Supplemental CSO Team - Session #11

Held: March 7, 2019

North Jersey Transportation Planning Authority

Newark, NJ

Agenda:

- Introductions and Background
  - Clean Waterways Healthy Neighborhoods
  - Combined Sewer Overflows (CSOs)
  - Regulatory Background
  - Long Term Control Plan Requirements
  - Current Project Status and Schedule
  - Clean
- Overview of CSO Control Technologies
- Evaluation of Alternatives Status Updates

CLEAN WATERWAYS

Healthy Neighborhoods

Supplemental CSO Team – Session 11

PVSC Service Area
North Bergen MUA Service Area (Woodcliff Treatment Plant)
Long Term Control Plan

March 7, 2019

CLEAN WATERWAYS
Healthy Neighborhoods

Meeting Purpose

Tonight's meeting is intended to:

- *Provide the public with an overview of the Clean Waterways Healthy Neighborhoods initiative*
- *Provide general background on CSOs, LTCPs, and NJPDES permit requirements*
- *Present updates on the Evaluation of Alternatives in each of the 9 combined sewer communities*
- *Solicit feedback from the Supplemental CSO Team and the general public*

Tonight's meeting is <u>not</u> intended to:

- *Select or eliminate CSO Control alternatives*
- *Provide detailed model results*
- *Address non-CSO related topics*
- *Be the end of the public participation process*

CLEAN WATERWAYS
Healthy Neighborhoods

Agenda

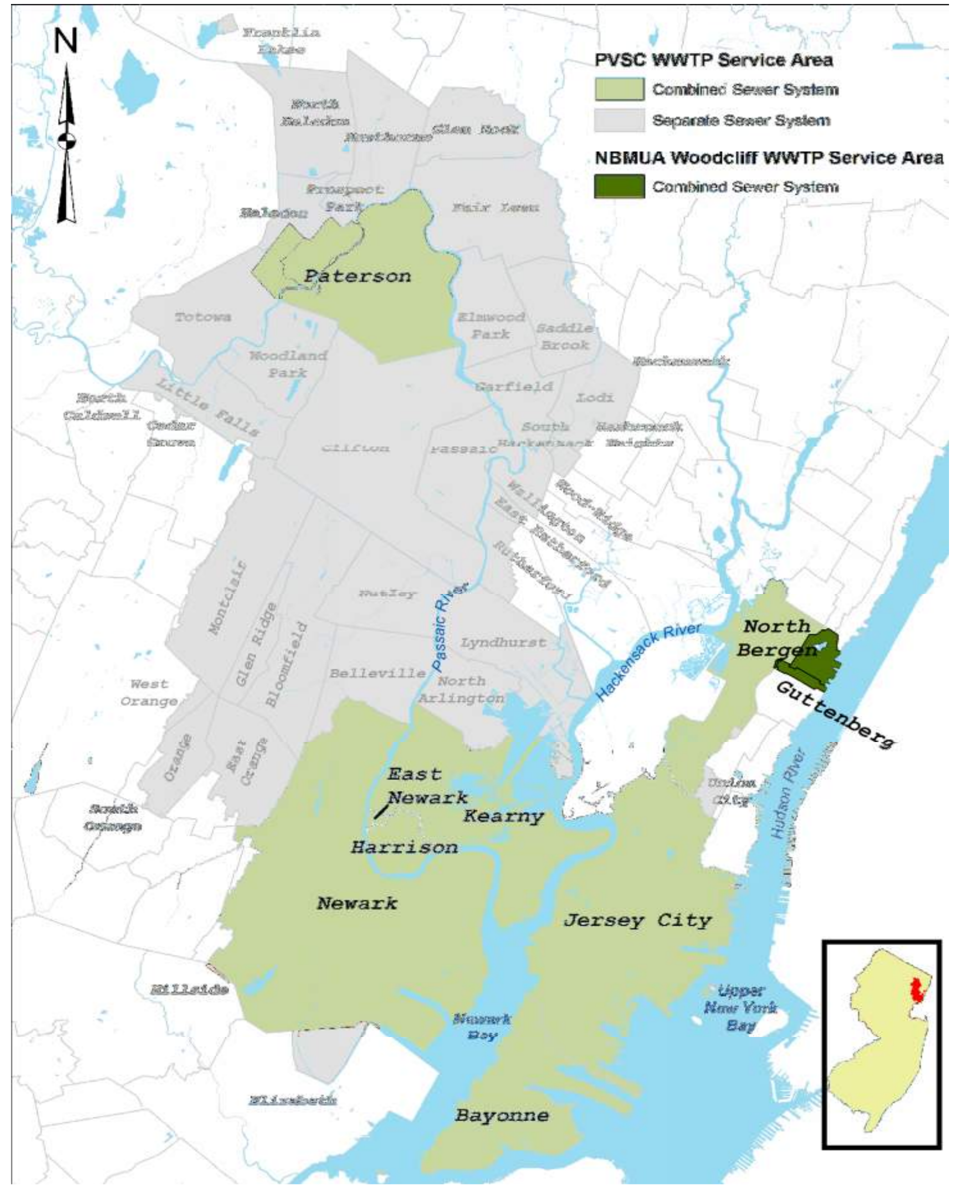
- Introduction and Background
  - Clean Waterways Healthy Neighborhoods
  - Combined Sewer Overflows (CSOs)
  - Regulatory Background
  - Long Term Control Plan Requirements
  - Current Project Status and Schedule
- Overview of CSO Control Technologies
- Evaluation of Alternatives Status Updates
  - *Bayonne*
  - *East Newark*
  - *Guttenberg*
  - *Harrison*
  - *Jersey City Municipal Utilities Authority*
  - *Kearny*
  - *Newark*
  - *North Bergen*
  - *Paterson*
- Questions and Discussion
- Adjourn

CLEAN WATERWAYS
Healthy Neighborhoods

Introduction and Background

CLEAN WATERWAYS
Healthy Neighborhoods

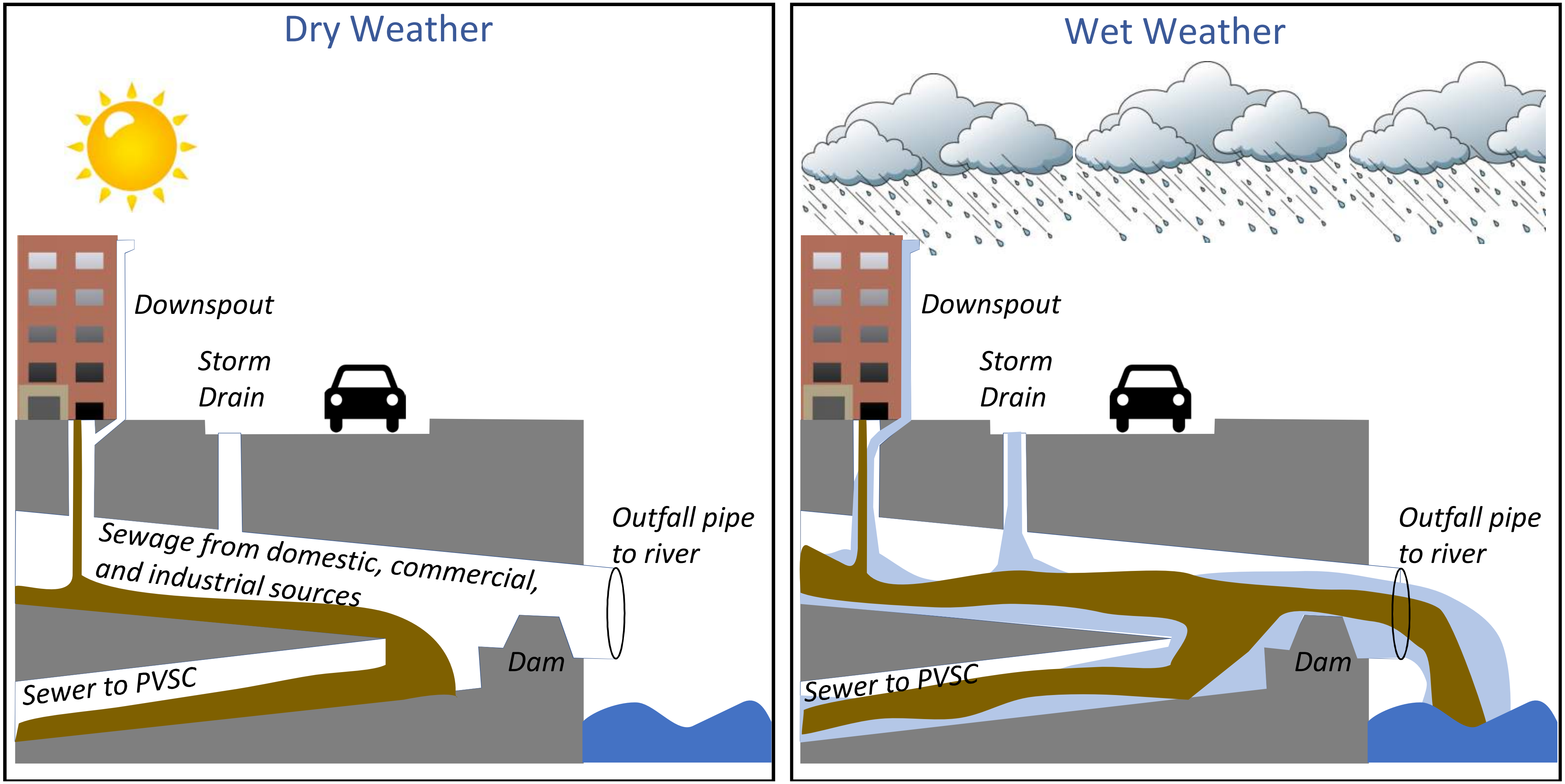
- City of Paterson
- City of Newark
- Town of Guttenberg
- Town of Harrison
- Town of Kearny
- Borough of East Newark
- North Bergen MUA
- Bayonne MUA
- Jersey City MUA
- Passaic Valley Sewerage Commission (PVSC)



Supplemental CSO Team Members

Member	Organization		Member	Organization
Dan Smereda	Bayonne Water Guardians		Sue Levine	Paterson Smart
Lisha Smereda	Bayonne Water Guardians		Ruben Gomez	City of Paterson Economic Development
Nicole Miller	Newark DIG		Sheri Ferreira	Greater Paterson Chamber of Commerce
Drew Curtis	Ironbound Community Corporation		Betty Jane Boros	New Jersey Business & Industrial Association
Robin Dougherty	Newark Greater Conservancy/Newark Business Partnership		Vacant	Montclair State University - Passaic River Institute
Jorge Santos	Newark Community Economic Development Corporation		Christopher C. Obropta, Ph.D	Rutgers University - Cooperative Extension Water Resources
Christopher Pianese	Township of North Bergen		Captain Bill Sheehan	Hackensack Riverkeeper
Janet Castro	Hudson Regional Health Commission Town of North Bergen		Harvey Morginstin	Passaic River Boat Club & Passaic River Superfund CAG
Thomas Stampe	North Bergen "Sustainable Jersey" group		Laurie Howard	Passaic River Coalition
Nancy Kontos	Bunker Hill Special Improvement District		Ben Delisle	Passaic River Rowing Association
Alison Cucco	Jersey City Environmental Commission		Patricia Hester-Fearon	Town of Kearny
Michele Langa	NY/NJ Baykeeper		Christopher Vasquez	Town of Kearny

What is a Combined Sewer Overflow (CSO)?



Why Are We Concerned About CSOs?

- CSOs discharge untreated wastewater during wet weather
- CSO discharges contain disease causing organisms, measured as enterococcus, fecal coliform, and e.coli
- These organisms can cause intestinal illness in recreational users of the waterbodies
  - Swimmers
  - Boaters
  - Waders

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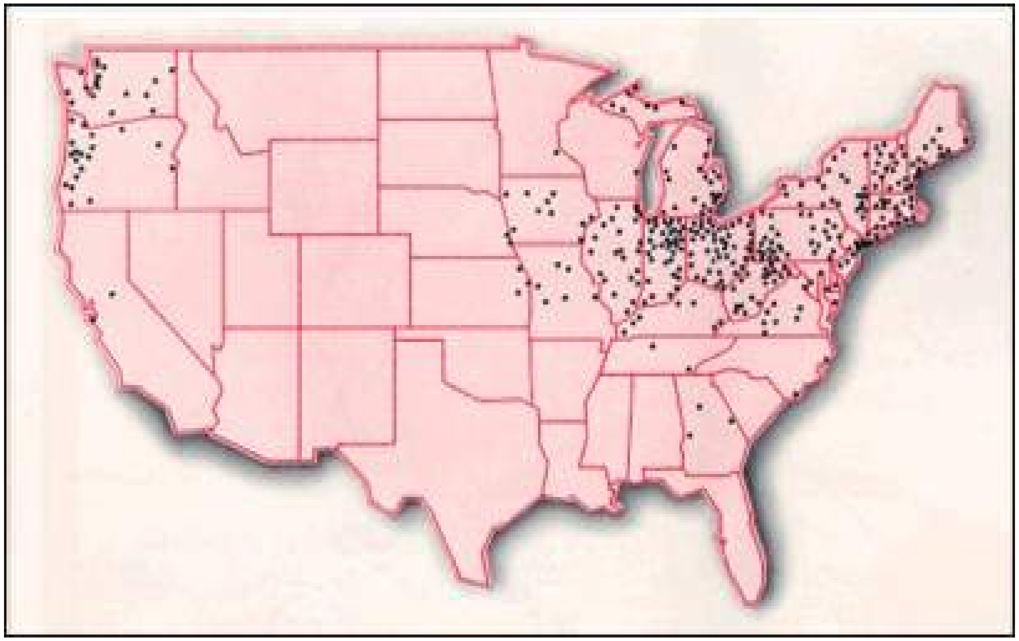
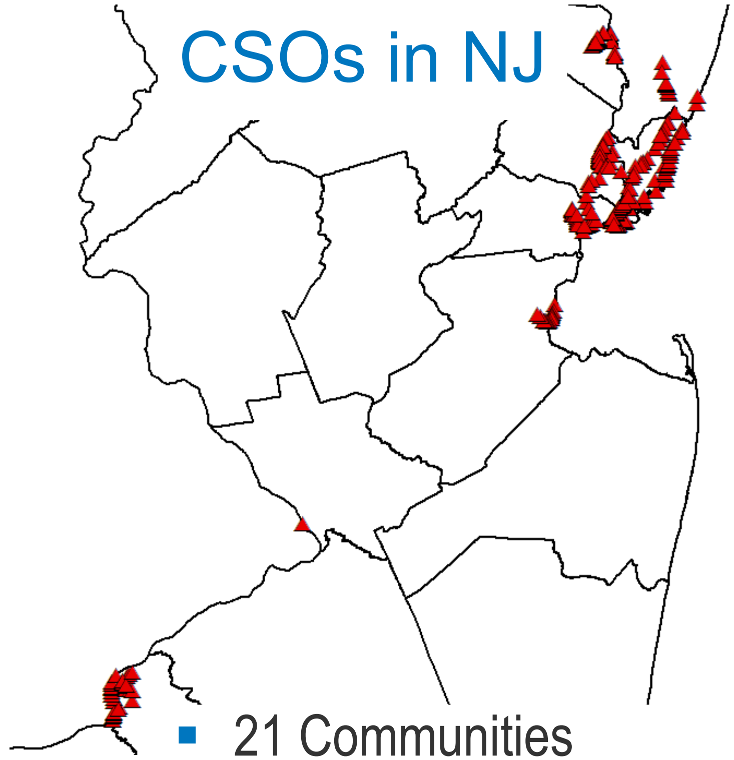
CSOs in the US



- 772 Communities
- 9,350 Outfalls
- 850 Billion Gallons Discharged Per Year

Source: USEPA Report to Congress on Impacts and Control of Combined Sewer Overflows and Sanitary Sewer Overflows Fact Sheet

CSOs in NJ



- 21 Communities
- 210 Permitted Outfalls
- 9 POTWs

Source: NJDEP

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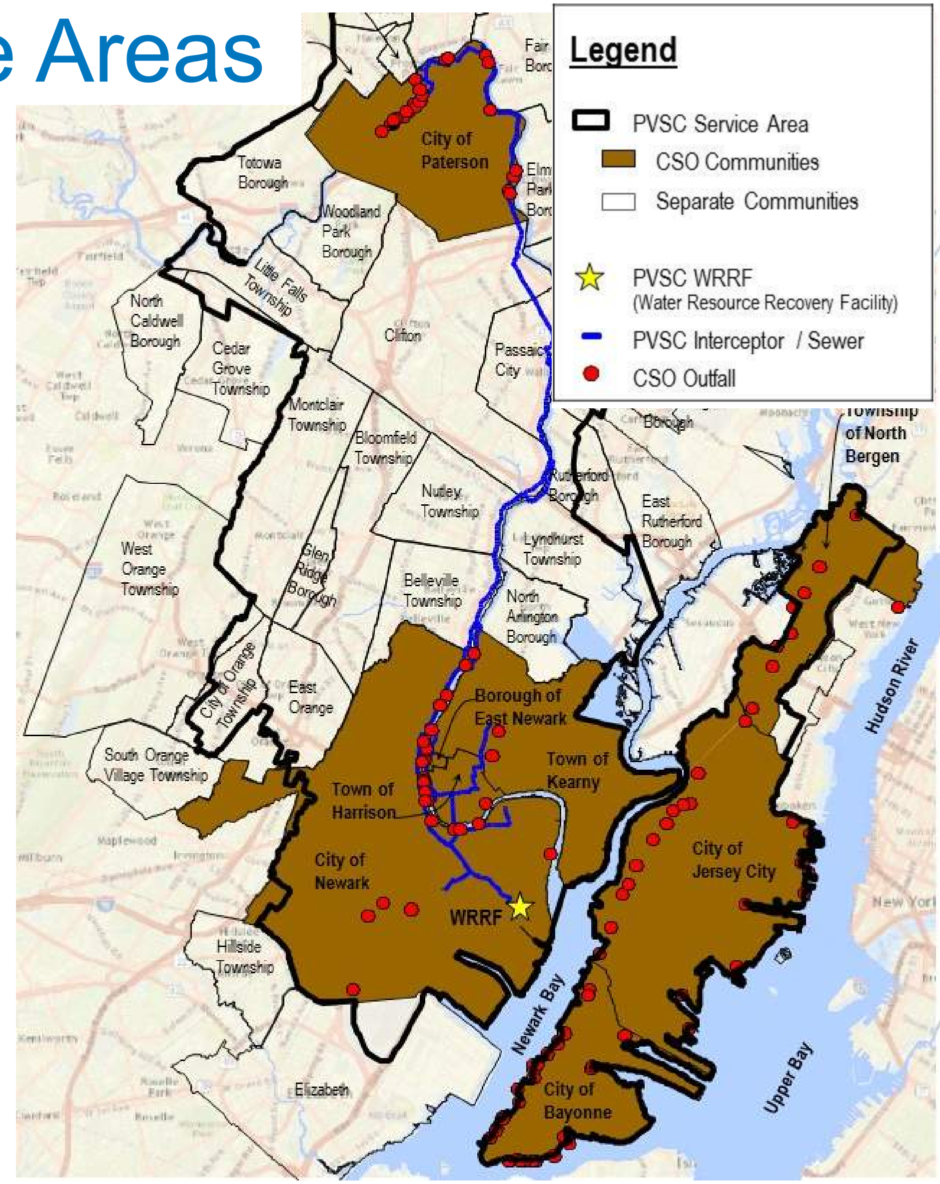
PVSC and Woodcliff Service Areas Combined Sewer Overflows

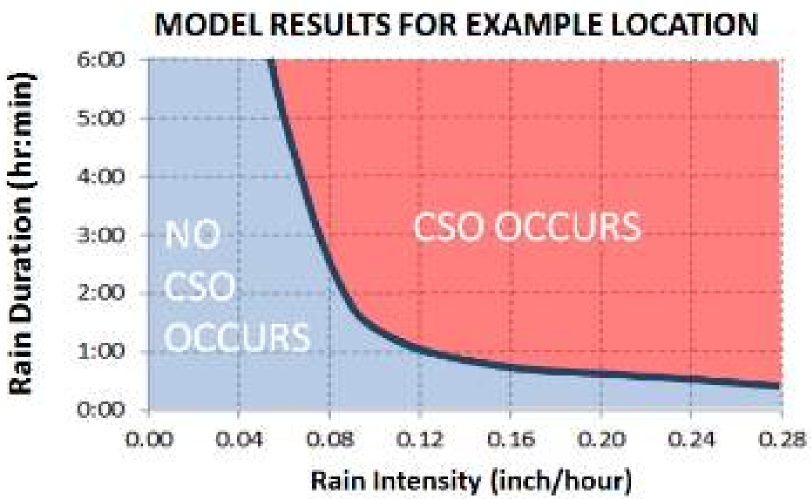
MEMBER	WWTP	CSOs
Bayonne MUA	PVSC	30
Borough of East Newark		1
Town of Harrison		7
Jersey City MUA		21
Town of Kearny		5
City of Newark		18
North Bergen MUA*		7
City of Paterson		23
PVSC		0
Town of Guttenberg	Woodcliff	1
North Bergen MUA*		1
TOTAL		**114**

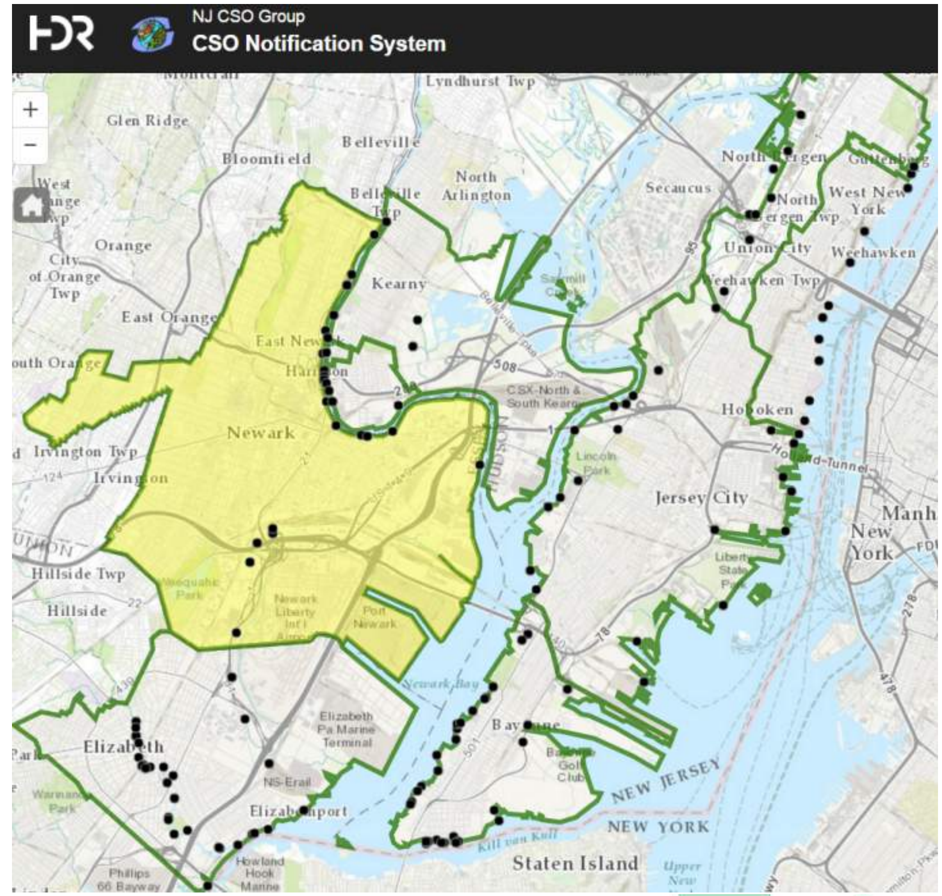
** North Bergen MUA conveys flows to both PVSC and Woodcliff WWTPs*



CSO Notification System

- Public notification system
  http://njcso.hdrgateway.com/
- A predictive system, not a monitoring system
- Utilizes model derived rating curves to predict overflow events at each outfall location





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Regulatory Setting – New Jersey

- New Jersey Pollutant Discharge Elimination System (NJPDES)
- 25 Permittees
  - Municipalities and Treatment Facilities
- Previous NJDEP Permits
  - Screening and Netting Facilities for Floatables Control
  - Some Cooperation Between Combined Sewer Municipalities and Treatment Facilities
- Current Combined Sewer Management (CSM) NJPDES Permits Went into Effect on July 1, 2015
  - New Regional Approach
    - Treatment Facilities Working with Contributing Municipalities
    - 9 **Long Term Control Plans** (LTCPs) Being Developed Across State
      - Due June 1, 2020

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Long Term Control Plan

- LTCP Will Evaluate Ways to Mitigate CSO Impacts to a Level that Would Meet the Requirements of the CSO Policy and Would Not Preclude Attainment of Water Quality Standards

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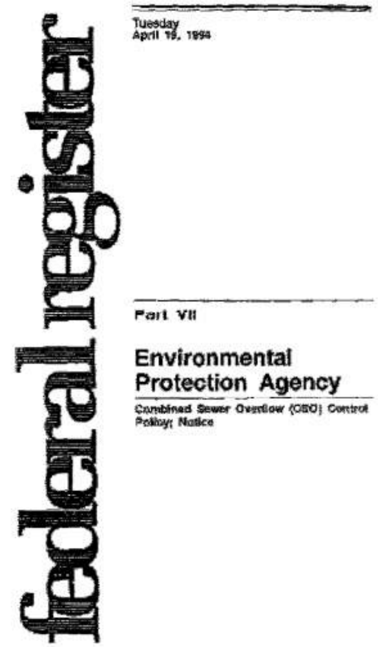
What Will Guide the LTCP?

- National Combined Sewer Overflow Control Policy (1994)
  - Consistent National Approach for Controlling discharges from CSOs
  - Comprehensive and Coordinated planning effort to achieve cost-effective CSO controls
    - Develop a Long Term Control Plan (LTCP)
    - Includes Public Participation

    "In developing its long-term CSO control plan, the permittee will employ a public participation process that actively involves the affected public in the decision-making to select the long-term CSO controls. The affected public includes rate payers, industrial users of the sewer system, persons who reside downstream from the CSOs, persons who use and enjoy these downstream waters, and any other interested persons."



- Other Guidance Documents

Long Term Control Plan Requirements

1. Monitoring and Modeling
2. Public Participation *(Supplemental CSO Team)*
3. Consideration of Sensitive Areas
4. Evaluation of Alternatives
5. Cost/Performance Considerations
6. Operational Plan
7. Maximizing Treatment at the Existing STP
8. Implementation Schedule
9. Compliance Monitoring Program

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What Can Be Done To Reduce CSO Impacts?

- Deliver more flow to the wastewater treatment plant
  - Optimize current operations
  - Expand treatment facilities
  - Provide additional conveyance capacity (pipes)
- Provide storage for excess volume until conveyance and plant capacity recover
  - Tanks
  - Tunnels
- Provide satellite treatment facilities
- Reduce flows getting to collection system
  - Separate sewers
  - Source controls
  - Green infrastructure
- ***ALL SIGNIFICANT CAPITAL PROJECTS***

This Will Be Expensive

- Possibly the largest capital expenditure in each municipalities' history
- Summary for CSO permittees from 2004 CSO permit reports was in hundreds of millions dollars
- In other CSO municipalities, sewer rates have doubled over a 20-year period
- Example LTCP program costs
  - New York City - $4.2 Billion
  - Philadelphia - $1.2 Billion
  - Northeast Ohio (Cleveland) - $3 Billion
  - Washington DC - $2.6 Billion

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59-Month Program Schedule and Milestones

January 1, 2016
- ✓ Coordinates of pumps, regulators, and outfalls
- ✓ System Characterization Work Plan
- ✓ Baseline Compliance Monitoring Program Work Plan

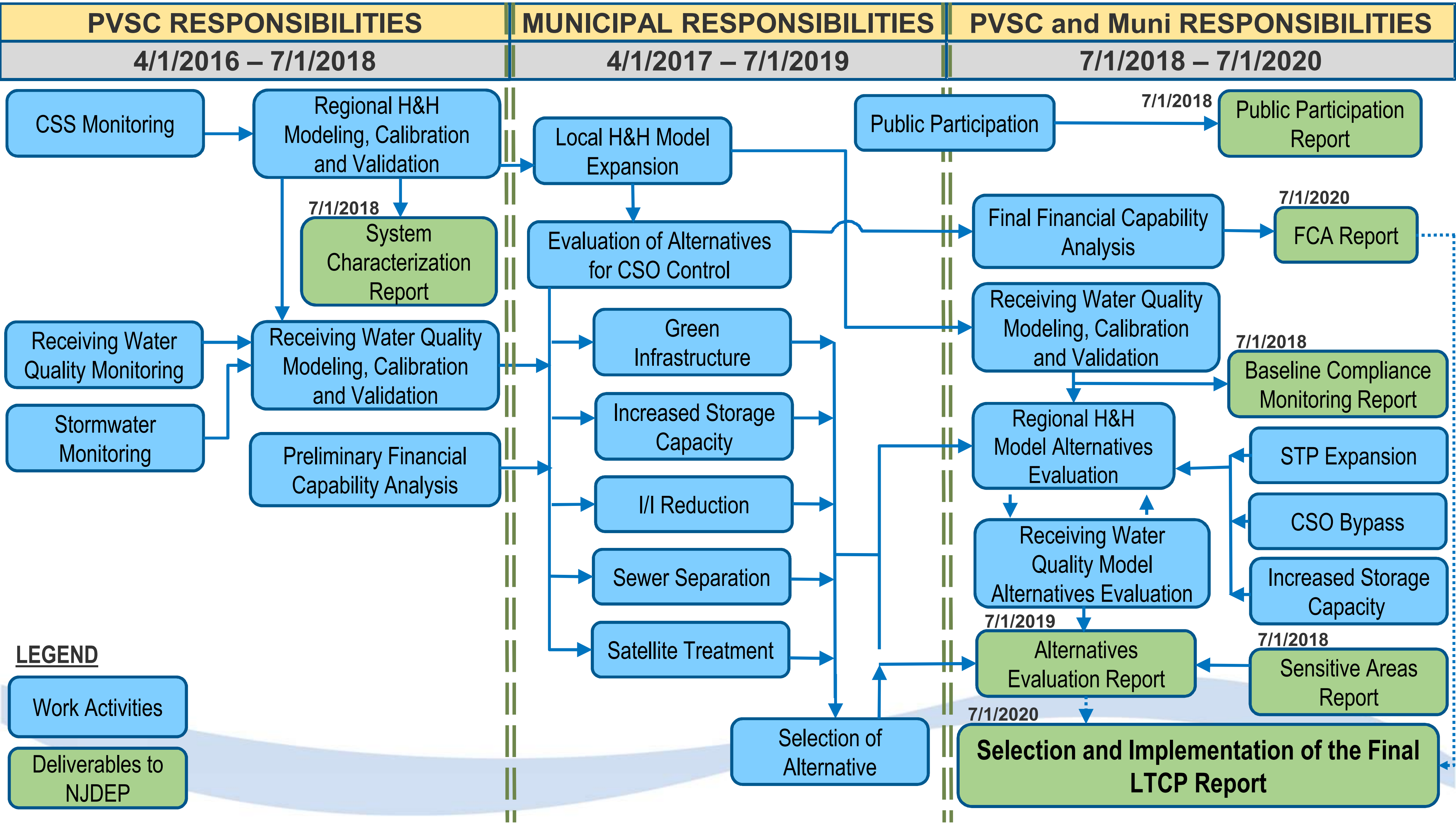
July 1, 2016
- ✓ Map of Combined and Separate Sewer Areas

July 1, 2018
- ✓ System Characterization Report
- ✓ Public Participation Process Report
- ✓ Compliance Monitoring Program Report
- ✓ Consideration of Sensitive Areas Plan

July 1, 2019
- Development and Evaluation of Alternatives Report

June 1, 2020
- Selection and Implementation of Alternatives Report in the Final LTCP

Permit Due Date



PVSC RESPONSIBILITIES
4/1/2016 – 7/1/2018
MUNICIPAL RESPONSIBILITIES
4/1/2017 – 7/1/2019
PVSC and Muni RESPONSIBILITIES
7/1/2018 – 7/1/2020
CSS Monitoring
Regional H&H Modeling, Calibration and Validation
7/1/2018
System Characterization Report
Receiving Water Quality Monitoring
Stormwater Monitoring
Receiving Water Quality Modeling, Calibration and Validation
Preliminary Financial Capability Analysis
Local H&H Model Expansion
Evaluation of Alternatives for CSO Control
Green Infrastructure
Increased Storage Capacity
I/I Reduction
Sewer Separation
Satellite Treatment
Selection of Alternative
Public Participation
7/1/2018
Public Participation Report
Final Financial Capability Analysis
7/1/2020
FCA Report
Receiving Water Quality Modeling, Calibration and Validation
7/1/2018
Baseline Compliance Monitoring Report
Regional H&H Model Alternatives Evaluation
STP Expansion
CSO Bypass
Increased Storage Capacity
Receiving Water Quality Model Alternatives Evaluation
7/1/2019
Alternatives Evaluation Report
7/1/2018
Sensitive Areas Report
7/1/2020
Selection and Implementation of the Final LTCP Report
LEGEND
Work Activities
Deliverables to NJDEP

Overview of CSO Control Technologies

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Permit Requirements

- Evaluate the feasibility of potential control alternatives, including:
  - Green infrastructure
  - Increased storage capacity in the collection system
  - Treatment expansion or storage at PVSC
  - Inflow and Infiltration (I/I) reduction
  - Sewer separation
  - *Treatment of CSO discharge*
  - CSO related bypass of secondary treatment at the treatment plant

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Green Infrastructure

- Capture stormwater runoff before it reaches the combined sewer system
  - Raingardens, pervious pavement, green roofs, blue roofs, etc.
- Less Runoff Reaching the Combined Sewer System = Less Overflow
- Hydrologic and Hydraulic (H&H) models to determine the potential overflow reductions
- Evaluate varying levels of GI control as a percentage of impervious cover controlled, specific projects and initiatives

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Increased Collection System Storage

- Capture and hold volume until conveyance and treatment capacity return
- Tanks, tunnels, pipes, etc.
- Regional H&H models used to size and evaluate the overflow reduction of potential storage solutions.

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Treatment Expansion or Storage at PVSC

- Convey additional flow to PVSC for treatment Plant is already at wet weather capacity, so it would require plant expansion
- The interceptor has limited capacity
- H&H models used to evaluate the potential overflow reductions of sending more flow to PVSC

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Inflow and Infiltration (I&I) Reduction

- I&I is water that enters the collection system through cracks, joints, etc.
- Rainfall and groundwater driven
- Some I&I is expected
- Excessive I&I uses conveyance and treatment capacity that would otherwise be available for combined sewage, and adds to CSOs
- H&H model used to evaluate overflow possible overflow reductions from reducing excessive I/I

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Sewer Separation

- Eliminate CSOs
  - Stormwater discharges still remain

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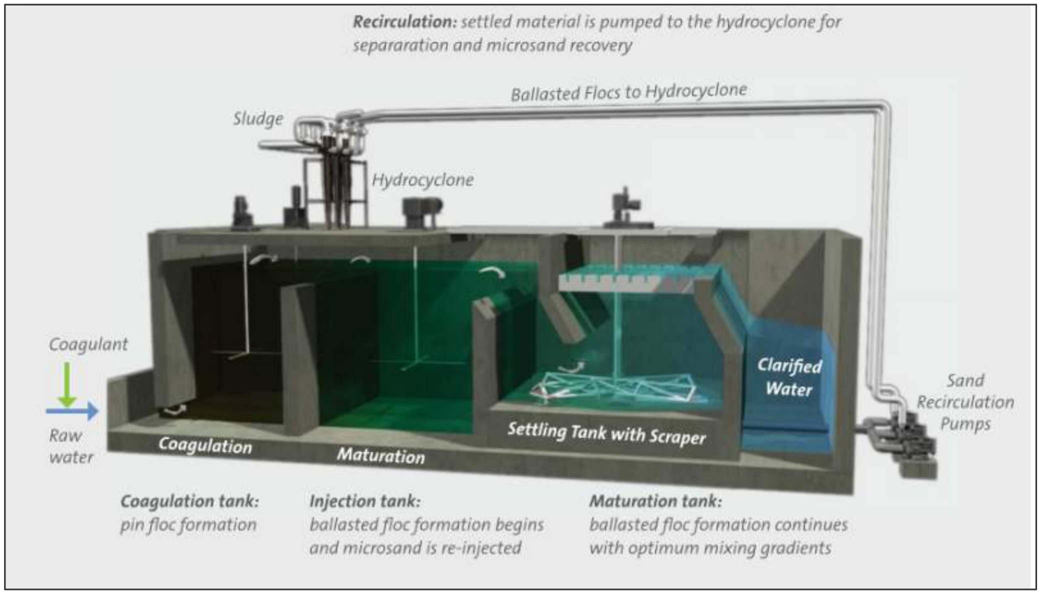
Treatment of CSO Discharge

- Disinfect the CSO discharge
- H&H models used to size the required disinfection facilities



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Secondary Treatment Bypass

- Convey additional flow to PVSC for treatment.
- Bypass secondary/biological treatment
- Additional conveyance required

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Project Status Update

TOWN OF GUTTENBERG
CSO LONG TERM CONTROL PLAN
DEVELOPMENT AND EVALUATION OF ALTERNATIVES

March 7, 2019

Mark A. Hubal, PE, BCEE

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GUTTENBERG FACTS

- Population – 11,700
- Area – 124 Acres (0.26 sq. mi.)
- Most densely populated municipality in the United States
- Highly urbanized – over 95% impervious cover

GUTTENBERG COMBINED SEWER SYSTEM

- NJPDES Permit No. NJ0108715
- Approximately 111 acres of combined sewers
- 11,200 LF of combined sewer, 175 catch basins
- Approximately 13 acres of separated sewer (waterfront)
- Flow to Woodcliff STP (North Bergen MUA) ★
- One CSO Outfall ☆
- No PVSC Discharge

CURRENT AND FUTURE FLOWS

- Current Conditions
  - Population – 11,700
  - Dry Weather Flow – approximately 1.1 MGD
  - Flow Control at Regulator Chamber GU-1
  - Flow Throttling at Woodcliff STP
- Future Conditions
  - Projected 2045 Population – 12,000 (NJTPA)
  - Potential Zoning Change – High-Rise Residential (6 acres)
  - Modest (<1,000) Change to Population
  - Insignificant Effect on Wet Weather Flows

SCREENING OF CSO CONTROL TECHNOLOGIES

- Initial Menu Provided by PVSC Consultants
- Three Major Groups:
  - Source Control (incl. Green Infrastructure)
  - Collection System
  - Storage and Treatment
- Reviewed and Modified by RVE for Local Conditions
- Feasible Options Referred for Further Study

Source Control Technologies

Technology Group	Practice	Primary Goals		Implementation & Operation Factors	Consider Combining w/ Other Technologies	Being Implemented	Recommendation for Alternatives Evaluation
		Bacteria Reduction	Volume Reduction				
Stormwater Management	Street/Parking Lot Storage (Catch Basin Control)	Low	Low	Flow restrictions to the CSS can cause flooding in lots, yards and buildings; potential for freezing in lots; low operational cost. Effective at reducing peak flows during wet weather events but can cause dangerous conditions for the public if pedestrian areas freeze during flooding.	No	No	No
	Catch Basin Modification (for Floatables Control)	Low	None	Requires periodic catch basin cleaning; requires suitable catch basin configuration; potential for street flooding and increased maintenance efforts. Reduces debris and floatables that can cause operational problems with the mechanical regulators.	No	No	No
	Catch Basin Modification (Leaching)	Low	Low	Can be installed in new developments or used as replacements for existing catch basins. Require similar maintenance as traditional catch basins. Leaching catch basins have minor effects on the primary CSO control goals.	No	No	No
Public Education and Outreach	Water Conservation	None	Low	Water purveyor is responsible for the water system and all related programs in the respective City. However, water conservation is a common topic for public education programs. Water conservation can reduce CSO discharge volume, but would have little impact on peak flows.	Yes	Yes	No
	Catch Basin Stenciling	None	None	Inexpensive; easy to implement; public education. Is only as effective as the public's acceptance and understanding of the message. Public outreach programs would have a more effective result.	Yes	No	No
	Community Cleanup Programs	None	None	Inexpensive; sense of community ownership; educational BMP; aesthetic enhancement. Community cleanups are inexpensive and build ownership in the city.	Yes	No	No
	Public Outreach Programs	Low	None	Public education program is ongoing. Permittee should continue its public education program as control measures demonstrate implementation of the NMC.	Yes	No	No
	FOG Program	Low	None	Requires communication with business owners; Permitee may not have enforcement authority. Reduces buildup and maintains flow capacity. Only as effective as business owner cooperation.	Yes	No	No
	Garbage Disposal Restriction	Low	None	Permitee may not be responsible for Garbage Disposal. This requires an increased allocation of resources for enforcement while providing very little reduction to wet weather CSO events.	Yes	No	No
	Pet Waste Management	Medium	None	Low cost of implementation and little to no maintenance. This is a low cost technology that can significantly reduce bacteria loading in wet weather CSO's.	Yes	Yes	No
	Lawn and Garden Maintenance	Low	Low	Requires communication with business and homeowners. Guidelines are already established per USEPA. Educating the public on proper lawn and garden treatment protocols developed by USEPA will reduce waterway contamination. Since this information is already available to the public it is unlikely to have a significant effect on improving water quality.	Yes	No	No
	Hazardous Waste Collection	Low	None	The N.J.A.C prohibits the discharge of hazardous waste to the collection system.	Yes	Yes	No
Ordinance Enforcement	Construction Site Erosion & Sediment Control	None	None	In building code; reduces sediment and silt loads to waterways; reduces clogging of catch basins; little O&M required; contractor or owner pays for erosion control. A Soil Erosion & Sediment Control Plan Application or 14-day notification (if Permitee covered under permit-by-rule) will be required by NJDEP per the N.J.A.C.	Yes	No	No
	Illegal Dumping Control	Low	None	Enforcement of current law requires large number of code enforcement personnel; recycling sites maintained. Local ordinances already in place can be used as needed to address illegal dumping complaints.	Yes	No	No
	Pet Waste Control	Medium	None	Requires resources to enforce pet waste ordinances. Public education and outreach is a more efficient use of resources, but this may also provide an alternative to reducing bacterial loads.	Yes	No	No
	Litter Control	None	None	Aesthetic enhancement; labor intensive; City function. Litter control provides an aesthetic and water quality enhancement. It will require city resources to enforce. Public education and outreach is a more efficient use of resources.	Yes	No	No
	Illicit Connection Control	Low	Low	Site specific; more applicable to separate sanitary system; new storm sewers may be required; interaction with homeowners required. The primary goal of the LTCP is to meet the NJPDES Permit requirements relative to POCs. Illicit connection control is not particularly effective at any of these goals and is not recommended for further evaluation unless separate sewers are in place.	Yes	No	No
Good Housekeeping	Street Sweeping/Flushing	Low	None	Labor intensive; specialized equipment; doesn't address flow or bacteria; City function. Street sweeping and flushing primarily addresses floatables entering the CSS while offering an aesthetic improvement.	Yes	Yes	No
	Leaf Collection	Low	None	Requires additional seasonal labor. Leaf collection maximizes flow capacity and removes nutrients from the collection system.	Yes	No	No
	Recycling Programs	None	None	Most Cities have an ongoing recycling program.	Yes	Yes	No
	Storage/Loading/Unloading Areas	None	None	Requires industrial & commercial facilities designate and use specific areas for loading/unloading operations. There may be few major commercial or industrial users upstream of CSO regulators.	Yes	No	No
	Industrial Spill Control	Low	None	PVSC has established a pretreatment program for industrial users subject to the Federal Categorical Pretreatment Standards 40 CFR 403.1.	Yes	No	No

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SCREENING RESULTS – SOURCE CONTROL TECHNOLOGIES

- Many Strategies Already Being Implemented by Guttenberg (Water Conservation, Recycle/Leaf Collection, Litter/Pet Waste Control, Catch Basin Cleaning)
- On-site Detention is Recommended for New Developments via Planning Process
- Most Strategies Have Little to No Impact on Wet Weather Flow Volume or Bacteriological Loading
- No Further Strategies Recommended for Further Study

SCREENING RESULTS – GREEN INFRASTRUCTURE

- Very Little Impervious Space for Bioswales and Rain Gardens
- Permeable Pavement not Feasible due to Usage and Maintenance Concerns
- Planter Boxes Considered but Limited Space Precludes Significant Adoption
- Green Roofs Impractical for Existing Low-Density Residential, but may be Used in New High-Density (R-5) Zone
- Rain Barrels Possible for Residential and Commercial Buildings (Approximately 2500 Existing Buildings)

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SCREENING RESULTS – COLLECTION SYSTEM TECHNOLOGIES

- Several Alternatives Already in Use by Guttenberg (Catch Basin Cleaning, Regulator Modifications)
- Some Options Not Possible due to Local Conditions (Outfall Consolidation, Real-Time Control, Sewer Flushing)
- Infiltration / Inflow Reduction is Feasible, based on Video Inspection of Sewer System
- Complete Sewer Separation is Prohibitively Expensive, But Individual / Partial Separation Can Be Considered:
  - Galaxy Towers
  - New High-Rise Developments
  - Certain Areas of the Town

SCREENING RESULTS – STORAGE / TREATMENT TECHNOLOGIES

- Linear Storage – Gravity Storage Not Possible; Pumped Storage May Be Feasible for Further Study
- Point Storage – Not Feasible for Guttenberg due to Space and Personnel Issues
- Treatment (CSO Outfall) – Guttenberg has no Treatment Capabilities or room at Outfall
- Treatment (STP) - Guttenberg has no Treatment Capabilities, but NBMUA is Expanding Woodcliff Plant
- Pretreatment – No Significant Industrial Users to Make SIU Program Feasible

SUMMARY OF SCREENING RESULTS

- I/I Reduction
- Woodcliff Treatment Plant Expansion (NBMUA)
- Separation of Galaxy Towers Flow (Storm and Sanitary)
- Separation of New High-Rise Buildings
- Linear Storage (Pumped)
- Partial Sewer System Separation
- Green Roofs
- Rain Barrels

MODEL ANALYSIS

- Infoworks ICM, Version 9.0
- Utilized Historical Model Set-up from 2007
  - 26 Manhole Locations
  - Portion of 70th Street and Main Intercepter along 71st Street
  - Rain Data from 2004
  - Woodcliff STP flow data
  - Limited Model Calibration
- Baseline System Performance:
  - Percent Capture: 78%
  - # of Overflow Events: 70

I/I REDUCTION

- Areas Currently Identified Through Video (CCTV) Inspection
- Future Inspection Planned
- Repairs can be Patches, Pipe Lining, or Replacement
- Can Be Done in Stages (Five-Year Plan) – Work Already Underway
- Assumed Reduction – 50,000 gpd (50% of main line infiltration)
- Estimated Cost - $1,500,000
- Impact on:
  - Percent Capture: 79%
  - No. of Overflow Events - Reduced to 61

EXPANSION OF WOODCLIFF STP

- Currently Under Design by NBMUA
- Expansion of Hydraulic Capacity 8 MGD – 10 MGD
- Approximate Split – 58% NBMUA / 42% Guttenberg
- Estimated Cost - $20,000,000
  - Guttenberg Share +/- $8,400,000
- Impact on:
  - Percent Capture: 92%
  - No. of Overflow Events - Reduced to 31

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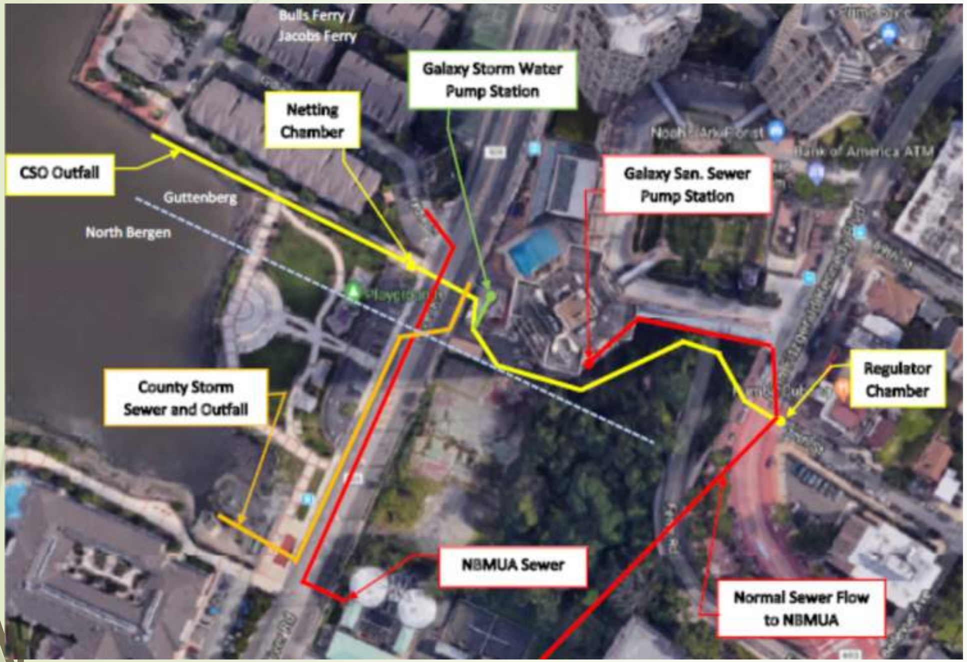
SEPARATION OF GALAXY TOWERS



- Storm Flow Currently Pumps to CSO Pipe (Downstream of Regulator)
  - Relocate to County Storm System in River Road
- Sanitary Currently Pumps to Regulator
  - Relocate to Sanitary Line in River Road
- Estimated Cost –
  - $150,000 (Storm) / $300,000 (Sanitary)
- Impact on:
  - Percent Capture: 78% (Storm) / 80% (Sanitary)
  - No. of Overflow Events - No Change (Storm) / Reduced to 53 (Sanitary)

SEPARATION OF HIGH-RISE UNITS

- Two Areas to be Rezoned (6 acres Total)
- Western Area Drains to West (Hackensack River) – would need North Bergen approval to run separate storm line.
- Eastern Area is small (<2 acres), and would have minimal impact on WWF
- Alternative rejected for further evaluation

LINEAR STORAGE (PUMPED)

- 1,600 LF of 60" Line
- 800 LF of 5' x 7' Box Culvert
- Total Storage = 450,000 gal
- 3 Pump Stations
- Estimated Cost - $8,000,000
- Impact on:
  - Percent Capture: 84%
  - No. of Overflow Events - Reduced to 59
- No Operational Experience in Guttenberg – Not a Recommended Option

GREEN INFRASTRUCTURE

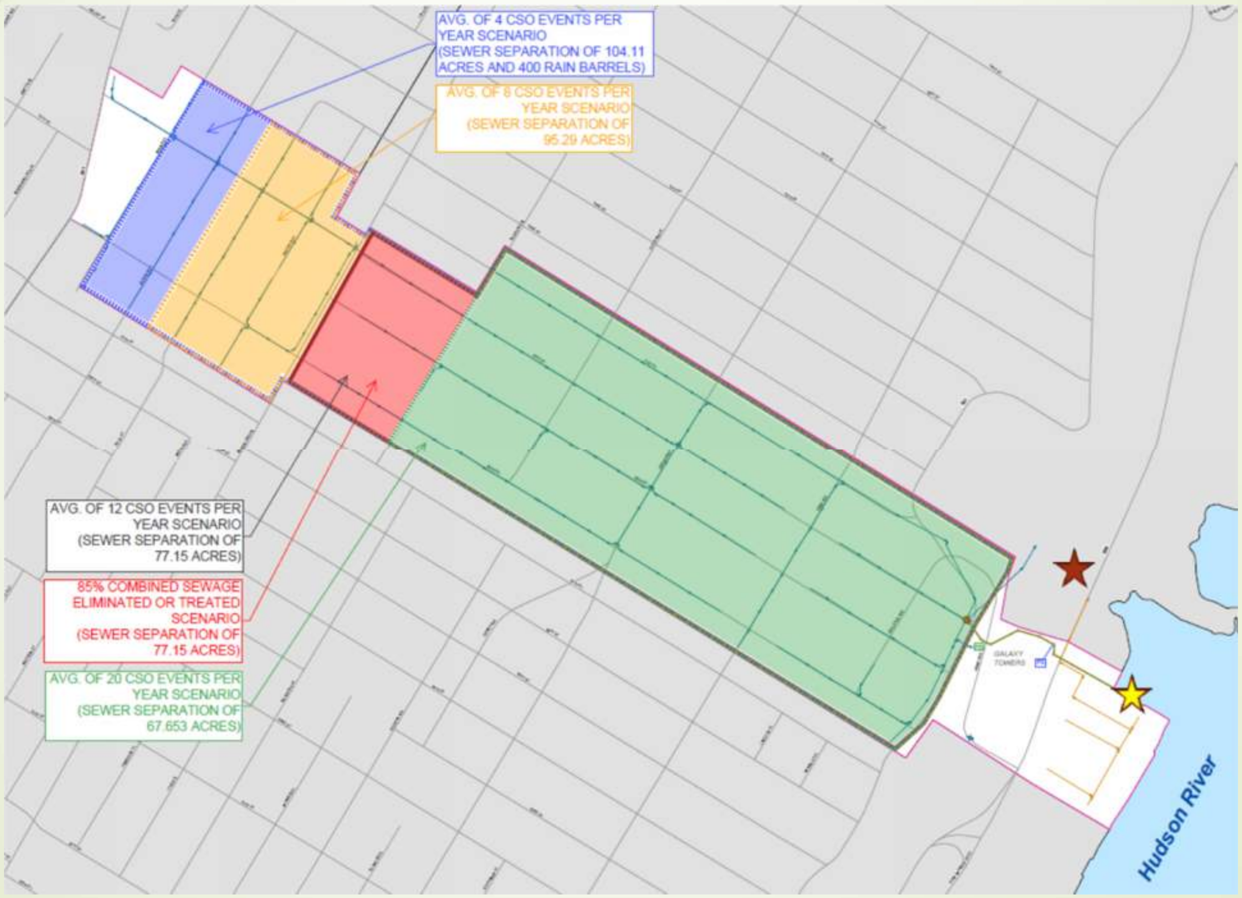
- Incentivize Green Roof Installation in New High-Rise (R-5) Zone
  - Assume 5-10% of Zone to be Utilized (0.3 – 0.6 acres)
- Estimated Cost – Privately Financed, Tax Incentives Unknown
- Impact on:
  - Annual Volume Released – 38.1 MG
  - No. of Overflow Events – 70 (Unchanged)
- Rain Barrels – Approximately 2,500 for Residential / Commercial Units
- Estimated Cost - $350,000
- Impact on:
  - Percent Capture: 78% (Green Roofs) / 90% (Rain Barrels)
  - No. of Overflow Events - 66

PARTIAL SEWER SYSTEM SEPARATION

- Used as Last Option to Achieve Compliance with Criteria (# of Events)
  - Assumes All Other Options have been Implemented
- Area to be calculated from Model Results
- Cost Estimate for Complete Separation of Combined System = $35,000,000 (111 Acres → approximately $325,000 per acre)

No. of Events	Acres to be Separated	Cost
20	68	$22,100,000
12	77	$25,000,000
8	95	$30,900,000
4	104	$33,800,000
0	111	$35,000,000

PARTIAL SEWER SYSTEM SEPARATION



MODEL RESULTS

- These Combinations Were Found to Meet the 85% Retention Criterion:
  - ** Currently Under Planning, Design or Construction*

Scenario	Cost to Guttenberg
Woodcliff Expansion* & Rain Barrels	$8.75 Million
Woodcliff Expansion* & Galaxy Separation*	$8.85 Million
Woodcliff Expansion* & I/I Reduction*	$9.9 Million
Woodcliff Expansion* & Linear Storage	$16.4 Million

CONCLUSIONS

- Two individual Strategies – NBMUA Expansion and Rain Barrels (if fully implemented) Can Meet 85% Retention Criterion
- Plans for NBMUA Expansion Are Currently Underway
- Various Other Strategies (Galaxy Separation, I/I Reduction, GI) Are Already Underway (Planning, Design and/or Construction) and Will Increase Capture

QUESTIONS?

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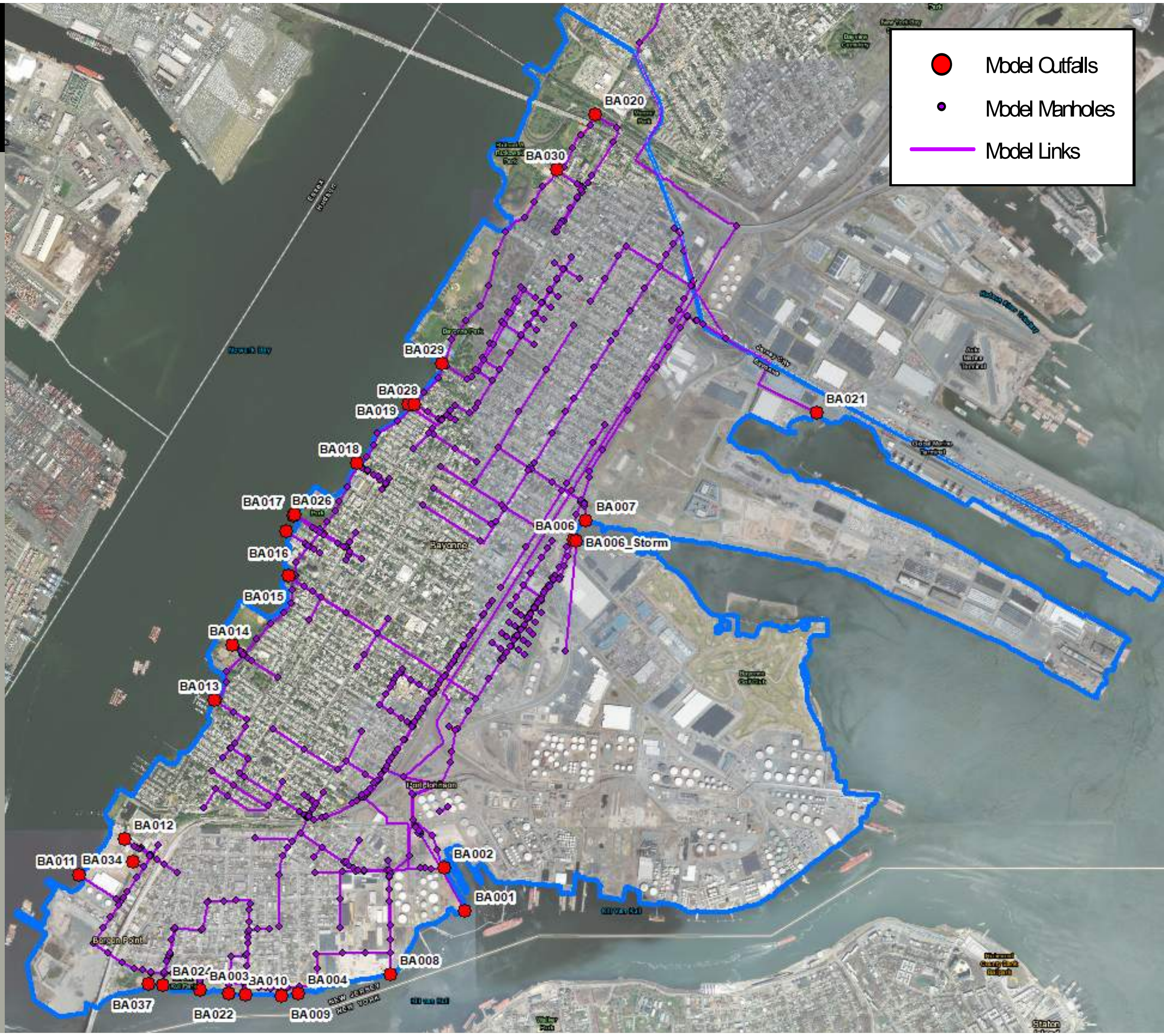
REMINGTON
& VERNICK
ENGINEERS

CITY OF BAYONNE EVALUATION OF CSO-CONTROL ALTERNATIVES

March 7, 2019 Public Presentation

CITY OF BAYONNE

- Study Area ~3 square miles
- Combined Sewer System
  - 28 CSO Outfalls
  - 13 Pump Stations
  - Up to 17.6 MGD pumped to PVSC for treatment
- Model of Combined System
  - 648 Pipe segments
  - 650 Manholes
  - 5 Pump Stations
  - 32 internal diversions
  - 17 regulators
  - Calibrated using 2016/2017 monitoring data



MODEL RESULTS (FUTURE NO ACTION)

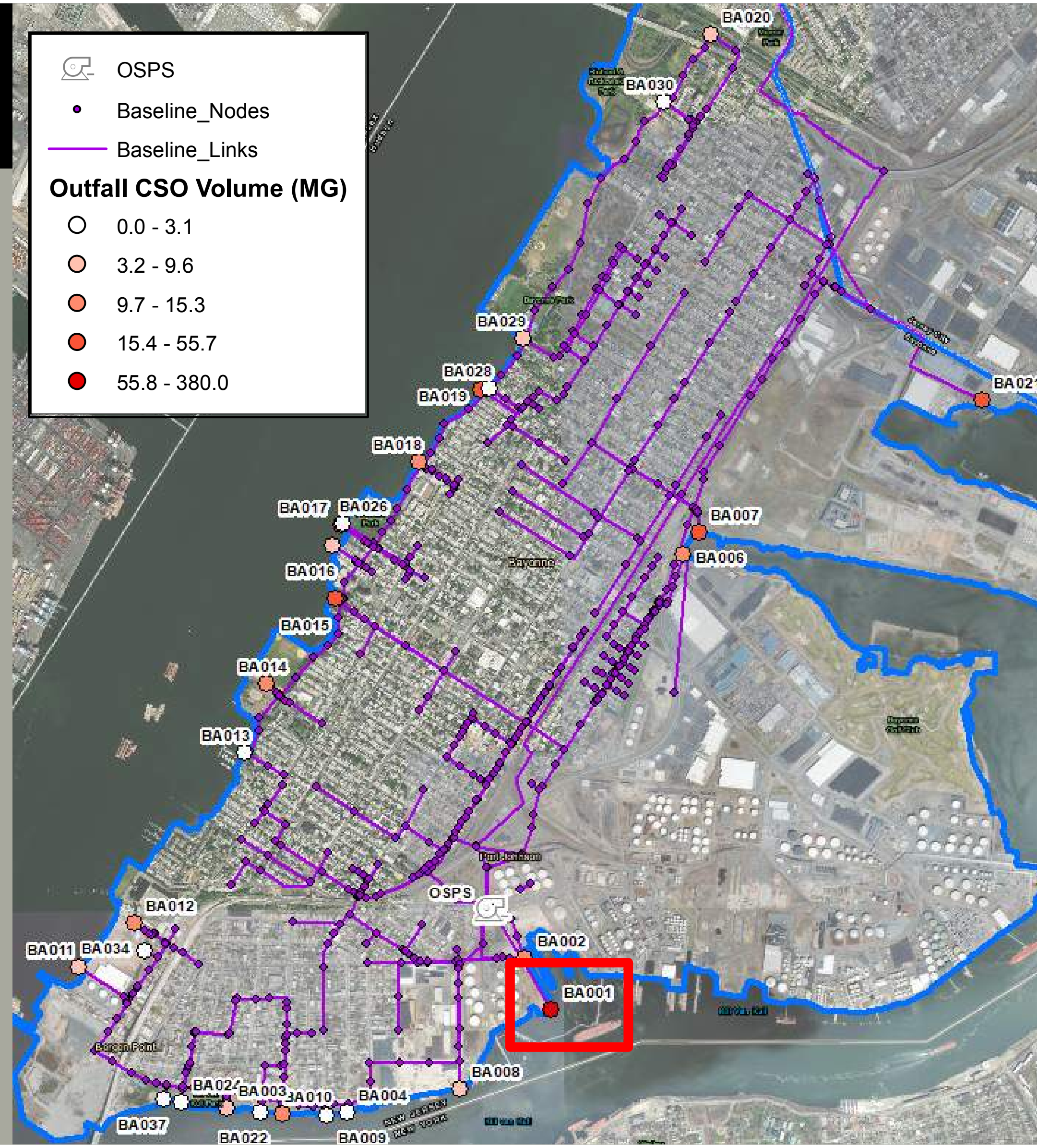
Calibrated model then applied to determine future conditions with and without CSO controls
➔ *This is how we evaluate CSO-control impacts*

<u>Future "No Action" Condition</u>

- Uses projected future population (2045)
- Uses a "design/typical year" rainfall

Model Results

- 60 storms cause overflows
- Total annual CSO: 748 MG
- Roughly half of total (380 MG) discharged from a *single outfall*: BA-001



CSO-CONTROL ALTERNATIVES

Sewer-System Controls

- ✓ BMPs (such as catch basin modifications, catch basing cleaning, catch basin stenciling, street sweeping, leaf collection, industrial spill control, recycling programs, pet-waste control, etc.)
- ✓ Floatables Netting
- Sewer Separation
- Regulator Modifications
- Storage: linear/tank/tunnels
- Increased Conveyance
- CSO Disinfection
- Green Infrastructure

Treatment-Plant Controls (PVSC)

- Additional Treatment Capacity
- Wet-Weather Blending

Existing storage tanks at Bayonne's E 5th St Facility

Green Infrastructure Facility (Camden)

CSO-CONTROL ALTERNATIVES

Sewer Separation

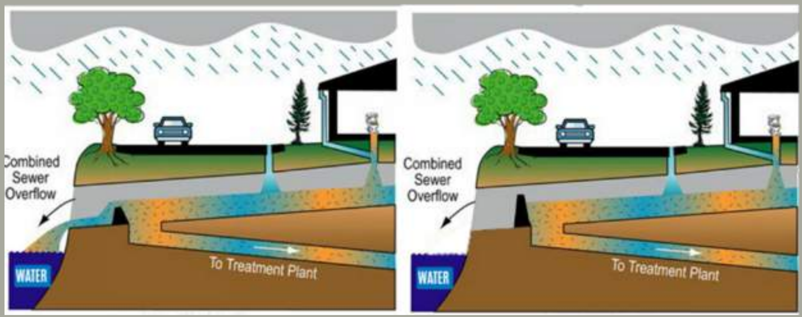
- System-wide separation involves digging up every street, laying new storm sewers, reconnecting catch basins
- Very costly, very disruptive, very time consuming
- Creates new storm sewer discharges to waterbody – *these may require treatment in future*

Regulator Modifications

- Increase existing sewer-system infrastructure to utilize more of its existing storage capacity

  There is not enough in-line storage capacity available to make a significant difference

Sewer Separation



Regulator Modifications

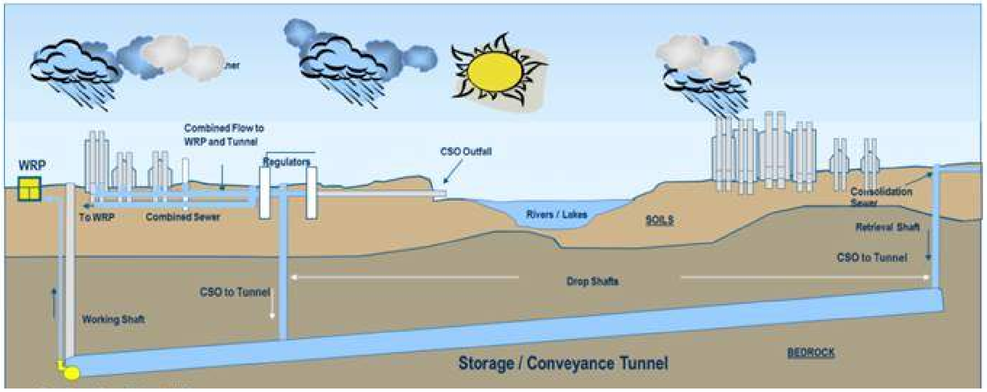
CSO-CONTROL ALTERNATIVES

Storage Solutions

- Idea: store what would overflow and pump back when extra capacity is available (such as after the storm ends)
- Types of storage:
  - Tanks (located near existing outfalls)
  - Storage Pipes (shallow, along surface)
  - Tunnels (deep under city)

CSO Tank

Inside a CSO Tunnel



CSO Tunnel

(Figure provided by F. Óksuz)

CSO-CONTROL ALTERNATIVES

<u>Storage Solutions (continued)</u>

- Bayonne's old treatment plant, near the largest CSO, has currently unused tanks that could be retrofitted to hold CSO
- *All analyses account for the potential use of these tanks!*

CSO-CONTROL ALTERNATIVES

Storage Solutions (continued)

- Based on siting tanks on city-owned land, and using *cutting edge "optimization software,"* the most cost-effective number and size of tanks were determined that would reduce CSOs from 60 to 20, 12, 8 and 4 per year:

Outfall	Tank Size for 4 CSO events (MG)	Tank Size for 8 CSO events (MG)	Tank Size for 12 CSO events (MG)	Tank Size for 20 CSO events (MG)
ST_01	7.00	5.20	3.70	2.60
ST_02	0.80	0.80	0.70	0.00
ST_03	0.90	0.90	0.60	0.00
ST_04	4.40	3.50	2.80	1.20
ST_05	3.10	3.10	1.90	1.50
ST_06	1.30	1.30	1.20	0.80
ST_07	1.30	1.10	1.00	0.40
ST_08	2.50	2.10	1.60	0.70
ST_09	15.30	14.10	9.60	8.10
Total	**36.60**	**32.10**	**23.10**	**15.30**

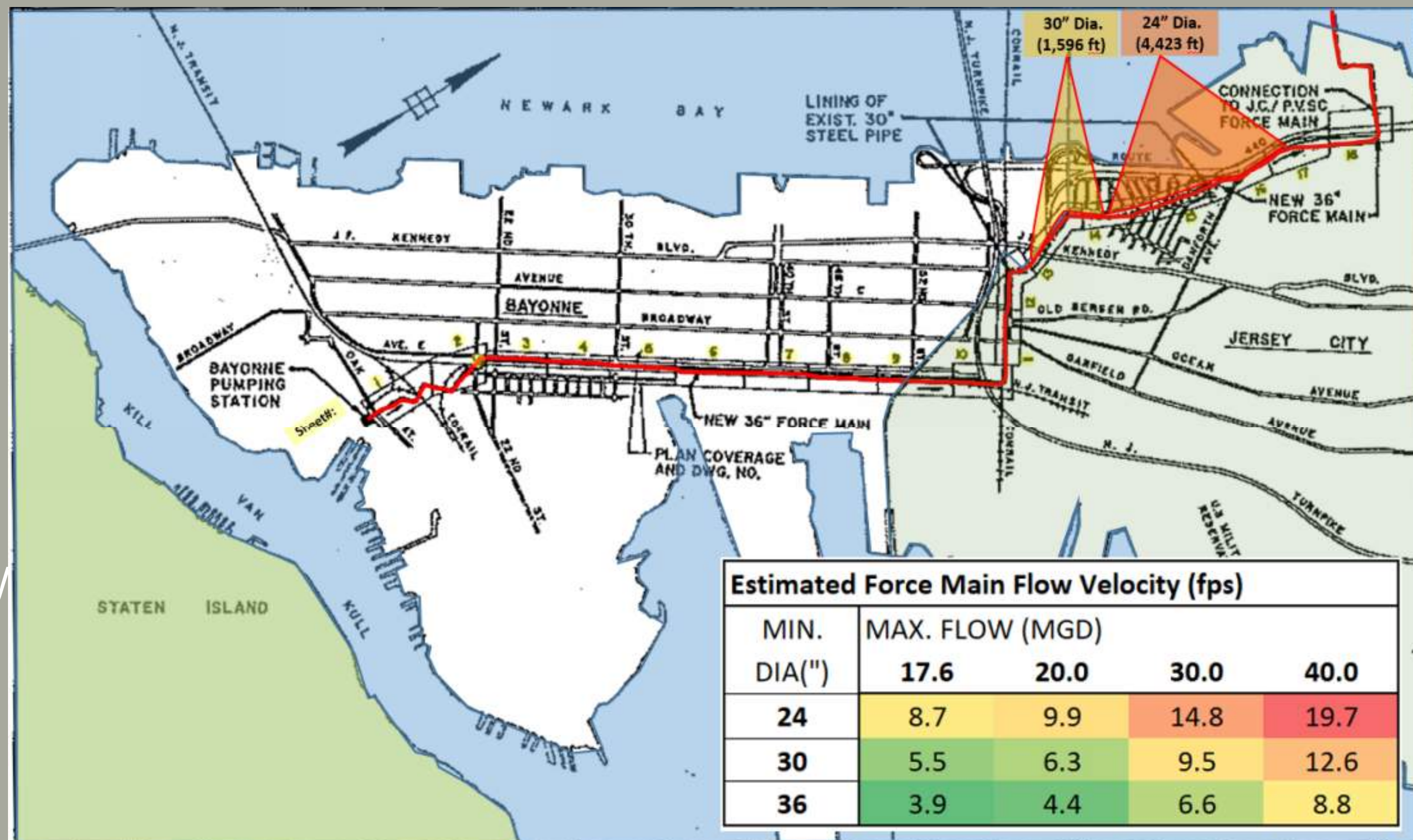
CSO-CONTROL ALTERNATIVES

Increased Conveyance

Idea: Bayonne's wastewater is currently limited to 17.6 MGD but the pumping station could convey up to ~20 MGD based on the existing size of the force main.

Further increases in flow are not possible without extensive construction to upsize the existing force main.

Increasing the conveyance capacity to 20 MGD would slightly reduce CSOs and would also enable stored overflow to be dewatered more quickly.



Estimated Force Main Flow Velocity (fps)

MIN. DIA(")	MAX. FLOW (MGD) 17.6	20.0	30.0	40.0
24	8.7	9.9	14.8	19.7
30	5.5	6.3	9.5	12.6
36	3.9	4.4	6.6	8.8

CSO-CONTROL ALTERNATIVES

Disinfection with Peracetic Acid (PAA)

- Bayonne MUA pilot study (2015) verified PAA performance to kill 99.9% of bacteria present in CSOs prior to discharge
- Advantages: PAA does not require a large, expensive facility and not leave a “chemical residual” that must be removed (unlike chlorine)
- PAA treatment facilities are small enough that they could be placed at each outfall or,
- A larger PAA treatment facility could be installed at the “optimized” locations developed for storage facilities

Figure 1. Peracetic acid Peragreen INJEXX system on project site

Peracetic Acid System - Pilot Study

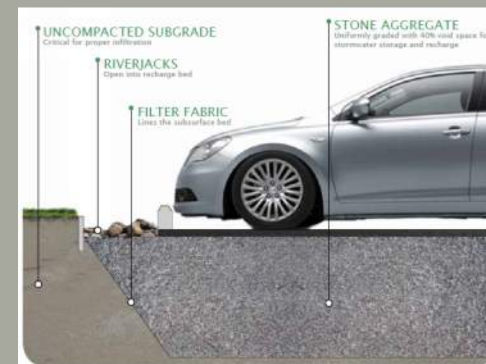
http://www.patoczka.net/Jurek%20Pages/Papers/Bayonne%20CSO%20WEFTEC%202016%20Patoczka,%20Denning,%20Rolak.pdf

CSO-CONTROL ALTERNATIVES

<u>Green Infrastructure</u>

- Idea: capture the rainfall before it enters the sewers
- Potential Green Infrastructure Types:
  - Pervious Pavement
  - Tree Pits
  - Bioretention Systems
  - Rainwater Harvesting
- In other urban areas, Green Infrastructure has controlled runoff from as much as 5% of the impervious areas (roads, sidewalks, rooftops, etc.)
  - This level of control in Bayonne would:
    - Reduce annual CSO volumes by 3% (~25 MG)
    - Reduce number of CSO events by 2% (1 event)

Planters (Camden)



Permeable Pavement

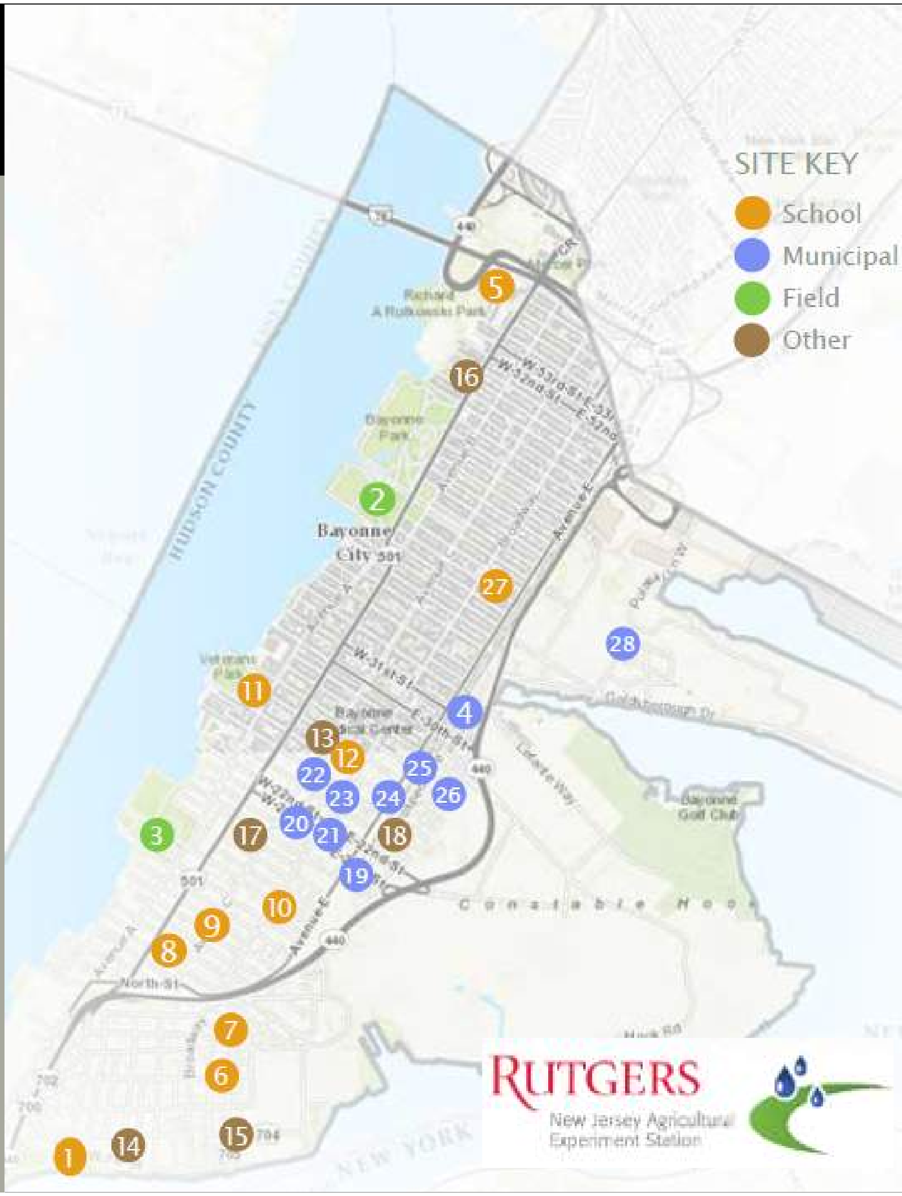
Tree Pits (Parsippany)

Bioretention (Camden)

CSO-CONTROL ALTERNATIVES

Rutgers University Green Infrastructure Feasibility Study

- Identified 28 potential GI projects in Bayonne, some with a mix of different types of GI:
  - 17 – Rain Gardens
  - 16 - Pervious Pavement
  - 11 – Stormwater Planters
  - 9 – Curb Cuts
  - 4 - Bioretention (Bioswale)
  - 3 – Cistern/Rainwater Harvesting
  - 3 – Depaving
  - 1 - Buffer



SUMMARY

- Bayonne is nearing completion of its analysis of CSO-control alternatives
- Once submitted to PVSC, Bayonne's solutions will be added into the mix of all municipalities in the PVSC service area
- PVSC will then assess the overall impact of all the municipalities' solutions
- CSO-control alternatives evaluation report is due to NJDEP by July, 2019
- Selected CSO-control alternative report is due to NJDEP by June, 2020

ARCADIS

Design & Consultancy for natural and built assets

JERSEY CITY MUNICIPAL UTILITIES AUTHORITY

Development and Evaluation of Alternatives for CSO Control

March 4, 2019

AGENDA

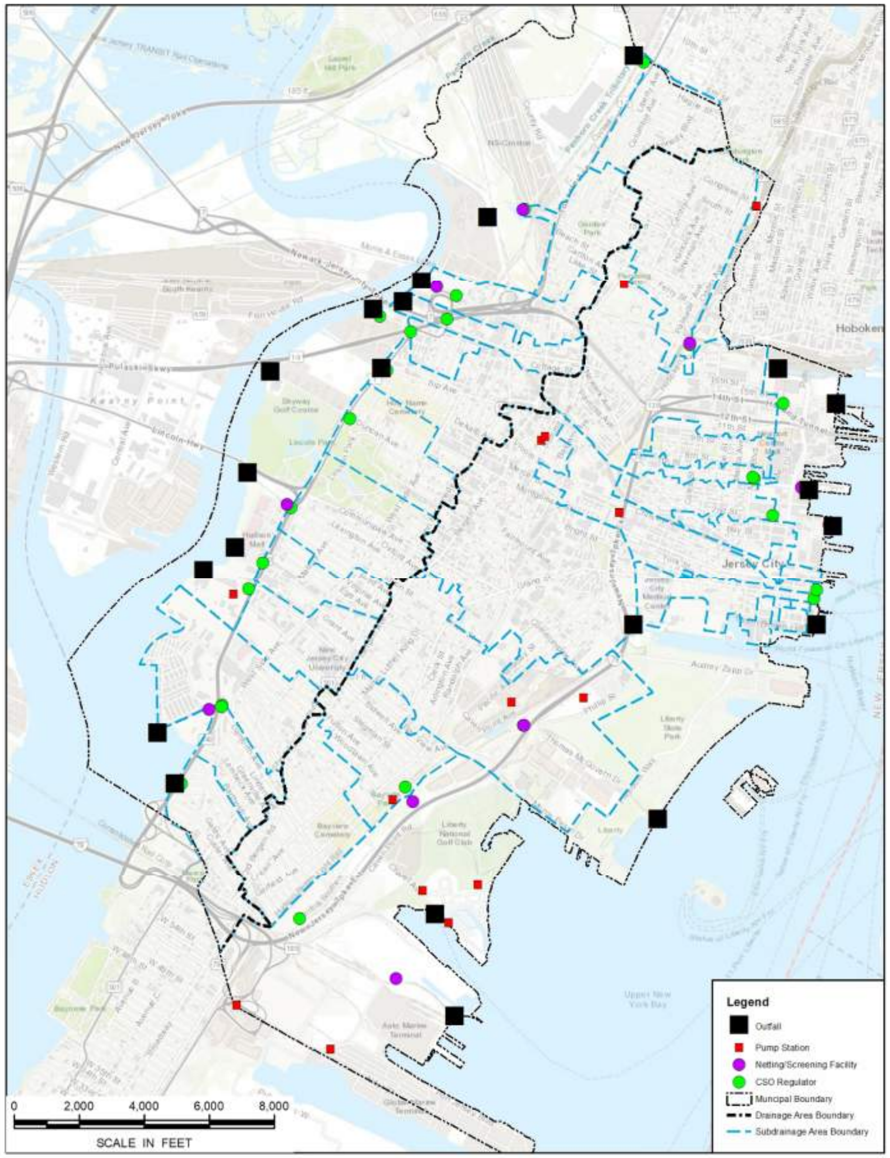
- Overview of JCMUA Combined Sewer System (CSS)
- Overview of Long Term Control Plan (LTCP) – The Goals for the Alternatives
- CSO Control Alternatives Developed to Date
- Next Steps

Overview of JCMUA Combined Sewer System (CSS)

Overview of JCMUA CSS

- Population Served: 247,597 (2010) to 270,753 (2017)
- 230 miles are in the Combined Sewer System
- Ninety Percent of the Sewers are 88 to 131 years old
- 21 Combined Sewer Overflow (CSO) discharge points
  - 1 discharge to Penhorn Creek
  - 11 discharges to the Hackensack River, Newark Bay
  - 9 discharges to the Hudson River
  - SE 2 or SE 3 Water Classification
- Normally Pumped to PVSC

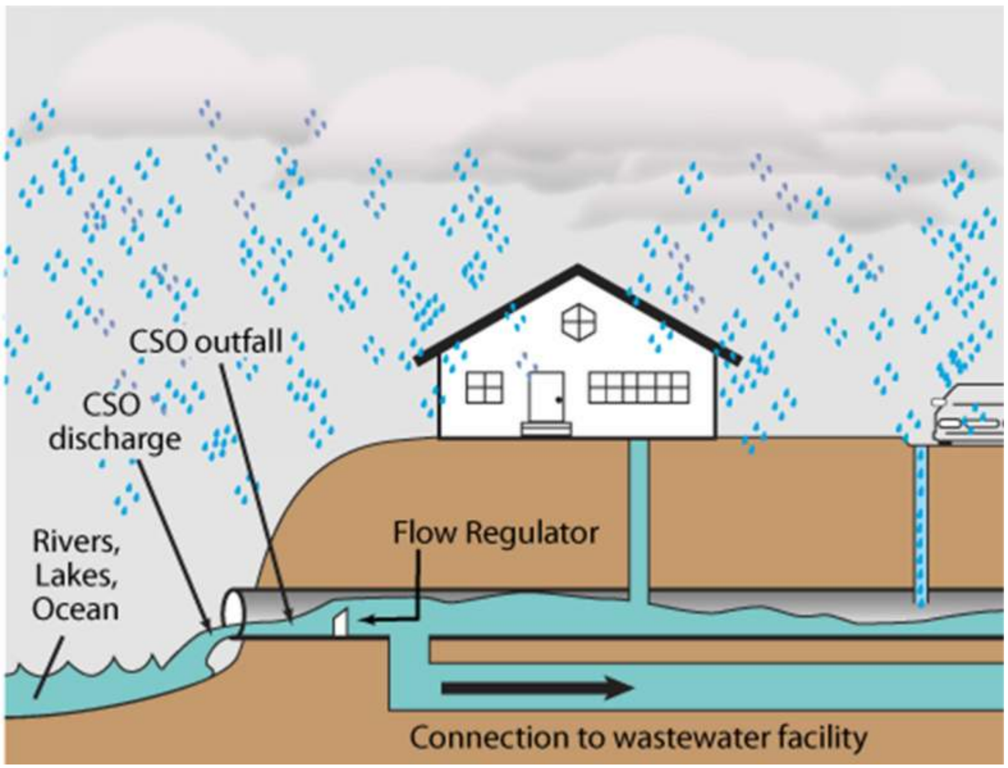
CSO Location Map



ARCADIS Design & Consultancy for natural and built assets

JCMUA CSO Control Facilities

Wet Weather Flow Discharged as Combined Sewer Overflows



Goals for the LTCP Alternatives

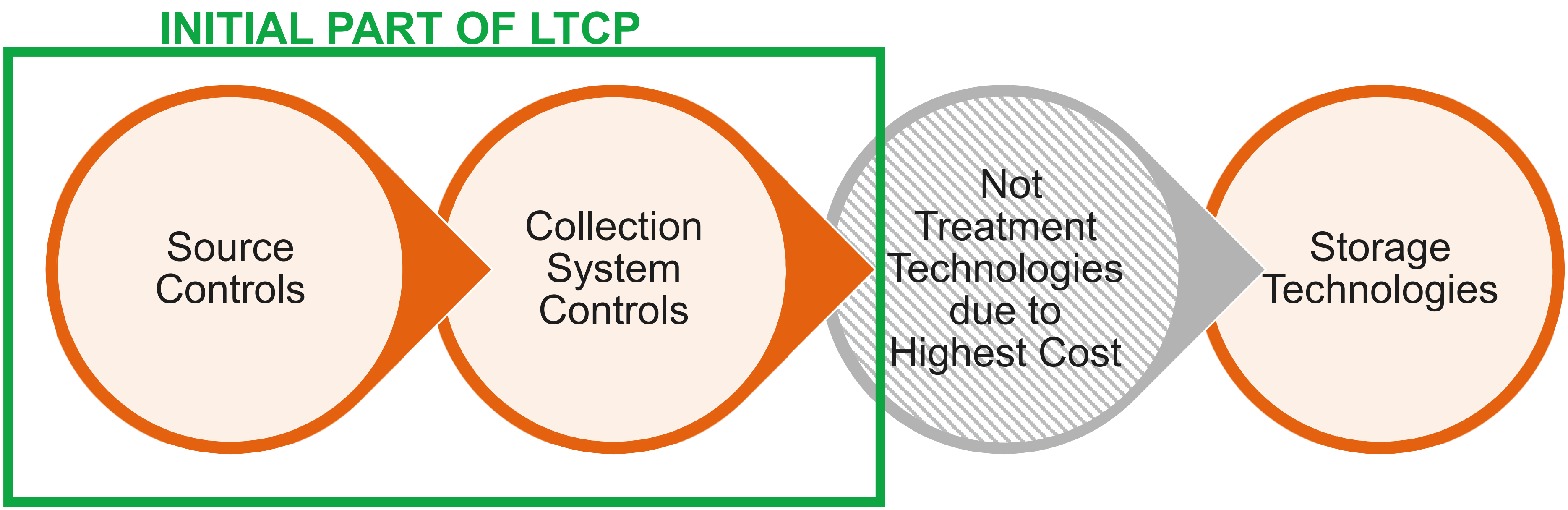
Reduce CSO to obtain Water Quality Compliance with Public Input

PRESUMPTION APPROACH: 85% Capture or 4-6 overflow/year

DEMONSTRATION APPROACH – Demonstrate compliance (4, 8, 12, and 20 overflows)

Develop Alternatives for CSO Control

Identify CSO Control Alternatives to Meet the Goals



CSO Control Alternatives Developed to Date

Source Controls

Green Infrastructure with Rain Gardens/Bioswales

Collection System Controls

Sewer Separation

Infiltration/Inflow Control

Maximizing Flow to the POTW (PVSC)

Program Objectives Drive Design Standards

Implementation Approach
Standardized designs

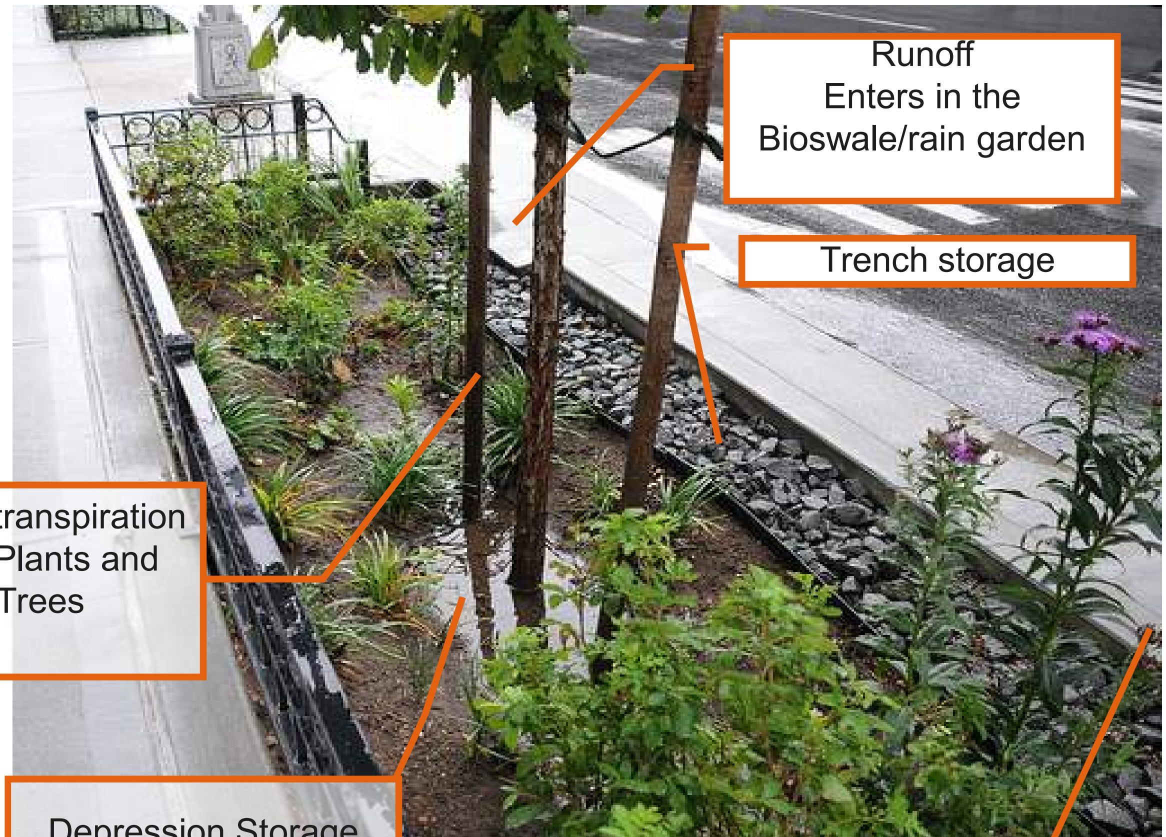
Design Methodology
Systems designed for storage/infiltration; underdrains to remove first 1" of rainfall

Site Considerations
Focus on street projects and schools, public housing and other city properties

Landscape
Standardizing plant palette based on performance

Construction
Oversight is key

Maintenance
Consideration during design



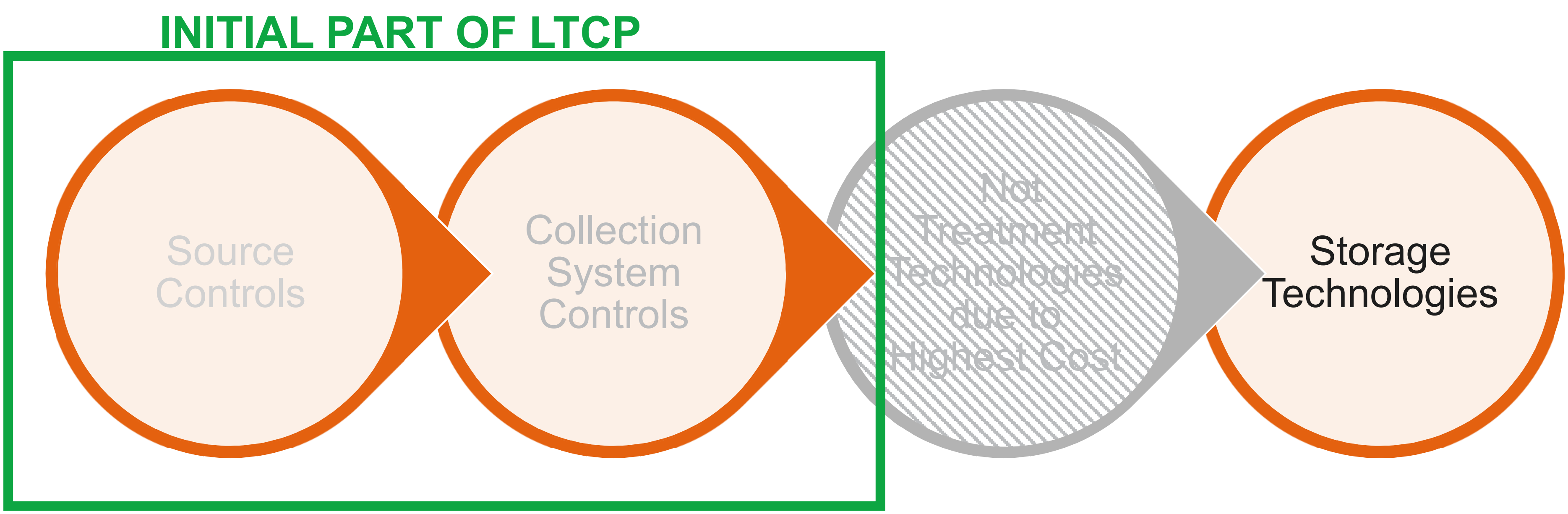
GI Location Map

Source Control & Collection System – Size and Performance

Alternative Name	Area, Acres or Flow, MGD	Linear Footage	Percent Capture	Overflows / year	Additional comments
Existing Systems Conditions (Baseline)	NA	NA	72.4%	68	
Inflow and Infiltration Reduction (I/I) – various locations throughout Jersey City	NA	88,000 (17 Miles)	73.2%	60	Needed for Consent Decree Compliance also
Sewer Separation – Bright Street	31 ac	NA	72.4%	60	Needed for Downtown Flooding
Rain Gardens/Bioswales* -as shown on Previous Map	297 (Impervious =189)	NA	72.5%	60	* This is 7% of the impervious area in the CSS and10% is also being evaluated
Maximizing Flow to PVSC (Existing Force Main Only)	Increase from 80 MGD to 120 MGD	0	75%	60	Require upgrades to pump size only

Develop Alternatives for CSO Control

Identify CSO Control Alternatives to Meet the Goals



2007 Storage Technologies Evaluated

In-Line Storage

- No or limited In-line storage capacity available in JCMUA system. Based on modeling, new in line storage not realistic.

Off-Line Storage

- Off-line storage diverts all or a portion of wet weather combined flows and stores them in large off-line storage tanks or deep tunnels.
- Stored flows are returned to the interceptor once system capacity is available.
- East and West Side Pumping Stations and Force Main System has capacity for 2 times average dry weather peak flow.

Tunnel Location Map

Offline Storage - Deep Tunnels Size and Performance

Alternative Name	Total Tunnel Storage Volume, MG	Linear Footage of Tunnel	Treatment Shaft* Diameter, ft	Percent Capture	Overflows/ year
Existing Systems Conditions (Baseline)	NA	NA	NA	72.4%	68
6.5 ft Diameter Tunnel	14	55206	36	96.5%	20
7 ft Diameter Tunnel	16	55206	35.5	98.7%	12
9.25 ft Diameter Tunnel	28	55206	36	99.5%	8
11 ft Diameter Tunnel	39	55206	55	99.7%	4

* All treatment shafts are at a depth of 118 ft.

Grouped Storage Tanks Alternative

Legend

Storage Tank

Offline Storage – Tank Storage (Treatment Shafts) Size and Performance

Alternative Name	Total Storage Tank Volume, MG	Diameter Range (ft)	Depth Range (ft)	Percent Capture	Overflows/ year
Existing Systems Conditions (Baseline)	NA	NA	NA	72.4%	68
Grouped Storage Tanks – 20 Overflows	11	24 to 80	42 to 125	92.9%	20
Grouped Storage Tanks – 12 Overflows	35	48 to 120	48 to 120	97.0%	12
Grouped Storage Tanks – 8 Overflows	45	60 to 120	40 to 140	97.9%	8
Grouped Storage Tanks – 4 Overflows	54	80 to 120	40 to 146	98.3%	4

Next Steps

2018-2019 Development and Evaluation of Alternatives for CSO Control

Overview of Development and Evaluation of Alternatives for CSO Control

- Evaluate CSO Control Alternatives
  - Costs
  - Performance (Finish up remaining)
  - Environmental Considerations
  - Technical Considerations
  - Implementation Considerations

TOWNSHIP OF NORTH BERGEN AND NORTH BERGEN MUNICIPAL UTILITIES AUTHORITY CSO ABATEMENT ALTERNATIVES

Preliminary CSO Controls Concepts

- Township of North Bergen
  - Central Pump Station NJPDES Permit No. NJ0108898 (formerly the Central Treatment Plant) serves the west side of North Bergen and discharges to the Bellmans, Chromakill and Penhorn Creeks
  - Woodcliff STP NJPDES Permit No. NJ0029084 serves the northeastern corner in North Bergen and Guttenberg and discharges to the Hudson River

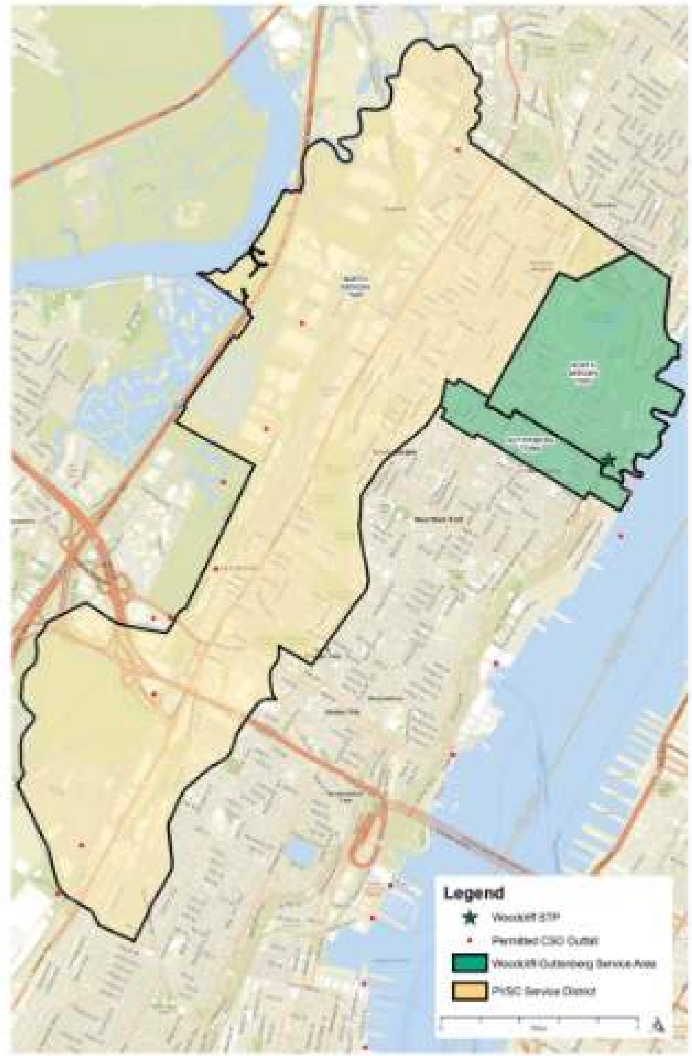
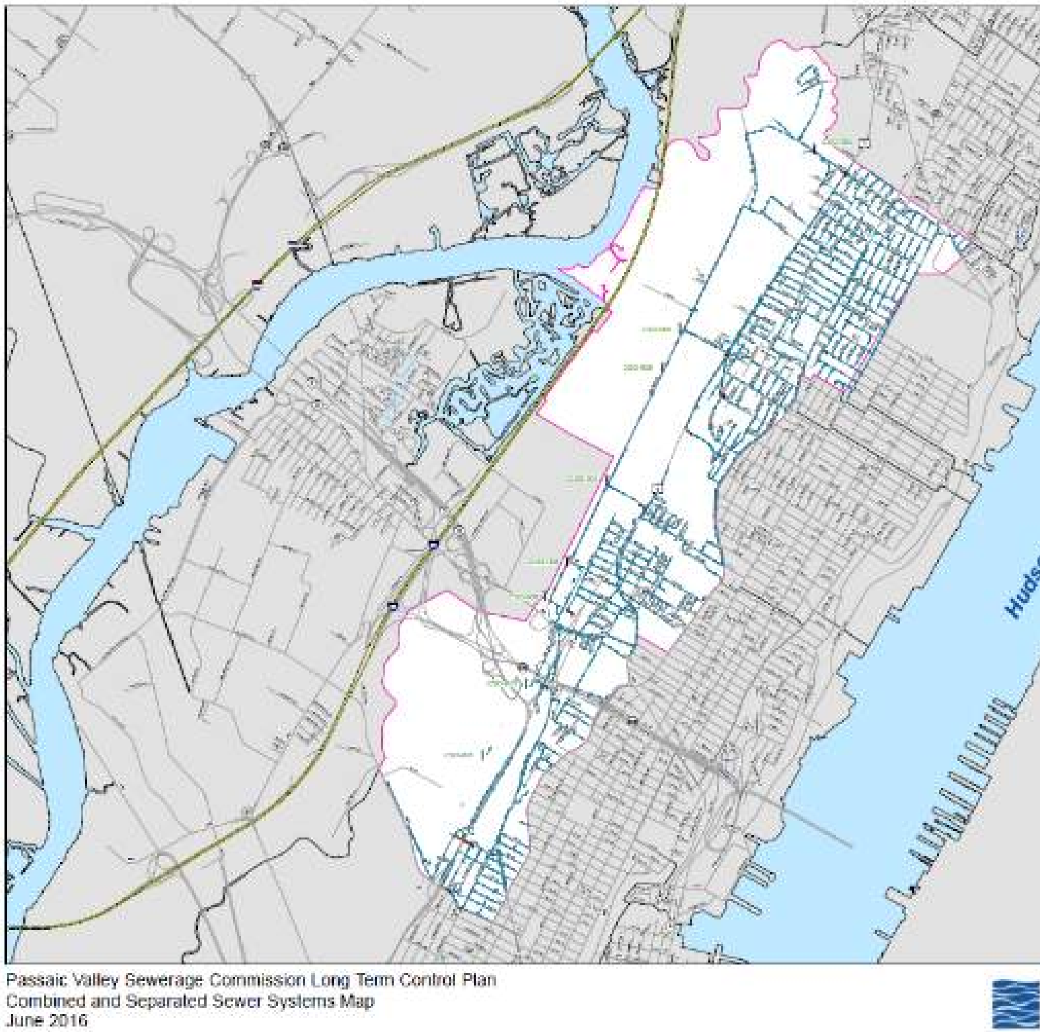


Figure A-2: The Woodcliff – Guttenberg Service Area

TOWNSHIP OF NORTH BERGEN



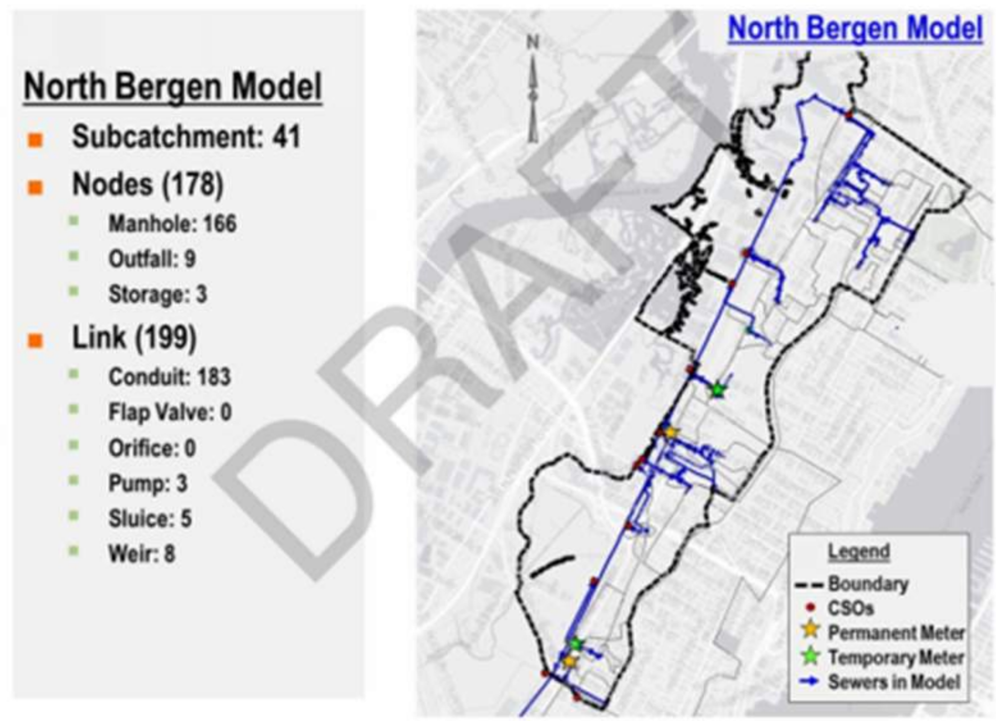


Figure I-17: Snapshot of Model Network in North Bergen

TOWNSHIP OF NORTH BERGEN OVERFLOWS

Table I-12: Typical Year CSO Overflow Volume and Frequency

CSO ID	Overflow Volume (MG)	Overflow Frequency	CSO ID	Overflow Volume (MG)	Overflow Frequency	CSO ID	Overflow Volume (MG)	Overflow Frequency
PT001	24.9	38	EN001	16.8	39	NB003	171.3	51
PT003	1.8	20	HR001	1.4	30	NB005	30.1	56
PT005	6.5	27	HR002	2.9	34	NB006	0.0	0
PT006	76.6	38	HR003	13.7	38	NB007	6.6	32
PT007	42.8	37	HR005	18.9	36	NB008	15.1	30
PT010	9.7	26	HR006	6.8	30	NB009	25.6	45
PT013	11.4	29	HR007	13.3	49	NB010	1.2	25
PT014	0.1	5	KE001	3.9	33	NB011	5.1	37
PT015	0.5	18	KE004	12.3	58	NB014	0.5	7
PT016	12.3	30	KE006	119.3	63	BA001	373.8	70
PT017	8.7	33	KE007	86.1	36	BA002	8.6	9
PT021	5.0	30	KE010	26.0	54	BA003	11.0	34
PT022	17.4	33	NE002	91.5	46	BA004	0.0	3
PT023	3.0	17	NE003	0.0	0	BA006	16.0	37
PT024	8.3	31	NE004	1.4	23	BA007	72.2	37
PT025	88.0	56	NE005	21.2	43	BA008	10.1	34
PT026	0.5	15	NE008	93.2	52	BA009	4.2	33
PT027	40.9	46	NE009	164.0	42	BA010	17.4	53
PT028	10.0	28	NE010	164.0	42	BA011	5.9	34
PT029	92.4	48	NE014	180.1	52	BA012	14.0	57
PT030	4.4	4	NE015	74.6	43	BA013	0.8	33
PT031	9.5	27	NE016	54.3	49	BA014	12.6	43
PT032	30.2	32	NE017	107.3	51	BA015	46.6	54
			NE018	75.6	53	BA016	6.5	48
			NE022	45.7	69	BA017	54.2	62
			NE023	16.8	35	BA018	14.6	58
			NE025	58.2	16	BA019	38.8	35
			NE026	16.6	17	BA020	10.1	33
			NE027	11.3	17	BA021	62.9	54
			NE030	10.3	19	BA022	0.0	0
						BA024	0.1	3
						BA026	1.3	9
						BA028	0.0	0
						BA029	6.8	24
						BA030	1.5	16
						BA034	0.1	7
						BA037	1.0	8

Passaic Valley Sewerage Commission
Service Area System Characterization Report

June 2018
Page 179 of 182

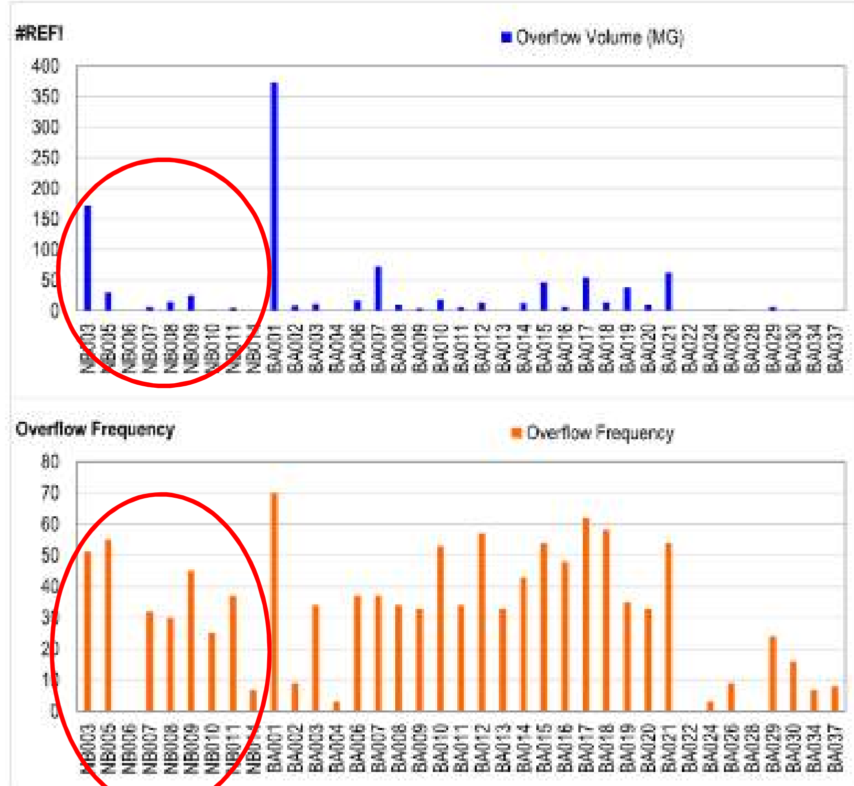


Figure I-42: Typical Year CSO Overflow Volume and Frequency North Bergen and Bayonne

NORTH BERGEN MUNICIPAL UTILITIES AUTHORITY

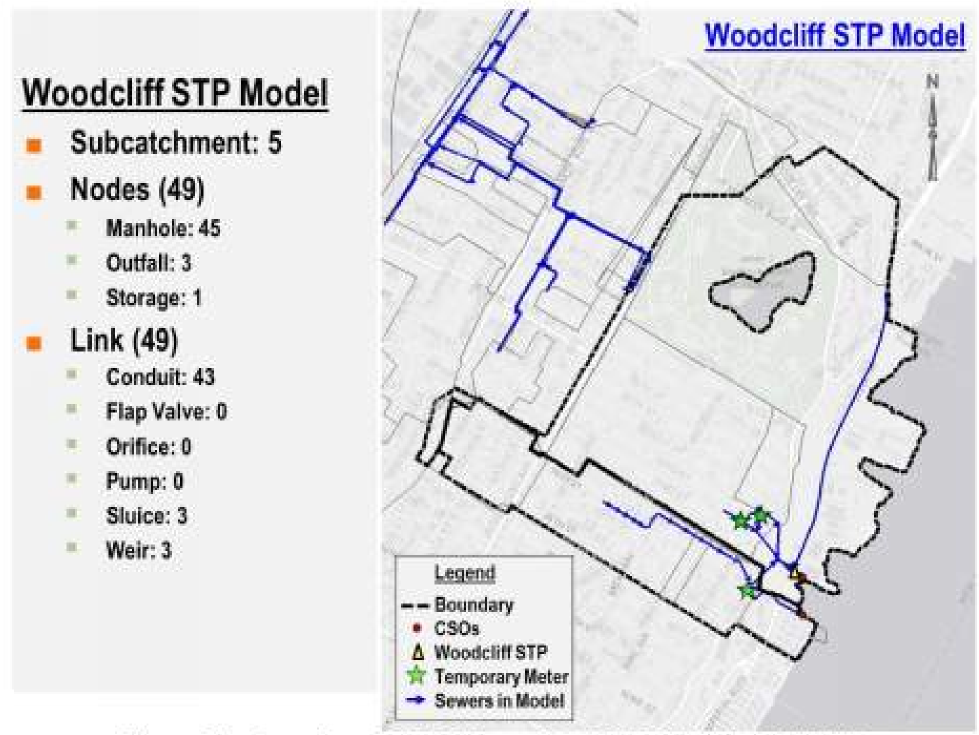


Figure I-7: Snapshot of Model Network for NBMUA Woodcliff STP

NBMUA OVERFLOWS

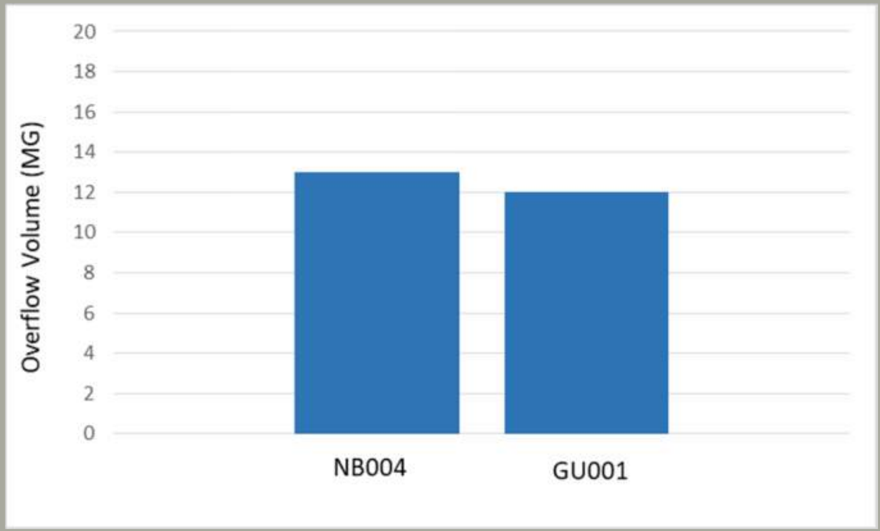
Table I-9: Typical Year CSO Overflow Volume and Frequency

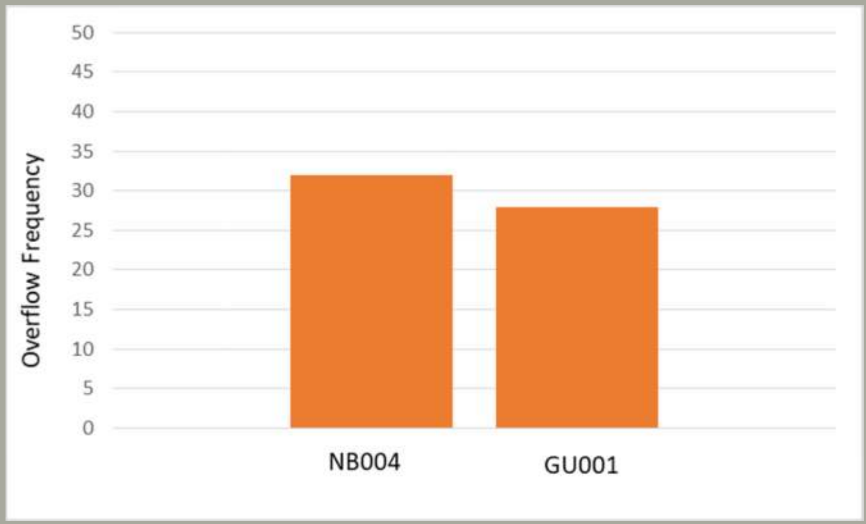
CSO ID	Overflow Volume (MG)	Overflow Frequency
NB004	13	32
GU001	12	28

Table I-10: Typical Year % Capture

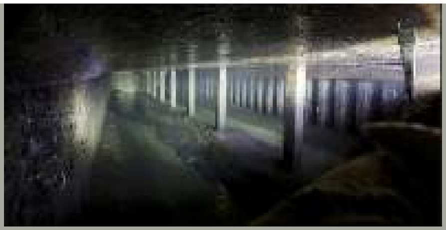
	Woodcliff STP
Total WWF Volume (MG)	229
Total CSO Volume (MG)	25
% Capture	89%

(preliminary estimate computed by CDM/GH)





GRAY INFRASTRUCTURE CSO CONTROL OPTIONS

On Site Controls

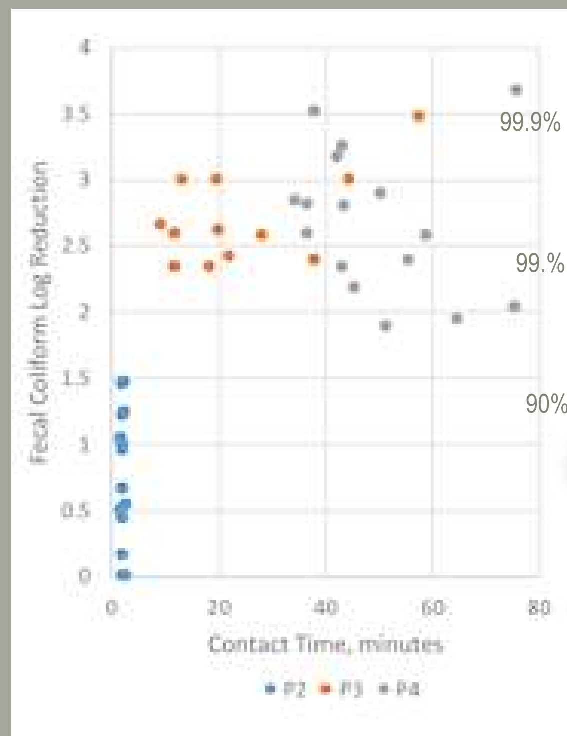
- Tank/Tunnel Storage
- Netting (current practice)
- TSS Removal
- Disinfection
- Sewer Separation
- Regulator Modifications
- BMPs (I/I reduction, Catch Basing Cleaning, Catch Basin Stenciling, Catch Basin Modifications, Water Conservation, Street Sweeping, Leaf Collection, Recycle Programs)

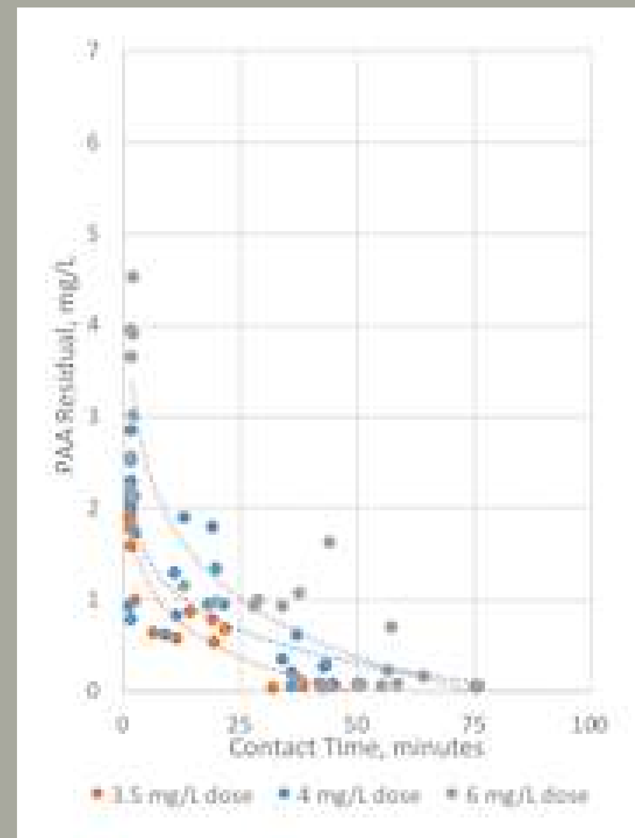
POTW Controls

- Additional Treatment Capacity
- Wet Weather Blending

<u>Peracetic Acid Disinfection</u>

- Available as a 12%, 15% or 22% solutions
- 6 month shelf life
- Typical dosage 2 to 6 mg/L
- Contact times 2 to 30 minutes
- Quenching of residual concentration is not required at typical dosages
- 99% to 99.9+ pathogen reductions

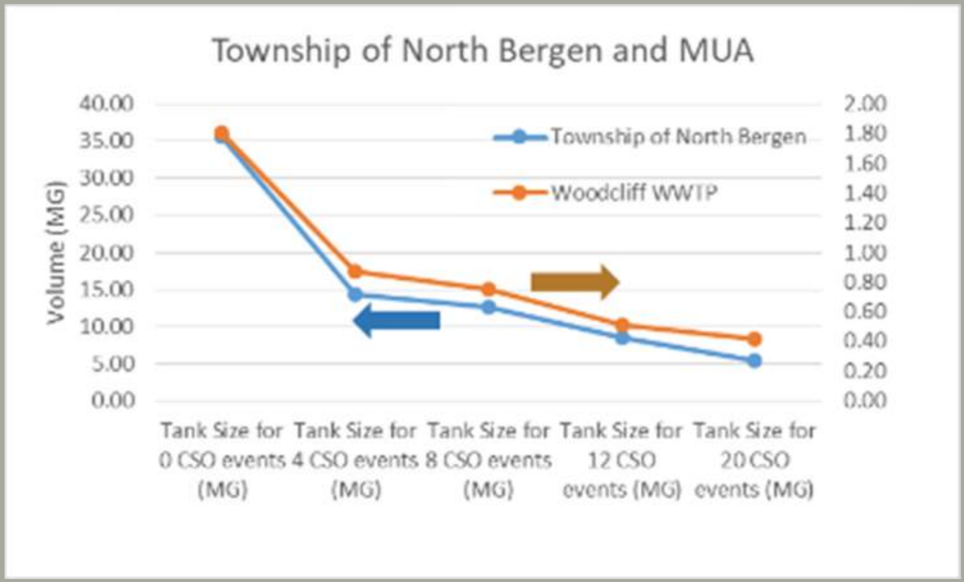




STORAGE EFFECT ON CSO VOLUME

	Storage Tank/Tunnel Size				
Outfall	Tank Size for 0 CSO events (MG)	Tank Size for 4 CSO events (MG)	Tank Size for 8 CSO events (MG)	Tank Size for 12 CSO events (MG)	Tank Size for 20 CSO events (MG)
NB003	19.35	7.61	7.31	4.87	3.05
NB005	3.04	1.28	1.06	0.81	0.49
NB006	0.00	0.00	0.00	0.00	0.00
NB007	2.05	0.80	0.68	0.42	0.29
NB008	3.71	1.45	1.09	0.77	0.42
NB009	3.71	1.50	1.21	0.81	0.52
NB010	0.14	0.10	0.09	0.07	0.06
NB011	2.48	1.12	0.89	0.60	0.35
NB014	1.21	0.41	0.36	0.21	0.17
Total	35.69	14.27	12.69	8.56	5.35

	Storage Tank/Tunnel Size				
Outfall	Tank Size for 0 CSO events (MG)	Tank Size for 4 CSO events (MG)	Tank Size for 8 CSO events (MG)	Tank Size for 12 CSO events (MG)	Tank Size for 20 CSO events (MG)
NB004 Woodcliff	1.81	0.87	0.75	0.51	0.42



- Pump back rate is a function of the stored CSO volume and the allowable discharge rate
- Pump back time must be < 3 days

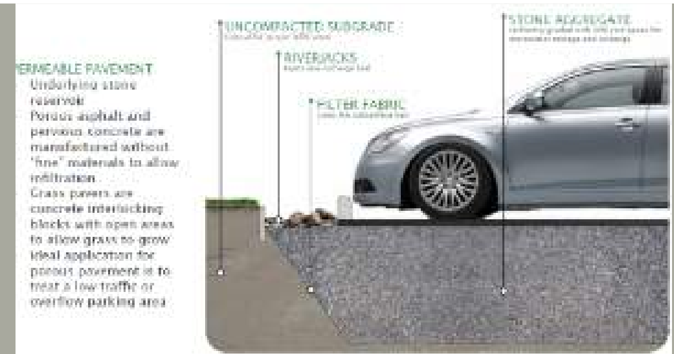
WOODCLIFF STP UPGRADE

- Replace the lamella-type secondary clarifiers with a membrane microfiltration system,
- Upgrades to the existing facility electrical service and upgrades to the existing auxiliary power system,
- Replace existing drives and columns in the two primary clarifiers,
- Repair the sludge storage tank and installation of a new mixing system,
- Rehab of the thickening facilities,
- Replace Sodium Bisulfite Dechlorination systems and controls,
- Upgrades to existing Service Water System.
- **Peak Wet Weather capacity increase from 8 MGD to 10 MGD will allow blending for CSO control**

Tree Pits (Parsippany)

Planters (Camden)

Bioretention (Camden)



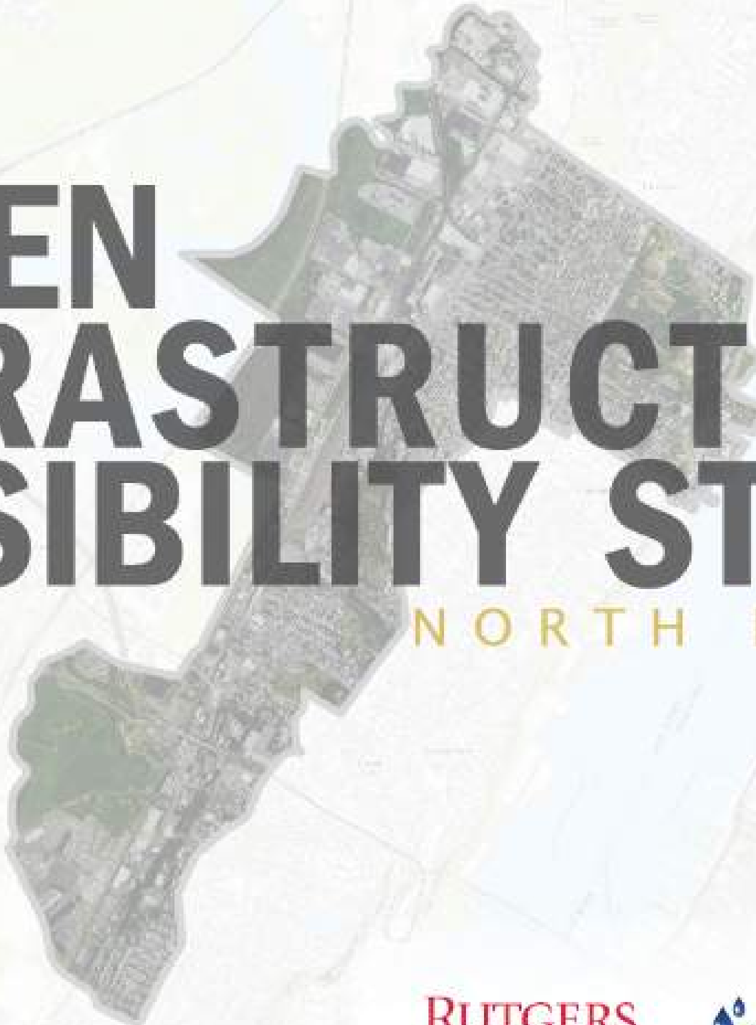
Permeable Pavement

Green Roof

GREEN INFRASTRUCTURE CSO CONTROL OPTIONS

GREEN INFRASTRUCTURE FEASIBILITY STUDY

NORTH BERGEN

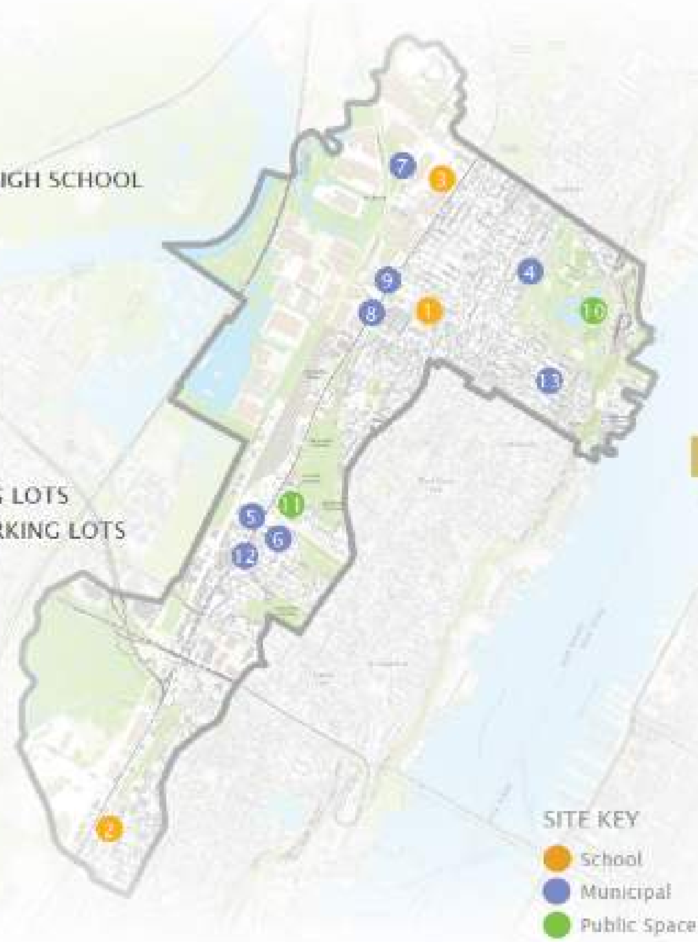


RUTGERS
New Jersey Agricultural
Experiment Station

Passaic Valley Sewerage Commission
"Protecting Public Health and the Environment"

POTENTIAL PROJECT SITES

1. NORTH BERGEN HIGH SCHOOL
2. JOHN F. KENNEDY ELEMENTARY SCHOOL
3. HUDSON COUNTY SCHOOL OF TECHNOLOGY ADULT HIGH SCHOOL
4. NORTH BERGEN PUBLIC LIBRARY
5. NORTH BERGEN PARKING AUTHORITY BUILDING
6. NORTH BERGEN MUNICIPAL BUILDING
7. NORTH BERGEN COMMUNITY POOL
8. NORTH BERGEN DEPARTMENT OF PUBLIC WORKS
9. NORTH BERGEN MUNICIPAL UTILITIES AUTHORITY
10. JAMES J. BRADDOCK PARK
11. MUNICIPAL PARK
12. NORTH BERGEN PARKING AUTHORITY STREET PARKING LOTS
13. NORTH BERGEN PARKING AUTHORITY OFF-STREET PARKING LOTS



STORAGE, QUANTITY, & INFILTRATION SYSTEM SUITABILITY: EXAMPLE PROJECT SITE

Stormwater flows quickly over impervious surfaces where it can contribute to flooding downhill.

STORAGE, QUANTITY, & INFILTRATION SYSTEM SUITABILITY: EXAMPLE PROJECT SITE

Creating curbside stormwater planters in no-parking zones will intercept stormwater runoff and provide traffic calming for pedestrians.

HUDSON COUNTY SCHOOL OF TECHNOLOGY
EVENING AND ADULT HIGH SCHOOL
2000 85th Street
North Bergen, NJ 07047

AN INTEGRATED APPROACH TO CSO CONTROL WILL CONSIDER GRAY AND GREEN INFRASTRUCTURE. THE FINAL SELECTION WILL CONSIDER:

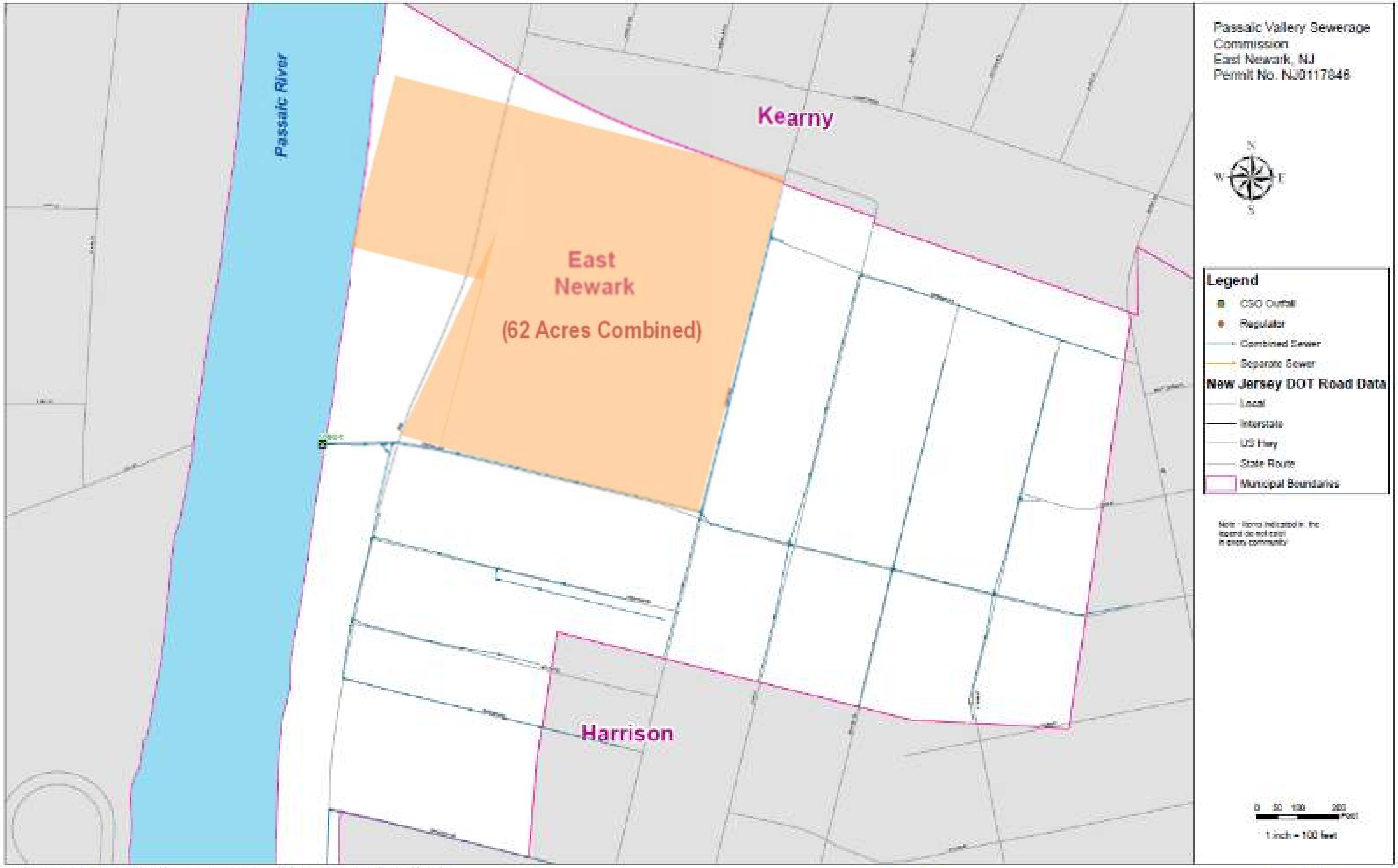
- *Environmental benefits*
- *Financial capability*
- *Availability of sites*
- *Public input*
- *Regulatory requirements*

BOROUGH OF EAST NEWARK
CSO ABATEMENT ALTERNATIVES

Preliminary CSO Controls Concepts

HDR

EAST NEWARK – A DENSELY DEVELOPED COMMUNITY



Passaic Valley Sewerage Commission Long Term Control Plan
Combined and Separated Sewer Systems Map
June 2016

GREELEY AND HANSEN

CDM Smith

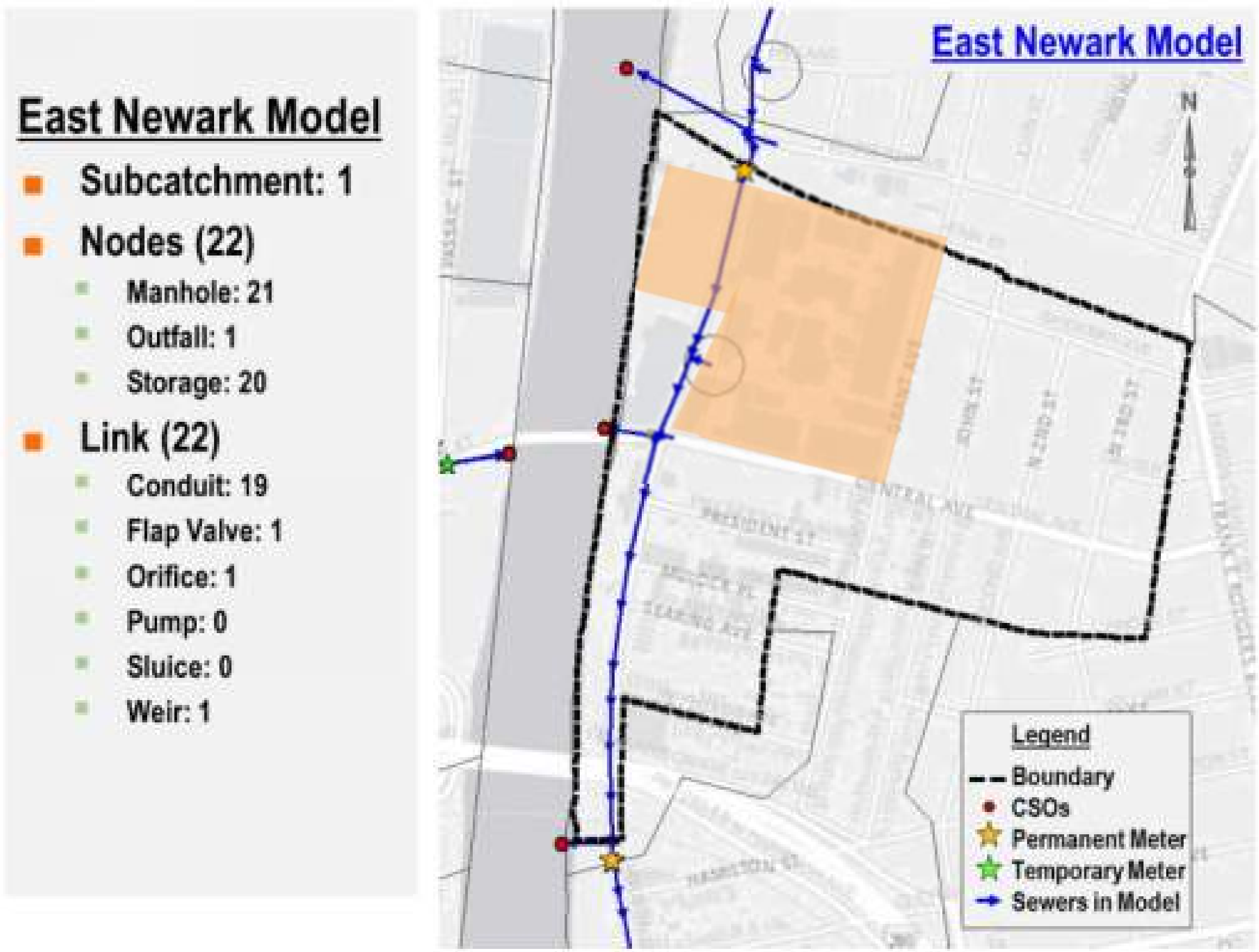


Figure I-9: Snapshot of Model Network in East Newark

EAST NEWARK OVERFLOWS

Table I-12: Typical Year CSO Overflow Volume and Frequency

CSO ID	Overflow Volume (MG)	Overflow Frequency	CSO ID	Overflow Volume (MG)	Overflow Frequency	CSO ID	Overflow Volume (MG)	Overflow Frequency
PT001	24.9	38	EN001	16.8	39	NB003	171.3	51
PT003	1.8	20	HR001	1.4	30	NB005	30.1	56
PT005	6.5	27	HR002	2.9	34	NB006	0.0	0
PT006	76.6	38	HR003	13.7	33	NB007	6.6	32
PT007	42.8	37	HR005	18.9	36	NB008	15.1	30
PT010	9.7	26	HR006	6.8	30	NB009	25.6	45
PT013	11.4	29	HR007	13.3	49	NB010	1.2	25
PT014	0.1	5	KE001	3.9	33	NB011	5.1	37
PT015	0.5	18	KE004	12.3	58	NB014	0.5	7
PT016	12.3	30	KE006	119.3	63	BA001	373.8	70
PT017	8.7	33	KE007	86.1	36	BA002	8.6	9
PT021	5.0	30	KE010	26.0	54	BA003	11.0	34
PT022	17.4	33	NE002	91.5	46	BA004	0.0	3
PT023	3.0	17	NE003	0.0	0	BA006	16.0	37
PT024	8.3	31	NE004	1.4	23	BA007	72.2	37
PT025	88.0	56	NE005	21.2	43	BA008	10.1	34
PT026	0.5	15	NE008	93.2	52	BA009	4.2	33
PT027	40.9	46	NE009	164.0	42	BA010	17.4	53
PT028	10.0	28	NE010	164.0	42	BA011	5.9	34
PT029	92.4	48	NE014	180.1	52	BA012	14.0	57
PT030	4.4	4	NE015	74.6	43	BA013	0.8	33
PT031	9.5	27	NE016	54.3	49	BA014	12.6	43
PT032	30.2	32	NE017	107.3	51	BA015	46.6	54
			NE018	75.6	53	BA016	6.5	48
			NE022	45.7	69	BA017	54.2	62
			NE023	16.8	35	BA018	14.6	58
			NE025	58.2	16	BA019	38.8	35
			NE026	16.6	17	BA020	10.1	33
			NE027	11.3	17	BA021	62.9	54
			NE030	10.3	19	BA022	0.0	0
						BA024	0.1	3
						BA026	1.3	9
						BA028	0.0	0
						BA029	6.8	24
						BA030	1.5	16
						BA034	0.1	7
						BA037	1.0	8

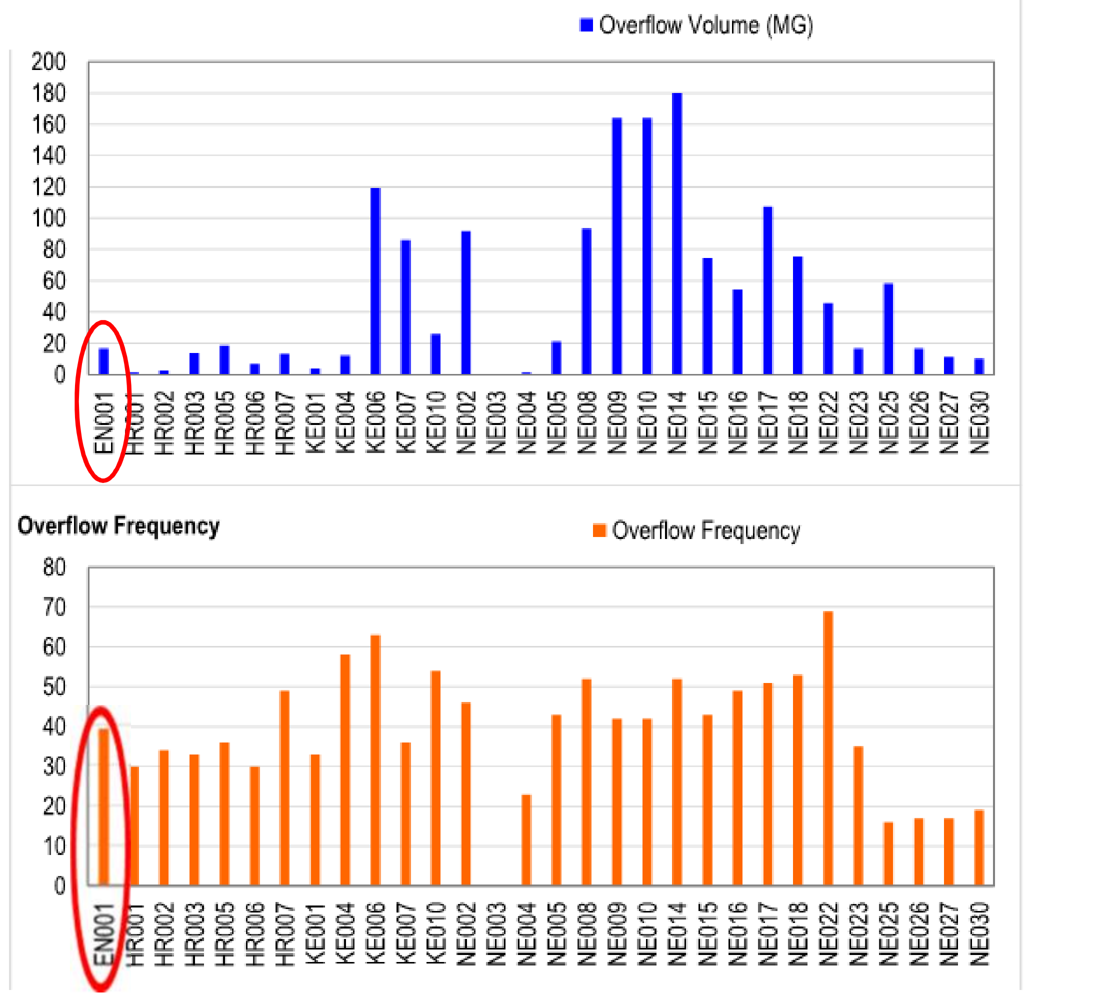


Figure I-41: Typical Year CSO Overflow Volume and Frequency East Newark, Harrison, Kearny and Newark

<u>On Site Controls</u>

- Tank/Tunnel Storage
- Netting (current practice)
- TSS Removal
- Disinfection
- Sewer Separation
- Regulator Modifications
- BMPs (I/I reduction, Catch Basing Cleaning, Catch Basin Stenciling, Catch Basin Modifications, Water Conservation, Street Sweeping, Leaf Collection, Recycle Programs)

<u>POTW Controls</u>

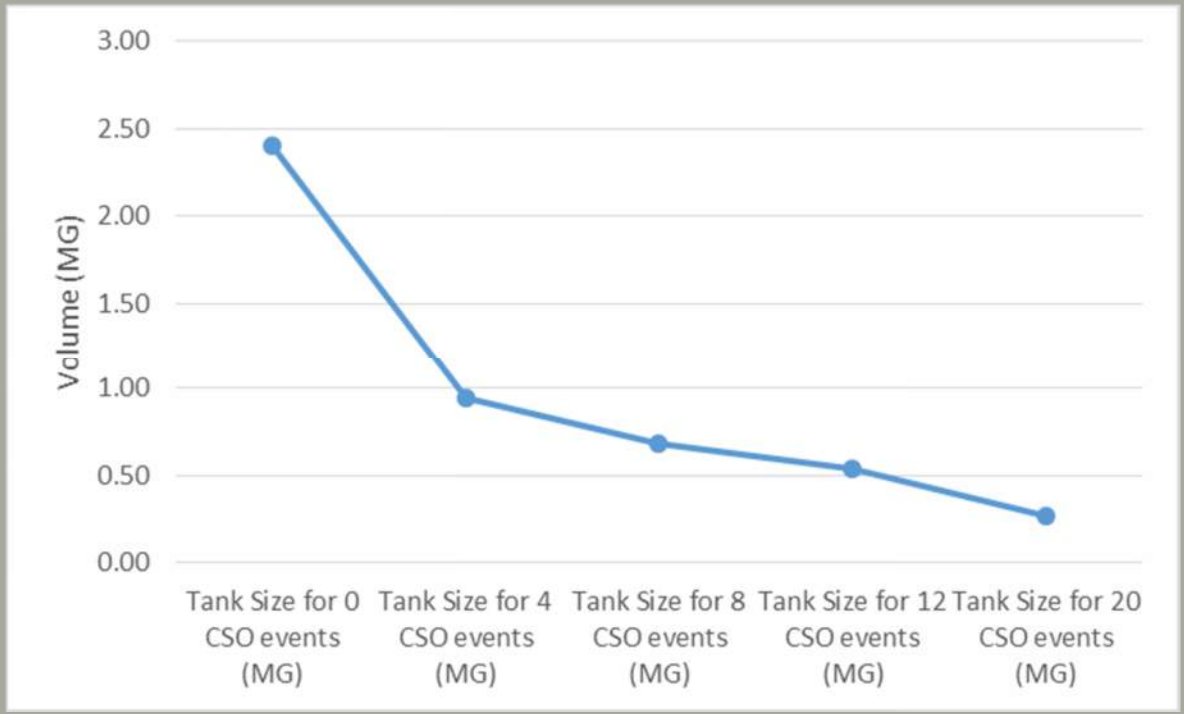
- Additional Treatment Capacity
- Wet Weather Blending

GRAY INFRASTRUCTURE CSO CONTROL OPTIONS

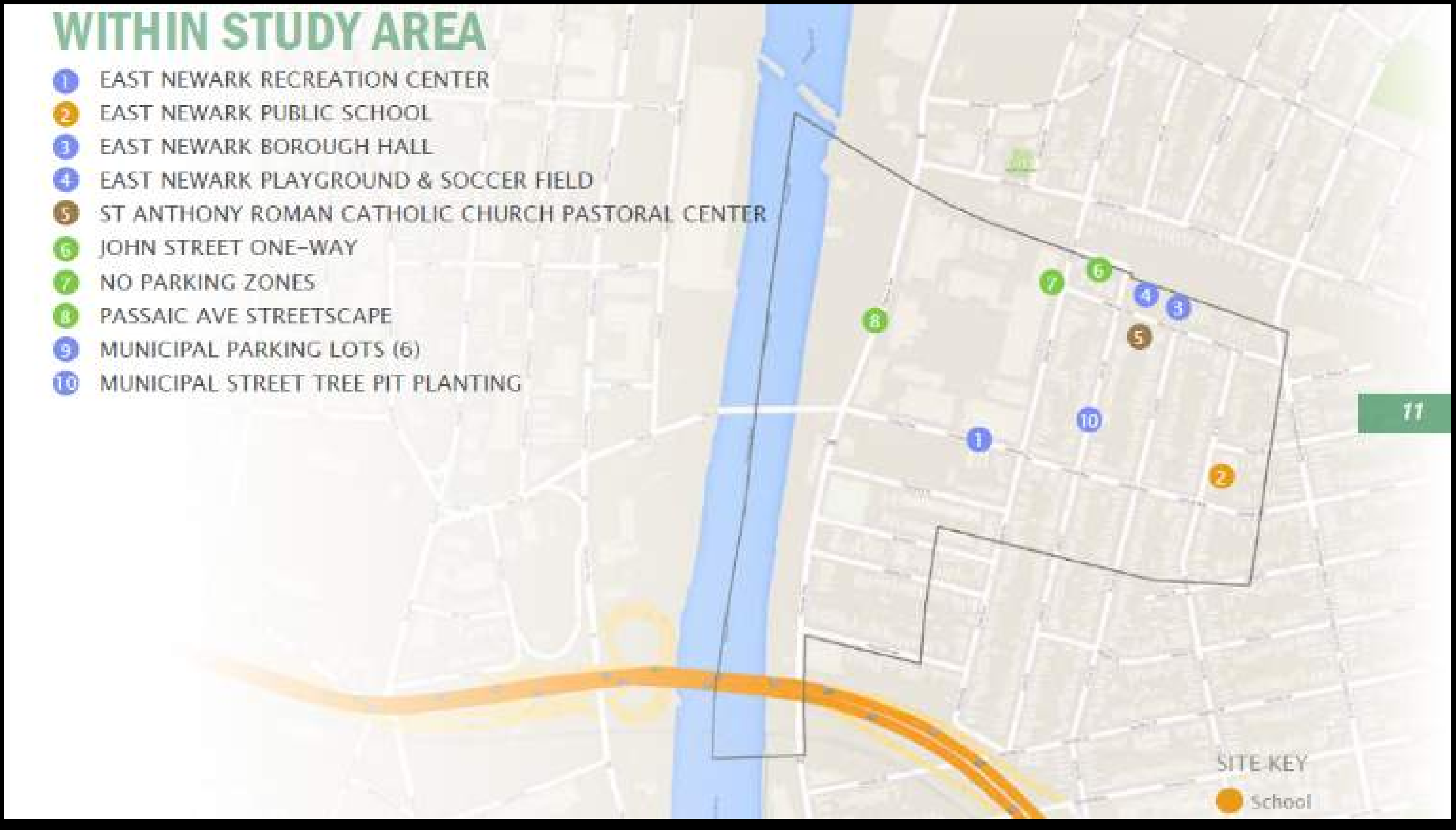
STORAGE EFFECT ON CSO VOLUME

Outfall	Tank Size for 0 CSO events (MG)	Tank Size for 4 CSO events (MG)	Tank Size for 8 CSO events (MG)	Tank Size for 12 CSO events (MG)	Tank Size for 20 CSO events (MG)
EN001	2.41	0.94	0.68	0.54	0.27

- Pump back rate is a function of the stored CSO volume and the allowable discharge rate
- Pump back time must be < 3 days



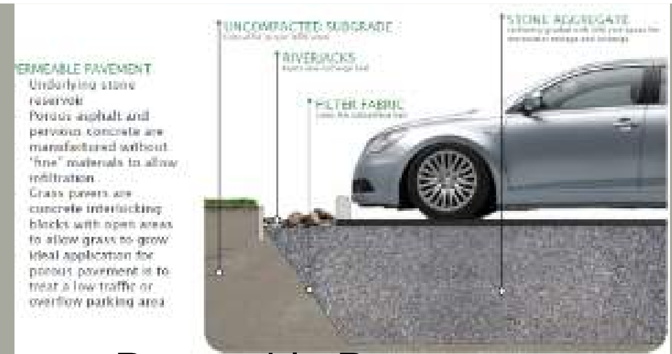
RUTGERS GREEN INFRASTRUCTURE FEASIBILITY



Tree Pits (Parsippany)

Planters (Camden)

Bioretention (Camden)



Permeable Pavement

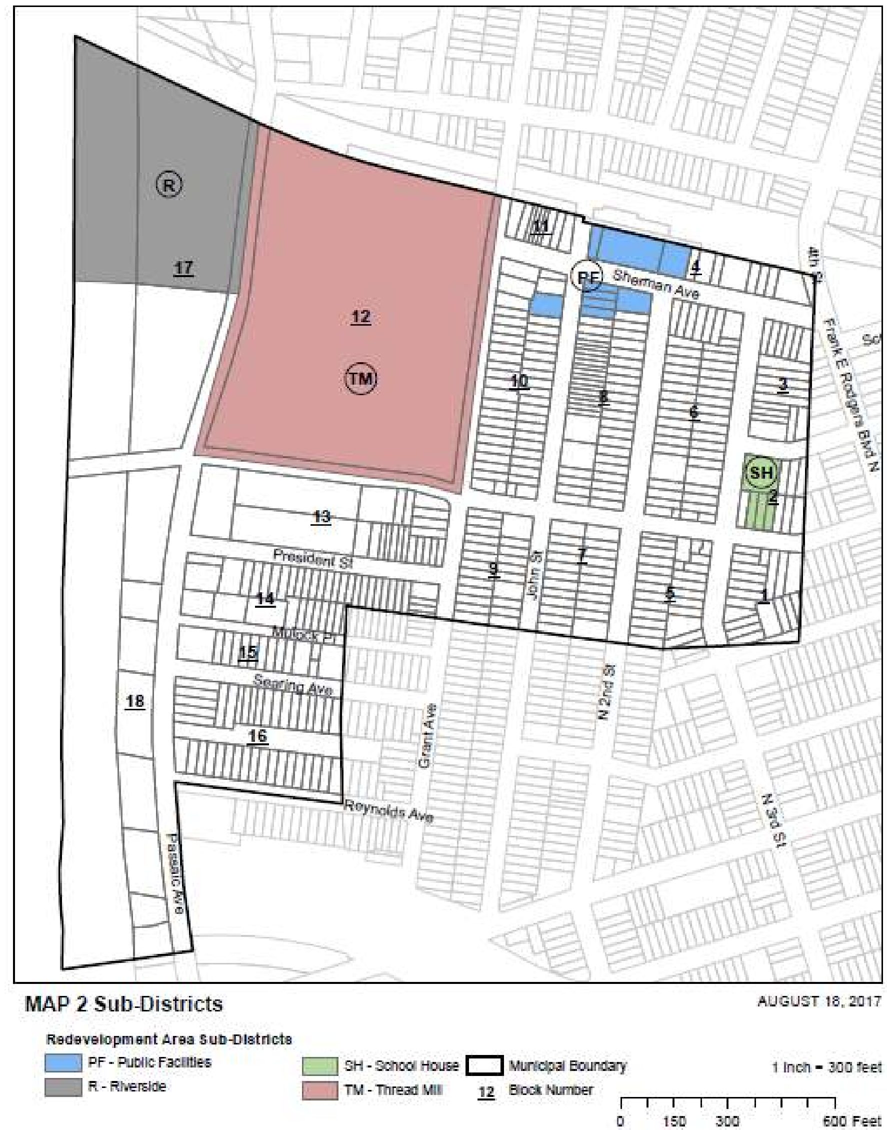
Green Roof

GREEN INFRASTRUCTURE CSO CONTROL OPTIONS

(simulate as 5% of combined area but could be as large as 20%)

REDEVELOPMENT AREA ~ 20%

- *Green/Blue Roofs*
- *Tree Pits*
- *Bioretention*
- *Planters*
- *Permeable Pavement*
- *Storage Tank Site*



AN INTEGRATED APPROACH TO CSO CONTROL WILL CONSIDER GRAY AND GREEN INFRASTRUCTURE. THE FINAL SELECTION WILL CONSIDER:

- *Environmental benefits*
- *Financial capability*
- *Availability of sites*
- *Public input*
- *Regulatory requirements*

TOWN OF KEARNY EVALUATION OF CSO-CONTROL ALTERNATIVES

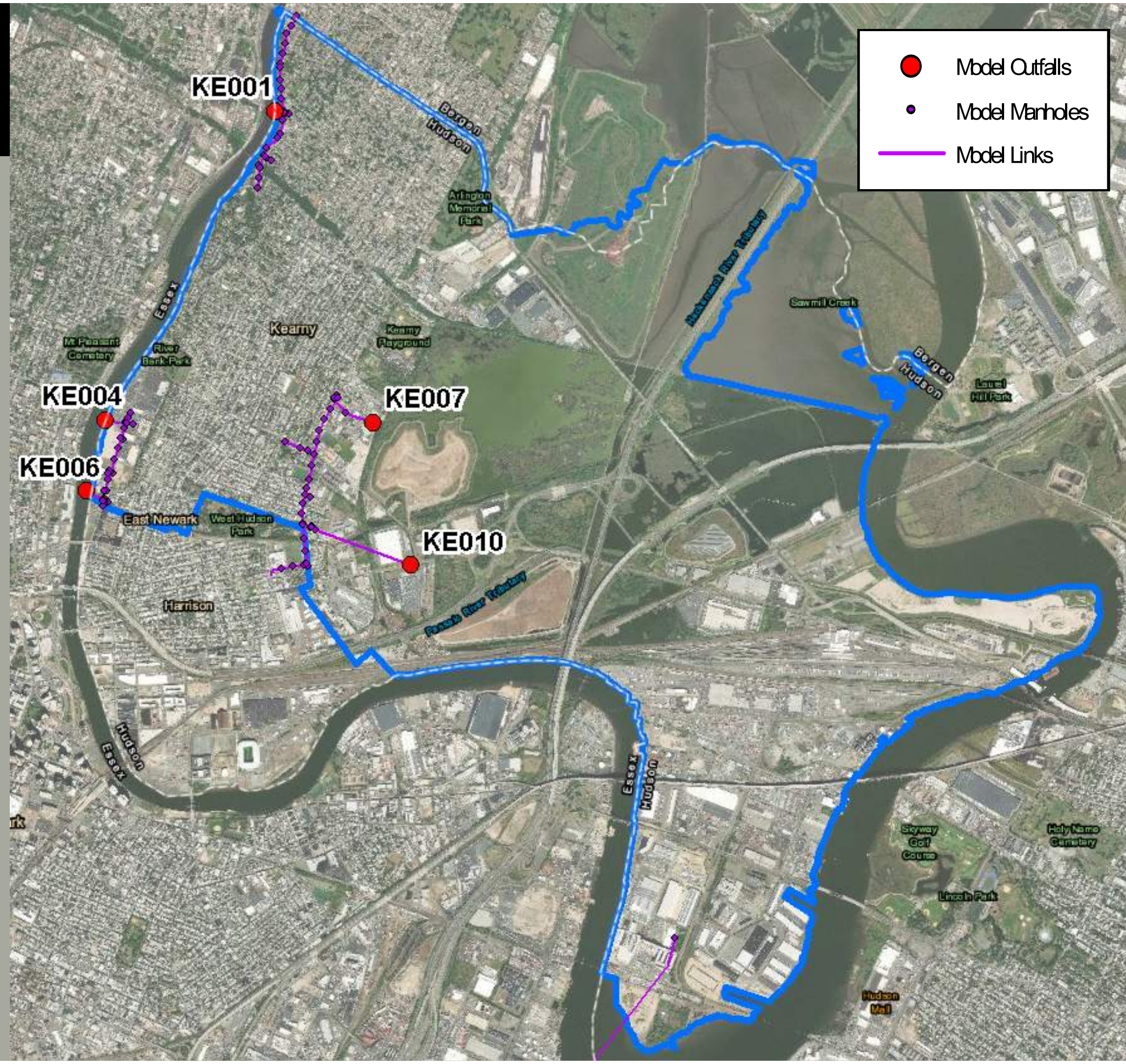
March 7, 2019 Public Presentation

NEGLIA ENGINEERING ASSOCIATES

HDR

TOWN OF KEARNY

- Study Area ~5 square miles
  - ~3 square miles sanitary
  - ~2 square miles combined
- Combined Sewer System:
  - 5 CSO Outfalls
  - 5 Pump Stations
- Model of Combined System
  - 78 Pipe Segments
  - 91 Manholes
  - 1 Pump Station
  - 5 Regulators
- Calibrated using 2016/2017 monitoring data

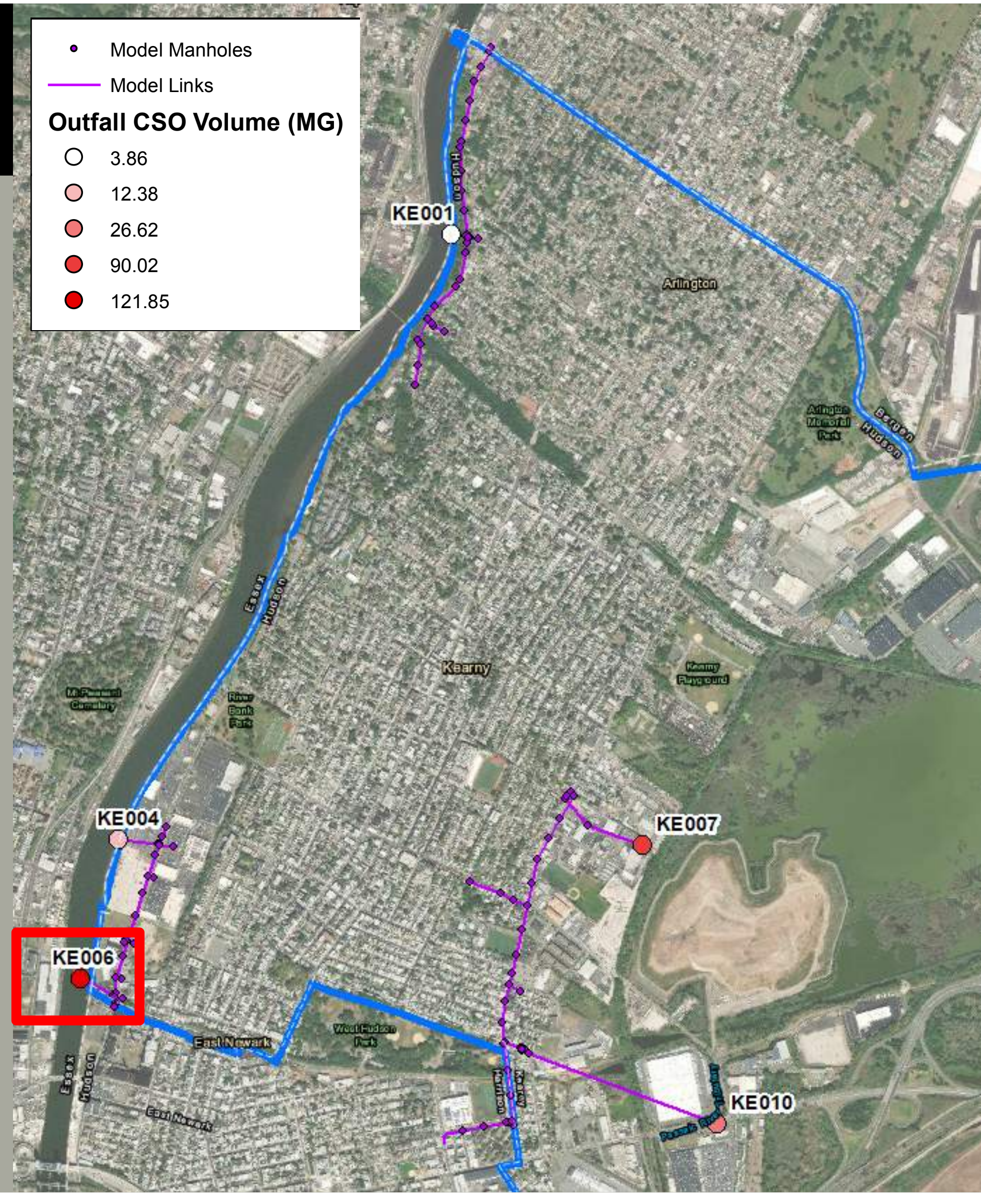


MODEL RESULTS (FUTURE NO ACTION)

Calibrated model then applied it to determine future conditions with and without CSO controls
➔ *This is how we evaluate CSO-control impacts*

Future "No Action" Condition
- Uses projected future population (2045)
- Uses a "design/typical year" rainfall

Model Results
- 61 storms cause overflows
- Total annual CSO: 255 MG
- Roughly half of total (122 MG) discharged from a *single outfall*: KE-006



CSO-CONTROL ALTERNATIVES

<u>Sewer-System Controls</u>

- ✓ BMPs (such as catch basin modifications, catch basing cleaning, catch basin stenciling, street sweeping, leaf collection, industrial spill control, recycling programs, etc.)
- ✓ Floatables Netting
- Regulator Modifications
- Sewer Separation
- Storage: linear/tank/tunnel
- CSO Disinfection
- Green Infrastructure

<u>Treatment-Plant Controls (PVSC)</u>

- Additional Treatment Capacity
- Wet-Weather Blending

Potential Green Infrastructure site suggested by Kearny AWAKE team

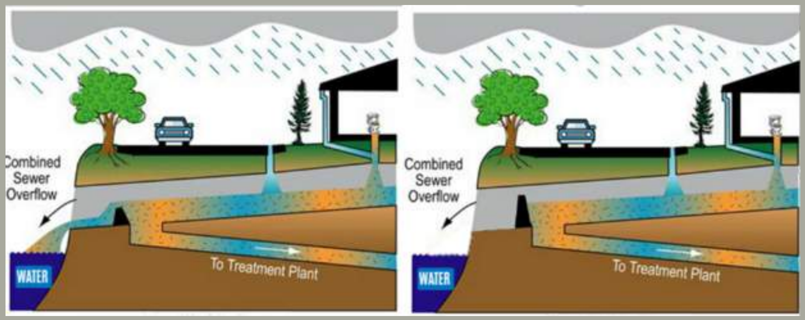
Figure 1. Peracetic acid Peragreen INJEXX system on project site

Peracetic Acid System - Pilot Study

CSO-CONTROL ALTERNATIVES

Regulator Modifications

- Increase existing sewer-system infrastructure to utilize more of its existing storage capacity
  There is not enough in-line storage capacity available to make a significant difference



Regulator Modifications

Sewer Separation

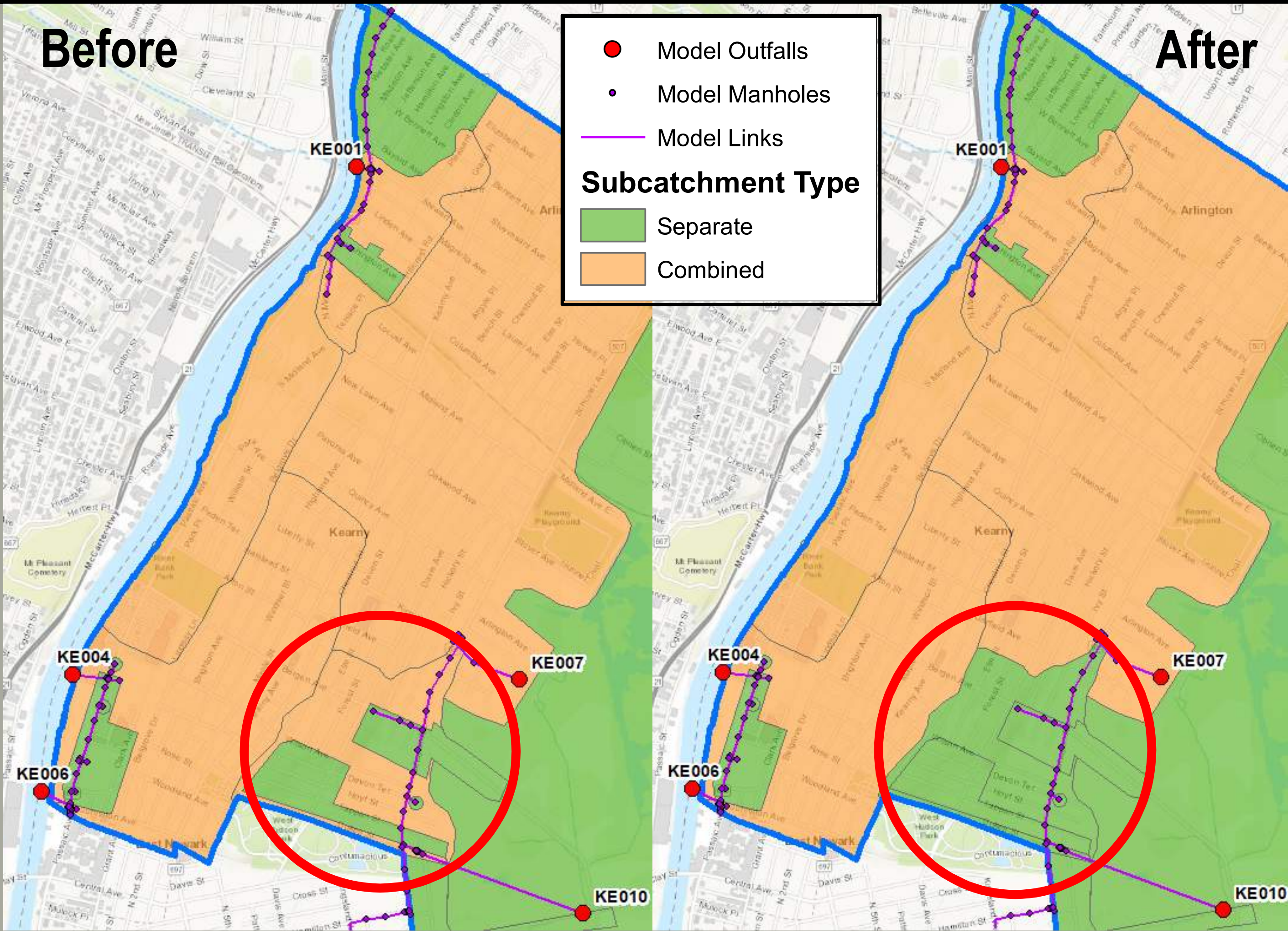
- System-wide separation involves digging up every street, laying new storm sewers, reconnecting catch basins
- Very costly, very disruptive, long time to complete
- Creates new storm sewer discharges to waterbody – *these may require treatment in future*
- *Partial sewer separation can be implemented to completely control CSOs for specific drainage areas*

Sewer Separation

CSO-CONTROL ALTERNATIVES

Sewer Separation (continued)

- The Town of Kearny will implement complete sewer separation of a 93-acre area draining to outfall KE010
  - This will remove stormwater from the combined sewer
  - Outfall KE010 will then discharge stormwater only
- Separating this area will reduce annual CSO volume 13.5% (~34.5MG)
- Separation of outfall KE010 is assumed for all subsequent alternative scenarios



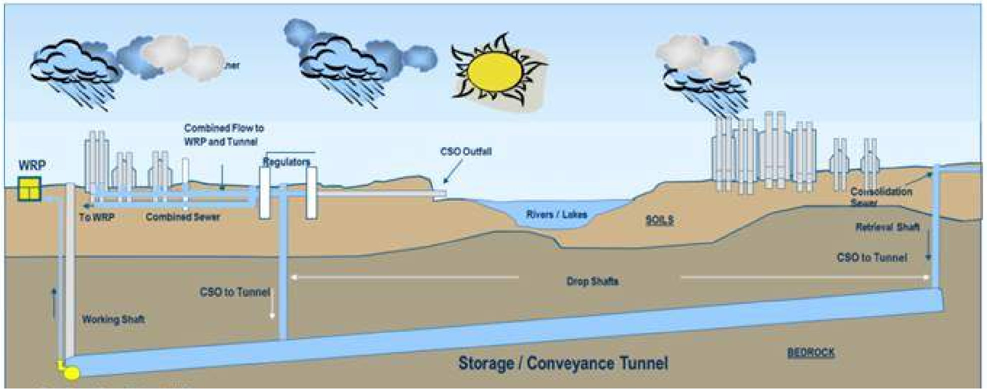
CSO-CONTROL ALTERNATIVES

CSO Tank

Storage Solutions

- Idea: store what would overflow, and pump it back when extra capacity is available (such as after the storm ends)
- Types of storage:
  - Tanks (located near existing outfalls)
  - Storage Pipes (shallow, along surface)
  - Tunnels (deep under city)

Inside a CSO Tunnel



CSO Tunnel

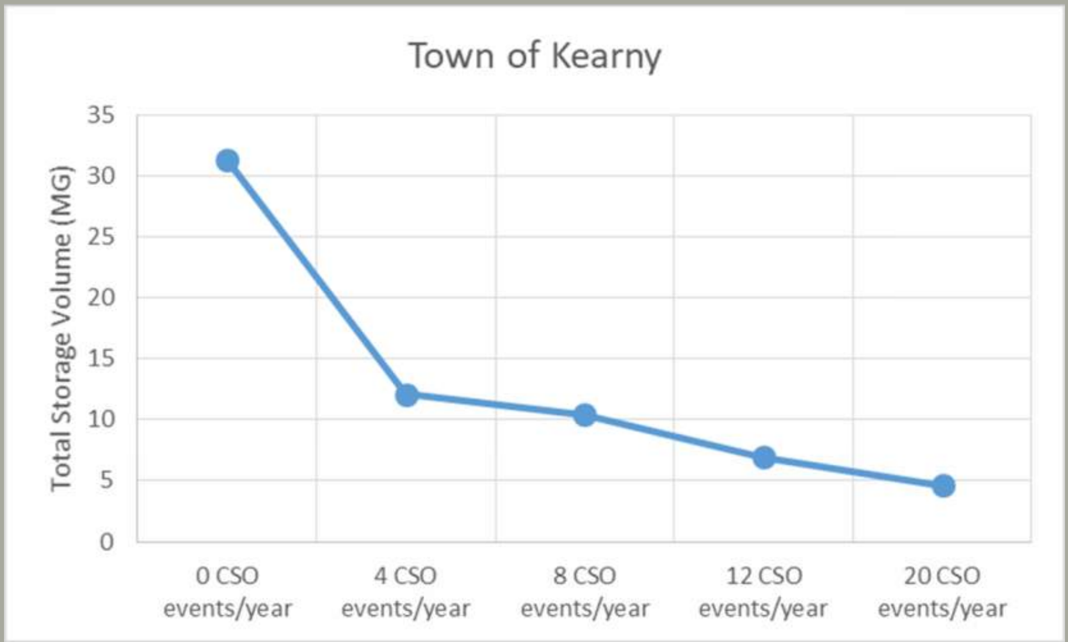
(Figure provided by F. Óksuz)

CSO-CONTROL ALTERNATIVES

- To reduce CSOs from 61 to 20, 12, 8 and 4 per year, analyses determined
  - the number and size of tanks at each CSO outfall
  - the size of a tunnel

Outfall	Tank Size for 0 CSO events (MG)	Tank Size for 4 CSO events (MG)	Tank Size for 8 CSO events (MG)	Tank Size for 12 CSO events (MG)	Tank Size for 20 CSO events (MG)
KE001	0.42	0.25	0.25	0.19	0.15
KE004	1.56	0.67	0.51	0.42	0.31
KE006	15.68	6.19	5.78	3.94	2.75
KE007	13.67	5.01	3.88	2.39	1.38
KE010	0.00	0.00	0.00	0.00	0.00
Total	**31.33**	**12.12**	**10.42**	**6.94**	**4.59**

	0 CSO per year	4 CSO per year	8 CSO per year	12 CSO per year	20 CSO per year
Tunnel Volume (MG)	30.34	11.52	10.28	6.47	4.28



CSO-CONTROL ALTERNATIVES

Disinfection with Peracetic Acid (PAA)

- Bayonne MUA pilot study (2015) verified PAA performance to kill 99.9% of bacteria present in CSOs prior to discharge
- Advantages: PAA does not require a large, expensive facility and not leave a “chemical residual” that must be removed (unlike chlorine)
- PAA treatment facilities are small enough that they could be placed at each outfall or,
- A larger PAA treatment facility could be installed at the “optimized” locations developed for storage facilities

Figure 1. Peracetic acid Peragreen INJEXX system on project site

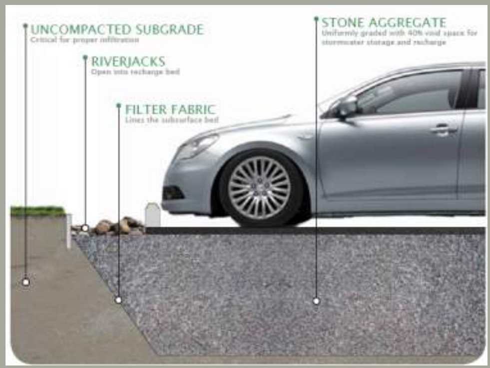
Peracetic Acid System - Pilot Study

CSO-CONTROL ALTERNATIVES

Green Infrastructure

- Idea: capture the rainfall before it enters the sewers
- Potential Green Infrastructure Types:
  - Pervious Pavement
  - Tree Pits
  - Bioretention Systems
  - Rainwater Harvesting
- In other urban areas, Green Infrastructure has controlled runoff from as much as 5% of the impervious areas (roads, sidewalks, rooftops, etc.)
  - This level of control in Kearny would:
    - Reduce annual CSO volumes by 2% (~4.5 MG)
    - No reduction in number of CSO events


Planters (Camden)



Permeable Pavement


Tree Pits (Parsippany)


Bioretention (Camden)

CSO-CONTROL ALTERNATIVES

Rutgers University Green Infrastructure Feasibility Study

- Identified 13 potential GI projects in Kearny, some with a mix of different types of GI:
  - 7 – Rain Gardens
  - 4 - Pervious Pavement
  - 2 – Stormwater Planters
  - 4 – Cistern/Rainwater Harvesting

Kearny AWAKE Team GI Sites

- The Kearny AWAKE team identified 2 additional potential GI sites
  - Afton St & Passaic Ave (Veterans Field)
  - South Midland Ave & Passaic Ave

SUMMARY

- Kearny is nearing completion of its analysis of CSO-control alternatives
- Once submitted to PVSC, Kearny's solutions will be added into the mix of all municipalities in the PVSC service area
- PVSC will then assess the overall impact of all the municipalities' solutions
- CSO-control alternatives evaluation report is due to NJDEP by July, 2019
- Selected CSO-control alternative report is due to NJDEP by June, 2020

CSO LONG TERM CONTROL PLANNING (LTCP)
FOR THE CITY OF PATERSON: NJ0108880

Status Update on LTCP and Evaluation of Alternatives

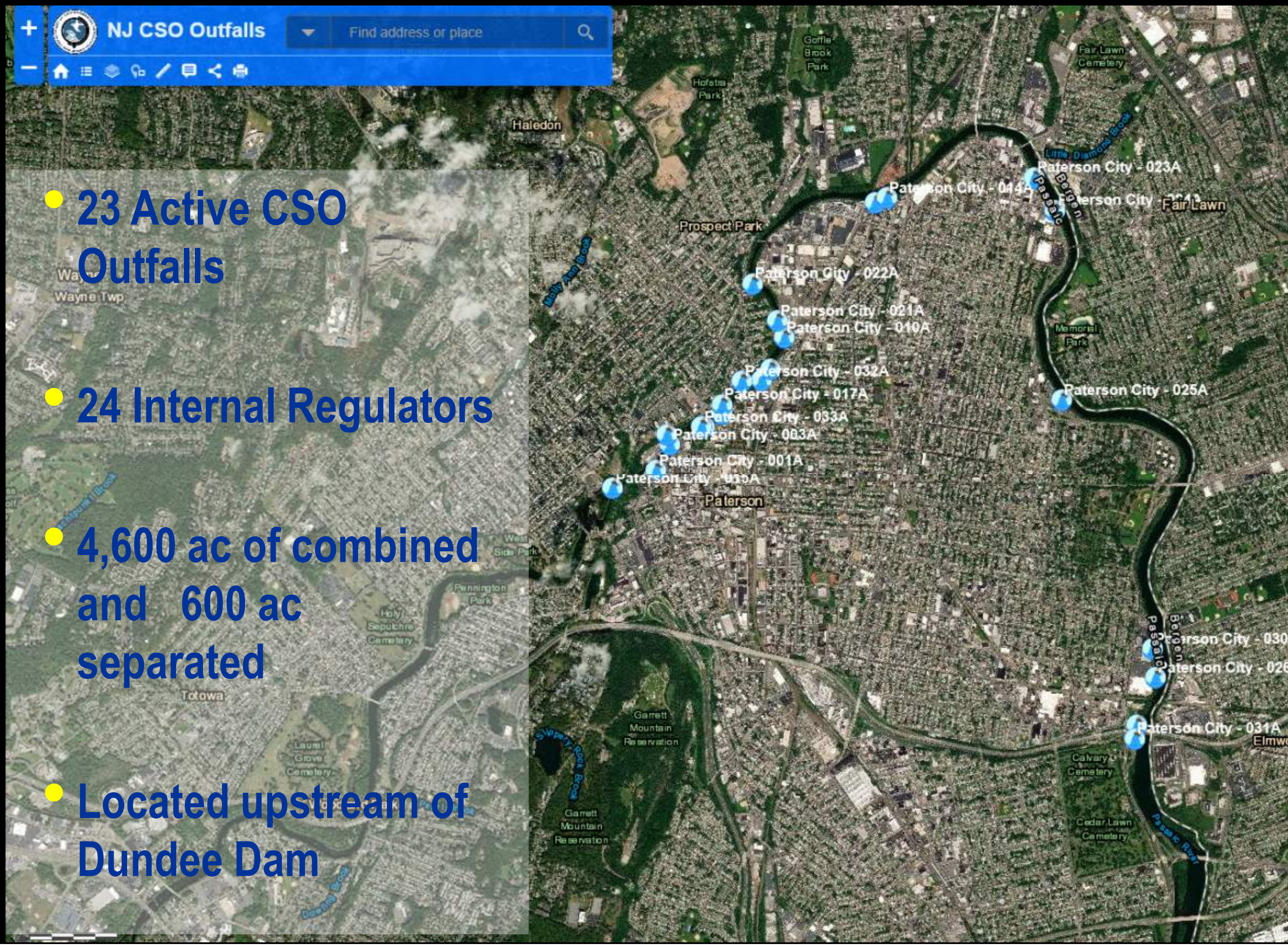
March 7, 2019

CITY OF PATERSON NEW JERSEY

PRESENTATION OUTLINE

- Existing System Model Updates
  - Detailed model development
  - Sewer separation projects
- Baseline Scenario
  - 2004 Typical hydrologic year – precipitation and river water levels
  - Wastewater flows for 2050 population increase
  - Water conservation
  - No-net increase in runoff/infiltration reduction
- Alternatives Analysis
  - System modification and Sewer Separation projects
  - Flood relief sewer project
  - Green stormwater infrastructure planning
  - Grey infrastructure planning

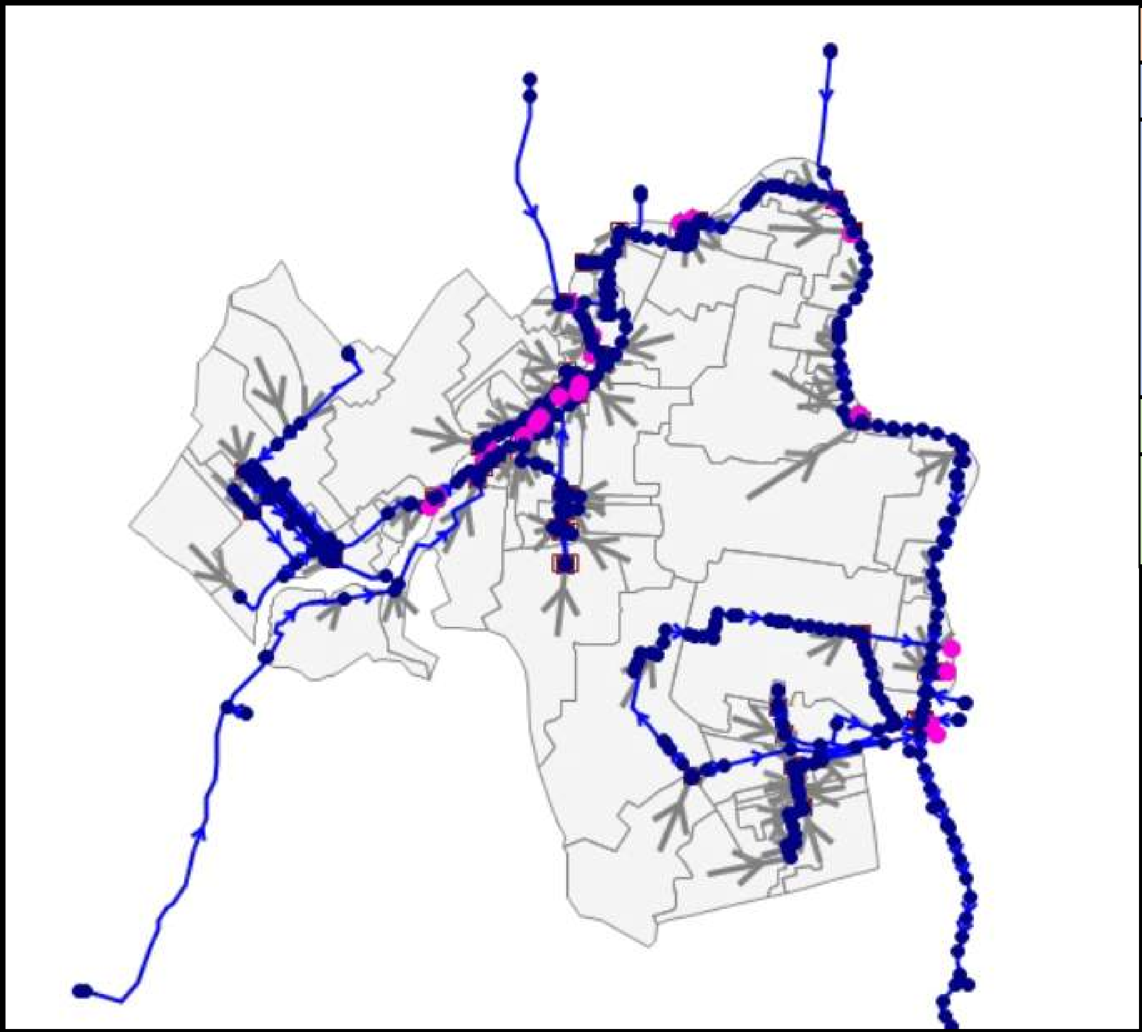
SYSTEM



- 23 Active CSO Outfalls
- 24 Internal Regulators
- 4,600 ac of combined and 600 ac separated
- Located upstream of Dundee Dam

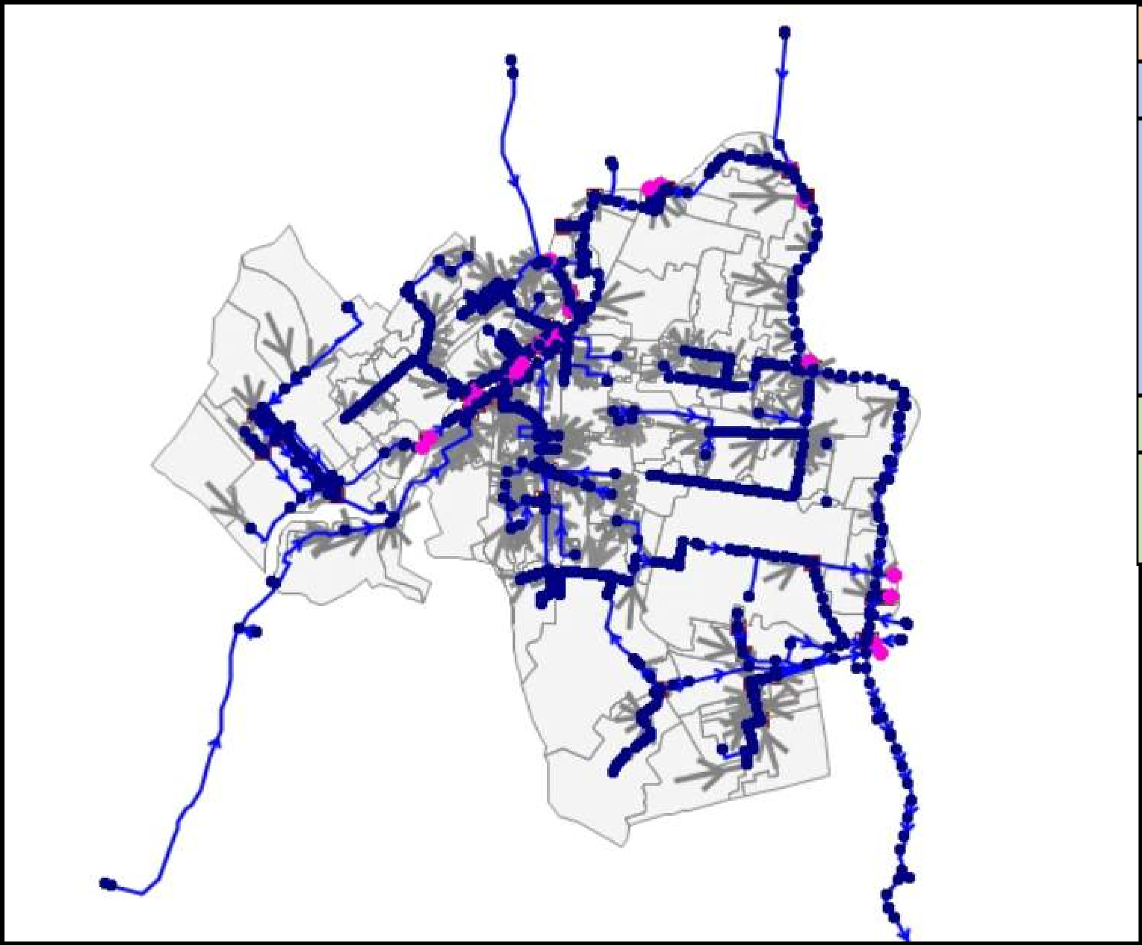
Existing System Model Updates

PVSC INFOWORKS ICM MODEL – PATERSON SYSTEM



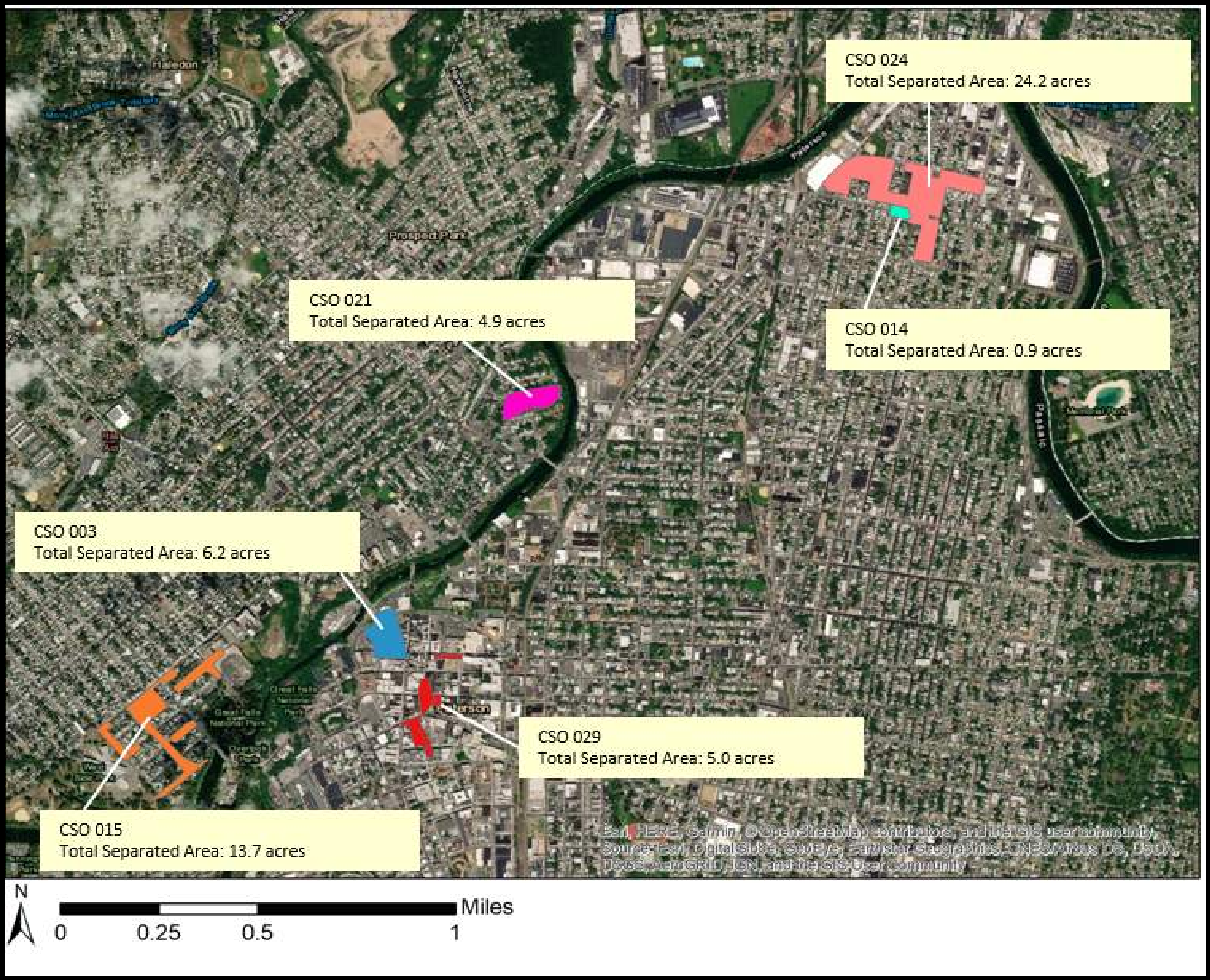
Subcatchments	**67**
Links	**575**
Conduits	480
Flap Valves	21
Orifice	22
Sluice	10
Weirs	42
Nodes	**568**
Manholes	545
Outfalls	23

DETAILED PATERSON ICM MODEL



Subcatchments	**226**
Links	**922**
Conduits	827
Flap Valves	21
Orifice	22
Sluice	10
Weirs	42
Nodes	**863**
Manholes	840
Outfalls	23

SEWER SEPARATION PROJECTS



Total Separated Drainage Area: 54.9 acres

Baseline Scenario

Baseline Scenario Assumptions

- Changes in Impervious Cover
  - Paterson has ordinance for no-net increase in runoff for 15+ years
  - Assuming current impervious cover
- Water Conservation
  - Low flush toilets used in new buildings
  - Assuming no conservation
- RDII Reduction from Separate Communities
  - Unaware of systematic approach/efforts to reduce rainfall-derived inflow & infiltration (RDII)
  - Assuming no reductions in RDII
- Infiltration Reduction from Paterson
  - Model currently uses a constant 7.5 MGD of infiltration through cracks and joints
  - Assuming no reductions in infiltration

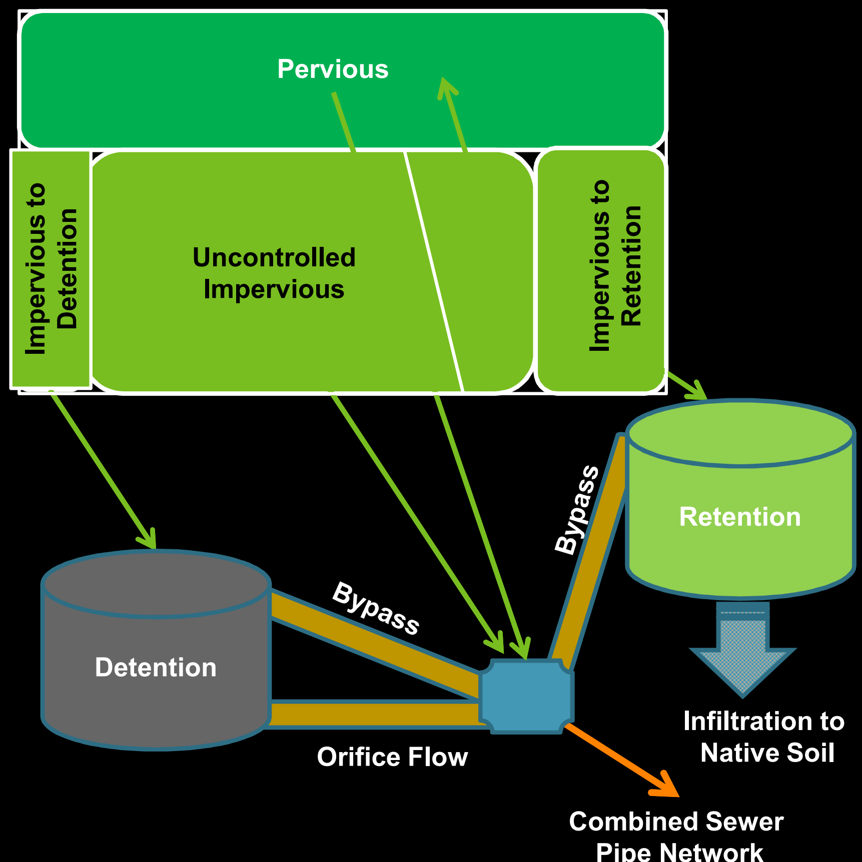
Alternatives Analysis

NJPDES PERMIT REQUIREMENTS

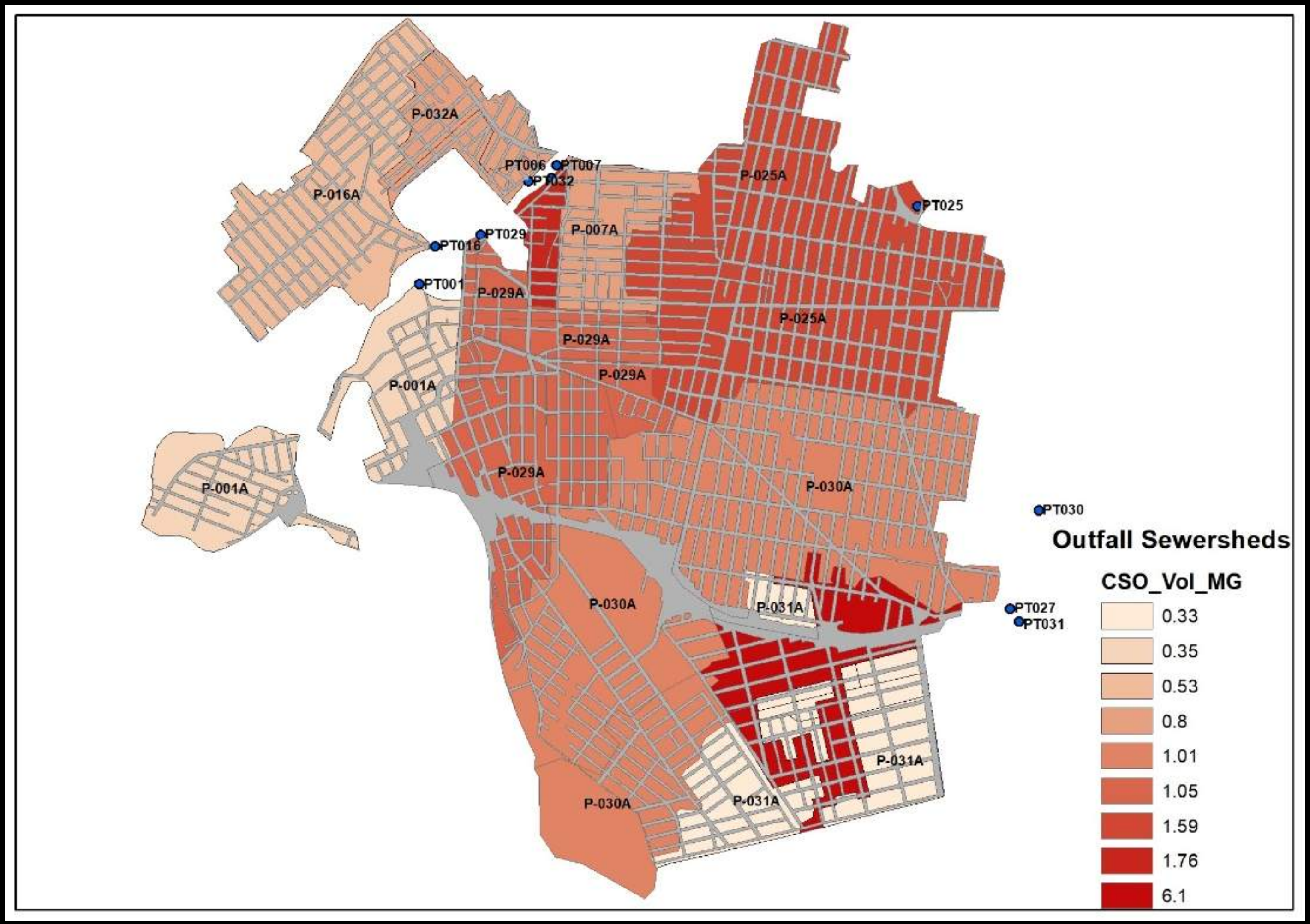
- Green Infrastructure (GI)
- Increased storage capacity in collection system
- STP expansion and/or storage at the Water Resources Recovery Facility (WRRF) (by PVSC)
- I/I reduction to meet the definition of non-excessive infiltration and non-excessive inflow as defined in N.J.A.C. 7:14A-1.2
- Sewer separation
- Treatment of CSO discharge
- CSO related bypass of secondary treatment portion of the STP in accordance with N.J.A.C. 7:14A-11.12 Appendix C (by PVSC)

GI PLANNING / EVALUATION FRAMEWORK

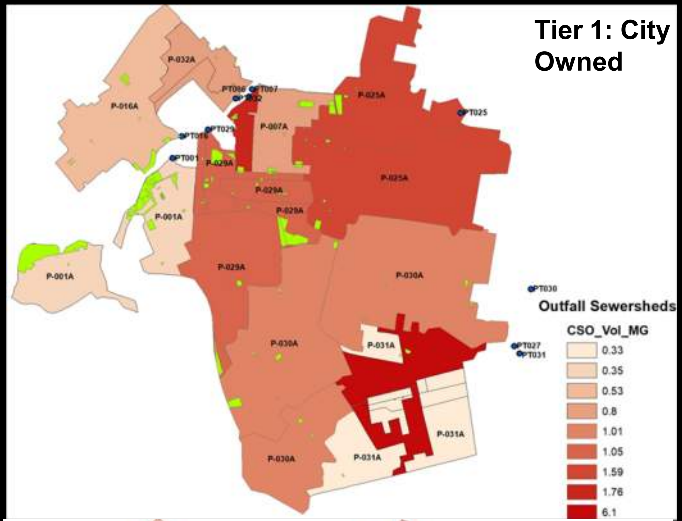
- Similar to other municipalities performing sensitivity analysis for up to 10% GI
  - 3% and 6% scenarios
- GI implemented by disconnecting portions of subcatchments according to level of implementation
- Green-Grey hybrid infrastructure is needed to achieve frequency/wet weather capture goals

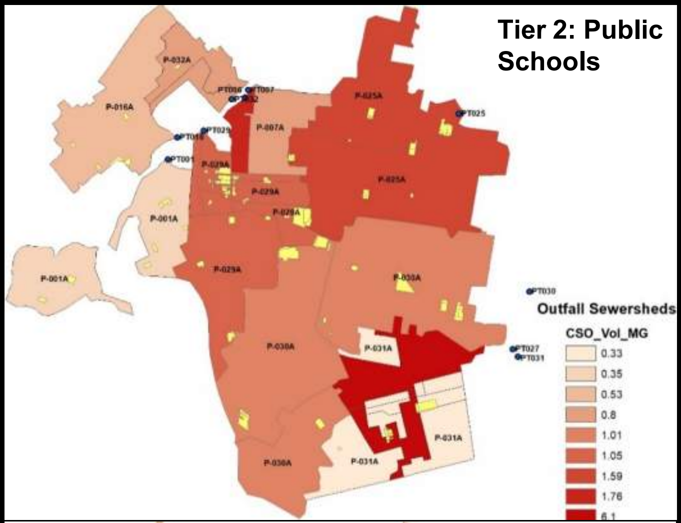


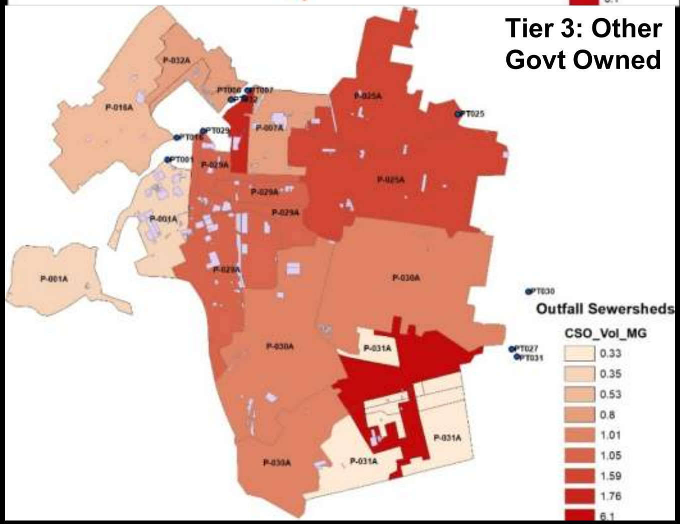
GI Planning – Right of Way

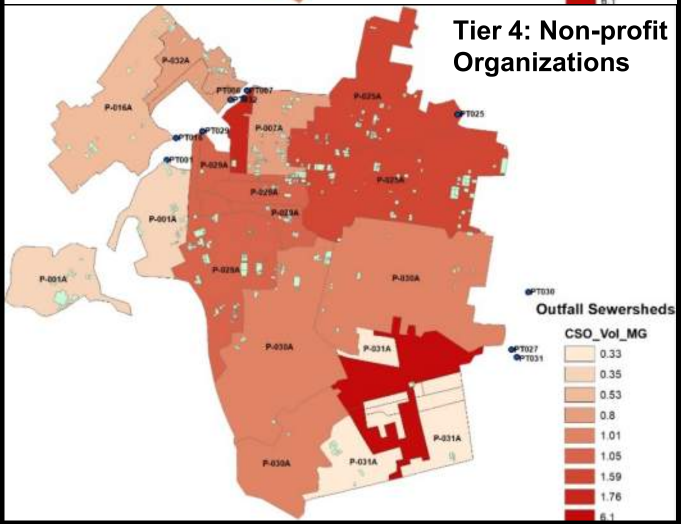


GI Planning


Tier 1: City Owned
Outfall Sewersheds
CSO_Vol_MG
0.33
0.35
0.53
0.8
1.01
1.05
1.59
1.76
6.1


Tier 2: Public Schools
Outfall Sewersheds
CSO_Vol_MG
0.33
0.35
0.53
0.8
1.01
1.05
1.59
1.76


Tier 3: Other Govt Owned
Outfall Sewersheds
CSO_Vol_MG
0.33
0.35
0.53
0.8
1.01
1.05
1.59
1.76


Tier 4: Non-profit Organizations
Outfall Sewersheds
CSO_Vol_MG
0.33
0.35
0.53
0.8
1.01
1.05
1.59
1.76

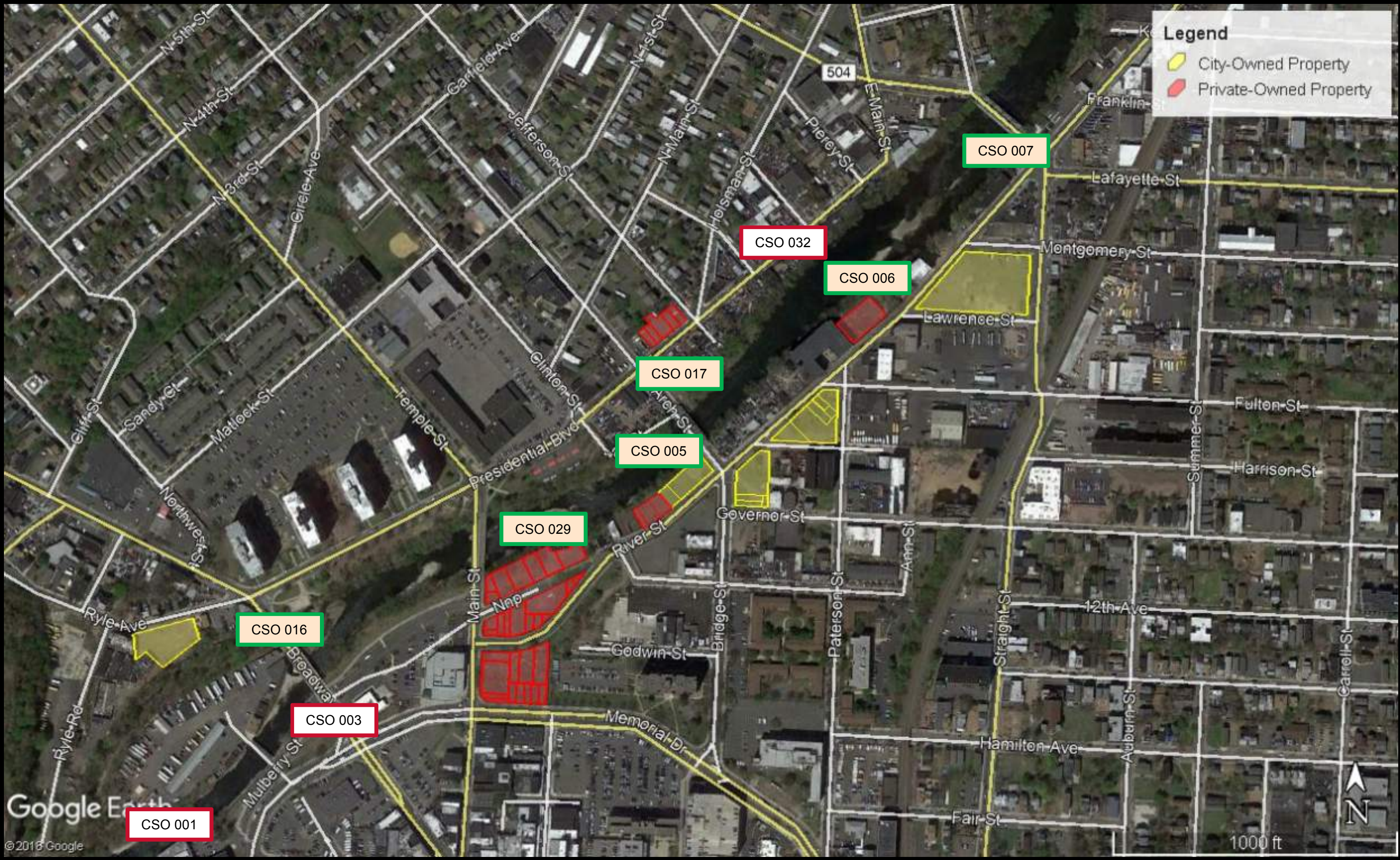
GREY ALTERNATIVES BEING EVALUATED

- Offline Storage
  - Outfall specific
  - Regionalized

- Deep Tunnel
  - Dropshafts along multiple outfalls to capture CSOs and dewater to PVSC interceptor

- High Rate Screening + Disinfection
  - Select outfalls – potentially, PT029, PT025 and PT006

Offline Storage Tanks – Siting



Offline Storage Tanks – Considerations

- Costs
  - Land acquisition (where privately owned)
  - Site clearing
  - Pump facilities & forcemains
  - Coarse screens, diversions, control gates, etc.
- 100-Year Floodplain
  - Storage tanks built within the floodplain are limited to below-grade
  - Excavation & restoration

MOTT MACDONALD

Town of Harrison Development and Evaluation of Alternative Controls – Update

PVSC CSO Group Supplemental CSO Team Meeting

March 7, 2019

Town of HARRISON

Evaluation Overview

Prework

- **Available Space Analysis**

Alternatives

- **Green Infrastructure**
- **Storage**
- **Treatment Plant Expansion – NA**
- **I/I Reduction – NA**
- **Sewer Separation**
- **CSO Treatment**
- **WWTP Alternative Wet Weather Protocol – NA**

Available Space Analysis

Objective: Identify potential sites for storage or end-of-pipe treatment

GIS Analysis

Aerial Imagery, Sewer Facilities (pipes, outfalls, etc.), Land Use/Cover, Parcel Data, Contours, Contaminated Sites

Site Considerations

What's on the site?

What's the site use for?

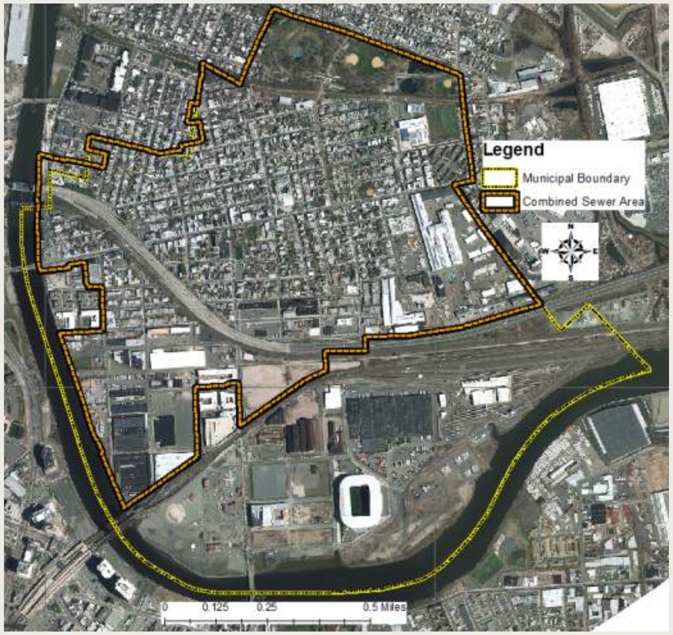
Who owns the property?

How close is it to the outfall?

Is the soil contaminated?

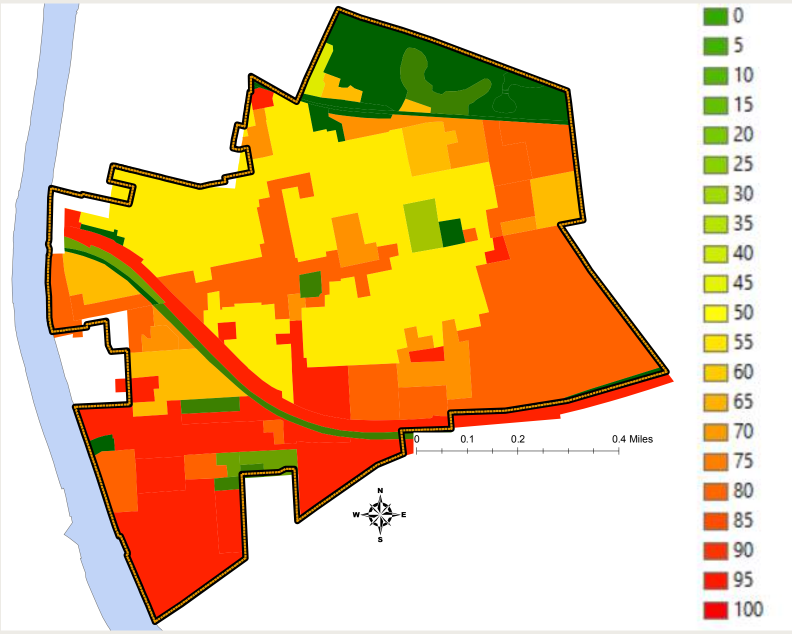
CSO - 005

Green Infrastructure



Total area: 848 acres

Combined sewer service area: 497 acres (58.6% of total area)



Percent Impervious (2012) in combined sewer area.

346 acres of impervious (69% of CS area)

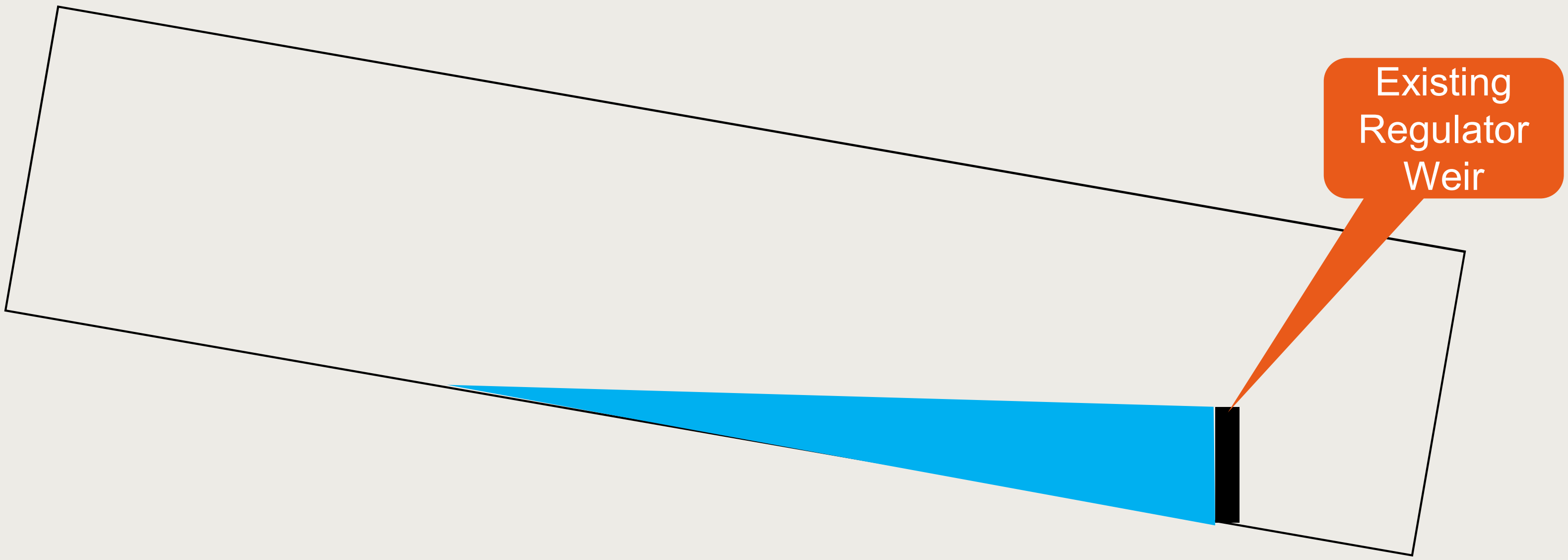
Maximum % of impervious that can be treated by GSI?

Evaluate Maximum, 50% and 25% of Maximum

Storage

Existing Inline Storage

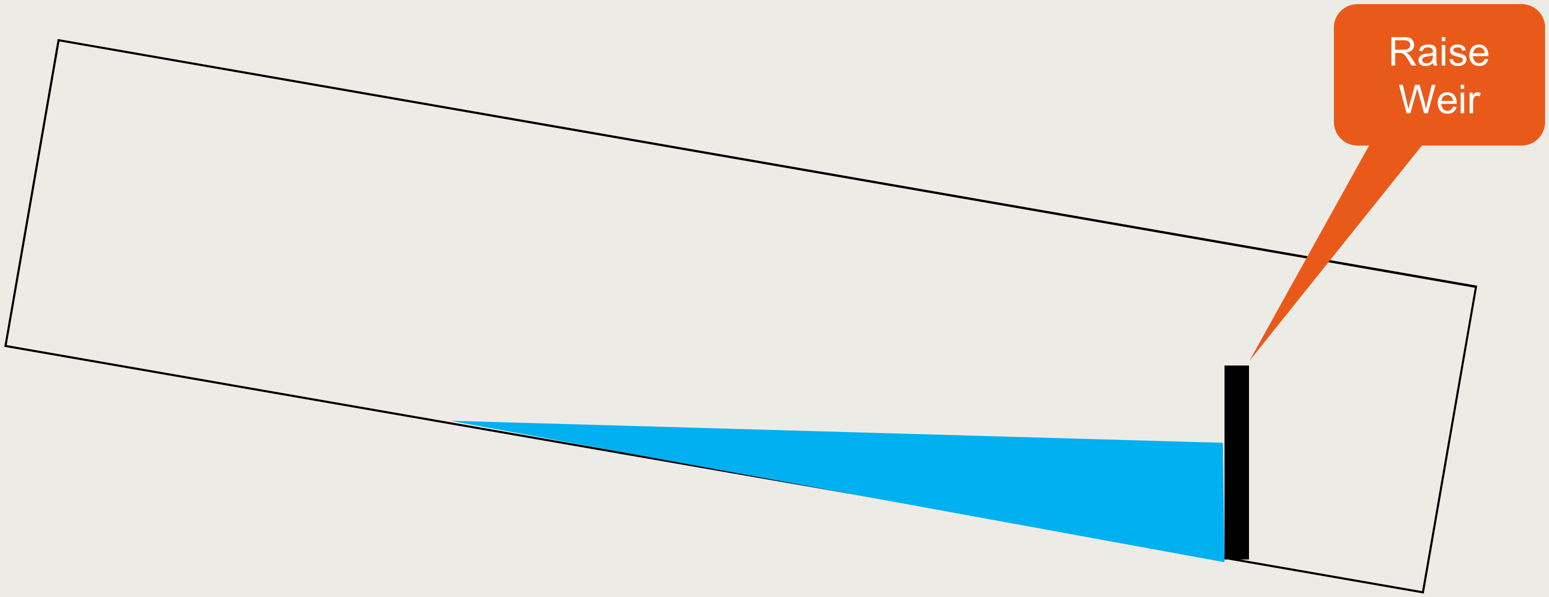
Maximize inline storage capacity



Storage

Existing Inline Storage

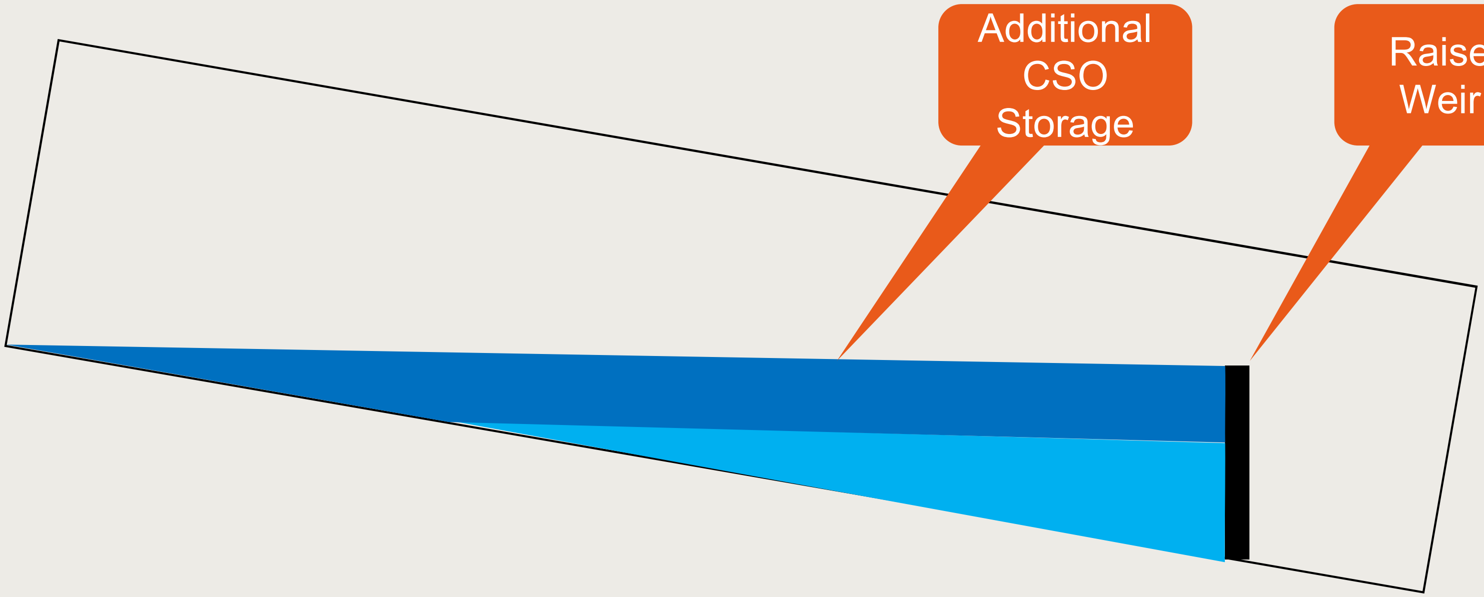
Maximize inline storage capacity



Storage

Existing Inline Storage

Maximize inline storage capacity



Storage

Existing Inline Storage

Maximize inline storage capacity

Most weirs at or above pipe crown

Storage

New Offline Storage – Tunnel

Not feasible: No suitable route within the Town

Storage

New Offline Storage – Tanks

Construction Challenges

Potential Consolidation

Sewer Separation

WQ Impacts – Treatment Requirements

Pending Stormwater Rule Changes

Evaluate separation of CSO 005 along Angelo Cifelli Drive – Partially separated

Drainage Area and Sewers for CSO 005

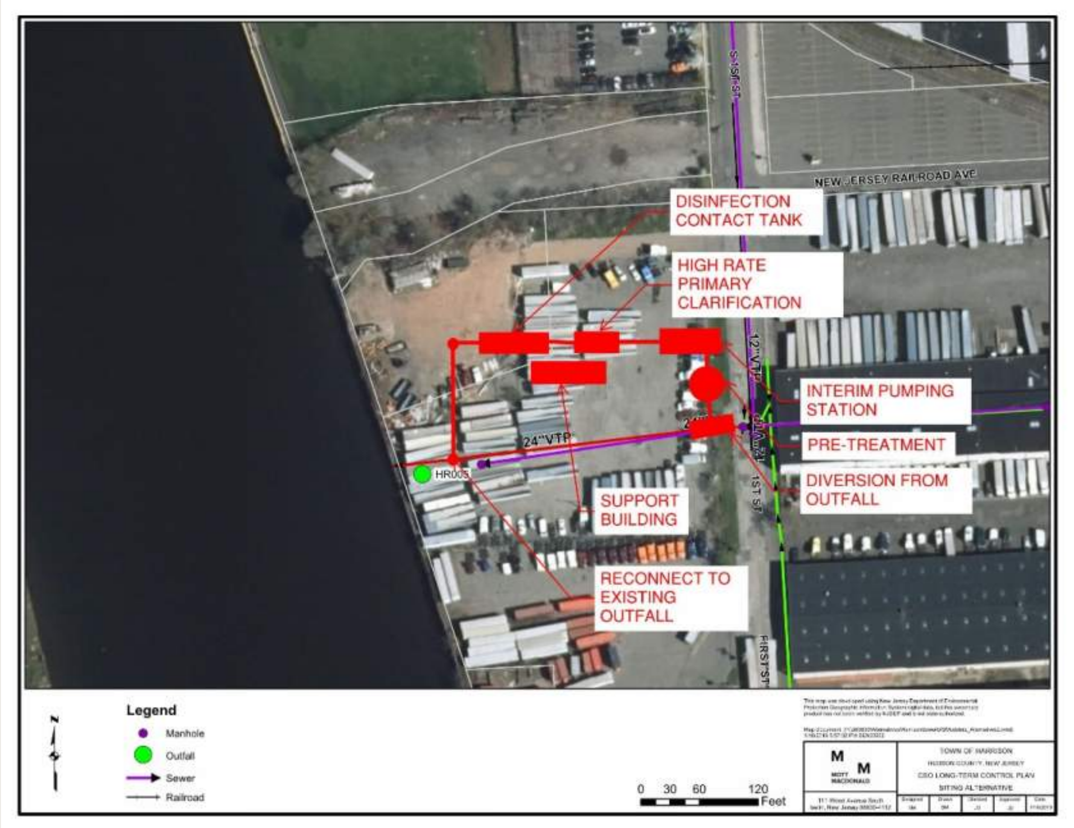
CSO Treatment

Pretreatment

Primary Clarification

Disinfection

Potential Consolidation



Thank you

Contact Information

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Newark CSO Alternatives Analysis
Preliminary Results

Model Development

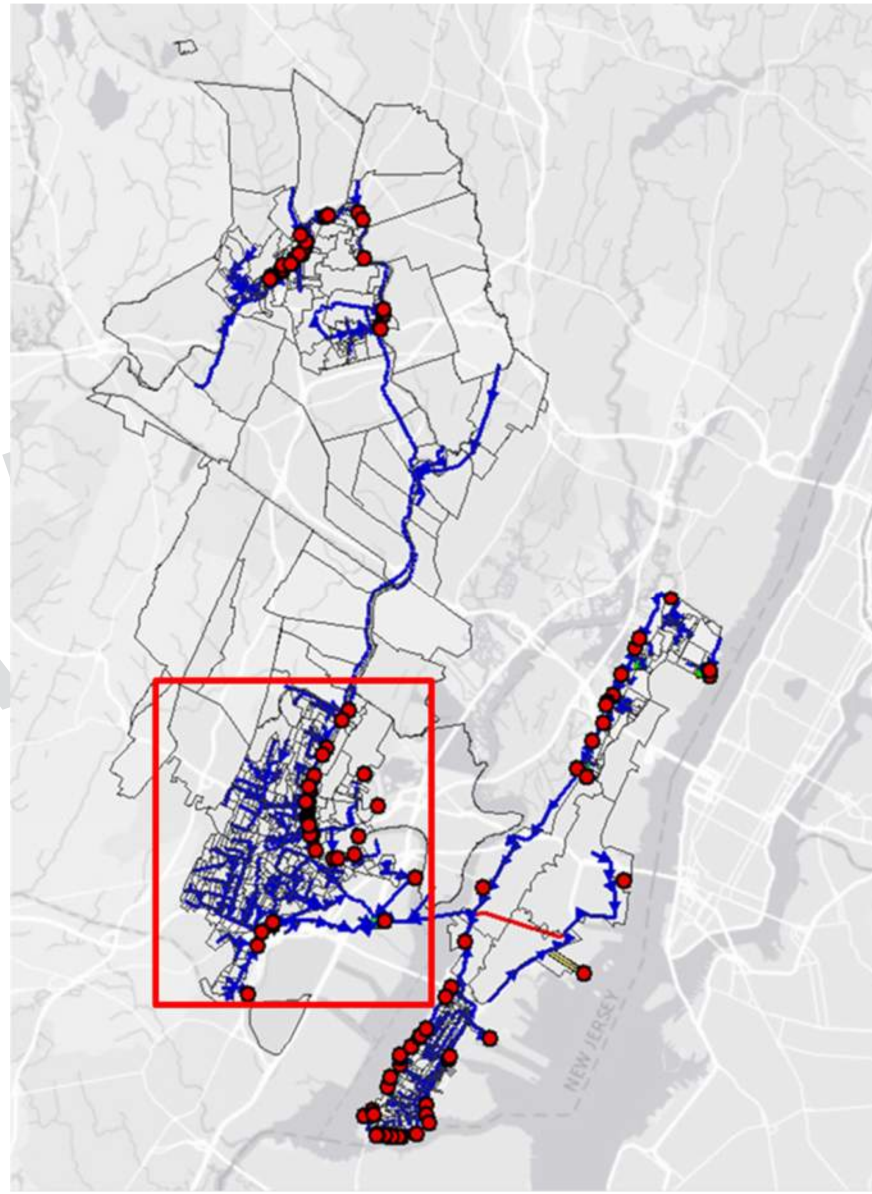
Baseline Results

Alternatives Evaluated to Date

Conclusion

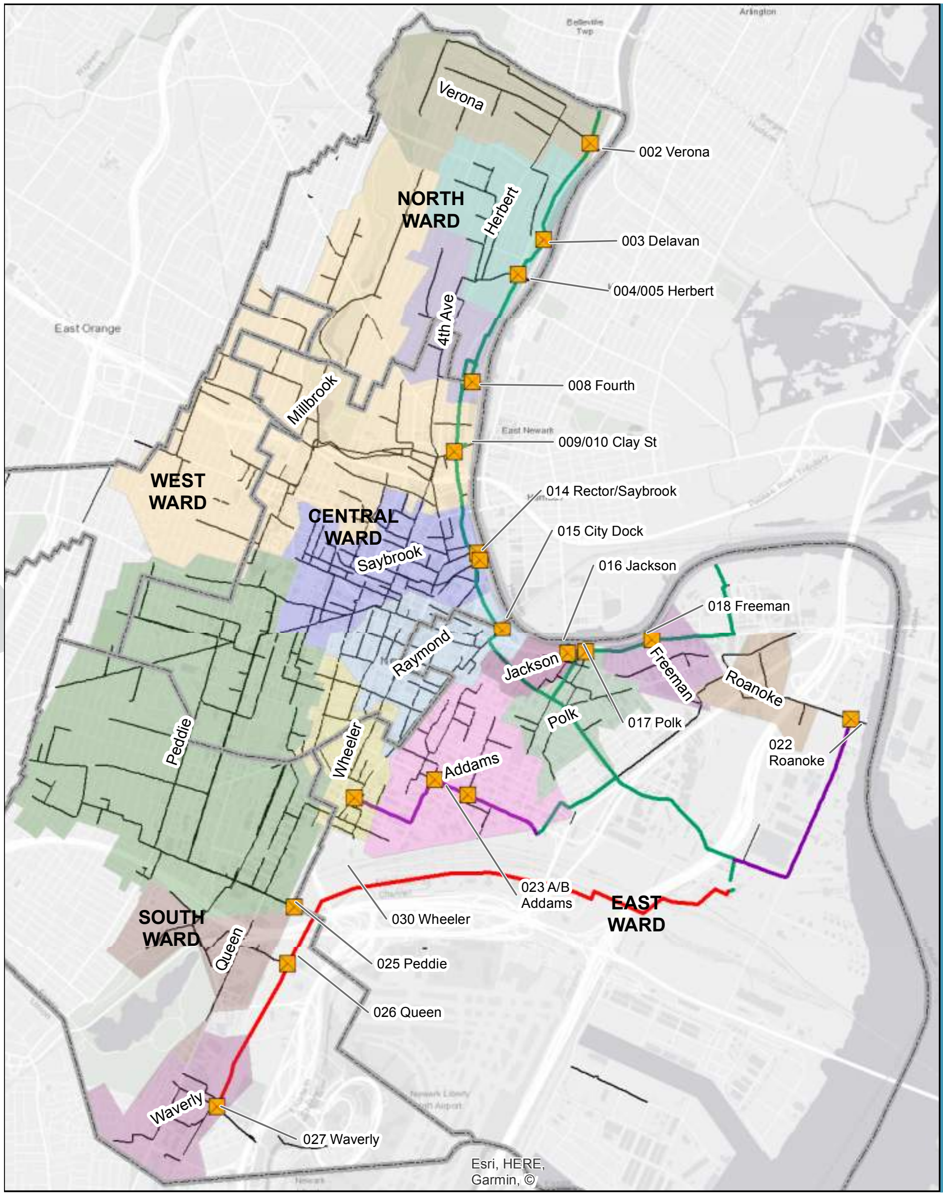
Model Development

- CSO Characterization and Modeling Study (2000)
  - Created XP-SWMM model
  - Calibrated to monitored data
  - Final report 2005
- PVSC LTCP Phase I (2005-2008)
  - Integrated into PVSC model
  - Converted to InfoWorks CS
- PVSC LTCP Phase II (2016-2018)
  - Interceptor Recalibration
  - Converted InfoWorks ICM
  - Calibrated to monitored data



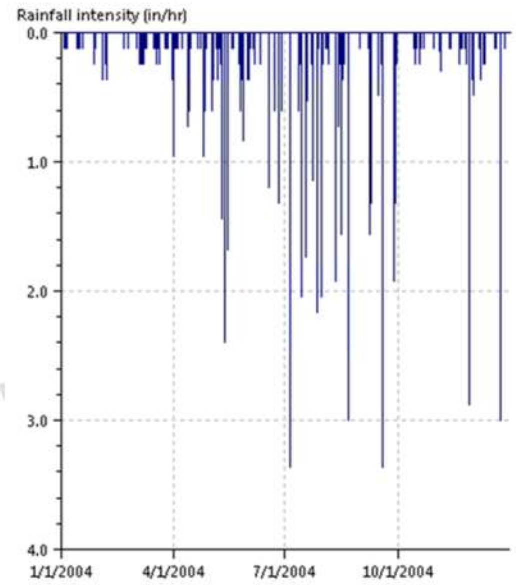
Model Development

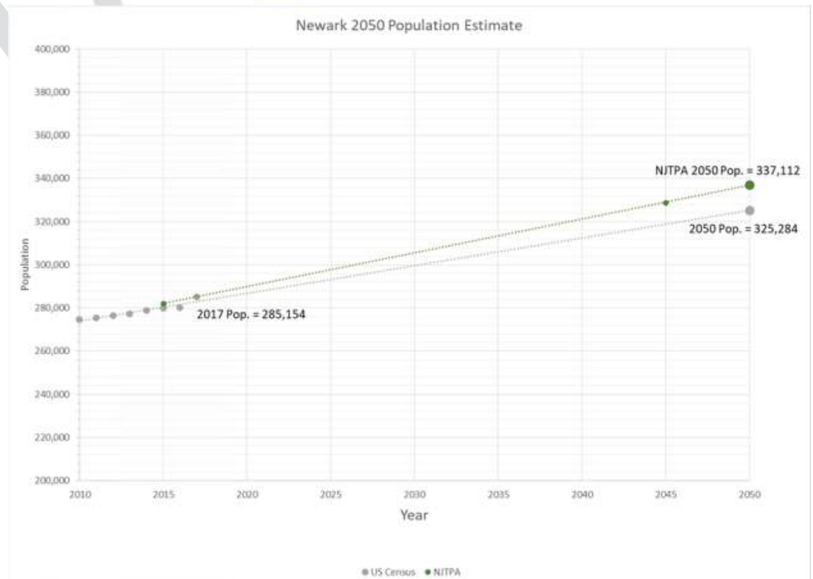
- Collection System Overview
  - Combined CSO System
  - Interceptors
    - PVSC
    - South Side
    - Newark Internal
  - Regulators
    - 18 Regulators
    - 11 PVSC, 7 Newark
  - Outfalls
    - 16 Permitted Outfalls
- Recent Updates
  - 2016 Calibration Data
  - Branch Brook Park Drainage Area and Flow
  - Weequahic Park Flow



Model Development

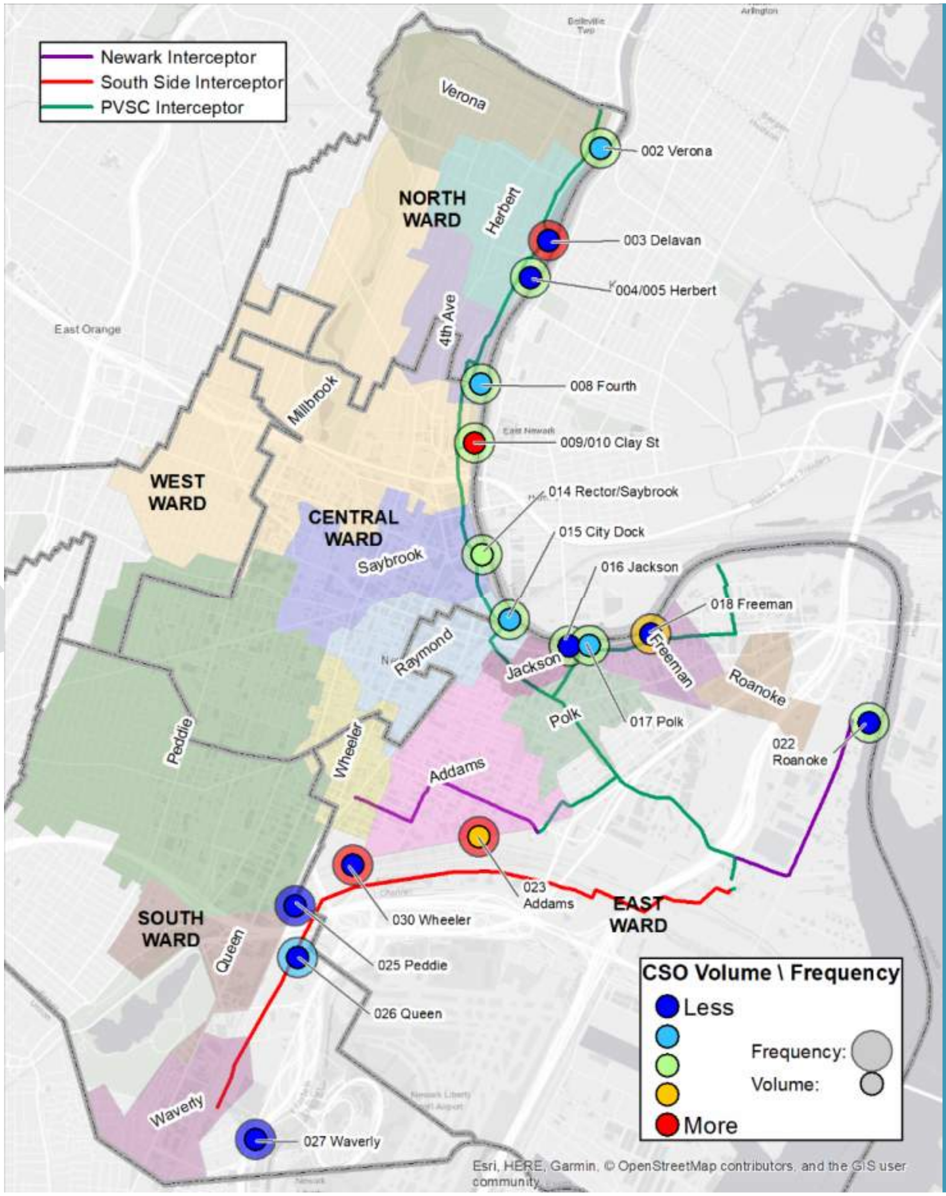
- Baseline Condition
  - Established 2004 as Typical Year for LTCP Evaluation (6hr. Inter-event Time used)
    - Total Precip: 48.37 in.
    - Max Peak Intensity: 1.33 in./hr.
    - Max Total Precip: 3.68 in. (2yr- 24hr)
    - Average Duration: 10.3 hrs
    - Average Intensity: 0.084 in./hr.
    - Number of Events >=0.1“: 73
  - Base Flow (2050 Population)
    - NJTPA 2045 forecast
    - Scaled to 2050
    - Comparable to US Census Projection
    - Newark NJTPA Population = 337,112





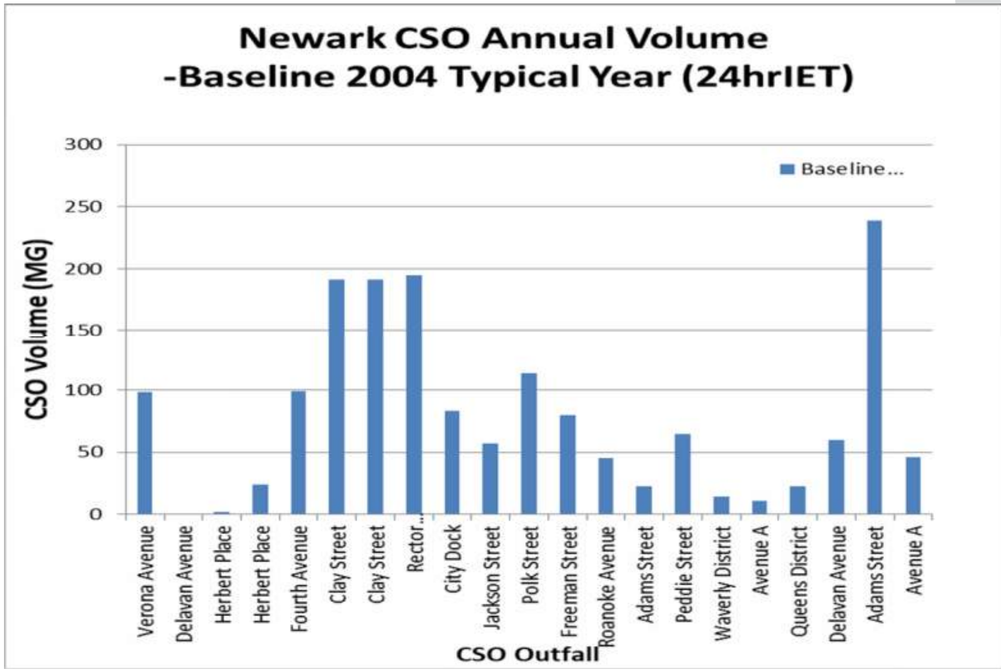
Baseline Results

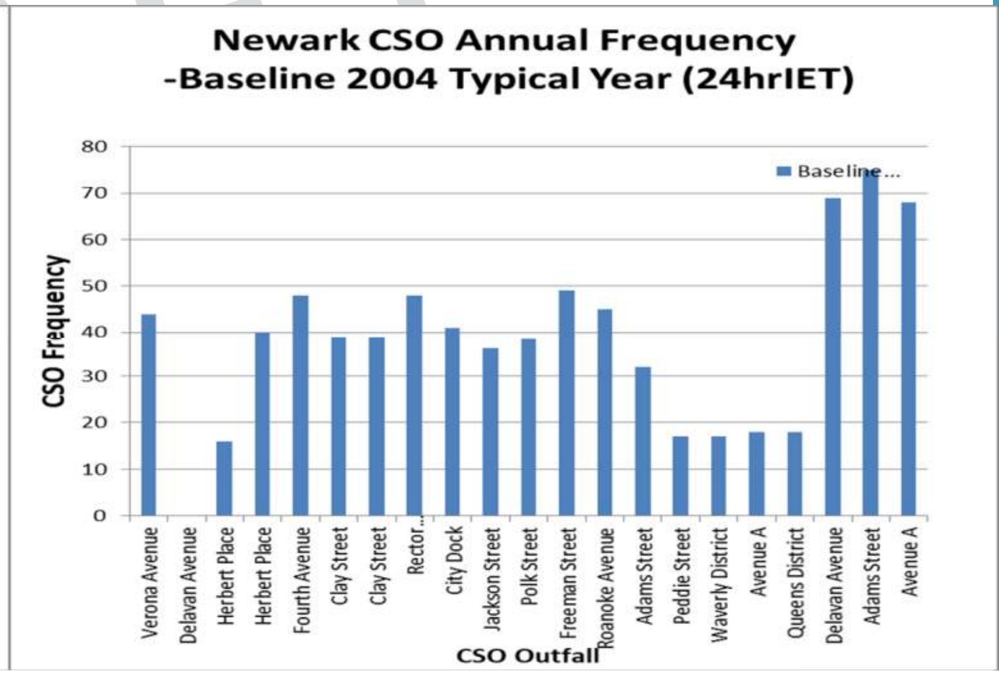
- 2004 Baseline Annual Overflow Map
  - Volume Top 4 Outfalls
    - Clay
    - Addams
    - Rector/Saybrook
    - Polk
  - Frequency Top 4 Outfalls
    - Addams
    - Delavan
    - Wheeler
    - Freeman



Baseline Results

- Total CSO Volume: 1,313 MG
- Total to PVSC: 61,925 MG



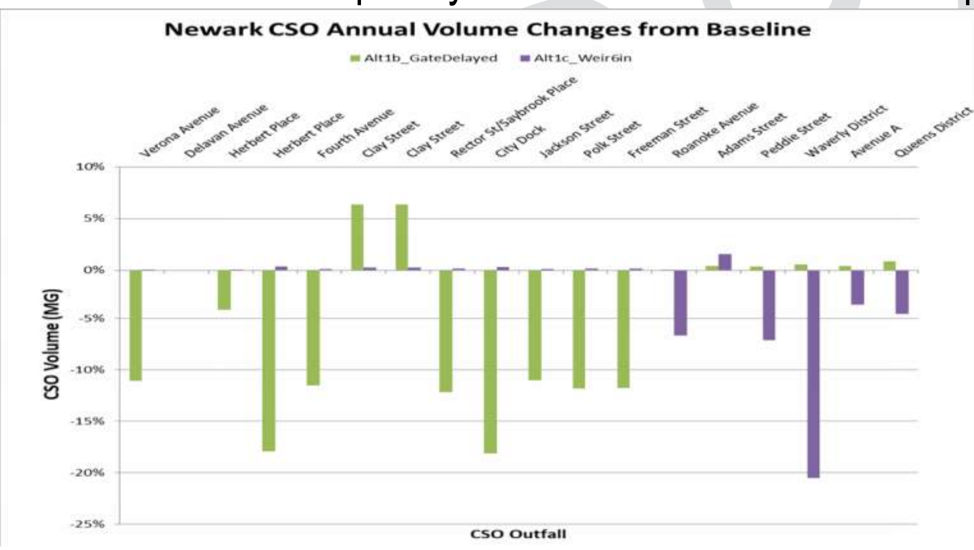


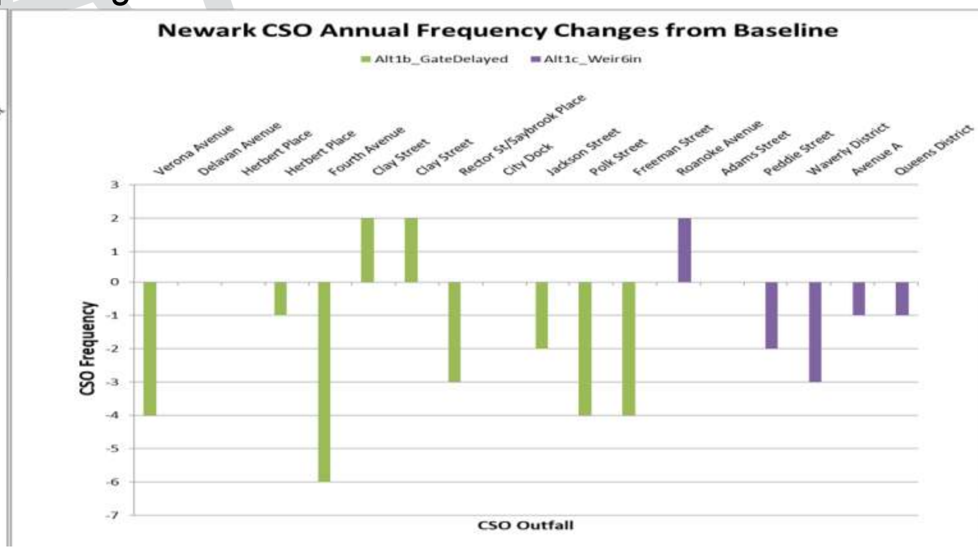
Alternatives Evaluated to Date

- Alternative 1 – Regulator Modifications
  - Alternative 1B – Regulator Gate Operation Change
    - Modify PVSC gate closure point by +10% (no change at Clay St Regulator)
  - Alternative 1C – Newark Regulator Modification
    - Increase weir hights at Newark owned regulators by 6 inches
- Alternative 2 – Green Infrastructure
  - Alternative 2A – 10% Impervious area managed
  - Alternative 2B – 5% Impervious area managed
  - Alternative 2C – Rutgers Scenario
- Alternative 3 – Storage
  - Alternative 3A – 0 Overflows
  - Alternative 3B – 4 Overflows
  - Alternative 3C – 8 Overflows
  - Alternative 3D – 12 Overflows
  - Alternative 3E – 20 Overflows
- Alternative 4 – Inflow / Infiltration Reduction
  - Eliminate base flow from Branch Brook Park and:
  - 90% I/I Reduction
  - 75% I/I Reduction
  - 50% I/I Reduction
- Alternative 5 – Conservation
  - Reduce water/wastewater use by 10%
- Alternative 6 – Disinfection
  - Not modeled
  - Cost Developed

Alternative 1 – Regulator Modifications

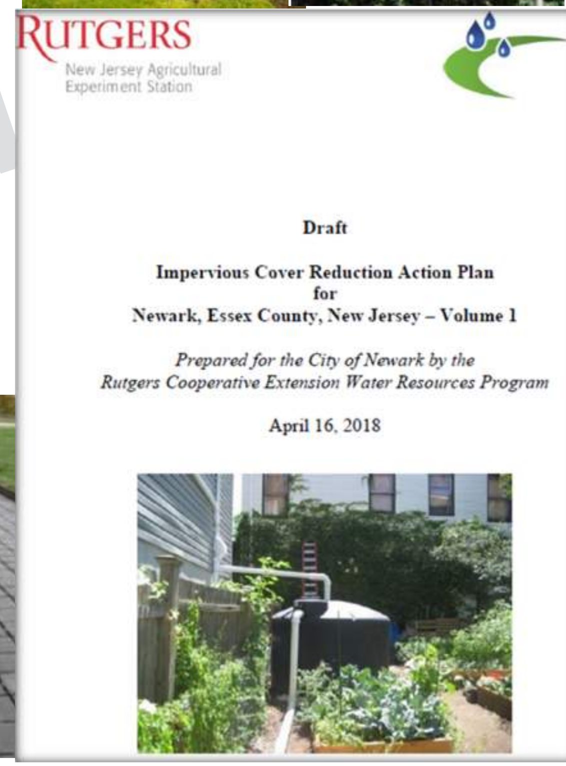
- Alternative 1B – Regulator Gate Operation Change
  - CSO Volume Reduction: 5.3% (69 MG)
  - Overflow Frequency Reduction: 1-6 Overflows depending on outfall
- Alternative 1C – Newark Regulator Modification
  - CSO Volume Reduction: 0.7% (9.5 MG)
  - Overflow Frequency Reduction: 1-3 Overflows depending on outfall





Alternative 2 – Green Infrastructure

- Alternative 2A – 10% Impervious area managed
- Alternative 2B – 5% Impervious area managed
- Alternative 2C – Rutgers Scenario



RUTGERS
New Jersey Agricultural Experiment Station

Draft

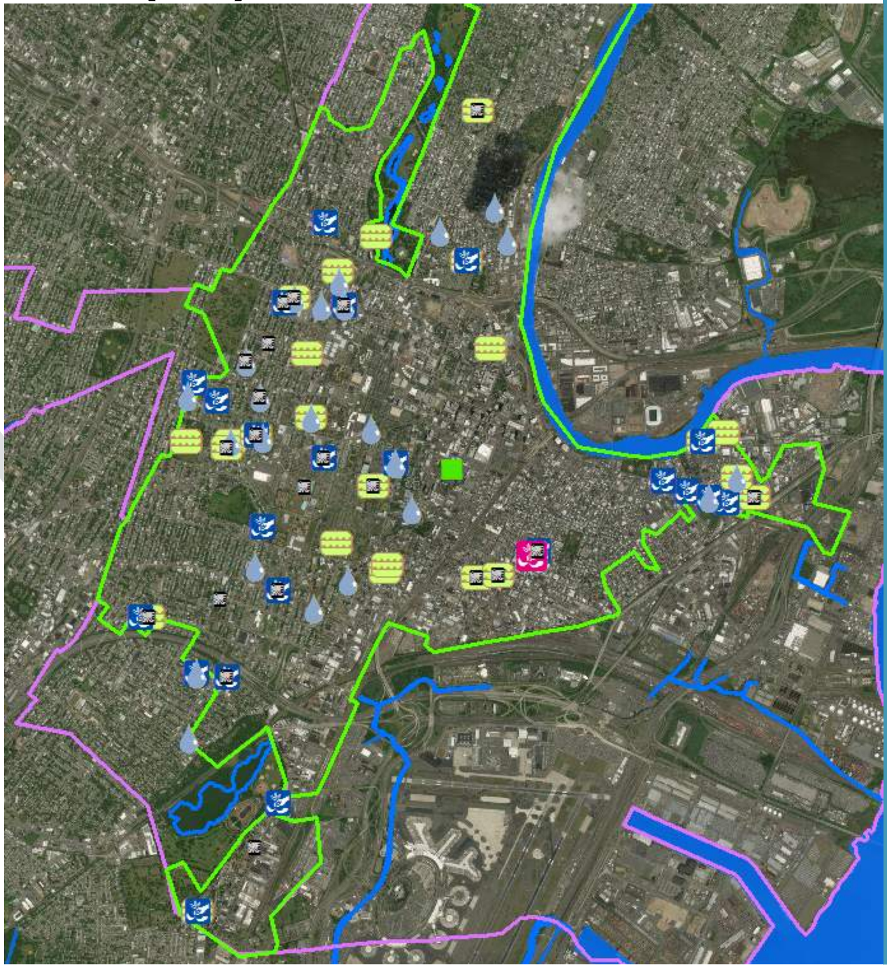
Impervious Cover Reduction Action Plan
for
Newark, Essex County, New Jersey – Volume 1

Prepared for the City of Newark by the
Rutgers Cooperative Extension Water Resources Program

April 16, 2018

Alternative 2 – Green Infrastructure (GI)

- 63 Sites (52 model catchments)
- Total Managed Area: 11.7 acres
- GI managed area is 100% impervious (75% with depression storage, 25% without depression storage)
- Directly connected to manholes, no internal routing to previous areas first
- For maximization scenarios, 10% and 5 % impervious area will be the target
- Ratio of management area to GI footprint area is 30 to 1. (assuming 3000sqft management area to 10'x2.5' ROW bioswale)



Alternative 2 – Green Infrastructure (GI)

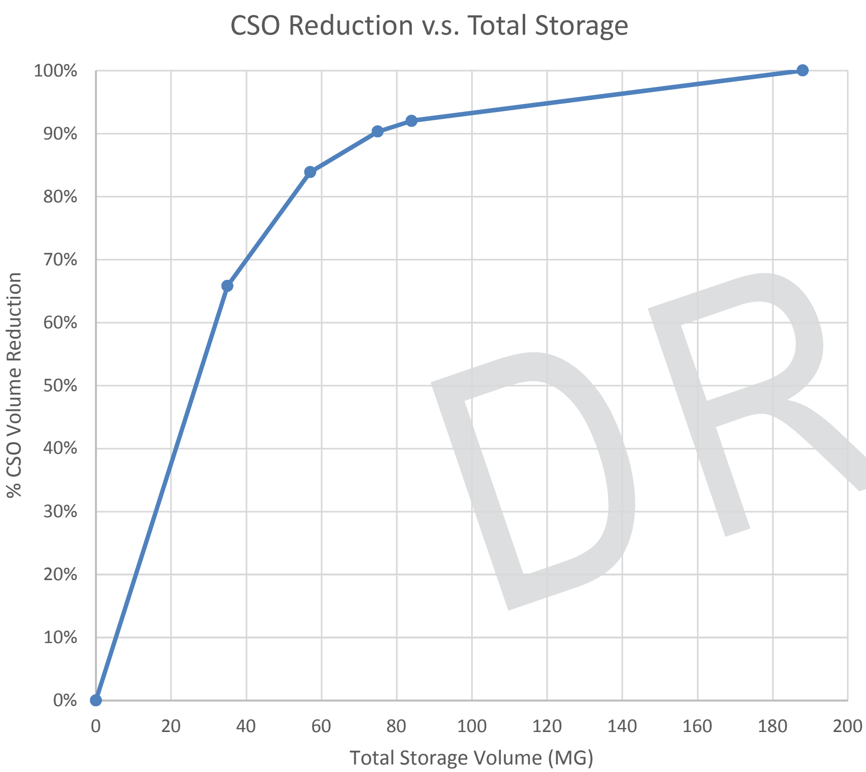
- Alternative 2C – Rutgers Scenario
  - CSO Volume Reduction: 0.3% (3.9 MG)
  - Overflow Frequency Reduction: No reduction in frequency
- Alternative 2B – 5% Impervious area managed
  - CSO Volume Reduction: 7.4% (97 MG)
  - Overflow Frequency Reduction: 0-6 Overflows depending on outfall
- Alternative 2A – 10% Impervious area managed
  - CSO Volume Reduction: 5.3% (69 MG)
  - Overflow Frequency Reduction: 0-8 Overflows depending on outfall

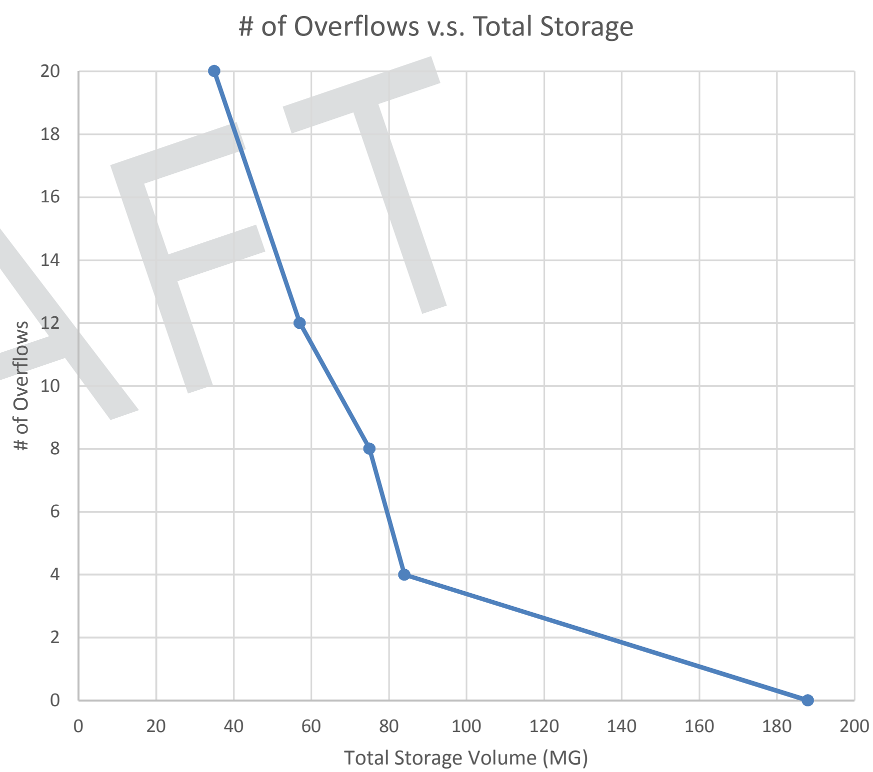
Alternative 3 – Storage

- Storage scenarios
  - 0, 4, 8,12, 20 overflows
  - 12 hrs. for system to return to normal before pump back
  - Pump back should not be greater than 75% of total average dry weather flow

Alt #	Overflow Frequency	Total Storage Volume (MG)	Approximate Days to Dewater	Volume Captured (MG)	% Volume Reduction
3E	0	188	5.0	1,313	100%
3A	4	84	2.5	1,208	92%
3B	8	75	2.0	1,186	90%
3C	12	57	1.5	1,101	84%
3D	20	35	1.0	864	66%

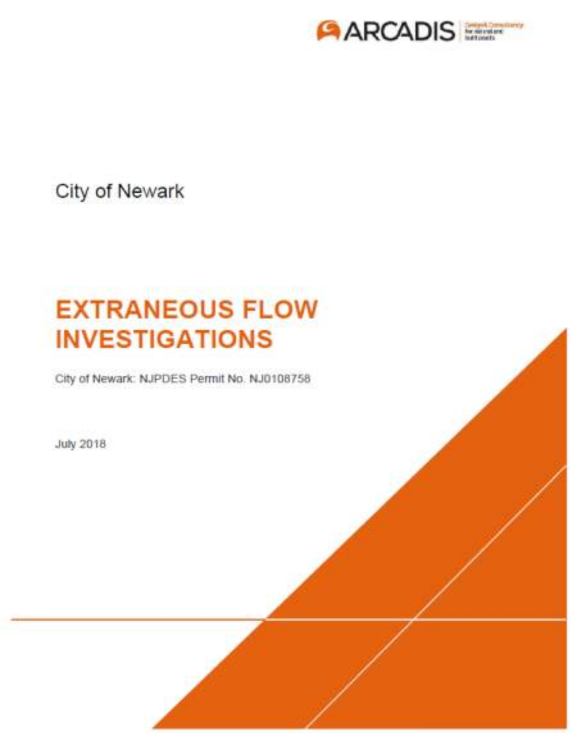
Alternative 3 – Storage





Alternative 4 – Infiltration / Inflow Reduction

- Eliminate base flow from Branch Brook Park
  - CSO Volume Reduction: 2.7% (35.7 MG)
  - Overflow Frequency Reduction: 0-2 Overflows depending on outfall
- 10% I/I Reduction
  - CSO Volume Reduction: 1.4% (18.8 MG)
  - Overflow Frequency Reduction: 0-2 Overflows depending on outfall
- 25% I/I Reduction
  - CSO Volume Reduction: 3.4% (44.3 MG)
  - Overflow Frequency Reduction: 0-4 Overflows depending on outfall
- 50% I/I Reduction
  - CSO Volume Reduction: 6.7% (88.5 MG)
  - Overflow Frequency Reduction: 0-5 Overflows depending on outfall


ARCADIS

City of Newark

EXTRANEOUS FLOW INVESTIGATIONS

City of Newark: NJPDES Permit No. NJ0108758

July 2018

Alternative 5 – Conservation

- Alternative 5 – Conservation (10% Reduction in water use)
  - CSO Volume Reduction: 2.7% (35.7 MG)
  - Overflow Frequency Reduction: 0-2 Overflows depending on outfall
- Conservation measure
  - Low flow shower heads (1.6-2.5 gpm v.s. 5-8 gpm)
  - Low flow toilets (1.3-1.6 gpf v.s. 3-5 gpf)
  - Conservation education
  - City and Building Ordinances

Alternative 6 – Disinfection

- Pollutant of concern is pathogens
- Newark CSO Discharge to Lower Passaic River and Newark Bay
- Percent Attainment of Pathogen Water Quality Standards
  - Passaic River
    - WQ Classification is FW2-SE2 and SE3
    - % Attainment for FW2-SE2 is approximately 87%
    - % Attainment for SE3 is between 95% and 100%
  - Newark Bay
    - WQ Classification is FW2-SE2 and SE3
    - % Attainment for Newark Bay is 100%
- Disinfection of Overflows not modeled in landside model but will be evaluated with WQ model
- Cost were developed
- Disinfection at targeted outfalls to meet WQ standads 100% of time everywhere

Next Steps

- Short Term (next few months)
  - Finalize Model Simulations
  - Summarize Findings
  - Develop Alternatives evaluation report
- Long term (next year)
  - Refine alternatives
  - Select alternative
  - Alternatives selection report

Questions and Discussion

CLEAN WATERWAYS
Healthy Neighborhoods