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Humboldt Bay Area Plan Communities at Risk Sea Level Rise Vulnerability Assessment

Aldaron Laird

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Humboldt County Humboldt Bay Area Plan



King Salmon King Tide Flooding 9.4 feet NAVD 88, January 2017

Communities at Risk Sea Level Rise Vulnerability Assessment

November 2018

Revised November 20, 2019

HUMBOLDT COUNTY

Humboldt Bay Area Plan

Communities at Risk King Salmon, Fields Landing, and Fairhaven/Finntown

Sea Level Rise Vulnerability Assessment

Prepared By

Aldaron Laird
Trinity Associates

November 2018

Revised November 20, 2019

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DISCLAIMER: The following Communities at Risk from Sea Level Rise Vulnerability Assessment of King Salmon, Fields Landing, and Fairhaven was prepared for Humboldt County. All statements are the sole responsibility of Aldaron Laird of Trinity Associates and do not necessarily reflect the views or policies of Humboldt County. This assessment is for planning purposes and is not a substitute for site-specific analysis of vulnerability and risk from sea level rise.

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Glossary

This report relies in part on terms and definitions that were derived from the California Coastal Commission (CCC) Sea Level Rise Policy Guidance, adopted August 12, 2015.

Adaptation: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which minimizes harm or takes advantage of beneficial opportunities.

Adaptive capacity: The ability of a system to respond to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, and to cope with the consequences.

Backwater or Backwater flooding: Upstream flooding caused by downstream conditions such as channel restriction or high tide blocking high river flows from entering estuaries.

Coastal-dependent development or use: Any development or use which requires a site on, or adjacent to, the sea to be able to function at all.

Coastal resources: A general term used throughout the Guidance to refer to those resources addressed in Chapter 3 of the California Coastal Act, including beaches, wetlands, agricultural lands, and other coastal habitats; coastal development; public access and recreation opportunities; cultural, archaeological, and paleontological resources; and scenic and visual qualities.

Development: On land, in or under water, the placement or erection of any solid material or structure; discharge or disposal of any dredged material or of any gaseous, liquid, solid, or thermal waste; grading, removing, dredging, mining, or extraction of any materials; change in the density or intensity of use of land, including, but not limited to, subdivision pursuant to the Subdivision Map Act (commencing with Section 66410 of the Government Code), and any other division of land, including lot splits, except where the land division is brought about in connection with the purchase of such land by a public agency for public recreational use; change in the intensity of use of water, or of access thereto; construction, reconstruction, demolition, or alteration of the size of any structure, including any facility of any private, public, or municipal utility; and the removal or harvesting of major vegetation other than for agricultural purposes, kelp harvesting, and timber operations which are in accordance with a timber harvesting plan submitted pursuant to the provisions of the Z'berg-Nejedly Forest Practice of 1973 (commencing with Section 4511).

Environmentally Sensitive [Habitat] Area (ESHA): Any area in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments.

Erosion: The wearing away of land and removal of shoreline, beach or sand dune sediments by wave action, high tides, tidal currents, and overtopping shoreline structures such as dikes.

Flood (or Flooding): Refers to normally dry land becoming temporarily covered in water, either episodically (e.g., storm or tsunami flooding) or periodically (e.g., tidal flooding). Annual king tides are an example of tidal flooding of lands normally not covered by daily or monthly high tides. Coastal Hazard planning generally addresses episodic 100-year floods that have 1% probability of occurring in any year but like all floods are unpredictable as to when they might occur. Floods do recede, and flooded lands generally do dry out again.

Inundation: Inundation as used in this report is a form of tidal flooding. Inter-tidal areas are those lands above the lowest tide and below the highest tide elevations that periodically experience tidal inundation. Areas that are below the lowest tide elevation are submerged lands, and thus are permanently inundated. Tidal inundation datums are generally described as to their frequency of occurrence and elevation, such as daily mean low or high water (MLW and MHW); mean monthly and mean annual maximum high water are additional tidal datums (MMMW and MAMW). Tidal inundation is very predictable. Tide charts are published each year that identify when, and how low or high, the tides are expected reach common daily tidal datums: mean lower low water (MLLW), MLW, MHW, and mean higher high water (MHHW). Inundation maps used in this report depict areas that could be inundated by MMMW under various sea level rise scenarios, absent storm surge or wind wave conditions.

Mean sea level: The average relative sea level over a period, such as a month or a year, long enough to average out transients such as waves and tides.

Relative sea level: Combination of regional sea level measured by a tide gauge and vertical land motion trends of the land upon which the gauge is situated.

Risk: Commonly considered to be the combination of the likelihood of an event and its consequences – *i.e.*, risk equals the probability of climate hazard occurring multiplied the consequences a given system may experience.

Sea level: The height of the ocean relative to land; tides, wind, atmospheric pressure changes, heating, cooling, and other factors cause sea level changes.

Sea level change/sea level rise: Sea level can change, both globally and locally, due to (a) changes in the shape of the ocean basins, (b) changes in the total mass of water and (c) changes in water density. Factors leading to sea level rise under global warming include both increases in the total mass of water from the melting of land-based snow and ice, and changes in water density from an increase in ocean water temperatures and salinity changes. Relative sea level rise occurs where there is a local increase in the level of the ocean relative to the land, which might be due to ocean rise and/or land level subsidence.

Sea level rise impact: An effect of sea level rise on the structure or function of a system.

Sensitivity: The degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., climatic or non-climatic stressors may cause people to be more sensitive to additional extreme conditions from climate change than they would be in the absence of these stressors).

Shore protection: Structures or sand placed at or on the shore to reduce or eliminate upland damage from wave action or flooding during storms.

Shoreline protective devices: A broad term for constructed features such as seawalls, revetments, riprap, earthen berms, cave fills, and bulkheads that block the landward retreat of the shoreline and are used to protect structures or other features from erosion and other hazards.

Shoreline vulnerability rating: A quantitative measure of vulnerability that uses combinations of shoreline attributes (cover type and relative elevation to modeled MMMW) to rank shoreline segment's vulnerability to erosion and/or overtopping due to extreme tides, storm surges, and sea level rise. (Laird and Powell 2013)

Still water level: The elevation that the surface of the water would assume if all wave action was absent.

Storm surge: A rise above normal water level on the open coast due to the action of wind stress on the water surface. Storm surge resulting from a hurricane also includes the rise in water level due to atmospheric pressure reduction as well as that due to wind stress.

Subsidence: Sinking or down-warpage of a part of the earth's surface; can result from seismic activity, changes in loadings on the earth's surface, fluid extraction, or soil settlement.

Tectonic: Of or relating to the structure of the earth's crust and the large-scale processes that take place within it.

Tidelands: Lands which are located between the lines of mean high tide and mean low tide.

Vulnerability: The extent to which a species, habitat, ecosystem, or human system is susceptible to harm from sea level rise impacts. More specifically, the degree to which a system is exposed to, susceptible to, and unable to cope with, the adverse effects of sea level rise, and tidal extremes.

1 Introduction

Humboldt County received a grant from the California Coastal Commission to engage at-risk communities from sea level rise by initiating the process of educating stakeholders of their vulnerability. In August of 2018, two workshops were held for at-risk communities: one workshop for King Salmon and Fields Landing, and another for Fairhaven and Finntown. A comprehensive sea level rise vulnerability assessment was prepared for the County's Humboldt Bay Area Plan (HBAP) jurisdiction, including these at-risk communities (Laird 2018). This document can be found at the following link on the County's Local Coastal Plan Update website: <https://humboldt.gov/DocumentCenter/View/62872/Humboldt-Bay-Area-Plan-Sea-Level-Rise-Vulnerability-Assessment-Report-PDF?bidId=>

Based on the Coastal Commission's 2015 sea level rise guidance, the at-risk communities workshops utilized scenario-based high sea level rise projections (NHE 2014) to address when specific water levels might occur (Figure 1).

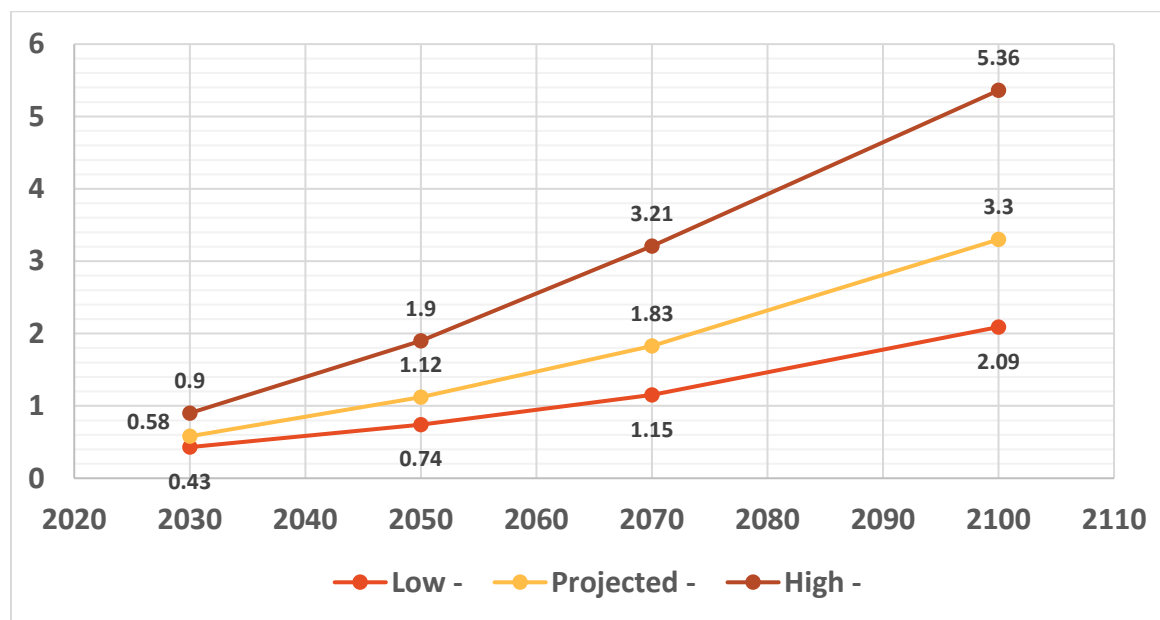


Figure 1. Sea level rise elevations (shown in feet) based on high greenhouse gas emission scenario for the North Spit tide gauge (NHE 2014).

At-risk communities are vulnerable to sea level rise of 1.6 feet (0.5 meter) and 3.3 feet (1.0 meter) for three tidal datums: king tides or mean annual maximum water (MAMW), mean monthly maximum water (MMMW), and mean higher high water (MHHW), which represent nuisance flooding, chronic flooding, and tidal conversion, respectively (Figure 2).

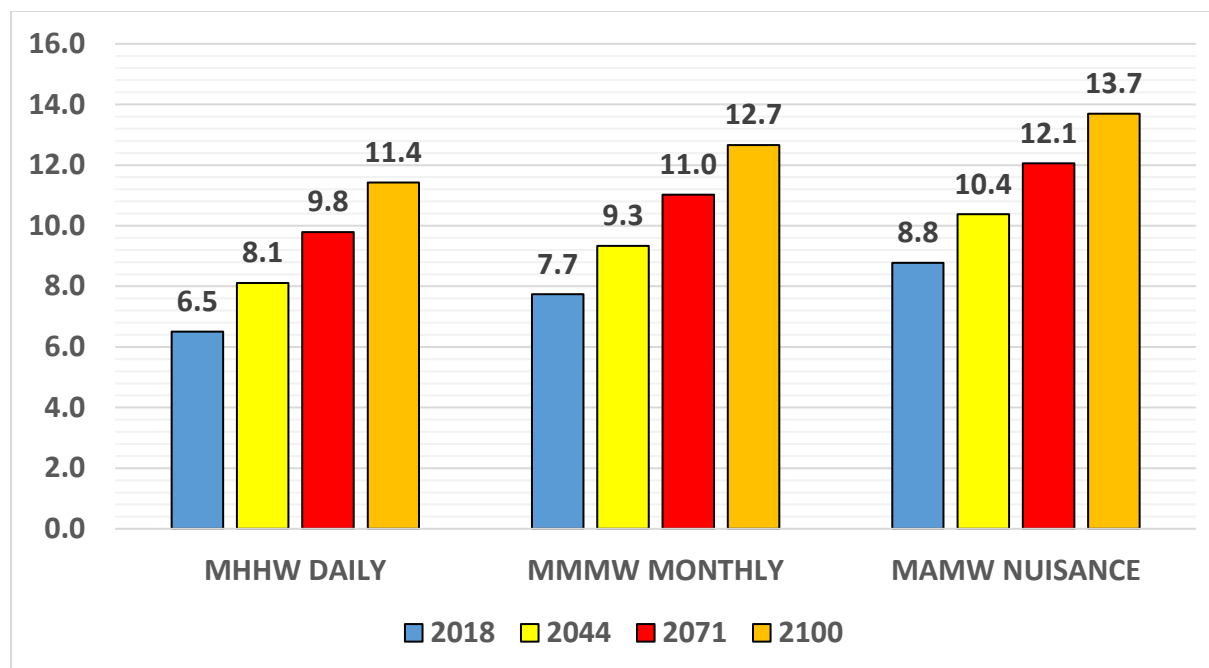


Figure 2. Sea level rise elevations (shown in feet) based on high greenhouse gas emission scenario for the North Spit tide gauge as expressed by daily, monthly, and annual high tides (NHE 2014).

The Ocean Protection Council (2018) and just recently the Coastal Commission (2018) have adopted probabilistic projections for sea level rise based on three levels of risk aversion (low, medium-high, and extreme). The medium-high risk aversion projections are very similar to the scenario used for high projections of 1.6 feet (0.5 meter) by 2040 and 3.3 feet (1.0 meter) by 2070. However, the new extreme risk aversion projections indicate that these two critical water levels may occur earlier, by 2030 and 2050.

This vulnerability assessment report:

- Describes properties and infrastructure that are at risk from sea level rise in the at-risk communities of King Salmon, Fields Landing, and Fairhaven and Finntown (areas of inundation are identified assuming no shoreline protective structure, and without consideration of wind waves or storm surge);
- Identifies stakeholders for each community;
- Discusses stakeholder adaptive capacity to respond to sea level rise;
- Summarizes stakeholder workshops;
- Summarizes sea level rise adaptation planning in other economically disadvantaged communities;
- Summarizes relevant portions of the Coastal Commission's residential sea level rise adaptation guidance (2018), Pacific Gas & Electric Company's (PG&E) sea level rise vulnerability assessment report to the Commission (2005); and
- Reviews recent Coastal Commission Coastal Development Permits (CDP) issued in at-risk communities.

2 Sea level rise vulnerabilities and risks for affected properties and infrastructure in each community

In the HBAP's jurisdiction, the communities at risk and area at risk from 3.3 feet (1.0 meters) of sea level rise are: King Salmon (176 acres), Fields Landing (183 Acres), and Fairhaven/Finntown (509 acres). These areas represent the maximum extent of the area covered in this vulnerability assessment. All four communities front Humboldt Bay and are in the unincorporated area of the County.

2.1 King Salmon

The community of King Salmon with its tidal canal system is very vulnerable to rising water levels (Figure 3) under current conditions. Approximately 16% of the residential parcels in King Salmon are vacant. The residential and commercial areas of King Salmon have a surface elevation that ranges from approximately 8 to 10 feet. The daily high tide (MHHW) is 6.5 feet (NAVD 88). Two of the tributary canals can become pathways for tidal inundation on Perch, Crab and Cod Streets, during present MHHW (Figure 4). During an average king tide (MAMW) of 8.8 feet, all the tributary canals become pathways for tidal inundation of much of the residential and commercial developments (Figure 5). With just 1.6 feet (0.5 meters) of sea level rise, king tides (10.4 feet) will be able to inundate nearly the entire community, as well as King Salmon Avenue which is the only vehicular access to this community (Figure 6). When sea level rise reaches 3.3 feet (1.0 meter), the Humboldt Bay Power Generating Station could also be tidally inundated by MMMW (11.0 feet; Figure 7).

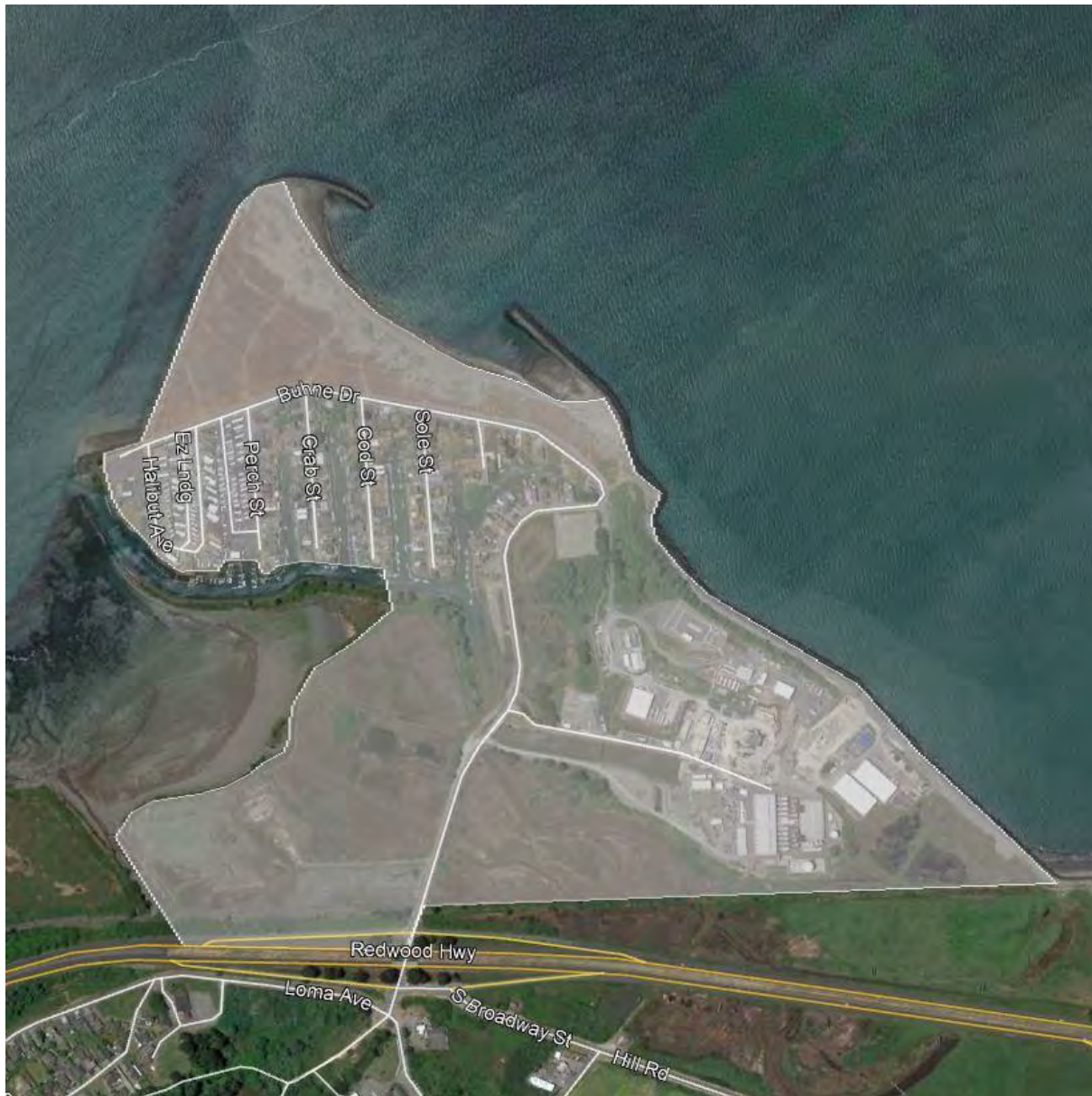


Figure 3. Community of King Salmon.



Figure 4. King Salmon potential tidal inundation areas during the daily high tide (MHHW) of 6.5 feet, assuming shoreline barrier structures do not exist or are breached.



Figure 5. King Salmon potential tidal inundation areas during a king tide (MAMW) of 8.8 feet, assuming shoreline barrier structures do not exist or are breached.



Figure 6. King Salmon potential tidal inundation areas with 1.6 feet (0.5 meter) of sea level rise during a king tide (MAMW) of 10.4 feet, assuming shoreline barrier structures do not exist or are breached. King Salmon Avenue becomes compromised.



Figure 7. King Salmon potential tidal inundation areas with 3.3 feet (1.0 meter) of sea level rise during a king tide (MMM_W) of 11.0 feet, assuming shoreline barrier structures do not exist or are breached. The Humboldt Bay Power Generating Station becomes compromised.

Laird:20181114; revised 20191120



Figure 9. Fields Landing during a recent king tide (MAMW) of 8.8 feet with storm water flooding of residential area.

Primary pathways for tidal inundation of the entire residential portion of Fields Landing are where the railroad grade reaches the bay on the north and south. Inundation via these pathways may occur with 1.0 to 1.6 feet (0.5 meter) of sea level rise during MMMW of 8.8 to 9.3 feet (Figure 10). The waterfront, except for Humboldt County's boat launch, is higher in elevation than these tides. However, king tides of 10.4 feet with 1.6 feet of sea level rise would breach the waterfront at multiple locations and tidally inundate the residential and commercial areas to the east (Figure 11). When sea level rise reaches 3.3 feet (1.0 meter), nearly all developed areas of Fields Landing could be tidally inundated by MMMW of 11.0 feet; Figure 12).



Figure 10. The railroad grade in Fields Landing provides the primary pathway for tidal inundation of inland, low-lying residential areas by 1.6 feet (0.5 meter) of sea level rise during MMMW of 9.3 feet, assuming shoreline barrier structures do not exist or are breached.



Figure 11. Fields Landing's waterfront could potentially be breached by king tides (MAMW) of 10.4 feet, with 1.6 feet (0.5 meter) of sea level rise, assuming shoreline barrier structures do not exist or are breached.



Figure 12. Potential inundation of nearly all developed areas in Fields Landing during MMMW of 11.0 feet, with 3.3 feet (1.0 meter) of sea level rise, assuming shoreline barrier structures do not exist or are breached.

2.3 Fairhaven and Finntown

The general community area, known as Fairhaven is located on the North Spit on the western shore of Humboldt Bay. Access to the community of Fairhaven is from County maintained New Navy Base Road and Highway 255. Fairhaven was built on a sand dune formation along the shore of Humboldt Bay (Figure 13 and Figure 14).



Figure 13. The Community of Fairhaven (white shading) is between New Navy Base Road and the shore of Humboldt Bay, the area historically called Finntown is north of Comet Street (aka Bivalve Way) along the waterfront.



Figure 14. The community of Fairhaven's undeveloped waterfront (0.5 miles), shoreline of dunes and beach, ranging in elevation from 9 to 10 feet and bordering a deep navigation channel.

Historically, the community was associated with the ship building era of 19th century. The community is located east of New Navy Base Road and south of Bay Street. Humboldt Bay's main navigation channel is adjacent to Fairhaven. A former pulp mill, which is now the Fairhaven Business Park with an unused bulk cargo dock and several commercial warehouses, fronts 0.5 miles of shoreline that has been fortified with rock and concrete rubble and is generally greater than 14 feet in elevation. A large residential area is bounded by Lincoln Avenue to the west, Duprey Street to the south, and Broadway and the Fairhaven Business Park to the east. The Samoa Peninsula Fire District Station is located adjacent to this residential area.

The residential area relies on individual wastewater septic tank/leachfield systems on lots that range in elevation between 9 and 12 feet NAVD 88 with low-lying wetland areas (6 to 9 feet in elevation, Figure 15). Unlike King Salmon and Fields Landing, 65% of the residential lots in Fairhaven are undeveloped.



Figure 15. Low-lying wetland areas (blue) that range in elevation from 6 to 9 feet between Fairhaven and the higher elevation dune shoreline of 9 to 10 feet, showing inundation under today's MHHW of 6.5 feet.

There is a commercial fishing enclave and residential/commercial development on the north shore of Fairhaven, between Comet (aka Bivalve Way) and Bay Streets that historically was referred to as Finntown. This area is nestled between high dunes to the west and the Bay to the east, and has a strong orientation to the Bay with an active marine repair/dry dock facility, aquaculture pier, other commercial uses, and waterfront residential parcels. The shoreline in Finntown is approximately 0.25 miles long and generally 9 feet or less in elevation. The marine repair dry dock facility in Finntown has a gently sloping boat ramp up to an elevation of 9 feet. The approximately 500 feet of shoreline in front of the residential area is undeveloped and another segment 370 feet in length to the north is fortified (Figure 16). Inland residential/commercial developments range in elevation from 9 to 12 feet. Neither Fairhaven nor Finntown are served by a community wastewater system; individual septic-leach field systems are employed.



Figure 16. Finntown's developed commercial waterfront, generally less than 9 feet in elevation, bordering a deep navigation channel.

These communities presently are not tidally inundated by king tides (MAMW of 8.8 feet), although groundwater does rise in the wetlands during these high tide events. The undeveloped shoreline in Fairhaven and the shoreline in Finntown could be overtopped with 1.6 feet (0.5 meter) of sea level rise during king tides (10.4 feet). Residential areas east of Lincoln Avenue could be tidally inundated approximately four times a year. With mean monthly maximum tides (9.3 feet), residential areas east of Lindstrom Avenue could become tidally inundated once a month (Figure 17). With 3.3 feet (1.0 meter) of sea level rise, the daily high tide (MHHW of 9.8) feet could inundate these same residential areas daily.



Figure 17. The undeveloped shoreline in Fairhaven and the shoreline in Finntown could be overtopped with 1.6 feet (0.5 meter) of sea level rise (10.4 feet), assuming shoreline barrier structures do not exist or are breached. Residential areas east of Lincoln Avenue could also become tidally inundated 4 to 12 times a year by king tides and monthly maximum tides.

With 3.3 feet (1.0 meter) of sea level rise, king tides could reach 12.1 feet. Under current conditions, this would flood most of the developed areas of Fairhaven and Finntown (Figure 18). Mean monthly maximum tides could tidally inundate the residential and commercial developments east of Lincoln Avenue on a monthly basis. Most of the Coastal-Dependent Industrial lands and developments between Fairhaven and Finntown would not be tidally inundated.

Nearly the same area would be tidally inundated daily by MHHW of 11.4 feet with 4.9 feet (1.5 meters) of sea level rise.



Figure 18. With 3.3 feet (1.0 meter) of sea level rise, king tides could reach 12.1 feet. Nearly all of Fairhaven and Finntown could become tidally inundated 4 times a year, assuming shoreline barrier structures do not exist or are breached.

3 List of stakeholders for each community and their existing and potential adaptive capacity

Community stakeholders can include a range of individuals and agencies. They can be private or public property owners, residents, business owners, private or government utility providers, government-maintained or private transportation and stormwater infrastructure, and the public who utilize recreational and natural resources.

3.1 King Salmon stakeholders

King Salmon has residential property owners, trailer park and RV park owners and residents, several commercial and recreational businesses, the region's largest privately-owned (PG&E) power generating station, public recreational facilities, public utilities and roads, and publicly utilized beach. Humboldt County Public Works maintains community streets, including King Salmon Avenue and its bridge, the only means of vehicular access to King Salmon. Humboldt County Public Works also maintains several water control structures for stormwater runoff. Utility service providers include Humboldt Community Services District, which maintains three deep wells, pump stations and a distribution pipe system to deliver municipal water, and sewer lines and lift stations to convey wastewater to the City of Eureka's Elk River Wastewater Treatment Plant. Pacific Gas & Electric Company provides natural gas and electricity to the community. Several private companies maintain communications infrastructure to deliver their services to the community. There are several privately owned commercial

and recreational fishery service providers including a fuel dock, bilge and sewage pump-out station, 80 boat berths, EZ Landing and Johnny's Landing boat launch ramps, and many private docks.

The Humboldt Bay Harbor, Recreation and Conservation District (Harbor District) owns and maintains the jetties that protect the community from wave induced erosion caused by the jetties at the entrance of the bay. The Harbor District also owns and maintains the beach and dune ecosystem/recreational area between the King Salmon jetties. PG&E maintains rock slope protection/sea wall along the north shore of the community that it allows to be used as a part of a coastal trail and shields the bluff on Buhne Hill from erosion. The North Coast Railroad Authority has property and an abandoned railroad grade and water control structures along the eastern boundary of the community. Caltrans maintains Highway 101, including off and on ramps and water control structures, along the eastern boundary of the community.

3.2 Fields Landing stakeholders

Fields Landing has residential property owners and residents; several commercial and Coastal-Dependent Industrial properties, facilities and businesses; and public roads, public facilities and public utilities. Humboldt County Public Works maintains community streets and stormwater runoff water control structures. Utility service providers include Humboldt Community Services District, which maintains pump stations and a distribution pipe system to deliver municipal water, and sewer lines and lift stations to convey wastewater to the Elk River Wastewater Treatment Plant in Eureka. Pacific Gas & Electric company provides natural gas and electricity to the community. Several private companies maintain communications infrastructure to deliver their services to the community.

The U.S. Army Corps of Engineers maintains the Fields Landing navigational channel to a depth of 30 feet. There is a multi-purpose dock previously used for heavy loading but currently in poor repair and a commercial fishing dock also in poor repair in the community. Humboldt County maintains a boat ramp and parking facilities, and the Harbor District owns and maintains the Fields Landing boat yard with dry dock facilities for commercial and recreational boat repairs. The Harbor District also owns Coastal-Dependent Industrial waterfront property. The North Coast Railroad Authority has property and an abandoned railroad grade and water control structures that divide the commercial/industrial waterfront from the residential area of the community. Caltrans maintains Highway 101, including off and on ramps and water control structures, along the eastern boundary of the community.

3.3 Fairhaven and Finntown stakeholders

Fairhaven and Finntown have residential property owners and residents, several commercial businesses, Fairhaven Business Park, public facilities, and public utilities. Humboldt County Public Works maintains community streets and drainage infrastructure. New Navy Base Road is the only means of vehicular access to these

communities. Utility service providers include Humboldt Bay Municipal Water District, which maintains a distribution pipe system and retail hook-ups to deliver municipal water. These communities are not presently served by a wastewater treatment facility; instead they rely on individual septic systems for waste disposal. A Peninsula Community Services District is forming to take over delivery of municipal water and will explore developing a community wastewater treatment facility to serve these communities. The Samoa Peninsula Fire District has a station house in Fairhaven. The Pacific Gas & Electric company provides natural gas and electricity to the community. Several private companies maintain communications infrastructure to deliver their services to the community.

The U.S. Army Corps of Engineers maintains the Samoa navigation channel to a depth of 45 feet in front of Fairhaven and Finntown. Zerlang & Zerlang Marine Services and boat yard and several other commercial businesses are in Finntown. The Fairhaven Business Park is located between Fairhaven and Finntown and provides space for several commercial businesses and a multi-purpose heavy loading dock and facilities on the shipping channel.

3.3.1 Communities at Risk Stakeholder Adaptive Capacity

The ability of people and organizations who own assets to mitigate the adverse effects from sea level rise is dependent on their ability to fund, design, permit and implement mitigation actions. Funding for the protection of publicly owned or maintained assets (such as navigation channels, boat launch and dry dock facilities, jetties, beach and dune recreation areas, streets, roads, highways, stormwater runoff water control structures, municipal water and wastewater systems, streets, bridges, and fire stations) is often possible from state and federal hazard mitigation programs and other general obligation bond funds. Private utility service providers (energy and communications) have a ratepayer base to support maintenance of their infrastructure, as well as trained staff to develop and implement adaptation strategies and measures. Small business owners and residential property owners are financially and technically at a significant disadvantage to fund, design, permit and implement adaptation measures compared to large utility providers or public agencies. Non-property-owning residents and the public who visit coastal resource areas in these at-risk communities have very little adaptive capacity to address asset vulnerabilities and risk.

4 Summary of stakeholder meetings and discussions of sea level rise vulnerabilities and stakeholder adaptive capacities

4.1 Community interviews

In advance of the workshops, seventeen King Salmon residents and business owners participated in one-on-one interviews, providing their reactions to and knowledge of local sea level rise and flooding. King Salmon was selected because this community is the most vulnerable of the four communities assessed in this report. Of all communities across the entire U.S. West Coast, King Salmon is predicted to be at the highest risk of sea level rise inundation.

Questions were presented to the community in a conversational, semi-structured format; not all questions were asked of each participant. Relevant questions included:

- Has flooding affected your property or activities? How?
- What do you do when it floods? How does it affect your life or activities?
- How do feel the level and amount of flooding has changed over time?
- Scientists project that water levels will continue to increase in this area and flooding will be more common. What do you think about these projections? What would you want to do to respond?

Experiences with past flooding

All participants shared anecdotes of past flooding, though it was apparent that localized flooding within the small community varied drastically. One shared a story of waking up after the first night in his new home to discover water rushing into his yard from a canal. Another explained that his car had been flooded on the street so many times, with floodwaters covering the wheels and saltwater entering his engine, that his car was deemed totaled by his insurance agency. One resident described in detail the musty smell in his car from floodwaters soaking into the carpet. Another participant told a story of a major flood occurring on trash day, with the mess causing an entire street's trash cans to float overturned down the road. The popular "Gill's by the Bay" restaurant displayed a photo with the establishment nearly surrounded by water with the cheeky caption "Gill's IN the Bay".

A major concern mentioned by one resident was related to emergency services. This person takes care of his elderly mother who requires frequent doctor's appointments. About once a month, his street is too flooded to drive on and he cannot exit his home. He tries to plan appointments around the tides but has had to cancel doctor's appointments due to flooding in the past. Flooding could become more than a nuisance if there were a real emergency that required an ambulance to travel on the inundated streets.

Climate change beliefs

Overall, most of the participants agreed that flooding in King Salmon has worsened over time. Some were opposed to the term “sea level rise”. Some didn’t believe that the cause was climate change, or if it was, it was not caused by human activities.

Adaptation ideas

When asked about how to respond to future flooding and sea level rise, the consensus from the group was that something needs to be done, but they were not exactly sure what. Many in the community are already using simple adaptation strategies to protect their homes and belongings. For example, most residents store important items on cinder blocks or similar raised structures to allow for floodwaters to enter their garages, yards, or even homes. Some even park their cars on cinder blocks in preparation for king tides.

Interestingly, even though all residents interviewed experienced negative flooding experiences, they appeared to have a strong connection to their community and their homes, and a desire to stay if possible. Although a few lived there by necessity, most moved there purposefully to be near the water. Some are commercial fishermen whose livelihood depends on the water. Others enjoyed recreational activities that only a waterfront community can provide, like kayaking, sailing, crabbing, or simply walking their dogs on the beach. One concerned resident passed out a monthly newsletter to neighbors warning them of the highest tides, so they could prepare accordingly.

A recurring theme was that residents accepted the current risks of living in a hazardous area, but hoped that they would not live long enough to have to deal with more severe risks in the future. Many agreed that retreating from the area was a probable future necessity, though they hoped that the sea would be held back during their lifetimes.

A few respondents brought up the idea of buyouts, but again specified interest in staying in their home until they passed. Buyouts were thought of as a supplement for their heirs, not a solution for now. Most of the residents interviewed belonged to an aging population, which may explain this view.

In August 2018, two public workshops targeting all four at-risk communities (one workshop for King Salmon and Fields Landing, and one for Fairhaven and Finntown) were organized to convey vulnerability information so stakeholders could plan and participate in developing adaptation strategies. Workshop venues were selected within the communities for ease of transportation to encourage local participation. All parcel owners received an invitation to their community’s workshop. Flyers were placed within the communities, and a press release sent to news outlets and numerous other subscribers was published by the County. County staff also reached out to the communities online through social media.

The two workshops followed similar formats. Large posters were printed for both workshops showing localized tidal inundation areas during king tides, and with 1.6, 3.3, and 4.9 feet (0.5, 1.0 and 1.5 meters) of sea level rise. Humboldt County Supervisor Rex Bohn provided opening remarks at the King Salmon/Fields Landing workshop. Trinity Associates Environmental Planner Aldaron Laird addressed the why, when, how, where and what sea level rise impacts might occur. He provided localized sea level rise projections catered specifically to each community, including maps. Humboldt County Supervising Planner Michael Richardson discussed the pending updates to the Humboldt Bay Area Plan, the relationship of local coastal plans to the planning and development processes, coastal development permit jurisdictions for Humboldt County and the Coastal Commission, and Humboldt County's sea level rise adaptive capacity strategies. He also introduced the Local Coastal Plan update website, which was displayed on a PowerPoint slide and listed on feedback forms distributed to attendees. John Miller, Humboldt County Senior Planner, reviewed the tsunami safety planning that will be developed concurrent with the County's sea level rise planning. Coastal Commission staff provided an overview of the role of Coastal Act and the local planning aspect and reviewed the Coastal Commission's preferred adaptation strategies. After the presentations, there was an open question and answer session.

After hearing the presentations, participants understandably had questions and comments. A summary of participant discussion for each workshop follows in Section 4.2. Humboldt County Planning and Building Director John Ford moderated the discussion for the King Salmon/Fields Landing workshop, and Mr. Laird moderated the discussion for the Fairhaven/Finntown workshop. Following the workshops, the slide presentation with annotated notes, and a summary of community comments, were posted to the Local Coastal Plan update website for attendees and community members to review, and are attached herein as Appendices 8.1 – 8.4.

4.2 August 7, 2018: King Salmon and Fields Landing discussion

Concerns

Participants were invited to share their adaptation strategy ideas, but some community members expressed concern that they were not prepared to provide ideas on short notice. They were worried about the absence of a concrete plan and wondered how to move forward quickly. The objective of the workshop was explained, which highlighted the desire to gather public input to be used to identify strategies and approaches to develop policies and plans.

Multiple attendees were concerned about the value of their home and about their property taxes as sea level begins to rise. One attendee asked if property taxes might rise to pay for adaptation implementations while another was curious if property taxes might be reduced if the value of their home plummets due to sea level rise projections. One participant expressed concern that publicly announcing these sea level rise

projections would decrease the value of his home; if he sells it at its present value, he would not be able to afford another coastal property.

Similarly, a resident purchased a home in Fields Landing knowing that it would not hold up to sea level rise and could not be passed on to her children. She wondered why Humboldt County would be interested in saving her home at all. Director Ford explained that all homes have value as community assets beyond their market value. Humboldt County's position is to protect homes and communities for as long as possible, followed by a graceful retreat.

Suggestions/Comments

Specific adaptive strategies suggested include pumps behind dikes to reduce flooding, raising levees, and flood gates. This discussion triggered complaints of poor dike and flood gate maintenance that are exacerbating flooding. Some property owners complained that when attempting to implement their own adaptive strategies, they have been hindered by the Coastal Commission's long, expensive, and complicated approval process.

A woman offered a suggestion to look at Holland, New York, and Venice as examples of how to adapt, as the entire world is experiencing the same climate change issues. Director Ford agreed and noted that Humboldt County is looking into how other communities are adapting to flooding and sea level rise, which will be incorporated into the Humboldt Bay Area Plan update.

One attendee commented that he was blacklisted for general homeowners insurance for two years after making a flood insurance claim, warning others to not depend on their flood insurance policies.

Someone noted that the scenarios described may be moot due to the aging community.

There was one person who vocalized disbelief that sea level rise was occurring. He said he had been monitoring the water level changes in King Salmon for fifteen years and has not noticed a steady rise.

4.3 August 14, 2018: Fairhaven and Finntown, Discussion

Concerns

One attendee expressed concern that building barriers in Fairhaven would not address rising groundwater. Mr. Laird agreed and explained that even elevating culverts and storm drains could result in backwater flooding. Groundwater mapping for the Fairhaven area has not been fulfilled, and this issue will need to be addressed in specific locations because all soil types are different.

A group of participants shared concerns about sea level rise impacts to insurance and home loans. Mr. Laird replied that insurance companies are aware of sea level rise and have been protecting themselves accordingly. Insurance companies will most likely

continue to update their rules and their market. This has been a major issue in Florida, with expensive coastal properties losing value with sea level rise and flooding. The Coastal Commission staff responded that insurance companies require structures damaged by floods to be rebuilt using adaptation strategies.

Someone was curious if sea level will continue to rise, or eventually level off or even decline. Mr. Laird replied that based on projected carbon dioxide emissions and heat absorbed by the ocean, sea levels are expected to continue to rise. The rate of change may even increase based on present trends. When we develop new infrastructure, we will need to be thinking further ahead and considering how long the infrastructure will be around. Another attendee asked if the models used for the assessment presented, take the accelerating rate of change into account. Mr. Laird replied that they used the latest data on local conditions at the time, but the focus should be on preparing for sea level rise effects at certain levels, not dates. Coastal Commission staff agreed and noted that some of the latest extreme projections are double the projections used in the presentation.

Contamination was a recurring concern. One person was worried about what would happen with septic systems as sea level rises. Another person was concerned about pollutants leaching into the water with flooding and suggested that we look at relocating homes before sea level rise impacts contaminated sites. A Samoa Community Services District member expressed apprehension about the new sewer systems they are planning.

Some participants attended from the neighboring community of Manila and were curious about sea level rise impacts in their community. Fortunately, most of Manila (and neighboring Samoa) will not be impacted, and sewer treatment facilities are high enough in elevation to avoid sea level rise impacts.

Suggestions/Comments

Funding was a popular topic among attendees. One attendee suggested that others write to their congress members. One attendee suggested that a logical funding source is a carbon tax. Someone suggested a saltwater treatment plant or selling our freshwater to fund adaptive strategies.

Someone suggested that we use dredge spoils to armor shorelines around Humboldt Bay. Mr. Laird replied that this is theoretically possible, but the current approved practice is to deposit it at sea. Coastal Commission staff reported that the Coastal Commission is looking at using dredged sand to replenish and nourish local beaches. Another attendee commented that they have seen the dredging done to armor shorelines in Ventura.

4.4 Stakeholder adaptive capacities

Key local utility and transportation infrastructure stakeholders include Humboldt County, Humboldt Community Services District, and PG&E. Currently, these stakeholders are in the beginning stages of developing adaptation strategies.

Members from all three key stakeholders were present at stakeholder meetings, although they were there to listen and not offer adaptive strategies. For example, a major concern introduced by workshop attendees was the radioactive waste stored at the PG&E facility in King Salmon. Allison Talbott of PG&E was in attendance and explained that there did not appear to be political will to move the fuel rods anytime soon, although it is the federal government's responsibility to do so. These nuclear rods present a major hazard with sea levels rising and prioritization of their removal should be considered. Humboldt County is building their adaptive capacity by updating the HBAP, but there is still much work to be done. The adaptive capacity of the utility and transportation stakeholders was not explored at the public meetings.

Residents, property owners, and business owners are also important stakeholders within the communities at risk. These stakeholders expressed concern at the public workshops that they would not be able to afford modifications to their homes and businesses required to protect themselves from sea level rise. The workshops themselves provided the first step in building adaptive capacity in this group, delivering educational information to help them begin preparing.

Funding is the primary issue that will need to be addressed to develop adaptive capacity. In order to implement adaptation strategies like raising roads or relocating sewer lines, funding sources will need to be identified. Similarly, these economically distressed communities will need funding support to implement adaptation strategies to their own structures. A final adaptation plan must include ideas for funding sources.

5 Summary of sea level rise adaptation planning efforts in other economically disadvantaged communities in California, and the adaptive capacity of stakeholders

Other coastal communities in California will also need to prepare for sea level rise. In most communities, planning is in the very early stages. We are mostly all in the beginning phases of updating our Local Coastal Plans. For example, as of 2018, Ventura County, the City of Encinitas (San Diego County), and the City of Dana Point (Orange County) have all prepared vulnerability assessments and presented them in public workshop formats to their respective communities. In Pacifica and Brisbane (both San Mateo County), public workshops were held in 2018 and focused on general overviews of sea level rise. The City of Pacifica engaged a community workgroup to review maps and identify vulnerabilities in early 2018. An adaptation plan is currently

being developed. In early 2018, the Coastal Commission certified an amendment to the City of San Clemente's local coastal program that included general policies addressing possible future sea level rise and coastal hazards.

San Francisco's "Sea Level Rise Action Plan" was developed by the Planning Department of San Francisco and adopted by the City and County of San Francisco in March 2016. The plan is an exploratory and preparatory document to assist in the development of a future sea level rise adaptation plan. The action plan identifies risks to public and private assets, reviews the regulations governing coastal development and planning, and distinguishes actions the city may take in the face of sea level rise. A final city-wide plan remains in progress. In May of 2018, the Coastal Commission certified an amendment to San Francisco's local coastal program related to coastal hazards, including sea level rise.

In October 2016, the San Francisco Bay Conservation and Development Commission (BCDC) adopted eight policy recommendations to adapt to rising sea levels in the San Francisco Bay area. The BCDC is a 27-member commission with appointees from various California and federal agencies and local bay area governments whose jurisdiction includes the San Francisco Bay and the first 100 feet inland from the shoreline. The preamble to the Final Rising Sea Level Policy Recommendations recognizes the importance of safe housing, economic vitality, healthy ecosystems, social equity, and emissions reductions as all covariates in a successful future sea level rise adaptation plan.

Marin County appears to be an innovative leader in sea level rise planning efforts, though final adaptation plans are still being developed. In 2015, a research team used 360-degree 3D viewers allowing users to virtually see their current coastal environment in different flooding and sea level rise scenarios, and displayed potential responses such as seawalls. The device also allowed for users to submit their comments during and after using the devices. The purpose was to include the community in its own sea level rise discussions and planning. They found that users showed increased concern after viewing the 3D images, leading to interest in becoming more involved with the planning process.

Marin County also arranged for signs indicating 2030, 2050, and 2100 projected sea levels at Stinson Beach. They created an interactive game in 2015 called "Game of Floods", encouraging questions and participation from the community at tabling events. An extensive vulnerability assessment called "BayWAVE" was developed in 2017 covering the entire Marin shoreline, from the Golden Gate Bridge to the northern county line in Novato. Marin County also appears to be the only California community to receive grant funding for actual engineering and designs of adaptation plans, though these actual efforts have not yet been implemented.

The San Rafael Canal Community is one of the lowest-income communities in Marin County, situated on canals like the Humboldt County community of King Salmon. This

community has been identified as being the most vulnerable to sea level rise in Marin County, though the only efforts to support adaptation planning have been through nonprofit organizations like ShoreUp Marin, not local governments. Formal adaptation plans are not yet in place.

Outside of California, some communities are further along in their adaptation planning. For example, the coastal Quinault Indian Nation village of Taholah in Washington State is at high risk of sea level rise and flooding. The tribe conducted a vulnerability assessment incorporating numerous community forums, resulting in a relocation plan. The plan includes relocating 650 village members to a site half a mile away, 120 feet above sea level and outside current flood and tsunami zones. A Master Plan was finalized in 2017, but relocation efforts have not yet been initiated.

The Biloxi-Chitimacha-Choctaw Indians of Isle de Jean Charles near New Orleans, Louisiana have been coined by Smithsonian Magazine as the first “American climate change refugees”. In 1955, the island covered approximately 22,000 acres, but today, only 320 acres remain due to a combination of sea level rise and land subsidence. The tribe received \$48.3 million in federal funding to relocate eighty remaining residents together as a community to a new site in Louisiana. Groundbreaking on the new site is scheduled for late 2018 and the current timeline suggests that the move will be complete by 2022. This is the first sea level rise relocation effort attempted in the United States.

Other coastal communities in California are certainly in a higher income bracket and have access to more resources than the communities at risk in Humboldt County. For example, San Francisco was able to tax parcels to raise funding for a sea level rise adaptation plan. This access to funding through private taxpayers allows other coastal California communities more adaptive capacity.

6 Summary of relevant portions of Coastal Commission draft residential sea level rise adaptation guidance (2018), PG&E 2005 sea level rise vulnerability assessment report to the Coastal Commission, and the Coastal Commission’s coastal development permits for King Salmon, Fields Landing, and Fairhaven

6.1 Coastal Commission’s Residential Sea Level Rise Guidance

In July 2017, Coastal Commission staff released the Draft Residential Adaptation Policy Guidance, Interpretive Guidelines for Addressing Sea Level Rise in Local Coastal Programs. The Guidelines recommend several actions to address the vulnerability of residential development in hazard areas: use the best available science, disclose risks to property owners, avoid hazards through siting and design, and regulate

redevelopment. The design life of most new residential structures is 100 years. One hundred years is a recommended planning horizon to determine the range of water levels that these structures may be exposed to. Potential tools include:

- Mapping and adopting sea level hazard overlay zones for the range of projected water elevations within the 100-year planning horizon;
- Developing site-specific flood hazard residential development design standards;
- Requiring developers/property owners to assume risk for developing in a hazard area; and
- Requiring real estate disclosures for developments in hazard areas.

These recommendations are very similar to what the Coastal Commission requested in 2015 for a coastal development permit to build a residence in King Salmon.

6.2 Pacific Gas and Electric Company Sea Level Rise Vulnerability Assessment

The Coastal Commission asked PG&E to analyze the coastal erosion and sea level rise vulnerability of its Interim Spent Fuel Storage Installation (ISFSI) site on Buhne Hill in King Salmon. Buhne Hill, or Red Bluff as it was historically referred, experienced severe erosion following the construction of the jetties that form the entrance to Humboldt Bay that funneled incoming waves directly at the hill/bluff. Erosion of Buhne Hill was abated in the 1950s with the installation of a rock riprap sea wall.

The spent nuclear fuel rods and waste at the ISFSI are stored in below-grade canisters at an elevation of 44 feet (MLLW). The PG&E report used a current land level change of 1.3 feet of uplift per hundred years (4 mm/yr). Vertical land motion at the North Spit tide gauge, which is directly across the bay from Buhne Hill, has been documented at -2.3 mm of subsidence per year (Patton 2017). PG&E's 2005 report stated that maximum rate of sea level rise was not expected to exceed 3.3 feet (1.0 meter) per century, the maximum rate of sea level rise recorded during and interglacial interval in the geologic record for the past 400,000 years. Relative sea level rise at the North Spit tide gauge is reported to be 1.5 feet for the last 100 years (NHE 2014). Currently the North Spit tide gauge has the highest rate of relative sea level rise on the west coast of the U.S. of 4.73 mm/year (NOAA). If PG&E's rate of relative sea level rise was under estimated, wave induced erosion could occur at Buhne Hill unless the shoreline fortifications are increased in elevation. PG&E power generating facilities as they now exist could become tidally inundated by king tides with 3.3 feet (1.0 meter) of sea level rise (Figure 19).

PG&E's facilities at King Salmon other than those on Buhne Hill will need to be protected from water levels that exceed 10.0 feet elevation, which are likely to be reached during king tides before 1.6 feet (0.5 meter) of sea level rise is reached.



Figure 19. Pacific Gas and Electric Company Humboldt Bay Power Generating Station and facilities in King Salmon with 3.3 feet (1.0 meter) of sea level rise during a king tide, assuming shoreline barrier structures do not exist or are breached.

6.3 Coastal Commission Coastal Development Permits

The Coastal Commission's state retained jurisdiction area in the HBAP is significant in scope (75%) and implications for adaptation planning. In King Salmon, nearly the entire developed portion of this community is under state jurisdiction. In Fields Landing, the entire waterfront area and shoreline are also under state jurisdiction (Figure 20).

In Fairhaven and Finntown, the state's retained jurisdiction is primarily along the shoreline and waterfront (Figure 21).



Figure 20. State retained jurisdiction areas (blue) and HBAP jurisdiction (yellow) in King Salmon and Fields Landing.



Figure 21. State retained jurisdiction areas (blue) and HBAP jurisdiction (yellow) in Fairhaven and Finntown.

Since 2010, the Coastal Commission has issued five coastal development permits (CDPs) for residential development in the community of King Salmon and none in Fields

Landing, Fairhaven or Finntown. The five CDPs in King Salmon span 2010 to 2015 and depict a progression of growing awareness and concern over the potential for sea level rise to impact this community. The requirements for development in a flood hazard zone due to sea level rise are best illustrated in the most recent CDP that the Commission issued in 2015 (Coastal Commission 2015).

The primary Coastal Act issue addressed is whether a residential structure in an area such as King Salmon can be constructed in a manner that complies with the requirements of Coastal Act Section 30253 to minimize risks to life and property in areas of high flood hazard. The Commission required the applicant/property owner to determine the combined elevation of the 100-year sea level rise and wave run-up scenarios on the parcel where the residential structure was proposed. The Commission required that the new residential structure limit its habitable living area to the second floor, the first floor walls be made of reinforced concrete blocks in some areas and break-away walls in other areas to accommodate flood water without collapsing the structure, and required all utility installations to be attached to first floor walls. In this location on Buhne Avenue, the second story needed to be approximately 11 feet above the ground surface (19.8 feet NAVD 88; Figure 22). The CDP also required the applicant to assume all risk of developing in this hazard area. Any future alteration to this development would require Coastal Commission approval, and the deed for this parcel was required to include the CDP restrictions.



Figure 22. Residential development with sea level rise accommodation design considerations; habitable portion of the home is the second floor, with break-away first floor walls.

Unfortunately, this type of accommodation to sea level rise impacts alone does not address the vulnerability of utilities and streets providing critical services (water, sewer, energy, and communications) and access to residential developments in a community at risk from sea level rise. Adaptation planning for at-risk communities needs to be developed and implemented at the community level at a minimum, within the regional context.

7 References

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8 Appendix

8.1 King Salmon and Fields Landing Workshop Presentation

8.2 King Salmon and Fields Landing Workshop Notes

8.3 Fairhaven Workshop Presentation

8.4 Fairhaven Workshop Notes