

APPENDIX D. NATURAL RESOURCES MAPS AND METHODS

To plan for the effects of sea level rise on coastal natural resources, vulnerable habitats, plant and animal species were identified and evaluated. Section 1 of this Appendix contains detailed information on the methodology used to complete the natural resources component of the Vulnerability Assessment. Section 2 contains the natural resources maps that are referenced in Sections 2.7 and 5.3 of the main body of the Report. The four habitat types evaluated were beaches, dunes, estuarine, and freshwater environments that could be exposed according to projections in sea level rise models. These habitats are mapped in Section 2. The two sections are organized as follows:

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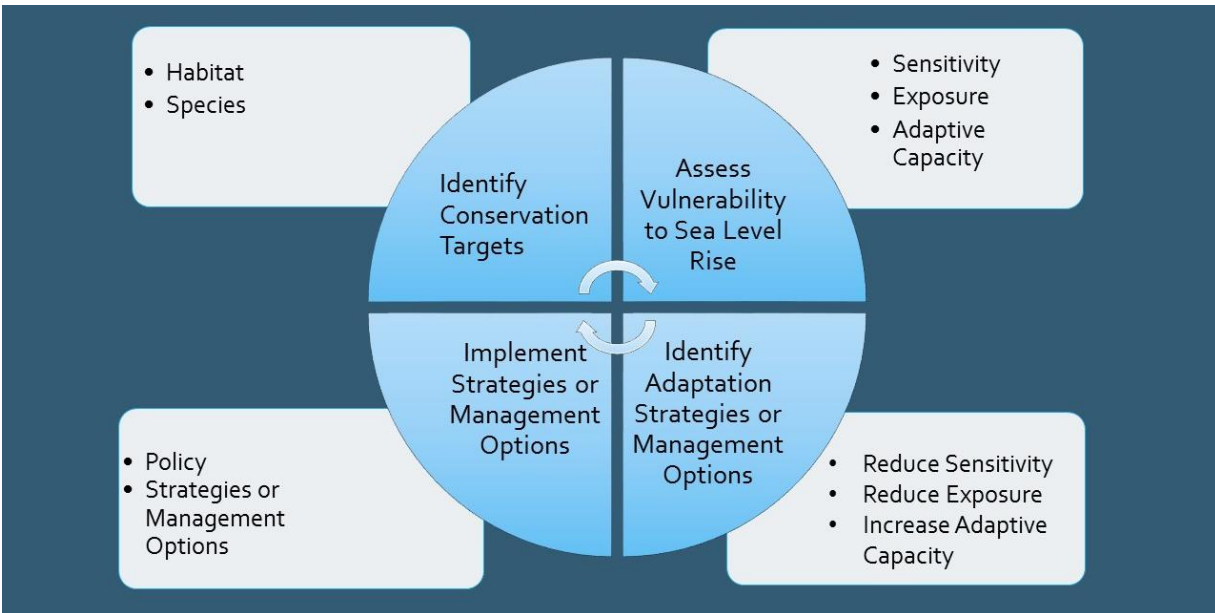
Section D-1: Sea Level Rise Planning Process for Natural Resources

The vulnerability of coastal natural resources to sea level rise is measured by an analysis of the extent to which a species, habitat, or ecosystem is susceptible to sea level rise impacts. The results of such an assessment may be used in the planning process for land managers, localities, and agencies to develop adaptation strategies that will increase the capacity of the County's natural resources to adapt to climate change. Understanding how and why these resources may be impacted is the first step in developing any adaptation strategy and it relies on assessing the sensitivity, exposure, and adaptive capacity of the resources to sea level rise. There are many types of vulnerability assessments (e.g., quantitative/qualitative) that can be conducted at various scales, so no two are alike.

The goal of the natural resource component of the project was to “coordinate and plan for the effects of sea level rise on existing coastal resources to ensure their resilience and conservation for future generations”. To meet this goal, the vulnerability assessment was designed to focus on specific ecosystems that are vulnerable to sea level rise. This translated into an evaluation of a subset of coastal habitats (beaches and dunes, estuaries and salt marsh, freshwater wetlands, rivers, streams and lakes) and selection of a suite of focal species that would provide the most guidance to implement adaptation strategies by land managers, agencies, and local governments as sea level rise occurs locally. The intent is to use focal species for a vulnerability assessment that will inform the development of adaptation strategies and be used to update the policies and ordinances of the Local Coastal Program¹⁷ (See Figure D-1).

¹⁷ Funding for this project was provided by the California Coastal Commission and the State Coastal Conservancy.

Figure D-1. Sea Level Rise Planning Process for Natural Resources



1.1 Species Vulnerability Assessment Overview

To develop effective adaptation strategies for sea level rise it is useful to identify which species are likely to be most affected, why they are vulnerable, and to gain an understanding of how those vulnerabilities to sea level rise may vary throughout the coastline. The following three components define the vulnerability of a species to a stressor: (1) its sensitivity to changes in its environment, (2) its anticipated exposure to those environmental changes, and (3) its capacity to adapt to those changes. By evaluating species vulnerabilities using these three criteria (sensitivity, exposure, adaptive capacity) along with recording how much confidence a scientist had in his/her assessment, an overall vulnerability and confidence score can be used to evaluate which species are potentially the most vulnerable to sea level hazards. Vulnerability assessments identify how and why a selected focal species may be vulnerable to sea level rise using the following definitions and guidance:

Sensitivity

How much is the species affected by a given the amount of change?

Example Considerations:

- Does the species have narrow environmental tolerances or thresholds to live? Direct (e.g., physiological) or indirect impacts from sea level rise such as rapid changes in salinity, sediment transport, the intensity/frequency of a disturbance regime such as wind, flooding, diseases, or storms, etc. can directly impact the long-term viability of a species. A species that has a high physiological sensitivity to such disturbances will be more vulnerable to sea level rise.
- Species that utilize multiple habitats or have multiple food sources are less likely to be sensitive to sea level rise. Conversely, species with very narrow habitat needs, or reliant on a single food source likely have greater sensitivity to sea level rise. In addition, species that may depend on a specific habitat type or environmental condition for part of a critical life stage (e.g., nesting, overwintering) may also be vulnerable to sea level rise changes.

Exposure

How much change will occur in the environment that would impact the species?

Example Considerations:

- How exposed is the species to changes in sea levels and major storms (e.g., inundation, physical damage/death from storm surge, erosion)? This includes secondary impacts such as rapid changes in salinity, sediment transport, reduced productivity with increasing inundation regimes, etc.
- Are there other physical threats unrelated to sea level rise? Species that must endure multiple stressors may be more sensitive to sea level rise. Other stressors may include: development, fragmentation, pollution, invasives, etc.

Adaptive Capacity

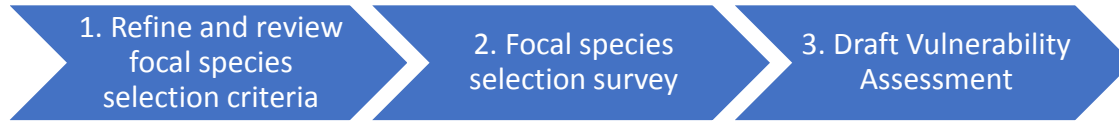
A species ability to adapt or respond to change.

Example Considerations:

- Species that demonstrate a diversity of life history strategies (e.g., variations in age at maturity, reproductive or nursery habitat use, or resource use) are likely to have greater adaptive capacity. Similarly, species able to express different and varying traits (e.g., phenology, behavior, physiology) in response to environmental variation have greater adaptive capacity than those that cannot modify their physiology or vary behavior to better cope with sea level rise changes and its associated effects.
- Some species and/or populations will be better able to adapt evolutionarily to sea level rise. For example, species may have greater adaptive capacity if they exhibit characteristics such as faster generation times, or geographic connectivity to allow for gene flow among sub-populations.
- Species that are currently widespread in their geographic extent, with a robust population status, high connectivity, and a high ability to disperse may be better able to withstand and persist into the future despite sea level rise and other non-related stressors. Species that are endemic, endangered, or with isolated or fragmented populations and/or limited ability to disperse will likely have lower adaptive capacity.
- A species response to management techniques will allow adaptive management strategies to be effective.

1.2 Methods and Process

The County formed a Natural Resources Working Group with 35 participants to help evaluate and assess the vulnerability of selected coastal species and habitats. This group consisted of federal, state, and local biologists, botanists, and ecologists familiar with the County's flora and fauna and who are subject-matter experts in the natural ecosystems of Ventura County. Participants were directly involved with the following tasks: (1) Refinement of criteria used to select focal species and assess species vulnerability; (2) Selection of focal species; and (3) Species Vulnerability Assessment. This work was conducted through three online surveys: (1) Survey for Focal Species Criteria for those working group members that missed or phoned in to the meeting on October 18, 2017; (2) Focal Species Selection Survey; (3) Species Vulnerability Assessment Survey. And three workshops: (1) Project Overview and Criteria Refinement; (2) Focal Species Selection Survey Results and Refinement of Final Focal Species Group; (3) Results of Vulnerability Assessment Survey and Selection of Eight Species for further analysis.



1.3 Methods for Ecosystem Selection and GIS Data Analysis

Four ecosystems were selected for evaluation based on Geographic Information Systems (GIS) data availability, types of ecosystem services, and potential ecosystem changes associated with sea level rise scenarios¹⁸ The ecosystems assessed were beach, dune, estuarine (e.g., estuaries, lagoons, salt marsh, etc.), and freshwater habitats (e.g., rivers, streams, lakes, wetlands, riparian, etc.).

GIS habitat metadata is presented in Table D-1 below. Using ArcMap 10.4 and the clip overlay function, acreages of each habitat type were extracted from the GIS layers listed in Table D-1 when they spatially overlapped with polygons in each of the five sea level rise models (see Report Section 4.3 Coastal Hazards Projections).

Table D-1. GIS Layer Metadata Excerpts

Habitat Layer	Base Data	Features Used
Beach	Digitized sandy beach areas above high tide line using 2017 aerial photos at 0.75-foot resolution at 1:400 scale.	Beach areas above high tide line.
Dune	Digitized dune areas above high tide line using 2017 aerial photos at 0.75-foot resolution at 1:400 scale.	Foredune, mid-dune and vegetated back dune features.
Estuarine	National Wetland Inventory Maps downloaded from website https://www.fws.gov/wetlands/Data/Data-Download.html November 2017.	Wetland Types in Analysis Layer: 1) Estuarine and Marine Wetland; 2) Estuarine and Marine Deepwater located in drainage features (e.g., Santa Clara River, Ventura River, Mugu Lagoon, Big Sycamore Canyon, etc.).
Freshwater	National Wetland Inventory Maps downloaded from website https://www.fws.gov/wetlands/Data/Data-Download.html November 2017.	Wetland Types in Analysis Layer: 1) Riverine; 2) Freshwater Pond; 3) Freshwater Emergent Wetland; and 4) Freshwater Forested/Shrub Wetland.
USFWS Critical Habitat	Downloaded from ECOS- Environmental Conservation Online System, USFWS. https://ecos.fws.gov/ecp/report/table/critical-habitat.html	Clipped layer to extract features in sea level rise projection zone. Features extracted were: Western Snowy Plover, Ventura marsh milk vetch, Tidewater Goby, and Southwestern Willow Flycatcher.

1.4 Focal Species Selection Methods

Refinement of Criteria and Questions for Focal Species Selection

The County is home to 49 *special status species* that may be vulnerable to sea level rise hazards¹⁹. Due to the limited project scope, between three and five species were selected within each ecosystem (i.e.,

¹⁸ The ecosystem selection process also took into account results of a climate change vulnerability assessment done for the central coast of California. (Climate Change Vulnerability Assessment for the North-central California Coast and Ocean, Marine Sanctuaries Conservation Series ONMS-15-02, Office of National Marine Sanctuaries and Department of Commerce, May 2015). In addition, projected sea level rise changes for the County were also taken into consideration based upon a visual assessment of which ecosystems may be affected.

¹⁹ This number was calculated by overlaying the extent of the projected sea level rise models to California Natural Diversity Database spatial information.

beaches, dunes, estuarine and freshwater habitats) that may be used to guide the development of land use adaptation policies for the vulnerable habitats in the County. The final focal species would also provide the natural resource community with the most guidance to conserve and manage these ecosystems with respect to the projected exposure to sea level rise.

The first workshop began with an overview of the entire project and how the natural resource component fits in with the County’s overall vulnerability assessment. County staff presented a set of base criteria for focal species selection (Table D-2) as well as a vulnerability assessment survey (Table D-7). The working group proceeded to review and refine the base criteria for focal species selection and the vulnerability assessment. To ensure that species selected for the assessment would be able to provide guidance within each of the different ecosystems, and to weight desired species characteristics higher than others, the working group ranked the importance of each of the base criteria from 0 (no importance) to 3 (high importance). The seven criteria were weighted by taking the averages of all the responses (Table D-2). Workshop participants who attended via conference call submitted the survey responses online. Table D-2 shows the weight of each selection criteria to be used when selecting focal species. Criteria 1, with a weighted value of 3.00 is the most important criteria. During the species selection stage, species that are considered “keystone, foundation, umbrella species” are ranked as more important than species that have “societal value” (criterion 6).

Table D-2. Weighted Values of Criteria Used to Select Focal Species

No.	Criteria	Weighted Value
1	The species is considered a keystone, foundation, umbrella species, or an indicator species of sea level rise changes.	3.00
2	The species has legal protections or is recognized as a species of concern for conservation (federal, state, local).	2.47
3	Level of knowledge of species’ life history requirements and the understanding of the role of that species within the ecosystem (ecological niche).	2.18
4	Species response to management techniques.	1.76
5	Stakeholder ability and resources to monitor the species over time.	2.18
6	Level of societal value of the species and/or the ecosystem services that the species provides.	1.56
7	Species dependence on habitats affected by sea level rise.	2.76

The seven selection criteria listed above were used to evaluate and select focal species from a list of 182 animal species and 209 plant species. The resources used to form the initial list of 391 species to be evaluated can be found in Table D-3. The species were selected to represent an ecosystem they are dependent upon: (1) Beaches and Dunes, (2) River, Riparian-Alluvial Vegetation Communities, and Freshwater Wetlands, and (3) Estuarine/Salt March ecosystems. Species that utilized more than one of the four ecosystems were placed in the ecosystem that the working group felt was most critical for the species. Survey responders answered “yes” or “no” for each criterion for each species survey (Table D-2)²⁰. In addition, working group members had the opportunity to submit species that were not on the original list (Table D-4). Staff presented the additional suggested species to other working group

²⁰ Criteria 2 was not included in the working group survey and was instead determined by the County staff biologist. County staff scored bird species as protected, if the species was listed as threatened or endangered by the state or federal government, or listed as a species of concern by either of these entities.

members during a follow-up workshop where the final focal species list was reviewed and finalized. The top-ranked species were not automatically chosen without the review of the working group due to additional species that were proposed during the survey. In addition, other unforeseen factors or assumptions that were not accounted for within the original criteria selection were discussed at this time.

Table D-3. Resources Used to Create Species List for Focal Species Selection

No.	Resource
1	California Natural Diversity Database
2	US Fish and Wildlife Services BIOS Information
3	California Native Plant Society Manual of California Vegetation
4	Calflora Plant Search
5	Santa Clara River Estuary Habitat Restoration and Enhancement Feasibility Study
6	Santa Clara River Parkway, California Conceptual Enhancement Plan and Staff Recommendation
7	Santa Clara River Enhancement and Management Plan
8	Prioritizing Sites Along the Santa Clara River for Conservation of Threatened and Endangered Species
9	Botanical Resources at Emma Wood State Beach and Ventura River Estuary
10	Integrated Natural Resources Management Plan for Naval Base Ventura County
11	The Ecology of Riparian Habitats of the Southern California Coastal Region: A Community Profile
12	Conservation Plan for the Lower Santa Clara River Watershed and Surrounding Areas

Table D-4. Additional Focal Species Suggested for Consideration by Working Group Members

Ecosystem	Common Name	Scientific Name
Beach and Dune	Coyote tobacco	<i>Nicotiana attenuata</i>
Beach and Dune	Red racer	<i>Coluber flagellum piceus</i>
Beach and Dune	Sand wasp	<i>Bembix spp.</i>
Beach and Dune	Pismo clams	<i>Tivela stultorum</i>
Beach and Dune	American black oystercatcher	<i>Haematopus bachmani</i>
Estuarine	Douglas' baccharis/ Salt marsh baccharis	<i>Baccharis douglasiana</i>
Estuarine	Common eelgrass	<i>Zostura marina</i>
Estuarine	Pacific eel grass	<i>Zostura pacifica</i>
Estuarine	Salt marsh snail	<i>Melampus olivaceus</i>
Estuarine	California horned snail	<i>Cerithideopsis californica</i>
Freshwater	Cottonwood (Fremont and Black)	<i>Populus spp.</i>
Freshwater	Rabbitsfoot grass	<i>Polypogon monspeliensis</i>
Freshwater	Virginia rail	<i>Rallus limicola</i>
Freshwater	Topsmelt	<i>Atherinops affinis</i>
Freshwater	Broad leaf cattail	<i>Typha latifolia</i>

A total of 17 participants submitted responses in person and online. The species were scored by averaging (weighted) the “YES” answers to the criteria in Table D-2. County staff calculated final scores by using the following equation:

$$Final\ Species\ Score = \sum \left(\frac{number\ of\ "yes"\ answers\ for\ that\ criterion}{number\ of\ responses\ for\ that\ criterion} \times criterion\ weight \right)$$

Species selection criteria scoring results were presented to the working group at a meeting on November 21, 2017 and are shown in Table D-5 below. Before and during the workshop, species were removed from consideration for the following reasons: (1) the species did not occur in the unincorporated County’s jurisdiction for the Local Coastal Program (e.g., eelgrasses, Pismo clams, light-

footed clapper rail); (2) there was not a large enough population within the unincorporated County to provide guidance for the adaptation strategies (e.g., red racer, lamprey, tricolored blackbird); (3) the species was found in numerous focal habitats (e.g., freshwater and estuarine ecosystems) and did not capture the characteristics of an important ecosystem niche for sea level rise hazards (e.g., American avocet, willet, coyote); (4) species captured similar niches within the ecosystem and one was selected over another (i.e., Bigelow's pickleweed and Belding's savannah sparrow); (5) the species would be too difficult to monitor or other factors associated with its life history (e.g., silvery legless lizard, Southern California legless lizard, senile tiger beetle); (6) highly unlikely that the species would be monitored by someone in the future (e.g., California beach flea, all species of crabs, wandering saltmarsh skipper); (7) a focal species survey was not filled out by any of the working group members due to limited experience or knowledge of a specific species²¹.

²¹ Scientific names are listed in Table D-5.

Table D-5. Focal Species Survey Results²².

Ecosystem	Taxa	Common Name	Species Name	Score
Beach and Dune	Plant Species	Red sand-verbena	<i>Abronia maritima</i>	15.18
Beach and Dune	Plant Species	South coast saltscale/saltbush	<i>Atriplex pacifica</i>	13.73
Beach and Dune	Plant Species	Silver dune lupine	<i>Lupinus chamissonis</i>	12.69
Beach and Dune	Plant Species	Ventura marsh milk vetch	<i>Astragalus pycnostachyus var. lanosissimus</i>	12.64
Beach and Dune	Plant Species	Sea scale, White-leaf saltbush	<i>Atriplex leucophylla</i>	12.35
Beach and Dune	Plant Species	Beach evening primrose	<i>Camissoniopsis cheiranthifolia</i>	12.32
Beach and Dune	Plant Species	Aphanisma	<i>Aphanisma blitoides</i>	11.97
Beach and Dune	Plant Species	Beach sand-verbena	<i>Abronia umbellata</i>	11.6
Beach and Dune	Plant Species	Beach morning-glory	<i>Calystegia soldanella</i>	11.6
Beach and Dune	Plant Species	Beach bur	<i>Ambrosia chamissonis</i>	11.545
Beach and Dune	Plant Species	Sea rocket	<i>Cakile maritima</i>	11.31
Beach and Dune	Animal Species	Western snowy plover*	<i>Charadrius alexandrinus nivosus</i>	15.69
Beach and Dune	Animal Species	California least tern*	<i>Sternula antillarum browni</i>	15.4
Beach and Dune	Animal Species	Elegant tern*	<i>Sterna elegans</i>	14.35
Beach and Dune	Animal Species	Marbled godwit*	<i>Limosa fedoa</i>	13.7
Beach and Dune	Animal Species	California brown pelican*	<i>Pelecanus occidentalis californicus</i>	13.58
Beach and Dune	Animal Species	American avocet*	<i>Recurvirostra americana</i>	13.34
Beach and Dune	Animal Species	Willet*	<i>Catoptrophorus semipalmatus</i>	12.66
Beach and Dune	Animal Species	Globose dune beetle	<i>Coelus globosus</i>	12.43
Beach and Dune	Animal Species	California grunion	<i>Leuresthes tenuis</i>	12.39
Beach and Dune	Animal Species	Southern California legless lizard*	<i>Anniella stebbinsi</i>	12.14
Beach and Dune	Animal Species	Silvery legless lizard*	<i>Anneilla pulchra</i>	11.89
Beach and Dune	Animal Species	Sand crabs, Mole crabs	<i>Emerita analoga</i>	11.82
Beach and Dune	Animal Species	Long-billed curlew*	<i>Numenius americanus</i>	11.78
Beach and Dune	Animal Species	Sandy beach tiger beetle	<i>Cicindela hirticollis gravida</i>	11.57
Beach and Dune	Animal Species	California beach flea	<i>Megalorchestia californiana</i>	11.26
Freshwater	Plant Species	Woolly seablite*	<i>Suaeda taxifolia</i>	12.91
Freshwater	Plant Species	Estuary seablite*	<i>Suaeda esteroa</i>	11.82
Freshwater	Plant Species	Southwestern spiny rush*	<i>Juncus acutus ssp. leopoldii</i>	11.15
Freshwater	Plant Species	Salt marsh bird's-beak*	<i>Chloropyron maritimum ssp. maritimum</i>	10.06
Freshwater	Plant Species	Coulter's goldfields*	<i>Lasthenia glabrata ssp. coulteri</i>	10.06
Freshwater	Animal Species	Southern steelhead*	<i>Oncorhynchus mykiss</i>	15.91
Freshwater	Animal Species	Great blue heron*	<i>Ardea herodias</i>	12.57
Freshwater	Animal Species	Belted kingfisher*	<i>Megaceryle alcyon</i>	12.47
Freshwater	Animal Species	Pacific lamprey*	<i>Entosphenus tridentata</i>	12.05
Freshwater	Animal Species	Tricolored blackbird	<i>Agelaius tricolor</i>	11.96
Freshwater	Animal Species	Great egret*	<i>Ardea alba</i>	11.4
Freshwater	Animal Species	Silvery legless lizard*	<i>Anneilla pulchra</i>	11.29
Freshwater	Animal Species	Least Bells vireo	<i>Vireo bellii pusillus</i>	11.28
Freshwater	Animal Species	Southwestern pond turtle	<i>Actinemys pallida</i>	11.22
Freshwater	Animal Species	White-faced ibis*	<i>Plegadis chihi</i>	11.05

²² Yellow highlighted rows in Table D-5 represent the plant and animal species ranked the highest within the ecosystem type.

Ecosystem	Taxa	Common Name	Species Name	Score
Freshwater	Animal Species	Western yellow-billed cuckoo	<i>Coccyzus americanus</i>	10.72
Freshwater	Animal Species	Two striped garter snake	<i>Thamnophis hammondi</i>	10.53
Freshwater	Animal Species	Arroyo toad	<i>Bufo californicus</i>	10.51
Freshwater	Animal Species	California red-legged frog	<i>Rana draytonii</i>	10.51
Freshwater	Animal Species	Western least bittern*	<i>Ixobrychus exilis</i>	10.46
Freshwater	Animal Species	Arroyo chub	<i>Gila orcutti</i>	10.15
Freshwater	Animal Species	Loggerhead shrike*	<i>Lanius ludovicianus</i>	10.1
Estuarine	Plant Species	Woolly sea-blite*	<i>Suaeda taxifolia</i>	15.91
Estuarine	Plant Species	Estuary seablite*	<i>Suaeda esteroa</i>	13.82
Estuarine	Plant Species	Glasswort, Pickleweed	<i>Salicornia pacifica</i>	13.44
Estuarine	Plant Species	Salt marsh bird's-beak	<i>Chloropyron maritimum ssp. maritimum</i>	13.43
Estuarine	Plant Species	California cordgrass	<i>Spartina foliosa</i>	12.56
Estuarine	Plant Species	Alkali heath, Alkali sea heath	<i>Frankenia salina</i>	12.35
Estuarine	Plant Species	Coulter's goldfields*	<i>Lasthenia glabrata ssp. coulteri</i>	12.06
Estuarine	Plant Species	Ventura marsh milk vetch*	<i>Astragalus pycnostachyus var. lanosissimus</i>	11.97
Estuarine	Plant Species	Pappose tarweed	<i>Centromadia parryi</i>	11.97
Estuarine	Plant Species	California sea-blite*	<i>Suaeda californica</i>	11.97
Estuarine	Plant Species	Inland saltgrass, Salt grass	<i>Distichlis spicata</i>	11.26
Estuarine	Plant Species	Bigelow's pickleweed, Dwarf saltwort	<i>Salicornia bigelovii</i>	10.18
Estuarine	Plant Species	Virginia glasswort	<i>Salicornia depressa</i>	10.18
Estuarine	Animal Species	Light-footed clapper rail	<i>Rallus longirostris levipes</i>	15.29
Estuarine	Animal Species	Western snowy plover*	<i>Charadrius alexandrinus nivosus</i>	14.69
Estuarine	Animal Species	Southern steelhead*	<i>Oncorhynchus mykiss</i>	14.56
Estuarine	Animal Species	Tidewater goby	<i>Eucyclogobius newberryi</i>	14.23
Estuarine	Animal Species	Pacific lamprey*	<i>Entosphenus tridentata</i>	14.14
Estuarine	Animal Species	California least tern*	<i>Sternula antillarum browni</i>	14.05
Estuarine	Animal Species	Belding's savannah sparrow	<i>Passerculus sandwichensis beldingi</i>	13.98
Estuarine	Animal Species	Arroyo chub*	<i>Gila orcutti</i>	13.39
Estuarine	Animal Species	Southern California saltmarsh shrew	<i>Sorex ornatus salicornicus</i>	12.77
Estuarine	Animal Species	California brown pelican*	<i>Pelecanus occidentalis californicus</i>	12.69
Estuarine	Animal Species	Elegant tern*	<i>Sterna elegans</i>	12.6
Estuarine	Animal Species	Wandering (saltmarsh) skipper	<i>Panoquina errans</i>	12.53
Estuarine	Animal Species	Western least bittern*	<i>Ixobrychus exilis</i>	12.24
Estuarine	Animal Species	Shiner surfperch	<i>Cymatogaster aggregate</i>	11.57
Estuarine	Animal Species	Marbled godwit*	<i>Limosa fedoa</i>	11.49
Estuarine	Animal Species	Long-billed curlew*	<i>Numenius americanus</i>	11.37
Estuarine	Animal Species	American avocet*	<i>Recurvirostra americana</i>	11.19
Estuarine	Animal Species	American white pelican*	<i>Pelecanus erythrorhynchos</i>	11.15
Estuarine	Animal Species	Santa Ana sucker	<i>Catostomus santaanae</i>	11.15
Estuarine	Animal Species	Yellow shore crab	<i>Hemigrapsus oregonensis</i>	11.12
Estuarine	Animal Species	Lined shore crab	<i>Pachygrapsus crassipes</i>	11.12
Estuarine	Animal Species	Southwestern pond turtle*	<i>Actinemys pallida</i>	11.11
Estuarine	Animal Species	Great egret*	<i>Ardea alba</i>	11.06
Estuarine	Animal Species	Osprey*	<i>Pandion haliaetus</i>	10.98
Estuarine	Animal Species	Senile tiger beetle	<i>Cicindeis sentilis frosti</i>	10.95
Estuarine	Animal Species	Prickly sculpin	<i>Cottus asper subspecies</i>	10.95
Estuarine	Animal Species	White-faced ibis*	<i>Plegadis chihi</i>	10.84
Estuarine	Animal Species	Double-crested cormorant*	<i>Phalacrocorax auritus</i>	10.77

Ecosystem	Taxa	Common Name	Species Name	Score
Estuarine	Animal Species	Belted kingfisher*	<i>Megaceryle alcyon</i>	10.74
Estuarine	Animal Species	Gabb's tiger beetle	<i>Cicindela gabbi</i>	10.49
Estuarine	Animal Species	Polychaete worm	<i>Polychaete</i>	10.48
Estuarine	Animal Species	California brackish water snail	<i>Tryonia imitator</i>	10.22
Estuarine	Animal Species	Great blue heron*	<i>Ardea herodias</i>	10.14
Estuarine	Animal Species	Willet*	<i>Catoptrophorus semipalmatus</i>	10.14

Note: * Species occurs in more than one of the focal ecosystems.

The selection scores were used to guide discussion on which species should be chosen as focal species. Although some of the focal species selected for the vulnerability assessment did not have the highest selection scores, they were chosen as the best species to guide future adaptation strategies planning. At the end of the workshop, the working group selected 21 focal species listed in Table D-6 for inclusion in the next task which was the vulnerability assessment.

Table D-6. Final Focal Species Selected for Vulnerability Assessment

Common Name	Species Name
Beach Habitats	
California grunion	<i>Leuresthes tenuis</i>
Western snowy plover	<i>Charadrius alexandrinus nivosus</i>
Dune Habitats	
Sand verbena	<i>Abronia maritima/umbellata</i>
Beach evening primrose	<i>Camissoniopsis cheiranthifolia</i>
Globose dune beetle	<i>Coelus globosus</i>
Riverine/Palustrine Habitats	
Arroyo willow	<i>Salix lasiolepis</i>
Rabbitsfoot grass	<i>Polypogon monspeliensis</i>
Cottonwood	<i>Populus spp.</i>
Broad leaf cattail	<i>Typha latifolia</i>
Southern steelhead	<i>Oncorhynchus mykiss</i>
Southern pond turtle	<i>Actinemys pallida</i>
Arroyo chub	<i>Gila orcuttii</i>
Estuarine Habitats	
Woolly sea-blite	<i>Suaeda taxifolia</i>
Alkali heath, Alkali sea heath	<i>Frankenia salina</i>
Bigelow's pickleweed, Dwarf saltwort	<i>Salicornia bigelovii</i>
Salt marsh snail	<i>Melampus olivaceus</i>
Virginia rail	<i>Rallus limicola</i>
Tidewater goby	<i>Eucylogobius newberryi</i>
Topsmelt	<i>Atherinops affinis</i>
Belding's savannah sparrow	<i>Passerculus sandwichensis beldingi</i>
California horned snail	<i>Cerithideopsis californica</i>

2.5 Vulnerability Assessment Methods

The vulnerability assessment was conducted through an online survey. The survey questions shown in Table D-7 below captured species characteristics associated with each vulnerability component (exposure, sensitivity, adaptive capacity), and was reviewed and revised by the working group during the two previous meetings. Work on the revisions in a group setting was intended to standardize as much as possible the interpretation of questions among all participants. Before experts evaluated the vulnerability of each focal species, background information on the predicted environmental changes

expected for Southern California was provided, as well as a synthesis of the vulnerability of riverine freshwater habitats to climate change²³. Participants were instructed to complete online surveys for only species with which they were familiar.

Table D-7. Vulnerability Assessment Survey Questions

Question #	Category	Question
1	Species Exposure	Within the species ecosystem, how exposed to sea level rise and major storms is the species niche habitat?" <i>Evaluated by County staff based upon results of the GIS-based sea level rise analysis of the ecosystems and was not included as a question in the assessment taken by the working group.</i>
2	Species Exposure	To what degree is the species fitness affected by other physical threats unrelated to sea level rise? Scale. 1= Low, 2=Low-Moderate, 3=Moderate, 4=Moderate-High, to 5= High. <i>Guidance. Assess the degree of exposure to other physical threats that affect the fitness of the species. In the comment box, please list what physical stressors affect the species fitness. Evaluate your confidence in the answer given.</i>
3	Species Sensitivity	How dependent is the species on specific interactions with other species for survival? Scale. 1= Low, 2=Low-Moderate, 3=Moderate, 4=Moderate-High, to 5= High. <i>Guidance. Assess the degree to which the species relies upon other species or conditions within its ecosystem for survival such as dependence on sensitive habitat types, specific prey or forage species for food, other dependencies (e.g., pollinators, dispersal mechanisms, tidal heights), generalist/specialist or a mixture of the two in certain life stages, etc., and evaluate your confidence in the answer given. Provide a short summary of the dependent interaction in the comment box.</i>
4	Species Sensitivity	Does the species have narrow environmental tolerances or thresholds to live? Scale. 1= Low, 2=Low-Moderate, 3=Moderate, 4=Moderate-High, to 5= High. <i>Guidance. Assess the degree of physiological sensitivity the species may have in response to direct sea-level rise changes. How sensitive is the species to the environmental stressors introduced by sea level rise? Evaluate your confidence in the answer given. Provide a short description of which stressors affect the species in the comment box.</i>
5	Adaptive Capacity	What is the species geographic extent? Scale. 1= Low (Small geographic region within a single state), 2= Low-Moderate (Moderate to large geographic region within a single state), 3= Moderate (Distribution within single state to two states), 4 = Moderate-High (Distribution within a region), 5= High (Transcontinental) <i>Guidance. Assess the species range and distribution and evaluate your confidence in the answer given.</i>
6	Adaptive Capacity	What is the connectivity among the species metapopulation? Scale. 1= Low (isolated and/or fragmented), 2= Low-Moderate (Somewhat isolated and/or fragmented), 3 = Moderate (patchy across an area with some connectivity among patches), 4= Almost continuous; 5=Continuous. <i>Guidance. Assess the degree of connectivity among the species within the metapopulation and evaluate your confidence in the answer given.</i>
7	Adaptive Capacity	What is the population status of the species? Scale. 1= Endangered, 2= Threatened, 3= Diminished, but generally stable, 4 = Stable population at abundant levels, 5=Healthy and/or expanding <i>Guidance. Is there evidence to suggest that the species is experiencing low genetic variability in our region through studies, watch lists, etc. In the comment box, provide any additional details. Evaluate your confidence in the response given.</i>

²³ Vulnerability assessments for alluvial scrub habitats and river and stream habitats were developed by EcoAdapt.

8	Adaptive Capacity	<p>Does the evolutionary strategy (r or k) make the species susceptible to sea level rise effects? (size of organism, energy for reproduction, number of offspring, maturity rate, life expectancy, survivorship pattern). How? Scale. Yes or No. <i>Guidance. Determine whether the impacts of sea level rise (physical damage/death from storm surge, erosion, rapid changes in salinity, sediment transport, intensity, and frequency of disturbance regime, etc.) favors the species' evolutionary strategies. In the comment box provided, describe how the strategy does or does not make the species susceptible to sea level rise effects. Evaluate your confidence in the response.</i></p>
9	Adaptive Capacity	<p>What is the species' dispersal ability? Scale. 1= Low, 2=Low-Moderate, 3=Moderate, 4=Moderate-High, to 5= High. <i>Guidance. Assess a species' dispersal ability. In the comment box provide the species maximum annual dispersal distance.</i></p>
10	Adaptive Capacity	<p>What is the likelihood of managing or alleviating the impacts of sea level rise? Scale. 1= Low, 2=Low-Moderate, 3=Moderate, 4=Moderate-High, to 5= High. <i>Guidance. Assess whether management activities have a high likelihood of alleviating the negative impacts of sea level rise on the species. If the species is currently managed, incorporate the success of the management actions into your answer. Use the comment box to further explain your response. Evaluate your confidence in the response given.</i></p>
11	Adaptive Capacity	<p>Societal value - Is the species highly valued? Scale. 1= Low, 2=Low-Moderate, 3=Moderate, 4=Moderate-High, to 5= High. <i>Guidance. Assess whether the species is valued by all residents, a portion of residents, or none. Evaluate your confidence in the response given. Use the comment box to further explain your response.</i></p>

County staff assessed vulnerability using the protocol used in the climate change vulnerability assessment for central coast natural resources²⁴. Each question in the assessment was answered using one of five scores (High-5, Moderate-High-4, Moderate-3, Moderate-Low-2, or Low-1). In addition, staff asked experts to assign one of three levels (High-3, Moderate-2, or Low-1) that indicated their confidence in the answers given for each question, along with the request to provide further details for answers given in a text box associated with the question. These additional explanations in combination with the vulnerability scoring provided guidance to why a species is vulnerable and what management actions may reduce vulnerabilities given possible tradeoffs when interpreting the assessment results.

The scores for exposure, sensitivity, and adaptative capacity were calculated from the survey responses. The exposure score is the average of all responses to questions 1 and 2, the sensitivity score is the average of all responses to questions 3 and 4, and the adaptive capacity score is the average of all responses to questions 5 through 11 (Table D-7). The overall vulnerability score for each species was then calculated using the following equation:

$$Vulnerability = \frac{(Exposure * 0.5 + Sensitivity)}{Adaptive Capacity}$$

Vulnerability increases with increasing exposure and sensitivity, and decreases with increasing adaptive capacity. In other words, higher exposure increases vulnerability, higher sensitivity increases vulnerability, and higher adaptive capacity decreases vulnerability. Due to the uncertainty associated

²⁴ Climate Change Vulnerability Assessment for the North-central California Coast and Ocean, Marine Sanctuaries Conservation Series ONMS-15-02, Office of National Marine Sanctuaries and Department of Commerce, May 2015.

with the magnitude and rate of sea level rise, the equation weights “Exposure” (0.5) less than sensitivity and adaptive capacity. As each question was scored on a scale of one through five, the maximum vulnerability score for each of the focal species also ranges between one through five. Draft results were presented to the natural resource working group at a workshop held on February 6, 2018 and are included in Table 5-19 of Report Section 5.3.

Section D-2 Natural Resource Maps for the Unincorporated County

The following pages contain natural resource maps that are cited in the main body of the Report.

Figure D-1. North Coast Map Key



Figure D-2. North Coast Ecosystems Vulnerable to Sea Level Rise (Study Areas 1 and 2)



Figure D-3. Central Coast Map Key

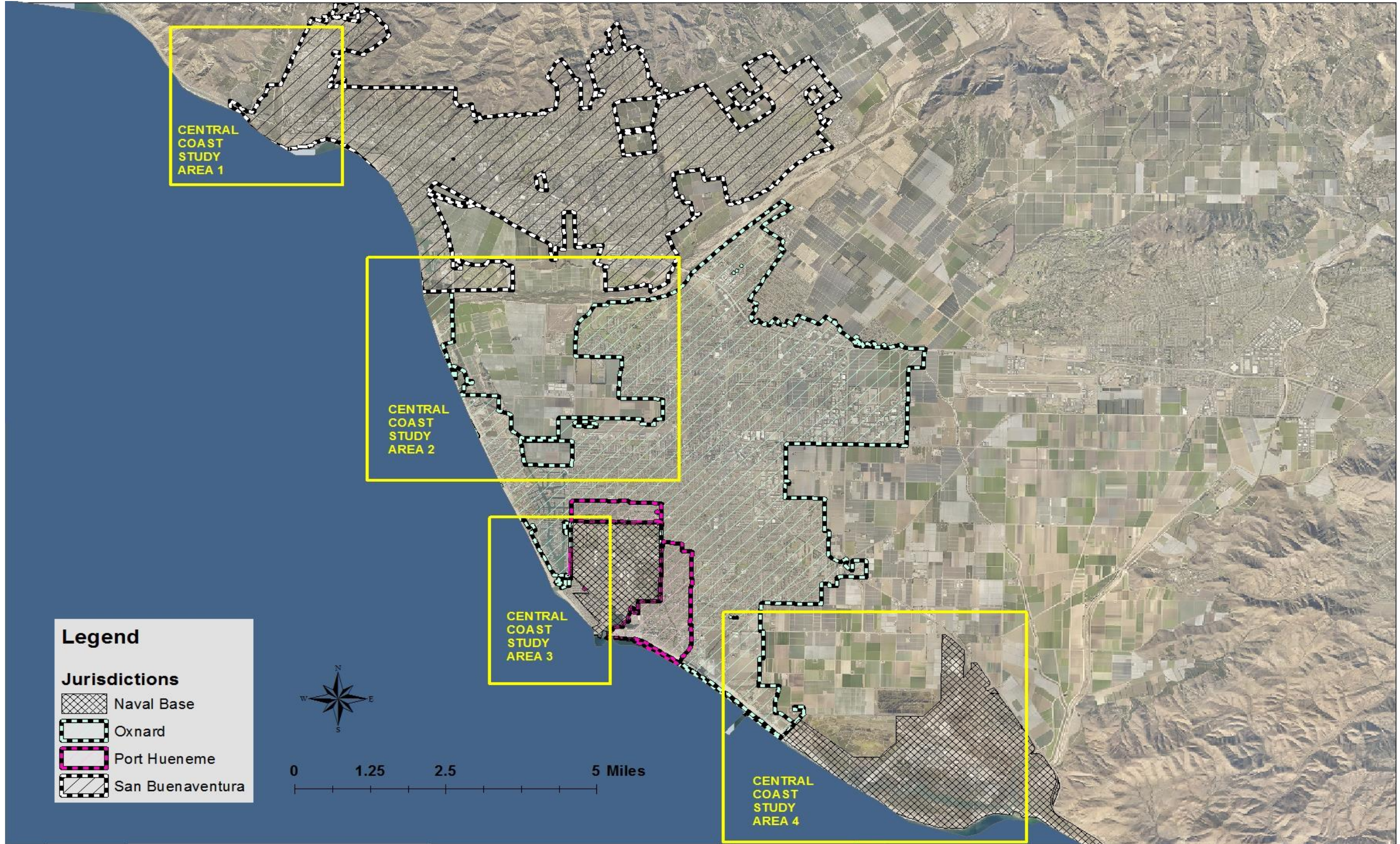


Figure D-4. Central Coast Ecosystems Vulnerable to Sea Level Rise (Study Area 1 and 2)

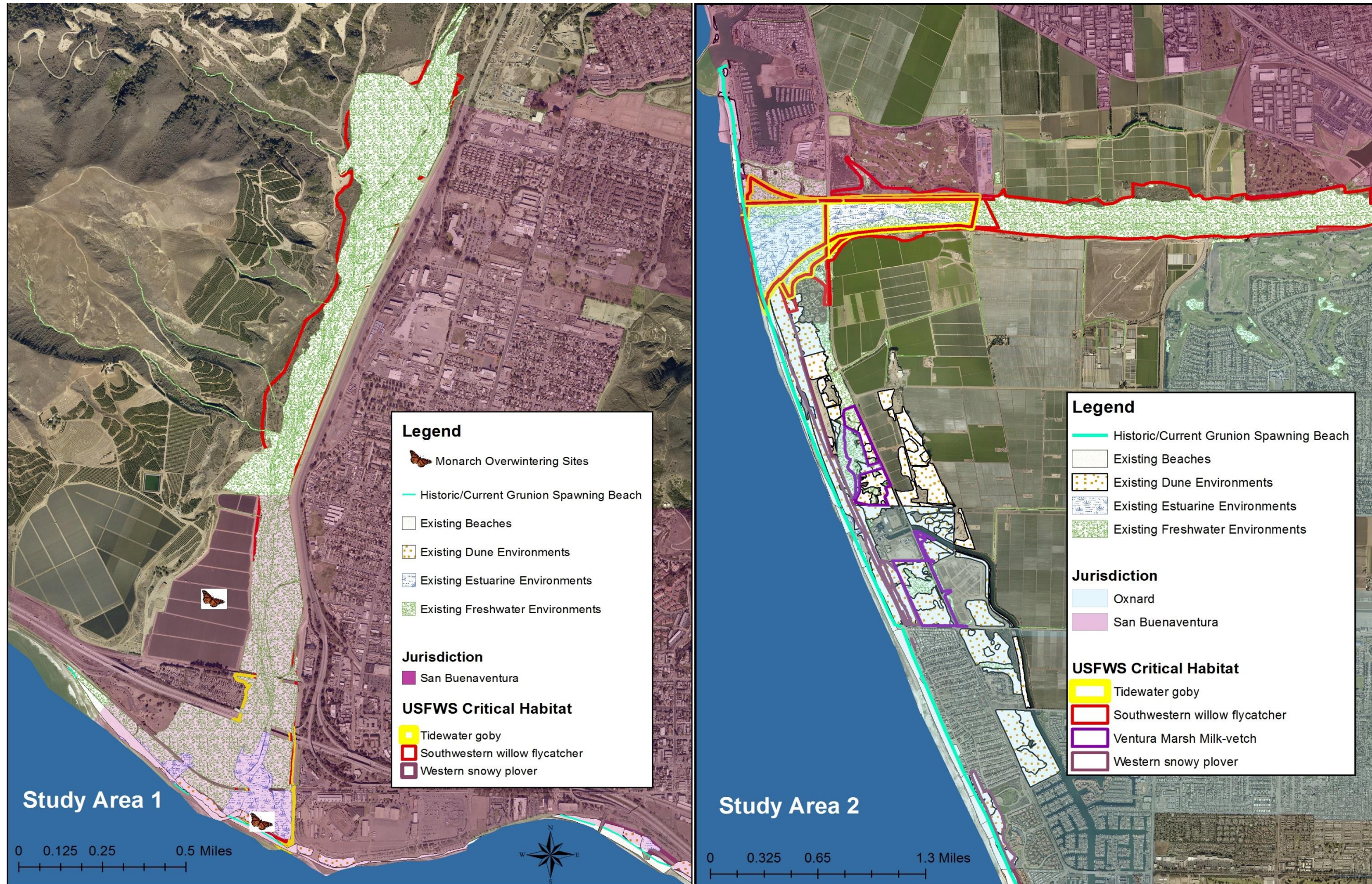


Figure D-5. Central Coast Ecosystems Vulnerable to Sea Level Rise (Study Areas 3 and 4)

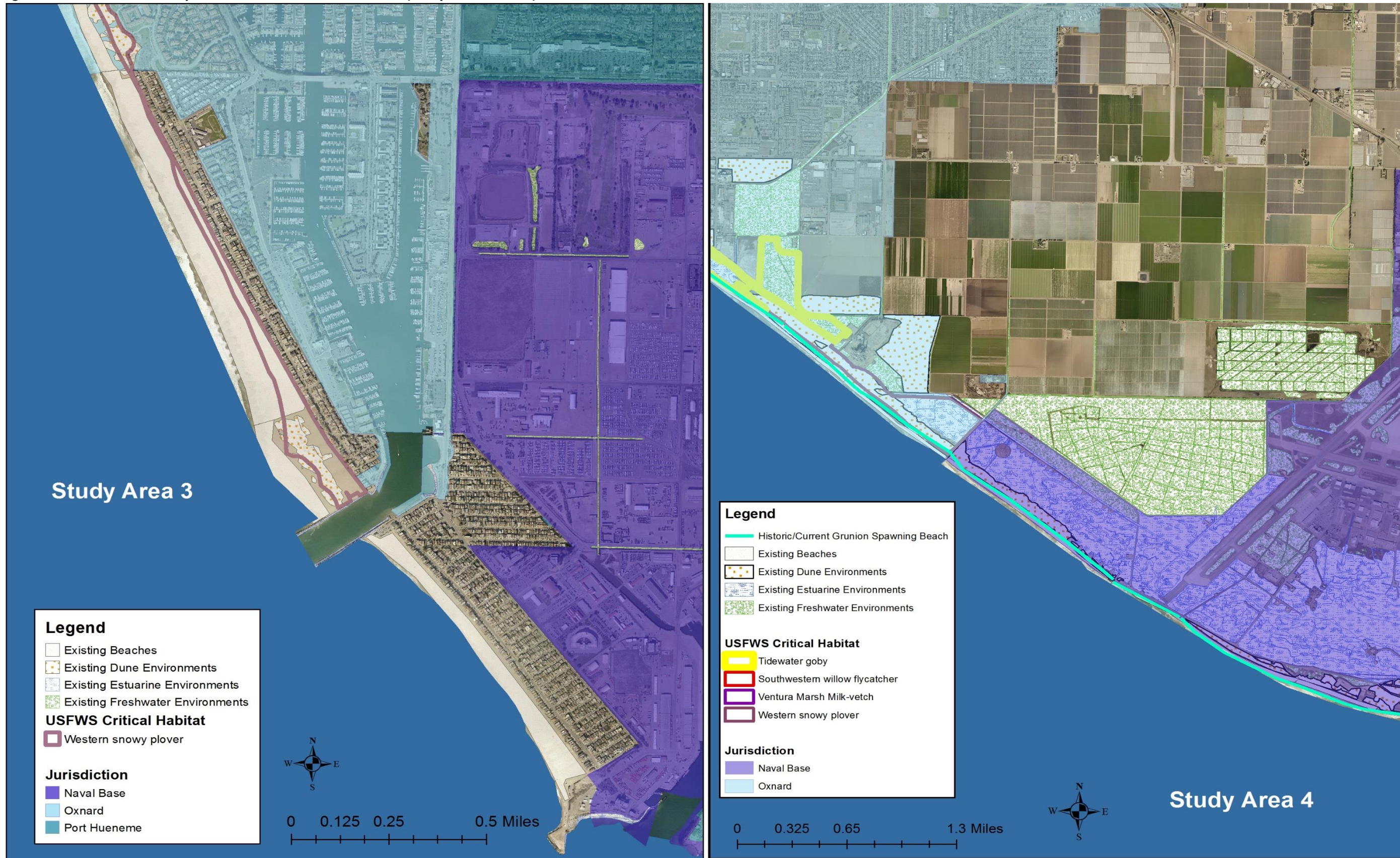


Figure D-6. South Coast Map Key



Figure D-7. South Coast Ecosystems Vulnerable to Sea Level Rise (Study Areas 1 and 2)

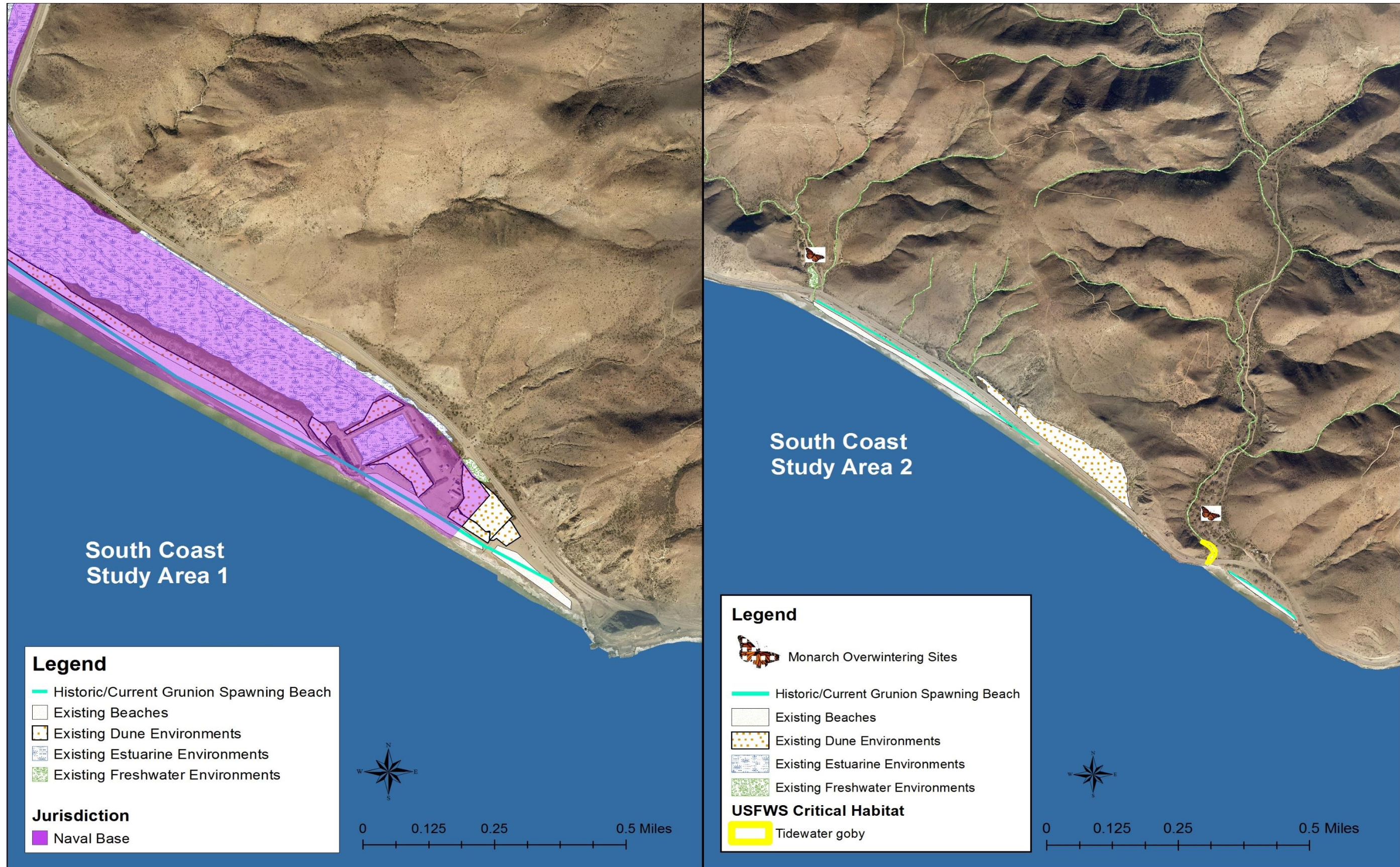


Figure D-8. South Coast Ecosystems Vulnerable to Sea Level Rise (Study Area 3)



Figure D-9. Beach Management Practices Occuring on USFWS Snowy Plover Critical Habitat

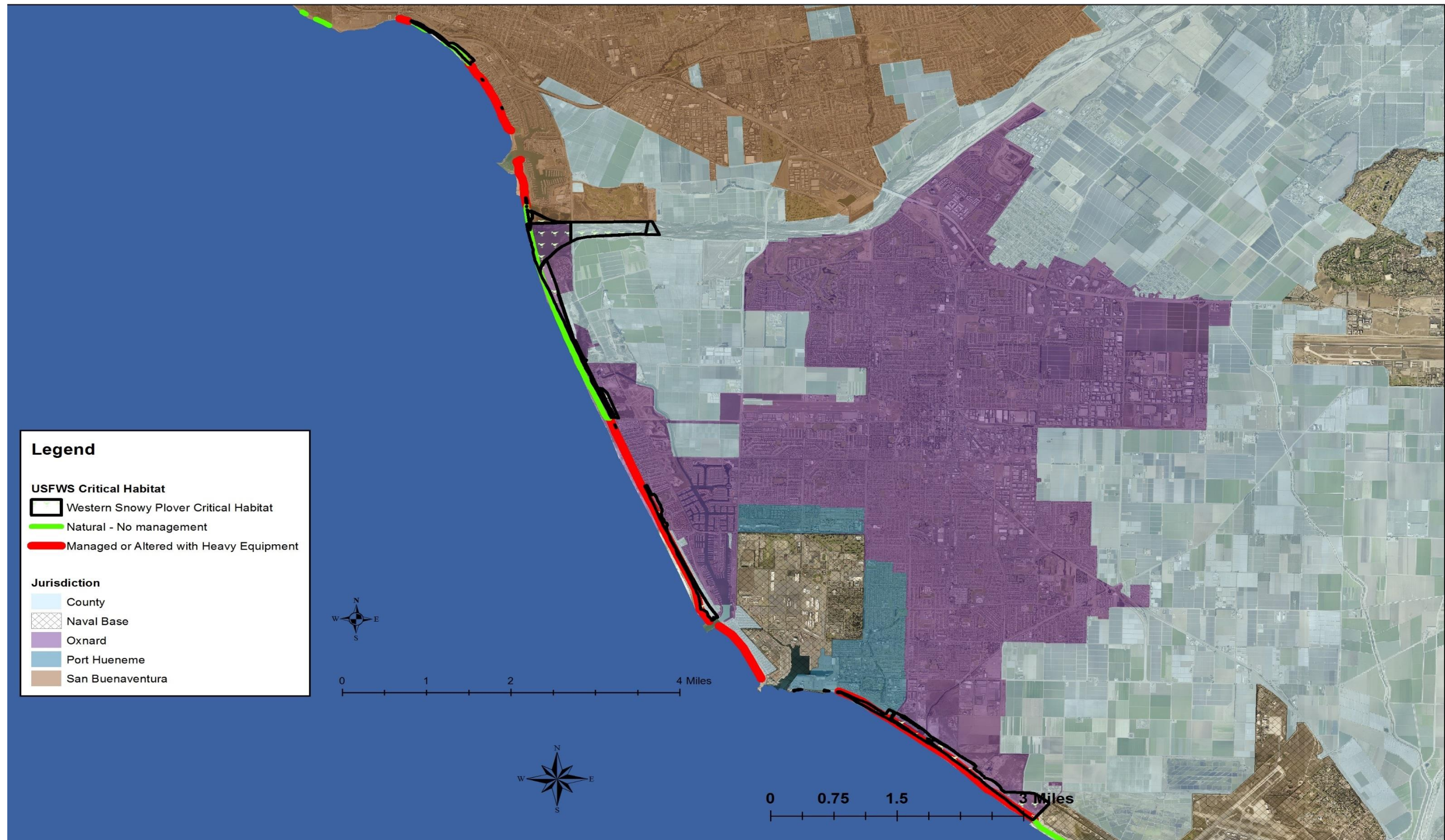


Figure D-10. Beach Management Practices Occuring on California Grunion Spawning Areas

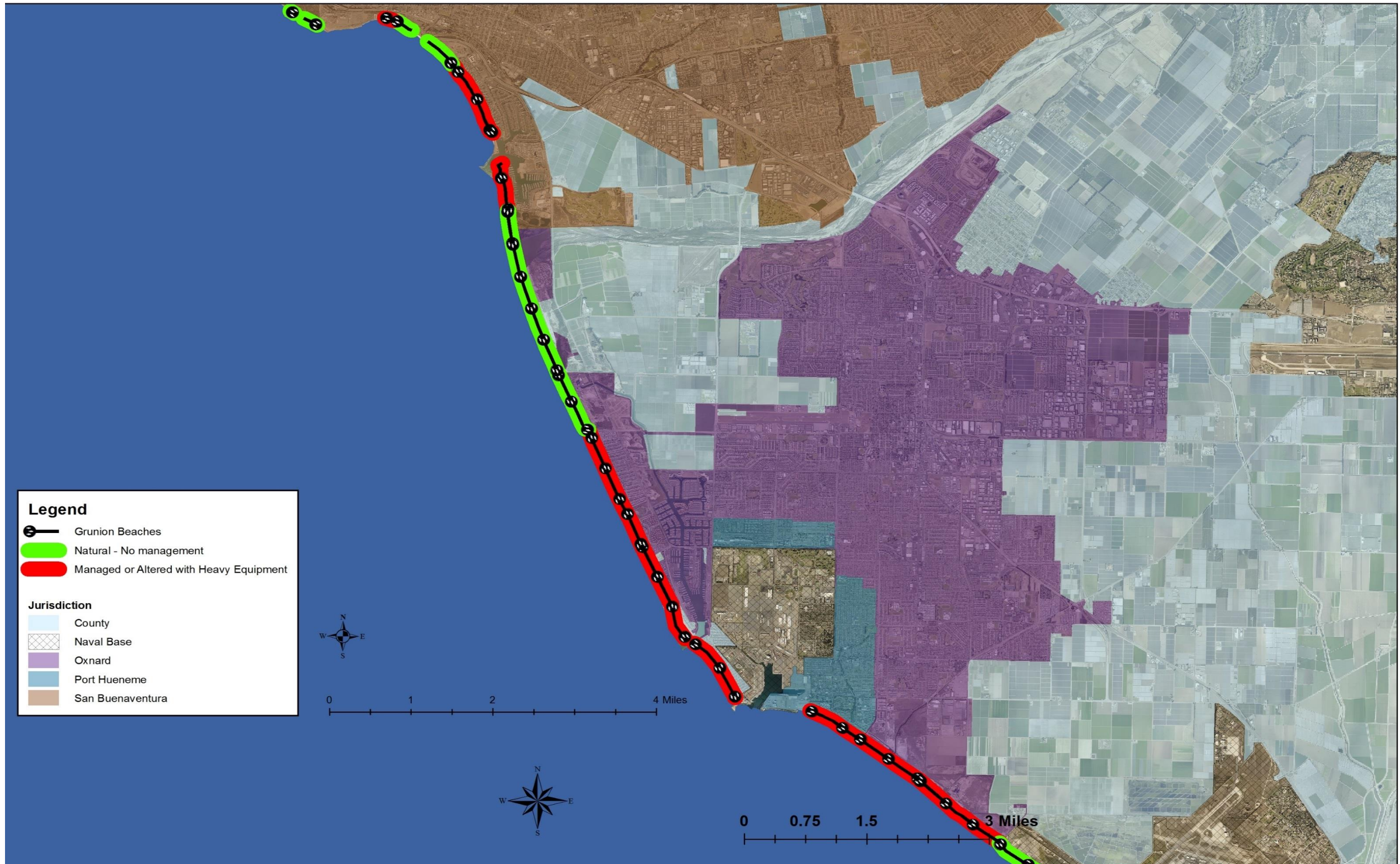


Figure D-11. Central Coast Projected Habitat Erosion Due to Sea Level Rise (Study Area 1)

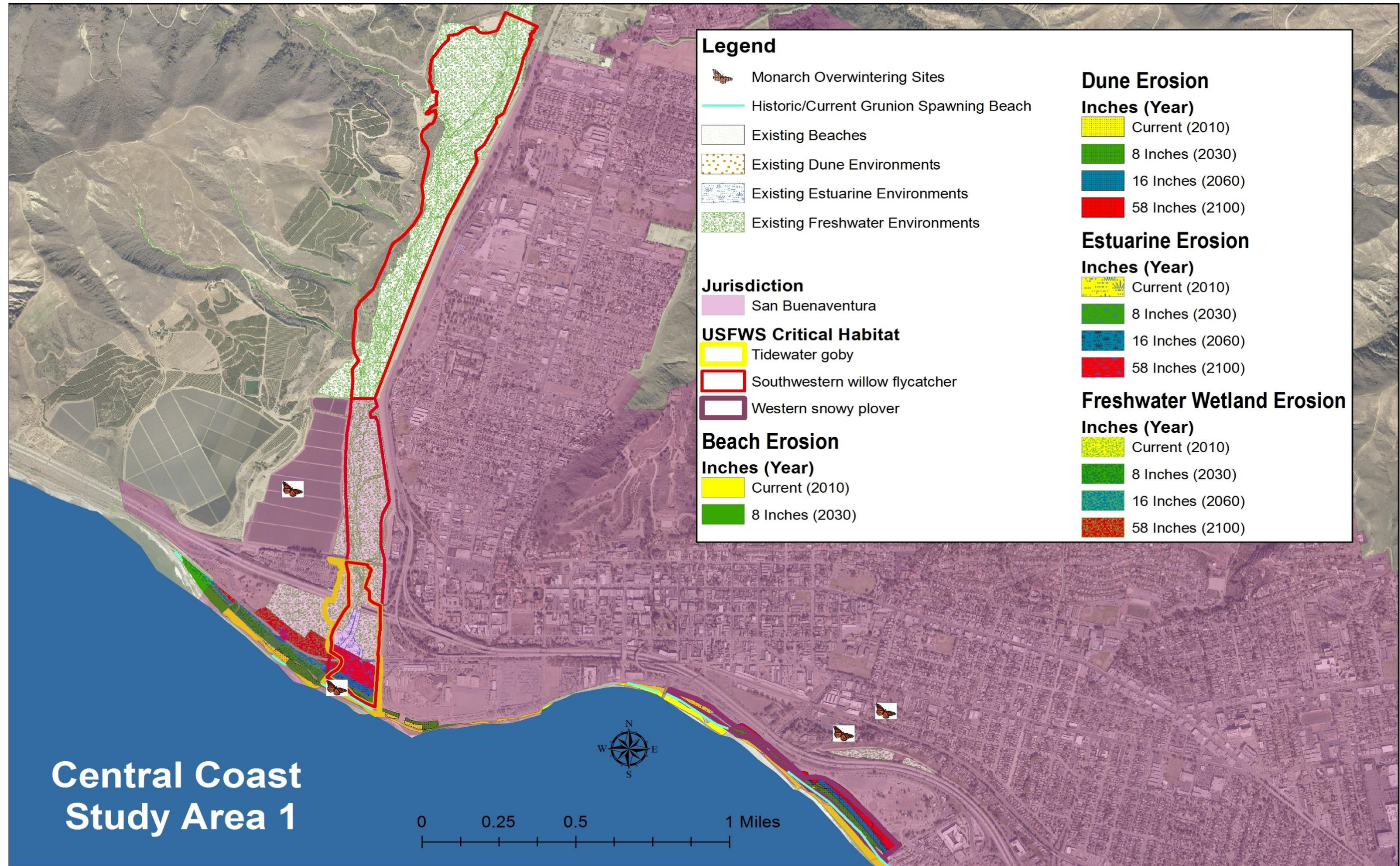


Figure D-12. Central Coast Projected Habitat Erosion Due to Sea Level Rise (Study Areas 2 and 3)

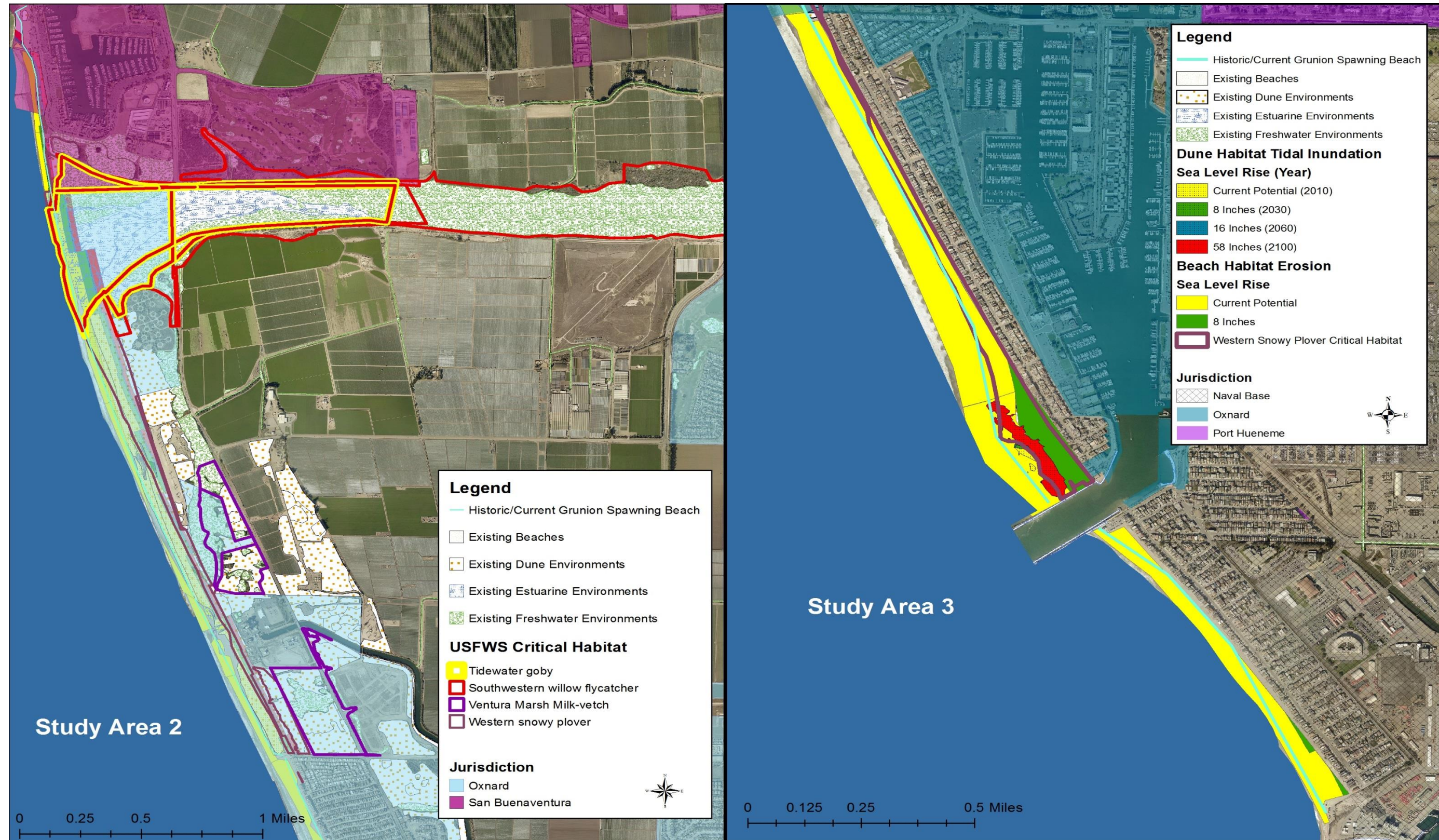


Figure D-13. Central Coast Projected Tidal Inundation Due to Sea Level Rise (Study Area 1)

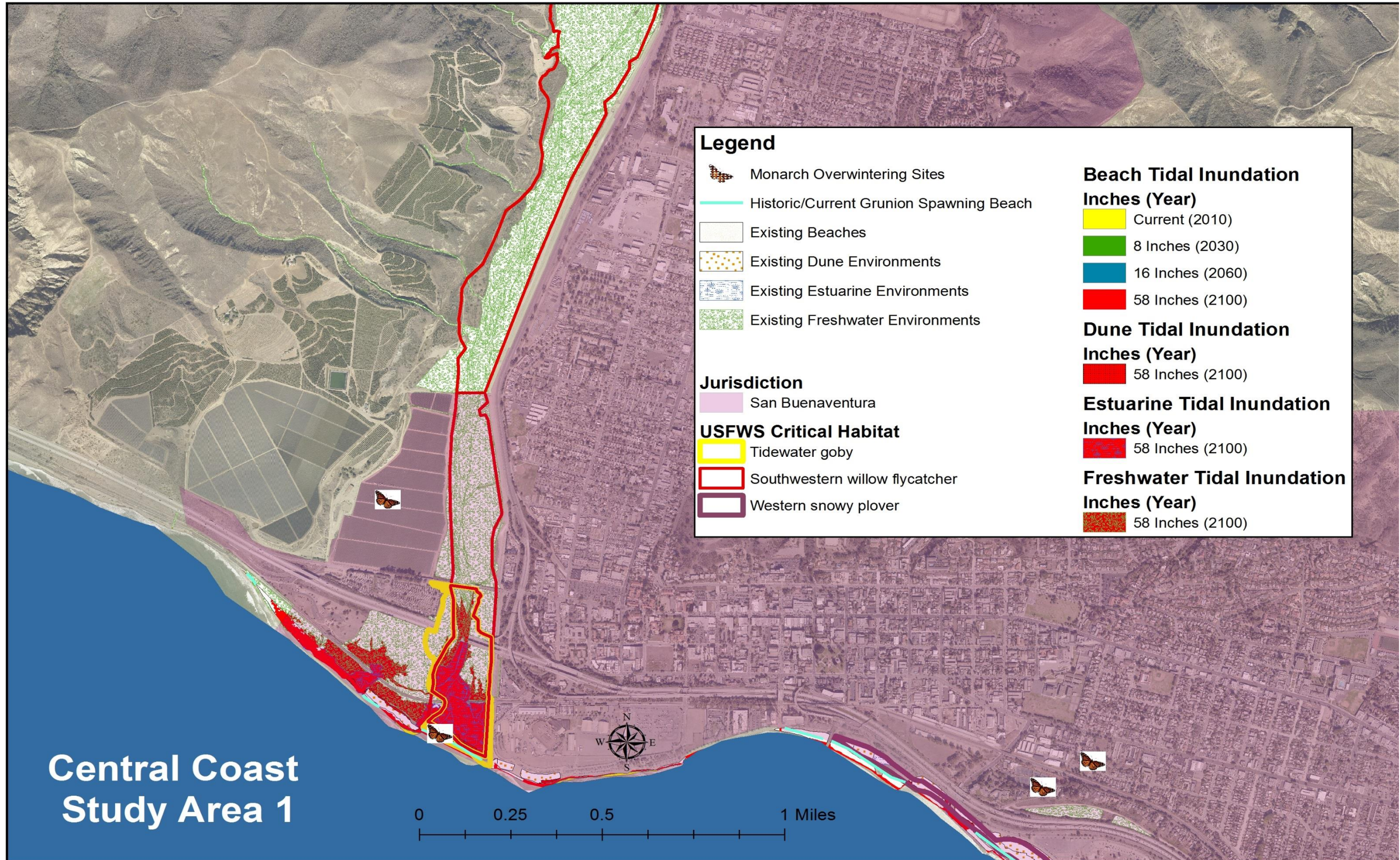


Figure D-14. Central Coast Projected Tidal Inundation Due to Sea Level Rise (Study Areas 2 and 3)

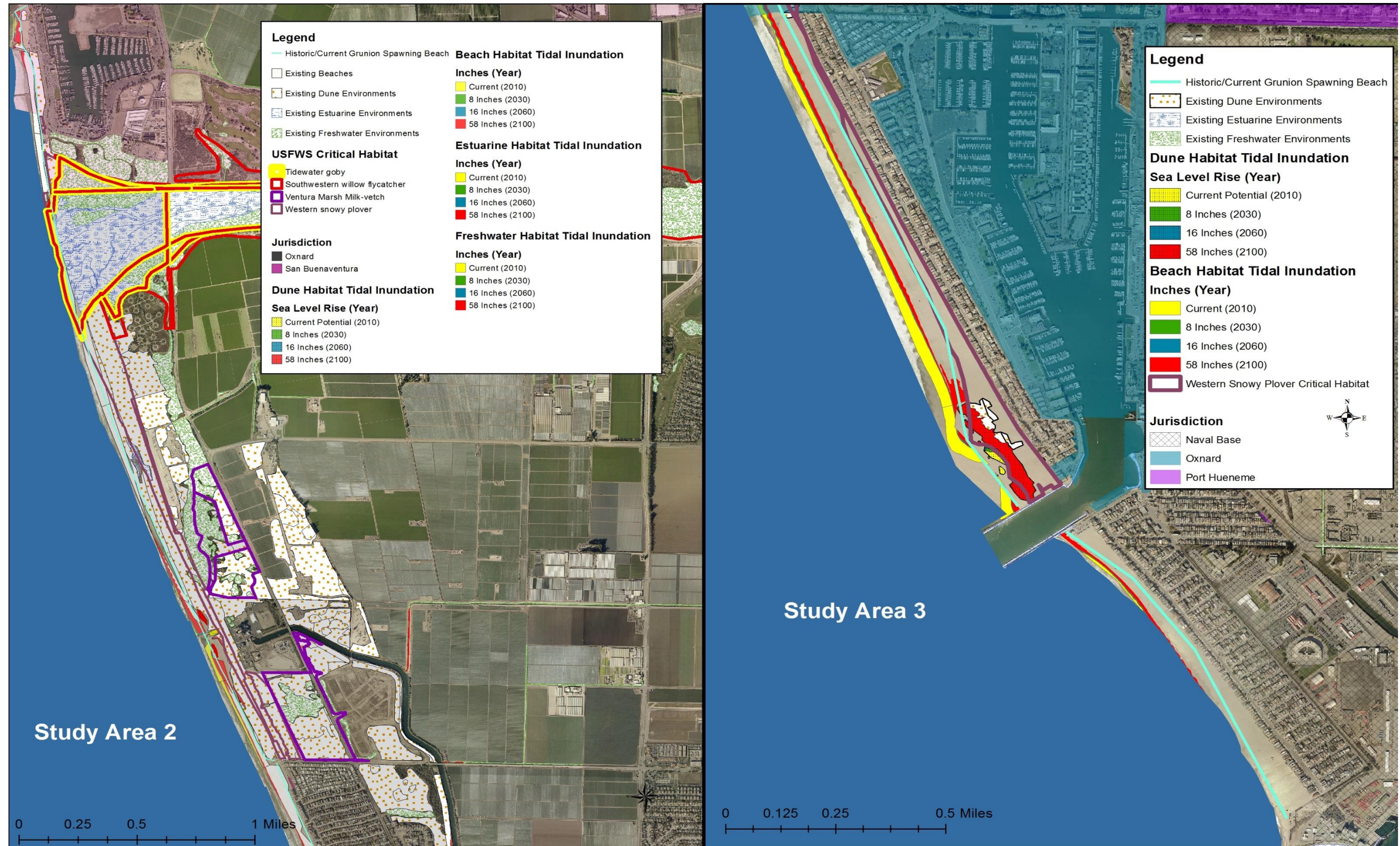


Figure D-15. North Coast Projected Tidal Inundation Due to Sea Level Rise (Study Areas 1 and 2)



Figure D-16. Central Coast Projected Coastal Storm Flooding Due to Sea Level Rise (Study Area 1)

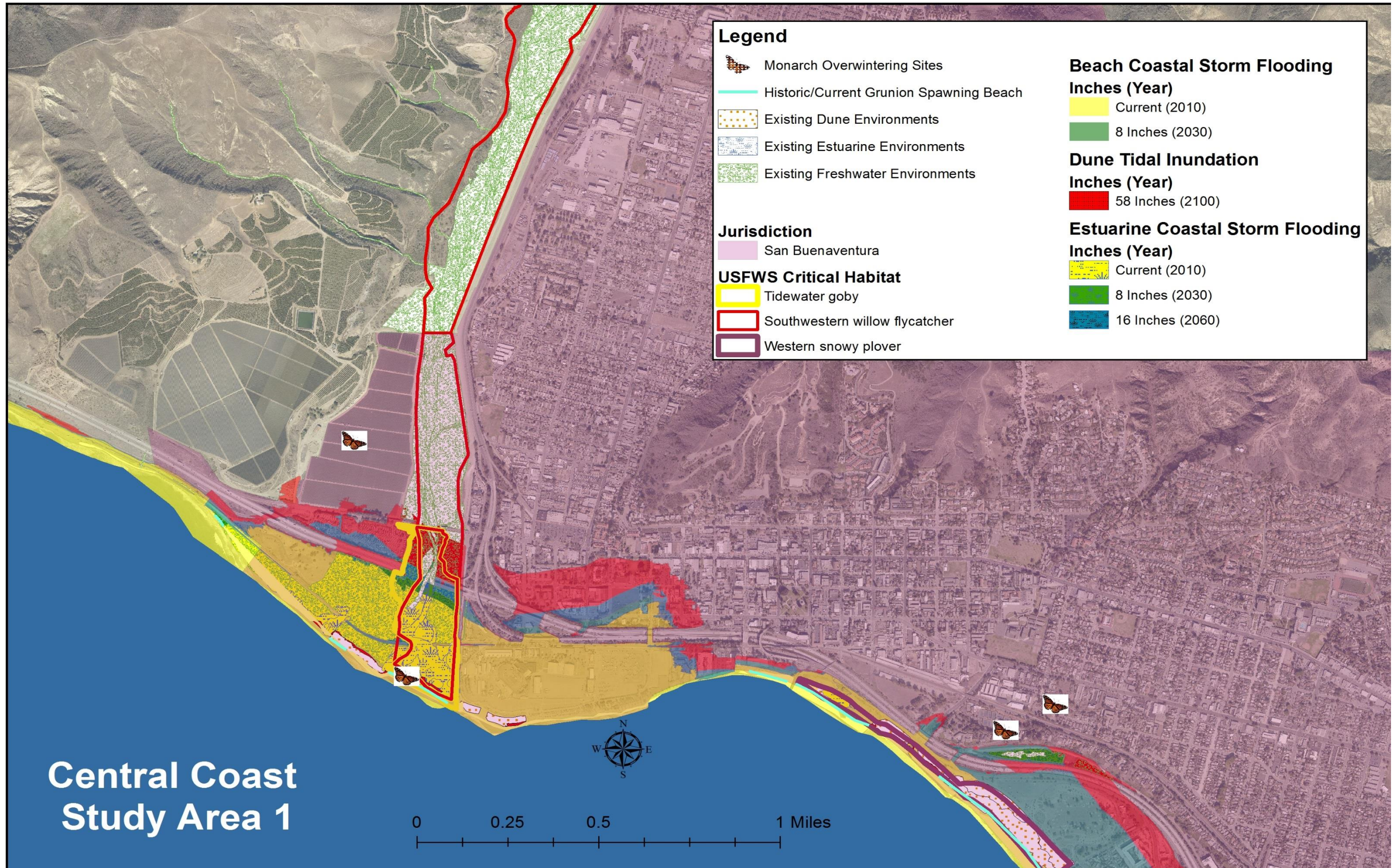


Figure D-17. Central Coast Projected Coastal Storm Flooding Due to Sea Level Rise (Study Areas 2 and 3)

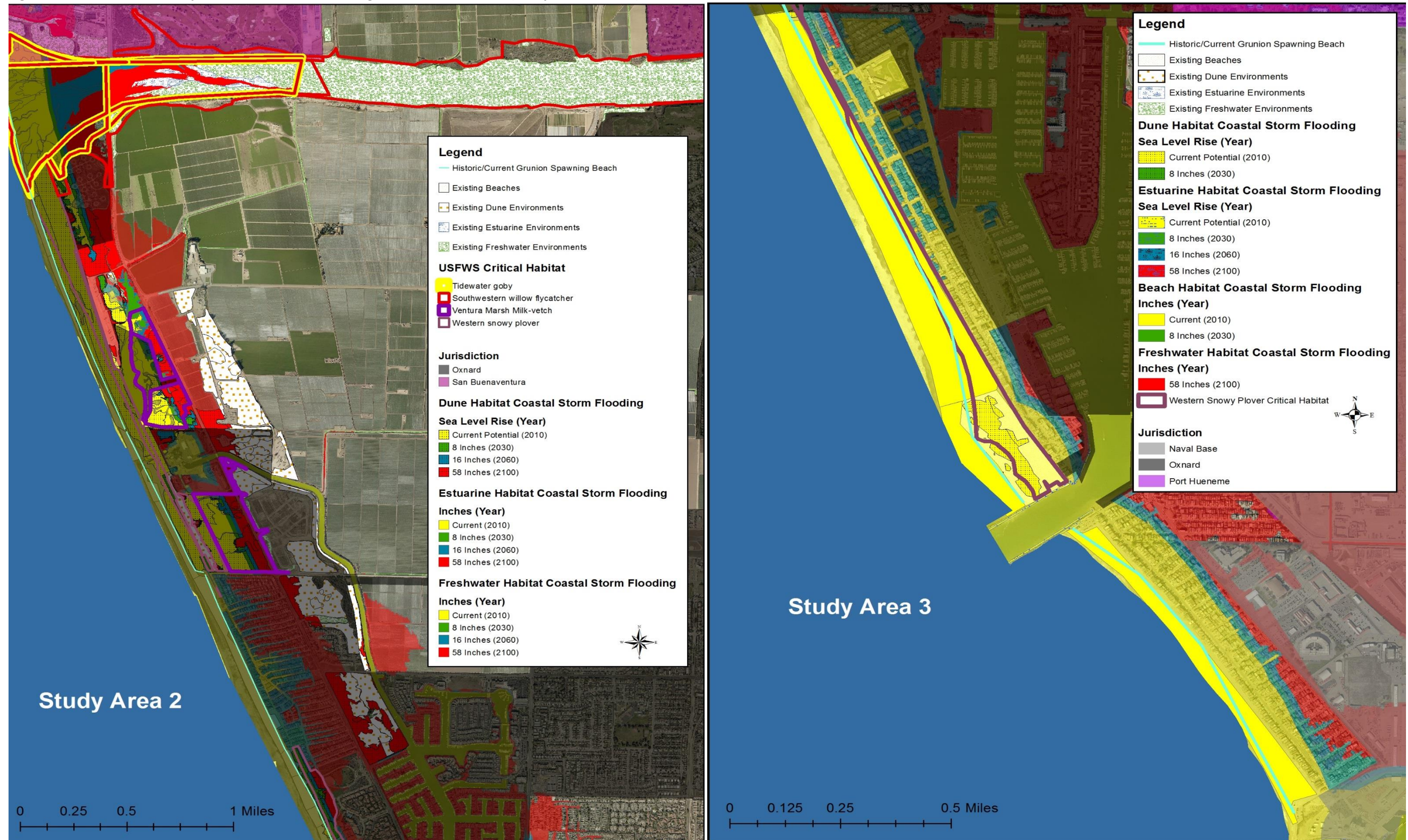


Figure D-18. North Coast Projected Coastal Storm Flooding Due to Sea Level Rise (Study Areas 1 and 2)

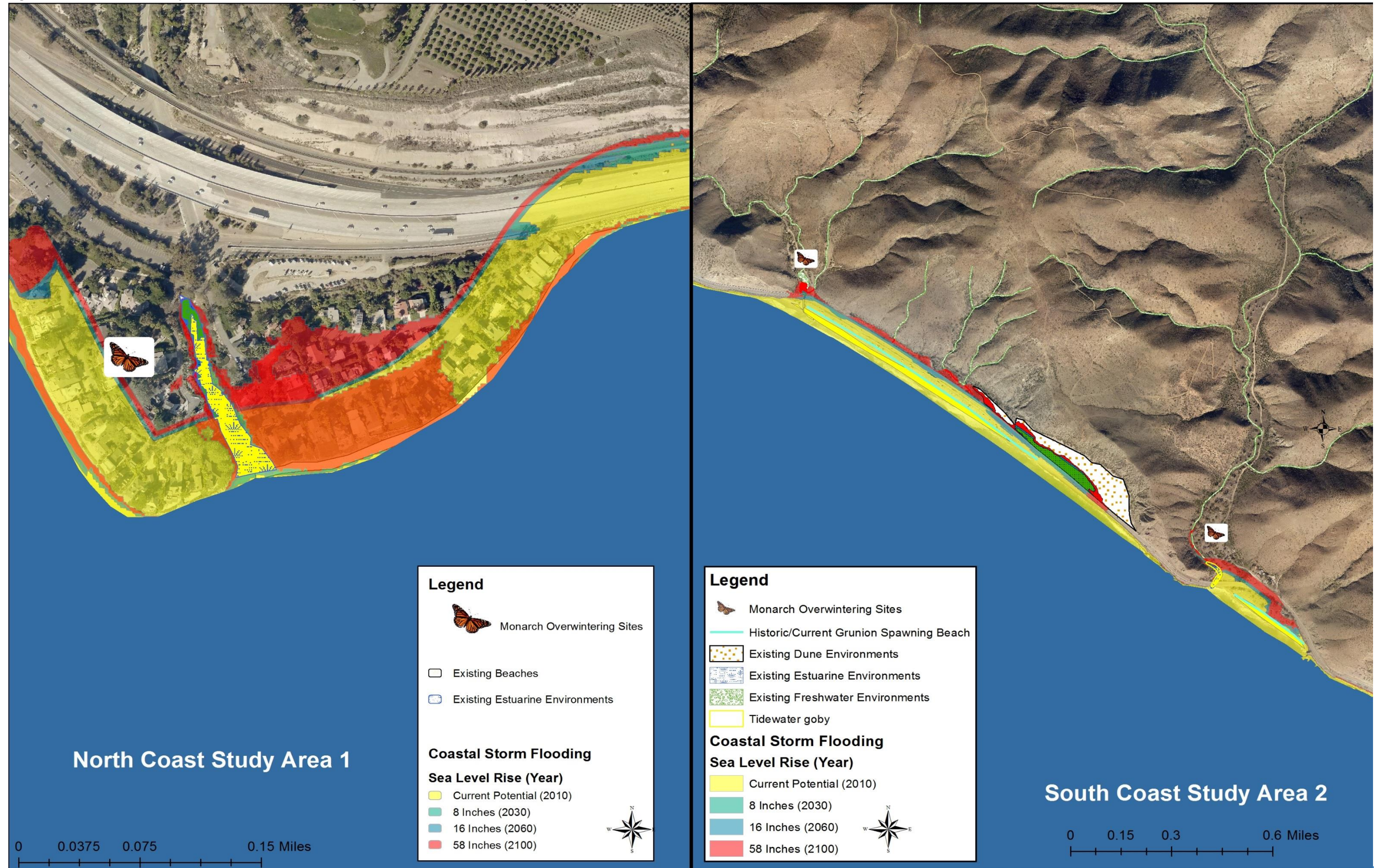


Figure D-19. Central Coast Projected Combined Flooding Due to Sea Level Rise (Study Area 1)

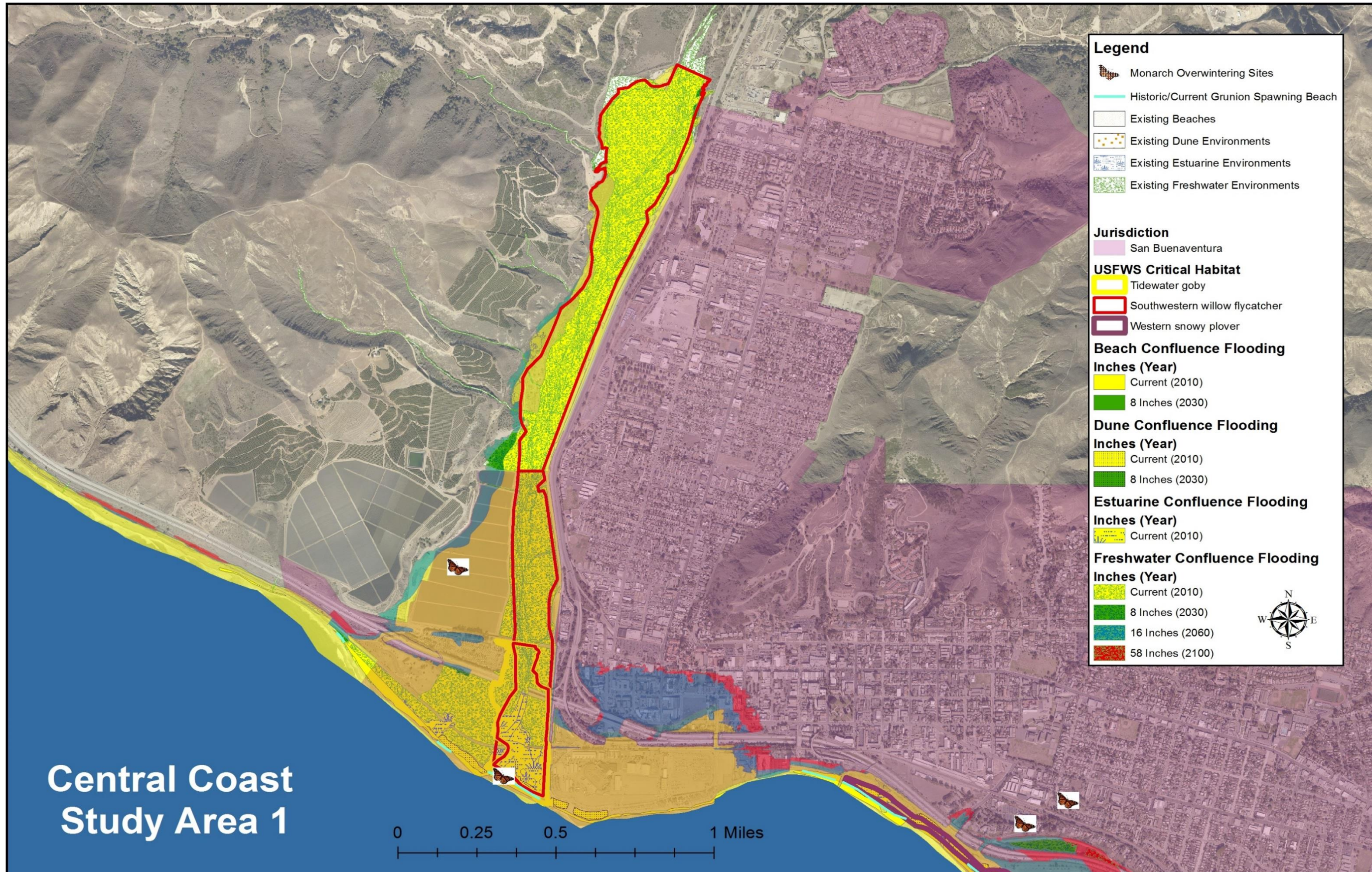


Figure D-20. Central Coast Projected Combined Flooding Due to Sea Level Rise (Study Areas 2 and 3)

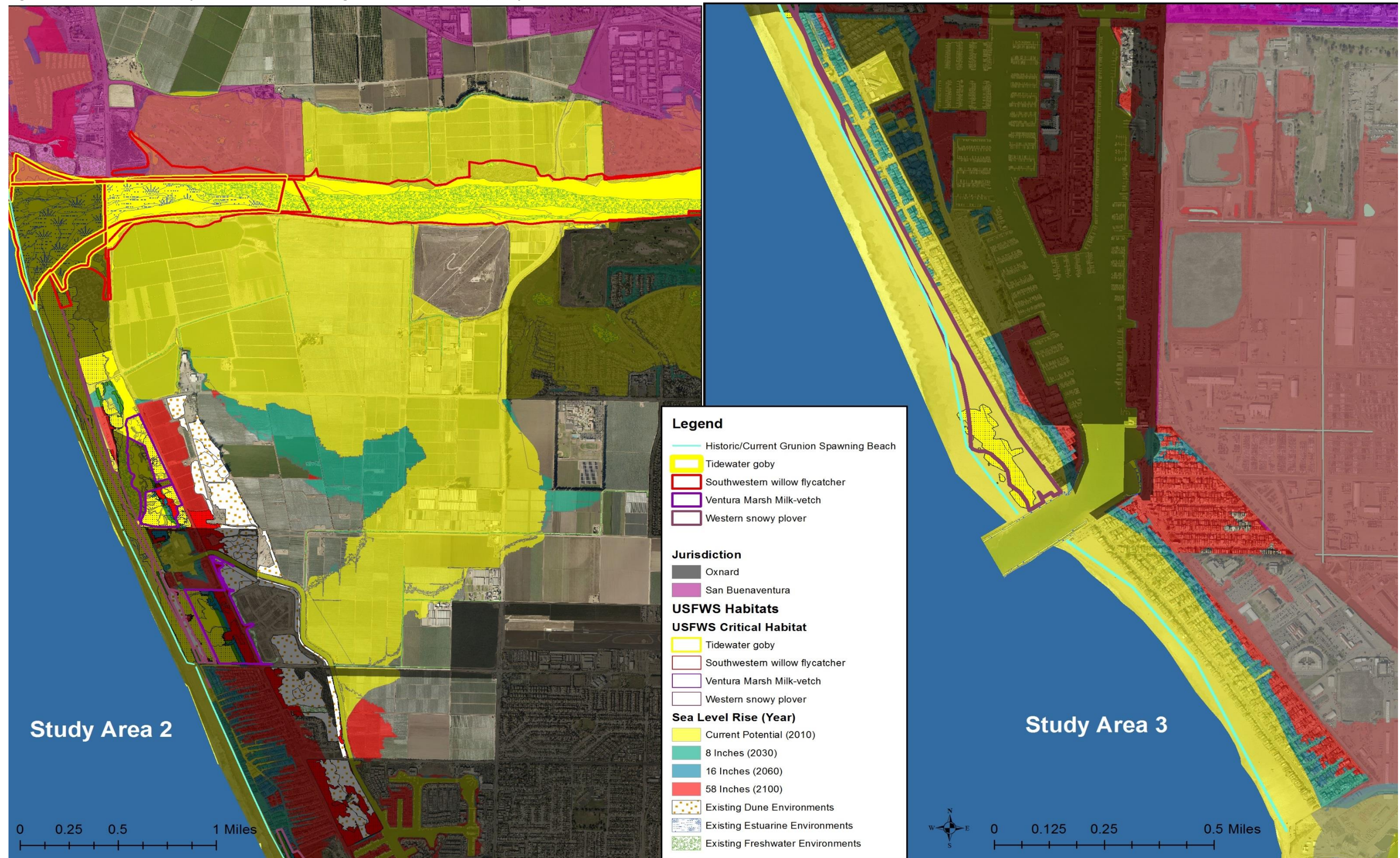


Figure D-21. North Coast Projected Combined Flooding Due to Sea Level Rise (Study Areas 1 and 2)

