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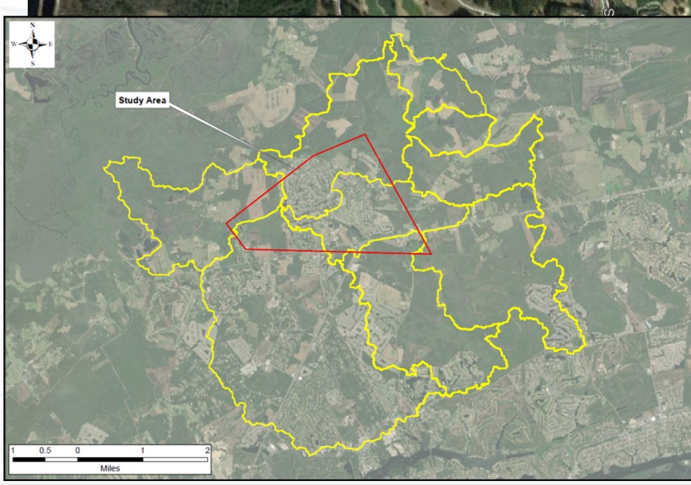
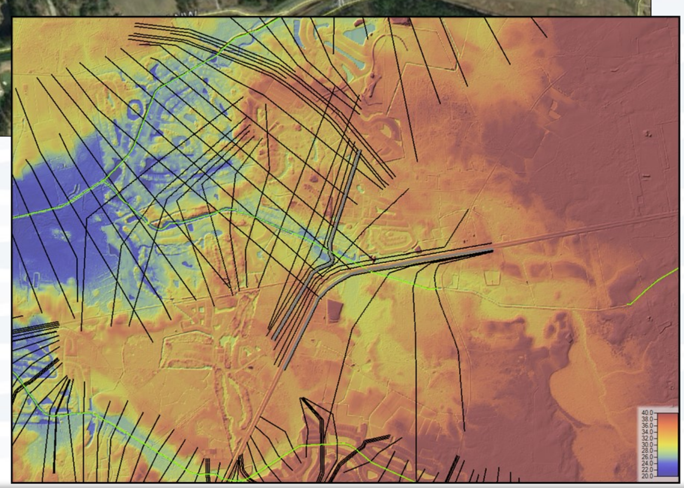
Qualifications for Cawcaw and Little Cawcaw Swamp Detailed Flood Study





Due by:

April 9, 2021 | 5:00 PM

ATM | DESIGN ENGINEERING CONSULTING

APPLIED TECHNOLOGY & MANAGEMENT, INC.

ATM | DESIGN ENGINEERING CONSULTING

April 9, 2021

John Shirk, CFM, CZO
Brunswick County Floodplain Administrator
75 Courthouse Drive, Building I
Bolivia, NC 28422

Re: Request for Qualifications (RFQ) for Cawcaw and Little Cawcaw Swamp Detailed Flood Study

Dear Mr. Shirk:

Applied Technology & Management, Inc. (ATM), is pleased to submit qualifications to provide professional engineering and Federal Emergency Management Agency (FEMA)-focused services. We have maintained a presence in the Carolinas for more than 35 years, are licensed in the state of North Carolina, and have provided services on approximately 50 projects in North Carolina with a focus on coastal and waterfront communities. Key staff have been involved in coastal and flood risk projects in Brunswick County (Towns of Holden Beach, Ocean Isle Beach, and Oak Island; Village of Bald Head Island, and unincorporated communities, including Supply and Calabash), New Hanover County (Mason Inlet and Wrightsville Beach), and Onslow County (North Topsail Beach and Jacksonville).

Key aspects that differentiate us from the competition include:

- ATM's assigned project manager, Fran Way, PE, is licensed in North Carolina and has managed more than 50 FEMA-related flood risk assessments, including a successful appeal for the Town of Wrightsville Beach, NC and appeal support services to the City of Jacksonville, NC. He assisted Brunswick County in the development of a FEMA V/LiMWA zone dock construction form.
- ATM's assigned technical advisor, Jeffrey King, PhD, PE, is a former in-house consultant to FEMA's National Flood Insurance Program (NFIP). Dr. King provided regulatory and program guidance to community officials, consultants, and property owners with pending or future issues before the FEMA NFIP. He was involved in more than 1,000 requests to change flood hazard boundaries based on existing or proposed flood control projects, levee and bridge construction, and fill placement.
- ATM's task manager for hydrologic and hydraulic analyses, Robert Burleson, PE, has more than 35 years' experience in water resources engineering, surface and groundwater hydrology, watershed planning, hydrologic research and analysis, floodplain analysis, and watershed and water quality modeling. He applies various hydrologic, hydrodynamic, and water quality models including SWMM, ICPR, PONDS, HEC-HMS, HEC-RAS, MODFLOW, BASINS/HSPF, WASP, PLUMES, CORMIX. DHI-MIKE ECO Lab, ArcGIS, and Groundwater Vistas.

We appreciate the opportunity to submit our credentials to provide engineering services under this solicitation. Fran Way, PE, ATM's project manager for this solicitation, is your point of contact and can be reached at 843.414.1050 or fway@appliedtm.com.

Sincerely,

Steven J. Peene, PhD
Principal

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Tab 1
Company Information

1. Company Information

Prime Consultant

Applied Technology & Management (ATM)
941 Houston Northcutt Blvd., Suite 201
Mount Pleasant, SC 29464
843.414.1040

Company Overview

Founded in 1984, ATM has been a leading provider of water resources, coastal and waterfront engineering services throughout the southeastern U.S. and internationally for more than 37 years. ATM has full-service offices in Mount Pleasant, SC, and Gainesville (corporate headquarters), St. Augustine, and West Palm Beach, FL. ATM also maintains one international office in Dubai, United Arab Emirates (UAE).

Our 36 domestic employees include 15 licensed professional engineers, four PhD-level scientists, a licensed professional geologist (PG), a licensed professional surveyor and mapper (PSM), a certified land planner (AICP), and two engineering interns (EIs). More than half (23) of our employees have advanced degrees in an engineering or science discipline. ATM’s workforce is notably stable, with an average company staff tenure of more than 12 years. This stability is further mirrored in our five managing principals, who together have more than 110 years of collective experience working for ATM.

ATM’s overall mission is to maximize our cross-discipline knowledge on water-related engineering projects to benefit coastal communities. Our technical diversity allows us to provide effective studies and solutions for any water-related issue. From projects involving sensitive headwaters to coastal systems, we provide customized data collection, assessments, computer modeling, alternatives analysis, management planning, design, and regulatory guidance. ATM's technical professionals have the expertise to economically deliver the range of services needed to resolve complex engineering and environmental challenges for projects in all environments.

ATM has maintained a presence in South Carolina for more than 35 years and has provided services on more than 700 projects in South Carolina and North Carolina that focus on coastal and waterfront communities. ATM is a licensed engineering company in North Carolina.

Water Resources Experience

A large part of our business is assisting clients with water resources issues. We specialize in performing watershed, hydraulic/hydrologic and coastal floodplain assessments and modeling in support of floodplain mapping, Federal Emergency Management Agency (FEMA) letters of map revisions (LOMRs), FEMA map appeals, and other FEMA studies (e.g., National Flood Insurance Program [NFIP] updates, technical bulletins, and coastal construction manual) as well as expert witness testimony. Additionally, we have significant expertise in the areas of storm surge and sea level rise modeling and assessments to support project development, future risk planning and regulatory compliance. We integrate geographic information system (GIS) in all projects, including field studies, data collection, asset management, geospatial analysis, watershed, hydrologic and water quality model pre- and post-processing.

1. Company Information

Coastal Experience

Coastal flood hazard risk assessment is one of our specialties. ATM has 11 coastal engineers, and four of ATM's managing principals have advanced degrees in coastal engineering (two have PhDs in coastal engineering). We design progressive and traditional coastal flood mitigation infrastructure, depending on what is best for the subject site and the client. Traditional mitigation structures are hard coastal structures such as seawalls, groins, breakwaters and revetments. Progressive structures are soft coastal structures such as beach nourishment, dune revitalization and living shorelines. We use our expertise with hard and soft coastal structures to enhance our mitigation design and analysis of flood hazard risk in coastal floodplains and special flood hazard areas.

Flood Risk Identification and Reduction

Through our water resources and coastal teams, we provide specialized engineering services focused on flood hazard identification and mapping. The water resources team conducts watershed assessments and surface water master planning to identify flooding hot spots and opportunities for mitigation or reduction through best management practices while concurrently seeking to improve water quality.

Our coastal engineers, who are fluent with FEMA's flood zone mapping and remapping efforts, routinely review flood hazard maps for accurate representation of flood zones at a local level, which can lead to the filing of Flood Insurance Rate Map (FIRM) appeals or LOMRs. Further, since FEMA's flood zone maps do not take into account sea level rise, our engineers perform detailed numerical modeling analyses of storm surge, waves, and coastal inundation to quantify and map areas of vulnerability (riverine, estuarine and coastal locations). Our coastal team provides structural and non-structural solutions to reduce flood hazards and coastal erosion.

ATM has a thorough understanding of the FEMA NFIP. Utilizing the LOMR process, we have revised and amended NFIP Special Flood Hazard Areas (SFHAs) throughout coastal South Carolina, North Carolina, and the southeastern U.S. *For example, ATM successfully appealed a FEMA preliminary map for Harbor Island in Wrightsville Beach, NC. Upon deducing several potential appeal items, ATM worked with the Town and the North Carolina Flood Mapping Program to develop a FEMA flood model that was more representative of existing conditions. ATM collected survey data and developed all necessary models, maps, and reports to update the FEMA maps.*

Please see Section 7.C for detailed relevant company and project experience.

1. Company Information

Subconsultant

Coastal Geomatics, PLLC
5041-3 Main Street
Shallotte, NC 28470
910.356.1800

Recently formed in January 2021 by Chris Stanley, PLS, who has been providing surveying services in Brunswick County since 1991, Coastal Geomatics is a full-service surveying company with ten employees. Most of the firm's employees are not only residents, but are natives to the area and offer a true devotion toward high quality performance in service for their community.

With over 60 years of combined experience in the surveying industry, the Coastal Geomatics team has performed more than 600 miles of route surveys, permitting, and project management within Brunswick County. Routine services include boundary, topographical, and wetland surveys for residential, commercial, and municipal projects; performing as-built surveys, site construction staking, annexation surveys, legal descriptions, title research, easement descriptions, beach monitoring and hydrographic surveys of beaches and shorelines. Coastal Geomatics is very familiar with North Carolina Division of Coastal Management permitting regulations and has performed numerous Coastal Area Management Act (CAMA) surveys.

For this solicitation, Coastal Geomatics will assist ATM with field survey and data reconnaissance. ATM and Coastal Geomatics have an established working relationship through their services to the Town of Holden Beach, NC.

Tab 2
Project Approach

2. Project Approach

In this section, we describe our management approach, including our ability to meet schedules, and deliver services within budget, as well as our capacity to perform and manage the work that is described in detail in Section 3.

Management Approach - Managing Budget and Schedule

ATM has been providing focused support to communities for more than 37 years. We understand how local governments operate and the time and budget requirements of their projects. *Our willingness to meet the needs of our clients is best exemplified by the long-term relationships we have maintained with multiple communities in North Carolina, including the Towns of Holden Beach, North Topsail Beach, and Wrightsville Beach.* Our principals and project managers are experienced and motivated to exceed the expectations of our local government clients.

Effective project management encompasses schedule control, budget control and quality assurance/quality control (QA/QC). These three factors are keys to the success of any project. ATM's general project management strategy is geared toward each segment of a project being organized, directed and controlled by an experienced task manager to ensure its efficient completion within budget, on schedule and in a cost-effective manner. The project manager's primary function and responsibility, working with the assigned task manager, is to lead the team, control scheduled activities, ensure the quality of the project deliverables, monitor and assure the commitment of necessary resources, and ensure that the project stays on track and within budget. At initiation, the project will be subdivided into measurable and manageable project tasks with milestones that allow definitive assignments of budget, schedule and quality control. The delineation of tasks also allows ATM and the County to efficiently focus on managing each task as it is being accomplished.

Management Plan

We are committed to maintaining a strong and proactive relationship with the County. As a firm that has provided similar services to government clients throughout the southeast for more than three decades, we are committed to providing the County with targeted, proactive service on a timely and cost-effective basis. To deliver on this goal, ATM will implement the following strategies:

1. ATM's Water Resources Principal (Steven Peene, PhD) is personally committed to exceeding the expectations of the County and will remain engaged throughout the life cycle of this contract.

2. Senior staff with direct technical expertise will oversee project tasks and will be fully available to meet on an as-needed basis to discuss issues and provide project support.

3. Senior staff will provide targeted and focused recommendations, including proposed tasks, and will remain actively engaged in the execution of project efforts.

4. ATM will strive to provide services in the most cost-effective manner possible, including collaboration with other County consultants and existing resources.

5. ATM will dedicate appropriate and sufficient resources to complete tasks in a timely and cost-effective manner.

6. ATM will regularly and proactively communicate with County staff.

7. ATM will strive to meet the fundamental needs of County staff, administration and residents in all its efforts.

8. All tasks will be clearly defined in terms of hourly effort, rate, and expense. ATM will strive to utilize the most efficient employee rate to complete project tasks and will not utilize senior staff to complete tasks in lieu of lower rate staff.

9. ATM will strictly adhere to the terms and budget of each approved task order. ATM will not request additional budget for any task unless a specific and justifiable change in condition is evident. In such a case, ATM will specifically request a change order in writing prior to initiation of any additional effort beyond the approved task order.

The organizational chart in Section 5 reflects the ATM team structure for this solicitation. The framework of the team centers on the principal-in-charge (PIC), project manager (PM), and task managers (TMs). Fran Way, PE, *licensed in North Carolina,* as the PM will:

1. Facilitate all scope development, cost proposal preparation, negotiation, and task order execution with the TMs
2. Serve as primary point of contact for the County
3. Review and provide QA/QC for all task order deliverables with the designated technical advisor, Jeffrey King, PhD, PE, *a former in-house consultant with the Federal Emergency Management Agency's National Flood Insurance Program*
4. Ensure all task order schedules are met
5. Address and facilitate solutions for any issues that arise during the execution of task orders
6. Facilitate coordination and communication among all team members

Working closely with Mr. Way, each TM will:
1. Coordinate scope development, cost proposal preparation, negotiation, and task order execution
2. Oversee tasks
3. Provide the first review and QA/QC of deliverables
4. Provide coordination and communication between internal and external team personnel

ATM will implement the following practices to maintain excellence throughout all project tasks:
- Continual communication between the PIC, PM and TMs regarding the project scope, interim and final deliverables, and budgets and schedule requirements
- Timely corrective action, such as redirection of work effort or reassigning staff if costs begin to exceed progress on specific elements of work
- Regular external communication to keep the County informed of project progress, successes, problems, and work solutions to ensure satisfaction with project deliverable fulfillments and scope achievements
- Staffing of task assignments based on the best match of experience and task assignment requirements

2. Project Approach

Managing the Project

Upon receipt of an executed task order, Dr. Peene (PIC) and Fran Way, PE (PM) will conduct a kick-off meeting with the County to review project scope, budget, schedule, and other elements of the task plan (discussed below); file transfer information; and establish administrative procedures including lines of communication, schedules, contacts and priority issues. ATM's emphasis on – and success in – meeting project schedules and controlling costs is attributed in part to the strength and flexibility of our standard project management procedures.

The following describes ATM's standard procedures associated with schedule and budget control.

- Task Plan. In conjunction with development of the draft scope and budget, a draft task plan will be prepared that outlines fundamental information that is critical to properly fulfilling the executed task order. This document utilizes the scope of work as a base and identifies project personnel, project schedule, project vision/critical success factors (developed in conjunction with the County PM and staff), document control, quality assurance personnel and plan, communications plan and methods/schedule for reporting progress to the County.
- Schedule Control. ATM maintains established schedules throughout the project. We conduct regular meetings with the client and project team members to review the status of the scope of work, deadlines and budgets. Additionally, we regularly prepare project status reports that Mr. Way reviews and compares to the task plan. The schedule of meetings and the schedule for project status reports is outlined within the approved task plan.
- Cost Control. ATM uses BST Enterprise Project Management Software (BST), a web-based, management-information system specifically designed for professional service organizations. BST provides real-time information on various components of project management that are critical to successfully keeping a project on schedule and within budget. Some of the components measured and monitored by BST include billings per employee, task and project remaining and total budgets, project expense charges and percent complete. BST is a very effective tool that allows ATM to keep abreast of all project charges and completion levels. Detailed analysis of the project management reports provides a means to bring projects with overrun potential back on track. Use of this software on a daily or weekly basis allows Mr. Way and the TMs to proactively avoid project overruns and keep the project on schedule.

Assuring the Quality of the Project

QA/QC is an important part of ATM's project planning and execution. Our QA/QC process helps to ensure that all project deliverables are reviewed by ATM team members with the appropriate technical knowledge and experience. QA begins at the concept phase and is a part of all phases through project completion. Our QA/QC process draws on years of experience by identifying critical QC points and issues to be reviewed, using tracking mechanisms within BST, and identifying responsibilities for experienced reviewers independent of the project team. Internal QC points or milestones within the task order will be established during the project planning stage and will be outlined within the task plan. This, in turn, will be communicated to the project team at the kickoff meeting. The QA/QC schedule is part of the task plan. This independent oversight helps to ensure consistent quality on all task orders issued under this solicitation.

Ensuring Subconsultant Quality and Schedule Compliance

Advanced technology enables ATM to provide services efficiently, effectively, and in a seamless manner. Daily use and monitoring of electronic communications via computers, tablets, smart phones, and cell phones ensures responsiveness by all team members. Digital file sharing occurs via file transfer protocol (FTP) and cloud-based storage systems such as Dropbox, which allow file access anywhere there is an Internet connection. ATM utilizes state-of-the-art technology to facilitate communication and transfer information between our offices and clients. We can quickly and efficiently set up virtual conferences, transmit documents and renderings, and reduce costs by working remotely wherever possible during the course of a project. Our employees utilize every available system to communicate effectively and economically around the world, regardless of location. For this solicitation, ATM will establish and maintain a cloud-based site to facilitate interactive information sharing for uploading and downloading of electronic files.

ATM will ensure smooth interfacing with our surveying subconsultant, Coastal Geomatics, through careful planning, clear communication of requirements, timely monitoring of deliverables, and regular reviews of financial and performance data. ATM follows a proven, straightforward philosophy for subconsultant management:

- Determine project objectives together
- Encourage value engineering suggestions
- Review progress regularly
- Schedule work to meet objectives
- Implement corrective actions as required
- Verify documentation

Since ATM's key personnel have prior working relationships with the key personnel of Coastal Geomatics, we anticipate smooth coordination and communication.

2. Project Approach

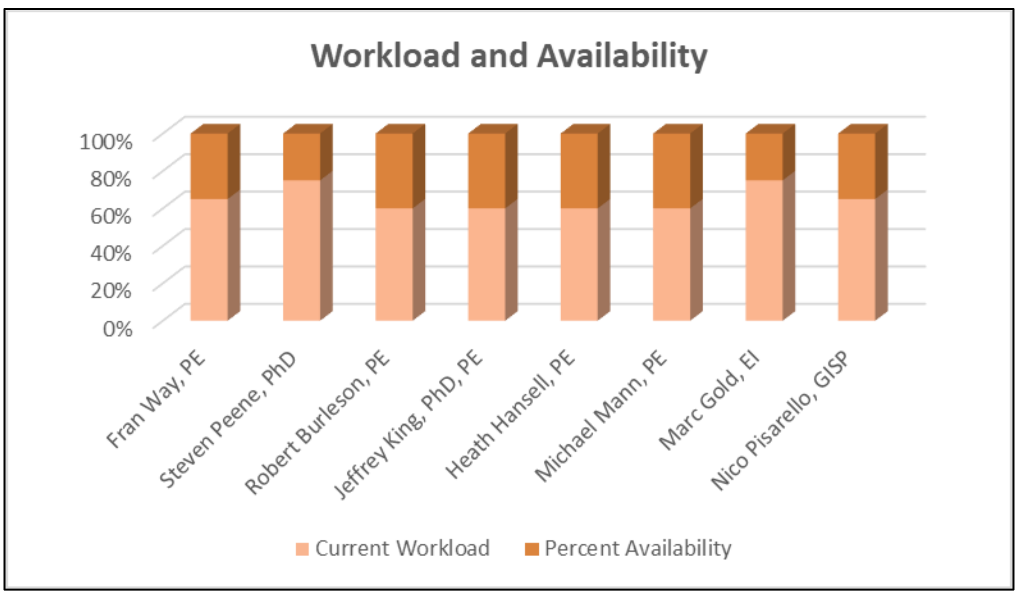
Capacity

In the midst of the COVID-19 global pandemic, ATM's short- to medium-term projects have remained largely unchanged, and our staff continues to advance these efforts under current social distancing and stay-at-home guidelines, with an increased reliance on remote work and coordination. ATM's offices remain open throughout the crisis. Primary reductions in workload are associated with international projects, particularly private/resort projects, and the cruise industry. These efforts in total represent a minor fraction of ATM's overall workload. Their loss has not resulted in loss of staff, resources, or capabilities.

ATM has a successful record of accomplishment in executing multiple concurrent projects and contracts. This record reflects the capacity and ability of our staff to multitask while providing high-quality deliverables within established budgets and timeframes. Our repeat business rate of 75% is a testament to our capabilities, commitment, and dedication to client satisfaction.

For this solicitation, our sole subconsultant, Coastal Geomatics, has committed to ATM to have the resources available and ability to meet assigned deadlines and budgets. From our experience working with this team member, we fully expect this commitment will be met. If Coastal Geomatics cannot meet a project deadline, or if there is a loss of key personnel, ATM will utilize both internal and external resources as necessary to meet the overall project deadlines.

ATM maintains a backlog projection report that is updated monthly. This report identifies available and scheduled contracted work as well as projections of potential work to be contracted. Based on the current backlog report, ATM has sufficient and increasing availability to provide the County with necessary resources to fully support any anticipated needs of the County. All project personnel are available to begin work immediately upon execution of a contract with the County. A depiction of workload and availability for key ATM personnel is below.



Tab 3
Scope of Work

3. Scope of Work

Project Understanding and Background

ATM has a thorough understanding of the Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP). We conduct detailed studies to modernize, maintain, update, revise, and amend NFIP Special Flood Hazard Areas (SFHAs) throughout North Carolina and the southeastern U.S. Additionally, ATM's technical advisor for this solicitation, Dr. Jeffrey King, PE, was a research hydrologist at the U.S. Geological Survey (USGS) for a decade and served for three years as an in-house technical evaluation advisor to the NFIP in Washington DC.

Brunswick County requests a detailed floodplain study of the Cawcaw Swamp and Little Cawcaw Swamp to support the County's floodplain management program because development continues in this area (see Figure 1). The study area is approximately 2,200 acres in size and consists of two river/stream systems (the Cawcaw and Little Cawcaw Swamps). These streams were studied using limited detailed methods for the effective FEMA Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for Brunswick County.

The proposed study location encompasses approximately 2.65 stream miles of the Cawcaw Swamp. The effective FEMA flood study for the Little Cawcaw Swamp ends at Thomosboro Road. The County requests that this reach of detailed study be extended 2,500 feet upstream of Thomosboro Road, resulting in detailed flood hazard analyses of approximately 2.55 stream miles of the Little Cawcaw Swamp.

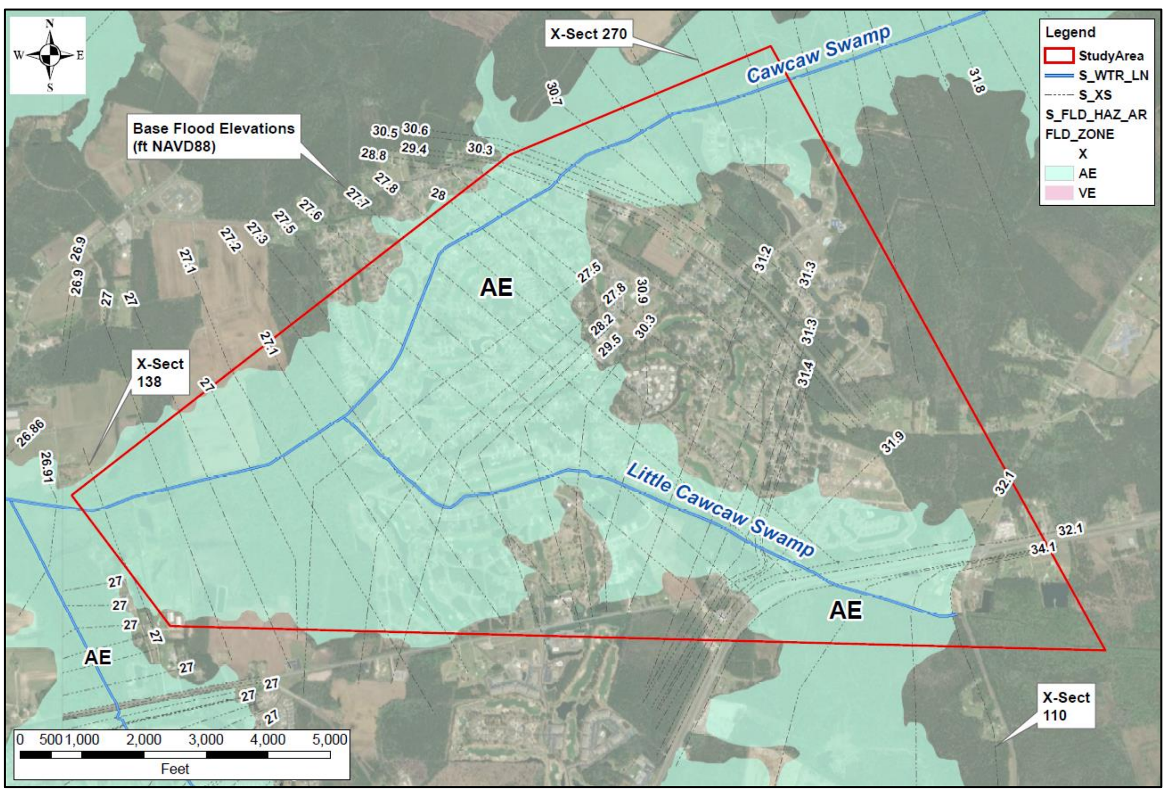


Figure 1. *Effective Digital FIRM data (FIRM 372010 2600K) dated August 28, 2018, showing SFHA Zone AE (blue polygon), model cross-sections, BFEs, and study area (outlined in red) in Brunswick County, North Carolina.*

While the effective FIS for Brunswick County is from 2018, the analysis and model for the study area is about 20 years old and utilized limited detailed methods at the time. Significant land

3. Scope of Work

development has occurred since and is expected to increase, necessitating an updated, detailed flood study for the County to accurately determine floodway boundaries, base flood elevations (BFEs), and SHFA extents.

ATM is very familiar with FEMA's Effective Limited Detailed Flood Hazard Study for these two reaches that was used to map the current effective AE zone and effective BFEs. Our proposed scope of work is described in the following subsections. ATM will use its flood mapping experience and local knowledge of the study area to aid the County in detailing the existing floodplain.

Our scope of work provides details regarding specific methodologies, approaches, tasks, and the proposed schedule. ATM will use FEMA NFIP guidelines and standards for flood risk analysis and mapping activities. We indicate any work or resources that are to be subcontracted and work or resources assumed to be provided by Brunswick County.

Scope of Work

ATM recommends conducting the detailed floodplain study through five primary tasks:

1. Baseline Model and GIS Data Collection
2. Field Survey and Reconnaissance
3. Detailed Hydrologic and Hydraulic (H&H) Analyses
4. Final Mapping, Supporting Data, and Report Development
5. Meetings and Coordination

ATM will produce maps and a report with supporting data – model files, GIS shapefiles, other documentation—to be retained by Brunswick County or used by the County in support of a Physical Map Revision (PMR) to change BFEs, SFHAs, and the regulatory floodway. Scope and details of each task are provided below.

Task 1. Baseline Model and GIS Data Collection

ATM will obtain and review the following resource data.

- Existing study area information and topographic data
  - Available site surveys
  - Publicly available light detection and ranging (LiDAR) data
  - Other available topographic information
  - Previous H&H studies and/or H&H data relevant to the study area
  - Readily available, relevant drainage and flood control structure information
- Effective FEMA information
  - Technical data, model files, and documentation in support of the 2018 Effective FEMA FIS for Brunswick County and, specifically, the Limited Detailed Flood Hazard Studies for the Cawcaw and Little Cawcaw Swamps.

ATM has previous experience with the Limited Detailed Flood Hazard Study for this area, and we will build upon our compiled digital library of previously obtained publicly available data (GIS and model files) and in-house surveys (Figure 2).

3. Scope of Work

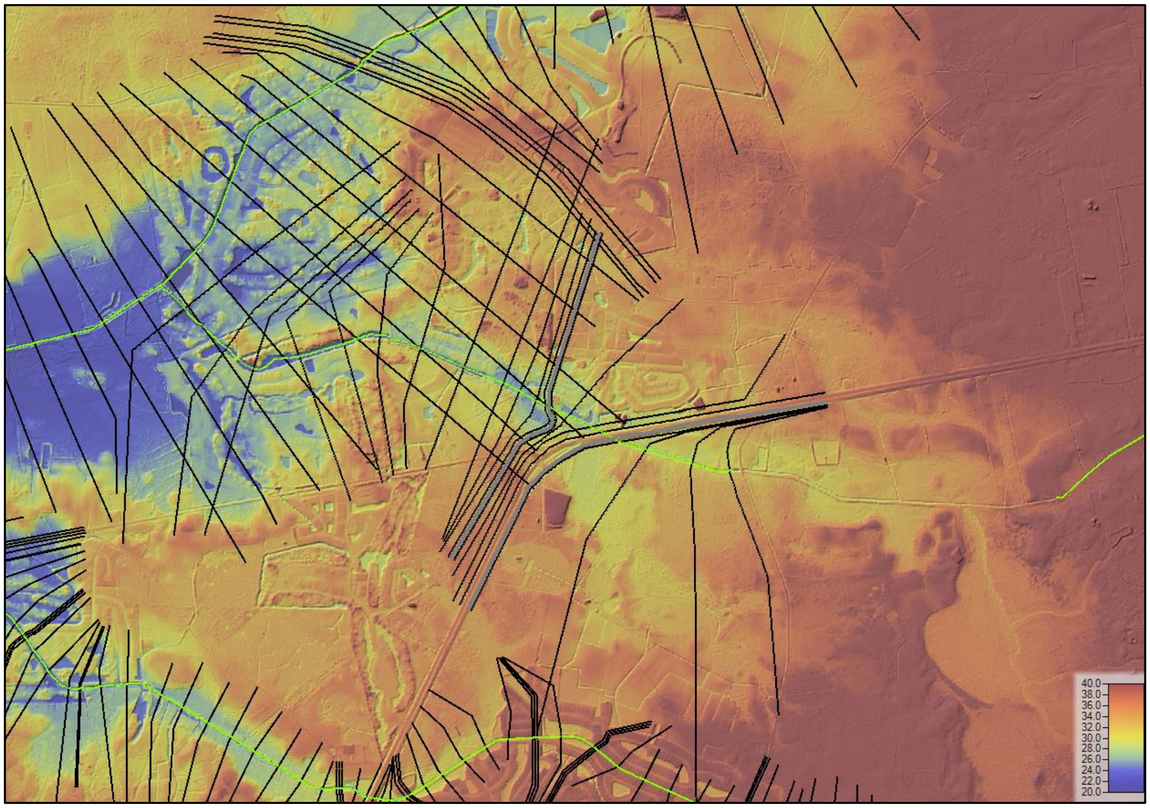


Figure 2. *FEMA Effective HEC-RAS model overlain on ATM's current Digital Terrain Model for portions of the study area streams.*

Task 1 Deliverable

We will prepare a summary memorandum that describes information obtained in support of a more detailed flood hazard risk assessment.

Task 1 Schedule

Task 1 will begin immediately upon project initiation and is estimated to take 4 to 6 weeks for completion.

Task 2. Field Survey and Reconnaissance

ATM will subcontract with Coastal Geomatics for field survey services. To fully capture study reaches for detailed analyses, stream profile (cross-section) surveys of the Cawcaw and Little Cawcaw Swamps are proposed to be conducted for the study area extents at a minimum cross-section spacing of 100 feet. The effort will fully capture detailed bathymetry and slope changes of the stream channels and embankments and describe all hydraulic control structures in the creeks.

Other flow control measures located outside of the study streams (e.g., swales, ponds and other water features, structural openings) that convey the base flood will be surveyed on a case-by-case basis (as recommended by ATM and confirmed by Brunswick County).

Coastal Geomatics conducted preliminary reconnaissance of the study site streams and determined a boat will be required for several sections of the project reaches. A 3- or 4-man survey team is proposed to be used with the boat. One of two men in the boat will collect the water shots with one man on each side of the bank. There are quite a few cross-section profiles that will be much wider than the typical creek width due to the swamp/stream expanding into ponds. Some of these cross-section profile lines may be 300 to 400 feet wide to capture the entire water body. The streams also run through undeveloped areas that are substantially wooded and may need to have traditional survey lines run in with elevation. Coastal Geomatics proposes to the following items:

1. Establish all profile lines in NC Grid so they can be stationed, staked and marked in the field for visibility from the ground.
2. Use GPS to set control points at every 100- to 200-foot stations. These can be used for the cross-section profiles and can accommodate less than 100-foot spacing, if needed. Setting control this close will help the survey crew if they have to use traditional equipment in place of GPS (such as in wooded areas with large canopies).
3. Use GPS in the open areas on the banks and the boat in the water.
4. Run control with traditional equipment in the wooded sections.
5. Use a bush-hog, if necessary, to cut the canal banks in some areas.

Task 2 Deliverable

Data will be provided to the County in its preferred format and for ATM's immediate use for model input at Task 3.

Task 2 Schedule

Task 2 will begin immediately upon project initiation and is estimated to take 14 to 16 weeks to complete.

Task 3. Detailed H&H Analyses

As described by FEMA, "a limited detailed study is a 'buildable' product that can be upgraded to a fully detailed study at a later date by verifying stream channel characteristics, bridge and culvert opening geometry, and by analyzing multiple recurrence intervals." ATM will build upon the effective, limited detailed study to create a detailed flood hazard risk assessment in the Cawcaw Swamp and the Little Cawcaw Swamp. ATM will analyze watershed hydrology, river hydraulics, and delineate flood hazard areas and a regulatory floodway.

ATM will update hydrological analyses following FEMA guidelines and standards to determine accurate discharges for Hydrologic Engineering Centers River Analysis System (HEC-RAS) input, which will be used in hydraulic analyses of the study area for BFEs, SFHAs, and other flood hazard information.

Hydrology

Hydrologic analyses in the effective, limited detailed study of the Little Cawcaw Swamp were based on a 1999 rural, regional regression equation for North Carolina. In 2002, Dr. King, ATM's technical advisor on this project, described rural and urban regional regression studies for North Carolina in USGS Fact Sheet FS–007–00 (https://pubs.usgs.gov/fs/fs-007-00/).

Dr. King referenced Robbins and Pope's (1996) USGS study of urban streams in North Carolina (https://pubs.er.usgs.gov/publication/wri964084), and Pope, Tasker and Robbin's (2001) USGS study of rural streams in North Carolina (https://pubs.er.usgs.gov/publication/wri014207). Pope,

3. Scope of Work

Tasker and Robbin's (2001) USGS study of rural streams in North Carolina superseded the 1999 equation used in the effective, limited detailed study of the Little Cawcaw Swamp. Feaster, Gotvald, and Weaver's (2011) USGS study subsequently updated estimation tools for flood magnitude and frequency for urban and small, rural streams in Georgia, South Carolina, and North Carolina (https://pubs.usgs.gov/fs/2014/3015/).

ATM will use regression equations in Feaster, Gotvald, and Weaver (2011) to estimate discharge for floods with 10-percent, 2-percent, 1-percent, and 0.2-percent changes of being exceeded in any given year (Table 1). We will use a published basin delineation (Figure 3) to calculate drainage area, the 2006 National Land Cover Dataset to calculate percent impervious area, and precipitation information in Feaster, Gotvald, and Weaver (2011) to determine 24-hour duration, 50-year maximum precipitation.

Table 1. Regional regression equations from Feaster, Gotvald, and Weaver (2011) for the Carolina coastal plain, where DRANAREA is drainage area in square miles, IMPNLCD06 is the percent impervious area from the 2006 National Land Cover Dataset, in percent, and I24H50Y is the 24-hour duration, 50-year maximum precipitation, in inches.

Percent annual exceedance probability	$0.10\ mi^2 \leq DRNAREA \leq 53.5\ mi^2$
50	$26.3(DRNAREA)^{0.5908} 10^{(0.0173*IMPNLCD06)} 10^{(0.0515*I24H50Y)}$
20	$40.6(DRNAREA)^{0.5958} 10^{(0.0125*IMPNLCD06)} 10^{(0.0623*I24H50Y)}$
10	$51.8(DRNAREA)^{0.6004} 10^{(0.0101*IMPNLCD06)} 10^{(0.0666*I24H50Y)}$
4	$67.1(DRNAREA)^{0.6067} 10^{(0.0075*IMPNLCD06)} 10^{(0.0708*I24H50Y)}$
2	$78.4(DRNAREA)^{0.6111} 10^{(0.0058*IMPNLCD06)} 10^{(0.0738*I24H50Y)}$
1	$90.5(DRNAREA)^{0.6154} 10^{(0.0043*IMPNLCD06)} 10^{(0.0762*I24H50Y)}$
0.5	$103(DRNAREA)^{0.6201} 10^{(0.0029*IMPNLCD06)} 10^{(0.0785*I24H50Y)}$
0.2	$119(DRNAREA)^{0.6261} 10^{(0.0012*IMPNLCD06)} 10^{(0.0813*I24H50Y)}$

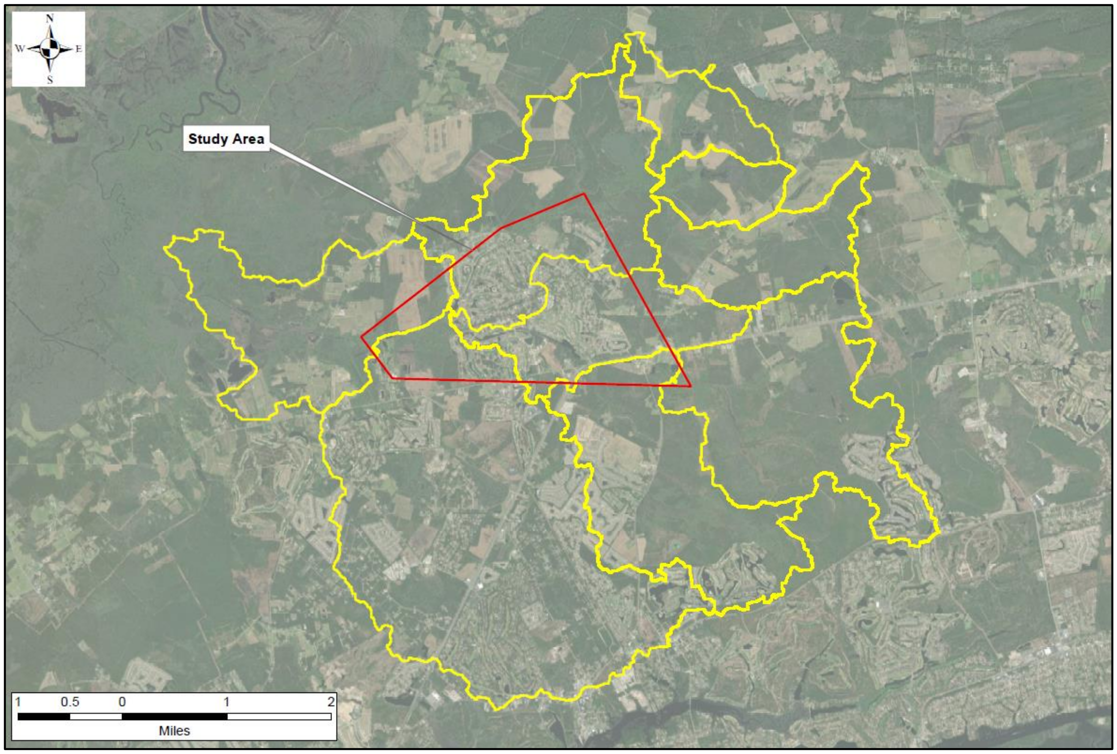


Figure 3. *Cawcaw and Little Cawcaw Swamp Subbasins used in hydrological analyses for Effective FEMA FIS.*

Hydraulic Analyses for BFEs, SFHAs, and Other Flood Hazard Information

ATM will use the existing, effective HEC-RAS models and effective FIS inputs for Cawcaw Swamp and Little Cawcaw Swamp to the extent practical and where effective model parameters are accurate and representative of conditions along these reaches. ATM will revise the effective HEC-RAS models where corrections are necessary, where more detail is necessary, and to incorporate changes to study reaches that have occurred since the effective model was created.

Using surveyed cross-sections (from Task 2) and available topography (from Task 1), ATM will create a seamless digital elevation model that covers the project area to correct or update HEC-RAS model input. The updated models for Cawcaw Swamp and Little Cawcaw Swamp will be based on detailed, contemporary cross-sections and information to describe flood control structures. Figure 4 presents an example effective model cross-section in the study area. As the effective model was a limited detailed study, only approximated, idealized cross-section geometries were used in the creek channel. The detailed study proposed herein is based on surveyed profiles with existing topography to assess existing flood hazards more accurately.

3. Scope of Work

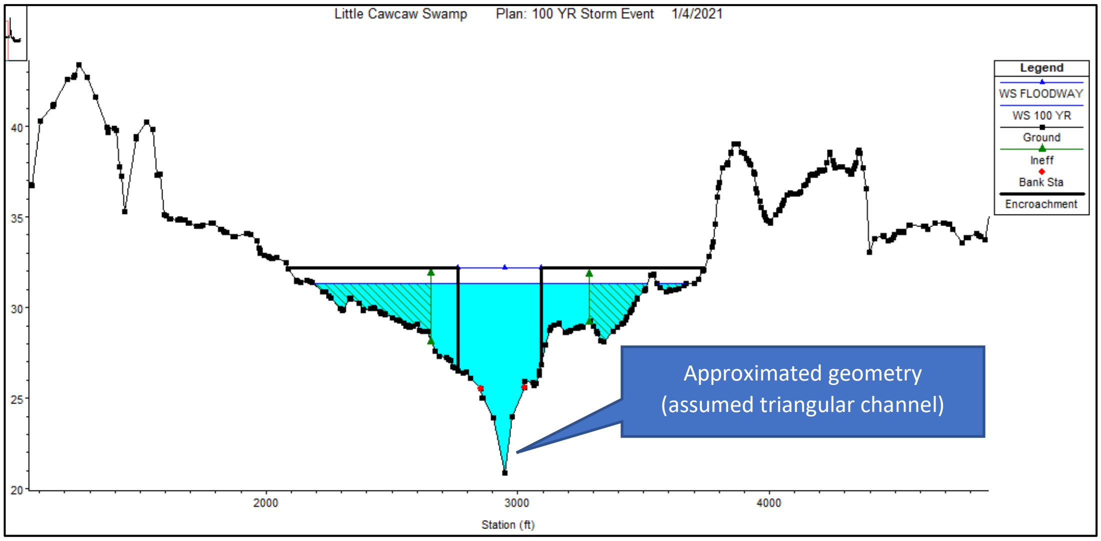


Figure 4. *Example HEC-RAS Model Cross-Section within the Effective Limited Detailed Study Model*

Using the updated, detailed HEC-RAS models, ATM will simulate water surface elevations for floods with 10-percent, 2-percent, 1-percent, and 0.2-percent chances of being exceeded in any given year in study reaches for Cawcaw Swamp and Little Cawcaw Swamp. Results will be used in determining BFEs, delineating a regulatory floodway, creating flood profiles, and mapping both the SFHA and the floodplain for the area inundated by the flood with a 0.2-percent chance of being exceeded in any given year, throughout the entire study area.

Floodway Analyses

ATM will simulate a regulatory floodway to identify parts of the channel and adjacent land areas that must be reserved to discharge the base flood without cumulatively increasing the water surface elevation more than 1 foot. The effective FIS uses 1-foot water-surface elevation during the base flood as the floodway constraint in other Brunswick County streams (Table 22, Brunswick County FIS). The NFIP requires that communities regulate development in floodways to ensure that development does not cause increases greater than 1 foot in upstream BFEs. Alternatively, if Brunswick County wishes to use a surcharge less than 1 foot, ATM will simulate a floodway based on this alternate surcharge.

Task 3 Deliverable

ATM will provide a memorandum summarizing the H&H modeling for all required return periods (10-year, 50-year, 100-year, 500-year) for the project study area.

Task 3 Schedule

Task 3 will begin as Task 2 progresses and is anticipated to take 14 to 16 weeks to complete.

Task 4. Final Mapping, Supporting Data, and Report Development

ATM will produce preliminary flood maps based upon the updated analysis for the County's review and input, specifically regarding regulatory floodway boundary delineations. We will coordinate closely with Brunswick County throughout the process.

ATM has considerable experience with FEMA NFIP map revision requirements and will assure all reporting and deliverables for this task will meet FEMA NFIP criteria to be used by the County in support of a PMR request to revise flood hazard information.

Task 4 Deliverable

ATM will prepare a report and provide all supporting data and final mapping deliverables—such as GIS shapefiles, model files, and hydrology calculations—to the County in a format suitable for use in a formal PMR request of the NFIP for the study area. The data will be summarized using textual information in the NFIP FIS report template and will include frequency discharge-drainage area curves for the Cawcaw Swamp and Little Cawcaw Swamp.

Task 4 Schedule

Task 4 will begin as Task 3 progresses and is anticipated to take 10 to 12 weeks to complete.

Task 5. Meetings and Coordination

ATM will meet and coordinate with the County and interested stakeholders throughout the study process, as described above. ATM will memorialize the coordination through written notes or email communications.

Please note that the following Items are not covered in this scope of work: environmental analysis, NFIP coordination, PMR project planning, or National Flood Hazard Layer (NFHL) processing.

Schedule

		2021								2022											
		May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	Project Month	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*
Task	**Description**																				
1	Baseline Model and GIS Data Collection																				
2	Field Survey and Reconnaissance																				
3	Detailed H&H Analyses																				
4	Final Mapping, Supporting Data, and Report Development																				
5	Meetings and Coordination																				

Tab 4
Contract Manhours

4. Contract Manhours

The following table summarizes deliverables and total estimated manhours by task as outlined in the scope of work in Section 3. Hourly rates for ATM and Coastal Geomatics professionals are also provided for reference.

		Estimated Manhours	
Task	Deliverables	ATM	Coastal Geomatics
1. Baseline Model and GIS Data Collection	Summary Memorandum	90	-
2. Field Survey and Reconnaissance	Field Survey Data	40	805
3. Detailed H&H Analyses	Summary Memorandum of H&H modeling for all required return periods for the project study area	470	-
4. Final Mapping, Supporting Data, and Report Development	Report with supporting data and final mapping deliverables in a format suitable for use in a formal PMR request of for the study area	190	-
5. Meetings and Coordination	Written notes or email communications to memorialize communications and coordination	40	-
	Total Estimated Manhours:	**830**	**805**

Note: Task 2 manhours provided for Coastal Geomatics assume 100-foot cross-section spacing, considered sufficient for this study. Estimates for different spacing criteria can be provided if desired by the County.

4. Contract Manhours

Hourly Rates

ATM

Name of Key Professional	Role on this Project	Hourly Billing Rate
Fran Way, PE	Project Manager and Task Manager for Final Mapping, Supporting Data, and Report Development	$180
Steven Peene, PhD	Principal-in-Charge	$250
Jeffrey King, PhD, PE	Technical Advisor	$185
Robert Burleson, PE	Task Manager for H&H Analyses	$185
Heath Hansell, PE	Task Manager for Baseline Model and GIS Data Collection, and Field Survey and Reconnaissance	$152
Michael Mann, PE	Professional Engineer	$127
Marc Gold, EI	Engineering Associate	$130
Nico Pisarello, GISP	Geospatial Analyst	$120

Coastal Geomatics

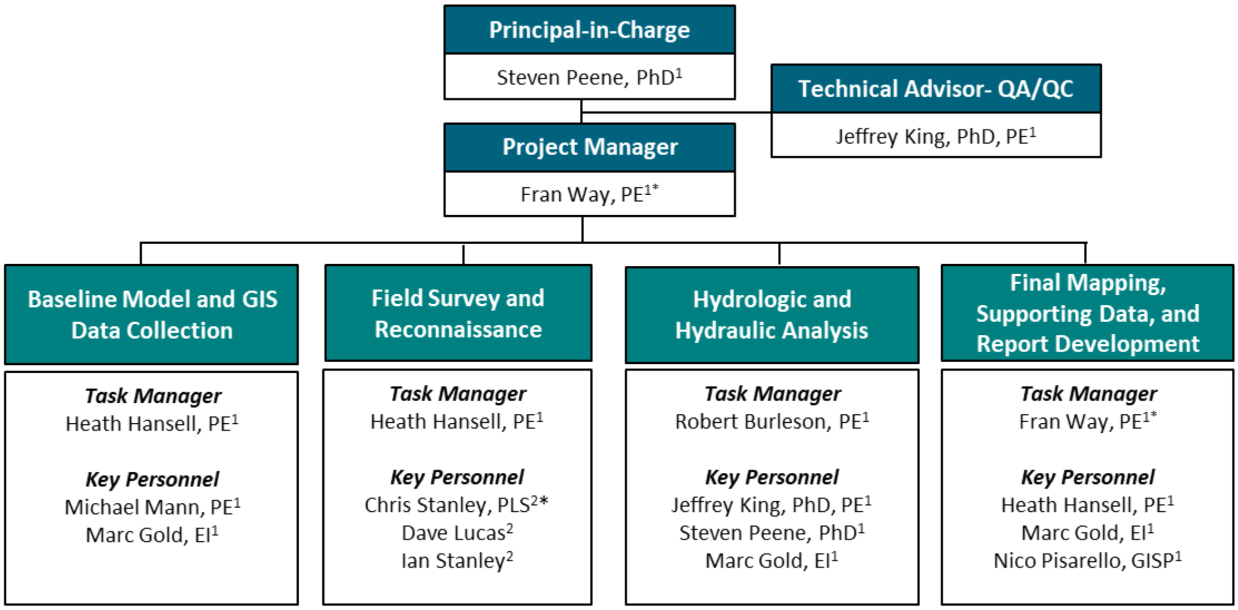
Name of Key Professional	Role on this Project	Hourly Billing Rate
Chris Stanley, PLS	Professional Surveyor and Mapper	$130
Dave Lucas	Survey Project Manager	$110
Ian Stanley	Survey Technician	$90

Tab 5
Project Team

5. Project Team

Organization of Project Team

The ATM personnel identified in this organizational chart possess an average of 11.5 years with ATM and an overall average experience of 18.5 years. In addition to the services identified for key ATM personnel for this solicitation, ATM has the capacity to provide geotechnical and environmental assessments utilizing in-house staff. Subconsultant Coastal Geomatics will provide field surveying and assist with field reconnaissance.



<u>Notes</u>

1. Applied Technology & Management
2. Coastal Geomatics

* *Licensed in North Carolina*

Availability and Commitment to Serve the County

ATM is committed to meeting the County's timeline and budget expectations associated with this solicitation. Further, ATM guarantees that all key personnel are available and accessible to the County immediately upon execution of a contract with the County. As demonstrated when assisting the County in development of the FEMA V/LiMWA zone dock construction form, Mr. Way and his team will continue consistent communication and interaction with the County via telephone, email, and online platforms such as Zoom and Microsoft Teams, and of course, in person. If in-person meetings are restricted due to the COVID-19 global pandemic, we will continue to utilize Teams and Zoom to facilitate video conferencing. ATM successfully conducts pre-bid meetings, regulatory consultations, and presentations via Teams and Zoom.

Summary of Key Personnel

A summary of key personnel is located on the next page; resumes are located in Section 7.

5. Project Team

Name	Company	Role	Total Years Experience	Assigned Project Tasks
Fran Way, PE	ATM	Project Manager and Task Manager for Final Mapping, Supporting Data, and Report Development	22.5	• Engineer-of-Record • Project Management • Subconsultant Coordination • Field Reconnaissance • Floodplain Mapping • Data Collection • Report Development • QA/QC
Steven Peene, PhD	ATM	Principal-in-Charge	32	• Contracting Authority • Technical Review • Hydrologic and Hydraulic Analysis
Jeffrey King, PhD, PE	ATM	Technical Advisor-QA/QC	26	• Technical Review • QA/QC • Hydrologic and Hydraulic Analysis
Robert Burleson, PE	ATM	Task Manager for Hydrologic and Hydraulic Analysis	36	• Hydrologic and Hydraulic Analysis • Technical Review • QA/QC
Heath Hansell, PE	ATM	Task Manager for Baseline Model and GIS Data Collection, and Field Survey and Reconnaissance	10	• Data Collection and Review • Field Reconnaissance • Baseline Model • Floodplain Mapping • Report Development • QA/QC
Michael Mann, PE	ATM	Professional Engineer	11	• Data Collection and Review • Baseline Model
Marc Gold, EI	ATM	Engineering Associate	5.5	• Data Collection and Review • Baseline Model • Hydrologic and Hydraulic Analysis • Floodplain Mapping • Report Development
Nico Pisarello, GISP	ATM	Geospatial Analyst	5	• Floodplain Mapping • Data Development
Chris Stanley, PLS	Coastal Geomatics	Professional Land Surveyor	26	• Field Survey • Field Reconnaissance
Dave Lucas	Coastal Geomatics	Survey Project Manager	32	• Field Survey • Field Reconnaissance
Ian Stanley	Coastal Geomatics	Survey Technician	5	• Field Survey • Field Reconnaissance

Tab 6
Financial Capacity

6. Financial Capacity

ATM is an established, financially stable engineering firm licensed in North Carolina, South Carolina, and Florida. We have the necessary resources – both human and financial – to fully support the needs of Brunswick County under this solicitation. ATM is currently profitable, with assets exceeding liabilities. *Our balance sheet through March 26, 2021 is attached.*

Dun & Bradstreet Number (DUNS)
14-704-7575

Federal Tax Identification Number
59-2413268

Applied Technology & Management
Balance Sheet
As of March 26, 2021

	2021	2020
Assets		
110022 - Petty Cash - Gainesville	200.00	200.00
110029 - Petty Cash - Dubai (AED)	285.61	880.19
110160 - Charleston Wells Fargo Account	1,313.25	1,627.86
110200 - Wells Fargo Operating Account	935,273.65	990,845.34
110300 - ADCB- Dirham acct	292,589.81	286,774.06
Total Cash	1,229,662.32	1,280,327.45
112001 - Accounts Receivable	1,477,592.47	1,181,619.48
112099 - Accounts Receivable - other	45.09	14.45
114002 - Allowance for Bad debts	(284,188.65)	(199,408.44)
Total Accounts Receivable	1,193,448.91	982,225.49
Total Work In Process	562,743.24	520,024.64
Total Current Assets	2,985,854.47	2,782,577.58
Total Leasehold Improvements	40,092.42	40,092.42
Total Vehicle & Boats	21,199.96	5,768.64
Total Furniture Equipment	344,669.14	299,627.15
Total Computer Equipment	410,022.42	389,410.18
Total Accumulated Depreciation	(644,561.55)	(557,694.16)
Total Property Equipment	171,422.39	177,204.23
112320 - Employee Payroll Advance	27,073.31	4,868.03
118001 - Prepaid - Insurance	107,344.16	102,022.33
118010 - Prepaid - Maintenance	67,052.76	63,693.71
118020 - Prepaid - Rent	25,419.08	50,218.26
118999 - Prepaid - Other	17,462.16	19,049.13
119001 - Deposits	41,137.88	57,225.35
Total Other Assets	285,489.35	297,076.81
Total Other Assets	285,489.35	297,076.81
Total Assets	**3,442,766.21**	**3,256,858.62**

Applied Technology & Management
Balance Sheet
As of March 26, 2021

Current Liabilities		
Payables		
212001 - Accounts Payable	210,816.34	392,293.97
213145 - Retirement Liability - S/H Life Ins	1,101,021.05	1,105,547.51
220010 - Social Security & Medicare Payable	130,208.02	-
236010 - VatTax Payable	6,944.65	35,791.02
240110 - Accrued Expenses - Other	654,952.68	395,990.06
265030 - Retainer	-	192,968.84
266012 - Federal Income Tax Payable	103,588.00	126,563.92
266015 - State Income Tax Payable	7,236.23	2,622.00
Total Payables	2,214,766.97	2,251,777.32
213010 - Accrued Salaries and Wages	126,182.58	145,600.19
213080 - Accrued Vacation Pay	111,923.54	91,512.82
Total Accrued Salaries	238,106.12	237,113.01
260057 - M9 Riversurveyor Note	10,667.50	29,412.73
260058 - Xylem-Sidelooker equipment note	33,996.63	-
Total Notes Payable	44,664.13	29,412.73
Total Current Liabilities	**2,497,537.22**	**2,518,303.06**
266020 - Deferred Income Tax Payable	(558,052.27)	(409,267.43)
270090 - Due to IGY	119,848.32	293,349.17
286010 - Deferred Income Tax Payable LT	93,681.70	106,686.93
Total Non-Current Liabilites	**(344,522.25)**	**(9,231.33)**
Stockholders Equity		
Common Stock		
291010 - Common Stock - ATM	8,080,000.00	8,080,000.00
297001 - Paid in Capital Stock Options	103,275.00	57,375.00
Total Common Stock	8,183,275.00	8,137,375.00
Total Additional Paid In Capital	1,593,000.00	1,593,000.00
Total Retained Earnings	(8,636,789.55)	(9,194,233.25)
Total Stockholders Equity	1,139,485.45	536,141.75
Total Liabilities and Equity	3,292,500.42	3,045,213.48
Interim Profit & Loss	150,265.79	211,645.14
Total Liabilities & Equity	**3,442,766.21**	**3,256,858.62**

Tab 7
Statement of Qualifications

Tab 7.A
Key Personnel Qualifications

Fran Way, PE
Project Manager/Sr. Prof. Engineer

YEARS OF EXPERIENCE
Total: 22.5
With Current Firm: 20.5

AREAS OF SPECIALIZATION
- FEMA Flood Zone Analysis and Remapping
- Data Collection and Statistical Analysis
- Hydrodynamic Modeling
- Water Quality Modeling
- Wave Modeling
- Coastal Processes and Sediment Transport Modeling
- Shoreline Erosion Modeling

EDUCATION
- MS, Ocean Engineering, Texas A&M University, 2000
- BS, Biology, Boston College, 1993

REGISTRATIONS/CERTIFICATIONS
- Professional Engineer, SC #27831
- Professional Engineer, NC #044849

EXPERIENCE SUMMARY

Mr. Way specializes in coastal, environmental, and water resources engineering. He applies his background of coastal and water resources to flood hazard risk assessments, wave and current modeling, beach nourishment, dredging and navigation studies, alternatives analyses, and shoreline stabilization projects. He utilizes various surface water hydrodynamic, hydrologic, hydraulic, and water quality models. Mr. Way has provided services on more than 50 FEMA letters of map revision (LOMRs) and flood insurance rate map (FIRM) appeals.

REPRESENTATIVE EXPERIENCE

FEMA Map Appeal, Jacksonville, NC: Led a review of the City's preliminary FEMA maps and developed a technical strategy for appeal. Several items related to storm surge modeling as well as riverine modeling were identified for appeal. ATM continues to work with city staff while FEMA and NC FEMA mapping partners review and update the mapping per ATM modeling and analysis.

FEMA Preliminary Flood Zone Map Appeal, Wrightsville Beach, NC: Led the Town's successful appeal of the preliminary FEMA maps from beginning to end. Reviewed the FEMA maps and developed a technical strategy for appeal. Worked with FEMA mapping partners during the project to ensure project success. Moved 175 acres of VE zone into AE zone.

Seaside Landing Condominium FEMA Flood Zone Support, Ocean Isle Beach, NC: Resolved a potential FEMA VE flood zone development violation and submitted a LOMR to FEMA to remove the entire property from the Special Flood Hazard Area (SFHA). Performed a site assessment and analysis to determine if past construction activities at the property, which had taken place in a FEMA VE flood zone, had potentially increased flood hazard risks to their and/or neighbor's properties. Reviewed FEMA flood maps and flood study data/information, and created a CMS-Wave model grid to establish 100-year conditions at the site shoreline. Ran the FEMA coastal/wave model CHAMP and conducted FEMA transect analysis under pre- and post-construction conditions to determine the effects of the site's construction.

Ocklawaha River Modeling for Rodman Dam Removal, Marion County, FL: Developed an EFDC hydrodynamic model for a 30-mile reach of the Ocklawaha River where overbank flooding occurs regularly. Modeled existing conditions as well as proposed restoration conditions that included dam removal.

Steven Peene, PhD
Principal-in-Charge

YEARS OF EXPERIENCE
Total: 32
With Current Firm: 26

AREAS OF SPECIALIZATION
- Sea Level Rise – Coastal Surge Modeling
- Modeling and analyses in support of total maximum daily load (TMDL) evaluations, environmental impact studies, NPDES permitting and design alternative evaluation
- Multidimensional circulation, transport and water quality modeling and analyses of watersheds, rivers, lakes, estuaries, offshore, and beach processes
- Design and implementation of hydrodynamic and water quality monitoring programs in support of circulation, transport and water quality studies

EDUCATION
- PhD, Coastal and Oceanographic Engineering, University of Florida, 1995
- MS, Coastal and Oceanographic Engineering, University of Florida, 1987
- BS, Civil Engineering, Lehigh University, 1982

AFFILIATIONS
- Southeast Stormwater Association
- South Carolina Association of Stormwater Managers
- Water Environment Research Federation Modeling Review Committee

EXPERIENCE SUMMARY

Dr. Peene has extensive experience in water resources analysis including sea level rise, coastal surge modeling, watershed planning, stormwater management planning, NPDES MS4 permitting, evaluation of non-point and point source pollution in surface water systems, hydrologic, hydrodynamic, sediment transport and water quality modeling for lakes, rivers, estuaries, coastal embayments, and offshore; evaluation of impacts to ecological resources in surface waters; design and implementation of monitoring in surface water systems; and hydrologic and water quality restoration. He is experienced in the management and coordination of large interdisciplinary projects involving public and agency participation and has managed numerous major projects for clients that examine the effects of physical, chemical, and hydrologic changes in surface water systems, both freshwater and estuarine.

REPRESENTATIVE EXPERIENCE

Whiskey Creek Watershed Plan, Lee County, FL: Project manager for concept designs of three projects within the 9.3 square mile Whiskey Creek watershed to provide flood attenuation for areas that experienced extensive flooding during Hurricane Irma in 2017.

North Fort Myers Florida Power & Light (FPL) Feasibility Project, Lee County, FL: Project manager on a feasibility study and concept designs for four projects within five watersheds. The study's goal is to alleviate flooding problems created by diversion of flows along the FPL right-of-way that pass through the watersheds.

San Sebastian River Resiliency Assessment, St. Johns County, FL: Principal-in-charge on the determination of future 100-year flood hazards using the ADCIRC+SWAN model with sea level rise projections at an area of the San Sebastian River to estimate tailwater conditions and future coastal flood risks associated with increased storm surge elevations and wave heights.

Coastal Hazard Assessment, City of Atlantic Beach, FL: Principal-in-charge on the determination of future 100-year flood hazards due to anticipated sea level rise for the years 2044, 2069, and 2119 by estimating future coastal flood risks from increased storm surge elevations and wave heights at Atlantic Beach.

Jeffrey King, PhD, PE
Technical Advisor – QA/QC

YEARS OF EXPERIENCE
Total: 26
With Current Firm: 2

AREAS OF SPECIALIZATION
- Hydrology
- Hydrogeology
- Hydrography
- Coastal Science and Engineering
- Water Quality Science and Engineering
- Hydrologic, Hydrodynamic and Water Quality Modeling
- Stormwater Management
- Watershed Planning
- Floodplain Mapping

EDUCATION
- PhD, Coastal and Oceanographic Engineering, University of Florida, 2007
- MS, Environmental Water Resources Engineering, University of California at Berkeley, 1995
- BS, Civil Engineering, University of Florida, 1993

REGISTRATION/CERTIFICATION
Professional Engineer, FL #54599

AFFILIATION
- American Water Resources Association¬–Florida Section
- National Groundwater Association

EXPERIENCE SUMMARY

Dr. King has more than 25 years professional experience, including a decade as a research hydrologist with the U.S. Geological Survey in its Caribbean and Florida Water Science Center, and three years as an in-house consultant to the Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP) in greater Washington D.C. Dr. King models and analyzes wetlands, watersheds, rivers, alluvial fans, lakes, estuaries, the ocean, and aquifers to address practical challenges for both governmental entities and private clients.

REPRESENTATIVE EXPERIENCE

Technical Evaluation Contractor, FEMA NFIP: Provided regulatory and program guidance to community officials, consultants, and property owners with pending or future issues before the FEMA NFIP. Involved in more than 1,000 requests to change flood hazard boundaries based on existing or proposed flood control projects, levee and bridge construction, and fill placement. Reviewed and assessed the validity of hydraulic and hydrologic simulations with HEC-1, HEC-2, HEC-6, HEC-RAS, HEC-IFH, HEC-HMS, WES-RMA2, SMS, and Flo-2D.

Hogtown Creek, Possum Creek, and Hogtown Prairie Watersheds, Gainesville and Alachua County, FL: Simulated flood hazards in Hogtown Creek, Possum Creek, and Hogtown Prairie watersheds with ICPR4. Simulation was necessary to retrofit or redesign flood mitigation structures in Florida Park and Mason Manor neighborhoods and to obtain a FEMA letter of map revision (LOMR) to reflect contemporary flood hazards in about 60 percent of the Gainesville area.

Alafia River Watershed Management Plan, Hillsborough and Polk Counties, FL; Assessed flood control, water quality, water quantity, and habitat of the 420-square-mile Alafia River watershed. Simulated watershed hydrology and river hydraulics with a version of SWMM, modified by Hillsborough County.

MK Ranch Hydrological Assessment, Apalachicola, FL: Assessed the effectiveness of prior hydrological restoration at the 6,500-acre MK Ranch in Gulf County near the Apalachicola River and Bay estuary. Simulated the surface water system on and near the ranch with ICPR4. The simulation included surface water/groundwater interaction, a 2-D overland flow computational framework, a 1-D link-node computational framework, and an interface between the 2-D and 1-D frameworks. Managed hydrologic data with GIS and hydrologic databases.

Robert Burleson, PE
H&H Analysis Task Manager

YEARS OF EXPERIENCE
Total: 36
With Current Firm: 23

AREAS OF SPECIALIZATION
- Water Resources Engineering
- Surface and Groundwater Hydrology
- Watershed Planning
- Hydrologic, Hydrodynamic and Water Quality Modeling
- Stormwater Management
- Urban and Agricultural Best Management Practices (BMPs)

EDUCATION
- ME, Agricultural Engineering, University of Florida, 1988
- BSE, Agricultural Engineering, University of Florida, 1984
- BSBA, Finance, University of Florida, 1979

REGISTRATION/CERTIFICATION
Professional Engineer, FL #42497

AFFILIATIONS
- Southeast Stormwater Association
- South Carolina Association of Stormwater Managers
- Florida Stormwater Association

EXPERIENCE SUMMARY

Mr. Burleson's areas of expertise include water resources engineering, surface and groundwater hydrology, watershed planning, surface water quality modeling, stormwater management, reclaimed water reuse, and urban and agricultural BMPs. His professional experience includes hydrologic research and analysis, water quality assessments, river basin management plans, stormwater master plans, floodplain analysis, watershed and water quality modeling, effluent disposal and wetland treatment system design, and wetland mitigation.

REPRESENTATIVE EXPERIENCE

Hydrologic/Hydraulic Analysis of Steinhatchee River, Suwannee River Water Management District, Dixie and Taylor Counties, FL: Performed statistical analyses on flow and stage data for the Steinhatchee River. Constructed and calibrated a HEC-RAS model to evaluate floodplain inundation and support in-channel ecosystems modeling.

Hydraulic Analysis of Econfina Creek, Northwest Florida Water Management District (NFWMD), Bay, Washington and Jackson Counties, FL: Constructed a HEC-RAS model of Econfina Creek to support NWFWMD's recovery efforts following impacts from Hurricane Michael in 2018. Multiple recovery scenarios were evaluated to determine effects on flood levels and to support prioritization of post-Michael recovery efforts.

Alligator Lake/Clay Hole Creek Watershed Flood Management Plan, Columbia County, FL: Used HEC-HMS and HEC-RAS (unsteady flow option) to perform hydrologic and hydraulic assessments in support of a study to develop flood mitigation alternatives. Scenarios evaluated included the September 2004 hurricane events (Frances and Jeanne) and the 100-year, 24-hour storm. Using the constructed models, performed a level-of-service assessment for retention facilities within the Eastwood subdivision, located adjacent to Clay Hole Creek.

Okatie River Watershed Management Plan, Beaufort and Jasper Counties, SC: Developed a comprehensive watershed management plan for the 24-square-mile Okatie River watershed in Beaufort and Jasper Counties. The study involved an evaluation of present and future hydrologic/hydraulic conditions as well as stormwater quantity and quality, nonpoint-source pollutant loadings, BMPs, and current water quality conditions. Alternatives to correct flooding and water quality problems for both present and future land use conditions were developed and evaluated.

Heath Hansell, PE
Data and Field Recon. Task Manager

YEARS OF EXPERIENCE
Total: 10
With Current Firm: 9

AREAS OF SPECIALIZATION
- Field Investigations and Instrumentation
- FEMA Flood Zone Engineering and Remapping
- Hydrodynamic, Wave, and Sediment Transport Modeling
- Due Diligence and Post-Storm Damage Assessments
- Coastal Processes - Shoreline Evaluation, Protection, and Restoration
- Coastal Hazard and Resiliency Analysis

EDUCATION
- MS, Ocean Engineering, Florida Institute of Technology, 2012
- BS, Civil Engineering, Mississippi State University, 2009

REGISTRATIONS/CERTIFICATIONS
- Professional Engineer, SC #32927
- Professional Engineer, GA #042340
- Professional Engineer, MS #28545
- Professional Engineer, ME #15751

AFFILIATIONS
- South Carolina Beach Advocates
- Charleston Resiliency Network

EXPERIENCE SUMMARY

Mr. Hansell specializes in the prediction and evaluation of project performance in the physical water environment, including comprehensive site evaluations; field data collection and statistical analyses of oceanographic conditions, wave-structure interactions, coastal processes and structural design; and project development. He applies his background in civil and coastal engineering to the planning, design, permitting, construction, and monitoring of projects. His diverse experience includes flood risk assessments, FEMA flood mapping, coastal hazard analysis, resilient design, and numerical modeling and analysis of hydrodynamic, wave, flushing, and coastal processes in support of coastal and waterfront projects.

REPRESENTATIVE EXPERIENCE

FEMA Preliminary Flood Map Appeal, Wrightsville Beach, NC:
Provided coastal engineering and FEMA flood mapping analysis of island community seeking appeal of FEMA's updated preliminary flood maps. Reviewed FEMA engineering, analysis, and modeling data; coordinated with FEMA, NC and local officials; and developed an official appeal package with updated, detailed analysis and supporting exhibits. Worked with FEMA and NC officials to ensure revisions would be incorporated into FEMA's updated mapping products.

James Island Letter of Map Revision (LOMR), James Island SC:
Performed site assessment and preliminary coastal engineering analysis to evaluate potential for reduction in wave effects during 100-year flood conditions per FEMA requirements. Completed coastal engineering analysis using updated LiDAR topography, site survey data, and FEMA-approved wave transect analyses (WHAFIS model) to determine portions of the subject properties that could be remapped as FEMA AE flood zone versus VE zone. Prepared and coordinated a FEMA LOMR application and submittal on behalf of the owner to reflect the proposed flood zone changes.

Pier Pointe Villas Letter of Map Revision (LOMR), Folly Beach, SC:
Assessed feasibility for a LOMR to revise FEMA flood zones at a condominium site one block off the beachfront. Based on a previous coastal protection project ATM performed at the adjacent beachfront property, conducted updated FEMA mapping analysis to show reduced coastal risk to the landward property. Developed and submitted engineering analysis and documentation and coordinated with local and federal/FEMA review agencies to revise the FEMA flood map and significantly reduced flood insurance premiums.

Michael Mann, PE
Professional Engineer

YEARS OF EXPERIENCE
Total: 11
With Current Firm: 5

AREAS OF SPECIALIZATION
- Data Collection
- Coastal Conditions Analysis
- Waterfront Structures
- Waterfront Planning, Design and Permitting
- Site Inspections
- Construction Administration
- Post-Construction Monitoring
- Grant Funding

EDUCATION
BS, Ocean Engineering, Florida Institute of Technology, 2009

REGISTRATION/CERTIFICATION
- Prof. Engineer, FL, No. 85217, 2018
- Prof. Engineer, SC, No. 37050, 2019
- Prof. Engineer, GA, No. 44882, 2019
- Prof. Engineer, VA, No. 61305, 2019

EXPERIENCE SUMMARY

Mr. Mann has a broad range of experience in waterfront and coastal projects. His tasks include project design, regulatory permitting, funding opportunities, construction administration, and post-construction monitoring. He facilitates the planning and permitting of water access facilities (docks, ramps). He regularly engages with state and federal agencies during the design, permitting and construction process of projects to assure regulatory approvals.

REPRESENTATIVE EXPERIENCE

Smith Floodplain Support, Calabash, NC: Performing a fill study in a FEMA non-encroachment area. Tasks include site assessment, data collection, and feasibility review.

North Fort Myers Florida Power & Light (FPL) Feasibility Project, Lee County, FL: Prepared concept designs for four projects to alleviate flooding problems created by diversion of flows along the FPL right-of-way that passes through the watersheds.

Nimmer Property Drainage and Erosion Analysis, Bluffton, SC: Conducted an analysis of creek flow to determine potential cause of erosion along homeowner's property.

Chartwell Mews Pond and Drainage Remediation, Bluffton, SC: Assisted in development of construction-level stormwater drainage plans to take ponded water from property to appropriate channels.

Ichetucknee Trace Flood Control Facilities for Columbia County, FL: Assisted with environmental resource permit (ERP) documents for the Eastwood Subdivision Emergency Pumping System to alleviate flooding. An ERP was obtained from the Suwannee River Water Management District.

Six Senses Resort, Turks and Caicos Islands: Determined environmental conditions at the site, ran SMS STWAVE model to determine maximum wave heights, and prepared cut/fill calculations for lagoon area.

Marc Gold, EI
Engineering Associate

YEARS OF EXPERIENCE
Total: 5.5
With Current Firm: 5.5

AREAS OF SPECIALIZATION
- FEMA Risk Analysis
- Coastal Processes and Sediment Transport
- Wave Modeling
- Sediment Transport and Shoreline Modeling
- Assessment of Coastal Structures
- Field Data Collection
- Data Analysis and GIS

EDUCATION
- MS, Coastal and Oceanographic Engineering, University of Florida, 2015
- BS, Physics, University of Florida, 2013

REGISTRATION/CERTIFICATION
Engineer Intern, #52941, 2015

AFFILIATIONS
- USACE Coasts, Oceans, Ports, and Rivers Institute
- American Shore and Beach Preservation Association
- States Organization for Boating Access

EXPERIENCE SUMMARY

Mr. Gold specializes in the analysis of processes along coasts, wetlands and estuarine environments including sediment transport and nearshore hydrodynamics. His experience includes permitting, numerical modeling, statistical and time series analysis, and international field data collection. Mr. Gold utilizes his coastal engineering background to perform FEMA flood zone and risk analysis remapping and coastal conditions assessments.

REPRESENTATIVE EXPERIENCE

FEMA Flood Zone Support for Holmes Residence at 3193 Waterway Drive, Supply, NC: Performed a site assessment and analysis to determine if the site's fill and retaining wall, having been constructed in a VE zone, potentially increased flood hazard risks to their and/or their neighbor's properties. Reviewed FEMA flood maps and flood study data/information, and created a CMS-Wave model grid to assess wave reflection/deflection to other properties and to establish 100-year conditions at the site shoreline. Conducted FEMA transect wave runup analysis under pre- and post-construction conditions to determine the effects of the site's construction. Coordinated a submittal with the county and state to resolve the issue and demonstrate that the construction at the site is not in violation.

FEMA FIRM Appeals for Cape Charles and Kiawah Beach Club Sites, Kiawah Island, SC: Performed a site assessment and feasibility analysis to evaluate the potential for remapping the site into a FEMA AE zone. Conducted a review of the preliminary Charleston County FEMA FIRM and confirmed that the VE zone designated for the site was primarily due to an inaccurate/outdated mapping of the Primary Frontal Dune (PFD) and a wave height analysis that was conducted using older elevation data. Utilized updated elevation data (LiDAR and site survey data) and site reconnaissance information to map a more accurate delineation of the PFD at the site and reran the FEMA wave model based on the updated topography. Developed and coordinated an appeal application and submittal to reflect the proposed flood zone changes.

Stormwater Management Plan Update, Beaufort County, SC: Set up an updated ICPR model to identify areas of road overtopping from stormwater under various storm conditions and assisted in developing recommendations to improve these areas. Collated output data provided by the water quality modeling team to develop maps, exhibits and GIS information of recommended monitoring areas and regional best management practices.

Nico Pisarello, GISP
Geospatial Analyst

YEARS OF EXPERIENCE
Total: 5
With Current Firm: 3

AREAS OF SPECIALIZATION
- Geospatial Analyses
- Vulnerability Assessments
- Database Management
- Geographic Information Systems (GIS)
- Hydrodynamic Modeling

EDUCATION
- MS, Environmental Engineering Sciences, University of Florida, 2016
- BS, Environmental Sciences, University of Georgia, 2012

REGISTRATIONS/CERTIFICATIONS
- GIS Professional (GISP) Certificate, #160931, 2020
- Stormwater Operator – Level 1, 2019
- Graduate Certificate, Geographic Information Systems for Urban and Regional Planners, 2019

AFFILIATION
PIANC (World Association for Waterborne Transport Infrastructure), Secretary, Recreation Commission

EXPERIENCE SUMMARY

Mr. Pisarello is an engineering associate with practical experience in stormwater management plans and issues related to the National Pollutant Discharge Elimination System (NPDES). He prepares geospatial analyses as part of coastal vulnerability and resilience studies and performs GIS analyses, hydrological and hydrodynamic modeling, flood mapping, statistical analyses, and research.

REPRESENTATIVE EXPERIENCE

North Fort Myers FPL Feasibility Project, Lee County, FL: Provided GIS analyses, developed presentation and report figures, constructed flow models, and digitized project drawings and sketches.

Whiskey Creek Watershed Plan, Lee County, FL: Assisted with development of concept designs for three projects within the 9.3-square-mile Whiskey Creek watershed to provide flood attenuation for areas within the watershed that experienced extensive flooding during Hurricane Irma in 2017.

San Sebastian River Resiliency Assessment, St. Johns County, FL: Assisted in development of model inputs to simulate the hydrodynamic conditions of proposed project conditions. Provided GIS analysis and prepared figures for presentation.

Coastal Hazard Assessment, City of Atlantic Beach, FL: Determined future 100-year flood hazards due to anticipated sea level rise for the years 2044, 2069, and 2119 to estimate future coastal flood risks from increased storm surge elevations and wave heights at Atlantic Beach due to rising seas.

Multi-Jurisdictional Climate Change Vulnerability Assessment Support, South Florida Consortium of Local Governments, Palm Beach County, FL: Developed tools for modeling storm surge and tidal flooding as part of an overall vulnerability assessment for seven local governments.

Flushing Model Analysis, Dulfeen Island, Saudi Arabia: Assisted in development of model inputs to simulate the hydrodynamic conditions surrounding the island with respect to proposed project conditions. Provided GIS analysis and map making for figures used in the report.

Grupo Puntacana, Dominican Republic: Provided preliminary assessment of the hydrologic and water quality conditions of a series of future manmade lakes along the coast of the Dominican Republic.

COASTALGEOMATICS
LAND SURVEYING • MAPPING • PLANNING

Key Personnel Bios

Chris Stanley, PLS, is a licensed professional land surveyor with more than 26 years of experience in the surveying industry and extensive experience in both the private and public sectors. He has performed over 500,000 linear feet of route surveys associated with numerous Brunswick County projects. He provides boundary, topographic, wetland, as-built, highway construction, site construction staking, subdivision development, annexation surveys, legal descriptions, title research, easement acquisition, beach monitoring and hydrographic surveys. He performs Coastal Area Management Act (CAMA) surveys and is very familiar with the permitting process. Mr. Stanley has an extensive background with Carlson and AutoCAD Civil 3D software, allowing for the collection of raw field data and efficiently translating the data into usable information necessary for civil engineering design. His knowledge of field information required during the design phase of a project is an asset and he works closely with engineers to assure timely and cost-efficient services.

Dave Lucas has more than 32 years of experience in the surveying industry. He provides boundary, topographic, wetland, as-built, highway construction, DOT rights-of- way acquisition, site construction staking, subdivision development, annexation surveys, legal descriptions, title research, easement acquisition, beach monitoring and hydrographic surveys. His extensive knowledge and background with Carlson, AutoCAD Civil 3D, and related software streamlines translation of the raw field date he has collected into usable information necessary for civil engineering design.

Ian Stanley has five years of experience in a variety of surveying services, including boundary, topographic, route survey/as-built, and construction staking. He has a great deal of knowledge of survey equipment and is responsible for all field personnel training, including field data collection, quality control, adherence to company survey protocols, and field crew safety procedures.

Tab 7.B
References

7.B. References

Reference No. 1	Town of Wrightsville Beach, NC
Address	321 Causeway Drive
City, State, ZIP	Wrightsville Beach, NC 28480
Contact Person	Timothy Owens, AICP, Town Manager
Telephone & E-mail	910.239.1770; towens@towb.org
Date(s) of Service	Harbor Island FEMA Map Appeal (February 2015 to December 2015)
Comments	ATM led the successful preliminary FEMA map appeal for the Town of Wrightsville Beach. Upon finding several potential appeal items, ATM worked with the Town and the North Carolina Flood Mapping Program (NCFMP) to develop a FEMA flood model that was more representative of existing conditions. ATM collected updated survey data and developed all necessary models, maps, and reports to update the FEMA products.

Reference No. 2	Northwest Florida Water Management District (NWFWMD)
Address	81 Water Management Drive
City, State, ZIP	Havana, FL 32333-4712
Contact Person	Paul Thurman, PhD
Telephone & E-mail	850.539.5999; Paul.Thurman@nwfwater.com
Date(s) of Service	St. Marks and Wakulla Rivers HEC-RAS (July 2016 to December 2018) Econfina Creek HEC-RAS (March/April 2019)
Comments	ATM developed a calibrated unsteady flow Hydrologic Engineering Centers River Analysis System (HEC-RAS) model of the St. Marks and Wakulla Rivers. The model simulated a wide range of flow conditions including low flows, Hurricane Irma, and sea level rise scenarios. ATM also constructed a HEC-RAS model of Econfina Creek to support NWFWMD's recovery efforts following impacts from Hurricane Michael in 2018. Multiple recovery scenarios were evaluated to determine effects on flood levels and to support prioritization of post-Michael recovery efforts. *Note: ATM has had a continuing services contract with NWFWMD since 2016 that has resulted in 22 task orders on water resources matters.*

Reference No. 3	Suwannee River Water Management District (SRWMD)
Address	9225 CR 49
City, State, ZIP	Live Oak, FL 32060
Contact Person	John Good, PE
Telephone & E-mail	386.647.3145; jcg@srwmd.org
Date(s) of Service	Steinhatchee River HEC-RAS (December 2015 to July 2017)
Comments	ATM constructed a HEC-RAS model of the Steinhatchee River. Supporting statistical analyses on flow and stage data for the Steinhatchee River were performed. The model was calibrated and used to support environmental flow evaluations, including floodplain inundation, and in-channel ecosystems modeling. *Note: ATM has had a continuing services contract with SRWMD since 2006 that has resulted in 15 task orders on water resources matters.*

Tab 7.C
Project Experience and Work Sample

7.C. Project Experience and Work Sample

Project Experience

The following table identifies 21 relevant, similar flood-risk-related projects ATM has completed since 2010 in relation to the services requested in this solicitation. This is in addition to the more than 50 FEMA letters of map revision (LOMRs) and appeals ATM has undertaken since 2008.

ATM Flood-Risk-Related Projects to Services (since 2010)

	Project-Related Experience to County-Requested Services												
ATM Projects	FEMA-Related	Floodplain Study	Coastal Analysis	Estuarine Analysis	H&H Analysis	Modeling	Data Collection/Recon.	Field Surveys/Data Collection	Surveying (Topo, Bathy or LiDAR)	GIS Mapping	Report Development	Agency Coordination	Stakeholder Coordination
V/VE/LiMWA Zone Dock Construction Form Assessments, Brunswick County, NC	X			X									
Seaside Landing Condos LOMR, Brunswick County, NC	X		X			X	X	X	X	X	X		X
City of Jacksonville, NC FEMA Map Appeal	X		X	X		X	X			X	X	X	X
Town of Wrightsville Beach, NC FEMA Map Appeal	X	X	X	X		X	X	X	X	X	X	X	X
Smith Floodplain Support, Calabash, NC	X	X			X	X	X	X	X	X	X	X	
Deerfield Beach Stormwater Management and Flood Resilience, FL		X	X	X			X			X	X		X
Whiskey Creek Watershed Flood Protection Plan, Lee County, FL		X			X	X	X	X	X	X	X		X
North Fort Myers Feasibility to Alleviate Flooding, FL		X			X	X	X	X	X	X	X		X
Resiliency Assessment, Atlantic Beach, FL			X	X	X	X	X	X	X	X	X		X
Resiliency Assessment, St. Johns County, FL		X	X	X	X	X	X	X	X	X	X		X
South County Coastal Vulnerability Assessment, Palm Beach County, FL			X	X			X		X	X	X		X
St. Marks and Wakulla Rivers HEC-RAS Models, FL		X		X	X	X	X	X	X	X	X		X
Econfina Creek Post-Hurricane HEC-RAS Flood Change, FL		X		X	X	X	X	X	X	X	X		X
Alligator Lake/Clay Hole Creek Watershed Management Plan, Columbia County, FL		X			X	X	X	X	X		X		X
Aquatic Gardens Stormwater and Flooding Analysis, Atlantic Beach, FL		X			X	X	X	X	X		X		X
Ocklawaha River Hydrodynamic Model of Overbank Flooding, FL						X	X		X				
Lower Ocklawaha River EFDC Model Flood Inundation, FL						X	X		X				
EFDC Floodplain Grid of the Middle St. Johns River, FL						X	X		X				
Scientific Resolution Panel for FEMA Map Appeal, Cumberland County, ME	X		X							X	X	X	
Scientific Resolution Panel for FEMA Map Appeal, York County, ME	X		X							X	X	X	
V/VE Zone and Fill Placement Form Development for Mount Pleasant, SC	X		X	X								X	

LOMR = Letter of Map Revision

7.C. Project Experience and Work Sample

The following table links the 21 projects to key ATM personnel assigned to provide services under this solicitation.

ATM Flood-Risk Related Projects to Key Personnel

	ATM Project Team Personnel Experience							
ATM Projects	Fran Way, PE, Project Manager	Steven Peene, PhD, Principal	Jeffrey King, PhD, PE, Tech. Advisor	Robert Burleson, PE, Sr. Prof. Eng.	Heath Hansell, PE, Prof. Engineer	Michael Mann, PE, Prof. Engineer	Marc Gold, EI, Engineering Assoc.	Nico Pisarello, GISP, Analyst
V/VE/LiMWA Zone Dock Construction Form Assessments, Brunswick County, NC	X				X		X	
Seaside Landing Condos LOMR, Brunswick County, NC	X						X	
City of Jacksonville, NC FEMA Map Appeal	X							
Town of Wrightsville Beach, NC FEMA Map Appeal	X				X		X	
Smith Floodplain Support, Calabash, NC	X		X	X		X	X	
Deerfield Beach Stormwater Management and Flood Resilience, FL		X	X	X				X
Whiskey Creek Watershed Flood Protection Plan, Lee County, FL		X		X			X	X
North Fort Myers Feasibility to Alleviate Flooding, FL		X		X		X	X	X
Resiliency Assessment, Atlantic Beach, FL	X	X			X		X	X
Resiliency Assessment, St. Johns County, FL	X	X	X				X	X
South County Coastal Vulnerability Assessment, Palm Beach County, FL		X					X	X
St. Marks and Wakulla Rivers HEC-RAS Models, FL				X				
Econfina Creek Post-Hurricane HEC-RAS Flood Change, FL				X				X
Alligator Lake/Clay Hole Creek Watershed Management Plan, Columbia County, FL				X				
Aquatic Gardens Stormwater and Flooding Analysis, Atlantic Beach, FL				X				
Ocklawaha River Hydrodynamic Model of Overbank Flooding, FL	X	X						
Lower Ocklawaha River EFDC Model Flood Inundation, FL	X	X						
EFDC Floodplain Grid of the Middle St. Johns River, FL		X						
Scientific Resolution Panel for FEMA Map Appeal, Cumberland County, ME	X						X	
Scientific Resolution Panel for FEMA Map Appeal, York County, ME	X						X	
V/VE Zone and Fill Placement Form Development for Mount Pleasant, SC	X				X			

7.C. Project Experience and Work Sample

The balance of this section is a narrative description of our relevant project experience. An example of our work, the supporting documentation report to successfully appeal a FEMA preliminary flood map for Harbor Island, on behalf of the Town of Wrightsville Beach, NC, is attached.

Watershed/Floodplain Studies

Successful watershed management balances water quality and quantity issues with use, attainability, and sustainability. On the broadest of scales, we develop comprehensive stormwater master plans and watershed management plans, as well as facilitate stormwater utility development based on the specific, unique qualities of each community. For site-specific applications, we develop comprehensive facility inventories, geographic information system (GIS) based applications, hydrodynamic and hydraulic flow modeling, stormwater facilities and systems designs, and best management practices (BMPs). We balance environmental concerns, regulatory mandates, and economic constraints to develop effective solutions for the most complex surface water issues by completing the following tasks:

- Accurate data collection and analysis
- Watershed characterization and assessment
- Evaluation of land use
- BMP identification, selection, evaluation and design
- Infrastructure design and rehabilitation

Examples

For Columbia County, FL, ATM prepared the Alligator Lake/Clay Hole Creek Watershed Flood Management Plan. ATM constructed Hydrologic Engineering Centers Hydrologic Modeling System (HEC-HMS) and Hydrologic Engineering Centers River Analysis System (HEC-RAS) (unsteady flow option) models to perform hydrologic and hydraulic assessments in support of a study to develop flood mitigation alternatives. Scenarios evaluated included the September 2004 hurricane events (Frances and Jeanne) and the 100-year, 24-hour storm. Using the constructed models, ATM performed a level-of-service assessment for retention facilities within the Eastwood subdivision, located adjacent to Clay Hole Creek.

For the Northwest Florida Water Management District (NWFWMD), ATM developed a calibrated unsteady flow HEC-RAS model of the St. Marks and Wakulla Rivers. The model simulated a wide range of flow conditions including low flows, Hurricane Irma and sea level rise scenarios. In addition, ATM constructed a HEC-RAS model of Econfina Creek to support NWFWMD's recovery efforts following impacts from Hurricane Michael in 2018. Multiple recovery scenarios were evaluated to determine effects on flood levels and to support prioritization of post-Michael recovery efforts.

ATM constructed a HEC-RAS model of the Steinhatchee River for the Suwannee River Water Management District (FL). Supporting statistical analyses on flow and stage data for the Steinhatchee River were performed. The model was calibrated and used to support environmental flow evaluations including floodplain inundation and to support in-channel ecosystems modeling.

7.C. Project Experience and Work Sample

For the City of St. Augustine, FL, ATM evaluated the existing drainage system to design a storm sewer system, using the Stormwater Management Model (SWMM), to relieve flooding in the neighborhoods adjacent to Coquina Ditch, a tributary to the San Sebastian River. The analysis and design included the incorporation of sea level rise scenarios.

For the City of Atlantic Beach, FL, ATM evaluated and updated an existing SWMM model for the Hopkins Creek Basin to analyze flooding issues in the Aquatic Gardens area of Atlantic Beach. Two alternatives were evaluated to mitigate flooding, including a pumped system at the Aquatic Gardens Pond and a weir and pumped system located in the Skate Road Ditch.

For Bluffton, SC, ATM performed hydrologic/hydraulic modeling of the Bluffton Park development and surrounding wetland areas using Hydrological Simulation Program–Fortran (HSPF) and Interconnected Pond Routing (ICPR) models. Alternatives for restoring wetland hydroperiods and freshwater flow patterns to Verdier Cove/May River were developed, including a proposed stormwater wetland/environmental park.

For Volusia County, FL, ATM prepared watershed management plans for the Turnbull Creek and Deland Ridge watersheds. The studies involved a comprehensive evaluation of present and future hydrologic/hydraulic conditions as well as stormwater quantity and quality, nonpoint-source pollutant loadings, and BMPs. Alternatives to correct flooding and water quality problems for both present and future land use conditions were developed and evaluated. Surface water monitoring plans to meet National Pollutant Discharge Elimination System (NPDES) requirements and cost estimates of recommended alternatives were developed. Recommendations included a Capital Improvement Program (CIP), non-structural BMP implementation, and ordinance and regulatory modifications. SWMM and the pollutant loading spreadsheet model, Nonpoint Source Load Analysis Model (NPSLAM), were used for performing water quantity and water quality evaluations.

Coastal Flooding Experience

ATM has a comprehensive background in coastal flooding analysis, evaluation, investigation, study, research, and review, including recent resiliency services for National Aeronautics and Space Administration (NASA) Kennedy Space Center, St. John's County and Atlantic Beach, FL. In addition to analyzing and assessing existing and future conditions, ATM assists clients in developing plans to mitigate for 100-year storm surge and 100-year river flooding as well as more common extreme king tide flooding events. ATM builds on existing data/studies by developing appropriate numerical models (e.g., wave, current, flow, sediment morphology) and collecting data (e.g., current, flow, water level, wave data), when required. This results in essential information to communities to improve resiliency. For example, for the City of Atlantic Beach, ATM assessed increases in flood risks due to potential sea level rise and identified areas of vulnerability by mapping flood hazards due to extreme storms under future sea level rise scenarios using FEMA's Coastal Hazard Analysis Modeling Program (CHAMP) model suite, GIS and FEMA flood mapping methodology.

FEMA-Specific Experience

ATM's senior professional engineer, Jeffrey King, PhD, PE, served as an in-house consultant to FEMA's National Flood Insurance Program (NFIP). During this three-year term, Dr. King provided regulatory and program guidance to community officials, consultants, and property owners with pending or future issues before the FEMA NFIP. Dr. King was involved in more than 1,000 requests to change flood hazard boundaries based on existing or proposed flood control projects, levee and bridge construction, and fill placement. Dr. King reviewed and assessed the validity of hydraulic and hydrologic simulations with HEC-1, HEC-2, HEC-6, HEC-RAS, HEC-IFH, HEC-HMS, WES-RMA2, SMS, and Flo-2D.

Further, ATM's FEMA experience includes routine review of flood hazard maps for accurate representation of flood zones at a local level to provide technical advocacy to local governments and property owners. To date, we have submitted more than 50 LOMRs in South Carolina, North Carolina and Florida and five flood insurance rate map (FIRM) appeals (two in South Carolina, two in Florida, and one in North Carolina (Town of Wrightsville Beach). We also provided appeal support services to the City of Jacksonville, NC.

ATM staff also provide affidavits and expert witness testimony regarding flood hazards and coastal zone development. Our coastal engineers perform FEMA beach and dune mitigation projects following major storms. ATM is currently working for the Towns of Holden Beach and North Topsail Beach, NC, related to effects of Hurricane Florence (2018) and Hurricane Dorian (2019); Hurricane Isaias (2020) for Holden Beach. ATM works with towns and municipalities to provide FEMA with the necessary reports, data and analysis required from initial post-storm damage inspections to final project closeout (which can be several years).

Modeling

ATM has offered water resources monitoring and modeling as a core service for more than three decades. We specialize in performing hydraulic, hydrologic and hydrodynamic monitoring and modeling of creeks, rivers, wetlands, floodplains, lakes, estuaries, and watersheds.

ATM provides both screening-level and detailed evaluations of watershed and receiving water hydrology and hydraulics to support floodplain assessments in both upland and coastal areas. We use HEC-HMS/GeoHMS, HEC-RAS/GeoRAS, ICPR-3 and ICPR-4 to assess flooding impacts in watersheds and sub-basins. For example, in 2018, ATM updated Beaufort County's stormwater management plan by modeling floodplains with ICPR and representing model output with GIS and AutoCAD. We compared our flood hazard risk assessments to previous assessments with other models, for both the contemporary and future land use conditions.

ATM has extensive experience in coastal storm surge and inundation modeling. We use the Advanced Circulation (ADCIRC) model for simulation of coastal surge and sea level rise analyses. We recently used the FEMA Atlantic and Gulf of Mexico ADCIRC model to assess storm surge and sea level rise impacts in the San Sebastian Estuary, in St. Augustine, FL. This assessment included refinement of the model grid to represent local conditions and simulation of storm surge under contemporary and future sea level rise scenarios.

7.C. Project Experience and Work Sample

Technical Capabilities (software and field equipment)

ATM has extensive resources (equipment, software, and hardware) readily available to successfully perform tasks associated with this solicitation. These resources are identified below.

Surface Water, Hydrodynamic, & Water Quality Models

- WASP7
- QUAL-2K
- CLHYD
- WQMAP (BFHYDRO, BFWASP)
- CE-QUAL-W2
- SMS
- EFDC
- SSFATE
- CORMIX
- Visual PLUMES
- BATHTUB
- MIKE21, MIKE11
- ECO Lab
- ECOMSED
- ADCIRC

Equipment

- Mobil B61 HD rotary rig, Failing F-7 rotary rig and AMS 9600 Pro and track mounted Power Probes (Direct Push)
- Trimble Geo7x handheld GPS Unit
- DJI Phantom 4 Pro Drone (Optical)
- DJI Matrice 210 RTK Drone (Optical/FLIR Thermal)
- Full service Groundwater/Surface Water Sampling Capabilities

Groundwater Models

- GroundWater Vistas
- Visual MODFLOW
- MODRET
- ArcNLET

Watershed Runoff Models

- HSPF
- LSPC+
- BASINS
- WAM
- WMM

Programming and Visualization Tools

- Fortran Compiler
- Tecplot 10
- SURFER
- GRAPHER
- JAVA
- Visual Basic for Applications (VBA)
- ArcGIS VBA
- Python (ArcGIS Programming)
- MATLAB
- Pix4D

Stormwater Models

- SWMM5
- HEC-WMS, HEC-1, HEC-HMS, HEC-GeoHMS, HEC-RAS
- ICPR4.03
- PONDS

GIS/Mapping/CAD/ Graphics Programs

- ArcInfo Workstation/ArcMap 10 with Spatial-3D-Geostatistical Analyst Extensions
- Autodesk Architecture, Engineering & Construction Collection 2019
- AutoCAD Civil 3D 2015, AutoCAD Map 3D 2015
- CorelDraw Graphics Suite X6 (CorelDraw 16, Corel Photo-Paint, Bitstream Font Navigator)
- Adobe Design Premium CS4 Suite (Photoshop CS4, Illustrator CS4, Adobe InDesign CS4, Adobe Fireworks CS4, Adobe Image Ready)
- Adobe Acrobat Pro DC
- Hypack 2014

FEMA Preliminary Flood Map Appeal
Supporting Documentation Report
Harbor Island, North Carolina

Town of Wrightsville Beach, New Hanover County, North Carolina

Submitted on Behalf of:

Town of Wrightsville Beach, North Carolina
Tim Owens, Town Manager

Submitted By:

Applied Technology & Management, Inc.
PO Box 20336
Charleston, SC 29413

Revision 1
December 2015

TABLE OF CONTENTS

1.0 INTRODUCTION

This report is submitted in support of a Preliminary Map Appeal for Harbor Island, located in the Town of Wrightsville Beach, New Hanover County, North Carolina (Figure 1). The following sections detail study area setting, the basis for appeal, supporting analyses, and final proposed revised preliminary mapping based on the current study.

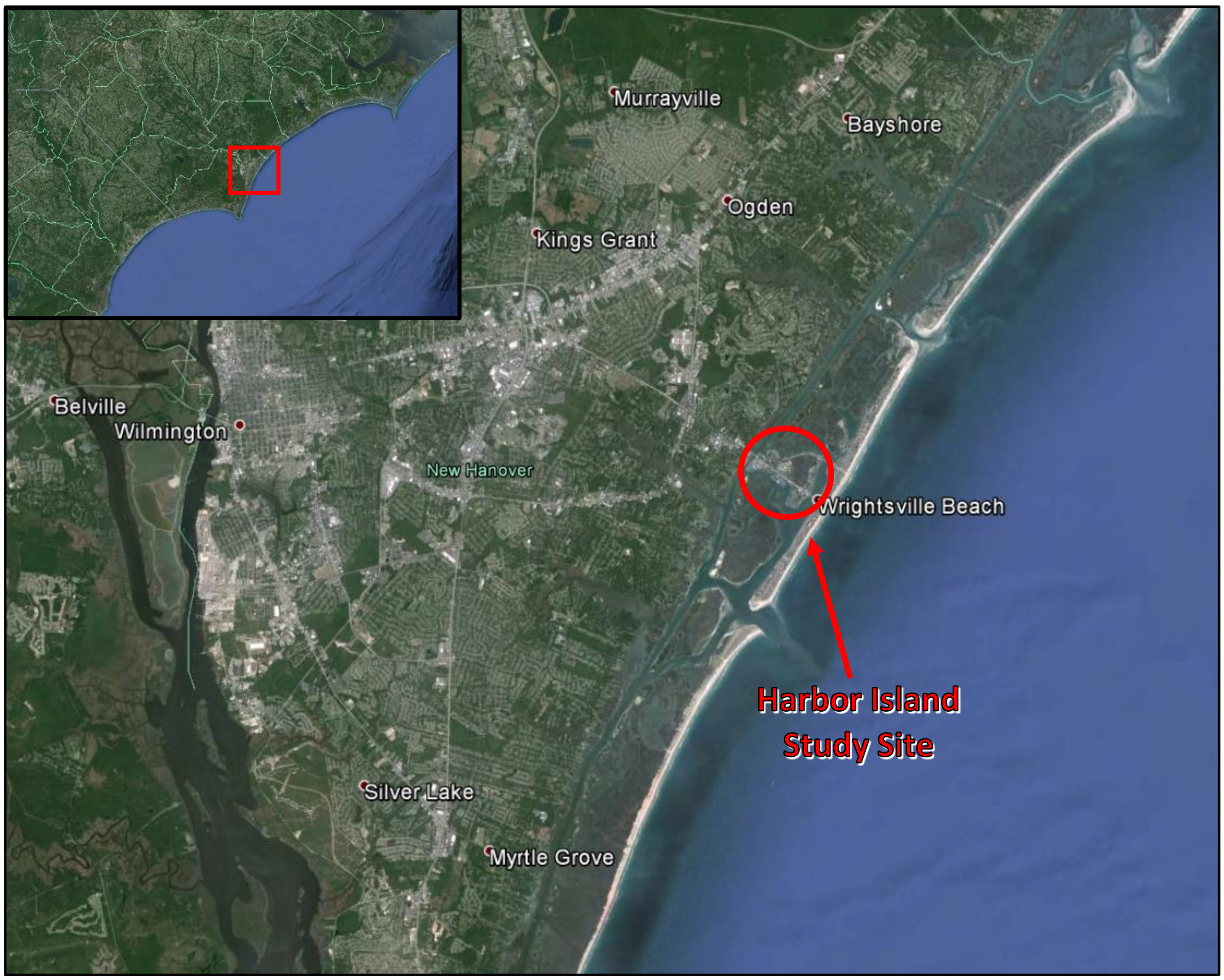


Figure 1. Location and Overview Aerial Imagery of the Approximate Harbor Island Study Area (Google Earth Imagery Date 10/5/2014)

2.0 SETTING

Harbor Island is located within the limits of the Town of Wrightsville Beach, near the Atlantic Coast of New Hanover County and is accessed via U.S. Highway 74/76 (Figures 1 and 2). The study site (Harbor Island) is approximately 300 acres in size, with about 4,800 feet (ft) of the island frontage facing the Atlantic Ocean, which is beyond Banks Channel and Wrightsville Beach (Figure 2).

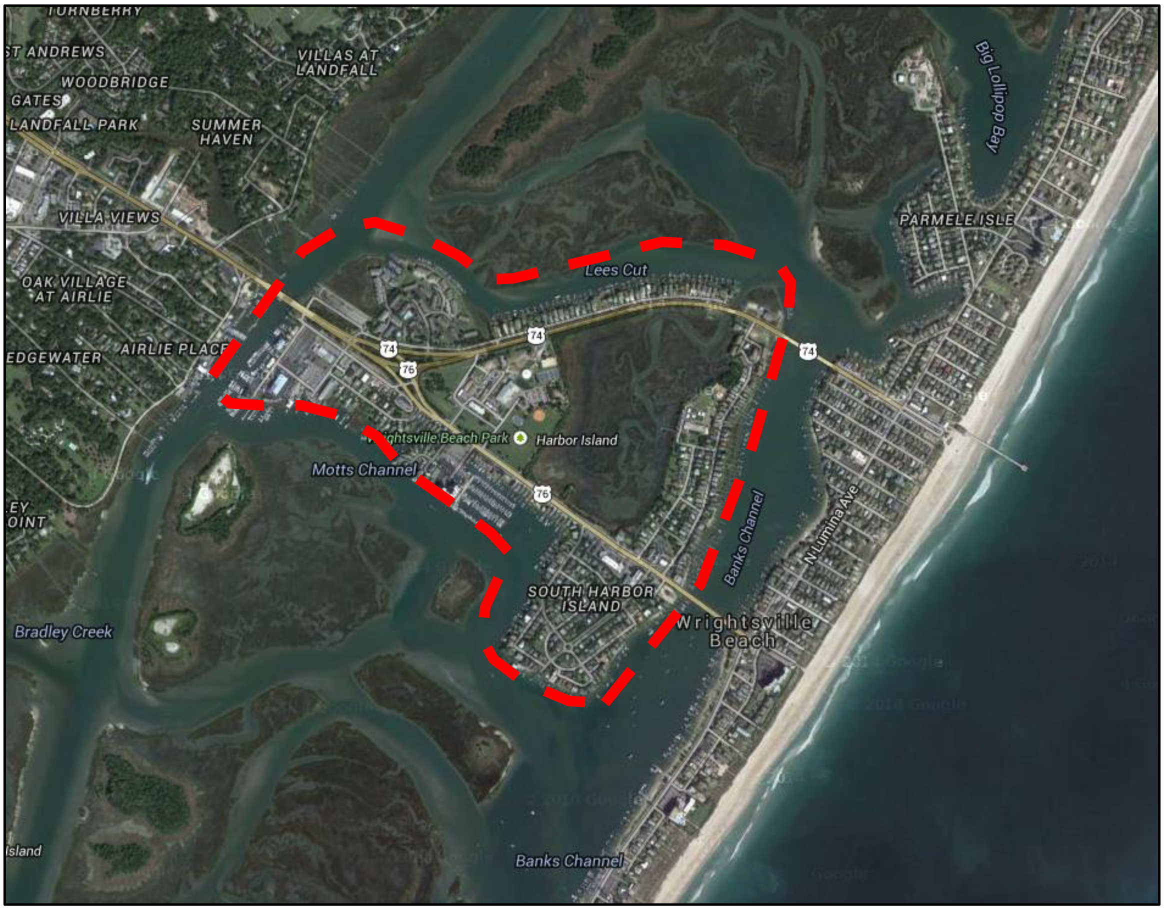


Figure 2. Site View Aerial Imagery of the Harbor Island Study Area (Red Dotted Line) (NOAA Data Access Viewer Imagery)

As seen in Figure 2, the area is mostly developed with single-family homes, with a mix of commercial and townhome/condominium development as well. A portion of the island's interior includes intertidal marsh. The site is separated from the mainland by the Atlantic Intracoastal Waterway (AIWW) to the northwest and bordered by Lees Cut, Banks Channel, and Motts Channel to the north, east, and south, respectively (Figure 2). Numerous marsh and U.S. Army Corps of Engineers (USACE) AIWW spoil islands are present throughout the area, to the northeast and southwest. The Atlantic Ocean shoreline of Wrightsville Beach, where the FEMA WHAFIS[1] wave model transects begin (discussed in subsequent sections), is approximately 1,800 to 2,500 ft southeast of the Harbor Island/Banks Channel shoreline. Banks Channel widths between Harbor Island and Wrightsville Beach range from approximately 600 to 1,200 ft. As was concluded in the Federal Emergency Management Agency (FEMA) preliminary Flood Insurance Study (FIS) and subsequent mapping efforts, under elevated water level and storm conditions, Harbor Island will generally be exposed to locally regenerated wave effects from the offshore waves breaking on and traveling over the Wrightsville Beach barrier island.

[1] WHAFIS = Wave Height Analysis for Flood Insurance Studies (FEMA wave model)

3.0 BASIS OF PRELIMINARY FLOOD MAP APPEAL

Applied Technology and Management, Inc. (ATM) reviewed the relevant preliminary FEMA mapping studies, datasets, analysis assumptions, model results, and Flood Insurance Rate Maps (FIRMs). Initial review of the topographic data utilized merited a more detailed investigation into the data (discussed in the following sections). To effectively coordinate a potential appeal, ATM contacted representatives of the North Carolina Flood Mapping Program (NCFMP) to discuss initial approaches and other issues. NCFMP representatives hosted a conference call about preliminary map efforts and appeals. It was recommended that ATM utilize the existing FEMA preliminary map transects, incorporating the updated topography from the current study and adjusting WHAFIS "BU" or building model cards, to be more representative of actual site conditions (discussed in following sections). Based on the discussions with, and recommendation from NCFMP and other representatives, ATM utilized existing FEMA preliminary map transects, updated topography and "BU" WHAFIS model cards as the basis for the current study.

FEMA's *Appeals, Revisions, and Amendments to National Flood Insurance Program Maps, A Guide for Community Officials* (FEMA, 2009) states that appeals to preliminary flood maps must be supported by documentation showing that the proposed base flood elevations (BFEs) and/or base flood depths are scientifically or technically incorrect.

The current study proposes that the preliminary FIRMs for the study site (Harbor Island, NC) are:

1. *Scientifically incorrect:* Assumptions made as part of the methodology are inappropriate or incorrect:
    - Building obstruction "BU" WHAFIS card coefficient inputs conservatively neglected existing structures and realistic site conditions

2. *Technically incorrect: Methodology was based on insufficient or poor-quality data:*
    - Topographic data utilized is outdated and/or misrepresentative of site conditions

The following sections detail the basis of the appeal and methodologies utilized to account for WHAFIS obstruction BU cards and topographic data that is more representative of actual site conditions at the Harbor Island study site.

3.1 BUILDING OBSTRUCTIONS

Structures such as homes or buildings have the potential to obstruct wave energy as it propagates inland from offshore hurricane conditions. To account for these obstructions, FEMA's WHAFIS model uses "BU" cards to represent structures with the potential to inhibit wave energy transmission along the WHAFIS transects. BU cards are specified on the transect as rows of structures perpendicular to the transect and require input values representing the number of rows and the ratio of open space to total space. This is simply the sum of distances between the structures in a row, divided by the total length of that row (FEMA, 2007). FEMA's Wave Transformation, Focused Study Report (FEMA, 2005) describes the modeled wave transmission through BU cards:

> "Energy propagation though rows of buildings is determined by the fractional open aperture between the buildings along a row, and the number of rows within the segment. The fraction of incident energy passing through a row is assumed to be equal to the average fractional open aperture between adjacent buildings; between rows, energy is assumed to be laterally redistributed before encountering the subsequent row."

FEMA guidelines state that if structures are elevated above the base flood wave crest on pilings or columns, waves will propagate under the structures with minimal reduction in height. Mapping partners should code these buildings using the BU card and indicate 100-percent open space (acknowledging the buildings but assuming they are completely transparent to waves) (FEMA, 2007). For most coastal applications (and based on site conditions, construction methodology, etc.), FEMA generally assumes a 100 percent open space for conservatism and consistency in mapping efforts. The preliminary mapping efforts for the New Hanover County Harbor Island study area also utilized this method of acknowledging structures with the WHAFIS BU carding, but implementing 100 percent open space for inputs. However, the conservatism of this approach does not accurately reflect the realistic conditions of the Wrightsville Beach barrier island and Harbor Island development characteristics.

Figure 3 shows an oblique view of the study area from the open ocean looking landward (Google Earth 3D Imagery). Preliminary FEMA mapping efforts conservatively neglected the presence of the structures on Wrightsville Beach and within the Harbor Island study area. While a small portion of the structures in the developed areas have open foundations, supported on piles or columns above the base flood level (validating 100 percent open space), an overwhelming majority are enclosed structures, on-grade, or curtain-wall (crawl space) buildings that would realistically constitute obstructions to the passage of wave energy.

Determination of BU card coefficients for the use in the current study's WHAFIS model was based on aerial imagery, geographic information system (GIS) measurements, site reconnaissance and engineering judgment. Up to three representative building rows along each transect were evaluated to produce an idealized coefficient for use in the study area. Effective building rows (approximately perpendicular WHAFIS transects) were assumed to span half the distance between adjacent transects, thus providing "full" coverage of the site area. Outer transects (57 and 60) utilized symmetric distancing to cover the extent of the study site. Figure 4 illustrates the beachfront building rows along Transects 57 and 58 as an example.

Figure 3. Oblique View Aerial Imagery of the Wrightsville Beach Barrier Island and Harbor Island Study Site. Viewing from the open ocean looking landward. View south of Causeway Drive (Top) and north of Causeway Drive (Bottom). (Google Earth Imagery, 3D Buildings).

Figure 4. Example of Effective Building Row at Transect 57

Total distance along building rows, average gap distance between structures and structure characteristics were used to calculate fractional open aperture for each section. Table 1 summarizes the data utilized and shows variable open-aperture percentages from 15 to 30 percent, with an average of 23 percent open space. During initial coordination, FEMA NCFMP representatives suggested a preliminary estimate of 15 to 20 percent open space. The analysis performed for the current work showed relatively good agreement with this initial estimate, although a more conservative average (23 percent) was found, and a final idealized project value of 25 percent open space was utilized for the updated WHAFIS modeling in a majority of BU card locations. Areas with less dense development utilized 50 percent and 100 percent open space (Figure 5).

Table 1. Building Row and BU Coefficient Assessment Values

Transect	Location	Total Length, ft	Average Gap Between Structures, ft	Structures	Total Gap, ft	Percent Open
57	Wrightsville Beach - Oceanfront	760	15	12	165	22%
57	Harbor Island - Banks Channel	870	20	12	220	25%
57	Harbor Island - Interior	870	20	12	220	25%
58	Wrightsville Beach - Oceanfront	670	25	5	100	15%
58	Harbor Island - Banks Channel	730	25	8	175	24%
58	Harbor Island - Interior/Waterfront	654	15	10	135	21%
59	Wrightsville Beach - Oceanfront	1280	20	17	320	25%
59	Harbor Island - Banks Channel	1300	15	23	330	25%
60	Wrightsville Beach - Oceanfront	2030	25	19	450	22%
60	Wrightsville Beach - Interior	2030	20	22	420	21%
60	Harbor Island - Banks Channel	2030	30	21	600	30%
					Average	*23%*
					Idealized for Current Study	*25%*

Figure 5 shows the location of WHAFIS BU cards from preliminary FEMA model transects at the subject site. In preliminary modeling, these are considered placeholders to indicate the presence of buildings while using 100 percent open space, neglecting the structures, except in limited areas based on site conditions. In the current study, only building cards on the Wrightsville Beach barrier island and the southeastern section of Harbor Island (along Banks Channel) were included to implement the idealized 25 percent open space coefficients in WHAFIS modeling. Several BU card locations on Harbor Island along Transects 58 and 59 merited use of 50 percent open space based on localized construction characteristics and building densities. The balance of the transects utilized typical fetch or vegetation model cards. This method was based on construction characteristics, structure densities and desire to maintain conservatism and consistency with FEMA preliminary mapping methods.

Site photos are presented in Appendix A, and BU card coefficient estimate analysis information is provided in Appendix B.)

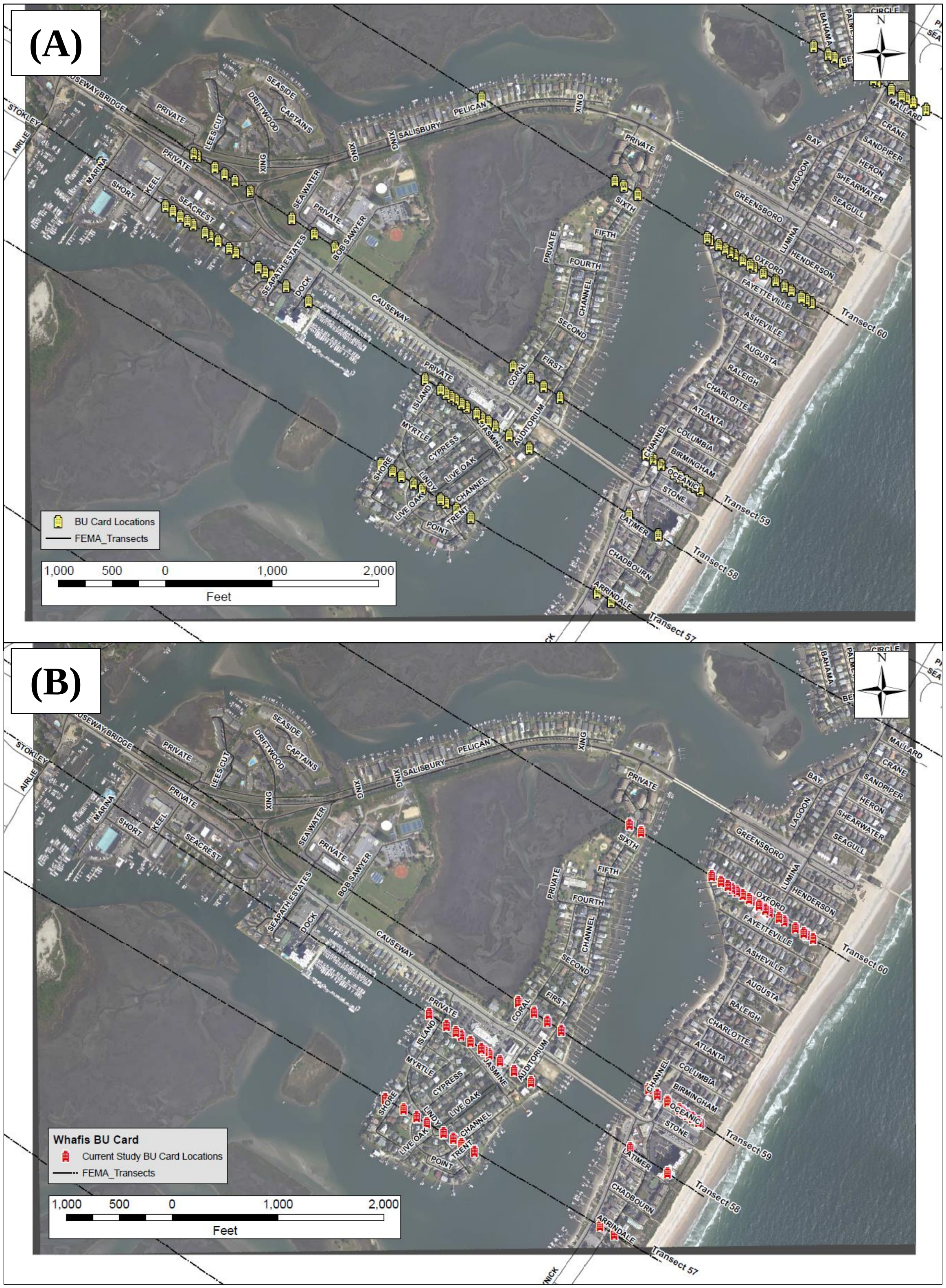


Figure 5. WHAFIS Transects and Obstruction BU Card Locations for (A) FEMA Preliminary Mapping Efforts -100% Open Space, and (B) the Current Study -25% and 50% Open Space

3.2 TOPOGRAPHIC DATA

3.2.1 FEMA PRELIMINARY MAPPING EFFORTS-TOPOGRAPHIC DATA SOURCES

The preliminary FEMA mapping efforts for New Hanover County were based on North Carolina 2001 light detection and ranging (LiDAR) datasets and beach profile ground surveys collected in October/November 2010. A statewide triangulated irregular network (TIN), and 10-ft resolution digital elevation model (DEM) raster were produced and the 10-ft DEM was utilized. Where field survey data exist, such as those collected to identify primary frontal dunes, the survey data superseded the LiDAR based DEM (NC_NewHanover_County_Methodology_Summary_Report_ 11122013.doc).

3.2.2 UPDATED PRELIMINARY MAPPING EFFORTS-TOPOGRAPHIC DATA SOURCES

The topography utilized for this study includes several sources of data:

1. Field survey data collected by FEMA (October 2010 beach survey data used by FEMA) (FEMA,2010)
2. National Coastal Mapping Program 2010 LiDAR (Wrightsville Beach updated topography) [National Oceanic and Atmospheric Administration (NOAA), 2010]
3. North Carolina 2001 LAS (raw LiDAR data used by FEMA)

The data sources utilized for this study were generally prioritized in the order listed (i.e. field survey data supersedes all other data, then 2010 LiDAR taking priority, and finally, the 2001 LiDAR). FEMA NCFMP provided the field survey data that was incorporated directly into WHAFIS model transects (discussed in subsequent sections). All datasets were referenced to the North American Vertical Datum 1988 (NAVD88) to match the preliminary mapping datum.

The 2010 LiDAR, which only covers the Wrightsville Beach barrier island portion of the study site, is an updated and more detailed and accurate dataset than the 2001 LiDAR that FEMA utilized. The 2010 data was obtained from NOAA Digital Coast (http://www.csc.noaa.gov/digitalcoast/, see Appendix C for LiDAR metadata) and processed for the Wrightsville Beach island area as an improvement on the less detailed topography utilized for the preliminary mapping efforts. Data was downloaded in Geotiff/raster (DEM) format, with a horizontal resolution of 3 ft.

The 2001 LiDAR data was also obtained from NOAA Digital Coast (see Appendix D for LiDAR metadata) and processed for the site and immediate surroundings. The 2001 LiDAR data coverage is much larger than the 2010 data, which was limited to the Wrightsville Beach barrier island. The 2001 dataset is only available in LASer (LAS) file format, a public binary file format for the interchange of 3-dimensional point cloud data. The LAS data was processed in ESRI ArcGIS 9.3 software. The LAS data was "unclassified," which means that LiDAR data points included return signals from trees, buildings, and other objects, in addition to bare-earth ground points. ATM used standard methodology to process the LAS data to classify and remove all non-ground points, leaving only bare-earth topography. Only the last return signals were classified as "ground points," and an extra fine granularity was used for improved resolution and processing. Finally, a step threshold was placed on data points and processed to remove non-ground returns, such as buildings and trees. The resulting bare-earth TIN was merged with 2010 LiDAR DEM.

3.2.3 TOPOGRAPHIC DATA ANALYSIS

Figure 6 shows a comparison of the topography utilized in the preliminary FEMA mapping and the processed NOAA Digital Coast LiDAR datasets ATM utilized for the current study.

The FEMA topographic data generally exhibit lower elevations than the updated datasets used for the current study. The ground-classified, bare-earth 2010 National Coastal Mapping LiDAR dataset is be considered improved and more accurate data along the Wrightsville Beach barrier island. To verify the processed 2001 LAS topographic dataset utilized for the current study in the vicinity of Harbor Island, a site-specific survey was conducted to determine ground truth elevations throughout the project area (Robert H. Goslee & Associates, PA, 2015 - See Appendix E).

Figure 7 shows the locations of surveyed elevation points. Points were focused along the preliminary FEMA mapping transects and specifically located along the large main road (Causeway Drive) running through Harbor Island. The fixed nature (constant elevation) and open space (no trees or buildings to interfere with raw LiDAR data collection and subsequent processing) along Causeway Drive make an ideal location for comparing 2001 LiDAR data to recent topographic survey points. Table 2 summarizes the comparison of the survey data to FEMA's DEM used in the preliminary mapping and the updated topographic dataset utilized for the current study.

Table 2. Comparison of Topographic Datasets with Site Surveys

	Difference	FEMA Preliminary Mapping Topographic Dataset	Updated Topographic Dataset
Causeway Drive Survey Points	Maximum Difference	-1.00 ft	0.52 ft
	Average Difference	-1.25 ft	0.21 ft
	Minimum Difference	-1.48 ft	-0.48 ft
All Survey Points	Maximum Difference	2.85 ft	2.33 ft
	Average Difference	-0.91 ft	0.44 ft
	Minimum Difference	-6.34 ft	-3.50 ft

Note: *Positive Values Indicate Dataset Elevations Higher than Survey Data, Negative Values Indicated Dataset Elevations Lower than Survey Data*

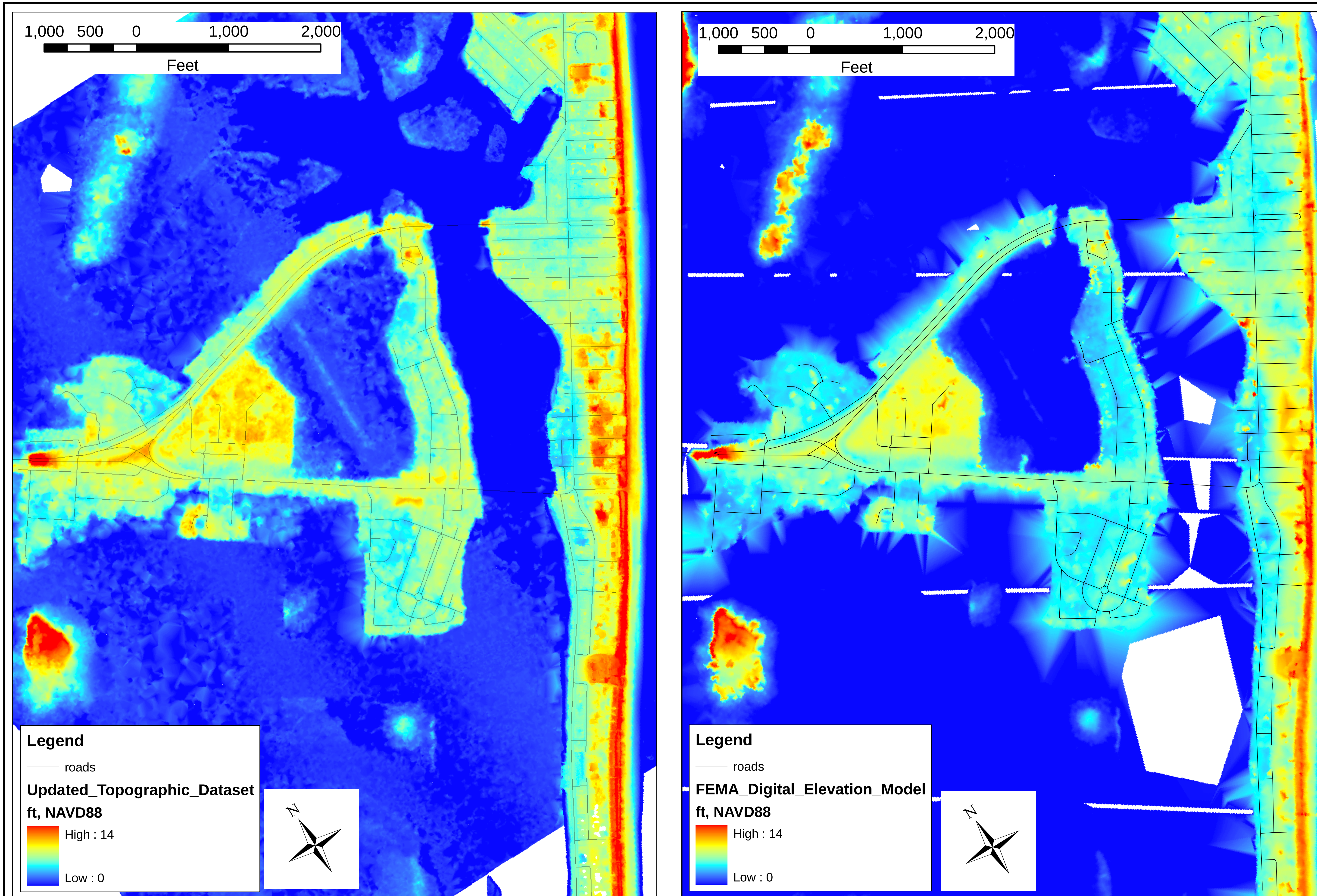


Figure 6. Comparison of Updated Topographic Dataset Utilized for the Current Study (left panel) and the Digital Elevation Model (DEM) (rigth panel) Used by FEMA for Preliminary Mapping Efforts. Roadway Lines Shown for Reference.

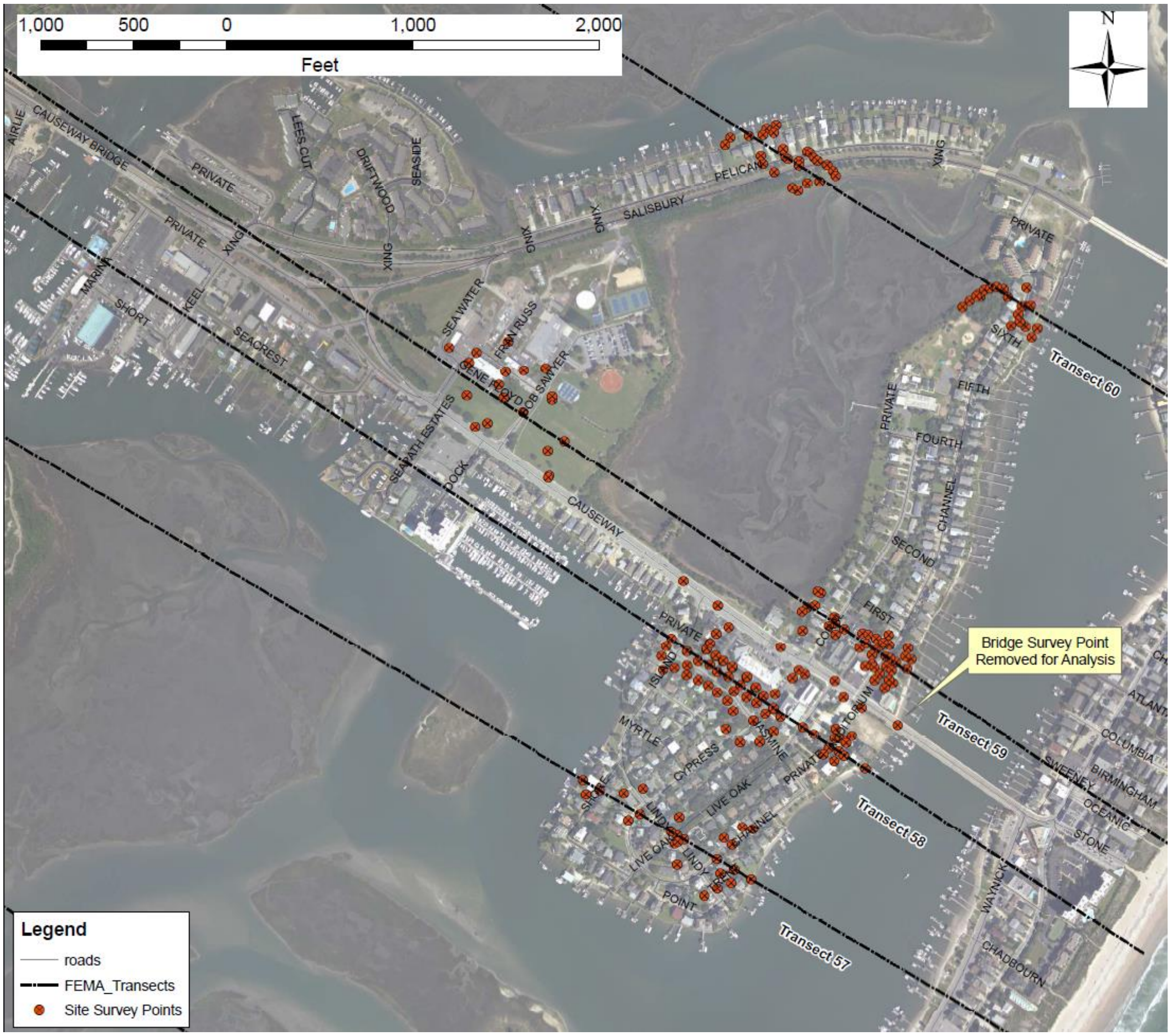


Figure 7. Locations of Site-Specific Survey Elevation Data Points. WHAFIS Analysis Transects Shown for Reference. Note Bridge Survey Point Removed for Analysis with FEMA and Updated Topography Datasets

Based on site observations and site-specific topographic survey data, the combined dataset utilized in the current study (2010 LiDAR and processed 2001 LAS) represents the best available and most accurate and detailed topography for the study area and is representative of the general conditions at the site and surrounding marshes and upland areas. This topographic dataset is considered an updated improvement on the data utilized in FEMA's preliminary mapping efforts.

It should also be noted that a new set of 2014 LiDAR topographic data was released when the current study was in its final stages. The current study relied on the previously described updated topographic dataset since incorporation of the recently released 2014 data would require duplicated efforts and was deemed impractical.

4.0 EXISTING STUDY SITE TOPOGRAPHY

Based on the updated and improved dataset used for the current study, the topography of the area (i.e., Harbor Island and Wrightsville Beach) varies by location (Figure 8). Along the Atlantic coast, the Wrightsville Beach dune system reaches heights of more than 16 ft NAVD88, with elevations between approximately 8 and 11 ft NAVD88 generally in the interior areas of the barrier island. Elevations along Wrightsville Beach typically decrease to approximately 4 to 7 ft NAVD88 moving inland toward the Banks Channel shoreline.

Harbor Island (study site) topography generally ranges between approximately 6 and more than 9 ft NAVD88 along Banks Channel, portions of the island interior and areas along Lees Cut. Various areas maintain elevations up to more than 12 ft NAVD88 near Wrightsville Beach Park and along U.S. Highway 74/76. Small areas with lower elevation (generally between 4 and 6 ft NAVD88) are scattered throughout the developed island. Intertidal marsh within and surrounding the island typically maintains elevations between 1 and 2 ft, with more substantially vegetated islands and USACE AIWW spoil islands reaching elevations of 8 to more than 12 ft. NOAA tidal datums for Wrightsville Beach are provided in Table 3 for reference.

Table 3. NOAA Tidal Datums, Station: 8658163, Wrightsville Beach, NC

Datum	Elevation ft, NAVD88	Description
MHHW	1.77	Mean Higher-High Water
MHW	1.42	Mean High Water
NAVD88	0.0	North American Vertical Datum of 1988
MTL	-0.48	Mean Tide Level
MSL	-0.49	Mean Sea Level
DTL	-0.38	Mean Diurnal Tide Level
MLW	-2.38	Mean Low Water
MLLW	-2.53	Mean Lower-Low Water

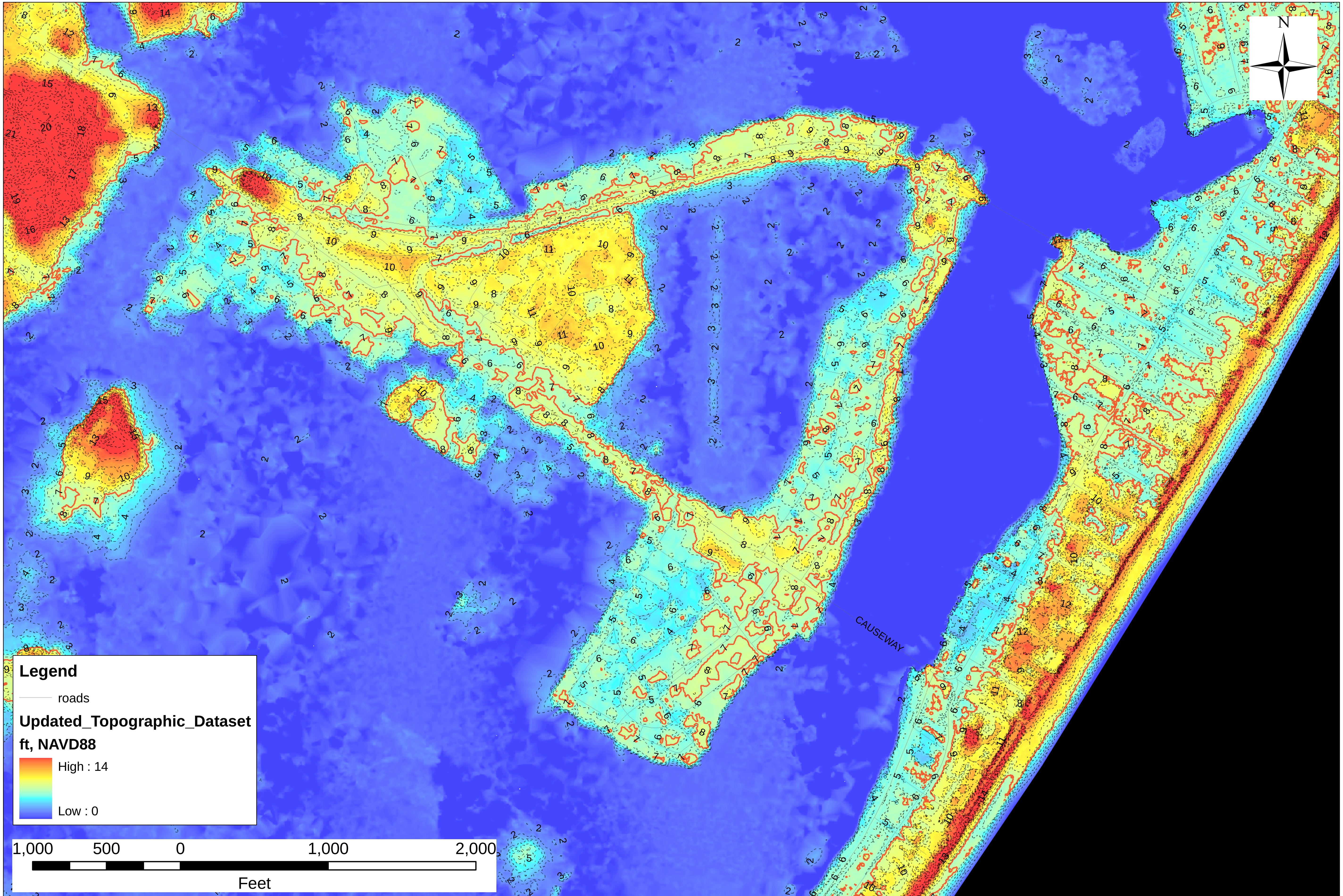


Figure 8. Study Site Topography Utilized for the Current Efforts (Merged 2001 and 2010 LiDAR Topographic Data downloaded from NOAA Digital Coast). 7 ft NAVD88 Contour Highlighted for Reference.

5.0 PRELIMINARY FEMA FLOOD HAZARDS AND ZONES

The preliminary FEMA FIRM, dated August 29, 2014, locates the Harbor Island study site within Zones VE, elevation 13-15, and AE, elevation 12-14, as shown on the August 29, 2014 New Hanover County Preliminary FIRM #3720, Panels 3157K, 3166K, and 3167K (Figures 9 through 11). The FIRM scale for the project area is 1 inch equals 500 ft for all panels. A review of the preliminary FIS for New Hanover County shows four FEMA analysis transects in the immediate vicinity of the site (Figure 12). These preliminary FIS transects are spaced approximately 550 to 2,000 ft apart along the shoreline.

Data contained in the preliminary FIS (summarized in Table 4) indicates that the 100-year still water elevation (SWEL) along the closest transects ranges from 10.7 ft NAVD88 at the Wrightsville Beach/Atlantic Ocean shoreline to 11.9 ft NAVD88 on the mainland at the terminus of the transects. This was confirmed upon review of the preliminary mapping CHAMPS/WHAFIS digital model files. The current study utilized the same spatially variable 100-year SWEL as FEMA's preliminary mapping efforts. In keeping with the preliminary FIS, wave setup along the ocean front shoreline was included in the SWEL.

Table 4. Coastal Transect Parameters (source: preliminary FIS)

Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				
	Significant Wave Height Hs (ft)	Peak Wave Period Tp (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	.2% Annual Chance
57	19.7	12.6	*	*	*	10.7	14.4
			*	*	*	10.7 - 11.6	14.3 - 15.5
59	19.7	12.6	*	*	*	10.7	14.4
			*	*	*	10.7 - 11.9	14.3 - 15.8
61	19.7	12.6	*	*	*	10.7	14.4
			*	*	*	10.7 - 11.7	14.3 - 15.6

**Excerpt from Preliminary FIS, Table 20*

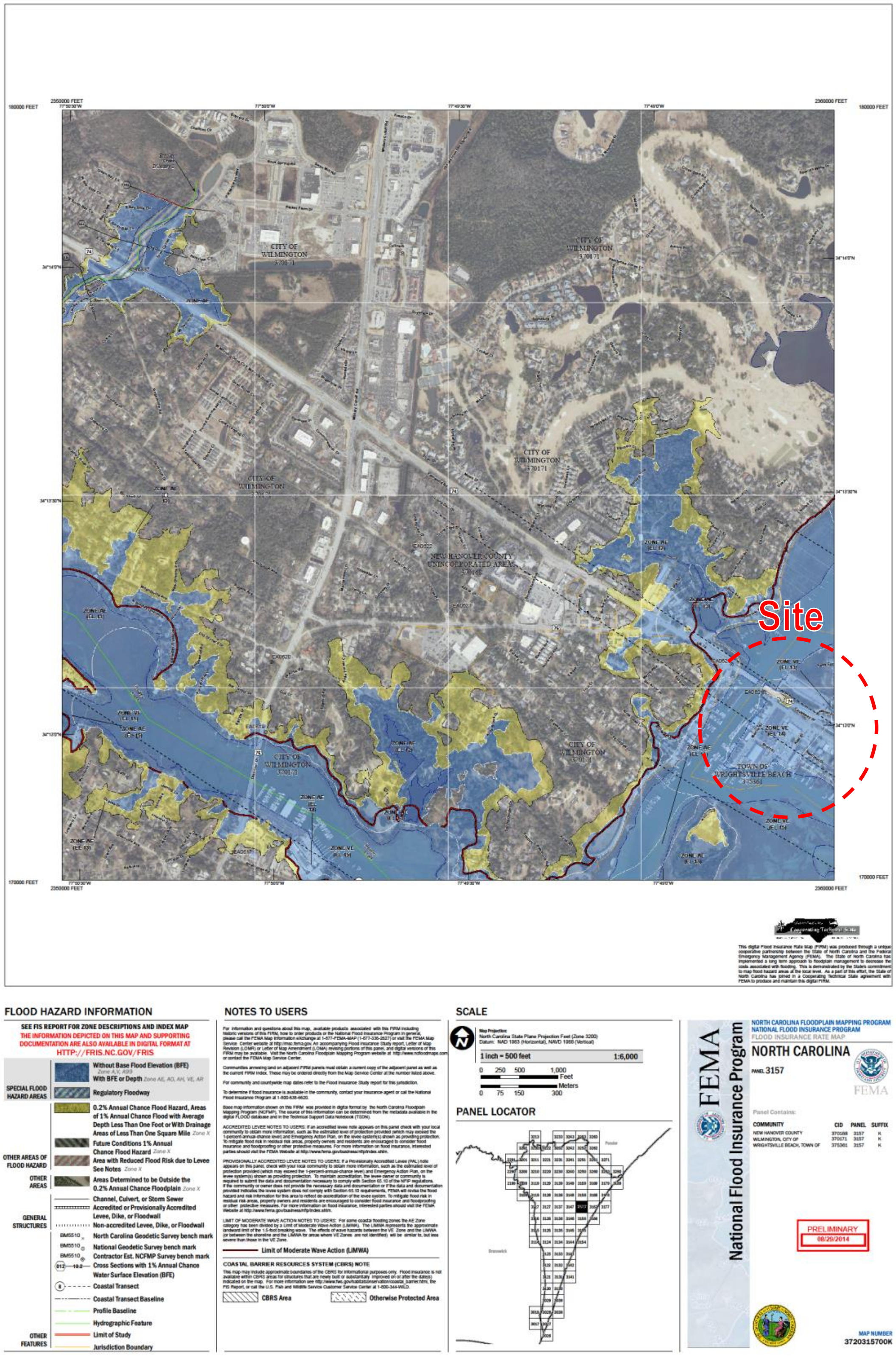


Figure 9. Preliminary FIRM Panel 3157K

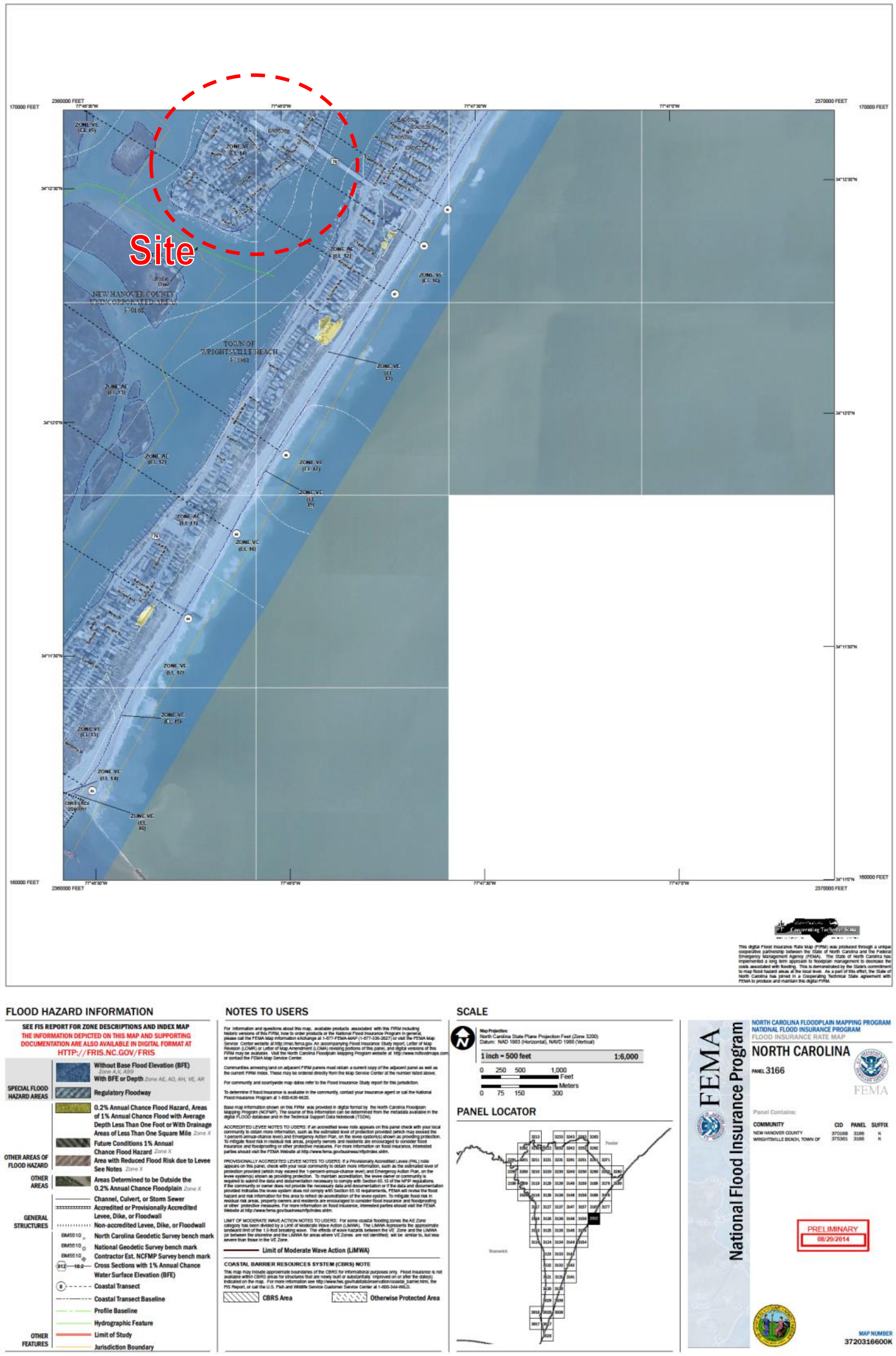


Figure 10. Preliminary FIRM Panel 3166K

Figure 11. Preliminary FIRM Panel 3167K

Figure 12. Preliminary FIS Transects (AECOM, 2013)

6.0 WHAFIS WAVE HEIGHT ANALYSIS

The revised wave modeling undertaken for this study utilized standard FEMA methodology and similar inputs as preliminary FEMA efforts for New Hanover County. Improved topographic data and BU card coefficients described in previous sections were implemented as well. Starting 100-year wave conditions (Table 4) included significant wave heights of 19.7 ft and deep water periods of 12.6 seconds, consistent with FEMA preliminary mapping efforts.

Base flood conditions at the Harbor Island site were computed using CHAMP v. 2.0 (the latest version) by running the transects from the ocean shoreline over the Wrightsville Beach barrier island, across the marsh/Harbor Island project site area and onto the upland/mainland. For consistency, the updated WHAFIS runs incorporated eroded beach/dune topographic profiles from original FEMA preliminary mapping efforts. These profiles were integrated from the beginning of the transects to the primary frontal dune heel points. Topography beyond the primary frontal dune heel was based on the previously described updated topography.

Marsh vegetation was input into WHAFIS model transects based on aerial imagery and site reconnaissance. Vegetation was defined as medium saltmeadow cordgrass, typical for this region and consistent with FEMA preliminary efforts. Overland fetch (OF) cards were used from the transect starting locations and extended to the lee side of Wrightsville Beach island (except where BU or other carding was applicable). Landward of the Wrightsville Beach barrier island, inland fetch (IF) cards were used to compute wave regeneration through "somewhat sheltered fetches and over shallow inland water bodies," as recommended by FEMA guidelines (FEMA, 2007). This is consistent with previously approved map revision projects performed by ATM at similar study settings (LOMR Case No.: 13-04-1047P, 13-04-1093P, 13-04-5644P, 13-04-6316P, 14-04-3646P, 14-04-9826P, 14-04-9102P, 15-04-0360P, 15-04-5450P, et. al.).

Results of the WHAFIS wave analysis are graphically depicted in Figures 13 through 16. WHAFIS data output files (including inputs) are provided in Appendix F, and all digital CHAMP/WHAFIS model files are included in the accompanying DVD. It is apparent from the updated WHAFIS analysis that the topographic data and BU carding coefficients utilized in the preliminary FIS/FIRM do not resolve the actual topography, obstructions and resulting realistic wave height conditions that are characteristic of the subject site. The updated analysis for the current study reveals that a majority of the Harbor Island study site should be located in FEMA Flood Hazard AE Zones (elevation 12 and 13 ft NAVD88), instead of the VE Zones shown in the preliminary FIRMs.

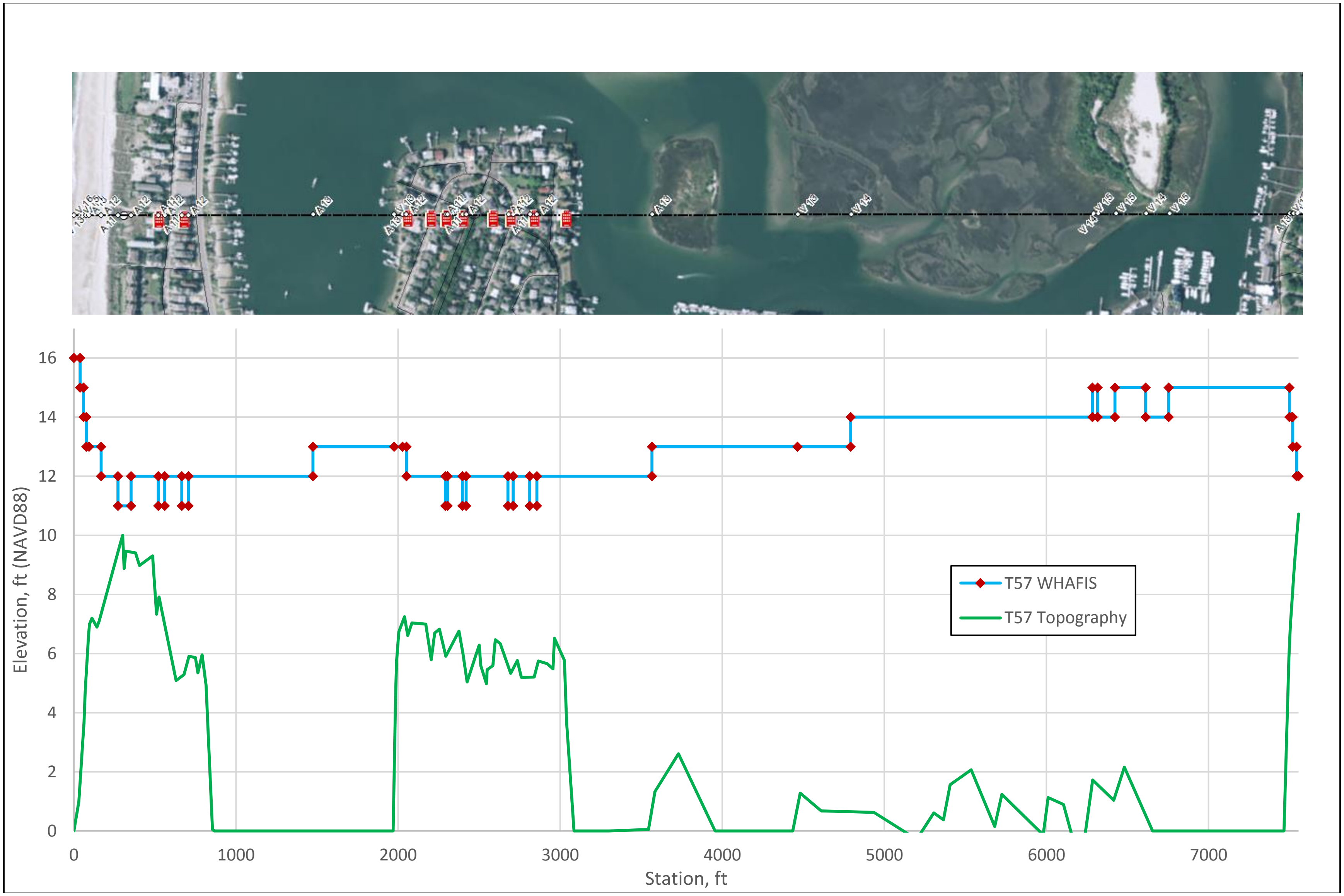


Figure 13. WHAFIS Transect 57 Input Topography and Resulting Flood Zone Designations (AE/VE line approximate, see Figure 17 and Workmap)

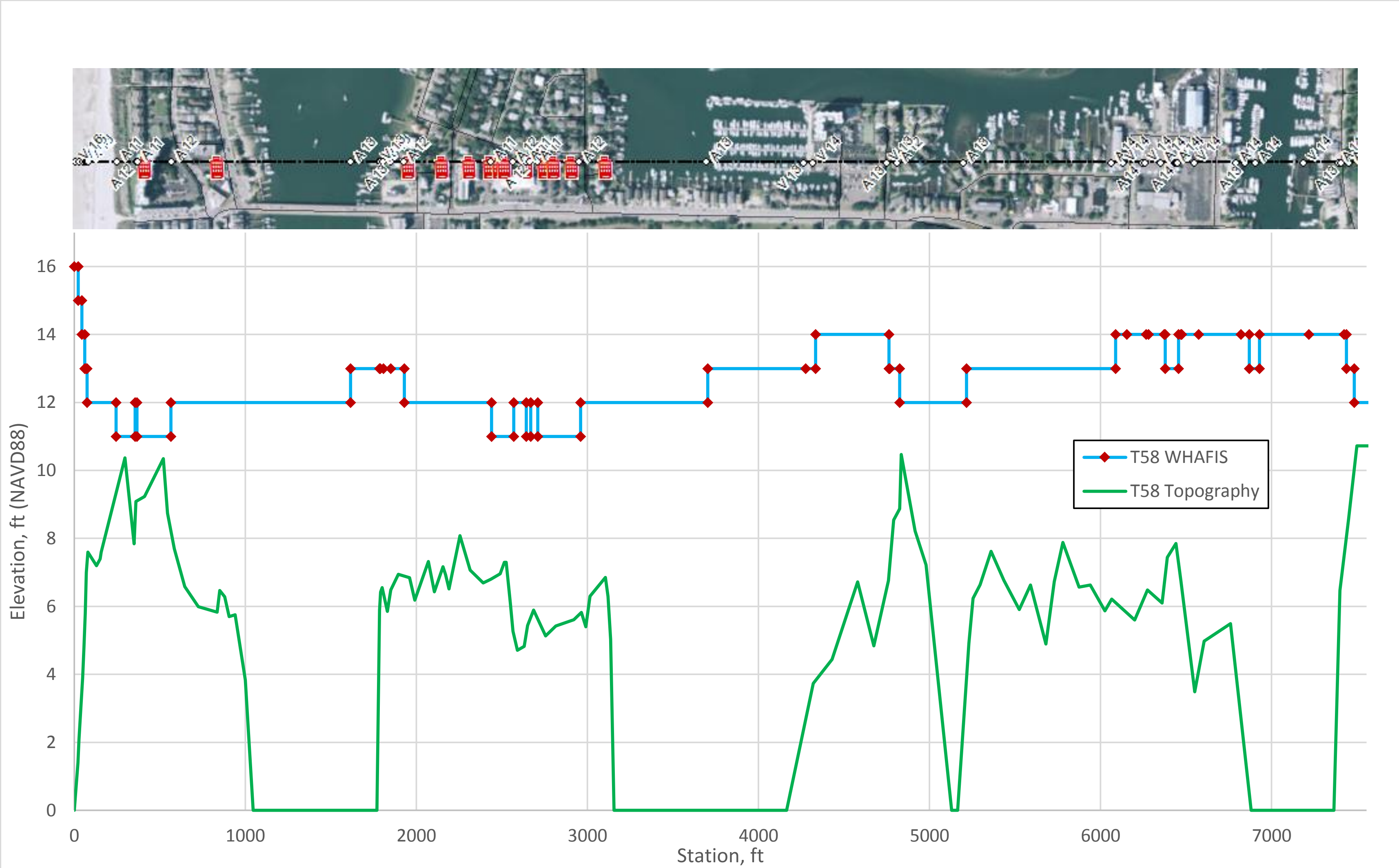


Figure 14. WHAFIS Transect 58 Input Topography and Resulting Flood Zone Designations (AE/VE line approximate, see Figure 17 and Workmap)

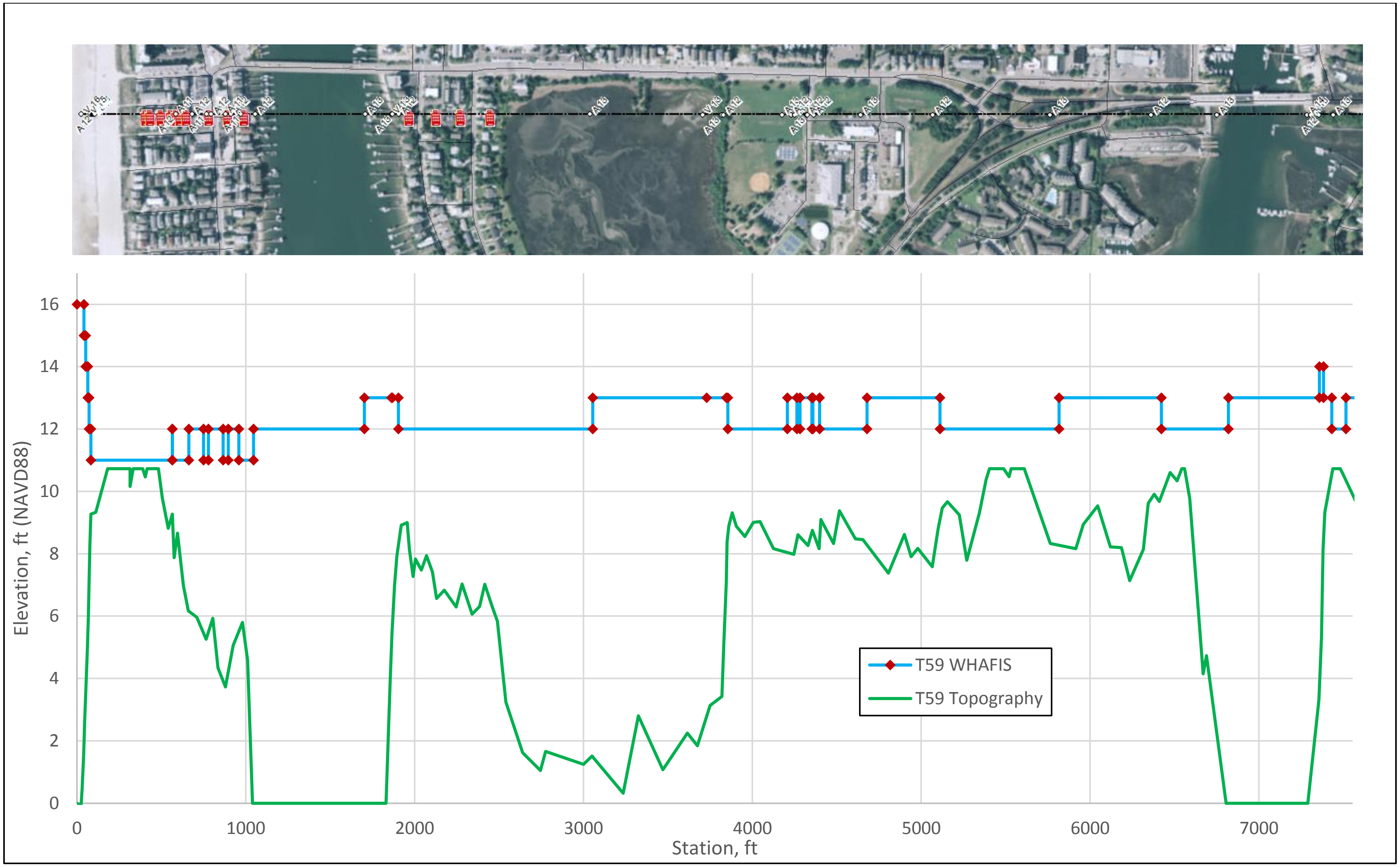


Figure 15. WHAFIS Transect 59 Input Topography and Resulting Flood Zone Designations (AE/VE line approximate, see Figure 17 and Workmap)

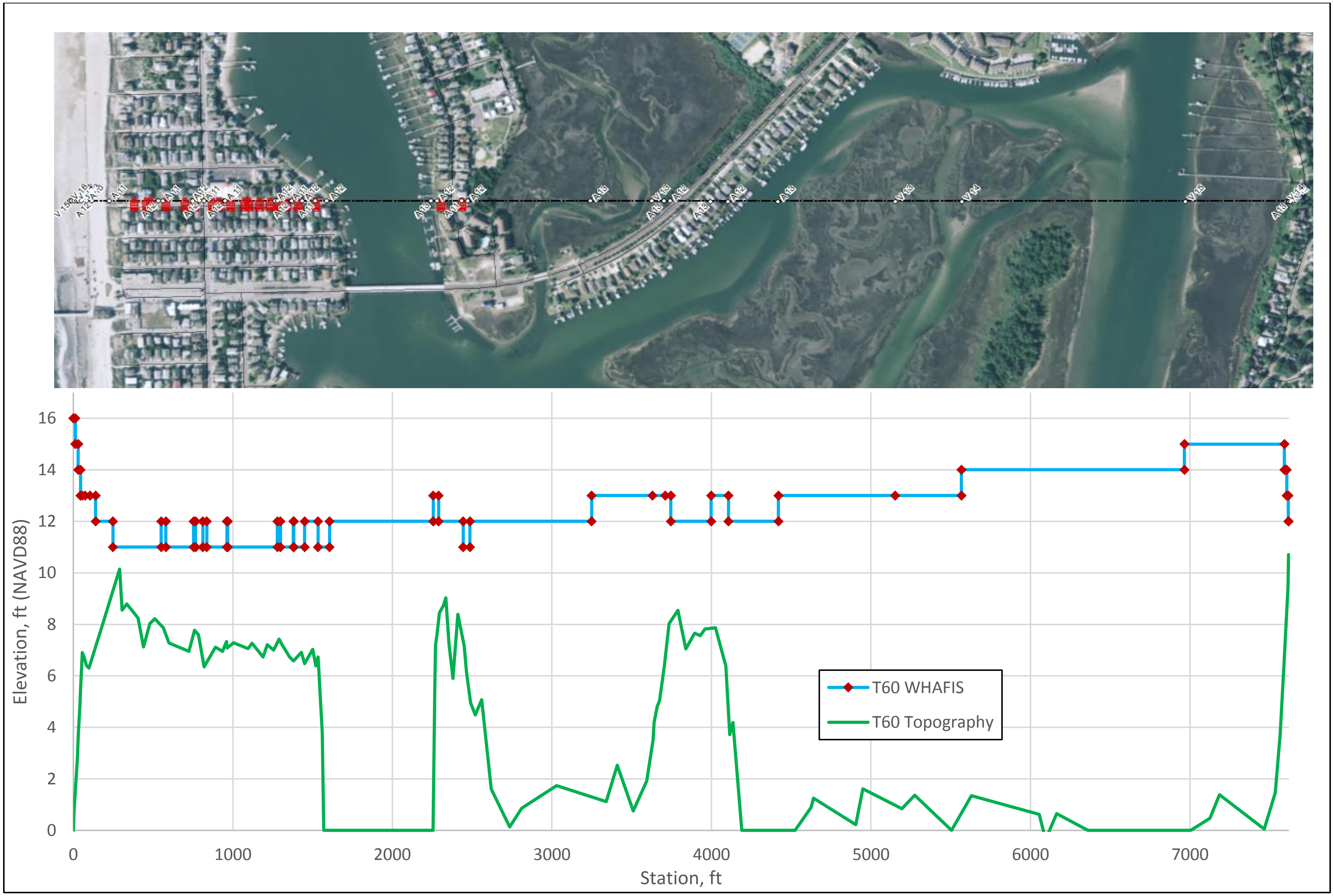


Figure 16. WHAFIS Transect 60 Input Topography and Resulting Flood Zone Designations (AE/VE line approximate, see Figure 17 and Workmap)

7.0 PROPOSED REVISED FLOOD HAZARD ZONES AND BASE FLOOD ELEVATIONS

The analyses performed herein, utilizing improved topographic data and representative WHAFIS carding methodology, show that the existing site conditions will cause the incident 100-year waves to break down further seaward than preliminary mapping illustrates. Wrightsville Beach topography and limited exposure between the site and barrier island does not realistically allow for VE zone critical wave heights to be generated as the preliminary FIRM indicates. Analyses for the current study indicate that 100-year starting wave conditions (H_s = 19.7 ft, T_p = 12.6 sec) break down to critical wave heights ranging from 0.05 ft to 0.62 ft along Wrightsville Beach (i.e., complete wave breakdown). WHAFIS model equations conservatively maintain the longer 12.6-second period to predict the purely wind-wave regeneration in the lee of the island affecting the Harbor Island study site.

WHAFIS results for Transects 57, 58 and 59 indicate small sections of VE zone wave prediction at the Harbor Island/Banks Channel shoreline. Predicted VE zones range from 5 ft to 53 ft in total width. These small areas were neglected based on the conservative 12.6-second wave period utilized by WHAFIS (and subsequent localized shoaling affects attributable to longer-than-realistic-period waves), as well as engineering judgement and map scale limitations (FIRM scale at site: 1 inch:500 ft; minimum zone width = 100 ft).

As seen in Figures 13 through 16, WHAFIS results indicate typical wave breakdown and regeneration based on local topography and actual site conditions. A majority of the subject site is predicted as AE zone (elevation 12-14 ft NAVD88), with small sections of AE (elevation 11 ft) and VE zone (elevation 13-14 ft) near higher elevations (and BU carding density) and in lower elevation areas with larger fetch expanses, respectively. Depending on localized conditions, map scale limitations and consistent mapping methodology, some of these smaller zones were merged with surrounding BFE zones.

Since Harbor Island was the sole focus of this study, preliminary FEMA mapping WHAFIS results for areas outside of the subject site were generally maintained in the proposed revision for consistency and conservatism. While WHAFIS results show AE zones landward of certain sections of the leeward Harbor Island shoreline, the sheltered fetch surrounding the island merits consideration of wind-wave generation from various directions, and AE/VE zone delineation generally “hugs the shoreline.”

In addition to flood zone delineations, all new or updated FEMA Flood Insurance Rate Map products include a line showing the Limit of Moderate Wave Action (LiMWA), which is the inland limit of the area expected to receive 1.5-foot or greater breaking wave heights during the 1-percent-annual-chance flood event. Based on WHAFIS predicted wave heights for updated transects, the LiMWA line was also adjusted to accurately reflect the revised analysis. Predicted LiMWA locations based on the revised transects match well with the preliminary LiMWA locations along the approximate mainland coastline of the AIWW. The LiMWA line along this area is proposed to remain unchanged from preliminary delineations. Within the Harbor Island study site, revised analysis predictions do alter the preliminary LiMWA line. Based on updated WHAFIS wave height predictions, preliminary and proposed revised flood zone transitions, and map scaling, a revised LiMWA delineation is proposed as seen in Figure 18.

The locations of the WHAFIS resulting flood zone gutters for the analysis transects were plotted on the preliminary FIRM map data with updated topography. Proposed flood zone delineations from the WHAFIS results were drawn to merge with the effective flood zones (including transitions back to effective delineations), utilizing both the existing topography contours and engineering judgment. Figures 17 and 18 show WHAFIS results and final proposed/revised flood hazard zone delineations for the Harbor Island study area overlaid on the topographic data and preliminary flood hazard zone delineations, respectively (full-size certified/stamped work map with more detailed information is included in Appendix G).

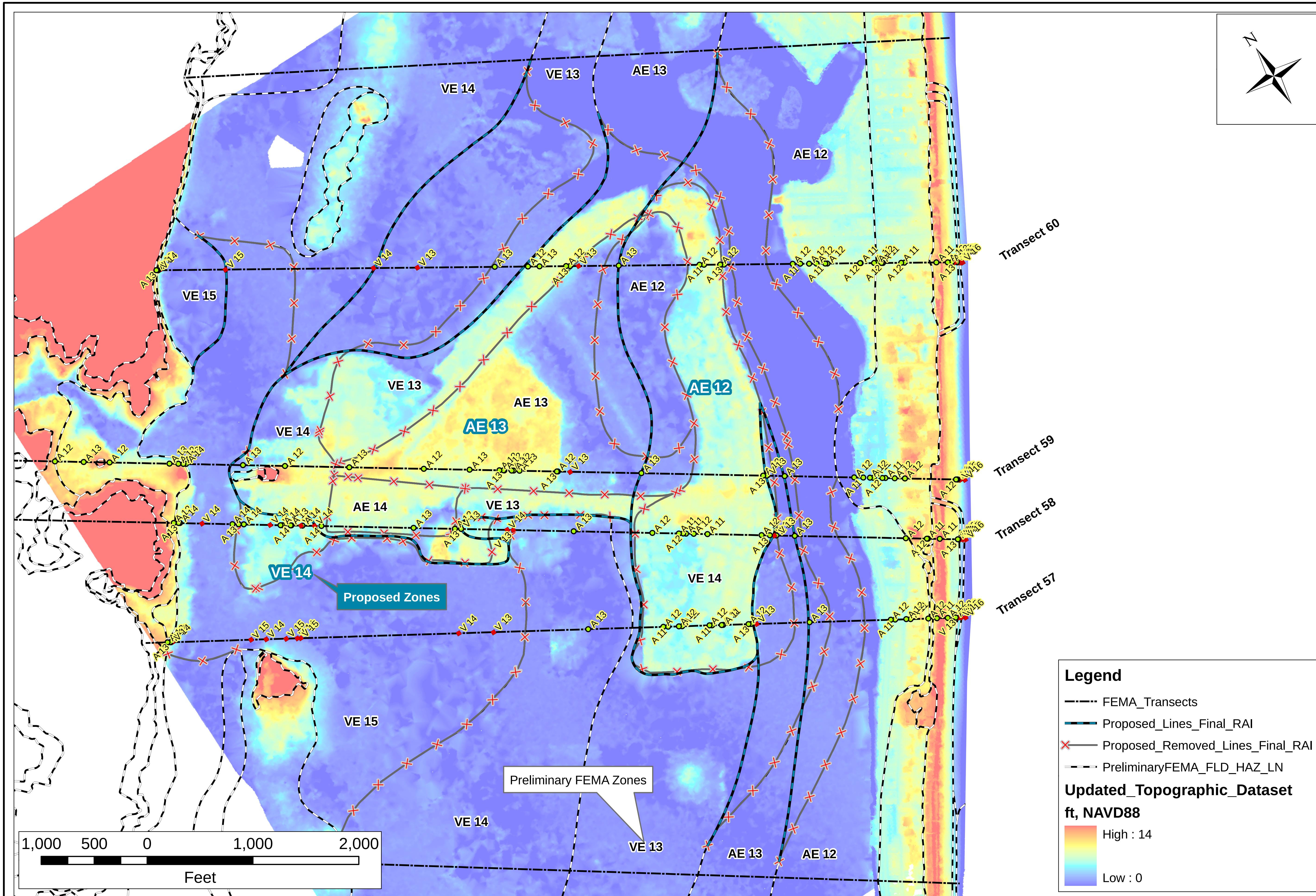


Figure 17. Detailed WHAFIS Results, Preliminary FEMA Flood Hazard Zones, and Proposed Map Revisions for Harbor Island, NC Study Site.
(Updated LiDAR Dataset Shown, Beach Profile Survey Transect Topo not shown for clarity)

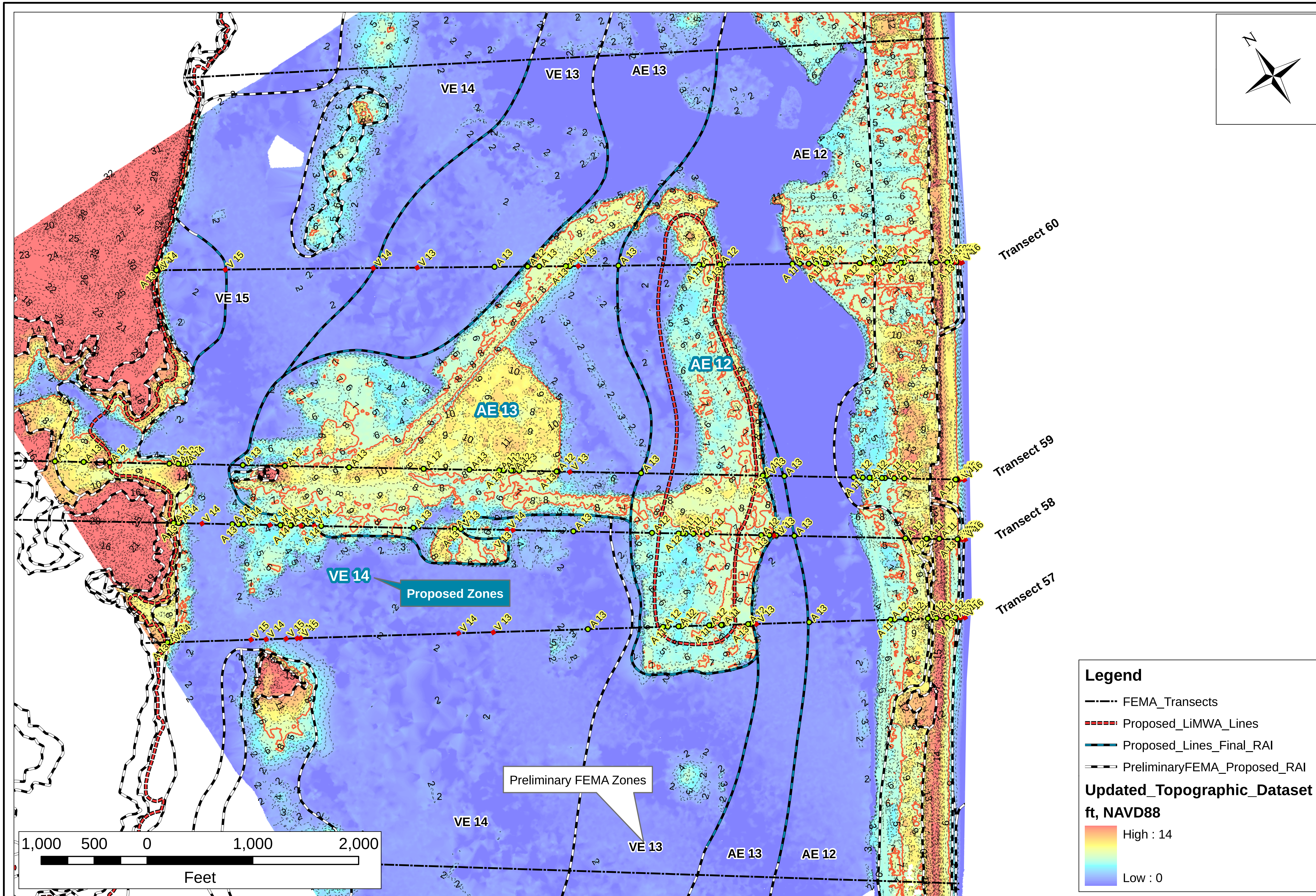


Figure 18. Detailed WHAFIS Results and Preliminary FEMA Flood Hazard Zones merged with Proposed Map Revisions for Harbor Island, NC Study Site. (Updated LiDAR Dataset Shown, Beach Profile Survey Transect Topo not shown for clarity. 7 ft NAVD88 contour highlighted for reference).

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