CITY of PARK RIDGE

CITYWIDE SEWER STUDY

SUMMARY REPORT

Prepared for

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EXECUTIVE SUMMARY

This Citywide Sewer Study was initiated by the City of Park Ridge (City) to gain a complete understanding of the capacity and limitations of its existing sewer systems. The impetus of the study was widespread flooding caused by recent large rainfall events, most notably the September 2008 and July 2010 storm events. Christopher B. Burke Engineering, Ltd. (CBBEL) completed an initial flooding assessment following the September 2008 storm event, and CBBEL personnel were out visiting various areas of the city during the July 2010 storm event. Although several improvement projects were proposed following these storms, the need for an understanding of the overall system operations and capacities was apparent. The City's sewer system is extensive and highly interconnected; understanding how improvements in one area would affect others required a study of the entire City.

The main focus of the Citywide Sewer Study was to establish the capacity of the existing sewer systems. This is not a simple question for which a general label such as "10-year capacity" is sufficient. The analysis concluded that there are two major sewer systems, or watersheds, within the City. The ability of these two systems to handle runoff from the same storm event is drastically different. The Devon watershed, which is generally the southern 1/3 of the City, performs well. A 10-year storm in the Devon watershed produces little street flooding, and the sewer system generally handles the runoff without extensive surcharging. The Sibley watershed, the northern 2/3 of the City, has much less capacity. An intense 10-year storm in the Sibley watershed causes widespread surcharging, and in several locations results in severe street flooding.

To illustrate the system capacity, multiple exhibits have been created. The main deliverable of the study, in addition to the detailed computer model, is the Sewer Capacity Altas. The City was divided into a grid of 53 sheets, with each sheet showing the sewers and manholes included in the model, as well as subbasin boundaries, depressional storage areas, and overland flow locations. Each sewer is labeled with its ID#, diameter, full flow capacity, and actual maximum flow. Each manhole is labeled with the rim elevation and Hydraulic Grade Line elevation (HGL), which a measure of the water level in the manhole. These atlas sheets can be used by City staff when evaluating a particular location to see all the pertinent sewer data. GIS shape files with all the necessary sewer data, compatible with the City's GIS database, have also been provided so that other mapping can be created if necessary.

In addition to the existing system analysis, several improvement projects have been developed based on our understanding of the function and limitations of the system. Twelve project areas have been identified, with estimated costs ranging from $50,000 to $6.3 million. A complete description of the cost and benefits of each project is included in this report.

BACKGROUND

The City of Park Ridge (City) is a fully developed community of 7.1 square miles with an extensive sewer system comprised mainly of combined sewers supplemented by relief sewers that outfall to the Des Plaines River. There are also scattered areas with separate storm and sanitary sewers, and several detention facilities located throughout the City. All of these drainage systems are interconnected, and when coupled with overland flow routes, depressional storage areas, varying river levels, etc., create complex conditions that affect the performance of the system and its ability to handle runoff during storm events. Also, because of the interconnected nature of the system, it is difficult to assess the capacity of one area of the City without studying the entire system.

In recent years, the City has experienced several major storm events that have resulted in flooding throughout the City, both from basement backups and overland flow. In particular, a storm on September 13-14, 2008 caused widespread flooding. As a result, the City hired Christopher B. Burke Engineering Ltd. (CBBEL) to complete a flood study that identified several key problem areas and proposed concept-level improvements. However, the improvements for each area were proposed without the benefit of information on the performance of the overall system and the benefit of being able to improve several areas with one project because of the isolated study areas. It became apparent that to be able to answer the questions being asked about broader project benefits and consequential influences to other areas, a comprehensive study of the City's sewer system would be necessary.

This report summarizes the results of the citywide sewer study. The main deliverable from the study is a computer model of the City's sewer system. The model contains all the information on sewer sizes, capacity, hydraulic grade lines, flooding locations, etc. The sewer system includes over 160 miles of sewers and over 5000 manholes, and when running multiple storm events, an overwhelming amount of data is generated. While the data is best viewed and interpreted within the model itself, multiple exhibits are included in this report to depict the performance of the system. The data has also been organized within GIS-based files compatible with the City's GIS database so that if needed, City staff can generate additional drawings for specific areas or to answer specific questions.

In addition to the computer model of the existing sewer system, we have also proposed and analyzed several improvement projects aimed at reducing flooding and improving system performance. Those project areas are described in this report as well as the accompanying exhibits. Concept-level cost estimates have also been prepared.

SEWER SYSTEM MODELING

DATA COLLECTION

Creating the computer model requires input data for the sewer system as well as the tributary watershed. For the watershed, topography is required to delineate the drainage area tributary to each section of sewer. The City provided 1' contour interval aerial topographic mapping, which was sufficient to delineate the necessary subbasins.

Required input data for the sewer system includes manhole locations and rim elevations, and sewer locations, inverts, and diameters. The City's GIS database provided much of this data, however additional data was required. Many of the sewer sizes and/or inverts were missing from the database. Where available, plan sets for various sewer projects were obtained from the City's archives and reviewed to supplement the GIS database. More than 20 plan sets were reviewed and the plan data was used to "fill in the blanks" in the GIS database, however some data was still missing. The remaining data, either pipe size or invert, was estimated based on the nearest known invert and/or diameter. Field surveying of selected areas was also completed so that there were fewer areas of missing data and better estimations could be made.

MODEL DEVELOPMENT

The input data was used to create a computer model of the City's sewer system. InfoSWMM software was used, which is a proprietary program based on the US EPA's Storm Water Management Model (SWMM). InfoSWMM is GIS-based, which allows transfer of input data from the City's GIS database into the model, as well as export of data from the model back into the GIS database for convenient mapping uses.

There are two main components to the system to be developed: the hydrologic (watershed characteristics, imperviousness, topography, etc.) and the hydraulic (sewer size, slope, material, etc.). To develop the hydrology parameters, the City was divided into over 800 subbasins with an average size of less than 5 acres, which provides a high level of detail for the model. The imperviousness of each subbasin was categorized into one of three categories: residential, commercial/business, or a combination of both. A typical impervious percentage for each land use type was calculated and applied as appropriate to each subbasin. A handful of subbasins did not fit into these categories, in particular park areas with minimal impervious area, and their imperviousness was calculated separately. Other watershed parameters, such as each subbasin's characteristic width and slope, were generated through GIS tools that analyze the contour mapping.

The hydraulic elements of the model, including sewer diameters, inverts, lengths, etc., were imported from the sewer database described previously. Importing of the data was completed after the database was enhanced with the archive plan data and the estimated inverts. Another major element to the sewer system's function, overland flow routes, were also input to the model. By reviewing the topography, the routing of overland flow was determined and input to the model. If a sewer does not have sufficient capacity to convey the tributary runoff, it will become surcharged and eventually back up out of the manhole rim. When this occurs, water will

flow by gravity along overland flow routes that follow the topography. Where overland flow routes converge at depressional areas, ponding areas were entered to the model so that the depth and volume of ponding could be modeled. Finally, other hydraulic elements such as pumps and restrictors were added to the model where they were known to exist.

After the model was developed, it was run for several design storm events. The 1-, 2-, 5-, 10-, and 100-year design storms were analyzed. The September 2008 storm was also run using recorded rainfall gage data to compare the model results to known flooding areas. The results from these models, in particular the September 2008, were reviewed with City staff and compared to the residential flooding reports from the September 2008 storm. There was an accurate correlation between the model results and actual flooding locations. City staff identified some locations that were not shown by the model, and others where the model predicted flooding that has not been witnessed. Minor calibration of the model was made for these areas by adjusting one or more of several factors that are input to the model by the user.

SYSTEM DESCRIPTION

There are three watersheds within the City, referred to as the Devon, Sibley, and North Area watersheds. The Devon watershed is 1300 acres in size and includes everything tributary to the Devon Avenue combined sewer, which conveys sanitary flow to MWRD facilities for treatment, as well as two relief sewer networks that provide relief to the combined sewer system. One relief sewer discharges to the Des Plaines River at Devon Avenue, and the second discharges to the Des Plaines River downstream of Higgins Road. Exhibit 1 shows the limits of the watershed and the major trunk and relief sewers.

The Sibley watershed is 2400 acres in size and includes everything tributary to the Sibley Avenue combined sewer, which conveys sanitary flow to MWRD facilities for treatment, as well as two relief sewer networks that provide relief to the combined sewer system. One relief sewer network discharges to the Des Plaines River at Algonquin Road, and the second discharges to the Des Plaines River at Touhy Avenue. Exhibit 2 shows the limits of the watershed and the major trunk and relief sewers. The Sibley watershed includes a large pump station at Sibley Avenue near the Des Plaines River. The pump station allows dry weather flows and limited wet weather flows to drain to the MWRD facilities, and higher flows to be pumped directly to the Des Plaines River. The Sibley Pump Station has a maximum design capacity of 400 cubic feet per second (cfs).

The third watershed is referred to as the North Area, which is north of the Sibley watershed, and is approximately 340 acres. This area is not tributary to the rest of the City's combined sewer system and contains several individual drainage systems. Much of the area is drained by storm sewer systems on Dempster Avenue, which are under IDOT's jurisdiction and were not modeled. Other smaller drainage systems include Mayfield Estates, the Carol & Crain area, and areas north of Ballard Road. Models were developed for each of these three drainage systems. Exhibit 2 shows the limits of the watershed and the major trunk and relief sewers.

DESIGN STORM EVENTS

The existing conditions models were run for the 1-, 2-, 5-, 10-, and 100-year storm events. The critical duration storm for the system, that is the storm that produces the highest runoff, is the

1-hour storm. Illinois State Water Survey's Bulletin 71 rainfall depths and Huff rainfall distributions were used in the analysis, which are the standards used for stormwater modeling. The September 2008 storm event was also run to verify known flooding areas. Recorded rainfall depths from a nearby Cook County Precipitation Network rain gage were used to simulate the September 2008 storm.

Table 1 shows the rainfall depths of the various 1-hour duration storm events considered in the analysis:

Table 1 – ISWS Bulletin 70 Rainfall Depths

Storm Event	Storm Duration	Rainfall Depth (in)
1-year	1-hour	1.18
2-year	1-hour	1.43
5-year	1-hour	1.79
10-year	1-hour	2.10
100-year	1-hour	3.56

SYSTEM CAPACITY

The models were run to determine the capacity of the system. Several storm events were run, including the September 2008 storm event. The model results were reviewed with City staff and accurate correlation between the predicted and actual flooding limits was noted.

The "capacity" of the system can be described in many ways. In simple terms, sewer capacity is based strictly on the sewer's diameter, slope, and material. This is referred to as the *full flow capacity*, which is the maximum flow the pipe will convey without becoming *surcharged*, or operating under pressure. When a pipe is surcharged, the water level at one end of the pipe is higher than the pipe itself. The higher water level, referred to as *head*, puts the pipe under pressure and forces more flow through the pipe. Greater surcharge depths will result in more flow through the pipe. Therefore, "capacity" is a relative term that corresponds with the amount of head on the pipe.

Often, a term such as "10-year capacity" is used to describe a storm sewer. A more specific description would be "10-year full capacity without surcharging", or "10-year capacity with the hydraulic gradeline below the rim". The *Hydraulic Grade Line (HGL)* is synonymous with *head*; when drawing a profile of a storm sewer line, the HGL connects the water level at each manhole on the sewer line.

The City's sewer system is extensive and complex, with multiple interconnected systems. It is not adequate to assign a generic "X-year capacity" description; the purpose of this study was to develop a more detailed understanding of the system's function. With this understanding in mind, there are several figures and exhibits in this report that are key to describing the capacity of the system. They are described below:

- **Appendix 1 – Sewer Capacity Atlas**: These atlas sheets are the main deliverable of the Citywide Sewer Study. The City was divided into 53 atlas sheets, with a key showing the sheet's location within the City. Each sheet shows the sewers and manholes included in the model, as well as subbasin boundaries, depressional storage areas, and overland flow locations. Each sewer is labeled with its ID#, diameter, full flow capacity, and actual maximum flow. Each manhole is labeled with the rim elevation and HGL elevation. Overland flow is shown only where the model predicts that it will occur, not at every location entered in the model. These atlas sheets can be used by City staff when evaluating a particular location to see where the HGL is relative to street level. The atlases have been generated for a 10-year storm only, although the data is available to show other storms.
- **Exhibits 5-8, Surcharge Depth Exhibits**: These exhibits for the 1-, 2-, 5-, and 10-year storms are color coded to show the HGL elevation relative to street level. The manholes shown in red have HGL's that are above the rim elevation, indicating surface ponding/overland flow. The manholes shown in blue have HGL's more than 3' below the street level. The HGL's in the orange manholes are between 0' and 3' below the surface. These exhibits were intended as an indicator of capacity and problem areas, as well as potential for basement backups.
- **Exhibits 9-12, Overland Flow Locations**: These exhibits show where the model predicts overland flow. They generally correspond to the Surcharge Depth exhibits; in most circumstances, surcharged manholes (shown in red) will generate overland flow.

CONCLUSIONS

A few general conclusions can be drawn from the study regarding the capacity of the City's sewer system. The main conclusion is that the Devon and Sibley systems perform drastically different. Reviewing the Surcharge Depth exhibits shows mostly blue manholes for the Devon system, indicating HGL elevations well below the street level, up through the 10-year storm. The limited number of surcharged manholes in the Devon system are distributed throughout the watershed. In contrast, most of the entire Sibley system is surcharged in a 10-year storm. While assigning a capacity level to the overall system is not possible, as described previously, it is noted that there are considerably more surcharged manholes in the 5-year storm compared to the 2-year storm for the Sibley system.

A second conclusion is that there are very few sewers with available capacity, and most are located within the Devon watershed. Improvement projects in the Sibley watershed will have limited benefits unless they include stormwater storage or entirely new drainage systems with new outfalls to the river.

PROPOSED IMPROVEMENTS

Part of the scope of this study was to identify several potential improvements that could be made to the system to increase performance and reduce the frequency or severity of flooding. Each of the proposed projects is described in this section. Initial thoughts were to design improvements to reach a standard capacity level or level or protection. However, after completing the assessment of the existing system, it was obvious that this could not always be accomplished. Therefore, each project has different design criteria and different levels of

benefits. Exhibit 15 is an overall project location map, and exhibits are provided to conceptually show each project area. The 12 projects are described below.

AREA #1 – NORTH PARK NEIGHBORHOOD

The North Park area, including Fenton, Burton, De Cook, and Manor between Vernon and Parkside, experiences frequent flooding. A previous proposal has been advanced to construct a detention basin within North Park to alleviate the flooding. While this original proposal remains a valid option, additional alternatives have been developed as part of this report to identify other improvement options.

To alleviate flooding on Fenton and Burton Lane, Alternative #1A evaluates the impact of constructing a new storm sewer system to convey flow west along Farrell Avenue, connecting to a large storm sewer on Potter Road. The Potter Road storm sewer connects to the Glenview relief sewer but is restricted and used for storage. Through this study, we have determined that the pipe storage has little effect on the overall system, and removing the restrictor would not cause any problems. It would also allow the Potter Road storm sewer to be used for conveyance, making it one of the only large sewers in the watershed with available capacity. *Most importantly, the Potter Road sewer is low enough to allow a new sewer to be constructed to provide gravity drainage from the North Park area*.

The Potter Road sewer can handle runoff from Fenton Lane and Burton Lane. Other streets such as De Cook cannot be drained to Potter Road without causing impacts (unless detention storage is provided). Therefore, Alternative #1A will not create any direct benefits to residents on any streets other than Fenton and Burton Lanes. This is a major difference between Alternative #1A and the previously proposed North Park detention basin project, which provided benefits for a larger area.

Alternative #1A includes constructing the new sewers on Fenton and Burton Lane to the depressional areas located mid-block. This alternative will lower the existing HGL by 1-2' and provide 10-year street flooding protection at both locations. ***This is the maximum benefit that can be obtained strictly through sewer improvements and without detention storage***.

If a higher level of protection is desired, detention storage is needed. Alternative #1B includes extending the 30" sewer on Burton Lane east into North Park and constructing a ±3 acre-foot detention basin in the park. This minimum volume would reduce the street ponding on Burton Lane to less than 1' during a 100-year storm. Additional storage would provide even more protection. The basin would function as a surge basin, with flow both entering and leaving the basin through the 30" sewer. Design of the specific footprint, depth, etc. for the basin has not been designed at this time. As in Alternative #1A, this alternative will benefit areas on Fenton Lane and Burton Lane but cannot be expanded to provide benefits for other streets (De Cook, Manor, etc.).

Alternative #1B would require approximately ¼ of the storage volume that was originally proposed for the original North Park detention basin, which could minimize the footprint area. However, due to elevation requirements, the proposed basin would still need to be several feet deep and would still require extensive modifications to the park.

A third alternative, #1C, was also developed. This alternative includes a ±8 acre-foot detention basin located on Maine East High School property, near the intersection of Farrell Road and Vernon Road. This alternative would function similarly to #1B but with the detention storage at Maine East instead of North Park. Alternative #1C also includes drainage from De Cook Road, so the benefits provided are comparable to the original North Park detention basin proposal. The storage required at the Maine East High School location is less than is required at North Park, because at North Park the surrounding sewers do not have available capacity and the full runoff volume must be stored assuming no release rate from the basin. At Maine East, the proposed 36" sewer on Farrell Road would allow a release rate up to 20 cfs, which allows the pond to be smaller. However, the length of sewer improvements needed for Alternative #1C is considerably greater than the original North Park plan.

Final engineering for either of these potential projects would have to analyze the sanitary sewer system to determine where sanitary flow from Fenton and Burton Lane should be directed. If the proposed sewer on Farrell Road is used as a combined sewer, its flat slope would likely cause maintenance problems. Leaving the existing sanitary flow routing as it currently does may leave Fenton Lane and Burton Lane susceptible to basement backups from high downstream HGL elevations. The worst case scenario may require a separate sanitary sewer and lift station on Farrell Road. That expense has not been included in the cost estimate at this point.

The conceptual cost estimate for Alternative #1A is $970,000.
The conceptual cost estimate for Alternative #1B is $2.1 million.
The conceptual cost estimate for Alternative #1C is $3.4 million.

Exhibit 14 shows both alternatives #1A and #1B for the Fenton Lane and Burton Lane project area. Exhibit 15 shows the layout of Alternative #1C.

AREA #2 – NORTHWEST PARK, NEW OUTFALL TO RIVER

Problem areas exist at De Cook Road, Manor Lane, Birch Street and Habberton Avenue between Dee Road and Parkside Road. These problems areas are all located east of Northwest Park. There are no existing sewers in the vicinity with excess capacity that can provide relief to the area. Therefore, the available options are to provide detention storage or a new adequately sized sewer system with an outfall to the Des Plaines River.

Alternative #2 is a relief sewer draining the Northwest Park area to the Des Plaines River. Additional storm sewers will extend to each of the problem areas to aid in increasing conveyance to the relief sewer. The sewer sizes shown on Exhibit 17 are based on a 10-year design, which would keep the HGL below street level for a 10-year, 1-hour storm.

The conceptual cost estimate for Alternative #2 is $4.8 million.

Exhibit 16 shows the proposed route for the new relief sewer and the additional storm sewers

AREA #3 – NORTHWEST PARK, STORAGE OPTIONS FOR 10-YEAR AND 100-YEAR PROTECTION

This alternative will provide protection to the problem areas east of Northwest Park. Rather than constructing a new outfall to the Des Plaines River, as in Alternative #2, this option proposes detention storage located in Northwest Park. A relief sewer network would still be required to convey runoff into the proposed detention basin.

Alternative #3A includes the sewer sizes and storage volume required to provide 10-year protection from street flooding. This option requires 12.5 acre-feet of storage in Northwest Park. Design of the specific footprint, depth, etc. for the basin has not been completed at this time.

Alternative #3B includes the sewer sizes and storage volume required to provide 100-year protection from street flooding (allowing <1' maximum ponding depth). This option requires 40 acre-feet of storage in Northwest Park. Design of the specific footprint, depth, etc. for the basin has not been completed at this time.

The conceptual cost estimate for Alternative #3A is $3.2 million.
The conceptual cost estimate for Alternative #3B is $6.3 million.

Exhibit 17 shows both alternatives #3A and #3B for the Northwest Park project area.

AREA #4 – PARK RIDGE COUNTRY CLUB VICINITY & SIBLEY RELIEF SEWER

Exhibit 18 shows the elements of Alternative #4, which would alleviate flooding in the corridor along Sibley Avenue between Riverside and Busse Highway, as well as the areas directly west of the Park Ridge Country Club. The existing sewers in this area do not have available capacity, therefore building limited relief sewers was not an option. Instead, a new relief sewer system with a new outfall to the Des Plaines River has been proposed.

Alternative #4 also includes detention storage on the Park Ridge Country Club. A potential PRCC basin has previously been proposed, and the conceptual size of the basin used in this analysis is consistent with the earlier proposals. Through this current analysis, it has been determined that a detention basin alone will not alleviate the flooding west of PRCC. However, it does reduce the size of the relief sewer system, and would have benefits for smaller storms as well, therefore it remains a worthwhile project on its own.

Alternative #4A has been sized to provide 10-year street flooding protection, and #4B provides 100-year street flooding protection (<1' maximum ponding depth). The alignment of the relief sewer is the same for both alternatives.

The conceptual cost estimate for Alternative #4A is $5.0 million.
The conceptual cost estimate for Alternative #4B is $5.2 million.

Exhibit 18 shows both alternatives 4A and 4B for the PRCC project area.

AREA #5 – OVERHILL & LAHON AVENUE

Flooding occurs at the intersection of Overhill and Lahon Avenues due to insufficient sewer capacity. Currently, the model predicts minor street flooding in a 1-year storm, and more sever flooding for larger storms. No sewer improvement alternatives were found that could significantly improve the level of protection.

Alternative #5 includes the construction of a new 24-inch relief sewer west down Lahon Street towards Northeast Park. The new 24-inch storm sewer would connect to a 48-inch relief sewer that currently exists in Northeast Park. This project would create moderate benefits for frequent storms but would have no benefit in the larger storms that produce the major flooding. For instance, the proposed improvement would lower the HGL in a 1-year storm by almost 2', which would eliminate the minor street flooding. However, the project would not have any benefits for the 2-year and larger storm events.

The conceptual cost estimate for Alternative #5 is $400,000.

Exhibit 19 shows the layout of Alternative #5.

AREA #6 – GILLICK STREET RELIEF SEWER

The intersection of Stewart and Warren Avenues, within the Devon watershed, shows surcharging in a 2-year storm and street ponding in a 5-year event. The existing outlet for the area is along Home Avenue. This sewer is at full capacity, therefore increasing the size of the existing sewers to the outlet sewer would not be beneficial.

There is an existing 36-inch relief sewer along Gillick extends west from Greenwood to Lincoln Avenue. Alternative #6 would extend a new relief sewer from the intersection of Lincoln and Gillick to the intersection of Stewart and Warren. The relief sewer eliminates street ponding for the 10-year storm and decreases the HGL along Warren by 3 feet and along Engel by 1 foot.

The conceptual cost estimate for Alternative #6 is $650,000.

Exhibit 20 shows the layout of Alternative #6.

AREA #7 – CUMBERLAND AVENUE NORTH OF TALCOTT

The combined sewer on Cumberland Avenue north of Talcott has elevated HGL profiles and shows street flooding at the intersection of Cumberland and Gillick and Cumberland and Belle Plaine for a 5-year storm. This area is tributary to an existing 4 foot by 6 foot box culvert along Talcott Road but is restricted by an 18-inch sewer at Talcott Road.

The Cumberland Ave sewer is not connected to the Gillick Street relief sewer under existing conditions. Both the Gillick Street relief sewer and the Talcott box culvert have available capacity for the peak 10-year event.

The proposed improvements for Alternative #7 are shown on Exhibit 19 and described below. The improvements will eliminate street ponding at Belle Plaine and Gillick for a 10-year storm event. The HGL along Cumberland Avenue will decrease up to 8 feet and the system will be at full flow for the 10-year storm event.

- Replace 18-inch from connection at Talcott to Cumberland with a 30-inch sewer
- Connect the existing 12-inch along Cumberland to the 54-inch relief sewer at Gillick
- Install an 18-inch sewer from Belle Plaine to Gillick
- Install additional inlets at Belle Plaine

The conceptual cost estimate for Alternative #7 is $350,000.

Exhibit 20 shows the layout of Alternative #7.

AREA #8 – SOUTH OF TALCOTT, PROSPECT, COURTLAND, AND CRESCENT

Improvements in Area #8 include an additional outlet to the Devon Avenue combined sewer at Prospect and Courtland Avenues. The additional outlets will eliminate street flooding at Talcott Place, Courtland and Ashland Avenues during a 10-year storm event. Street flooding is also eliminated at Prospect and Granville while the HGL decreases 2-5 feet along Prospect, Courtland and Crescent Avenues for the 10-year storm event. The following is a list of the proposed improvements:

- 36-inch relief sewer at Prospect and Devon, with a connection to the existing 12-inch on Prospect.
- 36-inch lateral connecting Crescent at Talcott Place to the proposed 36-inch relief sewer with connections to the existing sewers at Courtland and Crescent.
- Additional 21-inch relief sewer at Crescent and Talcott.
- 36-inch lateral along Talcott Place from Vine to Crescent.
- 12-inch lateral connecting Ashland to Vine along Glenlake. This directs water away from the identified problem area.

The conceptual cost estimate for Alternative #8 is $530,000.

Exhibit 21 shows the layout of Alternative #8.

AREA #9 – WESTERN, SOUTH OF TALCOTT

Under existing conditions, this portion of Western Avenue drains north to Devon Avenue. Modeling indicates moderate surcharging in this area with elevated 5- and 10-year HGL profiles but no street flooding.

The improvements in Alternative #9 include a 12-inch relief sewer connected to the existing system draining south to a 42-inch relief sewer north of Bonita Drive. Sanitary flow would

continue to flow north to Devon. The proposed relief sewer decreases the HGL 2-5 feet along Western Avenue for the 10-year storm event.

The conceptual cost estimate for Alternative #9 is $125,000.

Exhibit 21 shows the layout of Alternative #9.

AREA #10 – GRANVILLE AT LINCOLN AVENUE

Under existing conditions Granville at Lincoln Avenue drains east to Greenwood Avenue. Modeling indicates surcharging in a 2-year storm and street flooding for the 5-year and greater storms.

Alternative #10 includes a 12-inch sewer draining west to the 42-inch sewer along Western Avenue. The proposed connection eliminates street flooding at Lincoln and Granville and lowers the HGL along Granville 2-3 feet for the 10-year storm event.

The conceptual cost estimate for Alternative #10 is $50,000.

Exhibit 21 shows the layout of Alternative #10.

AREA #11 – CHESTER, SOUTH OF DEVON

Modeling indicates surcharging in the combined sewer along Chester Avenue between Bonnie and Bonita and street flooding for a 5-year and greater storm event.

Alternative #11 includes a 15-inch relief sewer along Chester Avenue and an 18-sewer along Bonita, connecting to the existing 18-inch sewer on Bonita. The proposed improvements will eliminate street flooding along Chester and decrease the HGL 5-6 feet along Chester Avenue for the 10-year storm event.

The conceptual cost estimate for Alternative #11 is $150,000.

Exhibit 21 shows the layout of Alternative #11.

AREA #12 – PROSPECT, SOUTH OF GRANVILLE

Alternative #12 consists of a 24-inch relief sewer from Granville to Glenlake along Prospect Avenue. The 24-inch will combine with the 42-inch trunk sewer along Glenlake. This relief sewer provides an additional outlet for Prospect Avenue and eliminates street flooding at Granville and Prospect. The HGL decreases 2-3 feet along Prospect north of Granville for the 10-year storm event.

The conceptual cost estimate for Alternative #12 is $225,000.

Exhibit 21 shows the layout of Alternative #12.

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APPENDIX 1

SEWER CAPACITY ATLAS SHEETS