VILLAGE OF LA GRANGE
Department of Public Works

MEMORANDUM

TO: Robert J. Pilipiszyn, Village Manager

FROM: Ryan Gillingham, Director of Public Works

DATE: December 19, 2014

RE: South of 47th Street Drainage Basin Study
Analysis and Recommendations

This past summer the Village experienced multiple high intensity rain events that exceeded the limited capacity of the Village's sewer system resulting in flooded basements, streets and rear yards. In response to the increasing frequency and intensity of rain events, the Village Board requested staff to pursue funding and engineering solutions that reduce flooding in an affordable and shorter time frame than currently planned.

In late September, staff recommended to the Board a tiered approach to the prioritization of flooding objectives given the Village's limited resources. In the first tier, staff recommended implementing solutions that will address overland flooding and water pooling in depressional areas. Staff recommended implementing these solutions first as residents that experience this type of flooding are generally unable to undertake individual private property solutions to address this type of flooding. In the second tier, staff recommended implementing solutions that will reduce the frequency of combined sewer backups. As the next tier, staff recommended carrying out solutions that reduce the incidences of rear yard flooding.

Based on this tiered approach, a contract with Baxter & Woodman was executed to update the hydraulic model of the area south of 47th Street to evaluate alternatives that directly address overland flooding in the depressional areas. The purpose of this memorandum is to transmit the completed hydraulic study, provide analysis and summary of the results, and make recommendations based on the effectiveness and affordability of the different flood mitigation alternatives considered.

Analysis

The first step was to develop a hydrologic and hydraulic model of the area south of 47th Street so that the proposed solutions to address flooding could be simulated. The model was calibrated and compared against experiences from actual flooding events and other hydraulic models created for this area. The modeled flood depths were generally consistent with flooding reports, observations and other available data. Once the model was completed, the following five drainage improvements were simulated in the model to determine their effectiveness in alleviating overland flooding.

Alternative No. 1: **Brainard Avenue Floodwall** – Construction of a floodwall from 52nd Street to north of 50th Street to prevent water from overtopping the roadway

Alternative No. 2: **50th Street Storm Sewer** – Construction of a relief storm sewer from an outlet at East Avenue to 50th and Spring Avenue [Depression No. 2]

Alternative No. 3: **50th Street Storm Sewer, Laterals and Extensions** – Construction of a relief storm sewer from an outlet at East Avenue to 50th and Spring Avenue [Depression No. 2] and construction of lateral storm sewers to the following depressional areas:

Depression 1 – Sunset Avenue and Linklater Avenue
Depression 3 – Ashland Avenue and 48th Street
Depression 4 – La Grange Road and 48th Street
Depression 5 – 9th Avenue and 48th Street
Depression 6 – 12th Avenue and 50th Street

Alternative No. 4: **50th Street Storm Sewer, Laterals and Extension, Upsized Outlet** – Construction of Alternative No. 3 and the construction of a new 84" sewer to the replace the existing 54" sewer crossing the quarry.

Alternative No. 5: Combination of Alternatives 1 and 4

In summary, their analysis of the alternatives found that a storm sewer constructed on 50th Street with connecting lateral storm sewers to depressional areas was the most effective solution to address overland flooding in the area south of 47th Street. Specifically, the model showed that no surface ponding would occur in the 5 and 10-year storm events at the intersection of 50th Street and Spring Avenue. The model also showed that additional flood reduction benefits are gained by constructing lateral segments to the individual depressional areas listed above and by constructing a larger sewer crossing the quarry.

While relief storm sewers were found to be the most effective in lowering the depth of flooding in many rain events, it should be noted that in the critical duration events ponding water will occur in depressional areas. The critical duration storm event is the storm event that results in the greatest depth of flooding. The severity of a storm event depends on two factors: the depth of rainfall and the period of time in which it falls. For example a 100-year storm event, which is a storm event that has a 1% chance of occurring in any given year, could be 2.8 inches of rain falling in 30 minutes, 4.5 inches of rain falling in 2 hours, or 7.6 inches of rain falling in 24 hours. Statistically speaking, each of those storm events has a 1% chance of occurring in any given year. A critical duration analysis involves modeling a range of storm durations to determine which duration produces the highest flood elevation. Therefore it is important to note that reductions in the depths of flooding from the proposed 50th Street Storm sewer vary depending on the severity of the rain event.

Notably, the Brainard Avenue floodwall was found only to be effective in lowering the depth of flooding when water would overtop Brainard Avenue from the Country Club in the 100 year storm event. The proposed floodwall would not reduce flooding in events that do not currently cause overtopping of the roadway such as the 5-year and 10-year storm events. Specifically, the floodwall would only reduce flooding by approximately 1' in the 100-year critical duration rain event for Depression No. 2 only.

As part of the analysis Baxter & Woodman also considered the Plainfield Road sewer improvement project being planned by MWRD. While a significant amount of water would be diverted from the Plainfield Road project, the resulting reduction in the depth of flooding in depressional areas south of 47th Street was determined to be minimal. The reason for the minimal reduction is that flooding in the depressional areas was determined to be principally the result of localized rainfall draining directly to these low areas. Therefore, the Plainfield Road sewer project, while still important regionally, was not considered further in the model due to its limited benefits in reducing the depth of flooding in depressional areas.

The installation of inlet restrictors to provide flood storage in roadways was also considered. The volume of water storage required to make an appreciable difference in lowering the depth of flooding was determined to not be feasible within existing roadways. Therefore this alternative was not considered further.

Lastly, alternate alignments for the storm sewer were also considered such as 51st Street. A storm sewer on 50th Street was selected as the preferred alignment due to its proximity to the depressional areas and fewer conflicts with the existing storm sewer on 51st Street. While the sewer would cross multiple north-south combined sewers, the new storm sewer was modeled to be below these existing sewers thus avoiding these conflicts.

A summary of the cost for each of the alternatives is provided in the below table:

Description	**Cost**
Alternative No. 1: Brainard Avenue Floodwall	$750,000
Alternative No. 2 – Relief Storm Sewer	$11,720,000
Alternative No. 3 – Relief Storm Sewer, Laterals and Extensions	$22,380,000
Alternative No. 4 – Relief Storm Sewer, Laterals and Extension, Upsized Outlet	$22,890,000
Alternative No. 5 – Combination of Alternatives 1 and 4	$23,640,000

As conceived, the relief sewer on 50th Street from Spring Avenue to East Avenue would serve as the backbone for the other contemplated lateral extensions to other depressional areas. Due to the significant differences in cost between Alternative No. 2 [50th Street storm sewer] and Alternative No. 4 [50th Street storm sewer, laterals and extensions, upsized outlet], staff requested the cost, properties impacted, and depth of flooding for each lateral extension and depressional area. With this information a phased approach for implementation could be considered. The following chart details this information:

Description	Properties Impacted – 100-year, Existing Conditions	Flooding Depth (ft) - 100-year, Existing Conditions	Cost Per Property Impacted	Cost
Depression 1 – Sunset Avenue and Linklater Avenue	43	2.9	\$86,512	\$3,720,000
Depression 3 – Ashland Avenue and 48th Street	17	1.4	\$113,529	\$1,930,000
Depression 4 – La Grange Road and 48th Street	64	1.8	\$40,625	\$2,600,000
Depression 5 – 9th Avenue and 48th Street	112	2.7	\$18,839	\$2,110,000
Depression 6 – 12th Avenue and 50th Street	34	3.3	\$9,412	\$320,000

In addition to the completion of the hydraulic model and analysis, geotechnical information was also collected to determine expected subsurface conditions. This data is important as the depth of rock has a significant impact on the overall cost of the project. As such a total of eight borings were taken along the proposed sewer route. The results from these borings indicate that shallowest depth of rock encountered was at 25 feet, which is deeper than the depth of the sewers being considered. Based on these results, rock excavation should not be a factor in construction as it was for the recently completed segment of the Maple Avenue Relief Sewer.

Legal

Currently, there is an existing 54" storm sewer in the Hansen quarry located just east of East Avenue between 50th and 51st Streets. This storm sewer transmits water from a storm sewer collection system west of East Avenue in La Grange. Easements for this sewer were granted to the Village in the 1920's and 1940's. The proposed 50th Street Storm Sewer would use these existing storm sewer easements. The Village Attorney will provide a separate analysis regarding this easement.

Recommendations

Baxter & Woodman identifies Alternative No. 4 as the most effective alternative in reducing flooding in the area south of 47th Street. However the anticipated cost to construct this option exceeds funding sources that have been discussed to date. Therefore based on the above analysis and anticipated funding, staff recommends a phased approach to the implementation of the identified relief sewers for the area south of 47th Street as follows:

	Phase 1	Cost
A	Construct 50th Street Relief Sewer to Depression 2	$11,720,000
B	Upsize 84" Outlet	$520,000
C	Construct Lateral to Depression 5	$2,110,000
	Total Phase 1	**$14,350,000**
	Phase 2	
D	Construct Lateral to Depression 3	$1,930,000
E	Construct Lateral to Depression 4	$2,600,000
	Total Phase 2	**$4,530,000**
	Phase 3	
F	Construct Lateral to Depression 1	$3,720,000
G	Construct Lateral to Depression 6	$320,000
	Total Phase 3	**$4,040,000**

As part of Phase 1, we recommend increasing the size of the 54" diameter sewer crossing the quarry to an 84" diameter sewer as this will provide additional capacity to transmit water from the depressional areas. However, as shown in the hydraulic model, significant benefits are gained from constructing the 50th Street storm sewer and connecting it to the existing 54" pipe. Should the Village include increasing the size of the downstream sewer to 84", additional time should be added for legal review and coordination. Further refinement of individual sewer sizes would be completed as part of the detailed design process in order to optimize flood reduction benefits at the multiple depressional areas.

Staff also recommends construction of the sewer lateral to Depression 5 as part of Phase 1 due to the number of properties impacted by flooding in this area, depth of flooding, and anticipated benefits from constructing a storm sewer to this depressional area. Using the same criteria, staff recommends constructing laterals to Depression 3 and 4 as part of a Phase 2 program. Lastly, laterals to Depressions 1 and 6 are recommended to be constructed as part of Phase 3.

Staff does not recommend pursuing the construction of the Brainard Avenue floodwall due to the limited benefits demonstrated in the hydraulic model in reducing incidences of flooding.

As noted earlier, the proposed relief storm sewers will significantly decrease, but not eliminate the incidences of flooding in depressional areas. By their nature, ponding water will occur in depressional areas when the water flowing into an area exceeds the capacity of the storm sewer to drain the water. The challenge is to find a balance between the effectiveness of a particular storm sewer design and its cost of implementation. Based on the hydraulic model and resulting analysis, staff recommends the 50th Street Storm Sewer design as the most effective and affordable solution to reduce the incidences of overland flooding.

Based on this recommendation and funding availability, the following schedule for completion of the engineering and construction is anticipated:

Task	**Duration**
Complete Detailed Engineering, Plans and Specifications	4 months
Permitting	2 months
Bid and Award Project	2 months
Construction	24 months

A separate, but parallel schedule would also need to be identified for the funding of these projects. Should the Village Board decide to pursue one or more of the alternatives, staff will work towards the development and approval of a detailed engineering agreement as the next step. Funding for the detailed engineering would need to be identified as the anticipated cost for the recommended alternative is between $530,000 and $765,000.

Lastly, Baxter & Woodman will be prepared to present and answer any questions regarding their hydraulic analysis at the Board meeting on January 12, 2015.

TECHNICAL MEMORANDUM

DATE: December 17, 2014

TO: Ryan Gillingham, P.E., Director of Public Works

FROM: Paul Siegfried P.E., CFM, CPESC

SUBJECT: South Basin Modeling (Task Order No. 71)

Introduction

The South Basin region of the Village of LaGrange is an approximately 3,030-acre watershed located south of 47th Street and draining east to the Des Plaines River in Cook County, Illinois. This area experienced extensive flooding and property damage resulting from rainfall events which occurred during the summers of 2010 and 2014. Numerous roadways, yards, and residences were inundated, and the severity of flooding raised concerns regarding the condition and capacity of the existing drainage system. The Village commissioned a study to evaluate existing drainage and the flooding of 2010, as well as to provide recommendations for potential remediation. Heuer and Associates Consulting Engineers (Heuer) performed that study and issued a report detailing their findings, dated May 10, 2011.

Baxter and Woodman, Inc. (B&W) was retained by the Village of LaGrange in September of 2014 to review and expand upon the Heuer study. B&W reviewed the May 10, 2011 report prepared by Heuer, obtained additional information and data, and performed additional analyses of the existing conditions and five (5) proposed drainage alternatives. Results, conclusions, and recommendations are summarized in this memorandum.

Data Collection and Review

B&W recovered and reviewed the following information:

- South Basin Drainage Investigation, prepared by Heuer (May 10, 2011);
- La Grange Country Club Drainage and Stormwater Management Study and Recommendations, prepared by Engineering Resource Associates, Inc. (October 2007);
- Plans for Proposed County Highway: Brainard Avenue, 55th Street to 47th Street, As-Built Drawings (September 18, 1999);
- Available Cook County GIS data, including topographic mapping, roadway and parcel information, and aerial photography;
- Village sewer atlas; and
- Flooding data and rainfall records provided by the Village.

Flooding data and rainfall records provided by the Village included incremental rainfall data, flooding incident reports, and flooding incident location maps for rainfall events during the summer of 2014. Flooding was observed and reported to be the most severe during the storm spanning August 21 and 22, 2014. Based on flooding data and conversations with Village staff, high intensity, short duration storms have generally resulted in flooding due to combined sewer backups. Overtopping of Brainard Avenue has been observed during long duration, high volume storms.

SUPPLEMENTAL SURVEY

B&W collected survey data on November 18, 19, and 26. Survey data obtained included:

- Ground elevations for overland flow routes at six depressions within the study area;
- Cross sections of the Brainard Avenue and right-of-way at the overflow location just north of 51st Street; and
- Low opening elevation data and flooding elevations of eighteen (18) residences selected within areas of high flood risk.

EXISTING CONDITIONS DRAINAGE ANALYSIS

Heuer prepared an existing conditions hydrologic and hydraulic model of approximately 3,030 acres of the South Basin region tributary to McCook Ditch. The model was developed using the United States Environmental Protection Agency (EPA) Storm Water Management Model (SWMM) software. Overland flow, storm sewer, and combined sewer were evaluated and distinctly represented in the model.

B&W recreated the Heuer existing conditions model using the XP Solutions XPSWMM hydrologic and hydraulic modeling software. Input data was derived from model input documented in the May 10, 2011 Heuer report. The existing condition model was run for the 5-, 10-, and 100-year events with durations ranging from 30-minutes to 24-hours. Design rainfall data was derived from Bulletin 71 rainfall depths and appropriate Huff distributions. XPSWMM model results were found to be generally consistent with the Heuer EPA SWMM model results.

B&W then made several enhancements to the model, including the following:

- All storage volume data was updated to reflect the current Cook County 1-foot topography;
- Two (2) additional storage nodes were added to the model to evaluate flooding at the 48th Street and Ashland Avenue intersection and at the 48th Street and LaGrange Avenue intersection;
- Input data for overland flow routes at the six (6) depressions evaluated in this study was revised based on survey data collected by B&W on November 18 and 19, 2014;
- The Brainard Avenue overflow was revised based on B&W survey performed November 18, 2014;
- Combined sewer and storm sewer laterals were added to the model; and

- Manning roughness coefficients for conduits and overland flow routes were reviewed and revised as appropriate.

The six (6) depressions analyzed are labeled as Depressions 1 through 6 on the attached exhibits.

After the existing conditions model was enhanced, the model was run for the 5-, 10-, and 100-year events, as well as the August 21-22, 2014 storm. Modeled flood depths for the August event were generally consistent with flooding reports, observations, and other available data.

PROPOSED IMPROVEMENTS AND ANALYSES

B&W evaluated five (5) proposed drainage improvements for effectiveness in alleviating flooding in the South Basin region. They include and build upon improvements proposed in the Heuer study. Proposed alternatives were modeled using XPSWMM and are referred to as Alternatives 1 through 5 in this memorandum and supporting documentation. Flood reduction benefits were analyzed at six (6) critical depression areas identified throughout the South Basin region for the 5-, 10-, and 100-year storm events. Concept plan are shown on Exhibits 1 through 5. Flood elevations presented in this memorandum are based on the critical duration rainfall event, with the exception of Figures 7 through 12 which present a range of durations.

Cost estimates have been prepared for each alternative and are included in Appendix 3. "Open cut" estimates assume that a trench will be opened to construct the proposed sewer and remove existing pipe and appurtenances, if necessary. Unit prices include restoration of the roadway and costs of addressing utility conflicts.

"Tunneling and open cut" estimates assume that the proposed 60-inch diameter storm sewer extending from Spring Avenue to 9th Avenue will be tunneled to avoid conflicts with the existing combined sewer system and to minimize surface impacts. The remainder of the proposed sewer will be constructed using an open cut method. Tunneling costs assume shafts will be constructed at each intersection along the length of the proposed sewer to facilitate construction. Unit prices of the shafts include installation of manholes and restoration.

Alternative 1: Brainard Avenue Floodwall

Estimated Cost - $750,000

Alternative 1 proposes construction of a floodwall along Brainard Avenue to prevent overtopping of the roadway. Flood waters have been observed overtopping Brainard Avenue by approximately 2-feet, inundating portions of the adjacent residential neighborhood. The proposed flood wall would raise the 100-year flood elevation on the LaGrange Country Club by approximately 2.3 feet to an elevation of 656.7. A floodwall elevation of 658.00 with an emergency overflow elevation of 657.00 was selected to prevent overtopping during the 100-year rainfall event.

As-built drawings for Brainard Avenue improvements dated September 18, 1999 indicate that the low point of the roadway profile along the proposed flood wall location was lowered from 655.2 to 653.6 during reconstruction. Survey data indicates an existing overflow elevation of 653.73 at Brainard Avenue. This alternative would exacerbate flooding within the La Lagrange Country Club during storm events which currently result in overtopping of Brainard Avenue. As such, plans to construct a floodwall would require cooperation of the Country Club.

Alternative 2: Relief Storm Sewer

Estimated Cost, Open Cut - $11,720,000
Estimated Cost, Tunneling and Open Cut - $13,270,000

Alternate 2 includes construction of a 60-inch diameter relief storm sewer along 50th Street from Spring Avenue to 9th Avenue. Between 9th Avenue and East Avenue, the existing 36-inch storm sewer would be replaced with 72-inch storm sewer. The 72-inch sewer would continue south approximately 180-feet along East Avenue to the existing 54-inch outlet to the Hanson Quarry. The storm sewer in this alternative would convey stormwater from Depressions 2 and 6 to the quarry but would not drain any other depressions.

Available storage volume in the Hanson Quarry would be utilized to detain stormwater, which would be pumped to the existing outlet pipe. The existing outlet ultimately discharges to the McCook Ditch. Analysis of a new pumping system for the quarry was not evaluated as part of this study.

Relief storm sewer alignments along both 50th Street and 51st Street were considered. 50th Street was chosen for the following reasons:

- 50th Street is closer in proximity to the depressions it is intended to drain than 51st Street;
- Constructing the relief sewer along 50th Street would avoid conflicts with the existing storm sewer running along 51st Street; and
- Although there are more combined sewer conflicts along 50th Street than 51st Street, it is assumed that the relief sewer would be constructed below the combined sewer system.

Soil borings were performed at eight (8) locations along the sewer alignments considered. Boring logs indicate that the relief sewer can likely be constructed entirely above bedrock and that soils would be adequate to construct a large segment of the sewer by tunneling, which would minimize construction impacts. Soil boring logs and a location map are included in Appendix 2.

Alternative 3: Relief Storm Sewer, Laterals and Extension

Estimated Cost, Open Cut - $22,380,000
Estimated Cost, Tunneling and Open Cut - $23,920,000

Alternative 3 includes the same storm sewer configuration as Alternative 2 with additional laterals and an extension to drain all six (6) critical depressions in the study area. Stormwater runoff to Depressions 1, 3, 4, 5, and 6 would be conveyed to the proposed storm sewer via 36-inch diameter storm sewers. Costs for each individual lateral or extension are included in Appendix 3. Associated benefits are shown on Exhibits 3A, 3B, and 3C.

Alternative 4: Relief Storm Sewer, Laterals and Extension, Upsized Outlet

Estimated Cost, Open Cut - $22,890,000
Estimated Cost, Tunneling and Open Cut - $24,440,000

Alternative 4 includes the same storm sewer configuration as Alternative 3 except that the existing 54-inch diameter outlet would be replaced by an 84-inch diameter storm sewer.

Alternative 5: Combination of Alternatives 1 and 4

Estimated Cost, Open Cut - $23,640,000
Estimated Cost, Tunneling and Open Cut - $25,180,000

Alternative 5 includes the same storm sewer configuration as Alternative 4 along with the proposed floodwall described in Alternative 1.

Other Improvements Considered

The following design alternates were considered in addition to the five (5) alternatives described above:

- Plainfield Road storm sewer extension;
- Installation of inlet restrictors to provide flood storage in roadways; and
- 48- and 72-inch diameter relief sewers.

An existing 30-inch diameter storm sewer flows northwest along Plainfield Road from Willow Springs Road to a receiving sewer along 55th Street. Cook County is currently engaged in a project to extend the existing storm sewer northeast, eliminating the connection with the 55th Street storm sewer and utilizing a new outfall. The storm sewer would also be upsized to accommodate design flows. Although the sewer would divert significant volumes of stormwater away from the existing sewer system, this diversion would only reduce the duration of the flood and would not appreciably reduce the depth of flooding. Results of a preliminary XPSWMM analysis of the Plainfield Road storm sewer extension indicated that the sewer would reduce peak flooding elevations by less than 0.2-feet at the six (6) depressions evaluated.

Installation of inlet restrictors throughout the watershed was considered as an alternative to options involving construction of new mainline storm sewers; however, over 18-acre-feet of storage volume would need to be created in order to provide 5-year flood protection at Depression

2. Over 15-acre-feet of storage would be required to provide 5-year flood protection at Depression 4. It is not be practical to provide this storage volume within the rights-of-way in the South Basin. Inlet restrictors were not considered further.

A 48-inch diameter relief storm sewer along 50th Street was considered as part of this study, but was determined to provide significantly less flood protection than the 60-inch relief sewer. A 72-inch diameter relief storm sewer along 50th Street was also evaluated and determined to provide additional flood depth reduction of up to 0.8-feet for storms up to the 100-year event. However, associated construction costs of a 72-inch sewer were estimated to be 15% higher than those presented for the 60-inch relief sewer, plus additional costs related to construction below the bedrock elevation, combined sewer conflicts, and/or achieving positive slope to the outlet location.

RESULTS

Modeled flood elevations were evaluated at six (6) critical depressions identified throughout the South Basin region to assess flood reduction benefits of each alternative considered. Tables and figures summarizing the results are included in Appendix 1. Exhibits 1 through 5 show anticipated flooding limits for each alternative compared with existing conditions flooding limits for the 5-, 10-, and 100-year events.

Tables 1 through 3 and Figures 1 through 6 summarize peak flood elevations at each of the depressions analyzed for the 5-, 10-, and 100-year events.

Results for each alternative are described below.

Alternative 1: Brainard Avenue Floodwall

Existing conditions model results indicate Brainard Avenue will not overtop in the 5- and 10-year rainfall events, but will during the 100-year storm. The proposed floodwall would prevent overtopping during events up to and including the 100-year event. Additionally, peak flood elevations would be reduced at Depression 2. However, flood reduction benefits would be negligible at Depressions 3 through 6.

The proposed Brainard Avenue floodwall would not provide any flood reduction benefit for flooding events which do not currently overtop the existing Brainard Avenue overflow.

Alternative 2: Relief Storm Sewer

Alternative 2 would reduce flooding depths at Depression 2 by up to 2.5-feet in the 100-year event. Additionally, flooding durations would be reduced significantly, typically by more than 50%. Flooding at Depression 2 would be eliminated entirely in the 5- and 10-year events. Depressions downstream of Depression 2 would experience less significant benefit, with flood elevations reduced by up to 0.5-feet for the events analyzed. However, peak flood elevations would not be reduced at Depression 1 because it would still be drained by the existing sewer.

It should be noted that utilizing the existing 54-inch diameter outlet with the proposed drainage improvements would increase Hydraulic Grade Lines (HGLs) in the East Avenue sewer system just upstream of the outlet; however, the XP-SWMM analysis indicates the HGL would not exceed ground elevations.

Alternative 3: Relief Storm Sewer, Laterals and Extension

Flooding at Depression 2 would be eliminated entirely in the 5-year event. For the 10- and 100-year events, Alternative 3 provides less flood protection at Depression 2 than Alternative 2. However, it provides more flood reduction benefit at Depressions 3 through 6 and also reduces flood elevations at Depression 1.

It should be noted that utilizing the existing 54-inch diameter outlet with the proposed drainage improvements would increase HGLs in the East Avenue sewer system just upstream of the outlet; however, the XP-SWMM analysis indicates the HGL would not exceed ground elevations.

Alternative 4: Relief Storm Sewer, Laterals and Extension, Upsized Outlet

Alternative 4 provides some increased flood reduction benefit beyond those provided by Alternative 3, most notably at Depressions 5 and 6 during storm durations longer than the critical duration. Additionally, HGLs in the East Avenue storm sewer system just upstream of the outlet are reduced, but still show increases from those in existing conditions.

Alternative 5: Combination of Alternatives 1 and 4

Alternative 5 generally produces the same results as Alternative 4, but local flooding due to overtopping of Brainard Avenue would be prevented for events up to and including the 100-year event. Additionally, minor benefit would be realized at Depression 2 with 100-year flood depths reduced by approximately 0.1-feet from Alternative 4.

CONCLUSIONS

Relief Storm Sewer

Results of the analyses performed for this study indicated that alternatives which include some variation of the proposed relief sewer are significantly more effective than the other flood reduction alternatives considered. The following conclusions were reached based on the XPSWMM analysis:

- The benefits of each proposed relief sewer configuration far exceed those of the other alternatives considered. It may be possible to optimize the relief sewer during detailed design by increasing and decreasing pipe sizes in specific locations to spread the benefits to more depressional areas.

- The greatest overall benefit is provided by Alternative 4, the storm sewer configuration which includes a 36-inch diameter lateral to Depressions 3 through 6, a 36-inch diameter extension to Depression 1, and an 84-inch diameter outlet to the Hanson Quarry.
- Alternative 2, the 60-inch diameter storm sewer draining only Depression 2, provides the greatest flood relief at Depression 2 while also reducing flood elevations at Depression 5. Flood reductions at the other depressions analyzed are minimal.

Brainard Avenue Floodwall

Alternative 1, the Brainard Avenue floodwall, only provides relief for local flooding caused by overtopping of Brainard Avenue for events up to and including the 100-year storm. Existing conditions model results indicate overtopping will not occur in the 5- and 10-year events, but will during the 100-year storm. Overtopping contributes to roadway flooding and overland flow through adjacent properties. None of the other alternatives considered prevent overtopping of Brainard Avenue and associated flooding.

Other

The Plainfield Road storm sewer extension was considered as a potential solution. Flooding durations through the study area would be reduced, but decreases in peak flood elevations would be negligible. Cook County may implement this alternative, but the alternatives recommended in this memorandum would provide greater benefits to the South Basin region. Potential to provide flood storage in roadways through the implementation of inlet restrictors was also evaluated. However, providing the storage volume necessary to significantly reduce flooding was determined to be impractical.

RECOMMENDATIONS

- B&W recommends implementation of Alternative 4, which includes the proposed relief sewer along 50th Street, laterals and extensions to Depressions 1 and 3 through 6, and an upsized outlet to the Hanson Quarry. However, depressional areas which are drained solely by sewer are inherently at risk of flooding. Flooding can occur in the South Basin when the capacity of the relief sewer is exceeded, during instances of partial or complete blockages, or due to structural failure.
- The relief sewer should be constructed in phases, with the first phase including the mainline relief storm sewer. The laterals to Depressions 3 through 6, the extension to Depression 1, and the 84-inch diameter outlet to the Hanson Quarry can be constructed as later phases. Costs for each of these future phases are included in Appendix 3.
- The cost of installing the relief sewer by tunneling will be greater than the cost of installing the relief sewer by open cutting the sewer trench, but the Village should strongly consider tunneling the relief sewer in order to minimize the impact of the project on residents and trees.

- The Village should evaluate the benefits of smaller diameter sewers at the upstream end and larger diameter sewers at the downstream end. These modifications may help the Village optimize the flood reduction benefits of the relief sewer at multiple depressional areas. Further refinement of pipe sizes should be completed as part of preparation of detailed plans and specifications.
- The Village should evaluate alternatives to a storm sewer extension for Depression 1 since the cost estimate for this extension is significantly greater than the cost estimates for laterals to the other depressions. With the cooperation of the LaGrange Country Club, it may be possible to reduce flood depths in Depression 1 at a lower cost by constructing a stormwater detention basin on the Country Club property.
- Inlet capacity should be evaluated in detail during final design of a relief sewer to ensure that modeled discharges can be conveyed to the proposed storm sewer. The analyses performed for this memorandum did not consider inlet capacity.
- Benefits of intercepting drainage from south of 50th Street should be evaluated during final design of a relief sewer. Flow could be intercepted via inlets installed at intersections along 50th Street.
- Legal ramifications of increasing the discharge to Hanson Quarry should be investigated.
- The alternatives evaluated in this study assume a 60-inch diameter relief sewer between Spring Avenue and 9th Avenue. The Village should evaluate available funding for the project and a cost-benefit analysis should be performed if greater flood protection or reduced construction costs are desired.

Secondary Recommendations

- Should the Village wish to reduce costs of the project, B&W recommends Alternative 2 as a solution to address flooding at Depression 2, which appears to affect the most residences based on available flooding data.
- If funding will not be available to construct any of the proposed relief sewer options, Alternative 1 is recommended to address local flooding and overland flow through yards due to overtopping of Brainard Avenue. This option would also provide some benefit at Depression 2 during less frequent storm events.
- Constructing a floodwall west of Brainard Avenue would increase flooding within the La Lagrange Country Club during storm events which currently overtop Brainard Avenue. Plans to construct a floodwall would require the cooperation of the Country Club.

FIGURE 1

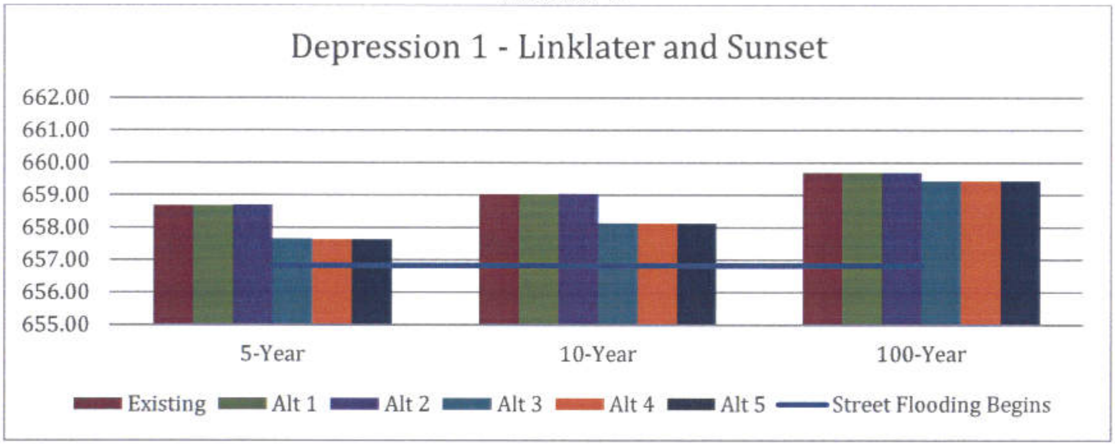


FIGURE 2

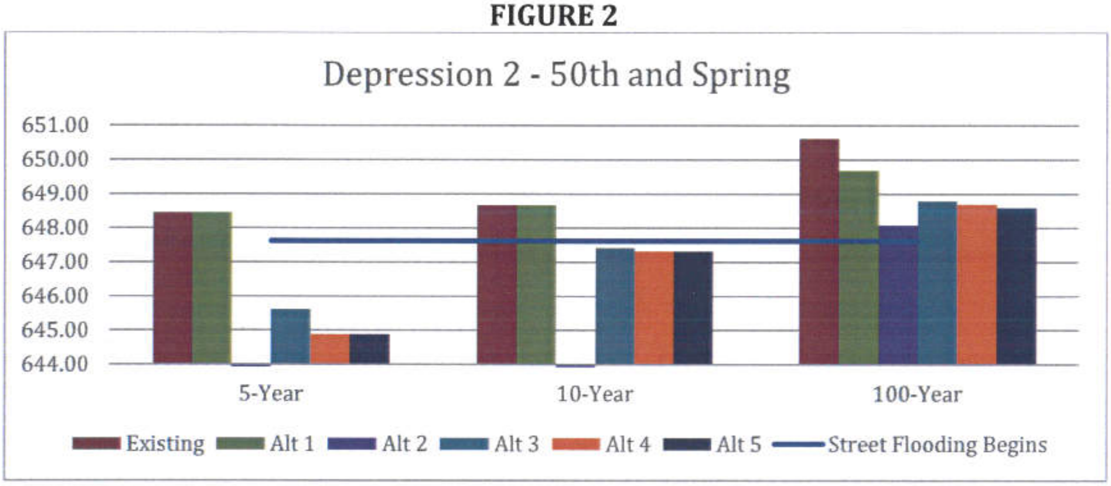


FIGURE 3

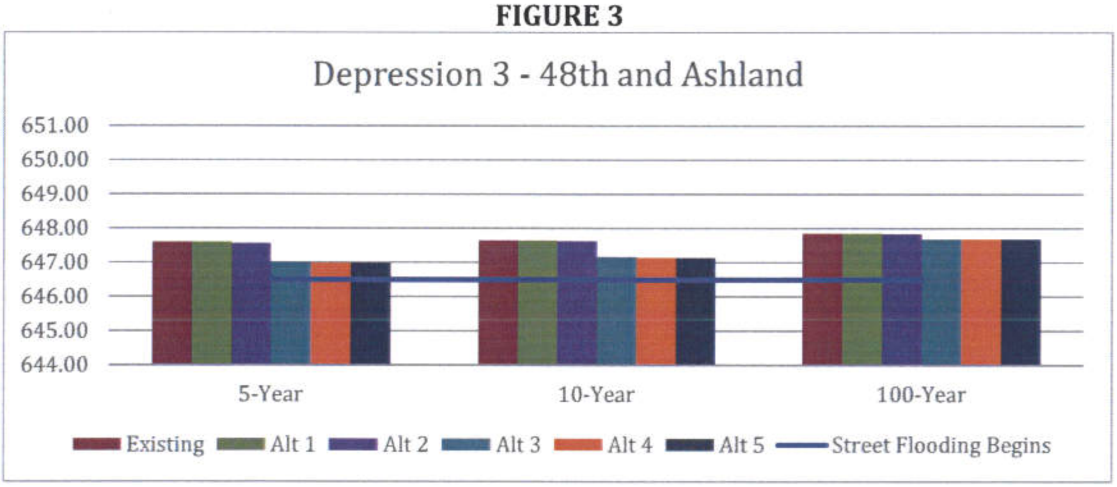


FIGURE 4

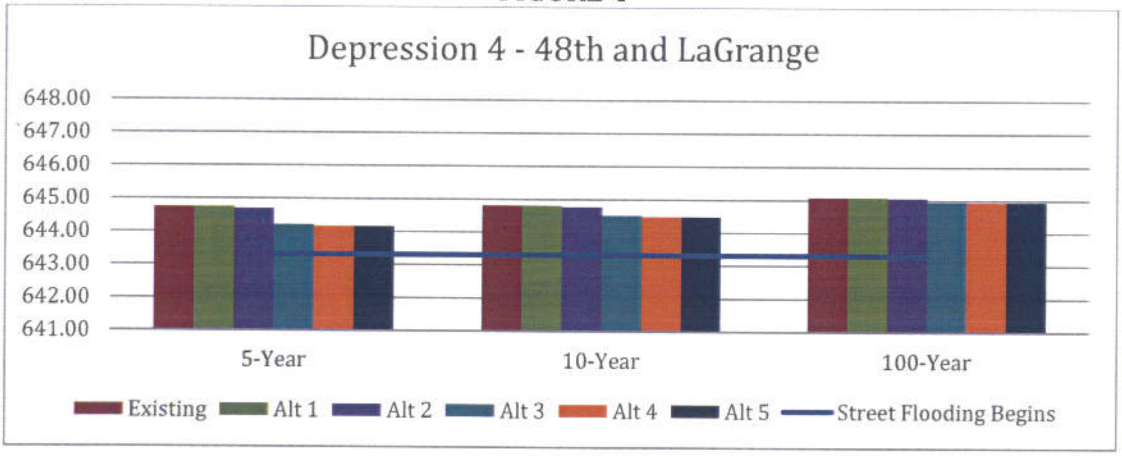


FIGURE 5

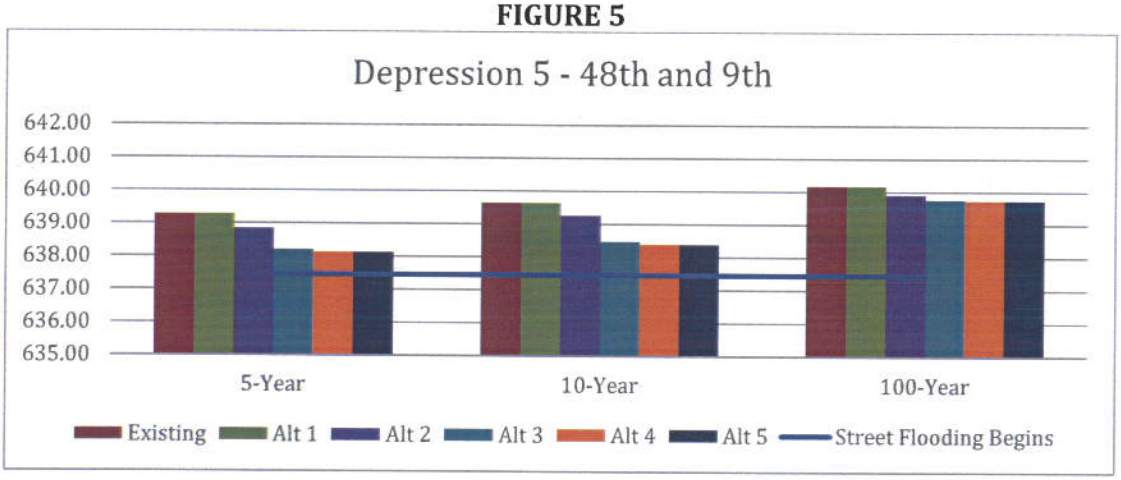


FIGURE 6

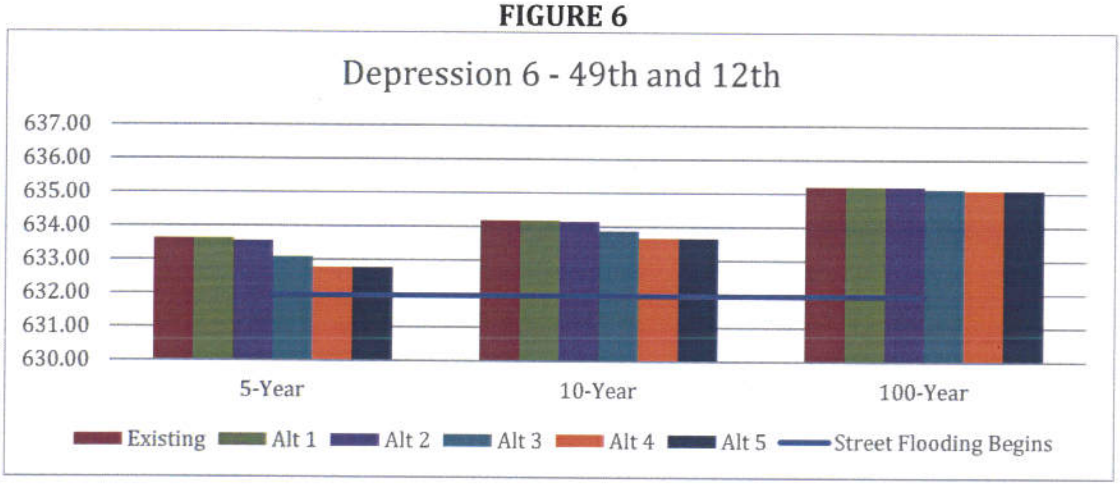


FIGURE 7A

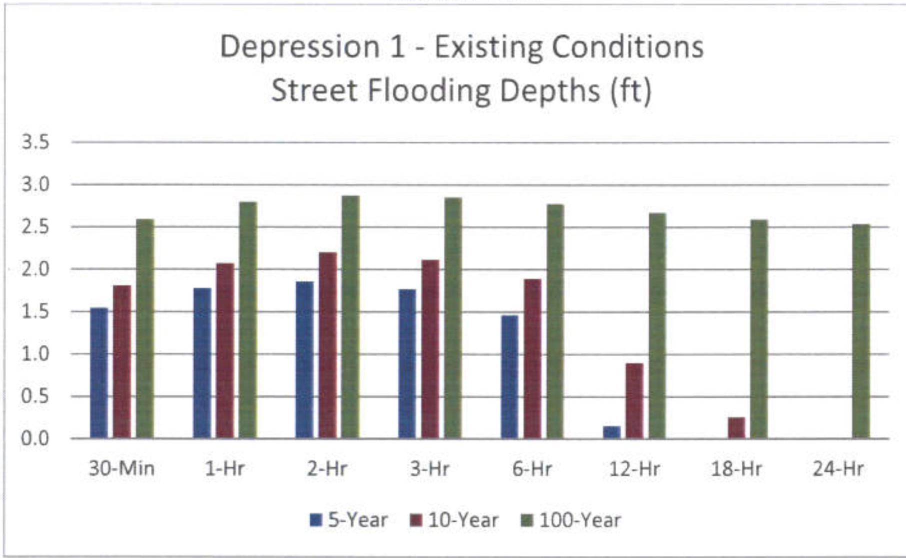


FIGURE 7B

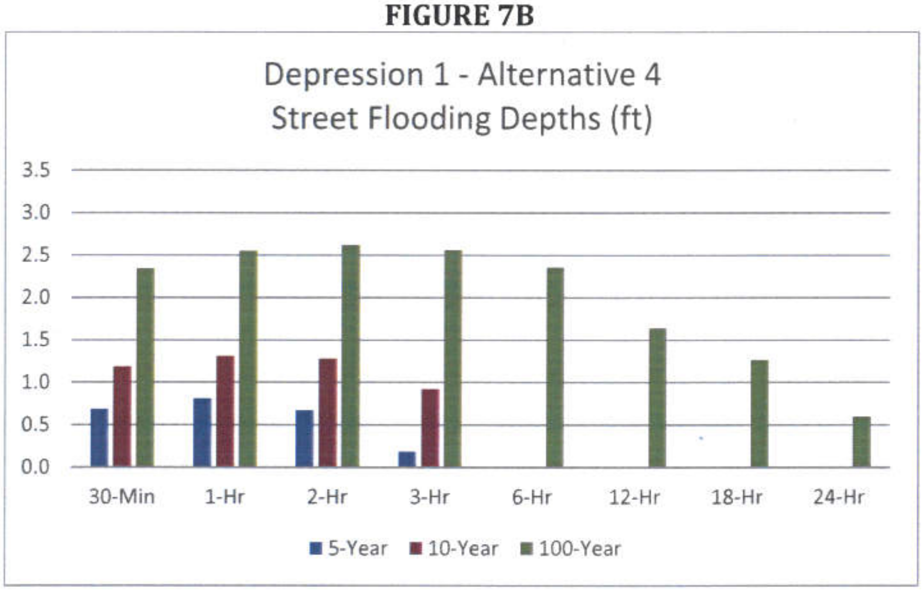


FIGURE 8A

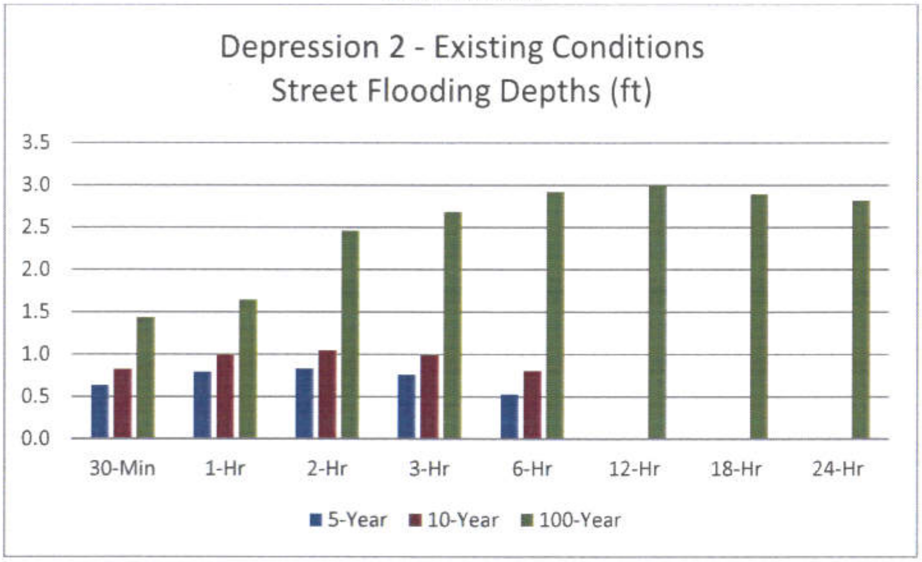


FIGURE 8B

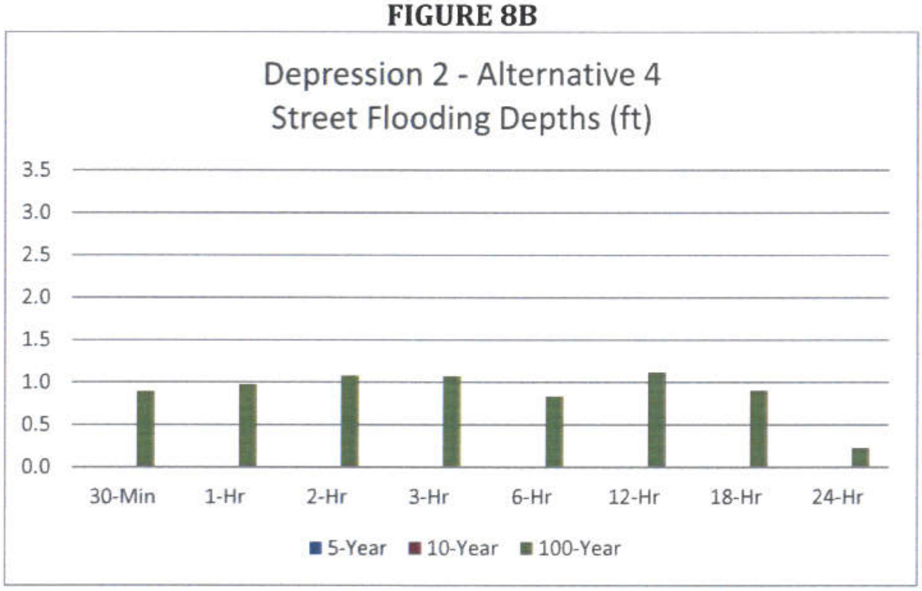


FIGURE 9A

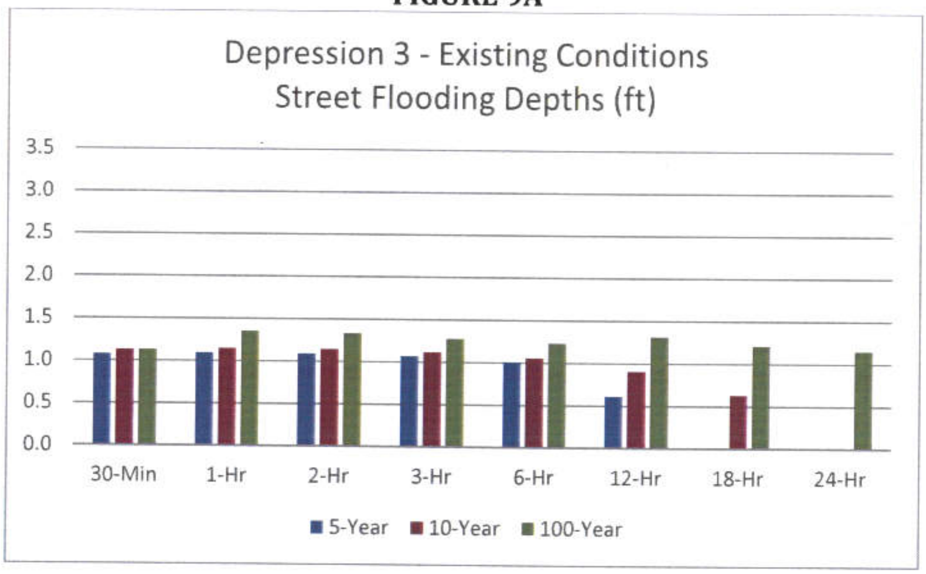


FIGURE 9B

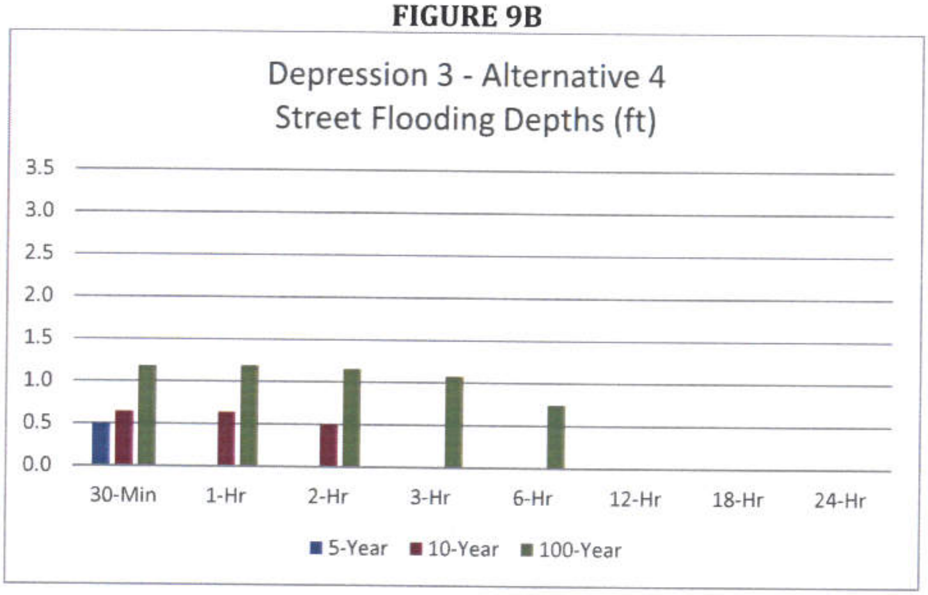


FIGURE 10A

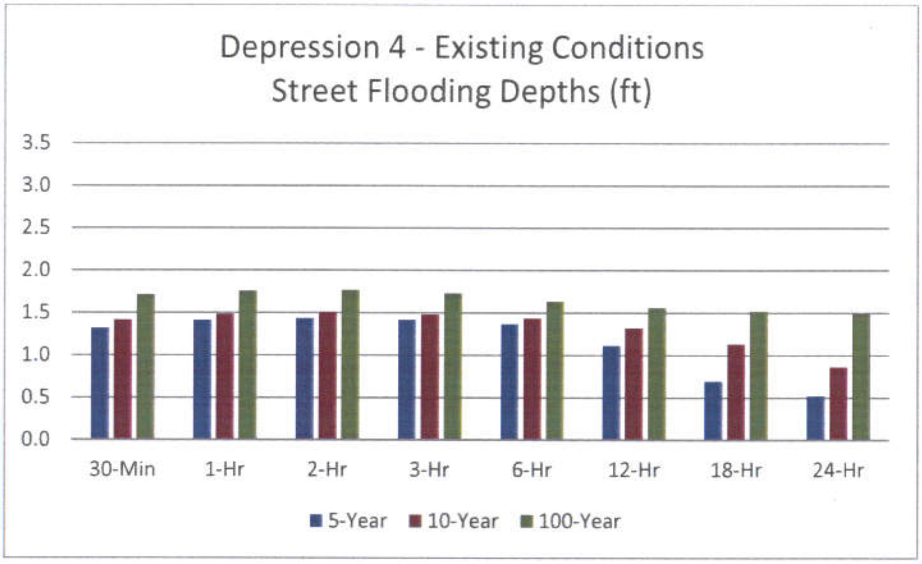


FIGURE 10B

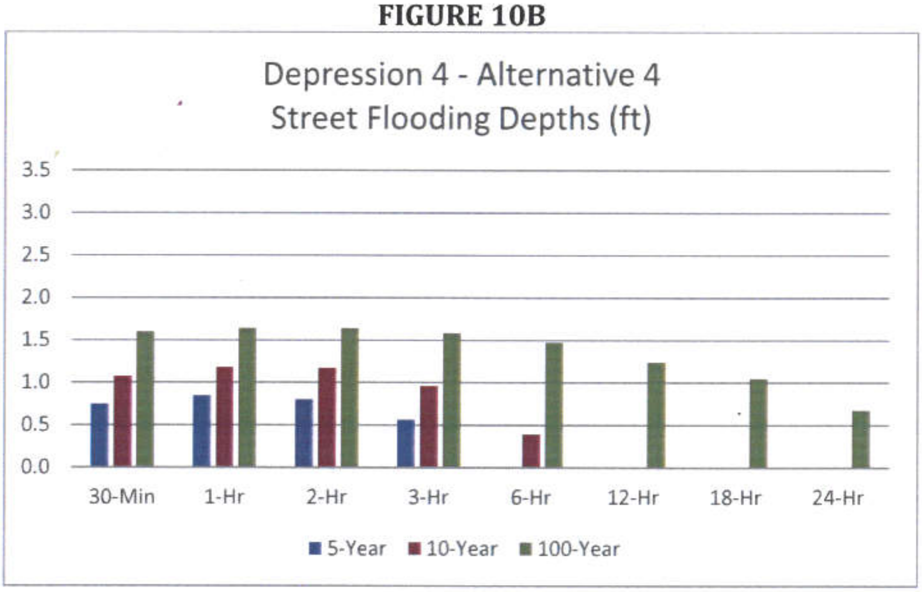


FIGURE 11A

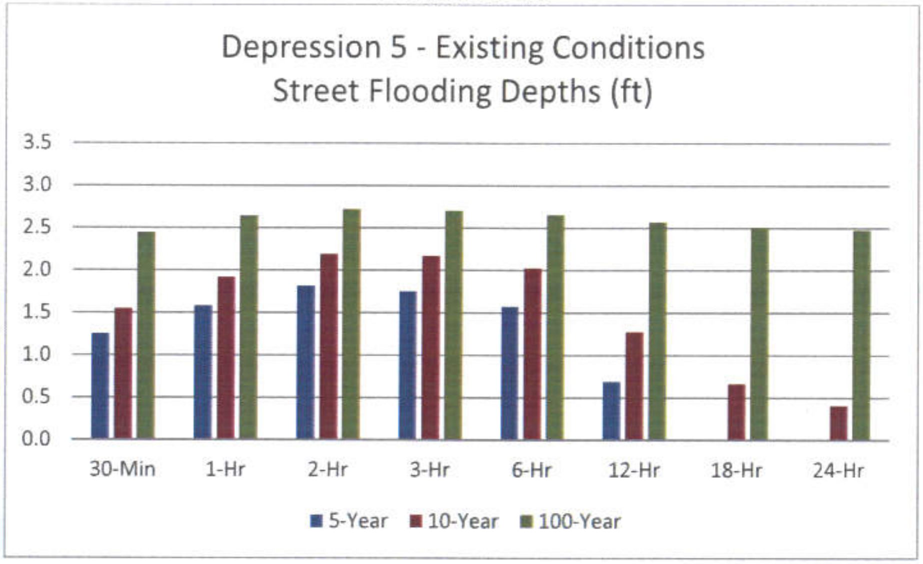


FIGURE 11B

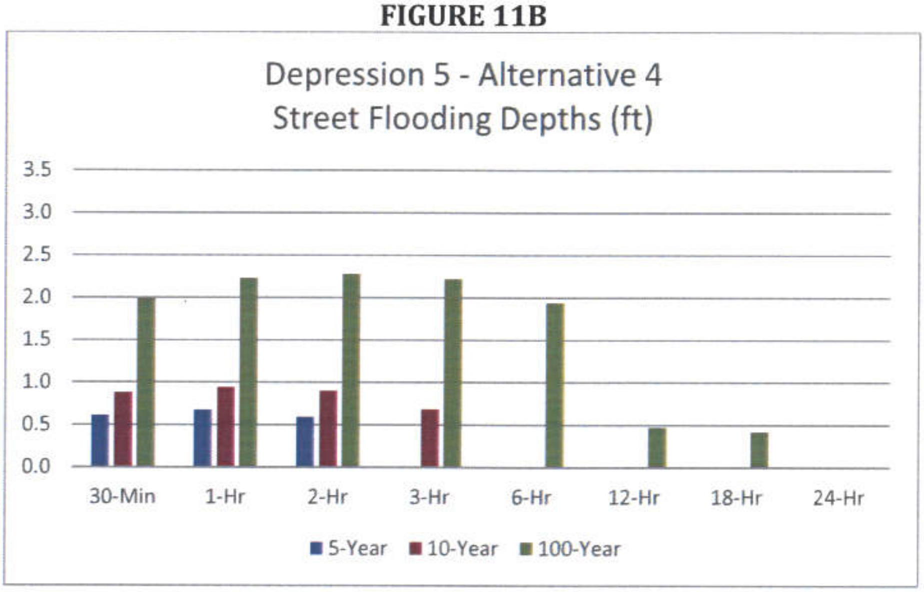


FIGURE 12A

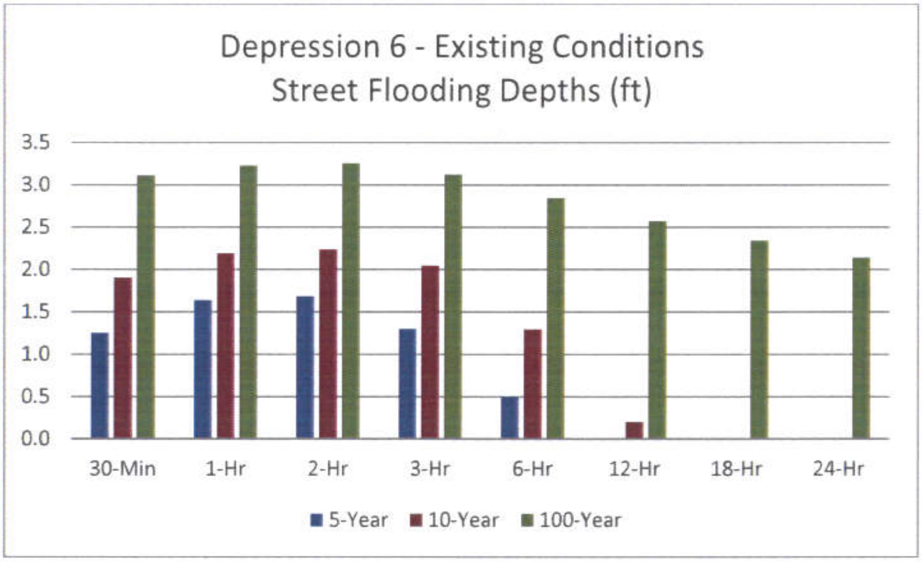


FIGURE 12B

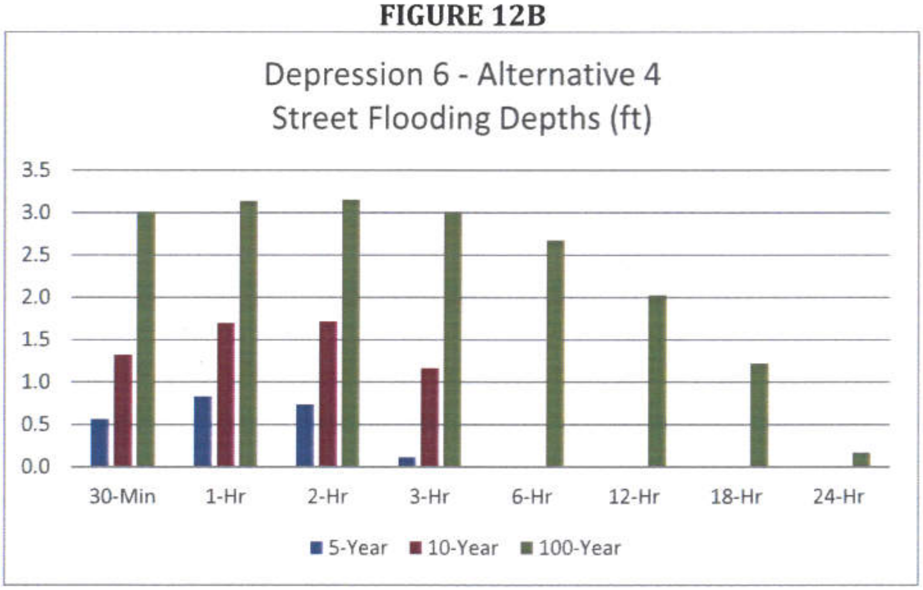


Table 1. XPSWMM Model Results - 5-Year, Critical Duration Flood Elevations

Depression	XPS Node	Ponding Elevation	5-Year, Critical Duration Flood Elevation					
			Exist	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1 - Linklater and Sunset	LG-NW.DEP	656.8	658.7	658.7	658.7	657.6	657.6	657.6
2 - 50th and Spring	SPRING	647.6	648.5	648.5	637.1	645.6	644.9	644.9
3 - 48th and Ashland	48-ASH.DEP	646.5	647.6	647.6	647.6	647.0	647.0	647.0
4 - 48th and LaGrange	48-LAG.DEP	643.3	644.7	644.7	644.7	644.2	644.2	644.2
5 - 48th and 9th	LG-N.DEP	637.5	639.3	639.3	638.8	638.2	638.1	638.1
6 - 49th and 12th	LG-E.DEP	631.9	633.6	633.6	633.6	633.1	632.8	632.8

Table 2. XPSWMM Model Results - 10-Year, Critical Duration Flood Elevations

Depression	XPS Node	Ponding Elevation	10-Year, Critical Duration Flood Elevation					
			Exist	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1 - Linklater and Sunset	LG-NW.DEP	656.8	659.0	659.0	659.0	658.1	658.1	658.1
2 - 50th and Spring	SPRING	647.6	648.7	648.7	641.4	647.4	647.3	647.3
3 - 48th and Ashland	48-ASH.DEP	646.5	647.6	647.6	647.6	647.2	647.1	647.1
4 - 48th and LaGrange	48-LAG.DEP	643.3	644.8	644.8	644.8	644.5	644.5	644.5
5 - 48th and 9th	LG-N.DEP	637.5	639.6	639.6	639.3	638.5	638.4	638.4
6 - 49th and 12th	LG-E.DEP	631.9	634.2	634.2	634.1	633.9	633.7	633.7

Table 3. XPSWMM Model Results - 100-Year, Critical Duration Flood Elevations

Depression	XPS Node	Ponding Elevation	100-Year, Critical Duration Flood Elevation					
			Exist	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1 - Linklater and Sunset	LG-NW.DEP	656.8	659.7	659.7	659.7	659.4	659.4	659.4
2 - 50th and Spring	SPRING	647.6	650.6	649.7	648.1	648.8	648.7	648.6
3 - 48th and Ashland	48-ASH.DEP	646.5	647.9	647.9	647.8	647.7	647.7	647.7
4 - 48th and LaGrange	48-LAG.DEP	643.3	645.1	645.1	645.1	645.0	645.0	645.0
5 - 48th and 9th	LG-N.DEP	637.5	640.2	640.2	639.9	639.8	639.7	639.7
6 - 49th and 12th	LG-E.DEP	631.9	635.2	635.2	635.2	635.1	635.1	635.1

TSC

PROJECT **50th Street Storm Sewer, between Waiola and East Avenues, La Grange, IL**

CLIENT **Baxter & Woodman, Inc., 8678 Ridgefield Road, Crystal Lake, IL**

BORING **RB-1** DATE STARTED **10-30-14** DATE COMPLETED **10-30-14** JOB **L-82,468**

ELEVATIONS

GROUND SURFACE **636.8**

END OF BORING **606.8**

WATER LEVEL OBSERVATIONS

WHILE DRILLING	**Dry**
AT END OF BORING	**Dry**
24 HOURS	

SAMPLE NO.	SAMPLE TYPE	N	WC	Qu	γDRY	DEPTH	ELEV.	SOIL DESCRIPTIONS
								FILL - Black clayey TOPSOIL (OL)
						1.0	635.8	
1	SS	8	24.4	2.5*	102			FILL - Brown and black silty CLAY, little sand, trace gravel, trace organic, moist (CL)
						3.0	633.8	
2	SS	19	18.6	4.5+*				Hard brown and gray silty CLAY, little sand, trace gravel, moist (CL)
3	SS	17	19.1	4.5+*				
4	SS	17	20.8	8.22 4.5+*				
5	SS	22	21.6	4.5+*				
						13.0	623.8	
6	SS	8	21.1	2.68 2.5*				Very tough gray silty CLAY, little sand, trace gravel, moist (CL)
7	SS	11	19.8	2.5*				
8 A	SS	76	22.2	3.74 3.5*		19.0	617.8	
8 B								Very dense gray silty SAND and GRAVEL, moist (SM/GM)
						20.0	616.8	
9	SS	35						Dense to very dense gray silty SAND, trace gravel, occasional Cobbles and Boulders, moist (SM)
10	SS	100/5"						
						25.5	611.3	
11	SS	49-50/1"	5.3					Very dense gray sandy SILT, numerous Cobbles and Boulders, moist (ML)
						29.0	607.8	
12	SS	57	11.1	4.5+*				Hard gray very silty CLAY, little sand and gravel, moist (CL-ML)
								End of Boring at 30.0'

DISTANCE BELOW SURFACE IN FEET: 0, 5, 10, 15, 20, 25, 30, 35, 40

* Approximate unconfined compressive strength based on measurements with a calibrated pocket penetrometer.

DRILL RIG NO. **315**

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.

PROJECT **50th Street Storm Sewer, between Waiola and East Avenues, La Grange, IL**

CLIENT **Baxter & Woodman, Inc., 8678 Ridgefield Road, Crystal Lake, IL**

TSC

BORING **RB-2** DATE STARTED **10-30-14** DATE COMPLETED **10-30-14** JOB **L-82,468**

ELEVATIONS

GROUND SURFACE **642.5**

END OF BORING **607.5**

WATER LEVEL OBSERVATIONS

WHILE DRILLING **Dry**

AT END OF BORING **Dry**

24 HOURS

DISTANCE BELOW SURFACE IN FEET

SAMPLE NO.	SAMPLE TYPE	N	WC	Qu	γDRY	DEPTH	ELEV.	SOIL DESCRIPTIONS
1	SS	10	34.6		86			FILL - Black clayey TOPSOIL, trace Brick pieces, very moist (OL)
						3.0	639.5	
2	SS	11	17.7	4.5+*				Hard brown silty CLAY, little sand and gravel, moist (CL)
						5.5	637.0	
3	SS	15	21.6	4.5+*				Hard brown and gray silty CLAY, little sand, trace gravel, moist (CL)
4	SS	16	21.2	5.57 4.5+*				
5	SS	20	21.1	4.5+*				
						13.0	629.5	
6	SS	9	21.5	2.42 2.25*				Very tough gray silty CLAY, little sand, trace gravel, moist (CL)
7	SS	11	21.7	2.0*				
8	SS	10	21.5	2.81 2.5*				
9	SS	12	21.8	2.25*				
10	SS	8	22.0	3.74 3.5*				
11	SS	9	21.1	2.0*				
						28.0	614.5	
12	SS	38	13.0					Dense gray silty SAND and GRAVEL, moist (SM/GM)
						30.5	612.0	
13	SS	75	8.2	4.5+*				Hard gray very silty CLAY, little sand and gravel, moist (CL-ML)
14	SS	54	11.7	4.5+*				
								End of Boring at 35.0'

End of Boring at 35.0'

* Approximate unconfined compressive strength based on measurements with a calibrated pocket penetrometer.

DRILL RIG NO. **315**

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.

PROJECT **50th Street Storm Sewer, between Waiola and East Avenues, La Grange, IL**

CLIENT **Baxter & Woodman, Inc., 8678 Ridgefield Road, Crystal Lake, IL**

TSC

BORING **RB-3** DATE STARTED **11-4-14** DATE COMPLETED **11-4-14** JOB **L-82,468**

ELEVATIONS		WATER LEVEL OBSERVATIONS	
GROUND SURFACE	648.9	WHILE DRILLING	Dry
END OF BORING	613.9	AT END OF BORING	Dry
		24 HOURS	

Sample NO.	Sample TYPE	N	WC	Qu	γ_{DRY}	DEPTH	ELEV.	SOIL DESCRIPTIONS
						0.8	648.1	Black clayey TOPSOIL (OL)
1	SS	12	25.6	3.0*		3.0	645.9	Very tough brown silty CLAY, little sand, trace gravel, moist (CL)
2	SS	8	17.8	2.81 2.75*				
3	SS	12	20.6	3.75*				Very tough to hard brown and gray silty CLAY, little sand, trace gravel, moist (CL)
4	SS	12	21.1	4.5+*		10.5	638.4	
5	SS	16	20.6	3.14 3.25*				
6	SS	17	20.7	3.5*				Very tough gray silty CLAY, little sand, trace gravel, moist (CL)
7	SS	14	21.4	3.47 3.5*		22.0	626.9	
			11.2	3.0*		24.0	624.9	Very tough gray sandy CLAY, little gravel, moist (CL-ML)
8	SS	100/4"				25.0	623.9	Weathered/Fractured Bedrock or Possible Boulder Zone [Hard Drilling]
9	RC	Recovery = 100% RQD = 40%						DOLOMITE, light tan, motteled gray to dark gray, Silty, Thin to Medium Bedded, some Styolitic, 10-15% pinpoint vugs. Slight to moderate fracture at 27.5' - 28.0' and 32' - 34' Core Run: 25' to 35'

DISTANCE BELOW SURFACE IN FEET: 0, 5, 10, 15, 20, 25, 30, 35, 40

End of Boring at 35.0'

* Approximate unconfined compressive strength based on measurements with a calibrated pocket penetrometer.

DRILL RIG NO. **315**

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.

TSC 82468.GPJ TSC_ALL.GDT 11/13/14

PROJECT 50th Street Storm Sewer, between Waiola and East Avenues, La Grange, IL

CLIENT Baxter & Woodman, Inc., 8678 Ridgefield Road, Crystal Lake, IL

TSC

BORING **RB-4** DATE STARTED **10-31-14** DATE COMPLETED **10-31-14** JOB **L-82,468**

ELEVATIONS		WATER LEVEL OBSERVATIONS	
GROUND SURFACE	649.1	WHILE DRILLING	Dry
END OF BORING	614.1	AT END OF BORING	Dry
		24 HOURS	

SAMPLE NO.	TYPE	N	WC	Qu	γ_{DRY}	DEPTH	ELEV.	SOIL DESCRIPTIONS
								Black clayey TOPSOIL (OL)
						1.1	648.0	
1	SS	5	21.4	2.25*				Very tough brown and dark brown silty CLAY, little sand, trace gravel, trace organic, moist (CL)
						3.0	646.1	
2	SS	11	21.9	3.5*				Very tough to hard brown and gray silty CLAY, little sand, trace gravel, moist (CL)
3	SS	12	21.9	3.34 3.0*				
4	SS	18	20.6	3.25*				
5	SS	18	21.7	5.32 4.5+*				
						13.0	636.1	
6	SS	15	21.4	2.75*				Very tough gray silty CLAY, little sand, trace gravel, moist (CL)
7	SS	11	21.2	2.81 2.5*				
8	SS	10	21.6	1.75*				
						28.0	621.1	
9	SS	100/2"						Weathered/Fractured Bedrock or Possible Boulder Zone [Hard Drilling]
10	SS	89-50/3"						

End of Boring at 35.0'

* Approximate unconfined compressive strength based on measurements with a calibrated pocket penetrometer.

DISTANCE BELOW SURFACE IN FEET (0–40)

DRILL RIG NO. **315**

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.

TSC

PROJECT 50th Street Storm Sewer, between Waiola and East Avenues, La Grange, IL

CLIENT Baxter & Woodman, Inc., 8678 Ridgefield Road, Crystal Lake, IL

BORING **RB-5** DATE STARTED **10-31-14** DATE COMPLETED **10-31-14** JOB **L-82,468**

ELEVATIONS		WATER LEVEL OBSERVATIONS	
GROUND SURFACE	647.0	WHILE DRILLING	Dry
END OF BORING	612.0	AT END OF BORING	Dry
		24 HOURS	

DISTANCE BELOW SURFACE IN FEET	SAMPLE NO.	SAMPLE TYPE	N	WC	Qu	γDRY	DEPTH	ELEV.	SOIL DESCRIPTIONS
0							1.0	646.0	Black clayey TOPSOIL (OL)
	1	SS	9	24.5	3.0*				Very tough to hard brown and gray silty CLAY, little sand, trace gravel, moist (CL)
5	2	SS	9	23.5	3.87 3.75*				
	3	SS	18	20.0	4.5+*				
10	4	SS	11	20.3	3.0*		10.5	636.5	
	5	SS	22	20.4	2.68 2.25*				Very tough to tough gray silty CLAY, little sand, trace gravel, moist to very moist (CL)
15	6	SS	9	21.4	1.75*				
20	7	SS	7	21.5	2.15 2.0*				
25	8	SS	9	19.6	1.25*				
30	9	SS	10	22.5	1.49 1.5*		32.0	615.0	
35	10	SS	100/5"	11.2	4.5+*				Hard gray very silty CLAY, little sand and gravel, occasional Cobbles, moist (CL-ML)
40									End of Boring at 35.0'

* Approximate unconfined compressive strength based on measurements with a calibrated pocket penetrometer.

DRILL RIG NO. 315

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.

TSC 82468.GPJ TSC_ALL.GDT 11/13/14

PROJECT **50th Street Storm Sewer, between Waiola and East Avenues, La Grange, IL**

CLIENT **Baxter & Woodman, Inc., 8678 Ridgefield Road, Crystal Lake, IL**

TSC

BORING **RB-6** DATE STARTED **10-31-14** DATE COMPLETED **10-31-14** JOB **L-82,468**

ELEVATIONS

GROUND SURFACE **647.7**

END OF BORING **617.7**

WATER LEVEL OBSERVATIONS

WHILE DRILLING **Dry**

AT END OF BORING **Dry**

24 HOURS

Distance Below Surface in Feet	Sample No.	Type	N	WC	Qu	γDRY	Depth	Elev.	Soil Descriptions
0	1	SS	10	31.1					Black clayey TOPSOIL, very moist (OL)
							3.0	644.7	
5	2	SS	10	24.3	2.0*				Very tough to hard brown and gray silty CLAY, little sand, trace gravel, moist (CL)
	3	SS	16	20.5	4.79 4.5+*				
10	4	SS	18	18.0	4.5+*				
							10.5	637.2	
	5	SS	11	20.9	3.34 3.0*				Very tough gray silty CLAY, little sand, trace gravel, moist (CL)
15	6	SS	14	21.7	2.25*				
							17.0	630.7	
20	7	SS	4	25.9	0.70 0.75*				Stiff to tough gray silty CLAY, little sand, trace gravel, very moist (CL)
25	8	SS	5	24.7	1.25*				
							27.0	620.7	
30	9	SS	10	18.8	1.62 1.5*				Tough gray silty CLAY, little sand and gravel, moist (CL)
35									End of Boring at 30.0'
40									* Approximate unconfined compressive strength based on measurements with a calibrated pocket penetrometer.

DRILL RIG NO. **315**

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.

TSC 82468.GPJ TSC_ALL.GDT 11/13/14

PROJECT **50th Street Storm Sewer, between Waiola and East Avenues, La Grange, IL**

CLIENT **Baxter & Woodman, Inc., 8678 Ridgefield Road, Crystal Lake, IL**

TSC

BORING **RB-7** DATE STARTED **11-4-14** DATE COMPLETED **11-4-14** JOB **L-82,468**

ELEVATIONS	
GROUND SURFACE	**649.1**
END OF BORING	**604.1**

WATER LEVEL OBSERVATIONS	
▽ WHILE DRILLING	**Dry**
▽ AT END OF BORING	**Dry**
▼ 24 HOURS	

DISTANCE BELOW SURFACE IN FEET

SAMPLE NO.	SAMPLE TYPE	N	WC	Qu	γ_{DRY}	DEPTH	ELEV.	SOIL DESCRIPTIONS
								Black clayey TOPSOIL (OL)
						1.0	648.1	
1	SS	8	24.3	1.25*				Tough dark brown silty CLAY, trace sand, trace organic, very moist (CL)
						3.0	646.1	
2	SS	20	18.9	5.90 4.5+*				
3	SS	19	19.4	4.5+*				Hard brown and gray silty CLAY, little sand, trace gravel, moist (CL)
4	SS	16	21.3	5.57 4.5+*				
5	SS	14	21.4	4.5+*				
						13.0	636.1	
6	SS	11	22.1	3.60 3.5*				
7	SS	8	20.6	2.25*				
8	SS	10	19.7	3.08 3.0*				Very tough gray silty CLAY, little sand, trace gravel, moist (CL)
9	SS	10	20.5	2.0*				
						32.0	617.1	
10	SS	89	9.8					Very dense gray sandy SILT, little gravel, moist (ML)
11	SS	95-50/2"	8.9					

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

TSC 82468.GPJ TSC_ALL.GDT 11/13/14

DRILL RIG NO. **315**

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.

PROJECT **50th Street Storm Sewer, between Waiola and East Avenues, La Grange, IL**

CLIENT **Baxter & Woodman, Inc., 8678 Ridgefield Road, Crystal Lake, IL**

TSC

BORING **RB-7** DATE STARTED **11-4-14** DATE COMPLETED **11-4-14** JOB **L-82,468**

ELEVATIONS		WATER LEVEL OBSERVATIONS	
GROUND SURFACE	649.1	WHILE DRILLING	Dry
END OF BORING	604.1	AT END OF BORING	Dry
		24 HOURS	

DISTANCE BELOW SURFACE IN FEET	LENGTH	RECOVERY	SAMPLE NO.	SAMPLE TYPE	N	WC	Qu	γ_{DRY}	DEPTH	ELEV.	SOIL DESCRIPTIONS
40											Very dense gray sandy SILT, little gravel, moist (ML)
			A 12 B	SS	55	13.9 8.2			44.0	605.1	Very dense gray SAND and GRAVEL, moist (SP/GP)
45											End of Boring at 45.0'
											* Approximate unconfined compressive strength based on measurements with a calibrated pocket penetrometer.
50											
55											
60											
65											
70											
75											
80											

TSC 82468.GPJ TSC_ALL.GDT 11/13/14

DRILL RIG NO. **315**

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.

PROJECT 50th Street Storm Sewer, between Waiola and East Avenues, La Grange, IL

CLIENT Baxter & Woodman, Inc., 8678 Ridgefield Road, Crystal Lake, IL

TSC

BORING RB-8 DATE STARTED 11-4-14 DATE COMPLETED 11-4-14 JOB L-82,468

ELEVATIONS

GROUND SURFACE 654.2

END OF BORING 624.2

WATER LEVEL OBSERVATIONS

WHILE DRILLING Dry

AT END OF BORING Dry

24 HOURS

DISTANCE BELOW SURFACE IN FEET

LENGTH RECOVERY	SAMPLE NO.	SAMPLE TYPE	N	WC	Qu	γ_{DRY}	DEPTH	ELEV.	SOIL DESCRIPTIONS
							1.1	653.1	Black clayey TOPSOIL (OL)
	1	SS	9	24.4	2.0*				Very tough to hard brown and gray silty CLAY, little sand, trace gravel, moist (CL)
	2	SS	10	26.3	2.5*				
	3	SS	16	21.5	4.5+*				
	4	SS	11	22.2	4.20 4.5*		10.5	643.7	
	5	SS	12	21.5	3.75*				Very tough to tough gray silty CLAY, little sand, trace gravel, moist to very moist (CL)
	6	SS	6	20.3	1.98 1.75*				
	7	SS	7	21.1	1.75*				
	8	SS	9	21.6	2.22 2.0*				
	9	SS	6	24.4	1.5*				

End of Boring at 30.0'

* Approximate unconfined compressive strength based on measurements with a calibrated pocket penetrometer.

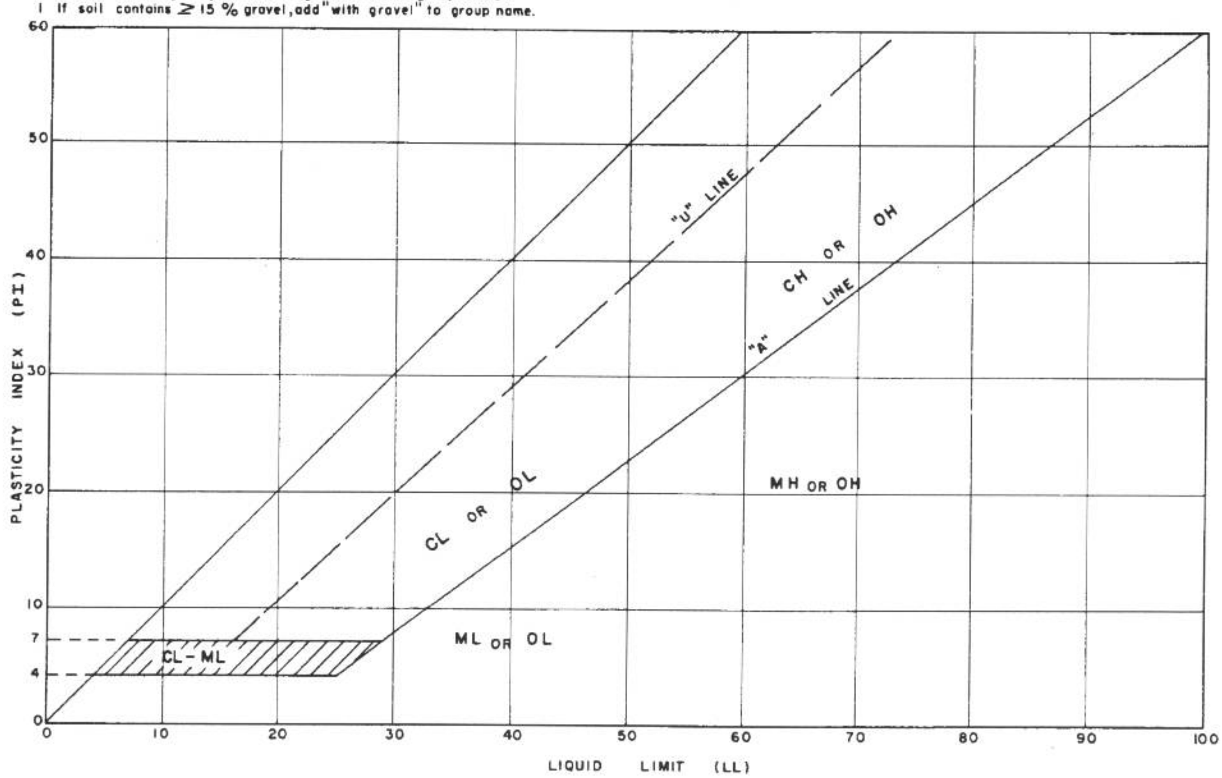
DRILL RIG NO. 315

Division lines between deposits represent approximate boundaries between soil types; in-situ, the transition may be gradual.

TESTING SERVICE CORPORATION
UNIFIED CLASSIFICATION CHART

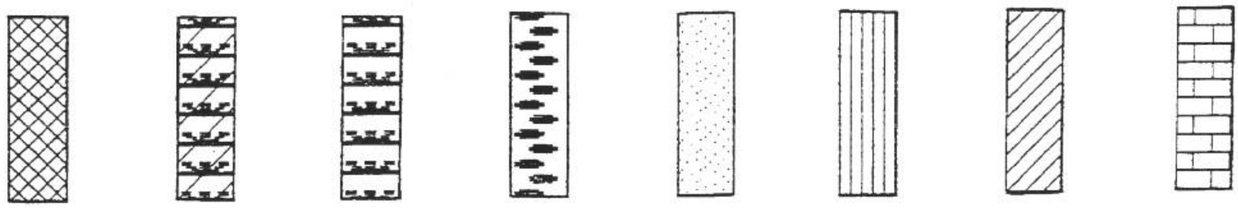
Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [a]				Soil Classification: Group Symbol	Group Name [b]
COARSE-GRAINED SOILS more than 50% retained on No. 200 sieve	GRAVELS More than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS Less than 5% fines [c]	$C_u \geq 4$ and $1 \leq C_c \leq 3$ [e]	GW	Well graded gravel [f]
			$C_u < 4$ and/or $1 > C_c > 3$ [e]	GP	Poorly graded gravel [f]
		GRAVELS WITH FINES More than 12% fines [c]	Fines classify as ML or MH	GM	Silty gravel f,g,h
			Fines classify as CL or CH	GC	Clayey gravel f,g,h
	SANDS 50% or more of coarse fraction passes No. 4 sieve	CLEAN SANDS Less than 5% fines [d]	$C_u \geq 6$ and $1 \leq C_c \leq 3$ [e]	SW	Well-graded sand [i]
			$C_u < 6$ and/or $1 > C_c > 3$ [e]	SP	Poorly graded sand [i]
		SANDS WITH FINES More than 12% fines [d]	Fines classify as ML or MH	SM	Silty sand g,h,i
			Fines classify as CL or CH	SC	Clayey sand g,h,i
FINE-GRAINED SOILS 50% or more passed the No. 200 sieve	SILTS & CLAYS Liquid limit less than 50%	Inorganic	PI > 7 and plots on or above "A" line j	CL	Lean clay k,l,m
			PI < 4 or plots below "A" line j	ML	Silt k,l,m
		Organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OL	Organic clay k,l,m,n Organic silt k,l,m,o
	SILTS & CLAYS Liquid limit 50% or more	Inorganic	PI plots on or above "A" line	CH	Fat clay k,l,m
			PI plots below "A" line	MH	Elastic silt k,l,m
		Organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OH	Organic clay k,l,m,p Organic silt k,l,m,q
Highly organic soils		Primarily organic matter, dark in color, and organic odor		PT	Peat

a. Based on the material passing the 3-in (75-mm) sieve.
b. If field sample contained cobbles and/or boulders, add "with cobbles and/or boulders" to group name.
c. Gravels with 5 to 12% fines require dual symbols
GW-GM well graded gravel with silt
GW-GC well graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
d. Sands with 5% to 12% fines require dual symbols
SW-SM well graded sand with silt
SW-SC well graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay
e.
$$C_u = D_{60}/D_{10} \qquad C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$
f. If soil contains ≥ 15% sand, add "with sand" to group name.
g. If fines classify as CL-ML, use dual symbol GC-GM, SC-SM.
h. If fines are organic, add "with organic fines" to group name.
i. If soil contains ≥ 15% gravel, add "with gravel" to group name.
j. If Atterberg Limits plot in hatched area, soil is a CL-ML, silty clay.
k. If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel" whichever is predominant.
l. If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
m. If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
n. PI ≥ 4 and plots on or above "A" line.
o. PI ≥ 4 or plots below "A" line.
p. PI plots on or above "A" line.
q. PI plots below "A" line.



TESTING SERVICE CORPORATION

LEGEND FOR BORING LOGS



FILL TOPSOIL PEAT GRAVEL SAND SILT CLAY DOLOMITE

SAMPLE TYPE:

SS = Split Spoon
ST = Thin-Walled Tube
A = Auger

FIELD AND LABORATORY TEST DATA:

N = Standard Penetration Resistance in Blows per Foot
Wc = In-Situ Water Content
Qu = Unconfined Compressive Strength in Tons per Square Foot
* Pocket Penetrometer Measurement; Maximum Reading = 4.5 tsf
γD = Dry Unit Weight in Pounds per Cubic Foot

WATER LEVELS:

▽ While Drilling
▽ End of Boring
▼ 24 Hours

SOIL DESCRIPTION:

MATERIAL	PARTICLE SIZE RANGE
BOULDER	Over 12 inches
COBBLE	12 inches to 3 inches
Coarse GRAVEL	3 inches to ¾ inch
Small GRAVEL	¾ inch to No. 4 Sieve
Coarse SAND	No. 4 Sieve to No. 10 Sieve
Medium SAND	No. 10 Sieve to No. 40 Sieve
Fine SAND	No. 40 Sieve to No. 200 Sieve
SILT and CLAY	Passing No. 200 Sieve

COHESIVE SOILS

CONSISTENCY	Qu
Very Soft	Less than 0.3
Soft	0.3 to 0.6
Stiff	0.6 to 1.0
Tough	1.0 to 2.0
Very Tough	2.0 to 4.0
Hard	4.0 and over

COHESIONLESS SOILS

RELATIVE DENSITY	N
Very Loose	0 - 4
Loose	4 - 10
Firm	10 - 30
Dense	30 - 50
Very Dense	50 and over

MODIFYING TERM	PERCENT BY WEIGHT
Trace	1 - 10
Little	10 - 20
Some	20 - 35

NOTE: GROUND SURFACE ELEVATIONS AT THE BORINGS WERE ACQUIRED BY TSC USING A TRIMBLE R8 GNSS RECEIVER.

LEGEND

SOIL BORING LOCATION

BORING LOCATION PLAN
50th STREET STORM SEWER
LA GRANGE SOUTH BASIN
LA GRANGE, ILLINOIS

TSC
TESTING SERVICE CORPORATION
457 EAST GUNDERSEN DRIVE
CAROL STREAM, ILLINOIS 60188

DRAWN BY: TRP	PAGE NO.
CHECKED BY: MVM	
JOB NO. : L-82,468	1 OF 1
DATE: 11-11-14	

Village of La Grange
South Basin Modeling

BAXTER & WOODMAN Consulting Engineers

ALTERNATIVE 1 - BRAINARD AVENUE FLOODWALL

No.	Pay Item	Quantity	Unit	Unit Price	Amount
1	MOBILIZATION / DEMOBILIZATION:			Lump Sum	$ 40,000
2	TREE PRUNING / REMOVAL:	3	Days	$ 3,000	$ 9,000
3	PVC SHEET PILING WALL:				
	Wall - 9"x 24" Section	15,130	Sq. Ft.	$ 25	$ 378,250
	Cap - 10" Channel shape	1,520	Foot	$ 15	$ 22,800
	Overflow	185	Foot	$ 5	$ 925
4	CULVERT AND HEADWALL:				
	Modify culvert			Lump Sum	$ 5,000
	Remove and Replace Headwall			Lump Sum	$ 15,000
	Riprap	20	Cu. Yd.	$ 100	$ 2,000
5	FILL MATERIAL FOR SLOPE:	400	Cu. Yd.	$ 20	$ 8,000
6	RESTORATION OF PARKWAY:				
	Topsoil and Sod / HydroSeed	1,600	Sq. Yd.	$ 15	$ 24,000
7	EROSION AND SEDIMENTATION CONTROL:				
	Inlet Filters and Cleaning	24	Each	$ 250	$ 6,000
	Silt Fence	1,600	Foot	$ 10	$ 16,000
8	TRAFFIC CONTROL AND PROTECTION:			Lump Sum	$ 12,000
9	CASH ALLOWANCE:			Lump Sum	$ 20,000

		SUBTOTAL, CONSTRUCTION	$ 558,975
10	CONSTRUCTION CONTINGENCY	15 %	$ 83,846
		TOTAL, CONSTRUCTION	$ 642,821
11	ENGINEERING, DESIGN	6.0 %	$ 33,539
12	ENGINEERING, CONSTRUCTION	7.5 %	$ 41,923
13	LEGAL AND ADMINISTRATIVE	2.0 %	$ 11,180
14	FINANCIAL CONSULTANT	2.5 %	$ 13,974
		PROJECT TOTAL	**$ 750,000**

Notes

1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2014.

Village of La Grange
South Basin Modeling

BAXTER & WOODMAN
Consulting Engineers

ALTERNATIVE 2 - RELIEF STORM SEWER
OPEN CUT

No.	Pay Item	Quantity	Unit	Unit Price	Amount
1	60" STORM SEWER, OPEN CUT				
	Avg. 17' deep	960	Foot	$ 1,700	$ 1,632,000
	Avg. 20' deep	715	Foot	$ 1,850	$ 1,322,750
	Avg. 19' deep	1,335	Foot	$ 1,800	$ 2,403,000
2	72" STORM SEWER, OPEN CUT				
	Avg. 14' deep	1,000	Foot	$ 1,675	$ 1,675,000
	Avg. 15' deep	305	Foot	$ 1,750	$ 533,750
	Avg. 17' deep	180	Foot	$ 1,900	$ 342,000
3	INLET CAPACITY AT DEPRESSIONS	2	Each	$ 450,000	$ 900,000

			SUBTOTAL, CONSTRUCTION	$ 8,808,500
4	CONSTRUCTION CONTINGENCY	15 %		$ 1,321,275
			TOTAL, CONSTRUCTION	$ 10,129,775
5	ENGINEERING, DESIGN	6.0 %		$ 528,510
6	ENGINEERING, CONSTRUCTION	7.5 %		$ 660,638
7	LEGAL AND ADMINISTRATIVE	2.0 %		$ 176,170
8	FINANCIAL CONSULTANT	2.5 %		$ 220,213
			PROJECT TOTAL	**$ 11,720,000**

Notes

1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2014.

Village of La Grange
South Basin Modeling

BAXTER & WOODMAN Consulting Engineers

ALTERNATIVE 2 - RELIEF STORM SEWER
TUNNELING AND OPEN CUT

No.	Pay Item	Quantity	Unit	Unit Price	Amount
1	60" STORM SEWER, TUNNELED				
	Avg. 17' deep	960	Foot	$ 2,000	$ 1,920,000
	Avg. 20' deep	715	Foot	$ 2,000	$ 1,430,000
	Avg. 19' deep	1,335	Foot	$ 2,000	$ 2,670,000
2	72" STORM SEWER, OPEN CUT				
	Avg. 14' deep	1,000	Foot	$ 1,675	$ 1,675,000
	Avg. 15' deep	305	Foot	$ 1,750	$ 533,750
	Avg. 17' deep	180	Foot	$ 1,900	$ 342,000
3	INLET CAPACITY AT DEPRESSIONS	2	Each	$ 450,000	$ 900,000
4	SHAFTS - MANHOLES/RESTORATION	10	Each	$ 50,000	$ 500,000

			SUBTOTAL, CONSTRUCTION	$ 9,970,750
5	CONSTRUCTION CONTINGENCY	15 %		$ 1,495,613
			TOTAL, CONSTRUCTION	$ 11,466,363
6	ENGINEERING, DESIGN	6.0 %		$ 598,245
7	ENGINEERING, CONSTRUCTION	7.5 %		$ 747,806
8	LEGAL AND ADMINISTRATIVE	2.0 %		$ 199,415
9	FINANCIAL CONSULTANT	2.5 %		$ 249,269
			PROJECT TOTAL	**$ 13,270,000**

Notes
1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2014.

Village of La Grange
South Basin Modeling

BAXTER & WOODMAN Consulting Engineers

ALTERNATIVE 3 - RELIEF STORM SEWER, LATERALS AND EXTENSION
OPEN CUT

No.	Pay Item	Quantity	Unit	Unit Price		Amount	
1	36" STORM SEWER, OPEN CUT						
	Avg. 12' deep	1,465	Foot	$	550	$	805,750
	Avg. 17' deep	1,330	Foot	$	800	$	1,064,000
	Avg. 15' deep	675	Foot	$	700	$	472,500
	Avg. 16' deep	1,330	Foot	$	750	$	997,500
	Avg. 18' deep, IDOT R.O.W.	1,330	Foot	$	1,131	$	1,503,565
	Avg. 18' deep	1,330	Foot	$	850	$	1,130,500
	Avg. 10' deep	435	Foot	$	550	$	239,250
2	60" STORM SEWER, OPEN CUT						
	Avg. 17' deep	960	Foot	$	1,700	$	1,632,000
	Avg. 20' deep	715	Foot	$	1,850	$	1,322,750
	Avg. 19' deep	1,335	Foot	$	1,800	$	2,403,000
3	72" STORM SEWER, OPEN CUT						
	Avg. 14' deep	1,000	Foot	$	1,675	$	1,675,000
	Avg. 15' deep	305	Foot	$	1,750	$	533,750
	Avg. 17' deep	180	Foot	$	1,900	$	342,000
4	INLET CAPACITY AT DEPRESSIONS	6	Each	$	450,000	$	2,700,000

		SUBTOTAL, CONSTRUCTION	$	16,821,565
5	CONSTRUCTION CONTINGENCY	15 %	$	2,523,235
		TOTAL, CONSTRUCTION	$	19,344,800
6	ENGINEERING, DESIGN	6.0 %	$	1,009,294
7	ENGINEERING, CONSTRUCTION	7.5 %	$	1,261,617
8	LEGAL AND ADMINISTRATIVE	2.0 %	$	336,431
9	FINANCIAL CONSULTANT	2.5 %	$	420,539
		PROJECT TOTAL	**$**	**22,380,000**

Notes

1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2014.

Village of La Grange
South Basin Modeling

ALTERNATIVE 3 - RELIEF STORM SEWER, LATERALS AND EXTENSION
TUNNELING AND OPEN CUT

No.	Pay Item	Quantity	Unit	Unit Price		Amount	
1	36" STORM SEWER, OPEN CUT						
	Avg. 12' deep	1,465	Foot	$	550	$	805,750
	Avg. 17' deep	1,330	Foot	$	800	$	1,064,000
	Avg. 15' deep	675	Foot	$	700	$	472,500
	Avg. 16' deep	1,330	Foot	$	750	$	997,500
	Avg. 18' deep, IDOT R.O.W.	1,330	Foot	$	1,131	$	1,503,565
	Avg. 18' deep	1,330	Foot	$	850	$	1,130,500
	Avg. 10' deep	435	Foot	$	550	$	239,250
2	60" STORM SEWER, TUNNELED						
	Avg. 17' deep	960	Foot	$	2,000	$	1,920,000
	Avg. 20' deep	715	Foot	$	2,000	$	1,430,000
	Avg. 19' deep	1,335	Foot	$	2,000	$	2,670,000
3	72" STORM SEWER, OPEN CUT						
	Avg. 14' deep	1,000	Foot	$	1,675	$	1,675,000
	Avg. 15' deep	305	Foot	$	1,750	$	533,750
	Avg. 17' deep	180	Foot	$	1,900	$	342,000
4	INLET CAPACITY AT DEPRESSIONS	6	Each	$	450,000	$	2,700,000
5	SHAFTS - MANHOLES/RESTORATION	10	Each	$	50,000	$	500,000

		SUBTOTAL, CONSTRUCTION	$	17,983,815
6	CONSTRUCTION CONTINGENCY	15 %	$	2,697,572
		TOTAL, CONSTRUCTION	$	20,681,387
7	ENGINEERING, DESIGN	6.0 %	$	1,079,029
8	ENGINEERING, CONSTRUCTION	7.5 %	$	1,348,786
9	LEGAL AND ADMINISTRATIVE	2.0 %	$	359,676
10	FINANCIAL CONSULTANT	2.5 %	$	449,595
		PROJECT TOTAL	**$**	**23,920,000**

Notes
1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2014.

Village of La Grange
South Basin Modeling

BAXTER & WOODMAN Consulting Engineers

ALTERNATIVE 4 - RELIEF STORM SEWER, LATERALS AND EXTENSION, UPSIZED OUTLET OPEN CUT

No.	Pay Item	Quantity	Unit	Unit Price	Amount
1	36" STORM SEWER, OPEN CUT				
	Avg. 12' deep	1,465	LF	$ 550	$ 805,750
	Avg. 17' deep	1,330	LF	$ 800	$ 1,064,000
	Avg. 15' deep	675	LF	$ 700	$ 472,500
	Avg. 16' deep	1,330	LF	$ 750	$ 997,500
	Avg. 18' deep, IDOT R.O.W.	1,330	LF	$ 1,131	$ 1,503,565
	Avg. 18' deep	1,330	LF	$ 850	$ 1,130,500
	Avg. 10' deep	435	LF	$ 550	$ 239,250
2	60" STORM SEWER, OPEN CUT				
	Avg. 17' deep	960	Foot	$ 1,700	$ 1,632,000
	Avg. 20' deep	715	Foot	$ 1,850	$ 1,322,750
	Avg. 19' deep	1,335	Foot	$ 1,800	$ 2,403,000
3	72" STORM SEWER, OPEN CUT				
	Avg. 14' deep	1,000	Foot	$ 1,675	$ 1,675,000
	Avg. 15' deep	305	Foot	$ 1,750	$ 533,750
	Avg. 17' deep	180	Foot	$ 1,900	$ 342,000
4	84" STORM SEWER, OPEN CUT				
	Avg. 21' deep	155	Foot	$ 2,500	$ 387,500
5	INLET CAPACITY AT DEPRESSIONS	6	Each	$ 450,000	$ 2,700,000

		SUBTOTAL, CONSTRUCTION		$ 17,209,065
6	CONSTRUCTION CONTINGENCY	15 %		$ 2,581,360
		TOTAL, CONSTRUCTION		$ 19,790,425
7	ENGINEERING, DESIGN	6.0 %		$ 1,032,544
8	ENGINEERING, CONSTRUCTION	7.5 %		$ 1,290,680
9	LEGAL AND ADMINISTRATIVE	2.0 %		$ 344,181
10	FINANCIAL CONSULTANT	2.5 %		$ 430,227
			PROJECT TOTAL	**$ 22,890,000**

Notes

1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2014.

Village of La Grange
South Basin Modeling

BAXTER & WOODMAN Consulting Engineers

ALTERNATIVE 4 - RELIEF STORM SEWER, LATERALS AND EXTENSION, UPSIZED OUTLET TUNNELING AND OPEN CUT

No.	Pay Item	Quantity	Unit	Unit Price		Amount	
1	36" STORM SEWER, OPEN CUT						
	Avg. 12' deep	1,465	Foot	$	550	$	805,750
	Avg. 17' deep	1,330	Foot	$	800	$	1,064,000
	Avg. 15' deep	675	Foot	$	700	$	472,500
	Avg. 16' deep	1,330	Foot	$	750	$	997,500
	Avg. 18' deep, IDOT R.O.W.	1,330	Foot	$	1,131	$	1,503,565
	Avg. 18' deep	1,330	Foot	$	850	$	1,130,500
	Avg. 10' deep	435	Foot	$	550	$	239,250
2	60" STORM SEWER, TUNNELED						
	Avg. 17' deep	960	Foot	$	2,000	$	1,920,000
	Avg. 20' deep	715	Foot	$	2,000	$	1,430,000
	Avg. 19' deep	1,335	Foot	$	2,000	$	2,670,000
3	72" STORM SEWER, OPEN CUT						
	Avg. 14' deep	1,000	Foot	$	1,675	$	1,675,000
	Avg. 15' deep	305	Foot	$	1,750	$	533,750
	Avg. 17' deep	180	Foot	$	1,900	$	342,000
4	84" STORM SEWER, OPEN CUT						
	Avg. 21' deep	155	Foot	$	2,500	$	387,500
5	INLET CAPACITY AT DEPRESSIONS	6	Each	$	450,000	$	2,700,000
6	SHAFTS - MANHOLES/RESTORATION	10	Each	$	50,000	$	500,000

		SUBTOTAL, CONSTRUCTION	$	18,371,315
7	CONSTRUCTION CONTINGENCY	15 %	$	2,755,697
		TOTAL, CONSTRUCTION	$	21,127,012
8	ENGINEERING, DESIGN	6.0 %	$	1,102,279
9	ENGINEERING, CONSTRUCTION	7.5 %	$	1,377,849
10	LEGAL AND ADMINISTRATIVE	2.0 %	$	367,426
11	FINANCIAL CONSULTANT	2.5 %	$	459,283
		PROJECT TOTAL	**$**	**24,440,000**

Notes

1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2014.

Village of La Grange
South Basin Modeling

BAXTER & WOODMAN Consulting Engineers

ALTERNATIVE 5 - COMBINATION OF ALTERNATIVES 1 AND 4
OPEN CUT

No.	Pay Item	Quantity	Unit	Unit Price	Amount
1	ALTERNATIVE 1			LUMP SUM	$ 558,975
2	ALTERNATIVE 4			LUMP SUM	$ 17,209,065

			SUBTOTAL, CONSTRUCTION	$ 17,768,040
3	CONSTRUCTION CONTINGENCY	15 %		$ 2,665,206
			TOTAL, CONSTRUCTION	$ 20,433,246
4	ENGINEERING, DESIGN	6.0 %		$ 1,066,082
5	ENGINEERING, CONSTRUCTION	7.5 %		$ 1,332,603
6	LEGAL AND ADMINISTRATIVE	2.0 %		$ 355,361
7	FINANCIAL CONSULTANT	2.5 %		$ 444,201
			PROJECT TOTAL	**$ 23,640,000**

Notes

1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2014.

Village of La Grange
South Basin Modeling

BAXTER & WOODMAN Consulting Engineers

ALTERNATIVE 5 - COMBINATION OF ALTERNATIVES 1 AND 4
TUNNELING AND OPEN CUT

No.	Pay Item	Quantity	Unit	Unit Price	Amount
1	ALTERNATIVE 1			LUMP SUM	$ 558,975
2	ALTERNATIVE 4			LUMP SUM	$ 18,371,315
			SUBTOTAL, CONSTRUCTION		$ 18,930,290
3	CONSTRUCTION CONTINGENCY	15 %			$ 2,839,544
			TOTAL, CONSTRUCTION		$ 21,769,834
4	ENGINEERING, DESIGN	6.0 %			$ 1,135,817
5	ENGINEERING, CONSTRUCTION	7.5 %			$ 1,419,772
6	LEGAL AND ADMINISTRATIVE	2.0 %			$ 378,606
7	FINANCIAL CONSULTANT	2.5 %			$ 473,257
			PROJECT TOTAL		**$ 25,180,000**

Notes
1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2014.

Village of La Grange
South Basin Modeling

BAXTER & WOODMAN Consulting Engineers

Depression 1 Extension
OPEN CUT

No.	Pay Item	Quantity	Unit	Unit Price	Amount
1	36" STORM SEWER, OPEN CUT				
	Avg. 12' deep	1,465	Foot	$ 550	$ 805,750
	Avg. 17' deep	1,330	Foot	$ 800	$ 1,064,000
	Avg. 15' deep	675	Foot	$ 700	$ 472,500
2	INLET CAPACITY AT DEPRESSIONS	1	Each	$ 450,000	$ 450,000

		SUBTOTAL, CONSTRUCTION	$	2,792,250
3	CONSTRUCTION CONTINGENCY	15 %	$	418,838
		TOTAL, CONSTRUCTION	$	3,211,088
4	ENGINEERING, DESIGN	6.0 %	$	167,535
5	ENGINEERING, CONSTRUCTION	7.5 %	$	209,419
6	LEGAL AND ADMINISTRATIVE	2.0 %	$	55,845
7	FINANCIAL CONSULTANT	2.5 %	$	69,806
		PROJECT TOTAL	**$**	**3,720,000**

Notes

1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2014.

Village of La Grange
South Basin Modeling

Depression 3 Extension
OPEN CUT

No.	Pay Item	Quantity	Unit	Unit Price	Amount
1	36" STORM SEWER, OPEN CUT Avg. 16' deep	1,330	Foot	$ 750	$ 997,500
2	INLET CAPACITY AT DEPRESSIONS	1	Each	$ 450,000	$ 450,000
				SUBTOTAL, CONSTRUCTION	$ 1,447,500
3	CONSTRUCTION CONTINGENCY	15 %			$ 217,125
				TOTAL, CONSTRUCTION	$ 1,664,625
4	ENGINEERING, DESIGN	6.0 %			$ 86,850
5	ENGINEERING, CONSTRUCTION	7.5 %			$ 108,563
6	LEGAL AND ADMINISTRATIVE	2.0 %			$ 28,950
7	FINANCIAL CONSULTANT	2.5 %			$ 36,188
				PROJECT TOTAL	**$ 1,930,000**

Notes

1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2014.

Village of La Grange
South Basin Modeling

BAXTER & WOODMAN Consulting Engineers

Depression 4 Extension
OPEN CUT

No.	Pay Item	Quantity	Unit	Unit Price	Amount
1	36" STORM SEWER, OPEN CUT Avg. 18' deep, IDOT R.O.W.	1,330	Foot	$ 1,131	$ 1,503,565
2	INLET CAPACITY AT DEPRESSIONS	1	Each	$ 450,000	$ 450,000
	SUBTOTAL, CONSTRUCTION				$ 1,953,565
3	CONSTRUCTION CONTINGENCY	15 %			$ 293,035
	TOTAL, CONSTRUCTION				$ 2,246,600
4	ENGINEERING, DESIGN	6.0 %			$ 117,214
5	ENGINEERING, CONSTRUCTION	7.5 %			$ 146,517
6	LEGAL AND ADMINISTRATIVE	2.0 %			$ 39,071
7	FINANCIAL CONSULTANT	2.5 %			$ 48,839
	PROJECT TOTAL				**$ 2,600,000**

Notes
1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2014.

Village of La Grange
South Basin Modeling

BAXTER & WOODMAN
Consulting Engineers

Depression 5 Extension
OPEN CUT

No.	Pay Item	Quantity	Unit	Unit Price	Amount
1	36" STORM SEWER, OPEN CUT Avg. 18' deep	1,330	Foot	$ 850	$ 1,130,500
2	INLET CAPACITY AT DEPRESSIONS	1	Each	$ 450,000	$ 450,000
				SUBTOTAL, CONSTRUCTION	$ 1,580,500
3	CONSTRUCTION CONTINGENCY	15 %			$ 237,075
				TOTAL, CONSTRUCTION	$ 1,817,575
4	ENGINEERING, DESIGN	6.0 %			$ 94,830
5	ENGINEERING, CONSTRUCTION	7.5 %			$ 118,538
6	LEGAL AND ADMINISTRATIVE	2.0 %			$ 31,610
7	FINANCIAL CONSULTANT	2.5 %			$ 39,513
				PROJECT TOTAL	**$ 2,110,000**

Notes

1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2014.

Village of La Grange
South Basin Modeling

BAXTER & WOODMAN Consulting Engineers

Depression 6 Extension
OPEN CUT

No.	Pay Item	Quantity	Unit	Unit Price	Amount
1	36" STORM SEWER, OPEN CUT Avg. 10' deep	435	Foot	$ 550	$ 239,250
			SUBTOTAL, CONSTRUCTION		$ 239,250
2	CONSTRUCTION CONTINGENCY	15 %			$ 35,888
			TOTAL, CONSTRUCTION		$ 275,138
3	ENGINEERING, DESIGN	6.0 %			$ 14,355
4	ENGINEERING, CONSTRUCTION	7.5 %			$ 17,944
5	LEGAL AND ADMINISTRATIVE	2.0 %			$ 4,785
6	FINANCIAL CONSULTANT	2.5 %			$ 5,981
			PROJECT TOTAL		**$ 320,000**

Notes

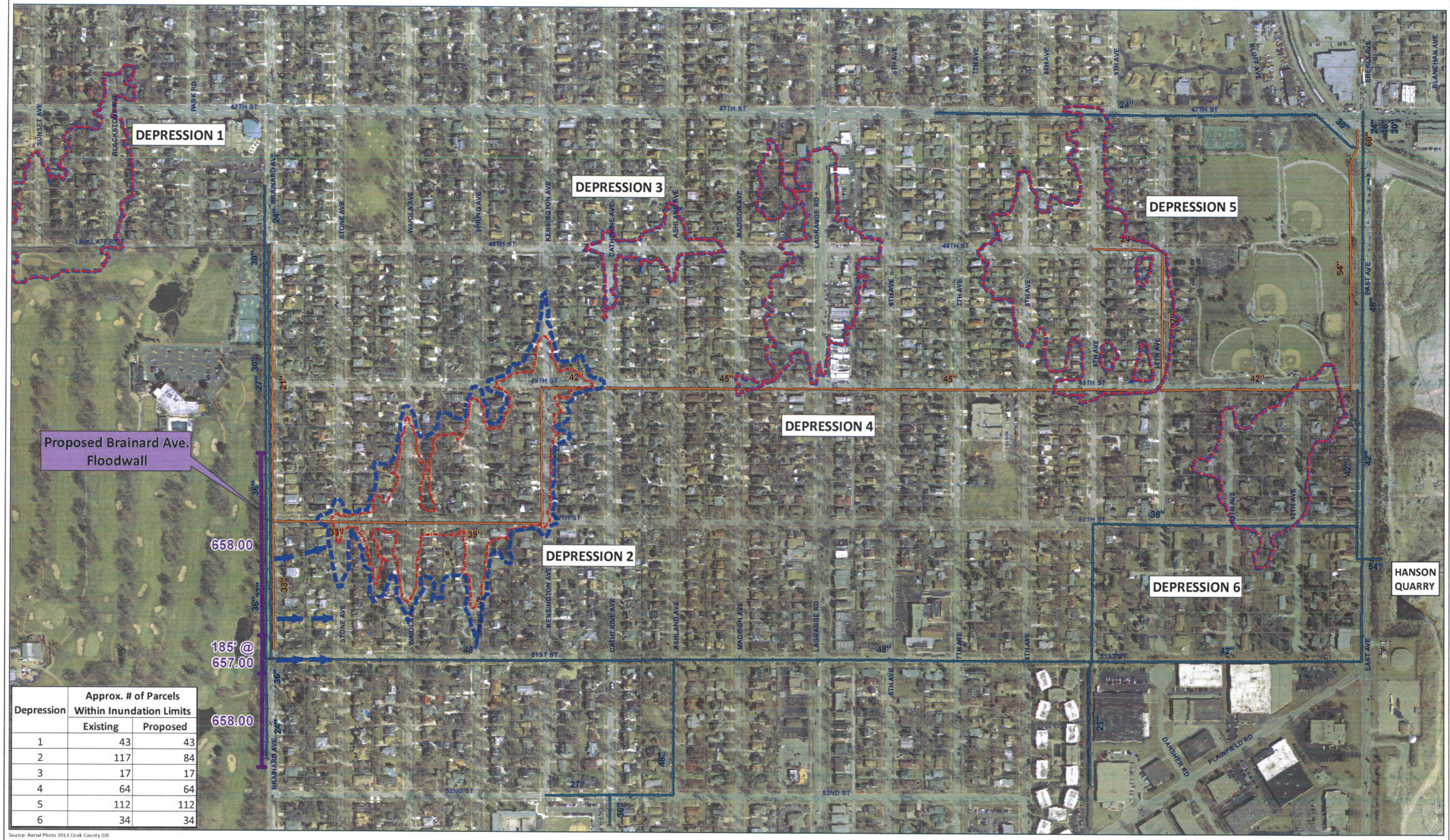
1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2014.

Village of La Grange
South Basin Modeling

Upsized Outlet
OPEN CUT

No.	Pay Item	Quantity	Unit	Unit Price	Amount
1	84" STORM SEWER, OPEN CUT Avg. 21' deep	155	Foot	$ 2,500	$ 387,500
		SUBTOTAL, CONSTRUCTION			$ 387,500
2	CONSTRUCTION CONTINGENCY	15 %			$ 58,125
		TOTAL, CONSTRUCTION			$ 445,625
3	ENGINEERING, DESIGN	6.0 %			$ 23,250
4	ENGINEERING, CONSTRUCTION	7.5 %			$ 29,063
5	LEGAL AND ADMINISTRATIVE	2.0 %			$ 7,750
6	FINANCIAL CONSULTANT	2.5 %			$ 9,688
		PROJECT TOTAL			**$ 520,000**

Notes
1. Prices include sanitary sewer and water service relocation/adjustment, trench backfill, pavement or lawn restoration, traffic control, erosion control, construction layout, and mobilization
2. Prices do not include right-of-way acquisition, temporary or permanent easements, or relocating other utilities.
3. Prices are current for 2014.



Depression	Approx. # of Parcels Within Inundation Limits	
	Existing	Proposed
1	43	43
2	117	84
3	17	17
4	64	64
5	112	112
6	34	34

BAXTER & WOODMAN Consulting Engineers

0 100 200 300 400 Feet

Estimated Cost

$750,000

VILLAGE OF LA GRANGE, ILLINOIS

ALTERNATIVE 1

BRAINARD AVENUE FLOODWALL

100 - YEAR INUNDATION LIMITS

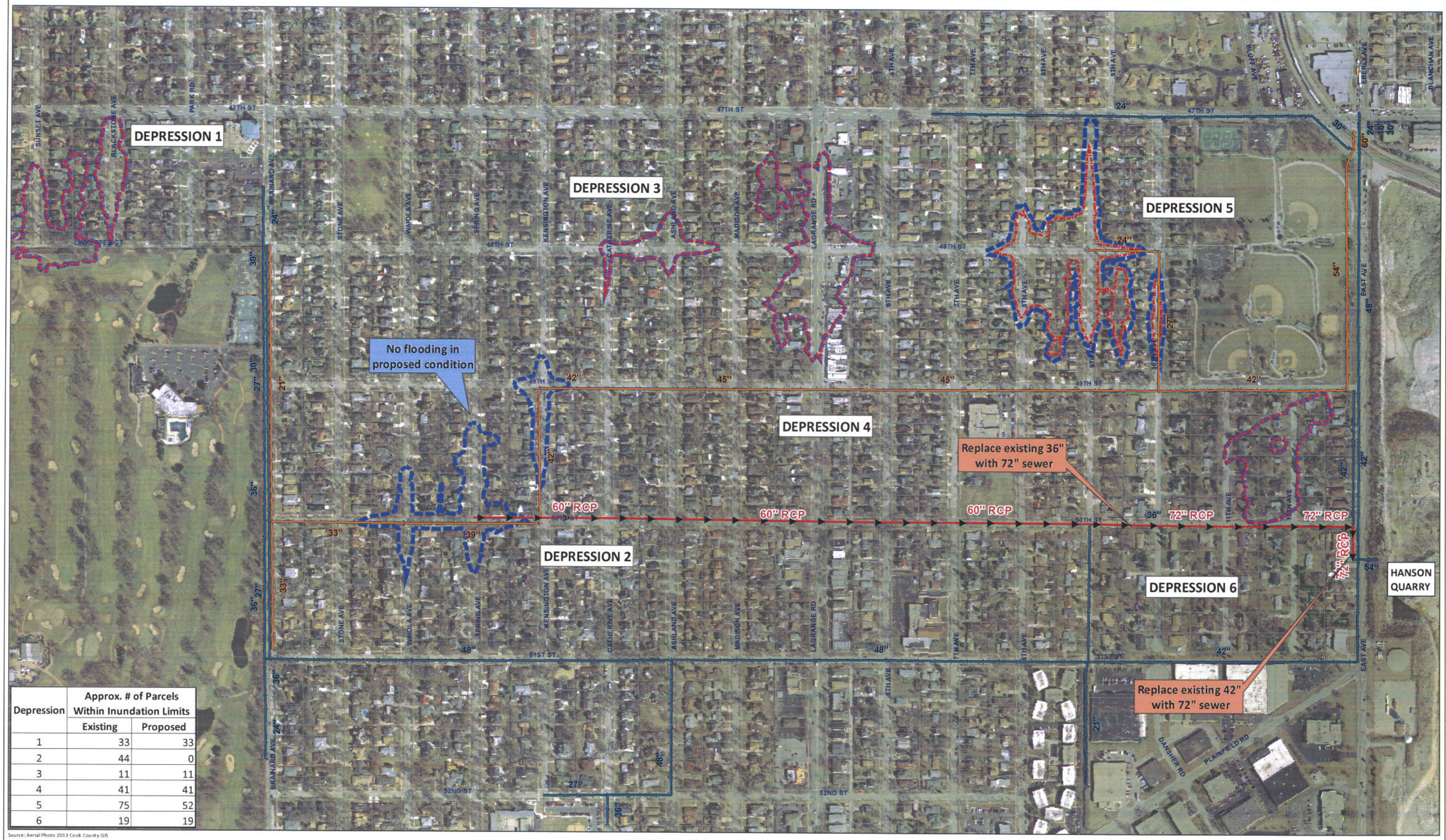
Existing Sewers: Combined; Storm

Proposed: Floodwall

Inundation Limits: Existing 100-Year Inundation; Proposed 100-Year Inundation

Overland Flow: Existing

Exhibit 1



Depression	Approx. # of Parcels Within Inundation Limits	
	Existing	Proposed
1	33	33
2	44	0
3	11	11
4	41	41
5	75	52
6	19	19

BAXTER & WOODMAN

0 100 200 300 400 Feet

Estimated Cost

Open Cut - $11,720,000

Open Cut & Tunneling - $13,270,000

VILLAGE OF LA GRANGE, ILLINOIS

ALTERNATIVE 2

RELIEF STORM SEWER

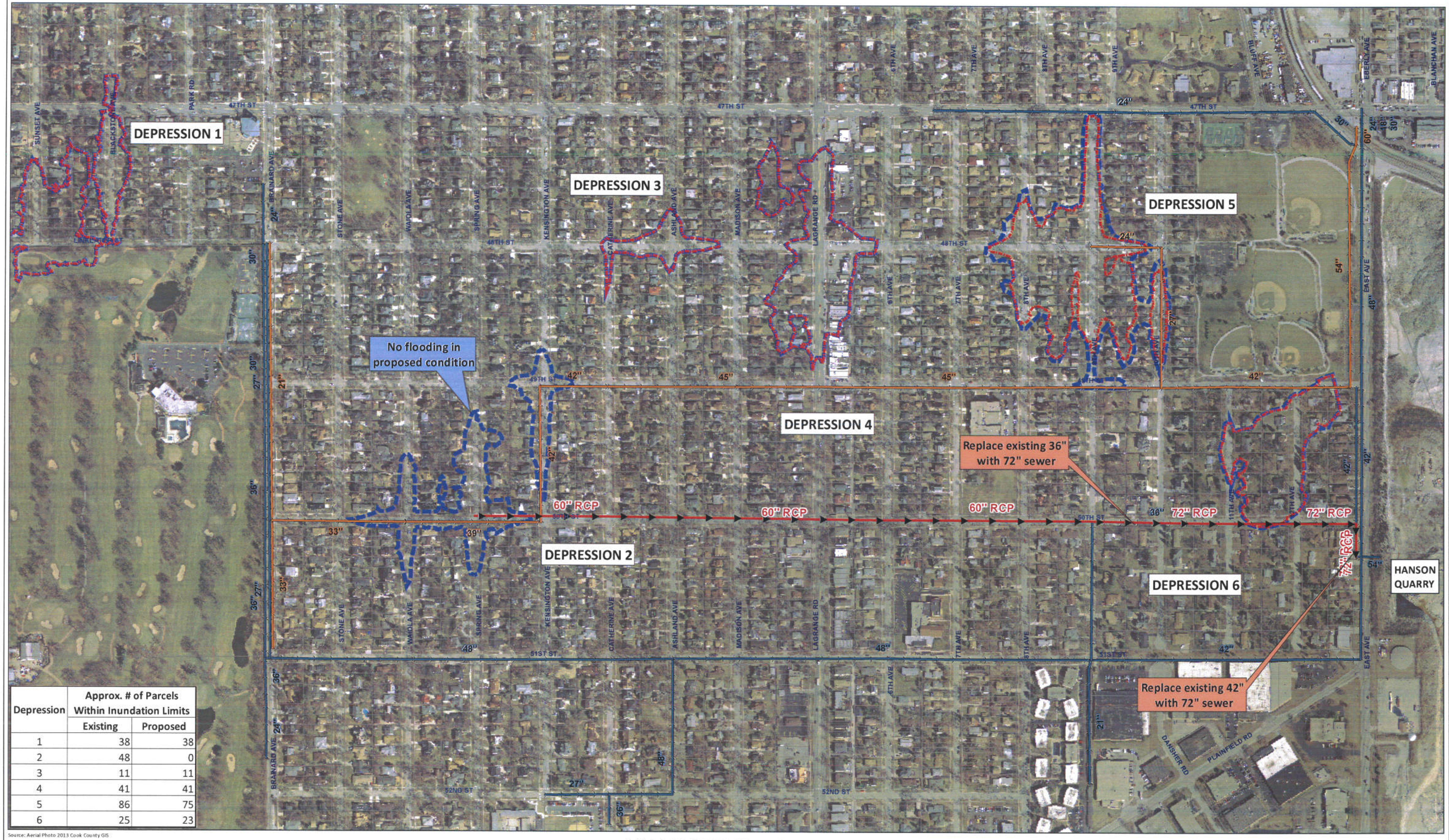
5-YEAR INUNDATION LIMITS

Existing Sewers: Combined, Storm

Proposed Sewers: Storm

Inundation Limits: Existing 5-Year Inundation, Proposed 5-Year Inundation

Exhibit 2A



Depression	Approx. # of Parcels Within Inundation Limits	
	Existing	Proposed
1	38	38
2	48	0
3	11	11
4	41	41
5	86	75
6	25	23

Source: Aerial Photo 2013 Cook County GIS

BAXTER & WOODMAN

0 100 200 300 400
Feet

Estimated Cost

Open Cut - $11,720,000
Open Cut & Tunneling - $13,270,000

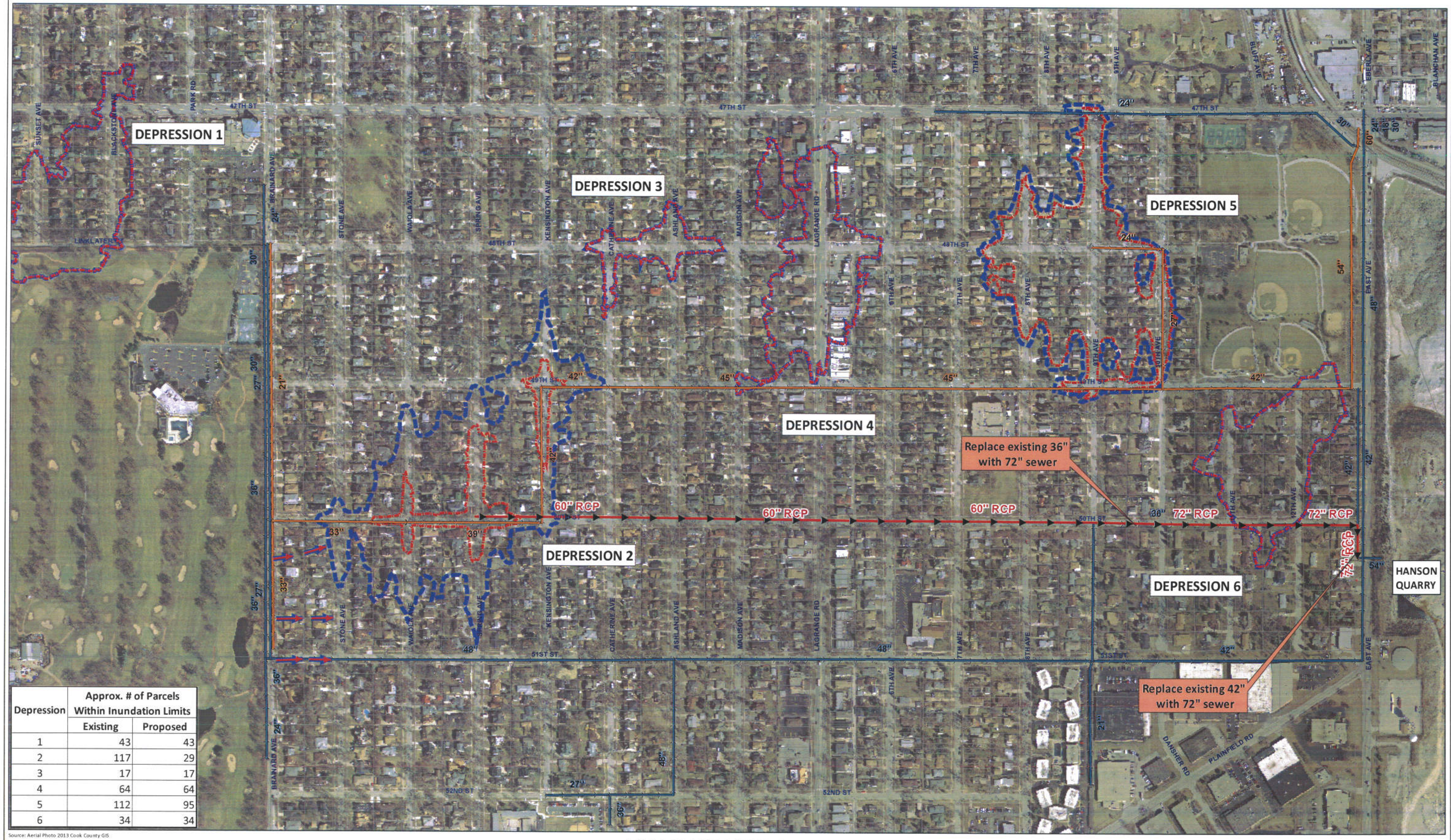
VILLAGE OF LA GRANGE, ILLINOIS
ALTERNATIVE 2
RELIEF STORM SEWER
10-YEAR INUNDATION LIMITS

Existing Sewers
- Combined
- Storm

Proposed Sewers
- Storm

Inundation Limits
- Existing 10-Year Inundation
- Proposed 10-Year Inundation

Exhibit 2B



Depression	Approx. # of Parcels Within Inundation Limits	
	Existing	Proposed
1	43	43
2	117	29
3	17	17
4	64	64
5	112	95
6	34	34

BAXTER & WOODMAN Consulting Engineers

0 100 200 300 400 Feet

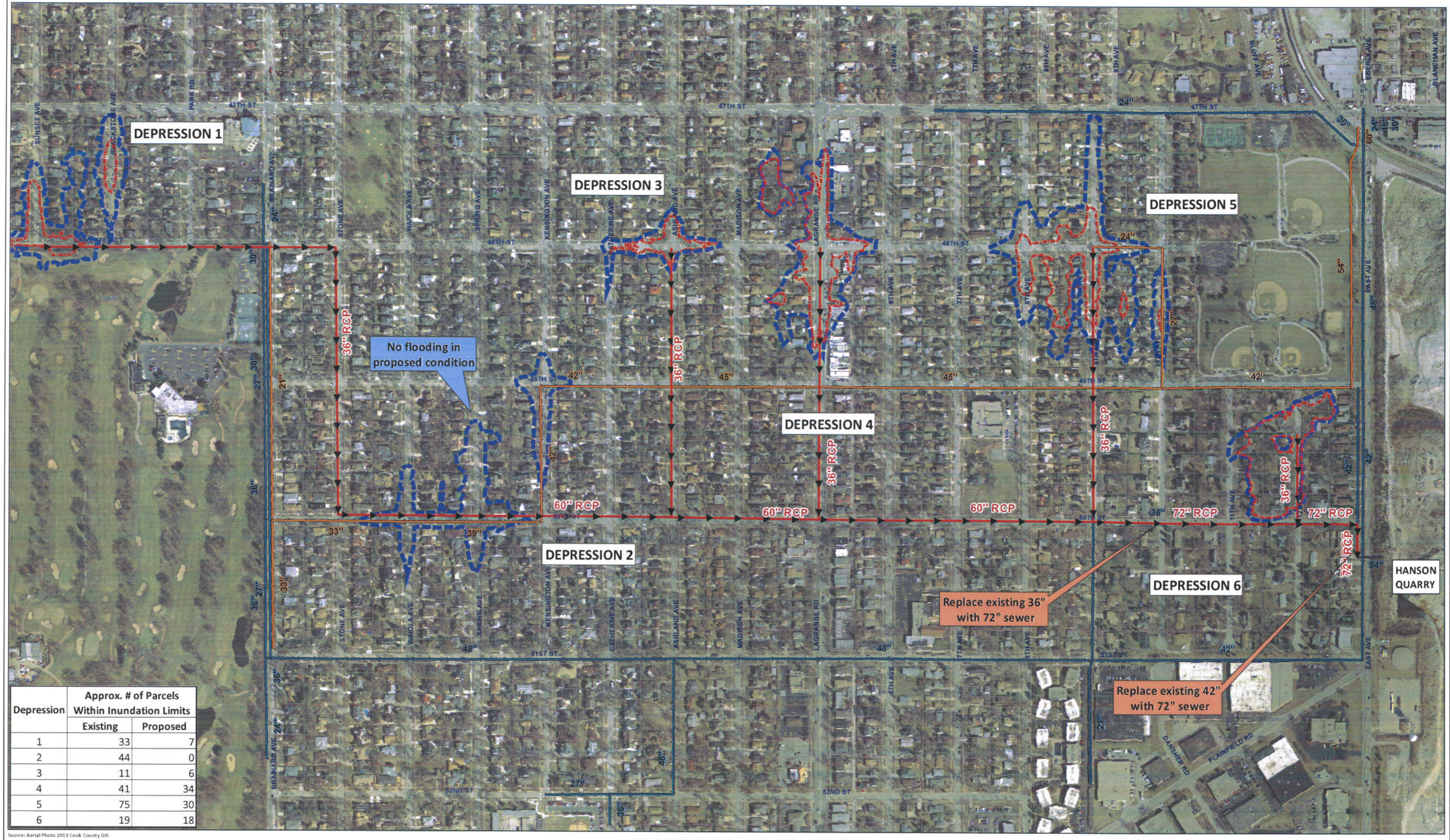
Estimated Cost

Open Cut - $11,720,000
Open Cut & Tunneling - $13,270,000

VILLAGE OF LA GRANGE, ILLINOIS
ALTERNATIVE 2
RELIEF STORM SEWER
100-YEAR INUNDATION LIMITS

Existing Sewers: Combined; Storm
Proposed Sewers: Storm
Inundation Limits: Existing 100-Year Inundation; Proposed 100-Year Inundation
Overland Flow: Proposed; Existing

Exhibit 2C



Depression	Approx. # of Parcels Within Inundation Limits	
	Existing	Proposed
1	33	7
2	44	0
3	11	6
4	41	34
5	75	30
6	19	18

Source: Aerial Photo 2013 Cook County GIS

BAXTER & WOODMAN Consulting Engineers

0 100 200 300 400 Feet

Estimated Cost

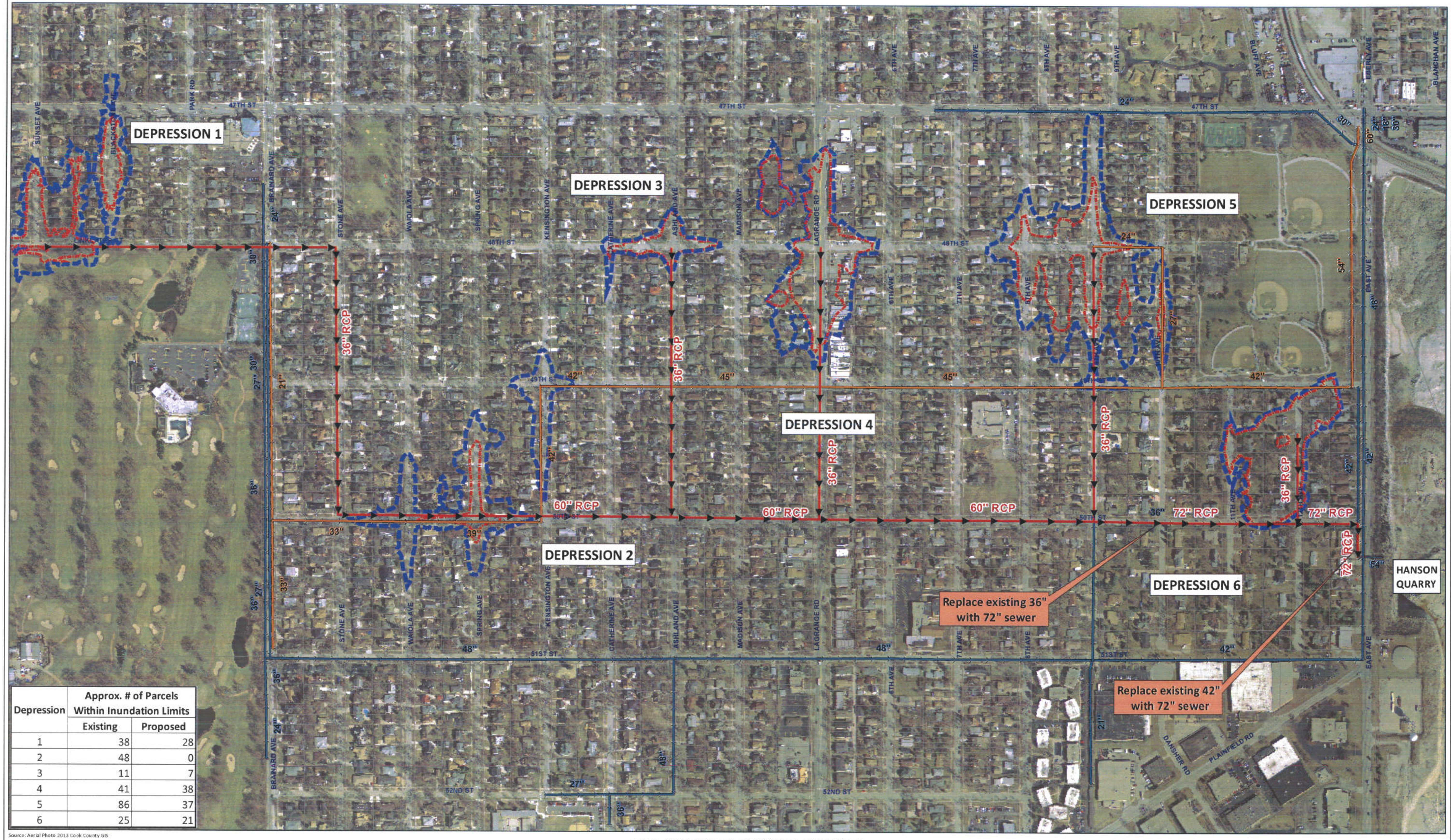
Open Cut - $22,380,000
Open Cut & Tunneling - $23,920,000

VILLAGE OF LA GRANGE, ILLINOIS

ALTERNATIVE 3
RELIEF STORM SEWER, LATERALS AND EXTENSION
5 - YEAR INUNDATION LIMITS

Existing Sewers: Combined; Storm
Proposed: Storm Sewer
Inundation Limits: Existing 5-Year Inundation; Proposed 5-Year Inundation

Exhibit 3A



Depression	Approx. # of Parcels Within Inundation Limits	
	Existing	Proposed
1	38	28
2	48	0
3	11	7
4	41	38
5	86	37
6	25	21

Source: Aerial Photo 2013 Cook County GIS

BAXTER & WOODMAN

0 100 200 300 400 Feet

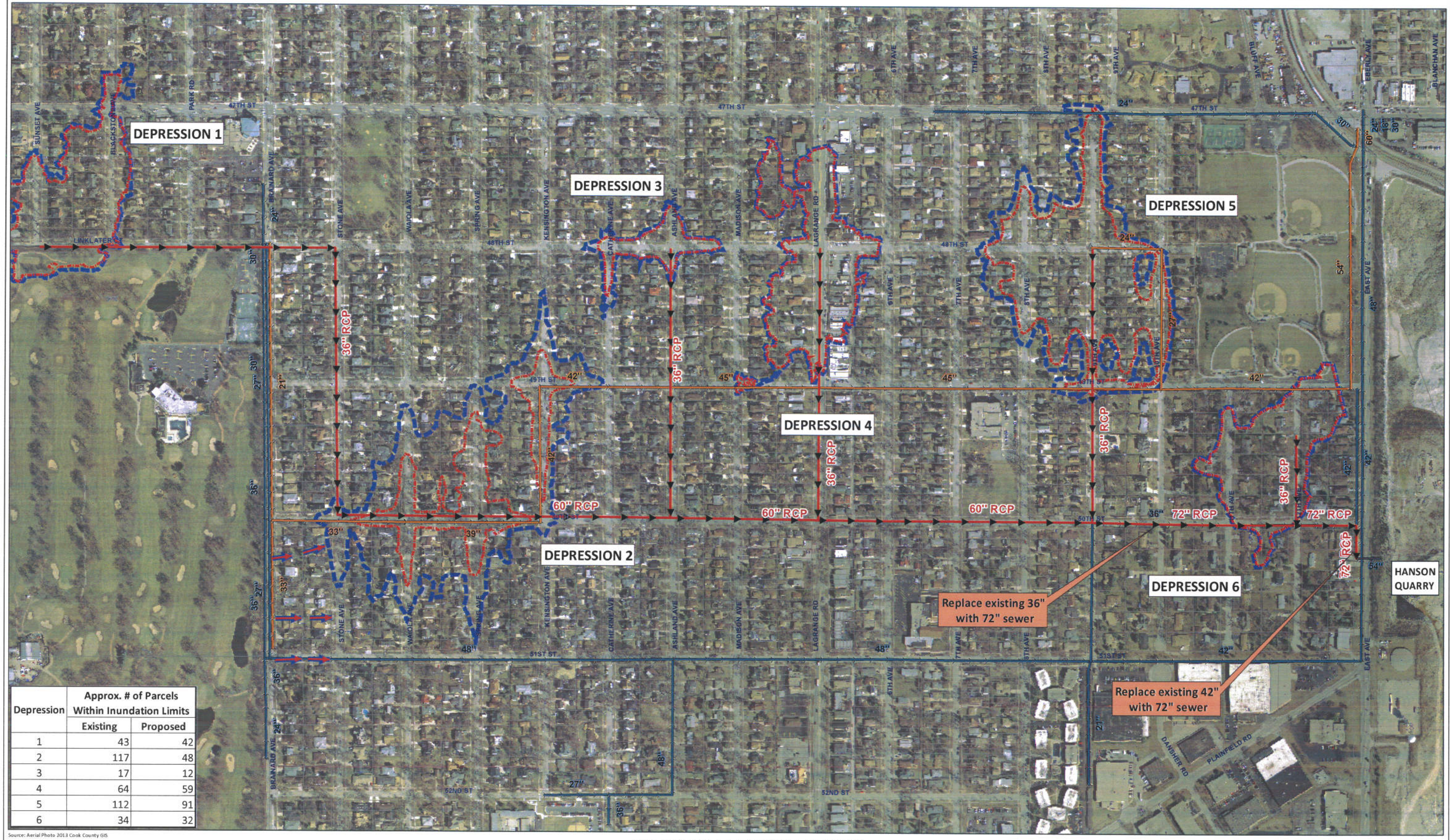
Estimated Cost

Open Cut - $22,380,000
Open Cut & Tunneling - $23,920,000

VILLAGE OF LA GRANGE, ILLINOIS
ALTERNATIVE 3
RELIEF STORM SEWER, LATERALS AND EXTENSION
10 - YEAR INUNDATION LIMITS

Existing Sewers: Combined; Storm
Proposed: Storm Sewer
Inundation Limits: Existing 10-Year Inundation; Proposed 10-Year Inundation

Exhibit 3B



Depression	Approx. # of Parcels Within Inundation Limits	
	Existing	Proposed
1	43	42
2	117	48
3	17	12
4	64	59
5	112	91
6	34	32

Source: Aerial Photo 2013 Cook County GIS

BAXTER & WOODMAN Consulting Engineers

0 100 200 300 400 Feet

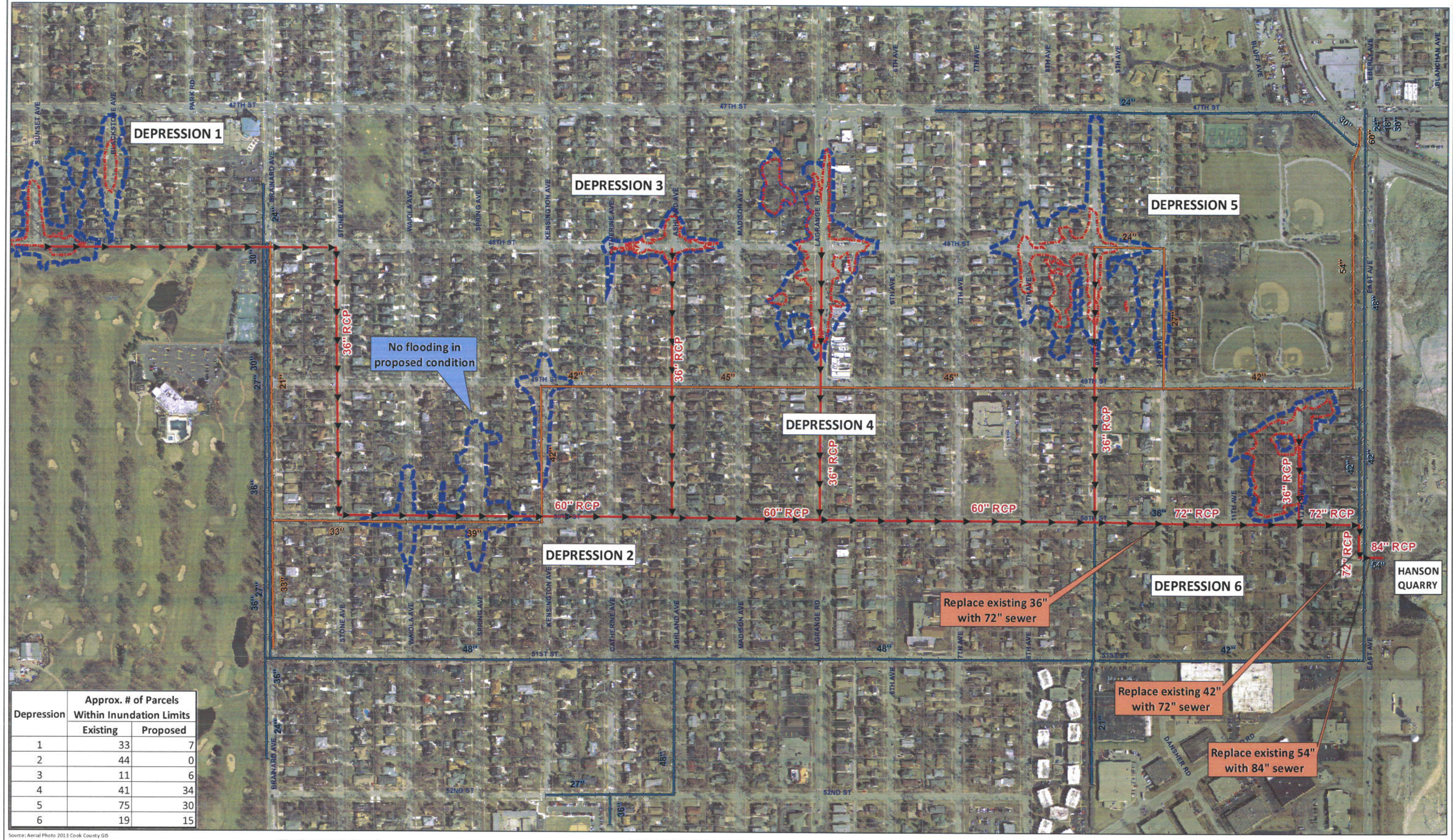
Estimated Cost

Open Cut - $22,380,000
Open Cut & Tunneling - $23,920,000

VILLAGE OF LA GRANGE, ILLINOIS
ALTERNATIVE 3
RELIEF STORM SEWER, LATERALS AND EXTENSION
100 - YEAR INUNDATION LIMITS

Existing Sewers: Combined; Storm
Proposed: Storm Sewer
Inundation Limits: Existing 100-Year Inundation; Proposed 100-Year Inundation
Overland Flow: Proposed; Existing

Exhibit 3C



Depression	Approx. # of Parcels Within Inundation Limits	
	Existing	Proposed
1	33	7
2	44	0
3	11	6
4	41	34
5	75	30
6	19	15

BAXTER & WOODMAN

0 100 200 300 400 Feet

Estimated Cost

Open Cut - $22,890,000
Open Cut
& Tunneling - $24,440,000

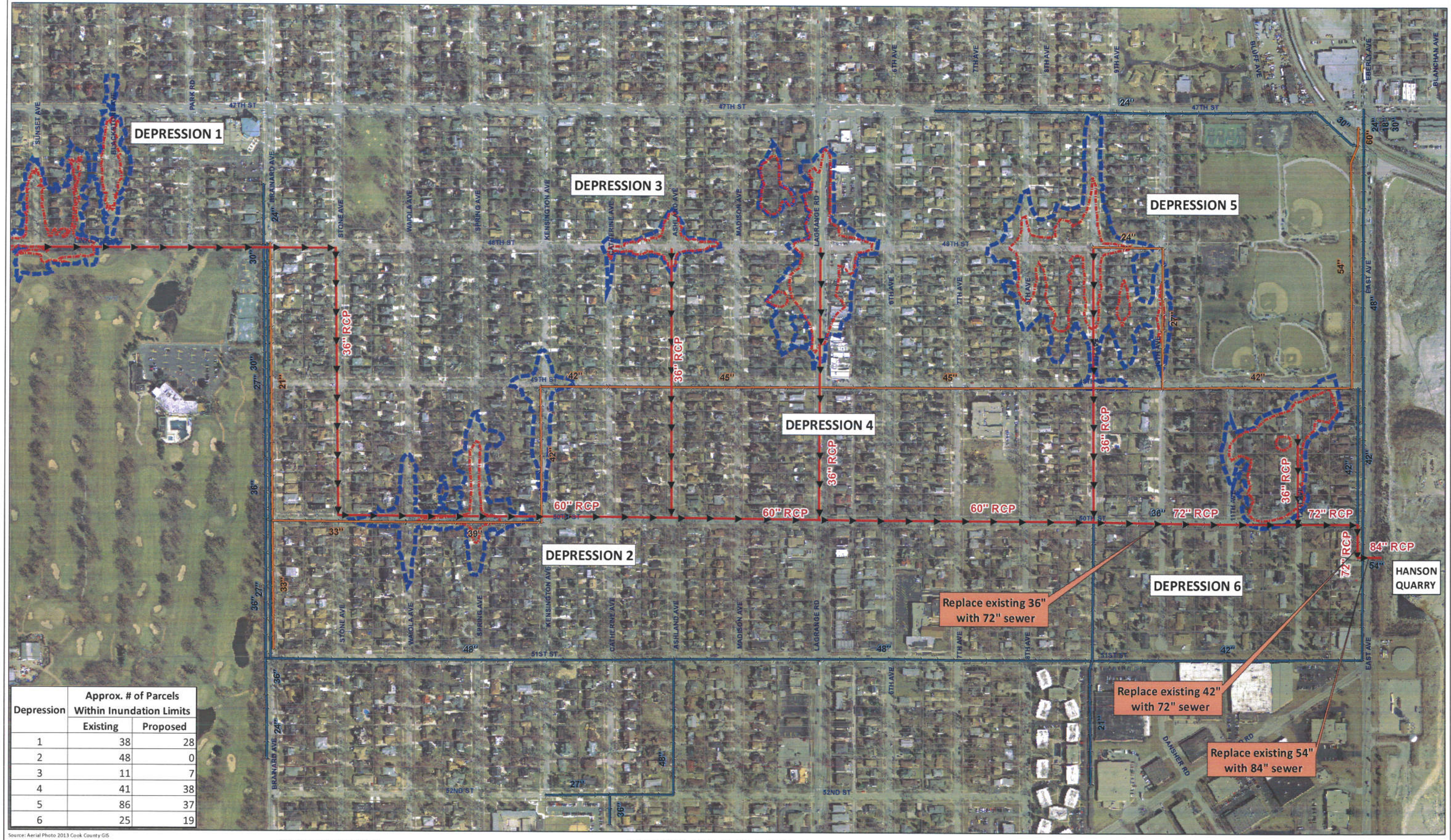
VILLAGE OF LA GRANGE, ILLINOIS
ALTERNATIVE 4
RELIEF STORM SEWER, LATERALS AND EXTENSION, UPSIZED OUTLET
5-YEAR INUNDATION LIMITS

Existing Sewers
Combined
Storm

Proposed
Storm Sewer

Inundation Limits
Existing 5-Year Inundation
Proposed 5-Year Inundation

Exhibit 4A



Depression	Approx. # of Parcels Within Inundation Limits	
	Existing	Proposed
1	38	28
2	48	0
3	11	7
4	41	38
5	86	37
6	25	19

Source: Aerial Photo 2013 Cook County GIS

BAXTER & WOODMAN

0 100 200 300 400 Feet

Estimated Cost

Open Cut - $22,890,000
Open Cut & Tunneling - $24,440,000

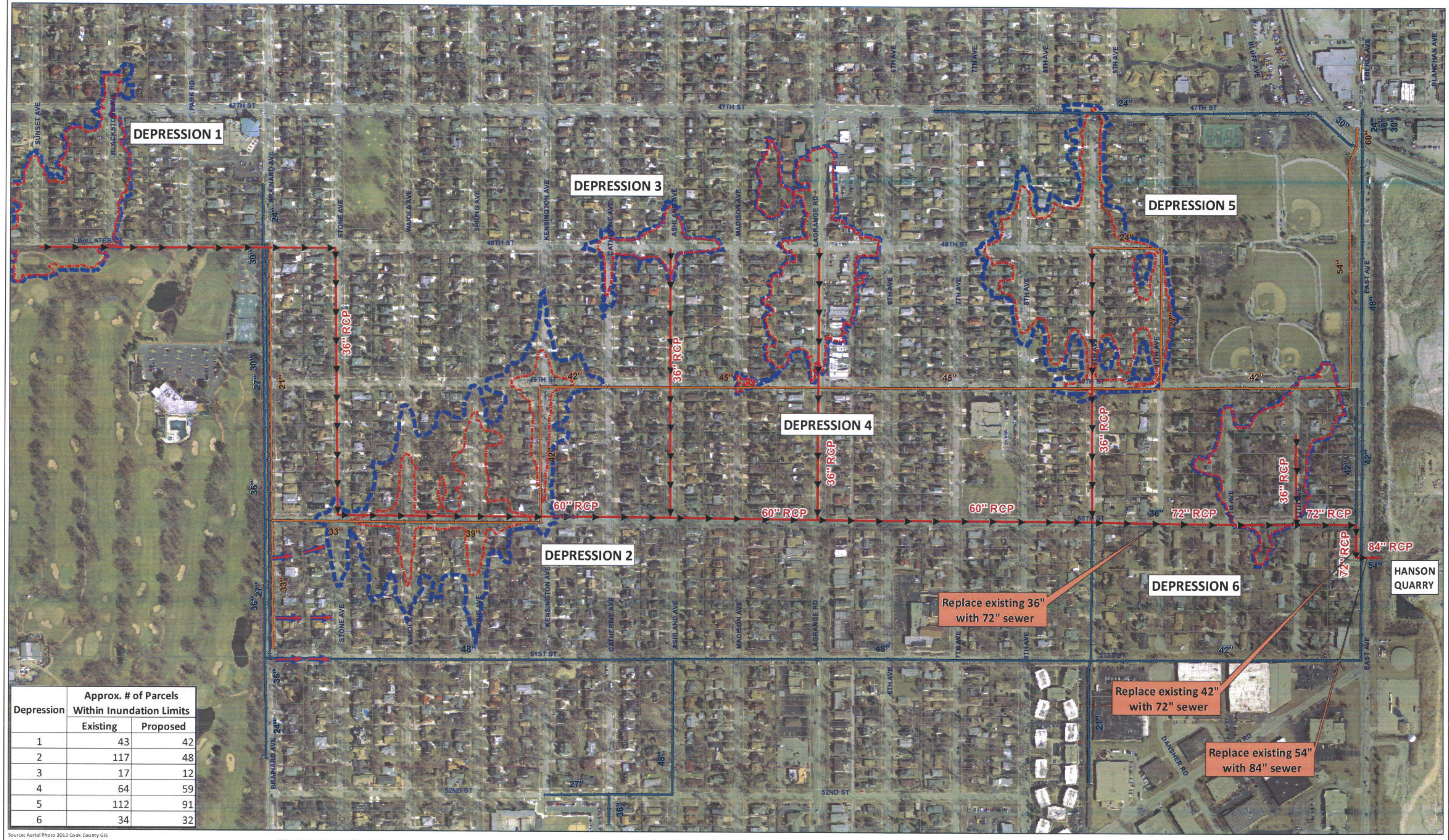
VILLAGE OF LA GRANGE, ILLINOIS
ALTERNATIVE 4
RELIEF STORM SEWER, LATERALS AND EXTENSION, UPSIZED OUTLET
10-YEAR INUNDATION LIMITS

Existing Sewers
- Combined
- Storm

Proposed
- Storm Sewer

Inundation Limits
- Existing 10-Year Inundation
- Proposed 10-Year Inundation

Exhibit 4B



Depression	Approx. # of Parcels Within Inundation Limits	
	Existing	Proposed
1	43	42
2	117	48
3	17	12
4	64	59
5	112	91
6	34	32

Source: Aerial Photo 2013 Cook County GIS

BAXTER & WOODMAN Consulting Engineers

0 100 200 300 400 Feet

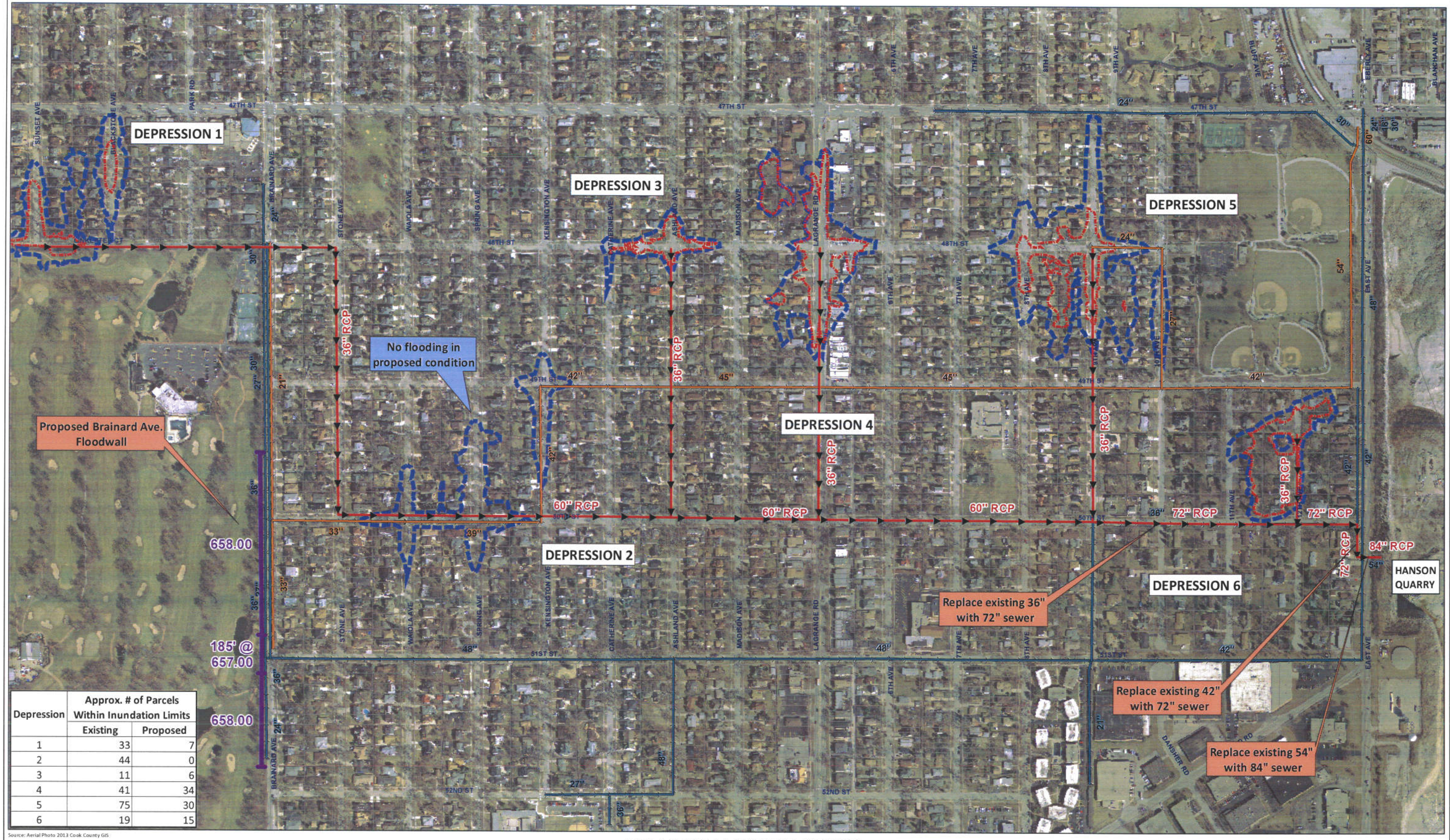
Estimated Cost

Open Cut - $22,890,000
Open Cut & Tunneling - $24,440,000

VILLAGE OF LA GRANGE, ILLINOIS
ALTERNATIVE 4
RELIEF STORM SEWER, LATERALS AND EXTENSION, UPSIZED OUTLET
100-YEAR INUNDATION LIMITS

Existing Sewers: Combined; Storm
Proposed: Storm Sewer
Inundation Limits: Existing 100-Year Inundation; Proposed 100-Year Inundation
Overland Flow: Proposed; Existing

Exhibit 4C



Depression	Approx. # of Parcels Within Inundation Limits	
	Existing	Proposed
1	33	7
2	44	0
3	11	6
4	41	34
5	75	30
6	19	15

Source: Aerial Photo 2013 Cook County GIS

BAXTER & WOODMAN Consulting Engineers

0 100 200 300 400 Feet

Path: I:\Mokena\LAGRV\General\GIS\MapDocuments\140853\Alt 5 5yr.mxd

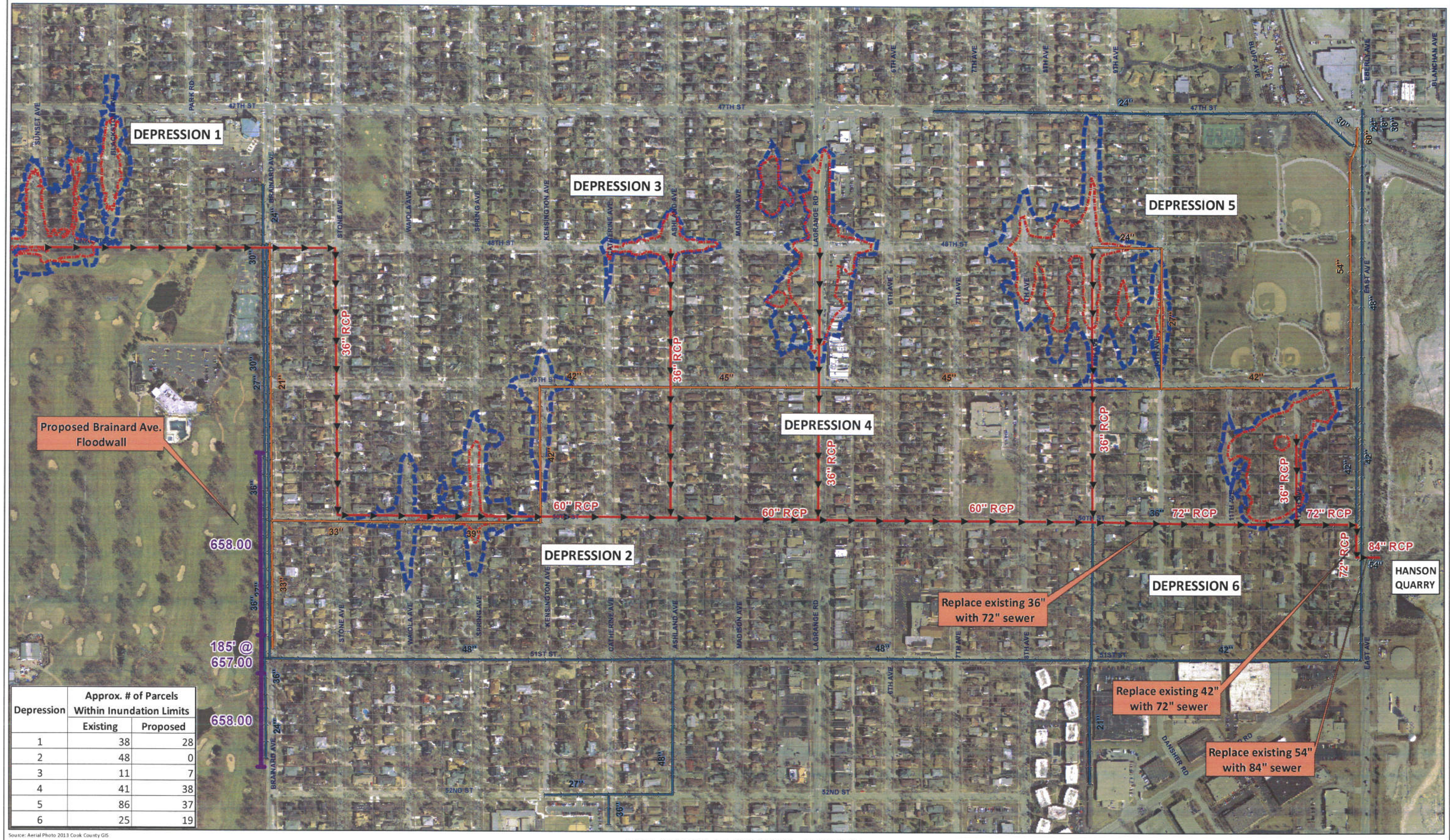
Estimated Cost

Open Cut - $23,640,000
Open Cut & Tunneling - $25,180,000

VILLAGE OF LA GRANGE, ILLINOIS
ALTERNATIVE 5
COMBINATION OF ALTERNATIVES 1 AND 4
5-YEAR INUNDATION LIMITS

Existing Sewers: Combined, Storm
Proposed: Storm Sewer, Floodwall
Inundation Limits: Existing 5-Year Inundation, Proposed 5-Year Inundation

Exhibit 5A



Depression	Approx. # of Parcels Within Inundation Limits	
	Existing	Proposed
1	38	28
2	48	0
3	11	7
4	41	38
5	86	37
6	25	19

BAXTER & WOODMAN Consulting Engineers

0 100 200 300 400 Feet

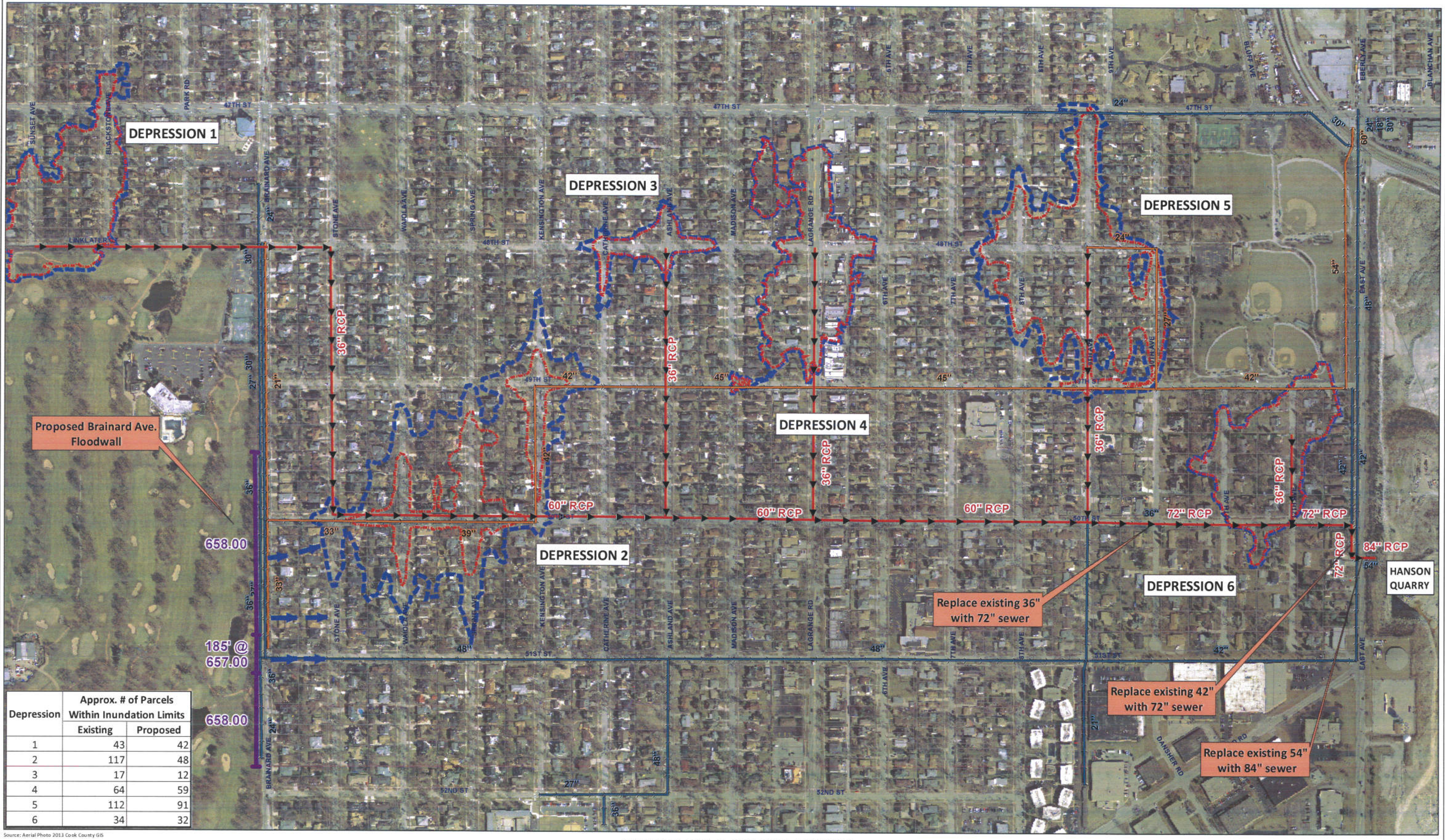
Estimated Cost

Open Cut - $23,640,000
Open Cut & Tunneling - $25,180,000

VILLAGE OF LA GRANGE, ILLINOIS
ALTERNATIVE 5
COMBINATION OF ALTERNATIVES 1 AND 4
10-YEAR INUNDATION LIMITS

Existing Sewers: Combined; Storm
Proposed: Storm Sewer; Floodwall
Inundation Limits: Existing 10-Year Inundation; Proposed 10-Year Inundation

Exhibit 5B



Depression	Approx. # of Parcels Within Inundation Limits	
	Existing	Proposed
1	43	42
2	117	48
3	17	12
4	64	59
5	112	91
6	34	32

BAXTER & WOODMAN Consulting Engineers

Feet: 0 100 200 300 400

Estimated Cost

Open Cut - $23,640,000
Open Cut & Tunneling - $25,180,000

VILLAGE OF LA GRANGE, ILLINOIS
ALTERNATIVE 5
COMBINATION OF ALTERNATIVES 1 AND 4
100-YEAR INUNDATION LIMITS

Existing Sewers: Combined; Storm
Proposed: Storm Sewer; Floodwall
Inundation Limits: Existing 100-Year Inundation; Proposed 100-Year Inundation
Overland Flow: Existing

Exhibit 5C