



Coastal Hazards & Sea-Level Rise Asset Vulnerability Assessment for Point Reyes National Seashore

Summary of Results

NPS 612/199461, April 2026



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Historic Lifeboat Station Boathouse at Point Reyes National Seashore

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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 Point Reyes National Seashore (PORE) 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 401 buildings (including visitor centers, maintenance facilities, comfort stations, cabins, barns, vault toilets, historic structures, and residences), and 284 transportation assets (roads, road segments, trails, trail segments, parking lots, bridges, trail bridges, piers/docks, and a marine railway) at PORE. Less than one-fifth (12%) of assets analyzed have high or moderate vulnerability to the evaluated coastal hazards and SLR. The majority (84%) have minimal vulnerability (are not in any of the evaluated hazard zones). The significant number of minimal vulnerability assets is a factor of the high elevations in many areas of the park, leading to lower exposure overall to coastal flooding and SLR. Scoring details and results for all assets evaluated at PORE 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.”

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. PORE exposure indicators and hazard data source.

Exposure Indicator (Description)	Data (Citation)
Flooding potential (1% annual-chance)	Effective FEMA VE & A zones (FEMA 2017) USGS CoSMoS 25 cm SLR + 100-year flood zone (Barnard et al. 2022)
Shoreline change (erosion, cliff retreat, coastal proximity)	USGS Short-Term Shoreline Change Rates (Hapke and Reid 2006) USGS Cliff Retreat data (Hapke et al. 2008) USGS CoSMoS coastal cliff retreat due to SLR (Barnard et al. 2022) 30-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-foot SLR zone (NOAA 2022)
Extreme event flooding (tsunami)	California Tsunami Hazard Areas (Graehl et al. 2022)
Reported coastal hazards (historic flooding/active cliff retreat)	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.

Only twelve assets (2%) analyzed at PORE have high exposure to the evaluated coastal hazards (Table 2, and Figures 1-6), including the Historic Lifeboat Station Boathouse, Sacramento Landing Pier, and Historic Lifeboat Marine Railway. Eight assets are within all evaluated exposure zones: Historic Lifeboat Station Boathouse, Mendoza Fish Dock, Mendoza Fish Dock Shed, Duck Cove Pier, Estero Trail Bridge (near Home Bay), Historic Lifeboat Marine Railway, Sacramento Landing Pier, and Schooner Bay Parking Lot. Sixty-two assets (9%) have moderate exposure, and 38 (6%) have low exposure. Over three-quarters (84%) of assets have minimal exposure (Figure 1), a result of the park's higher elevation leading to lower exposure overall to coastal flooding and SLR.

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

Assets	High Exposure		Moderate Exposure		Low Exposure		Minimal Exposure		Total
	#	%	#	%	#	%	#	%	#
Buildings	3	1%	22	5%	12	3%	364	91%	401
Transportation	9	3%	40	14%	26	9%	209	78%	284
All Assets	12	2%	62	9%	38	6%	573	84%	685

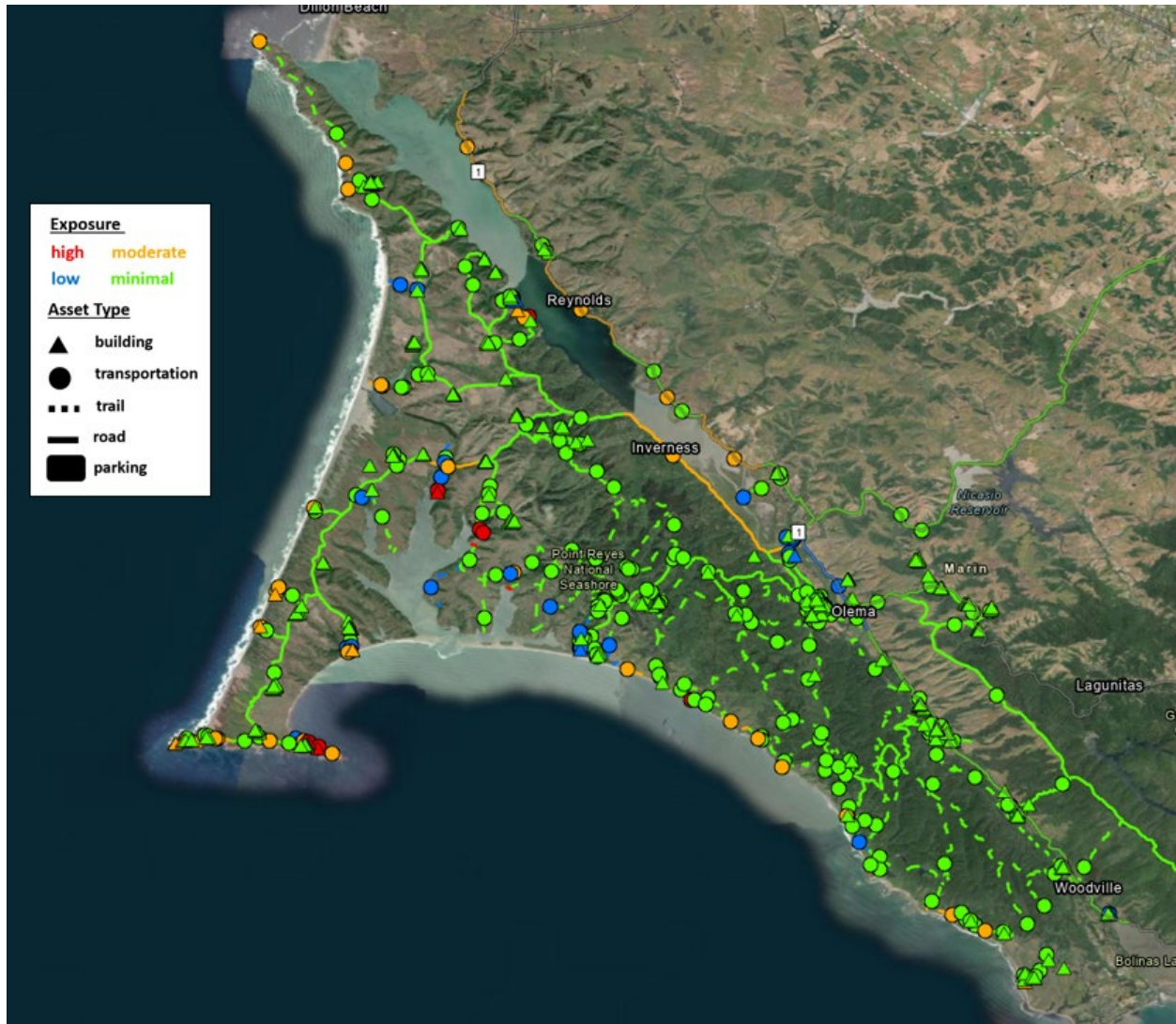


Figure 1. PORE exposure results overview. Background is 2022 ESRI world imagery.

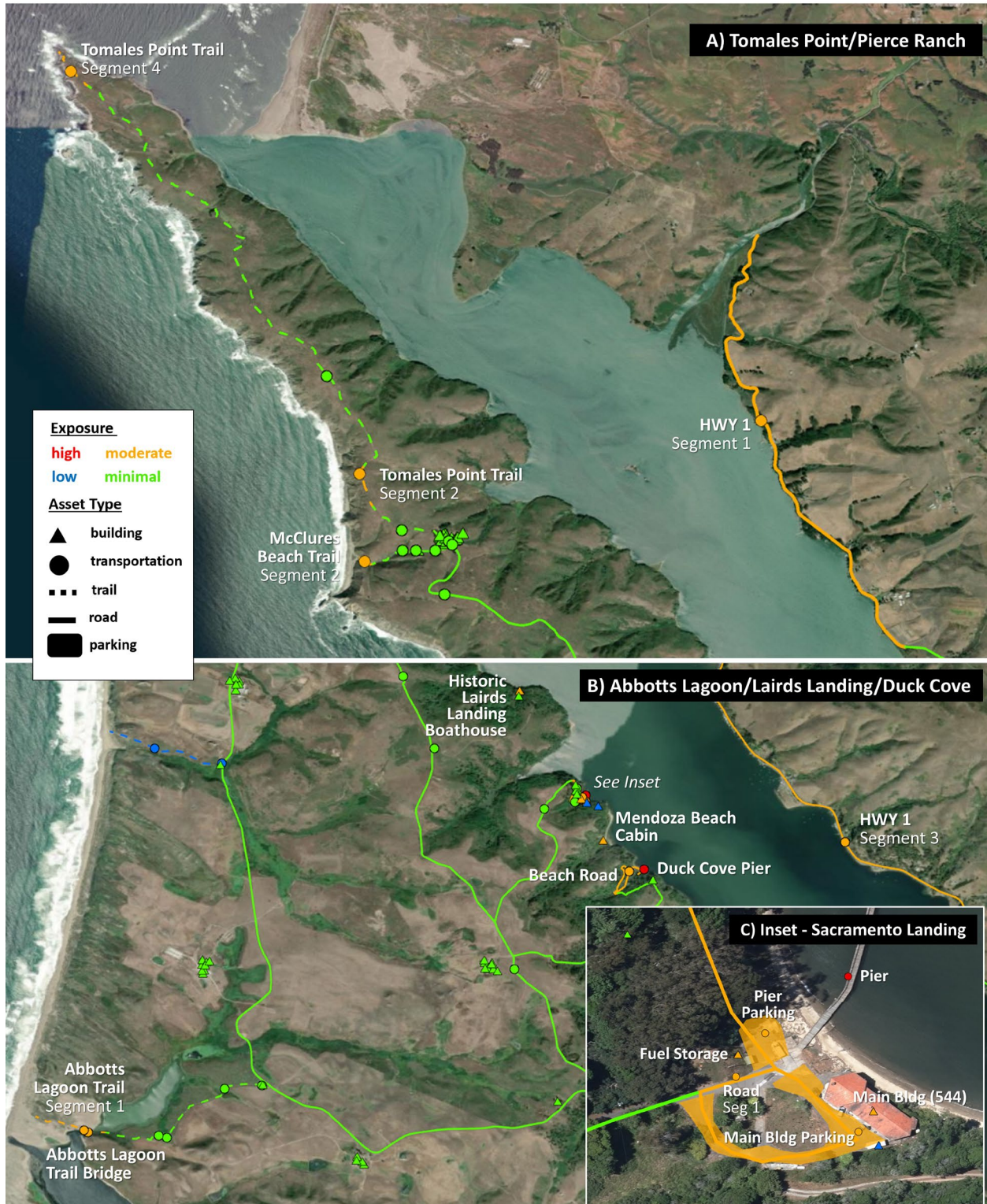


Figure 2. PORE exposure results summary for the A) Tomales Point/Pierce Ranch, B) Abbotts Lagoon/Lairds Landing/Duck Cove, and C) Inset – Sacramento Landing areas. Only high and moderate exposure assets are labeled. Background is 2023 ESRI world imagery.

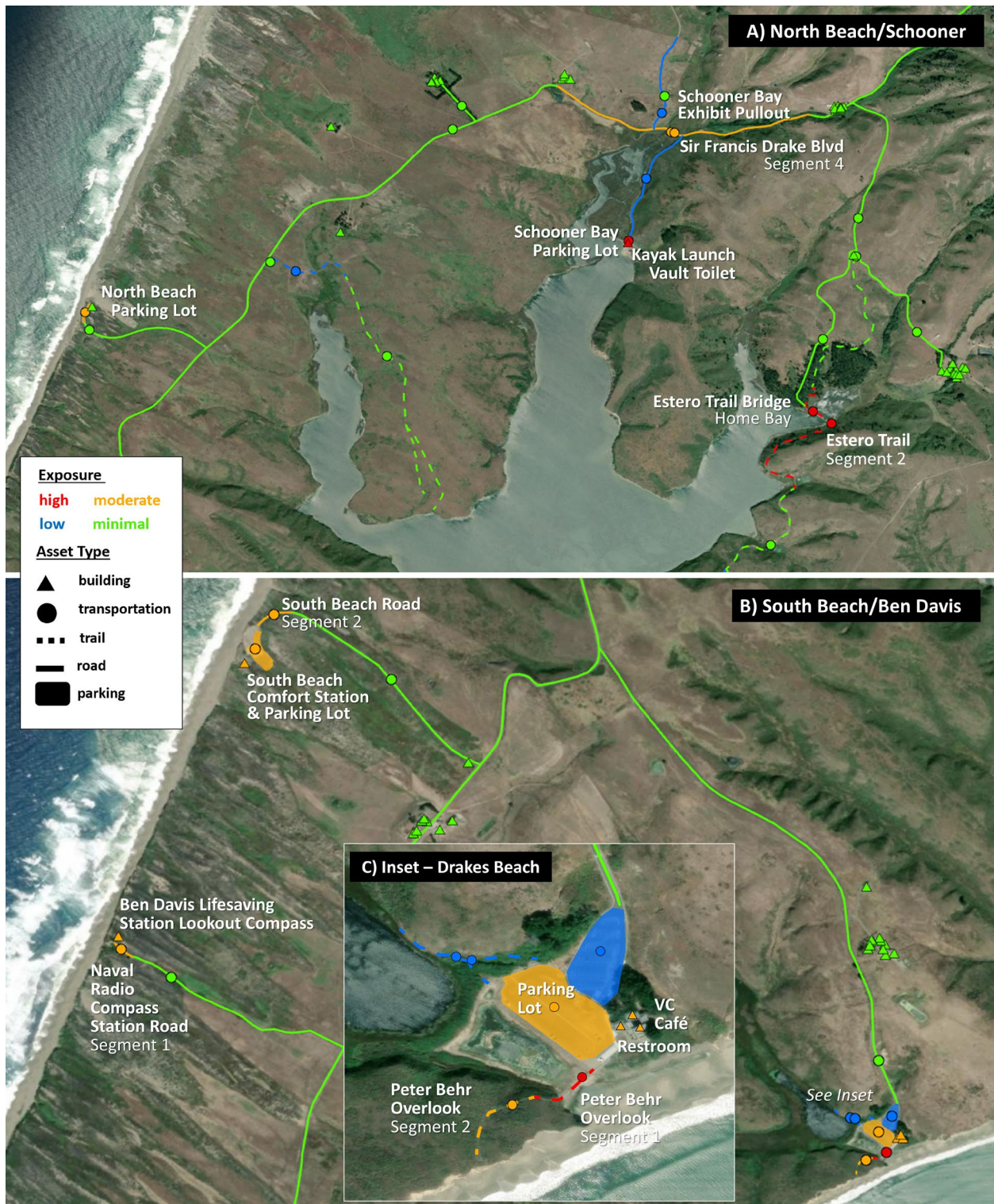


Figure 3. PORE exposure results summary for the A) North Beach/Schooner, B) South Beach/Ben Davis, and C) Inset – Drakes Beach areas. Only high and moderate exposure assets are labeled. Background is 2023 ESRI world imagery.

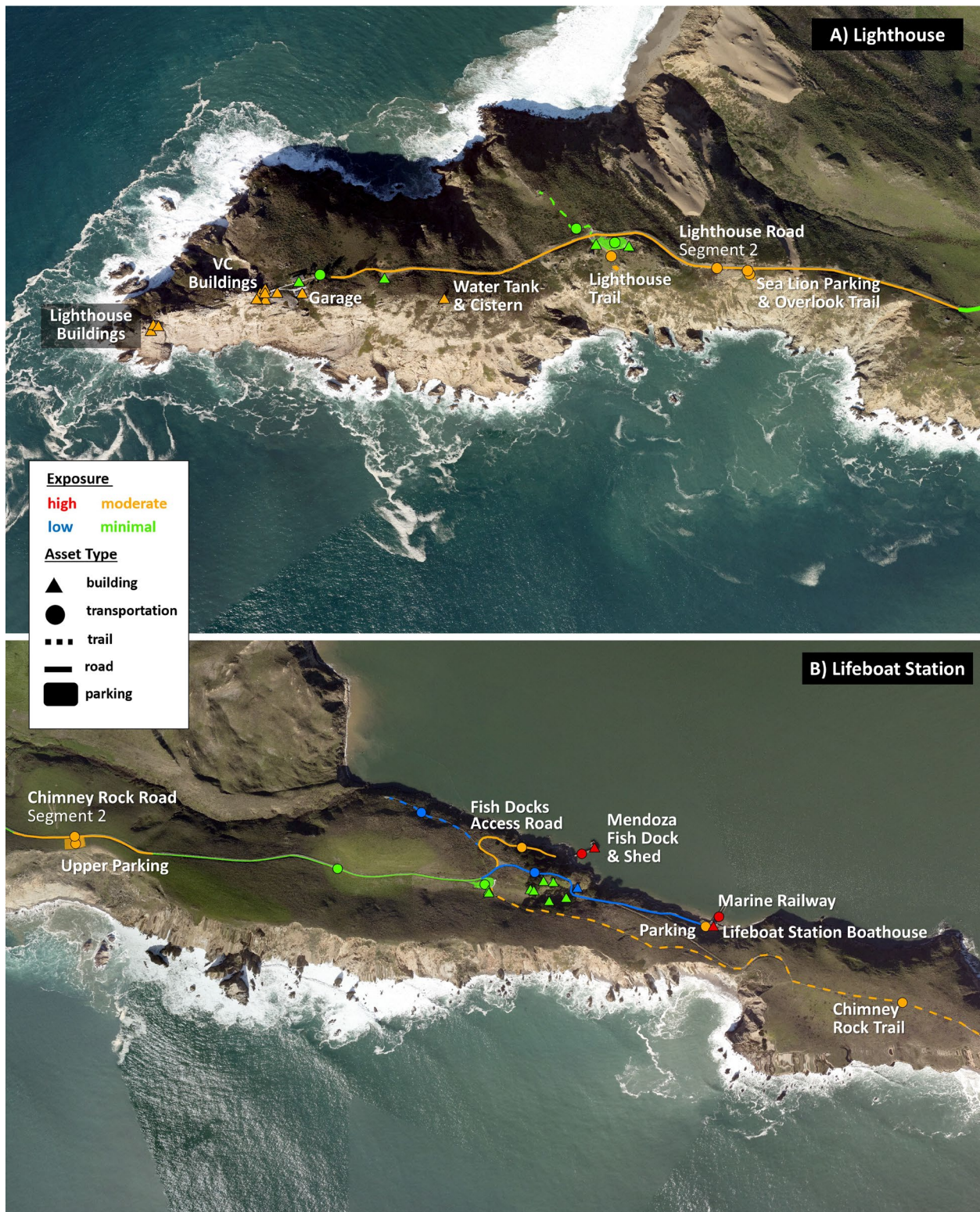


Figure 4. PORE exposure results summary for the A) Lighthouse and B) Lifeboat Station areas. Only high and moderate exposure assets are labeled. Background is NOAA NGS 2023 imagery (NGS 2025).

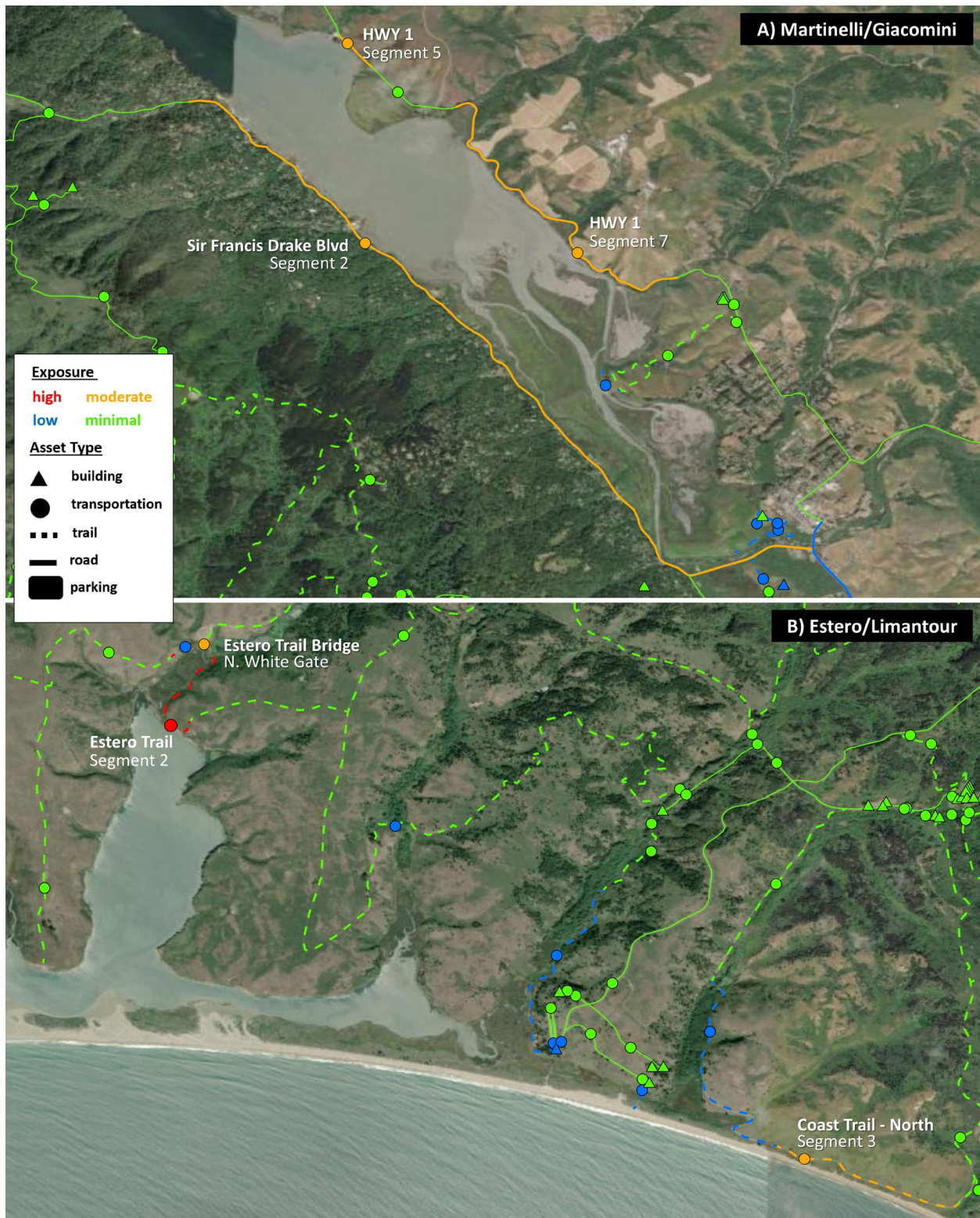


Figure 5. PORE exposure results summary for the A) Martinelli/Giacomini and B) Estero/Limantour areas. Only high and moderate exposure assets are labeled. Background is 2023 ESRI world imagery.

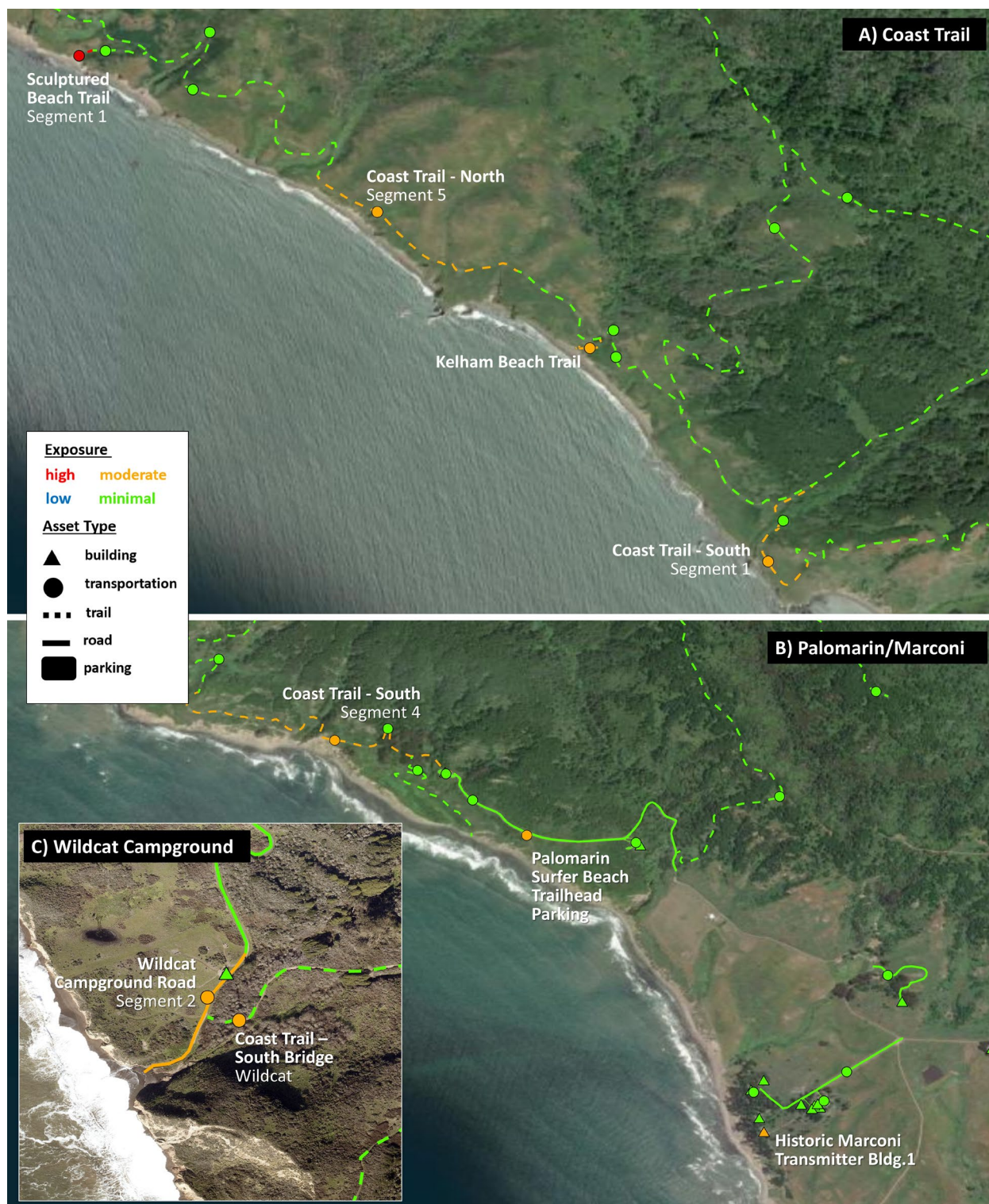


Figure 6. PORE exposure results summary for the A) Coast Trail, B) Palomarin/Marconi, and C) Wildcat Campground areas. Only high and moderate exposure assets are labeled. Background is A-B) 2023 ESRI world imagery and C) NOAA NGS 2023 imagery (NGS 2025).

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 573 assets at PORE).

Twenty-four assets (21%) analyzed at PORE have high sensitivity to coastal hazards and SLR, including the Lifesaving Station Lookout Compass and Naval Radio Compass Station Road (west segment) at Ben Davis; Historic Lairds Landing Shed/Boathouse; Historic Marconi Transmitter Bldg. 1; Chimney Rock Road - Segment 2 (near Chimney Upper Parking); Sacramento Landing Pier; and Oyster Farm Road. The majority (79%) of assets have moderate sensitivity, and no assets have low sensitivity (Table 3). Few assets at PORE are significantly elevated above local ground level, storm resistant, or protected by effective engineering. However, most evaluated assets are in good condition and have not been damaged by flooding or erosion in the past. Ten assets received an unfavorable rating for all sensitivity indicators, including the Duck Cove Pier; Visitor Center, Café, and Restroom at Drakes Beach; Mendoza Fish Dock and Shed; and Schooner Bay Parking Lot.

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

Assets	High Sensitivity		Moderate Sensitivity		Low Sensitivity		Total Analyzed	Excluded*
	#	%	#	%	#	%	#	#
Buildings	10	27%	27	73%	0	0%	37	364
Transportation	14	19%	61	81%	0	0%	75	209
All Assets	24	21%	88	79%	0	0%	112	573

*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).

Twenty-four assets (4%) analyzed at PORE have high vulnerability to the evaluated coastal hazards (Table 4, and Figures 7-11). Nine assets have both high exposure and high sensitivity: Mendoza Fish Dock, Mendoza Fish Dock Shed, Schooner Bay Kayak Launch Vault Toilet, Schooner Bay Parking Lot, Estero Trail Bridge (near Home Bay), Sculptured Beach Trail – Segment 1 (west near stairs), Peter Behr Overlook – Segment 1 (near parking), Duck Cove Pier, and Sacramento Landing Pier. Fifty-three (8%) assets have moderate vulnerability, 35 (5%) have low vulnerability, and 573 (84%) assets have minimal vulnerability. The significant number of minimal vulnerability assets is a factor of the high elevations in many areas of the park.

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

Assets	High Vulnerability		Moderate Vulnerability		Low Vulnerability		Minimal Vulnerability		Total
	#	%	#	%	#	%	#	%	#
Buildings	10	2%	16	4%	11	3%	364	91%	401
Transportation	14	5%	37	13%	24	8%	209	74%	284
All Assets	24	4%	53	8%	35	5%	573	84%	685

Nine assets have both high vulnerability and a high asset priority index ($API \geq 70$, as reported in FMSS; Table 5). Four of these assets are also listed within the Historic Structures in the Cultural Resources Inventory System (HS-CRIS).

Table 5. PORE assets with high vulnerability and a high priority ($API \geq 70$), sorted by area.

Asset Name	PORE Area	API	Historic*
Historic Ben Davis Lifesaving Station Lookout Compass	Ben Davis	79	
Drakes Beach Restroom Facility	Drakes Beach	88	
Drakes Beach Ken Patrick Visitor Center	Drakes Beach	77	
Historic Lifeboat Station Boathouse	Lifeboat Station	83	Yes
Chimney Rock Road Route – Segment 2 (near Upper Parking)	Lifeboat Station	80	
Historic Lighthouse East Water Tank & Cistern	Lighthouse	85	Yes
Historic Marconi Transmitter Bldg.1	Marconi	70	Yes
Sacramento Landing Pier	Sacramento Landing	77	Yes
Tomales Point Trail - segment 4 near Tomales Point	Tomales Point	70	

* Included in the Historic Structures in the Cultural Resources Inventory System (HS-CRIS)



Figure 7. PORE vulnerability results summary for the A) Tamales Point/Pierce Ranch, B) Abbotts Lagoon/Lairds Landing/Duck Cove, and C) Inset – Sacramento Landing areas. Only high and moderate vulnerability assets are labeled. Background is 2023 ESRI world imagery.

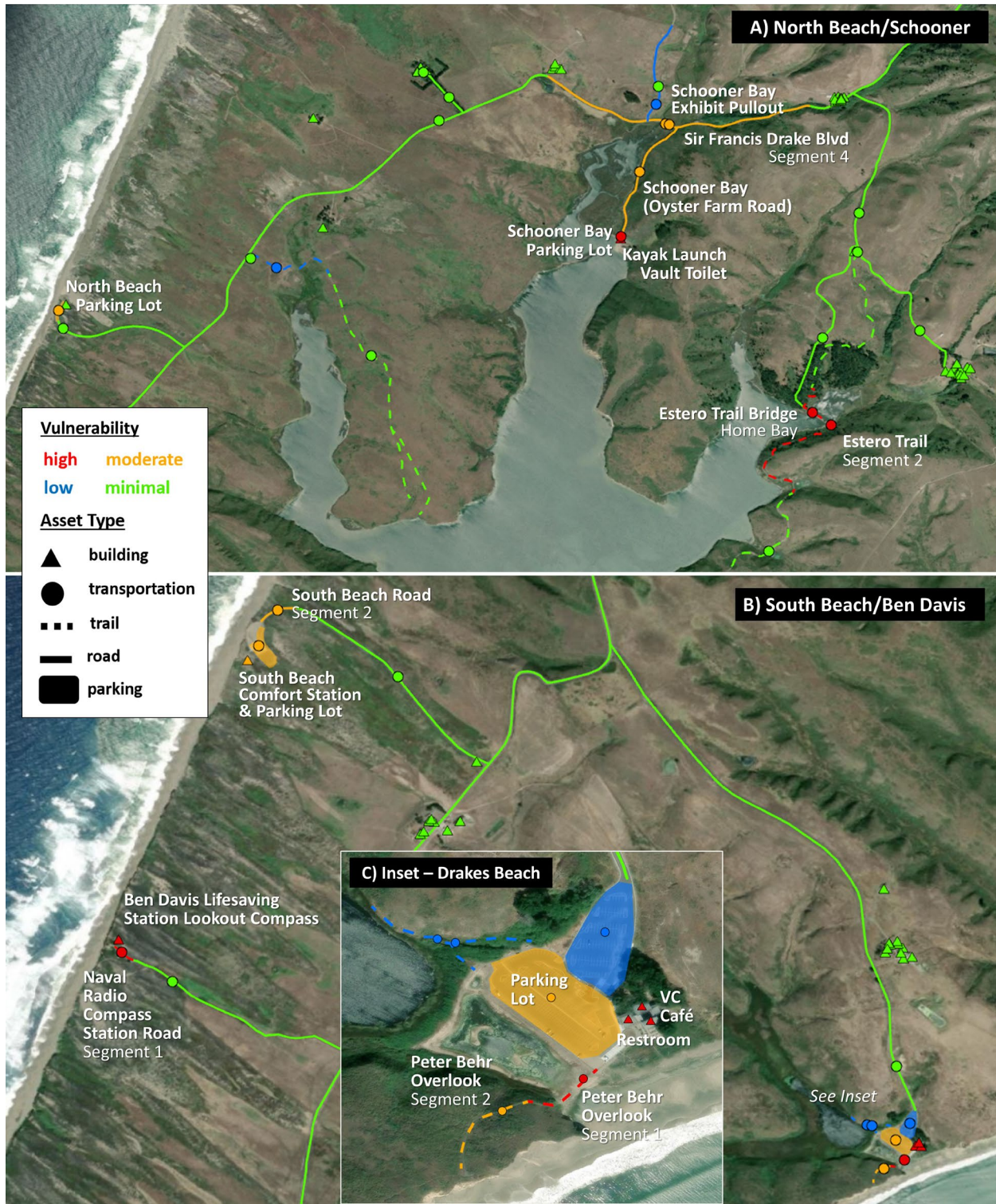


Figure 8. PORE vulnerability results summary for the A) North Beach/Schooner, B) South Beach/Ben Davis, and C) Inset – Drakes Beach areas. Only high and moderate vulnerability assets are labeled. Background is 2023 ESRI world imagery.

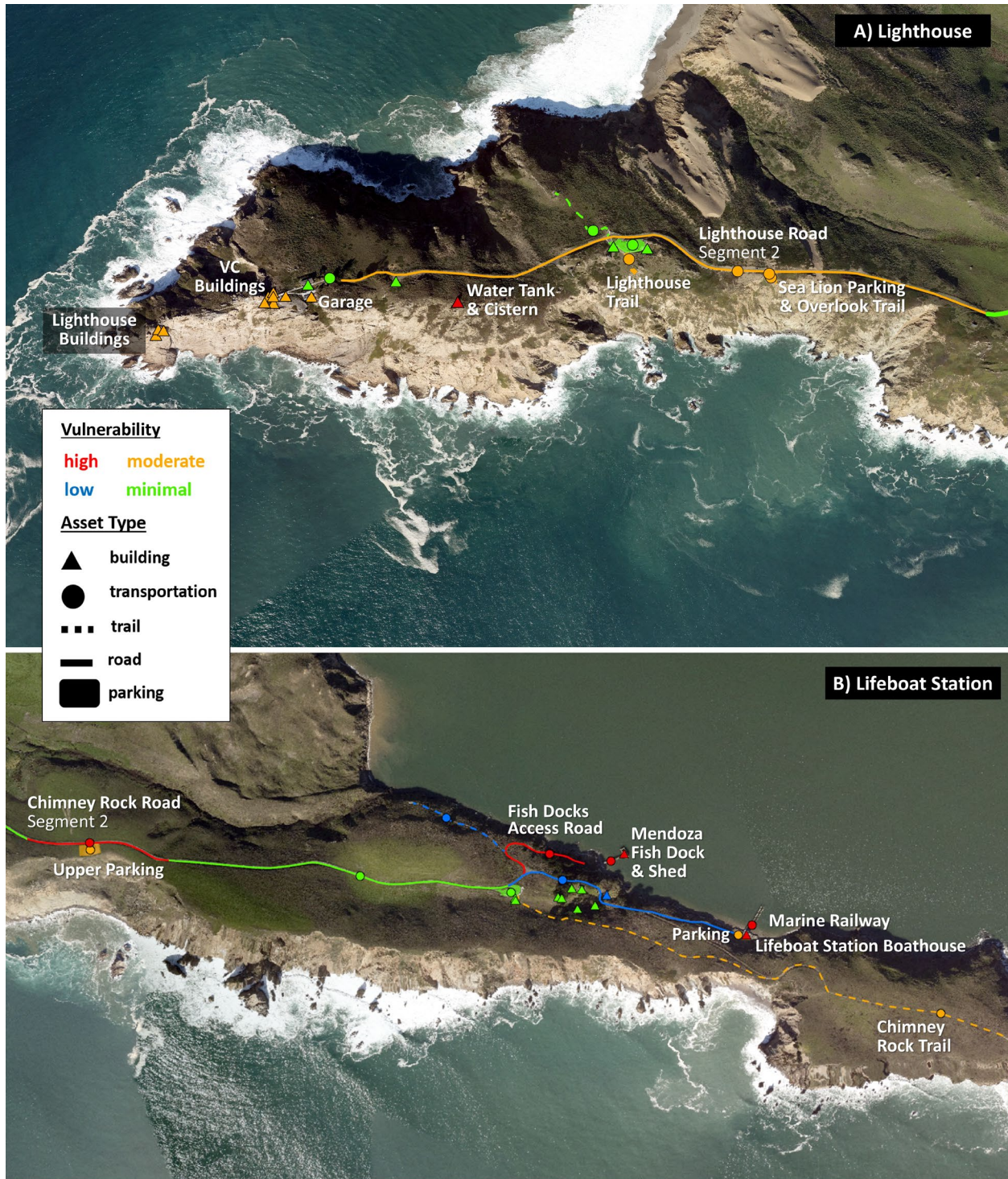


Figure 9. PORE vulnerability results summary for the A) Lighthouse and B) Lifeboat Station areas. Only high and moderate vulnerability assets are labeled. Background is NOAA NGS 2023 imagery (NGS 2025).

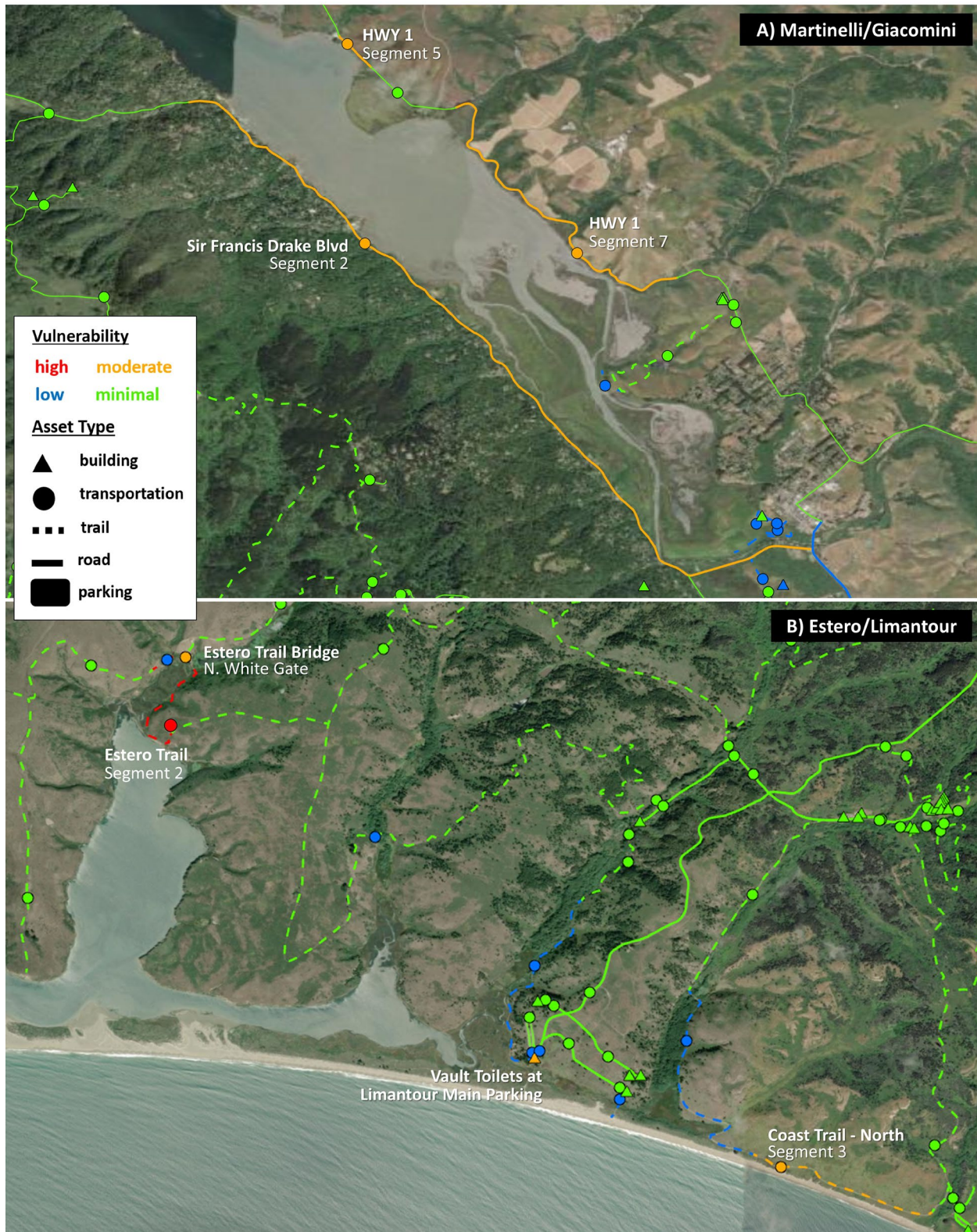


Figure 10. PORE vulnerability results summary for the A) Martinelli/Giacomini and B) Estero/Limantour areas. Only high and moderate vulnerability assets are labeled. Background is 2023 ESRI world imagery.

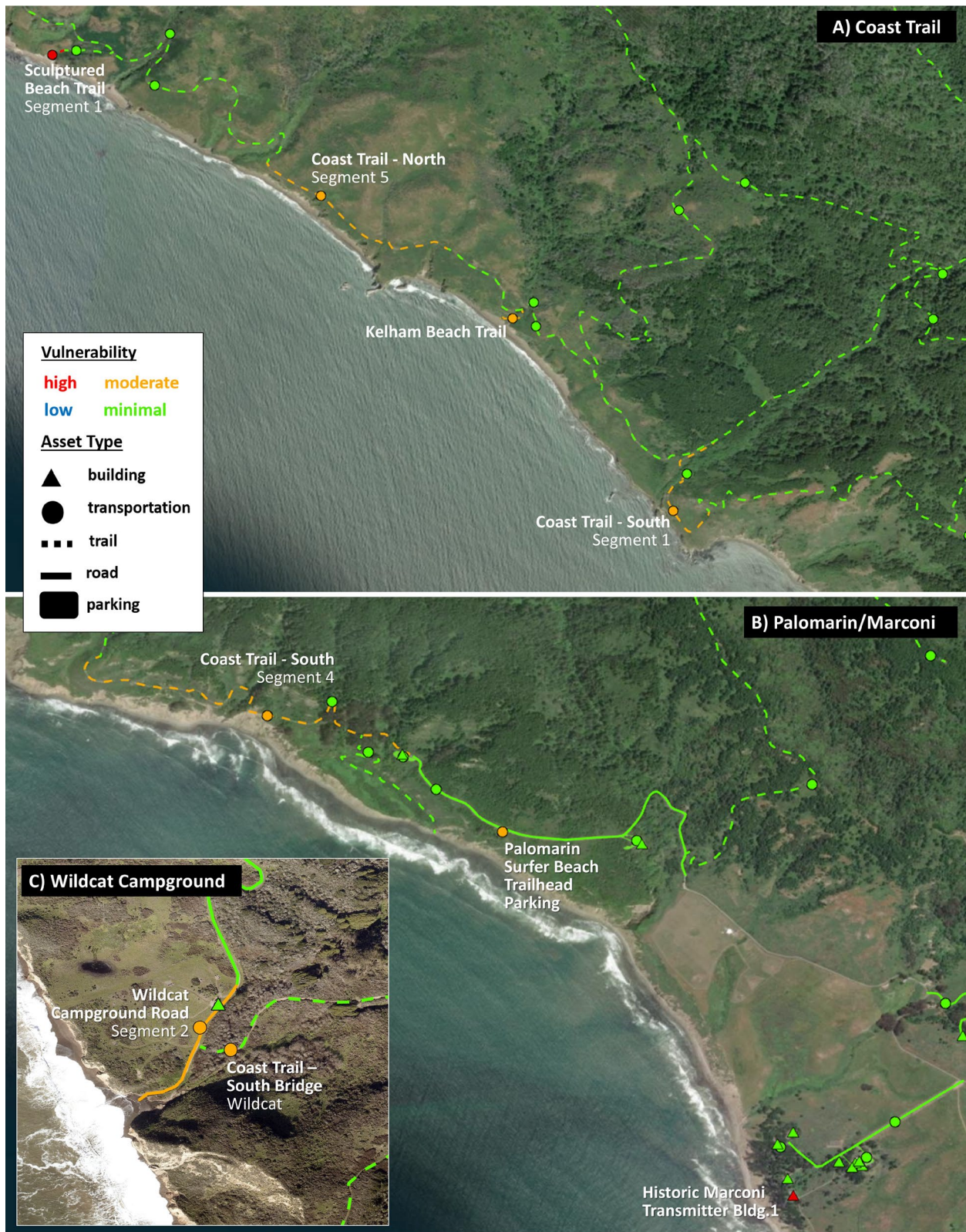


Figure 11. PORE vulnerability results summary for the A) Coast Trail, B) Palomarin/Marconi, and C) Wildcat Campground areas. Only high and moderate vulnerability assets are labeled. Background is A-B) 2023 ESRI world imagery and C) NOAA NGS 2023 imagery (NGS 2025).

PORE Unique Considerations

Linear assets: Due to exposure variability, we segmented eight roads at PORE: Sir Francis Drake Boulevard (five segments), Highway One (10 segments), Naval Radio Compass Station Road (two segments), Lighthouse Road (two segments), Chimney Rock Road (three segments), South Beach Road (two segments), Wildcat Campground Road (two segments), and Sacramento Landing Road (two segments). We also segmented 12 trails: Coast Trail – South (four segments), Coast Trail – North (six segments), Tomales Point Trail (four segments), Estero Trail (two segments), Abbotts Lagoon Trail (two segments), McClures Beach Trail (two segments), Ocean Lake Trail (two segments), Sculptured Beach Trail (two segments), Muddy Hollow Trail (two segments), Tomales Bay – Martinelli Trail (two segments), Bull Point Trail (two segments), and Peter Behr Overlook (two segments).

We evaluated each segment individually for exposure, sensitivity, and vulnerability, and assigned each segment a modified location code (segments share the same FMSS attributes). Any statistics or estimates of value represent the entire road or trail, even if only a small portion has high exposure or vulnerability.

Flood potential data: In addition to the effective Federal Emergency Management Agency (FEMA) data for Marin County (2017), we used the United States Geological Survey (USGS) CoSMoS 25 cm SLR plus 100-year flood zone (Barnard et al. 2022).

Shoreline change data: We used USGS Short-Term Shoreline Change Rates (endpoint) for Central California 1971-1998 (Hapke and Reid 2006) and USGS Cliff Erosion Rates (endpoint) for Central California 1929-2002 (Hapke et al. 2008) to create erosion buffer zones for PORE (see Peek et al. 2022 for methodology). We also included the Central California CoSMoS v3.1 projections of coastal cliff retreat due to 21st century sea-level rise (0.25 m + cliff retreat projection; Barnard et al. 2022) for comparison. For PORE shorelines that do not have erosion rate data we used a simple 30-meter proximity buffer.

SLR data: We used two sources for the SLR exposure 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 0.62 ft rise for PORE).

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