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July 30, 2025
GZA File No. 01.0177993.00

Glenn Lussier
Director of Public Works
Groton Long Point Association
44 Beach Road, PO Box 3737
Groton Long Point, CT 06340

Re: 30 Percent Level Design of Flood Mitigation Alternatives
Groton Long Point, Connecticut

Dear Mr. Lussier

In accordance with our contract signed February 21, 2025, GZA GeoEnvironmental, Inc. (GZA) is pleased to submit this Final Report to the Groton Long Point Association.

This report summarized GZA's project activities including site reconnaissance, hazards and vulnerabilities, stormwater modeling, and development of 30 percent level design alternatives for select proposed project sites within Groton Long Point (Site). This project evaluated two flood mitigation projects that were selected as part of the conceptual design phase, and advanced them to the 30 percent design level. The selected project sites included the Upper Lagoon and West Shore Ave. GZA worked closely with GLP stakeholders to develop resilience improvement alternatives and concept designs for select measures as described in the report.

We appreciate the opportunity to continue to work with you. Please contact Alex Roper at 781-278-5740 or alexander.roper@gza.com with any questions.

Very truly yours,
GZA GEOENVIRONMENTAL, INC.

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Final Report for 30% Level Design of Flood Mitigation Alternatives- Groton Long Point Association

Groton Long Point, CT

June 30, 2025
File No. 01.0177993.00

PREPARED FOR:
Groton Long Point Association

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EXECUTIVE SUMMARY

GZA GeoEnvironmental, Inc. (GZA) carried forward two project sites from the conceptual design phase to evaluate flood mitigation alternatives. GZA collected pertinent hazard data through a desktop analysis and stormwater infrastructure data during a site visit. This data was used to conduct a hydraulic assessment of the existing stormwater system. The performance of the stormwater system that drains to the Upper Lagoon was evaluated during coincident coastal flooding and intense rainfall events, and results were used to inform the design of flood mitigation projects. GZA prepared a 30% Level Design of a raised walkway around the Upper Lagoon to protect against stormwater flooding, along with proposed backflow prevention in the West Shore Ave site for stormwater improvement.

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1.0 INTRODUCTION

GZA GeoEnvironmental, Inc. (GZA) of Norwood, Massachusetts, was contracted by the Groton Long Point Association (GLPA and Client) to provide engineering services, including visual site reconnaissance, document conditions, hazards, and vulnerabilities, and perform a hydrologic and hydraulic assessment to evaluate flood mitigation alternatives. As part of a previous phase of our work with GLPA, GZA developed conceptual design alternatives for select proposed project sites within Groton Long Point (Site). The conclusion from the conceptual design was the selection of two project sites to be further analyzed and advanced to a 30% design level. Through assessment using the PERSISTS (Permittable, Equitable, Realistic, Safe, Innovative, Scientific, Transferrable, Sustainable) decision support criteria and in categories such as constructability, cost, view-scape, hazard mitigation, lifespan, and adaptation capabilities, GLPA selected the West Shore Ave Drainage Improvements and Inner Lagoon project sites. Our findings are subject to the limitations in **Attachment A**.

All elevations in this report are presented in the North American Vertical Datum of 1988 (NAVD88) feet unless otherwise specified.

1.1 OBJECTIVES

The objective of this project is to build upon the conceptual design alternatives (see conceptual design report under separate cover; GZA, 2025) for the two selected project sites to the 30-percent level. This work also consisted of site reconnaissance and a hydrologic and hydraulic assessment to inform the design of flood mitigation improvements in the West Shore Ave and Upper Lagoon project sites.

1.2 BACKGROUND

Groton Long Point (GLP) is located on a peninsula, bordered on the west by Mumford Cove and on the south and east by Fishers Island Sound and on the north by Groton Long Point Road (**Figure 1**). The GLP study area is approximately 0.5 square miles, containing residential development, sandy beaches, salt and freshwater marshes, a lagoon, and wooded areas featuring nature trails. A harbor has been created in the lagoon protected by a sandy spit (containing West Shore Ave.); the upper portion of the lagoon forms a sheltered pond (Upper Lagoon). GLP is accessible by car via the Palmer Cove bridge and causeway, or by foot or bicycle through Haley Farm and Mumford Cove Association.

GLP is administered by the Groton Long Point Association, a private association that was created by a Special Act of the Connecticut Legislature in 1921. The Association can tax and issue bonds to provide services independent of the Town of Groton.

Figure 1: Site Locus

2.0 DATA COLLECTION

2.1 FLOOD HAZARD DATA

2.1.1 Coastal Flood

GZA conducted a Site specific metocean data analysis for bathymetry/ topography, water levels, and historic and projected sea level rise (SLR), summarized below.

Water Levels: To evaluate the combined flooding impacts of coastal storm tide and precipitation, GZA evaluated rainfalls events during coincident high tides. GZA evaluated different precipitation events during Mean Sea Level (MSL), Mean Higher High Water (MHHW), the 2-yr and 10-yr storms. GZA reviewed stillwater levels (coastal storm tide) for the project-specific annual exceedance probability flood events for the project area based on data from the New London NOAA Tide Gauge (Sta. 8461490). Stillwater elevations are summarized in **Table 1**.

Table 1: Stillwater Elevations (feet, NAVD88)

Annual Exceedance Probability	NOAA New London Tide Gauge (1992)	NOAA New London Tide Gauge (2025)
Mean Sea Level (MSL)	-0.3	0.0
Mean Higher-High Water (MHHW)	1.2	1.5
2-Year (50%)	3.5	3.8
10-Year (10%)	4.9	5.2

Sea Level Rise: GZA reviewed historical observed sea level trends in the region, provided by the NOAA New London Tidal Station. NOAA tidal gauge levels are relative to water levels measured over the 1983-2001 tidal epoch (average of 1992) and have also been translated to water levels at present day (2025) using historic long-term sea level change trends (**Figure** 2) to represent current conditions and sea level rise (SLR) realized since 1992. Since installation of the New London gauge, sea levels have risen at an average rate of 0.1 inches/year or approximately 0.3 feet over the past 33 years. Note that since 1992, sea level rise rates have increased and have approximately doubled in recent years.

For sea level rise projections, GZA referred to Connecticut State guidance, which encourages communities to prepare for sea level rise of up to 20 inches (1.7 feet) by 2050 in Long Island Sound. This guidance uses the year 2000 as a baseline. For further information on SLR, the most recent NOAA sea level rise data (NOAA et. al 2022) has similar SLR projections to the state guidance, with the low, intermediate, and high projections at 1.2, 1.5, and 1.8 feet of SLR, respectively (with a 1992 baseline).

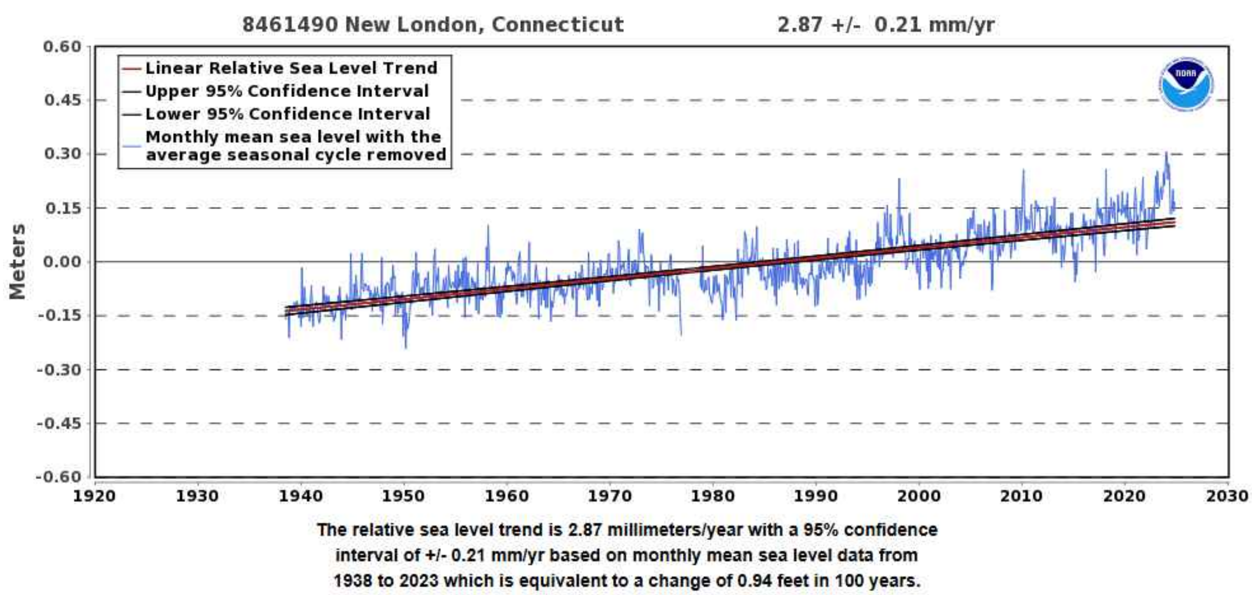


Figure 2: New London Historic Long-Term Sea Level Change Trends

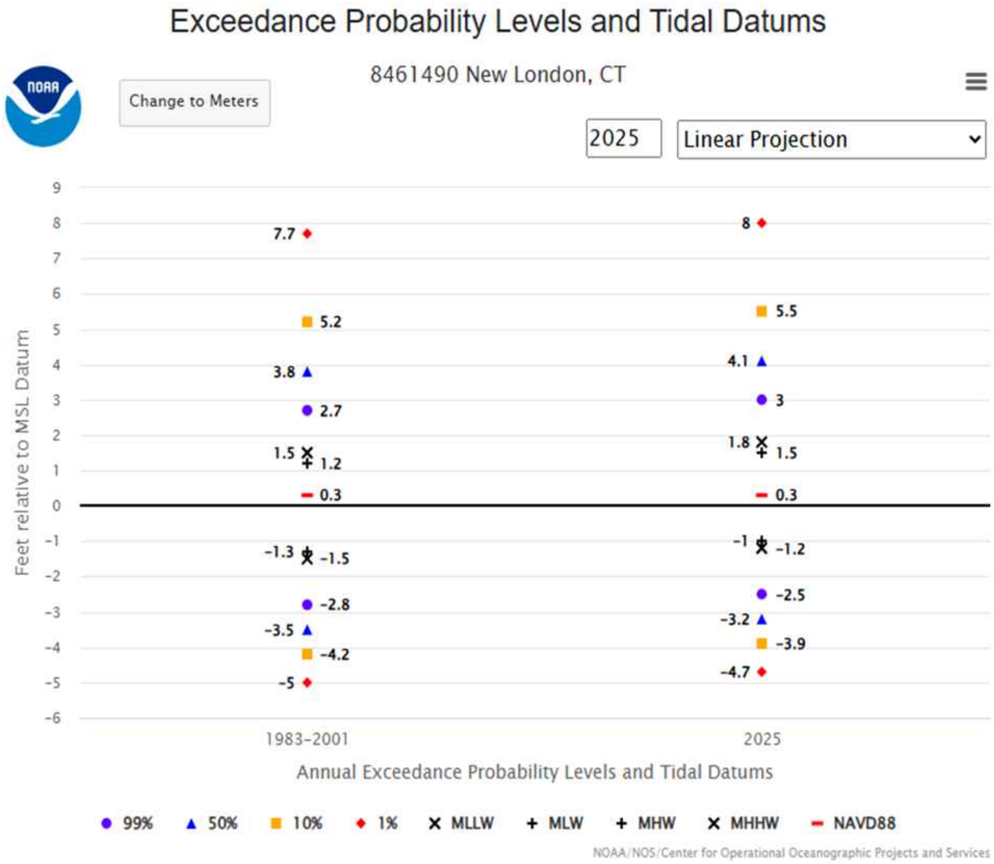


Figure 3: Tidal Datums (right column is present day, 2025) and Exceedance Probabilities at NOAA New London Gauge

The following elevations in **Table 2** were utilized in the hydraulic evaluation of the stormwater system during present day (2025) and future (2050) scenarios.

Table 2: Recommended Design Stillwater Elevations (feet, NAVD88)

Annual Exceedance Probability	Recommended Present Day Design Stillwater Elevation (feet, NAVD88)	Recommended 2050 Design Stillwater Elevation (feet, NAVD88)[1]
Mean Sea Level (MSL)	0.0	1.4
Mean Higher-High Water (MHHW)	1.5	2.9
2-Year (50%)	3.8	5.2
10-Year (10%)	5.2	6.6

[1]Note: The current tidal epoch (1983-2001) was used along with State of CT guidance (20 inches by 2050) and linear SLR trends from 1992 to 2000 to approximate water levels in 2050.

2.1.2 Precipitation Flood

GZA used precipitation estimates from NOAA Atlas 14 for present day precipitation depths. GZA evaluated the 2, 10, and 100-year recurrence interval rainfall events, which were temporally distributed over 24 hours using the Soil Conservation Service (SCS, now known as the Natural Resources Conservation Service, NRCS) Type III distribution. For future precipitation, GZA used CIRCA[1] guidance (**Table 3**) to estimate changes in precipitation by mid-century.

Table 3: Projected Changes in 1-Day Maximum Precipitation

Annual Exceedance Probability	1970-99 Reference	2040-69 Changes
Mean Precipitation	2.8±0.1	0.7±0.2 (27%)
10-Year (10%)	4.1±0.2	2.0±0.8 (49%)
100-Year (10%)	6.6±0.4	5.9±3.7(91%)

Since there was no projection for the 2-year storm, GZA applied the projected changes to mean precipitation to the present day 2-year precipitation depth. Precipitation depths for present day and future (2050) are shown in **Table 4**.

Table 4: Present Day and Future Precipitation Depths

Annual Exceedance Probability	Present Day (inches)	2050 (inches)
2-Year (50%)	3.42	4.34
10-Year (10%)	5.11	7.61
100-Year (10%)	7.78	14.86

2.2 STORMWATER INFRASTRUCTURE DATA

GZA reviewed existing GIS data provided by the Town of Groton, which included approximate locations of catch basins, outfalls, and stormwater mains. It should be noted that no dimensions or elevation data was included with this data. The stormwater infrastructure associated with drainage to the Upper Lagoon are presented in **Figure 4**. A total of 45 catch basins are connected to eight (8) outfalls that drain into the Upper Lagoon.

[1] CIRCA, Connecticut Physical Climate Science Assessment Report (PCSAR), August 2019.

Figure 4: Upper Lagoon Stormwater Infrastructure

2.3 FIELD DATA COLLECTION

GZA performed a site visit on May 7, 2025 to collect data to supplement the existing stormwater infrastructure data. In order to assess the hydraulic performance of the stormwater system in the Upper Lagoon project site, GZA developed a hydraulic model, described in Section 3.0. GZA collected topographic data for the stormwater infrastructure during the site visit to eventually inform the hydraulic model. **Figure 5**, from the HEC-RAS User's Manual, exhibits the necessary data to model stormwater infrastructure in the hydraulic model.

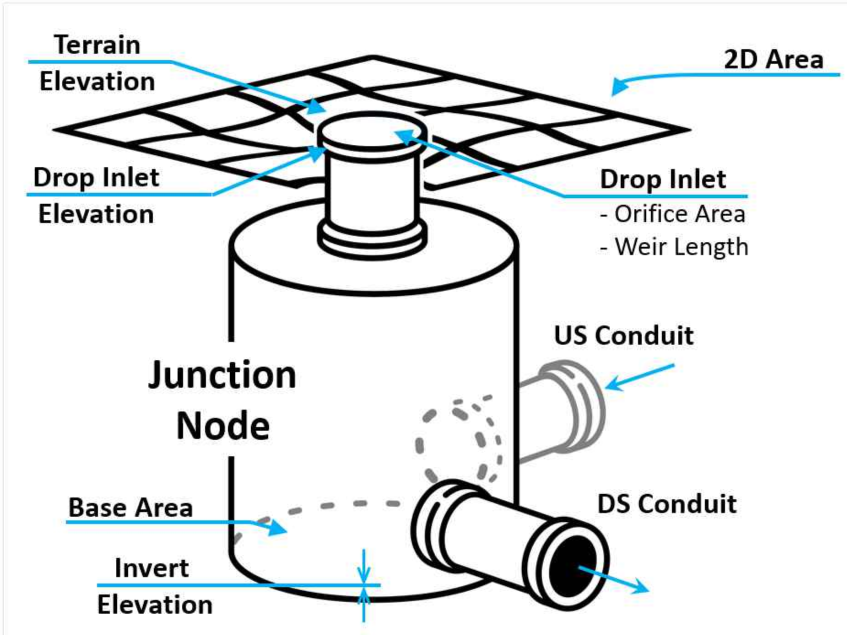


Figure 5: Stormwater Infrastructure Node Attributes

GZA used this exhibit as a guide for field data collection. During the field visit, GZA collected topographic data at each catch basin and outfall for the parameters shown above, and measured dimensions of the catch basin area and conduit diameters. Existing conditions elevation data that was collected is shown on the Existing Conditions Plans as part of the 30% Level Design Drawings, included as **Appendix B**.

3.0 HYDRAULIC ASSESSMENT

3.1 MODEL DEVELOPMENT

GZA developed a hydrologic and hydraulic model of the watershed using the HEC-RAS version 6.6 software. The model is made up of a user-defined grid (e.g., mesh) that encompasses the watershed. Rainfall is added to each grid cell. The runoff from each grid cell is computed by subtracting the infiltration volume from the rainfall, based on the infiltration rate assigned to each grid cell. The runoff is then routed from one grid cell to another based on the underlying input terrain and land roughness (i.e., Manning's n values) along each grid cell's faces. Breaklines are used to line up grid cell faces with topographic high ground (e.g. roadways and ridges) and low ground (e.g. streambeds). The flow between grid cells and through culverts and crossing structures is computed using 2D flow/hydraulic equations.

Terrain and Bathymetry

The model terrain was developed using bathymetric and topographic data for the project area based on the 2023 Connecticut DEM data available via CT Geodata Portal. The model terrain is shown in **Figure 6**.

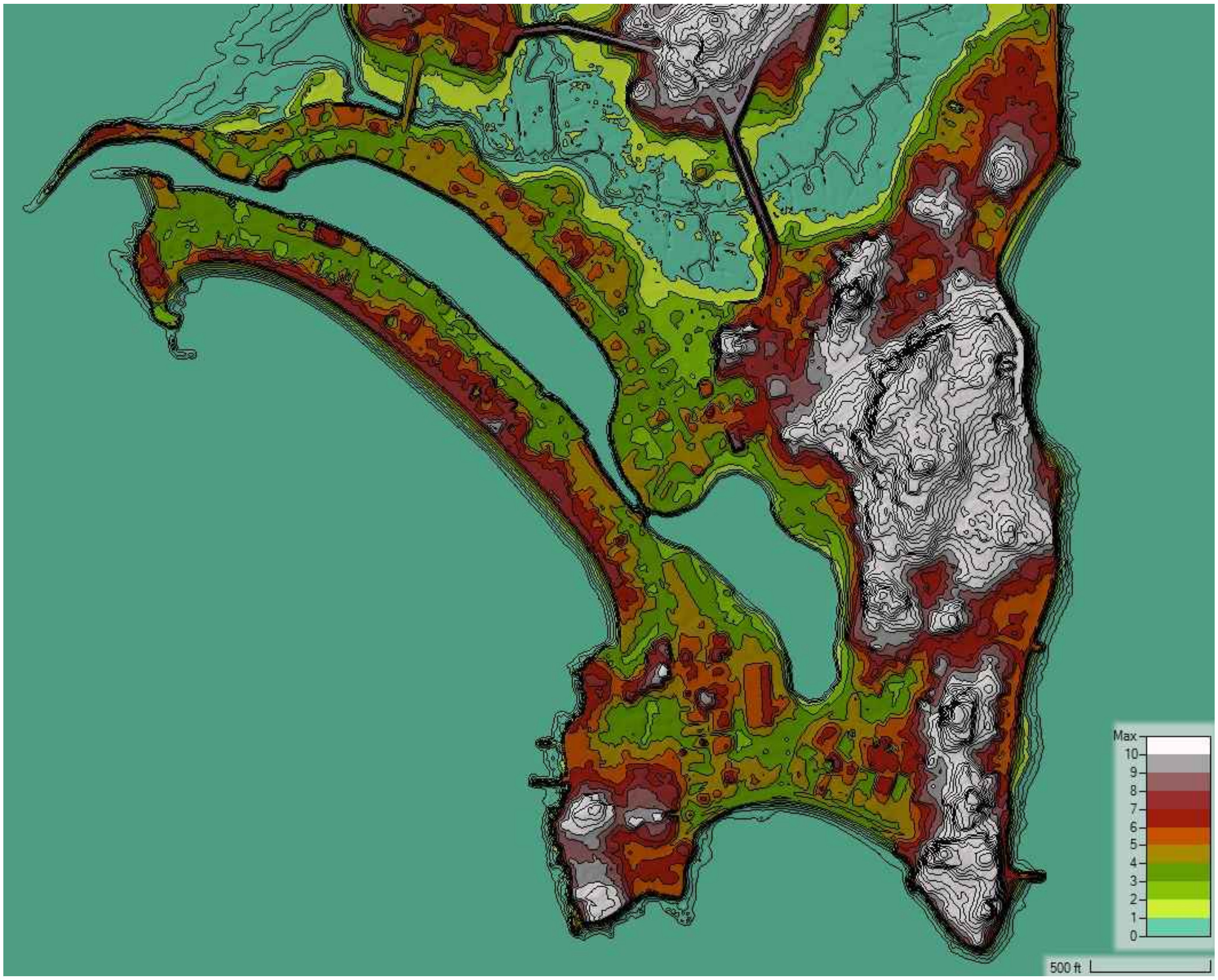


Figure 6: Model Terrain, Elevations in ft, NAVD88

2D Flow Area

GZA estimated the 2D flow area by estimating the watershed area using the model terrain. The area was further refined by using the extents of the stormwater system's drainage area to develop the perimeter of the grid. The majority of the grid has a cell resolution of 20 feet. Within the stormwater system's pipe network, the cell size was reduced to a resolution of 10 feet.

Manning's n

GZA assigned Manning's n land roughness values based on land cover data from the 2021 Connecticut land use dataset by the NOAA Coastal Change Analysis Program (C-CAP). The Manning's n value for each land use type was selected using the HEC-RAS 2D User's Manual and is presented in **Table 5**.

Table 5: Estimated Manning's n Values for Land Uses

Land Use	Manning's n	Land Use	Manning's n
Developed – Medium Intensity	0.12	Developed – Low Intensity	0.10
Developed – Open Space	0.04	Deciduous Forest	0.15
Developed – High Intensity	0.15	Evergreen Forest	0.12
Palustrine Scrub-Shrub Wetland	0.10	Palustrine Forested Wetland	0.12
Mixed Forest	0.15	Open Water	0.05
Scrub-Shrub	0.12	Palustrine Emergent Wetland	0.07
Barren Land	0.025	Grassland – Herbaceous	0.03
Estuarine Emergent Wetland	0.10	Pasture – Hay	0.035

Infiltration Rates

The HEC-RAS model was set up using the SCS Curve Number method along with an abstraction ratio (which defines initial losses) to model infiltration. A minimum infiltration rate which limits the infiltration rate was also added as a parameter to set a threshold which will not allow the infiltration rate to be lower than the user entered value even when the soil becomes saturated.

Hydrologic soil groups were identified by the soil types as documented in the National Cooperative Soil Survey (NCSS) Web Soil Survey, a dataset hosted by the USDA Natural Resources Conservation Service. The hydrologic soil group classifications are A, B, BD, D, and Water, from lowest runoff potential to highest runoff potential. The minimum infiltration rate were assigned based on the soil group, the selected infiltration rates are presented in **Table 6**.

Table 6: Minimum Infiltration Rates for Hydrologic Soil Groups

Hydrologic Soil Group	Minimum Infiltration Rate (in/hr)
A	0.30
B	0.15
BD	0.15
D	0
W	0

The SCS curve number and abstraction ratio were estimated based on Land Cover and Soils data.

Hydraulic Structures

GZA identified one hydraulic structure in the 2D Flow Area located at Beach Road and modeled the structure using a SA/2D Connector. The Beach Road Culvert connects the GLP Harbor to the Upper Lagoon. The hydraulic structure was modeled based on aerial imagery, and LiDAR data. GZA confirmed dimensions of the hydraulic structure during the site visit. The culvert crossing data is summarized in **Table 7**.

Table 7: Beach Road Dimensions

Shape	Span (ft)	Rise (ft)	Inlet Elevation (ft, NAVD88)	Outlet Elevation (ft, NAVD88)
Arch	14	9	-3.0	-3.0

Pipe Network

GZA modeled the stormwater system using a pipe network consisting of nodes connected by conduits. Nodes were placed to model junction boxes or manholes between multiple conduits, drop inlets or catch basins, and outfalls. The locations of the pipe network was based on Town GIS files, aerial imagery, LiDAR and confirmed during the site visit. Additionally, invert elevations were assigned to nodes based on LiDAR and confirmed during site visit. Additionally, conduit sizes were assumed to be 1 foot unless able to be confirmed during site visit. A Manning's n of 0.012 was assigned to each conduit. HEC-RAS creates a separate grid to represent the pipe network which was assigned a cell resolution of 10 feet.

Model Scenarios

GZA evaluated the performance of the existing stormwater system under the four coastal floods (MSL, MHHW, 2-yr, 10-yr) for the three rainfall events (2, 10, 100-yr) for the present day and future (2050) scenarios, totaling 24 simulations. The coastal flooding was applied as an initial condition elevation in the lagoon, and the rainfall was applied as a precipitation hyetograph to the 2D flow area.

3.2 MODEL RESULTS

GZA evaluated water surface elevations in the Upper Lagoon for the various scenarios. Peak water surface elevations for the present day scenarios are shown in **Table 8**.

Table 8: Present Day Upper Lagoon Water Surface Elevations

Condition	2-yr Rainfall	10-yr Rainfall	100-yr Rainfall
MSL	0.8	1.5	3.4
MHHW	2.0	2.9	3.8
2-yr	4.0	4.2	4.5
10-yr	5.3	5.5	5.8

There is a greater range in water surface elevation with different precipitation events during MSL and MHHW. During the 2-yr and 10-yr coastal tide levels coinciding with the rainfall, the lagoon is already generally full, and the stormwater system is not performing as effectively since there is nowhere for the drainage to go.

Peak water surface elevations for the future (2050) scenarios are shown in **Table 9**.

Table 9: 2050 Upper Lagoon Water Surface Elevations

Condition	2-yr Rainfall	10-yr Rainfall	100-yr Rainfall
MSL	3.2	3.7	4.4
MHHW	3.6	4.0	4.9
2-yr	5.5	5.9	6.4
10-yr	6.9	7.1	7.9

Peak water surface elevations in the Upper Lagoon are notably higher by 2050 with the impacts of climate change. By 2050, starting water levels are expected to be higher due to sea level rise, and precipitation depth is also expected to increase. The combined effects of increased rainfall intensity and sea level rise result in an increased flood vulnerability in the Upper Lagoon area.

4.0 PROJECT SITE MITIGATION ACTIONS

As a result of the conceptual design phase, GLPA stakeholders selected two project sites to move forward to this 30% level design phase: West Shore Ave and the Upper Lagoon. GZA used the hydraulic assessment described in Section 3 to inform the design of the stormwater improvements.

4.1 UPPER LAGOON

The Upper Lagoon Raised Walking Path concept would raise the low-lying land around the Upper Lagoon. This grade raise would be located along the current walking path and prevent flooding pathways from the Upper Lagoon to the surrounding areas. This concept would not only reduce the flooding frequency around the Upper Lagoon, but allow for the marsh vegetation to have elevated areas to retreat to as sea levels rise.

An approximately 42-acre area drains to the Upper Lagoon via overland flow and the stormwater system, consisting of 45 catch basins connected to 8 outfalls along the lagoon. Stormwater has caused flooding problems in the past, particularly in combination with higher tides. The paved walkway surrounding the lagoon has a variable elevation, with low lying spots creating flood pathways out of the lagoon. The conceptual phase of this project identified an option of raising the walking path to a constant elevation to eliminate flood pathways out of the lagoon during heavy precipitation and coastal floods.

The topography of the existing walk path, shown on **Attachment B- Drawing 4**, ranges between elevation 2 feet to 5 feet. Given the location of high ground to tie the walkway into and the results of the hydraulic analysis, GZA recommends designing the walking path with a crest elevation of 4 feet. The proposed configuration of the raised walkway is shown on **Attachment B- Drawing 6**.

A raised walkway at elevation 4 feet would protect against present day flooding during heavy precipitation events coinciding with ‘normal’ tidal flooding (i.e. MSL & MHW). If the precipitation events occur when there is also significant coastal flooding (i.e. 2-yr & 10-yr), there is less available volume in the lagoon for the runoff, resulting in a peak water surface elevation greater than 4 feet. During 2050, the walkway would protect against the 2-yr and 10-yr rainfall during normal tidal flooding (i.e. MSL & MHW), but not against the 100-yr rainfall. The CIRCA guidance projects that the 100-yr rainfall depth will increase by 90% by 2050, which will overwhelm the system. Similar to present day, the raised walkway would be overwhelmed by flooding if the rainfall were to occur coincident with the 2-yr or 10-yr coastal floods. In addition to providing protection from intense rainfall, the raised walkway will also provide protection against future tidal flooding, as MHHW is projected to be 2.9 feet by 2050.

To accomplish a crest elevation of 4 feet, the slopes of the berm would be a maximum of a 3-foot horizontal to a 1-foot vertical, still allowing the raised area to be traversed. The maximum amount that the existing walkway would need to be raised above existing grade is approximately 18 inches. An existing conditions survey of the area would be required in future design phases to more accurately

It should be noted that while the construction of a raised walkway surrounding the lagoon will close off flood pathways away from the lagoon, it will also close off pathways into the lagoon from direct stormwater runoff (this is referenced as "interior drainage" in FEMA and US Army Corps of Engineers guidance). Although there are numerous catch basins in the area surrounding the lagoon, there are still some areas that drain directly to the lagoon without entering the stormwater system. This amount of runoff is not expected to create significant flooding outside of the walkway, as there is undeveloped land for the runoff to eventually infiltrate. However, during coincident coastal floods and intense rainfall events, the walkway is expected to flood and overtop. With the raised walkway, overtopping flows would not be able to drain back into the lagoon when the water recedes. Therefore, it is recommended that GLPA investigate drainage back into the lagoon during later design phases. Potential solutions include pumping or installing surface drains with backflow preventors restricting backflow from the lagoon.

In addition to raising the walkway, the existing outfalls to the lagoon would also need to be fitted with backflow prevention to prevent high coastal flooding from backing up the system. There are eight outfalls around the lagoon that would need backflow prevention installed. The preventors are described further in the West Shore Ave project site.

4.2 WEST SHORE AVE

The stormwater improvements in the West Shore Ave project site include the installation of backflow prevention. The roadway elevation of West Shore Ave ranges between 3 to 4 feet, and Atlantic Ave, to the north of the GLP Harbor, ranges between 2.5 to 4.5 feet. During high tide events, water backs up through the stormwater system, resulting in flooding the roadway. With sea level rise, sunny day flooding is expected to increase without intervention. Sunny day flooding is already occurring, as shown in **Figure 7.**

Figure 7: Sunny Day Flooding of Stormwater System (January 2025)

The addition of backflow prevention allows for flow in only one direction (towards the harbor/ ocean) and stops water from infiltrating from the coast and coming out of the low-lying catch basins and flooding roadways. The installation location at the catch basins allows for regular maintenance to be performed more easily and reduces potential failures in the system, such as debris and biofouling. There are 10 outfalls that drain to the GLP harbor that should have backflow preventors installed.

GZA recommends that GLPA install Tideflex Checkmate Check Valves (or equivalent) at each of the outfalls connected to the GLP Harbor. Specifically, the valves should be installed at the upstream end of the stormwater main connected to the outfall, to allow for easier access through the catch basin for installation and maintenance. Locations and details of the check valves are shown on **Attachment B- Drawing 4**. In cases where the existing catch basin or manhole is undersized for access to the check valves or in otherwise poor structural condition, replacement catch basins or manholes should be considered. This should be confirmed during later design phases.

It should be noted that in some lower-lying areas, the backflow prevention would only protect against flooding until the tides reach the roadway elevation, which is at approximately 3 feet in the lowest point.

4.3 <u>COST ESTIMATE</u>

For planning purposes, GZA developed conceptual order-of-magnitude cost estimates for the drainage improvements, presented in **Table 10**.

Table 10: Conceptual Cost Estimates

Project Site	**Order of Magnitude Construction Cost***
Upper Lagoon	Berm Cost: $400,000 Sidewalk Cost: $150,000 Check Valves: $80,000 Engineering and Design ~ 30%: $200,000 Contingency ~ 25%: $200,000 Total: $1,030,000
West Shore Ave	Check Valves: $100,000 Engineering and Design ~ 30%: $30,000 Contingency ~ 25%: $35,000 Total: $165,000

*These values are approximate and subject to change given many factors including time/ date of construction, materials cost, and contractor availability.

5.0 CONCLUSIONS AND NEXT STEPS

GZA carried forward two project sites from the conceptual design phase to evaluate flood mitigation alternatives. GZA collected pertinent hazard data through a desktop analysis and stormwater infrastructure data during a site visit. This data was used to conduct a hydraulic assessment of the existing stormwater system. The performance of the stormwater system that drains to the Upper Lagoon was evaluated during coincident coastal flooding and intense rainfall events, and results were used to inform the design of flood mitigation projects. GZA prepared a 30% Level Design of a raised walkway around the Upper Lagoon to protect against stormwater flooding, along with proposed backflow prevention in the West Shore Ave site for stormwater improvement.

Permitting

Based on GZA's history of work within the State of CT and completing similar jobs in the area, GLP could likely anticipate permitting with entities such as CT DEEP and the USACE, and Town of Groton. It is also recommended that GLP complete a pre-application meetings with each agency, prior to final design of each project to ensure a smoother permitting process and help elevate potential conflicts with permitting agencies.

Potential Funding Sources

Potential funding sources for the projects discussed at this conceptual design phase include; 1) CT DEEP Climate Resilience Fund for Design and Permitting; 2) FEMA Building Resilient Infrastructure and Communities (BRIC) 2026; 3) FEMA Flood Mitigation Assistance (FMA) 2026; 4) FEMA Hazard Mitigation Grant Program (HMGP) 2026; 5) Long Island Sound Futures Fund (NFWF/EPA /QAPP) with a 50% Match, Design/Planning Projects: $50,000 to $500,000 (2025 Notice of Funding Opportunity (NOFO) closed May 29, 2025 with funds awarded in November); 6) CT DEEP Matching Fund Grant Program for FEMA/NOAA/EPA Grants; and 7) National Coastal Resilience Fund (NCRF). GZA believes that the CT DEEP Climate Resilience Fund would be the best choice for the community and type of work involved, however there is currently no match of funds. The NCRF fund primarily invests in nature-based solutions that protect coastal communities from coastal hazards.

Attachment A- Limitations

USE OF REPORT

1. GeoEnvironmental, Inc. (GZA) prepared this Report on behalf of, and for the exclusive use of the Groton Long Point Association for the stated purpose(s) and location(s) identified in the Report. Use of this Report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not identified in the agreement, for any use, without our prior written permission, shall be at that party's sole risk, and without any liability to GZA.

STANDARD OF CARE

2. Our findings and conclusions are based on the work conducted as part of the Scope of Services set forth in the Report and/or proposal and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work. Conditions other than described in this Report may be found at the subject location(s).
3. The interpretations and conclusions presented in the Report were based solely upon the services described therein, and not on scientific tasks or procedures beyond the scope of the described services. The work described in this Report was carried out in accordance with the agreed upon Terms and Conditions of Engagement.
4. GZA's elevation, hydrologic, and hydraulic evaluation was performed in accordance with generally accepted practices of qualified professionals performing the same type of services at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made. The findings are dependent on numerous assumptions and uncertainties inherent in the assessment process. The findings of the evaluation are not an absolute characterization of actual risks, but rather serve to highlight potential sources of risk at the site(s).
5. The study included review of flood elevations developed for the current climate.
6. Unless specifically stated otherwise, the evaluations performed by GZA and associated results and conclusions are based upon evaluation of historic data, trends, references, and guidance with respect to the current climate and sea level conditions. Future climate change may result in alterations to inputs which influence flooding at the site (*e.g.*, rainfall totals, storm intensities, mean sea level, *etc*.). Such changes may have implications on the estimated flood elevations, flood frequencies and/or other parameters contained in this Report.

RELIANCE ON INFORMATION FROM OTHERS

7. In conducting our work, GZA has relied upon certain information made available by public agencies, Client and/or others. GZA did not attempt to independently verify the accuracy or completeness of that information. Any inconsistencies in this information which we have noted are discussed in the Report.

COMPLIANCE WITH CODES AND REGULATIONS

8. We used reasonable care in identifying and interpreting applicable codes and regulations necessary to execute our scope of work. These codes and regulations are subject to various, and possibly contradictory, interpretations. Interpretations with codes and regulations by other parties are beyond our control.

COST ESTIMATES

9. Unless otherwise stated, our cost estimates are for comparative, or general planning purposes. These estimates may involve approximate quantity evaluations and may not be sufficiently accurate to develop construction bids, or to predict the actual cost of work addressed in this Report. Further, since we have no control over the labor and material costs required to plan and execute the anticipated work, our estimates were made using our experience and readily available information. Actual costs may vary over time and could be significantly more, or less, than stated in the Report.

ADDITIONAL INFORMATION

10. In the event that the Client or others authorized to use this Report obtain information on conditions at the site(s) not contained in this Report, such information shall be brought to GZA's attention forthwith. GZA will evaluate such information and, on the basis of this evaluation, may modify the opinions stated in this Report.

ADDITIONAL SERVICES

11. GZA recommends that we be retained to provide services during any future investigations, design, implementation activities, construction, and/or property development/ redevelopment at the Site. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.

Attachment B- 30% Level Design Drawings

GROTON LONG POINT 30% LEVEL DESIGN
FLOOD MITIGATION ALTERNATIVES

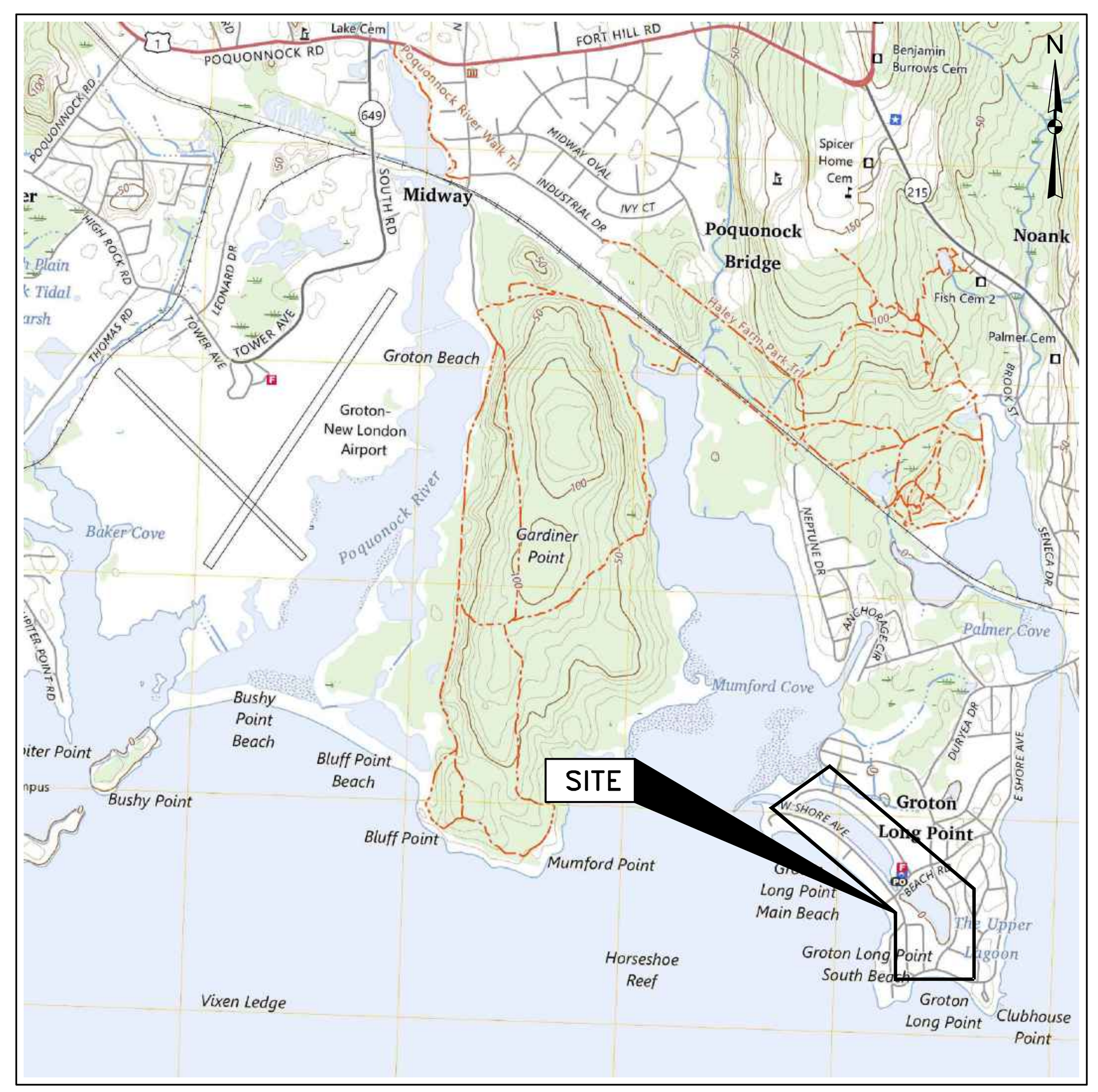
GROTON LONG POINT, CONNECTICUT

PREPARED FOR

GROTON LONG POINT ASSOCIATION, INC.
44 BEACH ROAD P.O. BOX 3737
GROTON LONG POINT, CT 06340

PREPARED BY

GZA GEOENVIRONMENTAL, INC.
249 VANDERBILT AVENUE
NORWOOD, MA 02062



PROJECT LOCUS MAP

SOURCE: USGS TOPOGRAPHIC QUADRANGLES DOWNLOADED FROM USGS NATIONAL GEOLOGIC MAP DATABASE
CONTOUR INTERVAL 10 FEET, NORTH AMERICAN VERTICAL DATUM OF 1988 NAVD88

NOT TO SCALE

AERIAL MAP

SOURCE: BING AERIAL MAP DOWNLOADED FROM
AUTOCAD GEOLOCATION MAP SERVICES

0 500' 1000' 2000' 3000'

SCALE: 1" = 1000 FEET

INDEX OF DRAWINGS:

SHEET 1 TITLE SHEET AND INDEX OF DRAWINGS
SHEET 2 EXISTING KEY PLAN AND NOTES
SHEET 3 EXISTING CONDITIONS PLAN WEST SHORE AVE
SHEET 4 EXISTING CONDITIONS PLAN UPPER LAGOON
SHEET 5 PROPOSED CONDITIONS PLAN WEST SHORE AVE
SHEET 6 PROPOSED CONDITIONS PLAN UPPER LAGOON
SHEET 7 PROPOSED STAGING PLAN AND EROSION CONTROL DETAILS

NOT FOR CONSTRUCTION

NO.	ISSUE/DESCRIPTION	BY	DATE

GROTON LONG POINT 30% LEVEL DESIGN
FLOOD MITIGATION ALTERNATIVES
GROTON LONG POINT, CT

TITLE SHEET AND INDEX OF DRAWINGS

PREPARED BY:	PREPARED FOR:
GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com	GROTON LONG POINT ASSOCIATION, INC.

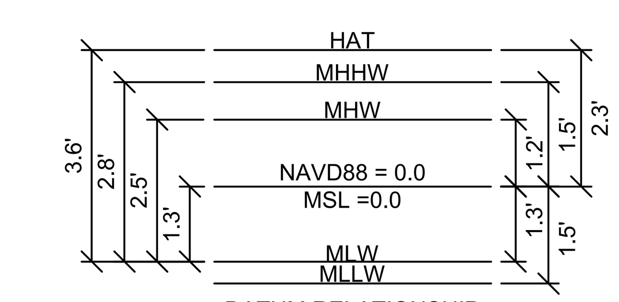
PROJ MGR: AMR	REVIEWED BY: TRG	CHECKED BY: DML	DRAWING 1
DESIGNED BY: MG/AMR	DRAWN BY: LFT	SCALE: AS SHOWN	
DATE: JUNE 2025	PROJECT NO. 01.0177993.00	REVISION NO. #	SHEET NO. 1 OF 7

GENERAL NOTES

1. VERTICAL DATUM: ELEVATIONS AND CONTOURS ARE IN FEET AND REFERENCE THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88): MLLW= -1.5, MLW= -1.3, MSL= 0.0, NAVD88=0.0, MHW=1.2, MHHW=1.5. TIDAL DATUM RELATIONSHIP AND CONVERSION REFERENCED TO NOAA NEW LONDON TIDE GAUGE.
2. HORIZONTAL DATUM: CONNECTICUT STATE PLANE, NAD83, US FEET.
3. TOPOGRAPHIC LiDAR SURVEY DATA FROM THE 2016 CONNECTICUT DIGITAL ELEVATION MODEL.
4. LIMITED TOPOGRAPHIC (ELEVATION) MEASUREMENTS PERFORMED BY GZA GEOENVIRONMENTAL, INC., ON MAY 7, 2025, USING A REAL-TIME KINEMATIC (RTK) DIFFERENTIAL GLOBAL POSITIONING SYSTEM (DGPS) UNIT AND REPRESENTS CONDITIONS AT THE TIME OF THE SURVEY.
5. THE BACKGROUND AERIAL IMAGERY WAS PROVIDED BY MICROSOFT AND IS DATED 2025. THE USE OF AERIAL PHOTOGRAPHY CAN OFTEN MAKE BUILDINGS AND OTHER SITE FEATURES APPEAR TO BE OVERLAPPING AND DISTORTED WHEN OVERLAID WITH ACTUAL SITE FEATURES.
6. LOCATION OR PRESENCE OF UTILITIES SHOWN ON THESE DRAWINGS ARE APPROXIMATE. VERIFY LOCATIONS, DEPTHS, AND OVERHEAD CLEARANCE OF ALL EXISTING UTILITY UTILITIES AND NOTIFY APPROPRIATE UTILITY COMPANY AND AUTHORITY TO ALLOW MARKING OF THEIR LINES.
7. THE HAT, CJL, MHHW, MHW, MLW, AND MLLW ELEVATIONS REFLECT CURRENT CLIMATE CONDITIONS.

LEGEND

- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- MEAN LOW WATER (MLW) = -1.3'
- MEAN HIGH WATER (MHW) = 1.2'
- COASTAL JURISDICTION LINE (CJL) = 2.0'
- HIGHEST ANNUAL TIDE (HAT) = 2.3'



DATUM RELATIONSHIP
NOT TO SCALE

NOT FOR CONSTRUCTION

NO.	ISSUE/DESCRIPTION	BY	DATE

GROTON LONG POINT 30% LEVEL DESIGN
FLOOD MITIGATION ALTERNATIVES
GROTON LONG POINT, CT

EXISTING KEY PLAN AND NOTES

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
GROTON LONG POINT ASSOCIATION, INC.

PROJ MGR: AMR	REVIEWED BY: TRG	CHECKED BY: DML	DRAWING
DESIGNED BY: MG/AMR	DRAWN BY: LFT	SCALE: AS SHOWN	2
DATE: JUNE 2025	PROJECT NO. 01.0177993.00	REVISION NO. #	SHEET NO. 2 OF 7

EXISTING CONDITIONS PLAN WEST SHORE AVE

SCALE 1" = 80'

0 40' 80' 160'

SCALE IN FEET 1" = 80'

LEGEND

— — —	EXISTING CONTOUR MAJOR
- - -	EXISTING CONTOUR MINOR
· · · ·	MEAN LOW WATER (MLW) = -1.3'
———	MEAN HIGH WATER (MHW) = 1.2'
— · · —	COASTAL JURISDICTION LINE (CJL) = 2.0'
—— - - ——	HIGHEST ANNUAL TIDE (HAT) = 2.3'
—— D —— D ——	EXISTING STORM DRAINS
× 1.0	EXISTING SPOT ELEVATION

NOT FOR CONSTRUCTION

NO.	ISSUE/DESCRIPTION	BY	DATE

GROTON LONG POINT 30% LEVEL DESIGN
FLOOD MITIGATION ALTERNATIVES
GROTON LONG POINT, CT

EXISTING CONDITIONS PLAN
WEST SHORE AVE

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
GROTON LONG POINT ASSOCIATION, INC.

PROJ MGR: AMR	REVIEWED BY: TRG	CHECKED BY: DML	DRAWING 3
DESIGNED BY: MG/AMR	DRAWN BY: LFT	SCALE: AS SHOWN	
DATE: JUNE 2025	PROJECT NO. 01.0177993.00	REVISION NO. #	SHEET NO. 3 OF 7

EXISTING CONDITIONS PLAN UPPER LAGOON

SCALE 1" = 60'

0 30' 60' 120'

SCALE IN FEET 1" = 60'

LEGEND

— — — — —	EXISTING CONTOUR MAJOR
— — — — —	EXISTING CONTOUR MINOR
· · · · · · · ·	MEAN LOW WATER (MLW) = -1.3'
————	MEAN HIGH WATER (MHW) = 1.2'
— · — · —	COASTAL JURISDICTION LINE (CJL) = 2.0'
— — — —	HIGHEST ANNUAL TIDE (HAT) = 2.3'
—— D —— D ——	EXISTING STORM DRAINS
× 1.0	EXISTING SPOT ELEVATION

NOT FOR CONSTRUCTION

NO.	ISSUE/DESCRIPTION	BY	DATE

GROTON LONG POINT 30% LEVEL DESIGN FLOOD MITIGATION ALTERNATIVES GROTON LONG POINT, CT

EXISTING CONDITIONS PLAN UPPER LAGOON

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

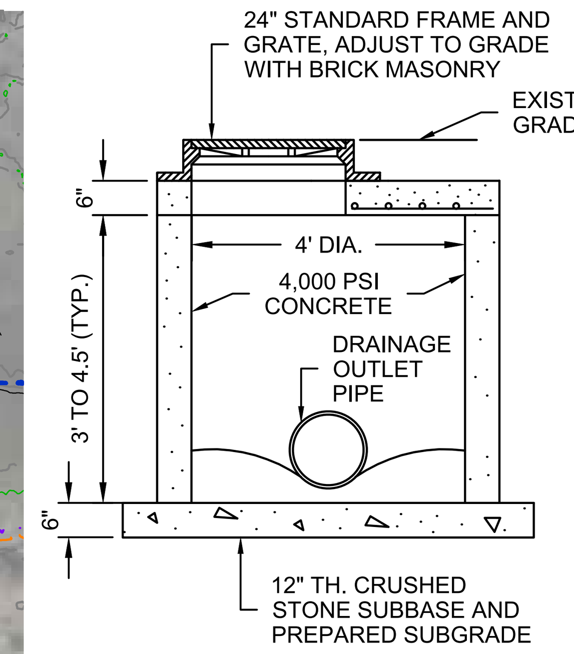
PREPARED FOR:
GROTON LONG POINT ASSOCIATION, INC.

PROJ MGR: AMR	REVIEWED BY: TRG	CHECKED BY: DML	DRAWING 4
DESIGNED BY: MG/AMR	DRAWN BY: LFT	SCALE: AS SHOWN	
DATE: JUNE 2025	PROJECT NO. 01.0177993.00	REVISION NO. #	SHEET NO. 4 OF 7

PROPOSED CONDITIONS PLAN WEST SHORE AVE

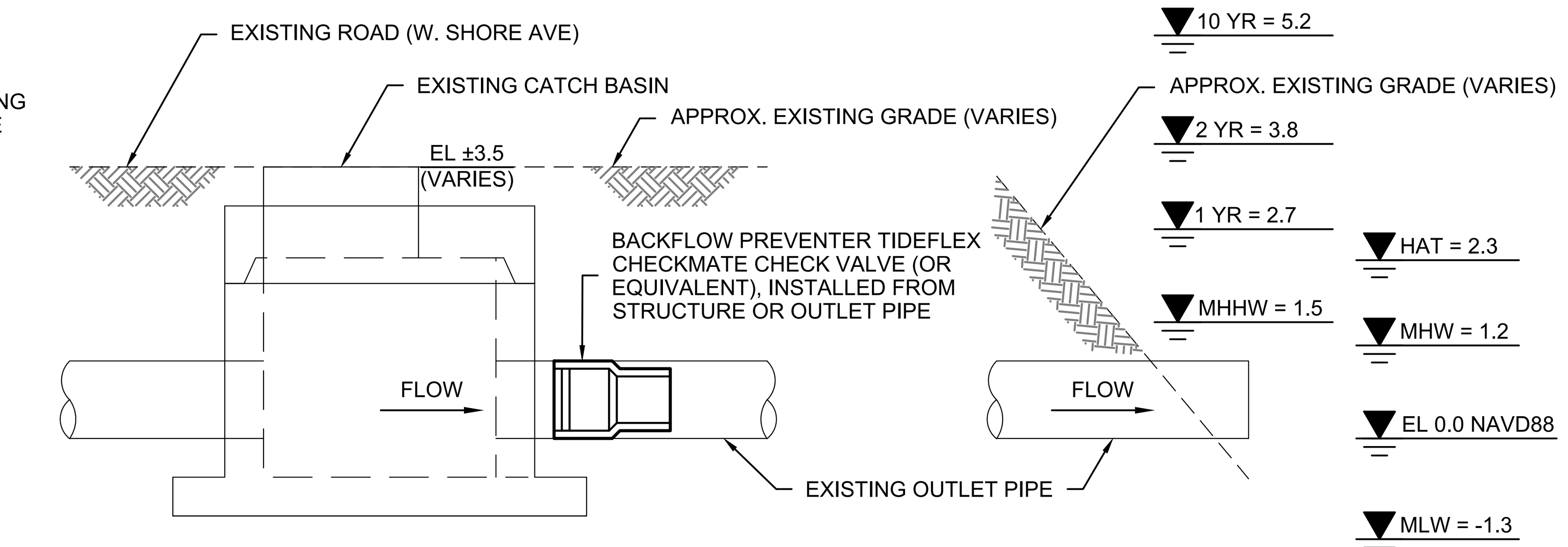
SCALE 1" = 80'

0 40' 80' 160'
SCALE IN FEET 1" = 80'



TYPICAL SHALLOW CATCH BASIN MANHOLE DETAIL

NOT TO SCALE



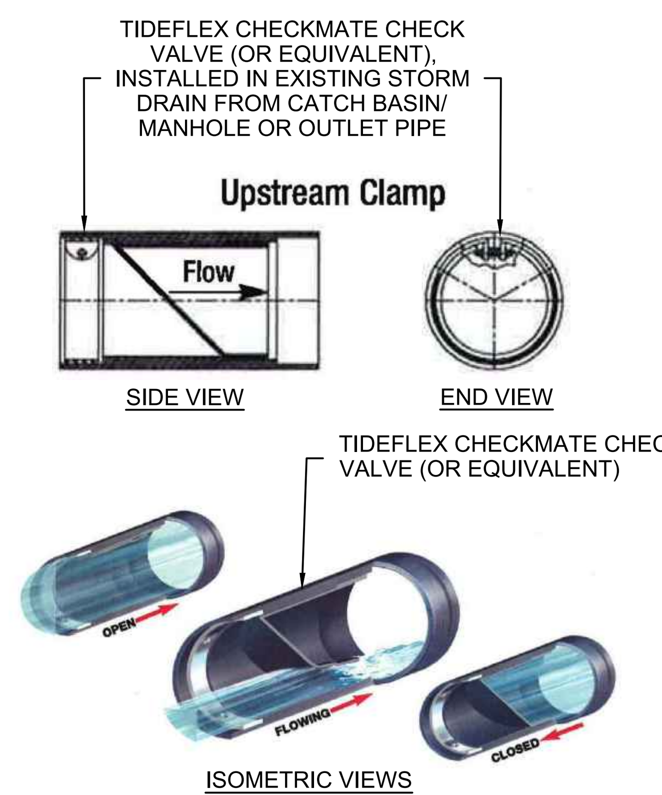
PROPOSED TYPICAL BACKFLOW PREVENTER DETAIL SECTION

SCALE 1" = 2'

0 1' 2' 4'
SCALE IN FEET 1" = 2'

BACKFLOW PREVENTER NOTES:

1. BACKFLOW PREVENTERS SHALL BE TIDEFLEX CHECKMATE CHECK VALVE OR APPROVED EQUIVALENT.
2. FINAL INSTALLATION LOCATIONS SHALL BE COORDINATED WITH THE OWNER.
3. INSPECT EXISTING CATCH BASIN OR MANHOLE FOR STRUCTURAL INTEGRITY PRIOR TO INSTALLATION OF BACKFLOW PREVENTER. REPLACE OR REPAIR THE STRUCTURE AS NEEDED.
4. INSTALL IN ACCORDANCE WITH MANUFACTURER RECOMMENDATIONS AND PROCEDURES.



BACKFLOW PREVENTER DETAIL: TIDEFLEX CHECKMATE CHECK VALVE

NOT TO SCALE

LEGEND

- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- MEAN LOW WATER (MLW) = -1.3'
- MEAN HIGH WATER (MHW) = 1.2'
- COASTAL JURISDICTION LINE (CJL) = 2.0'
- HIGHEST ANNUAL TIDE (HAT) = 2.3'
- D —— D EXISTING STORM DRAINS
- × 1.0 EXISTING SPOT ELEVATION
- ○ PROPOSED BACKFLOW PREVENTER

NOT FOR CONSTRUCTION

NO.	ISSUE/DESCRIPTION	BY	DATE

GROTON LONG POINT 30% LEVEL DESIGN
FLOOD MITIGATION ALTERNATIVES
GROTON LONG POINT, CT

PROPOSED CONDITIONS PLAN WEST SHORE AVE AND SECTIONS/DETAILS

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
GROTON LONG POINT ASSOCIATION, INC.

PROJ MGR: AMR	REVIEWED BY: TRG	CHECKED BY: DML	DRAWING
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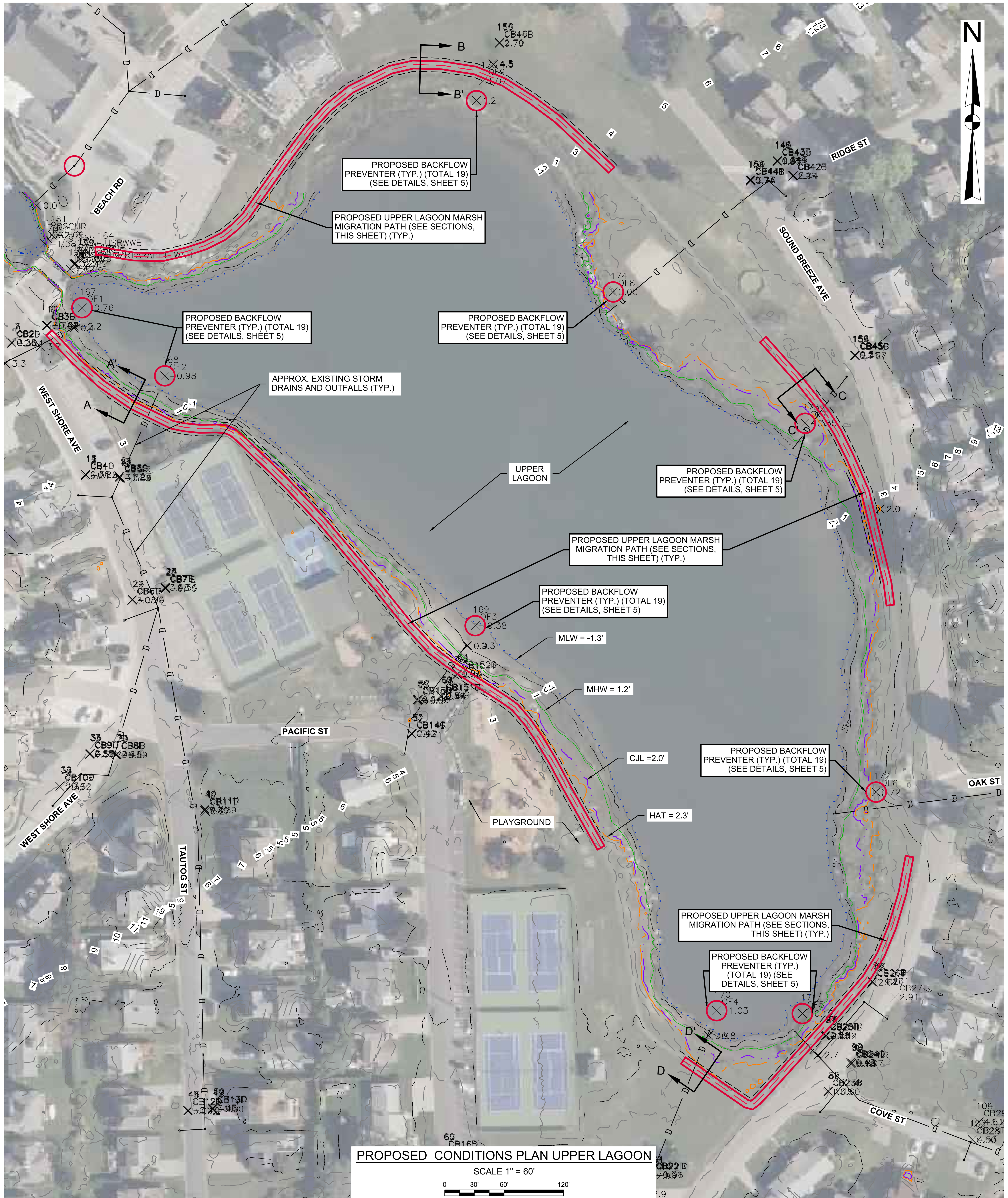
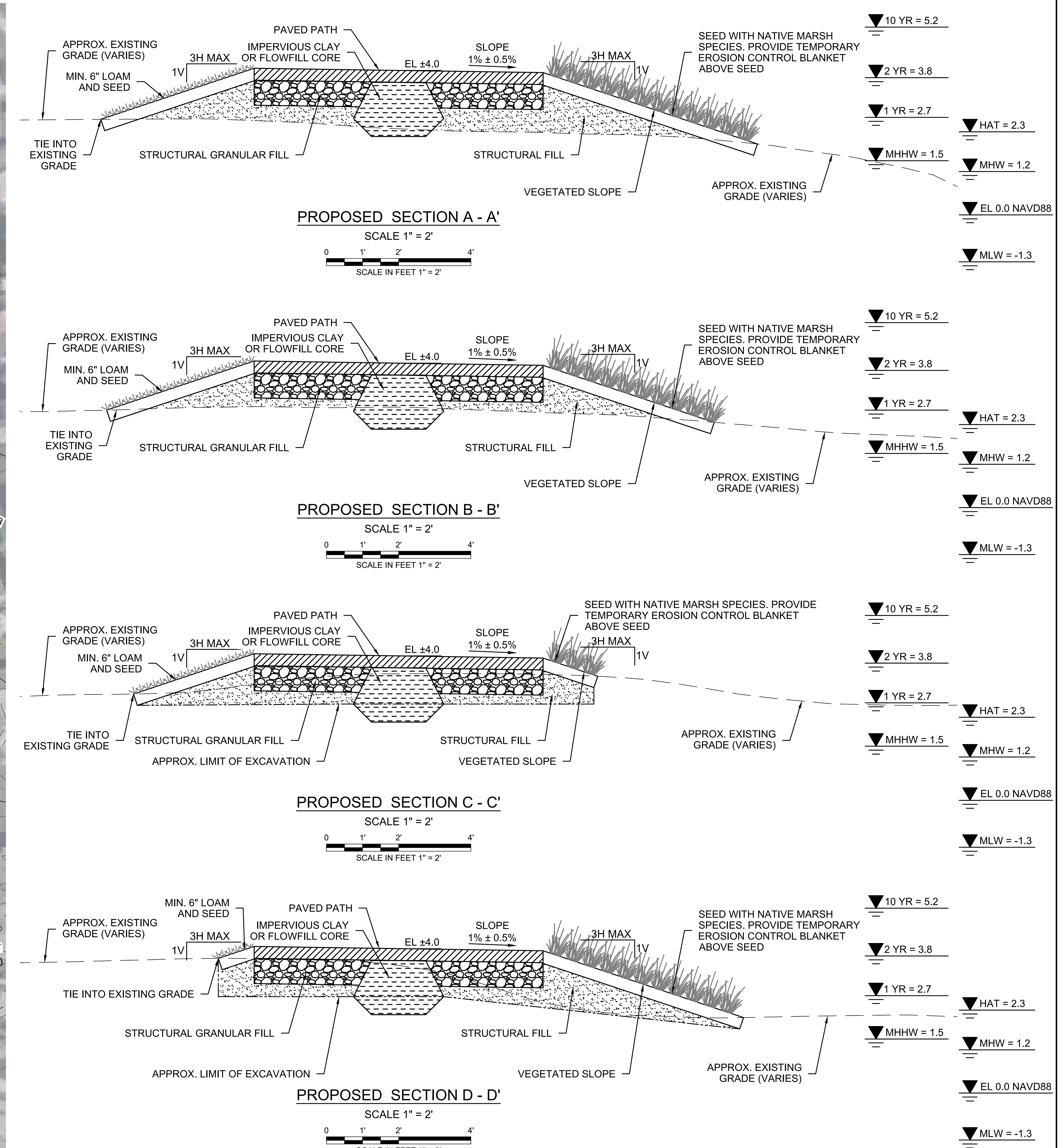
DATE: JUNE 2025	PROJECT NO. 01.0177993.00	REVISION NO. #	SHEET NO. 5 OF 7



PROPOSED CONDITIONS PLAN UPPER LAGOON

SCALE 1" = 60'

SCALE IN FEET 1" = 60'



PROPOSED SECTION A - A'

SCALE 1" = 2'

PROPOSED SECTION B - B'

SCALE 1" = 2'

PROPOSED SECTION C - C'

SCALE 1" = 2'

PROPOSED SECTION D - D'

SCALE 1" = 2'

SCALE IN FEET 1" = 2'

LEGEND

- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- MEAN LOW WATER (MLW) = -1.3'
- MEAN HIGH WATER (MHW) = 1.2'
- COASTAL JURISDICTION LINE (CJL) = 2.0'
- HIGHEST ANNUAL TIDE (HAT) = 2.3'
- EXISTING STORM DRAINS
- EXISTING SPOT ELEVATION (1.0)
- PROPOSED PATH
- PROPOSED PATH CENTERLINE
- PROPOSED CONTOURS
- PROPOSED BACKFLOW PREVENTER

NOT FOR CONSTRUCTION

NO.	ISSUE/DESCRIPTION	BY	DATE

GROTON LONG POINT 30% LEVEL DESIGN
FLOOD MITIGATION ALTERNATIVES
GROTON LONG POINT, CT

PROPOSED CONDITIONS PLAN UPPER LAGOON AND SECTIONS/ DETAILS

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
GROTON LONG POINT ASSOCIATION, INC.

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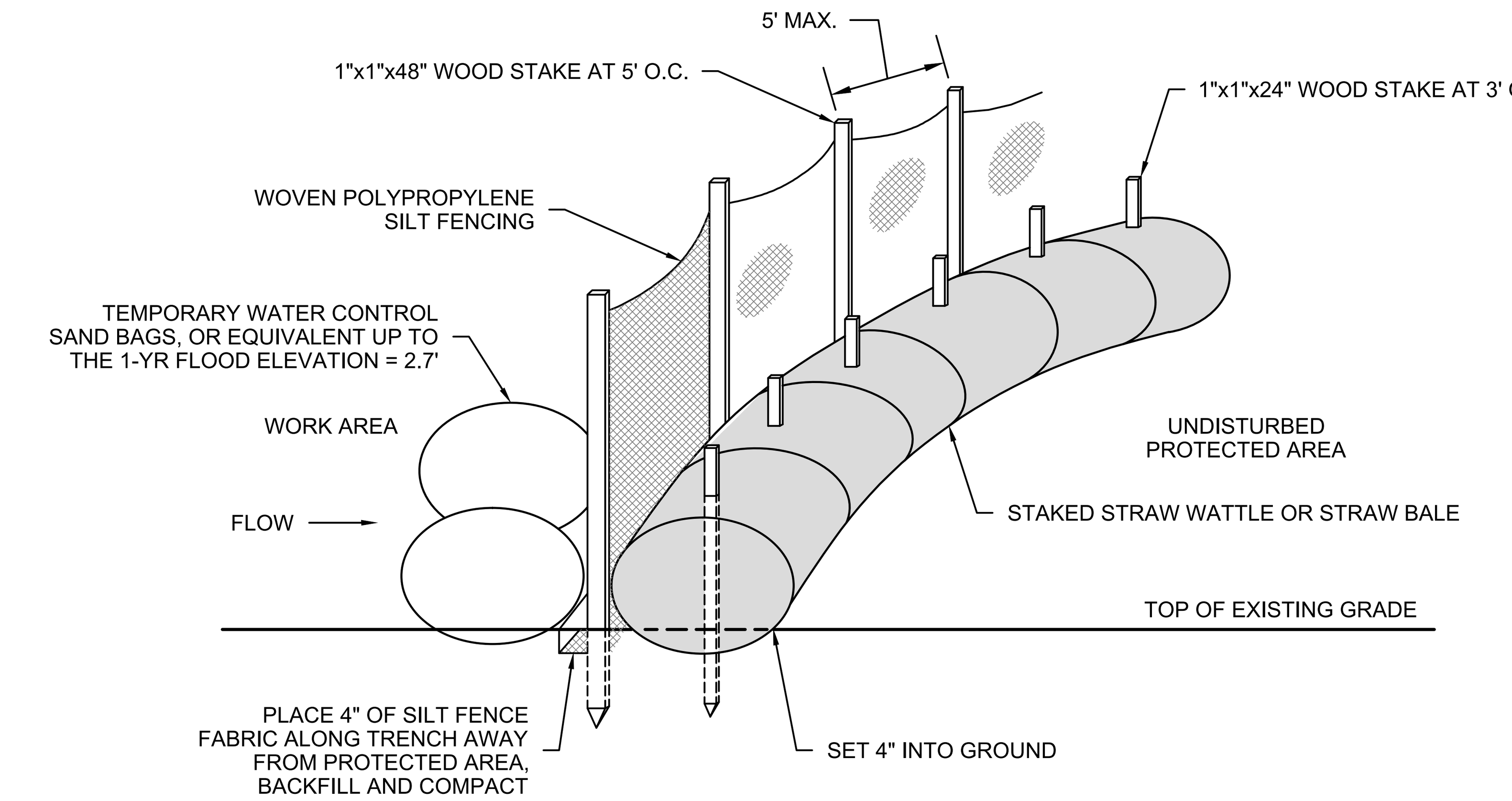
DATE: JUNE 2025	PROJECT NO. 01.0177993.00	REVISION NO. #	SHEET NO. 6 OF 7

PROPOSED STAGING PLAN

SCALE 1" = 60'

0 30' 60' 120'

SCALE IN FEET 1" = 60'



TYPICAL EROSION CONTROL DETAIL

SCALE N.T.S.

EROSION CONTROL NOTES:

1. TEMPORARY EROSION AND SEDIMENTATION CONTROLS SHALL BE INSTALLED SURROUNDING THE PROPOSED LIMITS OF WORK AND CONSTRUCTION ACCESS.
2. THE EROSION CONTROLS SHALL ALSO ACT AS THE LIMIT OF DISTURBANCE, AND NO ALTERATION SHALL TAKE PLACE BEYOND IT.
3. EROSION CONTROLS SHALL BE INSPECTED DURING THE WORK AND MAINTAINED IN GOOD REPAIR.
4. EROSION CONTROLS SHALL REMAIN IN PROPER FUNCTIONING CONDITION UNTIL ALL DISTURBED AREAS HAVE BEEN STABILIZED.

DEWATERING AND WATER CONTROL NOTES:

1. TEMPORARY WATER CONTROL DURING CONSTRUCTION FOR MITIGATION OF POTENTIAL COASTAL FLOODING THAT WOULD OTHERWISE INUNDATE THE WORK SITE DURING THE 1-YR FLOOD ELEVATION (2.7 FT)
2. CONTRACTOR SHALL FURNISH, MAINTAIN AND REMOVE TEMPORARY WATER CONTROL MEASURES ADEQUATE TO PROTECT, DRAIN, AND REMOVE SURFACE WATER ENTERING EXCAVATIONS.
3. DEWATERING OF EXCAVATIONS SHALL BE PERFORMED SO AS TO PREVENT SILTATION INTO WATER BODIES, WETLANDS, OR OTHER PROTECTED AREAS.
4. DISCHARGE FROM DEWATERING ACTIVITIES SHALL BE FILTERED THROUGH STRAW BALE SEDIMENT TRAPS, SILT FILTER BAGS, OR OTHER MEANS APPROVED BY THE REGULATING AGENCIES.

CONSTRUCTION STAGING AND ACCESS NOTES:

1. CONSTRUCTION STAGING AND ACCESS AREAS SHALL BE COORDINATED WITH THE OWNER.
2. STAGING AND ACCESS LOCATIONS SHALL BE RESTORED TO THEIR ORIGINAL PRE-CONSTRUCTION CONDITIONS.

LEGEND

- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- MEAN LOW WATER (MLW) = -1.3'
- MEAN HIGH WATER (MHW) = 1.2'
- COASTAL JURISDICTION LINE (CJL) = 2.0'
- HIGHEST ANNUAL TIDE (HAT) = 2.3'
- EXISTING STORM DRAINS
- 1.0 EXISTING SPOT ELEVATION
- PROPOSED EROSION CONTROLS
- PROPOSED CONSTRUCTION ACCESS
- PROPOSED CONSTRUCTION STAGING

NOT FOR CONSTRUCTION

NO.	ISSUE/DESCRIPTION	BY	DATE

GROTON LONG POINT 30% LEVEL DESIGN
FLOOD MITIGATION ALTERNATIVES
GROTON LONG POINT, CT

PROPOSED STAGING PLAN AND EROSION CONTROL DETAILS

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
GROTON LONG POINT ASSOCIATION, INC.

PROJ MGR: AMR	REVIEWED BY: TRG	CHECKED BY: DML	DRAWING 7
DESIGNED BY: MG/AMR	DRAWN BY: LFT	SCALE: AS SHOWN	
DATE: JUNE 2025	PROJECT NO. 01.0177993.00	REVISION NO. #	SHEET NO. 7 OF 7

GZA GeoEnvironmental, Inc.