HONOAPI‘ILANI HIGHWAY IMPROVEMENTS PROJECT,
WEST MAUI: UKUMEHAME TO LAUNIUPOKO

Appendix 5 – Evaluation of Viaduct and Embankment for Ukumehame Preferred Alternative Alignment

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Prepared for

Honoapi‘ilani Highway Improvements

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Appendix 5 Evaluation of Viaduct and Embankment for Ukumehame Preferred Alternative Alignment

As part of the identification and refinement of the Preferred Alternative, HDOT considered design options in the area of the Pali connection through the HDOT detention basin and into the Ukumehame Firing Range. This appendix summarizes the consideration of cost, constructability, environmental effects, and overall support of the Project’s purpose and need.

As set forth in Chapter 5, Alternative 1 was identified as the Preferred Alternative in Ukumehame, but HDOT determined that there were appropriate refinements to the alignment—primarily to avoid newly identified areas of archaeological resources. To avoid these resources, the refined alignment would be moved makai. This adjustment would result in the Preferred Alternative crossing through the center of the large HDOT detention basin that serves a large upland watershed, allowing for sediment to settle out of the impounded water before its discharge to the ocean.

For this two-lane extension of the new highway from its Pali connection to and through the Ukumehame Firing Range, HDOT has considered two basic options:

- Viaduct structure carrying traffic over the detention basin and portions of the firing range (with a small footprint for piers and columns within the detention basin). FIGURE 5-5 shows this option.

- At grade on a filled embankment through the detention basin and across portions of the firing range (this would eliminate the functional capacity and operation of the detention basin and require a redesign of the system). FIGURE 5-6 shows this option.

Since the embankment scenario is less expensive in a direct comparison of construction costs, this evaluation examined the balancing of reduced cost compared with environmental effects, constructability, and implementation constraints of the two options. Table 5-1 provides a matrix of key findings for this evaluation.

Overall, the viaduct option was seen as the best option despite the higher cost:

- The environmental effects of the embankment option are more pervasive and leave the option less aligned with the Project’s purpose and need to avoid hardened infrastructure within the 3.2-foot SLR-XA.

- The viaduct option provides for a more direct connection and the ability to retain the existing firing range driveway, but the embankment option would require new means of access and additional land acquisition.

- The embankment option would be substantially more difficult to implement and construct. It would require a full watershed management evaluation and the redesign a new system to be built mauka and makai of the new highway alignment. Additionally, it would mostly likely require the use of adjacent wetlands on the County-owned firing range and further wetland mitigation.

- Implementing the embankment option would be expected to add substantial time to overall project implementation:

    - The larger upland watershed would need to be modeled and analyzed as the basis for a new management system.

    - There would be extended coordination with resources agencies such that the Draft Environmental Impact Statement would need to be expanded and to be rescoped to allow for public input on the more extensive effect on wetlands and the resulting mitigation plans.

FIGURE 5-1. **Build Alternatives**

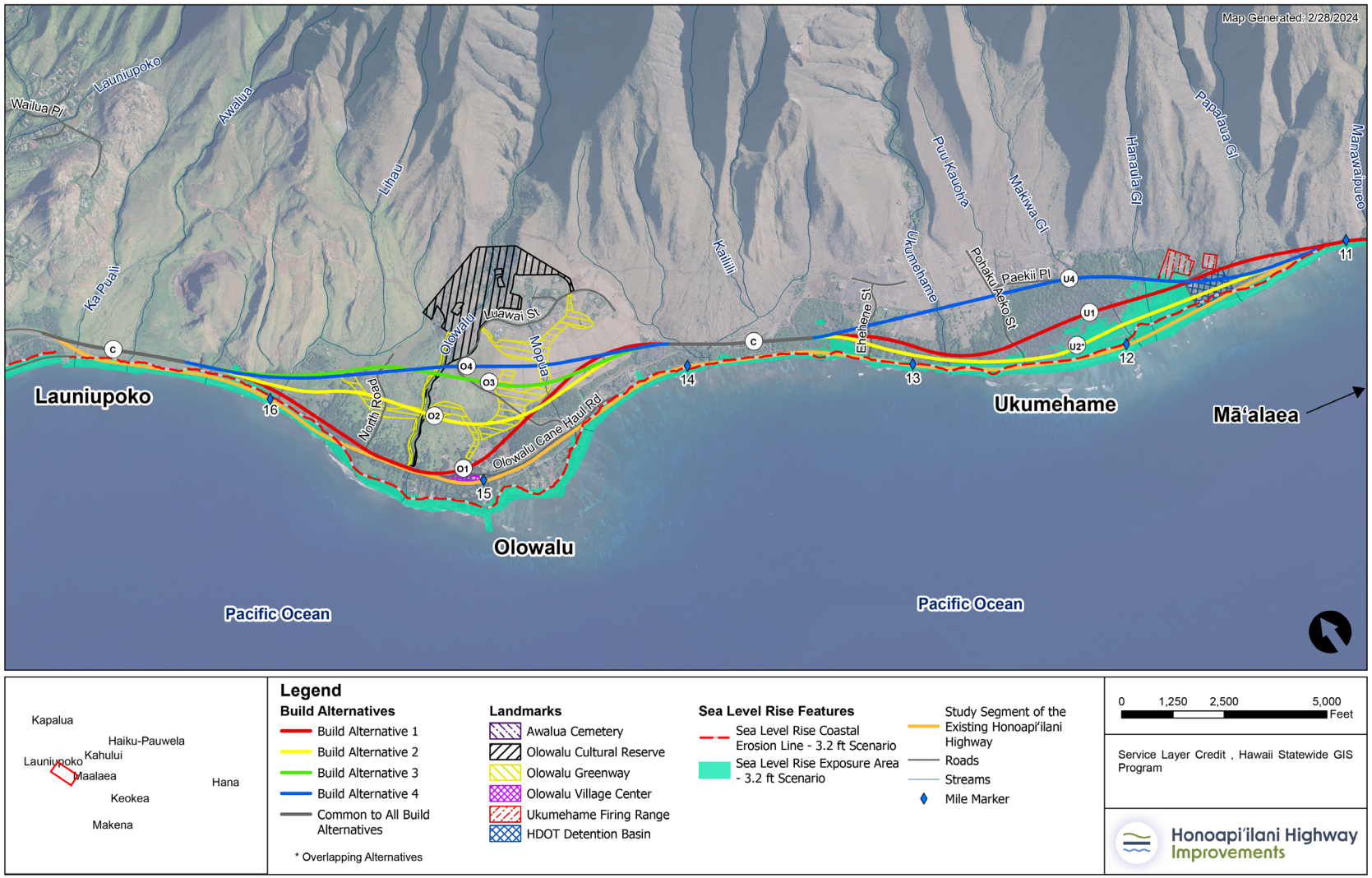


FIGURE 5-2. **Preferred Alternative**

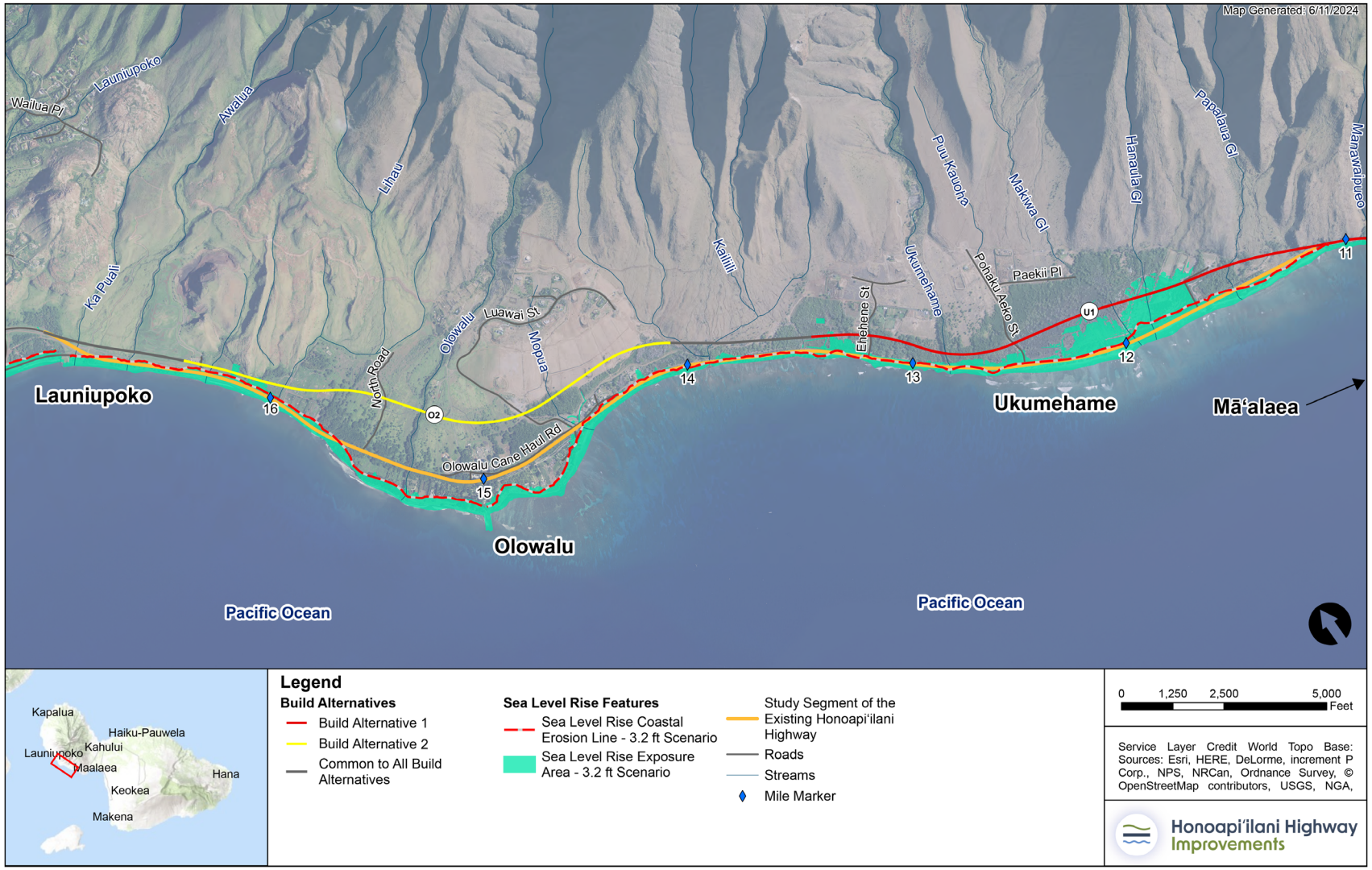


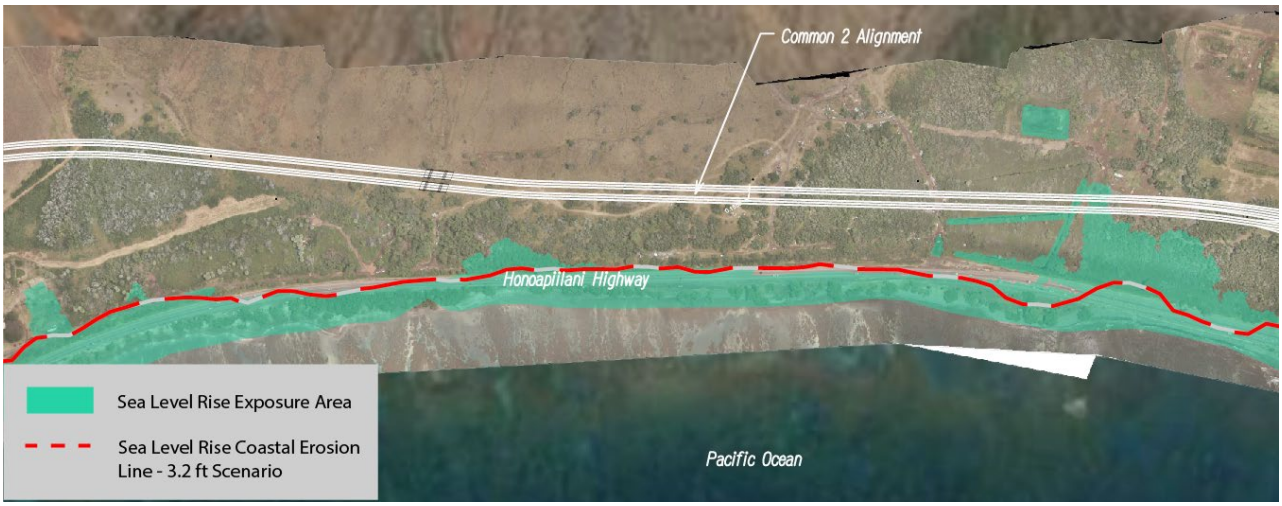
FIGURE 5-3. **Olowalu – Refinement at Northern Connection to Existing Lāhainā Bypass**

a) Original Alignment

b) Refined Alignment

FIGURE 5-4. **Ukumehame – Refinement at Northern Connection to Olowalu**

a) Original Alignment



b) Refined Alignment

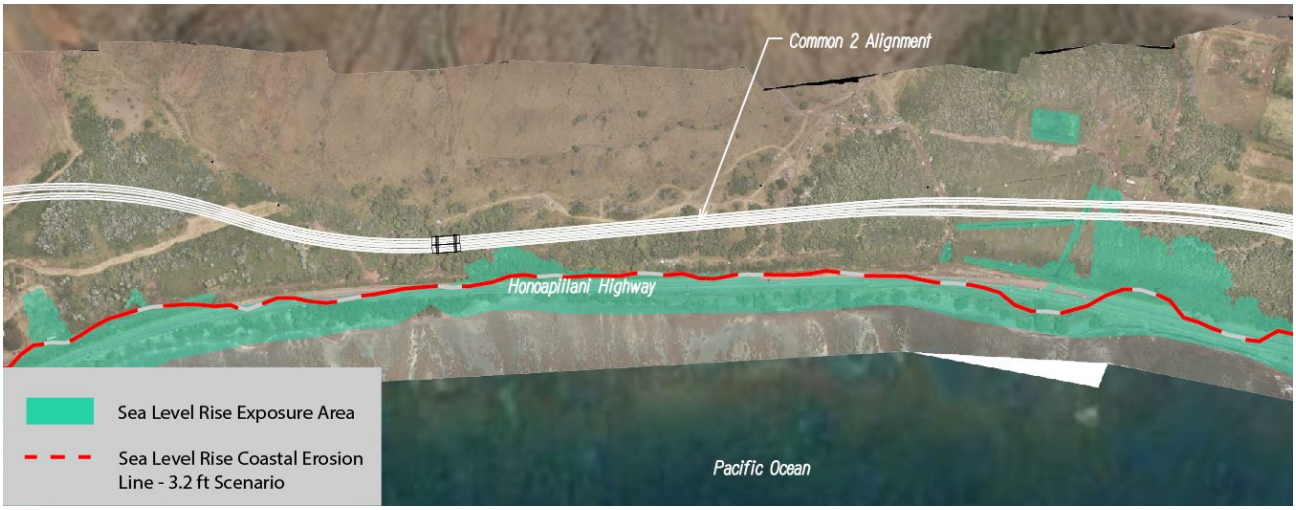


FIGURE 5-5. **Ukumehame – Viaduct Option**

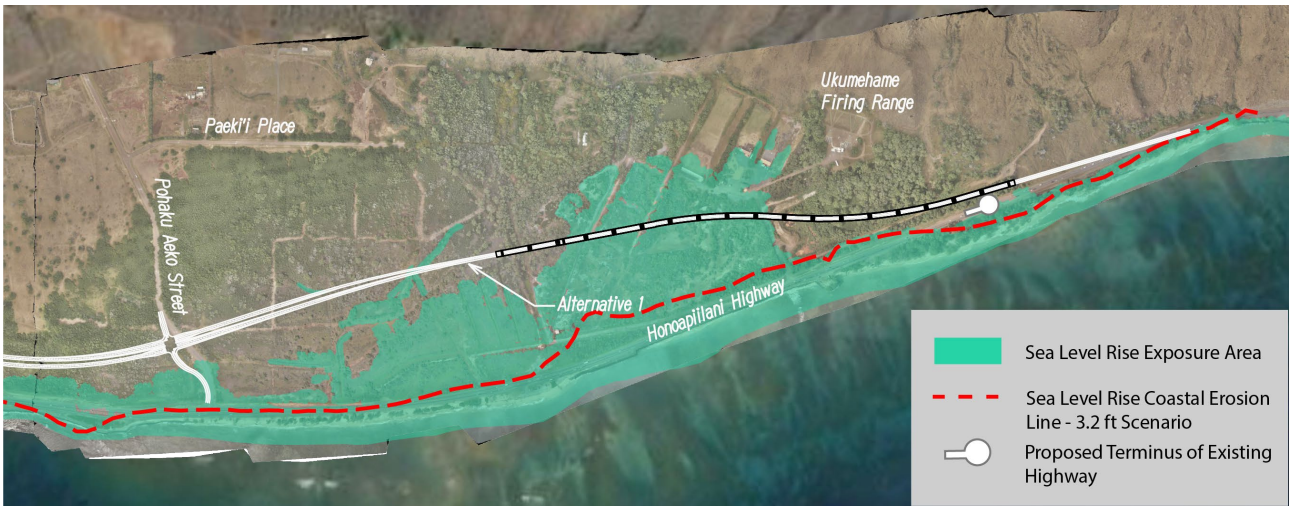


FIGURE 5-6. **Ukumehame – Embankment Option**

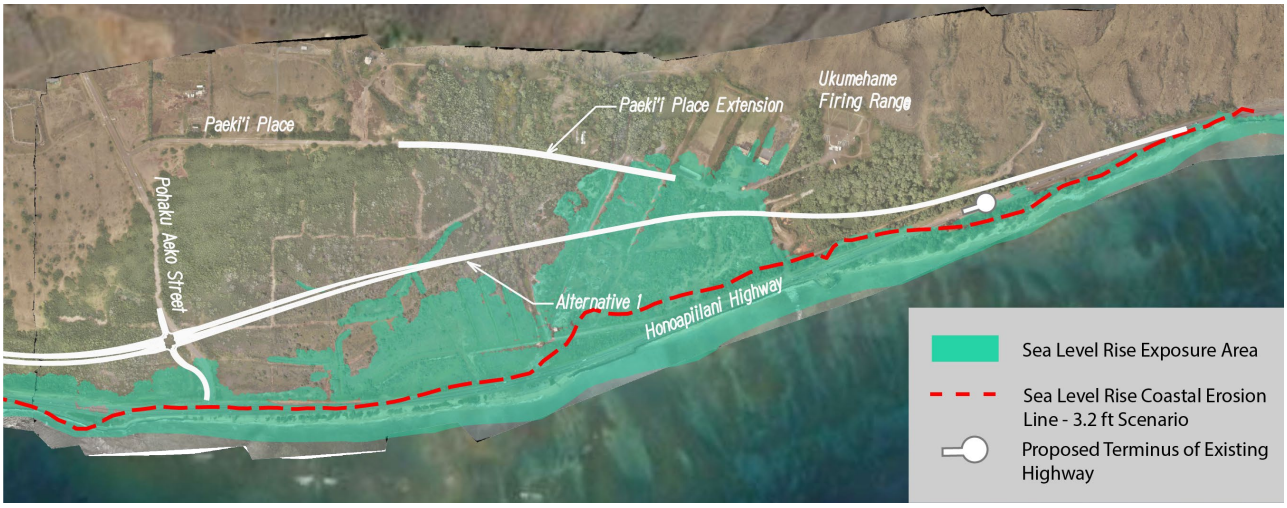


Table 5-1 Evaluation of Viaduct and Embankment Options

TOPIC	MODIFIED BUILD ALTERNATIVE 1 ON EMBANKMENT	MODIFIED BUILD ALTERNATIVE 1 ON VIADUCT
Sediment Basin Displacement	Embankment within sediment basin would displace a significant amount of the basin's capacity (see FIGURE 5-6). A detailed study of the watersheds contributing to the existing basin would be required to design a new basin that would address the displaced capacity of the basin caused by the additional fill within it. Wetland area west of the sediment basin would be required to be redeveloped for the purpose of replacing the capacity of the basin that is lost due to the embankment fill (see FIGURE 5-6). Design of new basin area would need to account for maintenance activities associated with the periodic removal of sediment that is collected from the upper watersheds. Would likely require a substantially larger area of wetlands mitigation/restoration and rebuilding of ocean connections to fully manage existing watershed flows and changes generated by highway.	Minimal displacement of basin capacity. Viaduct starts on existing embankment and columns are placed within the basin footprint. Column spacing could be maximized to minimize displaced capacity.
Firing Range Access	Embankment for the alternative alignment would be too close to the firing range to support the development of an at-grade driveway from the alternative alignment. Alternate access would be required for the firing range. Since initial segment of new alignment would be two lanes through the firing range area (with no intersections or driveways), the new driveway would need to mauka of the highway and the most logical new access would be a new driveway off of, or an extension of Paekiʻi Place. Additional cost of ROW acquisition and construction costs associated with this road extension would be required.	Existing firing range access road could be retained, and access could be provided via existing Honoapiʻilani Highway.

TOPIC	MODIFIED BUILD ALTERNATIVE 1 ON EMBANKMENT	MODIFIED BUILD ALTERNATIVE 1 ON VIADUCT
Meets Overall Project Purpose and Need	Not compatible with overall purpose and need (see Constructability below). Displacement of sediment basin volume would result in more wetland disturbance and the development of more infrastructure within the SLR-XA Inundation Zone (the newly developed sediment basin). Embankment would still be within the inundation area between the Ukumehame Firing Range driveway and Pāhaku 'Aeko Street (FIGURE 5-6).	Most compatible with the overall purpose and need. Has the least amount of realigned highway within the SLR-XA. Wave runup within the area in which the viaduct crosses through can be addressed using scour countermeasures around columns or other design considerations such as taking anticipated erosion due to wave runup into account.
Constructability	Entire area on grade would require an embankment elevation above SLR-XA inundation and wave action. Entire linear length of on-grade alignment would require armoring of the makai embankment against wave action inundation. This armoring would interrupt natural coastal processes and has been a consistent point of concern for various stakeholders, including the public. Extended portions of this armoring could be makai of the highway itself to include the existing makai wall of the detention basin as well as the new makai edge of new stormwater management facilities integrated into the wetlands north of the firing range access driveway.	Piers and columns would require less intrusive disturbance.

TOPIC	MODIFIED BUILD ALTERNATIVE 1 ON EMBANKMENT	MODIFIED BUILD ALTERNATIVE 1 ON VIADUCT
Design and Regulatory Considerations	Would require full watershed analysis (volume, sediment loading, water quality) for existing conditions as well as changes created by filling and embankments for new alignment. Water management infrastructure would require extensive use of existing mapped wetlands, including wetlands restoration beyond area specific to new infrastructure. Would likely create need to comprehensively address water flow, sedimentation, and all ocean connections within this larger wetland area. In addition, freshwater impoundment mauka of new alignment would require management and wetland mitigation Embankment would cross through and fill areas of known endangered species activity. Known cultural resource sites crossed by embankment. Given extent of watershed management and wetland mitigation/restoration: • Would likely require a NEPA/HEPA evaluation of the new system either as a rescoping of the current EIS or as an independent action. • Would HDOT be the owner/operator of this new system? Would it be considered a Corps-led project, a DLNR-based State project, or a Maui County project? • Assume a two year or more extension of effort for project approvals, therefore meeting RAISE Grant timeline is infeasible. • Regulatory process not fully defined regarding jurisdictional waters and county-defined wetlands meaning impacts cannot be described with high confidence. • The proposed designs are hot button issue for the public and agency stakeholders, as it relates to outcomes and expectations, and will be scrutinized.	Would require adding replacement capacity by modifying existing detention basin Effects to endangered fauna would be minimized to areas of pier placement. Avoid construction within cultural resource sites to pier placement.

TOPIC	MODIFIED BUILD ALTERNATIVE 1 ON EMBANKMENT	MODIFIED BUILD ALTERNATIVE 1 ON VIADUCT
Cost	Less expensive than a viaduct option but with unknowns in costs. Base Costs: - Roadway on Embankment Construction - $9.4M (3240 ft @ $2,900/ft) - Armoring of embankment within SLR-XA Wave Run-up area – $4.5M (1800 ft @ 2500/ft) - Access to firing range - $5.3M (2200 ft @ $2,400/ft extension of Aeki Place) - Planning and redesign of multiple sedimentation basins. - Property acquisitions - $1.7M (additional acquisition for extension of Aeki'i Place) - New Sediment Basin - $3.8M (assumed, 1500' earth embankment @ $2,200/ft plus ancillaries) - Initial Wetland Mitigation/Restoration - $ To Be Determined Long Term Maintenance Costs - Maintenance of sediment basin system - Restored Wetlands upkeep/maintenance Non-Market Cost - Time (further studies, public meetings) - Project challenges (litigation)	Base costs: - Viaduct Construction - $39M (3240ft @ $12k/ft) - Maintenance Long Term Maintenance Costs - Maintenance of sediment basin - Viaduct maintenance Non-Market Costs - Opportunity cost of large-scale wetlands restoration and extensive basin system redesign project(s)