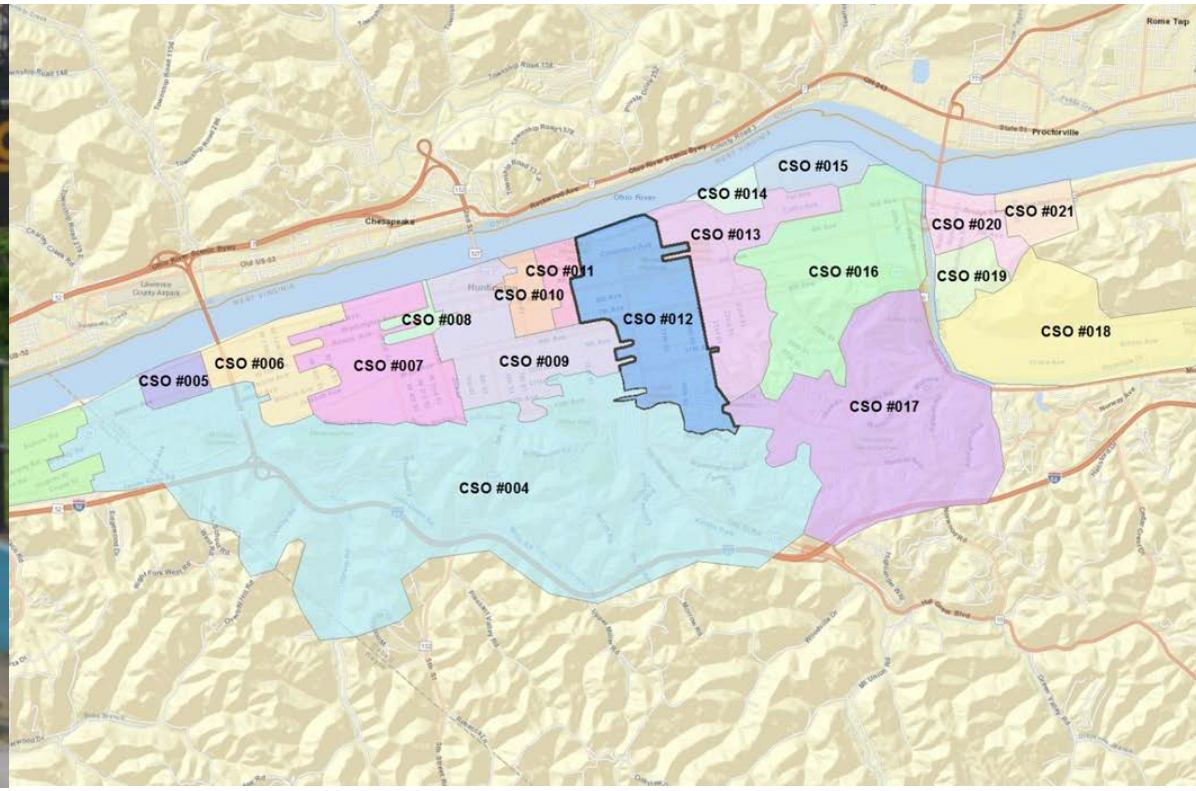
ALTERNATIVES FOR STREET FLOOD MITIGATION PLAN
CITY OF HUNTINGTON CASE STUDY

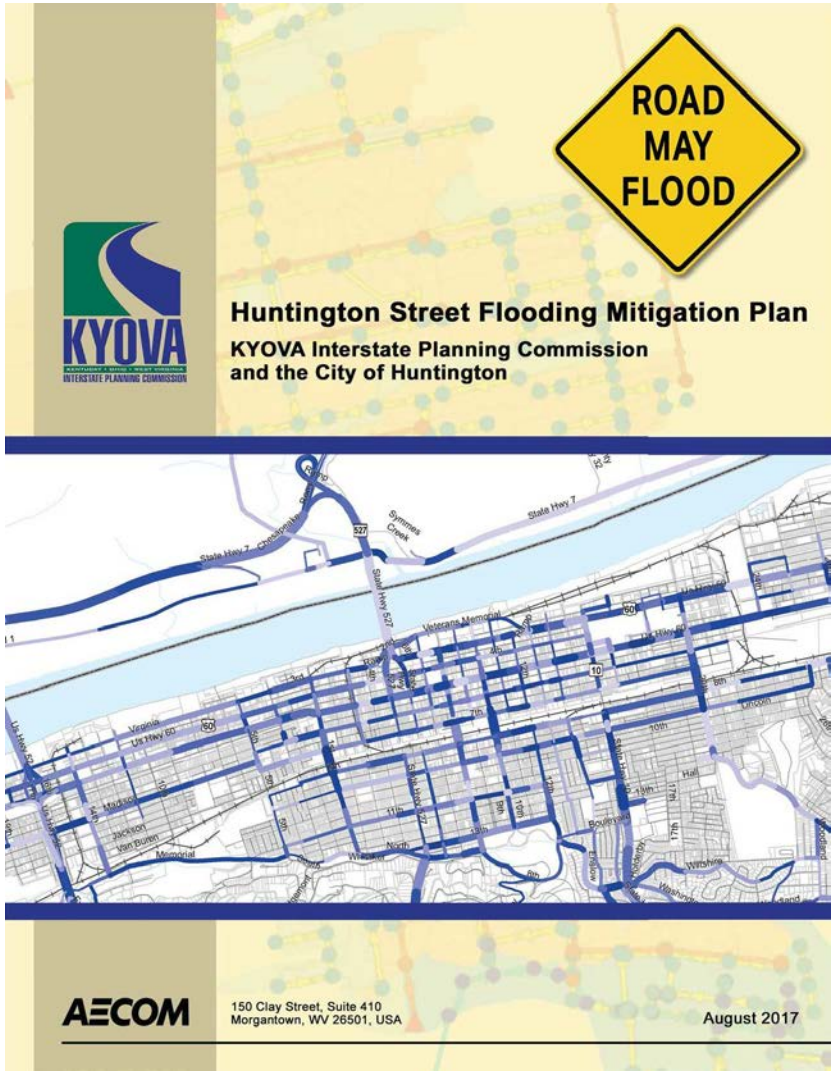


2018 OHIO STORMWATER CONFERENCE 11th Annual

Presentation Outline

- Introduction
- Project Overview
- Goals and Objectives
- System Deficiencies
- Existing Conditions H&H Analysis
- Development of Alternatives/Alternatives Analysis
- Conclusions

Project Introduction



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INTERSTATE PLANNING COMMISSION

CITY OF HUNTINGTON

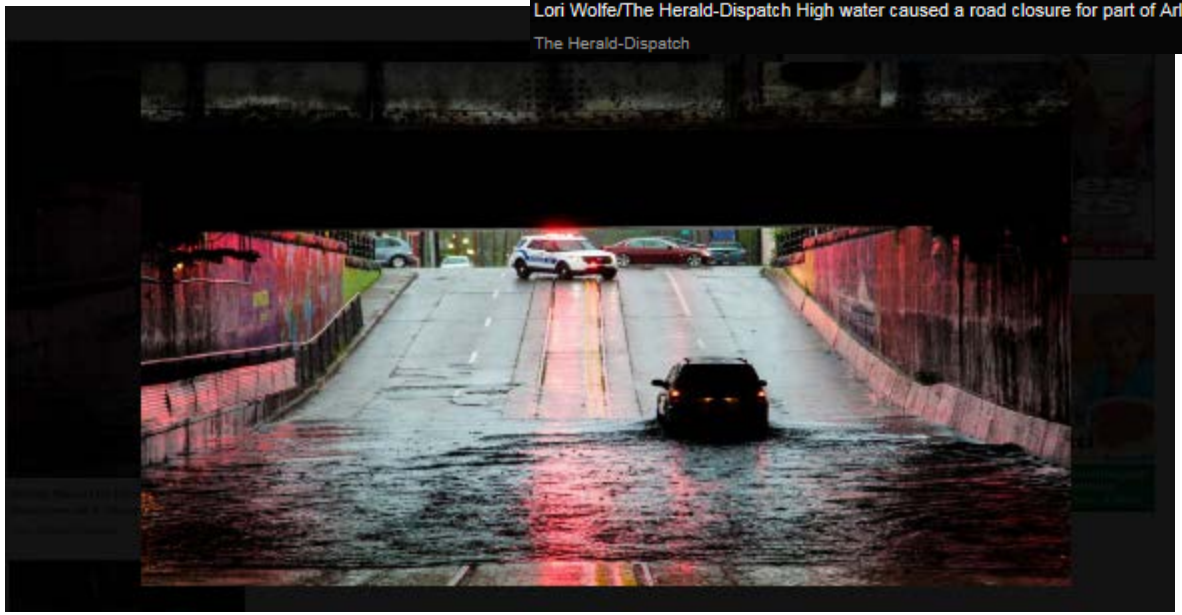
MARSHALL

Flooding in Underpasses

- Drainage System lacks Capacity, CSO flooding in underpasses
- Flooding in north-south and east-west connectors
- Flooding of major connector streets, including U.S. 60 and the underpasses
- Safety concerns are amplified, as emergency service vehicles are unable to respond quickly due to the shutdown of the network
- The repeated stormwater problems put immense stress on driving surfaces and hillsides, often causing closures throughout the city

Lori Wolfe/The Herald-Dispatch High water caused a road closure for part of Arlington Blvd., Friday, Feb. 16, 2018, in Huntington.

The Herald-Dispatch



Bishop Nash/The Herald-Dispatch A car attempts to cross the high floodwaters that forced close the 8th Street underpass as a heavy thunderstorm rolls into Huntington on Monday, July 13, 2015.

Goals and Objectives of Study

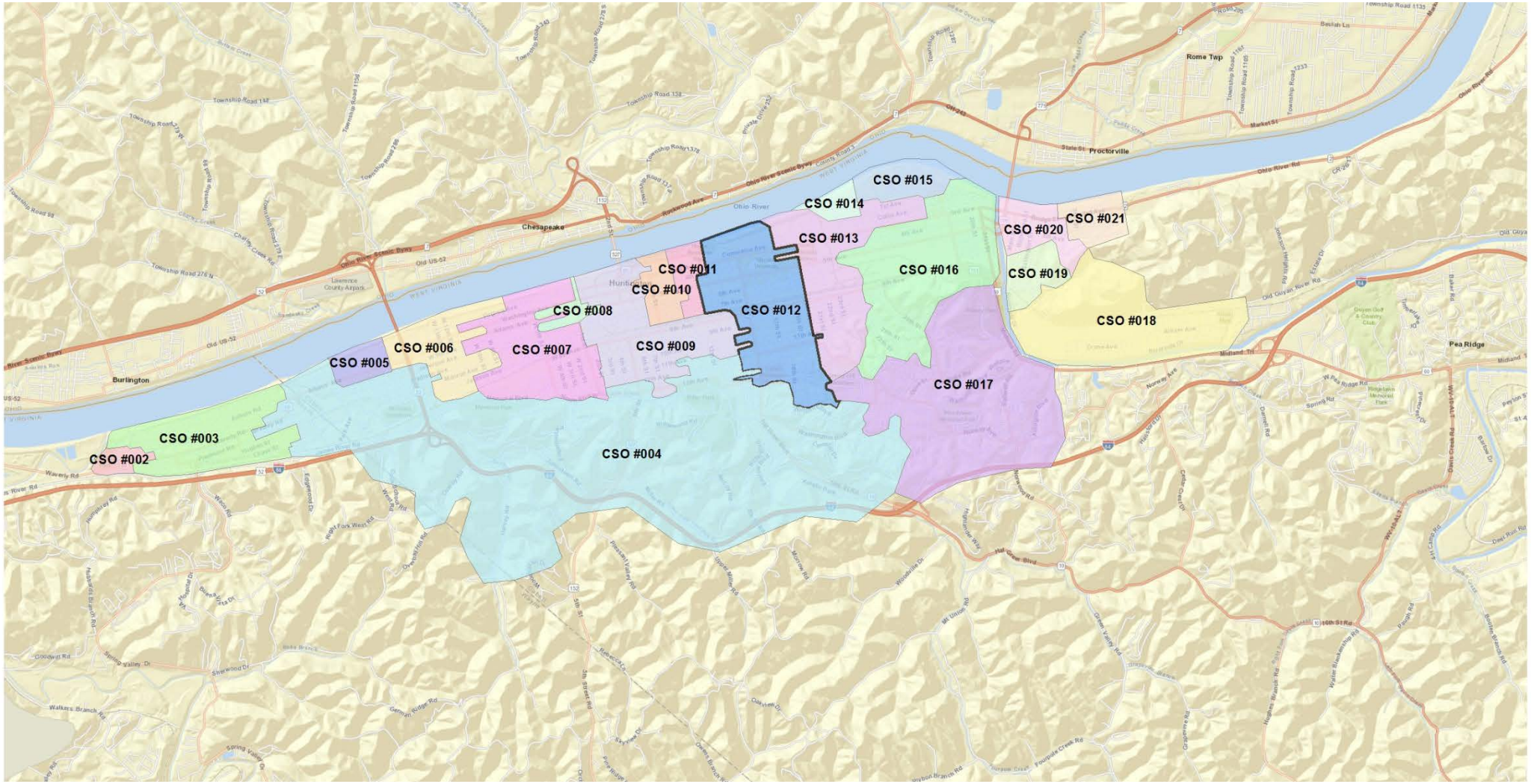
The overall plan will address three interrelated issues and their impacts to the transportation network:

- Flooding in five (5) underpasses at 1st Street, 8th Street, 10th Street, 16th Street, and 20th Street
- Street flooding (5th Avenue and 3rd Avenue (U.S.60) in particular)
- Standing water that deteriorates driving surfaces

Huntington Sanitary Board Long Term Control Plan

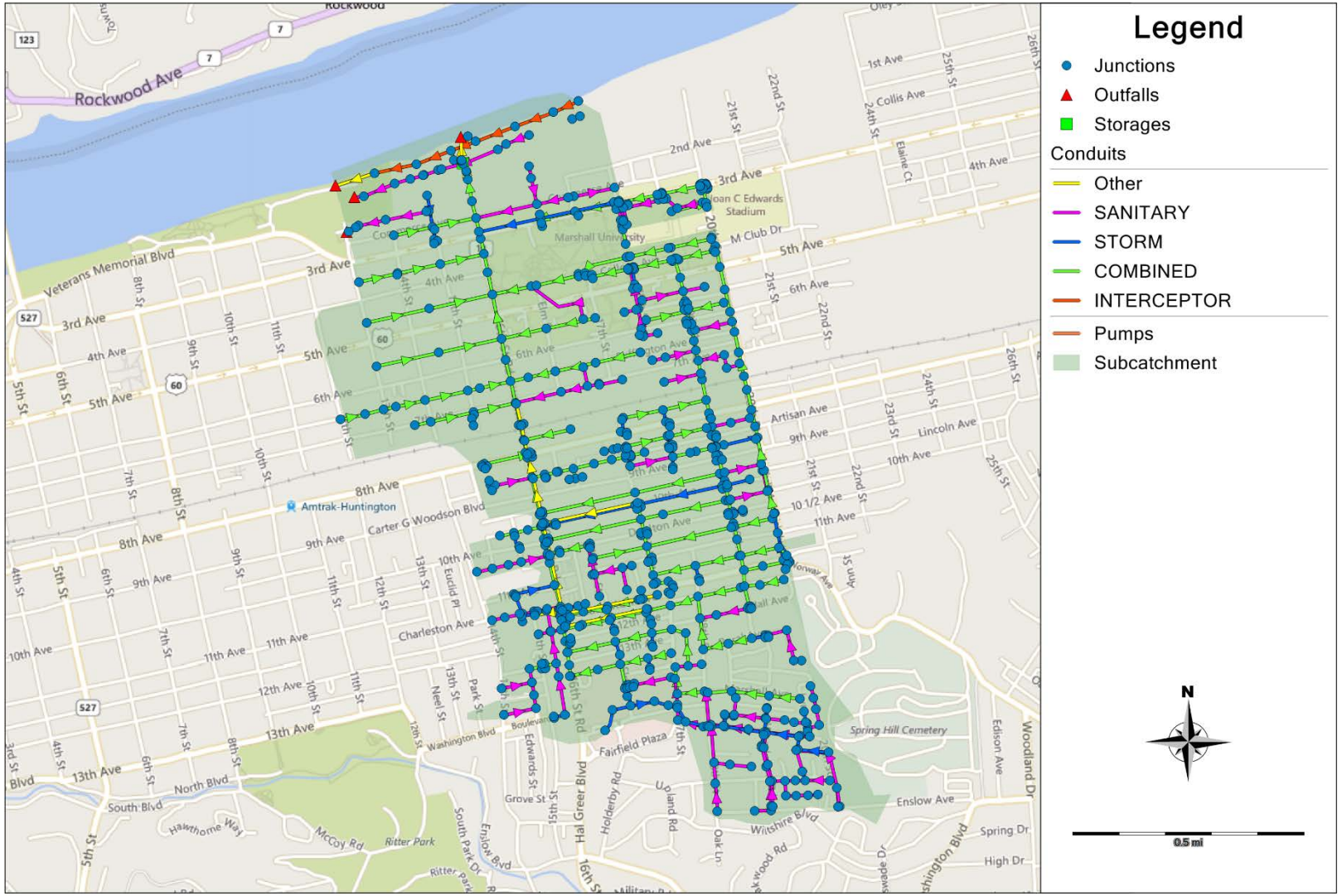
- LTCP for USEPA/ WV DEP
- CSO and water quality goals
- The 16th Street (Hal Greer Boulevard) Regulator (012) is located on the river side of the levee upstream of Harris Riverfront Park
- 16th Street Regulator and CSO overflows is a priority for HSB.
- 16th Street CSO Weir is within the flood protected area.

Project Location Map

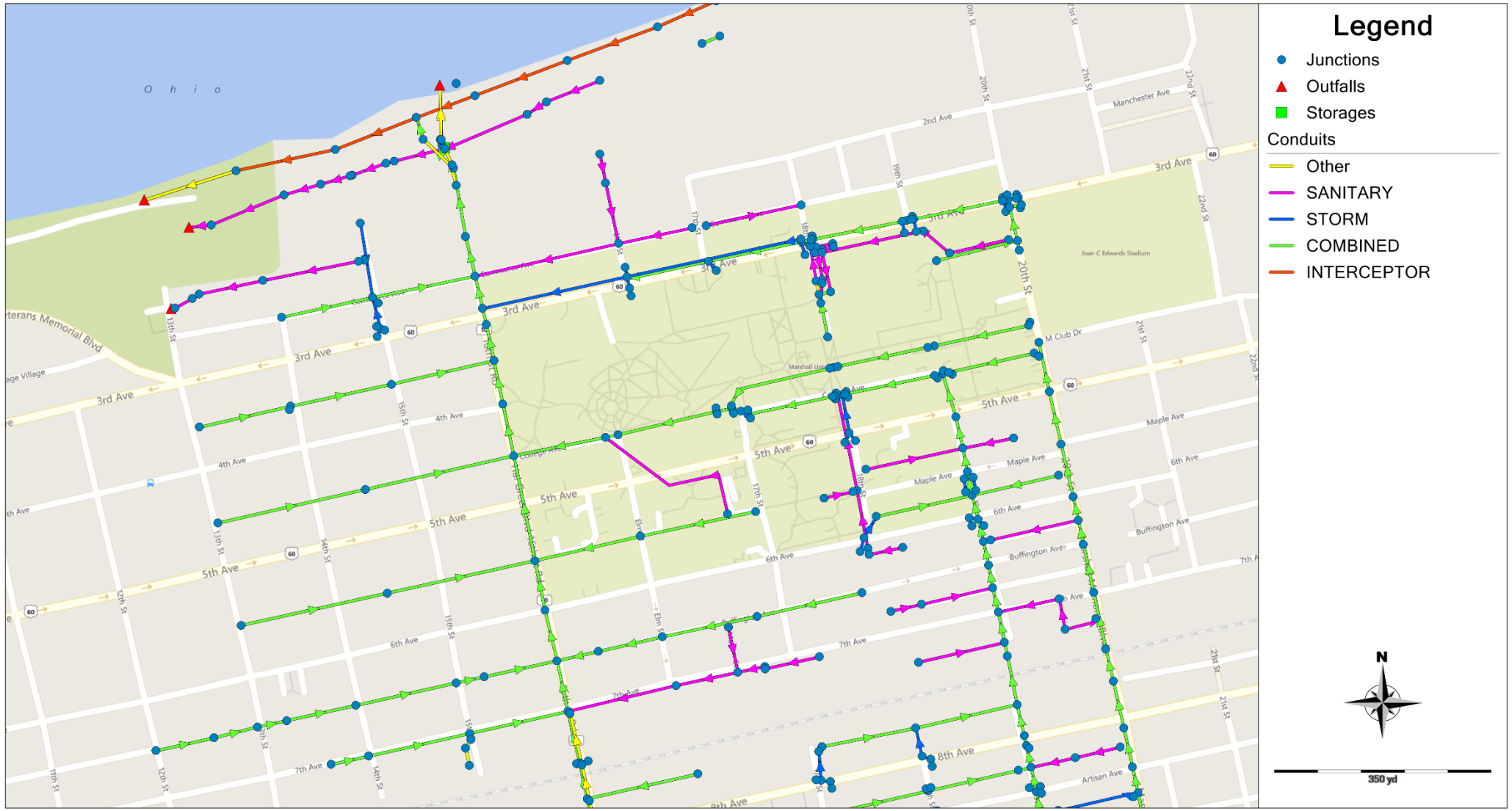


Storm Sewer and Outfalls Map

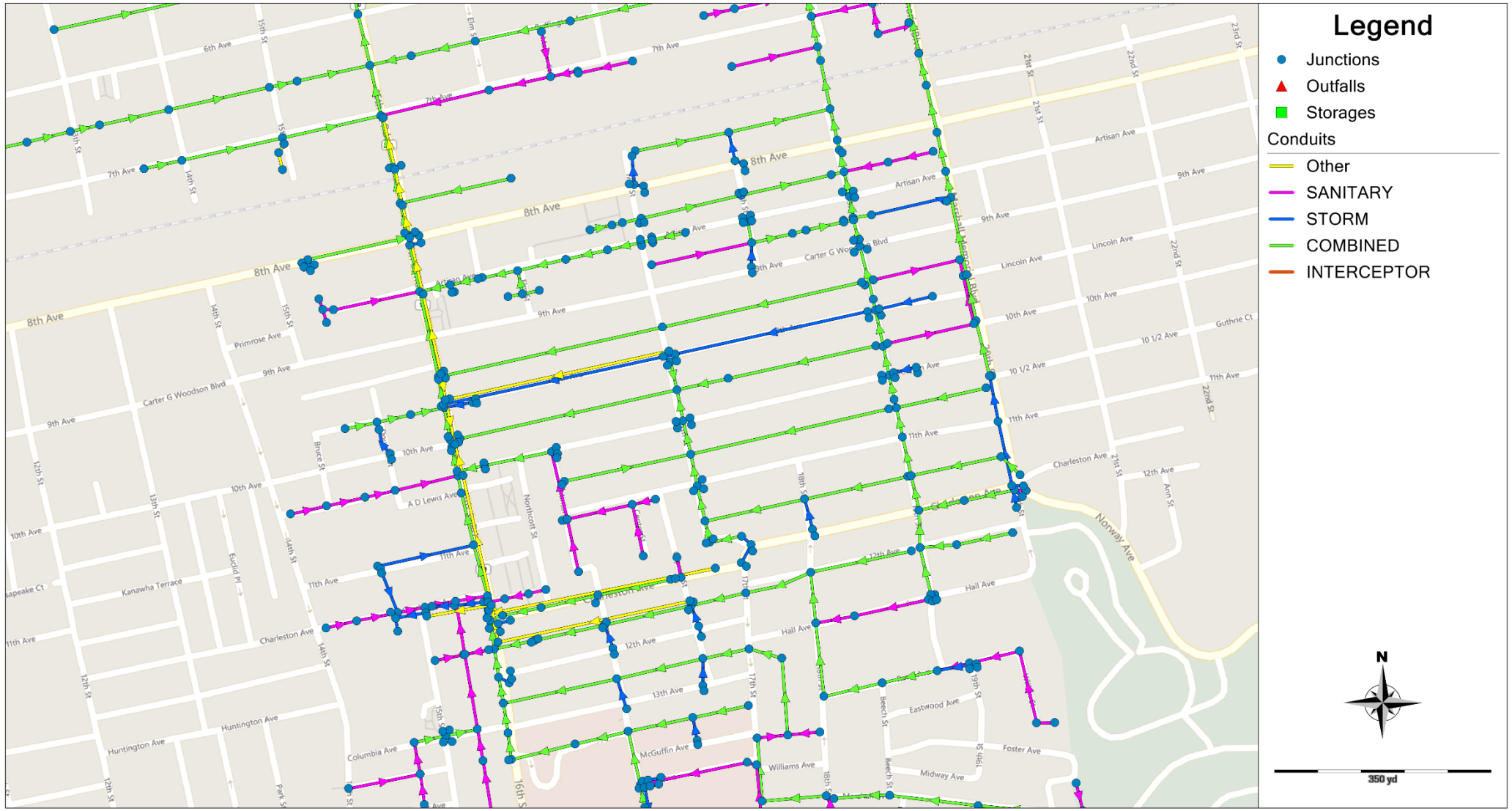
- Storm Sewer System century old and is combined
- Long-standing flooding issues
- Flooding related to system capacity
- Combined sewer flooding in roads and Underpasses



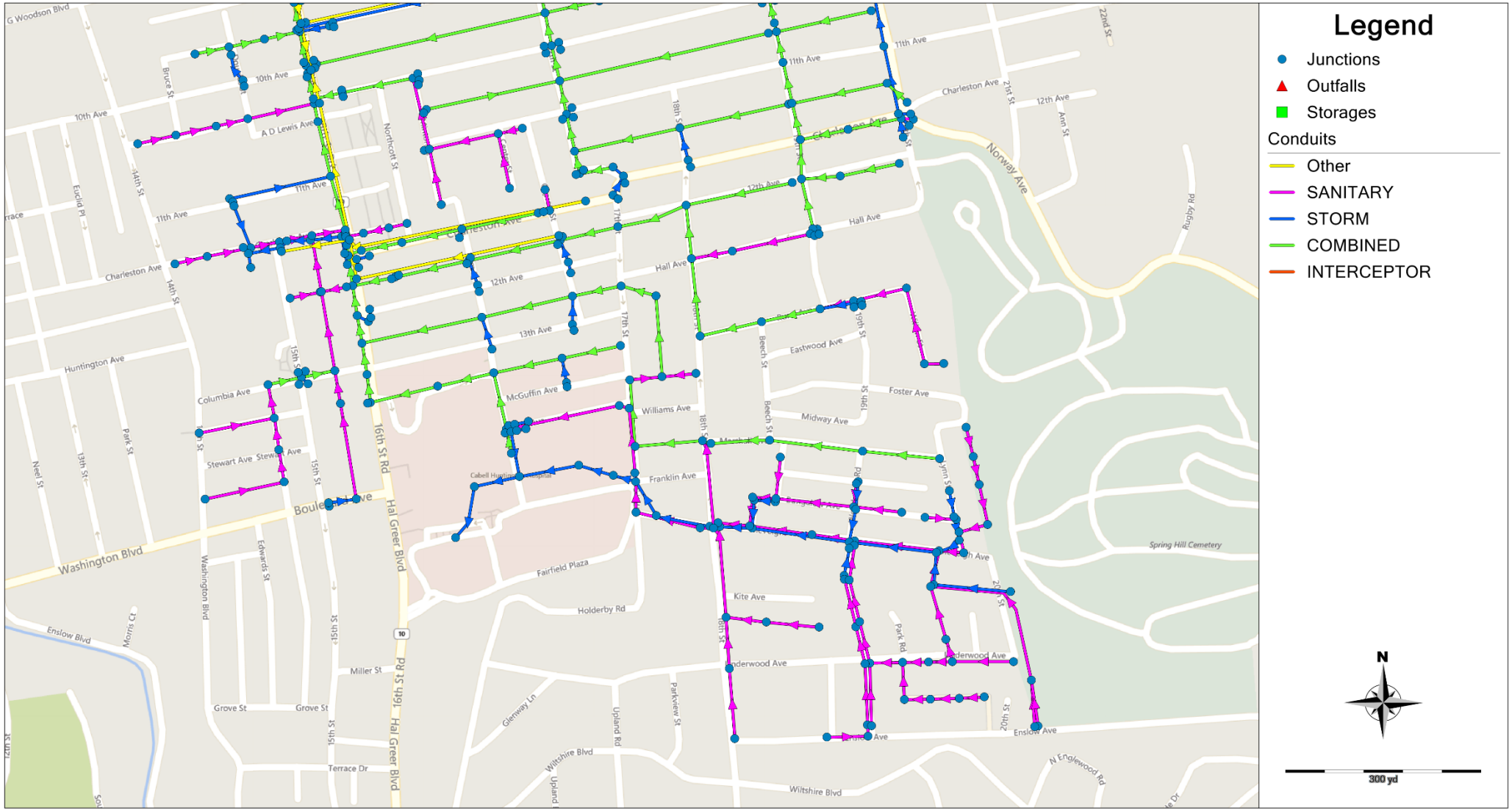
Storm Sewer Map - Downstream



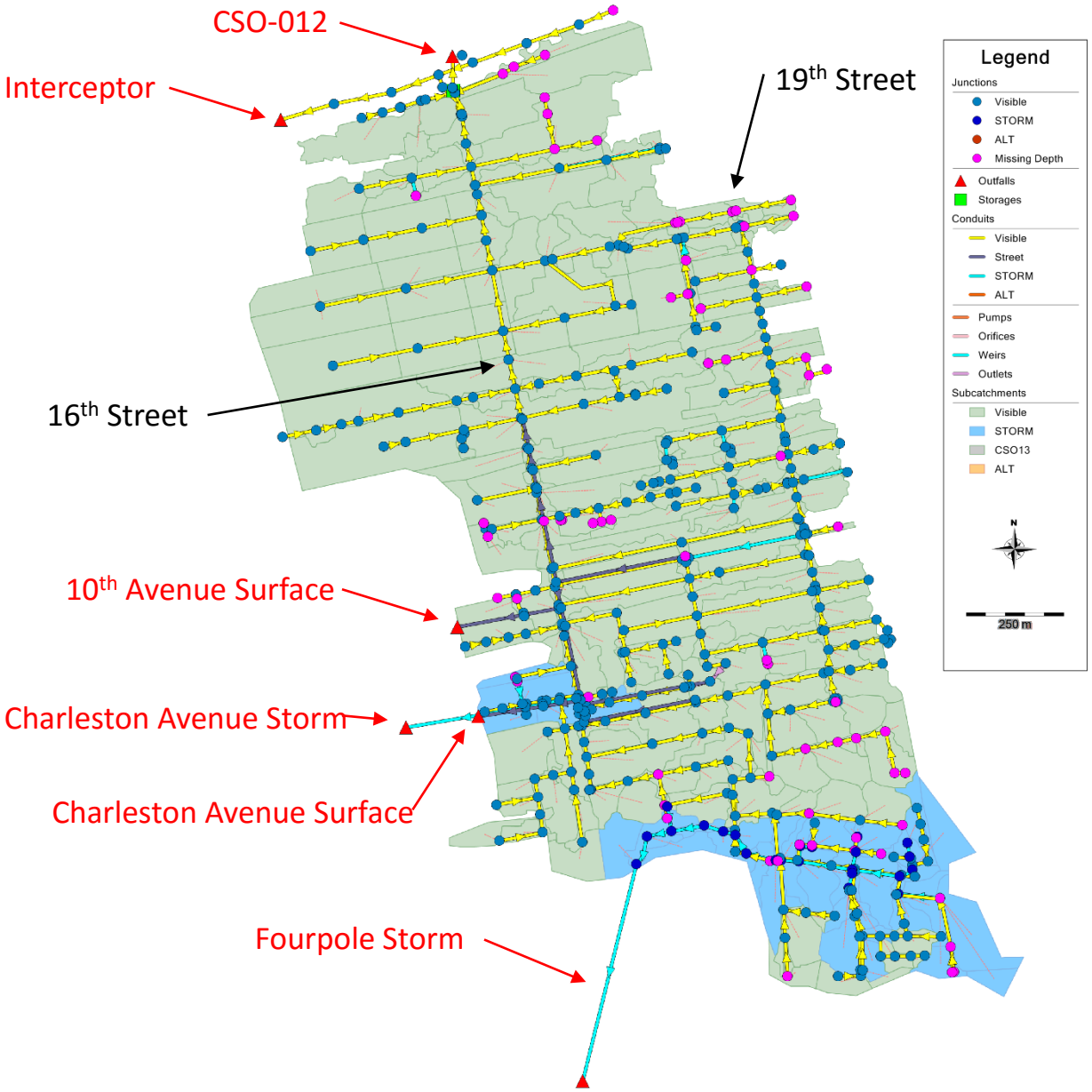
Storm Sewer Map - Middle



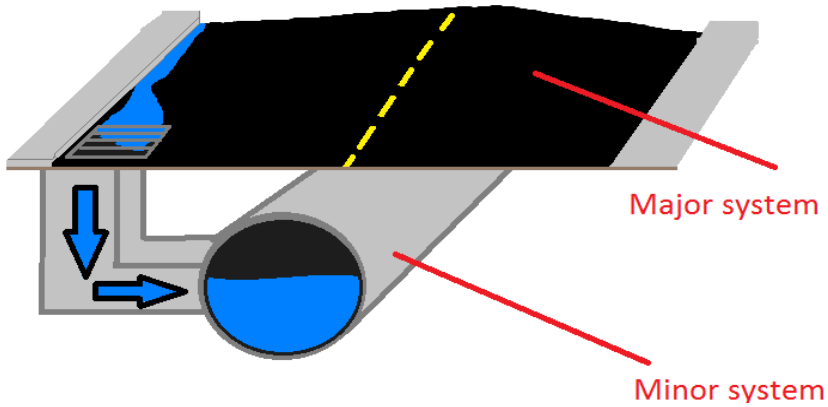
Storm Sewer Map - Upstream

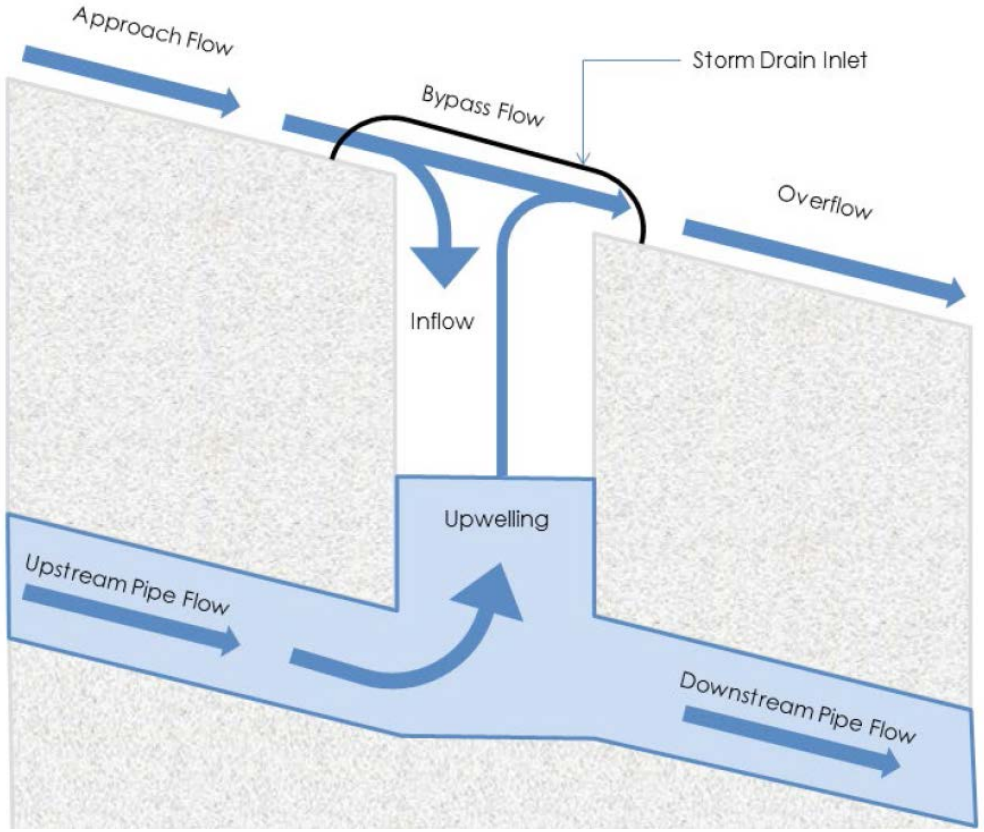


Existing System Configuration



Existing System Configuration

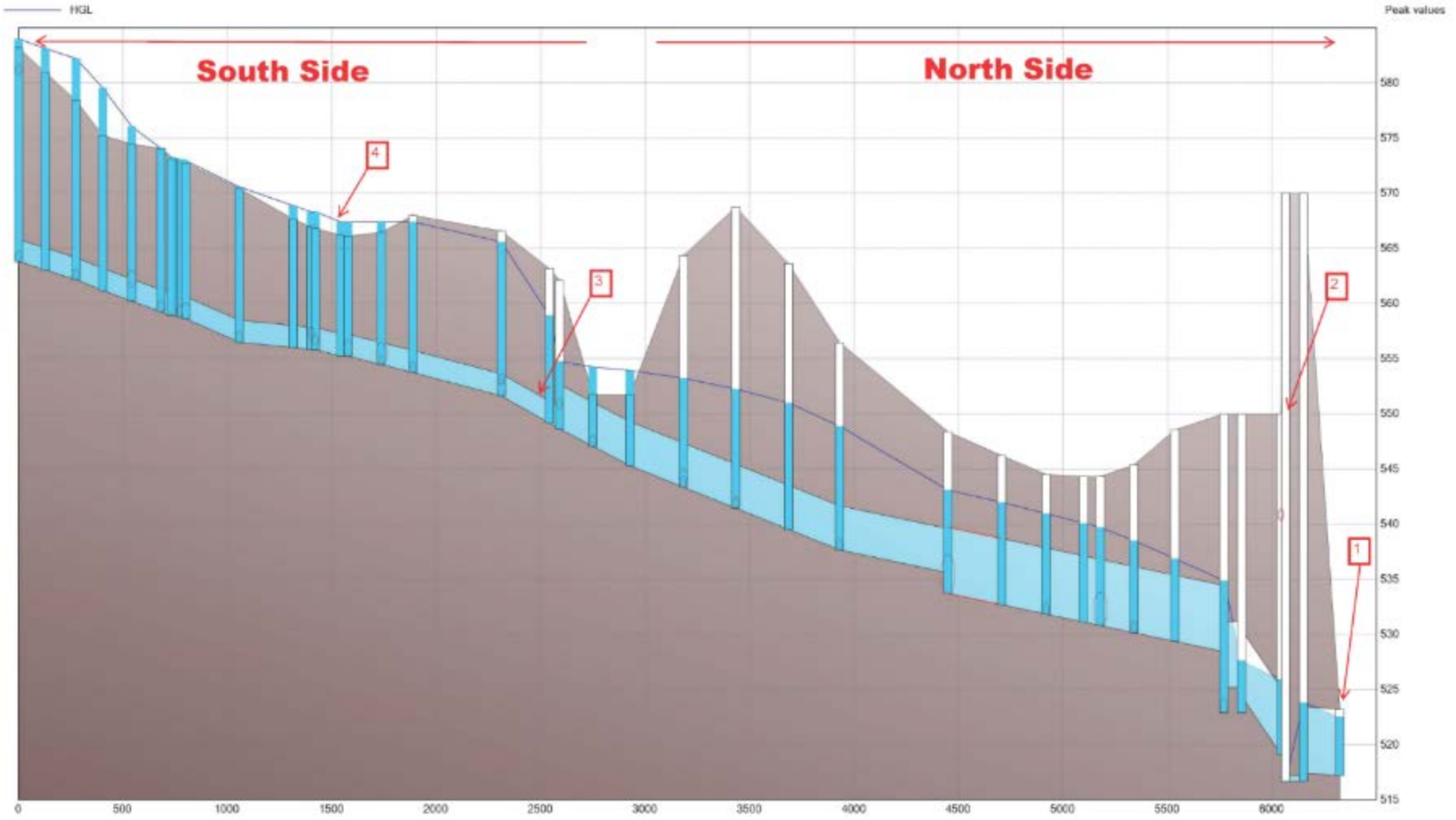




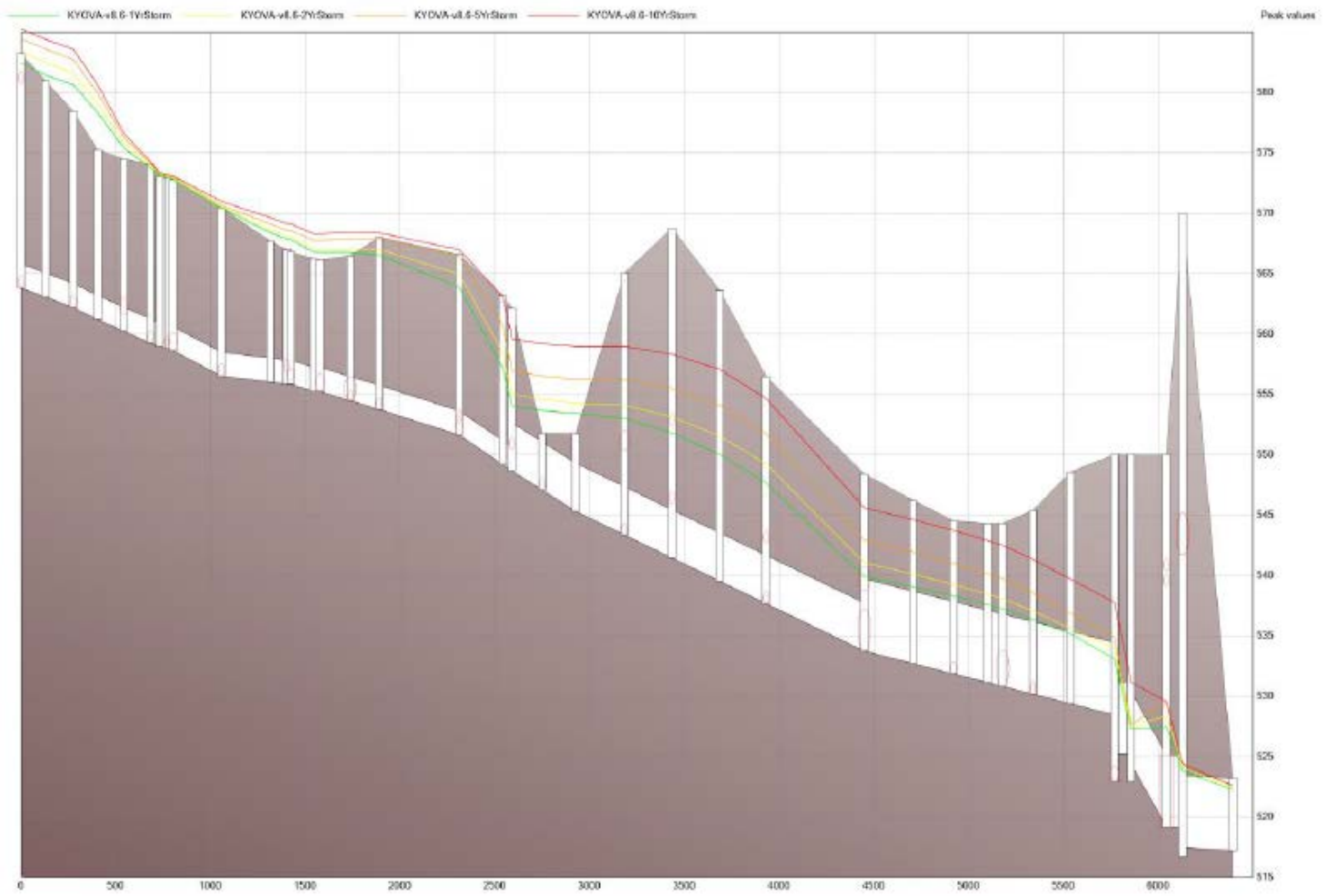
- The existing conditions model was run using the 1-year (2.22 in), 2-year (2.64 in), 5-year (3.2 in), and 10-year (3.65 in) design storms.
- In the 1-year design storm simulation, most of the manholes and pipes in the vicinity of the underpass were surcharged. Indicating that the system was heavily tasked.
- The model indicates that the inundation of the 16th Street underpass was caused upward outflow (upwelling) from the combined sewers.

System Limitations

1. Ohio River Level- river level proportionally increases upstream hydraulic grade line (HGL)
2. Pump Station- PS capacity increases upstream HGL
3. Undersized Sewer- Increases HGL and causes localized flooding
4. Surface Overflow- system flooding forces flow to overflow into other basins



Existing System Results



	1-Year Storm (2.22-inch)				5-Year Storm (3.20-inch)			
	Charleston Storm	Charleston Surface	Fourpole Storm	10th Surface	Charleston Storm	Charleston Surface	Fourpole Storm	10th Surface
Maximum Flow (MGD)	15.1	3.2	67.9	36.6	21.4	10.4	102.3	61.9
Total Flow (MG)	0.73	0.04	2.14	1.31	1.31	0.26	3.37	2.82

	Existing (MG)
Interceptor	7.2
Storm Sewer	4.7
Street Surface	3.1
CSO	25.5
Total	40.5

Alternative Selection - Project Goals

The proposed alternatives will be evaluated for the following goals for this project:

- Eliminate underpass flooding up to a specified design storm.
- Reduce the localized flooding issues within the basin.
- Reduce the number of CSO events per LTCP.
- Improve water quality.

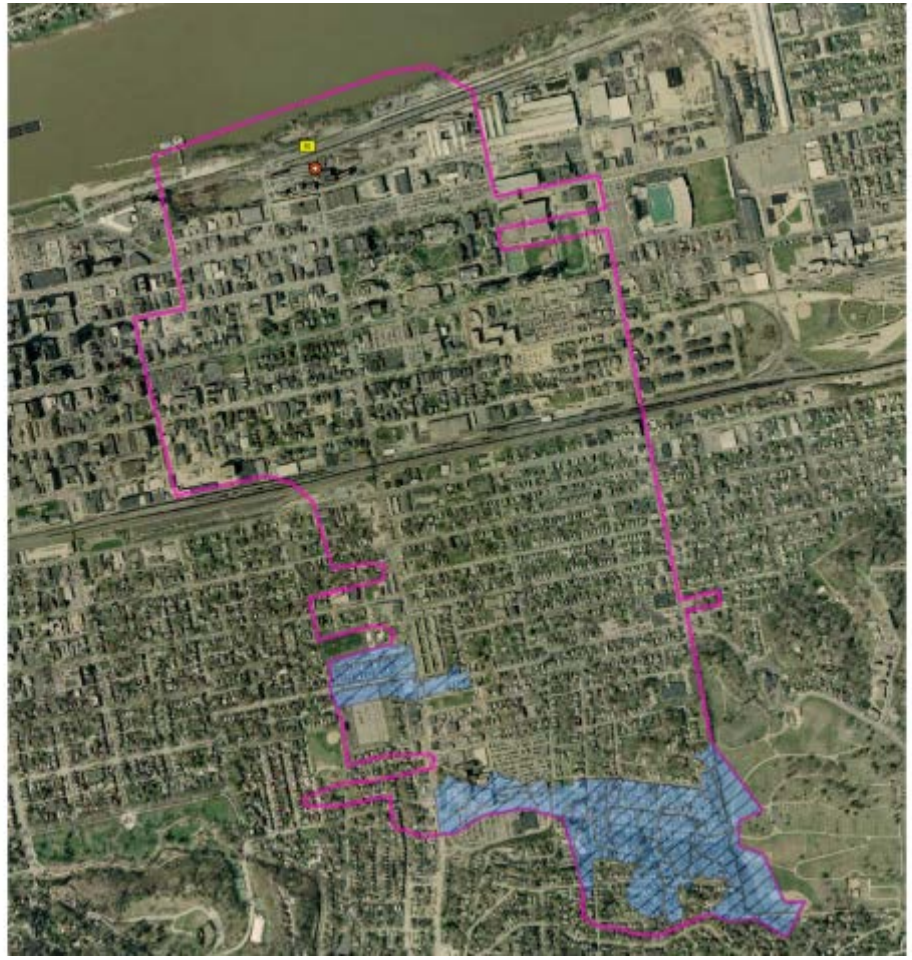
Alternative	Underpass	Local 16th	Local 19th	Events	Quality
Example Alternative					

Alternative Development

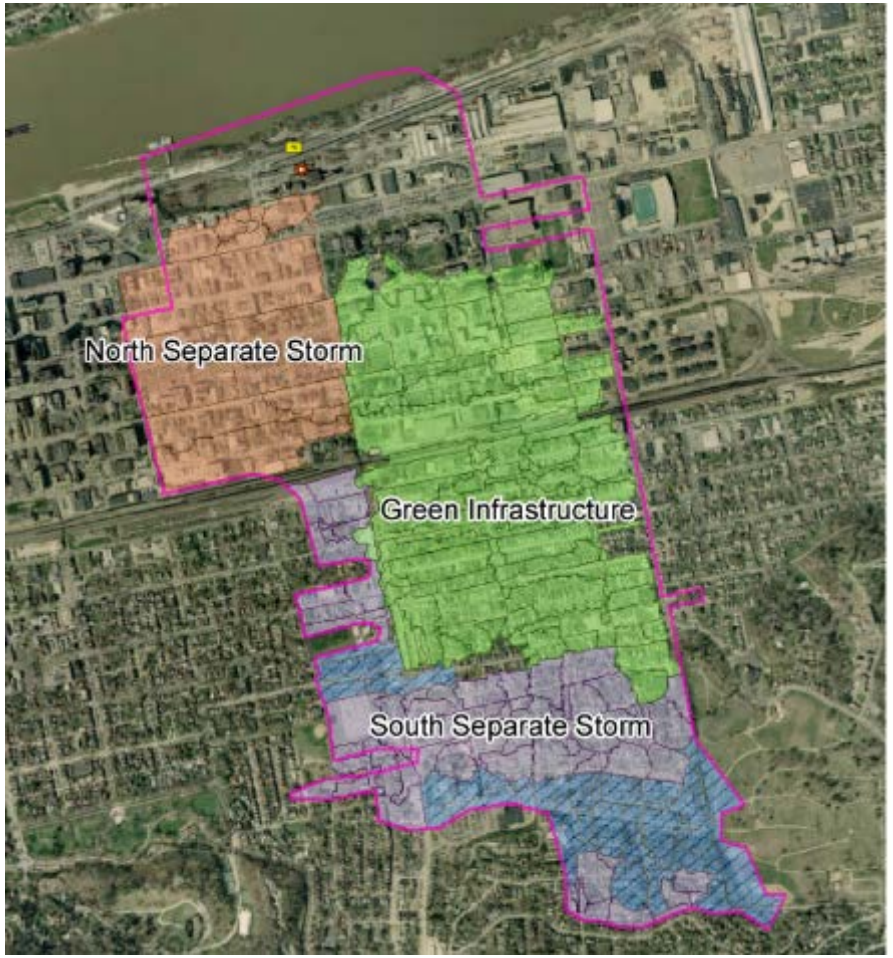
- Conveyance
- Combined Sewer Separation
- Storage
- Green Infrastructure

Alternative Considerations

EXISTING



ALTERNATIVE



Conveyance Alternative

- Parallel 36” to 72” sewer along 16th Street
  - Complete relief along 16th Street

	Existing (MG)	Conveyance #1 (MG)
Interceptor	7.2	7.1
Storm Sewer	4.7	4.1
Street Surface	3.1	0.0
CSO	25.5	29.3

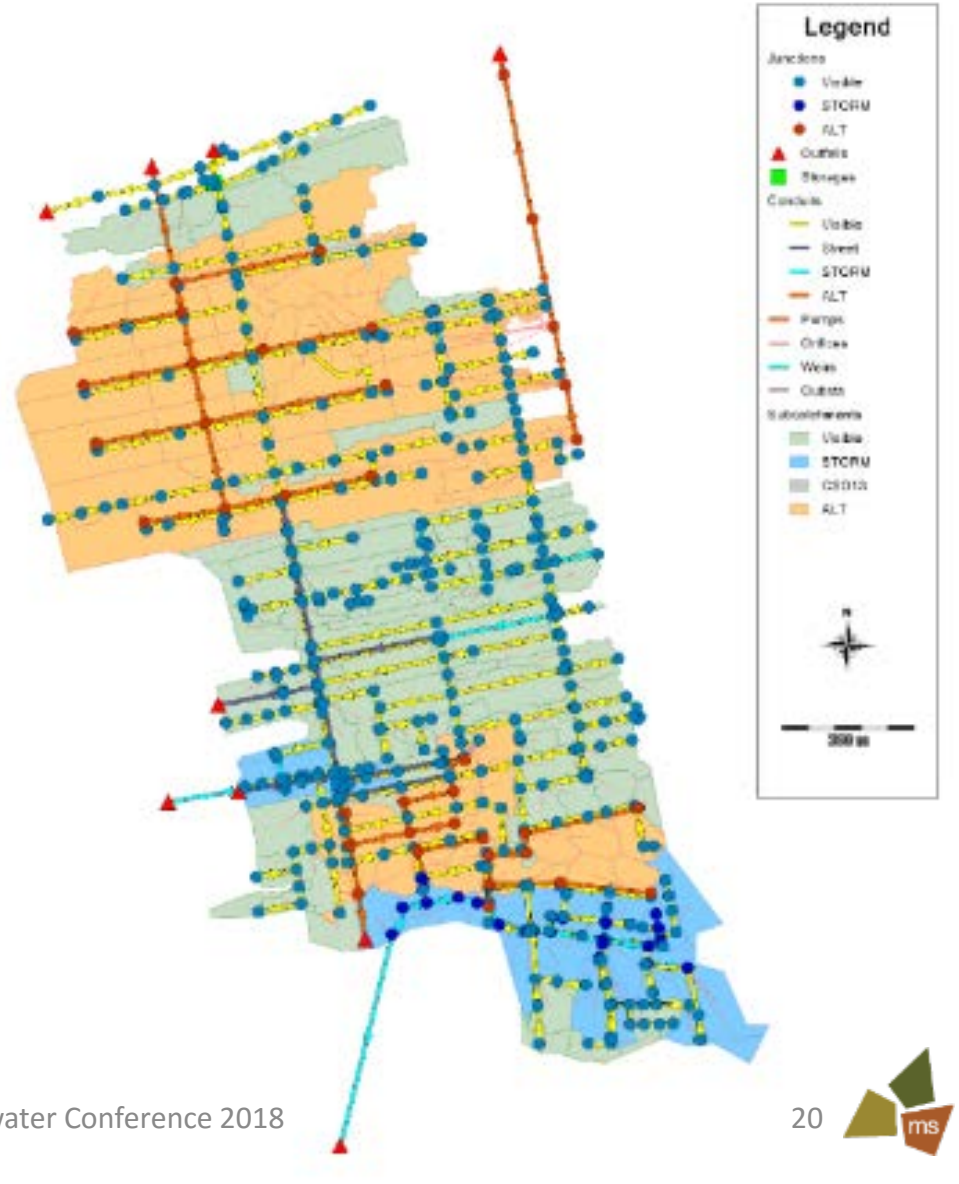
Alternative	Underpass	Local 16th	Local 19th	Events	Quality
Conveyance #1	✓	✓	✗	✗	✗

Combined Sewer Separation Alternative 1

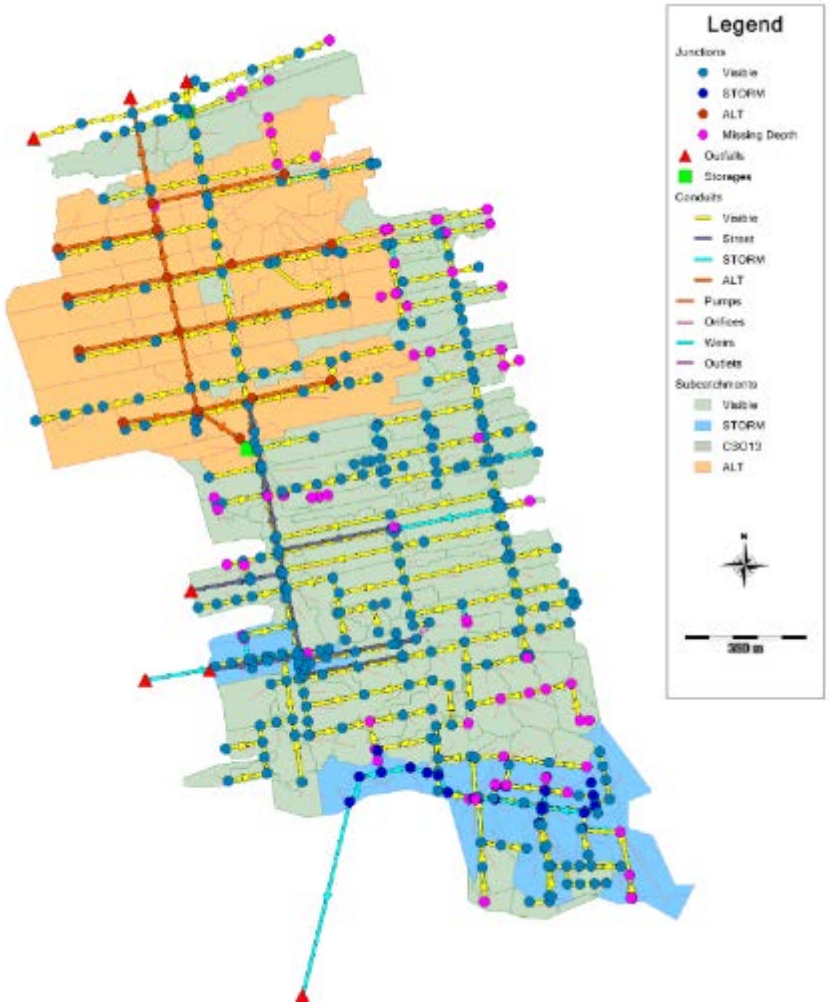
- Sep. #1.A- Separate storm system down 15th Street
  - Removes downstream system limitations
- Sep. #1.B- Separate storm system along south side
  - Relieves upstream system congestion
- Sep. #1.C- Separate storm system down 20th Street
  - Benefits both CSO-012 & CSO-013

	Existing (MG)	Separation #1 (MG)
Interceptor	7.2	5.7
Storm Sewer	4.7	23.2
Street Surface	3.1	2.0
CSO	25.5	9.0

Alternative	Underpass	Local 16th	Local 19th	Events	Quality
Sewer Separation #1	✓	!	!	✓	✓



Combined Sewer Separation Alternative 2

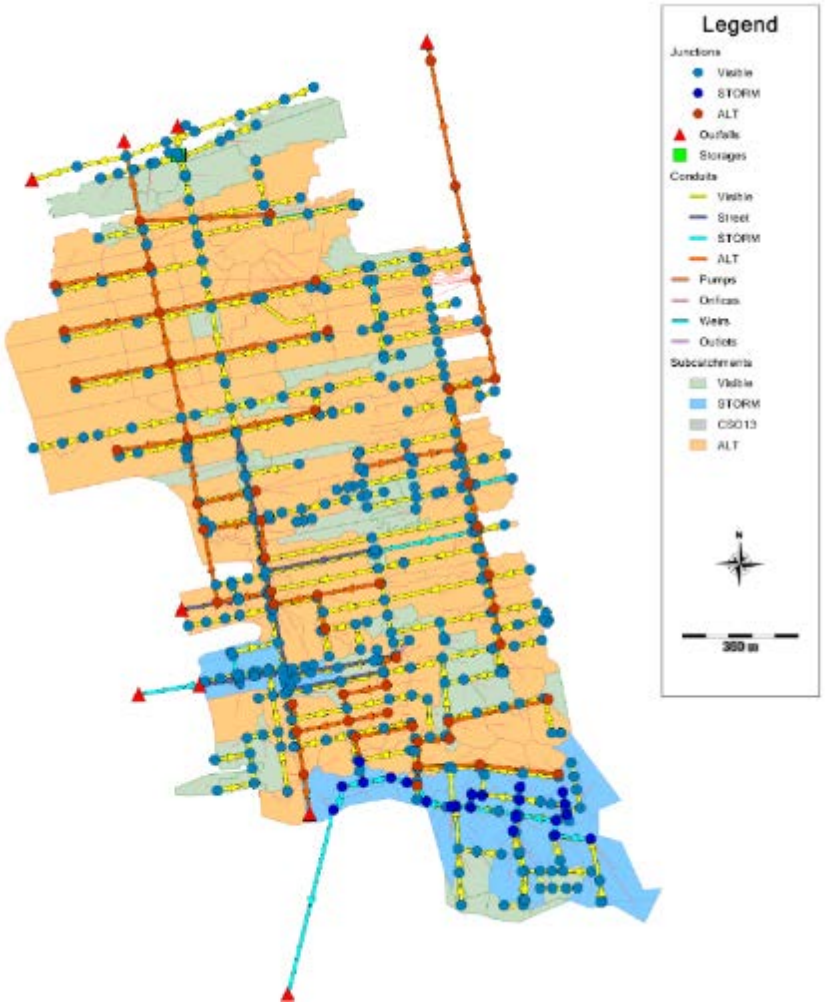


- Sep. #1.A- Separate storm system down 15th Street
  - Removes downstream system limitations
- Stormwater Pump Station at Underpass
  - Bolt down lids on combined sewer
  - Separated catch basins in underpass

	Existing (MG)	Separation #2 (MG)
Interceptor	7.2	6.4
Storm Sewer	4.7	18.7
Street Surface	3.1	3.0
CSO	25.5	11.9

Alternative	Underpass	Local 16th	Local 19th	Events	Quality
Sewer Separation #2	✓	!	✗	!	!

Combined Sewer Separation Alternative 3

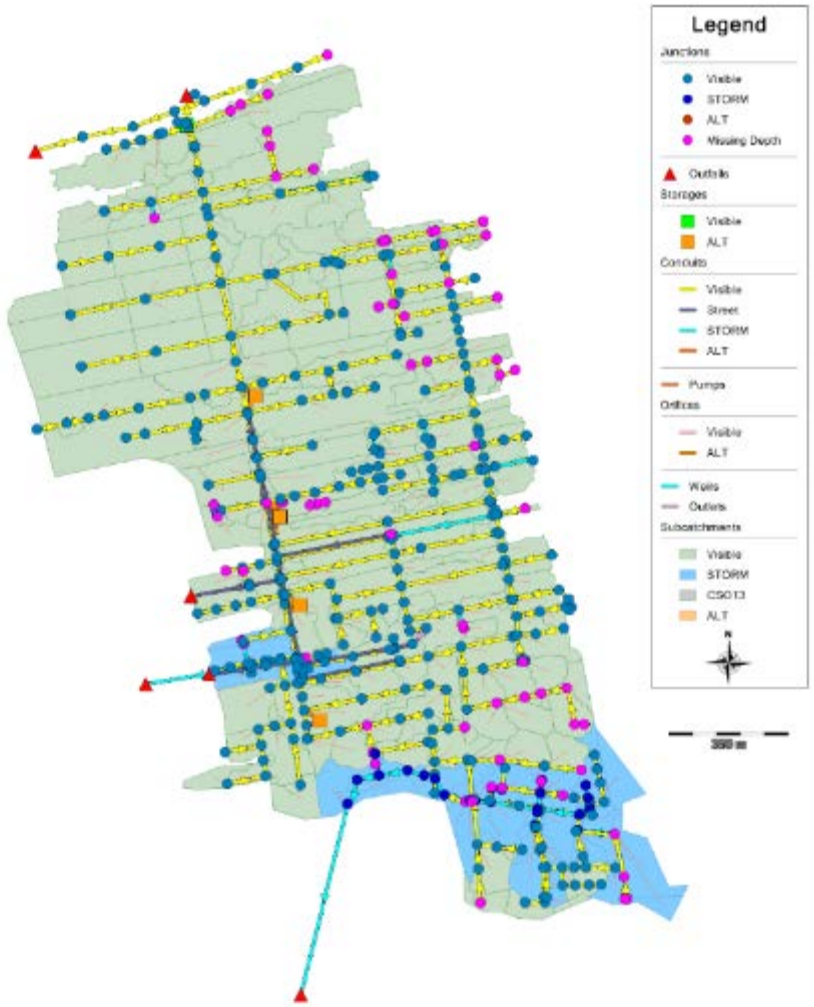


- Separate storm systems down 15th Street & 20th Street
- Separate storm system throughout south side

	Existing (MG)	Separation #3 (MG)
Interceptor	7.2	3.9
Storm Sewer	4.7	29.7
Street Surface	3.1	0.0
CSO	25.5	5.1

Alternative	Underpass	Local 16th	Local 19th	Events	Quality
Sewer Separation #3	✓	✓	✓	✓	✓

Storage

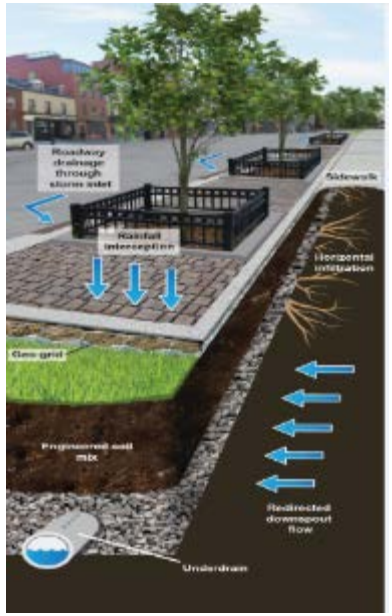


- Four locations are needed to address 16th Street flooding issues.
- A total of 7 MG of required storage

	Existing (MG)	Storage #1 (MG)
Interceptor	7.2	7.1
Storm Sewer	4.7	4.1
Street Surface	3.1	0.0
CSO	25.5	23.3

Alternative	Underpass	Local 16th	Local 19th	Events	Quality
Storage #1	✓	✓	✗	✗	✗

Green Infrastructure



- A total of 400,000 sq.ft. of green infrastructure was simulated to match the 7 MG storage.

	Existing (MG)	G.I. #1 (MG)
Interceptor	7.2	6.2
Storm Sewer	4.7	4.3
Street Surface	3.1	1.0
CSO	25.5	17.2

Alternative	Underpass	Local 16th	Local 19th	Events	Quality
Green #1	!	!	!	!	✓

Optimal Alternative

Combined Sewer Separation Alternative #1 + Green Infrastructure

	Existing (MG)	Optimized #1 (MG)
Interceptor	7.2	4.4
Storm Sewer	4.7	22.0
Street Surface	3.1	0.7
CSO	25.5	6.5

Alternative	Underpass	Local 16th	Local 19th	Events	Quality
Optimized #1	✓	!	!	✓	✓

Preferred Alternatives

- Combined Sewer Separation Alternative Number 1
- Combined Sewer Separation Alternative Number 3
- Optimal Alternative

	1-Year Design Storm (2.22-inch)			
	Existing (MG)	Separation #1 (MG)	Separation #3 (MG)	Optimized #1 (MG)
Interceptor	6.5	4.6	2.8	3.4
Storm Sewer	2.9	2.7	3.9	3.6
Street Surface	1.4	0.8	0.0	0.1
CSO	16.3	5.7	2.8	3.6
Proposed Storm		12.2	17.3	11.7
Depth at Underpass (ft)	1.7	0.3	0.3	0.1
	2-Year Design Storm (2.64-inch)			
	Existing (MG)	Separation #1 (MG)	Separation #3 (MG)	Optimized #1 (MG)
Interceptor	6.8	5.1	3.2	3.8
Storm Sewer	3.7	3.4	4.8	4.4
Street Surface	1.9	1.2	0.0	0.2
CSO	20.2	6.9	3.5	4.7
Proposed Storm		14.7	20.7	14.1
Depth at Underpass (ft)	2.4	0.3	0.3	0.1
	5-Year Design Storm (3.20-inch)			
	Existing (MG)	Separation #1 (MG)	Separation #3 (MG)	Optimized #1 (MG)
Interceptor	7.2	5.7	3.7	4.4
Storm Sewer	4.7	4.3	6.0	5.4
Street Surface	3.1	2.0	0.0	0.7
CSO	25.5	9.0	4.6	6.5
Proposed Storm		18.1	25.1	16.6
Depth at Underpass (ft)	3.3	0.5	0.4	0.2
	10-Year Design Storm (3.65-inch)			
	Existing (MG)	Separation #1 (MG)	Separation #3 (MG)	Optimized #1 (MG)
Interceptor	7.5	6.4	4.0	4.9
Storm Sewer	5.5	5.1	7.0	6.2
Street Surface	4.2	2.6	0.0	1.3
CSO	30.0	10.7	5.6	8.1
Proposed Storm		21.0	28.7	19.4
Depth at Underpass (ft)	4.1	0.7	0.4	0.2

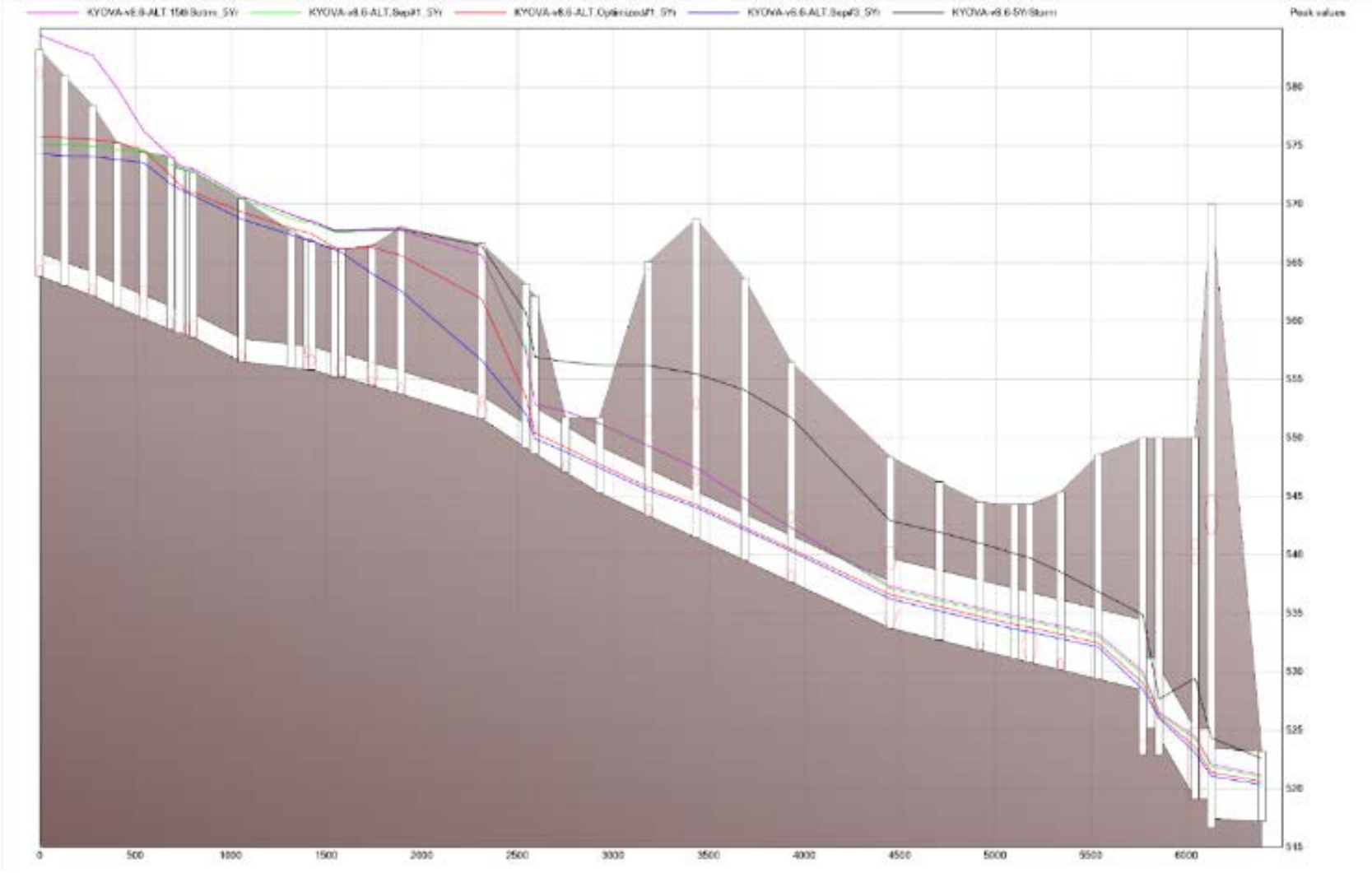
Preferred Alternatives Pros and Cons

Pros:

- Level of protection is greatly increased.
- All Preferred Alternatives can be phased.
- First phase (Sep. #1.A) provides greatest benefit to underpass flooding and has other ancillary benefits.
- G.I. helps meet project goals for harder to separate areas.

Cons:

- All proposed improvements are needed to meet project goals.
- No one solution meets all project goals.
- Large stormwater pump stations are needed to discharge water during high river levels.



Conclusions

- Dual Drainage Model helpful in simulating surface flooding and external routing potential.
- Level of Service goals included flood mitigation and long term control plan goals.
- Optimal Alternatives include combination of combined sewer separation, pump station improvements and Green Infrastructure