LOWER VENTNOR HEIGHTS RESILIENCY PROJECT

FEBRUARY 2023

Ventnor City
New Jersey

Presented By:

DEBLASIO & ASSOCIATES
CONSULTING ENGINEERS AND PLANNERS

Introduction

The City of Ventnor is located on the Atlantic Ocean coastline and back bay intercoastal waterway in Atlantic County, New Jersey. The City is located on 8.1-mile (13.0 km) long Absecon Island, along with Atlantic City to the northeast, and Margate City and Longport on the southwest. Each year the City is presented with a constant threat to this community from sea level rise, coastal flooding, Nor'easters and tropical-borne storm activity, introducing severe wave and flood impacts.

The City of Ventnor has been historically subject to flooding, beach erosion and many other associated problems that require an aggressive approach to successfully manage infrastructure maintenance and flood damage mitigation. Mitigation is any sustained action taken to reduce or eliminate the risk to life and property from hazardous events. The City has developed a varied approach to protect and maintain its infrastructure, natural areas, public safety, welfare, and property of its residents, and continues to improve annually with the implementation of improvements, new technologies and with assistance from outside public agencies.

This report focuses on Ventnor Heights which is a suburban section of Ventnor City located on a former marsh island and the area nearest the Dorset Avenue bridge has a concentration of repetitive loss properties, low elevation, older housing stock compared to the rest of the Ventnor Heights, and prevalence of year-round occupancy. The Study Area, defined roughly south of Calvert Avenue, north and east of Inside Thorofare, and west of East Canal waterways, comprises approximately 400 housing units and 736 people as of the 2010 Census. Elevations in this area range from approximately two feet NAVD88 on streets near the Bay to approximately six feet NAVD88 on some blocks. Most homes are built where the grade of the surrounding land is approximately four to five feet NAVD88. By comparison, homes in the newer section of the Heights are built where the grade is closer to seven feet NAVD88. The neighborhood is protected by a system of bulkheads owned by private property owners, which are at varied heights and materials.

The City will continue to pursue and improve upon methods to educate its residents, protect its coastline, manage its infrastructure and natural areas, and mitigate the efforts from flood damage and natural disasters. This Resiliency Study Report demonstrates the City's continued commitment to these goals.

➢ This Report was developed for the purpose of:

- Educating the City, public and private property owners of the existing flooding challenges facing the City;
- Establishing recommendations to mitigate the adverse impact of flooding that do not adversely affect natural resources and conforms to local, state and Federal regulations;
- Providing flood mitigation infrastructure options to guide the City including construction cost estimates and permitting requirements;
- Prioritizing flood mitigation capital improvement projects based upon certainty of success, cost restrictions, and need for further analysis;
- Determine crucial flooding vulnerabilities, holes in floodwalls and low-lying areas.

Executive Summary

The City of Ventnor has made significant progress over the last several decades to mitigate flooding, including instituting several development ordinances, constructing storm sewer infrastructure improvements, maintaining natural assets and participating in regulatory initiatives. This report was developed for the purposes of assessing the existing factors contributing to the flooding problems, establishing recommendations to mitigate the adverse impact of flooding, providing flood mitigation infrastructure options to guide the City, prioritizing flood mitigation capital improvement projects based upon certainty of success, cost restrictions and need for further analysis and to determine crucial flooding vulnerabilities.

Our recommendations are categorized in the following manner:

A. Capital Infrastructure Projects
B. Preventative Actions
C. Natural Resources and Regulatory Agencies

A. <u>Capital Infrastructure Projects: Mitigate Flooding by Developing Projects to Control Floodwater</u>

1. Construct bayside tide control improvements to reduce tidal ("nuisance") flooding from entering City streets through the existing storm sewer system.

2. Elevate City roadways in cooperation with private property owners to reduce flooding with particular emphasis on tidal "nuisance" flooding events.

3. Replace or retrofit City bulkheads to increase heights to elevation 8.0 (NAVD 1988). All components of the bulkhead system should be constructed to be watertight by backfilling up against the landward side or any other method approved by the City Engineer.

4. Construct storm sewer pump stations along the bayside at strategic locations to increase the hydraulic capacity of the storm sewer system and to control tidal flooding. Those locations have been determined to be at Derby Avenue and Surrey Avenue.

5. Increase the hydraulic capacity of the existing storm sewer system when completing capital infrastructure projects thru retrofitting, replacement and supplementation of storm sewer inlets and piping.

Executive Summary Cont.

B. <u>Preventative Actions: Mitigate Susceptibility to Flooding</u>

1. Enact a bulkhead ordinance that requires new bulkheads to be constructed at a minimum elevation of 8.0 (NAVD 1988), including waterproofing, time connected compliance, a substantial improvement requirement and continued monitoring of sea level rise. Utilize updated sea level rise data to evaluate increasing the minimum bulkhead height elevation.

2. Consider a lot grading and drainage ordinance that requires private property owners to raise their lot frontage to a minimum elevation, construct garage floors and flood vents at a minimum elevation and install underground stormwater recharge.

3. Educate and improve communication to property owners of flooding events through advance warning systems, forecasting and emergency planning. Coordinate with the City's Office of Emergency Management to install advanced flood warning signs and sirens.

4. Encourage elevating or floodproofing new and existing buildings through local zoning codes, building requirements and development policies.

5. Adopt policy on current Sea Level Rise based on data collected by Rutgers University and recommendations from the NJDEP.

C. <u>Preservation and Restoration of Natural Resources and Participation with Regulatory Agencies: Mitigate Flooding by Maintaining Natural Environments and Through Cooperative Partnerships</u>

1. Evaluate and enact local zoning ordinances, policies and design requirements that are consistent with New Jersey Department of Environmental Protection and U.S. Army Corps of Engineers' regulations.

2. Consider land acquisition, purchasing repetitive loss properties and open space preservation in flood prone areas. Also, evaluate areas of the City that will become vulnerable to future flooding under the predicted sea level rise scenarios.

3. Continue to participate in the New Jersey Coastal Coalition.

4. Continue to participate and collaborate in Atlantic County HMP initiatives.

➢ Existing Conditions

1. Topography
2. Storm Sewer Infrastructure & Drainage Areas
3. Coastal Tidal Data and Sea Level Rise
4. Bulkhead Elevations

1. Topography

Existing topographical maps have been developed to analyze the water flow paths throughout the Study Area. A topographic map is characterized by a detailed representation of the elevations of an area. This is generally created using contour lines that connect places of equal elevation. The closer together the contour lines, the steeper the terrain.

The topographic information was obtained by a New Jersey Professional Land Surveyor and completed between June 10 – August 26, 2022. The topographic information was obtained using Real Time Kinematics (RTK) through a GPS unit, providing the most accurate data to the City.

As seen on the Existing Conditions Plan, areas along the bayfront are lower than the properties located in the interior of the Study Area. The stormwater generally travels from the interior towards the bayfront until it reaches a natural or manmade barrier. Along the bay side, roadway elevations generally range from two (2) to five (5) feet and the interior roadway elevations generally range from three (3) to six (6) feet in the NAVD 1988 datum. The highest area of the Study Area is the Dorset Avenue bridge, and the lowest areas of the Study Area is the intersection of Harvard Avenue and Calvert Avenue.

Once these maps were developed, it created a way to determine stormwater flow patterns along the surface of the Study Area and low areas can be clearly seen and prioritized in storm water management programs. Higher areas can be targeted for suitable areas for groundwater recharge.

The flow path of stormwater becomes important when developing drainage areas and stormwater management infrastructure. The topographical maps clearly show the boundaries of the existing drainage areas and can be used to track where the water flows. After the drainage areas are developed the size and location of the stormwater management infrastructure can be determined.

2. Storm Sewer Infrastructure & Drainage Areas

- The City of Ventnor storm sewer infrastructure is designed to remove excess rainwater from impervious surfaces such as paved streets, parking lots, sidewalks, and roofs. The subcomponents of the system vary in size and complexity and are solely gravity sewers that carry excess water untreated to surrounding bodies of water.

- An Existing Storm Sewer Infrastructure Map of the Study Area was generated and included in this report. Through GPS locators, extensive field work, and cooperation from the City of Ventnor Public Works, the map includes all storm sewer inlets, manholes, and outfalls. The City's storm sewer infrastructure includes approximate locations of inlets, manholes, and outfalls. The outfalls include 9 bayside gravity outfalls and 2 bayside force main outfalls located at the existing Calvert Avenue Pump Station.

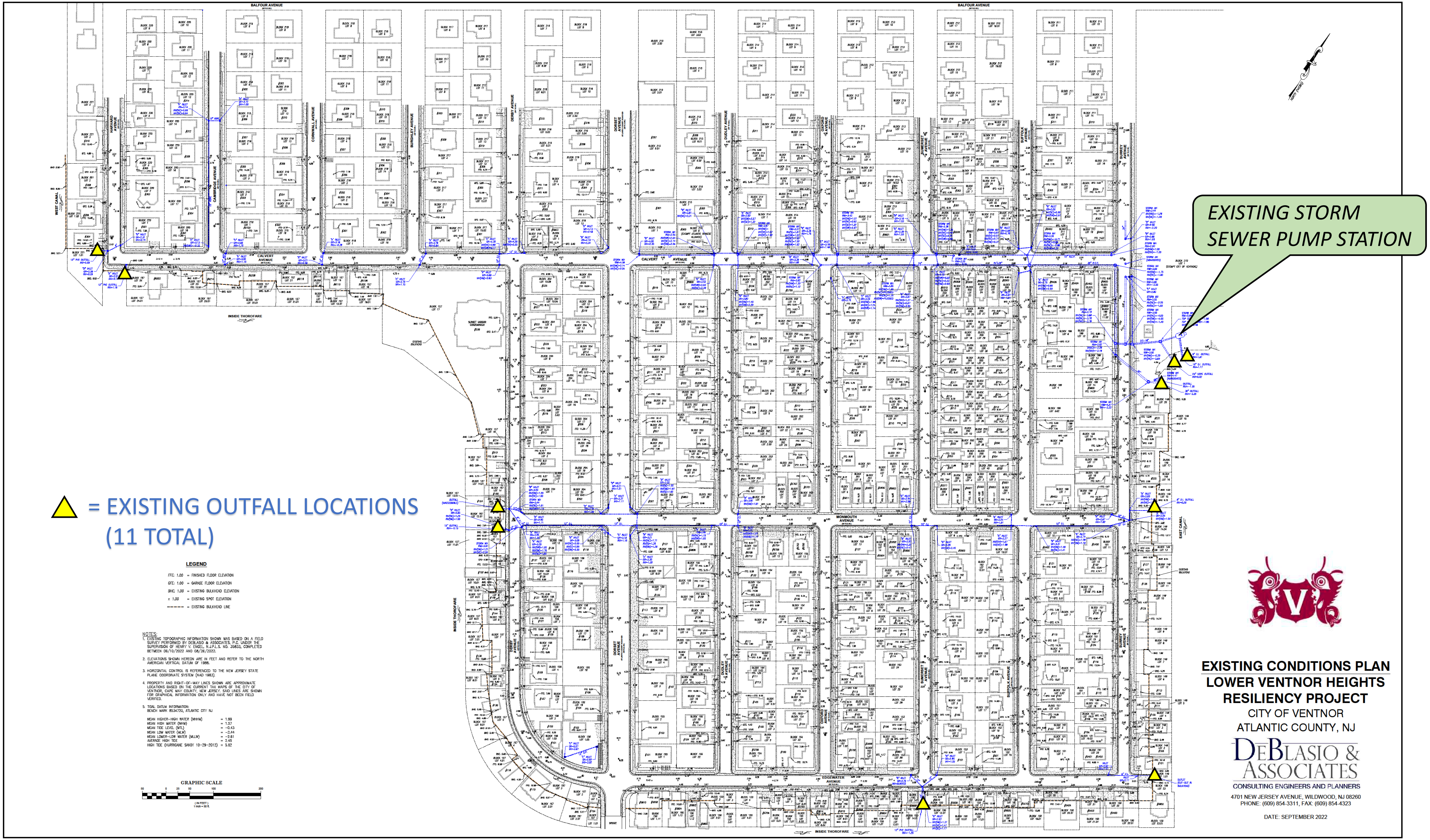
- Storm sewer inlets throughout the City remove stormwater from the surface through a variety of grated drains and manholes allow access to the underground infrastructure. The internal network of piping contains different sizes and material to transport water to discharge outfalls. Outfalls allow collected stormwater to be removed and released into the bay or ocean.

- The City's storm sewer infrastructure is a combination gravity and pump station system and includes the following components:

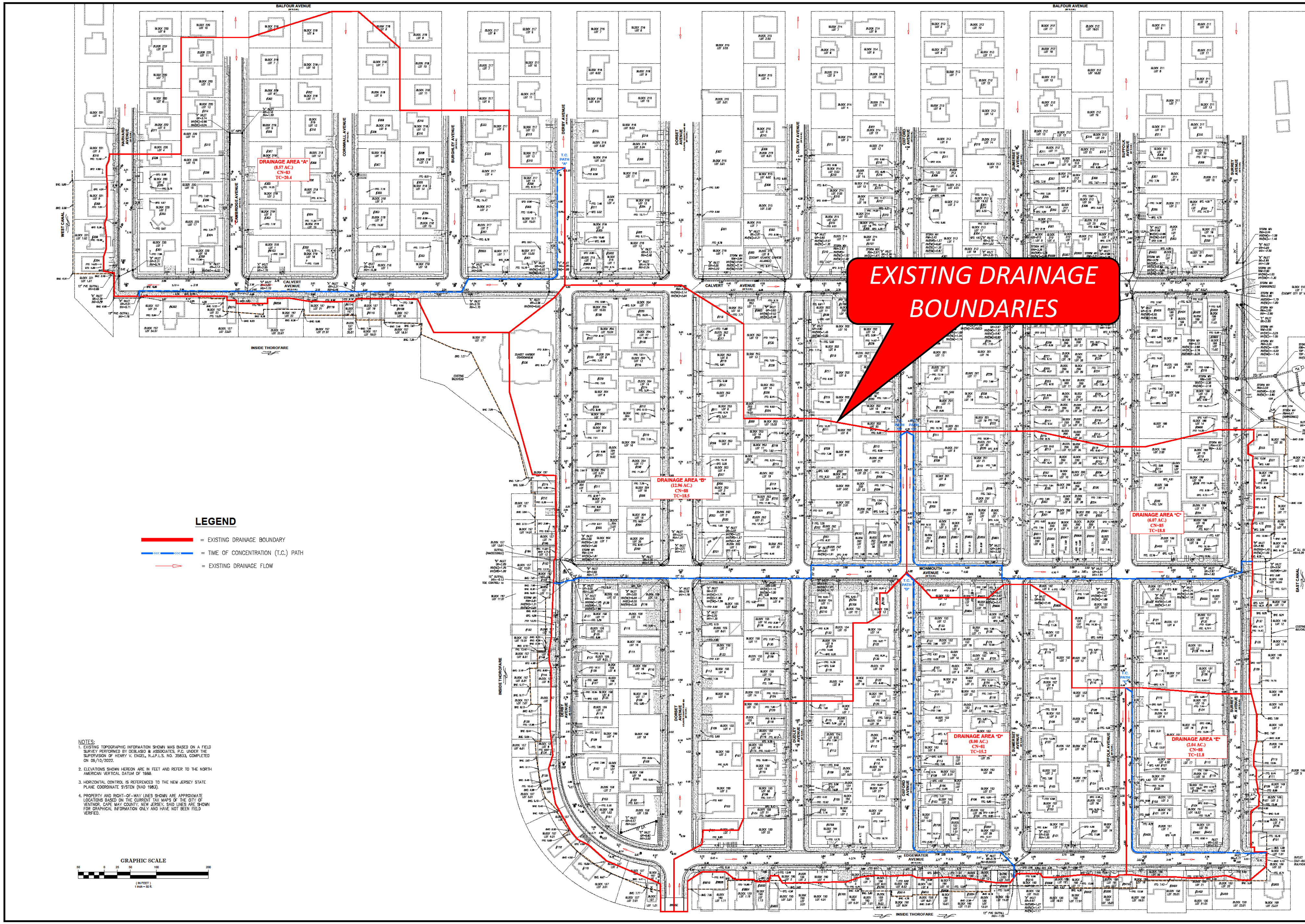
  - Existing roadway gutters to transport water above ground from one intersection to another until an inlet is reached and then transported to an outfall.
  - "Bubbler" systems that utilize inlets to temporarily hold storm water until the water "bubbles up" from the lower inlet and is transported along the surface to the lower side of the intersection and eventually to an outfall.
  - Inlets with connecting storm sewer pipes that hold and transport water to existing outfalls.
  - All current storm sewer systems are gravity driven and utilize hydraulic gradients to transport water from the surface to existing outfalls.

- The existing system contain some deficiencies that are often undersized and cannot support the amount of stormwater. Without the capacity to handle the stormwater, it can prolong surface flooding.

- As tide levels increase, bay water begins to surcharge through the storm inlets and create nuisance flooding at low points. Some of the bayside outfalls lack valves or are not provided with proper valves to control tidewater. When high tide coincides with rain events, major flooding can occur. The reliance on a gravity-fed system exacerbates this challenge.



EXISTING STORM SEWER PUMP STATION
= EXISTING OUTFALL LOCATIONS (11 TOTAL)
BALFOUR AVENUE
CALVERT AVENUE
MONMOUTH AVENUE
EDGEWATER AVENUE
INSIDE THOROFARE
WEST CANAL
EAST CANAL
HARVARD AVENUE
CAMBRIDGE AVENUE
CORNWALL AVENUE
BURGHLEY AVENUE
DERBY AVENUE
DORSET AVENUE
DUDLEY AVENUE
OXFORD AVENUE
SOMERSET AVENUE
SUFFOLK AVENUE
SURREY AVENUE
LEGEND
FFE: 1.00 = FINISHED FLOOR ELEVATION
GFE: 1.00 = GARAGE FLOOR ELEVATION
BHE: 1.00 = EXISTING BULKHEAD ELEVATION
x 1.00 = EXISTING SPOT ELEVATION
= EXISTING BULKHEAD LINE
NOTES:
1. EXISTING TOPOGRAPHIC INFORMATION SHOWN WAS BASED ON A FIELD SURVEY PERFORMED BY DEBLASIO & ASSOCIATES, P.C. UNDER THE SUPERVISION OF HENRY V. ENGEL, N.J.P.L.S. NO. 35833, COMPLETED BETWEEN 06/10/2022 AND 08/26/2022.
2. ELEVATIONS SHOWN HEREON ARE IN FEET AND REFER TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.
3. HORIZONTAL CONTROL IS REFERENCED TO THE NEW JERSEY STATE PLANE COORDINATE SYSTEM (NAD 1983).
4. PROPERTY AND RIGHT-OF-WAY LINES SHOWN ARE APPROXIMATE LOCATIONS BASED ON THE CURRENT TAX MAPS OF THE CITY OF VENTNOR, CAPE MAY COUNTY, NEW JERSEY. SAID LINES ARE SHOWN FOR GRAPHICAL INFORMATION ONLY AND HAVE NOT BEEN FIELD VERIFIED.
5. TIDAL DATUM INFORMATION:
BENCH MARK 8534720, ATLANTIC CITY NJ
MEAN HIGHER-HIGH WATER (MHHW) = 1.99
MEAN HIGH WATER (MHW) = 1.57
MEAN TIDE LEVEL (MTL) = -0.43
MEAN LOW WATER (MLW) = -2.44
MEAN LOWER-LOW WATER (MLLW) = -2.61
AVERAGE HIGH TIDE = 2.45
HIGH TIDE (HURRICANE SANDY 10-29-2012) = 5.62
GRAPHIC SCALE
50 0 25 50 100 200
(IN FEET)
1 inch = 50 ft.
EXISTING CONDITIONS PLAN
LOWER VENTNOR HEIGHTS
RESILIENCY PROJECT
CITY OF VENTNOR
ATLANTIC COUNTY, NJ
DEBLASIO & ASSOCIATES
CONSULTING ENGINEERS AND PLANNERS
4701 NEW JERSEY AVENUE, WILDWOOD, NJ 08260
PHONE: (609) 854-3311, FAX: (609) 854-4323
DATE: SEPTEMBER 2022



EXISTING DRAINAGE AREA MAP
LOWER VENTNOR HEIGHTS RESILIENCY PROJECT

CITY OF VENTNOR
ATLANTIC COUNTY, NJ

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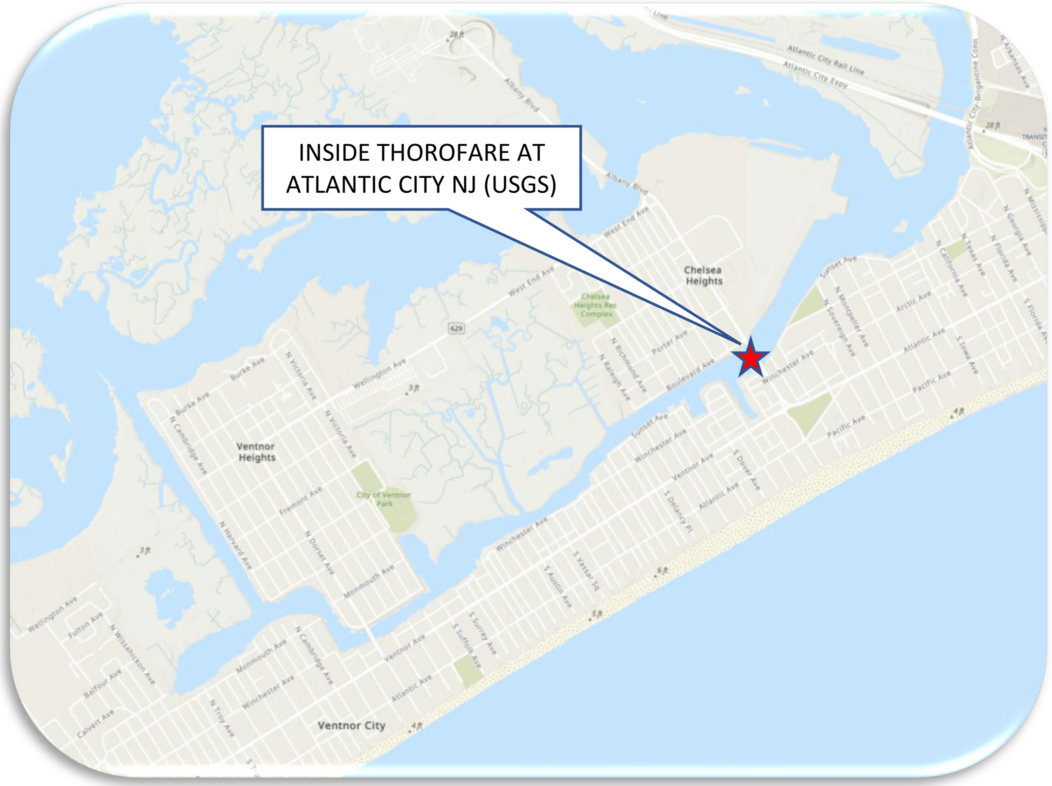
4701 NEW JERSEY AVENUE, WILDWOOD, NJ 08260
PHONE: (609) 854-3311, FAX: (609) 854-4323

DATE: SEPTEMBER 2022

3. Coastal Tidal Data & Sea Level Rise



The City of Ventnor experiences semi-diurnal tides, two high tides and two low tides per lunar day with one high tide typically higher than the other. The U.S. Geological Survey (USGS), in cooperation with the New Jersey Department of Transportation (NJDOT), designed the New Jersey Tide Telemetry System (NJTTS) in 1997. This statewide network of tide gauges collect data in real time, especially in the back bays.

After looking at the Tide Gauge Station locations, the closest back bay station to the City of Ventnor can be found on the southern side of the bridge on US Route 40 and Albany Street in Chelsea Heights section of Atlantic City. (Lat 39°21'13", long 74°27'25"). The datum for the gauges is at 0.00 feet based on NAVD of 1988 and the data was collected and reviewed from 2012 to 2022 for a total of 3,777 observations. Here is a table of the number of days with tides above elevations:

Atlantic City Station - Average High Tide: 2.45

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total #	Average #
Total Observations	365	365	365	365	365	365	365	365	365	365	199	3777	
Above 2 feet	273	251	250	238	274	286	283	302	291	298	143	2889	263
Above 2.5 feet	151	134	147	150	160	171	180	208	197	188	76	1762	160
Above 3 feet	58	43	55	40	61	57	69	98	81	78	37	677	62
Above 3.5 feet	19	14	18	10	18	23	30	25	25	17	11	210	19
Above 4 feet	7	2	4	4	8	5	13	6	5	5	4	63	6
Above 4.5 feet	3	1	1	0	4	3	3	2	0	1	1	19	2
Above 5 feet	1	0	0	0	1	0	1	0	0	0	0	3	0
Above 6 feet	0	0	0	0	0	0	0	0	0	0	0	0	0
Above 7 feet	0	0	0	0	0	0	0	0	0	0	0	0	0

The maximum tide during this time period for the gauge in Atlantic City was 5.62 feet on October 29, 2012 during Hurricane Sandy. Below is a table of the top three tide elevations for the station:

Date	Storm Name	Atlantic City Station
10/29/2012	Superstorm Sandy	5.62
10/27/2018	Nor'easter	5.40
1/23/2016	Winter Storm Jonas	5.28

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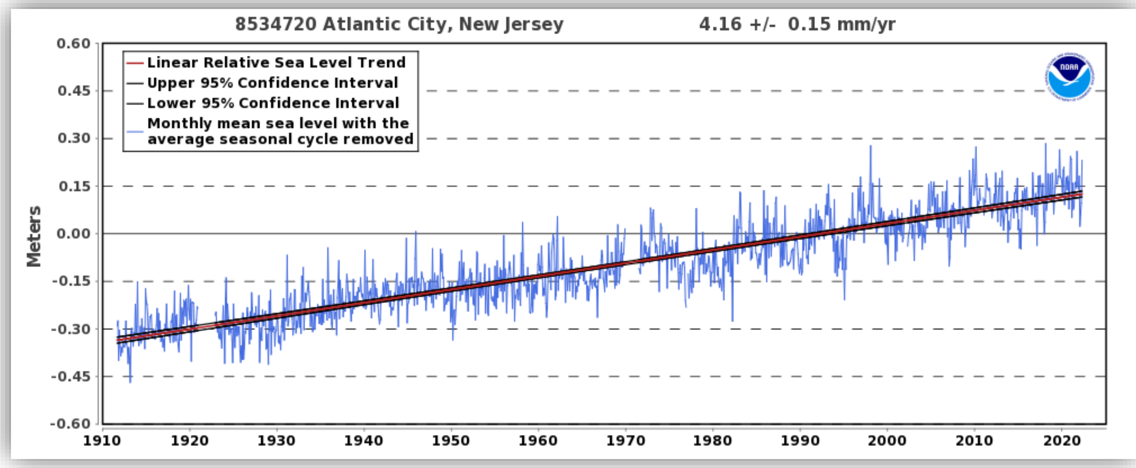
3. Coastal Tidal Data & Sea Level Rise

Providing projections of future climate change can be challenging. The further the projection, the more dynamic it becomes. A short-term projection is based on recent trends and can be more accurate. The New Jersey Climate Adaptation Alliance is a network of organizations that work together in preparing New Jersey for climate change. Rutgers University, the facilitator of this program, indicates that sea levels along the New Jersey coast are rising faster than the global average. Sea level rise can cause more frequent severe storms. They completed a report in November 2019 that evaluates the rising sea levels and changing coastal storms in New Jersey.

The report identified and evaluated the most current science on sea level rise to project the rise by using the year 2000 as a baseline. The results are summarized into low-end to high-end sea level rise chance of occurrence. Different future emission scenarios impact the projections of sea level rise. According to the Sea-Level Rise Guidance for New Jersey report published by the NJDEP in June 2021, the sea level rise scenarios should be assessed based on the risk tolerance of an activity. Activities in the State with the low risk tolerance should plan for the upper end of the likely range and reflect a 17% chance of being met or exceeded. These activities include residential housing, commercial development, most energy transmission, bridges, or evacuation routes. Activities with high risk tolerance may not need to be planned to the projections listed above and could be planned for 2.0 feet of SLR which is likely unavoidable. These activities include parks and open space, natural-based projects, or marinas. See below table for a summary of the projections:

		2030	2050	2070			2100			2150		
				Emissions								
	Chance SLR Exceeds			Low	Mod.	High	Low	Mod.	High	Low	Mod.	High
Low End	> 95% chance	0.3	0.7	0.9	1	1.1	1.0	1.3	1.5	1.3	2.1	2.9
Likely Range	> 83% chance	0.5	0.9	1.3	1.4	1.5	1.7	2.0	2.3	2.4	3.1	3.8
	~50 % chance	0.8	1.4	1.9	2.2	2.4	2.8	3.3	3.9	4.2	5.2	6.2
	<17% chance	1.1	2.1	2.7	3.1	3.5	3.9	5.1	6.3	6.3	8.3	10.3
High End	< 5% chance	1.3	2.6	3.2	3.8	4.4	5.0	6.9	8.8	8.0	13.8	19.6

Relative Sea Level Trend



The National Oceanic and Atmospheric Administration (NOAA) is a governmental agency that observes a network of more than 200 permanent water level stations. NOAA was able to look at tidal trends beginning in 1900 and predict tidal levels to 2020. This long-term linear trend is on a 95% confidence interval. NOAA completed a tide flooding study and report in February 2018 that evaluates the impact of sea level rise and increased flooding across the country.

According to this trend, between 1911 and 2021 at the station Atlantic City the sea level trend is 4.16 +/- 0.15 mm/yr (0.16 in/yr) which is equivalent to a change of 1.36 feet in 100 years.

MAP OF AREAS BELOW ELEVATION 2.5 FT
Lower Ventnor Heights Resiliency Project
City of Ventnor, Atlantic County, New Jersey
September 2022
DATA SOURCE:
Digital Elevation Model (DEM) was provided by NJ Geographic Information Network, dated 2019.
Elevations shown hereon are in feet and refer to the North American Vertical Datum of 1988.
Horizontal datum is referenced to the New Jersey State Plane Coordinate System (NAD 1983).
Digital Orthophotography was provided by the NJ Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS), dated 2020.
Parcel Data was provided by the Atlantic County Office of Geographic Information Systems.
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MAP OF AREAS BELOW ELEVATION 3.0 FT
Lower Ventnor Heights Resiliency Project
City of Ventnor, Atlantic County, New Jersey
September 2022
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MAP OF AREAS BELOW ELEVATION 3.5 FT
Lower Ventnor Heights Resiliency Project
City of Ventnor, Atlantic County, New Jersey
September 2022
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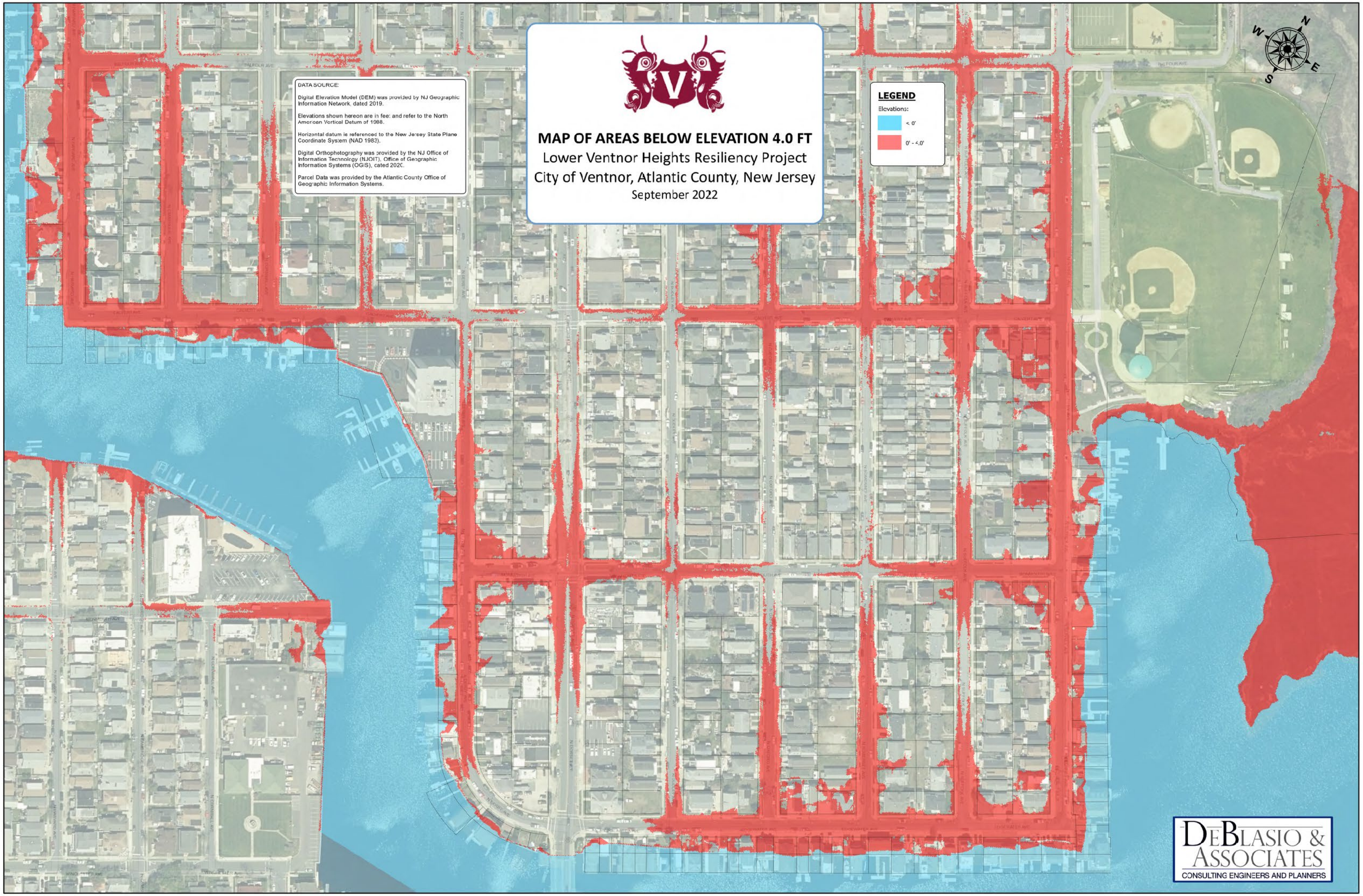

MAP OF AREAS BELOW ELEVATION 4.0 FT
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City of Ventnor, Atlantic County, New Jersey
September 2022
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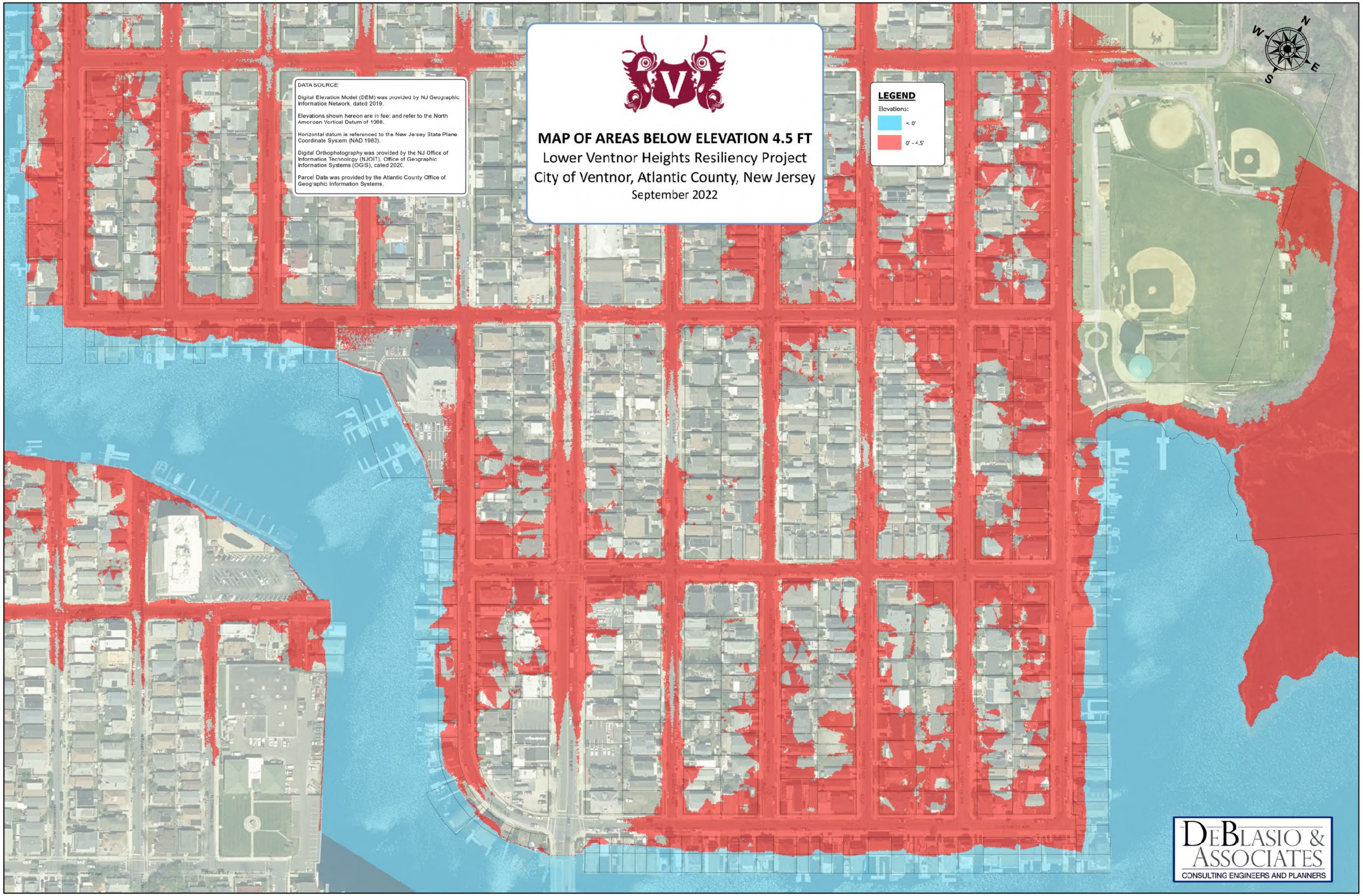
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City of Ventnor, Atlantic County, New Jersey
September 2022
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MAP OF AREAS BELOW ELEVATION 5.0 FT
Lower Ventnor Heights Resiliency Project
City of Ventnor, Atlantic County, New Jersey
September 2022
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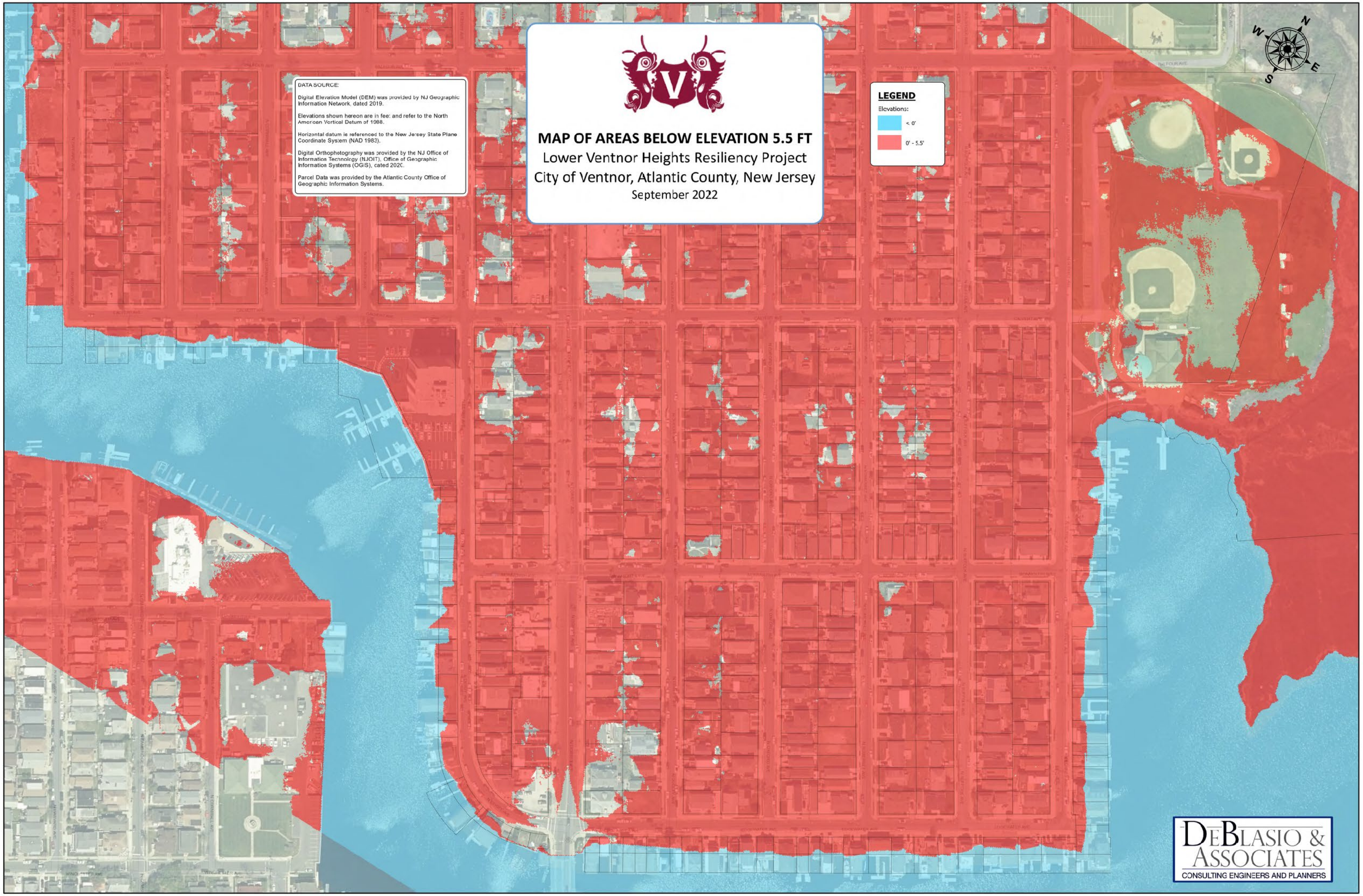

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V
MAP OF AREAS BELOW ELEVATION 5.5 FT
Lower Ventnor Heights Resiliency Project
City of Ventnor, Atlantic County, New Jersey
September 2022
LEGEND
Elevations:
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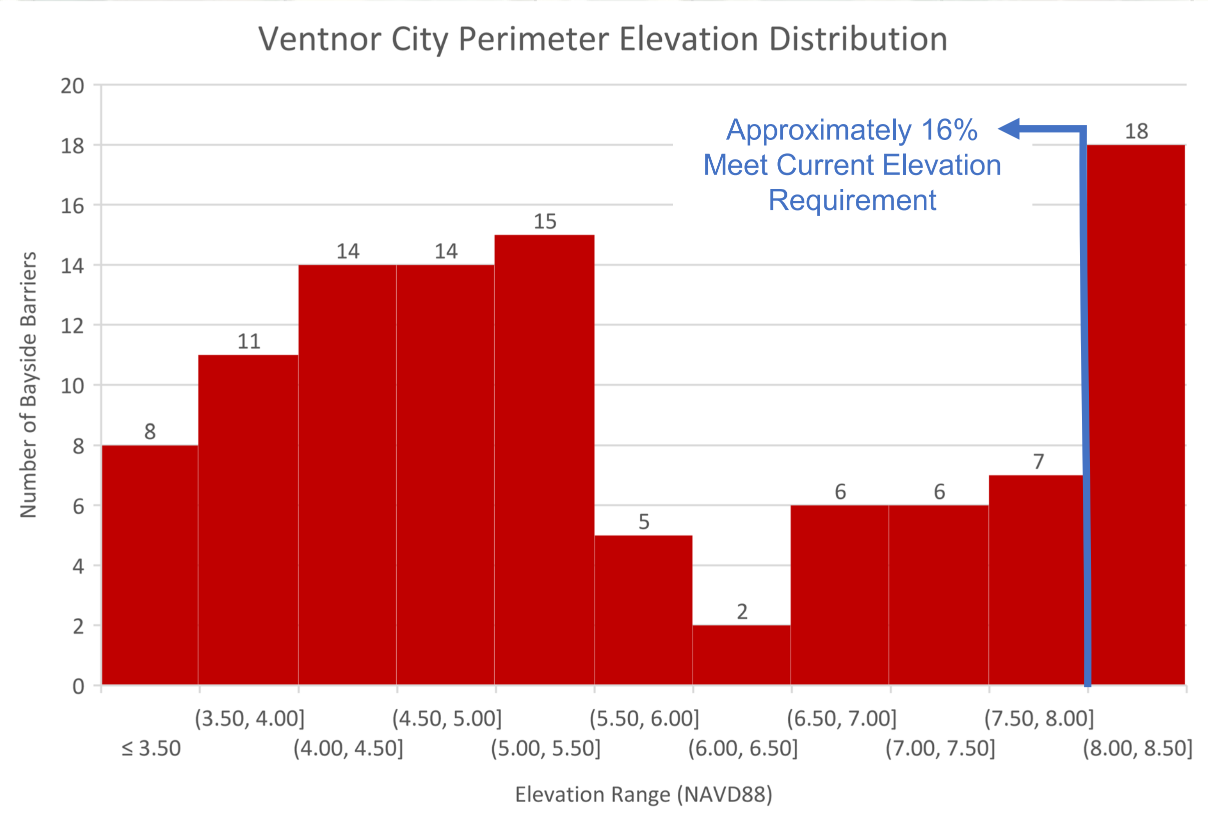
4. Bulkhead Elevations

A bulkhead and land berm system are the main barrier between the mainland and the bay. Our firm was tasked with data collection of all public and private bulkheads, upland areas, and land berms along the City's bayfront on the eastern part of Ventnor Heights. A survey of bayfront properties was started on June 9th and completed on June 10th, 2022. The GPS receiver was placed on each property's barrier top surface and that elevation was recorded in the North American Vertical Datum of 1988.

The data was collected to assess the bulkhead elevations to help determine crucial flooding vulnerabilities and low-lying bayside protection. The current bulkhead ordinance for the City of Ventnor § 92-8 Bulkheads and Seawalls requires the top elevation of constructed bulkheads to be set to a minimum elevation of 8.0 feet NAVD88 and a maximum elevation of 9.0 feet NAVD88 unless the adjacent grade is higher.



LOWEST ELEVATION	**=2.59 FT.**
HIGHEST ELEVATION	**=8.49 FT.**
MEAN ELEVATION	**=5.67 FT.**
MEDIAN ELEVATION	**=5.21 FT.**

As the City continues its efforts to decrease tidal flooding, bulkheads with the lowest finished elevations should be a priority. The tidal water will enter through the lowest access point along the bay side of the barrier island. Creating a continuous protective border increases the flood resiliency of the City.

➢Proposed Improvement Recommendations

1. Elevate Bulkheads
2. Elevate Roadways
3. Bayside Tide Control
4. Storm Sewer Pump Stations

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1. Elevate Bulkheads – Elevation 8.00 NAVD88

As sea level continues to rise, the elevation of the City of Ventnor will need to increase. Land berms and bulkheads provide protection to bay side properties by blocking out tidal water. The City has adopted a bulkhead ordinance requiring the finished height of newly constructed bayside bulkheads to be 8.00 NAVD 88. There is one City owned bulkhead located at the Calvert Avenue and Harvard Avenue intersection. The existing bulkhead elevation in this location is 6.80 in the NAVD datum. As residents begin to raise the height of their newly constructed bulkheads, the City owned bulkhead will need to be elevated as well.

The City is responsible for all street end bulkheads that are found in the roadway right-of-way and on City owned property. These bulkheads range in elevation from 3.15 to 9.40 feet. As the City continues its efforts to decrease tidal flooding, bulkheads with the lowest finished elevations should be a priority. The tidal water will enter through the lowest access point along the bay side of the barrier island.

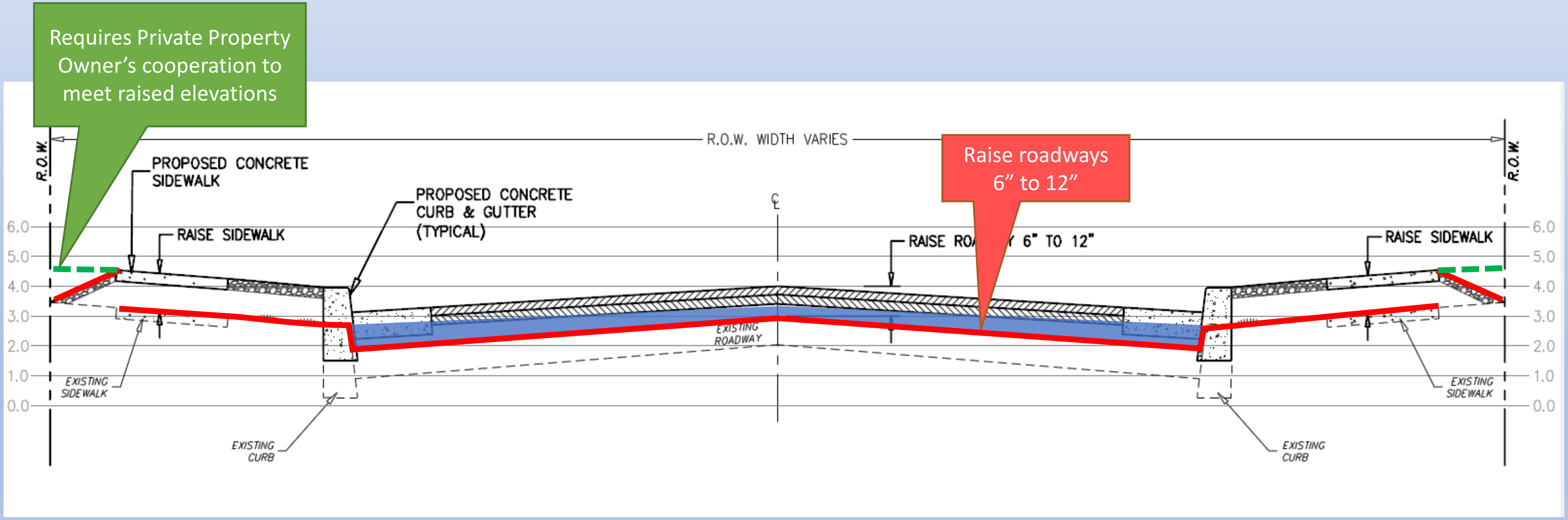
2. Elevate Roadways

As flooded roads become more of a problem for coastal communities, raising the street elevation is a possible solution. The City of Ventnor contains roadways with elevations as low as three feet. When the tide rises above this point, the roadway will flood and make it difficult for residents to pass through. According to the USGS tidal gauge located on Albany Street Bridge in Atlantic City, the high tide is above three feet in elevation 62 times a year. That means that for 62 days out of the year, some roadways in the City experience tidal flooding.

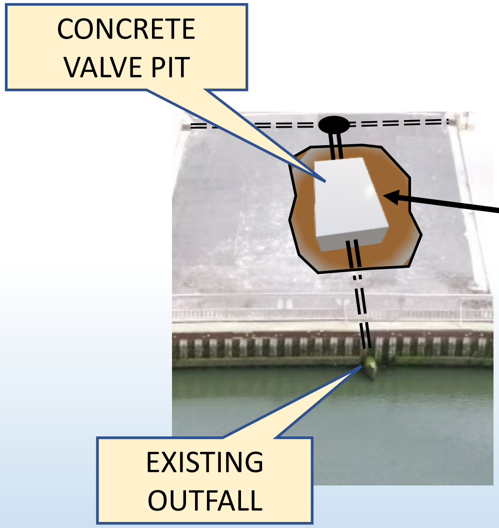
The roadways along the bay are lowest in elevation with the lowest areas bounded by Calvert Avenue, Derby Avenue, Edgewater Avenue and Surrey Avenue. The roadways in this area range from three feet to six feet. As discussed before, the roadways that are at elevation three feet will flood 62 days of the year. If the roadways are raised to four feet in elevation, the flooding decreases to only 6 times a year. If the roadways are raised to five feet in elevation, the flooding decreases to 0 days a year.

Although the benefit of elevating roadways is clear, there are high costs and difficulties associated with it. The challenges associated with this improvement include coordination with the property owners, connecting the roadway to adjacent properties and widening the travel way. All elevation roadway design should consider the current sea level rise studies and account for higher water levels.

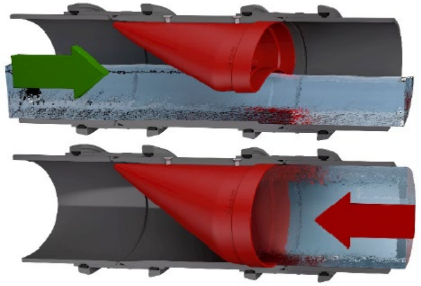
As the roadways increase in height, property owners would be required to raise their properties to meet and match the roadway. This would require an outreach program to work with the property owners to explain the advantage of elevated roadways to decrease tidal flooding in the City. Raising the roads keeps as much water as possible from coming up the stormwater inlets and flooding the surface.



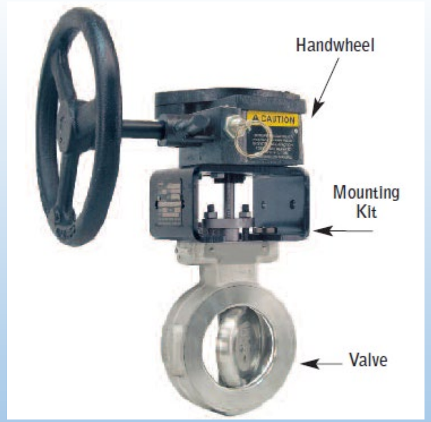
3. Bayside Tide Control



TYPICAL LAYOUT



OPTION "A" (IN-LINE CHECK VALVE)



OPTION "B" (MANUALLY OPERATED TIDE CONTROL VALVE)

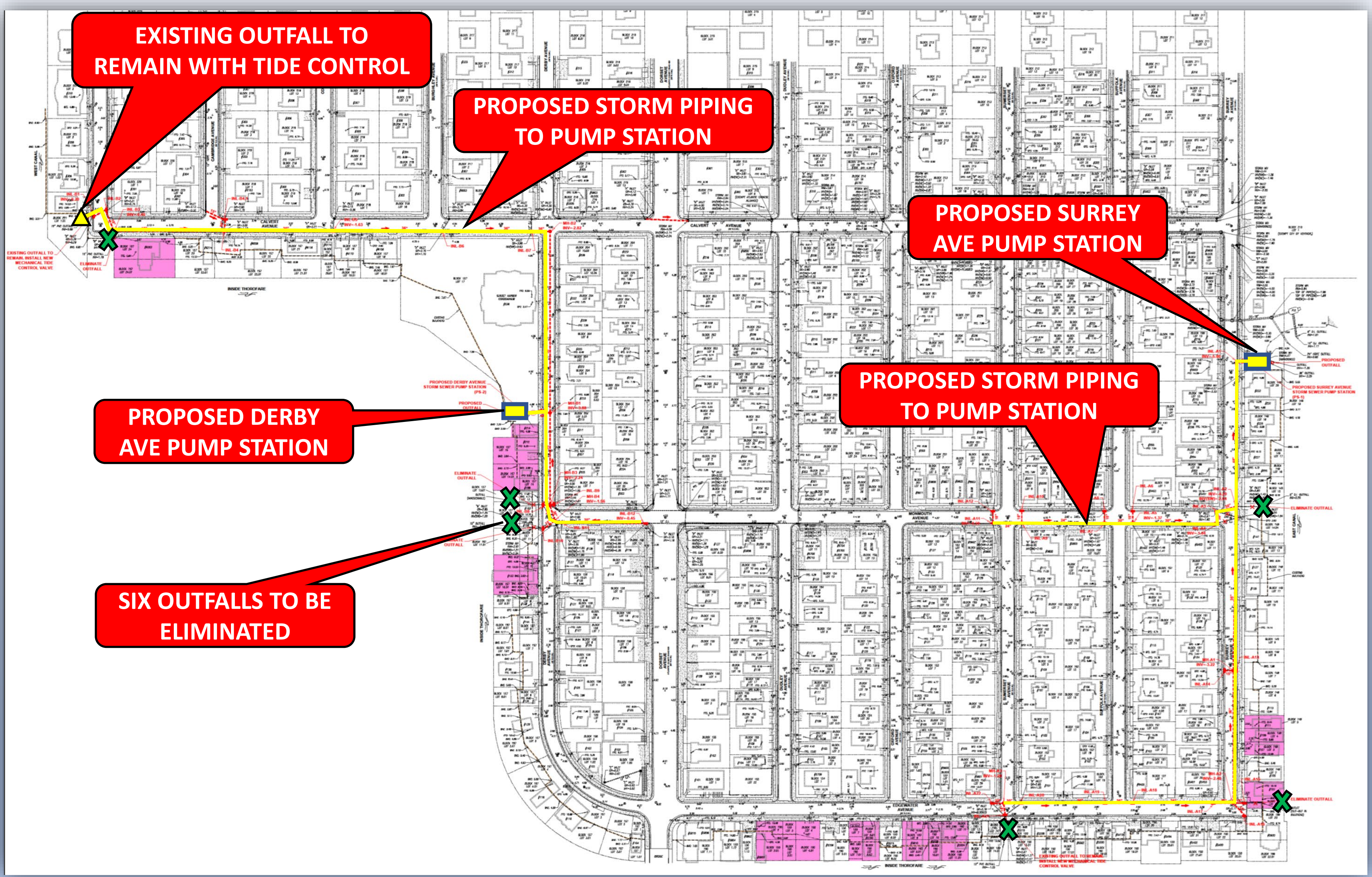
OPTION "C" (SCADA OPERATED TIDE CONTROL VALVE)

DEBLASIO & ASSOCIATES
CONSULTING ENGINEERS AND PLANNERS

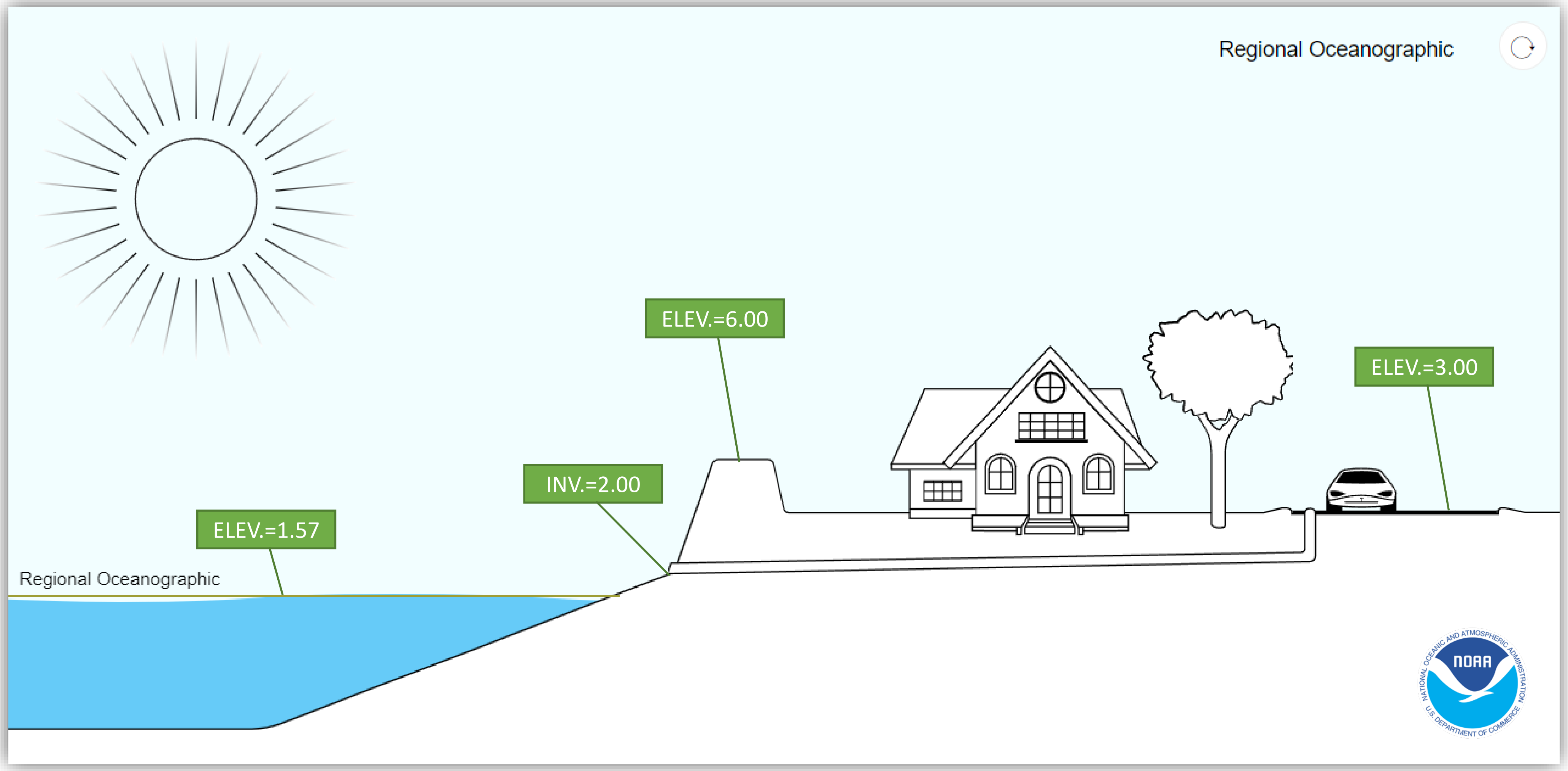
4. Storm Sewer Pump Stations

Bayside tidal control is an essential aspect of flood mitigation in the City of Ventnor. Techniques described that utilize passive, manual, or SCADA controlled valves will mitigate tidal flooding from increasing tidal elevation, but it will not be able to control stormwater flooding. When the tidal elevation is above the bay discharge outfalls, stormwater will not drain from the island. During a severe rain event with high tidal elevation, flooding will have damaging effects.

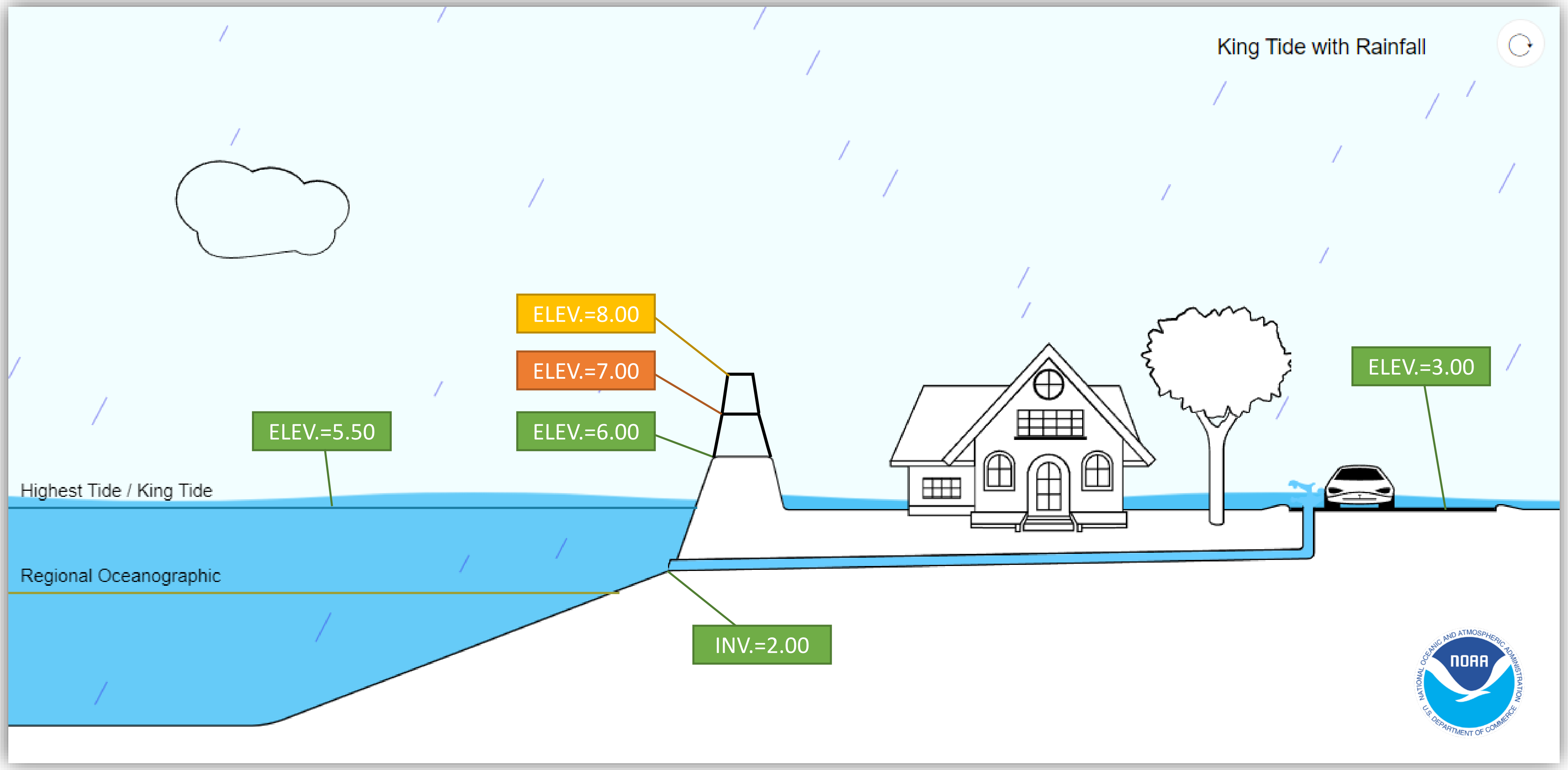
Currently, stormwater management in the City utilizes gravity and force main systems. When the tidal elevations are high, the gravity systems are not effective. Pump stations are required to mitigate tidal and stormwater flooding. Pump stations would be designed to evacuate stormwater runoff from rain events. It is recommended that the City install two (2) bayside pump stations located at Derby Avenue and Surrey Avenue. Stormwater would discharge through force mains through existing bayside bulkheads. The design of the pump station should consider sea level rise and account for the higher water level.



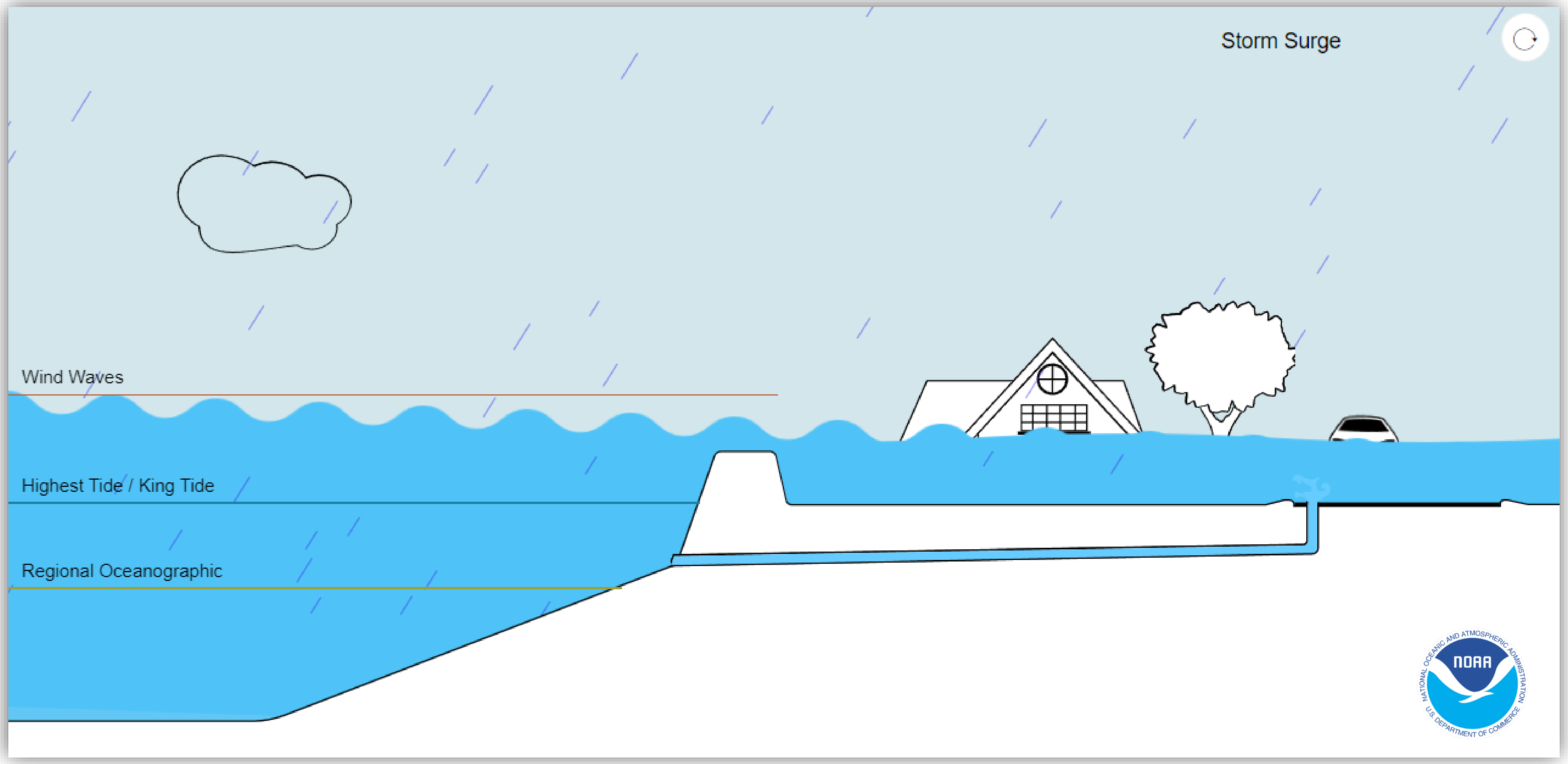
Bayside Protection



Bayside Protection



Bayside Protection



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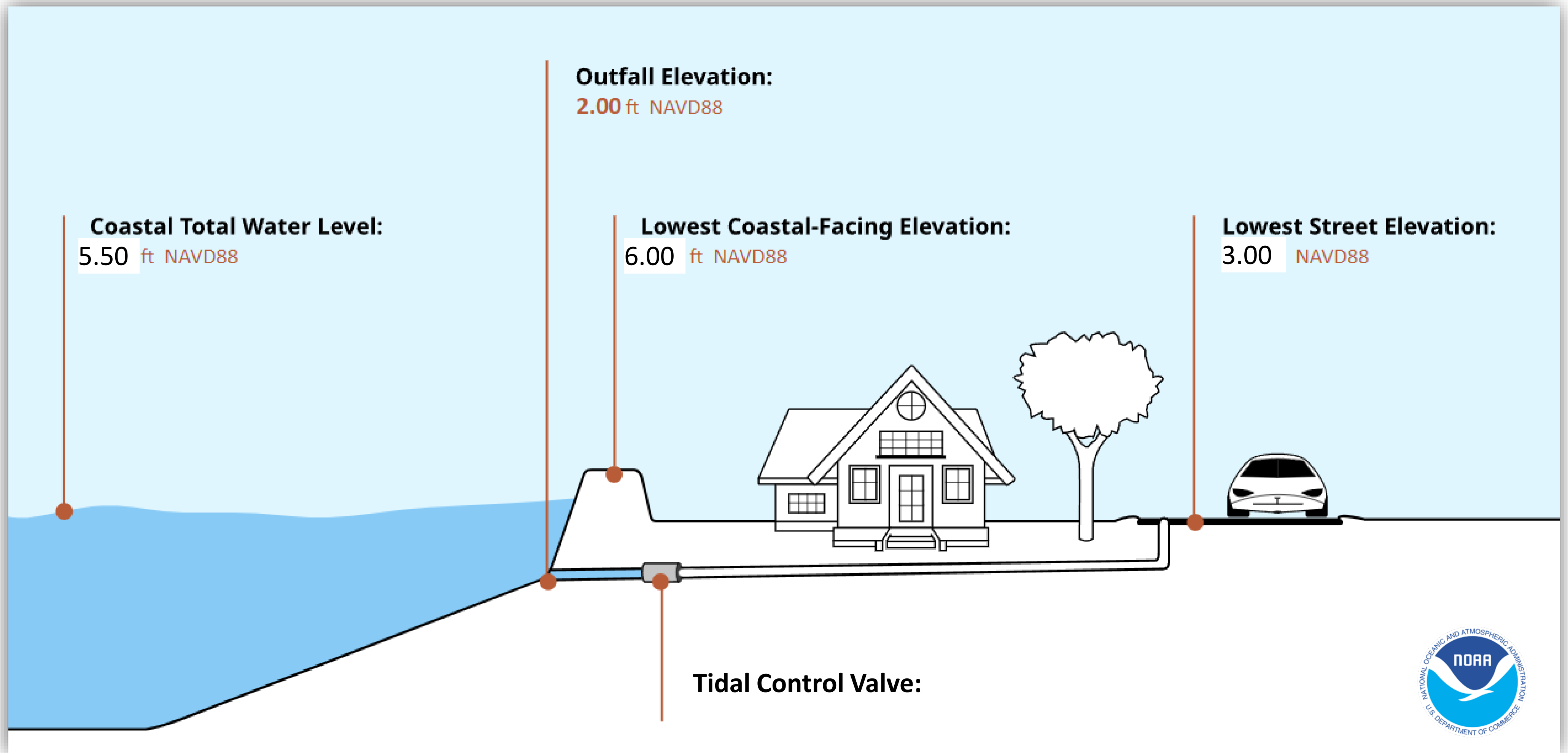
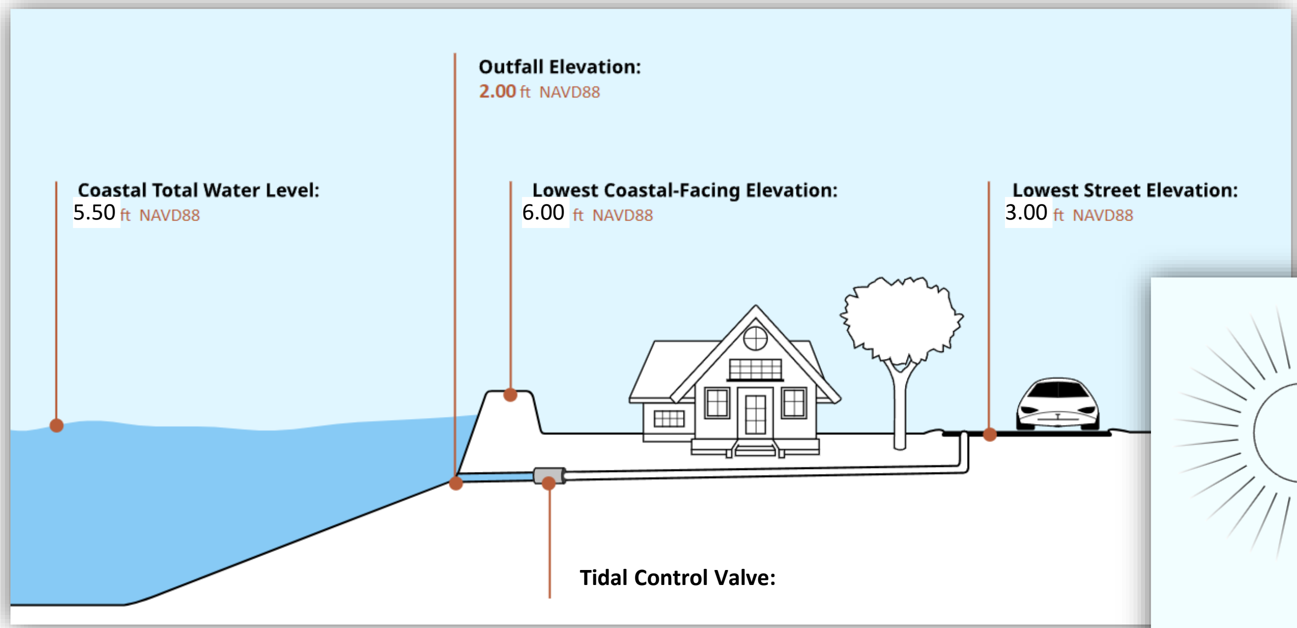
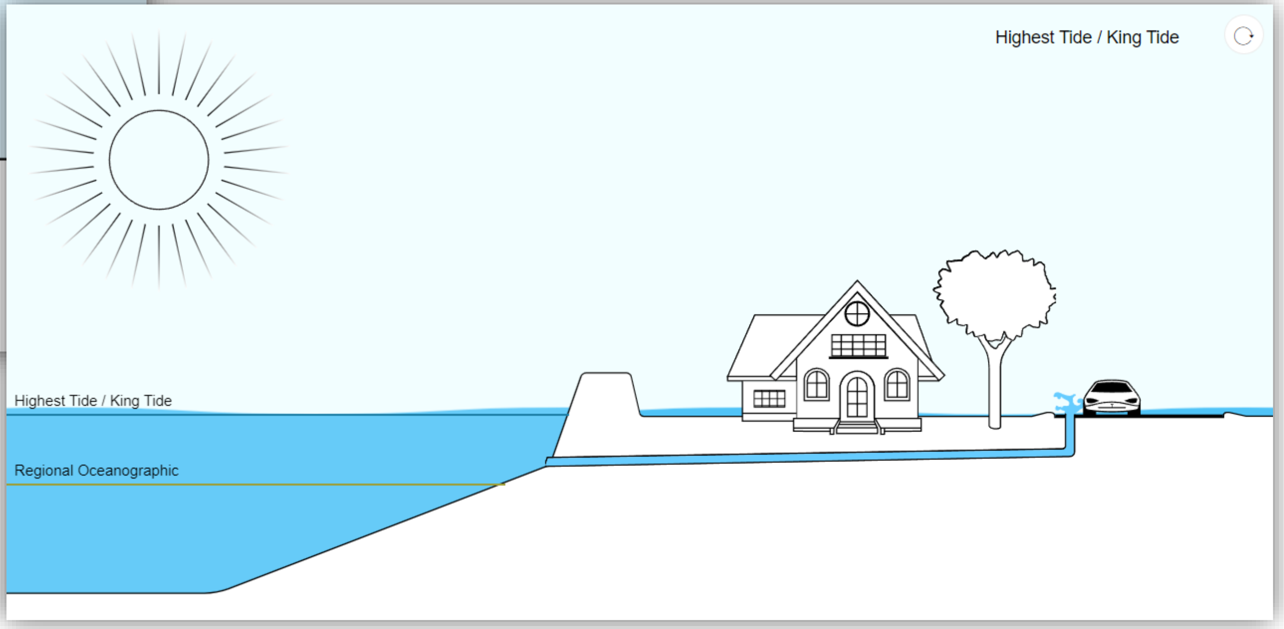


Bayside Protection

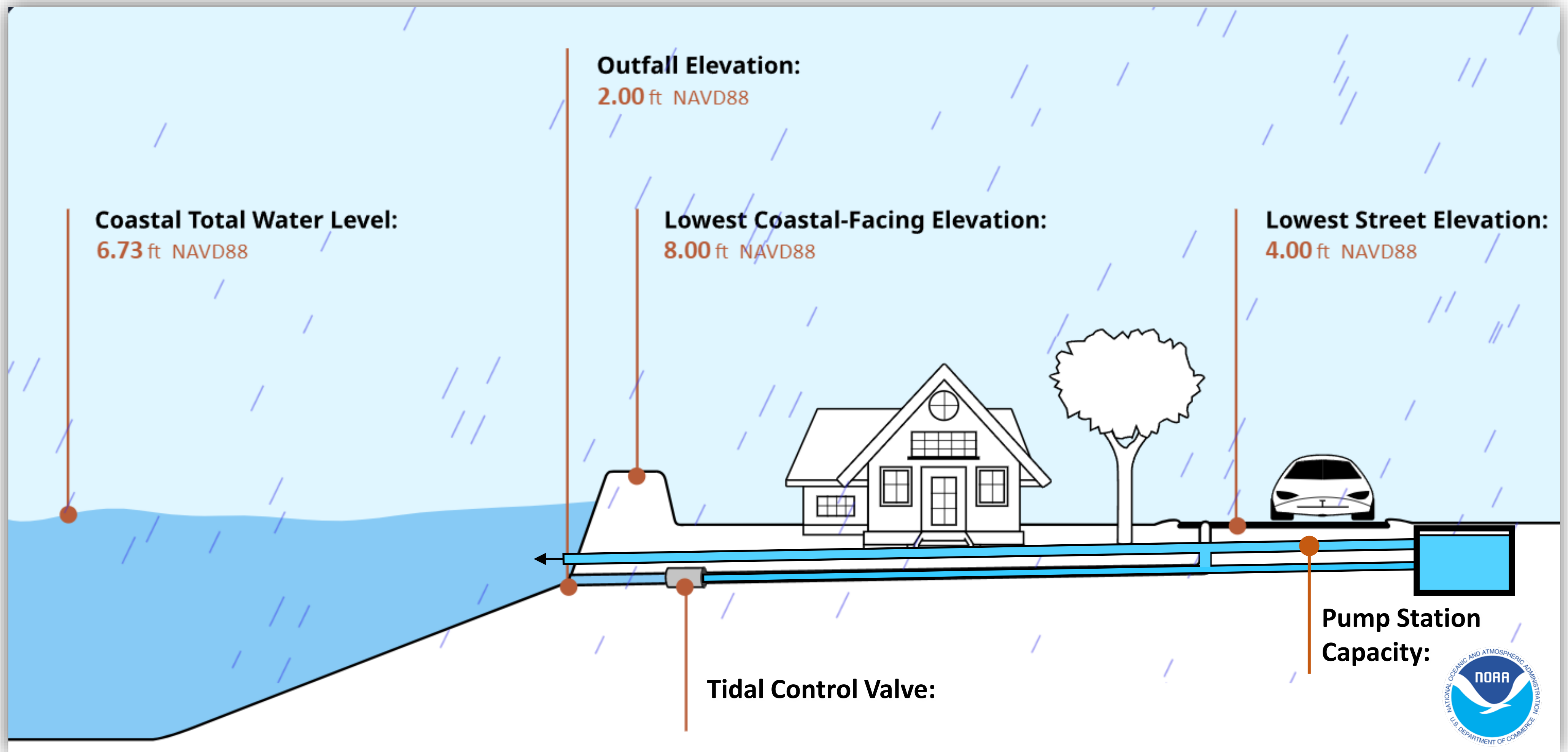


With Tide Control Valve



Without Tide Control Valve

Bayside Protection



CAPITAL INFRASTRUCTURE IMPROVEMENTS BAYSIDE TIDE CONTROL				
OPTION	**ADVANTAGES**	**DISAVANTAGES**	**REGULATORY PERMITS REQUIRED**	**COST**
Bayside Tide Control				
a). Passive Control Valve	▪ No power required ▪ Installed landward of bulkhead ▪ Can be maintained on land ▪ No real estate/property issues ▪ Not visible – installed underground	▪ Reliability on a firm closure/seal ▪ Maintenance ▪ Inability to evacuate surface rain water during high tide	Yes	$
b). Manually Operated Control Valves	▪ No power required ▪ Installed landward of bulkhead ▪ Can be maintained on land ▪ No real estate/property issues ▪ Not visible – installed underground	▪ Requires manual labor to close valve ▪ High labor intensive ▪ Maintenance ▪ Inability to evacuate surface rain water during high tide	Yes	$$
c). SCADA Operated Control Valves	▪ Controlled remotely ▪ Reliability ▪ Low labor intensive ▪ No real estate/property issues ▪ Installed landward of bulkhead	▪ Requires Power ▪ Requires backup generator ▪ Cost ▪ Visible above ground controls ▪ Inability to evacuate surface rain water during high tide	Yes	$$$
d). Storm Sewer Pump Stations	▪ Ability to pump surface rainwater during high tide ▪ Reliability ▪ Low labor intensive ▪ Installed landward of bulkhead	▪ Requires Power ▪ Requires backup generator ▪ Real estate issues ▪ Cost to operate ▪ Visible above ground structures	Yes	$$$$

Comments & Questions

- Presentation will be posted on City Website:
  - https://www.ventnorcity.org/
- Detailed comments & questions can be submitted via email to:
  - marc@deblasioassoc.com