Rebuild by Design
Living with the Bay Project

Benefit Cost Analysis
APA Full Narrative

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Prepared for the New York State Governor's Office of Storm Recovery

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I. Executive Summary

This benefit cost analysis (BCA) was prepared for the Rebuild by Design (RBD) Living with the Bay (LWTB) Project Area on behalf of the New York State Governor's Office of Storm Recovery. The Project Area is located in Nassau County, New York, and would benefit communities generally located within the Mill River Watershed. The BCA was prepared following US Department of Housing and Urban Development (HUD) Benefit Cost Analysis (BCA) Guidance for Action Plan Amendments (APA) for RBD Projects (HUD CPD-16-06). The analysis used generally accepted economic and financial principles for BCA as articulated in Office of Management and Budget (OMB) Circular A-94.

<u>LWTB Project Objectives:</u> The objectives of the LWTB Project are to increase community resilience by mitigating local risk from tidal and stormwater flooding, while incorporating co-benefits such as improved water quality, ecological restoration and recovery, and aquifer recharge. In addition, the Project helps to address regional needs for southern Nassau County as defined through the RBD process, including (i) Protection from tidal inundation, including future storm conditions with sea-level rise; (ii) Better management of river water and stormwater through storage and infiltration; (iii) Improved water quality and riparian restoration; (iv) Ecological restoration of coastal marshes and for flora and fauna; (v) Provision of enhanced public access and Greenway interconnection along the Mill River, and (vi) Provision of education and capacity building for environmental stewardship and climate change adaptation resilience.

The objectives can be summarized in the following goal categories:

- Manage Flooding: Reduce inundations from storm surge, stormwater, and tidal flooding;
- Strengthen the Ecosystem: Improve the quality of the surface water, groundwater and the natural environment;
- Increase Access along the Mill River waterfront and improve quality of life: Develop a "Greenway" linking communities through a multi-use path along the Mill River, from Hempstead Lake State Park to Bay Park, thereby creating access to educational and recreational activities, opportunities and infrastructure, improve the quality of park assets and environmental and recreational amenities; and,
- Create Local Adaptation and Social Resiliency: Develop education initiatives, public awareness campaigns, and a "restoration economy" project.

<u>Project Interventions to Meet LWTB Objectives:</u> The Project includes several interventions which are divided into six projects. The specific projects, and their respective locations associated with the Stormwater Retrofit interventions have not been identified yet. The BCA evaluates the following project interventions within the LWTB Project that address the goals and objectives of the LWTB Project's resiliency strategy:

- Hempstead Lake State Park
- Smith Pond
- East Rockaway High School
- Coastal Restoration Project

- Greenway Project
- Stormwater Retrofits

BCA Economic Feasibility Results: The BCA demonstrates that the LWTB Project will generate substantial net benefits (i.e., the benefits exceed the costs of the Project over its useful life). The benefits to the host community and region would be substantial and justify the costs of implementation and operations. The assets (i.e., physical improvements to HLSP, ERHS, Smith Pond, Coastal Restoration, and Greenway) created or improved by the Project enhancements will create large resiliency values, social values, environmental values and economic revitalization benefits to communities within the Mill River Watershed well as other beneficiaries from Nassau County and the region, including those who use the improved Hempstead Lake State Park and the new Greenway. Costs and benefits were monetized for five of the six projects. The sixth project - Stormwater Retrofits - was evaluated separately on a prototypical basis because it is not location-specific at this time.

Table ES1 shows the monetized costs and benefits for each Project individually, and for the combined five monetized Projects. The largest group of benefits consists of resiliency values related to flood risk protection provided by the Projects' assets. In summary, the combined lifecycle costs to build and operate the proposed Projects' assets for the LWTB resiliency Project (amounting to **$117,063,711** in constant 2017 present value dollars) would generate the following total benefits:

- **$402,165,167,** of which:
  - Resiliency Values: $ 225,898,740
  - Environmental Values: $ 42,090,550
  - Social Values: $ 72,420,235
  - Economic Revitalization Benefits $ 61,755,642

Table ES1: Benefit Cost Analysis Summary - RBD Living with the Bay
[Constant 2017 US Dollars - Discount Rate, 7%, Cumulative Present Values, 2017-2067]

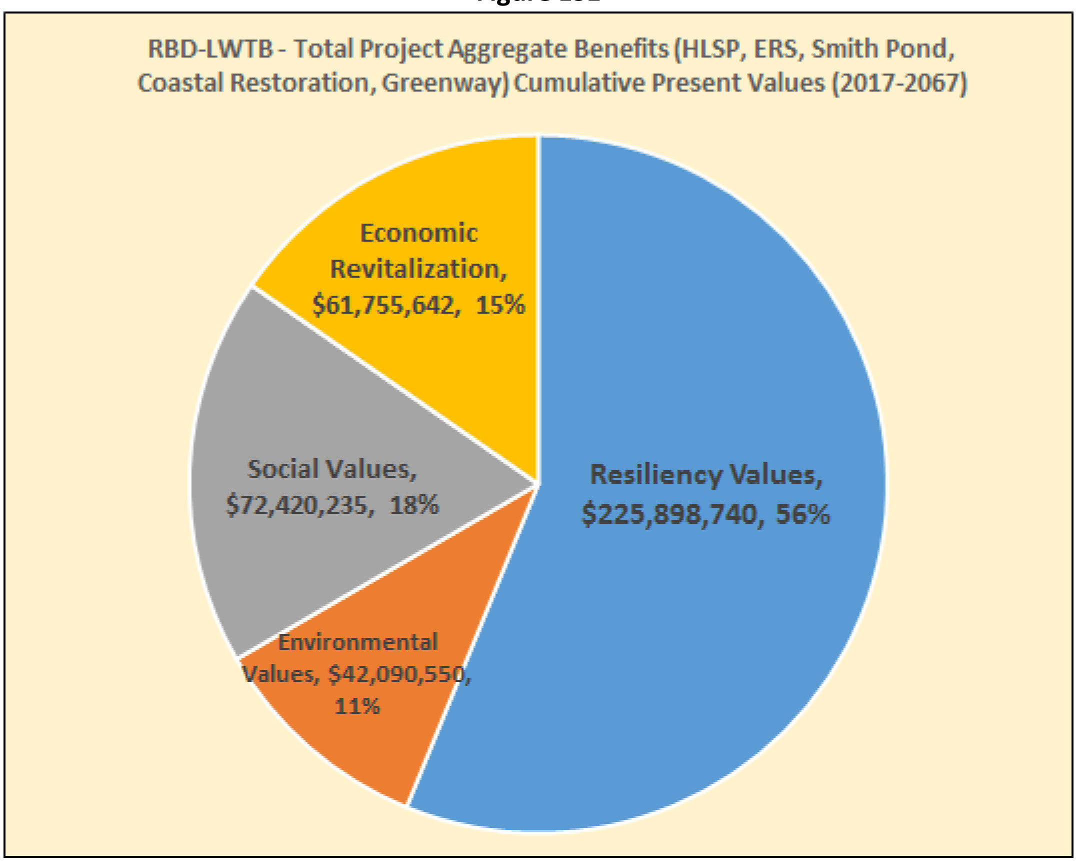
Cumulative Present Values (2017-2067)	Hempstead Lake State Park \b	East Rockaway High School	Smith Pond	Coastal Restoration Project	Greenway Project	Sub-Total	Stormwater Retrofits \c
LIFECYCLE COSTS							
Project Investment Costs \a	$32,261,025	$4,642,415	$22,571,456	$14,991,416	$25,156,457	$99,622,769	*
Operations & Maintenance	$3,636,195	$1,847,610	$2,529,652	$1,084,246	$8,343,239	$17,440,942	*
Total Costs	$35,897,221	$6,490,025	$25,101,108	$16,075,662	$33,499,696	$117,063,711	*
BENEFITS							
Resiliency Values	$19,905,296	$5,443,197	$121,220,778	$17,525,215	$61,804,253	$225,898,740	++
Environmental Values	$7,683,582	$428,446	$5,378,508	$3,463,444	$25,136,570	$42,090,550	++
Social Values	$14,820,335	$6,518,585	$7,841,915	$3,093,449	$40,145,951	$72,420,235	++
Economic Revitalization Benefits	$32,079,935	$1,914,791	$2,236,997	$10,949,773	$14,574,146	$61,755,642	++
Total Benefits	$74,489,149	$14,305,019	$136,678,199	$35,031,882	$141,660,919	$402,165,167	++
Benefits less Costs							
Net Present Value (Net Benefits @ 7%)	$38,591,928	$7,814,994	$111,577,091	$18,956,220	$108,161,223	$285,101,456	++
Benefit Cost Ratio (BCR)	**2.08**	**2.20**	**5.45**	**2.18**	**4.23**	**3.44**	++

Table ES1: Benefit Cost Analysis Summary - RBD Living with the Bay [Constant 2017 US Dollars - Discount Rate, 7%, Cumulative Present Values, 2017-2067]							
Cumulative Present Values (2017-2067)	**Hempstead Lake State Park \b**	**East Rockaway High School**	**Smith Pond**	**Coastal Restoration Project**	**Greenway Project**	**Sub-Total**	**Stormwater Retrofits \c**
RBD LWTB Rate of Return	30.0%	23.0%	39.4%	22.2%	45.3%	35.8%	

\Notes:
\a Costs represent the discounted present value of the nominal projected costs (over 2018-2019). Therefore they will appear smaller than the nominal costs due to the application of the 7% HUD recommended discount rate.
\b HLSP resiliency benefits associated with the dam improvements such as the retention of greater volumes of water, and improved management capabilities within the upstream catchment portion of the watershed are not reflected within the BCR but are acknowledged to be a significant benefit that would be assigned a ++ (i.e., expected strong positive impact) per HUD qualitative rating instructions. The resiliency calculation valuations performed for HLSP were based on available data for pond dredging and water volume storage improvements from depth increases. Therefore, the resiliency benefits quantified and monetized for HSLP represent a lower bound estimate. Water quality values for HLSP were included from wetlands creation within the Environmental Value section of the BCA.
\c ++ Based upon the Qualitative Risk Ranking System outlined in CPD-16-06, this project is ranked as "Expected strong positive impact" (*= Location specific project lifecycle costs have not yet been estimated, ++ = Expected strong positive impacts)

Figure ES1 shows the breakdown in total benefits for the combined five Project elements that were monetized.

Figure ES1



Measures of Project Merit: Living with the Bay Projects (HLSP, ERHS, Smith Pond, Coastal Restoration Project, and Greenway Project)

- The Living with the Bay Projects (HLSP, ERHS, Smith Pond, Coastal Restoration, & Greenway Project) are economically feasible and have a combined positive benefit cost ratio of 3.4. Benefits are valued at three times the cumulative present value of lifecycle costs.

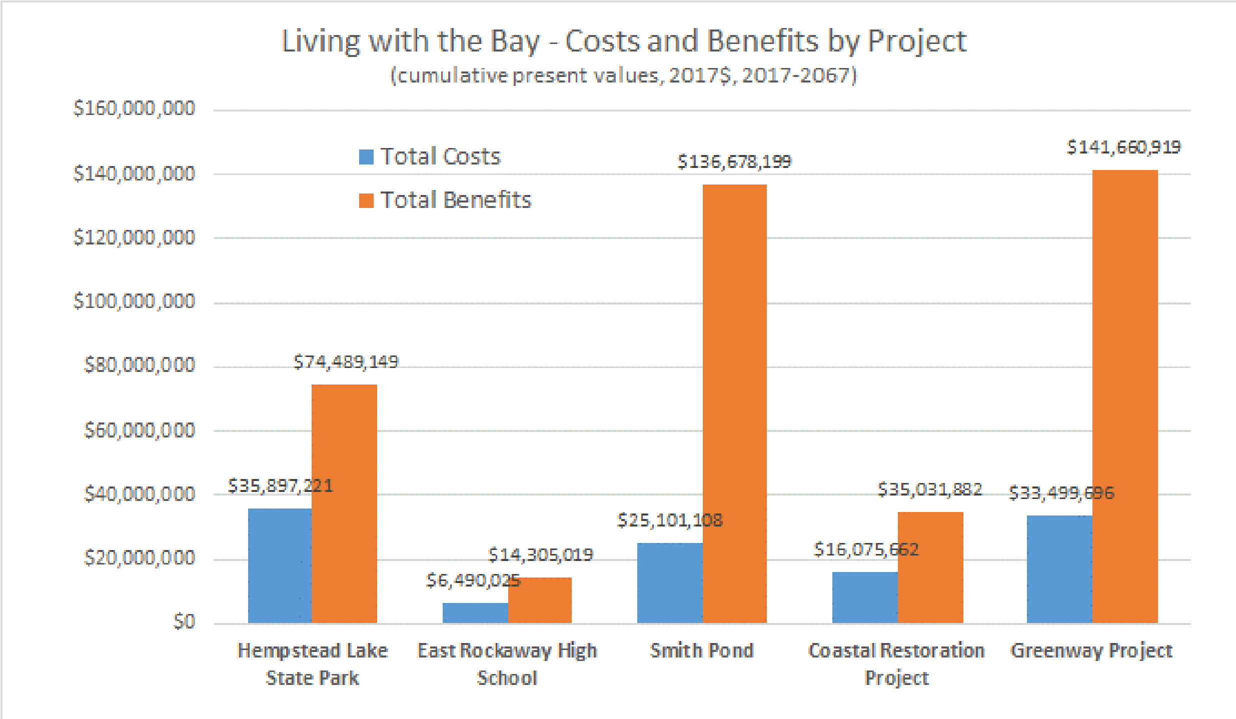
- The combined cumulative net present value (benefits less costs) of the five projects is $285 million. A project with a positive net present value is considered an economically viable public project that will add value to the community.

- For a project to be economically feasible, the internal rate of return (IRR) must exceed the discount rate. The combined rate of return of 35.8% of the five projects exceeds the HUD recommended project discount rate of 7.0%.

- A critical piece of the LWTB program is addressing flood mitigation. For the program area, this includes finding solutions to chronic drainage problems in the community that continue to worsen as a result of more frequent critical storm events and tidal surges. The approach to address this problem is through a variety of retrofits incorporating stormwater best management practices (BMPs). The LWTB design identified the desirability of green infrastructure retrofit projects which will improve stormwater collection and conveyance to mitigate flooding and incorporate water quality improvement components. Some of the project types which are being developed in the Resiliency Strategy include the following : (1) Parcel-Based Green Infrastructure, (2) Green Streets, and (3) Green-Gray Infrastructure (Tetra Tech, 2017):

- The stormwater retrofits implemented as part of the Living with the Bay Project will result in additional resiliency, environmental, social and economic revitalization benefits. Specific benefits for these proposed projects have not been quantified and monetized within this BCA given that designs have not been finalized. However, the qualitative assessment section of the BCA shows these benefits are expected to be significant. The benefits are expected to have a strong positive impact on the community equivalent to **++**, per HUD's qualitative rating criteria.

Figure ES2


Living with the Bay - Costs and Benefits by Project
(cumulative present values, 2017$, 2017-2067)
$160,000,000
$140,000,000
$120,000,000
$100,000,000
$80,000,000
$60,000,000
$40,000,000
$20,000,000
$0
Total Costs
Total Benefits
$35,897,221
$74,489,149
$6,490,025
$14,305,019
$25,101,108
$136,678,199
$16,075,662
$35,031,882
$33,499,696
$141,660,919
Hempstead Lake State Park
East Rockaway High School
Smith Pond
Coastal Restoration Project
Greenway Project

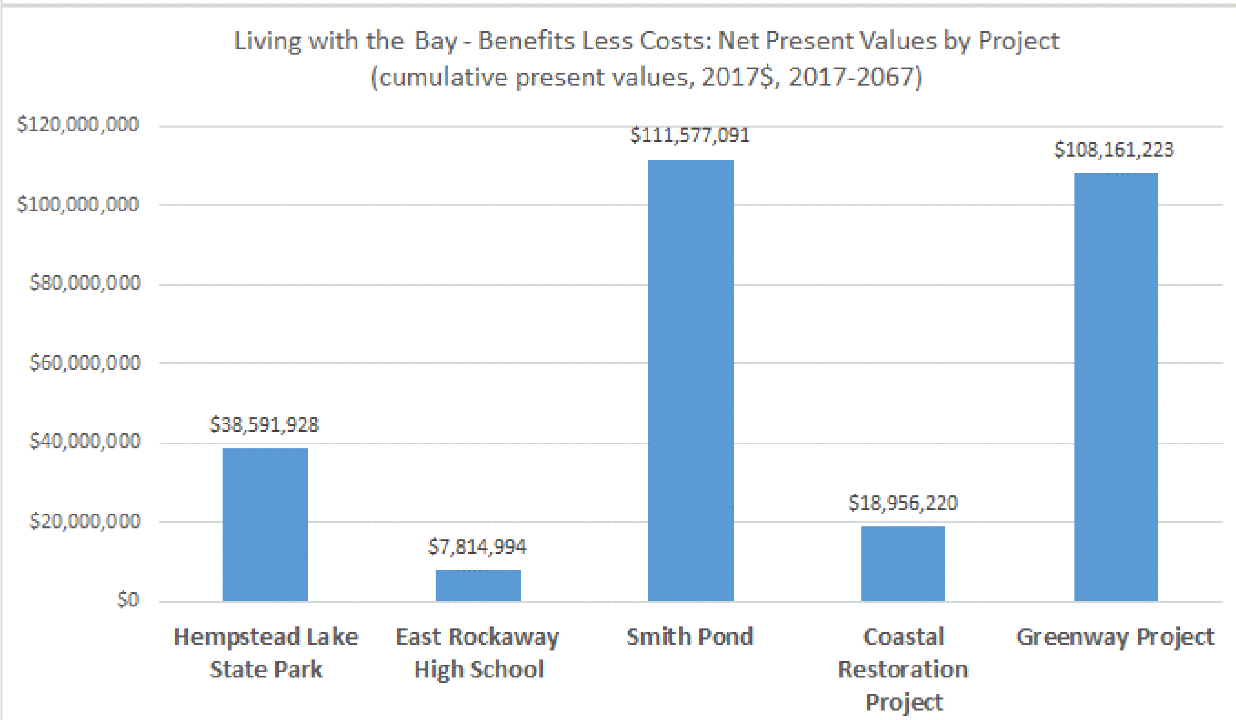
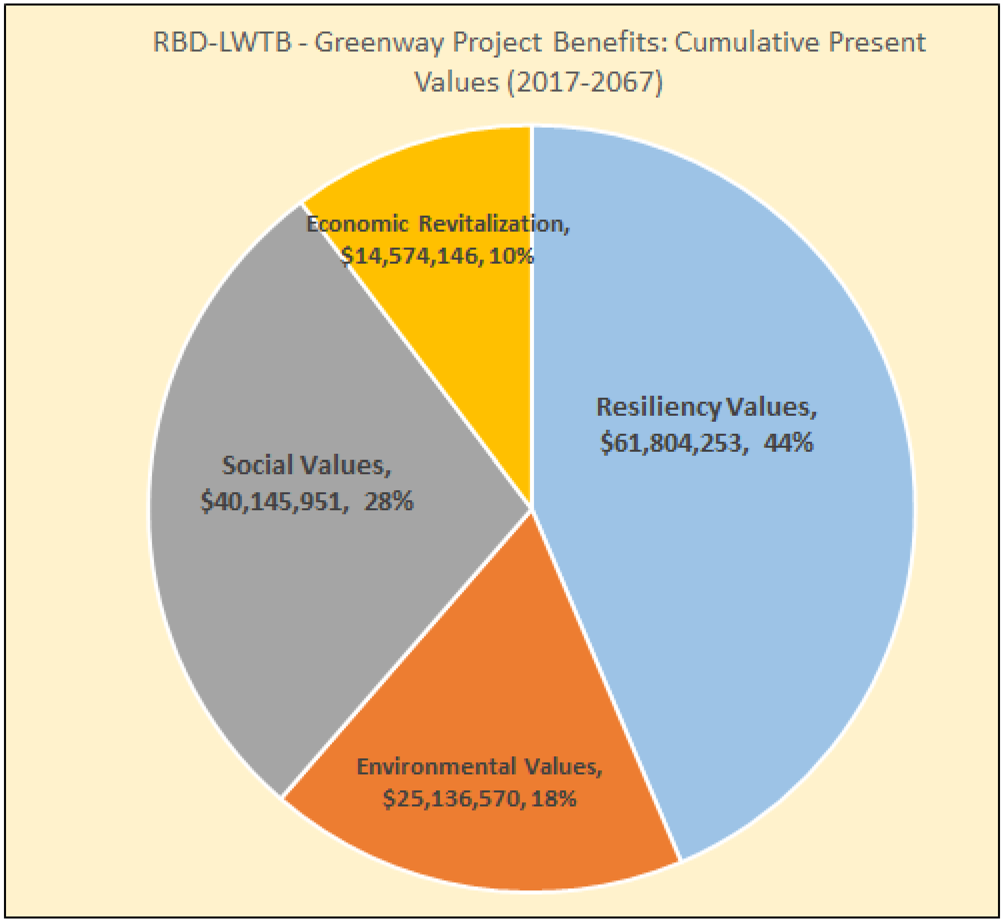

Living with the Bay - Benefits Less Costs: Net Present Values by Project
(cumulative present values, 2017$, 2017-2067)
$120,000,000
$100,000,000
$80,000,000
$60,000,000
$40,000,000
$20,000,000
$0
$38,591,928
$7,814,994
$111,577,091
$18,956,220
$108,161,223
Hempstead Lake State Park
East Rockaway High School
Smith Pond
Coastal Restoration Project
Greenway Project

Figure ES-3 – LWTB Benefits Breakdown by Project (*Pie Segments to Scale within Project, Not Across Projects)

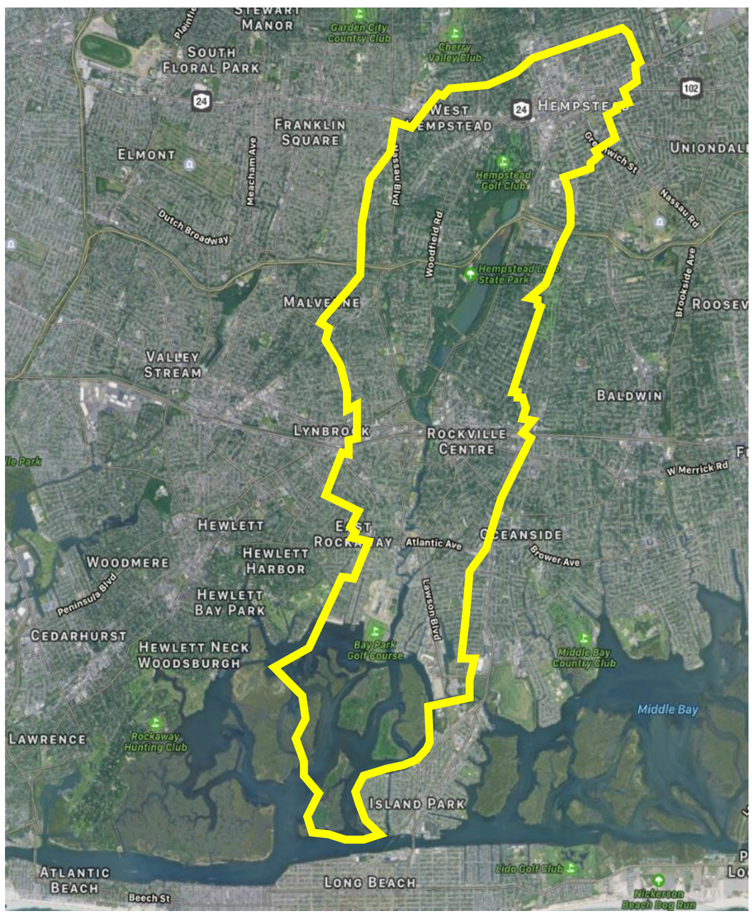

RBD-LWTB - Greenway Project Benefits: Cumulative Present Values (2017-2067)
Economic Revitalization, $14,574,146, 10%
Resiliency Values, $61,804,253, 44%
Social Values, $40,145,951, 28%
Environmental Values, $25,136,570, 18%

II. Introduction

The Rebuild by Design Living with the Bay Project Benefit Cost Analysis (BCA) was completed by applying procedures described in the US Department of Housing and Urban Development (HUD) Guidance document CPD-16-06 for Rebuild by Design (RBD) projects. The analysis is also consistent with procedures and principles found in OMB Circular A-94. The analysis follows the "with without" project evaluation framework that is used to isolate the net benefits of the intervention.

This BCA evaluates the main project elements or interventions that will be necessary to implement the Living with the Bay Resiliency Strategy's goals and objectives. **Figure 1** provides an overview of the Project Area for background context.

Figure 1: Living with the Bay Project Area



Source: Tetra Tech, 2017

Living with the Bay provides a comprehensive suite of resiliency interventions for Nassau County communities surrounding the Mill River, which is an environmentally degraded north-south tributary flowing from Hempstead State Park into the South Shore of Long Island's Back Bay (GOSR, 2017).

The Resiliency Strategy will include coordinated projects focusing on improved drainage collection and conveyance, tidal and storm surge prevention, water quality improvements, habitat restoration, improved public pathways/Greenway leading to the waterfront, and public education components. These projects will incorporate projected sea level rise into their design. (Tetra Tech, 2017).

The interventions evaluated in this BCA include the following projects that are described in more detail below:

- Hempstead Lake State Park
- Smith Pond
- East Rockaway High School
- Stormwater Retrofits
- Coastal Restoration Project
- Greenway Project

III. Process for Preparing the BCA

This BCA narrative document was prepared by Louis Berger U.S, Inc. (Louis Berger) using inputs provided by the New York State Department of Parks Recreation and Historic Preservation, the New York State Governor's Office of Storm Recovery (GOSR), and their respective consultants, Stantec and Tetra Tech. The BCA incorporates information and inputs from the various contributors to the watershed characterization and assessment and the Environmental Assessment (EA) currently being completed for the Hempstead Lake State Park Project. Louis Berger provided value added expertise relevant to the BCA in terms of resilience, landscape design, coastal and environmental engineering, ecology, economic analysis, geographic information systems, stormwater management, project evaluation, engineering economics and socio-economics. In addition, Louis Berger applied its own research findings, collective multidisciplinary expertise, experience, and professional judgment in completing the BCA on behalf of GOSR.

IV. Proposed Funded Project

The Living with the Bay Project contemplates a capital budget of $125 million to be applied to the five project elements. For BCA analysis purposes, construction is generally assumed to start in 2018 and end by 2019. Project operations (and the generation of benefits) would therefore start in 2020. The construction is assumed to occur concurrently within the Northern (HLSP, Smith Pond) and Southern (ERHS, Coastal Restoration) portions of the Watershed.

<u>Project Schedule, Useful Life and Discount Rate:</u>
Project construction is anticipated to start in 2018 and last 24 months. For the purposes of this BCA, the capital construction costs (Project Investment Costs) are phased in ratably over this time period. The BCA

also assumes a 50-year project evaluation time horizon. A discount rate of 7%, recommended by HUD and per OMB Guidelines, is applied.

V. Full Project Cost

Table 1 shows the estimated capital costs for five out of the six project elements within the BCA.

Table 1: Summary of Capital Cost Estimates for Living with the Bay by Project Element \a

Project	Low Range Estimate	Midpoint of Range	High Range Estimate
Hempstead Lake State Park	$35,686,616	$35,686,616	$35,686,616
East Rockaway High School	$3,084,723	$5,135,363	$7,186,002
Smith Pond	$14,540,817	$24,718,174	$34,895,531
Coastal Restoration Project	$16,583,258	$16,583,258	$16,583,258
Greenway Project	$11,358,424	$19,593,042	$27,827,659
Subtotal:	$81,253,838	$101,716,453	$122,179,066
Budget Funds Remaining for Stormwater Retrofits Projects			
Stormwater Retrofits	$43,746,162	$23,283,547	$2,820,934
Total:	$125,000,000	$125,000,000	$125,000,000

Notes: \a BCA applies midpoint range of costs but addresses high cost impacts on economic feasibility within the sensitivity analysis
Source: DT Annex 2, 2016, : <<LWTB Parks Cost Est. 20160912.pdf>>, Louis Berger est. Coastal Restoration

Table 1 shows estimated capital construction costs for each Project element. For the Hempstead Lake State Park Project and the Coastal Restoration Project, there is one cost estimate as these projects have greater definition at this time. For the ERHS and Smith Pond Projects, a low, midpoint and high estimate was created to reflect potential variability in project characteristics. The BCA applies the midpoint cost estimate in all calculations but addresses the higher cost range estimates within the sensitivity analysis. Since Stormwater Retrofit projects have not been sized yet, **Table 1** shows the residual or remaining budget fund amounts that could in part be applied to these projects after committing funds to the five projects.

VI. Current Situation and Problem to Be Solved

The types of documented flooding problems in the Project Area range from poor to inadequate drainage collection and conveyance capacity to high tailwater conditions deeming the existing stormwater systems inadequate for critical storms to overtopping surge events, such as Superstorm Sandy that inundated more than 3,000 residential properties. Other well documented problems include habitat and shoreline degradation and decreased water quality from the effects of untreated urban runoff (Tetra Tech, 2017).

During Superstorm Sandy, Nassau County was hit with heavy rain and an 18 foot tidal surge. Fourteen people lost their lives and approximately 113,197 homes were destroyed. Public and private infrastructure along the Mill River were damaged, including bridges, businesses, parks, roads, schools, and a wastewater treatment facility at the entrance of the Bay. Over the last century, the Mill River watershed has become more populated with communities growing along each bank. Increasing populations and continued development has made the Mill River communities more susceptible to flooding from storm surge and rain events. Along the Mill River, low-density suburban development has degraded natural buffers that once offered protection to neighborhoods and ecosystems alike. Without robust vegetated buffers along the river to absorb and store rainwater and coastal inundation, stormwater drained rapidly into the Mill River, backing up outflow pipes and causing severe inland flooding. Tidal surge also impacted the Bay Park Sewage Treatment Plan at the mouth of Mill River, sending not just untreated stormwater, but also untreated sewage, into the Bay (GOSR, 2017).

The Resiliency Strategy will include coordinated projects focused on addressing the problems with the anticipated sea level rise impacts accounted for in the analysis. This includes improved drainage collection and conveyance, tidal and storm surge prevention, water quality improvements, habitat restoration, improved public pathways to the waterfront, and public education components. The Strategy has projects strategically prioritized with program-specific timeframes and costs for planning, design, permitting, procurement, construction, and project closeout (Tetra Tech, 2017).

VII. Risks Facing Project Area Community

The Mill River watershed community faces risk associated with flooding due to storm surge and tidal inundation (within the Southern catchment portion of Watershed) and also frequent and extreme high velocity stormwater events which disrupt the quality of life and economy of the community throughout the watershed. In the Southern catchment portion there are risks associated with ongoing coastal habitat degradation, erosion and loss of marsh wetlands, and attendant water quality problems. In addition, there is a desire to improve the public's access to the waterfront and provide a contiguous enhanced Greenway linking the Mill River's surface water bodies.

Ecosystem services in the Mill River Watershed have been degraded by decades of suburban development, associated with a measurable increase in impervious surfaces and stormwater runoff. Stormwater runoff over impervious surfaces causes increases in non-point source pollution. The runoff carries pollutants that ultimately deposit into the nearby water bodies, such as Hempstead Lake, South Pond, Smith Pond, and the Mill River itself. Pollution and the associated impaired waters of the Mill River travel downstream to the back bays, where the resulting elevated nitrates deteriorate the wetlands (LB 2016).

In addition, there are long-term risks associated with climate change adaptation. While the damage from Sandy was caused primarily by storm surge, stormwater flooding poses a significant risk from precipitation events. Both storm surge and stormwater flooding may be exacerbated through the impacts of climate change. Localized stormwater flooding, which occurs approximately twice a month on spring tide and moon tides, is expected to increase as a result of anticipated increases in general sea level and frequency of extreme events such as high wind induced surges (LB 2016).

The Resiliency Strategy and project interventions will mitigate community risks and educate the public on stormwater and environmental management and climate change resilience issues. The final outcome of the Resiliency Strategy will be a suite of coordinated and prioritized projects with an implementation schedule (Tetra Tech, 2017).

VIII. Costs and Benefits by Project Element

This section describes the anticipated lifecycle costs and benefits by each resource area, for each proposed intervention. The project evaluation horizon extends from 2017 to 2067, a 50-year period per HUD Benefit Cost analysis Guidelines (HUD CPD-16-06).

a. Hempstead Lake State Park

Project Objectives: Improve and enhance the resilience of Hempstead Lake State Park and its infrastructure as necessitated by the increased development of the watershed since its original establishment as a water reservoir and as exacerbated during major storm events, which are expected to increase in severity and frequency over time. Hempstead Lake State Park falls within the upper portion of the Mill River Watershed and provides key opportunities to improve flood management, enhance the natural ecosystems, provide connectivity between diverse populations, and enhance safety and provide emergency response facilities, all while promoting environmental education and increased usage of the Park (Parks, 2017 a).

Project Description: The Project involves the northernmost portion of the Rebuild by Design: Living with the Bay project and it encompasses several elements in and around Hempstead Lake State Park. Project elements include dams, gatehouses, ponds, bridges, the education and resilience center and greenway waterfront improvements.

- The dams component would make the flow control structures operable and provide a means to manage and store flood waters, include dam improvements to meet current regulatory standards, and gatehouse renovations.
- The ponds component would involve the installation of floatables catchers and sediment basins at pond inlets, as well as creation of stormwater filtering wetlands and dredging of the Northeast Pond to remove debris, improve water quality and increase impoundment capacity.
- The stormwater wetland component will reestablish flow patterns through the ponds and wetlands that have been impacted by the floatables debris and sediments that have blocked the flow patterns.
- Trails through the new wetland areas and along paths near the sediment basin and floatables collection offer the opportunity to provide additional educational messages about the interrelationship between the runoff from downtown Hempstead and the tidal bays to the south. The project would also involve installation of an improved greenway and trail system throughout the park, as well as new bridge connections to allow pedestrian, and bicyclist access and connectivity.
- Improved emergency response, vehicle access and coordination of incident command.
- West of Lakeside Drive, the project would include construction of a new, two- story, 8,000-square-foot Education and Resilience Center (Parks, 2017 a). The focus of the Education and Resiliency Center would be on environmental stewardship, and climate change adaptation resiliency.

i. Lifecycle Costs

Lifecycle costs consist of both capital construction costs and the long-term annually recurring operations and maintenance costs that would be required to maintain the Hempstead Lake State Park (the "Park") assets and improvements delivered by the intervention. **Table 2** shows a breakdown of the main capital costs by project component.

Table 2: Hempstead Lake State Park Project Capital Costs by Main Project Element

Description	Total	Percent of Total
Dam Improvements and Bridge Crossings	$4,209,500	11.8%
North West Pond	$409,750	1.1%
North East Pond	$8,866,570	24.8%
Education and Resilience Center	$3,083,100	8.6%
Greenway / Waterfront Improvements	$9,290,947	26.0%
Subtotal:	$25,859,867	72.5%
38% Contingency \a	$9,826,749	27.5%
Total:	$35,686,616	100.0%

Source: <<LWTB Parks Cost Est. 20160912.pdf>>
Notes:
\a Thirty-eight percent contingency is calculated based on base capital costs in subtotal.

The Hempstead Lake State Park Project (hereafter, "HLSP") is expected to cost approximately $35.7 million. The North East Pond and Greenway / Waterfront Improvements represent about one-half of this capital construction cost.
Operational and maintenance costs consist of the elements shown in **Table 3**.

Table 3: Hempstead Lake State Park Project Annual Operational and Maintenance Costs

O&M Element	Annual Cost	Percent of Total
Floatables collection system annual cost	$130,000	42.9%
NW Pond and SSP Collection	$32,000	10.6%
Sediment Basins Cleaning	$40,000	13.2%
Filtering wetlands clean-up and maintenance	$10,000	3.3%
Trails/Waterfront Structures/Waterways/Bridges/Greenway Parking/Education and Resiliency Center	$91,200	30.1%
Annual O&M	$303,200	100.0%

Source: Parks 2017
Parks, 2017 a, b

Floatables collection annual costs represent the largest share of annual O&M for HLSP.

ii. Resiliency Value

The main resiliency values for the Hempstead Lake State Park Project are associated with the dams' component that would make the flow control structures operable and provide a means to manage and store flood waters, and include dam improvements to meet current regulatory standards, and gatehouse renovations. In addition, the ponds component would involve the installation of floatables catchers and sediment basins at pond inlets, as well as creation of stormwater filtering wetlands and dredging of the Northeast Pond to remove debris, improve water quality and increase impoundment capacity. HLSP resiliency benefits associated with the dam improvements such as the retention of greater volumes of water, and improved management capabilities within the upstream catchment portion of the watershed are not reflected within the BCR but are acknowledged to be a significant benefit that would be assigned a ++ (i.e., expected strong positive impact) per HUD qualitative rating instructions. The resiliency calculation valuations performed for HLSP were based on available data for pond dredging and water volume storage improvements from depth increases as shown below. Therefore, the resiliency benefits quantified and monetized for HSLP represent a lower bound value estimate, and if dams' monetized value was included, the benefit cost ratio for HLSP would be higher. Water quality values for HLSP were included from wetlands creation that is included within the Environmental Value section of the BCA.

The main quantified resiliency value within the BCA report was derived from the ponds dredging and associated increase in impoundment capacity of the ponds. This resiliency value relates to the estimated value of the impounded water expected from increased pond depth. The ability to retain stormwater within a deeper pond would allow for an increased impoundment volume and an improved ability to manage and attenuate peak stormwater flows from upstream runoff. To estimate and monetize the water value for these features, the following steps were applied based on assumptions shown in **Table 4**.

Table 4: Data and Parameters Applied to Calculate Resiliency Values for Hempstead Lake State Park

Northeast Pond Dredging		
Dredging, Dewatering and disposal	**Values**	**Unit**
Dredge additional depth (to increase impoundment volume)	18,000	CY
1 cubic yard =	201.974	Gallons
Adjustment for groundwater location	0.545454545	\a
Additional storage, gallons	1,983,017	Gallons
Treatment cost per gallon (Drainage plus Sewer)	$0.0063	$/gal \b, \d
Avoided drainage infrastructure cost per gallon (CSO based value)	$0.2359	$/gal \c
Avoided cost of wastewater treatment	$12,471	$
Avoided stormwater infrastructure costs	$467,852	$
Total Annual Avoided Costs:	$480,322	$
Northwest Pond	**Value**	**Unit**
Dredge Pond for 6' depth (to improve aquatic habitat)	44,200	CY
Adjustment for groundwater location	0.545454545	=\a
Additional storage gallons	4,869,409.53	Gallons
Avoided cost of wastewater treatment	$30,622	$
Avoided stormwater infrastructure costs	$1,148,836	$
Total:	$1,179,458	$
Combined Pond Annual Value of Storage:	$1,659,780	$
Sources/Notes: \a USGS, 2013, \b New York State, 2017, \c EPA 2014, \d Nassau County, 2017.		

The estimated dredge depth cubic yards of spoil to reach an additional depth was converted to a liquid volume estimate and adjusted for storage potential based on the groundwater location. These amounts were then converted to an economic value by assigning a gray infrastructure stormwater management cost to a comparable volume of water that would be retained in a drainage system and subject to conveyance and treatment processing. This method is a way to arrive at the economic shadow price of impounded water, and is an approximation of value that is closer to the avoided cost than it is to the willingness to pay for improved storage capability and water management. Water quality estimates are provided in the Environmental Value section.

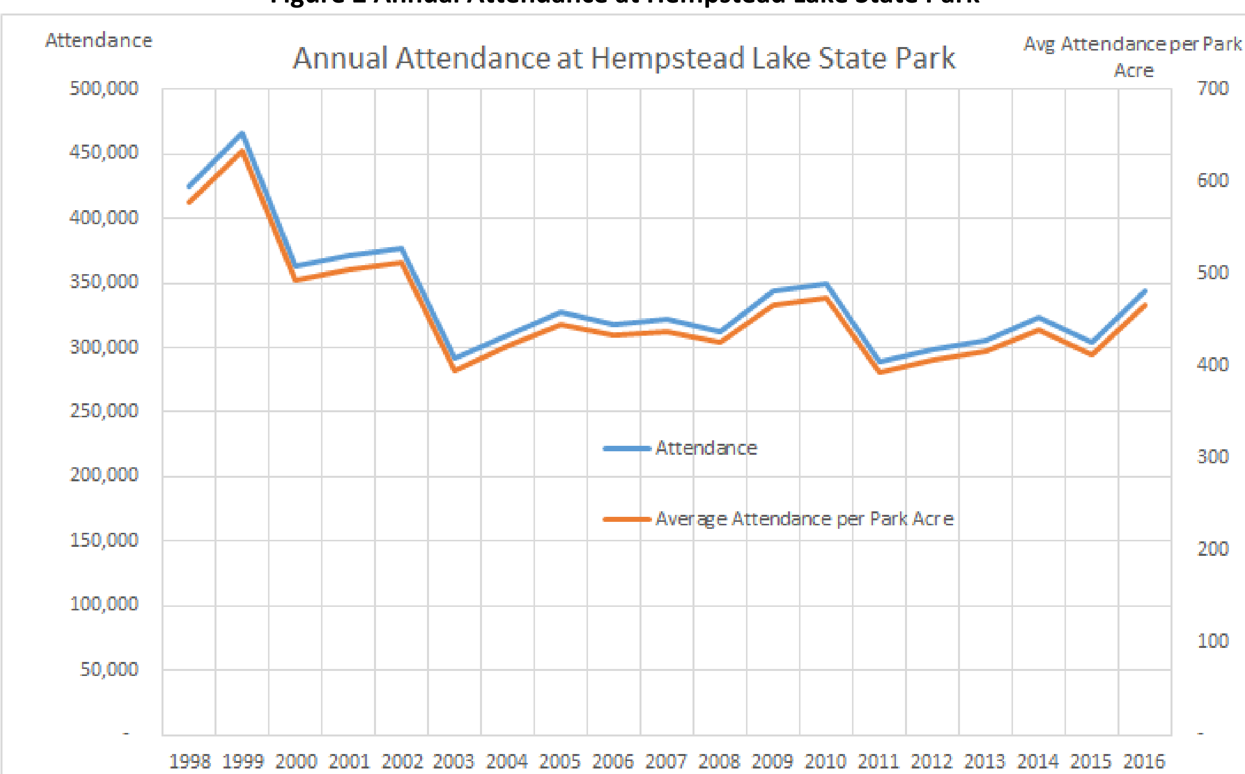
The cumulative present value of the annual value of increased pond storage impoundment was estimated to be **$19,905,296** over the 50 year project evaluation horizon.

iii. Social Value

Visitation User Value

The HLSP project will open up additional park space for users and will also enhance the existing recreational experience for park visitors. It is likely that over time, more visitors will attend as knowledge spreads about enhanced park features and park amenities experienced by friends, neighbors and broadcast through word of mouth, public outreach and press/media coverage. **Figure 2** shows the historic annual attendance at HSLP and the average attendance per park acre. The HLSP has 736 acres.

Figure 2 Annual Attendance at Hempstead Lake State Park



The Project will result in approximately 7 additional acres for public access. This additional access does not mean that all 7 acres will be cleared, only that they will be publicly accessible (Stantec, 2017).

Expansion of Hempstead Lake State Park and Incremental Recreational User Value

Cleanup of debris and solid waste along the shoreline and removal of invasive vegetation in the nearby woodland areas of the pond system, along with installation of a floatable debris catchment system, will enable Hempstead Lake State Park (HLSP) to open up an additional novel area for recreational visitors. The North Pods section of the park will be more accessible, with additional trails and passive recreational space in a fairly densely populated area.

The proposed space will accommodate parking for approximately 48 cars to the general public. To estimate the additional visitation that might be accommodated with this increase in parking, the average annual visitation per space at HLSP's current parking facilities (near Lakeside Drive and Southern State Parkway) was calculated. This value averaged approximately 391 visitors, per year, per parking space. **Table 5** shows the data and assumptions that were applied in estimating the park incremental user value associated with anticipated visitation.

Table 5: Data Applied to Estimate HLSP Incremental General Usage		
Element	**Value**	**Unit**
HLSP estimated number of existing parking spaces	868	Parking space
Living with the Bay Project additional new spaces	48	Parking space
Annual Average Visitors Per Existing Parking Space	391	Est. Visits/space
Incremental Annual Attendance	18,747	No. visitors
Recreational Use Value per User Day (see below)	$55.62	$
Annual Incremental Recreational Use Value	$1,042,704	
Recreation Use Values per Person per Day by Primary Activity-Northeastern Region \a		
Activity	**Value/pc/day**	
General Recreation	$34.53	
Wildlife Viewing	$59.78	
Hiking	$72.56	
Average:	$55.62	
Sources: Hempstead Lake State Park \ RUVD 2016		

The bottom portion of **Table 5** shows recreational use values per day by primary activity. These values were obtained from the updated Recreational Use Value Database for North America, applying the Northeastern Region mean values (RUVD 2016)[1]. An average recreational use value per visitor day was applied reflecting likely uses for visitors to HLSP.

[1] The RUVD (2016 update), maintained by Oregon State University currently contains 421 documents of economic valuation studies that estimated the use value of recreation activities in the U.S. and Canada from 1958 to 2015, totaling 3,192 estimates in per person per activity day units, adjusted to 2016 USD. Twenty-one primary activity types are provided. These recreation use value estimates are measures of net willingness-to-pay or consumer surplus for recreational access to specific sites, or for certain activities at broader geographic scales (e.g., state or province, national) in per person per activity day units.

The cumulative present value of the annual value of incremental park visitation was estimated to be **$12,504,863** over the 50 year period.

Value of the Education and Resilience Center

West of Lakeside Drive, the project would include construction of a new, single story Education and Resiliency Center, with an unfinished basement. The approximately 8,000-square-foot (an irregular footprint of approximately 52' x 96') center would include an education room, lobby, overlook deck, offices, restrooms, kitchen, and storage facilities. The space would be designed to be flexible enough to accommodate many different uses, including as a gathering space during a storm event such as Sandy. The Center will provide a connection point for residents to the Hempstead Lake. The proposed Center would be designed to a high LEED standard with a goal toward a net-zero energy solution.

The Education and Resiliency Center would seek to build partnerships with local schools to make use of the education space and wet lab, and would educate students on the importance of parks and wetlands—particularly during extreme weather. There would also be information about the Mill River Corridor system as a whole, local wildlife and history of the area. Permit applications administered by New York State Parks would be processed from the center.

During an extreme weather event, the proposed addition of this Center would help assist the community by serving as a command center during major storm events. The Center would provide a single point of access for information for local residents seeking access to community services. Also, by virtue of maintaining a generator on site, the Center would ensure that residents continued to have access to electricity during a storm event—guaranteeing that the community would have a secure location to charge mobile phones and reach outside resources.

The Center would also include an office for the Nassau County Law Enforcement Exploring Program and will be used as training space for the program. This volunteer program provides an opportunity for young adults to receive basic law enforcement training and to learn about career opportunities within law enforcement. In addition to training and education, volunteers participate in community service events throughout the year to encourage volunteerism and build stronger communities.

In order to quantify the benefit the Education and Resiliency Center would provide to the local community, a per-visit utility value was applied. The visitor utility use value was provided by a study conducted by Texas A&M University. The study found that visitors to educational facilities derived a benefit valued at $25.00 (Harnik and Crompton, 2014). This value was applied to the total number of visits per year to the education facility, estimated as equal to one visit every three years by students at one of the six neighboring school districts. The universe of potential school districts who may gravitate to the Center included West Hempstead Union Free School District, Hempstead Union Free School District, Malverne Union Free School District, Rockville Centre Union Free School District, East Rockaway Union Free School District, Oceanside Union Free School District, and two Charter Schools. The annual amount of estimated student visits was 7,618 per year.

Adjusting for inflation in the original educational utility value, the cumulative present value of this benefit is estimated to be equal to **$2,315,472.**

An important component of this project is consideration for the students who would be served by such an educational facility. According to the New York State Education Department, the area is majority-minority and serves a large number of economically-disadvantaged students. Within the 41 schools in the project vicinity, including 39 public schools and two charter schools, 60 percent of the students are non-white, 45 percent are economically disadvantaged, and 14 percent of students have limited English proficiency (NYSED, 2015).

Community Cohesion

Parks offer an opportunity for community members to meet, interact, strengthen the community and build social capital. Several studies on the value of parks and open space include community cohesion as one of the benefits of parks (NPRA, 2010; Harnik, 2009). In neighborhood parks, residents of all ages have the opportunity to interact which improves the quality of life in the neighborhood. Furthermore, the social capital that is created through parks - especially when neighbors work together to create, save or renew a park or open space - not only benefits resident quality of life but wards off anti-social problems, reducing the need for police, prisons, and rehabilitation.

The benefit of community cohesion was not quantified. The magnitude of the benefit will be affected by the level of community involvement during the planning and development of the project as well as by the use of the project area and facilities by residents upon the project's completion.

iv. Environmental Value

The environmental values associated with Hempstead Lake State Park were assessed based on the number of acres that would be created and would add ecosystem service values, and improve water quality. The number of acres was provided by the NYS Parks Department (20). The Project proposed to create approximately 20 acres of new wetland including filtering wetlands within and to the north of NE Pond to filter flow from Mill Creek and from the Southern State Parkway outfalls, as well as develop riparian wetland edge along the southeastern edge of NW Pond east of the dam to enhance the trail system through that area (Parks 2017 a).

Wetland areas add ecosystem service flows perennially. A benefits transfer approach was applied to value the twenty acres of incremental service flows to the Park based on applying the National annual average benefit values per acre for individual ecosystem services per year produced by wetlands mitigation required under Section 404 of the Clean Water Act (Adusumilli, 2015). **Table 6** shows the tables of values that were applied within the benefits transfer application.

Table 6: National annual average benefit values per acre for individual ecosystem services		
Ecosystem Service Value per Acre Applied in Valuation	**Annual Average Benefit Value per Acre (2010 $)**	**Annual Average Benefit Value per Acre (2017$) \a**
Recreational Fishing	$2,288	$2,548
Bird Watching	$11,166	$12,435
Water Supply Protection	$5,882	$6,551
Flood Control	$1,442	$1,606
Water Quality Protection	$7,987	$8,895
Notes: \a Updated to 2017 by applying the US CPI Source: Adusumilli, 2015		

Applying the ecosystem service values to the 20 acres resulted in combined annual ecosystem service flows of $23,140 for the combined services of Recreational Fishing, Bird Watching, Water Supply Protection and Flood Control. The Water Supply value was calculated separately using $6,551 per acre. The cumulative present value of the ecosystem service values over the 50 year project evaluation period amounts to **$7,683,582.**

v. Economic Revitalization

Upon completion of the project, economic revitalization benefits will accrue to owners of properties located near the Hempstead Lake State Park. Short-term construction economic impacts are primarily considered a transfer of activity from one economic sector to another. Therefore, these activities are not considered as a net benefit to society (and thus not included within the benefit cost ratio). However, the project will contribute to the local economy by supporting jobs in the construction and related industries during the design and construction phases.

<u>Property Value Impacts</u>

There is an extensive body of research that shows that well-maintained parks and open space positively contribute to the value of nearby properties. Economists often use hedonic pricing techniques to isolate the effect of various attributes, such as proximity to a safe and clean park or pond that can influence property values. Hedonic methods analyze how the different characteristics of a marketed good, including environmental quality, might affect the price people pay for the good or factor. This type of analysis provides estimates of the implicit prices paid for each characteristic, such as number of rooms, and the quality of the adjacent host environment. A hedonic price function for residential property sales might decompose sale prices into implicit prices for the characteristics of the lot (e.g., acreage), characteristics of the house (e.g., structural attributes such as square footage of living area), and neighborhood and environmental quality characteristics. In terms of aquatic ecosystems, properties with closer proximity to these systems may sell for more than similar properties that do not have this adjacency or proximity (NRC, 2005).

Based on an extensive review of existing hedonic pricing studies and other research, in a 2004 report for the National Recreation and Park Association (NRPA) Texas A&M University Professor John Crompton developed a methodology that can be used to estimate the property value premium of parks when it is not feasible to perform an hedonic pricing study. Based on NRPA's methodology, residences within 500 feet of an average or higher quality park benefit from a property value premium of 5 to 15 percent (NRPA 2004). While there is no conclusive research, it is likely that below average quality parks have a negative effect on the property value of the nearby properties. Park quality scored using a five point scale as presented in **Figure 3**.

Figure 3 – Park Quality Scale for determining proximity premiums

Unusual Excellence: A signature park; exceptionally attractive; natural resource based; distinctive landscaping and/or topography; often mentioned in sales advertisements for nearby properties; well maintained; genuine ambiance; engenders a high level of community pride and "passionate attachment."

Above Average: Natural resource based; has charm and dignity; regarded with affection by the local community; pleasant, well maintained.

Average: Rather nondescript; not really "noticed" by the local community; adequately maintained; no distinguishing features.

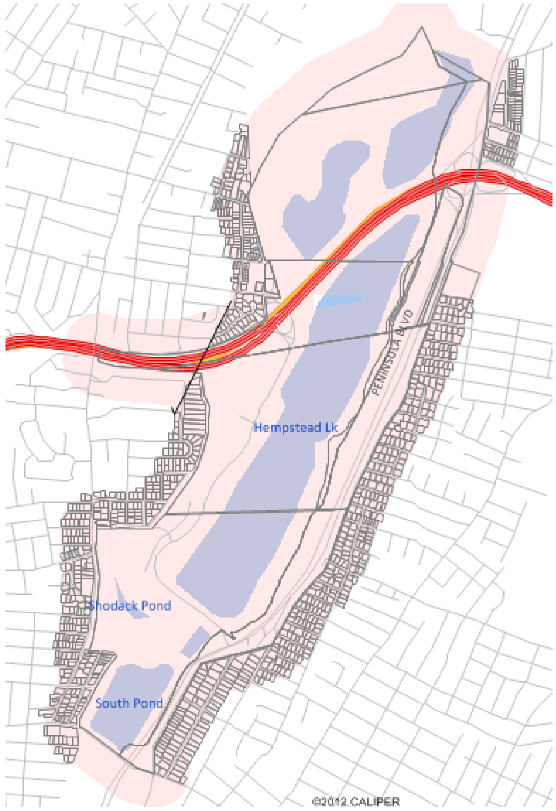
Below Average: Sterile; absence of landscaping or trees; athletic fields with noise, lights, congestion; intensive use.

Dispirited, Blighted: Dilapidated, decrepit facilities; broken equipment; unkempt, dirty; unofficial depository for trash; noisy; undesirable groups congregate there; rejected and **avoided by the community.**

Source: NRPA (2004)

Louis Berger applied the NRPA methodology to estimate the premium for residences near Hempstead Lake Park. A total of 849 residential properties are located within a 500 feet buffer around the park. Based on the property assessment records, these properties have a combined market values of $381.5 million in 2014-2015. **Figure 4** shows the location of the properties proximate to Hempstead Lake State Park.

Figure 4: Hempstead Lake State Park Proximate Properties (within 500' buffer area)



Source: Louis Berger: V. Amerlynck, 2017

Louis Berger classified the park in its current condition as an average park. Following the improvements included in the Project, Louis Berger assumes the park would become an above average park, which in the five-point NDRC scale is defined as a natural resource based park that has charm and dignity, is regarded with affection by the local community, pleasant and well-maintained. Planned improvements include safety enhancements, trails and bridge connections for pedestrians and cyclists, waterfront improvements, installation of floatable catchers and wetlands cleanup. These improvements would make the park more attractive to residents. Following the NRPA methodology, the property value premium of moving from a below average quality park to an above average quality park is 10 percent.

The cumulative discounted present value of this one-time benefit occurring in 2020 is **$32,079,935**.

Job Creation

During the construction phase, the Project will create jobs in the construction and related industries. Based on the 30 percent design, the construction cost of the improvements to Hempstead Park, is $35.7 million, including the contingency. In addition to the jobs that will be directly created by the proposed project, additional jobs will be supported through the contractor's purchase of construction materials at other New York State businesses and through the local household spending by construction workers and other workers. Upon its completion, the project will support jobs related to the operations and maintenance (O&M) of the park. Parks personnel man-hours are included in the annual $303,200 O&M budget for the floatables collection system, sediment basin cleaning, filtering wetlands and trail maintenance. Similar to the construction spending, spending on materials and supplies required for the operations and maintenance of the park as well as household spending by its employees will support additional jobs within New York State. While typically not a net benefit to society, job creation constitutes a positive contribution to the New York State economies.

vi. Benefit Cost Analysis Results

Table 7 summarizes the results of the BCA for the Hempstead Lake State Park Project.

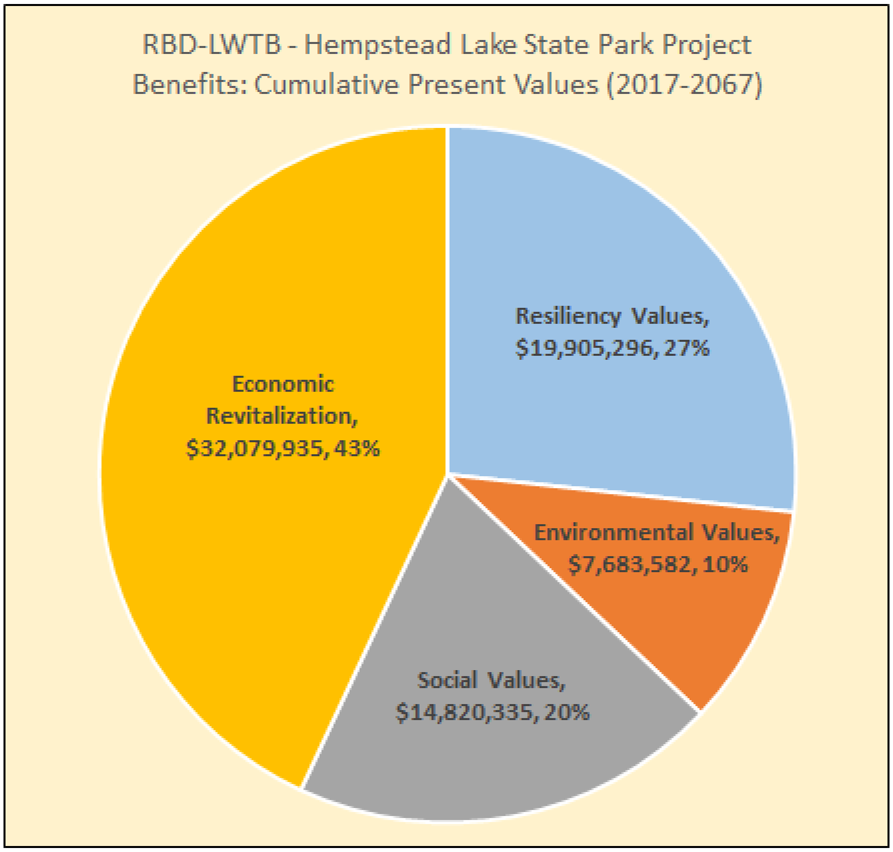
Table 7: Benefit Cost Analysis RBD-Living with the Bay Hempstead Lake State Park Project (Constant 2017 US Dollars)		
	Category	**Cumulative Present Value**
	LIFECYCLE COSTS	**(2017-2067)**
	Project Investment Costs	$32,261,025
	Operations & Maintenance	$3,636,195
[1]	**Total Costs**	**$35,897,221**
	BENEFITS	
[2]	Resiliency Values	$19,905,296
	Increased Water Storage/Impoundment	$19,905,296
[3]	Environmental Values	$7,683,582
	Ecosystem services value of freshwater wetlands marsh	$5,550,129
	Water Quality Improvement	$2,133,453
[4]	Social Values	$14,820,335
	Recreation Value of Improved Park Amenity	$12,504,863
	Value of Education and Resilience Center	$2,315,472
[5]	Economic Revitalization Benefits	
	Property Value Impacts ([proximity to Improved HLSP])	$32,079,935
[6]	**Total Benefits**	**$74,489,149**
[7]	**Measures of Project Merit:**	
	Benefits less Costs [Net Present Value (Net Benefits @ 7%)]	$38,591,928
	Benefit Cost Ratio (BCR)	2.08
	RBD Rate of Return	30.0%

Measures of RBD Project Merit

- The Hempstead Lake State Project is economically feasible and has a positive benefit cost ratio of 2.08. Benefits are more than two times the cumulative present value of lifecycle costs.
- The cumulative net present value (benefits less costs) is $38.6 million. A project with a positive net present value is an economically viable public project that will add value to the community.
- For a project to be economically feasible, the internal rate of return (IRR) must exceed the discount rate. The RBD rate of return of 30% exceeds the HUD recommended project discount rate of 7.0%.

Figure 5 below shows a breakdown of the benefits of the HLSP.

Figure 5


RBD-LWTB - Hempstead Lake State Park Project
Benefits: Cumulative Present Values (2017-2067)
Resiliency Values, $19,905,296, 27%
Economic Revitalization, $32,079,935, 43%
Environmental Values, $7,683,582, 10%
Social Values, $14,820,335, 20%

b. East Rockaway High School

Background: East Rockaway High School is located on the west bank of Mill River just north of Pearl Street. The school and its grounds were severely damaged by Superstorm Sandy and the teacher parking lot routinely floods at an approximate 1-year storm event frequency. The school building and grounds were repaired after Sandy and a recently approved FEMA project is intended to mitigate the flooding of the school's buildings. The teacher parking lot and school's fields remain vulnerable to frequent tidal flooding and shoreline erosion. The bleachers and two story storage and press box at the sports field are on the verge of falling into the Mill River due to ongoing shoreline erosion (Tetra Tech, 2017).

The disruptions to physical education activities and athletic events and cancelled contests have been documented. According to the Athletic Director, the average loss of time for physical education and athletic events on the playing fields averaged 30% of the year over his 20-year tenure as director. Operational budgets have been impacted by securing alternate locations, transportation needs and permits due to the displacement from school facilities that is a chronic result of nuisance field inundations and poor drainage (ERS Memo, 2015).

Project Objectives: The presence of the continuous stretch of publicly owned land along the western bank of the river at the school offers a range of opportunities to protect the school property from flood damage and create waterfront access for the public. The goal for this area is to determine the feasibility of design options that help reduce the school's vulnerability to flooding and stabilize its eroding shoreline. The designed interventions also have the opportunity to facilitate a continuous north-south route along the water for pedestrians and cyclists, and contribute to improving the quality and operations of the school and its sports fields by enhancing the connection between the school and the river.

Project Description: Linear flood risk mitigation and shoreline stabilization is currently being evaluated at the school with design considerations to alleviate the tailwater and surge flooding occurring in the teacher parking lot. Living shoreline elements with stormwater outlet treatment systems to improve water quality in the area are also being analyzed. As noted, the high school's football field bleachers are located at the river bank. Due to ongoing erosion of the bank, the structural stability of these stands is being compromised. The design proposal provides an integrated solution that stabilizes the river bank, raises its flood protection level, and enhances the conditions for the grandstand. The proposed level of protection service for the design is the current 1/100y FEMA flood elevation of 9ft.

i. Lifecycle Costs

Lifecycle costs consist of both capital construction costs and the long-term annually recurring operations and maintenance costs that would be required to maintain the project assets and improvements delivered by the intervention. **Table 8** shows a breakdown of the main capital costs by project component.

Table 8: East Rockaway High School Project Capital Costs by Main Project Element				
Description	**Low**	**Mid**	**High**	**%**
Back Flow Prevention	$1,750	$3,125	$4,500	0.1%
Existing Bulkhead Elevation	$684,140	$1,125,800	$1,567,460	21.9%
New Stepped Quay	$3,549	$5,105	$6,660	0.1%
New Bulkhead w/Excavation	$519,701	$888,095	$1,256,490	17.3%
New bulkhead	$403,500	$685,950	$968,400	13.4%
New Levee	$72,000	$103,500	$135,000	2.0%
Outfall Filter	$121,297	$163,352	$205,408	3.2%
Landscaping	$142,477	$186,978	$231,479	3.6%
Sport Fields	$72,944	$100,736	$128,528	2.0%
Paths	$24,798	$57,504	$90,210	1.1%
Furniture	$3,000	$4,250	$5,500	0.1%
Site Prep	$67,700	$138,850	$210,000	2.7%
Backup Generator (300 KW)	$111,000	$143,000	$175,000	2.8%
subtotal:	$2,227,856	$3,606,245	$4,984,635	70.2%
Construction Administration	$299,903	$627,556	$955,209	12.2%
Contingency (25% of subtotal)	$556,964	$901,561	$1,246,159	17.6%
Grand Total \a	**$3,084,723**	**$5,135,363**	**$7,186,002**	**100.0%**
Source: << Annex 2 Cost estimate.pdf>>, Louis Berger estimates for Backup Generator Notes: \a removes cost estimate for greenway floating jetty part of Paths				

The East Rockaway High School Project (hereafter, "ERHS") is expected to cost approximately $5.1 million. This is a midpoint estimate between a low and high estimate. For the purposes of the BCA the full range is shown. The sensitivity analysis will test the tolerance of the positive benefit cost ratio (BCR) to increases in capital costs that will address the high estimate.

Backup Generator

The cost of the backup power generator was estimated based on obtaining information on the peak power load for the ERHS. The Village of East Rockaway Bay Park Community Microgrid Feasibility Study produced by Nassau County described the load characterization for the ERHS, at 262 Peak KW based on utility data (Nassau County, 2016). From this information a bid offer quote for a Caterpillar C9 Generator set, rated at 300 kW diesel generator was obtained (Caterpillar, 2017). Added to this cost was the cost of the generator platform and contingencies.

Operational and maintenance costs were estimated at 3% of the capital construction costs.

ii. Resiliency Value

Three measures of Resiliency Value benefits were calculated based on the avoided cost and risk adjusted avoided cost method. Information on the damages impacts to ERHS from Hurricane Sandy was obtained from ERHS (Colvin, 2017a). This information was supplemented by other damages reports and bid estimates for replacing damaged structures (HS Garage and Shop). Outside of 100 year event based damages, annually recurring estimates of losses from school activity interruptions and disruptions attributable to nuisance flooding were estimated based on information obtained from ERHS (Colvin, 2017b).

Avoided damages to structures (100 yr. event based)

Damages incurred to the ERHS and grounds were communicated by staff and also visible in Hazard Mitigation Proposal vendor furnished quotes for equipment and repairs. This cost information was converted to an annual 1% chance probability amount (100 Yr. Storm Event) that was then entered into the BCA Project Resource Statement as an Expected Annual Damages probabilistic estimate over the 50 year horizon. It was estimated that at least $12 million in damages was incurred by the ERHS. School District expenditures included items such as temporary relocation facilities, temporary generators, boilers and equipment, vehicles, grounds equipment and parts, permanent building repairs, school restoration, athletic field fence repair and debris removal (ERSD 2016, Colvin 2017, CEF 2016).

The formula applied, and Expected Annual Damages (EAD) was based on the following equation:

Equation 1:

$$EAD = \left(\sum Historic\ Hurricane\ Sandy\ ERHS\ Expenditures\right)\ x\ \left({}^{1}/_{100}\right)$$

Avoided Athletic Event Interruption Costs

As mentioned above, disruptions to physical education activities and athletic events and cancelled sport contests have been a frequent, recurrent problem for ERHS. These disruptions have negatively affected the high school experience for many student athletes. According to the Athletic Director, the average loss of time for physical education and athletic events on the playing fields averaged 30% of the year over his twenty year tenure as director (ERS Memo, 2015). While many of these impacts to students (and coaches) are intangible and can't be quantified, because they have occurred so frequently, this BCA attempts to recognize a minimum value for such losses. To quantify and monetize this annually recurring loss that would be avoided with the Project infrastructure and drainage improvements in place, the following calculation was performed.

Table 9 shows budget data sourced from the East Rockaway School District that reflects average expenditures per student. While these expenditures cover all activities, the data was expressed on an average hourly basis to show the opportunity cost of lost and interrupted athletic events. The following assumptions were made. **Table 9** converts the average student budget spending to an hourly figure for working purposes. Assume that for one Fall season, approximately 166 student athletes take part in extracurricular team events. The School's website lists the following Fall season duration and team events: Fall Sports August 15, 2016*- November 27, 2016* (*All Football, *Cheerleading), All Others:

August 22, 2016 - November 20, 2016 (Boys Soccer, Girls Soccer, Cheerleading, Boys X-Country, Girls X-Country, Modified (JH): September 6, 2016 - October 29, 2016 (Cheerleading, Girls Soccer, Football,) (ERHS Athletics, 2017).

Table 9 then converts a percentage of lost activity days attributable to unusable field and facilities to a monetary value in hours based on the estimated number of students who would have experienced cancellations and activity disruptions and relocations. The estimated lost activity cost was based on assuming a two hour hourly budget cost of "inconvenience" per each student athlete. Summed over an estimated 22 lost activity days per student athlete, this opportunity cost amounts to $146,489 per year (for one season).

Table 9: Data Applied in Estimating Avoided Athletic Event Interruption Costs		
	Calculation Element / Assumption	**Value**
1	ER School District Average Annual Spending per Student \a	$29,380
2	ERHS Number of Students \b	554
3	Estimated Number of School Days:	180
4	Spending per day per student	$163.22
5	Hourly spending (Assumes 8 am to 4 pm)/per student (=Spend day/8)	$20.403
6	Estimated No. students who participate in Athletics, %	30%
7	Number of student athletes	166.2
8	Semester athletic season (assume 3 months, for Fall or Spring) Practice days+event days (=6 d/wk x 4wk/m x 3 mo) (one season)	72
9	Lost or interrupted sports days (% of year), Applied per Season \c	30%
10	Lost days Per One Sports Season	21.6
11	Lost days for all student athletes	3,590
12	Budget value of a lost/disrupted sport day (assume 2 hours)/per student	$40.81
13	Budget value of lost sports days (all student athletes) (one example sports season)	$146,489
14	Value of lost / disrupted sports days (for 2 seasons, Fall and Spring)	$292,978

Notes:
\a Source: NCES 2017
\b https://en.wikipedia.org/wiki/East_Rockaway_High_School
\c ERS Memo, 2015

The cumulative present value of this avoided cost is equal to **$3,513,598** over the fifty year project evaluation period.

Avoided Parking Lot Staff Time Costs

Nuisance flooding of the ERHS parking lot has burdened staff and has forced them to leave the school building to move their cars to surrounding streets and then walk back to the building. These events have recurred approximately 5-10 times per year, especially when there are heavy rains in the springtime. It has been estimated that it takes approximately 40 to 50 minutes for staff to leave the building, walk to the parking lot, move their cars to surrounding streets, and then walk back to the building. The footprint area of the property that does not flood is quite small (Colvin, 2017b).

Table 10 shows this information and data and additional information on average salaries that is used to estimate a monetary cost of this unnecessary and burdensome activity that would be avoided by the ERHS Project's structural and drainage improvements.

Table 10: Data Applied in Estimating Avoided Parking Lot Staff Time Costs		
	Value	**Unit**
Number of Staff Cars in Parking Lot \a	60	No.
Frequency of parking lot floods/yr. \a	10	No./yr.
Amount of time necessary to move car from lot \a	50	Minutes
Average Salary (High School) \b	$83,560	$/yr.
Average Hourly Wage Rate	$40.17	$/hr.
Cost per 45 minute (work day interruption)	$30.13	
Total Cost for 60 Cars (50 min. work day interruption)	$1,807.79	Cost/event
Total Cost for 10 flood events in a year	$18,077.88	Annual Cost
Source/Notes: \a Colvin, 2017b \b http://www.teachersalaryinfo.com/ (East Rockaway High School)		

Average annual salary information for ERHS was converted to an average hourly wage rate and the time spent in moving and parking cars was calculated. For 60 parking spaces and 10 flood events per year, the annual opportunity cost of this nuisance flooding on staff lost time is $18,078. This calculation does not include the lost time spent with students and others caused by these interruptions that can impact a much larger number of individuals, also in intangible ways that are not monetized in this benefit cost analysis.

The cumulative present value of this avoided cost is equal to **$216,803** over the fifty year project evaluation period.

iii. Social Value

The social value estimate was based on enhanced path/trail based recreation utility value that would benefit residents and visitors in the vicinity who would use and traverse the Greenway near the school grounds. To arrive at a value of visitors per trail mile, the Hempstead Lake State Park trail density was examined. This figure was equal to (=[343,512 attendance / 7.7 m trail = 44,612 visitors/mile]) based on approximately 8 miles of trail.

Evidence from other communities who have revitalized Greenways in densely populated areas shows that these enhanced paths and trails are very heavily used. For example, the Whittier Greenway Trail, is a 4.5-mile recreational and commuter bikeway and pedestrian path that begins on the western City boundary near Los Angeles County's San Gabriel River Bike Trail and travels through Whittier, linking schools, homes, parks, shopping areas and transit stops. Public art and interpretive exhibits dot the pathway. Residents use the Whittier Greenway Trail for recreation, transportation, exercise or to simply enjoy the outdoors. A usage survey was undertaken in September 2012 as part of the National Bike and Pedestrian Documentation (NBPD). The NBPD has developed a system to determine the usage and extrapolate it into a reasonably accurate count of hourly, daily, weekly, monthly and yearly trail use. By using this methodology, the current Greenway Trail usage is: 140.7 persons per hour; 782 per day; 6,015 per week; 25,804 per month; and a grand total of 234,582 annually. These figures include both pedestrian and bicycle use. This annual usage over the 4.5 mile span translates into 52,129 trail users per mile (Whittier, 2017). This trail density usage is about 17% above the per trail mile average annual usage at Hempstead Lake State Park. As a conservative estimate of enhanced Greenway trail usage per mile in the vicinity of the ERHS Greenway trail segment, 50% of the usage per mile at HLSP is applied, (=44,612 * 50% = 22,306). **Table 11** shows the data that was applied in the calculation.

Table 11: Data Applied to Estimate ERHS Greenway Path/Trail Incremental Recreational Usage		
Element	**Value**	**Unit**
Working estimate of linear feet of improved path \a	2,401	LF
LF in a mile	5,280.0	LF
Average Attendance / mile	22,306	Trail Users/mile
Average Attendance / lf	4.2	Avg Trail user/lf
ERHS vicinity Estimated Trail/Path Usage	10,141	ERHS vicinity trail usage visit /yr.
Annual value of visits (use value)	$543,545	Trail usage visits x Rec Use Value/day
Recreation Use Values per Person per Day by Primary Activity-Northeastern Region \b		
Activity	**Value/pc/day**	
General Recreation	$34.53	
Wildlife Viewing	$59.78	
Hiking	$72.56	
Leisure Bicycling	$47.52	
Average:	$53.60	
Sources: Hempstead Lake State Park \a DT Annex 2, 2016, \b RUVD 2016		

The cumulative present value of the enhanced recreational trail usage in the vicinity of ERHS is equal to **$6,518,585** over the fifty year project evaluation period.

iv. Environmental Value

The environmental value that was estimated for the ERHS features was estimated by applying the Green Infrastructure calculator (CNT 2010). The calculator quantified the gallons of stormwater runoff that would be absorbed and filtered by trees and fringe wetlands. The calculator also quantified the pounds of criteria air pollutants that would be removed by trees and vegetation, and the pounds of carbon dioxide that would be sequestered and energy savings. Unit values, per pound of pollutant removed, and per gallon of stormwater runoff reduced were also applied. The Stormwater Retrofits report section describes the calculator features and equations in more detail.

The cumulative present value of the annual Green Infrastructure benefit from trees and fringe wetlands was equal to **$428,446** over the 50 year project evaluation period.

v. Economic Revitalization

Upon completion of the project, economic revitalization benefits will accrue to owners of properties located near the ERHS and Greenway trail. Short-term construction economic impacts are primarily considered a transfer of activity from one economic sector to another. Therefore, these activities are not considered as a net benefit to society (and thus not included within the benefit cost ratio). However, the project will contribute to the local economy by supporting jobs in the construction and related industries during the design and construction phases.

Property Value Impacts

Unlike the positive impact of well-maintained parks and ponds on property values, there is less consensus in the literature about the property value impacts of trails. For a trail, the added property value impact would be derived from the access to the trail for linear recreation activities, such as hiking or bicycling (NRPA 2004). If the trail is connected to the larger greenway and provides access to the bay, it would be reasonable to expect a larger value impact on adjacent properties.

A study in San Antonio, Texas, found that neighborhood trails were associated with a two percent house price premium while trails that were surrounded by greenbelts were associated with a five percent house price premium (Asabere and Huffman, 2007). A study of the Little Miami Scenic Trail in Ohio found that, up to a mile away from the trail, property values increase by about $7 for every foot closer to the trail. This means that a home a half mile from the trail would sell for about nine percent less than a home adjacent to the trail (Karadeniz, 2008). A study in Houston Texas found that the price premium for lots adjacent to a trail ranged from 6 to 20 percent depending on whether the neighborhood had views of the greenbelt surrounding the trail and whether it had direct neighborhood access to the trail (Nicholls and Crompton, 2005).

The proposed project involves a trail to the west of the river that would allow North South travel for the cyclists and pedestrians. There are 124 residential properties within 500 feet of the trail that are expected to benefit from the trail. Most of these properties are on the west side of the river, but properties to the east of the river near river crossings are included. Based on the 2004-2005 tax roll, the affected residential properties had a combined property value of $45.5 million. It was conservatively assumed the trail would generate a 5 percent property value premium for these properties. **Figure 6** shows a map image of these properties.

Figure 6: ERHS Greenway Proximate Properties (within 500' buffer area)

Source: Louis Berger: V. Amerlynck, 2017

Assuming the construction would be completed in 2020, the cumulative discounted present value benefit of the one-time property value premium over the 50 year analysis period would be **$1.9 million**.

Job Creation

During the construction phase, the project will create jobs in the construction and related industries. Based on the 30 percent design, the construction cost of the improvements to the East Rockaway High School structure and surrounding grounds and path is $5.1 million, including the contingency. In addition to the jobs that will be directly created by the proposed project, additional jobs will be supported through the contractor's purchase of construction materials at other New York State businesses and through the local household spending by construction workers and other workers. Upon its completion, the project will support jobs related to the operations and maintenance (O&M) of the trail. Similar to the construction spending, spending on materials and supplies required for the operations and maintenance of the park as well as household spending by its employees will support additional jobs within New York State. While typically not a net benefit to society, job creation constitutes a positive contribution to the New York State economies.

vi. Benefit Cost Analysis Results

Table 12 summarizes the results of the BCA for the ERHS Project.

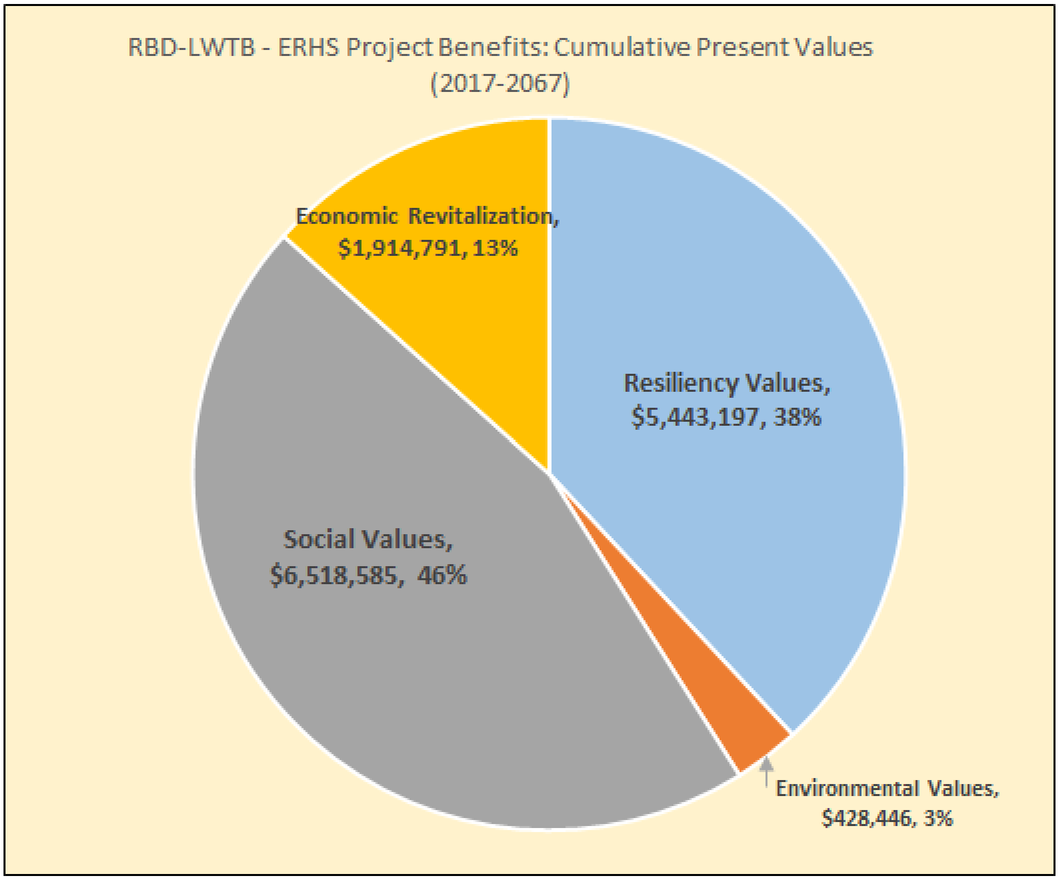
	Table 12: Benefit Cost Analysis RBD-Living with the Bay East Rockaway High School Project (Constant 2017 US Dollars)	
	Category	**Cumulative Present Value**
	LIFECYCLE COSTS	**(2017-2067)**
	Project Investment Costs	$4,642,415
	Operations & Maintenance	$1,847,610
[1]	**Total Costs**	**$6,490,025**
	BENEFITS	
[2]	Resiliency Values	$5,443,197
	Avoided damages to structures (100 yr. event based)	$1,712,796
	Avoided Athletic Event Interruption Costs	$3,513,598
	Avoided Parking Lot Staff Time Costs	$216,803
[3]	Environmental Values	
	Green Infrastructure Value of Property (Trees/Wetlands)	$428,446
[4]	Social Values	
	Recreation Value of Improved Greenway Link Trails/ Improved Paths	$6,518,585
[5]	Economic Revitalization Benefits	
	Property Value Impacts ([proximity to Enhanced Greenway Amenity])	$1,914,791
[6]	**Total Benefits**	**$14,305,019**
[7]	**Measures of Project Merit:**	
	Benefits less Costs [Net Present Value (Net Benefits @ 7%)]	$7,814,994
	Benefit Cost Ratio (BCR)	2.20
	RBD Rate of Return	23.0%

Measures of RBD Project Merit

- The ERHS Project is economically feasible and has a positive benefit cost ratio of 2.2. Benefits are more than two times the cumulative present value of lifecycle costs.
- The cumulative net present value (benefits less costs) is $7.8 million. A project with a positive net present value is an economically viable public project that will add value to the community.
- For a project to be economically feasible, the internal rate of return (IRR) must exceed the discount rate. The RBD rate of return of 23% exceeds the HUD recommended project discount rate of 7.0%.

Figure 7 below shows a breakdown of the benefits of the ERHS Project.

Figure 7


RBD-LWTB - ERHS Project Benefits: Cumulative Present Values
(2017-2067)
Economic Revitalization,
$1,914,791, 13%
Resiliency Values,
$5,443,197, 38%
Social Values,
$6,518,585, 46%
Environmental Values,
$428,446, 3%

c. Smith Pond

Background: Smith Pond is a 22-acre freshwater pond located in the center of the LWTB Project Area. It is the confluence point of the two primary drainage branches (Pines Brook and Mill River) conveying water from the north end of the Mill River watershed. As a result, it receives both the flow (water quantity) and the nutrient loads (water quality) for the entire watershed. Smith Pond is also a unique location as the connecting water body between the upper freshwater system and the lower tidal and salt water system. There is a historic account of invasive plants in the pond that inhibit sunlight from penetrating the water column and create anoxic conditions when the plants die and decompose.

Project Objectives: The objectives of the Smith Pond Project are to improve water storage for flood control and stormwater conveyance and detention purposes, improve water quality and habitat quality and enhance the Greenway public access features of Smith Pond such that an improved link to the Greenway and broader public access is possible. The Smith Pond intervention will also provide better water management and debris management to avoid negative downstream consequences on receiving water bodies, in terms of both water quantity and quality. Smith Pond has been identified as a key site for restoration and intervention.

Flood mitigation alternatives in areas around the pond at lower elevations are being evaluated from the standpoint of protecting the immediate surrounding area. Stormwater from part of Rockville Centre discharges directly into the basin downstream of the Smith Pond weir and options are being evaluated to improve conveyance and treatment of this runoff. There will likely be modifications to the existing weir at the south end of the Pond to improve flood stage elevations around the Pond. Options to modify the weir are being evaluated carefully considering the age of the existing weir and the opportunity to incorporate a fish ladder in the weir modifications (Tetra Tech 2017).

Pond bathymetry and topography surrounding the pond has been recently collected to begin assessing dredging and flood mitigation options. Additional environmental samples are being collected such as pond bottom borings to document the soil characteristics and support a dredging management plan and environmental permitting. Biological assessments are also being conducted to document the current and historic types of vegetation in the pond and along the pond's shoreline so that the final pond elevations following dredging promote habitat restoration. A dredging management plan will be prepared evaluating the opportunity to increase water depths to greater than eight (8) feet in depth to supplement storm runoff attenuation with the additional pond volume and to improve environmental conditions. The current shallow water depths in areas of the Pond combined with high nutrient loads from upstream runoff and warmer temperatures contribute to invasive plant growth in the Pond during certain months. Deeper water depths will help eliminate the opportunity for the invasive plants to thrive and appear to be able to be achieved with the dredging of approximately 33,000 cubic yards of pond bottom at average dredged depths of 12-24-inches. Part of the dredging plan will also include improving pond bottom habitat for fish so that with the inclusion of a fish ladder at the Pond weir, the fish will have appropriate habitat in the Pond (Tetra Tech 2017).

i. Lifecycle Costs

Lifecycle costs consist of both capital construction costs and the long-term annually recurring operations and maintenance costs that would be required to maintain the project assets and improvements delivered by the intervention. **Table 13** shows a breakdown of the main capital costs by project component.

Table 13: Smith Pond Project Capital Costs by Main Project Element				
	Description	**Low**	**Mid**	**High**
1	Shoreline Stabilization Natural	$180,606	$276,521	$372,436
2	Bioswales	$308,250	$453,365	$598,480
3	Recharge Basins	$160,204	$209,572	$258,940
4	Permeable Pavement - Parking Lot	$790,900	$1,564,775	$2,338,650
5	Smith Pond Outfall - Option 1 - Keep Existing Weir	$50,000	$126,500	$203,000
6	Smith Pond Outfall - Option 2 – Replacement	$280,542	$973,661	$1,666,780
7	Freshwater Wetlands - Low Marsh	$2,139,935	$2,732,768	$3,325,600
8	Freshwater Wetlands - High Marsh	$2,884,835	$3,923,243	$4,961,650
9	Dredging	$2,546,677	$5,573,358	$8,600,038
10	Landscaping	$284,256	$406,995	$529,734
11	Bridges Across Mill River	$1,042,500	$1,363,750	$1,685,000
12	Paths	$642,348	$1,012,504	$1,382,660
13	Lighting and Appurtenances	$70,120	$316,160	$562,200
14	Site Prep	$28,840	$91,340	$153,840
15	Total Construction Costs Option 1-Keep Weir	$11,129,471	$18,050,850	$24,972,228
16	Construction administration	$890,358	$1,943,513	$2,996,667
17	Contingency	$2,225,894	$3,610,170	$4,994,446
18	Option 1 Grand Total:	$14,245,723	$23,604,532	$32,963,341
19	Total Construction Costs Option 2-Replacement Weir	$11,360,013	$18,898,011	$26,436,008
20	Construction administration	$908,801	$2,040,561	$3,172,321
21	Contingency	$2,772,003	$4,029,602	$5,287,202
22	Option 2 Grand Total	$15,040,817	$24,968,174	$34,895,531

Source: << Annex 2 Cost estimate.pdf>>
Notes:
\a

The Smith Pond Project is expected to cost between $11.1 million and $34.9 million, depending on which weir option is taken (either keep the existing Weir, or replace it). For the purposes of the BCA, the midpoint cost of the more expensive option was applied. This is a midpoint estimate between a low and high estimate for the more expensive Option 2. The sensitivity analysis will test the tolerance of the positive benefit cost ratio (BCR) to increases in capital costs that will address the high estimate.

Operational and maintenance costs were estimated based on applying a typical percent of construction cost to the main construction cost elements. For the main elements the following percentages were applied and shown in **Table 14** below.

Table 14: Assumptions Applied in Smith Pond Annual O&M Cost Estimates			
O&M Element	**Construction Cost**	**O&M % \a**	**Annual O&M**
Freshwater Wetlands combined (Low and High Marsh)	$6,656,005	3.00%	$199,680
Bioswale	$453,125	1.80%	$8,156
Recharge basin	$209,572	1.00%	$2,096
Pervious Pavement \b			$1,000
subtotal:	$7,318,702		$210,932
Sources/Notes: \a Weiss et al, 2005 \b Narayanan and Pitt, 2005 ENR 2017			

The pervious pavement annual O&M cost was based on a per acre vacuum sweeping and high-pressure jet hosing and inspection cost for porous pavement. These historic unit costs were escalated to 2017 dollars based on applying the ENR Cost Index for the New York area.

ii. Resiliency Values

The resiliency values were calculated by estimating the value of the Project elements that will store water and provide detention and water management services, pollutant removal services and energy savings. Environmental values associated with wetlands benefits are described in the environmental value section. For this section, the water quantity and water quality benefits are described as they relate to resilient pond feature improvements. The Smith Pond project element (the bioswale, permeable pavement, recharge basin and trees) benefits were estimated by applying the Green Infrastructure calculator (CNT 2010). For the bioswales, permeable pavement, and proposed recharge basin the calculator quantified the combined gallons of stormwater from receiving and drainage areas. This runoff benefit for these project features was valued on an avoided cost basis by applying unit values reflecting treatment (per gallon) within Nassau County (New York State 2017, Nassau County 2017). The GI calculator also quantified the avoided electricity savings in (kWh) and dollars associated with surface water treatment and the avoided criteria air pollutants, and carbon dioxide reductions from energy saved. The Stormwater Retrofits report section describes the calculator features and equations in more detail.

Table 15 shows the monetized values by each category and by each project element for the Smith Pond Project.

Table 15: Smith Pond Annual Benefits from Green Infrastructure Project Features					
Parameter	**Trees**	**Bioswales**	**Permeable Pavement**	**Recharge Basin**	**Combined Total**
Stormwater	$383	$7,645	$71,854	$136,937	$216,819
CSO based value	$14,352	$286,275	$2,690,522	$5,127,529	$8,118,679
Electricity	$36	$29	$277	$527	$869
Natural Gas	$85	$0	$0	$0	$85
Ozone	$11	$12	$0	$146	$169
Nitrogen Dioxide	$27	$11	$11	$139	$187
Sulfur Dioxide	$13	$5	$4	$60	$83
PM10	$22	$20	$0	$236	$277
Carbon dioxide	$65	$8	$73	$140	$287
Subtotal:	$14,995	$294,005	$2,762,741	$5,265,714	$8,337,455
Sources: CNT 2010, Nassau Cty 2017, EPA 2014, <<GreenInfrastructure_Methodology.xlsx>>					

Table 16 shows the data and assumptions that were applied to calculate the benefits from the pond depth Increase, in terms of increased water storage.

Table 16: Data and Parameters Applied to Calculate Resiliency Values for Smith Pond		
Northeast Pond Dredging		
	Values	**Unit**
Dredging, Dredge sediment	66,667	yd^3 \e
1 cubic yard =	201.974	Gallons
Adjustment for groundwater location	0.545454545	\a
Estimated gallons stored	7,309,127	Gallons
Treatment cost per gallon (Drainage plus Sewer)	$0.0063	$/gal \b, \d
Avoided drainage infrastructure cost per gallon (CSO based value)	$0.2359	$/gal \c
Avoided cost of wastewater treatment	$45,965	$
Avoided stormwater infrastructure costs	$1,724,436	$
Total Annual Avoided Costs:	$1,770,401	$
Sources/Notes: \a USGS, 2013 \b New York State, 2017 \c EPA 2014 \d Nassau County, 2017, \e DT Annex 2, 2016		

The estimated value of increased pond storage was calculated by converting the cubic yards of dredged sediment removed to liquid gallons and then reducing this amount to take into account groundwater and water table elevations in Nassau County. These storage quantities were then converted to an economic value by assigning a gray infrastructure stormwater management cost to a comparable volume of water that would be retained in a drainage system and subject to conveyance and treatment processing. This method is a way to arrive at the economic shadow price of impounded water, and is an approximation of value that is closer to the avoided cost, than it is to the willingness to pay for improved storage capability and water management. Water quality estimates are provided in the Environmental Value section.

The cumulative present value of the annual value of combined green infrastructure and increased pond storage impoundment was estimated to be **$121,220,778** over the 50 year project evaluation horizon.

iii. Social Value

The social value estimate was based on enhanced path/trail based recreation utility value that would benefit residents and visitors in the vicinity who would use and traverse the Greenway near the school grounds. To arrive at a value of visitors per trail mile, the Hempstead Lake State Park trail density was examined. This figure was equal to (= [343,512 attendance / 7.7 m trail = 44,612 visitors/mile]) based on approximately 8 miles of trail. As a conservative estimate of enhanced Greenway trail usage per mile in the vicinity of the Smith Pond Greenway trail segment, 50% of the usage per mile at HLSP was applied, (=44,612 * 50% = 22,306). **Table 17** shows the data that was applied in the calculation.

Table 17: Data Applied to Estimate Smith Pond Greenway Path/Trail Incremental Recreational Usage		
Element	**Value**	**Unit**
Working estimate of linear feet of improved path \a	4,313	LF
LF in a mile	5,280.0	LF
Average Attendance / mile	22,306	Trail Users/mile
Average Attendance / lf	4.22	Avg Trail user/lf
Smith Pond vicinity Estimated Trail/Path Usage	18,221	Smith Pond vicinity trail usage visit /yr.
Annual value of visits (use value)	$653,889	Trail usage visits x Rec Use Value/day
Recreation Use Values per Person per Day by Primary Activity-Northeastern Region \b		
Activity	**Value/pc/day**	
General Recreation	$34.53	
Wildlife Viewing	$59.78	
Hiking	$72.56	
Leisure Bicycling	$47.52	
Average:	$53.60	
Sources: Hempstead Lake State Park \a DT Annex 2, 2016, \b RUVD 2016		

The cumulative present value of the enhanced recreational trail usage in the vicinity of ERHS is equal to **$7,841,915** over the fifty year project evaluation period.

iv. Environmental Value

The environmental values associated with Smith Pond were assessed based on the number of acres that would be created and would add ecosystem service values, and improve water quality. The number of acres was provided by the Annex 2 cost estimate for freshwater wetlands construction (low and high marsh). The Project would create approximately 14 acres of new wetland. Wetland areas add ecosystem service flows perennially. A benefits transfer approach was applied to value the 14 acres of incremental service flows to Smith Pond based on applying the National annual average benefit values per acre for individual ecosystem services per year produced by wetlands mitigation required under Section 404 of the Clean Water Act (Adusumilli, 2015). **Table 18** shows the values that were applied within the benefits transfer application.

Table 18: National annual average benefit values per acre for individual ecosystem services, Smith Pond Application

Ecosystem Service Value per Acre Applied in Valuation	Annual Average Benefit Value per Acre (2010 $)	Annual Average Benefit Value per Acre (2017$) \a
Recreational Fishing	$2,288	$2,548
Bird Watching	$11,166	$12,435
Water Supply Protection	$5,882	$6,551
Flood Control	$1,442	$1,606
Water Quality Protection	$7,987	$8,895

Notes:
\a Updated to 2017 by applying the US CPI
Source: Adusumilli, 2015

Applying the ecosystem service values to the 14 acres resulted in combined annual ecosystem service flows of $23,140 for the combined services of Recreational Fishing, Bird Watching, Water Supply Protection and Flood Control. The Water Supply value was calculated separately using $6551 per acre. The cumulative present value of the ecosystem service values over the 50 year project evaluation period amounted to **$5,378,508**.

v. Economic Revitalization

Upon completion of the project, economic revitalization benefits will accrue to owners of properties located near the Smith Pond. Short-term construction economic impacts are primarily considered a transfer of activity from one economic sector to another. Therefore, these activities are not considered as a net benefit to society (and thus not included within the benefit cost ratio). However, the project will contribute to the local economy by supporting jobs in the construction and related industries during the design and construction phases.

<u>Property Value Impacts</u>

As described above for Hempstead Lake State Park, there is an extensive body of research that shows that well-maintained parks and open space positively contribute to the value of nearby properties. Economists often use hedonic pricing techniques to isolate the effect of various attributes, such as proximity to a safe and clean park or pond that can influence property values (NRC, 2005). NRPA developed a methodology that can be used to estimate the property value premium of parks when it is not feasible to perform a hedonic pricing study (NRPA, 2004). Based on the methodology, residences within 500 feet of an average or higher quality park benefit from a property value premium of 5 to 15 percent (NRPA 2004). Louis Berger applied this NRPA methodology for parks to estimate the premium for residences near Smith Pond. A total of 81 residential properties are located within a 500 feet buffer around the park. Based on the property assessment records, these properties had a combined market value of $26.6 million in 2014-2015.

Figure 8: Smith Pond Greenway Proximate Properties (within 500' buffer area)

Source: Louis Berger: V. Amerlynck, 2017

Assuming a 10 percent premium for the improvement in the park quality, which corresponds to the property value premium according to the NRPA methodology of moving from a below average quality or blighted park to an above average quality park, the proximate home values would receive a one-time premium equal to $2,740,418. Assuming the construction would be completed in 2020, the total discounted present value of this property value premium would be **$2,236,997**.

<u>Job Creation</u>

During the construction phase, the project will create jobs in the construction and related industries. Based on the 30 percent design, the construction cost of the improvements to Smith Pond, can range between $11.3 and $35 million, including the contingency. In addition to the jobs that will be directly created by the proposed project, additional jobs will be supported through the contractor's purchase of construction materials at other New York State businesses and through the local household spending by construction workers and other workers. Upon its completion, the project will support jobs related to the operations and maintenance (O&M) of the pond and park. Similar to the construction spending, spending on materials and supplies required for the operations and maintenance of the park as well as household spending by its employees will support additional jobs within New York State. While typically not a net benefit to society, job creation constitutes a positive contribution to the New York State economies.

vi. Benefit Cost Analysis Results

Table 19 summarizes the results of the BCA for the Smith Pond Project.

Table 19: Benefit Cost Analysis
RBD-Living with the Bay
Smith Pond Project
(Constant 2017 US Dollars)

	Category	Cumulative Present Value
	LIFECYCLE COSTS	**(2017-2067)**
	Project Investment Costs	$22,571,456
	Operations & Maintenance	$2,529,652
[1]	**Total Costs**	**$25,101,108**
	BENEFITS	
[2]	Resiliency Values	$121,220,778
	Bioswale contribution	$3,525,925
	Permeable Pavement contribution	$33,132,800
	Recharge Basin contribution	$63,150,282
	Trees contribution	$179,828
	Pond Depth Increase/Increased water storage	$21,231,944
[3]	Environmental Values	$5,378,508
	Ecosystem services value of freshwater wetlands marsh	$3,885,091
	Value of improved Pond water quality	$1,493,417
[4]	Social Values	
	Recreation Value of Improved Pond and Greenway Amenity	$7,841,915
[5]	Economic Revitalization Benefits	
	Property Value Impacts ([proximity to Enhanced Greenway Amenity])	$2,236,997
[6]	**Total Benefits**	**$136,678,199**
[7]	**Measures of Project Merit:**	
	Benefits less Costs [Net Present Value (Net Benefits @ 7%)]	$111,577,091
	Benefit Cost Ratio (BCR)	5.45
	RBD Rate of Return	39.4%

Notes:
\a Costs represent the discounted present value of the nominal projected costs (over 2018-2019). Therefore they will appear smaller than the nominal costs due to the application of the 7% HUD recommended discount rate.

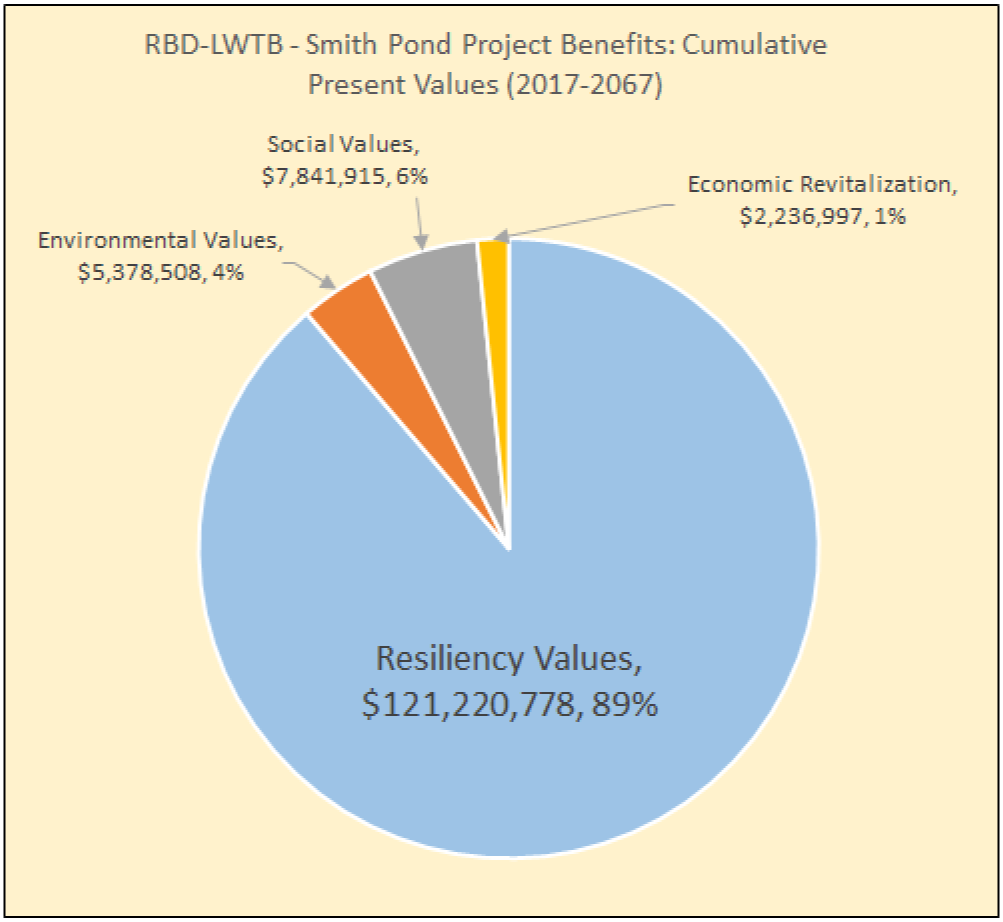
<u>Measures of Smith Pond Project Merit</u>

- The Smith Pond Project is economically feasible and has a positive benefit cost ratio of 5.45. Benefits are more than five times the cumulative present value of lifecycle costs.
- The cumulative net present value (benefits less costs) is $111.6 million. A project with a positive net present value is an economically viable public project that will add value to the community.

- For a project to be economically feasible, the internal rate of return (IRR) must exceed the discount rate. The RBD rate of return of 39.4% exceeds the HUD recommended project discount rate of 7.0%.

Figure 9 below shows a breakdown of the benefits of the Smith Pond Project.

Figure 9



d. Coastal Restoration Project

Background: The existing marshes in the project area are facing two significant problems that must be addressed if the marshes are to maintain their storm protection, ecosystem service provision, and recreational/cultural asset capabilities. These are:

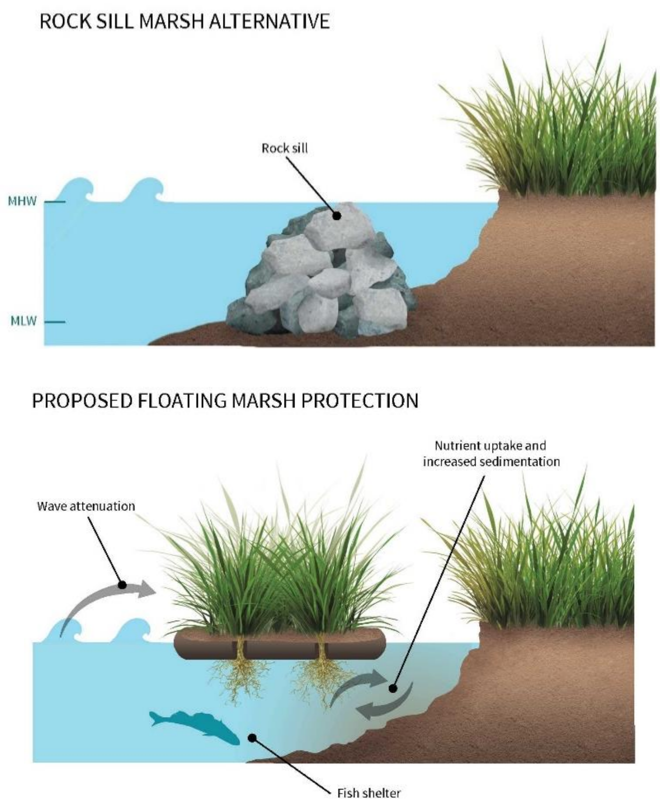
- Chronic erosion losses at the marsh fringes due to waves and boat wakes.
- Degradation and loss of marsh areas due to the effects of sea level rise.

Project Objectives: The Coastal Restoration will seek to combat and arrest erosion and degradation losses from sea level rise, and provide a more resilient coastal environment that will provide added buffering protection from future storm events and also restore ecosystem services and contain potentially harmful contaminants embedded within sediments.

Project Restoration Elements Sediment sampling has indicated that there are relatively clean marsh sediments in the upper 15-20 cm of the profile. Sediment horizons below this level show higher contaminant concentrations; the release of these contaminants represents important ecological and human health risks. Reducing the erosion of the marsh fringes and providing long-term stability of multiple marsh environments will help contain the contaminants and reduce their release into the surrounding waters and sediments (Tetra Tech, 2017).

Rock sills are a common living shoreline technique for protection of fragile marsh edges. They dampen wave energy that would otherwise erode the unstable marsh fringe area. The sills can be built with an edge to allow the use of dredged material to fill the marsh areas to higher elevations. Planting a diversity of vegetation helps the newly filled areas transition into high marsh habitat that is more resilient to changing environmental conditions and future extreme storm events. **Figure 10** below shows a schematic.

Figure 10: Schematic of Rock Sill Marsh and Floating Marsh



Source: Tetra Tech, 2017.

Floating marsh islands are another alternative to protect eroding marsh edges. Floating islands mimic the natural floating marsh systems found in Louisiana and other coastal locations. Marsh plants begin to grow on mats of floating reeds to form a tightly bound mass of vegetation that is not rooted in the bottom of the water body. Artificial floating islands are constructed of durable, recycled plastics and are vegetated with native plant materials. The floating island modules are bound together and the system is anchored immediately offshore of the marsh edge. They dampen wave energy that would otherwise erode the unstable marsh fringe area. This allows the marsh system to maintain its present level of storm surge and wave attenuation. Floating islands are also known as floating treatment wetlands since they promote the formation of biofilms that have nutrient and contaminant removal capabilities. This annual service function would help remove excess nutrients in Back Bay and prevent the area from becoming eutrophic.

These restoration techniques would be used to help protect vulnerable marsh edges from additional erosion. Beneficial reuse of dredge material in the bay would build up the marsh areas to create new marsh habitats and protect against future environmental conditions (Tetra Tech, 2017).

i. Lifecycle Costs

The Project's lifecycle costs consist of both project investment costs (upfront capital construction costs) and long-term annually recurring operations and maintenance costs. In addition, regulatory related monitoring and adaptive management costs are included for the first three years after construction. Periodic monitoring costs associated with structural integrity monitoring and assessment of the rock sills and floating marsh islands will be incurred over the lifecycle of the project.

Project investment costs were developed with inputs from the TetraTech team on the proposed project design parameters and the development of a cost estimate based on sources from recent similar projects in the region. **Table 20** shows the breakdown of the Project capital investment costs.

Table 20: Cost estimate for the design, construction and monitoring of 26.9 acres of restored tidal high marsh in Back Bay

Construction Item	Units	Unit Cost	Estimated Quantity	Total Cost
Design & Permitting (8% of construction cost)	LS	$1,011,715.84	1	$975,486
Mobilization	LS	$60,000	1	$60,000
Erosion Controls	LF	$4.84	1010	$4,890
Turbidity Barrier	LF	$93.79	11386	$1,067,893
Floating Marsh (40'x8')	Unit	$100,000	86	$8,600,000
Clean Fill (Sand)	CY	$38.00	33736	$1,281,979
Rock Sill	TON	$50.00	13471	$673,570
High Marsh Planting	SY	$2.55	25302	$64,521
Herbivory Fencing	LF	$4.55	30927	$140,719
Survey Operations	DAY	$2,500	120	$300,000
Construction Admin/Oversight (10% of construction cost)	LS	$1,219,357	1	$1,219,357
Monitoring (3 years)	LS			$117,600
Adaptive Management (3% of construction cost)	LS			$365,807
Total				$14,871,822
Contingency (15% of construction)				$1,829,036
Grand Total				$ 16,700,858

The capital cost estimate for the design, construction and monitoring of restored tidal high marsh in Back Bay is shown in **Table 20**. The above three years of monitoring costs ($117,600) are lifecycle costs that were entered into the Project Resource Statement in the years 2020-2022, at $39,200 per year. The annual O&M costs were estimated at 0.5% of the capital construction costs.

ii. Resiliency Value

Coastal wetlands reduce the damaging effects of hurricanes on coastal communities. The resiliency value for this element was based on a study that assessed the impact of coastal damages (from 34 major US hurricanes) on these communities by assessing wind speed and wetlands area in the swath, as variables that could influence and buffer the magnitude of damages. These two variables explained a high proportion of the damages inflicted on these communities (where damages were measured in Gross Domestic Product, GDP). The study found that a loss of 1 hectare of wetlands corresponded to a median ($5,000, 2004$) increase in storm damage. The study then mapped the buffering value of these wetlands after taking into account the probability of storm frequencies and varying intensities. The mean annual value per hectare was found to be $8240/ha/yr. (Costanza et al 2008). The mean value per hectare for storms that plagued the NY area was $51,263/ha in 2017 dollars. This value reflects the high per acre GDP value of the NY Metro area.

The mean annual value per acre for the NY sample was converted from hectares and updated to current dollars and was estimated to be $20,746/ac. This value was then calculated for the annual number of acres that would be preserved over time from future erosion and degradation losses (that have recurred annually) once the coastal restoration project is implemented. The cumulative present value of the hurricane storm buffering protective value on the Back Bay vicinity was estimated to be **$17,525,215** over the 50 year project evaluation period.

iii. Social Value

<u>Boating</u>

The coastal restoration of marshes has the potential to improve the recreational boating experience of small boat operators who go on excursions in the vicinity of Back Bay. Within four miles of the mouth of the Mill River, there are at least 27 marinas providing access to approximately 1,241 slips (Marinas.com, 2017). From the total number of slips, an estimate of potential visitation associated with the slip space was estimated. It is assumed that approximately two-thirds of the slip capacity boats would be drawn to the Mill River area given improved environmental conditions three times a year. This is a reasonable assumption, assuming the restoration would be completed within a few years and would draw curious boaters, bird watchers and recreational fishers.

Table 21: Marina Capacity in Project Area: Number of Slips

Marina	Slips
Bay Park Yacht Harbor is the waterfront home of All Island Marine	250
Bailey's Park Marina	40
Woodmere Bay Yacht Club	40
Reed Channel Marine	30
Matthews Waterfront Marina	40

Table 21: Marina Capacity in Project Area: Number of Slips	
Marina	**Slips**
Hewlett Point Yacht Club	30
Crows Nest Marina	40
Skip's Marina	55
Saltaire Marine	45
East Rockaway Yacht Club Inc	55
Waterview Marina	25
Davisons Boatyard	20
K & K Outboard	88
Hempstead Bay Sailing Club	60
Shell Creek Marina	15
Empire Point Marina	45
Aero Marine	15
Apache Yacht Club	45
Ultzen Boat Service	8
The Rochester Yacht Club	30
Hutchinson Marina	25
Dolphin Marina Inc.	20
The Mooring	25
Harbor Performance Marina	50
Baldwin Harbor Marine Center	35
West Marina Town Of Hempstead	60
Village of Lawrence Marina	50
TOTAL	**1,241**

To estimate the recreational value that the enhanced 29.6 acres of coastal marsh would provide to boaters in Back Bay, a per-use value was applied from a study developed for the Peconic Estuary Sanctuary in Suffolk County, New York. This value was estimated to be $30.13 (1995 dollars) (Johnston et al, 2002). Updating this use value to current dollars, this use value was ($47.46) per boating trip. The estimated number of trips in a year, assumed to start in 2020, was 4,964. The annual incremental value of boat recreation was estimated to be $235,568) per year. The cumulative present value of additional boating activity is estimated at **$2,825,107.**

The social value also includes a valuation based on coastal residents' willingness to pay for coastal restoration improvements. This value takes into account non-use values, such as existence, preservation and conservation value, and bequest value. The value was adapted from a study in Rhode Island that measured the annual willingness to pay for a household associated with the post-restoration change in the coastal wetland asset (Bauer, 2004, Abt Associates 2014). This value, estimated at $1.54 per coastal household, was updated to current dollars and applied to the Hewlett Harbor community households that would most likely have similar non-use valuations for the restored coastal wetlands proximate to Hewlett

Harbor. The cumulative present value of this non-use value was estimated to be **$268,341** over the 50 year project evaluation period.

iv. Environmental Value

The environmental value of the Project was estimated through the evaluation of ecosystem service provisioning provided by the Project and subtracting negative effects of the Project on existing ecosystem services affected by Project implementation. The ecosystem services for the Project were derived from a combination of the estimated habitat area in acres, and from habitat values per acre obtained from several published literature sources. The TetraTech team provided the estimates of the habitat sizes in acres for the Project that would be gained and Louis Berger estimated the areas of displaced habitat. The ecosystems services valuation for the BCA is limited to the value of net acres gained by ecological service type.

Table 22 below shows the ecosystem service types valued and the original values per acre per year. The HUD BCA Guidelines (HUD CPD-16-06) guidance on escalating prior year values to 2017 constant dollars was applied to update the original value estimates to 2017 values.

The conversion of existing mudflat and subtidal habitat areas to rock sill and high marsh habitats will result in a net change in ecosystem service value. The proposed use of floating marsh islands will not result in the filling and loss of subtidal habitat. Therefore, this area was not deducted as a loss of existing ecosystem service value.

Table 22: Summary of Ecosystem Services Applied to the Proposed Coastal Protection Project

Service Type	Measurement	Estuary	Rock Sills	Saltwater Wetland	Original Date of Valuation
Gas/Climate Regulation	Metric tons CO2/acre	0.5 metric tons/CO2/ hectare/yr. $28-$100/metric tons		1.78 metric tons CO2/acre/yr.; $28-$100/metric ton	2012
Disturbance Regulation	Acre/year	$344	$344	$373	2012
Water Supply	Acre/year	$39			2012
Nutrient Cycling	Acre/year	$12,814			2012
Waste Treatment	Acre/year		$3458	$6508-$7322	2012
Biological Control	Acre/year	$47			2012
Habitat/Refugia	Acre/year	$378-$438	$260	$242-$277	2012
Aesthetic	Acre/year	$351-$364		$31	2012
Recreational bird & wildlife watching	User day/acre			$649	2013
Cultural/Spiritual	Acre/year	$18		$216	2012

Note: 1 – Rock sills waste treatment value was reduced by 50% to account for lack of vegetation component.

Total Gross Ecosystem Annual Service Gains (+)

Ecosystem services annual gains were assessed for the proposed coastal wetland restoration, floating marsh and rock sill using the services listed in **Table 22** above. Monetary values are derived from USACE (2013), Costanza et. al. (2006) and Kaval and Loomis (2003). The monetary values from the literature were adjusted to 2017 values using the U.S. Bureau of Labor Statistics CPI index. These current dollar estimates are shown in **Table 23**. When a range of values were given, a midpoint value was calculated and used as the value. The estimated acreage of each habitat type was derived from calculations developed by Louis Berger based on input provided by the TetraTech team. In addition, the floating marsh islands were assessed for fewer services compared to the restored and existing marsh since these systems will not have the same properties, and functions, as a natural marsh. These factors were all applied to adjust the available surface area of the structures that have the potential to provide annual ecosystem service flows.

Table 23: Ecosystem Services Monetary Values Adjusted to 2017

Service Type	Measurement	Estuary	Rock Sills	Floating Marsh	Saltwater Wetland
		27.45 ac	0.55 acres	1.57 acres	26.3 acres
Gas/Climate Regulation	Metric tons CO2/acre	$14.7		$118.8	$118.8
Disturbance Regulation	Acre/year	$63.8	$94.5	$394.5	$394.5
Water Supply	Acre/year	$62.8			
Nutrient Cycling	Acre/year	$13,553.2			
Waste Treatment	Acre/year		$3657.5	$7313.8	$7313.8
Biological Control	Acre/year	$49.7			
Habitat/Refugia	Acre/year	$383.9	$275	$275	$275
Aesthetic/Recreation	Acre/year	$378.7			$32.8
Recreational bird & wildlife watching	User day/acre				$686.4
Cultural/Spiritual	Acre/year	$19			$228.5

To account for a lag time in the establishment of saltmarsh habitat and benefits, percentages (out of 100% of full annual ecosystem service delivery) are applied to specific services during the first three years post-construction. **Table 24** lists the modifiers used in this analysis. The values applied are based on references reporting on monitoring observations for constructed reefs and breakwaters.

Table 24: Ecosystem Services Extended Value/Time Lag Modifiers by Habitat Type

Service Type	Measurement	Rock Sills	Floating Marsh	Saltwater Wetland
		Extended Value / Time Lag Modifiers		
		Years 1-3	Years 1-3	Years 1-3
Gas/Climate Regulation	Metric tons CO2/acre		50%,75%,100%	50%,75%,100%
Disturbance Regulation	Acre/year	100%	50%,75%,100%	50%,75%,100%
Nutrient Cycling	Acre/year	80%,90%,100%	100%	100%
Waste Treatment	Acre/year	50%,75%,100%	50%,75%,100%	50%,75%,100%

Table 24: Ecosystem Services Extended Value/Time Lag Modifiers by Habitat Type				
Service Type	**Measurement**	**Rock Sills**	**Floating Marsh**	**Saltwater Wetland**
		Extended Value / Time Lag Modifiers		
Biological Control	Acre/year	100%	100%	100%
Habitat/Refugia	Acre/year	80%,100%,100%	80%,100%,100%	80%,100%,100%
Aesthetic/Recreation	Acre/year		90%,100%,100%	90%,100%,100%
Recreational bird & wildlife watching	User day/acre		90%,100%,100%	90%,100%,100%
Cultural/Spiritual	Acre/year		100%	100%

<u>Total Ecosystem Annual Services Displaced (-)</u>
The construction of the saltmarsh would displace approximately 26.9 acres of mudflat and subtidal open water bottom habitat. For these habitats, services and monetary values were derived from USACE (2013) and Costanza et al (2004) appropriate benefit transfer sources. The services include disturbance regulation, water supply, biological control, nutrient regulation, and cultural and spiritual values. Costanza (2004) referred to the shallow tidal zones coastal zones as “Estuary” which was defined as tidal bays.

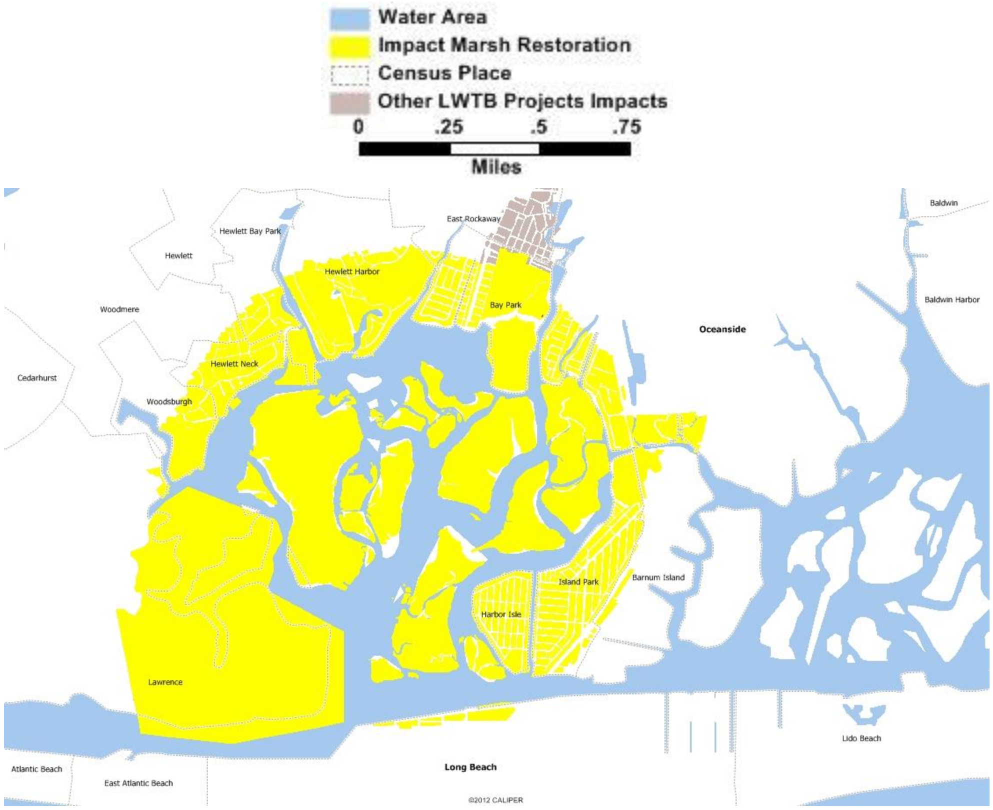
<u>Net Ecosystem Annual Service Gains (+)</u>
The total calculated value for the displaced mud flat and subtidal habitat was subtracted or netted from the coastal saltmarsh total values. The combined cumulative discounted present value for the combination of High Marsh Ecosystem Services Annual Values, Low Marsh Ecosystem Services (Floating Marsh Islands) Annual Values, and the Rock Sill Value was **$3,463,444.**

v. Economic Revitalization

Upon completion of the project, economic revitalization benefits will accrue to owners of properties located near the coastal marshes in the Back Bay vicinity. Short-term construction economic impacts are primarily considered a transfer of activity from one economic sector to another. Therefore, these activities are not considered as a net benefit to society (and thus not included within the benefit cost ratio). However, the project will contribute to the local economy by supporting jobs in the construction and related industries during the design and construction phases.

<u>Property Values</u>
The coastal restoration project impact on coastal property values was based on a study that examined the one-time market price impact on the reduction in flood risks attributable to coastal restoration. The study surveyed available hedonic property valuation studies that indicated that a 1% reduction in flood risk translates to approximately 0.5%-5% improvement in property values (Abt Associates 2014). Data on the value of homes in the vicinity of the coastal restoration project that would receive a one-time property value enhancement benefit were assembled. **Figure 11** shows the vicinity.

Figure 11: Coastal Restoration Project Proximate Properties (within 500' buffer area)



Source: Louis Berger: V. Amerlynck, 2017

A 1% market price premium was applied to the estimated market value of these homes. The cumulative present value of the one-time market premium was estimated to be **$10,949,773.**

Short-term Construction Phase Economic Impacts

The construction phase of the coastal restoration project will also benefit select industries and their linked suppliers and vendors who are involved in coastal marsh restoration. Related engineering and construction consulting services will also benefit as will marine services that provide support. The wages spent from earnings derived from restoration linked contracts and linked suppliers will also benefit the south shore and Nassau County economy.

vi. Benefit Cost Analysis Results

Table 25 summarizes the results of the BCA for the Coastal Restoration Project.

Table 25: Benefit Cost Analysis
RBD-Living with the Bay
Coastal Restoration Project
(Constant 2017 US Dollars)

	Category	**Cumulative Present Value**
	LIFECYCLE COSTS	**(2017-2067)**
	Project Investment Costs	$14,991,416
	Monitoring (3 years)	$89,853
	Operations & Maintenance	$994,393
[1]	**Total Costs**	$16,075,662
	BENEFITS	
[2]	Resiliency Values	$17,525,215
[3]	Environmental Values	$3,463,444
	High Marsh Ecosystem Services Values	$3,265,610
	Low Marsh Ecosystem Services Values	$166,507
	Rock Sill Value	$31,327
[4]	Social Values	$3,093,449
[5]	Economic Revitalization Benefits	$10,949,773
[6]	**Total Benefits**	$35,031,882
[7]	**Measures of Project Merit:**	
	Benefits less Costs [Net Present Value (Net Benefits @ 7%)]	$18,956,220
	Benefit Cost Ratio (BCR)	2.18
	RBD Rate of Return	22.2%

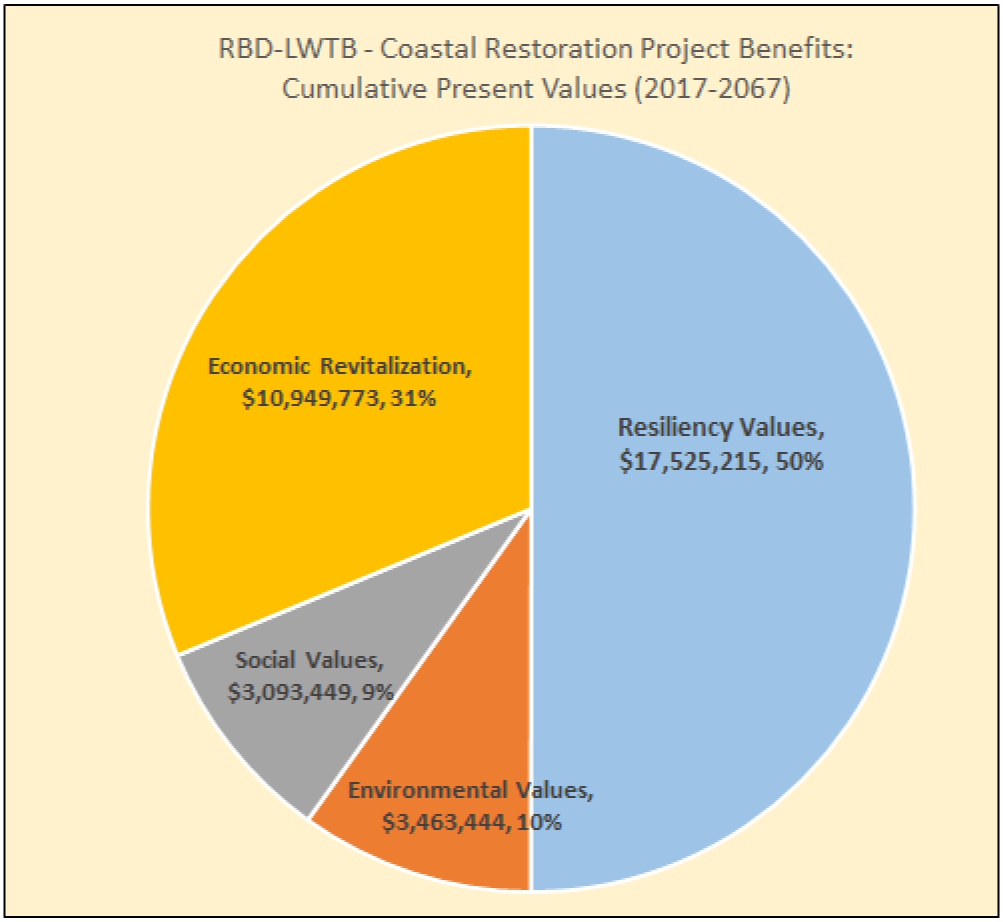
Notes:
\a Costs represent the discounted present value of the nominal projected costs (over 2018-2019). Therefore they will appear smaller than the nominal costs due to the application of the 7% HUD recommended discount rate.

Measures of Project Merit: Coastal Restoration Project

- The Coastal Restoration Project is economically feasible and has a positive benefit cost ratio of 2.18. Benefits are two times larger than the cumulative present value of lifecycle costs.
- The cumulative net present value (benefits less costs) is $18.9 million. A project with a positive net present value is an economically viable public project that will add value to the community.
- For a project to be economically feasible, the internal rate of return (IRR) must exceed the discount rate. The RBD rate of return of 22.2% exceeds the HUD recommended project discount rate of 7.0%.

Figure 12 below shows a breakdown of the benefits of the Coastal Restoration Project.

Figure 12


RBD-LWTB - Coastal Restoration Project Benefits:
Cumulative Present Values (2017-2067)
Economic Revitalization,
$10,949,773, 31%
Resiliency Values,
$17,525,215, 50%
Social Values,
$3,093,449, 9%
Environmental Values,
$3,463,444, 10%

e. Stormwater Retrofits

i. Background

A critical piece of the LWTB program is addressing flood mitigation. For the program area, this includes finding solutions to chronic drainage problems in the community that continue to worsen as a result of more frequent critical storm events and tidal surge similar to the problem area shown in **Figure 13** and the problems experienced during and after Superstorm Sandy. The approach to address this problem is through a variety of retrofits incorporating stormwater best management practices (BMPs) with a complementary intent and underlying theme of the LWTB concept being that the projects can be duplicated elsewhere in the program area and on Long Island.

Figure 13: Chronic flooding problem in the Village of Lynbrook (Source Tetra Tech, 2017)

The LWTB design identified the desirability of green infrastructure retrofit projects which will improve stormwater collection and conveyance to mitigate flooding and incorporate water quality improvement components. Some of the project types which are being developed in the Resiliency Strategy include the following (Tetra Tech, 2017):

Parcel-Based Green Infrastructure. Green infrastructure typically incorporates multiple practices utilizing the natural features of the site in conjunction with the goal of the project. Multiple BMPs can be incorporated into a site to complement and enhance the current land use while also providing volume reduction and water quality treatment. Green infrastructure practices are those methods that provide control and/or treatment of stormwater runoff on or near locations where the runoff initiates. Typical parcel based practices include approaches such as vegetated infiltration basins, stormwater wetlands, and subsurface practices as shown in **Figures 14 and 15**. Publicly owned open space parcels will be evaluated throughout the watershed to identify potential opportunities to incorporate green infrastructure practices to reduce flooding in areas with limited or no drainage infrastructure.

The Hempstead Housing Authority (HHA) is located in a low lying area affected by 10-year flood events. The proposed interventions for the HHA include the creation of additional stormwater storage by creating a storage/recharge basin to mitigate storm water peak flows.

Figure 14: Typical surface infiltration basins (Source: Tetra Tech, 2017).

Figure 15: Stormwater wetland in a park (Source: Tetra Tech, 2017).

<u>Green Streets</u>. Green streets are a dense network of distributed BMPs concentrated on a public right-of-way. Green streets are often referred to as BMPs, but actually employ multiple distributed BMPs in a linear (rather than parcel-based) fashion. The green street BMP configuration strategy implements BMPs within the street right-of-way with designs that reduce runoff volume and improve water quality of the runoff both from the street and adjacent parcels. Green Street features can include vegetated curb extensions incorporating bioretention, sidewalk planters, bump outs at intersections incorporating bioretention, permeable paving, and suspended pavement systems. Green streets could be implemented throughout the residential areas to reduce localized flooding where there are micro depressions and little or no drainage infrastructure.

The most common approaches include bioretention areas located between the edge of the pavement and the edge of the right-of-way and permeable pavement installed in the parking lanes. Permeable pavement in Long Island is less desirable due to the use of sand to treat roadways and the limitation of small municipalities to expand maintenance activities. An alternative option for integrating water quantity and water quality improvements is to integrate storage and treatment under the sidewalk using a suspended pavement system. Suspended pavement uses structural frames to support the weight generated by sidewalks and roadways while providing open void space for runoff storage and treatment underneath. The runoff is treated as it passes beneath the pavement and through an engineered soil media before exiting through infiltration or an underdrain. Suspended pavement systems allow for the integration of BMPs with little to no disturbance to the surface, and serve as an improved BMP over more traditional dry wells located throughout the program area.

The benefits of green streets will be evaluated using a multi-step process to (1) evaluate the typical green street configuration (2) quantify potential unit load reductions (3) and apply the unit load reductions to streets throughout the watersheds based on expected opportunity. The storage and treatment capacity of the green street can be significantly increased by utilizing available storage under the full width of the right of way. Substantial flood mitigation combined with water quality improvement may be possible. **Figure 16** shows some of the potential components of a green street or right-of-way system, including suspended sidewalk and bioretention. **Figure 17** shows a typical green street cross section.

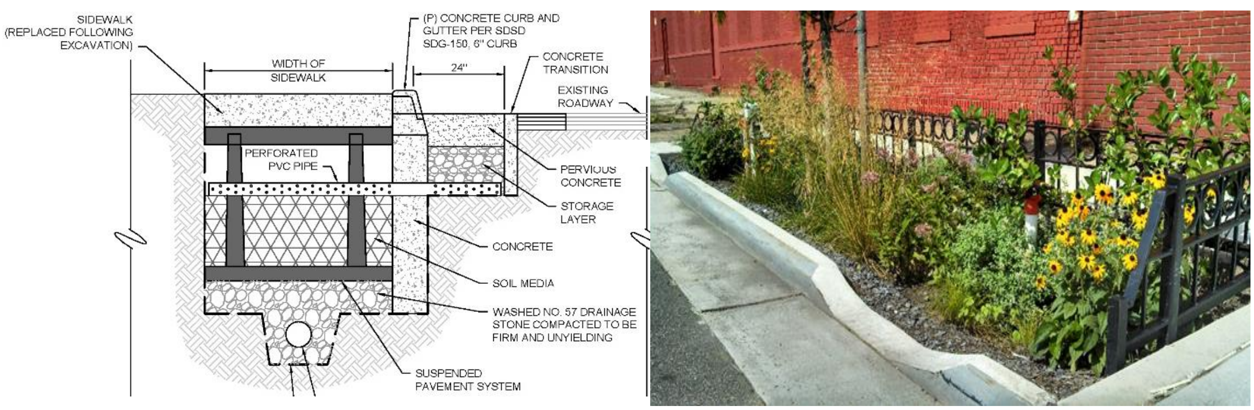


Figure 16: Suspended sidewalk system (left) and bioretention in the Right-of-Way (right).
Source: Tetra Tech 2017.

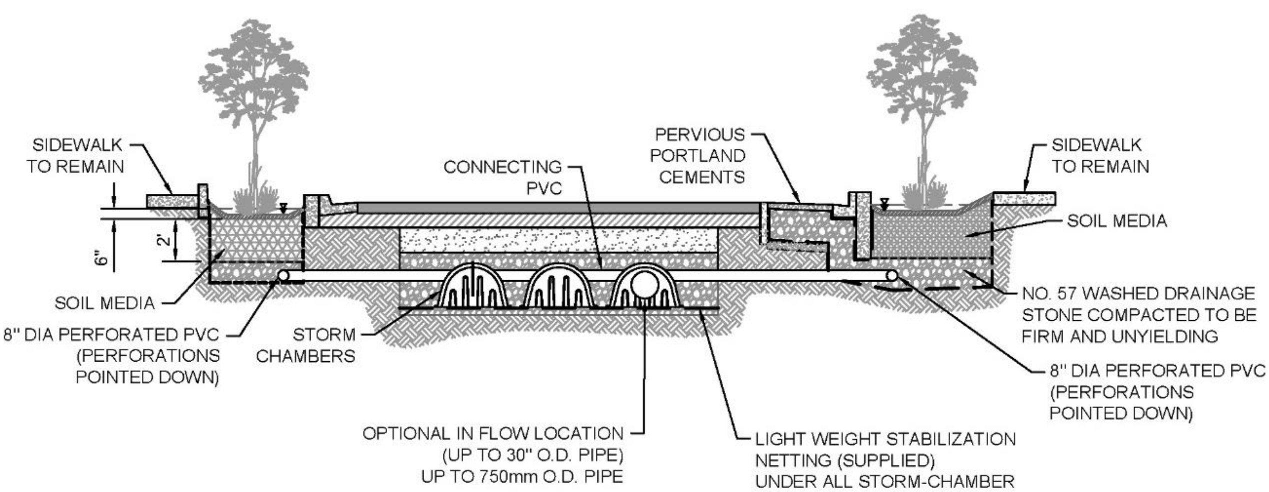


Figure 17: Typical green street cross section (Source: Tetra Tech, 2017).

Green-Gray Infrastructure. In some cases, traditional structural or "gray" infrastructure in the form of additional inlets and stormwater pipe will be required to provide the necessary flood mitigation. At locations where this will occur, the design team will incorporate "green" infrastructure elements that will provide more ecological and environmental benefits where practical. Exfiltration beds and/or structures could be utilized to retain and treat the runoff rather than sending the collected water immediately downhill. In addition, minor design elements, such as stormwater structures with sumps (two to three foot deep bottoms) can help collect sediment prior to being discharged to downstream surface waters.

Figure 18: Typical green-gray infrastructure construction (Source: Tetra Tech, 2017)

Currently, the estimated budget for this focus area is approximately $9.2 million. The Stormwater Retrofit projects are expected to reach 100% design in the fourth quarter of 2018 with construction expected to take place from the second quarter of 2019 to the third quarter of 2022.

ii. Stormwater Retrofits – Qualitative Benefits Assessment

As described above, the stormwater retrofits implemented as part of the Living with the Bay Project will result in additional resiliency, environmental, social and economic revitalization benefits. Specific benefits for these proposed projects have not been quantified and monetized within this BCA given that designs have not been finalized. However, this section provides a qualitative assessment of these benefits. The benefits are expected to have a strong positive impact on the community equivalent to **++**.

One significant benefit of stormwater retrofits is the flood mitigation value they provide. Stormwater retrofits provide flood mitigation through two notable methods. First, stormwater retrofits reduce or slow the amount of stormwater entering the stormwater drainage system. By doing so, the load on the drainage system is decreased and the frequency and severity of stormwater backups are mitigated. Second, stormwater retrofits filter out sediments and other material that may otherwise clog the stormwater drainage system. Clogs in the stormwater drainage system reduces its capacity and increases the severity and frequency of stormwater backups. By reducing the opportunity of clogs and impediments to flow, stormwater retrofits not only mitigate stormwater backups, but also reduce the need for maintenance on the stormwater drainage system (NRC 2008).

The benefits from flood mitigation by stormwater retrofits can be quantified by modeling the change in severity and frequency of stormwater flooding. Then, benefits of the flood mitigation can be monetized by analyzing the assets that will experience the reduced flooding. Assets can realize the benefits of flood mitigation in several ways (DNREC, 2011).

Mitigating stormwater flooding reduces the damages done to properties within the flood area. Damages from stormwater flooding affect both the structure on the property flooded and the contents of the structures. The damages to both the structure and its contents can be modeled as a function of flood depth and property value. The relationship between damages, flood depth, and property values are delineated by depth damage functions. The Federal Emergency Management Agency (FEMA) provides a multitude of depth damage functions that could be applied to a broad range of structures (FEMA, 2011).

In addition, stormwater retrofits reduce the amount of sediments entering the stormwater drainage system and downstream water bodies. For example, the sump pumps implemented as part of the Living With The Bay projects would collect sediments prior to being discharged to downstream surface waters. Reducing the sediments in surface waters would reduce the clogging of the water and mitigate bank erosion, and flooding. Reducing sediments will also mitigate the deterioration of the storage capacity of reservoirs, destroying of wetland areas, and degradation of water quality. Furthermore, sediments in surface waters cover spawning areas, smother eggs, aquatic insects, and oxygen producing plants. Sediments will increase the turbidity, or suspended sediments, which increases water temperature, reduces light penetration and plant growth, and affects the ability of fish to locate and capture prey. Thus, reducing sediments in surface waters would protect the aquatic habitat of species in those waters (NC State, 2017).

The stormwater retrofits proposed in the Living with the Bay Project would also remove pollutants from runoff and prevent them from entering the drainage system. The removed pollutants would otherwise need to be treated at a treatment facility. Removing the amount of pollutants from the system reduces the load on treatment facilities and may lead to higher water quality. The quantification and monetization of this benefit is further described in the previous section.

On top of the benefits described above, stormwater retrofits can increase the property value of parcels that are positively affected by the implementations. The Ontario Ministry of Environment found that property values can increase by 5% due to reduced downstream flooding and by 15% due to an improvement in water quality (NC State, 2017). These benefits will not only increase the value of assets of property owners in the Living With The Bay study area, but will also increase the attractiveness of properties in the area for incoming home or business owners.

f. Greenway Project

Project Background and Objectives: Continuous safe pedestrian pathways from the residential areas to the waterfront in the Living with the Bay Project area are rare and if they exist, they are fragmented with little connectivity for any significant lengths. The winning RBD, Living with the Bay project noted the overall scale and existing land use of the project area makes it ideal for biking, walking, and boating, but existing routes toward or along the river and bay are ad-hoc and discontinuous, and the adjacent neighborhoods' access to the river is poor. Combining this fact with the potential degradation of stormwater management and environmental habitat has created a concern for the sustainable resilience of the community.

Project Description: The RBD Living with the Bay design called for the landscapes along Mill River to be interconnected into a strong "blue green" framework in order to improve public accessibility and visibility of the Mill River as a means to increase safety, and enhance the ecological and landscape value of this historic water course. It will also increase recreational opportunities for the densely populated communities around the river as an effort that will only be good for the community as a long-term positive benefit to the residents. The development of a continuous Greenway is intended to be a strong feature for the suburban layout along and adjacent to the Mill River, thus transforming it into an attractive public amenity. The intent is to take the currently disconnected recreational and open resources in the LWTB project area, as well as schools, and link them into a coherent system of pedestrian and bike paths, resulting in the creation of a new blue green identity. Another goal of the Greenway component of the project is to adopt and develop new sites along the Mill River that are presently underutilized and / or not accessible, and make these sites productive towards the LWTB objectives.

The design level of service elements of the multi-use path will, where practical, typically include 10 feet wide permeable pavement with water storage and infiltration under the path. As a linear element and where space permits, the paths will serve as interceptors of surface stormwater runoff through parallel bioswales.

i. Lifecycle Costs

Lifecycle costs consist of the capital construction and long-term running or operational costs estimated to maintain the Greenway. **Table 26** shows the estimated capital costs for the Greenway Project. In the BCA the high cost estimate was applied to be conservative and to reflect the possibility of additional costs contingencies.

Table 26: Greenway Project Capital Costs	
Project	**Cost – (high est.)**
Greenway	$10,894,916
Mill River Complex South	$6,263,651
Mill River Complex North	$5,005,859
Sunrise Highway	$5,663,233
Total:	$27,827,659

The main project elements include permeable pavement and materials, bioswale, water filters, excavation, greenway signage and trail markers and linkage construction and associated structures needed to enable the Greenway concept, at various watershed nodes, and create a contiguous uninterrupted path with enhanced access features. Long-term O&M costs were estimated at 2.5% of capital cost. Maintenance costs associated with maintaining porous pavement (to a high function) can consist of vacuum sweeping and high-pressure jet hosing and inspection costs.

Based on locations and sources of flooding identified during project development, green infrastructure improvements initially identified for the Greenway in the Living with the Bay Project application may be re-prioritized to Stormwater Retrofits to maximize flood mitigation.

ii. Resiliency Value

The main resiliency values associated with the Greenway are based on the permeable pavement values and their contribution to stormwater flood risk mitigation and attenuation of stormwater nuisance flooding events by improving the remnants of the Mill River floodplain within an urban setting. Replacing impervious surfaces in urban areas with permeable pavement materials that allow stormwater to infiltrate and be absorbed back into the ground can reduce stormwater contributions to runoff and high velocity poor water quality contributions to the Mill River and downstream catchment areas. In addition, and because permeable pavement tends to be more reflective than dark pavement and more evaporative, it absorbs less heat.

The resiliency and environmental values quantified for the Greenway Project were estimated by applying the Green Infrastructure calculator (CNT 2010). The calculator quantified the gallons of stormwater runoff that would be absorbed and filtered by the urban greenspace allocated to the Greenway. The calculator also quantified the pounds of criteria air pollutants that would be removed by trees and vegetation, and the pounds of carbon dioxide that would be sequestered and energy savings. Unit values, per pound of pollutant removed, and per gallon of stormwater runoff reduced were also applied. The Stormwater BMP / Green Infrastructure report section describes the calculator features and equations in more detail.

Because of the resiliency value of the large amount of permeable, porous acreage that would be created by the Greenway Project, that would contribute to more effective stormwater management and reducing nuisance flooding and high velocity runoff, and river bank erosion and destabilization, this value was categorized under the “Resiliency Value” category.

The cumulative present value of the resiliency value over the project evaluation period was estimated to be **$61,804,253.**

iii. Social Value

Studies have documented the numerous social, economic, environmental and community benefits of Greenways. Greenway benefits include the following: (i) Creating value and generating economic activity, (iii) Improving public health through active living, and providing a convenient urban area for this use, (iv) Enhancing cultural awareness and community Identity (Greenways, 2017). The trails and their signage / educational mission can provide a living classroom type of experience to users also. This BCA quantifies and monetizes the recreational benefits of the Greenway that reflects per user per day utility values for biking, walking/hiking, bird watching and wildlife viewing and general recreation.

The main social benefit was based on similar methods applied above that considered the recreational usage of the Greenway and the use value to users. The improved and enhanced, interconnected Greenway acres of 7 acres was applied in the calculation (PPT, 2017). This value was multiplied by an estimated number of average trail users, taken at 1/5th the value of the Hempstead Lake State Park trail density and was equal to (8,922.39 visitors/mile). Applying this figure to the seven mile estimate, resulted in an annual Greenway usage visitation equal to 62,457 visitors per year. This estimated annual visitation was multiplied by an average recreational use value per person per day of $53.6. This value reflects the main uses of general recreation, wildlife viewing, leisure bicycling and walking/hiking. The annual total value of visitation was estimated to be $3,347,524 per year.

The cumulative present value of the quantified social value over the project evaluation period was estimated to be **$40,145,951.**

iv. Environmental Value

The environmental values that were quantified and monetized for the Greenway Project reflect the value of bioswales and also the atmospheric gas and climate change regulating ecosystem services provided by the Greenway.

Bioswales are a stormwater treatment best management practice which are effective at treating the first flush of discharge from a precipitation event. This is critical in that the first flush of any stormwater event often contains the greatest amount of entrained sediments and contaminants (e.g., oils, salt, etc.). The bioswales can remove the entrained sediments and contaminants of the first-flush water before it enters the ecosystem. Because of this water quality improvement benefit, bioswale values are credited within the BCA's Environmental Value category. The benefit of bioswales was estimated using the Green Infrastructure Green calculator (CNT 2010). The calculator quantified the gallons of stormwater runoff that would be captured and treated by the bioswale feature in the Greenway. The calculator also quantified the pounds of criteria air pollutants that would be removed by trees and vegetation, and the pounds of carbon dioxide that would be sequestered and energy savings. Unit values, per pound of pollutant removed, and per gallon of stormwater runoff reduced were also applied.

The climate and atmospheric gas regulation function associated with urban greenspaces was estimated by applying a benefits transfer value to the estimated number of Greenway acres. The value per acre applied was estimated at $432/ac (Gas & Climate Regulation, Costanza, 2006). The cumulative present value of this ecosystem service was estimated to be **$23,209,195** over the 50 year project evaluation period.

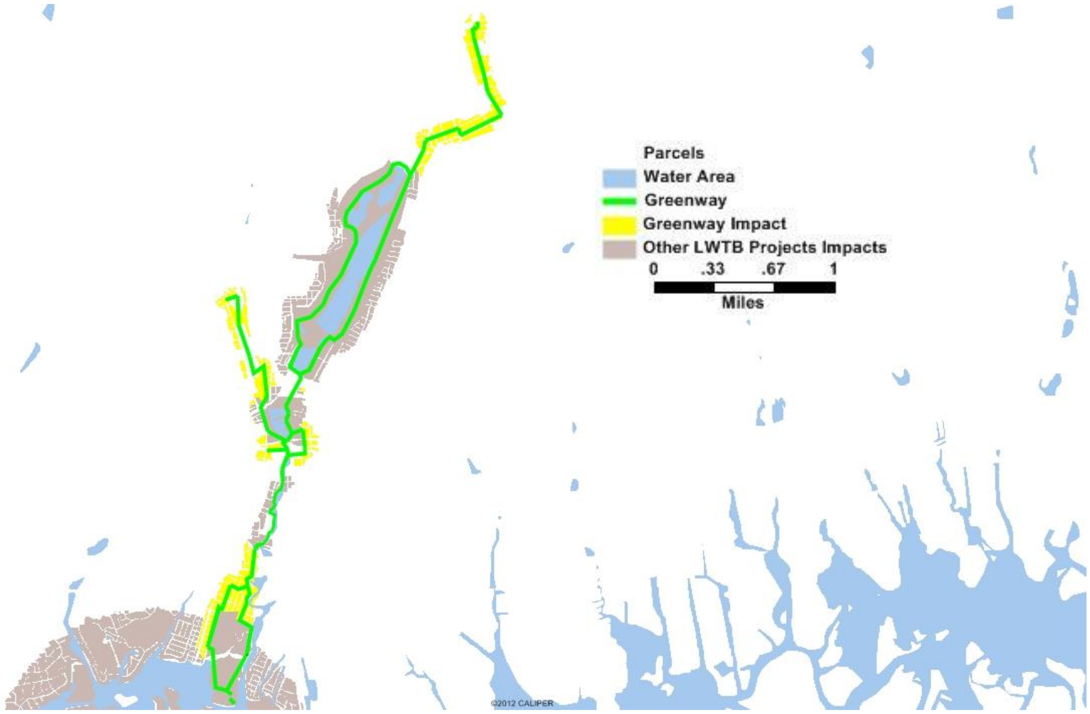
v. Economic Revitalization

Upon completion of the Greenway Project, economic revitalization benefits will accrue to owners of properties located near the Greenway. Short-term construction economic impacts are primarily considered a transfer of activity from one economic sector to another. Therefore, these activities are not considered as a net benefit to society (and thus not included within the benefit cost ratio). However, the project will contribute to the local economy by supporting jobs in the construction and related industries during the design and construction phases.

<u>Property Value Impacts</u>

As described above for the other project elements linked to the Greenway, there is an extensive body of research that shows that well-maintained parks and green open spaces positively contribute to the value of nearby residential properties. Economists often apply hedonic pricing techniques to isolate the effect of various attributes, such as proximity to a safe and clean park, pond or urban Greenway, that can influence property values (NRC, 2005). NRPA developed a methodology that can be used to estimate the property value premium of parks when it is not feasible to perform a hedonic pricing study (NRPA, 2004). Based on the methodology, residences within 500 feet of an average or higher quality park benefit from a property value premium of 5 to 15 percent (NRPA 2004). Louis Berger applied this NRPA methodology for parks to estimate the premium for residences near the Greenway footprint.

Figure 19: Greenway Proximate Properties (within 500’ buffer area)



Source: Louis Berger: V. Amerlynck, 2017

The property value impact calculations have all been adjusted for potential double counting of the Greenway segments that are part of the other LWTB projects evaluated. The Greenway Project residential parcels only reflect those that are nearest to this project element. Assuming the construction would be completed in 2020, the total discounted present value of this property value premium would be **$14,574,146**.

Job Creation

During the construction phase, the project will create jobs in the construction and related industries. In addition to the jobs that will be directly created by the proposed project, additional jobs will be supported through the contractor’s purchase of construction materials at other New York State businesses and through the local household spending by construction workers and other workers.

Upon its completion, the project will support jobs related to the operations and maintenance (O&M) of the Greenway and upkeep of permeable pavement, trails and signage and bioswales. Similar to the construction spending, spending on materials and supplies required for the operations and maintenance of the Greenway as well as household spending by maintenance workers will support additional jobs within New York State. While typically not a net benefit to society, job creation constitutes a positive contribution to the New York State economies.

vi. Benefit Cost Analysis Results

Table 27 summarizes the results of the BCA for the Greenway Project.

	Table 27: Benefit Cost Analysis RBD-Living with the Bay Greenway Project (Constant 2017 US Dollars)	
	Category	**Cumulative Present Value**
	LIFECYCLE COSTS	**(2017-2067)**
	Project Investment Costs	$25,156,457
	Operations & Maintenance	$8,343,239
[1]	**Total Costs**	$33,499,696
	BENEFITS	
[2]	Resiliency Values	$61,804,253
[3]	Environmental Values	$25,136,570
[4]	Social Values	$40,145,951
[5]	Economic Revitalization Benefits	$14,574,146
[6]	**Total Benefits**	**$141,660,919**
[7]	**Measures of Project Merit:**	
	Benefits less Costs [Net Present Value (Net Benefits @ 7%)]	$108,161,223
	Benefit Cost Ratio (BCR)	4.23
	RBD LWTB Rate of Return	45.3%

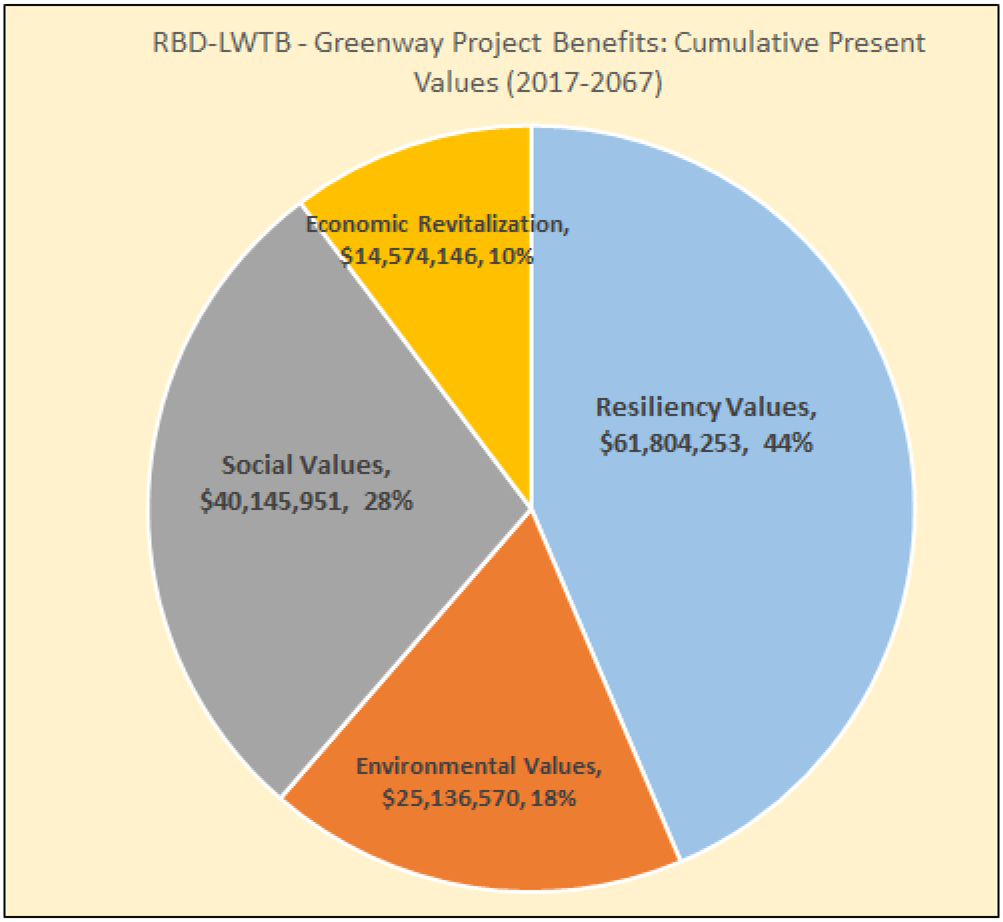
Notes:
\a Costs represent the discounted present value of the nominal projected costs (over 2018-2019). Therefore they will appear smaller than the nominal costs due to the application of the 7% HUD recommended discount rate.

<u>Measures of Project Merit: Greenway Project</u>

- The Greenway Project is economically feasible and has a positive benefit cost ratio of 4.23. Benefits are four times larger than the cumulative present value of lifecycle costs.
- The cumulative net present value (benefits less costs) is $108.2 million. A project with a positive net present value is an economically viable public project that will add value to the community.
- For a project to be economically feasible, the internal rate of return (IRR) must exceed the discount rate. The RBD LWTB rate of return of 45.3% exceeds the HUD recommended project discount rate of 7.0%.

Figure 20 below shows a breakdown of the benefits of the Greenway Project.

Figure 20


RBD-LWTB - Greenway Project Benefits: Cumulative Present Values (2017-2067)
Economic Revitalization, $14,574,146, 10%
Resiliency Values, $61,804,253, 44%
Social Values, $40,145,951, 28%
Environmental Values, $25,136,570, 18%

IX. Project Risks

a. Description of Project Risks

A large-scale watershed based intervention such as the Living with the Bay Project can be confronted with numerous risks. These risks run the gamut from increased costs for construction raw materials and labor to schedule delays, stakeholder and coordination issues, and potentially disruptive acts brought by disgruntled stakeholders who do not appreciate nor understand the goals of the Project. These risks can also influence the proposed timing of the project interventions and schedule. With these short-term manageable risks, comes the long-term uncertainly of climate change and the likelihood of more frequent and severe climatic events that can influence the Mill River Basin, Greenway and surface water bodies.

b. Sensitivity Analysis

A sensitivity analysis was completed that assessed the impacts of the Project's cumulative present value of net benefits and Benefit Cost Ratios (BCRs) based on potential increases in lifecycle costs, reductions in anticipated benefits for the categories providing the most value, and construction delays. **Table 28** shows the results of the sensitivity analysis.

Table 28: Benefit Cost Analysis Sensitivity Analysis Living with the Bay Combined Projects*

Test	Baseline Project / Net Present Value / BCR	Project Net Present Value with Change	BCR with Test Change	Switching Value \a
[1]	[2]	[3]	[4]	[5]
Increase in Capital Costs (30%)	$285,101,456 / 3.44	$255,214,626	2.74	286.0%
Increase in Annual O&M (50%) \a	$285,101,456 / 3.44	$276,425,912	3.20	1640%
Decrease in Resiliency Benefits (Percent of Baseline Estimates):				
75% of Baseline	$285,101,456 / 3.44	$228,717,961	2.95	$285,101,456
50% of Baseline	$285,101,456 / 3.44	$172,334,466	2.47	$285,101,456
25% of Baseline	$285,101,456 / 3.44	$115,950,970	1.99	$285,101,456
Zero Resiliency Benefits	$285,101,456 / 3.44	$59,567,475	1.51	$285,101,456

Notes:
\a the switching value is the percentage change in the variable of interest that renders the cumulative net present value of the Project (benefits – costs) equal to zero (BCR = 1.0), holding all of the other variables constant.
*Sensitivity test was run on the combined projects (HLSP, ERHS, Smith Pond, Coastal Restoration and Greenway)

Column [1] shows the type of stress test that the net present value amount (benefits less costs, or net benefits) and the Benefit Cost Ratio (BCR) were subjected to. A 30% increase in capital costs would the lower the BCR from 3.44 to 2.74, and lower the cumulative net present value of the Project (net benefits) by $255 million. The switching value shows the increase in capital construction costs that would render the net present value of the Project equal to zero. A 50% increase in annual operational and maintenance costs (O&M) would result in the baseline BCR declining to 3.44 from 3.2.

Resiliency values represent the largest category of values (56%). The sensitivity analysis starts by reducing the combined value of resiliency benefits to a percentage of the baseline total value for this category. The Project's total net present value would still be positive even if resiliency benefits fell by 75%, to a level representing 25% of the baseline total amount. The other value categories (Environmental, Social and Economic Revitalization) could sustain the positive Benefit Cost Ratio, if resiliency values were zero.

X. Assessment of Implementation Challenges

Implementing a large project in a densely populated area can present challenges during the various project stages: design, construction and operations. During the construction phase, there are challenges likely to be encountered with area traffic management and working near the Southern State Parkway. In addition, there are logistical challenges associated with finding adequate space for laydown and staging areas, to store equipment and materials in tight spaces in some areas along the Mill River within the Project Area.

There is also a risk that with some of the Projects (coastal restoration) the demand for certain raw materials (sand, rocks) may drive prices higher than initially estimated. This heightened level of construction and development activity may present increased demands on scarce resources such as skilled labor and craft workers, select materials and equipment and contractors available for work on specific project elements and contract packages. These kinds of market demands can be reflected in higher costs for both labor and materials, and potentially result in scheduling delays.

Given the large number of public agencies, and other stakeholders (both public and private) involved in the Project, there may be some challenges encountered related to coordination, communication and scheduling / sequencing of events, and timing. These coordination issues are likely to arise during the design, construction/implementation and operational stages of the Project.

XI. Conclusion

<u>Project Interventions to Meet LWTB Objectives:</u> The BCA evaluates the following Projects within the Living with the Bay Project that address the goals and objectives of the LWTB Project. The interventions evaluated in this BCA include the following projects that are described in more detail below:

- Hempstead Lake State Park
- Smith Pond
- East Rockaway High School
- Coastal Restoration Project
- Greenway Project
- Stormwater Retrofits

<u>BCA Economic Feasibility Results:</u> The BCA demonstrates that the Project will generate substantial net benefits (i.e., the benefits exceed the costs of the Project over its useful life). The benefits to the host

community and region would be substantial and justify the costs of implementation and operations. The Project assets will create large resiliency values, social values, environmental values and economic revitalization benefits to communities within the Mill River Watershed well as other beneficiaries from Nassau County and the region who use the Hempstead Lake State Park, Smith Pond, ERHS, linked Greenway and who recreate on Back Bay.

Table 29 shows the monetized costs and benefits for each Project individually, and for the combined five Projects. The largest group of benefits consists of resiliency values related to flood risk protection provided by the Projects' assets. In summary, the combined lifecycle costs to build and operate the proposed Projects' assets for the LWTB resiliency Project (amounting to **$117,063,711** in constant 2017 present value dollars) would generate the following total benefits:

- **$402,165,167,** of which:
  - Resiliency Values: $ 225,898,740
  - Environmental Values: $ 42,090,550
  - Social Values: $ 72,420,235
  - Economic Revitalization Benefits $ 61,755,642

Table 29: Benefit Cost Analysis Summary - RBD Living with the Bay

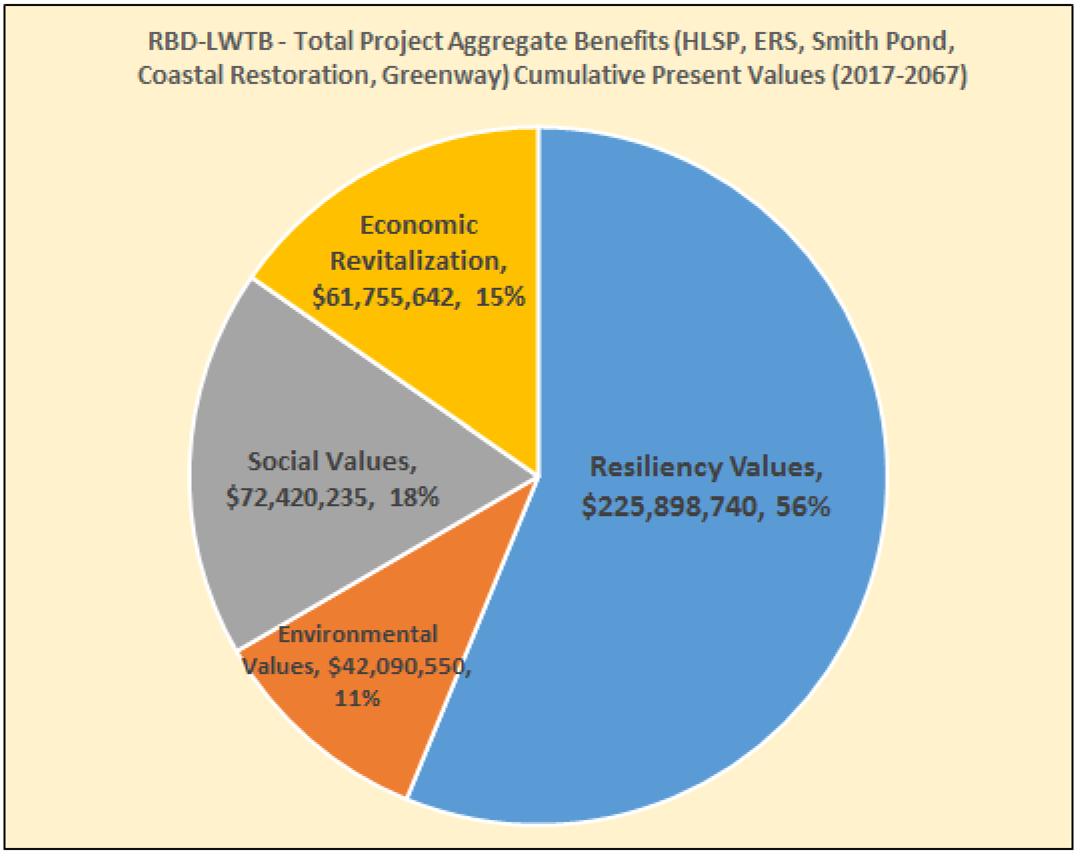
[Constant 2017 US Dollars - Discount Rate, 7%, Cumulative Present Values, 2017-2067]

Cumulative Present Values (2017-2067)	Hempstead Lake State Park \b	East Rockaway High School	Smith Pond	Coastal Restoration Project	Greenway Project	Sub-Total	Stormwater Retrofits \c
LIFECYCLE COSTS							
Project Investment Costs \a	$32,261,025	$4,642,415	$22,571,456	$14,991,416	$25,156,457	$99,622,769	*
Operations & Maintenance	$3,636,195	$1,847,610	$2,529,652	$1,084,246	$8,343,239	$17,440,942	*
Total Costs	$35,897,221	$6,490,025	$25,101,108	$16,075,662	$33,499,696	$117,063,711	*
BENEFITS							
Resiliency Values	$19,905,296	$5,443,197	$121,220,778	$17,525,215	$61,804,253	$225,898,740	++
Environmental Values	$7,683,582	$428,446	$5,378,508	$3,463,444	$25,136,570	$42,090,550	++
Social Values	$14,820,335	$6,518,585	$7,841,915	$3,093,449	$40,145,951	$72,420,235	++
Economic Revitalization Benefits	$32,079,935	$1,914,791	$2,236,997	$10,949,773	$14,574,146	$61,755,642	++
Total Benefits	$74,489,149	$14,305,019	$136,678,199	$35,031,882	$141,660,919	$402,165,167	++
Benefits less Costs							
Net Present Value (Net Benefits @ 7%)	$38,591,928	$7,814,994	$111,577,091	$18,956,220	$108,161,223	$285,101,456	++
Benefit Cost Ratio (BCR)	**2.08**	**2.20**	**5.45**	**2.18**	**4.23**	**3.44**	++
RBD LWTB Rate of Return	30.0%	23.0%	39.4%	22.2%	45.3%	35.8%	++

\Notes:
\a Costs represent the discounted present value of the nominal projected costs (over 2018-2019). Therefore they will appear smaller than the nominal costs due to the application of the 7% HUD recommended discount rate.
\b HLSP resiliency benefits associated with the dam improvements such as the retention of greater volumes of water, and improved management capabilities within the upstream catchment portion of the watershed are not reflected within the BCR but are acknowledged to be a significant benefit that would be assigned a ++ (i.e., expected strong positive impact) per HUD qualitative rating instructions. The resiliency calculation valuations performed for HLSP were based on available data for pond dredging and water volume storage improvements from depth increases. Therefore, the resiliency benefits quantified and monetized for HSLP represent a lower bound estimate. Water quality values for HLSP were included from wetlands creation within the Environmental Value section of the BCA.
\c ++ Based upon the Qualitative Risk Ranking System outlined in CPD-16-06, this project is ranked as "Expected strong positive impact" (*= Location specific project lifecycle costs have not yet been estimated, ++ = Expected strong positive impacts)

Figure 21 shows the breakdown in total benefits for the combined four Project elements.

Figure 21



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