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Technical Memorandum

Division and Lake Street Drainage Study

November 29, 2017

HR Green Project No: 171109

Prepared For:

Village of Mundelein
300 Plaza Circle
Mundelein, IL 60060

VILLAGE OF Mundelein
Incorporated in 1909

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Executive Summary

In July of 2017, the Village of Mundelein experienced a severe storm event which resulted in widespread flooding throughout the Village and most notably the area surrounding the intersection of Division Street and Lake Street (US Route 45). HR Green, Inc. (HR Green) was contracted by the Village to complete a drainage study of the study area and to evaluate feasible alternates to reduce flood impacts. The study area is located within the Seavey Drainage Ditch watershed.

The Seavey Drainage Ditch culvert under the Metra North Central Service Line (Railroad) is the primary outlet for the study area. Beyond the study area, the Seavey Drainage Ditch eventually drains into Indian Creek near Vernon Hills and then eventually into the Des Plaines River near Lincolnshire. The total watershed to the study area was delineated using Lake County topography and was determined by HR Green to be approximately 1,220 acres and generates approximately 449-cfs flow for the 1% chance storm (also referred as the 100-year storm event).

The area north of Division Street and west of Lake Street is prone to flooding due to the topography of the area and storm sewer capacity. This area fully relies on an existing 54" storm sewer along Division Street to drain; this storm sewer can only convey up to a 50% chance storm (or the 2-year storm event). Many of the rear yard low lying areas lack adequate storm sewer outlets. The impacted area is also a low lying area and does not have any overland flood routes for stormwater to flow to once the storm sewer capacity is exceeded and until portions of the existing neighborhood have flooded up to 3' deep in some locations.

Four alternatives were evaluated that included a combination of upstream detention in the Memorial Park, increased storm sewer capacity along Division Street along with extension of pipe in low lying rear yard areas and detention at the existing US Music site to minimize increase of flow downstream of the Railroad along Seavey Ditch. Based on meetings with Village staff, one alternate appeared to be more favorable than others and was further evaluated to determine improvements required to provide a 10% chance storm (or the 10-year storm), 4% chance storm (or the 25-year storm event), 2% chance storm (or the 50-year storm event) and the 1% chance storm (or the 100-year storm event) level of protection. The construction costs (in 2017 dollars) for the preferred alternate ranges from $5.9M to $13.1M based on level of protection desired. Note that these are concept level budgetary costs and additional investigations will be required as the project is advanced in the design stage including a more detailed review of construction feasibility, utility impacts, and existing infrastructure condition assessment such as the televised inspection of the existing 54" pipe and review of inlet capacities.

In the decision making process, the Village must consider the pros and cons of the alternatives proposed, desired level of protection, construction feasibility, real estate impacts and benefit to cost ratio. Additionally, the Village must consider developing a phasing and implementation plan should these improvements need to be spanned over multiple years. In addition, we recommend coordinating these flood control improvements with other Capital Improvement Projects and development opportunities along or in the vicinity of the project to maximize cost-effectiveness and minimize construction related impacts to the neighborhood and the business district. Finally, Lake Street (US45) is an IDOT jurisdictional road. Any work within the IDOT ROW will require coordination with IDOT. As part of this coordination, Village shall consider requesting cost participation/funding opportunities through IDOT.

Purpose and Need

In July of 2017, the Village of Mundelein experienced a severe storm event which resulted in widespread flooding throughout the Village and most notably in the area surrounding the intersection of Division Street and Lake Street (US Route 45). The impacted area is generally bounded by the Pershing Avenue to the west, Courtland Street to the south, railroad crossing to the east and Hammond Avenue to the north. HR Green was contracted by the Village to complete a drainage study of the impacted study area and to evaluate feasible alternates to reduce flood impacts. This Technical Memorandum discusses the hydrology and hydraulic analysis completed for the drainage study, presents the alternatives evaluated and presents the associated construction costs for consideration by the Village.

Watershed Characteristics

The study area is located within the Seavey Drainage Ditch watershed. The Seavey Drainage Ditch culvert under the Metra North Central Service Line is the primary outlet for the study area. Beyond the Study area, the Seavey Drainage Ditch eventually drains into Indian Creek near Vernon Hills and then eventually into the Des Plaines River near Lincolnshire. The total watershed to the study area was delineated using Lake County topography and was determined by HR Green to be approximately 1,220 acres. Much of the watershed area is developed and consists of residential and commercial land use. Please see Exhibit 1 for a drainage area exhibit. The delineated watershed was compared with the Lake County Flood Insurance Study (FIS). HR Green's watershed area was moderately higher than the FIS study watershed. Given the FIS study is older and the HR Green study is based on more recent topographic maps, the HR Green delineated watershed was used for the study; Table 1 summarizes the interpreted watersheds and their sources.

Table 1: Watershed Area Comparison

Watershed Area Comparison	
Source	**Area (acres)**
FIS	987
HR Green	1,220

History

A review of available plat maps dating back to the 1840's indicates that prairie was located in the area where the current day Seavey Drainage Ditch is located; no stream was noted in this area. This would indicate that the stream did not exist back in the 1840's and that over time, the stream formed as a result of increased runoff. The runoff increased as the prairie was converted to agricultural use and eventually urban use. Historical aerial photography from 1939 was also reviewed; Exhibit 2 shows the current study area with the historical aerial background. In 1939 the Seavey Drainage Ditch is visible downstream of Lake Street and upstream of Hawley but there is no clear channel through the study area. This could mean that the watershed was enclosed in a conduit or farm field tile at this time or it was being stored in wet areas in the agricultural fields. This also means that this portion of the Seavey Drainage Ditch is approximately 100 years old and is the result of a loss of the native prairie. HR Green also reviewed the United States Geological Survey (USGS) produced Hydraulic Atlas (HA) maps in the 1960's and 1970's, which include the historic HA map divides (shown as black lines with two dots) based on 10 foot topography. As shown in Exhibit 3, the USGS HA map indicates that the stream has been enclosed in a pipe from west of Midlothian Road to Lake Street for over 50 years; this is noted on Exhibit 3 by the note stating "Stream enters underground conduit".

Hydrology

HR Green utilized the hydrologic and hydraulic modeling software XP SWMM (2017) to model the watershed tributary to the study area. XP SWMM uses the SCS Runoff Curve Number methodology and is a hydrograph based routing method. The rainfall data used in the model was referenced from the Lake County Watershed Development Ordinance. The modeled July 2017 storm was determined by researching data from the Lake County (Lindenhurst) rain gage data and was scaled to match the reported 6.2" rainfall depth that fell in Mundelein. The Lindenhurst gage was used as this was the closest public gage with information regarding the intensity over time of the July 2017 storm. The total depth was determined using CoCoRaHS data and the National Weather Service's daily precipitation data. HR Green modeled 987 acres of the watershed in XP SWMM and utilized known flow releases from the remainder 233 acre area west of IL Route 60. The model also utilized the release from the Tullamore Dam. HR Green also modeled two low flow storm sewer connections from Stafford Lane which connect into the drainage system along Midlothian Road.

The Curve Numbers (CN) used are based on the NRCS soils report (used to determine hydrologic soils class) and Tables 2.2a, 2.2b, and 2.2c from the TR-55 manual, Second Edition, June 1986. According to the NRCS Web Soil Survey, the soils within the tributary area are generally hydrologic soil class D, which means the soils are poorly drained and hydrologic soil class C, which means the soils are somewhat poorly drained (See NRCS Soil Report in the Appendix). The land use consisted of a mixture of commercial, industrial, residential lots (1/4 acre sizes), open space, pavement, and schools. The soils classification and land use were overlaid using Geographic Information System (GIS) software to determine a composite runoff curve number each sub-catchment. The time of concentration (TC) was calculated using a TR-55 based spreadsheet method for sub-catchments greater than 2 acres. For sub-catchments less than 2 acres, the time of concentration was assumed to be 10 minutes, which is a conservative value. Multiple duration storms including the 1, 2, 3, 6, 12 and 24-hour storms were modeled to determine the critical duration storm. The critical duration storm has been determined to be the 2 hour storm. The watershed has large areas of residential land use that where constructed prior to the Lake County Watershed Development Ordinance and therefore do not have detention ponds. This lack of detention in the watershed and the large amount of storm sewer results in the watershed being more vulnerable to flash floods from short intense storms.

Table 2 compares the existing condition flows from the Lake County FIS Study and USGS StreamStats and the HR Green XP SWMM Model. Table 2 provides the flows at Seymour Avenue which is the first culvert on the Seavey Drainage Ditch downstream of the Lake Street storm sewer outfall. As evident by the table, according to the HR Green XP SWMM model, the flows at Seymour Avenue are typically much larger than the FIS flows; this is likely because the XP SWMM model incorporates a larger watershed than the FIS and the XP SWMM model is using the current 2017 land use data. StreamStats is a useful tool to compare drainage area delineations and magnitude of flows but the flows computed by StreamStats can be overestimated in urban settings. Since StreamStats is an automated tool, it may have not incorporated wetland storage or the detention in the Tullamore Dam or other detention basins in its calculations. The flows and results in the XP SWMM model are more reliable, since they have been calibrated to an actual July 2017 storm event. Therefore, the XP SWMM flows were utilized for design.

Table 2: Flow Comparison at Seymour Avenue

Flow Comparisons at Seymour Avenue				
Storm Event Frequency	**50% Chance**	**10% Chance**	**2% Chance**	**1% chance**
FIS	N/A	154	240	285
StreamStats	147	306	507	614
HRG XP SWMM Model	189	243	314	449

Hydraulics

Existing Conditions

HR Green utilized numerous data sources to model the existing storm sewer system in the Division and Lake Street study area. The Village provided GIS storm sewer data, including manhole locations, storm sewer locations, and storm sewer lengths, pipe sizes and invert elevations. Rim elevations of the storm sewer system were obtained from the Village provided GIS data and were compared to County LiDAR. Additionally, HR Green performed a field investigation of the storm sewer structures within the Lake Street right-of-way which is under the jurisdiction of the Illinois Department of Transportation and, therefore, was not included in the Village's GIS data. HR Green also utilized record drawings (provided by the City) of Division Street and other locations within the watershed, when applicable, to verify model layout and input data. Note that a detailed survey of the existing pipe network and overland flow was not in the scope of this study. The conveyance system was modeled using a two dimensional (2D) XP SWMM model. The model's conduits included storm sewers, open channels, control structures and overland flow paths. All of the models that were run assumed a default head loss coefficient of 0.3 which is generally considered to be conservative. See Exhibits 4 thru 7 for the 50%, 10%, 2% and the 1% chance storm event existing condition flood maps.

Hydraulic analysis of Seavey Drainage Ditch's open channel (between Lake Street and the Metra Rail line) was modeled using a two-dimensional (2D) digital terrain surface available through Lake County. The modeling software was set to use a 7' grid cell size which allowed for the flow through the open channels to be seen as flowing on the 2D surface. HR Green also compared the Seavey Drainage Ditch model with previously completed studies of the stream.

The area north of Division Street and west of Lake Street is prone to flooding due to the topography of the area and storm sewer capacity. This area is only drained by an existing 54" storm sewer along Division Street that can only convey up to a 50% chance storm event. Many of the rear yard low lying areas lack adequate storm sewer outlets. The impacted area is also a low lying area and does not have any overland flood routes for stormwater to flow to once the storm sewer capacity is exceeded and until portions of the existing neighborhood have flooded up to 3' deep in some locations. According to the Lake County topographic maps, the area will pond to a depth of 733.2 and then begin to overland flow around the southeast side of the businesses at the corner of Division and Lake Street and eventually in to the Seavey Drainage Ditch. Everything within the area outlined by the 733.2 contour, as shown on Exhibit 8, relies fully on the storm sewer system to drain; if the storm sewer system is at full capacity then surface flooding will occur in the area.

Model Calibration

HR Green modeled the July 2017 storm event which was approximately a 2% chance storm. The rain was distributed over approximately sixteen hours with three durations of intense rainfall within the storm. This storm was used to calibrate the model to match the inundation experienced during this event. The Village provided an aerial photograph taken above Lincoln and Division Street looking east towards the intersection of Division and Lake Streets; the inundation results from modeling this event matched closely with the photo provided. Additionally, the Village provided a GIS data set for residents who reported flooding during the July 2017 rain event. These flooding reports were overlaid with the inundation maps and match closely with the damage reported by residents. The calibrated model was used to create Exhibit 9 which depicts the flooding limits and depths from the July 2017 rain event. The Village staff was presented this exhibit and they concurred that the flooding shown in the exhibit closely matched what was observed in July 2017.

Design Criteria

The 10% chance design storm event was set to convey flows through the pipe and overland system to allow no more than 3 inches of ponding in the street. Generally, current storm sewer design standards are that the 10% chance storm event will not surcharge a storm sewer however, since this is a modification of an existing storm sewer, the Village and HR Green determined that some ponding (less than 3") would be acceptable in the streets and away from structures. The 1% chance storm event design criterion is set to convey flows through the pipe and overland system to minimize ponding in the street and with no damage to structures. For all storms, the proposed improvements will reduce the duration of surface flooding. These criterions were developed through a collaborative effort between the Village and HR Green. Consideration was paid to the current ordinance regulations and guidance as well as what level of service could be expected through a retrofit of the existing drainage system. Utility conflicts have been considered for water main and sanitary sewer mains, but will need to be reevaluated during the design phase of this project. The design phase will also have to look into gas main, service lines, communication lines and other subterranean utilities, as they were considered but not fully reviewed in developing this concept.

HR Green has studied Alternative 4 as a preferred alternate in greater detail to determine what modifications to the system would be required to increase the level of protection from a 10% chance storm event to a 4%, 2% or 1% chance storm event level of protection. Based on Village input, either one of the remaining alternates can be further studied. The following summarizes these findings.

Proposed Improvements

There are three primary strategies to managing stormwater. The first option is to convey it; this means installing large storm sewers, culverts and opening up ditches to allow stormwater runoff to drain away as quickly as possible. The second option is to detain the runoff; this incorporates detention basins which will hold water for a period of time and slowly drain it down over a set timeline. The third option is to infiltrate the water into the ground. This can be done through naturalized detention basins, rain gardens, bioswales or other best management practices. HR Green studied the effects of detention, conveyance improvements, and a combination of the two to determine the best way to manage stormwater in the study area. Due to the extent of existing development and the in-situ soil types, infiltration was not considered a viable solution to the flooding issues. HR Green modeled four (4) alternatives to improve flooding conditions and completed an engineer's opinion of probable construction cost for each option.

Generally the alternatives consist of varying sizes of detention basins located at Memorial Park, various storm sewer improvements between Memorial Park and Kracklauer Park and various sizes of detention basins on the former U.S. Music site. All alternatives include a level of detention. Potentially sever adverse effects would occur to sensitive flood receptors along the Seavey Drainage Ditch downstream of the study area if the conveyance

system was improved with no detention to compensate for the increased flows entering the Seavey Drainage Ditch. The proposed detention will be used to mitigate for the increased flows that will result from modifying the Division and Lake Street storm sewer systems. Memorial Park, in comparison to other open space available near and adjacent to the study area, appeared to be best suited for detention as it is located along the flow path of the drainage area tributary to the study area. Also, it is just upstream of the mainline storm sewer system along Division. Providing detention at this location can help reduce the flows downstream and have the most significant impact in minimizing storm sewer improvements while having the maximum benefit in reducing flooding. Please see Exhibits 10 thru 13 for a visual depiction of the four alternatives studied for the 10% chance storm event. Table 3 also summarizes the improvements required to meet the 10% chance design storm event. The four alternatives are further identified below:

- **Alternative 1**: As depicted in Exhibit 10, Alternative 1 consists of approximately 30 acre-ft. of surface detention in the Memorial Park at the upstream limits of the study area to reduce the peak flow from upstream watershed, addition of a new and parallel 36" storm sewer along Division Street (between Prairie Street and Lake Street) and along Lake Street, and extension of 18" sewers laterals in the rear yards. The existing 54" storm sewer will be maintained in this alternate. No detention is being proposed at the US Music Factory in this alternate. Alternative 1 meets the 10% chance design event and is able to achieve a significant reduction in flooding for a 1% chance design event while maintaining or reducing downstream impacts. However, the 30-acre foot detention in the Memorial Park will need to be coordinated with the Mundelein Parks and Recreation Board, homeowners and perhaps will require relocation of the park.

- **Alternative 2:** As depicted in Exhibit 11, Alternative 2 consists of approximately 16 acre-ft. of surface detention in the Memorial Park at the upstream limits of the study area, addition of a new and parallel 30" storm sewer along Division Street (between Pershing Avenue and Lake Street) and along Lake Street, and extension of 18" sewers laterals in the rear yards. The existing 54" storm sewer will be maintained in this alternate. Approximately 16 acre-ft. detention is also proposed on the former US Music Factory site to maintain flows downstream and minimize or reduce downstream impacts. Alternative 2 also meets the 10% chance design event and is able to achieve a significant reduction in flooding for a 1% chance design event while maintaining or reducing downstream impacts. The 16 acre-ft. detention storage in Memorial Park still utilizes significant portion on the park site and will require coordination with the Mundelein Parks and Recreation Board, homeowners and perhaps will require relocation of the park. Since flow at Seymour Avenue will be increased with this alternative before being attenuated at the detention basin at the former US Music Factory, streambank stabilization downstream of Seymour Avenue and upstream of the former U.S. Music site would also be required as part of implementing this option.

- **Alternative 3:** As depicted in Exhibit 12, Alternative 3 consists of an addition of a new and parallel 60" storm sewer along Division Street (between Pershing Avenue and Lake Street) and along Lake Street, and extension of 18" sewers laterals in the rear yards. In lieu of adding a parallel 60" pipe, the existing 54" storm sewer can be removed and replaced with a single 84" pipe to achieve the same flood reduction. Approximately 30 acre-ft. detention is also proposed on the former US Music Factory site to maintain flows downstream and minimize or reduce downstream impacts. Alternative 3 also meets the 10% chance design event and is able to achieve a significant reduction in flooding for a 1% chance design event while maintaining or reducing downstream impacts. Since flow at Seymour Avenue will be increased with this alternative before being attenuated at the detention basin at the former US Music

Factory, streambank stabilization downstream of Seymour Avenue and upstream of the former U.S. Music site would also be required as part of implementing this option.

- **Alternative 4:** As depicted in Exhibit 13, Alternative 4 consists of approximately 5 acre-ft. of surface detention in the Memorial Park at the upstream limits of the study area, addition of a new and parallel 48" storm sewer along Division Street (between Pershing Avenue and Lake Street) and along Lake Street, and extension of 18" sewers laterals in the rear yards. The existing 54" storm sewer will be maintained in this alternate. Approximately 25 acre-ft. detention is also proposed on the former US Music Factory site to maintain flows downstream and minimize or reduce downstream impacts. Alternative 4 also meets the 10% chance storm design event and is able to achieve a significant reduction in flooding for a 1% chance design event while maintaining or reducing downstream impacts. The 5 acre-ft. detention storage in Memorial Park is more favorable in regards to impacts to the park property compared to Alternate 1 and 2 but will still require coordination with the Mundelein Parks and Recreation Board and homeowners. Finally, since flow at Seymour Avenue will be increased with this alternative before being attenuated at the detention basin at the former US Music Factory, streambank stabilization downstream of Seymour Avenue and upstream of the former U.S. Music site would also be required as part of implementing this option.

The alternates are further summarized in Table 3 below:

Table 3: Alternative Summary (10% chance storm design)

Proposed Alternative Summary				
Alternative	**Detention at Memorial Park (ac-ft.)**	**Storm Sewer Size Under Division**	**Detention at US Music (ac-ft.)**	**Construction Costs (2017 Dollars)**
1	30	Install new parallel 36" storm sewer and maintain existing 54" storm sewer	0	$4.6M
2	16	Install new parallel 30" storm sewer and maintain existing 54" storm sewer	15	$5.2M
3	0	Install new parallel 60" storm sewer, maintain 54" storm sewer OR remove and replace existing 54" with an 84" storm sewer	30	$6.1M
4	5	Parallel 48" storm sewer, maintain 54" storm sewer	25	$5.9M

Note that along with proposed improvements for either of the alternatives, we also recommend that additional investigations be completed as the project is advanced in the design stage including a more detailed review of construction feasibility, utility impacts, and existing infrastructure condition assessment such as the televised inspection of the existing 54" pipe and review of inlet capacities. Also, note that the level of improvements described above are only for the 10% chance design storm event and does not provide protection for storms greater than the 10% chance storm event frequency.

HR Green reviewed all four alternatives and it is determined that Alternative 4 is the recommended alternative, subject to Village Board approval. HR Green has further advanced Alterative 4 in greater detail to determine what modifications to the system improvements will be required (above the 10% chance design level) to increase the level of protection from a 10%, 4%, 2% and 1% chance storm event level of protection, respectively. The following summarizes the additional analysis completed for Alternative 4 for greater storm events starting with a summary of the 10% chance storm event related improvements:

- **Alternative 4.10, 10% Chance Storm Event Protection**
  As depicted in Exhibit 14 and as discussed previously at the progress meeting, Alternative 4.10 proposes adding 5 acre-ft. detention at Memorial Park, adding a parallel 48" storm sewer system along Division Street to improve the conveyance towards Seavey Ditch, adding extensions of 18" sewers laterals in the rear yards and adding 25 acre-ft. of detention at the former U.S. Music site. The increase in upstream conveyance capacity will increase the amount of flow entering Seavey Ditch significantly. However, the existing 6' corrugated metal pipe (CMP) culvert at Kracklauer Park and 8'x7' box culvert at Seymour Ave are hydraulically adequate and can be maintained, provided these culverts are in good condition. The construction costs estimated in 2017 dollars for this alternate for 10% chance storm event level of protection is approximately $5.9M.

- **Alternative 4.25, 4% Chance Storm Event Protection**
  As depicted in Exhibit 15, Alternative 4.25 proposes adding a 5 acre-ft. detention at Memorial Park, removing and replacing the existing 54" with a new 96" diameter storm sewer along Division Street, adding extensions of 18" sewers laterals in the rear yards and adding 35 acre-ft. detention at the former U.S. Music site. Since flow at Seymour Avenue will be increased with this alternative before being attenuating at the detention basin at the former US Music Factory, streambank stabilization downstream of Seymour Avenue and upstream of the former U.S. Music site would also be required as part of implementing this option. The existing 6' CMP culvert at Kracklauer Park would need to be upsized while the 8' x 7' box culvert at Seymour Ave could be maintained. The construction costs estimated in 2017 dollars for this alternate for 4% chance storm event level of protection is approximately $8.0M.

- **Alternative 4.50, 2% Chance Storm Event Protection**
  As depicted in Exhibit 16, Alternative 4.50 proposes adding 5 acre-ft. detention at Memorial Park, removing and replacing the existing 54" with a new 8' x 8' box culvert along Division Street, adding extensions of 18" sewers laterals in the rear yards and adding 40 acre-ft. of detention at the former U.S. Music site. Since flow at Seymour Avenue will be increased with this alternative before being attenuating at the detention basin at the former US Music Factory, streambank stabilization downstream of Seymour Avenue and upstream of the former U.S. Music site would also be required as part of implementing this option. The existing 6' CMP culvert at Kracklauer Park and the existing 8' x 7' culvert at Seymour Avenue will need to be upsized to prevent overtopping. The total project cost is estimated to be approximately $11.8M. This option would still result in minimal flooding of the streets and backyards of some properties however the duration and severity of flooding would be greatly reduced.

- **Alternative 4.100, 1% Chance Storm Event Protection**
  As depicted in Exhibit 17, Alternative 4.100 proposes adding detention at Memorial Park, upsizing the trunk line along Division Street to improve the conveyance towards Seavey Ditch, and adding detention at the former U.S. Music site. A 5 ac-ft. surface basin is proposed at Memorial Park to detain some of the runoff for the trunk line. The proposed Division Street storm sewer is sized as a 10' x 8' box culvert between Prairie and Lake with 18" lateral sewers to drain backyard areas. Both the existing 6' RCP

culvert at Kracklauer Park and the existing 8' x 7' box culvert at Seymour Ave would need to be upsized to prevent overtopping. In order to match the existing flow at the downstream railroad crossing, this option includes a surface basin with 45 ac-ft. of storage at the former U.S. Music site. Stabilization of the streambanks downstream of Seymour and upstream of the former U.S. Music site would also be required as part of implementing this option. The total project cost is estimated to be approximately $13.1M. This option would still result in minimal flooding of the streets and backyards of some properties however the duration and severity of flooding would be greatly reduced.

All alternative levels of service for Alternative 4 will not result in an increase in flow leaving the study area through the Railroad culvert. Detailed design of the U.S. Music detention basin grading, control structure and spill way will need to be carefully completed to ensure that the flow is not increased. Table 4 below summarizes the key aspects of the different levels of service that can be achieved by Alternative 4:

Table 4: Preferred Alternative Summary

Proposed Alternative Summary				
Alternative	**Detention at Memorial Park (ac-ft.)**	**Storm Sewer Size Under Division (ft.)**	**Detention at US Music (ac-ft.)**	**Surface Flooding Severity**
4.10 (10% Chance)	5	Add parallel 48"	25	Negligible
4.25 (4% Chance)	5	Replace with96"'	35	Negligible
4.50 (2% Chance)	5	Replace with 8'x8'	40	Minimal
4.100 (1% Chance)	5	Replace with 10'x8'	45	Minimal

Recommendations

Several factors were considered when determining the recommended option for proposed improvements, including cost effectiveness, convenience, level of service and feasibility. After careful consideration and numerous discussions between HR Green and the Village, Alternative 4 is recommended.

In the decision making process, the Village must consider the pros and cons of the alternatives proposed, desired level of protection, construction feasibility, real estate impacts and benefit to cost ratio. Additionally, Village must consider developing a phasing and implementation plan should these improvements need to be spanned over multiple years. In addition, we recommend coordinating these flood control improvements with other Capital Improvement Projects and development opportunities along or in the vicinity of the project to maximize cost-effectiveness and minimize construction related impacts to the neighborhood and the business district. Finally, Lake Street (US45) is an IDOT jurisdictional road. Any work within the IDOT ROW will require coordination with IDOT. As part of this coordination, Village shall consider requesting cost participation/funding opportunities through IDOT.

Conclusion

HR Green has completed this drainage study which will guide the Village of Mundelein in initiating key drainage improvements within the designated study area; this study and its recommendations are intended to reduce the frequency and severity of flooding within the watershed. This Technical Memorandum discussed the hydrology and hydraulics completed for drainage analysis, and identified and analyzed the feasibility of four proposed improvement options, and provided a prioritization plan for the recommended Alternative.

EXHIBIT 1

DA NAME	AREA (AC)	DA NAME	AREA (AC)
1	8.44	48	5.62
2	5.51	49	4.87
3	9.13	50	21.41
4	4.13	51	7.21
5	2.23	52	4.79
6	3.43	53	5.48
6	2.18	54	2.97
7	2.76	55	3.87
8	1.47	56	5.91
9	5.72	57	6.20
10	4.66	58	44.93
11	4.77	59	8.95
12	6.39	60	3.99
13	4.83	62	1.88
14	7.00	63	1.07
18	19.82	64	5.67
21	14.97	65	6.71
22	6.96	66	6.96
24	42.59	67	6.95
25	187.87	68	6.74
26	24.19	69	2.49
27	1.91	70	12.66
28	21.53	72	11.92
29	5.73	73	2.74
31	6.13	74	2.74
32	5.86	75	2.91
33	12.59	76	16.81
34	4.12	77	14.45
35	3.60	78	5.86
36	4.86	79	2.20
37	21.04	80	3.87
38	63.37	81	2.06
40	2.11	82	0.93
41	7.55	83	31.87
42	2.72	84	3.10
43	1.97	85	4.02
44	1.27	86	6.23
45	1.41	87	6.24
46	1.75	88	4.10
47	4.25	89	254.78

TOTAL DRAINAGE AREAS AT SEYMOUR AVE

HR GREEN: 1220 ACRES
FIS: 960 ACRES

233 ACRES
443 ACRES
110 ACRES
112 ACRES
311 ACRES
121 ACRES

DA89 DA24 DA26 DA27 DA72 DA29 DA25 DA83 DA49 DA50 DA68 DA22 DA31 DA28 DA32 DA33 DA48 DA51 DA65 DA66 DA67 DA80 DA81 DA77 DA74 DA82 DA18 DA21 DA14 DA10 DA9 DA34 DA47 DA53 DA64 DA63 DA69 DA62 DA76 DA12 DA79 DA52 DA6 DA75 DA13 DA11 DA5 DA8 DA35 DA46 DA54 DA55 DA60 DA86 DA85 DA78 DA4 DA3 DA7 DA36 DA45 DA84 DA1 DA43 DA40 DA41 DA2 DA42 DA59 DA70 DA87 DA37 DA88 DA57 DA58 DA38

Drainage Area Exhibit
Division/Lake Drainage Study

Village of Mundelein
Illinois

Legend

- Seavey Ditch Drainage Areas
- Outside Area with Overflow Connections to Seavey Ditch Drainage Area
- Sub-Drainage Areas (Name Labeled)

Data Source: Villiage of Mundelein, Lake County, HRG
Projected Coordinate System: IL State Plane East
Author: C Pugh

0 400 800 1,600
Feet

N

HRGreen

HRG PLOT: 2:24:53 PM 11/10/2017 BY: cpugh FILE: J:\2017\171109\Design\GIS\MXD\111317-Mtg\Drainage_Areas.mxd

EXHIBIT 2

Historic Aerial (1939)

Glenview
Cairo
Blue Spruce
Emerald
Wellington
Walker
Holcomb
Wildwood
Arbour
Greenwood
Norton
IL Route 176
Maple
Bonniebrook
Ridgemoor
Idlewild
Park
Greenview
Grace
Morris
James
Norton
Fairlawn
Bobby
Fairhaven
Chandler
Chicago
McKinley
Hawley
Edington
Midlothian
Barlow
Stafford
California
Hammond
Pershing
Prairie
Lake
US Highway 45
Seymour
Archer
Plaza
Anthony
Prospect
Dean
Lange
Brice
Dalton
Wilcox
Lenox
Rouse
Shaddle
Countryside
Noel
French
Gifford
Thomas
Division
Albion
Tall Grass
Crystal
Courtland
Midland
Linden
Oak
Hawthorne
Walnut

Legend

- Curent Road Alignments
- Study Area

Data Source: ISGS Clearinghouse, Lake County
Projected Coordinate System: IL State Plane East
Author: Gilbertsen

0 200 400 800
Feet

N

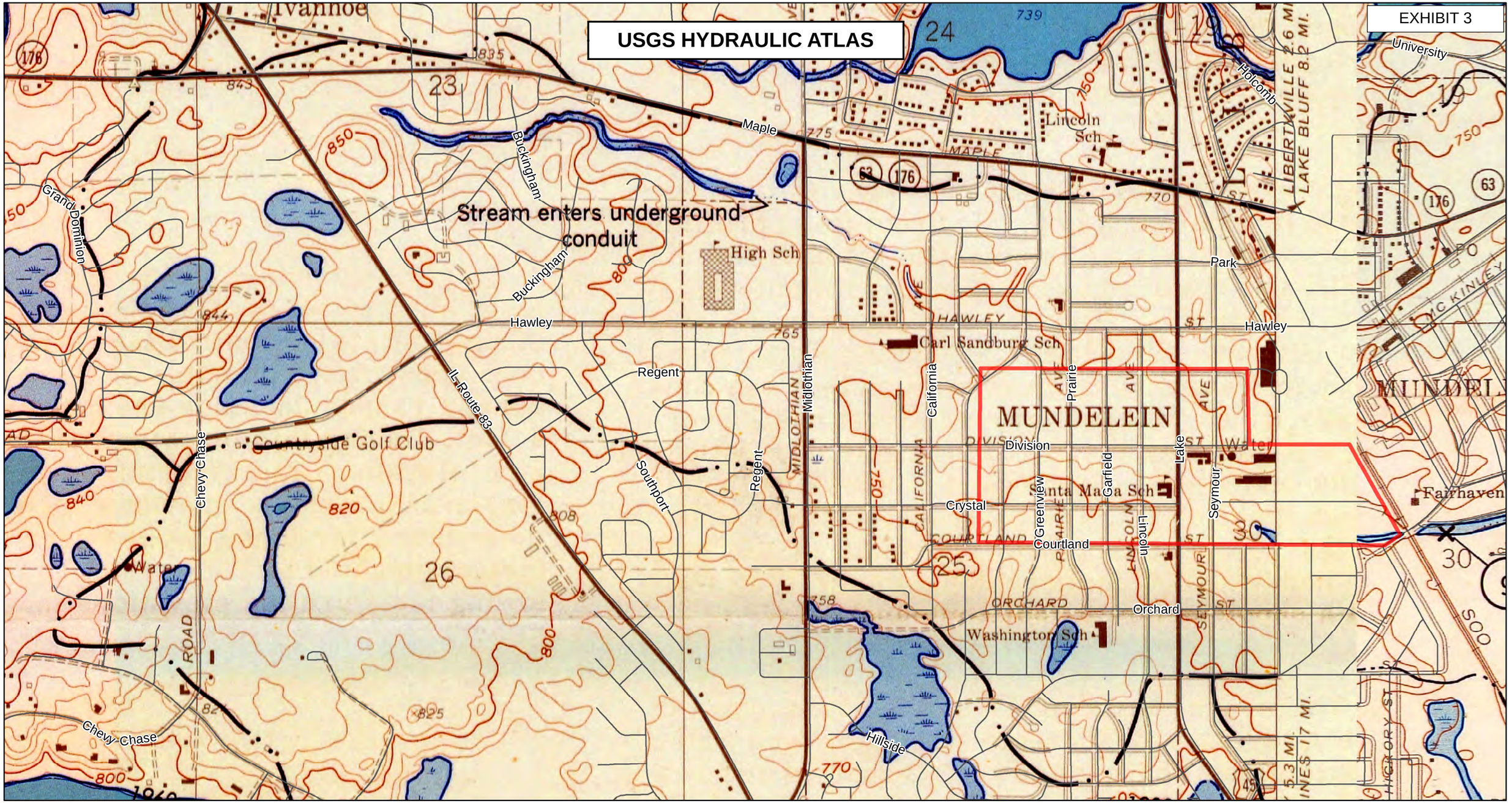
HRGreen

Historic Aerial (1939)
Division/Lake Drainage Study

Village of Mundelein
Illinois

EXHIBIT 3

USGS HYDRAULIC ATLAS



USGS Hydraulic Atlas
Division/Lake Drainage Study

Village of Mundelein
Illinois

Legend

- Study Area
- Current Road Alignments

Data Source: Villiage of Mundelein, Lake County, HRG
Projected Coordinate System: IL State Plane East
Author: C Pugh

0 400 800 1,600
Feet

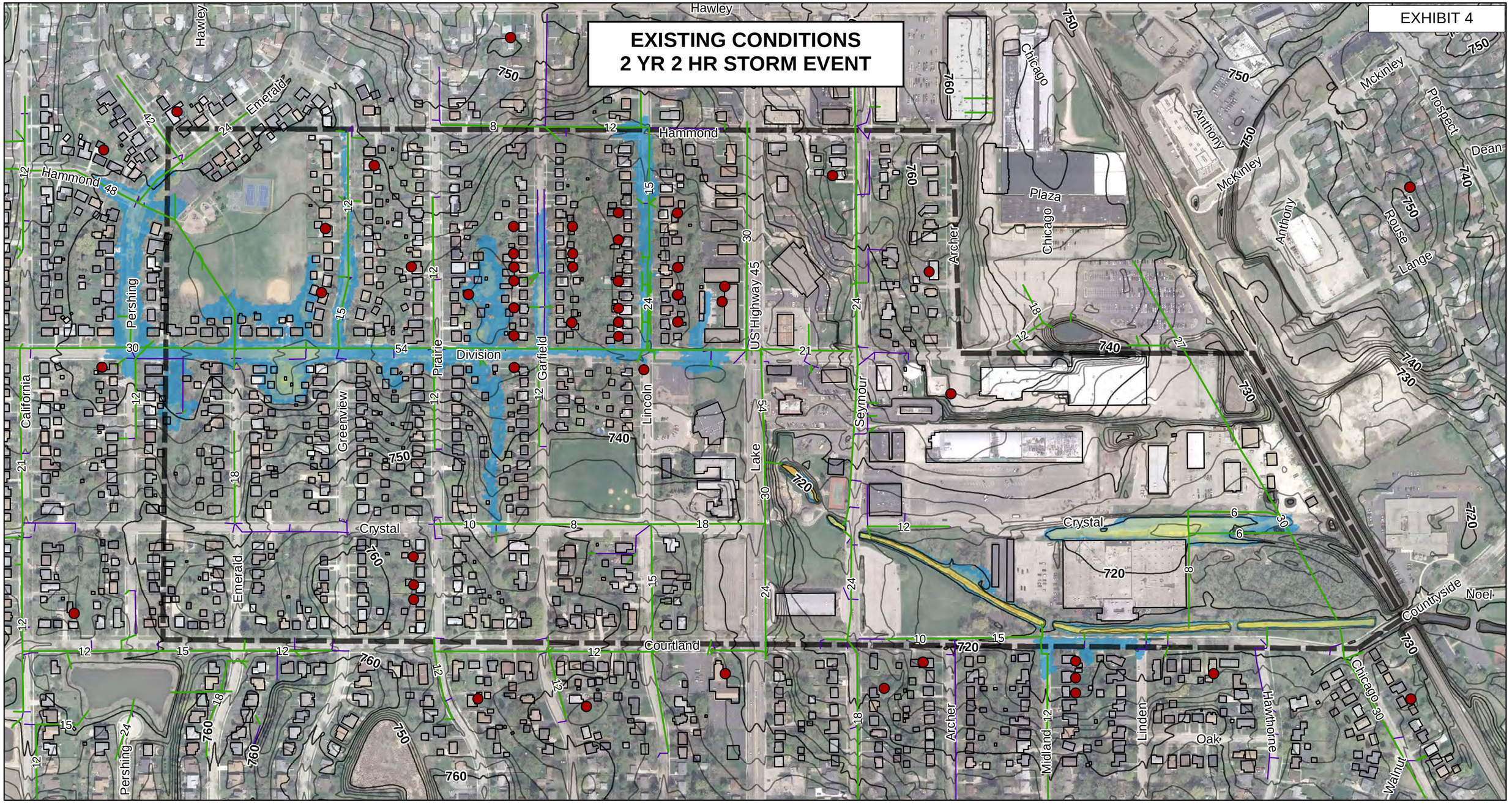
N

HRGreen

HRG PLOT: 1:37:32 PM 11/10/2017 BY: LGILBER FILE: J:\2017\171109\Design\GIS\MXD\110617-Mtg\HA_Map.mxd

EXHIBIT 4

EXISTING CONDITIONS
2 YR 2 HR STORM EVENT



XPSWMM Results
Division/Lake Drainage Study

Village of Mundelein
Illinois

Legend

- Reported Flood Incidents July 12, 2017
- Building Outlines
- Storm Sewer
- Storm Laterals
- Study Area

Inundation (ft)

0.1 - 0.5	3 - 4
0.5 - 1	4 - 5
1 - 2	5 - 6
2 - 3	6 - 7
	7 - 8

Data Source: Villiage of Mundelein, Lake County, HRG
Projected Coordinate System: IL State Plane East
Author: C Pugh

0 150 300 600
Feet

N

HRGreen

HRG PLOT: 3:16:07 PM 11/10/2017 BY: LGILBER FILE: J:\2017\171109\Design\GIS\MXD\111317-Mtg\Existing_Results-2yr.mxd

EXHIBIT 5

EXISTING CONDITIONS
10 YR 2 HR STORM EVENT

XPSWMM Results
Division/Lake Drainage Study

Village of Mundelein
Illinois

Legend

- Reported Flood Incidents July 12, 2017
- Building Outlines
- Storm Sewer
- Storm Laterals
- Study Area

Inundation (ft)

0.1 - 0.5	3 - 4
0.5 - 1	4 - 5
1 - 2	5 - 6
2- 3	6 - 7
	7 - 8

Data Source: Villiage of Mundelein, Lake County, HRG
Projected Coordinate System: IL State Plane East
Author: C Pugh

HRGreen

0 150 300 600
Feet

N

HRG PLOT: 3:10:56 PM 11/10/2017 BY: LGILBER FILE: J:\2017\171109\Design\GIS\MXD\111317-Mtg\Existing_Results-10yr.mxd

EXHIBIT 6

EXISTING CONDITIONS
50 YR 2 HR STORM EVENT

XPSWMM Results
Division/Lake Drainage Study

Village of Mundelein
Illinois

Legend

- Reported Flood Incidents July 12, 2017
- Building Outlines
- Storm Sewer
- Storm Laterals
- Study Area

Inundation(ft)

0.1 - 0.5	3 - 4
0.5 - 1	4 - 5
1 - 2	5 - 6
2 - 3	6 - 7
	7 - 8

Data Source: Villiage of Mundelein, Lake County, HRG
Projected Coordinate System: IL State Plane East
Author: C Pugh

HRGreen

0 150 300 600
Feet

N

HRG PLOT: 6:25:18 PM 11/12/2017 BY: lgilber FILE: J:\2017\171109\Design\GIS\MXD\111317-Mtg\Existing_Results-50yr.mxd

EXHIBIT 7

EXISTING CONDITIONS
100 YR 2 HR STORM EVENT

XPSWMM Results
Division/Lake Drainage Study

Village of Mundelein
Illinois

Legend

- Reported Flood Incidents July 12, 2017
- Building Outlines
- Storm Sewer
- Storm Laterals
- Study Area

Inundation (ft)

0.1 - 0.5	3 - 4
0.5 - 1	4 - 5
1 - 2	5 - 6
2 - 3	6 - 7
	7 - 8

Data Source: Villiage of Mundelein, Lake County, HRG
Projected Coordinate System: IL State Plane East
Author: C Pugh

HRGreen

0 150 300 600
Feet

N

HRG PLOT: 6:51:19 PM 11/12/2017 BY: lgilber FILE: J:\2017\171109\Design\GIS\MXD\111317-Mtg\Existing_Results-100yr.mxd

EXHIBIT 8

PONDING AREA EXHIBIT
The area within the red boundary relies fully on storm sewers to drain.

Overland Flow Route
Elevation ~733.2

Ponding Area Exhibit
Division/Lake Drainage Study

Village of Mundelein
Illinois

Legend

- Reported Flood Incidents July 12, 2017
- Building Outlines
- Ponding Area
- Storm Sewer
- Storm Laterals
- Study Area

Data Source: Villiage of Mundelein, Lake County, HRG
Projected Coordinate System: IL State Plane East
Author: C Pugh

HRGreen

0 150 300 600
Feet

N

HRG PLOT: 3:41:18 PM 11/10/2017 BY: LGILBER FILE: J:\2017\171109\Design\GIS\MXD\111317-Mtg\map-PondingArea.mxd

EXHIBIT 9

EXISTING CONDITIONS
JULY 2017 STORM EVENT

Looking East along Division from Lincoln/Division - July 2017 Flood

Hawley
Emerald
Hammond
Pershing
Division
Prairie
Garfield
Lincoln
US Highway 45
Lake
Seymour
Archer
California
Greenview
Crystal
Courtland
Midland
Linden
Oak
Hawthorne
Chicago
Countryside
Noel
Walnut

XPSWMM Results
Division/Lake Drainage Study

Village of Mundelein
Illinois

Legend

- Reported Flood Incidents July 12, 2017
- Building Outlines
- Storm Sewer
- Storm Laterals
- Study Area

Inundation (ft)

0.1- 0.5	3 - 4
0.5 - 1	4 - 5
1 - 2	5 - 6
2- 3	6 - 7
	7 - 8

Data Source: Villiage of Mundelein, Lake County, HRG
Projected Coordinate System: IL State Plane East
Author: C Pugh

0 150 300 600
Feet

N

HRGreen

HRG PLOT: 1:21:43 PM 11/10/2017 BY: LGILBER FILE: J:\2017\171109\Design\GIS\MXD\111317-Mtg\Existing_Results-Actual.mxd

EXHIBIT 10

PROPOSED CONDITIONS
ALTERNATIVE 1 - 10 YR STORM

Proposed
30 ac-ft Detention

Hawley
Hammond
Division
Courtland
Crystal
Plaza
Chicago
Emerald
Pershing
California
Greenview
Prairie
Garfield
Lincoln
Lake
US Highway 45
Seymour
Archer
Mckinley
Anthony
Prospect
Dean
Rouse
Lange
Countryside
Noel
Midland
Linden
Oak
Hawthorne
Walnut

Legend

- Reported Flood Incidents July 12, 2017
- Building Outlines
- Proposed-SS
- Storm Sewer
- Storm Laterals
- Study Area

Inundation

0.1 - 0.5	3 - 4
0.5 - 1	4 - 5
1 - 2	5 - 6
2 - 3	6 - 7
	7 - 8

XPSWMM Results
Division/Lake Drainage Study

Village of Mundelein
Illinois

Data Source: Villiage of Mundelein, Lake County, HRG
Projected Coordinate System: IL State Plane East
Author: C Pugh

0 150 300 600
Feet

N

HRGreen

HRG PLOT: 11:35:28 AM 11/13/2017 BY: cpugh FILE: J:\2017\171109\Design\GIS\MXD\111317-Mtg\ProposedAlt1_Results-10yr.mxd

EXHIBIT 11

PROPOSED CONDITIONS
ALTERNATIVE 2 - 10 YR STORM

Proposed
16 ac-ft Detention

Hawley
Emerald
Hammond
Pershing
California
Greenview
Prairie
Division
Garfield
Lincoln
US Highway 45
Lake
Seymour
Archer
Chicago
Plaza
Anthony
Mckinley
Prospect
Dean
Rouse
Lange
Crystal
Courtland
Midland
Linden
Oak
Hawthorne
Countryside
Noel
Walnut

Legend

- Reported Flood Incidents July 12, 2017
- Building Outlines
- Proposed Storm Sewer
- Storm Sewer
- Storm Laterals
- Study Area

Inundation (ft)

0.1- 0.5	3 - 4
0.5 - 1	4 - 5
1 - 2	5 - 6
2 - 3	6 - 7
	7 - 8

XPSWMM Results
Division/Lake Drainage Study

Village of Mundelein
Illinois

Data Source: Villiage of Mundelein, Lake County, HRG
Projected Coordinate System: IL State Plane East
Author: C Pugh

0 150 300 600
Feet

N

HRGreen

HRG PLOT: 11:36:49 AM 11/13/2017 BY: cpugh FILE: J:\2017\171109\Design\GIS\MXD\111317-Mtg\ProposedAlt2_Results-10yr.mxd

EXHIBIT 12

PROPOSED CONDITIONS
ALTERNATIVE 3 - 10 YR STORM

XPSWMM Results
Division/Lake Drainage Study

Village of Mundelein
Illinois

Legend

- Proposed Storm Sewer
- Reported Flood Incidents July 12, 2017
- Building Outlines
- Storm Sewer
- Storm Laterals
- Study Area

Inundation (ft)

0.1 - 0.5	3 - 4
0.5 - 1	4 - 5
1 - 2	5 - 6
2 - 3	6 - 7
	7 - 8

Data Source: Villiage of Mundelein, Lake County, HRG
Projected Coordinate System: IL State Plane East
Author: C Pugh

HRGreen

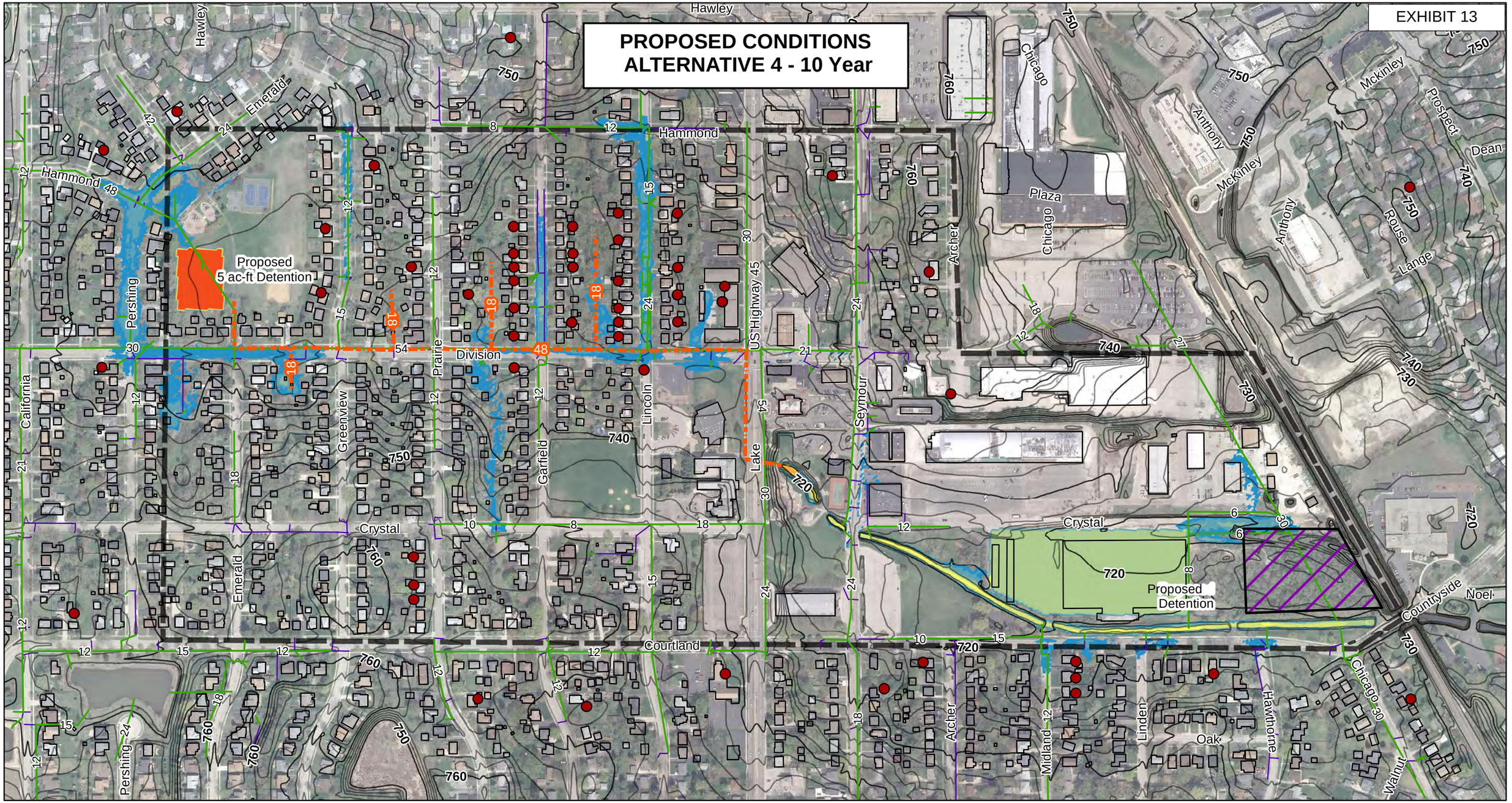
0 150 300 600
Feet

N

HRG PLOT: 1:07:52 PM 11/13/2017 BY: cpugh FILE: J:\2017\171109\Design\GIS\MXD\111317-Mtg\ProposedAlt3_Results-10yr.mxd

EXHIBIT 13

PROPOSED CONDITIONS
ALTERNATIVE 4 - 10 Year



XPSWMM Results
Division/Lake Drainage Study

Village of Mundelein
Illinois

Legend

- Reported Flood Incidents July 12, 2017
- Building Outlines
- Proposed Storm Sewer
- Proposed 3 Acre Development
- Storm Sewer
- Storm Laterals

Inundation (ft)

0.1 - 0.5	2 - 3	6 - 7	Study Area
0.5 - 1	3 - 4	7 - 8	
1 - 2	4 - 5	8 - 9	
	5 - 6	9 - 10	

Data Source: Villiage of Mundelein, Lake County, HRG
Projected Coordinate System: IL State Plane East
Author: C Pugh

0 150 300 600
Feet

N

HRGreen

HRG PLOT: 4:17:31 PM 11/16/2017 BY: cpugh FILE: J:\2017\171109\Design\GIS\MXD\111717\Proposed_Results-10yr.mxd

EXHIBIT 14

PROPOSED CONDITIONS
ALTERNATIVE 4.10

Proposed
5 ac-ft Detention

Proposed
Detention

Hawley
Emerald
Hammond
Pershing
California
Greenview
Prairie
Division
Garfield
Lincoln
US Highway 45
Lake
Seymour
Archer
Chicago
Plaza
Anthony
Mckinley
Prospect
Dean
Rouse
Lange
Crystal
Courtland
Countryside
Noel
Midland
Linden
Oak
Hawthorne
Walnut

Legend

- Reported Flood Incidents July 12, 2017
- Building Outlines
- Proposed Storm Sewer
- Proposed 3 Acre Development
- Storm Sewer
- Storm Laterals

Inundation (ft)
0.1 - 0.5
0.5 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10

Study Area

XPSWMM Results
Division/Lake Drainage Study

Village of Mundelein
Illinois

Data Source: Villiage of Mundelein, Lake County, HRG
Projected Coordinate System: IL State Plane East
Author: C Pugh

0 150 300 600
Feet

N

HRGreen

HRG PLOT: 4:17:31 PM 11/16/2017 BY: cpugh FILE: J:\2017\171109\Design\GIS\MXD\111717\Proposed_Results-10yr.mxd

EXHIBIT 15

PROPOSED CONDITIONS
ALTERNATIVE 4.25

Proposed
5 ac-ft Detention

UPSIZE CULVERT

STREAMBANK STABILIZATION

Proposed
Detention

Hawley
Hammond
Emerald
Pershing
Prairie
Division
California
Greenview
Garfield
Lincoln
Lake
US Highway 45
Seymour
Archer
Chicago
Plaza
Anthony
Mckinley
Prospect
Dean
Rouse
Lange
Crystal
Courtland
Linden
Oak
Hawthorne
Midland
Countryside
Noel
Walnut

XPSWMM Results
Division/Lake Drainage Study

Village of Mundelein
Illinois

Legend

- Reported Flood Incidents July 12, 2017
- Building Outlines
- Proposed Storm Sewer
- Proposed 3 Acre Development
- Storm Sewer
- Storm Laterals

Inundation (ft)

0.1 - 0.5	2 - 3	6 - 7	Study Area
0.5 - 1	3 - 4	7 - 8	
1 - 2	4 - 5	8 - 9	
	5 - 6	9 - 10	

Data Source: Villiage of Mundelein, Lake County, HRG
Projected Coordinate System: IL State Plane East
Author: C Pugh

HRGreen

0 150 300 600
Feet

N

EXHIBIT 16

PROPOSED CONDITIONS
ALTERNATIVE 4.50

Proposed
5 ac-ft Detention

UPSIZE CULVERT

UPSIZE CULVERT

Proposed
Detention

STREAMBANK STABILIZATION

Hawley
Hammond
Emerald
Pershing
Division
Prairie
Greenview
Garfield
Lincoln
Lake
US Highway 45
Seymour
Archer
Chicago
Plaza
Anthony
Mckinley
Prospect
Dean
Rouse
Lange
California
Crystal
Courtland
Countryside
Noel
Midland
Linden
Oak
Hawthorne
Walnut

Legend

- Reported Flood Incidents July 12, 2017
- Building Outlines
- Proposed Storm Sewer
- Proposed 3 Acre Development
- Storm Sewer
- Storm Laterals

Inundation (ft)
0.1 - 0.5
0.5 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10

Study Area

XPSWMM Results
Division/Lake Drainage Study

Village of Mundelein
Illinois

Data Source: Villiage of Mundelein, Lake County, HRG
Projected Coordinate System: IL State Plane East
Author: C Pugh

0 150 300 600
Feet

N

HRGreen

HRG PLOT: 4:27:12 PM 11/16/2017 BY: cpugh FILE: J:\2017\171109\Design\GIS\MXD\111717\Proposed_Results-50yr.mxd

EXHIBIT 17

PROPOSED CONDITIONS
ALTERNATIVE 4.100

Proposed
5 ac-ft Detention

UPSIZE CULVERT

UPSIZE CULVERT

STREAMBANK STABILIZATION

Proposed
Detention

XPSWMM Results
Division/Lake Drainage Study

Village of Mundelein
Illinois

Legend

- Reported Flood Incidents July 12, 2017
- Building Outlines
- Proposed Storm Sewer
- Proposed 3 Acre Development
- Storm Sewer
- Storm Laterals

Inundation (ft)

0.1 - 0.5	2 - 3	6 - 7	Study Area
0.5 - 1	3 - 4	7 - 8	
1 - 2	4 - 5	8 - 9	
	5 - 6	9 - 10	

Data Source: Villiage of Mundelein, Lake County, HRG
Projected Coordinate System: IL State Plane East
Author: C Pugh

0 150 300 600
Feet

N

HRGreen

HRG PLOT: 4:28:20 PM 11/16/2017 BY: cpugh FILE: J:\2017\171109\Design\GIS\MXD\111717\Proposed_Results-100yr.mxd

EXHIBIT 18

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COSTS - CONCEPT

Project #: **171109**
Project: **DIVISION/LAKE DRAINAGE STUDY**
Location: **Village of Mundelein, Illinois**

By LRG Date 11/10/2017
Checked Date

HRGreen

DRAINAGE IMPROVEMENTS - 10 YEAR DESIGN

				ALTERNATIVE 1		ALTERNATIVE 2		ALTERNATIVE 3		ALTERNATIVE 4	
	BID ITEM	UNITS	UNIT COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST
1.00	DETENTION BASIN EXCAVATION - PARK	AC-FT	$ 80,000.00	30	$ 2,400,000.00	16	$ 1,280,000.00	0	$ -	5	$ 400,000.00
1.01	DETENTION BASIN EXCAVATION - FACTORY	AC-FT	$ 80,000.00		$ -	10	$ 800,000.00	30	$ 2,400,000.00	25	$ 2,000,000.00
1.02	STREAM BANK STABILIZATION	LF	$ 600.00		$ -	750	$ 450,000.00	750	$ 450,000.00	750	$ 450,000.00
1.03	STORM SEWERS COMPLETE- 18" RCP	LF	$ 240.00	1,120	$ 268,800.00	1,120	$ 268,800.00	1,120	$ 268,800.00	1,120	$ 268,800.00
1.04	STORM SEWERS COMPLETE- 30" RCP	LF	$ 330.00		$ -	2,600	$ 858,000.00		$ -		$ -
1.05	STORM SEWERS COMPLETE- 36" RCP	LF	$ 350.00	1,500	$ 525,000.00		$ -		$ -		$ -
1.06	STORM SEWERS COMPLETE- 48" RCP	LF	$ 390.00		$ -		$ -		$ -	2,600	$ 1,014,000.00
1.07	STORM SEWERS COMPLETE- 60" RCP	LF	$ 450.00		$ -		$ -	2,600	$ 1,170,000.00		$ -
				SUB TOTAL	$ 3,193,800.00	SUB TOTAL	$ 3,656,800.00	SUB TOTAL	$ 4,288,800.00	SUB TOTAL	$ 4,132,800.00
	CONSTRUCTION SUB TOTAL				$ 3,193,800.00		$ 3,656,800.00		$ 4,288,800.00		$ 4,132,800.00
	CONSTRUCTION CONTINGENCY (25%)				$ 798,450.00		$ 914,200.00		$ 1,072,200.00		$ 1,033,200.00
	EROSION CONTROL (5% OF EARTHWORK)				$ 159,690.00		$ 182,840.00		$ 214,440.00		$ 206,640.00
	TRAFFIC CONTROL (1%)				$ 31,938.00		$ 36,568.00		$ 42,888.00		$ 41,328.00
	ENGINEERING DESIGN & RECORD DRAWINGS (12%)				$ 383,256.00		$ 438,816.00		$ 514,656.00		$ 495,936.00
	CONSTRUCTION OBSERVATION AND LAYOUT(10%)				$ 319,380.00		$ 365,680.00		$ 428,880.00		$ 413,280.00
	TOTAL COST				**$ 4,567,134.00**		**$ 5,229,224.00**		**$ 6,132,984.00**		**$ 5,909,904.00**

Project Assumptions/Notes/Comments:

HRG is not a construction cost estimator or construction contractor, nor should HRG'S rendering an opinion of probable construction costs be considered equivalent to the nature and extent of service a construction cost estimator or construction contractor would provide. HRG'S opinion will be based solely upon his or her own experience with construction. This requires HRG to make a number of assumptions as to actual conditions that will be encountered on site; the specific decisions of other design professionals engaged; the means and methods of construction the contractor will employ; the cost and extent of labor, equipment and materials the contractor will employ; contractor's techniques in determining prices and market conditions at the time, and other factors over which HRG has no control. Given the assumptions which must be made, HRG cannot guarantee the accuracy of his or her opinions of cost, and in recognition of that fact, the CLIENT waives any claim against HRG relative to the accuracy of HRG'S opinion of probable construction cost.

NOTES:

Printed on: 11/17/2017

\\hrgreen.com\HRG\Data\2017\171109\Design\Calc\opc-Concept_DivLake-111017.xlsx

EXHIBIT 19

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COSTS - CONCEPT

Project #: **171109**
Project: **DIVISION/LAKE DRAINAGE STUDY**
Location: **Village of Mundelein, Illinois**

By LRG Date 11/17/2017
Checked AJJ Date 11/17/2017

HRGreen

DRAINAGE IMPROVEMENTS - ALTERNATIVE 4, VARIED LEVEL OF SERVICE (10-Yr, 25-Yr, 50-Yr & 100-Yr)

				ALTERNATIVE 4.10		ALTERNATIVE 4.25		ALTERNATIVE 4.50		ALTERNATIVE 4.100	
	BID ITEM	**UNITS**	**UNIT COST**	**QUANTITY**	**COST**	**QUANTITY**	**COST**	**QUANTITY**	**COST**	**QUANTITY**	**COST**
1.00	DETENTION BASIN EXCAVATION - PARK	AC-FT	$ 80,000.00	5	$ 400,000.00	5	$ 400,000.00	5	$ 400,000.00	5	$ 400,000.00
1.01	DETENTION BASIN EXCAVATION - FACTORY	AC-FT	$ 80,000.00	25	$ 2,000,000.00	35	$ 2,800,000.00	40	$ 3,200,000.00	45	$ 3,600,000.00
1.02	STREAM BANK STABILIZATION	LF	$ 600.00	750	$ 450,000.00	750	$ 450,000.00	750	$ 450,000.00	750	$ 450,000.00
1.03	STORM SEWERS COMPLETE- 18" RCP	LF	$ 240.00	1,120	$ 268,800.00	1,120	$ 268,800.00	1,120	$ 268,800.00	1,120	$ 268,800.00
1.04	STORM SEWERS COMPLETE- 30" RCP	LF	$ 330.00		$ -		$ -		$ -		$ -
1.05	STORM SEWERS COMPLETE- 36" RCP	LF	$ 350.00		$ -		$ -		$ -		$ -
1.06	STORM SEWERS COMPLETE- 48" RCP	LF	$ 390.00	2,600	$ 1,014,000.00		$ -		$ -		$ -
1.07	STORM SEWERS COMPLETE- 60" RCP	LF	$ 450.00		$ -		$ -		$ -		$ -
1.08	STORM SEWERS COMPLETE- 96" RCP	LF	$ 620.00		$ -	2,600	$ 1,612,000.00		$ -		$ -
1.09	STORM SEWERS COMPLETE- 8'x8' BOX CULVERT	LF	$ 1,450.00		$ -		$ -	2,600	$ 3,770,000.00		$ -
1.10	STORM SEWERS COMPLETE- 10'x8' BOX CULVERT	LF	$ 1,650.00		$ -		$ -		$ -	2,600	$ 4,290,000.00
1.11	CULVERT UPSIZE - KRACKLAUER PARK	LF	$ 1,300.00		$ -	60	$ 78,000.00	60	$ 78,000.00	60	$ 78,000.00
1.12	CULVERT UPSIZE - SEYMOUR AVE	LF	$ 1,300.00		$ -		$ -	60	$ 78,000.00	60	$ 78,000.00
				SUB TOTAL	$ 4,132,800.00	SUB TOTAL	$ 5,608,800.00	SUB TOTAL	$ 8,244,800.00	SUB TOTAL	$ 9,164,800.00
	CONSTRUCTION SUB TOTAL				$ 4,132,800.00		$ 5,608,800.00		$ 8,244,800.00		$ 9,164,800.00
	CONSTRUCTION CONTINGENCY (25%)				$ 1,033,200.00		$ 1,402,200.00		$ 2,061,200.00		$ 2,291,200.00
	EROSION CONTROL (5% OF EARTHWORK)				$ 206,640.00		$ 280,440.00		$ 412,240.00		$ 458,240.00
	TRAFFIC CONTROL (1%)				$ 41,328.00		$ 56,088.00		$ 82,448.00		$ 91,648.00
	ENGINEERING DESIGN & RECORD DRAWINGS (12%)				$ 495,936.00		$ 673,056.00		$ 989,376.00		$ 1,099,776.00
	CONSTRUCTION OBSERVATION AND LAYOUT(10%)				$ 413,280.00		$ 560,880.00		$ 824,480.00		$ 916,480.00
	TOTAL COST				**$ 5,909,904.00**		**$ 8,020,584.00**		**$ 11,790,064.00**		**$ 13,105,664.00**

Project Assumptions/Notes/Comments:

HRG is not a construction cost estimator or construction contractor, nor should HRG'S rendering an opinion of probable construction costs be considered equivalent to the nature and extent of service a construction cost estimator or construction contractor would provide. HRG'S opinion will be based solely upon his or her own experience with construction. This requires HRG to make a number of assumptions as to actual conditions that will be encountered on site; the specific decisions of other design professionals engaged; the means and methods of construction the contractor will employ; the cost and extent of labor, equipment and materials the contractor will employ; contractor's techniques in determining prices and market conditions at the time, and other factors over which HRG has no control. Given the assumptions which must be made, HRG cannot guarantee the accuracy of his or her opinions of cost, and in recognition of that fact, the CLIENT waives any claim against HRG relative to the accuracy of HRG'S opinion of probable construction cost.

NOTES:

Printed on: 11/17/2017

APPENDIX

United States Department of Agriculture

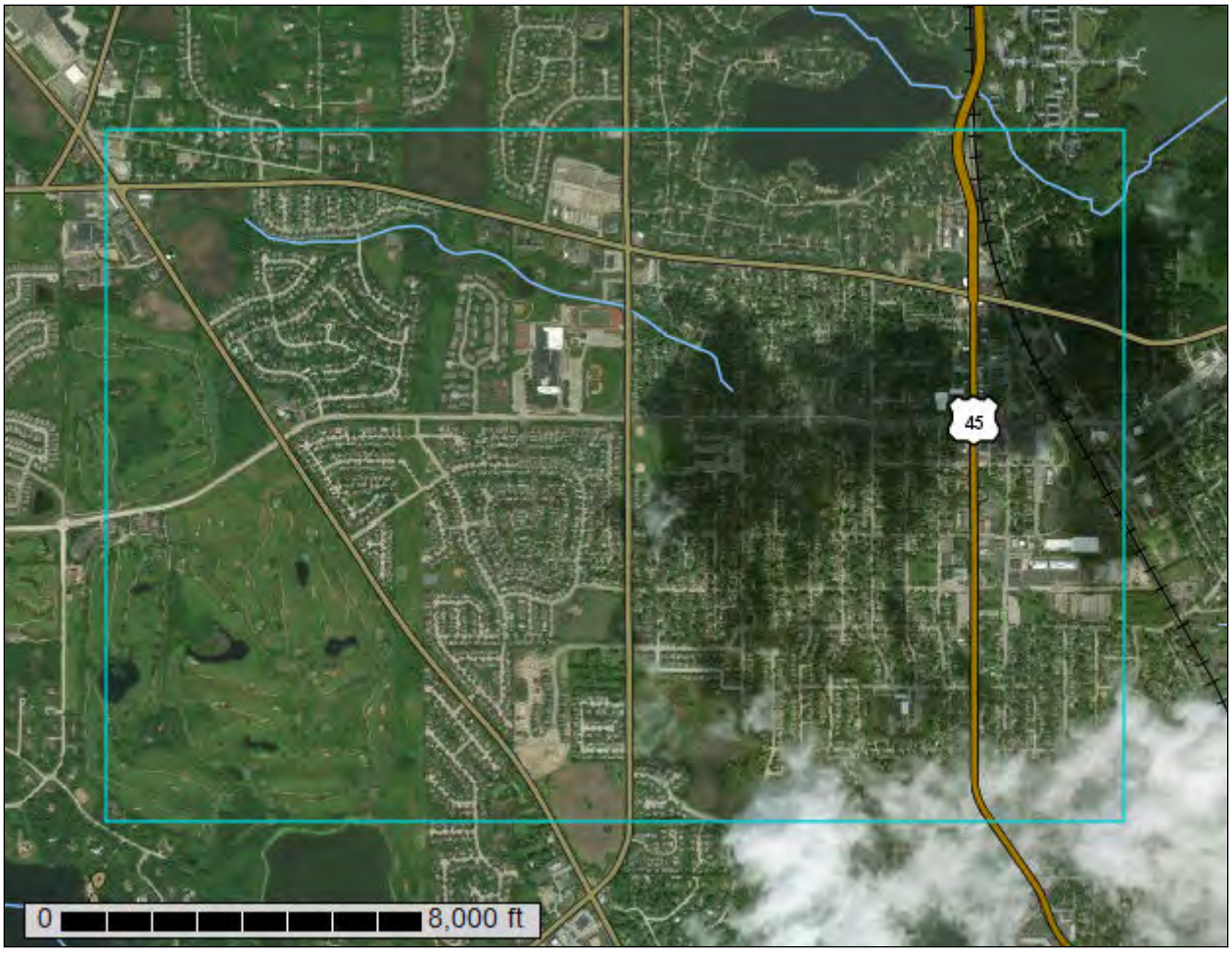
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Lake County, Illinois

APPENDIX



October 24, 2017

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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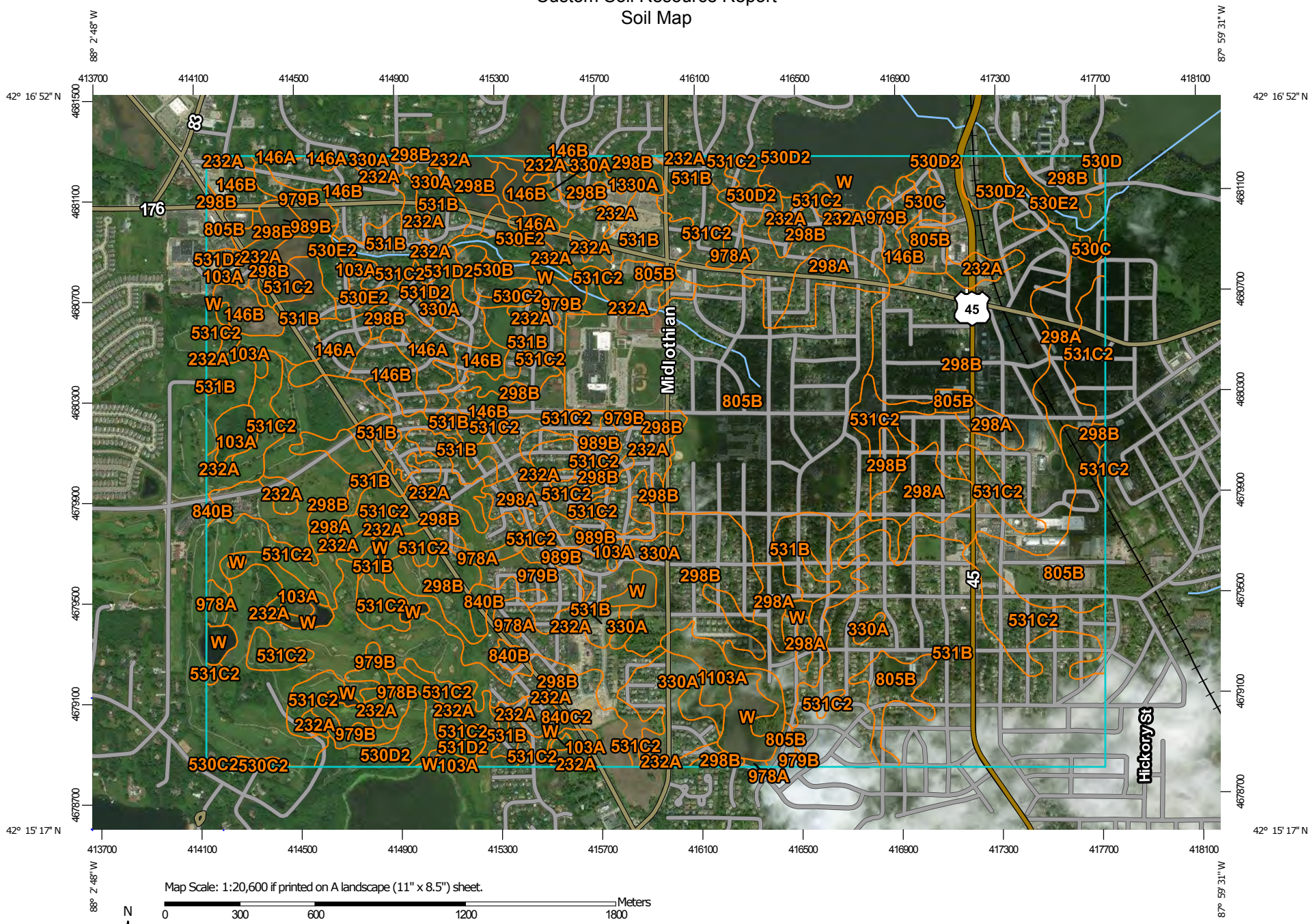
Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lake County, Illinois
Survey Area Data: Version 10, Sep 16, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 3, 2011—Oct 22, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
103A	Houghton muck, 0 to 2 percent slopes	25.4	1.2%
146A	Elliott silt loam, 0 to 2 percent slopes	33.1	1.5%
146B	Elliott silt loam, 2 to 4 percent slopes	85.9	4.0%
232A	Ashkum silty clay loam, 0 to 2 percent slopes	211.9	9.8%
298A	Beecher silt loam, 0 to 2 percent slopes	88.3	4.1%
298B	Beecher silt loam, 2 to 4 percent slopes	532.5	24.6%
330A	Peotone silty clay loam, 0 to 2 percent slopes	13.7	0.6%
530B	Ozaukee silt loam, 2 to 4 percent slopes	3.7	0.2%
530C	Ozaukee silt loam, 4 to 6 percent slopes	6.6	0.3%
530C2	Ozaukee silt loam, 4 to 6 percent slopes, eroded	3.8	0.2%
530D	Ozaukee silt loam, 6 to 12 percent slopes	1.0	0.0%
530D2	Ozaukee silt loam, 6 to 12 percent slopes, eroded	42.0	1.9%
530E2	Ozaukee silt loam, 12 to 20 percent slopes, eroded	31.6	1.5%
531B	Markham silt loam, 2 to 4 percent slopes	340.2	15.7%
531C2	Markham silt loam, 4 to 6 percent slopes, eroded	244.5	11.3%
531D2	Markham silt loam, 6 to 12 percent slopes, eroded	25.5	1.2%
805B	Orthents, clayey, undulating	290.1	13.4%
840B	Zurich and Ozaukee silt loams, 2 to 4 percent slopes	10.1	0.5%
840C2	Zurich and Ozaukee silt loams, 4 to 6 percent slopes, eroded	5.0	0.2%
978A	Wauconda and Beecher silt loams, 0 to 2 percent slopes	16.9	0.8%
978B	Wauconda and Beecher silt loams, 2 to 4 percent slopes	4.2	0.2%
979B	Grays and Markham silt loams, 2 to 4 percent slopes	41.0	1.9%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
989B	Mundelein and Elliott silt loams, 2 to 4 percent slopes	15.6	0.7%
1103A	Houghton muck, undrained, 0 to 2 percent slopes	25.6	1.2%
1330A	Peotone silty clay loam, undrained, 0 to 2 percent slopes	4.6	0.2%
W	Water	61.7	2.8%
Totals for Area of Interest		**2,164.7**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

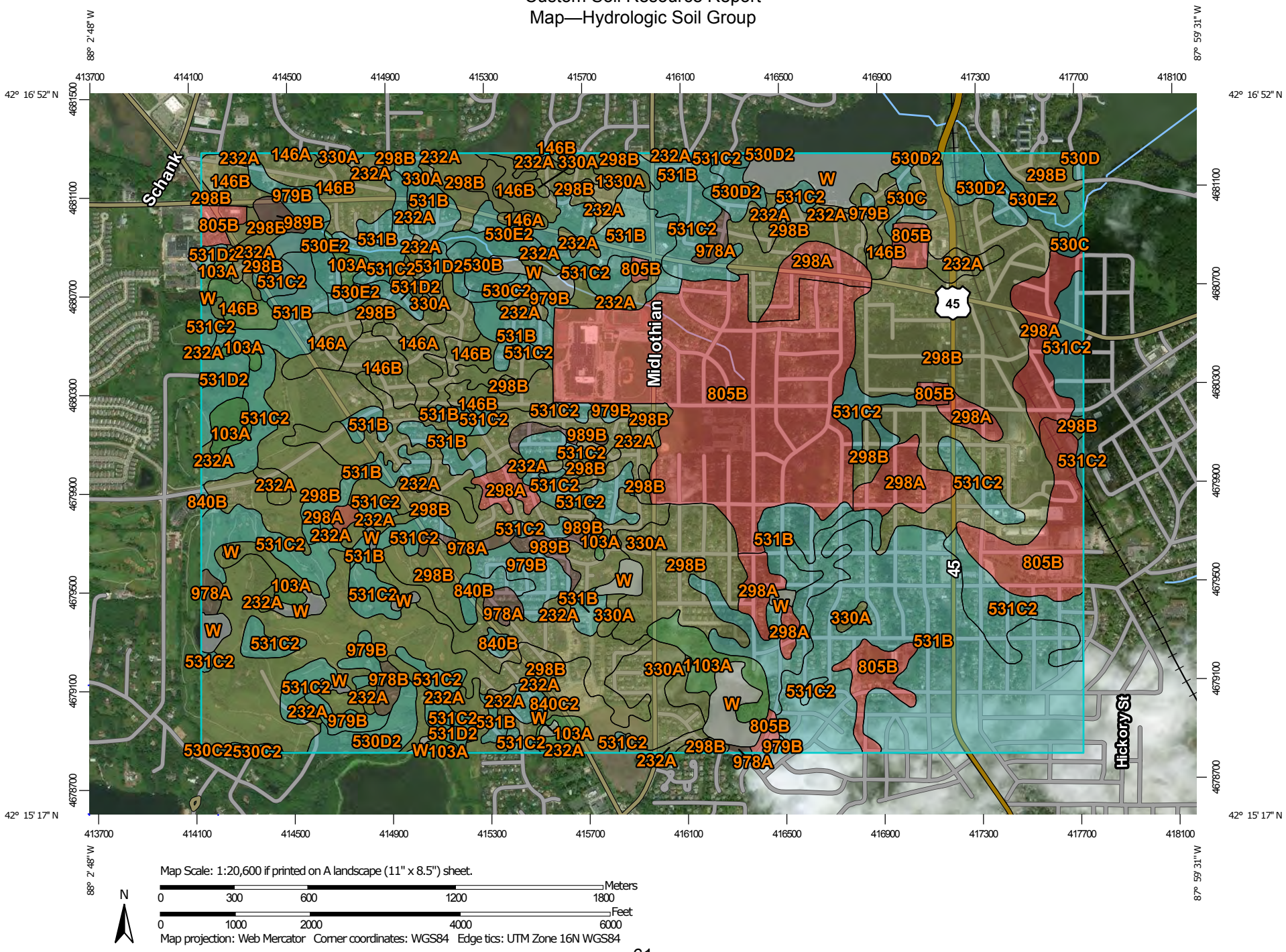
Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.


88° 2' 48" W
87° 59' 31" W
42° 16' 52" N
42° 15' 17" N
413700
414100
414500
414900
415300
415700
416100
416500
416900
417300
417700
418100
4681500
4681100
4680700
4680300
4679900
4679500
4679100
4678700
Schank
Midlothian
Hickory St
45
Map Scale: 1:20,600 if printed on A landscape (11" x 8.5") sheet.
N
0 300 600 1200 1800 Meters
0 1000 2000 4000 6000 Feet
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

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The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
103A	Houghton muck, 0 to 2 percent slopes	A/D	25.4	1.2%
146A	Elliott silt loam, 0 to 2 percent slopes	C/D	33.1	1.5%
146B	Elliott silt loam, 2 to 4 percent slopes	C/D	85.9	4.0%
232A	Ashkum silty clay loam, 0 to 2 percent slopes	C/D	211.9	9.8%
298A	Beecher silt loam, 0 to 2 percent slopes	D	88.3	4.1%
298B	Beecher silt loam, 2 to 4 percent slopes	C/D	532.5	24.6%
330A	Peotone silty clay loam, 0 to 2 percent slopes	C/D	13.7	0.6%
530B	Ozaukee silt loam, 2 to 4 percent slopes	C	3.7	0.2%
530C	Ozaukee silt loam, 4 to 6 percent slopes	C	6.6	0.3%
530C2	Ozaukee silt loam, 4 to 6 percent slopes, eroded	C	3.8	0.2%
530D	Ozaukee silt loam, 6 to 12 percent slopes	C	1.0	0.0%
530D2	Ozaukee silt loam, 6 to 12 percent slopes, eroded	C	42.0	1.9%
530E2	Ozaukee silt loam, 12 to 20 percent slopes, eroded	C	31.6	1.5%
531B	Markham silt loam, 2 to 4 percent slopes	C	340.2	15.7%
531C2	Markham silt loam, 4 to 6 percent slopes, eroded	C	244.5	11.3%
531D2	Markham silt loam, 6 to 12 percent slopes, eroded	C	25.5	1.2%
805B	Orthents, clayey, undulating	D	290.1	13.4%
840B	Zurich and Ozaukee silt loams, 2 to 4 percent slopes	C	10.1	0.5%
840C2	Zurich and Ozaukee silt loams, 4 to 6 percent slopes, eroded	C	5.0	0.2%
978A	Wauconda and Beecher silt loams, 0 to 2 percent slopes	B/D	16.9	0.8%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
978B	Wauconda and Beecher silt loams, 2 to 4 percent slopes	B/D	4.2	0.2%
979B	Grays and Markham silt loams, 2 to 4 percent slopes	C	41.0	1.9%
989B	Mundelein and Elliott silt loams, 2 to 4 percent slopes	B/D	15.6	0.7%
1103A	Houghton muck, undrained, 0 to 2 percent slopes	A/D	25.6	1.2%
1330A	Peotone silty clay loam, undrained, 0 to 2 percent slopes	C/D	4.6	0.2%
W	Water		61.7	2.8%
Totals for Area of Interest			**2,164.7**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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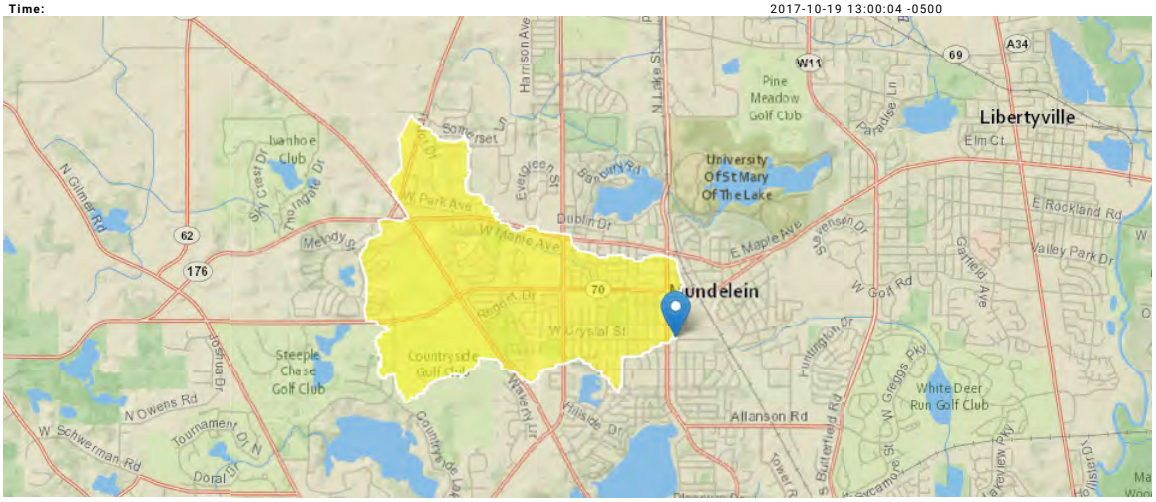
APPENDIX

StreamStats Report

Region ID:	IL
Workspace ID:	IL20171019175945702000
Clicked Point (Latitude, Longitude):	42.26449, -88.00287
Time:	2017-10-19 13:00:04 -0500



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	2.58	square miles
FLC11DVLMH	Fraction of drainage area that is in low to high developed land-use classes 22-24 from NLCD 2011	0.687	decimal fraction
FSSURGDC78	Fraction of land area that is in very poorly drained and unknown likely water drainage classes 7 and 8 from SSURGO	0.066	decimal fraction
RELRELF	Basin relief divided by basin perimeter	12.47	feet per mi
BASINPERIM	Perimeter of the drainage basin as defined in SIR 2004-5262	11.27	
BASLENAH	Basin length from outlet to basin divide determined using the method in the ArcHydro Toolset	2.64	miles
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	32.043	feet per mi
ELEVMAX	Maximum basin elevation	865	feet
ILREG1	Indicator variable for IL region 1, enter 1 if site is in region 1 else 0	1	dimensionless
ILREG3	Indicator variable for IL region 3, enter 1 if site is in region 3 else 0	1	dimensionless
ILREG5	Indicator variable for IL region 5, enter 1 if site is in region 5 else 0	1	dimensionless
ILREG6	Indicator variable for IL region 6, enter 1 if site is in region 6 else 0	1	dimensionless
ILREG7	Indicator variable for IL region 7, enter 1 if site is in region 7 else 0	1	dimensionless
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	94.6	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	31.8	percent
MINBELEV	Minimum basin elevation	724	feet
RELIEF	Maximum - minimum elevation	141	feet
SOILPERM	Average Soil Permeability	0.635	inches per hour
URBTHE2010	Fraction of drainage area that is in urban classes 7 to 10 from Theobald 2010	0.782	dimensionless
WATWET	Percent open water and herbaceous wetland from NLCD	1.008	percent

Peak-Flow Statistics Parameters [Region 2 Peak Rural and Urban 2016 5050]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.58	square miles	0.078	1351
FLC11DVLMH	Frac_Lo_Med_Hi_Developed_from_NLCD2011	0.687	decimal fraction	0.0022	0.979
FSSURGDC78	Fraction_SSURGO_Drainage_Classes_7_and_8	0.066	decimal fraction	0	0.256
RELRELF	Relative Relief	12.47	feet per mi	0.821	37.3

Peak-Flow Statistics Flow Report [Region 2 Peak Rural and Urban 2016 5050]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	Plu	SEp
Urban 2 Year Peak Flood	147	ft^3/s	70.9	307	46
Urban 5 Year Peak Flood	235	ft^3/s	111	497	47.1
Urban 10 Year Peak Flood	306	ft^3/s	141	668	49.6
Urban 25 Year Peak Flood	414	ft^3/s	180	951	52.9
Urban 50 Year Peak Flood	507	ft^3/s	211	1210	55.9
Urban 100 Year Peak Flood	614	ft^3/s	244	1540	59.4
Urban 500 Year Peak Flood	915	ft^3/s	330	2540	66.9

Peak-Flow Statistics Citations

Over, T.M. , Saito, R.J., Veilleux, A.G., Sharpe, J.B., Soong, D.T., and Ishii, A.L.,2016, Estimation of peak discharge quantiles for selected annual exceedance probabilities in northeastern Illinois: U.S. Geological Survey Scientific Investigations Report 2016-5050, 50 p. (http://dx.doi.org/10.3133/sir20165050)