Northwest Maritime Center Coastal Geologic Report – Revised

Project Number: 20-001

Prepared for Miller Hull Partnership, LLP

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Introduction and Purpose

The purpose of this report is to detail the site assessment, analyze alternatives, design rationale, and potential cumulative effects for the proposed design to satisfy WAC 220-660-370 as a part of the application to WDFW for the Hydraulic Project Approval (HPA) and completion of the City of Port Townsend shoreline permit application. Coastal Geologic Services, Inc. (CGS) was subcontracted by Miller Hull Partnership, LLP (CLIENT), to assist with design and complete the permitting and planning for structure repair along the southeast beach at the Northwest Maritime Center in Port Townsend, WA (Figure 1).

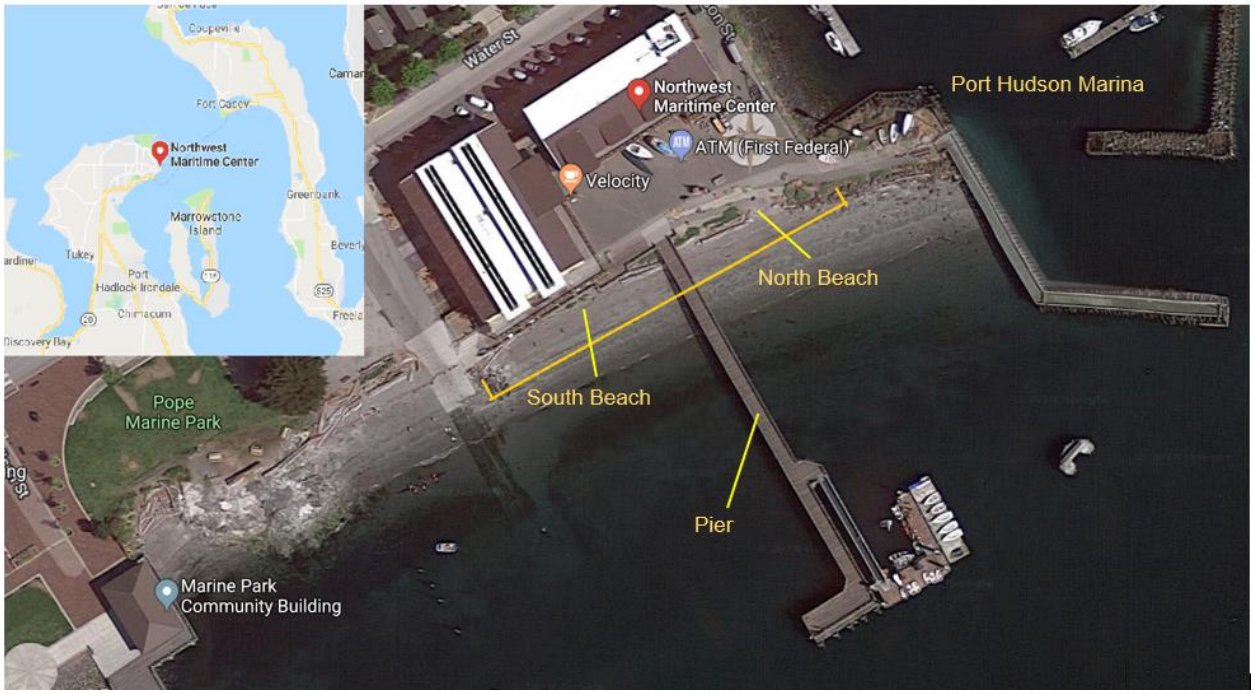

Figure 1. Site location and beach vicinity map.

Site Conditions

The site is located on the waterfront of Port Townsend, on the northwest side of Port Townsend Bay adjacent to Point Hudson Marina (Figure 1). The property consists of a multi-purpose building, a hardscape staging area surfaced with pavers, and a concrete stairway that descends from the staging area to the beach. CGS has conducted previous assessments and reviews of conditions at the NWMC in 2008, 2012, with the most recent assessment in 2019 to examine post-storm conditions at the waterfront of the property.

Coastal Processes

Coastal conditions and parameters for the site were assessed in the 2019 CGS memo (Coastal Geologic Services, 2019) based on NOAA data and are summarized below. Other information on coastal processes including littoral/net shore-drift is summarized below also.

Water Elevations

All elevations are referenced to local mean lower low water in feet (FT, MLLW). Local MLLW is 1.09 FT below the North America Vertical Datum (NAVD 88).

Tidal levels

Mean Higher High Water (MHHW):	8.50 FT
Mean Sea Level (MSL):	4.82 FT
Mean Lower Low Water (MLLW):	0.00 FT

Storm Water levels

Dec 10, 1993, Storm (Extreme Water Level on Record):	11.73 FT
Mar 10, 2016, Storm:	11.22 FT
Dec 20, 2018, Storm:	11.12 FT

Extreme Water levels

1-year return period wave level:	9.71 FT
2-year return period wave level:	10.73 FT
10-year return period wave level:	11.32 FT
100-year return period wave level:	11.71 FT

Sea Level Rise

A recent study by the Washington State Coastal Resilience Network published localized sea level rise projections for the state (Miller et al., 2018). For this site we assessed a higher (RCP 8.5) emissions scenario with a 1% and 50% exceedance level for 2050, as shown below.

Sea Level Rise Projections

2050 50% Exceedance	0.8 FT
2050 1% Exceedance	1.4 FT

It should be noted that the long-term effect of Sea Level Rise (SLR) has not been factored in for the long-term extreme water level projections in the previous section. Ongoing sea level rise will increase the frequency that structures on the site will be directly impacted by high water and storm events.

Wave Impact

Storm waves generated off the property site could reach 4 FT or higher in significant wave height (the mean wave height of the highest 1/3 of waves). However, large waves reaching the site would break on the beach before reaching the toe of shore structures. At high water level conditions, when waves are interacting with shore structures, even moderate wave or wave-breaking induced wave turbulence and runup would cause significant impact to the beach and existing structures. A recent modeling effort from PNNL modeled that the 1% significant wave height for this site, based on observational hindcast data, is approximately 1.65 FT (Yang et al., 2019).

Net Shore-drift

The net-shore drift (longshore drift or littoral drift) associated with this site has been mapped in recent years (Coastal Geologic Services, 2017a; Keuler, 1988; Schwartz et al., 1991). The beach at the site is mapped as an area of no appreciable net-shore drift in the general area of drift cell JEMA0081 (Coastal Geologic Services, 2017b). The beach at the site was mapped as an artificial pocket beach, which is described as a beach contained by two headlands (at this site, built infrastructure) that essentially functions as a closed system in terms of littoral sediment transport.

Storm winds and waves affecting this beach are predominantly southerly or southeasterly, therefore causing northward beach sediment transport. In a previous report on this site by Jim Johannessen of CGS (Johannessen, 2008), it was determined that urbanization and hardening of shores up-drift (south and southwest) of the Maritime Center had greatly impacted (eliminated or substantially reduced) littoral sediment delivery to the site, such that the site is no longer actively accreting sediment. This is caused by the total blockage of littoral transport by the Boat Haven Marina in the south part of town, and the partial blockages caused by the WSDOT ferry terminal and numerous other overwater structures of the downtown waterfront. These modifications to the coastal system have led to beach erosion at the site.

December 2018 Storm Impacts

The December 2018 storm was a significant storm event that combined king tides with high winds and wave action approaching from an impactful angle. It is considered a 1-in-5-year storm according to historical water level statistics, nearly matching the March 2016 peak storm water level (see “water elevations” summary, above). The storm impact was likely worse than the previous significant event in 2016 due to likely more persistent, intense, and better-aligned local wind and wave conditions. It should be noted that the occurrences of two 1-in-5-year scale storms in the past 2.5 years could suggest a future trend of increased storm intensity and/or frequency.

During the December 2018 storm, the peak water level reached 11.12 FT MLLW, which included 2.25 FT of storm surge. The upper beach elevation appears to have been reduced (eroded) by this storm. The beach elevation was measured at approximately 3-4 FT below the porch deck during the site visit. After reviewing the original facility design sheets, the deck elevation of the porch and the pier were found to be 12.95 FT using the city vertical datum (likely NAVD 88, to be confirmed) or 14.04 FT MLLW, which would place the beach elevation at approximately 10 – 11 FT MLLW. This indicated that the beach in front of the porch and at the toe line of the concrete structures would have been largely submerged during the peak of the storm, resulting in direct wave-structure interaction at the toe of the structure, as well as causing floating logs and other debris reaching the shore to directly impact these structures.

During the subsequent field visit in early 2019, storm damage observations (Coastal Geologic Services, 2019) were made and are summarized below:

- Upper beach erosion and toe scour with exposure and loss of foundation base rocks at the northeast end of the concrete pathway at North Beach, which provides wheelchair beach access (Photo Page: photos A and B).
- Toe line scour and base exposure along the toe of the concrete stairway leading to the North Beach (Photo Page: C). Similar toe line scour at the South Beach leading to the paved concrete boat ramp.

- Decorative landscaping boulders that had previously been integrated into the concrete structure were undermined and displaced due to toe scour beneath the boulders (Photo Page: D).
- At least one large log (we understand some were removed prior to 2018) that had been originally installed and anchored at the upper beach had been displaced. One approximately 40 FT-long log was found partially stuck under the porch deck. Evidence of impact and abrasion between the log and the metal truss (deck supporting member) was evident. Other large and small logs and wood pieces were scattered on the upper beach/backshore (Photo Page: E)
- The electric box and wire conduit (HDPE pipes) at the shore end of the pier on the North Beach side were broken and deformed, apparently damaged by debris impact during the storm (Photo Page: F).
- The low elevation bank at the north end of the concrete stairway was under-protected. Earth material was exposed with signs of recent bank erosion and collapsing, requiring urgent rock repair/enhancement (Photo Page: G). Insufficient crest elevation of the existing revetment had reportedly resulted in a large volume of seawater overtopping during the storm.

The main causes of damage were determined to be from:

- A lowered beach due to modifications in the former drift cell
- Waves directly interacting with the structures which caused scour at the toe lines
- Anchored logs being lifted and moved by high tide and storm surge resulting in anchorage assembly failure
- Floating wood debris and logs under wave action impacting structures and abrading surfaces as well as wire tubes and an electrical box
- Wave runup and overtopping eroding the bank at the north end of the concrete stairway were under or un-protected and insufficient crest elevation of existing revetment

The evidence of erosion and damages demonstrate that the existing infrastructure on the project site is being threatened by continued erosion during winter storms, and action is warranted to prevent further damage in the near-term.

Recent Storms

Small amounts of additional damage occurred during other significant winter storms following the December 2018 storm described above. This included the January 13, 2021, Nov 15, 2021, and January 7, 2022, storms, all of which coincided with higher tides and most with some amount of storm surge. Large and small logs got further underneath the deck in the two January storms, with a number of the vertical posts broken in the January 2022 storm and damage to the deck beams (Photo Page 2). The deck was observed to be pumping up and down in the 2022 storm from log impact, with possible damage affecting these structural beams.

Alternatives Analysis

Three main design alternatives were considered at the project site:

- No Action
- Hard Armor Protection
- Soft Shore Protection

The **No Action alternative** would simply be a continuation of present conditions. This would not create any additional protection to the site or add any habitat value. In this scenario, storm damage would likely continue to damage the structures on site causing significant impacts and damage likely within the next three years. With the absence of a naturally derived sediment supply from the surrounding shores, the site will continue to erode in the current condition.

The **Hard Armor Protection alternative** would involve constructing a vertical seawall just landward of the deck. This would cause significant short-term effects from substantial construction activities and long-term effects from habitat modification for several species potentially in the project area. More details on species and critical habitats for the project site can be found in the Biological Evaluation of the site (Marine Surveys & Assessments, 2021). Additionally, as sea levels continue to rise, hard armor would limit the beach width causing narrowing of the beach through time, reducing potential habitat areas. This alternative would act as a debris barrier to the existing structures; however, it would not help dissipate wave energy and would likely increase scour and wave energy from reflection at the hard surface, potentially negatively impacting adjacent properties.

The **Soft Shore Protection alternative** involves beach nourishment and strategic placement of large boulders to help dissipate wave energy and act as debris barriers, as well as some repair of existing structures. Beach nourishment would dissipate wave energy and reduce wave runup while helping to maintain a slightly higher beach elevation. The large boulders will act as a debris barrier to reduce wave and debris impacts to the deck, pier supports, and the building on the uppermost beach. Installation of anchored logs was also considered for this alternative, however as all previously installed anchored protection logs were detached during storms, this action was not considered viable for this site.

Preferred Design Alternative

The Soft Shore Protection alternative is the preferred design alternative for the site. This alternative would achieve the project goals of repairing damage from erosion and preventing damage from future erosion, while minimizing the impacts to habitats (Marine Surveys & Assessments, 2021). The No Action alternative would not achieve the project goals and continue to put the project site infrastructure at risk. The Hard Armor alternative would cause significant negative impacts to nearshore habitats and could increase wave impacts on to the neighboring properties with increased wave reflectance.

Project Description

The preferred design alternative project is to repair the exposed foundation of the concrete pathway and beach stairs at the plaza and to protect the first and second floor deck supports after chronic beach erosion during major storms in the last 5 years. The repair will involve excavating upper beach sand and gravel at the undermined concrete step foundations and placing deeply buried, small, angular rock (quarry spall) and pouring a new concrete footing (all below grade) to fill the voids and deepen the foundation to avoid re-exposure of the foundation.

To prevent future toe scour and damage, existing upper beach sediment will be excavated, and cobble-gravel beach nourishment will be imported at the upper beach near the structure area to protect the structure against potential future toe scour. The cobble will extend as far waterward at elevation 7.7 FT MLLW, just above the MHHW line and be keyed below existing grade. Cobble will be placed starting 24 FT southwest of the existing per and 9- FT northeast of the pier, for a total length of 128 FT. Most of the

excavated sediment will be placed on top the imported cobble in a 0.5 FT or slightly thicker surface layer.

Large boulders will be placed strategically as debris barriers to reduce wave and debris impact to deck and pier supports on the uppermost beach. A total of 8 3-man, 14 4-man, and 5 5-man boulders will be used. Boulders will be placed on buried quarry spall rock placed at least 1.0 FT below existing grade.

The displaced boulders and eroded upper beach have resulted in undermining the north bank adjacent to the concrete stairway shall be repaired by the excavation of existing beach sediment at the existing structure's toe and the placement of quarry spall 9-21" below grade. Large boulders shall be placed scattered and in groups on beach grade.

The following lists the proposed project actions that are shown on the project design sheets (see design sheets):

1. ***Concrete Foundation Repair***
    a. Excavate toe sand at the concrete foundation.
    b. Form a new concrete step/footing at the base of the existing footing.
    c. Deepen and widen the foundation toe line and fill the voids under the exposed parts of the concrete foundation with quarry spalls to avoid re-exposure of the foundation.

2. ***Scour Control along Structure Toe Line on North Beach***
    a. Excavate existing beach approximately 1.75 ft below the existing grade.
    b. Introduce 1.5 ft minimum cobble-gravel beach nourishment at the upper beach near the structure to raise the beach elevation and to protect the structure against toe line scour.
    c. Place 0.5 ft of excavated beach sediment atop newly placed cobble.
    d. Place large boulders strategically as debris barriers to reduce wave and debris impact to structures.

3. ***Revetment Repair at North Bank Adjacent to the Concrete Stairway***
    a. Place quarry spall 9-21" below grade.
    b. Place large boulders scattered and in groups on beach grade.

4. ***Protection of Porch Deck at South Beach and Pier Deck at its Connection to Shore***
    a. Protect Utility (water) pipes and supporting structural members beneath the porch deck, as well as the electric wire conduits beneath the pier.
    b. Place quarry spall 9-21" below grade.
    c. Place large boulders scattered and in groups on beach grade.

5. ***South Stairs Repair***
    a. Remove existing scattered boulders from the beach surface.
    b. Excavate sand at and the edge of the concrete.
    c. Add concrete footing below existing paving.

Mitigation and Rehabilitation

The following are the proposed mitigation actions for the site that are shown on the project design sheets (see design sheets):

1. Remove rock boulders from the upper beach just northeast of the northeast end of the concrete stairway near the plaza—move to the eroded low bank immediately adjacent above elevation 11 FT MLLW.
2. Install small (approximately 356 SF) planting area in uppermost beach/ backshore (see design sheets). This would involve planting American dunegrass (*Leymus mollis*) on the north side of the existing pier, in front of the paved terrace.

Port Townsend Code Compliance

5.5 Shorelines of Statewide Significance

(5.5) Areas Designated – Within the Port Townsend shoreline jurisdiction, the waters of Puget Sound and Strait of Juan de Fuca lying seaward from the line of extreme low tide are designated as shorelines of statewide significance.

Response: Project activities and impacts are planned to occur landward of the extreme low tide line and therefore not in an area designated as "shorelines of statewide significance."

5.6 Aquatic

(5.6) The purpose of the Aquatic designation is to protect, restore and enhance the unique characteristics and resources of marine waters…

Response: Project activities within the Aquatic shoreline designation are in support of existing permitted water dependent uses. Furthermore, the project is consistent with policy 5.6.6 which states "*refurbish or rebuild existing piers and wharves along Port Townsend Bay to maintain a modern-day link with the community's maritime history".* The project is intended to preserve pier access for the Northwest Maritime Center and does not propose any new uses.

5.13 Port Hudson Marina District – Maritime Heritage Corridor

(5.13.5.b) This area, which includes the NWMC site, should continue to support the majority of the marine trades and other water-dependent and water-related uses located in Point Hudson…

Response: Project activities support the above policy by maintaining safe access to the marine trades and other water-dependent and water-related uses located in Point Hudson.

6 Environmental Protection

Response: The project activities include mitigation to offset all unavoidable project impacts. The project Geotechnical report and Habitat Assessment detail the alternative analysis, cumulative impact analysis, and mitigation plan.

9.7 Shoreline Stabilization Measures & Flood Protection Works

Response: The project geotechnical report provides compliance with section 9.7.

10.6.6 Criteria for Granting Shoreline Conditional Use Permits

…Filing is not complete until all the required documents have been received by the Department of Ecology and the Attorney General…

…In the event of an appeal refer to the provisions of RCW 90.58.140 for when construction work may begin.

Response: The project shall follow all permit timing requirements and comply with all conditions of approval prior to, during, and after project implementation, including the Department of Ecology's process.

Cumulative Impacts Analysis

As previously described, the absence of naturally derived littoral (beach) sediment supply from the shores to the southeast to the site makes this site less resilient to erosive forces. The historical drift cell that ran for miles from the southwest to northeast to this site was interrupted by a number of large overwater structures in the downtown Port Townsend waterfront, virtually eliminating all natural sediment supply. Unprotected beaches under current conditions at this site are therefore expected to continue to erode. To avoid the need to hard armor at the site over the intermediate term, the buried, larger grain size sediment (cobble and gravel) placed on the upper beach through beach nourishment were included in the design to try to offset the long-term trend of erosion.

All previously installed soft shore protection logs were detached during storms or by managers as the "natural" beach has lowered, leaving the beach and the porch deck more exposed to storm wave attack. With no action, the upper beach elevation could be further lowered in a future storm which would allow more wave energy to reach the structures. The proposed project seeks to avoid this, but could lead to some potential cumulative effects, as outlined below.

Possible cumulative effects of the proposed project along with the assessment of the likelihood are the following:

- Other adjacent properties could potentially install similar isolated boulders and beach nourishment areas.
  This action is not possible as most adjacent properties on the SE shore of Port Townsend up to the Point Hudson Marina already have hard armor structures consisting of rock revetments and various types of shoreline bulkheads covering the upper beach. One exception is the small beach area (as part of the marine park property) immediately SW of the site, however, there is not a building or other structure to be protected near the shore and current shoreline codes would not allow one as close as the NWMC building is. A similar project could be proposed/installed north of the site and the marina near Hudson Street. The impacts of this would be negligible, and beach nourishment would generally be viewed as favorable in this sediment-starved environment. Boulders theoretically placed in new areas in the drift log zone would likely trap some amount of naturally deposited large logs, again, which would generally not be viewed as a negative impact.
- Another potential cumulative impact of a proliferation of similar projects is that the placed beach nourishment sediment could overwhelm surrounding habitat areas or cause deposition in different, off-site areas. The fact that the shores of Port Townsend are severely sediment

starved (the area suffers a deficit of littoral (beach) sediment) makes this potential outcome highly unlikely. Beach nourishment sediment from the direct project area is also unlikely to leave the project area beach. Littoral drift in northeastward, such that sediment should not move to the SW. On the NE end, the Point Hudson marina inlet structures, which are currently undergoing replacement, hold the existing beach in place and do not allow for sediment transport further to the north into the channel or to adjacent beaches.

- Stair and walkway improvement are limited to filling in under the existing concrete structures. If this action were repeated in other areas, impacts would be negligible at most.
- The existing rock revetment on the NE end of the site will be repaired inside its original footprint. This action could also be repeated at other sites, as this action is common in the region. This type of maintenance action would not have negative impacts on nearshore habitats, if the work was indeed within the original footprints.

Biological Evaluation Summary

The Northwest Maritime Center is exposed to high wave energy in Puget Sound terms and has been impacted by several high-water storm in events in the recent years. Without action, the site will continue to experience erosion with additional impacts to existing infrastructure, likely within next 3 years. The proposed project design or preferred alternative provides a strategy to repair damage from erosion and prevent damage from future erosion.

Based on the Biological Evaluation, the proposed design will also reduce negative impacts to nearshore habitats compared to other alternatives (Marine Surveys & Assessments, 2021). The main conclusions of the Biological Evaluation report were as follow:

- "since the majority of the work (i.e. excavation and placement of beach nourishment) will be done in the high upper-intertidal zone (above MHHW) in the dry, turbidity **effects are expected to be localized and brief, it at all**. Any disturbed sediment that may become suspended on an incoming tide is not anticipated to stay suspended for more than one tidal cycle"
- "sediment supply and transport is **not expected to be impacted** by this project. **This project should actually help retain sediment** on the upper beach through beach nourishment and the strategic placement of large boulders to further help dissipate wave energy and act as debris barriers"
- "The upland area of the project site is completely developed with paved surfaces and buildings. No riparian vegetation will be removed."
- "Some disturbance, crushing, or smothering of benthic meiofauna in the extreme upper intertidal zone may occur while stockpiling materials, operating equipment in the intertidal work corridor, removing the existing bulkhead, and installing the rock bulkhead. The **impacts will be relatively short in duration** and will occur within recommended the 25-ft work corridor in the upper intertidal zone."
- "The proposed project would facilitate continued habitat alteration along the shoreline and may promote future activities, including fishing, swimming, and any other water dependent recreational activity. The influence of these activities cannot be quantified in this assessment, but with appropriate regulations in place, **these activities are not anticipated to have an adverse effect on state and ESA-listed species and/or critical habitat."**

Limitations of This Report

This report was prepared for the specific conditions present at the subject property to meet the needs of specific individuals. No one other than the landowner and their agents should apply this report for any purposes other than that originally contemplated without first conferring with the geologist that prepared this report. The findings and recommendations presented in this report were reached based on a brief field visit. The report does not reflect detailed examination of sub-surface conditions present at the site, or drainage system designs, which are not known to exist. It is based on examination of surface features, bank exposures, soil characteristics, gross vegetation characteristics, and beach processes. In addition, conditions may change at the site due to human influences, floods, groundwater regime changes, or other factors. This report may not be all that is required to carry out recommended actions. More detailed design specifications may be needed for proper implementation of a habitat enhancement project.

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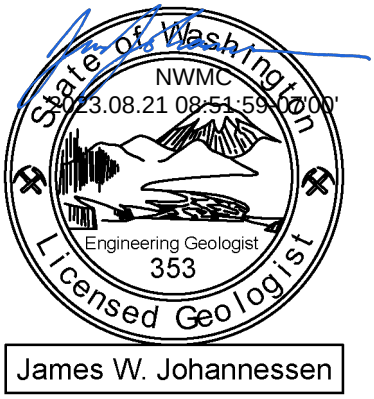

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ATTACHMENTS:

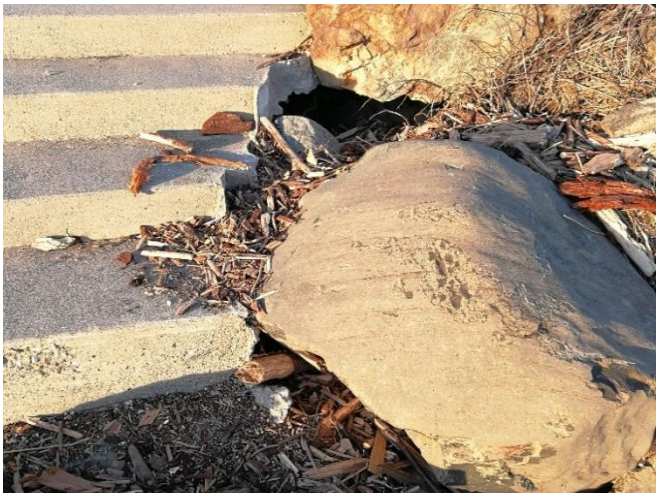
Photo Pages 1. Ground photographs of observed erosion from December 20, 2018, storm event at the project area taken January 28, 2019.

Photo Page 2. Ground photographs of observed erosion and damage after Jan. 2021 and Jan. 2022 storms.

A. Concrete pathway for wheelchair and beach access

B. Foundation rocks underlying concrete pathway

C. Scour and exposed base of concrete stairs



D. Displaced landscaping boulder and voids

E. Displaced large logs from backshore beach

F. Damaged electrical box and HDPE wire conduit

Photo Page 1. Ground photographs of observed erosion from December 20, 2018, storm event at the project area taken January 28, 2019.

G. Under-protected and eroded bank northeast of concrete stariway from 12/20/18 storm event at the project area.

H. Damage and debris under deck after 1/13/21 storm.

I. Damage and debris under deck after 1/13/21 storm.

J. Damage and debris under deck after 1/7/22 storm.

K. Damage and debris under deck after 1/7/22 storm.

Photo Page 2. Ground photographs of observed erosion and damage after Jan. 2021 and Jan. 2022 storms.