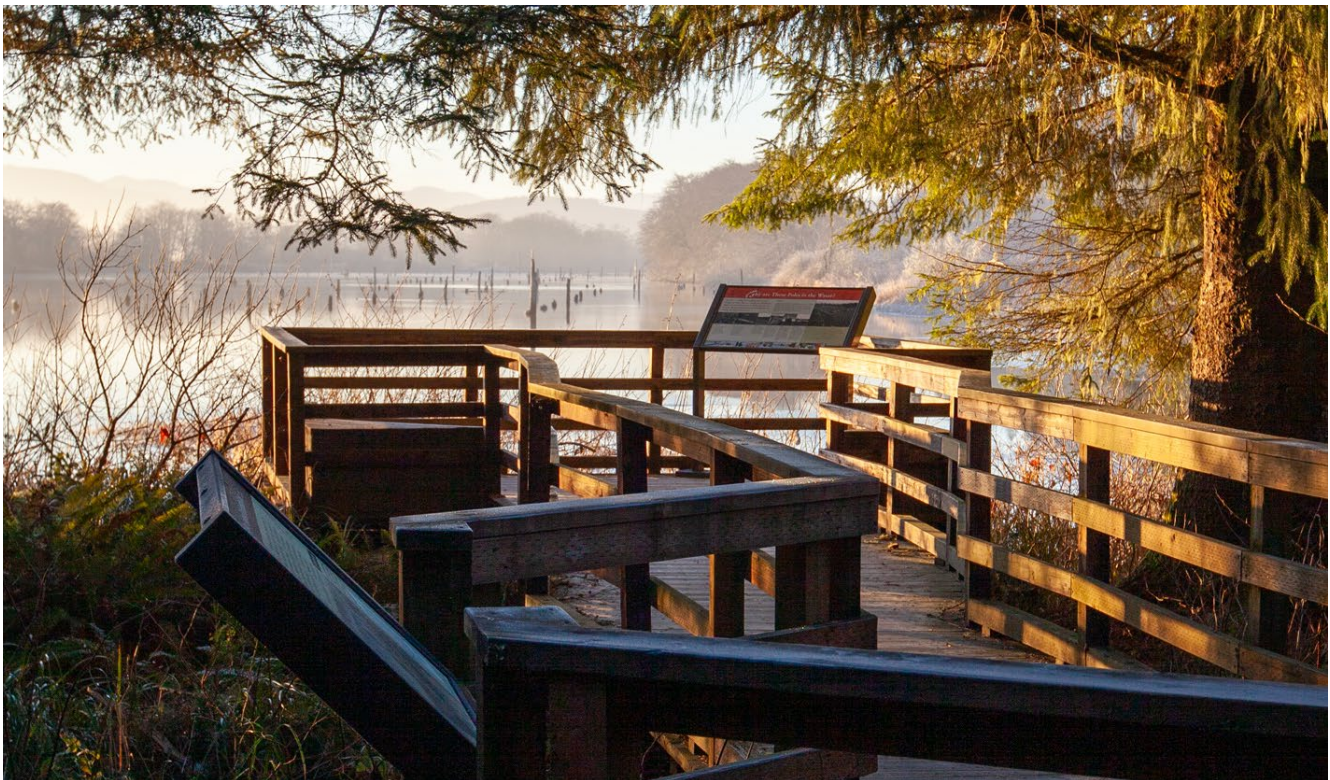




Coastal Hazards & Sea-Level Rise Asset Vulnerability Assessment for Lewis and Clark National Historical Park

Summary of Results

NPS 405/199169, March 2026



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Historic Canoe Landing at Lewis and Clark National Historical Park

Photo credit: Lewis & Clark Trail Alliance

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Program for the Study of Developed Shorelines
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Executive Summary

This document presents the results of the **Coastal Hazards & Sea-Level Rise (SLR) Asset Vulnerability Assessment (VA)** completed by Western Carolina University at Lewis and Clark National Historical Park (LEWI) in 2025. In this VA, we evaluate the vulnerability (as a combination of exposure and sensitivity) of NPS buildings and transportation assets¹ to identified coastal hazards and climate change factors, approximately to the year 2050 (for full methodology, see Peek et al. 2022).

We assessed 26 buildings (including a visitor center, fortification replica, comfort stations, shelters, vault toilets, and historic structures), and 55 transportation assets (roads, parking lots, trails/trail segments, and bridges) at LEWI. Almost half of the assets evaluated at LEWI have high (16%) or moderate (32%) vulnerability to the evaluated coastal hazards and SLR, while 12% have low vulnerability. Over one-third (40%) have minimal vulnerability (outside of all hazard zones). Most of the high vulnerability assets are located along the Lewis and Clark River in the Fort Clatsop and Netul Landing areas of LEWI. Scoring details and results for all assets evaluated at LEWI are reported in the provided Excel sheets.

¹ The NPS Facility Management Software System (FMSS) database defines assets as “...a physical structure or grouping of structures, land features, or other tangible property that has a specific service or function, such as a farm, cemetery, campground, marina, or sewage treatment plant. The term ‘asset’ shall also be applied to movable items, such as vehicles and equipment.”

LEWI Exposure Results

Exposure is a measure of the character, magnitude, and rate of changes a target may experience (e.g., from the impacts of natural hazards or climate change; NPS 2021). In this VA, we evaluate the exposure of each asset to the following coastal hazard indicators: flooding potential, shoreline change, SLR inundation, extreme event flooding, and reported coastal hazards (Table 1).

Table 1. Exposure indicators and hazard data sources used for LEWI.

Exposure Indicator (Description)	Data (Citation)
Flooding potential (1% annual-chance)	Effective FEMA VE & A zones (FEMA 2010; 2015; 2016) Preliminary FEMA VE & A Zones (FEMA 2025)
Shoreline change (erosion, coastal proximity)	USGS Pacific Northwest Shoreline Change data (Kratzmann et al. 2013) WA Coastal Erosion Hazard Assessment (WA Dept of Ecology 2021) 25-m shoreline proximity buffer (Peek et al. 2022)
SLR inundation (2050)	NPS 2050 8.5 RCP SLR model; 0.19 m rise (Caffrey et al. 2018) NOAA 1 ft SLR inundation zone (NOAA 2022)
Extreme event flooding (tsunami inundation)	Washington State DNR Tsunami Hazard Areas (WGS 2024) Oregon State Tsunami Evacuation Zones (Priest et al. 2013)
Reported coastal hazards (historic flooding/active erosion)	Questionnaire results & discussions (Peek et al. 2022)

Assets with high exposure are within at least four exposure indicator hazard zones. Assets with moderate exposure are within two or three exposure indicator hazard zones. Assets with low exposure are within only one exposure indicator hazard zone. The asset could still be seriously impacted by this hazard. Assets with minimal exposure are not in any exposure indicator hazard zone. This does not mean that the asset has no exposure to coastal hazards, but it is not within the exposure hazard data used in this study.

Six (7%) transportation assets analyzed at LEWI have high exposure to the coastal hazards evaluated (Table 2, and Figures 1-3). None of the 26 buildings/structures analyzed have high exposure. Three assets are within all exposure zones: Fort Clatsop Highway Bridge, Netul River Trail Foot Bridge, and Netul River Trail Bridge (Figure 2). Twenty-six assets (32%) evaluated at LEWI have moderate exposure and 17 (21%) have low exposure; over one-third (40%) of assets have minimal exposure (Table 2, and Figures 1-3).

Table 2. LEWI exposure results. Sum of percentages may not equal 100 due to rounding.

Assets	High Exposure		Moderate Exposure		Low Exposure		Minimal Exposure		Total #
	#	%	#	%	#	%	#	%	
Buildings	0	0%	9	35%	4	15%	13	50%	26
Transportation	6	11%	17	31%	13	24%	19	35%	55
All Assets	6	7%	26	32%	17	21%	32	40%	81

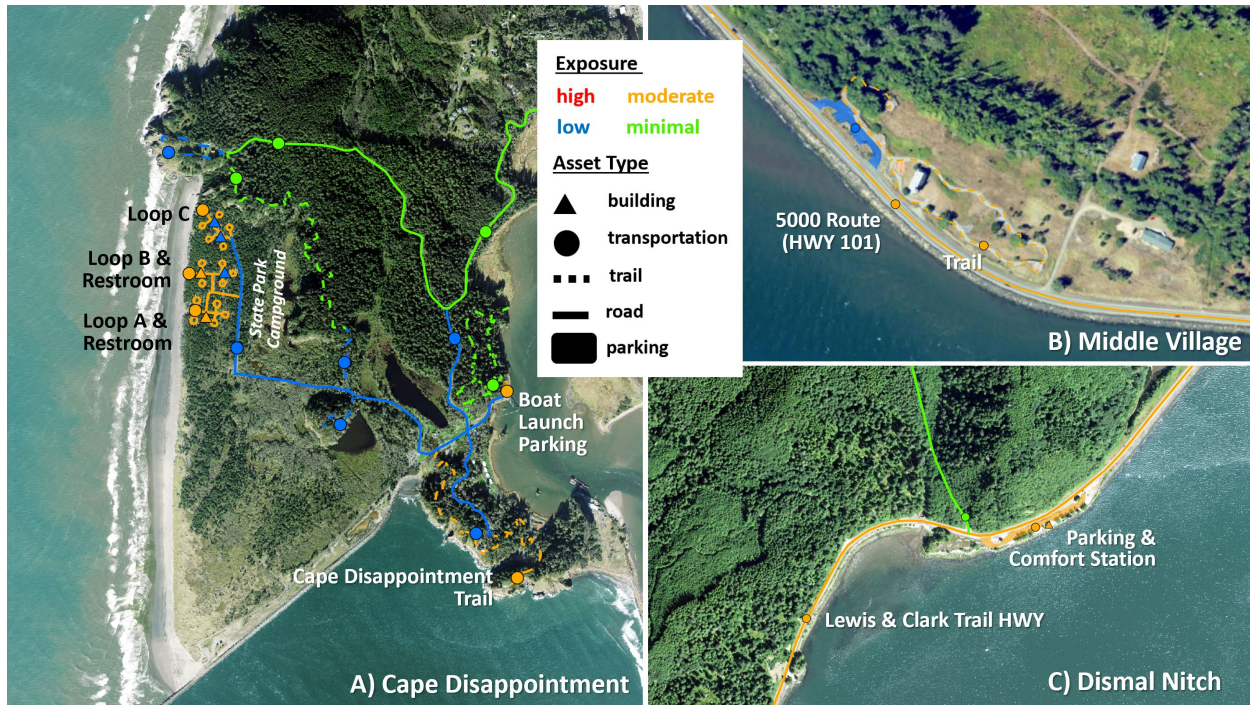


Figure 1. LEWI exposure results in the A) Cape Disappointment, B) Middle Village, and C) Dismal Nitch areas of the park. Only moderate exposure assets are labeled. Background is 2023 NAIP Imagery (USDA 2025).

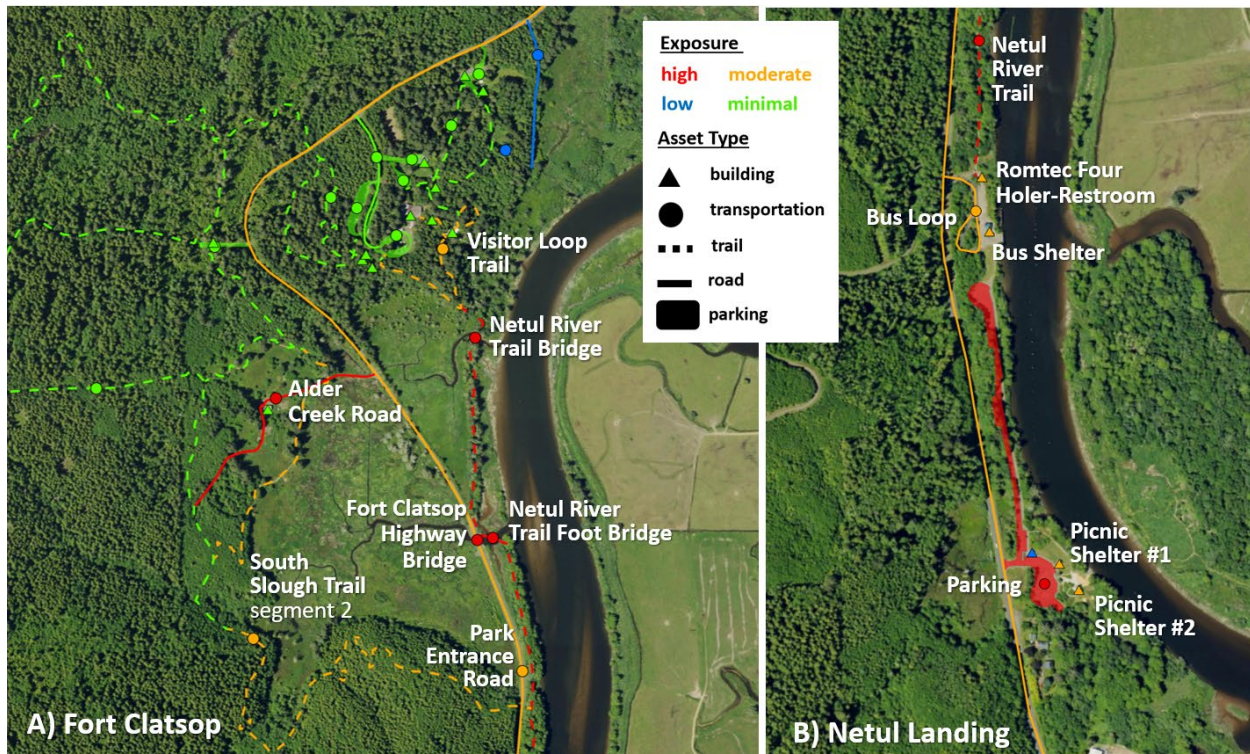


Figure 2. LEWI exposure results in the A) Fort Clatsop and B) Netul Landing areas of the park. Only high and moderate exposure assets are labeled. Background is 2022 NAIP Imagery (USDA 2025).



Figure 3. LEWI exposure results in the A) Sunset Beach and B) Seaside areas of the park. Only moderate exposure assets are labeled. Background is 2022 NAIP Imagery (USDA 2025).

LEWI Sensitivity Results

Sensitivity reflects the degree to which a resource is affected by exposure (NPS 2021). In this VA, we assess the following sensitivity indicators: flood damage potential, storm resistance and condition, historic damage, and protective engineering. In general, assets with high sensitivity have unfavorable determinations for three or four of these indicators, moderate sensitivity assets have unfavorable determinations for two indicators, and low sensitivity assets have unfavorable determinations for zero or one indicator. Assets with minimal exposure are not analyzed for sensitivity (this is the case for 32 assets at LEWI).

Over one-third (35%) of all assets analyzed at LEWI have high sensitivity to the coastal hazards evaluated (Table 3). The remaining assets (65%) have moderate sensitivity (no assets have low

sensitivity). In most cases, assets were high sensitivity (versus moderate) due to poor condition. No assets were reported to be storm resistant, and most do not have effective protective engineering. Three assets received unfavorable rankings for all sensitivity indicators: Cape Disappointment State Park Interpretive Center Parking Lots (not in FMSS); Alder Creek Road, and Netul River Trail Foot Bridge.

Table 3. LEWI sensitivity results. Sum of percentages may not equal 100 due to rounding.

Assets	High Sensitivity		Moderate Sensitivity		Low Sensitivity		Total Analyzed	Excluded*
	#	%	#	%	#	%	#	#
Buildings	6	46%	7	54%	0	0%	13	13
Transportation	11	31%	25	69%	0	0%	36	19
All Assets	17	35%	32	65%	0	0%	49	32

*Minimal exposure assets were excluded from the sensitivity analysis; total number analyzed is different for sensitivity.

LEWI Vulnerability Results

Vulnerability is a measure of the degree to which park resources and assets are “susceptible to harm from direct and indirect effects of climate change, including variability and extremes” (NPS 2021). In this VA, we evaluate the vulnerability of infrastructure assets as a simple combination of exposure and sensitivity ratings. It should be noted that the vulnerability of any asset can change with time (e.g., due to adaptation actions or the result of geomorphic change).

Thirteen assets (16%) analyzed at LEWI have high vulnerability to the evaluated coastal hazards (Table 4, and Figures 4-7), ten of which are transportation assets. Over half of the high vulnerability assets are located along the Lewis and Clark River in the Fort Clatsop and Netul Landing areas of the park (Figure 6). Three assets evaluated at LEWI have both high exposure and high sensitivity: Alder Creek Road, Fort Clatsop Highway Bridge, and Netul River Trail Foot Bridge (Figure 6). Nine assets have both high vulnerability and a high asset priority index ($API \geq 70$, as reported in FMSS), including: Park Entrance Road, Netul River Trail, Netul River Trail Bridge, and Sunset Beach Education Center. Twenty-six (32%) assets have moderate vulnerability, ten (12%) have low vulnerability, and 32 (40%) assets have minimal vulnerability (Table 4, and Figure 4-7).

Table 4. LEWI vulnerability results. Sum of percentages may not equal 100 due to rounding.

Assets	High Vulnerability		Moderate Vulnerability		Low Vulnerability		Minimal Vulnerability		Total
	#	%	#	%	#	%	#	%	#
Buildings	3	12%	9	35%	1	4%	13	50%	26
Transportation	10	18%	17	31%	9	16%	19	35%	55
All Assets	13	16%	26	32%	10	12%	32	40%	81



Figure 4. LEWI vulnerability results for the Cape Disappointment area. Only high or moderate vulnerability assets are labeled. Background is 2023 NOAA Imagery (NGS 2025).



Figure 5. LEWI vulnerability results for the A) Middle Village and B) Dismal Nitch areas. Only moderate vulnerability assets are labeled. Background is 2023 NAIP imagery (USDA 2025).

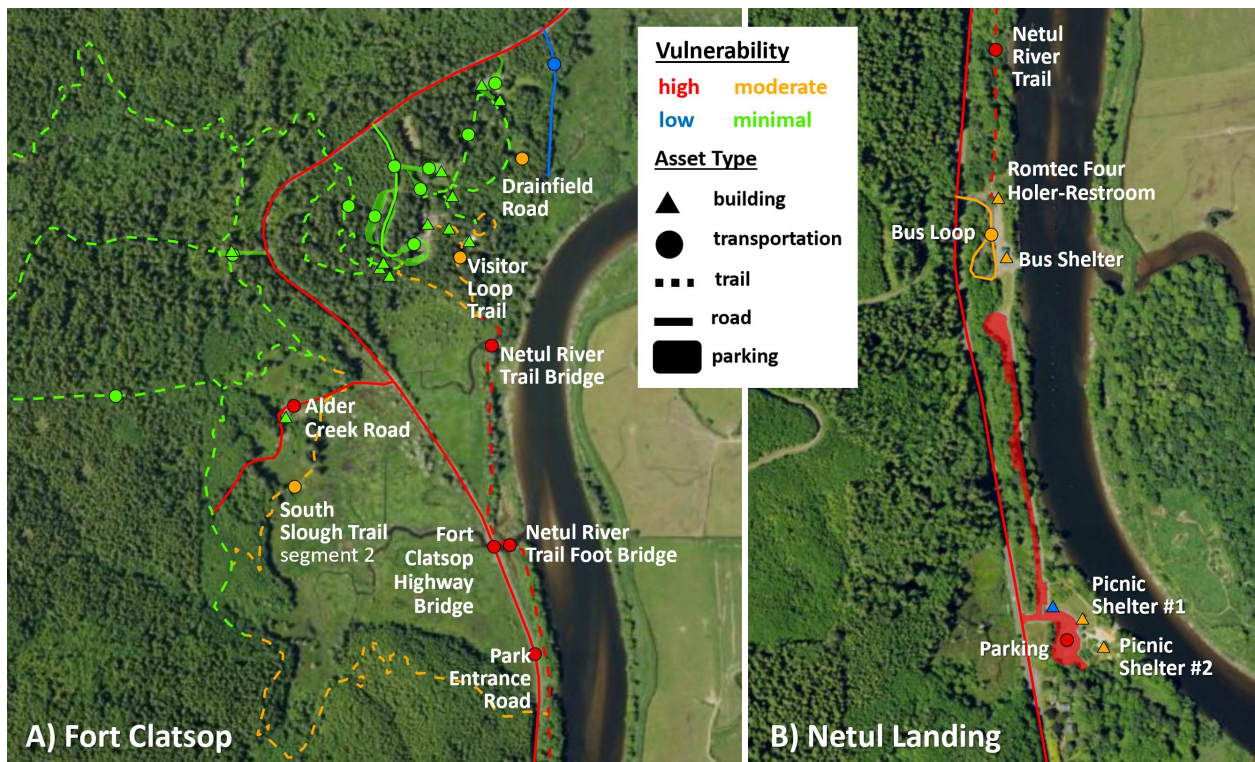


Figure 6. LEWI vulnerability results for the A) Fort Clatsop and B) Netul Landing areas. Only high or moderate vulnerability assets are labeled. Background is 2022 NAIP imagery (USDA 2025).



Figure 7. LEWI vulnerability results in the A) Sunset Beach and B) Seaside areas of the park. Only high and moderate vulnerability assets are labeled. Background is 2022 NAIP Imagery (USDA 2025).

LEWI Unique Considerations

FMSS Assets: We analyzed 25 assets at LEWI that are not listed in FMSS. Sixteen of these assets are located within Cape Disappointment State Park.

Linear assets: Due to exposure variability, we segmented three trails at LEWI: Fort to Sea Trail (two segments), South Slough Trail (two segments), and North Head Trail (two segments). We evaluated each segment individually for exposure, sensitivity, and vulnerability, and assigned each segment a modified location code. Any statistics or estimates of value represent the entire road or trail, even if only a small portion has high exposure or vulnerability.

SLR Data: We used two sources for the SLR indicator: 1) National Oceanic and Atmospheric Administration (NOAA) 1 ft SLR model (2022), and 2) NPS 2050 8.5 Representative Concentration Pathway SLR projection and inundation model (Caffrey et al. 2018; 0.19 m or 0.6 ft rise for LEWI).

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