As sample treatment hydrograph can be seen below in Figure 48. Overflows beyond the treatment capacity were tracked and a list of storms identifying remaining overflows generated. The list of remaining overflows generated was compared to the allowable list, and the treatment capacity increased until the remaining storms consisted only of those allowable on the systemwide basis.

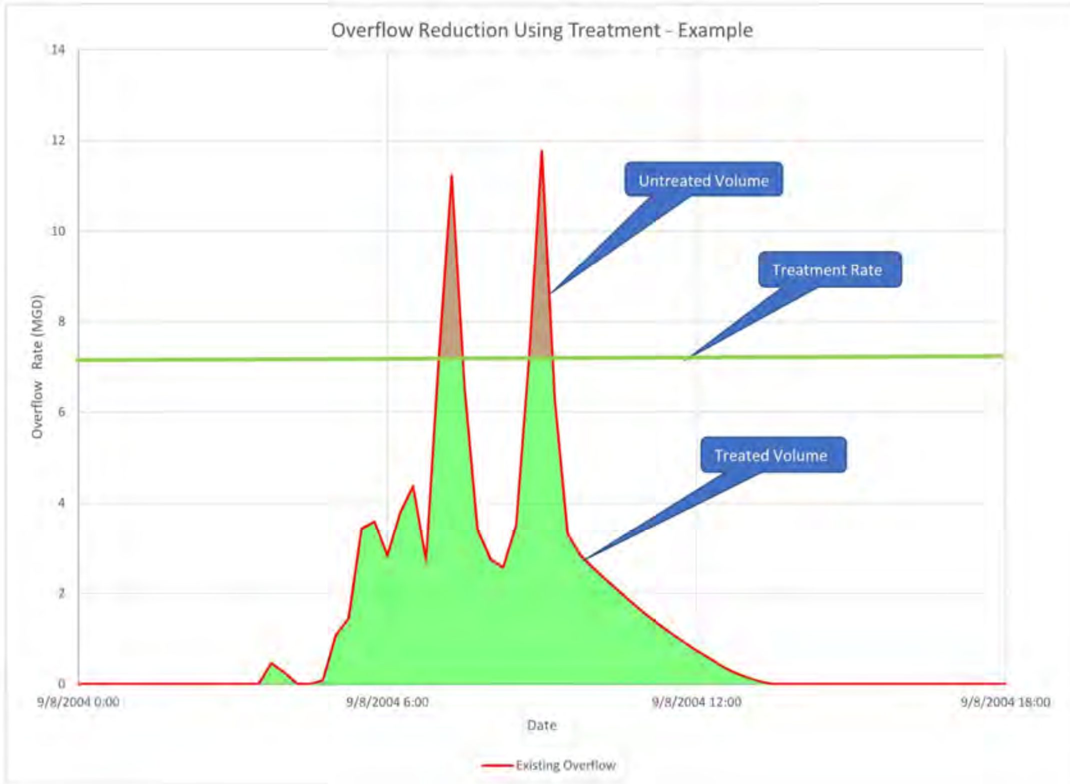

Figure 48: Sample Treatment Hydrograph

D.2.4.3 Control Program 4 Institutional Issues

The institutional issues surrounding Control Program 4 are typical of a large-scale construction project in an urban area. While located in an urban area, construction of the facilities associated with this control program will require environmental permits. Below is list of anticipated permits required:

- Waterfront Development Permit
- Flood Hazard Area Permit
- USACE Nationwide 404 Permit
- Local Permits
- NJDEP Treatment Works Approval

The end-of-pipe facility at outfall 006A is located on the site of a planned park. The facility must be constructed primarily below grade and must be installed prior to creation of the park at which time the site will become encumbered by Green Acres. It may also be possible to write the Green Acres agreement to allow for the facility to be installed, but this may come with additional requirements. In addition, there could be significant public resistance to disturbing a newly established park and a general public feeling that the sequencing of the project showed a lack of fiscal responsibility, and poor municipal coordination oversight in planning and construction of these two projects.

These permits are standard permits and while they must be obtained, they do not appear to have the potential to greatly extend the project schedule or add excessive risk to the project.

D.2.4.4 Control Program 4 Implementability

Installation of end-of-pipe treatment facilities in an urban area like Harrison is challenging due to space and access limitations. Unlike end-of-pipe storage tanks, end-of-pipe treatment facilities are generally above-grade. As such, excavation is not required, reducing cost as well as complexity of excavation in proximity to the foundations of nearby buildings. Depth to groundwater is also not a consideration; thus, the possibility of a floating subsurface structure is not of concern. There is little available information on the soil conditions at the sites. Given the depth to bedrock and proximity to the floodplain, soil conditions may be poor, and the facilities may need to be situated on piles. It does not appear to be feasible to implement end of pipe treatment at Outfall 001A due to the impact to the hotel and residential complex. At Outfall 003A there is insufficient space for end of pipe treatment. The facility at Outfall 006A will need to be essentially entirely below grade to allow for construction of the planned park.

The long-term costs to maintain and operate these facilities would place an ongoing burden on the Town's financial resources and workforce. End of pipe facilities tend to require greater level of operations and maintenance resources when compare to the other alternatives.

D.2.4.5 Control Program 4 Public Acceptance

Because the facilities proposed are generally above-grade, they have the potential to produce odors and noise, making them more difficult to site in residential and commercial areas. There may be concerns with odors, particularly at 001A, 002A/003A (as noted there does not appear to be adequate space to address outfall 03A at this location) and 006A which are in commercial and residential areas. Following construction, end-of-pipe facilities are less preferable than tanks due to the permanent visibility of the structure. It also uses land area that could otherwise be utilized by the community for other purposes.

In terms of public acceptance, there strong opposition would be expected to placing end-of-pipe treatment at Outfall 001A as it would result in taking the two commercial parking lots, as shown in Figure 43.

The construction required for end-of-pipe treatment is less than storage tanks but is still large and invasive, making public acceptance of the project a concern. This is particularly true for Outfalls 001A and 002A/003A (as noted there does not appear to be adequate space to address outfall 03A at this location) which are located in heavily trafficked areas and on private property. The facility on 006A is located on a parcel of land slated for redevelopment and the construction may be more acceptable in terms of public acceptance. The construction at 007A is in an industrial area and may raise fewer concerns from the public, however, there would be a significant impact on the property owner.

D.2.4.6 Control Program 4 Performance Summary

Per the National CSO Policy, discharges receiving the minimum required treatment are not considered overflows. Accordingly, to align with the systemwide levels of control (0, 4, 8, 12 and

20 overflows), treatment rates were set to treat all events smaller than those allowed to discharge under the various levels of control. While the outfalls will continue to discharge many times a year, the flows will not be considered overflow unless they exceed the treatment rate. This may create some confusion for the public who may observe discharges and not be certain if the flow is treated or not. Additional indicators, such as warning lights which would flash when full treatment is not being provided may be required. The performance of Control Program 4 is summarized in Table 45 through Table 50 which present the results for the equivalent treatment for 0, 4, 8, 12, and 20 overflows per year.

Table 45: Control Program 4 - Outfall Treatment, Performance Summary – 0 Overflows

	Baseline 2015			Treatment 0 Overflows				Change		
Outfall	# of Events	Volume (MG)	Duration (HR)	Treatment Rate (MGD)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001A	26	1.9	97	10.0	0	0.0	0	-26	-1.9	-97
H-002A	35	3.2	162	28.1	0	0.0	0	-35	-3.2	-162
H-003A	32	13.1	155	90.9	0	0.0	0	-32	-13.1	-155
H-004A	10	0.3	6	0.0	0	0.0	0	-10	-0.3	-6
H-005A	34	20.5	229	0.0	0	0.0	0	-34	-20.5	-229
H-006A	28	8.0	122	69.4	0	0.0	0	-28	-8.0	-122
H-007A	53	14.5	352	77.6	0	0.0	0	-53	-14.5	-352
Total		61.5				0.0			-61.5	

Table 46: Control Program 4 - Outfall Treatment, Performance Summary – 4 Overflows

	Baseline 2015			Treatment 4 Overflows				Change		
Outfall	# of Events	Volume (MG)	Duration (HR)	Treatment Rate (MGD)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001A	26	1.9	97	7.4	1	0.0	0	-25	-1.9	-97
H-002A	35	3.2	162	15.5	1	0.1	0	-34	-3.1	-161
H-003A	32	13.1	155	51.4	1	0.3	0	-31	-12.9	-155
H-004A	10	0.3	6	0.0	0	0.0	0	-10	-0.3	-6
H-005A	34	20.5	229	0.0	0	0.0	0	-34	-20.5	-229
H-006A	28	8.0	122	44.7	1	0.1	0	-27	-7.8	-122
H-007A	53	14.5	352	53.2	1	0.3	1	-52	-14.2	-351
Total		61.5				0.8			-60.8	

Table 47: Control Program 4 - Outfall Treatment, Performance Summary – 8 Overflows

	Baseline 2015			Treatment 8 Overflows				Change		
Outfall	# of Events	Volume (MG)	Duration (HR)	Treatment Rate (MGD)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001A	26	1.9	97	6.3	2	0.0	0	-24	-1.9	-97
H-002A	35	3.2	162	13.4	2	0.1	0	-33	-3.1	-161
H-003A	32	13.1	155	51.4	1	0.3	0	-31	-12.9	-155
H-004A	10	0.3	6	0.0	0	0.0	0	-10	-0.3	-6
H-005A	34	20.5	229	0.0	0	0.0	0	-34	-20.5	-229
H-006A	28	8.0	122	43.1	2	0.2	0	-26	-7.8	-122
H-007A	53	14.5	352	53.2	1	0.3	1	-52	-14.2	-351
Total		61.5				0.8			-60.7	

Table 48: Control Program 4 - Outfall Treatment, Performance Summary – 12 Overflows

	Baseline 2015			Treatment 12 Overflows				Change		
Outfall	# of Events	Volume (MG)	Duration (HR)	Treatment Rate (MGD)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001A	26	1.9	97	4.0	5	0.1	1	-21	-1.9	-96
H-002A	35	3.2	162	13.4	2	0.1	0	-33	-3.1	-161
H-003A	32	13.1	155	51.4	1	0.3	0	-31	-12.9	-155
H-004A	10	0.3	6	0.0	0	0.0	0	-10	-0.3	-6
H-005A	34	20.5	229	0.0	0	0.0	0	-34	-20.5	-229
H-006A	28	8.0	122	42.9	3	0.2	0	-25	-7.8	-122
H-007A	53	14.5	352	40.7	3	0.7	1	-50	-13.7	-350
Total		61.5				1.3			-60.2	

Table 49: Control Program 4 - Outfall Treatment, Performance Summary – 20 Overflows

	Baseline 2015			Treatment 20 Overflows				Change		
Outfall	# of Events	Volume (MG)	Duration (HR)	Treatment Rate (MGD)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001A	26	1.9	97	1.5	11	0.3	5	-15	-1.6	-93
H-002A	35	3.2	162	6.7	7	0.4	2	-28	-2.8	-160
H-003A	32	13.1	155	26.6	7	1.4	2	-25	-11.7	-154
H-004A	10	0.3	6	0.0	0	0.0	0	-10	-0.3	-6
H-005A	34	20.5	229	0.0	0	0.0	0	-34	-20.5	-229
H-006A	28	8.0	122	21.2	7	1.2	2	-21	-6.8	-120
H-007A	53	14.5	352	15.7	10	3.4	5	-43	-11.1	-347
Total		61.5				6.7			-54.8	

Table 50: Control Program 4 - Harrison Summary Overflow Reduction

	Baseline 2015 (MG)	Control Program 4	% Reduction from 2015	Baseline 2050 (MG)*	% Reduction from 2050
0 Overflows	61.5	0.0	100%	42.8	100%
4 Overflows	61.5	0.8	99%	42.8	98%
8 Overflows	61.5	0.8	99%	42.8	98%
12 Overflows	61.5	1.3	98%	42.8	97%
20 Overflows	61.5	6.7	89%	42.8	84%

*Note 30.4% reduction in annual overflow volume due to planned project incorporated in 2050 baseline.

D.2.4.7 Control Program 4 Cost Summary

The Class 5 (+100%, -50%) cost estimate of Control Program 4 are summarized in Table 51.

Table 51: Control Program 4 – Outfall Treatment, Cost Summary

Control Program 4 - End of Pipe Treatment (Individual Sites)					
	Equivalent to Noted Overflows per Year				
	0	4	8	12	20
Capital Cost ($ Million)	$153.1	$117.6	$115.5	$110.3	$80.6
O&M Cost ($ Million)	$1.4	$1.2	$1.2	$1.2	$1.0
20-Yr Net Present Worth ($ Million)	$174.5	$136.0	$133.6	$128.0	$95.6

D.2.5 Control Program 5 Consolidated End of Pipe Treatment

D.2.5.1 Control Program 5 Description

This will be the same as Control Program 4 except that consolidation piping will be run to consolidate the overflow from H-001A, 002A, 003A and 006A to the site of the future park, where more space is available. There would be no change to Outfall 007a, and consolidation piping would be required to connection H-001A, 002A, 003A and 006A. This control program offers some advantages over Control Program 4:

- The result will be only two outfalls; the consolidated outfall and outfall 007A. This will simplify future permitting and effectively eliminate three outfalls.
- This control program will result in fewer facilities for the town to maintain and operate.
- It makes use of public rights-of-way and land that will be under the control of the town.

There are also some potential disadvantages:

- There will be more disturbance to local streets as a result of the consolidation piping.
- There will be additional costs associated with the consolidation piping.
- The larger above ground facility would have a greater impact, reducing the usable area available for the park. The benefit would be reduced impacts on the rest of the Town.
- To construct the park this facility will need to be essentially entirely underground, which will increase project costs.

A conceptual layout for the consolidated treatment of Outfalls 001A, 002A, 003A and 006A is shown in Figure 49 and Figure 50. The configuration at Outfall 007A will be identical to Control Program 4 shown in Figure 47.

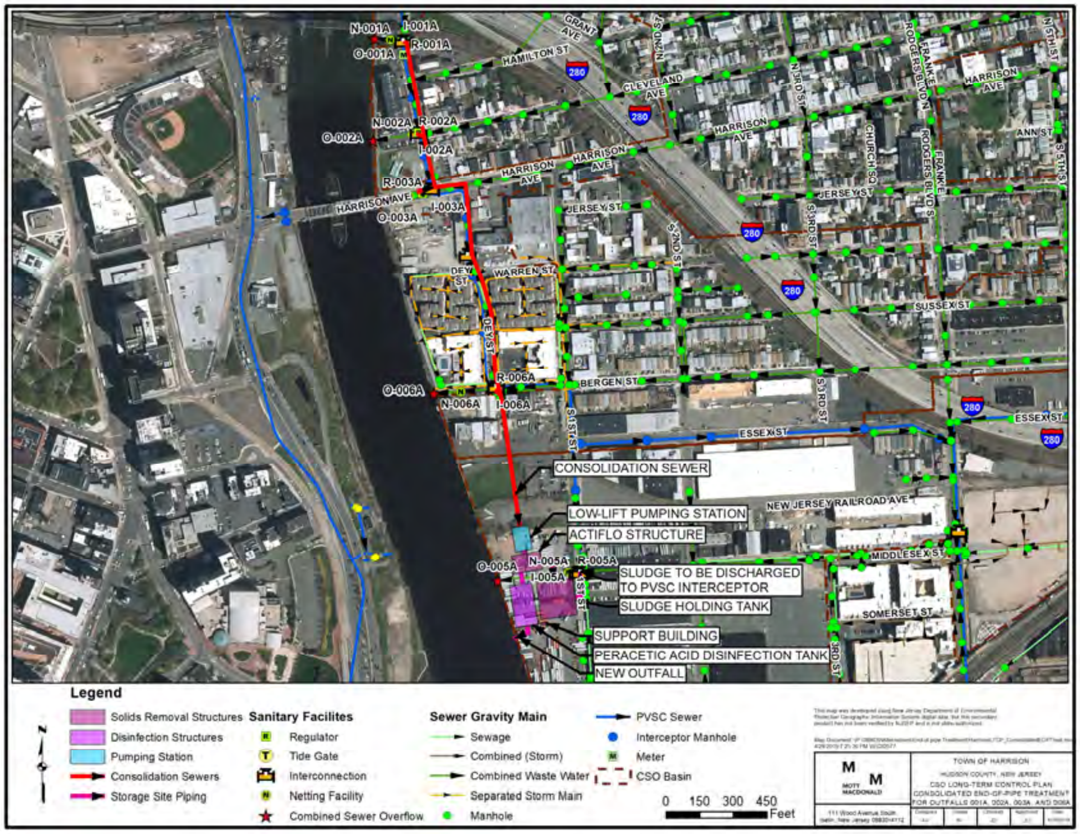

Figure 49: Consolidation for Treatment of Outfalls, overview 001A, 002A, 003A and 006A

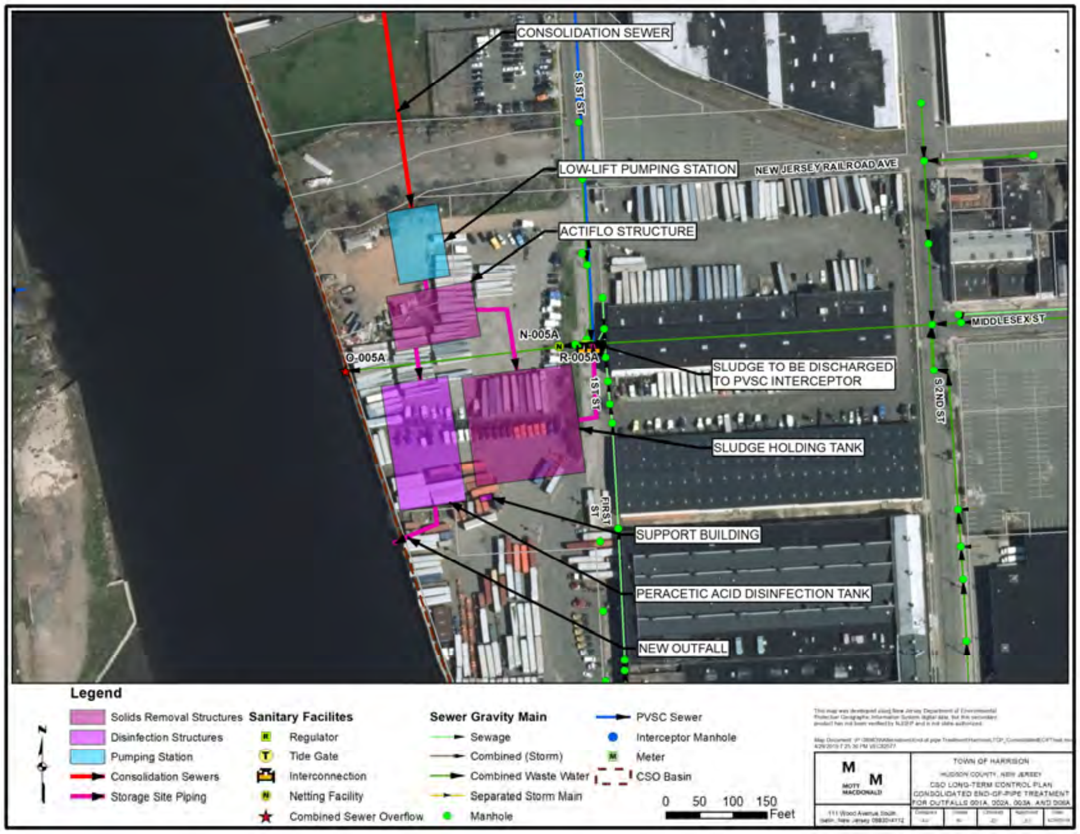

Figure 50: Consolidation Treatment of Outfalls, treatment facilities area for 001A, 002A, 003A and 006A

D.2.5.2 Control Program 5 Analysis

The consolidated end-of-pipe treatment was implemented in the 2050 baseline model by sizing pipes ranging from 3 feet to 6 feet in diameter to convey the modeled runoff from Outfalls 001A, 002A, 003A and 006A to the consolidated facility tank site. The consolidation piping capacity was evaluated for the Typical Year and it was sized such that there would be no adverse impacts (water surface increases) to the upstream system. The treatment rate was established by analyzing the flow in the consolidation piping. The peak flow rate for each storm was listed and sorted highest to lowest. The systemwide storms corresponding to the level of control were placed next to this list and the treatment rate was set at the flow rate of the highest storm that was not allowed to overflow.

D.2.5.3 Control Program 5 Institutional Issues

The institutional issues surrounding Control Program 5 are typical of a large-scale construction project in an urban area. While located in an urban area, construction of the facilities associated with this control program will require environmental permits. Below is list of anticipated permits required:

- Waterfront Development Permit
- Flood Hazard Area Permit
- USACE Nationwide 404 Permit
- Local Permits
- NJDEP Treatment Works Approval

The consolidated end-of-pipe facility at outfall 006A is located on the site of a planned park. The tank must be installed prior to creation of the park at which time the site will become encumbered by Green Acres. It may also be possible to write the Green Acres agreement to allow for the tank to be installed, but this may come with additional requirements. In addition, there could be significant public resistance to disturbing a newly established park and a general public feeling that the sequencing of the project showed a lack of fiscal responsibility, and poor municipal coordination oversight in planning and construction of these two projects.

These permits are standard permits and while they must be obtained, they do not appear to have the potential to greatly extend the project schedule or add excessive risk to the project.

D.2.5.4 Control Program 5 Implementability

Installation of end-of-pipe treatment facilities in urban areas can be challenging due to space and access limitations. Unlike end-of-pipe storage tanks, end-of-pipe treatment facilities are generally above-grade. As such, excavation is not required, reducing cost as well as the complexity of excavation in proximity to the foundation of nearby buildings. Depth to groundwater is also not a consideration, thus a possibility of a floating subsurface structure is not of concern. There is little available information on the soil conditions at the sites, however, given the depth to bedrock and proximity to the floodplain, soil conditions may be poor, and the facilities may need to be situated on piles.

Installing the large diameter consolidation piping within the Harrison Street could be challenging. There are numerous other utilities in the street, including an existing stormwater outfall that must be crossed and the Kearny-East Newark-Harrison Branch Interceptor which must be avoided.

The long-term costs to maintain and operate these facilities would place an ongoing burden on the Town's financial resources and workforce. End of pipe facilities tend to require greater level of operations and maintenance resources when compare to the other alternatives.

D.2.5.5 Control Program 5 Public Acceptance

The construction required for an end-of-pipe facility is large and invasive, making public acceptance of the project a concern. Because the facilities proposed are generally above-grade, they have the potential to produce odors and noise, making them more difficult to site in residential and commercial areas. There may be concerns with odors at the proposed site near Outfall 006A due to proximity to commercial and residential areas.

Following construction, end-of-pipe treatment facilities are less preferable than tanks due to the permanent visibility of the structure. They also use land area that could otherwise be utilized by the community for other purposes. The consolidated site is located on a parcel of land slated for redevelopment and the construction may be more acceptable in terms of public acceptance than other sites.

D.2.5.6 Control Program 5 Performance Summary

Per the National CSO Policy, discharges receiving the minimum required treatment are not considered overflows. Accordingly, to align with the systemwide levels of control (0, 4, 8, 12 and 20 overflows) treatment rates were set to treat all events smaller than those allowed to discharge under the various levels of control. While the outfalls will continue to discharge many times a year the flows will not be considered overflow unless they exceed the treatment rate. As noted for Control Program 4, warning signals may be required to distinguish between treated and untreated flows. The performance of Control Program 5 is summarized in Table 52 through Table 57, which present the results for the equivalent treatment for 0, 4, 8, 12, and 20 overflows per year.

Table 52: Control Program 5 - Consolidated Treatment, Performance Summary – 0 Overflows

	Baseline 2015			Consolidated Treatment 0 Overflows				Change		
Outfall	# of Events	Volume (MG)	Duration (HR)	Treatment Rate (MGD)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001	26	1.9	97	0.0	0	0.0	0	-26	-1.9	-97
H-002	35	3.2	162	0.0	0	0.0	0	-35	-3.2	-162
H-003	32	13.1	155	0.0	0	0.0	0	-32	-13.1	-155
H-004	10	0.3	6	0.0	0	0.0	0	-10	-0.3	-6
H-005	34	20.5	229	0.0	0	0.0	0	-34	-20.5	-229
Consolidated H-006	28	8.0	122	184.7	0	0.0	0	-28	-8.0	-122
H-007	53	14.5	352	77.6	0	0.0	0	-53	-14.5	-352
Total		61.5				0.0			-61.5	

Table 53: Control Program 5 - Consolidated Treatment, Performance Summary – 4 Overflows

	Baseline 2015			Consolidated Treatment 4 Overflows				Change		
Outfall	# of Events	Volume (MG)	Duration (HR)	Treatment Rate (MGD)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001	26	1.9	97	0.0	0	0.0	0	-26	-1.9	-97
H-002	35	3.2	162	0.0	0	0.0	0	-35	-3.2	-162
H-003	32	13.1	155	0.0	0	0.0	0	-32	-13.1	-155
H-004	10	0.3	6	0.0	0	0.0	0	-10	-0.3	-6
H-005	34	20.5	229	0.0	0	0.0	0	-34	-20.5	-229
Consolidated H-006	28	8.0	122	112.7	1	0.5	0	-27	-7.5	-122
H-007	53	14.5	352	53.2	1	0.3	1	-52	-14.2	-351
Total		61.5				0.8			-60.7	

Table 54: Control Program 5 - Consolidated Treatment, Performance Summary – 8 Overflows

	Baseline 2015			Consolidated Treatment 8 Overflows				Change		
Outfall	# of Events	Volume (MG)	Duration (HR)	Treatment Rate (MGD)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001	26	1.9	97	0.0	0	0.0	0	-26	-1.9	-97
H-002	35	3.2	162	0.0	0	0.0	0	-35	-3.2	-162
H-003	32	13.1	155	0.0	0	0.0	0	-32	-13.1	-155
H-004	10	0.3	6	0.0	0	0.0	0	-10	-0.3	-6
H-005	34	20.5	229	0.0	0	0.0	0	-34	-20.5	-229
Consolidated H-006	28	8.0	122	112.7	1	0.5	0	-27	-7.5	-122
H-007	53	14.5	352	53.2	1	0.3	1	-52	-14.2	-351
Total		61.5				0.8			-60.7	

Table 55: Control Program 5 - Consolidated Treatment, Performance Summary – 12 Overflows

Outfall	Baseline 2015			Consolidated Treatment 12 Overflows				Change		
	# of Events	Volume (MG)	Duration (HR)	Treatment Rate (MGD)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001	26	1.9	97	0.0	0	0.0	0	-26	-1.9	-97
H-002	35	3.2	162	0.0	0	0.0	0	-35	-3.2	-162
H-003	32	13.1	155	0.0	0	0.0	0	-32	-13.1	-155
H-004	10	0.3	6	0.0	0	0.0	0	-10	-0.3	-6
H-005	34	20.5	229	0.0	0	0.0	0	-34	-20.5	-229
Consolidated H-006	28	8.0	122	106.0	3	0.6	1	-25	-7.4	-122
H-007	53	14.5	352	40.7	3	0.7	1	-50	-13.7	-350
Total		61.5				1.4			-60.2	

Table 56: Control Program 5 - Consolidated Treatment, Performance Summary – 20 Overflows

Outfall	Baseline 2015			Consolidated Treatment 20 Overflows				Change		
	# of Events	Volume (MG)	Duration (HR)	Treatment Rate (MGD)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001	26	1.9	97	0.0	0	0.0	0	-26	-1.9	-97
H-002	35	3.2	162	0.0	0	0.0	0	-35	-3.2	-162
H-003	32	13.1	155	0.0	0	0.0	0	-32	-13.1	-155
H-004	10	0.3	6	0.0	0	0.0	0	-10	-0.3	-6
H-005	34	20.5	229	0.0	0	0.0	0	-34	-20.5	-229
Consolidated H-006	28	8.0	122	52.3	7	3.5	2	-21	-4.5	-120
H-007	53	14.5	352	15.7	10	3.4	5	-43	-11.1	-347
Total		61.5				6.9			-54.6	

Table 57: Control Program 5 - Harrison Summary Overflow Reduction

	Baseline 2015 (MG)	Control Program 5	% Reduction from 2015	Baseline 2050 (MG)*	% Reduction from 2050
0 Overflows	61.5	0.0	100%	42.8	100%
4 Overflows	61.5	0.8	99%	42.8	98%
8 Overflows	61.5	0.8	99%	42.8	98%
12 Overflows	61.5	1.4	98%	42.8	97%
20 Overflows	61.5	6.9	89%	42.8	84%

*Note 30.4% reduction in annual overflow volume due to planned project incorporated in 2050 baseline.

D.2.5.7 Control Program 5 Cost Summary

The Class 5 (+100%, -50%) costs estimates for Control Program 5 are summarized in Table 58.

Table 58: Control Program 5 – Consolidated End of Pipe, Cost Summary

Control Program 5 - End of Pipe Treatment (Consolidated Sites)					
	Equivalent to Noted Overflows per Year				
	0	4	8	12	20
Capital Cost ($ Million)	$118.6	$90.4	$90.4	$84.0	$57.4
O&M Cost ($ Million)	$1.0	$0.8	$0.8	$0.8	$0.6
20-Yr Net Present Worth ($ Million)	$134.1	$102.8	$102.8	$95.9	$66.8

D.2.6 Control Program 6 Sewer Separation

D.2.6.1 Control Program 6 Description

This control program constitutes constructing a new sanitary sewer system and converting the existing combined sewer into a storm sewer, for the entire combine sewer area. This would effectively remove Harrison from being a CSO community.

The benefits of this alternative include:

- Work remains in public right-of-way, no new land required
- Opportunity for system renewal, reconstruction
- Elimination of outfalls

The challenges include:

- Highly disruptive to roads and traffic
- Need to redirect every sanitary service connection on each street
- Possible stormwater controls and treatment in the future.
- High expense

D.2.6.2 Control Program 6 Analysis

The system was modeled in the 2050 baseline InfoWorksICM model, by converting the combined sub-catchments into sanitary sub-catchments.

D.2.6.3 Control Program 6 Institutional Issues

The institutional issues surrounding Control Program 6 are typical of a large-scale construction project in an urban area. While located in an urban area, construction of the facilities associated with this control program will require environmental permits. Below is list of anticipated permits required:

- Waterfront Development Permit
- Flood Hazard Area Permit
- USACE Nationwide 404 Permit
- Local Permits
- NJDEP Treatment Works Approval

These permits are standard permits and while they must be obtained, they do not appear to have the potential to greatly extend the project schedule or add excessive risk to the project.

In addition, it is noted that separating out stormwater flow may not be an effective long-term solution. This is because stormwater contributes to pollution of the receiving waters, and as such will eventually need to be treated or controlled. Under the NJDEP's current enforcement practices, TSS removal would be required for the separate stormwater outfalls. Recently proposed stormwater regulations include increased treatment requirements for creating separately sewered areas that would greatly increase the costs and impacts of performing separation.

D.2.6.4 Control Program 6 Implementability

In terms of land acquisition, this alternative ranks highly, because the proposed work would be completed within the existing right-of-way. However, installation of separate sewers in Harrison would be challenging due to traffic impacts and space limitations. Such an undertaking will result in road closures across the city and resulting traffic redirection over the course of construction. Assuming this alternative will be implemented over the course of 30 years, this means that about

12 acres would need to be addressed each year. Unlike the separation of H-004 and H-005, there is little likelihood the separation could be accomplished through redevelopment. Installation of new sanitary lateral connections to each residence and business and will be a very extensive undertaking.

At least initially, the separate sewers would require minimal maintenance except for where siphons are required. However, in the long term there would be two systems for the town to maintain rather than one.

D.2.6.5 Control Program 6 Public Acceptance

The construction required for sewer separation is large and invasive, making public acceptance of the project a significant concern. Installation of a new sanitary sewer system and connections will result in road closures and resulting impacts on traffic as well as access to local business and institutions during construction, which will not be received favorably by residents. This is also a very costly alternative, as such may not be preferred.

Following construction, sewer separation might be preferable from the stand point of public acceptance since the resulting facilities would be underground.

D.2.6.6 Control Program 6 Performance Summary

The performance of Control Program 6 is summarized in Table 59.

Table 59: Control Program 6 – Sewer Separation, Performance Summary

	Baseline 2015			Baseline 2050			Change		
Outfall	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001	26	1.9	97	0	0.0	0	-26	-1.9	-97
H-002	35	3.2	162	0	0.0	0	-35	-3.2	-162
H-003	32	13.1	155	0	0.0	0	-32	-13.1	-155
H-004	10	0.3	6	0	0.0	0	-10	-0.3	-6
H-005	34	20.5	229	0	0.0	0	-34	-20.5	-229
H-006	28	8.0	122	0	0.0	0	-28	-8.0	-122
H-007	53	14.5	352	0	0.0	0	-53	-14.5	-352
Total		61.5			0.0			-61.5	

D.2.6.7 Control Program 6 Cost Summary

The Class 5 (+100%, -50%) costs estimate for Control Program 6 are summarized in Table 60.

Table 60: Control Program 6 – Sewer Separation, Cost Summary

Control Program 6 - Sewer Separation					
	Equivalent to Noted Overflows per Year				
	0	4	8	12	20
Capital Cost ($ Million)	$180.7	NA	NA	NA	NA
O&M Cost ($ Million)	$0.0	NA	NA	NA	NA
20-Yr Net Present Worth ($ Million)	$180.7	NA	NA	NA	NA

D.2.7 Control Program 7 Green Infrastructure

D.2.7.1 Control Program 7 Description

This control program consists of installing green infrastructure to provide storage or detention to contribute to meeting the overflow requirements. Green infrastructure (GI) refers to practices which reduce stormwater volume or flow rate by allowing the stormwater to infiltrate, be stored, or be treated by vegetation or soils. As mentioned previously, bioswales have been selected as the representative type of green infrastructure (GI) to evaluate for the purposes for model calculations. The number of bioswales was determined by the amount of impervious to be treated. However, the anticipated green infrastructure is expected to consist primarily of bioswales and permeable pavement, but the breakdown between the two technologies will depend on field conditions. If this alternative is selected for inclusion in the LTCP, further refining of types and specific locations of GI will be determined in future planning stages.

D.2.7.2 Control Program 7 Analysis

For purposes of evaluation, directing 2.5%, 5%, 7.5% and 10% of the impervious area within the combined sewer area to green stormwater infrastructure was evaluated. However, evaluating fixed amounts of impervious to green stormwater infrastructure ignores whether such an approach is practical or technically feasible. Using the guidance documents previous discussed, an attempt was made to determine the maximum amount of impervious area that could be directed from impervious areas to green infrastructure. Experience from New York City has shown that the vast majority of sites identified through a desktop GIS study are deemed unsuitable once field investigations and geotechnical (infiltration) testing are conducted. An analysis conducted of sites in one basin showed that of the sites identified at the planning level, only 17% were found suitable to proceed to construction. As previously noted, the available data on soils and groundwater levels in Harrison indicate that ground conditions are likely not conducive to infiltrating green stormwater infrastructure, thus bioswales were assumed to be non-infiltrating and equipped with a sub-drain to drain back into the collection system.

Suitability of a site for green infrastructure was determined at a high-level based on desktop studies of land use (Figure 51), areas of impervious cover (Figure 52), groundwater information (Figure 8) and publicly owned land (Figure 10).

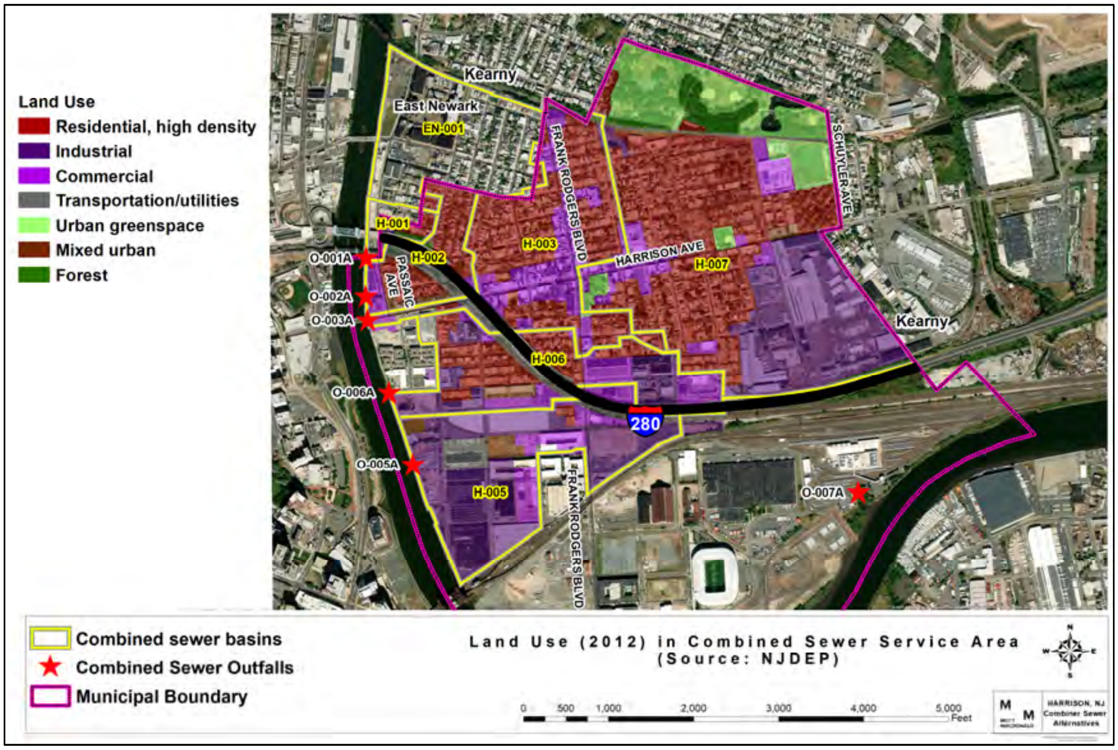

Figure 51: Harrison Land Use Map

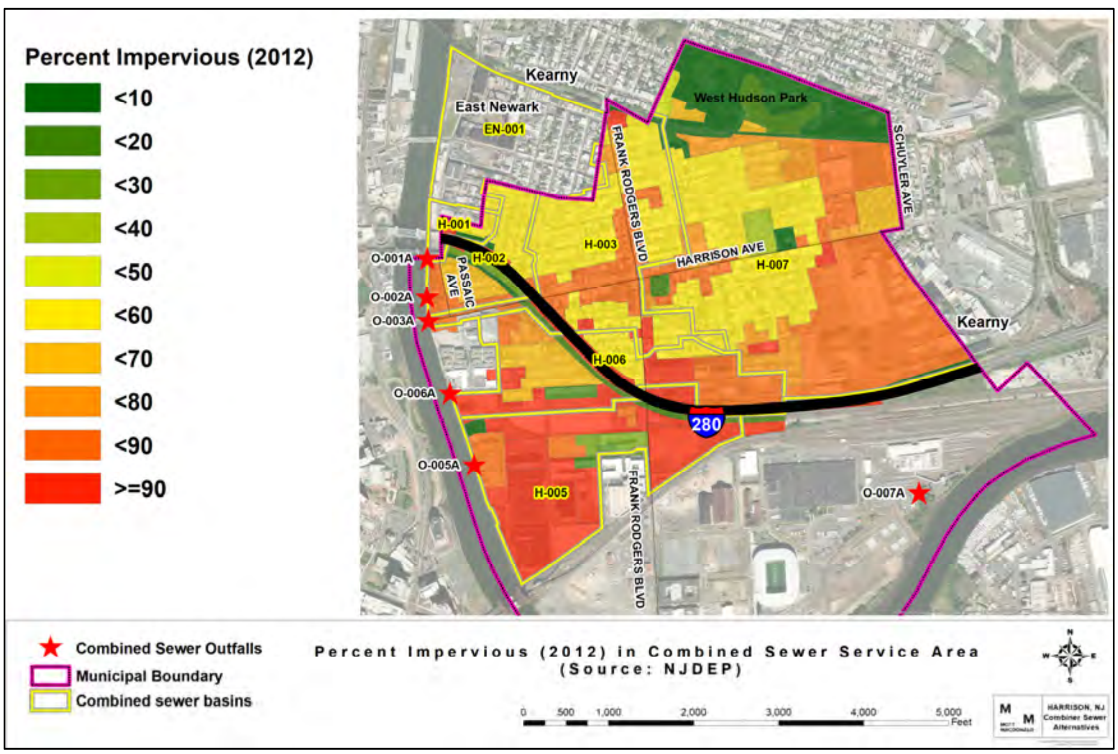

Figure 52: Harrison Impervious Cover Map

As was shown in Section C.2.5, the public right-of-way offers the best opportunity for green stormwater infrastructure. Accordingly, a typical street segment within the city was examined to estimate the potential for implementing green stormwater infrastructure. It is noted that much of the curb space is consumed with driveway entrance and walkways to houses with limited grass areas between the sidewalk and street, see Figure 10). Many of the available areas between the sidewalk and street are also occupied by mature trees, which typically are not removed in order to install green stormwater infrastructure.

Accordingly, it was assumed that only one bioswale could be installed per each side of the street segment (see Figure 53). Hence, a typical street segment would have two bioswales (one on each side), and a typical street segment would have one on each side or four per block. The typical bioswale is 20’x3’ and using a 15:1 loading ratio it would treat 900 sf of impervious area. Through GIS analysis, it was determined the Town has approximately 256 street segments which result in 512 bioswales. Conservatively, applying a planning level to installation rate of 25% (versus 17% from New York City) results in 128 bioswales with a treatment area of 115,200 sf or 2.6 acres of impervious area treated.

The other feasible green stormwater infrastructure practice is permeable pavement. The recommended practice is to apply the permeable paving to parking lanes. Again, referring to a typical street segment which is approximately 340 feet long. It is assumed that the last 50 feet at either end of the block would be reserved for turning lanes, resulting in 240 linear feet of parking area available for permeable pavement on each side of the street. The parking lane is assumed to be 6 feet wide for a total area of 2,880 sf per street segment. Given the un certainty in groundwater and soil condition, it was assumed that only 10% of the Town is suitable for installation of permeable pavement, resulting in a maximum of 73,700 sf of permeable paving in the Town. Applying the recommended loading ratio of 4:1, 294,800 sf or 6.8 acres of impervious area can be treated.

Figure 53: Typical street segment with green stormwater infrastructure

When combined, bioswales and permeable paving could treat 9.4 acres of impervious area out 345 acres of total impervious area in the existing combined sewer area, representing 2.7% of the total impervious area or approximately 10% of the modeled, directly connected impervious area.

Bioswales were modelled in the 2050 baseline InfoWorksICM model as a representative 20’x3’ unit with and 18” soil depth and 3.5’ storage layer. This was input in the InfoWorksICM SUDS module (Figure 54) to create a typical green infrastructure unit to evaluate the impact that green infrastructure would have on the frequency and volume of CSO events. It can be seen from the representative figure (Figure 55) below that GI has a very minimal impact on both peak flow and volume mitigation. As such, it is understood that a high level of proliferation of GI is required to provide a significant improvement in CSO reduction.

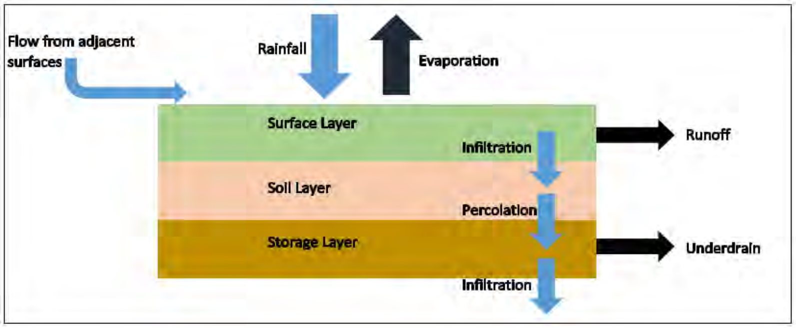

Figure 54: InfoWorks SUDS diagram

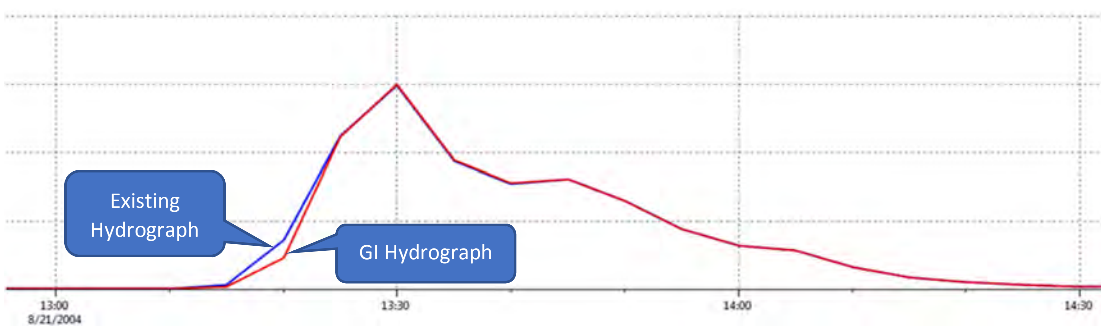

Figure 55: Representative green infrastructure hydrograph

D.2.7.3 Control Program 7 Institutional Issues

Typically, the institutional issues associated with green stormwater infrastructure are minimal. Their construction would generally fall within the overall goals of the Town’s planning by providing additional green space. Permit requirements would be minimal and may include the following based on the location of the green stormwater infrastructure.

- Waterfront Development Permit if located in the waterfront zone
- Local Permits, likely minimal requirements since project will be conducted by the Town
- NJDEP Treatment Works Approval

Additional permits and coordination may be required if green stormwater infrastructure is implemented on State or County property.

D.2.7.4 Control Program 7 Implementability

From a land acquisition standpoint, green infrastructure would rate highly for implementability. The intent is to site the green stormwater infrastructure in the public right-of-way which is owned by the Town. Accordingly, no land acquisition would be required. However, there are other implementability challenges associated with green stormwater infrastructure to be considered. As has been experienced by other entities such as New York City, there are myriad of field conditions that can prevent construction of green stormwater infrastructure on a site identified through a desktop study, including soil conditions, utility locations, and proximity to trees, building entrances, or bus stops. New York City implements a multi-layered planning approach consisting of desktop studies, field visits, utility mark outs and infiltration testing. At each phase, many potential sites are eliminated due to factors not identified in the desktop study. This high level of attrition has been reflected in the estimate of green stormwater infrastructure proposed, in an effort to realistically reflect this implementability challenge.

The long-term costs to maintain and operate these facilities would place an ongoing burden on the Town's financial resources and workforce. Green infrastructure requires frequent, but often lower skill personnel, rather than requiring additional training and skills as is the case with the other control programs.

D.2.7.5 Control Program 7 Public Acceptance

It is generally assumed that public acceptance of green stormwater infrastructure will be high since it serves as an amenity to the community. This is likely true for implementation of bioswales as they provide additional green space and the construction footprint is relatively small. The implementation of permeable pavement on which the green infrastructure alternative relies heavily may be less accepted by the public as the construction is more invasive. However, upon completion of the project, the area will closely resemble the existing condition. Accordingly, the likelihood of public acceptance for green stormwater infrastructure should be considered high.

D.2.7.6 Control Program 7 Performance Summary

The performance of Control Program 7 is summarized in Table 61 through Table 66. Percent impervious expresses as the percent of modeled directly connected impervious area directed to green stormwater practices. As noted previously it is estimated that 10% of the modeled directly connected impervious area, is the upper bound of what could be directed to green infrastructure. It is noted that when compared to the 2015 base it looks like green infrastructure provides a significant reduction in overflow volume, however the vast majority if the volume reduction is the result of planned sewer separation. For an indication of the performance when compared to the 2050 baseline which shows the direct impact of the green infrastructure refer to Table 66 and Table 69

Table 61: Control Program 7 – Green Stormwater Infrastructure, Performance Summary – Treatment of 2.5% Impervious

	Baseline 2015			Green Infrastructure 2.5%			Change		
Outfall	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001A	26	1.9	97	25	1.5	59	-1	-0.5	-39
H-002A	35	3.2	162	25	2.2	75	-10	-1.0	-86
H-003A	32	13.1	155	33	12.8	107	1	-0.4	-48
H-004A	10	0.3	6	0	0.0	0	-10	-0.3	-6
H-005A	34	20.5	229	0	0.0	0	-34	-20.5	-229
H-006A	28	8.0	122	27	7.0	105	-1	-1.0	-17
H-007A	53	14.5	352	50	19.3	345	-3	4.8	-7
Total		61.5			42.7			-18.8	

Note CSO volume reduction is 0.1 MG when planned separations are excluded.

Table 62: Control Program 7 – Green Stormwater Infrastructure, Performance Summary – Treatment of 5% Impervious

	Baseline 2015			Green Infrastructure 5%			Change		
Outfall	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001A	26	1.9	97	25	1.5	59	-1	-0.5	-39
H-002A	35	3.2	162	25	2.2	77	-10	-1.0	-84
H-003A	32	13.1	155	33	12.7	107	1	-0.4	-49
H-004A	10	0.3	6	0	0.0	0	-10	-0.3	-6
H-005A	34	20.5	229	0	0.0	0	-34	-20.5	-229
H-006A	28	8.0	122	27	7.0	105	-1	-1.0	-17
H-007A	53	14.5	352	49	19.2	344	-4	4.7	-7
Total		61.5			42.6			-18.9	

Note CSO volume reduction is 0.2 MG when planned separations are excluded.

Table 63: Control Program 7 – Green Stormwater Infrastructure, Performance Summary – Treatment of 7.5% Impervious

	Baseline 2015			Green Infrastructure 7.5%			Change		
Outfall	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001A	26	1.9	97	25	1.5	59	-1	-0.5	-39
H-002A	35	3.2	162	24	2.2	77	-11	-1.0	-84
H-003A	32	13.1	155	33	12.7	107	1	-0.4	-49
H-004A	10	0.3	6	0	0.0	0	-10	-0.3	-6
H-005A	34	20.5	229	0	0.0	0	-34	-20.5	-229
H-006A	28	8.0	122	27	7.0	103	-1	-1.0	-19
H-007A	53	14.5	352	49	19.1	344	-4	4.6	-8
Total		61.5			42.5			-19.0	

Note CSO volume reduction is 0.3 MG when planned separations are excluded.

Table 64: Control Program 7 – Green Stormwater Infrastructure, Performance Summary – Treatment of 10% Impervious

Outfall	Baseline 2015			Green Infrastructure 10%			Change		
	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001A	26	1.9	97	25	1.5	59	-1	-0.5	-39
H-002A	35	3.2	162	24	2.2	75	-11	-1.0	-86
H-003A	32	13.1	155	33	12.7	107	1	-0.4	-49
H-004A	10	0.3	6	0	0.0	0	-10	-0.3	-6
H-005A	34	20.5	229	0	0.0	0	-34	-20.5	-229
H-006A	28	8.0	122	27	7.0	103	-1	-1.0	-19
H-007A	53	14.5	352	49	19.1	341	-4	4.6	-11
Total		61.5			42.5			-19.1	

Note CSO volume reduction is 0.4 MG when planned separations are excluded.

Table 65: Control Program 7 – Green Stormwater Infrastructure, Performance Summary – Treatment of 15% Impervious

Outfall	Baseline 2015			Green Infrastructure 15%			Change		
	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)	# of Events	Volume (MG)	Duration (HR)
H-001A	26	1.9	97	25	1.5	58	-1	-0.5	-40
H-002A	35	3.2	162	24	2.2	75	-11	-1.0	-86
H-003A	32	13.1	155	32	12.6	106	0	-0.5	-49
H-004A	10	0.3	6	0	0.0	0	-10	-0.3	-6
H-005A	34	20.5	229	0	0.0	0	-34	-20.5	-229
H-006A	28	8.0	122	27	7.0	103	-1	-1.0	-19
H-007A	53	14.5	352	49	19.0	327	-4	4.5	-25
Total		61.5			42.3			-19.2	

Note CSO volume reduction is 0.5 MG when planned separations are excluded.

Table 66: Control Program 7 - Harrison Summary Overflow Reduction

	Baseline 2015 (MG)	Control Program 7	% Reduction from 2015	Baseline 2050 (MG)*	% Reduction from 2050
2.5% Impervious	61.5	42.7	30.5%	42.8	0.2%
5% Impervious	61.5	42.6	30.7%	42.8	0.4%
7.5% Impervious	61.5	42.5	30.9%	42.8	0.7%
10% Impervious	61.5	42.5	31.0%	42.8	0.9%
15% Impervious	61.5	42.3	31.3%	42.8	1.2%

*Note 30.4% reduction in annual overflow volume due to planned project incorporated in 2050 baseline.

D.2.7.7 Control Program 7 Cost Summary

The Class 5 (+100%, -50%) cost estimates for Control Program 7 are summarized in Table 67.

Table 67: Control Program 7 – Green Infrastructure, Cost Summary

Control Program 7 - Green Infrastructure					
	% of Impervious Area Managed				
	2.5%	5%	7.50%	10%	15%
Capital Cost ($ Million)	$1.8	$3.7	$5.5	$7.4	$11.0
O&M Cost ($ Million)	$0.3	$0.5	$0.8	$1.0	$1.6
20-Yr Net Present Worth ($ Million)	$5.8	$11.6	$17.5	$23.3	$34.9

D.2.8 Summary of Cost Opinions

D.2.8.1 Anticipated LTCP Costs

The Class 5 (+100%, -50%) 20-year net present worth cost opinions for the various alternatives are summarized in below in Table 68. The reduction in CSO volume for each control plan is summarized in Table 69 and the net present worth costs normalized by gallon of CSO reduction are summarized in Table 70.

Table 68: 20-Year net present worth for all control plans

	NPW Summary - Overflows per Year ($M)				
Control Plan	0	4	8	12	20
1) Point Storage	$88	$63	$61	$48	$40
2) Consolidated Storage	$78	$59	$58	$47	$41
3) Tunnel	$160	$152	$146	$142	$139
4) Treatment (Individual Sites)	$174	$136	$134	$128	$96
5) Consolidated Treatment	$134	$103	$103	$96	$67
6) Sewer Separation	$181	NA	NA	NA	NA
	NPW Summary - % of Impervious Area Managed ($M)				
	2.50%	5%	7.50%	10%	15%
7) Green Infrastructure	$6	$12	$18	$23	$35

Table 69: Summary of CSO volume reductions for control programs relative to 2050 baseline

	Volume Reduction per # of Overflows/Year (MG)				
Control Plan	0	4	8	12	20
1) Point Storage	42.8	38.3	38	32	26.2
2) Consolidated Storage	42.8	39	38.8	33	29.4
3) Tunnel	42.8	41.7	38.9	33.5	27.8
4) Treatment (Individual Sites)	42.8	42	42	41.5	36.1
5) Consolidated Treatment	42.8	42	42	41.4	35.9
6) Sewer Separation	42.8	NA	NA	NA	NA
	Volume Reduction for Impervious Area Managed (MG)				
	2.50%	5%	7.50%	10%	15%
7) Green Infrastructure	0.1	0.2	0.3	0.4	0.5

Table 70: Net present worth costs normalized by gallon of CSO reduction

	Cost per Gallon of CSO Volume Reduction ($/gal)				
Control Plan	0	4	8	12	20
1) Point Storage	$2.1	$1.7	$1.6	$1.5	$1.5
2) Consolidated Storage	$1.8	$1.5	$1.5	$1.4	$1.4
3) Tunnel	$3.7	$3.6	$3.8	$4.2	$5.0
4) Treatment (Individual Sites)	$4.1	$3.2	$3.2	$3.1	$2.6
5) Consolidated Treatment	$3.1	$2.4	$2.4	$2.3	$1.9
6) Sewer Separation	$4.2	NA	NA	NA	NA
	Volume Reduction for Impervious Area Managed (MG)				
	2.50%	5%	7.50%	10%	15%
7) Green Infrastructure	$58	$58	$58	$58	$70

D.2.8.2 Costs Including Future Baseline

The Town of Harrison has undertaken separation work through redevelopment as previously discussed, and anticipates additional separation work to be accomplished through planned redevelopment as discussed earlier in this report. The costs of these separation projects are borne through the Town directly or indirectly through a variety of payment methods. They represent a significant investment of political capital as agreements with the developers to undertake the separation represent concessions and investments the developers were not required to make elsewhere. Accordingly, the Town should receive credit towards their LTCP for the cost of these improvements. These costs were not included in the analysis presented in the prior sub-section because the intent was to show the impact of funds expended by the Town directly on the reduction of CSO volumes and frequencies. Including the separation work would tend to obscure the true costs of removing additional CSO volume from the future baseline.

Presented below in Table 71 through Table 73 are the alternatives' costs including the estimated capital cost of $41.7 M to account for the value of the planned separations. As can be seen by comparing Table 70 and Table 73 including the planned separations greatly alters the costs normalized by gallon of CSO removed during the Typical Year. Accordingly, these costs are presented for reference purposes only, and should not be used to evaluate the effectiveness of a particular control program.

Table 71: 20-Year net present worth for all control plans Including Planned Separations Costs

	NPW Summary - Overflows per Year ($M)				
Control Program	0	4	8	12	20
1) Point Storage	$130	$105	$102	$90	$82
2) Consolidated Storage	$120	$100	$99	$88	$83
3) Tunnel	$202	$193	$188	$183	$180
4) Treatment (Individual Sites)	$216	$178	$175	$170	$137
5) Consolidated Treatment	$176	$144	$144	$138	$108
6a) Sewer Separation	$222	NA	NA	NA	NA
	NPW Summary - % of Impervious Area Managed ($M)				
	2.50%	5%	7.50%	10%	15%
7) Green Infrastructure	$47.5	$53	$59	$65	$77

Table 72: CSO Volume Reduction Including Planned Separations

	Volume Reduction per # of Overflows/Year (MG)				
Control Program	0	4	8	12	20
1) Point Storage	61.5	57	56.7	50.7	44.9
2) Consolidated Storage	61.5	57.7	57.5	51.7	48.1
3) Tunnel	61.5	60.4	57.6	52.2	46.5
4) Treatment (Individual Sites)	61.5	60.7	60.7	60.2	54.8
5) Consolidated Treatment	61.5	60.7	60.7	60.1	54.6
6) Sewer Separation	61.5	NA	NA	NA	NA
	Volume Reduction for Impervious Area Managed (MG)				
	2.50%	5%	7.50%	10%	15%
7) Green Infrastructure	18.8	18.9	19	19.1	19.2

Table 73: Net present worth costs normalized by gallon of CSO reduction Including Planned Separations

	Cost per Gallon of CSO Volume Reduction ($/gal)				
Control Program	0	4	8	12	20
1) Point Storage	$2.1	$1.8	$1.8	$1.8	$1.8
2) Consolidated Storage	$1.9	$1.7	$1.7	$1.7	$1.7
3) Tunnel	$3.3	$3.2	$3.3	$3.5	$3.9
4) Treatment (Individual Sites)	$3.5	$2.9	$2.9	$2.8	$2.5
5) Consolidated Treatment	$2.9	$2.4	$2.4	$2.3	$2.0
6) Sewer Separation	$3.6	NA	NA	NA	NA
	Volume Reduction for Impervious Area Managed (MG)				
	2.50%	5%	7.50%	10%	15%
7) Green Infrastructure	$2.5	$2.8	$3.1	$3.4	$4.0

D.3 PRELIMINARY ALTERNATIVES

D.3.1 Evaluation Factors

The Control Programs were evaluated on a number of factors which include:

- Cost – Costs were normalized by $/gal of annual CSO reduction based on the Typical Year and level of control corresponding to 4 overflows and 10% of directly connected impervious areas directed to green stormwater infrastructure. Cost is a primary driving factor and was assigned a weighting of 25% of the overall score. The following ratings were assigned based on the normalized cost.
    - 5: $0-$1.00 per gallon of CSO removed
    - 4: $1.00-$2.00 per gallon of CSO removed
    - 3: $2.00-$3.00 per gallon of CSO removed
    - 2: $3.00-$4.00 per gallon of CSO removed

- 1: over $4.00 per gallon of CSO removed

- CSO Reduction – Since the outfalls in Harrison all discharge to the Passaic River along a relatively short reach, it is appropriate to consider the overall reduction achieved by the control alternatives. For evaluation purposes the CSO reduction achieved through the Future Baseline resulting from the separation of Outfall 004A and the planned separation of Outfall 005A, as well at the increase at 007A from anticipated system upgrades represent approximately 18.7 MG of net CSO removal, which is used to establish the lower bound for performance. CSO reduction volumes were based on the Typical Year. CSO reduction was considered a key factor and was assigned a weighting of 15%. The following ratings were applied to the CSO volume reductions:
  - 5: over 50 MG of CSO volume reduction in the Typical Year
  - 4: 45 MG - 50 MG of CSO volume reduction in the Typical Year
  - 3: 35 MG - 45 MG of CSO volume reduction in the Typical Year
  - 2: 25 MG - 35 MG of CSO volume reduction in the Typical Year
  - 1: under 25 MG of CSO volume reduction in the Typical Year
- CSO Frequency – The frequency of overflow is an important metric both in regard to regulatory compliance under the Presumptive Approach and in terms of public acceptance. Since overflow frequency is closely related to overflow volume, it is assigned a weighting of 15%. The following ratings were applied to the CSO volume reductions:
  - 5: 4 or fewer overflows during the Typical Year
  - 4: 5 to 8 overflows during the Typical Year
  - 3: 9 to 12 overflows during the Typical Year
  - 2: 13 to 20 overflows during the Typical Year
  - 1: over 20 overflows during the Typical Year
- Institutional Issues (Permitting) – Institutional issues, particularly permitting, can have a significant impact on a project, particularly the schedule of design which can then delay the commencement of construction. If institutional issues cannot be overcome, the project may need to be redesigned, potentially affecting not just the schedule, but the cost. Experience has shown for important projects, such as CSO LTCP, institutional issues can generally be overcome due to the overall need for the project. Accordingly, institutional issues are assigned a weighting of 15%. The following ratings were assigned to institutional issues:
  - 5: Unlikely to impact schedule or budget.~~high possibility to delay project by more than six months and impact budget by 10% or more.~~
  - 4: small possibility of delay in schedule less than six months.~~medium possibility to delay project more than six months and impact budget by more than 5%.~~
  - 3: medium possibility to delay project less than six months and impact budget by 5%.

  - 2: ~~small possibility of delay in schedule less than six months.~~ medium possibility to delay project more than six months and impact budget by more than 5%.
  - 1: ~~Unlikely to impact schedule or budget.~~ high possibility to delay project by more than six months and impact budget by 10% or more.

- Implementability – High level planning studies such as LTCP must formulate plans based on incomplete information. Unexpected factors such as poor soil condition and conflicts with unknown existing infrastructure can impact a project's schedule and budget. Accordingly, implementability was assigned a weighting of 15%. The following ratings were assigned to implementability:
  - 5: Unlikely to impact schedule or budget.~~high possibility to delay project by more than six months and impact budget by 10% or more.~~
  - 4: small possibility of delay in schedule less than six months.~~medium possibility to delay project more than six months and impact budget by more than 5%.~~
  - 3: medium possibility to delay project less than six months and impact budget by 5%.
  - 2: ~~small possibility of delay in schedule less than six months.~~ medium possibility to delay project more than six months and impact budget by more than 5%.
  - 1: ~~Unlikely to impact schedule or budget.~~ high possibility to delay project by more than six months and impact budget by 10% or more.
- Public Acceptance – Public acceptance of an alternative is largely based on experience which guides anticipated public reaction. These reactions can change as demographic and economic changes occur as well as overall societal attitudes towards the environment develop. Public acceptance is an important criterion, but ultimately the Towns obligations are driven by the permit requirements, accordingly, public acceptance is assigned a weighting of 15%. The following ratings were applied to the anticipated public acceptance.
  - 5: Public would welcome and support proposed plan.
  - 4: Public would accept proposed plan, but not provide external support.
  - 3: Public objects to proposed plan but takes minimal action.
  - 2: Public objects to proposed plan, and actively opposes.
  - 1: Strong public opposition, including legal challenges

Each of the seven control programs was rated as per the above criteria. To provide a more concise comparison each control program was rated for the level of control corresponding to four overflows in the Typical Year. This is not a decision-making matrix, but rather a tool to provide a relative comparison between the control programs. For Control Program 7, green stormwater infrastructure, the results for 10% of modeled directly connected impervious were presented which is closest to the estimated maximum amount of green infrastructure that can be formally attributed to the LTCP. Green infrastructure does not achieve the desired level of control in terms of volume reduction or reduction in CSO frequency. However, it does provide a volume reduction, and it is anticipated, that if included in the LTCP, it would additive to other control programs. The results of the rating process are summarized in Table 74.

Table 74: Summary Rating of Control Programs

Control Program	Cost	CSO Volume Reduction	CSO Frequency Reduction	Institutional Issues	Implement-ability	Public Acceptance	Weighted Score
1) Point Storage	4	5	5	3	1	2	3.40
2) Consolidated Storage	4	5	5	4	3	3	4.00
3) Tunnel Storage	2	5	5	4	2	2	3.20
4) End of Pipe Treatment	2	5	5	2	1	1	2.60
5) Consolidated End of Pipe Treatment	3	5	5	2	3	2	3.30
6) Sewer Separation	1	5	5	3	2	2	2.80
7) GI - 10% of Impervious	1	1	1	5	4	5	2.65
Weighting	25%	15%	15%	15%	15%	15%	100%

D.3.2 Regulatory Compliance

Six of the seven control plans formulated were sized to provide regulatory compliance with the Presumptive Approach requirement for 4 overflows during the Typical Year. The proposed separation projects the Town has completed since 2015 and that it intends to take through redevelopment provides a reduction of 18.7 MG which provides adequate reduction in overflow volume to achieve 85% capture. As discussed, the performance of the Harrison facilities was coordinated with the other PVSC CSO Group's interceptor communities. The reader is referred to the Main Report for additional discussion of regulatory compliance with the hydraulically connected system as required by the Permit.

D.3.3 Preliminary Alternatives

The decision to select alternatives will take place during the next phase of the permit from July 1, 2019 to June 1, 2020. The selected plan may include one of the Control Programs evaluated, it may consist of a combination of Control Programs or include items not discussed in this report. The LTCP selection will not be just the outcome of an engineering evaluation, but may be influenced by the community's ability to afford the alternative, political considerations, environmental justice, public acceptance, and the community's long-term planning and policy decisions relating to potential future CSO permitting actions. While no decisions are being made at this time, the overall ratings in Table 74, indicate that in general options that include consolidation may be preferable to options that address each outfall individually and that storage options may be preferable to end of pipe treatment options. Green infrastructure does not meet the required control levels but could be implemented to supplement other technologies or apart from the LTCP.

APPENDIX E

Development and Evaluation of Alternatives Report
Jersey City MUA

Dated: June 2019
Revised: November 2019

Jersey City Municipal Utilities Authority

REVISED DEVELOPMENT AND EVALUATION OF ALTERNATIVES REPORT

NJPDES Permit No. NJ0108723

November 2019

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SECTION A INTRODUCTION

This Jersey City Municipal Utilities Authority (JCMUA) Development and Evaluation of Alternatives Report (Alternatives Report) was prepared in accordance with the requirements of the JCMUA's Surface Water Renewal Permit No. NJ0108723 (Permit), which regulates discharges from the JCMUA's combined sewer system (CSS). This Alternatives Report is part of the JCMUA's Long Term Control Plan (LTCP) process for combined sewer overflow (CSO) control, which will culminate with the implementation of a set of CSO control measures, as approved by the New Jersey Department of Environmental Protection (NJDEP).

The JCMUA Alternatives Report is a subset of a regional Development & Evaluation of Alternatives Report that was prepared and coordinated by the Passaic Valley Sewerage Commission (PVSC). The PVSC regional report, including this JCMUA Alternatives Report as an appendix, was prepared as a cooperative effort between PVSC and the eight other CSO Permittees identified in this JCMUA Alternatives Report.

The objectives of this JCMUA Alternatives Report are as follows:

- to reflect the development and evaluation of the CSO abatement alternatives as they pertain to the specific site conditions and other influencing factors within Jersey City (the City) and to certain other areas outside Jersey City served by the JCMUA, except where various regional alternatives were considered;
- to provide information that can be used for future coordination with the Bayonne and North Bergen CSO permittees to develop one regional alternative;
- to consider existing and future conditions as they pertain to the development of alternatives;
- to describe various CSO abatement alternatives that were considered by the JCMUA for Jersey City based upon its specific site conditions and other factors;
- to screen a broad list of alternatives into a short list of alternatives that are determined to be most suitable for Jersey City specific site conditions and other influencing factors;
- to develop, through a more detailed evaluation process that includes performing model simulations of the various alternatives, the preliminary sizes and locations of those technologies that were determined to provide feasible solutions to address the CSO Permit requirements and JCMUA needs;
- to evaluate the performance of the short-listed CSO alternatives that were determined to be most advantageous. This includes estimating Jersey City's CSO percent volume captured, the reduction in number of overflows, and the reduction of overall CSO volume discharge as it pertains to the CSS drainage area owned and operated by the JCMUA; and
- to evaluate the alternatives and various combinations of the alternatives that present the most favorable evaluation results based on but not limited to siting, institutional issues, implementability, public acceptance, performance, and life cycle costs.

SECTION B FUTURE CONDITIONS

B.1 INTRODUCTION

Future conditions and their potential impacts need to be considered for a complex planning project such as the JCMUA's LTCP. The primary future conditions considered for this LTCP are as follows:

- population growth within the municipal boundaries of Jersey City
- the JCMUA's planned future projects over the next five years
- the JCMUA's future dry weather flows up to the design year 2050
- tidal elevations extrapolated for the design year 2050

B.2 PROJECTIONS FOR POPULATION GROWTH

The population changes in Jersey City over time are shown in Table B.2-1. The population projection for 2050 uses the growth rate indicted by the North Jersey Transportation Planning Authority (NJTPA).

Table B.2-1 Population Estimates for Jersey City

Year	Population	Annual percent change since last estimate	Percent change since 1990	Source
1990	228,537	-	0.0%	US Census
2000	240,055	0.5%	5.0%	US Census
2010	247,597	0.3%	8.3%	US Census
2013	251,384	0.5%	10.0%	American Community Survey (ACS)
2018	270,753	1.5%	18.5%	US Census
2050	399,000	1.2%	75%	NJTPA 1.2% annual growth

B.3 PLANNED PROJECTS

The following JCMUA projects currently are underway or are planned for future implementation:

- As required by Consent Decree, JCMUA is proceeding with the Phase V, VI, and VII sewer replacement projects for the replacement of over 71,700 linear feet of combined sewers that have a structural rating of 4 or 5, which indicates that they are at risk of potential failure within five to ten years.
- Reconditioning the Claremont/Carteret Regulator Chamber and associated hardware.

- An internal dive inspection on the 96" outfall on Thomas McGovern Drive and the Claremont/Carteret 96" and 72" combined sewers.
- National Water Main is cleaning the combined sewers on Grand Street between Fairmount Street & Hudson Street.
- JCMUA's contractor is replacing the 18" combined sewer on Van Winkle Avenue between Kennedy Blvd. & Senate Street.

B.4 PROJECTED FUTURE WASTEWATER FLOWS

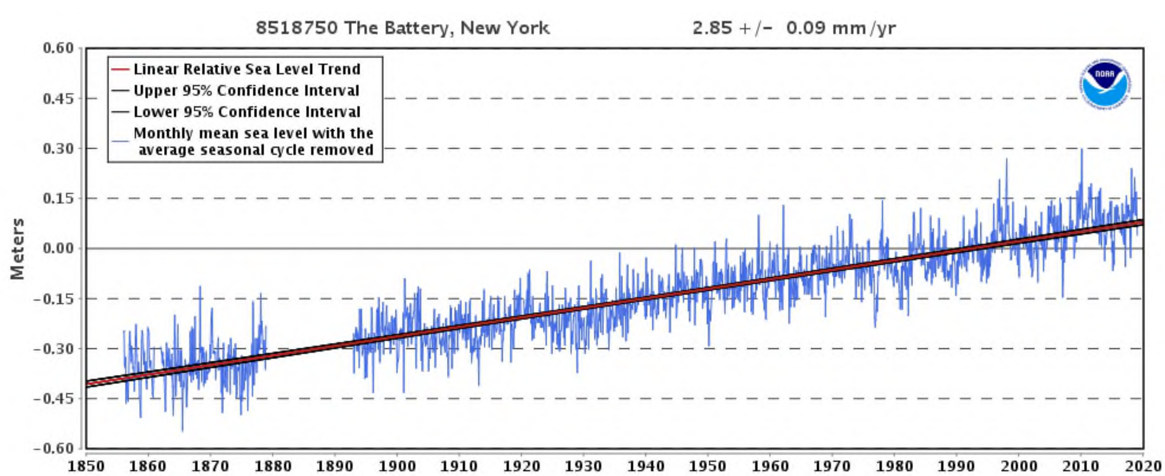
Current average dry weather flows in Jersey City are 34 MGD. By 2050, this average daily flow is projected to increase to 50.2 MGD. This flow projection is based upon the projected population growth, as estimated based on annual population growth rates from the NJTPA, only, and does not include the addition of significant industrial or commercial flows.

B.5 PROJECTED TIDAL & SEA LEVEL CHANGES DUE TO CLIMATE CHANGE

Tidal depth data for the typical year (2004) was obtained from the National Oceanic and Atmospheric Administration (NOAA). In consideration of sea level changes due to climate change, the projected tidal depth of 2050 is based on the historical long-term linear trend at the Battery station located in Battery Park in New York City.

Figure B.5-1, below, shows the projected monthly mean sea level at the Battery from 1856 to 2018 without the regular seasonal fluctuations due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents. The long-term linear trend also is shown. According to NOAA, the relative sea level trend is an increase of 0.94 feet in 100 years.

Figure B.5-1 Relative Sea Level Trend 8518750 the Battery, New York



Source: https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=8518750

Based on the relative sea level trend reported by NOAA, the sea level rise from 2004 to 2050 is extrapolated to be 0.43 feet. An addition of 0.43 feet is applied to each time step of the 2004 tidal time series to predict the 2050 tidal time series used in the model to simulate the receiving water body boundary in 2050. Based on the model simulation results, the number of overflows decreases by only 1 from 60 to 59 with 2050 predicted time series for base model. Therefore, the impact of sea level rise on CSO overflow is not considered for all the alternatives model simulation.

SECTION C SCREENING OF CSO CONTROL TECHNOLOGIES

C.1 INTRODUCTION

This section provides background and descriptions of the CSO control technologies that were considered for the JCMUA service area and introduces the unique conditions of the JCMUA CSS assessed to identify the effectiveness of the alternatives considered.

C.2 SOURCE CONTROL

The United States Environmental Protection Agency (EPA) defines source controls as those that impact the quality or quantity of runoff entering the combined sewer system. Source control measures can reduce volumes, peak flows, or pollutant discharges and may decrease the need for more capital-intensive technologies downstream in the CSS. However, source controls typically require a high level of effort to implement on a scale that can achieve a measurable impact. Source controls discussed in the following sections include both quantity control and quality control measures. Specifically, the source control measures considered for JCMUA include green infrastructure, stormwater management, and public outreach.

C.2.1 Green Infrastructure

A variety of factors were considered to evaluate the implementation of green infrastructure in Jersey City. The selected green infrastructure technology will need to be both visually appealing and effective at retaining at least 1 inch of rainwater from the designated treatment area. The green infrastructure technologies that were initially were roadside rain gardens/ bioswales, and tree pits. These technologies can be effective for both stormwater quantity control and stormwater quality control.

Roadside rain gardens/bioswales are flexible in that they can be designed to operate in a variety of locations and treat rainwater in a large impervious area. This technology is proven to be effective in certain applications. Roadside raingardens/bioswales are being implemented at large scales in cities such as New York City and Philadelphia. Given the design flexibility and the positive results in other cities, roadside rain gardens were chosen for further evaluation as a green infrastructure technology alternative.

Tree pits are another example of a green infrastructure alternative that is flexible and easy to implement. A tree pit allows stormwater to be absorbed by the soil and tree. Tree pits can be implemented in the City in accordance with City requirements, where space allows. The width of the sidewalk and the distance to electrical overhead wiring are factors that limit the variety of species of trees that can be successfully planted. For example, trees such as the Canadian Serviceberry (Amelanchier canadensis) are recommended for installation on narrow streets and under power lines. Tree pits are a flexible green infrastructure technology that were further evaluated as an alternative.

C.2.2 Stormwater Management

Stormwater management controls consist of measures designed to capture, treat, or delay stormwater prior to entering the CSS. Under Jersey City's Stormwater Management Program Criteria, Jersey City is a Tier A municipality due to its population of over 100,000 people. Therefore, Jersey City is required to maintain a Stormwater Management Plan, which includes Jersey City's ordinance requirements regarding control of stormwater.

C.2.2.1 Catch Basin Modification (Floatables Control)

One example of a stormwater management control that has been implemented in Jersey City is modifications to catch basins. Catch basins in Jersey City have been modified to include an inlet grate or plate that covers the traditionally large curb openings. This modification prevents large floatables from entering the CSS by reducing the amounts of street litter and debris that enter the catch basins. A potential disadvantage of catch basin outlet modifications and other insert-type devices is the fact that retained materials could clog the outlet if cleaning is not performed regularly (and cause ponding in streets). To prevent this from becoming an issue, Jersey City performs bi-weekly street cleaning.

C.2.3 Public Outreach Program

Public education and outreach are non-structural control measures aimed at limiting the negative effects of certain human behaviors on the CSS. Promoting certain human actions and discouraging others can impact the quality and quantity of water discharged to the receiving waterbodies. Jersey City has many beneficial programs, such as Adopt a Catch Basin, which help educate both students and the community about the Jersey City CSS. Jersey City and the JCMUA also hold community meetings throughout the city to educate the community about the CSS and the City's plans for the CSS. Such public outreach programs are discussed in greater detail in the Public Participation Process Report, May 2018, by PVSC on behalf of the group of participating permittees, of which the JCMUA is a member.

C.2.3.1 Catch Basin Stenciling

Stenciling consists of marking catch basins with symbols or text such as, "'Drains to the River". This measure can help increase public awareness of how the CSS works and discourage the public from dumping trash into the CSS. Jersey City takes stenciling a little further with its Adopt a Catch Basin program; adopted catch basins often have colorful murals of aquatic life painted on them to show that the CSS is connected to the water ways.

C.3 INFILTRATION AND INFLOW CONTROL

Excessive infiltration and inflow (I/I) can consume the hydraulic capacity of a collection system and increase overall operations and maintenance (O&M) costs. Inflow comes from sources such as roof drains, manhole covers, cross connections from storm sewers, catch basins, and surface runoff which enter the CSS by design. Within a CSS, surface drainage is the primary source of inflow. Infiltration refers to groundwater that seeps into the CSS through leaking pipe joints, cracked pipes, manholes, and other similar sources. The flow from infiltration tends to be constant, but at a lower volume than that of inflow.

Identifying I/I sources is labor intensive and requires specialized equipment. Significant I/I reductions can also be difficult and expensive to achieve. I/I reduction for combined sewers provides limited gains, since water tends to find another way into the system. However, the benefit of a good I/I control program is that it can save money by extending the life of the system, reducing the need for expansion, and lowering pumping and treatment costs.

C.4 SEWER SYSTEM OPTIMIZATION

The JCMUA has implemented a continuous program to optimize its sewer system that includes but is not limited to the following:

- The addition of two tide gates in series at each regulator outfall to reduce tidal inflow and prevent inadvertent tidal inflow leakages through tide gate redundancy
- Regular tide gate and Brown and Brown CSO regulator gate maintenance by JCMUA operations crews
- Periodic overhauls of tide gate gasket seals and the Brown and Brown regulator gates at each regulator
- Raising weir elevation whenever possible to obtain the highest inline storage in the sewers

These Items were first addressed between 2000 and 2004 as a result of the "JCMUA CSO Corrections Project and have been addressed again once every few years as deemed necessary by the JCMUA staff

C.4.1 Increased Storage Capacity in the Collection System

The JCMUA has taken measures to increase storage capacity in the collection system (i.e. increase inline storage). This started in 2000 with the designs of the netting facilities under Phases I and II of the "JCMUA CSO Correction Project, 1999," which also included several CSO regulator modifications for CSO abatement. During the various phases of the CSO Correction Project, the weirs at the Secaucus (RW1), Claremont/Carteret (RE 3/4), York (RE-11), and 18th Street (RE-19) regulators were raised to maximize inline storage in the combined sewers.

C.5 STORAGE

The objective of a storage alternative is to reduce overflows by capturing and storing wet weather flows within the system. Once the wet weather event subsides, the captured combined sewage will be pumped back into the system where it will be conveyed to the publicly owned treatment works (POTW) facility. A storage facility is sized to handle a certain quantity of flow. If a storm exceeds the design capacity of the storage system, the first flush, or the most hazardous combined sewage, will be captured and the remaining portion, which would be primarily stormwater, will overflow to the receiving waterbody. Storage technologies typically have high construction and O&M costs compared to other CSO control technologies, but they are a very reliable means of achieving CSO control goals. Inline storage, deep tunnels, and storage tanks, which are various types of storage technologies, were evaluated for Jersey City.

C.5.1 Inline Storage

Inline storage takes advantage of storage within the existing CSS pipes. In the past, the JCMUA increased inline storage by incrementally raising weir elevations until inline storage capacity was reached. Further raising the weir elevations would exacerbate street flooding. Therefore, inline storage as a CSO control technology was not further considered.

C.5.2 Tunnels

Tunnels were evaluated as a storage alternative in Jersey City. Tunnels are advantageous because they do not take up valuable aboveground area in the City, where land is very expensive. Tunnels will also be drilled about 100 feet below ground so they would not disturb any existing infrastructure or utilities. The east and west tunnel will be connected to the east and west side outfalls respectively by drop down shafts. Tunnels usually have a high overall cost, but their cost per million gallons of storage is reasonable compared to other storage technologies. Due to the relatively low cost per unit of storage and low conflicts with existing infrastructure, it was determined that a tunnel alternative was worth further analyzing for Jersey City.

C.5.3 Storage Tanks

Another technology for off-line storage of combined sewage is storage tanks/shafts, which temporarily store combined sewage during wet weather events until the downstream CSS and treatment facility have restored capacity. Implementation of this technology involves construction of large storage tanks directly upstream of existing outfalls. The storage tanks are covered, underground structures that typically include odor control facilities. A dewatering pump at each tank conveys the combined sewage through a force main back to the existing interceptor sewer after each wet weather event. To prevent flooding of upstream systems, the storage tanks are equipped with an overflow to discharge combined sewage to the receiving water body if the captured volume of combined sewage exceeds the available storage in the tank.

The use of storage tanks, sized to allow a targeted number of overflows per year, can effectively limit the quantity and frequency of CSOs. This technology can be implemented incrementally, with prioritization for construction of storage tanks in locations with more significant water quality concerns or flooding issues. Drawbacks of this technology include the relatively large land area requirements, high construction and O&M costs, and potential odor issues.

The April 2007 Cost and Performance Analysis Report (2007 Report) that was prepared for the JCMUA by Malcolm Pirnie, Inc. (now Arcadis) evaluated two options for off-line storage tanks: nine "grouped" tanks (each of the nine tanks serves one or more outfalls) and twenty-one individual tanks (one tank for each outfall). The 2007 Report concluded that the nine grouped tanks option was more cost effective than the individual tanks option. Therefore, the current report only evaluates the nine grouped tanks option as an alternative.

C.6 STP EXPANSION OR STORAGE AT THE PLANT

CSOs potentially can be reduced by increasing the treatment capacity of the plant. The plant expansion allows a larger portion of wet weather flows to be directed to the treatment plant instead of being discharged to receiving waterbodies. Increasing the portion of flows that is directed to the treatment plant cannot entirely achieve CSO abatement controls because the existing interceptors cannot convey sufficient wet weather flows to the East and West Side Pump Stations to achieve 85% capture, one of the Presumption criteria approaches listed in the US EPA CSO Control Policy.

However, increasing the flow capacity of the East and West Side Pump Stations may reduce the size of other technologies that are being evaluated in Section D of this report and may remain on the alternatives short list to explore further cost saving impacts during the final selection process in 2019 or 2020.

C.7 SEWER SEPARATION

Sewer separation refers to conversion of the CSS into separate stormwater and sanitary systems. This can involve construction of a new stormwater conveyance system and utilization of the existing CSS for sanitary only, or vice versa. Sewer separation eliminates the occurrence of combined sewage back-ups into streets or basements. In a complete sewer separation scenario, sanitary flows would be conveyed to the treatment plant during wet weather and dry weather and stormwater flows would discharge directly to receiving waterbodies. Complete sewer separation meets water quality goals by significantly reducing the quantities of fecal coliform and other bacteria that enter receiving waters; complete sewer separation is considered the only technology that can achieve zero combined sewer overflows. However, complete sewer separation is costly and disruptive to the public, especially in highly dense urban areas such as Jersey City. Partial sewer separation in critical areas that are susceptible to flooding can be beneficial and cost effective. The JCMUA has performed various sewer separation projects since the mid-2000's on Washington Street and Essex Street.

C.8 TREATMENT OF CSO DISCHARGE

JCMUA evaluated several treatment options to manage compliance with NJPDES General Permit guidelines for its CSS along with the EPA Guidance for Long Term Control Plans. The evaluation considered the following abatement technologies (all of which are discussed in greater lengths in the PVSC CSO Long Term Control Plan Updated Technical Guidance Manual, January 2018):

- Screenings
    - Netting Systems
    - Fine Screens
    - Band and Belt Screens
    - Drum Screens
- Pretreatment Technologies
    - Vortex/Swirl Separation Technology
    - Ballasted Flocculation
    - Compressible Media Filtration Process
- Disinfection
    - Chlorine Dioxide

- Sodium Hypochlorite
- Peracetic Acid (PAA) Disinfection
- UV Disinfection

The JCMUA already has netting/screening systems on all CSO outfalls. Screening and pretreatment technologies are extensively reviewed and evaluated in the PVSC CSO Long Term Control Plan Updated Technical Guidance Manual (PVSC TGM 2018), and thus the following discussion will pertain exclusively to the evaluation of the disinfection options. Chlorine dioxide will be excluded from further evaluation as it has many drawbacks, including safety issues during transport and storage, stability, and production of toxic byproducts. Sodium hypochlorite is one disinfection option that the JCMUA may consider if necessary: however, this process will likely require the addition of sodium bisulfite for dechlorination which raise O&M costs higher than other alternative disinfectant such peracetic acid. Disinfection typically is performed on a total suspended solids (TSS)-reduced stream following screening and other pretreatment. The efficiencies of the disinfection alternatives listed above are affected by the TSS concentration of the liquid that is being disinfected. The costs that are presented in the following discussion do not include those prior treatment steps.

Based on the results of an EPA-funded pilot study investigating the use of PAA for disinfection of CSOs in Bayonne, NJ, which are presented in the "Wet Weather Flow Treatment and Disinfection Demonstration Project Report, September 2017" (2017 Disinfection Report) a minimum dosage of 0.01 mg/L of PAA per 1 mg/L of chemical oxygen demand (COD) would be required to meet requirements of disinfection. The study also indicated that a dosage of 0.015 mg/L of PAA per 1 mg/L of COD would provide an additional log magnitude of disinfection. PAA often is found commercially as a 12% concentration and costs, on average, between $3.00-$5.50 per gallon. The average COD based on sampling was approximately 310 mg/L. Therefore, disinfection using PAA for the JCMUA would cost approximately $107M. A detailed cost evaluation for the lower dosage (0.01 mg/L of PAA per 1 mg/L of COD), which meets disinfection limits for the JCMUA CSO study, is shown in Appendix A.

PAA is not widely used in practice and thus the cost per gallon is relatively expensive compared to other disinfectants (i.e. hypochlorite, etc.). Further, disinfection would require pretreatment and thus there would be requirements for flocculation/separation. Based on the 2007 Cost and Performance Analysis Report, a Floc Sep system would cost approximately $850M in 2018 dollars and thus the total treatment system including disinfection would amount to nearly $960M. Treatment/disinfection is screened out from further consideration because this combined level of treatment is a very high cost solution to CSO abatement, specifically compared to the storage alternatives, and costs are consistent with the higher costs determined in the 2007 report.

C.9 SCREENING OF CONTROL TECHNOLOGIES

A listing of all the alternatives considered during this screening process is shown in Tables C.9-1 through C.9-3. These tables show all the source, collection system, storage, and treatment control technology alternatives considered for this screening process. Eight alternatives from the larger group of alternatives have been selected for more detailed evaluation and analysis based upon the following:

- Potential for reduction of pathogens, CSO volume, and sewer related flooding
- Flexibility to be combined with other CSO abatement technologies
- Current implementation and operation factors
- New Jersey Department of Environmental Protection (NJDEP) permit requirements

Table C.9-1: Screening table for Source Control Technologies

Technology Group	Practice	Primary Goals		Community Benefit	Implementation & Operation Factors	Consider Combining w/ Other	Being Implemented	Recommendation for Alternatives Evaluation
		Bacteria Reduction	Volume Reduction					
Stormwater Management	Street/Parking Lot Storage (Catch Basin Control)	Low	Low	- Reduced surface flooding potential	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	Yes*	No
	Catch Basin Modification (for Floatables Control)	Low	None	- Water quality improvements - Reduced surface flooding potential	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	Yes	No
	Catch Basin Modification (Leaching)	Low	Low	- Reduced surface flooding potential - Water quality improvements	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	- Reduced surface flooding potential - Align with goals for a sustainable community	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	- Align with goals for a sustainable community	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	Yes*	No
	Community Cleanup Programs	None	None	- Water quality improvements - Align with goals for a sustainable community	Inexpensive; sense of community ownership; educational BMP; aesthetic enhancement. Community cleanups are inexpensive and build ownership in the city.	Yes	Yes	No
	Public Outreach Programs	Low	None	- Align with goals for a sustainable community	Public education program is ongoing. Permittee should continue its public education program as control measures demonstrate implementation of the NMC.	Yes	Yes	No
	FOG Program	Low	None	- Water quality improvements - Improves collection system efficiency	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	Yes	No
	Garbage Disposal Restriction	Low	None	- Water quality improvements	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	- Water quality improvements	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	- Water quality improvements	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	Yes*	No
	Hazardous Waste Collection	Low	None	- Water quality improvements	The N.J.A.C prohibits the discharge of hazardous waste to the collection system.	Yes	Yes	No
	Construction Site Erosion & Sediment Control	None	None	- Cost-effective water quality improvements	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	Yes*	No

Table C.9-1: Screening table for Source Control Technologies

Technology Group	Practice	Primary Goals		Community Benefit	Implementation & Operation Factors	Consider Combining w/ Other	Being Implemented	Recommendation for Alternatives Evaluation
		Bacteria Reduction	Volume Reduction					
Ordinance Enforcement	Illegal Dumping Control	Low	None	- Water quality improvements - Aesthetic benefits	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	Yes	No
	Pet Waste Control	Medium	None	- Water quality improvements - Reduced surface flooding	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	Yes*	No
	Litter Control	None	None	- Property value uplift - Water quality improvements - Reduced surface flooding	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	Yes*	No
	Illicit Connection Control	Low	Low	- Water quality improvements - Align with goals for a sustainable community	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	Yes*	No
Good Housekeeping	Street Sweeping/Flushing	Low	None	- Reduced surface flooding potential	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	- Reduced surface flooding potential - Aesthetic benefits	Requires additional seasonal labor. Leaf collection maximizes flow capacity and removes nutrients from the collection system.	Yes	Yes*	No
	Recycling Programs	None	None	- Align with goals for a sustainable community	Most Cities have an ongoing recycling program.	Yes	Yes	No
	Storage/Loading/Unloading Areas	None	None	- Water quality improvements	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	Yes*	No
	Industrial Spill Control	Low	None	- Protect surface waters - Protect public health	PVSC has established a pretreatment program for industrial users subject to the Federal Categorical Pretreatment Standards 40 CFR 403.1.	Yes	Yes**	No
Green Infrastructure Buildings	Green Roofs	None	Medium	- Improved air quality - Reduced carbon emissions - Reduced heat island effect - Property value uplift - Local jobs - Reduced surface flooding - Reduced basement sewage flooding - Align with goals for a sustainable community	Adds modest cost to new construction; not applicable to all retrofits; low operational resource demand; will require the Permitee or private owners to implement; requires regular cleaning of gutters & pipes; upkeep of roof vegetation. Portions of Cities have densely populated areas, but this technology is limited to rooftops. Can be difficult to require on private properties.	Yes	Yes*	No
	Blue Roofs	None	Medium	- Reduced heat island effect - Property value uplift - Local jobs - Reduced surface flooding - Reduced basement sewage flooding - Align with goals for a sustainable community	Adds modest cost to new construction; not applicable to all retrofits; low operational resource demand; will require the Permitees or private owners to implement; requires regular cleaning of gutters & pipes; upkeep of roof debris. Portions of the Cities have densely populated areas, but this technology is limited to rooftops. Can be difficult to require on private properties.	Yes	Yes*	No
	Rainwater Harvesting	None	Medium	- Reduced surface flooding - Reduced basement sewage flooding - Align with goals for a sustainable community - Water Saving	Simple to install and operate; low operational resource demand; will require the Permitees or private owners to implement; requires regular cleaning of gutters & pipes. Portions of the Cities have densely populated areas, but this technology is limited to capturing rooftop drainage. Capture is limited to available storage, which can vary on rainwater use. Can be difficult to require on private properties.	Yes	Yes*	Yes*

Table C.9-1: Screening table for Source Control Technologies

Technology Group	Practice	Primary Goals		Community Benefit	Implementation & Operation Factors	Consider Combining w/ Other	Being Implemented	Recommendation for Alternatives Evaluation
		Bacteria Reduction	Volume Reduction					
Green Infrastructure Impervious Areas	Permeable Pavements	Low	Medium	- Improved air quality - Reduced carbon emissions - Reduced heat island effect - Property value uplift - Cost-effective water quality improvements - Reduced surface flooding - Reduced basement sewage flooding - Align with goals for a	Not durable and clogs in winter; oil and grease will clog; significant O&M requirements with vacuuming and replacing deteriorated surfaces; can be very effective in parking lots, lanes and sidewalks. Maintenance requirements could be reduced if located in low-traffic areas, and can utilize underground infiltration beds or detention tanks to increase storage.	Yes	Yes*	No
	Planter Boxes with Trees	Low	Medium	- Improved air quality - Reduced carbon emissions - Reduced heat island effect - Property value uplift - Reduced surface flooding - Reduced basement sewage flooding - Align with goals for a sustainable community	Site specific; good BMP; minimal vegetation & mulch O&M requirements with regular overflow and underdrain cleaning; effective at containing, infiltrating and evapotranspirating runoff in developed areas. Flexible and can be implemented even on a small-scale to any high-priority drainage areas. Underground infiltration beds or detention tanks can be utilized to increase storage.	Yes	Yes*	Yes
Green Infrastructure Pervious Areas	Bioswales	Low	Low	- Improved air quality - Reduced carbon emissions - Reduced heat island effect - Property value uplift - Local jobs - Passive and active recreational improvements - Reduced surface flooding - Reduced basement sewage flooding - Community aesthetic improvements - Reduced crime	Site specific; good BMP; minimal vegetation & mulch O&M requirements; not as flexible or infiltrate as much stormwater as planter boxes. Technology requires open space and is primarily a surface conveyance technology with additional storage & infiltration benefits. Can be modified with check dams to slow water flow. Limited open space in most Cities means land can be utilized in more effective ways with the existing infrastructure.	Yes	Yes*	Yes*
	Free-Form Rain Gardens or Trees or including Trees	Low	Medium	- Improved air quality - Reduced carbon emissions - Reduced heat island effect - Property value uplift - Passive and active recreational improvements - Reduced surface flooding - Reduced basement sewage flooding - Community aesthetic improvements	Site specific; good BMP; minimal vegetation & mulch O&M requirements with regular overflow and underdrain cleaning; effective at containing, infiltrating and evapotranspirating diverted runoff. Rain Gardens are flexible and can be modified to fit into the previous areas. Underground infiltration beds or detention tanks can be utilized to increase storage.	Yes	Yes*	Yes*

* - Implemented: some combinaed of these technologies are required for new developments via the Jersey City Stormwater Ordinance and SWMP intially in 2007

** implemented indirectly via PVSC pretreatment control requirements

Table C.9-2: Screening table for Collection System Technologies

Technology Group	Practice	Primary Goals		Community Benefit	Implementation & Operation Factors	Consider Combining w/ Other Technologies	Being Implemented	Recommendation for Alternatives Evaluation
		Bacteria Reduction	Volume Reduction					
Operation and Maintenance	I/I Reduction	Low	Medium	- Water quality improvements - Reduced basement sewage flooding	Requires labor intensive work; changes to the conveyance system require temporary pumping measures; repairs on private property required by homeowners. Reduces the volume of flow and frequency; Provides additional capacity for future growth; House laterals account for 1/2 the sewer system length and significant sources of I/I in the sanitary sewer.	Yes	Yes	Yes
	Advanced System Inspection & Maintenance	Low	Low	- Water quality improvements - Reduced basement sewage flooding	Requires additional resources towards regular inspection and maintenance work. Inspection and maintenance programs can provide detailed information about the condition and future performance of infrastructure. Offers relatively small advances towards goals of the LTCP.	No	Yes	No
	Combined Sewer Flushing	Low	Low	- Water quality improvements - Reduced basement sewage flooding	Requires inspection after every flush; no changes to the existing conveyance system needed; requires flushing water source. Ongoing: CSO Operational Plan; maximizes existing collection system; reduces first flush effect.	No	Yes	No
	Catch Basin Cleaning	Low	None	- Water quality improvements - Reduced surface flooding	Labor intensive; requires specialized equipment. Catch Basin Cleaning reduces litter and floatables but will have no effect on flow and little effect on bacteria and BOD levels.	No	Yes	No
Combined Sewer Separation	Roof Leader Disconnection	Low	Low	- Reduced basement sewage flooding	Site specific; Includes area drains and roof leaders; new storm sewers may be required; requires home and business owner participation. The Cities are densely populated and disconnected roof leaders have limited options for discharge to pervious space. Disconnection may be coupled with other GI technologies but is not considered an effective standalone option.	Yes	Yes	No
	Sump Pump Disconnection	Low	Low	- Reduced basement sewage flooding	Site specific; more applicable to separate sanitary system; new storm sewers may be required; interaction with homeowners required. The Cities are densely populated and disconnected sump pumps have limited options for discharge to pervious space. Disconnection may be coupled with other GI technologies but is not considered an effective standalone option.	No	Yes	No
	Combined Sewer Separatior	High	High	- Water quality improvements - Reduced basement sewage flooding - Reduced surface flooding	Very disruptive to affected areas; requires homeowner participation; sewer asset renewal achieved at the same time; labor intensive.	No	Yes	Yes
Combined Sewer Optimization	Additional Conveyance	High	High	- Water quality improvements - Reduced basement sewage flooding	Additional conveyance can be costly and would require additional maintenance to keep new structures and pipelines operating.	Yes	Yes	Yes
	Regulator Modifications	Medium	Medium	- Water quality improvements	Relatively easy to implement with existing regulators; mechanical controls requires O&M. May increase risk of upstream flooding. Permitees have an ongoing O&M program and system wide replacement program for CSO regulators and tide gates.	Yes	No	No
	Outfall Consolidation/Reloca	High	High	- Water quality improvements - Passive and active recreational improvements	Lower operational requirements; may reduce permitting/monitoring; can be used in conjunction with storage & treatment technologies. Combining and relocating outfalls may lower operating costs and CSO flows. It can also direct flow away from specific areas.	Yes	No	No
	Real Time Control	High	High	- Water quality improvements - Reduced basement sewage flooding	Requires periodic inspection of flow elements; highly automated system; increased potential for sewer backups. RTC is only effective if additional storage capacity is present in the system.	Yes	No	No

Table C.9-3: Screening table for Storage Treatment Technologies

Technology Group	Practice	Primary Goals		Community Benefit	Implementation & Operation Factors	Consider Combining w/ Other Technologies	Being Implemented	Recommendation for Alternatives Evaluation
		Bacteria Reduction	Volume Reduction					
Linear Storage	Pipeline	High	High	- Water quality improvements - Reduced surface flooding potential - Local jobs	Can only be implemented if in-line storage potential exists in the system; increased potential for basement flooding if not properly designed; maximizes use of existing facilities. Pipe storage for a CSS typically requires large diameter pipes to have a significant effect on reducing CSOs. This typically requires large open trenches and temporary closure of streets to install.	No	No	No
	Tunnel	High	High	- Water quality improvements - Reduced surface flooding potential	Requires small area at ground level relative to storage basins; disruptive at shaft locations; increased O&M burden.	No	Yes	Yes
Point Storage	Tank (Above or Below Ground)	High	High	- Water quality improvements - Reduced basement sewage flooding	Storage tanks typically require pumps to return wet weather flow to the system which will require additional O&M; disruptive to affected areas during construction. Several CSO outfalls have space available for tank storage. There may be existing tanks in abandoned commercial and industrial areas to be converted to hold stormwater. Tanks are an effective technology to reduce wet weather CSO's.	No	Yes	Yes
	Industrial Discharge Detention	Low	Low	- Water quality improvements	Requires cooperation with industrial users; more resources devoted to enforcement; depends on IUs to maintain storage basins. IUs hold stormwater or combined sewage until wet weather flows subside; there may be commercial or industrial users upstream of CSO regulators.	Yes	No	No
Treatment-CSO Facility	Vortex Separators	None	None	- Water quality improvements	Space required; challenging controls for intermittent and highly variable wet weather flows. Vortex separators would remove floatables and suspended solids when installed. It does not address volume, bacteria or BOD.	Yes	No	No
	Screens and Trash Racks	None	None	- Water quality improvements	Prone to clogging; requires manual maintenance; requires suitable physical configuration; increased O&M burden. Screens and trash racks will only address floatables.	Yes	No	No
	Netting	None	None	- Water quality improvements	Easy to implement; labor intensive; potential negative aesthetic impact; requires additional resources for inspection and maintenance. Netting will only address floatables.	Yes	Yes	No
	Contaminant Booms	None	None	- Water quality improvements	Difficult to maintain requiring additional resources. Contaminant booms will only address floatables.	Yes	No	No
	Baffles	None	None	- Water quality improvements	Very low maintenance; easy to install; requires proper hydraulic configuration; long lifespan. Baffles will only address floatables.	Yes	No	No
	Disinfection & Satellite Treatment	High	None	- Water quality improvements - Reduced basement sewage flooding	Requires additional flow stabilizing measures; requires additional resources for maintenance; requires additional system analysis. Disinfection is an effective control to reduce bacteria and BOD in CSO's.	No	No	No
	High Rate Physical/Chemical Treatment (High Rate Clarification Process - ActiFlo)	None	None	- Water quality improvements	Challenging controls for intermittent and highly variable wet weather flows; smaller footprint than conventional methods. This technology primarily focuses on TSS & BOD removal, but does not help reduce the bacteria or CSO discharge volume.	Yes	No	No
	High Rate Physical (Fuzzy Filters)	None	None	- Water quality improvements	Relatively low O&M requirements; smaller footprint than traditional filtration methods. This technology primarily focuses on TSS removal, but does not help reduce the bacteria or CSO discharge volume.	Yes	No	No
Treatment-WRTP	Additional Treatment Capacity	High	High	- Water quality improvements - Reduced surface flooding - Reduced basement sewage flooding	May require additional space; increased O&M burden.	No	No	No
	Wet Weather Blending	Low	High	- Water quality improvements - Reduced surface flooding - Reduced basement sewage flooding	Requires upgrading the capacity of influent pumping, primary treatment and disinfection processes; increased O&M burden. Wet weather blending does not address bacteria reduction, as it is a secondary treatment bypass for the POTW. Permittee must demonstrate there are no feasible alternatives to the diversion for this to be implemented.	Yes	Yes	No
Treatment-Industrial	Industrial Pretreatment Program	Low	Low	- Water quality improvements - Align with goals for a sustainable community	Requires cooperation with Industrial User's; more resources devoted to enforcement; depends on IU's to maintain treatment standards. May require Permits.	Yes	Yes	Yes**

** implemented indirectly via PVSC pretreatment control requirements

Section D of this report presents the detailed evaluations of the selected alternatives. From this point of this Alternative Report forward, the term "Alternatives" shall mean these alternatives that have been selected for detailed evaluation based on the criteria established for the PVSC regional approach of the CSO permittees in Section D.SECTION D ALTERNATIVES ANALYSIS

D.1 DEVELOPMENT AND EVALUATION OF ALTERNATIVES

This section of the Alternatives Report presents the detailed evaluation of CSO control technologies under consideration for the JCMUA CSS, as identified in Section C. The alternatives are evaluated in accordance with the factors of siting, institutional issues, implementability, public acceptance, and performance.

D.1.1 Siting

The following sections present the methodology used to determine the siting considerations for each of the alternatives. As described, the alternatives range from being sited entirely within the public right-of-way of roads to requiring construction in public spaces or easements on private properties.

D.1.1.1 Siting for Inflow and Infiltration Collection System Controls

A total of 6,926 pipe segments (approximately 67% of the sewer pipes in the JCMUA system) were inspected to identify defects and to classify the type of defect according to Pipeline Assessment Certification Program (PACP) standards (stain, weeper, dripper, runner and gusher). The results of these inspections determined that 805 pipe segments, representing a total length of 87,896 ft, should be replaced or rehabilitated to decrease I/I in the JCMUA system. Figure D.1-1 shows the pipe segments that were recommended for replacement or rehabilitation and the type of defect found in each segment. Additional quantitative discussion is provided in Section D.1.5.1, which presents the projected I/I flows that may be removed from each Subdrainage Area (SDA) through pipe replacement or rehabilitation.

D.1.1.2 Siting for Separate Sewer Collection System Controls

As stated in Section C.7, partial sewer separation projects can be effective for alleviating combined sewage flooding. For evaluation of the sewer separation alternative, a sewer separation project in the Bates Street Redevelopment Area was considered. As described in the JCMUA System Characterization Report dated June 2018 as prepared by Arcadis U.S., Inc, the Bates Street Redevelopment Area is located within the area of Jersey City with the highest flood activity, so there is a strong case for the sewer separation project. The design drawings associated with the Bates Street Redevelopment Area sewer separation are included as Appendix B to this Alternatives Report.

D.1.1.3 Siting for Green Infrastructure Source Controls

Roadside rain gardens/bioswales are installed in sidewalks along roadways with curb cut-outs to allow street runoff to enter the rain garden and for excess water to exit when the rain garden is at capacity. Rain gardens typically are four to five feet wide and ten to twenty feet long. They can be placed on any sidewalk if they do not interfere with utilities or the pedestrian right of way. Rain gardens are most effective in areas with at least ten feet of depth to bedrock or ground water. Optimal areas for green infrastructure were chosen using boring data gathered from previous projects around the City. The borings were plotted in GIS and shape files were drawn with the assistance of a rock geology map

~~to~~ that encompass areas which haved groupings of favorable borings with depth to rock and ground water in excess of ten feet. The optimal green infrastructure areas cover 297 acres of Jersey City and contain 7% of the City's impervious area. Figure D.1-2 shows the optimal green infrastructure locations. Previous studies for the JCMUA had identified additional sites that could be utilized, although they are not optimal due to high ground water or bedrock. These additional sites are shown in Figure D.1-3 and could be considered for use to achieve green infrastructure coverage controls up to 10% of Jersey City's impervious areas if the JCMUA chooses the green infrastructure alternative. Testing would be required to confirm the use of these additional sites

Tree pits can be placed anywhere in Jersey City where allowed by permit. According to the Jersey City Forestry Standards, a tree pit is typically five feet wide, ten feet long, and two feet deep when installed on a sidewalk at least ten feet wide. The area of exposed soil is five feet by five feet with the remainder covered by porous pavers or pavement. Any sidewalk less than eight feet wide would require the forester's approval. Signs and utilities also must be considered when placing tree pits; details on the required clearances can be found in the Jersey City Forestry Standards.

D.1.1.4 Siting for Maximizing Flow to the POTW

During an LTCP coordination meeting with PVSC, JCMUA and other Hudson County representatives with their Consultant on March 8, 2019, it was proposed that a total wet weather flow of 235 MGD could be accommodated by the PVSC for the Hudson County force main contributors to maximize the flow to the POTW. For the JCMUA, an upgrade of the existing East and West Side Pump Stations would be required along with a new 12,000 L.F. shared 9-foot diameter force main to the plant that is substantially larger than the existing force main. The new and larger force main would convey the additional wastewater flows from the East and West Side Pump Station to PVSC from the JCMUA system. It is assumed that the new, larger force main would follow parallel to the existing 6-foot diameter force main. Further study would be required to determine the specifications of the larger diameter force main and implementation schedule which would include flow allocation/costs for the Hudson County force main contributors.

D.1.1.5 Siting for Off-line Storage with Tunnels

As part of this alternative analysis, an off-line storage tunnel was considered for JCMUA. The tunnel alternative consists of two tunnels, the East Tunnel and the West Tunnel. The East Tunnel would intersect all the outfalls on the east side of Jersey City, and the West Tunnel would intersect all the outfalls on the west side of Jersey City to capture CSO. The East and West Tunnels would provide additional off-line storage and channel water to storage tanks located near the east and west pump stations respectively. These tanks allow for additional storage which decreases the diameter of the tunnel and can be modified to provide additional treatment (disinfection) if required. Each tank includes a pumping station that pumps water out of the tunnel and to the wet well of the East and West Side Pump Stations, respectively. The pumps installed at the tunnel pump station were modeled to pump at a rate just below the east and west side pump station rates, to not overwhelm them. The tunnels were sized for 4, 8, 12, and 20 overflows using the modeling software PCSWMM. These targeted numbers of overflows were achieved using the existing pump capacity. The diameters of the tunnels range from 6.5 feet to 12 feet depending on the pump scenario and target number of overflows.

The projected paths of the tunnels can be seen in Figure D.1-4. The paths of the tunnels were chosen to maximize the ease of drilling and limit the number of drop shafts by minimizing the number of bends. The paths of the tunnels as currently identified can take advantage of public easements whenever possible. The tunnels will be drilled 100 feet beneath the ground in bedrock and will not interfere with any existing utilities. The depth of the tunnel was chosen so that drilling can be completed in bedrock. The overall siting score for tunnel storage would be high due to the minimal surface disruption.

D.1.1.6 Siting for Off-line Storage with Storage Tanks/Treatment Shafts

As stated in Section C.5, the off-line storage tank alternative involves construction of nine grouped storage tanks in proximity to existing combined sewer outfalls. Preliminary grouped tanks have a depth range for 4 overflows to 20 overflows to keep that the diameter of tank (land use) from significant changes, shown in table D.1-3, which has already taken the feasible land area availability in consideration at the selected sites. Several factors were taken into consideration for selection of sites for storage tanks and new gravity sewers to connect existing outfalls. Preference was given to public easements, public land and undeveloped lots. There is no intention to build tanks in ~~the~~ an area with development. For the multi-use purpose, the tanks are preferably built under the surface, so it is beneficial to combine GI technology or site under parks or parking lots (i.e. -subsurface). It is ~~inevitable~~ not possible to build grouped tanks without additional piping. In the grouped tanks alternative, only 9 outfalls are active in service and the flow to other outfalls are routed to the grouped tanks~~other outfalls are closed~~. Thus, each active outfall and its associated tank need pipes to connect to the upstream of the closed outfalls in its proximity. New gravity sewers were routed through the public right-of-way wherever possible. Each grouped tank has a pump to ~~drain ou~~pump back ~~t~~ the stored flow after rain events, ~~but there is no greater flow pumped~~the pump back rate is designed to be below ~~exceeding~~ the force main capacity to PVSC. The preliminary locations for the nine grouped storage tanks are shown in Figure D.1-5.

D.1.2 Institutional Issues

Institutional issues pertain to factors and influences from various organizational, social, community, or other special interest groups that may have significant impacts on the success or failure of a given project. Proposed CSO abatement projects in Jersey City may meet significant resistance if various institutional issues are not adequately addressed in advance to meet the given institution's needs or desires. Sometimes giving more to an institution's requests can aid in achieving overall project approval even though the portion of the project that contributes to the given institution's cause may only represent a small portion of the overall project. In Jersey City, the relevant institutional issues and their potential impacts to the alternatives that have been selected for further evaluation are as follows:

- **Real Estate:** Since Jersey City has a very successful real estate market this may make alternatives that require land, such as tunnels with access shafts and/or storage tanks, less favorable to those real estate institutions. Alternatives such as collection system controls, sewer separation, and green infrastructure would be located in easements or public rights-of-way which is neutral territory for most real estate institutions. Developers are a real estate institution that can have significant impact on a project. A developer's representative attended one of the six public LTCP presentations given by the JCMUA and Arcadis. Green infrastructure would seem to be more favorable and can enhance real estate values in certain areas.

- **Location equity:** The tunnel and storage tank alternatives will generally be located near the waterfront areas of Jersey City because that is the final discharge location of the CSO outfalls. In the western drainage area, some outfalls are located in remote areas. In the northern and eastern CSS drainage areas, the areas surrounding outfalls have high density housing complexes, cultural centers, parks, and are, in some cases, within historic districts, where there may be more resistance to these types of structures. Collection system and sewer separation projects may meet temporary discord during construction; however, since they are in public easements the impacts would be minor, and with a robust public participation program, it should be manageable. Green infrastructure likely would be more favorable and pleasing to all the public regardless of location. Care should be taken to ensure that implementation of the CSO control technologies is fairly distributed across groups of varying socioeconomic status.
- **Government institutions:** NJ Transit, the US Postal Service, and County agencies, and State parklands are government institutions that will have to be managed with all the alternatives.
- **Special Interest Groups:** Multiple members from START, Sustainable Jersey City, and the Hudson County Sierra Club Group have attended at least one of six public presentation events about the evaluation of these alternatives. They clearly have stated that they want more green infrastructure including, but not limited to, bioswales, rain gardens, trees, and rain barrels or cisterns included in the JCMUA plan.
- **Utility rate payers:** Since this LTCP will require rate increases to cover the costs, most Jersey City rate payers have an interest in the selection and implementation of alternatives. With respect to the implementation of alternatives to address CSOs, it is important to provide technically sound and cost-effective solutions to mitigate impacts to the rates.

Based upon the facts or probable outcomes described above, the overall ratings for institutional issues are as follows:

- Green infrastructure should rank the as the highest regarding institutional issues.
- Rehabilitation of I/I should rank very high.
- Replacement of pipe for I/I removal and sewer separation will probably rank good with institutional issues since the public outreach to communicate the high age of Jersey City's sewers has been significant and the flood problems also are well known in the selected areas.
- Storage tanks and tunnels will have the greatest difficulty with institutional issues, so they have a poor rating.

The institutional ranks as scores are shown and discussed further relative to the other evaluation criteria in Section D.3.1.

D.1.3 Implementability

Implementability and technical issues for each alternative identified in this JCMUA Alternatives Report were evaluated based on criteria from the EPA CSO Guidance for Long-Term Control Plan document. For the current analysis, implementability and technical issues consist of constructability, reliability, operability, and adaptability. As discussed further in Section D.3.1, these factors will be graded on a 1-5 scale (1=poor, 2=fair, 3=good,4=very good, 5=excellent). Definitions of these factors for the current evaluation are as follows:

- **Constructability** – Constructability refers to the level of challenges associated with activities during the project construction phase. While cost usually is a driving factor behind whether a project is implemented or not, there are other qualitative issues that affect constructability. Projects that take place near the surface and are of a smaller scale would receive a grade of excellent in constructability. Projects that require a river crossing or rely on complex machinery or other complicated construction methods would receive a poor score in constructability.
- **Reliability** – There are many technologies and techniques that have been developed to manage CSOs. The reliability score is based on the track record of these technologies as well as their complexity. Complexity increases with the amount of moving parts involved with the technology. Technologies that are proven and have been implemented successfully in other locations would receive a higher score, while an alternative that has not been proven or successfully implemented and has many moving parts would receive a poor score.
- **Operability** – Consideration of operability includes the requirements for personnel to complete O&M and waste management. An alternative that requires skilled personnel for O&M and that generates a large amount of waste, or waste that has difficult disposal, would receive a poor score.
- **Adaptability** – The ability for an alternative to be implemented in phases affects the adaptability score. Phased implementation is beneficial because the capital costs can be distributed over time. Additionally, implementing an alternative in small parts allows the earlier phases to be used to guide later phases and to determine whether the alternative should be implemented across the City. If an alternative can effectively be implemented in various locations or in phases, it would receive an excellent score. If the location for implementation is restricted and the project can only be completed in large parts, the alternative would receive a poor score.

The following sections present the evaluations of each alternative based on the framework described above in accordance with the EPA guidance.

D.1.3.1 Implementability for Inflow and Infiltration Collection System Controls

Pipe replacement/rehabilitation for infiltration and inflow control requires labor intensive work and changes to the conveyance system require temporary pumping measures. However, it will result in reduced volume of flow and additional capacity for future growth. It may also decrease the chance of neighborhood flooding or water in basements. It can be considered for combination with other technologies to provide effective solutions.

Pipe Lining Alternative

- **Constructability** – Pipe lining received an excellent score in constructability since the lining is easy to construct and at a small scale.
- **Reliability** – Pipe lining received a very good score in reliability. It is a widely applied technology and not complex to implement, with solid performance.
- **Operability** – Pipe lining received an excellent score in operability. It does not require skilled personnel and generates little waste.
- **Adaptability** – Pipe lining received an excellent score in adaptability. It can easily be phased in various locations, over a period of time, at a small scale.

Pipe Replacement Alternative

- **Constructability** – Pipe replacement received a poor score in constructability. There are many challenges including conflicts with existing utilities, extensive impacts to traffic, and coordination with individual properties to re-connect service lines.
- **Reliability** – Pipe replacement received an excellent score in reliability. It is a widely applied, effective technology and has limited moving parts.
- **Operability** – Pipe replacement received an excellent score in operability. It does not require skilled personnel and generates little waste.
- **Adaptability** – Pipe replacement received a very good score in adaptability. It can easily be phased in various locations over a period of time.

D.1.3.2 Implementability for Separate Sewer Collection System Controls

Sewer separation is a reliable and adaptable technology, but its primary drawback is constructability challenges associated with the construction of additional pipelines.

- **Constructability** – There are many challenges associated with construction of separated sewers, including conflicts with existing utilities, extensive impacts to traffic, and coordination with individual properties to re-connect service lines.
- **Reliability** – Sewer separation is considered highly reliable because separated sewer systems are a proven technology and have been widely implemented within the region and nation. Separate sewer systems have low complexity and limited moving parts.
- **Operability** – The O&M procedures for separated sewer systems do not require significant labor or materials.

- **Adaptability** – Sewer system separation is adaptable for phased implementation because portions of the combined sewer system can undergo sewer separation projects in phases. For example, sewer separation projects in areas of the City that are highly prone to flooding can be prioritized.

D.1.3.3 Implementability for Green Infrastructure Source Controls

Green infrastructure is a flexible, low impact technology for CSO control.

- **Constructability** – Green infrastructure source controls received a very good score in constructability due to their ability to be constructed with limited specialized equipment outside of the vehicular travel lane.
- **Reliability** - Green infrastructure source controls received a good score in reliability. They are known to perform well but are prone to several issues such as clogging from debris.
- **Operability** - Green infrastructure source controls received a good score in operability because operating and maintaining green infrastructure does not take highly trained workers and the solids removed are not considered hazardous. Any solids removed from the green infrastructure feature can be disposed of as litter. The amount of maintenance and disposal can vary depending on frequency and severity of rain.
- **Adaptability** - Green infrastructure source controls received an excellent score in adaptability. The City can install any number of green infrastructure installations at any time at any location permitted by the city.

D.1.3.4 Implementability for Maximizing Flow to the POTW

Improvements for additional conveyance can be costly and would require additional maintenance to keep new structures and pipelines operating. As discussed previously, a total length of 12,000 feet of force main upsizing would be difficult to implement due to financial issues associated with ownership uncertainty. The discussion below presents the evaluation of two alternatives that involve maximizing flow to the POTW: the first would involve upgrading the East and West Side Pump Stations and constructing a new force main to PVSC, and the second would involve only upgrading the pump stations.

Maximizing Flow to the POTW with Pumps and Force Main Upgrades

- **Constructability** – Maximizing flow to the POTW received a poor score in constructability. As discussed in Section D.1.1.4, this alternative would require upsizing a total length of 12,000 feet of force main, would involve a river crossing, and would rely on complex machinery, making the alternative complex and difficult to construct.
- **Reliability** - Maximizing flow to the POTW received a very good score in reliability. Force main and pump station upgrades are widely applied technologies with reliable performance.

- **Operability** - Maximizing flow to the POTW received a very good score in operability. Once the force main is built and the pump station is upgraded, it does not require skilled personnel for O&M or generate much waste.
- **Adaptability** - Maximizing flow to the POTW received a poor score in adaptability. The location for implementation is extremely restricted and the project must be completed in large parts.

Maximizing Flow to the POTW with Pump Upgrades and Existing Force Main

- **Constructability** – Maximizing flow to the POTW received a very good in constructability. It is relatively easy and less costly to upgrade pump stations only.
- **Reliability** - Maximizing flow to the POTW received a very good score in reliability. Upgrading pump stations is a very mature technology widely utilized to solve CSO issues.
- **Operability** - Maximizing flow to the POTW received a very good score in operability. Once the pump stations are upgraded, they do not require skilled personnel to operate/maintain or generate much waste.
- **Adaptability** - Maximizing flow to the POTW received a good score in adaptability. The two pump upgrades can be phased and adapted as needed.

D.1.3.5 Implementability for Off-line Storage with Tunnels

Implementing off-line storage tunnels would be a large and complex project. The following factors were evaluated to determine the alternative's implementability.

- **Constructability** – Off-line storage with tunnels received a poor score in constructability. Building two tunnels along the east and west sides of Jersey City would be a large project. The lengths of the East and the West Tunnels are 27,462 ft and 27,780 ft, respectively. The tunnel alternative would require the involvement of both highly trained workers and specialized equipment.
- **Reliability** – Off-line storage with tunnels received an excellent score in reliability. Storage tunnels are a proven technology and a popular solution utilized to manage CSOs. This technology is currently being implemented in other urban cities like Washington, D.C.
- **Operability** – Off-line storage with tunnels received a fair score in operability because the storage tunnels would not require frequent O&M but would require highly trained workers and solids removal. The solids that are removed from the tunnel would require specialized transport and disposal.
- **Adaptability** - Off-line storage with tunnels received a fair score in adaptability. There is limited flexibility when it comes to the phased implementation of storage tunnels. Once work begins on a tunnel it usually continues until the tunnel is complete. Phasing tunnel construction by segments leads to increased cost associated with repeated assembly and disassembly of tunnel boring machines. However, the two individual tunnels can effectively be constructed in two phases.

D.1.3.6 Implementability for Off-line Storage with Storage Tanks/Treatment Shafts

The storage tank alternative ranks high in adaptability and reliability but low in constructability and operability relative to the other alternatives.

- **Constructability** – Construction of the grouped storage tank alternative has several challenges. The grouped storage tank alternative would require construction of approximately seven miles of new combined sewer pipes to connect the existing outfalls; this would require careful planning for avoidance of conflicts with existing utilities. The storage tanks/treatment shafts would require specialized equipment and highly trained workers for construction. Additionally, the storage tanks/treatment shafts would require strong foundations and would ideally be constructed in deep rock formations.
- **Reliability** – Off-line storage tanks/treatment shafts are considered a reliable and proven technology because they have been implemented in various locations nationwide.
- **Operability** – Similar to the off-line storage with tunnels, storage tanks would require highly skilled labor to conduct regular maintenance and hazardous solids removal.
- **Adaptability** – The storage tank alternative is highly adaptable for phased implementation. The JCMUA could prioritize constructing the storage tanks in the areas with higher water quality and local flooding concerns. Each additional storage tank constructed would have an incremental impact to the percent capture of the JCMUA system and to the overall water quality of the receiving water bodies.

D.1.4 Public Acceptance

~~The JCMUA has held numerous public meetings to gauge how the public feels about various alternatives. Some alternatives have received a lot of support while others received little support or opposition.~~ The JCMUA and ARCADIS have completed 5 public meetings with presentations of the results of the Preliminary DEAR modeled results followed by 30 minute or more question and answer period. The following public participation meetings were conducted in the manner described above:

- Preliminary DEAR modeling results were presented in a Supplemental CSO Team on Thursday, March 7, 2019 6:00 PM-8:30 PM at North Jersey Transportation Planning Authority - Newark, NJ. The information presented is shown on the web site https://www.njcleanwaterways.com/supplemental-cso-team-presentations as Supplemental CSO Team Meeting # 11 with all 13 of those meetings completed currently. A public new report was issue in the Hudson reporter where the news on this is recorded at this public link: https://hudsonreporter.com/2019/03/21/combatting-sewage-overflow/)
- Community Meetings No. 1 through 4 in Jersey City where conducted between the hours of 6:00 and 7:30pm where less technical presentations of the preliminary DEAR results made on 3/7/19. A copy of the presentation is included in the revised DEAR in Appendix D. The JCMUA and Arcadis staff completed 4 presentations to public audiences of 10 or more Jersey City citizens and stakeholders at the following locations and dates shown below:

  - **Community Meeting No. 1:** On 3/12/2019, Mary McLeod Bethune Center, 140 Martin Luther King Blvd , Jersey City, NJ
  - **Community Meeting No. 2:** On 3/14/2019, City Hall: Council Chambers, 280 Grove St, Jersey City, NJ
  - **Community Meeting No. 3:** On 3/28/2019, Hank Gallo Center, Lincoln Park, Jersey City, NJ 07307
  - **Community Meeting No. 4:** On 4/4/2019, Primary School No. 28 at 167 Hancock Avenue, Jersey City, NJ
- **START Meeting presenting the JCMUA DEAR**: On 8/8/2019, Arcadis provided a presentation of the complete JCMUA DEAR results that were delivered to NJDEP on 7/1/2019. A copy of the presentation is included in the Revised DEAR in Appendix D.

In addition to taking the comment of the public into consideration, the JCMUA also generated a list of environmental factors and evaluated them to determine which alternatives would be most beneficial to the public. The factors evaluated were environmental impacts, society benefits, performance, and multi-use considerations. These factors were chosen based on criteria from the EPA CSO Guidance for Long-Term Control Plan document and were graded based on the same scale found in Section D.1.3.

- **Environmental Impact** – When assessing the environmental impact of a project the impact on nature and the residents must be assessed. Effects on nature include water quality, threats to endangered species, Wetlands Impacts, Soil Erosion, flooding, and other forms of habitat destruction. Effects on the residents include noise, traffic, and utilities relocation. Alternatives that involve minimal disruption to the lives of residents and nature would receive an excellent score. An alternative which is very disruptive would receive a poor score
- **Social Benefit** – An alternative that adds positive aspects to the lives of Jersey City residents would be viewed positively by Jersey City residents. An alternative that adds to the physical and or mental well-being of the residents would receive an excellent score, and an alternative that has no benefit to the physical or mental well-being of the residents would receive a poor score.
- **Multi-use Considerations** – An alternative which serves a use to the public would be beneficial in gaining support for its implementation. If an alternative can be designed to include a park or walking path it would have multiple beneficial uses and receive an excellent score. If an alternative only operates as a CSO control it would receive a poor score.

D.1.4.1 Public Acceptance for Inflow and Infiltration Collection System Controls

As discussed in Section D.1.3.1, pipe replacement for inflow and infiltration reduction would involve extensive construction with roadways, which would largely interrupt transportation. Therefore, public acceptance for pipe replacement for I/I reduction may not be high. Public acceptance for pipe rehabilitation would be relatively higher than for pipe replacement because it is less invasive.

Pipes Replacement Alternative

- **Environmental Impacts** – Pipe replacement received a poor score for environmental impacts. It has negative environmental impacts from the construction including traffic disruption, potential utilities relocation, noise and dust.
- **Social Benefits** – Pipe replacement received a poor score for social benefits. No additional aesthetic value is achieved during or after the construction. Instead, it causes adverse environmental impacts.
- **Multiple-use Considerations** – Pipe replacement received a poor score for multiple-use considerations. It solely serves CSO and flooding control.

Pipes Lining Alternative

- **Environmental Impacts** – Pipe lining received a good score because it does not need to reconstruct which is less disrupting compared to replacement with less impact and shorter lifecycle.
- **Social Benefits** – Pipe lining received a poor score for social benefits. No additional aesthetic value is achieved during or after the construction.
- **Multiple-use Considerations** – Pipe replacement received a poor score for multiple-use considerations. It solely serves CSO and flooding control.

D.1.4.2 Public Acceptance for Separate Sewer Collection System Controls

The public may not favor large scale sewer separation because of the disruption associated with construction of separated systems. Several factors involving public acceptance are discussed below:

- **Environmental Impacts** – Sewer separation could have negative environmental impacts because of the extensive amount of construction activities required to implement this control. The construction could cause high levels of noise, dust, and traffic in highly dense and residential areas.
- **Social Benefits** – Sewer separation does not provide many opportunities for social benefits; however, the infrastructure is buried and would not be a visual nuisance or a source of significant odor. Sewer separation in the Bright Street and Bates Street subcatchments would help reduce flooding in the Bates Street Redevelopment Area, which is a significant public concern.
- **Multiple-use Considerations** – Sewer separation is not conducive for multiple uses because separate sewers serve only as a CSO and stormwater control measure.

D.1.4.3 Public Acceptance for Green Infrastructure Source Controls

The implementation of roadside rain gardens and tree pits was viewed favorably by the public and brought up in multiple public CSO meetings in Jersey City. Residents were eager to have green infrastructure implemented to their own neighborhoods.

- **Environmental Impacts** – Green infrastructure source controls received a very good score due to light construction which should generate minimal impacts to things like traffic, dust, and noise.
- **Social Benefits** – Green infrastructure source controls received an excellent score in social benefits due to the green space generated from its implementation. Attractive native plants can be used in green infrastructure installations. These trees can provide shade or even fruits to the community.
- **Multiple-use Considerations** – Green infrastructure source controls received a very good score for multiple-use considerations because green space generated by infrastructure can be used as recreational space or be used to grow beneficial plants that can help the community like marigold and lavender which ward off mosquitos.

D.1.4.4 Public Acceptance for Maximizing Flow to the POTW

The public may not favor the alternative of an extremely expensive project to build approximately 12,000 feet of force main across Newark Bay. This project would be disruptive to public life. Ownership issues regarding joint ownership of the Hudson County force main system would have to be discussed with all stakeholders. However, maximizing the flow in the existing force main by purely upgrading the east and west pumps should have public acceptance since the environmental impacts are relatively small, especially when compared to building a new force main.

Maximizing Flow to the POTW with Pumps and Force Main Upgrades

- **Environmental Impacts** – Maximizing flow to the POTW with force main upgrades receives a fair score for environmental impacts, because building force main under the Hackensack River may cause potential pollution to nearby waterbodies.
- **Social Benefits** – Maximizing flow to the POTW with force main upgrades receives a poor score for social benefits. It does not provide any benefits to public well-being.
- **Multiple-use Considerations** – Maximizing flow to the POTW with existing force main receives a poor score for social benefits. It is upgraded purely for CSO control.

Maximizing Flow to the POTW with Existing Force Main

- **Environmental Impacts** – Maximizing flow to the POTW with the existing force main receives a very good score for environmental impacts because the East and West Side Pump Stations are isolated from public access and construction would have relatively small impacts for residential areas.
- **Social Benefits** – Maximizing flow to the POTW with existing force main receives a poor score for social benefits. It does not provide any benefits to public well-being.
- **Multiple-use Considerations** – Maximizing flow to the POTW with existing force main receives a poor score for social benefits. It is upgraded purely for CSO control.

D.1.4.5 Public Acceptance for Off-line Storage with Tunnels

The public should not object to the implementation of a tunnel alternative. Tunnels are viewed as a favorable alternative because there will be limited traffic and utilities disruption as well as little impact to above ground real estate. It is recommended that the tunnel alternative be paired with green infrastructure to give the public a visible representation of the City's improvements.

- **Environmental Impacts** – Tunnel Storage received a very good score because most of the construction will take place beneath the ground and would cause minimal disruption to nature and the residents of Jersey City. Construction should not generate traffic, noise or require the movement of utilities. Natural environments would also be minimally impacted.
- **Social Benefits** – Off-line tunnel storage received a good score in society benefits because they could have a positive effect on water quality and generate useful space over dropdown shafts.
- **Multiple-use Considerations** – Tunnel storage received a good score for multiple-use considerations because dropdown shafts could be turned into parks or playgrounds. Either of these options could add to the usefulness of the tunnel beyond CSO control.

D.1.4.6 Public Acceptance for Off-line Storage with Storage Tanks/Treatment Shafts

Factors that affect public acceptance are discussed below for the off-line storage with storage tanks alternative:

- **Environmental Impacts** – Since the storage tanks are located on the periphery of the City, construction of the tanks should have minimal negative environmental impacts to residential or densely populated areas. However, the construction could impact natural environments and various permits would need to be obtained. Environmental impacts associated with storage tank implementation would have to be addressed on a site-specific basis.
- **Social Benefits** – Storage tank construction projects could be combined with park or redevelopment projects (see Multiple-use Considerations below) that would be beneficial to the community
- **Multiple-use Considerations** – Off-line storage tanks also are well-suited for multi-use applications; they can be constructed beneath parks or other public spaces.

D.1.5 Performance Considerations

D.1.5.1 Performance for Inflow and Infiltration Collection System Controls

The alternative with inflow and infiltration reduction through pipe replacement or rehabilitation does not reduce the number of overflows in the typical year of 2004. The JCMUA system's percent capture is estimated at 73.2% with implementation of I/I reduction, compared with a percent capture of 72.4% for the baseline scenario. The equation used to calculate the percent capture for the baseline (and all evaluated alternatives) is referenced in Section C.1.1 of the PVSC Development and Evaluation of Alternatives Regional Report.

Table D.1-1 shows the inflow and infiltration flows for each sub drainage area with implementation of I/I reduction measures; a total flow rate of 0.88 MGD can be eliminated through inflow and infiltration pipes replacement or rehabilitation.

D.1.5.2 Performance for Separate Sewer Collection System Controls

The evaluation of the sewer separation project in the Bates Street Redevelopment Area showed that this sewer separation project did not have a significant impact on the system's percent capture. This alternative was simulated in PCSWMM by identifying the subcatchment areas that would be impacted by the separation project. Those subcatchment areas were assigned timeseries with no rainfall; this simulated the removal of stormwater from those areas of the CSS (or diversion of stormwater into the separate stormwater sewer system). The combined sewer system's percent capture with the separation project was 72.4%, which is equivalent to the percent capture of the baseline condition.

D.1.5.3 Performance for Green Infrastructure Source Controls

The roadside rain gardens will be designed to treat rainwater from an impervious area at a loading rate ranging from 5:1 to 10:1 of impervious area to rain garden area. Each installation should capture the first inch of rain that falls on the sub catchment area route to the rain gardens. Model simulations in PCSWMM indicated that green infrastructure was not effective in significantly lowering the number of overflows or reducing the CSO volume. To discover the effectiveness of GI per square foot a 100% GI scenario was performed, which assigned a depression storage of 1 inch and actual evaporation across the entire city during the 2004 typical year. One inch of depression storage was chosen based on the goal of effective GI stated by NYCDEP in the 2016 Green Infrastructure Performance Metrics Report is "…to manage the equivalent of stormwater generated by one inch of precipitation…". By using this run, we were able to determine an average volumetric retention per square foot in Jersey City. The percent capture increases from the baseline condition are as follows:

- Control of 7% of the imperious area increases the percent capture by 1% from the baseline percent capture of 72.4%.
- Control of 10% of the imperious area increases the percent capture by 1.4% from the baseline percent capture.
- Control of 100% of the imperious area increases the percent capture by 7.6 % from the baseline percent capture.

The results of GI source control alternative can be found in the Performance Results table, Table D.1-2.

D.1.5.4 Performance for Maximizing Flow to the POTW

The alternative of maximizing flow to the POTW involves upsizing approximately 12,000 feet of force main to 9 feet in diameter in order to pump 235 MGD to the POTW. The system percent capture reaches 80% with 60 overflows in the typical year of 2004 with the higher flow alternative at 235 MGD. The system percent capture only reaches 75% by upgrading only the pumps to the maximum velocity of the 6-foot diameter force main.

Table D.1-1 Inflow and Infiltration Flow Per Sub Drainage Area

Sub Drainage Area (SDA)	Sum of I-I flow, CFS	Pipes Length (ft)
Brown Place(RE-1)	0.10	7369
Richard Street(RE-2)	0.16	9059
Claremont & Carteret (RE-3/4)	0.07	8441
Mill Creek & Pine (RE-5/6)	0.16	16550
Grand Street(RE-10/11)	0.08	5875
Second Street(RE-15)	0.03	4967
Sixth Street (RE-16/17)	0.03	6273
Fourteenth Street(RE-18)	0.23	10642
Eighteenth Street(RE-19)	0.02	1838
Secaucus Road(RW-1)	0.01	4974
Manhattan Avenue(RW-2)	0.00	0
St. Paul's Avenue(RW-3)	0.00	794
Van Winkle Avenue(RW-4)	0.01	1020
Broadway Avenue 1(RW-5)	0.00	0
Sip Avenue(RW-6)	0.00	0
Duncan Avenue(RW-7)	0.00	142
Clendenny Avenue(RW-8)	0.12	1238
Claremont Avenue(RW-9)	0.00	0
Fisk Street(RW-10)	0.24	2891
N. and S. Danforth Avenue(RW-11/12)	0.08	3772
Mina Drive(RW-13)	0.02	2050
Grand Total	**1.36**	**87896**

Table D.1-2: Performance Results

Sub Drainage Area (SDA), Regulator, and Outfall Name	Brown Place (RE-1)	Richard Street (RE-2)	Claremont & Carteret (RE-3/4)	Mill Creek & Pine (RE-5/6)	Grand Street (RE-10/11)	Second Street (RE-15)	Sixth Street (RE-16/17)	Fourteenth Street (RE-18)	Eighteenth Street (RE-19)	Secaucus Road (RW-1)	Manhattan Avenue (RW-2)	St. Paul's Avenue (RW-3)	Van Winkle Avenue (RW-4)	Broadway Avenue 1 (RW-5)	Sip Avenue (RW-6)	Duncan Avenue (RW-7)	Clendenny Avenue (RW-8)	Claremont Avenue (RW-9)	Fisk Street (RW-10)	N. and S. Danforth Avenue (RW-11/12)	Mina Drive (RW-13)	East Side Pump Station	West Side Pump Station	Total Flow to PVSC	Total Wet Weather Overflow Volume East Side Drainage Area	Total Wet Weather Overflow Volume West Side Drainage Area	Total Wet Weather Overflow Volume From Jersey City	Percent of Capture in JCMUA Drainage Areas and Municipal System (By Protocol)			Number of Overflows in JCMUA Drainage Areas and Municipal System	Percentage of Overflow Volume reduce from current baseline condtions
Outfall number	JC014	JC015	JC016	JC018	JC020	JC025	JC026	JC028	JC029	JC001	JC002	JC003	JC004	JC005	JC006	JC007	JC008	JC009	JC010	JC011	JC013											
Sub Drainage Area (SDA) Numbers	E1	E2	E34	E56	E1011	E15	E1617	E18	E19	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W1112	W13	ESPS	WSPS	TO PVSC								
Name of Alternative	**VOLUMES DISCHARGED OR CAPTURED TO PVSC**																											East Side Pump Station	West Side Pump Station	Total Flow to PVSC		
ORIGINAL- Baseline condItions for 2004	22.6	29.8	76.1	170.2	70.2	45.6	8.0	83.9	207.9	75.3	36.3	52.8	25.1	12.0	85.2	41.3	124.6	48.0	34.6	73.9	92.0	2,015.1	1,530.1	3,545.8	714.3	701.0	1,415.3	73.8%	68.6%	71.5%	68	
UPDATED- Baseline condtions for 2004*	22.5	30.0	74.6	198.0	69.5	45.6	1.8	84.3	224.9	89.7	48.9	85.4	33.6	16.9	91.7	46.2	129.9	50.1	37.2	79.2	97.4	2,258.3	1,834.6	4,093.8	751.2	806.3	1,557.4	75.0%	69.5%	72.4%	60	
ALTERNATIVE 1a - Green Infrastructure (GI) 7% Impervious Area -Most Effective areas	20.9	28.5	63.4	157.7	59.5	38.3	1.6	73.7	209.4	84.5	45.8	77.9	31.3	15.4	79.9	37.2	117.6	46.8	34.6	74.5	88.8	2,084.0	1,739.1	3,823.3	653.0	734.3	1,387.3	76.1%	70.3%	73.4%	59	10.9%
ALTERNATIVE 1b - GI -implemented on 10% imperious Area in Jersey City	20.9	28.5	62.8	164.4	53.5	35.8	1.5	72.9	180.4	84.5	45.8	78.3	31.4	15.4	79.9	37.3	117.4	46.8	34.6	74.7	89.1	2,069.7	1,742.7	3,812.7	620.7	735.3	1,356.0	76.9%	70.3%	73.8%	60	12.9%
ALTERNATIVE 2 - Bright Street Sewer Separation	22.5	30.0	74.2	203.1	64.7	45.2	1.8	83.9	225.3	89.7	48.7	86.3	33.6	17.0	91.7	46.1	130.0	50.1	37.2	79.5	97.4	2,252.7	1,835.5	4,089.2	750.7	807.4	1,558.1	75.0%	69.4%	72.4%	60	0.0%
ALTERNATIVE 3 - Removal of Inflow and Infiltration	22.3	29.9	73.6	180.6	68.9	45.1	1.8	83.0	232.3	89.6	49.0	84.8	33.8	16.9	91.4	46.4	129.1	50.0	36.7	79.2	97.5	2,319.3	1,898.2	4,217.1	737.4	804.3	1,541.7	75.9%	70.2%	73.2%	60	1.0%
Alternative 4a: East and West Tunnels -11ft 4 overflows	-	-	-	11.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	-	-	2,819.9	2,678.3	5,522.8	11.2	4.5	15.7	99.6%	99.8%	99.7%	4	99.0%
Alternative 4b: East and West Tunnel- 9.25ft Diameter Tunnel	-	-	-	19.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.4	-	-	2,804.8	2,772.6	5,614.3	19.2	7.4	26.6	99.3%	99.7%	99.5%	8	98.3%
Alternative 4c: East and West Tunnels - 7 ft Diameter Tunnel 35.5ft Storage	-	-	-	58.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.7	-	-	2,840.0	2,597.1	5,436.7	58.3	14.7	73.0	98.0%	99.4%	98.7%	12	95.3%
Alternative 4d: East and West Tunnels - 6.5 ft Diameter Tunnel 35ft Storage	-	-	-	114.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56.0	-	-	2,560.2	2,192.1	4,750.6	114.2	56.0	170.2	95.7%	97.5%	96.5%	20	89.1%
Alternative 4e: West Tunnel only - 6.5 ft Diameter Tunnel 35ft Storage	22.5	30.0	74.6	198.0	69.5	45.6	1.8	84.3	224.9	-	-	-	-	-	-	-	-	-	56.0	-	-	2,560.2	2,192.1	4,750.6	751.2	56.0	807.2	77.3%	97.5%	85.5%	60	48.2%
Alternative 5a: Grouped Tanks - 4 overflows	~~ ~~	~~ ~~	~~7.4~~	~~12.8~~	~~9.7~~	~~4.9~~	~~ ~~	~~ ~~	~~ ~~	~~ ~~	~~13.5~~	~~ ~~	~~1.6~~	~~ ~~	~~ ~~	~~ ~~	~~ ~~	~~ ~~	~~20.6~~	~~12.3~~	~~ ~~	~~2,574.8~~	~~2,386.7~~	~~4,962.2~~	~~35.8~~	~~48.0~~	~~83.8~~	~~98.6%~~	~~98.0%~~	~~98.3%~~	~~4~~	~~94.6%~~
Alternative 5b: Grouped Tanks - 8 overflows	~~-~~	~~-~~	~~12.5~~	~~18.1~~	~~10.7~~	~~6.6~~	~~ ~~	~~0.0~~	~~ ~~	~~ ~~	~~17.9~~	~~ ~~	~~4.8~~	~~ ~~	~~ ~~	~~ ~~	~~ ~~	~~ ~~	~~21.7~~	~~16.1~~	~~ ~~	~~2,585.4~~	~~2,382.0~~	~~4,967.7~~	~~47.0~~	~~60.4~~	~~108.3~~	~~98.2%~~	~~97.5%~~	~~97.9%~~	~~8~~	~~93.0%~~
Alternative 5c: Grouped Tanks - 12 overflows	~~ ~~	~~ ~~	~~15.0~~	~~34.8~~	~~19.3~~	~~7.5~~	~~ ~~	~~3.1~~	~~ ~~	~~ ~~	~~20.2~~	~~ ~~	~~2.8~~	~~ ~~	~~ ~~	~~ ~~	~~ ~~	~~ ~~	~~28.1~~	~~21.4~~	~~ ~~	~~2,579.6~~	~~2,391.9~~	~~4,972.8~~	~~79.7~~	~~72.5~~	~~152.2~~	~~97.0%~~	~~97.1%~~	~~97.0%~~	~~12~~	~~90.2%~~
Alternative 5d: Grouped Tanks - 20 overflows	~~ ~~	~~ ~~	~~42.9~~	~~84.8~~	~~38.3~~	~~13.5~~	~~ ~~	~~5.4~~	~~ ~~	~~ ~~	~~40.7~~	~~ ~~	~~6.9~~	~~ ~~	~~ ~~	~~ ~~	~~ ~~	~~ ~~	~~79.1~~	~~56.0~~	~~ ~~	~~2,561.6~~	~~2,376.0~~	~~4,938.4~~	~~184.9~~	~~191.7~~	~~376.6~~	~~93.3%~~	~~92.5%~~	~~92.9%~~	~~20~~	~~75.8%~~
Alternative 6a: Maximum flow East and West Pump Stations and Forcemain Capacities with New System at 150%	21.8	29.6	46.7	100.3	49.1	24.7	1.1	62.4	226.6	88.4	45.0	68.7	27.3	11.5	78.6	37.3	119.2	45.7	30.6	69.4	88.6	2,455.1	1,926.4	4,382.7	562.3	710.4	1,272.7	81.4%	73.1%	77.5%	53	18.3%
Alternative 6b: Maximum flow East and West Pump Stations and Forcemain Capacities with New System at 235 MGD	22.1	29.8	56.4	133.0	54.8	31.4	1.3	67.8	232.8	85.1	35.5	24.1	19.8	1.6	23.9	19.9	92.3	34.2	16.8	57.8	73.5	2,395.8	2,140.7	4,537.6	629.3	484.4	1,113.7	79.2%	81.5%	80.3%	60	28.5%
Program Alternatives:																																
Collection System and Source Controls 7%	20.8	28.3	62.3	147.6	54.8	37.7	1.6	71.6	206.5	84.5	45.7	81.0	31.3	15.3	79.7	37.3	116.8	46.7	34.2	74.6	88.8	2,049.4	1,729.3	3,778.9	631.2	735.8	1,367.0	76.5%	70.2%	73.4%	60	12.2%
Collection System and Source Controls 10%	20.8	28.3	61.8	152.2	49.4	35.0	1.5	71.0	181.0	84.5	45.4	78.3	31.2	15.4	79.7	37.1	116.7	46.7	34.2	79.1	88.6	2,033.1	1,732.5	3,765.6	601.0	736.9	1,337.9	77.2%	70.2%	73.8%	56	14.1%
Collection System and Source Controls with Offline Storage																																
with only the W1 and W2 tanks for Manhattan and Secaucus sized for 4 overflows	22.3	29.8	73.5	180.6	64.0	44.9	1.8	82.3	226.7	-	13.5	82.2	33.8	16.7	90.9	45.5	129.1	50.0	36.8	79.2	96.9	2,220.4	1,826.4	4,047.5	725.9	674.7	1,400.5	75.4%	73.0%	74.3%	60	10.1%
with only the W1 through W5 tanks sized for 4 overflows	22.3	29.8	73.5	180.6	64.0	44.9	1.8	82.3	226.7	-	13.5	-	1.6	-	90.9	45.5	129.1	50.0	36.8	79.2	96.9	2,220.4	1,826.4	4,047.5	725.9	543.6	1,269.4	75.4%	77.1%	76.1%	60	18.5%
with only the W1 through W5 tanks sized for 4 overflows and W6 to W13 at 20 overflows	22.3	29.8	73.5	180.6	64.0	44.9	1.8	82.3	226.7	-	13.5	-	1.6	-	-	-	-	-	79.1	56.0	-	2,220.4	2,376.0	4,047.5	725.9	150.2	876.1	75.4%	94.1%	82.2%	60	43.7%
with only the W1 through W5 tanks sized for 4 overflows and W6 to W13 & E19, E18 down to 20 overflows	~~22.3~~	~~29.8~~	~~73.5~~	~~180.6~~	~~64.0~~	~~44.9~~	~~1.8~~	~~5.4~~	~~-~~	~~-~~	~~13.5~~	~~-~~	~~1.6~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~79.1~~	~~56.0~~	~~-~~	~~2,220.4~~	~~2,376.0~~	~~4,047.5~~	~~422.2~~	~~150.2~~	~~572.4~~	~~84.0%~~	~~94.1%~~	~~87.6%~~	~~60~~	~~63.2%~~

Table D.1-2: Performance Results

Sub Drainage Area (SDA), Regulator, and Outfall Name	Brown Place (RE-1)	Richard Street (RE-2)	Claremont & Carteret (RE-3/4)	Mill Creek & Pine (RE-5/6)	Grand Street (RE-10/11)	Second Street (RE-15)	Sixth Street (RE-16/17)	Fourteenth Street (RE-18)	Eighteenth Street (RE-19)	Secaucus Road (RW-1)	Manhattan Avenue (RW-2)	St. Paul's Avenue (RW-3)	Van Winkle Avenue (RW-4)	Broadway Avenue 1 (RW-5)	Sip Avenue (RW-6)	Duncan Avenue (RW-7)	Clendenny Avenue (RW-8)	Claremont Avenue (RW-9)	Fisk Street (RW-10)	N. and S. Danforth Avenue (RW-11/12)	Mina Drive (RW-13)	East Side Pump Station	West Side Pump Station	Total Flow to PVSC	Total Wet Weather Overflow Volume East Side Drainage Area	Total Wet Weather Overflow Volume West Side Drainage Area	Total Wet Weather Overflow Volume From Jersey City	Percent of Capture in JCMUA Drainage Areas and Municipal System (By Protocol)			Number of Overflows in JCMUA Drainage Areas and Municipal System	Percentage of Overflow Volume reduce from current baseline condtions
Outfall number	JC014	JC015	JC016	JC018	JC020	JC025	JC026	JC028	JC029	JC001	JC002	JC003	JC004	JC005	JC006	JC007	JC008	JC009	JC010	JC011	JC013											
Sub Drainage Area (SDA) Numbers	E1	E2	E34	E56	E1011	E15	E1617	E18	E19	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W1112	W13	ESPS	WSPS	TO PVSC								
Name of Alternative	VOLUMES DISCHARGED OR CAPTURED TO PVSC																											East Side Pump Station	West Side Pump Station	Total Flow to PVSC		
ORIGINAL- Baseline condItions for 2004	22.6	29.8	76.1	170.2	70.2	45.6	8.0	83.9	207.9	75.3	36.3	52.8	25.1	12.0	85.2	41.3	124.6	48.0	34.6	73.9	92.0	2,015.1	1,530.1	3,545.8	714.3	701.0	1,415.3	73.8%	68.6%	71.5%	68	
UPDATED- Baseline condtions for 2004*	22.5	30.0	74.6	198.0	69.5	45.6	1.8	84.3	224.9	89.7	48.9	85.4	33.6	16.9	91.7	46.2	129.9	50.1	37.2	79.2	97.4	2,258.3	1,834.6	4,093.8	751.2	806.3	1,557.4	75.0%	69.5%	72.4%	60	
ALTERNATIVE 1a - Green Infrastructure (GI) 7% Impervious Area -Most Effective areas	20.9	28.5	63.4	157.7	59.5	38.3	1.6	73.7	209.4	84.5	45.8	77.9	31.3	15.4	79.9	37.2	117.6	46.8	34.6	74.5	88.8	2,084.0	1,739.1	3,823.3	653.0	734.3	1,387.3	76.1%	70.3%	73.4%	59	10.9%
ALTERNATIVE 1b - GI -implemented on 10% imperious Area in Jersey City	20.9	28.5	62.8	164.4	53.5	35.8	1.5	72.9	180.4	84.5	45.8	78.3	31.4	15.4	79.9	37.3	117.4	46.8	34.6	74.7	89.1	2,069.7	1,742.7	3,812.7	620.7	735.3	1,356.0	76.9%	70.3%	73.8%	60	12.9%
ALTERNATIVE 2 - Bright Street Sewer Separation	22.5	30.0	74.2	203.1	64.7	45.2	1.8	83.9	225.3	89.7	48.7	86.3	33.6	17.0	91.7	46.1	130.0	50.1	37.2	79.5	97.4	2,252.7	1,835.5	4,089.2	750.7	807.4	1,558.1	75.0%	69.4%	72.4%	60	0.0%
ALTERNATIVE 3 - Removal of Inflow and Infiltration	22.3	29.9	73.6	180.6	68.9	45.1	1.8	83.0	232.3	89.6	49.0	84.8	33.8	16.9	91.4	46.4	129.1	50.0	36.7	79.2	97.5	2,319.3	1,898.2	4,217.1	737.4	804.3	1,541.7	75.9%	70.2%	73.2%	60	1.0%
Alternative 4a: East and West Tunnels -11ft 4 overflows	-	-	-	11.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	-	-	2,819.9	2,678.3	5,522.8	11.2	4.5	15.7	99.6%	99.8%	99.7%	4	99.0%
Alternative 4b: East and West Tunnel- 9.25ft Diameter Tunnel	-	-	-	19.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.4	-	-	2,804.8	2,772.6	5,614.3	19.2	7.4	26.6	99.3%	99.7%	99.5%	8	98.3%
Alternative 4c: East and West Tunnels - 7 ft Diameter Tunnel 35.5ft Storage	-	-	-	58.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.7	-	-	2,840.0	2,597.1	5,436.7	58.3	14.7	73.0	98.0%	99.4%	98.7%	12	95.3%
Alternative 4d: East and West Tunnels - 6.5 ft Diameter Tunnel 35ft Storage	-	-	-	114.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56.0	-	-	2,560.2	2,192.1	4,750.6	114.2	56.0	170.2	95.7%	97.5%	96.5%	20	89.1%
Alternative 4e: West Tunnel only - 6.5 ft Diameter Tunnel 35ft Storage	22.5	30.0	74.6	198.0	69.5	45.6	1.8	84.3	224.9	-	-	-	-	-	-	-	-	-	56.0	-	-	2,560.2	2,192.1	4,750.6	751.2	56.0	807.2	77.3%	97.5%	85.5%	60	48.2%
Alternative 5a: Grouped Tanks - 4 overflows	-	-	7.4	24.0	9.5	8.5	-	22.5	-	-	12.7	-	5.5	-	-	-	-	-	13.7	11.3	-	2,442.8	2,089.0	4,531.5	72.0	43.2	115.1	97.1%	98.0%	97.5%	4	92.6%
Alternative 5b: Grouped Tanks - 8 overflows	-	-	16.2	21.2	9.6	8.7	-	25.4	-	-	15.8	-	10.9	-	-	-	-	-	15.3	14.5	-	2,439.8	2,088.1	4,527.7	81.0	56.6	137.6	96.8%	97.4%	97.0%	8	91.2%
Alternative 5c: Grouped Tanks - 12 overflows	-	-	15.0	34.8	19.3	7.5	-	3.1	-	-	20.2	-	2.8	-	-	-	-	-	28.1	21.4	-	2,579.6	2,391.9	4,972.8	79.7	72.5	152.2	97.0%	97.1%	97.0%	12	90.2%
Alternative 5d: Grouped Tanks - 20 overflows	-	-	41.8	79.8	37.4	28.0	-	92.7	-	-	33.8	-	30.9	-	-	-	-	-	80.2	48.3	-	2,460.8	2,097.1	4,557.9	279.8	193.2	473.0	89.8%	91.6%	90.6%	20	69.6%
Alternative 6a: Maximum flow East and West Pump Stations and Forcemain Capacities with New System at 150%	21.8	29.6	46.7	100.3	49.1	24.7	1.1	62.4	226.6	88.4	45.0	68.7	27.3	11.5	78.6	37.3	119.2	45.7	30.6	69.4	88.6	2,455.1	1,926.4	4,382.7	562.3	710.4	1,272.7	81.4%	73.1%	77.5%	53	18.3%
Alternative 6b: Maximum flow East and West Pump Stations and Forcemain Capacities with New System at 235 MGD	22.1	29.8	56.4	133.0	54.8	31.4	1.3	67.8	232.8	85.1	35.5	24.1	19.8	1.6	23.9	19.9	92.3	34.2	16.8	57.8	73.5	2,395.8	2,140.7	4,537.6	629.3	484.4	1,113.7	79.2%	81.5%	80.3%	60	28.5%
Program Alternatives:																																
Collection System and Source Controls 7%	20.8	28.3	62.3	147.6	54.8	37.7	1.6	71.6	206.5	84.5	45.7	81.0	31.3	15.3	79.7	37.3	116.8	46.7	34.2	74.6	88.8	2,049.4	1,729.3	3,778.9	631.2	735.8	1,367.0	76.5%	70.2%	73.4%	60	12.2%
Collection System and Source Controls 10%	20.8	28.3	61.8	152.2	49.4	35.0	1.5	71.0	181.0	84.5	45.4	78.3	31.2	15.4	79.7	37.1	116.7	46.7	34.2	79.1	88.6	2,033.1	1,732.5	3,765.6	601.0	736.9	1,337.9	77.2%	70.2%	73.8%	56	14.1%
Collection System and Source Controls with Offline Storage																																
with only the W1 and W2 tanks for Manhattan and Secaucus sized for 4 overflows	22.3	29.8	73.5	180.6	64.0	44.9	1.8	82.3	226.7	-	13.5	82.2	33.8	16.7	90.9	45.5	129.1	50.0	36.8	79.2	96.9	2,220.4	1,826.4	4,047.5	725.9	674.7	1,400.5	75.4%	73.0%	74.3%	60	10.1%
with only the W1 through W5 tanks sized for 4 overflows	22.3	29.8	73.5	180.6	64.0	44.9	1.8	82.3	226.7	-	13.5	-	1.6	-	90.9	45.5	129.1	50.0	36.8	79.2	96.9	2,220.4	1,826.4	4,047.5	725.9	543.6	1,269.4	75.4%	77.1%	76.1%	60	18.5%
with only the W1 through W5 tanks sized for 4 overflows and W6 to W13 at 20 overflows	22.3	29.8	73.5	180.6	64.0	44.9	1.8	82.3	226.7	-	13.5	-	1.6	-	-	-	-	-	79.1	56.0	-	2,220.4	2,376.0	4,047.5	725.9	150.2	876.1	75.4%	94.1%	82.2%	60	43.7%
with only the W1 through W5 tanks sized for 4 overflows and W6 to W13 & E19, E18 down to 20 overflows	20.8	28.3	61.6	139.8	53.3	35.8	1.5	83.0			14.9	-	7.2		-	-	-	-	60.1	43.3	-	2,151.1	1,983.1	4,133.7	424.1	125.4	549.6	83.5%	94.1%	88.3%	48	64.7%

D.1.5.5 Performance for Off-line Storage with Tunnels

The tunnels performance was evaluated based on achieving a certain number of overflows and a minimum percent capture. The results of the evaluation were attained using PCSWMM modeling software. The targets were 4, 8, 12, and 20 overflows, and the percent capture target was 85%. Modeling showed that the tunnel would be effective in attaining the overflow goals. Each overflow goal resulted in a percent capture over 80%. 85 percent capture was attained by running the model with just the west side tunnel constructed. The east side outfalls were left unchanged from the baseline condition. It was determined that storage tunnels would be effective in reducing the number of CSO overflows. The characteristics of the tunnels for each alternative and their performance results are presented in Table D.1-2.

D.1.5.6 Performance for Off-line Storage with Storage Tanks/Treatment Shafts

The performance of the off-line grouped storage tanks alternative was evaluated for 4, 8, 12, and 20 overflows in the typical year. Nine storage nodes were added to the PCSWMM model at approximately the tank locations shown in Figure D.1-5. Twelve of the existing outfall nodes were closed (converted to manhole nodes), and new conduits were added to connect those outfalls to the new storage nodes. The new conduits were sized to be consistent with the size of existing conduits directly upstream. A pump link was connected from each storage tank to the interceptor pipe to model the pumping back of combined sewage from the storage tanks after each wet weather event. Constraints were added to the pumps using the Control Rules Editor in PCSWMM so that the pumps were set to "OFF" during wet weather events and started pumping sewage from the storage tank back to the interceptor after wet weather events ended. Each storage tank also was connected to a weir that discharged to an outfall; this simulated overflows from the tanks when the tank capacities were exceeded.

The nine tanks were sized by iteratively running the PCSWMM model and adjusting the tank diameters and depths to achieve the targeted number of overflows per year. The preliminary tank dimensions for the 4, 8, 12, and 20 overflow alternatives are shown in Table D.1-3. The total overflow volumes and percent capture values for the storage tank alternatives are shown in Table D.1-2.

Table D.1-3 Storage Tank Dimensions

Tank	4 Overflows			8 Overflows			12 Overflows			20 Overflows		
	Diameter (ft)	Depth (ft)	Volume (MG)	Diameter (ft)	Depth (ft)	Volume (MG)	Diameter (ft)	Depth (ft)	Volume (MG)	Diameter (ft)	Depth (ft)	Volume (MG)
ST_E1011	80	120	4.51	80	120	4.51	80	110	4.14	80	48	1.80
ST_E15E1617	60	90	1.90	60	85	1.80	60	75	1.59	48	55	0.74
ST_E18E19	~~100~~	~~120~~	~~7.05~~	~~100~~	~~100~~	~~5.87~~	~~100~~	~~100~~	~~5.87~~	80	85	3.20
ST_E1E4	100	125	7.34	100	95	5.58	100	95	5.58	80	85	3.20
ST_E56	140	130	14.97	~~125~~	~~130~~	~~11.84~~	120	130	11.00	100	90	5.29
ST_W11W13	104	130	8.22	104	130	8.22	100	120	7.05	80	115	4.32
ST_W1W2	~~85~~	~~130~~	~~5.56~~	85	130	5.56	80	120	4.51	80	98	3.68
ST_W3W5	100	120	7.05	80	130	4.89	80	110	4.14	80	80	3.01
ST_W6W10	186	130	26.44	181	130	25.11	153	130	17.96	120	120	10.15

Table D.1-3 Storage Tank Dimensions

Tank	4 Overflows			8 Overflows			12 Overflows			20 Overflows		
	Diameter (ft)	Depth (ft)	Volume (MG)	Diameter (ft)	Depth (ft)	Volume (MG)	Diameter (ft)	Depth (ft)	Volume (MG)	Diameter (ft)	Depth (ft)	Volume (MG)
ST_E1011	80	120	4.51	80	120	4.51	80	110	4.14	80	48	1.80
ST_E15E1617	60	90	1.90	60	85	1.80	60	75	1.59	48	55	0.74
ST_E18E19	120	120	10.15	120	100	8.46	102	100	6.11	80	85	3.20
ST_E1E4	100	125	7.34	100	95	5.58	100	95	5.58	80	85	3.20
ST_E56	140	130	14.97	140	130	14.97	120	130	11.00	100	90	5.29
ST_W11W13	104	130	8.22	104	130	8.22	100	120	7.05	80	115	4.32
ST_W1W2	90	130	6.18	85	130	5.56	80	120	4.51	80	98	3.68
ST_W3W5	100	120	7.05	80	130	4.89	80	110	4.14	80	80	3.01
ST_W6W10	186	130	26.44	181	130	25.11	153	130	17.96	120	120	10.15

D.2 PRELIMINARY CONTROL PROGRAM ALTERNATIVES

This section of the Alternatives Report evaluates combinations of the CSO abatement technologies that were discussed in Section D.1. This section illustrates how the institutional, implementability, public acceptance, and performance factors change as a result of the combination of alternatives into one control program.

D.2.1 Collection System and Source Controls

As described in Section B.3, the JCMUA has sewer replacement contracts currently underway to replace pipes that were identified as being near failure and in need of immediate replacement. Many of these pipes also are pipes with I/I issues; therefore, JCMUA already has begun I/I reduction efforts through current projects. Continuing with this approach for I/I reduction likely will be the first phase of the JCMUA LTCP. Another high priority for the JCMUA is dealing with flooding issues, as identified in the JCMUA System Characterization Report. One way that the JCMUA has planned to address flooding is with the sewer separation project in the downtown area near Bates Street and along Bright Street; this will likely be the next possible phase of the LTCP. Another possible next phase of the LTCP is implementing one of the green infrastructure programs to achieve runoff reduction for 7% to 10% of the City's impervious area. Based upon the feedback from the public during the JCMUA's six most recent public meeting and presentations, there is strong interest in implementation of GI, including more trees; therefore, the GI phase will help improve acceptability of the LTCP for the public.

If this program is implemented in the sequence above, the evaluated outcome is predicted to result in the following:

- Implementability and technical issues would have a "Very Good" rating
- Environmental considerations would have a "Fair" to "Good" rating
- Although performance would only be "Fair," the institutional, siting, and cost criteria would be "Very Good" to "Excellent."

Table D.2-1 presents the actual rating numbers and final ranking for this alternative. It is estimated that implementation of this control program would improve the percent capture from 72.4% for the baseline condition to 72.6%, and no overflows would be reduced. Regardless, this program would help attain higher public acceptance because improvements would be readily seen; if the gray infrastructure projects (for example, off-line storage) also need to be implemented to achieve water quality or CSO reduction goals, the public may be more supportive after completion of these initial collection system and source control projects.

Table D.2-1 Alternatives Evaluation Matrix

Alternatives	Constructability	Reliability	Operability	Adaptability	Environmental Impacts	Social Benefits	Multiple-use Considerations	Performance	Institutional Issues*	Siting	Cost	Overall Score
Green Infrastructure Source Controls	4	3	3	5	4	5	4	2	5	3	4	42
Maximizing Flow to the POTW with only Pumps Upgraded	4	4	4	3	4	1	2	5	4	5	5	41
Inflow and Infiltration Collection System Controls (Lining)	5	4	5	5	3	1	1	1	4	5	5	39
Off-line Storage with Storage Tanks/Treatment Shafts	2	5	2	4	4	4	5	5	1	3	2	37
Partial Separate Sewer Collection System Controls	1	5	5	4	2	1	1	1	2	4	5	31
Inflow and Infiltration Collection System Controls (Replacement)	1	5	5	4	1	1	1	2	2	4	3	29
Off-line Storage with Tunnels	1	5	2	2	4	3	3	5	1	1	2	29
Maximizing Flow to the POTW with both Pumps and Force Main Upgrades	1	4	4	1	2	1	2	3	1	3	1	23
Collection System and Source Controls	4	4	4	4	3	2	2	2	4	4	5	38
Collection System and Source Controls with Offline Storage	3	4	4	4	3	2	3	3	3	4	4	37

* Public acceptance is reflected in this criteria

D.2.2 Collection System and Source Controls with Off-Line Storage

The most significant impact of adding off-line storage to the control program alternative discussed in Section D.2.1 is that performance of the CSO controls will improve. As shown in Table D.2-1, the storage tanks/treatment shafts have a higher overall rating score than the tunnel alternative. Storage tanks/treatment shafts also have the advantage of being well-suited for phased implementation, in which the percent capture and overflow reduction numbers would increase with each additional tank added to the CSS.

Table D.2-1 shows that the ratings for the alternative with collection system and source controls with off-line storage; some rating benefits are improved because of the addition of off-line storage, and others are reduced. A summary of the rating changes is provided below:

- While GI has a "very good" environmental impact rating and an "excellent" institutional rating, its combination with off-line storage reduces these ratings because the off-line storage alternative will require more disruption to land and the environment during construction.
- While the performance of GI with collection system controls is only rated as "fair," the addition of off-line storage improves the overall program performance to "good."

Table D.1-2 shows the results of the PCSWMM model runs for the combination control program alternatives.

The short list of alternatives recommended for the LTCP program at this time is a combination of:

- I/I removal by lining leaking pipes
- Sewer separation in the Bates Street Redevelopment Area
- Green infrastructure with bioswales and tree planting
- One of the off-line storage alternatives with or without the option to upgrade the East and West Side Pump Stations.

D.2.3 Summary of Cost Opinions

The cost and performance analysis presented herein was prepared in accordance with Passaic Valley Sewerage Commissioners CSO Long Term Control Plan Updated Technical Guidance Manual January 2018. All Present Worth Costs include the present-day costs for capital costs, land costs, and O&M costs over a 20-year period or life of the project. All capital costs include an additional 25% for contingencies, 20% for engineering costs and 15% for contractor overhead and profit. At each level of control, assuming an interest rate of 2.75% and a 20-year life cycle for present value calculations, a Present Worth (PW) factor of 15.227 was used. The total present worth (TPW) cost is calculated as the sum of the capital cost, land cost, and the O&M costs multiplied by the 15.227 PW factor. All costs have been adjusted for present day worth using the ENR construction indices. For tabulation of cost ratings, the follow cost ranges were used: $50M or less received a score of 5 (excellent), $50M-$100M received a score of 4 (very good), $100M-$300M received a score of 3 (good), $300M-$1B received a score of 2 (fair), and $1B+ received a score of 1 (poor). Detailed cost opinions of all the alternatives are presented in Appendix A.

As shown in Table D.2-2, reduction of I/I through pipe replacement has a TPW cost of $130 M, and the pipe rehabilitation (lining) alternative has a TPW cost of $43 M. It is noted that, in both cases, the pipe sizes remain the same.

As shown in Table D.2-3, the partial sewer separation alternative at Bates Street has a TPW cost of $16 M. The TPW cost for the system-wide sewer separation alternative is $5,824 M, which is not a feasible alternative; the cost is provided as a hypothetical reference for the cost to achieve zero overflows.

Table D.2-4 presents the cost for green infrastructure with bioswale (rain garden) technology applied. The TPW costs were estimated at $73 M for the 7% impervious area controlled alternative and $105 M for the 10 % impervious area controlled alternative. The tree planting alternative is estimated to have a relatively lower cost: $21 M for 7% impervious area and $30 M for 10% imperious area (O&M costs not considered).

Tables D.2-5 and D.2-6 show the capital, O&M, and TPW costs for the storage alternatives including the storage tunnel alternatives and the 9 grouped storage tanks. These tables present the costs for various levels of performance based upon the number of overflows of 4, 8, 12, and 20. The following summarizes the conclusions:

- Both the grouped tanks and tunnels alternatives have no significant cost difference with upgrades to the East and West Side Pump Stations. Therefore, only the alternatives without pump upgrades are presented.
- The tunnel alternatives with 4, 8, 12, and 20 overflows have TPW costs of $890 M, $834 M, $688 M and $584 M, respectively. The storage tank alternatives with 4, 8, 12, and 20 overflows have TPW costs of $884 ~~857~~ M, $833 ~~794~~ M, $722 ~~719~~ M and $547 M, respectively. The storage tank alternative has lower costs than the tunnel alternative at 4, 8, and 20 overflows but higher costs than the tunnel alternative at 12 overflows.

The detailed costs for each alternative are available in Appendix A.

Several assumptions specific to Jersey City were used during evaluation of control alternatives. These assumptions include the following:

- Land cost in Jersey City was estimated to be $5,123,300 per acre based on information on averages of several real estate property quotes in Jersey City.
- The amount of land required for all treatment and disinfection systems is equal to the sum of the land required for the tanks, equipment, and buildings plus a twenty-five-foot buffer around the area for access and maintenance.

The O&M costs for tanks, tunnels, and green infrastructure are shown in Table D.2-7. These cost estimates were developed based on the materials provided by Greeley and Hansen/CDM Smith at the March 21st CSO permittee meeting. Operation costs (labor costs and requirements) for the various CSO control technologies were based on the average cost of maintaining a single operation post manned by one operator on a 24-hour, year-round basis. Local operation labor is approximately $53.60/hour, including fringe benefits. Assuming an eight-hour workday, with three shifts per day, for 365 days per year, the average cost for a Continuous Operating Post (COP) would be $470,000. Maintenance costs are taken as a percentage of the construction cost.

Table D.2-2 Capital, O&M, and Present Worth Cost Breakdown for Inflow and Infiltration

Inflow and Infiltration	Present Worth Cost			
	Total Capital Cost	Land Cost	Annual O&M Cost	Present Worth
Replacement	$130,248,000	NA	NA	$ 130,248,000
			Total Present Worth Cost	$ 130,248,000
Rehabilitation	$ 43,142,000	NA	NA	$ 43,142,000
			Total Present Worth Cost	$ 43,142,000

Table D.2-3 Capital, O&M, and Present Worth Cost Breakdown for Sewer Separation

Sewer Separation	Present Worth Cost			
	Total Capital Cost	Land Cost	Annual O&M Cost	Present Worth
Bates Street	$ 13,290,000	NA	$ 160,000	$ 15,690,000
			Total Present Worth Cost	$ 15,690,000
System Wide	$ 4,933,990,000	NA	$ 58,480,000	$ 5,824,420,000
			Total Present Worth Cost	$ 5,824,420,000

Table D.2-4 Capital, O&M, and Present Worth Cost Breakdown for GI

GI	Present Worth Cost			
	Total Capital Cost	Land Cost	Annual O&M Cost	Present Worth
7% Impervious Area Controlled	$ 50,070,000	NA	~~$ 1,130,000~~	~~$ 67,250,000~~
			Total Present Worth Cost	~~$ 67,250,000~~
10% Impervious Area Controlled	$ 71,910,000	NA	~~$ 1,620,000~~	~~$ 96,580,000~~
			Total Present Worth Cost	~~$ 96,580,000~~

GI	Present Worth Cost			
	Total Capital Cost	Land Cost	Annual O&M Cost	Present Worth
7% Impervious Area Controlled	$ 50,070,000	NA	$ 1,500,000	$ 72,970,000
			Total Present Worth Cost	$ 72,970,000
10% Impervious Area Controlled	$ 71,910,000	NA	$ 2,160,000	$ 104,800,000
			Total Present Worth Cost	$ 104,80,000

Table D.2-5 Capital, O & M, Present Worth Cost Breakdown for Tunnels

Tunnel	Storage Tunnel					Present Worth Cost			
	Length (ft)	Depth (ft)	Tunnel Diameter (ft)	Storage Diameter (ft)	Land Required (Acres)	Total Capital Cost	Land Cost	Annual O&M Cost	Present Worth
Tunnel Size for 4 Overflows									
West Side	27,780	118	12	65	0.96	$ 370,320,000	$ 4,920,000	$ 4,570,000	$ 444,830,000
East Side	27,426	118	12	65	1.03	$ 371,170,000	$ 5,300,000	$ 4,530,000	$ 445,410,000
								Total Present Worth Cost	$ 890,240,000
Tunnel Size for 8 Overflows									
West Side	27,780	118	11	60	0.96	$ 346,380,000	$ 4,920,000	$ 4,270,000	$ 416,370,000
East Side	27,426	118	11	60	1.03	$ 347,510,000	$ 5,300,000	$ 4,230,000	$ 417,280,000
								Total Present Worth Cost	$ 833,650,000
Tunnel Size for 12 Overflows									
West Side	27,780	118	8.25	55	0.96	$ 284,590,000	$ 4,920,000	$ 3,530,000	$ 343,240,000
East Side	27,426	118	8.25	55	1.03	$ 286,470,000	$ 5,300,000	$ 3,500,000	$ 345,050,000
								Total Present Worth Cost	$ 688,290,000
Tunnel Size for 20 Overflows									
West Side	27,780	118	6.5	36	0.96	$ 240,450,000	$ 4,920,000	$ 2,970,000	$ 290,590,000
East Side	27,426	118	6.5	36	1.03	$ 242,820,000	$ 5,300,000	$ 2,950,000	$ 292,970,000
								Total Present Worth Cost	$ 583,560,000

D.2-6 Capital, O & M, and Present Worth Cost Breakdowns for 9 Storage Tanks

Construction Phase	Tank Location	Storage Tank			Present Worth Cost			
		Diameter (ft)	Tank Volume (MG)	Land Required (acres)	Total Capital Cost	Land Cost	Annual O&M Cost	Present Worth
Tank Size for 4 Overflows								
~~1~~	~~Secaucus / Manhattan~~	~~85~~	~~5.56~~	~~0.329~~	~~$ 67,650,000~~	~~$ 1,680,000~~	~~$ 940,000~~	~~$ 83,670,000~~
2	St. Paul's / Van Winkle / Broadway	100	7.05	0.406	$ 54,470,000	$ 2,080,000	$ 1,070,000	$ 72,910,000
3	York/Grand & Essex	80	4.51	0.305	$ 35,830,000	$ 1,560,000	$ 850,000	$ 50,280,000
4	Mill Creek & Pine	140	14.97	0.651	$ 88,060,000	$ 3,330,000	$ 1,790,000	$ 118,590,000
5	Second / Sixth	60	1.90	0.218	$ 21,700,000	$ 1,120,000	$ 610,000	$ 32,150,000
6	Sip / Duncan / Clendenny / Claremont / Fisk	186	26.44	1.004	$ 182,000,000	$ 5,140,000	$ 2,820,000	$ 230,030,000
7	Danforth & Mina	104	8.22	0.428	$ 62,740,000	$ 2,190,000	$ 1,180,000	$ 82,900,000
~~8~~	~~Fourteenth / Eighteenth~~	~~100~~	~~7.05~~	~~0.406~~	~~$ 59,380,000~~	~~$ 2,080,000~~	~~$ 1,070,000~~	~~$ 77,820,000~~
9	Brown / Richard / Claremont & Carteret	100	7.34	0.406	$ 91,740,000	$ 2,080,000	$ 1,100,000	$ 110,590,000
							Total Present Worth Cost	~~**$ 858,960,000**~~
Tank Size for 8 Overflows								
1	Secaucus / Manhattan	85	5.56	0.329	$ 67,650,000	$ 1,560,000	$ 940,000	$ 83,670,000
2	St. Paul's / Van Winkle / Broadway	80	4.89	0.305	$ 43,540,000	$ 1,560,000	$ 880,000	$ 58,510,000
3	York/Grand & Essex	80	4.51	0.305	$ 35,830,000	$ 1,560,000	$ 850,000	$ 50,280,000
~~4~~	~~Mill Creek & Pine~~	~~125~~	~~11.84~~	~~0.552~~	~~$ 72,270,000~~	~~$ 2,670,000~~	~~$ 1,510,000~~	~~$ 98,020,000~~
5	Second / Sixth	60	1.80	0.218	$ 21,170,000	$ 1,120,000	$ 600,000	$ 31,470,000
6	Sip / Duncan / Clendenny / Claremont / Fisk	181	25.11	0.962	$ 175,320,000	$ 3,690,000	$ 2,700,000	$ 221,330,000
7	Danforth & Mina	104	8.22	0.428	$ 62,740,000	$ 2,080,000	$ 1,180,000	$ 82,900,000
~~8~~	~~Fourteenth / Eighteenth~~	~~100~~	~~5.87~~	~~0.406~~	~~$ 53,440,000~~	~~$ 2,080,000~~	~~$ 970,000~~	~~$ 70,280,000~~
9	Brown / Richard / Claremont & Carteret	100	5.58	0.406	$ 82,840,000	$ 2,080,000	$ 940,000	$ 99,270,000
							Total Present Worth Cost	~~**$ 795,730,000**~~
Tank Size for 12 Overflows								
1	Secaucus / Manhattan	80	4.51	0.305	$ 62,330,000	$ 1,560,000	$ 850,000	$ 76,790,000
2	St. Paul's / Van Winkle / Broadway	80	4.14	0.305	$ 39,740,000	$ 1,560,000	$ 810,000	$ 53,680,000
3	York/Grand & Essex	80	4.14	0.305	$ 33,930,000	$ 1,560,000	$ 810,000	$ 47,870,000
4	Mill Creek & Pine	120	11.00	0.521	$ 67,990,000	$ 2,670,000	$ 1,430,000	$ 92,420,000
5	Second / Sixth	60	1.59	0.218	$ 20,100,000	$ 1,120,000	$ 580,000	$ 30,110,000
6	Sip / Duncan / Clendenny / Claremont / Fisk	153	17.96	0.743	$ 139,180,000	$ 3,330,000	$ 2,060,000	$ 174,280,000
7	Danforth & Mina	100	7.05	0.406	$ 56,800,000	$ 2,080,000	$ 1,070,000	$ 75,250,000
~~8~~	~~Fourteenth / Eighteenth~~	~~100~~	~~5.87~~	~~0.406~~	~~$ 53,440,000~~	~~$ 2,080,000~~	~~$ 970,000~~	~~$ 70,280,000~~
9	Brown / Richard / Claremont & Carteret	100	5.58	0.406	$ 82,840,000	$ 2,080,000	$ 940,000	$ 99,270,000
							Total Present Worth Cost	~~**$ 719,950,000**~~
Tank Size for 20 Overflows								
1	Secaucus / Manhattan	80	3.68	0.305	$ 58,150,000	$ 1,560,000	$ 770,000	$ 71,470,000
2	St. Paul's / Van Winkle / Broadway	80	3.01	0.305	$ 34,040,000	$ 1,560,000	$ 710,000	$ 46,440,000
3	York/Grand & Essex	80	1.80	0.305	$ 22,150,000	$ 1,560,000	$ 600,000	$ 32,900,000
4	Mill Creek & Pine	100	5.29	0.406	$ 39,130,000	$ 2,080,000	$ 920,000	$ 55,160,000
5	Second / Sixth	48	0.74	0.173	$ 15,850,000	$ 890,000	$ 510,000	$ 24,470,000
6	Sip / Duncan / Clendenny / Claremont / Fisk	120	10.15	0.521	$ 99,700,000	$ 2,670,000	$ 1,350,000	$ 122,980,000
7	Danforth & Mina	80	4.32	0.305	$ 43,030,000	$ 1,560,000	$ 830,000	$ 57,220,000
8	Fourteenth / Eighteenth	80	3.20	0.305	$ 39,910,000	$ 1,560,000	$ 730,000	$ 52,560,000
9	Brown / Richard / Claremont & Carteret	80	3.20	0.305	$ 70,780,000	$ 1,560,000	$ 730,000	$ 83,440,000
							Total Present Worth Cost	~~**$ 546,650,000**~~

D.2-6 Capital, O & M, and Present Worth Cost Breakdowns for 9 Storage Tanks

Construction Phase	Tank Location	Storage Tank			Present Worth Cost			
		Diameter (ft)	Tank Volume (MG)	Land Required (acres)	Total Capital Cost	Land Cost	Annual O&M Cost	Present Worth
Tank Size for 4 Overflows								
1	Secaucus / Manhattan	90	6.18	0.353	$ 70,780,000	$ 1,810,000	$ 1,000,000	$ 87,770,000
2	St. Paul's / Van Winkle / Broadway	100	7.05	0.406	$ 54,470,000	$ 2,080,000	$ 1,070,000	$ 72,910,000
3	York/Grand & Essex	80	4.51	0.305	$ 35,830,000	$ 1,560,000	$ 850,000	$ 50,280,000
4	Mill Creek & Pine	140	14.97	0.651	$ 88,060,000	$ 3,330,000	$ 1,790,000	$ 118,590,000
5	Second / Sixth	60	1.90	0.218	$ 21,700,000	$ 1,120,000	$ 610,000	$ 32,150,000
6	Sip / Duncan / Clendenny / Claremont / Fisk	186	26.44	1.004	$ 182,000,000	$ 5,140,000	$ 2,820,000	$ 230,030,000
7	Danforth & Mina	104	8.22	0.428	$ 62,740,000	$ 2,190,000	$ 1,180,000	$ 82,900,000
8	Fourteenth / Eighteenth	120	10.15	0.521	$ 75,040,000	$ 2,670,000	$ 1,350,000	$ 98,310,000
9	Brown / Richard / Claremont & Carteret	100	7.34	0.406	$ 91,740,000	$ 2,080,000	$ 1,100,000	$ 110,590,000
						Total Present Worth Cost		**$ 883,530,000**
Tank Size for 8 Overflows								
1	Secaucus / Manhattan	85	5.56	0.329	$ 67,650,000	$ 1,680,000	$ 940,000	$ 83,670,000
2	St. Paul's / Van Winkle / Broadway	80	4.89	0.305	$ 43,540,000	$ 1,560,000	$ 880,000	$ 58,510,000
3	York/Grand & Essex	80	4.51	0.305	$ 35,830,000	$ 1,560,000	$ 850,000	$ 50,280,000
4	Mill Creek & Pine	140	14.97	0.651	$ 88,070,000	$ 3,330,000	$ 1,790,000	$ 118,600,000
5	Second / Sixth	60	1.80	0.218	$ 21,170,000	$ 1,120,000	$ 600,000	$ 31,470,000
6	Sip / Duncan / Clendenny / Claremont / Fisk	181	25.11	0.962	$ 175,320,000	$ 4,930,000	$ 2,700,000	$ 221,330,000
7	Danforth & Mina	104	8.22	0.428	$ 62,740,000	$ 2,190,000	$ 1,180,000	$ 82,900,000
8	Fourteenth / Eighteenth	120	8.46	0.521	$ 66,490,000	$ 2,670,000	$ 1,200,000	$ 87,450,000
9	Brown / Richard / Claremont & Carteret	100	5.58	0.406	$ 82,840,000	$ 2,080,000	$ 940,000	$ 99,270,000
						Total Present Worth Cost		**$ 833,480,000**
Tank Size for 12 Overflows								
1	Secaucus / Manhattan	80	4.51	0.305	$ 62,330,000	$ 1,560,000	$ 850,000	$ 76,790,000
2	St. Paul's / Van Winkle / Broadway	80	4.14	0.305	$ 39,740,000	$ 1,560,000	$ 810,000	$ 53,680,000
3	York/Grand & Essex	80	4.14	0.305	$ 33,930,000	$ 1,560,000	$ 810,000	$ 47,870,000
4	Mill Creek & Pine	120	11.00	0.521	$ 67,990,000	$ 2,670,000	$ 1,430,000	$ 92,420,000
5	Second / Sixth	60	1.59	0.218	$ 20,100,000	$ 1,120,000	$ 580,000	$ 30,110,000
6	Sip / Duncan / Clendenny / Claremont / Fisk	153	17.96	0.743	$ 139,180,000	$ 3,810,000	$ 2,060,000	$ 174,280,000
7	Danforth & Mina	100	7.05	0.406	$ 56,800,000	$ 2,080,000	$ 1,070,000	$ 75,250,000
8	Fourteenth / Eighteenth	102	6.11	0.417	$ 54,630,000	$ 2,080,000	$ 990,000	$ 71,790,000
9	Brown / Richard / Claremont & Carteret	100	5.58	0.406	$ 82,840,000	$ 2,130,000	$ 940,000	$ 99,330,000
						Total Present Worth Cost		**$ 721,520,000**
Tank Size for 20 Overflows								
1	Secaucus / Manhattan	80	3.68	0.305	$ 58,150,000	$ 1,560,000	$ 770,000	$ 71,470,000
2	St. Paul's / Van Winkle / Broadway	80	3.01	0.305	$ 34,040,000	$ 1,560,000	$ 710,000	$ 46,440,000
3	York/Grand & Essex	80	1.80	0.305	$ 22,150,000	$ 1,560,000	$ 600,000	$ 32,900,000
4	Mill Creek & Pine	100	5.29	0.406	$ 39,130,000	$ 2,080,000	$ 920,000	$ 55,160,000
5	Second / Sixth	48	0.74	0.173	$ 15,850,000	$ 890,000	$ 510,000	$ 24,470,000
6	Sip / Duncan / Clendenny / Claremont / Fisk	120	10.15	0.521	$ 99,700,000	$ 2,670,000	$ 1,350,000	$ 122,980,000
7	Danforth & Mina	80	4.32	0.305	$ 43,030,000	$ 1,560,000	$ 830,000	$ 57,220,000
8	Fourteenth / Eighteenth	80	3.20	0.305	$ 39,910,000	$ 1,560,000	$ 730,000	$ 52,560,000
9	Brown / Richard / Claremont & Carteret	80	3.20	0.305	$ 70,780,000	$ 1,560,000	$ 730,000	$ 83,440,000
						Total Present Worth Cost		**$ 546,640,000**

Table D.2-7 O&M Cost for Tanks, Tunnels and Green Infrastructure

	Item	Unit	Cost Basis (per year)
Operation	Pump Station (Up to 100 MGD)*	COP	0.5 × $470K
	Storage	COP	0.5 × $470K
	Tunnels	COP	1 × $470K
Maintenance	Green Infrastructure	Per Impervious Acre Managed	$8,000
	Pump Station	% of construction cost	2.0%
	Storage	% of construction cost	3.0%
	Tunnels	% of construction cost	2.0%
	Conveyance Pipelines /Sewer Separation	% of construction cost	2.0%

*Pump station operation for tunnels included in tunnel operation.
- Only add pump station operation costs if stand-alone pump station.
- COP = Continuous operating post

D.3 PRELIMINARY SELECTION OF ALTERNATIVES

D.3.1 Evaluation Factors

Each alternative was evaluated based on the factors previously described in this Alternatives Report. Each factor was graded on a 1-5 scale, which ranged from poor to excellent. Implementability and technical factors (constructability, reliability, operability, and adaptability) were described in Section D.1.3. Environmental factors (public acceptance, environmental impacts, social benefits, and multiple-use considerations) were described in section D.1.4. Cost was evaluated using the scale described in section D.2.3. Institutional issues were described in section D.1.1. Siting was evaluated based on ease of site acquisition and graded on a scale from 1-5 (poor to excellent). If an alternative will be constructed on public property or a site owned by the City, then it would receive an excellent score. If an alternative is required to be constructed on a site that is private, must be purchased or requires intensive permitting it would receive a poor score. A list of the alternatives, the factors evaluated and their scores can be found on Table D.2-1.

D.3.2 Regulatory Compliance

The evaluation of alternatives included in the report were analyzed in compliance with the LTCP regulatory (EPA and NJSPDES) requirements. The analysis of the alternatives included a range of CSO control measures to select preliminary alternatives that will meet necessary CSO controls. To better compare the alternatives analyzed, cost opinions were developed in addition to other considerations. The JCMUA, in cooperation with the regional team, will later determine whether the presumption approach or demonstration approach is more applicable.

D.3.3 Selection of Preliminary Alternatives

As discussed in Section D.2.2, the following preliminary alternatives are being considered for selection in the LTCP in accordance with the established criteria:

- I/I removal by lining the leaking pipes
- Sewer separation in the Bates Street Redevelopment Area
- Green infrastructure with bioswales and perhaps tree replacement
- A variant of one of the off-line storage alternatives with or without the option to upgrade the East Side and West Side pump stations. These variations may be as follows:
    - Storage tanks/treatment shafts for the W1 and W2 subdrainage areas
    - If necessary, additional storage tanks for W3 to W13
    - If the Hudson River is viewed as being in need of CSO abatement, the E18 and E19 storage tanks may be added

- A tunnel on the west side, alone, may be favored if the storage tank/treatment shafts are deemed less favorable.

Although no final selected plan is being proposed in this report, some combination of these alternatives may be able to be implemented over 30 years by the JCMUA in a cost-effective approach. If they cannot be implemented in a 30-year period, the I/I removal, sewer separation, and GI alternatives would become the planned approach.

FIGURES

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JERSEY CITY MUNICIPAL UTILITIES AUTHORITY
DEVELOPMENT AND EVALUATION OF ALTERNATIVES REPORT
INFLOW & INFILTRATION PIPES

FIGURE D.1-1

JERSEY CITY MUNICIPAL UTILITIES AUTHORITY

DEVELOPMENT AND EVALUATIONS OF ALTERNATIVESREPORT

OPTIMAL GREEN INFRASTRUCTURE LOCATIONS

FIGURE **D.1-2**

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JERSEY CITY MUNICIPAL UTILITIES AUTHORITY

DEVELOPMENT AND EVALUATIONS OF ALTERNATIVES REPORT
ADDITIONAL GREEN INFRASTRUCTURE LOCATIONS

FIGURE **D.1-3**

JERSEY CITY MUNICIPAL UTILITIES AUTHORITY
DEVELOPMENT AND EVALUATION OF ALTERNATIVES **REPORT**
PROPOSED JERSEY CITY TUNNEL ALIGNMENT

FIGURE D.**1-4**

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JERSEY CITY MUNICIPAL UTILITIES AUTHORITY
DEVELOPMENT AND EVALUATION OF ALTERNATIVES REPORT
GROUPED STORAGE TANK LOCATIONS

FIGURE D.1-5

APPENDIX A

DETAILED TOTAL CAPITAL, O&M, AND PRESENT WORTH COSTS FOR JCMUA ALTERNATIVES

JCMUA Development and Evaluation of Alternatives
Table 1: Grouped Storage Tanks Alternative (4 Overflows)

Construction Phase	Description	Estimated Quantities	Unit Cost	Units	Total
	Grouped Storage Tanks Alternative (4 Overflows)				
TS 1	**Tank #1: Secaucus / Manhattan (W1W2)**				
	Tanks including Installation	6.2	$ 4,106,900	MG.	$ 25,390,000
	Gravity Sewer including Installation (8' x 10')	5,840	$ 2,800	L.F.	$ 16,350,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 41,940,000
	Total Cost with Contingency (25%)				$ 52,430,000
	Overhead and Profit (15%)				$ 7,860,000
	Legal and Engineering Costs (20%)				$ 10,490,000
	Total Capital Cost				**$ 70,780,000**
	Land Use	**0.35**	**$ 5,123,300**	**AC.**	**$ 1,810,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 760,000
	Annual O & M Cost				**$ 1,000,000**
	***Present Worth O & M Cost**				**$ 15,180,000**
	***Total Present Worth**				**$ 87,770,000**
TS 2	**Tank #2: St. Paul's / Van Winkle / Broadway (W3W5)**				
	Tanks including Installation	7	$ 3,970,300	MG.	$ 27,990,000
	Gravity Sewer including Installation (6')	1,660	$ 1,600	L.F.	$ 2,620,000
	Gravity Sewer including Installation (4' x 6')	860	$ 1,600	L.F.	$ 1,360,000
	Gravity Sewer including Installation (8')	50	$ 2,100	L.F.	$ 100,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 32,280,000
	Total Cost with Contingency (25%)				$ 40,350,000
	Overhead and Profit (15%)				$ 6,050,000
	Legal and Engineering Costs (20%)				$ 8,070,000
	Total Capital Cost				**$ 54,470,000**
	Land Use	**0.41**	**$ 5,123,300**	**AC.**	**$ 2,080,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 840,000
	Annual O & M Cost				**$ 1,070,000**
	***Present Worth O & M Cost**				**$ 16,360,000**
	***Total Present Worth**				**$ 72,910,000**
TS 3	**Tank #3: York/Grand & Essex (E1011)**				
	Tanks including Installation	4.5	$ 4,519,000	MG.	$ 20,390,000
	Gravity Sewer including Installation (8' x 10')	230	$ 2,800	L.F.	$ 640,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 21,230,000
	Total Cost with Contingency (25%)				$ 26,540,000
	Overhead and Profit (15%)				$ 3,980,000
	Legal and Engineering Costs (20%)				$ 5,310,000
	Total Capital Cost				**$ 35,830,000**
	Land Use	**0.3**	**$ 5,123,300**	**AC.**	**$ 1,560,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 610,000
	Annual O & M Cost				**$ 850,000**
	***Present Worth O & M Cost**				**$ 12,890,000**
	***Total Present Worth**				**$ 50,280,000**
TS 4	**Tank #4: Mill Creek & Pine (E56)**				
	Tanks including Installation	15	$ 3,454,200	MG.	$ 51,710,000
	Gravity Sewer including Installation (6')	110	$ 1,600	L.F.	$ 170,000
	Gravity Sewer including Installation (8')	50	$ 2,100	L.F.	$ 100,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 52,180,000
	Total Cost with Contingency (25%)				$ 65,230,000
	Overhead and Profit (15%)				$ 9,780,000
	Legal and Engineering Costs (20%)				$ 13,050,000
	Total Capital Cost				**$ 88,060,000**
	Land Use	**0.65**	**$ 5,123,300**	**AC.**	**$ 3,330,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 1,550,000
	Annual O & M Cost				**$ 1,790,000**
	***Present Worth O & M Cost**				**$ 27,200,000**
	***Total Present Worth**				**$ 118,590,000**
TS 5	**Tank #5: Second / Sixth (E15E1617)**				
	Tanks including Installation	1.9	$ 6,607,600	MG.	$ 12,580,000
	Gravity Sewer including Installation (8' x 10')	30	$ 2,800	L.F.	$ 80,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 12,860,000
	Total Cost with Contingency (25%)				$ 16,080,000
	Overhead and Profit (15%)				$ 2,410,000
	Legal and Engineering Costs (20%)				$ 3,220,000
	Total Capital Cost				**$ 21,700,000**
	Land Use	**0.22**	**$ 5,123,300**	**AC.**	**$ 1,120,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 380,000
	Annual O & M Cost				**$ 610,000**
	***Present Worth O & M Cost**				**$ 9,320,000**
	***Total Present Worth**				**$ 32,150,000**

Construction Phase	Description	Estimated Quantities	Unit Cost	Units	Total
TS 6	**Tank #6: Sip / Duncan / Clendenny / Claremont / Fisk (W6W10)**				
	Tanks including Installation	26.4	$ 3,254,900	MG.	$ 86,050,000
	Gravity Sewer including Installation (6' x 10')	1,800	$ 2,300	L.F.	$ 4,160,000
	Gravity Sewer including Installation (8' x 10')	6,180	$ 2,800	L.F.	$ 17,300,000
	Gravity Sewer including Installation (6')	90	$ 1,600	L.F.	$ 140,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 107,850,000
	Total Cost with Contingency (25%)				$ 134,820,000
	Overhead and Profit (15%)				$ 20,220,000
	Legal and Engineering Costs (20%)				$ 26,960,000
	Total Capital Cost				**$ 182,000,000**
	Land Use	**1**	**$ 5,123,300**	**AC.**	**$ 5,140,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 2,580,000
	Annual O & M Cost				**$ 2,820,000**
	***Present Worth O & M Cost**				**$ 42,890,000**
	***Total Present Worth**				**$ 230,030,000**
TS 7	**Tank #7: Danforth & Mina (W11W13)**				
	Tanks including Installation	8.2	$ 3,830,900	MG.	$ 31,510,000
	Gravity Sewer including Installation (8')	2,210	$ 2,100	L.F.	$ 4,570,000
	Gravity Sewer including Installation (8' x 12')	220	$ 3,000	L.F.	$ 670,000
	Gravity Sewer including Installation (9')	100	$ 2,300	L.F.	$ 230,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 37,180,000
	Total Cost with Contingency (25%)				$ 46,480,000
	Overhead and Profit (15%)				$ 6,970,000
	Legal and Engineering Costs (20%)				$ 9,300,000
	Total Capital Cost				**$ 62,740,000**
	Land Use	**0.43**	**$ 5,123,300**	**AC.**	**$ 2,190,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 950,000
	Annual O & M Cost				**$ 1,180,000**
	***Present Worth O & M Cost**				**$ 17,970,000**
	***Total Present Worth**				**$ 82,900,000**
TS 8	**Tank #8: Fourteenth / Eighteenth (E18E19)**				
	Tanks including Installation	10.1	$ 3,672,500	MG.	$ 37,270,000
	Gravity Sewer including Installation (10')	2,640	$ 2,600	L.F.	$ 6,750,000
	Gravity Sewer including Installation (8' x 10')	90	$ 2,800	L.F.	$ 250,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 44,470,000
	Total Cost with Contingency (25%)				$ 55,580,000
	Overhead and Profit (15%)				$ 8,340,000
	Legal and Engineering Costs (20%)				$ 11,120,000
	Total Capital Cost				**$ 75,040,000**
	Land Use	**0.52**	**$ 5,123,300**	**AC.**	**$ 2,670,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 1,120,000
	Annual O & M Cost				**$ 1,350,000**
	***Present Worth O & M Cost**				**$ 20,600,000**
	***Total Present Worth**				**$ 98,310,000**
TS 9	**Tank #9: Brown / Richard / Claremont & Carteret (E1E4)**				
	Tanks including Installation	7.3	$ 3,931,200	MG.	$ 28,870,000
	Gravity Sewer including Installation (5')	4,860	$ 1,300	L.F.	$ 6,500,000
	Gravity Sewer including Installation (6')	5,610	$ 1,600	L.F.	$ 8,870,000
	Gravity Sewer including Installation (8')	4,800	$ 2,100	L.F.	$ 9,930,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 54,370,000
	Total Cost with Contingency (25%)				$ 67,960,000
	Overhead and Profit (15%)				$ 10,190,000
	Legal and Engineering Costs (20%)				$ 13,590,000
	Total Capital Cost				**$ 91,740,000**
	Land Use	**0.41**	**$ 5,123,300**	**AC.**	**$ 2,080,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 870,000
	Annual O & M Cost				**$ 1,100,000**
	***Present Worth O & M Cost**				**$ 16,770,000**
	***Total Present Worth**				**$ 110,590,000**
All Phases	***Total Present Worth**				**883,530,000**

*20 years life cycle costs for operation and maitenance with an interest rate of 2.75% for present value calculation (P/A = 15.227)

JCMUA Development and Evaluation of Alternatives
Table 2: Grouped Storage Tanks Alternative (8 Overflows)

Construction Phase	Description	Estimated Quantities	Unit Cost	Units	Total
	Grouped Storage Tanks Alternative (8 Overflows)				
TS 1	**Tank #1: Secaucus / Manhattan (W1W2)**				
	Tanks including Installation	5.6	$ 4,230,600	MG.	$ 23,540,000
	Gravity Sewer including Installation (8' x 10')	5,840	$ 2,800	L.F.	$ 16,350,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 40,090,000
	Total Cost with Contingency (25%)				$ 50,110,000
	Overhead and Profit (15%)				$ 7,520,000
	Legal and Engineering Costs (20%)				$ 10,020,000
	Total Capital Cost				**$ 67,650,000**
	Land Use	**0.33**	**$ 5,123,300**	**AC.**	**$ 1,680,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 710,000
	Annual O & M Cost				**$ 940,000**
	***Present Worth O & M Cost**				**$ 14,330,000**
	***Total Present Worth**				**$ 83,670,000**
TS 2	**Tank #2: St. Paul's / Van Winkle / Broadway (W3W5)**				
	Tanks including Installation	4.9	$ 4,401,700	MG.	$ 21,510,000
	Gravity Sewer including Installation (6')	1,660	$ 1,600	L.F.	$ 2,620,000
	Gravity Sewer including Installation (4' x 6')	860	$ 1,600	L.F.	$ 1,360,000
	Gravity Sewer including Installation (8')	50	$ 2,100	L.F.	$ 100,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 25,800,000
	Total Cost with Contingency (25%)				$ 32,250,000
	Overhead and Profit (15%)				$ 4,840,000
	Legal and Engineering Costs (20%)				$ 6,450,000
	Total Capital Cost				**$ 43,540,000**
	Land Use	**0.3**	**$ 5,123,300**	**AC.**	**$ 1,560,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 650,000
	Annual O & M Cost				**$ 880,000**
	***Present Worth O & M Cost**				**$ 13,410,000**
	***Total Present Worth**				**$ 58,510,000**
TS 3	**Tank #3: York/Grand & Essex (E1011)**				
	Tanks including Installation	4.5	$ 4,519,000	MG.	$ 20,390,000
	Gravity Sewer including Installation (8' x 10')	230	$ 2,800	L.F.	$ 640,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 21,230,000
	Total Cost with Contingency (25%)				$ 26,540,000
	Overhead and Profit (15%)				$ 3,980,000
	Legal and Engineering Costs (20%)				$ 5,310,000
	Total Capital Cost				**$ 35,830,000**
	Land Use	**0.3**	**$ 5,123,300**	**AC.**	**$ 1,560,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 610,000
	Annual O & M Cost				**$ 850,000**
	***Present Worth O & M Cost**				**$ 12,890,000**
	***Total Present Worth**				**$ 50,280,000**
TS 4	**Tank #4: Mill Creek & Pine (E56)**				
	Tanks including Installation	15	$ 3,454,200	MG.	$ 51,710,000
	Gravity Sewer including Installation (6')	110	$ 1,600	L.F.	$ 170,000
	Gravity Sewer including Installation (8')	50	$ 2,100	L.F.	$ 100,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 52,190,000
	Total Cost with Contingency (25%)				$ 65,230,000
	Overhead and Profit (15%)				$ 9,790,000
	Legal and Engineering Costs (20%)				$ 13,050,000
	Total Capital Cost				**$ 88,070,000**
	Land Use	**0.65**	**$ 5,123,300**	**AC.**	**$ 3,330,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 1,550,000
	Annual O & M Cost				**$ 1,790,000**
	***Present Worth O & M Cost**				**$ 27,200,000**
	***Total Present Worth**				**$ 118,600,000**
TS 5	**Tank #5: Second / Sixth (E15E1617)**				
	Tanks including Installation	1.8	$ 6,820,100	MG.	$ 12,260,000
	Gravity Sewer including Installation (8' x 10')	30	$ 2,800	L.F.	$ 80,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 12,550,000
	Total Cost with Contingency (25%)				$ 15,680,000
	Overhead and Profit (15%)				$ 2,350,000
	Legal and Engineering Costs (20%)				$ 3,140,000
	Total Capital Cost				**$ 21,170,000**
	Land Use	**0.22**	**$ 5,123,300**	**AC.**	**$ 1,120,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 370,000
	Annual O & M Cost				**$ 600,000**
	***Present Worth O & M Cost**				**$ 9,180,000**
	***Total Present Worth**				**$ 31,470,000**

Construction Phase	Description	Estimated Quantities	Unit Cost	Units	Total
TS 6	**Tank #6: Sip / Duncan / Clendenny / Claremont / Fisk (W6W10)**				
	Tanks including Installation	25.1	$ 3,268,600	MG.	$ 82,090,000
	Gravity Sewer including Installation (6' x 10')	1,800	$ 2,300	L.F.	$ 4,160,000
	Gravity Sewer including Installation (8' x 10')	6,180	$ 2,800	L.F.	$ 17,300,000
	Gravity Sewer including Installation (6')	90	$ 1,600	L.F.	$ 140,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 103,900,000
	Total Cost with Contingency (25%)				$ 129,870,000
	Overhead and Profit (15%)				$ 19,480,000
	Legal and Engineering Costs (20%)				$ 25,970,000
	Total Capital Cost				**$ 175,320,000**
	Land Use	**0.96**	**$ 5,123,300**	**AC.**	**$ 4,930,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 2,460,000
	Annual O & M Cost				**$ 2,700,000**
	***Present Worth O & M Cost**				**$ 41,080,000**
	***Total Present Worth**				**$ 221,330,000**
TS 7	**Tank #7: Danforth & Mina (W11W13)**				
	Tanks including Installation	8.2	$ 3,830,900	MG.	$ 31,510,000
	Gravity Sewer including Installation (8')	2,210	$ 2,100	L.F.	$ 4,570,000
	Gravity Sewer including Installation (8' x 12')	220	$ 3,000	L.F.	$ 670,000
	Gravity Sewer including Installation (9')	100	$ 2,300	L.F.	$ 230,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 37,180,000
	Total Cost with Contingency (25%)				$ 46,480,000
	Overhead and Profit (15%)				$ 6,970,000
	Legal and Engineering Costs (20%)				$ 9,300,000
	Total Capital Cost				**$ 62,740,000**
	Land Use	**0.43**	**$ 5,123,300**	**AC.**	**$ 2,190,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 950,000
	Annual O & M Cost				**$ 1,180,000**
	***Present Worth O & M Cost**				**$ 17,970,000**
	***Total Present Worth**				**$ 82,900,000**
TS 8	**Tank #8: Fourteenth / Eighteenth (E18E19)**				
	Tanks including Installation	8.5	$ 3,808,000	MG.	$ 32,200,000
	Gravity Sewer including Installation (10')	2,640	$ 2,600	L.F.	$ 6,750,000
	Gravity Sewer including Installation (8' x 10')	90	$ 2,800	L.F.	$ 250,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 39,400,000
	Total Cost with Contingency (25%)				$ 49,250,000
	Overhead and Profit (15%)				$ 7,390,000
	Legal and Engineering Costs (20%)				$ 9,850,000
	Total Capital Cost				**$ 66,490,000**
	Land Use	**0.52**	**$ 5,123,300**	**AC.**	**$ 2,670,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 970,000
	Annual O & M Cost				**$ 1,200,000**
	***Present Worth O & M Cost**				**$ 18,290,000**
	***Total Present Worth**				**$ 87,450,000**
TS 9	**Tank #9: Brown / Richard / Claremont & Carteret (E1E4)**				
	Tanks including Installation	5.6	$ 4,227,000	MG.	$ 23,590,000
	Gravity Sewer including Installation (5')	4,860	$ 1,300	L.F.	$ 6,500,000
	Gravity Sewer including Installation (6')	5,610	$ 1,600	L.F.	$ 8,870,000
	Gravity Sewer including Installation (8')	4,800	$ 2,100	L.F.	$ 9,930,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 49,090,000
	Total Cost with Contingency (25%)				$ 61,360,000
	Overhead and Profit (15%)				$ 9,200,000
	Legal and Engineering Costs (20%)				$ 12,270,000
	Total Capital Cost				**$ 82,840,000**
	Land Use	**0.41**	**$ 5,123,300**	**AC.**	**$ 2,080,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 710,000
	Annual O & M Cost				**$ 940,000**
	***Present Worth O & M Cost**				**$ 14,350,000**
	***Total Present Worth**				**$ 99,270,000**
All Phases	***Total Present Worth**				**833,480,000**

*20 years life cycle costs for operation and maitenance with an interest rate of 2.75% for present value calculation (P/A = 15.227)

JCMUA Development and Evaluation of Alternatives
Table 3: Grouped Storage Tanks Alternative (12 Overflows)

Construction Phase	Description	Estimated Quantities	Unit Cost	Units	Total
	Grouped Storage Tanks Alternative (12 Overflows)				
TS 1	**Tank #1: Secaucus / Manhattan (W1W2)**				
	Tanks including Installation	4.5	$ 4,519,000	MG.	$ 20,390,000
	Gravity Sewer including Installation (8' x 10')	5,840	$ 2,800	L.F.	$ 16,350,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 36,940,000
	Total Cost with Contingency (25%)				$ 46,170,000
	Overhead and Profit (15%)				$ 6,930,000
	Legal and Engineering Costs (20%)				$ 9,230,000
	Total Capital Cost				**$ 62,330,000**
	Land Use	**0.3**	**$ 5,123,300**	**AC.**	**$ 1,560,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 610,000
	Annual O & M Cost				**$ 850,000**
	***Present Worth O & M Cost**				**$ 12,890,000**
	***Total Present Worth**				**$ 76,790,000**
TS 2	**Tank #2: St. Paul's / Van Winkle / Broadway (W3W5)**				
	Tanks including Installation	4.1	$ 4,657,500	MG.	$ 19,260,000
	Gravity Sewer including Installation (6')	1,660	$ 1,600	L.F.	$ 2,620,000
	Gravity Sewer including Installation (4' x 6')	860	$ 1,600	L.F.	$ 1,360,000
	Gravity Sewer including Installation (8')	50	$ 2,100	L.F.	$ 100,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 23,550,000
	Total Cost with Contingency (25%)				$ 29,440,000
	Overhead and Profit (15%)				$ 4,420,000
	Legal and Engineering Costs (20%)				$ 5,890,000
	Total Capital Cost				**$ 39,740,000**
	Land Use	**0.3**	**$ 5,123,300**	**AC.**	**$ 1,560,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 580,000
	Annual O & M Cost				**$ 810,000**
	***Present Worth O & M Cost**				**$ 12,380,000**
	***Total Present Worth**				**$ 53,680,000**
TS 3	**Tank #3: York/Grand & Essex (E1011)**				
	Tanks including Installation	4.1	$ 4,657,500	MG.	$ 19,260,000
	Gravity Sewer including Installation (8' x 10')	230	$ 2,800	L.F.	$ 640,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 20,110,000
	Total Cost with Contingency (25%)				$ 25,130,000
	Overhead and Profit (15%)				$ 3,770,000
	Legal and Engineering Costs (20%)				$ 5,030,000
	Total Capital Cost				**$ 33,930,000**
	Land Use	**0.3**	**$ 5,123,300**	**AC.**	**$ 1,560,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 580,000
	Annual O & M Cost				**$ 810,000**
	***Present Worth O & M Cost**				**$ 12,380,000**
	***Total Present Worth**				**$ 47,870,000**
TS 4	**Tank #4: Mill Creek & Pine (E56)**				
	Tanks including Installation	11	$ 3,620,100	MG.	$ 39,810,000
	Gravity Sewer including Installation (6')	110	$ 1,600	L.F.	$ 170,000
	Gravity Sewer including Installation (8')	50	$ 2,100	L.F.	$ 100,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 40,290,000
	Total Cost with Contingency (25%)				$ 50,360,000
	Overhead and Profit (15%)				$ 7,550,000
	Legal and Engineering Costs (20%)				$ 10,070,000
	Total Capital Cost				**$ 67,990,000**
	Land Use	**0.52**	**$ 5,123,300**	**AC.**	**$ 2,670,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 1,190,000
	Annual O & M Cost				**$ 1,430,000**
	***Present Worth O & M Cost**				**$ 21,760,000**
	***Total Present Worth**				**$ 92,420,000**
TS 5	**Tank #5: Second / Sixth (E15E1617)**				
	Tanks including Installation	1.6	$ 7,330,200	MG.	$ 11,630,000
	Gravity Sewer including Installation (8' x 10')	30	$ 2,800	L.F.	$ 80,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 11,910,000
	Total Cost with Contingency (25%)				$ 14,890,000
	Overhead and Profit (15%)				$ 2,230,000
	Legal and Engineering Costs (20%)				$ 2,980,000
	Total Capital Cost				**$ 20,100,000**
	Land Use	**0.22**	**$ 5,123,300**	**AC.**	**$ 1,120,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 350,000
	Annual O & M Cost				**$ 580,000**
	***Present Worth O & M Cost**				**$ 8,890,000**
	***Total Present Worth**				**$ 30,110,000**

Construction Phase	Description	Estimated Quantities	Unit Cost	Units	Total
TS 6	**Tank #6: Sip / Duncan / Clendenny / Claremont / Fisk (W6W10)**				
	Tanks including Installation	18	$ 3,377,600	MG.	$ 60,670,000
	Gravity Sewer including Installation (6' x 10')	1,800	$ 2,300	L.F.	$ 4,160,000
	Gravity Sewer including Installation (8' x 10')	6,180	$ 2,800	L.F.	$ 17,300,000
	Gravity Sewer including Installation (6')	90	$ 1,600	L.F.	$ 140,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 82,480,000
	Total Cost with Contingency (25%)				$ 103,100,000
	Overhead and Profit (15%)				$ 15,460,000
	Legal and Engineering Costs (20%)				$ 20,620,000
	Total Capital Cost				**$ 139,180,000**
	Land Use	**0.74**	**$ 5,123,300**	**AC.**	**$ 3,810,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 1,820,000
	Annual O & M Cost				**$ 2,060,000**
	***Present Worth O & M Cost**				**$ 31,290,000**
	***Total Present Worth**				**$ 174,280,000**
TS 7	**Tank #7: Danforth & Mina (W11W13)**				
	Tanks including Installation	7	$ 3,970,300	MG.	$ 27,990,000
	Gravity Sewer including Installation (8')	2,210	$ 2,100	L.F.	$ 4,570,000
	Gravity Sewer including Installation (8' x 12')	220	$ 3,000	L.F.	$ 670,000
	Gravity Sewer including Installation (9')	100	$ 2,300	L.F.	$ 230,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 33,660,000
	Total Cost with Contingency (25%)				$ 42,080,000
	Overhead and Profit (15%)				$ 6,310,000
	Legal and Engineering Costs (20%)				$ 8,420,000
	Total Capital Cost				**$ 56,800,000**
	Land Use	**0.41**	**$ 5,123,300**	**AC.**	**$ 2,080,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 840,000
	Annual O & M Cost				**$ 1,070,000**
	***Present Worth O & M Cost**				**$ 16,360,000**
	***Total Present Worth**				**$ 75,250,000**
TS 8	**Tank #8: Fourteenth / Eighteenth (E18E19)**				
	Tanks including Installation	6.1	$ 4,120,400	MG.	$ 25,170,000
	Gravity Sewer including Installation (10')	2,640	$ 2,600	L.F.	$ 6,750,000
	Gravity Sewer including Installation (8' x 10')	90	$ 2,800	L.F.	$ 250,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 32,370,000
	Total Cost with Contingency (25%)				$ 40,470,000
	Overhead and Profit (15%)				$ 6,070,000
	Legal and Engineering Costs (20%)				$ 8,090,000
	Total Capital Cost				**$ 54,630,000**
	Land Use	**0.41**	**$ 5,123,300**	**AC.**	**$ 2,080,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 760,000
	Annual O & M Cost				**$ 990,000**
	***Present Worth O & M Cost**				**$ 15,080,000**
	***Total Present Worth**				**$ 71,790,000**
TS 9	**Tank #9: Brown / Richard / Claremont & Carteret (E1E4)**				
	Tanks including Installation	5.6	$ 4,227,000	MG.	$ 23,590,000
	Gravity Sewer including Installation (5')	4,860	$ 1,300	L.F.	$ 6,500,000
	Gravity Sewer including Installation (6')	5,610	$ 1,600	L.F.	$ 8,870,000
	Gravity Sewer including Installation (8')	4,800	$ 2,100	L.F.	$ 9,930,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 49,090,000
	Total Cost with Contingency (25%)				$ 61,360,000
	Overhead and Profit (15%)				$ 9,200,000
	Legal and Engineering Costs (20%)				$ 12,270,000
	Total Capital Cost				**$ 82,840,000**
	Land Use	**0.42**	**$ 5,123,300**	**AC.**	**$ 2,130,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 710,000
	Annual O & M Cost				**$ 940,000**
	***Present Worth O & M Cost**				**$ 14,350,000**
	***Total Present Worth**				**$ 99,330,000**
All Phases	***Total Present Worth**				**721,520,000**

*20 years life cycle costs for operation and maitenance with an interest rate of 2.75% for present value calculation (P/A = 15.227)

JCMUA Development and Evaluation of Alternatives
Table 4: Grouped Storage Tanks Alternative (20 Overflows)

Construction Phase	Description	Estimated Quantities	Unit Cost	Units	Total
	Grouped Storage Tanks Alternative (20 Overflows)				
	Tank #1: Secaucus / Manhattan (W1W2)				
TS 1	Tanks including Installation	3.7	$ 4,861,100	MG.	$ 17,910,000
	Gravity Sewer including Installation (8' x 10')	5,840	$ 2,800	L.F.	$ 16,350,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 34,460,000
	Total Cost with Contingency (25%)				$ 43,080,000
	Overhead and Profit (15%)				$ 6,460,000
	Legal and Engineering Costs (20%)				$ 8,620,000
	Total Capital Cost				**$ 58,150,000**
	Land Use	**0.3**	**$ 5,123,300**	**AC.**	**$ 1,560,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 540,000
	Annual O & M Cost				**$ 770,000**
	***Present Worth O & M Cost**				**$ 11,760,000**
	***Total Present Worth**				**$ 71,470,000**
	Tank #2: St. Paul's / Van Winkle / Broadway (W3W5)				
TS 2	Tanks including Installation	3	$ 5,281,000	MG.	$ 15,880,000
	Gravity Sewer including Installation (6')	1,660	$ 1,600	L.F.	$ 2,620,000
	Gravity Sewer including Installation (4' x 6')	860	$ 1,600	L.F.	$ 1,360,000
	Gravity Sewer including Installation (8')	50	$ 2,100	L.F.	$ 100,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 20,170,000
	Total Cost with Contingency (25%)				$ 25,220,000
	Overhead and Profit (15%)				$ 3,780,000
	Legal and Engineering Costs (20%)				$ 5,040,000
	Total Capital Cost				**$ 34,040,000**
	Land Use	**0.3**	**$ 5,123,300**	**AC.**	**$ 1,560,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 480,000
	Annual O & M Cost				**$ 710,000**
	***Present Worth O & M Cost**				**$ 10,830,000**
	***Total Present Worth**				**$ 46,440,000**
	Tank #3: York/Grand & Essex (E1011)				
TS 3	Tanks including Installation	1.8	$ 6,805,200	MG.	$ 12,280,000
	Gravity Sewer including Installation (8' x 10')	230	$ 2,800	L.F.	$ 640,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 13,130,000
	Total Cost with Contingency (25%)				$ 16,410,000
	Overhead and Profit (15%)				$ 2,460,000
	Legal and Engineering Costs (20%)				$ 3,280,000
	Total Capital Cost				**$ 22,150,000**
	Land Use	**0.3**	**$ 5,123,300**	**AC.**	**$ 1,560,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 370,000
	Annual O & M Cost				**$ 600,000**
	***Present Worth O & M Cost**				**$ 9,190,000**
	***Total Present Worth**				**$ 32,900,000**
	Tank #4: Mill Creek & Pine (E56)				
TS 4	Tanks including Installation	5.3	$ 4,295,400	MG.	$ 22,710,000
	Gravity Sewer including Installation (6')	110	$ 1,600	L.F.	$ 170,000
	Gravity Sewer including Installation (8')	50	$ 2,100	L.F.	$ 100,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 23,190,000
	Total Cost with Contingency (25%)				$ 28,990,000
	Overhead and Profit (15%)				$ 4,350,000
	Legal and Engineering Costs (20%)				$ 5,800,000
	Total Capital Cost				**$ 39,130,000**
	Land Use	**0.41**	**$ 5,123,300**	**AC.**	**$ 2,080,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 680,000
	Annual O & M Cost				**$ 920,000**
	***Present Worth O & M Cost**				**$ 13,950,000**
	***Total Present Worth**				**$ 55,160,000**
	Tank #5: Second / Sixth (E15E1617)				
TS 5	Tanks including Installation	0.7	$ 12,232,200	MG.	$ 9,110,000
	Gravity Sewer including Installation (8' x 10')	30	$ 2,800	L.F.	$ 80,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 9,390,000
	Total Cost with Contingency (25%)				$ 11,740,000
	Overhead and Profit (15%)				$ 1,760,000
	Legal and Engineering Costs (20%)				$ 2,350,000
	Total Capital Cost				**$ 15,850,000**
	Land Use	**0.17**	**$ 5,123,300**	**AC.**	**$ 890,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 270,000
	Annual O & M Cost				**$ 510,000**
	***Present Worth O & M Cost**				**$ 7,740,000**
	***Total Present Worth**				**$ 24,470,000**

*20 years life cycle costs for operation and maitenance with an interest rate of 2.75% for present value calculation (P/A = 15.227)

Construction Phase	Description	Estimated Quantities	Unit Cost	Units	Total
	Tank #6: Sip / Duncan / Clendenny / Claremont / Fisk (W6W10)				
TS 6	Tanks including Installation	10.2	$ 3,672,200	MG.	$ 37,280,000
	Gravity Sewer including Installation (6' x 10')	1,800	$ 2,300	L.F.	$ 4,160,000
	Gravity Sewer including Installation (8' x 10')	6,180	$ 2,800	L.F.	$ 17,300,000
	Gravity Sewer including Installation (6')	90	$ 1,600	L.F.	$ 140,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 59,080,000
	Total Cost with Contingency (25%)				$ 73,850,000
	Overhead and Profit (15%)				$ 11,080,000
	Legal and Engineering Costs (20%)				$ 14,770,000
	Total Capital Cost				**$ 99,700,000**
	Land Use	**0.52**	**$ 5,123,300**	**AC.**	**$ 2,670,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 1,120,000
	Annual O & M Cost				**$ 1,350,000**
	***Present Worth O & M Cost**				**$ 20,610,000**
	***Total Present Worth**				**$ 122,980,000**
	Tank #7: Danforth & Mina (W11W13)				
TS 7	Tanks including Installation	4.3	$ 4,585,200	MG.	$ 19,830,000
	Gravity Sewer including Installation (8')	2,210	$ 2,100	L.F.	$ 4,570,000
	Gravity Sewer including Installation (8' x 12')	220	$ 3,000	L.F.	$ 670,000
	Gravity Sewer including Installation (9')	100	$ 2,300	L.F.	$ 230,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 25,500,000
	Total Cost with Contingency (25%)				$ 31,870,000
	Overhead and Profit (15%)				$ 4,780,000
	Legal and Engineering Costs (20%)				$ 6,370,000
	Total Capital Cost				**$ 43,030,000**
	Land Use	**0.3**	**$ 5,123,300**	**AC.**	**$ 1,560,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 590,000
	Annual O & M Cost				**$ 830,000**
	***Present Worth O & M Cost**				**$ 12,630,000**
	***Total Present Worth**				**$ 57,220,000**
	Tank #8: Fourteenth / Eighteenth (E18E19)				
TS 8	Tanks including Installation	3.2	$ 5,146,600	MG.	$ 16,450,000
	Gravity Sewer including Installation (10')	2,640	$ 2,600	L.F.	$ 6,750,000
	Gravity Sewer including Installation (8' x 10')	90	$ 2,800	L.F.	$ 250,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 23,650,000
	Total Cost with Contingency (25%)				$ 29,560,000
	Overhead and Profit (15%)				$ 4,430,000
	Legal and Engineering Costs (20%)				$ 5,910,000
	Total Capital Cost				**$ 39,910,000**
	Land Use	**0.3**	**$ 5,123,300**	**AC.**	**$ 1,560,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 490,000
	Annual O & M Cost				**$ 730,000**
	***Present Worth O & M Cost**				**$ 11,090,000**
	***Total Present Worth**				**$ 52,560,000**
	Tank #9: Brown / Richard / Claremont & Carteret (E1E4)				
TS 9	Tanks including Installation	3.2	$ 5,146,600	MG.	$ 16,450,000
	Gravity Sewer including Installation (5')	4,860	$ 1,300	L.F.	$ 6,500,000
	Gravity Sewer including Installation (6')	5,610	$ 1,600	L.F.	$ 8,870,000
	Gravity Sewer including Installation (8')	4,800	$ 2,100	L.F.	$ 9,930,000
	Force Main including Installation	300	$ 700	L.F.	$ 200,000
	Construction Total Cost				$ 41,950,000
	Total Cost with Contingency (25%)				$ 52,430,000
	Overhead and Profit (15%)				$ 7,860,000
	Legal and Engineering Costs (20%)				$ 10,490,000
	Total Capital Cost				**$ 70,780,000**
	Land Use	**0.3**	**$ 5,123,300**	**AC.**	**$ 1,560,000**
	Operation Storage				$ 240,000
	Maintenance Storage				$ 490,000
	Annual O & M Cost				**$ 730,000**
	***Present Worth O & M Cost**				**$ 11,090,000**
	***Total Present Worth**				**$ 83,440,000**
All Phases	***Total Present Worth**				**546,640,000**

JCMUA Development and Evaluation of Alternatives
Table 5: Tunnel Alternative (4 Overflows)

Description	Estimated Quantities	Unit Price	Units	Total
Tunnel Alternative (4 Overflows)				
West Deep Tunnel				
Tunnel including Installation	27,780	$ 6,000	L.F.	$165,340,000
Tunnel Drop Shaft including Installation	13	$ 2,607,300	EA.	$33,890,000
Storage including Installation	2.9	$ 5,361,500	MG	$15,700,000
Force Main Installation	300	$ 500	L.F.	$150,000
Pumps for Storage Tanks including Installation	1	$ 4,365,500	EA.	$4,370,000
Construction Total Cost				$219,450,000
Total Cost with Contingency (25%)				$274,310,000
Overhead and Profit (15%)				$41,150,000
Legal and Engineering Costs (20%)				$54,860,000
Total Capital Cost				**$370,320,000**
Land Use	**0.96**	**$5,123,300**	**AC.**	**$4,920,000**
Operation Tunnel				$470,000
Operation Storage				$240,000
Maintenance Tunnel				$3,310,000
Maintenance Pump Station				$90,000
Maintenance Storage				$470,000
Annual O & M Cost				**$4,570,000**
***Present Worth O & M Cost**				**$69,590,000**
***Total Present Worth**				**$444,830,000**
East Deep Tunnel				
Tunnel including Installation	27,426	$ 6,000	L.F.	$163,230,000
Tunnel Drop Shaft including Installation	14	$ 2,607,300	EA.	$36,500,000
Storage including Installation	2.9	$ 5,361,500	MG	$15,700,000
Force Main Installation	300	$ 500	L.F.	$150,000
Pumps for Storage Tanks including Installation	1	$ 4,365,500	EA.	$4,370,000
Construction Total Cost				$219,950,000
Total Cost with Contingency (25%)				$274,940,000
Overhead and Profit (15%)				$41,240,000
Legal and Engineering Costs (20%)				$54,990,000
Total Capital Cost				**$371,170,000**
Land Use	**1.03**	**$5,123,300**	**AC.**	**$5,300,000**
Operation Tunnel				$470,000
Operation Storage				$240,000
Maintenance Tunnel				$3,260,000
Maintenance Pump Station				$90,000
Maintenance Storage				$470,000
Annual O & M Cost				**$4,530,000**
***Present Worth O & M Cost**				**$68,950,000**
***Total Present Worth**				**$445,410,000**
***Total Present Worth -- Two Tunnels**				**$890,240,000**

*20 years life cycle costs for operation and maitenance with an interest rate of 2.75% for present value calculation (P/A = 15.227)

JCMUA Development and Evaluation of Alternatives
Table 6: Tunnel Alternative (8 Overflows)

Description	Estimated Quantities	Unit Price	Units	Total
Tunnel Alternative (8 Overflows)				
West Deep Tunnel				
Tunnel including Installation	27,780	$ 5,500	L.F.	$152,460,000
Tunnel Drop Shaft including Installation	13	$ 2,607,300	EA.	$33,890,000
Storage including Installation	2.5	$ 5,769,100	MG	$14,400,000
Force Main Installation	300	$ 500	L.F.	$150,000
Pumps for Storage Tanks including Installation	1	$ 4,365,500	EA.	$4,370,000
Construction Total Cost				$205,260,000
Total Cost with Contingency (25%)				$256,580,000
Overhead and Profit (15%)				$38,490,000
Legal and Engineering Costs (20%)				$51,320,000
Total Capital Cost				**$346,380,000**
Land Use	**0.96**	**$5,123,300**	**AC.**	**$4,920,000**
Operation Tunnel				$470,000
Operation Storage				$240,000
Maintenance Tunnel				$3,050,000
Maintenance Pump Station				$90,000
Maintenance Storage				$430,000
Annual O & M Cost				**$4,270,000**
***Present Worth O & M Cost**				**$65,070,000**
***Total Present Worth**				**$416,370,000**
East Deep Tunnel				
Tunnel including Installation	27,426	$ 5,500	L.F.	$150,510,000
Tunnel Drop Shaft including Installation	14	$ 2,607,300	EA.	$36,500,000
Storage including Installation	2.5	$ 5,769,100	MG	$14,400,000
Force Main Installation	300	$ 500	L.F.	$150,000
Pumps for Storage Tanks including Installation	1	$ 4,365,500	EA.	$4,370,000
Construction Total Cost				$205,930,000
Total Cost with Contingency (25%)				$257,410,000
Overhead and Profit (15%)				$38,610,000
Legal and Engineering Costs (20%)				$51,480,000
Total Capital Cost				**$347,510,000**
Land Use	**1.03**	**$5,123,300**	**AC.**	**$5,300,000**
Operation Tunnel				$470,000
Operation Storage				$240,000
Maintenance Tunnel				$3,010,000
Maintenance Pump Station				$90,000
Maintenance Storage				$430,000
Annual O & M Cost				**$4,230,000**
***Present Worth O & M Cost**				**$64,480,000**
***Total Present Worth**				**$417,280,000**
***Total Present Worth -- Two Tunnels**				**$833,650,000**

*20 years life cycle costs for operation and maitenance with an interest rate of 2.75% for present value calculation (P/A = 15.227)

JCMUA Development and Evaluation of Alternatives
Table 7: Tunnel Alternative (12 Overflows)

Description	Estimated Quantities	Unit Price	Units	Total
Tunnel Alternative (12 Overflows)				
West Deep Tunnel				
Tunnel including Installation	27,780	$ 4,200	L.F.	$ 117,040,000
Tunnel Drop Shaft including Installation	13	$ 2,607,300	EA.	$ 33,890,000
Storage including Installation	2.1	$ 6,292,800	MG	$ 13,200,000
Force Main Installation	300	$ 500	L.F.	$ 150,000
Pumps for Storage Tanks including Installation	1	$ 4,365,500	EA.	$ 4,370,000
Construction Total Cost				$ 168,640,000
Total Cost with Contingency (25%)				$ 210,800,000
Overhead and Profit (15%)				$ 31,620,000
Legal and Engineering Costs (20%)				$ 42,160,000
Total Capital Cost				**$ 284,590,000**
Land Use	**0.96**	**$5,123,300**	**AC.**	**$ 4,920,000**
Operation Tunnel				$ 470,000
Operation Storage				$ 240,000
Maintenance Tunnel				$ 2,340,000
Maintenance Pump Station				$ 90,000
Maintenance Storage				$ 400,000
Annual O & M Cost				**$ 3,530,000**
***Present Worth O & M Cost**				**$ 53,740,000**
***Total Present Worth**				**$ 343,240,000**
East Deep Tunnel				
Tunnel including Installation	27,426	$ 4,200	L.F.	$ 115,550,000
Tunnel Drop Shaft including Installation	14	$ 2,607,300	EA.	$ 36,500,000
Storage including Installation	2.1	$ 6,292,800	MG	$ 13,200,000
Force Main Installation	300	$ 500	L.F.	$ 150,000
Pumps for Storage Tanks including Installation	1	$ 4,365,500	EA.	$ 4,370,000
Construction Total Cost				$ 169,760,000
Total Cost with Contingency (25%)				$ 212,200,000
Overhead and Profit (15%)				$ 31,830,000
Legal and Engineering Costs (20%)				$ 42,440,000
Total Capital Cost				**$ 286,470,000**
Land Use	**1.03**	**$5,123,300**	**AC.**	**$ 5,300,000**
Operation Tunnel				$ 470,000
Operation Storage				$ 240,000
Maintenance Tunnel				$ 2,310,000
Maintenance Pump Station				$ 90,000
Maintenance Storage				$ 400,000
Annual O & M Cost				**$ 3,500,000**
***Present Worth O & M Cost**				**$ 53,280,000**
***Total Present Worth**				**$ 345,050,000**
***Total Present Worth -- Two Tunnels**				**$ 688,290,000**

*20 years life cycle costs for operation and maitenance with an interest rate of 2.75% for present value calculation (P/A = 15.227)

JCMUA Development and Evaluation of Alternatives
Table 8: Tunnel Alternative (20 Overflows)

Description	Estimated Quantities	Unit Price	Units	Total
Tunnel Alternative (20 Overflows)				
West Deep Tunnel				
Tunnel including Installation	27780	$ 3,400	L.F.	$ 94,500,000
Tunnel Drop Shaft including Installation	13	$ 2,607,300	EA.	$ 33,890,000
Storage including Installation	0.9	$10,667,500	MG	$ 9,580,000
Force Main Installation	300	$ 500	L.F.	$ 150,000
Pumps for Storage Tanks including Installation	1	$ 4,365,500	EA.	$ 4,370,000
Construction Total Cost				$ 142,490,000
Total Cost with Contingency (25%)				$ 178,110,000
Overhead and Profit (15%)				$ 26,720,000
Legal and Engineering Costs (20%)				$ 35,620,000
Total Capital Cost				**$ 240,450,000**
Land Use	**0.96**		**AC.**	**$ 4,920,000**
Operation Tunnel				$ 470,000
Operation Storage				$ 240,000
Maintenance Tunnel				$ 1,890,000
Maintenance Pump Station				$ 90,000
Maintenance Storage				$ 290,000
Annual O & M Cost				**$ 2,970,000**
***Present Worth O & M Cost**				**$ 45,220,000**
***Total Present Worth**				**$ 290,590,000**
East Deep Tunnel				
Tunnel including Installation	27426	$ 3,400	L.F.	$ 93,290,000
Tunnel Drop Shaft including Installation	14	$ 2,607,300	EA.	$ 36,500,000
Storage including Installation	0.9	$10,667,500	MG	$ 9,580,000
Force Main Installation	300	$ 500	L.F.	$ 150,000
Pumps for Storage Tanks including Installation	1	$ 4,365,500	EA.	$ 4,370,000
Construction Total Cost				$ 143,890,000
Total Cost with Contingency (25%)				$ 179,870,000
Overhead and Profit (15%)				$ 26,980,000
Legal and Engineering Costs (20%)				$ 35,970,000
Total Capital Cost				**$ 242,820,000**
Land Use	**1.03**	**5123300**	**AC.**	**$ 5,300,000**
Operation Tunnel				$ 470,000
Operation Storage				$ 240,000
Maintenance Tunnel				$ 1,870,000
Maintenance Pump Station				$ 90,000
Maintenance Storage				$ 290,000
Annual O & M Cost				**$ 2,950,000**
***Present Worth O & M Cost**				**$ 44,850,000**
***Total Present Worth**				**$ 292,970,000**
***Total Present Worth -- Two Tunnels**				**$ 583,560,000**

*20 years life cycle costs for operation and maitenance with an interest rate of 2.75% for present value calculation (P/A = 15.227)

JCMUA Development and Evaluation of Alternatives
Table 9: Green Infrastructure Alternative #1: 10% of Impervious Area Controled

Description	Estimated Quantities	Unit Cost	Units	Total
Green Infrastructure Alternative #1: 10% of Impervious Area Controled				
Green Infrastructure Total Construction Cost	270	$157,800	AC.	$ 42,610,000
Total Cost with Contingency (25%)				$ 53,270,000
Overhead and Profit (15%)				$ 7,990,000
Legal and Engineering Costs (20%)				$ 10,650,000
Total Capital Cost				**$ 71,910,000**
Maintenance Green Infrastructure				$ 2,160,000
Annual O & M Cost				$ 2,160,000
***Present Worth O & M Cost**				**$ 32,890,000**
***Total Present Worth**				**$ 104,800,000**

*20 years life cycle costs for operation and maitenance with an interest rate of 2.75% for present value calculation (P/A = 15.227)

JCMUA Development and Evaluation of Alternatives

Table 10: Green Infrastructure Alternative #2: 7% of Impervious Area Controled

Description	Estimated Quantities	Unit Cost	Units	Total
Green Infrastructure Alternative #2: 7% of Impervious Area Controled				
Green Infrastructure Total Construction Cost	188	$157,800	AC.	$ 29,670,000
Total Cost with Contingency (25%)				$ 37,090,000
Overhead and Profit (15%)				$ 5,560,000
Legal and Engineering Costs (20%)				$ 7,420,000
Total Capital Cost				**$ 50,070,000**
Maintenance Green Infrastructure				$ 1,500,000
Annual O & M Cost				$ 1,500,000
***Present Worth O & M Cost**				**$ 22,900,000**
***Total Present Worth**				**$ 72,970,000**

*20 years life cycle costs for operation and maitenance with an interest rate of 2.75% for present value calculation (P/A = 15.227)

JCMUA Development and Evaluation of Alternatives
Table 11: Bates Street Redevelopment Area- Bright Street Sewer Separation Alternative

Description	Estimated Quantities	Unit Cost	Units	Total
Bates Street Sewer Separation (modeled alternative)				
Sewer Separation Total Construction Cost	2,845	$ 2,800	L.F.	$ 7,880,000
Total Cost with Contingency (25%)				$ 9,850,000
Overhead and Profit (15%)				$ 1,480,000
Legal and Engineering Costs (20%)				$ 1,970,000
Total Capital Cost				**$ 13,290,000**
Annual O & M Cost				$ 160,000
***Present Worth O & M Cost**				**$ 2,400,000**
***Total Present Worth**				**$ 15,690,000**

*20 years life cycle costs for operation and maitenance with an interest rate of 2.75% for present value calculation (P/A = 15.227)

JCMUA Development and Evaluation of Alternatives
Table 12: System-wide Separation (0 overflow)

Description	Estimated Quantities	Unit Cost	Units	Total
System-wide Separation (0 overflow)				
Sewer Separation Total Construction Cost	1,056,000	$ 2,800	L.F.	$ 2,923,840,000
Total Cost with Contingency (25%)				$ 3,654,810,000
Overhead and Profit (15%)				$ 548,220,000
Legal and Engineering Costs (20%)				$ 730,960,000
Total Capital Cost				**$ 4,933,990,000**
Annual O & M Cost				$ 58,480,000
***Present Worth O & M Cost**				**$ 890,430,000**
***Total Present Worth**				**$ 5,824,420,000**

*20 years life cycle costs for operation and maitenance with an interest rate of 2.75% for present value calculation (P/A = 15.227)

JCMUA Development and Evaluation of Alternatives
Table 13: Inflow and Infiltration (I/I) Source Control Pipes Replacement Costs

Description	Estimated Quantities	Unit Cost	Units	Total
Replacement of Existing Sewer with 12 DI Sewer Pipes	2,100	80	L.F.	$ 169,000
Replacement of Existing Sewer with 18 DI Sewer Pipes	32,000	122	L.F.	$ 3,896,000
Replacement of Existing Sewer with 24 DI Sewer Pipes	6,970	164	L.F.	$ 1,140,000
Replacement of Existing Sewer with 30 DI Sewer Pipes	12,460	222	L.F.	$ 2,769,000
Replacement of Existing Sewer with 36 DI Sewer Pipes	6,600	283	L.F.	$ 1,869,000
Replacement of Existing Sewer with 42 DI Sewer Pipes	9,390	335	L.F.	$ 3,145,000
Replacement of Existing Sewer with 48 DI Sewer Pipes	10,360	407	L.F.	$ 4,219,000
Replacement of Existing Sewer with 54 DI Sewer Pipes	2,440	462	L.F.	$ 1,127,000
Replacement of Existing Sewer with 60 DI Sewer Pipes	1,950	573	L.F.	$ 1,117,000
Replacement of Existing Sewer with 66 DI Sewer Pipes	920	657	L.F.	$ 604,000
Replacement of Existing Sewer with 72 DI Sewer Pipes	960	744	L.F.	$ 714,000
Replacement of Existing Sewer with 78 DI Sewer Pipes	590	842	L.F.	$ 497,000
Replacement of Existing Sewer with 84 DI Sewer Pipes	760	929	L.F.	$ 706,000
Replacement of Existing Sewer with 96 DI Sewer Pipes	390	1159	L.F.	$ 452,000
Demolition of Existing Sewer	87,920	$ 120	L.F.	$ 10,550,000
Sheeting and shoring at 10 foot average depth	131,420	$ 120	L.F.	$ 15,770,000
Manholes Replacement with frames and covers	11,920	$ 120	Ea.	$ 1,430,000
Pipe Bedding 10 foot depth	10,000	$ 120	CY	$ 1,200,000
DGA 10 foot depth	54,000	$ 120	CY	$ 6,480,000
Base Course Bituminous Pavement	30,670	$ 120	S.Y.	$ 3,680,000
Surface Course Bituminous Pavement	19,250	$ 120	S.Y.	$ 2,310,000
Testing	17,500	$ 120	L.F.	$ 2,100,000
Load, Haul and Dispose of ID-27 Material	93,670	$ 120	Ton	$ 11,240,000
Construction Total Cost				$ 77,184,000.00
Total Cost with Contingency (25%)				$ 96,480,000.00
Overhead and Profit (15%)				$ 14,472,000.00
Legal and Engineering Costs (20%)				$ 19,296,000.00
Total Capital Cost				**$ 130,248,000**
Sewer Maintenance **(Not Applicable to Replacement of Existing System)****				$ -
Annual O & M Cost				$ -
Total Present Worth O & M Cost				-
***Total Present Worth**				**$ -**
*Total O & M Cost				-
***Total Present Worth**				**$ 130,248,000**

*20 years life cycle costs for operation and maintenance with an interest rate of 2.75% for present value calculation (P/A = 15.227)

**Sewer maintenance is current annual cost that the JCMUA pays not and not a new project cost

JCMUA Development and Evaluation of Alternatives
Table 14: Inflow and Infiltration (I/I) Source Control Pipes Rehabilitation Costs

Description	Estimated Quantities	Unit Cost	Units	Total
CIPPL Rehabilitation of Existing 12 inch Sewer Pipes	2,100	50	L.F.	$ 169,000
CIPPL Rehabilitation of Existing 18 inch Sewer Pipes	32,000	70	L.F.	$ 3,896,000
CIPPL Rehabilitation of Existing 24 inch Sewer Pipes	6,970	95	L.F.	$ 1,140,000
CIPPL Rehabilitation of Existing 30 inch Sewer Pipes	12,460	130	L.F.	$ 2,769,000
CIPPL Rehabilitation of Existing 36 inch Sewer Pipes	6,600	200	L.F.	$ 1,869,000
CIPPL Rehabilitation of Existing 42 inch Sewer Pipes	9,390	260	L.F.	$ 3,145,000
CIPPL Rehabilitation of Existing 48 inch Sewer Pipes	10,360	300	L.F.	$ 4,219,000
CIPPL Rehabilitation of Existing 54 inch Sewer Pipes	2,440	380	L.F.	$ 1,127,000
CIPPL Rehabilitation of Existing 60 inch Sewer Pipes	1,950	450	L.F.	$ 1,117,000
CIPPL Rehabilitation of Existing 66 inch Sewer Pipes	920	540	L.F.	$ 604,000
CIPPL Rehabilitation of Existing 72 inch Sewer Pipes	960	630	L.F.	$ 714,000
CIPPL Rehabilitation of Existing 78 inch Sewer Pipes	590	730	L.F.	$ 497,000
CIPPL Rehabilitation of Existing 84 inch Sewer Pipes	760	830	L.F.	$ 706,000
CIPPL Rehabilitation of Existing 96 inch Sewer Pipes	390	1070	L.F.	$ 452,000
Install layflat hose	500	0.3	L.F.	$ 150
Breakdown/Clean/Load layflat hose	4,000	0.5	L.F.	$ 2,000
6" pump rental	260	650	Wk	$ 169,000
6" pump fuel cost	43,680	18	HR	$ 786,240
Pump operator cost	43,680	50	HR	$ 2,184,000
Construction Total Cost				$ 25,570,000
Total Cost with Contingency (25%)				$ 31,960,000
Overhead and Profit (15%)				$ 4,794,000
Legal and Engineering Costs (20%)				$ 6,392,000
Total Capital Cost				**$ 43,146,000**
Sewer Maintenance **(Not Applicable to Replacement of Existing System)****				$ -
Annual O & M Cost				$ -
Total Present Worth O & M Cost				-
***Total Present Worth**				**$ -**
*Total O & M Cost				-
***Total Present Worth**				**$ 43,146,000**

*20 years life cycle costs for operation and maintenance with an interest rate of 2.75% for present value calculation (P/A = 15.227)

**Sewer maintenance is current annual cost that the JCMUA pays not and not a new project cost

JCMUA Development and Evaluation of Alternatives

Table 15: Disinfection Costs with PAA

Tank	Peak flow (MGD)	Construction Cost	Contingency (25%)	Overhead & Profit (15%)	Legal & Engineering (20%)	Total Capital Cost	Annual O&M Costs	Total Present Worth
W1W2	290.2	$ 3,850,000	$ 960,000	$ 720,000	$ 960,000	$ 6,490,000	$ 524,000	$ 15,400,000
W3W5	97.5	$ 2,210,000	$ 550,000	$ 410,000	$ 550,000	$ 3,730,000	$ 197,000	$ 7,100,000
W6W10	338.5	$ 3,880,000	$ 970,000	$ 730,000	$ 970,000	$ 6,550,000	$ 606,000	$ 16,700,000
W11W13	312.1	$ 3,860,000	$ 970,000	$ 720,000	$ 970,000	$ 6,520,000	$ 561,000	$ 16,000,000
E1E4	140.6	$ 2,640,000	$ 660,000	$ 490,000	$ 660,000	$ 4,450,000	$ 270,000	$ 9,200,000
E56	257.2	$ 3,820,000	$ 960,000	$ 720,000	$ 960,000	$ 6,450,000	$ 468,000	$ 14,500,000
E1011	76.3	$ 2,150,000	$ 540,000	$ 400,000	$ 540,000	$ 3,630,000	$ 161,000	$ 6,500,000
E15E1617	60.1	$ 1,930,000	$ 480,000	$ 360,000	$ 480,000	$ 3,250,000	$ 133,000	$ 5,700,000
E18E19	304.7	$ 3,860,000	$ 960,000	$ 720,000	$ 960,000	$ 6,510,000	$ 548,000	$ 15,800,000
							TOTAL	**$ 106,900,000**

G:\Project\01129_JCMUA\01129179_2018_CSO_Permit_Services\Development_and_Evaluation_of_Alternatives\Cost_Estimates\Cost Estimate_Disinfection_JDDisinfection Costs

APPENDIX B

PARTIAL SEWER SEPARATION DESIGN DRAWINGS

APPENDIX C

REGIONAL CORRESPONDANCE

Minnett, John

From:	Minnett, John
Sent:	Monday, March 18, 2019 11:59 AM
To:	'Mohammed K. Ali'; Rich Haytas; 'Brian Messler'; Grey, Gary; Newman, Thomas (Thomas.Newman@hdrinc.com); Del Bove, Mark; McKenna, Bridget
Cc:	Christine Ballard; Tim Boyle; David.Missig@suez-na.com; Akgun, Tugba
Subject:	RE: Regional LTCP meeting
Categories:	Critical Hold

Tracking:

Recipient	Read
'Mohammed K. Ali'	
Rich Haytas	
'Brian Messler'	
Grey, Gary	
Newman, Thomas (Thomas.Newman@hdrinc.com)	
Del Bove, Mark	Read: 3/18/2019 12:53 PM
McKenna, Bridget	
Christine Ballard	
Tim Boyle	
David.Missig@suez-na.com	
Akgun, Tugba	

I have no agenda in mind. The only alternative that I would think might be beneficial to all is a Regional Tunnel of some type where cost would be share equally for those who tie into it. Beyond that alternative I have not others that I can think of yet. At regional alternative of this time would have to be modeled by others and reviewed by ARCADIS in order for us to recommend it to the JCMUA.

From: Mohammed K. Ali <MAli@tandmassociates.com>
Sent: Monday, March 18, 2019 11:20 AM
To: Minnett, John <John.Minnett@arcadis.com>; Rich Haytas <r.haytas@jcmua.com>; 'Brian Messler' <b.messler@jcmua.com>; Grey, Gary <Gary.Grey@hdrinc.com>; Newman, Thomas (Thomas.Newman@hdrinc.com) <Thomas.Newman@hdrinc.com>; Del Bove, Mark <Mark.DelBove@arcadis.com>; McKenna, Bridget <BMcKenna@PVSC.COM>
Cc: Christine Ballard <CBallard@tandmassociates.com>; Tim Boyle <tboyle@baynj.org>; David.Missig@suez-na.com; Akgun, Tugba <tugba.akgun@suez.com>
Subject: RE: Regional LTCP meeting

John,
Thanks. This invitation did not include Tim Boyle, I will forward the invitation to Tim. Also, will Kearny be part of this meeting? Not sure if anyone from Kearny attend the March 8th meeting. Do you have any agenda in mind?

Thanks

MOHAMMED K. ALI, PE
SENIOR TECHNICAL ENVIRONMENTAL ENGINEER

11 Tindall Road, Middletown, NJ 07748
T + 732.671.6400 **D** + 732.865.9503 **C** + 347.244.2526
MALI@TANDMASSOCIATES.COM | TANDMASSOCIATES.COM

-----Original Appointment-----
From: Minnett, John <John.Minnett@arcadis.com>
Sent: Monday, March 18, 2019 11:06 AM
To: Rich Haytas; 'Brian Messler'; Grey, Gary; Mohammed K. Ali; Newman, Thomas (Thomas.Newman@hdrinc.com); Del Bove, Mark; McKenna, Bridget
Subject: Regional LTCP meeting
When: Wednesday, March 20, 2019 9:00 AM-11:15 AM (UTC-05:00) Eastern Time (US & Canada).
Where: JCMUA conference Room
Importance: High

It is my understanding that the JCMUA has reserved the conference room at the JCMUA for the times shown in this appointment for the JCMUA their consultant and the consultants from North Bergen and Bayonne. As Bridget has mentioned, we were not expected PVSC consultants to attend but if the choose to attend that is, of course, fine as well. I have provided a Skype link for any who cannot attend the meeting but would still like to have conference call access to this meeting to hear the discussions.

Join Skype Meeting

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Minnett, John

Subject:	Regional LTCP meeting
Location:	JCMUA conference Room
Start:	Wed 3/20/2019 9:00 AM
End:	Wed 3/20/2019 11:15 AM
Show Time As:	Tentative
Recurrence:	(none)
Meeting Status:	Not yet responded
Organizer:	Minnett, John
Required Attendees:	Richard Haytas; Brian Messler; Grey, Gary; Mohammed K. Ali <MAli@tandmassociates.com>; thomas.newman@hdrinc.com; Mark DelBove; McKenna, Bridget
Categories:	Critical Hold
Importance:	High

It is my understanding that the JCMUA has reserved the conference room at the JCMUA for the times shown in this appointment for the JCMUA their consultant and the consultants from North Bergen and Bayonne. As Bridget has mentioned, we were not expected PVSC consultants to attend but if the choose to attend that is, of course, fine as well. I have provided a Skype link for any who cannot attend the meeting but would still like to have conference call access to this meeting to hear the discussions.

....

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....

Minnett, John

From:	Mohammed K. Ali <MAli@tandmassociates.com>
Sent:	Monday, March 18, 2019 10:13 AM
To:	McKenna, Bridget; Minnett, John; Tim Dupuis; 'FPNBMUA@aol.com'; 'gdiaz@boswellengineering.com'; Gary Grey; Brian Messler; Del Bove, Mark; Malafronte, Jean; Rich Haytas; Maria Polimeni; Joseph Coviello
Cc:	Akgun, Tugba; Missig, David; Tim Boyle; Christine Ballard; Newman, Thomas (Thomas.Newman@hdrinc.com); David Ksyniak; Lopes, Patricia
Subject:	RE: [EXTERNAL] CSO LTCP Evaluation of Alternatives Meeting - Jersey City, Bayonne, NBMUA
Categories:	Critical Hold

Hi Bridget,
You are correct - I did not have the impression that PVSC or its consultant will attend the follow-up meeting.
Thanks

MOHAMMED K. ALI, PE
SENIOR TECHNICAL ENVIRONMENTAL ENGINEER

11 Tindall Road, Middletown, NJ 07748
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MALI@TANDMASSOCIATES.COM | TANDMASSOCIATES.COM

From: McKenna, Bridget <BMcKenna@PVSC.COM>
Sent: Monday, March 18, 2019 9:56 AM
To: Mohammed K. Ali <MAli@tandmassociates.com>; John Minnett <john.minnett@arcadis.com>; Tim Dupuis <dupuistj@cdmsmith.com>; 'FPNBMUA@aol.com' <FPNBMUA@aol.com>; 'gdiaz@boswellengineering.com' <gdiaz@boswellengineering.com>; Gary Grey <gary.grey@hdrinc.com>; Brian Messler <b.messler@jcmua.com>; Del Bove, Mark <Mark.DelBove@arcadis.com>; Malafronte, Jean <jmalafronte@greeley-hansen.com>; Rich Haytas <r.haytas@jcmua.com>; Maria Polimeni <m.polimeni@jcmua.com>; Joseph Coviello <j.coviello@jcmua.com>
Cc: Akgun, Tugba <tugba.akgun@suez.com>; Missig, David <david.missig@suez.com>; Tim Boyle <tboyle@baynj.org>; Christine Ballard <CBallard@tandmassociates.com>; Newman, Thomas (Thomas.Newman@hdrinc.com) <Thomas.Newman@hdrinc.com>; David Ksyniak <ksyniakda@cdmsmith.com>; Lopes, Patricia <PLopes@PVSC.COM>
Subject: RE: [EXTERNAL] CSO LTCP Evaluation of Alternatives Meeting - Jersey City, Bayonne, NBMUA

Good morning Mohammed,
Just for clarification, this meeting does not include PVSC and its consultants, this is a meeting following up on the meeting that was held on March 8th, correct?
Thanks,
Bridget

From: Mohammed K. Ali [mailto:MAli@tandmassociates.com]
Sent: Monday, March 18, 2019 9:00 AM
To: John Minnett <john.minnett@arcadis.com>; Tim Dupuis <dupuistj@cdmsmith.com>; 'FPNBMUA@aol.com' <FPNBMUA@aol.com>; 'gdiaz@boswellengineering.com' <gdiaz@boswellengineering.com>; Gary Grey <gary.grey@hdrinc.com>; Brian Messler <b.messler@jcmua.com>; Del Bove, Mark <Mark.DelBove@arcadis.com>; Malafronte, Jean <jmalafronte@greeley-hansen.com>; Rich Haytas <r.haytas@jcmua.com>; Maria Polimeni

<m.polimeni@jcmua.com>; Joseph Coviello <j.coviello@jcmua.com>
Cc: Akgun, Tugba <tugba.akgun@suez.com>; Missig, David <david.missig@suez.com>; Tim Boyle <tboyle@baynj.org>; Christine Ballard <CBallard@tandmassociates.com>; Newman, Thomas (Thomas.Newman@hdrinc.com) <Thomas.Newman@hdrinc.com>; McKenna, Bridget <BMcKenna@PVSC.COM>; David Ksyniak <ksyniakda@cdmsmith.com>; Lopes, Patricia <PLopes@PVSC.COM>
Subject: [EXTERNAL] CSO LTCP Evaluation of Alternatives Meeting - Jersey City, Bayonne, NBMUA

All,
Have not seen any communication, thought I should check. We are meeting at JCMUA on Wednesday (3/20) @ 9 AM – is this correct?

Thanks,
Mohammed Ali
T&M Associates

-----Original Appointment-----
From: Eley, Marques <MEley@PVSC.COM>
Sent: Tuesday, February 26, 2019 3:53 PM
To: Eley, Marques; David Ksyniak; McKenna, Bridget; Sheldon Lipke (slipke@sjlconsultants.com); Tim Dupuis; Witt, Michael; John Minnett; Mohammed K. Ali; Newman, Thomas (Thomas.Newman@hdrinc.com); 'FPNBMUA@aol.com'; 'gdiaz@boswellengineering.com'; Gary Grey; Brian Messler; Tim Boyle; Del Bove, Mark; Malafronte, Jean; Rich Haytas; Lopes, Patricia; Maria Polimeni
Cc: Joseph Coviello
Subject: CSO LTCP Evaluation of Alternatives Meeting - Jersey City, Bayonne, NBMUA
When: Friday, March 8, 2019 10:00 AM-12:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Jersey City MUA, 555 Route 440, Jersey City, NJ

This meeting is to discuss the CSO alternatives being evaluated as part of its LTCP process by the permittees connected to PVSC via the Hudson County Force Main: Jersey City, Bayonne, and North Bergen MUA.

NOTE: If an alternate meeting location, such as JCMUA, would be more desirable, please indicate that.

Minnett, John

From:	Minnett, John
Sent:	Friday, March 22, 2019 6:49 PM
To:	'Grey, Gary'; Hope, Michael; David A. Ksyniak (ksyniakda@cdmsmith.com)
Cc:	'Rich Haytas'; Brian Messler; Newman, Thomas; Bundz, Hayley; Del Bove, Mark
Subject:	RE: Jersey City storage tunnel OPCC
Attachments:	Tunnel Cost_JD.pdf; Tunnels.xlsx
Categories:	Critical Hold

Tracking:

Recipient	Read
'Grey, Gary'	
Hope, Michael	
David A. Ksyniak (ksyniakda@cdmsmith.com)	
'Rich Haytas'	
Brian Messler	
Newman, Thomas	
Bundz, Hayley	
Del Bove, Mark	Read: 10/11/2019 11:57 AM

Gary, As per your request, attached are our Sizes and Opinions of Probable Construction Cost for our Tunnel Alternatives with an East and West tunnel breakdown and they can be used for pricing the Hudson County Regional Alternative we discussed this Wednesday.

Mike and Dave more detailed tables are coming for the tunnels and the other alternatives where we have provided our modeling results and simulations on previous dates. The data received yesterday on the O&M was very helpful and it was incorporated into these costs. Although we were not able to get all of the alternative costs to you all today, we should have the rest to you by early next week which is pretty close to the two weeks requested.

-----Original Message-----
From: Grey, Gary <Gary.Grey@hdrinc.com>
Sent: Thursday, March 21, 2019 4:52 PM
To: Minnett, John <John.Minnett@arcadis.com>; Del Bove, Mark <Mark.DelBove@arcadis.com>
Cc: Newman, Thomas <Thomas.Newman@hdrinc.com>; Bundz, Hayley <Hayley.Bundz@hdrinc.com>
Subject: Jersey City storage tunnel

John.

Your presentation I believe has the total storage volume. I don’t see where it is broken out for the Eastside and Westside of Jersey City. Can you tell us what the Westside volume will be for four through 20 overflows per year so we can size and close the tunnel? Or should we consider the volumes in the presentation for all CSO from Jersey City?

Thanks,
Gary

Minnett, John

From: Minnett, John
Sent: Thursday, June 6, 2019 3:27 PM
To: Dupuis, Timothy J.
Cc: 'Richie Haytas'; 'Brian Messler'; McKenna, Bridget; 'Hope, Michael'; Ksyniak, David A.; Eley, Marques; Sheldon Lipke; Del Bove, Mark; Newman, Thomas; Mohammed K. Ali
Subject: RE: Project Cost for an New Force main with East and West side pumps
Attachments: Proposed_Flow_Allocations_for_Hudson_Regional_Group.xlsx

Categories: Critical Hold
Tracking:

Recipient	Read
Dupuis, Timothy J.	
'Richie Haytas'	
'Brian Messler'	
McKenna, Bridget	
'Hope, Michael'	
Ksyniak, David A.	
Eley, Marques	
Sheldon Lipke	
Del Bove, Mark	Read: 10/16/2019 11:16 AM
Newman, Thomas	
Mohammed K. Ali	

-As per the attached spreadsheet, Max Capacity of existing force main based on 8 Ft/s which the JCMUA has agreed upon is as follows

- 146.2 MGD for the 6 foot diameter force main
- 82. 2 MGD for the 4.5 foot diameter force main from the East Side Pump Station (ESPS)
- 36.5 MGD for 3 foot diameter Force main (WSPS)

-Max Capacity of existing pump station:

Firm Pump Capacities	GPM	MGD
WSPS=	30000	43.17
ESPS=	34200	49.21
Combined PS flow		92.37

-The Upgraded capacities of the East and West pump station, if Bayonne increase their rate to 20 MGD and assuming the Kearny flow doubles to 17 MGD as per scenario 3 in the attached spreadsheet:

- 146.2 MGD for the sum flows of all multi-municipal pump stations and 6 foot force main as limited by the 6 foot diameter force main
- 72.7 MGD for the ESPS as limited by the 6 foot diameter forcemain
- 36.5 for the WSPS as limited by the 3 foot diameter Force main

If the Kearny flow is not likely to increase then it would be 8.5 MGD as Mr. Lipke indicated yesterday then another 8.5 could be allocated to Bayonne or the JCMUA ESPS or WSPS locations.

If Bayonne selects flow allocation scenario 4 where their flow would be raised to 40 MGD which the JCMUA probably would be okay with, then the ESPS could only be raised from 49.2 to 52.7 and I would not recommend to the JCMUA a 3.5 MGD upgrade unless it was an impeller upgrade or something simple like that which does not appear to be possible on the East Side but if it where done on the West side the shorter 3' diameter Force Main would need to be upgraded and while it might be possible my guess is that it also would not be worth the cost of the upgrade.

Is this Clearer now?

From: Dupuis, Timothy J. <dupuistj@cdmsmith.com>
Sent: Wednesday, June 5, 2019 5:21 PM
To: Minnett, John <John.Minnett@arcadis.com>; Newman, Thomas <Thomas.Newman@hdrinc.com>
Cc: 'Richie Haytas' <r.haytas@jcmua.com>; 'Brian Messler' <b.messler@jcmua.com>; McKenna, Bridget <BMcKenna@PVSC.COM>; 'Hope, Michael' <mhope@greeley-hansen.com>; Ksyniak, David A. <ksyniakda@cdmsmith.com>; Eley, Marques <MEley@PVSC.COM>; Del Bove, Mark <Mark.DelBove@arcadis.com>
Subject: RE: Project Cost for an New Force main with East and West side pumps

John,

Thank you for these as they are helpful. Last week, my request was more related to the flows and capacities of infrastructure.

-Max Capacity of existing forcemain
-Max Capacity of existing pump station
-Upgraded capacity of pump station (if you're considering anything beyond what you have now, even if it's just replace in kind to get back to original capacity)

Let me know if you have these available.

Tim

From: Minnett, John <John.Minnett@arcadis.com>
Sent: Wednesday, June 5, 2019 4:42 PM
To: Dupuis, Timothy J. <dupuistj@cdmsmith.com>; Newman, Thomas <Thomas.Newman@hdrinc.com>
Cc: 'Richie Haytas' <r.haytas@jcmua.com>; 'Brian Messler' <b.messler@jcmua.com>; McKenna, Bridget <BMcKenna@PVSC.COM>; 'Hope, Michael' <mhope@greeley-hansen.com>; Ksyniak, David A. <ksyniakda@cdmsmith.com>; Eley, Marques <MEley@PVSC.COM>; Del Bove, Mark <Mark.DelBove@arcadis.com>
Subject: Project Cost for an New Force main with East and West side pumps

Mr. Neuman yesterday I had mentioned yesterday that you had requested the attached costs but realized later that it was Mr. Dupuis and not Mr. Neuman. My apologies for thconfusion. Mr. Dupuis here are the costs you requested at last Friday's meeting.

	InDirect Regional Force main Contributors	Direct Regional Force main Contributors				
Flow Allocation Scenario	North Bergen	JCMUA West	JCMUA East	Bayonne	Kearny	Total flow to Existing Regional 6 foot Forcemain
1. JCMUA Maximizes their flows and Bayonne, North Bergen, and Kearny stay at their existing agreed flows	Daily Flows = 6 to 16 MGD into JCMUA West	36.5	82.2	8.8	8.5	136
2. JCMUA Maximizes their flows then Bayonne, and Kearny double their flows, and North Bergen stays at their existing agreed flows	Daily Flows = 6 to 16 MGD into JCMUA West	36.5	75.1	17.6	17	146.2
3. JCMUA Maximizes their flows then Bayonne increases flows to 20 MGD, Kearny double their flows, and North Bergen stays at their existing agreed flows	Daily Flows = 6 to 16 MGD into JCMUA West	36.5	72.7	20	17	146.2
4. JCMUA Maximizes their flows then Bayonne increases flows to 40 MGD, Kearny double their flows, and North Bergen stays at their existing agreed flows	Daily Flows = 6 to 16 MGD into JCMUA West	36.5	52.7	40	17	146.2

Scenario Number and Description	Item Description for Scenario Shown	JCMUA designated Maximum Force Main Velocity, FT/S	Diameter of Forcemain, FT	Maximum Flow, CFS	Maximum Flow, MGD	comments
1. JCMUA Maximizes their flows and Bayonne, North Bergen, and Kearny stay at their existing agreed flows	Maximum Flow through Existing Regional Force main	8	6	226.2	146.2	As the JCMUA's consultant we recommend that the velocity should not be permitted to be operated for a signficant amount of time above the set velocity of 8 feet per second to prevent abasive scouring and that we propose that this be used as the maximum flow allocation limit for all contributing muncipalities: Bayonne, Jersey City, and Kearny. It is recognized that North Bergen also contributes to this flow but it's flow is directly into th the West Side Pump Station via the JCMUA North West Interceptor. North Bergen has an agreement with the JCMUA not to exceed as certain flow so as not to exceed the JCMUA's conveyance capacity. So if they were to request more flow the this would reduce the JCMUA West Side pumping capacity for Jersey City residents. No numerical flow increases by North Bergen have been requested or are proposed at the present time and this assumes they will remain consant as they have been with an Average flow of 6 MGD and not higher than 16 MGD maximum daily flow and 18.7 MGD Maximum hour
1. JCMUA Maximizes their flows and Bayonne, North Bergen, and Kearny stay at their existing agreed flows	Maximum Flow through Existing JCMUA Forcemain from their East Side pump station	8	4.5	127.2	82.2	
1. JCMUA Maximizes their flows and Bayonne, North Bergen, and Kearny stay at their existing agreed flows	Maximum Flow through Existing JCMUA Forcemain from their West Side pump station	8	3	56.5	36.5	
1. JCMUA Maximizes their flows and Bayonne, North Bergen, and Kearny stay at their existing agreed flows	Recommended Maximum flow from JCMUA				118.7	Scenario 1 flow allocated of 136 MGD does not exceed Maximum Force Main Recommendation of 146 MGD, so this is OKAY no adjustments will be required
1. JCMUA Maximizes their flows and Bayonne, North Bergen, and Kearny stay at their existing agreed flows	Current Estimated Bayonne flow				8.8	
1. JCMUA Maximizes their flows and Bayonne, North Bergen, and Kearny stay at their existing agreed flows	Current Estimated Kearny flow				8.5	
1. JCMUA Maximizes their flows and Bayonne, North Bergen, and Kearny stay at their existing agreed flows	total JC,NB, B, and K combined Flow				136	Scenario 1 flow allocation of 136 MGD does not exceed Maximum Force Main Recommendation of 146 MGD, so this is OKAY no adjustments will be required
2. JCMUA Maximizes their flows then Bayonne, and Kearny double their flows, and North Bergen stays at their existing agreed flows	Maximum Flow through Existing Regional Force main	8	6	226.2	146.2	
2. JCMUA Maximizes their flows then Bayonne, and Kearny double their flows, and North Bergen stays at their existing agreed flows	East Side Pump				75.1	JCMUA would not raise their East Side flow to 82.2 MGD, so as to exceed the Maximum velocity of the 6 ft diameter Regional Force Main.
2. JCMUA Maximizes their flows then Bayonne, and Kearny double their flows, and North Bergen stays at their existing agreed flows	Maximum Flow through Existing JCMUA Forcemain from their West Side pump station	8	3	56.5	36.5	
2. JCMUA Maximizes their flows then Bayonne, and Kearny double their flows, and North Bergen stays at their existing agreed flows	Recommended Maximum flow from JCMUA				111.6	
2. JCMUA Maximizes their flows then Bayonne, and Kearny double their flows, and North Bergen stays at their existing agreed flows	Current Estimated 2 X Bayonne flow				17.6	
2. JCMUA Maximizes their flows then Bayonne, and Kearny double their flows, and North Bergen stays at their existing agreed flows	Current Estimated 2 X Kearny flow				17	
2. JCMUA Maximizes their flows then Bayonne, and Kearny double their flows, and North Bergen stays at their existing agreed flows	total JC,NB, B, and K combined Flow				146.2	Scenario 2 flow allocation of does not exceed Maximum Force Main Recommendation of 146 MGD as long as JCMUA flows do not exceed 111.6 MGD , so this is OKAY as long as the the East side flows do not exceed 75.1 or of the East Side flows remain at their Maximum of 82.2 then the West Side flow would need to be reduced to 29.4 MGD
3. JCMUA Maximizes their flows then Bayonne increases flows to 20 MGD, Kearny double their flows, and North Bergen stays at their existing agreed flows	Maximum Flow through Existing Regional Force main	8	6	226.2	146.2	

Scenario Number and Description	Item Description for Scenario Shown	JCMUA designated Maximum Force Main Velocity, FT/S	Diameter of Forcemain, FT	Maximum Flow, CFS	Maximum Flow, MGD	comments
3. JCMUA Maximizes their flows then Bayonne increases flows to 20 MGD, Kearny double their flows, and North Bergen stays at their existing agreed flows	East Side Pump				72.7	
3. JCMUA Maximizes their flows then Bayonne increases flows to 20 MGD, Kearny double their flows, and North Bergen stays at their existing agreed flows	Maximum Flow through Existing JCMUA Forcemain from their West Side pump station	8	3	56.5	36.5	
3. JCMUA Maximizes their flows then Bayonne increases flows to 20 MGD, Kearny double their flows, and North Bergen stays at their existing agreed flows	Recommended Maximum flow from JCMUA				109.2	
3. JCMUA Maximizes their flows then Bayonne increases flows to 20 MGD, Kearny double their flows, and North Bergen stays at their existing agreed flows	Projected Bayonne flow scenario 1				20	
3. JCMUA Maximizes their flows then Bayonne increases flows to 20 MGD, Kearny double their flows, and North Bergen stays at their existing agreed flows	Current Estimated 2 X Kearny flow				17	
3. JCMUA Maximizes their flows then Bayonne increases flows to 20 MGD, Kearny double their flows, and North Bergen stays at their existing agreed flows	total JC,NB, B, and K combined Flow				146.2	Scenario 3 flow allocation of does not exceed Maximum Force Main Recommendation of 146 MGD as long as JCMUA flows do not exceed 109.2 MGD , so this is OKAY as long as the the East side flows do not exceed 72.7
4. JCMUA Maximizes their flows then Bayonne increases flows to 40 MGD, Kearny double their flows, and North Bergen stays at their existing agreed flows	Maximum Flow through Existing Regional Force main	8	6	226.2	146.2	
4. JCMUA Maximizes their flows then Bayonne increases flows to 40 MGD, Kearny double their flows, and North Bergen stays at their existing agreed flows	East Side Pump				52.7	
4. JCMUA Maximizes their flows then Bayonne increases flows to 40 MGD, Kearny double their flows, and North Bergen stays at their existing agreed flows	Maximum Flow through Existing JCMUA Forcemain from their West Side pump station	8	3	56.5	36.5	
4. JCMUA Maximizes their flows then Bayonne increases flows to 40 MGD, Kearny double their flows, and North Bergen stays at their existing agreed flows	Recommended Maximum flow from JCMUA				89.2	
4. JCMUA Maximizes their flows then Bayonne increases flows to 40 MGD, Kearny double their flows, and North Bergen stays at their existing agreed flows	Projected Bayonne flow scenario 1				40	
4. JCMUA Maximizes their flows then Bayonne increases flows to 40 MGD, Kearny double their flows, and North Bergen stays at their existing agreed flows	Current Estimated 2 X Kearny flow				17	
4. JCMUA Maximizes their flows then Bayonne increases flows to 40 MGD, Kearny double their flows, and North Bergen stays at their existing agreed flows	total JC,NB, B, and K combined Flow				146.2	Scenario 4 flow allocation of does not exceed Maximum Force Main Recommendation of 146 MGD as long as JCMUA flows do not exceed 89.2 MGD , so this is OKAY as long as the the East side flows do not exceed 52.7

APPENDIX D

PUBLIC PARTICIPATION CORRESPONDENCE AND DOCUMENTATION OF PUBLIC PARTICIPATIN

Minnett, John

From: Reid, James
Sent: Tuesday, January 8, 2019 5:17 PM
To: Aaron Johnson; amirescu@resilientcity.com; alisoncuc@gmail.com; Allison Solowsky; Althea Bernheim; Andrew Lim; Benjamin Delisle; jbergstrom@envsci.rutgers.edu; Brian Weller; bmckenna@pvsc.com; b.kelly@jcmua.com; obropta@envsci.rutgers.edu; baysideparkneighborhood@gmail.com; dreile@njcu.edu; debitaliano@gmail.com; Drew Banghart; meley@pvsc.nj.gov; epyshnik@envsci.rutgers.edu; e.andal@jcmua.com; gristorucci@gmail.com; galber@pvsc.com; greggielanez@gmail.com; hjung@njcu.edu; Jasmine Wade; jbottcher@hcnj.us; j.farrell@jcmua.com; jessejlowe@gmail.com; j.newman@jcmua.com; John Hanussak; j.coviello@jcmua.com; Katherine Lawrence; kevinciesla@gmail.com; kforce@hcnj.us; k.rodema@jcmua.com; c21plazaskolar@aol.com; LPiraino@jcnj.org; Lindsey Sigmund; lsimms@njtreefoundation.org; luke.schray@gmail.com; mverdibello45@hotmail.com; meley@pvsc.com; mcrowley@embankment.org; mmassey@hcnj.us; michelle.a.luebke@gmail.com; mkinberg@njfuture.org; plopes@pvsc.com; rachael.pepe@dep.nj.gov; r.prakash@jcmua.com; r.haytas@jcmua.com; r.mogro@jcmua.com; smittman@njcu.edu; simon@jcnjcert.org; TakeyaMeggett@gmail.com; tmalavasi@hcnj.us; gibbonstm@me.com; wmontgomery@njcu.edu; y.coleman@jcmua.com; ambassador@hackensackriverkeeper.org; jerseycitystart@gmail.com
Cc: Minnett, John
Subject: Proposed Green Infrastructure locations for the Jersey City LTCP
Attachments: RockGeology JR_w_borings.pdf

Categories: Critical Hold

Good afternoon,

Please recall attending the Stormwater Long-term Control Plan presentation presented by Arcadis on either September 6th, September 13th, or October 13th. During these meetings green infrastructure was one of the popular control alternatives. Some limitations of green infrastructure that were discussed included high bedrock and high ground water. Attached is the promised map which uses boring data to determine optimal locations for green infrastructure (ground water and bedrock depth 10+ feet) in Jersey City. The optimal areas are indicated in Green on the map. The Pink represents high bedrock near the surface. The Blue represents slightly deeper bedrock. In addition to the boring data and the optimal green infrastructure locations I have also attached additional green infrastructure locations suggested by the Urban Environmental Green Infrastructure Design Plan (Compiled by Maser Consulting P.A, ORG Permanent Modernity, and Matrix Neworld on February 16, 2017). It is important to note that green infrastructure is not limited to the optimal areas. With proper design Green infrastructure can work in a variety of situations. The areas on the map represent the areas targeted by Arcadis to achieve maximum efficiency. If you have any questions regarding the map, locations of the green infrastructure suggestions, or additional location suggestions please feel free to let me know. I look forward to your comments.

Thank you,

James T. Reid II | james.reid@arcadis.com
Arcadis | T. +1 201 398 4322
www.arcadis.com

Minnett, John

From: Brittany Rose Kelly <b.kelly@jcmua.com>
Sent: Monday, March 11, 2019 2:11 PM
To: Minnett, John
Subject: RE: CSO Long Term Control Plan (LTCP) Presentation

Categories: Critical Hold

Hi John,

Joe would like for you to present the slides on the alternatives. As for getting the news out, allow me time to speak with Joe to see how he would like to move forward.

Thank you.

Brittany Kelly
Project Manager
Jersey City Municipal Utilities Authority
555 Route 440
Jersey City, NJ 07305
(201) 432- 1150, ext 3142

JCMUA
WWW.JCMUA.COM

From: Minnett, John [mailto:John.Minnett@arcadis.com]
Sent: Monday, March 11, 2019 9:50 AM
To: Brittany Rose Kelly
Cc: Rich Haytas; Reid, James; Bushlow, Megan; Belardo, Frank
Subject: RE: CSO Long Term Control Plan (LTCP) Presentation

No problem. Slides look Great! I can present these as Rich requested. Please clarify if assist does that mean that you need me there as the person presenting the material or as support to another presenter for this material.

Also Please note that in our Hudson County coordination meeting last week with PVSC, North Bergen, Bayonne, and the JCMUA, PVSC has requested that we reach out to the Supplemental CSO Team members for the JCMUA and ask them to proceed with "Getting the News out about the LTCP" which would include the current status of our Development of the Alternatives analysis. However, before I proceeded to do this, I wanted to check with you first though before I proceeded to contact: Allison Cucco, JC Environmental Commission and Ben Delisle, Planning who are list on my copy of the CSO Team Roster. Also, I though we might contact Commissioner Gibbons and Mr. Italiano to assist in this effort also despite they are not officially on the Supplemental CSO Team Roster they have been quite passionate about this subject and Ms Italiano has not missed any of the presentations that we have provided.

Of course, If you want me to bow out of doing this PVSC requested activity just say the work and I will step back.

From: Brittany Rose Kelly <b.kelly@jcmua.com>
Sent: Friday, March 8, 2019 10:14 AM
To: Minnett, John <John.Minnett@arcadis.com>
Subject: CSO Presentation

Hi John,

Sorry for the delay. I have attached the approved presentation and the narrative created. Joe would like for you to assist us with the first presentation on the 12th. Please let me know if you have any questions.

Thanks!

Brittany Kelly
Project Manager
Jersey City Municipal Utilities Authority
555 Route 440
Jersey City, NJ 07305
(201) 432- 1150, ext 3142

JCMUA
WWW.JCMUA.COM

Passaic Valley Sewerage Commission LTCP

Consolidated Comments

Comment No.	Date	Report Section	Comment made by	Consolidated -- Review Comment / Questions	JCMUA Responses
1	6/21/2019	General	SewageFree Streets and Rivers Partners; JC START	Include the stomwater treatment within the cost analysis. According to NJDEP, some level of stormwater treatment would be required for all storm sewer separated outfalls.	No stormwater treatment is required by NJDEP regulations or MS4 Permits at the present time
2	6/21/2019	General	JC START	Recommended to use the TBL (triple bottom line) approach that considers social, environmental and financial aspects when evaluating each alternative. This approach would be best suited for GI, specifically useful in calculating the benefits of GI. For example, increasing Jersey City's tree canopy has other benefits such as health, aesthetics and the reduction of the urban heat island effect.	We have evaluated for constructability, reliability, operability, *adaptability* , *environmental impacts* , *social benefits* , *multiple-use considerations* , performance, *institutional issues* , siting, and costs. The italicized factors were considered part of the TBL which were also considered in this analysis, reference Appendix F Table D.2-1.
3	6/21/2019	General	JC START; Sustainable Jersey City/SewageFree Streets and Rivers Partners	Why is GI only being considered on public lands? Was private land considered in the evaluation of GI? As well as programs like Rain Check that incentivizes homeowners to implement GI?	The use of a GI Incentive Program to encourage implementation on private land is currently being considered by JCMUA.
4	6/21/2019	General	Sustainable Jersey City/SewageFree Streets and Rivers Partners	Within the definition of public lands, are right of way plantings included? Does public land include streetscapes?	Public lands include city owned properties, streetscapes and right of ways.
5	6/21/2019	General	JC START; Sustainable Jersey City/SewageFree Streets and Rivers Partners	Is there a way to measure the contribution of GI implementation within the private sector, if so, include these numbers in the alternative analysis? Jersey City requires GI in some Redevelopment Plans and additional requirements are being added within the Stormwater Management Ordinance and the proposed Flood Overlay	No, current GI targets are based on land areas and are not distributed between public and private properties. We can not predict the GI contributions offered by private property owners.
6	6/21/2019	General	JC START; Sustainable Jersey City/SewageFree Streets and Rivers Partners	Can the greater TBL of the targeted 30K Trees for Jersey City be calculated as additional GI commitment to leverage the outcomes being targeted? Possibly include already committed investment toward urban forestry/trees (over x period of years/annually) toward this alternatives evaluation.	Any committed GI investsments including trees will count towards our GI target.
7	6/21/2019	General	JC START; Sustainable Jersey City/SewageFree Streets and Rivers Partners	Does the targeted 7-10% GI equate to 7-10% of the budget expenditure?	No, 7 - 10 % equates to impervious area in Jersey City as stated in the report.
8	6/21/2019	General	Sustainable Jersey City/SewageFree Streets and Rivers Partners	Can there be a scenario analysis done that could increment GI from 7 to 10%, quantifying TBL analysis, similar to what was used by Philadelphia Water Dept (PWD) to understand if GI solutions were modeled into the mix of alternativesa at 20% or 30%, what the outcomes might be?	We have done an analysis for 7, 10, 100% GI control. We have found that the percent capture is 73.4, 73.8, and 80%. Based upon our TBL analysis, the increased cost of implementing 20 or 30% GI would be $193.2M and $289.8M while environmental factors would increase by 1 point, the cost factor would drop to 1 point. So there is no TBL advantage by doing a higher percentage.
9	6/21/2019	General	JC START; Sustainable Jersey City/SewageFree Streets and Rivers Partners	What impact analysis is being done to consider the peracetic acid application to the surrounding waterways?	JCMUA DEAR is not considering peracetic acid as a disinfection option at this time.
10	6/21/2019	General	JC START; Sustainable Jersey City/SewageFree Streets and Rivers Partners	What engagement and outreach will take place over the next year and how will additional public comment be incorporated into the final plan? Public outreach should be evaluated and included in the LTCPs. The need for public outreach is extensive and is not being met by the current regional meetings (Supplemental CSO Team Meetings).	In 2018, the JCMUA conducted eight public presentations related to this DEAR report. Two presentations were to START, the Jersey City staff and the public on September 6th and 13th, 2018. One presentation was to the JCMUA engineering committee on October 16th, 2018. The interim results of the JCMUA DEAR were presented to the Supplemental CSO Team on March 7th, 2019 as was reported in the Hudson Reporter - https://hudsonreporter.com/2019/03/21/combatting-sewage-overflow/. The other four presentations were community presentations from the JCMUA to the general public in Jersey City in different Wards on March 12th, 14th, 28th and April 4th, 2019. In the coming year, the JCMUA will present similar results of the DEAR at various locations. Discussions for presentations at each of the 8 Wards may occur and the standard presentations of the Supplemental
11	6/21/2019	General	Sustainable Jersey City; JC START	Is it possible to map the alternative analyses along with the new Flood Overlay plan being developed by the Planning Division in order to see if there are opportunities to leverage GI in these corridors?	We can explore that provided if the shapefiles of the flood plan is provided to Arcadis.
12	6/21/2019	General	JC START; SewageFree Streets and Rivers Partners	Why aren't permeable pavements recommended for Alternative Evaluation? Not using permeable pavements would limit GI implementation in Jersey City.	Generally speaking, permeable pavements have been found to be at least twice the cost of other GI alternatives. As per the technical guidance manual, the cost of permeable pavements (porous asphalt, porous concrete, or interlocking concrete pavers) is $12 to $34 per square foot to construct. Bioswales and other green infrastructure costs are significantly less than permeable pavements at a cost of $6.22 per square foot. Based upon these cost differences, permeable pavements were screened out for further consideration within this DEAR. However, the stormwater management plan does not limit its use.
13	6/21/2019	General	SewageFree Streets and Rivers Partners	The alternative analysis does not include an evaluation of more intense storms that are predicted as a result of climate change or increase in annual rainfall totals. There should be some sensitivity analysis performed for a range of storm intensities and annual rainfall increases, which could be included within the appendices with projected growth and wastewater flow projections.	The 2004 typical year does take increase rainfall into consideration. The 2004 typical year was selected based on the higher rainfall period from 1970 to the present day while the entire rainfall record for Newark Liberty International Airport goes back to 1948. The latter half includes those higher rainfall periods only.
14	6/21/2019	General	JC START	We were encouraged to see that green infrastructure was given a “very good” rating in the alternative analysis. However, we would like to see an analysis of higher percentages of green infrastructure (15%, 20% and 30%) and more analysis of specific green infrastructure approaches.	See the response for comment 8.
15	6/21/2019	General	SewageFree Streets and Rivers Partners	Ordinances and zoning changes that could have a significant impact on combined sewer overflows were not included.	No they were not, however, the JCMUA is planning a new GI Incentive Ordinance at this time.
16	6/21/2019	General	SewageFree Streets and Rivers Partners	Alternatives were ruled out for further evaluation because they are already being implemented. This assumes that they are being implemented for their maximum benefits. Low cost solutions like I/I and ordinance enforcement should be evaluated further.	I/I is an alternative fully evaluated in the DEAR report and is being proposed for the Selected Plan in the LTCP.
17	6/21/2019	General	SewageFree Streets and Rivers Partners	Newark included existing financing programs in their cost analysis. All of the permittees should include, where feasible, available financing programs to ensure an accurate cost estimate.	See the response for comment 15.
18	6/21/2019	General	JC START	How can each of the cities optimize the stormwater management opportunities that result from development and redevelopment or from regular maintenance activities and projects? Is this addressed in the city level LTCPs and the regional LTCP?	No, it is not being addressed in the LTCP. It is being addressed and implemented now as a future city ordinance in Jersey City. See the response for comment 15.
19	6/21/2019	General	SewageFree Streets and Rivers Partners	Page 86 – “85% capture” presumption approach which equates to 20+ overflows per year. Will this meet WQS standards?	Yes.

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JERSEY CITY MUNICIPAL UTILITIES AUTHORITY

Development and Evaluation of Alternatives Report (DEAR) for CSO Control – NJDEP submittal 7/1/2019

August 8, 2019

AGENDA

- Overview of JCMUA Combined Sewer System (CSS)
- The Goals for JCMUA Development and Evaluation Of Alternatives (DEAR)
- CSO Control Alternatives Developed, Evaluated, & Proposed for Consideration in the Selected Plan
- Next Steps

Overview of JCMUA Combined Sewer System (CSS)

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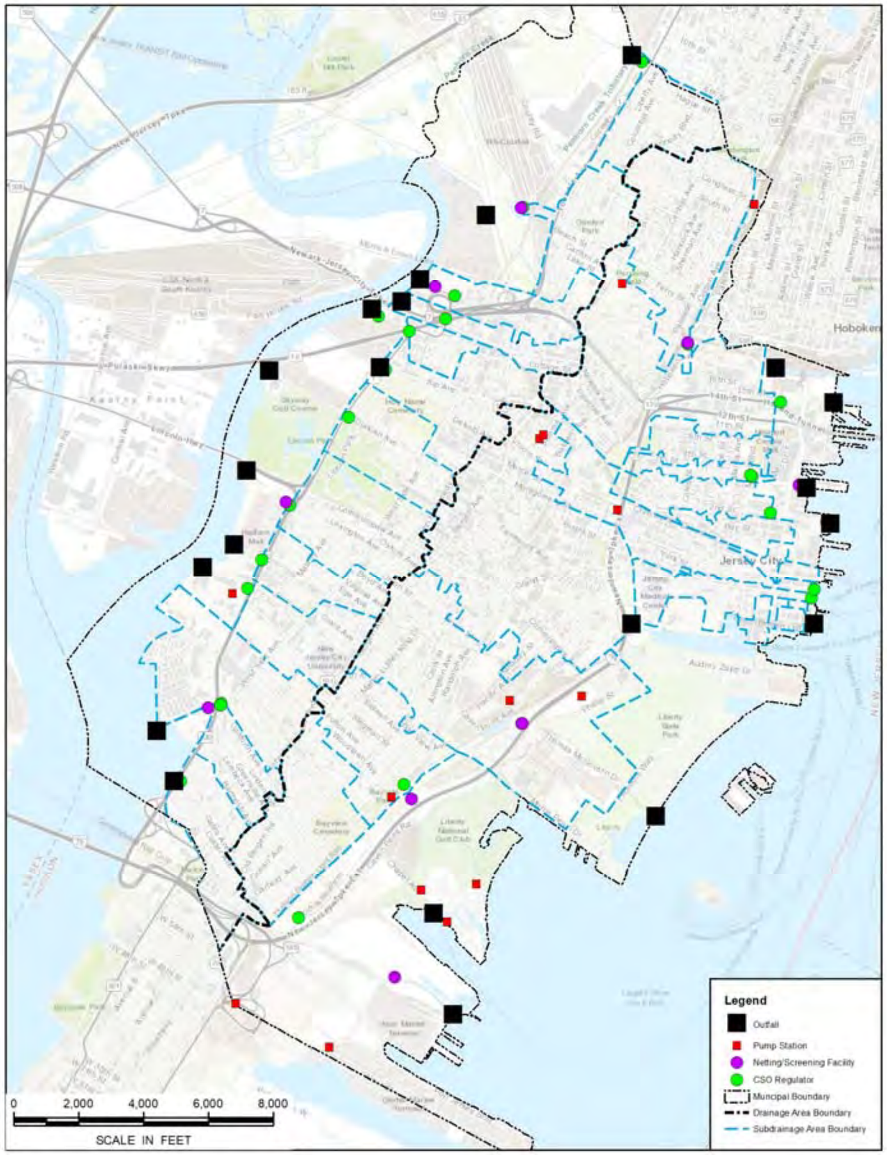
Overview of JCMUA CSS

- 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



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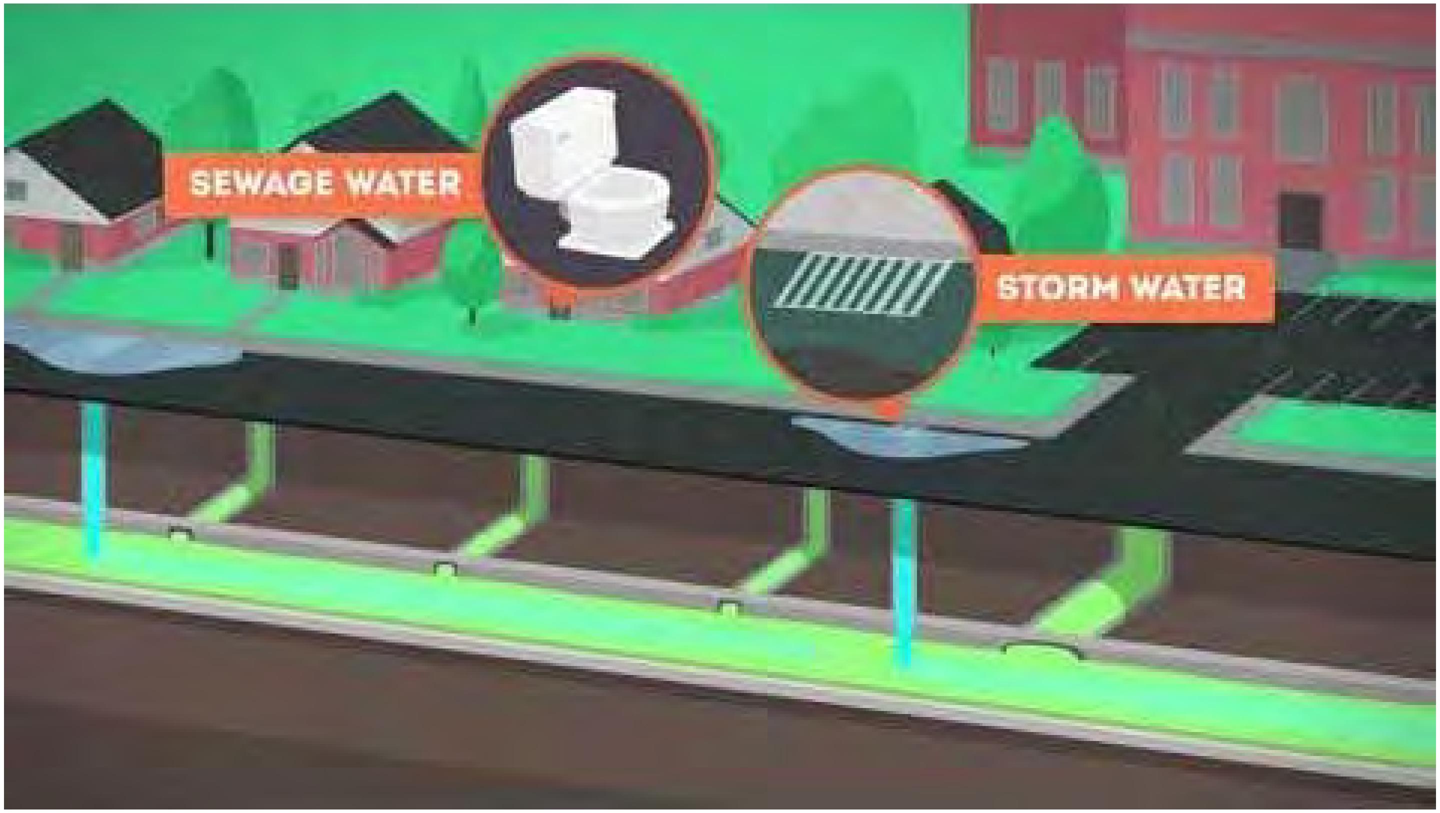
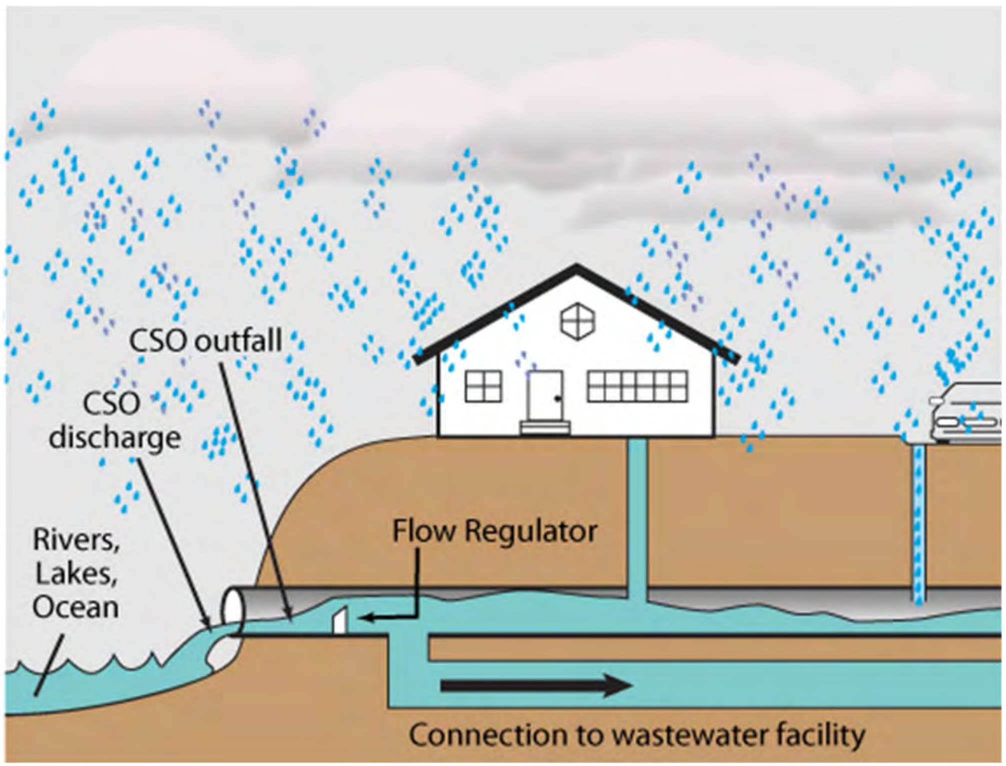
JCMUA CSO Control Facilities

Wet Weather Flow Discharged as Combined Sewer Overflows



JCMUA CSO Control Facilities

Wet Weather Flow Discharged as Combined Sewer Overflows



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Goals for the JCMUA DEAR

Develop and Evaluate a Range of CSO Control Alternatives for All CSO in the System based on Cost and other Performance Controls

Required Alternatives: Green Infrastructure (GI), Inflow and Infiltration (I/I) removal, Sewer Separation,Storage, and Treatment

Selection of the APPROACH: DEMONSTRATION and/or PRESUMPTION

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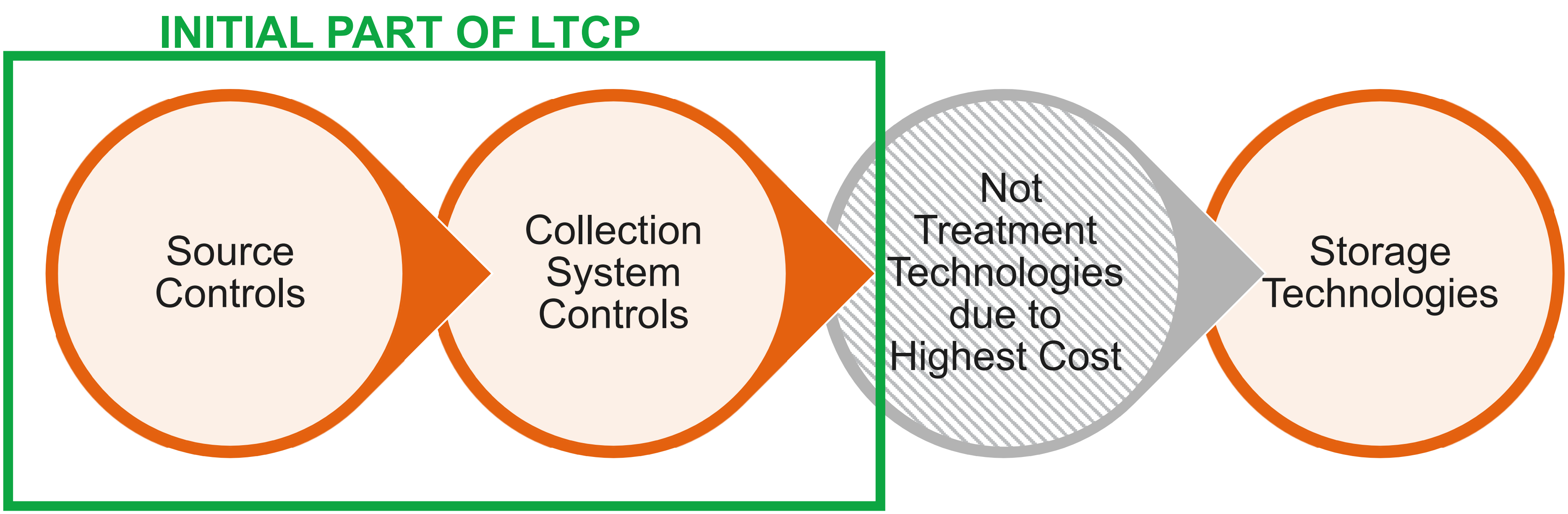
Cost and Performance Factors

- Constructability*
- Reliability*
- Operability*
- Adaptability*
- Environmental Impacts*
- Social Benefits
- Multi-Use Considerations*
- Performance – can 85% capture or 4 to 20 overflows be achieved*
- Institutional issues*
- Siting
- Costs*

*Recommneded factors from EPA's CSO LTCP Guidance, 1995

Develop Alternatives for CSO Control
Identify CSO Control Alternatives to Meet the Goals



CSO Control Alternatives Developed and Evaluated

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

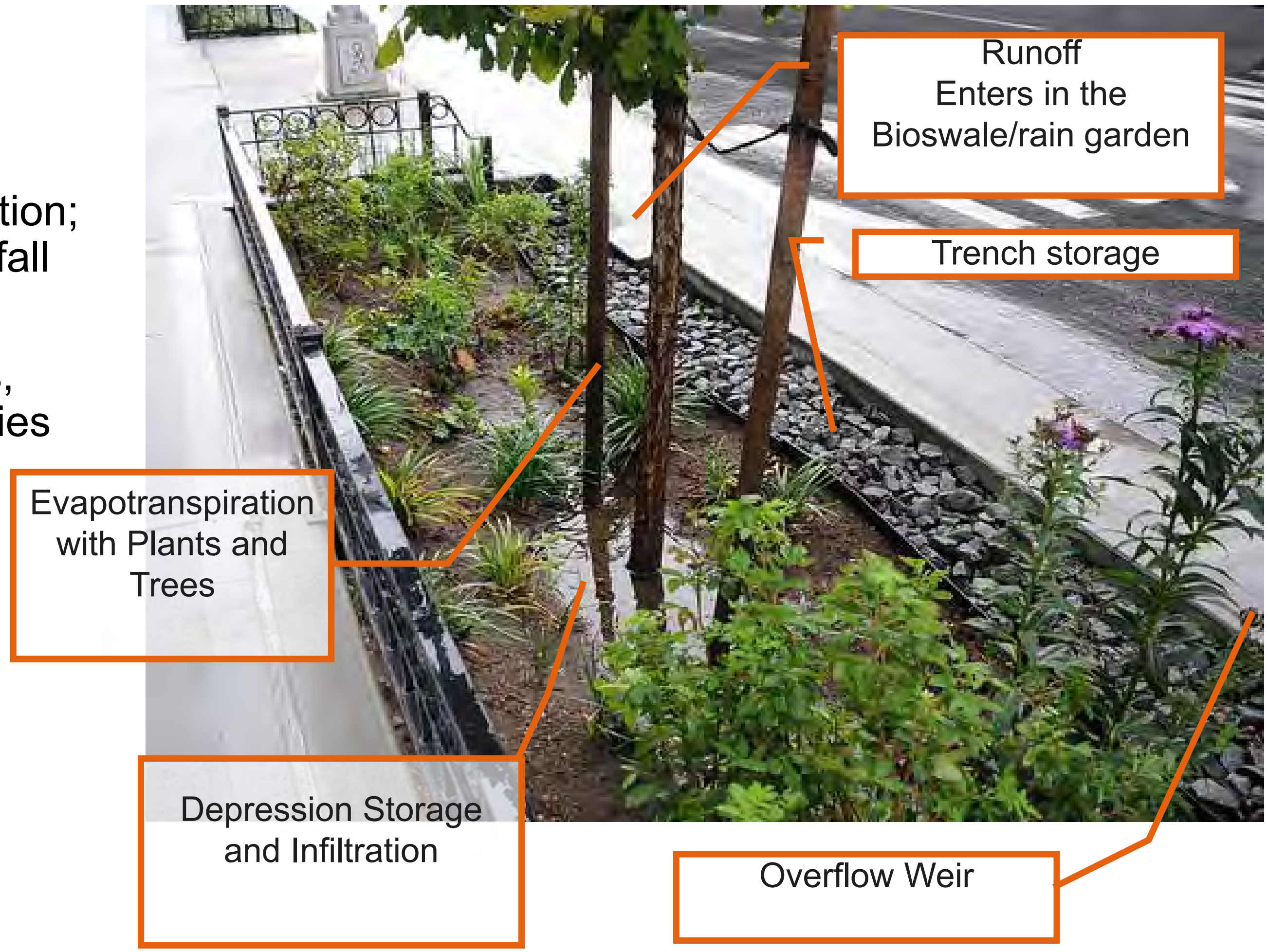
Design Methodology
Systems designed for storage/infiltration; underdrains to remove first 1” of rainfall

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

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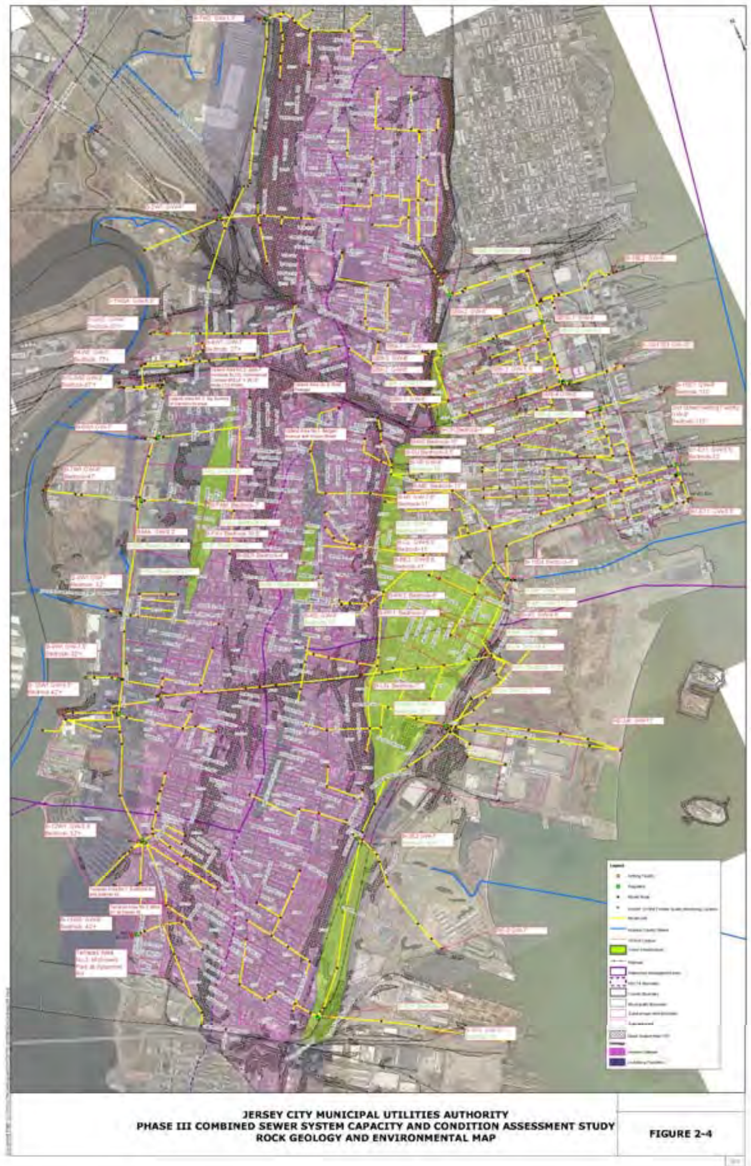


Source Control & Collection System – Performance, Costs and all Factors

Alternative Name	Size	Percent Capture	Overflows/ year	Total Capital Cost, $ Millions	Annual O&M Cost, $ Millions	Total Present Worth Cost, $ Millions	Points in Evaluation matrix (Maximum Score 55)	Additional comments
Existing Systems Conditions (Baseline)	NA	72.4%	68	0	0	0	0	
Inflow and Infiltration Reduction (I/I) – various locations throughout Jersey City	88,000 (17 Miles)	73.2%	60	$ 13.3	$ 0.2	$ 15.7	39	Needed for Consent Decree Compliance also
Sewer Separation – Bright Street	31 ac	72.4%	60	$ 43.1	0	$ 43.1	31	
Rain Gardens/Bioswales- 7% Impervious Area -as shown on Previous Map	Impervious Area=188 acres	73.4%	60	$ 50.1	$ 1.1	$67.7	42	
Rain Gardens/Bioswales- 10% Impervious Area -as shown on Previous Map	Impervious Area=270 acres	73.8%	60	$ 71.9	$ 1.6	$ 96.6	40	
Maximizing Flow to PVSC (Existing Force Main Only)	146 MGD	77.5%	60	$ 10.5	$ 0.3	$ 14.6	41	Requires upgrades to pump sizes only

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.

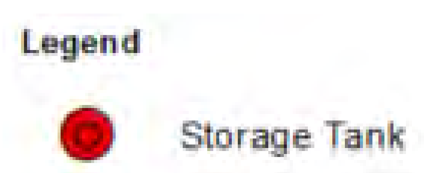
Tunnel Location Map

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	Total Capital Cost, $ Millions	Annual O&M Cost, $ Millions	Total Present Worth Cost, $ Millions	Points in Evaluation matrix (Maximum Score 55)
Existing Systems Conditions (Baseline)	NA	NA	NA	72.4%	68	$ 0	$ 0	$ 0	0
11 ft Diameter Tunnel	39	55,206	55	99.7%	4	$ 751.7	$ 9.1	$ 890.3	<29
9.25 ft Diameter Tunnel	28	55,206	36	99.5%	8	$ 704.1	$ 8.5	$ 833.5	<29
7 ft Diameter Tunnel	16	55,206	35.5	98.7%	12	$ 581.3	$ 7.0	$ 688.3	<29
6.5 ft Diameter Tunnel	14	55,206	36	96.5%	20	$ 493.5	$ 5.9	$ 583.6	29

* All treatment shafts are at a depth of >100 feet

Grouped Storage Tanks Alternative



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	Total Capital Cost, $ Millions	Annual O&M Cost, $ Millions	Total Present Worth Cost, $ Millions	Points in Evaluation matrix (Maximum Score 55)
Existing Systems Conditions (Baseline)	NA	NA	NA	72.4%	68	$ 0	$ 0	$ 0	0
Grouped Storage Tanks – 4 Overflows	54	80 to 120	40 to 146	98.3%	4	$ 683.2	$ 11.4	$ 859.0	<37
Grouped Storage Tanks – 8 Overflows	45	60 to 120	40 to 140	97.9%	8	$ 633.2	$ 10.6	$ 795.7	<37
Grouped Storage Tanks – 12 Overflows	35	48 to 120	48 to 120	97.0%	12	$ 574.4	$ 9.5	$ 719.4	<37
Grouped Storage Tanks – 20 Overflows	11	24 to 80	42 to 125	92.9%	20	*$ 437.7*	*$ 7.2*	*$ 546.6*	37

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Overview of Development and Evaluation of Alternatives for CSO Control

- Evaluate CSO Control Alternatives
  - Costs
  - Performance
  - Environmental Considerations: Impacts, Social factors, Multi uses, etc
  - Technical Considerations: Constructability, Reliability, Operatability,
  - Adaptabiliity, Institutional and Siting issues

Storage Tanks and What is a Treatment Shaft?

Table D.2-1 Alternatives Evaluation Matrix

Alternatives	Constructability	Reliability	Operability	Adaptability	Environmental Impacts	Social Benefits	Multiple -uses	Performance	Institutional Issues	Siting	Cost	Total Score
Green Infrastructure Source Controls	4	3	3	5	4	5	4	2	5	3	4	42
Maximizing Flow to the POTW with only Pumps Upgraded	4	4	4	3	4	1	2	5	4	5	5	41
Inflow and Infiltration Collection System Controls (Lining)	5	4	5	5	3	1	1	1	4	5	5	39
Off-line Storage with Storage Tanks/Treatment Shafts	2	5	2	4	4	4	5	5	1	3	2	37
Partial Separate Sewer Collection System Controls	1	5	5	4	2	1	1	1	2	4	5	31
Inflow and Infiltration Collection System Controls (Replacement)	1	5	5	4	1	1	1	2	2	4	3	29
Off-line Storage with Tunnels	1	5	2	2	4	3	3	5	1	1	2	29
Maximizing Flow to the POTW with both Pumps and Force Main Upgrades	1	4	4	1	2	1	2	3	1	3	1	23
Collection System and Source Controls	4	4	4	4	3	2	2	2	4	4	5	38
Collection System and Source Controls with Offline Storage	3	4	4	4	3	2	3	3	3	4	4	37

AND WHAT ABOUT THE APPROACH?

- Is it the PRESUMPTION or DEMONSTRATION?
- This is still undecided and pending additional Water Quality Modeling Simulations
- The Jersey City Approach has been proposed to be a Combination of both:
  - PRESUMPTION: On Penhorn Creek and the North Hackensack for the Secaucus to Broadway (W1 to W5) Subdrainage Areas- 85% or 4 overflows
  - DEMONSTRATION: 20 Overflows from some or all of the other locations

Potential Elements of the Selected Plan for CSO Control Alternatives

- I/I removal by lining the leaking pipes
- Sewer separation in the Bates Street Redevelopment Area
- Green infrastructure with bioswales and perhaps tree replacement
- A variant of one of the off-line storage alternatives with or without the option to upgrade the East Side and West Side pump stations. These variations may be as follows:
  - Storage tanks/treatment shafts for the W1 and W2 subdrainage areas
  - If necessary, additional storage tanks for W3 to W13
  - If the Hudson River is viewed as being in need of CSO abatement, the E18 and E19 storage tanks may be added
  - A tunnel on the west side, alone, may be favored if the storage tank/treatment shafts are deemed less favorable.

ARCADIS Design & Consultancy for natural and built assets

Next Steps

2019-2020 Selection and Implemention of LTCP Program for CSO Control

ARCADIS Design & Consultancy for natural and built assets

2019-2020 Selection and Implementation of LTCP

PUBLIC PARTICIPATION

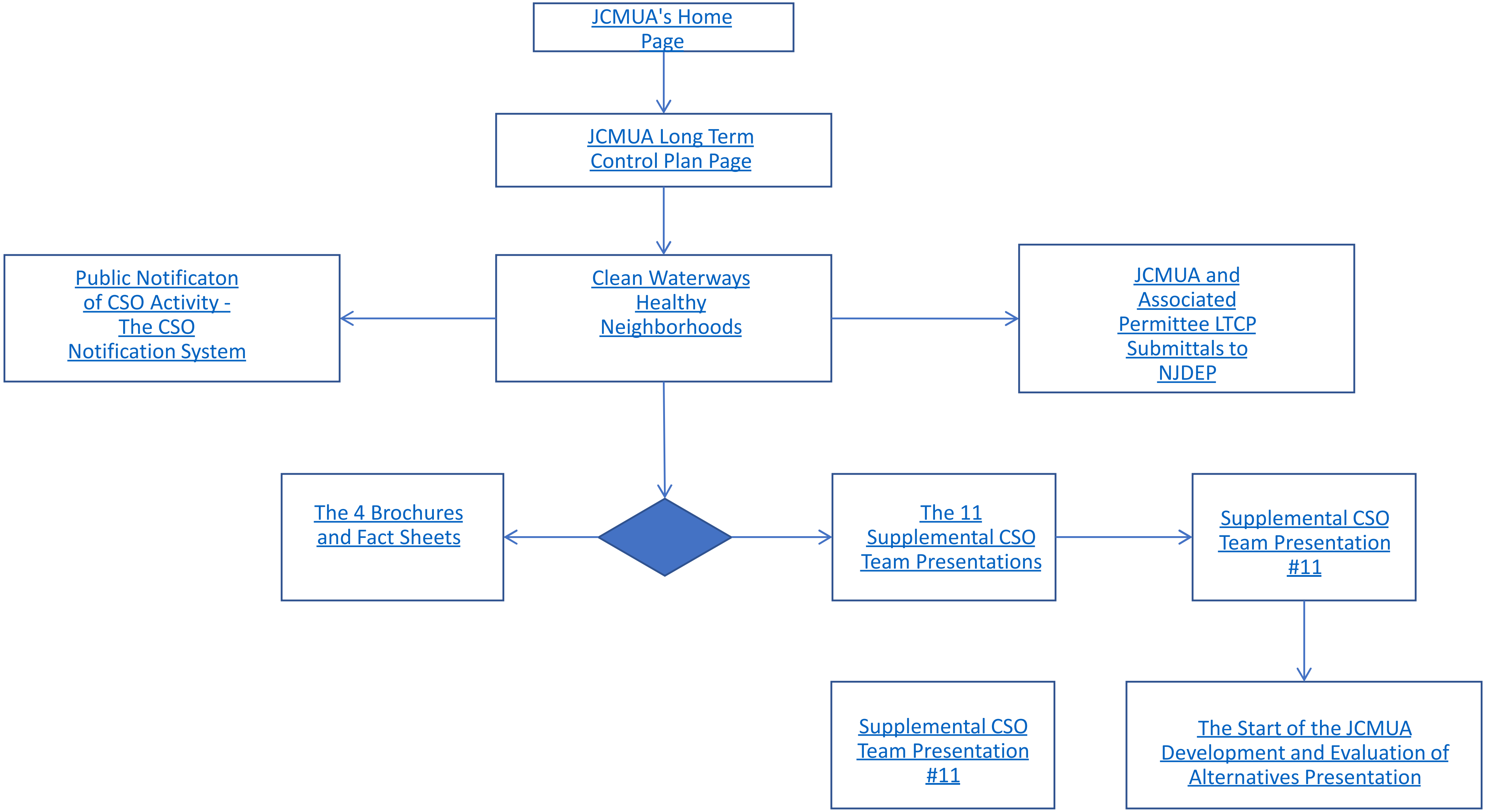
Final Selection of the LTCP with Implementation Schedule

Selected LTCP Costs and Affordability Analysis

Operational Plan

Compliance Monitoring Program

Long Term Control Plan (LTCP) Links to get to various Information requested



j.farrell@jcmua.com; jessejlowe@gmail.com; j.newman@jcmua.com; John Hanussak <JHanussak@jcnj.org>; j.coviello@jcmua.com; Katherine Lawrence <KLawrence@jcnj.org>; kevinciesla@gmail.com; kforce@hcnj.us; k.rodema@jcmua.com; c21plazaskolar@aol.com; LPiraino@jcnj.org; lsimms@njtreefoundation.org; luke.schray@gmail.com; mverdibello45@hotmail.com; meley@pvsc.com; mcrowley@embankment.org; mmassey@hcnj.us; michelle.a.luebke@gmail.com; plopes@pvsc.com; rachael.pepe@dep.nj.gov; r.prakash@jcmua.com; r.haytas@jcmua.com; r.mogro@jcmua.com; smittman@njcu.edu; simon@jcnjcert.org; TakeyaMeggett@gmail.com; tmalavasi@hcnj.us; wmontgomery@njcu.edu; y.coleman@jcmua.com; ambassador@hackensackriverkeeper.org; jerseycitystart@gmail.com; Keith Donath <KDonath@jcnj.org>; JPietrykoski@PVSC.com; acecase88@gmail.com; hudsonsierraclub@gmail.com; naman.buch93@gmail.com; cancoparkconservancy@gmail.com; Carolina Ramos <CRamos@jcnj.org>; SecyCPC@gmail.com; jnord5852@aol.com; dkrasnuk@hcnj.us; dshon.williams93@gmail.com; cperez@envsci.rutgers.edu; Minnett, John <John.Minnett@arcadis.com>
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"cancoparkconservancy@gmail.com" <cancoparkconservancy@gmail.com>; "Carolina Ramos" <CRamos@jcnj.org>; "SecyCPC@gmail.com" <SecyCPC@gmail.com>; "jnord5852@aol.com" <jnord5852@aol.com>; "dkrasnuk@hcnj.us" <dkrasnuk@hcnj.us>; "dshon.williams93@gmail.com" <dshon.williams93@gmail.com>; "cperez@envsci.rutgers.edu" <cperez@envsci.rutgers.edu>; "Minnett, John" <John.Minnett@arcadis.com>
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Thanks,

NEW JERSEY FUTURE

Mo Kinberg

Community Outreach Manager

mkinberg@njfuture.org | Cell: 510-452-7178
16 W. Lafayette St. | Trenton, NJ 08608

On Fri, Mar 15, 2019 at 10:57 AM Lindsey Sigmund <LSigmund@jcnj.org> wrote:

Good morning START,

Unfortunately, due to the number of members who cannot attend on Monday, we have decided to cancel the meeting. My apologies to those who shared the flyer. I appreciate you taking the time to get the word out! We'll update the flyer once we have a new date. Please fill out this doodle poll so we can find a good night to reschedule - https://doodle.com/poll/edswmvavppwsyzv3 - Meeting will be at 6 PM.

However, let's focus on getting the word out about MUA's Long-Term Control Plan Meetings! The next two meetings are **Thursday March 28th** and **Thursday April 4th**. The flyer is attached – please share with community groups and on social media!

Brittany – can you send us the LTCP presentation so we can provide comments? Thank you!

All the best,

Lindsey

Lindsey Sigmund
Environmental Planner
Jersey City, Division of City Planning
201-547-5010
lsigmund@jcnj.org

Minnett, John

From:	Minnett, John
Sent:	Tuesday, March 19, 2019 4:12 PM
To:	'Thomas Gibbons'; Moriah Kinberg; Lindsey Sigmund; 'Debra A. Italiano'; 'Brittany Rose Kelly'; Elmer Andal
Cc:	bmckenna@pvsc.com; obropta@envsci.rutgers.edu; j.coviello@jcmua.com; Katherine Lawrence; r.prakash@jcmua.com; r.haytas@jcmua.com; r.mogro@jcmua.com; Reid, James
Subject:	LTCP Meetings - Quick Links page
Attachments:	Key_JCMUA_LTCP_Links_to_JCMUAs_Website.pptx; Proposed Green Infrastructure locations for the Jersey City LTCP
Categories:	Critical Hold

Tracking:

Recipient	**Read**
'Thomas Gibbons'	
Moriah Kinberg	
Lindsey Sigmund	
'Debra A. Italiano'	
'Brittany Rose Kelly'	
Elmer Andal	
bmckenna@pvsc.com	
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Katherine Lawrence	
r.prakash@jcmua.com	
r.haytas@jcmua.com	
r.mogro@jcmua.com	
Reid, James	Read: 3/19/2019 4:39 PM

The purpose of this email to address some the comments made during our last two JCMUA LTCP Community Meeting by various attendees:

1. Attached is a Power Point slide with several critical links to LTCP information such as: The CSO Notification Page, Multi-language Brochures, links to all NJDEP Report Submittals and CSO supplemental team presentations. It also shows a diagram of how one can maneuver to each of the items shown and how the different websites relate to the others. Hopefully this is a easier reference for provide quicker access to these items which was the concern of some attendees. On this slide is also a link to the last slide of Supplemental CSO Team meeting #11 slide presentation for the JCMUA which shows the metrics that are currently being evaluated for the Alternative within Development and Evaluation of Alternatives Report.
2. One member requested that we resend the Map for the “Proposed Green Infrastructure locations for the Jersey City LTCP” with the Rock geology and ground water levels. So that 1/8/2019 email with the map is also attached. Our current plan for JC Green Infrastructure related to this LTCP is as shown in the following priority sequence:
    a. Complete as many as feasible in the “Green” zone marked on the attached Map of the 1/8/19 email which represents 7% of the Impervious Area in Jersey City.

b. Based upon comments received, an Alternative expanding the number of these locations to address up to 10% of the Impervious Area in Jersey City will look beyond the attached map locations to implement additional sites from the Rutgers Report and additional reports on GI locations provided by the Office of Innovation.
c. The LTCP GI program will also recommend a continuation of GI where selected sites identified in 2.a. and 2.b. fail to meet the require construction screening criteria outlined in the NJ GI Design Manual and using the Rutgers report, etc. as a guide.

From: Thomas Gibbons <gibbonstm@me.com>
Sent: Friday, March 15, 2019 2:14 PM
To: Moriah Kinberg <mkinberg@njfuture.org>; Lindsey Sigmund <LSigmund@jcnj.org>
Cc: Aaron Johnson <AJohnson@jcnj.org>; Alexander Mirescu <amirescu@resilientcity.com>; alisoncuc@gmail.com; Allison Solowsky <ASolowsky@jcnj.org>; Althea Bernheim <ABernheim@jcnj.org>; Andrew Lim <AndrewL@jcnj.org>; Benjamin Delisle <DelisleB@jcnj.org>; jbergstrom@envsci.rutgers.edu; Brian Weller <WellerB@jcnj.org>; bmckenna@pvsc.com; b.kelly@jcmua.com; obropta@envsci.rutgers.edu; baysideparkneighborhood@gmail.com; dreile@njcu.edu; debitaliano@gmail.com; Drew Banghart <DBanghart@jcnj.org>; meley@pvsc.nj.gov; epyshnik@envsci.rutgers.edu; e.andal@jcmua.com; gristorucci@gmail.com; galber@pvsc.com; greggielanez@gmail.com; hjung@njcu.edu; jbottcher@hcnj.us; j.farrell@jcmua.com; jessejlowe@gmail.com; j.newman@jcmua.com; John Hanussak <JHanussak@jcnj.org>; j.coviello@jcmua.com; Katherine Lawrence <KLawrence@jcnj.org>; kevinciesla@gmail.com; kforce@hcnj.us; k.rodema@jcmua.com; c21plazaskolar@aol.com; LPiraino@jcnj.org; lsimms@njtreefoundation.org; luke.schray@gmail.com; mverdibello45@hotmail.com; meley@pvsc.com; mcrowley@embankment.org; mmassey@hcnj.us; michelle.a.luebke@gmail.com; plopes@pvsc.com; rachael.pepe@dep.nj.gov; r.prakash@jcmua.com; r.haytas@jcmua.com; r.mogro@jcmua.com; smittman@njcu.edu; simon@jcnjcert.org; TakeyaMeggett@gmail.com; tmalavasi@hcnj.us; wmontgomery@njcu.edu; y.coleman@jcmua.com; ambassador@hackensackriverkeeper.org; jerseycitystart@gmail.com; Keith Donath <KDonath@jcnj.org>; JPietrykoski@PVSC.com; acecase88@gmail.com; hudsonsierraclub@gmail.com; naman.buch93@gmail.com; cancoparkconservancy@gmail.com; Carolina Ramos <CRamos@jcnj.org>; SecyCPC@gmail.com; jnord5852@aol.com; dkrasnuk@hcnj.us; dshon.williams93@gmail.com; cperez@envsci.rutgers.edu; Minnett, John <John.Minnett@arcadis.com>
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However, let's focus on getting the word out about MUA's Long-Term Control Plan Meetings! The next two meetings are **Thursday March 28th** and **Thursday April 4th**. The flyer is attached – please share with community groups and on social media!

Brittany – can you send us the LTCP presentation so we can provide comments? Thank you!

All the best,

Lindsey

Lindsey Sigmund

Environmental Planner

Jersey City, Division of City Planning

201-547-5010

lsigmund@jcnj.org

Minnett, John

From: Lindsey Sigmund <LSigmund@jcnj.org>
Sent: Friday, March 22, 2019 12:47 PM
To: Minnett, John
Cc: bmckenna@pvsc.com; obropta@envsci.rutgers.edu; j.coviello@jcmua.com; Katherine Lawrence; r.prakash@jcmua.com; r.haytas@jcmua.com; r.mogro@jcmua.com; Reid, James; Thomas Gibbons; Moriah Kinberg; Debra A. Italiano; Brittany Rose Kelly; Elmer Andal; Keith Donath
Subject: RE: LTCP Meetings - Quick Links page

Categories: Critical Hold

Hi John,

Thank you for taking the time to address our comments and provide additional information.

After discussing with JC START members, we had a few requests regarding the remaining LTCP public meetings:

1. There was a questionnaire provided during the first public meeting. It would be beneficial in terms of gathering meaningful feedback from the public to post this on MUA's LTCP website. This would allow members of the community who cannot attend a 6 PM meeting to provide feedback. This would also allow MUA to gather comments after the April 4th meeting.
2. To enable some dialogue during the presentation, posing those questions during the meeting would also be useful. We recommend breaking attendees up into smaller groups to discuss said questions. We realize that this can be a lot to facilitate, therefore START members will gladly assist during this portion of the meeting. Let us know what you think so we can recruit our members, which include City employees, to help out.
3. Lastly, we have some suggestions for additional content for your presentation:
    a. A slide on next steps and on how community input is being considered in the evaluation of alternatives
    b. A slide on the Long Term Control Plan Process
    c. A slide on stormwater runoff
    d. A slide on how alternatives are being evaluated i.e. cost and water quality
    e. More localized information on where these projects could go would be helpful for residents to get a better idea of the plans and to provide input
    f. If START's information can be included on a concluding slide to allow those interested in green infrastructure to get involved, it would be much appreciated!
        i. Website: http://www.jcmakeitgreen.org/jcstart/
        ii. You can also share my contact information, which is also on the JC START web page

Thank you in advance for taking the time. We look forward to hearing from you!

All the best,

Lindsey

Lindsey Sigmund
Environmental Planner
201-547-5010

From: Minnett, John <John.Minnett@arcadis.com>
Sent: Tuesday, March 19, 2019 4:12 PM

To: Thomas Gibbons <gibbonstm@me.com>; Moriah Kinberg <mkinberg@njfuture.org>; Lindsey Sigmund <LSigmund@jcnj.org>; Debra A. Italiano <debitaliano@gmail.com>; Brittany Rose Kelly <b.kelly@jcmua.com>; Elmer Andal <e.andal@jcmua.com>
Cc: bmckenna@pvsc.com; obropta@envsci.rutgers.edu; j.coviello@jcmua.com; Katherine Lawrence <KLawrence@jcnj.org>; r.prakash@jcmua.com; r.haytas@jcmua.com; r.mogro@jcmua.com; Reid, James <James.Reid@arcadis.com>
Subject: LTCP Meetings - Quick Links page

The purpose of this email to address some the comments made during our last two JCMUA LTCP Community Meeting by various attendees:

1. Attached is a Power Point slide with several critical links to LTCP information such as: The CSO Notification Page, Multi-language Brochures, links to all NJDEP Report Submittals and CSO supplemental team presentations. It also shows a diagram of how one can maneuver to each of the items shown and how the different websites relate to the others. Hopefully this is a easier reference for provide quicker access to these items which was the concern of some attendees. On this slide is also a link to the last slide of Supplemental CSO Team meeting #11 slide presentation for the JCMUA which shows the metrics that are currently being evaluated for the Alternative within Development and Evaluation of Alternatives Report.
2. One member requested that we resend the Map for the "Proposed Green Infrastructure locations for the Jersey City LTCP" with the Rock geology and ground water levels. So that 1/8/2019 email with the map is also attached. Our current plan for JC Green Infrastructure related to this LTCP is as shown in the following priority sequence:
    a. Complete as many as feasible in the "Green" zone marked on the attached Map of the 1/8/19 email which represents 7% of the Impervious Area in Jersey City.
    b. Based upon comments received, an Alternative expanding the number of these locations to address up to 10% of the Impervious Area in Jersey City will look beyond the attached map locations to implement additional sites from the Rutgers Report and additional reports on GI locations provided by the Office of Innovation.
    c. The LTCP GI program will also recommend a continuation of GI where selected sites identified in 2.a. and 2.b. fail to meet the require construction screening criteria outlined in the NJ GI Design Manual and using the Rutgers report, etc. as a guide.

From: Thomas Gibbons <gibbonstm@me.com>
Sent: Friday, March 15, 2019 2:14 PM
To: Moriah Kinberg <mkinberg@njfuture.org>; Lindsey Sigmund <LSigmund@jcnj.org>
Cc: Aaron Johnson <AJohnson@jcnj.org>; Alexander Mirescu <amirescu@resilientcity.com>; alisoncuc@gmail.com; Allison Solowsky <ASolowsky@jcnj.org>; Althea Bernheim <ABernheim@jcnj.org>; Andrew Lim <AndrewL@jcnj.org>; Benjamin Delisle <DelisleB@jcnj.org>; jbergstrom@envsci.rutgers.edu; Brian Weller <WellerB@jcnj.org>; bmckenna@pvsc.com; b.kelly@jcmua.com; obropta@envsci.rutgers.edu; baysideparkneighborhood@gmail.com; dreile@njcu.edu; debitaliano@gmail.com; Drew Banghart <DBanghart@jcnj.org>; meley@pvsc.nj.gov; epyshnik@envsci.rutgers.edu; e.andal@jcmua.com; gristorucci@gmail.com; galber@pvsc.com; greggielanez@gmail.com; hjung@njcu.edu; jbottcher@hcnj.us; j.farrell@jcmua.com; jessejlowe@gmail.com; j.newman@jcmua.com; John Hanussak <JHanussak@jcnj.org>; j.coviello@jcmua.com; Katherine Lawrence <KLawrence@jcnj.org>; kevinciesla@gmail.com; kforce@hcnj.us; k.rodema@jcmua.com; c21plazaskolar@aol.com; LPiraino@jcnj.org; lsimms@njtreefoundation.org; luke.schray@gmail.com; mverdibello45@hotmail.com; meley@pvsc.com; mcrowley@embankment.org; mmassey@hcnj.us; michelle.a.luebke@gmail.com; plopes@pvsc.com; rachael.pepe@dep.nj.gov; r.prakash@jcmua.com; r.haytas@jcmua.com; r.mogro@jcmua.com; smittman@njcu.edu; simon@jcnjcert.org; TakeyaMeggett@gmail.com; tmalavasi@hcnj.us; wmontgomery@njcu.edu; y.coleman@jcmua.com; ambassador@hackensackriverkeeper.org; jerseycitystart@gmail.com; Keith Donath <KDonath@jcnj.org>; JPietrykoski@PVSC.com; acecase88@gmail.com; hudsonsierraclub@gmail.com; naman.buch93@gmail.com; cancoparkconservancy@gmail.com; Carolina Ramos <CRamos@jcnj.org>; SecyCPC@gmail.com; jnord5852@aol.com; dkrasnuk@hcnj.us; dshon.williams93@gmail.com;

cperez@envsci.rutgers.edu; Minnett, John <John.Minnett@arcadis.com>
Subject: Re[2]: 3-18 START Meeting Canceled / LTCP Meetings

Lindsey, et al

I think it is disappointing that the we canceled the meeting on Monday and will not be able to discuss these issues in person. Very unfortunate timing.

I also attended the presentation yesterday and agree with Mo's comments. I was surprised that there was no discussion of next steps in the process or when/how stakeholders can provide feedback in the future. No discussion of metrics for evaluating the alternatives. No explanation of the triple bottom line approach we previously discussed and advocated or why we should be using that approach. No specific examples of alternatives, their location, impact on environment, or cost. No participation by the City, etc.

Despite the great examples of how municipalities before us have used this as an opportunity engage stakeholders and introduce green sustainable practices, like green streets, parks and gardens to help manage storm water, we don't seem to moving in that direction.

Mo,

I'll do my best to reach out to folks that i know to attend the next two meetings but I think we need to do more than just ask them to attend. I think we need to include a primer the includes What this is about, Why it matters, and What you can do about it... or something along those lines. Perhaps a link to your Sewer Free Streets campaign...

Also a flyer that is a bit more compelling and conveys a sense of urgency may be helpful.

------ Original Message ------
From: "Moriah Kinberg" <mkinberg@njfuture.org>
To: "Lindsey Sigmund" <LSigmund@jcnj.org>
Cc: "Aaron Johnson" <AJohnson@jcnj.org>; "Alexander Mirescu" <amirescu@resilientcity.com>; "alisoncuc@gmail.com" <alisoncuc@gmail.com>; "Allison Solowsky" <ASolowsky@jcnj.org>; "Althea Bernheim" <ABernheim@jcnj.org>; "Andrew Lim" <AndrewL@jcnj.org>; "Benjamin Delisle" <DelisleB@jcnj.org>; "jbergstrom@envsci.rutgers.edu" <jbergstrom@envsci.rutgers.edu>; "Brian Weller" <WellerB@jcnj.org>; "bmckenna@pvsc.com" <bmckenna@pvsc.com>; "b.kelly@jcmua.com" <b.kelly@jcmua.com>; "obropta@envsci.rutgers.edu" <obropta@envsci.rutgers.edu>; "baysideparkneighborhood@gmail.com" <baysideparkneighborhood@gmail.com>; "dreile@njcu.edu" <dreile@njcu.edu>; "debitaliano@gmail.com" <debitaliano@gmail.com>; "Drew Banghart" <DBanghart@jcnj.org>; "meley@pvsc.nj.gov" <meley@pvsc.nj.gov>; "epyshnik@envsci.rutgers.edu" <epyshnik@envsci.rutgers.edu>; "e.andal@jcmua.com" <e.andal@jcmua.com>; "gristorucci@gmail.com" <gristorucci@gmail.com>; "galber@pvsc.com" <galber@pvsc.com>; "greggielanez@gmail.com" <greggielanez@gmail.com>; "hjung@njcu.edu" <hjung@njcu.edu>; "jbottcher@hcnj.us" <jbottcher@hcnj.us>; "j.farrell@jcmua.com" <j.farrell@jcmua.com>; "jessejlowe@gmail.com" <jessejlowe@gmail.com>; "j.newman@jcmua.com" <j.newman@jcmua.com>; "John Hanussak" <JHanussak@jcnj.org>; "j.coviello@jcmua.com" <j.coviello@jcmua.com>; "Katherine Lawrence" <KLawrence@jcnj.org>; "kevinciesla@gmail.com" <kevinciesla@gmail.com>; "kforce@hcnj.us" <kforce@hcnj.us>; "k.rodema@jcmua.com" <k.rodema@jcmua.com>; "c21plazaskolar@aol.com" <c21plazaskolar@aol.com>;

"LPiraino@jcnj.org" <LPiraino@jcnj.org>; "lsimms@njtreefoundation.org" <lsimms@njtreefoundation.org>; "luke.schray@gmail.com" <luke.schray@gmail.com>; "mverdibello45@hotmail.com" <mverdibello45@hotmail.com>; "meley@pvsc.com" <meley@pvsc.com>; "mcrowley@embankment.org" <mcrowley@embankment.org>; "mmassey@hcnj.us" <mmassey@hcnj.us>; "michelle.a.luebke@gmail.com" <michelle.a.luebke@gmail.com>; "plopes@pvsc.com" <plopes@pvsc.com>; "rachael.pepe@dep.nj.gov" <rachael.pepe@dep.nj.gov>; "r.prakash@jcmua.com" <r.prakash@jcmua.com>; "r.haytas@jcmua.com" <r.haytas@jcmua.com>; "r.mogro@jcmua.com" <r.mogro@jcmua.com>; "smittman@njcu.edu" <smittman@njcu.edu>; "simon@jcnjcert.org" <simon@jcnjcert.org>; "TakeyaMeggett@gmail.com" <TakeyaMeggett@gmail.com>; "tmalavasi@hcnj.us" <tmalavasi@hcnj.us>; "gibbonstm@me.com" <gibbonstm@me.com>; "wmontgomery@njcu.edu" <wmontgomery@njcu.edu>; "y.coleman@jcmua.com" <y.coleman@jcmua.com>; "ambassador@hackensackriverkeeper.org" <ambassador@hackensackriverkeeper.org>; "jerseycitystart@gmail.com" <jerseycitystart@gmail.com>; "Keith Donath" <KDonath@jcnj.org>; "JPietrykoski@PVSC.com" <JPietrykoski@pvsc.com>; "acecase88@gmail.com" <acecase88@gmail.com>; "hudsonsierraclub@gmail.com" <hudsonsierraclub@gmail.com>; "naman.buch93@gmail.com" <naman.buch93@gmail.com>; "cancoparkconservancy@gmail.com" <cancoparkconservancy@gmail.com>; "Carolina Ramos" <CRamos@jcnj.org>; "SecyCPC@gmail.com" <SecyCPC@gmail.com>; "jnord5852@aol.com" <jnord5852@aol.com>; "dkrasnuk@hcnj.us" <dkrasnuk@hcnj.us>; "dshon.williams93@gmail.com" <dshon.williams93@gmail.com>; "cperez@envsci.rutgers.edu" <cperez@envsci.rutgers.edu>; "Minnett, John" <John.Minnett@arcadis.com>
Sent: 3/15/2019 11:19:58 AM
Subject: Re: 3-18 START Meeting Canceled / LTCP Meetings

Hi All,

We could really use all of your help to get the word out about the next two JC MUA public meetings on March 28 and April 4 on the plans to stop sewage from being dumped into our waterways. We had small groups of dedicated residents who attended the first two meetings. Brittany has done a great job sending information out to community groups. This is going to be one of the largest infrastructure investments in a generation and we really need everyone's participation.

I was able to attend the meetings and have some feedback on the presentations (see more detailed feedback below). The presentation is a great starting point and was delivered well by Elmer and John but could use a few additional slides on the process, next steps and background information and the discussion would benefit from a little more structure.

It would be great if the presentation and survey could be shared with the JC START group today so that feedback could be gathered and incorporated into the presentation before the next public meeting. This is exactly the collaborative process that the DEP was emphasizing at their workshop last week.

Feedback on the JCMUA presentations:
- The discussions were good but a more structured discussion on community priorities in small groups with report backs would help ensure that all voices are heard. I suggest keeping 20 min. for questions and 15 min. for small group discussions on the questions in the survey and then 10 min. for report backs.
- Please add a slide on the Long Term Control Plan Process
- Please add a slide on stormwater runoff
- Please add a slide on how alternatives are being evaluated

- More localized information on where these projects could go would be helpful for residents to get a better idea of the plans and to provide input.
- A slide on next steps and on how community input is being considered in the evaluation of alternatives

Thanks,

Mo Kinberg

Community Outreach Manager

mkinberg@njfuture.org | Cell: 510-452-7178
16 W. Lafayette St. | Trenton, NJ 08608

On Fri, Mar 15, 2019 at 10:57 AM Lindsey Sigmund <LSigmund@jcnj.org> wrote:

Good morning START,

Unfortunately, due to the number of members who cannot attend on Monday, we have decided to cancel the meeting. My apologies to those who shared the flyer. I appreciate you taking the time to get the word out! We'll update the flyer once we have a new date. Please fill out this doodle poll so we can find a good night to reschedule - https://doodle.com/poll/edswmvavppwsyzv3 - Meeting will be at 6 PM.

However, let's focus on getting the word out about MUA's Long-Term Control Plan Meetings! The next two meetings are **Thursday March 28th** and **Thursday April 4th**. The flyer is attached – please share with community groups and on social media!

Brittany – can you send us the LTCP presentation so we can provide comments? Thank you!

All the best,

Lindsey

Lindsey Sigmund

Environmental Planner

Jersey City, Division of City Planning

201-547-5010

lsigmund@jcnj.org

From: Roger Heitmann
To: Bushlow, Megan
Cc: elmer.andal@gmail.com
Subject: Combined sewer overflow
Date: Friday, April 5, 2019 12:30:33 PM

Dear Megan,

Thank you for your involvement and help with understanding this massive public works project which could easily take 25 years to complete.

I attended the meeting in the heights last night and have a few questions and comments. I am not an expert but have been following this subject for years.

It's pretty clear that even if we do all the rain gardens and plant all the trees and have all the rain barrels we can, it will only take care of about 20% of the stormwater runoff. Most of this project will involve tearing up streets to separate the system and building giant stormwater retention systems.

I'm retired and live on a fixed income. I pay pretty high real estate taxes and know that school taxes are likely to dramatically increase over the next few years.

My question is:

What can I expect to have to pay per month for my water sewer connection usage when this begins to take effect likely in 2020 or later?

What kind of interruptions in service can I expect including access to my one way street?

I leave it to the expert engineers to figure out the best course of action that is most cost effective. I don't think you can expect the public to offer much more than what you heard last night as they were focused mostly on green infrastructure.
The best efforts there, although great, are not going to have the huge impact I think some believe. You will get much more feedback when people's bills go way up though.

One suggestion (although a bit far out):

It might be helpful to use the Bergen Arches running below route 139 to install conduit to pump some of the stormwater either east or west to holding tanks. The old rail bed is is depressed and owned by NJ Transit but has not been used in many years. The city wants to build a bikeway there. Maybe it could be used for both purposes. You could save millions of dollars using this route to move water and even pump it to the meadowlands after its treated. I believe the bed is about a mile long at least.

Please let me know when the cost analysis becomes available so I know what to expect.

Thanks again.

Best,
Roger Heitmann
raven242@verizon.net

less overflow volume being discharge over the CSO Regulators weir.

From: Phil Jonat <philip.jonat@gmail.com>
Sent: Thursday, April 11, 2019 3:43 PM
To: Minnett, John <John.Minnett@arcadis.com>
Cc: Bushlow, Megan <Megan.Bushlow@arcadis.com>
Subject: Re: Jersey City Heights meeting-John Minnett's contact informations

Thanks John and Megan.

Do you have any sense of how much water efficiency can help the CSO problem in NJ?

Similar to "Watt-time", I think we need an app to help notify people in real time to reduce usage and communicate directly to dishwashers, laundry machines, etc. Have you seen any proposals like that from NJ DEP or others?

Phil

On Mon, Apr 8, 2019 at 4:18 PM Minnett, John <John.Minnett@arcadis.com> wrote:

> As per your request here is my contact information.
>
> **John A. Minnett, P.E., BCEE** | **Senior Environmental Engineer** | John.Minnett@arcadis.com
> **Arcadis**
> **17-17 Route 208 North. Fair Lawn, NJ 07410**
> **Tel: 201-398-4352 Mob: 914-484-1305**
>
> Professional Registrations: PA PE041350E, NJ, 24GE04221900 & Academy of Environmental Engineers 09-20052
>
> **Connect with us at** LinkedIn: http://www.linkedin.com/pub/john-minnett-p-e-bcee/48/7a3/20a
>
> ARCADIS Design & Consultancy for natural and built assets
>
> **Be green, leave it on the screen.**
>
> ---
>
> **From:** Bushlow, Megan <Megan.Bushlow@arcadis.com>
> **Sent:** Friday, April 5, 2019 12:21 PM
> **To:** Minnett, John <John.Minnett@arcadis.com>
> **Subject:** FW: Jersey City Heights meeting
>
> **Megan Bushlow, EIT** | Water Resource Consultant | megan.bushlow@arcadis.com
> **Arcadis | Arcadis U.S., Inc.**
> 17-17 Route 208 North, Fair Lawn, NJ | 07410 | USA
> T. +1 201 398 4310 | M. +1 917 843 0202
>
> Connect with us! www.arcadis.com | LinkedIn | Twitter | Facebook | Connect App
>
> ARCADIS Design & Consultancy for natural and built assets
>
> EXPLOREArcadis DOWNLOAD OUR MOBILE APP Arcadis CONNECT

Be green, leave it on the screen.

From: Phil Jonat <philip.jonat@gmail.com>
Sent: Friday, April 5, 2019 11:29 AM
To: Bushlow, Megan <Megan.Bushlow@arcadis.com>
Subject: Jersey City Heights meeting

Megan,
Thanks for taking the time to speak with our community last night about the CSO long term control plan. Can you please send contact information for John and the gentleman from JCMUA?
Thanks,
Phil

Minnett, John

From: Elmer Andal <e.andal@jcmua.com>
Sent: Tuesday, March 26, 2019 10:54 AM
To: Minnett, John; Brittany Rose Kelly
Cc: Reid, James; Rich Haytas; Brian Messler
Subject: RE: Community Public Meeting No 3 of 4 for LTCP: Any new needs?

Categories: Critical Hold

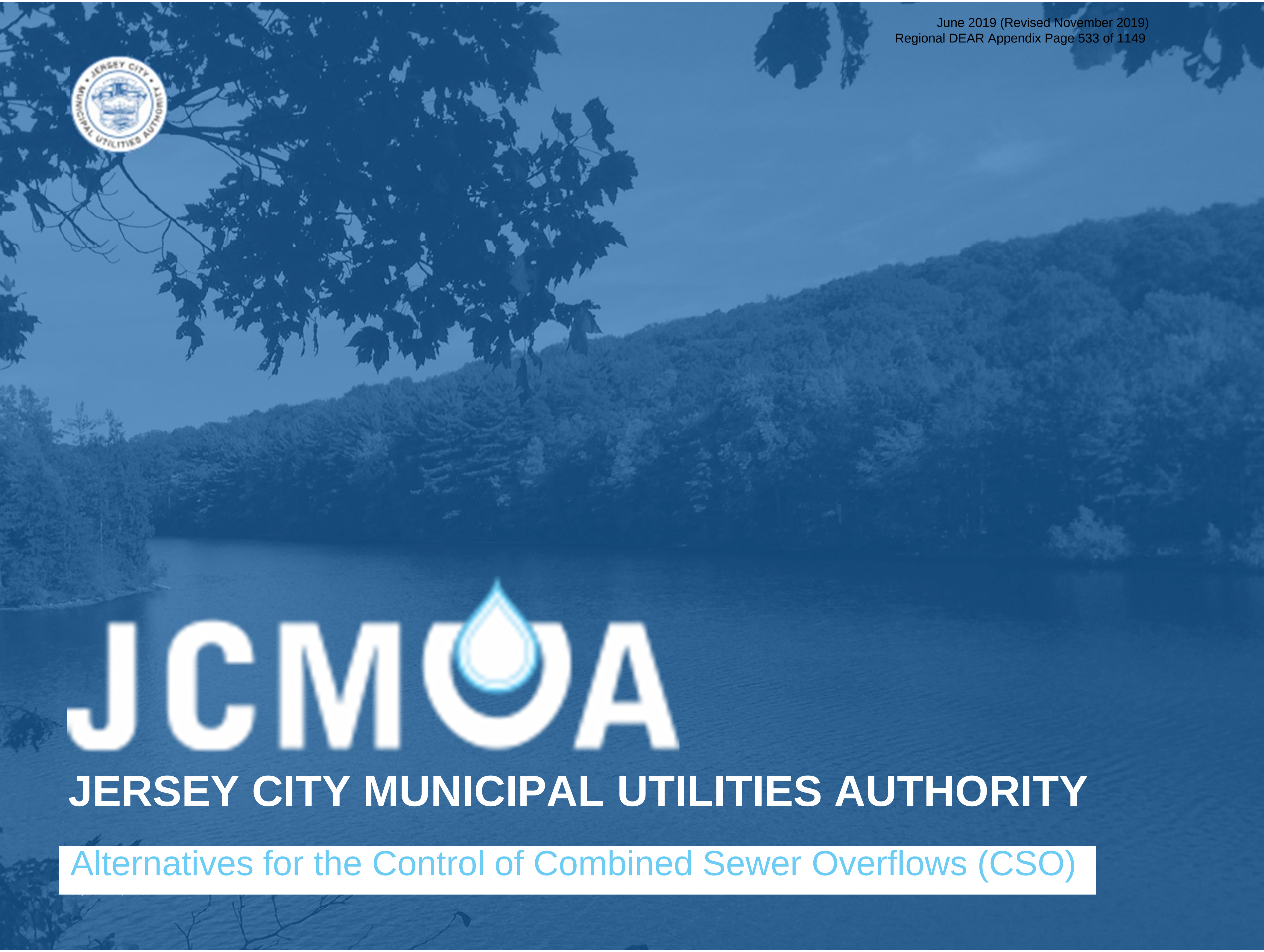
No additional info, lets just complete the presentation followed by Q&A.

Yes we have a work area for you.

Elmer Andal
Director, Operations
Jersey City Municipal Utilities Authority
555 Route 440
Jersey City NJ 07305
P: 201.432.3008
C: 201.273.0296
F: 201.433.8089

From: Minnett, John <John.Minnett@arcadis.com>
Sent: Tuesday, March 26, 2019 9:48 AM
To: Brittany Rose Kelly <b.kelly@jcmua.com>; Elmer Andal <e.andal@jcmua.com>
Cc: Reid, James <James.Reid@arcadis.com>; Rich Haytas <r.haytas@jcmua.com>; Brian Messler <b.messler@jcmua.com>
Subject: Community Public Meeting No 3 of 4 for LTCP: Any new needs?
Importance: High

Are there any changes or additional needs in regard to this Thursdays presentation at the Hank Gallo Center on Lincoln Park that you need Jame or I to address? Or is the plan just complete the presentation as before and we are there to answer questions? Also, since I will be at the JCMUA for another meeting that day at 10am is there a conference room or cube somewhere that I could work the rest of the day there?



JCMUA

JERSEY CITY MUNICIPAL UTILITIES AUTHORITY

Alternatives for the Control of Combined Sewer Overflows (CSO)

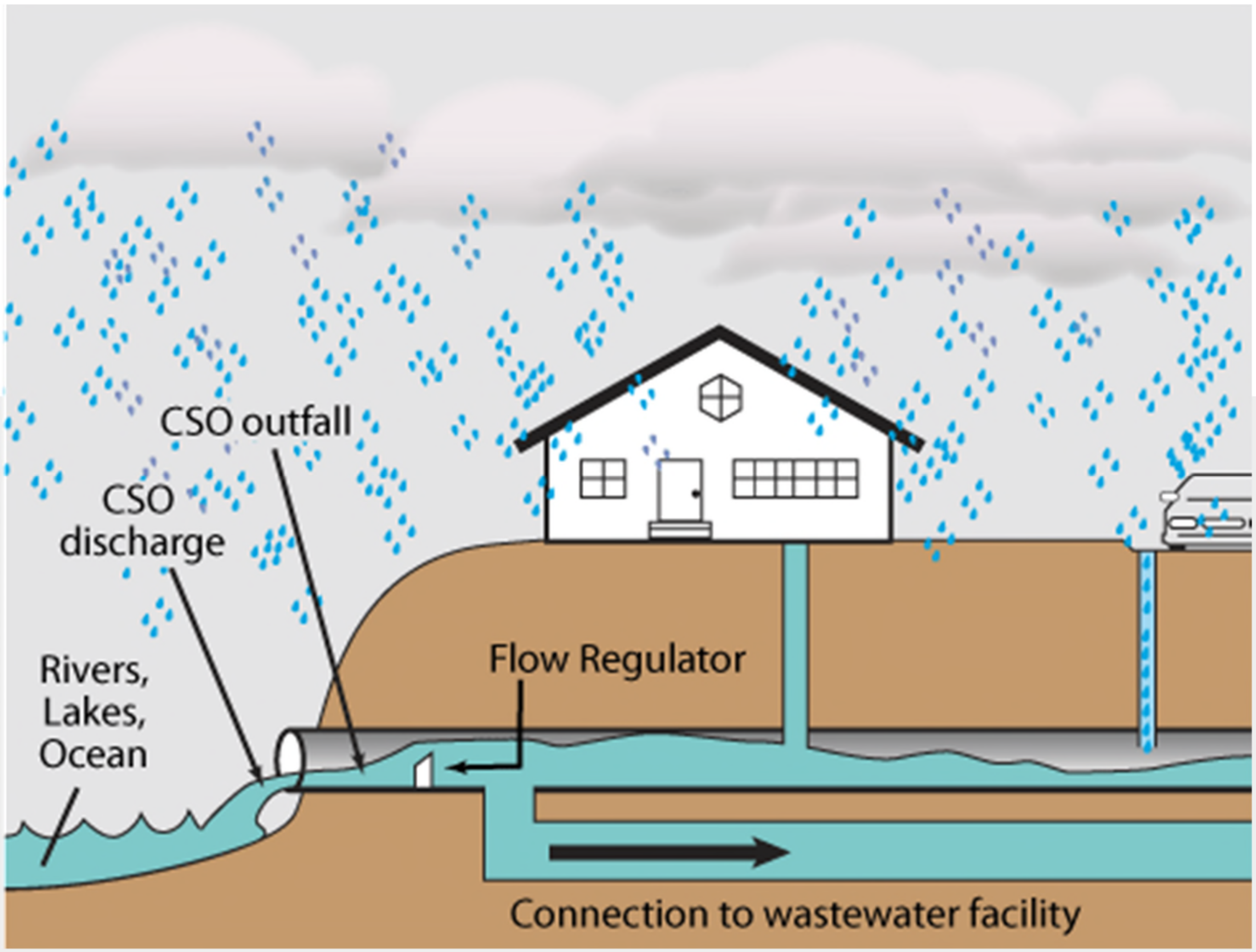
AGENDA #1

Overview of JCMUA Combined Sewer System (CSS)

JCMUA CSO Control Facilities

Wet Weather Flow Discharged as Combined Sewer Overflows

Combined Sewer Systems

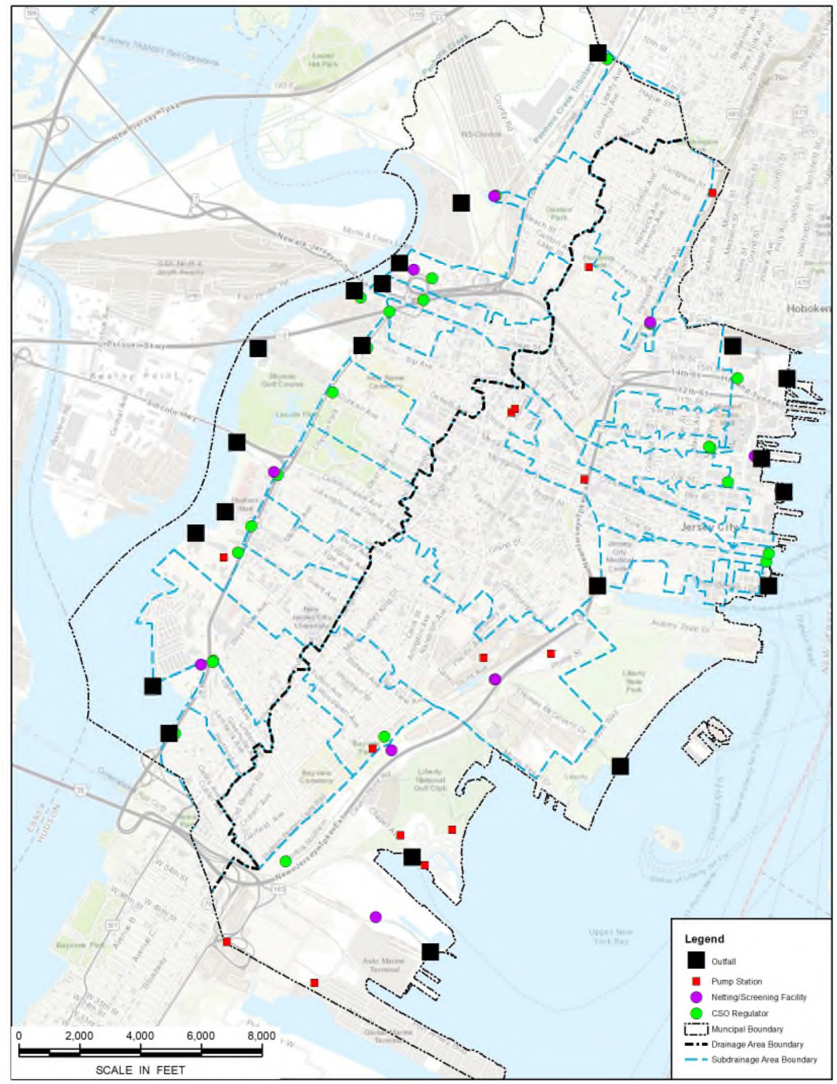


Combined Sewer Overflow Location Map

21

Combined Sewer Overflow discharge points

- 1 discharge to Penhorn Creek
- 11 discharges to the Hackensack River, Newark Bay
- 9 discharges to the Hudson River



CSO Netting Facilities

Nets are removed and replaced. The old nets are transported to a land fill for disposal.

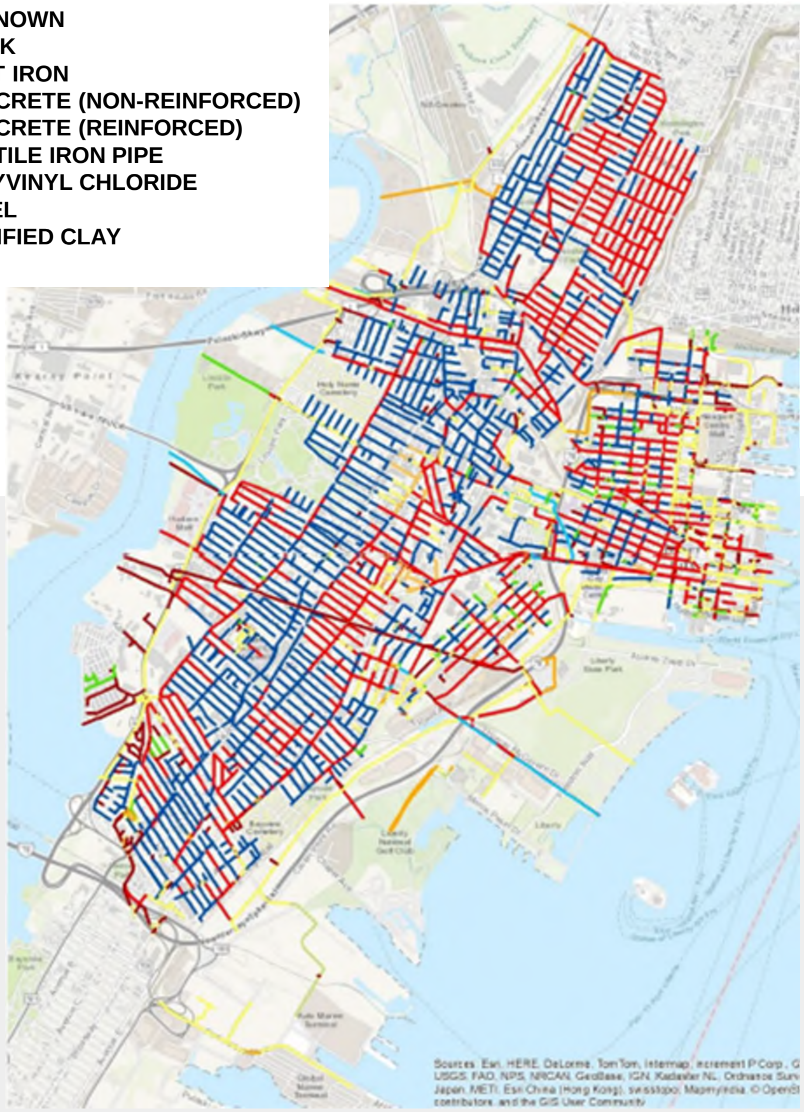
Sewer Pipes & Materials

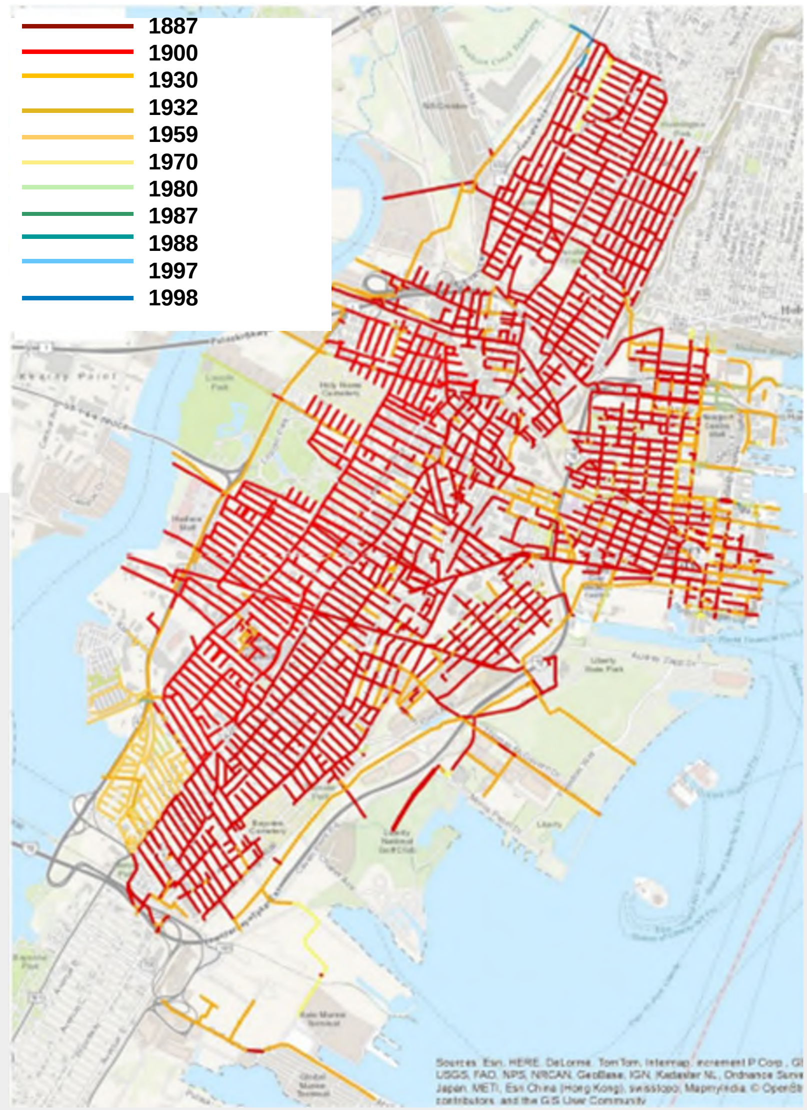
230 mi. in the Combined Sewer System

90% of the sewers are **88-131 years old**

Pipe Material & Age

UNKNOWN
BRICK
CAST IRON
CONCRETE (NON-REINFORCED)
CONCRETE (REINFORCED)
DUCTILE IRON PIPE
POLYVINYL CHLORIDE
STEEL
VITRIFIED CLAY





Deteriorated Sewer Line under NJ Transit

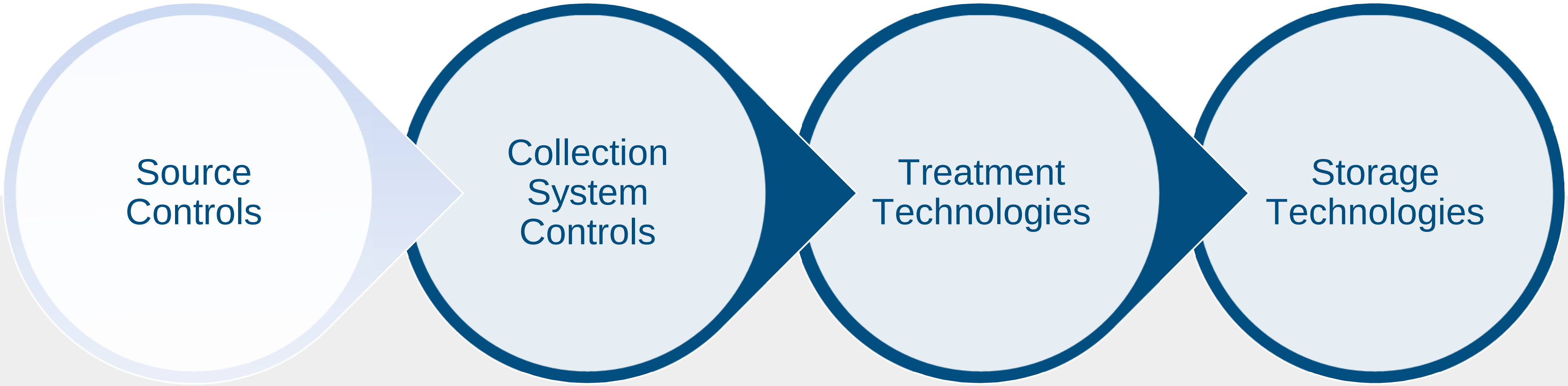
Sewer Replacement

Replacement includes;

- **Rehabilitation of existing sewers by Cured in Pipe Lining (CIPP)**
- **Removal & replacement of existing sewers with new pipe**
- **Removal & replacement of man holes, catch basins and water mains.**

Develop Alternatives for CSO Control

Identify CSO Control Alternatives



Source Controls

Green Infrastructure – Stores, Absorbs & Uses Storm Water Runoff.

Examples

Positives:

- Low Cost
- Reduce Flooding

Negatives:

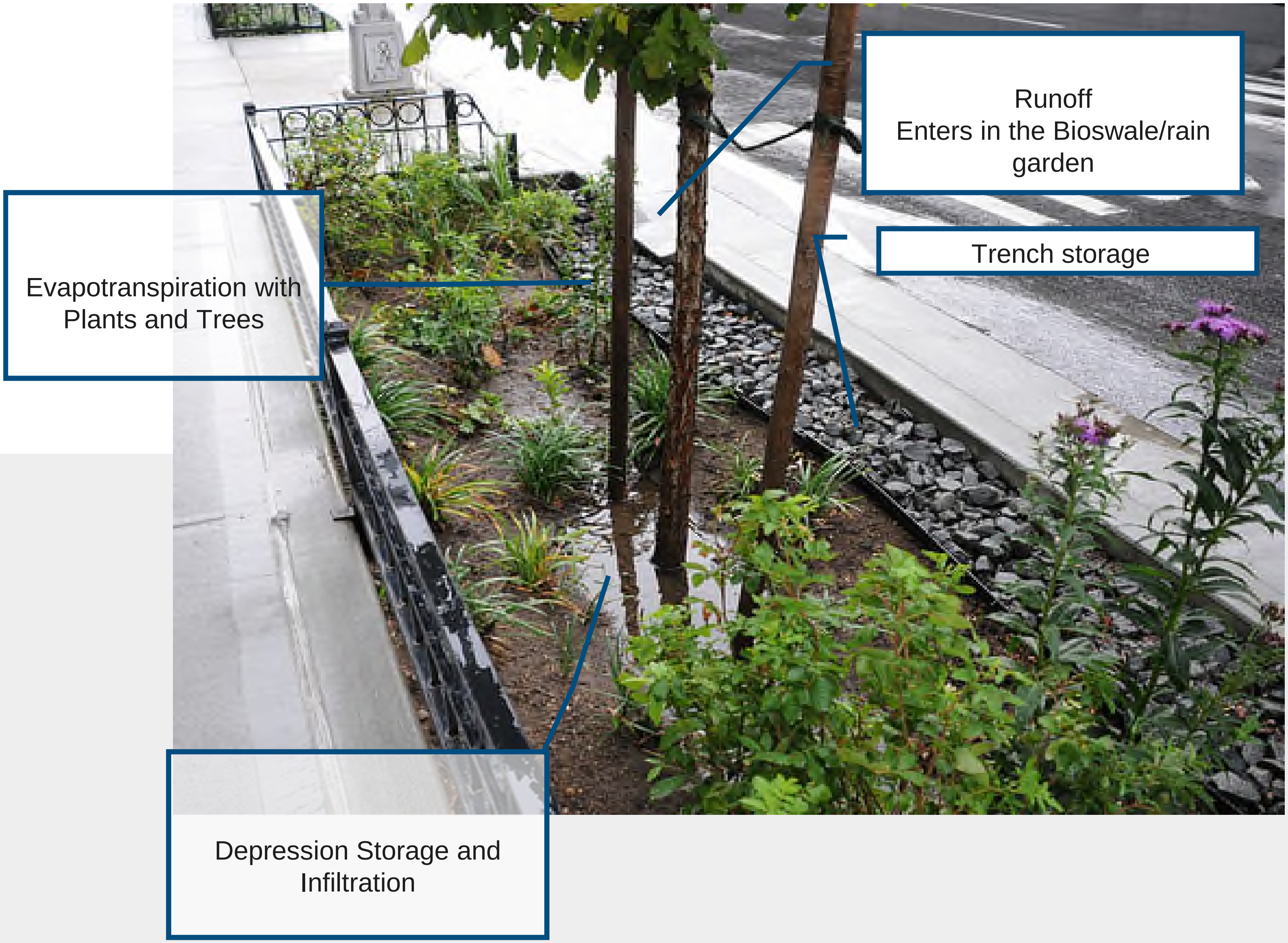
- Maintenance Concerns
- Site Specific

Green Roof

Bioswale

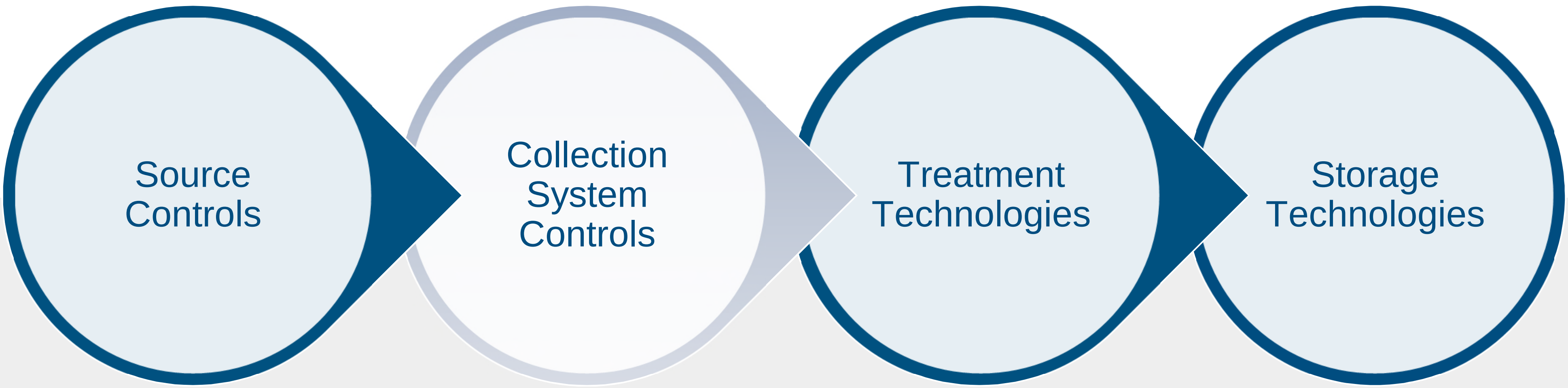
Rain Garden

Green Infrastructure



Develop Alternatives for CSO Control

Identify CSO Control Alternatives



Collection System Controls

Sewer Separation

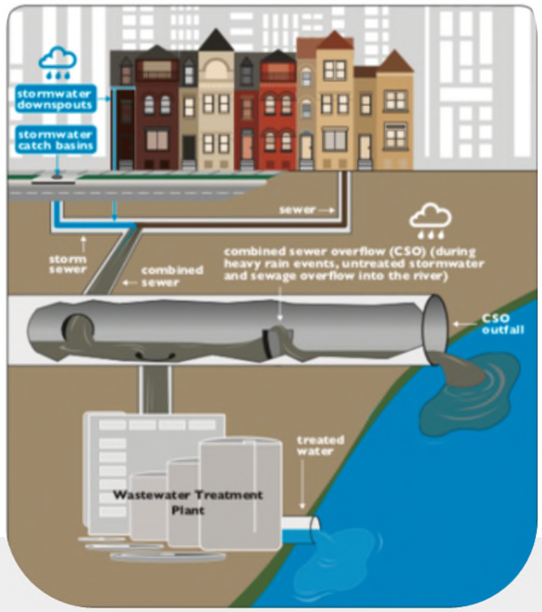
Positives:

- Improve water quality
- Reduce or eliminate untreated sanitary discharge
- Reduce flooding in basements and streets

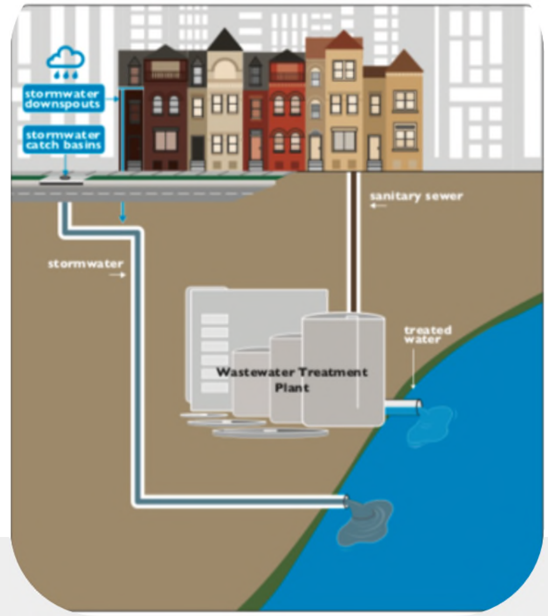
Negatives:

- High cost
- Extensive Construction
- Internal Plumbing Work

combined sewer overflow (CSO) system



separated sewer system



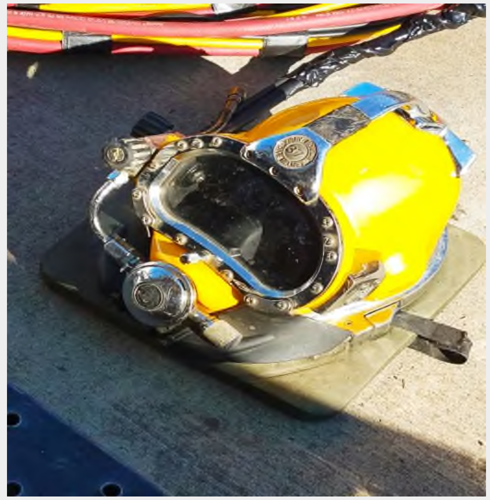
Infiltration/Inflow Control

Positives:

- Improve water quality
- Reduction of combined sewer volumes

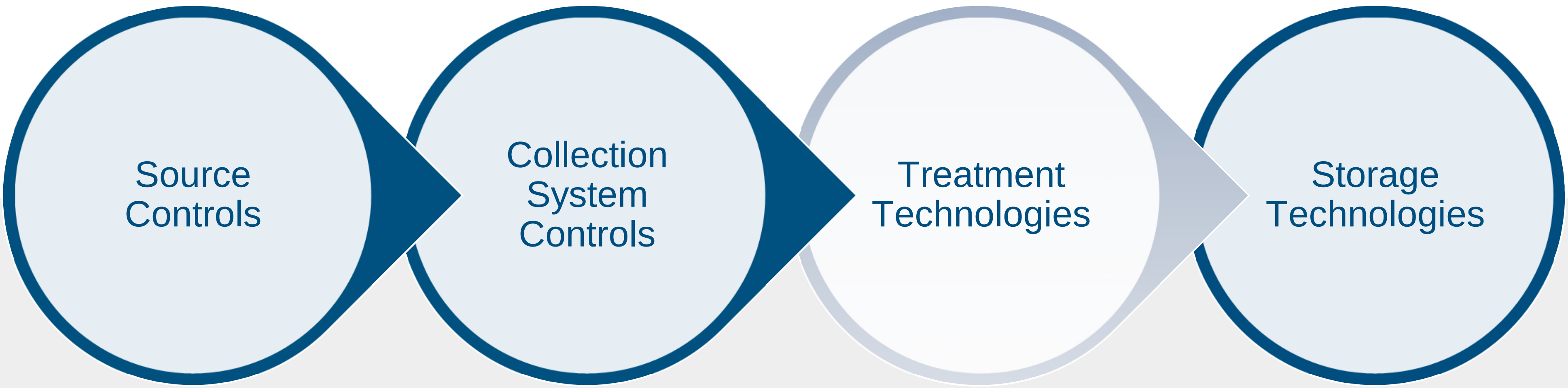
Negatives:

- High Cost
- Possible disruption in services
- Extensive Construction



Develop Alternatives for CSO Control

Identify CSO Control Alternatives



Treatment Technologies

Screening:

JCMUA's CSO facilities are currently equipped with netting facilities

Disinfection Alternatives:

- Sodium Hypochlorite
- Chlorine Dioxide

Positives:

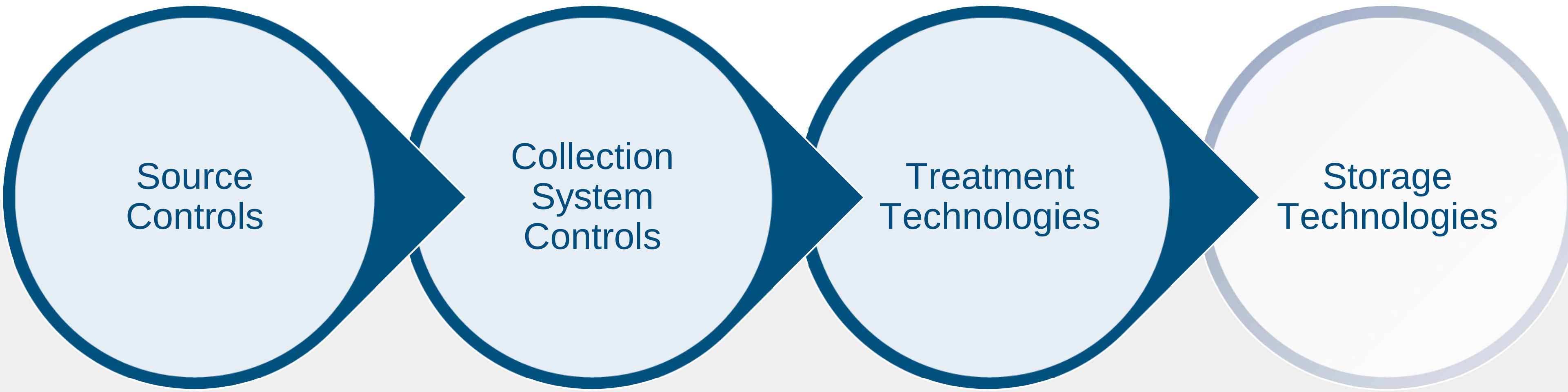
- Easy to produce
- Equipment requires less space
- The chlorine residual that remains can prolong disinfection

Negatives:

- Limited use in the US
- Hazardous to transport
- Can potentially produce toxic byproducts

Develop Alternatives for CSO Control

Identify CSO Control Alternatives



Storage Technologies

In-Line Storage – Near Surface Storage

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

Off-Line Storage – Basins or Concrete Tanks

- 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.

Positives:

- **Eliminates or reduce sewer backups**
- **Improves the efficiency of the of existing treatment capacity**
- **Improves quality of treatment plant**

Negatives

- **Lack of real estate**
- **Difficulty managing flows to and from the basin**
- **High cost**

JCMUA

NEXT STEPS

- Questions/Feedback
- Questionnaire