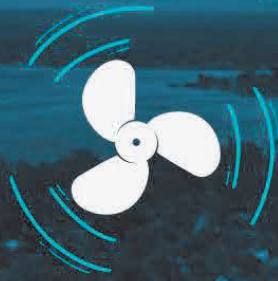


Propelling Resilience



PART II:
Town of Colonial Beach
Stormwater Management Plan

Stormwater Management Plan

October 2024

PRESENTED TO

Town of Colonial Beach
315 Douglas Avenue
Colonial Beach, VA 22443

PRESENTED BY

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ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
BMP	best management practice
CIP	Capital Improvement Program
FY	Fiscal Year (July 1 – June 30)
GSI	green stormwater infrastructure
O&M	operation and maintenance
NBS	nature-based solutions
Plan	Town of Colonial Beach Stormwater Management Plan
RSC	regenerative stormwater conveyance
Town	Town of Colonial Beach
VDOT	Virginia Department of Transportation

STORMWATER MANAGEMENT PLAN BACKGROUND AND NEED

The Town of Colonial Beach (Town) is in the northwestern part of Westmoreland County on Virginia's Northern Neck peninsula. It is bounded by the Potomac River, Monroe Bay, and Monroe Creek, the confluence of which empties into the Chesapeake Bay, 35 nautical miles downstream.

The Town is working to identify and correct deficiencies in its drainage system to prevent localized flooding. Most of the system is older and undersized for the current and future volume of stormwater from new development. Portions of the system were not formally designed and are not functioning properly. In addition, tidal influences from the Potomac River and Monroe Bay backflow into the system, affecting its capacity to convey stormwater.

As part of its 2020–2030 Comprehensive Plan, the Town identified the need to prepare a stormwater management plan “to address stormwater management with greater efficiency and economy.” The plan’s purpose would be to mitigate the impacts of new development and help remediate current erosion, flooding, and/or water quality problems. A stormwater management plan is a strategy designed to manage and control runoff from rainfall events, reduce flooding, prevent water pollution, and protect the environment. It often includes mapping drainage areas, identifying best management practices (BMPs), and ensuring compliance with regulations to minimize stormwater’s negative impacts on infrastructure and ecosystems.

To address this need for a stormwater management plan, the Town, with the assistance of a planning and civil and environmental engineering consultant team comprised of Berkley Group and Tetra Tech, developed the *Town of Colonial Beach, Virginia, Stormwater Management Plan* (Part 2 of Propelling Resilience – Town of Colonial Beach Flood Resilience and Stormwater Management Plan). The primary purposes of the stormwater management plan are to:

- (1) Identify and plan for incorporation of stormwater treatment and/or stabilization at multiple outfalls of existing open and closed stormwater conveyance systems;
- (2) Plan for incorporation of green stormwater infrastructure (GSI) within the developable properties, parks, and municipal properties;
- (3) Plan for the effective management of stormwater in developed areas where it is currently insufficiently managed;
- (4) Identify future costs for effective program implementation and administration; and
- (5) Identify, prioritize, and provide cost projections for projects.

This effort was developed in parallel with the Flood Resilience Plan (referred to as Part I). The two plans will work in coordination to identify projects, programs, and other actions the Town can implement to reduce flooding impacts and improve resilience for the community.

PLAN DEVELOPMENT PROCESS

At the start of the project, interviews were held with Town staff, the Town Council, the Planning Commission, and the public to identify areas subject to flooding. These areas were then

evaluated using a set of criteria to determine which were the priority for this Plan. A site visit was conducted to evaluate the top three priority areas for potential solutions to address the identified concerns. This Plan summarizes the results of the flooding area prioritization, provides concepts and high-level cost estimates for potential projects, and makes recommendations for Town-wide measures and modifications to current policies and ordinances to support better stormwater management.

For this Plan, the flooding due to stormwater runoff was evaluated to identify potential projects and measures to reduce the impacts of stormwater runoff. Areas of the Town where the flooding is due to tidal influences are included in Part I of this Plan.

EXISTING STORMWATER FLOODING CONCERNS IDENTIFIED

Based on the interviews and coordination with Town staff discussed in Part I of this Plan, the following areas were identified as having ongoing flooding concerns:

Virginia State Road 205 near Wilkerson's Seafood – The road has a low spot with ongoing flooding that causes access issues at the bridge. The Virginia Department of Transportation (VDOT) maintains the road, so any modifications to address this issue must be coordinated with them. Figure 2-2 shows this area in the red box in the northern portion along the water.

9th Street – The numbered streets between 7th Street and 12th Street have ongoing flooding problems. Homes in this area were developed a while ago, and the existing stormwater infrastructure is insufficient for the level of development. This area is noted by the pink box in the southeast corner of Figure 2-1.

Virginia Avenue – The portion between Lincoln Avenue and Maryland Avenue and Washington Avenue and the beach experiences flooding that affects the homes along the road. The flooding is caused by undersized stormwater infrastructure and inundation from the Potomac River. Sometimes the river rises onto the end of the street, pushing sand from the beach into the stormwater infrastructure and further limiting the system's capacity. This area is shown in the red box along the eastern side of Figure 2-3.

Monroe Bay at Dennison Street – The roads in this area slope downward and drainage collects in a low point on Dennison Street. This low point floods during storm and tidal events, and then water stands on the roads for several days before receding. The stormwater system along this road lacks the capacity for both stormwater runoff and tidal flooding from Monroe Bay. This area is shown in the red box on the western side of Figure 2-3.

Santa Maria Avenue – The drainage network in this area, from Locust Avenue, Mimosa Avenue, and Cedar Avenue to the beach, has undersized pipes and ditches, which leads to flooding. This area is shown in the pink box in the northern portion of Figure 2-1.

Irving Avenue – The road experiences beach erosion and flooding issues, especially during high tides because of the road's location along the coast. This area is shown in the orange box on the eastern side of Figure 2-4.

Potomac River Beach Outfalls – Severe beach erosion is occurring at each of the outfalls located at the municipal pier, Wilder Avenue at the Riverboat, Colonial Avenue near the pump house, and Madison Street. The beach is a key tourist attraction, and the erosion at the outfalls is affecting the aesthetics of the beach. The outfalls are shown as green dots along the coast in Figure 2-3 and Figure 2-4.

Undeveloped Area – The area to the west of the numbered streets is currently undeveloped and consists of small lots that were platted decades ago. Development will occur here in the future, and the limited stormwater infrastructure in place will add to stormwater management issues in this area and the numbered streets. This area is shown in the yellow box in Figure 2-1.

Figure 2-1: Map of observed flooding – North



Colonial Beach, VA Map



Figure 2-2: Map of observed flooding – North



Figure 2-3: Map of observed flooding – Town Center



Figure 2-4: Map of observed flooding Areas – South and the Point



CAPITAL IMPROVEMENT PROGRAM STORMWATER PROJECT ASSESSMENT AND ANALYSIS

The Town's Capital Improvement Program (CIP) accounts for all financial resources needed in the acquisition or construction of capital assets. Incorporating short- and long-term CIPs for stormwater improvement will be vital to decreasing stormwater runoff and flooding impacts for Colonial Beach. The Town identified multiple areas currently susceptible to flooding due to stormwater impacts. Many of these areas are in low-lying locations with little to no topography available to help drain the stormwater. Using stormwater BMPs in conjunction with an increased carrying capacity (increased stormwater inlet, pipe, and culvert sizes) will be vital to helping the Town manage stormwater volume with the added benefits of improving water quality.

INITIAL STORMWATER PROJECT IDENTIFICATION

Eight stormwater flooding areas were identified based on interviews with the Town and the public. These areas were further evaluated to determine which should be prioritized for this Plan. These areas were assessed against four risk categories: safety, flooding, economic, and equity. Each category included subcategories that were assigned a score based on the following likelihood of occurrence:

- 0 – 2: Very Low/Very Unlikely
- 3 – 4: Low/Low Likelihood
- 5 – 6: Medium/Likely
- 7 – 8: High/Highly Likely
- 9 – 10: Very High/Near Certain

Table 2-1 shows the matrix with the risk categories and subcategories. The subcategory scores for each area were totaled, and an overall ranking was assigned. The area with the highest number of points received the highest (number 1) ranking. Table 2-2 presents the scores and ranking results for the flooding areas.

Table 2-1: Ranking matrix to evaluate flooding areas.

Risk Category	Consequence Subcategory	Ranking and Score: Impact and Probability of Occurrence				
		Very Low/ Very Unlikely	Low/Low Likelihood	Medium/ Likely	High/ Highly Likely	Very High/ Near Certain
Safety	Loss of life	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
	Building flood impact (major, greater than 50% substantial damage, greater than 4 feet)	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
	Increased emergency response time	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
	Evacuation	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
Flooding	Yard flooding	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
	Building flood impact (minor, less than 50% substantial damage, less than 4 feet)	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
	Roadway flooding	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
	Ditch/inlet flooding	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
Economic	Negative impacts to Town's tourism areas (access, enjoyment, visibility)	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10

Risk Category	Consequence Subcategory	Ranking and Score: Impact and Probability of Occurrence				
		Very Low/ Very Unlikely	Low/Low Likelihood	Medium/ Likely	High/ Highly Likely	Very High/ Near Certain
	Increases Town infrastructure maintenance costs	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
	Negative impacts to natural features	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
Equity	Negative impacts to disadvantaged communities (based on U.S. Environmental Protection Agency EJScreen metrics)	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10

Table 2-1: Ranking results for priority flooding areas.

Risk Category	Consequence Subcategory	Project Location and Ranking								
		State Road 205 at Wilkerson's Seafood	9 th Street Between 7 th and 12 th Streets	Virginia Avenue Outfall	Monroe Bay at Dennison Street	Santa Maria Avenue	Irving Avenue	Potomac River Beach Outfalls	Undeveloped Area (Current Conditions)	Undeveloped Area (Future Conditions)
Safety	Loss of life	8	3	10	5	3	5	5	3	3
	Building flood impact (major, greater than 50% substantial damage, greater than 4 feet)	10	3	10	5	3	5	5	1	3
	Increased emergency response time	8	8	10	8	5	5	5	4	8
	Evacuation	5	5	10	5	5	8	5	2	5
Flooding	Yard flooding	2	10	10	8	10	5	6	2	8
	Building flood impact (minor, less than 50% substantial damage, less than 4 feet)	10	10	10	8	8	8	6	2	8
	Roadway flooding	10	10	10	10	8	8	10	6	10
	Ditch/inlet flooding	8	10	10	10	8	6	10	6	10
Economic	Negative impacts to Town's tourism areas (access, enjoyment, visibility)	4	2	8	6	6	8	10	4	6
	Increases Town infrastructure maintenance costs	2	8	8	6	8	8	10	4	6
	Negative impacts to natural features	6	4	4	8	8	6	10	4	4
Equity	Negative impacts to disadvantaged communities (based on U.S. Environmental Protection Agency EJScreen metrics)	4	10	6	6	10	6	6	4	10
Calculated score		77	83	106	85	82	78	88	42	81
Stormwater Management Plan project ranking		N/A*	4	1	3	5	7	2	8	6

Notes: N/A = not applicable

* Flooding on State Road 205 is the responsibility of VDOT and outside of the Town's authority.

From this ranking, the areas selected for further investigation were: **(1) Virginia Avenue, (2) Monroe Bay at Dennison Street, and (3) Potomac River Beach Outfalls (see Figure 2-1).**

Additional details about the issues in each of these areas are provided further below.

Figure 2-4: Locations of the selected priority areas



IDENTIFIED PRIORITY STORMWATER CIP PROJECTS

On February 1, 2024, Tetra Tech conducted a field visit to the three priority areas identified above in Figure 2-4 and met with Town staff to discuss the issues in these areas in more detail. Based on the additional assessment, the flooding issues on Virginia Avenue were determined to be largely caused by tidal impacts. Therefore, potential options for this area are included in Part I of this Plan.

The following sections describe the flooding concerns in the Monroe Bay at Dennison Street and the Potomac River Beach Outfalls priority areas and present potential projects that can be implemented to address the issues.

PRIORITY AREA #1: MONROE BAY AT DENNISON STREET

Dennison Street is a low point where stormwater runoff flows down the sides of the road in shallow ditches. The roadway sag (low point) near the intersection of Dennison Street with Douglas Avenue is prone to flooding due to the undefined ditches and undersized stormwater infrastructure. The stormwater runoff remains for a significant time after a rain event and is influenced by tidal fluctuations coming up the outlet pipe and ditches from Monroe Bay. The drainage area covers approximately 23 acres and originates north of Wilder Avenue and east of Washington Avenue. New development in the area is increasing the amount of impervious surface, which is compounding stormwater runoff volumes (Figure 2-2).

Figure 2-5: Examples of standing water in the Dennison Street area



PHASE 1: IMPROVE EXISTING STORMWATER SYSTEM

One option for this area is to improve the existing system to accommodate more runoff. The improvements could include increasing the ditch capacity by widening and/or deepening the ditches and adding vegetation and storage capacity to create bioswales. The stormwater pipes can be increased in size, and tidal gates can be added to allow stormwater discharge into the bay while preventing bay water from entering the system during high tides. Continual maintenance should be considered in this area to ensure the stormwater system remains

clean and operates properly. Examples of pipe modifications to reduce tidal influences are shown in Figure 2-3.

Figure 2-6: Examples of stormwater system pipe modifications that reduce tidal influence



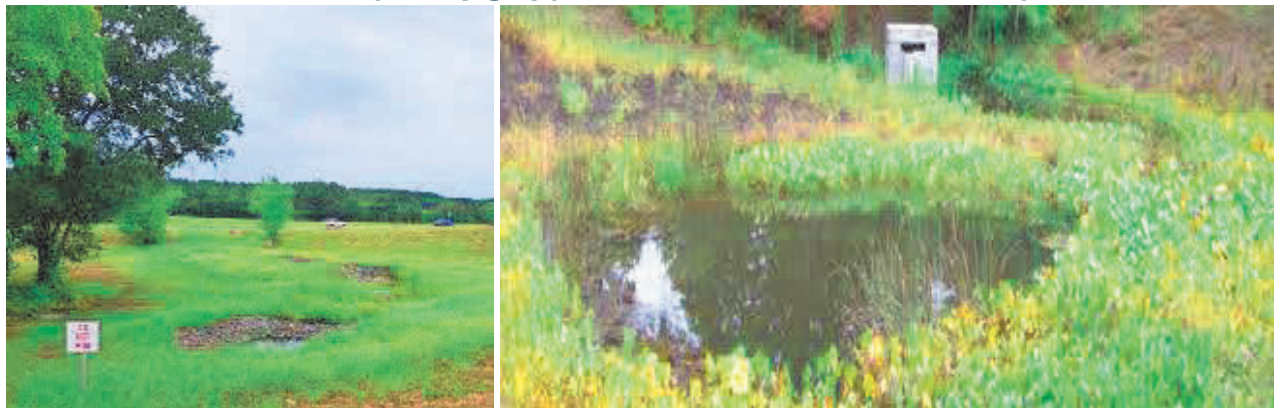
PHASE 2: CONSTRUCTED WETLAND/FILTER MARSH

Another option is to add a constructed wetland on the property near the southwest corner of the road (Figure 2-4). This wetland would help slow tidal water coming up into the stormwater system from the bay during high tide, and it would detain stormwater runoff during rain events. These changes could lead to reduced stormwater flooding on the road. Examples of constructed wetlands are shown in Figure 2-5. The proposed property is privately owned, so the Town would need to determine whether purchasing a portion of the property is feasible.

Figure 2-7: Dennison Street at Monroe Bay: Potential location for constructed wetland



Figure 2-8: Examples of a constructed submerged gravel wetland (left) and a stormwater BMP constructed wetland pond (right) planted with native non-invasive plants



CONSTRUCTED WETLAND CONCEPTUAL PLAN AND ESTIMATED COST

An initial conceptual plan has been developed for the repairs and constructed wetland at Dennison Street (Figure 2-6). In addition, high-level cost estimates were determined as summarized in Table 2-2. The Monroe Bay at Dennison Street project would include improving the existing stormwater system by widening the ditches, converting portions of the ditches to bioretention cell swales as appropriate, and adding tidal gates at the ends of the pipes. A constructed wetland be added to the open parcel of land along Dennison Street to accept and detain stormwater runoff from the roadway and reduce tidal impacts from Monroe Bay.

Figure 2-6: Initial concept plan for Priority Area #1: Monroe Bay at Dennison Street



Table 2-2: Estimated costs for Priority Area #1: Monroe Bay at Dennison Street

Category	High-level Estimated Cost
Design	\$150,000
Acquisition/Right-of-Way (rough estimate)	\$100,000
Construction	\$400,000
<i>Subtotal</i>	<i>\$650,000</i>
Contingency (20%)	\$130,000
Total	\$780,000

PRIORITY AREA #2: POTOMAC RIVER BEACH OUTFALLS

There are four 12-inch outfalls to the beach, which discharge stormwater from a system that captures runoff from an area extending a couple of blocks back from the beach. As more development occurs in this area, stormwater from the additional impervious surfaces is tied into these outfalls, which leads to more damage at the outfalls. The outfall under the municipal pier is broken from excessive stormwater flows, and the pipe is now partially buried in the sand. In addition, stormwater exiting the outfalls is causing deep erosion on the beach. The Town has been continuously replacing the sand, only to have it washed out by the stormwater discharges. There are also obvious signs of scouring caused by stormwater running onto the beach from the road, concrete areas, and sidewalks (Figure 2-7 and Figure 2-8).

Figure 2-7: Beach scouring at an outfall (left) and from pavement (right) along Beach Terrace/Irving Avenue (February 1, 2024)



Figure 2-8: Beach erosion from generator platform, bathhouse/bathroom, and parking/pavement (February 1, 2024)



OUTFALLS IMPROVEMENT

One option for improving the outfalls and reducing the scouring is to increase the size of all the outfall pipes leading into the Potomac River, which would accommodate additional stormwater and reduce the velocity at which discharges are occurring on the beach. Adding tidal gates to the outfalls would allow stormwater outflow to discharge to the beach but prevent river water from moving up the outfall into the stormwater system. The pipe under the municipal pier could be upsized as a concrete pipe to accommodate the high flows, and it could be extended further into the river under the pier to move the discharge off the beach. The other outfalls could be moved up the beach and closer to the road, and features such as rocks and vegetation could be added to help dissipate the discharge velocity (see Figure 2-9).

Figure 2-9: Stormwater outlet end treatment example: Regenerative stormwater control (RSC) measures



VEGETATED DUNES

Another option is to add low, vegetated dunes between the sidewalk or parking lot and the beach to help intercept stormwater runoff from the road and reduce erosion between the pavement and the beach (Figure 2-10). The dunes would help reduce the elevation difference from the pavement to the beach, which is causing scouring. Based on historical depictions of Colonial Beach (Figure 2-11), the beach previously had vegetation, so adding this feature will restore the historical look and provide an amenity for the community and visitors. Scattered trees could also be included to provide shade during the summer months. Local vegetation appropriate for a beach environment should be used to reduce maintenance requirements.

Figure 2-10: Green stormwater infrastructure, vegetated dunes, and bioswale examples



Figure 2-11: Old postcard of boardwalk area. (From Colonial Beach, Virginia: Playground of the Potomac, by J. Tigner, Jr., May 2008, Schiffer Publishing)



GREEN STORMWATER INFRASTRUCTURE/NATURE-BASED SOLUTIONS

A third option is to add GSI/nature-based solutions (NBS) dispersed along the roads and parking areas near the beach to capture stormwater before it reaches the beach and contributes to erosion. Potential GSI/NBS concepts include adding a bioswale along the boardwalk to the municipal pier, re-grading the existing roadside ditches to make them deeper and adding vegetation to create bioswales (Figure 2-12), adding a cistern and/or green roof on the bathroom building to capture rainfall (Figure 2-13), and adding pervious pavement (with wider spaces so that sand is not an issue) on the street parking. In addition, in the median with the War Memorial Cannon, the landscaping can be modified to include a bioswale and rain garden using local vegetation to capture stormwater (Figure 2-14). This would also provide a potential location for educational signage about GSI to inform the community and visitors.

Figure 2-12: Opportunity for bioretention swales and stormwater infrastructure upgrades on the west side of Irving Avenue (February 1, 2024)



Figure 2-13: Example of a roof leader cistern



Figure 2-16: Opportunity for small bioretention swales along the sides of the Cannon War Memorial and a bioretention pond/rain garden at the Point (February 1, 2024)



POTOMAC RIVER OUTFALLS CONCEPTUAL PLAN AND ESTIMATED COST

An initial conceptual plan has been developed for the improvements to the Potomac River Outfalls located along Beach Terrace and Irving Avenue, as shown in Figure 2-17. In addition, high-level cost estimates were determined, as summarized in Table 2-4. The Potomac River Outfalls project would include constructing a bioretention cell around the point of the Cannon War Memorial at the intersection of Beach Terrace and Irving Avenue (not disturbing the memorial itself); adding bioretention cell swales on the riverside (east) of the sidewalk along

Irving Avenue; adding a small berm/dune for detention on the backside of the bioretention swale; planting low-height native, non-invasive vegetation; and installing outfall energy dissipation (regenerative stormwater conveyance or similar measure) at the ends of each stormwater pipe outfall to reduce runoff velocities from eroding the beach.

Figure 2-17: Initial concept plan for Priority Area #2: Potomac River Outfalls

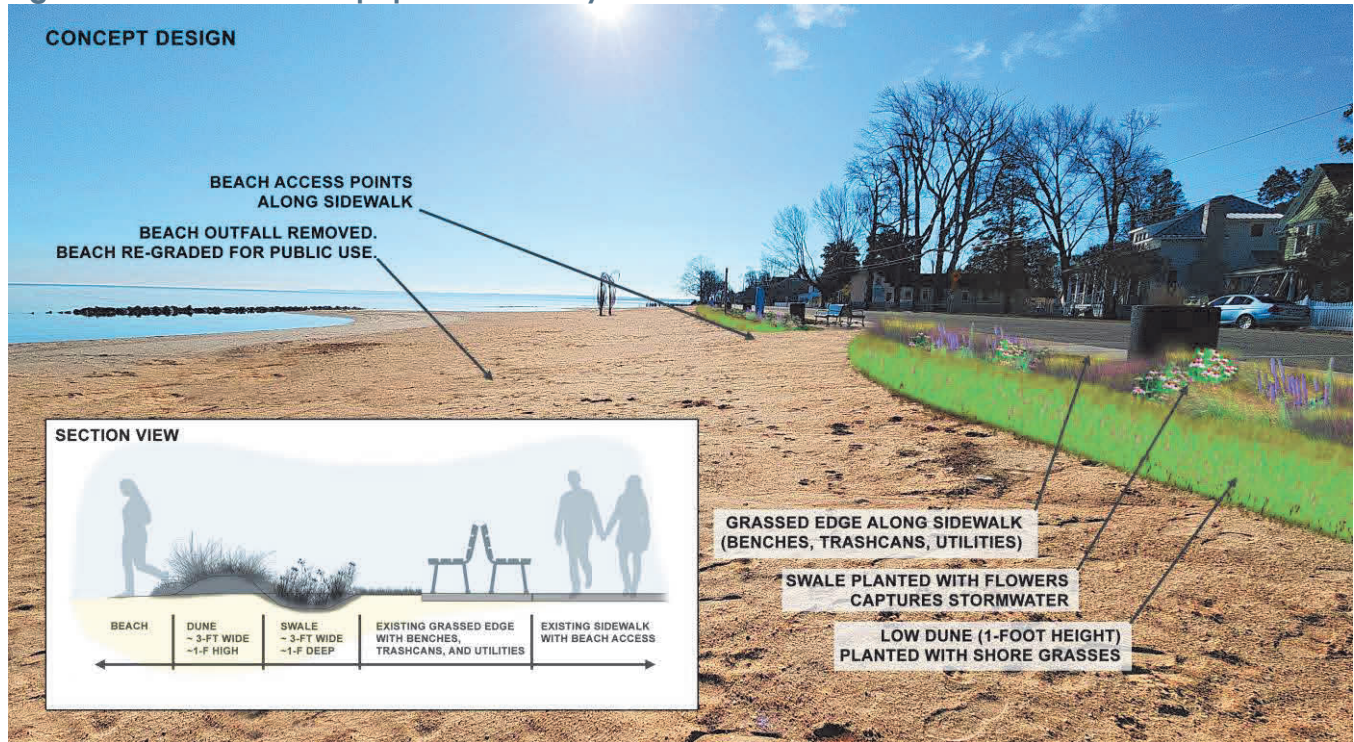


Table 2-3: Estimated costs for Priority Area #2: Potomac River Outfalls.

Category	High-level Estimated Cost
Design	\$300,000
Acquisition/Right-of-Way (rough estimate)	\$0
Construction	\$1,200,000
<i>Subtotal</i>	<i>\$1,500,000</i>
Contingency (20%)	\$300,000
Total	\$1,800,000

EVALUATION OF POTENTIAL PROJECTS

To provide information to the Town for evaluation of the potential projects in the identified priority areas, Tetra Tech developed a ranking matrix that summarizes the construction cost, operation and maintenance (O&M) cost, and flooding impact. Table 2-42-5 provides the results of this evaluation matrix by priority area and potential project. The resulting evaluation data shows that the Monroe Bay at Dennison Street project is more economically feasible overall with a medium-to-high stormwater flood reduction. The Potomac River Outfalls project

will also reduce flooding at a medium-to-high level; however, due to its prime location along Irving Avenue, the initial construction costs will likely be higher due to phasing, the integration of overall aesthetics, compliance with Americans with Disabilities Act requirements, and visitor safety.

Table 2-4: Priority project evaluation matrix

Priority Area	Priority Project	Construction Cost	O&M Cost	Flood Reduction
Monroe Bay at Dennison Street	Improve existing stormwater system	Medium	Medium	High
	Constructed wetland	Medium	Medium/Low	Medium
Potomac River Beach Outfalls, Phases 1 and 2	Outfalls improvement	Medium	Medium	High
	Vegetated dunes	High	Medium	High
	GSI/NBS	High	Medium	Medium/High

The matrix above uses the following categories for each of the criteria parameters:

- Initial construction cost parameters (not for budgeting purposes)
 - High: Initial cost estimates are over \$1,000,000
 - Medium: Initial cost estimates are between \$500,000 and \$1,000,000
 - Low: Initial cost estimates are under \$500,000

- O&M cost parameters
 - High: O&M cost estimates are over \$100,000/annually
 - Medium: O&M costs estimates are between \$50,000 and \$100,000/annually
 - Low: O&M cost estimates are under \$50,000/annually

- Flooding impact parameters
 - High: Addresses over 75% of the flooding issues (estimated)
 - Medium: Addresses between 50% and 75% of the flooding issues (estimated)
 - Low: Addresses under 25% of the flooding issues (estimated)

STORMWATER MANAGEMENT PROGRAM AND REGULATORY UPDATE RECOMMENDATIONS

In addition to stormwater infrastructure improvements, several program and regulatory measures could be implemented across the Town to help improve current stormwater management and reduce stormwater impacts from future development. These measures include:

- Adopting ordinances to guide future development to ensure that additional infrastructure is added to address the stormwater runoff from new development.

- Implementing an outreach and education campaign about what community members can do to help manage stormwater and flooding, such as reducing the impervious area on their properties, adding rain gardens, and using rain barrels.

- Developing a stormwater utility fee to create a dedicated funding source for project implementation.
- Participating in the Federal Emergency Management Agency National Flood Insurance Program and Community Rating System to allow for reduced flood insurance rates and grants.

These are discussed specifically in Part I of the Plan.

STORMWATER MANAGEMENT STRATEGIC ACTION PLANNING

The proposed projects within the prioritized stormwater problem areas are presented here in the revised priority order for implementation. Table 2-6 provides estimated timelines for design and construction of CIP projects, as well as estimated costs. Additional field verification, data collection, and/or engineering will be required to verify feasibility and refine the projects, which may change the priority order. In addition, the Town will likely need to pursue outside funding to implement the projects (see Part I of this Plan for grant options); depending on the timing of funding, project priorities might need to be shifted.

Table 2-6: Stormwater CIP list

Revised Priority Area	Project	Stormwater Impact	Fiscal Year (FY)	Estimated Cost
1	Monroe Bay at Dennison Street	Upgrade ditches and pipes, purchase easement or portion of property, build constructed wetland, and add gate valves at end of pipes to reduce tidal/sunny day flooding.	FY26–29	\$780,000
2A	Potomac River Beach Outfalls Along Irving Avenue – Erosion and Detention	Beach erosion reduction and stormwater runoff reduction and detention.	FY27–30	\$1,800,000
2B	Potomac River Beach Outfalls Along Beach Terrace from Hawthorn Street – Repair and/or Replace Outlet Pipe Under Municipal Pier	Replace high-density polyethylene pipe with larger capacity reinforced concrete Class IV pipe due to increased impervious surface, sea level rise, and tidal action.	FY26–27 (due to immediate need)	To be determined (TBD)

NEXT STEPS

In addition to the strategic action plan priority project areas listed in Section 0, the Town should complete two assessments to better understand the current stormwater management capacity and future needs. The first evaluation should be a stormwater asset inventory and assessment to identify the existing infrastructure locations, materials composition, sizes, and conditions. This information would then be used in a hydrologic and hydraulic model of all or parts of the stormwater system to evaluate the current stormwater carrying capacity and estimate the changing needs as development occurs. Additional details about these assessments are included in Table 2-7.

Table 2-7: Stormwater assessment projects

Focus Area	Stormwater Impact
Stormwater asset inventory and assessment	Obtain a detailed understanding of stormwater carrying capacity by evaluating public right-of-way stormwater infrastructure, including stormwater inlets, pipes, and ditches. Asset inventory includes location, size, materials composition, and condition assessment.
Townwide stormwater hydrologic and hydraulic watershed modeling (HEC-RAS, HEC-HMS, or SWMM)	Model Townwide rainfall events and stormwater efficiency based on existing pipe carrying capacity, storm size (frequency and duration), future conditions, and stormwater infrastructure requirements needed to carry the design storm. As new development occurs, require similar models as part of development design standards.

Based on the results of the two assessments noted above, this Plan should be revised once completed to include additional measures to address the remaining focus areas targeting reductions in community flooding related to stormwater runoff.

Table summarizes the additional stormwater focus areas and potential measures.

Table 2-8: Additional stormwater focus areas

Focus Area	Stormwater Impact
9 th Street between 7 th and 12 th streets	Reduce flooding in ditches due to increased impervious surface from new construction/development. Consider stormwater ordinance maximum impervious surface limits on new development or require stormwater BMPs.
Santa Maria Avenue	Unbury the stream to reduce flooding and increase carrying capacity.
Undeveloped area (future conditions)	Consider adding stormwater ordinance maximum impervious surface limits on new development or require stormwater BMPs. Use modeling results to determine additional stormwater infrastructure needed to manage future runoff.
Irving Avenue	Shoreline erosion reduction needed to stabilize banks and reduce roadway infrastructure failure.
Undeveloped area (current conditions)	Consider adding stormwater ordinance maximum impervious surface limits on new development or require stormwater BMPs; conduct a drainage and flood study to determine pre-development conditions.
State Road 205 at Wilkerson’s Seafood – bridge and sag elevation	Coordinate with VDOT on a second bridge at the low point in road or elevating the roadway to reduce flooding approximately 850 feet east of Wilkerson’s.

Proposed Projects - Plant List

Beach Outfall



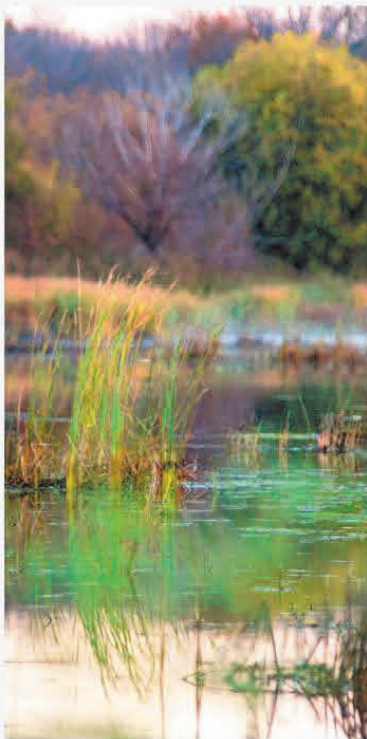
Low growing Native Grasses:

- Pink Muhly Grass,
- Autumn Bentgrass,
- Prairie Dropseed,
- American Beach Grass,
- Coastal Switchgrass

Low growing Flowering Perennials:

- Blazing Star Liastris,
- Purple Cone Flower,
- Lanceleaf Coreopsis,
- Lavender Hyssop,
- Butterfly Weed,
- Sky Blue Aster,
- Mistflower

Constructed Wetland



Sedges and Rushes:

- Common Rush,
- Tussock Sedge,
- Fox Sedge

Flowering Perennials:

- Cardinal Flower,
- Swamp Sunflower,
- Rose Mallow,
- Pickerel Weed,
- Turtlehead,
- Virginia Iris,
- Culver's Root

Small Trees and Shrubs with Seasonal Interest:

- Buttonbush,
- Elderberry,
- Northern Spicebush,
- Fringe Tree,
- Downy Serviceberry,
- Sweet Crabapple,
- American Snowbell