A City with a Plan is a City with a Vision. Developing the City-Wide Sewer Separation Master Plan in Chelsea, MA

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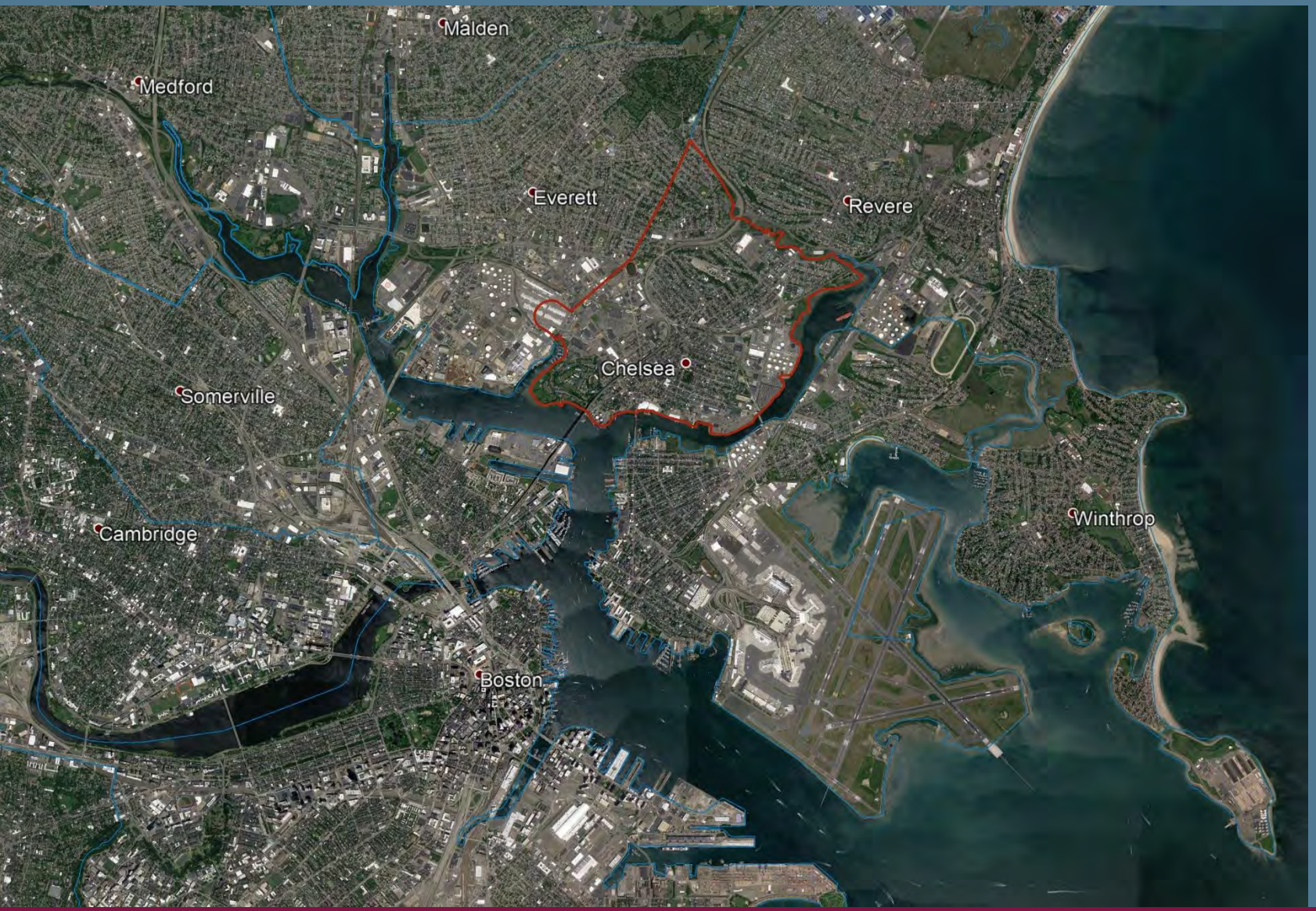
The City of Chelsea



- The City is roughly 1.8 square miles and has about 44 miles of roadways and around 83 miles of sewers and drains today.
- The City is located north of East Boston across the Chelsea River.
- The City is bounded by the Chelsea River to the S and E, Revere to the N/NE across the Mill River, the Island End River to the SW and Everett to the W/NW.

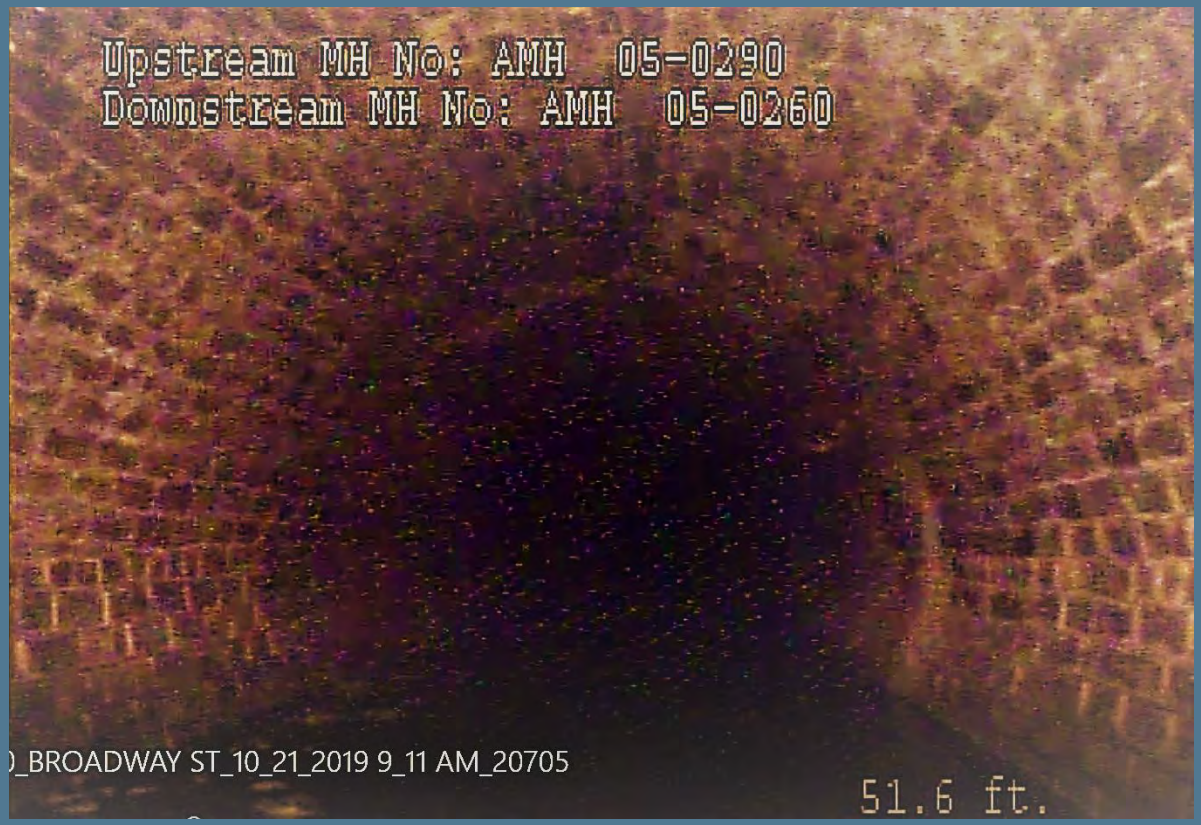
Developing a Long-Term Infrastructure Vision

- Citywide sewer separation is part of the City's comprehensive master planning and asset management approach.
- In partnership with the Department of Planning & Development, Chelsea DPW is taking steps toward improving GIS data for all City water, sewer, drain, fiber optic, and electrical facilities.
- The City also developed a Citywide ground-level LIDAR point cloud for use in master planning, base mapping for design, and spatial correction of GIS assets.

History of the Chelsea Sewer System

- Like Boston, Cambridge, and Somerville, the Chelsea sewer system was built initially as a combined sanitary sewerage and stormwater drainage system starting before the Civil War. The first sewers were built in 1846 and were constructed of brick.

- By 1872, cement pipes were introduced. By this point roughly 1/3 of the City had brick sewers. Cement pipe fell out of favor with the introduction of vitrified clay pipe around 1880. VC remained the material of choice until the early 1970s when PVC began to be used.



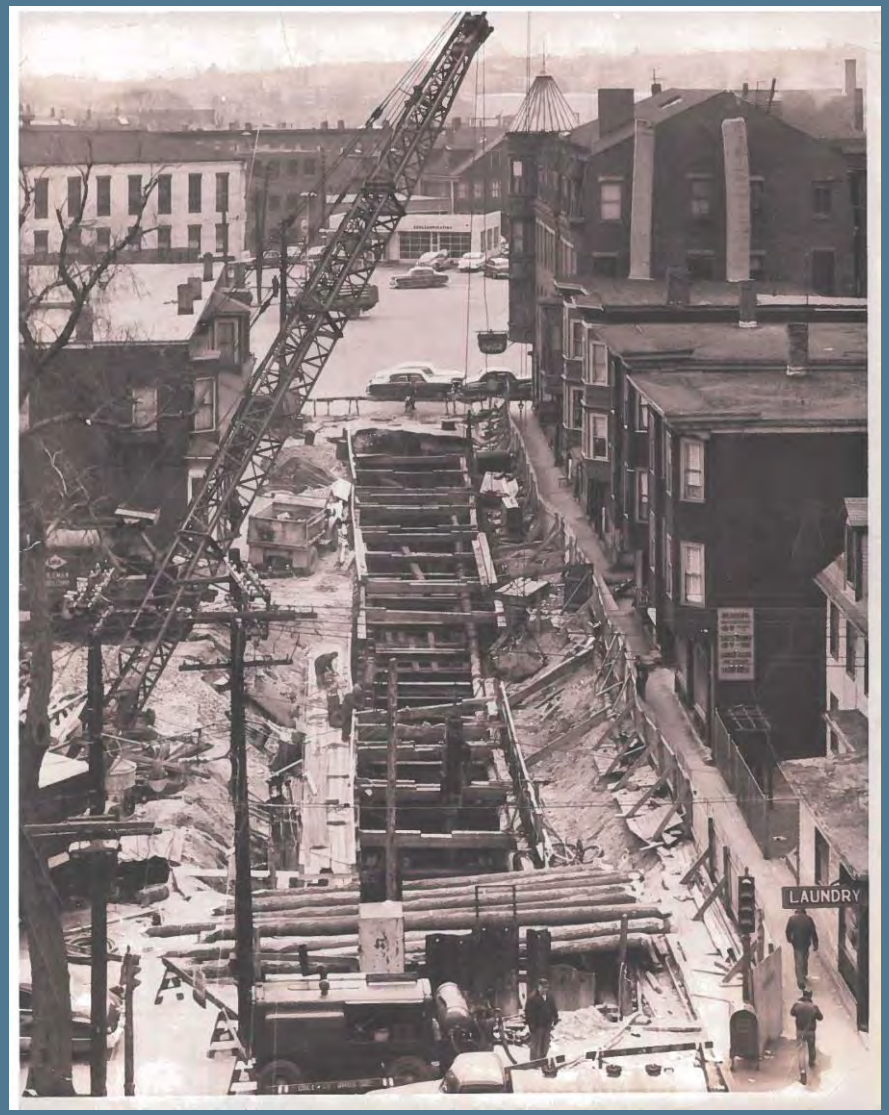
72-inch combined sewer along Broadway

History of the Chelsea Sewer System

The combined sewer system built between 1846 and 1939s

Construction timeline:

- 1846 – 1859 6.1 miles of sewers
- 1860 – 1869 5.2 miles of sewers
- 1870 – 1879 12.9 miles of sewers
- 1880 – 1889 5.8 miles of sewers
- 1890 – 1899 7.6 miles of sewers
- 1900 – 1939 7.2 miles of sewers
  (approximately 44.8 miles of sewer in total)
- 1940 – present Around 26 additional miles of drains and 12 additional miles of new dedicated sanitary sewers were built
- Total pipe coverage is about 83 miles City-wide



Second Street sewer construction, 1949

Existing System Conditions

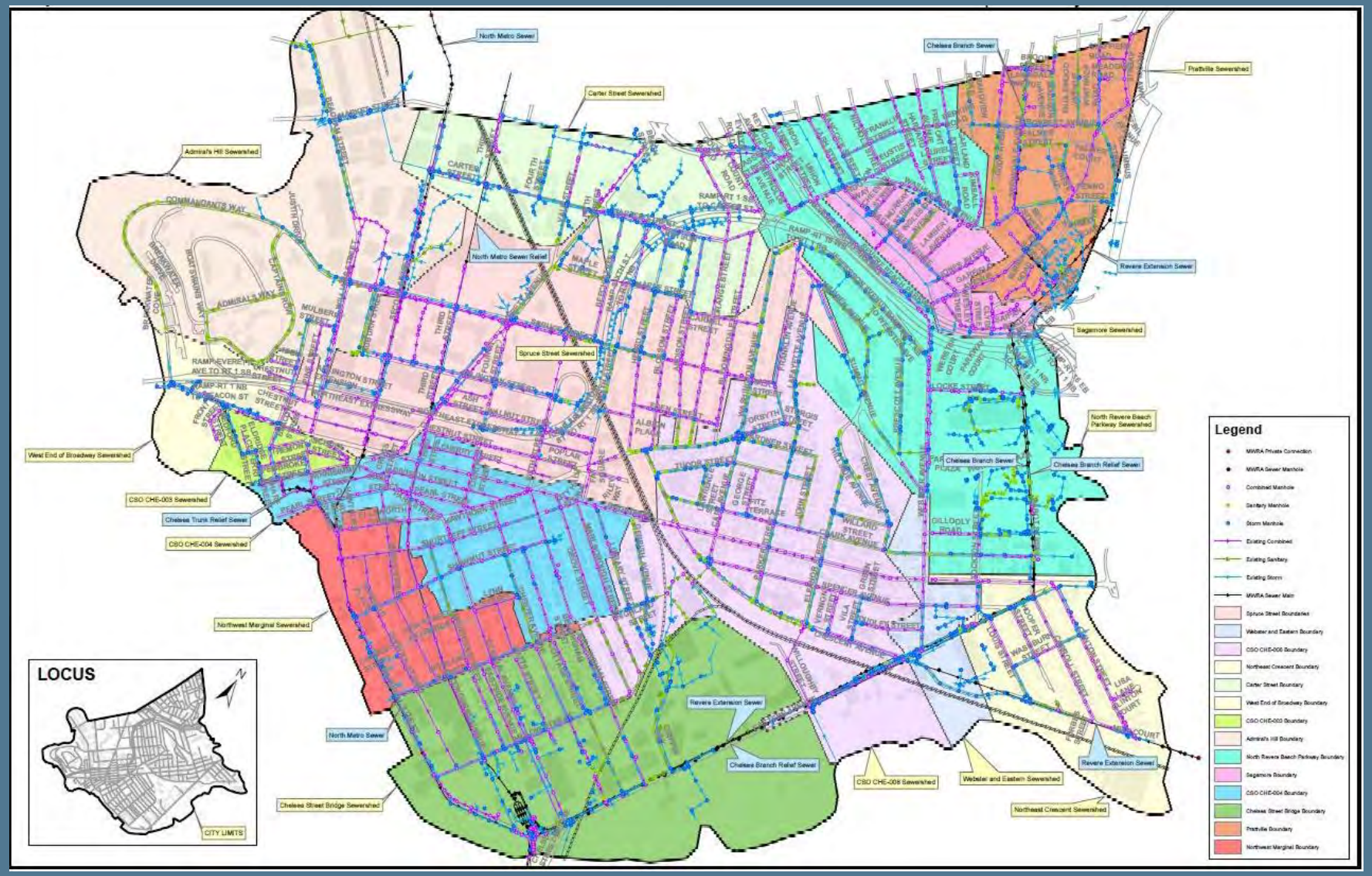
CSO Areas

- CHE-003
- CHE-004
- CHE-008

Non-CSO Areas

- Fully or partially separated
- Significant wet weather contributions remain in the combined sewer system
- All combined sewer flows go to MWRA's Chelsea Screen House and Pump Station Facility

Existing System Conditions



Existing System Conditions –CSO Areas

Current Challenges and Drivers

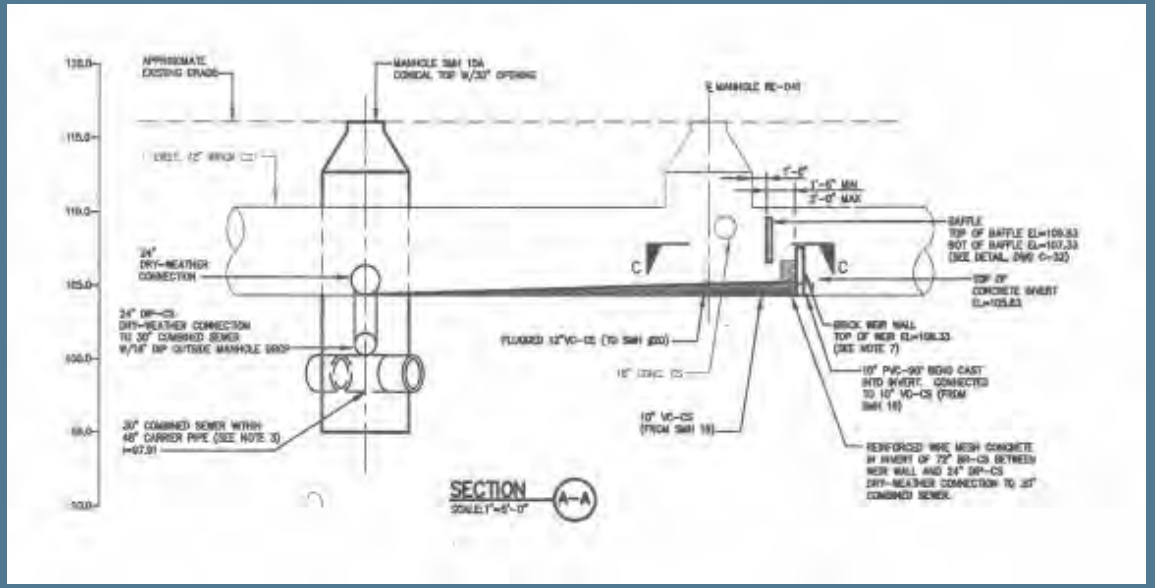
- CSOs: Ultimate goal is to eliminate CSO Spills
- Public Health: Reduce street flooding and sewer backups
- Improve system's structural integrity over time
- Reduce costs associated with treating stormwater entering combined sewer system

Current Challenges and Drivers

CSO Spills: Chelsea has three active CSOs.

The most active area CHE-008 and CHE-004. CHE-003 rarely activates

- CHE-008: 3.5MG in 2018
- CHE-004: 1.8MG in 2018
- CHE-003: No spills in 2018

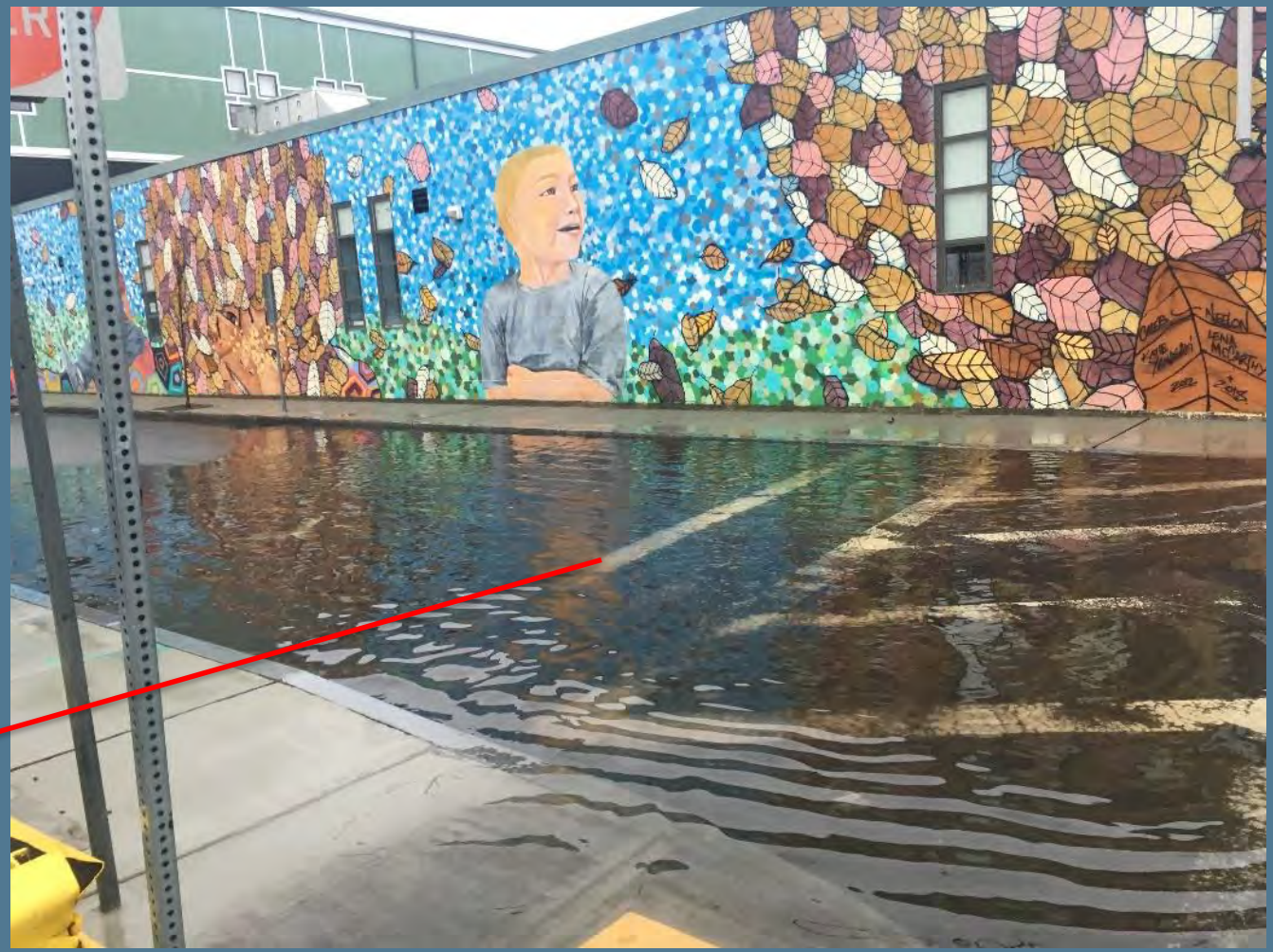


Current Challenges and Drivers

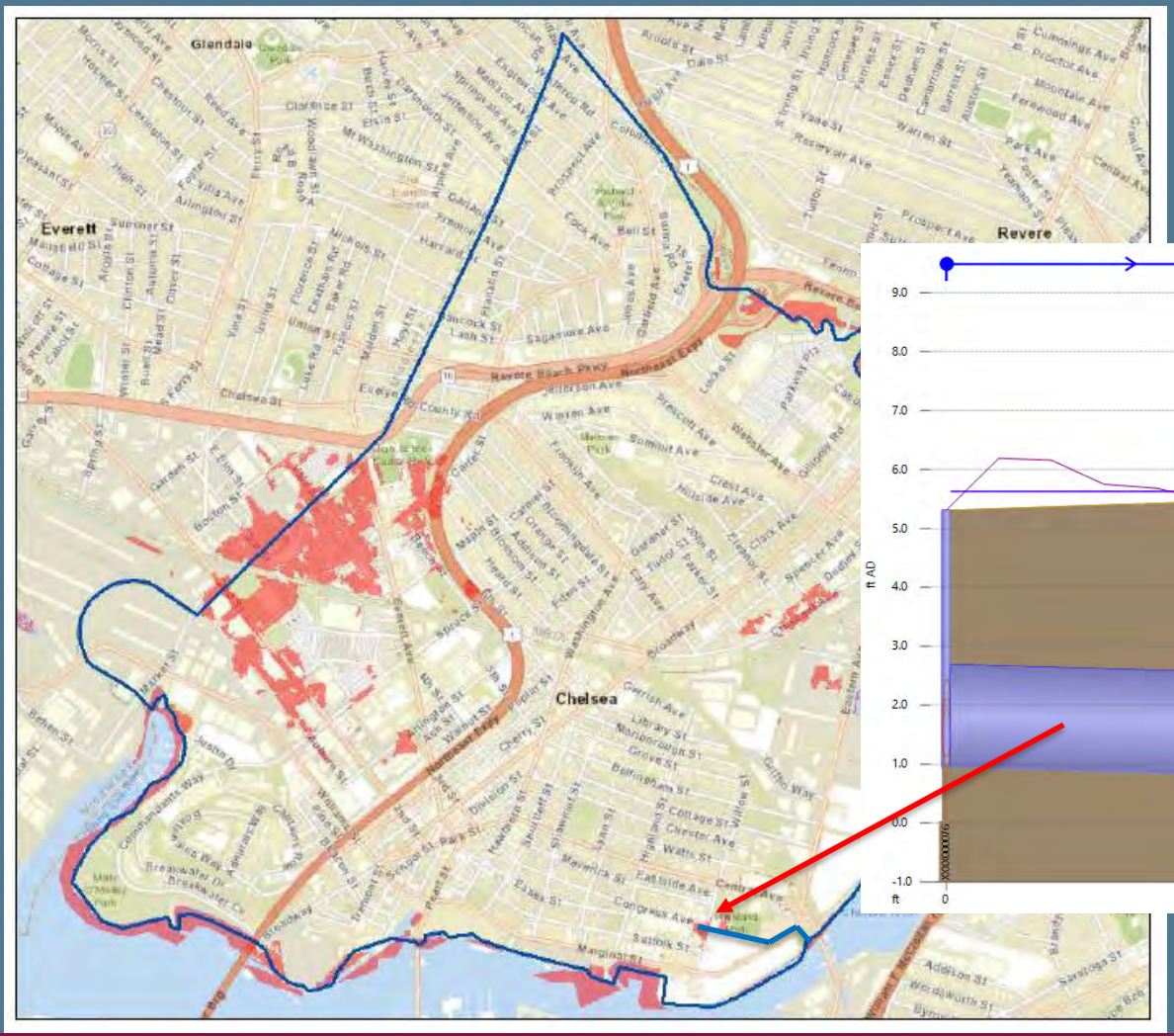
Flooding: Recurrent flooding occurs at some locations for different reasons

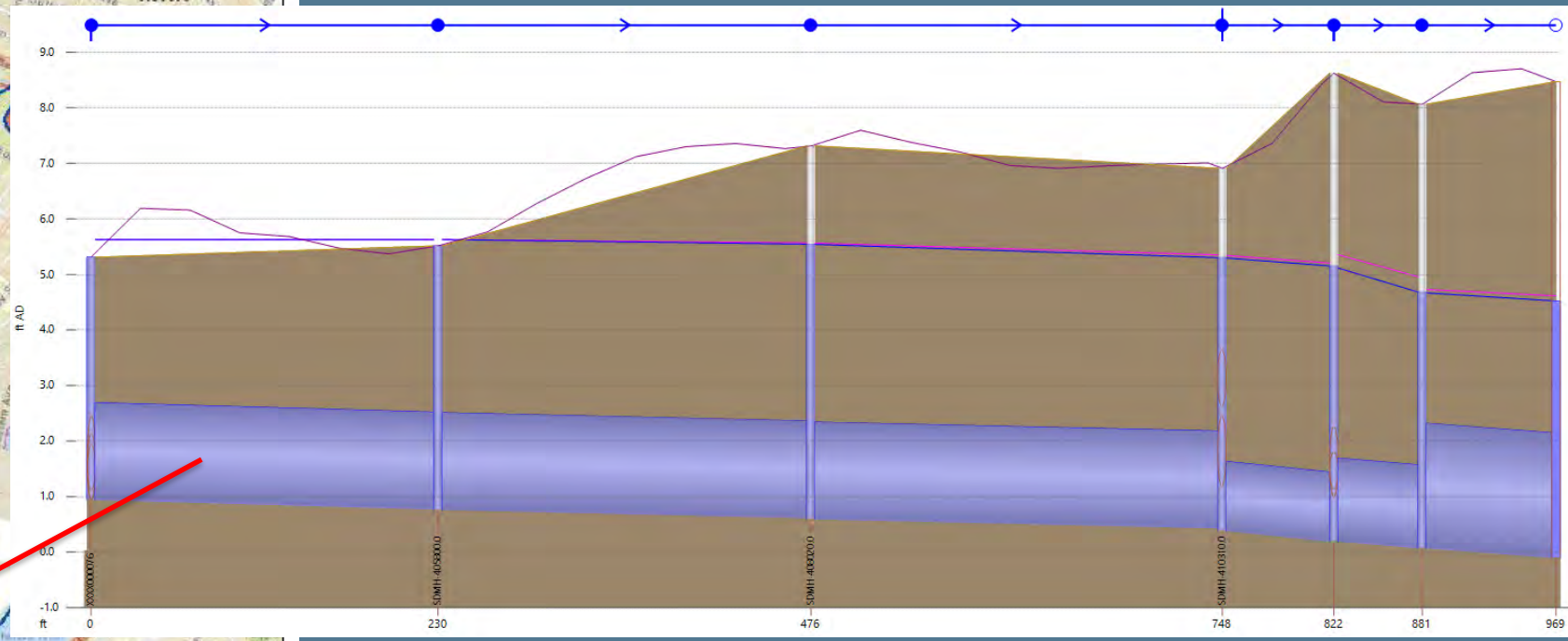
- Insufficient pipe conveyance capacity
- Topography – A good portion of the City is barely above Mean High Waters (4.3ft-NAVD88)
- Tidal Influenced Outfalls –
  - Tidal pipe backups if tide gates malfunction
  - Stormwater can't drain if storm hits during high tide conditions

Current Challenges and Drivers-Flooding



Current Challenges and Drivers-Flooding





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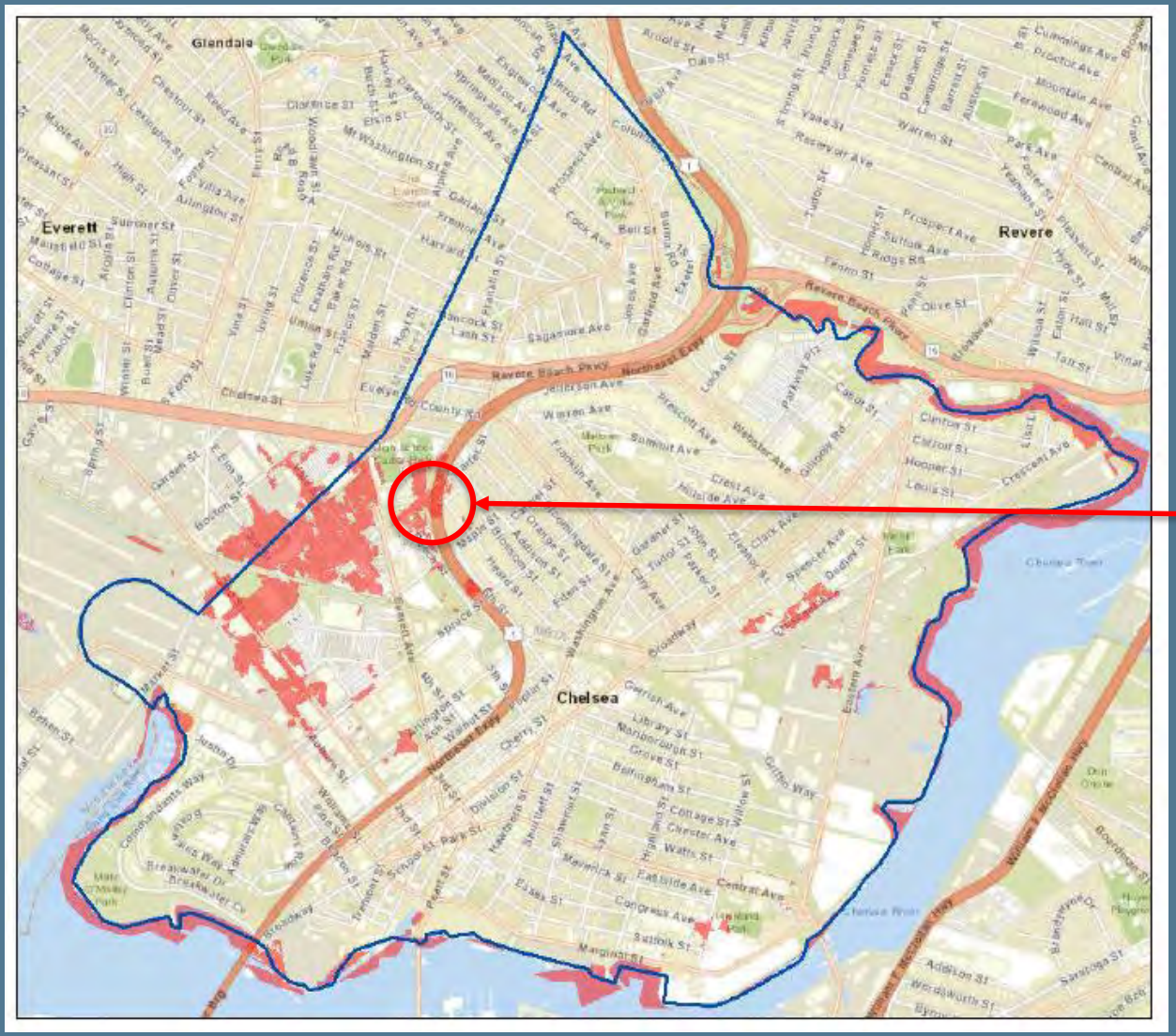
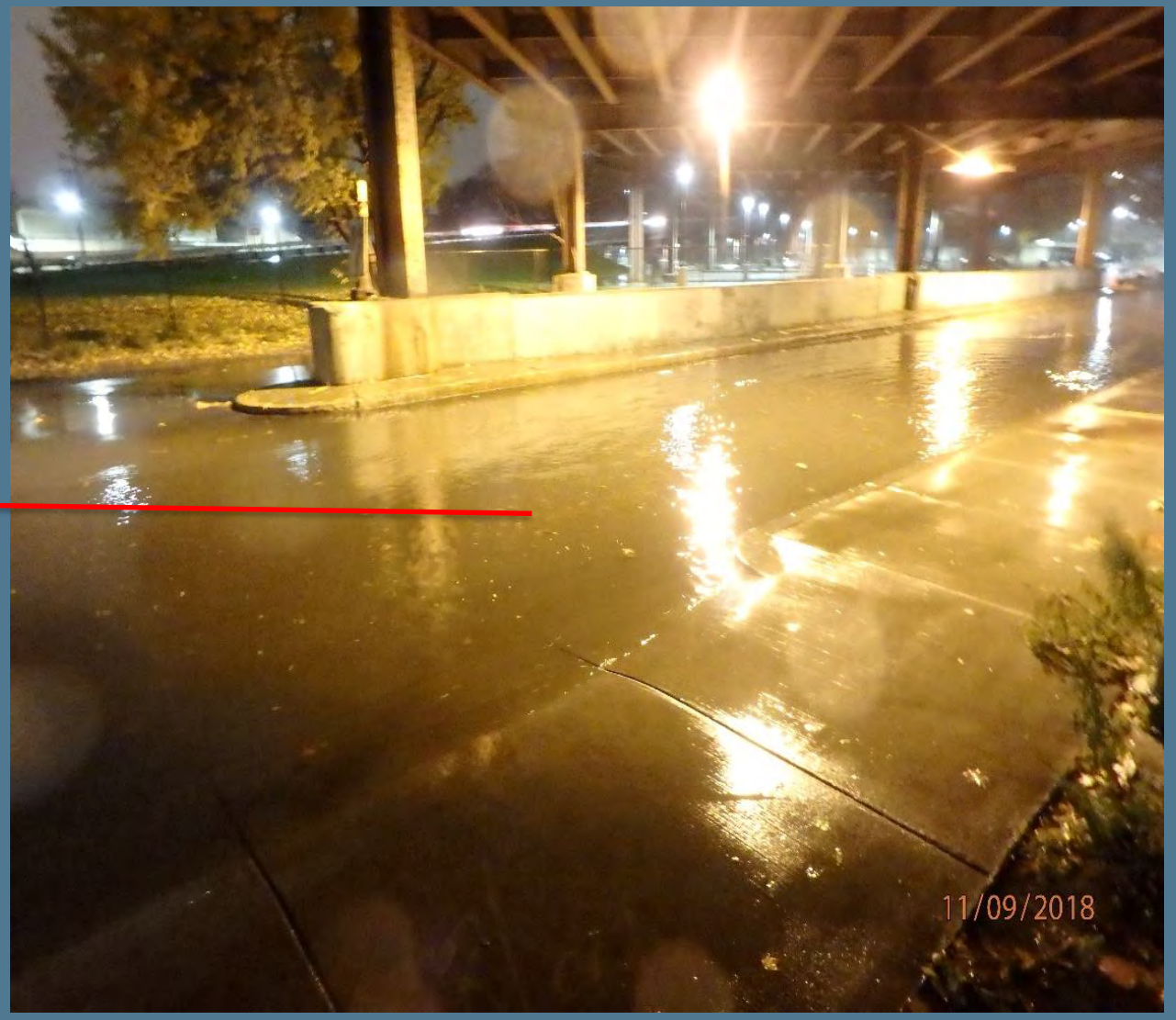
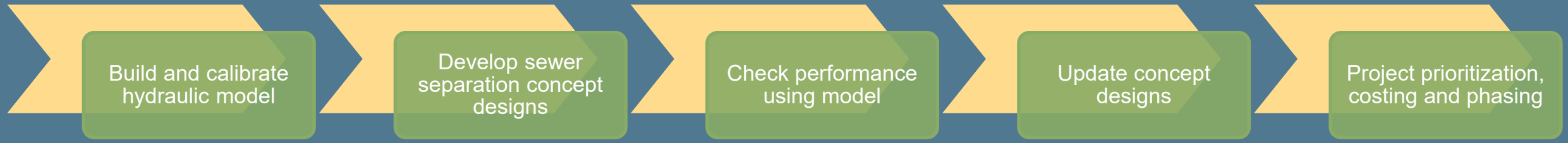
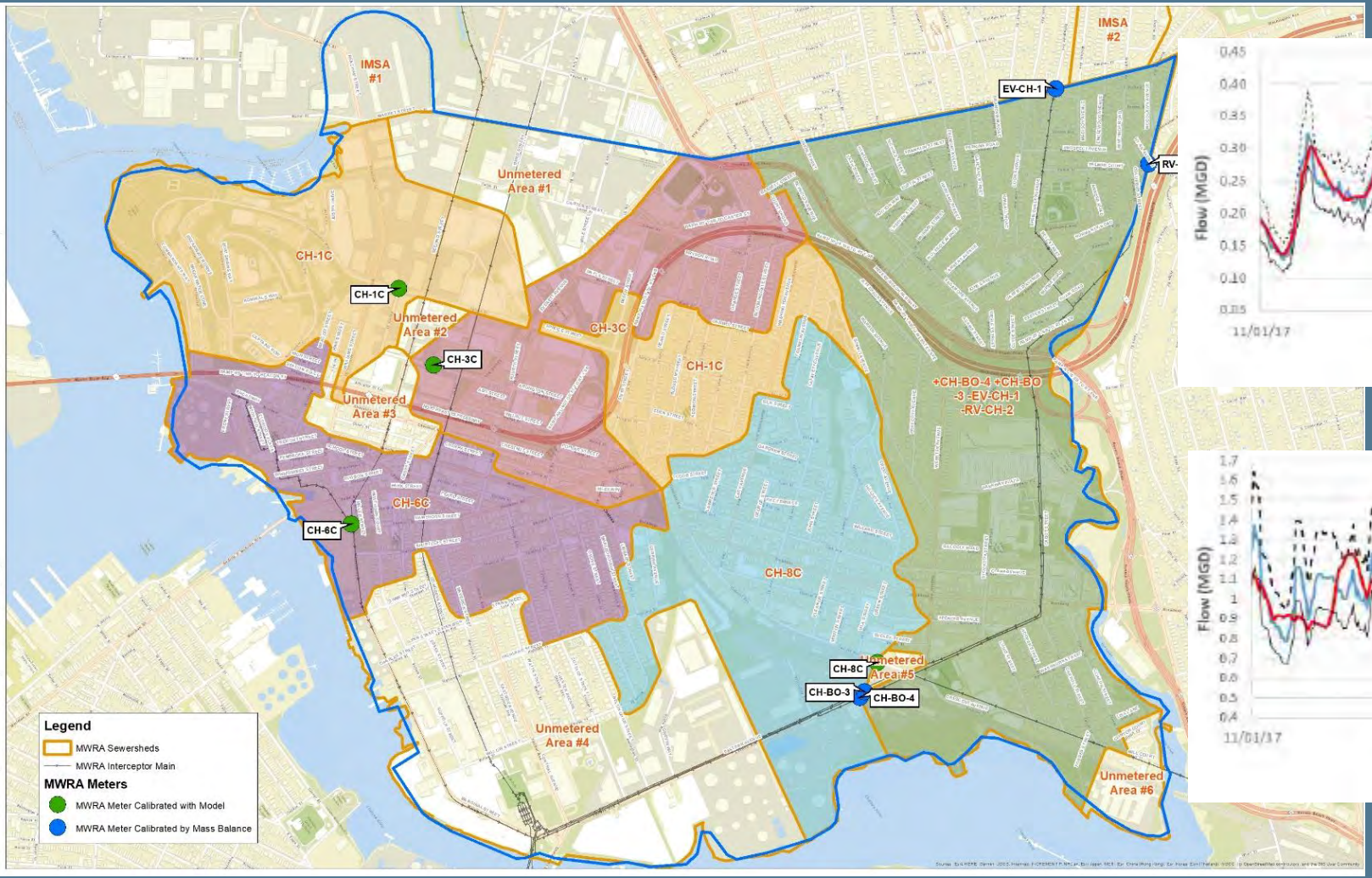


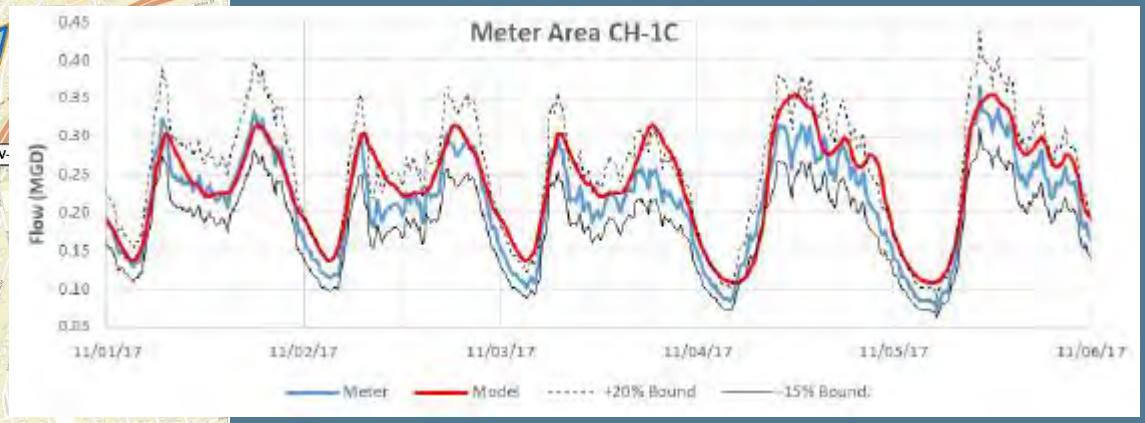


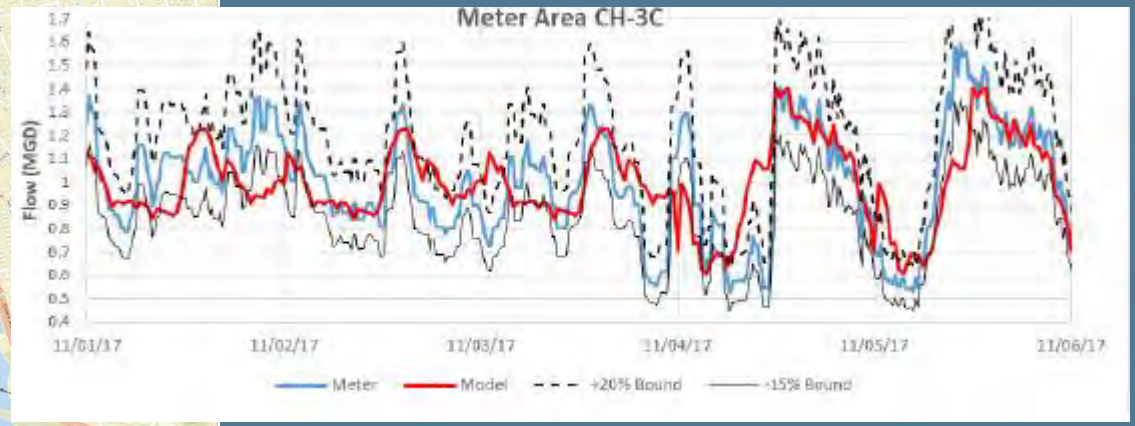
Development of Master Plan- Process



Development of Master Plan – Model Development and Calibration

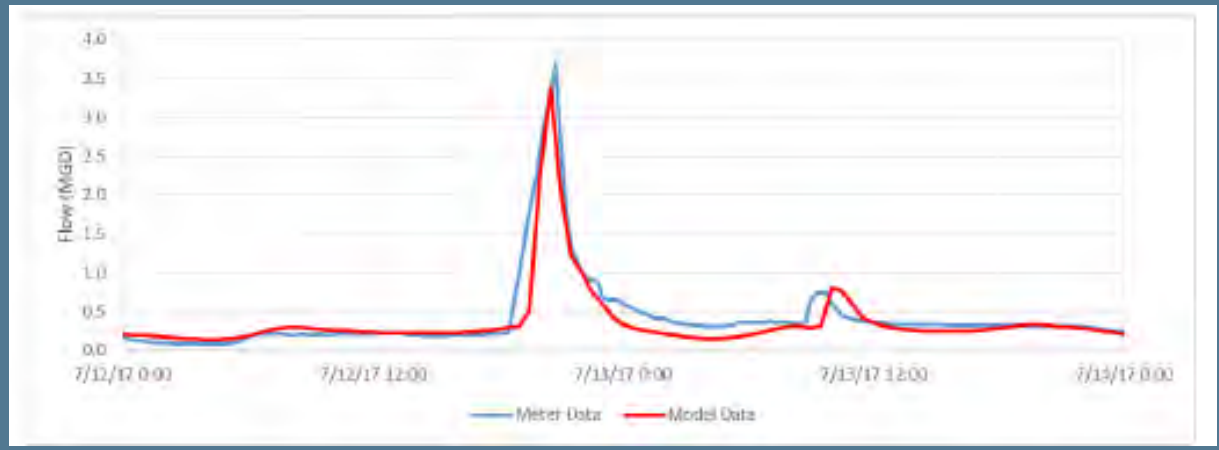


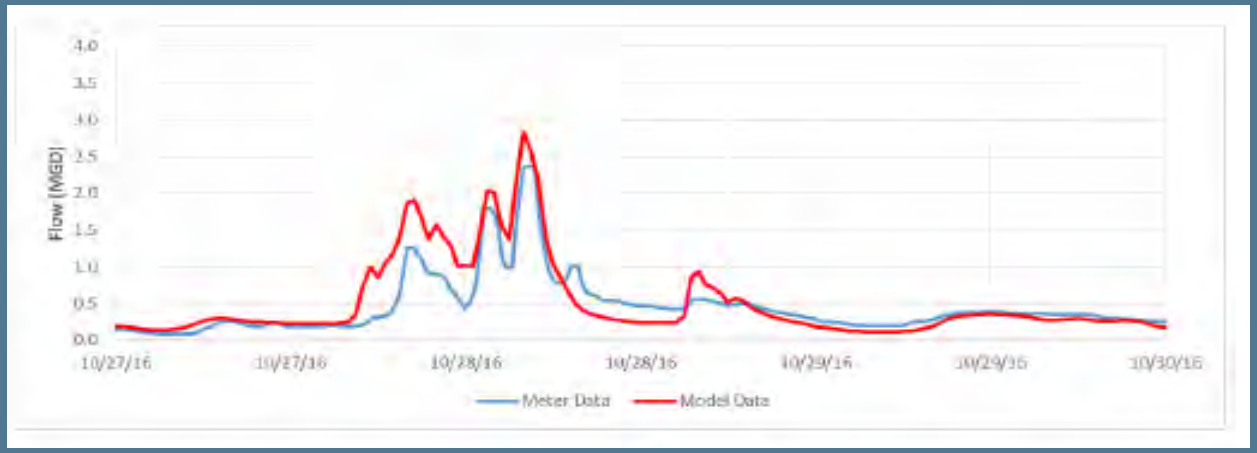


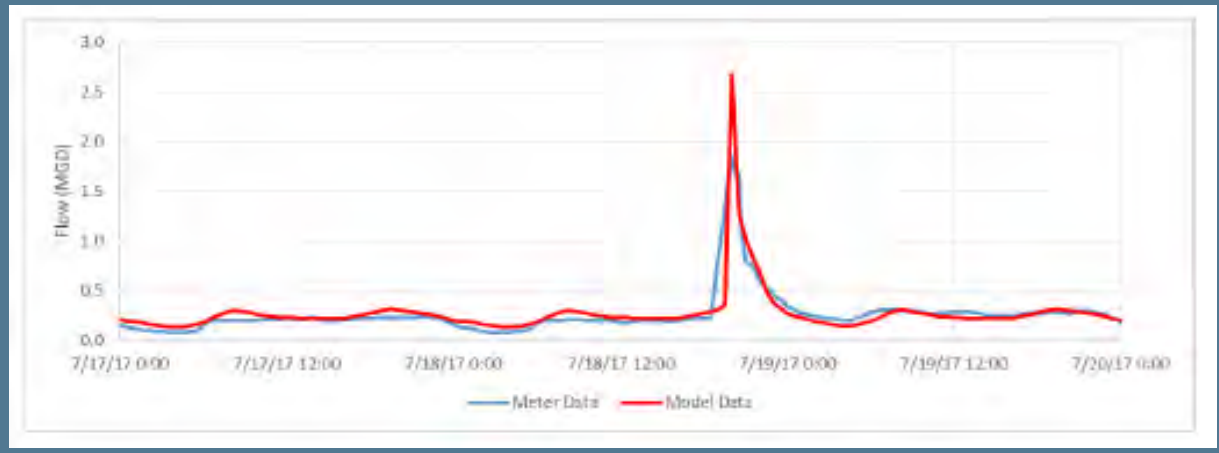


Development of Master Plan – Model Development and Calibration

Storm Event Date	Antecedent Dry Period	Total Rainfall (inches)	Peak 15-minute intensity (in/h)	Snow or Snowmelt impacts
October 27, 2016	>24h	1.46	0.36	No
July 12, 2017	>24h	1.82	2.36	No
July 18, 2017	>24h	0.77	2.64	No







Development of Sewer Separation Concepts

Storm System Design Criteria

- 4’ of ground cover
- 10-year 24-hour design storm
- New outfalls above MHW whenever possible
- High tide coinciding with peak of the storm
- Drain by gravity whenever possible

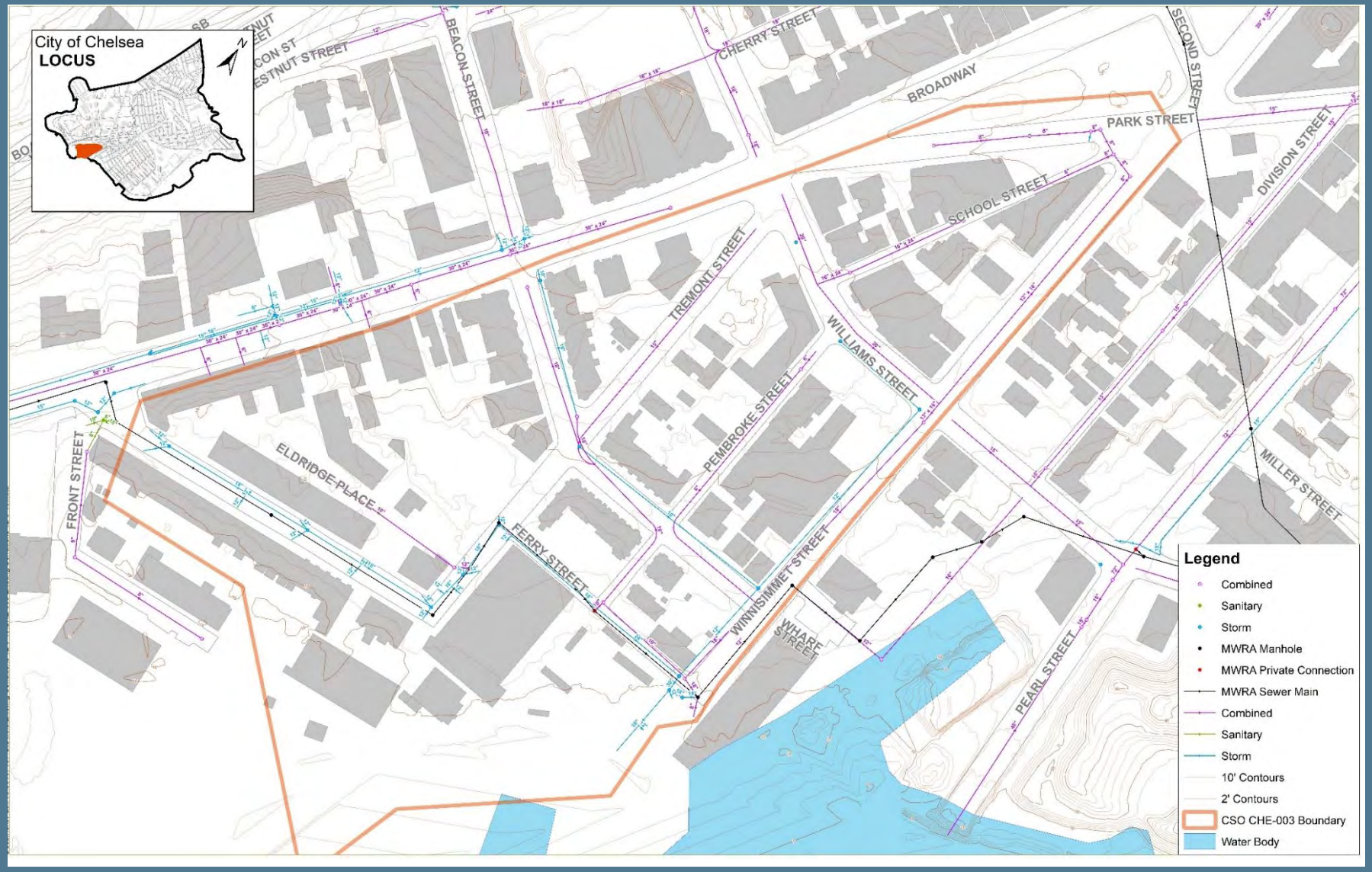
Sanitary System Criteria

- Below storm drain
- Scouring velocity or minimum slope
- Some inflow sources to remain connected (15%)
- Population growth of 30%

Development of Sewer Separation Concepts

CSO Areas

- CHE-003:



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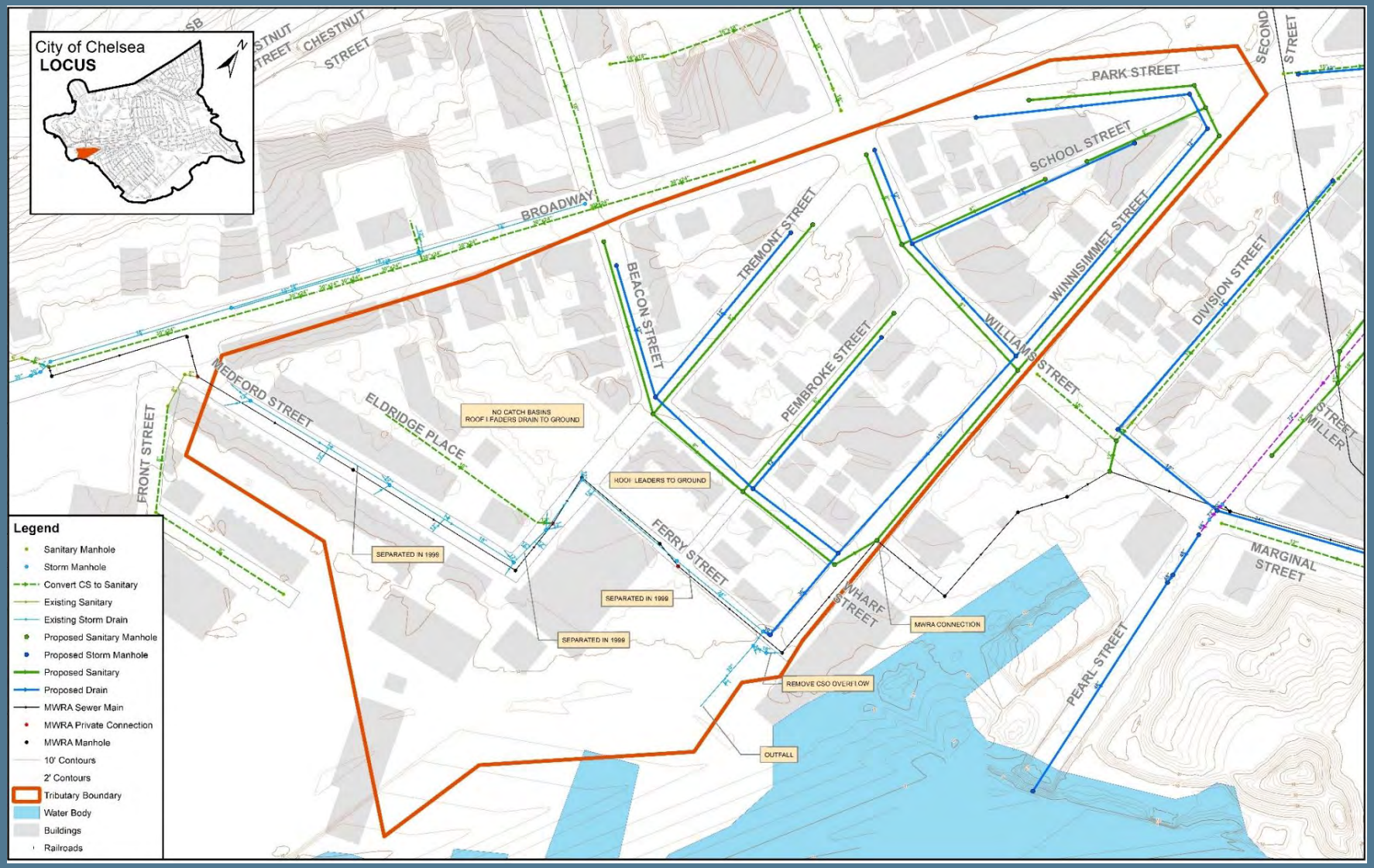

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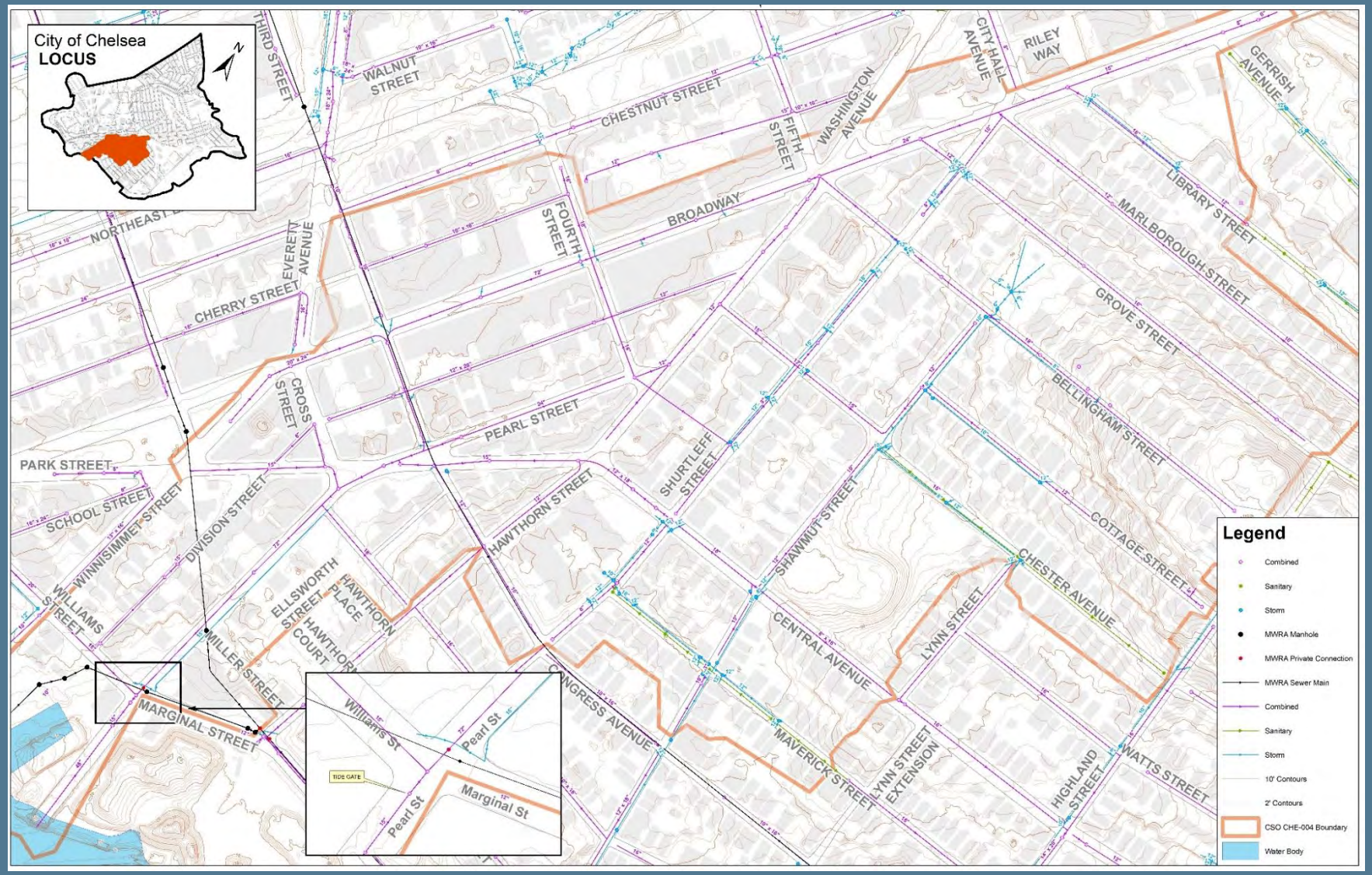
CSO Areas

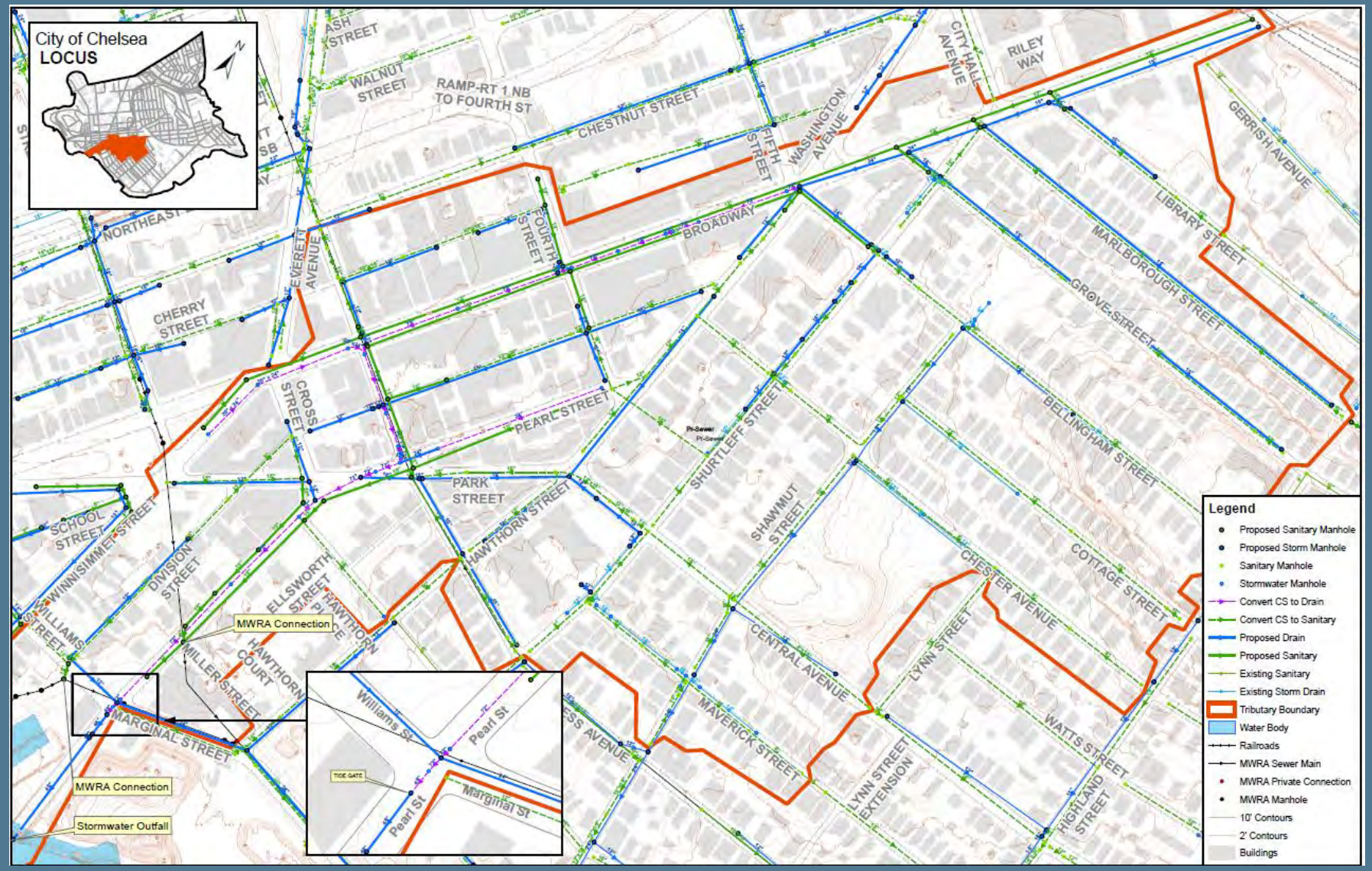
- CHE-004:



Development of Sewer Separation Concepts

CSO Areas

- CHE-004:



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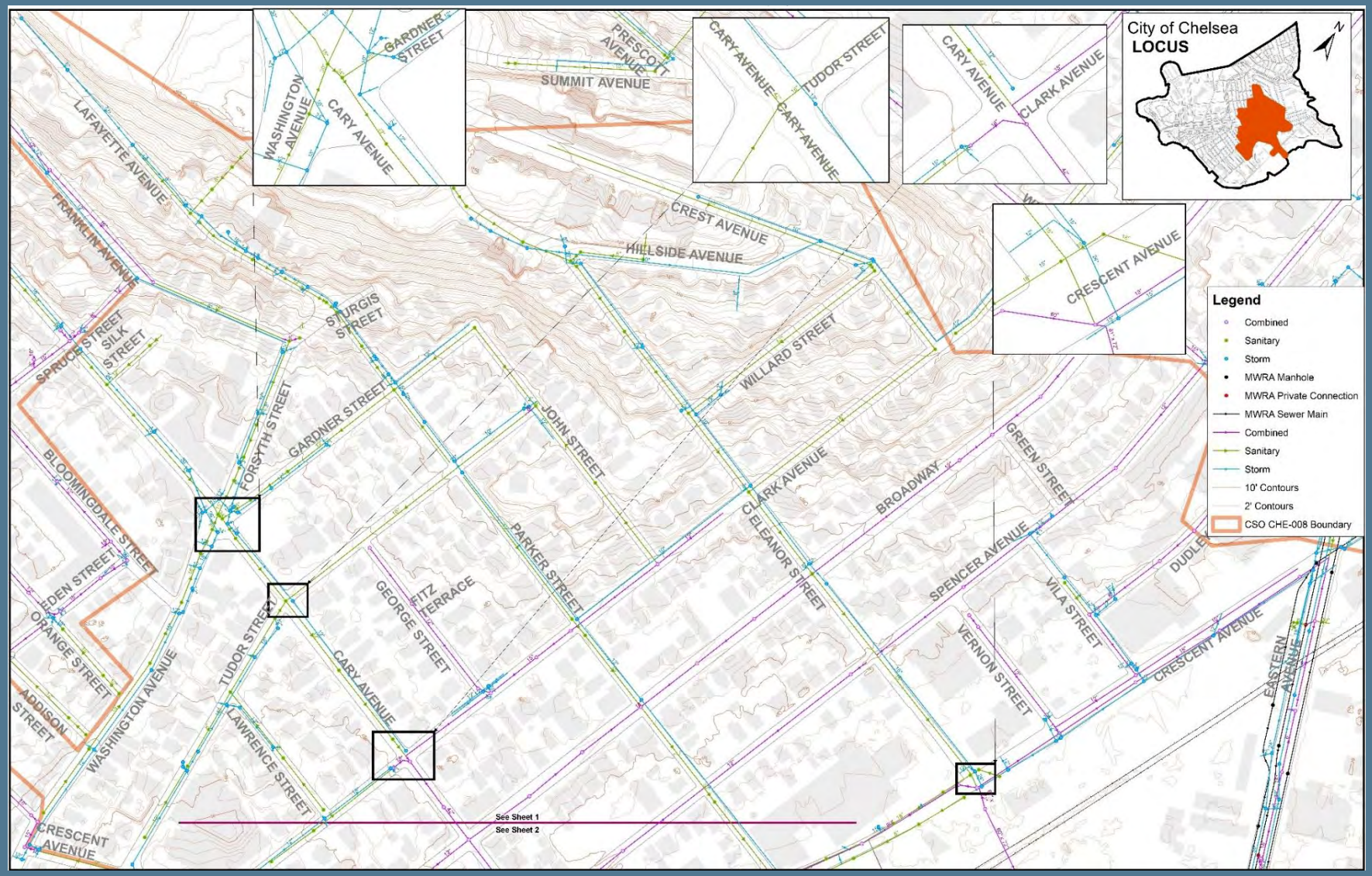
CSO Areas

- CHE-008:



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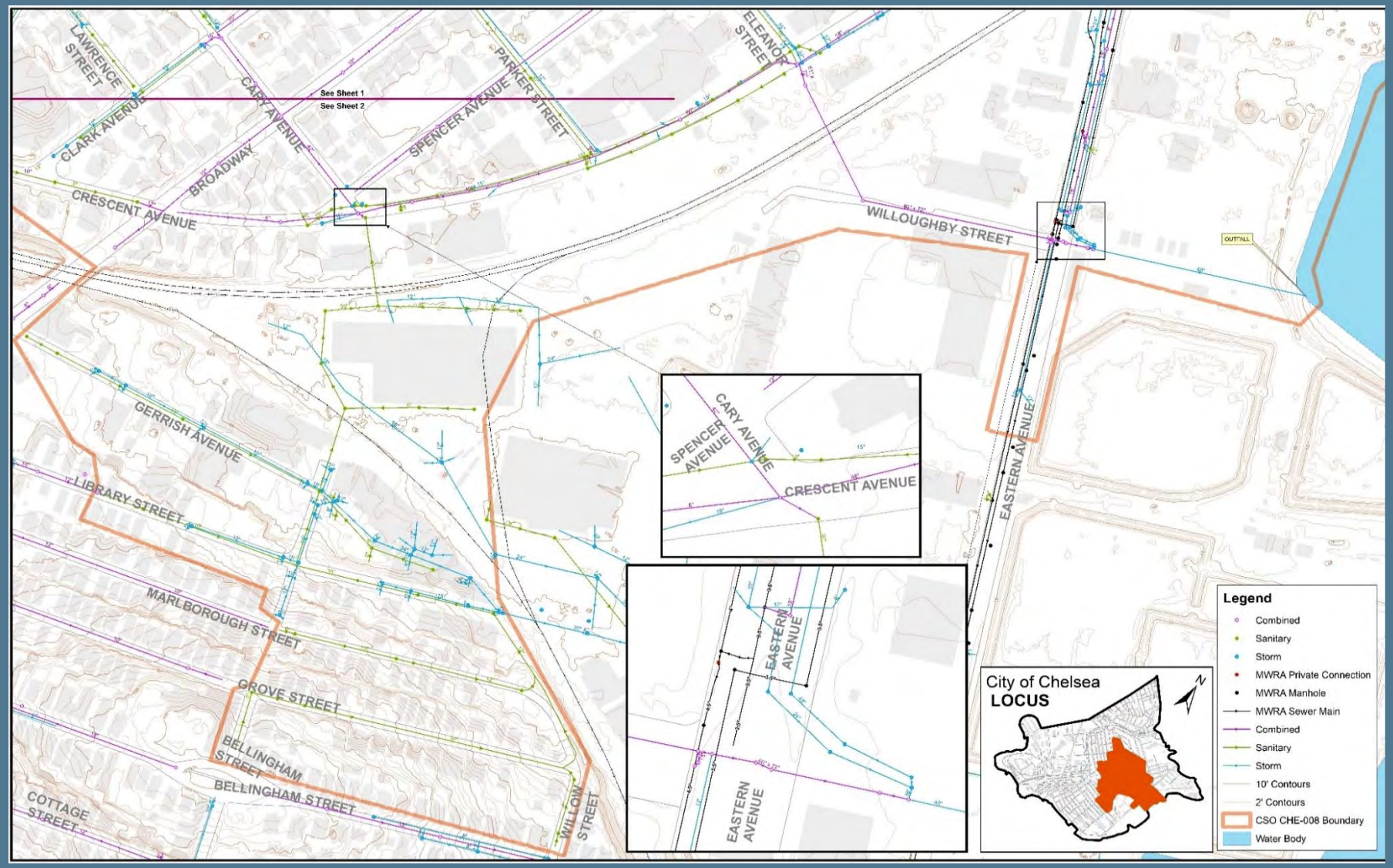

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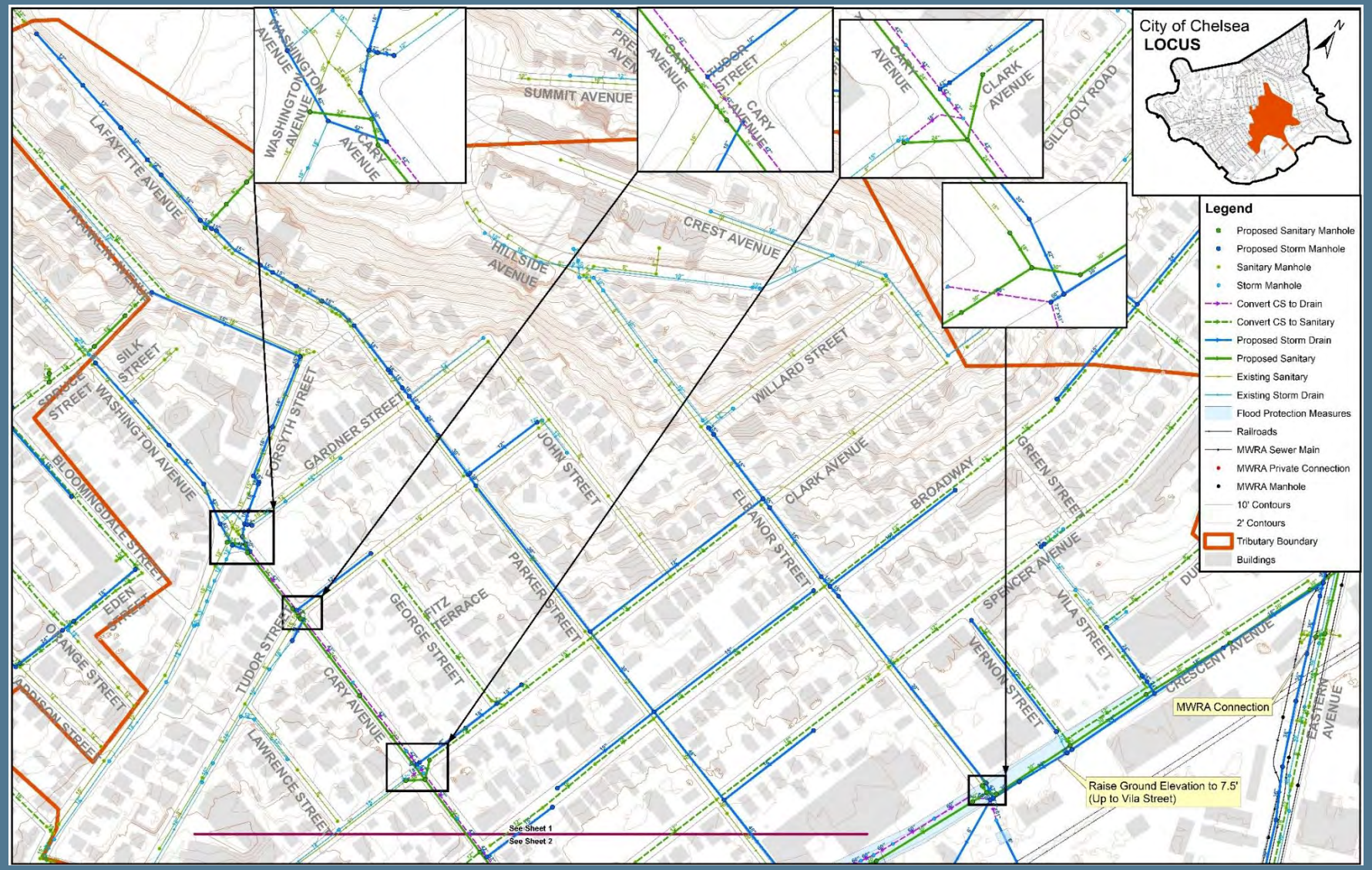

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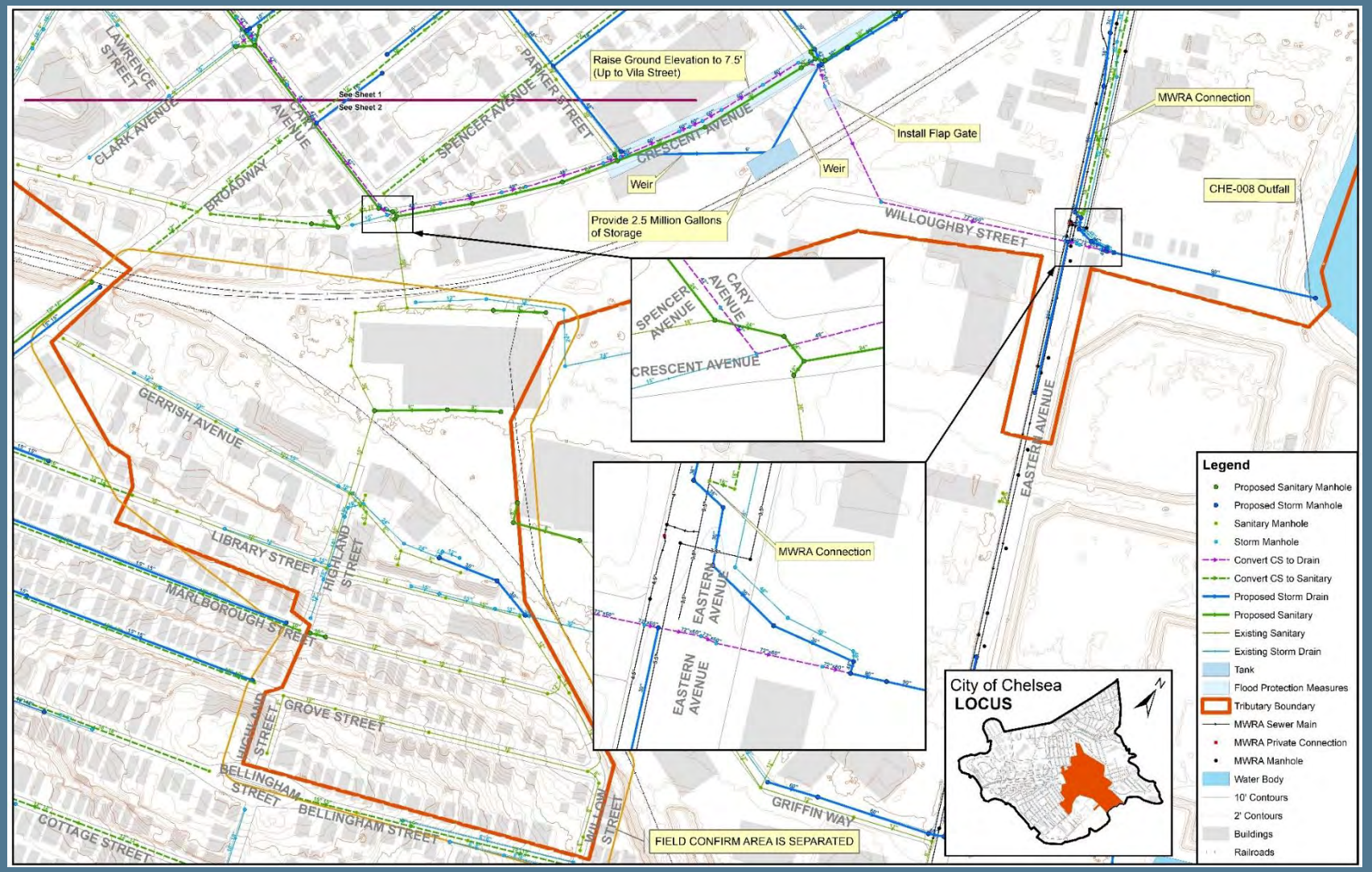

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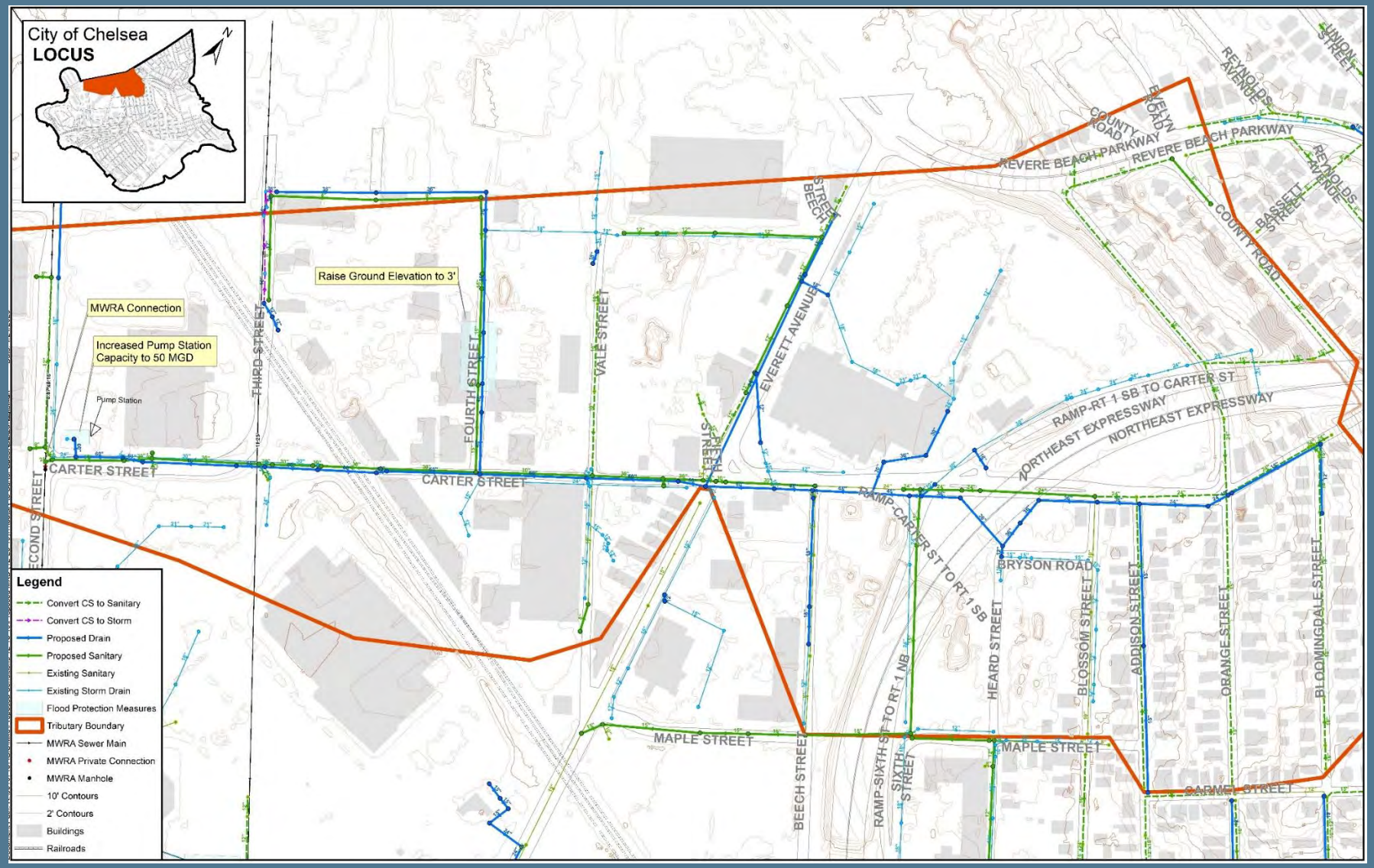
Willow Street:

Development of Sewer Separation Concepts

Carter Street:



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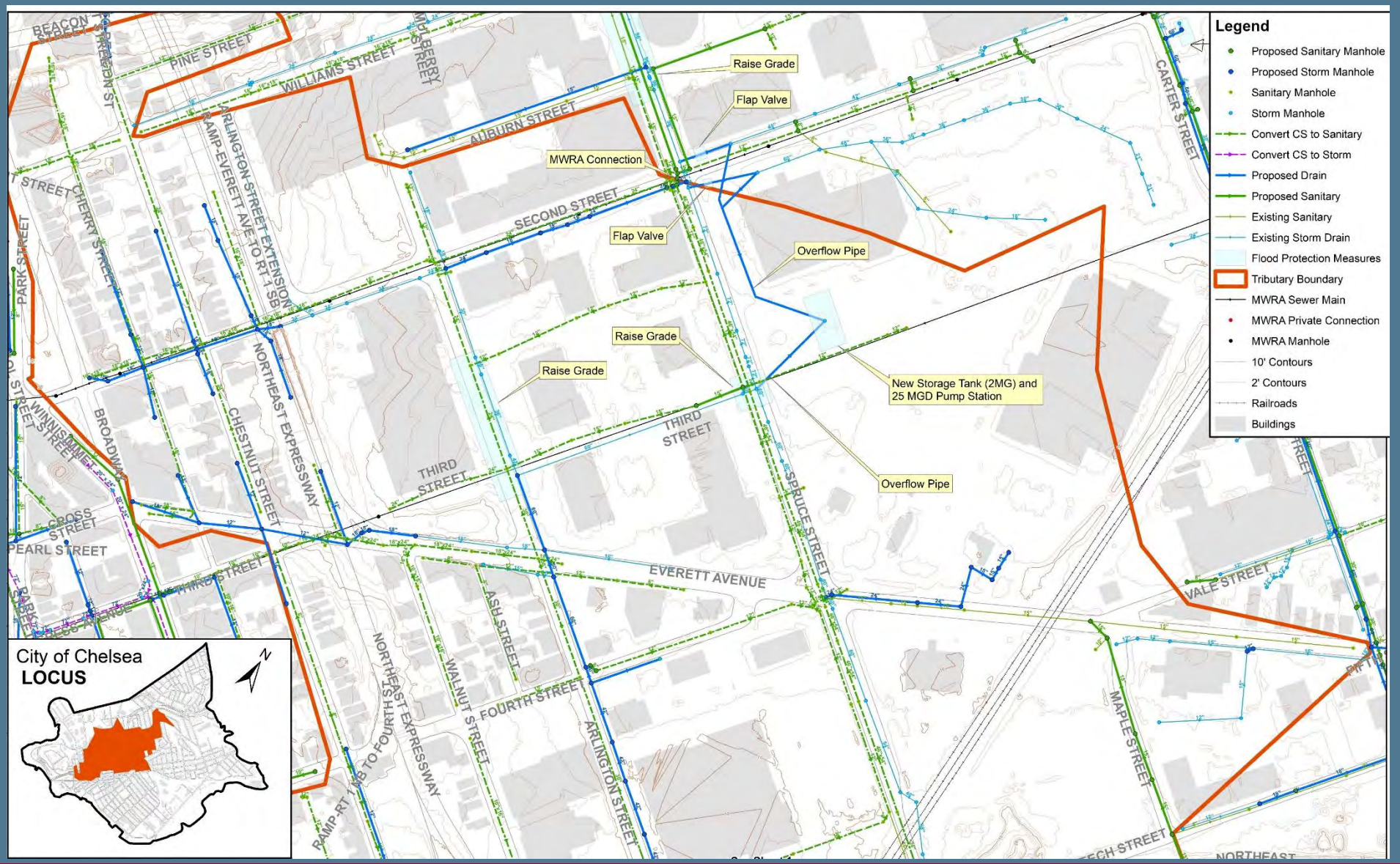

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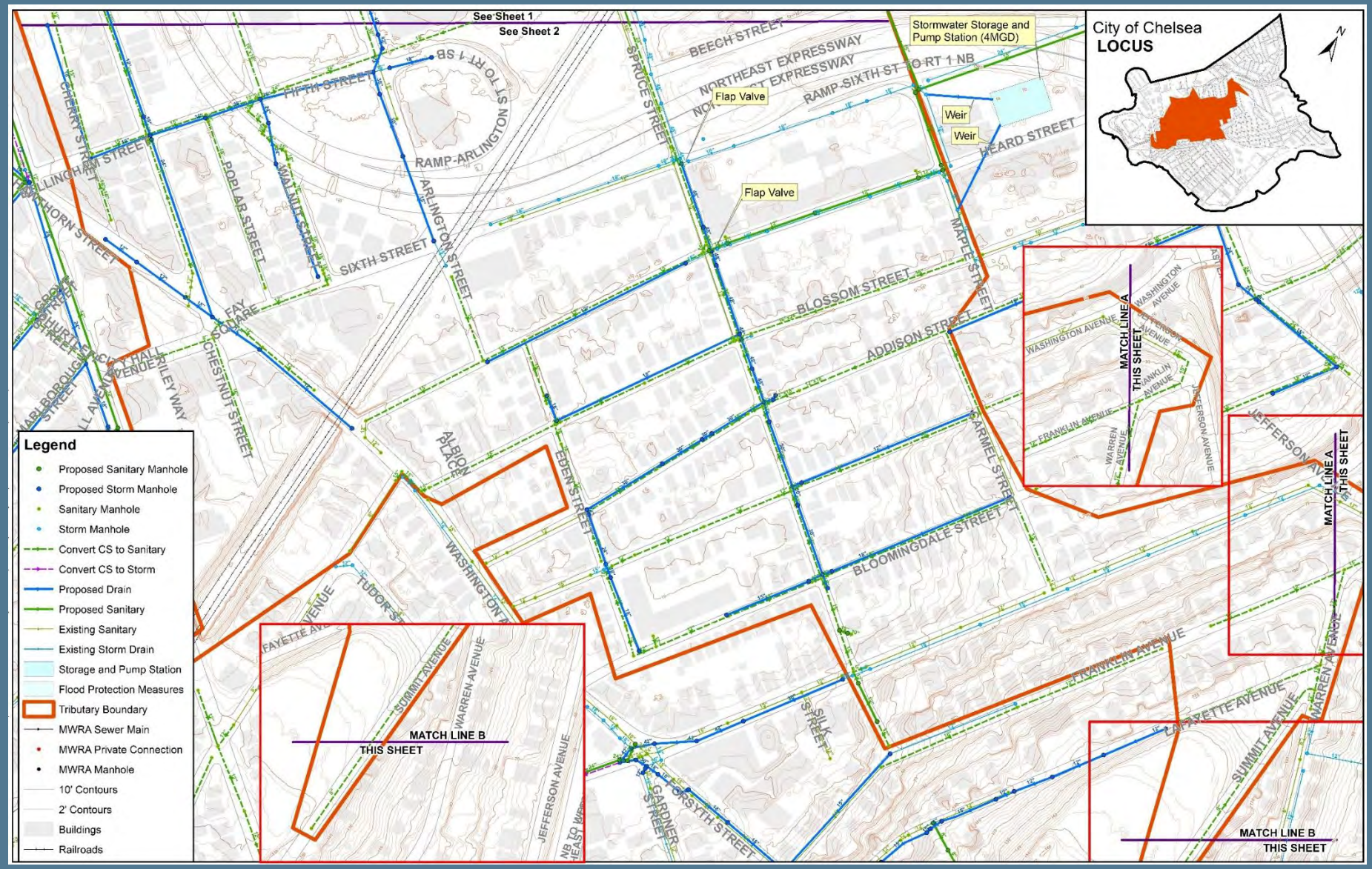

Project Costing

Unit costs were obtained from multiple sources:

- MassDOT
- Engineering estimates for projects of similar nature
- Recent construction bids
- RSMeans software

Assumptions in the costing:

- Soil Disposal: Factor based on City area was used
- Depth of trench and anticipated type of excavation
- Non-linear items were calculated as separate projects

Project Costing

Proposed Separation Improvements Cost Estimate			
Item No.	Item	Total	Estimated Construction Timeline
1	CHE-003 CSO Sewershed	$ 2,050,000	2023-2024
2	CHE-004 CSO Sewershed	$ 12,500,000	2022-2027
3	CHE-008 CSO Sewershed	$ 13,650,000	2028-2033
4	Chelsea Street Bridge Sewershed	$ 15,150,000	2034-2036
5	Webster & Eastern Sewershed	$ 1,100,000	2037
6	Carter Street Sewershed	$ 15,800,000	2038-2041
7	Spruce Street Sewershed	$ 40,400,000	2042-2048
8	Northwest Marginal Sewershed	$ 5,100,000	2049-2052
9	Admiral's Hill Sewershed	$ 2,300,000	2053-2054
10	Northeast Crescent Sewershed (Mill Hill)	$ 4,300,000	2055-2057
11	Prattville Sewershed	$ 4,150,000	2058-2060
12	Sagamore Sewershed	$ 1,800,000	2061-2062
13	North Revere Beach Parkway Sewershed	$ 10,300,000	2063-2067
14	West End of Broadway Sewershed	$ 655,000	2068
	Estimated Total Project Costs	**$ 129,250,000**	

Notes:

1. 2020: Investigation for CHE-003 closure begins.
2. 2020-2021 design/permitting begins for early projects.
3. Most projects will include water distribution upgrades or replacement.
4. Many projects will involve CIPP to reuse combined sewers as sanitary.
5. All projects will include full width/full depth street and sidewalk reconstruction.

Program Estimated ConstructionTimeline

PROJECTS	2020-2025	2026-2030	2031-2035	2036-2040	2041-2045	2046-2050	2051-2055	2056-2060	2061-2065	2066-2070
CHE-003 CSO Sewershed										
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Questions

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