NEWPORT BEACH ACCESS RESILIENCY PLAN

JUNE 3, 2021

SUBMITTED TO

CITY OF NEWPORT
169 SW COAST HWY
NEWPORT, OR 97365

SUBMITTED BY

KPFF CONSULTING ENGINEERS
111 SW 5TH AVENUE, SUITE 2600
PORTLAND, OR 97204

Introduction

The Oregon Department of Land Conservation and Development (DLCD) retained a team led by KPFF to evaluate existing beach access points north of Yaquina Bay in Newport, OR. This team recommended three beach access points for seismic improvements in our March 19, 2021 Beach Access Resiliency Plan Evaluation Memo (Appendix A).

The three access points recommended for improvements in our memo were:

- Nye Beach Turnaround
- Agate Beach State Recreation Site
- Schooner Creek at NW 68th Street

This report contains concept level designs and estimated construction costs for each of the three access points as well as discussion of structural, geotechnical, site design and regulatory/permitting considerations. The designs are concept level and are based on a general assumption of soil conditions and approximate site grades. No engineering modelling/analysis, survey, or geotechnical investigations were performed in the development of these concept designs.

Nye Beach Turnaround

Figure 1: Nye Beach Turnaround

Site Design Considerations

This site design is driven by the following factors:

1. The approximately 12-foot differential between the Nye Beach turnaround and the beach.

2. Potential for the adjacent existing masonry wall (associated with an early-20th Century Natatorium facility that existed at the site) to fail during a large earthquake and partially or fully obscure the existing access ramp.
3. The location of a storm drain outfall to the south of the turnaround.
4. Potential to provide access for a large number of people due to the popularity of this location.
5. Opportunity for this site to be connected to the Sam Moore Parkway Trail to provide additional pedestrian circulation benefits supporting passive recreation for residents as well as for potential tourism value.

The proposed access is anticipated to consist of a reinforced concrete structure with a 10-foot-wide pedestrian path consisting of four ADA-compliant ramps, five landings, and a section nearest the beach running at five percent. Total length is approximately 250 feet. The lowest section would land approximately two feet below grade to provide resilience to shoreline erosion. The structure would be designed to wrap around the existing wall and present consistently in terms of matching existing materials. Additional evacuation signage is recommended on the streets to guide people out of the Tsunami Inundation Zone efficiently.

Proposed Concept Design

The proposed access retrofit concept plan and structural section is shown in Figure 2 and Figure 3, with suggested improvements to tsunami evacuation signage shown in Figure 4.

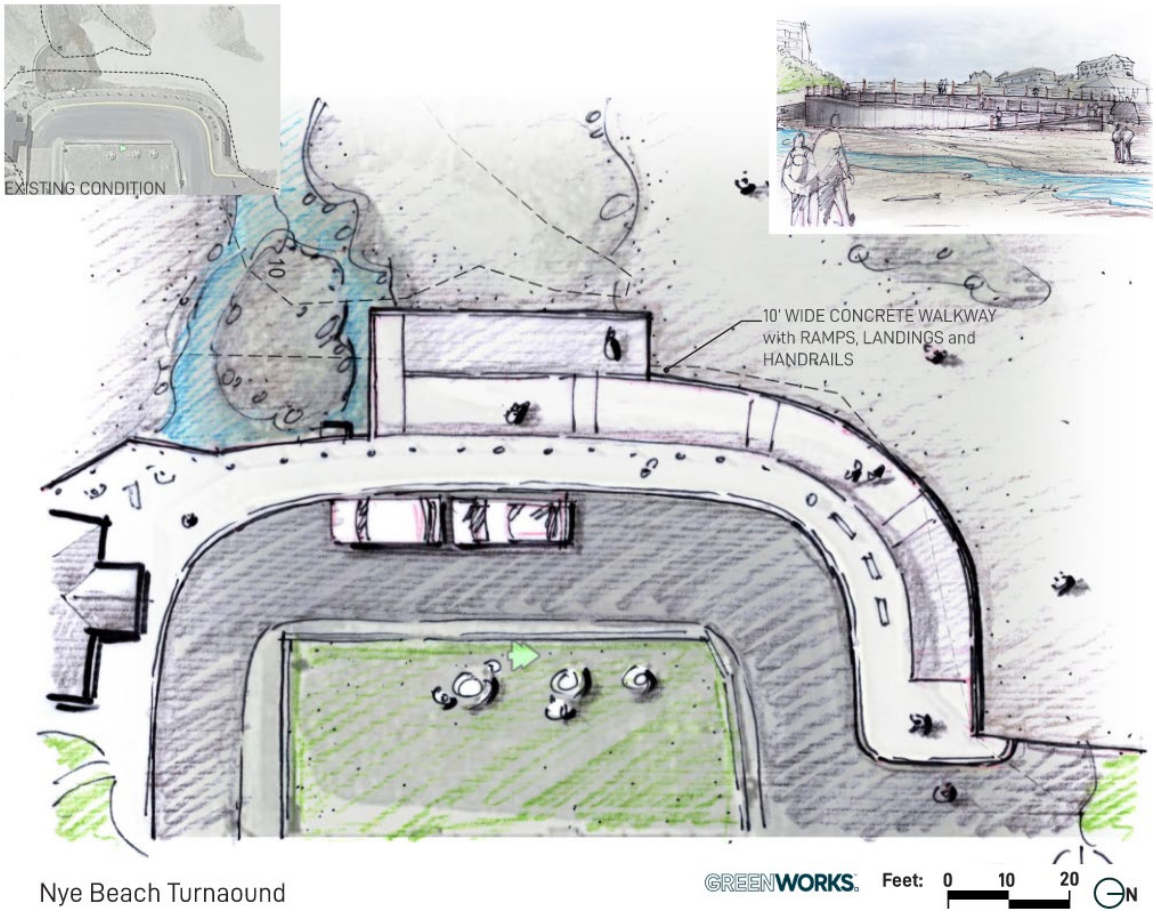

Figure 2: Concept Plan

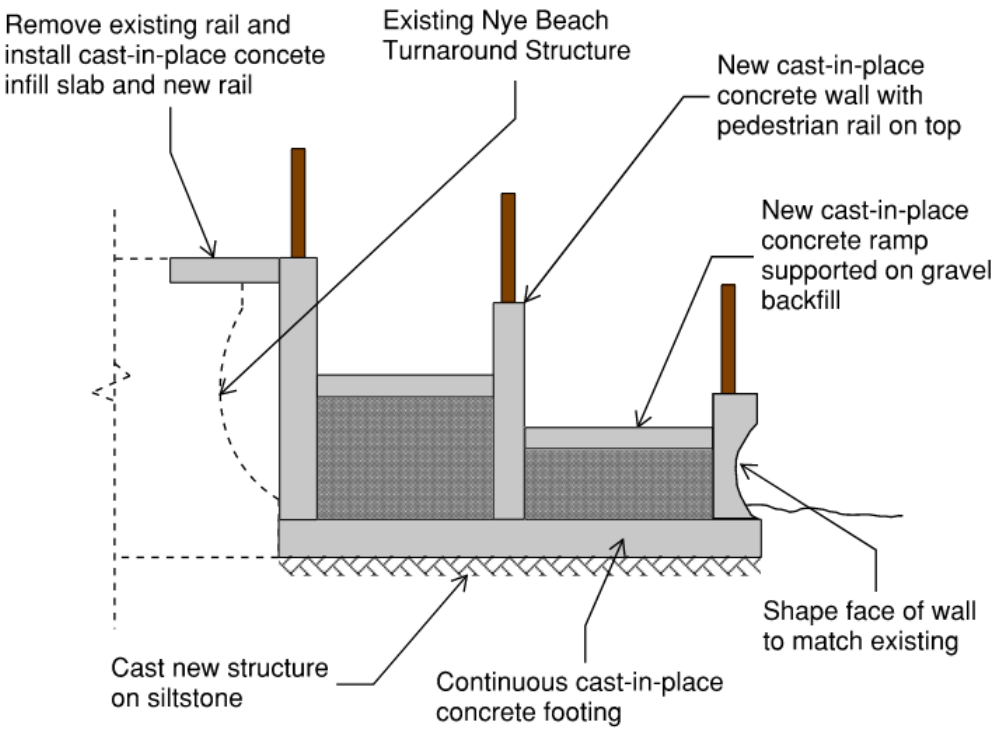

Figure 3: Concept Structural Section

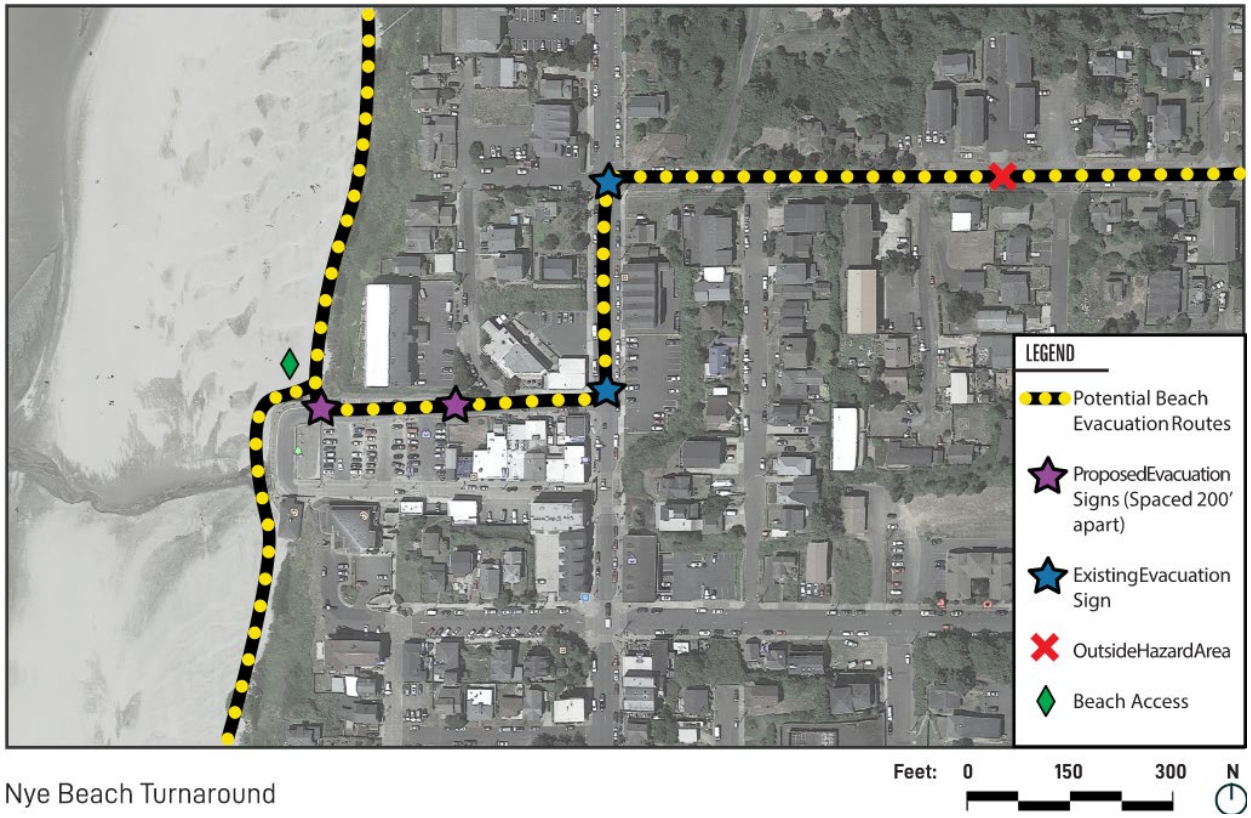

Figure 4: Proposed Improvements to Tsunami Evacuation Signage

Geotechnical Considerations

Subsurface conditions observed at the Nye Beach access indicate new foundations for the concrete walkway/ramp can likely be founded on shallow spread footings bearing on the native siltstones currently exposed at the base of the existing wall. Foundations would need to be sufficiently embedded to provide both lateral passive resistance as well as below the anticipated depth of scour. In general, the exposed siltstone soils have low to moderate erosion/scour potential compared to the beach sand nearby. Additional geotechnical site investigation would be necessary to verify that the siltstone exposed is sufficiently thick and to verify its presence where obscured by near surface beach sand.

Structural Design Considerations

The new reinforced concrete walkway would be designed to remain operational after a major seismic event. Stabilization or reconstruction of the adjacent existing concrete wall at the perimeter of the turnaround roadway may also be necessary, as its current seismic resilience is unknown and may present a hazard to life safety and the operation of the new access ramp if it were to fail.

Reconstruction of the existing wall could be accomplished with a conventional reinforced concrete wall at the same height and in the same location as the existing wall. Replacement of the existing wall would affect the adjacent turnaround roadway during construction. Alternatively, strengthening could be accomplished by using the new access ramp to buttress the existing wall.

Permitting/Regulatory Considerations

Several sensitive resources are thought to exist in the general vicinity of the Nye Beach Turnaround. National Wetland Inventory (NWI) mapping shows a creek as well as an estuarine and marine wetland in the project vicinity. FEMA floodplain mapping shows flood zone VE (coastal floodplain) in the project area. Threatened and endangered species protected by the Endangered Species Act (ESA) may occur in the general vicinity of the project. City of Newport maps show the project area as being in a geologic hazard area, tsunami hazard overlay zone, beach and sand dune areas, ocean shorelands, 100-year floodplain, and a wetland area. The masonry wall associated with an early 20th century natatorium may be a historic resource.

Clean Water Act Section 401 and 404 permits may be required if there are impacts to wetlands or waters of the United States. If there is a federal nexus (need for a federal permit or federal funding), impacts to ESA-listed species and cultural resources will need to be addressed. If there are impacts below the line of statutory vegetation or actual vegetation line, an Ocean Shore Permit through Oregon Parks and Resources Department (OPRD) will be required. Impacts to waters of the state (wetlands or waters) above the line of statutory vegetation or actual vegetation line may trigger the need for a Removal-Fill Permit through the Oregon Department of State Lands (DSL). The project will need to show consistency with the Coastal Zone Management Act (CZMA). City of Newport regulations concerning geologic hazards, beach and sand dune area, ocean shorelands, 100-year floodplain, and wetlands may need to be addressed. Nye Beach is located within the City of Newport design review overlay area.

Alternative Design Options

Alternate structural materials could include wood or structural steel. Both these alternative options would consist of a framed, elevated walkway with a wood or concrete deck along the same alignment as the proposed concrete walkway.

Steel and wood framing are less durable than concrete in a marine environment.

The new concrete walkway structure can also be used to buttress the existing wall that separates the turnaround from the beach. The proposed solid concrete structure allows this buttress to be accomplished with simple gravel backfill between the new structure and the existing wall. A steel or wood framed structure would not provide the same level of protection for the existing wall.

A wood or steel framed structure can be designed to provide a similar level of seismic resiliency to the proposed concrete structure. However, both structure types would likely require significantly more maintenance over a simple concrete structure due to the coastal environment.

Agate Beach State Recreation Site

Figure 5: Existing Agate Beach Access

Site Design Considerations

This site design is driven by the following factors:

1. Minimal grade issues at this site.
2. The slough coming from the south that drains to Big Creek, as well as a wetland between the existing ramp and the beach.
3. Potential to provide access for a large number of people due to the popularity of this location.

4. Oregon State Parks or a nearby hotel may be willing to share in funding some of the improvements which could support a stronger connection (identified as an opportunity in the Park System Master Plan) to the adjacent Ocean to Bay Trail for residents and tourists alike.

The proposed access is anticipated to consist of a concrete framed boardwalk with a minimum 14-foot-wide path beginning at the end of the existing parking lot ramp and running approximately 120 feet onto the beach. The boardwalk would serve mobility-impaired users. The structure could be designed in a Cascadian architectural style to blend materially with nearby state park facilities. Additional evacuation signage is recommended to guide people across Ocean Avenue and out of the Tsunami Inundation Zone efficiently.

Proposed Concept Design

The proposed access retrofit concept plan and structural section is shown in Figure 6 and Figure 7, with suggested improvements to tsunami evacuation signage shown in Figure 8.

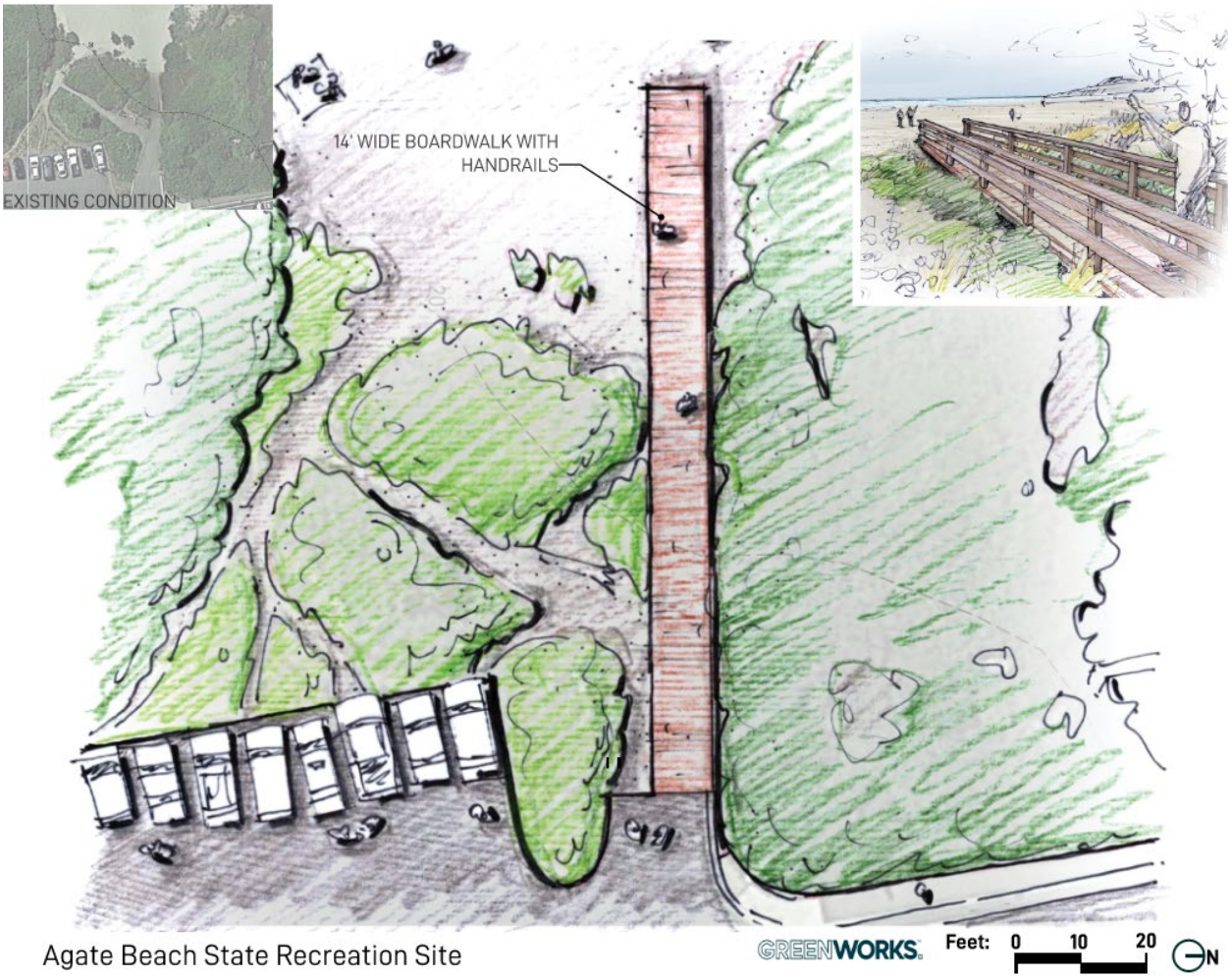

Figure 6: Concept Plan

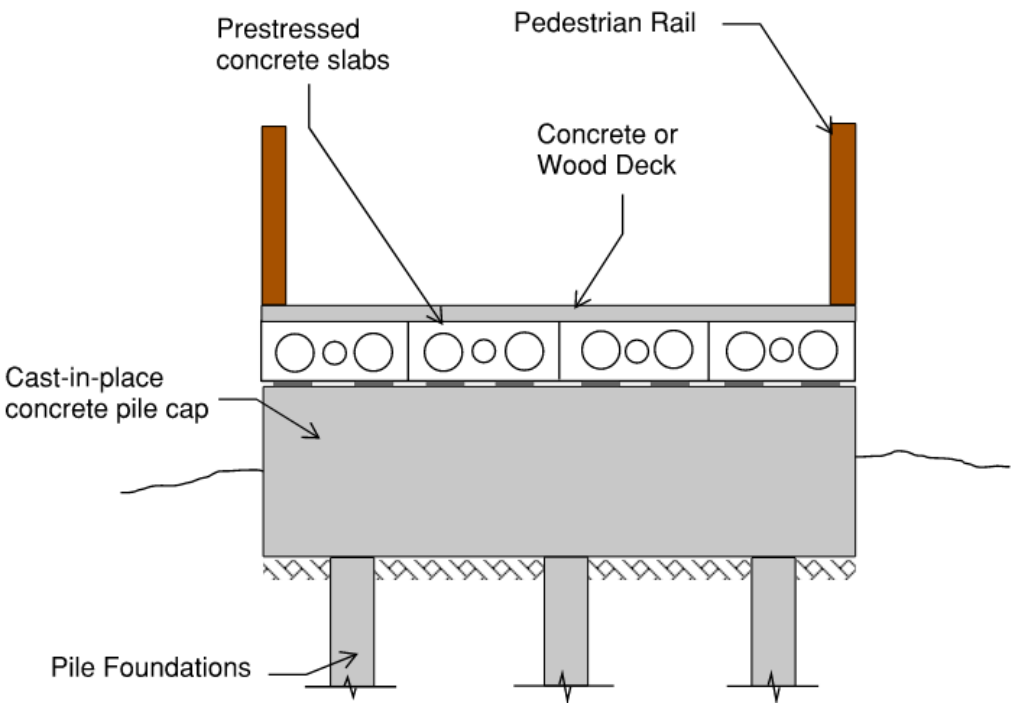

Figure 7: Concept Structural Section

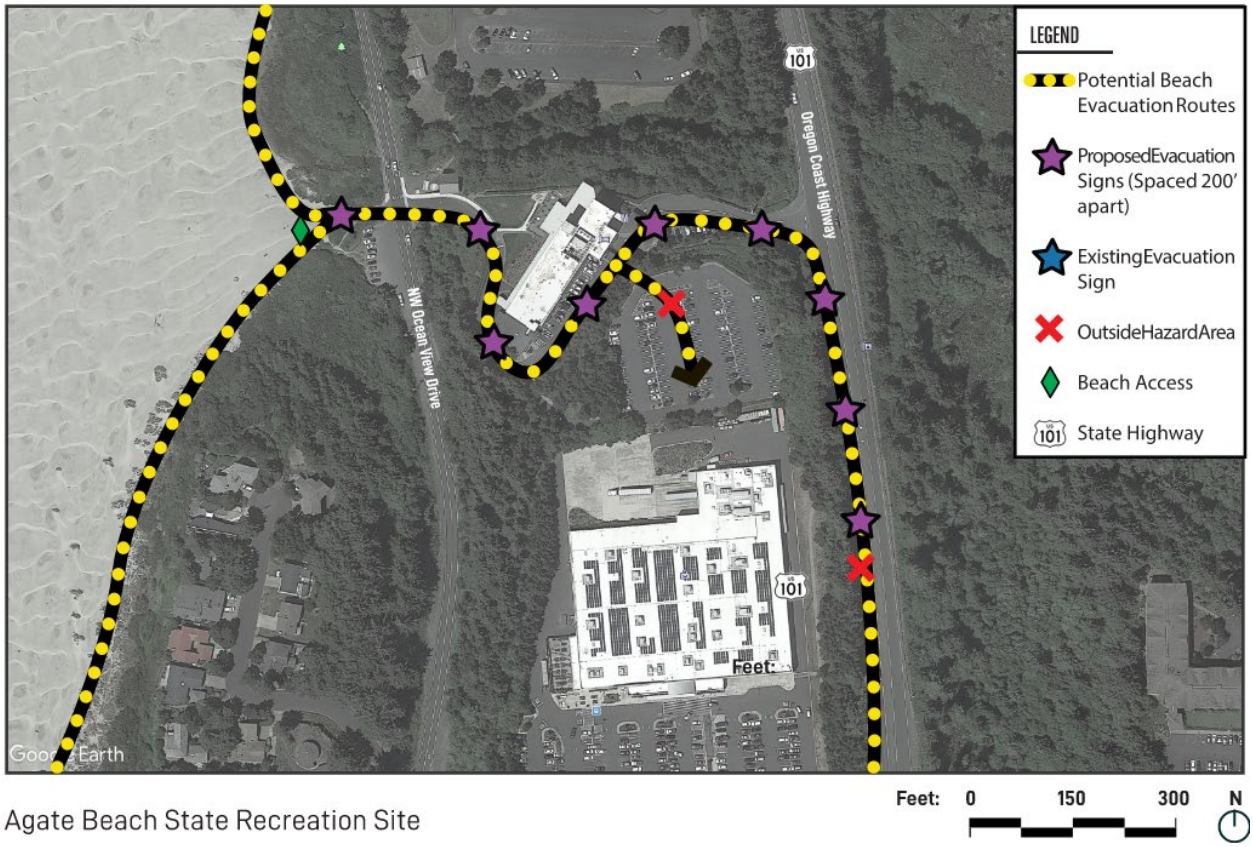

Figure 8: Proposed Improvements to Tsunami Evacuation Signage

Geotechnical Considerations

Existing access at Agate Beach consists of a relatively gently sloped on grade path down to the beach. Due to the presence of shallow/standing water at times and relatively loose sands at the surface, liquefaction is a hazard at this site for a CSZ earthquake. Considering the seismic hazard and review of available geological maps, we anticipate the boardwalk would be supported on driven or drilled piles such as pipe piles or helical piles, founded in the underlying dense sands and/or siltstone. Foundations would likely need to extend sufficiently deep to provide lateral resistance during shaking, resist downdrag, and to mitigate scour potential from the adjacent creek. Additional geotechnical site investigation would be necessary to confirm the depth of dense sand/siltstone as well as constructability considerations for various foundation types.

Based on review of historical photographs, we understand the alignment of Big Creek changes substantially with time and over the last 30 years has shifted to flow north toward Yaquina Head, away from the Agate beach access point. While the proposed approach does not mitigate all potential alignments of Big Creek, it does provide a resilient egress path considering the stream channel locations observed in the last 30 years. Additionally, the stream alignment has been relatively stable in recent years with its general location maintained for over 10 years.

Structural Design Considerations

The structural design of the boardwalk will need to consider partial inundation during high water and storm surge, the corrosive marine environment, and the need to remain operational after a major seismic event. Reinforced concrete piers and prestressed concrete slabs would accomplish this goal. The deck would likely be a concrete deck to support pedestrian and vehicular traffic (emergency vehicles and beach maintenance vehicles).

The design of the pedestrian rail should consider long term durability, cost, and the aesthetics of the surrounding area as key considerations.

The structure would be subject to tidal energy and loading from large wood debris washing up on the beach. The structural design will need to accommodate this additional loading. While the concrete structure would be sufficiently robust, the pedestrian guardrail would be more susceptible to damage. The final design should consider developing ramp grades that minimize the need for rails and, where rails are required, incorporate a rail design that can be easily repaired or replaced if damaged.

Due to the location of this structure, it is possible that changing beach conditions could require future adjustments to the connecting grade at the beach end of the ramp.

Permitting/Regulatory Considerations

Several sensitive resources are thought to exist in the general vicinity of the Agate Beach State Recreation Site. NWI mapping shows Big Creek and wetlands (R1UBV - riverine tidal unconsolidated bottom, permanently flooded-tidal and M2USP - marine intertidal unconsolidated shore, irregularly flooded). FEMA floodplain maps show flood zone VE (coastal floodplain) in the project area. Threatened and endangered species protected by the ESA may occur in the general vicinity of the project. City of Newport maps show the project area as being in a geologic hazard area, tsunami hazard overlay zone, beach and sand dune areas, ocean shorelands, 100-year floodplain, and a wetland area.

Clean Water Act Section 401 and 404 permits may be required if there are impacts to wetlands or waters of the United States. If there is a federal nexus (need for a federal permit or federal funding), impacts to ESA-listed species and any cultural resources will need to be addressed. If there are impacts below the line of statutory vegetation or actual vegetation line, an Ocean Shore Permit through OPRD will be required. Impacts to waters of the state (wetlands or waters) above the line of statutory vegetation or actual vegetation line may trigger the need for a Removal-Fill Permit through the DSL. The project will need to show consistency with the CZMA. City of Newport regulations concerning geologic hazards, beach and sand dune areas, ocean shorelands, 100-year floodplain, and wetlands may need to be addressed.

Alternative Design Options

The proposed structure consists of an elevated boardwalk constructed with prestressed concrete slabs supporting a concrete deck – providing a resilient, durable structure, capable of supporting pedestrian and vehicular loads. A wood framed or steel framed structure could be used. However, this is not recommended due to the significant maintenance required for a structure of this type in a coastal environment.

Another option would consist of an on grade ramp with retaining walls along the edges. However, this would block passage of Big Creek and result in a large environmental footprint in comparison with the proposed steel framed structure that sits on individual foundations.

The creek that the boardwalk crosses varies in width and depth of water. Recognizing that this area is likely subject to liquefaction, there may be uneven grade post-earthquake and the proposed structure would provide an access that could efficiently allow people to exit whether the creek was full or not. A no-boardwalk solution would likely not function as well when the slough is full.

The boardwalk location can vary easily from that shown in this report and could be relocated to the south of the beach entrance to improve vehicular access.

Schooner Creek at NW 68th Street

Figure 9: Existing Schooner Creek Outlet

Site Design Considerations

This site design is driven by the following factors:

1. Schooner Creek runs immediately north of the existing ramp and there is potential for debris flow during a Cascadia Subduction Zone Earthquake that could partially or fully obscure the existing access.
2. Tightly constrained public right-of-way.
3. An approximately eight-foot grade difference between the existing gravel turnaround and the beach.
4. Improvements to this site would tie in nicely with the following opportunities identified in the Park System Master Plan: proposed Highway 101 undercrossing and connection to Nautical Hill Open Space and a potential future trail back to the Ernest Bloch/Lucky Gap.

The proposed access is anticipated to consist of a 10-foot wide path (potentially a reinforced concrete walking surface) adjacent to a rock/boulder retaining wall. The lowest section would land approximately two feet below grade to provide resilience to shoreline erosion. The proposed path could impact existing private right-of-way and is proposed steeper than 5% to minimize these right-of-way impacts. It will also incorporate a log jam structure to protect the access point from debris that may flow from Schooner Creek.

Proposed Concept Design

The proposed access retrofit concept plan and structural section is shown in Figure 10 and Figure 11, with suggested improvements to Tsunami Evacuation signage shown in Figure 12.

Figure 10: Concept Plan

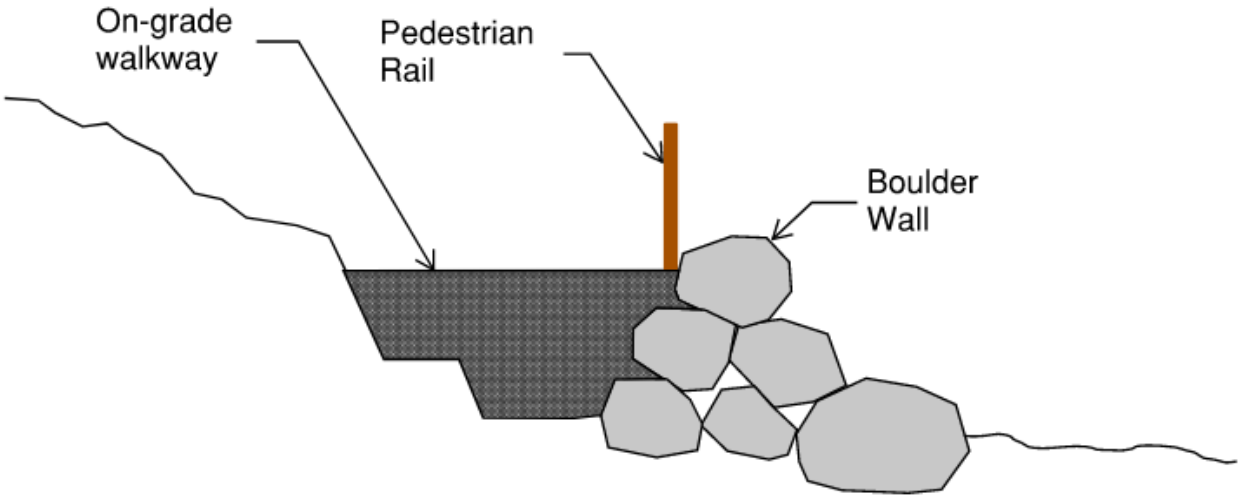

Figure 11: Concept Structural Section

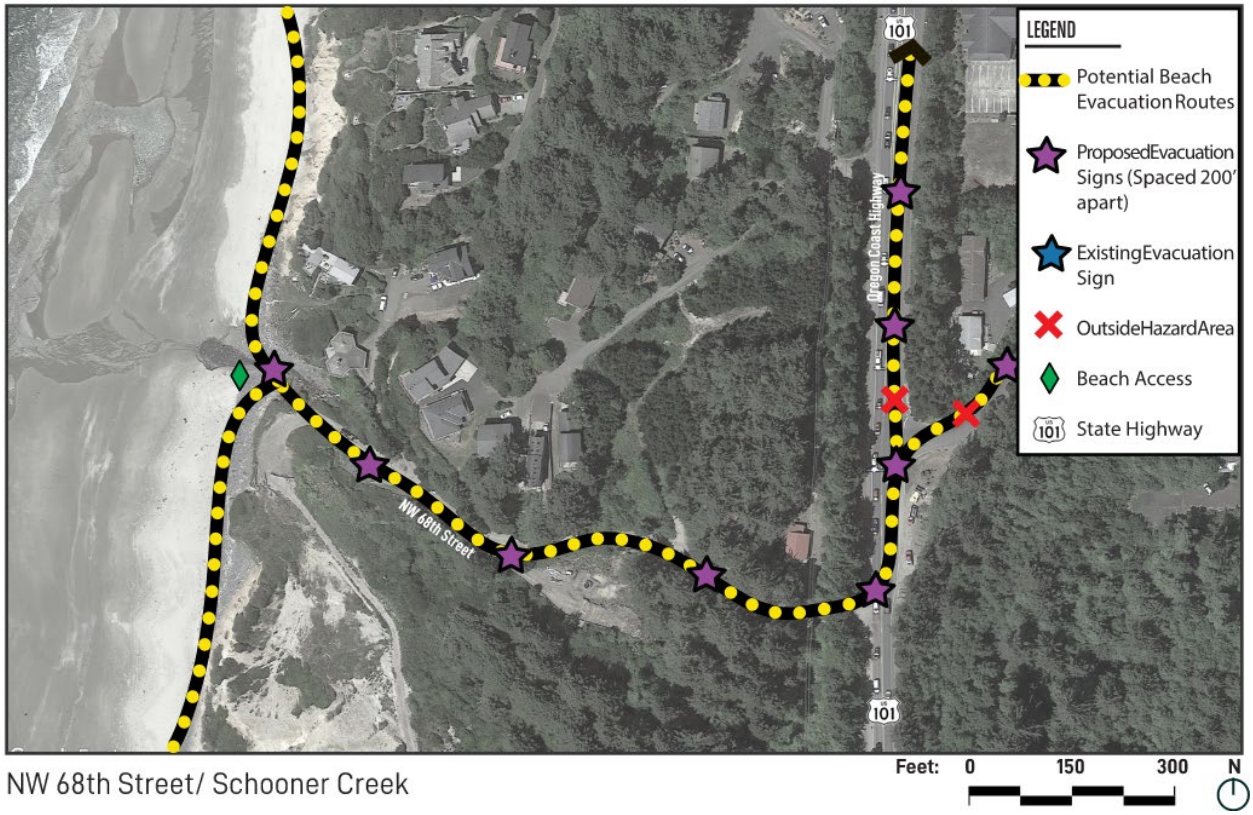

Figure 12: Proposed Improvements to Tsunami Evacuation Signage

Geotechnical Considerations

The 68th Court beach access location, while geographically important, presents additional considerations with regard to the presence of existing debris flow derived conglomerate overlying siltstone/sandstone. Considering the potential for incremental movement of the conglomerate during a seismic event, we recommend the ramp be supported by a rock/boulder retaining wall or gabion basket wall – both of which are generally considered to have increased tolerance of movement compared to traditional concrete wall structures. The wall should be founded and embedded sufficiently in the underlying siltstone/sandstone to limit such movements, provide lateral resistance, and mitigate scour potential. Additionally, existing conglomerate underlying the existing proposed walkway should be removed and replaced with crushed aggregate. Explorations are recommended to further evaluate the potential for movement of the existing conglomerate as well as verify the consistency of the exposed siltstone soils.

Structural Design Considerations

This on-grade walkway is supported behind rock/boulder walls. The wall can accommodate the potential movements of the underlying soils. In addition to resisting future soil movements, the wall should be sufficiently embedded to accommodate future scouring of the surrounding grade. It is anticipated that the walkway surface would utilize a material that can accommodate movements of the underlying soils and can be easily repaired by City maintenance crews.

Permitting/Regulatory Considerations

Several sensitive resources are thought to exist in the general vicinity of the Schooner Creek at the NW 68th Street project site. NWI mapping shows Schooner Creek, freshwater wetlands, and estuarine and marine wetlands in the project vicinity. FEMA floodplain mapping shows flood zone VE (coastal floodplain) in the project area. Threatened and endangered species protected by the ESA may occur in the general vicinity of the project. City of Newport maps show the project area as being in a geologic hazard area, tsunami hazard overlay zone, beach and sand dune areas, ocean shorelands, 100-year floodplain, and a wetland area.

Clean Water Act Section 401 and 404 permits may be required if there are impacts to wetlands or Waters of the United States. If there is a federal nexus (need for a federal permit or federal funding), impacts to ESA-listed species and any cultural resources will need to be addressed. If there are impacts below the line of statutory vegetation or actual vegetation line, an Ocean Shore Permit through OPRD will be required; this project may require both an Access Way & Other Miscellaneous Projects Permit and a Shoreline Protection Structure Permit. This location is not eligible for beachfront protection under Statewide Planning Goal 18 and the city's corresponding regulations; therefore, the City would need to adopt an exception to construct beachfront protection in this area. Impacts to waters of the state (wetlands or waters) above the line of statutory vegetation or actual vegetation line may trigger the need for a Removal-Fill Permit through the DSL. The project will need to show consistency with the CZMA. City of Newport regulations concerning geologic hazards, beach and sand dune areas, ocean shorelands overlay, 100-year floodplain, and wetlands may need to be addressed.

Alternative Design Options

Several options were considered for the Schooner Creek access point including construction of a rigid concrete structure, gabion walls, Mechanically Stabilized Earth (MSE) or gravity retaining structures, and slope reinforcement. The potential for deformations from the active landslide at the Schooner Creek access point could damage a rigid concrete structure. As a result, it would likely require deep foundations or other restraining system to maintain tolerable deformations. While slope reinforcement is a potential, it would likely require the installation of shear piles and/or slope anchors such as soil nails to stabilize movement. This option would likely require property acquisitions to accomplish as well as carrying a relatively high cost for the mitigations.

Gabion walls, while able to accommodate movement of the underlying soils, present challenges due to corrosion of the gabion basket wires in the coastal environment. Similarly, vegetated MSE walls would require significant consideration of corrosion and soil movement on the MSE facing elements.

A longer walkway would reduce the slope of the ramp and improve accessibility. However, due to narrow available right-of-way, a longer walkway would require significant right-of-way acquisition.

Estimated Costs and Possible Funding Sources

Estimated Costs

The following tables show estimated costs for each of the proposed improvements.

The costs are based on calendar year 2021 unit prices and should be escalated by an appropriate amount for the anticipated year of construction. The costs do not include the following items:

- State/City project management and administration costs
- Permitting costs
- Utility relocation
- Right-of-way acquisition
- Signage and wayfinding
- Temporary detour structures/re-routing of traffic and beach users during construction

Table 1: Nye Beach Turnaround

Item Number	Item	Cost
1	250-foot-long x 10-foot-wide walkway structure	$750,000
2	750-foot pedestrian rail	$150,000
3	Backfill and cap existing Nye Beach wall	$50,000
4	Contingency (40%)	$380,000
5	Engineering fees (40%)	$532,000
	ESTIMATED TOTAL	$1,900,000

Table 2: Agate Beach State Recreation Site

Item Number	Item	Cost
1	150-foot-long x 14-foot-wide walkway structure	$630,000
2	300-foot pedestrian rail	$60,000
3	Contingency (40%)	$276,000
4	Engineering fees (40%)	$386,000
	ESTIMATED TOTAL	$1,350,000

Table 3: Schooner Creek at NW 68th Street

Item Number	Item	Cost
1	70-foot -long x 10-foot-wide walkway structure	$140,000
2	140-foot pedestrian rail	$28,000
3	Log jam structure	$50,000
5	Contingency (40%)	$87,000
5	Engineering fees (40%)	$122,000
	ESTIMATED TOTAL	$430,000

Potential Funding Sources

Below is a list of potential finding sources. This list is not exhaustive, and funding programs evolve over time, so this list is subject to change. These funding sources can potentially be used for all sites as appropriate.

Revenue Sources

- SDCs (System Development Charges) – Transportation SDCs can be used both on and off-street facilities.
- LIDs (Local Improvement Districts) – Money used to fund and construction local projects.
- CETs (Construction Exercise Tax) – Money can be used for non-housing purposes.
- Urban Renewal – Money used to improve poorly underdeveloped areas.
- State Highway Fund
- Federal/State/Local Gas Tax
- Transient Room Taxes
- Property Tax

State Grants and Loans

- ODOT Bike-Pedestrian Program – https://www.oregon.gov/odot/programs/pages/bikeped.aspx
- ODOT Transportation Safety Grant Program - https://www.oregon.gov/odot/Safety/Pages/Grantee.aspx
- Oregon Special Public Works Fund – https://www.orinfrastructure.org/Infrastructure-Programs/SPWF/
- ODOT Funding Options - https://www.oregon.gov/ODOT/LocalGov/Pages/Funding.aspx
- All Roads Transportation Safety (ARTS) – the ARTS Program is designed to address safety needs on all public roads in Oregon http://www.oregon.gov/ODOT/Engineering/Pages/ARTS.aspx
- Oregon Community Paths Program – http://www.oregon.gov/ODOT/Programs/Pages/OCP.aspx
- Travel Oregon Grants – matching grants for projects with a tourism purpose http://www.Industry.TravelOregon.com/Grants

Federal Grants and Loans

- FEMA Mitigation Assistance Grants/Building Resilient Infrastructure and Communities (BRIC) – http://www. ema.gov/grants/mitigation/building-resilient-infrastructure-communities
- Surface Transportation Block Grant Program (STBG) – http://www.fhwa.dot.gov/specialfunding/stp
- Transportation Alternatives Program (TA funds) – Transportation Alternatives is a set-aside within STBG. Bike-ped projects including recreational trails and safe routes projects are eligible http://www.fhwa.dot.gov/environment/transportation_alternatives

- Federal Fixing America's Surface Transportation (FAST) Act – https://www.fhwa.dot.gov/fastact/funding.cfm
- Federal Lands Access Program (FLAP) – The Access Program supplements State and local resources for public roads, transit systems, and other transportation facilities, with an emphasis on high-use recreation sites and economic generators https://highways.dot.gov/federal-lands/programs-access
- National Coastal Resilience Fund – This program supports competitive grants that restore or expand natural features such as coastal wetlands, dunes, and coral reefs to protect coastal communities from flooding and provide habitat for fish and wildlife. https://coast.noaa.gov/resilience-grant/

APPENDIX A

MARCH 19, 2021 BEACH ACCESS EVALUATION MEMO

NEWPORT BEACH ACCESS RESILIENCY PLAN

EVALUATION MEMO

MARCH 19, 2021

SUBMITTED TO

CITY OF NEWPORT
169 SW COAST HWY
NEWPORT, OR 97365

SUBMITTED BY

KPFF CONSULTING ENGINEERS
111 SW 5TH AVENUE, SUITE 2600
PORTLAND, OR 97204

Introduction

The Oregon Department of Land Conservation and Development (DLCD) has retained a team led by KPFF to evaluate existing beach access points north of Yaquina Bay in Newport, OR. This evaluation will identify three access points to develop concept level seismic improvements for, to withstand shaking from a Cascadia Subduction Zone earthquake and allow evacuation of pedestrians from the beach to existing Tsunami Evacuation Routes before the arrival of a local tsunami. This study is provided to the DLCD and City of Newport (City) for review prior to development of the concept improvements.

For each access point, the team will provide a concept level seismic evaluation. KPFF is supported by GRI, who will provide a concept level geotechnical assessment, and Greenworks, who will provide an assessment of connectivity to City streets and the Tsunami Evacuation Routes.

This evaluation is based on a limited visual observation of existing conditions and a limited evaluation of available geotechnical documentation. No engineering analysis has been performed in the development of this assessment.

Executive Summary

On February 23, 2021, eleven beach access sites were visited by Derrick Tokos – City of Newport Community Development Director, Rod Black – City of Newport Fire Department, Stuart Finney – KPFF, Jason Bock – GRI, and Paul Agrimis – GreenWorks. These access points are identified in Figure 1 on the following page.

Considerations briefly discussed on site included location along the beach, accessibility, adjacent slope stability, structural stability, emergency vehicle access, community connectivity and relative retrofit complexity.

This report contains the KPFF team initial assessment of each access point and recommendations for further, more detailed evaluation of the following three access points:

- Nye Beach Turnaround
- Agate Beach State Recreation Site
- Schooner Creek at NW 68th Street

These sites have been selected for further evaluation based on:

- Lack of, or limited impact from, local landslides
- Geographic spread along the north portion of Newport's beach
- Lower anticipated cost of seismic improvements relative to other sites
- Proximity to popular beach and community areas

A detailed description of each access location is included below.

Regional Seismicity

Newport is located in an area of high seismicity along the Oregon Coast and is expected to experience significant ground shaking in the event of a Cascadia Subduction Zone earthquake (CSZE). This earthquake is expected to result in a tsunami reaching the Oregon Coast as soon as 15 minutes after

the initial shaking. The CSZE is expected to result in widespread structural damage and landslides along the Oregon Coast, potentially damaging beach access structures and blocking exit points from the beach.

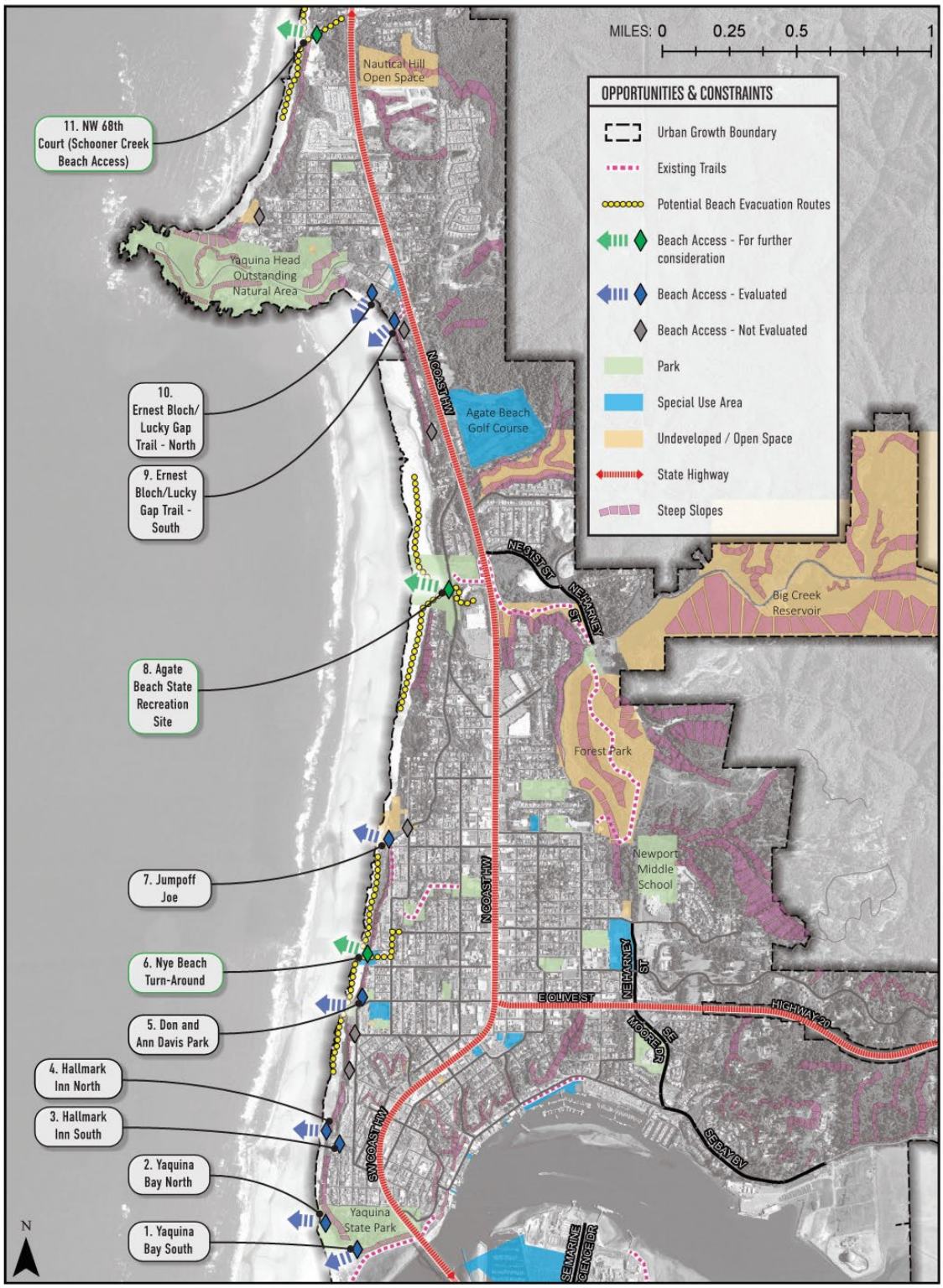

Figure 1: Newport Beach Access Points

Geological Conditions

Available geologic literature and GRI's experience in the area indicate the Newport coastline is typically comprised of three units, Pleistocene age marine terrace sand, Miocene age Astoria Formation, and Micoene age Nye Mudstone. In general, marine terrace sand is found at the ground surface and is underlain by a sandstone/siltstone unit of the Astoria Formation which is then underlain uncomfortably by the Nye Mudstone. The depth of the contact between the Astoria Formation and the upper weathered portions of the Nye Mudstone varies along the coastline. This variability directly correlates with the presence of active and prehistoric landslides. Where these contacts are relatively shallow and steep exposures (steeper than about 1.5H:1V) of Astoria Formation are present, episodic erosional slope movements are often seen. There are four primary landslides along the Newport coastline, and these are the Mark Street landslide, Jumpoff Joe landslide, Yaquina Head landslide, and Schooner Creek landslide.

Beach Access Evaluations

1 - Yaquina Bay South

This site is identified by the Oregon Parks and Recreation Department (OPRD) as Beach Access 60. The site was posted as closed due to seasonal flooding.

The access is located on the north side of Yaquina Bay, adjacent to the North Jetty. The beach access trail consists of a relatively steep asphalt trail with occasional sets of on grade stairs. Elevations of the trail range from approximately 90 feet at the parking lot to 20 feet at the toe of the slope.

Slopes are generally steep, and review of available geologic information and the visual reconnaissance indicate the upper portions of the slope are comprised of marine terrace sands and the lower portions are comprised of Astoria Formation. While no obvious indications of slope movement were observed, the presence of the near surface uncemented marine terrace sands as well as the relative steepness and height of the slope, present a risk of movement during a design level earthquake associated with the CSZ.

Highwater filled the landward interdunal depression – this wetland was inundated either by backwater from the Yaquina River or seasonal high groundwater.

Evaluation: This site is not recommended for further consideration due to:

- Potential for lateral slope deformation.
- Steep access and significant elevation difference along the trail.
- Substantial reconstruction needed to stabilize existing trail/retaining walls and to construct an elevated walkway to allow egress from the beach during periods of interdunal depression inundation.

2 - Yaquina Bay North

This site is also identified by OPRD as beach access 60.

The Yaquina Bay State Park north access is located near the north side of Yaquina Bay, adjacent to the North Jetty. The beach access trail consists of a relatively steep asphalt trail and has several small

retaining walls supporting both the trail and the slope above the trail. Elevations of the trail range from approximately 80 feet at the parking lot to 20 feet at the toe of the slope.

Slopes are generally steep, and review of available geologic information and the visual reconnaissance indicate the upper portions of the slope are comprised of marine terrace sands and the lower portions are comprised of Astoria Formation. No obvious indications of significant slope movement were observed, however, localized movements of the trail (cracked and deformed asphalt) as well as reverse batter of several retaining walls indicate active surficial movement of the near surface uncemented marine terrace sands. Considering the observed surficial movements as well as the relative steepness and height of the slope, a risk of movement during a design level earthquake associated with the CSZ is present.

Highwater in the landward interdunal depression (same deflation plain as Yaquina Bay South) came up to the edge of a small sand embankment recently constructed by OPRD that allows ingress and egress during highwater periods.

Evaluation: This site is not recommended for further consideration due to:

- Potential for lateral slope deformation
- Steep access and significant elevation difference along the trail
- Substantial reconstruction needed to stabilize existing retaining walls

3 - Hallmark Inn South

The Hallmark Resort Access #1 is located on the south side of the Hallmark Resort near the intersections of SW Bay Street and SW Elizabeth Street. The trail is comprised of an improved gravel slope starting at an elevation of approximately 80 feet and extending down to approximately elevation 70 feet followed by an elevated timber staircase traversing a relatively steep portion of the slope down to about elevation 15 feet.

The timber staircase appears to be founded on concrete piers embedded into the slope. As-built information regarding the piers is currently not available, however erosion of the near surface soils has exposed a steel pipe around the concrete pier in one of the upper slope foundations. Slopes are generally steep with an average slope of approximately 1.3 to 1.4H:1V which is slightly steeper than the approximate angle of repose (static stability) for tertiary sedimentary rocks (Astoria Formation) and marine terrace sands.

Based on review of available geologic maps, the site is mapped within an area of active slope movement known as the Mark Street landslide and indicates a dip of approximately 3.5^{o} at the interface between the partially cemented marine terrace sands overlying the Astoria Formation.

Evaluation: This site is not recommended for further consideration due to:

- Potential for lateral slope deformation.
- Substantial costs to strengthen the existing stair structure remain operable immediately after a CSZE.

4 - Hallmark Inn North

The Hallmark Resort – Access #2 is located near the central portion of the Hallmark Resort near the intersections of SW Case Street and SW Elizabeth Street. The trail starts as two individual trails at an elevation of approximately 75 feet. Both trails start as elevated staircases with the southern staircase being approximately 10 feet tall and the northern staircase being approximately 35 feet tall. Following the staircases, the trail is comprised of sand with both trails intersecting at about elevation 40 feet and continuing down to the beach at about elevation 15 feet. The timber staircase foundations were not visible; however, we anticipate they are likely founded on small concrete piers, like Access #1. Based on review of available geologic maps, the site is mapped within an area of active slope movement known as the Mark Street landslide and indicates a dip of approximately 3.5^{o} at the interface between the partially cemented marine terrace sands overlying the Astoria Formation.

Evaluation: This site is not recommended for further consideration due to:

- Potential for lateral slope deformation
- Substantial costs to strengthen the existing stair structure remain operable immediately after a CSZE.

5 - Don and Ann Davis Park

The Veterans Park beach access is located at Don and Ann Davis Park which is located at the intersection of W Olive Street and SW Elizabeth Street. The beach access trail consists of an improved path constructed of pavers with a relatively short retaining wall (about 4 feet tall) located on the upslope side of the trail. The beach access trail terminates on a section of rip rap boulders placed at the toe of the slope. The trail starts at an elevation of approximately 80 feet and terminates at the beach at about elevation 15 feet.

Review of geologic information and site observations indicated the upper portions of the slope consist of marine terrace deposits overlying the Astoria Formation. Portions of the slope above the trail consist of a near vertical exposure of moderately cemented marine terrace sand. Heights of the vertical exposure vary from approximately 0 to about 8 to 10 feet in height. These exposed near vertical faces exhibited moderate weathering and several large fractures. While global stability of the access route appears stable, the upper, near vertical portions of the slope present a hazard of surficial block failures during a design earthquake. These risks could be reduced by regrading the upper portions of the slope to the angle of repose (about 1.5H:1V) or regular inspection/scaling of the slope.

Evaluation: This site is not recommended for further consideration due to:

- Potential of surficial block failures
- Near proximity to the preferred Nye Beach access

6 - Nye Beach Turnaround

This site is identified by OPRD as beach access 59. It is an active area with nearby shops and restaurants. There is a gentle asphalt ramp to the beach and a clear marking to a safe gathering area. There is an adjacent stone wall that is thought be associated with an early-20th Century Natatorium facility that existed at the site. The stability of that wall during the CSZE would need to be evaluated

to determine the likelihood of failure and then blocking the ramp with debris. This site does not meet ADA requirements, but could provide utility to mobility impaired people.

The western extent of the loop road is supported on a concrete wharf founded on siltstone of the Astoria Formation with the remaining portions of the road supported on Holocene age alluvial soils overlying marine terrace deposits and the Astoria Formation. The slope of Beach Drive is relatively gentle with an average slope of approximately 7H:1V. The surrounding slopes near the beach access are typically steep to moderately steep (up to 1.5H:1V) and are less than the angle of repose except for a retaining wall located on the north side of the access loop road. Details of the retaining wall construction are currently unknown; however, due to the width of the access route, emergency egress could route to the south side of the loop to avoid hazards associated with the wall.

Evaluation: This site is recommended for further consideration due to:

- Its active use by a relatively high number of visitors.
- The good condition of existing surfaces.
- Favorable slope conditions and foundation soils.
- Limited costs to re-align access away from historic wall.
- Limited costs to connect this route to the Sam Moore Parkway Trail and provide additional pedestrian circulation benefits supporting passive recreation for residents as well as for potential tourism value.

7 - Jumpoff Joe

The Jumpoff Joe beach access consists of a moderately steep gravel/wood chip trail located near the intersection of NW Spring Street and NW 12th Street. Based on review of geologic mapping, the beach access is located within the currently active Jumpoff Joe Landslide.

Evaluation: This site is not recommended for further consideration due to:

- Existence of an active landslide

8 - Agate Beach State Recreation Site

This site is identified by OPRD as beach access 58a and is located along NW Oceanview Drive approximately 900 feet north of NW 25th Street. The beach access consists of a short gravel approach that drops approximately 10 feet from elevation 25 feet in the parking lot to elevation 10 feet on the beach. Big Creek is located directly north of the beach access path.

Based on review of historical photographs, the path of Big Creek changes substantially over time with the current path following the edge of the beach to the north before entering the Pacific Ocean near Yaquina Head. Based on geologic mapping and onsite observations, the beach access is situated on a combination of Quaternary beach sand, Marine Terrace sand, as well as fill likely placed during construction of NW Oceanview Drive.

A small bridge would be required to provide year-round access. There is ready access on an asphalt road leading to the identified tsunami evacuation gathering area at the nearby Walmart. This site does not meet ADA requirements, but could provide utility to mobility impaired people.

Evaluation: This site is recommended for further consideration due to:

- Relatively low risk of slope movements.
- Its active use by a relatively high number of visitors.
- Existing connection to a nearby gathering area.
- Minimal changes to function as an evacuation route.
- Oregon State Parks may be willing to share in funding some of the improvements, which could support a stronger connection (identified as an opportunity in the Park System Master Plan) to the adjacent Ocean to Bay Trail.

9 - Ernest Bloch/Lucky Gap Trail South

The Ernest Bloch/Lucky Gap south access trail is located south of Yaquina Head. The south trail is located near the intersection of NW Woody Way and NW Gilbert Way. The trails consist of a combination of paved surfaces and an elevated staircase. A culvert is located at the upper portions of the trail as it crosses Little Schooner Creek, and a retaining wall is located on the downslope side of the trail approximately midway down. The trails start at an elevation of approximately 100 feet and descends to the beach at an elevation of approximately 15 feet. Portions of the trail indicated movements likely associated with erosion along the creek, including the mid-slope retaining wall, beginning to fail. Additional review of LIDAR indicates the potential for relatively recent slope movements along and on the slopes directly above the beach near the base of the trail.

Evaluation: This site is not recommended for further consideration due to:

- The presence of active slope movement
- Steep access and significant elevation difference along the trail
- Substantial reconstruction needed to stabilize existing retaining walls

10 - Ernest Bloch/Lucky Gap Trail North

The Ernest Bloch/Lucky Gap south access trail is located south of Yaquina Head. The north trail is located near the intersection of NW Gilbert Way and NW Agate Way. The trails consist of a combination of paved surfaces, gravel path, stairs, and a section of boulders/rip-rap. The trails start at an elevation of approximately 100 feet and descends to the beach at an elevation of approximately 15 feet and the City indicated high use by surfers.

Based on review of geologic mapping and the site reconnaissance, active slope movements were observed along the trail. Geologic maps indicate the trail is located entirely within a zone of historical and active landslide.

Evaluation: This site is not recommended for further consideration due to:

- The presence of active slope movement
- Steep access and significant elevation difference along the trail

11 - Schooner Creek

The NW 68th Street beach access route is located along NW 68th Street at the intersection with US101. NW 68th Street intersects US101 at an elevation of approximately 95 feet and terminates in a paved

parking lot at an elevation of approximately 30 feet. A dirt and gravel path extends from the parking lot and terminates on the beach at an elevation of approximately 15 feet.

The current beach access is directly adjacent to Schooner Creek and consists of large angular rock (pit run) to likely limit erosion due to the presence of the creek. The slopes adjacent to the access trail are typically 10 feet tall near vertical banks cut into the conglomerate overlying Astoria Formation.

Observations while on site indicate regular erosional wear of the bank likely due to storms and/or king tides and would need to be considered for any permanent structures located in this location.

This location is a moderately active use area near Yaquina Head. The existing surfaces are in good condition. However, the debris flow materials onsite and the adjacent Schooner Creek Landslide present increased risks and raise a question about what improvements might need to be made so that this access could serve as an effective evacuation route. Should the assessment of landslide vulnerability be favorable, making improvements here would tie in nicely with the following opportunities identified in the Park System Master Plan: proposed Highway 101 undercrossing and connection to Nautical Hill Open Space, and via a potential future trail back to the Ernest Bloch/Lucky Gap Trail.

Evaluation: This site is recommended for further consideration due to:

- The need for a beach access point north of Yaquina Head
- Moderate grade when compared to nearby access locations

Conclusion and Next Steps

We anticipate the three access points that we have proposed for further evaluation will be reviewed and agreed upon by DLCD and the City, after which, the KPFF team will begin development of concept level seismic resiliency improvements at the three selected locations.

Appendix A. Photos

Photo 1: Access Site 1 – Steep Slopes Adjacent to Trail

Photo 2: Access Site 2 – Steep Slopes Adjacent to Trail

Photo 3: Access Site 3 – Access Structure on Steep Slope

Photo 4: Access Site 4 – Access Structure on Steep Slope

Photo 5: Access Site 5 – Paved Walkway Adjacent to Steep Slope

Photo 6: Access Site 6 – Ramp to Beach Adjacent to Retaining Walls

Photo 7: Access Site 7 – Gravel Trail to Beach

Photo 8: Access Site 8 – Ramp and Creek Crossing

Photo 9: Access Site 9 – Steep Slopes Adjacent to Trail

Photo 10: Access Site 10 – Access Along Steep Slope

Photo 11: Access Site 11 – Adjacent to Creek Outlet