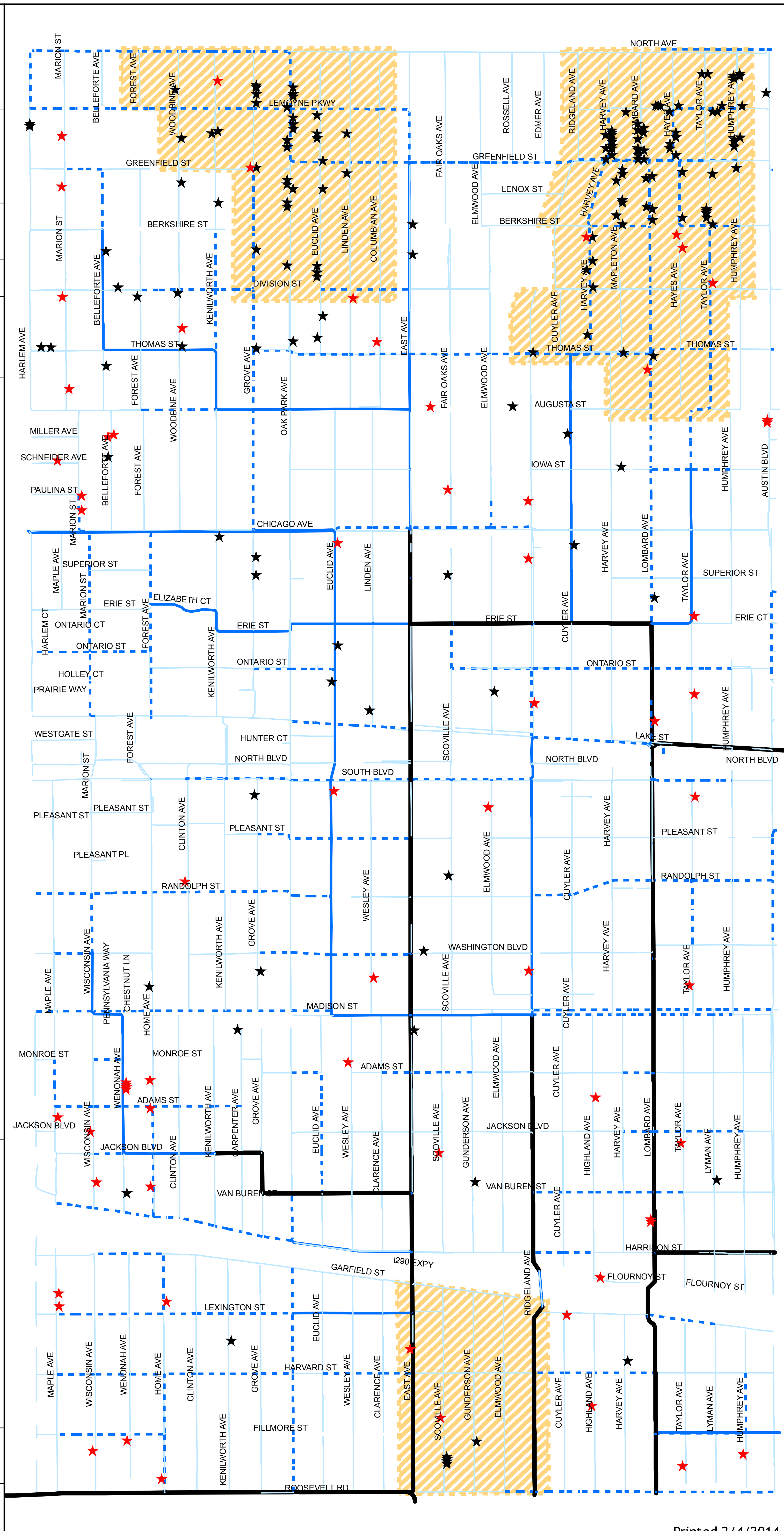
Figure 7: Historical Basement Flood Reports



Legend

April 2013

July 2011

Focus Areas

Existing Sewer Diameter

6 - 22 in.

24 - 48 in.

50 - 82 in.

84 - 180 in.

Feet

0 550 1,100

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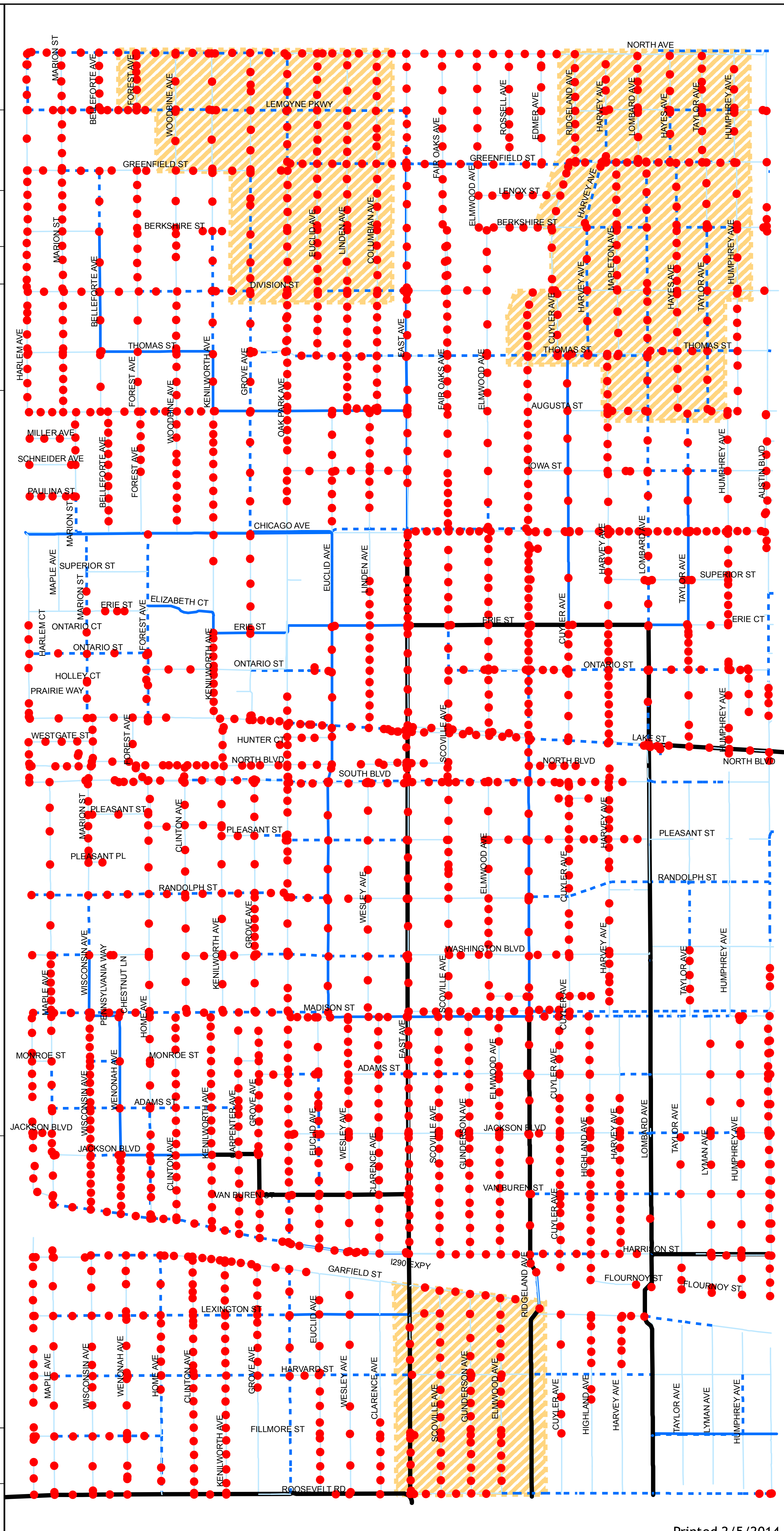
Figure 9: July 2011 Level of Service with Existing System



Printed 2/5/2014

Legend

- Flood Risk
- Focus Areas

Existing Sewer Diameter

- 6 - 22 in.
- 24 - 48 in.
- 50 - 82 in.
- 84 - 180 in.

Feet
0 550 1,100

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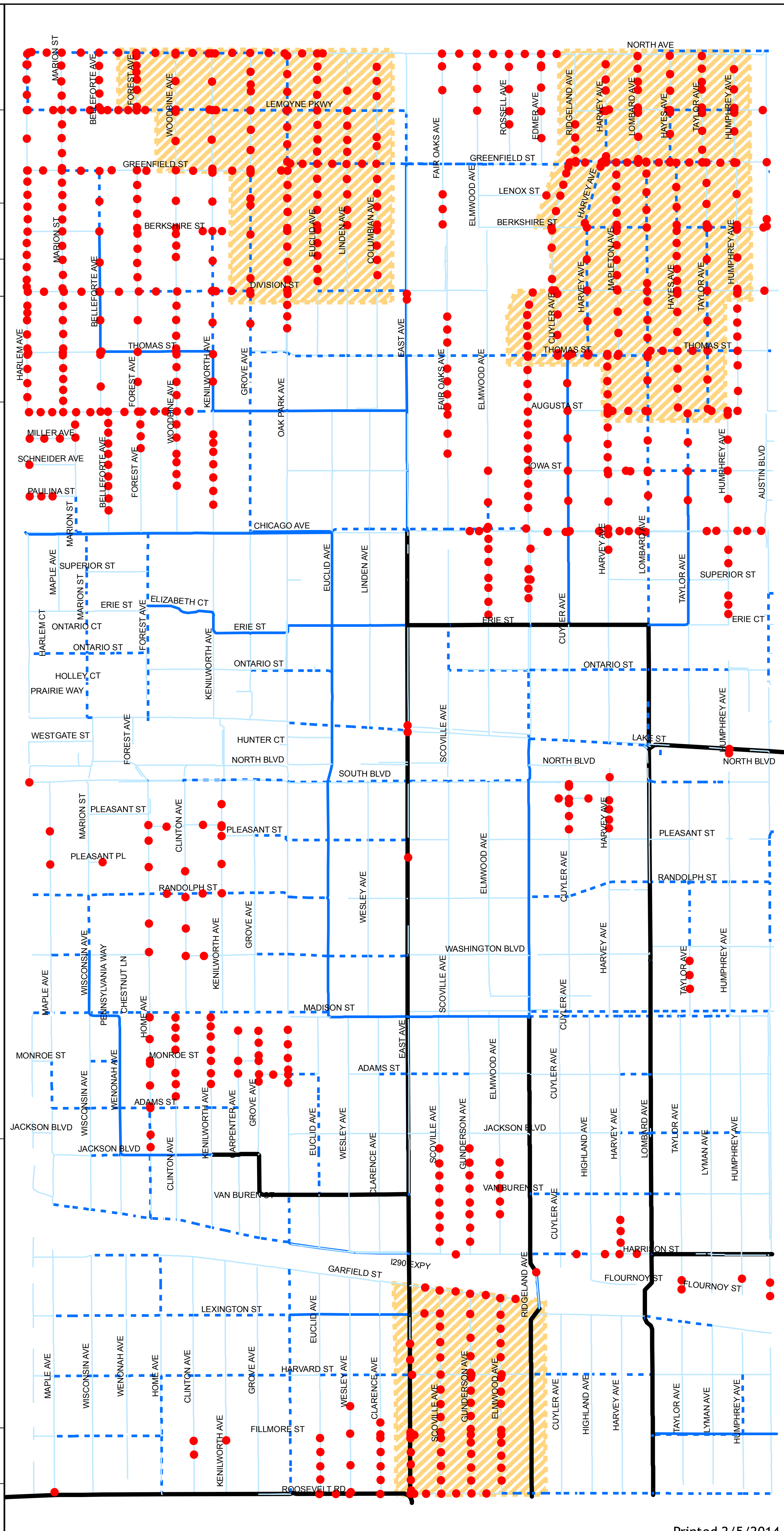
Figure 10:
April 2013
Level of Service
with Existing System



Legend

- Flood Risk
- Focus Areas

Existing Sewer Diameter

- 6 - 22 in.
- 24 - 48 in.
- 50 - 82 in.
- 84 - 180 in.

Feet
0 550 1,100

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6 EVALUATION OF IMPROVEMENT ALTERNATIVES

Projects identified in this section include traditional local and relief sewer improvements as well as an evaluation of green infrastructure alternatives, such as reduction of impervious area and implementation of rain barrels. Local and relief sewers were developed to increase protection against basement flooding to a 10-year level using existing trunk system capacity wherever possible. However, surcharging present throughout most of the Village system from a 10-year storm greatly limits the range of practical improvement options. In these cases, some projects have been designed for a 5-year level of protection to provide some level of improvement.

SEWER BACKUP CONTROL STRATEGIES

There are several strategies available to the Village for improvement of flooding conditions, many with limited benefit. Existing conditions such as number and size of outlets available and build-out conditions serve as constraints which limit the benefits associated with traditional gray infrastructure including trunk sewer improvements and regional detention.

The Project Type Matrix in Table 3 below shows strategies available for controlling sewer backups with their relative benefit and ease of implementation. On the top left, there are no project types given as high benefit and easy to implement. Analysis of the Village's system revealed that such a project does not exist. The types of conveyance projects required to provide a relatively high benefit cannot be implemented easily.

Existing system maintenance includes sewer repair and rehabilitation as well as simple televised inspection of sewers to verify they are in good condition and identify issues before they become problems. In the bottom right, regional detention is shown as a difficult project type with low benefit. The Village's near-build-out conditions make the footprint required for a large regional detention facility infeasible. All other project types, excluding backflow prevention, were investigated through the modeling software and are discussed in detail below.

Table 3: Project Type Matrix

Ease of Implementation

Flood Protection Benefit	Easy	Medium	Difficult
High	N/A	Local Improvements	Outlet Improvements Comprehensive Backflow Prevention Program
Medium	Backflow Prevention Cost Sharing Existing System Maintenance	Inlet Restriction with Downspout Disconnection (runoff rate reduction)	Trunk Improvements
Low	Rain Barrels with Downspout Disconnection (runoff volume reduction) Downspout Disconnection Only (runoff rate reduction)	Impervious Reduction (runoff volume reduction)	Regional Detention

FULL OUTLET CONDITIONS

In order to provide any reduction of basement flood risk under full outlet conditions, a new outlet must be constructed for the Village. The shortest route to a MWRD TARP tunnel that could potentially provide such capacity is through River Forest, as has been suggested in previous studies. A tunneled outlet to TARP via Division Street is shown as Project 201 in Figure 11 along with the resulting level of service that the proposed project would achieve. Nine key relief points have been identified throughout the Village that are needed to sufficiently lower HGL elevations and significantly reduce the risk of basement flooding. Relief points are assumed to consist of a junction chamber built around an existing pipe which is cut open above the springline to allow a dry weather flow bypass channel.

Project 201 gives a sense of the order of magnitude of a project needed to solve flooding problems under full outlet conditions. Project 201 is estimated at a cost of $42.4 million with a potential range of cost from $23.7 million to $56.0 million. Details of this cost estimate are provided in Appendix B.

At an estimated cost of $42.4 million and necessarily crossing another municipality for a connection to an MWRD sewer, this project would be difficult to implement both financially and politically. A more detailed hydraulic analysis and extensive negotiations with impacted agencies and communities would be needed to increase confidence in the feasibility of such a project before design and construction.

BASE FLOW OUTLET CONDTIONS

While Project 201 can provide improved protection under the full outlet scenario, the scope and cost required to provide protection for this scenario may be prohibitive. Local and relief sewers can be designed for a less conservative scenario and still provide benefits. Designing projects for base flow conditions (with the HGL at the outlets set to an average expected dry-weather flow value) may be the most feasible course of action for the Village. This approach allows the Village to maximize its system capacity both to accept flows from private service laterals and to deliver flows to MWRD outlets.

Local and Relief Sewers

Considering local and relief sewers alone, projects required to improve basement flood risk for base flow conditions are summarized in Table 4. Projects in Table 4 can be seen in Figure 12 with the improved level of protection provided by the projects. The simulation results shown include all projects simultaneously, although all have been tested individually and provide the same benefits independently as together. None of the projects result in increased flood risk in other areas of the Village. Cost estimates of the projects are shown in Table 5, and assumptions considered for the development of these costs are detailed in Appendix B. Costs in Table 5 are estimated on a per-block basis converted to cost per foot, then multiplied by the total length of pipe of each size.

Table 4: Sewer Project Descriptions

ID	Description	Justification
102	Replacement of existing 18" sewer with new 30" sewer on Roosevelt Rd from Wesley Ave to Scoville Ave. New 30" and 24" relief sewer on Fillmore St from East Ave to Ridgeland Ave. Replacement of existing 12" sewer with new 15" and 18" sewers on Clarence Ave from Harvard St to Roosevelt Rd.	Project increases conveyance capacity to East Ave and Ridgeland Ave trunks, replaces undersized sewers on Clarence Ave.
103	Replacement of small diameter sewers with 24" and 18" sewers on Garfield St and East Ave. New 36" and 30" relief sewer on Harvard St from East Ave to Ridgeland Ave.	Project increases conveyance capacity to East Ave and Ridgeland trunks, replaces undersized sewers on Garfield Ave.
104	Replacement of existing 12" sewer on Clinton Ave from Harvard St to Roosevelt Rd with new 15" and 18" sewers.	Project replaces undersized 12" sewer.
105	Replacement of existing 12" sewer on Kenilworth Ave from Harvard St to Roosevelt Rd with new 15" and 18" sewers.	Project replaces undersized 12" sewer.
106	Replacement of existing sewers with new 36" - 24" sewers on Jackson Blvd from Austin Blvd to Lombard Ave.	Project replaces undersized collector sewer, increases conveyance to Lombard interceptor.
107	New 42" and 36" relief sewer on LeMoyne Pkwy from Edmer to East Ave.	Project relieves undersized sewers on Fair Oaks Ave, Elmwood Ave, Rossell Ave, and Edmer Ave. Functions as underground storage in surcharged trunk conditions.
108	New 30" and 24" relief sewer on Van Buren St from Scoville Ave to Ridgeland Ave.	Project relieves three 12" undersized sewers.
109	Replacement of existing 12" sewer on Belleforte Ave from Augusta St to Chicago Ave with a new 15" and 18" sewers.	Project replaces undersized 12" sewer.
110	Replacement of existing 12" sewer on Woodbine Ave from Augusta St to Chicago Ave with new 15" and 18" sewers.	Project replaces undersized 12" sewer.
111	Replacement of existing 12" sewer on Kenilworth Ave from Augusta St to Chicago Ave with new 15" and 18" sewers.	Project replaces undersized 12" sewer.
112	Replacement of existing sewers on Augusta St, Forest Ave, and Chicago Ave with new relief sewer discharging to existing junction chamber.	Project increases conveyance to Chicago Ave interceptor.
113	Replacement of existing trunk sewer on Lombard Ave from Greenfield St to Erie St.	Project increases conveyance to Lombard Ave interceptor.
114	Replacement of upstream section of East Ave trunk sewer from LeMoyne Pkwy to Chicago Ave.	Project increases upstream conveyance of East Ave trunk sewer and reduces pressurization during intense events.
115	Replacement of undersized sewer on Columbian Ave from Berkshire St to Division St.	Project replaces undersized 12" sewer.

Table 4 Continued: Sewer Project Descriptions

ID	Description	Justification
116	Replacement and relief of undersized sewer on Fair Oaks Ave from Augusta St to Division St. Connection of existing sewers at Fair Oaks Ave and Berkshire St.	Project replaces and relieves undersized 12" sewers.
117	Connection of three existing 12" sewers on Columbian Ave, Euclid Ave, and Belleforte Ave to nearby trunk sewers.	Project relieves existing 12" sewers.
118	New 24" relief sewer on Berkshire St from Woodbine Ave to Belleforte Ave.	Project relieves two undersized 12" sewers on Forest Ave and Woodbine Ave.
119	New 18" connection from 12" Elmwood Ave sewer to 18" Chicago Ave sewer.	Project relieves undersized 12" sewer on Elmwood Ave from Chicago Ave to Erie St.
120	Replacement and elevation of existing trunk sewer on South Blvd from Harlem Ave to East Ave.	Project increases conveyance of South Blvd trunk sewer and reduces downstream backwater influence from East Ave trunk sewer.
203	Replacement of existing 12" sewer with new 18" sewer on Ridgeland Ave from Division St to Thomas St.	Project replaces undersized 12" sewer.
205	Replacement of existing sewers on Lenox St and Ridgeland Ave from Greenfield St to Berkshire St.	Project increases conveyance capacity in lower gradient Ridgeland Ave to match higher gradient sewers upstream in Lenox St.
206	New 30" - 24" sewer on Berkshire St from Linden Ave to Grove Ave with 12" connections to Linden Ave, Euclid Ave, and Oak Park Ave. New 15" sewer on Division St from Oak Park Ave to Grove Ave.	Project relieves three 12" undersized sewers.
208	Replacement of undersized 15" sewer on South Blvd from Cuyler Ave to Lombard Ave with new connection to existing 12" sewer on Cuyler Ave.	Project relieves undersized 12" sewer on Cuyler Ave from South blvd to Pleasant St.
209	New 24" relief sewer on Adams St from Euclid Ave to Wesley Ave and replacement from Wesley Ave to Clarence Ave. New 30" relief sewer on Monroe St from Kenilworth Ave to Wenonah Ave. Three new 12" connections from Grove Ave, Oak Park Ave, and Clinton Ave to existing 36" on Madison St. Three new short 12" connections from upstream ends of Home Ave, Clinton Ave and Kenilworth Ave to existing 30" on Madison St.	Project relieves six 12" undersized sewers and reduces flood risk over approx. 62 acres.
210	Replacement of existing 12" sewers on Harlem Ave and Marion St with new 15" sewers. Replacement of existing 15" sewer on Thomas St from Harlem Ave to Marion St with new 24" sewer.	Project relieves and replaces undersized sewers on Harlem Ave and Marion St near Thomas St.

Table 5: Sewer Project Cost Summary

ID	Length (ft)	Size (in)	Pipe/Manhole Cost	Restoration Cost	Estimated Total Construction Cost
102	40	36	$ 1,149,000	$ 746,000	$ 1,927,000
	1340	30			
	1010	24			
	660	18			
	660	15			
103	1010	24	$ 1,008,000	$ 603,000	$ 1,643,000
	560	18			
	1000	36			
	320	30			
104	660	18	$ 374,000	$ 245,000	$ 619,000
	660	15			
105	660	18	$ 374,000	$ 245,000	$ 619,000
	660	15			
106	360	36	$ 677,000	$ 413,000	$ 1,106,000
	660	30			
	310	24			
	690	18			
107	810	42	$ 657,000	$ 345,000	$ 1,018,000
	710	36			
108	670	30	$ 344,000	$ 212,000	$ 556,000
	335	24			
109	660	18	$ 375,000	$ 245,000	$ 620,000
	660	15			
110	660	18	$ 375,000	$ 245,000	$ 620,000
	660	15			
111	660	18	$ 375,000	$ 245,000	$ 620,000
	660	15			
112	80	36	$ 727,000	$ 449,000	$ 1,176,000
	670	30			
	720	27			
	670	24			
113	5190	72	$ 5,100,000	$ 1,469,000	$ 6,569,000
114	4620	84	$ 5,324,040	$ 1,396,000	$ 6,721,000

Table 5 Continued: Sewer Project Cost Summary

ID	Length (ft)	Size (in)	Pipe/Manhole Cost	Restoration Cost	Estimated Total Construction Cost
115	670	18	$ 271,000	$ 124,000	$ 395,000
116	80 1240 570	12 15 18	$ 722,000	$ 350,000	$ 1,072,000
117	150 180	12 15	$ 151,000	$ 62,000	$ 213,000
118	130 850	12 24	$ 415,000	$ 198,000	$ 613,000
119	90	18	$ 47,000	$ 17,000	$ 64,000
120	950 750 1190 1310	30 36 42 48	$ 2,246,000	$ 951,000	$ 3,197,000
203	440 260	18 15	$ 277,000	$ 130,000	$ 407,000
205	740 900	18 15	$ 637,000	$ 304,000	$ 941,000
206	780 330 420 130	30 24 15 12	$ 725,000	$ 336,000	$ 1,093,000
208	890 20 30	24 24 12	$ 418,000	$ 192,000	$ 610,000
209	670 760 1010	24 12 30	$ 1,044,000	$ 494,000	$ 1,554,000
210	1350 810	15 24	$ 859,000	$ 415,000	$ 1,290,000

Scoring

Benefit scores given to local and relief projects are shown in Table 6. Local and relief projects presented in this report are ranked in two ways; with a cost efficiency score and with a benefit score. Projects can first be evaluated and prioritized by their cost efficiency score. The cost efficiency score is shown as the Cost per Building Improved and is the total project cost shown divided by the number of buildings within all the subcatchments improved by that project. The number of buildings improved does not consider proposed level of protection, which varies from 5-year to 10-year.

Projects which have similar and acceptable cost efficiency scores can then be prioritized by their benefit score, which considers not only the final level of protection, but also the severity of existing flood risk improved upon.

The benefit score for each project is based on the improved basement flood risk for each impacted catchment. The score for each project is calculated as the average score of the catchments impacted by an improvement, weighted by the number of buildings in each catchment. For example, the score for Project 109 is a weighted average of a score of 7 for improving 26 buildings from a 2 year risk to a 10 year risk, and a score of 5 for improving 20 buildings from a 5 year risk to a 10 year risk, resulting in a final benefit score of 6.1. Table 6 summarizes benefit score assignment used in this analysis.

Table 6: Benefit score values assigned to each area improved

Existing Protection	Proposed Protection	Score
<1 year	10 year	10
<1 year	5 year	9
1 year	10 year	8
1 year	5 year	7
2 year	10 year	6
2 year	5 year	5
5 year	10 year	4

Table 7: Sewer Project Scoring Summary

ID	Existing Risk	Proposed Risk	Buildings	Benefit Score	Cost/Bldg Improved
102	2	5	90	**7.2**	**$ 4,000**
	5	>10	120		
	10	>10	30		
	1	>10	80		
	1	5	39		
	1	10	18		
	2	>10	100		
103	2	5	52	**7.1**	**$ 7,200**
	5	>10	48		
	2	>10	129		
104	5	10	65	**5.0**	**$ 9,500**
105	5	10	65	**5.0**	**$ 9,500**
106	5	>10	34	**4.5**	**$ 7,400**
	10	>10	116		
107	2	10	24	**5.3**	**$ 3,700**
	2	>10	29		
	5	10	1		
	5	>10	82		
	10	>10	140		
108	5	>10	96	**5.3**	**$ 3,800**
	10	>10	50		
109	2	10	26	**6.1**	**$23,846**
	5	10	20		
110	5	10	46	**5.0**	**$13,478**
111	5	10	30	**5.0**	**$20,667**
112+210	2	5	74	**5.7**	**$23,500**
	5	10	31		
113	2	10	26	**4.5**	**$ 5,400**
	5	10	166		
	5	>10	195		
	10	>10	832		
114+206+115	2	10	88	**5.4**	**$16,600**
	5	10	406		

Table 7 Continued: Sewer Project Scoring Summary

ID	Existing Risk	Proposed Risk	Buildings	Benefit Score	Cost/Bldg Improved
116	2	10	21	**6.6**	**$13,700**
	5	10	13		
	2	>10	18		
	5	>10	26		
114+206+117	2	10	88	**5.3**	**$15,400**
	5	10	434		
118	2	10	54	**7.0**	**$11,352**
119	2	10	28	**7.0**	**$ 2,286**
120	5	10	153	**4.7**	**$14,700**
	10	>10	65		
113+203	1	10	38	**4.6**	**$ 5,700**
	5	10	166		
	5	>10	195		
	10	>10	832		
113+205	5	10	200	**4.5**	**$ 6,100**
	5	>10	195		
	10	>10	832		
114+206	2	10	78	**5.1**	**$13,600**
	5	10	416		
	10	>10	81		
209	1	10	153	**7.6**	**$ 5,300**
	2	10	81		
	5	10	62		
208	5	>10	73	**6.0**	**$ 8,400**
210	2	10	72	**7.0**	**$17,900**

Green Infrastructure

The impacts of green infrastructure on flooding conditions are examined in this report both in focused areas and on a system-wide level. Both green infrastructure scenarios considered reduce total impervious surface within that area by 10 percent without any proposed gray infrastructure projects. On a Village-wide basis, the 10 percent reduction is approximately equivalent to the installation of permeable pavement in half of all Village alleyways and parking lots.

The impervious reduction scenarios in this report as modeled are intended to represent the implementation of rain gardens, vegetated swales, pervious pavement, or any other infiltration method over a previously impervious area. These various green infrastructure improvements can be grouped together in the model since the governing infiltration rate of the green infrastructure will be that of the underlying soil, which is considered at the subcatchment level. In other words, any methods of reducing impervious area are considered equivalent in the model.

The results of the first impervious reduction simulation are shown in Figure 13. This scenario focuses impervious area reduction in the areas of the Village with sandy soil, which has a much greater infiltration rate than the predominant clay soil, and is most suited for impervious area reduction. When compared to Figure 5, the extent of 10-year flood risk decreases most significantly in the stretch of Madison Avenue between Wisconsin and Grove Avenues, and along Oak Park Avenue from South Boulevard to Washington Boulevard. Flood risk intensity is reduced in several small areas representing less than one Village block.

The results of the second impervious reduction simulation are shown in Figure 14. This simulation includes expansion of the impervious reduction into the rest of the Village, mostly clay soil. Comparison with Figure 13 shows that the only area where there is a significant improvement is in the northeast focus area. Approximately a four-block area in northeastern Oak Park improves from a 5-year flood risk to a 10-year flood risk. The extent of 10-year flood risk is also slightly reduced.

Rain Barrels

The impact of rain barrels on flooding conditions is also examined in this report both in focused areas and on a system-wide level. The use of rain barrels was simulated to show the benefit provided by installation of two 55 gallon barrels per single family home. It was assumed that runoff from each rooftop would first fill the rain barrel, then be allowed to spill and flow overland to the sewer when the rain barrel was full.

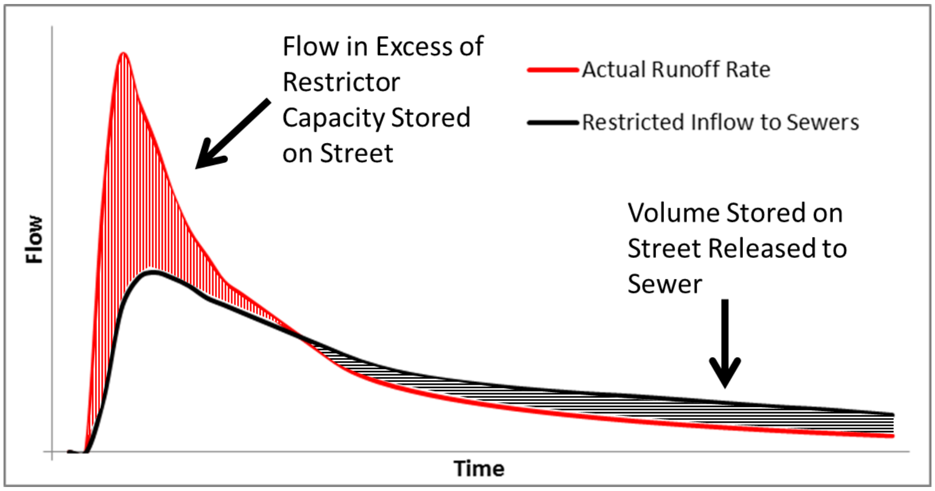
The first simulation considered rain barrel implementation only in the focus areas previously defined and is shown in Figure 15. There is some improvement just south of I-290 west of Grove Avenue, but very little reduction in spatial extent of 10-year flood risk Village-wide.

The second simulation considering rain barrel implementation Village-wide is shown in Figure 16. The total storage provided by the Village-wide use of rain barrels is approximately 1.2 million gallons, equivalent to a depth of 0.01 inches over the entire area of the Village. The results shown in Figure 16 suggest minimal improvement when compared to Figure 15. The total number of nodes improved is approximately 30 in a system of over 3000 nodes.

Inlet Control with Downspout Disconnection

Inlet control was also considered as an alternative to improve basement flooding. This approach limits inflows to the sewer system with retrofitted inlet restrictors, utilizing streets for temporary storage to delay inflows to the sewer system. The effect is to reduce flood peaks such as the example below in Figure 17.

Figure 17: Conceptual Example of Inlet Control



As the successful implementation of inlet control is dependent on achieving a high level of downspout disconnection, the two were simulated together. A downspout disconnection rate of 86 percent of single family homes was considered, doubling the existing rate as an upper limit of implementation and assuming 100 percent disconnection is unlikely.

The inlet control scenario assumes installation of a 0.15 cfs rated restrictor, with two exceptions noted below. Actual results from installation of restrictors with a different rating would not be consistent with this simulation and should be considered in an independent simulation.

The first exception is that no restrictors were modeled on three major roads in the proposed area: North Avenue, Harlem Avenue, and Oak Park Avenue. Inlet control is not recommended on major roads in order to keep them as clear as possible to allow emergency vehicles to pass with a greater degree of safety. The second exception is that restrictors were not modeled as installed in viaducts. Inlet control on roadways with depressed elevations could create a dangerous situation with excess stored water and is not recommended.

The simulation results with 86 percent downspout disconnection and 0.15 cfs inlet control are shown in Figure 18. As expected, there is a significant improvement in flooding conditions within the inlet control area. The reduced loading on the East Avenue trunk sewer also affects other areas fully or partially tributary to that sewer. In the northeast focus area, a four-block area is improved from a 5-year flood risk to a 10-year flood risk.

The main concern with inlet control is either exacerbating any existing surface flooding issues, or creating new issues where there were none previously. Pre- and post-inlet control simulation results were compared to address this concern. Assuming a typical public road easement profile, results were checked for locations where stored water would encroach upon sidewalks. This check is intended to keep stored water away from private property by limiting storage depth to 10 inches above the curb invert. All of the areas recommended for inlet control have a surface storage depth less than 9 inches for the 10-year simulated design storm. In the 100-year storm simulation, 18 subcatchments representing an area of roughly 150 acres in the northwest inlet control area simulated storage depths greater than 10 inches, but all were less than 13 inches deep. These results represent an initial screening of conditions. More detailed analysis of overland flow and ponding based on detailed surveys should be performed prior to the implementation of an extensive program of inlet control in any particular area.

Backflow Prevention

Overhead sewers, check valves, or other backflow prevention devices can be a very effective basement flooding prevention solution in that their ability to protect against basement backups is independent of the severity of the storm.

The cost effectiveness of backflow prevention is much greater than most of the local or relief sewers listed in Table 7. With a cost effectiveness score of $3,500 per building improved (the current rebate value), the Village could provide rebates for every single family home in the Village for approximately $35 million to $39 million. If the Village were to pay for 100 percent of the costs to provide exterior ejector pit systems at every home in Oak Park, it would cost approximately $75 million to $83 million. This would provide a much greater level of protection for each home they are installed in than any of the other projects considered in this report because its effectiveness is not tied to the magnitude of storms, but rather to the integrity of the installed system.

The implementation of Village-wide backflow prevention could increase the surface storage of combined sewage in the streets during large storm events as runoff is prevented from entering the existing, temporary storage of runoff provided by basements. Increased volume within the local sewer system may increase stress on the surcharged sewers and increase maintenance needs. Additionally, backups may increase in homes that remain without backflow prevention. These issues should be investigated through a more detailed study before system-wide implementation of backflow prevention.

REMAINING FLOODED AREAS

Although the Village's goal is to improve the level of protection Village-wide, simulation results indicate that some small areas of flooding could remain. Some isolated areas of flooding, affecting less than one half of a block, were identified which would require significant improvements to connect to a trunk sewer with available capacity. Because the anticipated costs far exceeded the potential benefits, projects are not recommended for implementation in these areas. In addition, the highly localized nature of these focus areas suggests that further review may be warranted before projects are considered for implementation. These further reviews could be based on more detailed surveys of ground elevations and/or pipe data, and would be used to verify the potential for flooding in these very localized problem areas.

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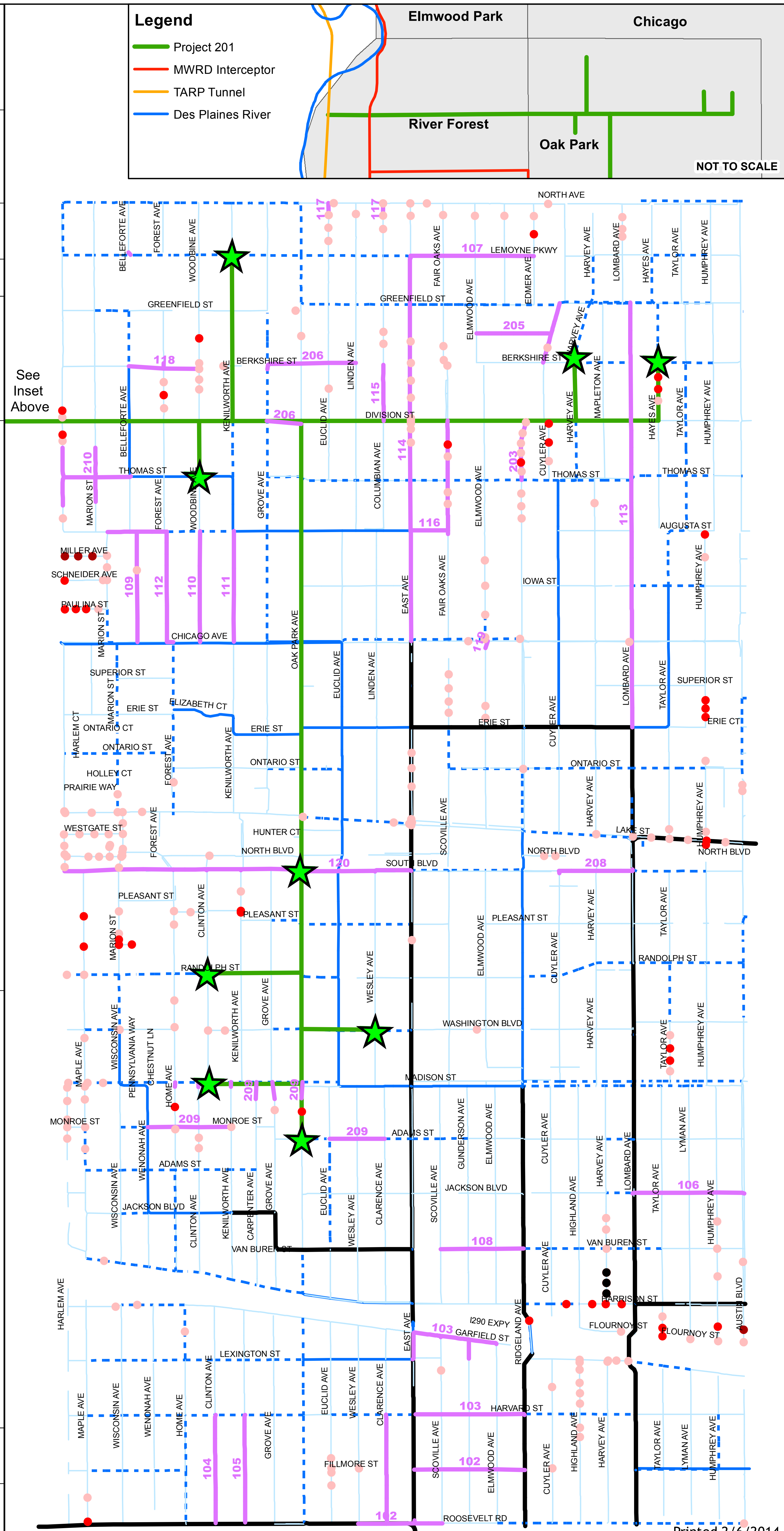
Figure 11:
Proposed Level of Service with Project 201 and Full Outlet Conditions



Legend

- Project 201
- Relief Point
- Other Projects
- 1yr Flood Risk
- 2yr Flood Risk
- 5yr Flood Risk
- 10yr Flood Risk

Existing Sewer Diameter

- 6 - 22 in.
- 24 - 48 in.
- 50 - 82 in.
- 84 - 180 in.

Feet
0 550 1,100

MWH

Village of Oak Park
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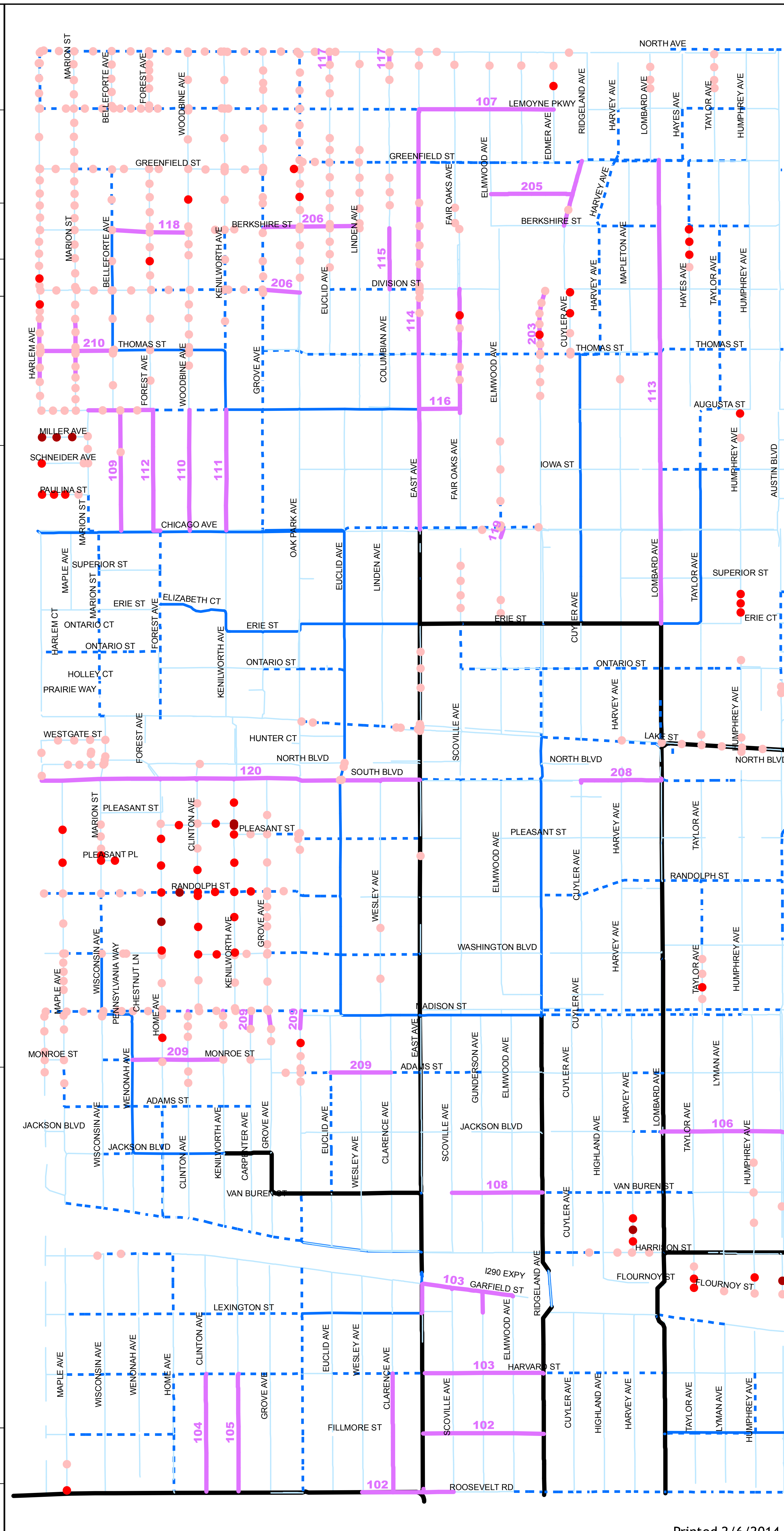
Figure 12:
Proposed Level of Service with Sewer Projects Only and Base Flow Outlet Conditions



Legend

- Projects
- 1yr Flood Risk
- 2yr Flood Risk
- 5yr Flood Risk
- 10yr Flood Risk

Existing Sewer Diameter

- 6 - 22 in.
- 24 - 48 in.
- 50 - 82 in.
- 84 - 180 in.

Feet
0 550 1,100

MWH

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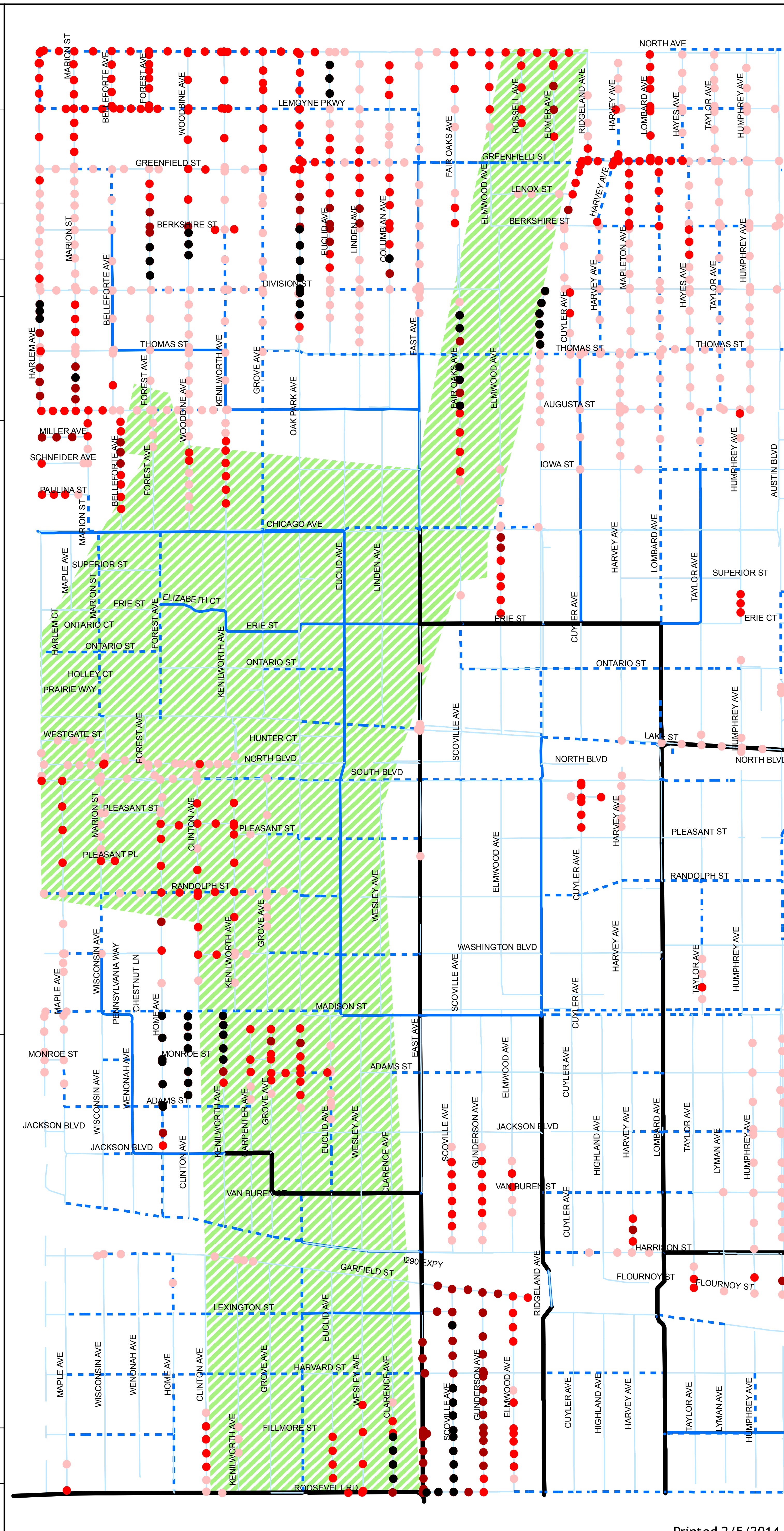
Figure 13:
Level of Service
with 10% Impervious
Surface Reduction
in Sandy Areas



Legend

- 10% Impervious Reduction
- 1yr Flood Risk
- 2yr Flood Risk
- 5yr Flood Risk
- 10yr Flood Risk

Existing Sewer Diameter

- 6 - 22 in.
- 24 - 48 in.
- 50 - 82 in.
- 84 - 180 in.

Feet
0 550 1,100

MWH

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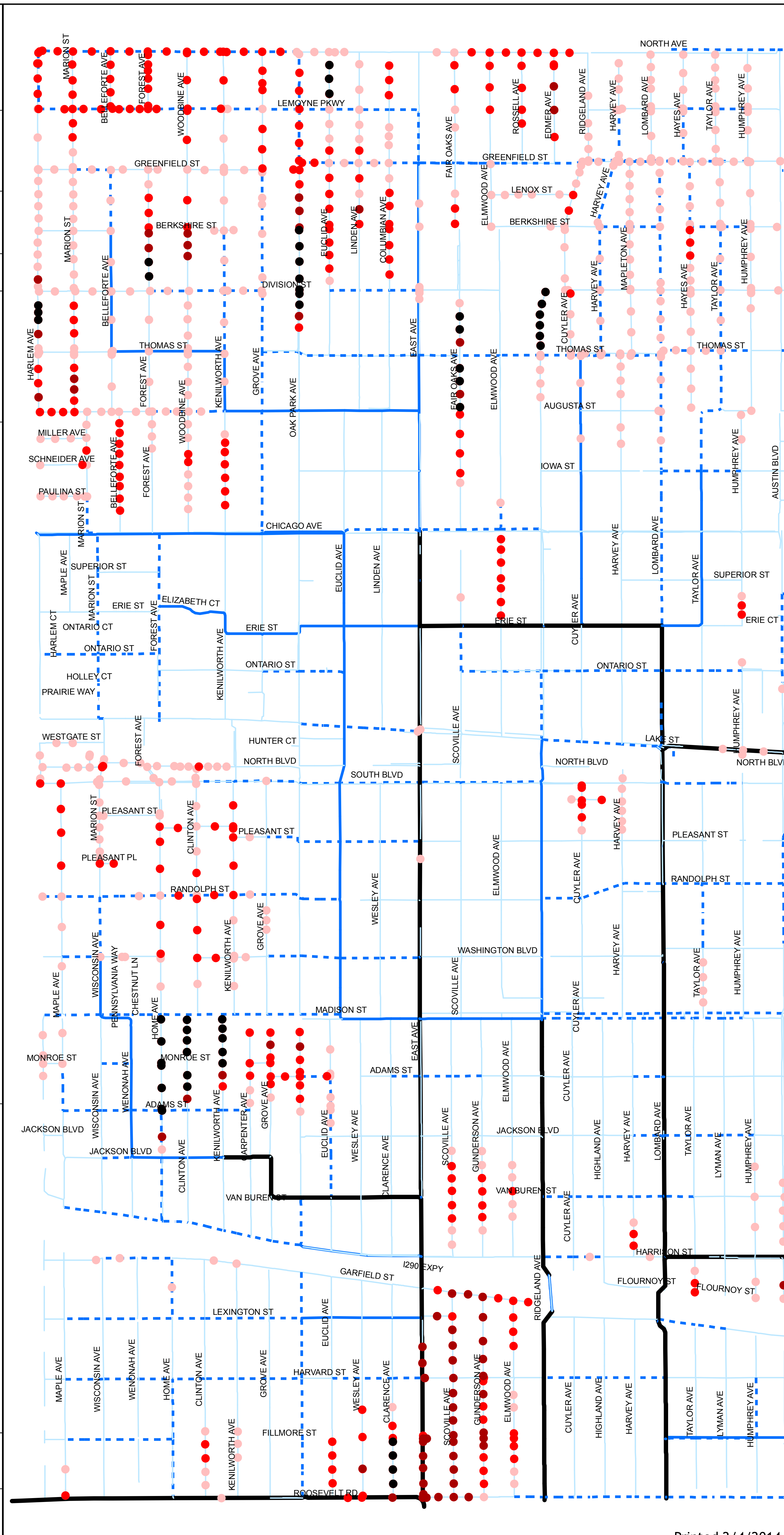
Figure 14: Level of Service with 10% Impervious Surface Reduction Village-Wide



Legend

- 1yr Flood Risk
- 2yr Flood Risk
- 5yr Flood Risk
- 10yr Flood Risk

Existing Sewer Diameter

- 6 - 22 in.
- 24 - 48 in.
- 50 - 82 in.
- 84 - 180 in.

Feet
0 550 1,100

MWH

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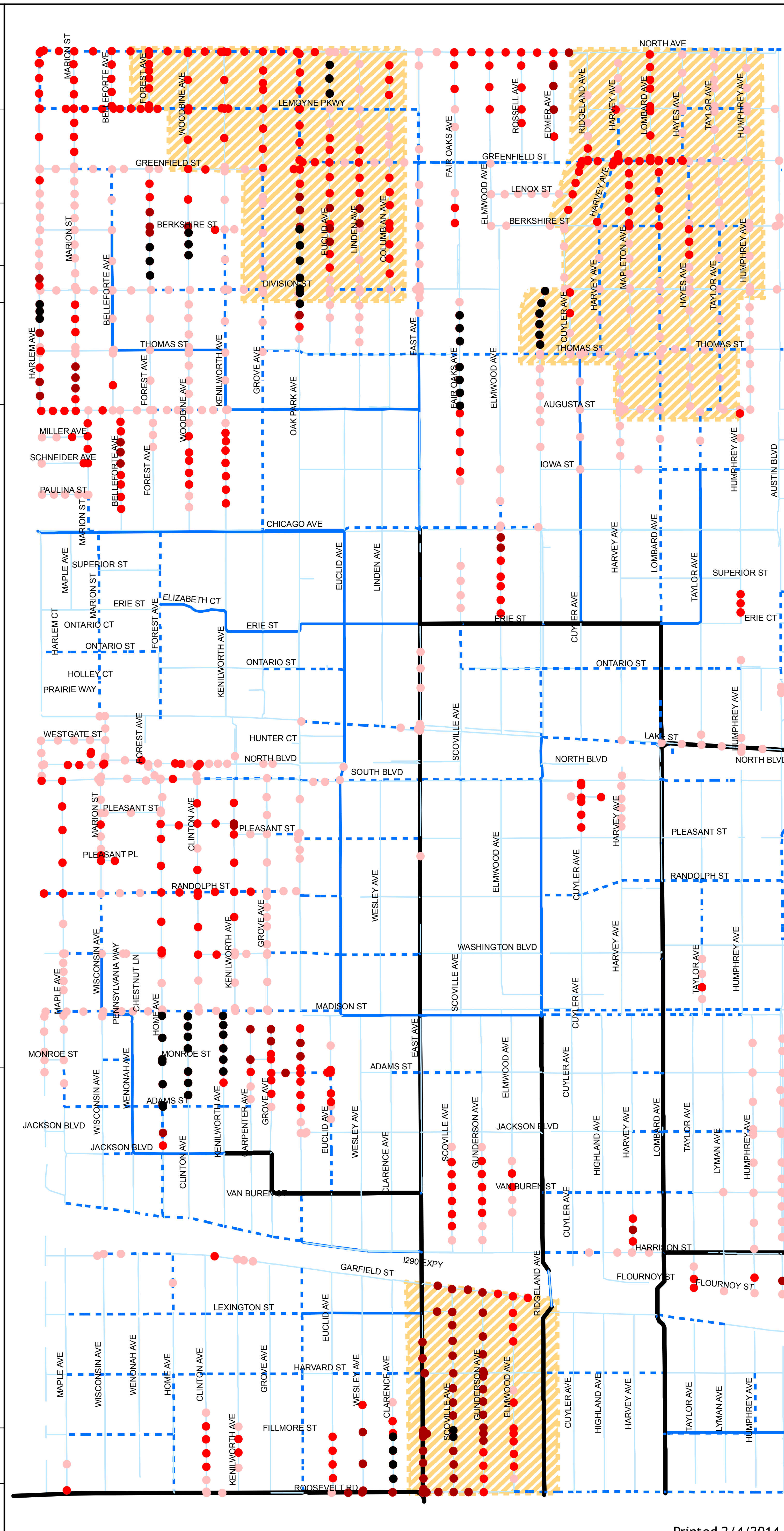
Figure 15:
Level of Service with
Rain Barrels in
Focus Areas Only



Legend

- Focus Areas
- 1yr Flood Risk
- 2yr Flood Risk
- 5yr Flood Risk
- 10yr Flood Risk

Existing Sewer Diameter

- 6 - 22 in.
- 24 - 48 in.
- 50 - 82 in.
- 84 - 180 in.

Feet
0 550 1,100

MWH

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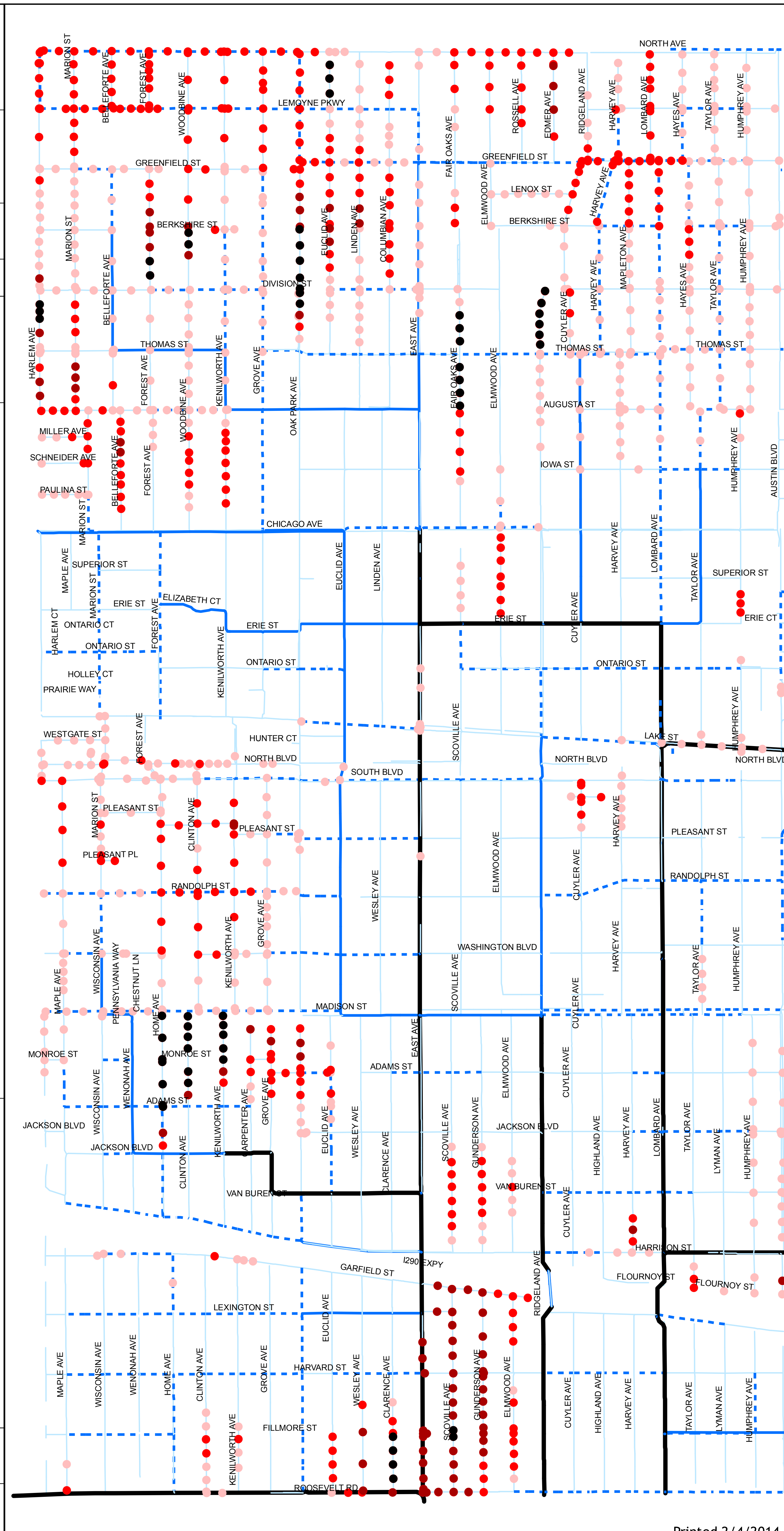
Figure 16:
Level of Service
with Rain Barrels
Village-Wide



Printed 2/4/2014

Legend

- 1yr Flood Risk
- 2yr Flood Risk
- 5yr Flood Risk
- 10yr Flood Risk

Existing Sewer Diameter

- 6 - 22 in.
- 24 - 48 in.
- 50 - 82 in.
- 84 - 180 in.

Feet
0 550 1,100

MWH

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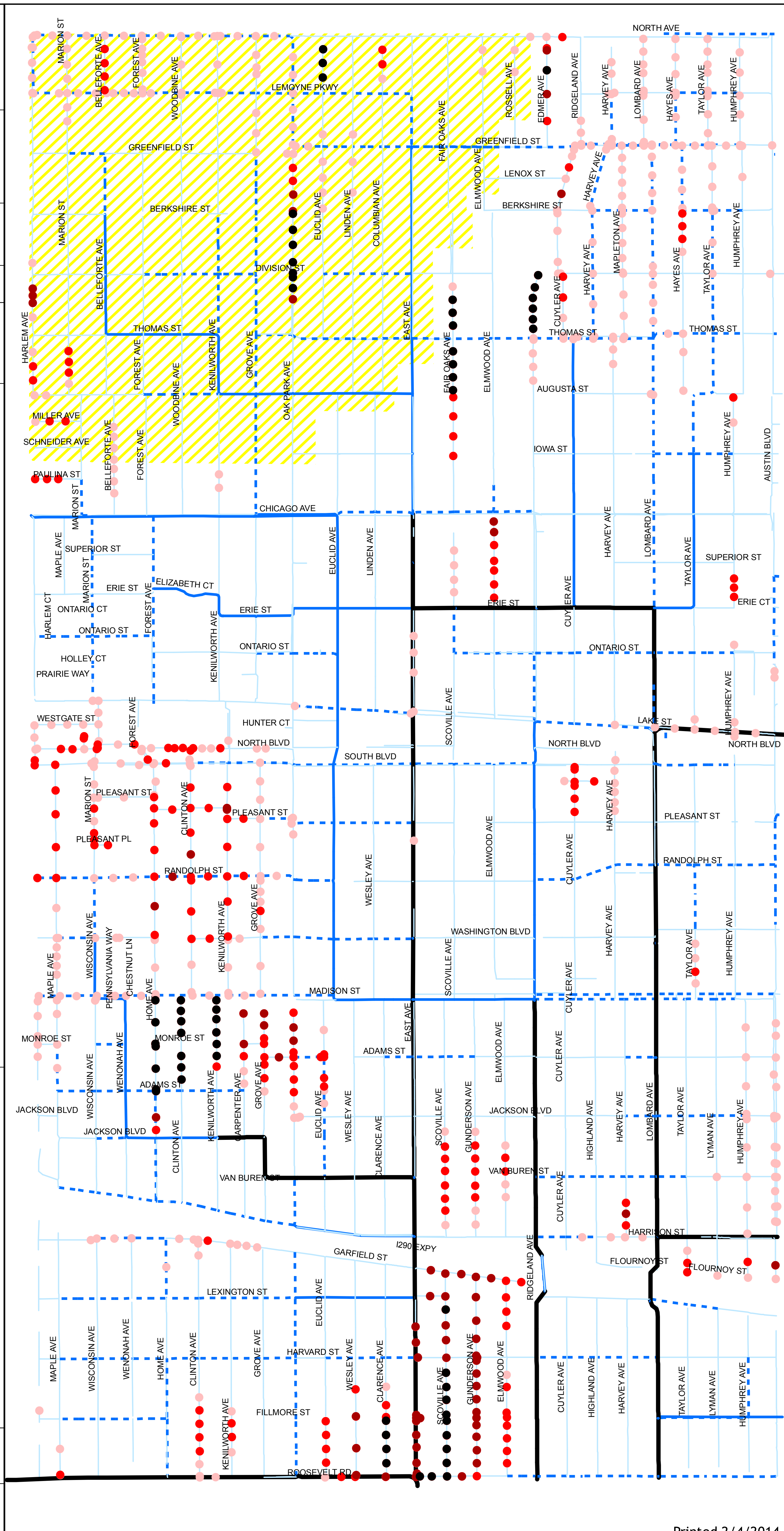
Figure 18:
Level of Service with
Inlet Control Only



Legend

- Inlet Control Area
- 1yr Flood Risk
- 2yr Flood Risk
- 5yr Flood Risk
- 10yr Flood Risk

Existing Sewer Diameter

- 6 - 22 in.
- 24 - 48 in.
- 50 - 82 in.
- 84 - 180 in.

Feet
0 550 1,100

MWH

7 RECOMMENDED PROGRAM

The biggest challenge facing the Village's sewer system is access to a consistently free discharge point for combined sewage or storm water. Since the existing system has limited storage capacity, runoff must be captured, conveyed, and discharged to a downstream point that has the capacity to accept the flow. When downstream capacity is not available, the ability of the Village's system to provide effective drainage is constrained.

Providing a new discharge point is technically feasible but would be extremely costly as demonstrated by Project 201 described previously. The significantly greater cost of Project 201 is difficult to justify by the additional protection it would provide against the modeled 10-year design storm with full outlets.

Given this constraint, the recommended program for improved stormwater management in Oak Park is a combination of runoff reduction, inlet control, local sewer improvements, and continued system maintenance structured to provide protection against basement flooding for events up to a 10-year storm. Due to varying conditions across the Village contributing to basement flood risk, different approaches must be taken for each focus area.

- The south central focus area lacks an effective connection to a large trunk sewer. Proposed sewers can be used to convey flows to a new drop structure on the East Avenue trunk, and to existing capacity on the Ridgeland Avenue trunk.

- In the northwest focus area, the relatively shallow depth of existing sewers and limited capacity of the East Avenue trunk causes sewer surcharging to reach private lateral elevations, creating basement flood risk. Project 114 is an important component to decrease flood risk here, increasing conveyance upstream in the East Avenue trunk, and serving as temporary underground storage when the East Avenue outlet is surcharged. Inlet control is also suggested to temporarily reduce inflows to East Avenue in order to reduce peak surcharge elevations further and reduce basement flood risk in this area.

- In the northeast focus area, the average ground elevation is much lower than the northwest focus area. Implementation of inlet control could potentially create problems caused by excess storage depth. However, the downstream Northwest Intercepting Sewer is much deeper, which can be taken advantage of by adding a relief sewer such as Project 113.

Simulation results of the recommended program show that a 10-year level of protection against basement flooding is achievable, as shown in Figure 19. The intensity of the July 2011 storm, however, is too great for the conveyance of the Village system, resulting in Village-wide basement flood risk with the recommended program in place as shown in Figure 20. The recommended program was successful in eliminating most of the basement flood risk associated with the April 2013 storm, shown by comparison of Figures 10 and 21.

Individual components of the recommended program are shown in Figure 22 and described below.

RUNOFF REDUCTION

In order to maximize the effectiveness of conveyance improvements, strategies may be taken to reduce both the total volume and rate of runoff entering the sewers.

Reduction of runoff rate and volume has benefits that carry through the entire network of conveyance, treatment, and discharge facilities. In addition to reducing the load on the Village system, every drop of water that is allowed to infiltrate to the soil rather than go to the Stickney WRP does not need to be treated, reducing energy usage at the plant and pollutant loading in the Chicago Area Waterway System.

Impervious Area Reduction

It is recommended that the Village proceed with efforts to achieve a long-term goal of a 10% reduction in impervious area throughout the sandy soil area. On average, the 10% reduction can be achieved by the installation of permeable pavement in half of alleyways and parking lots, which can be offset by the encouragement of voluntary homeowner impervious area reduction. In conjunction with the Village's current program of encouraging downspout disconnection, voluntary homeowner impervious area reduction would provide new areas to route downspout flows.

Rain Barrels

Simulation results suggest that large scale implementation of downspout disconnection with rain barrels has minimal benefit to flood risk. However, rain barrels have other benefits and should be included with the downspout disconnection program. This could be achieved by simply notifying residents on the Village website or newsletter that rain barrels are available at discounted rates from the MWRD.

For a small cost, benefits such as additional promotion of the downspout disconnection program could be acceptable. Those residents less informed of their options for downspout disconnection may be reluctant to participate. Introduction of rain barrels as an alternative to routing disconnected downspouts to their yard could provide enough to encourage more participation. Residents managing overland flows on their own property have the potential to create a more empowered and knowledgeable citizen base. Usage of rain barrels also helps to promote responsible water use and reduce the reliance of potable water for irrigation.

Downspout Disconnection

It is recommended that the Village continue their program of encouraging voluntary downspout disconnection with proper management of resulting overland flows. Direct connection of downspouts to the Village system provides a short path for runoff from rooftops to reach sewers. The public combined sewer system and private sewer laterals can become overloaded quickly as more flow enters sewers at once. To reduce the instantaneous loading of the local system, this path can be lengthened by disconnecting downspouts and effectively delaying runoff from rooftops entering sewers.

Also, direct connection of downspouts creates a risk of overloading private sewer laterals and causing back up into homes, which can be reduced by disconnection. In addition to these benefits, downspout disconnection is considered best practice and works most effectively together with other strategies recommended in this section, including impervious area reduction, rain barrels, and inlet control.

Inlet Control

Inlet control is recommended in the northwest part of the Village as shown in Figure 18. This approximately 500 acre area is nearly 100% tributary to the East Avenue trunk sewer, and contributes a significant fraction of the total loading of that sewer. Installation of inlet restrictors as described above have the potential to reduce peak inflow rate from this area roughly in half, from about 560 cfs to 280 cfs.

The ultimate goal of inlet control is to reduce excess flows to overloaded trunk sewers. In Oak Park's case, the focus is on the undersized East Avenue trunk sewer. Frequent surcharging of this trunk causes basement backups upstream in the northwestern part of the Village and to some extent the northeastern part tributary to East Avenue. The inlet control scenario considered here features installation of restrictors in an area tributary to the East Avenue trunk, approximately north of Iowa Street and west of East Avenue.

Due to the low, flat topography in some parts of the Village, excessive surface storage depths caused by depressed ground surface elevations could encroach on structures and private property. As part of any restrictor installation program, a detailed review of existing topography and a block-by-block survey of street elevations must be performed to confirm that overland flooding problems are not created or made worse by the installation of the restrictors. The survey is highly recommended to identify local low elevations not shown on the topography in Figure 2.

To verify potentially problematic overland flow paths with an even greater level of confidence, an integrated catchment model could be produced. This would simultaneously model the existing Village sewer system with an explicit model of overland surface flows. Modeling the interaction of these two drainage systems is a better representation of reality and allows identification of conflicts with specific structures rather than the assumption that all structures in a flooded subcatchment are at risk.

Street sweeping and catch basin maintenance should be performed on a regular schedule in the inlet control area. Any additional restriction caused by leaf pack or restrictor clogging was not modeled, and has the potential to increase surface storage depths beyond those that the model suggests.

RECOMMENDED SEWER PROJECTS

While the basement flood risk in some areas can be improved by the recommendations above, new and replacement sewers are the most important part of the program recommended to meet the Village's performance objectives. Recommended projects are presented below in Table 8 with their Benefit Score and Cost per Building Improved as detailed previously in this report. As in Table 7, some of the projects in Table 8 are scored together with other projects. In these cases, both projects are required to achieve the score given in the table.

Table 8: Recommended sewer improvement projects and scoring. Projects 115, 117, 203, 205 and 206 require reduced HGL's in the northeast and northwest focus area to be effective. These five projects are scored together with Projects 113 and 114 as indicated and scores for each combination are not valid without each project.

ID	Benefit Score	Cost/Bldg Improved	Estimated Total Cost	ID	Benefit Score	Cost/Bldg Improved	Estimated Total Cost
119	7.0	$ 2,300	$ 64,000	105	5.0	$ 9,500	$ 619,000
107	5.3	$ 3,700	$ 1,018,000	118	7.0	$ 11,400	$ 613,000
108	5.3	$ 3,800	$ 556,000	110	5.0	$ 13,500	$ 620,000
102	7.2	$ 4,000	$ 1,927,000	114+206	5.1	$ 13,600	$ 7,814,000
209	7.6	$ 5,300	$ 1,554,000	116	6.6	$ 13,700	$ 1,072,000
113	4.5	$ 5,400	$ 6,569,000	120	4.7	$ 14,700	$ 3,197,000
113+203	4.6	$ 5,700	$ 6,976,000	114+206+117	5.3	$ 15,400	$ 8,027,000
113+205	4.5	$ 6,100	$ 7,510,000	114+206+115	5.4	$ 16,600	$ 8,209,000
103	7.1	$ 7,200	$ 1,643,000	210	7.0	$ 17,900	$ 1,290,000
106	4.5	$ 7,400	$ 1,106,000	111	5.0	$ 20,700	$ 620,000
208	6.0	$ 8,400	$ 610,000	112+210	5.7	$ 23,500	$ 2,466,000
104	5.0	$ 9,500	$ 619,000	109	6.1	$ 23,800	$ 620,000

The key project for relief of the northeast focus area is Project 113. As suggested by Table 8, Project 113 not only relieves a significant portion of the Village on its own, it is also needed to create favorable conditions so that Projects 203 and 205 can be effective. Project 113 is recommended as replacement because the existing sewer in Lombard Avenue is undersized, nearly flat, and over 100 years old. This sewer is already undersized and rehabilitation by lining would reduce diameter further. Replacement of this sewer would provide an opportunity to increase slope and take advantage of the depth of the Lombard Avenue trunk.

As shown on Figure 19, there are several projects throughout the northwest focus area, although no single project is more important than Project 114 to improve this area. Project 114 lowers the HGL throughout this area and allows these smaller projects to function effectively. While Project 114 is not expected to provide significant benefits alone, it does provide favorable conditions for projects 115, 117, and 206. These three projects provide significant improvement for a low incremental cost when combined with Project 114.

As described above, the recommendation of inlet control reduces peak inflow to the sewer system in the area tributary to Project 114. Comparison of Figures A11 and A17 shows that nearly the entire inlet control area is improved from a 10-year basement flood risk to a 10-year level of protection. At roughly $55/restrictor and requiring approximately 500-600 restrictors, inlet control has a low incremental cost to provide a high incremental benefit when combined with Project 114.

There are two projects relieving the south central focus area, Projects 102 and 103. These projects provide direct connections to both the East Avenue trunk and the Ridgeland Avenue trunk, eliminating the bottleneck in this area.

MAINTENANCE PROGRAM

The Village currently uses a risk-based system for prioritizing sewer inspections, considering likelihood and consequence of failure. The system allows the Village to increase the effectiveness of the maintenance program.

It is recommended that the Village continue and expand their current program of sewer inspection. Given the increasing age of the Village system, it is becoming increasingly more important to maintain a regular schedule to identify problems before they cause flooding. Existing and proposed conditions presented in this report assume the existing system in good working condition, which can only be guaranteed with a regular inspection program. Suggested intervals for inspection include:

- Large diameter trunk sewers: Trunks 48 inches and larger should be inspected every 10 years. Priority should be given to older sewers and those that lack record of a recent inspection. This amounts to roughly 7,500 feet inspected annually.

- Smaller diameter local sewers: Sewers smaller than 48 inches should be inspected every 10 years and prioritize older pipes. This amounts to roughly 50,000 feet annually.

- Ridgeland Avenue siphon: The Ridgeland Avenue siphon is scheduled to be inspected and cleaned in December 2013, and was last inspected and cleaned preceding the 1988 lining of the southern reach of the Ridgeland Avenue trunk. It is recommended that the Ridgeland Avenue siphon should be inspected once every 10 years.

CONCLUSION

Through the recommended program detailed above, the Village can improve the level of protection against basement flooding to a 10 year level through nearly the entire Village. Existing conditions and proposed costs and benefits should be reviewed by the Village and used as the basis for policy decisions regarding the Village’s long-term approach to management of the combined sewer system.

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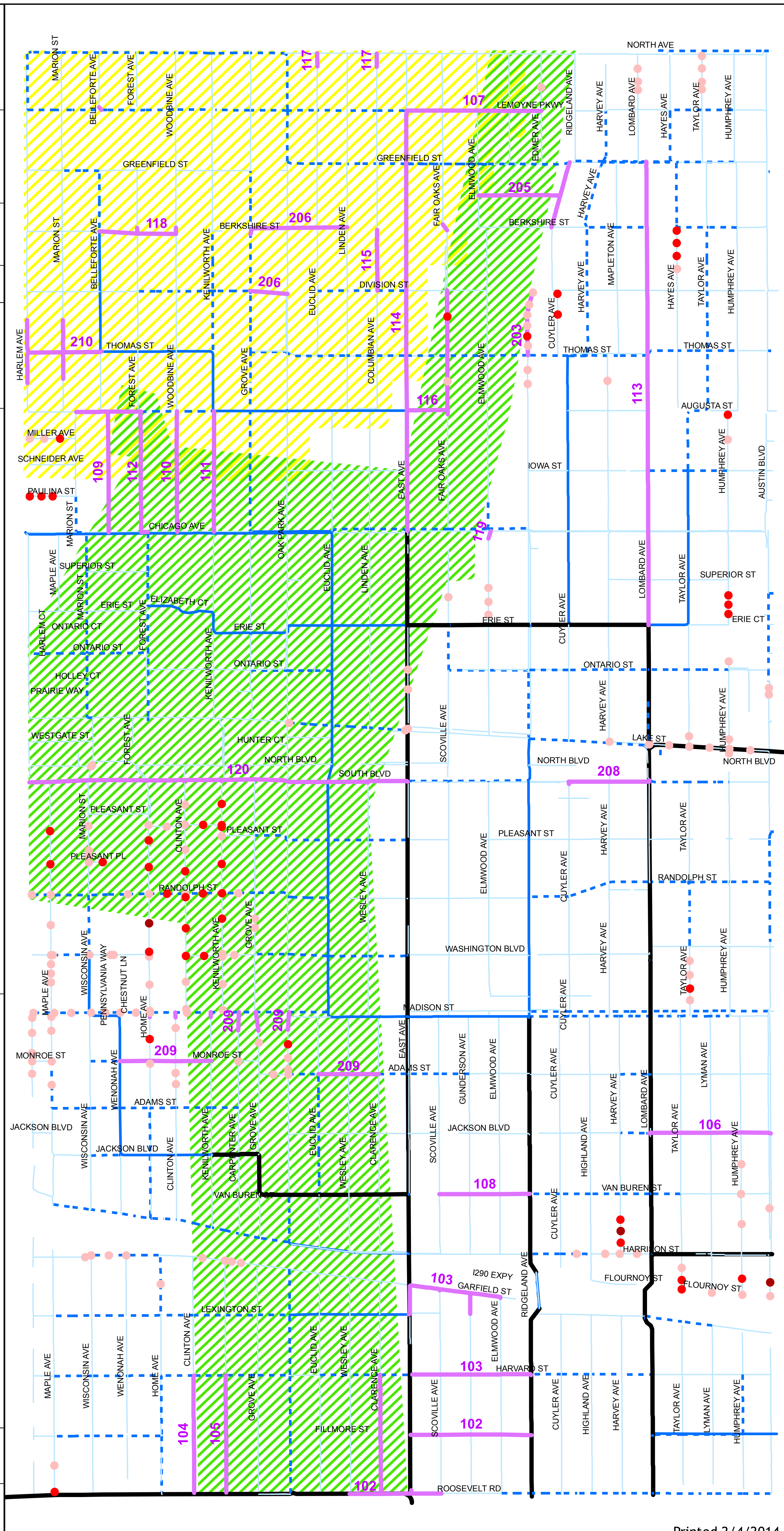
Figure 19:
Level of Service
with Recommended
Program



Legend

- Recommended Projects
- 10% Impervious Reduction
- Inlet Control Area
- 1yr Flood Risk
- 2yr Flood Risk
- 5yr Flood Risk
- 10yr Flood Risk

Existing Sewer Diameter

- 6 - 22 in.
- 24 - 48 in.
- 50 - 82 in.
- 84 - 180 in.

Feet
0 550 1,100

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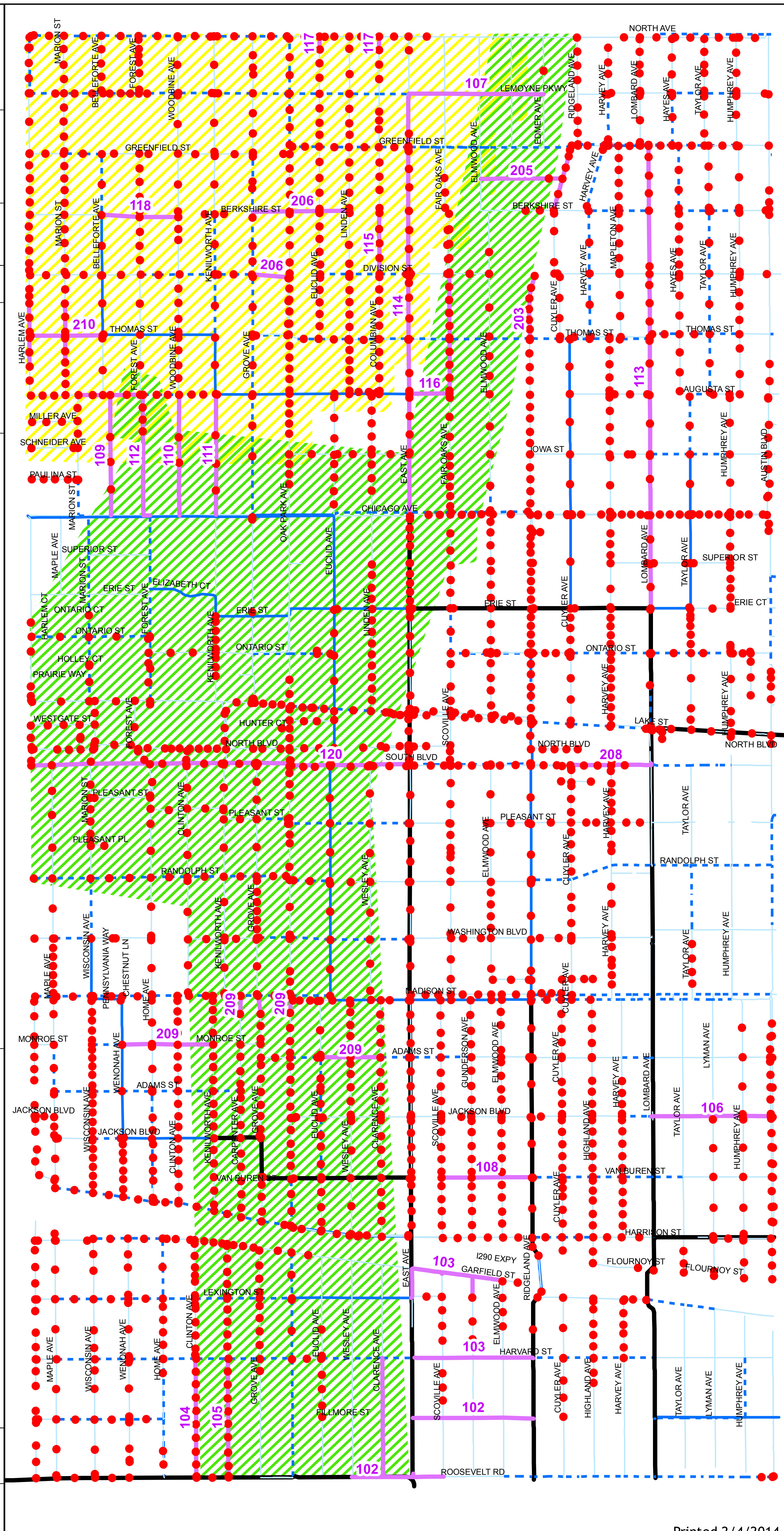
Figure 20:
July 2011
Level of Service
with Recommended
Program



Legend

- Recommended Projects
- 10% Impervious Reduction
- Inlet Control Area
- Flood Risk

Existing Sewer Diameter

- 6 - 22 in.
- 24 - 48 in.
- 50 - 82 in.
- 84 - 180 in.

Feet
0 550 1,100

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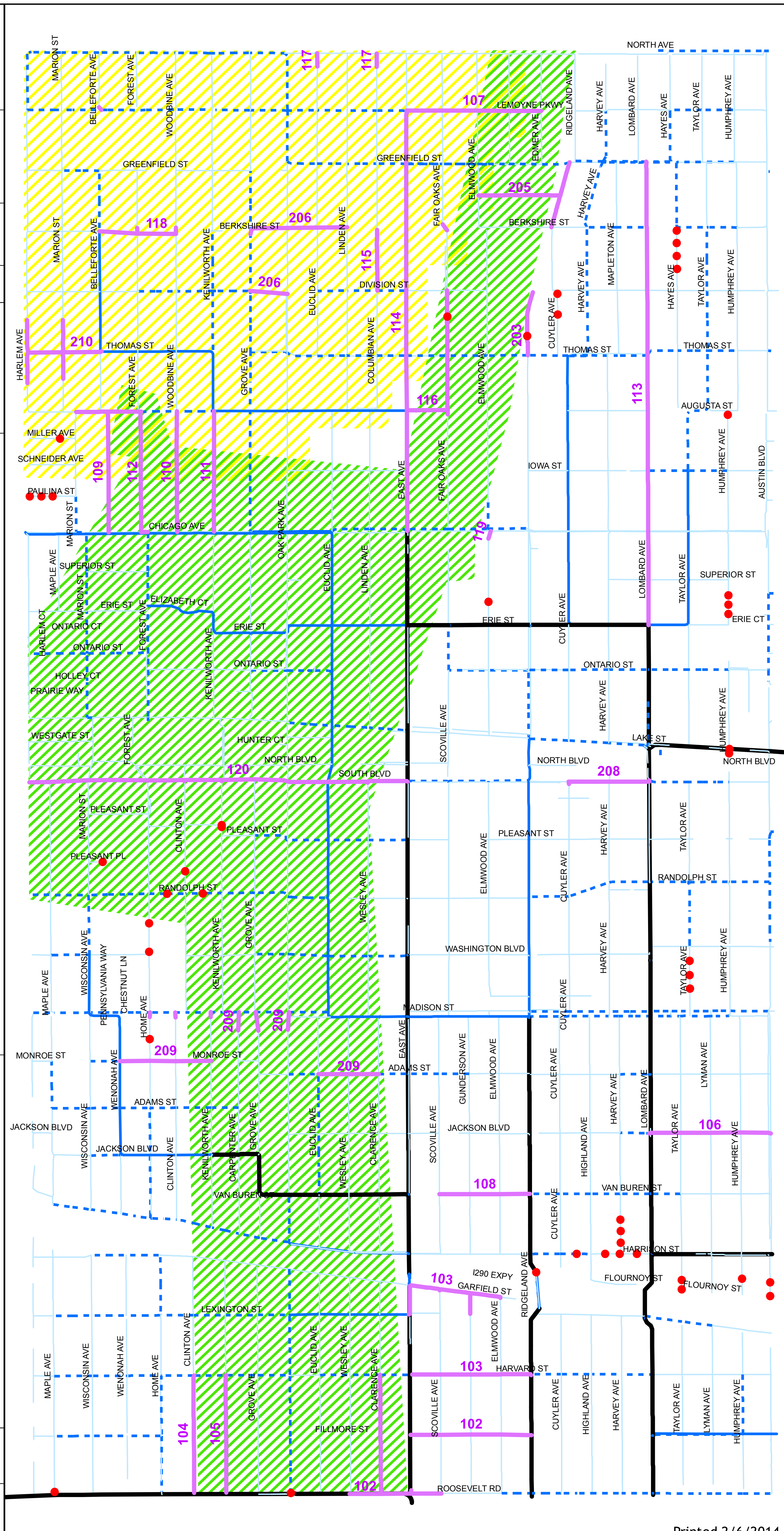
Figure 21:
April 2013
Level of Service
with Recommended
Program



Legend

Recommended Projects

10% Impervious Reduction

Inlet Control Area

Flood Risk

Existing Sewer Diameter

6 - 22 in.

24 - 48 in.

50 - 82 in.

84 - 180 in.

Feet
0 550 1,100

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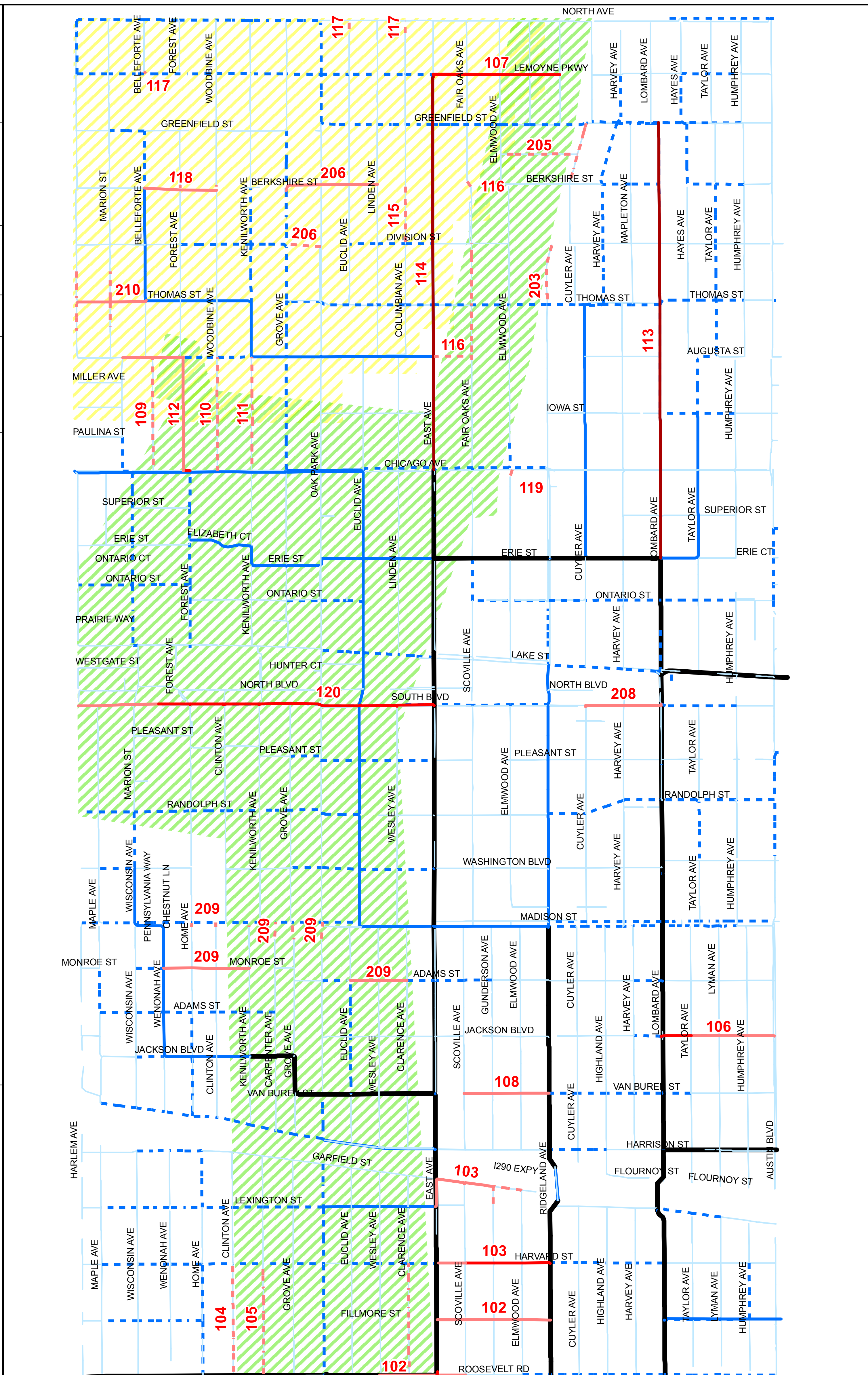
Figure 22:
Recommended
Projects



Legend

Recommended Projects

Diameter

- 12 - 18 in.
- 24 - 30 in.
- 36 - 48 in.
- 72 - 84 in.
- 10% Impervious Reduction
- Inlet Control Area

Existing Sewer

Diameter

- 6 - 22 in.
- 24 - 48 in.
- 50 - 82 in.
- 84 - 180 in.

Feet
0 650 1,300

MWH

ID	Benefit Score	Cost/Bldg Improved	Estimated Total Cost	ID	Benefit Score	Cost/Bldg Improved	Estimated Total Cost
119	7.0	$ 2,300	$ 64,000	105	5.0	$ 9,500	$ 619,000
107	5.3	$ 3,700	$ 1,018,000	118	7.0	$ 11,400	$ 613,000
108	5.3	$ 3,800	$ 556,000	110	5.0	$ 13,500	$ 620,000
102	7.2	$ 4,000	$ 1,927,000	114+206	5.1	$ 13,600	$ 7,814,000
209	7.6	$ 5,300	$ 1,554,000	116	6.6	$ 13,700	$ 1,072,000
113	4.5	$ 5,400	$ 6,569,000	120	4.7	$ 14,700	$ 3,197,000
113+203	4.6	$ 5,700	$ 6,976,000	114+206+117	5.3	$ 15,400	$ 8,027,000
113+205	4.5	$ 6,100	$ 7,510,000	114+206+115	5.4	$ 16,600	$ 8,209,000
103	7.1	$ 7,200	$ 1,643,000	210	7.0	$ 17,900	$ 1,290,000
106	4.5	$ 7,400	$ 1,106,000	111	5.0	$ 20,700	$ 620,000
208	6.0	$ 8,400	$ 610,000	112+210	5.7	$ 23,500	$ 2,466,000
104	5.0	$ 9,500	$ 619,000	109	6.1	$ 23,800	$ 620,000

Printed 2/4/2014

APPENDIX A: CALIBRATION RESULTS

Figure A1: Dry weather calibration results at meter M1

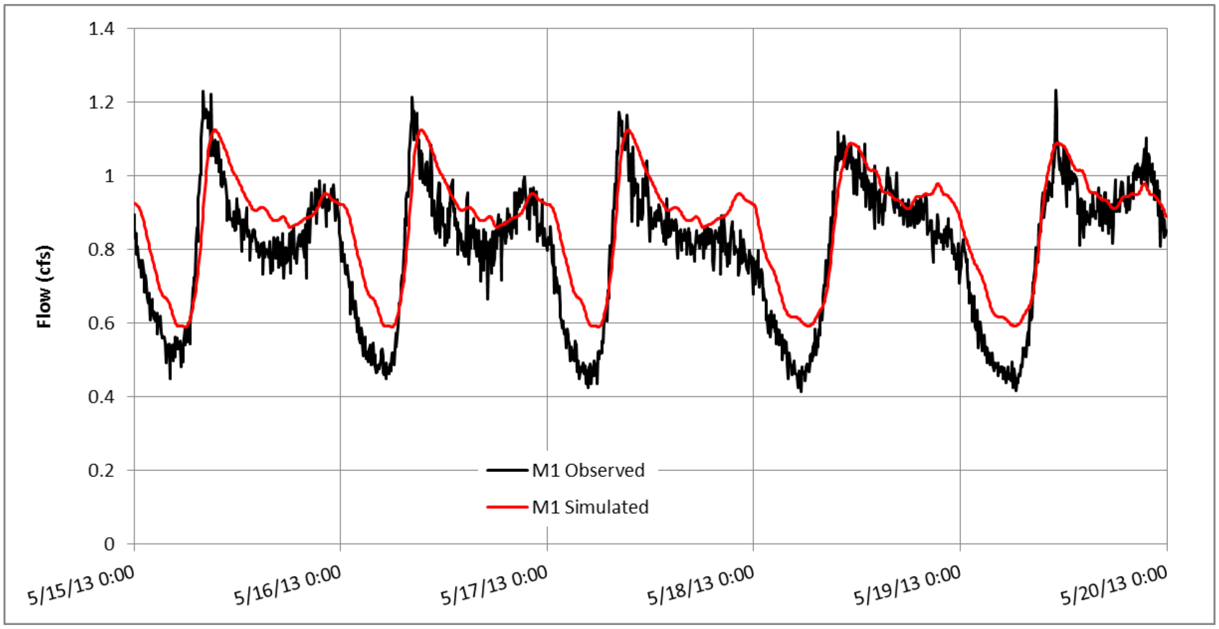


Figure A2: Dry weather calibration results at meter M2

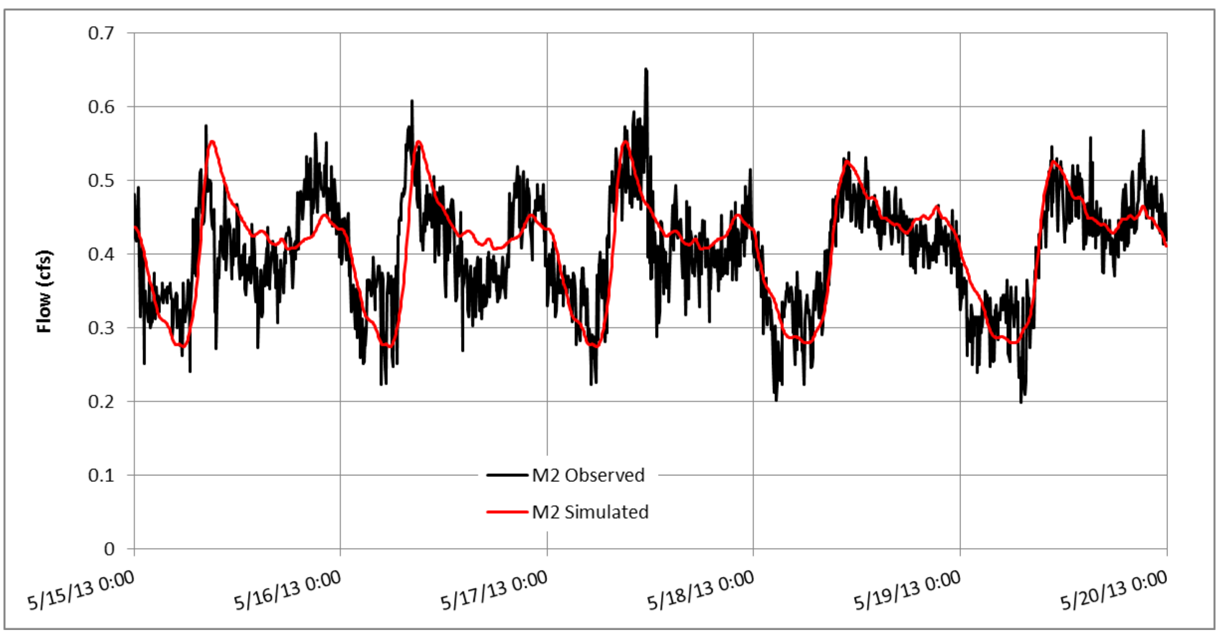


Figure A3: Dry weather calibration results at meter M3

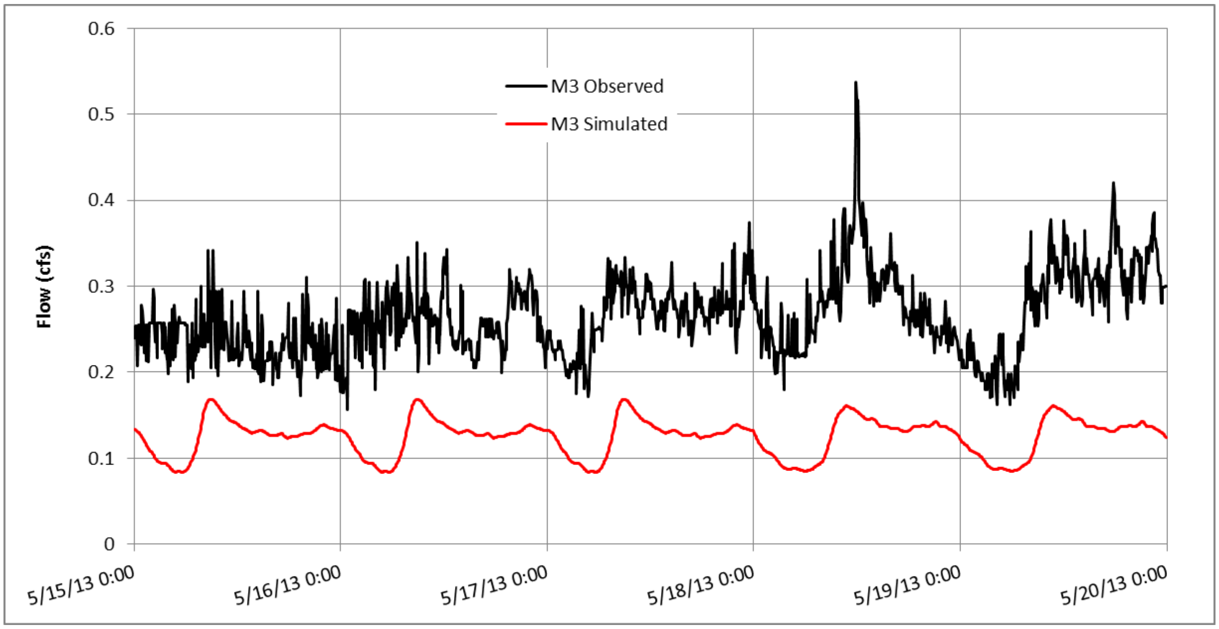


Figure A4: Dry weather calibration results at meter M4

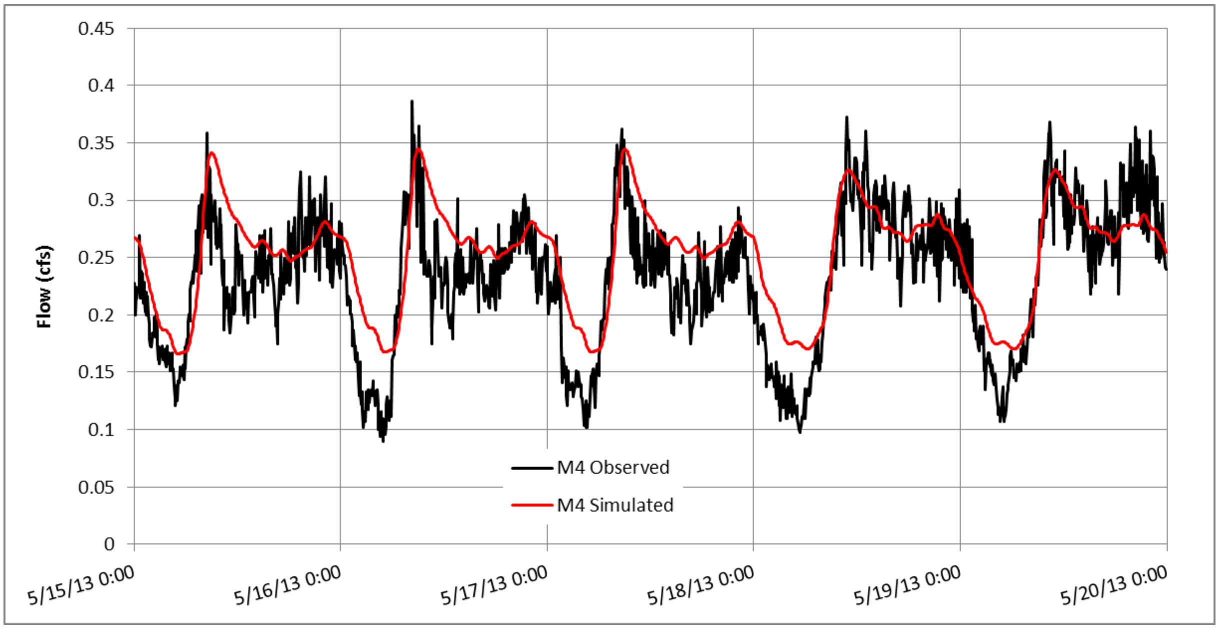


Figure A5: Dry weather calibration results at meter M5

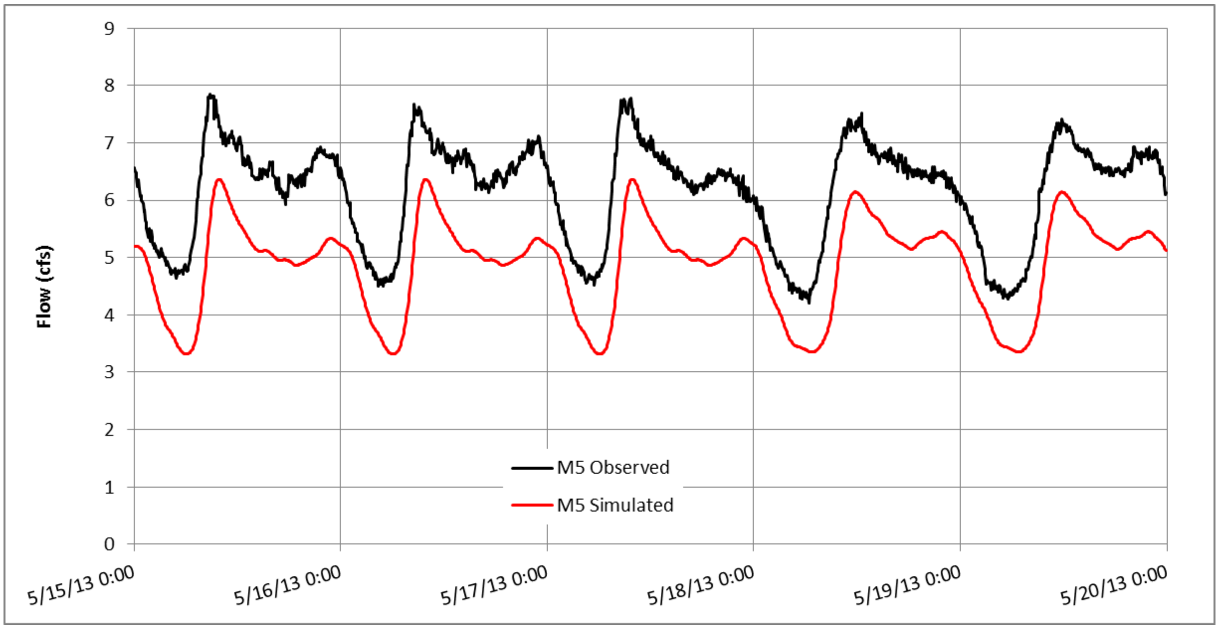


Figure A6: Dry weather calibration results at meter M6

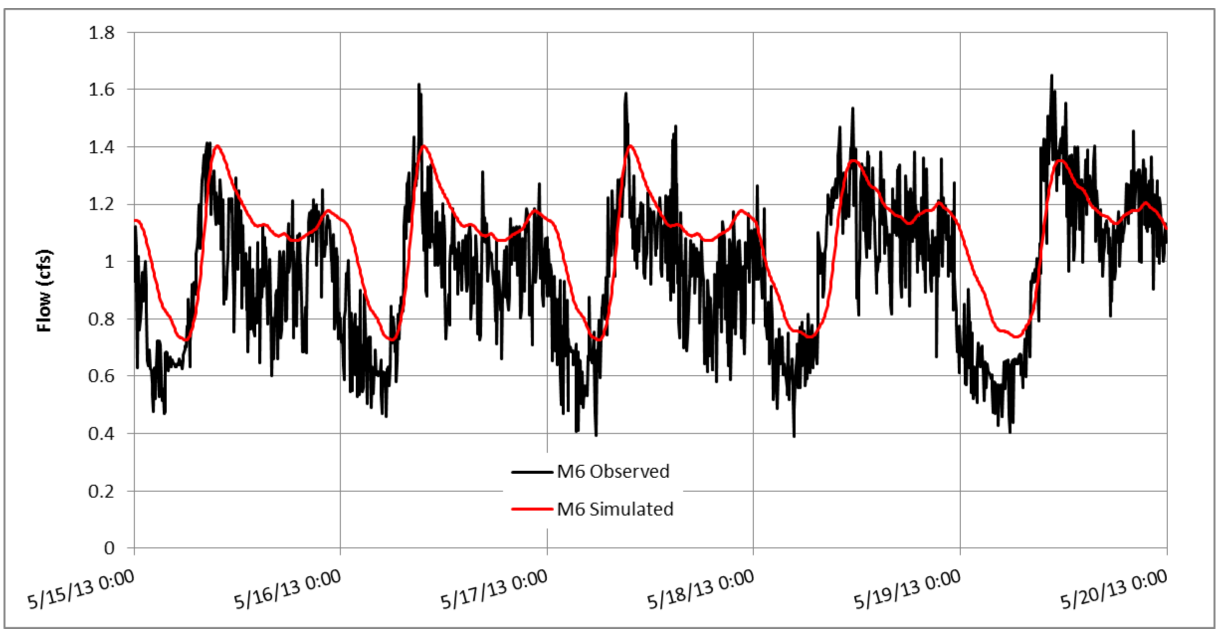


Figure A7: Wet weather calibration results at meter M1

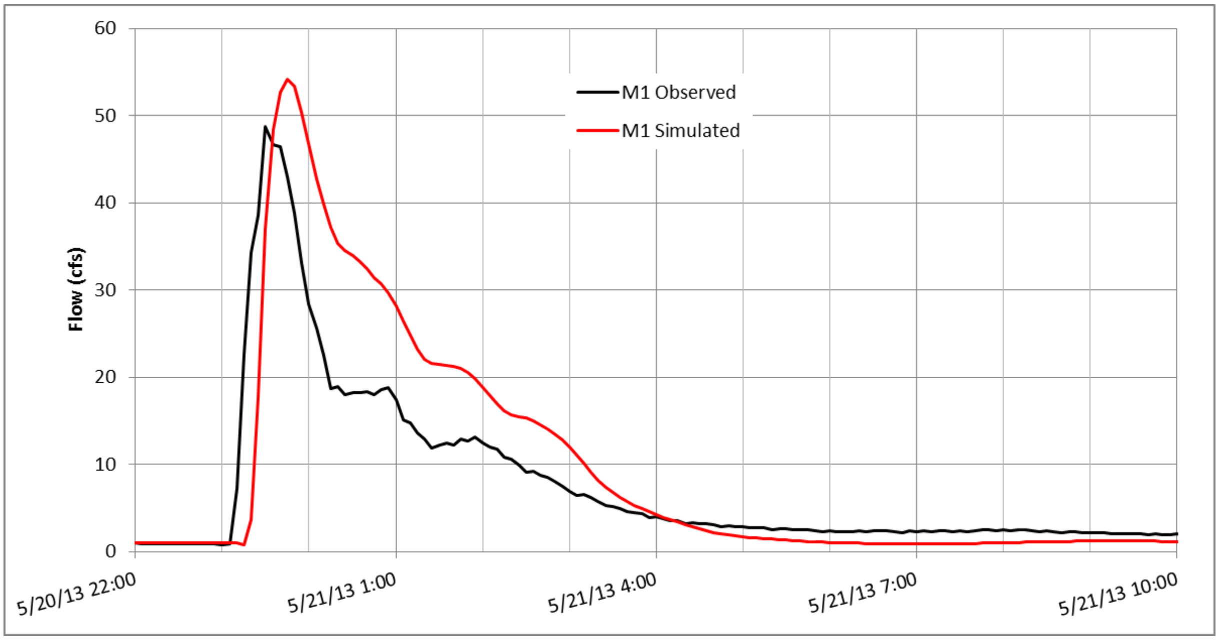


Figure A8: Wet weather calibration results at meter M2

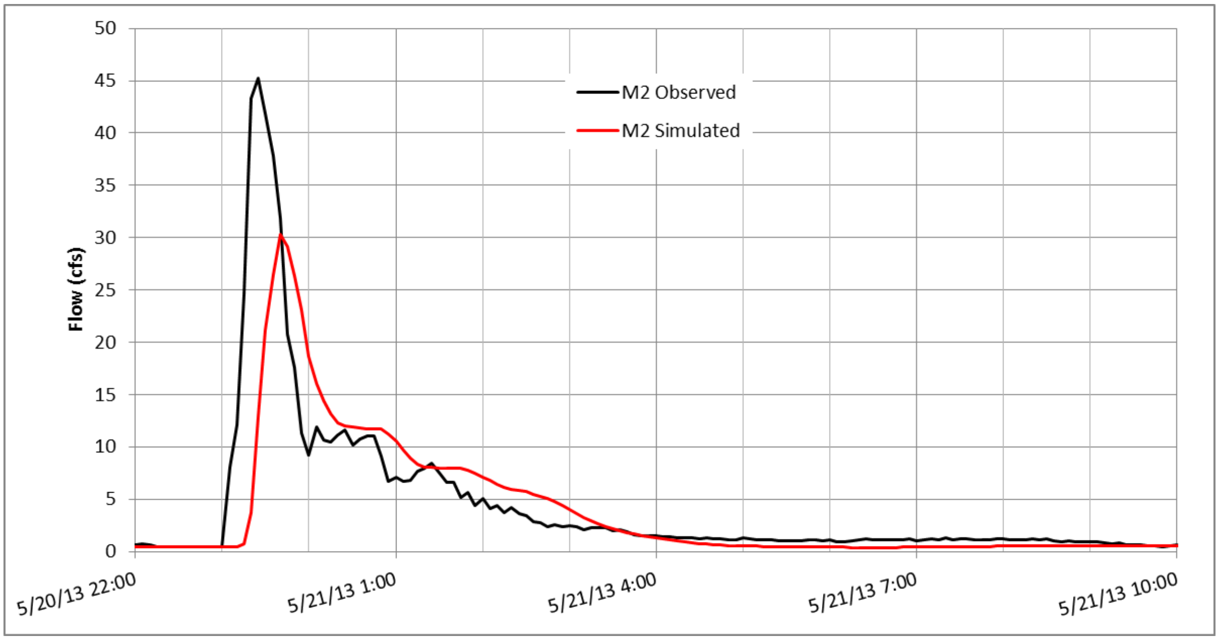


Figure A9: Wet weather calibration results at meter M3

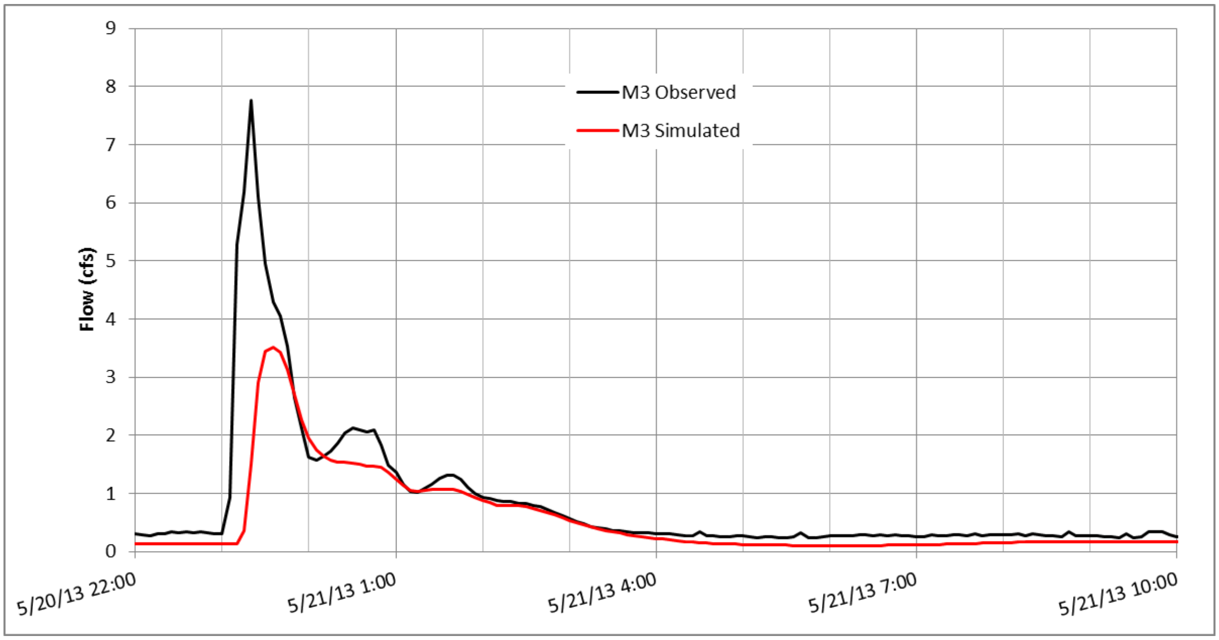


Figure A10: Wet weather calibration results at meter M4

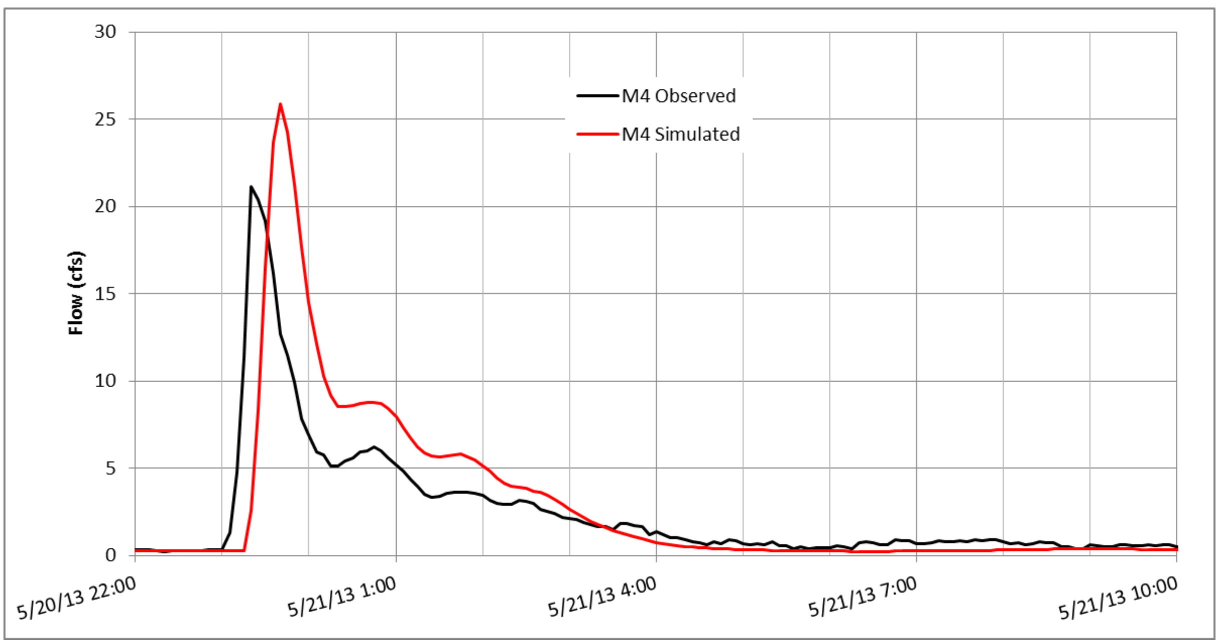


Figure A11: Wet weather calibration results at meter M5

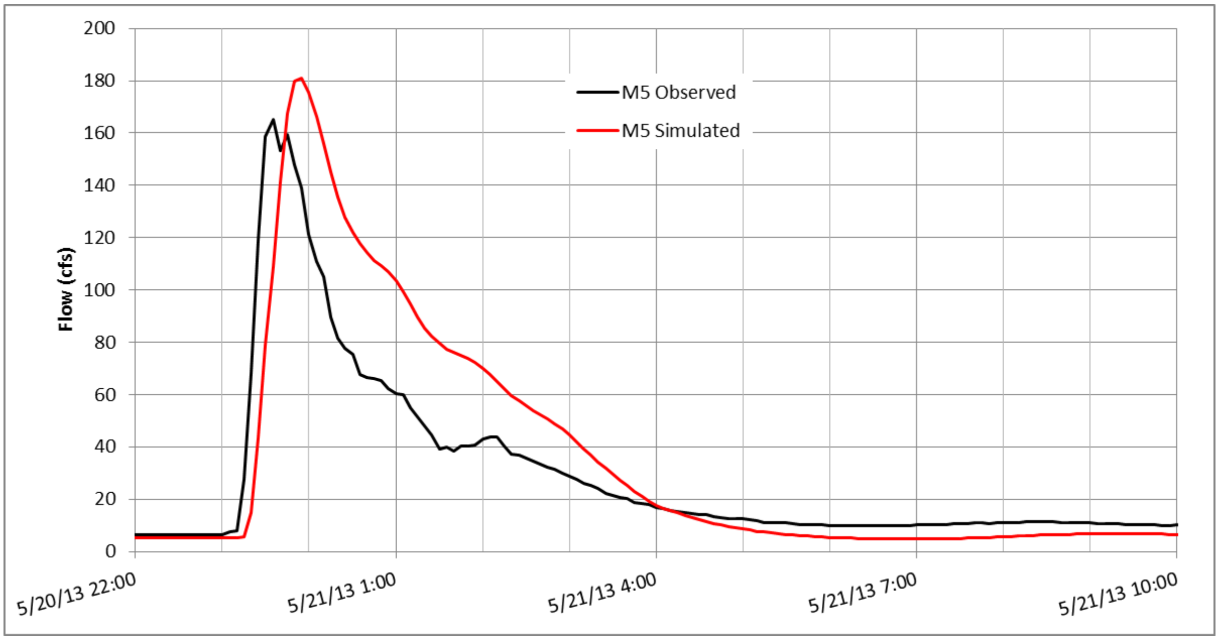
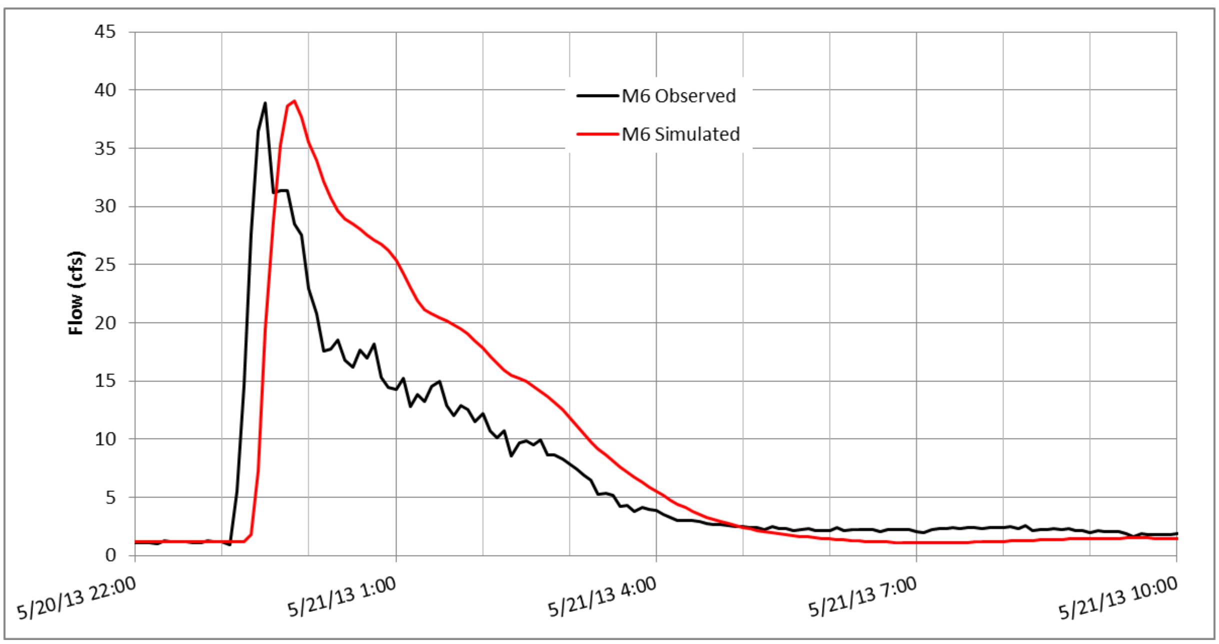


Figure A12: Wet weather calibration results at meter M6



APPENDIX B: COST ESTIMATION

MWHC RSM
11/27/2013

Oak Park, Illinois
Combined Sewer Relief Tunnel
Opinion of Probable Construction Cost
Class 5 AACEI

Currency: USD-United States- November 2013 Dollar

Grand Total Price: $ 42,424,700

Item #	Description	Quantity	UOM	Unit Price	Total Price	Comments
	Project Direct Costs					
	General				**$2,571,600**	
1	Mobilization/Demobilization	2	ea	$375,000	$750,000	
2	Resident Engineer Office	28	mo	$3,450	$96,600	includes utilities and cleaning
3	Temp Power/Light/Communications	2	ea	$80,000	$160,000	
4	Traffic Protection	2	ea	$125,000	$250,000	
6	Onsite Water Supply (Shafts)	14	ea	$27,500	$385,000	
8	Site and Tunnel Electric (Launch Shaft 144")	1	ls	$125,000	$125,000	Equipment purchase and erection
9	Site and Tunnel Electric (Launch Shaft 96")	1	ls	$100,000	$100,000	Equipment move up to shaft & transformers
10	Construction Water Treatment System (144 " tunnel)	1	ls	$100,000	$100,000	
11	Construction Water Treatment System (96 " tunnel)	1	ls	$100,000	$100,000	
12	Mobilize 144" TBM	1	ls	$200,000	$200,000	TBM/Trailing Gear/Bentonite & Grout Plants
13	Mobilize 96" TBM	1	ls	$175,000	$175,000	TBM/Trailing Gear/Bentonite & Grout Plants
14	Site, Tunnel and Shaft Lighting	2	ea	$65,000	$130,000	
	Tunnels				**$23,599,800**	
	144" Jacked Pipe Tunnel				**15,085,800.00**	
1	144" Combined Sewer Relief Tunnel	8,670	lf	$1,740	$15,085,800	Includes pipe, backgrouting and haul-off of tunnel excavation
	96" Jacked Pipe Tunnel				**$5,544,000**	
1	96" Combined Sewer Relief Tunnel	5,040	lf	$1,100	$5,544,000	Includes pipe, backgrouting and haul-off of tunnel excavation
	Rock Tunnel & MWRD Connecttion				**$2,970,000**	
1	12' Diameter Rock Tunnel	1,200	lf	$1,850	$2,220,000	Includes rock support (assumes competent rock, minimal support)
2	Connection to MWRD Deep Tunnel	1.00	ea	$750,000	$750,000	
	Dropshaft & Junction Structures				**$5,944,565**	
	Dropshaft				**3,061,340.00**	
1	Setup Dropshaft Site	1,500	sy	$100	$150,000	Grading/aggregate surface/drainage
2	Stage I Overburden Excavation	1,147	cy	$75	$86,025	36' l x 20' w x 43' deep starter shaft
3	Stage II Overburden Excavation	350	cy	$150	$52,500	18' o.d. Liner plate
4	Shaft SOE Stage I Overburden	4,820	sf	$85	$409,700	Support of Excavation (SOE)
5	Shaft SOE Stage II Overburden	2,093	sf	$150	$313,950	Support of Excavation (SOE)
6	Rock Excavation	1,080	cy	$200	$216,000	Includes haulling excess off site
7	Rock SOE	7,300	sf	$25	$182,500	Rock bolts, shotcrete (assumes competent rock, minimal support)
8	Dropshaft Concrete	891	cy	$1,815	$1,617,165	Includes formwork & reinforcement
9	Dropshaft Backfill	670	cy	$50	$33,500	Aggregate backfill
	Junction Structures				**2,883,225.00**	
1	144" Pipe Diameter Junction Structure	8	ea	$232,000	$1,856,000	18' x 18'
2	96" Pipe Diameter Junction Structure	5	ea	$205,445	$1,027,225	14' x 14'
	Unlisted Items Allowance (Project)			**2%**	**$642,300**	
				Sub Total Directs:	**$26,813,700**	
	Project Indirect Costs					
	Project Management			**2.0%**	**536,300**	
	Safety			**1.0%**	**268,100**	
	Administration, Home Office, Shops, etc.			**2.5%**	**670,300**	
	Equipment Costs (support equipment)			**2.0%**	**536,300**	
				Sub Total Indirects:	**$2,011,000**	7.50%
				Sub Total Directs + Indirects:	**$28,824,700**	
	Markups					
	Subcontractor Markups/General Conditions			**0.0%**	**$0**	
	Sale Tax Electrical - Mechanical Equipment	**$0**	**M**	**0.0%**	**$0**	
	Prime Contractor OH&P on Subs	**$0**	**M**	**5.0%**	**$0**	
	Prime Contractor OH&P on Self-Perform	**$27**	**M**	**15.0%**	**$4,000,000**	
	Contractor Insurance Program	**$32**	**M**	**1.5%**	**$400,000**	Performance/Payments Bonds, Genl Liability, & Bldr's Risk
	State Sales Taxes	**$0**	**M**	**0.0%**	**$0**	Excluded
	Contractor Financing		**M**	**0.0%**	**$0**	Excluded
	Escalation		**M**	**0.0%**	**$0**	Excluded
	Estimating Accuracy Contingency		**M**	**2.0%**	**$700,000**	Pricing Accuracy Contingency
				Sub Total Markups:	**$5,100,000**	
				Total Estimated Capital Costs:	**$33,924,700**	1.177
	Project Administration & Management					
	Construction Oversight & Mgt			**0.0%**	**$0**	Excluded
	Engineering			**0.0%**	**$0**	Excluded
	Engineering During Construction			**0.0%**	**$0**	Excluded
	Misc Owner's Soft Costs (All)			**0.0%**	**$0**	Excluded
	Land Acquisition			**0.0%**	**$0**	Excluded
	Scope Contingency On Civil	**$34**	**M**	**25.0%**	**$8,500,000**	Quantity Growth & Unknowns
	Scope Contingency On Equipment			**0.0%**	**$0**	Excluded
	Interest During Construction			**0.0%**	**$0**	Excluded
	Owner's Construction Contingency/Mgt Reserve			**0.0%**	**$0**	Excluded
				Sub Total Project Administrative Expenses:	**$8,500,000**	
				Grand Total:	**$42,424,700**	$35
			Cost Range:	**$23,747,300**	**$55,975,800**	-30% +65%
				Total Contingency:	**$8,500,000**	20%

Notes
1) Assumed prime contractor to self perform work
2) This OPCC is classified as a Class 5 cost estimate per AACE guidelines. Stated accuracy range = -30% to + 65%.
3) Pricing basis = Q4 2013 escalation to MPC excluded
4) Pricing assumes competitive market conditions at time of tender (+3 bidders/trade).
5) Pricing assumes that standard industry commercial terms will apply to all procurements.
6) Owner soft costs and project management expenses excluded.
7) Non-conventional environmental mitigation measures excluded.
11) All land acquisition by owner
12) System O&M costs are excluded.
13) Assumes contractors own TBM of similar size and capabilities

Oak Park, Illinois
Combined Sewer Relief Tunnel
Opinion of Probable Construction Cost
Class 5 AACEI

Currency: USD-United States- November 2013 Dollar

Grand Total Price: $ 42,424,700

Item #	Description	Quantity	UOM	Unit Price	Total Price	Comments
	Project Direct Costs					
8)	Project procurement strategy unknown and potentially not captured in project costs.					
9)	Preliminary subsurface geotech information not available for tunnel alignment at time of OPCC development					
10)	The actual subsurface conditions may differ substantially in quantities &/or material properties.					

OPCC Disclaimer

The client hereby acknowledges that MWH has no control over the costs of labor, materials, competitive bidding environments, unidentified field conditions, financial and/or commodity market conditions, or any other factors likely to affect the OPCC of this project, all of which are and will unavoidably remain in a state of change, especially in light of high market volatility attributable to Acts of God and other market forces or events beyond the control of the parties. As such, Client recognizes that this OPCC deliverable is based on normal market conditions, defined by stable resource supply/demand relationships, and does not account for extreme inflationary or deflationary market cycles. Client further acknowledges that this OPCC is a "snapshot in time" and that the reliability of this OPCC will degrade over time. Client agrees that MWH cannot and does not make any warranty, promise, guarantee or representation, either express or implied that proposals, bids, project construction costs, or cost of O&M functions will not vary significantly from MWH's good faith Class 5 OPCC

AACE International CLASS 5 Cost Estimate – Class 5 estimates are generally prepared based on very limited information, and subsequently have wide accuracy ranges. Typically, engineering is from 2% to 10% complete. They are often prepared for strategic planning purposes, market studies, assessment of viability, project location studies, and long range capital planning. Virtually all Class 5 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric techniques. Expected accuracy ranges are from –20% to –50% on the low side and +30% to 100% on the high side, depending on technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.(AACE International Recommended Practices and Standards).

Oak Park, Illinois
Open Cut Storm Sewer
Opinion of Probable Construction Cost
Class 5 AACEI

Currency: USD-United States- November 2013 Dollar

Grand Total Price: $ 5,745,790

Item #	Description	Quantity	UOM	Unit Price	Total Price	Comments
	Project Direct Costs					
	Open Cut Storm Sewer				**$3,516,150**	
1	12-Inch PVC DR 26 Combined Sewer	660	lf	$131	$86,625	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
2	15-Inch PVC DR 26 Combined Sewer	660	lf	$144	$94,875	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
3	18-Inch PVC DR 26 Combined Sewer	660	lf	$163	$107,250	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
4	21-Inch RCP CL3 O-ring Combined Sewer	660	lf	$175	$115,500	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
5	24-Inch RCP CL3 O-ring Combined Sewer	660	lf	$200	$132,000	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
6	27-Inch RCP CL3 O-ring Combined Sewer	660	lf	$194	$127,875	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
7	30-Inch RCP CL3 O-ring Combined Sewer	660	lf	$215	$141,900	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
8	36-Inch RCP CL3 O-ring Combined Sewer	660	lf	$275	$181,500	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
9	48-Inch RCP CL3 O-ring Combined Sewer	660	lf	$363	$239,250	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
10	54-Inch RCP CL3 O-ring Combined Sewer	660	lf	$419	$276,375	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
11	60-Inch RCP CL3 O-ring Combined Sewer	660	lf	$569	$375,375	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
12	66-Inch RCP CL3 O-ring Combined Sewer	660	lf	$669	$441,375	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
13	72-Inch RCP CL3 O-ring Combined Sewer	660	lf	$844	$556,875	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
14	78-Inch RCP CL3 O-ring Combined Sewer	660	lf	$969	$639,375	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
	Structures				**$46,728**	
	Manholes				**29,898**	
1	Manhole 4-Foot Diameter x 10' Depth	1	ea	$5,760	$5,760	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
2	Mahnole 5-Foot Diameter x 10' Depth	1	ea	$6,240	$6,240	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
3	Mahnole 6-Foot Diameter x 10' Depth	1	ea	$8,160	$8,160	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
4	Mahnole 7-Foot Diameter x 15' Depth	1	ea	$9,738	$9,738	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
	Catch Basins				**$16,830**	
1	Catch Basin 4-Foot Diameter x 10' Depth	1	ea	$3,942	$3,942	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
2	Catch Basin 5-Foot Diameter x 10' Depth	1	ea	$5,874	$5,874	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
3	Catch Basin 6-Foot Diameter x 10' Depth	1	ea	$7,014	$7,014	Includes, Excavation, Pipe Bedding, TBF, Haul-off & Temp Agg. Surface, Traffic Contol & General Conditions, Bonds, Insurance & Profit & Contingency, 10' Bury
	Water & Sewer Services				**$70,400**	
1	Adjusting 1" Water Service/block	640	lf	$50	$32,000	1" copper pipe x 20' long each service, no valve box, curb stop, corporation
2	Adjusting 6 " Sanitary Service/block	640	lf	$60	$38,400	6" PVC pipe x 20' long each service, no main connection
	Restoration				**$2,112,512**	
1	12-Inch PVC DR 26 Combined Sewer	660	lf	$185	$121,897	Includes HMA Pavement Removal and restoration, Curb Removal & restoration, Sidewalk Removal & restoration, 4” Aggregate Base, asphalt overlay, manhole cover and valve box adjustments, Topsoil and sodding
2	15-Inch PVC DR 26 Combined Sewer	660	lf	$185	$121,897	Includes HMA Pavement Removal and restoration, Curb Removal & restoration, Sidewalk Removal & restoration, 4” Aggregate Base, asphalt overlay, manhole cover and valve box adjustments, Topsoil and sodding
3	18-Inch PVC DR 26 Combined Sewer	660	lf	$185	$121,897	Includes HMA Pavement Removal and restoration, Curb Removal & restoration, Sidewalk Removal & restoration, 4” Aggregate Base, asphalt overlay, manhole cover and valve box adjustments, Topsoil and sodding
4	21-Inch RCP CL3 O-ring Combined Sewer	660	lf	$198	$130,516	Includes HMA Pavement Removal and restoration, Curb Removal & restoration, Sidewalk Removal & restoration, 4” Aggregate Base, asphalt overlay, manhole cover and valve box adjustments, Topsoil and sodding
5	24-Inch RCP CL3 O-ring Combined Sewer	660	lf	$204	$134,819	Includes HMA Pavement Removal and restoration, Curb Removal & restoration, Sidewalk Removal & restoration, 4” Aggregate Base, asphalt overlay, manhole cover and valve box adjustments, Topsoil and sodding
6	27-Inch RCP CL3 O-ring Combined Sewer	660	lf	$209	$138,049	Includes HMA Pavement Removal and restoration, Curb Removal & restoration, Sidewalk Removal & restoration, 4” Aggregate Base, asphalt overlay, manhole cover and valve box adjustments, Topsoil and sodding
7	30-Inch RCP CL3 O-ring Combined Sewer	660	lf	$214	$141,279	Includes HMA Pavement Removal and restoration, Curb Removal & restoration, Sidewalk Removal & restoration, 4” Aggregate Base, asphalt overlay, manhole cover and valve box adjustments, Topsoil and sodding
8	36-Inch RCP CL3 O-ring Combined Sewer	660	lf	$224	$147,740	Includes HMA Pavement Removal and restoration, Curb Removal & restoration, Sidewalk Removal & restoration, 4” Aggregate Base, asphalt overlay, manhole cover and valve box adjustments, Topsoil and sodding
9	48-Inch RCP CL3 O-ring Combined Sewer	660	lf	$234	$154,201	Includes HMA Pavement Removal and restoration, Curb Removal & restoration, Sidewalk Removal & restoration, 4” Aggregate Base, asphalt overlay, manhole cover and valve box adjustments, Topsoil and sodding
10	54-Inch RCP CL3 O-ring Combined Sewer	660	lf	$253	$167,122	Includes HMA Pavement Removal and restoration, Curb Removal & restoration, Sidewalk Removal & restoration, 4” Aggregate Base, asphalt overlay, manhole cover and valve box adjustments, Topsoil and sodding
11	60-Inch RCP CL3 O-ring Combined Sewer	660	lf	$263	$173,583	Includes HMA Pavement Removal and restoration, Curb Removal & restoration, Sidewalk Removal & restoration, 4” Aggregate Base, asphalt overlay, manhole cover and valve box adjustments, Topsoil and sodding
12	66-Inch RCP CL3 O-ring Combined Sewer	660	lf	$273	$180,043	Includes HMA Pavement Removal and restoration, Curb Removal & restoration, Sidewalk Removal & restoration, 4” Aggregate Base, asphalt overlay, manhole cover and valve box adjustments, Topsoil and sodding
13	72-Inch RCP CL3 O-ring Combined Sewer	660	lf	$283	$186,504	Includes HMA Pavement Removal and restoration, Curb Removal & restoration, Sidewalk Removal & restoration, 4” Aggregate Base, asphalt overlay, manhole cover and valve box adjustments, Topsoil and sodding

MWHC RSM
11/25/2013

Oak Park, Illinois
Open Cut Storm Sewer
Opinion of Probable Construction Cost
Class 5 AACEI

Currency: USD-United States- November 2013 Dollar

Grand Total Price: $ 5,745,790

Item #	Description	Quantity	UOM	Unit Price	Total Price	Comments
	Project Direct Costs					
14	78-Inch RCP CL3 O-ring Combined Sewer	660	lf	$292	$192,965	Includes HMA Pavement Removal and restoration, Curb Removal & restoration, Sidewalk Removal & restoration, 4" Aggregate Base, asphalt overlay, manhole cover and valve box adjustments, Topsoil and sodding

Notes

1) Assumed prime contractor to self perform work
2) This OPCC is classified as a Class 5 cost estimate per AACE guidelines. Stated accuracy range = -30% to + 65%.
3) Pricing basis = Q4 2013escalation to MPC excluded
4) Pricing assumes competitive market conditions at time of tender (+3 bidders/trade).
5) Pricing assumes that standard industry commercial terms will apply to all procurements.
6) Owner soft costs and project management expenses excluded.
7) Non-conventional environmental mitigation measures excluded.
8) Project procurement strategy unknown and potentially not captured in project costs.
9) Preliminary subsurface geotech information not available for tunnel alignment at time of OPCC development
10) The actual subsurface conditions may differ substantially in quantities &/or material properties.
11) Indirect costs are included in the unit prices
12) Contractor profit is included in the unit prices
13) Contingency is included in the unit prices
14) All land acquisition by owner
15) Does not include temporary HMA patches over excavation

OPCC Disclaimer

The client hereby acknowledges that MWH has no control over the costs of labor, materials, competitive bidding environments, unidentified field conditions, financial and/or commodity market conditions, or any other factors likely to affect the OPCC of this project, all of which are and will unavoidably remain in a state of change, especially in light of high market volatility attributable to Acts of God and other market forces or events beyond the control of the parties. As such, Client recognizes that this OPCC deliverable is based on normal market conditions, defined by stable resource supply/demand relationships, and does not account for extreme inflationary or deflationary market cycles. Client further acknowledges that this OPCC is a "snapshot in time" and that the reliability of this OPCC will degrade over time. Client agrees that MWH cannot and does not make any warranty, promise, guarantee or representation, either express or implied that proposals, bids, project construction costs, or cost of O&M functions will not vary significantly from MWH's good faith Class 5 OPCC

AACE International CLASS 5 Cost Estimate – Class 5 estimates are generally prepared based on very limited information, and subsequently have wide accuracy ranges. Typically, engineering is from 2% to 10% complete. They are often prepared for strategic planning purposes, market studies, assessment of viability, project location studies, and long range capital planning. Virtually all Class 5 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric techniques. Expected accuracy ranges are from –20% to –50% on the low side and +30% to 100% on the high side, depending on technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.(AACE International Recommended Practices and Standards).

APPENDIX C: FLOW MONITORING DATA

Oak Park
Flow Monitoring Study
2013

ADS Environmental Services

*Included as separate attachment