WBK ENGINEERING, LLC
FORMERLY WILLS BURKE KELSEY ASSOCIATES, LTD.

116 West Main Street, Suite 201
St. Charles, Illinois 60174
P: 630.443.7755
F: 630.443.0533

www.wbkengineering.com

ENGINEERS | SCIENTISTS | PLANNERS | MEDIATING THE BUILT AND NATURAL ENVIRONMENTS

WARD 1 DRAINAGE INVESTIGATION

September 1, 2016

HYROLOGIC AND HYDRAULIC ENGINEERING DESIGN EVALUATION

PREPARED FOR:
City of Batavia
Engineering Department
200 North Raddant Road
Batavia, IL 60510

WBK Project No. 16-0136

JOHN W. WITTE
062-058599
LICENSED PROFESSIONAL ENGINEER OF ILLINOIS

John W. Witte, P.E., CFM
Illinois Registered Professional Engineer
No. 062-058599

TABLE OF CONTENTS

Executive summary 1

Introduction 2

Existing Conditions 2

Existing Conditions Hydrologic and Hydraulic Analysis 2

Autodesk Hydrology 3

Autodesk Hydraulics 3

Autodesk Existing Condition Model Results 4

Kirk Road Culverts Existing Conditions Analysis 5

Future Projects 6

Estimate of Conceptual Costs 7

Appendix A- Tables

Appendix B- Exhibits

Appendix C- Estimate of Conceptual Costs

CD with supporting CAD, GIS files and Hydraulic Model

EXECUTIVE SUMMARY

The Ward 1 study area, an approximate 125 acre residential subdivision on the City of Batavia's east side, experiences repeated flooding during various storm events, especially in roadway depressions (sags) with no overland flow routes. These roadway sags create between 0.5 to 2.4 feet of ponding in the roadway which encroaches onto the residential lots before spilling out of the sag. These roadway sags are drained by the existing storm sewer system, which drains from west to east across the area outletting through several cross road culverts under Kirk Road. A majority of the existing storm sewer system is undersized to adequately drain the associated tributary area.

This study analyzed the existing storm sewer system to determine the deficiencies in the system, including analyzing the depth and duration of ponding in the roadway sags for the 10 and 100- year storms. The existing system was surveyed and then analyzed using Autodesk Storm and Sanitary model to calculate the volume and peak runoff of the drainage area and also the capacity of the storm sewer system. The model calculated the critical duration peak discharge for the 1, 2, 5, 10, and 100-year storms, and also calculated split flow in the storm sewer system. The model output provided depth and duration of ponding in the roadway sags and locations where the storm sewer system was undersized.

The results of modeling and analyzing the existing system indicated that;

- *25% of mainline pipes do not have enough capacity to convey the 1-year storm runoff*
- *40% of mainline pipes do not have enough capacity to convey the 2-year storm runoff*
- *50% of mainline pipes do not have enough capacity to convey the 5-year storm runoff*
- *59% of mainline pipes do not have enough capacity to convey the 10- year storm runoff*
- *50% of the sags fill and overtop during a 10-year storm, and 100% during a 100-year storm.*
- *60% of the sags require additional grates to allow stormwater to access the storm sewer.*
- *The culverts and outlet ditches along Kirk Road are in need of maintenance.*
- *Restrictions occur in the storm sewer system where the storm sewer decreases in size for downstream pipes.*

The scope of the study also included providing recommendations for future projects to reduce the depth and duration of ponding in the roadway sags and also bring the system up to a 10-year level of service. The recommendations included replacing and upsizing the mainline trunk sewers draining the roadway sags along Giese Rd. Larkspur Ln, Chillem Dr., Bluestem Ln. and Lexington Ln, and also replacing and upsizing storm sewer draining Orchard Court, Lexington Ln., and Chillem Dr. Recommendations also include maintenance of culverts under Kirk Road by the County Department of Transportation. The proposed storm sewer system includes installing over 5,500 lineal feet of storm sewer ranging in size from 4'x6' box culvert, to 12" storm sewer with a total conceptual cost of over $2 Million.

INTRODUCTION

The Ward 1 area on the City of Batavia's east side experiences repeated flooding during various storm events. More specifically, the area of concern is generally bound by Pine Street to the north, Raddant Road to the west, Giese Road to the south and Kirk Road to the east. In response to recent flooding during the June 15, 2015 rain event that included water filling numerous streets within this neighborhood, along with backups into yards and a few houses. The City retained WBK Engineering to complete an investigation and analysis of the storm sewer system in this area. The following report provides a summary of the drainage investigation including:

- An evaluation of the system's existing level of service.
- Development of potential future projects to alleviate flooding in this area.
- A conceptual estimate of construction cost for the potential future projects.

EXISTING CONDITIONS

Ward 1 in the City of Batavia is located on the City's east side and is generally bordered on the north by Pine Street, on the South by Giese Road, on the west by South Raddant Road, and on the east by Kirk Road. The Ward 1 area consists of single family homes with paved residential streets with curb and gutter drained by storm sewer. The Ward 1 area drains from west to east towards Kirk Road. Three culverts along Kirk Road drain Ward 1 under Kirk Road to the Fermi Research Alliance Campus. The northern most culvert is a 24" diameter reinforced concrete pipe (RCP) crossing under Kirk approximately 760 feet south of Pine Street which drains approximately 13.5 acres of Cardinal Court and Orchard Court under Kirk Road. Two more crossings under Kirk Road include a 24" RCP culvert at the Giese/Kirk intersection, and two- 36" RCP culverts located approximately 530 feet south of the intersection. These two culverts drain approximately 109.1 acres of Ward 1 under Kirk Road as shown on Exhibit 1 in Appendix B.

The Ward 1 area was originally a rural residential subdivision in Kane County (Woodland Hills) and was constructed in the late 1960's. The subdivision is drained by storm sewers of varying sizes towards the Giese/Kirk intersection as shown on Exhibit 2 in Appendix B. The area has experienced localized flooding of streets during intense storm events, and more recently experienced severe stormwater backups in a June 15, 2015 storm event. This storm was approximately between a 10 and 25-year recurrence interval storm by producing approximately 5.7" of rainfall in a 48 hour time span. These intense storm events create ponding water in roadway low points and in many cases the ponding water in the low points causes standing water on the adjacent residential lots. The major sags were analyzed as part of this study and include the following locations; Chillem Drive at Rye, Bluestem Lane at Lexington Lane, Lexington at Dover, Larkspur Lane at Clover, Chillem Drive at Kirk, and Giese Road at Kirk.

Existing Conditions Hydrologic and Hydraulic Analysis

The purpose of this study is to analyze the existing storm sewer system draining Ward 1, investigate where deficiencies lie in the system, and provide recommended solutions to improve the system to convey a 10-year event without ponding in the roadways.

The program Autodesk Storm and Sanitary Analysis was used to evaluate the depth and duration of ponding in the roadway sag points. The Autodesk program was used to analyze the main drainage system and determine the ponding depths and durations in the roadway sags, along with the locations where the storm sewer system is undersized. This program computes the hydrology of the watershed (how much runoff) and the hydraulics of the system (pipe and overland flow route capacity) to analyze the effectiveness of a drainage system. The program requires hydrologic and hydraulic components to analyze the drainage system. A description of the inputs for each component is described as follows.

Autodesk Hydrology

The hydrology method used in the model is EPASWMM with Green-Ampt infiltration parameters which uses the type of soil to determine how much rain soaks into the ground and thus how much rain runs off the residential lots. The Green-Ampt infiltration parameters used in the model are provided in Table A2 in Appendix A. The model contains 28 separate sub-basins ranging in size from 0.34 acres to 13.8 acres as shown on Exhibit 3 in Appendix B. Sub-basins were delineated using geographic information systems (GIS) software and are based on a digital terrain map (DTM) of the area. The DTM was downloaded from the Illinois Geospatial Clearinghouse Height Modernization Program and has a grid size of 4 feet. The delineated areas and estimated overland flow routes were compared to the Kane County 2-foot contours as well as the WBK survey data to ensure their accuracy. The sub-basin input parameters are calculated using GIS data. This included the following parameters: average slopes, equivalent width, impervious area, and Green-Ampt infiltration properties which are summarized in Table A1 in Appendix A. Several lots were randomly selected and the directly connected impervious area was measured to calculate an average percent impervious which was applied to all the subareas.

The model is simulated using Bulletin 70 rainfall data for northeast Illinois with the corresponding appropriate Huff rainfall distributions as shown on Table A3 in Appendix A. Storm durations of 1, 2, 3, 6, 12, 18, and 24 hours were run for the 1, 2, 5, 10, 25, 50, and 100-year return periods. Each rainfall distribution is based on cumulative rainfall during the specified design storm event and consists of 61 data points. The average rainfall intensities for each storm event are provided in Table A3.

Autodesk Hydraulics

WBK Engineering LLC (WBK) surveyed the storm sewer structures in the Ward 1 area. The survey included rim and inverts of storm sewer structures and pipe sizes. This survey data, along with coordination with the City of Batavia staff, was used to prepare a schematic layout of the existing storm sewer system. The model schematic along with the drainage divides is provided on Exhibit 4 in Appendix B. Digital Terrain topographic data was used to evaluate drainage patterns throughout Ward 1, and also estimate catchment areas to each storm sewer structure. This topographic data was also used to calculate the volume and stage storage of the roadway sag areas.

Additionally, WBK staff visited the site several times and documented; the frame and grate type for each inlet in the system, along with analyzing drainage patterns, conditions of culverts, and verifying overland flow routes. There are many different styles of frame and grates and a map depicting the type and location is provided as Exhibit 10 in Appendix B.

The roadway sags were input into the system as storage areas and included stage, and area/volume for the ponding in the roads and residential lots. The area used to calculate the volume was calculated using the LIDAR topographic data and was calculated in 0.25 foot increments. Overland flow routes between the sag points were input into the model as conveyance links which allows water to spill over one sag

point, down the street and into the next sag point. The watershed DTM data was processed in ArcGIS to determine flow accumulations and determine drainage areas to each structure and sag.

Notable items from analysis of existing system:

- Due to several inches of silt in the bottom of the two 36" cross road culverts under Kirk Road, cleaning of these culverts is recommended. Kirk Road is under the jurisdiction of Kane County Division of Transportation (KDOT), therefore maintenance is KDOT's responsibility.
- The outfall for the 24" culvert under Kirk Road at the Kirk/ Giese intersections is restrictive. On the site visit, it was noted that about 40% of the pipe had standing water in it due to the lack of a positive drainage outfall downstream.
- There are several locations where the storm sewers in Ward 1 decrease in size causing a "restriction" in the system.
    - Giese and Larkspur Lane Intersection: A 36" storm sewer drains into a short section of 24" storm sewer.
    - Chillem Drive and Bluestem Lane intersection: A 30"storm sewer drains into a 24" storm sewer which in turn drains into a 36" storm sewer.
    - Giese and Kirk Road intersection: A 36" storm sewer drains to an 18" pipe before discharging into the 24" culvert crossing Kirk road, and a backpitched 24" storm sewer draining to the south to the twin 36" culverts under Kirk Road.
- There are many reaches of 6" and 8" diameter storm sewer draining subdivision streets which is less than the standard minimum pipe size recommended by IDOT and the City of Batavia. These pipes were installed to alleviate nuisance drainage, and not as a mainline storm sewer system. A map showing the size and locations of the trunk storm sewers in Ward 1 is included as Exhibit 2.

Several roadway sag points were analyzed, and were based on flooding locations reported during the June 2015 storm event. These locations are provided in Table A4 in Appendix A along with rim elevations, overtopping elevation, and drainage area to each sag including direct drainage area and total drainage area based on roadway overtopping.

Several storm sewer laterals and structures drained the sag points with different elevations. The combined discharge to each sag point was calculated using a spreadsheet which included rim grade, frame open area, and head to calculate discharge at different elevations. This combined grate capacity was compared to the capacity of the storm sewer draining the sag point to determine if the pipe or grate capacity was the limiting factor. A summary of pipe capacity, and grate capacity for each sag point is included in Table A5 in Appendix A. For the sag locations, the ponding of water is caused by insufficient grate capacity or outlet pipe capacity, or both. Of the ten sag locations analyzed, the grate capacity was substandard (less than the 10-year flow) in the following six locations: Giese/Kirk N, Giese/Kirk S, Larkspur/Clover, Chillem/Rye, Orchard Court, and Cardinal Court

Autodesk Existing Condition Model Results

The modeling results indicate that the mainline storm sewer system is undersized to convey the 10-year storm event, and contributes to flooding of the roadway sag points. Analysis of the system was run for the 1, 2, 5, 10, 50, and 100-year events. A summary of the system's capacity is highlighted below:

- 25% of mainline pipes do not have enough capacity to convey the 1-year storm runoff

- 40% of mainline pipes do not have enough capacity to convey the 2-year storm runoff
- 50% of mainline pipes do not have enough capacity to convey the 5-year storm runoff
- 59% of mainline pipes do not have enough capacity to convey the 10- year storm runoff

For the 10-year storm, half of the roadway sags filled completely, and for the 100-year storm, all the roadway sags filled completely. A summary of statistics for the sags for the existing 10-year, and 100-year events are provided in Appendix A in Tables A6 and A7, respectively. Low openings of some of the structures were surveyed as part of the investigation. The surveyed low openings were compared to the existing and proposed 10 and 100-year water surface elevations (WSE). For the 10-year event, the WSE's were below the low openings thus indicating that none of the structures flood, although there is flooding of the front yards due to the street flooding. For the 100-year event, one structure adjacent to the Bluestem/ Lexington sag has the potential for flooding in the existing and proposed conditions due to the fact that the low opening is 0.5 feet below the sag overtopping point. Exhibit 5 depicts the capacity of the storm sewer pipes draining each sag along with the 10 and 100-year flows to those locations to compare capacity and runoff. Additionally, all trunk line pipes are marked as either being able to carry the direct surface runoff from the upstream drainage area or as being insufficient. The existing condition limits of inundation and the duration of inundation for the 10 and 100-year events are provided on Exhibit 6.

Kirk Road Culverts Existing Conditions Analysis

The culverts under Kirk Road convey the drainage from Ward 1 to the Fermi Campus and are under the jurisdiction of the Kane County Division of Transportation. The 24" culvert located 760 feet south of Pine Street, drains Cardinal Court and Orchard Court, and has a full flowing capacity of 29 cfs. The peak 10, and 100-year discharges from the 13.5 acre tributary area is 37.6 cfs and 81.9 cfs, respectively. Upon inspection, this culvert was clean without silt buildup.

A majority of Ward 1 is drained by the combination of a single 24" culvert located at Giese and Kirk Road, and the twin 36" culverts located 530 feet south of the intersection. The storm sewer system serving these two culverts splits at the intersection of Giese and Kirk with an 18" pipe heading east to the 24" culvert, and a 24" pipe heading south to the twin 36" culverts. The capacity of the 24" that flows east under Kirk and the twin 36" culverts is estimated to be 16.6 cfs and 78 cfs, respectively. The existing peak 10 and 100-year runoff values to the Giese/ Kirk intersection are 100 cfs, and 270 cfs, respectively. The existing storm sewer system needs to be modified to convey more flow to both Kirk Road culvert locations.

Upon field inspection, the two 36" culverts had several inches of silt (especially the northern culvert) in the bottom of the pipes and were in need of cleaning. The channel downstream was free flowing and the main channel was aligned with the southern 36" culvert. Capacity of the downstream channel did not seem to be the limiting factor. Any flow not conveyed by the two 36" culverts will continue to overflow south along the west Kirk Road right of way to the detention basin located along the west right of way (ROW) of Kirk Road and the Illinois Prairie Path.

The 24" culvert at Kirk/Giese had standing water just below the midline of the pipe indicating that the outlet ditch/ swale on in the east ROW of Kirk road is higher than the invert of the pipe. Further investigation including field topo will be required to determine the location of the blockage and propose a solution for a free flowing outlet.

The results confirm our assumptions that the current storm sewer system is undersized compared to present day design standards.

FUTURE PROJECTS

A proposed storm sewer system was designed using Autodesk Storm and Sanitary Analysis to determine the size and slope of the existing trunk storm sewer system. The streets with the trunk line storm sewers include Giese, Larkspur, Chillem, Bluestem, and Lexington. The existing conditions model was used as the base for the proposed conditions model. Both pipe sizes and slopes were modified in the proposed condition model to optimize capacity of the system and provide a trunk storm sewer system for Ward 1 that would reduce the depth of ponding below 0.5 feet for all sags. The system was developed to analyze the trunk sewers and does not analyze the capacity of the small laterals for curb inlets. The proposed system was designed to limit the hydraulic grade line at the sag locations to less than 0.5 feet of head over the low points for the 10-year event. Once the system was sized for the 10-year recurrence interval, the 100-year event was run to estimate the limits and duration of inundation for the sags. Exhibit 7 in Appendix B displays the proposed storm sewer sizes for Ward 1. Exhibit 8 in Appendix B displays the 10 and 100-year limits and duration of inundation for the proposed storm sewer system. Tables A8 and A9 in Appendix A compare the existing and proposed 10-year and 100-year water surface elevations (WSE) in the sags.

A Hydraflow storm sewer analysis was run for the existing storm sewer system to determine the capacity of the existing storm sewer pipe laterals. For analysis of this system, the 28 subbasins were further divided to determine the drainage area to each lateral structure. Unlike the Autodesk Storm and Sanitary Analysis, the Hydraflow hydraulic analysis does not analyze the split flow at the Giese and Kirk Intersection, and also does not take into account the storage and overtopping of the sags. Exhibit 9 depicts the undersized pipes in the storm sewer system and is a roadmap for future design of these storm sewer pipes which are not draining the sag locations.

With the proposed conditions analysis described above as a basis, and with the main objective to reduce the depth and duration of ponding in the roadway sags followed by bringing the remainder of the storm sewer system up to a 10-year design standard, several future projects were developed for consideration and are listed below in order of assumed priority.

- *Replace and increase size of storm sewer along Giese Road.* ($765,000) This improvement includes; upsizing the storm sewer connection to the 24” cross road culvert under Kirk Road at Giese, upsizing the 24” pipe from Giese Road to the two-36” culverts under Kirk, and upsizing all the storm sewer along Giese Road between Kirk Rd, and Larkspur Lane. The proposed size of the mainline storm sewer is provided as Exhibit 7.
- *Modification of the Kirk Road Storm Sewer:* This includes removing the direct connection between the 24” storm sewer along the east right of way of Kirk Road and the 24” culvert under Kirk Road at Giese and outletting this system directly into the ditch. (cost- KDOT responsibility)
- *Replace and increase size of storm sewer along Larkspur Lane and Chillem Drive.* ($331,000) Replacing the existing 36” storm sewer with 60” and 54” storm sewer.

- Replace and increase size of storm sewer along *Bluestem and Lexington Lanes.* ($334,000) This improvement includes upsizing the existing 30" and 24" storm sewer along Bluestem and Lexington, respectively with 48" and 42" storm sewer.
- *New storm sewer in the rear lots along Orchard Court redesigned to convey the discharge to the 24" culvert under Kirk Road*. ($55,000) Currently this system does not have a positive outlet. The average slope between the storm sewer structure directly east of Orchard Court, and the 24" culvert under Kirk Road is 0.5%. A combination of storm sewer (15") and extension of the Kirk Road ditch could be designed to drain Orchard Court. Utility conflicts would need to be investigated since there is an electrical transformer located along the flow path and may be the reason the storm sewer was not initially extended south from its present outfall.
- *Addition of structures with frame and grates in various sag locations:* This includes adding structures or replacing frame and grates at the following locations Giese/ Kirk, Larkspur/Clover, Chillem/ Rye, Orchard Court, Cardinal Court. ($25,000)
- *Upsize trunk storm sewer along Orchard Court:* The existing trunk line would be upsized from 12" to 15".
- *Replace and increase size of storm sewer systems on Lexington, Bluestem, and Chillem. ($357,000)*
    - *Upsize storm sewer; along Bluestem Ln. between Lexington and Woodland Hills:* The existing storm sewer would be upsized from 8" to 12" and 15".
    - U*psize storm sewer along Lexington Lane (West of Dover):* The existing storm sewer would be upsized from 15" to 18".
    - *Upsize storm sewer along Chillem Drive (West of Rye):* The existing storm sewer would be upsized from 8" to 15".
- *Construction of storm sewer along Raddant Road:* ($356,000) The existing trunk sewer is a 6" corrugated HDPE pipe. Design of a mainline pipe along the roadway draining north and south.

Per the request of the City of Batavia, a proposed storm sewer system was analyzed that includes installing parallel storm sewer pipes adjacent to the existing. WBK prepared and ran a conceptual model with this scenario. In summary, the water surface elevations in the sags were greater than the original proposed condition model. Further investigation of this alternative is suggested in the next phase of the project.

Estimate of Conceptual Costs

A conceptual cost estimate was prepared for upsizing the mainline trunk sewers to reduce the occurrence of flooding in the roadway sags and is provided in Appendix C.

High intensity storm events cause flooding in roadway depressions in Ward 1 district in the City of Batavia due to undersized storm sewer systems. Upsizing the existing storm sewer to alleviate the flooding at the studied sag locations will require removal and replacement of about 5,500 lineal feet of storm sewer at a conceptual cost of approximately $2.19M. Additional expense will be required to retrofit and reconstruct the storm sewer in other locations throughout Ward 1 (areas without ponding) to bring the system to a 10-year standard of design. Depending on the City's budget, these improvements could be phased in over time and is it recommended to coordinate the storm sewer reconstruction with the street maintenance program. The typical street resurfacing schedule for the City of Batavia is 20 years, but may vary depending on the condition of the roadway. Table A10 includes the location of the storm sewer in the street and the

year the last resurfacing occurred. Small improvements to the system which could be implemented include:

- Adding additional inlets and grates in the sag locations in which the grate capacity is the limiting factor to the draining of the roadway sag. (Giese/ Kirk, Larkspur/Clover, Chillem/ Rye, Orchard Court, Cardinal Court).
- Removing the restriction locations in the existing storm sewer system (Giese/Kirk), Giese/Woodland Hills.
- Maintenance of culverts under Kirk Road including removal of silt, and re-grading of a positive outlet downstream of culvert.

APPENDIX A

Tables

TABLE A1

Summary of Sub-Basin Hydrologic Inputs

SUBBASIN ID	AREA	PERCENT IMPERVIOUS AREA	AVERAGE SLOPE	EQUIVALENT WIDTH	GREEN-AMPT INFILTRATION PARAMETERS		
					SUCTION HEAD	HYDRAULIC CONDUCTIVITY	INITIAL DEFICIT
	(acres)	*(%)*	*(%)*	*(ft)*	*(inches)*	*(inches/hr)*	
K31	0.93	100.00	2.45	1484.20	10.63	0.04	0.41
K32	0.54	100.00	3.03	884.80	10.63	0.04	0.41
K33	0.34	100.00	2.92	541.60	10.63	0.04	0.41
N21	9.39	31.00	5.14	2846.20	7.82	0.20	0.40
N22	2.20	31.00	4.39	1424.40	9.04	0.13	0.40
N23	1.88	31.00	4.28	1254.60	7.24	0.23	0.39
S01	1.96	31.00	6.45	1199.40	8.04	0.19	0.40
S02	2.44	31.00	6.96	1925.10	8.34	0.17	0.40
S03	9.19	31.00	4.56	2015.00	7.86	0.20	0.40
S04	7.19	31.00	4.71	2221.30	8.26	0.17	0.40
S05	2.95	31.00	4.69	1757.60	6.75	0.26	0.39
S06	3.60	31.00	4.29	1998.40	7.19	0.23	0.39
S07	4.63	31.00	4.20	2442.20	7.69	0.20	0.40
S08	8.31	31.00	4.82	3373.90	8.51	0.16	0.40
S09a	3.29	31.00	4.12	1451.97	6.69	0.26	0.39
S09b	1.20	31.00	4.94	567.68	6.69	0.26	0.39
S10a	1.25	31.00	4.67	1387.43	6.69	0.26	0.39
S10b	1.08	31.00	3.84	1004.34	6.69	0.26	0.39
S11	6.58	31.00	3.98	1105.50	6.69	0.26	0.39
S12	4.89	31.00	4.38	1426.90	9.13	0.12	0.40
S13	11.03	31.00	4.90	2822.60	7.60	0.21	0.40
S14	1.11	31.00	5.52	677.90	6.69	0.26	0.39
S15	13.81	31.00	4.41	2090.50	8.45	0.16	0.40
S16	8.90	31.00	4.99	1594.80	7.13	0.24	0.39
S17	1.13	31.00	4.17	684.00	6.69	0.26	0.39
S18	7.01	31.00	4.90	1681.40	6.69	0.26	0.39
S19	3.47	31.00	4.96	2229.80	6.69	0.26	0.39
S20	4.05	31.00	4.28	1424.00	6.69	0.26	0.39

TABLE A2

Green Ampt Parameters for Different Soil Classes (Rawls et al., 1983)

Soil Class	Porosity, ϕ	Effective Porosity, ϕ_e*	Wetting Front Suction Head, ψ_s (in)	Saturated Hydraulic Conductivity, K_s (in/hr)
Sand	0.437 (0.374–0.500)	0.417 (0.354–0.480)	1.95 (0.38–9.98)	4.74
Loamy sand	0.437 (0.363–0.506)	0.401 (0.329–0.473)	2.41 (0.53–11.00)	1.18
Sandy loam	0.453 (0.351–0.555)	0.412 (0.283–0.541)	4.33 (1.05–17.90)	0.43
Loam	0.463 (0.375–0.551)	0.434 (0.334–0.534)	3.50 (0.52–23.38)	0.13
Silt loam	0.501 (0.420–0.582)	0.486 (0.394–0.578)	6.57 (1.15–37.56)	0.26
Sandy clay loam	0.398 (0.332–0.464)	0.330 (0.235–0.425)	8.60 (1.74–42.52)	0.06
Clay loam	0.464 (0.409–0.519)	0.309 (0.279–0.501)	8.22 (1.89–35.87)	0.04
Silty clay loam	0.471 (0.418–0.524)	0.432 (0.347–0.517)	10.75 (2.23–51.77)	0.04
Sandy clay	0.430 (0.370–0.490)	0.321 (0.207–0.435)	9.41 (1.61–55.20)	0.02
Silty clay	0.479 (0.425–0.533)	0.423 (0.334–0.512)	11.50 (2.41–54.88)	0.02
Clay	0.475 (0.427–0.523)	0.385 (0.269–0.501)	12.45 (2.52–61.61)	0.01

*Effective porosity is the difference between the porosity ϕ and the residual moisture content ϕr that remains after a saturated soil is allowed to drain thoroughly.
(Numbers in parentheses are ± one standard deviation from the parameter value shown.)

TABLE A3

Bulletin 70 Rainfall Data for Northeast Illinois

ISWS Bulletin 70 NE Sectional Rainfall Depths (inches)							
Storm Duration	**STORM EVENT FREQUENCY**						
	1-yr	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**
1 hour	1.18	1.43	1.79	2.1	2.59	3.04	3.56
2 hour	1.48	1.79	2.24	2.64	3.25	3.82	4.47
3 hour	1.6	1.94	2.43	2.86	3.53	4.14	4.85
6 hour	1.88	2.28	2.85	3.35	4.13	4.85	5.68
12 hour	2.18	2.64	3.31	3.89	4.79	5.62	6.59
18 hour	2.3	2.79	3.5	4.11	5.06	5.95	6.97
24 hour	2.51	3.04	3.8	4.47	5.51	6.46	7.58
ISWS Bulletin 70 NE Sectional Rainfall Average Intensities (inches/hour)							
Storm Duration	**STORM EVENT FREQUENCY**						
	1-yr	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**
1 hour	1.18	1.43	1.79	2.10	2.59	3.04	3.56
2 hour	0.74	0.90	1.12	1.32	1.63	1.91	2.24
3 hour	0.53	0.65	0.81	0.95	1.18	1.38	1.62
6 hour	0.31	0.38	0.48	0.56	0.69	0.81	0.95
12 hour	0.18	0.22	0.28	0.32	0.40	0.47	0.55
18 hour	0.13	0.16	0.19	0.23	0.28	0.33	0.39
24 hour	0.10	0.13	0.16	0.19	0.23	0.27	0.32

Note: The above rainfall cumulative depths were applied in the SWMM model using their appropriate Huff Quartile time-series distribution. Average intensities were not used in the modeling, but are available as a reference.

TABLE A4

Sag Location Summary

Sag Location	Low Rim	Overtopping Elev	Depth (ft)	Direct Drainage Area (Acre)	Total Drainage Area (Acres)
Giese/Kirk N	763.32	764.26	0.94	9.19	104.70
Giese/Kirk S	761.29	763.85	2.56	2.44	107.14
Chillem/Kirk	774.40	774.70	0.30	2.95	2.95
Larkspur/Clover	773.85	774.85	1.00	8.29	67.75
Chillem/Bluestem	777.55	777.80	0.25	4.89	54.55
Chillem/Rye	777.01	778.55	1.54	21.95	21.95
Bluestem/Lexington	776.99	778.85	1.86	12.10	32.60
Lexington/Dover	777.71	780.10	2.39	20.50	20.50
Orchard Court	777.31	777.90	0.59	1.88	1.88
Cardinal Court	775.66	777.20	1.54	2.20	2.20

TABLE A5

Sag Location Pipe and Grate Capacity Summary

Sag Loc.	Grate Capacity @ 0.5' ponding (cfs)	Grate Capacity at Overtopping (cfs)	Outlet Pipe Capacity (cfs)	Direct Peak Runoff (cfs)	
				10-year (cfs)	100-year (cfs)
Giese/Kirk N	7	9.1	48.2	14.5	55.9
Giese/Kirk S	3.6	8.3	11.3	5.5	22.8
Chillem/Kirk	9	9	4.9	8.6	23.6
Larkspur/Clover	10	29.5	33.8	15.8	63.4
Chillem/Bluestem	10.9	10.9	42.2	9.1	34.1
Chillem/Rye	15.4	61.7	12.8	20.1	72.5
Bluestem/Lexington	21.6	75	21.7	18.1	71.8
Lexington/Dover	18.6	62	10.9	12.8	50.1
Orchard Court	6.4	8.6	1.5	6.7	15.5
Cardinal Court	6.1	16	6.5	8.6	18.9

= insufficient capacity to convey the 10-year unoff

TABLE A6

Sag Location Existing Condition 10-Year Event Summary

10-year existing					
Sag Location	**Low Rim**	**10-yr HWL**	**Depth (ft)**	**Overtop**	**Duration of Inundation (hr)**
Giese/Kirk N	763.32	764.86	1.54	x	2.32
Giese/Kirk S	761.29	764.40	3.11	x	0.75
Chillem/Kirk	774.40	774.45	0.05		0.17
Larkspur/Clover	773.85	774.87	1.02	x	2.12
Chillem/Bluestem	777.55	777.09	0.00		x
Chillem/Rye	777.01	778.76	1.75	x	2.08
Bluestem/Lexington	776.99	778.15	1.16		1.88
Lexington/Dover	777.71	779.33	1.62		1.75
Orchard Court	777.31	778.08	0.77	x	0.75
Cardinal Court	775.66	776.49	0.83		0.33

TABLE A7

Sag Location Existing Condition 100-Year Event Summary

100 year existing					
Sag Location	**Low Rim**	**100-yr HWL**	**Depth (ft)**	**Overtop**	**Duration of Inundation (hr)**
Giese/Kirk N	763.32	765.19	1.87	x	6.12
Giese/Kirk S	761.29	764.93	3.64	x	2.43
Chillem/Kirk	774.40	775.05	0.65	x	1.28
Larkspur/Clover	773.85	775.14	1.29	x	5.48
Chillem/Bluestem	777.55	777.86	0.31	x	1.38
Chillem/Rye	777.01	779.25	2.24	x	4.82
Bluestem/Lexington	776.99	779.20	2.21	x	4.82
Lexington/Dover	777.71	780.59	2.88	x	4.70
Orchard Court	777.31	778.26	0.95	x	1.2
Cardinal Court	775.66	777.34	1.68	x	0.97

TABLE A8

Sag Location Existing vs. Proposed Condition 10-Year WSE Summary

10-year existing vs. proposed								
Sag Location	**Low Rim**	**Existing HWL**	**Proposed HWL**	**Existing Ponding Depth (ft)**	**Proposed Ponding Depth (ft)**	**Change WSE (ft)**	**Proposed Ponding Location**	**Low opening elevation**
Giese/Kirk N	763.32	764.86	764.21	*1.54*	*0.89*	**-0.65**	Street	
Giese/Kirk S	761.29	764.40	763.36	*3.11*	*2.07*	**-1.04**	Street/Lots	
Chillem/Kirk	774.40	774.45	774.44	*0.05*	*0.04*	**-0.01**	Street	
Larkspur/Clover	773.85	774.87	774.25	*1.02*	*0.40*	**-0.62**	Street	775.56
Chillem/Bluestem	777.55	777.09	776.42	-	-			
Chillem/Rye	777.01	778.76	777.47	*1.75*	*0.46*	**-1.29**	Street	781.50
Bluestem/Lexington	776.99	778.15	777.44	*1.16*	*0.45*	**-0.71**	Street	778.38
Lexington/Dover	777.71	779.33	777.99	*1.62*	*0.28*	**-1.34**	Street	781.06
Orchard Court	777.31	778.08	777.74	*0.77*	*0.43*	**-0.34**	Street	
Cardinal Court	775.66	776.49	776.75	*0.83*	*1.09*	**0.26**	Street/Lots	

TABLE A9

Sag Location Existing vs. Proposed Condition 100-Year WSE Summary

100-year existing vs. proposed								
Sag Location	**Low Rim**	**Existing HWL**	**Proposed HWL**	**Existing Ponding Depth (ft)**	**Proposed Ponding Depth (ft)**	**Change WSE (ft)**	**Proposed Ponding Location**	**Low opening elevation**
Giese/Kirk N	763.32	765.19	765.14	*1.87*	*1.82*	**-0.05**	Street/Lots	
Giese/Kirk S	761.29	764.93	764.83	*3.64*	*3.54*	**-0.10**	Street/Lots	
Chillem/Kirk	774.40	775.05	775.04	*0.65*	*0.64*	**-0.01**	Street	
Larkspur/Clover	773.85	775.14	774.95	*1.29*	*1.10*	**-0.19**	Street/Lots	775.56
Chillem/Bluestem	777.55	777.86	777.67	*0.31*	*0.12*	**-0.19**	Street	
Chillem/Rye	777.01	779.25	778.99	*2.24*	*1.98*	**-0.26**	Street/Lots	781.50
Bluestem/Lexington	776.99	779.20	778.79	*2.21*	*1.80*	**-0.41**	Street/Lots	778.38*
Lexington/Dover	777.71	780.59	779.69	*2.88*	*1.98*	**-0.90**	Street/Lots	781.06
Orchard Court	777.31	778.26	778.19	*0.95*	*0.88*	**-0.07**	Street	
Cardinal Court	775.66	777.34	777.40	*1.68*	*1.74*	**0.06**	Street/Lots	

*HWL above structure low opening. Residential floodproofing recommended for this structure.

TABLE A10

Storm Sewer Location and Street Resurfacing Summary

Street Name	Last Resurfaced	Storm Sewer Location
Giese Road	2005	N storm located 22' from CenterLine, S storm located 32' from S Curb in esmt
Larkspur Lane	2003	Storm located in E ROW (no specific dimensions) - no sidewalk
Clover Court	2001	Storm located in N ROW (no specific dimensions) - no sidewalk
Chillem	2003	Storm located 13' from the S ROW, approx. 6' from BC sidewalk on S side, possibly under SW
Rye Court	2001	No Storm Sewer, only at Chillem
Bluestem	2015	Storm located 13' from the E ROW, approx. 6' from BC, no sidewalk
Lexington Lane	2004	Storm located 13' from S ROW, no SW
Dover Court	1994	No Storm Sewer, only at Lexington
Garden Court	1996	Storm sewer located at W curb line, visable trench (from 2012)
Cardinal Court	1996	No storm sewer, only at end of cul-de-sac

APPENDIX B

Exhibits

W:\Projects\2016\160136 Ward1DrainageDist\cadd\GIS\mxd\Exhibits\DrainageAreas.mxd
7/29/2016 9:24:18 AM, bhanson

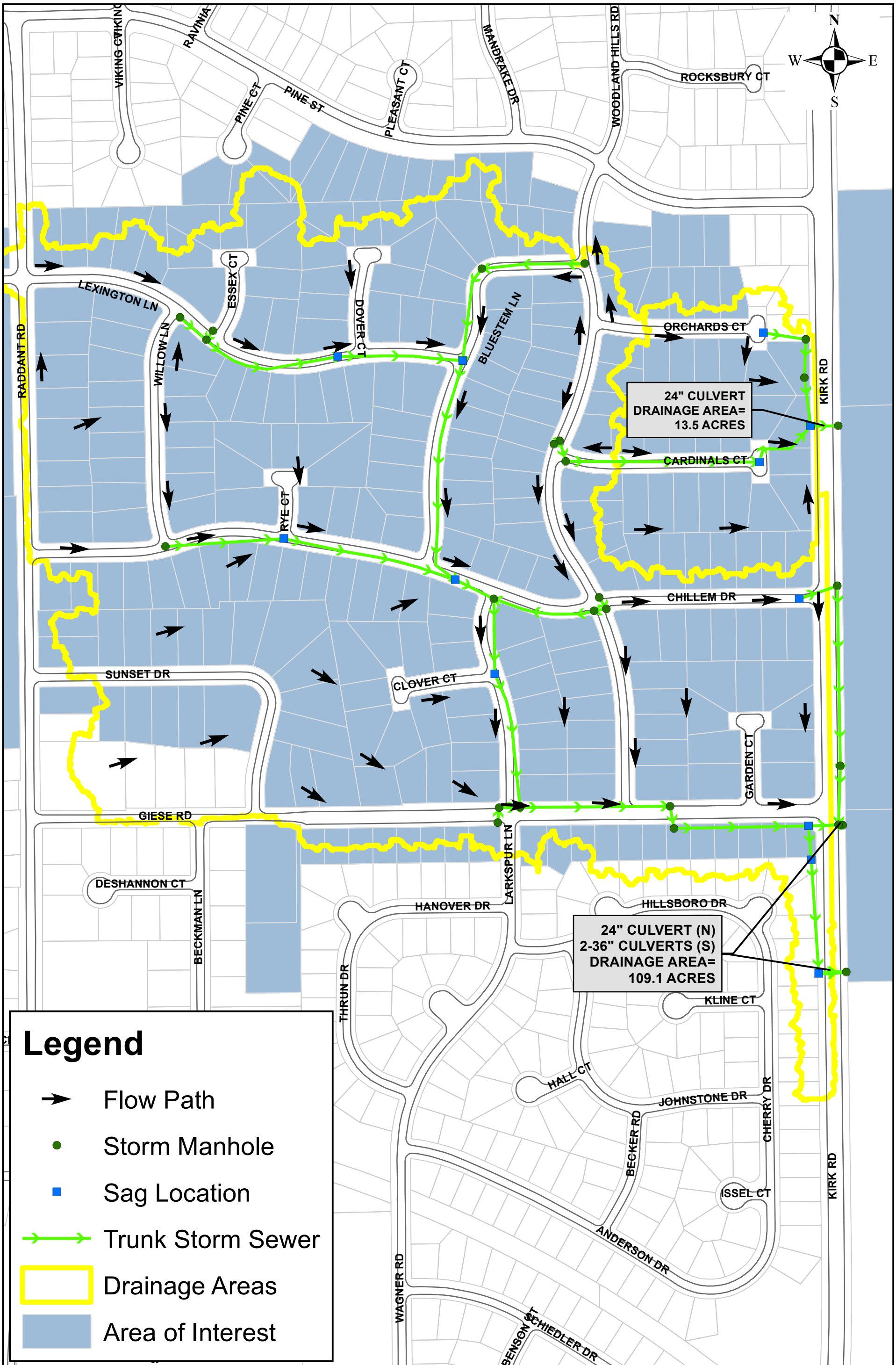


EXHIBIT 1

SHEET 1 OF 1

DATE 07/26/2016

PROJECT NO. 160136

WBK engineering

WBK ENGINEERING, LLC
116 WEST MAIN STREET, SUITE 201
ST. CHARLES, ILLINOIS 60174
(630) 443-7755

CLIENT:
CITY OF BATAVIA
100 N. ISLAND AVENUE
BATAVIA, IL 60510

NO.	DATE	NATURE OF REVISION

DSGN.	BEH
DWN.	EAM
CHKD.	JWW
SCALE: 1" = 300'	
DrainageAreas.mxd	

TITLE: BATAVIA WARD 1 DRAINAGE INVESTIGATION

DRAINAGE AREAS

W:\Projects\2016\160136 Ward1DrainageDist\cadd\GIS\mxd\Exhibits\PipeNetwork.mxd
8/15/2016 10:05:25 AM, emiller

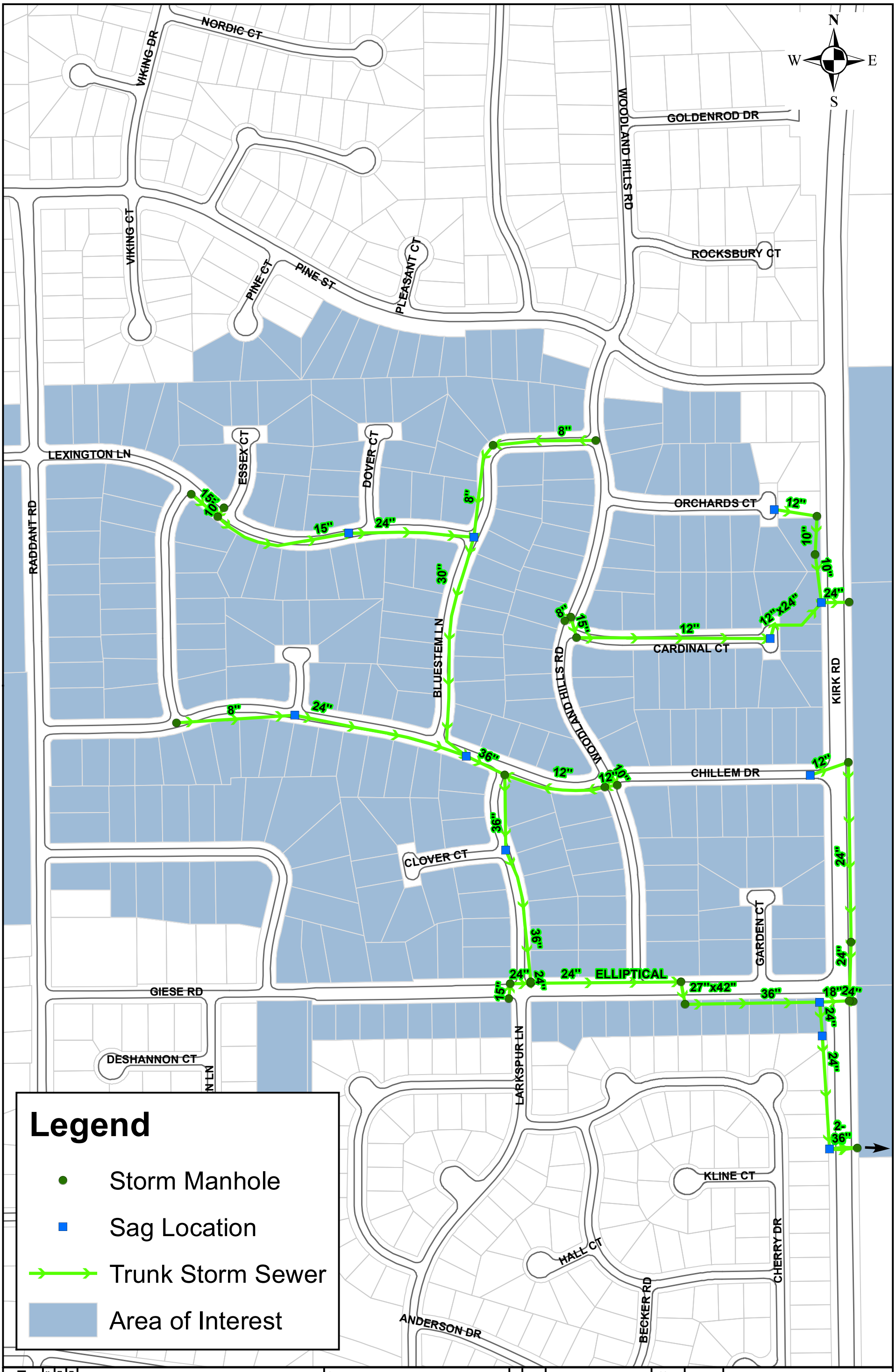


EXHIBIT 2

SHEET 1 OF 1

DATE 07/26/2016

PROJECT NO. 160136

WBK engineering

WBK ENGINEERING, LLC
116 WEST MAIN STREET, SUITE 201
ST. CHARLES, ILLINOIS 60174
(630) 443-7755

CLIENT:
CITY OF BATAVIA
100 N. ISLAND AVENUE
BATAVIA, IL 60510

NO.	DATE	NATURE OF REVISION

DSGN.	BEH
DWN.	EAM
CHKD.	JWW
SCALE: 1" = 300'	
PipeNetwork.mxd	

TITLE:
BATAVIA WARD 1
DRAINAGE IVESTIGATION

EXISTING CONDITIONS
PIPE NETWORK SIZES

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

TITLE: BATAVIA WARD 1 DRAINAGE INVESTIGATION

SSA MODELING SUB-BASIN MAP

DSGN.	BEH
DWN.	BEH
CHKD.	SFR
SCALE: 1" = 150'	
EX3_DrainageDividesmxd	

NO.	DATE	NATURE OF REVISION

CLIENT: CITY OF BATAVIA
100 N. ISLAND AVENUE
BATAVIA, IL 60510

WBK ENGINEERING, LLC
116 WEST MAIN STREET, SUITE 201
ST. CHARLES, ILLINOIS 60174
(630) 443-7755

WBK engineering

PROJECT NO. 160136

DATE 07-28-2016

SHEET 1 OF 1

EXHIBIT 3

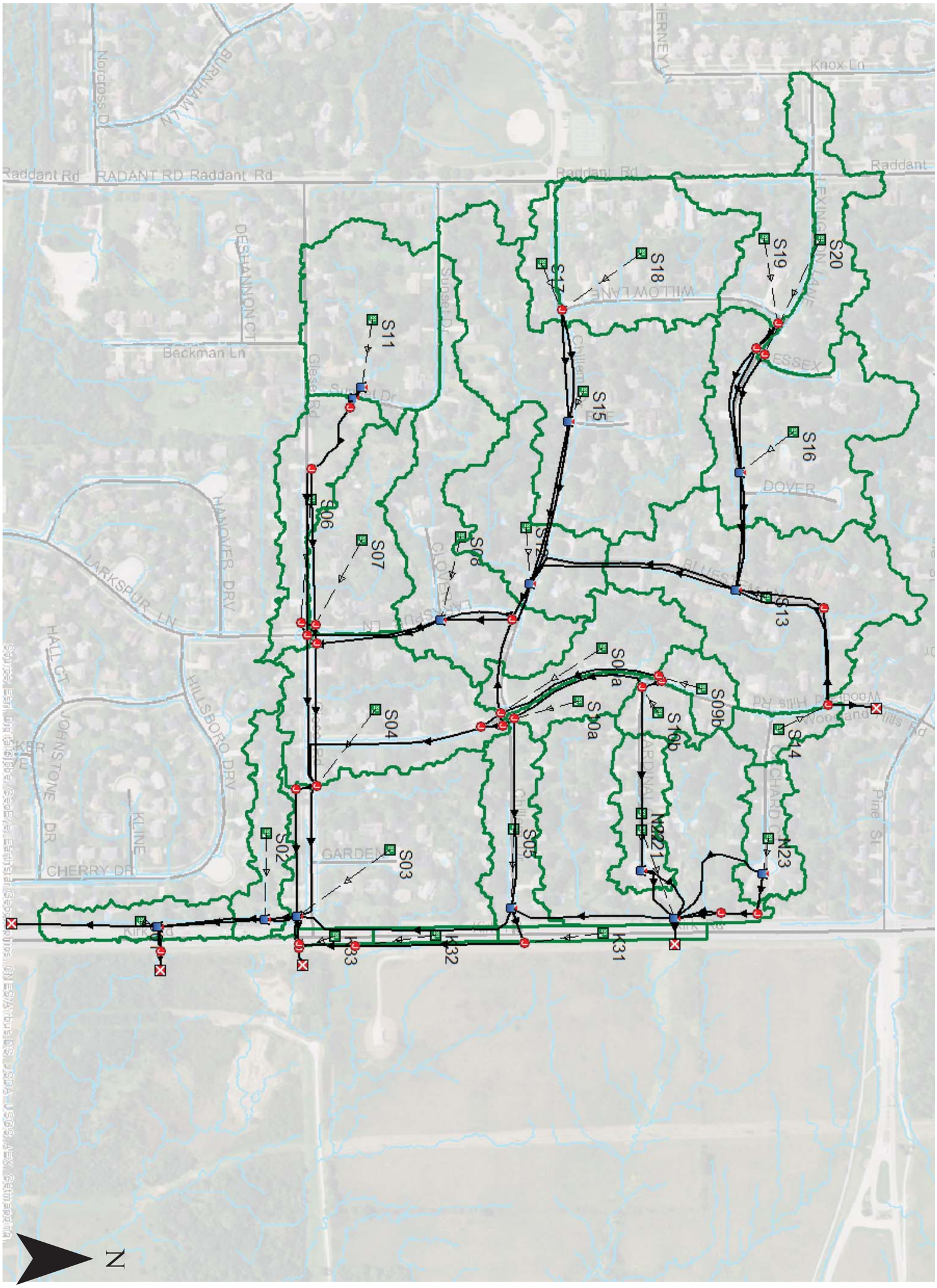


EXHIBIT 4	SHEET 1 OF 1	DATE 07-28-2016	PROJECT NO. 160136	WBK engineering	WBK ENGINEERING, LLC 116 WEST MAIN STREET, SUITE 201 ST. CHARLES, ILLINOIS 60174 (630) 443-7755	CLIENT: CITY OF BATAVIA 00 N RADDANT ROAD BATAVIA, IL 60510	

NO.	DATE	NATURE OF REVISION

DSGN.	BEH
DWN.	BEH
CHKD.	SFR
SCALE: n/a	
SSA_S e ati	

TITLE: **BATAVIA WARD 1 DRAINAGE INVESTIGATION**

SSA MODEL SCHEMATIC

Location	Lexington & Dover
Outflow Pipe Size	24"
Outflow Pipe Flow Capacity (cfs)	10.85
Return Period	Direct Runoff to Sag *(cfs)*
10-Yr	19.23
100-Yr	50.06

Location	Bluestem & Lexington
Outflow Pipe Size	30"
Outflow Pipe Flow Capacity	21.70
Return Period	Direct Runoff to Sag *(cfs)*
10-Yr	28.2
100-Yr	71.75

Location	Orchard Ct.
Outflow Pipe Size	10"
Outflow Pipe Flow Capacity	2.67
Return Period	Direct Runoff to Sag *(cfs)*
10-Yr	6.74
100-Yr	15.5

Location	Cardinal Ct.
Outflow Pipe Size	12"x 24" ELL.
Outflow Pipe Flow Capacity	6.50
Return Period	Direct Runoff to Sag *(cfs)*
10-Yr	8.57
100-Yr	18.87

Location	Chillem & Bluestem
Outflow Pipe Size	36"
Outflow Pipe Flow Capacity	42.18
Return Period	Direct Runoff to Sag *(cfs)*
10-Yr	14.14
100-Yr	34.08

Location	Chillem & Rye
Outflow Pipe Size	24"
Outflow Pipe Flow Capacity	12.80
Return Period	Direct Runoff to Sag *(cfs)*
10-Yr	28.62
100-Yr	72.52

Location	Chillem & Kirk
Outflow Pipe Size	12"
Outflow Pipe Flow Capacity	4.86
Return Period	Direct Runoff to Sag *(cfs)*
10-Yr	10.18
100-Yr	23.61

Location	Larkspur & Clover
Outflow Pipe Size	36"
Outflow Pipe Flow Capacity	42.18
Return Period	Direct Runoff to Sag *(cfs)*
10-Yr	26.97
100-Yr	63.44

Location	Giese & Kirk N
Outflow Pipe Size	18" (W) & 24" (S)
Outflow Pipe Flow Capacity	68.77
Return Period	Direct Runoff to Sag *(cfs)*
10-Yr	21.85
100-Yr	55.94

Location	Giese & Kirk S
Outflow Pipe Size	24"
Outflow Pipe Flow Capacity	28.26
Return Period	Direct Runoff to Sag *(cfs)*
10-Yr	21.85
100-Yr	22.83

TITLE: **BATAVIA WARD 1 DRAINAGE INVESTIGATION**

PIPE CAPACITIES RELATIVE TO DIRECT SURFACE FLOWS

DSGN. BEH
DWN. BEH
CHKD.
SCALE: 1
SCALE
E 5_Fo Su ar _RES E

NO.	DATE	NATURE OF REVISION

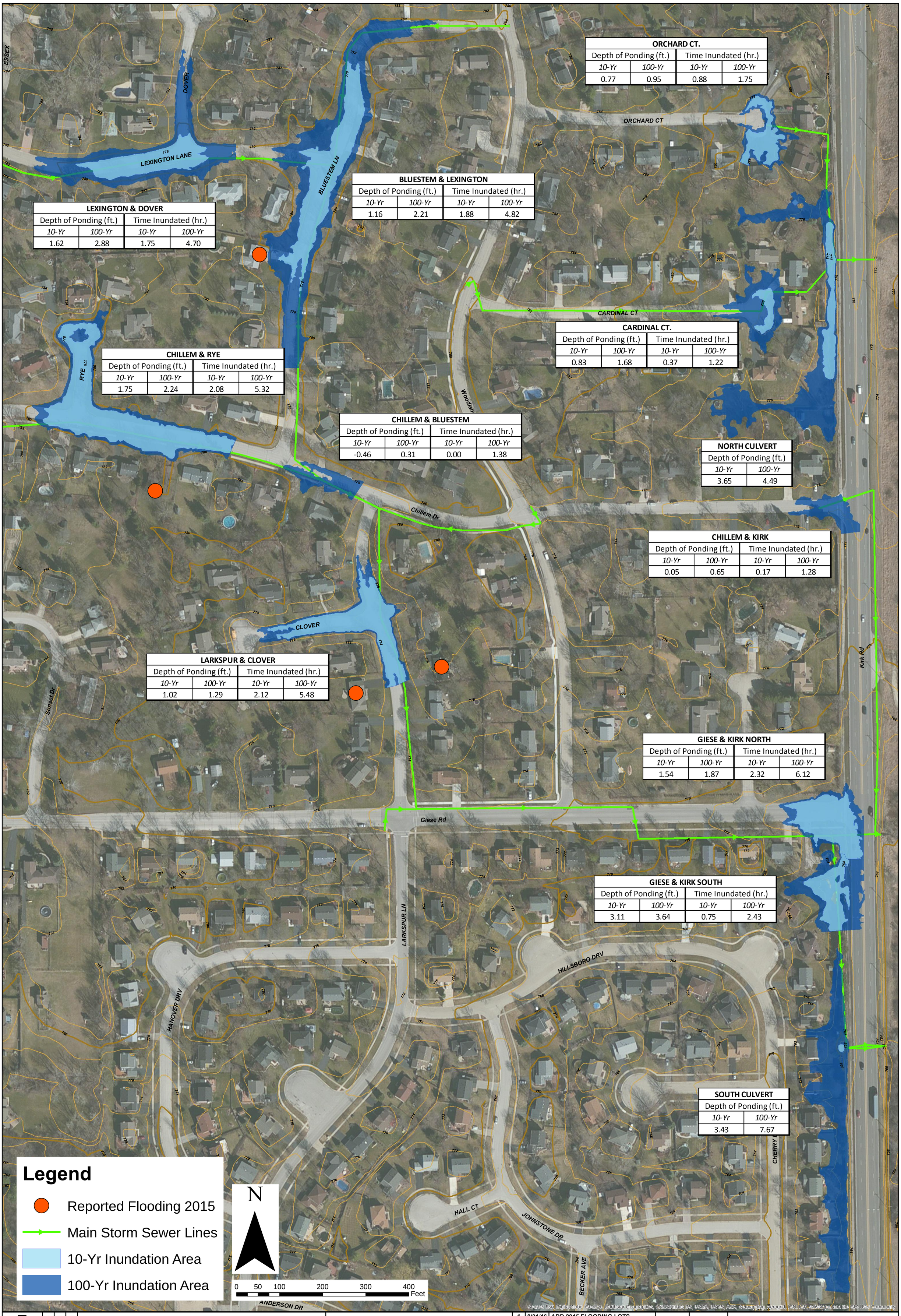
CLIENT:
CITY OF BATAVIA
100 N. ISLAND AVENUE
BATAVIA, IL 60510

WBK ENGINEERING, LLC
116 WEST MAIN STREET, SUITE 201
ST. CHARLES, ILLINOIS 60174
(630) 443-7755

PROJECT NO. 160136
DATE 07-2 -2016
SHEET 1 OF 1

EXHIBIT 5

W:\Projects\2016\160136 Ward1DrainageDist\cadd\GIS\mxd\Exhibits\Ward1_InundationMap.mxd
8/31/2016 3:55:33 PM, bhanson



LEXINGTON & DOVER

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
1.62	2.88	1.75	4.70

BLUESTEM & LEXINGTON

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
1.16	2.21	1.88	4.82

ORCHARD CT.

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
0.77	0.95	0.88	1.75

CHILLEM & RYE

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
1.75	2.24	2.08	5.32

CARDINAL CT.

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
0.83	1.68	0.37	1.22

CHILLEM & BLUESTEM

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
-0.46	0.31	0.00	1.38

NORTH CULVERT

Depth of Ponding (ft.)	
10-Yr	*100-Yr*
3.65	4.49

CHILLEM & KIRK

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
0.05	0.65	0.17	1.28

LARKSPUR & CLOVER

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
1.02	1.29	2.12	5.48

GIESE & KIRK NORTH

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
1.54	1.87	2.32	6.12

GIESE & KIRK SOUTH

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
3.11	3.64	0.75	2.43

SOUTH CULVERT

Depth of Ponding (ft.)	
10-Yr	*100-Yr*
3.43	7.67

EXHIBIT 6

SHEET 1 OF 1 | DATE 07-26-2016 | PROJECT NO. 160136

WBK engineering

WBK ENGINEERING, LLC
116 WEST MAIN STREET, SUITE 201
ST. CHARLES, ILLINOIS 60174
(630) 443-7755

CLIENT:

CITY OF BATAVIA
100 N. ISLAND AVENUE
BATAVIA, IL 60510

NO.	DATE	NATURE OF REVISION
1	8/31/16	ADD 2015 FLOODING LOTS

DSGN.	BEH
DWN.	BEH
CHKD.	<CHK>
SCALE: SEE SCALE BAR	
Ward1_InundationMap	

TITLE:

BATAVIA WARD 1 DRAINAGE INVESTIGATION

EXISTING CONDITIONS INUNDATION MAP

W:\Projects\2016\160136 Ward1DrainageDist\cadd\GIS\mxd\Exhibits\PipeNetworkPR.mxd
8/15/2016 11:16:50 AM, emiller

EXHIBIT 7

SHEET 1 OF 1

DATE 07/26/2016

PROJECT NO. 160136

WBK engineering

WBK ENGINEERING, LLC
116 WEST MAIN STREET, SUITE 201
ST. CHARLES, ILLINOIS 60174
(630) 443-7755

CLIENT:
CITY OF BATAVIA
100 N. ISLAND AVENUE
BATAVIA, IL 60510

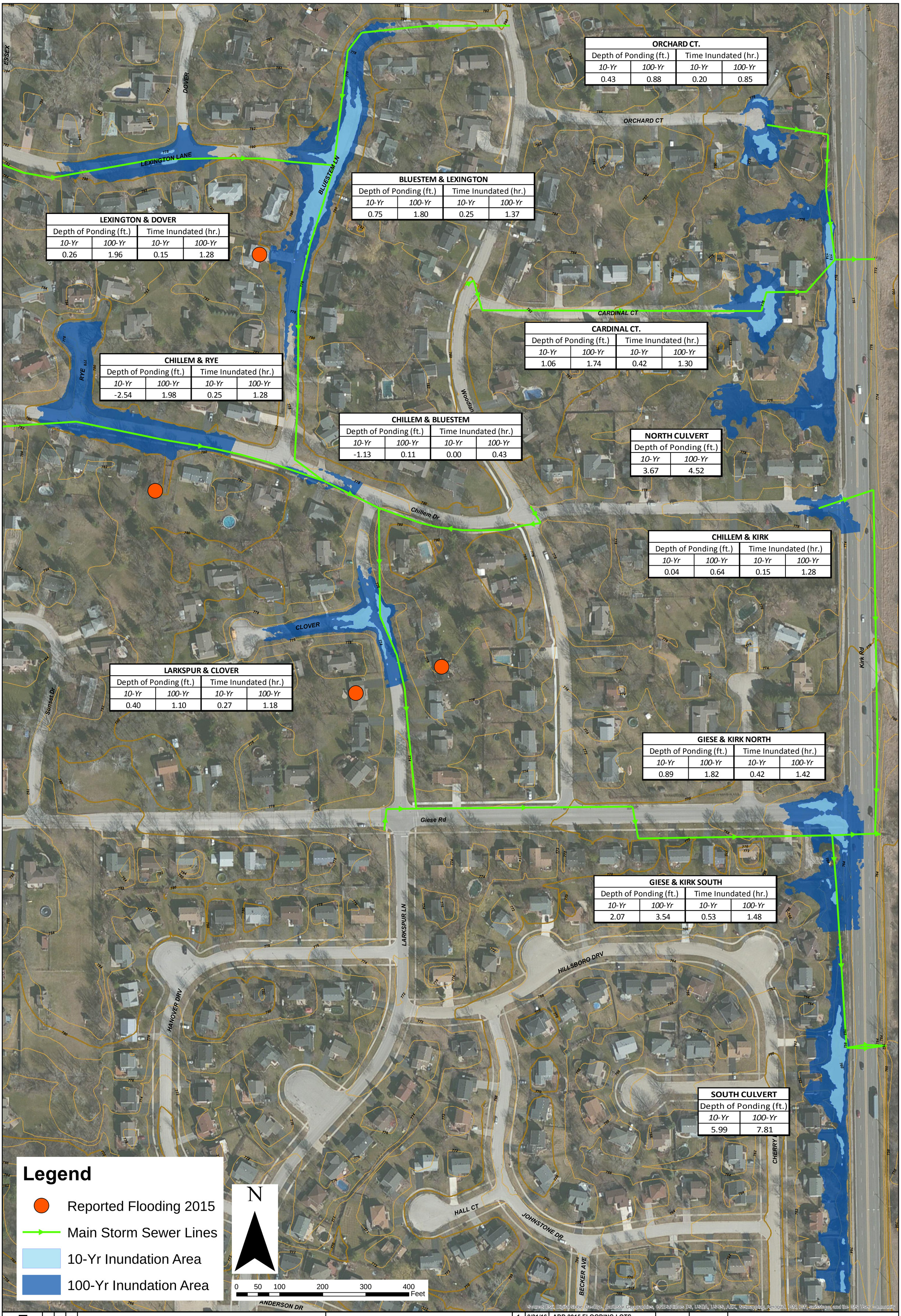
NO.	DATE	NATURE OF REVISION

DSGN.	BEH
DWN.	EAM
CHKD.	JWW
SCALE: 1" = 300'	
PipeNetworkPR.mxd	

TITLE: BATAVIA WARD 1 DRAINAGE IVESTIGATION

PROPOSED PIPE NETWORK

W:\Projects\2016\160136 Ward1DrainageDist\cadd\GIS\mxd\Exhibits\Ward1_InundationMapPR.mxd
8/31/2016 3:59:31 PM, bhanson



ORCHARD CT.

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
0.43	0.88	0.20	0.85

BLUESTEM & LEXINGTON

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
0.75	1.80	0.25	1.37

LEXINGTON & DOVER

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
0.26	1.96	0.15	1.28

CARDINAL CT.

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
1.06	1.74	0.42	1.30

CHILLEM & RYE

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
-2.54	1.98	0.25	1.28

CHILLEM & BLUESTEM

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
-1.13	0.11	0.00	0.43

NORTH CULVERT

Depth of Ponding (ft.)	
10-Yr	*100-Yr*
3.67	4.52

CHILLEM & KIRK

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
0.04	0.64	0.15	1.28

LARKSPUR & CLOVER

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
0.40	1.10	0.27	1.18

GIESE & KIRK NORTH

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
0.89	1.82	0.42	1.42

GIESE & KIRK SOUTH

Depth of Ponding (ft.)		Time Inundated (hr.)	
10-Yr	*100-Yr*	*10-Yr*	*100-Yr*
2.07	3.54	0.53	1.48

SOUTH CULVERT

Depth of Ponding (ft.)	
10-Yr	*100-Yr*
5.99	7.81

EXHIBIT 8

SHEET 1 OF 1 | DATE 07-26-2016 | PROJECT NO. 160136

WBK engineering

WBK ENGINEERING, LLC
116 WEST MAIN STREET, SUITE 201
ST. CHARLES, ILLINOIS 60174
(630) 443-7755

CLIENT:

CITY OF BATAVIA
100 N. ISLAND AVENUE
BATAVIA, IL 60510

NO.	DATE	NATURE OF REVISION
1	8/31/16	ADD 2015 FLOODING LOTS

DSGN.	BEH
DWN.	BEH
CHKD.	<CHK>
SCALE: SEE SCALE BAR	
Ward1_InundationMapPR	

TITLE:

BATAVIA WARD 1 DRAINAGE INVESTIGATION

PROPOSED CONDITIONS INUNDATION MAP

W:\Projects\2016\160136 Ward1DrainageDistricadd\GIS\mxd\Exhibits\EX9_HydraflowResults.mxd
8/2/2016 4:42:21 PM, bhanson

EXHIBIT

SHEET 1 OF 1

DATE 08-02-2016

PROJECT NO. 160136

WBK engineering

WBK ENGINEERING, LLC
116 WEST MAIN STREET, SUITE 201
ST. CHARLES, ILLINOIS 60174
(630) 443-7755

CLIENT:

CITY OF BATAVIA
100 N. ISLAND AVENUE
BATAVIA, IL 60510

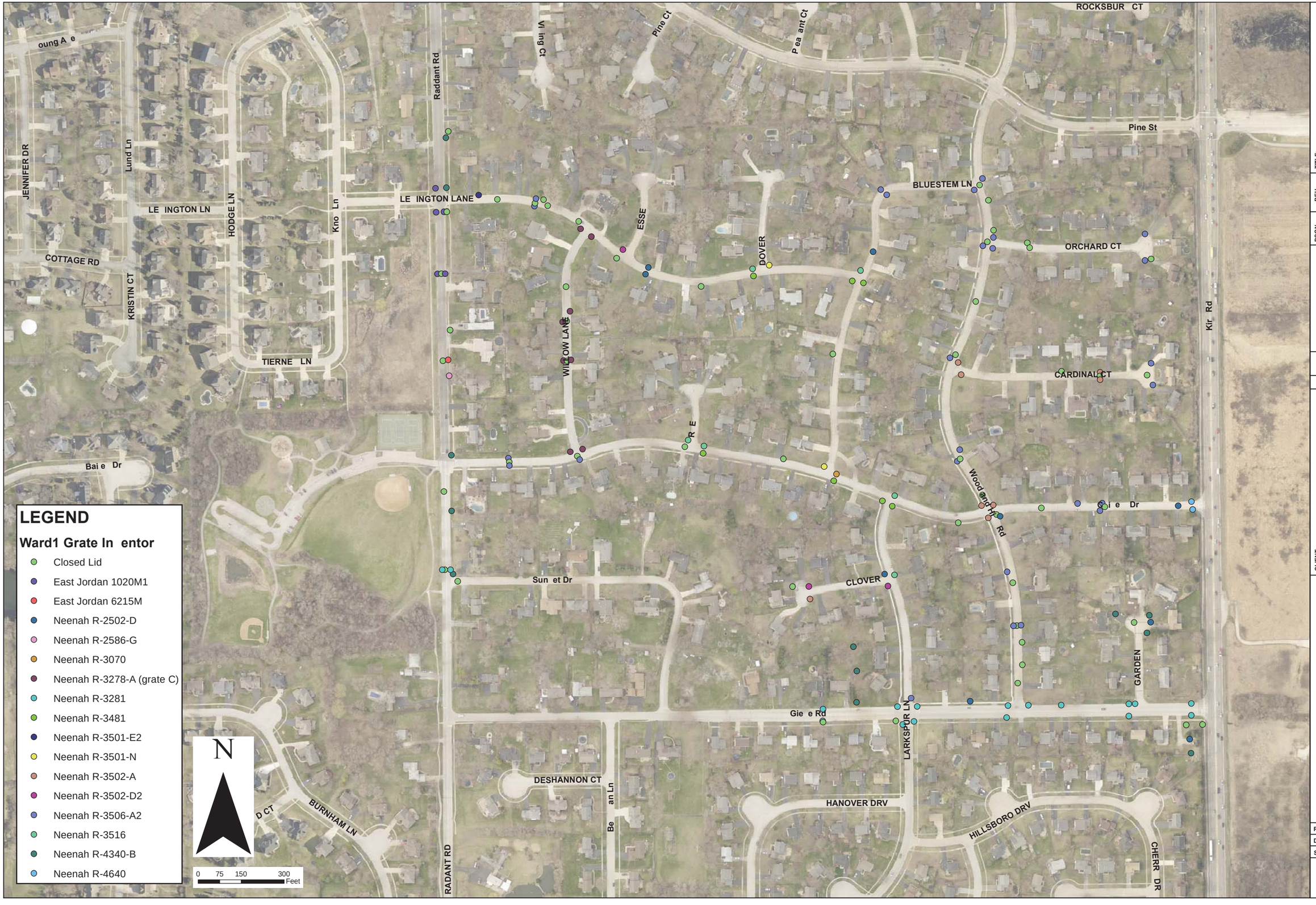
NO.	DATE	NATURE OF REVISION

DSGN.	BEH
DWN.	BEH
CHKD.	<CHK>
SCALE: SEE SCALE BAR	
E _H dra o Re u t	

TITLE:

BATAVIA WARD 1
DRAINAGE INVESTIGATION

HYDRAFLOW ANALYSIS
UNDERSI ED PIPES



TITLE: BATAVIA WARD 1 DRAINAGE INVESTIGATION

GRATE INVENTORY MAP

DSGN.	BEH
DWN.	BEH
CHKD.	JWW
SCALE: 1	SCALE
E 10_Grate In entor	

NO.	DATE	NATURE OF REVISION

CLIENT: CITY OF BATAVIA 00 N RADDANT ROAD BATAVIA, IL 60510

WBK ENGINEERING, LLC
116 WEST MAIN STREET, SUITE 201
ST. CHARLES, ILLINOIS 60174
(630) 443-7755

WBK engineering

PROJECT NO. 160136

DATE 08-10-2016

SHEET 1 OF 1

EXHIBIT 10

APPENDIX C

Estimate of Conceptual Costs

WARD 1 DRAINAGE DISTRICT
MAINLINE STORM SEWER IMPROVEMENTS COST ESTIMATE

Pay Item	Quantity	Unit	Unit Cost	Total
Giese Road Improvements				
SAW CUT FULL DEPTH	1200	L.F.	$ 2.00	$ 2,400.00
PAVEMENT REMOVAL AND REPLACEMENT	790	S.Y.	$ 50.00	$ 39,500.00
CURB AND GUTTER REMOVAL AND REPLACEMENT	900	L.F.	$ 30.00	$ 27,000.00
STORM SEWER REMOVAL	1094	L.F.	$ 5.00	$ 5,470.00
MANHOLE/CATCH BASIN REMOVAL	9	EACH	$ 500.00	$ 4,500.00
STORM SEWER, RCP, 60"	220	L.F.	$ 190.00	$ 41,800.00
REINFORCED CONCRETE BOX CULVERT- 4'X6'	680	L.F.	$ 250.00	$ 170,000.00
END SECTION 4'X6'	1	EACH	$ 3,500.00	$ 3,500.00
WATER MAIN SERVICE ADJUSTMENT	10	EACH	$ 2,000.00	$ 20,000.00
TRENCH BACKFILL	8880	C.Y.	$ 35.00	$ 310,800.00
TOPSOIL RESPREAD	1000	S.Y.	$ 10.00	$ 10,000.00
SEEDING	0.2	ACRE	$ 10,000.00	$ 2,000.00
		20% contingency		*$ 127,394.00*
Giese Road Improvements			**Subtotal**	**$ 764,364.00**
Larkspur (Giese to Bluestem)				
SAW CUT FULL DEPTH	500	L.F.	$ 2.00	$ 1,000.00
PAVEMENT REMOVAL AND REPLACEMENT	890	S.Y.	$ 50.00	$ 44,500.00
STORM SEWER REMOVAL	921	L.F.	$ 5.00	$ 4,605.00
CURB AND GUTTER REMOVAL AND REPLACEMENT	500	L.F.	$ 30.00	$ 15,000.00
STRUCTURE REMOVAL	5	EACH	$ 1,200.00	$ 6,000.00
MANHOLE/CATCH BASIN REMOVAL	5	EACH	$ 500.00	$ 2,500.00
STORM SEWER, RCP, 54"	220	L.F.	$ 130.00	$ 28,600.00
STORM SEWER, RCP, 60"	700	L.F.	$ 190.00	$ 133,000.00
MANHOLES, TYPE A, 5'-DIAMETER, TYPE 1FRAME, CLOSED LID	3	EACH	$ 2,850.00	$ 8,550.00
MANHOLES, TYPE A, 10'-DIAMETER, TYPE 1FRAME, CLOSED LID	2	EACH	$ 9,000.00	$ 18,000.00
Water Main Service Adjustment	7	EACH	$ 2,000.00	$ 14,000.00
TRENCH BACKFILL	900	C.Y.	$ 35.00	$ 31,500.00
TOPSOIL RESPREAD	2000	S.Y.	$ 10.00	$ 20,000.00
SEEDING	0.4	ACRE	$ 10,000.00	$ 4,000.00
		20% contingency		*$ 66,251.00*
Larkspur (Giese to Bluestem)			**Subtotal**	**$ 331,255.00**
Bluestem (Chillem to Lex), Lexington (Bluestem to Dover)				
SAW CUT FULL DEPTH	500	L.F.	$ 2.00	$ 1,000.00
PAVEMENT REMOVAL AND REPLACEMENT	950	S.Y.	$ 50.00	$ 47,500.00
CURB AND GUTTER REMOVAL AND REPLACEMENT	470	L.F.	$ 30.00	$ 14,100.00
STORM SEWER REMOVAL	1030	L.F.	$ 5.00	$ 5,150.00
MANHOLE/CATCH BASIN REMOVAL	4	EACH	$ 500.00	$ 2,000.00
STORM SEWER, RCP, 42"	350	L.F.	$ 100.00	$ 35,000.00
STORM SEWER, RCP, 48"	680	L.F.	$ 120.00	$ 81,600.00
MANHOLES, TYPE A, 5'-DIAMETER, TYPE 1FRAME, CLOSED LID	4	EACH	$ 2,850.00	$ 11,400.00
MANHOLES, TYPE A, 8'-DIAMETER, TYPE 1FRAME, CLOSED LID	1	EACH	$ 7,500.00	$ 7,500.00
Water Main Service Adjustment	10	EACH	$ 2,000.00	$ 20,000.00
TRENCH BACKFILL	1300	C.Y.	$ 35.00	$ 45,500.00
TOPSOIL RESPREAD	220	S.Y.	$ 10.00	$ 2,200.00
SEEDING	0.5	ACRE	$ 10,000.00	$ 5,000.00
Bluestem (Chillem to Lex), Lexington (Bluestem to Dover)		**20% contingency**		*$ 55,590.00*
			Subtotal	**$ 333,540.00**

WARD 1 DRAINAGE DISTRICT
MAINLINE STORM SEWER IMPROVEMENTS COST ESTIMATE

Pay Item	Quantity	Unit	Unit Cost	Total
Orchard Court				
CURB AND GUTTER REMOVAL AND REPLACEMENT	10	L.F.	$ 30.00	$ 300.00
STORM SEWER REMOVAL	308	L.F.	$ 5.00	$ 1,540.00
MANHOLE/CATCH BASIN REMOVAL	5	EACH	$ 500.00	$ 2,500.00
STORM SEWER, RCP, 15"	350	L.F.	$ 50.00	$ 17,500.00
MANHOLES, TYPE A, 4'-DIAMETER, TYPE 1FRAME, CLOSED LID	3	EACH	$ 2,130.00	$ 6,390.00
RCP FLARED END SECTION, 15" W/GRATE	1	EACH	$ 1,200.00	$ 1,200.00
TOPSOIL RESPREAD	1200	S.Y.	$ 10.00	$ 12,000.00
SEEDING	0.3	ACRE	$ 10,000.00	$ 3,000.00
		20% contingency		*$ 8,886.00*
Orchard Court			**Subtotal**	**$ 53,316.00**
Lexington (W of Dover); Chillem (W of Rye); Cardinal Court, Bluestem (N of Lex.)				
SAW CUT FULL DEPTH	1200	L.F.	$ 2.00	$ 2,400.00
PAVEMENT REMOVAL AND REPLACEMENT	933	S.Y.	$ 50.00	$ 46,650.00
CURB AND GUTTER REMOVAL AND REPLACEMENT	1200	L.F.	$ 30.00	$ 36,000.00
STORM SEWER REMOVAL	1250	L.F.	$ 5.00	$ 6,250.00
MANHOLE/CATCH BASIN REMOVAL	8	EACH	$ 500.00	$ 4,000.00
STORM SEWER, RCP, 12"	344	L.F.	$ 48.00	$ 16,512.00
STORM SEWER, RCP, 15"	227	L.F.	$ 50.00	$ 11,350.00
STORM SEWER, RCP, 18"	682	L.F.	$ 55.00	$ 37,510.00
MANHOLES, TYPE A, 4'-DIAMETER, TYPE 1FRAME, CLOSED LID	11	EACH	$ 2,130.00	$ 23,430.00
Water Main Service Adjustment	13	EACH	$ 2,000.00	$ 26,000.00
TRENCH BACKFILL	1554	C.Y.	$ 35.00	$ 54,390.00
TOPSOIL RESPREAD	2700	S.Y.	$ 10.00	$ 27,000.00
SEEDING	0.6	ACRE	$ 10,000.00	$ 6,000.00
		20% contingency		*$ 59,498.40*
Lexington (W of Dover); Chillem (W of Rye); Cardinal Court, Bluestem (N of Lex.)			**Subtotal**	**$ 356,990.40**
Raddant Road				
SAW CUT FULL DEPTH	1800	L.F.	$ 2.00	$ 3,600.00
PAVEMENT REMOVAL AND REPLACEMENT	1305	S.Y.	$ 50.00	$ 65,250.00
CURB AND GUTTER REMOVAL AND REPLACEMENT	50	L.F.	$ 30.00	$ 1,500.00
STORM SEWER REMOVAL	1600	L.F.	$ 5.00	$ 8,000.00
MANHOLE/CATCH BASIN REMOVAL	5	EACH	$ 500.00	$ 2,500.00
STORM SEWER, RCP, 12"	1000	L.F.	$ 48.00	$ 48,000.00
STORM SEWER, RCP, 15"	400	L.F.	$ 50.00	$ 20,000.00
STORM SEWER, RCP, 18"	400	L.F.	$ 55.00	$ 22,000.00
MANHOLES, TYPE A, 4'-DIAMETER, TYPE 1FRAME, CLOSED LID	6	EACH	$ 2,130.00	$ 12,780.00
Water Main Service Adjustment	13	EACH	$ 2,000.00	$ 26,000.00
TRENCH BACKFILL	2200	C.Y.	$ 35.00	$ 77,000.00
TOPSOIL RESPREAD	500	S.Y.	$ 10.00	$ 5,000.00
SEEDING	0.5	ACRE	$ 10,000.00	$ 5,000.00
		20% contingency		*$ 59,326.00*
Raddant Road			**Subtotal**	**$ 355,956.00**
			TOTAL	**$ 2,195,421.40**