Appendix M

Selection and Implementation of Alternatives Report for North Bergen MUA

Selection and Implementation of Alternatives Report

Township of North Bergen – Central Drainage Area

September 2020

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SECTION A - INTRODUCTION

The Township of North Bergen is a densely populated town in Hudson County, New Jersey. The North Bergen Municipal Alternative Authority (NBMUA) operates two collection system areas, the central area and the Woodcliff area. This report presents the Long Term Control Plan (LTCP) for Combined Sewer Overflow (CSO) control for the Township of North Bergen Municipal Alternative Authority (NBMUA) central area, shown in Figure A-1, where flows are conveyed to the PVSC treatment plant by the Central Pump Station.

The NBMUA owned and operated a small wastewater treatment plant called the Central Treatment Plant until its closure in October of 2010 when the Central Treatment Plant was replaced with the Central Pump Station. The Township's wastewater from the original service area of the Central Treatment Plant, about 7 MGD, is now pumped to the Jersey City Pump Station (JCMUA) and then conveyed to PVSC for treatment. The CSOs from this area of the township of North Bergen are tributary to the Hackensack River (central area) and the northeast section of CSOs are tributary to the Hudson River.

The total area of the township is about 3,568 acres, in the central area approximately 1,414 acres is serviced by the combined sewer system. The NBMUA central area has nine CSO outfalls discharging CSO overflows to the Hackensack River. All combined sewer flows from the central area are conveyed to the PVSC treatment plant through Hudson County Force Main with excess flow discharged to the Hackensack River. The township's combined sewer system is permitted under NJPDES Permit No. NJ108898 for the central area discharging to the PVSC wastewater treatment plant. A separate report entitled "Selection and Implementation of Alternative Report – North Bergen Woodcliff Drainage Area" has been prepared for the CSOs covered by NJPDES Permit No. NJ0029084.

In consistency with the 1994 USEPA's CSO Control Policy, the NJPDES permit requires implementation of CSO controls through development of a Long-Term Control Plan (LTCP). The permit includes an option to cooperatively develop the LTCP with PVSC and its hydraulically connected CSO permittees. This option has been selected. Each permittee is required to develop all necessary information for their portion of the hydraulically connected system they own and operate. This report presents the LTCP for North Bergen.

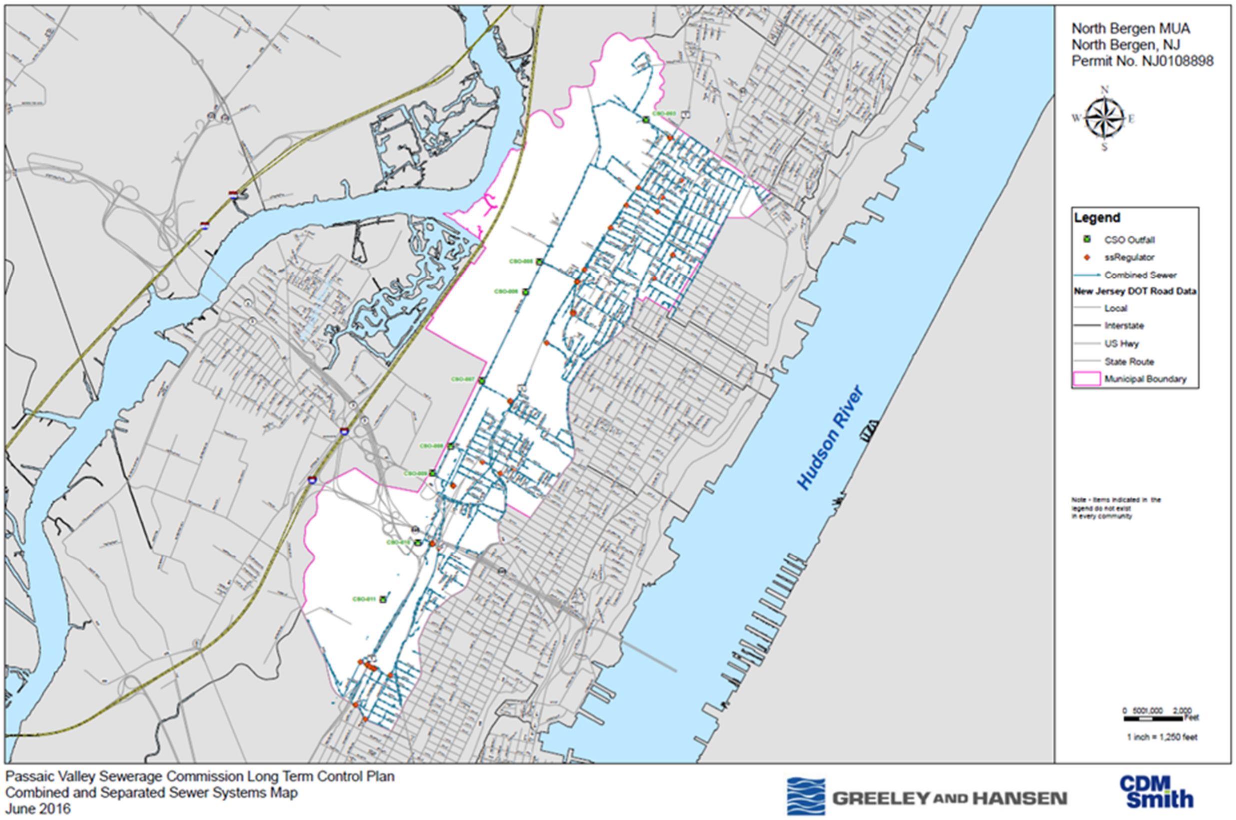

Figure A-1. North Bergen Central Drainage Area.

SECTION B - SCREENING OF CSO CONTROL TECHNOLOGIES (INTRO TO REF DEAR)

A wide variety of CSO control alternatives were reviewed as part of the technology screening process to identify the options that have the greatest potential in the Township of North Bergen to achieve the CSO control goals. Options identified during this screening process were subsequently evaluated for effectiveness and costs, as described in Section D of the "Development and Evaluation Of Alternative Report – Township of North Bergen" (DEAR).

As part of the screening process, each CSO control technology was evaluated for its effectiveness to achieve two goals: bacteria reduction and volume reduction. The other considerations included the ambient receiving water quality goals, the characteristics of the existing sewer system, the characteristics of the wet weather flow (peak flow rate, volume, frequency, and duration), hydraulic and pollutant loading, implementation requirements (land, neighborhood, noise, disruption), and the operational factors.

CSO control technologies can be grouped generally as Source Control, Collection System Control and Storage or Treatment technologies. Technologies under each group were also reviewed with respect to their potential program-role categories as shown below. These categories provide an indication of how a given technology could fit into the overall LTCP program:

- Primary Technology – High potential of meeting water-quality and CSO control goals;
- Complementary Technology – Some potential to bring positive impacts, but may be limited in effectiveness;
- Program Enhancement Technology – Generally good practices, but likely to have limited impact on water-quality and CSO control goals;
- In place/In-progress Technology – Already implemented or included in near-term plans; and
- Not Recommended Technology – Removed from consideration for various reasons (cost, maintenance, public acceptance, constructability, etc.).

The assessment presented in the DEAR involved high-level screening and was limited to the consideration of the general capabilities of CSO control technologies. Sections of the DEAR report present the technologies that were deemed viable in terms of effectiveness, cost, feasibility, and public acceptance. Section C.9 of the DEAR report presents details of the screening process and lists technologies retained for further evaluation in the alternative analysis.

SECTION C - EVALUATION OF ALTERNATIVES

C.1 INTRODUCTION

Siting of CSO control alternatives is commonly a subject of most public debate on CSO control projects. Therefore, one of the key considerations in assessing the overall feasibility of a CSO control alternative is the identification of an appropriate site for new facilities. The Township of

North Bergen is fully developed with not much available open space. Land availability can be an issue as most of the controls are preferred to be located near the waterfront, which is expensive and mostly developed in much of the city. It is recognized that issues involving facility location, land takings, and easements in both public and private lands can lead to disagreements among various stakeholders. Therefore, this alternative evaluations focus on the use of the city-owned available sites which have minimal impact on sensitive stakeholders and are less likely controversial. The environmental, political, socioeconomic, and regulatory impacts of locating a facility at a designated site will need to be evaluated in detail during the facilities planning and design phase.

An estimate was made of the CSO from each outfall in the DEAR report. The annual CSO overflows for the 2004 typical year for the nine outfalls are summarized in Table C-1. The rainfall for 2004 incorporates climate change. A total of 173.8 MG of CSO would be discharged in 52 events for the typical year. This represents 76.6% CSO capture in North Bergen central drainage area. Alternatives were first considered that could reduce overflows to 0, 4, 8, 12 and 20 overflows per year presuming that these frequencies would capture 85% of the CSO. After the system was modeled it was realized that a lower level of control (greater than 20 CSO overflows per year) would be needed to comply with EPAs CSO Policy, therefore, additional models runs were performed in preparation of this report with the objective of capturing 85% of the CSO.

Facility siting in this evaluation is preliminary in nature and it is based on the space requirements and available property. A buffer for roadways and access, potential conflicts with existing utilities at the site, highways, and local streets are also part of the preliminary facility siting considerations. The CSO control alternatives considered for North Bergen are discussed in detail in the "Development and Evaluation Of Alternative Report – Township of North Bergen" (DEAR).

Table C-1. Baseline CSO Volumes and Frequencies During the 2004 Typical Year

Regulator	CSO Frequency	CSO Volume (MG)	Percent CSO Capture
NB003	45	153.7	
NB005	48	26.0	
NB006	1	0.02	
NB007	29	14.2	
NB008	30	24.3	
NB009	35	27.7	
NB010	19	1.2	
NB011	33	19.4	
NB014	28	7.2	
Total	52	273.8	76.6%

C.2 DEVELOPMENT AND EVALUATION OF ALTERNTAIVES

Section C of the DEAR report described the CSO control technology screening performed to identify the preliminary CSO control measures. The following section presents an overview of various control alternatives developed for the Township of North Bergen. The preliminary alternatives that were presented in the DEAR report are:

- Inflow/infiltration reduction
- Regulator modifications
- Green infrastructure (GI)
- Storage tank
- Storage tunnel
- Treatment with PAA Disinfection

As the selection process proceeded it became apparent that Treatment with PAA Disinfection was not a viable alternative for satellite facilities that are not staffed or operated. This would be a candidate technology for central facilities that are staffed during wet weather, such as a wastewater treatment plant, however, as it currently exists it was removed from consideration because it is not demonstrated at satellite facilities.

CSO storage tunnels were also eliminated from consideration because only one new storage tank will be required for reaching 85% CSO capture. The second CSO storage tank will be retrofitted from a sludge storage tank at the retired Central Treatment Plant.

They are summarized as follows:

1) Inflow/Infiltration (I&I) Reduction

   The reduction of Inflow and Infiltration (I&I) was evaluated as one of the source control solutions. Two scenarios were evaluated - 10% and 50% of I&I reduction. Model results presented in the DAER report show that a 10% reduction will reduce CSO by 1% and a 50% reduction will reduce CSOs by 3%.These are only marginal reductions of CSO volume and demonstrate that a more robust alternative is needed. This control strategy will not be considered further.

2) Regulator Modifications

   Regulators limit the amount of flows to the Hudson County force main and divert excess flow to the outfalls during wet weather events. Modification of regulators such as increasing the weir length or height will hold flows back in the system. By raising the existing overflow weirs elevation 6 inches, the annual overflow volume was decreased from 273.8 MG to 273.3 MG per year city wide, about a 0.2% reduction. But overflow frequencies did not drop at all. This type of modification will not be considered because of the low level of control it offers. Another type of control is to consolidate regulators. This will be considered for consolidating NB014 with NB009. As shown in Table C-2, this alternative will reduce overflows by 5.4 MG in the typical year. This alternative is relatively easy to make.

Table C-2. CSO Reduction of Regulator Modification Consolidating NB014 with NB009

	Baseline		Consolidate Outfalls	
Regulator	CSO Volume (MG)	CSO Frequency	CSO Volume (MG)	CSO Frequency
NB009	27.7	35	29.5	35
NB014	7.2	28		

3) Green Infrastructure (GI)

GI can be used as a complementary CSO control technology in combination with other alternatives. This is summarized in the DEAR report. It was evaluated alone to find out if GI has a significant impact on CSO volume and frequency reduction. Two different target level of GI control were evaluated. Two levels of control to manage 1” of storm water runoff generated from 5% and 10% of impervious surfaces. Table D-3 shows the CSO volumes and frequencies before and after the implementation of GI comparing with the baseline. If 5% of impervious area (about 50 acres) was controlled by GI, we would expect a 3% CSO volume reduction, and a 6% CSO volume reduction with 10% of impervious area controlled with GI. Because of the relatively small impact achievable with GI, HDR decided to evaluate all alternatives conservatively, without GI, with the assumption that any additional impact of GI, however minor, would be considered in the development of the final selected alternatives. For this reason GI was not selected as a major component of the LTCP but would be considered for small areas of future development and areas already owned by North Bergen.

Table C-3. CSO Reduction by Green Infrastructure

	Baseline		5% Impervious Area			10% Impervious Area		
Regulator	CSO Volume (MG)	CSO Frequency	CSO Volume (MG)	CSO Frequency	Reduction	CSO Volume (MG)	CSO Frequency	Reduction
All	273.8	52	265.8	49	3%	257.7	49	6%

4) Storage Tanks

The conceptual evaluation of the storage tank for CSO reduction was performed and reported in the DEAR report. It is assumed that storage tanks are located near the existing outfalls and are below the ground. CSO is stored in tanks during wet weather events. The stored CSO is pumped back to the interceptor for conveyance to the PVSC treatment plant during dry weather and when the system capacity is available. Five scenarios were analyzed to size the storage tank in order to achieve CSO frequency control target of 0, 4, 8, 12, and 20 overflows per year. Based on this analysis it was found that a total stored CSO volume of above 20 overflows per year, as shown in Table C-4, would be required to achieve 85% CSO capture. This alternative will be evaluated further for the LTCP.

Table C-4. CSO Storage Tank Projected Overflow Frequencies and Volumes for the 2004 Rain Year

	Projected Overflows Frequencies and Volumes (MG) for 2004 Rain Year (MG)					
Regulator	Baseline	0	4	8	12	20
NB003	153.7	0	13.8	14.9	36.1	64.6
NB005	26.0	0	2.1	3.2	7.2	11.7
NB006	0.02	0	0.0	0.0	0.0	0.0
NB007	14.2	0	1.5	2.0	5.1	7.5
NB008	24.3	0	3.2	5.4	9.0	14.6
NB009	27.7	0	2.9	4.8	9.0	14.0
NB010	1.2	0	0.2	0.2	0.4	0.9
NB011	19.4	0	1.2	3.4	5.8	8.8
NB014	7.2	0	0.7	0.9	1.9	2.4
Total	273.8	0	25.6	34.8	74.4	124.5
CSO Capture	76.6%	100%	97.8%	97.1%	93.7%	89.5%

5) Storage Tunnel

CSO storage tunnels are generally considered in urban or suburban areas where existing development present using storage tanks. Storage tunnel solutions considered in this evaluation include an analysis to optimize the size of one centralized storage tunnel necessary to achieve each CSO frequency target of 0, 4, 8, 12, and 20 per year. This analysis assumed that overflow from all outfalls will be directed to a centralized, deep storage tunnel. The length of tunnel is assumed to be 18,480 feet long, with varying diameter to achieve required storage volume. The deep tunnel will store CSO generated during wet weather events and pump back stored CSO to PVSC for treatment during dry weather and when the capacity of system is available. Similar to the storage tank option, the sizing criteria for the storage tunnel is to capture the 5th biggest rainfall event during the typical year of 2004 for achieving 4 CSO events per year. Tank dewatering pump back rate is no more than 75% of the total average dry weather flows and tank can be dewatered within 72 hours except for 0 CSO control target. Overflows from the tank are the same as those listed in the January 7, 2019 Tech Memo "top 20 storm table" for each target. Table C-5 shows the number of overflows per year with the volume of the total overflow, tunnel volume and CSO capture. To get 85% CSO capture the the overflow frequency would be slightly greater than 20 overflows per year and tunnel would have to be slightly smaller than 5.3 MG. This alternative is technically feasible but would be more costly than CSO storage tanks.

Table C-5. CSO Storage Tunnel Sizing Requirements and CSO Capture

	Projected CSO Storage Tank Sizing Requirements and CSO Capture					
Regulator	Baseline	0	4	8	12	20
NB003	153.7					
NB005	26.0					
NB006	0.02					
NB007	14.2					
NB008	24.3					
NB009	27.7					
NB010	1.2					
NB011	19.4					
NB014	7.2					
Total	273.8	0	29.3	40.8	80.9	130.0
Tunnel Size (MG)	-	36.3	14.2	12.3	8.4	5.3
CSO Capture	76.6%	100%	97.5%	96.6%	93.1%	89.9%

6) Treatment - PAA Disinfection

Disinfection of combined sewer overflows is another option in the Township of North Bergen. Disinfection by PAA serves as the basis in the evaluation. Pathogens represent the primary pollutant of concern for CSO discharges. Disinfection facilities are sized based on the maximum CSO discharge flow rate for each event to fully treat all but 4, 8, 12, and 20 CSO discharges per year. CSO will be fully treated for flows below the design flow and partially treated for flows above the design flow. Full treatment is achieved only during times that flow rates of CSO discharges are less than the design peak flow. When full treatment is achieved, disinfection is assumed to remove 99.9% of pathogens (a "3-log kill."). This preliminary disinfection alternative assumes that PAA disinfection will be implemented at locations between the existing regulators and the existing outfalls. Table C-6 summarizes the partially treated overflow volumes that exceed the design flow at each CSO control target. The actual design flow for disinfection of 85% of the CSO would be greater than 20 overflows per year. This alternative is technically feasible; however, these would be satellite treatment systems that would rely on automation to start up, operate and shut down the systems. This is not a common practice and should be avoided until it becomes a demonstrated technology. Also, Peracetic acid would be required to be stored at each satellite location. This would pose an unnecessary public risk to North Bergen because PAA is a corrosive oxidizer that can cause skin burns, eye damage and respiratory damage. For these reasons PAA disinfection will not be considered.

Table C-6. Overflow Overflows for PAA Disinfection of CSO Overflows

	Projected Overflows For PAA Disinfection of CSO Overflows					
Regulator	Baseline	0	4	8	12	20
NB003	153.7	0	6.2	15.4	31.7	53.8
NB005	26.0	0	0.6	2.9	6.1	9.9
NB006	0.02	0	0.0	0.0	0.0	0.0
NB007	14.2	0	0.5	1.9	3.6	5.0
NB008	24.3	0	1.1	3.6	5.6	8.3
NB009	27.7	0	0.6	2.6	3.8	8.5
NB010	1.2	0	0.1	0.2	0.2	1.1
NB011	19.4	0	1.6	3.9	4.0	9.7
NB014	7.2	0	0.4	1.3	1.9	2.6
Total	273.8	0	11.1	31.9	56.9	99
CSO Capture	76.6%	100%	99.1%	97.3%	95.2%	91.9%

Cost analysis was performed for the potential alternatives including sewer separation, green infrastructure, storage tank, storage tunnel, PAA disinfection with FlexFilter. Assumptions used to estimate capital and O&M costs are described as followings:

1. Sewer Separation Costs
    a. Capital cost for complete sewer separation in the Township of North Bergen is $ 471,552,374. This is based on a normalized cost of $235,233 per acre (2006, HMM). To convert to 2018 costs, a ratio of 10817:7630 was applied herein, based on the Engineering News Record (ENR) Construction Cost Index (CCI) values for 2018 and 2006 respectively and are in Table D-12.
    b. O&M costs are estimated based on 2% of the capital cost (2019c, G&H) and are in Table D-12.
2. Treatment Costs
    a. Capital and O&M costs for PAA disinfection are based on the latest available guidance for permittees (2018, G&H) and are in Table D-12.
3. Storage Tank Costs
    a. Capital costs for tank storage solutions are based on the latest available guidance for permittees (2018, G&H) and are in Table D-12.
    b. O&M costs for tanks are based on operational costs at $235,000 and maintenance costs at 3% of the construction cost, in accordance with the latest available guidance for permittees (2019c, G&H) and are in Table D-12.

4. Storage Tunnel Costs
    a. Capital costs for tunnel storage solutions are based on the latest available guidance for permittees (2018, G&H) and are in Table D-12.
    b. O&M costs for tunnels are based on operational costs at $470,000 and maintenance costs at 2% of construction cost, in accordance with the latest available guidance for permittees (2019c, G&H) and are in Table D-12.
    c. The ground type for tunnel cost calculations is assumed to be of the type "unknown".
    d. Construction cost of drop shafts is not included in the cost estimate for tunnel-storage solutions. The construction cost of the tunnel only without the drop shaft is more expensive than the capital cost of tanks therefore the cost of drop shafts were not calculated.
5. Green Infrastructure Costs
    a. Capital costs for various GI solutions are based on the latest available guidance for permittees (2018, G&H) and are in Table D-13.
    b. O&M costs for Bioretention GI solutions were provided as $8,000 per managed acre (2019c, G&H) and are in Table D-13.
    c. O&M costs for Porous Pavement GI solutions were assumed to be $1,250 per managed acre (2018, DEP) and are in Table D-13.
6. Additional Cost Factors
    a. Present-value (PV) of life-cycle costs based on a 20-year period and an interest rate of 2.75% in accordance with the latest available guidance for permittees (2019a, G&H).
    b. Based on experiences on other similar CSO LTCP projects, HDR applied a capital-cost factor of 2.5 to calculate the probable total project cost (PTPC) of implementing each technology. The PTPC accounts for installation, non-component (electrical, piping, etc.), and indirect costs (freight, permits, etc.) for all storage and disinfection. A breakdown of how this factor was calculated is shown below.
        - Installation was estimated at 20% of equipment costs based on historic data experienced by HDR and industry standards for typical plants of similar size and complexity.
        - Non-component costs including: electrical (10%), piping (10%), instrumentation and controls ($15,000), and civil site work (25%) were estimated based on factors or percentages of equipment costs. These factors account for standard installation commodities, accessories, steal supports and standard testing support.
        - Freight was estimated at a lump sum of $20,000.
        - Sales tax was estimates at 8%
        - Permits were estimated at $20,000

- Start up, performance testing, operator training and O&M manual were estimated at $50,000
- Contract overhead and profit includes 29% for the following:
    a. Part time – Project management support, project controls, procurement, quality and safety support.
    b. Full time – Site construction manager (CM), site administration, standard CM travel pack.
- Engineering, administration, and legal fees were estimated at 10%.
- A contingency of 10% is included for the remaining equipment items and non-component costs.

For the cost of GI, the latest guidance available to permittees (2018, G&H and 2019c, G&H) provides capital and O&M costs for a variety of GI technologies, O&M costs are available for porous-pavement technologies from the NJDEP (2018, NJDEP). As widespread implementation of GI could involve a variety of GI technologies depending on specific site conditions, a range of costs is provided in Tables C-7 which shows the cost summary for each GI technology for implementation at 5% and 10% of impervious surface.

The cost for CSO controls from the DEAR report are summarized in Table C-7 and a cost curve is shown in Figure C-1.

Table C-7. Planning Level Costs for CSO Control for Gray and Green Infrastructure Alternatives

CSO Event Target/yr	Gray Infrastructure Type	Raw Capital Cost ($M)	PTPC Capital Cost ($M)	20-Yr O&M Cost as PV ($M)	Raw 20-Yr Life Cycle Cost as PV($M)	PTPC 20-Yr Life Cycle Cost as PV($M)
85% Capture	Alt_1A_85% Capture_PAA_FlexFilter	$22.7	$56.8	$6.07	$28.8	$64.7
0	Alt_2A_0_Tank	$144.9	$362.3	$94.82	$239.7	$457.1
0	Alt_2B_0_Tunnel	$170.7	$426.8	$59.15	$229.9	$485.9
0	Alt_2C_0_PAA_FlexFilter	$50.6	$126.4	$11.51	$49.7	$137.9
0	Alt_2D_0_Sewer Separation	N/A	$471.6	$143.63	N/A	$615.2
4	Alt_3A_4_Tank	$76.6	$191.5	$63.61	$140.2	$255.4
4	Alt_3B_4_Tunnel	$123.6	$308.9	44.79	$168.3	$354.0
4	Alt_3C_4_PAA_FlexFilter	$41.6	$103.9	$9.59	$51.2	$113.9
8	Alt_4A_8_Tank	$69.4	$73.4	$60.32	$129.7	234.5
8	Alt_4B_8_Tunnel	$118.0	$295.0	$3.09	$161.1	$338.8
8	Alt_4C_8_PAA_FlexFilter	$33.8	$84.6	8.14	$42.0	$93.5
12	Alt_5A_12_Tank	$51.3	$128.3	$52.08	$103.4	$181.5
12	Alt_5B_12_Tunnel	$105.5	$263.8	$39.29	$144.8	$304.2
12	Alt_5C_12_PAA_FlexFilter	$30.5	$76.3	$7.52	$38.1	$84.9
20	Alt_6A_20_Tank	$36.8	$92.0	$45.43	$82.2	$139.2
20	Alt_6B_20_Tunnel	$92.4	$231.0	$ 35.30	$127.7	$268.1
20	Alt_6C_20_PAA_FlexFilter	$24.3	$60.7	$6.35	$30.6	$68.8

Controlled % of Impervious Area	Green Infrastructure Type	Minimum Capital Cost PTPC ($M)	Maximum Capital Cost PTPC ($M)	20 Year O&M Cost ($M)	Minimum PTCP 20 Year Life Cycle Cost	Maximum PTCP 20 Year Life Cycle Cost
5% (~ 50 acres)	Rain Garden	$11.9	$37.9	$6,1	$18.0	$43.9
	Right-Of-Way Bioswale	$18.6	$62.1	$6.1	$24.7	$68.2
	Green Roof	$59.6	$303.0	$6.1	$65.7	$309.1
	Porous Asphalt	$32.3	$67.7	$0.9	$33.2	$68.6
	Pervious Concrete	$37.9	$75.8	$0.9	$38.8	$76.7
	Permeable Interlocking Pavers	$16.1	$46.0	$0.9	$17.1	$46.9
10% (~100 acres)	Rain Garden	$23.8	$75.8	$12.1	$36.0	$87.9
	Right-Of-Way Bioswale	$37.3	$124.2	$12.1	$49.4	$136.3
	Green Roof	$119.2	$606.1	$12.2	$131.3	$618.2
	Porous Asphalt	$64.6	$135.4	$1.9	$66.5	$137.3
	Pervious Concrete	$75.8	$151.5	$1.9	$77.7	$153.4
	Permeable Interlocking Pavers	$32.3	$91.9	$1.9	$34.2	$93.8

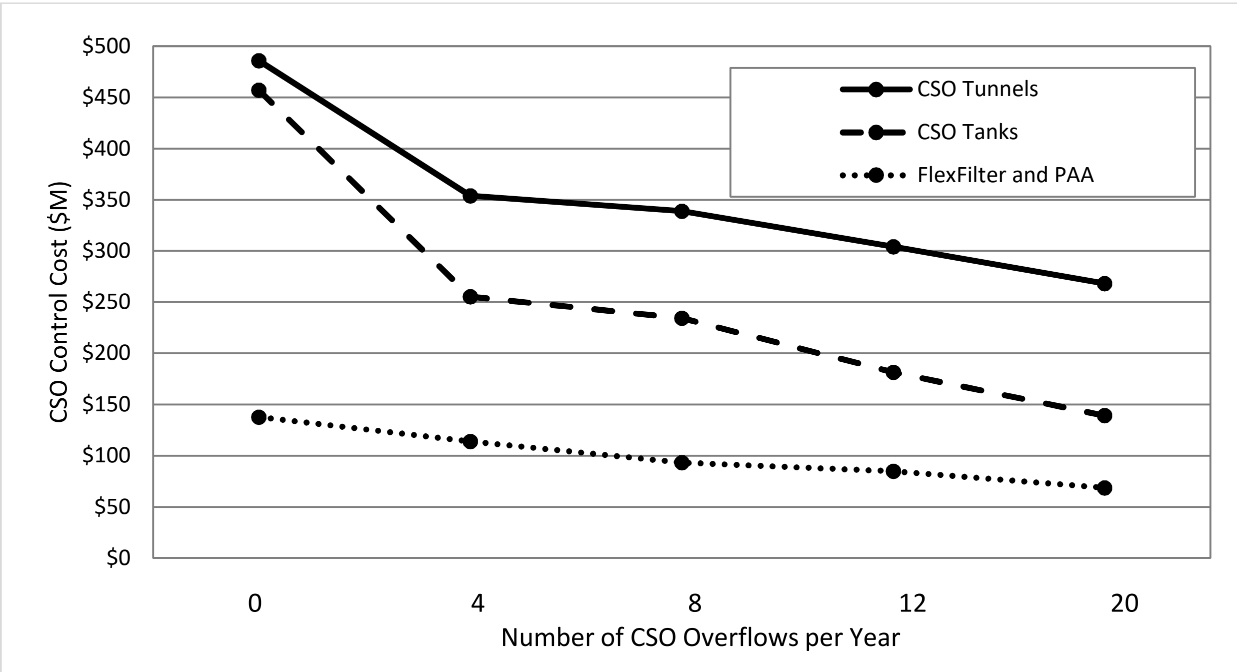

Figure C-1. Knee of the Curve for Gray Infrastructure CSO Control Alternatives

As the selection process proceeded it became apparent that Treatment with PAA Disinfection, although the least expensive control alternative, was not a viable alternative for satellite facilities that are not staffed or operated. This would be a candidate technology for central facilities that are staffed during wet weather, such as a wastewater treatment plant, however, as it currently exists it was removed from consideration because it is not demonstrated at satellite facilities.

CSO storage tunnels were also eliminated from consideration because only one new storage tank will be required for reaching 85% CSO capture. The second CSO storage tank will be retrofitted from a sludge storage tank at the retired Central Treatment Plant.

With these considerations the viable CSO control technologies for North Bergen are:

1. Regulator Improvements
2. CSO Storage Tanks
3. Green Infrastructure

SECTION D - SELECTION OF RECOMMENDED LTCP

D.1 INTRODUCTION

D.2 LTCP SELECTION PROCESS

This evaluation considered several factors to gauge the technical feasibility and applicability for CSO controls in the Township of North Bergen in conjunction with the hydraulically connected communities.. In general, the alternatives evaluation factors included, but not limited to, receiving water quality standards and uses and LTCP goals, sewer system characteristics and optimization opportunities, wet weather flow characteristics, hydraulic and pollutant loading, implementation requirements (land, neighborhood, noise, disruption), and maintenance requirements. Pathogen reduction in CSO discharges and the frequency and volume of untreated CSO discharges are accounted as the priorities for all alternatives along with their potential cost implications, and public acceptance and interests. The other significant factors considered in alternatives evaluation are:

- Performance capabilities and effectiveness under future (baseline) conditions.
- Applicability at a single CSO outfall or at grouped outfalls and capability to minimize number of new facilities required.
- Capability to beneficially integrate with hydraulically connected communities and the constraints involved.
- Community benefits (GI, as an example) and potential social and environmental impacts.
- Risk and potential safety hazards to operators and public.
- LTCP Regulatory (EPA and NJPDES) requirements

The alternatives evaluation included in the report was prepared in compliance with the LTCP regulatory (EPA and NJPDES) requirements and associated guidance documents. The analysis was conducted in cooperation with PVSC and the permittees within the PVSC Sewer District. The evaluation considered a wide range of BMPs and CSO control measures, including all specified in Part IV G.4.e of the NJPDES permit, to identify the preliminary alternatives that will provide the levels of CSO controls necessary to develop a LTCP as required by the State and Federal regulations. The selection of the preliminary alternatives is based on multiple considerations including public input, water quality benefits and designated use, costs and other aspects. The alternatives will result in full attainment of the existing pathogen water quality criteria providing the maximum bacterial reduction reasonably attainable. The remaining CSO discharges will not preclude the attainment of the water quality standards for bacteria or the designated uses of the receiving waters.

Further refinement and modifications of the alternatives is expected as the North Bergen further develops the LTCP through selection of the compliance approach in cooperation with the PVSC and hydraulically connected communities.

The evaluation and screening of a range of control alternatives described above resulted in a trend toward the use of storage tank, regulator modification and green infrastructure as the solutions based on the effectiveness of CSO frequency control. Although GI has limited impact on the CSO volume and frequency reductions, it can be used for its complimentary community benefit combined with CSO tank storage and regulator improvements to reach the CSO frequency control target..

D.3 SELECTION OF ALTERNATIVES

D.3.1 Description

The most important criteria for selection of an alternative was compliance with the townships NJPDES permit. This is a regulatory requirement and must be satisfied. The core of the permit and LTCP is to provide 85% CSO control. The second criteria was lifecycle cost, both capital and O&M costs. With these criteria in mind, CSO storage tanks and regulator modifications were found to be the alternatives that met both criteria. The third criteria was public acceptance. Many sources are promoting green infrastructure as a CSO solution, however, this technology cannot eliminate enough CSO to meet the 85% CSO control requirement. It can only control small amounts of CSO (0.1 to 1%) which is why it will be included in the LTCP as a minor technology.

D.3.2 Remaining Overflows

Additional control can be made if an 85% reduction is not achieved. The storage volume in the tank at NB008, which will be built in the later stages of the LTCP, can be increased or additional storage tanks at NB005 or NB009 could be constructed; however, this may include acquisition of private property.

D.3.3 Ability to Meet Water Quality Standards

The receiving water for North Bergen's CSO's is categorized as SE2 with a fecal coliform limit of 770 cfu/100mL. The current water quality meets this criteria (see Water Quality Modeling Calibration and Validation Report to be posted on the NJDEP webpage https://www.nj.gov/dep/dwq/cso-ltcpsubmittals.htm) with no additional CSO reduction.

D.3.4 Cost Opinion

The engineering cost estimate for the CSO Storage Tank at NB003 is presented in Table D-1. This estimate was developed by Boswell Engineers, the municipal engineer for North Bergen. The site shown in Figure D-1 is an existing parking lot and it is owned by North Bergen. The parking lot will service the new High Tech High School which is currently being designed and will be going into construction in approximately one year. Because of the construction schedule, this CSO control will be the first or second control constructed in the LTCP.

The cost estimate for all four phases of CSO control that will be described in the next section in the recommended CSO LTCP are presented in Table D-2.

Table D-1. Cost Estimate for The NB003 CSO Storage Tank

Furnish and Install CSO Storage Tank				
Task	**Unit**	**Unit Price**	**Quantity**	**Total**
Storage Tank				
6-MG Storage Tank	Lump Sum	$ 6,000,000	1	$ 6,000,000
Pumping Station				
Pumping station	Lump Sum	$ 500,000	1	$ 500,000
Screening system	Lump Sum	$ 600,000	1	$ 600,000
Diversion System	Lump Sum	$ 1,500,000	1	
Excavation				
Excavation	C.Y.	$ 40	48,000	$ 1,920,000
Tank Installation	Days	$ 8,500	30	$ 255,000
Soil Erosion and Sediment Control	Lump Sum	$ 20,000	1	$ 20,000
Waste Characterization	Sample	$ 1,500	25	$ 37,500
Stockpile soil	C.Y.	$ 20	48,000	$ 960,000
Soil Disposal				
Soil Load Out	Ton	$ 2.5	72,000	$ 180,000
Transportation and Disposal (Non-Hazardous)	C.Y.	$ 45	72,000	$ 3,240,000
Backfill, Site Restoration				
Subgrade	C.Y.	$ 40	1,300	$ 52,000
Clean Fill (backfill & compact)	C.Y.	$ 50	8,000	$ 400,000
Asphalt Pavement	S.Y.	$ 90	6,000	$ 540,000
Excavation Dewatering				
Wellpoint Installation/dewatering equipment/disposal	Lump Sum	$ 500,000	1	$ 500,000
Temporary Sheeting	S.F	$ 40	23,000	$ 920,000
			Subtotal	**$ 16,120,000**
			Allowance for Soil Disposal & Transportation of Hazardous Soil	**$ 1,550,000**
			Contingency (50%)	**$ 8,840,000**
			GRAND TOTAL	**$ 26,510,000**

Notes:

(1) Soil disposal and transportation cost will depend on testing of soil. Cost of disposing and transporting hazardous materials was assumed to be $250/Ton. Allowance was estimated using the difference between the hazardous and non-hazardous cost ($205/Ton). The amount of hazardous material in the excavated soil was assumed to be a percentage of the total excavated soil.

(2) It is important to point out that the proposed locations for the new holding tanks (Locations A, B, C, and D) are in an area known to have low soil bearing capacities.The cost estimates presented herein are based on the proposed structures being supported on conventional spread footings with a minimum allowable bearing capacity of 4,000 pounds per square foot (lb/ft2). If the allowable soil bearing pressure is below the current design assumptions, significant changes to the structure design and/or foundation system will be necessary. Potential changes may include the installation of piles, over excavation of poor soils with backfill of select fill, and reducing the height (and therefore the capacity per square foot) of the proposed structure. All of these potential changes will add significant costs to this project. As part of the final design, we (Boswell) recommend that a geotechnical investigation be performed to confirm the bearing capacity of the exiting soils. Note that if a geotechnical investigation is not performed with the design, and substandard foundation materials are found during construction, there will be significant cost increases above what would be expected during the normal bid process if the substandard soils are already accounted for. There could also be significant delays for the modified designs, if necessary, during construction.

Table D-2. Cost Estimate for The North Bergen LTCP

Outfall	CSO Control	Construction Cost ($M)	Annual O&M Cost ($M)	Lifecycle Cost ($M)
NB014	Consolidate Outfall with NB009	$0.1	$0	$0.1
NB003	Storage Tank	$26.5	$0.2	$28.8
Green Infrastructure		$0.39	$0.05	$0.435
NB008	Storage Tank	$8.5	$0.1	$9.4
Total		$35.49	$0.35	$38.745

D.3.5 Selection of Recommended Alternative

North Bergen has selected the Presumptive Approach with a goal of controlling 85% of the CSO. The CSO reduction will be made in drainage areas NB003, NB008 and NB014. The CSO volumes and frequencies before (Baseline) and after (Control) controls are shown in Table D-2. It should be noted that the CSO overflows at NB014 will be reduced by 7.2 MG, however, the overflows at NB009 (where B014 will be diverted to) will increase by 1.8 MG. There is also some allowance for GI on the LTCP; however, now credit has been taken for CSO reductions with this technology. GI alternatives such as permeable pavers or tree pits will be constructed on town owned property that is currently being maintained.

Table D-3. CSO Frequencies and Volumes Before and After Controls Are In Place for the Typical Rain Year of 2004

	Baseline		Control	
Regulator	CSO Frequency	CSO Volume (MG)	CSO Frequency	CSO Volume (MG)
NB003	**45**	**153.7**	**7**	**73.5**
NB005	48	26.0	48	26.0
NB006	1	0.02	1	0.02
NB007	29	14.2	30	15.9
NB008	**30**	**24.3**	**12**	**10.0**
NB009	35	27.7	35	29.5
NB010	19	1.2	19	1.3
NB011	33	19.4	33	19.4
NB014	**28**	**7.2**	**0**	**0.0**
Total	52	273.8	48	175.6
CSO Control	76.6%		85.%	

SECTION E - FINANCIAL CAPABILITY

E.1 Introduction

This section of North Bergen's Selection and Implementation of Alternatives Report (SIAR) quantifies the projected affordability impacts of North Bergen's proposed long term CSO controls for the North Bergen combined sewer system (CSS) and updates the 2019 preliminary FCA memo that was intended to guide the development and selection of long term controls. This section is excerpted from a memorandum prepared by the Passaic Valley Sewerage Commission (PVSC) which is incorporated as Appendix P of PVSC's SELECTION AND IMPLEMENTATION OF ALTERNATIVES FOR LONG TERM CONTROL PLANNING FOR COMBINED SEWER SYSTEMS - REGIONAL REPORT (Regional Report).

The Financial Capability assessment is a two-step process including ***Affordability*** which evaluates the impact of the CSO control program on the residential ratepayers and ***Financial Capability*** which examines a permittee's ability to finance the program. Affordability is measured in terms of the Residential Indicator (RI) which is the percentage of median household income spent on wastewater services. Total wastewater services exceeding 2.0% of the median household income are considered to impose a high burden by USEPA. The financial capability analysis uses metrics similar to the municipal bond rating agencies.

USEPA encourages the use of additional information and metrics to more accurately capture the impacts of the proposed CSO controls on the permittee and its residents. Therefore, this FCA includes information on the impacts of future costs among lower income residents and within the context of local costs of living.

Detailed discussion of the FCA for the PVSC service area and Permittees can be found in the Regional Report and a detailed analysis of North Bergen's FCA can be found in the FCA Memorandum specifically written for North Bergen attached as part of Appendix P of the Regional Report.

E.2 BASELINE CONDITIONS (WITHOUT CSO CONTROLS)

The estimated annual cost for wastewater services for a typical single-family residential user for 2019 is $557. This estimate is based on typical residential potable water usage is 4,500 gallons monthly. Based on the estimated MHI of $59,600 the Residential Indicator was approximately 0.9% in 2019, or at the border between what the EPA guidance defines as a low burden and a medium burden. By definition the current residential indicator for one half of the households is greater than the 0.9%.

In North Bergen, 15.8% of the population was living below the poverty line. This exceeds the national average poverty rate of 14.6%. The total Census households are broken out by income brackets on Table E-1 below, along with the respective current Residential Indicators by income bracket. The RI for each bracket was calculated from the mid-point income within the bracket. At the lowest income levels, the current RI is already between 2.6% and 10.6%.

Table E-1. Analysis of the Current Residential Indicator

Income Bracket	Households		Bracket Average Income	Bracket RI at Typical Cost per Household
	Number	Cumulative		
Less than $10,000	1,887	1,887	$5,000	10.57%
$10,000 to $14,999	1,050	2,937	$12,500	4.23%
$15,000 to $24,999	2,117	5,054	$20,000	2.64%
$25,000 to $34,999	2,004	7,058	$30,000	1.76%
$35,000 to $49,999	2,623	9,681	$42,500	1.24%
$50,000 to $74,999	4,171	13,852	$62,500	0.85%
$75,000 to $99,999	2,859	16,711	$87,500	0.60%
$100,000 to $149,999	3,290	20,001	$125,000	0.42%
$150,000 to $199,999	1,007	21,008	$175,000	0.30%
$200,000 or more	924	21,932	$200,000	0.26%
Total	21,932			

PVSC has developed a time-based model that calculates annual costs and revenue requirements based on assumed program costs, schedules and economic variables such as interest and inflation rates. The residential indicator is calculated for each year based upon the costs per typical residential users which changes annually based on the annual system revenue requirements.

The estimated inflationary impacts on wastewater costs per typical single family residential user without additional CSO control costs are shown on Table E-2. The costs are projected to the year 2041 based on the LTCP implementation schedule for North Bergen's Municipal Control Alternative in Section F of this SIAR report which targets the completion of capital improvements through 2040.

The year 2041 also corresponds to the completion of the potential regional control alternative in 2040. The regional alternative would result in lowered overall costs for the control of CSOs within the PVSC service area. Under this approach both the costs of the regional facilities such as a relief interceptor and the resultant savings would be allocated amongst the PVSC municipalities with combined sewer systems. As the basis of this allocation remains under discussion as of the writing of this SIAR, the FCA focuses on implementation of the Municipal Control Alternative. Should the permittees come to agreement on the cost allocation for the Regional Control Plan, the FCA will be revisited to reassess the affordability and schedule for implementation of the LTCP.

Assuming inflation, the projected cost per typical single family residential user are projected to increase from $557 in 2019 to $1,200 in 2041.

Table E-2 – North Bergen Projected Residential Indicator in 2041 Without CSO Controls

Metric	Baseline (2019)	Cost per Typical Residential Wastewater User in 2041
RI	0.9%	1.3%
Annual $	$557	$1,200

E.3 SUMMARY & CONCLUSION

E.3.1 Affordability Impacts of the Proposed CSO Controls

North Bergen has identified a long term CSO control strategy that will achieve 85% capture of wet weather flows during the typical year utilizing controls within and implemented by North Bergen. PVSC and the PVSC combined sewered municipalities have also developed a potential regional control strategy that would result in lower overall capital costs. These controls are summarized on Table E-3.

Table E-3 – North Bergen's Selected CSO Controls

Wet Weather Control Types	Municipal Control Alternative	
	Capital Costs ($ millions)	Incremental Annual O&M Costs ($ millions)
Storage Tank at NB003 (5.0 MG)	$26.5	$0.14
Storage Tank at NB008 (0.8 MG)	$8.0	$0.06
Closure of outfall NB014	$0.1	$0.0
Green infrastructure (1.0 ac)	$0.4	$0.0
Totals	$35.0	$2.0

Implementation of the $35 million North Bergen Municipal Control Alternative results in projected annual costs per typical single family user of $666 (without inflation) and a residential indicator of 1.2% in 2041, the first year after the projected full implementation of the controls ending in 2040. Accounting for inflation, annual costs would grow to $1,260 with a residential indicator of 1.4% in 2041 as shown in Table E-4.

Table E-4 – North Bergen's Projected Residential Indicator Upon Full Implementation of the Municipal Control Alternative

Metric	Baseline (2019)	Cost per Typical Residential Wastewater User in 2041			
		No LTCP		LTCP Implementation Completed in 2040	
		With Inflation	Without Inflation	With Inflation	Without Inflation
RI	0.9%	1.3%	1.1%	1.4%	1.2%
Annual $	$557	$1,200	$618	$1,260	$666

This analysis does not reflect the current and lingering financial impacts as a result of the COVID -19 pandemic and should be revisited upon memorializing the LTCP implementation schedule in North Bergen's next NJPDES Permit.

E.3.2 Financial Capability Assessment

The second part of the financial capability assessment - calculation of the financial capability indicator for the permittee - includes six items that fall into three general categories of debt, socioeconomic, and financial management indicators. The six items are:

- Bond rating
- Total net debt as a percentage of full market real estate value
- Unemployment rate
- Median household income
- Property tax revenues as a percentage of full market property value
- Property tax revenue collection rate

Each item is given a score of three, two, or one, corresponding to ratings of strong, mid-range, or weak, according to EPA-suggested standards. The overall financial capability indicator is then derived by taking a simple average of the ratings. This value is then entered into the financial capability matrix to be compared with the residential indicator for an overall capability assessment.

As shown on Table E-5, the overall score for the financial indicators is 2.0 yielding an EPA Qualitative Score of "midrange". As each of the financial indicators are generally based upon publicly available data from 2017 or earlier, this analysis does not reflect the current and lingering impacts of the COVID -19 pandemic and should be revisited upon memorializing the LTCP implementation schedule in the next NJPDES Permit.

Table E-5 – Permittee Financial Capability Indicator Benchmarks

Indicator	Rating	Numeric Score
Bond Rating	Strong	3
Overall Net Debt as a Percent of Full Market Property Value	Strong	3
Unemployment Rate	Weak	1
Median Household Income	Midrange	2
Property Tax as a Percent of Full Market Property Value	Midrange	2
Property Tax Collection Rate	Strong	3
Total		14
Overall Indicator Score: (numeric score / number of applicable indicators)		2.3
EPA Qualitative Score		Midrange

E.3.3 Implementation Feasibility Implications

The 1997 EPA guidance indicates that ratepayers and permittees who are highly burdened future expenditures added to their current wastewater treatment, conveyance, and collection costs can be allowed 15 years to complete capital projects to handle CSOs. In extreme cases, the guidance suggested a 20-year compliance schedule might be negotiated.[1]

The affordability analysis detailed above has documented that the $35 million (current dollars) in capital expenditures under North Bergen's Municipal Control Alternative along with related operation and maintenance costs would result in a Residential Indicator of 1.4% which is within the EPA "medium burden" range.

Additional economic factors are presented in the North Bergen FCA Memorandum presented in Appendix P of the SELECTION AND IMPLEMENTATION OF ALTERNATIVES FOR LONG TERM CONTROL PLANNING FOR COMBINED SEWER SYSTEMS - REGIONAL REPORT enforcing the limits to the affordability of CSO controls and North Bergen's financial capability.

While the affordability analysis detailed above has documented that the selected $35 million (current dollars) Municipal Control Alternative along with related operation and maintenance costs would result in a Residential Indicator of "medium impact" under EPA's criteria; the reality of the high poverty rates, low effective household incomes compared to the rest of New Jersey and nationally and the high costs of living in North Bergen argue strongly that the EPA metric understates the impacts of the CSO control costs on the residents of North Bergen. North Bergen is and is likely to remain financially distressed due to structural economic factors beyond its direct control and its ability to afford and finance future CSO control facilities is restricted. As evidenced by its New Jersey Municipal Revitalization Index score in the top 98th percentile, North Bergen's capacity for additional CSO controls, beyond those proposed in the SIAR, is limited.

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[1] Combined Sewer Overflows – Guidance for Financial Capability Assessment and Schedule Development, EPA 832-B-97-004, Page 46.

E.3.4 Potential Impacts of the COVID-19 Pandemic in Affordability

The projections and conclusions concerning the affordability of the Municipal Control Alternative proposed in this SIAR by North Bergen and North Bergen's financial capability to finance the CSO control program are premised on the baseline financial conditions of North Bergen as well as the economic conditions in New Jersey and the United States generally at the time that work on this SIAR commenced. While the impacts of the pandemic on the long-term affordability of the CSO LTCP are obviously still unknown, it is reasonable to expect that there will be potentially significant impacts. There are several dimensions to these potential impacts, including reduced utility revenues and household incomes.

Given the current and likely continuing uncertainties as to the New Jersey and national economic conditions, North Bergen will be reticent to commit to long term capital expenditures for CSO controls without the incorporation of adaptive management provisions, including provisions to revise and reschedule the long term CSO controls proposed in this SIAR based on emergent economic conditions beyond the permittees' control. As detailed in Section F of North Bergen's SIAR, these provisions could include scheduling the implementation of specific CSO control measures to occur during the five year NJPDES permit cycles. A revised affordability assessment should be performed during review of the next NJPDES permit to identify controls that are financially feasible during that next permit period.

SECTION F - RECOMMENDED LONG-TERM CONTROL PLAN

F.1 INTRODUCTION

North Bergen's LTCP consists of three technologies, CSO storage tanks, outfall relocation and GI. The following describes each step.

F.2 RECOMMENDED LTCP

There are four elements to the North Bergen LTCP, outfall consolidation, two CSO storage tanks and GI. The CSO reduction of the LTCP will be done as follows:

1 NB003 is the largest CSO with a discharge of 153.7 MG per year in the typical year. This is the CSO targeted for providing most of the CSO reduction to comply with the goal of 85% capture. During the selection of alternatives the Board of Education site at was identified as a potential site for a CSO storage tank. The site, shown in Figure D-1, is a four tier parking lot located at the corner of Tonnelle Avenue and 83rd Street in the NB003 drainage area. Inquiries with the Board of Education and their engineer have indicated that the Board would seriously consider using the parking lot for CSO control. A formal agreement is required to use the site; however, the new High Tech High School offers an opportunity to construct a CSO storage tank in the parking lot while the new school is constructed. This alternative would receive 5 MG of CSO by gravity from Tonnelle Avenue and store until it can be released, likely by gravity, to the trunk sewer on West Side Avenue for conveyance to PVSC. The property is owned by the Township of North Bergen and the site is an existing parking lot. This will likely be the first CSO control constructed in North Bergen. The new high school is planned to be constructed in the next three years. The CSO storage tank would follow the same construction schedule.

2 CSO NB014 produces 7.2 MG of CSO in the typical year. This CSO will be consolidated with NB009. This will allow North Bergen to shut down NB014 and CSO will be reduced by approximately 5.4 MGD. Consolidation of NB014 with NB009 will likely be the second CSO control implemented.

3 Two Green Infrastructure projects will be constructed as the third CSO control. These will likely be Pervious Paving and Bioretention alternatives. They will likely be constructed on township property as the third CSO control alternative. Initially this alternative will be limited to 1 acre because of cost. While visible to the public, green infrastructure does not provide significant control of CSO. For this reason North Bergen's financial resources will be used to construct the CSO tank at the new High Tech High School site.

4 The final control is one that will be constructed based on flow monitoring and PVSC CSO community's decision with regard to the Regional Plan. The site of the former Central Wastewater Treatment Plant has been reserved for CSO control. This is in the NB008 drainage area. The treatment plant site has an existing 0.8 MG sludge storage tank that could, pending a condition assessment, be stabilized and retrofitted as a CSO storage tank.

The initial estimate is a CSO reduction from 24.3 MG without control to 10 MG with control of a 0.8 MG storage tank. CSO flows will be monitored and if this control is needed it will be constructed. This control will be the fourth and final CSO control of the LTCP.

The effect of the LTCP on CSO capture is shown on Figure D-3. And Figure D-4 presents the construction schedule. The NB003 CSO storage tank will increase CSO capture by almost 7% to 83.5% capture. After this control in constructed flow metering will be done ti measure its effect. This will be done in the within 3 to 5 years of the CSO permit. After this is done NB014 will be redirected to outfall NB009 which will reduce CSOs by 13 MG or approximately 1.1% for a total reduction of 84.5%. This will be done within and 6 to 7 years of the CSO permit. In years 7 through 10 the GI controls will be constructed. Finally, after the CSO reductions of the constructed and their impact has been assessed, a storage tank at NB008 will be constructed if necessary. This would increase capture by 1% to a total capture of 85.58%.

Figure F-1. NB003 CSO Storage Tank Site

Figure F-2. Existing 0.8 MG CSO Storage Tank Site

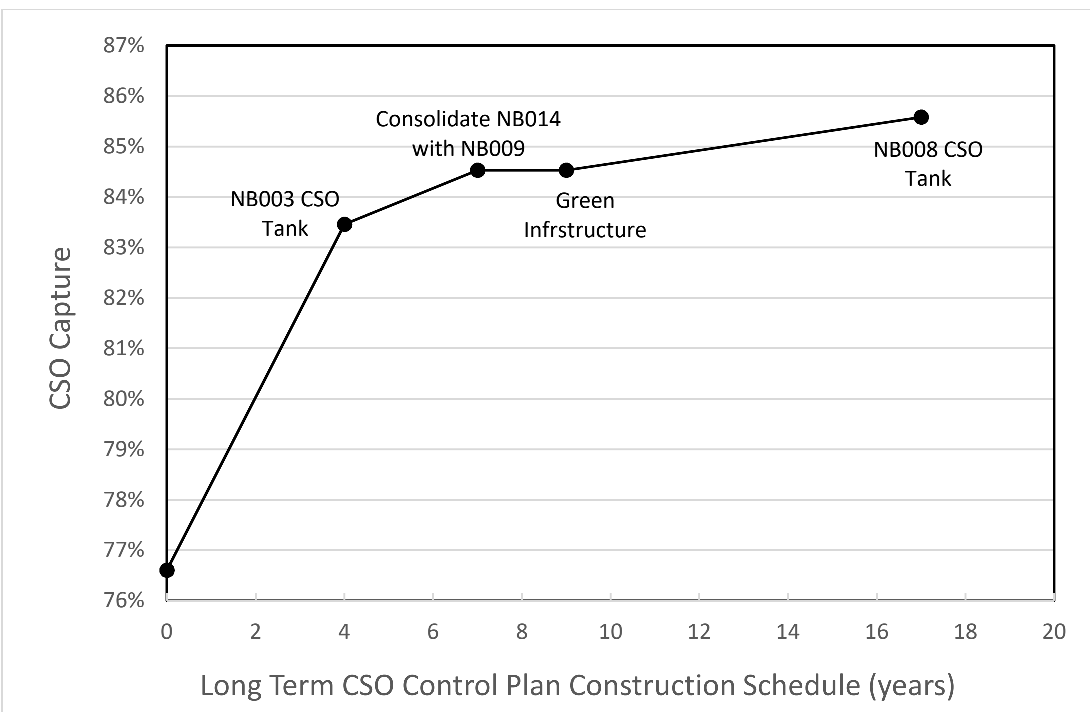

Figure F-3. North Bergen LTCP Percent CSO Capture and Schedule

F.3 IMPLEMENTATION COST OPINION

Table F-1 presents the costs of the LTCP and Figure F-4 presents a proposed schedule. Approximately $40M dollars will be spent if all phases of the LTCP are constructed.

Table F-1. Cost Estimate for the North Bergen LTCP

Outfall	CSO Control	Construction Cost ($M)	Annual O&M Cost ($M)	Lifecycle Cost ($M)
NB014	Consolidate Outfall with NB009	$0.1	$0	$0.1
NB003	Storage Tank	$26.5	$0.2	$28.8
Green Infrastructure		$0.39	$0.05	$0.435
NB008	Storage Tank	$8.5	$0.1	$9.4
Total		$35.49	$0.35	$38.745

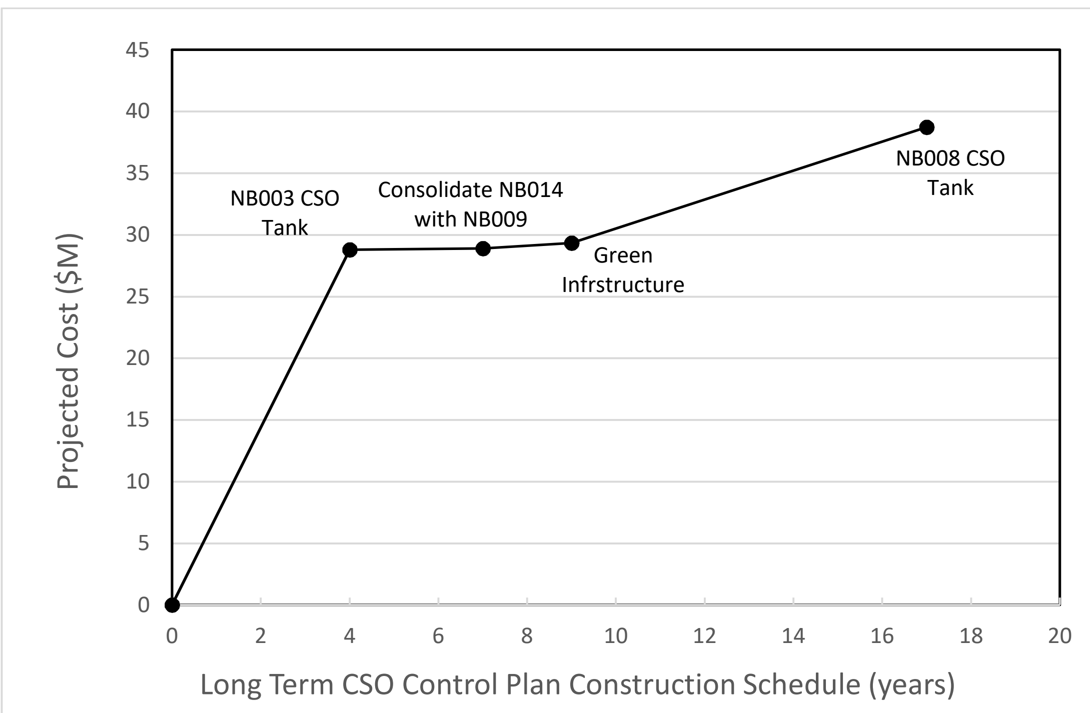

Figure F-4. LTCP Costs