Research Project Work Plan

for

US HIGHWAY 101 COASTAL HAZARD VULNERABILITY AND RISK ASSESSMENT FOR MITIGATION PRIORITIZATION

SPR-843

Submitted by

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1.0 Identification

1.1 Organizations Sponsoring Research

Oregon Department of Transportation (ODOT)
Research Section
555 13th Street NE
Salem, OR 97301 Phone: (503) 986-2700

Federal Highway Administration (FHWA)
Washington, D.C. 20590

1.2 Principal Investigator (ODOT requests only one per institution or firm)

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1.3 Associate Investigator(s)

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Chris Parrish, Associate Professor
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1.4 Technical Advisory Committee (TAC) Members

Geoff Crook, ODOT Adaptation Program Manager, *Champion*
Curran Mohney, ODOT Lead Engineering Geologist, *co-Champion*
Mike Tardif, ODOT Region 2 Senior Engineering Geologist
Savannah Crawford, ODOT Region 2 Project Manager
Janelle Stradtner, ODOT Region 3 Senior Transportation Planner
Becky Knudsen, ODOT Senior Economist
Meg Reed, DLCD Coastal Shores Specialist
Jay Sennewald, Oregon State Parks Ocean Shores Coordinator

Chris Glantz, ODOT Deputy State Surveyor
Cindy Callahan, FHWA
Kira Glover-Cutter, ODOT Research Coordinator, *Chair*

1.5 Research Coordinator

Kira M. Glover-Cutter, Ph.D., ODOT Research Coordinator, Phone: 503-986-2851

1.6 Project Champions

Geoff Crook, Adaptation Program Manager
Curran Mohney, Lead Engineering Geologist

2.0 Problem Statement

US 101 is a vital economic and emergency lifeline that connects coastal communities and provides access to numerous coastal destinations for Oregonians and tourists. Many sections of this highway are highly susceptible to coastal hazards such as erosion, landsliding, wave action, storm surge, flooding, and rising sea levels. Generally speaking, US 101 on the open coast is more impacted by wave-driven erosion hazards and landslides while US 101 in the estuaries is more vulnerable to impacts from storm surge, flooding, and rising sea levels. Structural mitigation of these susceptible areas is challenging due to the extensive regulatory exceptions process required by the Department of Land Conservation and Development (DCLD) through Statewide Planning Goal 18 (which prohibits shoreline armoring of highway infrastructure) for the open coast (e.g., beaches, seacliffs, and dunes). A related goal, Goal 16 applies in the estuaries. The need to revisit Goal 18 for maintaining and protecting public infrastructure has been recognized, with ODOT recently participating in a DLCD led Shoreline Armoring Focus Group. This Group identified that research providing a comprehensive and prioritized coastal highway vulnerability and risk assessment is key to informing upcoming DLCD Goal 18 policy updates. To proactively position ODOT to effectively manage risk and support Goal 18 updates, development of a coastal highway hazard prioritization matrix that includes vulnerability, risk assessment, mitigation options, and management strategies for planning and project development is critical.

2.1 Background and Significance of Work

Rising seas and extreme coastal weather events pose significant risks for the safety, reliability, and effectiveness of ODOT infrastructure and operations along the coast. Coastal erosion is particularly sensitive to climate drivers with sea-level rise, storm frequency and intensity, wave scour, and rainfall amounts. Coastal erosion is directly proportional to climate change effects and in many locations directly threatens disruption of ODOT's coastal infrastructure. US 101 has been particularly challenging for ODOT to maintain and has become very costly in the last several decades. For the section of highway from Port Orford to the California border, ODOT spends over $2 million annually in basic maintenance of pavement and guardrails damaged by seacliff collapse, landslide movements and other erosion-related activities. Sudden emergency repairs costing several hundred thousands to well over a million dollars, such as the February 2019 failure at Hooskanaden, are also common. The resulting closures of the highway also result in economic costs to ODOT and the public at large. Allan et al. (2009) provide an overview of coastal geomorphology, hazards and management issues in the Pacific Northwest.

Considering that ODOT is designated as a lead implementation agency for the Governor's Executive Order 20-04 on climate change, together with the observation that at least 26 sites totaling nearly 20 miles along Hwy 101 have already been identified by ODOT as vulnerable areas of concern, the need to assess coastal erosion impacts and sea level rise will become increasingly critical. The rate and magnitude of retreat, potential for ocean flooding during storms at high tides, sea level rise, and increased potential for landslides are all essential measures to be used in prioritizing highway segments near the coastline (open coast and estuary areas). These parameters would allow the agency to both prioritize sites for repair and financially plan for mitigation projects that are timed to maximize the utility of the existing facility. Research to directly address this concern is needed in order to optimize ODOT infrastructure planning, secure lifeline routes, and address the climate change adaptation focus of the Oregon Transportation Commission work plan.

Numerous studies have previously been undertaken in an effort to quantify short to long-term changes taking place on the Oregon coast. For example, Allan et al. (2003) analyzed early National Ocean Service topographic "T" sheets (measured in the 1920s (entire coast) and 1950s (around certain key estuary mouths)), orthorectified imagery (orthorectified 1967 and modern era imagery), GPS measurements, and lidar. The authors concluded that because Oregon's shoreline is sensitive to large seasonal and interannual (e.g. El Niños) variations in ocean water levels and impacts from storms that are episodic in nature, the use of simple linear regressions or end point rate calculations to determine erosion rates is problematic. Recognizing the same limitations, Ruggiero et al. (2013) nevertheless completed an assessment of short to long-term changes for the Pacific Northwest Coast of Oregon and Washington as part of the USGS national assessment of coastal change. Key to this work was recognizing the need to differentiate between long (1800s to 2020) and short- (1960s to 2002) term rates and patterns of change and the inclusion of uncertainty bands defined for different littoral cells. Because much of the Oregon coast had little historical data that could be used to document coastal change, while significant areas of the coast are backed by coastal bluffs and cliffs, Ruggiero et al. (2013) focused their analyses on the dune back beaches of the coast. Thus, parts of southern Oregon (e.g. Curry County) were not evaluated because of the dearth of data on which to define any changes that may be taking place.

Analyses by Allan and Hart (2007, 2008) describe efforts to establish GPS monitoring of discrete beach study sites established throughout Tillamook and Clatsop County in order to better define the seasonal to interannual changes taking place on Oregon beaches. The goal of this latter effort was to establish a systematic process for documenting seasonal changes taking place at key “sentinel” transect locations using real-time kinematic differential GPS (RTK-DGPS). The monitoring also included measurements of the mean higher high water (MHHW) tidal datum-based shoreline in order to better account for larger spatial changes in the position of the beach. Results from these studies and others demonstrate that the seasonal variability of Oregon’s dissipative beaches are typically around 30 m between summer/winter, increasing to ~60 m on intermediate to reflective beaches (e.g. Gleneden Beach, Gold Beach, Port Orford) and in the most extreme events could double to ~120 m (Allan et al., 2003). Such monitoring has been expanded to many other locations along the Oregon coast (http://nvs.nanoos.org/BeachMapping), as funding and time has allowed (e.g. Allan et al., 2018). Updated assessments in coastal change have also been undertaken by DOGAMI as part of a FEMA-funded effort to produce new coastal hydraulic flood modeling and storm-induced erosion assessments (e.g. Allan et al., 2012, Allan et al., 2015a,b,c,d, Allan et al., 2017). These latter efforts included estimates of the 1% storm-induced flooding associated with an extreme storm occurring around high tides, as well as updated assessments of coastal change determined from airborne lidar collected in 1997, 1998, 2002, 2010, and most recently in 2016. Additionally, the Oregon Lidar Consortium flew coastwide lidar in 2008/2009. Major challenges are discussed concerning these data as the early lidar were not bare-earth and therefore include vegetation effects, while in some areas the lidar point density was found to be quite poor.

Given the high levels of storm activity on the coast, sea level rise is of particular concern on the PNW coast. In 2012, the NRC published an interagency report (NRC, 2012) on the past, present, and future of sea level rise in Oregon and Washington. The report discusses difficulty in assessing sea level rise at the state or regional level given sparse data as well as the expertise required to perform the assessment. A committee of experts was convened to analyze available data and develop statistical predictions (with uncertainty) of sea level rise. The report also documents observations in increased wave heights and storm activities. As part of the Oregon Coastal Management Program, the Department of Land Conservation and Development (2017) evaluated the impact of sea level rise on assets within Oregon’s estuaries, including Highway 101. In total, six scenarios were considered based on combinations of time 2030 (short term), 2050 (midterm), and 2100 long term and exceedance probability (1% and 50% annual probability of exceeding an elevation). Several sites (e.g., Tilamook, Nestcucca, Siletz, Umpqua, and Coos Bay) are anticipated to have more than 1 mile of Highway 101 flooded based on a scenario with projected sea level rise in 2100 from the NRC (2012) projections and a flood event with a 1% annual probability of exceedance.

Notably, sea level rise does not tell the full story. Total water level is computed as the sum of mean sea level, astronomical tide, nontidal residuals, and wave runup for any given point in time. Mean sea level is provided based on the datum of the measurements (e.g., NAVD88) and astronomical tide and nontidal residuals are estimated from NOAA tide gauge data (https://tidesandcurrents.noaa.gov/). While these stations have high temporal resolution, unfortunately they are relatively sparse across the coast. There are only 6 operating stations along the Pacific Coast within or close to the border of Oregon. Wave run-up is computed from empirical models such as Ruggiero et al. (2001) and Stocktdon et al. (2006). These computations consider the beach slope, deep water significant wave height, deep water wavelength, and peak wave period. The beach slope can be reasonably estimated via airborne lidar; however, the beach slope will fluctuate and vary throughout the year. The other parameters can be estimated from wave buoys (e.g., CDIP). Serafin et al. (2014) build upon this approach to develop a more robust method to simulate extreme total water levels using a time-dependent, extreme value approach, which also provides confidence bounds.

While these prior efforts have been substantial, additional research is needed for ODOT to prioritize sites for potential mitigation. First, the prior work looked comprehensively at the shoreline and was not focused on Highway 101 as is necessary for this study. Second, aside from Ruggiero et al. (2013), prior studies were completed for a select group of counties at a time between the 1990s and present. Methods and data quality vary between studies especially given the rapid advance of lidar and photogrammetry technology in recent years; hence research is needed to verify the datasets and analyses to apply them in the context of evaluating Highway 101. Ruggiero et al. (2013) was part of a broader study evaluating the entire Pacific Northwest, but this work is based on relatively old airborne lidar derived shorelines (2002), which were what was available at that time. Next, coastal landslides and erosion of coastal bluffs were only quantified to a limited extent in these prior studies. A more detailed look is necessary for understanding the impacts on Highway 101. A common basis is also needed to compare prioritization of sites under Goal 16 (estuaries) with those under the purview of Goal 18 (beaches, seacliffs, dunes). Lastly, these studies generally quantify erosion rates or flooding extents but do not evaluate economic impacts. The intent of this research is to leverage the high caliber work completed in these previous studies to develop erosion and economic models that can be applied in a systematic fashion such that the prioritization is performed consistently along Highway 101. This methodology can then be utilized by ODOT in future years for model update as needed considering that erosional patterns can change dramatically over time.

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3.0 Objectives of the Study

The main objective of this research is to identify and prioritize sites along Highway 101 for possible mitigation. Specific objectives include:

- Develop erosion rate model(s) with uncertainty estimates
- Develop methodology for hazard vulnerability assessment
- Develop ODOT Highway 101 site prioritizations and adaptation options
- Deliver planning level GIS maps for distribution to ODOT stakeholders
- Deliver Final Report and Research Rollout sessions to ODOT stakeholders

3.1 Benefits

This research will enable ODOT to be proactive in managing coastal risks to infrastructure, directly informing potential Goal 16 and 18 revisions. Conducting this research now also ensures that ODOT is the lead agency assessing risks and priorities for US 101. Without this research, ODOT will remain in a passive and reactive position regarding the mitigation restrictions of Goal 18, while erosion and sea level rise will continue to threaten the safety and reliability of our iconic coastal highway. This research will provide valuable “pre-work” for future regulatory approvals for infrastructure protection, and strategic planning for short and longer-term adaptation options. This research will also help build a common understanding of risks and needs pertaining to the management of coastal hazards across ODOT and will help build partnerships amongst federal, state, and local stakeholders. Additionally, this research addresses infrastructure resilience and reliability under changing climate conditions with an adaptation framework that helps ensure a safe and reliable transportation system for the traveling public.

4.0 Implementation

Implementation will require coordinated effort between ODOT’s Adaptation Program Manager, the ODOT Climate Office Director, coastal Region Managers, the Engineering Geology Program, and the Research Coordinator. The coastal hazard prioritization maps will both inform STIP project development and provide direct support for DLCD Goal 18 Policy needs. Importantly, the vulnerability matrix and site options identified will also allow the agency to strategically assess and plan proactive maintenance and protection of US 101, including future Goal 18 exceptions, Region project development, maintenance priorities, and budget assessment for maintenance needs related to coastal hazards. To initiate use and implementation, tailored research showcase/Q&A sessions with the final map products and associated GIS data layers will be provided to our professionals from: Region 2, Region 3, coastal Maintenance Districts, the Maintenance and Operation Branch, the Statewide Project Delivery Branch, the Policy/Data/Analysis Division, and key stakeholders outside of the agency. The results of this research will also be appropriately distributed to the public through conference proceedings and peer reviewed publications.

5.0 Research Tasks

The PI and potentially co-PIs will meet with the Research Coordinator at least twice per fiscal year to discuss progress, data, and analysis. If needed, the Research Coordinator will schedule additional TAC meetings to share progress and receive direction.

The following work is envisioned for this research.

5.1 Expected tasks:

Task 1: TAC Meeting #1

Project Kickoff Meeting. At this meeting the research scope and strategy will be presented, discussed, and finalized. Any needs from ODOT or other state agencies will be identified with roles assigned for acquirement within the TAC.

Time Frame: August 2020
Responsible Party: PI, ODOT Research Coordinator, TAC
Cost: $5,000
Deliverable: TAC meeting attendance, TAC meeting presentation, TAC Meeting Minutes
TAC Action: Review and understand project work plan, underlying research question, the limits of the research, and the project schedule with implementation outcome in mind. Advise ODOT Research Coordinator regarding any critical issues with the project's scope or schedule. Advise PIs regarding related professional practices, standards, methods and context for the project.
ODOT Action or Decision: Review TAC advice, discuss with PI, and if necessary direct PI to make changes to project documents.

Task 2: Data Compilation and Review

Collate, review, and evaluate existing erosion data, future sea level rise projections, total water levels, existing monitoring data undertaken by various agencies and research organizations, geotechnical and geologic data from ODOT's Unstable Slopes Program, coastal maintenance review exercises from 2003, first-hand ODOT engineering experience, identified alternative route possibilities, historic/recent lidar and orthoimagery, relevant land-use data, and data on existing shore protection structures. The team will also perform site visits as necessary to verify data and report findings as well as collect limited supplemental information. Data will be collected, stored, and delivered to ODOT. The review rationale and review process together with the review findings will be summarized and delivered to ODOT as a short technical memo/email.

Time Frame: August to December 2020

Responsible Party: PI
Cost: $40,000
Deliverable: A Memo documenting the data compilation effort and assessment of which data are most reliable and applicable to the study.
TAC Action: None
ODOT Action or Decision: Review

Task 3: Develop Erosion Model(s)

Data gaps will be addressed in this Task through additional targeted lidar/orthoimagery data collection and evaluation. A coastal erosion rate model and associated geospatial layer will be developed using current ODOT/OSU research efforts from SPR807 together with change detection analysis from newly acquired lidar/orthoimagery compared to historical data from Task 2. These layers will also provide uncertainty estimates given that data availability and quality will vary by location.

The design of any specialized data collection tools or algorithms will be documented and delivered to the Agency. Data will be recorded in a standardized and secure form.

Time Frame: November 2020 to March 2021
Responsible Party: PI
Cost: $32,000
Deliverable: Memo describing the erosion model(s)
TAC Action: Review and comment
ODOT Action or Decision: Review

Task 4: Develop and Apply Methodology for Hazard Vulnerability Assessment

A GIS-based methodology to prioritize sites by coastal hazard assessment will be developed, focusing on erosion rate modeling and modeling for sites vulnerable to sea level rise and flooding from extreme tides or storm events, from Task 3 together with essential data identified in Task 2. This tool will be applied to sites with projected impacts from sea level rise and where US 101 is in close proximity to the coastline. A methodology section for the report will be developed encompassing the methods of Tasks 2-4.

The design of any specialized data collection tools or algorithms will be documented and delivered to the Agency. Data will be recorded in a standardized and secure form.

Time Frame: February to July 2021
Responsible Party: PI
Cost: $33,500
Deliverable: A prioritized list of coastal hazard sites, GIS layer of prioritized hazard sites containing the information and attributes from the matrix, and a corresponding Research Methodology Report Section summarizing efforts from Tasks 2-4
TAC Action: Review and comment
ODOT Action or Decision: Review

Task 5: TAC Meeting #2

A second TAC meeting will be scheduled to review progress to date (Tasks 2-4) and set the course for the completion of the project. Additionally, the methodology/strategy will be presented, discussed, and finalized for Task #6.

Time Frame: August 2021
Responsible Party: PI, ODOT Research Coordinator, TAC
Cost: $5,000
Deliverable: TAC meeting attendance, TAC meeting presentation, TAC Meeting Minutes, meeting agenda
TAC Action: TAC review of Deliverables for Task 2-4. Advise ODOT Research Coordinator regarding any critical issues with the project's research design. If possible, reach consensus regarding the content and methods in Tasks 3-6. Advise ODOT Research Coordinator regarding project next steps, including key parameters of interest for Task 6.
ODOT Action or Decision: Review TAC advice. Assess project potential for successful completion. If necessary, direct PI to make changes to project documents. Provide formal acceptance of Deliverables. Authorize PI to proceed with subsequent steps, notify by memo or email.

Task 6: Identify, Analyze, and Prioritize Adaptation Options

This Task will develop a multi-parameter hybrid methodology for assessing adaptation options for the highest priority sites that may consider both the Multi-Criteria Analysis (MCA) Method and the Economic Analysis Method from the FHWA's "Vulnerability Assessment and Adaptation Framework" publication. Input that may be considered for adaption option selection potentially include a combination of the following parameters: effectiveness in responding to climate stressors, capital and life-cycle costs, environmental impacts, technical feasibility/constructability, permitting constraints, public acceptance, environmental justice impacts, scale, direct costs, direct benefits, and indirect effects. The methodology will be applied to evaluate different adaptation options at a short list of sites (approximately five), including evaluating the immediacy of the adaptation (e.g., immediate, in a few years, decades) and design life of the infrastructure.

Time Frame: August 2021 to February 2022
Responsible Party: PI
Cost: $80,000
Deliverable: Draft Analysis Report Section containing documentation on methodology development, priority site adaptation options, and a decision matrix for prioritized coastal hazard sites.
TAC Action: Review and comment
ODOT Action or Decision: Review

Task 7: Finalize Prioritization List

Using results from Task 6 regarding adaptation options and feasibility, finalize coastal mitigation prioritization list developed in Task 4, highlighting those sites that would require Goal 18 exceptions or policy changes that are feasible based on the adaptation analysis in Task 6.

Time Frame: February 2022
Responsible Party: PI
Cost: $20,000
Deliverable: Draft chapter with the final prioritization list and rationale.
TAC Action: Review and comment
ODOT Action or Decision: Review

Task 8: Finalize GIS data layers

Finalize GIS data layers for site prioritization. In addition to revised digital geodatabase(s) containing the sites and attribute information from Tasks 4, 6, and 7, this Task will deliver planning level GIS maps for distribution to ODOT stakeholders.

Time Frame: February to May 2022
Responsible Party: PI
Cost: $22,434
Deliverable: GIS data layers, database(s), and maps.
TAC Action: Review and comment
ODOT Action or Decision: Review

Task 9: Draft Final Report

Publication ready Draft Final Report in the prescribed ODOT report format. (Formatting includes correct fonts, spacing, citations and graphics). Envisioned contents include: an updated abstract, acknowledgement, disclaimer, introduction, Summary of Data Compilation (Task 2), Draft Analysis Report Sections (Tasks 3,4, 6 and 7), Summary of GIS data layers (Task 8), discussion of results, conclusions, value of research findings to the Agency, limitations of the research, and potential for future research, application, or technology transfer, and other sections as appropriate.

Time Frame: February to July 2022
Responsible Party: PI
Cost: $27,066
Deliverable: Draft Final Report using ODOT's report template
TAC Action: TAC review and feedback to the ODOT Research Coordinator
ODOT Action or Decision: Review and counsel prior to TAC meeting

Task 10: TAC Meeting #3.

This TAC meeting will include a review of the Draft Final Report prior to the TAC meeting. The research team will deliver a final presentation including discussion of the final list of sites. The TAC will offer advice on the content and clarity of these work products. The TAC will also advise on post research implementation, including the plan for the research rollout.

Time Frame: July 2022
Responsible Party: PI, assisted by the ODOT Research Coordinator, TAC

Cost: $5,000
Deliverable: TAC meeting attendance, TAC meeting presentation, TAC Meeting Minutes
TAC Action: TAC review of Draft Final Report, and Draft Research Note. Advise ODOT Research Coordinator regarding any critical issues with the project's research design. Advise ODOT Research Coordinator regarding any required final edits to the Draft Final Report, and Draft Research Note.
ODOT Action or Decision: Review TAC advice. If necessary, direct PI to make changes to project documents.

Task 11: Final Report

Edit Draft Final Report to incorporate edits identified by the ODOT research Coordinator after the last TAC meeting.

Time Frame: August 2022 to October 2022
Responsible Party: PI
Cost: $12,000
Deliverable: Final Report
TAC Action: None
ODOT Action or Decision: Review. Provide formal acceptance of Final Report. Publish Final Report on ODOT's research website

Task 12: Research Rollout Sessions

The Research Coordinator will work with the TAC and research team to develop and coordinate research Informational/Q&A sessions for the finalized prioritized maps tailored for stakeholder group discussion.

Time Frame: October to December 2022
Responsible Party: PI
Cost: $7,500
Deliverable: Presentations at roll out meetings
TAC Action: Participate in roll out sessions.
ODOT Action or Decision: Coordinate the scheduling of roll out sessions.

5.2 Reporting

All reports shall be produced in the standard ODOT Research Section report format provided to the Project Investigator by the Research Coordinator unless some other format is deemed to be more appropriate. The Project Investigator shall be responsible for submitting deliverables as professional-level written composition equivalent to the writing standards of peer-reviewed journals. These writing considerations include grammar, spelling, syntax, organization, and conciseness.

The Project Investigator, in consultation with the TAC and Research Coordinator, shall deliver to ODOT in electronic format the data produced during the project. The Project Investigator shall ensure the data is labeled and organized to facilitate future access. ODOT shall warehouse the data.

5.3 Safety and Related Training

Prior to accessing ODOT right-of-way (ROW), all personnel who will work on ODOT ROW shall complete safety training appropriate to the work to be performed within the ROW. The Project Investigator shall notify Project Coordinator in writing (email accepted) prior to the first day of work within the ROW that all project personnel who will access ODOT ROW have been trained. Until all ROW work is completed, the Project Investigator shall notify Project Coordinator in writing (email accepted) annually that an active safety training appropriate to the work to be performed within the ROW has been completed by all personnel who will work on ODOT ROW.

6.0 Time Schedule

This section specifies the timeline for the project, listing the task headings and showing monthly and/or quarterly time blocks in which each task will be accomplished. Also shown are interim and final deliverables.

Task		2020						2021												2022											
		FY21												FY22												FY23					
		Jul - Sep			Oct - Dec			Jan - Mar			Apr - Jun			Jul - Sep			Oct - Dec			Jan - Mar			Apr - Jun			Jul - Sep			Oct - Dec		
1	TAC Formation & Mtg #1		*																												
2	Data Compilation & Review						*																								
3	Develop Erosion Models									*																					
4	Hazard Methodology													*																	
5	Tac Meeting 2														*																
6	Adaptation Options																				*										
7	Finalize Prioritization List																				*										
8	Finalize GIS data layers																							*							
9	Draft Final Report																									R					
10	TAC Meeting 3																									*					
11	Final Report																												F		
12	Research Rollout																														*

*Deliverables
R - Draft report submitted for ODOT review.
F - Revised report submitted to ODOT for publication. End of contract.

7.0 Budget Estimate

An itemized budget for the project is included here showing expenditures for each task by fiscal year and in total.

Task	FY21	FY22	FY23	Total
1-TAC Formation & Mtg #1	$5,000	$0	$0	$5,000
2-Data Compilation & Review	$40,000	$0	$0	$40,000
3-Develop Erosion Models	$32,000	$0	$0	$32,000
4-Hazard Methodology	$22,436	$11,064	$0	$33,500
5-Tac Meeting 2	$0	$5,000	$0	$5,000
6-Adaptation Options	$0	$80,000	$0	$80,000
7-Finalize Prioritization List	$0	$20,000	$0	$20,000
8-Finalize GIS data layers	$0	$22,434	$0	$22,434
9-Draft Final Report	$0	$25,000	$2,066	$27,066
10-TAC Meeting 3	$0	$0	$5,000	$5,000
11-Final Report	$0	$0	$12,000	$12,000
12-Research Rollout	$0	$0	$7,500	$7,500
Total for tasks (Contract amount)	$99,436	$163,498	$26,566	$289,500
Support/management (ODOT completes)	$6,000	$7,000	$7,000	$20,000
Total for ODOT (ODOT completes)	**$105,436**	**$170,498**	**$33,566**	**$309,500**