



Coastal Hazards & Sea-Level Rise Asset Vulnerability Assessment for Saint Croix Island International Historic Site

Summary of Results

NPS 443/188060, April 2023



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View looking towards Saint Croix Island at Saint Croix Island International Historic Site

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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 Saint Croix Island International Historic Site (SACR) in 2022. 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 nine buildings/structures (including a contact station, interpretation shelter, boat house, cabin, garage, vault toilet, and statues), and six transportation assets (a trail, stairs, road segments, and a parking lot) at SACR. Over one-quarter (27%) of assets have high vulnerability to the evaluated coastal hazards and SLR, while the majority (73%) of assets have low or minimal vulnerability. Scoring details and results for all assets evaluated at SACR are reported in the provided Excel sheets.

Exposure Results

Exposure is a measure of the character, magnitude, and rate of changes a target may experience (e.g., from the impacts of climate change or a natural hazard influenced by 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.

Exposure Indicator (Description)	SACR Data (Citation)
Flooding potential (1% annual-chance)	Effective FEMA VE & A zones (FEMA 2017)
Shoreline change (coastal proximity)	30-m shoreline proximity buffer (Peek et al. 2022)
SLR inundation (2050 proxy) *	NPS 2100 4.5 RCP SLR model; 0.36 m rise (Caffrey et al. 2018)
Extreme event flooding (category 3 surge)	NPS storm surge inundation model (Caffrey et al. 2018)
Reported coastal hazards (historic flooding)	Questionnaire results & discussions (Peek et al. 2022)

*See Unique Considerations

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.”

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.

Only four assets at SACR have high exposure to the evaluated coastal hazards and SLR (Table 2): St. Croix Island Maintained Grounds (Stairs to Beach), St. Croix Boat House, Red Beach Maintained Grounds (Stairs to Boat Ramp), and St. Croix Island Access Road (East Segment to Boat Access). The St. Croix Island Maintained Grounds (Stairs to Beach) is the only asset within all evaluated exposure zones. No assets have moderate exposure, six have low exposure, and five have minimal exposure.

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

Assets	High Exposure		Moderate Exposure		Low Exposure		Minimal Exposure		Total
	#	%	#	%	#	%	#	%	#
Buildings	1	11%	0	0%	4	44%	4	44%	9
Transportation	3	50%	0	0%	2	33%	1	17%	6
All Assets	4	27%	0	0%	6	40%	5	33%	15

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/elevated, storm resistance and condition, historic damage, and protective engineering. In general, assets with high sensitivity have unfavorable determinations for 3 or 4 of these indicators, moderate-sensitivity assets have unfavorable determinations for 2 indicators, and low-sensitivity assets have unfavorable determinations for 0 or 1 indicator. Assets with minimal exposure are not analyzed for sensitivity (this is the case for five assets at SACR).

Two of the assets analyzed at SACR have high sensitivity to coastal hazards and SLR, while eight assets have moderate (Table 3). No assets were reported to be significantly elevated above local ground level or storm resistant, while most are in good condition and have not been historically damaged by coastal flooding.

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

Assets	High Sensitivity		Moderate Sensitivity		Low Sensitivity		Total Analyzed	Excluded*
	#	%	#	%	#	%	#	#
Buildings	1	20%	4	80%	0	0%	5	4
Transportation	1	20%	4	80%	0	0%	5	1
All Assets	2	20%	8	80%	0	0%	10	5

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

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).

The vulnerability results at SACR are identical to the exposure results, which means that the vulnerability of these assets is primarily controlled by exposure (Table 4, and Figures 1-2). Four assets have high vulnerability to the evaluated coastal hazards and SLR: St. Croix Island Maintained Grounds (Stairs to Beach), St. Croix Boat House, Red Beach Maintained Grounds (Stairs to Boat Ramp), and St. Croix Island Access Road (East Segment to Boat Access). The St. Croix Boat House and St. Croix Island Maintained Grounds (Stairs to Beach) have both high exposure and high sensitivity. Most assets at SACR have low (40%) or minimal (33%) vulnerability to the evaluated coastal hazards.

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

Assets	High Vulnerability		Moderate Vulnerability		Low Vulnerability		Minimal Vulnerability		Total
	#	%	#	%	#	%	#	%	#
Buildings	1	11%	0	0%	4	44%	4	44%	9
Transportation	3	50%	0	0%	2	33%	1	17%	6
All Assets	4	27%	0	0%	6	40%	5	33%	15



Figure 1. SACR exposure and vulnerability results summary for the mainland area. Background is Google Earth streaming imagery.



Figure 2. SACR exposure and vulnerability results summary for Saint Croix Island. Background is Google Earth streaming imagery.

SACR Unique Considerations

Shoreline change data: United States Geological Survey (USGS) or other shoreline erosion rate data are not available for SACR, which has non-oceanfront coastlines. As a result, we used a simple coastal proximity buffer of 30 meters, which accommodates an erosion rate up to 1m/year and assumes that infrastructure near the coast is likely to experience multiple coastal hazards within the 30-year (approximately 2050) timeframe of this analysis (see Peek et al. 2022).

SLR data: We used the 2100 4.5 Representative Concentration Pathway (RCP) SLR projections and inundation model from Caffrey et al. (2018) developed specifically for NPS units to score exposure for this indicator (0.36 m rise for SACR). These data are used as a proxy for 2050 SLR to accommodate higher SLR projections recently released by NOAA (see Peek et al. 2022).

Linear assets: We divided the St. Croix Island Access Road into two segments (west segment near the Contact Station and east segment leading to the Boat Access). We evaluated each segment individually for exposure, sensitivity, and vulnerability, and assigned each segment a modified location code (segments share the same FMSS attributes).

FMSS assets: Several assets at SACR were not listed individually in FMSS, but instead are listed as part of a larger grounds area. We divided the Red Beach Maintained Grounds FMSS location into two assets, the trail and the stairs to the boat ramp. For the St. Croix Island Maintained Grounds FMSS location, we only analyzed the stairs to the beach.

References

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