# II. PMP Outline

## 1. Project Title: Integrated Risk-Based Environmental Modeling of Extreme Coastal Weather Events (ACTIONS)

## 2. P2 Project #: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## 3. PMP Approver: Dr. Elizabeth Ferguson

## 4. Complete List of PDT Members: This list should include the customer/sponsor, project manager, responsible branch chief(s), and all appropriate team members.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Organization | Role | Name | Phone | E-Mail |
| USACE | Customer/Sponsor |  |  |  |
| CEERD-EP-W | Project Manager/PI |  |  |  |
| CEERD-EP-W | Branch Chief/PM Proxy |  |  |  |
|  | Team Member(s) |  |  |  |
| CEERD-EP-W | PI | Dr. Todd E. Steissberg | 530-219-7990 | Todd.E.Steissberg@usace.army.mil |
| CEERD-EP-W | Co-PI | Mr. John R. Kucharski | 916-879-3155 | John.R.Kucharski@usace.army.mil |
| CEERD-EP-W | Co-PI | Dr. Jennifer Olszewski | 301-704-0894 | Jennifer.M.Olszewski@usace.army.mil |
| LimnoTech | Co-PI | Dr. Billy E. Johnson | 601-415-6299 | Billy.E.Johnson@usace.army.mil |
| CEERD-EP-W | Computer Scientist | Ms. Lora Johnson | 601-415-6300 | Lora.L.Johnson@usace.army.mil |
| CEERD-EM-J | PM Proxy | Jessica Coleman | 601-634-3976 | Jessica.G.Coleman@us.army.mil |
|  |  |  |  |  |

## 5. References:

This PMP is being developed in coordination with the ACTIONS team.

## 6. Background/Problem Description:

Military installations in coastal areas are threatened when a web of natural processes surrounding extreme weather events combine to drive hazards such as inundation, erosion, increased salinity, and other soil issues that limit land use for military activities. Impacts can be caused by a single meteorological event (e.g., extreme precipitation) or by a combination of separate events that occur either simultaneously or in close succession. For example, intense long-duration rainfall may occur before a strong wind event that combines with low atmospheric pressure to create a storm surge, resulting in overwash from the ocean, amplified by runoff from overflowing streams. Past studies have largely focused on historical events or statistical models of water levels to estimate risks to natural systems. However, research has shown that these methods are error prone and unable to accurately evaluate risk, due to the short period of record available in most locations and the complexity of interactions between waves, surges, and weather, which combine to produce hazardous events (Santiago-Collazo, 2019). Extreme events are linked to water quality concerns, which are in turn linked to soil and vegetation dynamics. The integrated assessment of extreme events, water quality, soil, and vegetation has been a significant missing component in coastal modeling. To understand and combat the range of natural threats to land use, freedom of movement, and continuity of operations on coastal military installations, research is required that links potential wave, surge and weather events to hydrodynamic processes, coastal morphology, water quality, soil systems and vegetation, all of which impact availability of land and freedom of movement in coastal systems.

## 7. Technical Objective/Project Scope:

This task will develop integrated models that simulate water levels and flow, water quality (salinity, nutrients, temperature, and contaminants), vegetation dynamics (in collaboration with our ACTIONS partners), land use change, and dynamic adaptation pathways. Risk-based time series of extreme coastal events will drive water quality and land use impact models, from which a full understanding of vulnerabilities and dynamic adaptation pathways will be developed. These integrated models will enable military installation planners and managers to assess and respond to risks to natural infrastructure in their coastal settings.

Past research has shown that the dimensionality of hazards that combine to produce extreme events in coastal events can lead to inadequate assessments of vulnerability and the occurrence of “surprise” events and catastrophic scenarios (Anderson et al., 2019). Traditional event-based hydrologic and hydraulic modeling is a time-intensive process that cannot adequately represent the large set of possible combinations of scenarios. For example, the timing, duration, magnitude, and spatial extent of storm surge combined with extreme precipitation and riverine flooding can lead to a wide variety of type and magnitude of impacts to terrain, structures, military operations, and natural infrastructure on military installations (Santiago-Collazo, 2019).

Stochastic simulation and scenario exploration programs allow us to investigate this large array of factors and better understand the risks to coastal areas, and enable the development of more robust risk mitigation strategies, such as erosion control and water quality protection, fortification and protection of critical infrastructure, and robust operating plans that consider timing and flow of flood waters, as well as post-event recovery plans that address erosion and salinity impacts of contaminant spills or releases from soils. For this task, a full range of internally consistent extreme water level and flow events will be stochastically simulated. These water levels and flows will then be used as boundary conditions for downstream water quality, vegetation, and land use change models.

The flow of water, nutrients, salinity, and contaminants through the watershed have a profound effect on vegetation growth, mortality, distribution, and species composition, as well as the chemical and structural properties of soil and the morphology of the landscape due to erosion and sediment deposition. These, in turn, affect the terrain of military installations, which affects mobility and operations. We have developed several water quality modules that can be linked with, or integrated into, existing hydrologic and hydraulic models to simulate temperature, nutrients, contaminants, and other constituents in freshwater systems. We have integrated these modules with a number of models, including HEC-RAS (River Analysis System) and the Gridded Surface Sub-Surface Hydrologic Assessment (GSSHA) model. Under a separate project, ERDC is linking these modules with the GSSHA model and coupling these capabilities with ERDC’s multi-species vegetation models that simulate aquatic and terrestrial vegetation. We will the water quality capabilities to model changes in water chemistry as salinity levels increase.

Vegetation patterns and local and near-surface hydrology are highly interdependent. Plants tolerate specific ranges of surface and subsurface water availability, which in turn influence the local hydrologic balance as they move water from their roots to their leaves in the process of evapotranspiration. Plants in coastal environments tolerate specific ranges of surface and subsurface water quality, especially salinity levels. The impacts of extreme coastal events on aquatic and terrestrial vegetation (e.g., destruction, movement, growth, and change in species composition) can affect the use of land and maneuverability on military installations.

These changes in vegetation also increase the vulnerability of installations to future extreme events. The project will improve the DOD’s ability to assess the exposure of military installations to threats driven by extreme events in coastal regions, such as storm surges and extreme precipitation. These events can cause severe erosion, long-term pooling of water, changes in the concentrations and distribution of nutrients, salinity, and contaminants, which have an impact on soil chemistry and vegetation.

The integrated hydrologic, water quality, and vegetation models will enable users to address several fundamental issues that lead to poorly understood risk, “surprise” hazards and an inability to adapt to ever-evolving threats. More specifically, it will include a coastal process model that produces a full range of internally consistent boundary conditions that drive coastal hazards due to storm surges combined with extreme precipitation-runoff events. The number of processes contributing to these events is too high for relatively short historical records to have measured all of the relevant combinations of surge (driven by strong wind and low atmospheric pressure), waves, sea level anomalies, river overflow, and watershed runoff. Therefore, stochastic models will be developed to simulate the environmental forcing processes (time series) that occur under extreme coastal conditions. These environmental forcing time series will be used to drive numerical models simulating watershed runoff and water quality (nutrients, salinity, temperature, etc.). The outputs of these models will be linked with ecological models (in collaboration with our ACTIONS partners) to simulate changes in vegetation health, distribution, and species composition. The hydrologic and hydraulic model outputs can be used to estimate flood damage to the military installations, and to develop integrated vulnerability assessments. Dynamic adaptation plans and pathways addressing the specific vulnerabilities of the system will, in turn, be identified (Poff et al., 2015; Haasnoot et al., 2013; Brown et al., 2015; Herman et al. 2020)

### Environmental Forcing Model

Coastal hazards are generally driven by the combined occurrence of multiple correlated time-dependent processes, including waves, surge, tides, and freshwater flows driven by overland weather. To generate a plausible range of coastal hazards while preserving the complex interaction between the contributing processes, a model will be developed (Steinschneider et al., 2019; Steinschneider and Brown, 2013; Anderson et al., 2019; Wilks and Wilby, 1999; Wilks, 1998; Wilks, 1992)) to simulate a full range environmental forcing conditions. This fundamental research will significantly advance the understanding of coastal risks by linking multiple coastal and weather processes in an internally and risk-based time series of extreme events. This computationally efficient model will be used within the context of a bottom-up framework that facilitates the exploration of a full range of system performance scenarios, while allowing for careful experimentation of cause-and-effect relationships. This process leads to the reliable identification of specific system vulnerabilities to one or more environmental stressors. This framework has been applied in many coastal and non-coastal contexts with success.

The coupling of wave and weather data within a unified stochastic model has long been a goal of both academic and government-lead coastal investigation; however, it has only recently become possible with multiple stochastic wave and weather models being linked to similar atmospheric process on variable time scales (Steinschneider et al., 2019; Steinschneider and Brown, 2013). This linkage allows better informed decision-making on military installations using continuous time series of synthetic data containing the water level extremes of concern to DOD planners and managers in coastal systems. To evaluate the cumulative effects of combinations of waves, surge, wind, and sea level anomalies, a coastal wave/surge model (Anderson et al., 2019) will be incorporated into this model, thereby creating hypothetical combinations of events that, taken together, amplify flood hazard potential.

Predicting extreme coastal flooding plays a vital role in evaluating near-term and long-term system vulnerabilities, which are forecast to increase as the mean sea level rises. The environmental forcing model will enable more precise prediction of the types and magnitudes of extreme coastal events. The outputs from this model will be analyzed and used to derive multiple alternative scenario inputs for the hydraulic, hydrologic, water quality, and vegetation models. These models will then be able to help predict the impacts of future extreme events on terrain and natural infrastructure, soil and water salinity levels, and short- and long-term release of toxic contaminants from military installation soils.

The environmental forcing model will be used to derive input time series for multiple alternative future scenarios for this model, which will then drive the water quality and vegetation simulations. This model, combined with the hydrologic models developed by our ACTIONS partners and our water quality models, will enable military installations to develop more robust risk mitigation strategies, such as implementing erosion control and water quality protection plans, fortifying and protecting critical infrastructure, developing robust operating directives that consider timing and flow of flood waters, and preparing strategies for post-event recovery that mitigate erosion and salinity impacts as well as contaminant spills or releases from soils.

### Water Quality Model

The water quality simulation capabilities for this task will be provided by a set of existing ERDC-EL water quality modules linked with the GSSHA model developed by our ACTIONS partners. The capabilities of the Temperature, Nutrient, and Contaminant Simulation Modules (TSM, NSM, and CSM) will be extended in this task and integrated with the hydrology and vegetation models (described below). These modules simulate the water temperature and biogeochemistry of natural and contaminated freshwater systems, including rivers, streams, watershed runoff, lakes, reservoirs, and detention ponds (Zhang and Johnson, 2016a; Zhang and Johnson, 2016b). The Temperature Simulation Module (TSM) computes water surface temperature by simulating radiative, sensible, and latent heat exchange with the environment and mixing processes resulting from meteorological forcing and density gradients.

The Nutrient Simulation Modules (NSM-I and NSM-II) simulate the following: carbonaceous biological oxygen demand (CBOD), dissolved oxygen (DO), simplified nitrogen, and phosphorus cycles, which produce organic nitrogen, ammonia, nitrate-nitrite, organic phosphorus, total inorganic phosphorus, algae, and benthic algae biomass as additional state variables. NSM-I provides simplified aquatic chemistry, while NSM-II allows more complex simulation of chemical transformations and pathways. Both modules contain a sediment diagenesis sub-module to simulate sediment chemical transformations and exchange with the water column.

Salinity intrusion alters the physical and chemical properties of freshwater systems. Physical properties, such as density gradients, alter complex mixing processes and affect the advection and diffusion of heat in these freshwater bodies. Elevated salinity concentrations also affect nutrient and contaminant chemistry, e.g., by altering saturation concentration values, to the point at which salinity can no longer be simulated independently of the other constituents (as a conservative constituent), unlike in purely freshwater environments. The Temperature and Nutrient Simulation Modules (TSM and NSM) will be extended, therefore, to consider the effects of salinity in coastal freshwater/brackish systems. The salinity modeling capabilities of NSM will be extended to incorporate salinity into the chemical interactions: data collected by our ACTIONS partners on effects of salinity on the leaching of nutrients from soils and sediments will be incorporated into this module, which will allow it to predict the effects of increased soil salinity on coastal freshwater systems.

The Contaminant Simulation Module (CSM) computes internal sources and sinks for a wide range of contaminants for both the water column and underlying sediment layer (Zhang and Johnson, 2016a). CSM was designed for simulating general contaminants, such as pesticides, polychlorinated biphenyls, halogenated aliphatic hydrocarbons, halogenated ethers, monocyclic aromatics, phthalate esters, polycyclic aromatic hydrocarbons, and nitrosamines. These chemicals can be toxic to aquatic organisms, and can also bioconcentrate through the food chain, directly affecting human health. Changes in inundation patterns and increased salinity exposure can alter soil geochemistry, thereby mobilizing previously sequestered contaminants (LeMonte et al., 2017, Zhao et al., 2013). Extreme coastal events can also increase the risk of contaminant releases (spills, etc.) from military facilities. Moreover, increased exposure to salinity can amplify contaminant impacts (Schafer, et al., 2012), further degrading ecosystem services and natural infrastructure.

This task will extend the current water quality simulation capabilities to model temperature, nutrients, and contaminants for coastal military installations under a combination of freshwater and saline conditions. CSM capabilities will be extended to incorporate salinity and then linked with the GSSHA model, the other water quality modules, and the vegetation models. Soil data and determinations from measurements and investigations of our ACTIONS partners will be used as inputs to the water quality model. The following measurements will be included: soil geochemistry (mineralogy, redox, pH, nutrients, etc.), soil hydraulic properties (saturation, infiltration rate, etc.), and soil and water contaminants of concern at the selected study sites.

Data on soil chemistry and physical properties collected by our ACTIONS partners will inform the water quality modeling. For example, saturated hydraulic conductivity (Ksat) has significant effects on salt, pesticide, nutrient and contaminant leaching, pollution transport to groundwater, water infiltration and consequently, controlling surface runoff. This will enable more complete understanding and aid in predicting the uses of complex terrain.

Salinity concentrations in surface waters have a strong impact on the type of wetlands that can be supported at a particular elevation and distance from the coastal margin. To address this, a salinity index function will be added to the water quality tool in collaboration with our ACTIONS partners, which will predict the type of wetland supported at a particular location. A visualization tool will be created that will generate maps of salinity and wetland categories for multiple future scenarios.

### Ecosystem Models

The use of nature in engineering design is a long-standing goal of water resource managers. Salt marshes are one example of natural and nature-based design features (NNBF) that serve a critical role in shoreline ecology, while also aiding in common water resources engineering design goals. For example, salt marshes can attenuate high coastal water levels and reduce shoreline erosion. These environments are also becoming scarce. The San Francisco Bay, which lost an estimated 90 percent of its salt marsh habitat in the 20th century, is representative of a larger trend. On a national scale, 70 percent of the historic salt marsh habitat has been lost, largely to human development. This dramatic reduction in salt marsh protection leaves coastal ecosystems and human communities more vulnerable both to existing variability and future threats like climate change and sea level rise. While it is agreed upon that NNBFs like salt marsh can benefit ecosystems and society alike, the reality of incorporating green elements into engineering designs is complicated by a myriad of biological and physical uncertainties. These inherent uncertainties in NNBFs lead to a simplistic notion that the choice between green and gray design features is a choice between unpredictable multi-objective benefits, and static single objective outcomes. This study proposes the development of a framework for designing constructed salt marshes that incorporates biological and physical uncertainties into the design process, providing greater understanding of the benefits of this green infrastructure. This framework will be developed through a demonstration study in the San Francisco Bay. A targeted laboratory experiment will also be leveraged to improve model parameters and relationships.

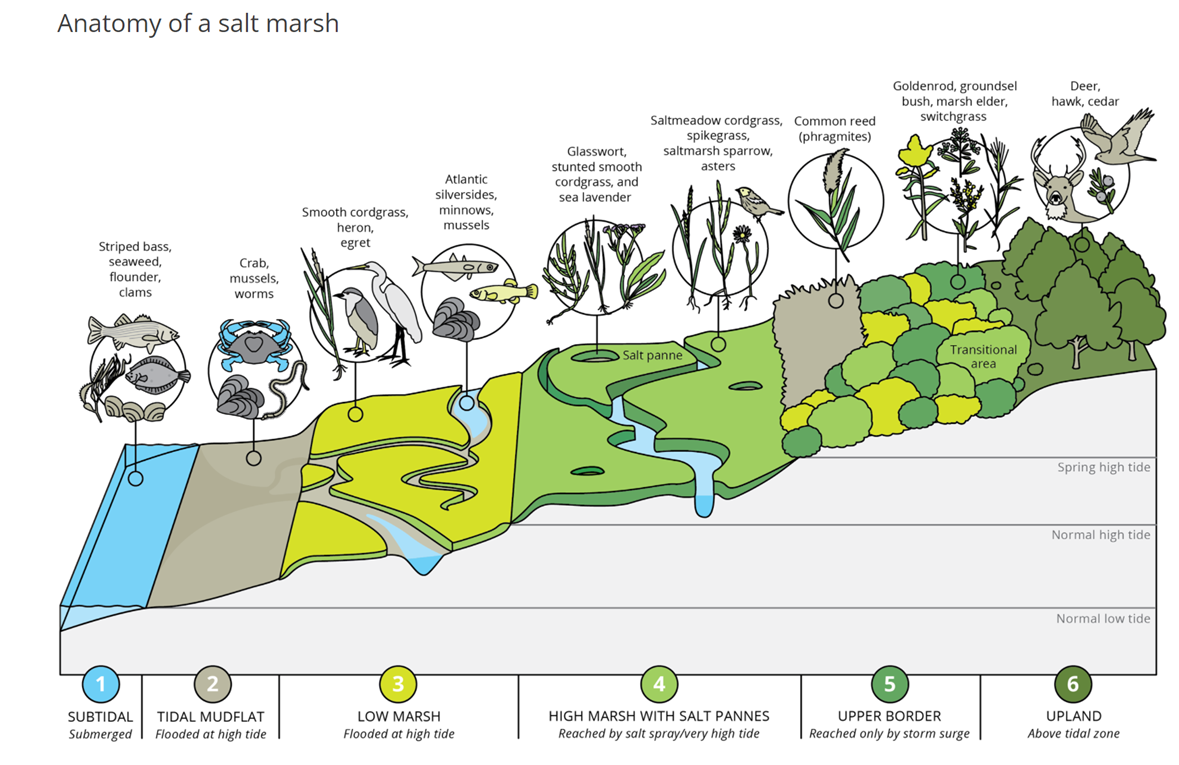


Figure . Diagram of the transitional zones from subtidal and tidal mudflats to salt marsh (low and high marsh) to upland (https://www.lucyreading.co.uk/project/anatomy-of-a-salt-marsh/). This study will focus on the design of salt marshes (i.e., the low and high marsh) to upland (https://www.lucyreading.co.uk/project/anatomy-of-a-salt-marsh/). This study will focus on the design of salt marshes (i.e., the low and high marsh zones 3 and 4).

### Vulnerability Assessment and Adaptation Planning

Using the outputs from the hydrologic, water quality, and vegetation simulations, vulnerabilities will be identified through a systematic and exhaustive scenario analysis, driven by the weather and wave generator. Multi-objective dynamic adaptation pathways will be formulated which will allow mitigating against specific risks identified in the vulnerability analysis. The vulnerability assessment will assess tipping points in natural system function, water quality, flooding, and water supply indicators associated with natural variability in wind, wave and storm conditions, sea-level rise, and human factors, such as water needs and population change. Methods employed will build on the foundation of well-established systems analysis, vulnerability assessment, and dynamic adaptation pathways (Poff et al., 2015; Haasnoot et al., 2013; Brown et al., 2015; Herman et al. 2020).

## 8. Technical Approach/Study Plan:

### Task 1. Project Kick-off Meeting. Design Meeting - Teleconference.

This meeting will present the Project Management Plan (PMP) to the project team and collaborators and refine the details of the project.

1. We will discuss the approach to developing flow and sediment output files for driving the water quality simulations, then develop nutrient solution files.
2. These output files will then be used in conjunction with GSSHA flow and sediment solution files to drive vegetation simulations within the ERDC Multi-species Vegetation Models for Aquatic and Terrestrial communities.

### Task 2. Select Pilot Study Site.

1. A pilot study site will be selected in coordination with LSU and UD. Site characteristics and data availability will be assessed and documented.

### Task 3. Initiate Water Quality Model Development.

1. Modify the Temperature Simulation module to consider salinity effects on mixing processes and the transport and diffusion of heat and the mass of water quality constituents.
2. Modify the Nutrient Simulation Module to include salinity in the nutrient chemistry reactions.
3. Modify the existing contaminant simulation module (CSM) to include salinity and link it with GSSHA’s flow and sediment solution files.
4. Determine flow and sediment data as well as output frequency needed from GSSHA to drive CSM. An analysis will be performed to identify the key information needed to drive the contaminant simulations.

### Task 4. Initiate Development of the Environmental Forcing Model.

1. Initiate linking the weather and wave/surge generation capabilities of two existing models.

### Task 5. Finalize Water Quality Model Development.

1. Complete the water quality module extensions.
2. Complete the linkage of EL’s Contaminant Simulation Module (CSM) with GSSHA.
3. Add wetland salinity index capability.
4. Add capability to create automated wetland type maps for each scenario.
5. Test and validate the water quality model.

### Task 6. Finalize Development of the Environmental Forcing Model.

1. Complete the model.
2. Test and validate the model.
3. Develop wetland salinity index capability.
4. Develop capability to create wetland category maps, based on salinity.

### Task 7. Water Quality Case Study.

1. In collaboration with LSU, develop a GSSHA hydrologic and water quality model for the case study site.
2. Simulate temperature, nutrients, and contaminants for a selected historical extreme event.
3. A technical note will be prepared documenting the findings.

### Task 8. Case Study: Model Extreme Events/Environmental Forcing Conditions.

1. Team members will model the range of potential wave, surge and weather events needed to accurately evaluate risks to available land uses and freedom of movement on coastal military installations for the selected pilot study site.
2. A technical note will be prepared to document the findings.

### Task 9. Publication of Water Quality Modeling Capabilities.

1. Two journal publications will be prepared that discuss the following: a. Simulating contaminant release from saline soils, and b. Predicting the water quality effects of extreme events for coastal military installations

### Task 10. Publication of Environmental Forcing Conditions.

1. A journal publication will be prepared describing the model used to create internally consistent extreme water level events resulting from combined wave, surge, tide, and sea level rise processes.

### Task 11. Hydro-ecological Salt Marsh Model

This task has two major goals:

1. Develop a “unit” salt marsh model that can demonstrate how to:
   1. Design salt marshes for specific performance objective(s) that are robust to range of potential future sea level and sediment input conditions
   2. Quantify performance using measurable performance metric(s)
   3. Identify those marsh parameters (e.g., platform depth, vegetation species dominance, etc.) to which performance is most sensitive to.
   4. Lead to the development of generalized salt marsh model design guidelines
2. Collaborate with LSU to further develop the landscape level salt marsh model that LSU is developing in the Atchafalaya basin. This includes:
3. Investigate potential use of weather generator to generate environmental (rainfall) forcings for the Atchafalaya models.
4. Evaluate the incorporating the GSSHA model to simulate groundwater water and salinity movement (and resulting contaminant dynamics)

### Task 12. Publication of Linked Extreme Events, Water Quality, and Vegetation Models.

1. A journal publication will be prepared that evaluates the integrated extreme event, water quality, soil, and vegetation impacts on coastal military installations by linking them to land use changes.

### Task 13. Vulnerability Assessment and Adaptation Measures.

1. The dimensionality of threats to land use and natural infrastructure on coastal military installations associated with the occurrence of extreme events will be evaluated using scenario exploration programs (i.e., CART).
2. These vulnerabilities will in turn be dynamically linked to root conditions that can be monitored and used to trigger dynamic adaptations.
3. A prototypical dynamic monitoring and adaptation planning framework will be provided.

### Task 14. Publication of Vulnerability Assessment and Dynamic Adaptation Planning Framework.

1. A journal publication will describe the framework associating vulnerabilities with contributing factors, and detail monitoring plans and dynamic adaptation measures.

## 9. Scheduling and Milestones:

### Schedule:



Scheduling and Milestones

### Milestones and Products:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Task | Description | Products | Project Year | Cost ($K) |
| 1 | Kick-off Project Meeting and Project Design | a. Meeting notes that outline the project plan b. Revised PMP | 1 | 25 |
| 2 | Select Pilot Study Sites | a. Selected case study site b. Documentation of site characteristics and data availability | 1 | 25 |
| 3 | Initiate water quality model development | Alpha version of WQ model with salinity and contaminant simulation capabilities | 1 | 125 |
| 4 | Initiate Development of the Environmental Forcing Model | Alpha version of the Environmental Forcing Model | 1 | 225 |
| 5 | Finalize water quality model | a. Final version of WQ model with salinity and contaminant simulation capabilities b. Wetland salinity index capability c. Wetland type mapping capability, based on salinity | 2 | 200 |
| 6 | Finalize development of the Environmental Forcing Model | Final version of the Environmental Forcing Model | 2 | 200 |
| 7 | Water Quality Case Study | Technical note | 3 | 40 |
| 8 | Case Study: Modeling Extreme Events/Environmental Forcing Conditions | Technical note | 3 | 200 |
| 9 | Publication of Water Quality Capabilities | Two peer-reviewed journal papers | 4 | 50 |
| 10 | Publication of Environmental Forcing Conditions | Peer-reviewed journal paper | 3 | 100 |
| 11 | Hydro-Ecological Salt Marsh Model | a. Vegetation model for coastal military installations; b. Peer-reviewed journal paper | 4 | 225 |
| 12 | Publication of Extreme Events, WQ, and Ecological Models | Peer-reviewed journal paper | 4 | 75 |
| 13 | Vulnerability Assessment and Adaptation Measures | Adaptations measures | 4 | 35 |
| 14 | Publication of Vulnerability Assessment and Dynamic Adaptation Planning Framework | Two peer-reviewed journal papers | 4 | 75 |

## 10. Technology Transfer:

Products will be disseminated through standard ERDC reporting systems (ERDC Library and Web sites) and software servers.

## 11. Sponsor’s Role:

In order to keep this project on track, the project team will coordinate with the Program Managers to ensure that any critical milestones associated with other projects within this program are identified and managed so as not to adversely affect the delivery of products listed in this PMP.

## 12. Resource Plan:

### Year 1 Budget:

|  |  |
| --- | --- |
| **Resource Item** | **Amount ($K)** |
| **OTHFACSVC** |  |
| **LABOR** |  |
| Dr. Todd Steissberg | 80.0 |
| Mr. John Kucharski | 85.0 |
| Mr. Kervi Ramos | 85.0 |
| Dr. Jennifer Olszewski | 45.0 |
| Dr. Billy Johnson | 10.0 |
| Dr. Mansour Zakikhani | 10.0 |
| Ms. Lora Johnson | 10.0 |
| **BURDENS** | 25.0 |
| **TRAVEL** | 0.0 |
| **SUPMATRLS** | 50.0 |
|  |  |
| **TOTAL** | 400.0 |

### Year 2 Budget:

|  |  |
| --- | --- |
| **Resource Item** | **Amount ($K)** |
| **OTHFACSVC** |  |
| **LABOR** |  |
| Dr. Todd Steissberg | 125.0 |
| Mr. John Kucharski | 80.0 |
| Dr. Jennifer Olszewski | 85.0 |
| Ms. Lora Johnson | 25.0 |
| Ms. Lauren Melendez | 30.0 |
| Dr. Mansour Zakikhani | 20.0 |
| **BURDENS** | 10.0 |
| **TRAVEL** | 15.0 |
| **SUPMATRLS** | 10.0 |
|  |  |
| **TOTAL** | 400.0 |

### Year 3 Budget:

|  |  |
| --- | --- |
| **Resource Item** | **Amount ($K)** |
| **OTHFACSVC** |  |
| **LABOR** |  |
| Dr. Todd Steissberg | 100.0 |
| Mr. John Kucharski | 70.0 |
| Dr. Jennifer Olszewski | 100.0 |
| Ms. Lauren Melendez | 53.0 |
| **BURDENS** | 15.0 |
| **TRAVEL** | 20.0 |
| **SUPMATRLS** | 10.0 |
|  |  |
| **TOTAL** | 368.0 |

## 13. Funding Information: Indicate funding received. Type indicates Project Order (PO), Direct Fund Cite (DFC), etc.

## 14. Communication Strategy:

The project team provide progress reports at the frequency set by the Program Manager’s Office. Internally, the project team, and collaborators, will communicate via e-mail, WebEx, and in-person meetings as needed to ensure the milestones are being successfully completed on time. If any issues develop that may impact the milestones, then the project lead will immediately information the program managers and a discussion of how to overcome the issues will be done.

## 15. Quality Management Plan:

Standard software development processes will be followed in creating the software framework, databases, data structures, data exchange mechanisms, API, user interface, and data visualization and analysis tools (plots, tables, reports, etc.). Standard statistical analyses will be performed when evaluating whether the models within the modules are successfully simulating meteorologic, hydrologic, storm surge, water quality, and vegetation processes. Safety and Occupational Health Plan (SOHP): All the work will be done in an office setting so no SOHP is necessary.

# III. Thresholds for Changes in the PMP

There are three thresholds based on scope, cost, and time:

* Scope: A sponsor, product, or other major milestone is dropped or added (e.g., report, field test, model).
* Cost: At any point, the total cost changes by +/- 25% from the current plan.
* Time: The PMP Approver will immediately contact Sponsors when the PM submits a PMP approval request showing any initial milestone dates being delayed. Based on discussions with the sponsor, revised milestone date(s) will then be coordinated with the PDT.

Statusing: The PM is responsible for “statusing” activities in P2. As the project dictates, activity work plans will be submitted to the PM for approval prior to the start of an activity. Activity works plans will include planned technical objectives and study and research methodologies and attached to the activity as noted in item 9 above.

# IV. Project Files

A file should be maintained on each project executed within the lab and retained for six years in accordance with Army Records Information Management System (ARIMS) requirements. Each project file shall include:

* Proposal or Scope of Work with a copy of the signed transmittal letter
* Approved PMP (all versions) and related documents (study plans, etc.)
* Funding documents
* Authorizations
* Status and draft reports with transmittal letters
* Technical drawings
* Photographs
* Meeting Notes
* Briefings
* Correspondence

After six years, the project files are to be reviewed by the records office for final deposition. Lab notebooks, raw data and metadata are to be retained for 30 years.

Note: P2 also allows for an effective and endless repository of electronic information. We suggest using the P2 Project WP/Doc area as a place to keep electronic copies of the above-mentioned files and appropriate backups. It is a wise idea to maintain hardcopies as well.

# V. References

Anderson, D., A. Rueda, L. Cagigal, J. A. A. Antolinez, F. J. Mendez, P. Ruggiero (2019). Time-varying emulator for short and long-term analysis of coastal flood hazard potential. *Journal of Geophysical Research: Oceans*, 124, 9209-9234. <https://doi.org/10.1029/2019JC015312>

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Herman, J., J. Quinn, S. Steinschneider, M. Giuliani, and S. Fletcher (2020), Climate adaptation as a control problem: Review and perspectives on dynamic water resources planning under uncertainty, *Water Resources Research*, 56, e24389. <https://doi.org/10.1029/2019WR025502>

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