

Asset-Level Hazards Vulnerability Assessment for The Town of Duck, NC

Project Narrative:

- A. The project meets both the Management Goals and Planning Objectives for Natural Hazards and Storm Recovery Projects. The Vulnerability Assessment will identify specific coastal features that provide protection to individual Town assets (buildings, roads, etc). In addition, this Vulnerability Assessment will provide detailed, individual hazards data for all public Town assets and select private assets. These data will be utilized to meet multiple planning objectives including the targeted protection of critical natural features, proactive mitigation planning, and identifying adaptation options for individual buildings and roads.

- B. Project Description: This project will support a partnership between the Town of Duck (Sponsor) and the Program for the Study of Developed Shorelines (PSDS) at Western Carolina University (subcontractor). Through a contract with the Department of Interior, PSDS has developed a comprehensive approach to assessing the vulnerability to coastal hazards and sea level rise of structures and transportation systems. The development of the Vulnerability Assessment Protocol was completed in 2015 (National Park Service, 2016) and the WCU team has completed full vulnerability assessments in seventeen national parks over the last three years. This work has included all North Carolina parks (e.g. Cape Hatteras N.S, Cape Lookout N.S. in North Carolina).

Assessing the vulnerability of a specific building, section of highway, or bridge involves more than just looking at a flood map or mapping potential storm surge. A multi-agency, federal task force proposed that a vulnerability assessment includes assessing three components: exposure, sensitivity, and adaptive capacity (Glick et al, 2011). Exposure is determining whether an asset is located in an area that is likely to experience a particular hazard (a flood zone, for example). Sensitivity measures how the asset will perform when exposed to that hazard (for example, an elevated building has a lower sensitivity to flooding). Adaptive capacity is a measure of how easily the exposure or sensitivity can be mitigated (e.g. it would be easier to move a small home than a large hotel). A complete vulnerability assessment must consider all three components.

The WCU PSDS approach is unique in that it is an asset-level assessment rather than a simple exposure map. There are many online tools available to communities to examine the potential exposure to a particular hazard. NOAA has a flood exposure mapper that allows a municipality to estimate which portions of a community may be exposed to flooding. However, planners and managers need detailed, science-based information about individual assets to answer simple questions like: This fire station keeps flooding, what can we do to reduce the likelihood of that happening in the future? What percentage of our public infrastructure is at risk to a Category three hurricane, and which of those assets are critical?

We propose to conduct a full Vulnerability Assessment of all public assets and select private assets for the Town of Duck. The approach begins with an inventory of all buildings, roads, bridges, etc to be assessed. The location of all assets is mapped and imported into Geographic Information System (GIS) format. Ground elevation and threshold elevation (elevation of the first, finished floor) data are typically not available for most assets and must be collected in the field. Exposure analysis is then conducted by gathering high-quality, digital data that is also imported into the GIS database. Hazards assessed include storm surge, coastal erosion, non-storm surge flooding, sea level rise inundation, among others. Historical data from previous hazard events are also gathered to supplement and confirm the predictive flood and surge maps. Each asset (e.g. building, road segment) is then given a cumulative exposure score based on this analysis.

Sensitivity analysis is then conducted on all exposed assets. Assets with no exposure do not warrant a sensitivity analysis. Sensitivity is location independent. Each asset is evaluated and scored for how it would fare when exposed to individual hazards. Buildings, roads, and bridges all require somewhat different criteria for determining sensitivity. Existing, digital data are not typically available for the sensitivity analysis. A set of sensitivity indicators have been developed for each asset type and they are evaluated through direct field inspection. For buildings and roads, these include factors like elevation, condition, structural integrity, and protective engineering. Bridges are evaluated for factors like clearance, scour rating, and age. Assets are given a cumulative score for sensitivity. The scores for exposure and sensitivity are combined to produce an overall vulnerability score for each building, road segment, and bridge. These data are all presented in GIS form and as large Excel spreadsheets where individual hazard and sensitivity indicators may be examined individually or in total.

The final step in the vulnerability assessment is the analysis of adaptive capacity and development of a menu of adaptive options for all vulnerable assets. This step is critical because it provides a suite of non-judgmental, science-based options to reduce vulnerability of an asset by either reducing the exposure (e.g. relocation) or reducing the sensitivity (e.g. elevating or engineered protection in place).

- C. Project Objectives: To protect and manage North Carolina's critical coastal economy, municipal leaders need easily accessible, high-quality, science-based information regarding the vulnerability of their public infrastructure. These data should drive decision-making on everything from the expenditure of public funds for maintenance and repair of buildings and roads, to plans for rebuilding post-storm. They can also be used to identify the most efficient and effective way to spend public funds on coastal protection projects (e.g. beach nourishment). This project has the following objectives:
 - a. Identify coastal features to target for protection due to their hazard mitigation properties.
 - b. Provide detailed site and asset specific information regarding infrastructure vulnerability for integration into all planning processes.

- c. Formulate detailed adaptation options for structures and transportation corridors that are identified as being vulnerable.
- D. Project Products:
 - a. Full Vulnerability Assessment with asset-level data provided in spreadsheet format and in a GIS database.
 - b. Final, Summary Report.
 - c. List of adaptation options for critical, vulnerable assets developed from the data in the Vulnerability Assessment.
- E. Pre-Project Tasks: Selection of all assets (structures and roads) to be evaluated as a part of the project.
- F. Local Government Approval (see attached)
- G. Not Applicable
- H. Certified Land Use Plan
- I. Date of Land Use Plan Implementation Status Report
- J. This Project meets priorities identified in the Town of Duck's LUP.
- K. Other Ordinances the project will benefit:
- L. Date Passed?
- M. The match in this project will be provided by a donation of Professional services by Robert S. Young, Licensed Professional Geologist in the State of North Carolina. Dr. Young will oversee the personnel conducting the Vulnerability Assessment and lead all direct interaction with local officials. Dr. Young will invoice the Town for his professional fees, but all fees will be forgiven.
- N. See Application Form
- O. See attached budget breakdown for project subcontract
- P. See Application Form
- Q. See Application Form