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Basis of Design Report

June 2023

ROCK ISLAND COVE SALT MARSH RESTORATION

QUINCY, MA

PREPARED FOR:
THE CITY OF QUINCY DEPARTMENT OF NATURAL RESOURCES

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1.0 BACKGROUND

The Rock Island Cove Salt Marsh is an approximately 124-acre marsh complex located within the area that adjoins the Hough's Neck and Germantown peninsulas in Quincy (See Figure 1). This marsh is important to the Salt Marsh Sparrow (*Ammospiza caudacuta*), a Species of Special Concern in Massachusetts. The Atlantic Coast Joint Venture (ACJV) Saltmarsh Sparrow Working Group has developed a Habitat Prioritization Tool to identify the most important marsh patches for Saltmarsh Sparrows to guide land protection and restoration efforts and help achieve their long-term population objective of sustaining 25,000 breeding Saltmarsh Sparrows. The complex at Rock Island Cove received the highest priority rank with an overall score within the top 2% of the 8,680 ranked patches within the region and at over 100 acres is the largest patch within Boston Harbor (See Figure 2).

Figure 1: Locus Map of Rock Island Cover Salt Marsh Complex

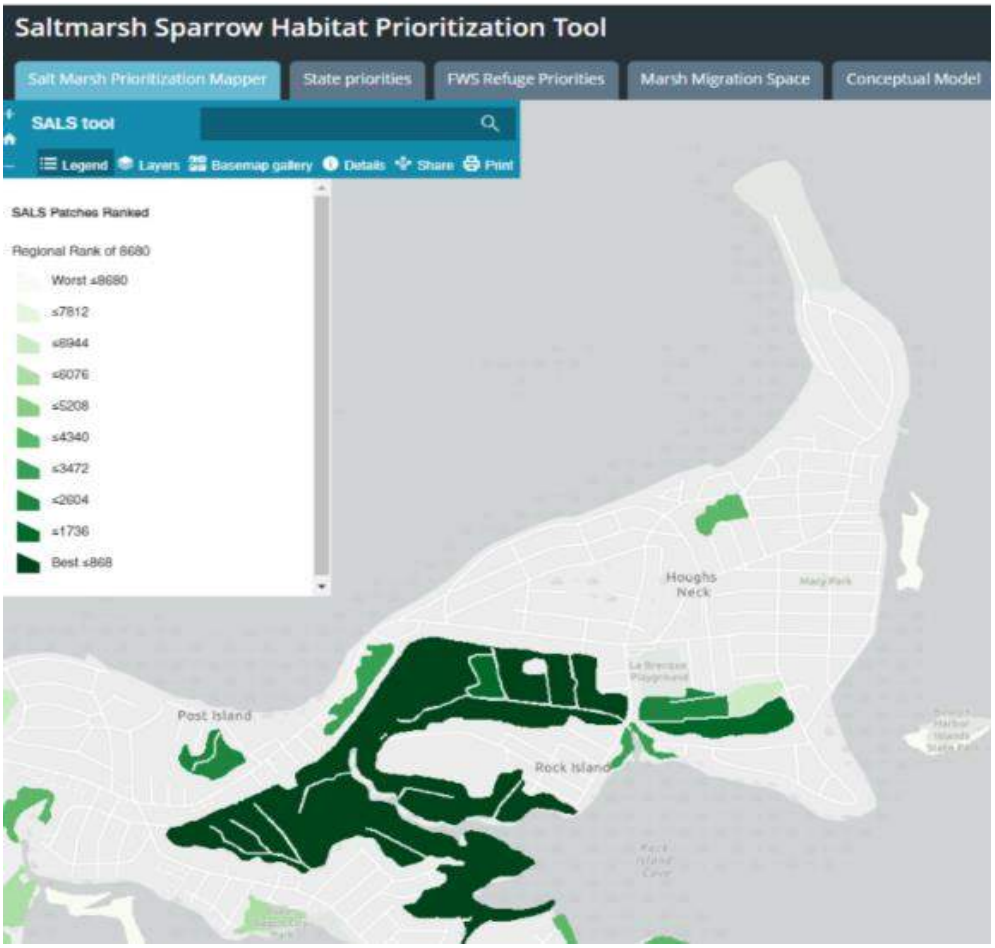

Figure 2: Saltmarsh Sparrow Habitat Priority Ranking within Rock Island Cove

In recent years, abutters of the marsh have reported alarming rates of erosion and calving of tidal creek banks, specifically downstream of a tidal stream crossing on Rockland Street (Photo 1) and have reached out to the City of Quincy to seek solutions to protect areas of concern within this marsh. Additionally, an at-grade road that runs from Lind Street to the marsh and the bay, which is used by commercial shell fishermen for waterfront access, is regularly inundated during high tides, which will likely worsen as climate driven sea level rise impacts increase in the future. Due to predictions of large losses of salt marsh, and high marsh habitat in particular, the City of Quincy has prioritized active management to increase the resilience and sustainability of salt marshes. The City's Open Space and Recreation Plan, Multi-Hazard Mitigation Plan, and Municipal Vulnerability Planning Assessment (all published in 2019) all indicate that salt marsh preservation is a high priority in protecting the City's infrastructure in the face of climate-driven sea level rise. The City applied for and was awarded a Coastal Habitat and Water Quality Grant from the Massachusetts Office of Coastal Zone Management (CZM) for FY2023.

It is with this salt marsh preservation goal that the City of Quincy has hired Weston & Sampson to conduct this salt marsh assessment at Rock Island Cove. The following sections will discuss environmental resources, project description, sea level rise, MarshRAM assessment, and restoration opportunities. CZM worked closely with the project team, provided technical assistance and support, including through meetings and a site visit. Additionally, SumCo provided invaluable support and technical knowledge.

Photo 1: Salt Marsh Down Stream from Rockland Street Culvert

1.1 Environmental Resources

Weston & Sampson created environmental resources maps (See Figure 3) to provide an overall understanding of environmental resources in the area. The data source of these map layers was the Massachusetts Geographic Information System (MassGIS). These areas included:

- NHESP Priority Habitats of Rare Species
- NHESP Estimated Habitats of Rare Wildlife
- NHESP Certified and Potential Vernal Pools
- Areas of Critical Environmental Concern (ACEC)
- Outstanding Resource Waters (ORW)
- FEMA Flood Zones
- Coldwater Fisheries
- Shellfish Suitability Area

Based on the MassGIS information, the entire site is located within the 100-year flood zone and portions of the site are located within shellfish suitability areas specifically for the species of soft-shell clams and European Oyster. There are no additional protected resource areas mapped within the Rock Island Cove Salt Marsh based on the resources above.

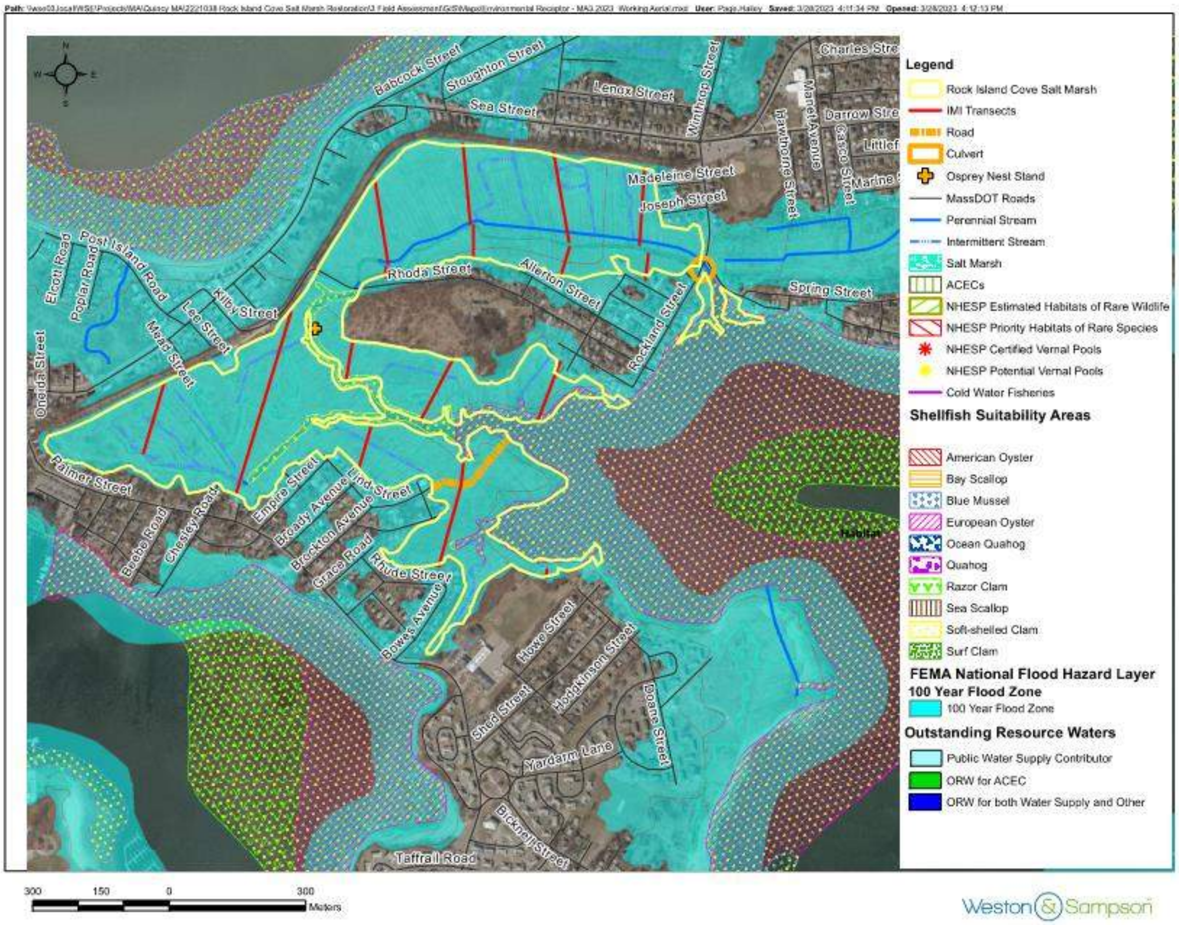

Figure 3: Rock Island Cove Salt Marsh Environmental Receptors Map

2.0 PROJECT DESCRIPTION

The focus of this project is to undertake an assessment of impairment indicators within the Rock Island Cove salt marsh complex in Quincy. This assessment will include identifying specific threats and evaluating risks to the marsh, identifying opportunities to address these threats, and prioritizing projects that will provide the greatest benefit to the critical high marsh habitat that Saltmarsh Sparrows require for nesting. The identification of threats and opportunities will be completed through desktop geospatial assessments of key data sources and field evaluations. In addition, conceptual level restoration plans will be developed for two previously identified restoration opportunities within the salt marsh complex; 1) just downstream of the box culvert under Rockland Street and, 2) the at grade-access road across the marsh extending from Lind Street to the creek bank. The following sections will discuss projected sea level rise at Rock Island Cove.

3.0 PROJECTED SEA LEVEL RISE

This section will be utilized to confirm the level of increase of sea level rise occurring in future events. This will be a helpful resource for the determination of future mitigation or restoration work within the Rock Island Cove Salt Marsh.

3.1 Data Source

The source of projected coastal design criteria presented in this report is the Massachusetts Coast Flood Risk Model (MC-FRM), a state-wide climate model developed by the Woods Hole Group (WHG) for MassDOT. For additional information about the MC-FRM, please reference the Frequently Asked Questions document, provided by WHG, located here: https://eea-nescaum-dataservices-assets-prd.s3.amazonaws.com/cms/GUIDELINES/MC-FRM_FAQ_04-06-22.pdf

3.2 Annual Probability of Flooding

The following maps (Figure 4 – Figure 7) demonstrate the annual probability of flooding for the project area, for the present-day, 2030, 2050, and 2070 planning horizons. Please note that these maps do now show daily or nuisance flooding, but instead describe the percent probability in which flooding to that extent might be expected. For example, areas covered in the 100% probability layer likely have a 100% probability of flooding at least once in a single year, but not 100% of the time.

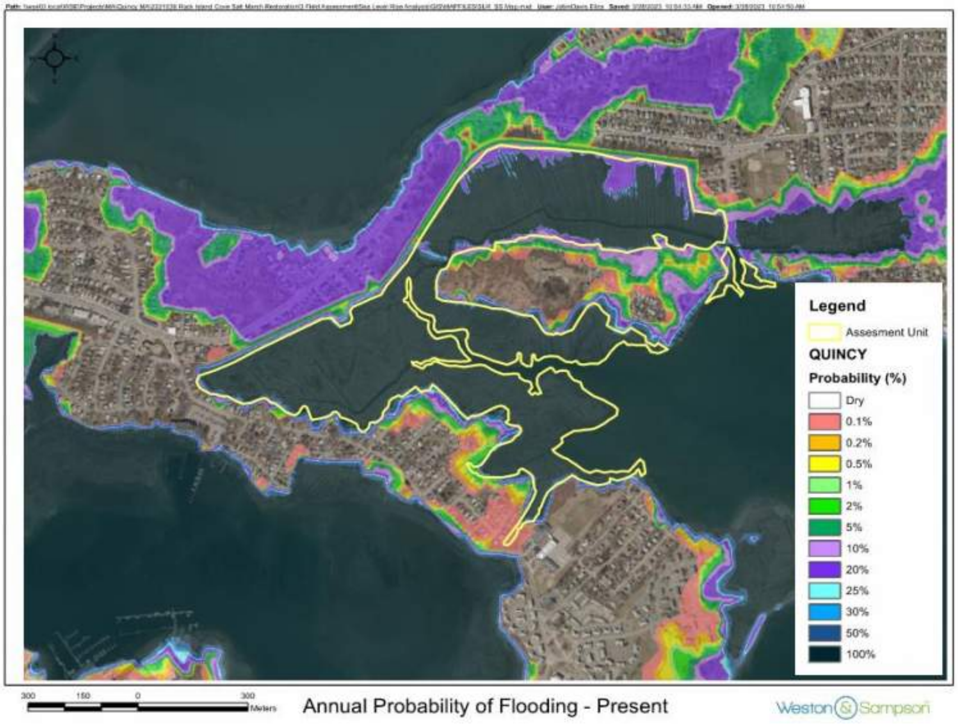

Figure 4: Annual Probability of Flooding Under Present Conditions

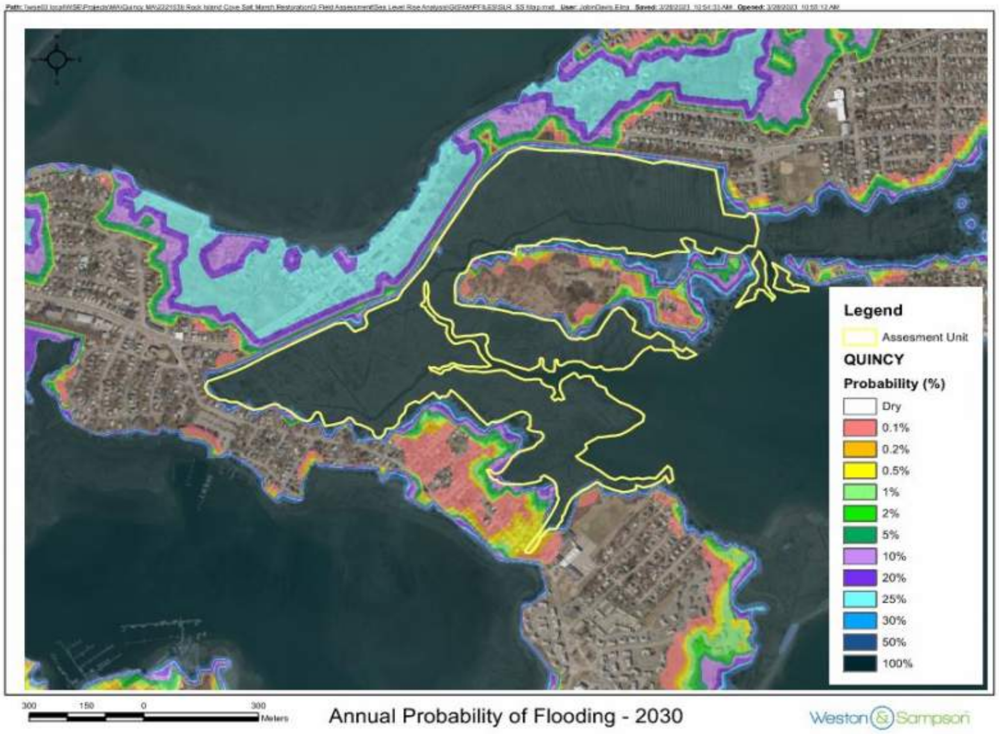

Figure 5: Annual Probability of Flooding Under 2030 Conditions

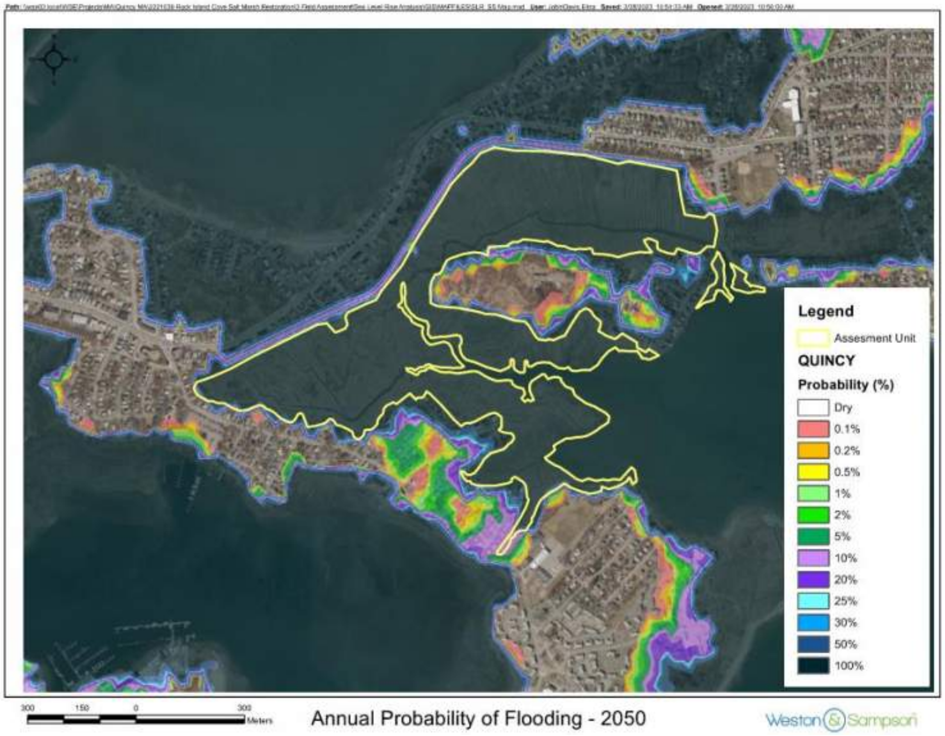

Figure 6: Annual Probability of Flooding Under 2050 Conditions

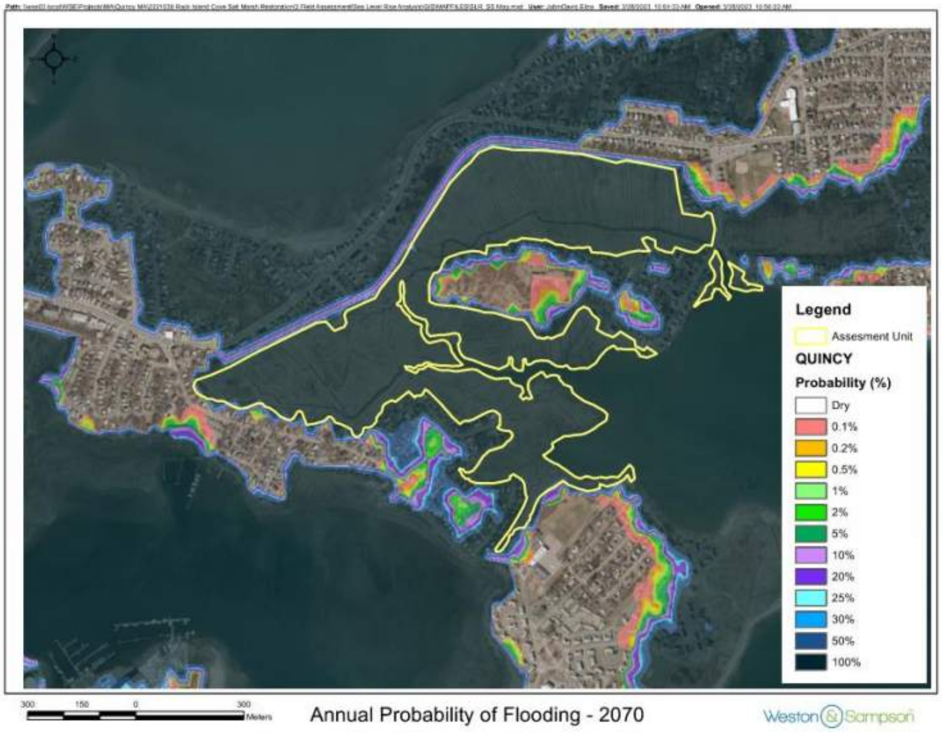

Figure 7: Annual Probability of Flooding Under 2070 Conditions

3.3 Projected Water Surface Elevation

The projected water surface elevations provided in Table 1, indicate the elevations for the 1% annual exceedance probability events in the 2030, 2050, and 2070 planning horizons. Water surface elevation is defined through the Resilient MA Action Team's Climate Resilience Design Standards Tool as the projected elevation for a specific future flood event, considering storm surge, tides, and wave setup.

Planning Horizon, Annual Exceedance Probability	Area-Weighted Average Projected Water Surface Elevation (ft-NAVD88)
2030, 1%	10.6
2050, 1%	12.3
2070, 1%	14.1

Table 1: Projected Water Surface Elevations for the 1% AEP, for the Assessment Unit Area

3.4 Projected Tidal Datums

A tidal datum is a standard vertical elevation reference defined by certain phases of the tide. Tidal datums are often the reference for shoreline or coastal property boundaries where an elevation related to local sea level is needed. Projected tidal datums can be used to identify the elevation of tide levels along a shoreline in the future based on sea level rise. Figure 8 and Table 2 depict and describe the projected tidal datums for the assessment unit area for the 2030, 2050, and 2070 planning horizons.

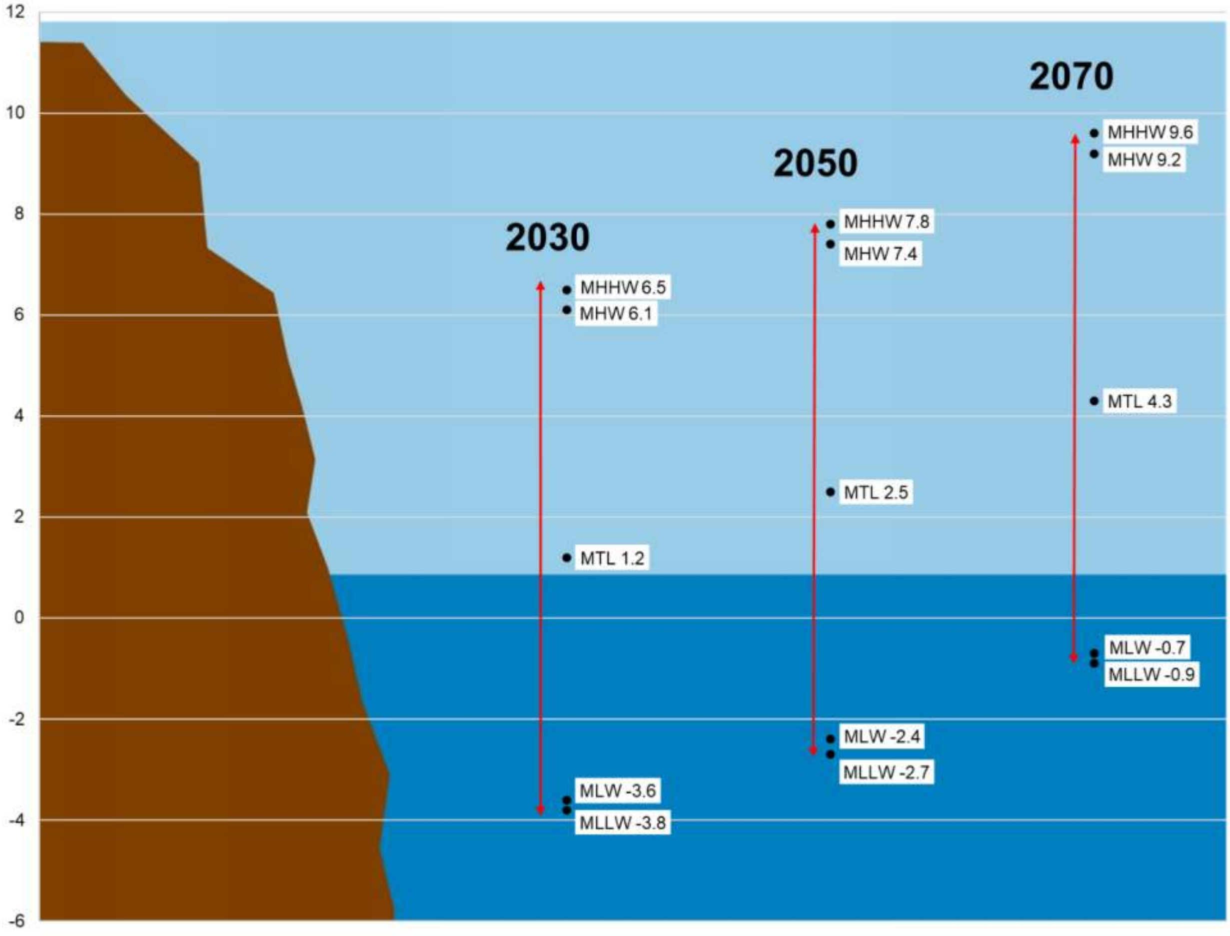

Figure 8: Tidal Datums Visualization for the Assessment Unit Area

Tidal Datum	Elevation (ft-NAVD88)		
	2030	2050	2070
MHHW	6.5	7.8	9.6
MHW	6.1	7.4	9.2
MTL	1.2	2.5	4.3
MLW	-3.6	-2.4	-0.7
MLLW	-3.8	-2.7	-0.9

Table 2: Tidal datum elevations across planning horizons for the Assessment Unit Area

Based on the presented data in this section, the Rock Island Cove Salt Marsh System should expect more regular, annual flooding over time. Coastal flooding poses a considerable threat to the erosion of the salt marsh system, and salt marsh sparrow and species of concern habitat. As sea levels continue to rise, and more intense and frequent extreme storms are expected, marsh maintenance and restoration must remain resilient and accommodating of coastal flood waters.

4.0 MARSHRAM ASSESMENT

4.1 Methodology

Weston & Sampson utilized the recently developed Salt Marsh Rapid Assessment Method (MarshRAM). Data requirements for this methodology have provided the majority of the anticipated desktop and field assessments conducted for the current study. MarshRAM is designed to produce metrics and indices characterizing salt marsh disturbances, platform integrity (plants and soils), landward migration potential, and ecological and cultural value, to inform salt marsh restoration, conservation, and policy.

The MarshRAM methodology includes five components. The first three are checklists of characteristics and condition indicators observed in the field, the fourth is a quantitative marsh community-composition survey and model, and the fifth is a semi-quantitative model that assesses aspects of landward salt marsh migration potential (See Appendix A for attached MarshRAM data).

4.2 Data Analysis and Results

4.2.1 Summary

A field assessment was conducted on October 3, 2022, at the Rock Island Cove Salt Marsh (See Appendix A for attached MarshRAM data assessment). To assess the entire marsh system, the marsh was broken into the northern (north marsh) and southern (south marsh) areas separated by Rhoda Street.

The investigators walked a total of 16 transects (See Appendix A Figure 1 for transect set up map) using the MarshRAM methodology to collect representative data on the entire Rock Island Cove Salt Marsh complex. Overall, the results of the assessment determined the Rock Island Cove Salt Marsh is a lower degraded marsh system. Therefore, it is important to preserve the marsh's health to prevent the marsh from further erosion and/or degradation. See additional parameters assessed explained in the sections below.

4.2.2 Marsh Characteristics

The first parameter of the MarshRAM Assessment is a check list method to identify the various marsh characteristics. The parameters determined through this section are the following: the size of the investigation area, position in watershed, marsh setting type, exposure to tides, natural habitat diversity, connected natural habitats and count of water birds present.

Both marsh areas (north and south) showed similar parameters for the characteristics of the marsh (See Appendix A). The entire marsh complex consists of an oligohaline system with open embankment and a platform system. Oligohaline systems consists of tidal water salinity levels between 0.5 to <5 parts per thousand (ppt). The adjacent upland consists of plain (residential areas, upland forest, and shrubland areas) and hardened shoreline due to an existing man-made wall around areas along the perimeter of the marsh (See Photo 3). The main inputs of freshwater to the system come from sheet flow and precipitation. The marsh system has high exposure to tides being majority of the system is under water during current high tide conditions. The natural habitat provided includes a brackish marsh, high marsh platform, and creeks throughout the marsh. Waterbirds present during the field assessment include species of wading birds and waterfowl*.

*Note at the time of the assessment there were no salt marsh sparrows observed

4.2.3 Ecosystem Function

The marsh complex analysis utilized the MarshRAM ecosystem function and services parameter in which twelve categories of ecosystem functions and services were rated on a scale of 0 (being not evidently provided) to 3 (being special importance). The twelve categories are the following: storm protection of property, floodflow alteration, part of a habitat complex or corridor, sediment/toxin retention, nutrient uptake, carbon storage, T/E species habitat, fish and shellfish habitat, wildlife habitat, hunting or fishing platform, other recreation, ad educational or historic significance.

At the end of the section the total sum of the ranks was determined to be 17 across the entire marsh system. This provided incite that this marsh complex is considered to be in the higher percentile of providing ecosystem functions and services.

4.2.4 Surrounding Land Use

A 150-meter (m) buffer was placed around the perimeter of the marsh to determine the adjacent land use weighted average. It was determined that within the buffer: the majority of the surrounding land was made up of residential/mowed areas and natural areas and open water, the surrounding homeowners use sewered residential systems, and additionally there was presence of raised roadbeds and footpaths/or trials. There also was a small area with a few boat docks/ramps or piers.

The overall weighted score of the surrounding land use was based off a scale of 1 (being natural areas) to 10 (being highly developed areas). This site surrounding land use sums for the north marsh equaled 4.6 and the south marsh equaled 5.2. The average score totaled 4.9 for the entire marsh system. This results in the indication that there is a moderately high developed surrounding land being mainly composed of residential areas.

4.2.5 Wetland Disturbances

Ten metrics were utilized for this portion of the assessment to identify any current disturbances that can impact the marsh system. These metrics included: buffer encroachment, impoundment and tidal restriction, ditching and drainage density, anthropogenic nutrient inputs, filling and dumping within the wetland, edge erosion, crab burrow intensity, ponding and die-off depressions, vegetation cutting/removal/soil disturbances, and phragmites within the wetland.

The impacts were rated on a scale from 1(indicating high intensity disturbance present) to 10 (indicating no or low disturbances present). The average score of the entire marsh complex totals 5.65, showing the marsh faces disturbances to the wetland system at a moderate level.

It was determined that the north marsh has greater wetland disturbances present in comparison to the south marsh. The biggest disturbance causing metrics were observed to be an outcome of buffer encroachment, tidal restrictions (the main cause being the culvert and roadways placements), dense ditching crab burrow density (more present in north marsh), fill within the wetland (the adjacent dike surrounding the marsh (See Photo 2), the at grade access path adjacent to Lind Street (See Photo 3) and fill placed within south marsh), and edge erosion being more present in the north marsh system (specifically adjacent to the Rockland Street culvert).

Photo 2: Man Made Wall Surrounding Portions of Marsh

Photo 3: Man Made At-Grade Access Path Adjacent to Lind Street

4.2.6 Marsh Community Composition and Index of Marsh Integrity

The investigators walked a total of 16 transects (See Figure Appendix A Figure 1 for transect set up) using the MarshRAM methodology. In each section of the marsh (north and south) a total of 8 transects were determined. A tally was kept of each category salt marsh cover type determined as walking along each transect (See Appendix A). See Figure 9 and Figure 10 for Salt Marsh Cover Tallies of both the north marsh and south marsh.

Salt marsh community cover types from the MarshRAM methodology include:

Type	Description
Salt Shrub	Infrequently flooded shrub community (>30% shrub cover) located at higher elevations on the marsh platform and at the upland interface; typically dominated by *Iva frutescens*, *Baccharis halimifolia*
Brackish Marsh Native	Emergent community where freshwater from the watershed dilutes infrequent flooding by seawater; typically dominated by non-halophytic, salt tolerant vegetation such as *Typha angustifolia*, *Schoenoplectus robustus*, *Spartina pectinata*
Phragmites	Areas where the invasive common reed *Phragmites australis* cover > 30%
Meadow High Marsh	Irregularly flooded emergent high marsh community dominated by any combination of *Spartina patens*, *Juncus gerardii*, *Distichlis spicata*; *S. alterniflora* absent
Mixed High Marsh	Irregularly flooded emergent high marsh community comprised of any combination of S. patens, *Juncus gerardii*, *Distichlis spicata*; *S. alterniflora* present
Sa High Marsh	Irregularly flooded emergent high marsh; typically monoculture of *S. alterniflora*, although *Salicornia* sp. may be present
Dieoff Bare Depression	Shallow gradual depression on marsh platform, irregularly flooded by tides but typically remaining flooded or saturated to the surface throughout the tide cycle; <30% vascular vegetation cover, or bare decomposing organic soil, typically with remnant roots of emergent vegetation; may have algal mat, filamentous algae, wrack, or flocculent matter present
Low Marsh	Regularly flooded, typically sloping emergent community located at the tidal edges of the marsh and dominated by tall-form *S. alterniflora*
Dieback Denuded Peat	Typically non-depressional marsh platform feature; marsh peat is exposed (vegetation < 30%) and perforated from grazing, crab burrowing, and erosion; typically at or near tidal edge
Natural Panne	Shallow steep-sided depression on marsh platform with clearly defined edge; irregularly flooded, typically dry at low tide; species may include any cover of *Plantago maritima*, *Sueda maritima*, *Salicornia* sp., *J. gerardii*, *Aster* sp.
Natural Pool	Shallow steep-sided depression on marsh platform with clearly defined edge; irregularly flooded by tides but typically remaining flooded throughout the tide cycle;

Type	Description
	organic or sandy substrate lacking emergent vegetation and roots but may support *Ruppia maritima*
Natural Creek	Narrow, natural, unvegetated, regularly-flooded or subtidal feature cutting into the marsh surface; typically sinuous
Ditch	Manmade ditches and associated spoils on the marsh surface; typically linear
Bare Sediments	Irregularly or infrequently flooded; sandy or gravelly sediments on the marsh surface with < 30% vegetation cover; typically from recent washover event or elevation enhancement project

Both sections of the salt marsh resulted in similar Index of Marsh Integrity Scores (IMI). The IMI scales the marsh on a scale of 1 (most degraded condition) to 9 (least degraded conditions being an undisturbed New England Marsh). The north marsh's IMI score came out to be 7.88 and the south marsh's IMI score came out to be 7.44 leading to an average of the combined marsh system to total 7.66. This index results provide insight that the Rock Island Cove Salt Marsh is in the higher percentile of salt marsh integrity meaning it is a lower degraded system.

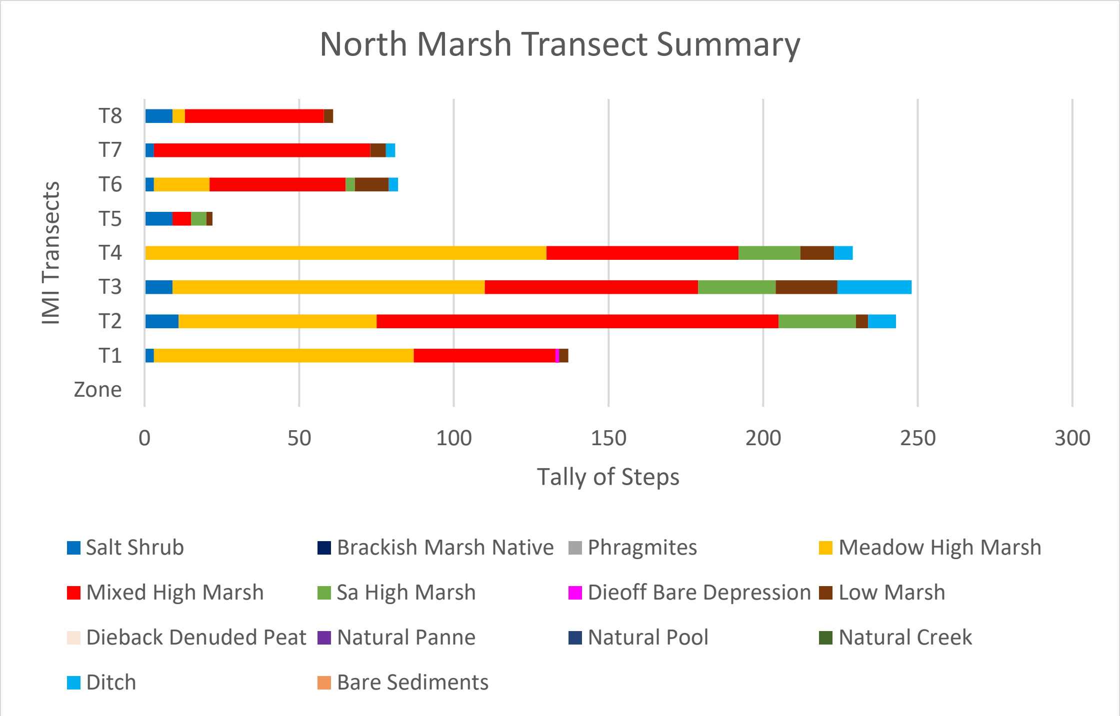

Figure 9: North Marsh Salt Marsh Cover Tally

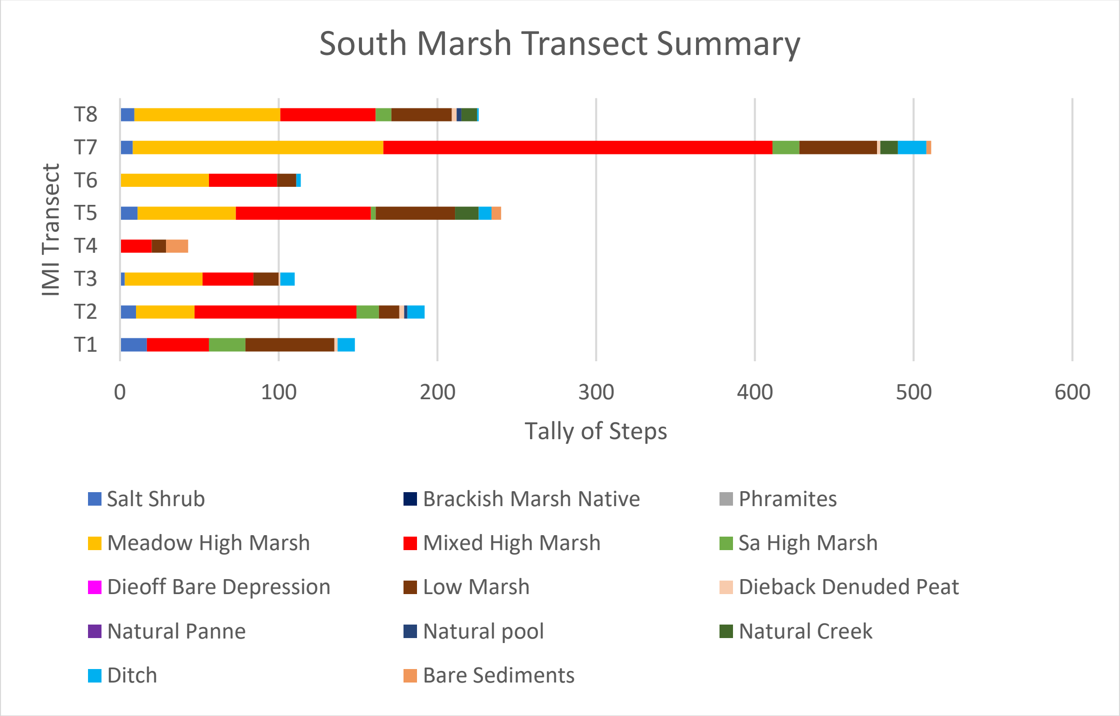

Figure 10: South Marsh Salt Marsh Cover Tally

4.2.7 Migration Potential

A 60-meter (m) buffer was placed around the perimeter of the marsh to determine the migration potential of the marsh system. This effort uses a combination of analyzing physical, biological, and social resistance to marsh landward migration areas using the method of desktop analysis using aerial imagery and utilizing MassGIS NOAA Seal Level Rise data showing the 5-foot increase of the mean high water to determined inundated areas (See appendix A Figure 2).

The metrics were on a scale of 1 (lowest migration potential) to 10 (highest migration potential). Based on the results it was determined the entire marsh system has limited migration potential. The main restriction of migration is that the Rock Island Cover Salt Marsh is surrounded by residential homes, an adjacent dike, an at-grade access path located adjacent to Lind Street, and adjacent roadways leaving little potential for the marsh to migrate into the adjacent upland areas.

5.0 RESTORATION OPPORTUNITIES

Additional parameters were assessed along with the MarshRAM Assessment for potential restoration opportunities. See the following restoration opportunities at the Rock Island Cove Salt Marsh.

5.1 Invasive Species

During the field investigation, the only invasive species observed on site was *Phragmites australis*. Areas located closer to residential back yards, next to the at grad path located at the end of Lind Street, adjacent areas to the Rhoda Street culvert and adjacent to Braintree/Weymouth pumping station were their presence of the invasive species (See Figure 11).

The invasive species are located in areas in the high marsh habitat and extend into adjacent uplands in areas where the species access to freshwater inputs. If the City looked to pursue to increase the movement of the freshwater in the high marsh habitat adjacent to the uplands this could lead to a reduction in the presence of invasives.

Figure 11: Approximate *Phragmites australis* locations

5.2 Tidal Restrictions

Possible tidal restriction areas are limited to the at-grade path located adjacent to Lind Street, the man-made wall/dike (located at landward edge of marsh system), and the Rhoda Street and Rockland Street Culverts. The main tidal restriction of this site is due to the placement of roads and culverts to allow flow underneath the roadways (Rhoda Street and Rockland Street Culvert). See Figure 12.

Figure 12: Possible Tidal Restrictions Map

The main tidal restriction in this system has been identified as the Rockland Street Culvert and at-grade path adjacent to Lind Street in which are scoped to be two of the main focuses of restoration efforts.

5.3 Spring Street Salt Marsh System

With the original field assessment and additional site walks it was also observed that the Spring Street Salt Marsh located north of Spring Street was noted to look as a more degraded marsh complex system. It was also observed there were culverts connecting the system to the Rock Island Cove marsh complex. This portion of the marsh was not included in the assessment performed but was called out as a candidate location for future assessment of the system and any restoration opportunities to be identified.

5.4 Marsh Edge Stabilization

Rockland Street Culvert

Overall, the Rock Island Cove Salt Marsh System is a healthy marsh with minimal eroded areas. One of the areas of concern is located adjacent to the Rockland Street culvert where the marsh has eroded at a much faster rate than anywhere else within the marsh system. Specifically at the downstream section of the culvert it is evident erosion has been taking place at a faster rate (See Photo 1). The rate of erosion downstream of the culvert between the years 1998 to current day (2023) can be seen in historic aerial images found in Appendix B. It is unclear what exact factors are increasing the rate of erosion in this area; however, it has been taken into consideration that the angle of the Rockland Street culvert may be assessed further in the future to determine the role that it may play in the movement of water through the system. The City is not looking to replace this culvert any time soon due to a bridge rehabilitation project that has taken place in 2015 this is not a priority project currently. Through this assessment this is one area the City is seeking restoration activities to take place to improve eroded conditions and maintain the roadway adjacent to the marsh, Spring Street.

Additionally, through the assessment a bulkhead was noted upstream of the Rockland Street culvert, and it was observed that an eddy is being formed as the tidal creek flows through and gets caught in between the end of the bulkhead and marsh system (See Photo 4). This area can be considered a potential area for restoration activities to take place.

Photo 4: Upstream of Rockland Street Culvert

Rhoda Street Culvert

It was observed each side of the Rhoda Street culvert, adjacent to the recently replaced (2003) culvert, exhibits what is believed to be placed 6" +/- rip rap stone at the surface, from the edge of the road extending out into the existing high marsh, and also along the channel bottom. It was identified that sometime between the years of 2014 – 2017 a water main failed in the area and an emergency repair was required, leading to the excessive placement of the riprap. The conditions adjacent to the Rhoda Street Culvert overtime can be seen in the historic aerial images dating from 1998 to current day (2023) can be found in Appendix C. These stoned areas are also either barren of vegetation or dominated by invasive *Phragmites australis*. As a part of the marsh assessment, this area has been added as a focal point for marsh edge restoration through the removal of the stone and subsequent surface restoration through proper grading of the channel bottom, treatment and removal of the Phragmites infestation, and restoration of the marsh and bank surfaces with appropriate native marsh vegetation.

5.5 Fill Removal

The south marsh contains fill within the marsh system that has potential to be removed. However, there is a dike surrounding the marsh system with a man-made wall which makes this a difficult candidate for fill removal. However, as shown in Figure 13, there is an area located in the middle of the south marsh system that could be considered for removal and allow approximately 2,100 SF of area for additional low marsh restoration. See photo 5 below.

Photo 5: Fill within Marsh System

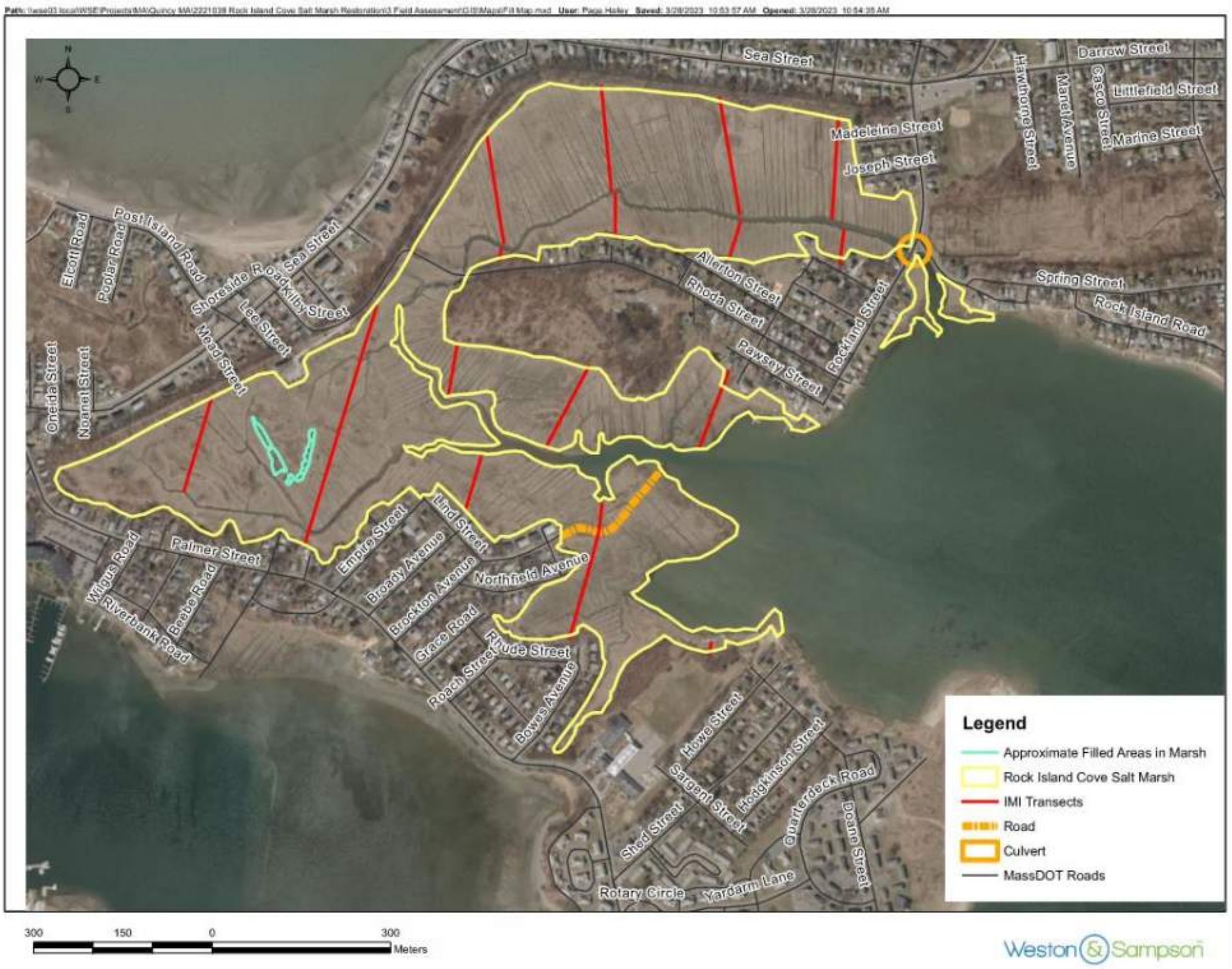

Figure 13: Fill Within Rock Island Cove Salt Marsh

5.6 Nutrient Input Reduction through Stormwater Design & Drainage Improvements

The following summarizes the Green Infrastructure/Low Impact Development (GI/LID) assessment conducted by Weston & Sampson (W&S) to evaluate potential alternatives to reduce pollutant loading to the Rock Island Cove Salt Marsh. The marsh is an important nesting area for species such as the saltmarsh sparrow and is being impacted by tidal restriction, nutrient inputs, erosion, vegetation die off, and invasion of invasive species such as *Phragmites australis*.

The team collected GIS data pertaining to property ownership, existing stormwater utility data, ground surface elevation, and tide levels. A desktop analysis was conducted to determine opportunities for GI/LID practices within the project area. The team prioritized City-owned parcels for GI/LID site selection, which are shown in Figure 14. GI/LID solutions are intended to incorporate aspects of and work with natural systems to reduce impacts of climate change, such as pollutant loading, flooding, urban heat, and erosion.

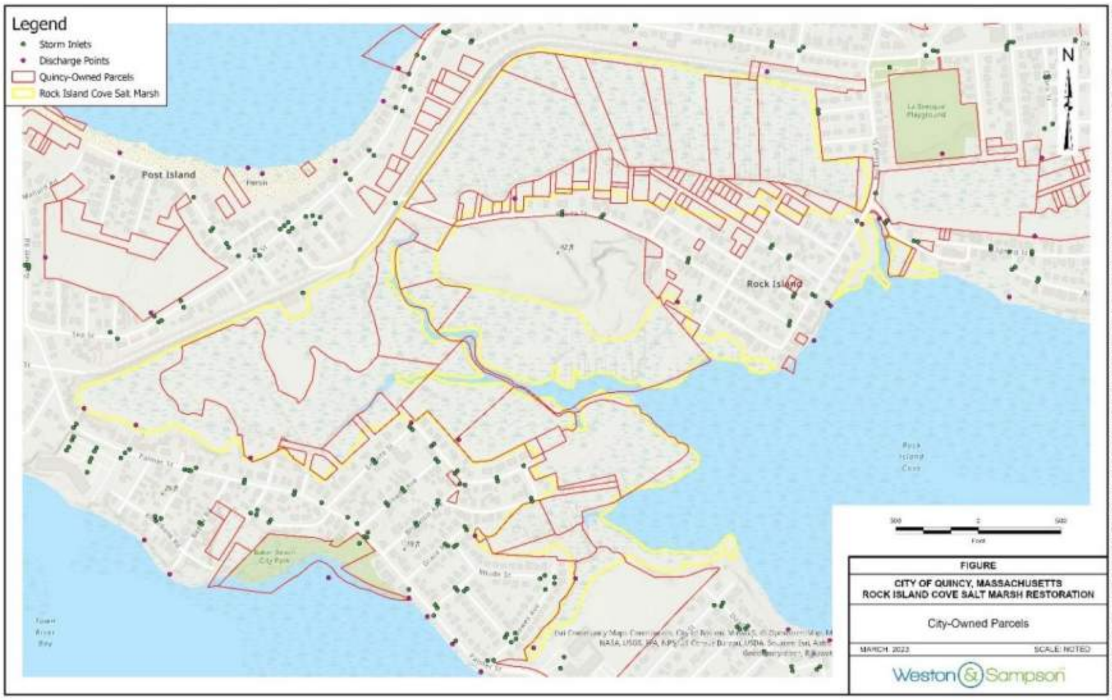

Figure 14: City-Owned Parcels

The analysis was conducted utilizing recommendations of the *Coastal Zone Management Assessment of Climate Change Impacts on Stormwater BMPs and Recommended BMP Design Considerations in Coastal Communities* report. Figure 15 provides various types of nature-based solutions, that Quincy can look to consider for downtown flood mitigation.

Bioswales / Sunken Planters
Bioswales or sunken planters capture and hold stormwater runoff and allow it to slowly infiltrate through soil media, thus reducing flooding.

Floodable Parks
Floodable parks and recreation spaces represent the greatest opportunity for large retention spaces within urban areas.

Wet Plazas
Wet plazas or floodable public spaces are another great opportunity for large retention capacity within denser urban environments.

Pond Restoration
Pond restoration and targeted dredging can help build capacity for stormwater through retention and detention.

Stream Daylighting
Daylighting pipes can involve reopening historic streams, formalizing existing streams, or creating new streams as conveyance connections between other cloudburst elements.

Street Tree Planters
Tree planters can be installed on their own, or in conjunction with bioswales.

Permeable Pavement
Roadways and sidewalks are big contributors to stormwater runoff.

Underground Storage
Underground Storage chambers can be used for reuse, retention, detention, or controlling the flow of on-site stormwater

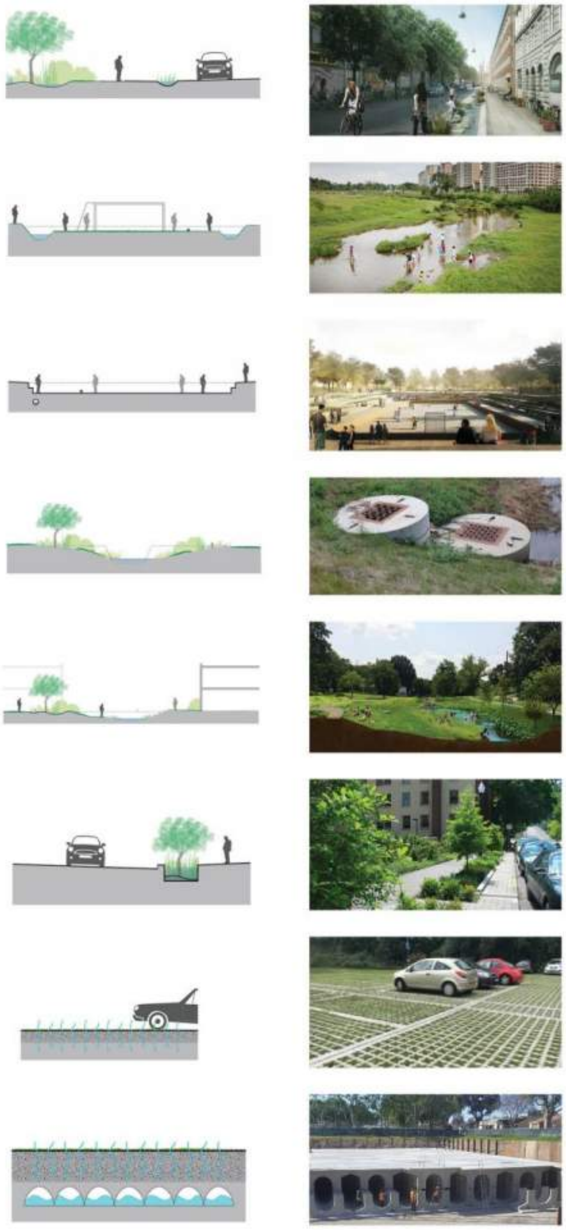

Figure 15: Green Infrastructure Toolbox

Weston & Sampson identified two potential sites for GI/LID in the area surrounding Rock Island Salt Marsh (including the Park on Pawsey Street and the area directly adjacent to where Rockland Street and Spring Street intersect) and provided recommendations on the type of GI/LID. The opportunities are conceptual in nature and have not yet been designed or tested through hydrologic and hydraulic (H&H) modeling to determine the volume of stormwater treated during various storm events. Further development will involve running detailed stormwater model analyses, site visits to verify the groundwater level and soil conditions throughout the site, and ability to tie-in to the existing stormwater system once the GI/LID system's capacity was reached, if necessary. The GI/LID site selection focused on strategies to remove pollutants before they enter the marsh, reduce loading on the stormwater system, and incorporate, detention, infiltration, and daylighting. Favorable locations are found on City-owned parcels, outside of the FEMA flood zone and wetland resources, and above the Highest Astronomical Tide (6.82 ft-NAVD88). These resource areas are shown in Figure 16.

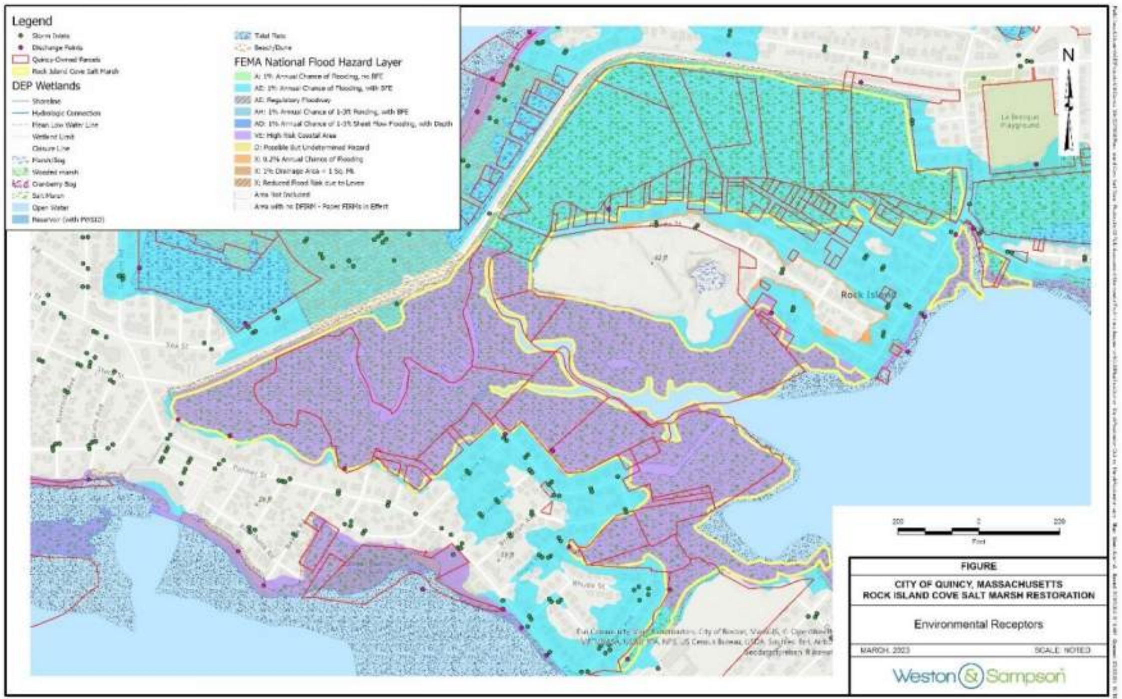

Figure 16: Environmental Receptors for GI/LID Site Selection

Sites will be reviewed and verified with the City for preference or impediments. The two locations selected through the desktop analysis are described below and shown in Figures 17-19.

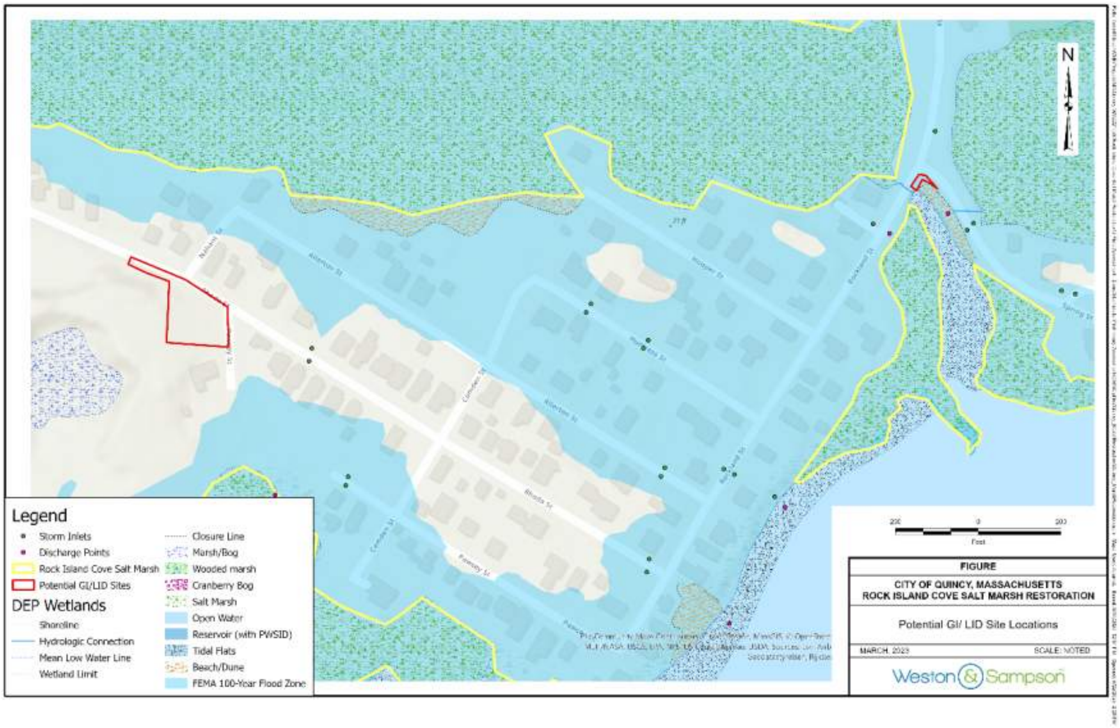

Figure 17: Potential GI/LID Site Locations

Location 1: Pawsey Street Corner

Location one is found along the Rhoda Street right-of-way and on the City-owned parcel at the corner of Rhoda Street and Pawsey Street. There is an adjacent, City-owned park that forms a small hill with a maximum elevation of 49 feet (NAVD-88), and lower, flat areas of the parcel and in the right-of-way in the vicinity of 22 ft (NAVD-88) along Rhonda Street. Stormwater inlets are located regularly along Rhoda Street, allowing for connection of the stormwater system directly into the GI/LID system. Treating street runoff will enable the collection and treatment of concentrated pollutants from the roadways before they enter the marsh. Two types of GI/LID that could be installed at the park are described below, and the following map (Figure 6) outlines the approximate location of the installation. Preferred treatment options at this site include:

1. **Bioswale.** This option will allow for roadway runoff to be captured and treated before entering the marsh. Pretreatment measures such as a bioswale can be tailored to remove nutrients such as nitrogen and phosphorus can remove 80% or more of the total suspended solids (TSS) in stormwater.
2. **Biofiltration.** A biofiltration system uses soils, plants, and microbes to treat stormwater before it is infiltrated and/or discharged. Stormwater runoff would be directed from the street or the existing stormwater system into cells. The runoff would then filter through the soil media. Biofiltration systems are designed to remove 90% TSS, 30-50% total nitrogen, 40-90% total

phosphorus, and 40-90% of metals, including copper, lead, zinc, and cadmium (Massachusetts Stormwater Handbook).

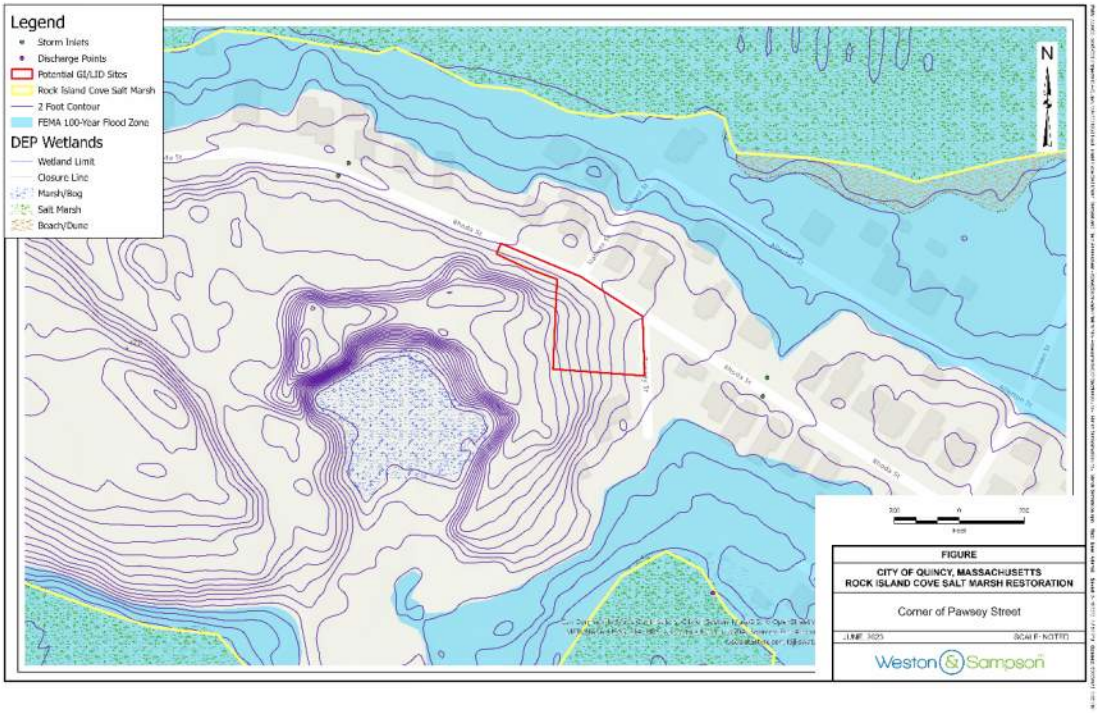

Figure 18: Corner of Pawsey Street

Location 2: Intersection of Rockland Street and Spring Street

The marsh passes beneath Spring Street and Rockland Street through two culverts. The two roads produce runoff which is flows into the marsh near the intersection. Rockland Street slopes from the north down towards the intersection, with only one known catch basin located along the length of the street north of the culvert. An outfall is located on Rockland Street across from Chatham Street, and on Spring Street south of the Spring Street culvert.

In order to reduce runoff, improve water quality, and mitigate impacts such as scour and erosion occurring along the bank at the intersection, the team proposes to install green infrastructure along the roadside. Natural system will improve the site conditions by reducing velocity and improving water quality prior to the stormwater entering the marsh. The team is proposing a bioswale along the right of way of Rockland Street, north of the intersections, and along Chatham Street, south of the intersections.

Additionally, the team has proposed installing a vegetated area at the corner of Rockland and Spring Street to reduce sediment, nutrients, and velocity of stormwater entering the marsh at this location. The design of this area can be incorporated into the culvert upgrades and may be designed and modified based upon the selected design along the marsh bank.

1. **Biofiltration.** A biofiltration system uses soils, plants, and microbes to treat stormwater before it is infiltrated and/or discharged. Stormwater runoff would be directed from the street or the existing stormwater system into cells. The runoff would then filter through the soil media. Biofiltration systems are designed to remove 90% TSS, 30-50% total nitrogen, 40-90% total phosphorus, and 40-90% of metals, including copper, lead, zinc, and cadmium (Massachusetts Stormwater Handbook).

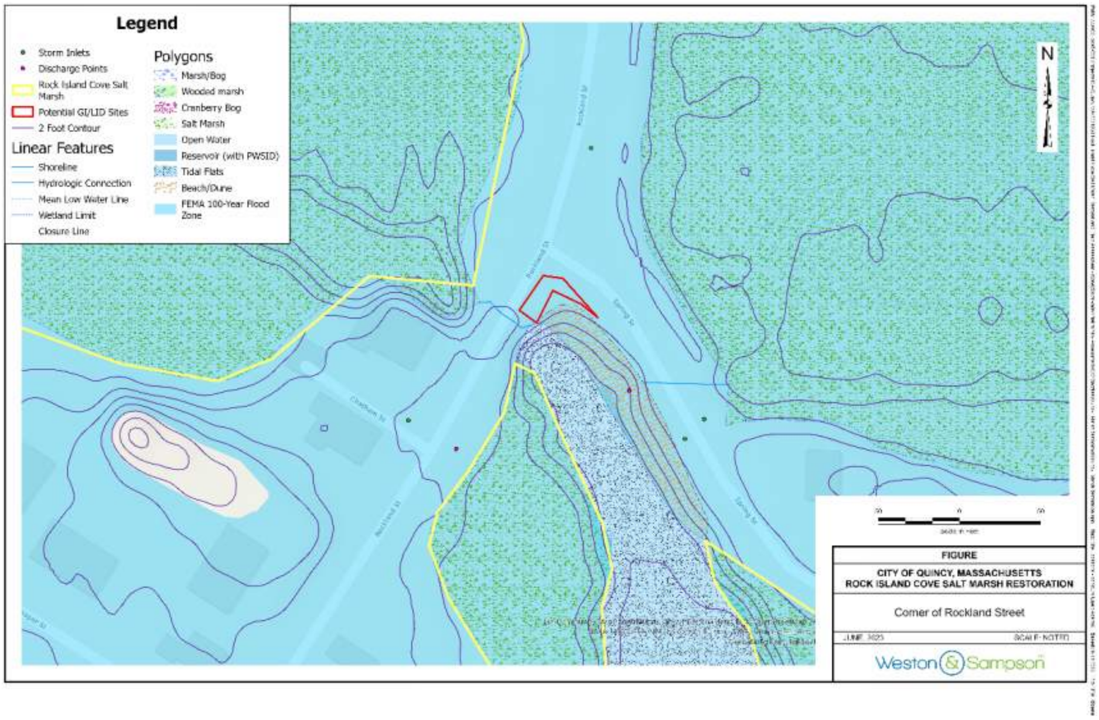

Figure 19: Corner of Rockland Street

6.0 MARSH RESTORATION AND RESILIENCY ALTERNATIVES

Based on the MarshRAM Assessment and additional analysis described above, the following alternatives were analyzed for restoration and resiliency efforts within the Rock Island Cove Marsh System. The City of Quincy had identified two locations for restoration alternatives prior to the MarshRAM assessment taking place (Rockland Street adjacent to the culvert and an at-grade path located off of Lind Street). This alternative analysis will provide alternatives for these initial areas and additionally identify other alternatives noted in other locations identified within the salt marsh complex for future consideration.

6.1 Primary Alternatives

This section will discuss alternatives that were identified as priority areas for restoration to take place. See Figure 20 for Primary Restoration Alternatives Locations Map depicting the estimated locations where each one of the alternatives are proposed. The list of alternatives below is separated into locations within the marsh system and categories of restoration and resiliency alternatives. Additionally, a list of advantages and disadvantages and a permitting scope based on general environmental impacts assumptions was identified for each alternative and is compiled below.

Figure 20: Primary Alternatives Locations Map

A. Rockland Street Culvert

The Rockland Street Culvert has few opportunities for restoration of the degraded area. Based on the MarshRAM Assessment and additional site walks it was identified that areas both upstream and downstream are facing erosion and degradation to the marsh. The alternatives in this area were determined to be a combination of resiliency and restoration efforts, therefore have been broken up into two sub-sections below. The areas where the greatest erosion has taken place is encroaching on Spring Street and the City would consider the area a primary concern for improvements to take place.

i. Restoration:

Alternative 1 – Upland Restoration Adjacent to Spring Street

Above the proposed marsh edge stabilization along Spring Street adjacent to the Rockland Street Culvert, a degraded high marsh and coastal bank could be restored. Currently covered in tide-deposited debris, the area provides critical stabilization potential for the adjacent Spring Street Marsh would be cleaned of accumulated debris, planted with appropriate plant communities, and surrounded with a perimeter of "Wrack Line Fence" to help prevent accumulating materials and allow the restoration to mature.

Advantages:

→ Will help preserve the coastal bank and delicate strip of high marsh habitat along Spring Street.

→ Improves habitat of the existing high marsh that currently remains under a blanket of accumulated tide debris.

Disadvantages:

→ May not be a long-term solution unless monitoring and maintenance provides for the removal of accumulated debris on a routine basis.

Estimated Cost Per Unit: There are too many variables to estimate the exact cost at this time, but it is estimated to range from $50,000 to $100,000 depending on the final design and funding source.

Environmental Permitting Scope:

1. Local Quincy Notice of Intent Submission
    a. Alteration of Salt Marsh
    b. Alteration of Coastal Bank
    c. Alteration in Riverfront Area
    d. Alteration Land Subject to Coastal Storm Flowage
2. MEPA EENF/EIR
    a. 301 CMR 11.03 (b)(1)(a) Alteration of Coastal Bank
    b. 301 CMR 11.06(7)(b) The Secretary shall require an EIR for any Project that is located within a Designated Geographic Area (1 Mile) around an Environmental Justice Population.

3. Mass DEP 401 WQC
    a. Work to occur within Waters of the US (Below High Tide Line)
        i. 314 CMR 9.04 (8) Any activity resulting in discharge of dredged or fill material in any salt marsh.
        ii. 314 CMR 9.04 (12) Dredging 100 CY or More
4. MassDEP Chapter 91 Waterways Application
    a. Work to occur below Mean High Water Line
5. Section 404 Permit – U.S Army Corp of Engineers
    a. Work occurring within Waters of the US (Below High Tide Line)
6. Massachusetts Historic Commission Project Notification Form
    a. Required per filing state permits.

Estimated Permitting Costs: Range from $45,000-$65,000.

ii. Resiliency:

Alternative 2 – Marsh Edge Stabilization – Stone Toe Hybrid

Stabilization of the existing toe of eroded marsh edge using stone as the base up to normal tide elevation, with a bioengineered apparatus on top of that to desired marsh platform elevation. See Figure 21 below for conceptual sketch.

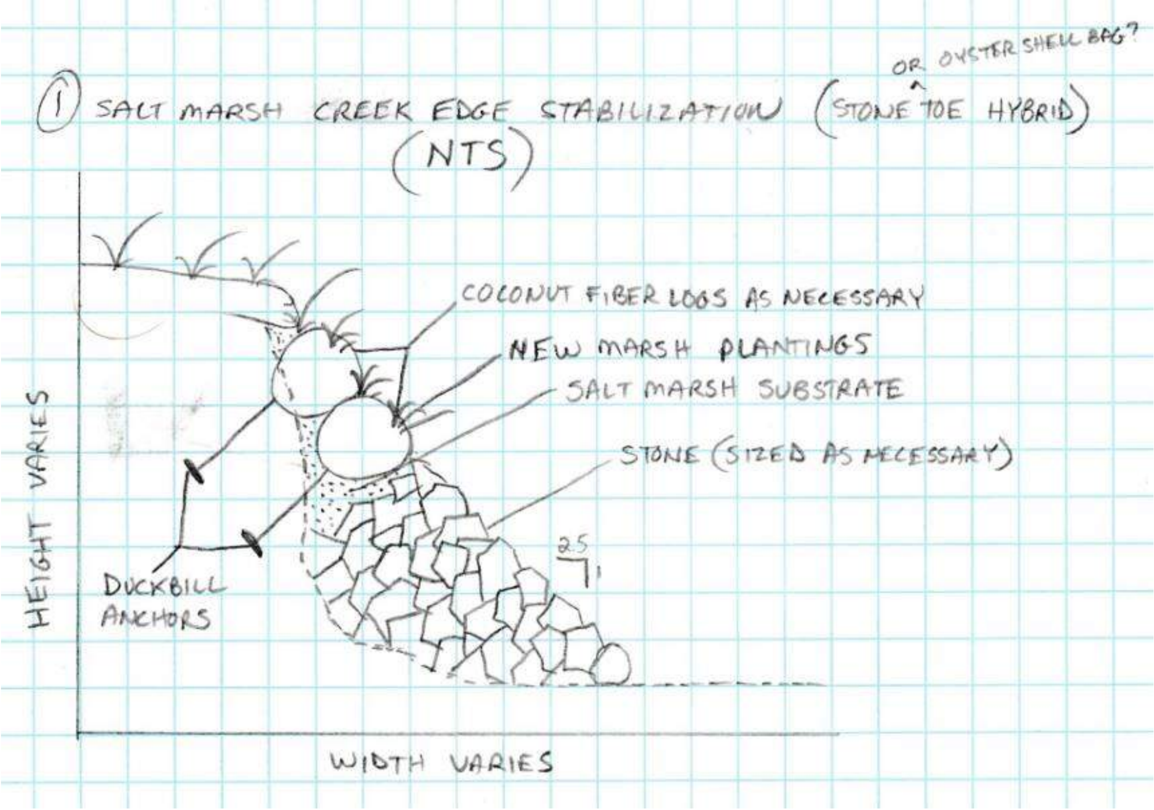

Figure 21: Stone Toe Hybrid

Advantages:

- → Makes use of an array of natural materials to create a strong outer edge. The toe of the eroded edge is strengthened with stone, which is critical to long-term stabilization, and the rest with natural biodegradable materials and plants.
- → Provides, arguably, the strongest defense against future erosion outside of using 100% stone.

Disadvantages:

- → Using stone in an environment that includes water velocities, waves, and other energies, always carries the risk of energy reflection to unprotected nearby surfaces.
- → Biodegradable materials in marsh environments in New England carry an expected lifespan of just a few years. Plant establishment for long-term success is critical.

Estimated Cost Per Unit: Range from $300-$1,000 per linear foot.

Environmental Permitting Scope:

1. Local Quincy Notice of Intent Submission
    a. Alteration of Salt Marsh
    b. Alteration of Coastal Bank
    c. Alteration in Riverfront Area
    d. Alteration Land Subject to Coastal Storm Flowage
2. MEPA EENF/EIR
    a. 301 CMR 11.03 (b)(1)(a) Alteration of Coastal Bank
    b. 301 CMR 11.03 (b)(1)(c) Alteration of 1000 SF or more of salt marsh
    c. 301 CMR 11.06(7)(b) The Secretary shall require an EIR for any Project that is located within a Designated Geographic Area (1 Mile) around an Environmental Justice Population.
3. Mass DEP 401 WQC
    a. Work to occur within Waters of the US (Below High Tide Line)
        i. 314 CMR 9.04 (1) More than 5,000 SF of Wetland Alteration
        ii. 314 CMR 9.04 (8) Any activity resulting in discharge of dredged or fill material in any salt marsh.
        iii. 314 CMR 9.04 (12) Dredging 100 CY or More
4. MassDEP Chapter 91 Waterways Application
    a. Work to occur below Mean High Water Line
5. Section 404 Permit – U.S Army Corp of Engineers
    a. Work occurring within Waters of the US (Below High Tide Line)
6. Massachusetts Historic Commission Project Notification Form
    a. Required per filing state permits.

Estimated Permitting Costs: Range from $45,000-$65,000.

Alternative 3 – Marsh Edge Stabilization – Stone

To protect Spring Street, stabilization of the existing eroded marsh edge in using stone consistent with adjacent existing stone protection at Rockland Street Culvert. See Figure 22 below for conceptual sketch.

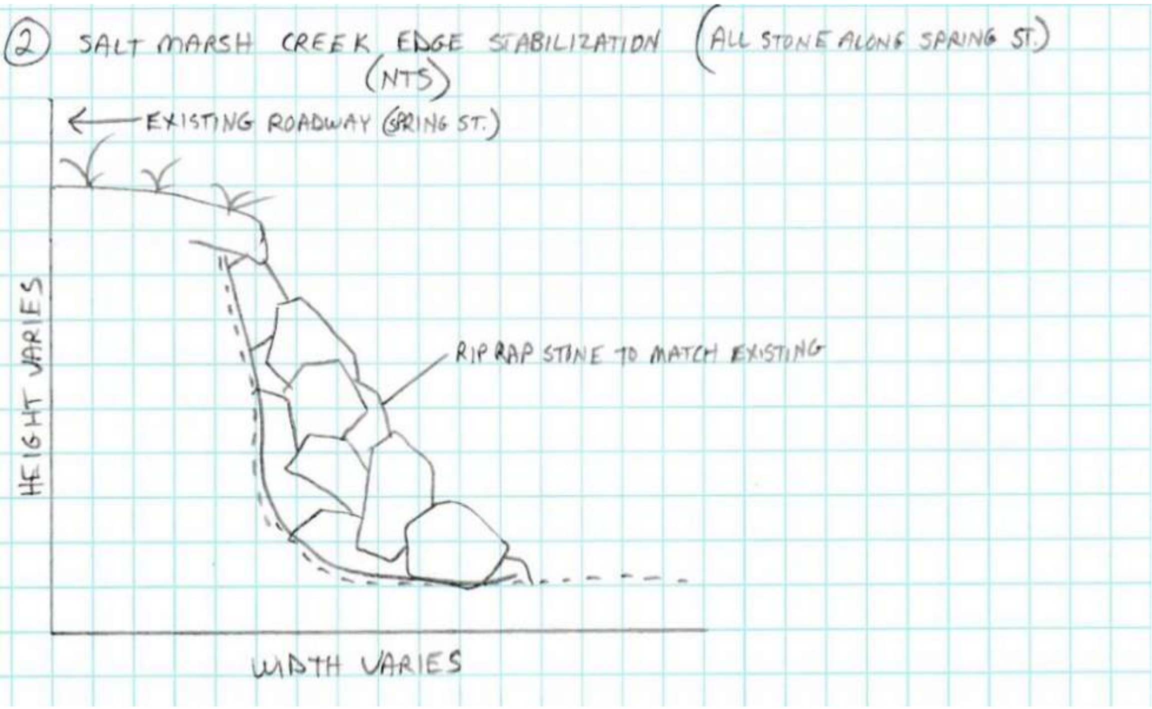

Figure 22: Stone Toe Stabilization

Advantages:

→ Provides an almost permanent stabilization solution right out of the gate, with little to no maintenance.

Disadvantages:

→ Using stone in an environment that includes water velocities, waves, and other energies, always carries the risk of energy reflection to unprotected nearby surfaces.

→ May be more difficult to permit based on current regulations.

Estimated Cost Per Unit: Range from $500-$1,000 per linear foot.

Environmental Permitting Scope:

1. Local Quincy Notice of Intent Submission
    a. Alteration of Salt Marsh
    b. Alteration of Coastal Bank
    c. Alteration in Riverfront Area
    d. Alteration Land Subject to Coastal Storm Flowage

2. MEPA EENF/EIR
    a. 301 CMR 11.03 (b)(1)(a) Alteration of Coastal Bank
    b. 301 CMR 11.06(7)(b) The Secretary shall require an EIR for any Project that is located within a Designated Geographic Area (1 Mile) around an Environmental Justice Population.
3. Mass DEP 401 WQC
    a. Work to occur within Waters of the US (Below High Tide Line)
        i. 314 CMR 9.04 (8) Any activity resulting in discharge of dredged or fill material in any salt marsh.
        ii. 314 CMR 9.04 (12) Dredging 100 CY or More
4. MassDEP Chapter 91 Waterways Application
    a. Work to occur below Mean High Water Line
5. Section 404 Permit – U.S Army Corp of Engineers
    a. Work occurring within Waters of the US (Below High Tide Line)
6. Massachusetts Historic Commission Project Notification Form
    a. Required per filing state permits.

Estimated Permitting Costs: Range from $45,000-$65,000.

B. At Grade Path

The at grade path located adjacent to Lind Street currently faces high tides that completely submerge a fair portion of the path. This path is used to access the marsh system for recreation purposes and shell fishing via foot traffic. During the public meeting information was expressed from the community that this path is no longer used often for recreational or commercial shell fishing and also MWRA has an easement located along this path. With the combination of the tidal influences, recreation activity, and MWRA usage has been a factor in the erosion adjacent to the pathway. In order for this path to exist, fill had to be placed to create the path within the marsh complex, portions of this fill have been dispersed and eroded over time. The alternatives in this area were determined to be a combination of resiliency and restoration efforts, therefore have been broken up into two sub-sections below.

i. Restoration

Alternative 4A – At-Grade Road Replacement with Helical Supported Boardwalk System

As an alternative to altering the existing pathway, which CZM expressed some concerns and questions regarding permitting (and overall ecological benefit), an alternative was developed that includes the installation of an elevated boardwalk system and associated restoration of the previous pathway. This alternative allows for the best chance to receive CZM grant money by incorporating a salt marsh restoration element, where the old pathway would be removed, and the area regraded to allow for salt marsh plant communities to thrive.

Advantages:

→ Removes and upgrades the existing pathway.

→ Creates an Opportunity to restore a significant portion of the marsh (Approx. 25,000 SF) that is currently elevated above tidal elevations and contains invasive plant species.

- → A more attractive alternative to permitting agencies and meet CHWQ (CZM) grant money.

Disadvantages:

- → Potentially expensive option if not supplemented with grant money.

Estimated Cost Per Unit: Helical-supported Boardwalk generally runs about $500-$1,000 per linear foot depending on specific design. Fill removal and marsh restoration depends on soil quantity removed and disposal location.

Environmental Permitting Scope:

1. Local Quincy Notice of Intent Submission
    a. Alteration of Salt Marsh
    b. Alteration of Coastal Bank
    c. Alteration in Riverfront Area
    d. Alteration Land Subject to Coastal Storm Flowage
2. MEPA EENF/EIR
    a. 301 CMR 11.03 (b)(1)(a) Alteration of Coastal Bank
    b. 301 CMR 11.03 (b)(1)(c) Alteration of 1000 SF or more of salt marsh
    c. 301 CMR 11.06(7)(b) The Secretary shall require an EIR for any Project that is located within a Designated Geographic Area (1 Mile) around an Environmental Justice Population.
3. Mass DEP 401 WQC
    a. Work to occur within Waters of the US (Below High Tide Line)
        i. 314 CMR 9.04 (1) More than 5,000 SF of Wetland Alteration
        ii. 314 CMR 9.04 (8) Any activity resulting in discharge of dredged or fill material in any salt marsh.
4. MassDEP Chapter 91 Waterways Application
    a. Work to occur below Mean High Water Line
5. Section 404 Permit – U.S Army Corp of Engineers
    a. Work occurring within Waters of the US (Below High Tide Line)
6. Massachusetts Historic Commission Project Notification Form
    a. Required per filing state permits.

Estimated Permitting Costs: Range from $45,000-$65,000.

ii. Resiliency

Alternative 4B – At-Grade Road Stabilization & Protection

Protection and stabilization of an existing informal roadway used for residential recreation and by local shell fishing activities. The existing road is a mix of gravel and other soils, varies in elevation, crosses existing ditches, includes degraded portions, and presents an erosion risk during storms. Improvements to this roadway would include addition of a stable surface material, stabilized shoulders, and shrub protection to minimize erosion potential. Potential to use sections of coarse stone under the roadway to improve existing ditch connectivity. See Figure 23 below for conceptual sketch.

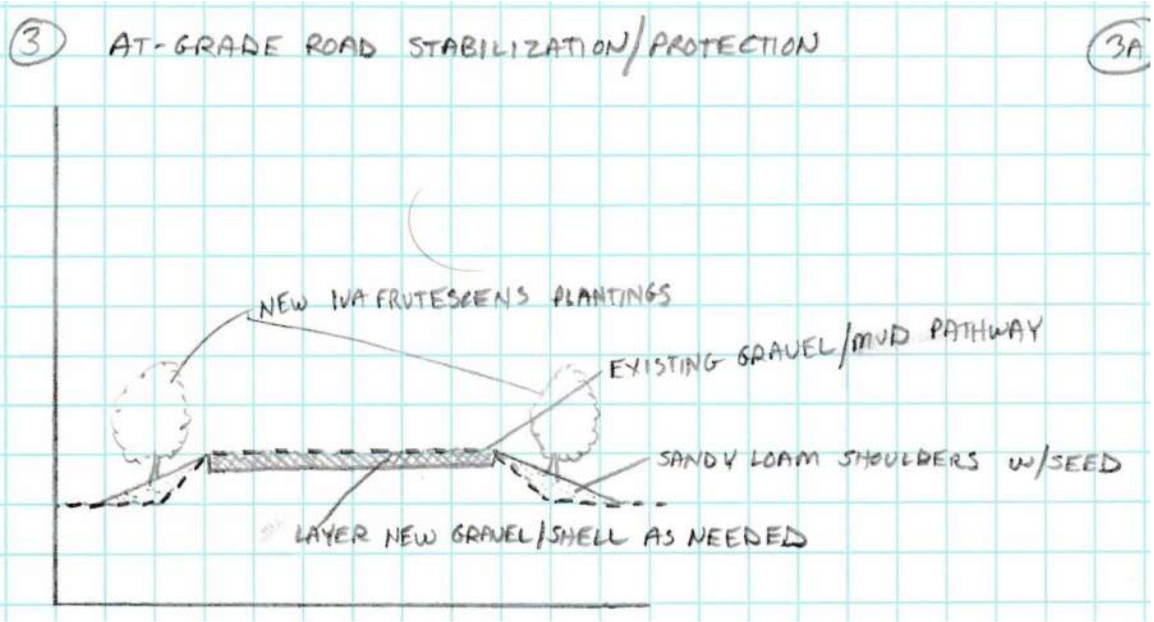

Figure 23: At Grade Path Stabilization

Advantages:

- → Solidifies and strengthens an existing informal roadway to minimize erosion.
- → Satisfies local population that uses the roadway for various reasons.
- → Relatively cost-effective

Disadvantages:

- → Improving the roadway could indirectly promote and attract unwanted use.
- → Construction of an erodible roadway in tidal zone will be difficult to permit.
- → Area would require significant erosion controls during construction that would need to be left in place until the roadway was completely stable.
- → When meeting with CZM on this alternative they expressed some concerns and questions regarding permitting (and overall ecological benefit).

Estimated Cost Per Unit: Cost is dependent on methods/materials and cross-sections.

Environmental Permitting Scope:

1. Local Quincy Notice of Intent Submission
    a. Alteration of Salt Marsh
    b. Alteration of Coastal Bank
    c. Alteration in Riverfront Area
    d. Alteration Land Subject to Coastal Storm Flowage
2. MEPA EENF/EIR
    a. 301 CMR 11.03 (b)(1)(a) Alteration of Coastal Bank
    b. 301 CMR 11.03 (b)(1)(c) Alteration of 1000 SF or more of salt marsh
    c. 301 CMR 11.06(7)(b) The Secretary shall require an EIR for any Project that is located within a Designated Geographic Area (1 Mile) around an Environmental Justice Population.
3. Mass DEP 401 WQC
    a. Work to occur within Waters of the US (Below High Tide Line)
        i. 314 CMR 9.04 (1) More than 5,000 SF of Wetland Alteration
        ii. 314 CMR 9.04 (8) Any activity resulting in discharge of dredged or fill material in any salt marsh.
        iii. 314 CMR 9.04 (12) Dredging 100 CY or More
4. MassDEP Chapter 91 Waterways Application
    a. Work to occur below Mean High Water Line
5. Section 404 Permit – U.S Army Corp of Engineers
    a. Work occurring within Waters of the US (Below High Tide Line)
6. Massachusetts Historic Commission Project Notification Form
    a. Required per filing state permits.

Estimated Permitting Costs: Range from $45,000-$65,000.

C. Rhoda Street Culvert

The Rhoda Street culvert was observed during the assessment as having the presence of a large amount of riprap both upstream and downstream of the culvert. With the placement of this riprap, it was also observed during lower tide events the flow is being limited by the large rocks placed through the culvert. Additionally, over time it seems that phragmites have become more dominant adjacent to this culvert. See proposed restoration alternative description below.

i. Restoration

Alternative 5– Restoration at Rhoda Street Culvert

The area of the Rhoda Street Culvert currently exhibits the use of excessive riprap stone for stabilization on the marsh surface, roadway embankment, and inside the channel on both sides. The team has assessed that this stone is not necessary and is exacerbating the growth of *Phragmites australis*. It is proposed that this stone should be removed/reused thoughtfully, and existing surfaces restored to their proper habitat type using natural techniques and materials. See Figure 24 below for an image of existing conditions.

Figure 24: Rhoda Street Culvert Existing Conditions

Advantages:

- → Removes the unnecessary stone along the roadway, down the bank, and on the marsh surface.
- → Restoration would include the eradication of the existing stand of invasive *Phragmites australis* with replacement of native plant communities.

→ Re-use of existing stone in strategic areas like the roadside, and in the transition zone where vegetation is typically tough to establish (choked riprap).

Disadvantages:

→ Engineering 'down' from the existing stone temporarily destabilizes the area and increases potential maintenance as new native habitat types establish.

Estimated Cost Per Unit: Cost is dependent on final designs. Range from $75,000 - $100,000.

Environmental Permitting Scope:

1. Local Quincy Notice of Intent Submission
    a. Alteration of Salt Marsh
    b. Alteration of Coastal Bank
    c. Alteration in Riverfront Area
    d. Alteration Land Subject to Coastal Storm Flowage
2. MEPA EENF/EIR
    a. 301 CMR 11.03 (b)(1)(a) Alteration of Coastal Bank
    b. 301 CMR 11.03 (b)(1)(c) Alteration of 1000 SF or more of salt marsh
    c. 301 CMR 11.06(7)(b) The Secretary shall require an EIR for any Project that is located within a Designated Geographic Area (1 Mile) around an Environmental Justice Population.
3. Mass DEP 401 WQC
    a. Work to occur within Waters of the US (Below High Tide Line)
        i. 314 CMR 9.04 (1) More than 5,000 SF of Wetland Alteration
        ii. 314 CMR 9.04 (8) Any activity resulting in discharge of dredged or fill material in any salt marsh.
4. MassDEP Chapter 91 Waterways Application
    a. Work to occur below Mean High Water Line
5. Section 404 Permit – U.S Army Corp of Engineers
    a. Work occurring within Waters of the US (Below High Tide Line)
6. Massachusetts Historic Commission Project Notification Form
    a. Required per filing state permits.

Estimated Permitting Costs: Range from $45,000-$65,000.

Alternative 6 – Phragmites Management near Rhoda Street Culvert

Chemical and/or mechanical removal of existing Phragmites australis stands in isolated populations along the edge of the marsh and near the Rhoda Street Culvert.

Advantages:

→ Removes minor but extensive threat to upland and high marsh habitat.

Disadvantages:

- → May not be necessary in light of likely potential sea level rise, where it could be kept at bay naturally.
- → Multi-Year treatment with herbicides likely.

Estimated Cost Per Unit: Range from initial cost $10,000 - $20,000 then $7,500 per acre for 3 years minimum.

Environmental Permitting Scope if using mechanical methods:

1. Local Quincy Notice of Intent Submission
    a. Alteration of Salt Marsh
    b. Alteration of Coastal Bank
    c. Alteration in Riverfront Area
    d. Alteration Land Subject to Coastal Storm Flowage
2. MEPA EENF/EIR
    a. 301 CMR 11.03 (b)(1)(a) Alteration of Coastal Bank
    b. 301 CMR 11.03 (b)(1)(c) Alteration of 1000 SF or more of salt marsh
    c. 301 CMR 11.06(7)(b) The Secretary shall require an EIR for any Project that is located within a Designated Geographic Area (1 Mile) around an Environmental Justice Population.
3. Mass DEP 401 WQC
    a. Work to occur within Waters of the US (Below High Tide Line)
        i. 314 CMR 9.04 (1) More than 5,000 SF of Wetland Alteration
        ii. 314 CMR 9.04 (8) Any activity resulting in discharge of dredged or fill material in any salt marsh.
        iii. 314 CMR 9.04 (12) Dredging 100 CY or More
4. MassDEP Chapter 91 Waterways Application
    a. Work to occur below Mean High Water Line
5. Section 404 Permit – U.S Army Corp of Engineers
    a. Work occurring within Waters of the US (Below High Tide Line)
6. Massachusetts Historic Commission Project Notification Form
    a. Required per filing state permits.

Estimated Permitting Costs: Range from $45,000-$65,000.

Environmental Permitting Scope if using herbicides:

1. Local Quincy Notice of Intent Submission
    a. Alteration of Salt Marsh
    b. Alteration of Coastal Bank
    c. Alteration in Riverfront Area

        d. Alteration Land Subject to Coastal Storm Flowage
2. MassDEP Herbicide Application (WM 04)

Estimated Permitting Costs: Range from $8,000 – $12,000.

D. South Marsh Fill Removal

Multiple locations in the southern marsh, totaling about an acre in size, exhibit piles of fill material from an unknown source. These areas currently exhibit upland characteristics & plant communities and could be removed to create high marsh habitat.

i. Restoration

Alternative 7 – South Marsh Fill Removal

Multiple locations in the southern marsh, totaling about an acre in size, exhibit piles of fill material from an unknown source. These areas currently exhibit upland characteristics & plant communities and could be removed to create high marsh habitat (See Figure 13 and Photo 5).

Advantages:

→ Removes existing upland habitat and replaces with high marsh habitat.

→ Presents potential opportunity to re-use existing fill to elevate lower areas of marsh to increase high marsh habitat or migration potential.

→ Also potentially satisfies CZM grant program criteria for marsh restoration.

Disadvantages:

→ Potentially expensive option depending on where fill is able to be relocated/reused r disposed.

→ Operations to remove the fill would require heavy equipment and would need to be done very carefully.

Estimated Cost Per Unit: Too many variables to estimate the cost of this effort.

Environmental Permitting Scope:

1. Local Quincy Notice of Intent Submission
    a. Alteration of Salt Marsh
    b. Alteration of Coastal Bank
    c. Alteration in Riverfront Area
    d. Alteration Land Subject to Coastal Storm Flowage
2. MEPA EENF/EIR
    a. 301 CMR 11.03 (b)(1)(a) Alteration of Coastal Bank
    b. 301 CMR 11.03 (b)(1)(c) Alteration of 1000 SF or more of salt marsh
    c. 301 CMR 11.06(7)(b) The Secretary shall require an EIR for any Project that is located within a Designated Geographic Area (1 Mile) around an Environmental Justice Population.
3. Mass DEP 401 WQC

        a. Work to occur within Waters of the US (Below High Tide Line)
            i. 314 CMR 9.04 (1) More than 5,000 SF of Wetland Alteration
            ii. 314 CMR 9.04 (8) Any activity resulting in discharge of dredged or fill material in any salt marsh.
            iii. 314 CMR 9.04 (12) Dredging 100 CY or More

4. MassDEP Chapter 91 Waterways Application
    a. Work to occur below Mean High Water Line
5. Section 404 Permit – U.S Army Corp of Engineers
    a. Work occurring within Waters of the US (Below High Tide Line)
6. Massachusetts Historic Commission Project Notification Form
    a. Required per filing state permits.

Estimated Permitting Costs: Range from $45,000-$65,000.

E. Green Infrastructure/ Low Impact development areas

Alternative 8 – Stormwater Infrastructure/BMPS

As stated in *section 5.6* above two locations were identified for implementation of Green Infrastructure/ Low Impact development areas. The same alternatives as described in *section 5.6* above were also analyzed both advantages and disadvantages, costs for implementation, and permitting scopes below.

1. **Bioswale.** This option will allow for roadway runoff to be captured and treated before entering the marsh. Pretreatment measures such as a bioswale can be tailored to remove nutrients such as nitrogen and phosphorus and can remove 80% or more of the total suspended solids (TSS) in stormwater.

    Advantages: This solution will fit into limited streetside space and has a low cost.

    Disadvantages: This system functions as pretreatment and is most effective followed by a primary treatment system, such as the biofiltration described below.

2. **Biofiltration.** A biofiltration system uses soils, plants, and microbes to treat stormwater before it is infiltrated and/or discharged. Stormwater runoff would be directed from the street or the existing stormwater system into cells. The runoff would then filter through the soil media. Biofiltration systems are designed to remove 90% TSS, 30-50% total nitrogen, 40-90% total phosphorus, and 40-90% of metals, including copper, lead, zinc, and cadmium (Massachusetts Stormwater Handbook).

    Advantages: This system is customizable for the site constraints and needs. There is a lower cost of installation than the underground storage system.

    Disadvantages: Maintenance is required to keep the system functioning well.

    Environmental Permitting Scope:

    1. Local Quincy Notice of Intent (NOI) or Request for Determination of Applicability (RDA) Submission
        a. Work will take place within wetland resource area buffer zones.

Estimated Permitting Costs: Range from $7,000 - $12,000.

6.2 Alternatives for Future Consideration

In this section additional restoration and resiliency alternatives are described that were identified in various locations within or adjacent to the Rock Island Cove Salt Marsh system following the MarshRAM Assessment that are to be considered by the City for future consideration.

A. Salt Marsh Ditch Manipulation

Manipulation of former mosquito and agricultural ditches through bottom filling/plugging of some, and promotion of others, presents an opportunity to equalize surface and perimeter stormwater drainage with promoting restoration of the ditches into marsh plant habitat.

Advantages:

- → Eliminates existing ditches and replaces with salt marsh habitat.
- → Leaves some ditches that are beneficial to proper marsh surface drainage and efficient movement of freshwater runoff from surrounding infrastructure.

Disadvantages:

- → Will require an extensive study to map out which ditches should be kept, and which should be "converted".

B. Additional Culvert at Rhoda Street

Improved flushing of the salt marsh and reduced road flooding potential could be accomplished through the addition of another culvert on Rhoda Street.

Advantages:

- → Provides better drainage between marshes and could alleviate flooding issues on Rhoda Street.
- → Opportunity to create new tidal channel and improve habitat along the roadway embankment.

Disadvantages:

- → Will require extensive engineering.
- → Could be tough to permit since it would require excavation of a new channel which deletes existing salt marsh habitat.

C. Spring Street Marsh Restoration

Spring Street Marsh was not included in the salt marsh assessment for Rock Island Cove Marsh as mentioned in *section 5.3* but could present an opportunity to study and restore an obviously degraded marsh system immediately adjacent to our subject system.

Advantages:

- → Opportunity to provide better drainage between Spring Street Marsh and Rock Island Cove Marsh.

→ Opportunity to naturalize primary drainage channels and secondary ditches, and also improve degraded marsh platform.

Disadvantages:

→ Will require a MarshRAM assessment of its own, and subsequent planning.

D. Re-Opening of the Berm Culverts

Existing original culverts under State Street that allow connection to the Rock Island Cove Marsh system were closed off at some point in the past and does not allow proper exchange of tidal waters through the entire marsh system. Removal of the blockages would tie the systems back together.

Advantages:

→ Opportunity to provide better connectivity and drainage between surrounding marsh systems.

→ Provides an opportunity to restore acres of previous marsh that is now dominated *Phragmites australis* and other non-native vegetation.

Disadvantages:

→ Will require a thorough investigation and planning.

→ Could impact residents on the Sea Street side of the berm by subjecting them to tidal flooding.

E. Additional Location for Implementation of Green Infrastructure/Low Impact Development

Along with the two locations previously discussed in *section 5.6*, an additional location was identified at La Brecque Playground and recreation fields that are located between Rockland Street, Sea Steer/Darrow Street, and Hawthorne Street (See Figure 25). The playground is comprised of a baseball field, soccer field, basketball court, playground, and a walking trail/track, and directly abuts a parking lot that is mostly privately-owned at the corner of Sea Street and Rockland Street. The elevation of the park varies between an elevation of 18 feet at the highest point and 6 feet at the lowest. The low point is located at the southeastern corner of the site and is classified as a wooded marsh that drains to the salt marsh.

By collecting, treating, and infiltrating stormwater from impervious surfaces on the site, the City could reduce pollutant loading in the salt marsh. There is a stormwater catch basin in the parking lot to the north of the site, which could tie into the treatment system, thus diverting stormwater from directly entering the salt marsh and instead entering GI/LID system. Preferred treatment options on the site include:

2. **Biofiltration:** The system utilizes natural systems to remove pollutants from stormwater and to infiltrate it into the soil. Biofiltration systems are designed to remove 90% TSS, 30-50% total nitrogen, 40-90% total phosphorus, and 40-90% metals, including copper, lead, zinc, and cadmium.

- **Porous asphalt pavement**: In its current state, the parking lot to the north of the fields covers approximately 36,000 square feet and is entirely impervious with no vegetation or opportunity for stormwater infiltration. The City could take the opportunity to install porous asphalt in the parking stalls, reducing impervious surface and allowing for infiltration of stormwater from the parking lot and surrounding roads. Porous pavement, when designed to prevent runoff, is properly maintained, and with adequate storage capacity, has an 80% TSS removal. If additional nutrient removal is desired, additional Best Management Practices (BMPs) can be considered for this area.

Advantages:

- → Porous asphalt treatment can be installed anywhere there is existing asphalt at the playground and will not require additional space.

Disadvantages:

- → Salt and sand is not recommended on porous asphalt parking lots due to the ability to clog the pores. A vacuum truck is required to maintain the parking lot periodically.
- → The parking lot is not City owned so a land swap or agreement would be required to allow work on parcel.

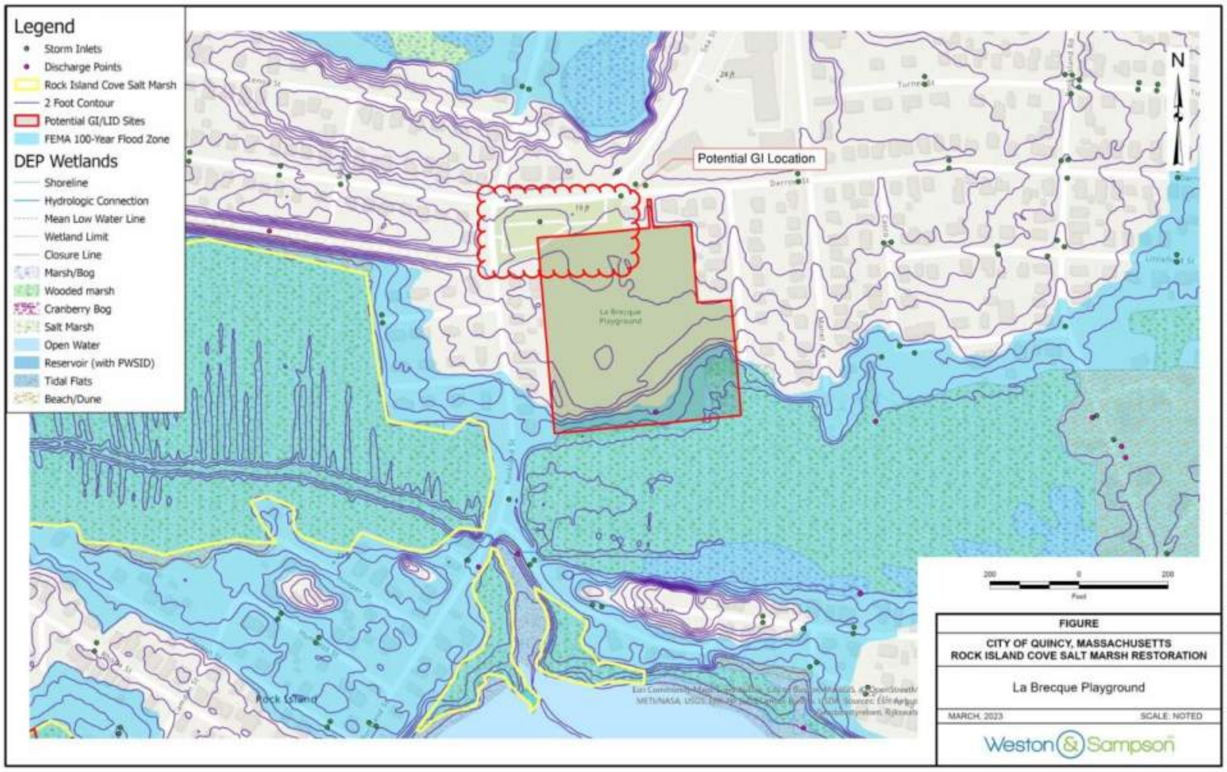

Figure 25: La Brecque Playground Parking Lot

7.0 PUBLIC INPUT

On May 31st, 2023, a public meeting was held in person in Quincy, MA to allow the community to provide input on the proposed alternatives (listed above). An estimated 44 attendees were present at this meeting. City staff and consultants gave a presentation on the project, followed by a discussion. The public was generally very pleased that a project was in the works to maintain/improve the marsh from the current conditions. Many of the attendees have lived on the Rock Island Cove Marsh complex for decades and provided additional information on how the marsh has changed over time in their view. The information they provided included the following:

- At Lind Street, the old at grade path was previously more of a straight line and is an MWRA easement.
- The at grade path off Lind Street used to flood when the tide was 15 feet, but now the marsh floods when over 12 feet.
- The community indicated that the at grade path off Lind Street is no longer used for commercial or recreational shell fishing and hasn't been for years. Some residents say there are no clams anymore anyways.
- The stone at the Rockland Street crossing was added after emergency work was done on the water main.
- There was a stone quarry in the open space off Rhoda Street years ago & the boulders along the road by the marsh were put in for safety.
- Currently, water pours through the tide gate at Edgewater Drive/beach and into the tidal creek, and the water didn't used to do this in the past.
- The road by the two homes at the beginning of Pawsey Street used to continue out into Rhoda Street, but backyards have taken over.
- The community indicated backyard flooding on a more regular basis than in the past.
- The abutters raised concern on there is less wildlife than in the past and wonder if it could be due to pollutants or excess nitrogen.
- A lot of trash and debris ends up in the marsh complex down by the radio tower due to a "funnel effect" of tides and wind, and the fact that there is less flow there on an 8 foot or 9 foot tide. The worst area is the whole southern edge above Palmer Street. Some is "marsh debris" but also Styrofoam, many vehicle tires, an old dock, etc. The city cleans behind the school, but this garbage is hard to access and hard to dispose of, especially tires. Recommendation to have different zones with scheduled clean up by City. One suggestion for access was the paper road next to 24 Empire St.
- There is a network of local sewage pipes that go to the pumping station, and these could be a concern in terms of pollution.
- The valve under the dike (aka berm) adjacent to the South marsh is broken. There is a twin-barreled culvert that used to be open to tidal flow, but at some point was bricked and blocked with cobblestones, cutting off the Willows Marsh.
- During the 2018 storm, the pumping station (located adjacent to the south marsh), which gets its power from Jewett Street area, lost power. The back up system worked but at some point, they couldn't get additional fuel for the backup. Residents are very concerned about what will happen if pumping stops working since there is no shut off valve, flooding will happen again,

and this is a major sewer line. There is frustration that City hasn't addressed this concern sufficiently despite residents expressing concern in the past.
- The ditches in the marsh system were cleaned ~10-12 years ago, and then the Spring Street gate was adjusted slowly to determine tide level that allowed tidal flows but not significant flooding, however sometime after that and before 2018, the tide gate was closed and not reopened. Noted that the tide gate is still not functioning correctly.

Additionally, during the public meeting the abutters had some additional suggestions they would like to see take place and take into consideration as this project is further developed including:

- Additional Hydrologic assessments (hydrology through the various culverts in the marsh)
- Keep the historic pilings in the marsh.
- Consider if possible, to raise the roadway of Rhoda Street, since the high marsh is under water during king tides now and road floods sometimes. The Cape Cod Commission's "Low Lying Roads Project" was mentioned.
- Make sure appropriate monitoring and maintenance takes place for whichever alternatives are implemented.
- Concerns working on private property adjacent to the marsh.
- Assessing the Spring Street Marsh.
- When considering the fill removal alternative emphasize on the habitat the vegetation located on create.
- The boy scouts installed an Osprey nest near empire and Lind Street (In South Marsh) and it is currently tilting.
- Can the Rockland Street Culvert be replaced?
- Has it been considered plugging up the ditches? Have we considered restoring salt ponds in the marsh? There was a discussion of open water marsh management, and formerly integrated marsh management.
- Suggestion to be creative with solutions, for example creating a matching berm on the other side of Rockland Street, from the berm that originates at Spring Street and wraps around onto Rockland Street. The existing berm does hold back some flooding.

Overall, the project team has assessed the community's input and tried to implement to the best extent their input into this report. The residents expressed support for this project and are excited to see what alternatives are utilized. City staff also had several meetings with individual residents and other stakeholders to discuss the marsh and the project. City staff is planning additional outreach and collaboration with residents and the general public going forward as well.

8.0 ASSESMENT CONCLUSIONS

Based on the collected information from this assessment, the Rock Island Cove Marsh complex is concluded to be a healthy marsh system at its current condition based on various criteria in the MarshRAM assessment protocol. However, the total salt marsh assessment revealed areas that are in need of restoration efforts to preserve the marsh, especially when seal level rise is considered.

Restoration activities will need to be designed to be resilient to sea level rise for over time the sea level will only continue to flood the marsh system on a more frequent basis which can lead to increase in erosion of the marsh. Additionally, it should be understood that there are limited opportunities for the marsh to naturally migrate landward. In time, there will be greater loss in high marsh habitats if preventative measures are not in place. It is necessary to identify methods to preserve this marsh system from erosion and degradation that will continue to take place with nowhere for the marsh to extend.

8.1 Alternatives for Conceptual Design

Following meetings with representatives from CZM office, holding a public meeting, and looking over numerous proposed alternatives, it was determined the areas adjacent to Spring Street and the Rockland Street culvert and the areas adjacent to the Rhoda Street culvert were the preferred alternatives and that conceptual level designs at these two sites would be developed. It was determined to propose a combination of the alternatives above at each of the two identified locations. Conceptual level design plans can be found in Appendix D.

Rockland Street Culvert Area

For the project proposed at Rockland Street, it is proposed to use a combination of alternatives 1-3 (as described in *section 6.1*) as a preferred alternative(s). These alternatives include the following scope:1) restoration of the high marsh adjacent to Spring Street and the Rockland Street Culvert, 2) stabilization of the existing toe of eroded marsh edge using stone as the base up to normal tide elevation, with a bioengineered apparatus on top of that to desired marsh platform elevation, 3) to protect Spring Street, stabilization of the existing eroded marsh edge using stone consistent with adjacent existing stone protection at Rockland Street Culvert, and 4) construct a bioretention area adjacent (see description of alternative 8 (2) for additional details) to the Rockland Street and Spring Street intersection (shown in Figure 19). See Appendix D for conceptual design plans.

Rhoda Street Culvert Area

For the proposed project adjacent to Rhoda Street a combination of alternatives 5 and 6 (as described in *section 6.1)* were selected as the preferred alternative(s). These alternatives include the following scope:1) removal of excessive riprap on marsh surface, roadway embankment, and inside of channels on both sides of the Rhoda Street Culvert, 2) restore high marsh habitat upon removal of riprap, and 3) chemical and/or mechanical removal of existing *Phragmites australis* stands in isolated populations along the edge of the marsh and near the Rhoda Street Culvert. See Appendix D for conceptual design plans.

Conclusion on Conceptual Design Alternatives

The combination of proposed alternatives at each location has been determined to be more financially beneficial to combine into single projects. If there is any reasonable chance the City will do all of the proposed work at either location, breaking the different alternatives into pieces adds cost due to economies of scale. Doing one large project is more efficient for construction crew costs, administrative costs, and engineering/planning costs. However, if the City decided to do one piece of the project at a time it will allow them for a more adaptive management approach.

9.0 NEXT STEPS

The City of Quincy gained valuable data and tools for protecting and restoring the Rock Island Cove Marsh through this CZM grant program. City staff intends to continue this important work. The next steps that were identified at this time include the following:

General

- Review final results and recommendations from the Rock Island Cove Marsh Conservation Planning project with relevant City staff and other stakeholders. Continue collaborations with CZM and other state agencies. Update the project webpage with the final report.
- Explore funding options for further research and implementation of the restoration alternatives, particularly those with conceptual designs in place. Also explore funding options for climate resiliency projects. Apply for additional grant opportunities.

Rockland & Rhoda Street Crossings

- Evaluate the feasibility and benefits of adding an additional culvert under Rhoda Street to increase tidal flows and flushing within the salt marsh.
- Assess the Rockland and Rhoda Street culvert designs and impacts under current conditions, and with predicted future sea level rise to determine if a reconfiguration or different design or size would be beneficial in the future. Also use historic aerial imagery to evaluate the rate of erosion and changes over time.
- Investigate how the culverts and hard substrate (rip rap, stones) are negatively impacting or stressing the salt marsh, particularly downstream of the Rockland Street culvert.
- Conduct a conditions assessment in the area downstream of the Rockland Street culvert to investigate potential options to mitigate this erosion.
- Investigate alternatives for the removal of rip rap and buffer protection in the marsh, tidal creek, and roadside embankment near the Rhoda Street culvert.

Marsh Structure & Function

- Research the impacts of grid ditching on marsh elevation and hydrology, and investigate the feasibility and benefits of ditch remediation (filling in or plugging mosquito ditches).
- Investigate the movement of organic and inorganic material within the salt marsh from accretion and erosion, to determine whether eroding material is providing sediment for marsh accretion in other areas.

Path at Lind Street

- Determine the usage of the at-grade path off Lind Street by further consultation with residents and City staff to help guide management and potential restoration efforts.
- Identify and assess alternatives to minimize the footprint and impacts of the at-grade path by narrowing, reconfiguring, etc.

Stormwater Management

- Work with other City staff on feasibility and potential timeframe for implementing the identified stormwater management improvements.
- Explore additional stormwater management options along public roadways and open spaces in the vicinity, as well as the potential to work with private property owners.

Wildlife

- Collaborate with local and state agencies regarding Salt Marsh Sparrow research and efforts to preserve or restore high marsh habitat.
- Work with residents and other members of the public to engage them in reporting potential sightings of Salt Marsh Sparrows.

Public Engagement

- Consider additional opportunities to include residents and the general public going forward, for example with reporting issues or conducting basic maintenance, and by conducting site walks, providing educational materials or signage, and promoting appropriate recreational use of the salt marshes and associated coastal resources in the area.

Other Salt Marsh Areas

- Conduct an assessment of the Spring Street salt marsh and identify restoration opportunities, similar to the current study in the Rock Island Cove marsh complex. Include an evaluation of the tide gate associated with the culvert under Spring St. and restoring appropriate tidal flows.
- Evaluate the feasibility and benefits of restoring tidal flows to the Willows Marsh, which is separated from the Rock Island Cove Marsh by an MWRA earthern berm and sewer line. Work can build on this study as well as a previously completed inundation study analysis of this adjacent area.

10.0 REFERENCES

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APPENDIX A

MarshRAM Assessment Data

westonandsampson.com

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Reading, MA 01867
tel: 978.532.1900

MarshRAM Assessment

March 2023

ROCK ISLAND COVE SALT MARSH

QUINCY, MA

SALT MARSH RAPID ASSESSMENT METHOD

PREPARED FOR:
CITY OF QUINCY

APPENDIX A

MarshRAM Field Datasheets

North Marsh

MarshRAM V.2 Investigators Craig Wood & Hailey Page Site Code__________ Date 10.3.22
Longitude (DD) 70° 58.193'W Latitude (DD) 42° 15.634'N

A. Marsh Characteristics; apply to the *current* state of the marsh. Not Scored.

1) Assessment Unit Area* 20 ha; select one class:

- <0.5 hectares
- 0.5 to 2.0 hectares
- 2.0 to 5.0 hectares
- 5.0 to 10 hectares
- 10 to 20 hectares
- [✓ 20 to 30 hectares]
- 30- 40 hectares
- \> 40 hectares

2) Position in Watershed

N.A. The Site is located in Quincy MA

3) Marsh Setting and Type

Geomorphic Setting; select primary one or two

- Open Coast
- [✓ Open Embayment]
- Valley
- Riverine
- Back Barrier Marsh
- Back Barrier Lagoon

Geoform; select one

- [✓ Platform]
- Fringe

Adjacent upland; select primary one or two

- Bluff
- [✓ Plain]
- Barrier spit or beach
- Rock
- [✓ Hardened shoreline]

Tidal water salinity; select one

- Fresh.............. <0.5 ppt
- [✓ Oligohaline.... 0.5 to <5 ppt]
- Mesohaline... 5 to <18 ppt
- Polyhaline...... >18 ppt

Freshwater input; select primary one or two

- River or stream
- [✓ Sheet flow]
- [✓ Precipitation only]
- Groundwater

4) Exposure to Tides

*Exposed Marsh Edge**; estimate exposed edge as a proportion of total unit circumference

< 5%	no or very low exposure
5 – 25 %	low exposure
26 – 50 %	moderate exposure
[✓ > 50 %]	[✓ high exposure]

*Effective Fetch of Tidal Water**

- < 0.5 km
- [✓ 0.5 - 1 km]
- 1 - 2 km
- 2-3 km
- \> 3 km

Tidal Range

- < 0.4 m
- 0.4 – 1 m
- 1 - 1.5 m
- [✓ >1.5 m]
- Unknown

5) Natural Habitat Diversity; indicate presence of all significant natural habitat types by checking all present

- [✓ Salt Shrubs]
- [✓ Brackish Marsh]
- [✓ High Marsh Platform]
- Pools
- Established Pannes
- Tall Sa Low Marsh
- [✓ Creeks]
- Ponds
- Overwash Fan

6) Connected Natural Habitats; check all natural habitats that occur within 150 m of the unit.

- Forested or shrub wetland
- Freshwater marsh or pond
- Brackish marsh or pond
- Other salt marsh
- Sand or cobble beach
- Coastal dunes or overwash
- Intertidal flats
- Eelgrass or other SAV
- [✓ Upland forest]
- [✓ Upland shrubland]
- [✓ Upland grassland]
- [✓ Other Residential Areas/Man-made Wall]

7) Count of Waterbirds Present:

Wading Birds 9
Shorebirds 0
Waterfowl 1
Swallows 0
Raptors 0
Gulls 0
Sparrows 0

*If the vegetated marsh area is larger than any open water feature encompassed by the unit, then the water is considered part of the unit. If open water feature is larger, it is considered the tidal water.

B. Ecosystem Functions and Services; estimate importance of all evident or known according to ranks provided:

3 Storm protection of property
1 Floodflow alteration
2 Part of a habitat complex or corridor
1 Sediment / toxin retention
1 Nutrient uptake
2 Carbon storage

1 T/E species habitat
2 Fish and shellfish habitat
2 Wildlife habitat
1 Hunting or fishing platform
1 Other recreation
0 Educational or historic significance

0...Not evidently provided
1...Minor or potential importance
2...Evident or known importance
3...Special importance

Sum of ranks = 17

Explain special importance Residential communities adjacent to marsh

MarshRAM V.2 Investigators Craig Wood & Hailey Page Site Code______________ Date 10.3.22

C. Surrounding Land Use

Adjacent Land Use Intensity weighted average within 150-m buffer.
Estimate proportion of each class to the ***nearest tenth*** and multiply (max = 10)

	Proportion	Score	Weighted Value
Very Low	0.1	× 10 =	1
Low	0	× 7 =	0
Moderately High	0.9	× 4 =	3.6
High	0	× 0 =	0

Sum weighted values for score = 4.6

Very Low.......Natural areas, natural open water
Low................Recovering natural lands, passive recreation, low trails, mooring fields
Mod High......Residential, pasture/hay, mowed areas, raised roads, marina docks
High................Urban, impervious land cover, new construction, row crops, turf crops, mining operations, paved roads > 2-lane, dense marina docks

Surrounding Land Uses: Check all that apply

Commercial or industrial development
Unsewered Residential development
[✓ Sewered Residential development]

New construction
Landfill or waste disposal
[✓ Raised road beds]
[✓ Foot paths / trails]
Row crops, turf, or nursery plants

Poultry or livestock operations
Orchards, hay fields, or pasture
Piers, docks, or boat ramps
Golf courses / recreational turf
Sand and gravel operations
Railroad bed
Power lines
Other______________________

D. Wetland Disturbances. Average metrics D.1 to D.10

1) Buffer Encroachment.

1

Estimate % cultural cover on adjacent land within 30-m buffer.

<5% (10)
6 to 25% (8)
26-50% (6)
51-75% (3)
[✓ >75% (1)]

Primary Associated Stressor; check one or two:

Road
Railway
[✓ Fill]
Raised Trail
Power Lines
Cleared/mowed Land
[✓ Buildings]

Paved Lot
Dirt Lot
Dam/dike
Other____________________

Primary Source of Stress; indicate as current (C) or historic (H):

C Private / Residential
__ Commercial
__ Agricultural
__ Public transportation
__ Public utilities
__ Public recreation
__ Undetermined

2) Impoundment and Tidal Restriction. Change in depth or hydroperiod. Select one.

If less than half of the marsh is impounded or restricted, average score with 10.

4

None observed (10)
Restriction observed but no change in vegetation or elevation evident (7)
[✓ Restriction observed with change in vegetation evident (4)]
Restriction observed with subsidence, ponding, or die-off evident (1)

Less than half the marsh is affected, average with 10 = ______

Primary Associated Stressor; check one:

[✓ Road]
Railway
Weir / Dam
Raised Trail
Development Fill
Other ____________

Evidence: check all that apply

Physical barrier across seaward edge of wetland
[✓ Dam or restricting culvert downstream of wetland]
Ponding or subsidence evident
Widening of wetland upstream of barrier
Change in vegetation across barrier
Dead or dying vegetation

Primary Source of Stress; indicate as current (C) or historic (H):

C Private / Residential
__ Commercial
__ Agricultural
C Public transportation
__ Public utilities
__ Public recreation
__ Undetermined

3) Ditching and draining density. Estimate the density of ditching and draining. For difficult determinations, use key.

1

Select one

None observed (10)
Low (7)
Moderate (4)
[✓ High (1)]

Key: density classes of ditches

Low:	< 100 m/Ha
Moderate:	100-300 m/Ha
[✓ High:]	[✓ > 300 m/Ha]

MarshRAM V.2 Investigators Craig Wood & Hailey Page______________ Site Code_____________ Date 10.3.22

4) Anthropogenic nutrient inputs.

7

Select the evidence of sources and impact.

No evidence (10)
[✓ Sources observed only (7)]
Sources observed and some impacts evident (4)
Sources and multiple or strong impacts clearly evident (1)

Evidence: check all that apply
Known high-nutrient tidal or fresh waters
[✓ Runoff sources evident]
Point sources evident
Sewage smell
Pervasive sulfide smell
Excessive algae in surface waters
Unusually tall Sa (≥ 1.5 m)
Dense and tall Phragmites (≥ 3m) abutting sources
Obvious plumes or suspended solids

Primary Associated Stressor;
Check one or two:
High-nutrient tidal water
High-nutrient up-stream water
Stormwater discharge
[✓ Sheet runoff]
Unsewered residential
Point effluent discharge
Organic / yard waste
Other point _______________
Multiple / non-point

Primary Source of Stress;
indicate as current (C) or historic (H):
C Private / Residential
__ Commercial
__ Agricultural
C Public transportation
__ Public utilities
__ Public recreation
__ Multiple / non-point
__ Undetermined

5) Filling and dumping within wetland. Select one or two from below. If fill is hardened to the edge subtract 1.

4

Fill includes typical construction fill, yard waste, and trash.

No fill observed (10)
Scattered trash in the marsh, aesthetic impacts only (9)
Fill covers <10% of the unit area or perimeter (7)
[✓ Fill covers 10-60% of the unit area or perimeter (4)]
Fill covers >60% of the unit area or perimeter (1)
Fill has hardened edge (subtract 1 from above)

Evidence: check all that apply
[✓ Unnaturally abrupt change in ground level]
Abrupt change in soil texture or content
Unnaturally straight or abrupt wetland edge
Unnatural items on or within the sediments

Primary Associated Stressor;
Check one:
Road Dam
Raised Trail [✓ Dike]
Railway Trash
Organic / yard waste
Fill
Other

Primary Source of Stress;
indicate as current (C) or historic (H):
C Private / Residential
__ Commercial
__ Agricultural
__ Public transportation
__ Public utilities
__ Public recreation
__ Undetermined

6) Edge erosion. Select the appropriate category. Edge includes seaward edge and major creeks.

4

Intensity of edge erosion
Minimal erosion observed (10)
Low (7): <10% of the seaward edge is eroded
[✓ Moderate (4): 10-60% of the seaward edge is eroded]
High (1): >60% of the seaward edge is eroded

Evidence: check all that apply
[✓ Vertical marsh edge from platform]
[✓ Undercut edge]
[✓ Disintegrating unvegetated edge]
Oversized crab burrows

7) Crab burrow intensity. Select the appropriate category. Marsh edge includes major creeks.

4

None (10): Burrows are limited to the peat edge with dense vegetation
Low (7): <10% of the marsh edge is densely burrowed and partly or fully denuded
[✓ Moderate (4): 10-60% of the marsh edge is densely burrowed and denuded]
High (1): >60% of the marsh edge is densely burrowed and denuded

Evidence: check all observed
[✓ Dense crab burrows]
[✓ Eroding or oversized crab burrows]
Abundant fiddler crabs
Purple marsh crabs
Clipped vegetation
Denuded areas of peat

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8) Ponding and Dieoff Depressions. Estimate the incidence of shallow ponding, dieoff, or sparsely vegetated soft peat on the high marsh platform.

7

None observed (10)
[✓ Low: <10% cover (7)]
Moderate: 10-60% cover (4)
High: >60% cover (1)

Evidence: check all observed on the marsh platform
Shallow ponding
Shallow unvegetated depressions
[✓ Sparsely vegetated soft peat]

9) Vegetation cutting / removal / soil disturbance. Select intensity of vegetation or soil disturbance.

10

[✓ None Observed (10)]
Low: <10% (7)
Moderate: 10-60% (4)
High: > 60% (1)

Evidence: check all that apply
Cut stems or stumps
Immature vegetation strata
Missing vegetation strata
Mowed areas
Browsing or grazing
Tire ruts
Cattle hoof prints / trampling
Human footprints / trampling
Excavation evident

Primary Associated Stressor;
Check one:
Power lines
Grazing
Crops
Lawn maintenance
Development clearing
View-shed clearing
Trails / non-raised roads
Shore access
Other_______________

Primary Source of Stress; indicate as current (C) or historic (H):
__ Private / Residential
__ Commercial
__ Agricultural
__ Public transportation
__ Public utilities
__ Public recreation
__ Undetermined

10) Phragmites within wetland. Select <u>one</u> class for total coverage.

7

None noted (10)
[✓ Low: <10% cover (7)]
Moderate: 10-60% cover (4)
High: >60% cover (1)

Primary Source of Stress; indicate as current (C) or historic (H):
C Private / Residential
__ Commercial
__ Agricultural
__ Undetermined
__ Public transportation
__ Public utilities
__ Public recreation

Primary Abutting Stressors;
Check one or two:
[✓ Road]
Railway
Raised Trail
Footpath
Dam / Dike
Organic / yard waste
Other Fill
Mowed Lawn
Crops
Pasture
Drainage ditch / tile
Stormwater input
Clearing
Multiple
[✓ Residential Development]
Other

Sum of D1 to D10 Scores = 49 ÷ 10 = 4.9 **D. Wetland Disturbance Score**

MarshRAM V.2 Investigators Craig Wood & Hailey Page Site Code______________ Date 10.3.22

E. Marsh Community Composition and **Index of Marsh Integrity.** Walking straight and evenly along each of 8 transects, tally every step traversing the listed community types.

Zone	**T1**		**T2**	
Salt Shrub		3		11
Brackish Marsh Native		0		0
Phragmites		0		0
Meadow High Marsh		84		64
Mixed High Marsh		46		130
Sa High Marsh		0		25
Dieoff Bare Depression		1		0
Low Marsh		3		4
Dieback Denuded Peat		0		0
Natural Panne		0		0
Natural Pool		0		0
Natural Creek		0		0
Ditch		0		9
Bare Sediments		0		0
	Sum:	137	Sum:	243
Sparrow Tally				

Zone	**T3**		**T4**	
Salt Shrub		9		0
Brackish Marsh Native		0		0
Phragmites		0		0
Meadow High Marsh		101		130
Mixed High Marsh		69		62
Sa High Marsh		25		20
Dieoff Bare Depression		0		0
Low Marsh		20		11
Dieback Denuded Peat		0		0
Natural Panne		0		0
Natural Pool		0		0
Natural Creek		0		0
Ditch		24		6
Bare Sediments		0		0
	Sum:	248	Sum:	229
Sparrow Tally				

MarshRAM V.2 Investigators Craig Wood & Hailey Page______________ Site Code______________ Date 10.3.22

Zone	T5		T6	
Salt Shrub		9		3
Brackish Marsh Native		0		0
Phragmites		0		0
Meadow High Marsh		0		18
Mixed High Marsh		6		44
Sa High Marsh		5		3
Dieoff Bare Depression		0		0
Low Marsh		2		11
Dieback Denuded Peat		0		0
Natural Panne		0		0
Natural Pool		0		0
Natural Creek		0		0
Ditch		0		3
Bare Sediments		0		0
	Sum:	22	Sum:	82
Sparrow Tally				

Zone	T7		T8	
Salt Shrub		3		9
Brackish Marsh Native		0		0
Phragmites		0		0
Meadow High Marsh		0		4
Mixed High Marsh		70		45
Sa High Marsh		0		0
Dieoff Bare Depression		0		0
Low Marsh		5		3
Dieback Denuded Peat		0		0
Natural Panne		0		0
Natural Pool		0		0
Natural Creek		0		0
Ditch		3		0
Bare Sediments		0		0
	Sum:	81	Sum:	61
Sparrow Tally				

MarshRAM V.2 Investigators Craig Wood & Hailey Page Site Code______ Date 10.3.22

	CCI	Total Tally	CCI X TT	% Cover*
Salt Shrub	9	47	423	4.26%
Brackish Marsh Native	10	0	0	0%
Phragmites	3	0	0	0%
Meadow High Marsh	10	401	4,010	36.36%
Mixed High Marsh	7	472	3,304	42.79%
Sa High Marsh	5	78	390	7.07%
Dieoff Bare Depression	1	1	1	0.09%
Low Marsh	8	59	472	5.35%
Dieback Denuded Peat	0	0	0	0%
Natural Panne	8	0	0	0%
Natural Pool	6	0	0	0%
Natural Creek	8	0	0	0%
Ditch	2	45	90	4.08%
Bare Sediments	4	0	0	0%
	Sums:	1,103	8,690	

E. Index of Marsh Integrity

$$= \frac{\text{Sum (CCI X TT)}}{\text{Sum (Total Tally)}}$$

8,690/1,103 =

= $\boxed{7.88}$

Marsh Community Composition:

$$\text{*For each cover type, \% Cover} = \frac{\text{Total Tally}}{\text{Sum (Total Tally)}}$$

B. Ecosystem Functions and Services (Sum) 17

C. Surrounding Land Use Score (max 10) 4.6

D. Wetland Disturbance Score (max 10) 4.9

E. Index of Marsh Integrity (max 10) 7.88

Investigator Craig Wood & Hailey Page Site ______________________________ Date 10.3.22

F. Migration Potential

Estimate the proportion, to the nearest tenth, of surrounding land within 60m falling into each class, and multiply. Total sum of proportions must = 1.0 and sum of weighted values must = 0.0 to 10.0.

Landward* Surface Waters

No Potential:
0 Ocean
0 Estuary
0 Lake/pond
0 Other
Sum = 0 **x 0 =** 0

*separated from marsh by upland

Elevated Land >1.5m above MHW

No Potential:
0 Bedrock
0.2 Hardened shoreline
0.4 Developed land
0 Landfill
0 Other__________________
Sum = 0.6 **x 0 =** 0

Low Potential:
0 Elevated erodible Land
Sum = 0 **x 2 =** 0

Low-lying Land <1.5m above MHW

No Potential:
0 Ocean Beach / Dune
0 Estuarine Beach
Sum = 0 **x 0 =** 0

Low Potential:
0.1 Paved street or lot
0.2 Residential development (structures present)
0 Industrial / commercial development (structures present)
0 Other__________________
Sum Low = 0.3 **x 2 =** 0.6

Moderate Potential:
0 Active farmland
0 Golf course
0 Sand and gravel operation
0 Undeveloped land behind a raised shoreline feature
0 Freshwater deep wetland
0 Other_____________________
Sum Moderate = 0 **x 5 =** 0

Moderately High Potential:
0 Forested or shrub wetland
0 Phragmites marsh
0.1 Forested or shrub upland
0 Mowed land, no structures
0 Pasture
0 Other__________________
Sum Mod High = 0.1 **x 8 =** 0.8

High Potential:
0 Emergent FW wetland
0 Upland field / meadow
0 Abandoned farmland
0 Other____________________
Sum High = 0 **x 10 =** 0

Sum weighted values for **Migration Potential score:** 1.4

a. Area of Marsh = 19 Ha
b. Area of surrounding land to 60m = 17 Ha
c. Proportion of Moderately High +High class = 0.1

d. Migration Area = (b x c) = 1.7

e. Replacement Ratio = (d ÷ a) = 0.09

South Marsh

MarshRAM V.2 Investigators Craig Wood & Hailey Page Site Code______ Date 10.3.22
Longitude (DD) 70° 58.193'W Latitude (DD) 42° 15.634'N

A. Marsh Characteristics; apply to the *current* state of the marsh. Not Scored.

1) Assessment Unit Area* 34 ha; select one class:

<0.5 hectares
0.5 to 2.0 hectares
2.0 to 5.0 hectares
5.0 to 10 hectares
10 to 20 hectares
20 to 30 hectares
[✓ 30- 40 hectares]
> 40 hectares

2) Position in Watershed

N.A. The Site is located in Quincy MA

3) Marsh Setting and Type

Geomorphic Setting; select primary one or two
Open Coast
[✓ Open Embayment]
Valley
Riverine
Back Barrier Marsh
Back Barrier Lagoon

Geoform; select one
[✓ Platform]
Fringe

Adjacent upland; select primary one or two
Bluff
[✓ Plain]
Barrier spit or beach
Rock
[✓ Hardened shoreline]

Tidal water salinity; select one
Fresh............. <0.5 ppt
[✓ Oligohaline.... 0.5 to <5 ppt]
Mesohaline... 5 to <18 ppt
Polyhaline...... >18 ppt

Freshwater input; select primary one or two
River or stream
[✓ Sheet flow]
[✓ Precipitation only]
Groundwater

4) Exposure to Tides

*Exposed Marsh Edge**; estimate exposed edge as a proportion of total unit circumference
< 5% no or very low exposure
5 – 25 % low exposure
26 – 50 % moderate exposure
[✓ > 50 % high exposure]

*Effective Fetch of Tidal Water**
< 0.5 km
[✓ 0.5 - 1 km]
1 - 2 km
2-3 km
> 3 km

Tidal Range
< 0.4 m
0.4 – 1 m
1 - 1.5 m
[✓ >1.5 m]
Unknown

5) Natural Habitat Diversity; indicate presence of all significant natural habitat types by checking all present

Salt Shrubs
[✓ Brackish Marsh]
[✓ High Marsh Platform]
Pools
Established Pannes
Tall Sa Low Marsh
[✓ Creeks]
Ponds
Overwash Fan

6) Connected Natural Habitats; check all natural habitats that occur within 150 m of the unit.

Forested or shrub wetland
Freshwater marsh or pond
Brackish marsh or pond
Other salt marsh
Sand or cobble beach
Coastal dunes or overwash
Intertidal flats
Eelgrass or other SAV
[✓ Upland forest
Upland shrubland
Upland grassland
Other Residential Areas/Man-made Wall]

7) Count of Waterbirds Present:
Wading Birds 11
Shorebirds 0
Waterfowl 15
Swallows 0
Raptors 0
Gulls 0
Sparrows 0

*If the vegetated marsh area is larger than any open water feature encompassed by the unit, then the water is considered part of the unit. If open water feature is larger, it is considered the tidal water.

B. Ecosystem Functions and Services; estimate importance of all evident or known according to ranks provided:

3 Storm protection of property
1 Floodflow alteration
2 Part of a habitat complex or corridor
1 Sediment / toxin retention
1 Nutrient uptake
2 Carbon storage

1 T/E species habitat
2 Fish and shellfish habitat
2 Wildlife habitat
1 Hunting or fishing platform
1 Other recreation
0 Educational or historic significance

0...Not evidently provided
1...Minor or potential importance
2...Evident or known importance
3...Special importance

Sum of ranks = 17

Explain special importance Residential communities adjacent to marsh

MarshRAM V.2 Investigators Craig Wood & Hailey Page Site Code______________ Date 10.3.22

C. Surrounding Land Use

Adjacent Land Use Intensity weighted average within 150-m buffer.

Estimate proportion of each class to the ***nearest tenth*** and multiply (max = 10)

	Proportion	Score	Weighted Value
Very Low	0.2	× 10 =	2
Low	0	× 7 =	0
Moderately High	0.8	× 4 =	3.2
High	0	× 0 =	0

Sum weighted values for score = 5.2

Very Low.......Natural areas, natural open water
Low................Recovering natural lands, passive recreation, low trails, mooring fields
Mod High......Residential, pasture/hay, mowed areas, raised roads, marina docks
High................Urban, impervious land cover, new construction, row crops, turf crops, mining operations, paved roads > 2-lane, dense marina docks

Surrounding Land Uses: Check all that apply

Commercial or industrial development
Unsewered Residential development
[✓ Sewered Residential development]
New construction
Landfill or waste disposal
[✓ Raised road beds]
[✓ Foot paths / trails]
Row crops, turf, or nursery plants
Poultry or livestock operations
Orchards, hay fields, or pasture
[✓ Piers, docks, or boat ramps]
Golf courses / recreational turf
Sand and gravel operations
Railroad bed
Power lines
Other______________________

D. Wetland Disturbances. Average metrics D.1 to D.10

1) Buffer Encroachment.

1

Estimate % cultural cover on adjacent land within 30-m buffer.

<5% (10)
6 to 25% (8)
26-50% (6)
51-75% (3)
[✓ >75% (1)]

Primary Associated Stressor; check one or two:

Road
Railway
[✓ Fill]
Raised Trail
Power Lines
Cleared/mowed Land
[✓ Buildings]
Paved Lot
Dirt Lot
Dam/dike
Other____________________

Primary Source of Stress; indicate as current (C) or historic (H):

C Private / Residential
__ Commercial
__ Agricultural
__ Public transportation
__ Public utilities
__ Public recreation
__ Undetermined

2) Impoundment and Tidal Restriction. Change in depth or hydroperiod. Select one.

If less than half of the marsh is impounded or restricted, average score with 10.

7

None observed (10)
[✓ Restriction observed but no change in vegetation or elevation evident (7)]
Restriction observed with change in vegetation evident (4)
Restriction observed with subsidence, ponding, or die-off evident (1)

Less than half the marsh is affected, average with 10 = ______

Primary Associated Stressor; check one:

[✓ Road]
Railway
Weir / Dam
Raised Trail
Development Fill
Other ____________

Evidence: check all that apply

Physical barrier across seaward edge of wetland
[✓ Dam or restricting culvert downstream of wetland]
Ponding or subsidence evident
Widening of wetland upstream of barrier
Change in vegetation across barrier
Dead or dying vegetation

Primary Source of Stress; indicate as current (C) or historic (H):

C Private / Residential
__ Commercial
__ Agricultural
__ Public transportation
__ Public utilities
__ Public recreation
__ Undetermined

3) Ditching and draining density. Estimate the density of ditching and draining. For difficult determinations, use key.

1

Select one

None observed (10)
Low (7)
Moderate (4)
[✓ High (1)]

Key: density classes of ditches

Low:	< 100 m/Ha
Moderate:	100-300 m/Ha
[✓ High:]	[✓ > 300 m/Ha]

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4) Anthropogenic nutrient inputs.

7

Select the evidence of sources and impact.

No evidence (10)
[✓ Sources observed only (7)]
Sources observed and some impacts evident (4)
Sources and multiple or strong impacts clearly evident (1)

Evidence: check all that apply
Known high-nutrient tidal or fresh waters
[✓ Runoff sources evident]
Point sources evident
Sewage smell
Pervasive sulfide smell
Excessive algae in surface waters
Unusually tall Sa (≥ 1.5 m)
Dense and tall Phragmites (≥ 3m) abutting sources
Obvious plumes or suspended solids

Primary Associated Stressor;
Check one or two:
High-nutrient tidal water
High-nutrient up-stream water
Stormwater discharge
[✓ Sheet runoff]
Unsewered residential
Point effluent discharge
Organic / yard waste
Other point ________________
Multiple / non-point

Primary Source of Stress;
indicate as current (C) or historic (H):
C Private / Residential
__ Commercial
__ Agricultural
C Public transportation
__ Public utilities
__ Public recreation
__ Multiple / non-point
__ Undetermined

5) Filling and dumping within wetland. Select one or two from below. If fill is hardened to the edge subtract 1.

4

Fill includes typical construction fill, yard waste, and trash.

No fill observed (10)
Scattered trash in the marsh, aesthetic impacts only (9)
Fill covers <10% of the unit area or perimeter (7)
[✓ Fill covers 10-60% of the unit area or perimeter (4)]
Fill covers >60% of the unit area or perimeter (1)
Fill has hardened edge (subtract 1 from above)

Evidence: check all that apply
[✓ Unnaturally abrupt change in ground level]
Abrupt change in soil texture or content
Unnaturally straight or abrupt wetland edge
Unnatural items on or within the sediments

Primary Associated Stressor;
Check one:
Road
Raised Trail
Railway
Organic / yard waste
Fill
Other
Dam
[✓ Dike]
Trash

Primary Source of Stress;
indicate as current (C) or historic (H):
C Private / Residential
__ Commercial
__ Agricultural
__ Public transportation
__ Public utilities
__ Public recreation
__ Undetermined

6) Edge erosion. Select the appropriate category. Edge includes seaward edge and major creeks.

7

Intensity of edge erosion

Minimal erosion observed (10)
[✓ Low (7): <10% of the seaward edge is eroded]
Moderate (4): 10-60% of the seaward edge is eroded
High (1): >60% of the seaward edge is eroded

Evidence: check all that apply
[✓ Vertical marsh edge from platform]
Undercut edge
Disintegrating unvegetated edge
Oversized crab burrows

7) Crab burrow intensity. Select the appropriate category. Marsh edge includes major creeks.

7

None (10): Burrows are limited to the peat edge with dense vegetation
[✓ Low (7): <10% of the marsh edge is densely burrowed and partly or fully denuded]
Moderate (4): 10-60% of the marsh edge is densely burrowed and denuded
High (1): >60% of the marsh edge is densely burrowed and denuded

Evidence: check all observed
[✓ Dense crab burrows]
Eroding or oversized crab burrows
Abundant fiddler crabs
Purple marsh crabs
Clipped vegetation
Denuded areas of peat

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8) Ponding and Dieoff Depressions. Estimate the incidence of shallow ponding, dieoff, or sparsely vegetated soft peat on the high marsh platform.

7

None observed (10)
[✓ Low: <10% cover (7)]
Moderate: 10-60% cover (4)
High: >60% cover (1)

Evidence: check all observed on the marsh platform
Shallow ponding
Shallow unvegetated depressions
[✓ Sparsely vegetated soft peat]

9) Vegetation cutting / removal / soil disturbance. Select intensity of vegetation or soil disturbance.

10

[✓ None Observed (10)]
Low: <10% (7)
Moderate: 10-60% (4)
High: > 60% (1)

Evidence: check all that apply
Cut stems or stumps
Immature vegetation strata
Missing vegetation strata
Mowed areas
Browsing or grazing
Tire ruts
Cattle hoof prints / trampling
Human footprints / trampling
Excavation evident

Primary Associated Stressor;
Check one:
Power lines
Grazing
Crops
Lawn maintenance
Development clearing
View-shed clearing
Trails / non-raised roads
Shore access
Other_______________

Primary Source of Stress; indicate as current (C) or historic (H):
__ Private / Residential
__ Commercial
__ Agricultural
__ Public transportation
__ Public utilities
__ Public recreation
__ Undetermined

10) Phragmites within wetland. Select <u>one</u> class for total coverage.

7

None noted (10)
[✓ Low: <10% cover (7)]
Moderate: 10-60% cover (4)
High: >60% cover (1)

Primary Source of Stress; indicate as current (C) or historic (H):
C Private / Residential
__ Commercial
__ Agricultural
__ Undetermined
__ Public transportation
__ Public utilities
__ Public recreation

Primary Abutting Stressors;
Check one or two:
[✓ Road]
Railway
Raised Trail
Footpath
Dam / Dike
Organic / yard waste
Other Fill
Mowed Lawn
Crops
Pasture
Drainage ditch / tile
Stormwater input
Clearing
Multiple
[✓ Residential Development]
Other

Sum of D1 to D10 Scores = 58 ÷ 10 = 5.8 D. Wetland Disturbance Score

MarshRAM V.2 Investigators Craig Wood & Hailey Page Site Code______________ Date 10.3.22

E. Marsh Community Composition and **Index of Marsh Integrity.** Walking straight and evenly along each of 8 transects, tally every step traversing the listed community types.

Zone	**T1**		**T2**	
Salt Shrub		17		10
Brackish Marsh Native		0		0
Phragmites		0		0
Meadow High Marsh		0		37
Mixed High Marsh		39		102
Sa High Marsh		23		14
Dieoff Bare Depression		0		0
Low Marsh		56		13
Dieback Denuded Peat		2		3
Natural Panne		0		0
Natural Pool		0		2
Natural Creek		0		0
Ditch		11		11
Bare Sediments		0		0
	Sum:	148	Sum:	192
Sparrow Tally				

Zone	**T3**		**T4**	
Salt Shrub		3		0
Brackish Marsh Native		0		0
Phragmites		0		0
Meadow High Marsh		49		0
Mixed High Marsh		32		20
Sa High Marsh		0		0
Dieoff Bare Depression		0		0
Low Marsh		16		9
Dieback Denuded Peat		1		0
Natural Panne		0		0
Natural Pool		0		0
Natural Creek		0		0
Ditch		9		14
Bare Sediments		0		0
	Sum:	110	Sum:	43
Sparrow Tally				

MarshRAM V.2 Investigators Craig Wood & Hailey Page Site Code__________ Date 10.3.22

Zone	T5		T6	
Salt Shrub		11		0
Brackish Marsh Native		0		0
Phragmites		0		0
Meadow High Marsh		62		56
Mixed High Marsh		85		43
Sa High Marsh		3		0
Dieoff Bare Depression		0		0
Low Marsh		50		12
Dieback Denuded Peat		0		0
Natural Panne		0		0
Natural Pool		0		0
Natural Creek		15		0
Ditch		8		3
Bare Sediments		6		0
	Sum:	240	Sum:	114
Sparrow Tally				

Zone	T7		T8	
Salt Shrub		8		9
Brackish Marsh Native		0		0
Phragmites		0		0
Meadow High Marsh		158		92
Mixed High Marsh		245		60
Sa High Marsh		17		10
Dieoff Bare Depression		0		0
Low Marsh		49		38
Dieback Denuded Peat		2		3
Natural Panne		0		0
Natural Pool		0		3
Natural Creek		11		10
Ditch		18		1
Bare Sediments		3		0
	Sum:	511	Sum:	226
Sparrow Tally				

MarshRAM V.2 Investigators Craig Wood & Hailey Page Site Code____________ Date 10.3.22

	CCI	Total Tally	CCI X TT	% Cover*
Salt Shrub	9	58	522	3.66%
Brackish Marsh Native	10	0	0	0%
Phragmites	3	0	0	0%
Meadow High Marsh	10	454	4,540	28.66%
Mixed High Marsh	7	626	4,382	39.52%
Sa High Marsh	5	67	335	4.23%
Dieoff Bare Depression	1	0	0	0%
Low Marsh	8	243	1,944	15.34%
Dieback Denuded Peat	0	11	0	0.69%
Natural Panne	8	0	0	0%
Natural Pool	6	5	30	0.32%
Natural Creek	8	36	288	2.27%
Ditch	2	61	122	3.85%
Bare Sediments	4	23	92	1.45%
	Sums:	1,584	12,255	

E. Index of Marsh Integrity

$$= \frac{\text{Sum (CCI X TT)}}{\text{Sum (Total Tally)}}$$

12,255/1,584 =

= 7.74

Marsh Community Composition:

$$\text{*For each cover type, \% Cover} = \frac{\text{Total Tally}}{\text{Sum (Total Tally)}}$$

B. Ecosystem Functions and Services (Sum) 17

C. Surrounding Land Use Score (max 10) 5.2

D. Wetland Disturbance Score (max 10) 5.8

E. Index of Marsh Integrity (max 10) 7.74

Investigator Craig Wood & Hailey Page Site ______________________________ Date 10.3.22

F. Migration Potential

Estimate the proportion, to the nearest tenth, of surrounding land within 60m falling into each class, and multiply. Total sum of proportions must = 1.0 and sum of weighted values must = 0.0 to 10.0.

Landward* Surface Waters

No Potential:

0 Ocean
0 Estuary
0 Lake/pond
0 Other
Sum = 0 **x 0 =** 0

*separated from marsh by upland

Elevated Land >1.5m above MHW

No Potential:

0 Bedrock
0.1 Hardened shoreline
0.5 Developed land
0 Landfill
0 Other_________________
Sum = 0.6 **x 0 =** 0

Low Potential:

0 Elevated erodible Land
Sum = 0 **x 2 =** 0

Low-lying Land <1.5m above MHW

No Potential:

0 Ocean Beach / Dune
0 Estuarine Beach
Sum = 0 **x 0 =** 0

Low Potential:

0.1 Paved street or lot
0.2 Residential development (structures present)
0 Industrial / commercial development (structures present)
0 Other__________________
Sum Low = 0.3 **x 2 =** 0.6

Moderate Potential:

0 Active farmland
0 Golf course
0 Sand and gravel operation
0 Undeveloped land behind a raised shoreline feature
0 Freshwater deep wetland
0 Other_____________________
Sum Moderate = 0 **x 5 =** 0

Moderately High Potential:

0 Forested or shrub wetland
0 Phragmites marsh
0.1 Forested or shrub upland
0 Mowed land, no structures
0 Pasture
0 Other__________________
Sum Mod High = 0.1 **x 8 =** 0.8

High Potential:

0 Emergent FW wetland
0 Upland field / meadow
0 Abandoned farmland
0 Other____________________
Sum High = 0 **x 10 =** 0

Sum weighted values for **Migration Potential score:** 1.4

a. Area of Marsh = 30 Ha
b. Area of surrounding land to 60m = 15 Ha
c. Proportion of Moderately High +High class = 0.1

d. Migration Area = (b x c) = 1.5

e. Replacement Ratio = (d ÷ a) = 0.05

APPENDIX B

Field Maps

Path: \\wse03.local\WSE\Projects\MA\Quincy MA\2221038 Rock Island Cove Salt Marsh Restoration\Field Assessment\GIS\Maps\MarshRam Field Map.mxd **User:** Page.Hailey **Saved:** 3/21/2023 3:51:33 PM **Opened:** 3/21/2023 3:52:11 PM

Figure 1: MarshRAM Field Map

Weston & Sampson

Path: \\wse03.local\WSE\Projects\MA\Quincy MA\2221038 Rock Island Cove Salt Marsh Restoration\Field Assessment\GIS\Maps\Migration Potential Working Map.mxd **User:** Page.Hailey **Saved:** 3/21/2023 3:51:29 PM **Opened:** 3/21/2023 3:52:34 PM

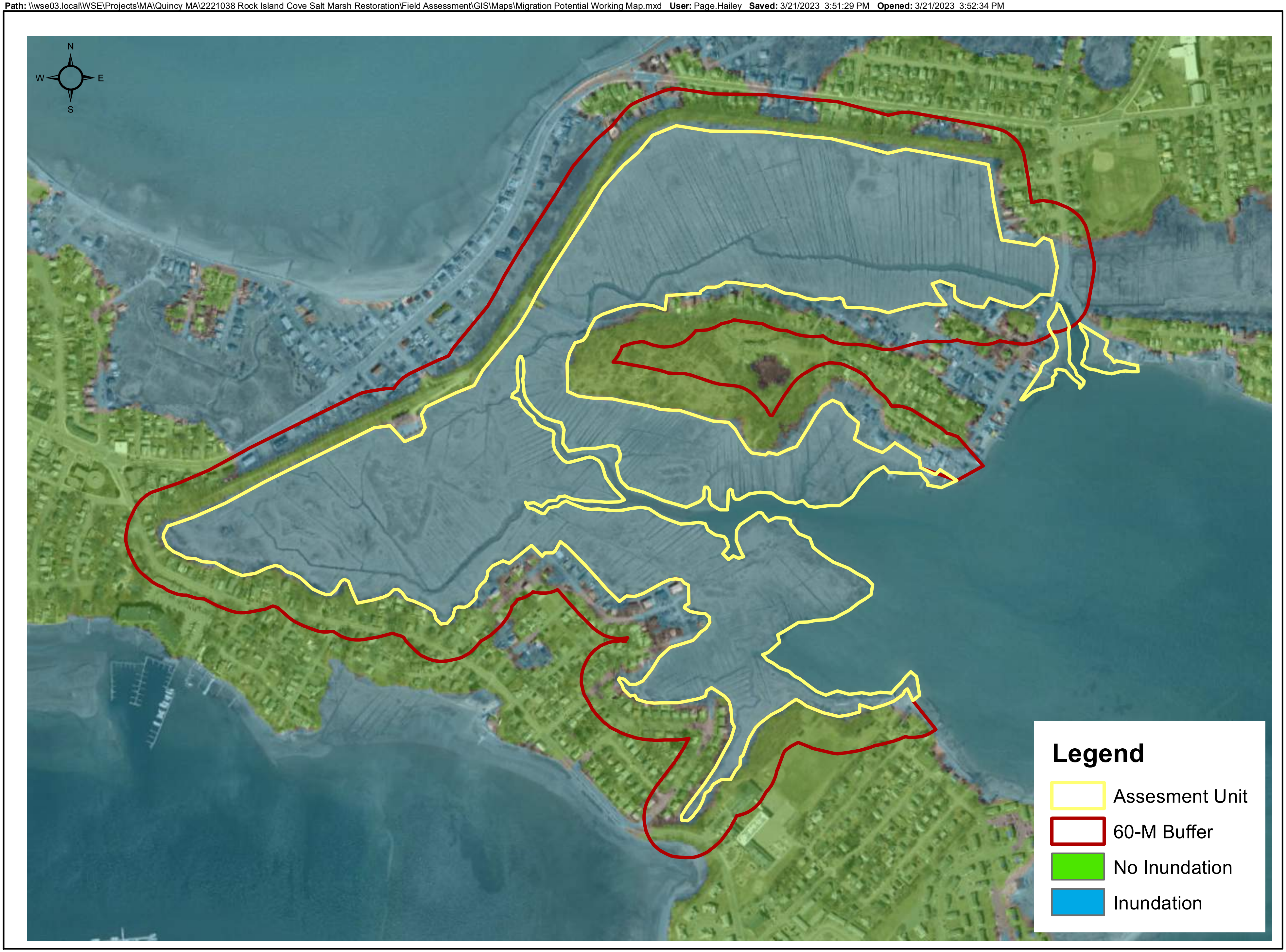

Figure 2: Estimating Migration Potential Map

Weston & Sampson

Path: \\wse03.local\WSE\Projects\MA\Quincy MA\2221038 Rock Island Cove Salt Marsh Restoration\Field Assessment\GIS\Maps\Environmental Receptor - MA3.2023_Working Aerial.mxd **User:** Page.Hailey **Saved:** 3/21/2023 4:11:05 PM **Opened:** 3/21/2023 4:11:43 PM

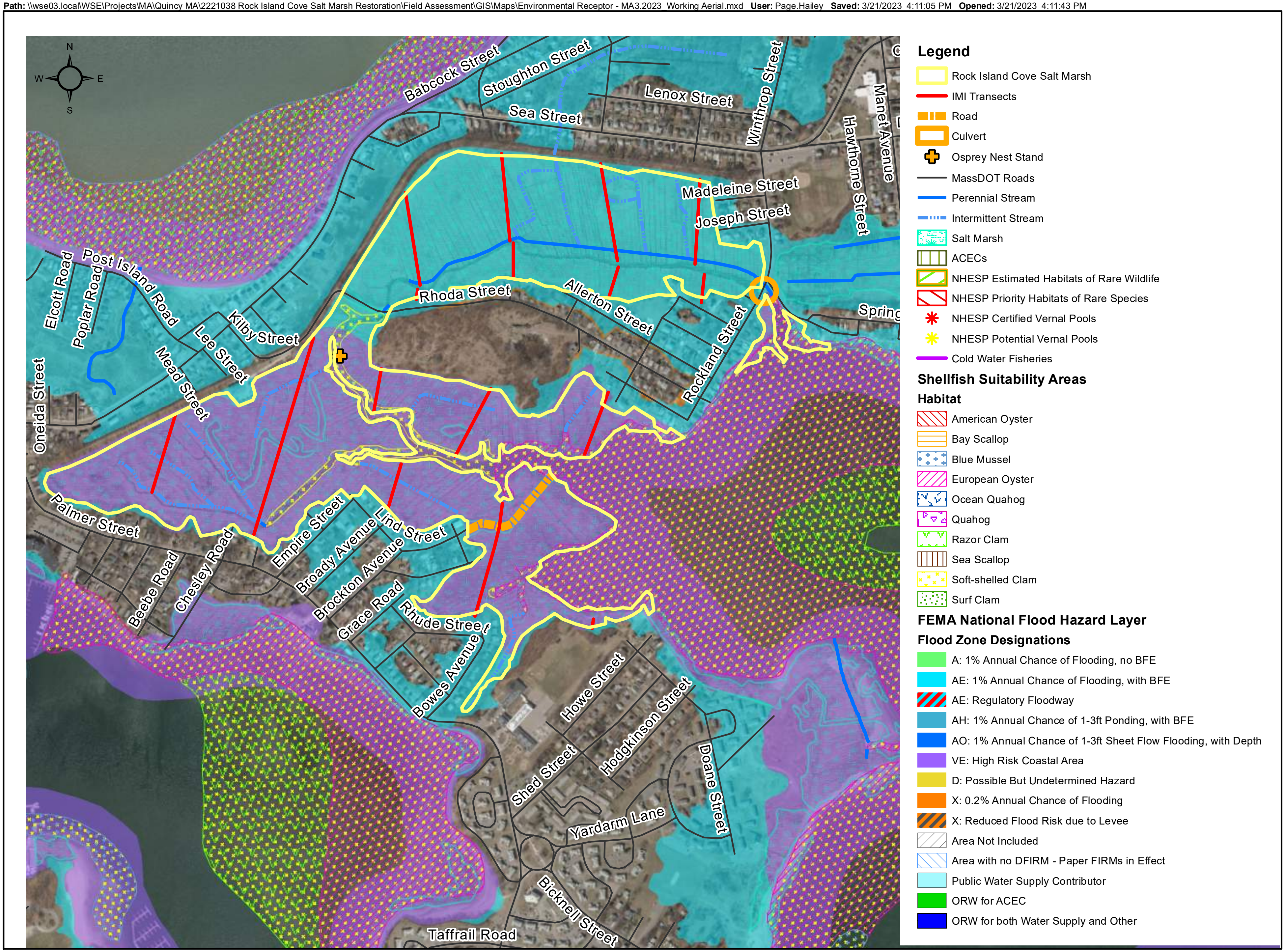

Figure 3: Environmental Receptors Map

Weston & Sampson

APPENDIX C

Photos

Photo 1: North Marsh Transect 1

Photo 2: North Marsh Transect 2

Photo 3: North Marsh Transect 3

Photo 4: North Marsh Transect 4

Photo 5: North Marsh Transect 5

Photo 6: North Marsh Transect 6

Photo 7: North Marsh Transect 7

Photo 8: North Marsh Transect 8

Photo 9: South Marsh Transect 1

Photo 10: South Marsh Transect 2

Photo 11: South Marsh Transect 3

Photo 12: South Marsh Transect 4

Photo 13: South Marsh Transect 5

Photo 14: South Marsh Transect 6

Photo 15: South Marsh Transect 7

Photo 16: South Marsh Transect 8

Photo 17: Natural Creek

Photo 18: Marsh Access Path (Located in South Marsh)

Photo 19: Rockland Street Culvert

Photo 20: Upland Berm in South Marsh

APPENDIX B

Rockland Street Culvert Historic Aerials

Photo 1: Rhoda Street Crossing 1998

Photo 2: Rhoda Street Crossing 2008

Photo 3: Rhoda Street Crossing 2011-2012

Photo 4: Rhoda Street Crossing 2014

Photo 5: Rhoda Street Crossing 2017

Photo 6: Rhoda Street Crossing 2019

Photo 7: Rhoda Street Crossing 2021

Photo 8: Rhoda Street Crossing Current Conditions

APPENDIX C

Rhoda Street Culvert Historic Aerials

Photo 1: Rhoda Street Crossing 1998

Photo 2: Rhoda Street Crossing 2008

Photo 3: Rhoda Street Crossing 2011-2012

Photo 4: Rhoda Street Crossing 2014

Photo 5: Rhoda Street Crossing 2017

Photo 6: Rhoda Street Crossing 2019

Photo 7: Rhoda Street Crossing 2021

Photo 8: Rhoda Street Crossing Current Conditions

APPENDIX D

Conceptual Design Plans

TOWN OF QUINCY, MASSACHUSETTS

ROCK ISLAND COVE SALT MARSH RESTORATION

PROJECT ADDRESS: ROCK ISLAND COVE, QUINCY MA 02169

Weston & Sampson Engineers, Inc.
55 Walkers Brook Drive, Suite 100
Reading, MA 01867
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www.westonandsampson.com

LOCATION MAP
NOT SCALE

VICINITY MAP
NOT SCALE

DRAWING INDEX

SHEET	TITLE
G000	COVER SHEET
C100	EXISTING CONDITIONS PLAN
C120	PROPOSED CONDITIONS PLAN - ROCKLAND STREET
C121	PROPOSED CONDITIONS PLANS - RHODA STREET
C500	DETAILS

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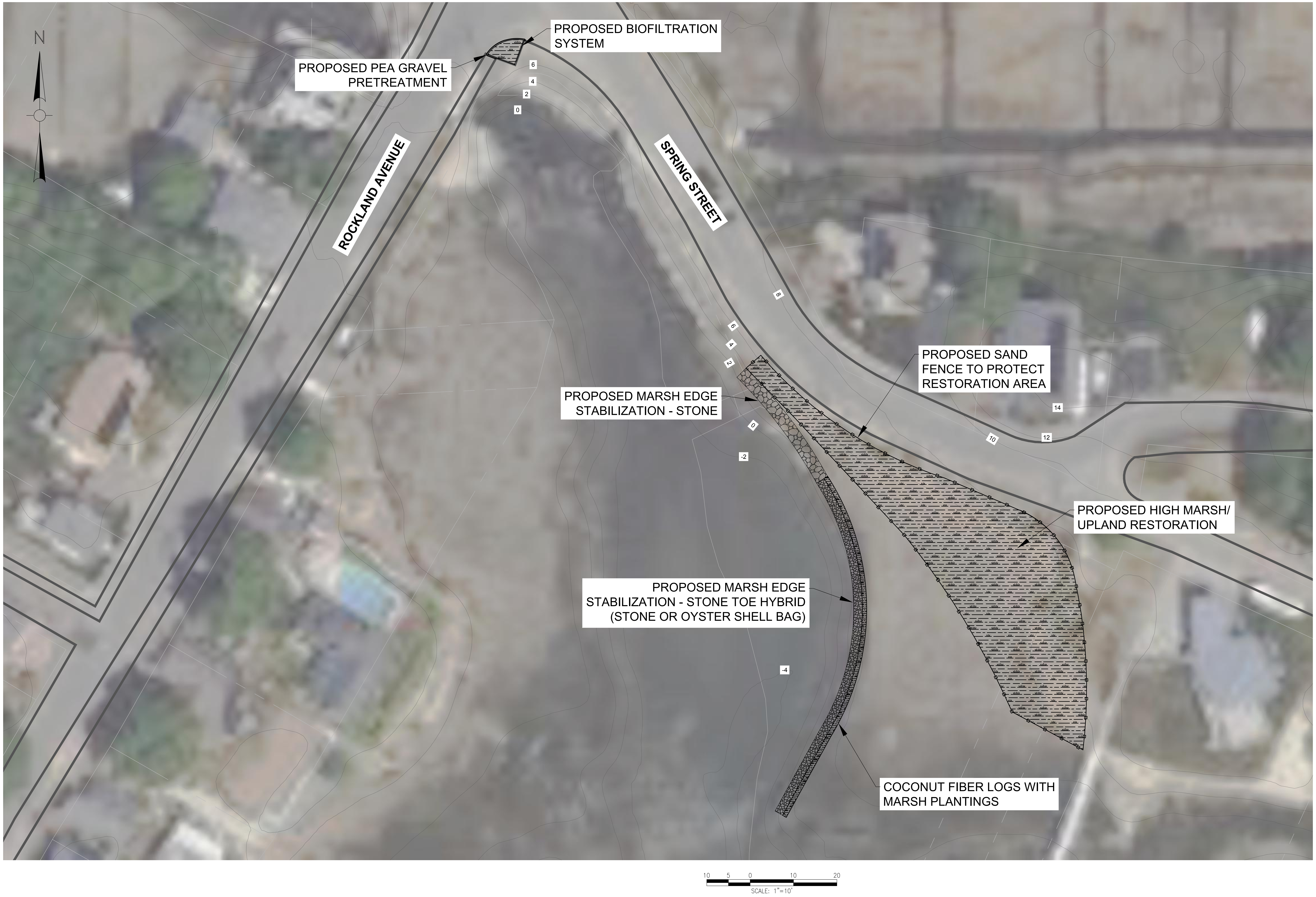

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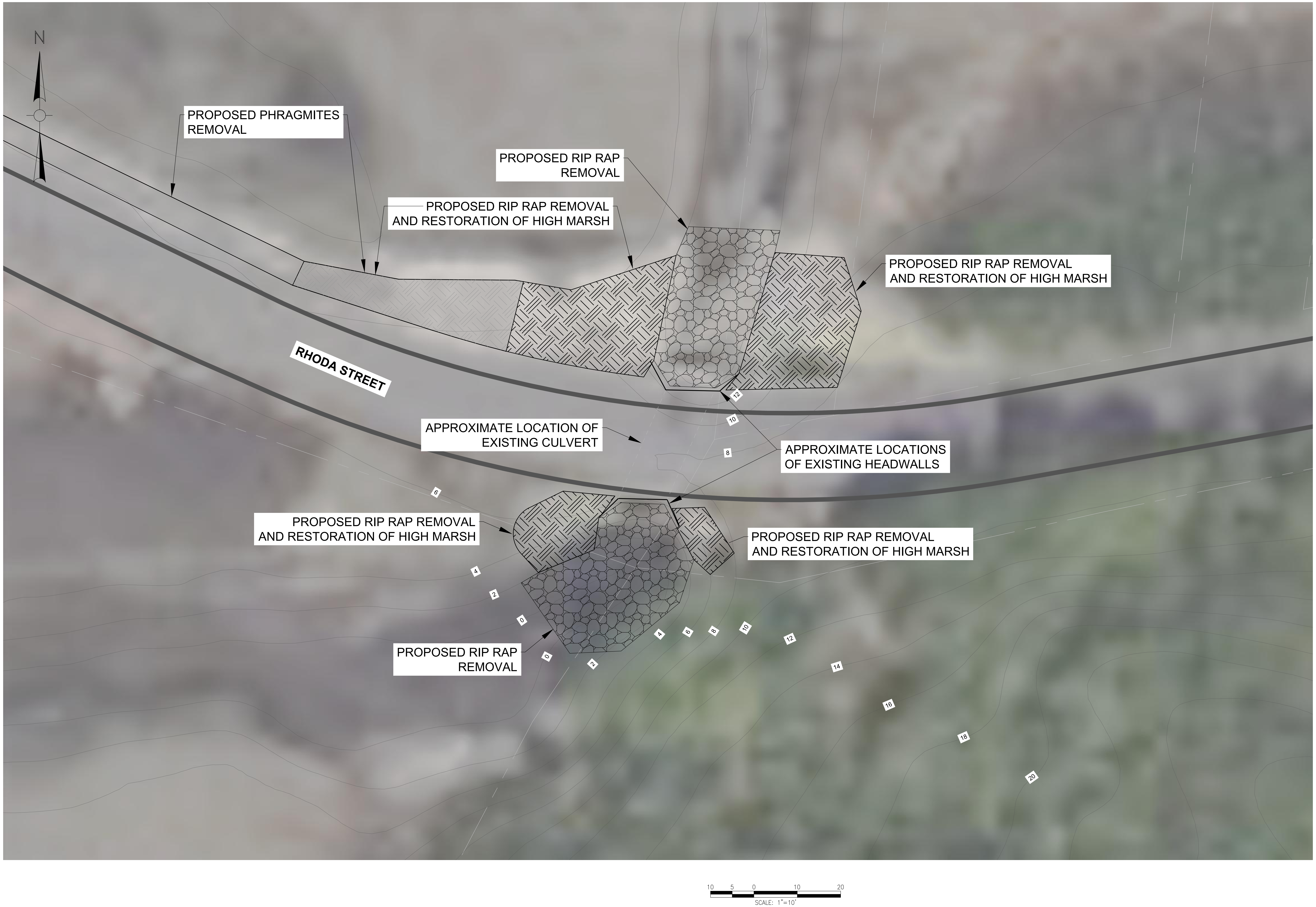

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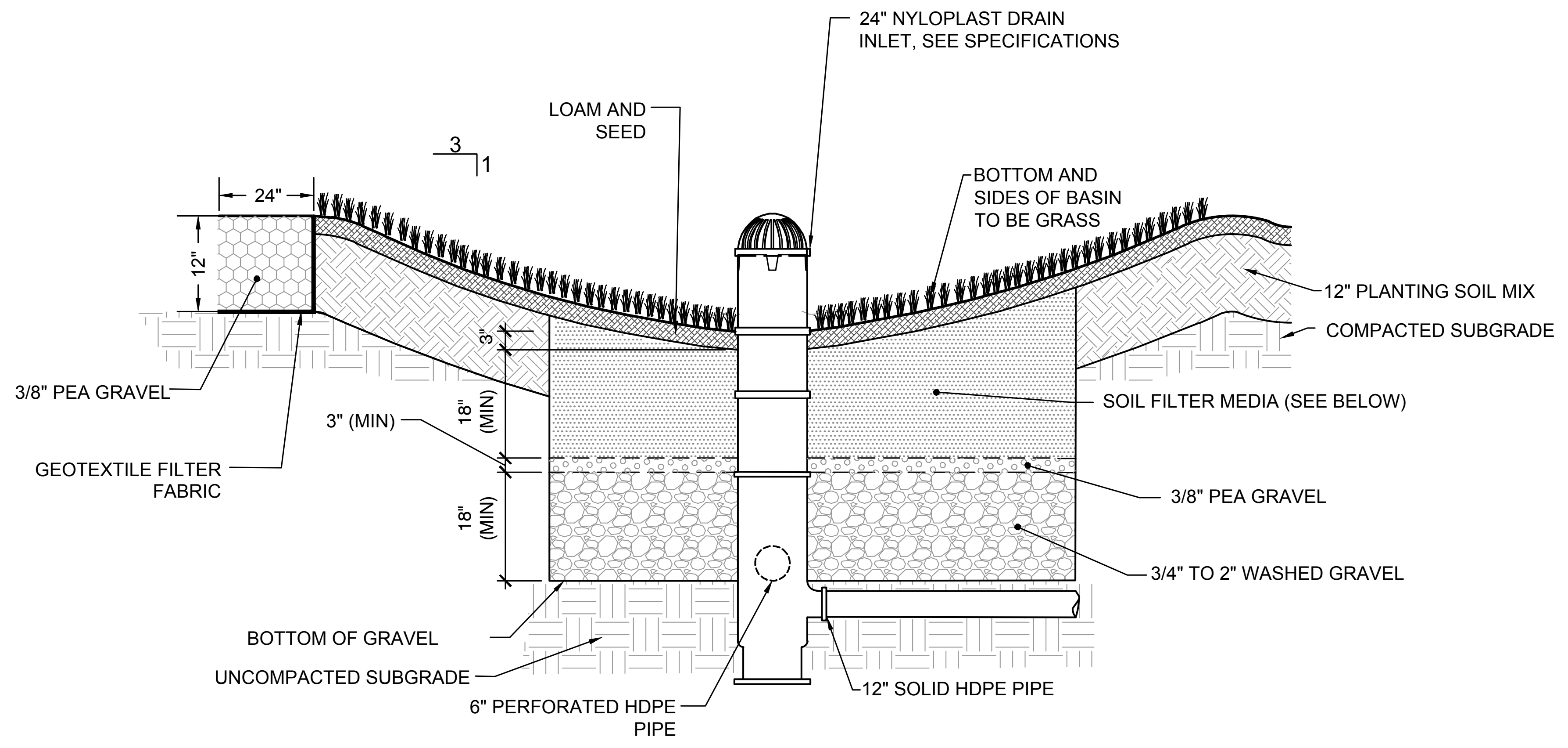

SOIL FILTER MEDIA
50% TO 55% BY VOLUME SAND THAT IS CERTIFIED BY ITS PRODUCER AS MEETING THE REQUIREMENTS FOR ASTM C-33 CONCRETE SAND, 20% TO 30% BY VOLUME OF LOAMY SAND TOPSOIL WITH 15% TO 25% FINES PASSING THE NUMBER 200 SIEVE, AND 20% TO 30% BY VOLUME MODERATELY FINE SHREDDED BARK OR WOOD FIBER MULCH WITH LESS THAN 5% PASSING THE NUMBER 200 SIEVE

1 BIORETENTION AREA

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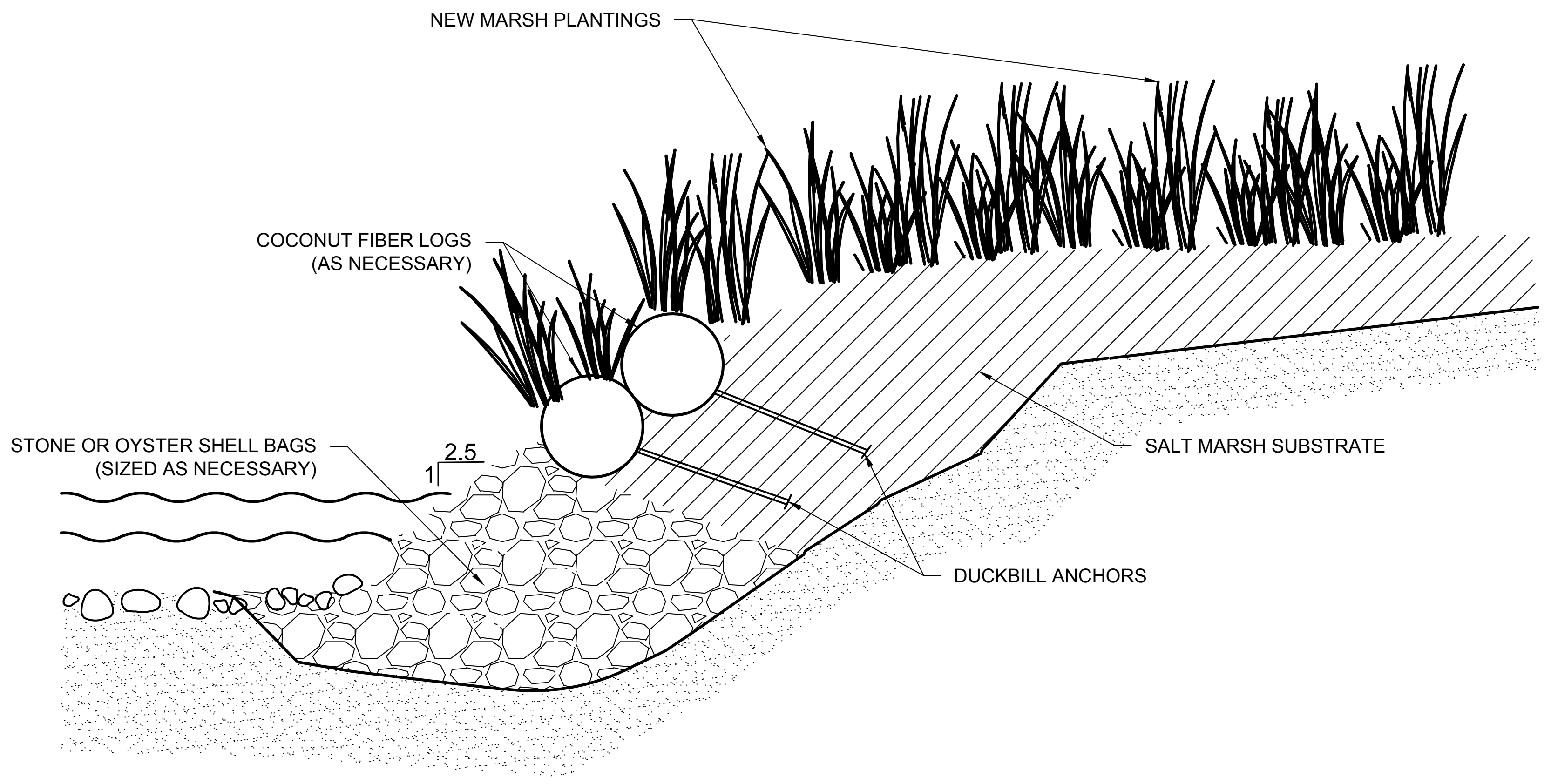

2 SALT MARSH CREEK EDGE STABILIZATION (STONE TOE HYBRID)

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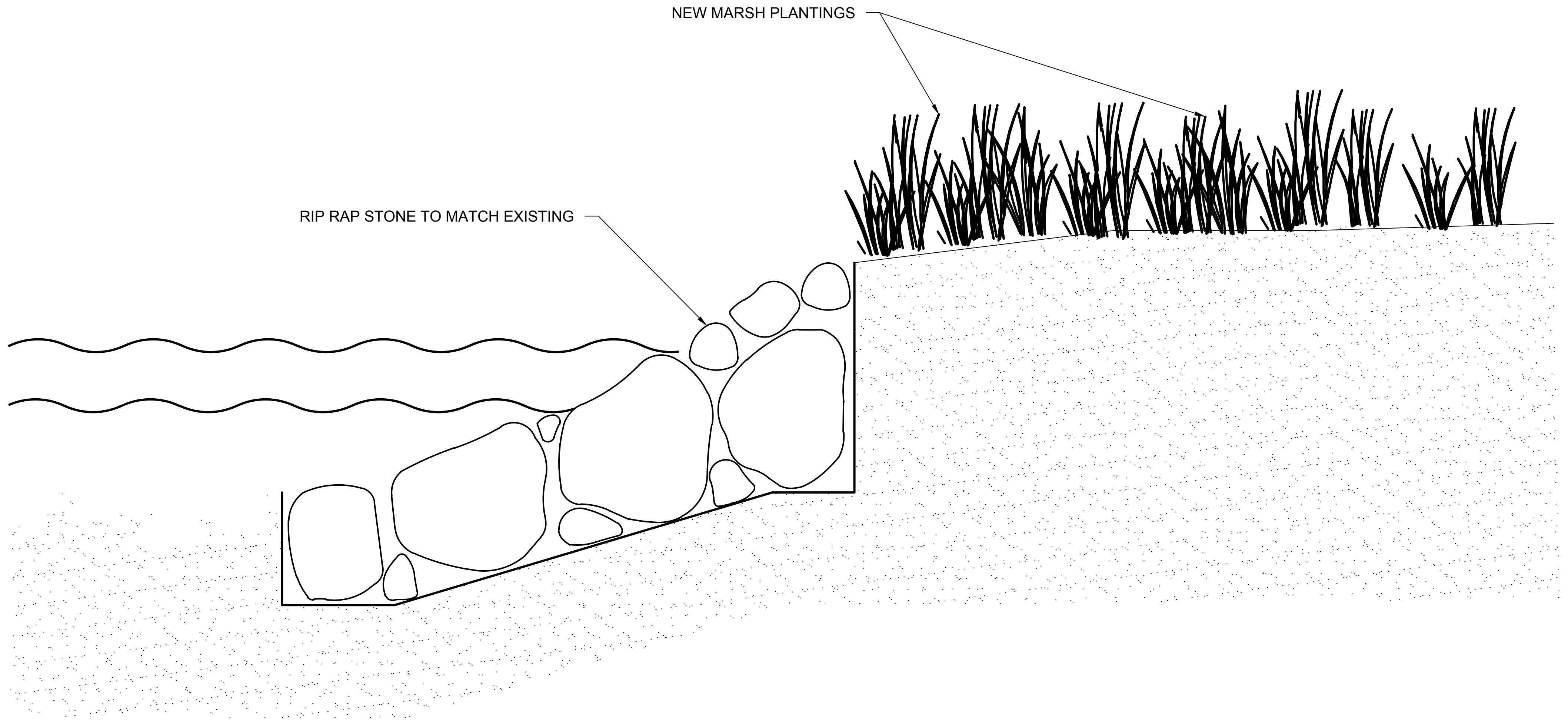

3 SALT MARSH CREEK EDGE STABILIZATION (STONE)

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4 WOODEN SAND FENCE

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