Supplemental CSO Team

Meeting No. 7
Long-Term Control Plan Permit Compliance

City of Elizabeth and
Joint Meeting of Essex & Union Counties (JMEUC)

April 11, 2019 – 10:00 am
Peterstown Community Center
408 Palmer Street, Elizabeth, NJ 07202
Meeting no. 7 agenda

- Prior meeting recap
- Public participation process update
- Long term control plan submission and NJDEP review status
- Background and existing conditions refresher
- Development and evaluation of alternatives
  - Increased conveyance to treatment
  - Sewer separation
  - Increased sewer system storage
  - Green infrastructure
  - Expanded treatment at the JMEUC wastewater treatment facility
  - Infiltration reduction

- Next meeting lookahead
Meeting no. 6 refresher

Material covered in prior meeting (1/30/2019):

- Interactive surveys
- Groundwork Elizabeth – Climate Safe Neighborhoods presentation
- NJDEP review of LTCP submittals
- Pathogen water quality model baseline estimates
- Alternatives analysis
  - Maximizing wet weather treatment at the JMEUC WWTF
  - Siting Alternatives Analysis
  - Green Infrastructure Analysis
Results of member surveys

What do you consider the primary benefit of green infrastructure practices?

- Water quality improvements: 25%
- Reduced flooding: 63%
- Water harvesting / conservation: 13%

What do you consider the primary barrier to green infrastructure implementation in public right-of-ways and open space areas?

- Project site identification: 44%
- Operations & maintenance requirements: 44%
- Cost effectiveness relative to storage (relative to other technologies): 44%
- Lack of funding/acceptance due to newer technology: 11%
Results of member surveys

What do you consider more appropriate in selecting CSO control alternatives?

- Low capital costs, higher long-term maintenance cost
- High capital costs, lower long-term maintenance cost

What do you consider the primary benefit of grey infrastructure practices?

- Reduced flooding: 27%
- Lower maintenance than green infrastructure: 18%
- Lower cost per gallon captured vs. green infrastructure: 55%
- Less visible: 20%
Results of member surveys

What do you consider the primary barrier to grey infrastructure implementation?

- Capital cost: 82%
- Large site disruption during construction
- Does not create long term jobs (less maintenance required)
- Does not contribute to community aesthetics/green spaces: 18%

Please select the indicator most important to your stakeholders in considering the financial capability of the community.

- Median household income: 30%
- Current cost of wastewater/water usage: 20%
- Unemployment rate
- Cost of living (available disposable income): 10%
- % of homes owned vs. rented in the City: 10%
- % of population receiving social security benefits
- % of population below the poverty line: 30%
- Other?
Public Participation Process Update

Public outreach and education

Recent Events

• March 6 - NJDEP Public Participation Workshop
  • Organized by NJDEP to gather Supplemental Team members and CSO Permittees from across the State.
  • Conducted here at Peterstown Community Center!
  • Discussed methods of identifying and effectively engaging with stakeholders

• City of Elizabeth Tree Planting Initiative
  • 15,000 copies of mailer sent in final week of March
  • Spread the word!

• Drone footage of Trumbull Street construction
  • Can be used for future public awareness videos

Upcoming Events

• May 3 – Future City Environmental Day school presentations
• June – Union County BioBlitz
• Others?
Long term control plan submission and NJDEP review status

Step 1.
- System Characterization Report
  – NJDEP Approval on 1/17/2019
- Baseline Compliance Monitoring Program Report
  – NJDEP Approval on 3/1/2019
- Consideration of Sensitive Areas Report
  – NJDEP Approval on 4/8/2019
- Public Participation Process Report
  – NJDEP Approval on 2/7/2019

Step 2.
- Development and Evaluation of Alternatives – Due on 7/1/2019

Step 3.
- Selection and Implementation of Alternatives Report
- Final LTCP – Due on 6/1/2020

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Background and existing conditions refresher
Combined Sewer System

- 29 outfalls
- 36 sub-basin; 3,500 acres
- 38 regulators and diversion chambers
- 166 miles of combined sewers, with 6,400 manholes & 3,300 inlets
- Complex network of interconnections
- 14.7 Mgal/day average flow, Trenton Ave PS
- Roselle Park storm sewer connection
JMEUC Tributary Area

- 11 member communities, 4 customer communities
- Total Service Area = 60 square miles
- Gravity sewers ranging from 10-inches in diameter to the twin 67 x 68-inch rectangular sewers at WWTP
- WWTP capacity:
  - Design flow = 85 mgd
  - Maximum capacity varies with tidal conditions: up to 225 mgd
# System Characterization - Typical Year Highlights

<table>
<thead>
<tr>
<th>Rain events</th>
<th>Total rainfall</th>
<th>Most Active Outfall (at John Street)</th>
<th>Largest overflow volume = 176 million gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
<td>48.4”</td>
<td></td>
<td>• At 041 (Morris Ave)</td>
</tr>
<tr>
<td>Acres of combined sewered area</td>
<td>Million gallons of total CSO volume</td>
<td>Total overflow events</td>
<td>Peak discharge rate = 190 million gallons/day</td>
</tr>
<tr>
<td>3,490</td>
<td>1,065</td>
<td>56</td>
<td>• At 003 (Westfield &amp; Magie)</td>
</tr>
</tbody>
</table>

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Control Objectives

What are the regulatory requirements?

Presumption Approach (performance based)

• No more than 4 to 6 overflows per year
• No less than 85% capture of annual overflow volume

Demonstration Approach (water quality based)

• Control level that will not prevent the attainment of water quality in the future

Receiving waters and water quality standards

• Elizabeth River – Fresh Water FW2 and Saline Estuary SE3
• Newark Bay, Arthur Kill, Peripheral Ditch and Great Ditch – Saline Estuary SE3

<table>
<thead>
<tr>
<th>Class</th>
<th>Bacterial Standards</th>
<th>Monthly Mean</th>
<th>Single Sample Max</th>
<th>Designated Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE3</td>
<td>Fecal</td>
<td>1500</td>
<td>NA</td>
<td>Secondary Contact</td>
</tr>
<tr>
<td>FW2</td>
<td>E-coli</td>
<td>126</td>
<td>235</td>
<td>Primary Contact Public Water Supply</td>
</tr>
</tbody>
</table>
Alternatives Evaluation

Main CSO Control Strategies Evaluated – Part IV

1. Increased conveyance to treatment

2. Sewer separation

3. Increased Sewer System Storage

4. Treatment of CSO discharges

5. Green infrastructure

6. Treatment plant expansion

7. Inflow / infiltration reduction

8. CSO operating protocol at treatment plant
Alternatives Evaluation

Preliminary Steps

1. Future Baseline Conditions
2. Siting Analysis
3. Storm Event Consistency
Future Baseline Conditions

Anticipated 30-Year Project Duration – 2050 Future Baseline

Population Growth – City of Elizabeth

• North Jersey Transportation Planning Authority 2045 ->2050 population=165,000
• New Jersey Department of Labor ->2050 Population 155,000
• US Census extrapolation -> 2050 Population 144,000

Non-Residential Flow Projection (Commercial, Industrial etc.)
• Not significant in combined areas

Current Construction and Planned Capital Projects
• Trumbull Street Stormwater Control Project
• South Street Flood Control Project
• Atlantic Street Stormwater Control Project
• Lincoln Avenue Storm Drainage Improvements Project
Siting Analysis

Identify potential open or under-utilized sites for CSO control facilities

**Preliminary assessment**
- Reviewed area surrounding each outfall and regulator
- Identified multiple potential sites for each basin
- Generous consideration of possible locations with large paved areas
  - Objective of minimizing need to acquire real estate with existing building and structures

**86 initial sites identified**
- Reviewed by City for suitability

<table>
<thead>
<tr>
<th>Favorable</th>
<th>Unfavorable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open paved or grass areas, vacant land</td>
<td>Buildings / Structures</td>
</tr>
<tr>
<td>Industrial, Commercial, Open Space</td>
<td>Green Acres, Residential, Transportation Corridors</td>
</tr>
<tr>
<td>Publicly owned</td>
<td>Privately owned</td>
</tr>
<tr>
<td>Small elevation change to outfall or regulator</td>
<td>Large elevation change to outfall or regulator</td>
</tr>
<tr>
<td>Close to outfall or regulator</td>
<td>Far from outfall and regulator</td>
</tr>
<tr>
<td>No soil or groundwater contamination</td>
<td>Known contaminated site or brownfield site</td>
</tr>
</tbody>
</table>
Siting Analysis

Identify potential open or under-utilized sites for CSO control facilities

City review of potential sites identified several restrictions due to:

- Existing use and ownership
- Easement requirements
- Redevelopment plans and recent construction
- Potential business and community disruptions
- Open space / Green Acres

Most sites rated poor and very poor as suitable locations

Very limited amount of open and under-utilized space; significant land acquisition will likely be required
Storm Event Consistency

System-wide evaluation for control levels

Establish consistent list of storms

- Across outfalls
- Across control methodology

Impacts conveyance, storage, and treatment unit sizes

- Time of maximum discharge rate and overflow volume varies by outfall

Grouping of outfalls by water body to be investigated further

<table>
<thead>
<tr>
<th>Top 2004 Storm Events by System-wide Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 thru 4</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
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</tbody>
</table>
Increased Conveyance to Treatment

Increased Wet Weather Flow from Existing Facilities

Trenton Avenue Pump Station

Existing System Components
(2) 60” incoming sewers (i.e., Easterly and Westerly Interceptors), with influent flow control gates
(2) mechanical bar screens
(5) extended vertical shaft dry pit centrifugal pumps, original pump casings from late 1950s
(1) 48” force main, approximately 930 LF

Estimated Maximum Pumping Capacity of 55 mgd
Estimated Force Main Capacity of ~ 65 mgd
Increased Conveyance to Treatment

Existing Regulator and Interceptor Capacities
Increased Conveyance to Treatment

Pump Station Flows, System Modifications, and Est. Overflow Reductions

1. 1017 MG
2. 878 MG
3. 789 MG
4. 741 MG
5. 723 MG

Trenton Ave Peak Flow, MGD

Overflow Volume, MG

36 MGD Real Time Controls
55 MGD TAPS Rehabilitation
65 MGD Force Main Upgrades
~70 MGD TAPS Replacement or Expansion
~85 MGD Upgrades to W. Interceptor
~90 MGD Regulator Modifications
~120 MGD E. Interceptor Upgrade

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Sewer Separation

Full Separation: Sanitary in one sewer, Stormwater in another

Install new sanitary sewer → Existing combined sewer becomes a storm sewer

- Work remains in public right-of-way, no new land required
- Opportunity for system renewal, reconstruction
- Highly disruptive
  - Over 100 miles of new sewers required
  - Need to redirect every service connection on each street
  - Over 30 year planning period, about 110 acres, 3.5 miles or 50 blocks need to be addressed each year
- Stormwater contributes to pollution of the receiving waters and will eventually need to be treated or controlled
Sewer Separation

Construction Cost Estimate

- Cost estimated for each basin based on basin area (acres), average daily flow (gallons per day), feet of sewers
- Total cost for all basins ~ $660 million
- Corresponds to about $0.62 per gallon of overflow eliminated per year
- Costs vary by basin

<table>
<thead>
<tr>
<th>Upper range</th>
<th>Lower range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basin 001: $72.7 million</td>
<td>Basin 042A: $0.64 million</td>
</tr>
<tr>
<td>Basin 039: $57.8 million</td>
<td>Basin 012: $0.89 million</td>
</tr>
<tr>
<td>Basin 003A: $57.3 million</td>
<td>Basin 014: $1.61 million</td>
</tr>
</tbody>
</table>
Increased Sewer System Storage

In-line Storage

- Uses available volume in existing sewer or new larger sewers in the same location
- Effectiveness driven by pipe size and slope
- Findings:
  - Larger trunk sewers reach full pipe condition during 2004 model run
  - Minimal additional storage volume is available
  - No reduction in number of overflows per year predicted
  - Very high cost per gallon stored
Storage Tanks

Tanks Located at Individual Outfalls

- Redirect outfall to off-line underground storage tank
- Flow stored up to tank volume
- Flow in excess of tank capacity discharged as overflow
- Select tank volume for targeted level of control
- Tank dewatered to interceptor
- Additional interceptor capacity and TAPS pumping may also be required.

Example: CSO-001 Tank Siting
Storage Tanks

Sizing and Construction Cost Estimates

- Estimated for each basin for:
  - Control levels: 0, 4, 8, 12, and 20 overflows per year
  - System-wide storm event ranking
  - 15’ deep tanks, with factors for dewatering pumps, screens, and connecting pipes
- Total Construction Cost – All Basins

<table>
<thead>
<tr>
<th>Control Level</th>
<th>Overflows per year</th>
<th>0</th>
<th>4</th>
<th>8</th>
<th>12</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Volume Required (Mgal)</td>
<td>145.0</td>
<td>62.4</td>
<td>46.9</td>
<td>37.7</td>
<td>20.4</td>
<td></td>
</tr>
<tr>
<td>Construction Cost ($ million)</td>
<td>$738.0</td>
<td>$374.0</td>
<td>$297.0</td>
<td>$253.0</td>
<td>$159.0</td>
<td></td>
</tr>
<tr>
<td>Overflow Volume Captured (Mgal)</td>
<td>1065</td>
<td>950</td>
<td>867</td>
<td>790</td>
<td>576</td>
<td></td>
</tr>
<tr>
<td>Cost per Gallon Captured ($/gal)</td>
<td>$0.69</td>
<td>$0.39</td>
<td>$0.34</td>
<td>$0.32</td>
<td>$0.28</td>
<td></td>
</tr>
</tbody>
</table>
Storage Tank Siting Review

Example 1: CSO-001

Area available:
- 1.1 acres near Newark Airport between Spring Street and U.S. Highway 1
- 550 feet west of Outfall 001A

Ownership:
- NJDOT

Site considerations:
- Diversion and return pipes must cross several major highways (outfall on other side of US 1-9 and Route 81)
- NJDOT approvals and easement grants required
- Potential traffic disruption for site access during construction and for tank maintenance
Storage Tank Siting Review

Example: CSO-002

Area available:
• 0.67 acres in parking area of warehouse distribution center
• Adjacent to Outfall 002A
• Possible use of triangular grass area

Ownership:
• Private

Site considerations:
• Potential interferences with existing infrastructure
• Disruption to business operations during construction and with final arrangement
• Loss of parking spaces.
• Easement requirements for site access and permanent facilities
Deep Tunnel Storage

General System Components

- Diversion structure / regulator
- Consolidation conduits
- Coarse screening
- Drop shafts
  - Approach channel
  - Inlet chamber
  - Vertical shaft
  - De-aeration chamber
  - Air vent shafts, recirculation, and odor control
- Main tunnel
- Dewatering pump station
- Overflow relief points

Source: DigIndy, citizens energy group, 2017
Deep Tunnel Storage

East Tunnel

Primary / south section

- Storage for 8 CSO basins
- South First Street and First Street
- 4 drop shafts, including launch & receiving
- Length: ~9,200 linear feet
- Diameter by control level

<table>
<thead>
<tr>
<th>Control Level (overflows/yr)</th>
<th>0</th>
<th>4</th>
<th>8</th>
<th>12</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vol, Mgal</td>
<td>30.5</td>
<td>13.6</td>
<td>10.5</td>
<td>7.7</td>
<td>4.4</td>
</tr>
<tr>
<td>Dia, ft</td>
<td>24</td>
<td>16</td>
<td>14</td>
<td>12</td>
<td>10</td>
</tr>
</tbody>
</table>
Deep Tunnel Storage

East Tunnel

Northern extension to Basins 001 & 002

- Adds 11,100 feet (120% increase)
- 2 more sites for drop shafts needed
- Excessive additional costs for remote outfall locations
- Tunnel extension – Not recommended
Deep Tunnel Storage

West Tunnel

Extends north, generally along river

- Storage for 17 CSO basins
- 4 additional drop shafts
- Large consolidation conduits
- Multiple river crossings
- Length: ~10,600 linear feet
- Diameter by control level

<table>
<thead>
<tr>
<th>Control Level (overflows/yr)</th>
<th>0</th>
<th>4</th>
<th>8</th>
<th>12</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vol, Mgal</td>
<td>89.6</td>
<td>38.1</td>
<td>29.1</td>
<td>23.7</td>
<td>12.6</td>
</tr>
<tr>
<td>Dia, ft</td>
<td>38</td>
<td>25</td>
<td>22</td>
<td>20</td>
<td>15</td>
</tr>
</tbody>
</table>
Deep Tunnel Storage

Combined East and West Tunnels

Statistics for both sections

- Length: ~19,800 linear feet
- Diameter by control level

<table>
<thead>
<tr>
<th>Control Level (overflows/yr)</th>
<th>0</th>
<th>4</th>
<th>8</th>
<th>12</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vol, Mgal</td>
<td>120</td>
<td>51.7</td>
<td>39.6</td>
<td>31.4</td>
<td>17</td>
</tr>
<tr>
<td>Dia, ft</td>
<td>32</td>
<td>21</td>
<td>19</td>
<td>16</td>
<td>12</td>
</tr>
</tbody>
</table>
Deep Tunnel Storage

Shaft Siting Considerations

Tunneling operations
Deep Tunnel Storage
Shaft Siting Considerations

Drop shaft construction
Treatment of CSO Discharges

Primary Clarification and Disinfection

- Permit requirements for CSO discharge minimum treatment
  - Solids and floatables disposal
  - Primary clarification
  - Disinfection of effluent

- Considers disinfection with peracetic acid at 6 min contact time

- Pilot Testing Required
Treatment of CSO Discharges

Peracetic Acid (PAA)

Acetic Acid and Hydrogen Peroxide solution

- Common Elements
  - 275 gallon totes or 55 gallon drums
  - Feed pumps
  - Mixers / diffusers
  - Instrumentation (flow, TSS)
  - Sampling equipment
  - Pressure relief
  - Heat monitoring
Treatment of CSO Discharges

Preliminary Sizing Calculations

Input requirements

- Peak flow rates
- Operating times
- Treatment volumes

Example: CSO-001
Peak Flow = 75.1 MGD

<table>
<thead>
<tr>
<th>Item</th>
<th>Footprint (sf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screening</td>
<td>120</td>
</tr>
<tr>
<td>Pump Station</td>
<td>2,500</td>
</tr>
<tr>
<td>Primary Clarification (Actiflo)</td>
<td>5,000</td>
</tr>
<tr>
<td>Disinfection Chamber</td>
<td>10,000</td>
</tr>
<tr>
<td>Support Building</td>
<td>1,600</td>
</tr>
</tbody>
</table>

Rough Construction Cost = $38 million
Green Infrastructure

Background

Green infrastructure (GI) = practices which reduce stormwater volume or flow rate by allowing the stormwater to infiltrate, be stored, or be treated by vegetation or soils

1. Estimate upper bound on impervious acres that could be feasibly managed by GI practices
2. Review GI practices for practical application citywide
3. Estimate potential number and size of units
4. Input GI areas into hydraulic model for performance simulation
Green Infrastructure

GIS Mapping Analysis

Land Use

Public Property Ownership

Soil Type

Impervious Area

Soil/GW Contamination

1. 2. 3. 4. 5. 6. 7. 8.
Green Infrastructure
Model Implementation

Representative Bioswale
- 3’ W x 20’ Long
- 18” Soil Depth
- 3.5’ Storage layer (Crushed Stone)
- Loading Ratio of 15:1
- Treated Impervious Area 900sf
- Mimic NJ SW BMP Manual

Results: Maximum of 2.6% of City impervious area can practically be directed to GI
- Will manage runoff from 2.9 million SF of impervious area
- 3,150 bioswales across Elizabeth
- Requires 18 additional staff for O&M (1 hr/month per bioswale, EPA)

Source: InfoWorksICM Manual
Green Infrastructure

Model Impact

- Minimal Impact on Peak Flow
- Minimal Impact on Volume
JMEUC Alternatives Evaluations

• Evaluation of expanded treatment of combined sewer flow from Elizabeth at the JMEUC Wastewater Treatment Facility (WWTF)

• Evaluation of costs and benefits of I/I reduction
• Core objective: Increase the capture and treatment of combined sewer flow during wet weather from the City of Elizabeth
• Interim plan to increase peak flow from TAPS to 55 mgd
• Long-term plan to increase peak flow from TAPS to 140 mgd
• Key elements of long-term plan:
  • Disinfection improvements required to accept additional CSO flows
  • Solids removal required for additional CSO flows prior to disinfection
  • Blending of treated CSO flows with normal wet weather plant effluent
WWTF Inflow, TAPS 55 mgd Capacity vs. Existing Conditions, 9/28/2004 Event

- TAPS 55 mgd Capacity With Control Rule
- Existing Conditions
Treatment of CSO Flows at JMEUC WWTP

- 153 mgd through existing facility (capacity ≥ 180 mgd)
- 85 mgd through new CSO treatment and new disinfection

Three treatment strategies evaluated:
A: All additional flow to a new treatment train [SELECTED]
B: Minimize capacity of new treatment train (maximize use of existing capacity)
C: Maximize use of secondary capacity (minimize additional pumping)

Expected maximum effluent concentrations:
- 27.2 mg/L TSS
- 33.3 mg/L CBOD
(at all CSO flows during the typical year)

Weekly average permit limits:
- 45 mg/L TSS
- 40 mg/L CBOD
## CSO Treatment Options

<table>
<thead>
<tr>
<th>Treatment Option</th>
<th>Benefits</th>
<th>Limitations</th>
<th>TSS Removal, %</th>
<th>CBOD Removal, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Bar Screens</td>
<td>Small footprint (approx. 8 ft x 11 ft)</td>
<td>Need container to hold screenings and odor control</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Fine Screens</td>
<td>Small footprint (approx. 20 ft x 5 ft)</td>
<td>Need regulators (weirs)</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Vortex/Swirl Units</td>
<td>Easy to operate, TSS removal</td>
<td>Larger footprint (approx. 42 ft x 51 ft), Need ancillary tank to hold screenings (and odor control)</td>
<td>35</td>
<td>15</td>
</tr>
<tr>
<td>Ballasted Flocculation</td>
<td>Good TSS and BOD removal</td>
<td>Larger footprint than others (approx. 78 ft x 64 ft), Need ancillary tank, Start-up time</td>
<td>80</td>
<td>50</td>
</tr>
</tbody>
</table>

- **Options Eliminated:**
  - Band and belt screens: low Technical Guidance Manual matrix rating; primarily due to complexity and land required
  - Drum screens: low Technical Guidance Manual matrix rating; primarily due to complexity and land required
  - Modified vortex: higher level treatment not required for this system
  - Polishing (“Fuzzy”) filter: higher level treatment not required for this system
Disinfection Options

- Chlorination
- Peracetic Acid
- Ultraviolet (UV) Disinfection

- Since the JMEUC WWTF already has a chlorination facility on site, CDM Smith recommends using **chlorination (and dechlorination)** as the disinfection technology for the proposed CSO flows.
- New chlorine contact tank with de-chlorination required
Conclusions and Next Steps – WWTF expansion

• Initial planning-level cost for additional CSO treatment (fine screens) is $14M (capital cost) and $450K annual operating cost

• Potential additional costs for TAPS expansion and new force main costs not yet included

• Evaluate WWTF expansion vs. other controls:
  • Compare these costs/benefits with those of other CSO control alternatives and select CSO controls based on all relevant decision criteria
  • I/I reduction evaluated as a means to reduce plant improvement costs
I/I Reduction Evaluation Approach - Overview

• Establish the maximum attainable I/I reduction for each sewershed
• Estimate potential I/I reduction costs for each sewershed
• Rank sewersheds by potential I/I volume removed per rehab $
• Develop cost effectiveness curve as plot of ranked sewershed removal vs. cost
• Evaluate potential benefits of I/I reduction
• Compare I/I costs and benefits
Sanitary Sewer System Components & Infiltration/Inflow Sources

Inflow Sources:
- Downspouts
- Sump pumps
- Foundation drains
- Storm sewers
- Manhole covers

Infiltration Sources:
- Deteriorated pipes
- Cracks
- Erosion
- Roots
- Leaky joints
- Poor manhole connections

Foundation drains
(Inflow/Infiltration)
• JMEUC has well-established programs in place to encourage members and customers to reduce I/I rates
• JMEUC service area has achieved I/I reduction of 30-40% since 1983
• JMEUC I/I rates are modest in comparison to other similar systems
## Potential I/I Reduction Targets by Sewershed

<table>
<thead>
<tr>
<th>Sewershed</th>
<th>Municipality</th>
<th>Estimated Typical Year Inflow (MG)</th>
<th>Estimated Attainable Inflow Reduction During Typical Year (MG; 50% maximum)</th>
<th>Incremental Inflow Reduction Target (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meter16</td>
<td>Irvington</td>
<td>10.15</td>
<td>5.08</td>
<td>50.00%</td>
</tr>
<tr>
<td>Meter04</td>
<td>Roselle Park</td>
<td>60.30</td>
<td>30.15</td>
<td>50.00%</td>
</tr>
<tr>
<td>Meter27</td>
<td>South Orange</td>
<td>44.83</td>
<td>22.41</td>
<td>50.00%</td>
</tr>
<tr>
<td>Meter9</td>
<td>Irvington</td>
<td>43.98</td>
<td>21.99</td>
<td>50.00%</td>
</tr>
<tr>
<td>Meter10</td>
<td>Newark</td>
<td>8.79</td>
<td>4.39</td>
<td>50.00%</td>
</tr>
<tr>
<td>Meter17/17E</td>
<td>Newark</td>
<td>20.89</td>
<td>10.44</td>
<td>50.00%</td>
</tr>
<tr>
<td>Meter12</td>
<td>Newark</td>
<td>3.43</td>
<td>1.72</td>
<td>50.00%</td>
</tr>
<tr>
<td>Meter06</td>
<td>Hillside</td>
<td>45.43</td>
<td>22.72</td>
<td>50.00%</td>
</tr>
<tr>
<td>Meter34</td>
<td>Hillside</td>
<td>5.19</td>
<td>2.60</td>
<td>50.00%</td>
</tr>
<tr>
<td>Meter32D</td>
<td>Millburn</td>
<td>35.73</td>
<td>17.86</td>
<td>50.00%</td>
</tr>
<tr>
<td>Meter18</td>
<td>Newark</td>
<td>12.73</td>
<td>5.89</td>
<td>46.30%</td>
</tr>
<tr>
<td>Meter29/30</td>
<td>West Orange</td>
<td>69.06</td>
<td>30.69</td>
<td>44.44%</td>
</tr>
<tr>
<td>Meter28</td>
<td>South Orange</td>
<td>57.43</td>
<td>19.44</td>
<td>33.85%</td>
</tr>
<tr>
<td>Meter15</td>
<td>South Orange</td>
<td>6.84</td>
<td>2.32</td>
<td>33.85%</td>
</tr>
<tr>
<td>Meter32C</td>
<td>Millburn</td>
<td>14.99</td>
<td>3.93</td>
<td>26.25%</td>
</tr>
<tr>
<td>Meter32E</td>
<td>Millburn</td>
<td>6.12</td>
<td>1.61</td>
<td>26.25%</td>
</tr>
<tr>
<td>Meter9A/9A-Up</td>
<td>Irvington</td>
<td>62.77</td>
<td>15.85</td>
<td>25.25%</td>
</tr>
<tr>
<td>Meter05/05A</td>
<td>Union</td>
<td>524.91</td>
<td>64.46</td>
<td>12.28%</td>
</tr>
<tr>
<td>Meter13</td>
<td>East Orange</td>
<td>12.86</td>
<td>0.00</td>
<td>0.00%</td>
</tr>
<tr>
<td>Meter22</td>
<td>Maplewood</td>
<td>12.01</td>
<td>0.00</td>
<td>0.00%</td>
</tr>
<tr>
<td>Meter21</td>
<td>Maplewood</td>
<td>18.32</td>
<td>0.00</td>
<td>0.00%</td>
</tr>
<tr>
<td>Meter26/31</td>
<td>Maplewood</td>
<td>18.93</td>
<td>0.00</td>
<td>0.00%</td>
</tr>
<tr>
<td>Meter14</td>
<td>East Orange</td>
<td>6.48</td>
<td>0.00</td>
<td>0.00%</td>
</tr>
<tr>
<td>Meter25</td>
<td>Maplewood</td>
<td>8.02</td>
<td>0.00</td>
<td>0.00%</td>
</tr>
<tr>
<td>Meter24</td>
<td>Summit</td>
<td>107.24</td>
<td>0.00</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

*No I/I reduction achieved to date*

*Partial I/I reduction achieved to date*

*Full I/I reduction achieved to date*
## I/I Reduction – Ranked List of Sewersheds with Feasible Reduction Opportunities

<table>
<thead>
<tr>
<th>Subcatchment</th>
<th>Municipality</th>
<th>% Reduction in R values for modeling</th>
<th>% of subcatchment to undergo comprehensive I/I reduction to achieve calculated % Reduction in Inflow</th>
<th>Estimated Dwelling Count</th>
<th>Pipe Length (mi)</th>
<th>Estimated Dwellings with laterals in need of lining</th>
<th>Estimated Cost of CIPP Lining Laterals ($)</th>
<th>Estimated pipe length in need of CIPP Lining (ft)</th>
<th>Estimated Cost of CIPP Lining Main Lines ($)</th>
<th>Total Estimated Rehabilitation Cost ($)</th>
<th>Estimated Existing Inflow During Typical Year (MG)</th>
<th>Estimated Attainable Inflow Reduction During Typical Year (MG)</th>
<th>Estimated gallons of I/I removed per $ spent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meter05/05A</td>
<td>Union</td>
<td>12.28%</td>
<td>14.00%</td>
<td>25,109</td>
<td>122.05</td>
<td>3,515</td>
<td>24,605,217</td>
<td>90,213</td>
<td>$3,157,443</td>
<td>$27,762,660</td>
<td>524,906</td>
<td>64.459</td>
<td>2.322</td>
</tr>
<tr>
<td>Meter28</td>
<td>South Orange</td>
<td>33.85%</td>
<td>51.17%</td>
<td>3,940</td>
<td>24.95</td>
<td>2,016</td>
<td>14,113,118</td>
<td>67,422</td>
<td>$2,359,775</td>
<td>$16,472,893</td>
<td>57.428</td>
<td>19.439</td>
<td>1.180</td>
</tr>
<tr>
<td>Meter04</td>
<td>Roselle Park</td>
<td>50.00%</td>
<td>100.00%</td>
<td>4,752</td>
<td>3.45</td>
<td>4,752</td>
<td>33,264,000</td>
<td>18,237</td>
<td>$638,295</td>
<td>$33,902,295</td>
<td>60.300</td>
<td>30.150</td>
<td>0.889</td>
</tr>
<tr>
<td>Meter27</td>
<td>South Orange</td>
<td>50.00%</td>
<td>100.00%</td>
<td>3,400</td>
<td>12.85</td>
<td>3,400</td>
<td>23,798,412</td>
<td>67,823</td>
<td>$2,373,805</td>
<td>$26,172,217</td>
<td>44.827</td>
<td>22.413</td>
<td>0.856</td>
</tr>
<tr>
<td>Meter15</td>
<td>South Orange</td>
<td>33.85%</td>
<td>51.17%</td>
<td>972</td>
<td>4,11</td>
<td>498</td>
<td>3,482,531</td>
<td>11,912</td>
<td>$416,910</td>
<td>$3,899,441</td>
<td>6.841</td>
<td>2.316</td>
<td>0.594</td>
</tr>
<tr>
<td>Meter32D</td>
<td>Millburn</td>
<td>50.00%</td>
<td>100.00%</td>
<td>3,966</td>
<td>34.95</td>
<td>3,966</td>
<td>27,762,427</td>
<td>184,553</td>
<td>$5,459,355</td>
<td>$34,221,782</td>
<td>35.725</td>
<td>17.863</td>
<td>0.522</td>
</tr>
<tr>
<td>Meter16</td>
<td>Irvington</td>
<td>50.00%</td>
<td>100.00%</td>
<td>1,398</td>
<td>2.98</td>
<td>1,398</td>
<td>9,788,630</td>
<td>15,722</td>
<td>$550,270</td>
<td>$10,338,900</td>
<td>10.153</td>
<td>5.077</td>
<td>0.491</td>
</tr>
<tr>
<td>Meter9A/9A-Up</td>
<td>Irvington</td>
<td>25.25%</td>
<td>33.78%</td>
<td>16,459</td>
<td>28.44</td>
<td>5,560</td>
<td>38,918,335</td>
<td>50,728</td>
<td>$1,775,469</td>
<td>$40,693,804</td>
<td>62.772</td>
<td>15.850</td>
<td>0.389</td>
</tr>
<tr>
<td>Meter34</td>
<td>Hillside</td>
<td>50.00%</td>
<td>100.00%</td>
<td>865</td>
<td>3.69</td>
<td>865</td>
<td>6,055,070</td>
<td>19,475</td>
<td>$681,625</td>
<td>$6,736,695</td>
<td>5.192</td>
<td>2.596</td>
<td>0.385</td>
</tr>
<tr>
<td>Meter06</td>
<td>Hillside</td>
<td>50.00%</td>
<td>100.00%</td>
<td>7,000</td>
<td>34.41</td>
<td>7,000</td>
<td>53,899,930</td>
<td>181,685</td>
<td>$6,358,975</td>
<td>$60,258,905</td>
<td>45.432</td>
<td>22.716</td>
<td>0.377</td>
</tr>
<tr>
<td>Meter32C</td>
<td>Millburn</td>
<td>26.25%</td>
<td>35.59%</td>
<td>3,755</td>
<td>25.72</td>
<td>1,336</td>
<td>9,355,270</td>
<td>48,340</td>
<td>$1,691,895</td>
<td>$11,047,165</td>
<td>14.989</td>
<td>3.935</td>
<td>0.356</td>
</tr>
<tr>
<td>Meter9</td>
<td>Irvington</td>
<td>50.00%</td>
<td>100.00%</td>
<td>9,039</td>
<td>24.74</td>
<td>9,039</td>
<td>63,269,685</td>
<td>130,642</td>
<td>$4,572,470</td>
<td>$67,842,155</td>
<td>43.983</td>
<td>21.992</td>
<td>0.324</td>
</tr>
<tr>
<td>Meter10</td>
<td>Newark</td>
<td>50.00%</td>
<td>100.00%</td>
<td>1,991</td>
<td>5.20</td>
<td>1,991</td>
<td>13,934,851</td>
<td>27,454</td>
<td>$960,890</td>
<td>$14,895,741</td>
<td>8.785</td>
<td>4.393</td>
<td>0.295</td>
</tr>
<tr>
<td>Meter17/17E</td>
<td>Newark</td>
<td>50.00%</td>
<td>100.00%</td>
<td>4,706</td>
<td>13.45</td>
<td>4,706</td>
<td>32,943,284</td>
<td>71,028</td>
<td>$2,485,980</td>
<td>$35,429,264</td>
<td>20.886</td>
<td>10.443</td>
<td>0.295</td>
</tr>
<tr>
<td>Meter32E</td>
<td>Millburn</td>
<td>26.25%</td>
<td>35.59%</td>
<td>2,114</td>
<td>12.49</td>
<td>752</td>
<td>5,267,341</td>
<td>23,464</td>
<td>$821,244</td>
<td>$6,088,585</td>
<td>6.118</td>
<td>1.606</td>
<td>0.264</td>
</tr>
<tr>
<td>Meter29/30</td>
<td>West Orange</td>
<td>44.44%</td>
<td>79.99%</td>
<td>20,179</td>
<td>111.53</td>
<td>16,140</td>
<td>112,982,061</td>
<td>471,021</td>
<td>$16,485,728</td>
<td>$129,476,789</td>
<td>69.056</td>
<td>30.689</td>
<td>0.237</td>
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<tr>
<td>Meter12</td>
<td>Newark</td>
<td>50.00%</td>
<td>100.00%</td>
<td>1,104</td>
<td>2.40</td>
<td>1,104</td>
<td>7,731,462</td>
<td>12,652</td>
<td>$442,820</td>
<td>$8,174,282</td>
<td>3.431</td>
<td>1.715</td>
<td>0.210</td>
</tr>
<tr>
<td>Meter18</td>
<td>Newark</td>
<td>46.30%</td>
<td>86.22%</td>
<td>9,626</td>
<td>14.12</td>
<td>8,299</td>
<td>58,094,346</td>
<td>64,258</td>
<td>$2,249,025</td>
<td>$60,343,371</td>
<td>12.725</td>
<td>5.892</td>
<td>0.098</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Cost-Effectiveness of I/I Reduction

- Meter05/A (Union)
- Meter28 (South Orange)
- Meter04 (Roselle Park)
- Meter27 (South Orange)
- Meter15 (South Orange)
- Meter32D (Millburn)
- Meter16 (Irvington) Meter9A/9A-Up (Irvington)
- Meter34 (Hillside)
- Meter10 (Newark)
- Meter17/17E (Newark)
- Meter29/30 (West Orange)
- Meter12 (Newark)
- Meter32C (Millburn)
- Meter6 (Hillside)
- Meter32E (Millburn)
- Meter9 (Irvington)
- Meter15 (South Orange)
- Meter27 (South Orange)
- Meter04 (Roselle Park)
- Meter28 (South Orange)
- Meter05/05A (Union)

Typical Year Inflow Reduction (MG) vs. Cost (Million $)
I/I Reduction Benefits – Key Factors

• System Characterization Report demonstrated that all wet weather flow in the typical year from member & customer communities (including TAPS at 55 mgd) can be delivered by JMEUC trunk sewers to the WWTF and fully treated

• Additional combined sewer flow at 140 mgd from Elizabeth/TAPS would require additional conveyance and treatment:
  • 55 mgd thru existing TAPS and JMEUC trunk sewers
  • 85 mgd thru expanded TAPS and new force main requires new CSO treatment train to provide the equivalent of primary treatment

• **Only I/I reduction benefit for CSO LTCP** is reduction in capacity of the new CSO treatment train (for Options B & C) by 25 mgd (~30%)
I/I does not limit current or future capture of CSO flow.
Flow rate (mgd)

~25 mgd reduction (peak hour)

Could allow additional flow (up to 25 mgd) to be shifted to existing treatment processes:

- No benefit for selected treatment strategy
- Modest benefit for other strategies (30% reduction in sizing)
Conclusions – I/I Reduction

- I/I reduction costs much higher than CSO treatment train costs:
  - ~$600M in I/I rehab costs → ~$6M in CSO treatment cost savings
- Reducing I/I rates to reduce required CSO treatment train capacity is not cost-effective
- JMEUC will continue to encourage I/I reduction in the sanitary sewer service areas but I/I reduction will not be included as an element of the CSO LTCP
Next Steps – Alternatives Report Timeline

March 2019:
Detailed evaluation of viable alternatives (cost, sizing, benefits)

Mid-April 2019:
Refine alternatives based on feedback

Mid-May 2019:
Finalize alternatives, draft report submission

June 2019:
Submit final report to NJDEP

Supplemental CSO Team Meeting
(�pending team input)
Next meeting lookahead

Next Supplemental CSO Team meeting

June 2019
Timing of meeting – weekday, weeknight, weekend?

Focusing on Development and Evaluation of Alternatives report

- Sizing and costing of viable alternatives
- Modeling for CSO performance
- Draft report sections
Questions?
Thank you

City of Elizabeth and
Joint Meeting of Essex & Union Counties (JMEUC)

Supplemental CSO Team

Meeting No. 7
Long-Term Control Plan Permit Compliance