



Date August 23, 2024  
To BERK Consulting  
From KPFF Consulting Engineers  
Subject Climate Impacts Assessment – Sea Level Rise Review

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## Climate Impacts Assessment – Sea Level Rise Review

On May 29, 2024, KPFF conducted a site visit, accompanied by representatives from the Town of Friday Harbor, to assess vulnerable areas and infrastructure from the Town's perspective. The purpose of this visit was to evaluate the potential impact of sea level rise (SLR) on the Town of Friday Harbor, highlighting specific concerns and vulnerabilities based on existing data and observations.

### I. Review of Estimated Sea Level Elevations and Current Shoreline Vulnerability

Based on current projections of sea level rise assuming the RCP8.5 emission scenario, the projected absolute sea level rise by 2100 is estimated to be between 1.6 and 2.0 feet<sup>1</sup>. Key elevations at the Friday Harbor tidal station with and without sea level rise are shown below:

Elevation	NAVD 88 Datum <sup>2</sup>	MLLW Datum <sup>3</sup>
Mean Higher High Water	7.13 ft	7.76 ft
Highest Astronomical Tide	8.75 ft	9.38 ft
Highest Observed Tide <sup>4</sup>	10.52 ft	11.15 ft
FEMA Zone AE Base Flood Elevation	13 ft	13.63
Mean Higher High Water + SLR	8.73 – 9.13 ft	9.36 – 9.76 ft
Highest Astronomic Tide + SLR	10.35 – 10.75 ft	10.98 – 11.38 ft
Highest Observed Tide + SLR	12.12 – 12.52 ft	12.75 – 13.15 ft
FEMA Base Flood Elevation + SLR	14.6 – 15 ft	15.23 – 15.63

The Highest Astronomical Tide is the highest predicted tide based solely on the gravitational effects of the sun and moon. These tides are frequently called “king tides” and can cause nuisance flooding in low-lying

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<sup>1</sup> Miller et al, 2018, Projected Sea Level Rise for Washington State, updated July 2019

<sup>2</sup> The North American Vertical Datum of 1988 (NAVD 88) is a geodetic datum used to provide a consistent reference for measuring elevations and heights across North America.

<sup>3</sup> The Mean Lower Low Water (MLLW) datum is a tidal datum used primarily in the United States to measure tidal and coastal elevations.

<sup>4</sup> The Highest Observed tide occurred on 12/16/1982 at 07:00 per NOAA Tides and Currents web site, <https://tidesandcurrents.noaa.gov/datums.html?id=9449880>. During this low-pressure event, the verified tide level was approximately 2.5 feet higher than the predicted tide.



areas. The highest observed tide typically occurs when a low-pressure storm system occurs at the same time as a king tide, which can increase water levels by nearly two feet in this area.

FEMA Flood Insurance Rate Maps are published using the NAVD 88 datum, so flood risk analysis should reference elevations using this datum. The Mean Lower Low Water datum is commonly used for navigation charts and waterfront construction and is approximately 0.627 feet higher than the NAVD 88 datum at Friday Harbor. The reference datum for any elevation data needs to be verified and corrected as necessary to make correct comparisons.

The Town of Friday Harbor is not within a designated floodplain and does not participate in the National Flood Insurance Program. Although the immediate flood risks may be lower, the Town could still be susceptible to the long-term impacts of sea level rise, especially during storm events accompanied by SLR and high tide events.

The Town has elevation and lidar data from 2016, which serve as a basis for understanding the current elevation profiles and potential future vulnerabilities. This data can show areas at risk and guide the planning of mitigation measures. The five-foot contour data available through the San Juan County GIS server was used to assess infrastructure risks in Friday Harbor.

New San Juan Country SLR data is expected to become available after this memo is submitted. The latest data should be reviewed carefully for any significant changes.

Moreover, the following maps shows a visual of the potential inundation scenarios.



Figure 1 Friday Harbor Inundation Map for SLR Scenario Projections in Downtown

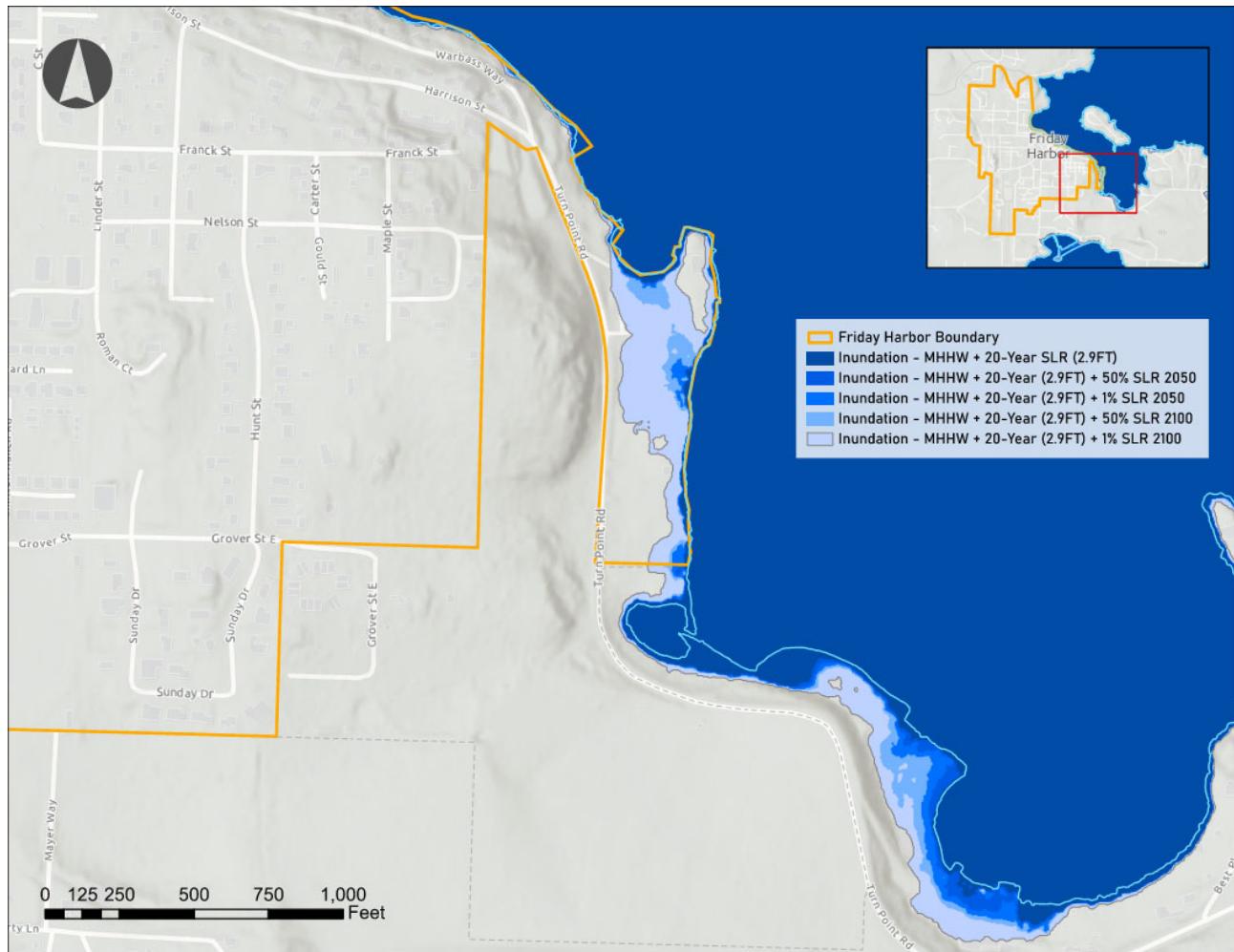


Figure 2 Friday Harbor Inundation Map for SLR Scenario Projections in Shipyard Cove Marina

## II. Identification of Vulnerable Shoreline Buildings and Infrastructure

Most buildings and infrastructure owned by the Town of Friday Harbor are not at immediate risk from sea level rise. However, overwater and shoreline infrastructure such as the marina piers and floating docks and the WSF ferry terminal are critical transportation facilities that will be affected by sea level rise. These facilities are owned by others, including the Port of Friday Harbor, Washington State Department of Transportation (WSDOT), and private owners.

WSDOT is assessing both flooding and seismic risks at its terminals throughout the system and prioritizing capital investments based on multiple factors, including but not limited to ridership and economic impacts. Lessons learned from other terminal improvements will be applied when developing designs to improve the resiliency of the Friday Harbor Terminal.

The map below shows parcels which have some portion that has coastal flooding exposure in the Town of Friday Harbor. For the majority of these shoreline parcels, this risk is low as it is only along the waterward edge of the parcel.



Figure 3 Coastal Flooding Exposure of the Town of Friday Harbor



Figure 4 View of Shipyard Cove Marina (KPFF)

The lowest areas of the Town include a private family estate and Shipyard Cove Marina, southeast of downtown. Both are susceptible to flooding due to SLR. According to the Jensen's/Shipyard Cove 2020 Master Plan, "excavation for redevelopment will generate enough suitable fill to raise the site by an

additional 2 to 3 feet, which would exceed the predicted SLR elevation within the 100-year timeframe.<sup>5</sup> This aligns with current predictions for likely sea level rise scenarios.

The Town's stormwater outfalls along the shoreline are designed to manage high tides and prevent backflow. The stormwater system is configured to drain effectively, even during high tides. However, continuous monitoring and upgrades may be necessary to ensure these systems remain effective in the face of climate change. The Town's sewer and stormwater systems are not combined, reducing potential cross-contamination risks.

The Town's sanitary sewer system includes two key pump stations, one near the Ferry Terminal and one at end of McDonald Ave, both of which could be vulnerable to sea level rise and potential flooding. These pump stations are essential for the Town's sewage and stormwater management, making their protection a high priority.

Notably, Pump Station 1, located behind the Cannery Landing Building, with a rim elevation of between 10 and 15 feet NAVD 88. While it is currently well above the FEMA base flood elevation, with two feet of sea level rise, it could be at risk of flooding during a 100-year flood event. Under king tide and king tide plus storm scenarios, the rim is unlikely to be overtopped, but the interior of the pump station would be at risk if there is any damage to the offshore force main that parallels Warbass Way or the private side sewers connected to the force main.



Present concerns include potential damage to the underwater force main from floating debris during storm events and the resulting seawater inflow. The existing force main is well protected in most places, and this risk is fairly low.



*Figure 7 View of Pump Station 1 Behind the Ferry Terminal (KPFF)*



*Figure 6 View of Underwater Pipe in the Vicinity of Pump 1 (KPFF)*

Another risk of seawater intrusion into the sanitary sewer system is the private sewer lines connecting to the Town's force main. Any exposed portions of these lines are at risk of damage due to floating debris, and even a partial failure could allow seawater to enter the system.

If seawater gets into the sewage treatment system due to high tides, storm surges, or damage to the sewer lines, it could cause significant environmental impacts. Saltwater intrusion into the sewage system can lead to corrosion of infrastructure, reduced efficiency of the pumps, and potential failure of sewage treatment processes. Untreated sewage can be released into the environment, leading to contamination of water bodies, harm to marine life, and health risks for the local population.

Pump Station 2 is at a slightly higher elevation than Pump Station 1 and is at lower risk as it is not served by an offshore force main with associated side sewers. The lower portion of the pump station, which is between 10' and 15' of elevation, could be at risk of inundation under king tide or 100-year flood events.



*Figure 8 View of Pump Station 2 in the Easement of McDonald Ave (KPFF)*

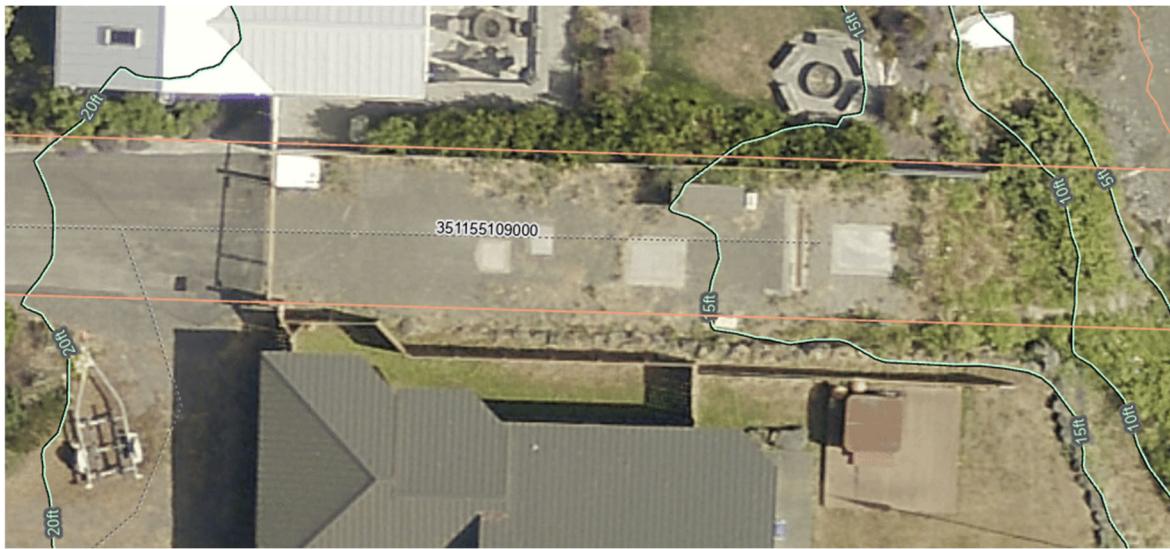


Figure 9: Pump Station 2 with 5' Elevation Contours (San Juan Country GIS)

### III. Conclusion

While the Town of Friday Harbor does not currently face immediate flood risks to its infrastructure, proactive measures are essential to address the vulnerabilities described, particularly regarding the two potentially at-risk pump stations. Maintaining these facilities and improving overall resilience will help mitigate the long-term impacts of sea level rise on the town's infrastructure. Additionally, addressing the potential environmental impacts of seawater backflow into the pumps is crucial for supporting the integrity of the town's infrastructure and protecting the local ecosystem.

Other critical infrastructure within the Town limits, including the marina and ferry terminal, are owned by others. While the Town is not responsible for these facilities, coordination with these other owners will be necessary to ensure the resiliency of the transportation systems serving the Town and the rest of San Juan Island.