



# Sea Wall and Sea Level Rise Study

Delaware City – April 15, 2024

# Meet The Team



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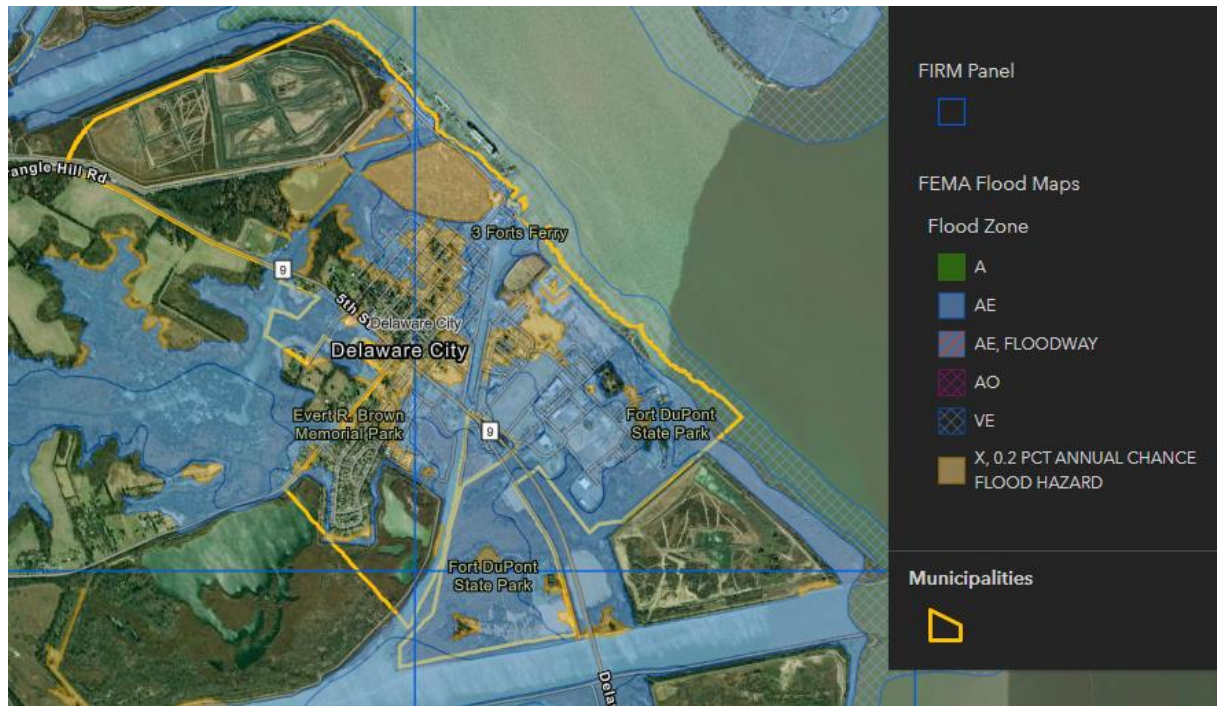
Frank Young, PE  
Senior Consultant,  
Structural Engineering

# Agenda

1. Introduction
2. Sea Level Rise and Flood Vulnerability Analysis
3. Sea Wall Evaluation
4. Summary and Recommendations
5. Madison and Monroe Streets FEMA Grant update



# Introduction – High Tide and Coastal Flooding



What are the projected high tide and flood elevations with sea level rise?

How will higher tides and floods impact structures, egress, and drainage?

# Introduction – Sea Wall



What is the structural condition of the sea wall?

What capital improvements may be required for the sea wall in the coming years?

What are the sea level rise considerations for the sea wall?

# Sea Level Rise Vulnerability - Data

DNREC Sea level rise projections  
(increase from 2023 in feet)

Year	Low	Intermediate	High
2030	0.08	0.17	0.25
2050	0.44	0.76	1.07
2080	1.10	1.88	2.81
2100	1.43	2.70	4.19

Topographic Data: LiDAR

FEMA 100-year flood elevations (1% annual chance flood)

NOAA (Reedy Point) tidal elevations:

- Mean Higher High Water (MHHW)
- Mean Sea Level (MSL)
- Mean Low Water (MLW)

# Sea Level Rise Vulnerability - Elevations

Year	MHHW Elevation	1% annual chance flood elevation
2023	2.9	8.5
2030	3.0	8.7
2050	3.6	9.3
2080	4.8	10.4
2100	5.6	11.2



# Sea Level Rise Vulnerability - Structures

Year	Structures impacted by MHHW	Structures impacted by 1% annual chance flood
2023	0	418
2030	3	436
2050	5	491
2080	27	655
2100	114	744





# Impacts to Egress

	High Tide	100-yr Flood
E1	2080	2023
E4	---	2023
E8/9	2080	2023



# Sea Level Rise Vulnerability - Drainage



- Approximated elevations of components at inlets
- Some components already lower than MHHW. Most will be lower than MHHW by 2050.
- By 2080, some components lower than MSL.

# Drainage and Flooding Recommendations

Storm drain and  
topographic  
survey

Coordination  
with DeDOT on  
roadway flooding

Drainage and  
pumping study

Evaluate  
floodwater  
access points

Sea wall height  
long-term  
improvements

# Sea Wall Review

## Sea Wall

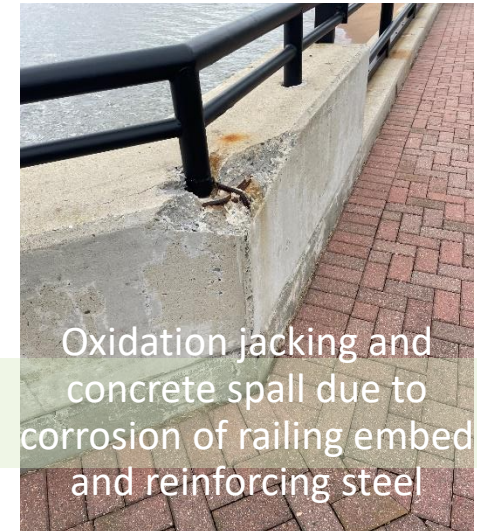
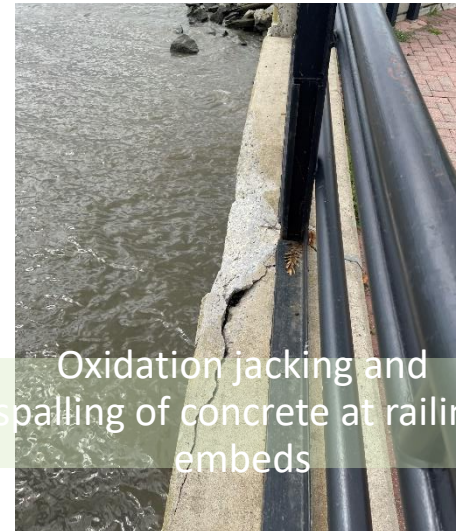
- Extends from near 3<sup>rd</sup> Street along the Branch Canal to the Delaware River along the north side of Battery Park
- Construction of the wall varies from a cast-in-place concrete cantilevered retaining wall to steel sheet piling with a concrete cap
- Wall constructed in phases from Mid 1970s to early 2000s

## Verdantas review

- Conducted in August 2023
- Visual review of exposed structure elements from water and land
- Provide the City with findings and recommendations regarding the current condition of the seawall as well as the implications of a projected rise in sea level



# Evaluation – Concrete sea wall and cap



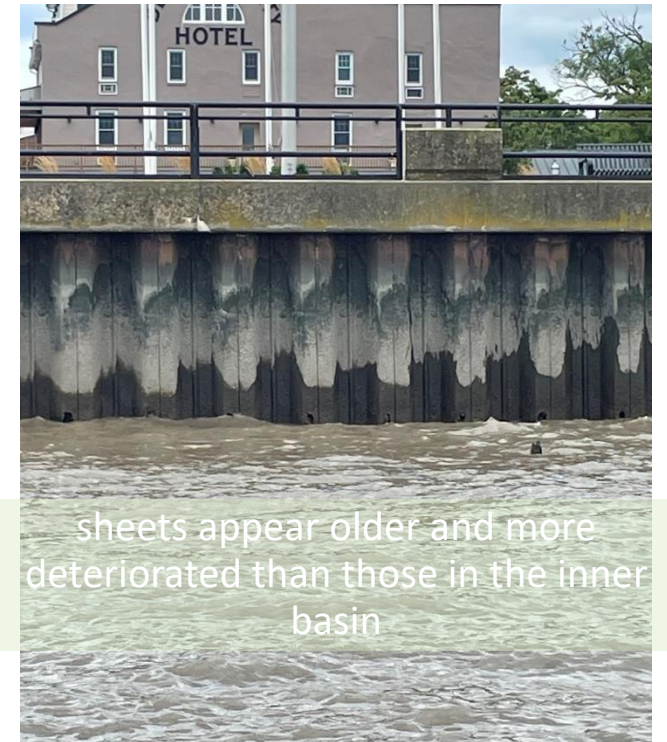
# Evaluation – Steel Sheet Piling



Sheet piling in inner basin. Note deterioration of coating in splash zone



Partial collapse of corrugated metal drain pipe, damaged and deteriorated grating

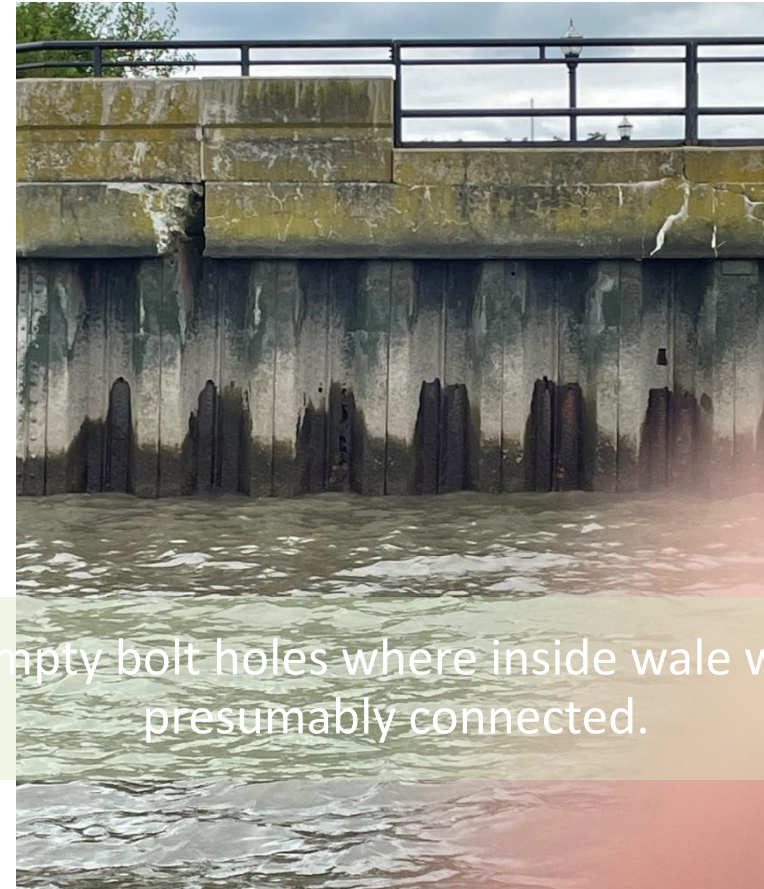


sheets appear older and more deteriorated than those in the inner basin

# Evaluation – Steel Sheet Piling



Drain holes in sheets have corroded and enlarged over time



Empty bolt holes where inside wale was presumably connected.

# Sea Wall Recommendations

## Concrete Sea Wall and Cap

- Remove and reset portions of steel fence
- Repair concrete spalls

## Steel sheet piling

- Monitor condition in inner basin and consider cleaning and recoating
- Repair discharge pipe and protective grating
- Monitor sheets along eastern and northern sides of Battery Park and consider steel patches for larger holes
- Investigate connection of the wale to the inside of the sheets



# Summary and Recommendations

## Short Term (1-5 years)

- Storm drain and topographic survey \$40,000-\$65,000
- Coordination with DeIDOT on roadway flooding
- Drainage and pumping study \$50,000-\$100,000
- Repair concrete spalls and embedded items \$95,000

## Medium Term (10-15 years)

- Replace eastern portion of sea wall along Delaware River \$1.3M

## Long Term (25+ years)

- Extend sea wall up approx. 2.5 feet \$225,000

# Madison and Monroe Streets FEMA Grant

# October 29, 2021 Flooding



Monroe St



Jefferson St



Madison St



Madison St



# FEMA Grant Project Update



- Application submitted to FEMA's Hazard Mitigation Grant Program (HMGP) through DEMA in January 2023
- Extensive application reviews
- DEMA expects funds to be obligated in April 2024
- Await award letter
- Phase 1: design and permitting
- Phase 2: construction

Questions?

