US Army Corps of Engineers®
St. Louis District

Piat Place & Harding Ditch
Flood Hazard Analysis
(Floodplain Management Services - FPMS)

Appendix B – Civil Design Quantities

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1.0 General

1.1 Computer Aided Design and Surface Data

CAD software: OpenRoads Designer version 10.12.01.59.
CAD Workspace: Version 4
Terrain Data: 2019 LiDAR and February 2019 cross section survey of Harding Ditch.

1.2 Quantities

Quantities were tracked and calculated where needing in Microsoft Excel for each alternative. A copy of the spreadsheet can be made available upon request. Snips of the summary tab are provided in the sections below.

1.3 Alternatives

See main report for detailed discussion of alternatives. A summary of each alternative copied from the main report is included in Table 1 for reference.

Table 1. Summary of Alternatives

Alternative	Short Description of Alternative
1 – Summit A (Limited Flood Risk Reduction)	Least flood risk reduction, least costly alternative for the area north of Summit Ave. provides limited flood risk reduction. Includes raising low sections of the road.
2 – Summit B (Maximum Flood Risk Reduction)	Higher flood risk reduction, higher cost alternative for the area north of Summit Ave. Provides greater flood risk reduction. Includes installing culverts and storm sewer line and adding a small pump station to Harding Ditch.
3 – State Street A (Limited Flood Risk Reduction)	Least flood risk reduction, least costly alternative for the area north of State Street but south of Summit Ave. Provides limited flood risk reduction. Includes replacing some inlets and storm sewer line, and adding a pump station to Harding Ditch.
4 – State Street B (Maximum Flood Risk Reduction)	Higher flood risk reduction, higher cost alternative for the area north of State Street. Provides greater flood risk reduction. Includes replacing some inlets and storm sewer line throughout the neighborhood, adding new storm sewer lines, and adding a larger pump station.
5 – Piat A (Intermediate Flood Risk Reduction A – South Ditch)	Intermediate flood risk reduction, least cost alternative for the Piat Place neighborhood. Increases the level of flood risk reduction to a similar level to Alternative 6. Includes directing flow south to a new ditch into Whispering Willow Lake in Frank Holten State Park.
6 – Piat B (Intermediate Flood Risk Reduction B – East Under Highway)	Intermediate flood risk reduction, intermediate cost alternative for the Piat Place neighborhood. Increases the level of flood risk reduction to a similar level to Alternative 5. Includes directing flow eastward into a storm sewer line bored under Interstate 255, to a new pump station feeding into Harding Ditch.
7 – Piat C (Maximum Flood Risk Reduction)	Higher flood risk reduction, highest cost alternative for the Piat Place neighborhood. Provides the highest level of flood risk reduction. Includes directing flow south to a new wetland into Whispering Willow Lake in Frank Holten State Park.

8 – Harding A (Limited Flood Risk Reduction)	Least flood risk reduction, least costly alternative for Harding Ditch. Provides limited flood risk reduction. Includes widening and deepening Harding Ditch, restoring it to approximately its design condition.
9 – Harding B (Intermediate Flood Risk Reduction)	Intermediate flood risk reduction, intermediate cost alternative for Harding Ditch. Increases the level of flood risk reduction. Includes widening and deepening Harding Ditch, restoring it to approximately its design condition, and adding one pump station at the existing south pump station location.
10 – Harding C (Maximum Flood Risk Reduction)	Highest flood risk reduction, highest cost alternative for Harding Ditch. Provides the highest level of flood risk reduction. Includes widening and deepening Harding Ditch, restoring it to approximately its design condition, and adding two pump stations at the existing south pump station location.

2.0 Earthwork – Mass Excavation

Figure 2-1 shows a summary of mass excavation quantities for the alternatives.

		North Wetland Area (Summit Avenue)				Area North of State Street		Piat Place Neighborhood			Harding Ditch			
		Low			High	Low	High	Low	High	Medium	Low	Medium	High	
		Raise Summit Ave (10 Year)	*Raise Summit Ave (25 Year)*	*Raise Summit Ave (100 Year)*	*Re-establish Drainage Through North Wetland*	*Area Draining Around Interstate 255 and State Street*	*Area Draining Around Interstate 255 and State Street Plus Streets to the West*	*Piat Place South to Ditch into Whispering Willow Lake*	*Piat Place East Under Interstate 255*	*Piat Place South to Wetland that Empties into Whispering Willow Lake*	*Dredge/Widen with no pump stations*	*Dredge and add one South Pump Station*	*Dredge and add Two Additional Pumps to the South Pump Station*	
		1A	1B	1C	2	3	4	5	6	7	8	9	10	Units
Earthwork	Embankment	20	36	70										CY
	Mass Excavation				2,963			7,633		267,665	358,064	358,064	358,064	BCY

Figure 2-1. Summary of Mass Excavation Quantities

2.1 Raise Summit Avenue

Small amounts of embankment are estimated to be required to fill the shoulders of Summit Avenue where the elevation is proposed to be raised in alternatives 1 and 2. See Section 3.1. for details on how the road raise was modeled.

2.2 Harding Ditch Dredging

Harding ditch cross sections were surveyed by USACE survey crews in February of 2024. Point data from these cross sections was used to create a 3D terrain of the ditch to serve as existing conditions. H&H provided proposed dredging cross sections and vertical profile geometry (see Appendix A). Two trapezoidal cross sections were applied:

- 25 FT Bottom w/ 3H:1V Side Slopes – STA 0+00 (St. Clair Ave. Bridge) to 220+50
- 30 FT Bottom w/ 3H:1V Side Slopes – STA 220+50 to 357+87 (Existing Pump Station)

The proposed ditch bottom elevation follows the existing ditch bottom from STA 0+00 (St. Clair Ave. Bridge) to 124+00. From there the ditch is proposed to be deepened approximately 1.4 FT to the STA 358+87 (Existing Pump Station), generally following the same slope as the existing. A 3D Corridor model of the proposed ditch was developed using the above cross sections and vertical geometer to estimate excavation volume.

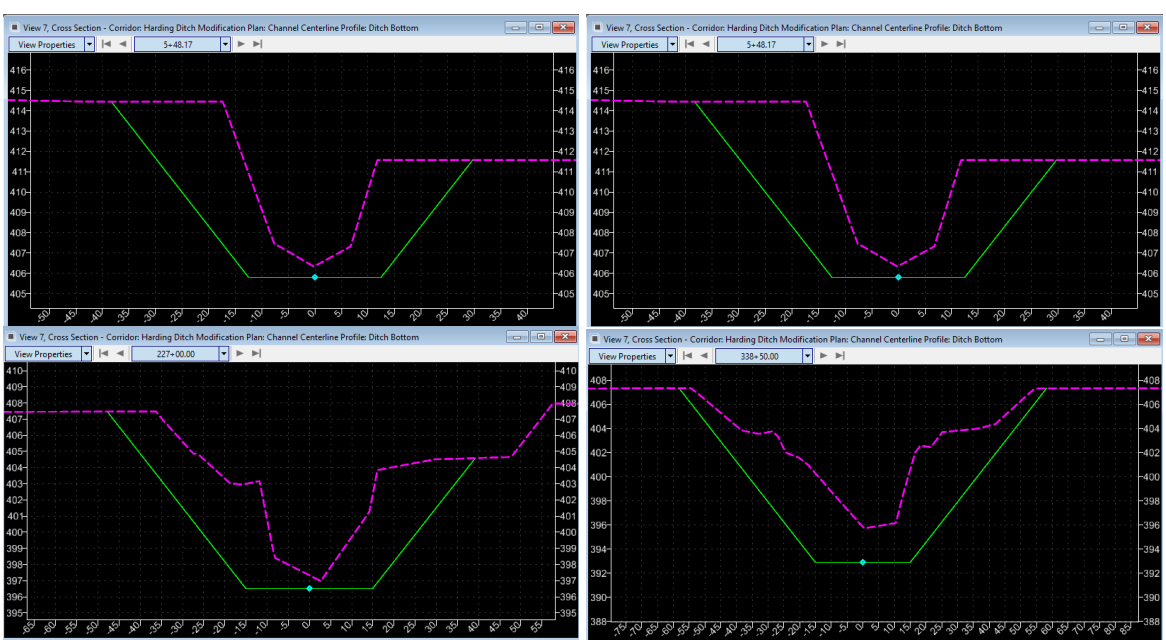

Figure 2-2. Harding Ditch Dredging Cross Sections at Select Stations

Figure 2-3. Harding Ditch Dredging Plan View

Figure 2-4. Harding Ditch Dredging Profile View

2.3 North Wetland Drainage Ditches

Alternative 4 includes a series of proposed ditches to convey water to Harding Ditch. The cross section dimensions and elevations were provided by H&H (see Appendix A) and the table below. Each ditch was modeled in CAD as corridors to estimate excavation quantities. 2019 Lidar was used as the existing terrain.

Table 2. North Wetland Ditch Dimensions

Name	Length (FT)	Base Width (FT)	Side Slope (_H:1V)	Inlet Elevation	Outlet Elevation	Excavation (BCY)
D99	416	5	3	408.5	408.0	755
NDNCO1-UNK8	651	4	3	408.7	409.0	886

NDNDJ2-CulvUnk13	545	5	3	408.7	408.5	974
NDOF50-NCI9	347	5	3	408.7	409.7	348

Figure 2-5. North Wetland Proposed Ditch Locations

2.4 Ditch Into Whispering Willow Lake

The horizontal and vertical geometries, as well as the cross section dimensions, for the proposed ditch into Whispering Willow Lake were provided by H&H (See Appendix A). The upstream end of the ditch starts at station 0+00 on the south side of Lake Dr. across from 62nd St. The ditch outlets at the edge of Whispering Willow Lake. There is 6 inches of fall across the 1,500 feet (0.04%). The trapezoidal cross section consists of an 8 FT bottom width with 3H:1V side slopes. A corridor model was created in CAD to estimate excavation volume.

The ditch fall will need to be re-evaluated during feasibility level design because of the exact edge of Whispering Willow Lake could not be determined from the terrain. A more ideal fall would be closer to 4 inches over 100 feet. Fall should be maximized to ensure adequate drainage.

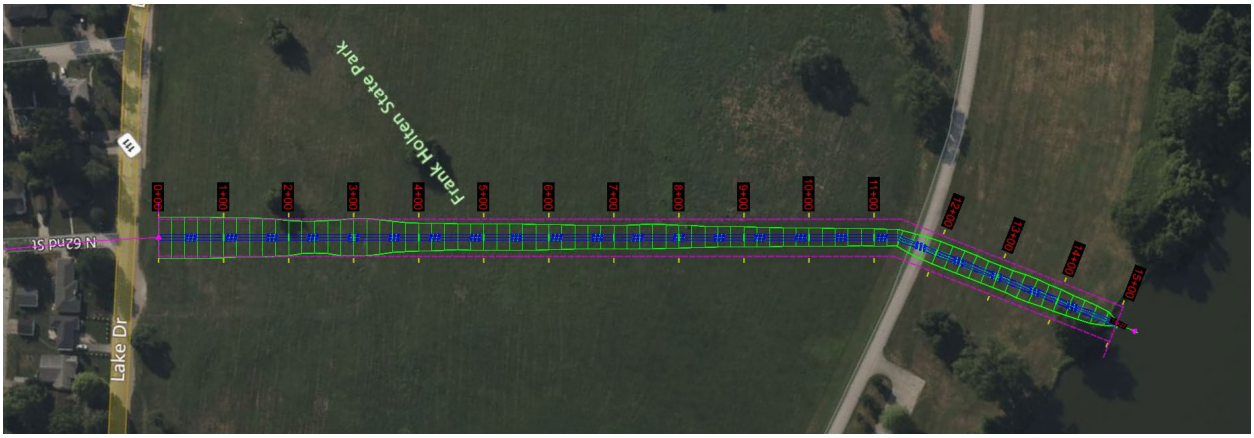

Figure 2-6. Ditch into Whispering Willow Lake Plan View

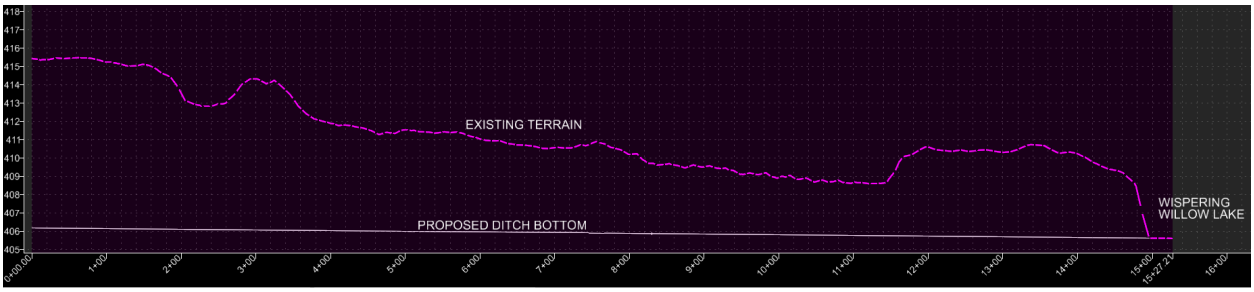

Figure 2-7. Ditch into Whispering Willow Lake Profile View

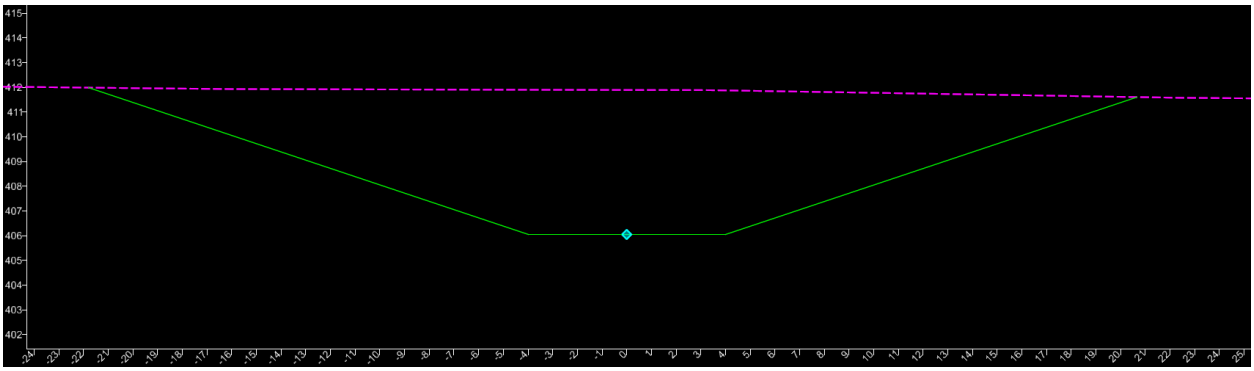

Figure 2-8. Ditch into Whispering Willow Lake Typical Cross Section

2.5 Wetland into Whispering Willow Lake

Proposed excavation contours were provided by H&H (See Appendix A). The contours were used to create a proposed terrain. The analyze volume tool was then used to estimate the excavation volume between the proposed and existing terrain models. The wetland excavation is approximately 23.8 acres with a typical depth below existing grade of 8 FT.

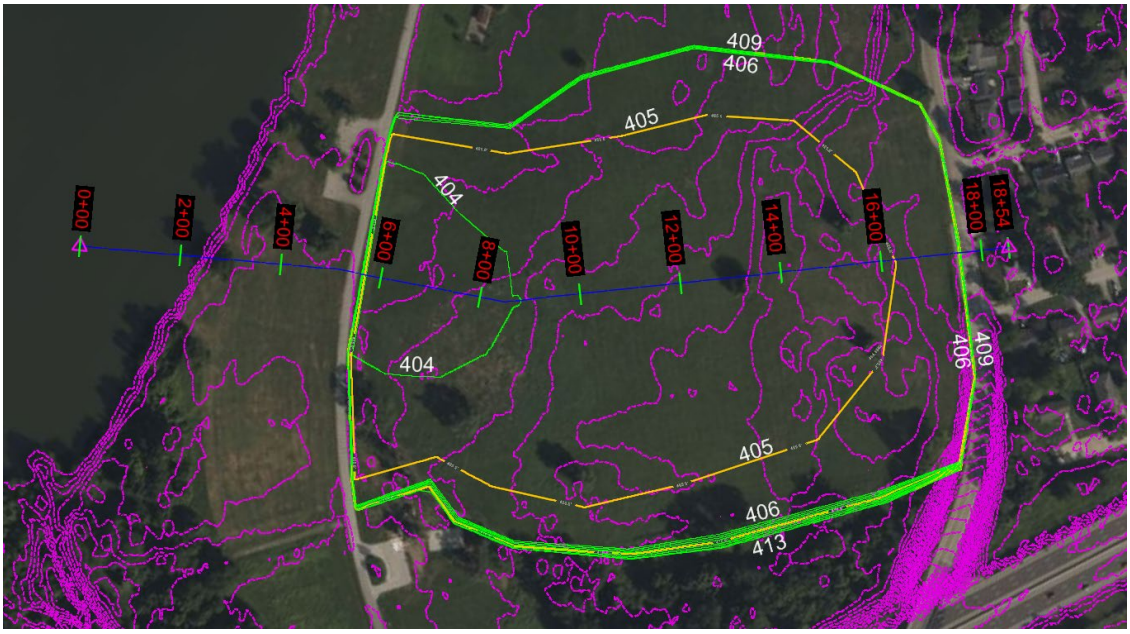

Figure 2-9. Wetland into Whispering Willow Lake Plan View

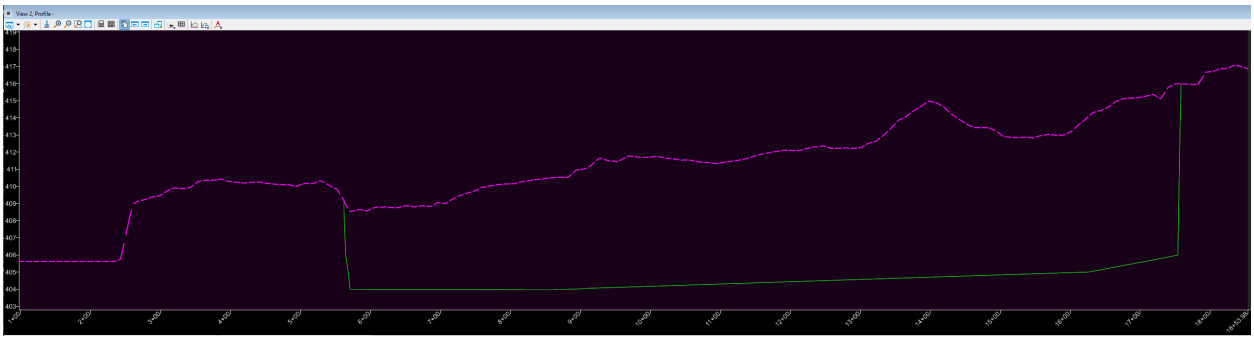

Figure 2-10. Wetland into Whispering Willow Lake Profile View Along Flow Path

3.0 Roadwork

		North Wetland Area (Summit Avenue)				Area North of State Street		Piat Place Neighborhood			Harding Ditch			
		Low			High	Low	High	Low	High	Medium	Low	Medium	High	
		Raise Summit Ave (10 Year)	*Raise Summit Ave (25 Year)*	*Raise Summit Ave (100 Year)*	*Re-establish Drainage Through North Wetland*	*Area Draining Around Interstate 255 and State Street*	*Area Draining Around Interstate 255 and State Street Plus Streets to the West*	*Piat Place South to Ditch into Whispering Willow Lake*	*Piat Place East Under Interstate 255*	*Piat Place South to Wetland that Empties into Whispering Willow Lake*	*Dredge/Widen with no pump stations*	*Dredge and add one South Pump Station*	*Dredge and add Two Additional Pumps to the South Pump Station*	
		1A	1B	1C	2	3	4	5	6	7	8	9	10	*Units*
Road Work	Subbase	149	258	352										*CCY*
	Asphalt Paving	487	809	1,147										*CCY*

Figure 3-1. Summary of Roadwork Quantities

3.1. Raise Summit Avenue – Initial Concept

H&H provided elevations and extents to raise the surface of Summit Ave for alternatives 1A, 1B, and 1C aligning with the 10% AEP, 4% AEP, and 2% AEP storm events respectively. 2019 LiDAR was uses as the existing terrain. An asphalt road corridor template matching the 24-foot width of the existing road was applied to the proposed vertical geometry to estimate quantities for asphalt, subbase, and embankment. The proposed road cross section consists of 0.4 FT of asphalt thickness and 0.5 FT of subbase.

It is assumed that no road removal would be done and that the raised road would just be placed on top of the existing road surface. Where the corridor model assumed the existing road would be cut to make way for the proposed road cross section, quantities were manually corrected to subtract that cut volume from the estimated subbase volume. Where less than 0.4 FT of elevation gain is needed, over-paving of the existing asphalt without adding subbase is assumed.

Figure 3-2. Proposed Summit Ave Raise Plan View

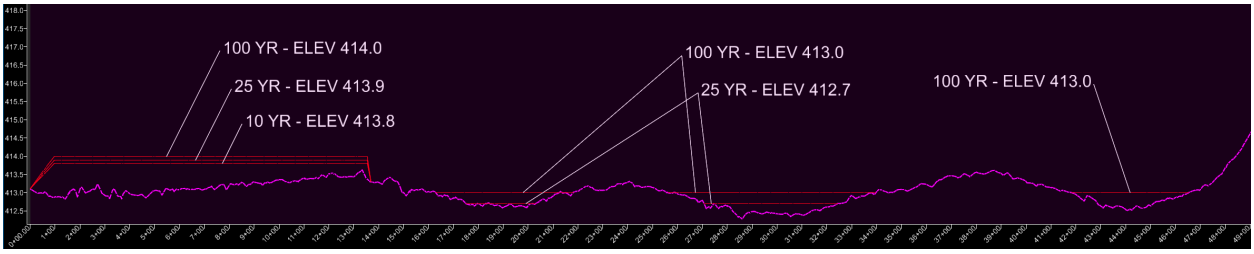

Figure 3-3. Proposed Summit Ave Raise Profile

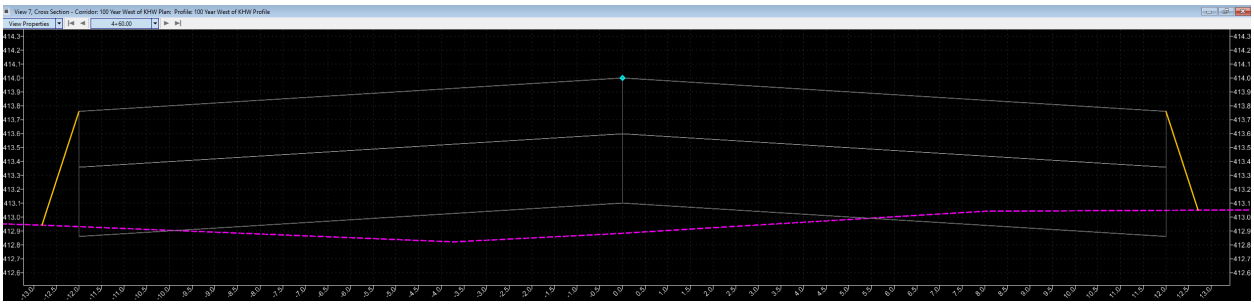

Figure 3-4. Typical Road Cross Section of Summit Ave Raise

3.2. Raise Summit Avenue – Additional Design

After initial assessment of the road raise concept, it was determined that vertical curvature should be considered to ensure that the cost estimate and associated efforts were properly captured. The design profiles for each storm event were adjusted to incorporate vertical curvature, and the western segment near Kingshighway was extended to tie into high ground.

Vertical curvature was calculated based on visual assessment, and on the Illinois Department of Transportation (IDOT), Bureau of Local Roads & Streets Manual, Chapter 30. The minimum vertical curve for Summit Ave (posted speed of 40 mph, assumed design speed of 50 mph) was 150 feet or 96 feet for each percent of grade (Rate of Vertical Curvature, K). Given the minimal elevation changes, the 150 feet was considered the controlling value for determining minimum curvature, though curve lengths in excess of this value were selected for use in estimating extents of work and associated costs. It should be noted that not all of the existing vertical curves match these requirements, and correcting any curves not impacted by the road raise is assumed to be outside of the scope of any proposed project resulting from this study.

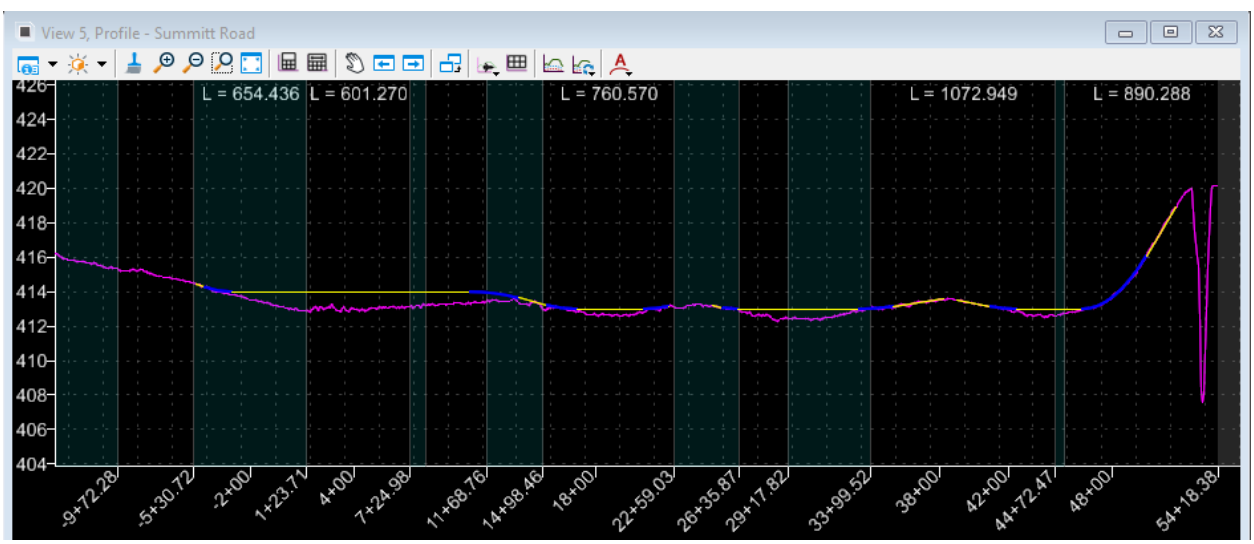

Figure 3-5: Summit Road Profiles - 1% AEP Storm

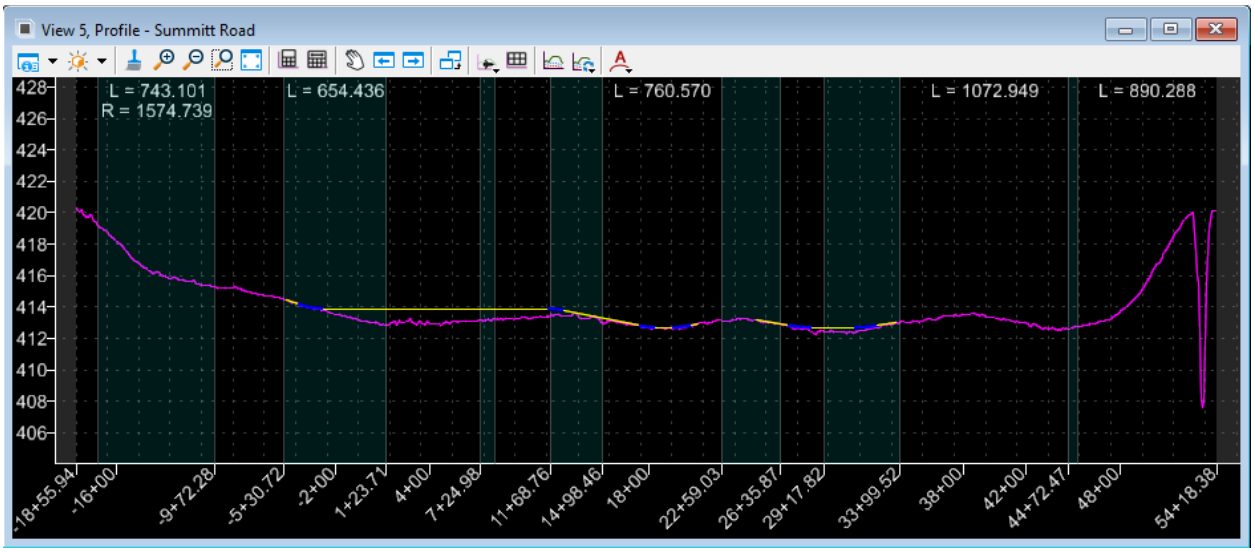

Figure 3-6: Summit Road Profiles - 4% AEP Storm

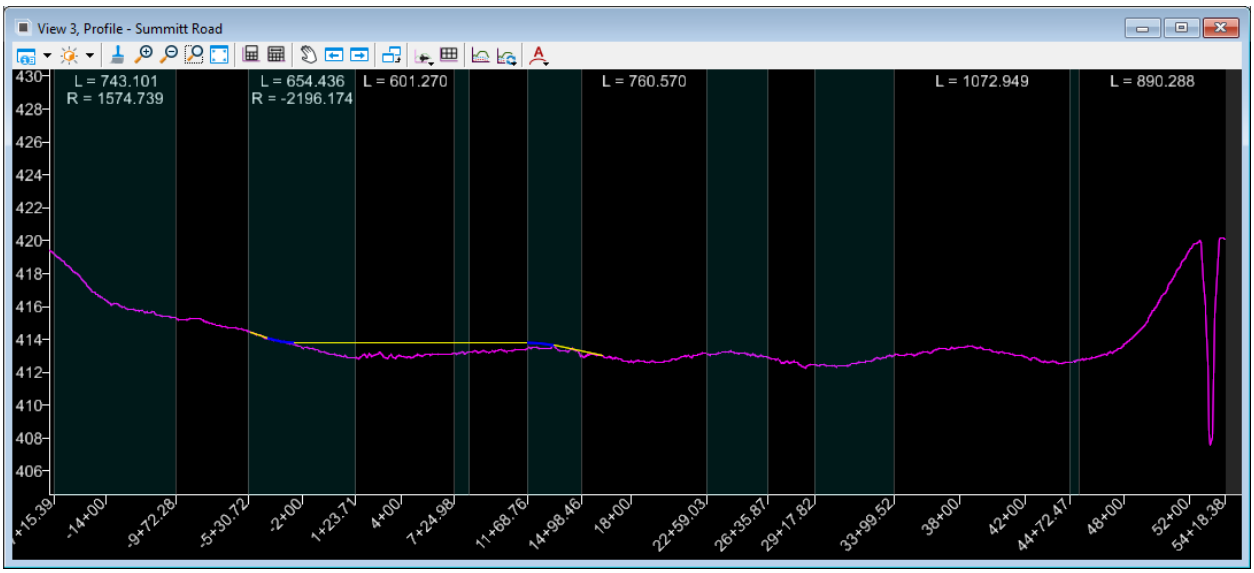

Figure 3-7: Summit Road Profiles - 10% AEP Storm

4.0 Pump Stations

		North Wetland Area (Summit Avenue)				Area North of State Street		Piat Place Neighborhood			Harding Ditch			
		Low			High	Low	High	Low	High	Medium	Low	Medium	High	
		Raise Summit Ave (10 Year)	*Raise Summit Ave (25 Year)*	*Raise Summit Ave (100 Year)*	*Re-establish Drainage Through North Wetland*	*Area Draining Around Interstate 255 and State Street*	*Area Draining Around Interstate 255 and State Street Plus Streets to the West*	*Piat Place South to Ditch into Whispering Willow Lake*	*Piat Place East Under Interstate 255*	*Piat Place South to Wetland that Empties into Whispering Willow Lake*	*Dredge/Widen with no pump stations*	*Dredge and add one South Pump Station*	*Dredge and add Two Additional Pumps to the South Pump Station*	
		1A	1B	1C	2	3	4	5	6	7	8	9	10	*Units*
Pump Stations	30 CFS Pump Station				1									*EA*
	100 CFS Pump Station					1								*EA*
	110 CFS Pump Station								1					*EA*
	131.5 CFS Pump Station											1	2	*EA*
	175 CFS Pump Station						1							*EA*

Figure 4-1. Summary of Pump Station Quantities

The quantity and capacity of pump stations for each alternative were provided by H&H (see Appendix A).

5.0 Storm Sewer Improvements

		North Wetland Area (Summit Avenue)				Area North of State Street		Piat Place Neighborhood			Harding Ditch			
		Low			High	Low	High	Low	High	Medium	Low	Medium	High	
		Raise Summit Ave (10 Year)	*Raise Summit Ave (25 Year)*	*Raise Summit Ave (100 Year)*	*Re-establish Drainage Through North Wetland*	*Area Draining Around Interstate 255 and State Street*	*Area Draining Around Interstate 255 and State Street Plus Streets to the West*	*Piat Place South to Ditch into Whispering Willow Lake*	*Piat Place East Under Interstate 255*	*Piat Place South to Wetland that Empties into Whispering Willow Lake*	*Dredge/Widen with no pump stations*	*Dredge and add one South Pump Station*	*Dredge and add Two Additional Pumps to the South Pump Station*	
		1A	1B	1C	2	3	4	5	6	7	8	9	10	*Units*
Trenching	Asphalt Saw Cut				2,456	5,455	19,861	7,089	4,074	7,089				*FT*
	Asphalt Removal				121	266	1,106	579	278	579				*BCY*
	Trench Excavation				1,583	4,080	13,525	6,703	4,875	6,703				*BCY*
	Removal of Existing CMP				-	1,670	2,709	2,709	2,075	2,709				*FT*
	Bedding Stone				2,689	3,406	12,499	12,499	8,488	12,499				*TN*
Ciricular Pipe Installation	9 IN Diameter Circular RCP				279									*FT*
	12 IN Diameter Circular RCP					441	576							*FT*
	15 IN Diameter Circular RCP					90	28	135	135	135				*FT*
	18 IN Diameter Circular RCP					86	182	135	135	135				*FT*
	21 IN Diameter Circular RCP						28		243					*FT*
	24 IN Diameter Circular RCP				326	324	425	380		380				*FT*
	27 IN Diameter Circular RCP						622	583	583	583				*FT*
	30 IN Diameter Circular RCP					143	186	155	155	155				*FT*
	33 IN Diameter Circular RCP						203	123	123	123				*FT*
	36 IN Diameter Circular RCP				1,027	400	704	517	46	517				*FT*
	39 IN Diameter Circular RCP							220		220				*FT*
	42 IN Diameter Circular RCP					617	1,035	61	347	61				*FT*
	45 IN Diameter Circular RCP						394							*FT*
	48 IN Diameter Circular RCP					583	60							*FT*
	51 IN Diameter Circular RCP						1,083							*FT*
	54 IN Diameter Circular RCP					60	729							*FT*
	60 IN Diameter Circular RCP					270	354							*FT*
	72 IN Diameter Circular RCP				320									*FT*
Arch Pipe Installation	60 IN Span Arch RCP					276	276							*FT*
	72 IN Span Arch RCP					180	357							*FT*
	84 IN span Arch RCP						557							*FT*
	96 IN span Arch RCP				327									*FT*
	108 IN Span Arch RCP							65	32	65				*FT*
	120 IN Span Arch RCP							32	1,541	32				*FT*
	132 IN Span Arch RCP							1,435		1,435				*FT*
Trench Backfill	Trench Fill				8	1,972	5,662	146	9	146				*CCY*
	Subbase in Trench				121	266	1,106	579	278	579				*CCY*
	Asphalt Replacment over Trench				121	266	1,106	579	278	579				*CCY*
Sewer Cleanout	Cleanout Existing Strom Sewer					235	313							*FT*
Jack and Bore	Jack and Bore 10 FT Diameter ARCH Pipe								247					*FT*
Concrete Structures	Ditch Inlet Section				4	0	0	0	25	0				*EA*
	Area Inlet				3	0	9	1		1				*EA*
	Flared End Section				4	0	0	1		1				*EA*
	Manhole				6	21	39	13		13				*EA*
	Curb Inlet				0	5	16	10		10				*EA*
	Average Structure Depth				*3*	*7*	*6*	*4*	*5*	*4*				*FT*
	Average Structure Interior Diameter				*6*	*4*	*5*	*7*	*7*	*7*				*FT*

Figure 5-1. Summary of Storm Sewer Improvement Quantities

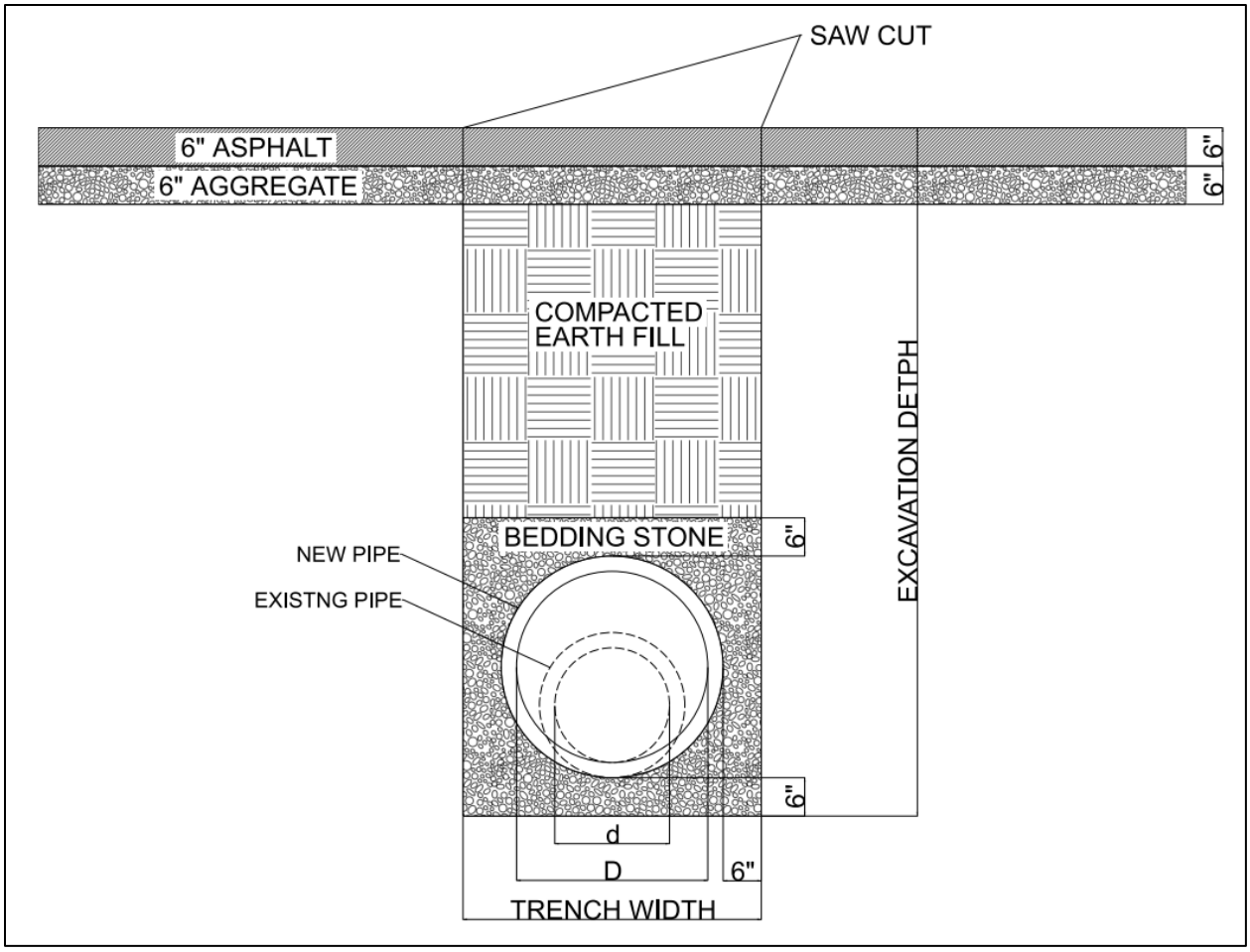

Figure 5-2. Typical Pipe Replacement Cross Section

5.1 Trench Excavation

Trench excavation and removal quantities were estimated by assuming a typical cross sectional area of asphalt and general excavation and applying that to the length of each pipe. The trench width assumed 6 inches of clearing on both sides of the larger pipe, as well as below the pipe to allow for installation and placement of bedding stone. Where pipes run under existing asphalt, it was assumed to require saw cut on both sides of the trench with 6 inches of asphalt thickness.

5.2 Pipe Installation

Where existing pipes are proposed to be replaced with larger pipes, the exiting pipe is removed and replaced with the new pipe in the same trench. Pipe diameters, shapes, and depths were provided by H&H (See Appendix A). Pipe shapes are either circular or arched depending on available depth and intended conveyance.

5.3 Trench Backfill

Bedding stone is assumed to be placed on all sides of the pipe within the trench, as well as 6 inches above the pipe. Where there is sufficient depth, compacted fill is placed to the surface unless the pipe is under asphalt, in which case 6 inches of aggregate base and 6 inches of

asphalt are placed on top. Quantities were estimated by calculating the cross sectional area of these respective components and multiplying them by the pipe length.

5.4 Sewer Cleanout

Sewers found to be filled with sediment are proposed to be cleaned out. Quantities for these instances are provided in linear feet of pipe.

5.5 Jack and Bore

Alternative 6 proposes the outfall of the pipe network pass under I-255 to Harding ditch. Jack and Bore of this pipe segment is assumed to be the most efficient installation method for this segment. Quantity for this item is provided in linear feet of pipe.

5.6 Concrete Structures

Five different types of precast concrete storm structures are proposed:

1. Ditch inlet (similar to area inlets, but with a trash rack affixed)
2. Area inlets
3. Flared end sections
4. Manhole
5. Curb Inlet

An average depth for each alternative was estimated based on average invert depth for all pipes for that alternative. This average depth was then applied uniformly to all area inlets, manholes, and curb inlets for each respective alternative for cost estimating purposes. Similarly, an average interior structure diameter was assumed by averaging all pipe diameters for each alternative then adding one foot in diameter. This average diameter was applied uniformly to all area inlets, manholes, and curb inlets.

6.0 Turf Establishment

		North Wetland Area (Summit Avenue)				Area North of State Street		Piat Place Neighborhood			Harding Ditch			
		Low			High	Low	High	Low	High	Medium	Low	Medium	High	
		Raise Summit Ave (10 Year)	*Raise Summit Ave (25 Year)*	*Raise Summit Ave (100 Year)*	*Re-establish Drainage Through North Wetland*	*Area Draining Around Interstate 255 and State Street*	*Area Draining Around Interstate 255 and State Street Plus Streets to the West*	*Piat Place South to Ditch into Whispering Willow Lake*	*Piat Place East Under Interstate 255*	*Piat Place South to Wetland that Empties into Whispering Willow Lake*	*Dredge/Widen with no pump stations*	*Dredge and add one South Pump Station*	*Dredge and add Two Additional Pumps to the South Pump Station*	
		1A	1B	1C	2	3	4	5	6	7	8	9	10	*Units*
Soil Stabilization	Seed and Straw (Cool Season Grass)				1.1						70.7	70.7	70.7	*AC*
	Seed and Straw (Native mix)							1.4		23.8				*AC*

Figure 6-1: Summary of Turf Establishment

Disturbance footprints were measured for each excavation area in CAD and converted to acres. All ditch excavations are seeded with a cool season grass mixture. The south wetland and ditch into Whispering Willow Lake are seeded with a native seed mixture.