PERSHING AVENUE / ELM STREET FLOOD PRONE AREA STUDY

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Executive Summary

The Pershing Avenue/Elm Street Flood Prone Area Study determined the locations and causes of flooding within the West and East Pershing/Elm Basins located in Wheaton, Illinois. The goal of this study is to develop concept-level alternatives that reduce flooding and protect homes located in the flood prone areas from the 1% annual chance design storm (100-year storm event).

Nine problem areas were identified by V3 as causing structural flooding during the 100-year storm event. These problem areas were identified during a review of the following information:

- Drainage assessment notes describing flooding issues provided by the City of Wheaton;
- Resident pictures taken during and after the April 2013 storm event;
- Topography provided by V3 Survey Department and DuPage County;
- XP-SWMM existing conditions results

All nine of these problem areas were evaluated to determine the apparent cause of flooding, and proposed alternatives were developed for each problem area.

The West basin includes three problem areas that affect seven homes. (Existing water surface elevations are higher than the low entry elevations at seven homes; additional homes are affected by ponding water on yards, streets, traffic impacts, etc.) Several engineering alternatives were considered, and the most feasible alternative can reduce water surface elevations to remove expected flooding from five of the seven homes. Two of the homes are very low, elevationally, and should be considered candidates for voluntary buyout or floodproofing. Due to the high cost of the engineering alternative relative to the five homes which are protected by the alternative, the most cost effective alternative in the West basin may be a combination of buyouts and floodproofing, although this will not reduce traffic or yard impacts.

The East basin includes five problem areas with existing water surface elevations that are higher than 33 residential structures. Storage and conveyance alternatives were considered to reduce water surface elevations, as were roadway profile improvements. Buyouts and floodproofing alternatives were also considered. An engineering alternative that combines storage and conveyance improvements can result in water surface elevations that are below the low entry elevation at 27 of 33 homes in the 100-year storm event, and appears to be the most cost effective alternative (with floodproofing and/or voluntary buyout of the remaining six homes, which are elevationally low.) Engineering alternatives can protect all 33 homes, but the incremental cost to protect 33 homes (versus 27) is greater than the cost of the homes themselves. Roadway improvements may also be cost-effective, but requires further investigation of possible utility conflicts, etc.

In both the East and West basins, floodproofing is the lowest cost alternative, but this does not lower the water surface elevations. The engineering alternatives have benefits beyond protection of the flooded homes, including reduced yard and nuisance flooding, improved safety and traffic access, and an increase in quality of life for the residents in the area. The economic benefit of these improvements is not included in the cost-benefit comparison. The City should consider these non-structural benefits versus the cost of the alternative, when selecting an alternative for implementation.

Introduction

The Pershing Avenue/Elm Street Flood Prone Area Study determined the locations and causes of flooding within the East and West Pershing/Elm Drainage Basins located in Wheaton. The goal of this study is to develop concept-level alternatives that reduce flooding and protect homes located in the flood prone area from the 1% annual chance design storm (100-year design storm). Reducing street and yard flooding is not a goal of this project, although street and yard flooding will be reduced as a consequence of projects that reduce structural house flooding.

The Pershing/Elm drainage basin and subbasin divides used for this study are shown in Exhibit 1. The study area is roughly bounded by Naperville Road on the west, Roosevelt Road on the north, Lambert Road on the east, and various local roads on the south including Fairway Lane, Alchester Drive, Johnstown Lane, and Loughborough Court. Weaver Court and Fischer Street divide the East and West Pershing/Elm basins. The East basin flows southeast towards Lake A at Presidents Park, and the West basin flows southwest towards Spring Brook No. 1.

Adjacent drainage basins also contribute runoff to surface and storm sewer flows in West and East Pershing/Elm Basins. For this reason, the adjacent drainage basins were also included in the analysis.

West Pershing/Elm Drainage Basin

The West Pershing/Elm drainage basin is a 43 acre basin primarily served by a separate storm sewer system that drains from east to west down Pershing Avenue to a 27" storm sewer and eventually outlets to Spring Brook No. 1, just south of Elm Street. It appears the storm sewers through this drainage basin are undersized and the basin lacks a well-defined overflow path which results in runoff ponding in two large depressional areas in residential areas.

An additional drainage basin to the south of the West Pershing/Elm basin was also modeled. The Southwest Pershing/Elm Basin is a 68 acre basin that consists of multiple sewers running west down Dawes and Elm Street, which combine with runoff from the West Pershing/Elm basin at the corner of Naperville and Elm Street. When the storm sewers are at capacity, runoff ponds in a depressional area within the Southwest Pershing/Elm drainage basin and eventually overflows to the West Pershing/Elm drainage basin. Part of this basin was located within the original City of Wheaton's delineation of the West Pershing/Elm basin. It was determined that this area should be modeled as a separate subbasin to allow low flow to exit the new subbasin via the storm sewers down Elm and Dawes, with overland flow into the West Pershing/Elm basin, as a more accurate representation of the area.

East Pershing/Elm Drainage Basin

The East Pershing/Elm drainage basin is a large 248 acre basin also served by a separate storm sewer system that travels under President Street and Coolidge Avenue and ultimately outlets to Presidents Park, also known as Lake A, located southwest of Coolidge Avenue and Lorraine Road. From there runoff drains to a series of lakes to the south of Lake A. Lake A drains south via a 30" gravity pipe which flows into a 66" diameter pipe. A pump is present within the basin, but it appears that the pump's primary function is to drain the underdrain system and help maintain a dry-bottom pond. The gravity outlet pipe is the primary outlet from Lake A. It is apparent that the storm sewers throughout the drainage basin are not large enough to convey

intense storm events, producing overland flow through backyards, side yards and streets, which causes drainage issues.

An additional drainage basin north of Roosevelt Road, known as Williston Basin, also drains to the East Pershing/Elm basin via large 48" to 54" sewers under President Street and Williston Street. In 2012, V3 prepared an existing conditions model of the Williston Basin for the City of Wheaton. This model was incorporated into the current model V3 prepared for the Pershing/Elm Flood Prone Area Study.

In general, the storm sewer systems are undersized, and in some cases non-existent, and there is a lack of storage, resulting in drainage problems in moderate to large storm events.

Flood Complaint Data and Model Calibration

The City of Wheaton provided resident complaint information for the flood prone areas which was used when evaluating the apparent cause of the drainage problems.

The City of Wheaton also provided resident pictures taken during and after the April 2013 storm event, an event which totaled 6.26 inches of rain in 18 hours, which is slightly larger than a 50-year storm event (5.95 inches in 18 hours). The water levels shown in these pictures, as well as survey data provided by the V3 Survey Department, provided approximate high water levels that could then be used to calibrate some areas of the existing model.

Existing Conditions Summary

The basin divides provided by the City of Wheaton were reviewed against the topographic mapping, survey data, storm sewer atlases, and other available information to refine basins as necessary. The basin divides used for this study generally match the basin divides provided by the City of Wheaton, though some minor changes were made to account for both storm sewers and basin topography. At some large drainage basins, divides were added to separate the area tributary to the study area from the area that bypasses the study area. A comparison of the City of Wheaton basin divides and the V3 Revised divides are shown on Exhibit 2.

Existing land use mapping, aerial mapping, soil mapping, wetland mapping, FEMA floodplain mapping, and MWRD inundation mapping was also reviewed to establish the existing conditions. These baseline maps can be found as Exhibits 26 – 35. An overview of the topographic maps, showing the topographic relief of the study area as a whole and of each individual subbasin, can be found in Exhibit 3.

Description of Flooding Issues

Drainage problems are shown in Table 1 based on a review of City of Wheaton data, resident photos taken during and after the April 2013 storm even, and XP-SWMM model results. The locations of these problem areas can be seen on Exhibit 4.

Table 1 – Flooding Issues

Problem ID	Basin	Location	Problem Description and Apparent Cause
A	West Pershing/Elm	Southwest of Pershing Ave/ Campbell Ave intersection	Ponding in backyards. Insufficient capacity in outlet pipe and/or downstream system
B	West Pershing/Elm	Area enclosed by Pershing Ave, Elm St, Weaver Ct, and Campbell Ave	Ponding in backyards without any outlet pipe
C	Southwest Pershing/Elm	Elm St, between Summery St and Chase St	Ponding water in street - overflow elevation in street is higher than adjacent homes
D	East Pershing/Elm	Area enclosed by Pershing Ave, Elm St, President St, and Weaver Ct	Ponding in backyards without any outlet pipe
E	East Pershing/Elm	Area enclosed by Pershing Ave, Wilson Ave, Williston St, and President St	Ponding in backyard without outlet pipe. Overflow path is between adjacent homes.
F	East Pershing/Elm	Pershing Ave and Williston St	Ponding in street - overflow elevation in street is higher than adjacent homes
G	East Pershing/Elm	Blanchard St and Wilson Ave	Ponding in street - overflow elevation in street is higher than adjacent homes
H	East Pershing/Elm	Prospect St and Elm St	Ponding water in street - overflow elevation in street is higher than adjacent homes

Drainage problems exist largely as a result of undersized conveyance systems and lack of stormwater storage. The effect of stormwater runoff and overland flow from rainfall events is yard flooding, street flooding, and structure flooding.

Hydrology and Hydraulics Summary (Existing Conditions)

An XP-SWMM hydrologic and hydraulic analysis was conducted for the Pershing/Elm Basins to evaluate the performance of the existing stormwater management system and determine which residential structures and accessory structures may be at risk of flooding. This section describes the calculation methodology used to establish the "existing condition", describes efforts to calibrate the model to known high water marks, and presents a summary of results.

XP-SWMM Modeling

XP-SWMM is a dynamic stormwater management model that computes runoff hydrographs and can route these hydrographs through a series of hydraulic elements including storm sewers, storm sewer inlets, depressional storage areas, and overland flow routes. The dynamic program models storm flow throughout an entire storm event (and not just at a single point in time corresponding to a peak condition, as is done with static models.) The program allows stormwater runoff to "choose" its route based on the elevation and capacity in the conveyance system. For example, runoff entering a manhole would first flow downstream through a pipe, but once the pipe reaches capacity and surcharges, any additional inflow would surcharge and is either stored at the surface or flow downstream via an overland flow route, depending on the specific physical characteristics of that location.

Exhibit 5 provides a graphic representation of the XPSWMM model, including subbasin delineation, flow direction, XPSWMM node IDs, and hydrologic input parameters.

Hydrologic Data

The basin hydrology was modeled using the SCS method, which uses a hydrograph routing technique and input parameters as described below. This method is similar to hydrograph routing performed in TR-20 or HEC-1. The following data sources were used to create the hydrologic input parameters for the model:

- Subbasin areas delineated using DuPage County 2-foot contour mapping supplemented with surveyed topography as well as the Wheaton storm sewer atlas;
- Runoff Curve Numbers established using standard SCS methodology based on land use and soil type;
- Times of Concentration based on NRCS methodology using DuPage County 2-foot contour mapping and aerial photography;
- Rainfall depths and distributions based on Bulletin 70 Table 13 for Northeastern Illinois as well as the April 2013 Willow Rain Station gage record as provided by the City of Wheaton;

Hydraulic Data

The following data sources were used to create the hydraulic input parameters for the model:

- Storm sewers were defined based on survey data provided by V3 Survey Department and atlas data provided by the City of Wheaton.
- Overland flow routes based on 2-ft topographic mapping from DuPage County and V3 survey where available.

- Depressional storage areas were defined using DuPage County 2-ft topographic mapping and V3 survey where available.

The XP-SWMM model represents the main conveyance routes. Not every single segment of sewer was modeled and some storm sewer segments were combined or removed from the model to simplify the model and improve computational analysis times. Inlet capacity was not modeled as a part of this study. If any of the proposed alternatives are incorporated, a more detailed analysis of inlet capacity should be completed to ensure runoff can enter the system and utilize the increased storage and sewer capacity provided by the proposed alternatives. Dual inlets and/or high-capacity inlets may be needed in some locations.

Boundary Conditions

The downstream boundary condition (tailwater condition) for both West and East Pershing/Elm Basins was set using a normal depth. As previously mentioned, the West Pershing/Elm Basin outlets to Spring Brook No. 1 and the East Pershing/Elm Basin outlets to a series of Lakes through Wheaton.

The West Pershing/Elm Basin is located approximately 30 feet higher than the sewer outlet at Spring Brook No. 1. For this reason, tailwater effects of the Spring Brook No. 1 floodplain are unlikely to propagate upstream through the system, and a normal depth boundary condition at the outfall was considered to be reasonable for this basin. A sensitivity test was performed to confirm this assumption.

The East Pershing/Elm basin outlets to Lake A in Presidents Park. Downstream of Presidents Park is an existing 2,700 foot segment of 66" storm sewer that conveys water from Lake A to the downstream Briarcliffe Lake 1. An investigation into the downstream system and topography suggests little or no influence of Briarcliffe Lake 1 water levels on the Pershing/Elm flood prone areas being studied as part of this project. For this reason, a normal depth boundary condition at the downstream end of the 2,700 foot 66" storm sewer was determined to be appropriate.

Key Assumptions

The following lists the key assumptions that were made in the creation of the XP-SWMM model for the Pershing/Elm Basins.

- The pump in Lake A within Presidents Park was not included in the analysis, as the pump appears to be a sump pump that drains the underdrain system, rather than a storm pump. Lake A is drained by the downstream 30 inch gravity pipe, during the large storm events that were analyzed.
- Notes provided by the City of Wheaton state that the 30" flap-gated outlet pipe on the south side of Lake A is often lodged open by debris during large storm events. For this reason, the outlet pipe was not modeled as a flap-gated pipe, but instead as a pipe that allows flow into and out of the basin freely. This condition does not appear to affect the high water level in Lake A because the majority of runoff entering the basin flows through the 24" storm sewers at the northwest and northeast corner of Lake A.
- Inverts for storm sewers with no surveyed invert data were approximated based on local topography and adjacent surveyed structures. A slope of 0.5% was often used a default value. In general, these storm sewers are not directly responsible for the flooding (or for reducing the flooding) within the problem areas, but rather, serve a means to bring

tributary area towards the system. The effect of this assumption is unlikely to impact the results at the problem areas.

- As previously mentioned, it was assumed storm sewer capacity, not inlet capacity, controls runoff entering the stormwater system; that is, runoff can enter the system freely through the inlets and the capacity of the local storm sewers controls what's conveyed downstream. Leaves, debris, and sediment can cause reduced inlet capacity, and routine maintenance should be completed to ensure runoff can enter the stormwater system.

Note, these assumptions and boundary conditions are considered valid for the model, when evaluating alternatives and improvements in the East and West Elm/Pershing basins. If this model is used as a starting-point for analysis of other areas in the future, these assumptions should be reviewed for validity in those future areas.

Model Verification

The model calibration was completed based on the April 2013 storm event. The City of Wheaton provided residents' photos taken during and after the storm event which, when used with V3 survey data, provide approximate high water level marks for the model. The April 2013 precipitation data was recorded at the Willow Gage. There was 6.29 inches of rain in 18 hours, which is slightly larger than a 50 year storm event (50 year event produces 5.95 inches in 18 hours; 100 year event produces 6.97 inches in 18 hours).

The simulated model results were compared to high water marks recorded in the watershed. A total of 20 resident photos were provided by the City of Wheaton, which resulted in unique high water level data for 8 areas. The resident photos used in the calibration efforts can be seen in the appendix.

Typically, a difference of less than six inches is desirable when comparing simulated versus measured high water marks for high water marks of the highest level of confidence (such as a gage record). A larger tolerance is acceptable for high water marks with lower levels of confidence, such as photographs when the corresponding high water elevation must be approximated and the timing of the photo relative to true peak may be uncertain.

Final calibration results for the April 2013 storm (greater than a 50-year storm) are shown in Table 2.

Table 2 – Calibration Results

Location	Measured High Water Mark	Simulated High Water Mark in XP-SWMM	Difference (Simulated – Measured) (ft)
504 Pershing Ave	762.25	762.86	0.61
719 Weaver Ct	759 (Downstream)	759.49	0.49
816 Pershing Ave	759+	759.48	0.48
1009 Campbell Ave	763+	763.60	0.60
815 Pershing Ave	762+	761.97	-0.03
Lake A	750	750.55	0.55
Taft Ave/Blanchard St	759	759.54	0.53
Wilson Ave/Blanchard St	757.5	757.66	0.16

Overall, the model appears to result in elevations approximately 6" higher than the photos demonstrate. There are many variables which could explain this difference, including:

- Pictures that were taken at a time when the ponded water did not yet reach the high water level or was already receding after the high water level occurred;
- Rainfall data from an area outside of the basins being studied. Rainfall depths and intensities can change over relatively small distances. It's possible that rainfall over the Pershing/Elm Basins was actually slightly less than the rainfall at the Willow Rain Gauge.

It is difficult to determine if the variables listed above are the cause of the 6" discrepancy, though the results suggests the model is working properly for the areas where photos were provided for the April 2013 storm event. There are some critical areas where no calibration photos were provided. However, the results above suggest the rainfall amounts and modeling methodology appear to be resulting in fairly accurate elevations and the model represents the remaining problem areas throughout the basins.

Critical Duration Analysis

After accepting the model as "calibrated", the model was run to analyze the critical duration. The 10 and 100-year storm events were analyzed for the 1, 2, 3, 6, 12, 18, 24, and 48 hour durations. The results of the analysis suggest the 2-hour, 12-hour, and 48-hour storm events are critical for the 10-year storm event and the 2-hour, 3-hour, and 12-hour storm events are critical for the 100-year storm event. The 2-hour, 3-hour, 12-hour, and 48-hour durations were then used to analyze the remaining storm event frequencies and the proposed conditions alternatives.

Establishing Flood Protection Elevations

To determine an alternative's effectiveness to reduce or eliminate structural flood damage, it was necessary to have a flood protection elevation for each structure in flood prone study area. V3 Survey Department completed a full survey of low entry elevations for the structures within the flood prone areas, seen on Exhibits 22 through 25.

The existing conditions inundation areas and the locations of homes that may experience flooding of their home in the existing condition are shown on Exhibit 6A.

Existing XP-SWMM Analysis and Results

The existing conditions results suggest structure damage will begin to occur at the 2-year storm event for both the West and East Pershing/Elm Basin.

The XPSWMM model results were used to create the Inundation and At Risk Structure Map which can be seen in Exhibits 6A, 6B, and 6C. A complete record of XPSWMM results is included in the electronic transmission of project files. Table 3 summarizes the results of the modeling and shows the number of structures flooded in each storm. The Appendix provides a larger table showing key elevations from the XPSWMM Model versus low entry elevations, which were used for our Inundation Exhibit and for identifying at-risk structures.

Table 3 – Existing Conditions Results

Storm Event	West Pershing/Elm		East Pershing/Elm	
	Number of Damaged Properties	Total Property Value (from DuPage Cty Assessor Website)	Number of Damaged Properties	Total Property Value (from DuPage Cty Assessor Website)
1-year	0	$0	0	$0
2-year	1	$182,900	3	$837,500
5-year	3	$556,100	10	$2,435,100
10-year	3	$556,100	12	$2,935,900
25-year	3	$556,100	18	$3,871,100
50-year	7	$1,841,100	25	$6,750,900
100-year	7	$1,841,100	33	$8,680,200

Design Criteria

Project alternatives were designed with a goal of protecting all structures from flooding during the 100-year critical duration storm event. The 2-hr, 3-hr, and 12-hr duration storms were analyzed.

Other design criteria include:

- Bulletin 70 rainfall
- Storm sewers were designed to:
  - Provide adequate conveyance and capacity to reduce flooding to meet the residential structure protection goal; in most cases, the storm sewers have a minimum 10-year level of service based on a flowing full capacity.
  - Provide 2 feet of cover, minimum, between top/pipe and ground.
- Storage areas were graded with:
  - 3:1 side slopes.
  - Flat bottoms, to be planted with native vegetation.
  - A 5-foot buffer between the existing or proposed property line and the start of grading

Alternatives Identification and Analysis (Proposed Conditions)

The goal of the alternatives is to eliminate residential structure flooding during the 100-year storm event, including basement flooding caused by overland flow. The alternatives considered a range of conveyance, storage, floodproofing, and buy-out options.

Pershing/Elm West Area

Problem Areas A, B, and C are all depressional areas with no outlet pipe or an undersized outlet pipe. Alternatives that were considered to reduce structural damage in the 100-year storm include:

1. Conveyance
2. Conveyance and Storage
3. Floodproofing
4. Buyouts

Proposed Alternative 1 (West): Conveyance

A conveyance-only alternative was considered for the West Pershing/Elm area, which aims to reduce flooding using only publicly-owned land. This alternative would include increased conveyance capacity for storm sewers along Pershing Avenue, Naperville Road, and Elm Street, to reduce ponding and drainage issues in the problem areas.

Simply increasing the conveyance capacity without providing new storage volume reduces water surface elevation at the problem areas but results in increased flow rates downstream which may impact downstream properties. To reduce proposed peak flow rates to match existing flow rates, a storage basin was considered at Kelly Park, which is the only publicly-owned land in this vicinity, located just east of Spring Brook, south of Elm Street. The FEMA floodplain maps show that the majority of Kelly Park is in the floodplain. New storage could be created but its impact on peak attenuation would be tempered by the in-stream location making it an inefficient location for new storage. It was determined that a conveyance-only alternative is not feasible for the West Pershing/Elm basin, without creating new storage on public property or in costly underground storage chambers upstream of the floodplain.

Proposed Alternative 2 (West): Conveyance & Private Property Storage

Alternative 2 includes the construction of two large basins in two depressional areas, as shown in Exhibit 8, to reduce drainage problems in Problem Areas A, B and C.

The first storage area is located at the southwest corner of Pershing Ave. and Campbell Ave. The proposed alternative requires acquiring the backyards of two existing properties so the land can be used for the proposed detention basin. The alternative also includes rerouting the existing sewer along Pershing Ave. to the proposed basin as well as the installation of a new outlet pipe which will then reconnect to the existing storm sewer system under Pershing Ave.

The second storage basin is located between Pershing Ave., Elm St., Weaver Ct., and Campbell Ave. Because of the large lot sizes on this block, the alternative only requires property acquisition of the backyards of existing properties and the existing houses and garages can remain. The proposed alternative also includes installing a proposed sewer from the depressional area on Elm St. to the proposed storage area. A proposed restrictor structure and outlet pipe are also require to

connect this proposed storage basin to the proposed basin at the southwest corner of Pershing Ave. and Campbell Ave.

The two storage basins and proposed storm sewers reduce water surface elevation at five of seven structures but still result in water surface elevations that are above the low entry elevations at two structures in the 100-year flood, although flood depths are reduced. To protect those structures from the 100-year flood would require larger basins and storm sewers, and the incremental cost would exceed the cost of the two properties themselves. Therefore, it is recommended that these structures be floodproofed or purchased.

The first structure is located at 512 Pershing Avenue. The existing HWL is approximately 1.7 feet higher than the low entry elevation of this structure. The HWL is reduced approximately 7 inches at this location in the proposed condition, but the structure is still shown with approximately 1.1 feet of water depth above the low entry elevation of this structure in the 100-yr event. It is recommended this property is floodproofed or purchased and used for the proposed detention basin.

The second structure is located at 423 Pershing Avenue. The existing HWL is approximately 0.7 feet higher than the low entry elevation of this structure. The HWL is reduced approximately 6 inches at this location in the proposed condition, but the structure is still shown with approximately 0.2 feet of water depth above the low entry elevation of this structure in the 100-yr event. It is recommended that this structure is floodproofed to reduce flooding in the 100-year storm event. It should be noted that the downstream storm sewer could be increased to lower the HWL at this location, though this will result in increases in proposed flow rates downstream of the problem area, unless additional storage is added to offset the increased flow rate. The cost of the increased pipes and storage exceeds the cost of floodproofing this structure. For this reason, it was determined that floodproofing is a better option for this structure.

Alternative 2 for the West Pershing/Elm area is shown in Exhibit 8 and the reduction in inundation areas (reflecting the proposed condition) can be seen on Exhibit 13.

Table 4 summarizes the results of this Alternative. With floodproofing of two structures not fully protected by the engineering alternative, this alternative removes all structure flooding for the 100-year storm event.

Table 4 – Summary of Existing and Proposed Flood Depths with Alternative 2 (West)

		Existing Flood Depth Above Low Entry Elevation							Proposed Flood Depth Above Low Entry Elevation						
Street	**Number**	**1-yr**	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**	**1-yr**	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**
Pershing Ave	504						0.20	0.46							
Pershing Ave	508						0.20	0.46							
Pershing Ave	512*			0.17	0.52	1.03	1.40	1.66						0.31	1.04
E Elm St	610						0.18	0.36							
E Elm St	624			0.10	0.53	1.04	1.28	1.46							
Pershing Ave	624		0.12	0.44	0.70	1.02	1.26	1.71							
Pershing Ave	423*						0.33	0.65							0.13

*Floodproofing needed to remove this structure completely from the 100-yr inundation area. See floodproofing recommendations that follow in Table 5.

The engineer's estimated opinion of probable construction cost for this alternative is $2,827,500 and includes an estimate of the property acquisition for the rear yard parcels. An additional $105,000 is needed to floodproof the two properties identified above.

Proposed Alternative 3 & 4 (West): Floodproofing & Buy-Out

Additional alternatives that were also considered include floodproofing (Alternative 3) or purchasing structures (Alternative 4) damaged in the 100-year storm event. A total of seven properties would need to be floodproofed or purchased to protect all structures from flooding in the 100-year storm event.

Floodproofing seven homes to the 100-yr level of flooding would cost approximately $341,000. If this alternative was chosen, a more detailed investigation would need to be done to determine the specific floodproofing measures required for each structure. However, based on the depth of flooding and the source of the low entry, it appears most structures can be protected by raising window wells or installing removable flood shields.

Table 5 summarizes the floodproofing measures that appear feasible for each source of low entry. Some homes have multiple sources of low entry, and therefore have multiple rows in Table 5 to floodproof each potential source of entry.

Table 5 – Floodproofing Recommendations (West)

Street	Number	Low Entry Elevation	Existing Depth of Water Above Critical Elevation	Proposed Alt 2 Depth of Water Above Critical Elevation	Location of Low Entry	Potential Floodproofing Remedy
Pershing Ave	504	762.71	0.46		Window/Well	Raised Window Wells
Pershing Ave	504	762.94	0.23		Window/Well	Raised Window Wells
Pershing Ave	504	763.04	0.13		Window/Well	Raised Window Wells
Pershing Ave	504	763	0.17		Window/Well	Raised Window Wells
Pershing Ave	508	762.71	0.46		Window/Well	Raised Window Wells
Pershing Ave	508	762.8	0.37		Window/Well	Raised Window Wells
Pershing Ave	508	762.79	0.38		Window/Well	Raised Window Wells
Pershing Ave	508	762.81	0.36		Window/Well	Raised Window Wells
Pershing Ave	512	761.51	1.66	1.04	Foundation	See Note*
Pershing Ave	512	762.47	0.70	0.08	Door	Removable Flood Shield (for door)
E Elm St	610	764.32	0.36		Window/Well	Raised Window Wells
E Elm St	610	764.32	0.36		Window/Well	Raised Window Wells
E Elm St	610	764.32	0.36		Window/Well	Raised Window Wells
E Elm St	610	764.32	0.36		Window/Well	Raised Window Wells
E Elm St	624	763.22	1.46		Window/Well	Raised Window Wells
E Elm St	624	763.62	1.06		Foundation	See Note*
E Elm St	624	762.97	1.71		Window/Well	Raised Window Wells
E Elm St	624	762.97	1.71		Window/Well	Raised Window Wells
E Elm St	624	763.22	1.46		Window/Well	Raised Window Wells
Pershing Ave	624	762.45	1.71		Window/Well	Raised Window Wells
Pershing Ave	624	763.72	0.44		Foundation	Additional Drainage Improvements
Pershing Ave	423	762.03	0.65	0.13	Window/Well	Raised Window Wells

*Note: Some homes have a surveyed foundation elevation that is lower than the expected water surface elevation. At most of these locations, the doors and windows were surveyed separately and those low entry elevations were compared to water surface elevations; protecting the doors and windows may be adequate to reduce flood potential without needing to separately floodproof the foundation. However, a cost of $100,000 is added to each of these structures in case a detailed architectural and structural review of the home suggests additional measures are required.

At other locations, the top of foundation is below the water surface elevation, with no other sources of entry. A detailed architectural and structural review of the home is required to determine whether flood waters can enter the home and cause damage. An estimated cost of

$140,000 is added to each of these structures to allow for structural elevation as a worst-case floodproofing measure. Less costly measures, such as berming or temporary flood barriers, may also provide protection.

The approximate cost for a buy-out of seven homes is approximately $1,841,100. These costs are based on home assessment values found on the DuPage County website, and subject to change upon completion of a professional appraisal.

Structures that are damaged in the 2-year to 100-year storm events and require floodproofing or a buy-out can be seen on Exhibit 9.

Pershing /Elm East Area

Problem Areas D and E are both depressional areas with no outlet pipe or an undersized outlet pipe. Problem Areas F, G, and H are all roadway areas with undersized conveyance systems and overflow elevations that are higher than the low entry elevations of adjacent structures. Alternatives that were considered to reduce structural damage in the 100-year storm include:

1. Conveyance
2. Conveyance and Storage
3. Floodproofing
4. Buyouts

<u>Proposed Alternative 1 (East): Conveyance</u>

Alternative 1 is a conveyance alternative that reduces inundation in all five problem areas.

Alternative 1 includes increased conveyance throughout the East Pershing/Elm Basin area, and no private property acquisition, although an outlet pipe from the depressional area at Problem Area D will need to be installed through private property and an easement will be needed.

The proposed alternative consists of:

- Increasing storm sewer sizes along President Avenue and Coolidge Avenue from 54" storm sewers to dual 54" storm sewers for the upstream end of the system and dual 60" storm sewers at the downstream end of the system to help alleviate flooding problems in the President St. and Pershing Ave. area.
- Installing an outlet pipe (with easement as mentioned above) in the depressional area located between Pershing Ave., Elm St., Weaver Ct., and President St.
- Increasing the two existing 24" storm sewers outletting to the Presidents Park to dual 48" storm sewers and lowering their inverts to increase conveyance to Lake A.

Because this alternative drains a large amount of runoff that was previously ponded throughout the basin, additional modifications at Lake A are also required to avoid increasing flow rates downstream of Lake A and impacting downstream properties. The additional volume needed is approximately 11 acre-feet. To achieve an increase of 11 acre-feet, Lake A would need to be expanded in one of the following ways:

a) Expand vertically (deeper) by 2.2 feet with possible adjustments to pump settings; or
b) Expand horizontally by adding retaining walls to the existing footprint (to gain 1.8 ac-ft extra) plus expanding vertically (deeper) by 1.85 feet with possible adjustments to pump settings; or
c) Horizontal-only expansion, however, this would require increasing the footprint beyond the limits of the existing park, resulting in impacts to adjacent roads, homes, and/or multi-family buildings. This horizontal-only expansion was determined to be the least preferred expansion alternative, due to the additional cost of property acquisition and the impact to adjacent properties.

Option (a) was modeled, as it appears the most feasible and cost effective alternative. Lowering the basin would require a pump to drain the bottom-most portion of the reservoir. A pump is present within the basin to evacuate the underdrain system, and it may be possible to modify the existing pump to serve this purpose, although a replacement pump and/or pump station may be necessary depending on pump capacity. It appears that the pump station wet well elevation is low enough that it may be possible to lower the basin without the pump station structure needing to be modified.

This alternative would require an additional investigation into Lake A during preliminary engineering, including analysis of the groundwater table and the pump station to determine if adjustments to the pump station and/or pumps are required.

Alternative 1 for the East Pershing/Elm area can be seen on Exhibit 10 and proposed inundation areas can be seen on Exhibit 14.

This alternative reduces the 100-year WSEL below the low entry elevations at 30 of 33 structures that flood in the existing condition, but Alternative 1 improvements would still result water surface elevations that are above the low entry elevations at three structures in the 100-year flood, although flood depths are reduced as shown in Table 6. To protect those structures from the 100-year flood would require larger storm sewers, and the incremental cost would exceed the cost of the three properties themselves. Therefore, it is recommended that these structures be floodproofed or purchased.

In lieu of floodproofing, the conveyance alternative could use larger diameter pipes on Pershing Ave., Blanchard St., Elm St., and Prospect St. The current alternative shows dual 36” to 48” sewers and reduces water surface elevations below the low entry of all homes except for three. Increasing those proposed sewers to dual 48” to 54” sewers would provide enough additional capacity to decrease the water surface elevation further and protect all homes, including the three that would otherwise need floodproofing. The incremental cost and reduced constructability of this option is expected to be less feasible and less cost effective than floodproofing the three homes, therefore, this is not shown as the recommended alternative.

Table 6 – Summary of Existing and Proposed Flood Depths with Alternative 1 (East)

		Existing Flood Depth Above Low Entry Elevation							Proposed Flood Depth Above Low Entry Elevation						
Street	**Number**	**1-yr**	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**	**1-yr**	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**
S President St	903							0.11							
Pershing Ave	1006						0.48	0.94							
Pershing Ave	1010						0.52	0.98							
Pershing Ave	1014							0.05							
S President St	921						0.32	0.78							
Wilson Ave	1006*					0.57	1.30	1.76							0.01
Wilson Ave	1018							0.31							
Wilson Ave	1007						0.60	1.06							
S President St	815						0.00	0.46							
S President St	914		0.04	0.34	0.59	0.84	1.05	1.24							
S President St	920			0.21	0.46	0.71	0.92	1.11							
S President St	926					0.06	0.27	0.46							
Pershing Ave	1011						0.40	0.86							
Pershing Ave	1019							0.27							
Pershing Ave	1111			0.01	0.33	0.53	0.68	0.83							
Pershing Ave	1115			0.27	0.59	0.79	0.94	1.09							
Pershing Ave	1215				0.11	0.31	0.46	0.61							
Pershing Ave	1218			0.26	0.58	0.78	0.93	1.08							
Pershing Ave	1222						0.11	0.26							
Pershing Ave	1302					0.04	0.19	0.34							
Pershing Ave	1304					0.09	0.24	0.39							
Blanchard St	904*						0.07	0.22							0
S Williston St	824*			0.29	0.61	0.81	0.96	1.11							0.68
Pershing Ave	1119		0.39	0.97	1.29	1.49	1.64	1.79							
Wilson Ave	1407		0.01	0.13	0.20	0.28	0.38	0.57							
Wilson Ave	1504							0.08							
Wilson Ave	1512						0.05	0.24							
Wilson Ave	1513							0.18							
Wilson Ave	1410						0.02	0.21							
Elm St	1504							0.16							
Elm St	1516				0.05	0.44	0.61	0.81							
Taft Ave	1106						0.07	0.22							

*Floodproofing needed to remove this structure completely from the 100-yr inundation area. See floodproofing recommendations that follow in Table 8.

The engineer's estimated opinion of probable construction cost for this alternative is $11,437,300 and includes the cost of grading improvements at Pond A (assuming a vertical expansion, and assuming no pump improvements are needed). The additional cost to floodproof three structures is estimated as $25,000.

Proposed Alternative 2 (East): Conveyance & Private Property Storage

Alternative 2 consists of excavating the existing depressional area located between Pershing Ave., Elm St., Weaver Ct., and President St, to provide additional storage. This alternative also includes installing additional 48" storm sewers to drain the depressional areas near Pershing Ave. and Williston St. and near President St. and Pershing Ave. to the proposed storage area. A proposed outlet pipe is also required to drain the proposed storage area to the existing 54" storm sewers along President St.

This alternative reduces the 100-year WSEL below the low entry elevations at 27 of 33 structures that flood in the existing condition, but Alternative 2 improvements would still result water surface elevations that are above the low entry elevations at six structures in the 100-year flood, although flood depths are reduced as shown in Table 7. To protect those structures from the 100-year flood would require larger basins and storm sewers, and the incremental cost would exceed the cost of the six properties themselves. Therefore, it is recommended that these structures be floodproofed or purchased.

It should be noted that four of these six structures' low entry elevation is the garage opening of a split level structure, and the analysis assumes the living space elevation is equal to the garage opening elevation. The lower level on a split level structure can be even with the garage but can also be higher than the garage elevation. An interior survey of the garages and houses was not performed. This alternative would require further investigation to determine the elevation of the lower level floor; if higher than the garage elevation, floodproofing may not be necessary.

This alternative 2 (east) proposed the new flood basin at the southwest corner of Pershing and President. This location was chosen because it can be utilized without needing to remove any housing structures, although it will require acquisition of the rear yards of several properties. We explored the options of locating the storage on the east side of President, either north or south of Pershing. This would require acquisition of full properties including structure removal, however, the basin could be located where some of the flooding occurs. This location would remove those homes from flooding entirely, and, provide storage to benefit the remainder of the neighborhood. The hydraulic impact of the relocated storage is very similar, regardless of location in the vicinity of this intersection. The exact location can be determined in preliminary engineering, following discussions with the City and possibly the neighborhood to determine the location that appears most feasible for acquisition and construction.

Table 7 – Summary of Existing and Proposed Flood Depths with Alternative 2 (East)

		Existing Flood Depth Above Low Entry Elevation							Proposed Flood Depth Above Low Entry Elevation						
Street	**Number**	**1-yr**	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**	**1-yr**	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**
S President St	903							0.11							
Pershing Ave	1006						0.48	0.94							
Pershing Ave	1010						0.52	0.98							
Pershing Ave	1014							0.05							
S President St	921						0.32	0.78							
Wilson Ave	1006					0.57	1.30	1.76							
Wilson Ave	1018							0.31							
Wilson Ave	1007						0.60	1.06							
S President St	815						0.00	0.46							
S President St	914		0.04	0.34	0.59	0.84	1.05	1.24							
S President St	920			0.21	0.46	0.71	0.92	1.11							
S President St	926					0.06	0.27	0.46							
Pershing Ave	1011						0.40	0.86							
Pershing Ave	1019							0.27							
Pershing Ave	1111			0.01	0.33	0.53	0.68	0.83							
Pershing Ave	1115			0.27	0.59	0.79	0.94	1.09							
Pershing Ave	1215				0.11	0.31	0.46	0.61							
Pershing Ave	1218			0.26	0.58	0.78	0.93	1.08							
Pershing Ave	1222						0.11	0.26							
Pershing Ave	1302					0.04	0.19	0.34							
Pershing Ave	1304					0.09	0.24	0.39							
Blanchard St	904						0.07	0.22							
S Williston St	824			0.29	0.61	0.81	0.96	1.11							
Pershing Ave	1119		0.39	0.97	1.29	1.49	1.64	1.79							0.36
Wilson Ave	1407		0.01	0.13	0.20	0.28	0.38	0.57				0.24	0.24	0.34	0.45
Wilson Ave	1504							0.08							
Wilson Ave	1512						0.05	0.24						0.01	0.12
Wilson Ave	1513							0.18							0.06
Wilson Ave	1410						0.02	0.21							0.09
Elm St	1504							0.16							
Elm St	1516				0.05	0.44	0.61	0.81					0.18	0.48	0.64
Taft Ave	1106						0.07	0.22							

*Floodproofing needed to remove this structure completely from the 100-yr inundation area. See floodproofing recommendations that follow in Table 8.

The engineer's estimated opinion of probable construction cost for this alternative is $6,734,100 and includes an estimate of the property acquisition for the rear yard parcels. The additional cost to floodproof six structures is estimated as $47,240.

Alternative 2 for the East Pershing/Elm area can be seen on Exhibit 11 and proposed inundation areas can be seen on Exhibit 15.

Proposed Alternative 3 & 4 (East): Floodproofing & Buy-Out

Additional alternatives that were also considered to reduce flooding include floodproofing (Alternative 3) or purchasing structures (Alternative 4) damaged in the 100-year storm event.

A total of 33 properties would need to be floodproofed or purchased to reduce flooding in the 100-year storm event.

Floodproofing 33 homes would cost approximately $1,133,040. If this alternative was chosen, a more detailed investigation would need to be done to determine the specific floodproofing measures required for each structure. Based on the depth of flooding and the source of the low entry, the following floodproofing measures appear feasible:

Table 8 – Floodproofing Recommendations (East)

Street	Number	Low Entry Elevation	Existing Depth of 100-yr Flood Above Low Entry	Proposed Alt 1 Depth of 100-yr Flood Above Low Entry	Proposed Alt 2 Depth of 100-yr Flood Above Low Entry	Location of Low Entry	Potential Floodproofing Remedy
Blanchard St	904	759.13	0.22			Foundation	*See Note
Elm St	1504	755.88	0.16			Garage	Driveway Berm
Elm St	1516	755.23	0.81		0.64	Garage	Driveway Berm
Pershing Ave	1006	758.84	0.94			Window/Well	Raised Window Wells
Pershing Ave	1006	759.45	0.33			Window/Well	Raised Window Wells
Pershing Ave	1006	759.45	0.33			Window/Well	Raised Window Wells
Pershing Ave	1010	758.80	0.98			Window/Well	Raised Window Wells
Pershing Ave	1010	758.83	0.95			Window/Well	Raised Window Wells
Pershing Ave	1010	758.7	1.08			Window/Well	Raised Window Wells
Pershing Ave	1010	758.7	1.08			Window/Well	Raised Window Wells
Pershing Ave	1010	758.7	1.08			Window/Well	Raised Window Wells
Pershing Ave	1011	758.92	0.86			Window/Well	Raised Window Wells
Pershing Ave	1011	759.12	0.66			Foundation	Additional Drainage Improvements*
Pershing Ave	1014	759.73	0.05			Window/Well	Raised Window Wells
Pershing Ave	1019	759.51	0.27			Garage	Driveway Berm
Pershing Ave	1111	758.52	0.83			Window/Well	Raised Window Wells
Pershing Ave	1115	758.26	1.09			Window/Well	Raised Window Wells
Pershing Ave	1115	759.11	0.24			Window/Well	Raised Window Wells
Pershing Ave	1119	757.56	1.79	0.68	0.36	Window/Well	Raised Window Wells

Street	Number	Low Entry Elevation	Existing Depth of 100-yr Flood Above Low Entry	Proposed Alt 1 Depth of 100-yr Flood Above Low Entry	Proposed Alt 2 Depth of 100-yr Flood Above Low Entry	Location of Low Entry	Potential Floodproofing Remedy
Pershing Ave	1215	758.74	0.61			Window/Well	Raised Window Wells
Pershing Ave	1218	758.27	1.08			Door	Removable Flood Shield (for door)
Pershing Ave	1218	759.12	0.23			Foundation	Additional Drainage Improvements*
Pershing Ave	1222	759.09	0.26			Foundation	Elevate Structure
Pershing Ave	1302	759.01	0.34			Window/Well	Raised Window Wells
Pershing Ave	1304	758.96	0.39			Window/Well	Raised Window Wells
Pershing Ave	1308	759.24	0.11			Foundation	Elevate Structure
S President St	815	759.32	0.46			Window/Well	Raised Window Wells
S President St	815	759.32	0.46			Window/Well	Raised Window Wells
S President St	815	759.32	0.46			Window/Well	Raised Window Wells
S President St	815	759.32	0.46			Window/Well	Raised Window Wells
S President St	815	759.34	0.44			Window/Well	Raised Window Wells
S President St	903	759.67	0.11			Window/Well	Raised Window Wells
S President St	903	759.67	0.11			Window/Well	Raised Window Wells
S President St	903	759.67	0.11			Window/Well	Raised Window Wells
S President St	903	759.67	0.11			Window/Well	Raised Window Wells
S President St	903	759.67	0.11			Window/Well	Raised Window Wells
S President St	914	758.57	1.24			Window/Well	Raised Window Wells
S President St	920	758.70	1.11			Window/Well	Raised Window Wells
S President St	920	759.27	0.54			Window/Well	Raised Window Wells
S President St	920	759.27	0.54			Foundation	See Note*
S President St	920	759.25	0.56			Window/Well	Raised Window Wells
S President St	920	758.72	1.09			Window/Well	Raised Window Wells
S President St	921	759.00	0.78			Foundation	See Note*
S President St	921	759.2	0.58			Window/Well	Raised Window Wells
S President St	921	759.2	0.58			Lookout	Raised Window Wells
S President St	921	759.2	0.58			Lookout	Raised Window Wells
S President St	921	759.2	0.58			Window/Well	Raised Window Wells
S President St	926	759.35	0.46			Window/Well	Raised Window Wells
S President St	926	759.35	0.46			Window/Well	Raised Window Wells
S President St	926	759.35	0.46			Window/Well	Raised Window Wells
S President St	926	759.38	0.43			Window/Well	Raised Window Wells
S President St	926	759.35	0.46			Window/Well	Raised Window Wells

Street	Number	Low Entry Elevation	Existing Depth of 100-yr Flood Above Low Entry	Proposed Alt 1 Depth of 100-yr Flood Above Low Entry	Proposed Alt 2 Depth of 100-yr Flood Above Low Entry	Location of Low Entry	Potential Floodproofing Remedy
S Williston St	824	758.24	1.11	0.00		Door	Removable Flood Shield (for door)
S Williston St	824	758.34	1.01			Foundation	See Note*
Wilson Ave	1006	758.02	1.76	0.01		Garage	Driveway Berm or Removable Flood Shield
Wilson Ave	1007	758.72	1.06			Door	Removable Flood Shield (for door)
Wilson Ave	1007	759.5	0.28			Foundation	Additional Drainage Improvements*
Wilson Ave	1007	759.7	0.08			Lookout	Raised Window Wells
Wilson Ave	1007	759.73	0.05			Lookout	Raised Window Wells
Wilson Ave	1018	759.47	0.31			Garage	Driveway Berm
Wilson Ave	1407	757.41	0.57		0.45	Door	Removable Flood Shield (for door)
Wilson Ave	1410	757.77	0.21		0.09	Garage	Driveway Berm
Wilson Ave	1504	757.90	0.08			Garage	Driveway Berm
Wilson Ave	1512	757.74	0.24		0.12	Garage	Driveway Berm
Wilson Ave	1513	757.80	0.18		0.06	Garage	Driveway Berm
Taft Ave	1106	759.13	0.22			Window/Well	Driveway Berm

*Note: As with the west alternatives, some homes have a surveyed foundation elevation that is lower than the expected water surface elevation. At most of these locations, the doors and windows were surveyed separately and those low entry elevations were compared to water surface elevations; protecting the doors and windows may be adequate to reduce flood potential without needing to separately floodproof the foundation. However, a cost of $100,000 is added to each of these structures in case a detailed architectural and structural review of the home suggests additional measures are required.

At other locations, the top of foundation is below the water surface elevation, with no other sources of entry. A detailed architectural and structural review of the home is required to determine whether flood waters can enter the home and cause damage. A cost of $140,000 is added to each of these structures to allow for structural elevation as a worst-case floodproofing measure. Less costly measures, such as berming or temporary flood barriers, may also provide protection.

The approximate cost for a buy-out of 33 homes is approximately $8,680,200. These costs are based on home assessment values found on the DuPage County website. This number is not based on a current professional appraisal and is subject to change.

Structures that are damaged in the 2-year to 100-year storm events and require floodproofing or a buy-out can be seen on Exhibit 12.

Proposed Alternative 5 (East): Roadway Profile Adjustment

Alternative 5 consists of adjusting the roadway profile to provide an overland overflow route for ponding runoff in Problem Areas E, F, G, and H, to reduce ponding and subsequent structural flooding within these problem areas.

The proposed profile adjustment begins on Pershing Avenue, just east of President. The route continues east to the intersection of Pershing Avenue and Blanchard Street, south to Wilson Ave and Blanchard Street, then east to Wilson Avenue and Prospect Street, and finally south to Prospect Street and Coolidge Avenue where runoff will overflow to Lake A.

The alternative includes lowering the profile to an elevation six inches lower than the critical low entry elevations for the adjacent problem areas, to provide adequate flow capacity for ponded runoff. This translates to lowering the existing roadway profile by 0.5 to 2 feet for some stretches of the proposed improvements.

Because the roadway profile adjustment would only remove runoff ponded on the pavement, Alternative 5 would also require the installation of a storm sewer from the depressional area at Problem Area D and may also require the installation of a storm sewer from the depressional area in the rear yards located in Problem Area E. These areas would require an additional investigation into the size and location of the outlet pipes to ensure adjacent structures are not damaged. The outlet pipes will need to be installed through private property and therefore will require an easement.

Alternative 5 would also likely require the following modifications to the existing roadway and right-of-way:

- Installation of retaining walls for properties along the proposed overland flow route where there isn't enough space to tie-in the back of curb elevation to the right-of-way elevation at reasonable slopes (3H:1V or flatter), or, easements to perform grading within the front yards of the homes to provide the necessary tie-ins.
- Adjustment to existing residential driveways (there is also the potential for very steep driveways in the final condition).
- Adjustment to the profile of roadways perpendicular to the overland flow route (necessary to tie in to the proposed roadway profile, specifically at the intersections where the proposed overland flow route crosses).
- Adjustment to sidewalks to tie-in to proposed grades and ensure ADA compliance.
- Depth of existing utilities along the proposed roadway improvements are not fully known, and therefore there are potential utility relocations for water mains, water service lines, fire hydrants, storm sewers, storm structures, sanitary sewers, sanitary structures, sanitary service leads, gas lines, above ground and underground electric lines, etc.
- Removal and replacement of existing parkway trees, streets lights, mailboxes, roadway signage, landscaping, etc.

Because this alternative drains a large amount of runoff that was previously ponded, additional modifications at Lake A are also required to avoid increasing flow rates downstream of Lake A and impacting downstream properties. Determining the additional volume would require

additional modeling. Alternative 1 – East required approximately 11 acre-feet and it is expected that Alternative 5 may require a similar volume, which can be determined during detailed modeling in preliminary engineering.

Alternative 5 for the East Pershing/Elm area can be seen on Exhibits 16 through 21.

A rough ballpark estimate of the probable construction cost is estimated as $3.5M, including sanitary service and water service repairs but excluding work to the mains. The estimate also assumes all work can be completed within the ROW and no retaining walls are needed. The estimate is very conceptual, as the magnitude of ancillary improvements is undefined, and the actual estimate is likely to be higher once the full extent of ancillary improvements is identified. This alternative is expected to benefit 26 of the 33 homes with structural damage (it does not protect homes at Wilson & President). The cost per benefitting structure is $134,615.

The deepest adjustment to profile happens on Pershing between President and Williston, where the roadway profile requires an adjustment of over two feet. This provides an overflow route for the intersection of Pershing and President, which results in damage to seven homes. If this portion of the roadway improvements was eliminated, the cost would be reduced to approximately $3.2M based on the estimate, although the actual cost difference may be greater than shown due to the reduction in anticipated conflicts with underground utilities and reduction in other ancillary costs. 18 homes benefit from this alternative, at a cost of $177,778 per benefitting structure.

This alternative should be considered if and when the affected roads are scheduled for rehabilitation, to leverage roadway funding for a stormwater benefit.

Construction Estimate Summary

Engineer's estimated opinions of probable construction cost (EEOPCC) were prepared for each project alternative, reflecting the conceptual nature of the alternatives.

These estimates are shown in the Appendix: Engineer's Estimated Opinion of Probable Construction Cost.

Unit Costs and Assumptions

Unit costs were developed for the project by V3's professional cost estimators, and applied to all alternatives within this project. The estimates provide a planning-level cost estimate, and include many assumptions, reflective of the conceptual nature of the alternatives. These assumptions include:

- It is assumed that all earthwork must be hauled off. If space exists on a parcel to store the excavated material, earthwork costs could be reduced substantially.
- All Earth Excavation budgets are predicated on disposal at local CCDD facilities. They do not include trucking or disposal costs for subtitle D landfill disposal.
- Property acquisition costs for residential property acquisition were obtained from the Assessed value of the property, as obtained online in August 2017.
- The cost of native plantings includes the cost to plant each basin and perform three years of maintenance and monitoring.

- Pavement cost is based on patching only. Complete roadway replacement or rehabilitation is not included, except for streets that require full replacement.
- Pavement section for patching assumes a typical section, and may require refinement based on Wheaton's preferences and requirements.
- Asphalt Material Escalation is not included in this estimate. The Current Bituminous Price Index per IDOT is $336.36.
- This estimate does not include escalation factors for labor, fuel, equipment etc., all pricing is in Summer 2017 Dollars.
- This estimate does not include: Water Main Installation, ROW Acquisition, or Soft Costs not specifically listed in the individual detailed estimate breakdowns.
- The estimates include soft costs such as:
  - Topographic Survey, Construction Layout and As-Builts: 3%
  - Design & Permitting, 10%
  - Construction Administration, 6%
  - P&P Bonds, Insurance, & General Conditions, 4.25%
  - Contractor Mobilization, 6%
  - Traffic Control, 1%
  - Environmental Testing, 1%
- The estimates include a 20% general construction contingency to reflect the conceptual nature of the designs.

Opportunities for Funding Efficiencies

To achieve funding efficiencies, it is recommended that the storm sewer alternatives be constructed in conjunction with planned roadway improvement projects. This reduces the overall cost of the stormwater project, as the costs associated with the contractor's mobilization, pavement reconstruction or rehabilitation, site restoration, maintenance of traffic, and some utility work would be necessary to achieve the roadway improvement project goals. The incremental cost of the stormwater project is then the cost of any new or upsized sewer, utility trench, earthwork excavation, and drainage structures beyond those required by the roadway improvement project.

Summary of Estimated Costs

Table 9 and 10 below lists the Engineer's Opinion of Probable Construction Cost for each alternative as well as the cost per structured benefitted. As previously stated, there was no cost prepared for the West Pershing/Elm area Alternative 1 because it was not a considered a feasible alternative.

Table 9 – West Pershing Elm Cost-Benefit Summary

Storm Event	West Pershing/Elm						
	Number of Damaged Properties	Alt 2: Conveyance, Private Property Storage, and Flood-proofing Two Structures	Cost Per Structure Benefitted	Alt 3: Total Flood-proofing Cost	Cost Per Structure Benefitted	Alt 4: Total Buy-Out Cost	Cost Per Structure Benefitted
1-year	0	-	-	$0	-	$0	-
2-year	1	-	-	$2,000	$2,000	$182,900	$182,900
5-year	3	-	-	$215,000	$71,667	$556,100	$185,367
10-year	3	-	-	$215,000	$71,667	$556,100	$185,367
25-year	3	-	-	$215,000	$71,667	$556,100	$185,367
50-year	7	-	-	$241,000	$34,429	$1,645,500	$235,071
100-year	7	$2,827,500 for infrastructure project + $105,000 floodproofing	$418,929	$341,000	$48,714	$1,841,100	$263,014

Table 10 - East Pershing Elm Cost-Benefit Summary

Storm	Number of Damaged Properties	Alt 1: Convey-ance and Pond A Storage	Cost Per Structure Benefitted	Alt 2: Convey-ance & Private Property Storage	Cost Per Structure Benefitted	Alt 3: Total Flood-proofing Cost	Cost Per Structure Benefitted	Alt 4: Total Buy-Out Cost	Cost Per Structure Benefitted	Alt 5: Roadway Profile Improve-ments	Cost Per Structure Benefitted
1-year	0	-	-	-	-	$0	-	$0	-	-	-
2-year	3	-	-	-	-	$7,000	$2,333	$837,500	$279,167	-	-
5-year	8	-	-	-	-	$27,000	$3,375	$2,435,100	$304,388	-	-
10-year	10	-	-	-	-	$39,560	$3,956	$2,935,900	$293,590	-	-
25-year	14	-	-	-	-	$173,560	$12,397	$3,871,100	$276,507	-	-
50-year	25	-	-	-	-	$828,240	$33,130	$6,750,900	$270,036	-	-
100-year	33	$11,437,300 for CIP + $25,000 flood-proofing	$347,342	$6,734,100 for CIP + $47,200 flood-proofing	$205,495	$1,133,040	$34,335	$8,680,200	$263,036	$3,500,000*	$134,615*

**cost is more conceptual than others presented herein and likely will increase, due to uncertainty with utility conflicts, retaining walls, and other ancillary costs.*

Other Suggested Improvements and Considerations

Other non-project specific improvements and programs are recommended for the drainage area.

Funding or Cost Share Programs for GIs or BMPs

Some residents within the study area may be interested in private property GIs or BMPs. The City of Wheaton may wish to consider a program through which financial funding assistance is made available to individual homeowners to help residents with these costs. This could include financial assistance for installation of GI/BMPs that provide storage to reduce stormwater runoff (such as permeable pavers, rain cisterns, or rain gardens, rain barrels), or this could include financial assistance for residents who wish to implement floodproofing measures or devices on their own, apart from a City project.

Additional Inlets

A more in depth review of inlets should be performed for the study area during Preliminary Engineering to determine if it would benefit from additional storm sewer inlets to deliver flow into the existing (or proposed) storm sewer system. If it is determined additional inlets would be beneficial, additional inlets and/or higher capacity inlets should be specified to remove water from the street and deliver it to the storm sewer system more efficiently as roadway projects are completed throughout the study area. This will reduce the amount of flow that bypasses the storm sewer inlet grates and flows downstream, often creating or exacerbating a drainage problem.

The additional inlets will not be able to deliver more flow to the sewer than the sewers can handle. When the sewers reach capacity, water will surcharge onto the streets and flow down the streets to the low areas, which is the same as today's existing condition. Additional inlets could potentially reduce the amount of water flowing to low areas in the smaller storm events. They will also allow for faster draining of ponded waters during larger storm events, after the peaks have passed and the sewers have capacity.

Real Estate Considerations

Many of the projects require stakeholder coordination and cooperation, particularly with respect to real estate considerations. The proposed storage locations are not on public property, due to a lack of open public spaces available for storage. Property purchase and/or easements will be required to use the spaces. In all cases, the current use of the open space was considered and the proposed storage was designed to reduce impacts to the space to the extent possible, but the exact location and shape of the storage area can be tweaked to better suit the needs of the property owners.

Utility Considerations

Many of the proposed improvements will impact existing utilities. No utility information was available during this study, so utility considerations and explorations will be required for all proposed alternatives, particularly the alternatives that include large diameter pipes, as there is a higher likelihood for a large diameter pipe to conflict with an existing utility (versus a smaller diameter proposed pipe). If a utility conflict is identified, it could be mitigated in several ways, dependent on the nature of the conflict: by shifting the location of the proposed storm sewer; by

changing the material of the proposed storm sewer; by constructing a proposed siphon at the crossing; or by relocating the existing utility. Existing utility services may also be impacted by proposed alternatives, and may require replacement or reconnection.

Wetland Considerations

The proposed alternatives were not evaluated to determine the potential presence of waters of the United States (WOUS), which include wetlands under US Army Corp of Engineers jurisdiction, or isolated water of DuPage County which may be affected and any potential USACE permit requirements. It is unlikely that any jurisdictional wetlands would be present in the proposed backyard storage areas, within the manmade Pond A, or along the proposed storm sewer alignment. If a proposed alternative is chosen, a detailed wetland determination and impact review should be completed.

CCDD Considerations

All of the various project alternatives are expected to involve earth excavation and disposal. Storm sewer improvements may involve smaller volumes of earth excavation for the trench, and the proposed storage areas and expanded storage areas will involve larger volumes of earth excavation and disposal. An "uncontaminated soil" evaluation of these construction spoils should be performed for each project site, upon commencement of any alternative. The results of the uncontaminated soil evaluation have the potential to significantly increase earthwork cost if data testing shows that the material cannot be accepted by a CCDD facility.

Geotechnical Considerations

A geotechnical evaluation was not performed. Groundwater issues and soil stability issues are not expected at any of the proposed project alternative sites, but each site should be evaluated in detail upon selection for design, to ensure proper consideration of these factors. High groundwater could reduce potential to dig Lake A to a deeper depth.

The cost estimates assume soils are suitable for the proposed projects and special geotechnical features or mitigation is not required by any of the project alternatives.

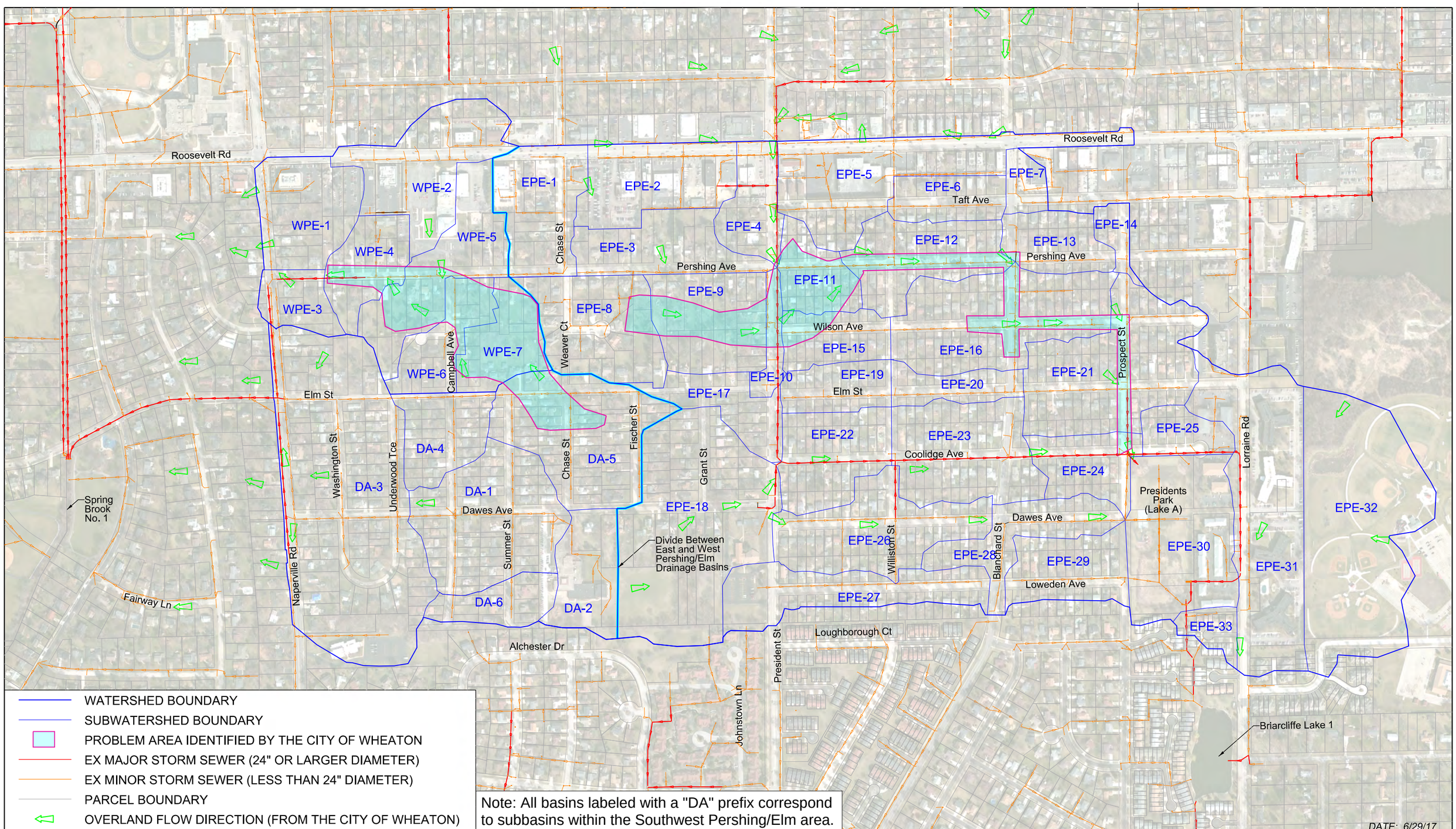
Recommendations

Based on the cost per benefitting structure, the floodproofing alternatives appear most cost effective in the West Pershing/Elm area. However, floodproofing only provides protection to the homes that incorporate floodproofing measures. The proposed engineering alternatives provide many other benefits, including reductions in yard flooding of many properties not identified in the tables, reductions in flood depths on streets, reductions in traffic impacts, reduction in impacts to commercial and industrial properties and business operations, improved emergency access, and other similar benefits. The value and need for these ancillary benefits should also be considered when evaluating the different project alternatives.

In the East area, floodproofing is also shown as the most cost-effective alternative, when evaluating benefits solely on the number of homes that are removed from flooding during the 100-year storm. As in the West area, this analysis excludes benefits associated with reduced yard flooding, street flooding, traffic impacts, and improvements to quality of life. Engineering Alternative 2 (storage and conveyance) provides a cost per benefitting structure that is less than the value of the homes, and therefore this may be a cost effective solution if an engineered alternative is preferred.

Additionally, all alternatives shown are designed to protect to the 100-year flood, per the project goals. If a lower level of protection is acceptable, the proposed pipes and storage areas could be reduced in size, resulting in a smaller project cost but increasing the number of homes that would require floodproofing measures. Depending on the level of protection that is acceptable to the City from the engineering alternative, there may be a more cost effective balance between engineering alternative and floodproofing alternative, which could be explored during preliminary engineering.

EXHIBITS



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PERSHING/ELM FLOOD PRONE AREA STUDY

WHEATON ILLINOIS

EXISTING CONDITIONS OVERVIEW EXHIBIT

SCALE: 1"= 500'

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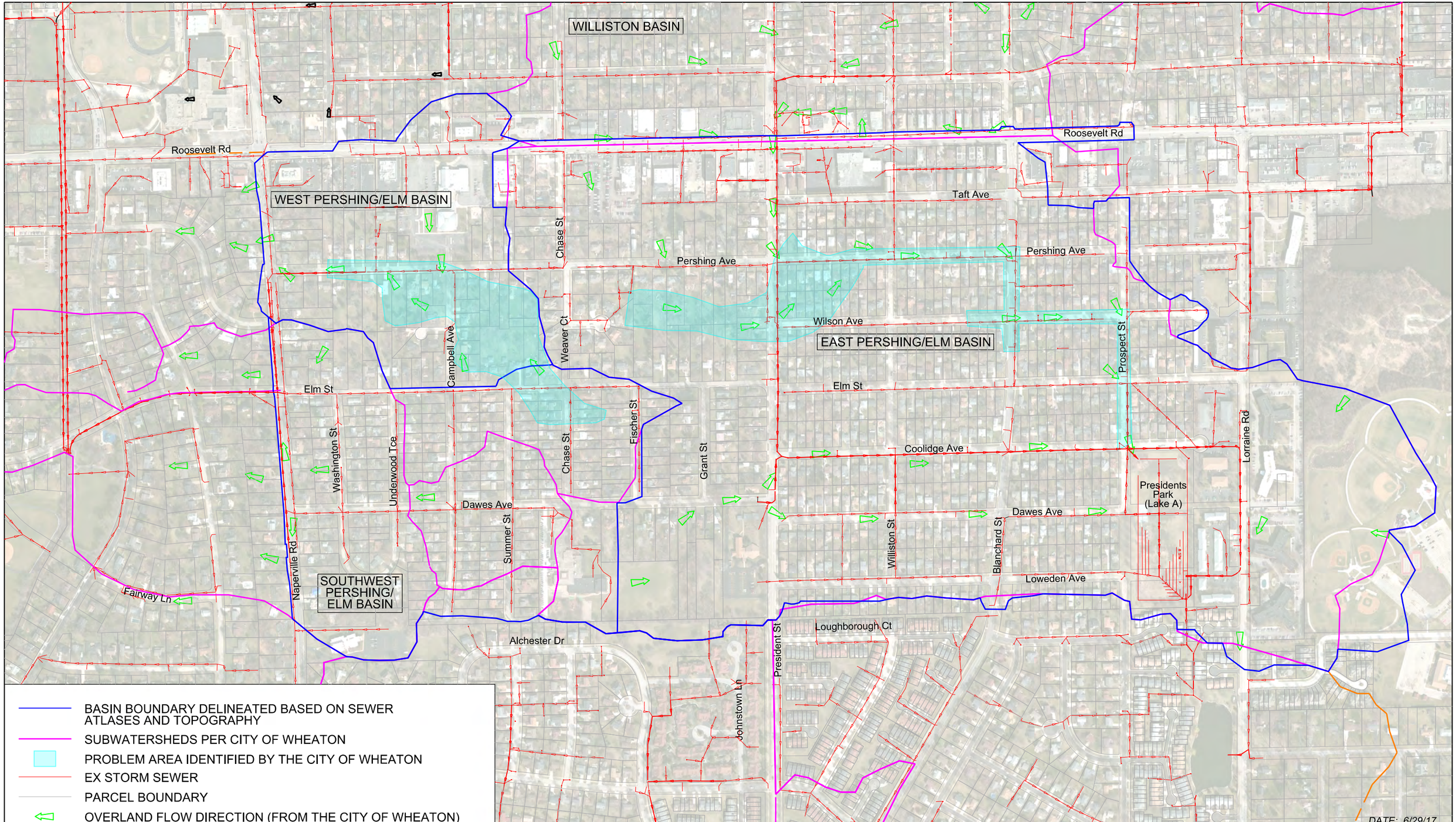
EXHIBIT 1



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PERSHING/ELM FLOOD PRONE AREA STUDY

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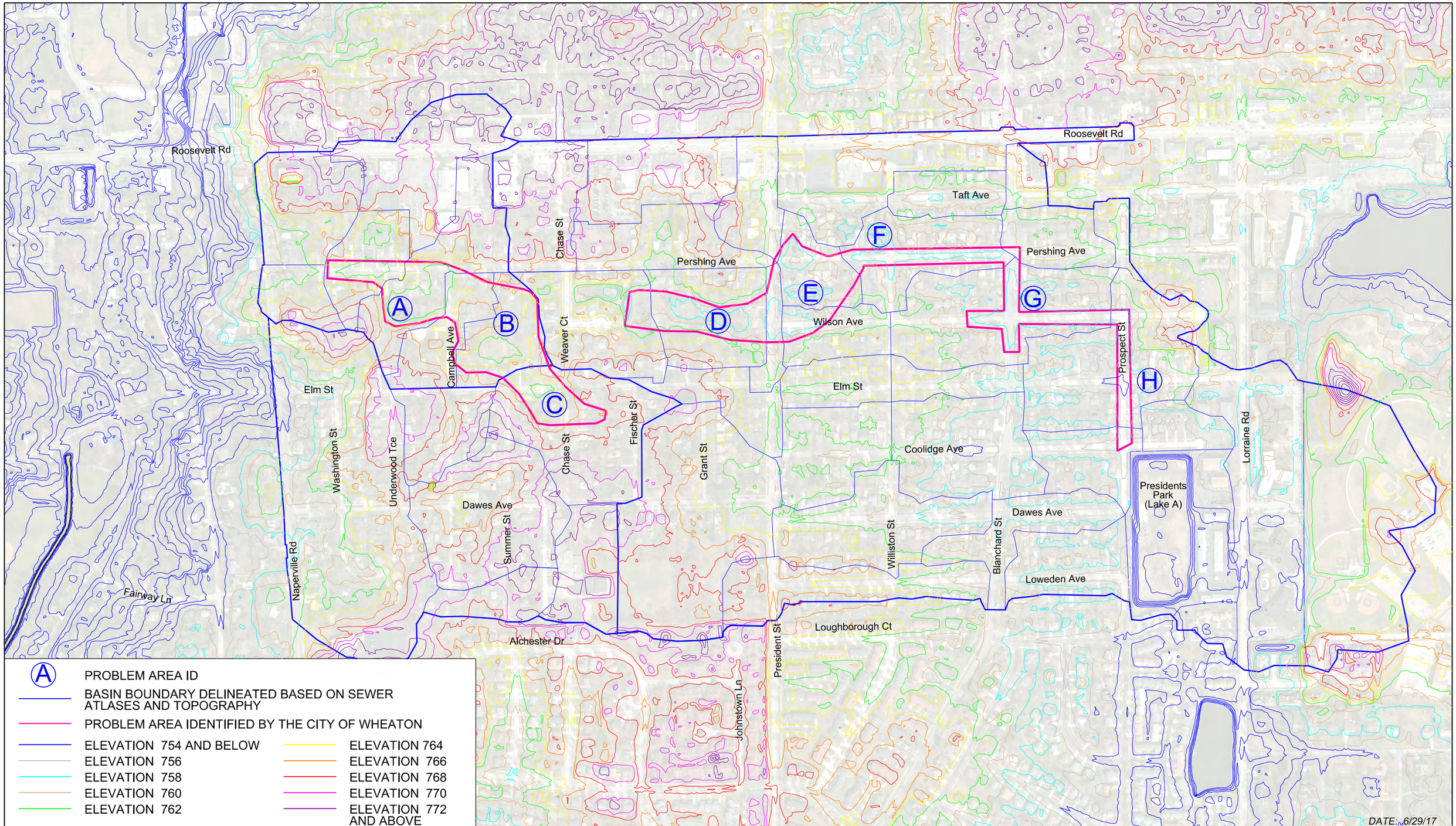
SUBWATERSHED AREA COMPARISON EXHIBIT

SCALE: 1"= 500'

$FILE$ 1/2/2018 7:38:

EXHIBIT 2



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TOPOGRAPHIC CHARACTER EXHIBIT

SCALE: 1"= 500'

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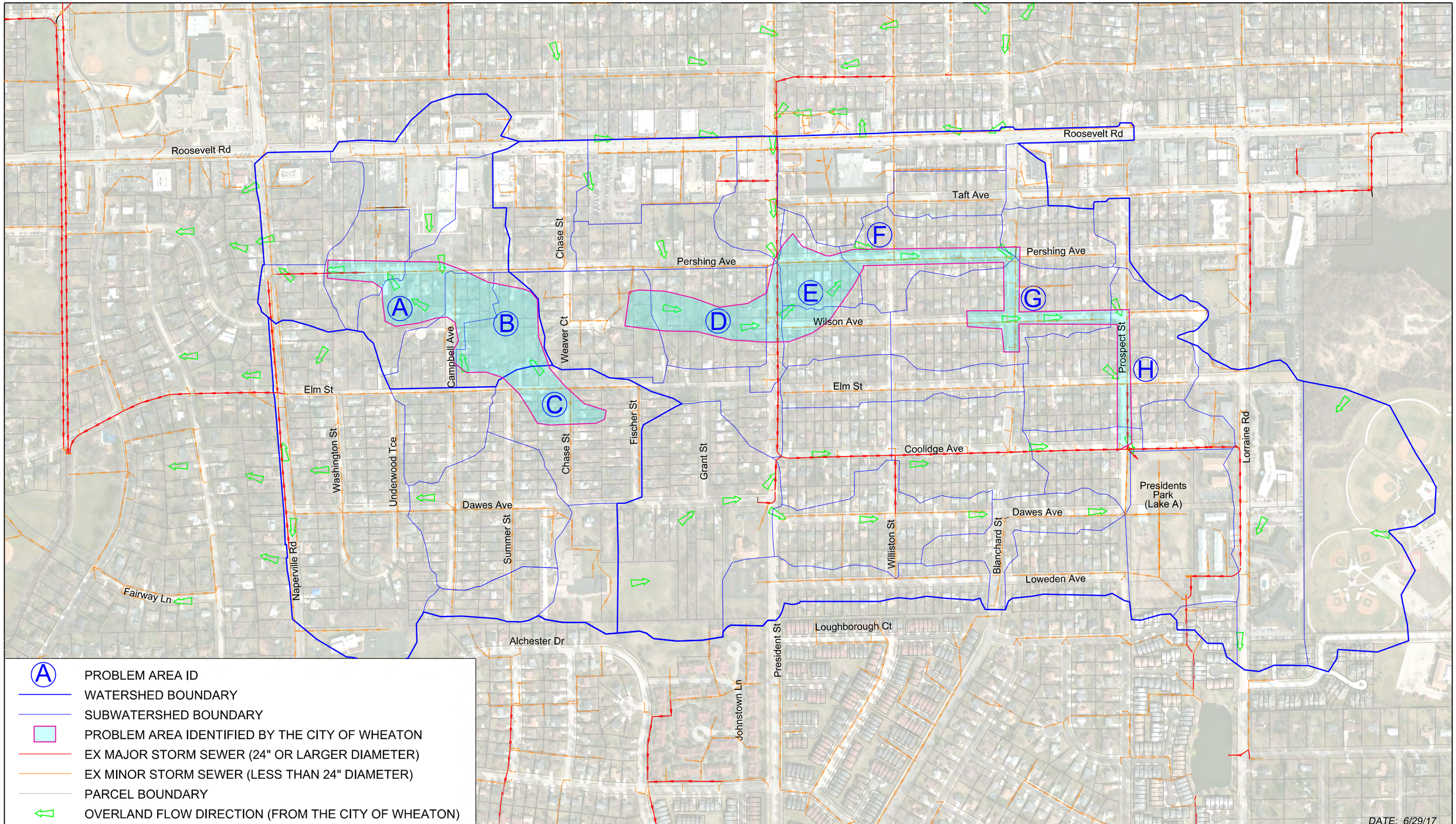

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WHEATON ILLINOIS

PROBLEM AREA EXHIBIT

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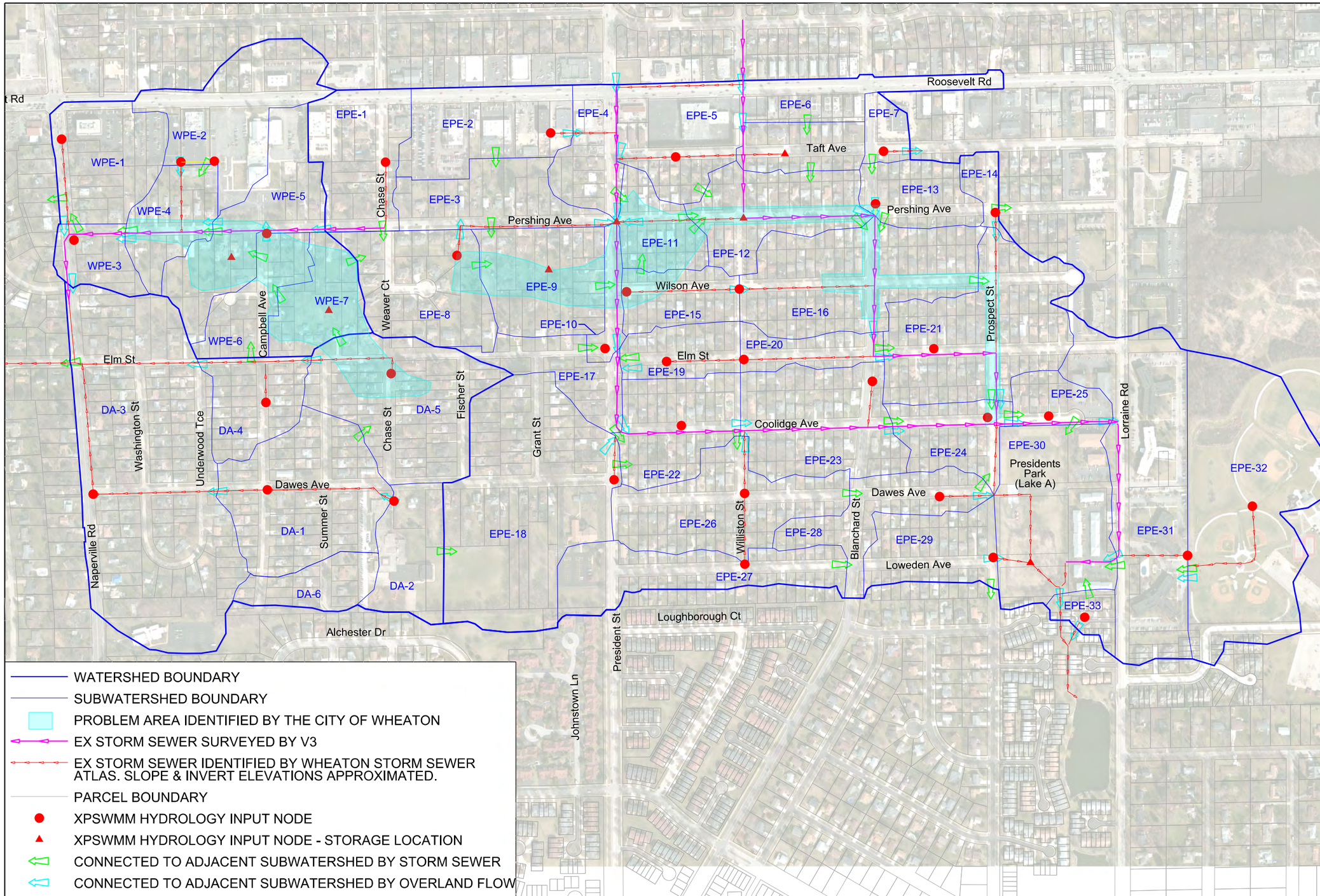

Sub-basin ID	Area (ac)	Weighted CN	Tc (min)
WPE-1	7.41	89	16
WPE-2	9.64	92	14
WPE-3	3.05	85	12
WPE-4	4.72	86	9
WPE-5	8.76	88	15
WPE-6	4.63	85	14
WPE-7	4.83	85	15
EPE-1	7.43	90	15
EPE-2	8.05	94	13
EPE-3	6.64	85	19
EPE-4	4.31	89	13
EPE-5	12.26	93	14
EPE-6	3.73	91	11
EPE-7	1.69	93	9
EPE-8	8.87	85	13
EPE-9	7.94	85	15
EPE-10	1.72	85	10
EPE-11	3.99	85	14
EPE-12	7.54	85	17
EPE-13	4.28	84	15
EPE-14	1.41	81	9
EPE-15	4.08	85	14
EPE-16	13.02	85	16
EPE-17	4.41	85	15
EPE-18	20.54	86	22
EPE-19	3.71	85	15
EPE-20	3.01	85	13
EPE-21	13.66	85	19
EPE-22	6.95	85	20
EPE-23	10.08	85	17
EPE-24	4.66	84	15
EPE-25	2.79	87	19
EPE-26	10.04	85	13
EPE-27	7.97	87	15
EPE-28	5.86	85	19
EPE-29	5.67	85	16
EPE-30	12.15	83	10
EPE-31	16.94	94	14
EPE-32	20.43	75	13
EPE-33	1.67	87	15
DA-1	12.36	86	15
DA-2	5.37	89	19
DA-3	29.64	86	16
DA-4	5.18	85	16
DA-5	12.24	85	18
DA-6	3.48	86	12

Note: All basins labeled with a "DA" prefix correspond to subbasins within the Southwest Pershing/Elm area.

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WHEATON ILLINOIS

EXISTING CONDITIONS XP-SWMM & HYDROLOGIC PARAMETERS EXHIBIT

SCALE: 1"= 500'

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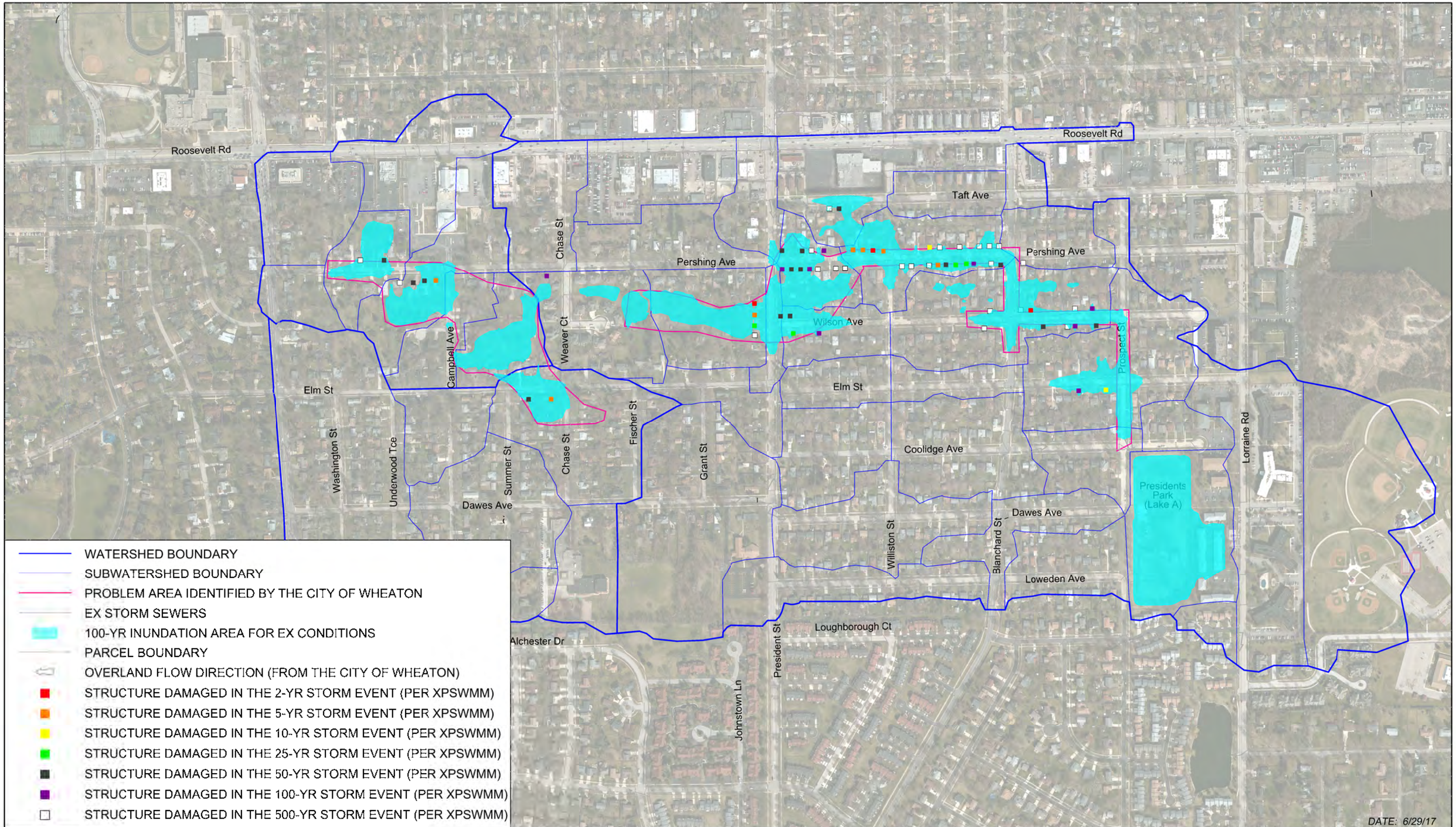
EXHIBIT 5



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PERSHING/ELM FLOOD PRONE AREA STUDY

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100-YR INDUNDATION AREAS AND AFFECTED PROPERTIES EXHIBIT FOR EXISTING CONDITIONS

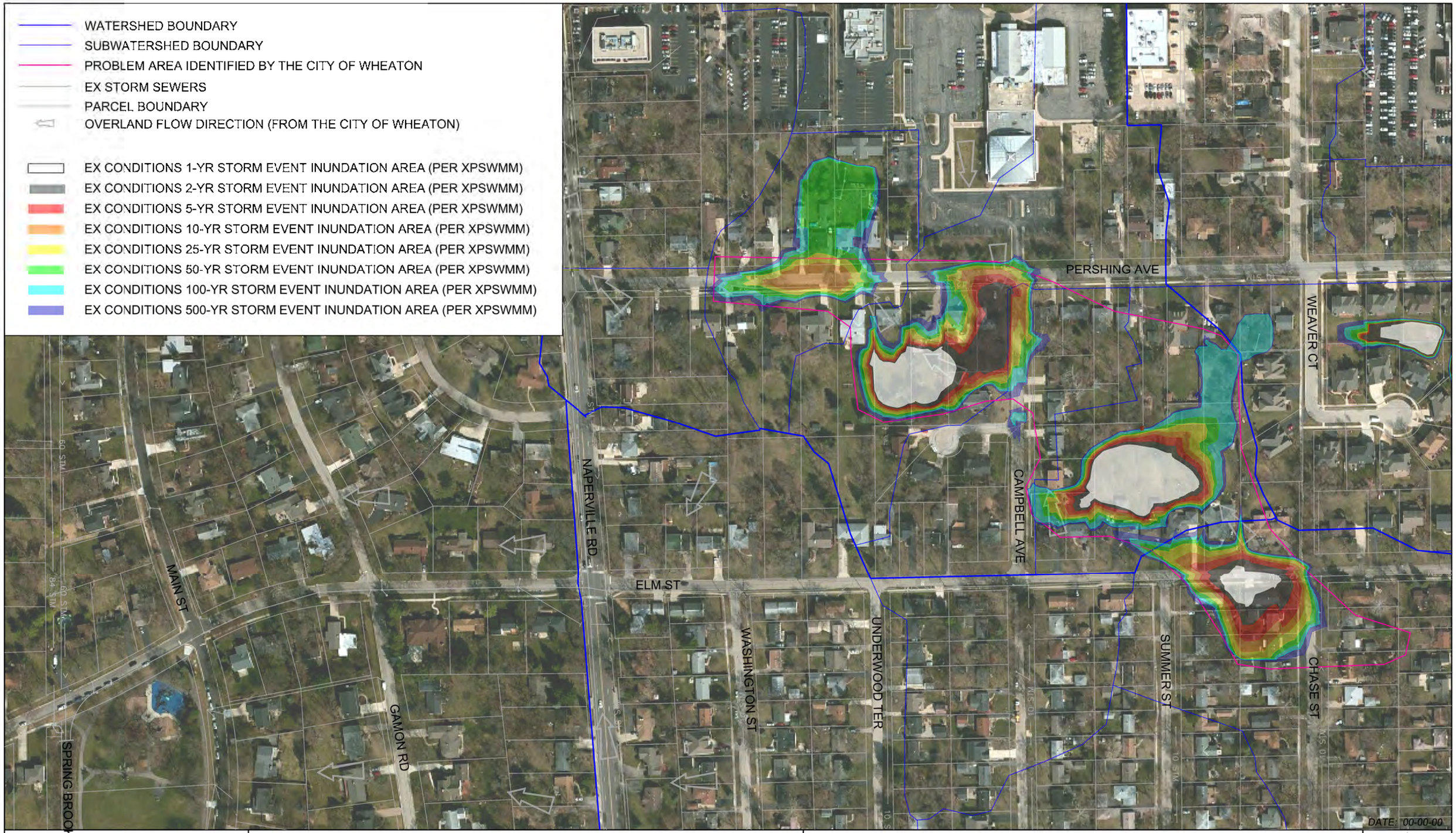
SCALE: 1"= 500'

$FILE$ 4/30/2018 4:4

EXHIBIT 6A

WATERSHED BOUNDARY
SUBWATERSHED BOUNDARY
PROBLEM AREA IDENTIFIED BY THE CITY OF WHEATON
EX STORM SEWERS
PARCEL BOUNDARY
OVERLAND FLOW DIRECTION (FROM THE CITY OF WHEATON)

EX CONDITIONS 1-YR STORM EVENT INUNDATION AREA (PER XPSWMM)
EX CONDITIONS 2-YR STORM EVENT INUNDATION AREA (PER XPSWMM)
EX CONDITIONS 5-YR STORM EVENT INUNDATION AREA (PER XPSWMM)
EX CONDITIONS 10-YR STORM EVENT INUNDATION AREA (PER XPSWMM)
EX CONDITIONS 25-YR STORM EVENT INUNDATION AREA (PER XPSWMM)
EX CONDITIONS 50-YR STORM EVENT INUNDATION AREA (PER XPSWMM)
EX CONDITIONS 100-YR STORM EVENT INUNDATION AREA (PER XPSWMM)
EX CONDITIONS 500-YR STORM EVENT INUNDATION AREA (PER XPSWMM)



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WHEATON ILLINOIS

2-YR THROUGH 500-YR INUNDATION AREAS EXHIBIT, EXISTING CONDITIONS, WEST AREA

SCALE: 1"= 200'

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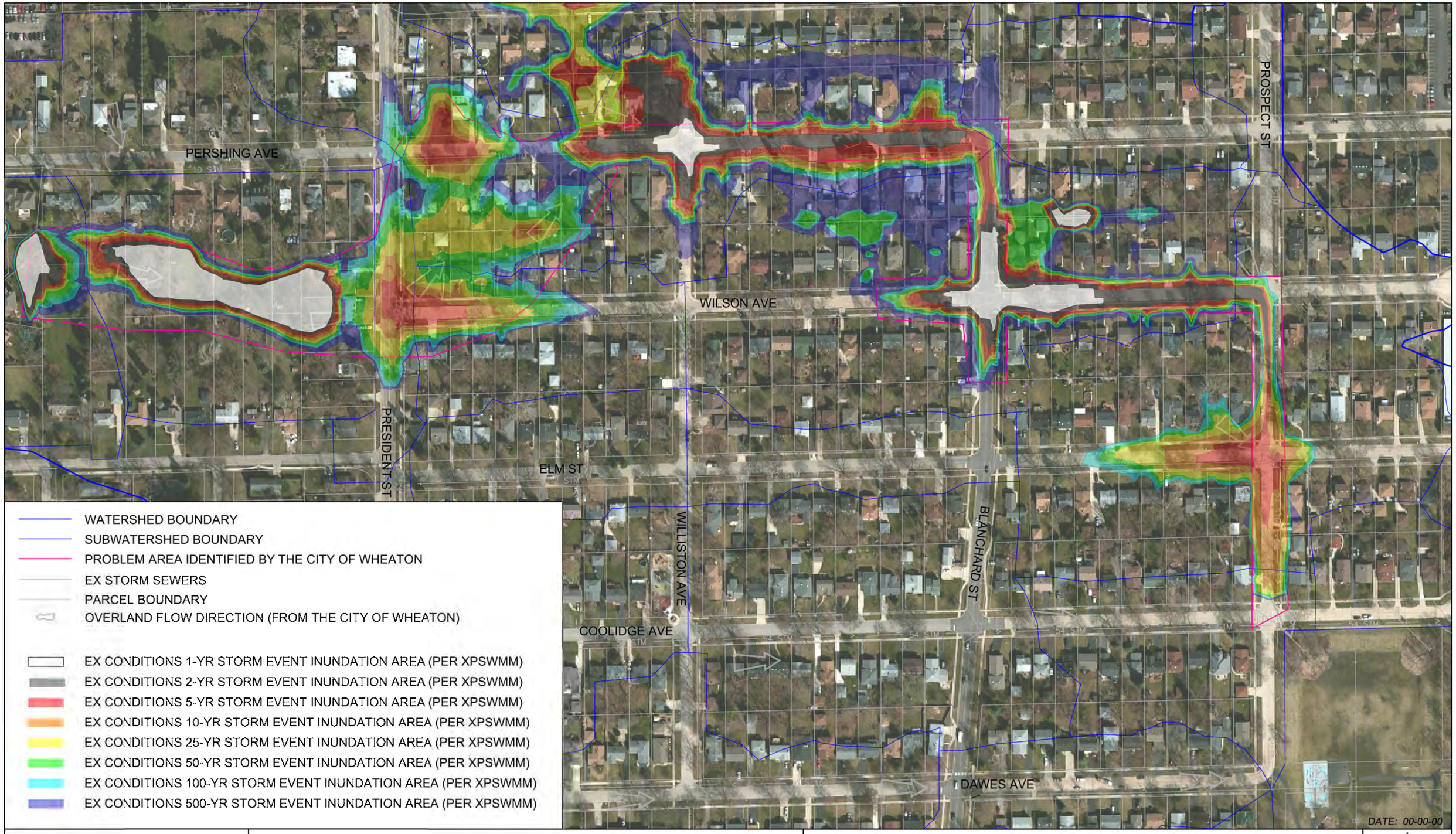
EXHIBIT 6B



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WHEATON ILLINOIS

2-YR THROUGH 500-YR INUNDATION AREAS EXHIBIT, EXISTING CONDITIONS, EAST AREA

SCALE: 1"= 200'

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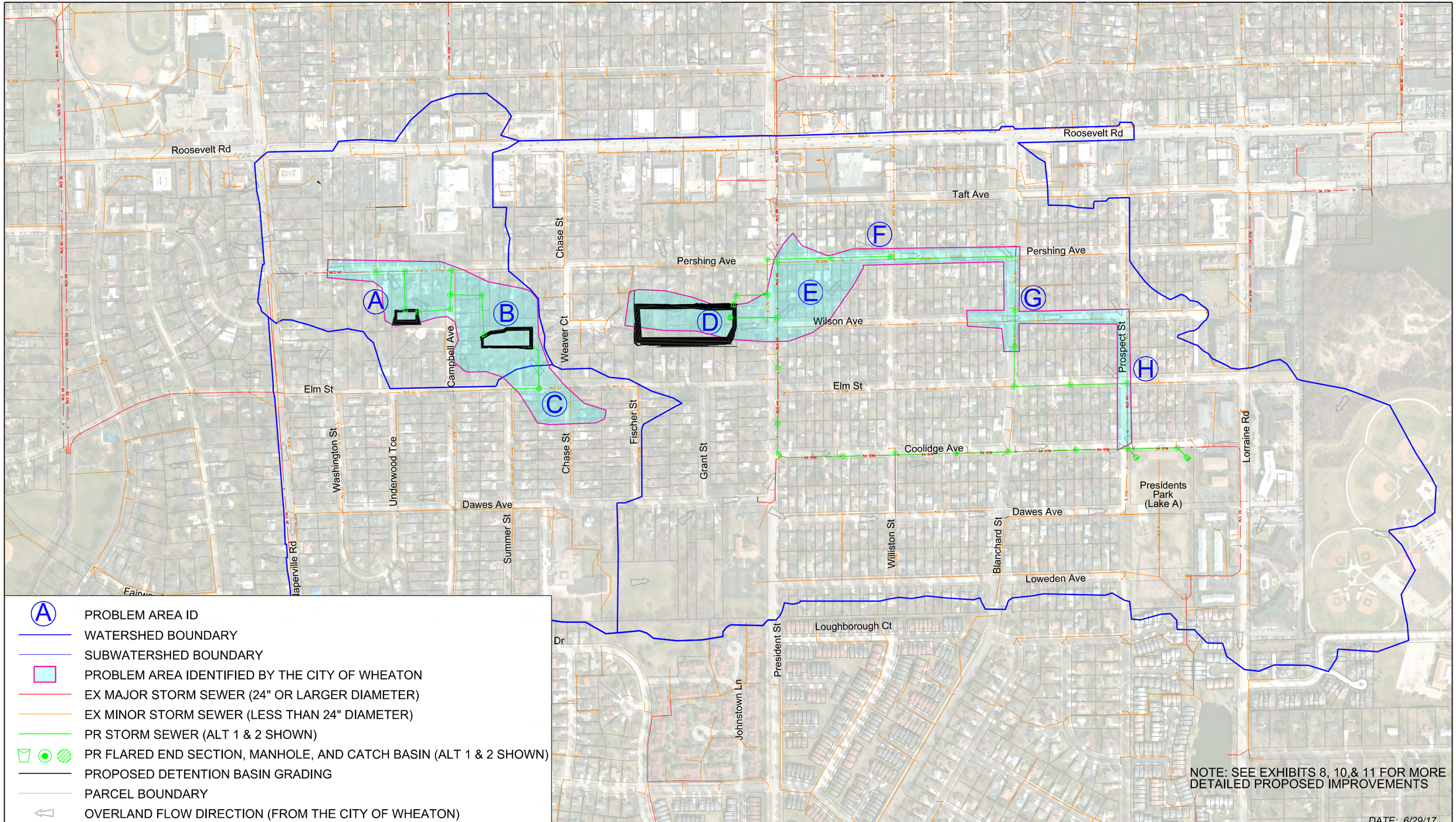
EXHIBIT 6C



- A — PROBLEM AREA ID
- WATERSHED BOUNDARY
- SUBWATERSHED BOUNDARY
- PROBLEM AREA IDENTIFIED BY THE CITY OF WHEATON
- EX MAJOR STORM SEWER (24" OR LARGER DIAMETER)
- EX MINOR STORM SEWER (LESS THAN 24" DIAMETER)
- PR STORM SEWER (ALT 1 & 2 SHOWN)
- PR FLARED END SECTION, MANHOLE, AND CATCH BASIN (ALT 1 & 2 SHOWN)
- PROPOSED DETENTION BASIN GRADING
- PARCEL BOUNDARY
- OVERLAND FLOW DIRECTION (FROM THE CITY OF WHEATON)

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PERSHING/ELM FLOOD PRONE AREA STUDY

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PROPOSED ALTERNATIVES OVERVIEW EXHIBIT

SCALE: 1"= 500'

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EXHIBIT 7

PR STORM SEWER

PR CATCH BASIN, MANHOLE, AND FLARED END SECTION OR MODIFY EX STRUCTURE

PR DETENTION BASIN GRADING

EX MAJOR STORM SEWER (24" OR LARGER DIAMETER)

EX MINOR STORM SEWER (LESS THAN 24" DIAMETER)

PARCEL BOUNDARY

● ALT 2 FLOODPROOFED STRUCTURE AND HOUSE NUMBER

ALT 2: COMBINATION OF STORAGE, FLOODPROOFING, AND CONVEYANCE

-PURCHASE PART OF THE PROPERTIES SHOWN AND GRADE DETENTION BASIN TO REDUCE HIGH WATER LEVELS (HWL) IN PROBLEM AREAS. INSTALL STORM SEWER TO CONVEY STORED RUNOFF INTO EX SEWER SYSTEM.

-INCREASE STORM SEWER SIZES (AND POSSIBLY INLET CAPACITY) IN PROBLEM AREAS TO CONVEY RUNOFF DOWNSTREAM TO PRESIDENTS PARK (LAKE A) AND ALLEVIATE FLOODING IN PROBLEM AREAS.

DATE: 00-00-00

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PERSHING/ELM WEST AREA PROPOSED ALTERNATIVE 2 EXHIBIT

SCALE: 1"= 200'

$FILE$ 1/2/2018 7:38:

EXHIBIT 8

ALT 3: FLOODPROOFING

-FLOODPROOF ALL PROPERTIES WITH FREQUENTY FLOODING PROBLEMS

-COST TO FLOOD PROOF HOMES DAMAGED FOR THE SPECIFIED FREQUENCY STORM EVENT:

2-YEAR = $2,000
5-YEAR = $115,000
10-YEAR = $215,000
25-YEAR = $215,000
50-YEAR = $241,000
100-YEAR = $341,000

ALT 4: BUYOUT

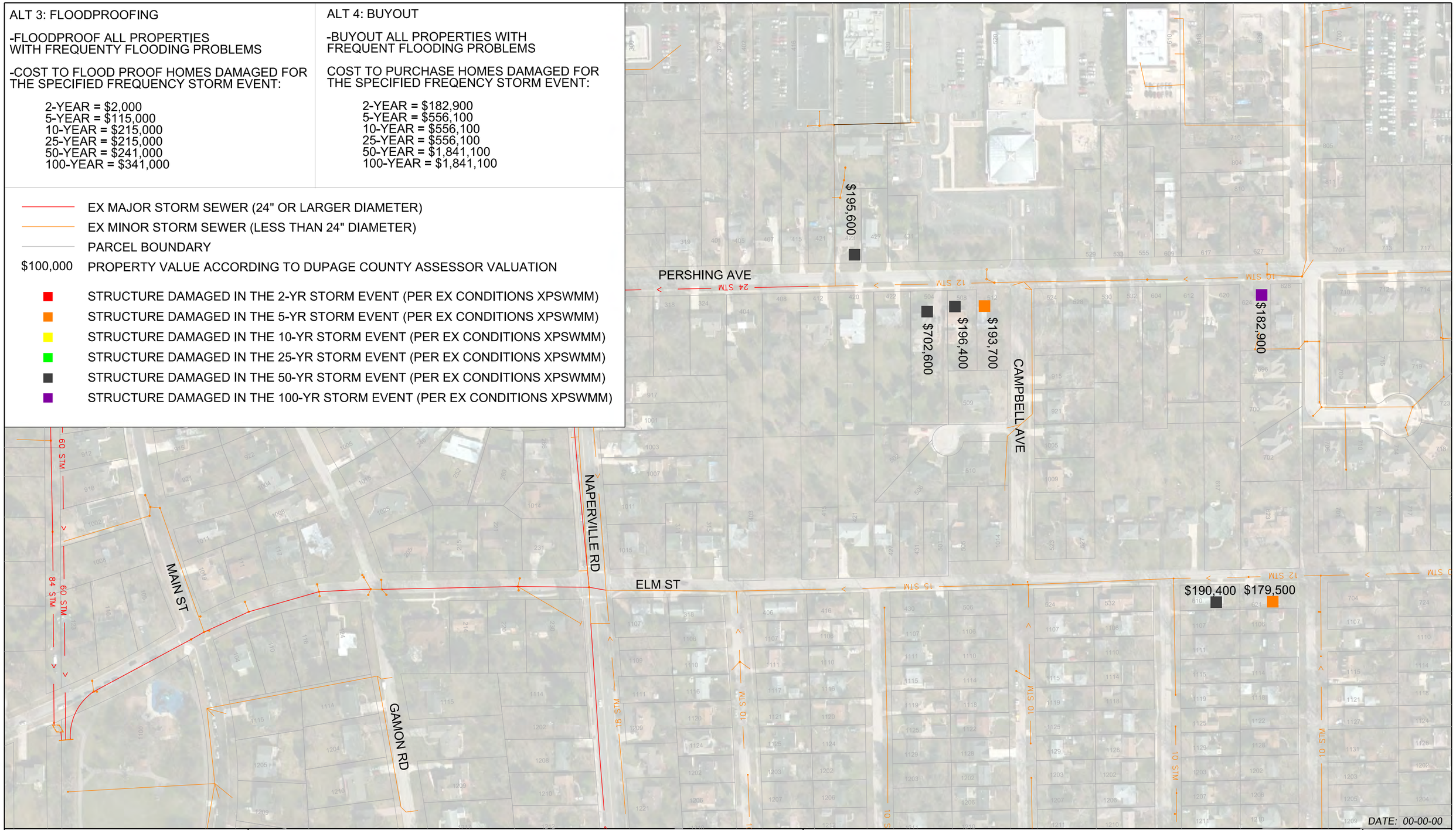
-BUYOUT ALL PROPERTIES WITH FREQUENT FLOODING PROBLEMS

COST TO PURCHASE HOMES DAMAGED FOR THE SPECIFIED FREQENCY STORM EVENT:

2-YEAR = $182,900
5-YEAR = $556,100
10-YEAR = $556,100
25-YEAR = $556,100
50-YEAR = $1,841,100
100-YEAR = $1,841,100

EX MAJOR STORM SEWER (24" OR LARGER DIAMETER)
EX MINOR STORM SEWER (LESS THAN 24" DIAMETER)
PARCEL BOUNDARY
$100,000 PROPERTY VALUE ACCORDING TO DUPAGE COUNTY ASSESSOR VALUATION

STRUCTURE DAMAGED IN THE 2-YR STORM EVENT (PER EX CONDITIONS XPSWMM)
STRUCTURE DAMAGED IN THE 5-YR STORM EVENT (PER EX CONDITIONS XPSWMM)
STRUCTURE DAMAGED IN THE 10-YR STORM EVENT (PER EX CONDITIONS XPSWMM)
STRUCTURE DAMAGED IN THE 25-YR STORM EVENT (PER EX CONDITIONS XPSWMM)
STRUCTURE DAMAGED IN THE 50-YR STORM EVENT (PER EX CONDITIONS XPSWMM)
STRUCTURE DAMAGED IN THE 100-YR STORM EVENT (PER EX CONDITIONS XPSWMM)



DATE: 00-00-00

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PERSHING/ELM FLOOD PRONE AREA STUDY

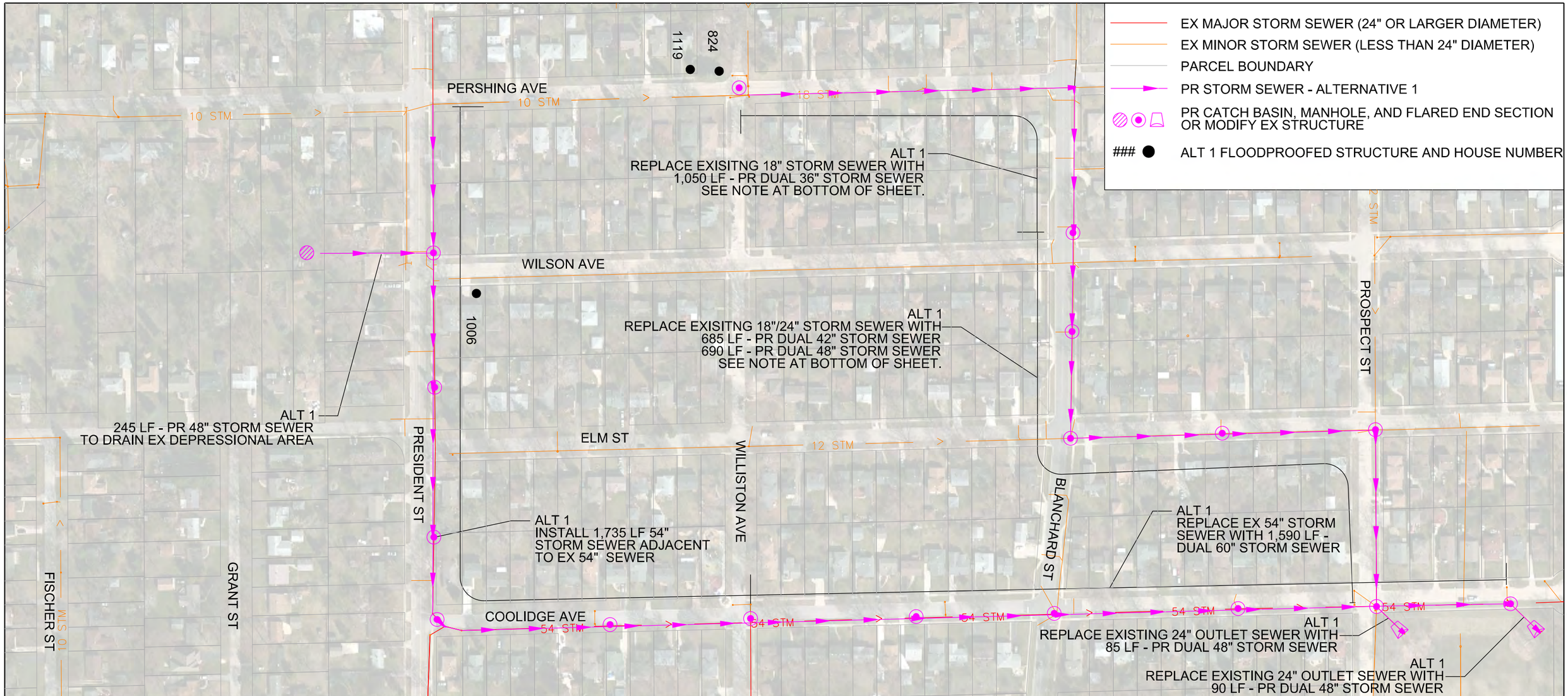
WHEATON ILLINOIS

PERSHING/ELM WEST AREA PROPOSED ALTERNATIVES 3 & 4 EXHIBIT

SCALE: 1"= 200'

$FILE$ 4/30/2018 9:53:

EXHIBIT 9



ALT 1: CONVEYANCE

-INCREASE STORM SEWER SIZES (AND POSSIBLY INLET CAPACITY) IN PROBLEM AREAS TO CONVEY RUNOFF DOWNSTREAM TO PRESIDENTS PARK (LAKE A) TO REDUCE FLOODING IN PROBLEM AREAS.

-EXPAND PRESIDENTS PARK EITHER VERTICALLY OR HORIZONTALLY TO ENSURE 100-YEAR DISCHARGE IS NOT BEING INCREASED BY PROPOSED WORK.

NOTE:
IN LIEU OF FLOODPROOFING, THE CONVEYANCE ALTERNATIVE COULD USE LARGER DIAMETER PIPES ON PERSHING AVE., BLANCHARD ST., ELM ST., AND PROSPECT ST. THE CURRENT ALTERNATIVE SHOWS DUAL 36" TO 48" SEWERS AND REDUCES WATER SURFACE ELEVATIONS BELOW THE LOW ENTRY OF ALL HOMES EXCEPT FOR THREE. INCREASING THOSE PROPOSED SEWERS TO DUAL 48" TO 54" SEWERS WOULD PROVIDE ENOUGH ADDITIONAL CAPACITY TO DECREASE THE WATER SURFACE ELEVATION FURTHER AND PROTECT ALL HOMES, INCLUDING THE THREE THAT WOULD OTHERWISE NEED FLOODPROOFING. THE INCREMENTAL COST AND REDUCED CONSTRUCTABILITY OF THIS OPTION IS EXPECTED TO BE LESS FEASIBLE AND LESS COST EFFECTIVE THAN FLOODPROOFING THE THREE HOMES, THEREFORE, THIS IS NOT SHOWN AS THE RECOMMENDED ALTERNATIVE.

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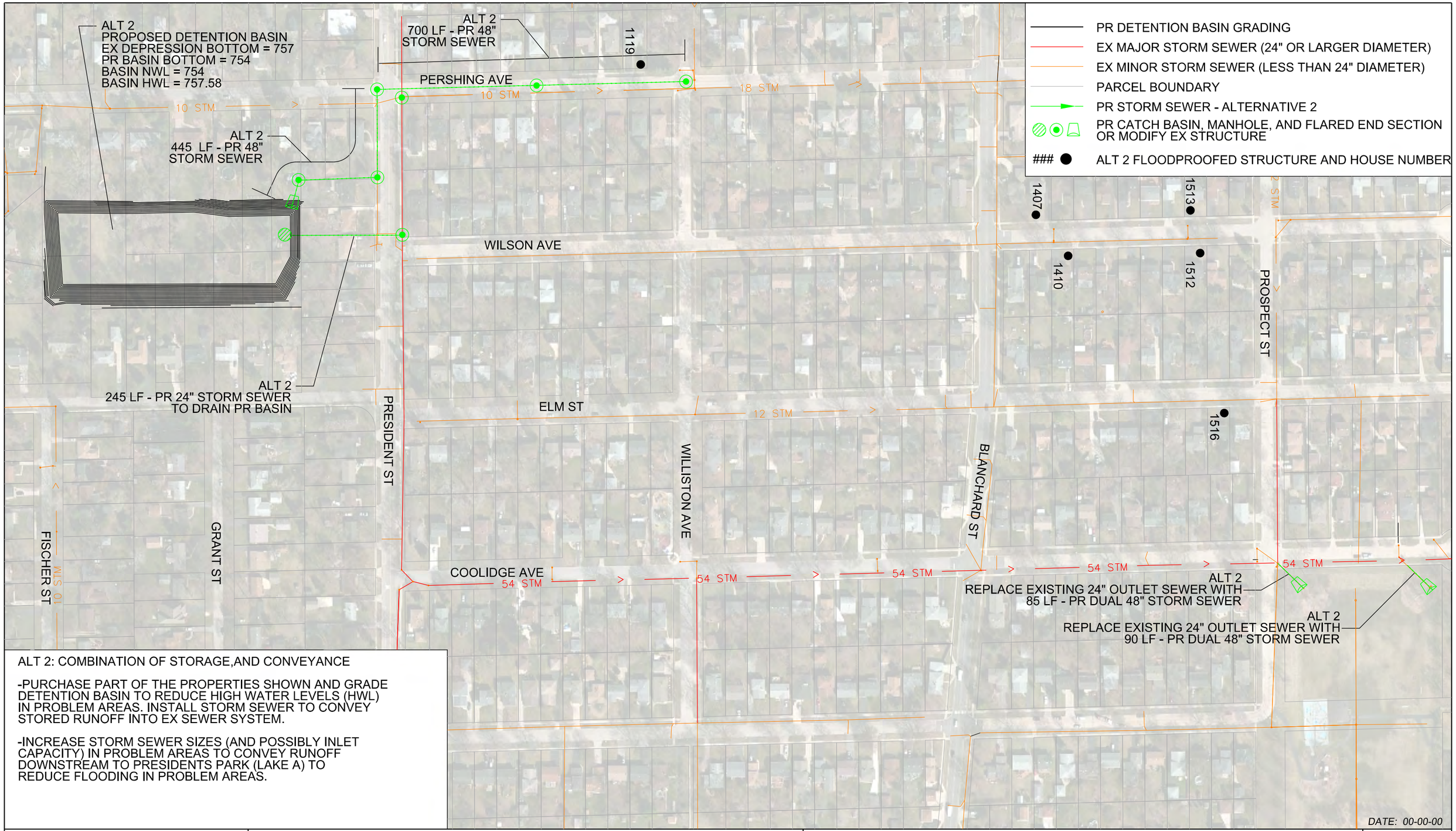
PERSHING/ELM FLOOD PRONE AREA STUDY

WHEATON ILLINOIS

PERSHING/ELM EAST AREA PROPOSED ALTERNATIVE 1 EXHIBIT

SCALE: 1"= 200'

$FILES 4/30/2018 9:5[illegible]



ALT 2: COMBINATION OF STORAGE,AND CONVEYANCE

-PURCHASE PART OF THE PROPERTIES SHOWN AND GRADE DETENTION BASIN TO REDUCE HIGH WATER LEVELS (HWL) IN PROBLEM AREAS. INSTALL STORM SEWER TO CONVEY STORED RUNOFF INTO EX SEWER SYSTEM.

-INCREASE STORM SEWER SIZES (AND POSSIBLY INLET CAPACITY) IN PROBLEM AREAS TO CONVEY RUNOFF DOWNSTREAM TO PRESIDENTS PARK (LAKE A) TO REDUCE FLOODING IN PROBLEM AREAS.

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PERSHING/ELM FLOOD PRONE AREA STUDY

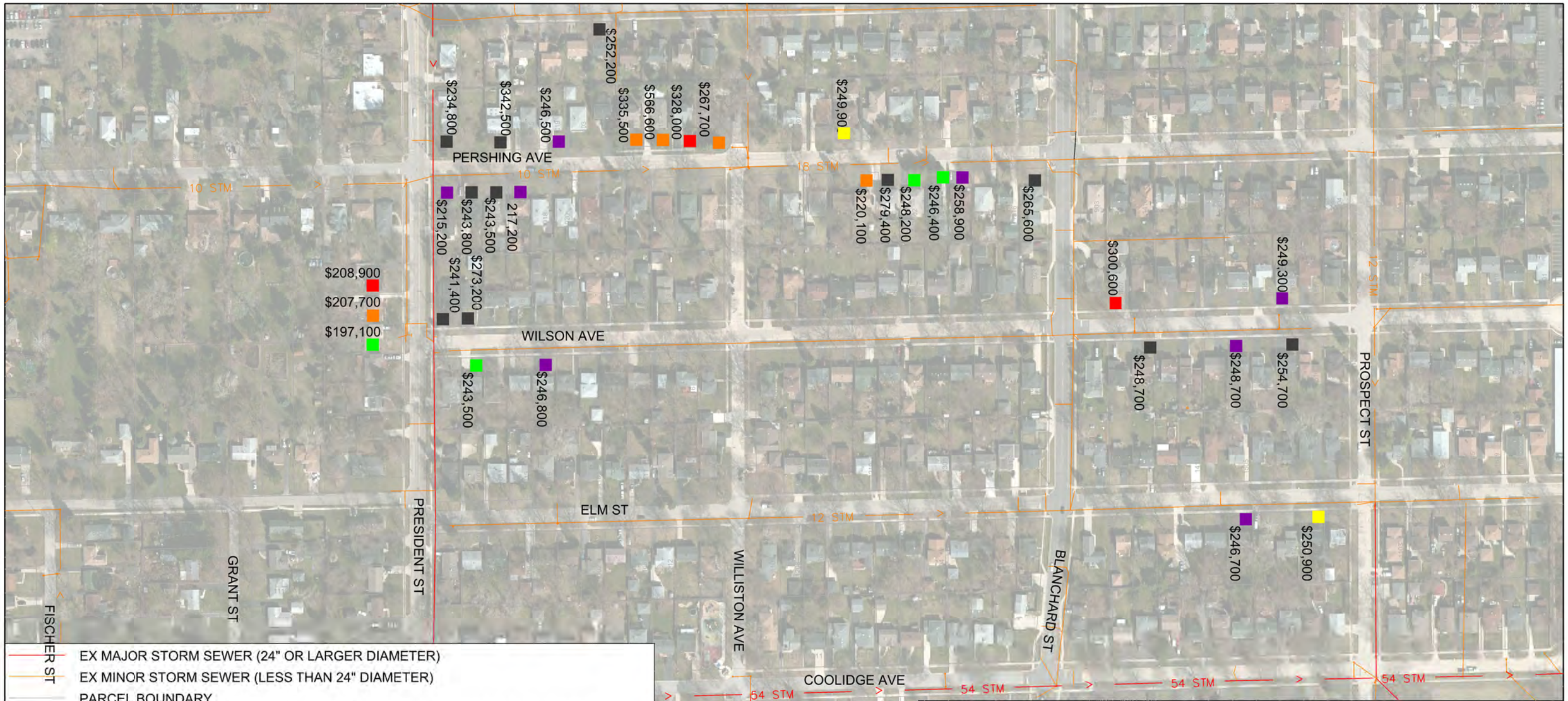
WHEATON ILLINOIS

PERSHING/ELM EAST AREA PROPOSED ALTERNATIVE 2 EXHIBIT

SCALE: 1"= 200'

$FILE$ 4/30/2018 9:5

EXHIBIT 11



EX MAJOR STORM SEWER (24" OR LARGER DIAMETER)
EX MINOR STORM SEWER (LESS THAN 24" DIAMETER)
PARCEL BOUNDARY
$100,000 PROPERTY VALUE ACCORDING TO DUPAGE COUNTY ASSESSOR VALUATION

- STRUCTURE DAMAGED IN THE 2-YR STORM EVENT (PER EX CONDITIONS XPSWMM)
- STRUCTURE DAMAGED IN THE 5-YR STORM EVENT (PER EX CONDITIONS XPSWMM)
- STRUCTURE DAMAGED IN THE 10-YR STORM EVENT (PER EX CONDITIONS XPSWMM)
- STRUCTURE DAMAGED IN THE 25-YR STORM EVENT (PER EX CONDITIONS XPSWMM)
- STRUCTURE DAMAGED IN THE 50-YR STORM EVENT (PER EX CONDITIONS XPSWMM)
- STRUCTURE DAMAGED IN THE 100-YR STORM EVENT (PER EX CONDITIONS XPSWMM)

ALT 3: FLOODPROOFING

-FLOODPROOF ALL PROPERTIES WITH FREQUENTY FLOODING PROBLEMS

-COST TO FLOOD PROOF HOMES DAMAGED FOR THE SPECIFIED FREQUENCY STORM EVENT:

2-YEAR = $7,000
5-YEAR = $27,000
10-YEAR = $39,560
25-YEAR = $173,560
50-YEAR = $828,240
100-YEAR = $1,133,040

ALT 4: BUYOUT

-BUYOUT ALL PROPERTIES WITH FREQUENT FLOODING PROBLEMS

COST TO PURCHASE HOMES DAMAGED FOR THE SPECIFIED FREQENCY STORM EVENT:

2-YEAR = $837,500
5-YEAR = $2,435,100
10-YEAR = $2,935,900
25-YEAR = $3,871,100
50-YEAR = $6,750,900
100-YEAR = $8,680,200

DATE: 00-00-00

V3 Companies
7325 Janes Avenue
Woodridge, IL 60517
630.724.9200 phone
630.724.9202 fax
www.v3co.com

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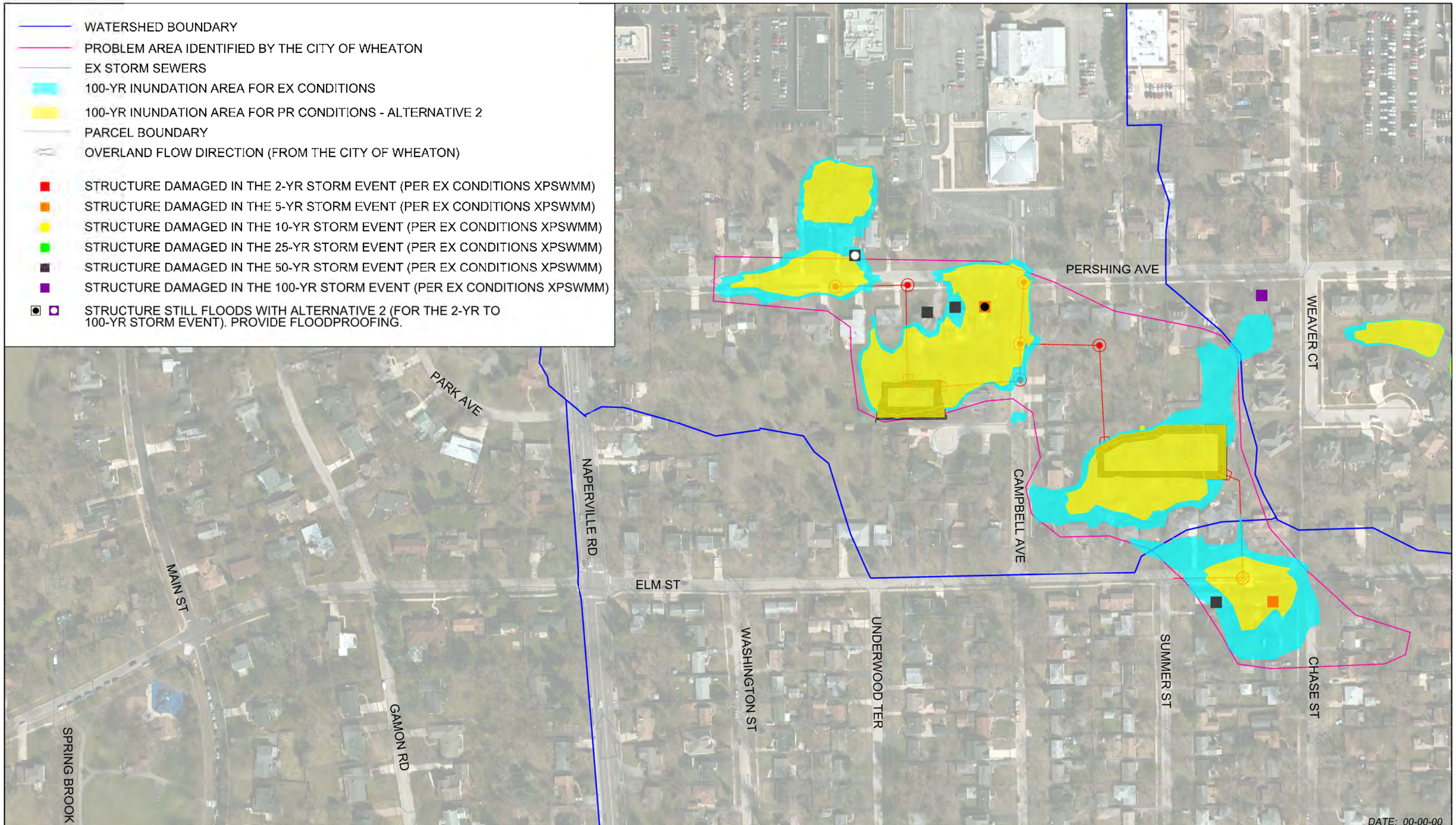
PERSHING/ELM FLOOD PRONE AREA STUDY

WHEATON ILLINOIS

PERSHING/ELM EAST AREA PROPOSED ALTERNATIVE 3 & 4 EXHIBIT

SCALE: 1"= 200'

$FILES 4/30/2018 4:26:59 PM



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630.724.9202 fax
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PERSHING/ELM FLOOD PRONE AREA STUDY

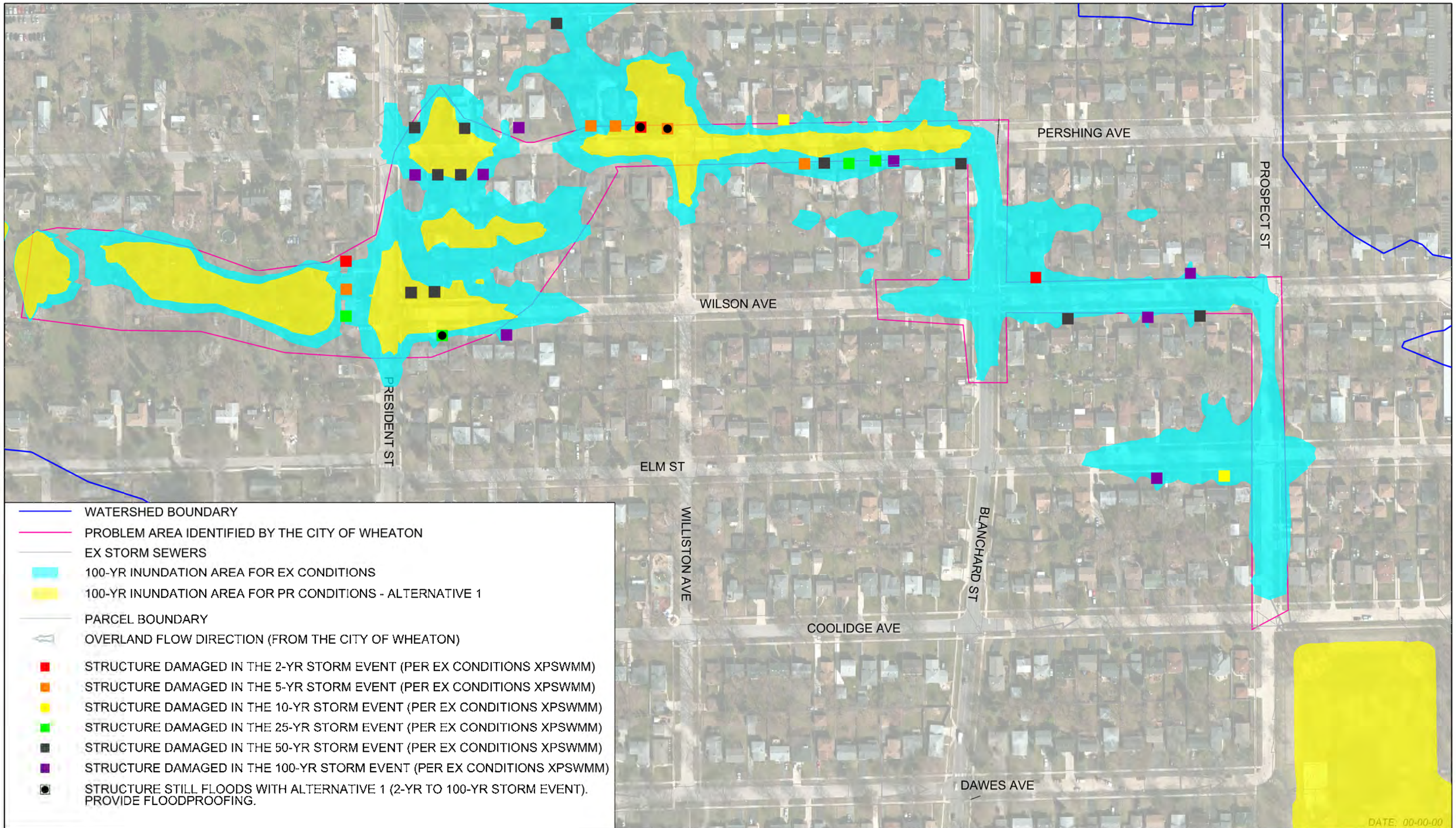
WHEATON ILLINOIS

PROPOSED CONDITIONS - WEST AREA INDUNDATION AREAS ALTERNATIVE 2

SCALE: 1"= 200'

$FILE$ 4/30/2018 5:0[illegible]

EXHIBIT 13



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630.724.9202 fax
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PERSHING/ELM FLOOD PRONE AREA STUDY

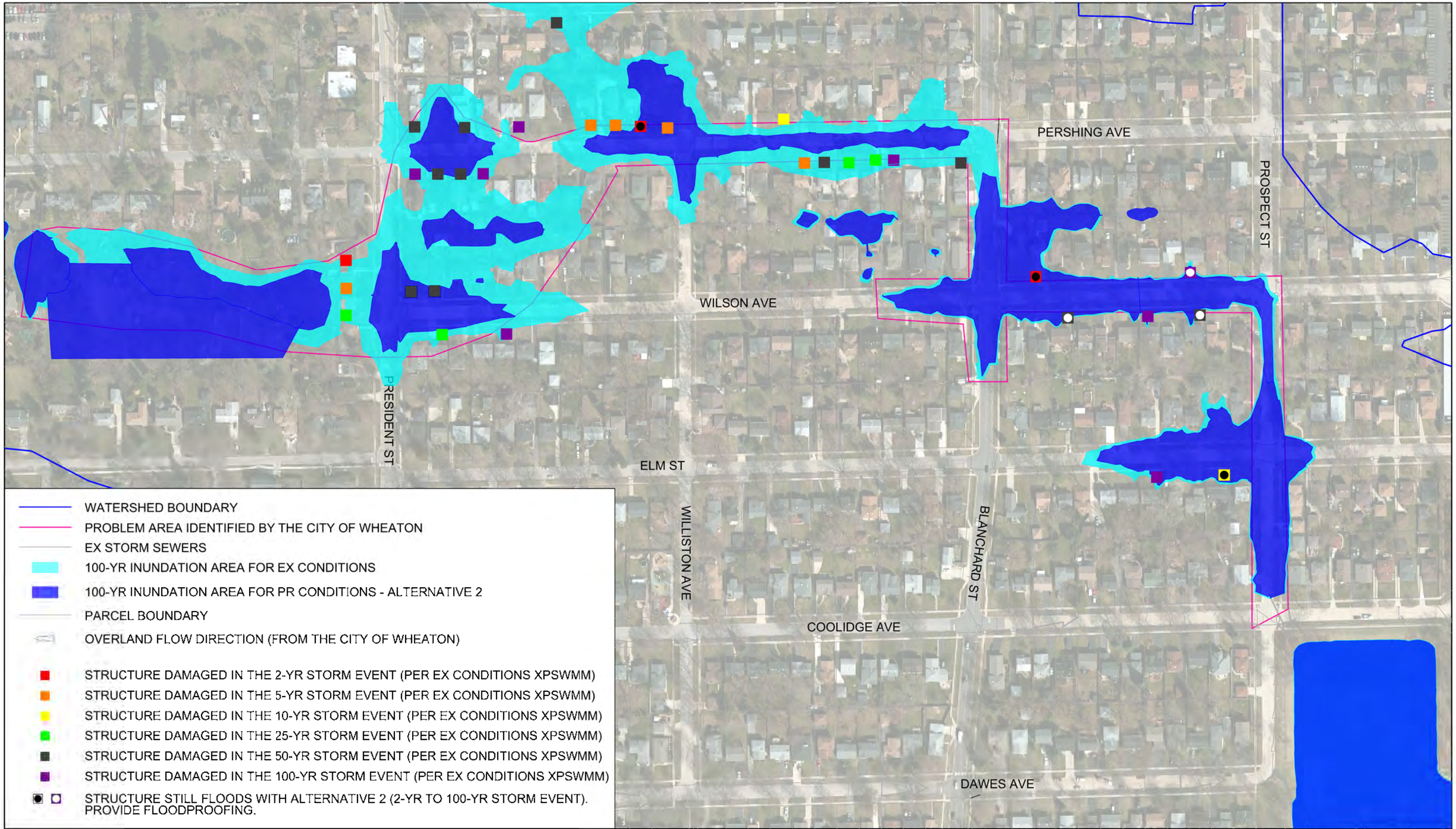
WHEATON ILLINOIS

PROPOSED CONDITIONS - EAST AREA INDUNDATION AREAS AND AFFECTED PROPERTIES EXHIBIT ALTERNATIVE 1

SCALE: 1"= 200'

$FILE$ 4/30/2018 4:5

EXHIBIT 14



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PERSHING/ELM FLOOD PRONE AREA STUDY

WHEATON ILLINOIS

PROPOSED CONDITIONS - EAST AREA INDUNDATION AREAS AND AFFECTED PROPERTIES EXHIBIT ALTERNATIVE 2

SCALE: 1"= 200'

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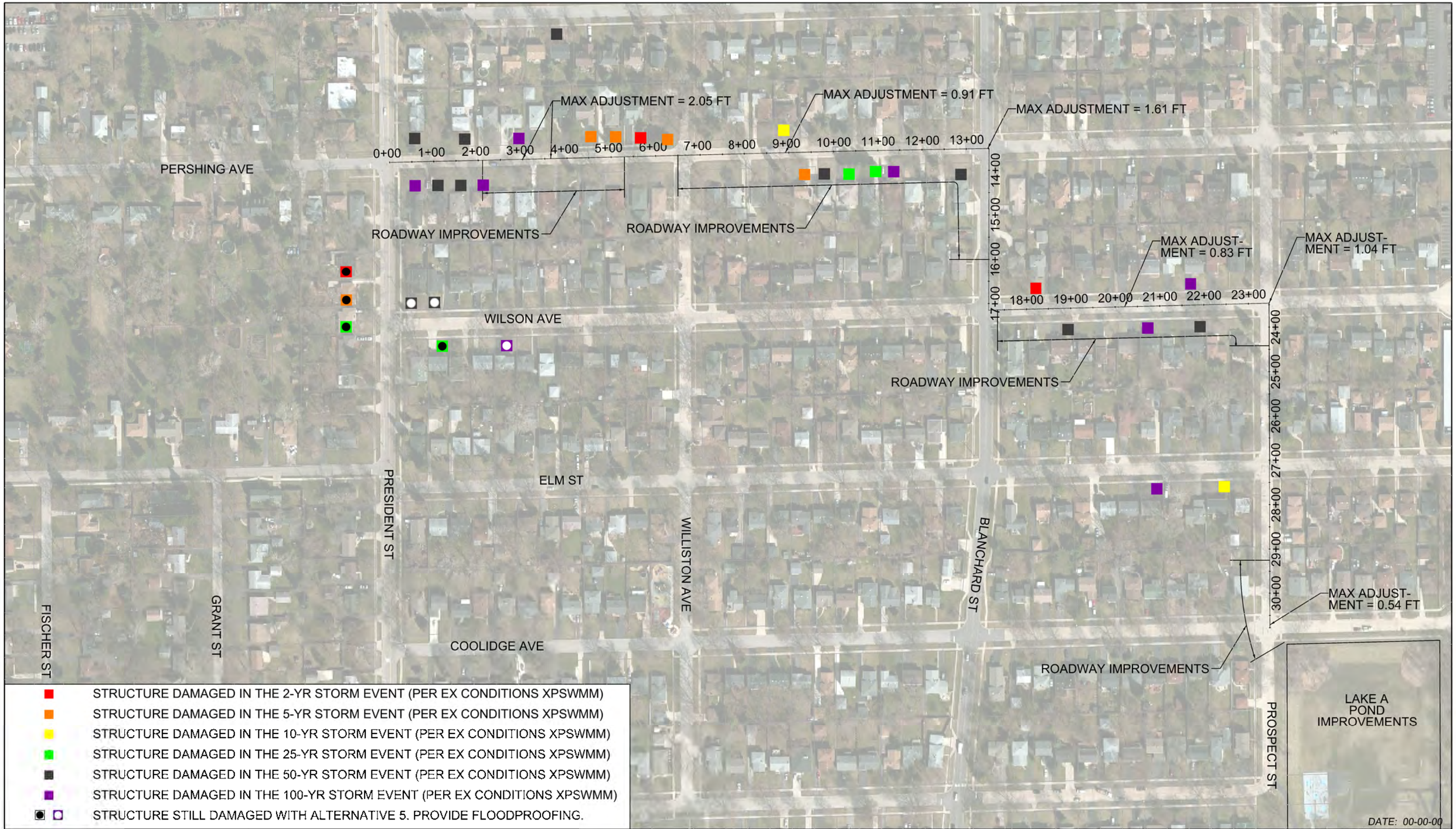

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630.724.9202 fax
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PERSHING/ELM FLOOD PRONE AREA STUDY

WHEATON ILLINOIS

PROFILE ADJUSTMENT ALTERNATIVE 5

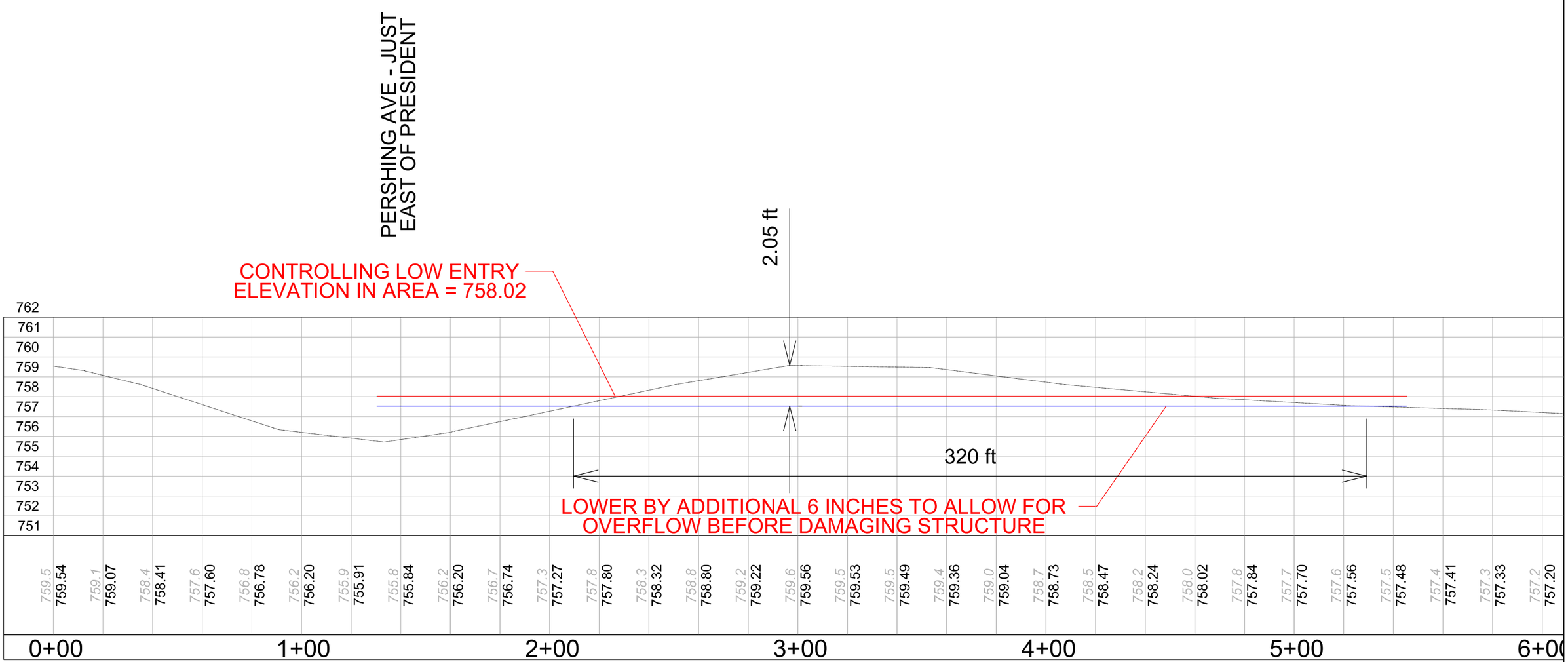
SCALE: 1"= 200'

$FILE$ 4/30/2018 4:30:45 PM

EXHIBIT 16

HORIZONTAL 1"=40' 40 0 40 80 SCALE FEET

VERTICAL 1"=5' 5 0 5 10 SCALE FEET



DATE: 00-00-00

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630.724.9200 phone
630.724.9202 fax
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PERSHING/ELM FLOOD PRONE AREA STUDY

WHEATON ILLINOIS

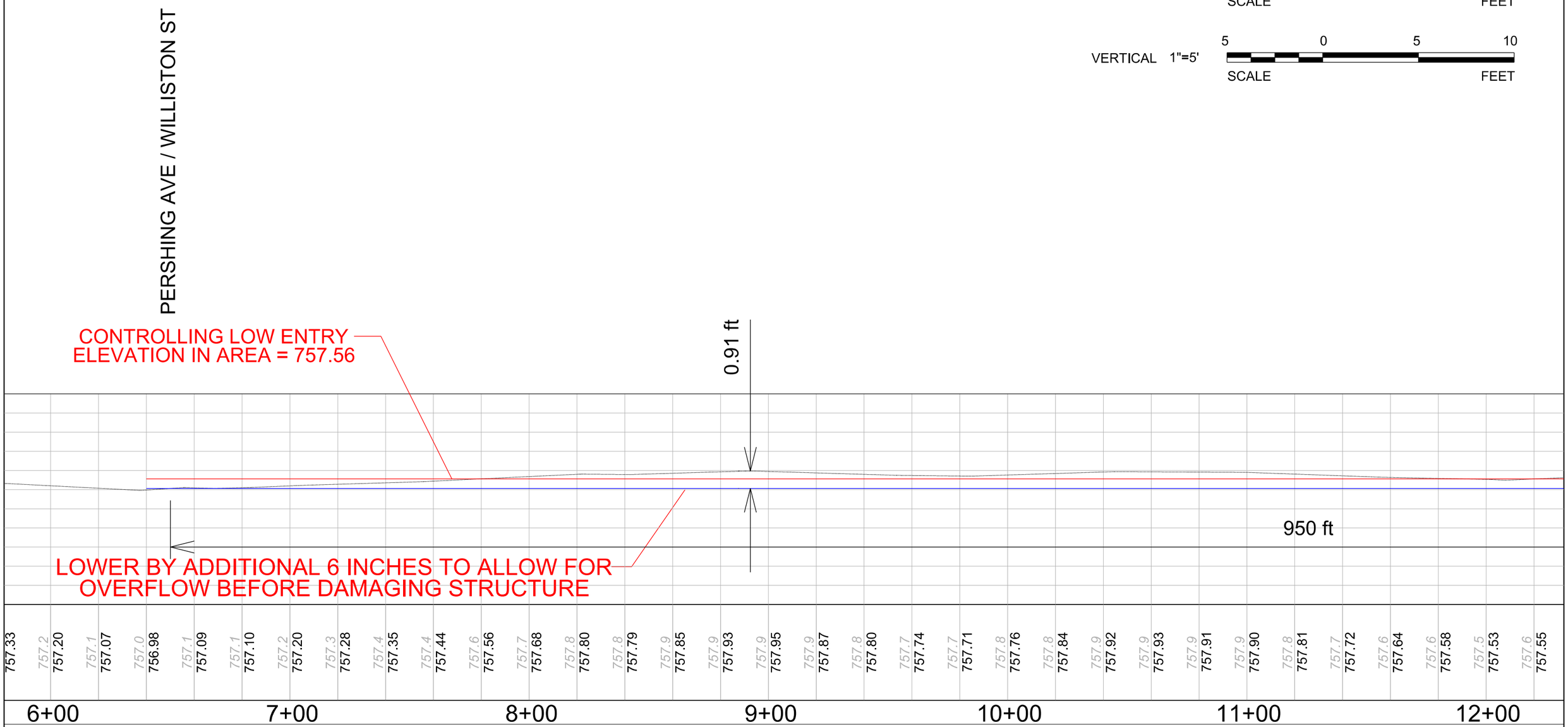
PROFILE ADJUSTMENT ALTERNATIVE 5

$FILE$ 11/27/2017 7:1

EXHIBIT 17

HORIZONTAL 1"=40' 40 0 40 80 SCALE FEET

VERTICAL 1"=5' 5 0 5 10 SCALE FEET



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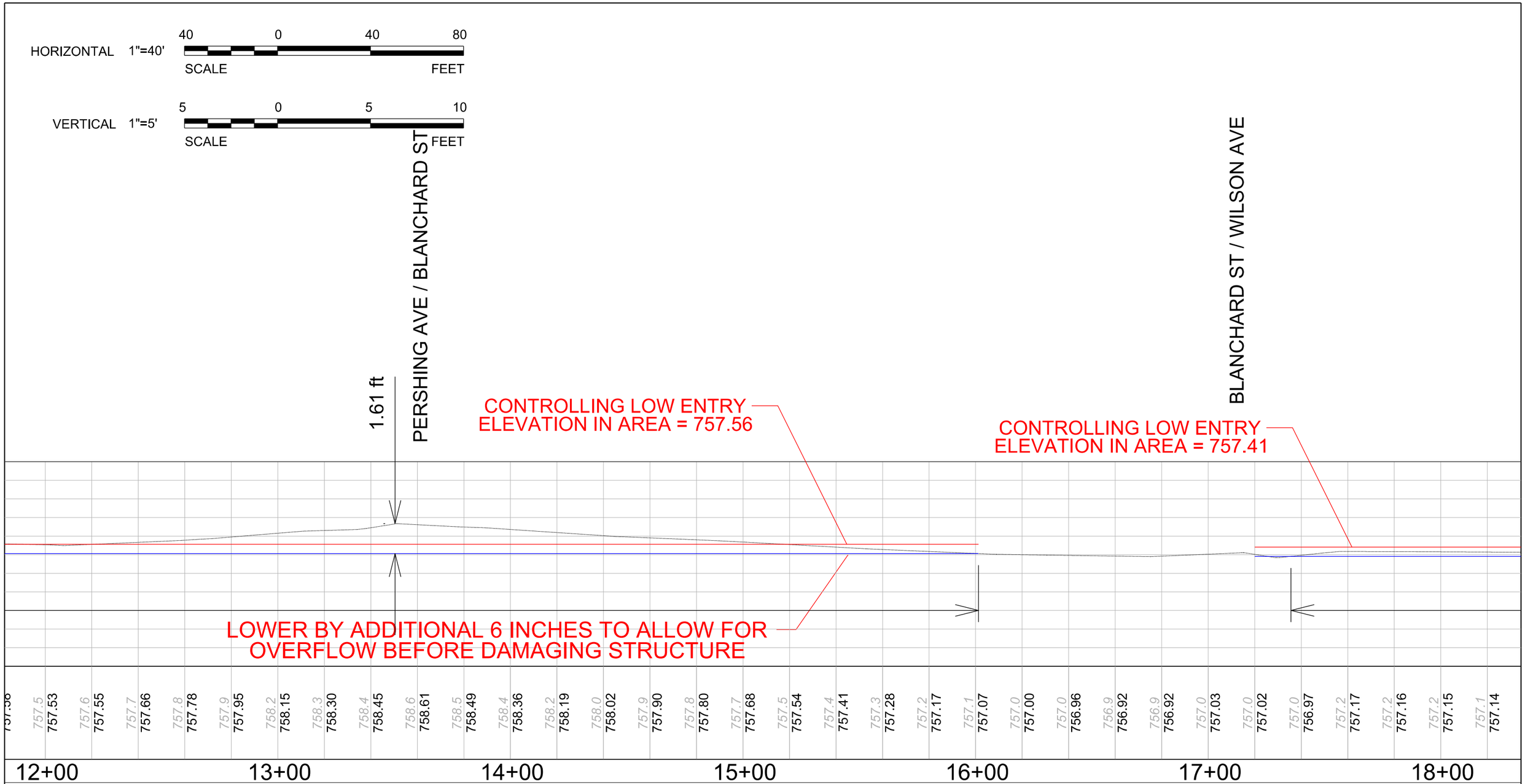
PERSHING/ELM FLOOD PRONE AREA STUDY

WHEATON ILLINOIS

PROFILE ADJUSTMENT ALTERNATIVE 5

$FILES 11/27/2017 7:1

EXHIBIT 18



DATE: 00-00-00

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PERSHING/ELM FLOOD PRONE AREA STUDY

WHEATON ILLINOIS

PROFILE ADJUSTMENT ALTERNATIVE 5

$FILES 11/27/2017 7:19:

EXHIBIT 19

HORIZONTAL 1"=40'

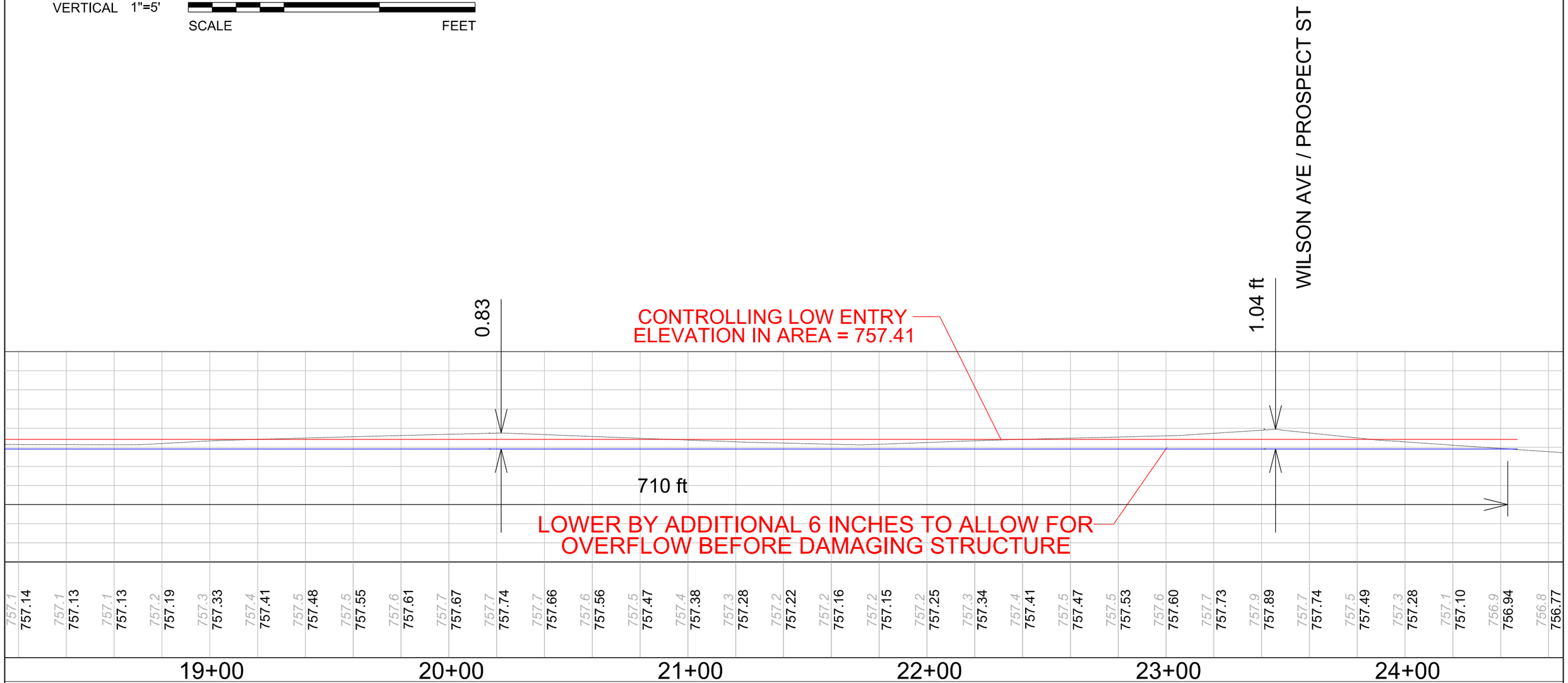
40 0 40 80

SCALE FEET

VERTICAL 1"=5'

5 0 5 10

SCALE FEET



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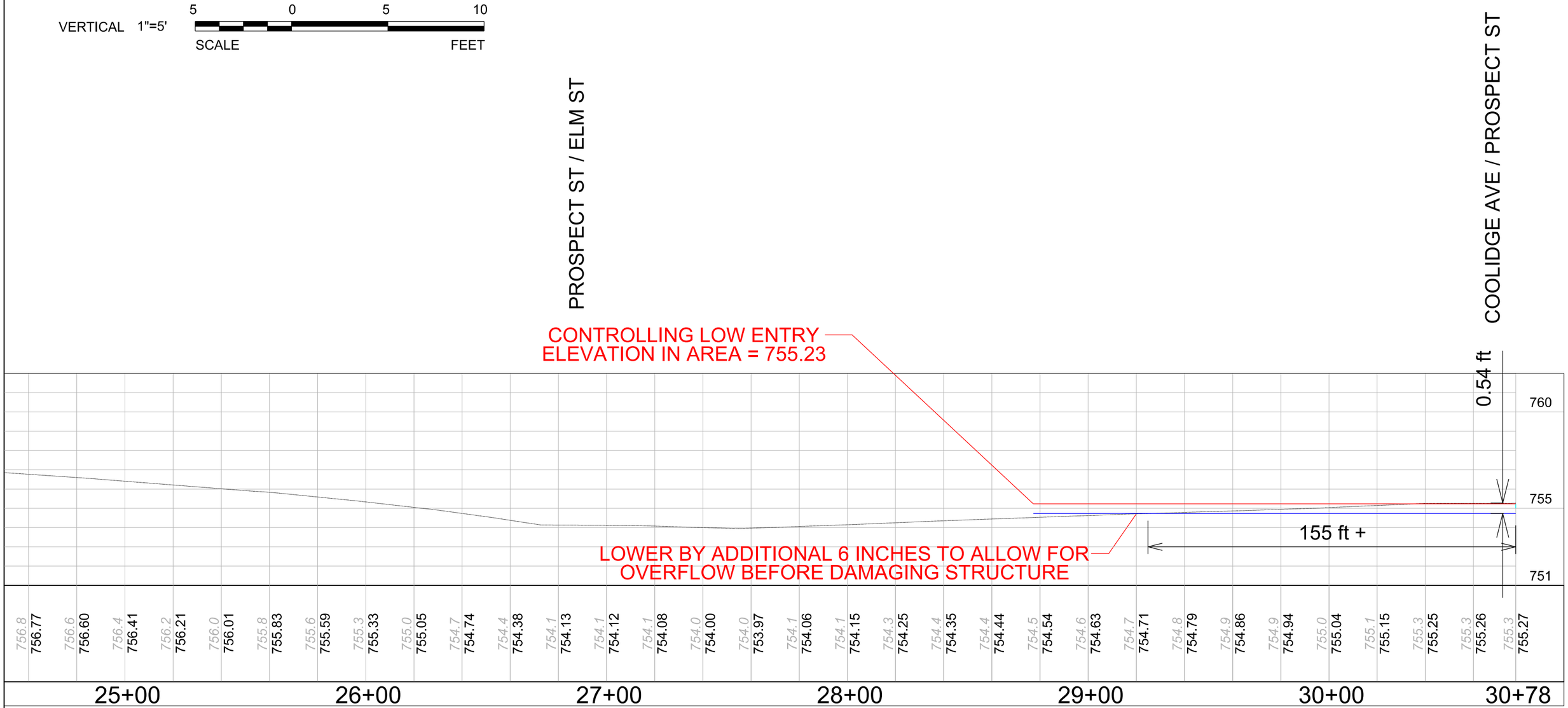
WHEATON ILLINOIS

PROFILE ADJUSTMENT ALTERNATIVE 5

$FILES 11/27/2017 7:1

HORIZONTAL 1"=40' — 40 0 40 80 — SCALE FEET

VERTICAL 1"=5' — 5 0 5 10 — SCALE FEET



DATE: 00-00-00

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PERSHING/ELM FLOOD PRONE AREA STUDY

WHEATON ILLINOIS

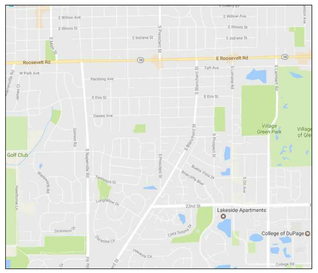
PROFILE ADJUSTMENT ALTERNATIVE 5

$FILE$ 11/27/2017 7:19 AM

EXHIBIT 21

TOPOGRAPHIC EXHIBIT
OF
FLOOD PRONE AREA STUDY 2
WHEATON, IL

PART OF SECTION 21 AND SECTION 22, TOWNSHIP 39 NORTH, RANGE 10
EAST OF THE THIRD PRINCIPAL MERIDIAN, IN DUPAGE COUNTY, ILLINOIS.



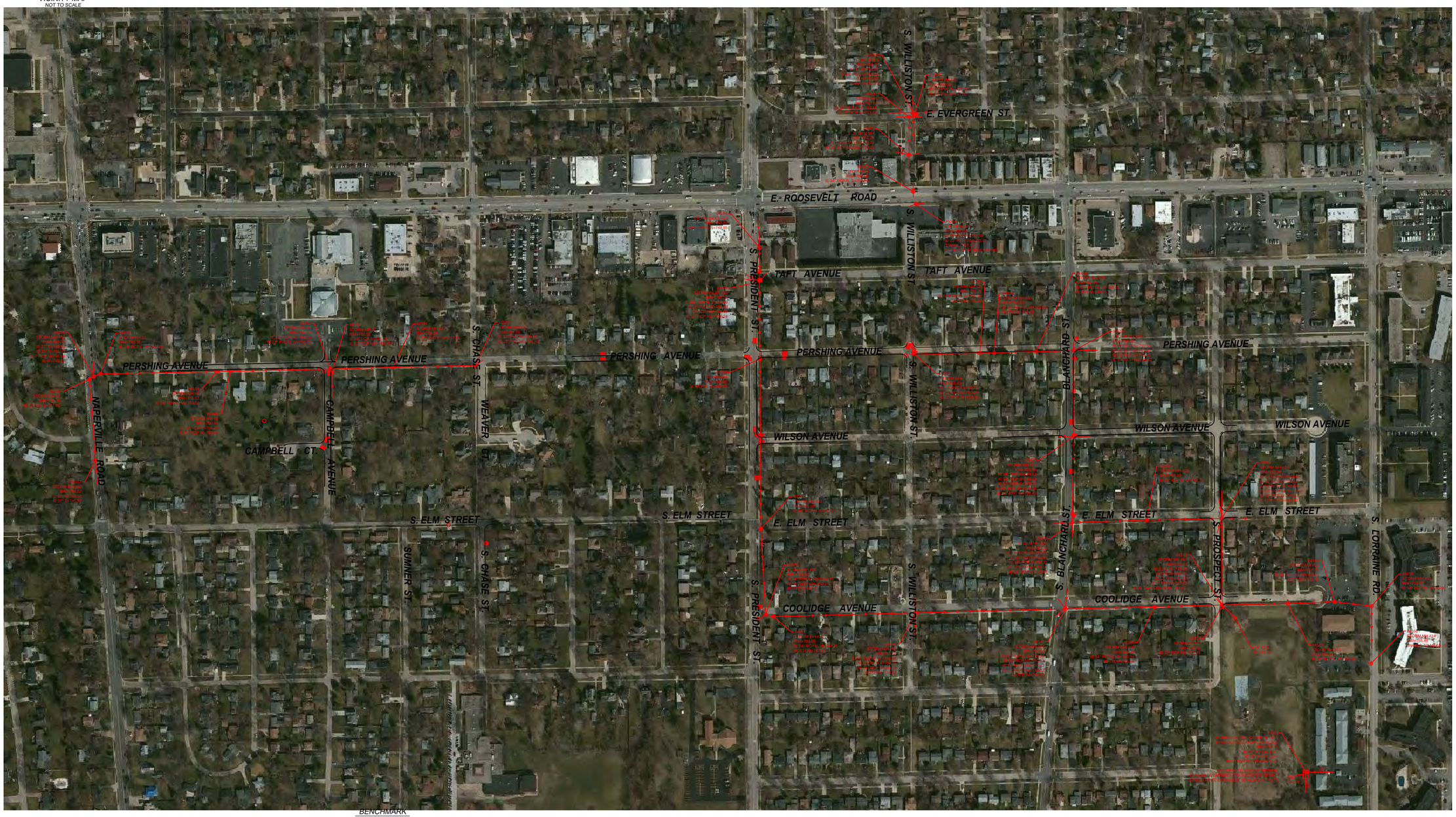
VICINITY MAP
NOT TO SCALE

BASIS OF BEARINGS

THE BASIS OF BEARINGS IS THE STATE PLANE COORDINATE SYSTEM (SPCS) NAD 83 (2007) ZONE 1201 (ILLINOIS EAST) WITH PROJECT ORIGIN AT:
LATITUDE: 41-51-25.88131 N
LONGITUDE: 88-05-29.69348 W
ELLIPSOID HEIGHT: 652.369
GROUND SCALE FACTOR 1.0000511738
ALL MEASUREMENTS ARE ON THE GROUND.

STATE PLANE MERIDIAN

GRAPHIC SCALE
150' 0 75' 150' 300' 600'
1" = 150'



BENCHMARK

SOURCE:

BENCHMARK ESTABLISHED VIA TRIMBLE'S VRS NETWORK.
DATUM IS NAVD88
LATITUDE: 41-51-25.88131 N
LONGITUDE: 88-05-29.69348 W
ELLIPSOID HEIGHT: 652.369
GROUND SCALE FACTOR 1.0000511738

SITE:

STATION DESIGNATION: SBMI1
ESTABLISHED BY: V3 COMPANIES
DATE: 04-10-17

ELEVATION: 765.57 (MEASURED)
DATUM: NAVD88
DESCRIPTION: NORTHEAST BOLT ON FIRE HYDRANT AT SOUTHWEST CORNER OF E. ELM AND S. CHASE STREET.

STATION DESIGNATION: SBMI2
ESTABLISHED BY: V3 COMPANIES
DATE: 04-10-17

ELEVATION: 766.47 (MEASURED)
DATUM: NAVD88
DESCRIPTION: SOUTHEAST BOLT ON FIRE HYDRANT AT SOUTHWEST CORNER OF CAMPBELL AVENUE AND CAMPBELL COURT INTERSECTION.

THE ELEVATIONS ABOVE WERE KNOWN TO BE ACCURATE AT THE TIME THEY WERE ESTABLISHED. V3 DOES NOT CERTIFY TO THE ACCURACY THEREAFTER, NOR ASSUMES RESPONSIBILITY FOR THE MIS-USE OR MIS-INTERPRETATION OF THE INFORMATION SHOWN HEREON.

IT IS ADVISED THAT ALL OF THE ABOVE ELEVATIONS BE CHECKED BETWEEN EACH OTHER AND VERIFY A MINIMUM OF 3 SURROUNDING UTILITY RIM ELEVATIONS AND ANY ADJACENT BUILDING FINISHED FLOOR OR TOP OF FOUNDATION ELEVATIONS SHOWN HEREON PRIOR TO USE OR COMMENCEMENT OF ANY CONSTRUCTION OR OTHER WORK.

PERSONS USING THIS INFORMATION ARE TO CONTACT V3 IMMEDIATELY WITH ANY DISCREPANCIES FOUND PRIOR TO THE START OF ANY WORK.

GENERAL NOTES

1. COMPARE ALL POINTS IN FIELD PRIOR TO ANY CONSTRUCTION AND REPORT ANY DISCREPANCIES TO SURVEYOR AT ONCE.
2. FOR BUILDING RESTRICTIONS AS ESTABLISHED BY LOCAL ORDINANCES NOT SHOWN HEREON, CONSULT YOUR LOCAL MUNICIPAL AUTHORITIES.
3. DO NOT SCALE DIMENSIONS FROM THIS MAP.
4. CALL J.U.L.I.E. AT 1-800-892-0123 FOR FIELD LOCATION OF ALL UNDERGROUND UTILITIES PRIOR TO ANY DIGGING OR CONSTRUCTION.
5. UTILITIES AND IMPROVEMENTS SHOWN HEREON BASED ON VISIBLE FIELD VERIFIED STRUCTURES.
6. BOUNDARY INFORMATION SHOWN HEREON, IF ANY EXISTS, IS FOR GRAPHICAL DEPICTION ONLY.
7. THE OWNER SHOULD COMPARE THE DESCRIPTION ON THIS MAP, IF ANY EXISTS, WITH HIS, OR HER DEED ABSTRACT, OR TITLE POLICY AND NOTIFY SURVEYOR OF ANY DIFFERENCES.
8. THIS MAP DOES NOT CONSTITUTE A PLAT OF SURVEY.
9. UNDERGROUND UTILITY LINES SHOWN HEREON ARE BASED ON FIELD LOCATED STRUCTURES IN COORDINATION WITH ATLAS INFORMATION PROVIDED BY UTILITY COMPANIES THROUGH J.U.L.I.E.'S DESIGN STAGE PROCESS. SEE "UTILITY ATLAS NOTES" HEREON FOR SPECIFICS.

LEGEND

CABLE TV PEDESTAL
TRAFFIC LIGHT POLE
TRAFFIC CONTROL BOX
TRAFFIC CONTROL VAULT
TRAFFIC LIGHT
TELEPHONE PEDESTAL
TELEPHONE MANHOLE
PAINTED TELEPHONE LINE
FIBER OPTIC CABLE LINE
ANCHOR
GUY POLE
UTILITY POLE
POWER POLE
LIGHT STANDARD
ELECTRIC MANHOLE
ELECTRIC PEDESTAL
ELECTRIC TRANSFORMER PAD
ELECTRIC METER
HANDHOLE
ELECTRICAL JUNCTION BOX
ELECTRIC VAULT
ELECTRIC SERVICE OUTLET BOX
PAINTED ELECTRIC LINE
TRANSFORMER PAD
PAINTED GAS LINE
GAS VALVE
GAS METER
GAS VALVE VAULT
GAS METER
PIPELINE MARKER
MONITORING WELL
POST INDICATOR VALVE
WELL HEAD
FLAGPOLE
MAILBOX
SIGN
POST
PUBLIC PAY TELEPHONE
PARKING METER
WETLAND MARKER
BASKETBALL HOOP
AIR CONDITIONER PAD/UNIT
DECIDUOUS TREE W/ TRUNK SIZE
NON-DECIDUOUS TREE W/ TRUNK SIZE
BUSH
SOIL BORING/ HOLE W/ NUMBER
HEADWALL
CURB INLET
STORM INLET
STORM MANHOLE
FLARED END SECTION
CLEANOUT
SANITARY MANHOLE
HOSE BIB
B-BOX
HYDRANT
WATER VALVE
WATER VALVE VAULT
PAINTED WATER LINE
SPRINKLER HEAD
WATER METER
FOUND DISK IN CONCRETE
FND FOUND BRASS DISC
FIR FOUND ROW MARKER
FIP FOUND IRON ROD
FRS FOUND RAILROAD SPIKE
FPK FOUND PK NAIL
FMG FOUND MAG NAIL
FCC FOUND CUT CROSS
FIP FOUND IRON PIPE
FIB FOUND IRON BAR
TP SET TRAVERSE POINT
SPK SET PK NAIL
SMG SET MAG NAIL
SIP SET IRON PIPE
SBM SET CONCRETE MONUMENT WITH BRASS DISC
SCM SET CONCRETE MONUMENT WITH IRON PIPE
SECTION CORNER
QUARTER SECTION CORNER

PROPERTY LINE
EXISTING RIGHT-OF-WAY LINE
PROPOSED RIGHT-OF-WAY LINE
EXISTING LOT LINE
PROPOSED LOT LINE
EX. & PROP. CENTERLINE
EXISTING EASEMENT LINE
PROPOSED EASEMENT LINE
EX. & PRO. BUILDING SETBACK LINE
SECTION LINE
EXISTING FENCELINE (CHAIN LINK)
EXISTING FENCELINE (WOOD)
EXISTING FENCELINE (WIRE)
GUARDRAIL
RAILROAD TRACKS
UNDERGROUND CABLE TV
UNDERGROUND CABLE TV(ATLAS INFO.)
UNDERGROUND FIBER OPTIC CABLE(ATLAS INFO.)
UNDERGROUND ELECTRIC
UNDERGROUND ELECTRIC(ATLAS INFO.)
UNDERGROUND TELEPHONE
UNDERGROUND TELEPHONE(ATLAS INFO.)
GAS MAIN
GAS MAIN(ATLAS INFO.)
WATER MAIN
WATER MAIN (ATLAS INFO.)
SANITARY SEWER
SANITARY SEWER(ATLAS INFO.)
STORM SEWER
STORM SEWER(ATLAS INFO.)
EDGE OF WATER
OVERHEAD WIRES
CURB
DEPRESSED CURB
EXISTING CONTOUR LINE
ASPHALT PAVING OR WATER (LABELED)
UNPAVED ROAD
CONCRETE
WETLANDS
EXISTING BUILDING
MARSH AREA

ABBREVIATIONS

783.63 EXISTING TOP OF CURB ELEVATION
782.12 EXISTING EDGE OF PAVEMENT ELEVATION
783 EXISTING SPOT ELEVATION
A.P. ACCESSIBLE PARKING
F.F. FINISHED FLOOR
T.F. TOP OF FOUNDATION
CMP CORRUGATED METAL PIPE
RCP REINFORCED CONCRETE PIPE
VCP VITRIFIED CLAY PIPE
FRM FRAME
BRK BRICK
TC TOP OF CURB
DEP DEPRESSED CURB
E.P. EDGE OF PAVEMENT
EP EDGE OF PAVEMENT
F.L. FLOW LINE
CONC CONCRETE
BIT BITUMINOUS
MH MANHOLE
CW CONCRETE WALK
TW TOP OF WALL
BW BOTTOM OF WALL
TP TOP OF PIPE
BW BACK OF WALK
FES FLARED END SECTION
INV INVERT
DIP DUCTILE IRON PIPE
SD STORM DRAIN
SAN SANITARY SEWER
N NORTH
W WEST
E EAST
W WEST
CB CHORD BEARING
A ARC LENGTH
R RADIUS
U.E. UTILITY EASEMENT
P.U.E. PUBLIC UTILITY EASEMENT
D.E. DRAINAGE EASEMENT
M.U.E. MUNICIPAL UTILITY EASEMENT
I.E. INGRESS & EGRESS EASEMENT
PC POINT OF CURVATURE
PCC POINT OF COMPOUND CURVATURE
PRC POINT OF REVERSE CURVATURE
PT POINT OF TANGENCY
(REC) RECORD DATUM
MEAS. MEASURED DATUM
(CALC) CALCULATED DATUM
<DEED> INFORMATION TAKEN FROM DEED
ETBE EXCEPTION TO BLANKET EASEMENT

EXHIBIT 22

Project No:	17034
Group No:	VP03.1
SHEET NO.	1 of 4

TOPOGRAPHIC EXHIBIT
FLOOD PRONE AREA STUDY 2, WHEATON, IL

DRAFTING COMPLETED:	5-12-17	DRAWN BY:	SPK
FIELD WORK COMPLETED:	5-03-17	CHECKED BY:	GVB
PROJECT MANAGER:	GVB	SCALE:	1" = 150'

NO.	DATE	DESCRIPTION
1	05-09-17	ADDITIONAL STORM INFORMATION
2	07-05-17	ADDITIONAL STORM INFORMATION
3	07-17-17	#4165 MH #15 VERIFICATION OF IE INFORMATION
2	02-09-18	ADDITIONAL CPE & FF ELEVATIONS

REVISIONS

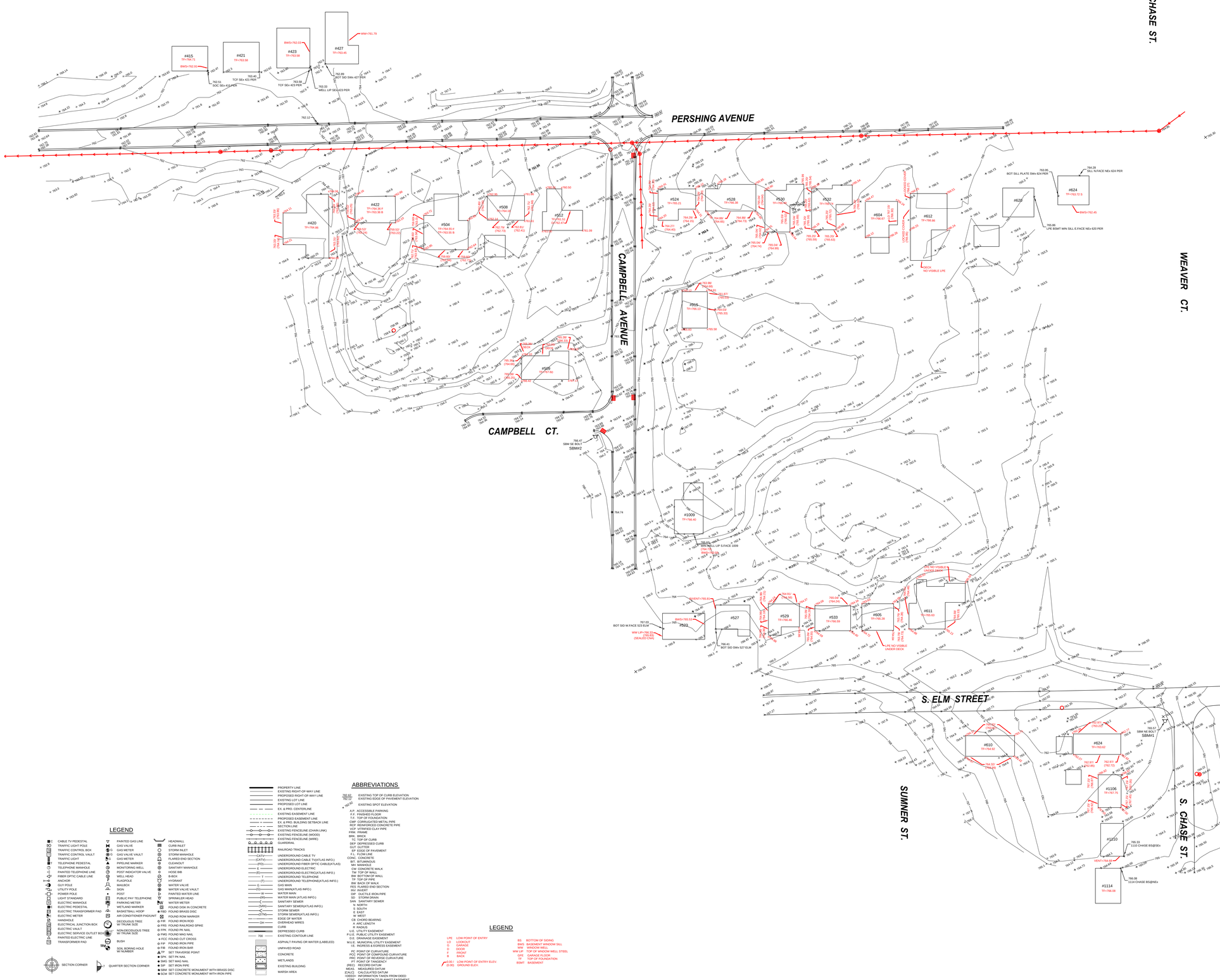
NO.	DATE	DESCRIPTION

PREPARED FOR:
City of Wheaton
303 West Wesley Street
Wheaton, IL 60187
630.260.2000

Engineers
Scientists
Surveyors

7325 Janes Avenue, Suite 100
Woodridge, IL 60517
630.724.9200 voice
630.724.0384 fax
v3co.com

TOPOGRAPHIC EXHIBIT
OF
FLOOD PRONE AREA STUDY 2
WHEATON, IL



STATE PLANE MERIDIAN

GRAPHIC SCALE

1" = 40'

LEGEND

CABLE TV PEDESTAL
TRAFFIC LIGHT POLE
TRAFFIC CONTROL BOX
TRAFFIC CONTROL VAULT
TRAFFIC LIGHT
TELEPHONE PEDESTAL
TELEPHONE MANHOLE
PAINTED TELEPHONE LINE
FIBER OPTIC CABLE LINE
ANCHOR
GUY POLE
UTILITY POLE
POWER POLE
LIGHT STANDARD
ELECTRIC MANHOLE
ELECTRIC PEDESTAL
ELECTRIC TRANSFORMER PAD
ELECTRIC METER
HANDHOLE
ELECTRICAL JUNCTION BOX
ELECTRIC VAULT
ELECTRIC SERVICE OUTLET BOX
PAINTED ELECTRIC LINE
TRANSFORMER PAD

PAINTED GAS LINE
GAS VALVE
GAS METER
GAS VALVE VAULT
GAS METER
PIPELINE MARKER
MONITORING WELL
POST INDICATOR VALVE
WELL HEAD
FLAGPOLE
MAILBOX
SIGN
POST
PUBLIC PAY TELEPHONE
PARKING METER
WETLAND MARKER
BASKETBALL HOOP
AIR CONDITIONER PADLAT
DECIDUOUS TREE W/ TRUNK SIZE
NON-DECIDUOUS TREE W/ TRUNK SIZE
BUSH
SOIL BORING HOLE W/ NUMBER

HEADWALL
CURB INLET
STORM INLET
STORM MANHOLE
FLARED END SECTION
CLEANOUT
SANITARY MANHOLE
HOSE BIB
B-BOX
HYDRANT
WATER VALVE
WATER VALVE VAULT
PAINTED WATER LINE
SPRINKLER HEAD
WATER METER
FOUND DISK IN CONCRETE
FBD FOUND BRASS DISC
FRM FOUND IRON MARKER
FIR FOUND IRON ROD
FRS FOUND RAILROAD SPIKE
FPK FOUND PK NAIL
FMG FOUND MAG NAIL
FCC FOUND CUT CROSS
FIP FOUND IRON PIPE
FIB FOUND IRON BAR
TP SET TRAVERSE POINT
SPK SET PK NAIL
SMG SET MAG NAIL
SIP SET IRON PIPE
SBM SET CONCRETE MONUMENT WITH BRASS DISC
SCM SET CONCRETE MONUMENT WITH IRON PIPE

SECTION CORNER
QUARTER SECTION CORNER

PROPERTY LINE
EXISTING RIGHT-OF-WAY LINE
PROPOSED RIGHT-OF-WAY LINE
EXISTING LOT LINE
PROPOSED LOT LINE
EX. & PRO. CENTERLINE
EXISTING EASEMENT LINE
PROPOSED EASEMENT LINE
EX. & PRO. BUILDING SETBACK LINE
SECTION LINE
EXISTING FENCELINE (CHAIN LINK)
EXISTING FENCELINE (WOOD)
EXISTING FENCELINE (WIRE)
GUARDRAIL
RAILROAD TRACKS
UNDERGROUND CABLE TV
UNDERGROUND CABLE TV(ATLAS INFO.)
UNDERGROUND FIBER OPTIC CABLE(ATLAS)
UNDERGROUND ELECTRIC
UNDERGROUND ELECTRIC(ATLAS INFO.)
UNDERGROUND TELEPHONE
UNDERGROUND TELEPHONE(ATLAS INFO.)
GAS MAIN
GAS MAIN(ATLAS INFO.)
WATER MAIN
WATER MAIN (ATLAS INFO.)
SANITARY SEWER
SANITARY SEWER(ATLAS INFO.)
STORM SEWER
STORM SEWER(ATLAS INFO.)
EDGE OF WATER
OVERHEAD WIRES
CURB
DEPRESSED CURB
EXISTING CONTOUR LINE
ASPHALT PAVING OR WATER (LABELED)
UNPAVED ROAD
CONCRETE
WETLANDS
EXISTING BUILDING
MARSH AREA

ABBREVIATIONS

763.62 EXISTING TOP OF CURB ELEVATION
763.62 EXISTING EDGE OF PAVEMENT ELEVATION
90.00 EXISTING SPOT ELEVATION
A.P. ACCESSIBLE PARKING
F.F. FINISHED FLOOR
T.F. TOP OF FOUNDATION
CMP CORRUGATED METAL PIPE
RCP REINFORCED CONCRETE PIPE
VCP VITRIFIED CLAY PIPE
FRM FRAME
BRK BRICK
TC TOP OF CURB
FL FLOW LINE OF CURB
GUT GUTTER
EP EDGE OF PAVEMENT
F.L. FLOW LINE
CONC CONCRETE
EX EXISTING
MH MANHOLE
CW CONCRETE WALK
TW TOP OF WALL
BW BOTTOM OF WALL
TP TOP OF PIPE
BW BACK OF WALK
INV INVERT OF PIPE SECTION
INV INVERT
DIP DUCTILE IRON PIPE
SD STORM DRAIN
SAN SANITARY SEWER
N NORTH
S SOUTH
E EAST
W WEST
CB CHORD BEARING
CH CHORD LENGTH
R RADIUS
U.E. UTILITY EASEMENT
P.U.E. PUBLIC UTILITY EASEMENT
D.E. DRAINAGE EASEMENT
M.U.E. MUNICIPAL UTILITY EASEMENT
I.E. INGRESS & EGRESS EASEMENT
PC POINT OF CURVATURE
PCC POINT OF COMPOUND CURVATURE
PRC POINT OF REVERSE CURVATURE
PT POINT OF TANGENCY
(REC) RECORD DATUM
MEAS. MEASURED DATUM
(CALC) CALCULATED DATUM
<DEED> INFORMATION TAKEN FROM DEED
ETBE EXCEPTION TO BLANKET EASEMENT

LEGEND

LPE LOW POINT OF ENTRY
LO LOOKOUT
G GARAGE
D DOOR
F FRONT
B BACK
90.0 LOW POINT OF ENTRY ELEV.
(0.00) GROUND ELEV.

BS BOTTOM OF SIDING
BWS BASEMENT WINDOW SILL
WW WINDOW WELL
WW LIP TOP OF WINDOW WELL STEEL
GFE GARAGE FLOOR
TF TOP OF FOUNDATION
BSMT BASEMENT

EXHIBIT 23

Project No:	17034
Group No:	VP03.1
SHEET NO.	2 of 4

TOPOGRAPHIC EXHIBIT
FLOOD PRONE AREA STUDY 2, WHEATON, IL

DRAFTING COMPLETED:	5-12-17	DRAWN BY:	SPK	PROJECT MANAGER:	GVB
FIELD WORK COMPLETED:	5-03-17	CHECKED BY:	GVB	SCALE:	1" = 40'

REVISIONS

NO.	DATE	DESCRIPTION
1	09-25-17	ADDITIONAL LPE
2	03-09-18	ADDITIONAL LPE & TF ELEVATIONS
3	04-27-18	ADDITIONAL TF ELEVATIONS

NO.	DATE	DESCRIPTION

PREPARED FOR:
City of Wheaton
303 West Wesley Street
Wheaton, IL 60187
630-260-2000

7325 Janes Avenue, Suite 100
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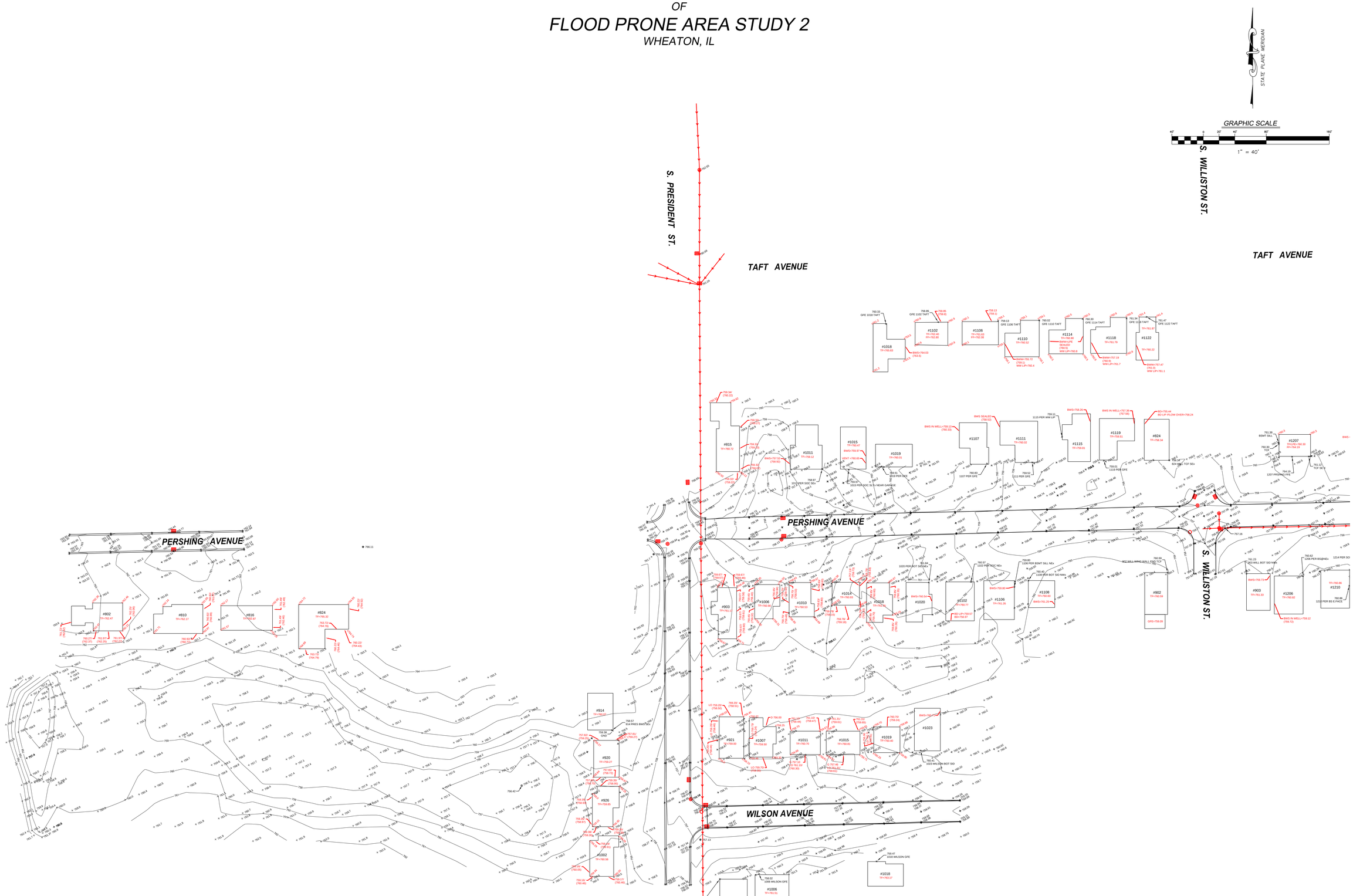
630.724.0200 office
630.724.0384 fax
v3co.com

Engineers
Scientists
Surveyors

TOPOGRAPHIC EXHIBIT
OF
FLOOD PRONE AREA STUDY 2
WHEATON, IL



LEGEND

- CABLE TV PEDESTAL
- TRAFFIC LIGHT POLE
- TRAFFIC CONTROL BOX
- TRAFFIC CONTROL VAULT
- TRAFFIC LIGHT
- TELEPHONE PEDESTAL
- TELEPHONE MANHOLE
- PAINTED TELEPHONE LINE
- FIBER OPTIC CABLE LINE
- ANCHOR
- GUY POLE
- UTILITY POLE
- POWER POLE
- LIGHT STANDARD
- ELECTRIC MANHOLE
- ELECTRIC PEDESTAL
- ELECTRIC TRANSFORMER PAD
- ELECTRIC METER
- HANDHOLE
- ELECTRICAL JUNCTION BOX
- ELECTRIC VAULT
- ELECTRIC SERVICE OUTLET BOX
- PAINTED ELECTRIC LINE
- TRANSFORMER PAD
- SECTION CORNER
- PAINTED GAS LINE
- GAS VALVE
- GAS METER
- GAS VALVE VAULT
- GAS METER
- PIPELINE MARKER
- MONITORING WELL
- POST INDICATOR VALVE
- WELL HEAD
- FLAGPOLE
- MAILBOX
- SIGN
- POST
- PUBLIC PAY TELEPHONE
- PARKING METER
- WETLAND MARKER
- BASKETBALL HOOP
- AIR CONDITIONER PAD/UNIT
- DECIDUOUS TREE W/ TRUNK SIZE
- NON-DECIDUOUS TREE W/ TRUNK SIZE
- BUSH
- SOIL BORING HOLE W/ NUMBER
- QUARTER SECTION CORNER
- HEADWALL
- CURB INLET
- STORM INLET
- STORM MANHOLE
- FLARED END SECTION
- CLEANOUT
- SANITARY MANHOLE
- HOSE BIB
- B-BOX
- HYDRANT
- WATER VALVE
- WATER VALVE VAULT
- PAINTED WATER LINE
- SPRINKLER HEAD
- WATER METER
- FOUND DISK IN CONCRETE
- FOUND BRASS DISC
- FOUND IRON MARKER
- FOUND IRON ROD
- FOUND RAILROAD SPIKE
- FOUND PK NAIL
- FOUND MAG NAIL
- FOUND CUT CROSS
- FOUND IRON PIPE
- FOUND IRON BAR
- SET TRAVERSE POINT
- SET PK NAIL
- SET MAG NAIL
- SET IRON PIPE
- SET CONCRETE MONUMENT WITH BRASS DISC
- SET CONCRETE MONUMENT WITH IRON PIPE

- PROPERTY LINE
- EXISTING RIGHT-OF-WAY LINE
- PROPOSED RIGHT-OF-WAY LINE
- EXISTING LOT LINE
- PROPOSED LOT LINE
- EX. & PRO. CENTERLINE
- EXISTING EASEMENT LINE
- PROPOSED EASEMENT LINE
- EX. & PRO. BUILDING SETBACK LINE
- SECTION LINE
- EXISTING FENCELINE (CHAIN LINK)
- EXISTING FENCELINE (WOOD)
- EXISTING FENCELINE (WIRE)
- GUARDRAIL
- RAILROAD TRACKS
- UNDERGROUND CABLE TV
- UNDERGROUND CABLE TV(ATLAS INFO.)
- UNDERGROUND FIBER OPTIC CABLE(ATLAS)
- UNDERGROUND ELECTRIC
- UNDERGROUND ELECTRIC(ATLAS INFO.)
- UNDERGROUND TELEPHONE
- UNDERGROUND TELEPHONE(ATLAS INFO.)
- GAS MAIN
- GAS MAIN(ATLAS INFO.)
- WATER MAIN
- WATER MAIN (ATLAS INFO.)
- SANITARY SEWER
- SANITARY SEWER(ATLAS INFO.)
- STORM SEWER
- STORM SEWER(ATLAS INFO.)
- EDGE OF WATER
- OVERHEAD WIRES
- CURB
- DEPRESSED CURB
- 700 EXISTING CONTOUR LINE
- ASPHALT PAVING ON WATER (LABELED)
- UNPAVED ROAD
- CONCRETE
- WETLANDS
- EXISTING BUILDING
- MARSH AREA

ABBREVIATIONS

- 782.42 / 782.52 — EXISTING TOP OF CURB ELEVATION
- 782.52 — EXISTING EDGE OF PAVEMENT ELEVATION
- 782.52 — EXISTING SPOT ELEVATION
- A.P. ACCESSIBLE PARKING
- F.F. FINISHED FLOOR
- T.F. TOP OF FOUNDATION
- RCP REINFORCED CONCRETE PIPE
- RCP REINFORCED CONCRETE PIPE
- VCP VITRIFIED CLAY PIPE
- FRM FRAME
- BRK BRICK
- CURB CONCRETE CURB
- DEP DEPRESSED CURB
- GUT GUTTER
- EP EDGE OF PAVEMENT
- F.L. FLOW LINE
- CONC CONCRETE
- BIT BITUMINOUS
- BLDG BUILDING
- CW CONCRETE WALK
- TW TOP OF WALL
- BW BOTTOM OF WALL
- SW SIDEWALK
- BW BACK OF WALK
- FES FLARED END SECTION
- INV INVERT
- DIP DUCTILE IRON PIPE
- SD STORM DRAIN
- SS SANITARY SEWER
- N NORTH
- S SOUTH
- E EAST
- W WEST
- SB SANITARY BEARING
- LA LAID LENGTH
- R RADIUS
- U.E. UTILITY EASEMENT
- P.U.E. PUBLIC UTILITY EASEMENT
- D.E. DRAINAGE EASEMENT
- M.U.E. MUNICIPAL UTILITY EASEMENT
- I.E. INGRESS & EGRESS EASEMENT
- PC POINT OF CURVATURE
- PRC POINT OF REVERSE CURVATURE
- PRC POINT OF REVERSE CURVATURE
- PT POINT OF TANGENCY
- (REC) RECORD DATUM
- MEAS. MEASURED DATUM
- (GEO) GEO DATUM (NAD 83/NAVD 88)
- <GEO> INFORMATION TAKEN FROM DEED
- ETBE EXCEPTION TO BLANKET EASEMENT

LEGEND

- LPE - LOW POINT OF ENTRY
- LO - LOCKOUT
- G - GARAGE
- D - DOOR
- F - FRONT
- B - BACK
- 10.00 / (10.00) - LOW POINT OF ENTRY ELEV. / GROUND ELEV.
- BS - BOTTOM OF SIDING
- BWS - BASEMENT WINDOW SILL
- WW - WINDOW WELL
- WW LIP - TOP OF WINDOW WELL STEEL
- GFE - GARAGE FLOOR
- TF - TOP OF FOUNDATION
- BSMT - BASEMENT

EXHIBIT 24

Project No:	17034
Group No:	VP03.1
SHEET NO.	3 of 4

TOPOGRAPHIC EXHIBIT

FLOOD PRONE AREA STUDY 2, WHEATON, IL

DRAFTING COMPLETED:	5-12-17	DRAWN BY:	SPK
FIELD WORK COMPLETED:	5-03-17	CHECKED BY:	GVB
PROJECT MANAGER:	GVB	SCALE:	1" = 40'

REVISIONS

NO.	DATE	DESCRIPTION
0	06-05-17	ADDITIONAL LPE
1	03-09-18	ADDITIONAL LPE, & TF ELEVATIONS.
2	04-27-18	ADDITIONAL TF ELEVATIONS
3		

PREPARED FOR:
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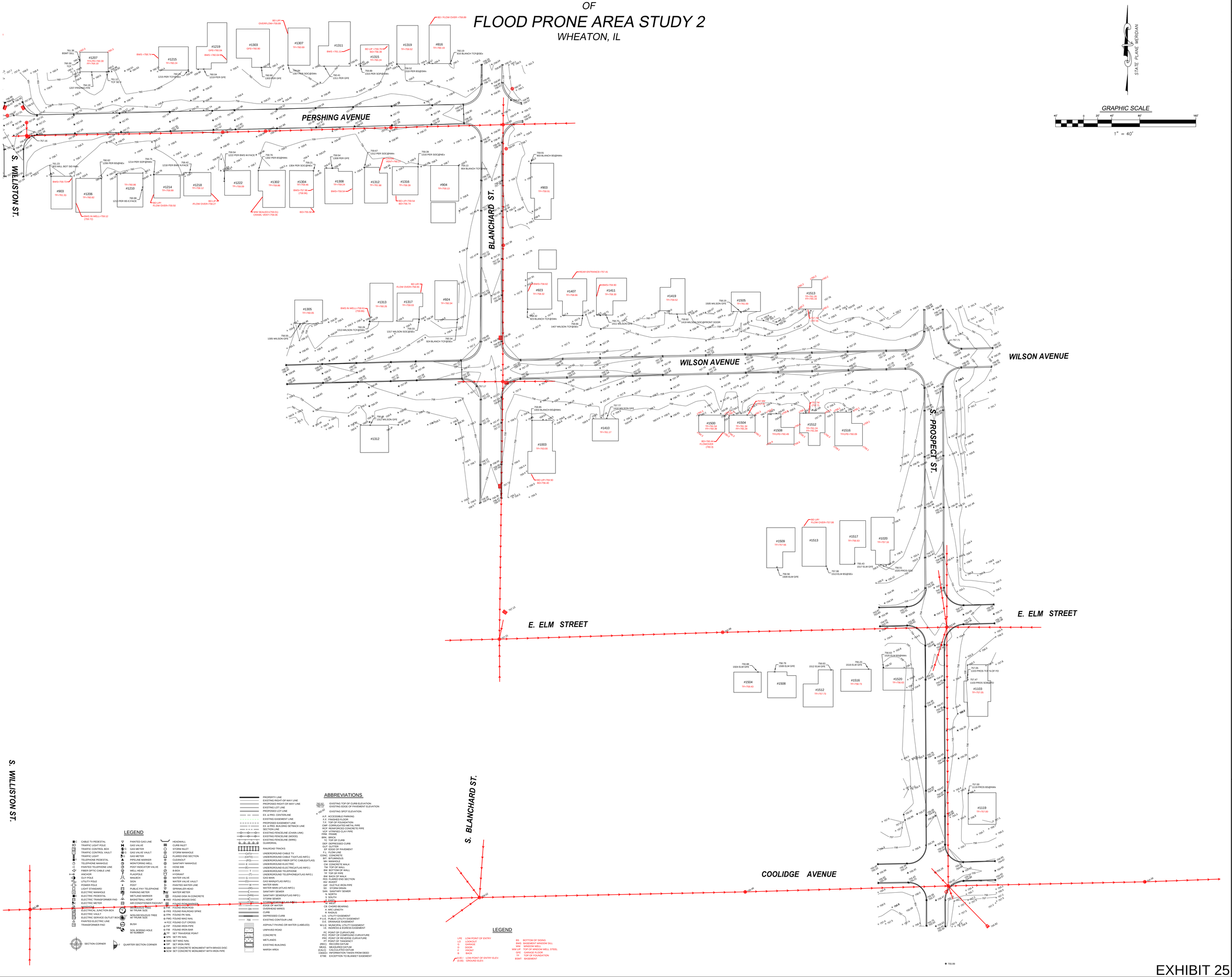
v3co.com

Engineers
Scientists
Surveyors

TOPOGRAPHIC EXHIBIT
OF

FLOOD PRONE AREA STUDY 2

WHEATON, IL



LEGEND

- CABLE TV PEDESTAL
- TRAFFIC LIGHT POLE
- TRAFFIC CONTROL BOX
- TRAFFIC CONTROL VAULT
- TRAFFIC LIGHT
- TELEPHONE PEDESTAL
- TELEPHONE MANHOLE
- PAINTED TELEPHONE LINE
- FIBER OPTIC CABLE LINE
- ANCHOR
- GUY POLE
- UTILITY POLE
- POWER POLE
- LIGHT STANDARD
- ELECTRIC MANHOLE
- ELECTRIC PEDESTAL
- ELECTRIC TRANSFORMER PAD
- ELECTRIC METER
- MANHOLE
- ELECTRICAL JUNCTION BOX
- ELECTRIC VAULT
- ELECTRIC SERVICE OUTLET BOX
- PAINTED ELECTRIC LINE
- TRANSFORMER PAD
- PAINTED GAS LINE
- GAS VALVE
- GAS METER
- GAS VALVE VAULT
- GAS METER
- PIPELINE MARKER
- MONITORING WELL
- POST INDICATOR VALVE
- WELL HEAD
- FLAGPOLE
- MAILBOX
- SIGN
- POST
- PUBLIC PAY TELEPHONE
- PARKING METER
- WETLAND MARKER
- BASKETBALL HOOP
- AIR CONDITIONER PAD/UNIT
- DECIDUOUS TREE W/ TRUNK SIZE
- NONDECIDUOUS TREE W/ TRUNK SIZE
- BUSH
- SOIL BORING HOLE W/ NUMBER
- HEADWALL
- CURB INLET
- STORM INLET
- STORM MANHOLE
- FLARED END SECTION
- CLEANOUT
- SANITARY MANHOLE
- HOSE BIB
- B-BOX
- HYDRANT
- WATER VALVE
- WATER VALVE VAULT
- PAINTED WATER LINE
- SPRINKLER HEAD
- WATER METER
- FOUND DISK IN CONCRETE
- FIRE FOUND BRASS DISC
- FOUND BOLT MARKER
- FIR FOUND IRON ROD
- FRR FOUND RAILROAD SPIKE
- FPN FOUND PK NAIL
- FMN FOUND MAG NAIL
- FCC FOUND CUT CROSS
- FIP FOUND IRON PIPE
- FIB FOUND IRON BAR
- TP SET TRAVERSE POINT
- SPK SET PK NAIL
- SMN SET MAG NAIL
- SIP SET IRON PIPE
- SBM SET CONCRETE MONUMENT WITH BRASS DISC
- SCM SET CONCRETE MONUMENT WITH IRON PIPE
- SECTION CORNER
- QUARTER SECTION CORNER

- PROPERTY LINE
- EXISTING RIGHT-OF-WAY LINE
- PROPOSED RIGHT-OF-WAY LINE
- EXISTING LOT LINE
- PROPOSED LOT LINE
- EX. & PRO. CENTERLINE
- EXISTING EASEMENT LINE
- PROPOSED EASEMENT LINE
- EX. & PRO. BUILDING SETBACK LINE
- SECTION LINE
- EXISTING FENCELINE (CHAIN LINK)
- EXISTING FENCELINE (WOOD)
- EXISTING FENCELINE (WIRE)
- GUARDRAIL
- RAILROAD TRACKS
- UNDERGROUND CABLE TV
- UNDERGROUND CABLE TV(ATLAS INFO.)
- UNDERGROUND FIBER OPTIC CABLE(ATLAS)
- UNDERGROUND ELECTRIC
- UNDERGROUND ELECTRIC(ATLAS INFO.)
- UNDERGROUND TELEPHONE
- UNDERGROUND TELEPHONE(ATLAS INFO.)
- GAS MAIN
- GAS MAIN(ATLAS INFO.)
- WATER MAIN
- WATER MAIN (ATLAS INFO.)
- SANITARY SEWER
- SANITARY SEWER(ATLAS INFO.)
- STORM SEWER
- STORM SEWER(ATLAS INFO.)
- EDGE OF WATER
- OVERHEAD WIRES
- CURB
- DEPRESSED CURB
- 700 EXISTING CONTOUR LINE
- ASPHALT PAVING OR WATER (LABELED)
- UNPAVED ROAD
- CONCRETE
- WETLANDS
- EXISTING BUILDING
- MARSH AREA

ABBREVIATIONS

- 782.62 EXISTING TOP OF CURB ELEVATION
- 782.13 EXISTING EDGE OF PAVEMENT ELEVATION
- 45.2 EXISTING SPOT ELEVATION
- A.P. ACCESSIBLE PARKING
- F.F. FINISHED FLOOR
- T.F. TOP OF FOUNDATION
- CMP CORRUGATED METAL PIPE
- RCP REINFORCED CONCRETE PIPE
- VCP VITRIFIED CLAY PIPE
- FRM. FRAME
- BRK. BRICK
- TC TOP OF CURB
- DEP DEPRESSED CURB
- E.P. EDGE OF PAVEMENT
- EP EDGE OF PAVEMENT
- F.L. FLOW LINE
- CONC. CONCRETE
- BIT. BITUMINOUS
- BW BOTTOM OF WALL
- CW CONCRETE WALK
- TW TOP OF WALL
- BW BOTTOM OF WALL
- TP TOP OF PIPE
- BW BOTTOM OF WALK
- FES FLARED END SECTION
- INV INVERT
- DIP DUCTILE IRON PIPE
- SD STORM DRAIN
- SAN SANITARY SEWER
- N NORTH
- S SOUTH
- E EAST
- W WEST
- CB CHORD BEARING
- A ARC LENGTH
- R RADIUS
- U.E. UTILITY EASEMENT
- P.U.E. PUBLIC UTILITY EASEMENT
- D.E. DRAINAGE EASEMENT
- M.U.E. MUNICIPAL UTILITY EASEMENT
- I.E. INGRESS & EGRESS EASEMENT
- PC POINT OF CURVATURE
- PCC POINT OF COMPOUND CURVATURE
- PRC POINT OF REVERSE CURVATURE
- PT POINT OF TANGENCY
- (REC) RECORD DATUM
- MEAS. MEASURED DATUM
- [CALC] CALCULATED DATUM
- <DEED> INFORMATION TAKEN FROM DEED
- ETBE EXCEPTION TO BLANKET EASEMENT

LEGEND

- LPE LOW POINT OF ENTRY
- U UNIT OFFICE
- G GARAGE
- D DOOR
- F FRONT
- B BACK
- 100.0 LOW POINT OF ENTRY ELEV.
- (0.00) GROUND ELEV.
- BS BOTTOM OF SIDING
- BWS BASEMENT WINDOW SILL
- WW WINDOW WELL
- WW UP TOP OF WINDOW WELL STEEL
- GFE GARAGE FLOOR
- BFE BOTTOM OF FOUNDATION
- BSMT BASEMENT

EXHIBIT 25

Project No:	17034
Group No:	VP03.1
SHEET NO.	4 of 4

TOPOGRAPHIC EXHIBIT

FLOOD PRONE AREA STUDY 2, WHEATON, IL

DRAFTING COMPLETED:	5-12-17
FIELD WORK COMPLETED:	5-03-17
DRAWN BY:	SPK
CHECKED BY:	GVB
PROJECT MANAGER:	GVB
SCALE:	1" = 40'

REVISIONS

NO.	DATE	DESCRIPTION
1	09-26-17	ADDITIONAL LFE
2	02-09-18	ADDITIONAL LFE & TF ELEVATIONS
3	04-27-18	ADDITIONAL TF ELEVATIONS

PREPARED FOR:
City of Wheaton
300 West Wesley Street
Wheaton, IL 60187
630.260.2000

7325 Janes Avenue, Suite 100
Woodridge, IL 60517
630.724.0202 office
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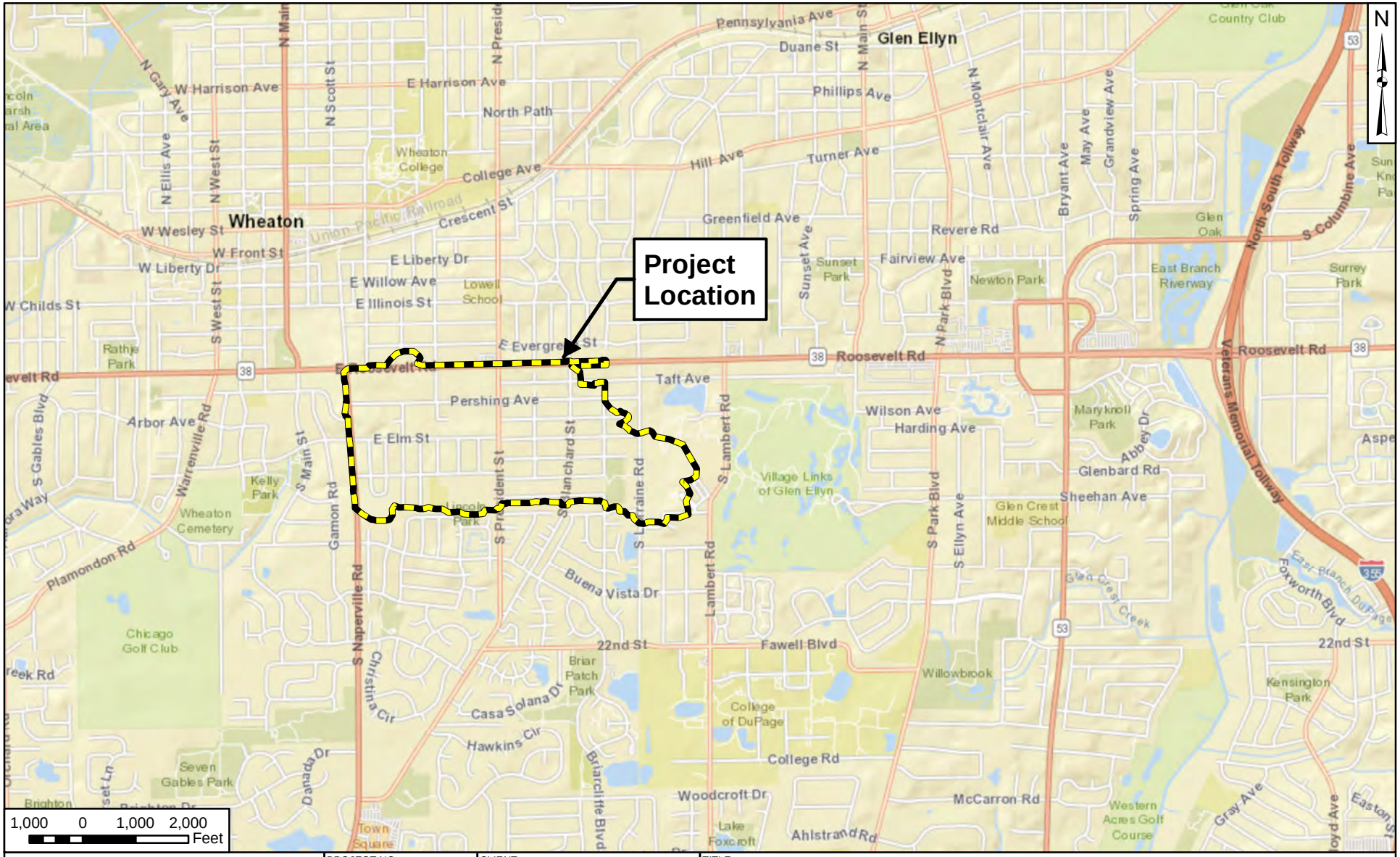
Engineers
Scientists
Surveyors



V3 Companies 7325 Janes Avenue Woodridge, Illinois 60517 630.724.9200 phone 630.724.9202 fax www.v3co.com	PROJECT NO.: 17034 CREATED BY: MMD	CLIENT: The City of Wheaton 303 W Wesley St Wheaton, Illinois 60187	TITLE: **PROJECT LOCATION MAP**
Visio, Vertere, Virtute... *"The Vision To Transform With Excellence"*	DATE: 08/29/17 SCALE: See Scale Bar	BASE LAYER: ESRI World Street Map	SITE: Pershing/Elm Flood Prone Area Study Wheaton, Illinois EXHIBIT:

N:\2017\17034\Drawings\ArcGIS\EXHloc17034.mxd

EXHIBIT 26

V3 Companies 7325 Janes Avenue Woodridge, Illinois 60517 630.724.9200 phone 630.724.9202 fax www.v3co.com	PROJECT NO.: 17034 CREATED BY: MMD	CLIENT: The City of Wheaton 303 W Wesley St Wheaton, Illinois 60187	TITLE: **AERIAL MAP**
Visio, Vertere, Virtute... *"The Vision To Transform With Excellence"*	DATE: 08/29/17 SCALE: See Scale Bar	BASE LAYER: DigitalGlobe Aerial Imagery (2015)	SITE: Pershing/Elm Flood Prone Area Study Wheaton, Illinois EXHIBIT:

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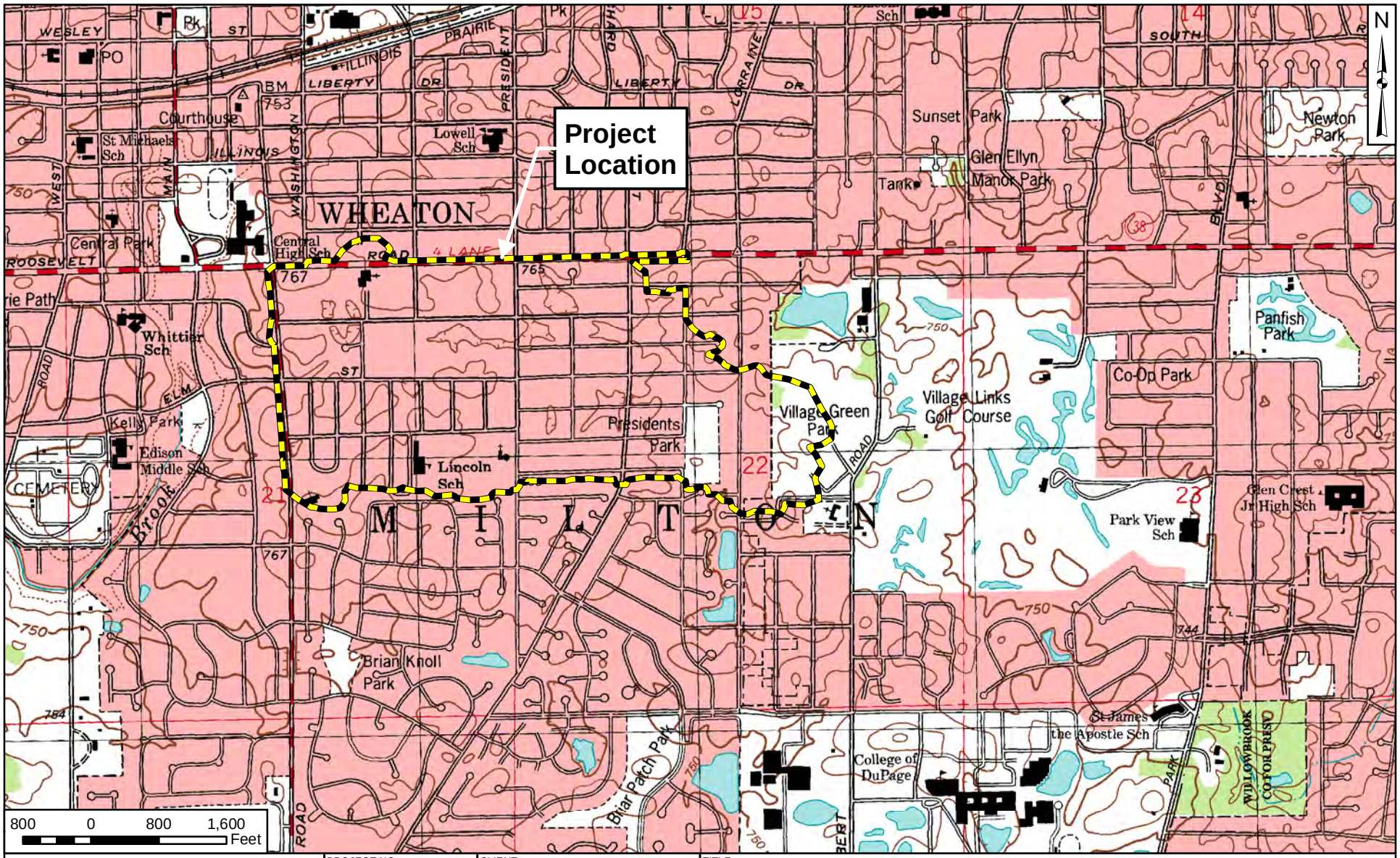
EXHIBIT 27



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630.724.9202 fax
www.v3co.com

Visio, Vertere, Virtute...
"The Vision To Transform With Excellence"

PROJECT NO.: 17034	CLIENT: The City of Wheaton, 303 W Wesley St, Wheaton, Illinois 60187	TITLE: **USGS TOPOGRAPHIC MAP**	
CREATED BY: MMD			
DATE: 08/29/17	BASE LAYER: USGS Topographic Map Wheaton Quadrangle (1998)	SITE: Pershing/Elm Flood Prone Area Study Wheaton, Illinois	EXHIBIT:
SCALE: See Scale Bar			

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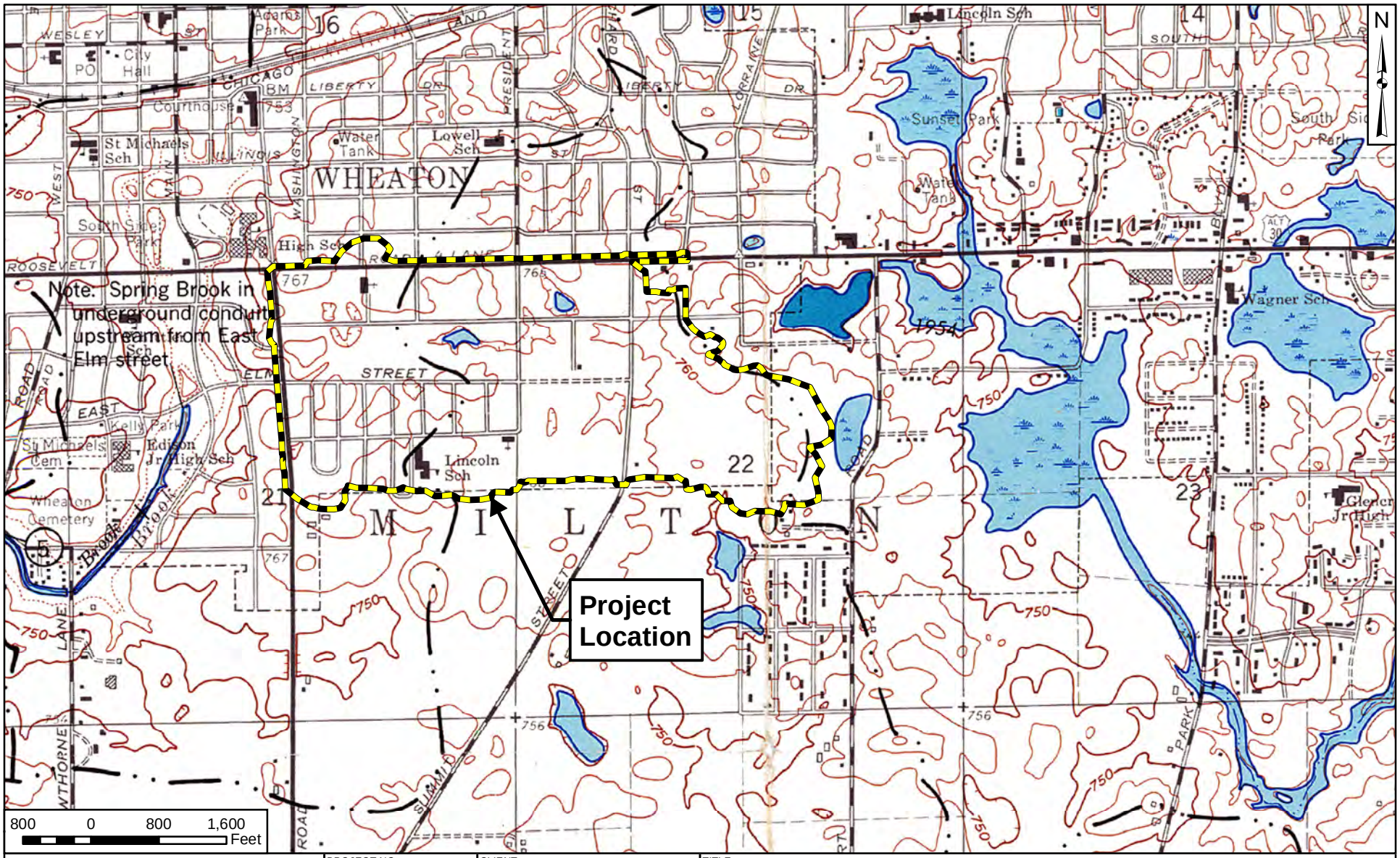
EXHIBIT 28



V3 Companies 7325 Janes Avenue Woodridge, Illinois 60517 630.724.9200 phone 630.724.9202 fax www.v3co.com	PROJECT NO.: 17034 CREATED BY: MMD	CLIENT: The City of Wheaton 303 W Wesley St Wheaton, Illinois 60187	TITLE: **USGS HYDROLOGIC ATLAS**
Visio, Vertere, Virtute... *"The Vision To Transform With Excellence"*	DATE: 08/29/17 SCALE: See Scale Bar	BASE LAYER: USGS Hydrologic Atlas (Wheaton Quadrangle)	SITE: Pershing/Elm Flood Prone Area Study Wheaton, Illinois EXHIBIT:

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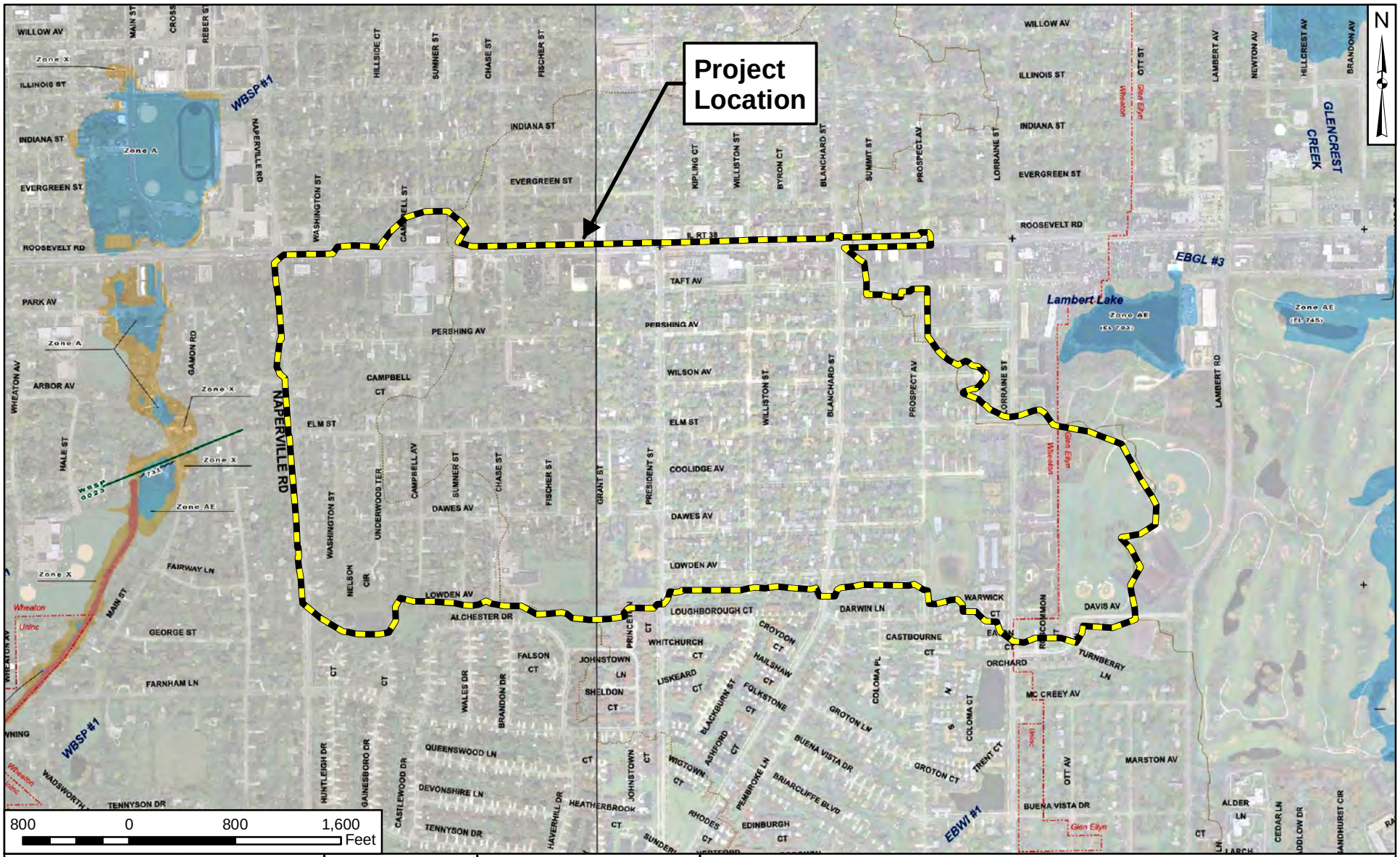
EXHIBIT 29



V3 Companies 7325 Janes Avenue Woodridge, Illinois 60517 630.724.9200 phone 630.724.9202 fax www.v3co.com	PROJECT NO.: 17034	CLIENT: The City of Wheaton 303 W Wesley St Wheaton, Illinois 60187	TITLE: **DUPAGE COUNTY REGULATORY FLOOD MAP (RFM)**
	CREATED BY: MMD		
	DATE: 08/29/17	BASE LAYER: DuPage County RFM Panels 0151 & 0152	SITE: Pershing/Elm Flood Prone Area Study Wheaton, Illinois
Visio, Vertere, Virtute... *"The Vision To Transform With Excellence"*	SCALE: See Scale Bar		EXHIBIT:

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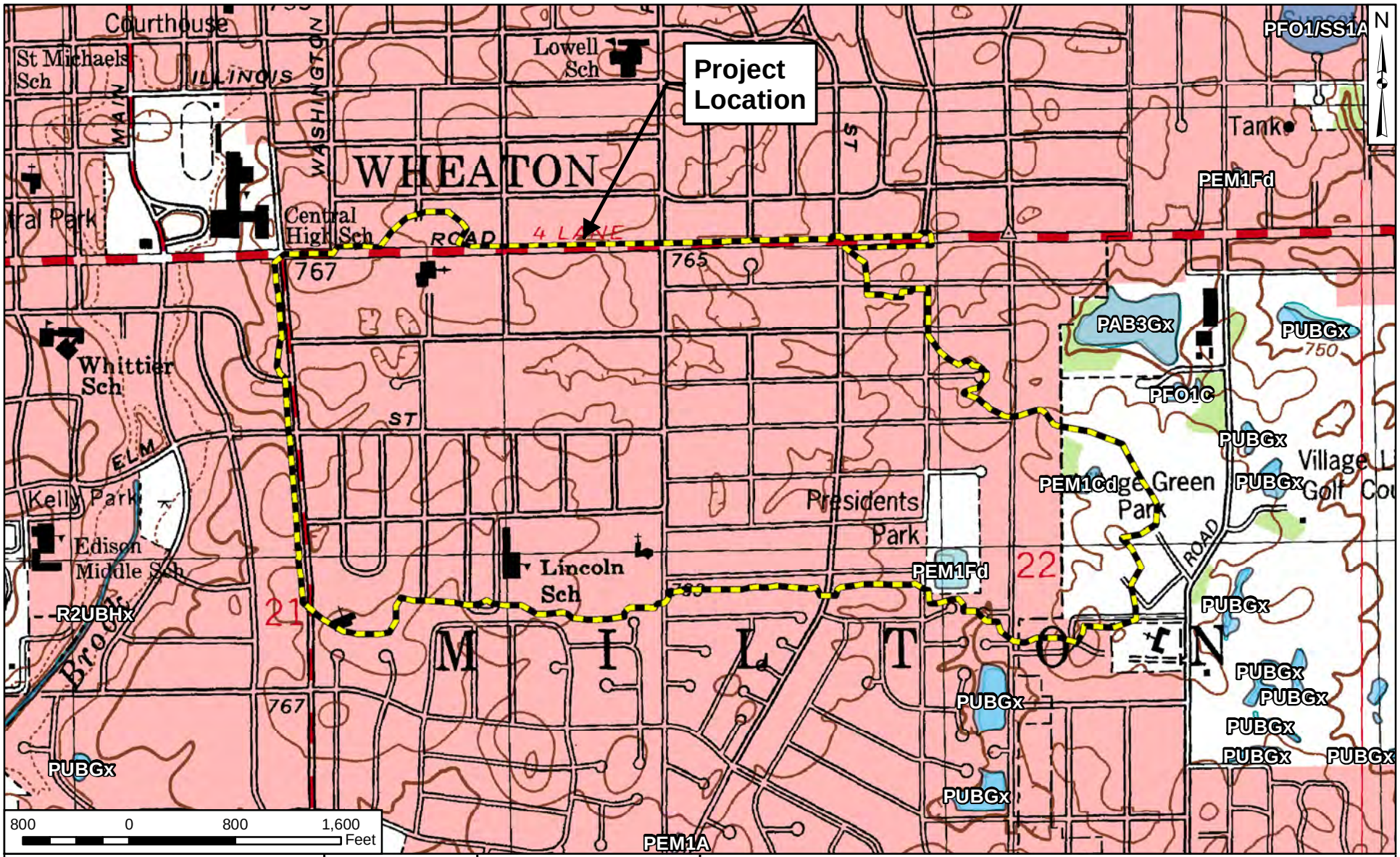
EXHIBIT 30



V3 Companies 7325 Janes Avenue Woodridge, Illinois 60517 630.724.9200 phone 630.724.9202 fax www.v3co.com	PROJECT NO.: 17034 CREATED BY: MMD	CLIENT: The City of Wheaton 303 W Wesley St Wheaton, Illinois 60187	TITLE: **NATIONAL WETLANDS INVENTORY (NWI) MAP**
	DATE: 08/29/17	BASE LAYER: USGS Topographic Map Wheaton Quadrangle (1998)	SITE: Pershing/Elm Flood Prone Area Study Wheaton, Illinois
Visio, Vertere, Virtute... *"The Vision To Transform With Excellence"*	SCALE: See Scale Bar		EXHIBIT:

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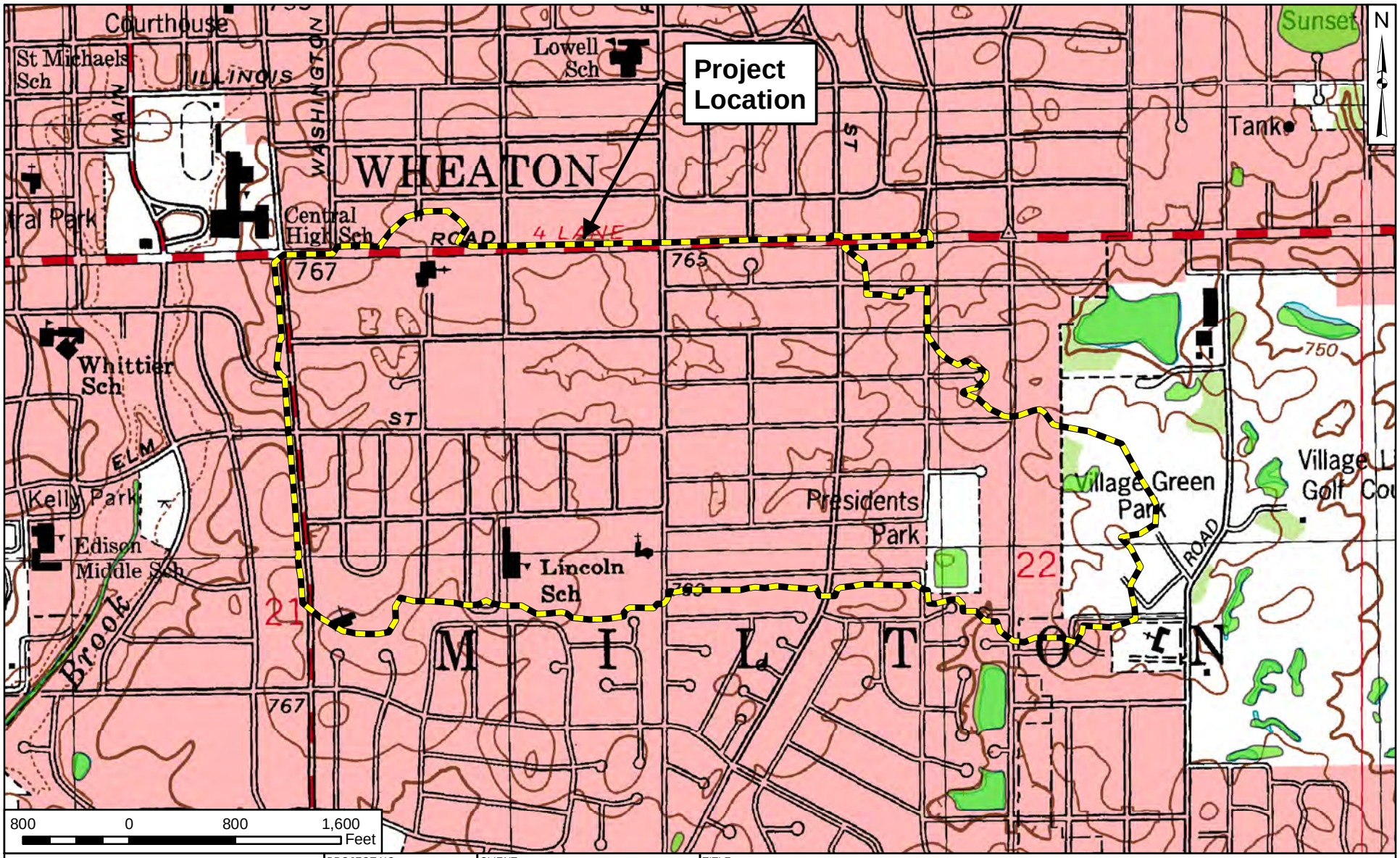
EXHIBIT 31



V3 Companies
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Woodridge, Illinois 60517
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630.724.9202 fax
www.v3co.com

Visio, Vertere, Virtute...
"The Vision To Transform With Excellence"

PROJECT NO.:	17034
CREATED BY:	MMD
DATE:	08/29/17
SCALE:	See Scale Bar

CLIENT: The City of Wheaton
303 W Wesley St
Wheaton, Illinois 60187

BASE LAYER: USGS Topographic Map
Wheaton Quadrangle
(1998)

TITLE: **DUPAGE COUNTY ADVANCED IDENTIFICATION OF WETLANDS (ADID) MAP**

SITE: Pershing/Elm Flood Prone Area Study
Wheaton, Illinois

EXHIBIT:

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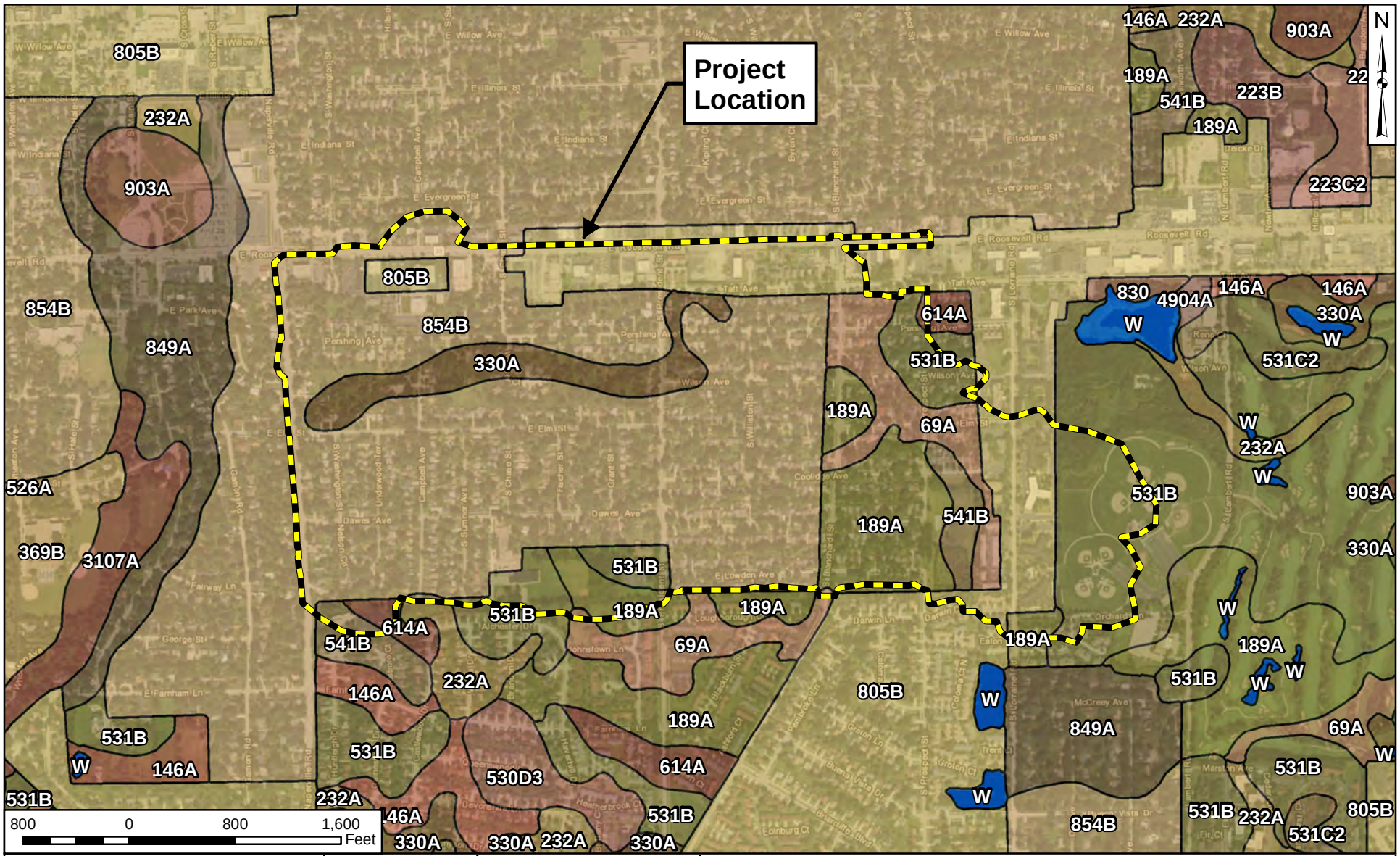
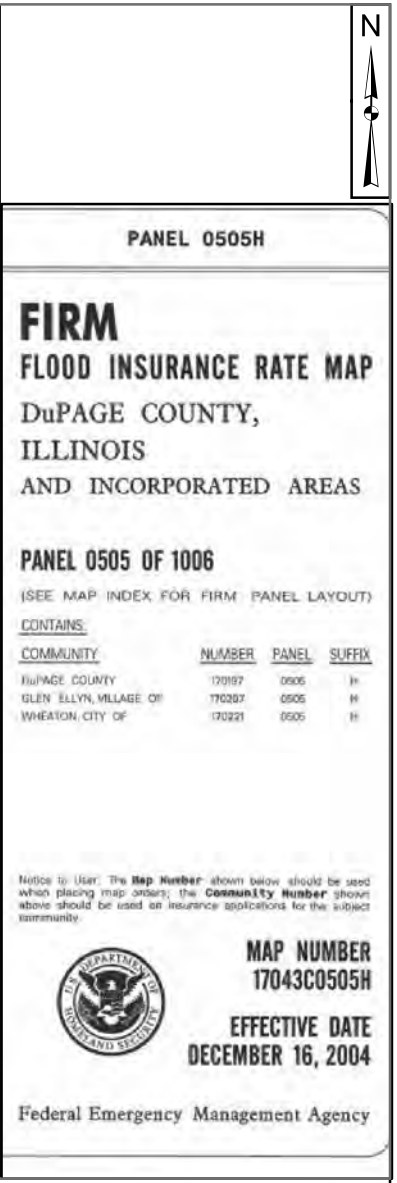
EXHIBIT 32



V3 Companies 7325 Janes Avenue Woodridge, Illinois 60517 630.724.9200 phone 630.724.9202 fax www.v3co.com	PROJECT NO.: 17034 CREATED BY: MMD	CLIENT: The City of Wheaton 303 W Wesley St Wheaton, Illinois 60187	TITLE: **SOIL SURVEY OF DUPAGE COUNTY, ILLINOIS (2015) MAP**
	DATE: 08/29/17	BASE LAYER: DigitalGlobe Aerial Imagery (2015)	SITE: Pershing/Elm Flood Prone Area Study Wheaton, Illinois
Visio, Vertere, Virtute... *"The Vision To Transform With Excellence"*	SCALE: See Scale Bar		EXHIBIT:

N:\2017\17034\Drawings\ArcGIS\EXHsoils17034.mxd

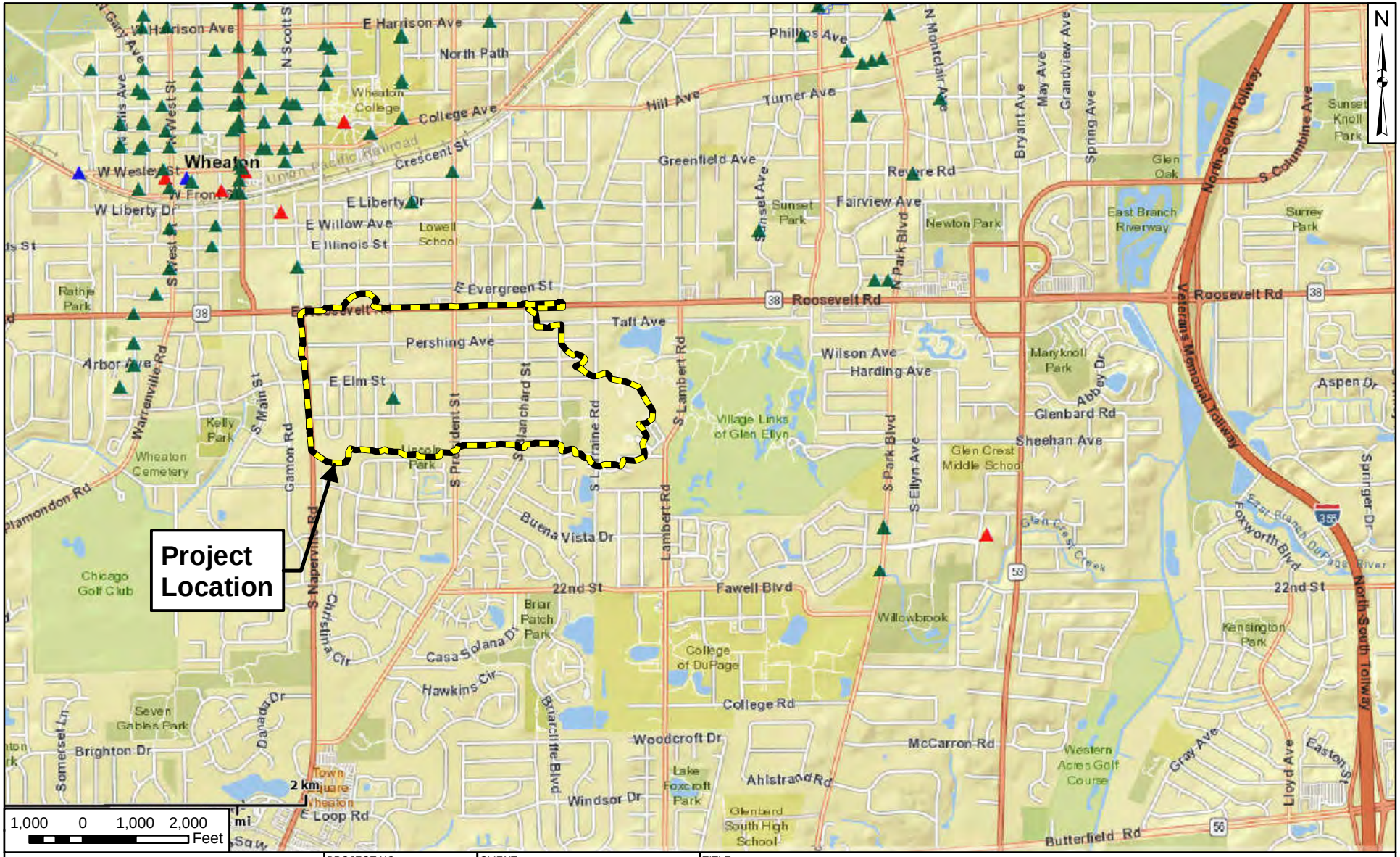
EXHIBIT 33



V3 Companies 7325 Janes Avenue Woodridge, Illinois 60517 630.724.9200 phone 630.724.9202 fax www.v3co.com	PROJECT NO.: 17034 CREATED BY: MMD	CLIENT: The City of Wheaton 303 W Wesley St Wheaton, Illinois 60187	TITLE: **FEMA FLOOD INSURANCE RATE MAP (FIRM)**
	DATE: 08/30/17	BASE LAYER: FEMA FIRM Panel 17043C0505H	SITE: Pershing/Elm Flood Prone Area Study Wheaton, Illinois
Visio, Vertere, Virtute... *"The Vision To Transform With Excellence"*	SCALE: See Scale Bar		EXHIBIT:

N:\2017\17034\Drawings\ArcGIS\EXHfirm17034.mxd

EXHIBIT 34



V3 Companies 7325 Janes Avenue Woodridge, Illinois 60517 630.724.9200 phone 630.724.9202 fax www.v3co.com	PROJECT NO.: 17034 CREATED BY: MMD	CLIENT: The City of Wheaton 303 W Wesley St Wheaton, Illinois 60187	TITLE: **ILLINOIS HISTORIC PRESERVATION AGENCY (IHPA) MAP**
Visio, Vertere, Virtute... *"The Vision To Transform With Excellence"*	DATE: 08/30/17 SCALE: See Scale Bar	BASE LAYER: IHPA HARGIS Online Map	SITE: Pershing/Elm Flood Prone Area Study Wheaton, Illinois EXHIBIT:

N:\2017\17034\Drawings\ArcGIS\EXHihpa17034.mxd

EXHIBIT 35

Appendix A: Calculations

Contents:

- CD with Model, Drawing Files, and other Source Data Files
- Time of Concentration Calculations
- Curve Number Calculations
- Stage Storage Calculations

TIME OF CONCENTRATION CALCULATIONS

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t through subareas WPE-1

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.020		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.168		0.168

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	539		
9. Watercourse slope, s		ft / ft	0.009		
10. Average velocity, V (figure 3-1)		ft / s	1.54		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.097		0.097

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.265

min. 16

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Note: All basins labeled with a "DA" prefix correspond to subbasins within the Southwest Pershing/Elm area.

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas WPE-2

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.020		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.168		0.168

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	153		
9. Watercourse slope, s		ft / ft	0.013		
10. Average velocity, V (figure 3-1)		ft / s	1.83		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.023		0.023

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	455		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.042		0.042

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.233

min. 14

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas WPE-3

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.020		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.168		0.168

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	338		
9. Watercourse slope, s		ft / ft	0.027		
10. Average velocity, V (figure 3-1)		ft / s	2.62		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.036		0.036

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.203

min. 12

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas WPE-4

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.030		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.142		0.142

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	114		
9. Watercourse slope, s		ft / ft	0.026		
10. Average velocity, V (figure 3-1)		ft / s	2.61		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.012		0.012

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.155

min. 9

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas WPE-5

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	122		
9. Watercourse slope, s		ft / ft	0.025		
10. Average velocity, V (figure 3-1)		ft / s	2.52		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.013		0.013

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	255		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.024		0.024

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.258

min. 15

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas WPE-6

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.016		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.183		0.183

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	261		
9. Watercourse slope, s		ft / ft	0.009		
10. Average velocity, V (figure 3-1)		ft / s	1.53		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.047		0.047

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	76		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.007		0.007

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.237

min. 14

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas WPE-7

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.016		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.183		0.183

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	396		
9. Watercourse slope, s		ft / ft	0.009		
10. Average velocity, V (figure 3-1)		ft / s	1.48		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.074		0.074

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.257

min. 15

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-1

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short grass prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	212		
9. Watercourse slope, s		ft / ft	0.017		
10. Average velocity, V (figure 3-1)		ft / s	2.06		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.029		0.029

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.250

min. 15

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-2

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.030		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.142		0.142

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Paved		
8. Flow Length, L		ft	79		
9. Watercourse slope, s		ft / ft	0.013		
10. Average velocity, V (figure 3-1)		ft / s	2.29		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.010		0.010

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	771		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.071		0.071

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.223

min. 13

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-3

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	571		
9. Watercourse slope, s		ft / ft	0.013		
10. Average velocity, V (figure 3-1)		ft / s	1.84		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.086		0.086

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	50		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.005		0.005

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.312

min. 19

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-4

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Prairie Grass		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.018		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.175		0.175

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	248		
9. Watercourse slope, s		ft / ft	0.008		
10. Average velocity, V (figure 3-1)		ft / s	1.44		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.048		0.048

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.223

min. 13

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-5

Sheet Flow (Applicable to T_c only)

		Segment ID	1		
1. Surface description (table 3-1).....			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1).....			0.15		
3. Flow Length, L (total L < 300 ft).....		ft	100		
4. Two-yr 24-hr rainfall, P_2.....		in	3.04		
5. Land slope, s.....		ft / ft	0.020		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t.....	hr	0.168		0.168

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved).....					
8. Flow Length, L.....		ft	0		
9. Watercourse slope, s.....		ft / ft	#DIV/0!		
10. Average velocity, V (figure 3-1).....		ft / s			
11. $T_c = \frac{L}{3600\,V}$	Compute T_c.....	hr			

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a.....		ft^2			
13. Wetted perimeter, P_w.....		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r.....	ft			
15. Channel slope, s.....		ft / ft			
16. Manning's roughness coeff., n.....					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V.....	ft / s	3.0		
18. Flow length, L.....		ft	744		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t.....	hr	0.069		0.069

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)..... hr 0.236

min. 14

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-6

Sheet Flow (Applicable to T_c only)

		Segment ID	1		
1. Surface description (table 3-1).....			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1).....			0.15		
3. Flow Length, L (total L < 300 ft).....		ft	100		
4. Two-yr 24-hr rainfall, P_2.....		in	3.04		
5. Land slope, s.....		ft / ft	0.020		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t.....	hr	0.168		0.168

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved).....			Unpaved		
8. Flow Length, L.....		ft	32		
9. Watercourse slope, s.....		ft / ft	0.031		
10. Average velocity, V (figure 3-1).....		ft / s	2.84		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c.....	hr	0.003		0.003

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a.....		ft^2			
13. Wetted perimeter, P_w.....		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r.....	ft			
15. Channel slope, s.....		ft / ft			
16. Manning's roughness coeff., n.....					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V.....	ft / s	3.0		
18. Flow length, L.....		ft	138		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t.....	hr	0.013		0.013

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)..... hr 0.183

min. 11

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-7

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.030		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.142		0.142

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)					
8. Flow Length, L		ft	0		
9. Watercourse slope, s		ft / ft	#DIV/0!		
10. Average velocity, V (figure 3-1)		ft / s			
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr			

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.142

min. 9

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-8

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.022		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.161		0.161

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	412		
9. Watercourse slope, s		ft / ft	0.021		
10. Average velocity, V (figure 3-1)		ft / s	2.30		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.050		0.050

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.211

min. 13

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-9

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.015		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.188		0.188

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	329		
9. Watercourse slope, s		ft / ft	0.008		
10. Average velocity, V (figure 3-1)		ft / s	1.39		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.066		0.066

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.254

min. 15

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-10

Sheet Flow (Applicable to T_c only)

		Segment ID		
1. Surface description (table 3-1).....				
2. Manning's roughness coeff., n (table 3-1).....				
3. Flow Length, L (total L < 300 ft).....	ft	0		
4. Two-yr 24-hr rainfall, P_2.....	in	3.04		
5. Land slope, s.....	ft / ft	#DIV/0!		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t.....	hr			

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved).....					
8. Flow Length, L.....	ft		0		
9. Watercourse slope, s.....	ft / ft		#DIV/0!		
10. Average velocity, V (figure 3-1).....	ft / s				
11. $T_c = \frac{L}{3600\,V}$ Compute T_c.....	hr				

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a.....	ft^2				
13. Wetted perimeter, P_w.....	ft				
14. Hydraulic radius, $r = a / P_w$ Compute r.....	ft				
15. Channel slope, s.....	ft / ft				
16. Manning's roughness coeff., n.....					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V.....	ft / s		3.0		
18. Flow length, L.....	ft				
19. $T_t = \frac{L}{3600\,V}$ Compute T_t.....	hr				

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)..... hr 0.000

min. 10

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-11

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	156		
9. Watercourse slope, s		ft / ft	0.026		
10. Average velocity, V (figure 3-1)		ft / s	2.57		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.017		0.017

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.238

min. 14

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-12

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	98		
9. Watercourse slope, s		ft / ft	0.031		
10. Average velocity, V (figure 3-1)		ft / s	2.81		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.010		0.010

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	653		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.060		0.060

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.291

min. 17

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-13

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Prairie Grass		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	64		
9. Watercourse slope, s		ft / ft	0.008		
10. Average velocity, V (figure 3-1)		ft / s	1.41		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.013		0.013

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	104		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.010		0.010

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.243

min. 15

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-14

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	76		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.026		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.121		0.121

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	166		
9. Watercourse slope, s		ft / ft	0.018		
10. Average velocity, V (figure 3-1)		ft / s	2.16		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.021		0.021

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	176		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.016		0.016

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.158

min. 9

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-15

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	68		
9. Watercourse slope, s		ft / ft	0.037		
10. Average velocity, V (figure 3-1)		ft / s	3.08		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.006		0.006

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.227

min. 14

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-16

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.015		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.188		0.188

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	512		
9. Watercourse slope, s		ft / ft	0.011		
10. Average velocity, V (figure 3-1)		ft / s	1.66		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.086		0.086

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.274

min. 16

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-17

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.012		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.206		0.206

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Paved		
8. Flow Length, L		ft	385		
9. Watercourse slope, s		ft / ft	0.018		
10. Average velocity, V (figure 3-1)		ft / s	2.71		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.040		0.040

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.245

min. 15

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-18

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	759		
9. Watercourse slope, s		ft / ft	0.009		
10. Average velocity, V (figure 3-1)		ft / s	1.48		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.142		0.142

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.364

min. 22

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-19

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	106		
9. Watercourse slope, s		ft / ft	0.019		
10. Average velocity, V (figure 3-1)		ft / s	2.20		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.013		0.013

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	176		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.016		0.016

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.251

min. 15

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-20

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)					
8. Flow Length, L		ft	0		
9. Watercourse slope, s		ft / ft	#DIV/0!		
10. Average velocity, V (figure 3-1)		ft / s			
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr			

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	40		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.004		0.004

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.225

min. 13

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-21

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.008		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.242		0.242

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	365		
9. Watercourse slope, s		ft / ft	0.009		
10. Average velocity, V (figure 3-1)		ft / s	1.50		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.068		0.068

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.309

min. 19

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-22

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.006		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.271		0.271

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	234		
9. Watercourse slope, s		ft / ft	0.006		
10. Average velocity, V (figure 3-1)		ft / s	1.24		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.053		0.053

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	32		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.003		0.003

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.327

min. 20

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-23

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	326		
9. Watercourse slope, s		ft / ft	0.011		
10. Average velocity, V (figure 3-1)		ft / s	1.66		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.055		0.055

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.276

min. 17

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-24

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	137		
9. Watercourse slope, s		ft / ft	0.011		
10. Average velocity, V (figure 3-1)		ft / s	1.67		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.023		0.023

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.244

min. 15

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-25

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.005		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.292		0.292

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Paved		
8. Flow Length, L		ft	105		
9. Watercourse slope, s		ft / ft	0.005		
10. Average velocity, V (figure 3-1)		ft / s	1.40		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.021		0.021

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.312

min. 19

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-26

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.012		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.206		0.206

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	103		
9. Watercourse slope, s		ft / ft	0.027		
10. Average velocity, V (figure 3-1)		ft / s	2.65		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.011		0.011

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	30		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.003		0.003

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.219

min. 13

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-27

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Paved		
8. Flow Length, L		ft	89		
9. Watercourse slope, s		ft / ft	0.011		
10. Average velocity, V (figure 3-1)		ft / s	2.16		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.011		0.011

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	186		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.017		0.017

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.250

min. 15

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-28

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.020		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.168		0.168

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	319		
9. Watercourse slope, s		ft / ft	0.003		
10. Average velocity, V (figure 3-1)		ft / s	0.89		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.099		0.099

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	597		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.055		0.055

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.322

min. 19

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-29

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.025		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.153		0.153

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	549		
9. Watercourse slope, s		ft / ft	0.007		
10. Average velocity, V (figure 3-1)		ft / s	1.36		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.112		0.112

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.265

min. 16

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-30

Sheet Flow (Applicable to T_c only)

		Segment ID		
1. Surface description (table 3-1).....				
2. Manning's roughness coeff., n (table 3-1).....				
3. Flow Length, L (total L < 300 ft).....	ft	0		
4. Two-yr 24-hr rainfall, P_2.....	in	3.04		
5. Land slope, s.....	ft / ft	#DIV/0!		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t.....	hr			

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved).....					
8. Flow Length, L.....	ft		0		
9. Watercourse slope, s.....	ft / ft		#DIV/0!		
10. Average velocity, V (figure 3-1).....	ft / s				
11. $T_c = \frac{L}{3600\,V}$ Compute T_c.....	hr				

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a.....	ft^2				
13. Wetted perimeter, P_w.....	ft				
14. Hydraulic radius, $r = a / P_w$ Compute r.....	ft				
15. Channel slope, s.....	ft / ft				
16. Manning's roughness coeff., n.....					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V.....	ft / s		3.0		
18. Flow length, L.....	ft				
19. $T_t = \frac{L}{3600\,V}$ Compute T_t.....	hr				

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)..... hr 0.000

min. 10

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-31

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.020		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.168		0.168

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)					
8. Flow Length, L		ft	0		
9. Watercourse slope, s		ft / ft	#DIV/0!		
10. Average velocity, V (figure 3-1)		ft / s			
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr			

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	631		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.058		0.058

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.226

min. 14

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-32

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.016		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.183		0.183

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	233		
9. Watercourse slope, s		ft / ft	0.019		
10. Average velocity, V (figure 3-1)		ft / s	2.20		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.029		0.029

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.213

min. 13

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas EPE-33

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved	Paved	
8. Flow Length, L		ft	38	174	
9. Watercourse slope, s		ft / ft	0.007	0.007	
10. Average velocity, V (figure 3-1)		ft / s	1.34	1.71	
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.008	0.028	0.036

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.257

min. 15

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas DA-1

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.015		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.188		0.188

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	336		
9. Watercourse slope, s		ft / ft	0.010		
10. Average velocity, V (figure 3-1)		ft / s	1.63		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.057		0.057

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.245

min. 15

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas DA-2

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	204		
9. Watercourse slope, s		ft / ft	0.020		
10. Average velocity, V (figure 3-1)		ft / s	2.25		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.025		0.025

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	709		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.066		0.066

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.312

min. 19

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas DA-3

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.020		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.168		0.168

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	490		
9. Watercourse slope, s		ft / ft	0.016		
10. Average velocity, V (figure 3-1)		ft / s	2.05		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.066		0.066

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	297		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.028		0.028

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.261

min. 16

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas DA-4

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	302		
9. Watercourse slope, s		ft / ft	0.017		
10. Average velocity, V (figure 3-1)		ft / s	2.06		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.041		0.041

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	34		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.003		0.003

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.265

min. 16

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas DA-5

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.010		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.221		0.221

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	414		
9. Watercourse slope, s		ft / ft	0.008		
10. Average velocity, V (figure 3-1)		ft / s	1.47		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.078		0.078

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft	80		
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr	0.007		0.007

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.307

min. 18

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

Time of Concentration (Tc) Calculation

Project: Pershing Elm Drainage Improvements By: JWW Date: 06/08/17

Location: Wheaton, IL

Circle One: Present Developed

Circle One: T_c T_t ☐ through subareas DA-6

Sheet Flow (Applicable to T_c only)

		Segment ID			
1. Surface description (table 3-1)			Short Grass Prairie		
2. Manning's roughness coeff., n (table 3-1)			0.15		
3. Flow Length, L (total L < 300 ft)		ft	100		
4. Two-yr 24-hr rainfall, P_2		in	3.04		
5. Land slope, s		ft / ft	0.020		
6. $Tt = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.168		0.168

Shallow Concentrated Flow

		Segment ID	1	2	
7. Surface Description (paved or unpaved)			Unpaved		
8. Flow Length, L		ft	159		
9. Watercourse slope, s		ft / ft	0.006		
10. Average velocity, V (figure 3-1)		ft / s	1.27		
11. $T_c = \frac{L}{3600\,V}$	Compute T_c	hr	0.035		0.035

Channel Flow

		Segment ID	1	2	
12. Cross sectional flow area, a		ft^2			
13. Wetted perimeter, P_w		ft			
14. Hydraulic radius, $r = a / P_w$	Compute r	ft			
15. Channel slope, s		ft / ft			
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	Compute V	ft / s	3.0		
18. Flow length, L		ft			
19. $T_t = \frac{L}{3600\,V}$	Compute T_t	hr			

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) hr 0.202

min. 12

Two-year, 24-hour rainfall was taken from Bulletin 70, Table 13

The Tc flow path for this area is drawn in ArcGIS: "E:\2014\14160\Drawings\ArcGIS\NR\Roberts Road Project_14160.mxd"

3 feet per second was used for channel flow (in storm sewers or other channels)

CURVE NUMBER CALCULATIONS

Worksheet 2: Runoff curve number and runoff — Sub-Basin: WPE-1

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			4.08	346.8
C/D	1130	94.5			3.33	314.685
[1] Use only one CN source per line				**Totals**	7.41	661.485

CN (weighted) = total product/total area = 89.27 ; **Use CN** **89**

Note: All basins labeled with a "DA" prefix correspond to subbasins within the Southwest Pershing/Elm area.

Worksheet 2: Runoff curve number and runoff — Sub-Basin: WPE-2

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked:	Date:

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			2.10	178.5
C/D	1130	94.5			7.54	712.53
				Totals ➡	9.64	891.03

[1] Use only one CN source per line

CN (weighted) = total product/total area = 92.43 ; **Use CN** ➡ **92**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: WPE-3

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			3.05	259.25
	Totals				3.05	259.25

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; Use CN → 85

Worksheet 2: Runoff curve number and runoff — Sub-Basin: WPE-4

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked	Date

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			4.14	351.9
C/D	1130	94.5			0.58	54.81
				Totals ➡	4.72	406.71

[1] Use only one CN source per line

CN (weighted) = total product/total area = 86.17 ; **Use CN** ➡ **86**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: WPE-5

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked	Date

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			5.63	478.55
C/D	1130	94.5			3.13	296.0685
[1] Use only one CN source per line				**Totals** ➡	8.76	774.6185

CN (weighted) = total product/total area = 88.40 ; **Use CN** ➡ **88**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: WPE-6

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked	Date

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			4.63	393.55
	Totals				4.63	393.55

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; Use CN → 85

Worksheet 2: Runoff curve number and runoff — Sub-Basin: WPE-7

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			4.83	410.55
	Totals				4.83	410.55

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; Use CN → **85**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-1

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			3.72	316.455
C/D	1130	94.5			3.30	311.85
D	1130	95			0.40	38.19
				Totals ➡	7.43	666.495

[1] Use only one CN source per line

CN (weighted) = total product/total area = 89.76 ; **Use CN** ➡ **90**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-2

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked	Date

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			0.39	33.15
C/D	1130	94.5			0.29	27.405
D	1130	95			7.37	700.15
				Totals ➡	8.05	760.705

[1] Use only one CN source per line

CN (weighted) = total product/total area = 94.50 ; **Use CN** ➡ **94**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-3

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			6.64	564.4
	Totals				6.64	564.4

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; Use CN → 85

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-4

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked	Date

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			2.36	200.6
C/D	1130	94.5			0.04	3.78
D	1110	87			0.33	28.71
D	1130	95			1.58	150.1
				Totals ➡	4.31	383.19

[1] Use only one CN source per line

CN (weighted) = total product/total area = 88.91 ; **Use CN** ➡ **89**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-5

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			1.80	153
D	1110	87			1.04	90.48
D	1130	95			9.28	881.6
C/D	1130	94.5			0.14	12.9465
				Totals ➡	12.26	1138.0265

[1] Use only one CN source per line

CN (weighted) = total product/total area = 92.85 ; **Use CN** ➡ **93**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-6

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked	Date

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			0.80	68
D	1110	87			0.79	68.73
D	1130	95			2.14	203.3
				Totals ➡	3.73	340.03

[1] Use only one CN source per line

CN (weighted) = total product/total area = 91.16 ; Use CN ➡ **91**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-7

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked	Date

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			0.12	10.2
D	1110	87			0.28	24.36
D	1130	95			1.29	122.55
				Totals ➡	1.69	157.11

[1] Use only one CN source per line

CN (weighted) = total product/total area = 92.96 ; **Use CN** ➡ **93**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-8

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked:	Date:

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			8.87	753.95
	Totals				8.87	753.95

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; Use CN → 85

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-9

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			7.94	674.9
	Totals				7.94	674.9

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; Use CN → 85

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-10

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			1.72	146.2
	Totals				1.72	146.2

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; Use CN → 85

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-11

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			3.99	339.15
				Totals ➡	3.99	339.15

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; Use CN ➡ **85**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-12

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			7.54	640.9
	Totals				7.54	640.9

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; Use CN → 85

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-13

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			3.14	266.9
C	1110	83			1.14	94.62
				Totals ➡	4.28	361.52

[1] Use only one CN source per line

CN (weighted) = total product/total area = 84.47 ; **Use CN** ➡ **84**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-14

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
D	1110	87			0.07	6.09
C	1110	83			0.88	73.04
C/D	3100	77			0.46	35.42
				Totals ➡	1.41	114.55

[1] Use only one CN source per line

CN (weighted) = total product/total area = 81.24 ; **Use CN** ➡ **81**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-15

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			4.08	346.8
	Totals				4.08	346.8

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; Use CN → **85**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-16

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked:	Date:

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			11.51	978.35
C	1110	83			1.51	125.33
				Totals ➡	13.02	1103.68

[1] Use only one CN source per line

CN (weighted) = total product/total area = 84.77 ; **Use CN** ➡ **85**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-17

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked:	Date:

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			4.41	374.85
	Totals				4.41	374.85

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; Use CN → 85

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-18

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			13.89	1180.65
C	1110	83			1.39	115.37
C	1130	94			1.00	94
C	1320	91			1.01	91.91
C	3100	74			0.26	19.24
C/D	1130	94.5			0.55	51.975
C/D	3100	77			0.76	58.52
C/D	1320	92			1.68	154.56
				Totals ➡	20.54	1766.225

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.99 ; **Use CN** ➡ **86**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-19

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked:	Date:

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			3.71	315.35
				Totals ➡	3.71	315.35

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; Use CN ➡ **85**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-20

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			3.01	255.85
	[1] Use only one CN source per line			**Totals** ➡	3.01	255.85

CN (weighted) = total product/total area = 85.00 ; **Use CN** ➡ **85**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-21

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C	1110	83			4.25	352.75
C/D	1110	85			9.16	778.6
D	1110	87			0.03	2.61
D	1130	95			0.18	17.1
C/D	1130	94.5			0.04	3.78
				Totals ➡	13.66	1154.84

[1] Use only one CN source per line

CN (weighted) = total product/total area = 84.54 ; **Use CN** ➡ **85**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-22

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			6.95	590.75
	Totals				6.95	590.75

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; Use CN → **85**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-23

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked:	Date:

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			10.08	856.8
	Totals				10.08	856.8

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; Use CN → **85**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-24

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked	Date

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			4.27	362.95
C	1110	83			0.11	9.13
C/D	3100	77			0.28	21.56
				Totals ➡	4.66	393.64

[1] Use only one CN source per line

CN (weighted) = total product/total area = 84.47 ; **Use CN** ➡ **84**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-25

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			0.92	78.2
C	1110	83			0.72	59.76
C/D	3100	77			0.04	3.08
C	3100	74			0.16	11.84
D	1130	95			0.76	72.2
C/D	1130	94.5			0.19	17.955
				Totals ➡	2.79	243.035

[1] Use only one CN source per line

CN (weighted) = total product/total area = 87.11 ; **Use CN** ➡ **87**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-26

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked	Date

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1130	94.5			0.01	0.945
C/D	1110	85			9.94	844.9
C	1110	83			0.09	7.47
				Totals ➡	10.04	853.315

[1] Use only one CN source per line

CN (weighted) = total product/total area = 84.99 ; **Use CN** ➡ **85**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-27

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			5.45	463.25
C/D	1130	94.5			0.78	73.71
C	1110	83			0.31	25.73
C	1130	94			1.43	134.42
				Totals ➡	7.97	697.11

[1] Use only one CN source per line

CN (weighted) = total product/total area = 87.47 ; **Use CN** ➡ **87**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-28

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked:	Date:

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			5.85	497.25
D	1110	87			0.01	0.87
				Totals ➡	5.86	498.12

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; **Use CN** ➡ **85**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-29

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked:	Date:

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	3100	77			0.12	9.24
C/D	1110	85			5.55	471.75
				Totals ➡	5.67	480.99

[1] Use only one CN source per line

CN (weighted) = total product/total area = 84.83 ; **Use CN** ➡ **85**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-30

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C	1130	94			0.48	45.12
C	3100	74			3.81	281.94
C/D	1110	85			0.22	18.7
C/D	1130	94.5			2.67	252.315
C/D	3100	77			3.10	238.7
D	1110	87			0.57	49.59
D	3100	80			0.04	3.2
D	1130	95			1.26	119.7
				Totals	12.15	1009.265

[1] Use only one CN source per line

CN (weighted) = total product/total area = 83.07 ; **Use CN** **83**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-31

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C	1110	83			0.10	8.3
C/D	1110	85			1.46	124.1
C/D	1130	94.5			0.48	45.36
D	1110	87			0.24	20.88
D	1130	95			13.95	1325.25
C	1130	94			0.71	66.74
				Totals	16.94	1590.63

[1] Use only one CN source per line

CN (weighted) = total product/total area = 93.90 ; **Use CN** **94**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-32

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C	3100	74			18.22	1348.28
C	1130	94			0.95	89.3
C/D	1110	85			0.04	3.4
C/D	3100	77			0.01	0.77
C/D	1130	94.5			0.02	1.89
C	1110	83			1.19	98.77
				Totals ➡	20.43	1542.41

[1] Use only one CN source per line

CN (weighted) = total product/total area = 75.50 ; **Use CN** ➡ **75**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: EPE-33

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked	Date

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			0.03	2.55
D	1110	87			1.64	142.68
				Totals ➡	1.67	145.23

[1] Use only one CN source per line

CN (weighted) = total product/total area = 86.96 ; **Use CN** ➡ **87**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: DA-1

Project: Pershing/Elm Drainage Study	By: JWW	Date: 6/7/2017
Location: Wheaton, IL	Checked	Date

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			11.35	964.75
C/D	1320	92			1.01	92.92
				Totals ➡	12.36	1057.67

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.57 ; **Use CN** ➡ **86**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: DA-2

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			1.30	110.5
C/D	1320	92			0.93	85.56
C	1320	91			2.75	250.25
C	3100	74			0.17	12.58
C	1110	83			0.22	18.26
				Totals	5.37	477.15

[1] Use only one CN source per line

CN (weighted) = total product/total area = 88.85 ; **Use CN** **89**

1

Worksheet 2: Runoff curve number and runoff — Sub-Basin: DA-3

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			27.26	2317.1
C	1110	83			0.31	25.73
C	1130	94			1.26	117.97
C/D	1130	94.5			0.81	76.8285
[1] Use only one CN source per line				**Totals** ➡	29.64	2537.629

CN (weighted) = total product/total area = 85.62 ; **Use CN** ➡ **86**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: DA-4

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			5.18	440.3
	Totals				5.18	440.3

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; **Use CN** → **85**

Worksheet 2: Runoff curve number and runoff — Sub-Basin: DA-5

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			12.24	1040.4
	Totals				12.24	1040.4

[1] Use only one CN source per line

CN (weighted) = total product/total area = 85.00 ; Use CN → 85

Worksheet 2: Runoff curve number and runoff — Sub-Basin: DA-6

Project	Pershing/Elm Drainage Study	By	JWW	Date	6/7/2017
Location	Wheaton, IL	Checked		Date	

Check one: ☑ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected impervious area ratio)	CN [1] Table 2-2	CN [1] Figure 2-3	CN [1] Figure 2-4	Area ☑ acres ☐ mi2 ☐ %	Product of CN x area
C/D	1110	85			2.72	231.115
C/D	1320	92			0.18	16.744
C	1110	83			0.30	24.734
C	1320	91			0.28	25.571
[1] Use only one CN source per line				**Totals** ➡	3.48	298.164

CN (weighted) = total product/total area = 85.68 ; **Use CN** ➡ **86**

STAGE STORAGE CALCULATIONS

Existing Stage-Storage Volume

PROJECT: **Pershing Ave/Elm St Flood Prone Area Study**
V3 FILE NO.: 17034
DATE: 07/26/17
PREPARED BY: JWW

XP-SWMM Node ID: HEPE_30

ELEVATION	AREA (acres)	AVERAGE AREA (acres)	STAGE VOLUME (acre-feet)	CUMULATIVE VOLUME (acre-feet)	COMMENT
743.74	0.800			0.000	
		0.909	0.236		
744.00	1.017			0.236	
		3.081	6.161		
746.0	5.144			6.397	
		5.372	10.744		
748.0	5.600			17.141	
		5.803	11.605		
750.0	6.005			28.746	
		7.102	14.203		
752.0	8.198			42.949	

Existing Stage-Storage Volume

PROJECT: **Pershing Ave/Elm St Flood Prone Area Study**
V3 FILE NO.: 17034
DATE: 07/26/17
PREPARED BY: JWW

XP-SWMM Node ID: HEPE_8

ELEVATION	AREA (acres)	AVERAGE AREA (acres)	STAGE VOLUME (acre-feet)	CUMULATIVE VOLUME (acre-feet)	COMMENT
757.00	0.037			0.000	
		0.112	0.112		
758.00	0.186			0.112	
		0.277	0.277		
759.0	0.367			0.388	
		0.632	0.632		
760.0	0.896			1.020	
		1.016	1.016		
761.0	1.135			2.035	
		1.311	1.311		
762.0	1.486			3.346	
		1.862	3.723		
764.0	2.24			7.069	

Existing Stage-Storage Volume

PROJECT: **Pershing Ave/Elm St Flood Prone Area Study**
V3 FILE NO.: 17034
DATE: 07/26/17
PREPARED BY: JWW

XP-SWMM Node ID: HEPE_9

ELEVATION	AREA (acres)	AVERAGE AREA (acres)	STAGE VOLUME (acre-feet)	CUMULATIVE VOLUME (acre-feet)	COMMENT
757.00	0.176			0.000	
		0.507	0.507		
758.00	0.838			0.507	
		1.140	1.140		
759.0	1.441			1.647	
		1.739	1.739		
760.0	2.036			3.385	
		2.313	2.313		
761.0	2.589			5.698	
		3.174	3.174		
762.0	3.758			8.871	
		5.157	10.314		
764.0	6.56			19.185	

Existing Stage-Storage Volume

PROJECT: **Pershing Ave/Elm St Flood Prone Area Study**
V3 FILE NO.: 17034
DATE: 07/26/17
PREPARED BY: JWW

XP-SWMM Node ID: HWPE_5

ELEVATION	AREA (acres)	AVERAGE AREA (acres)	STAGE VOLUME (acre-feet)	CUMULATIVE VOLUME (acre-feet)	COMMENT
759.00	0.023			0.000	
		0.080	0.080		
760.00	0.137			0.080	
		0.463	0.463		
761.0	0.788			0.543	
		1.051	1.051		
762.0	1.314			1.594	
		1.624	1.624		
763.0	1.934			3.218	
		2.383	2.383		
764.0	2.831			5.600	
		3.369	3.369		
765.0	3.907			8.969	

Existing Stage-Storage Volume

PROJECT: **Pershing Ave/Elm St Flood Prone Area Study**
V3 FILE NO.: 17034
DATE: 07/26/17
PREPARED BY: JWW

XP-SWMM Node ID: HWPE_7

ELEVATION	AREA (acres)	AVERAGE AREA (acres)	STAGE VOLUME (acre-feet)	CUMULATIVE VOLUME (acre-feet)	COMMENT
761.00	0.079			0.000	
		0.301	0.301		
762.00	0.522			0.301	
		0.763	0.763		
763.0	1.004			1.064	
		1.446	1.446		
764.0	1.887			2.509	
		2.213	2.213		
765.0	2.538			4.722	
		3.082	3.082		
766.0	3.625			7.803	

Existing Stage-Storage Volume

PROJECT: **Pershing Ave/Elm St Flood Prone Area Study**
V3 FILE NO.: 17034
DATE: 07/26/17
PREPARED BY: JWW

XP-SWMM Node ID: HEPE_1011

ELEVATION	AREA (acres)	AVERAGE AREA (acres)	STAGE VOLUME (acre-feet)	CUMULATIVE VOLUME (acre-feet)	COMMENT
756.00	0.044			0.000	
		0.234	0.234		
757.00	0.423			0.234	
		0.889	0.889		
758.0	1.354			1.122	
		2.149	2.149		
759.0	2.944			3.271	
		4.003	4.003		
760.0	5.062			7.274	

Proposed Stage-Storage Volume

PROJECT: **Pershing Ave/Elm St Flood Prone Area Study**
V3 FILE NO.: 17034
DATE: 07/26/17
PREPARED BY: JWW

XP-SWMM Node ID: HWPE_5

ELEVATION	AREA (acres)	AVERAGE AREA (acres)	STAGE VOLUME (acre-feet)	CUMULATIVE VOLUME (acre-feet)	COMMENT
755	0.109			0.000	
		0.120	0.120		
756.00	0.131			0.120	
		0.143	0.143		
757.0	0.154			0.263	
		0.167	0.167		
758.0	0.179			0.429	
		0.202	0.202		
759.0	0.225			0.631	
		0.267	0.267		
760.0	0.309			0.898	
		0.588	0.588		
761.0	0.866			1.486	
		1.008	1.008		
762.0	1.149			2.493	
		1.560	1.560		
763.0	1.970			4.053	
		2.401	2.401		
764.0	2.831			6.453	
		3.369	3.369		
765.0	3.907			9.822	

Proposed Stage-Storage Volume

PROJECT: **Pershing Ave/Elm St Flood Prone Area Study**
V3 FILE NO.: 17034
DATE: 07/26/17
PREPARED BY: JWW

XP-SWMM Node ID: HWPE_7

ELEVATION	AREA (acres)	AVERAGE AREA (acres)	STAGE VOLUME (acre-feet)	CUMULATIVE VOLUME (acre-feet)	COMMENT
757.00	0.452			0.000	
		0.476	0.476		
758.00	0.499			0.476	
		0.523	0.523		
759.0	0.546			0.998	
		0.571	0.571		
760.0	0.596			1.569	
		0.659	0.659		
761.0	0.722			2.228	
		0.851	0.851		
762.0	0.980			3.079	
		1.126	1.126		
763.0	1.272			4.205	
		1.580	1.580		
764.0	1.887			5.785	

Proposed Stage-Storage Volume

PROJECT: **Pershing Ave/Elm St Flood Prone Area Study**
V3 FILE NO.: 17034
DATE: 07/26/17
PREPARED BY: JWW

XP-SWMM Node ID: HEPE_9

ELEVATION	AREA (acres)	AVERAGE AREA (acres)	STAGE VOLUME (acre-feet)	CUMULATIVE VOLUME (acre-feet)	COMMENT
749.00	1.856			0.000	
		1.902	1.902		
750.00	1.948			1.902	
		1.995	1.995		
751.0	2.042			3.897	
		2.090	2.090		
752.0	2.138			5.987	
		2.187	2.187		
753.0	2.235			8.174	
		2.285	2.285		
754.0	2.334			10.458	
		2.384	2.384		
755.0	2.433			12.842	
		2.485	2.485		
756.0	2.536			15.326	
		2.621	2.621		
757.0	2.706			17.947	
		2.850	2.850		
758.0	2.994			20.797	
		3.229	3.229		
759.0	3.463			24.026	

Appendix B: Engineer's Estimated Opinion of Probably Construction Cost

Client: Joe Tebrugge
City of Wheaton
303 West Wesley Street
Wheaton, Illinois 60187
Phone: 630-848-5010
Email: JTebrugge@wheaton.il.us

Job Name: Flood Study
Pershing / Elm
Date of Plans: N/A
Revision Date: N/A
Project#: 17034
Date of Estimate: 10/12/2017

CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

FLOOD PRONE AREA STUDY 2 - EAST PERSHING / ELM - ALTERNATE #1 (Conveyance + Pond A Storage)							
ITEM	**DESCRIPTION**	**QUANTITY**			**UNIT PRICE**		**TOTAL**
1.00	*A1 - PERSHING AVENUE - WILSTON to BLANCHARD*	*706*	*LF*	*$*	*1,355.00*	*$*	*956,630.00*
2.00	*A1 - BLANCHARD AVENUE - PERSHING to ELM*	*740*	*LF*	*$*	*1,522.00*	*$*	*1,126,280.00*
3.00	*A1 - ELM STREET - BLANCHARD to PROSPECT*	*640*	*LF*	*$*	*1,760.00*	*$*	*1,126,400.00*
4.00	*A1 - PROSPECT STREET - ELM to COOLIDGE*	*370*	*LF*	*$*	*1,690.00*	*$*	*625,300.00*
5.00	*A1 - PRESIDENT STREET AND COOLIDGE - PRESIDENT TO WILLI*	*1,735*	*LF*	*$*	*940.00*	*$*	*1,630,900.00*
6.00	*A1 - COOLIDGE AVE - WILLISTON to END OF RUN*	*1,590*	*LF*	*$*	*3,480.00*	*$*	*5,533,200.00*
7.00	*A1 - 48" STORM SEWER CONNECTOR*	*245*	*LF*	*$*	*1,790.00*	*$*	*438,550.00*
	ALTERNATE 1 ESTIMATE TOTAL:			**$**			**11,437,260.00**

FLOOD PRONE AREA STUDY 2 - WEST PERSHING / ELM - ALTERNATE #2 (Conveyance + Private Property Storage)							
8.00	*A2 - EXHIBIT 8 CAMPBELL POND 1 CONST.*	*3.26*	*AC/FT*	*$*	*138,520.00*	*$*	*451,575.00*
9.00	*A2 - EXHIBIT 8 CAMPBELL POND 2 CONST.*	*1.73*	*AC/FT*	*$*	*625,830.00*	*$*	*1,082,686.00*
10.00	*A2 - 24" STORM SEWER (PERSHING & CAMPBELL)*	*305*	*LF*	*$*	*1,550.00*	*$*	*472,750.00*
11.00	*A2 - 36" & 12" STORM SEWER (REAR YARDS)*	*1,270*	*LF*	*$*	*646.00*	*$*	*820,420.00*
	ALTERNATE 2 ESTIMATE TOTAL:			**$**			**2,827,431.00**

FLOOD PRONE AREA STUDY 2 - EAST PERSHING / ELM - ALTERNATE #2 (Conveyance + Private Property Storage)							
ITEM	**DESCRIPTION**	**QUANTITY**			**UNIT PRICE**		**TOTAL**
12.00	*A2 - EXHIBIT 9 POND CONSTRUCTION*	*34.13*	*AC/FT*	*$*	*140,890.00*	*$*	*4,808,576.00*
13.00	*A2 - 48" STORM SEWER WILLISTON TO PRESIDENT*	*1,145*	*LF*	*$*	*1,140.00*	*$*	*1,305,300.00*
14.00	*A2 - 24" STORM SEWER CONNECTOR PRESIDENT*	*245*	*LF*	*$*	*1,480.00*	*$*	*362,600.00*
15.00	*A2 - COOLIDGE AVE - PRESIDENT to END OF RUN*	*280*	*LF*	*$*	*920.00*	*$*	*257,600.00*
	ALTERNATE 2 ESTIMATE TOTAL:			**$**			**6,734,076.00**

FLOOD PRONE AREA STUDY 2 - EAST PERSHING / ELM - ALTERNATE #5 (Roadway Profile Improvements)							
ITEM	**DESCRIPTION**	**QUANTITY**			**UNIT PRICE**		**TOTAL**
	A5 - Roadway, Pershing & President to Coolidge & Prospect	*2,135.00*	*LF*			*$*	*3,527,659.00*
	ALTERNATE 5 ESTIMATE TOTAL:			**$**			**3,527,659.00**

Notes:

1) ***This is a conceptual estimate. Actual quantities and scope for the project will be determined by final design and permit requirements.***
2) ***This conceptual estimate does not include soft costs (i.e. permit fees, engineering, design, ROW or temporary easement acquisition etc.)***

The Following is specifically excluded from this estimate:

1) ***Bonds, permits, special insurance (waiver of subrogation, pollution liability insurance), and testing including QC/QA.***
2) ***The demolition or handling of any petroleum contaminated soil, gas tanks, gas pumps etc.***
3) ***Removal of buried or above ground petroleum underground storage tanks***
4) ***Repair or restoration of asphalt roadways or paths that may need to be crossed with truck traffic for access to loading point.***
5) ***The handling or disposal of hazardous materials or non-hazardous special waste material.***
6) ***Compaction or Material Testing.***
7) ***Winter Conditions or Lime Stabilization of Subgrades unless noted otherwise.***

This Preliminary Cost Estimate is based on a design concept. Since V3 Companies of Illinois, Ltd. has no control over the cost of labor, materials, equipment or services furnished by others, or over the Contractor's methods of determining prices, or over competitive bidding or market conditions, this Opinion of Probable Construction Cost is made based on V3 Companies of Illinois' best judgment as an experienced and qualified professional contractor, familiar with the Construction industry; however, V3 Companies of Illinois cannot and does not guarantee that proposals, bids or actual Construction Costs will not vary from Opinions of Probable Construction Cost prepared by V3.

Client: Joe Tebrugge
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Job Name: Flood Study
Pershing / Elm
Date of Plans: N/A
Revision Date: N/A
Project#: 17034
Date of Estimate: 10/12/2017

CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

1.00	A1 - PERSHING AVENUE - WILSTON to BLANCHARD	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.10	**GENERAL CONDITIONS**				
1.11	Mobilization (10%)	1.000	LSUM	$ 63,000.00	$ 63,000.00
1.12	Dry Utility Relocates (20%)	1.000	LSUM	$ 126,000.00	$ 126,000.00
1.13	Contingency (20%)	1.000	LSUM	$ 126,000.00	$ 126,000.00
1.14	Tree Removal, Trimming & Root Pruning (2%)	1.000	LSUM	$ 13,000.00	$ 13,000.00
1.15	Undercutting & Backfill For Utilities (10% at 3.00')	110.000	CY	$ 90.00	$ 9,900.00
1.16	Pavement Removal	940.000	SY	$ 18.00	$ 16,920.00
1.17	PCC Curb & Gutter Removal	706.000	LF	$ 5.00	$ 3,530.00
1.20	**SEWER INSTALLATION**				
1.21	Install Dual 36" RCP Storm Sewer	1,412.000	LF	$ 137.00	$ 193,444.00
1.22	Bedding & Haunching	837.000	CY	$ 50.00	$ 41,850.00
1.23	Trench Backfill	90.000	CY	$ 45.00	$ 4,050.00
1.24	10' Storm Manhole Installation	3.000	EACH	$ 15,000.00	$ 45,000.00
1.26	Sanitary Service Repairs	11.000	EACH	$ 2,000.00	$ 22,000.00
1.27	Water Service Repairs	11.000	EACH	$ 2,000.00	$ 22,000.00
1.28	Spoil Removal	2,502.000	CY	$ 45.00	$ 112,590.00
1.30	**RESTORATION**				
1.31	Sod Installation	784.000	SY	$ 12.00	$ 9,408.00
1.32	Roadway Base	1,177.000	SY	$ 8.00	$ 9,416.00
1.33	Roadway Pavement	941.000	SY	$ 95.00	$ 89,395.00
1.34	PCC Curb & Gutter Installation	706.000	LF	$ 35.00	$ 24,710.00
1.35	Residential Driveway R&R Complete	300.000	SY	$ 60.00	$ 18,000.00
1.36	Parkway Tree Installation	10.000	EACH	$ 650.00	$ 6,500.00
				SUBTOTAL	**$ 956,713.00**

TOTAL LENGTH	**706 LF**
PRICE / LF	**$ 1,355.00**

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CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

2.00	A1 - BLANCHARD AVENUE - PERSHING to ELM	QUANTITY	UNIT	UNIT PRICE	TOTAL
2.10	**GENERAL CONDITIONS**				
2.11	Mobilization (10%)	1.000	LSUM	$ 74,000.00	$ 74,000.00
2.12	Contingency (20%)	1.000	LSUM	$ 148,000.00	$ 148,000.00
2.13	Dry Utility Relocates (20%)	1.000	LSUM	$ 148,000.00	$ 148,000.00
2.14	Tree Removal, Trimming & Root Pruning (2%)	1.000	LSUM	$ 15,000.00	$ 15,000.00
2.15	Undercutting & Backfill For Utilities (10% at 3.00')	115.000	CY	$ 90.00	$ 10,350.00
2.16	Pavement Removal	990.000	SY	$ 18.00	$ 17,820.00
2.17	PCC Curb & Gutter Removal	740.000	LF	$ 3.25	$ 2,405.00
2.20	**SEWER INSTALLATION**				
2.21	Install Dual 36" - 42" RCP Storm Sewer	1,480.000	LF	$ 152.00	$ 224,960.00
2.22	Trench Backfill	1,179.000	CY	$ 45.00	$ 53,055.00
2.23	Bedding & Haunching	880.000	CY	$ 50.00	$ 44,000.00
2.24	10' Storm Manhole Installation	3.000	EACH	$ 15,000.00	$ 45,000.00
2.25	Sanitary Service Repairs	2.000	EACH	$ 2,000.00	$ 4,000.00
2.26	Water Service Repairs	2.000	EACH	$ 2,000.00	$ 4,000.00
2.27	Spoil Removal	3,474.000	CY	$ 45.00	$ 156,330.00
2.30	**RESTORATION**				
2.31	Sod Installation	820.000	SY	$ 12.00	$ 9,840.00
2.32	Roadway Base	1,230.000	SY	$ 8.00	$ 9,840.00
2.33	Roadway Pavement	990.000	SY	$ 95.00	$ 94,050.00
2.34	PCC Curb & Gutter Installation	740.000	LF	$ 35.00	$ 25,900.00
2.35	PCC Sidewalk Installation Complete	3,700.000	SF	$ 10.00	$ 37,000.00
2.36	Parkway Tree Installation	4.000	EACH	$ 650.00	$ 2,600.00
				SUBTOTAL	**$ 1,126,150.00**

TOTAL LENGTH	**740 LF**
PRICE / LF	**$ 1,522.00**

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CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

3.00	A1 - ELM STREET - BLANCHARD to PROSPECT	QUANTITY	UNIT	UNIT PRICE	TOTAL
3.10	**GENERAL CONDITIONS**				
3.11	Mobilization (10%)	1.000	LSUM	$ 74,000.00	$ 74,000.00
3.12	Contingency (20%)	1.000	LSUM	$ 148,000.00	$ 148,000.00
3.13	Dry Utility Relocates (20%)	1.000	LSUM	$ 148,000.00	$ 148,000.00
3.14	Tree Removal, Trimming & Root Pruning (2%)	1.000	LSUM	$ 15,000.00	$ 15,000.00
3.15	Undercutting & Backfill For Utilities (10% at 3.00')	100.000	CY	$ 90.00	$ 9,000.00
3.16	Pavement Removal	850.000	SY	$ 15.00	$ 12,750.00
3.17	PCC Curb & Gutter Removal	640.000	LF	$ 3.25	$ 2,080.00
3.20	**SEWER INSTALLATION**				
3.21	Install Dual 42" - 48" RCP Storm Sewer	1,280.000	LF	$ 167.00	$ 213,760.00
3.22	Trench Backfill	1,026.000	CY	$ 45.00	$ 46,170.00
3.23	Bedding & Haunching	765.000	CY	$ 50.00	$ 38,250.00
3.24	12' Storm Manhole Installation	2.000	EACH	$ 30,000.00	$ 60,000.00
3.25	Sanitary Service Repairs	11.000	EACH	$ 2,000.00	$ 22,000.00
3.26	Water Service Repairs	11.000	EACH	$ 2,000.00	$ 22,000.00
3.27	Spoil Removal	2,997.000	CY	$ 45.00	$ 134,865.00
3.30	**RESTORATION**				
3.31	Sod Installation	710.000	SY	$ 12.00	$ 8,520.00
3.32	Roadway Base	1,070.000	SY	$ 8.00	$ 8,560.00
3.33	Roadway Pavement	850.000	SY	$ 95.00	$ 80,750.00
3.34	PCC Curb & Gutter Installation	640.000	LF	$ 35.00	$ 22,400.00
3.35	PCC Sidewalk Installation Complete	3,200.000	SF	$ 10.00	$ 32,000.00
3.36	Residential Driveway R&R Complete	365.000	SY	$ 60.00	$ 21,900.00
3.37	Parkway Tree Installation	11.000	EACH	$ 650.00	$ 7,150.00
				SUBTOTAL	**$ 1,127,155.00**

TOTAL LENGTH	**640 LF**
PRICE / LF	**$ 1,760.00**

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CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

4.00	A1 - PROSPECT STREET - ELM to COOLIDGE	QUANTITY	UNIT	UNIT PRICE	TOTAL
4.10	**GENERAL CONDITIONS**				
4.11	Mobilization (10%)	1.000	LSUM	$ 41,000.00	$ 41,000.00
4.12	Contingency (20%)	1.000	LSUM	$ 82,000.00	$ 82,000.00
4.13	Dry Utility Relocates (20%)	1.000	LSUM	$ 82,000.00	$ 82,000.00
4.14	Tree Removal, Trimming & Root Pruning (2%)	1.000	LSUM	$ 8,000.00	$ 8,000.00
4.15	Undercutting & Backfill For Utilities (10% at 3.00')	58.000	CY	$ 90.00	$ 5,220.00
4.16	Pavement Removal	490.000	SY	$ 15.00	$ 7,350.00
4.17	PCC Curb & Gutter Removal	370.000	LF	$ 3.25	$ 1,202.50
4.20	**SEWER INSTALLATION**				
4.21	Install Dual 48" RCP Storm Sewer	740.000	LF	$ 167.00	$ 123,580.00
4.22	Trench Backfill	660.000	CY	$ 45.00	$ 29,700.00
4.23	Bedding & Haunching	490.000	CY	$ 50.00	$ 24,500.00
4.24	12' Storm Manhole Installation	1.000	EACH	$ 30,000.00	$ 30,000.00
4.25	Sanitary Service Repairs	2.000	EACH	$ 2,000.00	$ 4,000.00
4.26	Water Service Repairs	2.000	EACH	$ 2,000.00	$ 4,000.00
4.27	Spoil Removal	1,930.000	CY	$ 45.00	$ 86,850.00
4.30	**RESTORATION**				
4.31	Sod Installation	410.000	SY	$ 12.00	$ 4,920.00
4.32	Roadway Base	620.000	SY	$ 8.00	$ 4,960.00
4.33	Roadway Pavement	490.000	SY	$ 95.00	$ 46,550.00
4.34	PCC Curb & Gutter Installation	370.000	LF	$ 35.00	$ 12,950.00
4.35	PCC Sidewalk Installation Complete	1,850.000	SF	$ 10.00	$ 18,500.00
4.36	Residential Driveway R&R Complete	70.000	SY	$ 60.00	$ 4,200.00
4.37	Parkway Tree Installation	4.000	EACH	$ 650.00	$ 2,600.00
				SUBTOTAL	**$ 624,082.50**

TOTAL LENGTH	**370 LF**
PRICE / LF	**$ 1,690.00**

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CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

5.00	A1 - PRESIDENT AND COOLIDGE - PRES TO WILLISTON	QUANTITY	UNIT	UNIT PRICE	TOTAL
5.10	**GENERAL CONDITIONS**				
5.11	Mobilization (10%)	1.000	LSUM	$ 107,000.00	$ 107,000.00
5.12	Contingency (20%)	1.000	LSUM	$ 214,000.00	$ 214,000.00
5.13	Dry Utility Relocates (20%)	1.000	LSUM	$ 214,000.00	$ 214,000.00
5.14	Tree Removal, Trimming & Root Pruning (2%)	1.000	LSUM	$ 21,000.00	$ 21,000.00
5.15	Undercutting & Backfill For Utilities (10% at 3.00')	270.000	CY	$ 90.00	$ 24,300.00
5.16	Pavement Removal	770.000	SY	$ 15.00	$ 11,550.00
5.17	PCC Curb & Gutter Removal	868.000	LF	$ 3.25	$ 2,821.00
5.20	**SEWER INSTALLATION**				
5.21	Install 54" RCP Storm Sewer Adjacent to Ex 54"	1,735.000	LF	$ 148.00	$ 256,780.00
5.22	Trench Backfill	2,410.000	CY	$ 45.00	$ 108,450.00
5.23	Bedding & Haunching	1,361.000	CY	$ 50.00	$ 68,050.00
5.24	12' Storm Manhole Installation	5.000	EACH	$ 30,000.00	$ 150,000.00
5.25	Sanitary Service Repairs	5.000	EACH	$ 2,000.00	$ 10,000.00
5.26	Water Service Repairs	5.000	EACH	$ 2,000.00	$ 10,000.00
5.27	Spoil Removal	4,180.000	CY	$ 45.00	$ 188,100.00
5.30	**RESTORATION**				
5.31	Sod Installation	1,930.000	SY	$ 12.00	$ 23,160.00
5.32	Roadway Base	1,160.000	SY	$ 8.00	$ 9,280.00
5.33	Roadway Pavement	770.000	SY	$ 95.00	$ 73,150.00
5.34	PCC Curb & Gutter Installation	868.000	LF	$ 35.00	$ 30,380.00
5.35	PCC Sidewalk Installation Complete	8,675.000	SF	$ 10.00	$ 86,750.00
5.36	Residential Driveway R&R Complete	160.000	SY	$ 60.00	$ 9,600.00
5.37	Parkway Tree Installation	10.000	EACH	$ 650.00	$ 6,500.00
				SUBTOTAL	**$ 1,624,871.00**

TOTAL LENGTH	**1105 LF**
PRICE / LF	**$ 940.00**

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CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

6.00	A1 - COOLIDGE AVE - WILLISTON to END OF RUN	QUANTITY	UNIT	UNIT PRICE	TOTAL
6.10	**GENERAL CONDITIONS**				
6.11	Mobilization (10%)	1.000	LSUM	$ 359,000.00	$ 359,000.00
6.12	Contingency (20%)	1.000	LSUM	$ 719,000.00	$ 719,000.00
6.13	Dry Utility Relocates (20%)	1.000	LSUM	$ 719,000.00	$ 719,000.00
6.14	Tree Removal, Trimming & Root Pruning (2%)	1.000	LSUM	$ 72,000.00	$ 72,000.00
6.15	Undercutting & Backfill For Utilities (10% at 3.00')	247.000	CY	$ 90.00	$ 22,230.00
6.16	Pavement Removal	2,120.000	SY	$ 15.00	$ 31,800.00
6.17	PCC Curb & Gutter Removal	1,590.000	LF	$ 3.25	$ 5,167.50
6.20	**SEWER INSTALLATION**				
6.21	Install Dual 60" RCP Storm Sewer	3,180.000	LF	$ 284.00	$ 903,120.00
6.22	Trench Backfill	4,410.000	CY	$ 45.00	$ 198,450.00
6.23	Bedding & Haunching	2,494.000	CY	$ 50.00	$ 124,700.00
6.24	15' Storm Manhole Installation	7.000	EACH	$ 45,000.00	$ 315,000.00
6.25	Sanitary Service Repairs	35.000	EACH	$ 2,000.00	$ 70,000.00
6.26	Water Service Repairs	35.000	EACH	$ 2,000.00	$ 70,000.00
6.27	Spoil Removal	7,660.000	CY	$ 45.00	$ 344,700.00
6.28	Remove Existing 54" RCP Pipe	1,590.000	LF	$ 60.00	$ 95,400.00
6.30	**BASIN EXCAVATION**				
6.31	Construction Entrance / Haul Route	575.000	SY	$ 25.00	$ 14,375.00
6.32	Earth Excavation to Disposal	18,560.000	CY	$ 38.50	$ 714,560.00
6.33	Furnish & Place Topsoil 6"	5,250.000	CY	$ 40.00	$ 210,000.00
6.40	**RESTORATION**				
6.41	Sod Installation	1,770.000	SY	$ 12.00	$ 21,240.00
6.42	Roadway Base	2,650.000	SY	$ 8.00	$ 21,200.00
6.43	Roadway Pavement	2,120.000	SY	$ 95.00	$ 201,400.00
6.44	PCC Curb & Gutter Installation	1,590.000	LF	$ 35.00	$ 55,650.00
6.45	PCC Sidewalk Installation Complete	7,950.000	SF	$ 10.00	$ 79,500.00
6.46	Residential Driveway R&R Complete	1,155.000	SY	$ 60.00	$ 69,300.00
6.47	Parkway Tree Installation	40.000	EACH	$ 650.00	$ 26,000.00
				SUBTOTAL	**$ 5,462,792.50**

TOTAL LENGTH	**2150 LF**
PRICE / LF	**$ 3,440.00**

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CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

7.00	A1 - 48" STORM SEWER CONNECTOR	QUANTITY	UNIT	UNIT PRICE	TOTAL
7.10	**GENERAL CONDITIONS**				
7.11	Mobilization (10%)	1.000	LSUM	$ 29,000.00	$ 29,000.00
7.12	Contingency (20%)	1.000	LSUM	$ 58,000.00	$ 58,000.00
7.13	Dry Utility Relocates (20%)	1.000	LSUM	$ 58,000.00	$ 58,000.00
7.14	Tree Removal, Trimming & Root Pruning (2%)	1.000	LSUM	$ 6,000.00	$ 6,000.00
7.15	Undercutting & Backfill For Utilities (10% at 3.00')	38.000	CY	$ 90.00	$ 3,420.00
7.16	Pavement Removal	85.000	SY	$ 15.00	$ 1,275.00
7.17	PCC Curb & Gutter Removal	50.000	LF	$ 3.25	$ 162.50
7.20	**SEWER INSTALLATION**				
7.21	Install 48" RCP Storm Sewer	245.000	LF	$ 300.00	$ 73,500.00
7.22	Jack & Auger 54" Casing Pipe	100.000	LF	$ 1,500.00	$ 150,000.00
7.23	Install 48" FES Complete	1.000	EACH	$ 4,500.00	$ 4,500.00
7.24	Trench Backfill	350.000	CY	$ 45.00	$ 15,750.00
7.25	Spoil Removal	515.000	CY	$ 45.00	$ 23,175.00
7.30	**RESTORATION**				
7.31	Sod Installation	320.000	SY	$ 12.00	$ 3,840.00
7.32	Roadway Base	85.000	SY	$ 8.00	$ 680.00
7.33	Roadway Pavement	85.000	SY	$ 95.00	$ 8,075.00
7.34	PCC Curb & Gutter Installation	50.000	LF	$ 35.00	$ 1,750.00
7.35	PCC Sidewalk Installation Complete	125.000	SF	$ 10.00	$ 1,250.00
7.36	Parkway Tree Installation	2.000	EACH	$ 650.00	$ 1,300.00
				SUBTOTAL	**$ 439,677.50**

TOTAL LENGTH	**245 LF**
PRICE / LF	**$ 1,790.00**

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CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

8.00	A2 - EXHIBIT 8 CAMPBELL POND 1 CONST.	QUANTITY	UNIT	UNIT PRICE	TOTAL
8.10	**GENERAL CONDITIONS**				
8.11	Mobilization (10%)	1.000	LSUM	$ 12,000.00	$ 12,000.00
8.12	Contingency (20%)	1.000	LSUM	$ 25,000.00	$ 25,000.00
8.13	Dry Utility Relocates (5%)	1.000	LSUM	$ 6,000.00	$ 6,000.00
8.14	Tree Removal, Trimming & Root Pruning (1%)	1.000	LSUM	$ 1,000.00	$ 1,000.00
8.15	CCDD Testing & Documentation	1.000	LSUM	$ 10,000.00	$ 10,000.00
8.16	Land Acquisition - 422 Pershing Backyard	1.000	LSUM	$ 155,760.00	$ 155,760.00
8.17	Land Acquisition - 504 Pershing Backyard	1.000	LSUM	$ 117,960.00	$ 117,960.00
8.20	**EARTH EXCAVATION**				
8.21	Construction Entrance / Haul Route	250.000	SY	$ 25.00	$ 6,250.00
8.22	Earth Excavation to Disposal	1,380.000	CY	$ 45.00	$ 62,100.00
8.23	Furnish & Place Topsoil 6"	410.000	CY	$ 50.00	$ 20,500.00
8.30	**RESTORATION**				
8.31	Native Restoration	0.500	ACRE	$ 40,000.00	$ 20,000.00
8.32	Maintenance & Monitoring	3.000	YEAR	$ 5,000.00	$ 15,000.00
				SUBTOTAL	**$ 451,570.00**

TOTAL STORAGE	**3.26 AC/FT**
PRICE / AC/FT	**$ 138,520.00**

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Job Name: Flood Study
Pershing / Elm
Date of Plans: N/A
Revision Date: N/A
Project#: 17034
Date of Estimate: 10/12/2017

CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

9.00	A2 - EXHIBIT 8 CAMPBELL POND 2 CONST.	QUANTITY	UNIT	UNIT PRICE	TOTAL
9.10	**GENERAL CONDITIONS**				
9.11	Mobilization (10%)	1.000	LSUM	$ 39,000.00	$ 39,000.00
9.12	Contingency (20%)	1.000	LSUM	$ 78,000.00	$ 78,000.00
9.13	Dry Utility Relocates (5%)	1.000	LSUM	$ 20,000.00	$ 20,000.00
9.14	Tree Removal, Trimming & Root Pruning (2%)	1.000	LSUM	$ 8,000.00	$ 8,000.00
9.15	CCDD Testing & Documentation	1.000	LSUM	$ 10,000.00	$ 10,000.00
9.16	Land Acquisition - 529 Elm Backyard	1.000	LSUM	$ 98,970.00	$ 98,970.00
9.17	Land Acquisition - 533 Elm Backyard	1.000	LSUM	$ 98,970.00	$ 98,970.00
9.18	Land Acquisition - 605 Elm Backyard	1.000	LSUM	$ 98,970.00	$ 98,970.00
9.19	Land Acquisition - 611 Elm Backyard	1.000	LSUM	$ 119,760.00	$ 119,760.00
9.20	Land Acquisition - 617 Elm Backyard	1.000	LSUM	$ 119,760.00	$ 119,760.00
9.30	**EARTH EXCAVATION**				
9.31	Construction Entrance / Haul Route	370.000	SY	$ 25.00	$ 9,250.00
9.32	Earth Excavation to Disposal	5,300.000	CY	$ 45.00	$ 238,500.00
9.33	Furnish & Place Topsoil 6"	890.000	CY	$ 50.00	$ 44,500.00
9.40	**RESTORATION**				
9.41	Private Property Restoration	1.000	LSUM	$ 40,000.00	$ 40,000.00
9.42	Native Restoration	1.100	ACRE	$ 40,000.00	$ 44,000.00
9.43	Maintenance & Monitoring	3.000	YEAR	$ 5,000.00	$ 15,000.00
				SUBTOTAL	**$ 1,082,680.00**

TOTAL STORAGE	**1.73 AC/FT**
PRICE / AC/FT	**$ 625,830.00**

Client:	Joe Tebrugge	**Job Name:**	Flood Study
	City of Wheaton		Pershing / Elm
	303 West Wesley Street	**Date of Plans:**	N/A
	Wheaton, Illinois 60187	**Revision Date:**	N/A
Phone:	630-848-5010	**Project#:**	17034
Email:	JTebrugge@wheaton.il.us	**Date of Estimate:**	10/12/2017

CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

10.00	A2 - 24" STORM SEWER (PERSHING & CAMPBELL)	QUANTITY	UNIT	UNIT PRICE	TOTAL
10.10	**GENERAL CONDITIONS**				
	10.11 Mobilization (10%)	1.000	LSUM	$ 29,000.00	$ 29,000.00
	10.12 Contingency (20%)	1.000	LSUM	$ 59,000.00	$ 59,000.00
	10.13 Dry Utility Relocates (20%)	1.000	LSUM	$ 59,000.00	$ 59,000.00
	10.14 Tree Removal, Trimming & Root Pruning (2%)	1.000	LSUM	$ 6,000.00	$ 6,000.00
	10.15 Undercutting & Backfill For Utilities (10% at 3.00')	83.000	CY	$ 90.00	$ 7,470.00
10.20	**SEWER INSTALLATION**				
	10.21 Install 24" RCP Storm Sewer	395.000	LF	$ 150.00	$ 59,250.00
	10.22 Install 12" RCP Storm Sewer	140.000	LF	$ 75.00	
	10.23 Install 48" Dia. Catch Basin / Manhole	3.000	EACH	$ 3,500.00	$ 10,500.00
	10.24 Install 24" FES Complete	1.000	EACH	$ 2,000.00	$ 2,000.00
	10.25 Jack & Auger 42" Casing Pipe	120.000	LF	$ 1,500.00	$ 180,000.00
	10.26 Spoil Removal	220.000	CY	$ 45.00	$ 9,900.00
10.30	**RESTORATION**				
	10.31 Sod Installation	470.000	SY	$ 12.00	$ 5,640.00
	10.32 PCC Sidewalk Installation Complete	1,500.000	SF	$ 10.00	$ 15,000.00
	10.33 Parkway Tree Installation	6.000	EACH	$ 650.00	$ 3,900.00
				SUBTOTAL	**$ 446,660.00**

TOTAL LENGTH	**390 LF**
PRICE / LF	**$ 830.00**

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CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

11.00	A2 - 36" & 12" STORM SEWER (REAR YARDS)	QUANTITY	UNIT	UNIT PRICE	TOTAL
11.10	**GENERAL CONDITIONS**				
11.11	Mobilization (10%)	1.000	LSUM	$ 52,000.00	$ 52,000.00
11.12	Contingency (20%)	1.000	LSUM	$ 105,000.00	$ 105,000.00
11.13	Dry Utility Relocates (20%)	1.000	LSUM	$ 105,000.00	$ 105,000.00
11.14	Tree Removal, Trimming & Root Pruning (2%)	1.000	LSUM	$ 10,000.00	$ 10,000.00
11.15	Undercutting & Backfill For Utilities (10% at 3.00')	176.000	CY	$ 90.00	$ 15,840.00
11.16	Pavement Removal	290.000	SY	$ 18.00	$ 5,220.00
11.17	PCC Curb & Gutter Removal	196.000	LF	$ 3.25	$ 637.00
11.20	**SEWER INSTALLATION**				
11.21	Install 24" RCP Storm Sewer	695.000	LF	$ 125.00	$ 86,875.00
11.22	Install 30" RCP Storm Sewer	275.000	LF	$ 195.00	$ 53,625.00
11.23	Install 12" RCP Storm Sewer (W/ TBF & Bedding)	160.000	LF	$ 100.00	$ 16,000.00
11.24	Trench Backfill	250.000	CY	$ 45.00	$ 11,250.00
11.25	Bedding & Haunching	502.000	CY	$ 50.00	$ 25,100.00
11.26	60" Storm Manhole Installation	4.000	EACH	$ 6,500.00	$ 26,000.00
11.27	Install 24" FES Complete	2.000	EACH	$ 2,500.00	$ 5,000.00
11.28	Install 30" FES Complete	1.000	EACH	$ 2,950.00	$ 2,950.00
11.29	Jack & Auger 48" Casing Pipe	100.000	LF	$ 1,500.00	$ 150,000.00
11.30	Spoil Removal	1,275.000	CY	$ 45.00	$ 57,375.00
11.40	**RESTORATION**				
11.41	Sod Installation	811.000	SY	$ 12.00	$ 9,732.00
11.42	Roadway Base	250.000	SY	$ 8.00	$ 2,000.00
11.43	Roadway Pavement	250.000	SY	$ 95.00	$ 23,750.00
11.44	PCC Curb & Gutter Installation	196.000	LF	$ 35.00	$ 6,860.00
11.45	PCC Sidewalk Installation Complete	1,300.000	SF	$ 10.00	$ 13,000.00
11.46	Parkway Tree Installation	20.000	EACH	$ 650.00	$ 13,000.00
				SUBTOTAL	**$ 796,214.00**

TOTAL LENGTH	**740 LF**
PRICE / LF	**$ 705.00**

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CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

12.00	A2 - EXHIBIT 9 POND CONSTRUCTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
12.10	**GENERAL CONDITIONS**				
12.11	Mobilization (10%)	1.000	LSUM	$ 238,000.00	$ 238,000.00
12.12	Contingency (20%)	1.000	LSUM	$ 475,000.00	$ 475,000.00
12.13	Dry Utility Relocates (5%)	1.000	LSUM	$ 119,000.00	$ 119,000.00
12.14	Tree Removal, Trimming & Root Pruning (1%)	1.000	LSUM	$ 24,000.00	$ 24,000.00
12.15	CCDD Testing & Documentation	1.000	LSUM	$ 10,000.00	$ 10,000.00
12.16	Land Acquisition - 802 Pershing Backyard	1.000	LSUM	$ 98,970.00	$ 98,970.00
12.17	Land Acquisition - 810 Pershing Backyard	1.000	LSUM	$ 117,960.00	$ 117,960.00
12.18	Land Acquisition - 816 Pershing Backyard	1.000	LSUM	$ 117,960.00	$ 117,960.00
12.19	Land Acquisition - 824 Pershing Backyard	1.000	LSUM	$ 117,960.00	$ 117,960.00
12.20	Land Acquisition - 904 Pershing Backyard	1.000	LSUM	$ 98,970.00	$ 98,970.00
12.21	Land Acquisition - 906 Pershing Backyard	1.000	LSUM	$ 98,970.00	$ 98,970.00
12.22	Land Acquisition - 910 Pershing Backyard	1.000	LSUM	$ 98,970.00	$ 98,970.00
12.23	Land Acquisition - 805 Elm Backyard	1.000	LSUM	$ 122,880.00	$ 122,880.00
12.24	Land Acquisition - 809 Elm Backyard	1.000	LSUM	$ 98,970.00	$ 98,970.00
12.25	Land Acquisition - 813 Elm Backyard	1.000	LSUM	$ 98,970.00	$ 98,970.00
12.26	Land Acquisition - 819 Elm Backyard	1.000	LSUM	$ 98,970.00	$ 98,970.00
12.27	Land Acquisition - 823 Elm Backyard	1.000	LSUM	$ 98,970.00	$ 98,970.00
12.28	Land Acquisition - 905 Elm Backyard	1.000	LSUM	$ 98,970.00	$ 98,970.00
12.29	Land Acquisition - 909 Elm Backyard	1.000	LSUM	$ 98,970.00	$ 98,970.00
12.30	Land Acquisition - 913 Elm Backyard	1.000	LSUM	$ 98,970.00	$ 98,970.00
12.40	**EARTH EXCAVATION**				
12.41	Construction Entrance / Haul Route	575.000	SY	$ 25.00	$ 14,375.00
12.42	Earth Excavation to Disposal	55,065.000	CY	$ 38.50	$ 2,120,002.50
12.43	Furnish & Place Topsoil 6"	2,550.000	CY	$ 40.00	$ 102,000.00
12.50	**RESTORATION**				
12.51	Native Restoration	3.160	ACRE	$ 35,000.00	$ 110,600.00
12.52	Maintenance & Monitoring	3.000	YEAR	$ 10,000.00	$ 30,000.00
				SUBTOTAL	**$ 4,808,407.50**

TOTAL STORAGE	**34.13 AC/FT**
PRICE / AC/FT	**$ 140,890.00**

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CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

13.00	A2 - 48" STORM SEWER WILLISTON TO PRESIDENT	QUANTITY	UNIT	UNIT PRICE	TOTAL
13.10	**GENERAL CONDITIONS**				
13.11	Mobilization (10%)	1.000	LSUM	$ 86,000.00	$ 86,000.00
13.12	Dry Utility Relocates (20%)	1.000	LSUM	$ 172,000.00	$ 172,000.00
13.13	Contingency (20%)	1.000	LSUM	$ 172,000.00	$ 172,000.00
13.14	Tree Removal, Trimming & Root Pruning (2%)	1.000	LSUM	$ 17,000.00	$ 17,000.00
13.15	Undercutting & Backfill For Utilities (10% at 3.00')	178.000	CY	$ 90.00	$ 16,020.00
13.16	Pavement Removal	1,530.000	SY	$ 18.00	$ 27,540.00
13.20	**SEWER INSTALLATION**				
13.21	Install 48" RCP Storm Sewer	1,145.000	LF	$ 167.00	$ 191,215.00
13.22	Bedding & Haunching	983.000	CY	$ 50.00	$ 49,150.00
13.23	Trench Backfill	2,380.000	CY	$ 45.00	$ 107,100.00
13.24	72" Storm Manhole Installation	5.000	EACH	$ 10,000.00	$ 50,000.00
13.25	Install 48" FES Complete	1.000	EACH	$ 4,500.00	$ 4,500.00
13.26	Sanitary Service Repairs	11.000	EACH	$ 2,000.00	$ 22,000.00
13.27	Water Service Repairs	11.000	EACH	$ 2,000.00	$ 22,000.00
13.28	Spoil Removal	3,890.000	CY	$ 45.00	$ 175,050.00
13.30	**RESTORATION**				
13.31	Sod Installation	1,272.000	SY	$ 12.00	$ 15,264.00
13.32	Roadway Base	1,530.000	SY	$ 8.00	$ 12,240.00
13.33	Roadway Pavement	1,530.000	SY	$ 95.00	$ 145,350.00
13.34	PCC Curb & Gutter Installation	205.000	LF	$ 35.00	$ 7,175.00
13.35	PCC Sidewalk Installation Complete	1,025.000	SF	$ 10.00	$ 10,250.00
13.36	Residential Driveway R&R Complete	30.000	SY	$ 60.00	$ 1,800.00
13.37	Parkway Tree Installation	3.000	EACH	$ 650.00	$ 1,950.00
				SUBTOTAL	**$ 1,305,604.00**

TOTAL LENGTH	**1145 LF**
PRICE / LF	**$ 1,140.00**

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CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

14.00	A2 - 24" STORM SEWER CONNECTOR PRESIDENT	QUANTITY	UNIT	UNIT PRICE	TOTAL
14.10	**GENERAL CONDITIONS**				
14.11	Mobilization (10%)	1.000	LSUM	$ 24,000.00	$ 24,000.00
14.12	Contingency (20%)	1.000	LSUM	$ 48,000.00	$ 48,000.00
14.13	Dry Utility Relocates (20%)	1.000	LSUM	$ 48,000.00	$ 48,000.00
14.14	Tree Removal, Trimming & Root Pruning (2%)	1.000	LSUM	$ 5,000.00	$ 5,000.00
14.15	Undercutting & Backfill For Utilities (10% at 3.00')	38.000	CY	$ 90.00	$ 3,420.00
14.16	Pavement Removal	85.000	SY	$ 15.00	$ 1,275.00
14.17	PCC Curb & Gutter Removal	50.000	LF	$ 3.25	$ 162.50
14.20	**SEWER INSTALLATION**				
14.21	Install 24" RCP Storm Sewer	245.000	LF	$ 150.00	$ 36,750.00
14.22	Jack & Auger 54" Casing Pipe	100.000	LF	$ 1,500.00	$ 150,000.00
14.23	Install 24" FES Complete	1.000	EACH	$ 2,000.00	$ 2,000.00
14.24	Trench Backfill	250.000	CY	$ 45.00	$ 11,250.00
14.25	Spoil Removal	375.000	CY	$ 45.00	$ 16,875.00
14.30	**RESTORATION**				
14.31	Sod Installation	320.000	SY	$ 12.00	$ 3,840.00
14.32	Roadway Base	85.000	SY	$ 8.00	$ 680.00
14.33	Roadway Pavement	85.000	SY	$ 95.00	$ 8,075.00
14.34	PCC Curb & Gutter Installation	50.000	LF	$ 35.00	$ 1,750.00
14.35	PCC Sidewalk Installation Complete	125.000	SF	$ 10.00	$ 1,250.00
14.36	Parkway Tree Installation	2.000	EACH	$ 650.00	$ 1,300.00
				SUBTOTAL	**$ 363,627.50**

TOTAL LENGTH	**245 LF**
PRICE / LF	**$ 1,480.00**

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CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

15.00	A2 - COOLIDGE AVE - PRESIDENT to END OF RUN	QUANTITY	UNIT	UNIT PRICE	TOTAL
15.10	**GENERAL CONDITIONS**				
15.11	Mobilization (10%)	1.000	LSUM	$ 19,000.00	$ 19,000.00
15.12	Contingency (20%)	1.000	LSUM	$ 38,000.00	$ 38,000.00
15.13	Dry Utility Relocates (20%)	1.000	LSUM	$ 38,000.00	$ 38,000.00
15.14	Tree Removal, Trimming & Root Pruning (2%)	1.000	LSUM	$ 4,000.00	$ 4,000.00
15.15	Undercutting & Backfill For Utilities (10% at 3.00')	27.000	CY	$ 90.00	$ 2,430.00
15.16	Pavement Removal	30.000	SY	$ 15.00	$ 450.00
15.17	PCC Curb & Gutter Removal	30.000	LF	$ 3.25	$ 97.50
15.20	**SEWER INSTALLATION**				
15.21	Install Dual 48" RCP Storm Sewer	350.000	LF	$ 167.00	$ 58,450.00
15.22	Install 48" FES Complete	4.000	EACH	$ 4,500.00	$ 18,000.00
15.23	Bedding & Haunching	137.000	CY	$ 50.00	$ 6,850.00
15.24	96" Storm Manhole Installation	2.000	EACH	$ 15,000.00	$ 30,000.00
15.25	Spoil Removal	600.000	CY	$ 45.00	$ 27,000.00
15.26	Remove Existing 24" RCP Pipe	175.000	LF	$ 30.00	$ 5,250.00
15.30	**RESTORATION**				
15.31	Sod Installation	190.000	SY	$ 12.00	$ 2,280.00
15.32	Roadway Base	290.000	SY	$ 8.00	$ 2,320.00
15.33	Roadway Pavement	230.000	SY	$ 95.00	$ 21,850.00
15.34	PCC Curb & Gutter Installation	30.000	LF	$ 35.00	$ 1,050.00
15.35	PCC Sidewalk Installation Complete	875.000	SF	$ 10.00	$ 8,750.00
15.36	Tree Installation	6.000	EACH	$ 650.00	$ 3,900.00
				SUBTOTAL	**$ 287,677.50**

TOTAL LENGTH	**280 LF**
PRICE / LF	**$ 1,640.00**

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CONCEPTUAL OPINION OF PROBABLE CONSTRUCTION COST

1.00	A5 - Roadway, Pershing & President to Coolidge & Prospect	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.10	**GENERAL CONDITIONS**				
1.11	Mobilization (10%)	1.000	LSUM	$ 232,000.00	$ 232,000.00
1.12	Dry Utility Relocates (20%)	1.000	LSUM	$ 464,000.00	$ 464,000.00
1.13	Contingency (20%)	1.000	LSUM	$ 464,000.00	$ 464,000.00
1.14	Tree Removal, Trimming & Root Pruning (2%)	1.000	LSUM	$ 46,000.00	$ 46,000.00
1.15	Pavement Removal	5,690.000	SY	$ 18.00	$ 102,420.00
1.16	PCC Curb & Gutter Removal	2,135.000	LF	$ 5.00	$ 10,675.00
1.20	**SEWER INSTALLATION**				
1.21	Sanitary Service Repairs	70.000	EACH	$ 2,000.00	$ 140,000.00
1.22	Water Service Repairs	70.000	EACH	$ 2,000.00	$ 140,000.00
1.30	**BASIN EXCAVATION**				
1.31	Construction Entrance / Haul Route	575.000	SY	$ 25.00	$ 14,375.00
1.32	Earth Excavation to Disposal	18,560.000	CY	$ 38.50	$ 714,560.00
1.33	Furnish & Place Topsoil 6"	5,250.000	CY	$ 40.00	$ 210,000.00
1.40	**RESTORATION**				
1.41	Sod Installation	4,744.000	SY	$ 12.00	$ 56,928.00
1.42	Roadway Base	7,117.000	SY	$ 8.00	$ 56,936.00
1.43	Roadway Pavement	5,693.000	SY	$ 95.00	$ 540,835.00
1.44	PCC Curb & Gutter Installation	4,270.000	LF	$ 35.00	$ 149,450.00
1.45	Residential Driveway R&R Complete	2,333.0	SY	$ 60.00	$ 139,980.00
1.46	Parkway Tree Installation	70	EACH	$ 650.00	$ 45,500.00
				SUBTOTAL	**$ 3,527,659.00**

TOTAL LENGTH	**2135.00**
PRICE / LF	**$ 1,652.00**

This estimate includes sanitary service and water service repairs but excludes work to the mains. The estimate also assumes all work can be completed within the ROW and no retaining walls are needed. The estimate is very conceptual, as the magnitude of ancillary improvements is undefined, and the actual estimate is likely to be higher once the full extent of ancillary improvements is identified.

Appendix C: Results Tables

West Pershing/Elm Area - Existing Conditions Damaged Structures

			1-year			2-year			5-year			10-year			25-year			50-year			100-year			500-year		
Street	Number	Problem Area ID	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation
Pershing Ave	420	A	760.90	763.62		761.20	763.62		761.68	763.62		762.04	763.62		762.54	763.62		762.91	763.62		763.17	763.62		763.55	763.62	
Pershing Ave	422	A	760.90	763.22		761.20	763.22		761.68	763.22		762.04	763.22		762.54	763.22		762.91	763.22		763.17	763.22		763.55	763.22	0.33
Pershing Ave	504	A	760.90	762.71		761.20	762.71		761.68	762.71		762.04	762.71		762.54	762.71		762.91	762.71	0.20	763.17	762.71	0.46	763.55	762.71	0.84
Pershing Ave	508	A	760.90	762.71		761.20	762.71		761.68	762.71		762.04	762.71		762.54	762.71		762.91	762.71	0.20	763.17	762.71	0.46	763.55	762.71	0.84
Pershing Ave	512	A	760.90	761.51		761.20	761.51		761.68	761.51	0.17	762.04	761.51	0.52	762.54	761.51	1.03	762.91	761.51	1.40	763.17	761.51	1.66	763.55	761.51	2.04
Pershing Ave	524	A	760.90	764.4		761.20	764.4		761.68	764.4		762.04	764.4		762.54	764.4		762.91	764.4		763.17	764.4		763.55	764.4	
Pershing Ave	528	A	760.90	764.88		761.20	764.88		761.68	764.88		762.04	764.88		762.54	764.88		762.91	764.88		763.17	764.88		763.55	764.88	
Pershing Ave	530	A	760.90	766.02		761.20	766.02		761.68	766.02		762.04	766.02		762.54	766.02		762.91	766.02		763.17	766.02		763.55	766.02	
Pershing Ave	532	A	760.90	765.2		761.20	765.2		761.68	765.2		762.04	765.2		762.54	765.2		762.91	765.2		763.17	765.2		763.55	765.2	
Pershing Ave	604	B	762.29	766.3		762.57	766.3		762.89	766.3		763.15	766.3		763.47	766.3		763.71	766.3		764.16	766.3		764.36	766.3	
Pershing Ave	612	B	762.29	766.86		762.57	766.86		762.89	766.86		763.15	766.86		763.47	766.86		763.71	766.86		764.16	766.86		764.36	766.86	
Campbell Ct	509	A	760.90	765.36		761.20	765.36		761.68	765.36		762.04	765.36		762.54	765.36		762.91	765.36		763.17	765.36		763.55	765.36	
Campbell Ave	915	A	760.90	765.03		761.20	765.03		761.68	765.03		762.04	765.03		762.54	765.03		762.91	765.03		763.17	765.03		763.55	765.03	
E Elm St	529	B	762.29	764.91		762.57	764.91		762.89	764.91		763.15	764.91		763.47	764.91		763.71	764.91		764.16	764.91		764.36	764.91	
E Elm St	533	B	762.29	765.04		762.57	765.04		762.89	765.04		763.15	765.04		763.47	765.04		763.71	765.04		764.16	765.04		764.36	765.04	
E Elm St	605	B	762.29	765.28		762.57	765.28		762.89	765.28		763.15	765.28		763.47	765.28		763.71	765.28		764.16	765.28		764.36	765.28	
E Elm St	611	B	762.29	764.51		762.57	764.51		762.89	764.51		763.15	764.51		763.47	764.51		763.71	764.51		764.16	764.51		764.36	764.51	
E Elm St	610	C	762.19	764.32		762.74	764.32		763.32	764.32		763.75	764.32		764.26	764.32		764.50	764.32	0.18	764.68	764.32	0.36	764.97	764.32	0.65
E Elm St	624	C	762.19	763.22		762.74	763.22		763.32	763.22	0.10	763.75	763.22	0.53	764.26	763.22	1.04	764.50	763.22	1.28	764.68	763.22	1.46	764.97	763.22	1.75
E Elm St	704	C	762.19			762.74			763.32			763.75			764.26			764.50			764.68			764.97		
S Chase St	1106	C	762.19	767.45		762.74	767.45		763.32	767.45		763.75	767.45		764.26	767.45		764.50	767.45		764.68	767.45		764.97	767.45	
S Chase St	1110	C	762.19			762.74			763.32			763.75			764.26			764.50			764.68			764.97		
S Chase St	1107	C	762.19	767.6		762.74	767.6		763.32	767.6		763.75	767.6		764.26	767.6		764.50	767.6		764.68	767.6		764.97	767.6	
S Chase St	1111	C	762.19	766.75		762.74	766.75		763.32	766.75		763.75	766.75		764.26	766.75		764.50	766.75		764.68	766.75		764.97	766.75	
E Elm St	527	B	762.29			762.57			762.89			763.15			763.47			763.71			764.16			764.36		
E Elm St	523	B	762.29	765.53		762.57	765.53		762.89	765.53		763.15	765.53		763.47	765.53		763.71	765.53		764.16	765.53		764.36	765.53	
S Chase St	1114	C	762.19	766.08		762.74	766.08		763.32	766.08		763.75	766.08		764.26	766.08		764.50	766.08		764.68	766.08		764.97	766.08	
Campbell Ave	1009	B	762.29	764.73		762.57	764.73		762.89	764.73		763.15	764.73		763.47	764.73		763.71	764.73		764.16	764.73		764.36	764.73	
Pershing Ave	624	B	762.29	762.45		762.57	762.45	0.12	762.89	762.45	0.44	763.15	762.45	0.70	763.47	762.45	1.02	763.71	762.45	1.26	764.16	762.45	1.71	764.36	762.45	1.90
Pershing Ave	620	B	762.29	765.86		762.57	765.86		762.89	765.86		763.15	765.86		763.47	765.86		763.71	765.86		764.16	765.86		764.36	765.86	
Pershing Ave	415	A	756.10	762.91		757.51	762.91		759.37	762.91		761.52	762.91		761.95	762.91		762.36	762.91		762.69	762.91		762.96	762.91	0.05
Pershing Ave	421	A	756.10	763.58		757.51	763.58		759.37	763.58		761.52	763.58		761.95	763.58		762.36	763.58		762.69	763.58		762.96	763.58	
Pershing Ave	423	A	756.10	762.03		757.51	762.03		759.37	762.03		761.52	762.03		761.95	762.03		762.36	762.03	0.33	762.69	762.03	0.65	762.96	762.03	0.93
Pershing Ave	427	A	756.10			757.51			759.37			761.52			761.95			762.36			762.69			762.96		

East Pershing/Elm Area - Existing Conditions Damaged Structures

			1-year			2-year			5-year			10-year			25-year			50-year			100-year			500-year		
Street	Number	Problem Area ID	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation
Pershing Ave	802	D	758.73	762.25		759.27	762.25		759.34	762.25		759.38	762.25		759.43	762.25		759.63	762.25		759.81	762.25		760.35	762.25	
Pershing Ave	810	D	758.31	760.92		758.61	760.92		758.91	760.92		759.16	760.92		759.41	760.92		759.62	760.92		759.81	760.92		760.35	760.92	
Pershing Ave	816	D	758.31	762.46		758.61	762.46		758.91	762.46		759.16	762.46		759.41	762.46		759.62	762.46		759.81	762.46		760.35	762.46	
Pershing Ave	824	D	758.31	764.43		758.61	764.43		758.91	764.43		759.16	764.43		759.41	764.43		759.62	764.43		759.81	764.43		760.35	764.43	
S President St	903	E	752.77	759.67		755.36	759.67		757.09	759.67		757.80	759.67		758.59	759.67		759.32	759.67		759.78	759.67	0.11	760.32	759.67	0.65
Pershing Ave	1006	E	752.77	758.84		755.36	758.84		757.09	758.84		757.80	758.84		758.59	758.84		759.32	758.84	0.48	759.78	758.84	0.94	760.32	758.84	1.48
Pershing Ave	1010	E	752.77	758.80		755.36	758.80		757.09	758.80		757.80	758.80		758.59	758.80		759.32	758.80	0.52	759.78	758.80	0.98	760.32	758.80	1.52
Pershing Ave	1014	E	752.77	759.73		755.36	759.73		757.09	759.73		757.80	759.73		758.59	759.73		759.32	759.73		759.78	759.73	0.05	760.32	759.73	0.59
Pershing Ave	1018	E	752.77	760.26		755.36	760.26		757.09	760.26		757.80	760.26		758.59	760.26		759.32	760.26		759.78	760.26		760.32	760.26	0.06
S President St	921	E	752.77	759.00		755.36	759.00		757.09	759.00		757.80	759.00		758.59	759.00		759.32	759.00	0.32	759.78	759.00	0.78	760.32	759.00	1.32
S President St	1003	E	752.77	761.41		755.36	761.41		757.09	761.41		757.80	761.41		758.59	761.41		759.32	761.41		759.78	761.41		760.32	761.41	
Wilson Ave	1006	E	752.77	758.02		755.36	758.02		757.09	758.02		757.80	758.02		758.59	758.02	0.57	759.32	758.02	1.30	759.78	758.02	1.76	760.32	758.02	2.30
Wilson Ave	1018	E	752.77	759.47		755.36	759.47		757.09	759.47		757.80	759.47		758.59	759.47		759.32	759.47		759.78	759.47	0.31	760.32	759.47	0.85
Wilson Ave	1007	E	752.77	758.72		755.36	758.72		757.09	758.72		757.80	758.72		758.59	758.72		759.32	758.72	0.60	759.78	758.72	1.06	760.32	758.72	1.60
Wilson Ave	1011	E	752.77	760.70		755.36	760.70		757.09	760.70		757.80	760.70		758.59	760.70		759.32	760.70		759.78	760.70		760.32	760.70	
Wilson Ave	1015	E	752.77	760.81		755.36	760.81		757.09	760.81		757.80	760.81		758.59	760.81		759.32	760.81		759.78	760.81		760.32	760.81	
Wilson Ave	1019	E	752.77	760.40		755.36	760.40		757.09	760.40		757.80	760.40		758.59	760.40		759.32	760.40		759.78	760.40		760.32	760.40	
S President St	815	E	752.77	759.32		755.36	759.32		757.09	759.32		757.80	759.32		758.59	759.32		759.32	759.32	0.00	759.78	759.32	0.46	760.32	759.32	1.00
S President St	914	D	758.31	758.57		758.61	758.57	0.04	758.91	758.57	0.34	759.16	758.57	0.59	759.41	758.57	0.84	759.62	758.57	1.05	759.81	758.57	1.24	760.35	758.57	1.78
S President St	920	D	758.31	758.70		758.61	758.70		758.91	758.70	0.21	759.16	758.70	0.46	759.41	758.70	0.71	759.62	758.70	0.92	759.81	758.70	1.11	760.35	758.70	1.65
S President St	926	D	758.31	759.35		758.61	759.35		758.91	759.35		759.16	759.35		759.41	759.35	0.06	759.62	759.35	0.27	759.81	759.35	0.46	760.35	759.35	1.00
S President St	1002	D	758.31	759.91		758.61	759.91		758.91	759.91		759.16	759.91		759.41	759.91		759.62	759.91		759.81	759.91		760.35	759.91	0.44
Pershing Ave	1011	E	752.77	758.92		755.36	758.92		757.09	758.92		757.80	758.92		758.59	758.92		759.32	758.92	0.40	759.78	758.92	0.86	760.32	758.92	1.40
Pershing Ave	1015	E	752.77	759.97		755.36	759.97		757.09	759.97		757.80	759.97		758.59	759.97		759.32	759.97		759.78	759.97		760.32	759.97	0.35
Pershing Ave	1019	E	752.77	759.51		755.36	759.51		757.09	759.51		757.80	759.51		758.59	759.51		759.32	759.51		759.78	759.51	0.27	760.32	759.51	0.81
Pershing Ave	1107	F	757.20	760.33		757.95	760.33		758.53	760.33		758.85	760.33		759.05	760.33		759.20	760.33		759.35	760.33		760.07	760.33	
Pershing Ave	1111	F	757.20	758.52		757.95	758.52		758.53	758.52	0.01	758.85	758.52	0.33	759.05	758.52	0.53	759.20	758.52	0.68	759.35	758.52	0.83	760.07	758.52	1.55
Pershing Ave	1115	F	757.20	758.26		757.95	758.26		758.53	758.26	0.27	758.85	758.26	0.59	759.05	758.26	0.79	759.20	758.26	0.94	759.35	758.26	1.09	760.07	758.26	1.81
Pershing Ave	1215	F	757.20	758.74		757.95	758.74		758.53	758.74		758.85	758.74	0.11	759.05	758.74	0.31	759.20	758.74	0.46	759.35	758.74	0.61	760.07	758.74	1.33
Pershing Ave	1219	F	757.20	760.04		757.95	760.04		758.53	760.04		758.85	760.04		759.05	760.04		759.20	760.04		759.35	760.04		760.07	760.04	0.03
Pershing Ave	1020	F	757.20	760.54		757.95	760.54		758.53	760.54		758.85	760.54		759.05	760.54		759.20	760.54		759.35	760.54		760.07	760.54	
Pershing Ave	1102	F	757.20	759.57		757.95	759.57		758.53	759.57		758.85	759.57		759.05	759.57		759.20	759.57		759.35	759.57		760.07	759.57	0.50
Pershing Ave	1106	F	757.20	759.80		757.95	759.80		758.53	759.80		758.85	759.80		759.05	759.80		759.20	759.80		759.35	759.80		760.07	759.80	0.27
Pershing Ave	1108	F	757.20	760.60		757.95	760.60		758.53	760.60		758.85	760.60		759.05	760.60		759.20	760.60		759.35	760.60		760.07	760.60	
Williston St	902	F	757.20	760.59		757.95	760.59		758.53	760.59		758.85	760.59		759.05	760.59		759.20	760.59		759.35	760.59		760.07	760.59	
Williston St	903	F	757.20	759.73		757.95	759.73		758.53	759.73		758.85	759.73		759.05	759.73		759.20	759.73		759.35	759.73		760.07	759.73	0.34
Pershing Ave	1206	F	757.20	759.72		757.95	759.72		758.53	759.72		758.85	759.72		759.05	759.72		759.20	759.72		759.35	759.72		760.07	759.72	0.35
Pershing Ave	1210	F	757.20	760.86		757.95	760.86		758.53	760.86		758.85	760.86		759.05	760.86		759.20	760.86		759.35	760.86		760.07	760.86	
Pershing Ave	1214	F	757.20	759.50		757.95	759.50		758.53	759.50		758.85	759.50		759.05	759.50		759.20	759.50		759.35	759.50		760.07	759.50	0.57
Pershing Ave	1218	F	757.20	758.27		757.95	758.27		758.53	758.27	0.26	758.85	758.27	0.58	759.05	758.27	0.78	759.20	758.27	0.93	759.35	758.27	1.08	760.07	758.27	1.80
Pershing Ave	1222	F	757.20	759.09		757.95	759.09		758.53	759.09		758.85	759.09		759.05	759.09		759.20	759.09	0.11	759.35	759.09	0.26	760.07	759.09	0.98
Pershing Ave	1302	F	757.20	759.01		757.95	759.01		758.53	759.01		758.85	759.01		759.05	759.01	0.04	759.20	759.01	0.19	759.35	759.01	0.34	760.07	759.01	1.06
Pershing Ave	1304	F	757.20	758.96		757.95	758.96		758.53	758.96		758.85	758.96		759.05	758.96	0.09	759.20	758.96	0.24	759.35	758.96	0.39	760.07	758.96	1.11
Pershing Ave	1308	F	757.20	759.24		757.95	759.24		758.53	759.24		758.85	759.24		759.05	759.24		759.20	759.24		759.35	759.24	0.11	760.07	759.24	0.83
Pershing Ave	1312	F	757.20			757.95			758.53			758.85			759.05			759.20			759.35			760.07		
Pershing Ave	1316	F	757.20	759.39		757.95	759.39		758.53	759.39		758.85	759.39		759.05	759.39		759.20	759.39		759.35	759.39		760.07	759.39	0.68
Blanchard St	904	F	757.20	759.13		757.95	759.13		758.53	759.13		758.85	759.13		759.05	759.13		759.20	759.13	0.07	759.35	759.13	0.22	760.07	759.13	0.94
Pershing Ave	1303	F	757.20	760.90		757.95	760.90		758.53	760.90		758.85	760.90		759.05	760.90		759.20	760.90		759.35	760.90		760.07	760.90	
Pershing Ave	1307	F	757.20	759.89		757.95	759.89		758.53	759.89		758.85	759.89		759.05	759.89		759.20	759.89		759.35	759.89		760.07	759.89	0.18
Pershing Ave	1311	F	757.20	761.11		757.95	761.11		758.53	761.11		758.85	761.11		759.05	761.11		759.20	761.11		759.35	761.11		760.07	761.11	
Pershing Ave	1315	F	757.20	759.79		757.95	759.79		758.53	759.79		758.85	759.79		759.05	759.79		759.20	759.79		759.35	759.79		760.07	759.79	0.28
Pershing Ave	1319	F	757.20	759.52		757.95	759.52		758.53	759.52		758.85	759.52		759.05	759.52		759.20	759.52		759.35	759.52		760.07	759.52	0.55
Blanchard St	816	F	757.20	759.89		757.95	759.89		758.53	759.89		758.85	759.89		759.05	759.89		759.20	759.89		759.35	759.89		760.07	759.89	0.18
Blanchard St	924	G	757.09	760.34		757.42	760.34		757.54	760.34		757.61	760.34		757.69	760.34		757.79	760.34		757.98	760.34		758.56	760.34	
Blanchard St	1003	G	757.09	759.50		757.42	759.50		757.54	759.50		757.61	759.50		757.69	759.50		757.79	759.50		757.98	759.50		758.56	759.50	
Blanchard St	903	F	757.20	759.91		757.95	759.91		758.53	759.91		758.85	759.91		759.05	759.91		759.20	759.91		759.35	759.91		760.07	759.91	0.16
S Williston St	824	F	757.20	758.24		757.95	758.24		758.53	758.24	0.29	758.85	758.24	0.61	759.05	758.24	0.81	759.20	758.24	0.96	759.35	758.24	1.11	760.07	758.24	1.83
Pershing Ave	1119	F	757.20	757.56		757.95	757.56	0.39	758.53	757.56	0.97	758.85	757.56	1.29	759.05	757.56	1.49	759.20	757.56	1.64	759.35	757.56	1.79	760.07	757.56	2.51
S Blanchard St	923	G	757.09	758.32		757.42	758.32		757.54	758.32		757.61	758.32		757.69	758.32		757.79	758.32		757.98	758.32		758.56	758.32	0.24
Wilson Ave	1305	G	757.09	758.83		757.42	758.83		757.54	758.83		757.61	758.83		757.69	758.83		757.79	758.83		757.98	758.83		758.56	758.83	

East Pershing/Elm Area - Existing Conditions Damaged Structures

			1-year			2-year			5-year			10-year			25-year			50-year			100-year			500-year		
Street	Number	Problem Area ID	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation
Wilson Ave	1313	G	757.09	759.86		757.42	759.86		757.54	759.86		757.61	759.86		757.69	759.86		757.79	759.86		757.98	759.86		758.56	759.86	
Wilson Ave	1317	G	757.09	758.55		757.42	758.55		757.54	758.55		757.61	758.55		757.69	758.55		757.79	758.55		757.98	758.55		758.56	758.55	0.01
Wilson Ave	1407	G	757.09	757.41		757.42	757.41	0.01	757.54	757.41	0.13	757.61	757.41	0.20	757.69	757.41	0.28	757.79	757.41	0.38	757.98	757.41	0.57	758.56	757.41	1.15
Wilson Ave	1411	G	757.09	759.30		757.42	759.30		757.54	759.30		757.61	759.30		757.69	759.30		757.79	759.30		757.98	759.30		758.56	759.30	
Wilson Ave	1419	G	757.09	759.52		757.42	759.52		757.54	759.52		757.61	759.52		757.69	759.52		757.79	759.52		757.98	759.52		758.56	759.52	
Wilson Ave	1505	G	757.09	758.19		757.42	758.19		757.54	758.19		757.61	758.19		757.69	758.19		757.79	758.19		757.98	758.19		758.56	758.19	0.37
Wilson Ave	1504	G	757.09	757.90		757.42	757.90		757.54	757.90		757.61	757.90		757.69	757.90		757.79	757.90		757.98	757.90	0.08	758.56	757.90	0.66
Wilson Ave	1500	G	757.09	758.08		757.42	758.08		757.54	758.08		757.61	758.08		757.69	758.08		757.79	758.08		757.98	758.08		758.56	758.08	0.48
Wilson Ave	1512	G	757.09	757.74		757.42	757.74		757.54	757.74		757.61	757.74		757.69	757.74		757.79	757.74	0.05	757.98	757.74	0.24	758.56	757.74	0.82
Wilson Ave	1513	G	757.09	757.80		757.42	757.80		757.54	757.80		757.61	757.80		757.69	757.80		757.79	757.80		757.98	757.80	0.18	758.56	757.80	0.76
Wilson Ave	1312	G	757.09	758.48		757.42	758.48		757.54	758.48		757.61	758.48		757.69	758.48		757.79	758.48		757.98	758.48		758.56	758.48	0.08
Wilson Ave	1410	G	757.09	757.77		757.42	757.77		757.54	757.77		757.61	757.77		757.69	757.77		757.79	757.77	0.02	757.98	757.77	0.21	758.56	757.77	0.79
Elm St	1509	H	750.83	757.56		752.56	757.56		754.69	757.56		755.28	757.56		755.67	757.56		755.84	757.56		756.04	757.56		756.57	757.56	
Elm St	1513	H	750.83	757.08		752.56	757.08		754.69	757.08		755.28	757.08		755.67	757.08		755.84	757.08		756.04	757.08		756.57	757.08	
Elm St	1517	H	750.83	756.63		752.56	756.63		754.69	756.63		755.28	756.63		755.67	756.63		755.84	756.63		756.04	756.63		756.57	756.63	
Prospect St	1020	H	750.83	757.16		752.56	757.16		754.69	757.16		755.28	757.16		755.67	757.16		755.84	757.16		756.04	757.16		756.57	757.16	
Elm St	1504	H	750.83	755.88		752.56	755.88		754.69	755.88		755.28	755.88		755.67	755.88		755.84	755.88		756.04	755.88	0.16	756.57	755.88	0.69
Elm St	1508	H	750.83	756.79		752.56	756.79		754.69	756.79		755.28	756.79		755.67	756.79		755.84	756.79		756.04	756.79		756.57	756.79	
Elm St	1512	H	750.83	757.73		752.56	757.73		754.69	757.73		755.28	757.73		755.67	757.73		755.84	757.73		756.04	757.73		756.57	757.73	
Elm St	1516	H	750.83	755.23		752.56	755.23		754.69	755.23		755.28	755.23	0.05	755.67	755.23	0.44	755.84	755.23	0.61	756.04	755.23	0.81	756.57	755.23	1.34
Elm St	1520	H	750.83	756.63		752.56	756.63		754.69	756.63		755.28	756.63		755.67	756.63		755.84	756.63		756.04	756.63		756.57	756.63	
Taft Ave	1018	F	757.20	764.03		757.95	764.03		758.53	764.03		758.85	764.03		759.05	764.03		759.20	764.03		759.35	764.03		760.07	764.03	
Taft Ave	1102	F	757.20	759.85		757.95	759.85		758.53	759.85		758.85	759.85		759.05	759.85		759.20	759.85		759.35	759.85		760.07	759.85	0.22
Taft Ave	1106	F	757.20	759.13		757.95	759.13		758.53	759.13		758.85	759.13		759.05	759.13		759.20	759.13	0.07	759.35	759.13	0.22	760.07	759.13	0.94
Taft Ave	1110	F	757.20	760.40		757.95	760.40		758.53	760.40		758.85	760.40		759.05	760.40		759.20	760.40		759.35	760.40		760.07	760.40	
Taft Ave	1114	F	757.20	760.80		757.95	760.80		758.53	760.80		758.85	760.80		759.05	760.80		759.20	760.80		759.35	760.80		760.07	760.80	
Taft Ave	1118	F	757.20	761.70		757.95	761.70		758.53	761.70		758.85	761.70		759.05	761.70		759.20	761.70		759.35	761.70		760.07	761.70	
Taft Ave	1122	F	757.20	760.22		757.95	760.22		758.53	760.22		758.85	760.22		759.05	760.22		759.20	760.22		759.35	760.22		760.07	760.22	
Pershing Ave	1207	F	757.20	760.30		757.95	760.30		758.53	760.30		758.85	760.30		759.05	760.30		759.20	760.30		759.35	760.30		760.07	760.30	
Wilson Ave	1508	G	757.09	760.49		757.42	760.49		757.54	760.49		757.61	760.49		757.69	760.49		757.79	760.49		757.98	760.49		758.56	760.49	
Wilson Ave	1516	G	757.09	760.09		757.42	760.09		757.54	760.09		757.61	760.09		757.69	760.09		757.79	760.09		757.98	760.09		758.56	760.09	
Prospect St	1103	H	750.83	757.05		752.56	757.05		754.69	757.05		755.28	757.05		755.67	757.05		755.84	757.05		756.04	757.05		756.57	757.05	
Prospect St	1119	H	750.83	757.00		752.56	757.00		754.69	757.00		755.28	757.00		755.67	757.00		755.84	757.00		756.04	757.00		756.57	757.00	

West Pershing/Elm Area - Damaged Structure Summary for the 100-year Storm Event

Street	Number	Problem Area ID	Low Entry Elevation	Depth of Water Above Critical Elevation	Location of Low Entry
Pershing Ave	420	A	763.62		Ponding on Side of House
Pershing Ave	422	A	763.22		Ponding on Side of House
Pershing Ave	504	A	762.71	0.46	Window/Well
Pershing Ave	504	A	762.94	0.23	Window/Well
Pershing Ave	504	A	763.04	0.13	Window/Well
Pershing Ave	504	A	763	0.17	Window/Well
Pershing Ave	508	A	762.71	0.46	Window/Well
Pershing Ave	508	A	762.8	0.37	Window/Well
Pershing Ave	508	A	762.79	0.38	Window/Well
Pershing Ave	508	A	762.81	0.36	Window/Well
Pershing Ave	512	A	761.51	1.66	Foundation
Pershing Ave	512	A	762.47	0.70	Door
Pershing Ave	524	A	764.4		Ponding on Side of House
Pershing Ave	528	A	764.88		Window/Well
Pershing Ave	530	A	766.02		Ponding on Side of House
Pershing Ave	532	A	765.2		Window/Well
Pershing Ave	604	B	766.3		Lookout
Pershing Ave	612	B	766.86		Foundation
Campbell Ct	509	A	765.36		Window/Well
Campbell Ave	915	A	765.03		Ponding on Side of House
E Elm St	529	B	764.91		Window/Well
E Elm St	533	B	765.04		Window/Well
E Elm St	605	B	765.28		Foundation
E Elm St	611	B	764.51		Window/Well
E Elm St	610	C	764.32	0.36	Window/Well
E Elm St	610	C	764.32	0.36	Window/Well
E Elm St	610	C	764.32	0.36	Window/Well
E Elm St	610	C	764.32	0.36	Window/Well
E Elm St	624	C	763.22	1.46	Window/Well
E Elm St	624	C	763.62	1.06	Foundation
E Elm St	624	C	762.97	1.71	Window/Well
E Elm St	624	C	762.97	1.71	Window/Well
E Elm St	624	C	763.22	1.46	Window/Well
E Elm St	704	C			
S Chase St	1106	C	767.45		Ponding on Side of House
S Chase St	1110	C			
S Chase St	1107	C	767.6		Foundation
S Chase St	1111	C	766.75		Foundation
E Elm St	527	B			

West Pershing/Elm Area - Damaged Structure Summary for the 100-year Storm Event

Street	Number	Problem Area ID	Low Entry Elevation	Depth of Water Above Critical Elevation	Location of Low Entry
E Elm St	523	B	765.53		Window/Well
S Chase St	1114	C	766.08		Foundation
Campbell Ave	1009	B	764.73		Window/Well
Pershing Ave	624	B	762.45	1.71	Window/Well
Pershing Ave	624	B	763.72	0.44	Foundation
Pershing Ave	620	B	765.86		Window/Well
Pershing Ave	415	A	762.91		Window/Well
Pershing Ave	421	A	763.58		Foundation
Pershing Ave	423	A	762.03	0.65	Window/Well
Pershing Ave	427	A			

East Pershing/Elm Area - Damaged Structure Summary for the 100-year Storm Event

Street	Number	Problem Area ID	Low Entry Elevation	Depth of 100-yr Flood Above Low Entry	Location of Low Entry
Blanchard St	816	F	759.89		Door
Blanchard St	903	F	759.91		Foundation
Blanchard St	904	F	759.13	0.22	Foundation
Blanchard St	924	G	760.34		Foundation
Blanchard St	1003	G	759.50		Door
Elm St	1504	H	755.88	0.16	Garage
Elm St	1508	H	756.79		Garage
Elm St	1509	H	757.56		Foundation
Elm St	1512	H	757.73		Foundation
Elm St	1513	H	757.08		Door
Elm St	1516	H	755.23	0.81	Garage
Elm St	1517	H	756.63		Foundation
Elm St	1520	H	756.63		Foundation
Pershing Ave	802	D	762.25		Ponding on Side of House
Pershing Ave	810	D	760.92		Window/Well
Pershing Ave	816	D	762.46		Ponding on Side of House
Pershing Ave	824	D	764.43		Ponding on Side of House
Pershing Ave	1006	E	758.84	0.94	Window/Well
Pershing Ave	1006	E	759.45	0.33	Window/Well
Pershing Ave	1006	E	759.45	0.33	Window/Well
Pershing Ave	1010	E	758.80	0.98	Window/Well
Pershing Ave	1010	E	758.83	0.95	Window/Well
Pershing Ave	1010	E	758.7	1.08	Window/Well
Pershing Ave	1010	E	758.7	1.08	Window/Well
Pershing Ave	1010	E	758.7	1.08	Window/Well
Pershing Ave	1011	E	758.92	0.86	Window/Well
Pershing Ave	1011	E	759.12	0.66	Foundation
Pershing Ave	1014	E	759.73	0.05	Ponding on Side of House
Pershing Ave	1015	E	759.97		Window/Well
Pershing Ave	1018	E	760.26		Ponding on Side of House
Pershing Ave	1019	E	759.51	0.27	Garage
Pershing Ave	1020	F	760.54		Window/Well
Pershing Ave	1102	F	759.57		Door
Pershing Ave	1106	F	759.80		Window/Well
Pershing Ave	1107	F	760.33		Window/Well
Pershing Ave	1108	F	760.60		Foundation
Pershing Ave	1111	F	758.52	0.83	Window/Well
Pershing Ave	1115	F	758.26	1.09	Window/Well
Pershing Ave	1115	F	759.11	0.24	Window/Well

East Pershing/Elm Area - Damaged Structure Summary for the 100-year Storm Event

Street	Number	Problem Area ID	Low Entry Elevation	Depth of 100-yr Flood Above Low Entry	Location of Low Entry
Pershing Ave	1119	F	757.56	1.79	Window/Well
Pershing Ave	1206	F	759.72		Window/Well
Pershing Ave	1207	F	760.30		Foundation
Pershing Ave	1210	F	760.86		Foundation
Pershing Ave	1214	F	759.50		Door
Pershing Ave	1215	F	758.74	0.61	Window/Well
Pershing Ave	1218	F	758.27	1.08	Door
Pershing Ave	1218	F	759.12	0.23	Foundation
Pershing Ave	1219	F	760.04		Garage
Pershing Ave	1222	F	759.09	0.26	Foundation
Pershing Ave	1302	F	759.01	0.34	Window/Well
Pershing Ave	1303	F	760.90		Garage
Pershing Ave	1304	F	758.96	0.39	Window/Well
Pershing Ave	1307	F	759.89		Door
Pershing Ave	1308	F	759.24	0.11	Foundation
Pershing Ave	1311	F	761.11		Window/Well
Pershing Ave	1312	F			
Pershing Ave	1315	F	759.79		Door
Pershing Ave	1316	F	759.39		Foundation
Pershing Ave	1319	F	759.52		Foundation
Prospect St	1020	H	757.16		Foundation
Prospect St	1103	H	757.05		Foundation
Prospect St	1119	H	757.00		Foundation
S Blanchard St	923	G	758.32		Foundation
S President St	815	E	759.32	0.46	Window/Well
S President St	815	E	759.32	0.46	Window/Well
S President St	815	E	759.32	0.46	Window/Well
S President St	815	E	759.32	0.46	Window/Well
S President St	815	E	759.34	0.44	Window/Well
S President St	903	E	759.67	0.11	Window/Well
S President St	903	E	759.67	0.11	Window/Well
S President St	903	E	759.67	0.11	Window/Well
S President St	903	E	759.67	0.11	Window/Well
S President St	903	E	759.67	0.11	Window/Well
S President St	914	D	758.57	1.24	Window/Well
S President St	920	D	758.70	1.11	Ponding on Side of House
S President St	920	D	759.27	0.54	Window/Well
S President St	920	D	759.27	0.54	Foundation
S President St	920	D	759.25	0.56	Window/Well

East Pershing/Elm Area - Damaged Structure Summary for the 100-year Storm Event

Street	Number	Problem Area ID	Low Entry Elevation	Depth of 100-yr Flood Above Low Entry	Location of Low Entry
S President St	920	D	758.72	1.09	Window/Well
S President St	921	E	759.00	0.78	Foundation
S President St	921	E	759.2	0.58	Window/Well
S President St	921	E	759.2	0.58	Lookout
S President St	921	E	759.2	0.58	Lookout
S President St	921	E	759.2	0.58	Window/Well
S President St	926	D	759.35	0.46	Window/Well
S President St	926	D	759.35	0.46	Window/Well
S President St	926	D	759.35	0.46	Window/Well
S President St	926	D	759.38	0.43	Window/Well
S President St	926	D	759.35	0.46	Window/Well
S President St	1002	D	759.91		Ponding on Side of House
S President St	1003	E	761.41		Window/Well
Taft Ave	1018	F	764.03		Window/Well
Taft Ave	1102	F	759.85		Window/Well
Taft Ave	1106	F	759.13	0.22	Window/Well
Taft Ave	1110	F	760.40		Window/Well
Taft Ave	1114	F	760.80		Window/Well
Taft Ave	1118	F	761.70		Window/Well
Taft Ave	1122	F	760.22		Foundation
S Williston St	824	F	758.24	1.11	Door
S Williston St	824	F	758.34	1.01	Foundation
Williston St	902	F	760.59		Foundation
Williston St	903	F	759.73		Window/Well
Wilson Ave	1006	E	758.02	1.76	Garage
Wilson Ave	1007	E	758.72	1.06	Door
Wilson Ave	1007	E	759.5	0.28	Foundation
Wilson Ave	1007	E	759.7	0.08	Lookout
Wilson Ave	1007	E	759.73	0.05	Lookout
Wilson Ave	1011	E	760.70		Foundation
Wilson Ave	1015	E	760.81		Foundation
Wilson Ave	1018	E	759.47	0.31	Garage
Wilson Ave	1019	E	760.40		Foundation
Wilson Ave	1305	G	758.83		Garage
Wilson Ave	1312	G	758.48		Garage
Wilson Ave	1313	G	759.86		Window/Well
Wilson Ave	1317	G	758.55		Door
Wilson Ave	1407	G	757.41	0.57	DOOR
Wilson Ave	1410	G	757.77	0.21	Garage

East Pershing/Elm Area - Damaged Structure Summary for the 100-year Storm Event

Street	Number	Problem Area ID	Low Entry Elevation	Depth of 100-yr Flood Above Low Entry	Location of Low Entry
Wilson Ave	1411	G	759.30		Foundation
Wilson Ave	1419	G	759.52		Foundation
Wilson Ave	1500	G	758.08		Garage
Wilson Ave	1504	G	757.90	0.08	Garage
Wilson Ave	1505	G	758.19		Garage
Wilson Ave	1508	G	760.49		Foundation
Wilson Ave	1512	G	757.74	0.24	Garage
Wilson Ave	1513	G	757.80	0.18	Garage
Wilson Ave	1516	G	760.09		Foundation

West Pershing/Elm Area - Proposed Alternative 2 Damaged Structures

			1-year			2-year			5-year			10-year			25-year			50-year			100-year		
Street	Number	Problem Area ID	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation
Pershing Ave	420	A	757.00	763.62		757.89	763.62		758.92	763.62		759.87	763.62		760.98	763.62		761.82	763.62		762.55	763.62	
Pershing Ave	422	A	757.00	763.22		757.89	763.22		758.92	763.22		759.87	763.22		760.98	763.22		761.82	763.22		762.55	763.22	
Pershing Ave	504	A	757.00	762.71		757.89	762.71		758.92	762.71		759.87	762.71		760.98	762.71		761.82	762.71		762.55	762.71	
Pershing Ave	508	A	757.00	762.71		757.89	762.71		758.92	762.71		759.87	762.71		760.98	762.71		761.82	762.71		762.55	762.71	
Pershing Ave	512	A	757.00	761.51		757.89	761.51		758.92	761.51		759.87	761.51		760.98	761.51		761.82	761.51	0.31	762.55	761.51	1.04
Pershing Ave	524	A	757.00	764.4		757.89	764.4		758.92	764.4		759.87	764.4		760.98	764.4		761.82	764.4		762.55	764.4	
Pershing Ave	528	A	757.00	764.88		757.89	764.88		758.92	764.88		759.87	764.88		760.98	764.88		761.82	764.88		762.55	764.88	
Pershing Ave	530	A	757.00	766.02		757.89	766.02		758.92	766.02		759.87	766.02		760.98	766.02		761.82	766.02		762.55	766.02	
Pershing Ave	532	A	757.00	765.2		757.89	765.2		758.92	765.2		759.87	765.2		760.98	765.2		761.82	765.2		762.55	765.2	
Pershing Ave	604	B	757.72	766.3		758.27	766.3		759.39	766.3		760.34	766.3		761.46	766.3		762.20	766.3		762.84	766.3	
Pershing Ave	612	B	757.72	766.86		758.27	766.86		759.39	766.86		760.34	766.86		761.46	766.86		762.20	766.86		762.84	766.86	
Campbell Ct	509	A	757.00	765.36		757.89	765.36		758.92	765.36		759.87	765.36		760.98	765.36		761.82	765.36		762.55	765.36	
Campbell Ave	915	A	757.00	765.03		757.89	765.03		758.92	765.03		759.87	765.03		760.98	765.03		761.82	765.03		762.55	765.03	
E Elm St	529	B	757.72	764.91		758.27	764.91		759.39	764.91		760.34	764.91		761.46	764.91		762.20	764.91		762.84	764.91	
E Elm St	533	B	757.72	765.04		758.27	765.04		759.39	765.04		760.34	765.04		761.46	765.04		762.20	765.04		762.84	765.04	
E Elm St	605	B	757.72	765.28		758.27	765.28		759.39	765.28		760.34	765.28		761.46	765.28		762.20	765.28		762.84	765.28	
E Elm St	611	B	757.72	764.51		758.27	764.51		759.39	764.51		760.34	764.51		761.46	764.51		762.20	764.51		762.84	764.51	
E Elm St	610	C	759.75	764.32		759.90	764.32		760.12	764.32		760.34	764.32		761.50	764.32		762.25	764.32		762.89	764.32	
E Elm St	624	C	759.75	763.22		759.90	763.22		760.12	763.22		760.34	763.22		761.50	763.22		762.25	763.22		762.89	763.22	
E Elm St	704	C	759.75			759.90			760.12			760.34			761.50			762.25			762.89		
S Chase St	1106	C	759.75	767.45		759.90	767.45		760.12	767.45		760.34	767.45		761.50	767.45		762.25	767.45		762.89	767.45	
S Chase St	1110	C	759.75			759.90			760.12			760.34			761.50			762.25			762.89		
S Chase St	1107	C	759.75	767.6		759.90	767.6		760.12	767.6		760.34	767.6		761.50	767.6		762.25	767.6		762.89	767.6	
S Chase St	1111	C	759.75	766.75		759.90	766.75		760.12	766.75		760.34	766.75		761.50	766.75		762.25	766.75		762.89	766.75	
E Elm St	527	B	757.72			758.27			759.39			760.34			761.46			762.20			762.84		
E Elm St	523	B	757.72	765.53		758.27	765.53		759.39	765.53		760.34	765.53		761.46	765.53		762.20	765.53		762.84	765.53	
S Chase St	1114	C	759.75	766.08		759.90	766.08		760.12	766.08		760.34	766.08		761.50	766.08		762.25	766.08		762.89	766.08	
Campbell Ave	1009	B	757.72	764.73		758.27	764.73		759.39	764.73		760.34	764.73		761.46	764.73		762.20	764.73		762.84	764.73	
Pershing Ave	624	B	757.72	762.45		758.27	762.45		759.39	762.45		760.34	762.45		761.46	762.45		762.20	762.45		762.84	762.45	See note
Pershing Ave	620	B	757.72	765.86		758.27	765.86		759.39	765.86		760.34	765.86		761.46	765.86		762.20	765.86		762.84	765.86	
Pershing Ave	415	A	756.38	762.91		757.27	762.91		758.37	762.91		759.32	762.91		760.52	762.91		761.57	762.91		762.16	762.91	
Pershing Ave	421	A	756.38	763.58		757.27	763.58		758.37	763.58		759.32	763.58		760.52	763.58		761.57	763.58		762.16	763.58	
Pershing Ave	423	A	756.38	762.03		757.27	762.03		758.37	762.03		759.32	762.03		760.52	762.03		761.57	762.03		762.16	762.03	0.13
Pershing Ave	427	A	756.38			757.27			758.37			759.32			760.52			761.57			762.16		

Note: Storage area needs to overtop an elevation of 764 before this home will be affected.

East Pershing/Elm Area - Proposed Alternative 1 Damaged Structures

			1-year			2-year			5-year			10-year			25-year			50-year			100-year		
Street	Number	Problem Area ID	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation
Pershing Ave	802	D	758.66	762.25		759.26	762.25		759.34	762.25		759.38	762.25		759.43	762.25		759.47	762.25		759.51	762.25	
Pershing Ave	810	D	750.43	760.92		750.89	760.92		752.08	760.92		753.79	760.92		756.74	760.92		757.73	760.92		758.45	760.92	
Pershing Ave	816	D	750.43	762.46		750.89	762.46		752.08	762.46		753.79	762.46		756.74	762.46		757.73	762.46		758.45	762.46	
Pershing Ave	824	D	750.43	764.43		750.89	764.43		752.08	764.43		753.79	764.43		756.74	764.43		757.73	764.43		758.45	764.43	
S President St	903	E	750.59	759.67		751.14	759.67		752.23	759.67		753.82	759.67		756.50	759.67		757.35	759.67		758.03	759.67	
Pershing Ave	1006	E	750.59	758.84		751.14	758.84		752.23	758.84		753.82	758.84		756.50	758.84		757.35	758.84		758.03	758.84	
Pershing Ave	1010	E	750.59	758.80		751.14	758.80		752.23	758.80		753.82	758.80		756.50	758.80		757.35	758.80		758.03	758.80	
Pershing Ave	1014	E	750.59	759.73		751.14	759.73		752.23	759.73		753.82	759.73		756.50	759.73		757.35	759.73		758.03	759.73	
Pershing Ave	1018	E	750.59	760.26		751.14	760.26		752.23	760.26		753.82	760.26		756.50	760.26		757.35	760.26		758.03	760.26	
S President St	921	E	750.59	759.00		751.14	759.00		752.23	759.00		753.82	759.00		756.50	759.00		757.35	759.00		758.03	759.00	
S President St	1003	E	750.59	761.41		751.14	761.41		752.23	761.41		753.82	761.41		756.50	761.41		757.35	761.41		758.03	761.41	
Wilson Ave	1006	E	750.59	758.02		751.14	758.02		752.23	758.02		753.82	758.02		756.50	758.02		757.35	758.02		758.03	758.02	0.01
Wilson Ave	1018	E	750.59	759.47		751.14	759.47		752.23	759.47		753.82	759.47		756.50	759.47		757.35	759.47		758.03	759.47	
Wilson Ave	1007	E	750.59	758.72		751.14	758.72		752.23	758.72		753.82	758.72		756.50	758.72		757.35	758.72		758.03	758.72	
Wilson Ave	1011	E	750.59	760.70		751.14	760.70		752.23	760.70		753.82	760.70		756.50	760.70		757.35	760.70		758.03	760.70	
Wilson Ave	1015	E	750.59	760.81		751.14	760.81		752.23	760.81		753.82	760.81		756.50	760.81		757.35	760.81		758.03	760.81	
Wilson Ave	1019	E	750.59	760.40		751.14	760.40		752.23	760.40		753.82	760.40		756.50	760.40		757.35	760.40		758.03	760.40	
S President St	815	E	750.59	759.32		751.14	759.32		752.23	759.32		753.82	759.32		756.50	759.32		757.35	759.32		758.03	759.32	
S President St	914	D	750.43	758.57		750.89	758.57		752.08	758.57		753.79	758.57		756.74	758.57		757.73	758.57		758.45	758.57	
S President St	920	D	750.43	758.70		750.89	758.70		752.08	758.70		753.79	758.70		756.74	758.70		757.73	758.70		758.45	758.70	
S President St	926	D	750.43	759.35		750.89	759.35		752.08	759.35		753.79	759.35		756.74	759.35		757.73	759.35		758.45	759.35	
S President St	1002	D	750.43	759.91		750.89	759.91		752.08	759.91		753.79	759.91		756.74	759.91		757.73	759.91		758.45	759.91	
Pershing Ave	1011	E	750.59	758.92		751.14	758.92		752.23	758.92		753.82	758.92		756.50	758.92		757.35	758.92		758.03	758.92	
Pershing Ave	1015	E	750.59	759.97		751.14	759.97		752.23	759.97		753.82	759.97		756.50	759.97		757.35	759.97		758.03	759.97	
Pershing Ave	1019	E	750.59	759.51		751.14	759.51		752.23	759.51		753.82	759.51		756.50	759.51		757.35	759.51		758.03	759.51	
Pershing Ave	1107	F	751.48	760.33		751.85	760.33		752.59	760.33		753.52	760.33		755.86	760.33		757.51	760.33		758.24	760.33	
Pershing Ave	1111	F	751.48	758.52		751.85	758.52		752.59	758.52		753.52	758.52		755.86	758.52		757.51	758.52		758.24	758.52	
Pershing Ave	1115	F	751.48	758.26		751.85	758.26		752.59	758.26		753.52	758.26		755.86	758.26		757.51	758.26		758.24	758.26	
Pershing Ave	1215	F	751.48	758.74		751.85	758.74		752.59	758.74		753.52	758.74		755.86	758.74		757.51	758.74		758.24	758.74	
Pershing Ave	1219	F	751.48	760.04		751.85	760.04		752.59	760.04		753.52	760.04		755.86	760.04		757.51	760.04		758.24	760.04	
Pershing Ave	1020	F	751.48	760.54		751.85	760.54		752.59	760.54		753.52	760.54		755.86	760.54		757.51	760.54		758.24	760.54	
Pershing Ave	1102	F	751.48	759.57		751.85	759.57		752.59	759.57		753.52	759.57		755.86	759.57		757.51	759.57		758.24	759.57	
Pershing Ave	1106	F	751.48	759.80		751.85	759.80		752.59	759.80		753.52	759.80		755.86	759.80		757.51	759.80		758.24	759.80	
Pershing Ave	1108	F	751.48	760.60		751.85	760.60		752.59	760.60		753.52	760.60		755.86	760.60		757.51	760.60		758.24	760.60	
Williston St	902	F	751.48	760.59		751.85	760.59		752.59	760.59		753.52	760.59		755.86	760.59		757.51	760.59		758.24	760.59	
Williston St	903	F	751.48	759.73		751.85	759.73		752.59	759.73		753.52	759.73		755.86	759.73		757.51	759.73		758.24	759.73	
Pershing Ave	1206	F	751.48	759.72		751.85	759.72		752.59	759.72		753.52	759.72		755.86	759.72		757.51	759.72		758.24	759.72	
Pershing Ave	1210	F	751.48	760.86		751.85	760.86		752.59	760.86		753.52	760.86		755.86	760.86		757.51	760.86		758.24	760.86	
Pershing Ave	1214	F	751.48	759.50		751.85	759.50		752.59	759.50		753.52	759.50		755.86	759.50		757.51	759.50		758.24	759.50	
Pershing Ave	1218	F	751.48	758.27		751.85	758.27		752.59	758.27		753.52	758.27		755.86	758.27		757.51	758.27		758.24	758.27	
Pershing Ave	1222	F	751.48	759.09		751.85	759.09		752.59	759.09		753.52	759.09		755.86	759.09		757.51	759.09		758.24	759.09	
Pershing Ave	1302	F	751.48	759.01		751.85	759.01		752.59	759.01		753.52	759.01		755.86	759.01		757.51	759.01		758.24	759.01	
Pershing Ave	1304	F	751.48	758.96		751.85	758.96		752.59	758.96		753.52	758.96		755.86	758.96		757.51	758.96		758.24	758.96	
Pershing Ave	1308	F	751.48	759.24		751.85	759.24		752.59	759.24		753.52	759.24		755.86	759.24		757.51	759.24		758.24	759.24	
Pershing Ave	1312	F	751.48	1000.00		751.85	1000.00		752.59	1000.00		753.52	1000.00		755.86	1000.00		757.51	1000.00		758.24	1000.00	
Pershing Ave	1316	F	751.48	759.39		751.85	759.39		752.59	759.39		753.52	759.39		755.86	759.39		757.51	759.39		758.24	759.39	
Blanchard St	904	F	751.48	759.13		751.85	759.13		752.59	759.13		753.52	759.13		755.86	759.13		757.51	759.13		758.24	759.13	
Pershing Ave	1303	F	751.48	760.90		751.85	760.90		752.59	760.90		753.52	760.90		755.86	760.90		757.51	760.90		758.24	760.90	
Pershing Ave	1307	F	751.48	759.89		751.85	759.89		752.59	759.89		753.52	759.89		755.86	759.89		757.51	759.89		758.24	759.89	
Pershing Ave	1311	F	751.48	761.11		751.85	761.11		752.59	761.11		753.52	761.11		755.86	761.11		757.51	761.11		758.24	761.11	
Pershing Ave	1315	F	751.48	759.79		751.85	759.79		752.59	759.79		753.52	759.79		755.86	759.79		757.51	759.79		758.24	759.79	
Pershing Ave	1319	F	751.48	759.52		751.85	759.52		752.59	759.52		753.52	759.52		755.86	759.52		757.51	759.52		758.24	759.52	
Blanchard St	816	F	751.48	759.89		751.85	759.89		752.59	759.89		753.52	759.89		755.86	759.89		757.51	759.89		758.24	759.89	

East Pershing/Elm Area - Proposed Alternative 1 Damaged Structures

			1-year			2-year			5-year			10-year			25-year			50-year			100-year		
Street	Number	Problem Area ID	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation
Blanchard St	924	G	750.73	760.34		751.11	760.34		751.75	760.34		752.30	760.34		753.49	760.34		754.59	760.34		755.58	760.34	
Blanchard St	1003	G	750.73	759.50		751.11	759.50		751.75	759.50		752.30	759.50		753.49	759.50		754.59	759.50		755.58	759.50	
Blanchard St	903	F	751.48	759.91		751.85	759.91		752.59	759.91		753.52	759.91		755.86	759.91		757.51	759.91		758.24	759.91	
S Williston St	824	F	751.48	758.24		751.85	758.24		752.59	758.24		753.52	758.24		755.86	758.24		757.51	758.24		758.24	758.24	0.00
Pershing Ave	1119	F	751.48	757.56		751.85	757.56		752.59	757.56		753.52	757.56		755.86	757.56		757.51	757.56		758.24	757.56	0.68
S Blanchard St	923	G	750.73	758.32		751.11	758.32		751.75	758.32		752.30	758.32		753.49	758.32		754.59	758.32		755.58	758.32	
Wilson Ave	1305	G	750.73	758.83		751.11	758.83		751.75	758.83		752.30	758.83		753.49	758.83		754.59	758.83		755.58	758.83	
Wilson Ave	1313	G	750.73	759.86		751.11	759.86		751.75	759.86		752.30	759.86		753.49	759.86		754.59	759.86		755.58	759.86	
Wilson Ave	1317	G	750.73	758.55		751.11	758.55		751.75	758.55		752.30	758.55		753.49	758.55		754.59	758.55		755.58	758.55	
Wilson Ave	1407	G	750.73	757.41		751.11	757.41		751.75	757.41		752.30	757.41		753.49	757.41		754.59	757.41		755.58	757.41	
Wilson Ave	1411	G	750.73	759.30		751.11	759.30		751.75	759.30		752.30	759.30		753.49	759.30		754.59	759.30		755.58	759.30	
Wilson Ave	1419	G	750.73	759.52		751.11	759.52		751.75	759.52		752.30	759.52		753.49	759.52		754.59	759.52		755.58	759.52	
Wilson Ave	1505	G	750.73	758.19		751.11	758.19		751.75	758.19		752.30	758.19		753.49	758.19		754.59	758.19		755.58	758.19	
Wilson Ave	1504	G	750.73	757.90		751.11	757.90		751.75	757.90		752.30	757.90		753.49	757.90		754.59	757.90		755.58	757.90	
Wilson Ave	1500	G	750.73	758.08		751.11	758.08		751.75	758.08		752.30	758.08		753.49	758.08		754.59	758.08		755.58	758.08	
Wilson Ave	1512	G	750.73	757.74		751.11	757.74		751.75	757.74		752.30	757.74		753.49	757.74		754.59	757.74		755.58	757.74	
Wilson Ave	1513	G	750.73	757.80		751.11	757.80		751.75	757.80		752.30	757.80		753.49	757.80		754.59	757.80		755.58	757.80	
Wilson Ave	1312	G	750.73	758.48		751.11	758.48		751.75	758.48		752.30	758.48		753.49	758.48		754.59	758.48		755.58	758.48	
Wilson Ave	1410	G	750.73	757.77		751.11	757.77		751.75	757.77		752.30	757.77		753.49	757.77		754.59	757.77		755.58	757.77	
Elm St	1509	H	748.75	757.56		748.96	757.56		749.26	757.56		749.54	757.56		750.30	757.56		751.34	757.56		752.48	757.56	
Elm St	1513	H	748.75	757.08		748.96	757.08		749.26	757.08		749.54	757.08		750.30	757.08		751.34	757.08		752.48	757.08	
Elm St	1517	H	748.75	756.63		748.96	756.63		749.26	756.63		749.54	756.63		750.30	756.63		751.34	756.63		752.48	756.63	
Prospect St	1020	H	748.75	757.16		748.96	757.16		749.26	757.16		749.54	757.16		750.30	757.16		751.34	757.16		752.48	757.16	
Elm St	1504	H	748.75	755.88		748.96	755.88		749.26	755.88		749.54	755.88		750.30	755.88		751.34	755.88		752.48	755.88	
Elm St	1508	H	748.75	756.79		748.96	756.79		749.26	756.79		749.54	756.79		750.30	756.79		751.34	756.79		752.48	756.79	
Elm St	1512	H	748.75	757.73		748.96	757.73		749.26	757.73		749.54	757.73		750.30	757.73		751.34	757.73		752.48	757.73	
Elm St	1516	H	748.75	755.23		748.96	755.23		749.26	755.23		749.54	755.23		750.30	755.23		751.34	755.23		752.48	755.23	
Elm St	1520	H	748.75	756.63		748.96	756.63		749.26	756.63		749.54	756.63		750.30	756.63		751.34	756.63		752.48	756.63	
Taft Ave	1018	F	751.48	764.03		751.85	764.03		752.59	764.03		753.52	764.03		755.86	764.03		757.51	764.03		758.24	764.03	
Taft Ave	1102	F	751.48	759.85		751.85	759.85		752.59	759.85		753.52	759.85		755.86	759.85		757.51	759.85		758.24	759.85	
Taft Ave	1106	F	751.48	759.13		751.85	759.13		752.59	759.13		753.52	759.13		755.86	759.13		757.51	759.13		758.24	759.13	
Taft Ave	1110	F	751.48	760.40		751.85	760.40		752.59	760.40		753.52	760.40		755.86	760.40		757.51	760.40		758.24	760.40	
Taft Ave	1114	F	751.48	760.80		751.85	760.80		752.59	760.80		753.52	760.80		755.86	760.80		757.51	760.80		758.24	760.80	
Taft Ave	1118	F	751.48	761.70		751.85	761.70		752.59	761.70		753.52	761.70		755.86	761.70		757.51	761.70		758.24	761.70	
Taft Ave	1122	F	751.48	760.22		751.85	760.22		752.59	760.22		753.52	760.22		755.86	760.22		757.51	760.22		758.24	760.22	
Pershing Ave	1207	F	751.48	760.30		751.85	760.30		752.59	760.30		753.52	760.30		755.86	760.30		757.51	760.30		758.24	760.30	
Wilson Ave	1508	G	750.73	760.49		751.11	760.49		751.75	760.49		752.30	760.49		753.49	760.49		754.59	760.49		755.58	760.49	
Wilson Ave	1516	G	750.73	760.09		751.11	760.09		751.75	760.09		752.30	760.09		753.49	760.09		754.59	760.09		755.58	760.09	
Prospect St	1103	H	748.75	757.05		748.96	757.05		749.26	757.05		749.54	757.05		750.30	757.05		751.34	757.05		752.48	757.05	
Prospect St	1119	H	748.75	757.00		748.96	757.00		749.26	757.00		749.54	757.00		750.30	757.00		751.34	757.00		752.48	757.00	

East Pershing/Elm Area - Proposed Alternative 2 Damaged Structures

			1-year			2-year			5-year			10-year			25-year			50-year			100-year		
Street	Number	Problem Area ID	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation
Pershing Ave	802	D	758.64	762.25		759.26	762.25		759.34	762.25		759.38	762.25		759.43	762.25		759.47	762.25		759.51	762.25	
Pershing Ave	810	D	750.28	760.92		751.12	760.92		752.60	760.92		754.00	760.92		755.36	760.92		756.44	760.92		757.55	760.92	
Pershing Ave	816	D	750.28	762.46		751.12	762.46		752.60	762.46		754.00	762.46		755.36	762.46		756.44	762.46		757.55	762.46	
Pershing Ave	824	D	750.28	764.43		751.12	764.43		752.60	764.43		754.00	764.43		755.36	764.43		756.44	764.43		757.55	764.43	
S President St	903	E	751.40	759.67		752.10	759.67		753.14	759.67		754.14	759.67		755.68	759.67		756.57	759.67		757.54	759.67	
Pershing Ave	1006	E	751.40	758.84		752.10	758.84		753.14	758.84		754.14	758.84		755.68	758.84		756.57	758.84		757.54	758.84	
Pershing Ave	1010	E	751.40	758.80		752.10	758.80		753.14	758.80		754.14	758.80		755.68	758.80		756.57	758.80		757.54	758.80	
Pershing Ave	1014	E	751.40	759.73		752.10	759.73		753.14	759.73		754.14	759.73		755.68	759.73		756.57	759.73		757.54	759.73	
Pershing Ave	1018	E	751.40	760.26		752.10	760.26		753.14	760.26		754.14	760.26		755.68	760.26		756.57	760.26		757.54	760.26	
S President St	921	E	751.40	759.00		752.10	759.00		753.14	759.00		754.14	759.00		755.68	759.00		756.57	759.00		757.54	759.00	
S President St	1003	E	751.40	761.41		752.10	761.41		753.14	761.41		754.14	761.41		755.68	761.41		756.57	761.41		757.54	761.41	
Wilson Ave	1006	E	751.40	758.02		752.10	758.02		753.14	758.02		754.14	758.02		755.68	758.02		756.57	758.02		757.54	758.02	
Wilson Ave	1018	E	751.40	759.47		752.10	759.47		753.14	759.47		754.14	759.47		755.68	759.47		756.57	759.47		757.54	759.47	
Wilson Ave	1007	E	751.40	758.72		752.10	758.72		753.14	758.72		754.14	758.72		755.68	758.72		756.57	758.72		757.54	758.72	
Wilson Ave	1011	E	751.40	760.70		752.10	760.70		753.14	760.70		754.14	760.70		755.68	760.70		756.57	760.70		757.54	760.70	
Wilson Ave	1015	E	751.40	760.81		752.10	760.81		753.14	760.81		754.14	760.81		755.68	760.81		756.57	760.81		757.54	760.81	
Wilson Ave	1019	E	751.40	760.40		752.10	760.40		753.14	760.40		754.14	760.40		755.68	760.40		756.57	760.40		757.54	760.40	
S President St	815	E	751.40	759.32		752.10	759.32		753.14	759.32		754.14	759.32		755.68	759.32		756.57	759.32		757.54	759.32	
S President St	914	D	750.28	758.57		751.12	758.57		752.60	758.57		754.00	758.57		755.36	758.57		756.44	758.57		757.55	758.57	
S President St	920	D	750.28	758.70		751.12	758.70		752.60	758.70		754.00	758.70		755.36	758.70		756.44	758.70		757.55	758.70	
S President St	926	D	750.28	759.35		751.12	759.35		752.60	759.35		754.00	759.35		755.36	759.35		756.44	759.35		757.55	759.35	
S President St	1002	D	750.28	759.91		751.12	759.91		752.60	759.91		754.00	759.91		755.36	759.91		756.44	759.91		757.55	759.91	
Pershing Ave	1011	E	751.40	758.92		752.10	758.92		753.14	758.92		754.14	758.92		755.68	758.92		756.57	758.92		757.54	758.92	
Pershing Ave	1015	E	751.40	759.97		752.10	759.97		753.14	759.97		754.14	759.97		755.68	759.97		756.57	759.97		757.54	759.97	
Pershing Ave	1019	E	751.40	759.51		752.10	759.51		753.14	759.51		754.14	759.51		755.68	759.51		756.57	759.51		757.54	759.51	
Pershing Ave	1107	F	752.78	760.33		753.15	760.33		753.78	760.33		754.56	760.33		756.22	760.33		757.34	760.33		757.92	760.33	
Pershing Ave	1111	F	752.78	758.52		753.15	758.52		753.78	758.52		754.56	758.52		756.22	758.52		757.34	758.52		757.92	758.52	
Pershing Ave	1115	F	752.78	758.26		753.15	758.26		753.78	758.26		754.56	758.26		756.22	758.26		757.34	758.26		757.92	758.26	
Pershing Ave	1215	F	752.78	758.74		753.15	758.74		753.78	758.74		754.56	758.74		756.22	758.74		757.34	758.74		757.92	758.74	
Pershing Ave	1219	F	752.78	760.04		753.15	760.04		753.78	760.04		754.56	760.04		756.22	760.04		757.34	760.04		757.92	760.04	
Pershing Ave	1020	F	752.78	760.54		753.15	760.54		753.78	760.54		754.56	760.54		756.22	760.54		757.34	760.54		757.92	760.54	
Pershing Ave	1102	F	752.78	759.57		753.15	759.57		753.78	759.57		754.56	759.57		756.22	759.57		757.34	759.57		757.92	759.57	
Pershing Ave	1106	F	752.78	759.80		753.15	759.80		753.78	759.80		754.56	759.80		756.22	759.80		757.34	759.80		757.92	759.80	
Pershing Ave	1108	F	752.78	760.60		753.15	760.60		753.78	760.60		754.56	760.60		756.22	760.60		757.34	760.60		757.92	760.60	
Williston St	902	F	752.78	760.59		753.15	760.59		753.78	760.59		754.56	760.59		756.22	760.59		757.34	760.59		757.92	760.59	
Williston St	903	F	752.78	759.73		753.15	759.73		753.78	759.73		754.56	759.73		756.22	759.73		757.34	759.73		757.92	759.73	
Pershing Ave	1206	F	752.78	759.72		753.15	759.72		753.78	759.72		754.56	759.72		756.22	759.72		757.34	759.72		757.92	759.72	
Pershing Ave	1210	F	752.78	760.86		753.15	760.86		753.78	760.86		754.56	760.86		756.22	760.86		757.34	760.86		757.92	760.86	
Pershing Ave	1214	F	752.78	759.50		753.15	759.50		753.78	759.50		754.56	759.50		756.22	759.50		757.34	759.50		757.92	759.50	
Pershing Ave	1218	F	752.78	758.27		753.15	758.27		753.78	758.27		754.56	758.27		756.22	758.27		757.34	758.27		757.92	758.27	
Pershing Ave	1222	F	752.78	759.09		753.15	759.09		753.78	759.09		754.56	759.09		756.22	759.09		757.34	759.09		757.92	759.09	
Pershing Ave	1302	F	752.78	759.01		753.15	759.01		753.78	759.01		754.56	759.01		756.22	759.01		757.34	759.01		757.92	759.01	
Pershing Ave	1304	F	752.78	758.96		753.15	758.96		753.78	758.96		754.56	758.96		756.22	758.96		757.34	758.96		757.92	758.96	
Pershing Ave	1308	F	752.78	759.24		753.15	759.24		753.78	759.24		754.56	759.24		756.22	759.24		757.34	759.24		757.92	759.24	
Pershing Ave	1312	F	752.78	1000.00		753.15	1000.00		753.78	1000.00		754.56	1000.00		756.22	1000.00		757.34	1000.00		757.92	1000.00	
Pershing Ave	1316	F	752.78	759.39		753.15	759.39		753.78	759.39		754.56	759.39		756.22	759.39		757.34	759.39		757.92	759.39	
Blanchard St	904	F	752.78	759.13		753.15	759.13		753.78	759.13		754.56	759.13		756.22	759.13		757.34	759.13		757.92	759.13	
Pershing Ave	1303	F	752.78	760.90		753.15	760.90		753.78	760.90		754.56	760.90		756.22	760.90		757.34	760.90		757.92	760.90	
Pershing Ave	1307	F	752.78	759.89		753.15	759.89		753.78	759.89		754.56	759.89		756.22	759.89		757.34	759.89		757.92	759.89	
Pershing Ave	1311	F	752.78	761.11		753.15	761.11		753.78	761.11		754.56	761.11		756.22	761.11		757.34	761.11		757.92	761.11	
Pershing Ave	1315	F	752.78	759.79		753.15	759.79		753.78	759.79		754.56	759.79		756.22	759.79		757.34	759.79		757.92	759.79	
Pershing Ave	1319	F	752.78	759.52		753.15	759.52		753.78	759.52		754.56	759.52		756.22	759.52		757.34	759.52		757.92	759.52	
Blanchard St	816	F	752.78	759.89		753.15	759.89		753.78	759.89		754.56	759.89		756.22	759.89		757.34	759.89		757.92	759.89	

East Pershing/Elm Area - Proposed Alternative 2 Damaged Structures

			1-year			2-year			5-year			10-year			25-year			50-year			100-year		
Street	Number	Problem Area ID	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation	High Water Level	Low Entry Elevation	Depth of Water Above Critical Elevation
Blanchard St	924	G	754.12	760.34		756.52	760.34		757.29	760.34		757.65	760.34		757.65	760.34		757.75	760.34		757.86	760.34	
Blanchard St	1003	G	754.12	759.50		756.52	759.50		757.29	759.50		757.65	759.50		757.65	759.50		757.75	759.50		757.86	759.50	
Blanchard St	903	F	752.78	759.91		753.15	759.91		753.78	759.91		754.56	759.91		756.22	759.91		757.34	759.91		757.92	759.91	
S Williston St	824	F	752.78	758.24		753.15	758.24		753.78	758.24		754.56	758.24		756.22	758.24		757.34	758.24		757.92	758.24	
Pershing Ave	1119	F	752.78	757.56		753.15	757.56		753.78	757.56		754.56	757.56		756.22	757.56		757.34	757.56		757.92	757.56	0.36
S Blanchard St	923	G	754.12	758.32		756.52	758.32		757.29	758.32		757.65	758.32		757.65	758.32		757.75	758.32		757.86	758.32	
Wilson Ave	1305	G	754.12	758.83		756.52	758.83		757.29	758.83		757.65	758.83		757.65	758.83		757.75	758.83		757.86	758.83	
Wilson Ave	1313	G	754.12	759.86		756.52	759.86		757.29	759.86		757.65	759.86		757.65	759.86		757.75	759.86		757.86	759.86	
Wilson Ave	1317	G	754.12	758.55		756.52	758.55		757.29	758.55		757.65	758.55		757.65	758.55		757.75	758.55		757.86	758.55	
Wilson Ave	1407	G	754.12	757.41		756.52	757.41		757.29	757.41		757.65	757.41	0.24	757.65	757.41	0.24	757.75	757.41	0.34	757.86	757.41	0.45
Wilson Ave	1411	G	754.12	759.30		756.52	759.30		757.29	759.30		757.65	759.30		757.65	759.30		757.75	759.30		757.86	759.30	
Wilson Ave	1419	G	754.12	759.52		756.52	759.52		757.29	759.52		757.65	759.52		757.65	759.52		757.75	759.52		757.86	759.52	
Wilson Ave	1505	G	754.12	758.19		756.52	758.19		757.29	758.19		757.65	758.19		757.65	758.19		757.75	758.19		757.86	758.19	
Wilson Ave	1504	G	754.12	757.90		756.52	757.90		757.29	757.90		757.65	757.90		757.65	757.90		757.75	757.90		757.86	757.90	
Wilson Ave	1500	G	754.12	758.08		756.52	758.08		757.29	758.08		757.65	758.08		757.65	758.08		757.75	758.08		757.86	758.08	
Wilson Ave	1512	G	754.12	757.74		756.52	757.74		757.29	757.74		757.65	757.74		757.65	757.74		757.75	757.74	0.01	757.86	757.74	0.12
Wilson Ave	1513	G	754.12	757.80		756.52	757.80		757.29	757.80		757.65	757.80		757.65	757.80		757.75	757.80		757.86	757.80	0.06
Wilson Ave	1312	G	754.12	758.48		756.52	758.48		757.29	758.48		757.65	758.48		757.65	758.48		757.75	758.48		757.86	758.48	
Wilson Ave	1410	G	754.12	757.77		756.52	757.77		757.29	757.77		757.65	757.77		757.65	757.77		757.75	757.77		757.86	757.77	0.09
Elm St	1509	H	749.41	757.56		750.37	757.56		752.73	757.56		754.22	757.56		755.41	757.56		755.71	757.56		755.87	757.56	
Elm St	1513	H	749.41	757.08		750.37	757.08		752.73	757.08		754.22	757.08		755.41	757.08		755.71	757.08		755.87	757.08	
Elm St	1517	H	749.41	756.63		750.37	756.63		752.73	756.63		754.22	756.63		755.41	756.63		755.71	756.63		755.87	756.63	
Prospect St	1020	H	749.41	757.16		750.37	757.16		752.73	757.16		754.22	757.16		755.41	757.16		755.71	757.16		755.87	757.16	
Elm St	1504	H	749.41	755.88		750.37	755.88		752.73	755.88		754.22	755.88		755.41	755.88		755.71	755.88		755.87	755.88	
Elm St	1508	H	749.41	756.79		750.37	756.79		752.73	756.79		754.22	756.79		755.41	756.79		755.71	756.79		755.87	756.79	
Elm St	1512	H	749.41	757.73		750.37	757.73		752.73	757.73		754.22	757.73		755.41	757.73		755.71	757.73		755.87	757.73	
Elm St	1516	H	749.41	755.23		750.37	755.23		752.73	755.23		754.22	755.23		755.41	755.23	0.18	755.71	755.23	0.48	755.87	755.23	0.64
Elm St	1520	H	749.41	756.63		750.37	756.63		752.73	756.63		754.22	756.63		755.41	756.63		755.71	756.63		755.87	756.63	
Taft Ave	1018	F	752.78	764.03		753.15	764.03		753.78	764.03		754.56	764.03		756.22	764.03		757.34	764.03		757.92	764.03	
Taft Ave	1102	F	752.78	759.85		753.15	759.85		753.78	759.85		754.56	759.85		756.22	759.85		757.34	759.85		757.92	759.85	
Taft Ave	1106	F	752.78	759.13		753.15	759.13		753.78	759.13		754.56	759.13		756.22	759.13		757.34	759.13		757.92	759.13	
Taft Ave	1110	F	752.78	760.40		753.15	760.40		753.78	760.40		754.56	760.40		756.22	760.40		757.34	760.40		757.92	760.40	
Taft Ave	1114	F	752.78	760.80		753.15	760.80		753.78	760.80		754.56	760.80		756.22	760.80		757.34	760.80		757.92	760.80	
Taft Ave	1118	F	752.78	761.70		753.15	761.70		753.78	761.70		754.56	761.70		756.22	761.70		757.34	761.70		757.92	761.70	
Taft Ave	1122	F	752.78	760.22		753.15	760.22		753.78	760.22		754.56	760.22		756.22	760.22		757.34	760.22		757.92	760.22	
Pershing Ave	1207	F	752.78	760.30		753.15	760.30		753.78	760.30		754.56	760.30		756.22	760.30		757.34	760.30		757.92	760.30	
Wilson Ave	1508	G	754.12	760.49		756.52	760.49		757.29	760.49		757.65	760.49		757.65	760.49		757.75	760.49		757.86	760.49	
Wilson Ave	1516	G	754.12	760.09		756.52	760.09		757.29	760.09		757.65	760.09		757.65	760.09		757.75	760.09		757.86	760.09	
Prospect St	1103	H	749.41	757.05		750.37	757.05		752.73	757.05		754.22	757.05		755.41	757.05		755.71	757.05		755.87	757.05	
Prospect St	1119	H	749.41	757.00		750.37	757.00		752.73	757.00		754.22	757.00		755.41	757.00		755.71	757.00		755.87	757.00	

West Pershing/Elm Area - Structure Floodproofing for the 100-year Storm Event

Street	Number	Low Entry Elevation	Existing Depth of Water Above Critical Elevation	Proposed Alt 2 Depth of Water Above Critical Elevation	Location of Low Entry	Potential Floodproofing Remedy	Cost	Total Structure Cost
Pershing Ave	504	762.71	0.46		Window/Well	Raised Window Wells	$2,000	$8,000
Pershing Ave	504	762.94	0.23		Window/Well	Raised Window Wells	$2,000	
Pershing Ave	504	763.04	0.13		Window/Well	Raised Window Wells	$2,000	
Pershing Ave	504	763	0.17		Window/Well	Raised Window Wells	$2,000	
Pershing Ave	508	762.71	0.46		Window/Well	Raised Window Wells	$2,000	$8,000
Pershing Ave	508	762.8	0.37		Window/Well	Raised Window Wells	$2,000	
Pershing Ave	508	762.79	0.38		Window/Well	Raised Window Wells	$2,000	
Pershing Ave	508	762.81	0.36		Window/Well	Raised Window Wells	$2,000	
Pershing Ave	512	761.51	1.66	1.04	Foundation	Additional Drainage Improvements*	$100,000	$103,000
Pershing Ave	512	762.47	0.70	0.08	Door	Removable Flood Shield (for door)	$3,000	
E Elm St	610	764.32	0.36		Window/Well	Raised Window Wells	$2,000	$8,000
E Elm St	610	764.32	0.36		Window/Well	Raised Window Wells	$2,000	
E Elm St	610	764.32	0.36		Window/Well	Raised Window Wells	$2,000	
E Elm St	610	764.32	0.36		Window/Well	Raised Window Wells	$2,000	
E Elm St	624	763.22	1.46		Window/Well	Raised Window Wells	$2,000	$110,000
E Elm St	624	763.62	1.06		Foundation	Additional Drainage Improvements*	$100,000	
E Elm St	624	762.97	1.71		Window/Well	Raised Window Wells	$2,000	
E Elm St	624	762.97	1.71		Window/Well	Raised Window Wells	$2,000	
E Elm St	624	763.22	1.46		Window/Well	Raised Window Wells	$2,000	
Pershing Ave	624	762.45	1.71		Window/Well	Raised Window Wells	$2,000	$102,000
Pershing Ave	624	763.72	0.44		Foundation	Additional Drainage Improvements*	$100,000	
Pershing Ave	423	762.03	0.65	0.13	Window/Well	Raised Window Wells	$2,000	$2,000
							TOTAL	**$341,000**

Table C9 for appendix

East Pershing/Elm Area - Structure Floodproofing for the 100-year Storm Event

Street	Number	Low Entry Elevation	Existing Depth of 100-yr Flood Above Low Entry	Proposed Alt 1 Depth of 100-yr Flood Above Low Entry	Proposed Alt 2 Depth of 100-yr Flood Above Low Entry	Location of Low Entry	Potential Floodproofing Remedy	Cost	Total Structure Cost
Blanchard St	904	759.13	0.22			Foundation	Elevate Structure	$140,000	$140,000
Elm St	1504	755.88	0.16			Garage	Driveway Berm	$10,560	$10,560
Elm St	1516	755.23	0.81		0.64	Garage	Driveway Berm	$10,560	$10,560
Pershing Ave	1006	758.84	0.94			Window/Well	Raised Window Wells	$2,000	$6,000
Pershing Ave	1006	759.45	0.33			Window/Well	Raised Window Wells	$2,000	
Pershing Ave	1006	759.45	0.33			Window/Well	Raised Window Wells	$2,000	
Pershing Ave	1010	758.80	0.98			Window/Well	Raised Window Wells	$2,000	$10,000
Pershing Ave	1010	758.83	0.95			Window/Well	Raised Window Wells	$2,000	
Pershing Ave	1010	758.7	1.08			Window/Well	Raised Window Wells	$2,000	
Pershing Ave	1010	758.7	1.08			Window/Well	Raised Window Wells	$2,000	
Pershing Ave	1010	758.7	1.08			Window/Well	Raised Window Wells	$2,000	
Pershing Ave	1011	758.92	0.86			Window/Well	Raised Window Wells	$2,000	$102,000
Pershing Ave	1011	759.12	0.66			Foundation	Additional Drainage Improvements*	$100,000	
Pershing Ave	1014	759.73	0.05			Window/Well	Raised Window Wells	$2,000	$2,000
Pershing Ave	1019	759.51	0.27			Garage	Driveway Berm	$10,560	$10,560
Pershing Ave	1111	758.52	0.83			Window/Well	Raised Window Wells	$2,000	$2,000
Pershing Ave	1115	758.26	1.09			Window/Well	Raised Window Wells	$2,000	$4,000
Pershing Ave	1115	759.11	0.24			Window/Well	Raised Window Wells	$2,000	
Pershing Ave	1119	757.56	1.79	0.68	0.36	Window/Well	Raised Window Wells	$2,000	$2,000
Pershing Ave	1215	758.74	0.61			Window/Well	Raised Window Wells	$2,000	$2,000
Pershing Ave	1218	758.27	1.08			Door	Removable Flood Shield (for door)	$3,000	$103,000
Pershing Ave	1218	759.12	0.23			Foundation	Additional Drainage Improvements*	$100,000	
Pershing Ave	1222	759.09	0.26			Foundation	Elevate Structure	$140,000	$140,000
Pershing Ave	1302	759.01	0.34			Window/Well	Raised Window Wells	$2,000	$2,000
Pershing Ave	1304	758.96	0.39			Window/Well	Raised Window Wells	$2,000	$2,000
Pershing Ave	1308	759.24	0.11			Foundation	Elevate Structure	$140,000	$140,000
S President St	815	759.32	0.46			Window/Well	Raised Window Wells	$2,000	$10,000
S President St	815	759.32	0.46			Window/Well	Raised Window Wells	$2,000	
S President St	815	759.32	0.46			Window/Well	Raised Window Wells	$2,000	
S President St	815	759.32	0.46			Window/Well	Raised Window Wells	$2,000	
S President St	815	759.34	0.44			Window/Well	Raised Window Wells	$2,000	
S President St	903	759.67	0.11			Window/Well	Raised Window Wells	$2,000	$10,000
S President St	903	759.67	0.11			Window/Well	Raised Window Wells	$2,000	
S President St	903	759.67	0.11			Window/Well	Raised Window Wells	$2,000	
S President St	903	759.67	0.11			Window/Well	Raised Window Wells	$2,000	
S President St	903	759.67	0.11			Window/Well	Raised Window Wells	$2,000	
S President St	914	758.57	1.24			Window/Well	Raised Window Wells	$2,000	$2,000
S President St	920	758.70	1.11			Window/Well	Raised Window Wells	$2,000	$108,000
S President St	920	759.27	0.54			Window/Well	Raised Window Wells	$2,000	
S President St	920	759.27	0.54			Foundation	Additional Drainage Improvements*	$100,000	
S President St	920	759.25	0.56			Window/Well	Raised Window Wells	$2,000	
S President St	920	758.72	1.09			Window/Well	Raised Window Wells	$2,000	
S President St	921	759.00	0.78			Foundation	Additional Drainage Improvements*	$100,000	$108,000
S President St	921	759.2	0.58			Window/Well	Raised Window Wells	$2,000	
S President St	921	759.2	0.58			Lookout	Raised Window Wells	$2,000	
S President St	921	759.2	0.58			Lookout	Raised Window Wells	$2,000	
S President St	921	759.2	0.58			Window/Well	Raised Window Wells	$2,000	
S President St	926	759.35	0.46			Window/Well	Raised Window Wells	$2,000	$10,000
S President St	926	759.35	0.46			Window/Well	Raised Window Wells	$2,000	
S President St	926	759.35	0.46			Window/Well	Raised Window Wells	$2,000	
S President St	926	759.38	0.43			Window/Well	Raised Window Wells	$2,000	
S President St	926	759.35	0.46			Window/Well	Raised Window Wells	$2,000	
S Williston St	824	758.24	1.11	0.00		Door	Removable Flood Shield (for door)	$3,000	$3,000
S Williston St	824	758.34	1.01			Foundation	Additional Drainage Improvements*	$100,000	
Wilson Ave	1006	758.02	1.76	0.01		Garage	Driveway Berm or Removable Flood Shield	$20,000	$20,000

Table C9 for appendix

East Pershing/Elm Area - Structure Floodproofing for the 100-year Storm Event

Street	Number	Low Entry Elevation	Existing Depth of 100-yr Flood Above Low Entry	Proposed Alt 1 Depth of 100-yr Flood Above Low Entry	Proposed Alt 2 Depth of 100-yr Flood Above Low Entry	Location of Low Entry	Potential Floodproofing Remedy	Cost	Total Structure Cost
Wilson Ave	1007	758.72	1.06			Door	Removable Flood Shield (for door)	$3,000	$107,000
Wilson Ave	1007	759.5	0.28			Foundation	Additional Drainage Improvements*	$100,000	
Wilson Ave	1007	759.7	0.08			Lookout	Raised Window Wells	$2,000	
Wilson Ave	1007	759.73	0.05			Lookout	Raised Window Wells	$2,000	
Wilson Ave	1018	759.47	0.31			Garage	Driveway Berm	$10,560	$10,560
Wilson Ave	1407	757.41	0.57		0.45	Door	Removable Flood Shield (for door)	$3,000	$3,000
Wilson Ave	1410	757.77	0.21		0.09	Garage	Driveway Berm	$10,560	$10,560
Wilson Ave	1504	757.90	0.08			Garage	Driveway Berm	$10,560	$10,560
Wilson Ave	1512	757.74	0.24		0.12	Garage	Driveway Berm	$10,560	$10,560
Wilson Ave	1513	757.80	0.18		0.06	Garage	Driveway Berm	$10,560	$10,560
Taft Ave	1106	759.13	0.22			Window/Well	Driveway Berm	$10,560	$10,560
								TOTAL	**$1,133,040**

Appendix D: Floodproofing Alternatives

Floodproofing Alternatives

A variety of floodproofing alternatives exist to provide protection to homes with low entry elevations below the expected water surface elevations. These include grading modifications such as driveway berms or berms/walls around a home; wet floodproofing options such as flow-through vents and utility elevation; dry floodproofing measures such as raised window wells or flood shields at exterior openings; or structural elevation.

A summary of each type of measure is presented in this appendix. It is expected that the following floodproofing measures could provide additional flood protection to a majority of the homes that are shown to have damage elevations below the low-entry elevation, and likely to be the most cost-effective within the study area.

- Driveway berms on reverse-slope driveways;
- Front yard berms where the home is low relative to street and surrounding grade;
- Dry floodproofing by raising window wells or using glass block windows;
- dry floodproofing by placing removable flood shields at a window or door.

A full list of floodproofing options included in this appendix is as follows:

Grading 2

DRIVEWAY BERMS 3
BARRIERS (BERMS/LEVEES/FLOODWALLS) 5

Wet Floodproofing 8

INSTALLING OPENINGS 8
ELEVATING UTILITIES 11

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RAISED WINDOW WELLS 15
GLASS BLOCK BASEMENT WINDOWS 17
CONTINUOUS IMPERMEABLE WALLS 19
FLOODPROOFED CORE INTERIOR AREAS 22
PERMANENT FLOOD SHIELDS FOR EXTERIOR OPENINGS 25
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GRADING

Properties that do not have adequate grading can re-grade their yards. The ground around the perimeter of the building should slope away from the structure to prevent stormwater runoff from ponding against the foundation wall, where it can seep into the building. Some of the advantages and disadvantages to re-grading landscaped areas are as follows:

Advantages

- Very effective in areas with shallow flooding,
- Lower capital costs than other flood mitigation strategies.

Disadvantages

- Cooperation may be needed from adjacent property owners,
- Flood insurance premiums will not be reduced for properties located in the floodplain, and
- Areas within the regulatory floodplain are restricted in that they cannot place fill in those areas.

If re-grading a yard is found to be the best alternative to reduce structural flooding, the following points should be considered:

- An elevation change of at least 1 foot over 10 feet (1% slope) from the exterior wall of the home is needed to adequately direct water away from the structure,
- Lot grading should direct water to an acceptable drainage outlet, and
- Discharges of stormwater should not negatively impact neighboring properties.

Areas where water naturally flows toward the structure can benefit from re-grading the yard. If water flows toward the building, a new swale or wall can direct the flow to the street or drainage-way. Filling and grading next to the building can also direct shallow flooding to the yard. When these types of drainage modifications are made, care must be taken not to adversely affect the drainage patterns of adjacent properties.

Often, water flows to a low entry point, such as a basement window well or patio door. Regrading around the structure can reduce the occurrence of structural flooding. Some ways to improve the grading around the structure include:

- Driveway berms, and
- Barriers (berms/levees/floodwalls)

These alternatives are discussed in detail in the following paragraphs.

Driveway Berms

Reverse sloped driveways are often used in high-density neighborhoods, where there is not sufficient area for external garages. This type of driveway, however, creates a significant flood risk as it can direct overland stormwater flows into homes. Water that enters homes through reverse sloped driveways can cause structural damage, and also contribute to sewer backups, if this water enters basement floor drains.

One solution is to construct a driveway berm, which ensures there is not a constant slope towards the structure from the street. This can be achieved by either raising the sidewalk and/or reconstructing the entire driveway. By raising the sidewalk, a high-point is created between the street and the point where the reverse-sloped driveway begins to slope down toward the structure. A portion of the driveway must be reconstructed to transition the grade of the driveway to the elevated sidewalk. This can reduce the chances that overland flooding will enter the structure through the reverse sloped driveway. Alternatively, the entire driveway can be reconstructed to provide a highpoint between the garage and the street, which will reduce the occurrence of surface water in the street flooding a below-grade garage.

An alternative solution is to convert the lower level garage into a basement and completely fill in the reverse-slope driveway. The garage door is removed and the opening is sealed. Then, fill is placed around the former garage until a positive slope is achieved away from the structure, towards the street.

Applicability

Driveway berms are typically used to address structural flooding that occurs as a result of reverse sloped driveways. Installing a driveway berm in a driveway that is already sloped away from the structure could direct runoff towards the structure.

Advantages

Driveway berms are one of the few options for correcting structural flooding from reverse sloped driveways. Some of the key advantages of driveway berms include:

- Occupants usually do not have to leave the structure during construction.
- Typically less expensive than structure elevation or relocation.
- Structural flood protection provided without significant changes to the structure.

Disadvantages

The disadvantages associated with driveway berms are as follows:

- Will not reduce flood insurance premiums.
- Overtopping or failure eliminates any protection provided.
- Interior drainage must be provided.

Design Considerations

The effectiveness of a driveway berm is impacted by the surrounding grading and drainage area. Some specific design considerations to keep in mind when considering a driveway berm include:

- Slope of the existing driveway
- Tributary area draining toward the structure
- Depth of ponding in the adjacent street
- Possible height of waves caused by traffic in the street.
- Drainage within the garage and lower level of the structure

Constructability
Some of the key construction elements to consider when constructing a driveway berm are as follows:

- The driveway berm shall be constructed of materials that are not easily erodible
- Compaction of the berm is critical to maintain the desired level of protection.
- Height of the berm shall be constructed in accordance with the design to provide a smooth grade transition.

Construction Cost
Constructing a driveway berm and replacing the driveway is approximately the same cost as replacing the driveway. This can typically be performed for $8.00 to $12.00 per square foot.

Assuming a 16-ft wide suburban driveway, a one foot rise, and a 10:1 transition on each side of the rise, requires a minimum of 20-ft length x 16-ft width is required for reconstruction.

For the purposes of a conservative cost estimate, and to satisfy anticipated homeowner concerns, it's assumed the full driveway would require replacement. Assuming a 35-ft setback, 15-ft apron and 5-ft sidewalk width, the replacement cost would be 55 ft driveway length x 16-ft driveway width = 880 sf x $12/sf = $10,560.

Required Maintenance
Provided that the driveway berm is constructed of material that is not easily erodible, there is no additional maintenance for the driveway berm in addition to regular maintenance of the driveway.

Flood Reduction Capabilities
Driveway berms can improve the drainage around a structure and reduce the occurrence of structural flooding; however, they provide a limited amount of protection. The height of the berm is limited based on the length of the driveway and surrounding grading. When creating a high point in the driveway, the slope of the driveway must remain within the allowable limits set by the local ordinances. Additionally, if there is a sidewalk across the driveway, the slope of the sidewalk must remain in compliance with ADA requirements. Driveway berms may reduce the occurrence of structural flooding, but will not reduce the volume of stormwater runoff.

Barriers (Berms/Levees/Floodwalls)

When properly designed and constructed, berms and levees can be effective in reducing structural damage from overbank flooding. The sides of a levee or berm are sloped to provide stability and resist erosion, thus the width is usually six to eight times its height. As a result, taller levees require more land. A floodwall is an engineered structure made of reinforced concrete or reinforced concrete block and varies in height from 1 foot to 20 feet. Similar to berms and levees, a floodwall can surround a structure or a portion of a structure. A typical levee and floodwall used to protect a residential structure are shown in Figure 1.

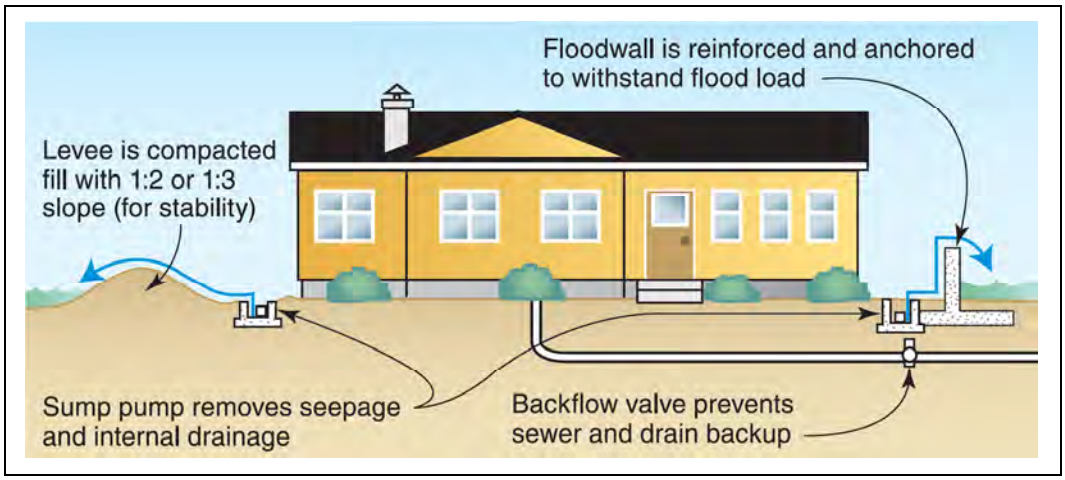

Figure 1. Berm and Levee Examples (Source: FEMA P-312)

Applicability

Barriers are not typically used to resolve structural flooding in urban areas due to the potential impacts on adjacent properties; however, they there are some situations where this flood mitigation strategy may be used. Some appropriate applications of barriers include:

- Areas outside the regulatory floodplain where the barrier can be constructed without adverse impacts to adjacent properties, and
- Structures with a low opening that can be protected without adverse impacts to adjacent properties.

The local floodplain management ordinance must be reviewed for restrictions on the use of barriers. Levees, berms, and floodwalls may not be used to bring a substantially improved or substantially damaged home into compliance with the local floodplain management ordinance. The height of the barrier needed to adequately protect the structure should also be considered. If the height of the levee, berm, or floodwall would make the project cost-prohibitive, then elevation or relocation of the structure should be considered.

Advantages

Some of the key advantages of barriers include:

- Reduces the flood risk to the structure and contents (if the design flood level is not exceeded);
- Reduces the physical, financial, and emotional strains that accompany flood events;
- Can protect multiple structures;
- Occupants usually do not have to leave the structure during construction;

- Typically less expensive than structure elevation or relocation; and
- Structural flood protection is provided without significant changes to the structure.

Disadvantages
Some of the disadvantages associated with barriers are as follows:

- May require land to construct (levees and berms typically require more land than floodwalls),
- Will not reduce flood insurance premiums,
- Overtopping or failure eliminates any protection provided,
- Human intervention is required to seal any openings,
- May restrict access to the structure,
- Interior drainage must be provided, and
- Could cause flooding of upstream and downstream properties.

Floodwalls do not rely as much on its mass to resist flood forces and, therefore, requires less space than a levee of similar height. However, floodwalls are typically higher cost.

Design Considerations
Some things to consider during the design of a barrier include:

- Levees and floodwalls should be built to protect the residence from predicted flood heights as depicted on FEMA FIRMs, FIS, or local flood vulnerability analysis.
- The higher the levee or floodwall, the greater the depth of water that builds behind it and the greater the water pressure exerted on the barrier. Taller levees and floodwalls must be designed and constructed to withstand the increased pressures.
- Taller levees and floodwalls must be stronger, so they usually require more space than is likely to be available on an individual lot.
- Local zoning and building codes may also restrict the use, size, and location of barriers.
- If the flood depth at the project site is above the practical height limits of available barriers, an alternative mitigation method, such as elevation, should be considered.
- The bearing capacity and permeability of the soils encountered may have a significant impact on the choice of barriers as a flood protection option.
- A berm or floodwall should be as far from the building as possible to reduce the threat of seepage and hydrostatic pressure.

The levee or floodwall can always be overtopped by a higher-than-expected flood regardless of the height of the barrier. Overtopping is a greater concern for a levee than a floodwall because a small amount of overtopping can cause erosion at the top of the levee and cause it to fail.

Constructability
Some of the key factors to consider when constructing a barrier include:

- To facilitate slope stability as well as maintenance and safe grass mowing, the side slopes of most levees should not be steeper than 1 foot vertically to 3 feet horizontally (1:3).
- Trees and large shrubs should not be located on barriers as they can be overturned during high-wind events and compromise the structural integrity of the levee. When trees and shrubs die, their roots decay, leaving cavities for water to pass through, which can cause the barrier to fail.

Construction Cost
The costs can vary greatly depending on the height, length, construction materials, labor, access closures, interior drainage systems, and the distance between the construction site and the source of the fill dirt used to build the levee or berm. In general, the practical, cost-effective heights of these levees and floodwalls are usually limited to 6 feet and 4 feet, respectively.

FEMA has provided general estimates for unit costs for typical barriers in *Publication 551: Selecting Appropriate Mitigation Measures for Floodprone Structures.* The unit prices provided in Publication 551were adjusted for inflation and are summarized in Table 1.

Table 1.Levee/Berm and Floodwall Costs

Barrier Type	Height Above Ground	Cost per Foot
Levee/Berm	2 Feet	$ 850
	4 Feet	$ 1,490
	6 Feet	$ 2,390
Floodwall	2 Feet	$ 1,300
	4 Feet	$ 1,970
	6 Feet	$ 2,740

Within the Pershing/Elm study area, it's anticipated that a landscaping berm may provide some protection in a few areas. The berms are no more than two feet high. For the purpose of establishing a conservative cost estimate, a cost of $10,000 per house is used, to reflect site grading and landscape restoration.

Required Maintenance
A barrier requires periodic inspections and maintenance to address any necessary repairs. Small problems, such as cracks, loss of surface vegetation, erosion and scour, animal tunnels, and trees and shrubs can quickly become large problems during a flood event. A barrier should be inspected at a least each spring and fall, before each impending flood, and after each flood event.

Flood Reduction Capabilities
Berms, levees, and floodwalls have been proven to protect structures from flooding; however they may increase the risk of flooding upstream and downstream. As a result, there are strict regulations on the construction of barriers that may prevent their implementation in some areas. Typically construction of a barrier will block the flow to an area and that lost storage volume must be compensated. When barriers are used, they are effective up to the design elevation. If the barrier is overtopped, the flood protection is lost.

WET FLOODPROOFING

Wet floodproofing allows floodwaters to enter the enclosed areas of a structure and quickly reach the same level as the floodwaters outside. As a result, there are equalized loads imposed on the exterior walls during a flood and the likelihood of structural damage may be greatly reduced.

Wet floodproofing requires openings in the exterior walls of a structure large enough for the water to flow through the structure. The openings must be sized to allow the water level inside the structure to rise and fall with the elevation of the water outside of the structure. This equilibrium of floodwater prevents hydrostatic pressure from damaging structural walls.

The two primary wet floodproofing techniques are installing openings and elevating utilities. These two techniques are discussed in the following subsections.

Installing Openings

Openings can be installed in the exterior walls of structures to allow floodwaters into uninhibited portions of an existing structure such as basements, crawlspaces, or attached garages or to the area below an elevated structure. Successful wet floodproofing typically involves the following:

- Allowing floodwaters to enter and exit the structure without the use of pumps;
- Ensuring that floodwaters inside the structure rise and fall at the same rate as floodwaters outside the structure;
- Reducing damage caused by contact with floodwaters to areas of the home that are below the flood level;
- Protecting service equipment inside and outside the structure; and
- Relocating high-value contents above the anticipated water level.

A typical example of a residential structure with openings is provided in Figure 2 along with a graphic showing the equalization of pressure on both sides of the opening.

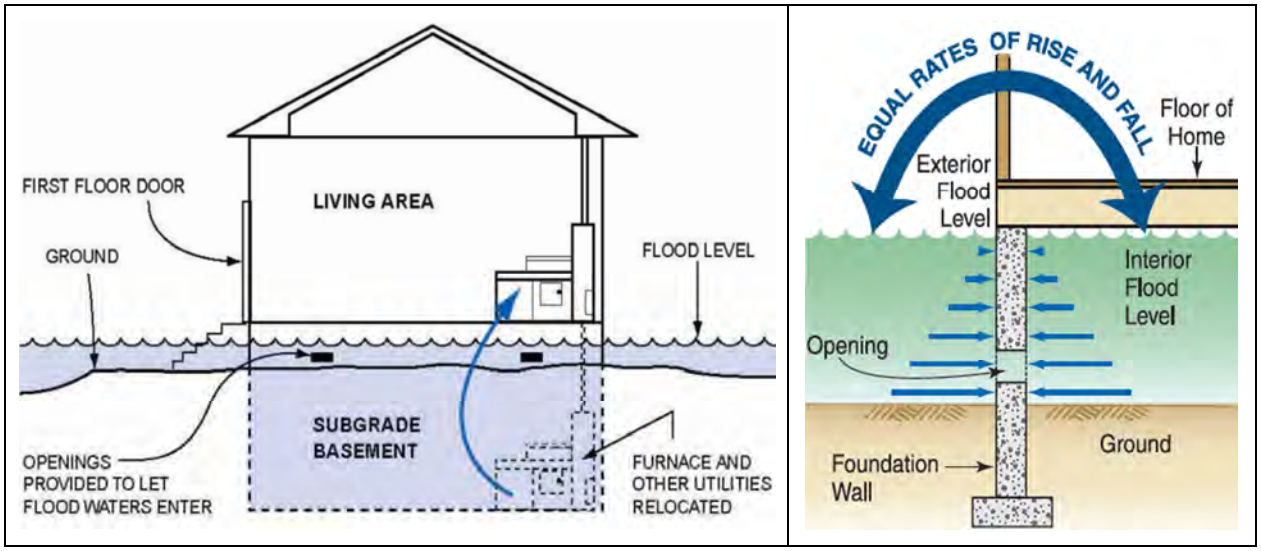

Figure 2. Wet Floodproofing Example (FEMA P-312, June 2014).

Alternative flood mitigation options should be carefully reviewed before installing openings and allowing floodwaters into a structure.

Applicability
Several examples of enclosures that require openings include:

- Solid perimeter foundation walls (crawlspaces, under-floor spaces, below-grade crawlspaces, and full-height under-floor spaces;
- Garages attached to elevated buildings;
- Enclosed areas under elevated buildings;
- Enclosed areas with breakaway walls under buildings elevated on open foundations in A zones;
- Solid perimeter foundation walls on which manufactured homes are installed; and
- Accessory structures (detached garages and storage sheds).

Advantages
Some of the key advantages of installing openings include:

- Reduces the potential of structural damage by minimizing flood forces on the structure; and
- Lower cost alternative compared to dry floodproofing.

Disadvantages
Some of the disadvantages of installing openings that should be considered before installing openings on a structure include:

- May require human intervention to function;
- Residential flood insurance premiums are not affected by wet floodproofing;
- Dirty floodwater will inundate the wet floodproofed area, which must be cleaned, sanitized, and dried out following a flood event; and
- Should not be used for areas to be used as living space.

Design Considerations
Some specific design considerations to keep in mind before installing openings include:

- A minimum of two openings must be provided on different sides of each enclosed area;
- Openings must have a total net area of not less than 1 square inch for every square foot of enclosed area subject to flooding; this criterion is not required if openings are engineered and certified;
- The bottom of all openings must be no higher than 1 foot above exterior or interior grade; and
- Openings may be equipped with screens, louvers, or other coverings or devices, provided these components permit the automatic entry and exit of floodwater and do not reduce the net open area to less than the required open area.

Constructability
Some of the key constructability considerations regarding openings include:

- The NFIP regulations do not allow buildings to be constructed with areas that are below grade on all sides (basements), except for certain engineered non-residential buildings that are designed and certified to be foodproofed. Therefore, crawlspaces that are below-grade on all sides are not allowed;
- Care should be taken when placing backfill, topsoil, and landscaping materials around the outside of enclosures, especially solid perimeter foundation walls. If the finished exterior grade is higher than the interior grade on all sides of the building, then the enclosed area becomes a basement as defined by the NFIP; and
- The trench that is excavated to construct footings and foundation walls must be backfilled completely, otherwise a basement is created. If the interior grade is higher than the exterior grade, the openings are to be no higher than 1-foot above the interior elevation.

Construction Cost
Installing openings is typically completed as part of a larger project (structure elevation, or construction of a new structure). The added cost for installing openings is typically negligible compared to the overall cost of the larger project.

Required Maintenance
The screens on openings in areas where floodwaters are expected to carry debris, such as grass clippings and leaves, tend to clog. Local officials may determine that additional openings are required to increase the likelihood that they will perform as expected, even if some openings become clogged with debris.

Flood Reduction Capabilities
Installing openings allows water into the structure, eliminating differential pressure on either side of an enclosed space and preventing collapse of those walls as a result. There is not a reduction in flooded properties by installing openings, but there could be a reduction in flood damages.

Elevating Utilities

Raising utilities above the anticipated water level protects them from being submerged during a storm event, thus minimizing replacement costs. When essential equipment is located below grade, elevating typically requires relocating the equipment to higher floors in the building. Unless space is already available, moving the equipment to a higher floor may reduce the available living space. Building owners may need to evaluate all available space, including the attic and second floor, to determine whether a small elevated addition would be an acceptable solution. Some examples of elevated utilities are shown in Figure 3.

Figure 3. Elevated Utilities Examples.

Elevating utilities can reduce replacement costs following a flood event and also reduces the health risks to homeowners. Electrical equipment exposed to water can be extremely dangerous if reenergized without proper reconditioning or replacement. When these systems are elevated above the water level, the risk of electric shock is greatly reduced.

For buildings constructed in the floodplain, there is a risk of serious flood damage to most, if not all, building utility systems constructed below the DFE. The level of risk depends on several factors, including the number of utility systems located below the DFE and their location relative to the building footprint.

Applicability

Equipment that must be placed in areas prone to flooding should be designed to (1) minimize disruptions to the portions of the mechanical systems that are above the floodwaters and (2) facilitate removal and replacement of flood-damaged mechanical equipment.

The most effective flood-resistant design of electrical systems in new and substantially improved buildings in flood-prone areas is elevation of all electrical components to levels at or above the DFE. Elevation gives the most assurance possible that, during a flood, the electrical system components would not be inundated by floodwaters.

Advantages

Some of the key advantages of elevating utilities include:

- Reduced health hazards following a flood event; and
- Reduction in time the utility is out of service following a flood event.

Disadvantages
The disadvantages associated with elevating utilities are as follows:

- Utilities are only protected to the design elevation and will not be protected for higher floodwaters and
- Only the elevated utility will be protected from flooding.

Design Considerations
All equipment that is vulnerable to flooding should be elevated above the DFE or located in dry-floodproofed areas. Equipment that must be placed in areas prone to flooding should be designed to minimize disruptions to the portions of the mechanical systems that are above the floodwaters and facilitate removal and replacement of flood-damaged mechanical equipment. Some design considerations for elevating utilities include:

- When elevating electrical services, the number of switches, wiring, and receptacles below the DFE should be limited to those items required for life safety. The use of motion detecting switches should limited whenever possible. Use only ground-fault-protected electrical breakers below the DFE. Use drip loops to minimize water entry at penetrations;
- Install HVAC components above the DFE;
- Large central mechanical units such air-cooled chillers, boilers, and pumps, should be placed above the DFE;
- Evaporator towers can be placed below the DFE if they can be readily cleaned or if the evaporative media are replaced after being in contact with floodwaters;
- HVAC controls should be placed as high as possible and installed in a way that facilitates their replacement if they are damaged by floodwaters;
- Central processing units that provide supervisory control can and should be installed above the DFE;
- Dedicated air handling units should be installed to serve flood-prone areas. Air handling units vulnerable to flood damage should have independent supplies, returns, and ventilation ducts that prevent cross contamination of conditioned air between areas damaged by floodwaters and those above the floodwaters;
- Isolation valves should be installed to allow damaged HVAC components to be replaced without requiring draining or disrupting chilled water or hot water distribution systems; and
- Domestic water lines supplying fixtures in flood-prone levels should be isolated from domestic water lines serving upper floors.

Constructability
Some of the key constructability considerations for elevating utilities include:

- Sewer services should rise above the DFE before connecting to the public sewer. To ensure safety, a backflow prevention valve or gate should be installed between the overhead portion and the point of connection to the municipal sewer. A back-up source of power should also be installed.
- Encase any wiring below the DFE in non-corrosive conduit that is installed vertically to promote thorough drainage.

- Elevate HVAC equipment above the DFE, or as high as possible
- Elevate duct work above the DFE or replace it with watertight ducts.
- Locate return and supply registers above the DFE or allow ample access for cleaning, thorough drainage, and install them without insulation to prevent mold growth in the ducts.
- Elevate wiring, receptacles, outlets, and switches above the DFE, or as high as possible. Place any receptacles below the DFE on one or two separate circuits. Install and clearly identify ground fault circuit interrupter breakers on those circuits. Receptacles and switches below the DFE should be installed in non-corrosive boxes with holes in the bottom to facilitate drying. The receptacles must be replaced after inundation by floodwaters.

Construction Cost
There is minimal additional cost to elevate a utility when it is being installed or replaced, provided the elevation can be achieved with minimal changes to the existing infrastructure. As the height needed to protect the utility increases, the cost and changes to other infrastructure increase as well.

Required Maintenance
The elevated utility has the same maintenance requirements as it did before it was elevated. The platform or bracket used to elevate the utility should be inspected annually and replaced as needed.

Flood Reduction Capabilities
Similar to installing openings, elevating utilities does not prevent flooding, but it does reduce the flood damages to the utilities that were elevated. All other utilities below the flood protection elevation remain susceptible to flooding and the elevated utility is only protected as long as the floodwaters do not rise above the flood protection elevation.

DRY FLOODPROOFING

Dry floodproofing completely seals the exterior of a building, below the anticipated water level, to prevent the entry of floodwaters keeping the interior of the structure dry. An example of dry floodproofing is provided in Figure 4.

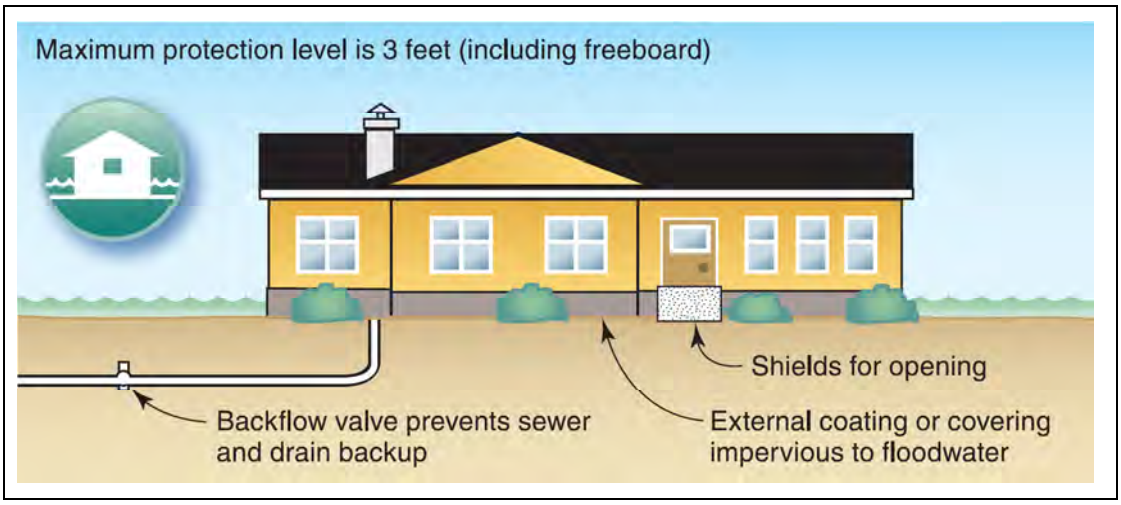

Figure 4. Dry Floodproofing Example (FEMA P-312, June 2014).

Unlike wet floodproofing, which allows water to enter the building through wall openings, dry floodproofing seals all openings below the flood level and relies on the walls of the building to keep water out. Even if a structure is dry floodproofed, water can still seep through small openings in the sealant system or through the gaskets of shields that are protecting openings. Internal drainage systems are required to remove any water that has seeped through and remove water collected from any necessary underdrain systems in the below-grade walls and floor of the home.

Dry floodproofing is not a good option for areas where floodwater is deep or flows quickly. The hydrostatic pressure and/or hydrodynamic force can structurally damage the building by causing the walls to collapse or causing the entire structure to float. Because the walls are exposed to floodwaters and the pressures they exert, dry floodproofing is practical only for homes with walls constructed of masonry or poured concrete and only where flood depths are low (typically no more than 2 to 3 feet).

Areas that have minimal velocity and low depth, dry floodproofing can be a good option. Dry floodproofing may not be used to bring a substantially damaged or substantially improved residential structure into compliance with the local floodplain management ordinance. Successful dry floodproofing techniques include:

- Raised Window Wells;
- Glass Block Basement Windows;
- Continuous Impermeable Walls;
- Floodproofed Core Interior Areas;
- Permanent Flood Shields for Exterior Openings;
- Permanent Flood Shields for Exterior Openings; and
- Removable Flood Shields for Exterior Openings.

These techniques are discussed in more detail on the following pages.

Raised Window Wells

Properties that do not have adequate protection of their low opening (window or basement door) can effectively raise the low opening height with a window well. Window wells can help improve drainage around basement windows to prevent water from entering the basement and can reduce dampness inside the structure. Window wells can also help to prevent rotting of window sills, which may compromise the ability of the windows to hold back flood water. Examples of raised concrete window wells are provided in Figure 5.

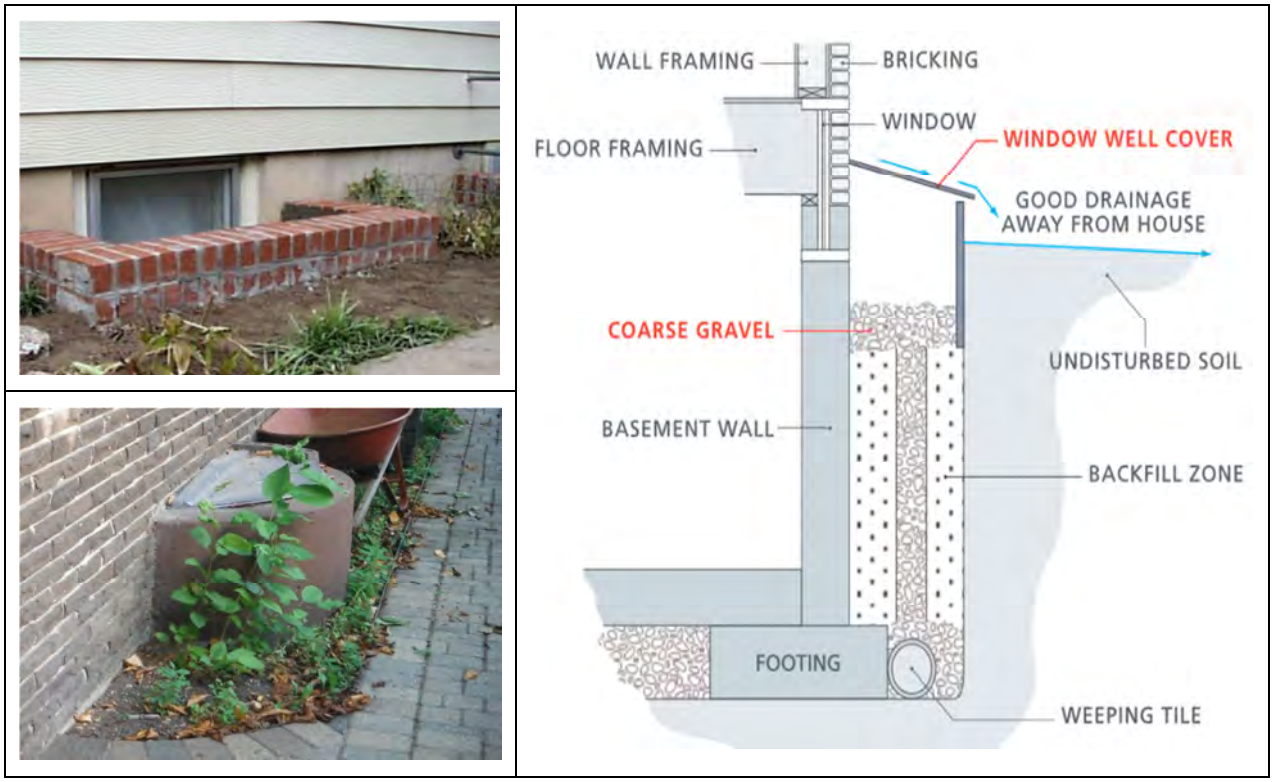

Figure 5. Raised Window Wells. (Source: FEMA 551)

Applicability

Window wells should be installed around all windows that are close to or below the ground surface. The ultimate height of the window well depends on the level of flood protection desired, appearance, cost and height of the window. The outer edges of the window well should be sealed to the side of the structure and the bottom of the well should be a least six inches below the underside of the window.

Advantages

Some of the key advantages of raised window wells include:

- Reduces the flood risk to the structure and contents (if the design flood level is not exceeded);
- Reduces the physical, financial, and emotional strains that accompany flood events;
- Typically less expensive than structure elevation or relocation; and
- Structural flood protection is provided without significant changes to the structure.

Disadvantages

Some of the disadvantages associated with barriers are as follows:

- Will not reduce flood insurance premiums,
- Overtopping or failure eliminates any protection provided, and
- May restrict egress access to the structure,

Design Considerations
Some things to consider during the design of a raised window well include:

- The height of the raised window well typically should not exceed 2 or 3 feet;
- Local zoning and building codes may also restrict the use of raised window wells; and
- The bearing capacity and permeability of the soils encountered may have a significant impact on the use of raised window wells.

The raised window well can always be overtopped by a higher-than-expected flood regardless of the height of the barrier.

Constructability
Some of the key factors to consider when constructing a raised window well include:

- To improve the drainage inside the window well, a mixture of coarse material such as gravel and soil should be placed at the bottom of the well;
- Proper lot grading is recommended that directs overland water away from window wells and building walls; and
- If there is the potential for a large volume of roof water to overflow the gutters and spill directly into the window well, or if large amounts of rain can fall into the well, a window well cover should be installed to divert this rainwater away from the window and house. The window well cover will reduce the chances that water will enter the basement through the window and reduce the amount of water that enters the foundation drainage system.

Construction Cost
The cost of constructing a raised window well varies depending upon the material used, size of the window, and height the window well is raised. A typical range of $600 - $2,000 per window can be anticipated. For a conservative estimate, this report assumes $2,000 per window.

Required Maintenance
Raised window wells require periodic inspections and maintenance to address any necessary repairs. The window and the seal around the window should be checked annually for cracks and potential leaks. Also, there should be positive drainage away from the window well.

Flood Reduction Capabilities
If the low opening to the structure is a window well and overland flow is getting into the structure through the window well, raising it can reduce the structural flooding that results from this low opening. However, the flood protection is limited. Only the structure with the elevated window well will see a reduction in flooding. Also, the level of flood protection is limited to the height of the window well, which should not exceed 2 or 3 feet.

Glass Block Basement Windows

An alternative to a raised window well is to remove the glass from the window and replaced it with glass blocks. When installed properly, glass blocks can withstand the pressure of a small amount of ponding floodwaters. The glass blocks will reduce the occurrence of seepage through a lower level window; however, they can only be used in limited applications. Some examples of low level windows that were successfully replaced with glass blocks are shown in Figure 6.

Figure 6. Glass Block Window Examples.

Another alternative to sealing low level windows with glass blocks is to replace the window with submarine glass systems. This alternative is used when glass blocks are not desired or when the depth of ponding water exceeds the recommended depth for glass blocks.

Applicability

Replacing a window with glass blocks will render the window inoperable, but the glass will still allow natural light into the area. If the window is serving as an emergency exit, it cannot be replaced with glass blocks. Similar to glass blocks, submarine glass will render the window inoperable, but the natural light will still be provided into the area. Floodproofed core areas should not be used in the following areas:

- Where floodwaters are known to carry debris
- Areas with high velocities or where there is wave action,
- Areas where floodwaters remain high for 24 hours or more, and
- Structures with frame and masonry veneer walls.

Advantages

Some of the advantages of glass block basement windows include:

- Reduces the flood risk to the structure and contents if the design flood level is not exceeded;
- May be less costly than other retrofitting measures;
- Does not require the extra land;
- Reduces the physical, financial, and emotional strains that accompany flood events; and
- Retains the structure in its present environment.

Disadvantages
The disadvantages associated with glass block basement windows are as follows:

- Does not satisfy the NFIP requirement for bringing Substantially Damaged or Improved residential structures into compliance;
- Requires ongoing maintenance;
- Does not reduce flood insurance premiums for residential structures;
- May not provide protection if measures fail or the flood event exceeds the design parameters;
- May result in more damage than flooding if design loads are exceeded, walls collapse, floors buckle, or the building floats;
- Does not eliminate the need to evacuate during floods;
- May adversely affect the appearance of the building;
- May lead to damage of the building and its contents if the glass blocks leak; and
- Does not minimize the potential for damage from high-velocity flood flow and wave action.

Design Considerations
Some things to consider during the design of a barrier structure include:

- Flood duration should be less than 24 hours,
- Flow velocity,
- Warning time,
- Floodborne debris, and
- Adjacent or shared walls.

Also, anchorage of the window frame and attachment of mullions to the frame and the seals between the window and the frame must be considered because they are common places that fail or leak.

Construction Cost
Cost for construction will vary based on accessibility, type of block chosen, size of window and condition of existing window openings but is expected to cost between $500 and $1000 per window treated. This report assumes $1,000 per window.

Required Maintenance
The components of glass block basement windows must be inspected and maintained to maintain the flood protection from this practice. The glass blocks and the seal around the window should be checked annually for cracks and potential leaks.

Flood Reduction Capabilities
If the low opening to the structure is a lower level window and overland flow is getting into the structure through the window, installing glass blocks can reduce the occurrence of structural flooding. However, the flood protection is limited. Only the structure with the glass block window will see a reduction in flooding. Also, the level of flood protection is limited based on the sealant and strength of the glass blocks.

Continuous Impermeable Walls

A continuous impermeable wall is substantially impermeable to the passage of water, and capable of resisting hydrostatic and hydrodynamic loads and the effects of buoyancy. After the primary wall system and foundation have been strengthened to resist flood loads (if necessary), the building must be sealed and entry points (e.g., windows, doors, utility points of entry) must be evaluated to determine how best to prevent floodwaters from entering the enclosed area.

In some instances, it may be more cost-effective to construct a continuous impermeable wall on the outside of the existing wall system. Some wall systems, such as steel stud wall systems, may be too difficult to make impermeable, and in those instances a new wall system may be constructed along the perimeter of the existing wall to provide protection.

Creating a waterproof barrier in a section of wall to make it impermeable may require the use of sealants. Sealants are applied directly to the exterior surface of the building to seal exterior walls and floors. Sealants can be either positive-side (applied to the wall exterior where the sealant acts as a barrier between floodwaters and the wall) or negative-side (applied to the interior of a wall or floor where the water pushes against the sealant after it has passed through the wall or slab) as shown in Figure 7.

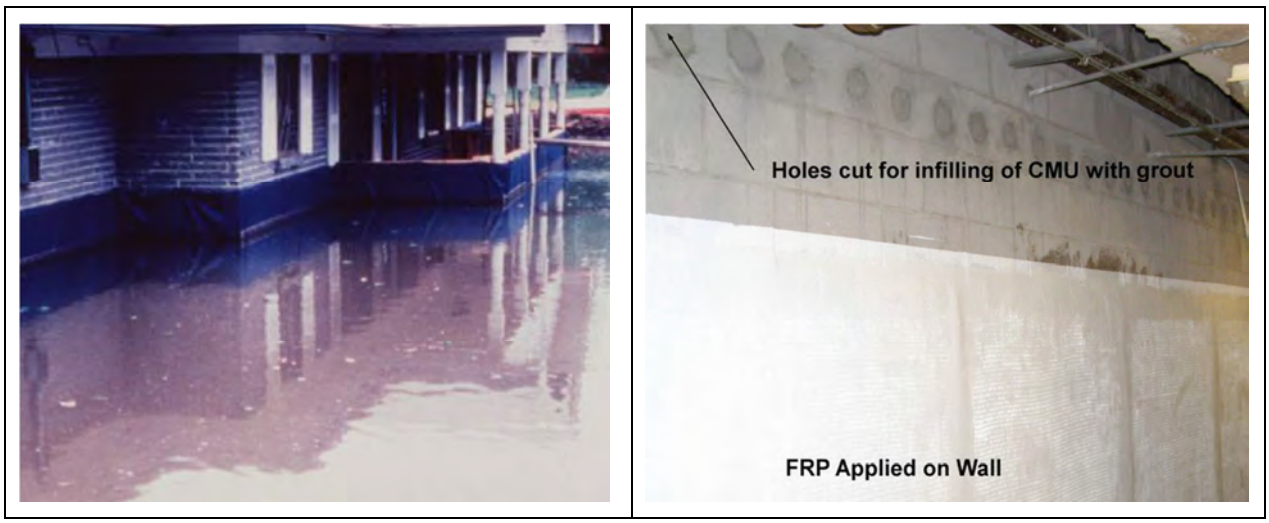

Figure 7. Positive-side Sealant (left) and Negative-side Sealant (right) Examples

Above-ground walls can be sealed using either category of sealant because interior and exterior sides are both typically accessible, while below-ground walls and floor slabs almost always require negative-side sealants. The appropriate sealant for a particular structure is dependent upon the compatibility of the sealant product with the expected duration and depth of flooding and the construction materials in the building.

Applicability

Continuous impermeable walls work well in the following applications:

- Areas where the velocity of flood flows are low and there is little to no wave action,
- Areas where floodwaters remain high for less than 24 hours, and
- Structures without basements or other below grade living spaces.

Impermeable walls should not be used in areas where floodwaters are known to carry debris or on structures with frame and masonry veneer walls. Also, they should not be used on structures with basements or crawlspaces.

Advantages
Some of the key advantages of impermeable walls include:

- Reduces the flood risk to the structure and contents, if the design flood level is not exceeded;
- May be less costly than other retrofitting measures;
- Does not require extra land that may be needed for floodwalls or reduced levees;
- Reduces the physical, financial, and emotional strains that accompany flooding; and
- Retains the structure in its present environment and may avoid significant changes in appearance.

Disadvantages
The disadvantages associated with impermeable walls are as follows:

- Does not satisfy the NFIP requirement for bringing Substantially Damaged or Improved residential structures into compliance
- Requires ongoing maintenance
- Does not reduce flood insurance premiums for residential structures
- May not provide protection if measures fail or the flood event exceeds the design parameters of the measure
- May result in more damage than flooding if design loads are exceeded, walls collapse, floors buckle, or the building floats
- Does not eliminate the need to evacuate during floods
- May adversely affect the appearance of the building if shields are not aesthetically pleasing
- May not reduce damage to the exterior of the building and other property
- May lead to damage of the building and its contents if the sealant system leaks
- Involves increased costs for a design professional
- May require invasive retrofits, and
- Does not minimize the potential for damage from high-velocity flood flow and wave action.

Design Considerations
The key design considerations when designing impermeable walls are:

- Flood duration should be less than 24 hours,
- Flow velocity,
- Warning time,
- Floodborne debris, and
- Adjacent or shared walls.

Even if both buildings are to be dry floodproofed, it may not be possible to seal all areas of the adjacent walls. The condition of adjacent or shared walls should be thoroughly investigated to ensure that the selected floodproofing measures will be effective.

Constructability
Constructability will be largely determined on a case by case basis depending on the anticipated flood loads and levels, type and condition of existing wall and foundation systems and condition and type of construction used in the building of the structure.

Construction Cost
The cost of making a continuous impermeable wall is generally in the middle range compared to the costs of implementing other mitigation measures. Costs that may need to be considered include:

- Preparation of the structure for elevation;
- Elevation of the structure, including cost of steel beams, jacks, etc.;
- Construction of the new, elevated foundation;
- Secure the structure to the new foundation; and
- Replacement or reconstruction of items removed from the structure prior to elevation.

Examples cost estimates from FEMA Publication 551: Selecting Appropriate Mitigation Measures for Floodprone Structures were adjusted for inflation and summarized in Table 2.

Table 2. Sealant Costs

Sealant	Cost
Waterproofing a concrete block or brick-faced wall by applying a polyethylene sheet or other impervious material and covering with facing material such as brick	$ 5.20 / square foot
Acrylic latex wall coating	$ 4.50 / square foot
Caulking/sealant with a high performance electrometric "urethane" sealant	$ 3.70 / linear foot
Bentonite grout (below grade waterproofing, 6 feet deep)	$ 29.40 / linear foot

Required Maintenance
The components of continuous impermeable walls must be inspected and maintained on a regular basis. Some considerations to facilitate a successful maintenance schedule are as follows:

- Develop an annual inspection plan, and
- Check walls, floors, and floodproof coatings for cracks and potential leaks.

Flood Reduction Capabilities
The areas that are sealed will be protected from future flooding, as long as the seal is maintained. The level of protection provided depends upon the type of sealant used and the design elevation. Only the areas that are sealed will have a reduction in flood risk.

Floodproofed Core Interior Areas

Critical core components and areas can be made flood resistant even if dry floodproofing the entire building footprint is not needed or possible. Typical critical core areas contain utilities such as electrical services, emergency generators, emergency fuel supplies, and other components that cannot be moved or elevated. In many large complexes or campuses of buildings (such as museums, universities, and large businesses), the utilities may be housed in a central building and linked to the other buildings via tunnels. Although the main utility building may not be at risk of flooding during a particular event, utility tunnels are often subject to more frequent flooding. Examples of watertight doors that would prevent flooding of a utility room are provided in Figure 8.

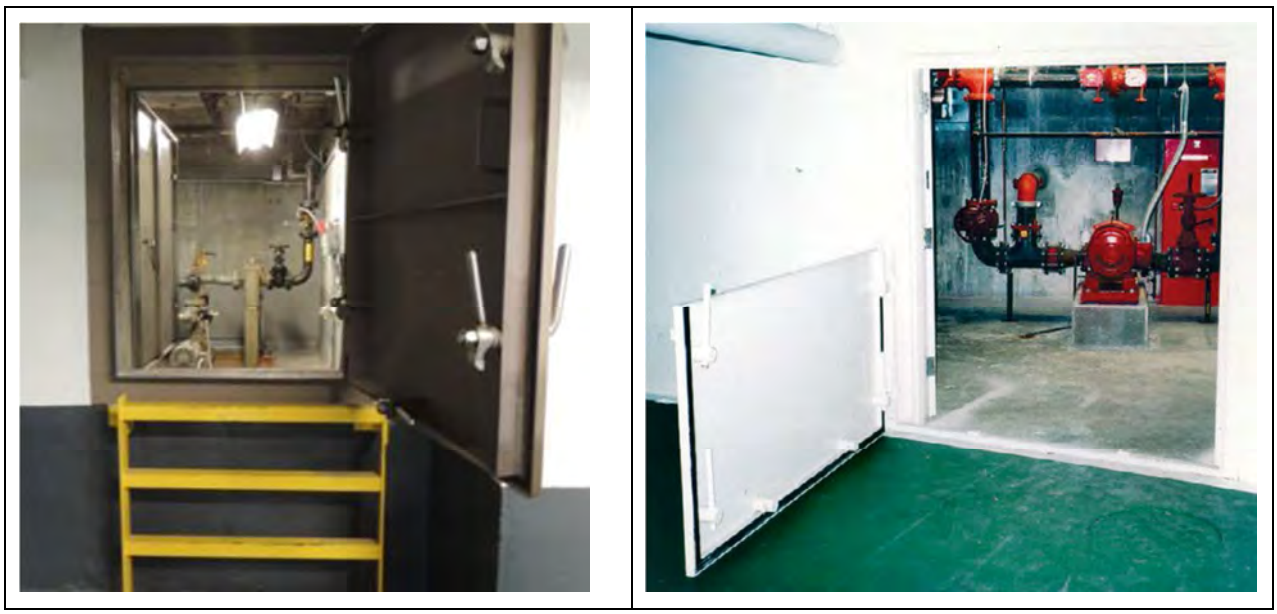

Figure 8. Floodproofed Core Area Examples

An important consideration in making a core area watertight is that floodwater levels may be higher than the height of typical dry floodproofing measures that protect the entire building, and additional anchorage may be needed to make sure the area does not become buoyant. Both the floor system and existing walls should be carefully studied and evaluated. Because these areas are typically designed to be fully resistant to high flood loads, additional anchoring or securing of the core area may be required to resist buoyancy forces.

Core areas can be made watertight by constructing infill walls or retrofitting existing interior walls. Waterproofed walls may be constructed of cast-in-place concrete tied to the floor slab. Fully grouted reinforced CMU walls can also be used to construct the interior walls; however, CMU walls may require additional waterproofing to be considered fully impermeable. Special detailing should be done at the joint between the floor slab and wall as this is a common location for leaks.

If access doors or hatches are necessary below the flood protection level, a hinged door is recommended, so the area can be sealed quickly. Doors or hatches above the flood protection level may allow continuous access even during flood events, but require stairs or ladders. Although stairs or ladders may allow maintenance personnel to access the area during a storm event, they may limit the ability to move items in and out of the area. A pump system is still required to address any unidentified leaks.

Applicability
Floodproofed core areas work well in the following applications:

- Non-residential buildings
- Areas where the velocity of flood flows are low and there is little to no wave action,
- Areas where floodwaters remain high for less than 24 hours, and
- Structures without basements or other below grade living spaces.

Floodproofed core areas should not be used in areas where floodwaters are known to carry debris or on structures with frame and masonry veneer walls.

Advantages
Some of the advantages of floodproofed core areas include:

- Reduces the flood risk to the structure and contents if the design flood level is not exceeded;
- May be less costly than other retrofitting measures;
- Does not require the extra land;
- Reduces the physical, financial, and emotional strains that accompany flood events; and
- Retains the structure in its present environment and may avoid significant changes in appearance.

Disadvantages
The disadvantages associated with floodproofed core areas are as follows:

- Does not satisfy the NFIP requirement for bringing Substantially Damaged or Improved residential structures into compliance;
- Requires ongoing maintenance;
- Does not reduce flood insurance premiums for residential structures;
- Typically requires human intervention and adequate warning time;
- May not provide protection if measures fail or the flood event exceeds the design parameters;
- May result in more damage than flooding if design loads are exceeded, walls collapse, floors buckle, or the building floats;
- Does not eliminate the need to evacuate during floods;
- May not reduce damage to other portions of the building and other property;
- May lead to damage of the building and its contents if the sealant system leaks;
- Involves increased costs for a design professional;
- May require invasive retrofits; and
- Does not minimize the potential for damage from high-velocity flood flow and wave action.

Design Considerations
The key design considerations include:

- Flood duration should be less than 24 hours,
- Flow velocity,
- Warning time,
- Floodborne debris, and
- Adjacent or shared walls.

Construction Cost
The cost of floodproofed core areas is similar to the cost of continuous impermeable walls. Refer to the previous section for those costs.

Required Maintenance
The components of floodproofed core areas must be inspected and maintained on a regular basis. Since this practice includes window and door closures as part of the system, closures must be available and in good condition. Some maintenance requirements include:

- Develop an inventory and location list of all closures,
- Develop an annual inspection plan to ensure closures fit properly,
- Inspect and replace rubberized seals as needed, and
- Check walls, floors, and floodproof coatings for cracks and potential leaks annually.

Flood Reduction Capabilities
The areas that are sealed and will be protected from future flooding; however, any areas that are not floodproofed will not see a reduction in flooding or flood damages.

Permanent Flood Shields for Exterior Openings

Basement windows can be the first entry point for floodwaters. Removing a window and incorporating the opening into the wall system may be easier than retrofitting a window with watertight flood shields. The decision of whether to eliminate the window may depend on the following:

- Use of the window (e.g., provides light, means of egress)
- Location of the window on the building, and
- The ease with which the opening can be filled in and incorporated into the wall system

Basement windows may be good candidates for elimination, whereas windows higher on the building may only need to be shielded partially rather than eliminated. Sealing openings should consider the wall or foundation system's ability to resist the loads. Any system of flood doors, panels, or shields will depend on the transfer of the flood loads from the shields to the wall. If the walls or foundation are structurally insufficient to carry these loads, they must be reinforced prior to sealing the opening.

Penetrations through walls for utilities have much narrower openings than those of doors or windows. Gaps in the opening around the utility line should be filled with expansive foam to create a waterproof seal. Sealants used to seal openings in walls or floors should be able to withstand being submerged for the anticipated duration of flooding. Two examples of sealed openings are provided in Figure 9.

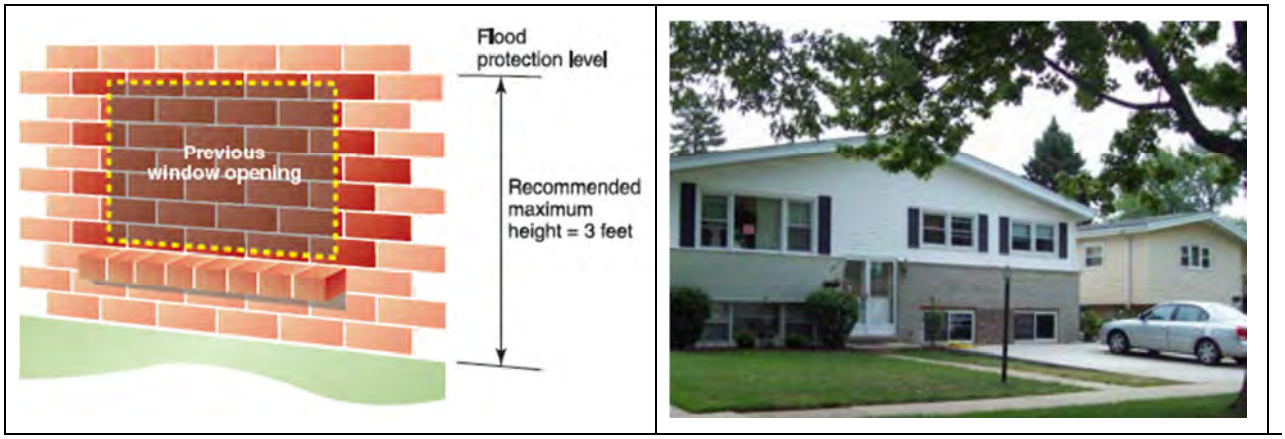

Figure 9. Sealed Window Opening (left) and Sealed Garage Opening (right) Examples

Nonresidential buildings may have ventilation shafts, exhaust fans, and louvered openings that should be protected with specially fitted flood shields. Placing the flood shields may require shutting down parts of the building or temporarily interrupting some of the building's utilities or mechanical systems. It may be feasible and cost-effective to reroute ventilation shafts, exhaust fans, or other utility openings above the flood protection level to avoid having to shut down some operations during a flood.

Applicability

Permanent flood shields for exterior openings work well in the following applications:

- Areas that can be re-graded to flow away from the structure, and
- Exterior openings that are not needed for ingress/egress.

Advantages
Some of the advantages of permanent flood shields for exterior openings include:

- Reduces the flood risk to the structure and contents if the design flood level is not exceeded;
- May be less costly than other retrofitting measures;
- Does not require the extra land to construct;
- Reduces the physical, financial, and emotional strains that accompany flood events; and
- Retains the structure in its present environment.

Disadvantages
The disadvantages associated with permanent flood shields for exterior openings are as follows:

- Does not satisfy the NFIP requirement for bringing Substantially Damaged or Improved residential structures into compliance;
- Does not reduce flood insurance premiums for residential structures;
- May not provide protection if measures fail or the flood event exceeds the design parameters;
- May result in more damage than flooding if design loads are exceeded, walls collapse, floors buckle, or the building floats;
- May adversely affect the appearance of the building;
- May not reduce damage to the exterior of the building and other property;
- May lead to damage of the building and its contents if the sealant system leaks;
- Involves increased costs for a design professional;

Design Considerations
The key design considerations include:

- Flood duration should be less than 24 hours,
- Flow velocity,
- Adjacent or shared walls, and
- Local regulations regarding regrading of the site and elimination of an existing opening.

Constructability
Some constructability considerations for permanent flood shields include:

- Location of rough openings to be sealed;
- Access for workers and materials;
- Availability of finishing materials to match the existing structure's façade;

Construction Cost
Cost for construction will vary based on accessibility, size and condition of rough opening, type of material used to seal the opening and type of facing material necessary to match the existing structure but is expected to cost between $500 and $1000 per window sealed.

Required Maintenance
The permanent flood shields must be inspected and maintained. An annual inspection plan should be prepared to check walls, floors, and floodproof coatings for cracks and potential leaks.

Flood Reduction Capabilities
If the low opening to the structure is a lower level window or garage door and overland flow is getting into the structure through the window, sealing the opening can reduce the occurrence of structural

flooding. However, the flood protection is limited. Only the structure with the sealed opening will see a reduction in flooding. Also, the level of flood protection is limited based on the sealant used.

Removable Flood Shields for Exterior Openings

During flood conditions, doors typically present the largest openings requiring protection from water intrusion into the building. Flood shields or panels are watertight structural systems that bridge the openings in walls to prevent the entry of floodwaters. Flood shields work in tandem with waterproof barriers to resist water penetration. Although flood shields are most often temporary measures, they can also be used as a permanent floodproofing measure. Flood shields transfer flood-induced forces to the adjacent structural components, which can overstress the structural capabilities of the building. Most flood shields are mounted against the exterior of the opening, allowing rising floodwaters to further compress the gaskets and seals between the flood shield and the wall system or frame of the opening. Some examples of removable flood shields for exterior openings are provided in Figure 10.

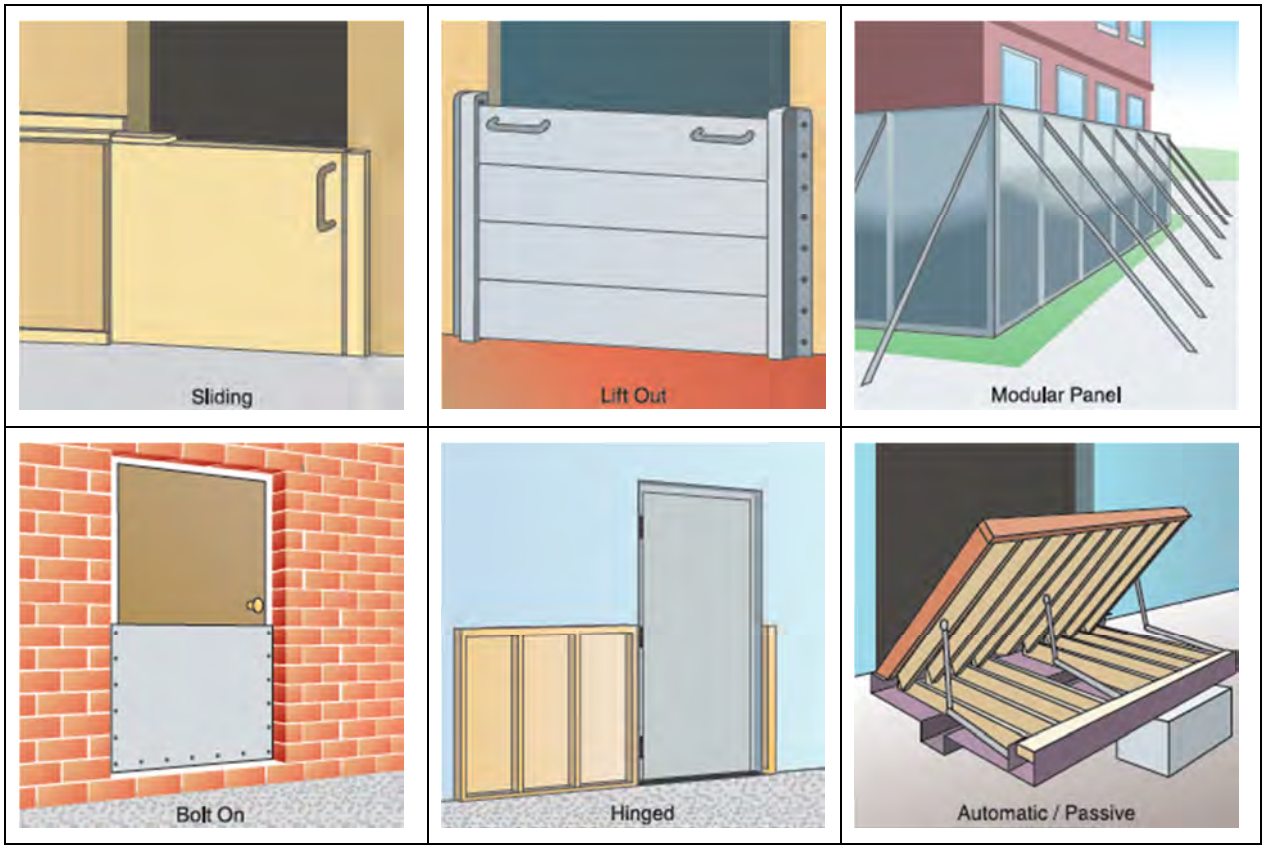

Figure 10. Example Flood Shields for Exterior Openings.

The type of shield that is used depends on the size of the opening that needs to be protected, the duration of flooding, the normal use of the opening, warning time available to install the shield and the use of the door as a means of egress from the building. For larger openings, passive (automatic) flood shields may be preferred to active flood shields, which require human intervention. Passive flood shields allow openings to be used until floodwaters reach a certain height. Passive flood shield systems may require room under the opening to allow the flood shield to be stored when it is not in use and may require a backup power supply.

Applicability

Removable flood shields work well in the following applications:

- Areas where the velocity of flood flows are low and there is little to no wave action,

- Areas where floodwaters remain high for less than 24 hours, and
- Structures without basements or other below grade living spaces.

Removable flood shields should not be used in areas where floodwaters are known to carry debris or on structures with frame and masonry veneer walls.

Advantages
Some of the advantages of removable flood shields include:

- Reduces the flood risk to the structure and contents if the design flood level is not exceeded;
- May be less costly than other retrofitting measures;
- Does not require the extra land;
- Reduces the physical, financial, and emotional strains that accompany flood events; and
- Retains the structure in its present environment.

Disadvantages
The disadvantages associated with removable flood shields are as follows:

- Does not satisfy the NFIP requirement for bringing Substantially Damaged or Improved residential structures into compliance;
- Requires ongoing maintenance;
- Does not reduce flood insurance premiums for residential structures;
- Typically requires human intervention and adequate warning time;
- May not provide protection if measures fail or the flood event exceeds the design parameters;
- May result in more damage than flooding if design loads are exceeded, walls collapse, floors buckle, or the building floats;
- Does not eliminate the need to evacuate during floods;
- May adversely affect the appearance of the building if shields are not aesthetically pleasing;
- May not reduce damage to the exterior of the building and other property;
- May lead to damage of the building and its contents if the sealant system leaks; and
- Does not minimize the potential for damage from high-velocity flood flow and wave action.

Design Considerations
The key design considerations include:

- Flood duration should be less than 24 hours,
- Flow velocity,
- Warning time,
- Floodborne debris,
- Installation requirements, and
- Availability of personnel to seal the opening.

Constructability/Installation Considerations
Exterior flood shields require human intervention, therefore someone must be willing and able to install all flood shields and carry out all other activities required for the successful operation of the system. As a result, not only must someone be physically capable of carrying out these activities, they must be available in time to do so before floodwaters arrive.

Construction Cost

The cost for exterior flood shields vary based on the type of shield (manual or automatic), material, and the size of the opening. Some of these are available at big box home improvement stores for $1,000 in material cost for use in residential applications. The cost estimate assumes $3,000 each for materials and installation.

Required Maintenance

The components of the flood shields must be inspected and maintained on a regular basis. Since this practice includes window and door closures as part of the system, closures must be available and in good condition. Some maintenance requirements include:

- Develop an inventory and location list of all closures,
- Develop an annual inspection plan to ensure the closures fit properly,
- Inspect and replace any rubberized seals as needed, and
- Check walls, floors, and floodproof coatings for cracks and potential leaks.

Flood Reduction Capabilities

Removable Flood Shields for Exterior Openings can seal a low opening that is receiving overland flow and reduce the occurrence of structural flooding. However, the flood protection is limited. Only the structure with the sealed opening will see a reduction in flooding. Also, the level of flood protection is dependent on someone being available to correctly install the flood shield in a timely manner.

OTHER MITIGATION OPTIONS

For some structures, dry or wet floodproofing cannot provide adequate protection from future flooding and greater measures must be taken. Other mitigation options include structure elevation, relocation and demolition. Structure elevation is described in the following paragraphs.

Structure Elevations

If the floodwaters are too high for dry floodproofing and the inhabited area is too low for wet floodproofing, it may be necessary to raise the structure. Short of relocating a structure outside a flood-prone area, the best way to protect it from surface flooding is to raise it above the flood level. The three most common elevation techniques are open foundations, continuous foundation walls, and extending existing walls. In all three elevation techniques, the area below the flood level is left open to allow floodwaters to flow under the building, causing little or no damage.

Elevation is usually most cost-effective for buildings on crawlspaces because it is easiest to get lifting equipment under the floor and disruption of the habitable part of the house is minimal. Examples of structures that have been elevated above the 100-year flood elevation are provided in Figure 11.

Figure 11. Example Elevated Structures

The ease with which an elevation project can be accomplished usually depends on the building's construction type. A large masonry building is more difficult to elevate than a smaller, compact wood-frame structure. The type of foundation is the most important factor. There are four types of foundations:

1. Crawlspace construction (easiest to elevate);
2. Piers, posts, and pile construction;
3. Basement construction; and
4. Slab-on-grade construction (hardest to elevate).

If the building is elevated eight feet or more, the owner may be tempted to convert the lower area into a habitable living space, which would negate the benefits of the elevation project. One way to help prevent

conversions is to have the owner sign a non-conversion agreement that is recorded on the deed to the property. Since the deed follows the property, future homebuyers are informed of the restrictions.

Applicability
In DuPage County, the DuPage County Stormwater Management and Flood Plain Ordinance requires all substantially improved residential structures have their lowest floor elevated one (1) foot above the 100-year flood elevation; the City of Wheaton municipal code requires structures to be elevated two (2) feet above the 100-year floodplain elevation. Raising a structure above the flood level on an open foundation (e.g., piles, piers, or posts) is an effective on-site property protection method. Water flows under the building, causing little or no damage to the structure or its contents.

- Elevating structures within the regulated floodplain must comply with local requirements concerning substantial improvements, use of flood resistant materials, protection against flood damage, etc.
- Concrete and masonry buildings and those with slab-on-grade foundations present special difficulties for lifting.
- Not advisable for structures that are in fair or poor condition
- Elevation on fill is not advisable in the floodway

Advantages
Some of the key advantages of elevating a structure include:

- Dependable way to protect the structure and contents, since everything subject to damage is raised above the flood level;
- Brings a substantially improved or substantially damaged structure into compliance with the National Flood Insurance Program (NFIP) regulations;
- Often reduces flood insurance premiums;
- Qualified contractors are often readily available; and
- Does not require the additional land that may be needed for floodwalls or levees.

Disadvantages
Some of the disadvantages of installing openings that should be considered before elevating a structure include:

- Elevation can be expensive, especially for large, masonry structures on slab foundations;
- The appearance of the structure may be adversely affected;
- Elevation is not appropriate in areas with high-velocity water flow, fast-moving ice or debris flow, or erosion, unless special measures are taken;
- Some zoning ordinances and subdivision covenants prohibit buildings above a certain height.
- Owners may lose their basements; and
- The surrounding area remains subject to flooding, which may make the structure inaccessible during large storm events.

Design Considerations
There are three primary methods to elevate structures, which include:

- Open foundation (e.g., piles, piers, or posts)
- Continuous foundation walls (creating an enclosed space below the building), or
- Compacted earthen fill.

Elevating on compacted fill is the most complicated and expensive alternative. The building has to be temporarily moved so the fill can be placed and properly compacted; the building is then moved back to the site. This process may make elevating on fill more costly than elevating on an open foundation or continuous foundation walls. In addition to the type of structure, the following should also be considered during the design process:

- Debris loads on walls or piers
- Special protective measures may be required in areas with velocities more than 5 feet per second
- Structures on the National Register of Historic Buildings may have restrictions that will not allow elevation of the structure, or have special requirements in order to elevate, which must be considered during the design process.
- Increased earthquake, wind, hydrostatic and hydrodynamic forces on the structure.
- Aesthetic treatments around the elevated structure (landscaping, grading, siding, etc.)

Constructability
Some of the key construction elements to consider are as follows:

- Elevating a structure that has a basement is also more difficult because the support structures for the lifting beams must be constructed outside of the basement's footprint in order to begin the lifting process.
- Additional supports are needed to lift the slab without damage. The area under the slab must be excavated to insert the lifting equipment and disconnect utilities. Alternatively, the structure can be removed from the slab, elevated, and place upon a new floor.
- In order to elevate a structure, there must be enough room free from obstructions. Construction easements on neighboring properties may be necessary and should be obtained in advance.
- Access to the structure following elevation must be considered. Alternatives include ramps, stairs, and/or elevators.
- Requirements in the local building code and floodplain ordinance must be followed.
- The occupants of the structure will need to be relocated for 1 to 3 months.

Construction Cost
The cost of elevating a structure is generally in the middle range compared to the costs of implementing other mitigation measures. Costs that may need to be considered include:

- Preparation of the structure for elevation;
- Elevation of the structure, including cost of steel beams, jacks, etc.;
- Construction of the new, elevated foundation;
- Secure the structure to the new foundation; and
- Replacement or reconstruction of items removed from the structure prior to elevation.

Examples cost estimates from *FEMA Publication 551: Selecting Appropriate Mitigation Measures for Floodprone Structures* were adjusted for inflation and summarized in Table 3.

Table 3.Structure Elevation Costs

Structure Type	Cost/square foot
Wood-frame building on piles, posts, or columns	$ 53
Wood-frame on concrete or building foundation walls	$ 47
Brick walls	$ 64
Slab-on-grade	$ 67

If a structure has been substantially damaged and it had flood insurance at the time the flood damage occurred, the structure is eligible for Increased Cost of Compliance (ICC) coverage and can receive up to $30,000 towards the cost of elevating the structure. Additionally, structure elevation is eligible for FEMA Hazard Mitigation Grant Program (HMGP) funding. HMGP funding is not guaranteed and does require a non-federal cost share; however, these funds can help offset the cost of structure elevation.

Required Maintenance

The additional maintenance required for the structure after it has been elevated structure is minimal. The following maintenance should be performed annually:

- Inspection of the supports for the elevated structure,
- Removal of debris under the structure, and
- Correction of any erosion.

Flood Reduction Capabilities

Structure elevation permanently mitigates the flood risk to the structure involved, since the structure is elevated above the anticipated water level. The area beneath the elevated structure, however, will continue to flood. Additionally, access to an elevated structure during a storm event may be restricted.

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