STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

ROY COOPER
GOVERNOR

JAMES H. TROGDON, III
SECRETARY

December 14, 2018

Mr. Hal R. Pitts
USCG-Fifth CG District
431 Crawford Street
Portsmouth, VA 23704-5004

Subject: US Coast Guard Bridge Permit Request for the Proposed Replacement of Bridge No. 73 (Earl C. Davis Memorial Bridge) and Bridge No. 96 on SR 1332/1335 (Harkers Island Rd.) over The Straits in Carteret County, North Carolina; TIP Project B-4863, Federal Aid Project No. BRSTP-1335(4); WBS Element 40212.1.3

Dear Mr. Pitts,

Application is hereby made for a Coast Guard bridge permit and permit amendment.

A. ADMINISTRATIVE AND NAVIGATION INFORMATION

Application Date: December 14, 2018

a. Applicant information:

1) Name: North Carolina Department of Transportation

2) Address: 1000 Birch Ridge Drive, Raleigh, NC 27610

3) Telephone number: 919-707-6111

4) Email address: jldilday@ncdot.gov

b. Consultant/Agent information (if employed): Consultant/Agent Information Not Applicable

1) Name (company or individual):

2) Address:

3) Telephone number:

4) Email address:

5) Letter authorizing a consultant/agent to obtain permits on behalf of the applicant included:
☐ Yes ☐ No

Mailing Address:
NC DEPARTMENT OF TRANSPORTATION
ENVIRONMENT ANALYSIS UNIT
1598 MAIL SERVICE CENTER
RALEIGH NC 27699-1598

Telephone: (919) 707-6000
Fax: (919) 212-5785
Customer Service: 1-877-368-4968
Website: www.ncdot.gov

Location:
1000 BIRCH RIDGE DRIVE
RALEIGH NC 27610

c. Name of Proposed Bridge(s): Replacement Bridge for Bridge No.'s 73 and 96

1) Name of the waterway that the bridge(s) would cross: The Straits

2) Number of miles above the mouth of the waterway where the bridge(s) would be located and provide latitude and longitude coordinates (degree/minute/second) at centerline of navigation channel (contact the local Coast Guard Bridge Office for guidance): The new bridge is proposed near the confluence of North River and Back Sound and is approximately 6 miles northeast of the Beaufort inlet. The centerline of the navigation channel (where the current swing bridge is located) is 34° 42' 57.24", -76° 34' 40.88".

3) City or town, county/parish, and state where the bridge(s) would be located at, near, or between: Harkers Island, Carteret County, North Carolina

4) Brief description of project to include type of bridge(s) proposed [fixed or movable (drawbridge, bascule, vertical lift, swing span, pontoon), highway, railway, pedestrian, pipeline] and existing bridge(s) at project site, if applicable: The proposed project involves the replacement of Bridge Nos. 73 and 96 over The Straits with a new, single fixed span bridge that will provide vehicular access to Harkers Island. The replacement of Bridge No. 73 entails the removal of the swing span bridge that is currently used to allow for naval passage using top-down removal methods and barge access. Bridge No. 96 will be retained as pedestrian access to the existing fishing pier (note that the existing fishing pier was destroyed during Hurricane Florence but is scheduled to be replaced). Work platforms will be required for the construction of the proposed Bridge 73. Traffic will be maintained onsite during construction of the project.

5) Drawbridge Regulations (if applicable): N/A

6) Date of plans and number of plan sheets: 10/1/2018; 7 plan sheets. See Appendix A.

7) Estimated cost of bridge(s) and approaches:

Provide the estimated cost of the bridge(s) as proposed, with vertical and horizontal navigational clearances: $34,000,000

Provide the estimated cost of a low-level bridge(s) on the same alignment with only sufficient clearance to pass high water while meeting the intended purpose and need: A low-level bridge would not meet the purpose and need of the project; therefore, no cost was estimated.

8) Type and source of project funding (federal, state, private, etc.): Federal

9) Proposed project timeline: Mobilization is proposed to begin in August 2019, with in-water construction scheduled to begin in October 2019. Proposed bridge completion is 2023 and demolition of the existing bridge 73 is scheduled for 2024.

10) Other Federal actions (e.g., permits, approvals, funding, etc.) associated with the proposal:

- US Army Corps of Engineers (USACE) Section 404 Permit, Section 10 Permit, Section 408 Approval
- National Marine Fisheries Service (NMFS) concurrence for Endangered Species Act listed species

- Additional federal agency concurrence through the National Environmental Policy Act/404 NCDOT Merger Process (US Environmental Protection Agency, US Fish and Wildlife Service, Federal Highway Administration)

d. Legal authority for proposed action:

1) Cite appropriate Bridge Act: General Bridge Act of 1946

2) If not the owner of the existing bridge(s) that is being replaced or modified, include a signed statement from the bridge owner authorizing the removal or modification work and cite its location: Not Applicable.

3) For privately owned bridges, cite authorization for right to build (e.g. deed or easement from the property owner authorizing the proposed construction or modification work): The proposed bridge will be a publicly owned bridge.

e. International bridges (if applicable): N/A

1) Cite the International Bridge Act of 1972, or a copy of the Special Act of Congress if constructed prior to 1972, as the legislative authority for international bridge construction: Not Applicable.

2) For permits issued under the International Bridge Act of 1972, cite Presidential approval, via the State Department, included with the application as required: Not Applicable.

NOTE: Please include a copy of State Department approval for international bridges in the application package for a Coast Guard bridge permit.

f. Dimensions of the proposed bridge(s):

1) Vertical clearance as indicated on plan sheets: MHW = 45.0'; MLW = 46.5'

2) Horizontal clearance as indicated on plan sheets: Channel Clearance = 125.0'

3) Length of bridge(s) project: 3,200'

If no prior permit exists, and this is a modification or replacement project, is the length the same as the old bridge: No

If not, what is the difference: +1,217'

4) Width of bridge(s) project: 34.6'

If no prior permit exists, and this is a modification or replacement project, is the width the same as the old bridge: No

If not, what is the difference: +5'

5) Depth of the waterway at project site at MHW if tidal or OHW if non-tidal, using the appropriate elevation and datum (e.g., NGVD 1929, NAVD 1988, etc.): Navigable channel depth at MHW: 14.5' and MLW: 13'

6) Width of waterway at project site at MHW if tidal or OHW if non-tidal: Approximately

0.6 to 0.7 mile.

7) Significant effect on flood heights and associated drift, if any that could cause a navigation hazard: There will be no effect on flood heights and associated drift. The proposed structure is approximately 4,500 ft. from the next closest navigational channel (indicated on NOAA Office of Coast Survey map 11545; this channel is not maintained by the U.S. Army Corps of Engineers).

g. Temporary Bridge(s) dimensions (vertical clearance, horizontal clearance, length and width), if applicable: An approximately 40 ft. wide temporary work bridge is proposed that will consist of two structures: one that extends from Harkers Island (approx. 810 ft. long) and one that extends from the mainland (approx. 2,290 ft. long). These structures will be separated by a minimum horizontal nautical clearance (HNC) of 125 ft. at the navigable channel for the entirety of project construction. The split segment temporary work bridge will allow the vertical nautical clearance (VNC) of existing Bridge No. 73 to remain until the proposed bridge girders are in place, in which case the proposed bridge's 45 ft. VNC would be provided.

h. [Include the following language, if applicable] Enclosed are the waterway data requirements as determined by the Coast Guard District Bridge Office. If a navigation impact report was conducted please cite location(s) in the case file, list title and date of document as appropriate: A "Navigational Impact Report for the Harkers Island Bridge Replacements Project" was completed in May 2018.

i. Existing bridge(s) if applicable:

1) Name of bridge(s): Bridge No. 73 (Earl C. Davis Memorial Bridge); Bridge No. 96

2) Type of bridge(s) and number of lanes (e.g., fixed or moveable (drawbridge, bascule, vertical lift, swing span, pontoon, etc.); highway, railway, pedestrian, pipeline):

Bridge No. 73: Steel Plate Girder Swing Span and fixed cored slab approach spans with two lanes of highway traffic.

Bridge No. 96: Fixed cored slab spans with two lanes of highway traffic.

3) For movable spans identify the existing drawbridge operating regulation governing the structure (e.g. 33 CFR 117.XXX, if applicable): 33 CFR 117.5; open upon request or signal.

When applicable, identify if the local Coast Guard Bridge Office identified that modification of an existing drawbridge requires revision or removal of the existing regulation (e.g. if the bridge project involves replacing the existing drawbridge with a fixed bridge): Not Applicable.

<u>NOTE</u>: If the waterway is not already identified in 117 Subpart B, please note if an operating schedule other than open on demand is being considered.

4) Latitude and longitude coordinates (degree/minute/second) at centerline of the bridge(s):

Bridge No. 73: Latitude 34°-42'-58.64" Longitude 76°-34'-40.51"

Bridge No. 96: Latitude 34°-43'-13.64" Longitude 76°-34'-32.60"

5) Dimensions of the existing bridge(s):

a) Vertical clearance(s) as indicated on previous plan sheets (include both the open and closed-to-navigation clearances for movable spans). [The proposed and existing vertical clearances must be compared using the same datums. This may require surveying the existing bridge]:

Bridge No. 73 (closed position): 14' at MHW

Bridge No. 96: 0' (indicates large vessels not meant to travel beneath)

b) Horizontal clearance as indicated on previous plan sheets:

Bridge No. 73: 36' (between fenders)

Bridge No. 96: 0' (indicates large vessels not meant to travel through)

c) Length of existing bridge(s):

Bridge No. 73: 1,396'

Bridge No. 96: 587.1'

d) Width of existing bridge(s):

Bridge No. 73: 30.3'

Bridge No. 96: 30.0'

6) Owner of the existing bridge(s): North Carolina Department of Transportation

j. Discuss construction methodology, if known, and removal of existing bridge(s), as applicable:

1) Discuss proposed construction methodology and restrictions: A temporary work platform is proposed to access the new bridge alignment except for the

navigation span, where barge access will be used. In-water work is restricted to October 1-March 31 (except within approved exclusion devices) due to a moratorium imposed by the NC Division of Marine Fisheries.

2) Discuss maintenance of land traffic during construction activities: Land traffic will be maintained on the existing structures during construction.

3) Discuss extent of removal of existing bridge(s) (e.g. in its entirety, two feet below the mud line, down to or below the natural bottom of the waterway or to a specific elevation), time needed for removal, etc.: Existing Bridge No. 73 will be removed completely, including piles, to the extent practicable. Due to NCDCM requirements, if a pile snaps off at a depth below scour and navigational clearance, and would require significant disturbance of substrate to remove, it will be cut at the mudline.. Bridge No. 96 will be left in place as a pedestrian bridge.

4) Discuss demolition methodology: Demolition of existing Bridge No. 73 will be accomplished through top-down and/or barge access, with no work platform required. Non-shattering methods will be implemented (no explosives) for bridge removal.

<u>NOTE</u>: In the interest of navigational safety, the Coast Guard must make the final decision concerning the extent of bridge(s) removal.

k. Other agencies with jurisdiction over the proposed project:

1) Agency:

US Army Corps of Engineers (USACE)
NC Division of Water Resources (NCDWR)
NC Division of Coastal Management (NCDCM)

2) Permits or type of approvals required for the project:

- USACE Section 404 Permit, Section 10 Permit, Section 408 Approval
- NCDWR Section 401 Water Quality Certification
- NCDCM Coastal Area Management Act (CAMA) Permit
- National Marine Fisheries Service (NMFS) concurrence for Endangered Species Act listed species
- Additional federal and state agency concurrence through the National Environmental Policy Act/404 NCDOT Merger process (US Environmental Protection Agency, US Fish and Wildlife Service, Federal Highway Administration, NC Wildlife Resource Commission)

B. ENVIRONMENTAL INFORMATION:

1. National Environmental Policy Act

Lead Federal Agency: Federal Highway Administration

List Cooperating Agencies for project: No additional Federal Cooperating Agencies

a. Type of environmental document.

☐ Environmental Impact Statement/Record of Decision (EIS/ROD)

Cite location(s) in the application package:

☐ Environmental Assessment/Finding of No Significant Impact (EA/FONSI)

Cite location(s) in the application package:

☒ Categorical Exclusion (CE)

Cite location(s) in the application package: See Appendix B

b. Has the environmental document been modified, reevaluated, supplemented or rescinded for the proposed action?

☐ Yes ☒ No

If yes, cite location(s) in the application package:

2. Environmental Effects Abroad

a. Does the proposed project involve a bridge connection to Canada or Mexico?

☐ Yes ☒ No

If yes, cite location(s) in NEPA document where environmental effects abroad are described:

3. Clean Water Act

a. Has a Water Quality Certification (WQC), waiver or statement that the WQC is not required been obtained from the appropriate federal, interstate, or state agency?

☐ Yes ☒ No

If yes, cite location(s) in the application package: A 401 permit application was submitted to the NCDWR on December 6, 2018.

NOTE: The USCG will not accept an application package as complete if a WQC, waiver, or statement from the appropriate regulatory body has not been obtained.

b. Name of the Federal, State or Tribal certifying agency and point of contact with phone and email address, if available: Joanne Steenhuis NCDWR, (910) 796-7306 joanne.steenhuis@ncdenr.gov

c. If the WQC is granted under a Programmatic Agreement (e.g., U.S. Army Corps of Engineers (USACE) Nationwide Permit (NWP) include the date of the NWP, the type of NWP (14, 15, etc.) and the NWP number and title:

When issued, the WQC will correspond with Nationwide Permit 14 (Linear Transportation Projects) approved by the USACE (WQC 4135).

d. For permit amendment actions, include a new WQC or a written confirmation from the certifying agency that the existing WQC has been reissued/renewed or is still valid for the proposed action.

☐ New WQC Attached

☐ Written Confirmation of WQC validity attached

Wetlands

a. Is the proposed project located in or adjacent to a wetland?

☒ Yes ☐ No

b. If yes, what is the acreage of wetlands that will be permanently and temporarily impacted by the proposed project?: 0.07 acre (permanent); 0.14 (temporary)

Include USACE permit (nationwide authorization or individual), if required, and cite where wetland mitigation measures are described in the application package: On-site wetland mitigation is being proposed to compensate for coastal wetland loss. The wetland mitigation plan is attached as Appendix C to this permit application. A Section 404 NW 14 permit application was submitted to the USACE on December 6, 2018.

Coastal Zone Management Act - The Coastal Zone Management Act **(**CZMA**)** of 1972 (16 U.S.C. § 1451), as amended, and its implementing regulations (15 CFR Part 930), requires all projects located within the designated coastal zone of a state to be consistent with the State's federally approved CZM plan (CZMP).

a. Is the project located in a state that has an approved Coastal Zone Management Act Plan (CZMP)?

☒ Yes ☐ No

b. If yes, is the project within an area included in the federally approved CZMP?

☒ Yes ☐ No

c. If yes, has the State specifically excluded this activity from its federally approved CZMP?
☐ Yes ☒ No

Include State CZM concurrence/with consistency certification and cite location(s) in the application package: An application for a Coastal Area Management Act (CAMA) Major Development Permit was submitted to the NC Division of Coastal Management on December 5, 2018.

Floodplains

a. Is the proposed project located in the base floodplain? An encroachment into the base floodplain does not exist when only the piers, pilings, or pile bents are located in the floodplain.

☒ Yes ☐ No

b. Is there a significant encroachment (constituting a considerable probability of loss of human life; likely future damage associated with the encroachment that could be substantial in cost or extent; or a notable adverse impact on natural and beneficial floodplain values) into the floodplain?
☐ Yes ☒ No

c. If yes, provide documentation and cite location(s) in the application package:

Wild and Scenic Rivers

a. Is the river involved in the proposed bridge project a designated Wild and Scenic River?

☐ Yes ☒ No

b. If yes, attach correspondence with the river-administering agency and cite location(s) in the application package:

Coastal Barrier Resources Act

a. Does the proposed project connect to a unit of the Coastal Barrier Resources System?

☐ Yes ☒ No

b. If yes, and the project is federally funded, cite location of Section 6 exception in the application package and any correspondence with the FWS:

Land and Water Conservation Fund Act

a. Does the proposed project involve a conversion of land or facilities funded under Section 6(f) of the Land and Water Conservation Fund Act?

☐ Yes ☒ No

b. If yes, include correspondence with the NPS and authorization from the Secretary of the Interior for that conversion and cite location(s) in the application package:

National Marine Sanctuaries Act

a. Is the proposed project in or adjacent to a National Marine Sanctuary?

☐ Yes ☒ No

b. Is the proposed bridge(s) likely to destroy, cause loss of, or injure a resource of a National Marine Sanctuary? (If no, provide evidence) Project is not within a National Marine Sanctuary.
☐ Yes ☒ No

c. If yes, include evidence of consultation with Office of National Marine Sanctuaries and the agency's findings/conditions and cite location(s) in the application package:

Marine Protected Areas

a. Is the proposed project in or adjacent to a Marine Protected Area (MPA) as defined in section 4(d) of Executive Order 13158?
☒ Yes ☐ No

b. If yes, will the proposed project affect the natural or cultural resources that are protected by the MPA? (If no, provide evidence)
☐ Yes ☒ No

The Straits is a 'mechanical harvesting of oysters prohibited area' MPA. Permanent impacts to surface waters from new bridge piles is minimal (0.02 acre), which will not adversely affect the natural resources protected by the MPA.

c. If yes, include evidence of correspondence with MPA Center, if applicable, and cite location(s) in the application package:

Endangered Species Act

a. Are there federally designated threatened or endangered species and/or critical habitat in the area that the proposed project is located? (If no, provide evidence)
☒ Yes ☐ No

b. May the proposed project affect federally designated threatened or endangered species and/or critical habitat? (If no, provide evidence)

☒ Yes ☐ No

c. If yes, was there formal or informal consultation with the United States Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS)?
☐ Formal consultation

☒ Informal consultation

d. If formal, provide date(s) and attach biological assessment, biological opinion, and any other relevant correspondence and cite location(s) in application package:

e. If informal, provide dates and include correspondence or documented phone conversations with and from USFWS/NMFS and cite location(s) in the application package: ESA Section 7 concurrence was received from NMFS for green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, and Atlantic and shortnose sturgeons in September 2018 and is attached here as Appendix D.

The US Fish and Wildlife Service has developed a programmatic biological opinion (PBO) in conjunction with the Federal Highway Administration, the US Army Corps of Engineers and NCDOT for the northern long-eared bat in eastern North Carolina. The PBO covers the entire NCDOT program in Divisions 1-8 (B-4863 is in Division 2), including all NCDOT projects and activities.

f. Include Biological Assessment/Biological Evaluation, as appropriate. Not Applicable.

Fish and Wildlife Coordination Act

a. Include any correspondence with USFWS and the relevant state wildlife agency regarding Fish and Wildlife Coordination Act coordination and cite location(s) in the application package:

Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA)

Will the proposed project likely adversely affect designated Essential Fish Habitats (EFH) as defined in the Magnuson-Stevens Act? (If no, provide evidence)

☐ Yes ☒ No

b. Identify location of EFH assessment and relevant correspondence with NMFS in the application package: The National Marine Fisheries Service (NMFS) has identified the Straits as an Essential Fish Habitat. Table 1 lists the fish species that may occur in the study area that are managed under MSFCMA (species listed by NMFS for the Straits), including the life stages which are known to occur.

Table 1. Commercial fish species reported to occur in the project area

Species	Life Stage
Red drum	E, L, J, A
Bluefish	J, A
Summer flounder	L, J, A
Brown shrimp	L, J, A
Pink Shrimp	L, J, A
White Shrimp	L, J, A
Cobia	J,A
King Mackerel	J, A
Spanish Mackerel	L, J, A
Smooth Dogfish	J
Small Coastal Sharks	J, A
Prohibited/Research Sharks	J, A
Black Sea Bass	L, J, A
Rock Sea Bass	J
Gag	J
Black Grouper	J
Gray Snapper	J
Yellow Jack	J
Blue Runner	J
Crevalle Jack	J
Bar Jack	J
Sheepshead	J, A

The proposed project will require that the existing structure over the Straits be removed and a new structure built in proximity. The new bridge structure will require footings to be placed within the Straits, though there will only be 108 square feet of direct permanent impacts to submerged aquatic vegetation (SAV) due to installation of bridge piles. In addition, bridge

footings of the existing Bridge 73 will be removed. Therefore, the proposed project will likely result in a negligible net effect on available Essential Fish Habitat.

Marine Mammal Protection Act

a. Does the proposed project involve a "take" of marine mammals as defined in the Marine Mammal Protection Act?
☐ Yes ☒ No

NCDOT's will adhere to the "Guidelines for Avoiding impacts to the West Indian Manatee: Precautionary Measures for Construction Activities in North Carolina Waters".

b. If yes, include the incidental harassment authorization or letter of authorization from NMFS and any relevant correspondence and cite location(s) in the application package:

Migratory Bird Treaty Act

a. Does the proposed project involve a potential take of migratory birds as defined in the Migratory Bird Treaty Act? (If no, provide evidence)
☐ Yes ☒ No

In-water work is restricted to October 1-March 31 which is outside the nesting season for swallows.

b. If yes, is a permit required?

☐ Yes ☒ No

c. If a permit is required, include it and any correspondence with USFWS and cite location(s) in the application package:

Bald and Golden Eagle Protection Act

a. May the proposed project take or disturb bald or golden eagles (including nests) as defined in the Bald and Golden Eagle Protection Act? (If no, provide evidence)
☐ Yes ☒ No

b. If yes, is a permit required?
☐ Yes ☐ No

c. If a permit is required, include it and any correspondence with USFWS and cite location(s) in the application package.

Invasive Species

a. Does the proposed project have potential to introduce or foster the spread of invasive species?

☐ Yes ☒ No

b. If yes, cite the document that describes measures that will be taken to minimize this risk and location(s) in the application package:

Section 106

a. Does the proposed project have potential to impact properties (including submerged abandoned shipwrecks) listed in or eligible for inclusion in the National Register of Historic Places?

☐ Yes ☒ No

b. If yes, provide evidence of consultation with the State Historic Preservation Officer (and the Advisory Council on Historic Preservation, if applicable) and cite location (s) in the application package. Include:

☐ Copies of the correspondence
☐ Memorandum of Agreement

☐ No effect determination

c. For projects involving Federal lands only provide:
☐ Archeological clearances

☐ Archeological reports

Clean Air Act

a. Does the proposed project occur in an area of nonattainment or maintenance for any criteria pollutant?

☐ Yes ☒ No

b. If project occurs in a nonattainment or maintenance area, do the transportation or general conformity regulations, or both, apply?

☐ General ☐ Transportation

c. Is the project exempt from a transportation conformity analysis for any of the reasons listed in 40 CFR § 93.126? Which reason?
☐ Yes ☐ No Reason:

d. Is the project exempt from a general conformity analysis for any of the reasons listed in 40 CFR § 93.153(c)?
☐ Yes ☐ No

e. If general conformity applies, is the project listed in a conforming State Implementation Plan (SIP)?

☐ Yes ☐ No

f. If a general conformity determination was prepared, include the draft and final determinations and any relevant correspondence and cite their location(s) in the application package:

g. If transportation conformity applies, is the project listed in a conforming SIP, Transportation Improvement Program (TIP), Regional Transportation Plan (RTP), or Federal Implementation Plan (FIP)?

☐ Yes ☐ No

h. If yes, cite location of information regarding listing in the application package:

i. If transportation conformity applies, does the project contribute to any new localized CO, PM_{10}, or $PM_{2.5}$ violations or increase the frequency or severity or any existing violations of the same?
☐ Yes ☐ No

j. If yes, cite location of information in the application package:

Actions to Address Environmental Justice in Minority or Low-Income Populations

a. Does the proposed project involve disproportionate adverse impacts to minority and/or low-income populations as defined in Executive Order 12898?

☐ Yes ☒ No

b. If yes, include the analysis describing the impacts and cite location(s) in the application package:

c. If yes, cite the location in the application package that describes measures to be taken to reduce those impacts:

Hazardous Materials, Substances or Wastes

a. Does the proposed project involve or is it located near a Superfund site or any site regulated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA) or State law regulating hazardous materials, substances or wastes?

☐ Yes ☒ No

b. If yes, cite the location(s) in the NEPA document where hazardous materials, substances or wastes are discussed:

See Enclosure [ ] for plan sheets.

See Enclosure [ ] for Waterway Data Requirements

WATERWAY DATA REQUIREMENTS (as required by the Coast Guard, include the below information as an attachment to the application letter per Appendix A of the BPAG)

A. Means of Data Collection: See BPAG for additional information

B. Present governing bridge(s) or aerial structure(s) on the waterway:

1. Identify all bridges upstream and downstream of the proposed bridge site and their existing horizontal and vertical clearances to determine the existing minimum horizontal and vertical clearances (including overhead transmission line clearances). Provide in table format.

There are no other bridges that cross the waterway (the Straits), and there are no bridges between Beaufort inlet and the proposed project.

2. Does the proposed bridge(s) match (or is greater than) the navigational clearance of existing structures on the waterway?

   Not Applicable

3. What is the most restrictive horizontal clearance on the waterway? (This may be a fixed bridge downstream/upstream of the proposed structure, a low hanging power line downstream/upstream of the bridge(s), or it may be some other structure that limits horizontal clearance. Sometimes the existing to-be-replaced bridge(s) is the most restrictive structure.)

   Existing Bridge No. 73 is the most restrictive structure to horizontal clearance on the waterway.

4. What is the most restrictive vertical clearance on the waterway? (This may be a fixed bridge downstream/upstream of the proposed structure, a low hanging power line downstream/upstream of the bridge(s), or it may be some other structure which limits vertical clearance. Sometimes the existing to-be-replaced bridge(s) is the most restrictive structure.)

   With existing Bridge No. 73 in the open position, the most restrictive structures to vertical clearance are the Carteret-Craven Electric Cooperative transmission lines that run parallel to the existing bridge on the east side. The authorized vertical clearance of these power lines is 70' above MHW.

5. Will the proposed bridge(s) become the most restrictive/obstructive structure across the waterway? Yes.

C. <u>Waterway characteristics:</u> (All domestic bridge navigational clearances should be stated in linear feet in decimal form vs. feet and inches. All international bridge navigational clearances should be stated in linear unit of measure as well as the metric equivalent.)

1. Various waterway stages: (Datum that is used). NAVD88

2. Natural flow of the waterway including currents, waterway velocity, water direction, and velocity fluctuations (seasonal, daily, hourly, etc.), that might affect navigation: The Straits is a coastal channel located between Back and Core Sounds and is affected by the tide; therefore, waterway velocity, direction, and velocity fluctuations are dependent on daily tidal changes.

3. Width of the waterway at bridge site: The bank to bank distance at the proposed bridge site is approximately 0.54 mile (2,860 ft.); the width of the navigable channel is approximately 115-135 ft. wide.

4. Depth of the waterway and elevation fluctuations at bridge site: [List the depth at each waterway bridge stage (ex. Range of tides, average high water elevation, etc.)]. Navigable channel depth is 14.5' at MHW and 13' at MLW

5. Waterway layout and geometry: (For example, is there a dam or lock; does the elevation of the approach impact the required bridge(s) clearance?) Not Applicable

6. Channel and waterway alignment: See Sheet 2 of bridge drawings for channel alignment under proposed bridge.

7. Other limiting factors: (For example, bends in the waterway within one-half mile of project site, hindrances to free navigation, fog, hydraulics, etc.) The proposed bridge is located approximately 2,600' from a 34 degree bend in the navigable channel.

D. <u>Do vessels that engage in emergency operations (i.e., law enforcement, fire, rescue, emergency dam repair, etc.), national defense activities (i.e. cruisers, fuel barges, munitions ships, etc.) or channel maintenance (i.e., dredges, dam and levee repair, etc.) operate on the waterway?:</u>

1. Does levee maintenance, bridge work (other bridges), channel maintenance and emergency operations upstream of bridge require certain vessels to transit the waterway?

   Not applicable.

2. Does the proposed bridge(s) impact USCG and/or other government vessels' ability to transit the bridge(s) to conduct mission essential functions (icebreakers, patrols, etc.)?

   During a vessel survey completed in 2014, a U.S. Coast Guard (USCG) vessel 16 ft. in height required the existing Bridge No. 73 swing span to open one time. Therefore, the proposed fixed-span bridge, with a VNC of 45 ft., should accommodate local USCG vessel traffic. There are no USCG guides defined for the Straits.

3. Vessels using the waterway during the proposed bridge(s) lifespan (should include):

   According to bridge tender logs between 2011 and 2016, the only vessels operated by the US Army Corps of Engineers that regularly transit the Straits are the survey vessels 'Beaufort' and 'Sanderson'. No dredges operated by the Wilmington District USACE use the waterway. Fire rescue vessels also use the waterway, though along the Carteret County coast these vessels do not exceed 20 ft. in height on average.

4. Will the proposed bridge(s) provide the horizontal and vertical clearances for the safe, efficient passage of the largest of these vessels? Why?

   In correspondence with the USACE and the USCG for the Navigation Impact Study, no clearance concerns were raised regarding the new fixed span bridge and vessels operated by either agency.

5. If no, estimate the number of vessels in each of the above categories unable to pass through the proposed bridge(s). Give the name, length overall (LOA), beam, draft and height of highest fixed point above the waterline for vessels affected by the bridge(s).

   Not Applicable

6. Can these vessels be modified (i.e., folding mast, relocation or equipment, etc.) without decreasing their respective response times? If so, name the vessels.

   Not Applicable

7. If modifications are feasible, state the name of the vessel(s), their trip frequency, the necessary modifications, the cost of the modification(s) and who will pay for them (i.e., vessel owner, applicant, other).

   Not Applicable

8. Provide any additional information concerning the potentially impacted or burdened users of the waterway as well as the future use of the waterway.

   Not Applicable

E. Has the United States Corps of Engineers (USACE) completed or does it plan to complete a federal navigation project on the waterway?:

The USACE does not plan to complete a federal navigation project on the waterway.

F. Describe the present and prospective recreational navigation: Will the proposed bridge(s) affect the safe, efficient movement of any segment of the present or prospective recreational fleet operation on the waterway?:

1. What is the estimated percentage of the recreational fleet, which may be affected by the proposed bridge(s)?

   During vessel height surveys completed in 2014, it was found that approximately 96% of vessels that transit under or through Bridge No. 73 are recreational in nature. This result is supported by the large numbers of these vessels recorded in tender logs for Bridge No. 73 between 2011 and 2016, which document the names and type of vessels that required bridge opening. Vessels in this category include sailboats and recreational fishing boats, as well as house and party boats. However, during the survey, none of these vessels were found to be over 45 ft. in height (proposed bridge vertical clearance), including two sailboats (the tallest of which was 42 ft.). Therefore, the proposed bridge replacement project should have no effect on the recreational fleet.

2. Will the proposed bridge(s) eliminate the access of these vessels to existing or planned commercial, water-oriented facilities (i.e., restaurants, shops, recreational areas, marinas, etc.) in the vicinity of the proposed bridge(s)? If yes, describe these facilities.

   Not Applicable

3. Is it feasible to modify the affected segments of the fleet to clear the proposed bridge(s) without substantially increasing operating costs? If yes, name the vessel(s), state the necessary modifications, cost of modifying each vessel and person or entity responsible for financing the modifications.

   Not Applicable

4. Provide any additional information concerning the potentially impacted or burdened users of the waterway as well as the future use of the waterway.

   Not Applicable

NOTE: Check with local USACE District Office, Chamber of Commerce or other organizations for proposed marinas, recreational areas, shops, etc.

G. Describe the present and waterway and prospective commercial navigation and the cargoes moved on the waterway: Will the proposed bridge(s) affect the safe, efficient movement of any segment of the present or prospective commercial fleet operating on the waterway?:

During vessel height surveys completed in 2014, it was found that approximately 4% of vessels that transit under or through Bridge No. 73 are for commercial purposes. These include commercial fishing boats, barges, dredges, and tow boats. Based on 2014 height surveys as well as reports and interviews with vessel owners and local marina staff, five commercial fishing boats that regularly travel through Bridge No. 73 are over 45 ft. in height (proposed bridge vertical clearance), with outriggers extended (Table 2). However, all five are able to lower their outriggers, which would require 80-100 ft. of

horizontal clearance to pass beneath a bridge with a 45 ft. vertical clearance. As the proposed horizontal clearance for the new bridge is 125 ft., it would not impede travel of these vessels (with outrigger adjustment) through the waterway.

There are no known cargo ships using the Straits, nor are they anticipated to in the future.

Table 2. Vessels over 45 ft. in Height Observed in Nearby Harbors and/or are reported to use Bridge No. 73.

Vessel Name	Vessel Type	Harbor Location	Number of Observations included in Bridge Tender Logs for Bridge No. 73							Approx. Vessel Height
			2011	2012	2013	2014	2015	2016	Total	
Lady Barbara	Comm. Fishing Boat	Marshallberg	0	0	0	0	0	0	**0**[+]	60 ft
Lady Michelle	Comm. Fishing Boat	Marshallberg	0	0	0	0	0	0	**0**[+]	50 ft
Mattie Marie	Comm. Fishing Boat	Harkers Island	0	0	0	0	0	3	**3**	50 ft
Miss Melissa	Comm. Fishing Boat	Marshallberg	0	2	5	1	0	0	**8**	67.8 ft*
Rebecca Lynn	Comm. Fishing Boat	Marshallberg	1	0	0	0	0	16	**17**	55 ft

Note: Approximate vessel heights based on mariner interviews, known nearby elevations, and engineering judgement. Vessel heights greater than 45 feet include vessels with outriggers up.
*Source: Average vessel height based on measurements obtained during the vessel height surveys completed intermittently over the course of May through October of 2014.
[+]Vessel owners reported regular travel through Bridge No. 73.

H. <u>Identify the name and contact information for marine facilities located within a 3-mile radius of the proposed project (public boat ramps, marinas or major docking facilities, boat repair facilities, etc.:</u>

Table 3. Marine Facilities within a 3-mile Radius

Facility Name	Facility Type	Address	Phone number
Marine Facilities within a 3-mile Radius			
Straits Landing (NCWRC) Boat Ramp	Public Boat Ramp	1648 Harkers Island Rd, Beaufort, NC 28516	-
Harkers Island Harbor	Harbor of Refuge	Island Rd., Harkers Island, NC 28531 (terminus of Brooks Creek)	-
Cape Pointe Marina	Marina, Boat Ramp	1390 Island Rd, Harkers Island, NC 28531	252.728.6181
Harkers Island Fishing Center	Marina, Boat Ramp	1002 Island Rd, Harkers Island, NC 28531	252.728.3907
Bayview Harbor Marina	Marina, Boat Ramp	309 Bayview Dr., Harkers Island, NC 28531	252.728.3827
East Bay Boat Works	Boat Repair Facility, Boat Ramp	201 Fulford Dr, Harkers Island, NC 28531	252.728.2004

Facility Name	Facility Type	Address	Phone number
Marshallberg Harbor	Harbor of Refuge	Moore Lane, Marshallberg, NC 28553	-
Outer Banks Boat Harbor	Full-Service Repair	970 Harkers Island Rd, Beaufort, NC 28516	252.728.6004
Cape Lookout National Seashore Park	Public Boat Ramp	1800 Island Rd, Harkers Island, NC 28531	252.728.2250
Rush Point	Public Boat Ramp	Rush Point Rd, Harkers Island, NC 28531	-

I. Will the proposed bridge(s) block access of any vessel presently using local service facilities (i.e., repair shops, parts distributors, fuel stations)?:

Access would be limited to 45 feet in height or less for vessels travelling east to west for access to the Straits Landing boat ramp, Harkers Island Harbor, and Rush Point. Access would be limited to 45 feet in height or less for vessels travelling west to east for access to East Bay Boat Works, Cape Lookout National Seashore, and Marshallberg Harbor. However, as documented above, navigation of vessels through Bridge No. 73 that are more than 45 ft. in height is negligible. In addition, those vessels potentially affected by the proposed vertical clearance could travel under the new bridge with outrigger adjustment.

J. Are alternate routes bypassing the proposed bridge(s) available for use by vessels unable to pass the proposed bridge(s)?:

No convenient alternative routes are available. Travelling around Harkers Island through Back Sound is not a feasible option as the water depths are unpredictable and unstable.

K. Will the bridge(s) prohibit the entry of any vessels to the local harbor of refuge? If yes, describe the harbor and provide the following information:

There is a harbor of refuge available within 3 miles of Bridge No. 73 to the east (Marshallberg Harbor) and west (Harkers Island Harbor). These harbors provide an option on either side of the bridge for any non-local vessels over 45 ft. in height. Four of the vessels identified over 45 ft. in height with outriggers extended in Table 1 (Section G) are located at Marshallberg Harbor, with the remaining vessel located at Harkers Island Harbor. Because their outriggers can be lowered and the proposed bridge's horizontal clearance allows for this adjustment, the bridge should not prohibit entry of these vessels to their harbor of refuge.

L. Will the proposed bridge(s) be located within one-half mile of a bend in a waterway? If yes, describe the bend and provide the following information:

There is a bend in the waterway approximately 2,600 ft. west of the Harkers Island Bridges to the north and south where the Straits waterway converges with North River. These channels in North River are surveyed by the USACE. This distance should allow proper vessel alignment for the safe, efficient passage of vessels through the proposed bridge.

M. Are there other factors (i.e., dockages, lightering areas, existing bridges, etc.) located within one-half mile of the proposed bridge(s), which would create hazardous passage through the proposed structure? If yes, provide the following information:

The existing Carteret-Craven Electric Cooperative (CCEC) transmission lines are located east of existing Bridge No. 73. It is currently unsafe for vessels exceeding 70 feet in height to traverse the channel and would remain a hazard in the channel (see Section B.4). As the proposed bridge would restrict transit by vessels exceeding 45 feet in height, the CCEC transmission lines are not anticipated to create hazardous passage.

N. Do local hydraulic conditions (i.e., wave chop, cross currents, tides, shoals, etc.) increase the hazard of passage through the proposed bridge(s)? If yes, provide the following information:

There are no known hydraulic conditions that would create hazardous passage through the proposed bridge.

O. Do local atmospheric conditions (i.e., strong, prevailing winds, fog, rapidly developing storms, etc.) increase the hazard of passage through the proposed bridge(s)? If yes, provide the following information:

The presence of seasonal hurricanes could increase the hazard of passage through the proposed bridge(s) but it is a hazard that exists regardless of this proposed bridge replacement project.

P. Have guide clearances been established for the waterway? If yes, provide the following information:

No known guide clearances exist for the Straits waterway.

It is anticipated that a guide clearance of 45 feet VNC and 125 feet HNC for the proposed bridge could be posted.

Q. Are there other natural or man-made conditions that affect navigation (atmospherics, exclusion zones, etc.)?

There are no known other natural or man-made conditions that would affect navigation through the proposed bridge.

R. State any other factors considered necessary for the safe, efficient passage of vessels through the proposed bridge(s)? Are clearance gauges needed? Why?

There are no other known factors that would be considered necessary for the safe, efficient passage of vessels through the proposed bridge.

The USCG District Commander will determine whether a clearance gauge is needed for the proposed bridge. The existing Harkers Island Bridge has clearance gauges for mariners. In order to be consistent with the existing provisions, a clearance gauge could be provided.

S. Include a description of the impacts to navigation caused or which could be reasonably caused by the proposed bridge(s) including but not limited to: proposed construction methodology, proposed or prospective changes to the existing bridge(s) operating schedule (for movable bridges), and any proposed mitigation to all unavoidable impacts to navigation.

Vehicular traffic is proposed to remain on the existing bridge during the construction of the proposed bridge and associated roadway improvements. The existing swing span bridge would continue to operate as it currently does during construction, opening for vessels exceeding 14 feet in height (See Section A.g). The construction of the proposed bridge will be conducted so as to minimize interference

with the operation and maintenance of the Straits waterway. Construction of the new bridge will require a combination of temporary work bridges and the use of barges.

T. <u>Is there any proposed or completed mitigation for impacted waterway users? Are there any impacts that cannot be mitigated?</u>

There is no known proposed or completed mitigation for impacted waterway users. As documented above, there are no known impacts that require mitigation for impacted waterway users.

Please initiate review of the proposed project for authorization under a U.S. Coast Guard Permit. It is requested that any correspondence from your office regarding this project include the NCDOT TIP Number (B-4863). Should you have any questions regarding this information, please contact Jason Dilday at (919) 707-6111 or jldilday@ncdot.gov.

Sincerely,

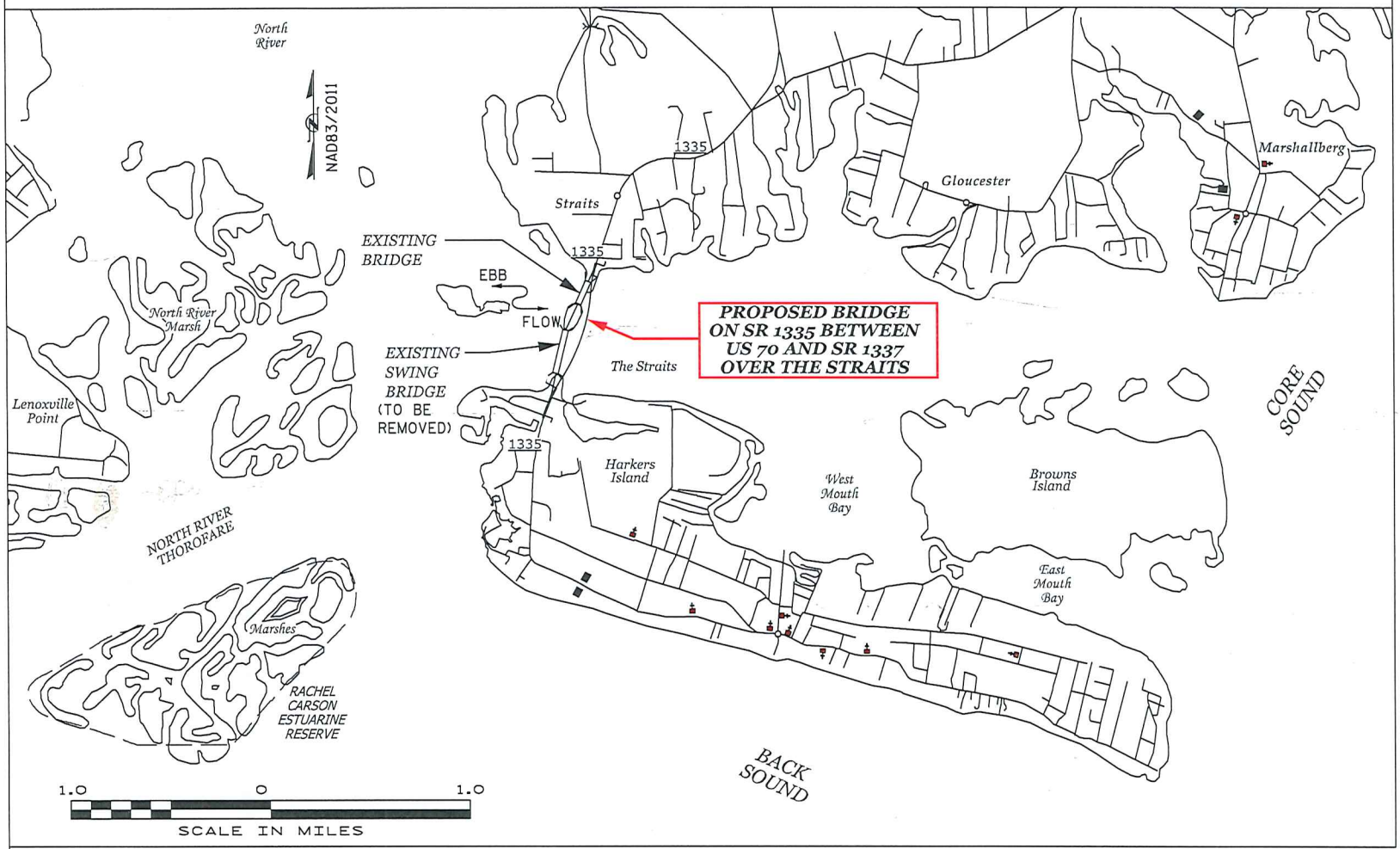
Philip S. Harris III, P.E., C.P.M.
Environment Analysis Unit Head

Enclosures:

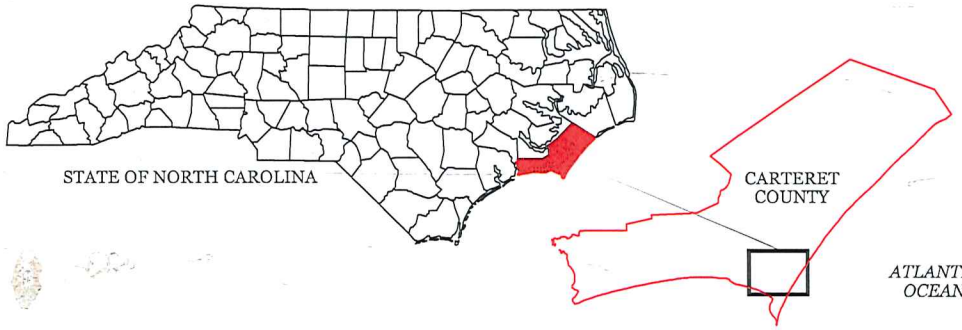
APPENDIX A: BRIDGE PLAN SHEETS
APPENDIX B: CATEGORICAL EXCLUSION
APPENDIX C: WETLAND MITIGATION PLAN
APPENDIX D: NMFS SECTION 7 CONCURRENCE LETTER
APPENDIX E: VESSEL HEIGHT SURVEY REPORT

APPENDIX A:
BRIDGE PLAN SHEETS

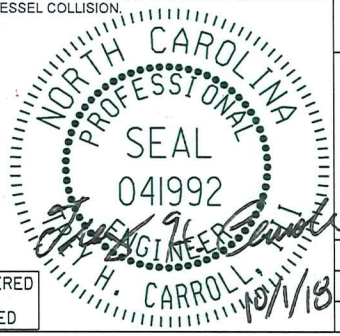
VICINITY MAP



A VESSEL IMPACT STUDY WAS PERFORMED FOR THE PROPOSED BRIDGE OVER THE STRAITS. NCDOT HAS SPECIFIED THAT, FOR THE PURPOSES OF VESSEL IMPACT RISK ANALYSIS, THE PROPOSED BRIDGE HAS AN OPERATIONAL CLASSIFICATION OF "CRITICAL". SITE-SPECIFIC DATA WAS COLLECTED AND AN ANALYSIS WAS PERFORMED IN ACCORDANCE WITH SECTION 3.14 - VESSEL COLLISION OF THE 2017 AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS. MINIMUM DESIGN FORCE IS ASSOCIATED WITH A SINGLE 35' x 120', 100 TON, DRIFTING HOPPER BARGE IN ACCORDANCE WITH THE 2017 AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS.



THIS BRIDGE HAS BEEN DESIGNED IN ACCORDANCE WITH THE REQUIREMENTS OF AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, INCLUDING REQUIREMENTS FOR VESSEL COLLISION.



DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

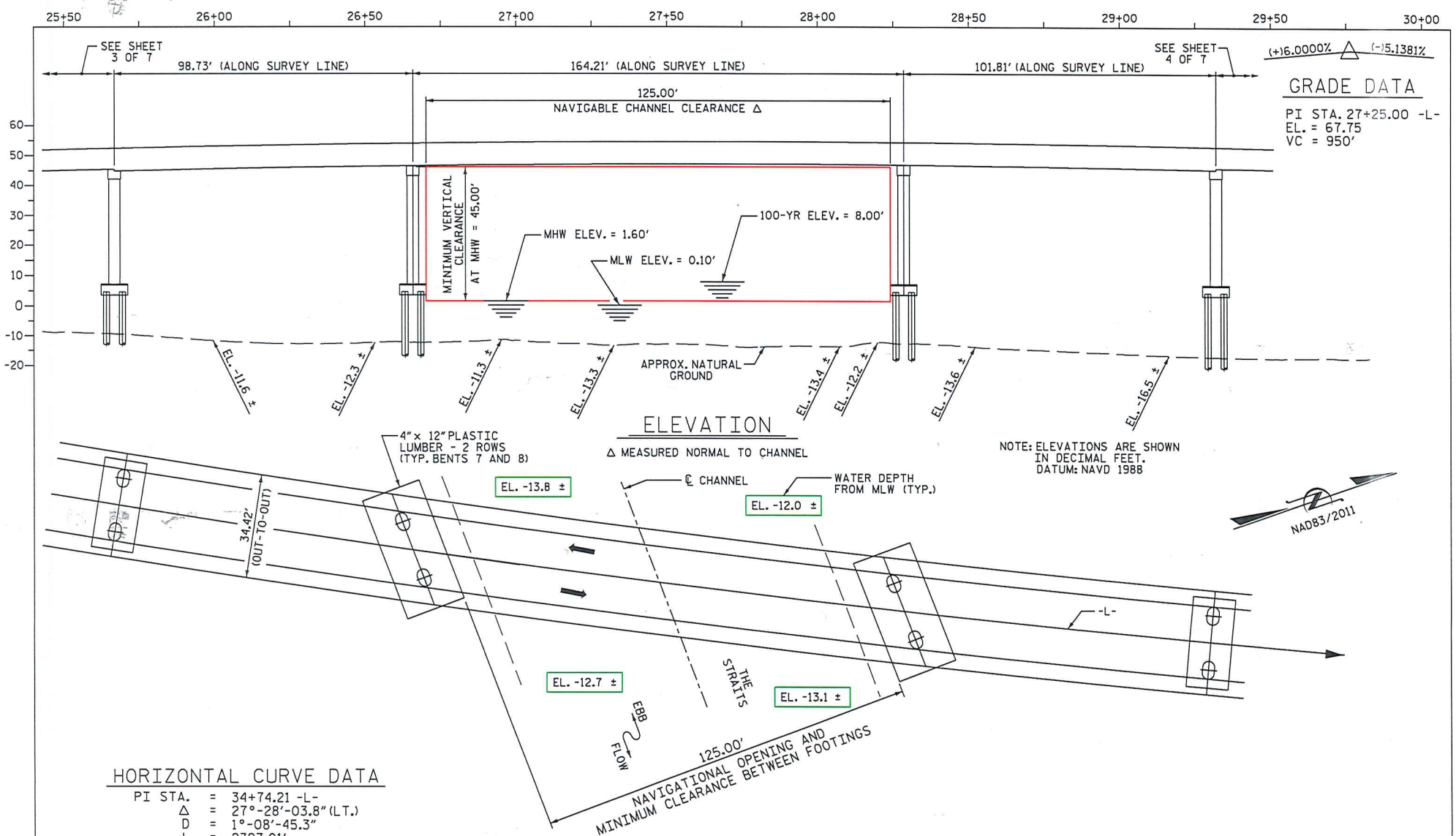
STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTAION
RALEIGH

PROPOSED BRIDGE
ON SR 1335 BETWEEN
US 70 AND SR 1337
OVER THE STRAITS
AT MILE POST 0.9
NEAR HARKERS ISLAND, NC

CARTERET COUNTY

STATE PROJECT NO.: B-4863

SEPTEMBER 20, 2018 SHEET 1 OF 7



HORIZONTAL CURVE DATA

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Δ = 27°-28'-03.8" (LT.)
D = 1°-08'-45.3"
L = 2397.01'
T = 1222.00'
R = 5000.00'

PLAN

THIS BRIDGE HAS BEEN DESIGNED IN ACCORDANCE WITH THE REQUIREMENTS OF AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, INCLUDING REQUIREMENTS FOR VESSEL COLLISION.

0 50
SCALE IN FEET

NORTH CAROLINA PROFESSIONAL SEAL 041992 ENGINEER TREY H. CARROLL, III

10/1/18

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STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTAION
RALEIGH

PROPOSED BRIDGE
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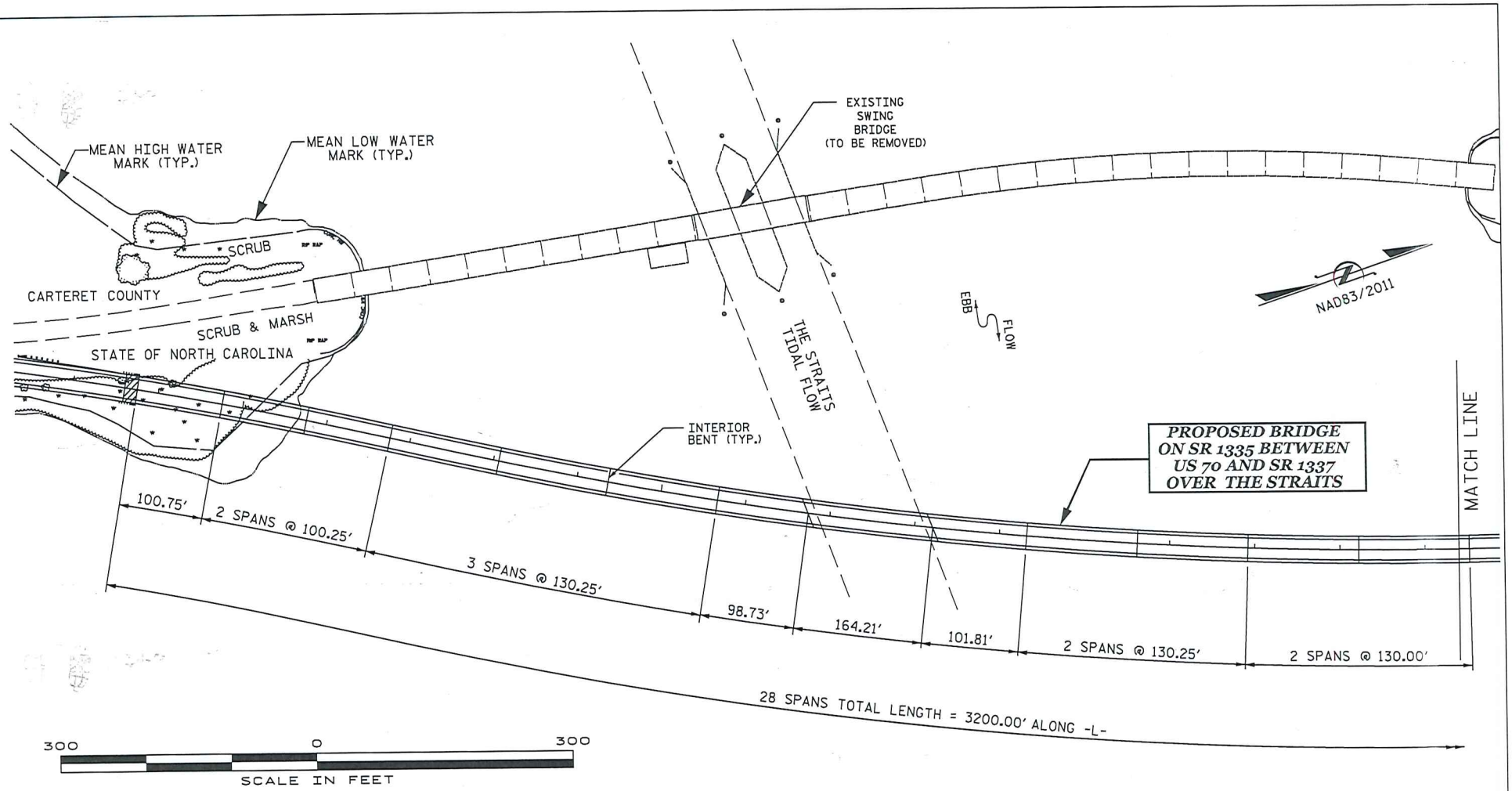
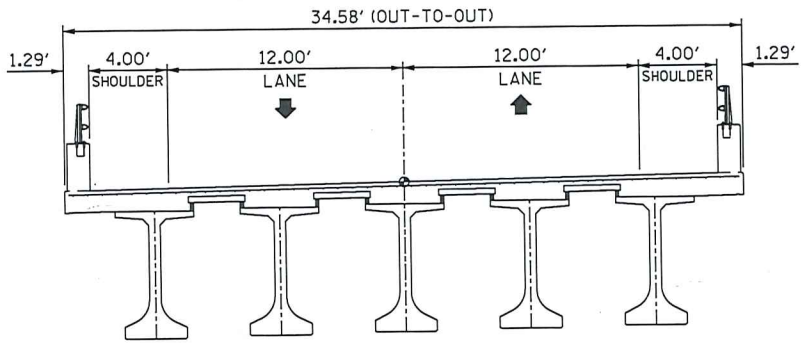
CARTERET COUNTY

STATE PROJECT NO.: B-4863

SEPTEMBER 20, 2018 SHEET 2 OF 7





CHANNEL SPAN TYPICAL SECTION

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SCALE IN FEET

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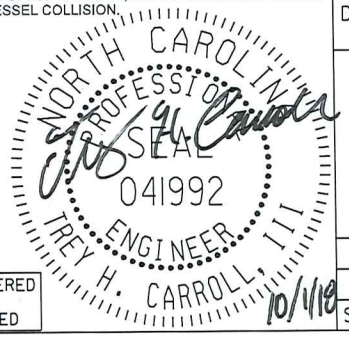


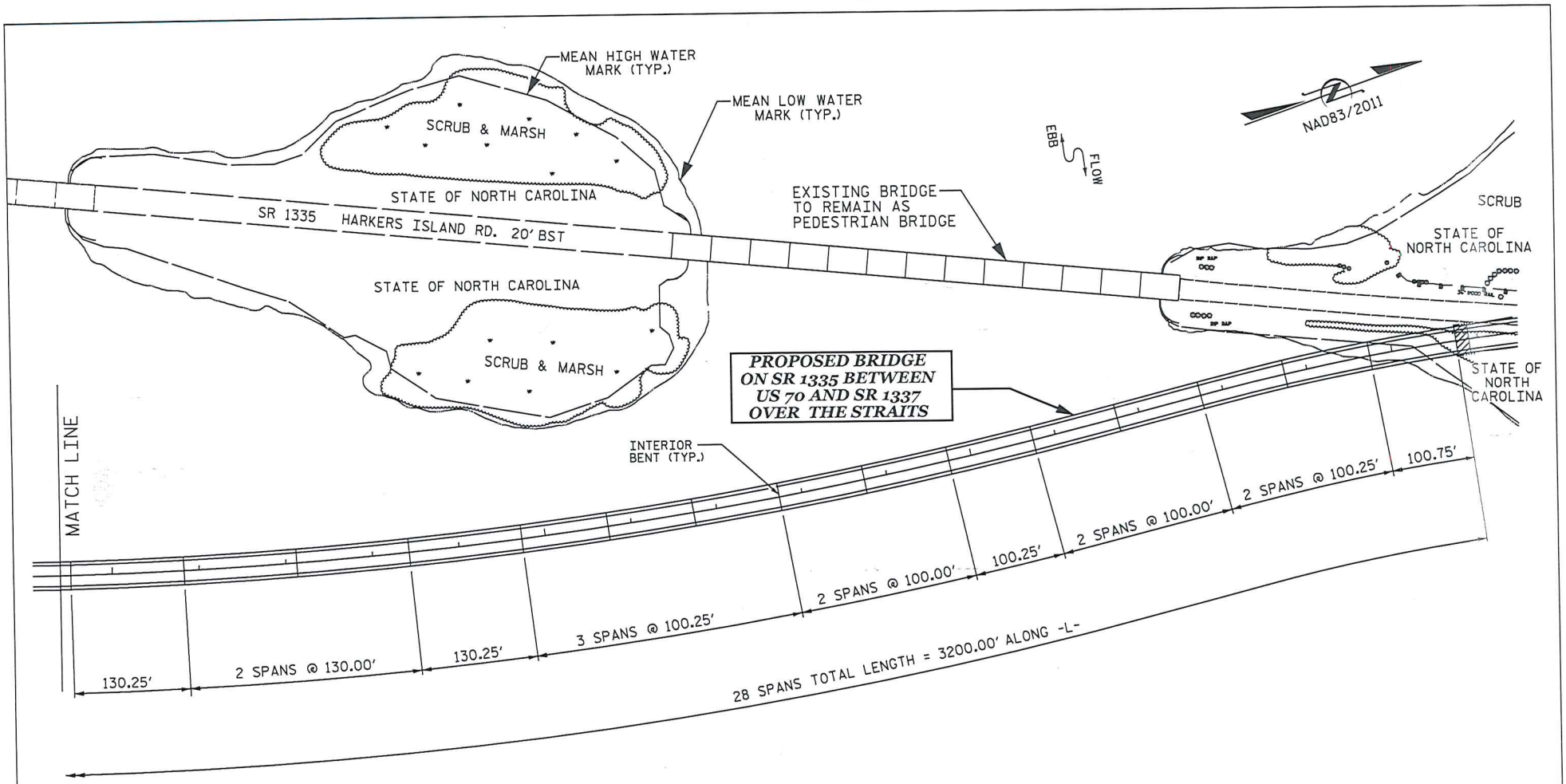
STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTAION
RALEIGH

PROPOSED BRIDGE
ON SR 1335 BETWEEN
US 70 AND SR 1337
OVER THE STRAITS
AT MILE POST 0.9
NEAR HARKERS ISLAND, NC

CARTERET COUNTY

STATE PROJECT NO.: B-4863

SEPTEMBER 20, 2018 SHEET 3 OF 7



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SCALE IN FEET

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NORTH CAROLINA PROFESSIONAL SEAL 041992 ENGINEER TREY H. CARROLL, III

10/1/18

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STATE OF NORTH CAROLINA
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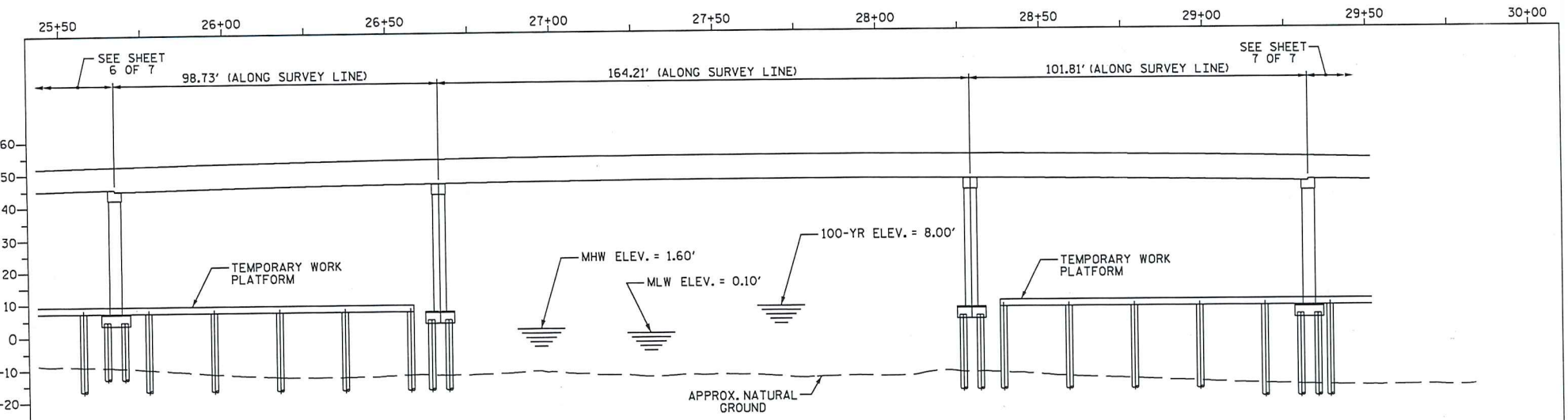
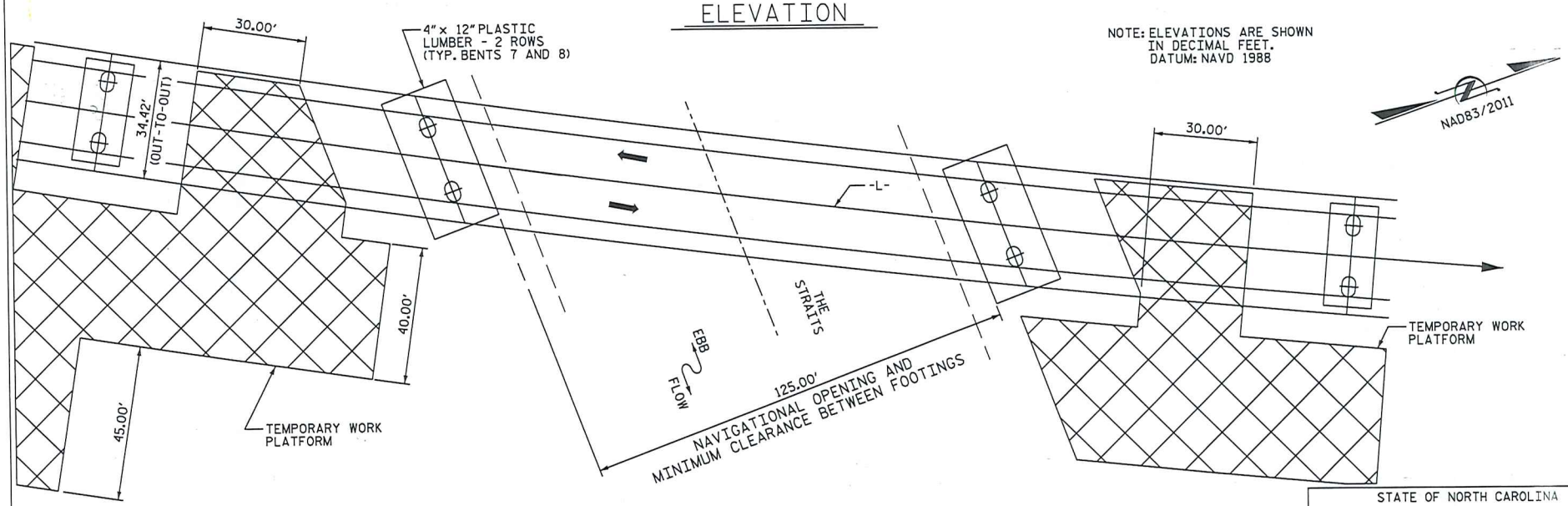
CARTERET COUNTY

STATE PROJECT NO.: B-4863

SEPTEMBER 20, 2018 SHEET 4 OF 7



ELEVATION



NOTE: ELEVATIONS ARE SHOWN IN DECIMAL FEET.
DATUM: NAVD 1988

NAD83/2011

PLAN

THIS BRIDGE HAS BEEN DESIGNED IN ACCORDANCE WITH THE REQUIREMENTS OF AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, INCLUDING REQUIREMENTS FOR VESSEL COLLISION.

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SCALE IN FEET

NORTH CAROLINA PROFESSIONAL SEAL 041992 ENGINEER TREY H. CARROLL, III
10/1/18

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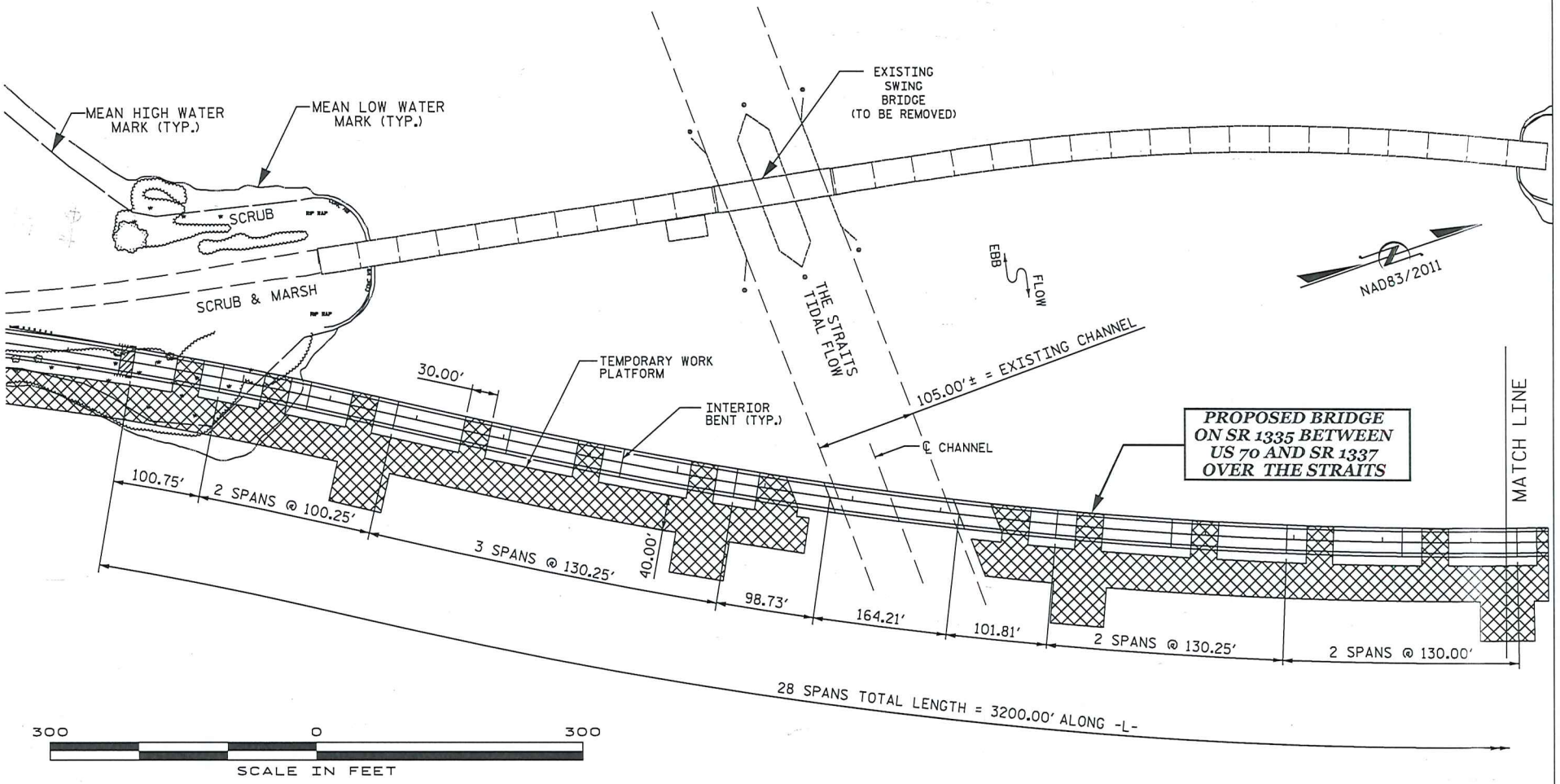
SEPTEMBER 20, 2018 SHEET 5 OF 7



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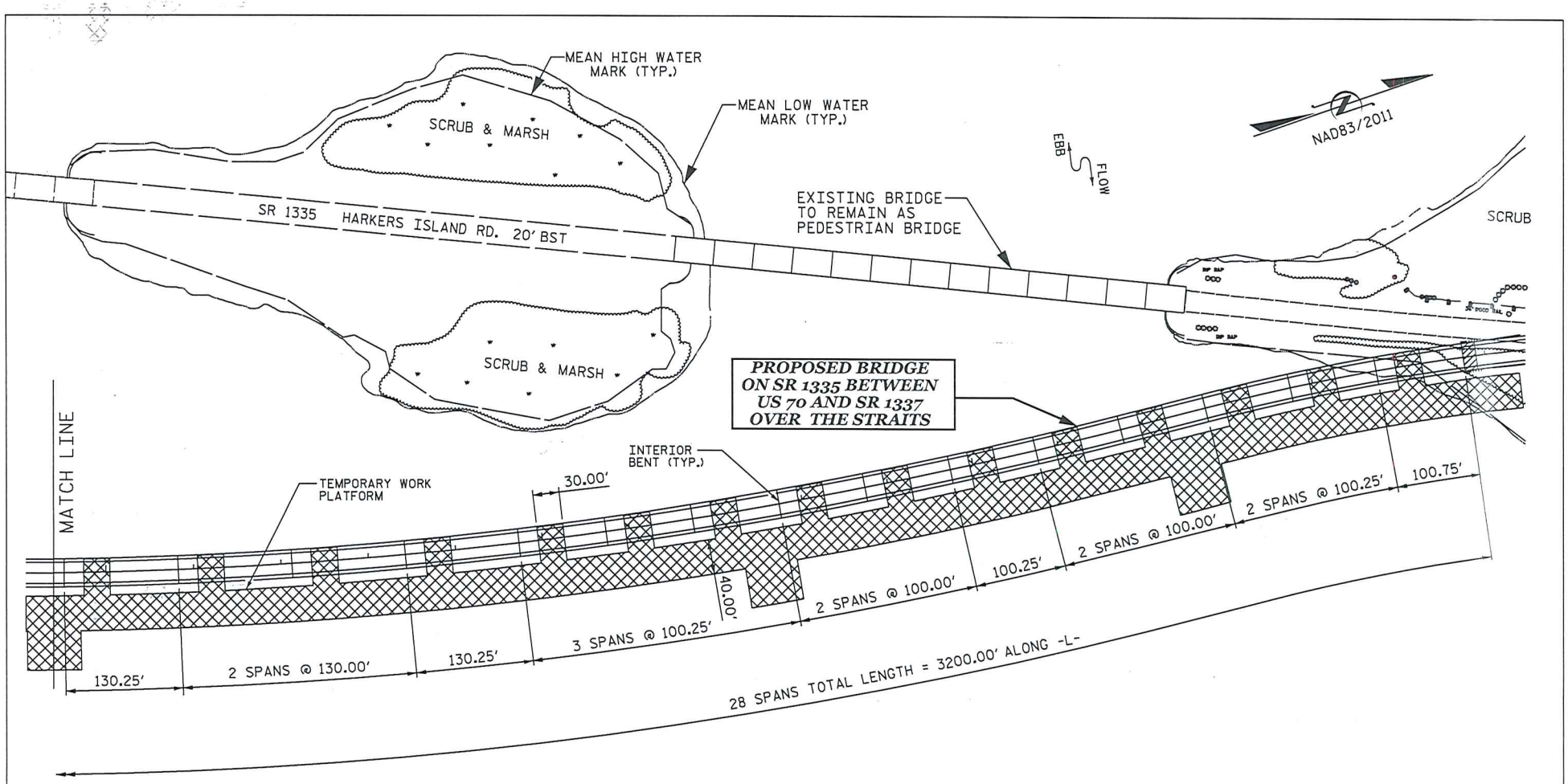
SEPTEMBER 20, 2018 SHEET 6 OF 7



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STATE PROJECT NO.: B-4863

SEPTEMBER 20, 2018 SHEET 7 OF 7

APPENDIX B:
CATEGORICAL EXCLUSION

Type III Categorical Exclusion Action Classification Form

STIP Project No.	**B-4863**
WBS Element	**40212.1.3**
Federal Project No.	**BRSTP-1335(4)**

A. Project Description:

The North Carolina Department of Transportation (NCDOT) proposes to replace Bridge No. 73 (known as the Earl C. Davis Memorial Bridge) and Bridge No. 96 carrying SR 1332/1335 (Harkers Island Road) over The Straits in Carteret County. Together these bridges provide the only vehicular access to Harkers Island. The project location is shown on Figure 1, and the project study area is shown on Figure 2.

This project is included in NCDOT's current federally approved 2018-2027 *State Transportation Improvement Program* (STIP) as Project B-4863. Right-of-way acquisition and utility relocation are scheduled to begin in Federal Fiscal Year (FFY) 2018 and construction in FFY 2020. This project followed the NEPA/Section 404 Merger Process. Comments received from agencies through the scoping and Merger processes have been addressed. Meeting minutes and signed concurrence forms are attached.

B. Description of Need and Purpose:

The need for the proposed action is to replace structurally deficient, functionally obsolete bridges. The purpose of the proposed action is to improve bridge structural safety and functionality for vehicular traffic.

The 2014 bridge inspection report for Bridge No. 73 indicates that the bridge is in poor condition with a sufficiency rating of 15 out of 100 and a status of structurally deficient due to the condition of the superstructure and substructure (both having a FHWA structural rating of 4 out of 9). The 2015 bridge inspection report for Bridge No. 96 indicates that the bridge is in good condition with a sufficiency rating of 47 out of 100 and has a status of functionally obsolete due to its horizontal width. The Division completed emergency repairs to replace the superstructure of Bridge No. 96 in 2013.

C. Categorical Exclusion Action Classification: Type III

D. Proposed Improvements:

NCDOT proposes to replace the existing Harkers Island Bridges (Bridge No. 73 and No. 96) on SR 1332/1335 (Harkers Island Road) in Carteret County. Replacement of Bridge No. 73 entails removal of the swing span bridge. Pending a municipal agreement between NCDOT and Carteret County for maintenance and

operations, Bridge No. 96 may remain for non-vehicular access to the Straits Fishing Pier. For the proposed bridge, two 12-foot travel lanes (one in each direction) and four-foot paved shoulders will be provided on each side. The shoulders and bridge rails (54 inches tall) will accommodate cyclists. Typical sections of the proposed bridge and roadway are presented in Figure 3.

Five alternatives with differing alignments and bridge options were evaluated, as shown on Figure 4. NCDOT has selected Alternative 5 as the proposed alternative, which replaces the bridges with one fixed span bridge to the east of the existing structures.

E. Special Project Information:

Technical Studies

The following technical studies were completed for this project and can be provided upon request:

- *B-4863 Geotechnical Report*, August 2009 – identifies potential hazardous material sites and geotechnical issues that could impact future phases of the project.

- *B-4863 Traffic Safety Review*, January 2011 – summarizes the crash data analysis and (2007) average annual daily traffic volume for Harkers Island Road.

- *B-4863 Natural Resources Technical Report*, April 2011 – describes the natural environmental features in the project study area, potential permits, and other applicable requirements by State and Federal regulatory agencies.

- *B-4863 Archaeological Survey and Evaluation*, January 2012 – a detailed analysis of the historical/environmental background research and the archaeological survey and evaluation for the proposed project area.

- *B-4863 Value Engineering Report*, September 2012 – summary of recommendations to consider for value engineering during the project design phase.

- *B-4863 Vessel Height Survey Report*, September 2015 – summarizes the survey to obtain height and frequency information about the vessels passing through the existing swing span bridge (Bridge No. 73) on The Straits waterway.

- *B-4863 Traffic Estimate*, November 2015 – provides the current and estimated average annual daily traffic on Harkers Island Road.

- *B-4863 Community Impact Assessment*, January 2016 – describes the community features and resources in the project study area and surrounding areas.

- *B-4863 Submerged Aquatic Vegetation (SAV) Survey Findings Report (Preferred Alternative 5)*, September 2017 – summarizes SAV investigations conducted in July 2017.

- *B-4863 Navigational Impact Report*, in progress – This report outlines the characteristics of the existing and proposed bridges and provides greater detail regarding the maritime traffic and industry in the project area.

Agency Involvement

The proposed project followed the NEPA/Section 404 Merger Process. The Merger process is a process to streamline the project development and permitting processes, combining ("merging") the requirements of the National Environmental Policy Act and Section 404 of the Clean Water Act. The process consists of representatives of state and federal agencies working together to reach decisions that achieve the regulatory and individual agency mandates. More information on this process is available on NCDOT's website:

https://connect.ncdot.gov/resources/Environmental/Pages/Merger.aspx

The Merger team met to reach concurrence for the following decision points:

- Concurrence Point 1 – February 2016 – Definition of Purpose and Need and Study Area
- Concurrence Point 2 – June 2016 – Detailed Study Alternatives Carried Forward
- Concurrence Point 2A – June 2017 – Bridging Decisions and Alignment Review
- Concurrence Point 3 – June 2017 – Selection of Alternative 5 as the Least Environmentally Damaging Practicable Alternative (LEDPA) / Preferred Alternative

Merger team meeting minutes and all correspondence are attached. Agency responses to the scoping letter are also attached.

The following meetings are anticipated in 2017-2018:

- Concurrence Point 4A – Avoidance and Minimization
- Concurrence Point 4B – 30 Percent Hydraulic Review
- Concurrence Point 4C – Permit Drawings Review

Public Input

The first public outreach activity for the project was conducted on March 14, 2016 at the Core Sound Waterfowl Museum with a Local Officials Meeting followed by Public Meeting #1. The meeting was announced via the NCDOT public meetings website, a newsletter that was mailed in February 2016 to over 1,230 addresses (all property owners and residents of Harkers Island, portions of Straits Township on the mainland north of the bridges, all parcels on Browns Island, local officials, and federal and state permitting agencies), and local media.

Functional roadway designs for Alternatives 1, 2, 3, and 4 were displayed. Over 60 people attended Public Meeting #1. Approximately 50 comments were received via comment sheets submitted the day of the meeting, and phone calls, email, and regular mail following the meeting. Alternatives 1 and 2 received no public support. Comments in favor of Alternatives 3 and 4 were split 50%/50%. Major comment themes included support for maintaining use and/or access of public resources in the study area, providing pedestrian and bicycle accommodations, proposed ideas for the new bridge(s), and residential and business property concerns.

The project's second newsletter, issued in October 2016, announced the elimination of Alternative 1 based on its low public support, potentially high impacts to community resources, and high cost. The newsletter also announced the introduction of Alternative 5 into consideration. The project's third newsletter, issued in February 2017, announced Public Meeting #2.

The second public meeting was held on March 2, 2017 at the Core Sound Waterfowl Museum on Harkers Island, with the same methods of advertisement and meeting format as Public Meeting #1. The project website (https://www.ncdot.gov/projects/harkersislandbridges/, live on February 15, 2017) was developed prior to Public Meeting #2 and also used for announcements and posting public meeting materials, including a video. Roadway designs for Alternatives 2, 3, 4, and 5 including plan views and artistic renderings of the profile views were displayed.

Over 100 people attended Public Meeting #2, from which over 60 comment cards were collected. An additional 23 people submitted comments following the meeting. Comments mostly included preferences and reasons for/against certain alternatives, concerns over flooding, parking, and continuing the use of public resources. The Project Team responded to all written comments received, and this response document is available on the project website. Alternative 5 received 84% of the public support, followed by Alternative 4 (9%), Alternative 3 (7%), and Alternative 2 (0%). A fourth newsletter announcing the selection of Alternative 5 was issued in August 2017.

The Carteret County Board of Commissioners expressed their support of Alternative 5 and their commitment to take ownership of the existing Bridge No. 96 for pedestrian access to the Straits Fishing Pier (center island). (Correspondence attached.)

Alternatives Analysis

No Build Alternative - The No Build Alternative would not meet the purpose of the proposed project to improve bridge safety and functionality and was eliminated at Concurrence Point 2.

Alternatives Eliminated from Detailed Study

Improve Existing Facility and Rehabilitation of Existing Bridges – The swing span and supports of Bridge No. 73, as well as the concrete span and supports of Bridge

No. 96, could be rehabilitated to extend the life of the existing bridges. However, rehabilitation would require a temporary detour to be constructed while the existing bridges are rehabilitated. The rehabilitation and temporary detour would result in significant costs and significant impacts to adjacent properties. In addition, NCDOT is no longer designing swing span structures due to the high long-term maintenance costs. These costs and impacts would be incurred without meeting the purpose to improve the safety or functionality of the existing bridge crossing.

Alternative Modes of Travel – Any transit service between the mainland and Harkers Island would still require bridge replacements, leading to the same purpose and need for the project as stated previously. A ferry system in lieu of a bridge crossing would be impractical given the volume of traffic crossing the bridges. In addition, a ferry system would not provide adequate access in the event of a hurricane evacuation. A ferry system would not meet the purpose of this project to improve the safety or functionality of the existing bridge crossing.

Traffic Management – No traffic management alternatives exist that would reduce the volume of traffic to a level where a bridge crossing is not required.

Build Alternative 1 – Two new fixed span bridges, each located to the west of the existing bridges, with 45-foot vertical navigational clearance (VNC) at Bridge No. 73. Alternative 1 was eliminated primarily due to no public support and potential impacts to three properties protected by Section 4(f).

Detailed Study Alternatives

The Detailed Study Alternatives were developed using AASHTO and NCDOT guidelines for a major collector facility using a 50 mph design speed. Two 12-foot lanes (one in each direction) will be provided with four-foot paved shoulders on each side. Typical sections and centerlines are included in Figures 3 and 4, respectively.

Alternative 2 – Two new fixed span bridges, one located to the east of Bridge No. 96 and one located to the west of Bridge No. 73, with 45-foot VNC at Bridge No. 73.

Alternative 3 – Two new fixed span bridges, each located to the east of the existing bridges, with 45-foot VNC at Bridge No. 73.

Alternative 4 – One new fixed span bridge, located to the east of the existing bridges, with 45-foot VNC at Bridge No. 73.

Upon further coordination with National Marine Fisheries Service (NMFS) following Public Meeting #1 and based on public input, it was determined that Alternatives 1, 2, 3, and 4 would result in impacts to the Straits Fishing Pier, which is protected under Section 4(f) of the US Department of Transportation Act. It is also a Public Trust Resource protected by the Coastal Area Management Act (CAMA). NMFS does not guarantee approval of a request to relocate the fishing pier to another location due to potential impacts to sea turtles (as related to the Endangered

Species Act, Section 7). Alternative 5 was developed as an option that did not directly impact the Straits Fishing Pier.

Alternative 5 – One new fixed span bridge, located to the east of the existing bridges, with 45-foot VNC at Bridge No. 73. Alternative 5 is similar to Alternative 4, but with the alignment located further east away from the existing Straits Fishing Pier (see Figures 5 and 6).

Costs/Impact tables

The following tables comparing Build Alternatives 2, 3, 4, and 5 were presented to the Merger Team at Concurrence Point 3 and used for alternative selection.

Table 1: Preliminary Design Alternatives Comparison Matrix

Category	Alt 2	Alt 3	Alt 4	Alt 5
Project Description				
Project Length (miles)	0.82	0.86	0.86	0.86
Bridge Length (Bridge No. 73/96 in feet)	1,880 / 690	1,555 / 825	2,905	3,200
Bridge Structure (sf) - Bridge No. 73 / Bridge No. 96	65,800 / 24,150	54,425 / 28,875	101,675	112,000
Miscellaneous				
Constructability Concerns	High	Medium	Medium	Low
Splash Zone Concerns	High	High	Low	Low
Evacuation/Flooding Concerns (potential for issue on center island)	High	High	Low	Low
Utility Impacts (no. of poles impacted)	7	7	7	7
Public Feedback				
Public Preference at Public Meeting #2 (Preferred Alt)	0%	7%	9%	84%
Costs				
Right-of-Way Costs	$884,440	$969,960	$990,560	$807,120
Utility Costs (*power pole relocations*)	$241,017	$214,466	$214,466	$214,466
Construction Costs	$28,900,000	$29,600,000	$31,400,000	$32,900,000
Total Costs (Rounded up to $100k)	**$30,300,000**	**$30,800,000**	**$32,700,000**	**$34,000,000**

Represents alternative with lowest impact in each category

Represents alternative with highest impact in each category

Table 2: Preliminary Design Alternatives Comparison Matrix – Environmental Impacts

Category	Alt 2	Alt 3	Alt 4	Alt 5
Human Environment Impacts[1]				
Straits Landing Boat Access Area[5] -- permanent/temporary (acres)	0.08 / 0.21	0.06 / 0.09	0.06 / 0.09	0.06 / 0.08
Section 4(f) Determination (Use, *De Minimis*, None)	*De Minimis*	*De Minimis*	*De Minimis*	*De Minimis*
Straits Fishing Pier[5] -- permanent/temporary (acres)	0.35 / 0.01	1.11 / 0.16	1.12 / 0.24	0 / 0
Section 4(f) Determination (Use, *De Minimis*, None)	Use	Use	Use	None
Harkers Island Beach Access[5] -- permanent/temporary (acres)	0.61 / 0.08	0.05 / 0	0.05 / 0	0.04 / 0
Section 4(f) Determination (Use, *De Minimis*, None)	Use	*De Minimis*	*De Minimis*	*De Minimis*
Properties Impacted (number) -- *no anticipated relocations*	11	14	14	12
Proposed Right-of-Way/Temporary Easements (acres)	1.38 / 0.09	1.23 / 0.05	1.21 / 0.04	0.89 / 0.08
Archeological Sites (number)[6]	1	1	1	1
Natural Environment				
Wetlands[2]: CAMA/Riparian Impacts (acres)	0.50 / 0	0.26 / 0.01	0.13 / 0.01	0.09 / 0.01
Total Wetland Impacts (acres)	0.50	0.27	0.14	0.10
Submerged Aquatic Vegetation[3] (SAV) (acres)				
July 2017 SAV Survey	0.07	0.13	0.13	0.48
Surface Water[4] (acres)	0.03	0	0	0

Represents alternative with lowest impact in each category

Represents alternative with highest impact in each category

NOTES

1) *Community Resource Impacts are areas based on proposed right-of-way and easement boundaries as determined from the preliminary design plans for each alternative.*

2) *Wetland Impacts are based on preliminary design permanent and temporary slope stakes, plus an additional 25 feet outside of each construction limit as determined from the preliminary design plans for each alternative. Impacts reported here are lower than impacts listed in the Concurrence Point 2A/3 packet and presentation due to a revised wetland boundary in the northwest quadrant.*

3) *Potential Submerged Aquatic Vegetation Impacts were investigated based on two methodologies: (1) the area of the proposed bridge above the surveyed SAV locations, and (2) accounting for shading with a bridge height/width ratio. Both methodologies resulted in the same impacts. Impacts reported do not account for any credits that may be possible due to existing bridge removal. SAV surveys were conducted in July and September 2016 and most recently in July 2017. Biologists waded the SAV areas to determine any changes in the original delineation, changes in species composition, and changes to SAV density. The July and September 2016 surveys resulted in findings within 0.01 acre. Survey findings in 2017 were very similar. There are no changes to potential impacts compared to the areas reported at the Merger meeting for Concurrence Point 3.*

4) *Surface Water Impacts are based on area of fill needed to construct the roadway approach and retaining walls within the existing water surface.*

5) *These properties are also considered Public Trust Resources by NCDCM/CAMA.*

6) *Archaeology Site 31CR76 is not eligible for the National Register of Historic Places.*

Selection of LEDPA/Preferred Alternative

Alternatives 2, 3, and 4 were not selected for the following reasons:

Alternative 2

- No public support (0%)
- Transportation use of two Section 4(f) resources (Harkers Island Beach Access and Straits Fishing Pier) (removes the pier)
- Impacts to CAMA/Riparian wetlands
- Constructability concerns
- Splash zone concerns

Alternative 3

- Low public support (7%)
- Transportation use of one Section 4(f) resource (Straits Fishing Pier) (removes the pier)
- Impacts to CAMA/Riparian wetlands
- Constructability concerns
- Splash zone concerns

Alternative 4

- Transportation use of one Section 4(f) resource (Straits Fishing Pier) (removes the pier)
- Low public support (9%)

Alternative 5 was selected as the LEDPA/Preferred Alternative for the following reasons:

- Straits Fishing Pier would remain in place; Carteret County to retain/own/maintain Bridge No. 96 for non-vehicular use
- Section 4(f) resources – Preliminary *de minimis* determination for Harkers Island Beach and Straits Landing Boat Access; no impact to Straits Fishing Pier
- Received highest public support (84%) and endorsed by the Carteret County Board of Commissioners
- Low constructability concerns with existing bridge structures
- Least impact to CAMA/Riparian wetlands compared to other Build alternatives
- Low splash zone concerns

Note: While Alternative 5 has lower impacts to human and natural resources than other Build alternatives, it impacts SAVs. Mitigation would likely be required to offset impacts and will be discussed further at Concurrence Point 4A.

Maintenance of Traffic

Temporary work bridges will be required to construct the proposed structure. To maintain traffic on the existing bridges during construction, temporary pavement and temporary shoring will be required to construct the approach slabs of the bridge ends on the mainland side. Avoidance and minimization of impacts to natural environmental and Public Trust Resources will be discussed at the Merger meeting for Concurrence Point 4A.

Public Parking

The North Carolina Wildlife Resources Commission (NCWRC) noted that elimination of vehicular access to the Straits Fishing Pier and center island would likely result in indirect impacts to the Straits Landing Boat Access Area's parking lot. The parking lot for the Boat Access Area is designated for vehicles with trailers only. NCWRC anticipates that additional parking demand for the Straits Fishing Pier would result in vehicles parked along the shoulders and right-of-way near the Boat Access Area. NCDOT will coordinate with NCWRC and Carteret County to explore options for providing additional parking for public resources in the project area, as included on the project's Green Sheet.

Based on the planning preliminary roadway designs, Alternative 5 would impact one parking space temporarily and one permanently at the Straits Landing Boat Access Area. However, these impacts will be reduced in the final design stage as it becomes possible to refine the horizontal and vertical alignment. It is not anticipated that Alternative 5 will require taking any parking spaces from Straits Landing Boat Access Area permanently. More information based on further design refinement and efforts to minimize impacts will be presented at Concurrence Point 4A and discussed with Merger Team members.

Harkers Island Beach Access is a public beach owned and maintained by Carteret County and located adjacent to Bridge No. 73 in the southwest quadrant of the study area, on the Island side. The beach is open to the public year-round. No designated or maintained parking area is available, but beach visitors park in an adjacent gravel area. Alternative 5 is anticipated to result in 0.04 acre of permanent impact to this property. Parking considerations discussed at Concurrence Point 4A will include Harkers Island Beach Access, as it is considered a CAMA Public Trust Resource.

F. Project Impact Criteria Checklists:

Type III Actions		Yes	No
1	Does the project involve potential effects on species listed with the US Fish and Wildlife Service (USFWS) or National Marine Fisheries (NMFS)?	☒	☐
2	Does the project result in impacts subject to the conditions of the Bald and Golden Eagle Protection Act (BGPA)?	☐	☒
3	Does the project generate substantial controversy or public opposition, for any reason, following appropriate public involvement?	☐	☒
4	Does the project cause disproportionately high and adverse impacts relative to low-income and/or minority populations?	☐	☒
5	Does the project involve substantial residential or commercial displacements or right of way acquisition?	☐	☒
6	Does the project include a determination under Section 4(f)?	☒	☐
7	Is a project-level analysis for direct, indirect, or cumulative effects required based on the NCDOT community studies screening tool?	☐	☒
8	Is a project level air quality Mobile Source Air Toxics (MSAT) analysis required?	☐	☒
9	Is the project located in anadromous fish spawning waters?	☐	☒
10	Does the project impact waters classified as Outstanding Resource Water (ORW), High Quality Water (HQW), Water Supply Watershed Critical Areas, 303(d) listed impaired water bodies, buffer rules, or Submerged Aquatic Vegetation (SAV)?	☒	☐
11	Does the project impact waters of the United States in any of the designated mountain trout streams?	☐	☒
12	Does the project require a U.S. Army Corps of Engineers (USACE) Individual Section 404 Permit?	☐	☒
13	Will the project require an easement from a Federal Energy Regulatory Commission (FERC) licensed facility?	☐	☒
14	Does the project include Section 106 of the National Historic Preservation Act (NHPA) effects determination other than a no effect, including archaeological remains? Are there project commitments identified?	☐	☒
15	Does the project involve hazardous materials and/or landfills?	☐	☒
16	Does the project require work encroaching and adversely affecting a regulatory floodway or work affecting the base floodplain (100-year flood) elevations of a water course or lake, pursuant to Executive Order 11988 and 23 CFR 650 subpart A?	☐	☒
17	Is the project in a Coastal Area Management Act (CAMA) county and substantially affects the coastal zone and/or any Area of Environmental Concern (AEC)?	☒	☐
18	Does the project require a U.S. Coast Guard (USCG) permit?	☒	☐
19	Does the project involve construction activities in, across, or adjacent to a designated Wild and Scenic River present within the project area?	☐	☒
20	Does the project involve Coastal Barrier Resources Act (CBRA) resources?	☐	☒

Type III Actions (continued)		Yes	No
21	Does the project impact federal lands (e.g. USFS, USFWS, etc.) or Tribal Lands?	☐	☒
22	Does the project involve any changes in access control?	☐	☒
23	Does the project have a permanent adverse effect on local traffic patterns or community cohesiveness?	☐	☒
24	Will maintenance of traffic cause substantial disruption?	☐	☒
25	Is the project inconsistent with the STIP or the Metropolitan Planning Organization's (MPO's) Transportation Improvement Program (TIP) (where applicable)?	☐	☒
26	Does the project require the acquisition of lands under the protection of Section 6(f) of the Land and Water Conservation Act, the Federal Aid in Fish Restoration Act, the Federal Aid in Wildlife Restoration Act, Tennessee Valley Authority (TVA), Tribal Lands, or other unique areas or special lands that were acquired in fee or easement with public-use money and have deed restrictions or covenants on the property?	☐	☒
27	Does the project involve Federal Emergency Management Agency (FEMA) buyout properties under the Hazard Mitigation Grant Program (HMGP)?	☐	☒
28	Is the project considered a Type I under the NCDOT's Noise Policy?	☐	☒
29	Is there prime or important farmland soil impacted by this project as defined by the Farmland Protection Policy Act (FPPA)?	☐	☒
30	Are there other issues that arose during the project development process that affected the project decision?	☐	☒

G. Additional Documentation as Required from Section F

Response to Question 1: Federally Protected Species

Federally protected species currently listed for Carteret County and their biological conclusions are included in Table 3.

Northern long-eared bat

The US Fish and Wildlife Service has developed a programmatic biological opinion (PBO) in conjunction with the Federal Highway Administration, the US Army Corps of Engineers and NCDOT for the northern long-eared bat (NLEB) (*Myotis septentrionalis*) in eastern North Carolina. The PBO covers the entire NCDOT program in Divisions 1-8, including all NCDOT projects and activities. The programmatic determination for NLEB for the NCDOT program is "**May Affect, Likely to Adversely Affect**." The PBO provides incidental take coverage for NLEB and will ensure compliance with Section 7 of the Endangered Species Act for five years for all NCDOT projects with a federal nexus in Divisions 1-8, which includes Carteret County.

Sea Turtles (Unresolved Biological Conclusions) and Atlantic Sturgeon (May Affect, Not Likely to Adversely Affect)

The biological conclusions for sea turtles are unresolved and will be discussed further at Concurrence Point 4A. More detailed design information is required to determine proposed bridge pier locations and the potential impact to sea turtles. Due to lack of nesting habitat, the biological conclusion for each of these species is no effect as far as the US Fish and Wildlife Service is concerned. NCDOT will coordinate appropriately with the National Oceanic and Atmospheric Administration (NOAA) – NMFS regarding the green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, loggerhead sea turtle, leatherback sea turtle, and Atlantic sturgeon prior to submittal of the Section 404 permit application, in compliance with Section 7 of the Endangered Species Act (ESA).

West Indian Manatees – May Affect, Not Likely to Adversely Affect

NCDOT's commitment to adhering to the *Guidelines for Avoiding impacts to the West Indian Manatee: Precautionary Measures for Construction Activities in North Carolina Waters* is documented on the project's Green Sheet.

Table 3: Federally Protected Species Listed for Carteret County

Scientific Name	Common Name	Federal Status	Habitat Present	Biological Conclusion
Alligator mississippiensis	American alligator	T (S/A)	Yes	Not required
Chelonia mydas	Green sea turtle	T	Yes	Unresolved
Eretmochelys imbricata	Hawksbill sea turtle	E	Yes	Unresolved
Lepidochelys kempii	Kemp's ridley sea turtle	E	Yes	Unresolved
Dermochelys coriacea	Leatherback sea turtle	E	Yes	Unresolved
Caretta caretta	Loggerhead sea turtle	T	Yes	Unresolved
Charadrius melodus	Piping plover	T	No	No Effect
Picoides borealis	Red-cockaded woodpecker	E	No	No Effect
Calidris canutus rufa	Rufa red knot	T	No	No Effect
Sterna dougallii dougallii	Roseate tern	T	No	No Effect
Acipenser brevirostrum	Shortnose sturgeon	E	Yes	No Effect
Trichechus manatus	West Indian manatee	E	Yes	MA-NLAA
Acipenser oxyrinchus	Atlantic sturgeon	E	Yes	MA-NLAA
Lysimachia asperulaefolia	Rough-leaved loosestrife	E	No	No Effect
Amaranthus pumilus	Seabeach amaranth	T	No	No Effect
Myotis septentrionalis	Northern long-eared bat	T	Yes	MA-LAA

E – Endangered; T – Threatened; T(S/A) – Threatened due to similarity of appearance;
MA-NLAA – May Affect – Not Likely to Adversely Affect; MA-LAA – May Affect – Likely to Adversely Affect

In-Water Work Moratorium

NCDOT will coordinate with the North Carolina Division of Marine Fisheries (NCDMF) and NMFS concerning the in-water construction moratorium for protected aquatic species.

The above species were verified on August 24, 2017, and no new listings have been added.

Response to Question 6: Section 4(f)

Three properties protected by Section 4(f) are located within the study area: Harkers Island Beach Access, Straits Fishing Pier Island, and Straits Landing Boat Access Area. These resources are also considered Public Trust Resources.

1. ***Harkers Island Beach Access*** – Harkers Island Beach Access is a public beach owned and maintained by Carteret County and located adjacent to Bridge No. 73 in the southwest quadrant of the study area, on the Island side. The beach is open to the public year-round. No designated/maintained parking area is available, though public users park in a gravel area adjacent to the beach access.

   Alternative 5 clips the beach property, resulting in 0.04 acre of permanent right-of-way required, based on the planning preliminary designs (as shown in Figure 5). Beach access and beach area would not be directly affected. The gravel area used for parking would not be affected. FHWA has made a *de minimis* determination (as defined in 23 CFR 774.17(2)) for the Harkers Island Beach Access due to the County's input that the Preferred Alternative would not adversely affect this property. Correspondence from Carteret County is attached.

2. ***Straits Fishing Pier Island*** – Straits Fishing Pier is a public fishing pier owned and maintained by Carteret County. It is located on the center island between Bridge No. 73 and Bridge No. 96. The pier is open to the public year-round. No designated/maintained parking area is available, though public users park in dirt/gravel areas on the center island and along the bridge roadway.

   Alternative 5 avoids the center island and fishing pier and would result in no direct permanent or temporary impacts. No right-of-way is needed from this property. Vehicular access to the center island would not be possible with Alternative 5, changing access to the fishing pier. Carteret County expressed its intent to assume ownership and maintenance of Bridge No. 96 if Alternative 5 was chosen as the Preferred Alternative (correspondence attached). Bridge No. 96 would become a non-vehicular facility and provide access to the center island for recreational use. FHWA has determined that Alternative 5 would have no impact on this Section 4(f) property.

3. ***Straits Landing Boat Access Area*** – The Straits Landing Boat Access Area is a public boat landing owned by the State and maintained by the NCWRC. It is located adjacent to Bridge No. 96 in the northwest quadrant of the study area, on the mainland side. The boat landing is open to the public year-round with a parking lot for vehicles with trailers. Overflow (undesignated/non-maintained) parking tends to occur on the center island, along the bridges, and in front of private residences during peak times/seasons. No parking for vehicles without trailers is available.

Alternative 5 clips the eastern portion of the boat landing property, resulting in 0.06 acre of permanent impacts and 0.08 acre of temporary impacts (Figure 5). The impacted area includes two parking spaces (one permanent and one temporary impact), the existing driveway, undeveloped and marshy land south of the boat ramps, ramp driveway, and a majority of the landscape between the roadway and the boat launch facility. With Alternative 5, boat launch access would remain as-is, but the driveway would be elongated due to the proposed alignments.

NCWRC has expressed concern that elimination of vehicular access to the center fishing pier island could increase parking demand on the Straits Landing Boat Access Area's parking lot. NCDOT will coordinate with NCWRC and Carteret County to explore options for providing additional parking for public resources in the project area, as included on the project's Green Sheet, and this will be addressed during Concurrence Point 4A.

FHWA has made a *de minimis* determination (as defined in 23 CFR 774.17(2)) for the Straits Landing Boat Access Area based on NCWRC's input that the Preferred Alternative would not adversely affect this property. Correspondence from NCWRC is attached.

Response to Question 10: ORW / HWQ / WSW / 303(d) / Buffers / SAV

The Straits has been assigned a best usage classification as SA High Quality Waters (HQW). The "SA" denotes "tidal salt water protected for market purposes" and also protects usage specified by the "SB" and "SC" classifications. The North Carolina 2014 Final 303(d) list of impaired waters includes The Straits from the Core Sound to the North River excluding a conditionally approved open section in the northwest portion adjacent to the North River. The Straits is listed as a Primary Nursery Area by NCDMF and NMFS and may have an in-water construction moratorium, pending coordination with those agencies.

Initial SAV surveys were conducted in the summer of 2016. Additional SAV surveys were completed in the summer of 2017. Areas containing SAVs from the 2017 survey are shown on Figure 6. Alternative 5 results in 0.48 acre of SAV impacts.

Response to Question 17: CAMA AECs

Two different types of CAMA Areas of Environmental Concern (AECs), Public Trust Water and CAMA coastal marsh wetlands, were identified in the study area. The Straits is a designated Public Trust Water with CAMA coastal marsh present at twelve different wetland sites. A CAMA permit from the NC Division of Coastal Management will be required for all impacts to designated AECs within the study area. Alternative 5 will impact 0.09 acre of CAMA wetland and 0.01 acre of Riparian wetland. Impacts will be discussed further during Concurrence Point 4A.

Response to Question 18: USCG Permit

A Draft Navigation Impact Report (NIR) was submitted to the United States Coast Guard (USCG) in December 2016 providing information on the proposed project navigational

needs in the area, vessel height surveys (completed in 2014 and available on the project website), interview data with local maritime community members, and waterway data from the United States Army Corps of Engineers (USACE) and NOAA. The USCG received a summary of public input from Public Meeting #1 to aid in their review, along with issuing a Preliminary Public Notice (PPN) to gather vessel information for the area around the Harkers Island Bridges. In March 2017, the USCG issued a Preliminary Navigational Clearance Determination (PNCD) that a 45-foot VNC and 125-foot minimum horizontal navigational clearance at the location of Bridge No. 73 would be sufficient for vessel traffic in the area. The final NIR will be submitted upon completion of the CE (with selection of Alternative 5 as the LEDPA/Preferred Alternative).

H. Project Commitments

Carteret County
Harkers Island Bridge Replacements
Federal Project No. BRSTP-1335(4)
WBS No. 40212.1.3
TIP No. B-4863

NCDOT Division 2:

- NCDOT will coordinate appropriately with the National Oceanic and Atmospheric Administration (NOAA) – National Marine Fisheries Service (NMFS) regarding the "unresolved" biological conclusion for the green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, loggerhead sea turtle, leatherback sea turtle, and Atlantic sturgeon prior to submittal of the Section 404 permit application, in compliance with Section 7 of the Endangered Species Act.

- Based on coordination with the United States Coast Guard (USCG), a USCG Permit is anticipated. The proposed bridge must provide the following clearances underneath the bridge: a vertical clearance of 45 feet above mean high water (MHW) and a horizontal clearance of 125 feet. NCDOT will coordinate with the USCG upon completion of the structural design to obtain the Advanced Approval for the project.

- NCDOT will coordinate with the North Carolina Division of Marine Fisheries (NCDMF) and NMFS concerning the in-water construction moratorium for protected aquatic species.

- NCDOT will adhere to *Guidelines for Avoiding Impacts to the West Indian Manatee: Precautionary Measures for Construction Activities in North Carolina Waters* for this project.

- NCDOT will coordinate with Carteret County to explore additional parking options for the Straits Island Fishing Pier.

NCDOT Local Programs Management Office and Division 2:

- NCDOT Local Programs Management Office and Division 2 will facilitate a formal municipal agreement between Carteret County and NCDOT regarding the County's commitment to maintain Bridge No. 96, to remain in-place for non-vehicular access to the Straits Fishing Pier after construction of the replacement bridge.

I. Categorical Exclusion Approval

STIP Project No.	**B-4863**
WBS Element	**40212.1.3**
Federal Project No.	**BRSTP-1335(4)**

Prepared By:

10/3/2017

DocuSigned by:
Meredith Van Duyn
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Date

Meredith H. Van Duyn, PE, Project Manager
RS&H Architects-Engineers-Planners, Inc.

Prepared For: North Carolina Department of Transportation

Reviewed By:

10/3/2017

DocuSigned by:
Maria Rogerson
CB5A4DFB490A4FC...

Date

Maria A. Rogerson, PE, Project Engineer
North Carolina Department of Transportation

NCDOT certifies that the proposed action qualifies as a Type III Categorical Exclusion.

10/3/2017

DocuSigned by:
Preston Hunter
5433AB43E8E9415...

Date

R. Preston Hunter, PE, Division Engineer
North Carolina Department of Transportation

FHWA Approval:

10/3/2017

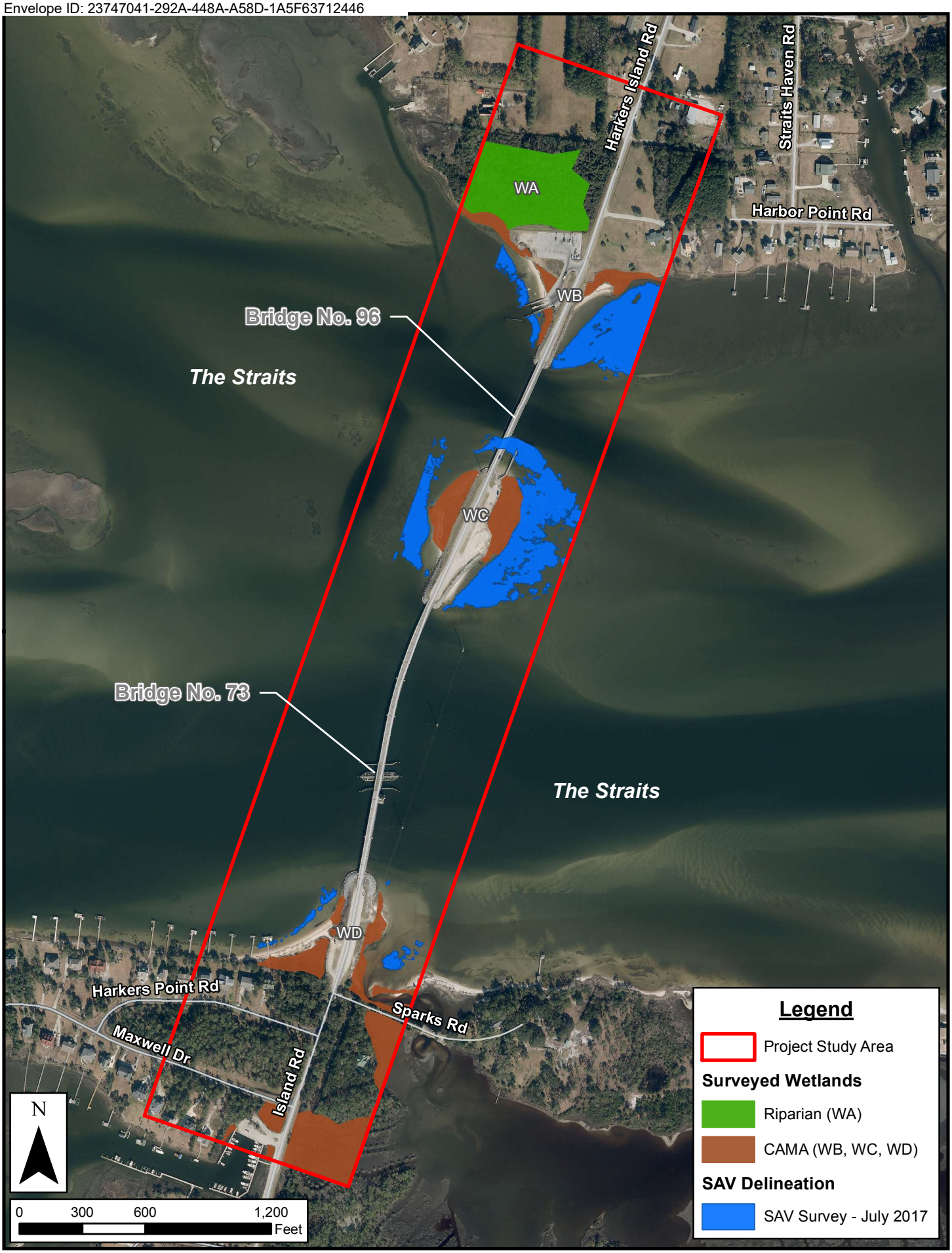
DocuSigned by:
Ron Lucas
7707B71B714A4F1...

Date

John F. Sullivan, III, PE, Division Administrator
Federal Highway Administration

FIGURES

	Carteret County	RS&H	**Harkers Island Bridge Replacements Project** Bridge No. 73 and No. 96 over The Straits - SR 1332/1335	TIP No. B-4863	**Figure 1:** Vicinity Map
				Division: 2	September 2017



Carteret County

RS&H

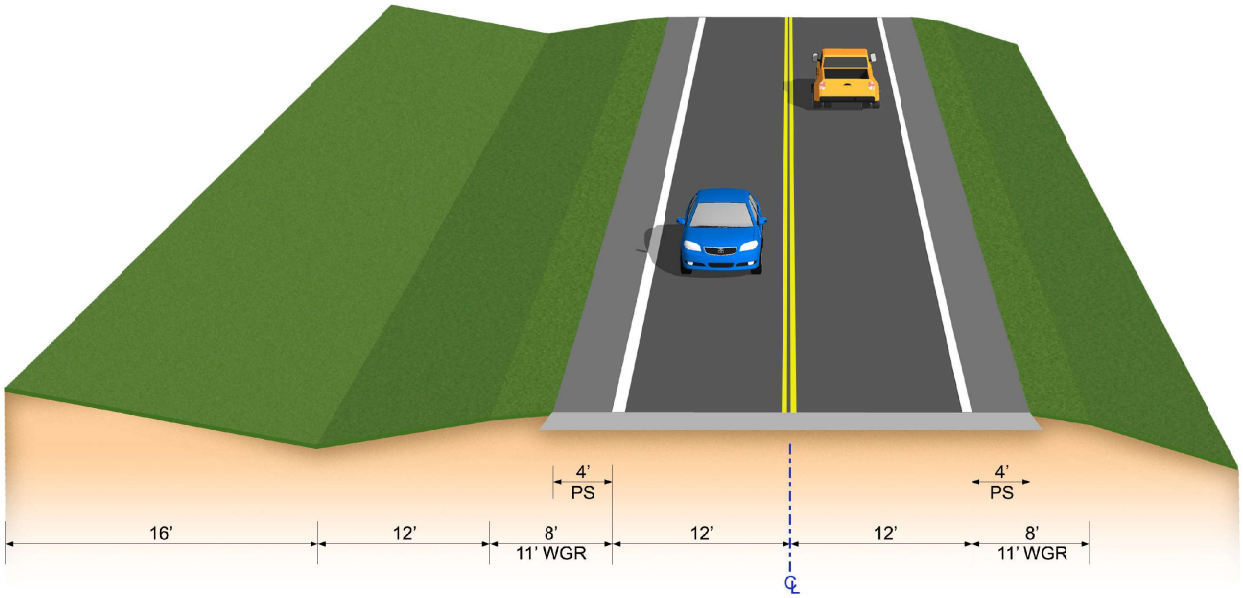
Harkers Island Bridge Replacements Project
Bridge No. 73 and No. 96 over
The Straits - SR 1332/1335

TIP No. B-4863

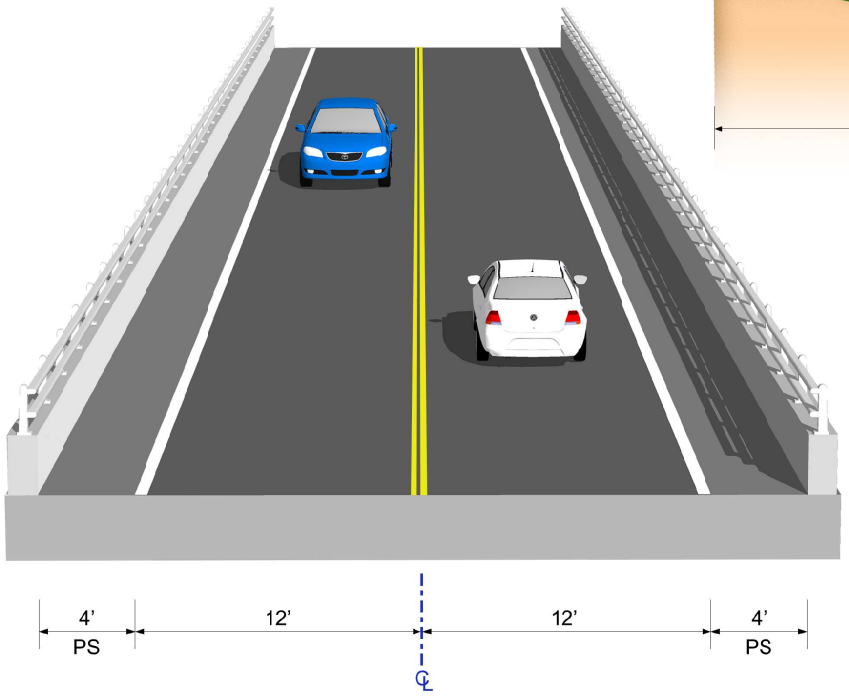
Figure 2: Environmental Features

Division: 2

September 2017



Roadway Typical Section



Bridge Typical Section

Typical Sections

RS&H

Carteret County, Div 2

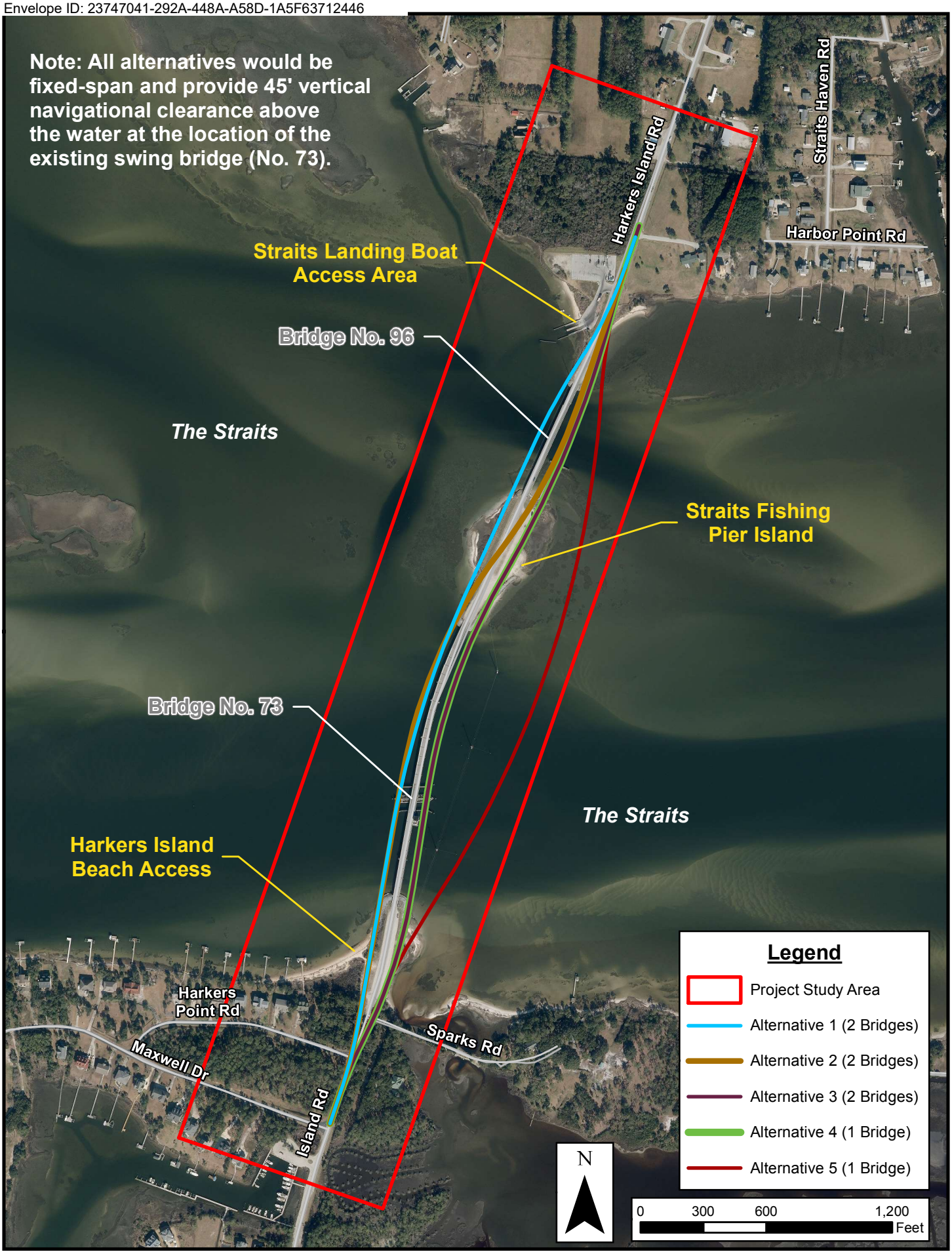
Harkers Island Bridge Replacements Project

TIP No: B-4863

Bridge No. 73 and No. 96 over The Straits - SR 1332/1335

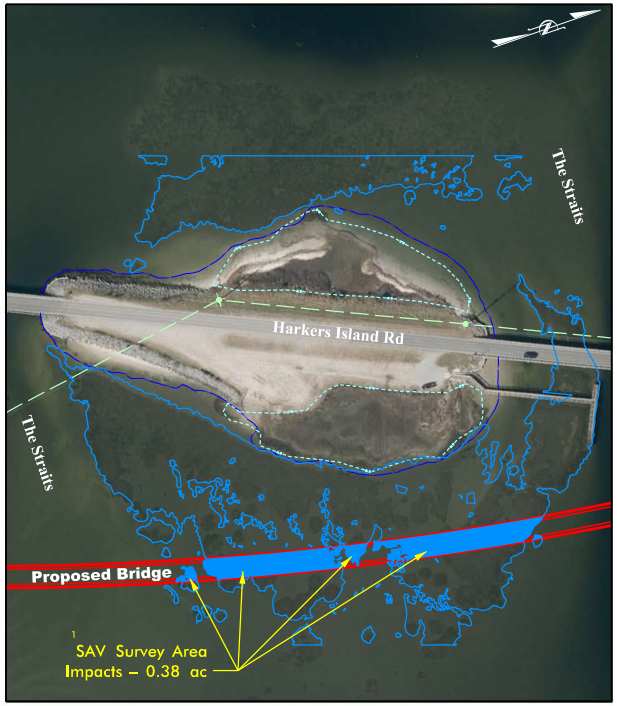
Figure 3

September 2017

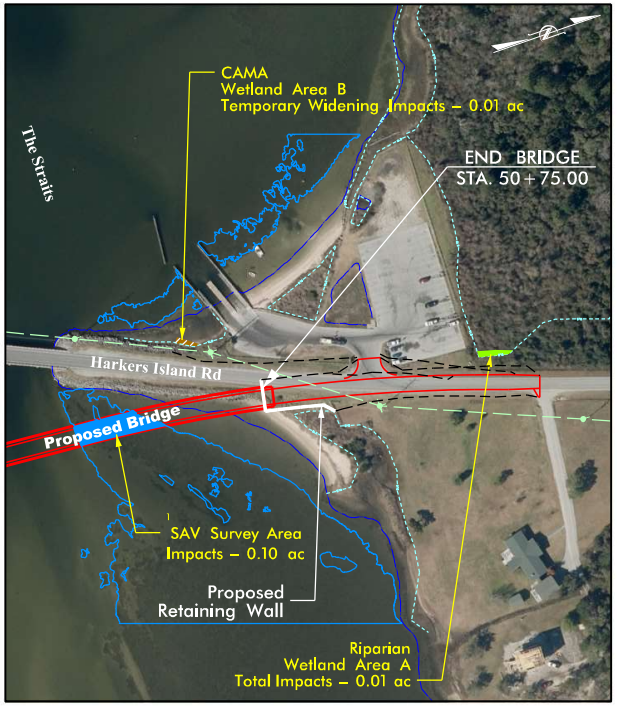


	Carteret County	RS&H	**Harkers Island Bridge Replacements Project** Bridge No. 73 and No. 96 over The Straits - SR 1332/1335	TIP No. B-4863	**Figure 4:** Alternatives
				Division: 2	September 2017

Island



Fishing Pier Island



Mainland

Total Riparian Wetland Impacts = 0.01 acres
Total CAMA Wetland Impacts = 0.09 acres
Total Surface Water Impacts = N/A

[1] Bridge footprint within July 2017 survey areas:
Total SAV Survey Area Impacts = 0.48 acres

Legend

- WLB – Wetland Boundary
- SAV Survey Area Boundary (July 2017)
- Water Boundary
- Roadway Footprint (Slope Stakes)
- Overhead Power Distribution Line
- SAV Survey Area Impacts (July 2017)
- Riparian Wetland Impacts
- CAMA Wetland Impacts
- Temporary Widening Wetland Impacts
- Surface Water Impacts

100′ 0′ 100′ 200′
50′ SCALE

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

Alternative 5
Affected Natural Environment

RS&H

Carteret County, Div. 2

Harkers Island Bridge Replacements Project
TIP No: B - 4863
Bridge No. 73 and No. 96 over The Straits - SR 1332/1335

Figure 6

September 2017

MERGER TEAM CONCURRENCE FORMS

NEPA/404 Merger Team Meeting Agreement

Concurrence Point 1: Purpose & Need and Study Area Defined

Project Name/Description: Harkers Island Bridge Replacements, Carteret County, NC

TIP Project No.: B-4863

Federal Aid Project No.: BRSTP-1335(3)

WBS No.: 40212.1.1

Need for Proposed Action

- Structurally deficient, functionally obsolete bridges

Purpose of Proposed Action

- Improve bridge structural safety and functionality

Study Area Defined

The study area is as shown on Figure 2 of the Concurrence Point 1 package.

The Project Team met and concurred on this date of February 18, 2016 with the Purpose & Need and Study Area Defined for the proposed project as stated above:

USACE		NCDOT	
USEPA		USFWS	
NCDCR		NCDWR	
FHWA		NCWRC	
USCG		NCDCM	
DERP ~~NCDMF~~		NMFS	

Meeting Notes Memorandum

Meeting Date: February 18, 2016

Subject: Concurrence Point 1 Meeting
B-4863 Harkers Island Bridge Replacements

Location: NCDOT Structure Design Conference Room CCA

Attendees:

NCDOT	Agencies	Consultants
Michele James, PDEA	Felix Davila, FHWA	Edith Peters, RS&H
Charles Cox, PDEA	Clarence Colman, FHWA	Radha Swayampakala, RS&H
Rob Hanson, PDEA	Cathy Brittingham, DCM	Meredith Van Duyn, RS&H
Tina Snell, Roadway	Gregg Bodar, DCM	Jennifer Farino, RS&H
Gary Lovering, Roadway	Stephen Lane, DCM	Drew Morrow, RS&H
Chris Rivenbark, NES	Garcy Ward, NCDWR	Jenny Noonkester, RS&H
Tyler Stanton, NES	Tom Steffens, USACE	
Mark Staley, REU	Keith Hanson, NOAA Fisheries contractor	
Hardee Cox, STIP	Ken Riley, NOAA Fisheries (On phone)	
Pareshkumar Patel, STIP	Dr. Cynthia Van Der Weile, USEPA (On phone)	
Paul Atkinson, Hydraulics	Travis Wilson, NCWRC (On phone)	
Anamika Ladd, HES-PI	Patrick Flannigan, Down East RPO (On phone)	
Herman Huang, HES-CS		
Korey Newton, SMU		
Ed Eatmon, Division 2		

Michele James opened the meeting and asked attendees to introduce themselves. The purpose of this meeting was to provide project information, decide if the project should go through the Merger Process, discuss Concurrence Point 1 (CP 1) and provide information on alternatives currently being studied.

- Edith noted the slight revisions to the CP 1 Packet since they were originally available to the agencies (Figures and Tables in Appendices A & B)
  - Revision to designs occurred after CP 1 packet was originally distributed which changed slope stakes in figures in Appendix B
  - Transmission lines were added to Appendix B figures
- As Edith went through the PowerPoint presentation, the following questions/comments were asked:
  - Was Bridge No. 96 sufficiency rating after emergency repairs were done?
    - Yes, since the repairs were done in 2012 and the inspection report was from 2013
  - How were study area distances determined?
    - Based on the current R/W footprint of the alternative designs

- Will the Natural Resources Technical Report (NRTR) include Submerged Aquatic Vegetation (SAV) surveys?
  - No, they will be provided, separate from the NRTR updates
  - Scheduled soon; later was noted that this would need to be done during growing season (Summer)
- FHWA asked if boat ramp is a Section 4(f) resource
  - Potential for all 3 human resources to be protected under Section 4(f)
  - Noted that a previous project had a boat ramp that qualified as a Section 4(f) resource and had to be mitigated.
  - DCM and NOAA noted that all 3 human resources are highly utilized (Carteret County Beach, Carteret County Fishing Pier, and NCWRC Boat Ramp)
- Will a Coast Guard Permit be required?
  - Yes; Edith explained about the vessel survey report that has been completed, and the upcoming Navigation Evaluation Report (NER)
  - DCM and USACE would like a copy of the vessel survey report and NER
  - DCM has different requirements on navigation under bridges; may affect vertical clearance on Bridge No. 96
  - Can a kayak fit under Bridge No. 96?
    - Yes
- How is the VNC of Bridge No. 96 stated as 0' in the packet?
  - Was based on Bridge Inspection Report
  - Will need to get a more accurate number
- Edith and Charles asked the agencies if this project meets the requirements to go through the Merger Process
  - Due to potential Section 4(f) resources and natural resource impacts, it was recommended to go through the Merger Process
  - DCM noted that there is a mechanism to remove a project from the Merger process at a later date if it is no longer necessary
- Can access needs be added to the Need and Purpose?
  - Since project need is stated to replace structurally deficient and functionally obsolete bridges, maintaining access to amenities is not a primary need
- What makes Bridge No. 96 functionally obsolete?
  - Existing clear width on bridge is below current standard
- Is the safety issue on Bridge No. 73 structural or traffic?
  - Structural; CP 1 form revised to clarify
- Remove "secondary purpose" and reference to packet from CP 1 form.
- CP 1 form was updated (see text below) and agencies agreed and signed on CP 1.
  - Need for Proposed Action

        - Structurally deficient, functionally obsolete bridges
    - Purpose of Proposed Action
        - Improve bridge structural safety and functionality
    - Study Area Defined
        - The study area is as shown on Figure 2 of the Concurrence Point 1 package.
- Can the design speed be reduced to provide access to the amenities along the project?
    - This would need to be determined on the Division level and can be discussed at a later CP meeting
- Does the 4' paved shoulder include bridge parapet and rail?
    - No, RS&H to revise typical section dimension
- Has sea level rise been considered on this project?
    - No, since there is not design guidance at this time
    - FHWA has created recent memos regarding this issue, and can address this later in the Merger Process
    - Cape Lookout National Seashore Museum has done a study in this area
    - Need a recommendation from FHWA on how to accommodate this
- USACE requested profiles of the alternatives in the next version of the packet to provide clarity
- Concerned with relocating fishing pier as this is a prime fishing location
- Parking is at a premium now; trucks and trailers usually park on existing grass shoulder
- Boat ramp access is difficult now with very tight maneuvers required due to existing constraints
- Relocating the fishing pier will cause a formal consultation from National Marine Fisheries Service Protected Resources Division
- There are very sensitive hatchery areas in the surrounding areas
- Need to include SAV on mapping
    - Survey to be scheduled soon; may not be included in supplemental information for NRTR
- Will this project require an extended moratorium?
    - Most likely yes; similar to Gallants Channel project which was February 15th through September 30th
        - Revise Packet to say September 30th instead of 31st
- DCM concerned with very high wetland impacts on all alternatives; anything over 1,000 sq. ft. of CAMA impacts is an alarm
    - Project team reiterated that a 25' buffer off of slope stakes was used to show potential worst case scenario for impacts
    - Avoidance and minimization have not been studied at this time but will be considered as design progresses.

- Concerned with keeping pieces of Bridge No. 96 as fishing pier due to maintenance and it adds a 10 month process according to FHWA
- Can the study area be expanded at bridge landings to look at additional alternatives?
  - Project team noted that this is the only access to the island and anywhere in this vicinity will have wetland impacts
  - Pending SAV survey results, potential to increase to study area at a later date
- Has stormwater treatment been evaluated?
  - Not yet, but will likely need maximum treatment due to high quality waters
  - Will only have small grass swales at tie-ins, keep in mind additional areas outside of roadside ditches will be needed (similar to B-4929)
- Sea grass beds are more scrutinized by NOAA and are harder to mitigate
- Likely need deck drains due to bridge lengths
- Possibly have wider shoulders to handle spread – this would help bicyclists as well
- Add slope stakes to Figure B-10
- Is this channel dredged?
  - Not known at this time
  - Middle fishing pier island appears to be a dredge spoil location
- Temporary work bridge construction preferred due to shallow depths outside of main channel and the impacts would need to be considered
- DCM encouraged project team to reduce number of alternatives evaluated
- NOAA has extensive vegetation surveys in this area
- FHWA asked if a Section 10 Permit will be required
  - USACE not sure if this is a federally maintained waterway
  - Project team stated that this is not on the Intracoastal Waterway but the Straits is a navigable waterway so Section 10 permit would apply
- Will this project require a full NEPA assessment?
  - The CE will look more like an EA and have a Section 4(f) assessment.
- Make sure the entire study area is delineated once NRTR wetland update is received

Action Items

- RS&H
  - Provide following items to agencies when available:
    - NRTR supplemental survey information
    - SAV studies
    - Vessel Survey Report
    - Navigation Evaluation Report
    - Plan & Profile
  - Determine more accurate vertical clearance for vessels at Bridge No. 96
  - Circulate CP 1 form for all agencies to sign
  - Revise typical section to show 4’ dimension of shoulder only (not bridge parapet and rail)

- Add slope stakes to figure B-10
- Research whether channel is dredged currently (as part of NER)

If any recipient of the meeting notes would like to add comments or feels a comment is erroneous or needs to be expanded, please feel free to contact Michele James by email at mjames@ncdot.gov.

Attachments:

CP1 Packet
PowerPoint Presentation

Copies to:

Meeting Attendees

U.S. Department of Homeland Security

United States Coast Guard

Commander
United States Coast Guard
Fifth Coast Guard District

431 Crawford Street
Portsmouth, VA 23704-5004
Staff Symbol: dpb
Phone: (757) 398-6222
Fax: (757) 398-6334
Email: Hal.R.Pitts@uscg.mil or
CGDFiveBridges@uscg.mil

16591
06 JAN 2016

Ms. Maria A. Rogerson, P. E.
North Carolina Department of Transportation
1581 Mail Service Center
Raleigh, NC 27699-1581

Dear Ms. Rogerson:

The Coast Guard has reviewed the North Carolina Department of Transportation; Harker's Island Bridge Replacement STIP No. B4863 project: Concurrence Point 1 (CP1) (Purpose and Need – Study Area Defined) document of February 2016, and Concurrence Point 2 (CP2) – (Detailed Study Alternatives Carried Forward) document of June 2016.

The Coast Guard has no objection to the decisions and findings contained in the CP1 and CP2 documents.

The Coast Guard will continue to participate in the North Carolina NEPA/404 Merger Team process and will provide letters to document the Coast Guard's review of NEPA/404 Merger Team Meeting Agreement documents, in lieu of signing the agreement documents. The Coast Guard will either provide a "statement of no objection" or "statement of objection", inclusive of a detailed rationale for the objection.

If you have any questions, please contact Mr. Hal R. Pitts at the above listed address, email or telephone number.

Sincerely,

HAL R. PITTS
Bridge Program Manager
By direction of the Commander
Fifth Coast Guard District

Copy: Harker's Island Merger Team Members
Edith Peters, RS&H Architects-Engineers-Planners, Inc.

NEPA/404 Merger Team Meeting Agreement

Concurrence Point 2: Detailed Study Alternatives Carried Forward

Project Name/Description: Harkers Island Bridge Replacements, Carteret County, NC

TIP Project No.: B-4863

WBS No.: 40212.1.1

Detailed Study Alternatives Carried Forward

Detailed study alternatives to be carried forward are Alternatives 2, 3, 4, and 5 for the referenced project.

The Project Team met and concurred on this date of June 15, 2016 with the detailed study alternatives to be carried forward for the proposed project as stated above:

USACE	[signature]	NCDOT	Michele L. James
*USEPA	Cynthia F. Van Der Wiele	USFWS	Gary Jordan
*NCDCM	Cathy Brittingham	NCDWR	Amy Ward
NMFS	[signature]	NCWRC	[signature]
FHWA	Ronald G [signature]	DERPO	[signature]
NCDCR	Renee Gledhill-Earley		

*DCM agrees with detailed study of these alternatives, but look forward to additional discussion about whether an additional alternative(s) should be added prior to CP2A.

* USEPA agrees w/ DCM comment.

Meeting Notes Memorandum

Meeting Date: June 15, 2016

Subject: Concurrence Point 2 Meeting
B-4863 Harkers Island Bridge Replacements

Location: NCDOT Structure Design Conference Room CCA

Attendees:

NCDOT	Agencies	Consultant
Michele James, PDEA	Mr. Hal Pitts, USCG*	Edith Peters, RS&H
Charles Cox, PDEA	Cathy Brittingham, DCM	Radha Swayampakala, RS&H
Zahid Baloch, PDEA	Gregg Bodnar, DCM	Meredith Van Duyn, RS&H
Kathy Herring, PDEA	Stephen Lane, DCM	Jennifer Farino, RS&H
Sam St. Clair, Roadway	Garcy Ward, NCDWR	Drew Morrow, RS&H
Gary Lovering, Roadway	Tom Steffens, USACE	
Chris Rivenbark, NES	Ken Riley, NOAA Fisheries	
Tyler Stanton, NES	Dr. Cynthia Van Der Weile, USEPA*	
Anamika Laad, PICS	Travis Wilson, NCWRC	
Brook Anderson, Hydraulics	Patrick Flannigan, Down East RPO*	
Mark Staley, REU	Gary Jordan, USFWS	
Lee Cowhig, TPB		
Mack Bailey, Structures		
Korey Newton, Structures		
Hardee Cox, STIP		
John Rouse, Division 2*		
Bill Kincannon, Division 2		
Ed Eatmon, Division 2		
Maria Rogerson, Division 2		

* *joined via phone*

Charles Cox opened the meeting and thanked everyone for attending. The purpose of this meeting was to discuss alternatives currently being studied and decide on which one(s) to carry forward. Mr. Cox emphasized the nature of the Merger Team and NCDOT / RS&H staff as a team, and everyone's input is critical to move the project forward. He apologized for the last-minute addition of Alternative 5 to the packet, and he noted that Edith Peters would cover it in detail in case everyone had not had a chance to review it yet. NCDOT decided on the addition last week and issued the updated information as quickly as possible. It was decided to continue to hold the meeting instead of delay the schedule. Attendees introduced themselves.

Ms. Peters confirmed that everyone received a packet and new additional information. There has been a change in funding since the meeting for Concurrence Point 1. STIP Project B-4863 will be funded by the state (no federal funds), which has changed the lead agency from the Federal Highway Administration to the Coast Guard. Mr. Pitts will discuss separately with Tom Steffens.

Cathy Brittingham asked Mr. Pitts if he anticipates this project continuing to follow the NEPA/404 Merger process. Mr. Pitts will look into it and follow up on this question.

- **Concurrence Point 1 Summary**
  - Held on February 1, 2016
  - Purpose of Proposed Action is to improve bridge safety and functionality
  - Need for Proposed Action is to replace deficient, functionally obsolete bridges
- **Project Study Area Description**
  - Ms. Peters pointed out resources in the study area (County/Public Beach Access, Straits Fishing Pier, Potential Archaeological site, NCWRC Boat Ramp)
- **Vertical Navigational Clearance and Survey**
  - The B-4863 Vessel Height Survey was conducted for 30 days between May and October 2014, for 5 days each month
  - 1,765 vessels observed (3.4 per day)
  - Average of 2.9 bridge openings per day
  - 99.9% of vessels were 40 feet in height or less
  - NCDOT recommends 45 feet of vertical navigational clearance (VNC) for this project
  - Next step: Navigation Evaluation Report (NER) to move forward with USCG permits
  - USCG has an MOA with Federal Highway Administration and would like to receive the NER as soon as possible for evaluation, and provide recommendations/approvals for the horizontal and vertical navigational clearances
  - Stephen Lane asked about having data from winter months. Mr. Pitts noted that the NER will query various stakeholder groups and include data from winter months if needed. USCG finds the VNC / Survey sufficient.
  - It was noted that fishing trawler traffic may have increased recently through the Straits (traveling between Core to Pamlico Sounds, where majority of shrimp fisheries occur) because of other channels filling with sediment/sand. Agencies encouraged USCG to consider vessels from Marshallburg and Atlantic harbors (for vessel heights and outrigger lengths). Would like horizontal span to be wide enough for vessels to be able to lower outriggers through the bridge (i.e. Miss Melissa).
  - NCDOT will be recommending a minimum horizontal clearance to USCG in the NER for USCG approval.
  - Fender type / system has not been discussed
  - RS&H to complete NER in Fall 2016 and will share with Merger Team. Not sure if the information will be necessary to reach CP3, but NCDOT will make it available prior to the meeting if possible.
- **Study Options**
  - No Build does not meet P&N
  - Improvements to existing facility not reasonable, given maintenance costs
  - Alternate Modes of Travel (none feasible)
  - Traffic Management (not feasible)
- **Typical Sections – Two 12-ft lanes and 4-ft paved shoulders**

- **Build Alternatives**
  - Alternative 1
    - The NCWRC Boat Ramp driveway would remain in the same location but has potential impacts to turn-around area for boat trailers.
    - Touches down on the center island but does not provide driveway access (change from CP1 package). Sight distance issues occur due to the close proximity of the bridge ends, no access to center island, but fishing pier would not have to be removed for construction of vehicular bridge (not known until after CP1 when NCDOT progressed the designs further.)
    - Two bridge option vs. one bridge option was thought to be less expensive when initial concepts were developed.
    - Alternative 1 includes a footpath beneath the proposed bridge to public beach access.
  - Alternative 2
    - Located on the east side of the existing Bridge 96 and west side of existing Bridge 73. Designed to avoid/minimize impacts to the utility poles which cross near the center island. Utilities will be a challenge on this project.
    - Similar to Alternative 1, the driveway to the NCWRC Boat Ramp can be maintained, and this alternative has less impacts to the boat ramp turn-around area than Alternative 1.
    - Touches down to the center island but impacts the fishing pier. Similar sight distance issue as Alternative 1 and does not provide vehicle access to the center island. Fishing pier would be removed.
    - Alternative 2 includes a footpath beneath the proposed bridge to public beach access.
  - Alternative 3
    - Located on the east of both existing bridges (No. 96 and 73).
    - The NCWRC Boat Ramp driveway is currently shifted slightly to accommodate required sight distance.
    - The sight distance near the center island is achieved, but Alternative 3 impacts fishing pier (would need to be removed/relocated). It was originally thought that the pier could be relocated to the other side of the island but now knowing NOAA concerns that may not be feasible.
      - Question: How close can the fishing pier stay to the proposed bridge? The Merger Team is not sure at this point but has some concerns with casting a fishing line if located too close. (RS&H assumed 100 feet of separation between the fishing pier and proposed vehicular bridge would be acceptable when developing horizontal design of Alt 5.)
    - Alternative 3 ties into the public beach parking area and does not have impacts to the beach area.
  - Alternative 4

- Includes one bridge, with an alignment similar to Alternative 3 (located to the east of the existing bridges 96 and 73).
- Sight distance issues occur near the NCWRC Boat Ramp.
- The proposed vehicular bridge would require removal/relocation of the fishing pier.
- The public beach access would be maintained, with no impacts to the beach area.
- Question: Would Bridge 96 be able to be used as a fishing pier with this option? Ms. Peters replied that it depends on Carteret County taking responsibility for ownership and maintenance costs of the existing bridge. It would also depend on whether this option is allowed by NOAA due to it being considered a new fishing location. NCDOT will continue discussions with the County, Division and NOAA. Carteret County expressed desire to continue the conversation and get more information on costs and impacts.
- NOAA Protected Resources Division will be included in the conversation about using the existing bridge as a future fishing pier to make a determination on permitting. Mr. Riley noted that he did not want the issue to become about building a new bridge around a fishing pier. Ms. Brittingham noted that all resources identified in the study area (including the Boat Ramp, Public Beach Access, and fishing pier) are considered protected coastal resources. For NCDCM to reach concurrence, an alternative needs to be presented that protects public access to the fishing pier.

- Alternative 5
  - Located to the east of both existing bridges 96 and 73.
  - Maintains driveway to the NCWRC Boat Ramp.
  - To maintain access to the fishing pier, it would need Bridge 96 to stay in place (again depends on Carteret County's willingness/desire to maintain/own).
  - The public beach and its access would not be impacted.
  - Build Alternative 5 was added recently as a result of agency concerns with relocating the fishing pier. RS&H developed Alternative 5 and it was reviewed with NCDOT staff. NCDOT decided last week that it is feasible and distributed information to the Merger Team as quickly as possible. Ms. Peters explained the alternatives in detail.
  - If sea turtles are present, NOAA has concerns with relocating the fishing pier to a new location. In response, NCDOT felt a fifth alternative needed to be added in case there are concerns with compliance with the Endangered Species Act (ESA). Clarification: NOAA is not supporting construction of any new structures used for fishing due to potential impacts to turtles. NOAA may approve of replacing the existing fishing pier deck but leaving current piles in place during construction of the new bridge. NOAA is currently working on installing signs on public fishing piers with contact information in case people encounter or catch sea turtles. Seventy-five voluntary reports of interactions with sea turtles were called in last year in North Carolina (no known interactions at this particular site).

- Even if no interactions with sea turtles are recorded, NOAA prefers not to construct a new large public fishing pier to replace the current pier on the center island.
- USFWS has jurisdiction of sea turtles when nesting on land. There is no nesting habitat for sea turtles present in the B-4863 study area, so USFWS defers to NOAA (who has jurisdiction of sea turtles in the water).

- **Public Meeting #1 Recap**
  - Public Meeting #1 was held on March 14, 2016 at the Core Sound Waterfowl Museum on Harkers Island. Sixty people attended, and 50 comments were received via comment cards, mailed, emailed, phone conversations. The public has not seen Alternative 5 since it was developed recently, but another public meeting will be held to present it if the Merger Team decides to include it going forward. John Rouse is meeting with the Carteret County Transportation Committee today and will discuss Alternative 5. This is a public meeting and may have media coverage.
  - Appendix B of the CP 2 packet includes a summary of all of the comments received.
  - Public opinion on best alternative: 50%/50% for Alternatives 3 and 4
  - Public opinion on worst alternative: Alternative 1 (43%), Alternative 2 (34%), Alternative 4 (17%), and Alternative 3 (6%). The public was made aware of the access issues to public resources.
  - Alternatives 3 and 4 had fewer impacts to the beach and fishing pier. Ms. Peters clarified that the Project Team did not indicate to the public that the fishing pier could be maintained or moved to existing Bridge 96 during the last public meeting.
- **Functional Design Alternative Matrix**
  - No relocations proposed but there are property (land only) impacts anticipated. Alt 5 is anticipated to have similar property (land only) impacts as Alt 4, but this will be reviewed further.
  - Natural Environment impacts – CAMA wetlands and Submerged Aquatic Vegetation (SAV) habitats were shown. Official SAV survey has not been performed yet, but file provided by NCDOT NES shows above-water surveys/reconnaissance. More detailed information to be provided soon. NCDOT plans to survey for SAV in June / July. The Merger Team requested surveys be completed in July and August, when all three species of SAV are present.
  - Blue on maps in CP2 packet = potential SAV habitat area, NCDOT ground-truthing the 2015 aerials (visual observation). In-water surveys will be done in June/July.
  - Alternative 2 would be the most difficult to construct based on maintenance of traffic. Alternative 5 would be the easiest to construct due to distance from the existing bridge.
  - Alternatives 1, 2, and 3: Have a high splash zone issue. Division has asked for a higher bridge clearance (14'). Minimum splash zone vertical clearance will not be provided when touching down on the center island.
  - Many comments from public included the desire for one bridge that would provide a more reliable evacuation route during a hurricane or other weather events.

Copy of Functional Design Alternatives Comparison Matrix (Table 6 from CP 2 Packet, page 9)

Category	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Project Description					
Project Length (miles)	0.85	0.85	0.89	0.85	0.86
Bridge Length (Bridge No. 73/96 in feet)	2,030/760	1,880/790	1,550/800	3,020	3,200
Human Environment Impacts					
Community Facilities Impacted (number)	3	3	2	2	2
Carteret County Beach	Medium	Medium	None	None	None
Straits Fishing Pier	High	High	High	High	Low
NCWRC Boat Ramp	High	Low	Medium	Medium	Low
Total Residential Relocations (number)	0	0	0	0	TBD
Total Business Relocations (number)	0	0	0	0	TBD
Property Only (number)	9	9	12	10	TBD
Archeological Sites (number)	1	1	1	1	1
Natural Environment					
Wetlands: CAMA/Riparian Impacts (acres)	0.98/0.06	0.46/0.00	1.18/0.08	0.77/0.07	0.43/0.07
Potential SAV Habitat Impacts (acres)	0.11	0.09	0.09	0.08	0.12
Straits Stream Crossing Lengths (Bridge No. 73/96 in feet)	1,500/650	1,400/550	1,400/600	1,400/850	3,000
Public Feedback (from Public Meeting #1)					
Public Preference for Best Option	0%	0%	50%	50%	-
Costs					
Right-of-Way Costs	$1,298,000	$1,303,000	$1,444,000	$1,245,000	TBD; anticipate similar to Alt 4
Utility Costs	$191,000	$191,000	$203,000	$203,000	
Construction Costs	$29,800,000	$29,000,000	$27,500,000	$32,300,000	
Total Costs	**$31,289,000**	**$30,494,000**	**$29,147,000**	**$33,748,000**	
Miscellaneous*					
Constructability Concerns	Medium	High	Medium	Medium	Low
Splash Zone Concerns	High	High	High	Low	Low
Evacuation/Flooding Concerns (potential for issue on center island)	High	High	High	None	None
Utility Impacts (no. of poles impacted)	5	5	6	6	TBD

Represents alternative with least impacts/costs in each category

Represents alternative with highest impacts/costs in each category

*Impacts shown for miscellaneous categories are qualitative based on known issues/challenges.

Notes: 1) No impacts to non-riparian wetlands, historic sites, superfund sites, or ponds are expected. Therefore, these impact categories are not provided.

2) Impacts are based on functional design right-of-way, slope stakes, and easement limits.

- **Elimination/Selection of Alternatives to Carry Forward**
  - The Merger Team agreed to eliminate Alternative 1 for the following reasons:
    - Community Feedback: 43% of respondents chose this as the worst alternative.
    - Alternative 1 negatively impacts all three public resources (fishing pier, NCWRC Boat Ramp, and public beach access)
    - Alternative 1 has the second highest cost (based on Functional Designs)
    - Higher splash zone concerns
  - NCDOT recommended eliminating Alternative 2 because of the public's comments (34% of respondents chose this as the worst alternative), negative potential impacts to public resources, constructability concerns, and higher splash zone concerns. However, the Merger Team would like to keep this alternative because it has the least amount of impacts to jurisdictional wetlands. The Merger Team would like to consider whether the alignment could be shifted slightly to achieve required sight distance at the center island driveway.
  - The Merger Team agreed to keep Alternatives 2, 3, 4, and 5 for further study.
  - The Division is very concerned about spalling concrete on the existing bridge (due mainly to the salt water splashing up on the structure) and the timeline for constructing the new bridge(s). Having a structure in the splash zone is a very real concern, and Division emphasized a sense of urgency in constructing a higher level bridge to reduce long-term maintenance efforts. This bridge is the only way on and off of the island and has been posted for weight in the past when repairs were needed. This posting has previously hindered school bus pickup/drop-off and trash collection for residents on the island for up to 90 days (the time that was needed for emergency repairs).
  - Costs associated with maintaining/owning Bridge 96 will be discussed with County soon.
  - NCWRC is concerned about parking on the center island if it is impacted and the possibility to replace it somewhere else. It was noted that parking is not allowed along the roadway on the mainland side.
- Details of the next meeting will be determined in a few months. NCDOT will present more information and possible avoidance/minimization efforts for each alternative (i.e. retaining walls) via email since time has run out for this meeting.
  - Ms. Peters and Mr. Swayampakala prepared the signature sheet to reflect that Alternative 1 would be eliminated, and Alternatives 2, 3, 4 and 5 would be studied further.
- If any recipient of the meeting notes would like to add comments or feels a comment is erroneous or needs to be expanded, please feel free to contact Edith Peters at edith.peters@rsandh.com.

Attachments:

CP2 Packet
PowerPoint Presentation

Copies to:

Meeting Attendees
April Annis, NCDOT PDEA

NEPA/404 Merger Team Meeting Agreement

Concurrence Point 2A: Bridging Decisions and Alignment Review

Project Name/Description: Harkers Island Bridge Replacements, Carteret County, NC

TIP Project No.: B-4863

WBS No.: 40212.1.1

Bridging Decisions and Alignment Review

The Project Team has reviewed the bridging and alignments of the four Detailed Study Alternatives (2, 3, 4, and 5) and agreed to carry all four alternatives forward into Concurrence Point 3. Alternative 1 was eliminated previously due to negative public feedback, relatively high cost, and high impacts to public resources. The table below shows begin and end stations and associated roadway/hydraulic bridge lengths associated with each DSA:

Detailed Study Alternative No.	Begin Station	End Station	Roadway/Hydraulic Control Bridge Length (feet)
Alt 2	17+20	36+00	1,880
	42+35	49+25	690
Alt 3	20+20	35+75	1,555
	41+00	49+25	825
Alt 4	20+20	49+25	2,905
Alt 5	18+75	50+75	3,200

The Project Team met and concurred on this date of June 15, 2017 on the bridging decisions for the proposed project as stated above:

USACE	Mark M. Matthews	NCDOT	Maria A. Rogerson
USEPA	Cynthia J. VanderWiele	USFWS	Gary Jordan
NCDCR		NCDWR	Gary Ward
FHWA	Ronald G. [illegible]	NCWRC	[illegible]
USCG		NCDCM	Cathy Brittingham
DERPO	[illegible]	NMFS	[illegible]

NEPA/404 Merger Team Meeting Agreement

Concurrence Point 3: Least Environmentally Damaging Practicable Alternative (LEDPA)

Project Name/Description: Harkers Island Bridge Replacements, Carteret County, NC

TIP Project No.: B-4863

WBS No.: 40212.1.1

Least Environmentally Damaging Practicable Alternative

The Project Team has reviewed the bridging and alignments of the four Detailed Study Alternatives (2, 3, 4, and 5) and selected Alternative 5 as the Least Environmentally Damaging Practicable Alternative and Preferred Alternative for the replacement of Bridge Nos. 73 and 96 in Carteret County. [1,2]

The Project Team met and concurred on this date of June 15, 2017 on the LEDPA for the proposed project as stated above:

USACE	Marie Matthews	NCDOT	Maria A. Rogerson
USEPA	Cynthia J. VanDerWiele	USFWS	Gary Jordan
NCDCR		NCDWR	Tracy Ward
FHWA	Ronald Lucas	NCWRC	
USCG		NCDCM	Cathy Brittingham
DERPO		NMFS	

[1] Pending formal documentation from Carteret County with commitment to maintain the operations of the Straits Island Fishing Pier and Bridge No. 96 (non-vehicular use only)

[2] NCDOT will continue to coordinate with Carteret County for parking for the Straits Island Fishing Pier.

Meeting Summary Memorandum

Meeting Date: June 15, 2017

Subject: Concurrence Point 2A/3 Meeting
B-4863 Harkers Island Bridge Replacements

Location: NCDOT Structure Design Conference Room C

Attendees:

John Rouse, NCDOT Division 2*
Bill Kincannon, NCDOT Division 2
Maria Rogerson, NCDOT Division 2
Kathy Herring, NCDOT EAU
Tyler Stanton, NCDOT EAU
Mike Sanderson, NCDOT EAU
Jason Dilday, NCDOT EAU
Mark Staley, NCDOT REU
Monte Matthews, USACE
(on behalf of Tom Steffens, USACE)
Ron Lucas, FHWA
Hal Pitts, USCG*
Cathy Brittingham, DCM
Stephen Lane, DCM
Gregg Bodnar, DCM
Curt Weychert, DCM Fisheries
Garcy Ward, NCDWR
Ken Riley, NMFS
Cynthia Van Der Wiele, USEPA
Travis Wilson, NCWRC
Patrick Flanagan, Down East RPO
Gary Jordan, USFWS
Meredith Van Duyn, RS&H
Charles Cox, RS&H
Alison Nichols, RS&H
Jennifer Farino, RS&H
Drew Morrow, RS&H
Brian Pownall, RS&H
Samantha Schober, RS&H*
Leigh Lane, Louis Berger
Robin Maycock, Louis Berger
Ana Passman, Louis Berger
Dean Hatfield, Louis Berger
Farzin Asefnia, Louis Berger
Ginny Snead, Louis Berger*
Phil May, Carolina Ecosystems
* *joined via phone*

Monte Matthews opened the meeting, and attendees introduced themselves. The purpose of this meeting was to discuss alternatives currently being studied (Alternatives 2, 3, 4, and 5) for STIP Project B-4863 and potential impacts, reach concurrence on bridging decisions and alignment review (CP 2A), and determine the Least Environmentally Damaging Practicable Alternative (LEDPA) (CP 3).

Maria Rogerson discussed the roles and responsibilities of the project team. Project Team management has changed since the Concurrence Point 2 meeting, from PDEA to Division 2, with management assistance from Louis Berger staff. Project management from RS&H has changed as well. Meredith Van Duyn is now the Project Manager for RS&H. A change in funding has also occurred since the meeting for Concurrence Point 2. STIP Project B-4863 will be federally funded, and a federal Categorical Exclusion (CE) will be prepared for the project. The Federal Highway Administration (FHWA) is the lead federal agency.

Meredith Van Duyn confirmed that everyone received a packet, thanked everyone for attending, and discussed the organization of the presentation.

- **Concurrence Point 1 Summary**
  - Held on February 18, 2016.
  - Purpose of Proposed Action is to improve bridge safety and functionality.

- Need for Proposed Action is to replace deficient, functionally obsolete bridges. *(Note: The need for the proposed action is to replace deficient, functionally obsolete bridges for vehicular traffic. It is possible, depending on a commitment from Carteret County, that Bridge No. 96 may remain in place for non-vehicular traffic.)*
- Meredith mentioned each property protected by Section 4(f) in the study area, including the Harkers Island Beach Access, Straits Fishing Pier, and Straits Landing Boating Access Area. These resources are also considered Public Trust Resources. An archaeological site located in the northeast quadrant of the bridge was surveyed, and artifacts were removed. The archaeology site does not require further survey or coordination with the State Historic Preservation Office or Office of State Archaeology and is not eligible for or listed on the National Register of Historic Places.
- Bridge maintenance and operational costs are a concern:
  - Bridge No. 73 has experienced mechanical issues as recently as June 11, 2017.
  - Bridge No. 96 underwent emergency repairs in 2013.
  - Division 2 is responsible for the continued costs of the bridge tender contract (staffing the bridge tender house and associated operational costs).

- **Concurrence Point 2 Summary**
  - Held on June 15, 2016.
  - Alternatives 2, 3, 4, and 5 carried forward.
- **Build Alternatives** – Meredith reviewed details of each alignment's horizontal and vertical profile. Alternatives 2 and 3 propose two replacement bridges that would touch down on the center island. Alternatives 4 and 5 propose a single fixed-span replacement bridge that would not touch down on the center island.
- **Typical Sections**
  - The bridge will consist of two 12-foot lanes (one in each direction) and 4-foot paved shoulders.
  - The bridge will have a 32-foot clear deck width (35-foot total structure width including guardrails).
- **Public Meeting #2 Recap**
  - Public Meeting #1 was held on March 14, 2016. A summary was included in the Concurrence Point 2 materials.
  - Public Meeting #2 was held on March 2, 2017 at the Core Sound Waterfowl Museum on Harkers Island. Over 100 people attended, and 83 comments were received via comment cards, both mailed and emailed, as well as phone conversations. A summary of comments and responses to them can be found on the project website. https://www.ncdot.gov/projects/harkersislandbridges/
  - Appendix B of the CP 2A/3 packet includes a summary of all of the comments received.
  - Most of the respondents are Harkers Island residents. 84% of the respondents preferred Alternative 5 as the best option.

- **Alternatives**
  - **Alternative 2** proposes two fixed-span bridges that would touch down on the center island. The bridge connecting the mainland to the center island is east of the existing bridge, and the bridge connecting the center island to Harkers Island is west of the existing bridge. The Straits Fishing Pier would have to be removed. The Division anticipates high splash zone concerns on this low bridge and has concerns about constructability due to crossing the existing roadway and proximity to the existing bridges. Zero percent of respondents at Public Meeting #2 chose Alternative 2 as the best alternative.
  - **Alternative 3** proposes two fixed-span bridges that would touch down on the center island. Both bridges would be located east of the existing bridges. The Straits Fishing Pier would have to be removed. The Division anticipates high splash zone concerns on this low bridge and has concerns about constructability due to proximity to the existing bridges. Seven percent of respondents at Public Meeting #2 chose Alternative 3 as the best alternative.
  - **Alternative 4** proposes one fixed-span bridge located east of the existing bridges that does not touch down on the center island. The Straits Fishing Pier would have to be removed. The Division anticipates low splash zone concerns due to the overall bridge height and possible constructability concerns due to proximity of the existing bridges. Nine percent of respondents at Public Meeting #2 chose Alternative 4 as the best alternative.
  - **Alternative 5** proposes one fixed-span bridge located east of the existing bridges that does not touch down on the center island. This alternative has the same tie-in locations as Alternative 4 but bypasses the Straits Fishing Pier, allowing the pier to remain. Carteret County would take ownership of Bridge No. 96, using it as a non-vehicular bridge (pedestrian use only) to access the pier. The Division anticipates low splash zone concerns due to the overall bridge height and low constructability concerns due to the distance away from the existing bridges. Eighty-four percent of respondents at Public Meeting #2 chose Alternative 5 as the best alternative.
  - Potential environmental impacts for each of the Alternatives can be found in the following tables.

Preliminary* Design Alternatives Comparison Matrix (Excerpt from Table 4, CP 2A/3 Packet, page 19)

Category	Alt 2	Alt 3	Alt 4	Alt 5
Project Description				
Project Length (miles)	0.82	0.86	0.86	0.86
Bridge Length (Bridge No. 73/96 in feet)	1,880 / 690	1,555 / 825	2,905	3,200
Bridge Structure (sf) - Bridge No. 73 / Bridge No. 96	65,800 / 24,150	54,425 / 28,875	101,675	112,000
Miscellaneous				
Constructability Concerns	High	Medium	Medium	Low
Splash Zone Concerns	High	High	Low	Low
Evacuation/Flooding Concerns (potential for issue on center island)	High	High	Low	Low
Utility Impacts (no. of poles impacted)	7	7	7	7
Public Feedback				
Public Preference at Public Meeting #2 (Preferred Alt)	0%	7%	9%	84%
Costs				
Right-of-Way Costs	$884,440	$969,960	$990,560	$807,120
Utility Costs (*power pole relocations*)	$241,017	$214,466	$214,466	$214,466
Construction Costs	$28,900,000	$29,600,000	$31,400,000	$32,900,000
Total Costs (Rounded up to $100k)	**$30,300,000**	**$30,800,000**	**$32,700,000**	**$34,000,000**

Represents alternative with lowest impact in each category

Represents alternative with highest impact in each category

* "Preliminary" Roadway Design is approximately a 15% design, with vertical and horizontal aspects of the alternative(s) included. Impacts noted in this chart are based on (planning) preliminary roadway designs for Alternatives 2, 3, 4, and 5. Following selection of the LEDPA, the roadway design for the Preferred Alternative is advanced to higher levels of precision and detail. It is at these further stages where more information regarding minimization of impacts is available.

Preliminary Design Alternatives Comparison Matrix – Environmental Impacts
(Excerpt from Table 5, CP 2A/3 Packet, page 20)

Category	Alt 2	Alt 3	Alt 4	Alt 5
Human Environment Impacts				
Straits Landing Boat Access Area[5] -- permanent/temporary (acres)	0.08 / 0.21	0.06 / 0.09	0.06 / 0.09	0.06 / 0.08
Section 4(f) Determination (Use, *De Minimis*, None) (23 CFR 774)	*De Minimis*	*De Minimis*	*De Minimis*	*De Minimis*
Straits Fishing Pier[5] -- permanent/temporary (acres)	0.35 / 0.01	1.11 / 0.16	1.12 / 0.24	0 / 0
Section 4(f) Determination (Use, *De Minimis*, None) (23 CFR 774)	Use	Use	Use	None
Harkers Island Beach Access[5] -- permanent/temporary (acres)	0.61 / 0.08	0.05 / 0	0.05 / 0	0.04 / 0
Section 4(f) Determination (Use, *De Minimis*, None) (23 CFR 774)	Use	*De Minimis*	*De Minimis*	*De Minimis*
Properties Impacted (number) -- *no anticipated relocations*	11	14	14	12
Proposed Right-of-Way/Temporary Easements (acres)	1.38 / 0.09	1.23 / 0.05	1.21 / 0.04	0.89 / 0.08
Archeological Sites (number)[6]	1	1	1	1
Natural Environment				
Wetlands: CAMA/Riparian Impacts (acres)	0.50 / 0	0.26 / 0.08	0.13 / 0.08	0.09 / 0.05
Total Wetland Impacts (acres)	0.50	0.34	0.21	0.14
Submerged Aquatic Vegetation (SAV) (acres) - (see Note 3)				
Summer 2016 SAV Survey	0.07	0.13	0.13	0.48
Surface Water (acres)	0.03	0	0	0

Represents alternative with lowest impact in each category

Represents alternative with highest impact in each category

NOTES

1) *Community Resource Impacts are areas based on proposed right-of-way and easement boundaries as determined from the preliminary design plans for each alternative.*

2) *Wetland Impacts are based on preliminary design permanent and temporary slope stakes, plus an additional 25 feet outside of each construction limit as determined from the preliminary design plans for each alternative.*

3) *Potential Submerged Aquatic Vegetation Impacts were investigated based on two methodologies: (1) the area of the proposed bridge above the surveyed SAV locations, and (2) accounting for shading with a bridge height/width ratio. Both methodologies resulted in the same impacts. Impacts reported do not account for any credits that may be possible due to existing bridge removal. SAV surveys were conducted in July and September 2016. Biologists waded the SAV areas to determine any changes in the original delineation, changes in species composition, and changes to SAV density. The July and September surveys resulted in findings within 0.01 acre.*

4) *Surface Water Impacts are based on area of fill needed to construct the roadway approach and retaining walls within the existing water surface.*

5) *These properties are also considered Public Trust Resources by NCDCM/CAMA.*

6) *Archaeology Site 31CR76 is not eligible for the National Register of Historic Places.*

- **Navigational Clearances**
  - The draft B-4863 Navigation Impact Report (NIR) was submitted to the US Coast Guard (USCG) in December 2016. The following information was included in the NIR:
    - The B-4863 Vessel Height Survey was completed in 2014.
    - Local maritime community members were interviewed.
    - Waterway data obtained from US Army Corps of Engineers (USACE) and National Oceanic and Atmospheric Administration (NOAA).
  - Preliminary navigational clearance determination given on March 24, 2017.
    - Minimum 45-foot vertical navigational clearance acceptable.
    - Minimum 125-foot horizontal navigational clearance acceptable.
    - Alternatives 2, 3, 4, and 5 meet these minimum clearances.
  - USCG will make a final navigational clearance determination following selection of the LEDPA and submittal of the Final NIR.
- **Project Schedule Following CP2A/3 Meeting:**
  - Categorical Exclusion (CE) – August 2017
  - CP 4A – Late 2017
  - Right-of-Way – 2018
  - Construction – 2020
- **Questions/Comments (CP 2A)**
  - Travis Wilson (North Carolina Wildlife Resources Commission) expressed concern regarding the public boat ramp parking lot, which is under the jurisdiction of the NCWRC. The dirt area on the center island is currently used as undesignated parking for the Straits Fishing Pier, but it would no longer be available for parking with the implementation of Alternative 5. The NCWRC concern is that closing the center island parking area would cause users to migrate to the public boat ramp parking lot, where parking is already limited and only for vehicles with boat trailers. He commented that removing the dirt parking area could place more demand on the parking area which concerns NCWRC. Ron Lucas (Federal Highway Administration) noted that the "None" designation for whether the proposed project would have a transportation use on this property was in keeping with Code of Federal Regulations 23, Section 774 (23 CFR 774) but noted the NCWRC's concern that there could be a potential effect to the boat ramp parking. Construction of Alternative 5 would not require the removal of the fishing pier, and it would still be accessible by pedestrians. (The center island will not be accessible by vehicle.) Alternative 5 is the only alternative that keeps the fishing pier in place. The Merger Team will discuss further at Concurrence Point 4A as this issue is related to avoidance and minimization design details for the LEDPA.
  - The Division is aware of the parking issue and plans to further investigate possibilities of replacing/adding parking on the mainland.
  - NC Division of Coastal Management (DCM) suggested using the NCDOT Recreational Use Guidelines.

- The CE will address the concern regarding parking and include correspondence from the County in the CE appendix. County commitments (as applicable) will be listed on the Green Sheet.
- DCM commented that the NC Administrative Code has requirements to protect navigation that are separate, and different, from those of USCG. DCM commented that the NC Administrative Code includes requirements that "Development shall not impede navigation or create undue interference with access to, or use of, public trust areas or estuarine waters," and "Development shall not interfere with existing public rights of access to, or use of, navigable waters or public resources." DCM expressed a concern that the existing VNC of the existing swing span is 70 feet when the bridge is open (limited by the overhead power lines), and that the proposed 45-foot VNC of the new fixed span replacement bridge would be a reduction. DCM noted that it is possible during the CAMA permit application review process, comments could be received in response to the Public Notice, or from an adjacent riparian landowner, for example, that would require DCM to consider a vertical navigational clearance greater than 45 feet. DCM also asked if a 65-foot clearance was possible.
- DCM commented that during the Merger process, the expectation is that when a permitting agency signs the Concurrence Point 3 form, they are reasonably sure that the LEDPA/Preferred Alternative is permittable, while acknowledging that a permit decision cannot be made until after the permit application review process is complete. DCM hoped that the extensive public outreach conducted by NCDOT throughout the project development process would ensure that any public concerns about navigational clearance would be resolved as best as possible prior to permit application submittal, thereby preventing the need for additional review of the navigation clearance requirements during the permit process.
    - RS&H responded that the NIR was exhaustive with public communication and that 45 feet of VNC accommodates 99% of boat traffic. The USCG has tentatively approved the 45-foot VNC. Increasing the VNC to 65 feet, given the same maximum grade for the roadway, would result in more impacts to access and to residences on Harkers Island.
- National Marine Fisheries Services (NMFS) commented that there is an informal safe harbor between Harkers Island and the mainland that boats use as refuge from storms. Ken Riley asked if these users were included in the NIR survey.
    - The Division stated that over 2,400 newsletters were mailed out prior to Public Meeting #2, in addition to the interviews and local input solicited for the NIR. *(Note: Following the meeting, RS&H staff spoke with Edith Peters about her conversations with marina owners and local fishermen last year. Edith contacted those whose contact information Ken provided and was able to speak with all except one. She conducted interviews during site visits on December 8, 2015 and November 8-9, 2016. There are two harbors of refuge, Harkers Island Harbor (island side, southwest of Bridge No. 73) and Marshallberg Harbor (mainland side), both of which were visited during the site visits. Neither harbor is manned. No one was present at the Harkers Island Harbor during the site visit, but notes were taken on the types of vessels there, estimated heights of vessels, conditions of the harbor, etc. At Marshallberg Harbor, a few commercial fishermen who dock there spoke with Edith. The NIR includes all information gathered during the field visits. All other docking areas, based on*

public information and discussions with local residents and business owners, are owned or operated by businesses and private citizens. Access to the Harkers Island Harbor from the south/west does not require vessels to travel through Bridge No. 73, as it is located southwest of the swing span. Mariners traveling from the north would likely choose Marshallberg Harbor for refuge rather than the Harkers Island Harbor, thus eliminating the need to travel through Bridge No. 73. All mariners who were interviewed stated that the use of Back Sound is not a reliable alternative means of travel around Harkers Island. The shoals frequently shift, and vessels with a higher draw risk running aground. A complete list of all interviews is included in the NIR.

- The Merger team signed the CP 2A form (copy attached).

- **Questions/Comments (CP 3)**
  - USACE asked FWHA from a Section 4(f) perspective if any Alternative other than 5 is practical.
    - FHWA stated that based on the information available, Alternatives 2, 3, and 4 remove the fishing pier, resulting in maximum harm to the resource. Alternative 5 avoids the use of the fishing pier and has been determined to be a feasible and prudent alternative. In accordance with 23 CFR 774, FHWA can only approve Alternative 5. FHWA further considered local support of Alternative 5 in its determination of the feasibility and prudence of the alternative. FHWA acknowledges the parking concerns raised and recommends that this issue be discussed further as part of avoidance and minimization following selection of the LEDPA.
  - NMFS explained the process to build a new fishing pier requires a lengthy paperwork process and that they cannot confirm whether it would be allowed if the existing pier is removed for the project. RS&H commented on the importance of avoidance because of this uncertainty.
  - NMFS would like to see the proposed bridge elevations at the next concurrence point due to potential shading impacts to SAV. They asked about the new shading ratios regarding SAV impacts.
    - RS&H stated that the potential SAV impacts shown in the packet on Figures 9-12 were calculated using a 35 foot out-to-out bridge width. Due to the proposed bridge height being less than 70% of the bridge width above the SAV areas, no reductions were made to the impact calculations.
  - DCM asked about shading to coastal wetlands and seagrass; they would prefer to minimize these impacts if possible. They also asked for the actual footing impacts.
    - Footing impacts will be available upon further design but are not known at this time.
  - RS&H stated that another SAV survey will be completed this year and will be available for the CP 4A meeting. *(Note: Following the meeting, NCDOT Environmental Analysis Unit (EAU) staff confirmed that surveys will be conducted July 26, 2017.)*
    - DCM requested that the survey be done close to the same time period as the previous survey.

- EAU staff noted that survey areas in July 2016 did not change much over several months (compared to surveys completed in September 2016) and that they expect the same when new surveys are completed this summer.

- DCM stated they prefer Alternative 5 contingent on certain commitments:
  - NCDOT will continue coordination with Carteret County to finalize commitments for maintaining Bridge No. 96 for non-vehicular use and the operation of Straits Fishing Pier.
  - NCDOT will continue efforts to minimize/mitigate SAV shading impacts.
    - DCM notes that it was unusual to choose an Alternative with the highest potential for impacts to SAV, but acknowledged there are many competing resources in the project study area.
- The Merger team selected Alternative 5 as the LEDPA/Preferred Alternative and signed the CP 3 form (attached) with the following commitments:
  - "Pending formal documentation from Carteret County with commitment to maintain the operations of the Straits Island Fishing Pier and Bridge No. 96 (non-vehicular use only)."
  - "NCDOT will continue to coordinate with Carteret County for parking for the Straits Island Fishing Pier."
- NMFS asked if the Project Description should be revised since Bridge No. 96 may remain in place as a non-vehicular facility.
  - RS&H stated that this will be included in the meeting minutes. The project description (CP 2A/3 Packet, Pg 1) will be updated to clarify that Bridge No. 96 will be converted to non-vehicular use if it remains in place.

➢ If any recipient of the meeting notes would like to add comments or feels a comment is erroneous or needs to be expanded, please feel free to contact Meredith Van Duyn at meredith.vanduyn@rsandh.com.

Attachments:

CP2A/3 Packet
CP2A/3 Concurrence Forms
PowerPoint Presentation

Copies to:

Meeting Attendees

U.S. Department of Homeland Security
United States Coast Guard

Commander
United States Coast Guard
Fifth Coast Guard District

431 Crawford Street
Portsmouth, VA 23704-5004
Staff Symbol: dpb
Phone: (757) 398-6222
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Email: Hal.R.Pitts@uscg.mil or
CGDFiveBridges@uscg.mil

07 JUL 2017

Ms. Maria A. Rogerson, P. E.
North Carolina Department of Transportation
P.O. Box 1587
Greenville, North Carolina 27835

Dear Ms. Rogerson:

The Coast Guard has reviewed the North Carolina Department of Transportation (NCDOT); Harkers Island Bridge Replacement STIP No. B4863 project: Concurrence Point 2A (CP2A) (Bridging Decisions and Alignment Review) document of June 15, 2017, and Concurrence Point 3 (CP3) – (Least Environmentally Damaging Practical Alternative (LEDPA)) document of June 15, 2017.

The Coast Guard has no objection to the decisions and findings contained in the CP2A and CP3 documents. Given the selection of Alternative 5 as the LEDPA for the project, which includes retention and re-purposing (highway to pedestrian) of the existing bridge between the mainland and the center fishing island, the following is provided to aid NCDOT in preparing to make application for bridge permit (s) to the Coast Guard.

1. The Coast Guard will need to issue a new bridge permit for the replacement of the Harkers Island Bridge (highway) on a new alignment (Alternative 5) and a bridge permit amendment for a pedestrian bridge (existing structure) between the mainland and the center fishing island.

2. To facilitate efficient bridge permitting, NCDOT should be the applicant for both permit actions above. NCDOT may submit a single application with the Administrative and Navigational Information tailored as needed to reflect two bridges, along with two sets of plan sheets (Harkers Island Bridge and Straits Fishing Pier Pedestrian Bridge), and common environmental documentation (FHWA/NCDOT categorical exclusion (CE)).

3. Upon receipt of the permit amendment, NCDOT may transfer the permit amendment to Carteret Count, North Carolina in accordance with Title 33 Code of Federal Regulations §115.20. A copy of the transfer instrument should be provided to this office.

If you have any questions, please contact Mr. Hal R. Pitts at the above listed address, email or telephone number.

Sincerely,

HAL R. PITTS
Bridge Program Manager
By direction of the Commander
Fifth Coast Guard District

Copy: Meredith Van Duyn, RS&H Architects-Engineers-Planners, Inc.

AGENCY CORRESPONDENCE

U.S. Department of Homeland Security
United States Coast Guard

Commander
United States Coast Guard
Fifth Coast Guard District

431 Crawford Street
Portsmouth, Va. 23704-5004
Staff Symbol: dpb
Phone: (757) 398-6587
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16591
15 JUN 09

Mr. Tracy Walter
North Carolina Department of Transportation
Bridge Project Development Unit
1598 Mail Service Center
Raleigh, NC 27699-1598

Dear Mr. Walter:

We have reviewed your proposed repair/replacement project for the two bridges over the Straits at Harkers Island in Carteret County, NC.

At the present time, it is premature to clearly identify and assess the navigable requirements for the proposed replacement bridges. However, the proposed vertical and horizontal clearances can be estimated. We suggest you perform the following: survey the heights of vessels transiting the waterway; use the existing drawbridge logs as a tool and interview the users of the public and local marinas, documenting their vessel height and width requirements in the navigational section of your planning/environmental document.

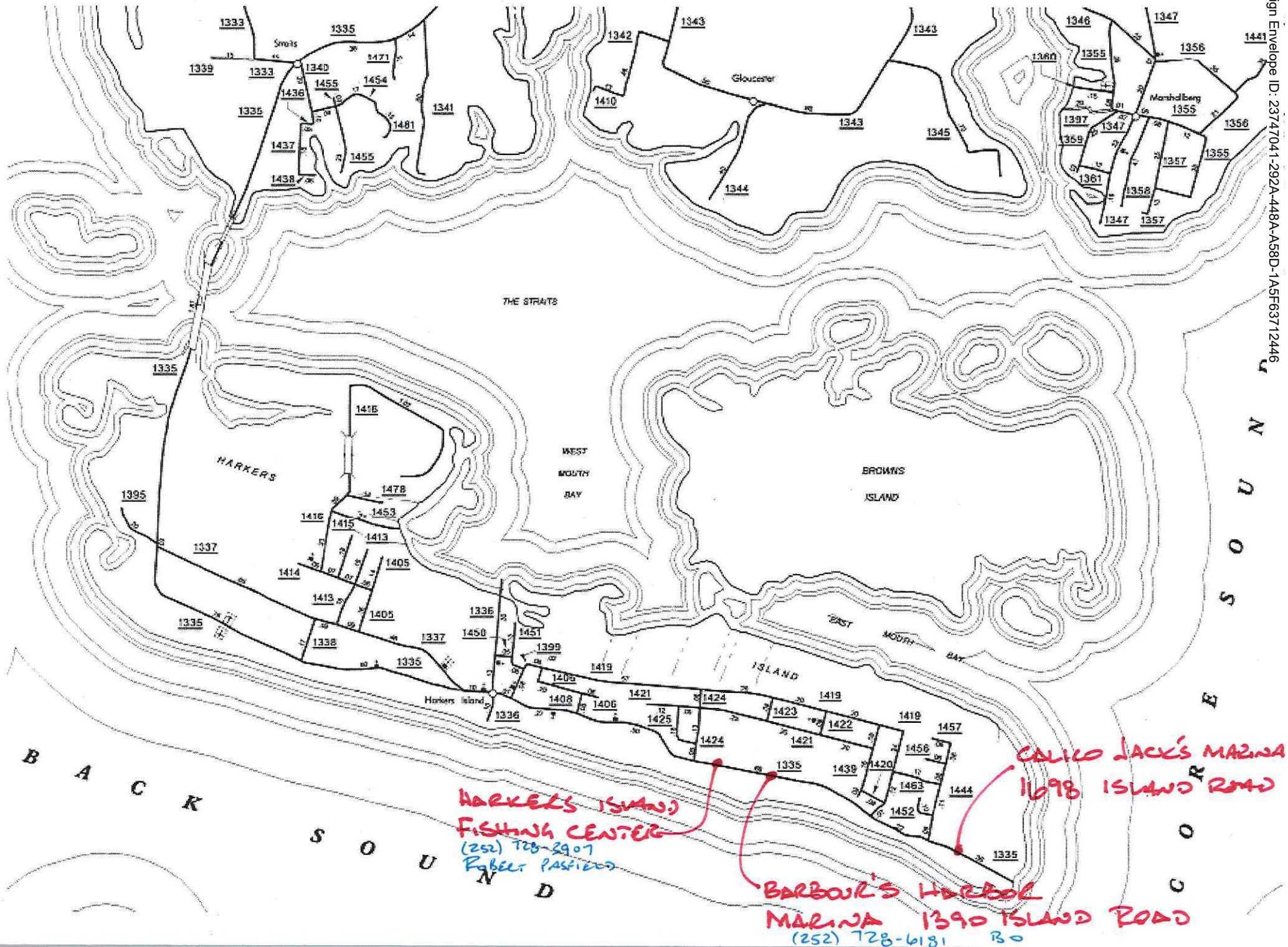
The existing swing bridge has a horizontal clearance of 36 feet, and 14 feet of vertical clearance in the closed position to vessels (unlimited when opened) and the US Coast Guard Cutter SMILAX regularly patrols this waterway and has a 43-foot beam, requiring a greater horizontal clearance.

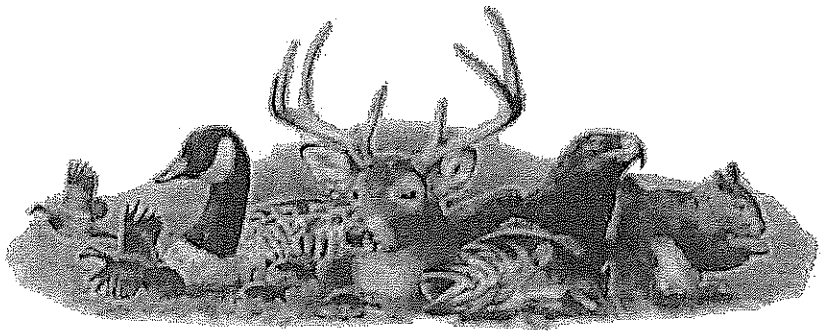
Furthermore, additional input can be gathered by disseminating a preliminary public notice of the proposed design plans of the replacement project and by informally consulting the following waterway facilities: Barbour's Harbor Marina Island Rd, Harkers Island, NC, Phone: 252-728-6181; Calico Jack's Marina, 1698 Island Rd, Harkers Island, NC, Phone: 252-728-3575; Harkers Island Fishing Center, 1002 Harkers Island Rd, Harkers Island, NC, Phone: 252-728-3907.

If you have any questions regarding this matter, please contact Mr. Terrance Knowles, at the phone number or address shown above.

Sincerely,

WAVERLY GREGORY, JR.
Chief, Bridge Administration Branch
By direction of the Commander
Fifth Coast Guard District





North Carolina Wildlife Resources Commission

Gordon Myers, Executive Director

MEMORANDUM

TO: Tracy Walter
Project Development and Environmental Analysis, NCDOT

FROM: Travis Wilson, Highway Project Coordinator
Habitat Conservation Program

DATE: June 30, 2009

SUBJECT: Response to the start of study notification from the N. C. Department of Transportation (NCDOT) regarding fish and wildlife concerns for the proposed replacement of bridge Nos. 73 and 96 on SR 1335 over the Straits at Harkers Island, Carteret County, North Carolina. TIP No. B-4863

This memorandum responds to a request from the NCDOT for our concerns regarding impacts on fish and wildlife resources resulting from the subject project. Biologists on the staff of the N. C. Wildlife Resources Commission (NCWRC) have reviewed the proposed improvements. Our comments are provided in accordance with certain provisions of the National Environmental Policy Act (42 U.S.C. 4332(2)(c)) and the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667d).

The subject bridge replacements are located in coastal waters; NCDOT should coordinate with the NC Division of Marine Fisheries and National Marine Fisheries Service to address concerns with aquatic resource impacts. However, there are three public use areas located within the project footprint including a NCWRC boating access area and a county maintained public fishing pier. These recreational areas are heavily utilized throughout the spring, summer, and fall recreational seasons, as well as non-designated use of the causeway for fishing access. Avoiding and minimizing impacts to these facilities during planning and construction will be a significant concern. Furthermore to help further facilitate document preparation and the review process, our general informational needs are outlined below:

1. Description of fishery and wildlife resources within the project area, including a listing of federally or state designated threatened, endangered, or special concern species. Potential borrow areas to be used for project construction should be included in the inventories. A listing of designated plant species can be developed through consultation with:

Mailing Address: Division of Inland Fisheries • 1721 Mail Service Center • Raleigh, NC 27699-1721
Telephone: (919) 707-0220 • **Fax:** (919) 707-0028

NC Natural Heritage Program
Dept. of Environment & Natural Resources
1601 Mail Service Center
Raleigh, NC 27699-1601.
WWW.ncnhp.org

and,

NCDA Plant Conservation Program

P. O. Box 27647
Raleigh, N. C. 27611
(919) 733-3610

2. Description of any streams or wetlands affected by the project. The need for channelizing or relocating portions of streams crossed and the extent of such activities.

3. Cover type maps showing wetland acreages impacted by the project. Wetland acreages should include all project-related areas that may undergo hydrologic change as a result of ditching, other drainage, or filling for project construction. Wetland identification may be accomplished through coordination with the U. S. Army Corps of Engineers (COE). If the COE is not consulted, the person delineating wetlands should be identified and criteria listed.

4. Cover type maps showing acreages of upland wildlife habitat impacted by the proposed project. Potential borrow sites should be included.

5. The extent to which the project will result in loss, degradation, or fragmentation of wildlife habitat (wetlands or uplands).

6. Mitigation for avoiding, minimizing or compensating for direct and indirect degradation in habitat quality as well as quantitative losses.

7. A cumulative impact assessment section which analyzes the environmental effects of highway construction and quantifies the contribution of this individual project to environmental degradation.

8. A discussion of the probable impacts on natural resources which will result from secondary development facilitated by the improved road access.

9. If construction of this facility is to be coordinated with other state, municipal, or private development projects, a description of these projects should be included in the environmental document, and all project sponsors should be identified.

Thank you for the opportunity to provide input in the early planning stages for this project. If we can further assist your office, please contact me at (919) 528-9886.

June 19, 2009

Mr. Tracy Walter
Bridge Replacement Planning
North Carolina Department of Transportation
1598 Mail Service Center
Raleigh, NC 27699-1598

Mr. Walter:

I am writing to support the addition of a pedestrian/bike lane as part of the bridge renovation project for the Harkers Island Bridge (Project B-4863), SR 1335 in Carteret County.

Carteret County Parks and Recreation has two public water access points, one on each side of that bridge, that are heavily used and would benefit from a pedestrian/bike lane addition to the bridge. One site is for beach use and the other is a fishing pier. They are separate from the popular N.C. Wildlife ramp on the west side of the bridge. The Harkers Island Bridge is the only access between Straits and the island, itself.

I hope you will strongly consider including the pedestrian/bike lane in this project and if there is anything else I can do to help achieve that goal, please let me know.

Sincerely,

Betty Fentress
Interim Director

BF/cap

cc: Katrina Marshall, Director of Planning, Carteret County
Jack Veit, Assistant County Manager, Carteret County
Robert Mosher, Division of Bicycle and Pedestrian Transportation, NCDOT

North Carolina Department of Cultural Resources
State Historic Preservation Office
Peter B. Sandbeck, Administrator

Beverly Eaves Perdue, Governor
Linda A. Carlisle, Secretary
Jeffrey J. Crow, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

April 8, 2009

MEMORANDUM

TO: Tracy Walter
Project Development and Environmental Analysis
Bridge Replacement Planning Unit

FROM: Peter Sandbeck RSS for Peter Sandbeck

SUBJECT: Bridges 73 and 96 on SR 1335 over the Straits at Harkers Island, B-4863, Carteret County, ER 09-0745

Thank you for your letter of March 27, 2009. We have reviewed the project referenced above and offer the following comments.

Archaeological site 31CR76 is located at the base of Bridge 73 at the northern end of the bridge at the mainland landing. The site contains prehistoric and historic components and has never been assessed in terms of the National Register of Historic Places (NRHP). It is recommended that site 31CR76 be relocated and assessed in terms of the NRHP prior to any ground disturbing activities associated with this project. If determined eligible and if adversely affected by the proposed undertaking we recommend NCDOT develop and implement a mitigation plan for the site. Two copies of all reports and one copy of an updated site form should be forwarded to the Office of State Archaeology for review and comment in advance of any construction activities. All activities associated with this work should be coordinated with the Office of State Archaeology.

We have conducted a search of our files and are aware of no structures of historical or architectural importance located within the planning area. However, since a comprehensive historical architectural inventory has never been conducted, there may be structures of which we are unaware located within the planning area.

If there are any structures more than fifty years old on or adjacent to the project site, please send us photographs of each structure. These photographs should be keyed to a map that clearly shows the site location. If there are no buildings over fifty years old on or adjacent to the project site, please notify us of this in writing.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comments, please contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579. In all future communication concerning this project, please cite the above-referenced tracking number.

cc: Matt Wilkerson, NCDOT
Mary Pope Furr, NCDOT

County Manager
W. Russell Overman
russello@carteretcountync.gov

Clerk to the Board
Rachel B. Hammer
rachel.hammer@carteretcountync.gov

June 29, 2016

Ms. Michele James
NCDOT Project Development
1516 Mail Service Center
Raleigh, North Carolina 27699-1516

RE: Harkers Island Bridge Replacement Project

Dear Ms. James:

At the June 27, 2016 meeting of the Carteret County Board of Commissioners, we unanimously approved the support of Alternative 5 for the Harkers Island Bridge Replacement Project. We had originally expressed our support of Alternative 4. With the development of this new Alternative 5 which still provides a 45-foot clearance above the primary channel, places the bridge further east of the proposed Alternative 4, and allows the Straits Fishing Pier to remain in place, we now support Alternative 5.

As stated in our letter of April 18, 2016, we continue to request that Bridge Number 96 remain in place and either be turned over to Carteret County or leased to our County for non-vehicular traffic. Our intentions are that this bridge could be used either for fishing and/or recreational purposes, as well as providing access to the island between Bridges 73 and 96.

We appreciate your consideration.

Sincerely,

Robin V. Comer
Chair, Board of Commissioners

RVC/rbh

Subject: FW: B-4863 Section 4(f) Letter - Carteret County
Attachments: Figure 1 - Affected Human Environ Alt 5_20170824.pdf; Figure 2 - Affected Natural Environ Alt 5.pdf

From: Tina Purifoy [mailto:tina.purifoy@carteretcountync.gov]
Sent: Tuesday, September 26, 2017 10:11 AM
To: Rogerson, Maria A <marogerson@ncdot.gov>
Cc: Eugene Foxworth <Eugene.Foxworth@carteretcountync.gov>
Subject: B-4863 Section 4(f) Letter - Carteret County

To: Maria Rogerson
From: Carteret County Parks and Recreation Department

Re: STIP Project B-4863, Harkers Island Bridge Replacements

The North Carolina Department of Transportation (NCDOT) proposes to replace Bridges 73 and 96 carrying SR 1332/1335 (Harkers Island Road) over The Straits in Carteret County as part of the *State Transportation Improvement Program*'s Project B-4863. The project includes the following:

- Replacement of Bridge No.73 entails removal of the swing span bridge.
- Pending a municipal agreement between NCDOT and Carteret County, Bridge No. 96 may remain for non-vehicular access to the Straits Fishing Pier.
- One fixed span bridge for vehicular traffic will be constructed to the east of the existing structures. The proposed bridge will include two 12-foot travel lanes (one in each direction) and four-foot paved shoulders on each side.

To construct the proposed project, NCDOT will need to acquire property from one public resource that is owned and maintained by Carteret County and protected under Section 4(f) of the US Department of Transportation Act of 1966. Preliminary roadway designs indicate that Alternative 5 (selected as the Preferred Alternative) impacts 0.04 acres (permanent) of the Harkers Island Beach Access for the purpose of connecting the gravel area used for parking to the new roadway approach to the proposed bridge. No temporary impacts are anticipated. Attached are figures detailing the proposed improvements and this resource.

NCDOT and Federal Highway Administration (FHWA) believe that the proposed project will not adversely affect the activities, features, and attributes that qualify this resource for protection under Section 4(f). As the Director of Parks and Recreation for Carteret County, North Carolina, and the official with jurisdiction over the Harkers Island Beach Access, I concur with the determination that proposed Project B-4863 as described in this letter and shown on the attached figures will not adversely affect the activities, features, and attributes that qualify this property for protection under Section 4(f) of the USDOT Act, as amended. I have been informed that, based on my concurrence, the FHWA intends to make a *de minimis* finding regarding impacts to the Harkers Island Beach Access, satisfying the requirements of Section 4(f).

Tina Purifoy
Director, Parks & Recreation Department / Crystal Coast Civic Center
Carteret County Government
Post Office Box 680 Morehead City, NC 28557
Parks & Recreation 252.808.3301 (ext 8156) / Civic Center 252.247.9247 (ext 5646)
tina.purifoy@carteretcountync.gov
www.crystalcoastcivicctr.com
http://ccpr.recdesk.com/recdeskportal/

Subject: FW: B-4863 Section 4(f) Draft Letter - NCWRC

From: Wilson, Travis W.
Sent: Tuesday, September 26, 2017 2:04 PM
To: Rogerson, Maria A <marogerson@ncdot.gov>
Subject: RE: B-4863 Section 4(f) Draft Letter - NCWRC

WRC has reviewed and concurs with the finding from FHWA of *de minimis*, for affects to the Straits Boating Access Area.

Travis W. Wilson
Eastern Region Highway Project Coordinator
Habitat Conservation Program

NC Wildlife Resources Commission
1718 Hwy 56 West
Creedmoor, NC 27522
Phone: 919-707-0370
Fax: 919-528-2524
Travis.Wilson@ncwildlife.org

ncwildlife.org

From: Rogerson, Maria A
Sent: Thursday, September 07, 2017 10:11 AM
To: Wilson, Travis W. <travis.wilson@ncwildlife.org>
Subject: B-4863 Section 4(f) Draft Letter - NCWRC

Travis:

Per our discussion please see below the language we have drafted for your concurrence. I have also provided the wetland information as requested. If you have any additional questions or concerns please do not hesitate to contact me. Thanks.

Maria

To: Maria Rogerson
From: North Carolina Wildlife Resources Commission

Re: STIP Project B-4863, Harkers Island Bridge Replacements

The North Carolina Department of Transportation (NCDOT) proposes to replace Bridges 73 and 96 carrying SR 1332/1335 (Harkers Island Road) over The Straits in Carteret County as part of the *State Transportation Improvement Program*'s Project B-4863. NCDOT's Merger process was followed for this project and included WRC as a concurring team member. In June of this year WRC concurred on selection of Alternative 5 has the least environmentally damaging practicable alternative (LEDPA). The project includes the following:

- Replacement of Bridge No.73 entails removal of the swing span bridge.
- Pending a municipal agreement between NCDOT and Carteret County, Bridge No. 96 may remain for non-vehicular access to the Straits Fishing Pier.
- One fixed span bridge for vehicular traffic will be constructed to the east of the existing structures. The proposed bridge will include two 12-foot travel lanes (one in each direction) and four-foot paved shoulders on each side.

To construct the proposed project, NCDOT will need to acquire property from one public resource that is owned and maintained by the NCWRC (Straits Landing Boat Access Area). This property is considered a 4(f) resource as defined by Section 4(f) of the US Department of Transportation Act of 1966. Preliminary roadway designs indicate that Alternative 5 would permanently impact no more than 0.06 acre of the Straits Landing Boat Access Area for the purpose of connecting the parking lot/driveway to the realigned roadway approach to the proposed bridge. Temporary impacts to this property are anticipated to be no more than 0.08 acre. These potential impacts will be reduced further in final roadway designs, since they are based on slopestakes plus a 25-foot buffer. There will be no net loss of parking spaces to the Straits Landing Boat Access Area as a result of this project. Attached are figures detailing the proposed improvements and this resource.

Federal Highway Administration (FHWA) has the responsibility to review the activities, features, and attributes that qualify this resource for protection under Section 4(f). If the project does not adversely impact the activities, features, and attributes that qualify the resource for projection, then a *de minimis* finding is issued by FHWA. Based on the nature of the impacts including input from the public and the Merger team's request for a commitment to explore additional parking options for the public resources in the public study area as the project advances through the Merger process, FHWA believes a *de minimis* finding is appropriate for the Straits Landing Boat Access Area and is seeking concurrence from WRC with this finding.

As the Eastern Region Highway Projects Coordinator for NCWRC, and the official with jurisdiction over the Straits Landing Boat Access Area, I concur with the determination that proposed Project B-4863 as described in this letter and shown on the attached figures will not adversely affect the activities, features, and attributes that qualify this property for protection under Section 4(f) of the USDOT Act, as amended. NCWRC requests, as part of this concurrence, that NCDOT coordinate with Carteret County to explore additional parking options for the public resources in the project study area.

<< Signature of NCWRC official with jurisdiction>>

Maria A. Rogerson, P.E.
Project Engineer
North Carolina Department of Transportation

252 439 2800 office
marogerson@ncdot.gov

105 Pactolus Hwy. (NC 33)

P.O. Box 1587
Greenville, NC 27835-1587

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Email correspondence to and from this sender is subject to the N.C. Public Records Law and may be disclosed to third parties.

GUIDELINES FOR AVOIDING IMPACTS TO THE WEST INDIAN MANATEE: PRECAUTIONARY MEASURES FOR CONSTRUCTION ACTIVITIES IN NORTH CAROLINA WATERS

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

GUIDELINES FOR AVOIDING IMPACTS TO THE WEST INDIAN MANATEE
Precautionary Measures for Construction Activities in North Carolina Waters

The West Indian manatee (*Trichechus manatus*), also known as the Florida manatee, is a Federally-listed endangered aquatic mammal protected under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) and the Marine Mammal Protection Act of 1972, as amended (16 U.S.C 1461 *et seq.*). The manatee is also listed as endangered under the North Carolina Endangered Species Act of 1987 (Article 25 of Chapter 113 of the General Statutes). The U.S. Fish and Wildlife Service (Service) is the lead Federal agency responsible for the protection and recovery of the West Indian manatee under the provisions of the Endangered Species Act.

Adult manatees average 10 feet long and weigh about 2,200 pounds, although some individuals have been recorded at lengths greater than 13 feet and weighing as much as 3,500 pounds. Manatees are commonly found in fresh, brackish, or marine water habitats, including shallow coastal bays, lagoons, estuaries, and inland rivers of varying salinity extremes. Manatees spend much of their time underwater or partly submerged, making them difficult to detect even in shallow water. While the manatee's principal stronghold in the United States is Florida, the species is considered a seasonal inhabitant of North Carolina with most occurrences reported from June through October.

To protect manatees in North Carolina, the Service's Raleigh Field Office has prepared precautionary measures for general construction activities in waters used by the species. Implementation of these measure will allow in-water projects which do not require blasting to proceed without adverse impacts to manatees. In addition, inclusion of these guidelines as conservation measures in a Biological Assessment or Biological Evaluation, or as part of the determination of impacts on the manatee in an environmental document prepared pursuant to the National Environmental Policy Act, will expedite the Service's review of the document for the fulfillment of requirements under Section 7 of the Endangered Species Act. These measures include:

1. The project manager and/or contractor will inform all personnel associated with the project that manatees may be present in the project area, and the need to avoid any harm to these endangered mammals. The project manager will ensure that all construction personnel know the general appearance of the species and their habit of moving about completely or partially submerged in shallow water. All construction personnel will be informed that they are responsible for observing water-related activities for the presence of manatees.

2. The project manager and/or the contractor will advise all construction personnel that

there are civil and criminal penalties for harming, harassing, or killing manatees which are protected under the Marine Mammal Protection Act and the Endangered Species Act.

3. If a manatee is seen within 100 yards of the active construction and/or dredging operation or vessel movement, all appropriate precautions will be implemented to ensure protection of the manatee. These precautions will include the immediate shutdown of moving equipment if a manatee comes within 50 feet of the operational area of the equipment. Activities will not resume until the manatee has departed the project area on its own volition (i.e., it may not be herded or harassed from the area).

4. Any collision with and/or injury to a manatee will be reported immediately. The report must be made to the U.S. Fish and Wildlife Service (ph. 919.856.4520 ext. 16), the National Marine Fisheries Service (ph. 252.728.8762), and the North Carolina Wildlife Resources Commission (ph. 252.448.1546).

5. A sign will be posted in all vessels associated with the project where it is clearly visible to the vessel operator. The sign should state:

> CAUTION: The endangered manatee may occur in these waters during the warmer months, primarily from June through October. Idle speed is required if operating this vessel in shallow water during these months. All equipment must be shut down if a manatee comes within 50 feet of the vessel or operating equipment. A collision with and/or injury to the manatee must be reported immediately to the U.S. Fish and Wildlife Service (919-856-4520 ext. 16), the National Marine Fisheries Service (252.728.8762), and the North Carolina Wildlife Resources Commission (252.448.1546).

6. The contractor will maintain a log detailing sightings, collisions, and/or injuries to manatees during project activities. Upon completion of the action, the project manager will prepare a report which summarizes all information on manatees encountered and submit the report to the Service's Raleigh Field Office.

7. All vessels associated with the construction project will operate at "no wake/idle" speeds at all times while in water where the draft of the vessel provides less than a four foot clearance from the bottom. All vessels will follow routes of deep water whenever possible.

8. If siltation barriers must be placed in shallow water, these barriers will be: (a) made of material in which manatees cannot become entangled; (b) secured in a manner that they cannot break free and entangle manatees; and, (c) regularly monitored to ensure that manatees have not become entangled. Barriers will be placed in a manner to allow manatees entry to or exit from essential habitat.

Prepared by (rev. 06/2003):
U.S. Fish and Wildlife Service
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726
919/856-4520

Figure 1. The whole body of the West Indian manatee may be visible in clear water; but in the dark and muddy waters of coastal North Carolina, one normally sees only a small part of the head when the manatee raises its nose to breathe.

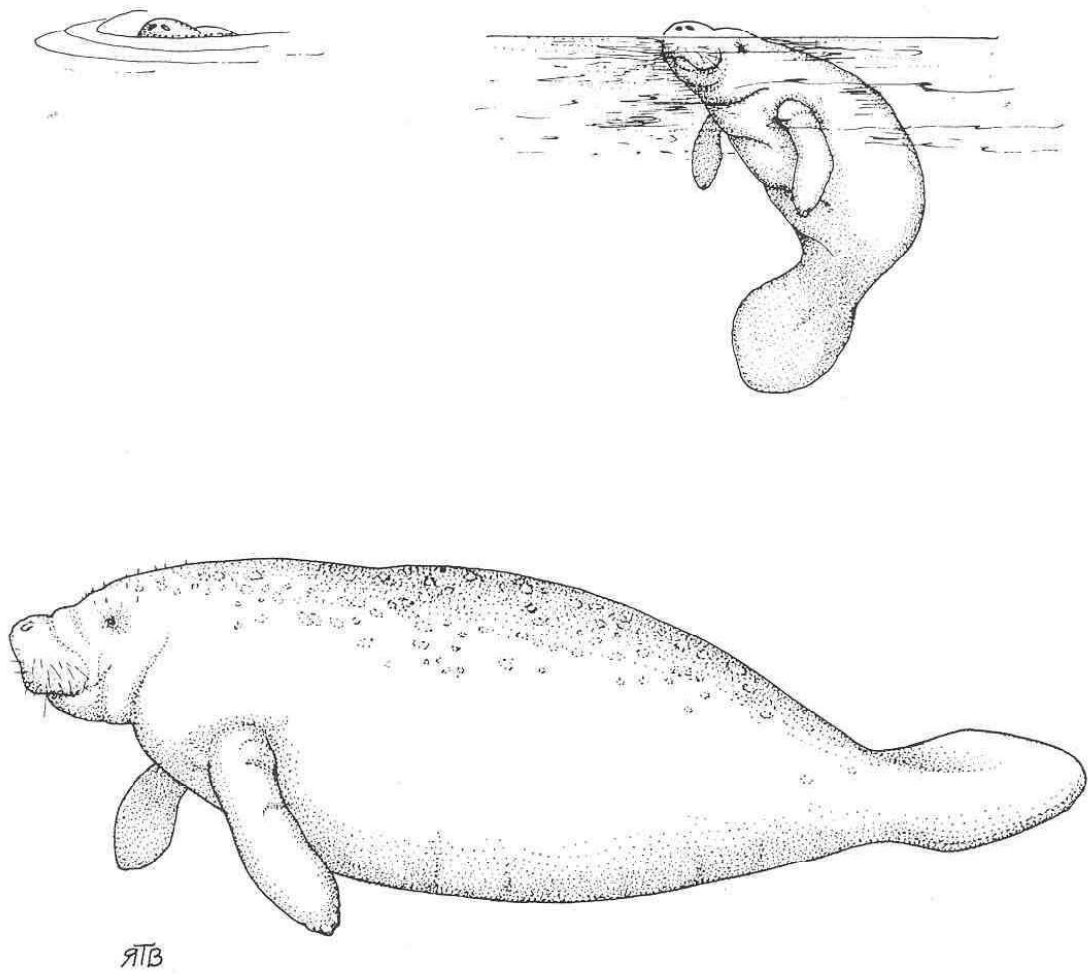

Illustration used with the permission of the North Carolina State Museum of Natural Sciences. Source: Clark, M. K. 1987. Endangered, Threatened, and Rare Fauna of North Carolina: Part I. A re-evaluation of the mammals. Occasional Papers of the North Carolina Biological Survey 1987-3. North Carolina State Museum of Natural Sciences. Raleigh, NC. pp. 52.

APPENDIX D:

NMFS SECTION 7 CONCURRENCE LETTER

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
http://sero.nmfs.noaa.gov

F/SER31:FI
SER-2018-19276

Preston Hunter, P.E.
Environmental Analysis Unit
North Carolina Department of Transportation
8521 Six Forks Road, Suite 400
Raleigh, North Carolina 27615

SEP 2 1 2018

Dear Mr. Hunter:

This letter responds to your request for consultation with us, the National Marine Fisheries Service (NMFS), pursuant to Section 7 of the Endangered Species Act (ESA) for the following action.

SER Number	Project Type
SER-2018-19276	Replacement of bridges

Consultation History
We received your letter requesting consultation dated April 19, 2018, on April 20, 2018. We requested additional information on May 29, 2018, and July 2, 2018. We received a final response on June 13, 2018, and July 17, 2018, respectively, and initiated consultation on July 17, 2018.

Project Location

Address	Latitude/Longitude	Water body
Bridge Number 73 (Earl C Davis Memorial Bridge) and Bridge Number 96 (Harkers Island Road) over the Straits in Carteret County, North Carolina	34.719082°N, 76.576584°W (North American Datum 1983)	"The Straits" between Harkers Island and Straits, North Carolina, 6.5 miles from the Atlantic Ocean

Image of the project location and surrounding area (©2018 Google)

Existing Site Conditions
Currently two bridges, Bridge Number 96 (north) and Bridge Number 73 (south), cross the Straits waterbody and are connected in the middle by a small island with parking and an existing fishing pier. A boat ramp is also located at the north end of the north bridge. Benthic conditions are described as sand with non-ESA listed seagrasses (eelgrass, shoal grass, and widgeon grass). The navigational channels are 10 feet (ft) deep. The width of the river at the bridge is approximately 3,500 ft.

Project Description
The applicant proposes to replace the two existing bridges with a single bridge structure. Work will be performed from barges and a temporary work platform and includes the removal of the south bridge and installation of up to 212 new 24-inch (in) concrete piles. The temporary work platform will run the entire length of the proposed bridge except at the navigational channel location. The work platform is anticipated to be 40 ft wide with a minimum 20-ft span length, and includes the installation of 1,260 36-in metal piles. Pile installation methods have yet to be determined so we are assuming the worst-case scenario of impact hammer installation. The applicant has agreed to ramp up procedures and the use of a pile cushioning block to minimize the effects of in-water noise from pile installation.

The applicant has stated that more than one pile may be installed at a time and construction may be performed using a 24-hour construction window for up to 3 years; however, in-water work will be prohibited from April 1 to September 30, when Atlantic sturgeon (adult, larval, and small juvenile stages) are at most risk of injury due to their spring and fall spawning runs that occur in the proposed action area. Approximately 0.1 acre of seagrasses are expected to be covered by bridge materials.

Pile Installation

Pile Types	Number of Piles	Installation Method	Confined Space or Open Water
Concrete (24-in)	212	Various and undetermined (assumed impact hammer)	Open
Metal (36-in)	1,260	Various and undetermined (assumed impact hammer)	Open

Construction Conditions

The contractor will comply with North Carolina Department of Transportation's Best Management Practices (BMPs) for Bridge Demolition and Removal including:

- Existing bridge piles in the navigation channel will be removed completely, unless not practicable, and piles located in seagrasses and wetland areas will be cut off at the mudline to minimize overall disturbance.
- The use of turbidity curtains will be evaluated for areas with sufficient depth, but lower velocity. Turbidity will be monitored during in-water work to ensure compliance with state water quality standards.
- Non-shattering methods will be implemented (no explosives) for bridge removal. No bridge deck or substructure components will be dropped in the water.
- Loose debris and road surface materials will be removed prior to demolition to minimize the potential for turbidity and contaminant discharge.

The applicant has also agreed to adhere to NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*[1] and to stop work if a sturgeon is spotted within 50 ft of operations.

Effects Determination(s) for Species the Action Agency or NMFS Believes May Be Affected by the Proposed Action

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Sea Turtles			
Green (North Atlantic [NA] distinct population segment [DPS])	T	NLAA	NLAA
Green (South Atlantic [SA] DPS)	T	NLAA	NLAA
Kemp's ridley	E	NLAA	NLAA
Leatherback	E	NLAA	NE
Loggerhead (Northwest Atlantic [NWA] DPS)	T	NLAA	NLAA
Hawksbill	E	NLAA	NE
Fish			
Shortnose sturgeon	E	NE	NLAA

[1] NMFS. 2006. Sea Turtle and Smalltooth Sawfish Construction Conditions revised March 23, 2006. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Protected Resources Division, Saint Petersburg, Florida. http://sero.nmfs.noaa.gov/protected_resources/section_7/guidance_docs/documents/sea_turtle_and_smalltooth_sawfish_construction_conditions_3-23-06.pdf.

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Atlantic sturgeon (Carolina DPS)	E	NLAA	NLAA
E = endangered; T = threatened; NLAA = may affect, not likely to adversely affect; NE = no effect			

We believe the project will have no effect on hawksbill and leatherback sea turtles, due to the species' very specific life history strategies, which are not supported at the project site. Leatherback sea turtles have pelagic, deepwater life history, where they forage primarily on jellyfish. Hawksbill sea turtles typically inhabit inshore reef and hard bottom areas where they forage primarily on encrusting sponges.

Critical Habitat

The project is not located in designated critical habitat, and there are no potential routes of effect to any designated critical habitat.

Analysis of Potential Routes of Effects to Species

Sea turtles and sturgeon may be injured if struck with the equipment and construction materials. However, we believe this effect is discountable because these species are likely to move away during construction. The applicant's implementation of NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions* will further reduce the risk by requiring all construction workers watch for protected species. Operation of any mechanical construction equipment will cease immediately if a sea turtle or sturgeon is seen within a 50-ft radius of the equipment. Activities will not resume until the protected species has departed the project area of its own volition.

Use of turbidity curtains, the construction activities, and related construction noise may prevent or deter sea turtles and Gulf sturgeon from entering the project area. We believe the effects to these species from temporary exclusion from the project area due to construction activities, including related noise and presence of turbidity curtains, will be insignificant. The open water environment of this long spanned bridge has numerous suitable alternative habitat sites in the area that these mobile species can use for foraging or refuge. Additionally, any exclusion effects will be temporary as only relatively small areas will be excluded at any point in time.

In-water construction activities will result in temporary increases in turbidity that could affect water quality. However, we anticipate any effects on sea turtles and sturgeon due to elevated turbidity will be insignificant, given the availability and abundance of habitat with naturally occurring water quality conditions (i.e., unaffected by construction activities) in the surrounding area, outside of the action area.

Effects to sea turtles and sturgeon as a result of noise created by the construction activities can physically injure animals in the affected areas or change animal behavior in the affected areas. Injurious effects can occur in 2 ways. First, immediate adverse effects can occur to listed species if a single noise event exceeds the threshold for direct physical injury. Second, effects can result from prolonged exposure to noise levels that exceed the daily cumulative exposure threshold for

the animals, and these can constitute adverse effects if animals are exposed to the noise levels for sufficient periods. Behavioral effects can be adverse if such effects interfere with animals migrating, feeding, resting, or reproducing, for example. Our evaluation of effects to sea turtles and sturgeon as a result of noise created by construction activities is based on the analysis prepared in support of the Opinion for SAJ-82.[2] The noise analysis in this consultation evaluates effects to sturgeon and sea turtles identified by NMFS as potentially affected in the table above.

Based on our noise calculations, the installation of 24-in concrete piles and 36-in metal piles using an impact hammer with a pile cushioning block may cause peak-pressure injury to sea turtles or sturgeon within 21 ft (6 m) of the pile driving. Additionally, the daily cumulative sound exposure level of multiple pile strikes over the course of a day may cause injury to sturgeon and sea turtles at a radius of up to 152 ft (46 m) away from the pile. Because more than one pile may be installed at a time, and construction may be performed using a 24-hour construction window for up to 3 years, the use of the ramp-up technique prior to full-force driving will be utilized to further minimize the effects of in-water noise from pile installation. The use of the ramp-up technique prior to full-force driving will provide sea turtles and sturgeon ample opportunity to leave the project area as noise levels increase and before the peak-pressure injury threshold is reached. Due to the mobility of sea turtles and sturgeon, and because the project occurs in open water, we expect them to move away from noise disturbances. Because we anticipate that sea turtles and sturgeon will move away from the project area during the ramp-up period, we believe that an animal's suffering physical injury from peak-pressure noise exposure is extremely unlikely to occur. Additionally, construction personnel will cease construction activities if an animal is sighted in the 50-ft radius per NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*. Thus, we believe the likelihood of any injurious effects occurring is discountable. An animal's movement away from the injurious impact zone is a behavioral response, with the same effects discussed below.

Based on our noise calculations, the installation of 24-in concrete piles and 36-in metal piles using an impact hammer with a pile cushioning block could also result in behavioral effects at a radii of up to 328 ft (100 m) for sea turtles and 1,523 ft (464 m) for sturgeon. Due to the mobility of sea turtles and sturgeon, we expect them to move away from noise disturbances in this open-water environment. Because there is similar habitat nearby, we believe behavioral effects will be insignificant. If an individual chooses to remain within the behavioral response zone, it could be exposed to behavioral noise impacts during pile installation. Additionally, in-water work will be prohibited from April 1 to September 30, when Atlantic sturgeon are at most risk of injury due to their spring and fall spawning runs that occur in the proposed action area. Therefore, we anticipate any behavioral effects will be insignificant.

Conclusion

Because all potential project effects to listed species were found to be discountable, insignificant, or beneficial, we conclude that the proposed action is not likely to adversely affect listed species under NMFS's purview. This concludes your consultation responsibilities under the ESA for species under NMFS's purview. Consultation must be reinitiated if a take occurs or new information reveals effects of the action not previously considered, or if the identified action is

[2] NMFS. Biological Opinion on Regional General Permit SAJ-82 (SAJ-2007-01590), Florida Keys, Monroe County, Florida. June 10, 2014.

subsequently modified in a manner that causes an effect to the listed species or critical habitat in a manner or to an extent not previously considered, or if a new species is listed or critical habitat designated that may be affected by the identified action. NMFS's findings on the project's potential effects are based on the project description in this response. Any changes to the proposed action may negate the findings of this consultation and may require reinitiation of consultation with NMFS.

We look forward to further cooperation with you on other projects to ensure the conservation of our threatened and endangered marine species and designated critical habitat. If you have any questions on this consultation, please contact Francesca Innocenti, Consultation Biologist, at (727) 824-5336, or by email at francesca.innocenti@noaa.gov.

Sincerely,

Roy E. Crabtree, Ph.D.
Regional Administrator

File: 1514-22.L.1

Onsite Wetland Mitigation Plan
Replacement of Bridge No. 73 and 96 and SR1335 (Harker's Island Road)
Carteret County
TIP B-4863
WBS No. 40212.1.1
November 19, 2018

The North Carolina Department of Transportation (NCDOT) proposes to replace bridge numbers 73 and 96 on SR.1335 (Harker's Island Road) over the Straits (TIP B-4863) in Carteret County.

This project will take place within the White Oak River basin, Hydrologic Unit 03020106, in the coastal plain physiographic region of North Carolina. The topography within the project vicinity is flat to very gently sloping, with level floodplains along streams. Elevations within the study area range from 0ft to 10ft above sea level. Land use in the project vicinity consists primarily of residential development and access to the water for recreational and commercial uses.

Within the study area of this project, there is only one jurisdictional stream and two types of jurisdictional wetlands that were identified. The chosen alternative for this project will permanently impact 0.07 acres of brackish marsh wetlands. There will be temporary fill impacts consisting of 0.14 acres of brackish marsh due to the transition from the roadway to the work platform for the new bridge.

Existing Conditions

B-4863 was reviewed for potential onsite mitigation along The Straits fishing pier island. There are brackish marsh wetlands along the east and west side of the island. The brackish marsh areas are regularly inundated by tidal flooding at The Straits and are dominated by black needlerush, smooth cord grass and salt meadow cord grass. The existing brackish marsh adjacent to the parking area on the east side of the island ranged from 0.45 to 0.73 feet above mean sea level at the time of the survey. The adjacent parking area ranged from 2.17 feet to 3.02 feet above mean sea level. The County will retain the northern part of the parking area to facilitate recreational activities for the adjacent fishing pier.

Proposed Conditions

The goal of this project is to remove a portion of the existing parking area on the Straits Fishing Pier Island to restore brackish marsh wetland. Only pedestrian access will be allowed to the area after construction is completed.

There will be approximately 1,170 cubic yards of fill material graded down to match the elevation of the adjacent marsh. The area will be replanted with appropriate mix of wetland herbaceous species. This will allow NCDOT to restore 15,246 sq. ft. (0.35 acres) of brackish marsh wetland. All excavated material will be wasted offsite.

NCDOT proposes that this brackish marsh mitigation site offset all permanent wetland impacts associated with B-4863.

The 0.14 acres of temporary fill will be removed once construction has taken place. Once completed, these areas will be restored by grading back to the existing elevation and by replanting the existing species.

An as-built report will be submitted within 60 days of completion of the project.

Success Criteria

The vegetation component of the wetland site will be deemed successful if the target wetland herbaceous species survives and has an average of 75 percent vegetative cover, not including any invasive species.

Hydrologic success will be based on achieving the target elevations based on the adjacent marsh elevations as documented in the as-built plans.

Monitoring

NCDOT shall monitor the mitigation site by visual observation and photo points for survival and aerial cover of vegetation. NCDOT shall monitor the site for a minimum of three years or until the site is deemed successful. Monitoring will be initiated upon completion of the site planting.

An annual monitoring report will be provided to the agencies for comment at the annual monitoring review meeting.


Excavation Area
0.35 acres
-L- +05.63
377.98' LT
SR 1335 HARKERS ISLAND RD. 20' BST
-EL-
RIP RAP
GR.
BST
40
Elevation
2.17 ft
Elevation
1.04 ft
Elevation
1.07 ft
Elevation
0.54 ft
Elevation
0.42 ft
Temporary Impacts
STATE OF NORTH CAROLINA
NDR
INNERDUCT
TV FO
SCRUB & MARSH
8
WLB
PROPERTY LINE IS HIGH WATER MARK
R
W

APPENDIX C:
WETLAND MITIGATION PLAN

APPENDIX E:

VESSEL HEIGHT SURVEY REPORT

FINAL

HARKERS ISLAND VESSEL HEIGHT SURVEY REPORT

TIP PROJECT B-4863

September 2015
Carteret County, NC

RS&H

FINAL

HARKERS ISLAND VESSEL HEIGHT SURVEY REPORT

TIP PROJECT B-4863

September 2015
Carteret County, NC

Prepared by RS&H, Inc. at the direction of the North Carolina Department of Transportation (NCDOT)

RS&H

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EXECUTIVE SUMMARY

This report provides a brief description of the methodology and a detailed discussion of the results of the vessel height survey for the Harkers Island Bridge Replacement Project in Carteret County, NC. The purpose of this survey is to obtain height and frequency information of the vessels passing through the existing swing span bridge (Bridge No. 73) over the Straits waterway.

The vessel height survey was conducted in six phases over a six-month period in 2014: May 21 to May 25, June 6 to June 10, July 9 to July 13, August 20 to August 24, September 10 to September 14, and October 2 to October 6, 2014 between 7 AM and 7 PM, daily.

The Project Team measured the heights of only those vessels which required a bridge opening during these vessel height surveys. The bridge is opened upon request or signal for all vessels unable to pass beneath it. Vessels not requiring the bridge to open were recorded and heights were estimated based on known nearby elevations.

During the 30-day survey period, a total of 1,765 vessels were observed, with an average of 3.4 vessels per day requiring a bridge opening at an average of 2.9 bridge openings per day. The majority of vessels traveling beneath the Harkers Island Bridge are for recreational use (96.1%) and the heights of these vessels are summarized below:

- 95% of the vessels observed were 15-feet in height or less.
- 96% of the vessels observed were 20-feet in height or less.
- 98% of the vessels observed were 30-feet in height or less.
- 99.9% of the vessels observed were 40-feet in height or less.

1. INTRODUCTION AND PURPOSE OF THE REPORT

The North Carolina Department of Transportation (NCDOT) proposes to replace the existing Harkers Island Bridges (NCDOT Bridge No. 73 and No. 96) on SR 1332/1335 (Harkers Island Road) in Carteret County (TIP No. B-4863). Replacement of Bridge No. 73, also known as the Earl C. Davis Memorial Bridge, entails removal of the existing movable swing span bridge (drawbridge) and replacement of Bridge No. 96 entails the removal of the existing fixed span bridge which together provide access across the Straits waterway to Harkers Island. Both bridges are proposed to be replaced with fixed span bridges. These bridges provide the only access point onto Harkers Island. The study area is shown in *Figure 1-1*.

Facing west toward the existing Harkers Island Bridge

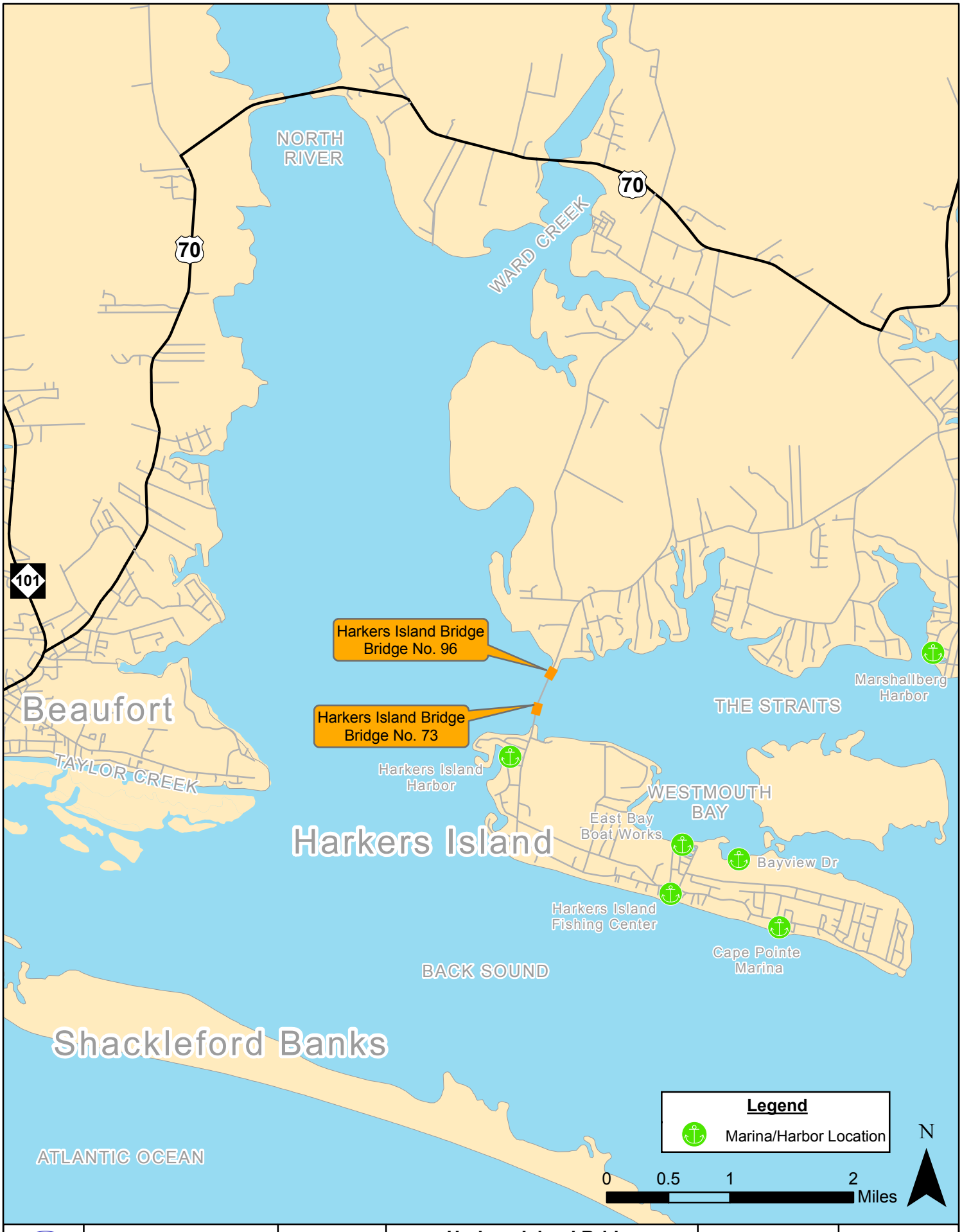
This report provides a brief description of the methodology and a detailed discussion of the results of the vessel height survey. The goal of this survey was to more accurately determine the types and heights of vessels traveling through the Straits waterway and the frequency of these trips. This data is valuable in establishing the U.S. Coast Guard clearance requirements for the proposed fixed span bridge to accurately meet current and future navigable requirements of the Straits waterway.

One primary constraint of the proposed fixed span bridge is the power lines traversing the Straits waterway. A posted sign within the channel indicates there is a 67-foot clearance at the bridge due to the power lines. However, according to the National Oceanic and Atmospheric Administration (NOAA) Navigation Chart 11545, the authorized clearance due to the power lines is 70-feet. Field measurements place the lowest power line at an elevation of approximately 80.6-feet in the center of the channel. The NOAA Navigation Chart 11545 also shows that the mean high water is 1.6-feet and the mean low water is 0.1-feet in the vicinity of the Harkers Island Bridge. Based on this information, the clearance to the power lines would be approximately 79.0-feet at mean high water and 80.5-feet at mean low water.

The existing bridges are located on SR 1332/1335 (Harkers Island Road) which is a two lane road approximately 24-feet wide with an Annual Average Daily Traffic (AADT) of 3,300 vehicles per day (vpd) in 2013. Bridge No. 73 is a swing span bridge built in 1969 to replace the original wooden structure (constructed in 1941). It is approximately 1,400-feet in length. According to the most recent NCDOT Bridge Survey Report, dated September 20, 2012, the existing Vertical Navigational Clearance (VNC) for the bridge in the closed position is 14-feet above mean high water and the depth of water below the bridge at high tide is approximately 24-feet. Bridge No. 96 is a fixed span bridge built in 1970 and is approximately 587-feet in length. According to the most recent NCDOT Bridge Survey Report, dated May 28 2013, Bridge No. 96 has an existing VNC of 0-feet above mean high water and the depth of water below the bridge at high tide is approximately 20-feet. The reported VNC of 0-feet indicates that vessels are not meant to travel beneath the bridge.

The existing swing span bridge (Bridge No. 73) opens for vessel traffic on demand. The current operating regulations, outlined in the Code of Federal Regulations Title 33 – Navigation and Navigable Waters Section 117.5, require the bridge to open upon request or signal. Currently, it takes approximately three minutes from the time the siren sounds to indicate the bridge is opening, to the time that a vessel can pass through the bridge opening. When the bridge is opened, vehicular traffic along SR 1332/1335 (Harkers Island Road) is stopped for approximately ten minutes to allow a single vessel to pass through. The bridge tender log from 2011 through 2013 indicated the existing bridge opened an average of three times per day during the peak months (June and September).

In order to determine more information on the maritime activity in the area, interviews were conducted with local marinas and visual surveys were conducted by vessel around the island from July 11 to 12 and September 10 to 11, 2014 while the vessel surveys were being done.



Carteret County

RS&H

Harkers Island Bridge Vessel Survey
Replacement of Harkers Island Bridges
Harkers Island, NC

T.I.P. No: B-4863

Figure 1-1
Study Area

Division: 2

September 2015

2. HISTORIC VESSEL TRAFFIC

Logs are maintained for all vessel traffic requiring an opening of the Harkers Island Bridge. The bridge tender log catalogs the following items for each vessel requiring a bridge opening:

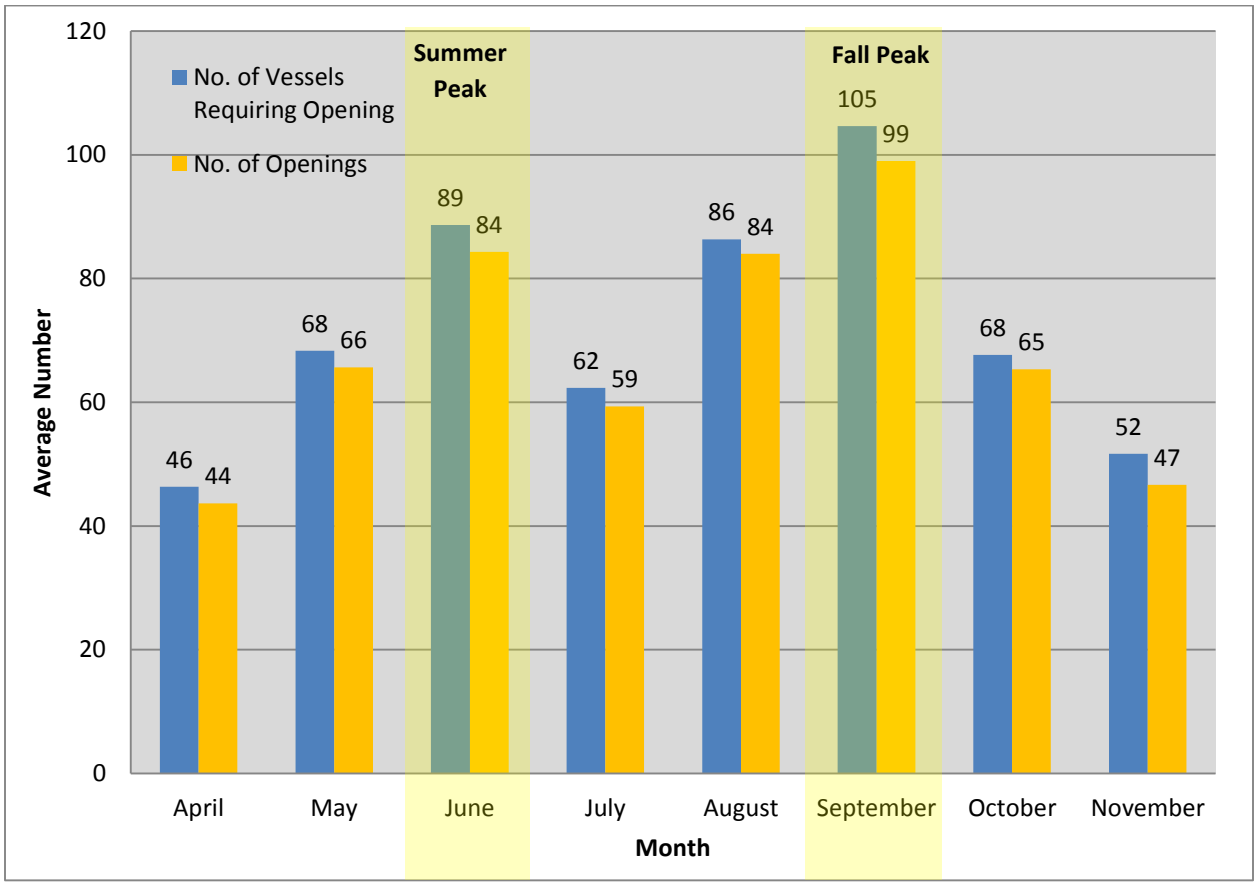
- Date
- Time of Vessel Signal
- Time Gates Closed
- Time Draw Fully Opens
- Type of Vessel
- Name or Number of Vessel
- Time Gates Open
- Delay Due to Bridge Opening
- Number of Vehicles Delayed by Bridge Opening
- Remarks
- Weather at Time of Opening
- Name of Operator

For the purposes of this report, the logs from 2011 through 2013 from April through November were reviewed and summarized. The peak periods of vessel traffic for the waterway were determined by analyzing the number of vessels and the number of bridge openings per month. *Table 2-1* shows a summary of the number of vessels per month requiring the bridge to open from April to November for years 2011 through 2013. *Chart 2-1* depicts the average number of vessels and number of openings for each month in this timeframe. As shown in *Chart 2-1*, the summer peak period occurs in June and the fall peak occurs in September. In addition, these months were further analyzed to determine the weeks with the highest concentration of vessel traffic and bridge openings. This data was used to define the peak weeks of vessel traffic for the waterway and to establish the dates of each five day vessel survey period over the course of six months. A summary of these logs is included in Appendix A.

Table 2-1 - Historic Vessel Traffic Monthly Summary from 2011 to 2013

Month	2011		2012		2013		Average	
	No. of Vessels Requiring Opening	No. of Openings	No. of Vessels Requiring Opening	No. of Openings	No. of Vessels Requiring Opening	No. of Openings	No. of Vessels Requiring Opening	No. of Openings
April	28	28	79	71	32	32	46	44
May	73	70	73	71	59	56	68	66
June	71	67	118	110	77	76	89	84
July	54	52	52	47	81	79	62	59
August	71	69	99	96	89	87	86	84
September	48	45	92	87	174	165	105	99
October	42	41	79	78	82	77	68	65
November	25	24	61	60	69	56	52	47
Total	**412**	**396**	**653**	**620**	**663**	**628**	**576**	**548**
Monthly Average	**52**	**50**	**82**	**78**	**83**	**79**	**72**	**69**

Chart 2-1 - Historic Vessel Traffic, Monthly Average from 2011 to 2013



3. SURVEY METHODOLOGY

A field visit was conducted in May 2014 to determine the survey site location. Due to the distance of the existing bridge from the shore, several locations were reviewed and test measurements were taken in order to determine from which location the most accurate data could be obtained for the vessel height surveys. The best site was determined to be on the southwest shore adjacent to Bridge No. 73.

Vessel height surveys were performed in order to more accurately determine the types and heights of vessels traveling through the Straits waterway and the frequency of these trips. The vessel height surveys were conducted in six phases between 7 AM and 7 PM daily on the following dates:

- May 21 to May 25, 2014
- June 6 to June 10, 2014
- July 9 to July 13, 2014
- August 20 to August 24, 2014
- September 10 to September 14, 2014
- October 2 to October 6, 2014

The Project Team measured the heights of only those vessels requiring a bridge opening during the vessel height surveys. The current operating regulations, outlined in the Code of Federal Regulations Title 33 – Navigation and Navigable Waters Section 117.5, require the bridge to open as needed upon request or signal. Vessels not requiring the bridge to open were also recorded and heights were estimated based on known nearby elevations.

3.1 Equipment and Control

The survey equipment used for the vessel height survey was the Topcon GPT 8003A Robotic and Reflectorless Total Station. Note, the reflectorless prism measurement range is published as 120-meters (393.7-feet). Reflectorless measurements are also dependent upon the type of surface being measured. Due to moving targets and distance between the bridge and survey site location, the reflectorless measurement was unable to be utilized.

Topcon GPT 8003A Robotic & Reflectorless Total Station

In order to properly measure the height of the vessels, it was necessary to establish a control point. A Tidal Bench Mark, designation VM 14924 by the Center for Operational Oceanographic Products and Services, was located at the south end of a retaining wall ledge on the southwest corner of Bridge No. 73. The disc, PID EA1523, is stamped No. 3 1973. The data sheet from the National Geodetic Survey (NGS) site shows the elevation of this disc at 3.47-feet (North American Vertical Datum (NAVD) 1988).

The survey team set up the equipment over a hole drilled into a stationary boulder. Using the benchmark VM 14924, with a known elevation of 3.47-feet, the measured elevation at the instrument location was determined to be 13.60-feet. In order to obtain a baseline, the antenna on the

bridge tender building was used as a back sight at zero degrees. Horizontal angles were based from this back sight.

3.2 Video Camera

A video camera was used to help verify measurements and vessel information of each bridge opening after returning from the site. The video camera was set up at a height of approximately 5-feet over an 8-inch nail daily, which was set beneath the ground's surface at an elevation of approximately 13.6-feet.

3.3 Procedure and Calculations

3.3.1 Survey Procedure

Each day, the instrument was set on the stationary boulder and the video camera on the 8-inch nail. The height of the instrument was recorded and a back sight was taken at zero degrees based on the antenna on the bridge tender building (the baseline).

Survey equipment set up on southwest side of Harkers Island Bridge

For each vessel that required a bridge opening the following was measured:

- Horizontal Angle
- Zenith Angle
- Horizontal Distance
- Elevation of Water

Due to the movement of the vessels through the waterway during the survey, state-of-the-art surveying methods, such as electronic data collection and reflectorless distance measurements, were not effective. The challenge of measuring a moving target occurs when a vessel is directly in front of the instrument (perpendicular). It is possible to accurately measure the horizontal distance to the side of the boat using reflectorless measurement; however it is impossible to obtain a matching zenith angle to the top of the vessel before the vessel has moved and the horizontal distance has then changed. When the vessel is approaching or moving away from the instrument, the zenith angle is easier to obtain but the horizontal distance cannot be obtained with reflectorless measurement.

As a solution to this challenge, the survey team used marked, constant distances between the fenders in the waterway. Two channels are provided for vessels traveling through the Harkers Island Bridge area: one for eastbound and one for westbound traveling vessels. The eastbound channel is between the southern-most fender and the middle fender and the westbound channel is between the middle fender and the northern-most fender.

Bridge fender structures

Every vessel must cross one of these points depending on their direction of travel; therefore, the zenith angle can be recorded and a reliable elevation calculated. The marked location for the eastbound channel yields a horizontal angle of 347°43'27" with the horizontal distance of 476.80-feet, while the marked location for the westbound channel yields a horizontal angle of 347°01'57" with the horizontal distance of 542.80-feet. The back sight used to calculate both horizontal angles is the antenna on the bridge tender building.

Naturally, it is difficult to consistently measure the zenith angle at these exact horizontal angles every time. Therefore, in order to remove errors, the differing horizontal angle can be used to calculate the accurate horizontal distance. This was verified by calculating the angles and distances to each vessel based on the surveyed horizontal and zenith angle, the direction of travel, the location of the waterway, the instrument, and the bridge. This theory is sound within the horizontal tolerance (+/- 1-foot) assuming the vessel is in the center of either the eastbound or westbound channels.

Since the conditions require measurement of the vessel while buoyant and in motion, at rapid speeds on occasion, this method has been determined as the most accurate. Finally, the distance to the top of the water was measured to adjust for the tide and the height of vessel above water was achieved through the calculations outlined in the following section.

3.3.2 Survey Calculations

Based on the recorded measurements, the height to the top of the vessel above the water was calculated in three steps:

Step 1: Calculate Vertical Distance

$$VD = \tan(90° - A) \times D$$

Where VD = Vertical Distance
A = Zenith Angle
D = Horizontal Distance

Step 2: Calculate Vessel Elevation

$$VE = VD + E + H_i$$

Where VE = Vessel Elevation
VD = Vertical Distance
E = Elevation of Observation Point
H_i = Height of Instrument

Step 3: Calculate Vessel Height above Water

$$H = VE - EW$$

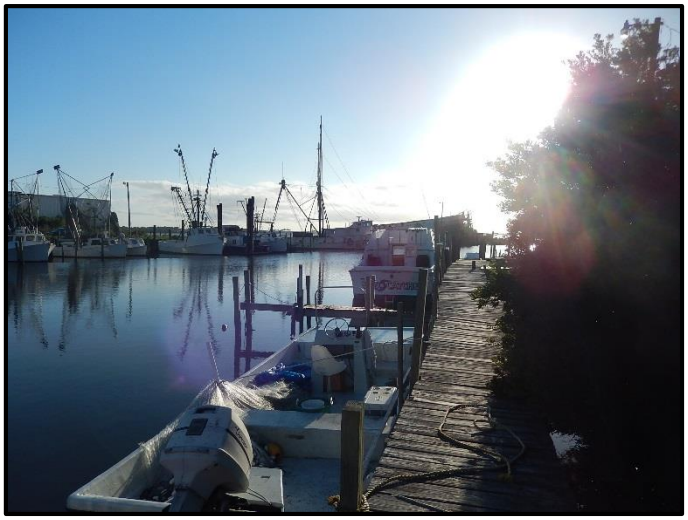
Where H = Vessel Height above Water
VE = Vessel Elevation
EW = Elevation of Water

The calculated height of the vessels above the water was within a reasonable tolerance (+/- 1-foot) for the majority of the vessels that were measured multiple times throughout the survey. However, this height could vary outside of this tolerance due to a number of factors:

- Raising/lowering of outriggers
- Raising/lowering of antenna
- Displacement (weight) of the vessel varying due to load, fuel level, etc.
- Tilt of a masted vessel due to wind

4. SURVEY RESULTS

This section presents a summary of the vessel survey results from May through October 2014. Survey data for each opening, as collected in the field during the survey, is included in Appendix B.



Marshallberg Harbor

Vessel traffic in the Straits waterway consists primarily of recreational vessels with a maximum distance from the surface of the water to the highest point on the vessel, or air draft, of 14-feet. Although maritime businesses are a major part of industry in the Harkers Island area, minimal commercial fishing boats were observed in the Straits waterway throughout the survey period. This may be due to the inconsistent depth of the Straits waterway requiring fishing vessels to operate at a reduced vessel draft (the vertical distance between the lowest point of the vessel, also known as keel, and the waterline), thus limiting the weight of fish that can be transported. An alternative route to the Straits waterway is Back Sound, on the south side of Harkers Island, which provides a consistently deeper channel.

4.1 May 2014 Results

During the five day survey period in May, while a total of 473 vessels were recorded, only 17 of those vessels required the bridge to open a total of 17 times. This data relates to an average of 3.4 vessels per day requiring a bridge opening and an average of 3.4 bridge openings per day. Two of these openings were for two vessels, *Rec. Vessel 1* and *Rec. Vessel 3*, less than 14-feet in height. The remaining 456 vessels ranged from approximately 2-feet to 14-feet in height.

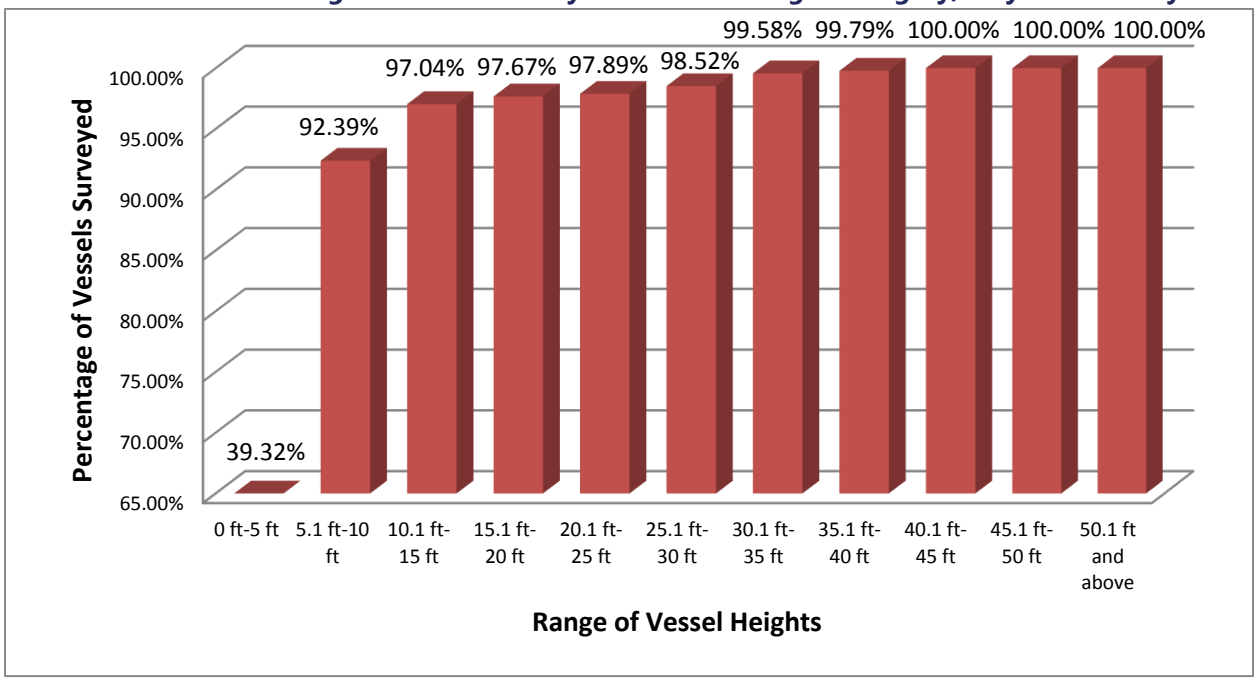
Table 4-1 and *Chart 4-1* summarize the vessel height ranges and provide the following conclusions for the May 2014 survey:

- The majority of vessels (97.04%) traveling beneath the Harkers Island Bridge are 15-feet in height or less.
- All of the vessels observed are 45-feet in height or less.

Table 4-1 - Number and Percentage of Vessels within Vessel Height Ranges, May 2014 Survey

Vessel Height Range	No. of Vessels Surveyed within Height Range	Percentage of Vessels Surveyed within Height Range	Cumulative Vessel Tally	Cumulative Vessel Percentage Tally
0 ft-5 ft	186	39.32%	186	39.32%
5.1 ft-10 ft	251	53.07%	437	92.39%
10.1 ft-15 ft	22	4.65%	459	97.04%
15.1 ft-20 ft	3	0.63%	462	97.67%
20.1 ft-25 ft	1	0.22%	463	97.89%
25.1 ft-30 ft	3	0.63%	466	98.52%
30.1 ft-35 ft	5	1.06%	471	99.58%
35.1 ft-40 ft	1	0.21%	472	99.79%
40.1 ft-45 ft	1	0.21%	473	100.00%
45.1 ft-50 ft	0	0.00%	473	100.00%
50.1 ft and above	0	0.00%	473	100.00%
Total	**473**	**100.00%**	**473**	**100.00%**

Chart 4-1 - Percentage of Vessels Surveyed vs. Vessel Height Category, May 2014 Survey



4.2 June 2014 Results

During the five day survey period in June, while a total of 330 vessels were recorded, only eight of those vessels required the bridge to open a total of seven times. This data relates to an average of 1.6 vessels per day requiring a bridge opening and an average of 1.4 required bridge openings per day. One of the vessels, *Rec. Vessel 8*, was less than 14-feet in height but traveled through the bridge during an opening for a larger vessel. The remaining 322 vessels ranged from approximately 2-feet to 14-feet in height.

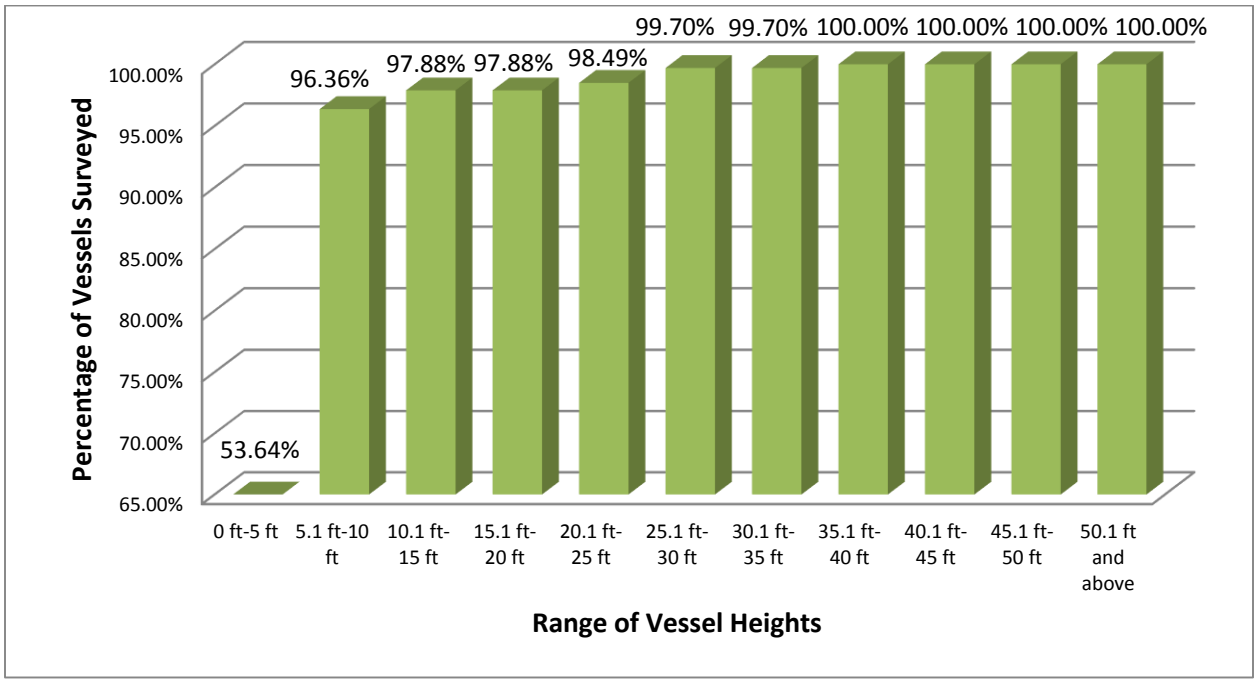
Table 4-2 and *Chart 4-2* summarize the vessel height ranges and provide the following conclusions for the June 2014 survey:

- The majority of vessels (96.36%) traveling beneath the Harkers Island Bridge are 10-feet in height or less.
- All of the vessels observed are 40-feet in height or less.

Table 4-2 - Number and Percentage of Vessels within Vessel Height Ranges, June 2014 Survey

Vessel Height Range	No. of Vessels Surveyed within Height Range	Percentage of Vessels Surveyed within Height Range	Cumulative Vessel Tally	Cumulative Vessel Percentage Tally
0 ft-5 ft	177	53.64%	177	53.64%
5.1 ft-10 ft	141	42.72%	318	96.36%
10.1 ft-15 ft	5	1.52%	323	97.88%
15.1 ft-20 ft	0	0.00%	323	97.88%
20.1 ft-25 ft	2	0.61%	325	98.49%
25.1 ft-30 ft	4	1.21%	329	99.70%
30.1 ft-35 ft	0	0.00%	329	99.70%
35.1 ft-40 ft	1	0.30%	330	100.00%
40.1 ft-45 ft	0	0.00%	330	100.00%
45.1 ft-50 ft	0	0.00%	330	100.00%
50.1 ft and above	0	0.00%	330	100.00%
Total	**330**	**100.00%**	**330**	**100.00%**

Chart 4-2 - Percentage of Vessels Surveyed vs. Vessel Height Category, June 2014 Survey



4.3 July 2014 Results

During the five day survey period in July, while a total of 421 vessels were recorded, only 20 of those vessels required the bridge to open a total of 19 times. This data relates to an average of 4.0 vessels per day requiring a bridge opening and an average of 3.8 required bridge openings per day. Three of these openings were for four vessels, *Isabell* observed two times, *On-Water Vessel 1*, and *Rec. Vessel 11*, less than 14-feet in height. The remaining 401 vessels ranged from approximately 2-feet to 14-feet in height.

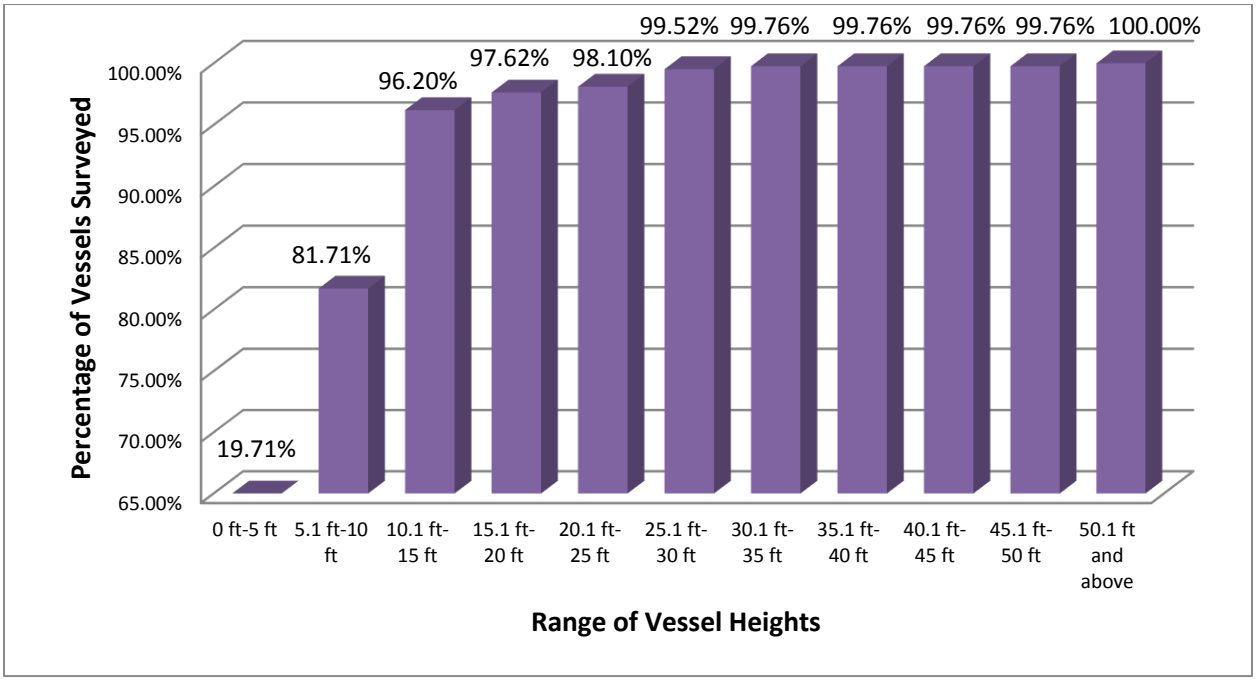
Table 4-3 and *Chart 4-3* summarize the vessel height ranges and provide the following conclusions for the July 2014 survey:

- The majority of vessels (96.20%) traveling beneath the Harkers Island Bridge are 15-feet in height or less.
- One vessel was measured over 50-feet in height: a commercial fishing boat called *Miss Melissa*, originating from Marshallberg Harbor.
- With the exception of *Miss Melissa*, all of the vessels observed are 35-feet in height or less.

Table 4-3 - Number and Percentage of Vessels within Vessel Height Ranges, July 2014 Survey

Vessel Height Range	No. of Vessels Surveyed within Height Range	Percentage of Vessels Surveyed within Height Range	Cumulative Vessel Tally	Cumulative Vessel Percentage Tally
0 ft-5 ft	83	19.71%	83	19.71%
5.1 ft-10 ft	261	62.00%	344	81.71%
10.1 ft-15 ft	61	14.49%	405	96.20%
15.1 ft-20 ft	6	1.42%	411	97.62%
20.1 ft-25 ft	2	0.48%	413	98.10%
25.1 ft-30 ft	6	1.42%	419	99.52%
30.1 ft-35 ft	1	0.24%	420	99.76%
35.1 ft-40 ft	0	0.00%	420	99.76%
40.1 ft-45 ft	0	0.00%	420	99.76%
45.1 ft-50 ft	0	0.00%	420	99.76%
50.1 ft and above	1	0.24%	421	100.00%
Total	**421**	**100.00%**	**421**	**100.00%**

Chart 4-3 - Percentage of Vessels Surveyed vs. Vessel Height Category, July 2014 Survey



4.4 August 2014 Results

During the five day survey period in August, while a total of 158 vessels were recorded, only 12 of those vessels required the bridge to open a total of 11 times. This data relates to an average of 2.4 vessels per day requiring a bridge opening and an average of 2.2 required bridge openings per day. The remaining 146 vessels ranged from approximately 2-feet to 14-feet in height.

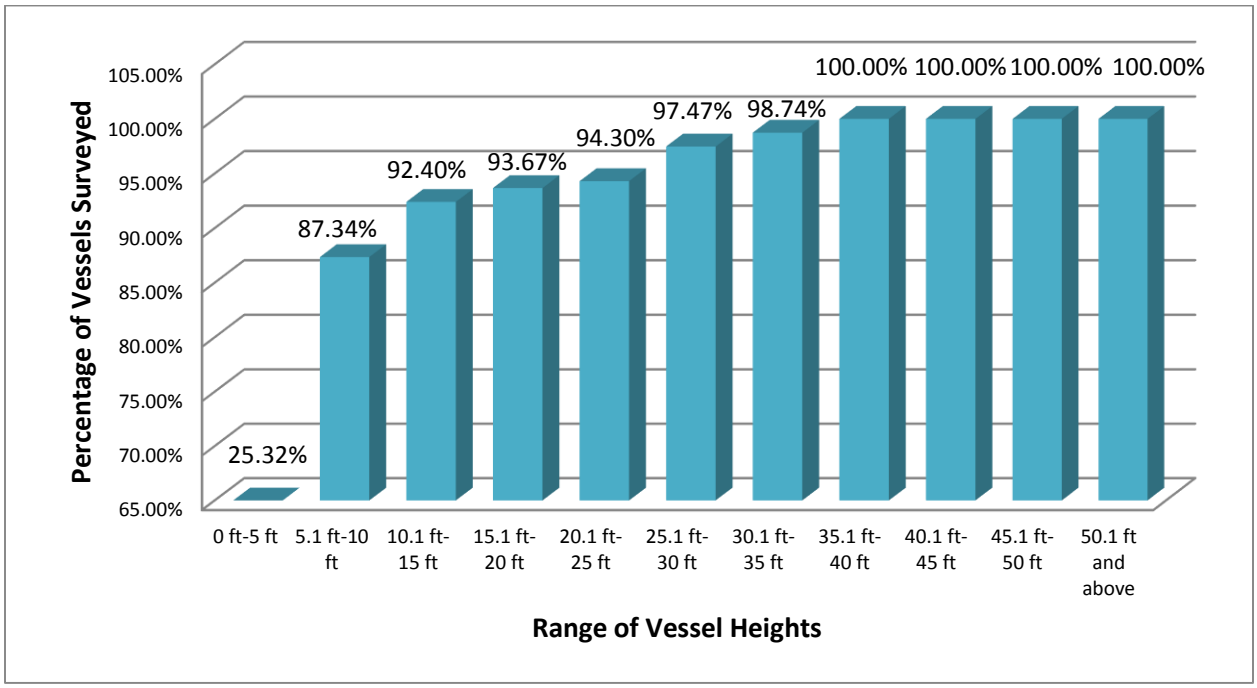
Table 4-4 and *Chart 4-4* summarize the vessel height ranges and provide the following conclusions for the August 2014 survey:

- The majority of vessels (94.30%) traveling beneath the Harkers Island Bridge are 25-feet in height or less.
- All of the vessels observed are 40-feet in height or less.

Table 4-4 - Number and Percentage of Vessels within Vessel Height Ranges, August 2014 Survey

Vessel Height Range	No. of Vessels Surveyed within Height Range	Percentage of Vessels Surveyed within Height Range	Cumulative Vessel Tally	Cumulative Vessel Percentage Tally
0 ft-5 ft	40	25.32%	40	25.32%
5.1 ft-10 ft	98	62.02%	138	87.34%
10.1 ft-15 ft	8	5.06%	146	92.40%
15.1 ft-20 ft	2	1.27%	148	93.67%
20.1 ft-25 ft	1	0.63%	149	94.30%
25.1 ft-30 ft	5	3.17%	154	97.47%
30.1 ft-35 ft	2	1.27%	156	98.74%
35.1 ft-40 ft	2	1.26%	158	100.00%
40.1 ft-45 ft	0	0.00%	158	100.00%
45.1 ft-50 ft	0	0.00%	158	100.00%
50.1 ft and above	0	0.00%	158	100.00%
Total	**158**	**100.00%**	**158**	**100.00%**

Chart 4-4 - Percentage of Vessels Surveyed vs. Vessel Height Category, August 2014 Survey



4.5 September 2014 Results

During the five day survey period in September, while a total of 175 vessels were recorded, only 20 of those vessels required the bridge to open a total of 13 times. This data relates to an average of 4.0 vessels per day requiring a bridge opening and an average of 2.6 required bridge openings per day. Three of these openings were for three vessels, *Isabell* observed two times and *On-Water Service Vessel 2*, less than 14-feet in height. The remaining 155 vessels ranged from approximately 2-feet to 14-feet in height.

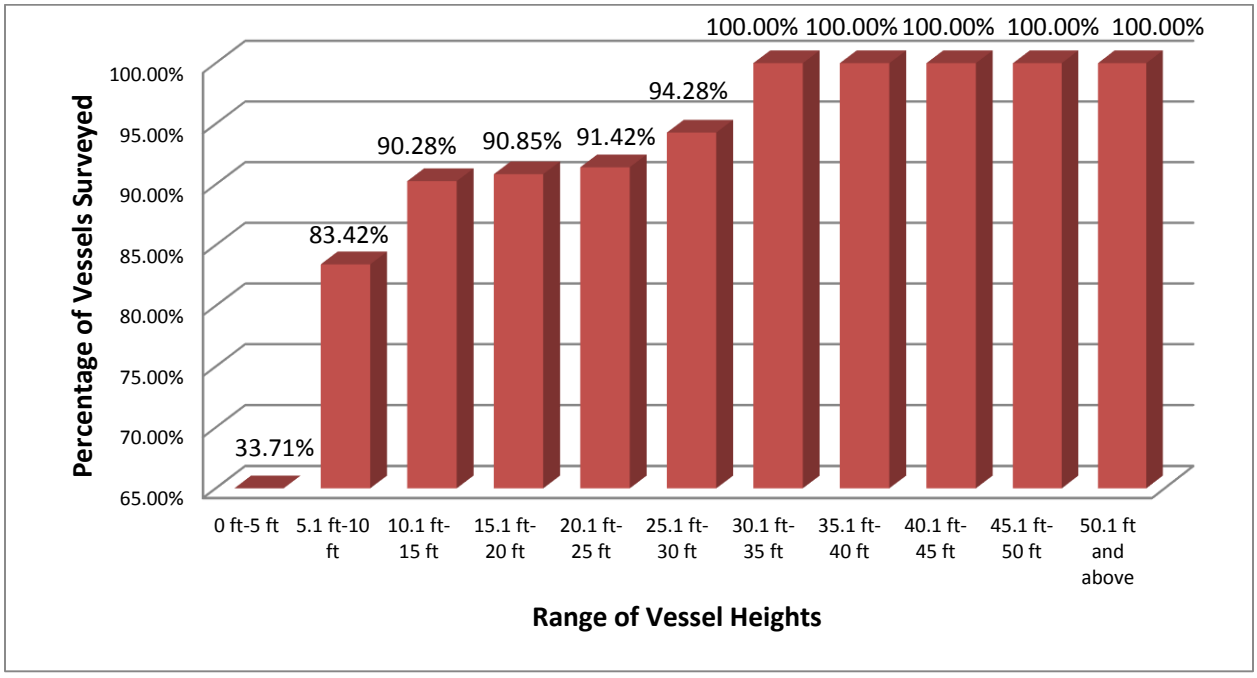
Table 4-5 and *Chart 4-5* summarize the vessel height ranges and provide the following conclusions for the September 2014 survey:

- The majority of vessels (94.28%) traveling beneath the Harkers Island Bridge are 30-feet in height or less.
- All of the vessels observed are 35-feet in height or less.

Table 4-5 - Number and Percentage of Vessels within Vessel Height Ranges, September 2014 Survey

Vessel Height Range	No. of Vessels Surveyed within Height Range	Percentage of Vessels Surveyed within Height Range	Cumulative Vessel Tally	Cumulative Vessel Percentage Tally
0 ft-5 ft	59	33.71%	59	33.71%
5.1 ft-10 ft	87	49.71%	146	83.42%
10.1 ft-15 ft	12	6.86%	158	90.28%
15.1 ft-20 ft	1	0.57%	159	90.85%
20.1 ft-25 ft	1	0.57%	160	91.42%
25.1 ft-30 ft	5	2.86%	165	94.28%
30.1 ft-35 ft	10	5.72%	175	100.00%
35.1 ft-40 ft	0	0.00%	175	100.00%
40.1 ft-45 ft	0	0.00%	175	100.00%
45.1 ft-50 ft	0	0.00%	175	100.00%
50.1 ft and above	0	0.00%	175	100.00%
Total	**175**	**100.00%**	**175**	**100.00%**

Chart 4-5 - Percentage of Vessels Surveyed vs. Vessel Height Category, September 2014 Survey



4.6 October 2014 Results

During the five day survey period in October, while a total of 208 vessels were recorded, only 25 of those vessels required the bridge to open a total of 19 times. This data relates to an average of 5.0 vessels per day requiring a bridge opening and an average of 3.8 required bridge openings per day. One of these openings was for two vessels, *Miss Darlene* and *Rec. Vessel 18*, both less than 14-feet in height. The remaining 183 vessels ranged from approximately 2-feet to 14-feet in height.

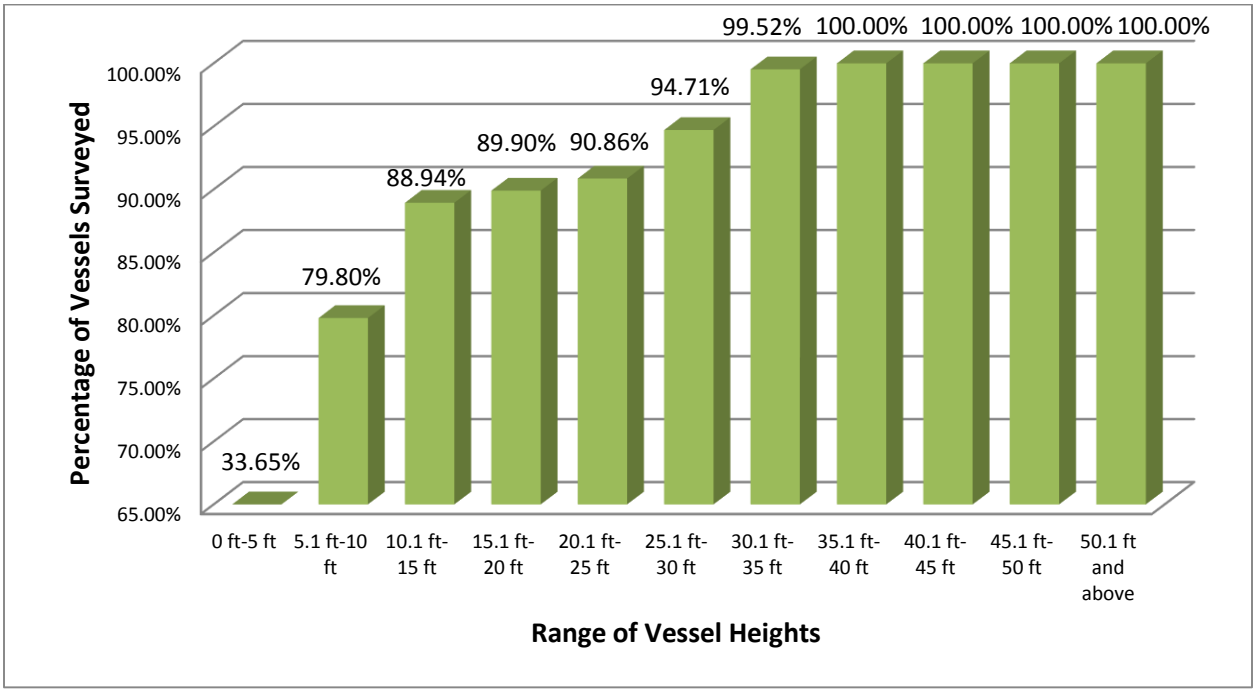
Table 4-6 and *Chart 4-6* summarize the vessel height ranges and provide the following conclusions for the October 2014 survey:

- The majority of vessels (94.71%) traveling beneath the Harkers Island Bridge are 30-feet in height or less.
- All of the vessels observed are 40-feet in height or less.

Table 4-6 - Number and Percentage of Vessels within Vessel Height Ranges, October 2014 Survey

Vessel Height Range	No. of Vessels Surveyed within Height Range	Percentage of Vessels Surveyed within Height Range	Cumulative Vessel Tally	Cumulative Vessel Percentage Tally
0 ft-5 ft	70	33.65%	70	33.65%
5.1 ft-10 ft	96	46.15%	166	79.80%
10.1 ft-15 ft	19	9.14%	185	88.94%
15.1 ft-20 ft	2	0.96%	187	89.90%
20.1 ft-25 ft	2	0.96%	189	90.86%
25.1 ft-30 ft	8	3.85%	197	94.71%
30.1 ft-35 ft	10	4.81%	207	99.52%
35.1 ft-40 ft	1	0.48%	208	100.00%
40.1 ft-45 ft	0	0.00%	208	100.00%
45.1 ft-50 ft	0	0.00%	208	100.00%
50.1 ft and above	0	0.00%	208	100.00%
Total	**208**	**100.00%**	**208**	**100.00%**

Chart 4-6 - Percentage of Vessels Surveyed vs. Vessel Height Category, October 2014 Survey



4.7 Overall Survey Results

During the 30-day survey period, while a total of 1,765 vessels were recorded, only 102 of those vessels (5.78%) required the bridge to open a total of 86 times. This data relates to an average of 3.4 vessels per day requiring a bridge opening and an average of 2.9 required bridge openings per day. Nine of these openings were for 11 vessels less than 14-feet in height. The remaining 1,663 vessels ranged from approximately 2-feet to 14-feet in height. *Table 4-7* provides a summary of the number of vessels and the number of bridge openings observed within the 30-day survey period.

Table 4-7 - Number of Vessels and Openings, Entire Survey Period

Period	Dates	No. of Vessels	No. of Vessels Requiring Opening	No. of Openings
Days 1 - 5	5/21/14 to 5/25/14	473	17	17
Days 6 - 10	6/6/14 to 6/10/14	330	8	7
Days 11 - 15	7/9/14 to 7/13/14	421	20	19
Days 16 - 20	8/20/14 to 8/24/14	158	12	11
Days 21 - 25	9/10/14 to 9/14/14	175	20	13
Days 26 - 30	10/2/14 to 10/6/14	208	25	19
GRAND TOTAL		**1,765**	**102**	**86**

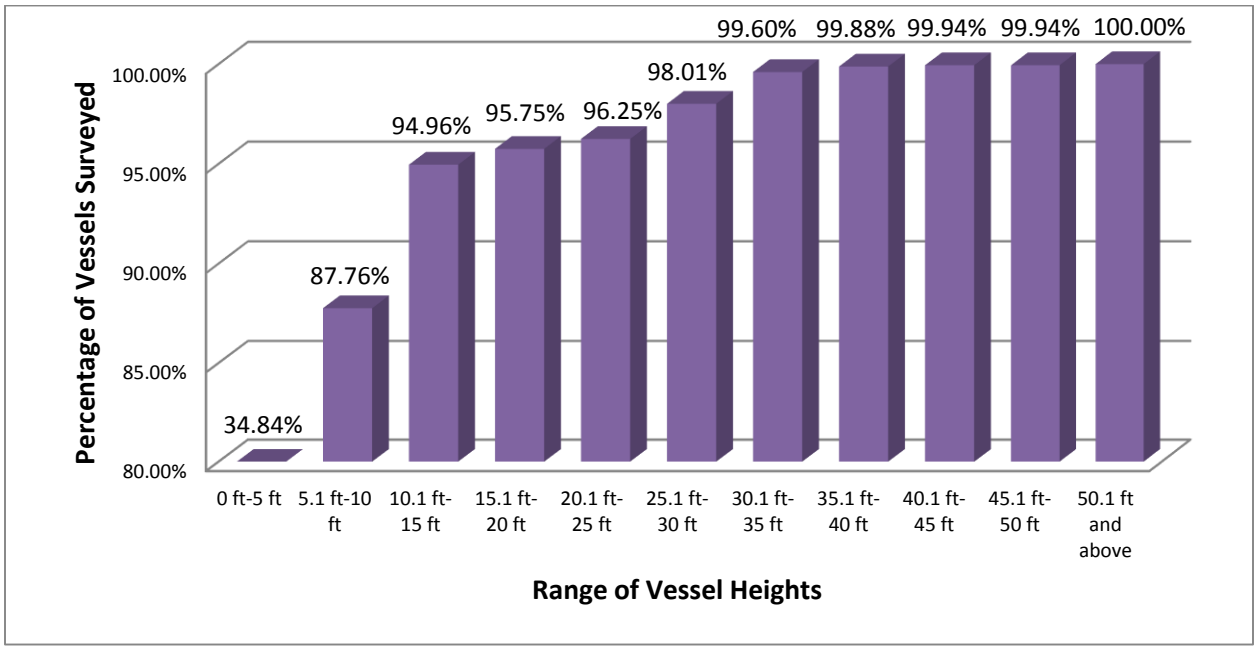
Table 4-8 and *Chart 4-7* summarize the vessel height ranges and provide the following conclusions for the entire survey:

- 95% of the vessels observed were 15-feet in height or less.
- 96% of the vessels observed were 20-feet in height or less.
- 98% of the vessels observed were 30-feet in height or less.
- 99.9% of the vessels observed were 40-feet in height or less.

Table 4-8 - Number and Percentage of Vessels within Vessel Height Ranges, Entire Survey Period

Vessel Height Range	No. of Vessels Surveyed within Height Range	Percentage of Vessels Surveyed within Height Range	Cumulative Vessel Tally	Cumulative Vessel Percentage Tally
0 ft-5 ft	615	34.84%	615	34.84%
5.1 ft-10 ft	934	52.92%	1,549	87.76%
10.1 ft-15 ft	127	7.20%	1,676	94.96%
15.1 ft-20 ft	14	0.79%	1,690	95.75%
20.1 ft-25 ft	9	0.50%	1,699	96.25%
25.1 ft-30 ft	31	1.76%	1,730	98.01%
30.1 ft-35 ft	28	1.59%	1,758	99.60%
35.1 ft-40 ft	5	0.28%	1,763	99.88%
40.1 ft-45 ft	1	0.06%	1,764	99.94%
45.1 ft-50 ft	0	0.00%	1,764	99.94%
50.1 ft and above	1	0.06%	1,765	100.00%
Total	**1,765**	**100.00%**	**1,765**	**100.0%**

Chart 4-7 - Percentage of Vessels vs. Vessel Height Category, Entire Survey Period



4.8 Surveyed Vessels Requiring Opening

Table 4-9 depicts the number of observations and average vessel heights of all vessels requiring a bridge opening measured throughout the survey period. Of all vessels observed, 99.9% measured 40-feet in height or less. The two vessels measured over 40-feet were the following. The first vessel, *Yard Sail*, is a Recreational Sailboat which was measured in May to be 42.17-feet in height. The second vessel, *Miss Melissa*, is a Commercial Fishing Boat which was measured in July to be 67.81-feet in height.

Table 4-10 summarizes the vessel height ranges and the number of vessels requiring the bridge to open during the survey period. Vessels measuring 25-feet to 30-feet in height had the highest percentage of openings (30%) when compared to the other vessel height ranges.

Table 4-9 - Average Vessel Height of Vessels Observed During Survey

Vessel Name	Vessel Type	Number of Observations	Average Vessel Height (ft)
Boss	Rec. Boat	1	23.60
Brooks	Barge w/ Backhoe	1	27.00
Cameron T	Comm. Fishing Boat	8	30.41
Cape Town Queen	Rec. Boat	1	18.39
Captain Charlie	Barge w/ Backhoe	1	36.00
Captain Gunnar	Comm. Fishing Boat	4	36.21
Cool Jerk	Rec. Boat	1	30.13
Cruz-N	Houseboat	3	17.32
Isabell	Rec. Boat	4	11.24
Jenny	Comm. Fishing Boat	1	24.59
Lady Jane	Comm. Fishing Boat	2	30.27
Lady Laura	Comm. Fishing Boat	2	24.52
Little One	Comm. Fishing Boat	1	19.56
Mad Lady II	Comm. Fishing Boat	5	31.67
Miss Addie	Comm. Fishing Boat	1	35.12
Miss Bertha	Comm. Fishing Boat	1	22.81
Miss Darlene	Houseboat	1	11.37
Miss Gina	Comm. Fishing Boat	3	30.69
Miss Melissa	Comm. Fishing Boat	1	67.81
Miss Sandy	Comm. Fishing Boat	6	27.10
Miss Sherry	Rec. Boat	4	29.46
Pearl	Rec. Boat	1	15.76
Pissed off Pearl	Comm. Fishing Boat	1	25.25
Strike 1	Rec. Boat	6	28.50
The Pearl	Comm. Fishing Boat	1	25.43
U.S. Coast Guard	U.S. Coast Guard	1	15.94
Wade Willis	Comm. Fishing Boat	1	25.30
Wanda Gale	Comm. Fishing Boat	1	33.62
Whale Tale II	Barge	1	25.12
Yard Sail	Sailboat	1	42.17
Comm. Fishing Vessel 1	Comm. Fishing Boat	1	31.67
Comm. Fishing Vessel 2	Comm. Fishing Boat	1	15.70
Comm. Fishing Vessel 3	Comm. Fishing Boat	1	31.08
Comm. Fishing Vessel 4	Comm. Fishing Boat	1	33.27
Comm. Fishing Vessel 5	Comm. Fishing Boat	1	25.32
Comm. Fishing Vessel 6	Comm. Fishing Boat	1	24.39
Comm. Fishing Vessel 7	Comm. Fishing Boat	1	25.43
Comm. Fishing Vessel 8	Comm. Fishing Boat	1	32.53
Comm. Fishing Vessel 9	Comm. Fishing Boat	1	31.78
Comm. Fishing Vessel 10	Comm. Fishing Boat	1	30.67
Comm. Fishing Vessel 11	Comm. Fishing Boat	1	24.99

Table 4-9 - Average Vessel Height of Vessels Observed During Survey (Continued)

Vessel Name	Vessel Type	Number of Observations	Average Vessel Height (ft)
Comm. Fishing Vessel 12	Comm. Fishing Boat	1	30.80
Comm. Fishing Vessel 13	Comm. Fishing Boat	1	25.06
Comm. Fishing Vessel 14	Comm. Fishing Boat	1	31.78
On-Water Service Vessel 1	Tow Boat	1	9.00
On-Water Service Vessel 2	Tow Boat	1	12.26
Rec. Sailboat 1	Sailboat	1	32.95
Rec. Vessel 1	Houseboat	1	13.74
Rec. Vessel 2	Houseboat	1	14.23
Rec. Vessel 3	Houseboat	1	12.11
Rec. Vessel 4	Rec. Boat	1	25.57
Rec. Vessel 5	Rec. Boat	1	16.14
Rec. Vessel 6	Rec. Boat	1	20.19
Rec. Vessel 7	Rec. Boat	1	28.73
Rec. Vessel 8	Rec. Boat	1	9.86
Rec. Vessel 9	Rec. Boat	1	28.18
Rec. Vessel 10	Rec. Boat	1	29.29
Rec. Vessel 11	Rec. Boat	1	10.00
Rec. Vessel 12	Rec. Boat	1	21.94
Rec. Vessel 13	Rec. Boat	1	19.53
Rec. Vessel 14	Rec. Boat	1	18.07
Rec. Vessel 15	Rec. Boat	1	25.56
Rec. Vessel 16	Rec. Boat	1	19.76
Rec. Vessel 17	Rec. Boat	2	19.50
Rec. Vessel 18	Rec. Boat	1	12.34

Table 4-10 - Percentage of Vessels Requiring Opening

Vessel Height Range	No. of Vessels Requiring Opening	Percentage of Vessels Requiring Opening
0'-5'	0	0.00%
5.1'-10'	4	3.92%
10.1'-15'	9	8.82%
15.1'-20'	14	13.73%
20.1'-25'	9	8.82%
25.1'-30'	31	30.39%
30.1'-35'	28	27.45%
35.1'-40'	5	4.90%
40.1'-45'	1	0.98%
45.1'-50'	0	0.00%
50.1' and above	1	0.98%
Total	**102**	**100.00%**

4.9 Types of Vessels Observed

Table 4-10 and *Chart 4-8* depict the number of vessels observed during the vessel surveys for the following vessel categories: recreational sailboats, recreational fishing boats, other recreational vessels, commercial marine industrial vessels, commercial excursion vessels, government vessels, and on-water service vessels. *Table 4-11* provides a listing of the vessel types included in each category. The majority of the "other recreational vessels" are recreational boats that were unable to be identified more specifically. A total of 96.10% of the vessels observed are for recreational use.

Table 4-11 - Number and Percentage of Vessels per Category

Vessel Category	No. of Vessels	Percentage of Vessels
Recreation Sailboat	49	2.78%
Recreation Fishing Boat	16	0.91%
Recreation (Other)	1631	92.41%
Commercial Marine Industrial	53	3.00%
Commercial Excursion	1	0.06%
Government	5	0.28%
On-Water Service	10	0.57%
Total	**1765**	**100.00%**

Chart 4-8 - Percentage of Vessels per Category

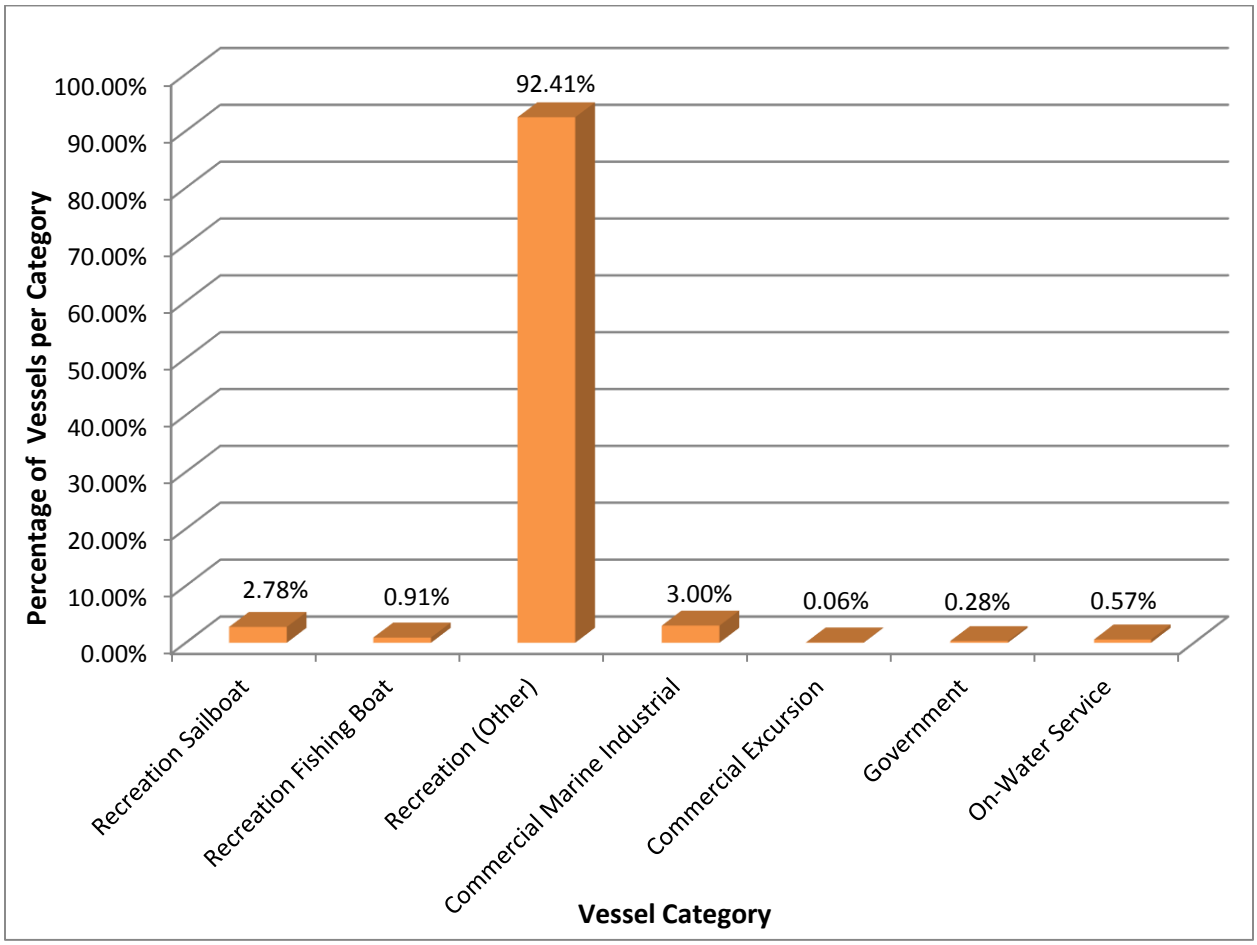


Table 4-12 - Vessel Types per Category

Vessel Category	Type of Vessel
Recreational Sailboats	Sailboat
Recreational Fishing Boats	Rec. Fishing Boat
Recreational (Other)	Rec. Boat, Houseboat, Kayak, Jet Ski
Commercial Marine Industrial	Barge, Barge w/ Backhoe, Comm. Fishing Boat
Commercial Excursion	Pirate Ship Replica
Government	U.S. Coast Guard
On-Water Service	Tow Boat

5. LOCAL MARINE INDUSTRY DATA

Six nearby marinas/harbors were identified by the Project Team. In order to determine more information on the maritime activity in the area, interviews were conducted with two of the marinas. The remaining four marinas/harbors were unmanned and a visual survey was performed at these locations. *Figure 1-1* shows these marina/harbor locations in relation to the existing Harkers Island Bridge.

Bayview Drive Harbor

The interviews and visual surveys were completed July 11 and 12 and September 10 and 11, 2014 while the vessel survey was being conducted. The marina owners interviewed provided estimates for each of the percentages reported as they do not document this data specifically for each vessel in their marina. Typically, marinas do not record the height of the vessel but rather the length. The visual surveys were conducted by vessel around the island. Photographs were taken and notes were recorded regarding any large vessels moored in the area. Also, an estimate of the height for each vessel was made. *Table 5-1* provides a summary of the information recorded during the interviews and visual surveys of the marinas/harbors.

Table 5-1 – Marina/Harbor Data

Marina/Harbor Name	No. of Vessels Currently Stored	Percentage of Annual Vessel Usage Leisure (Commercial)	Percentage of Vessels using Harkers Island Bridge
Marina Interviews			
Cape Pointe Marina	14	99% (1%)	1%
Harkers Island Fishing Center	80	100% (0%)	1%
Marina/Harbor Observations			
Harkers Island Harbor	25	10% (90%)	50%
East Bay Boat Works	32	99% (1%)	50%
Marshallberg Harbor	30	10% (90%)	80%
Bayview Drive Harbor	65	99% (1%)	50%

According to the owner, the vessels stored at Cape Pointe Marina are primarily leisure vessels traveling to Cape Lookout for day trips. These vessels average approximately 14-feet in height and do not typically travel through the Harkers Island Bridge.

Marshallberg Harbor

At the Harkers Island Fishing Center, the owners reported that 100% of the vessels are used for leisure, traveling to and from Cape Lookout, Beaufort Inlet, and Shackleford Banks for day trips. Rarely do any of these vessels travel through the Harkers Island Bridge. The maximum height for vessels docked at the Harkers Island Fishing Center measures approximately 30-feet.

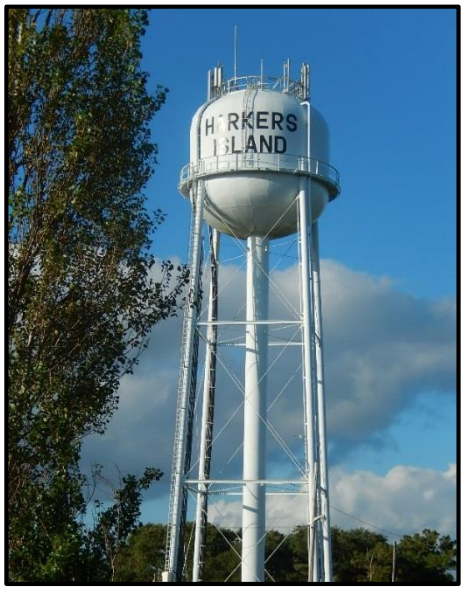
Visual surveys conducted at East Bay Boat Works and Bayview Drive Harbor revealed a majority of the vessels observed are used for leisurely activities. At Harkers Island Harbor and Marshallberg Harbor the majority of vessels are for commercial use. The majority of vessels observed at these marinas/harbors ranged in height from approximately 28-feet to 40-feet.

The vessels observed docked at Marshallberg Harbor were approximately 90% fishing vessels. Marshallberg Harbor is a designated harbor of refuge for commercial vessels. While most of these vessels travel east, local fishermen report that the vessels that leave Marshallberg Harbor and travel through the Harkers Island Bridge are typically headed to Core Creek and North River.

6. CONCLUSIONS

Vessel height surveys were performed for a total of 30 days between May and October 2014 to more accurately determine the types and heights of vessels traveling through the Straits waterway beneath the Harkers Island Bridge. During the 30-day survey period, a total of 1,765 vessels were observed, with an average of 3.4 vessels per day requiring a bridge opening at an average of 2.9 bridge openings per day. The majority of vessels traveling beneath the Harkers Island Bridge are for recreational use (96.1%) and the heights of these vessels are summarized below:

- 95% of the vessels observed were 15-feet in height or less.
- 96% of the vessels observed were 20-feet in height or less.
- 98% of the vessels observed were 30-feet in height or less.
- 99.9% of the vessels observed were 40-feet in height or less.



Harkers Island Water Tower

Appendix A – NCDOT Historic Bridge Tender Logs 2011-2013

B-4863 Harkers Island Bridge

2011 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
April 2011			
1	04/01/11	4	4
2	04/02/11	0	0
3	04/03/11	0	0
4	04/04/11	0	0
5	04/05/11	1	1
6	04/06/11	4	4
7	04/07/11	1	1
8	04/08/11	0	0
9	04/09/11	0	0
10	04/10/11	1	1
11	04/11/11	0	0
12	04/12/11	1	1
13	04/13/11	1	1
14	04/14/11	0	0
15	04/15/11	1	1
16	04/16/11	1	1
17	04/17/11	0	0
18	04/18/11	0	0
19	04/19/11	2	2
20	04/20/11	0	0
21	04/21/11	0	0
22	04/22/11	1	1
23	04/23/11	1	1
24	04/24/11	0	0
25	04/25/11	1	1
26	04/26/11	4	4
27	04/27/11	1	1
28	04/28/11	0	0
29	04/29/11	2	2
30	04/30/11	1	1
May 2011			
31	05/01/11	3	3
32	05/02/11	2	2
33	05/03/11	1	1
34	05/04/11	0	0
35	05/05/11	0	0
36	05/06/11	2	2
37	05/07/11	0	0
38	05/08/11	0	0
39	05/09/11	2	2
40	05/10/11	1	1

B-4863 Harkers Island Bridge

2011 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
41	05/11/11	0	0
42	05/12/11	0	0
43	05/13/11	0	0
44	05/14/11	2	2
45	05/15/11	3	3
46	05/16/11	3	3
47	05/17/11	3	4
48	05/18/11	0	0
49	05/19/11	2	2
50	05/20/11	4	4
51	05/21/11	5	6
52	05/22/11	7	7
53	05/23/11	6	6
54	05/24/11	5	5
55	05/25/11	5	5
56	05/26/11	1	1
57	05/27/11	1	1
58	05/28/11	2	3
59	05/29/11	4	4
60	05/30/11	5	5
61	05/31/11	1	1
June 2011			
62	06/01/11	3	5
63	06/02/11	2	2
64	06/03/11	2	2
65	06/04/11	5	5
66	06/05/11	6	6
67	06/06/11	3	3
68	06/07/11	0	0
69	06/08/11	2	2
70	06/09/11	1	1
71	06/10/11	2	2
72	06/11/11	3	4
73	06/12/11	3	3
74	06/13/11	0	0
75	06/14/11	4	4
76	06/15/11	4	4
77	06/16/11	2	2
78	06/17/11	3	3
79	06/18/11	1	1
80	06/19/11	3	3
81	06/20/11	1	1

B-4863 Harkers Island Bridge

2011 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
82	06/21/11	1	1
83	06/22/11	2	2
84	06/23/11	3	4
85	06/24/11	2	2
86	06/25/11	2	2
87	06/26/11	1	1
88	06/27/11	1	1
89	06/28/11	1	1
90	06/29/11	1	1
91	06/30/11	3	3
July 2011			
92	07/01/11	2	2
93	07/02/11	6	6
94	07/03/11	3	3
95	07/04/11	3	3
96	07/05/11	5	6
97	07/06/11	2	2
98	07/07/11	0	0
99	07/08/11	1	1
100	07/09/11	0	0
101	07/10/11	2	2
102	07/11/11	2	3
103	07/12/11	0	0
104	07/13/11	2	2
105	07/14/11	0	0
106	07/15/11	3	3
107	07/16/11	0	0
108	07/17/11	4	4
109	07/18/11	0	0
110	07/19/11	1	1
111	07/20/11	3	3
112	07/21/11	2	2
113	07/22/11	1	1
114	07/23/11	0	0
115	07/24/11	0	0
116	07/25/11	1	1
117	07/26/11	0	0
118	07/27/11	0	0
119	07/28/11	2	2
120	07/29/11	1	1
121	07/30/11	4	4
122	07/31/11	2	2

B-4863 Harkers Island Bridge

2011 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
August 2011			
123	08/01/11	1	1
124	08/02/11	1	1
125	08/03/11	1	1
126	08/04/11	0	0
127	08/05/11	1	1
128	08/06/11	1	1
129	08/07/11	4	4
130	08/08/11	4	4
131	08/09/11	1	1
132	08/10/11	2	2
133	08/11/11	0	0
134	08/12/11	1	1
135	08/13/11	1	1
136	08/14/11	0	0
137	08/15/11	0	0
138	08/16/11	3	3
139	08/17/11	1	1
140	08/18/11	1	1
141	08/19/11	2	2
142	08/20/11	0	0
143	08/21/11	4	4
144	08/22/11	6	6
145	08/23/11	4	5
146	08/24/11	6	6
147	08/25/11	12	13
148	08/26/11	3	3
149	08/27/11	0	0
150	08/28/11	0	0
151	08/29/11	6	6
152	08/30/11	1	1
153	08/31/11	2	2
September 2011			
154	09/01/11	2	2
155	09/02/11	6	6
156	09/03/11	4	4
157	09/04/11	2	2
158	09/05/11	3	3
159	09/06/11	1	1
160	09/07/11	2	2
161	09/08/11	0	0
162	09/09/11	3	4

B-4863 Harkers Island Bridge

2011 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
163	09/10/11	2	2
164	09/11/11	1	2
165	09/12/11	0	0
166	09/13/11	1	1
167	09/14/11	0	0
168	09/15/11	3	3
169	09/16/11	0	0
170	09/17/11	1	1
171	09/18/11	1	1
172	09/19/11	1	1
173	09/20/11	1	1
174	09/21/11	0	0
175	09/22/11	1	1
176	09/23/11	1	2
177	09/24/11	1	1
178	09/25/11	1	1
179	09/26/11	1	1
180	09/27/11	1	1
181	09/28/11	1	1
182	09/29/11	0	0
183	09/30/11	4	4
October 2011			
184	10/01/11	7	7
185	10/02/11	5	5
186	10/03/11	0	0
187	10/04/11	0	0
188	10/05/11	1	1
189	10/06/11	1	1
190	10/07/11	1	1
191	10/08/11	1	1
192	10/09/11	1	1
193	10/10/11	1	1
194	10/11/11	0	0
195	10/12/11	2	2
196	10/13/11	2	2
197	10/14/11	2	2
198	10/15/11	1	1
199	10/16/11	1	1
200	10/17/11	3	3
201	10/18/11	2	2
202	10/19/11	0	0
203	10/20/11	0	0

B-4863 Harkers Island Bridge

2011 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
204	10/21/11	2	2
205	10/22/11	2	3
206	10/23/11	1	1
207	10/24/11	1	1
208	10/25/11	0	0
209	10/26/11	2	2
210	10/27/11	1	1
211	10/28/11	1	1
212	10/29/11	0	0
213	10/30/11	0	0
214	10/31/11	0	0
November 2011			
215	11/01/11	1	1
216	11/02/11	3	4
217	11/03/11	3	3
218	11/04/11	0	0
219	11/05/11	0	0
220	11/06/11	1	1
221	11/07/11	0	0
222	11/08/11	0	0
223	11/09/11	0	0
224	11/10/11	3	3
225	11/11/11	0	0
226	11/12/11	0	0
227	11/13/11	0	0
228	11/14/11	1	1
229	11/15/11	1	1
230	11/16/11	1	1
231	11/17/11	0	0
232	11/18/11	0	0
233	11/19/11	1	1
234	11/20/11	1	1
235	11/21/11	0	0
236	11/22/11	2	2
237	11/23/11	0	0
238	11/24/11	1	1
239	11/25/11	0	0
240	11/26/11	2	2
241	11/27/11	0	0
242	11/28/11	2	2
243	11/29/11	0	0
244	11/30/11	1	1

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2012 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
April 2012			
1	04/01/12	0	0
2	04/02/12	0	0
3	04/03/12	2	4
4	04/04/12	5	5
5	04/05/12	3	3
6	04/06/12	3	3
7	04/07/12	0	0
8	04/08/12	2	2
9	04/09/12	11	14
10	04/10/12	1	1
11	04/11/12	1	1
12	04/12/12	2	2
13	04/13/12	2	2
14	04/14/12	1	1
15	04/15/12	6	8
16	04/16/12	7	7
17	04/17/12	4	4
18	04/18/12	2	2
19	04/19/12	3	3
20	04/20/12	3	3
21	04/21/12	1	1
22	04/22/12	0	0
23	04/23/12	0	0
24	04/24/12	1	1
25	04/25/12	1	1
26	04/26/12	1	1
27	04/27/12	4	5
28	04/28/12	3	3
29	04/29/12	1	1
30	04/30/12	1	1
May 2012			
31	05/01/12	1	1
32	05/02/12	2	2
33	05/03/12	1	1
34	05/04/12	5	5
35	05/05/12	0	0
36	05/06/12	4	4
37	05/07/12	2	2
38	05/08/12	3	3
39	05/09/12	2	2
40	05/10/12	2	2

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2012 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
41	05/11/12	2	2
42	05/12/12	1	1
43	05/13/12	2	2
44	05/14/12	1	1
45	05/15/12	3	3
46	05/16/12	2	2
47	05/17/12	2	2
48	05/18/12	6	6
49	05/19/12	1	1
50	05/20/12	1	1
51	05/21/12	1	1
52	05/22/12	1	1
53	05/23/12	1	1
54	05/24/12	2	2
55	05/25/12	1	1
56	05/26/12	2	2
57	05/27/12	1	2
58	05/28/12	1	1
59	05/29/12	6	6
60	05/30/12	6	7
61	05/31/12	6	6
June 2012			
62	06/01/12	2	2
63	06/02/12	7	7
64	06/03/12	4	6
65	06/04/12	7	7
66	06/05/12	3	6
67	06/06/12	4	4
68	06/07/12	4	4
69	06/08/12	3	3
70	06/09/12	3	3
71	06/10/12	7	9
72	06/11/12	10	11
73	06/12/12	9	9
74	06/13/12	5	5
75	06/14/12	3	3
76	06/15/12	2	2
77	06/16/12	0	0
78	06/17/12	3	3
79	06/18/12	4	4
80	06/19/12	3	3
81	06/20/12	2	2

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2012 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
82	06/21/12	3	3
83	06/22/12	2	2
84	06/23/12	3	3
85	06/24/12	4	4
86	06/25/12	0	0
87	06/26/12	4	4
88	06/27/12	4	4
89	06/28/12	0	0
90	06/29/12	2	2
91	06/30/12	3	3
July 2012			
92	07/01/12	1	1
93	07/02/12	5	5
94	07/03/12	1	1
95	07/04/12	4	4
96	07/05/12	2	2
97	07/06/12	0	0
98	07/07/12	0	0
99	07/08/12	4	4
100	07/09/12	2	2
101	07/10/12	3	3
102	07/11/12	3	5
103	07/12/12	2	4
104	07/13/12	0	0
105	07/14/12	2	2
106	07/15/12	3	3
107	07/16/12	1	1
108	07/17/12	3	3
109	07/18/12	0	0
110	07/19/12	0	0
111	07/20/12	0	0
112	07/21/12	0	0
113	07/22/12	2	2
114	07/23/12	0	0
115	07/24/12	1	1
116	07/25/12	1	1
117	07/26/12	3	4
118	07/27/12	1	1
119	07/28/12	0	0
120	07/29/12	2	2
121	07/30/12	0	0
122	07/31/12	1	1

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2012 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
August 2012			
123	08/01/12	2	2
124	08/02/12	0	0
125	08/03/12	0	0
126	08/04/12	1	1
127	08/05/12	4	4
128	08/06/12	3	3
129	08/07/12	8	8
130	08/08/12	6	6
131	08/09/12	6	6
132	08/10/12	2	2
133	08/11/12	0	0
134	08/12/12	1	1
135	08/13/12	5	6
136	08/14/12	8	8
137	08/15/12	7	7
138	08/16/12	2	2
139	08/17/12	0	0
140	08/18/12	0	0
141	08/19/12	4	5
142	08/20/12	2	2
143	08/21/12	1	1
144	08/22/12	2	2
145	08/23/12	4	4
146	08/24/12	3	3
147	08/25/12	3	3
148	08/26/12	11	12
149	08/27/12	3	3
150	08/28/12	0	0
151	08/29/12	1	1
152	08/30/12	3	3
153	08/31/12	4	4
September 2012			
154	09/01/12	1	1
155	09/02/12	2	2
156	09/03/12	5	5
157	09/04/12	8	9
158	09/05/12	6	6
159	09/06/12	11	13
160	09/07/12	3	3
161	09/08/12	3	3
162	09/09/12	4	4

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2012 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
163	09/10/12	5	5
164	09/11/12	4	4
165	09/12/12	3	3
166	09/13/12	7	8
167	09/14/12	2	2
168	09/15/12	2	2
169	09/16/12	3	4
170	09/17/12	6	6
171	09/18/12	6	6
172	09/19/12	1	1
173	09/20/12	3	3
174	09/21/12	1	1
175	09/22/12	1	1
176	09/23/12	0	0
177	09/24/12	0	0
178	09/25/12	0	0
179	09/26/12	0	0
180	09/27/12	0	0
181	09/28/12	0	0
182	09/29/12	0	0
183	09/30/12	0	0
October 2012			
184	10/01/12	2	3
185	10/02/12	3	3
186	10/03/12	0	0
187	10/04/12	2	2
188	10/05/12	6	6
189	10/06/12	1	1
190	10/07/12	8	8
191	10/08/12	2	2
192	10/09/12	2	2
193	10/10/12	2	2
194	10/11/12	2	2
195	10/12/12	4	4
196	10/13/12	2	2
197	10/14/12	2	2
198	10/15/12	4	4
199	10/16/12	2	2
200	10/17/12	2	2
201	10/18/12	2	2
202	10/19/12	3	3
203	10/20/12	0	0

B-4863 Harkers Island Bridge

2012 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
204	10/21/12	4	4
205	10/22/12	7	7
206	10/23/12	1	1
207	10/24/12	5	5
208	10/25/12	3	3
209	10/26/12	2	2
210	10/27/12	0	0
211	10/28/12	0	0
212	10/29/12	0	0
213	10/30/12	3	3
214	10/31/12	2	2
November 2012			
215	11/01/12	0	0
216	11/02/12	2	2
217	11/03/12	3	3
218	11/04/12	1	1
219	11/05/12	2	2
220	11/06/12	0	0
221	11/07/12	0	0
222	11/08/12	0	0
223	11/09/12	1	1
224	11/10/12	2	2
225	11/11/12	3	3
226	11/12/12	5	5
227	11/13/12	3	3
228	11/14/12	0	0
229	11/15/12	1	1
230	11/16/12	5	5
231	11/17/12	2	2
232	11/18/12	3	4
233	11/19/12	1	1
234	11/20/12	2	2
235	11/21/12	4	4
236	11/22/12	0	0
237	11/23/12	6	6
238	11/24/12	4	4
239	11/25/12	3	3
240	11/26/12	0	0
241	11/27/12	3	3
242	11/28/12	0	0
243	11/29/12	2	2
244	11/30/12	2	2

B-4863 Harkers Island Bridge

2013 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
April 2013			
1	04/01/13	0	0
2	04/02/13	0	0
3	04/03/13	0	0
4	04/04/13	0	0
5	04/05/13	1	1
6	04/06/13	0	0
7	04/07/13	0	0
8	04/08/13	1	1
9	04/09/13	3	3
10	04/10/13	0	0
11	04/11/13	1	1
12	04/12/13	1	1
13	04/13/13	1	1
14	04/14/13	0	0
15	04/15/13	1	1
16	04/16/13	0	0
17	04/17/13	1	1
18	04/18/13	1	1
19	04/19/13	2	2
20	04/20/13	3	3
21	04/21/13	1	1
22	04/22/13	1	1
23	04/23/13	3	3
24	04/24/13	2	2
25	04/25/13	0	0
26	04/26/13	0	0
27	04/27/13	1	1
28	04/28/13	1	1
29	04/29/13	2	2
30	04/30/13	5	5
May 2013			
31	05/01/13	2	2
32	05/02/13	3	3
33	05/03/13	1	1
34	05/04/13	0	0
35	05/05/13	1	1
36	05/06/13	3	3
37	05/07/13	4	4
38	05/08/13	0	0
39	05/09/13	1	1
40	05/10/13	1	1

B-4863 Harkers Island Bridge

2013 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
41	05/11/13	0	0
42	05/12/13	2	2
43	05/13/13	1	1
44	05/14/13	1	1
45	05/15/13	3	4
46	05/16/13	1	2
47	05/17/13	1	1
48	05/18/13	3	3
49	05/19/13	1	1
50	05/20/13	2	2
51	05/21/13	4	4
52	05/22/13	1	1
53	05/23/13	1	1
54	05/24/13	4	4
55	05/25/13	2	2
56	05/26/13	5	6
57	05/27/13	1	1
58	05/28/13	3	3
59	05/29/13	2	2
60	05/30/13	0	0
61	05/31/13	2	2
June 2013			
62	06/01/13	5	5
63	06/02/13	5	6
64	06/03/13	5	5
65	06/04/13	4	4
66	06/05/13	2	2
67	06/06/13	1	1
68	06/07/13	0	0
69	06/08/13	2	2
70	06/09/13	2	2
71	06/10/13	1	1
72	06/11/13	0	0
73	06/12/13	1	1
74	06/13/13	0	0
75	06/14/13	1	1
76	06/15/13	3	3
77	06/16/13	4	4
78	06/17/13	6	6
79	06/18/13	4	4
80	06/19/13	2	2
81	06/20/13	1	1

B-4863 Harkers Island Bridge

2013 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
82	06/21/13	5	5
83	06/22/13	4	4
84	06/23/13	6	6
85	06/24/13	5	5
86	06/25/13	3	3
87	06/26/13	1	1
88	06/27/13	1	1
89	06/28/13	2	2
90	06/29/13	0	0
91	06/30/13	0	0
July 2013			
92	07/01/13	4	4
93	07/02/13	1	1
94	07/03/13	2	2
95	07/04/13	1	1
96	07/05/13	0	0
97	07/06/13	0	0
98	07/07/13	5	5
99	07/08/13	1	1
100	07/09/13	1	1
101	07/10/13	0	0
102	07/11/13	1	1
103	07/12/13	0	0
104	07/13/13	3	3
105	07/14/13	3	3
106	07/15/13	2	2
107	07/16/13	1	1
108	07/17/13	6	6
109	07/18/13	4	4
110	07/19/13	3	3
111	07/20/13	2	2
112	07/21/13	3	3
113	07/22/13	2	2
114	07/23/13	4	4
115	07/24/13	2	2
116	07/25/13	4	4
117	07/26/13	4	4
118	07/27/13	3	3
119	07/28/13	5	7
120	07/29/13	8	8
121	07/30/13	2	2
122	07/31/13	2	2

B-4863 Harkers Island Bridge

2013 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
August 2013			
123	08/01/13	2	2
124	08/02/13	0	0
125	08/03/13	3	3
126	08/04/13	5	5
127	08/05/13	6	6
128	08/06/13	4	4
129	08/07/13	2	2
130	08/08/13	1	1
131	08/09/13	1	1
132	08/10/13	0	0
133	08/11/13	2	2
134	08/12/13	0	0
135	08/13/13	2	2
136	08/14/13	1	1
137	08/15/13	0	0
138	08/16/13	1	1
139	08/17/13	1	1
140	08/18/13	3	3
141	08/19/13	3	3
142	08/20/13	3	3
143	08/21/13	3	3
144	08/22/13	4	4
145	08/23/13	2	2
146	08/24/13	4	4
147	08/25/13	4	5
148	08/26/13	5	5
149	08/27/13	5	5
150	08/28/13	4	5
151	08/29/13	6	6
152	08/30/13	4	4
153	08/31/13	6	6
September 2013			
154	09/01/13	4	4
155	09/02/13	5	5
156	09/03/13	5	5
157	09/04/13	5	6
158	09/05/13	5	6
159	09/06/13	5	5
160	09/07/13	1	1
161	09/08/13	7	7
162	09/09/13	10	10

B-4863 Harkers Island Bridge

2013 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

Day No.	Date	No. of Openings	No. of Vessels
163	09/10/13	10	10
164	09/11/13	8	8
165	09/12/13	6	7
166	09/13/13	12	14
167	09/14/13	3	3
168	09/15/13	8	9
169	09/16/13	12	13
170	09/17/13	6	6
171	09/18/13	2	2
172	09/19/13	2	2
173	09/20/13	3	3
174	09/21/13	3	3
175	09/22/13	6	6
176	09/23/13	7	8
177	09/24/13	8	8
178	09/25/13	9	9
179	09/26/13	4	4
180	09/27/13	2	2
181	09/28/13	1	1
182	09/29/13	2	3
183	09/30/13	4	4
October 2013			
184	10/01/13	6	6
185	10/02/13	5	7
186	10/03/13	4	4
187	10/04/13	4	4
188	10/05/13	4	4
189	10/06/13	11	14
190	10/07/13	0	0
191	10/08/13	1	1
192	10/09/13	1	1
193	10/10/13	7	7
194	10/11/13	3	3
195	10/12/13	2	2
196	10/13/13	2	2
197	10/14/13	3	3
198	10/15/13	2	2
199	10/16/13	1	1
200	10/17/13	0	0
201	10/18/13	2	2
202	10/19/13	2	2
203	10/20/13	2	2

B-4863 Harkers Island Bridge

2013 NCDOT Bridge Tender Logs
Bridge No. 73, Carteret County, NC

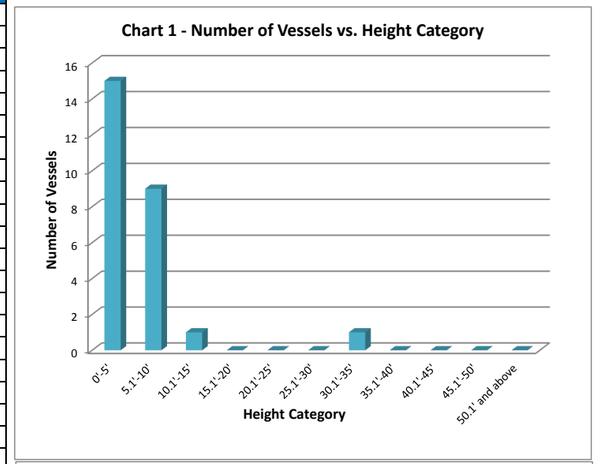
Day No.	Date	No. of Openings	No. of Vessels
204	10/21/13	0	0
205	10/22/13	0	0
206	10/23/13	0	0
207	10/24/13	2	2
208	10/25/13	0	0
209	10/26/13	4	4
210	10/27/13	3	3
211	10/28/13	2	2
212	10/29/13	1	1
213	10/30/13	3	3
214	10/31/13	0	0
November 2013			
215	11/01/13	1	1
216	11/02/13	1	1
217	11/03/13	4	4
218	11/04/13	0	0
219	11/05/13	3	4
220	11/06/13	2	2
221	11/07/13	1	1
222	11/08/13	1	1
223	11/09/13	5	7
224	11/10/13	1	1
225	11/11/13	8	11
226	11/12/13	1	1
227	11/13/13	0	0
228	11/14/13	0	0
229	11/15/13	2	6
230	11/16/13	0	0
231	11/17/13	1	1
232	11/18/13	0	0
233	11/19/13	2	2
234	11/20/13	2	2
235	11/21/13	3	3
236	11/22/13	2	3
237	11/23/13	5	5
238	11/24/13	0	0
239	11/25/13	4	4
240	11/26/13	0	0
241	11/27/13	0	0
242	11/28/13	0	0
243	11/29/13	5	7
244	11/30/13	2	2

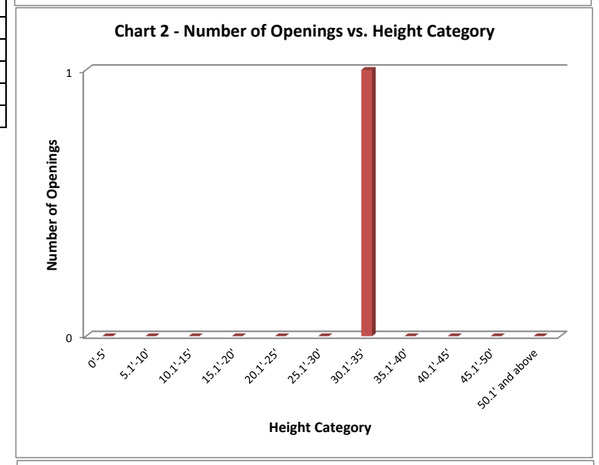
Appendix B – Daily Vessel Height Survey Data

Table B-1 through Table B-5:
Survey 1 (May) Daily Vessel Survey Data

Table B-1 - Survey 1: Day 1 Vessel Survey Data (May 21, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	8:34 AM	1	Rec. Boat	EB												3.00	
	9:14 AM	2	Rec. Boat	EB												6.00	
	9:43 AM	3	Rec. Boat	WB												8.00	
	10:00 AM	4	Rec. Boat	EB												6.00	
	12:40 PM	5	Rec. Boat	WB												6.00	
	12:51 PM	6	Rec. Fishing Boat	EB												6.00	
	1:01 PM	7	Rec. Boat	EB												6.00	
	1:40 PM	8	Rec. Fishing Boat	WB												6.00	
	1:48 PM	9	Rec. Fishing Boat	WB												6.00	
	2:07 PM	10	Rec. Boat	EB												3.00	
	2:38 PM	11	Rec. Fishing Boat	EB												3.00	
	2:48 PM	12	Rec. Boat	EB												3.00	
	2:49 PM	13	Rec. Fishing Boat	WB												3.00	
	2:55 PM	14	Rec. Boat	EB												3.00	
	3:37 PM	15	Rec. Boat	WB												3.00	
	3:48 PM	16	Rec. Boat	EB												3.00	
	4:27 PM	17	Rec. Boat	WB												3.00	
	4:27 PM	18	Rec. Boat	EB												3.00	
	5:21 PM	19	Rec. Boat	WB												4.00	
	5:21 PM	20	Rec. Boat	EB												6.00	
	5:28 PM	21	Rec. Boat	WB												4.00	
1	6:21 PM	22	Comm. Fishing Boat	EB	347	20	29	88	29	33	476.47	88.49	12.54	30.79	-0.88	31.67	Comm. Fishing Vessel 1
	6:25 PM	23	Rec. Boat	EB												4.00	
	6:43 PM	24	Rec. Boat	EB												12.00	
	6:52 PM	25	Rec. Boat	WB												4.00	
	7:00 PM	26	Rec. Boat	WB												4.00	





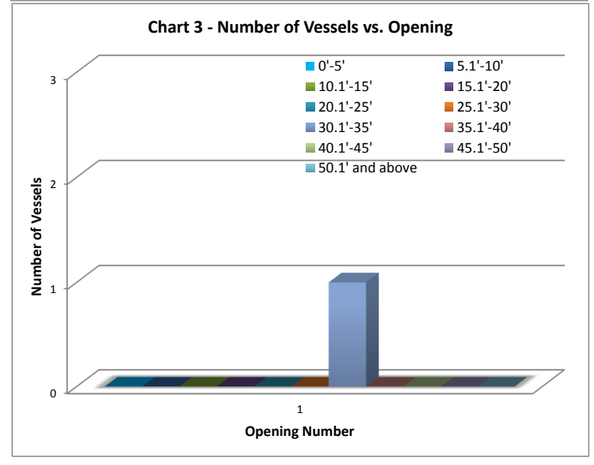
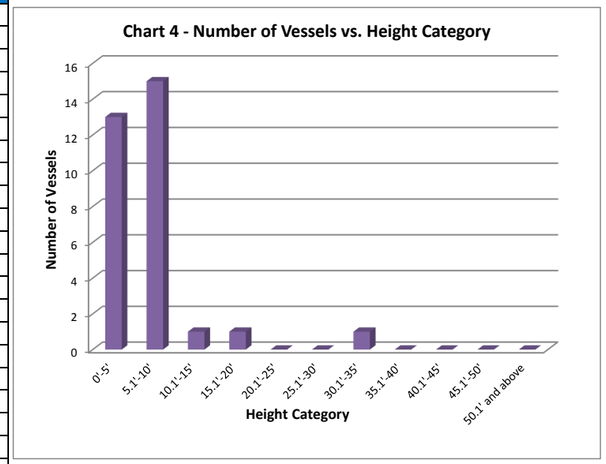
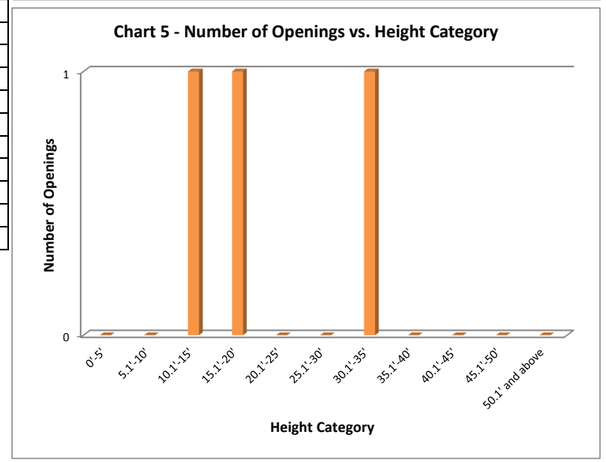


Table B-2 - Survey 1: Day 2 Vessel Survey Data (May 22, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	9:01 AM	27	Rec. Boat	WB												4.00	
	9:23 AM	28	Rec. Boat	EB												4.00	
	9:28 AM	29	Rec. Boat	WB												4.00	
	9:51 AM	30	Rec. Boat	EB												4.00	
	9:56 AM	31	Rec. Boat	EB												6.00	
	9:57 AM	32	Rec. Boat	WB												6.00	
	9:59 AM	33	Rec. Boat	EB												3.00	
	10:59 AM	34	Rec. Fishing Boat	EB												3.00	
	10:59 AM	35	Rec. Fishing Boat	EB												3.00	
	11:07 AM	36	Rec. Fishing Boat	EB												6.00	
	12:26 PM	37	Rec. Fishing Boat	WB												3.00	
	12:29 PM	38	Rec. Fishing Boat	WB												3.00	
	12:53 PM	39	Rec. Fishing Boat	EB												8.00	
	12:54 PM	40	Rec. Boat	WB												6.00	
	1:08 PM	41	Rec. Boat	WB												6.00	
	1:14 PM	42	Rec. Boat	EB												8.00	
	1:45 PM	43	Rec. Fishing Boat	WB												8.00	
	2:17 PM	44	Rec. Boat	EB												10.00	
1	2:22 PM	45	Houseboat	WB	346	47	22	90	28	5	542.58	90.47	-4.43	13.66	-0.08	13.74	Rec. Vessel 1
2	2:24 PM	46	Comm. Fishing Boat	WB	346	28	33	90	15	41	542.32	90.26	-2.47	15.62	-0.08	15.70	Comm. Fishing Vessel 2
	3:05 PM	47	Rec. Boat	WB												10.00	
	3:31 PM	48	Rec. Boat	EB												6.00	
	3:32 PM	49	Rec. Boat	EB												6.00	
	4:35 PM	50	Rec. Boat	EB												4.00	
	4:50 PM	51	Rec. Boat	EB												4.00	
	5:05 PM	52	Rec. Boat	EB												6.00	
	5:10 PM	53	Rec. Boat	EB												5.00	
	5:57 PM	54	Rec. Boat	WB												8.00	
	6:07 PM	55	Rec. Boat	WB												8.00	
	6:21 PM	56	Rec. Boat	WB												4.00	
3	6:25 PM	57	Comm. Fishing Boat	EB	347	24	14	88	25	27	476.53	88.42	13.11	31.20	0.12	31.08	Comm. Fishing Vessel 3





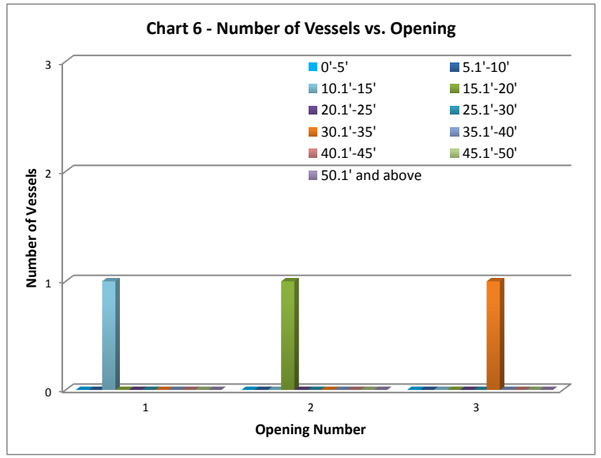
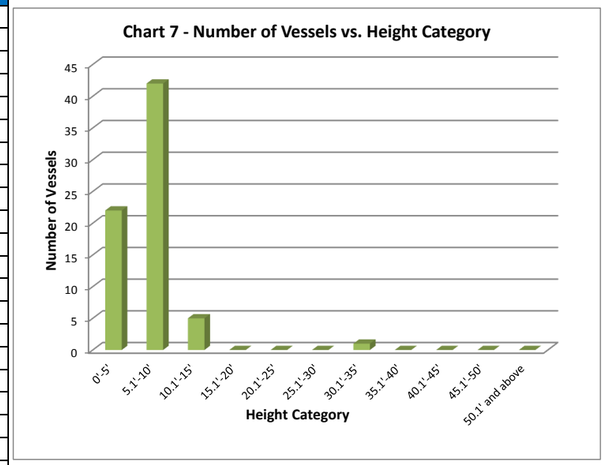
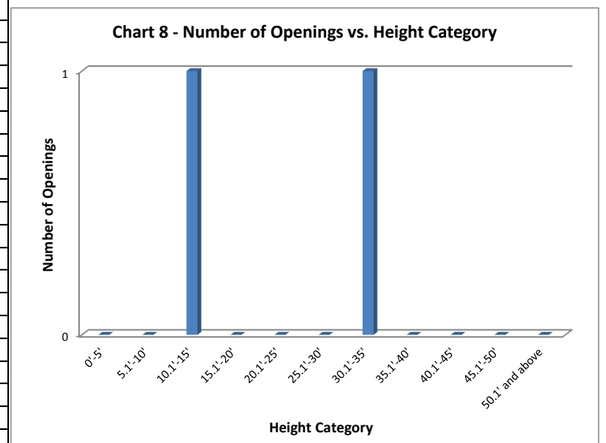


Table B-3 - Survey 1: Day 3 Vessel Survey Data (May 23, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
1	7:16 AM	58	Comm. Fishing Boat	EB	348	41	35	88	9	18	477.73	88.16	15.39	33.29	0.02	33.27	Comm. Fishing Vessel 4
	8:23 AM	59	Rec. Boat	WB												10.00	
	8:29 AM	60	Rec. Boat	WB												8.00	
	9:37 AM	61	Rec. Boat	EB												8.00	
	9:50 AM	62	Rec. Boat	EB												6.00	
	9:53 AM	63	Rec. Boat	EB												10.00	
	10:33 AM	64	Rec. Boat	WB												6.00	
	10:36 AM	65	Rec. Boat	EB												6.00	
	10:36 AM	66	Rec. Boat	WB												6.00	
	10:41 AM	67	Rec. Boat	WB												4.00	
	10:45 AM	68	Rec. Boat	WB												8.00	
	10:46 AM	69	Rec. Boat	WB												6.00	
	10:54 AM	70	Rec. Boat	EB												10.00	
	11:10 AM	71	Rec. Boat	EB												4.00	
	11:16 AM	72	Rec. Boat	WB												4.00	
	11:18 AM	73	Rec. Boat	EB												4.00	
	11:49 AM	74	Rec. Boat	EB												6.00	
	12:22 PM	75	Rec. Boat	EB												3.00	
	12:47 PM	76	Rec. Boat	WB												8.00	
	12:55 PM	77	Rec. Boat	EB												3.00	
	12:56 PM	78	Rec. Boat	WB												3.00	
	1:25 PM	79	Rec. Boat	EB												6.00	
	1:32 PM	80	Rec. Boat	WB												10.00	
	1:32 PM	81	Rec. Boat	WB												10.00	
	1:41 PM	82	Rec. Boat	EB												6.00	
	1:42 PM	83	Rec. Boat	WB												6.00	
	1:50 PM	84	Rec. Boat	WB												12.00	
	2:13 PM	85	Rec. Boat	WB												6.00	
	2:23 PM	86	Rec. Boat	EB												6.00	
	2:33 PM	87	Rec. Boat	WB												4.00	
	2:37 PM	88	Rec. Boat	WB												8.00	
	2:40 PM	89	Rec. Boat	EB												4.00	
	2:44 PM	90	Rec. Boat	EB												10.00	
	2:46 PM	91	Rec. Boat	WB												8.00	
2	2:51 PM	92	Houseboat	EB	346	40	19	90	25	38	475.95	90.43	-3.55	14.35	0.12	14.23	Rec. Vessel 2
	2:51 PM	93	Rec. Boat	EB												4.00	
	2:59 PM	94	Rec. Boat	EB												6.00	
	3:08 PM	95	Rec. Boat	WB												3.00	
	3:10 PM	96	Rec. Boat	EB												10.00	
	3:13 PM	97	Rec. Boat	WB												10.00	
	3:18 PM	98	Rec. Boat	EB												10.00	
	3:21 PM	99	Rec. Boat	EB												6.00	
	3:26 PM	100	Rec. Boat	EB												8.00	
	3:29 PM	101	Rec. Boat	EB												10.00	
	3:29 PM	102	Rec. Boat	EB												10.00	
	3:35 PM	103	Rec. Boat	WB												4.00	
	3:38 PM	104	Rec. Boat	EB												8.00	
	4:17 PM	105	Rec. Boat	WB												8.00	
	4:18 PM	106	Rec. Boat	EB												4.00	
	4:18 PM	107	Rec. Boat	EB												4.00	
	4:27 PM	108	Rec. Boat	EB												6.00	
	4:28 PM	109	Rec. Boat	EB												4.00	
	4:31 PM	110	Rec. Boat	WB												4.00	
	4:43 PM	111	Rec. Boat	EB												6.00	
	4:51 PM	112	Rec. Boat	WB												12.00	
	4:51 PM	113	Rec. Boat	WB												8.00	
	4:55 PM	114	Rec. Boat	EB												6.00	
	4:56 PM	115	Rec. Boat	EB												6.00	
	5:12 PM	116	Rec. Boat	WB												10.00	
	5:16 PM	117	Rec. Boat	EB												10.00	
	5:41 PM	118	Rec. Boat	EB												8.00	





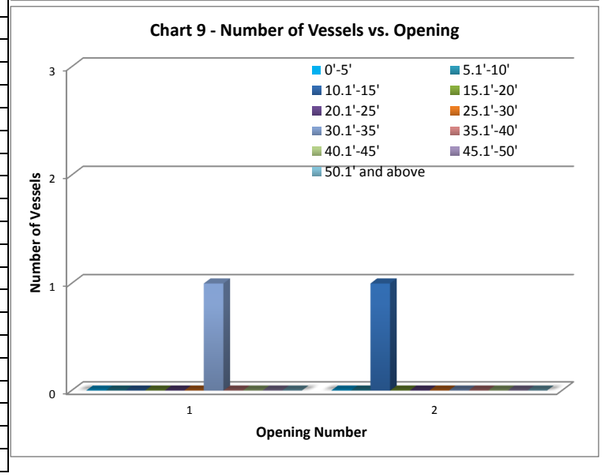
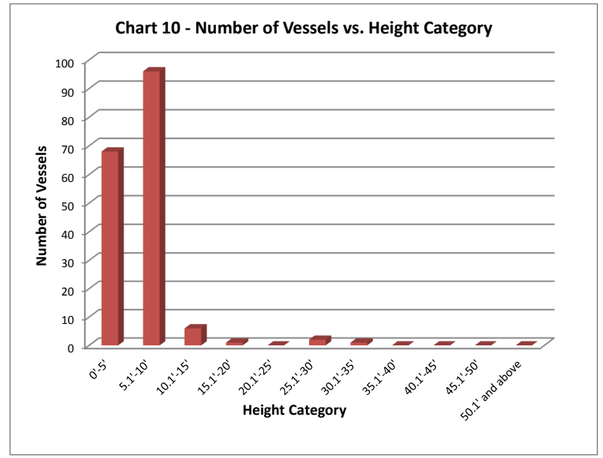


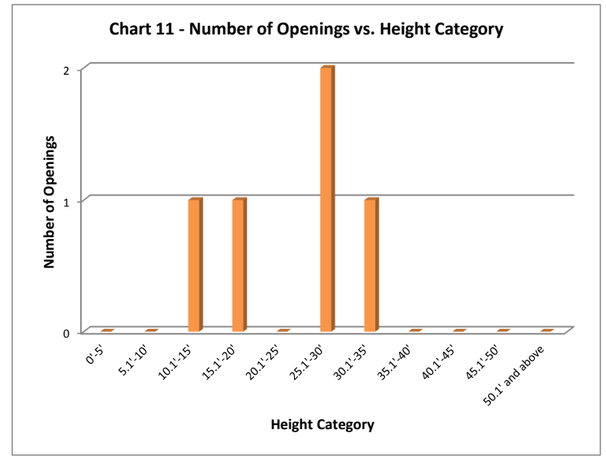
Table B-3 - Survey 1: Day 3 Vessel Survey Data (May 23, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	5:44 PM	119	Rec. Boat	EB												8.00	
	5:55 PM	120	Rec. Boat	WB												12.00	
	6:07 PM	121	Rec. Boat	EB												4.00	
	6:11 PM	122	Rec. Boat	EB												4.00	
	6:13 PM	123	Rec. Boat	WB												4.00	
	6:37 PM	124	Rec. Boat	EB												4.00	
	6:50 PM	125	Rec. Boat	EB												4.00	
	6:52 PM	126	Rec. Boat	WB												12.00	
	6:58 PM	127	Rec. Boat	EB												4.00	

Table B-4 - Survey 1: Day 4 Vessel Survey Data (May 24, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:31 AM	128	Rec. Boat	EB												4.00	
	7:55 AM	129	Rec. Boat	WB												8.00	
	7:56 AM	130	Rec. Boat	EB												4.00	
	8:29 AM	131	Rec. Boat	WB												6.00	
	9:12 AM	132	Rec. Boat	WB												4.00	
	9:22 AM	133	Rec. Boat	EB												6.00	
	9:28 AM	134	Rec. Boat	EB												6.00	
	9:33 AM	135	Rec. Boat	EB												4.00	
	9:37 AM	136	Rec. Boat	WB												5.00	
	9:57 AM	137	Rec. Boat	WB												4.00	
	10:09 AM	138	Rec. Boat	WB												8.00	
	10:22 AM	139	Rec. Boat	WB												6.00	
	10:31 AM	140	Rec. Boat	EB												4.00	
	10:38 AM	141	Rec. Boat	EB												10.00	
	10:41 AM	142	Rec. Boat	WB												4.00	
	10:46 AM	143	Rec. Boat	EB												6.00	
	10:52 AM	144	Rec. Boat	WB												4.00	
	10:54 AM	145	Rec. Boat	WB												6.00	
	10:54 AM	146	Rec. Boat	WB												8.00	
	10:54 AM	147	Rec. Boat	WB												8.00	
1	10:57 AM	148	Sailboat	EB	345	56	22	88	17	50	475.46	88.30	14.13	32.27	-0.68	32.95	Rec. Sailboat 1
	11:02 AM	149	Rec. Boat	EB												6.00	
	11:02 AM	150	Rec. Boat	WB												8.00	
	11:06 AM	151	Rec. Boat	WB												4.00	
	11:07 AM	152	Rec. Boat	EB												10.00	
	11:08 AM	153	Rec. Boat	WB												6.00	
	11:23 AM	154	Rec. Boat	EB												8.00	
	11:23 AM	155	Rec. Boat	WB												8.00	
	11:25 AM	156	Rec. Boat	WB												10.00	
	11:28 AM	157	Rec. Boat	WB												6.00	
	11:31 AM	158	Rec. Boat	WB												4.00	
	11:32 AM	159	Rec. Boat	WB												4.00	
	11:35 AM	160	Rec. Boat	EB												6.00	
	11:35 AM	161	Rec. Boat	WB												8.00	
	11:39 AM	162	Rec. Boat	WB												4.00	
	11:43 AM	163	Rec. Boat	WB												10.00	
	11:44 AM	164	Rec. Boat	WB												10.00	
	11:47 AM	165	Rec. Boat	WB												4.00	
	11:47 AM	166	Rec. Boat	EB												4.00	
	11:49 AM	167	Rec. Boat	WB												10.00	
	11:55 AM	168	Rec. Boat	WB												8.00	
	11:55 AM	169	Rec. Boat	EB												4.00	
	11:56 AM	170	Jet Ski	WB												2.00	
	12:01 PM	171	Rec. Boat	WB												10.00	
	12:02 PM	172	Rec. Boat	EB												4.00	
	12:03 PM	173	Rec. Boat	WB												4.00	
	12:05 PM	174	Rec. Boat	WB												4.00	
	12:12 PM	175	Rec. Boat	WB												4.00	
	12:13 PM	176	Rec. Boat	EB												10.00	
	12:14 PM	177	Rec. Boat	EB												10.00	
	12:18 PM	178	Rec. Boat	EB												4.00	
	12:23 PM	179	Rec. Boat	WB												8.00	
	12:24 PM	180	Rec. Boat	EB												6.00	
	12:27 PM	181	Rec. Boat	EB												8.00	
	12:28 PM	182	Rec. Boat	EB												6.00	
	12:31 PM	183	Rec. Boat	WB												6.00	
	12:32 PM	184	Rec. Boat	WB												4.00	
	12:32 PM	185	Rec. Boat	WB												4.00	
	12:36 PM	186	Rec. Boat	WB												5.00	
	12:36 PM	187	Rec. Boat	EB												5.00	
	12:37 PM	188	Rec. Boat	WB												10.00	





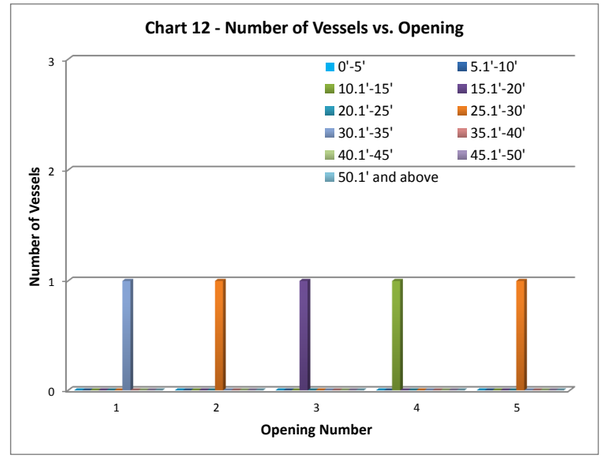


Table B-4 - Survey 1: Day 4 Vessel Survey Data (May 24, 2014)

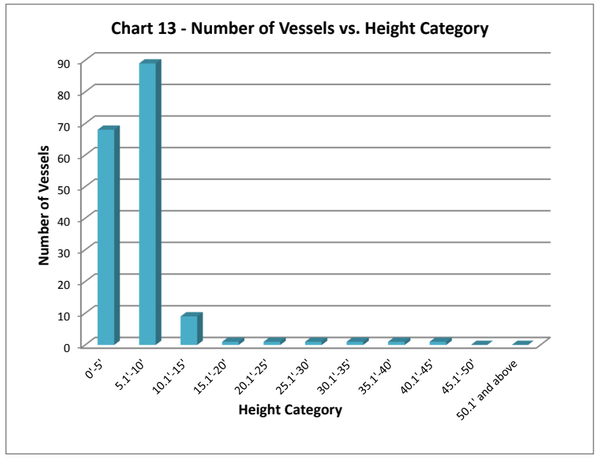
# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	12:40 PM	189	Rec. Boat	EB												4.00	
	12:41 PM	190	Rec. Boat	EB												8.00	
	12:46 PM	191	Rec. Boat	EB												12.00	
	12:56 PM	192	Rec. Boat	WB												8.00	
	12:56 PM	193	Rec. Boat	WB												10.00	
	1:02 PM	194	Rec. Boat	EB												10.00	
	1:06 PM	195	Rec. Boat	WB												6.00	
	1:15 PM	196	Rec. Boat	EB												10.00	
	1:17 PM	197	Rec. Boat	WB												8.00	
	1:22 PM	198	Rec. Boat	WB												4.00	
	1:25 PM	199	Rec. Boat	EB												10.00	
	1:25 PM	200	Rec. Boat	EB												6.00	
	1:25 PM	201	Rec. Boat	EB												6.00	
	1:28 PM	202	Rec. Boat	EB												10.00	
	1:29 PM	203	Rec. Boat	EB												12.00	
	1:29 PM	204	Rec. Boat	EB												6.00	
	1:31 PM	205	Rec. Boat	EB												8.00	
	1:35 PM	206	Rec. Boat	EB												4.00	
	1:39 PM	207	Rec. Boat	EB												6.00	
	1:53 PM	208	Rec. Boat	EB												10.00	
	1:53 PM	209	Rec. Boat	EB												8.00	
	1:54 PM	210	Rec. Boat	EB												6.00	
	1:54 PM	211	Jet Ski	EB												2.00	
	1:58 PM	212	Rec. Boat	WB												4.00	
	2:00 PM	213	Rec. Boat	WB												8.00	
	2:02 PM	214	Rec. Boat	WB												6.00	
	2"02 PM	215	Rec. Boat	EB												6.00	
	2:07 PM	216	Rec. Boat	WB												4.00	
	2:12 PM	217	Rec. Boat	WB												10.00	
	2:12 PM	218	Rec. Boat	WB												6.00	
	2:14 PM	219	Rec. Boat	EB												4.00	
	2:18 PM	220	Rec. Boat	WB												6.00	
	2:22 PM	221	Rec. Boat	EB												4.00	
	2:28 PM	222	Rec. Boat	WB												4.00	
	2:31 PM	223	Rec. Boat	EB												4.00	
	2:34 PM	224	Rec. Boat	WB												10.00	
	2:38 PM	225	Rec. Boat	WB												8.00	
	2:38 PM	226	Rec. Boat	EB												6.00	
	2:39 PM	227	Rec. Boat	EB												5.00	
	2:41 PM	228	Rec. Boat	WB												6.00	
	2:44 PM	229	Rec. Boat	WB												8.00	
	2:45 PM	230	Rec. Boat	WB												10.00	
	2:51 PM	231	Rec. Boat	WB												4.00	
	2:53 PM	232	Rec. Boat	WB												4.00	
	2:58 PM	233	Rec. Boat	EB												10.00	
	2:59 PM	234	Rec. Boat	WB												6.00	
	3:02 PM	235	Rec. Boat	WB												10.00	
	3:02 PM	236	Rec. Boat	EB												8.00	
	3:03 PM	237	Rec. Boat	EB												4.00	
2	3:07 PM	238	Comm. Fishing Boat	WB	348	33	57	89	14	50	544.42	89.25	7.15	25.29	-0.03	25.32	Comm. Fishing Vessel 5
	3:14 PM	239	Rec. Boat	WB												6.00	
	3:14 PM	240	Rec. Boat	WB												4.00	
	3:15 PM	241	Rec. Boat	EB												10.00	
	3:15 PM	242	Rec. Boat	EB												10.00	
	3:15 PM	243	Rec. Boat	WB												4.00	
	3:16 PM	244	Rec. Boat	EB												12.00	
	3:18 PM	245	Rec. Boat	WB												8.00	
	3:22 PM	246	Rec. Boat	WB												8.00	
	3:24 PM	247	Rec. Boat	WB												6.00	
	3:24 PM	248	Rec. Boat	EB												4.00	
	3:25 PM	249	Rec. Boat	WB												4.00	

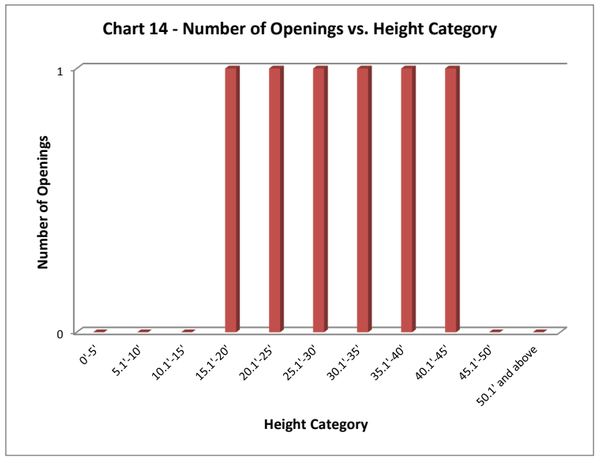
Table B-4 - Survey 1: Day 4 Vessel Survey Data (May 24, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	3:32 PM	250	Rec. Boat	WB												5.00	
	3:34 PM	251	Rec. Boat	EB												8.00	
	3:37 PM	252	Rec. Boat	EB												6.00	
	3:39 PM	253	Rec. Boat	EB												5.00	
	3:39 PM	254	Rec. Boat	EB												4.00	
	3:39 PM	255	Rec. Boat	EB												12.00	
	3:39 PM	256	Rec. Boat	EB												8.00	
	3:40 PM	257	Rec. Boat	EB												5.00	
	3:41 PM	258	Rec. Boat	EB												10.00	
	3:42 PM	259	Rec. Boat	EB												6.00	
	3:42 PM	260	Rec. Boat	EB												10.00	
	3:44 PM	261	Rec. Boat	EB												5.00	
	3:49 PM	262	Rec. Boat	WB												4.00	
3	3:59 PM	263	Rec. Boat	WB	346	26	26	90	13	2	542.29	90.22	-2.06	16.08	0.32	15.76	Pearl
	4:06 PM	264	Rec. Boat	EB												8.00	
	4:08 PM	265	Rec. Boat	WB												8.00	
	4:09 PM	266	Rec. Boat	WB												4.00	
	4:21 PM	267	Rec. Boat	EB												4.00	
	4:25 PM	268	Rec. Boat	EB												12.00	
	4:29 PM	269	Rec. Boat													4.00	
	4:31 PM	270	Rec. Boat													4.00	
	4:31 PM	271	Rec. Boat													4.00	
	4:31 PM	272	Rec. Boat													8.00	
	4:31 PM	273	Rec. Boat													8.00	
4	4:34 PM	274	Houseboat	WB	346	10	36	90	33	58	542.07	90.57	-5.36	12.78	0.67	12.11	Rec. Vessel 3
	4:33 PM	275	Rec. Boat	EB												8.00	
	4:44 PM	276	Rec. Boat	EB												8.00	
	4:45 PM	277	Rec. Boat	EB												8.00	
	4:45 PM	278	Rec. Boat	EB												7.00	
	4:50 PM	279	Rec. Boat	WB												6.00	
	4:55 PM	280	Rec. Boat	EB												4.00	
	5:00 PM	281	Rec. Boat	WB												4.00	
	5:03 PM	282	Rec. Boat	EB												5.00	
	5:12 PM	283	Rec. Boat	WB												4.00	
5	5:14 PM	284	Rec. Boat	EB	348	44	8	88	59	33	477.77	88.99	8.40	26.54	0.97	25.57	Rec. Vessel 4
	5:30 PM	285	Rec. Boat	EB												8.00	
	5:33 PM	286	Rec. Boat	EB												8.00	
	5:38 PM	287	Rec. Boat	WB												4.00	
	5:41 PM	288	Rec. Boat	WB												4.00	
	5:50 PM	289	Rec. Boat	EB												8.00	
	5:58 PM	290	Rec. Boat	EB												4.00	
	6:02 PM	291	Rec. Boat	WB												8.00	
	6:03 PM	292	Rec. Boat	WB												8.00	
	6:16 PM	293	Rec. Boat	EB												8.00	
	6:36 PM	294	Rec. Boat	EB												4.00	
	6:38 PM	295	Rec. Boat	EB												4.00	
	6:42 PM	296	Rec. Boat	EB												4.00	
	6:54 PM	297	Rec. Boat	EB												4.00	
	6:56 PM	298	Rec. Boat	EB												4.00	
	6:58 PM	299	Rec. Boat	EB												6.00	
	6:59 PM	300	Rec. Boat	EB												4.00	
	7:00 PM	301	Rec. Boat	EB												6.00	

Table B-5 - Survey 1: Day 5 Vessel Survey Data (May 25, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:04 AM	302	Rec. Boat	WB												4.00	
	7:38 AM	303	Rec. Boat	EB												8.00	
	7:47 AM	304	Rec. Boat	WB												3.00	
	7:52 AM	305	Rec. Boat	EB												8.00	
	7:56 AM	306	Rec. Boat	WB												8.00	
	7:59 AM	307	Rec. Boat	WB												8.00	
	8:34 AM	308	Rec. Boat	EB												4.00	
	8:44 AM	309	Rec. Boat	EB												8.00	
	8:46 AM	310	Rec. Boat	WB												8.00	
	8:51 AM	311	Rec. Boat	WB												8.00	
	9:06 AM	312	Rec. Boat	EB												6.00	
	9:19 AM	313	Rec. Boat	WB												7.00	
	9:21 AM	314	Rec. Boat	WB												4.00	
	9:42 AM	315	Rec. Boat	EB												4.00	
	9:48 AM	316	Rec. Boat	WB												4.00	
	9:56 AM	317	Rec. Boat	WB												8.00	
	9:56 AM	318	Rec. Boat	WB												8.00	
1	10:02 AM	319	Comm. Fishing Boat	EB	345	43	20	89	14	45	475.32	89.25	6.26	24.16	-0.23	24.39	Comm. Fishing Vessel 6
	10:14 AM	320	Rec. Boat	WB												4.00	
	10:27 AM	321	Rec. Boat	EB												4.00	
	10:27 AM	322	Rec. Boat	WB												4.00	
	10:33 AM	323	Rec. Boat	EB												4.00	
	10:35 AM	324	Rec. Boat	EB												4.00	
	10:42 AM	325	Rec. Boat	WB												4.00	
	10:42 AM	326	Rec. Boat	WB												8.00	
	10:43 AM	327	Rec. Boat	WB												5.00	
	10:45 AM	328	Rec. Boat	WB												4.00	
	10:45 AM	329	Rec. Boat	EB												4.00	
	10:48 AM	330	Rec. Boat	WB												5.00	
	10:49 AM	331	Rec. Boat	EB												8.00	
	10:57 AM	332	Rec. Boat	WB												8.00	
	10:57 AM	333	Rec. Boat	EB												8.00	
	11:05 AM	334	Rec. Boat	WB												4.00	
	11:05 AM	335	Rec. Boat	EB												4.00	
	11:06 AM	336	Rec. Boat	EB												4.00	
	11:23 AM	337	Rec. Boat	WB												4.00	
	11:23 AM	338	Rec. Boat	WB												6.00	
	11:28 AM	339	Rec. Boat	WB												4.00	
	11:32 AM	340	Rec. Boat	EB												4.00	
	11:58 AM	341	Rec. Boat	WB												8.00	
	12:19 PM	342	Rec. Boat	EB												8.00	
	12:21 PM	343	Rec. Boat	WB												5.00	
	12:23 PM	344	Rec. Boat	WB												4.00	
	12:25 PM	345	Rec. Boat	WB												8.00	
	12:30 PM	346	Rec. Boat	EB												4.00	
	12:42 PM	347	Rec. Boat	WB												4.00	
	12:44 PM	348	Rec. Boat	EB												8.00	
	12:45 PM	349	Rec. Boat	WB												10.00	
	12:47 PM	350	Rec. Boat	EB												12.00	
	12:48 PM	351	Rec. Boat	WB												12.00	
	12:52 PM	352	Rec. Boat	EB												8.00	
	12:54 PM	353	Rec. Boat	EB												10.00	
	12:57 PM	354	Rec. Boat	EB												5.00	
	12:57 PM	355	Rec. Boat	WB												6.00	
	12:58 PM	356	Rec. Boat	WB												8.00	
	12:59 PM	357	Rec. Boat	WB												5.00	
	1:02 PM	358	Rec. Boat	WB												5.00	
	1:03 PM	359	Rec. Boat	WB												8.00	
	1:06 PM	360	Rec. Boat	WB												8.00	
	1:06 PM	361	Rec. Boat	WB												5.00	
	1:13 PM	362	Rec. Boat	WB												12.00	





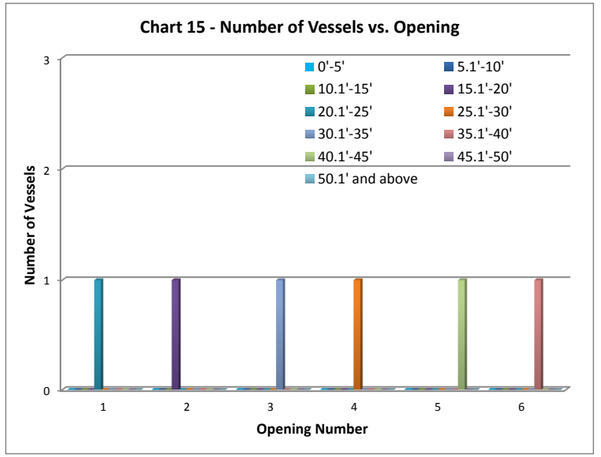


Table B-5 - Survey 1: Day 5 Vessel Survey Data (May 25, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	1:20 PM	363	Rec. Boat	WB												5.00	
	1:21 PM	364	Rec. Boat	WB												5.00	
	1:21 PM	365	Rec. Boat	WB												10.00	
	1:26 PM	366	Rec. Boat	WB												8.00	
	1:26 PM	367	Rec. Boat	WB												8.00	
	1:27 PM	368	Rec. Boat	WB												10.00	
	1:33 PM	369	Rec. Boat	EB												8.00	
	1:37 PM	370	Rec. Boat	EB												5.00	
	1:42 PM	371	Rec. Boat	WB												5.00	
	1:42 PM	372	Rec. Boat	EB												12.00	
	1:44 PM	373	Rec. Boat	WB												10.00	
	1:44 PM	374	Rec. Boat	WB												8.00	
	1:49 PM	375	Rec. Boat	EB												6.00	
	1:54 PM	376	Rec. Boat	WB												6.00	
	1:54 PM	377	Rec. Boat	WB												8.00	
	1:54 PM	378	Rec. Boat	EB												10.00	
	1:55 PM	379	Rec. Boat	EB												4.00	
	1:55 PM	380	Rec. Boat	EB												5.00	
	2:00 PM	381	Rec. Boat	EB												4.00	
	2:01 PM	382	Rec. Boat	WB												10.00	
	2:01 PM	383	Rec. Boat	EB												8.00	
	2:01 PM	384	Rec. Boat	EB												6.00	
	2:06 PM	385	Rec. Boat	EB												5.00	
	2:14 PM	386	Rec. Boat	EB												10.00	
	2:14 PM	387	Rec. Boat	EB												10.00	
	2:16 PM	388	Rec. Boat	WB												8.00	
	2:24 PM	389	Rec. Boat	WB												10.00	
	2:24 PM	390	Rec. Boat	EB												6.00	
2	2:30 PM	391	Rec. Boat	EB	346	57	19	90	19	45	476.16	90.33	-2.74	15.16	-0.98	16.14	Rec. Vessel 5
	2:36 PM	392	Rec. Boat	EB												12.00	
	2:40 PM	393	Rec. Boat	WB												4.00	
	2:41 PM	394	Rec. Boat	EB												8.00	
	2:41 PM	395	Rec. Boat	EB												5.00	
	2:43 PM	396	Rec. Boat	EB												12.00	
	2:43 PM	397	Rec. Boat	WB												10.00	
	2:52 PM	398	Rec. Boat	WB												5.00	
	3:01 PM	399	Rec. Boat	EB												10.00	
	3:04 PM	400	Rec. Boat	WB												4.00	
	3:04 PM	401	Rec. Boat	EB												8.00	
	3:06 PM	402	Rec. Boat	WB												8.00	
	3:12 PM	403	Rec. Boat	EB												5.00	
	3:17 PM	404	Rec. Boat	WB												5.00	
	3:20 PM	405	Rec. Boat	EB												10.00	
	3:27 PM	406	Rec. Boat	WB												10.00	
	3:29 PM	407	Rec. Boat	WB												4.00	
	3:31 PM	408	Rec. Boat	WB												15.00	
	3:38 PM	409	Rec. Boat	EB												12.00	
	3:39 PM	410	Rec. Boat	WB												10.00	
	3:40 PM	411	Rec. Boat	EB												8.00	
	3:44 PM	412	Rec. Boat	EB												8.00	
	3:48 PM	413	Rec. Boat	WB												8.00	
	3:48 PM	414	Rec. Boat	EB												8.00	
	3:50 PM	415	Rec. Boat	WB												7.00	
	3:50 PM	416	Rec. Boat	EB												10.00	
	3:52 PM	417	Rec. Boat	EB												10.00	
	4:00 PM	418	Rec. Boat	EB												10.00	
	4:00 PM	419	Rec. Boat	EB												4.00	
	4:04 PM	420	Rec. Boat	WB												8.00	
	4:05 PM	421	Rec. Boat	EB												4.00	
	4:05 PM	422	Rec. Boat	EB												8.00	
	4:05 PM	423	Rec. Boat	WB												8.00	

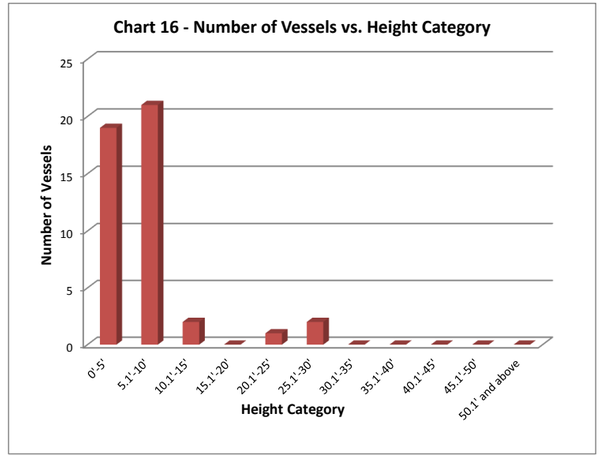
Table B-5 - Survey 1: Day 5 Vessel Survey Data (May 25, 2014)

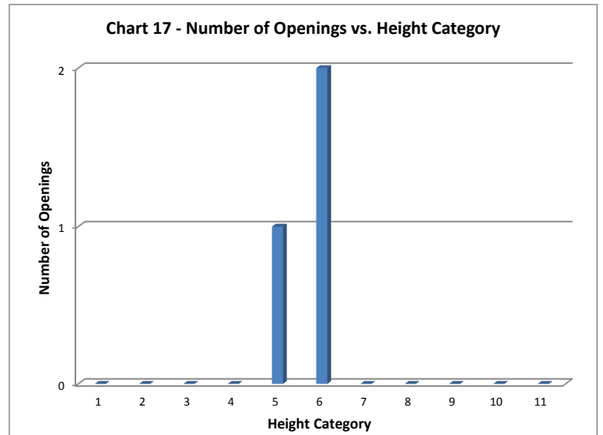
# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	4:07 PM	424	Rec. Boat	EB												5.00	
	4:07 PM	425	Rec. Boat	EB												5.00	
	4:10 PM	426	Rec. Boat	EB												8.00	
	4:13 PM	427	Rec. Boat	EB												12.00	
	4:16 PM	428	Rec. Boat	EB												4.00	
	4:19 PM	429	Rec. Boat	EB												8.00	
	4:23 PM	430	Rec. Boat	EB												8.00	
	4:24 PM	431	Rec. Boat	WB												4.00	
	4:29 PM	432	Rec. Boat	WB												8.00	
	4:31 PM	433	Rec. Boat	EB												6.00	
	4:31 PM	434	Rec. Boat	EB												8.00	
	4:33 PM	435	Rec. Boat	EB												8.00	
	4:34 PM	436	Rec. Boat	EB												6.00	
	4:42 PM	437	Rec. Boat	WB												4.00	
	4:42 PM	438	Rec. Boat	WB												4.00	
	4:44 PM	439	Rec. Boat	WB												6.00	
	4:50 PM	440	Rec. Boat	WB												8.00	
3	5:03 PM	441	Rec. Boat	EB	348	22	32	88	29	40	477.41	88.49	12.55	30.45	0.32	30.13	Cool Jerk
	5:10 PM	442	Rec. Boat	EB												8.00	
	5:10 PM	443	Rec. Boat	EB												8.00	
	5:14 PM	444	Rec. Boat	EB												8.00	
	5:16 PM	445	Pirate Ship Replica	EB												7.00	
	5:17 PM	446	Rec. Boat	EB												8.00	
	5:24 PM	447	Rec. Boat	EB												6.00	
	5:24 PM	448	Rec. Boat	WB												4.00	
4	5:34 PM	449	Rec. Boat	EB	348	25	9	88	32	19	477.45	88.54	12.18	30.08	0.57	29.51	Miss Sherry
	5:44 PM	450	Rec. Boat	EB												4.00	
	5:47 PM	451	Rec. Boat	WB												7.00	
	5:53 PM	452	Rec. Boat	EB												4.00	
	5:53 PM	453	Rec. Boat	EB												5.00	
	5:54 PM	454	Rec. Boat	EB												10.00	
	5:54 PM	455	Rec. Boat	EB												8.00	
	5:55 PM	456	Rec. Boat	WB												5.00	
	6:00 PM	457	Rec. Boat	WB												4.00	
	6:03 PM	458	Rec. Boat	WB												5.00	
5	6:04 PM	459	Sailboat	EB	350	54	3	86	59	52	480.38	87.00	25.19	43.09	0.92	42.17	Yard Sail
6	6:10 PM	460	Comm. Fishing Boat	EB	351	21	59	87	29	20	481.03	87.49	21.10	39.00	0.92	38.08	Captain Gunnar
	6:16 PM	461	Rec. Boat	EB												4.00	
	6:36 PM	462	Rec. Boat	EB												4.00	
	6:38 PM	463	Rec. Boat	EB												4.00	
	6:38 PM	464	Rec. Boat	EB												3.00	
	6:39 PM	465	Rec. Boat	EB												4.00	
	6:40 PM	466	Rec. Boat	EB												3.00	
	6:40 PM	467	Rec. Boat	EB												5.00	
	6:41 PM	468	Rec. Boat	WB												4.00	
	6:42 PM	469	Rec. Boat	WB												8.00	
	6:43 PM	470	Rec. Boat	EB												8.00	
	6:58 PM	471	Rec. Boat	EB												8.00	
	6:59 PM	472	Rec. Boat	EB												8.00	
	7:00 PM	473	Rec. Boat	EB												8.00	

Table B-6 through Table B-10:
Survey 1 (June) Daily Vessel Survey Data

Table B-6 - Survey 1: Day 6 Vessel Survey Data (June 6, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:54 AM	474	Rec. Boat	EB												4.00	
	8:00 AM	475	Rec. Boat	EB												4.00	
	8:33 AM	476	Rec. Boat	WB												4.00	
	10:08 AM	477	Rec. Boat	EB												8.00	
1	10:28 AM	478	Rec. Boat	WB	306	24	48	89	57	10	659.9	89.953	0.54	18.91	-1.28	20.19	Rec. Vessel 6
	10:44 AM	479	Rec. Boat	WB												2.00	
	10:45 AM	480	Rec. Boat	EB												2.00	
	11:23 AM	481	Rec. Boat	EB												4.00	
	11:35 AM	482	Rec. Boat	WB												2.00	
	11:55 AM	483	Rec. Boat	EB												4.00	
	11:58 AM	484	Rec. Boat	EB												2.00	
	11:59 AM	485	Jet Ski	EB												2.00	
	12:00 PM	486	Rec. Boat	WB												4.00	
	12:01 PM	487	Jet Ski	WB												2.00	
	12:15 PM	488	Rec. Boat	EB												6.00	
	12:20 PM	489	Rec. Boat	WB												6.00	
	12:31 PM	490	Rec. Boat	WB												4.00	
	12:42 PM	491	Rec. Boat	WB												2.00	
	1:35 PM	492	Rec. Boat	EB												6.00	
	1:58 PM	493	Rec. Boat	WB												8.00	
	1:59 PM	494	Rec. Boat	EB												8.00	
	2:12 PM	495	Rec. Boat	EB												6.00	
	2:17 PM	496	Rec. Boat	WB												8.00	
	2:20 PM	497	Rec. Boat	EB												8.00	
	2:48 PM	498	Rec. Boat	EB												6.00	
	2:56 PM	499	Rec. Boat	WB												8.00	
	2:56 PM	500	Rec. Boat	EB												8.00	
2	3:01 PM	501	Comm. Fishing Boat	EB	347	39	18	89	6	3	476.74	89.101	7.48	25.85	0.42	25.43	Comm. Fishing Vessel 7
	3:29 PM	502	Rec. Boat	EB												12.00	
	3:52 PM	503	Rec. Boat	WB												12.00	
	3:52 PM	504	Rec. Boat	WB												6.00	
	4:13 PM	505	Rec. Boat	WB												10.00	
	4:53 PM	506	Rec. Boat	EB												10.00	
3	4:59 PM	507	Rec. Boat	WB	349	12	2	88	50	47	545.21	88.846	10.98	29.35	0.62	28.73	Rec. Vessel 7
	5:01 PM	508	Rec. Boat	EB												4.00	
	5:09 PM	509	Rec. Boat	WB												4.00	
	5:11 PM	510	Rec. Boat	WB												4.00	
	5:11 PM	511	Rec. Boat	WB												6.00	
	5:20 PM	512	Rec. Boat	WB												10.00	
	5:48 PM	513	Rec. Boat	EB												10.00	
	5:50 PM	514	Rec. Boat	EB												4.00	
	6:30 PM	515	Rec. Boat	WB												6.00	
	6:50 PM	516	Rec. Boat	EB												6.00	
	6:54 PM	517	Rec. Boat	EB												5.00	
	6:58 PM	518	Rec. Boat	WB												8.00	





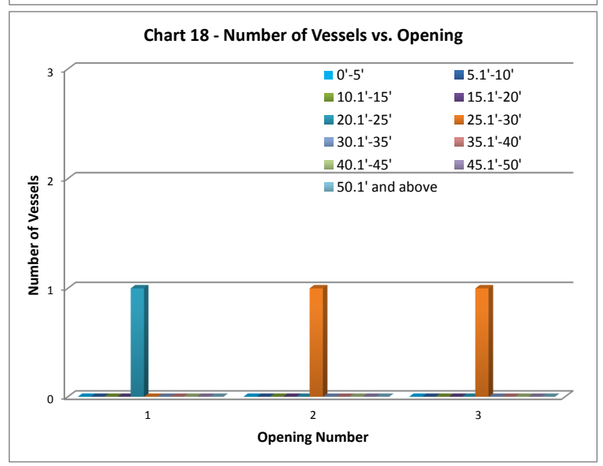
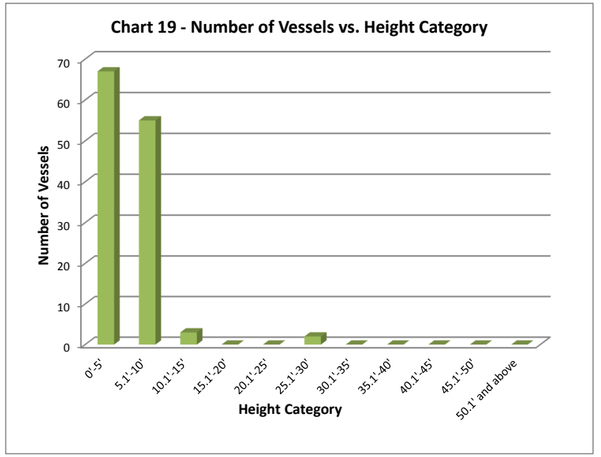
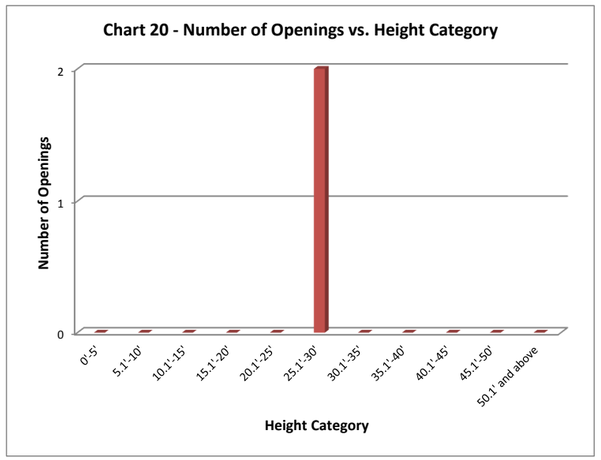


Table B-7 - Survey 1: Day 7 Vessel Survey Data (June 7, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	8:21 AM	519	Rec. Boat	EB												4.00	
	8:35 AM	520	Rec. Boat	WB												10.00	
	8:54 AM	521	Rec. Boat	WB												8.00	
	9:08 AM	522	Rec. Boat	WB												5.00	
	9:52 AM	523	Rec. Boat	EB												4.00	
	9:57 AM	524	Rec. Boat	EB												6.00	
	10:01 AM	525	Rec. Boat	WB												6.00	
	10:05 AM	526	Rec. Boat	EB												2.00	
	10:07 AM	527	Rec. Boat	EB												8.00	
	10:14 AM	528	Rec. Boat	EB												2.00	
	10:28 AM	529	Rec. Boat	EB												8.00	
	10:39 AM	530	Rec. Boat	EB												4.00	
	10:44 AM	531	Rec. Boat	WB												4.00	
	10:44 AM	532	Rec. Boat	WB												6.00	
	10:50 AM	533	Rec. Boat	EB												6.00	
	10:59 AM	534	Rec. Boat	EB												4.00	
	11:01 AM	535	Rec. Boat	WB												4.00	
	11:05 AM	536	Rec. Boat	EB												4.00	
	11:06 AM	537	Rec. Boat	EB												6.00	
	11:06 AM	538	Rec. Boat	WB												6.00	
	11:07 AM	539	Rec. Boat	WB												4.00	
	11:08 AM	540	Rec. Boat	EB												4.00	
	11:10 AM	541	Rec. Boat	WB												4.00	
	11:20 AM	542	Rec. Boat	EB												6.00	
	11:25 AM	543	Rec. Boat	EB												4.00	
	11:26 AM	544	Rec. Boat	EB												2.00	
	11:29 AM	545	Rec. Boat	WB												2.00	
	11:29 AM	546	Rec. Boat	EB												4.00	
	11:33 AM	547	Rec. Boat	WB												5.00	
	11:33 AM	548	Rec. Boat	EB												2.00	
	11:34 AM	549	Rec. Boat	WB												8.00	
	11:34 AM	550	Rec. Boat	WB												2.00	
	11:34 AM	551	Rec. Boat	WB												4.00	
	11:34 AM	552	Rec. Boat	WB												6.00	
	11:38 AM	553	Rec. Boat	WB												6.00	
	11:38 AM	554	Rec. Boat	EB												4.00	
	11:39 AM	555	Rec. Boat	EB												2.00	
	11:40 AM	556	Rec. Boat	WB												4.00	
	11:42 AM	557	Rec. Boat	WB												2.00	
	11:45 AM	558	Rec. Boat	EB												2.00	
	11:49 AM	559	Rec. Boat	WB												2.00	
	11:51 AM	560	Rec. Boat	EB												2.00	
	11:54 AM	561	Rec. Boat	EB												5.00	
	12:16 PM	562	Rec. Boat	WB												2.00	
	12:18 PM	563	Rec. Boat	EB												10.00	
	12:20 PM	564	Rec. Boat	EB												6.00	
	12:22 PM	565	Rec. Boat	EB												6.00	
	12:29 PM	566	Rec. Boat	EB												6.00	
	12:31 PM	567	Rec. Boat	WB												4.00	
	12:31 PM	568	Rec. Boat	WB												4.00	
	12:32 PM	569	Rec. Boat	EB												4.00	
	12:35 PM	570	Rec. Boat	WB												6.00	
	12:40 PM	571	Rec. Boat	WB												10.00	
	12:50 PM	572	Rec. Boat	WB												6.00	
	12:56 PM	573	Rec. Boat	EB												4.00	
	1:02 PM	574	Rec. Boat	WB												6.00	
	1:03 PM	575	Rec. Boat	EB												4.00	
	1:08 PM	576	Rec. Boat	WB												2.00	
	1:08 PM	577	Rec. Boat	EB												5.00	
	1:14 PM	578	Rec. Boat	EB												4.00	
	1:26 PM	579	Rec. Boat	EB												4.00	





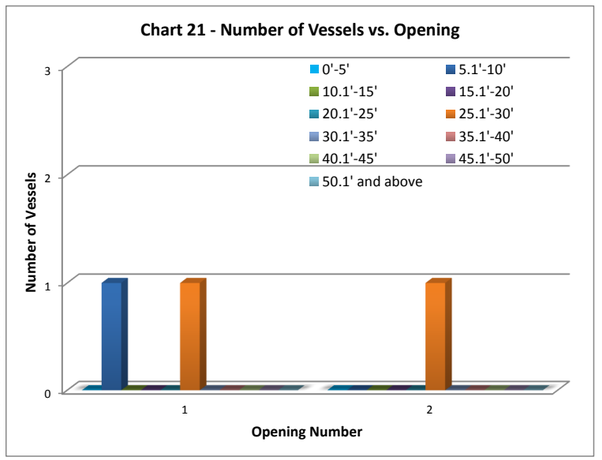


Table B-7 - Survey 1: Day 7 Vessel Survey Data (June 7, 2014)

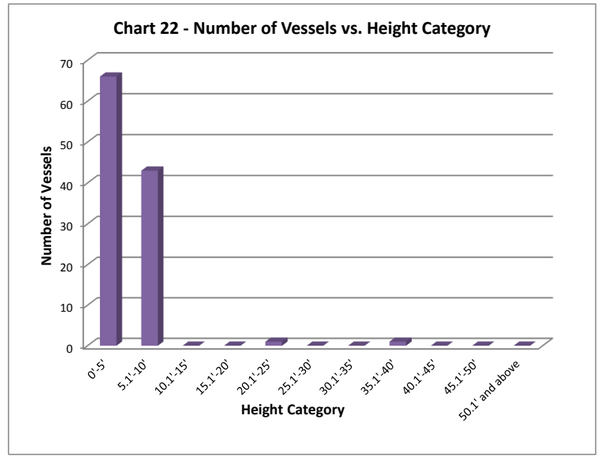
# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	1:38 PM	580	Rec. Boat	WB												4.00	
	1:48 PM	581	Rec. Boat	EB												4.00	
1	1:50 PM	582	Rec. Boat	WB	289	38	49	90	34	14	873.88	90.57	-8.70	9.63	-0.23	9.86	Rec. Vessel 8
		583	Rec. Boat	WB	332	59	39	88	59	27	546.19	88.99	9.62	27.95	-0.23	28.18	Rec. Vessel 9
	1:50 PM	584	Rec. Boat	EB												4.00	
	2:06 PM	585	Rec. Boat	WB												4.00	
	2:08 PM	586	Rec. Boat	WB												4.00	
	2:12 PM	587	Rec. Boat	EB												4.00	
	2:22 PM	588	Rec. Boat	EB												6.00	
	2:27 PM	589	Rec. Boat	WB												4.00	
	2:31 PM	590	Rec. Boat	EB												6.00	
	2:32 PM	591	Rec. Boat	WB												6.00	
	2:38 PM	592	Rec. Boat	WB												5.00	
	2:56 PM	593	Rec. Boat	EB												10.00	
	2:57 PM	594	Rec. Boat	EB												4.00	
	2:58 PM	595	Rec. Boat	WB												4.00	
	2:59 PM	596	Rec. Boat	WB												8.00	
	3:03 PM	597	Rec. Boat	WB												6.00	
	3:10 PM	598	Rec. Boat	WB												6.00	
	3:10 PM	599	Rec. Boat	EB												6.00	
	3:11 PM	600	Rec. Boat	WB												2.00	
	3:15 PM	601	Rec. Boat	WB												6.00	
	3:16 PM	602	Rec. Boat	WB												8.00	
	3:20 PM	603	Rec. Boat	EB												4.00	
	3:23 PM	604	Rec. Boat	WB												10.00	
	3:24 PM	605	Rec. Boat	EB												6.00	
	3:26 PM	606	Rec. Boat	EB												8.00	
	3:32 PM	607	Rec. Boat	EB												10.00	
	3:32 PM	608	Rec. Boat	EB												5.00	
	3:42 AM	609	Rec. Boat	WB												6.00	
	3:45 PM	610	Rec. Boat	WB												4.00	
	3:49 PM	611	Rec. Boat	WB												5.00	
	3:53 PM	612	Rec. Boat	EB												5.00	
	3:53 PM	613	Rec. Boat	EB												10.00	
	3:54 PM	614	Rec. Boat	WB												5.00	
	3:57 PM	615	Rec. Boat	WB												10.00	
	4:12 PM	616	Rec. Boat	EB												5.00	
	4:12 PM	617	Rec. Boat	EB												4.00	
	4:13 PM	618	Rec. Boat	EB												4.00	
	4:14 PM	619	Rec. Boat	WB												6.00	
	4:15 PM	620	Rec. Boat	EB												4.00	
	4:18 PM	621	Rec. Boat	EB												10.00	
	4:19 PM	622	Rec. Boat	EB												7.00	
	4:20 PM	623	Rec. Boat	EB												8.00	
	4:24 PM	624	Rec. Boat	WB												12.00	
	4:26 PM	625	Rec. Boat	WB												12.00	
	4:31 PM	626	Rec. Boat	WB												7.00	
	4:38 PM	627	Rec. Boat	EB												4.00	
	4:38 PM	628	Rec. Boat	WB												5.00	
	4:44 PM	629	Rec. Boat	EB												10.00	
	4:52 PM	630	Rec. Boat	WB												10.00	
	4:56 PM	631	Rec. Boat	EB												8.00	
	5:03 PM	632	Rec. Boat	EB												10.00	
	5:12 PM	633	Rec. Boat	WB												6.00	
	5:21 PM	634	Rec. Boat	EB												4.00	
	5:22 PM	635	Rec. Boat	EB												5.00	
	5:25 PM	636	Rec. Boat	EB												4.00	
	5:57 PM	637	Rec. Boat	EB												12.00	
	6:00 PM	638	Rec. Boat	EB												5.00	
	6:04 PM	639	Rec. Boat	EB												8.00	
2	6:14 PM	640	Rec. Boat	EB	352	28	47	88	38	14	482.73	88.64	11.48	29.81	0.52	29.29	Rec. Vessel 10

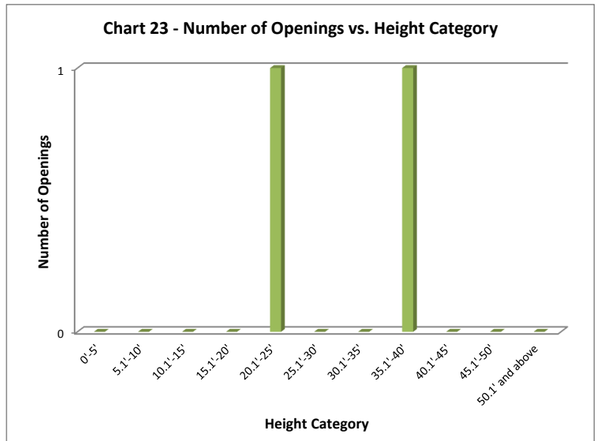
Table B-7 - Survey 1: Day 7 Vessel Survey Data (June 7, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	6:32 PM	641	Rec. Boat	EB												8.00	
	6:33 PM	642	Rec. Boat	WB												8.00	
	6:48 PM	643	Rec. Boat	EB												4.00	
	6:55 PM	644	Rec. Boat	EB												8.00	
	6:55 PM	645	Rec. Boat	WB												10.00	

Table B-8 - Survey 1: Day 8 Vessel Survey Data (June 8, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:15 AM	646	Rec. Boat	EB												10.00	
	8:36 AM	647	Rec. Boat	EB												10.00	
	8:51 AM	648	Rec. Boat	WB												8.00	
	8:54 AM	649	Rec. Boat	EB												6.00	
	9:07 AM	650	Jet Ski	EB												2.00	
	9:26 AM	651	Rec. Boat	WB												10.00	
	9:28 AM	652	Rec. Boat	WB												6.00	
	9:46 AM	653	Rec. Boat	EB												4.00	
	9:48 AM	654	Rec. Boat	WB												4.00	
	10:00 AM	655	Rec. Boat	WB												6.00	
	10:02 AM	656	Rec. Boat	EB												6.00	
	10:03 AM	657	Rec. Boat	EB												5.00	
	10:09 AM	658	Rec. Boat	WB												4.00	
	10:17 AM	659	Rec. Boat	WB												4.00	
	10:38 AM	660	Rec. Boat	EB												6.00	
	10:40 AM	661	Jet Ski	EB												2.00	
	11:01 AM	662	Jet Ski	WB												2.00	
	11:01 AM	663	Rec. Boat	EB												4.00	
	11:04 AM	664	Rec. Boat	WB												4.00	
	11:04 AM	665	Rec. Boat	EB												6.00	
	11:07 AM	666	Rec. Boat	EB												4.00	
	11:11 AM	667	Rec. Boat	EB												4.00	
	11:16 AM	668	Rec. Boat	EB												6.00	
	11:18 AM	669	Rec. Boat	EB												4.00	
	11:27 AM	670	Rec. Boat	WB												4.00	
	11:34 AM	671	Rec. Boat	WB												4.00	
	11:35 AM	672	Rec. Boat	EB												4.00	
	11:37 AM	673	Rec. Boat	EB												5.00	
	11:40 AM	674	Rec. Boat	WB												8.00	
	11:51 AM	675	Rec. Boat	WB												4.00	
	11:52 AM	676	Rec. Boat	WB												4.00	
	11:58 AM	677	Rec. Boat	EB												6.00	
	12:01 PM	678	Rec. Boat	EB												4.00	
	12:09 PM	679	Rec. Boat	WB												6.00	
	12:11 PM	680	Rec. Boat	WB												6.00	
	12:16 PM	681	Rec. Boat	WB												6.00	
	12:17 PM	682	Rec. Boat	EB												4.00	
	12:17 PM	683	Rec. Boat	WB												7.00	
	12:19 PM	684	Rec. Boat	EB												4.00	
	12:19 PM	685	Rec. Boat	WB												6.00	
	12:19 PM	686	Rec. Boat	WB												4.00	
	12:21 PM	687	Rec. Boat	WB												4.00	
	12:25 PM	688	Rec. Boat	WB												6.00	
	12:32 PM	689	Jet Ski	EB												2.00	
	12:34 PM	690	Rec. Boat	EB												4.00	
	12:35 PM	691	Rec. Boat	WB												4.00	
	12:38 PM	692	Rec. Boat	WB												8.00	
	12:44 PM	693	Rec. Boat	EB												6.00	
	12:45 PM	694	Rec. Boat	WB												6.00	
	1:09 PM	695	Rec. Boat	EB												6.00	
	1:27 PM	696	Rec. Boat	WB												4.00	
	1:55 PM	697	Rec. Boat	WB												4.00	
	1:55 PM	698	Rec. Boat	WB												4.00	
	2:01 PM	699	Rec. Boat	WB												6.00	
	2:02 PM	700	Rec. Boat	WB												6.00	
	2:09 PM	701	Rec. Boat	EB												7.00	
	2:10 PM	702	Jet Ski	EB												2.00	
	2:11 PM	703	Rec. Boat	EB												4.00	
	2:13 PM	704	Rec. Boat	WB												4.00	
	2:23 PM	705	Rec. Boat	EB												4.00	
	2:28 PM	706	Rec. Boat	EB												4.00	





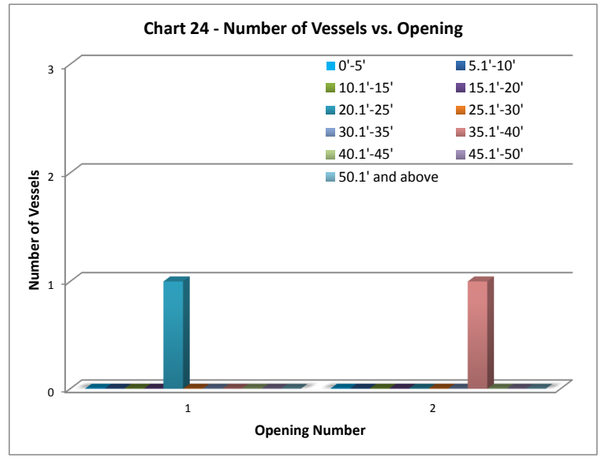


Table B-8 - Survey 1: Day 8 Vessel Survey Data (June 8, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	2:31 PM	707	Rec. Boat	WB												4.00	
	2:38 PM	708	Rec. Boat	EB												5.00	
	2:41 PM	709	Rec. Boat	WB												5.00	
	2;42 PM	710	Rec. Boat	WB												4.00	
	2:43 PM	711	Rec. Boat	EB												6.00	
	2:44 PM	712	Rec. Boat	WB												6.00	
	2:51 PM	713	Rec. Boat	EB												4.00	
	2:51 PM	714	Rec. Boat	EB												4.00	
	2:56 PM	715	Rec. Boat	EB												6.00	
	2:57 PM	716	Rec. Boat	WB												4.00	
	3:02 PM	717	Rec. Boat	WB												4.00	
	3:02 PM	718	Rec. Boat	WB												4.00	
	3:07 PM	719	Rec. Boat	EB												4.00	
	3:12 PM	720	Rec. Boat	WB												4.00	
	3:17 PM	721	Rec. Boat	WB												6.00	
	3:19 PM	722	Jet Ski	EB												2.00	
	3:22 PM	723	Jet Ski	WB												2.00	
	3:26 PM	724	Rec. Boat	WB												8.00	
	3:37 PM	725	Rec. Boat	WB												8.00	
	3:50 PM	726	Rec. Boat	EB												8.00	
	4:04 PM	727	Rec. Boat	EB												5.00	
	4:05 PM	728	Rec. Boat	EB												4.00	
	4:09 PM	729	Rec. Boat	WB												5.00	
	4:41 PM	730	Rec. Boat	WB												4.00	
	4:45 PM	731	Rec. Boat	EB												6.00	
	4:53 PM	732	Rec. Boat	EB												8.00	
	4:54 PM	733	Rec. Boat	WB												8.00	
	4:56 PM	734	Rec. Boat	EB												7.00	
	4:58 PM	735	Rec. Boat	EB												4.00	
	5:00 PM	736	Rec. Boat	EB												5.00	
	5:11 PM	737	Rec. Boat	EB												10.00	
1	5:22 PM	738	Comm. Fishing Boat	EB	349	44	18	89	16	42	478.89	89.28	6.03	24.59	0.52	24.07	Lady Laura
	5:34 PM	739	Rec. Boat	EB												6.00	
	5:35 PM	740	Rec. Boat	EB												6.00	
	5:37 PM	741	Rec. Boat	EB												4.00	
	5:37 PM	742	Rec. Boat	EB												4.00	
	5:39 PM	743	Rec. Boat	EB												5.00	
	5:41 PM	744	Rec. Boat	EB												4.00	
	5:42 PM	745	Rec. Boat	EB												5.00	
	5:43 PM	746	Rec. Boat	EB												4.00	
	5:58 PM	747	Rec. Boat	WB												4.00	
	6:04 PM	748	Rec. Boat	EB												4.00	
	6:04 PM	749	Rec. Boat	EB												5.00	
	6:05 PM	750	Rec. Boat	EB												10.00	
	6:07 PM	751	Rec. Boat	WB												5.00	
	6:17 PM	752	Rec. Boat	EB												10.00	
2	6:24 PM	753	Comm. Fishing Boat	EB	349	41	3	87	37	20	478.83	87.62	19.88	38.44	0.62	37.82	Captain Gunnar
	6:27 PM	754	Rec. Boat	WB												4.00	
	6:32 PM	755	Rec. Boat	EB												4.00	
	6:45 PM	756	Rec. Boat	WB												9.00	

Table B-9 - Survey 1: Day 9 Vessel Survey Data (June 9, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:27 AM	757	Rec. Boat	WB												4.00	
	8:33 AM	758	Rec. Boat	EB												8.00	
	8:57 AM	759	Rec. Boat	EB												4.00	
	9:14 AM	760	Rec. Boat	EB												5.00	
	9:56 AM	761	Rec. Boat	WB												6.00	
	10:11 AM	762	Rec. Boat	EB												4.00	
	10:29 AM	763	Rec. Boat	EB												6.00	
	10:35 AM	764	Rec. Boat	WB												4.00	
	10:35 AM	765	Rec. Boat	WB												4.00	
	11:40 AM	766	Rec. Boat	WB												4.00	
	11:41 AM	767	Rec. Boat	WB												4.00	
	12:12 PM	768	Rec. Boat	WB												6.00	
	12:17 PM	769	Rec. Boat	EB												4.00	
	12:57 PM	770	Rec. Boat	EB												4.00	
	1:04 PM	771	Rec. Boat	WB												4.00	
	1:42 PM	772	Rec. Boat	EB												6.00	
	2:14 PM	773	Rec. Boat	EB												4.00	
	2:15 PM	774	Rec. Boat	EB												6.00	
	3:18 PM	775	Rec. Boat	EB												4.00	
	3:23 PM	776	Rec. Boat	WB												4.00	
	3:28 PM	777	Rec. Boat	EB												6.00	
	3:30 PM	778	Rec. Boat	WB												6.00	
	3:39 PM	779	Rec. Boat	EB												5.00	
	5:12 PM	780	Rec. Boat	WB												8.00	
	5:43 PM	781	Rec. Boat	WB												5.00	
	6:55 PM	782	Rec. Boat	EB												5.00	

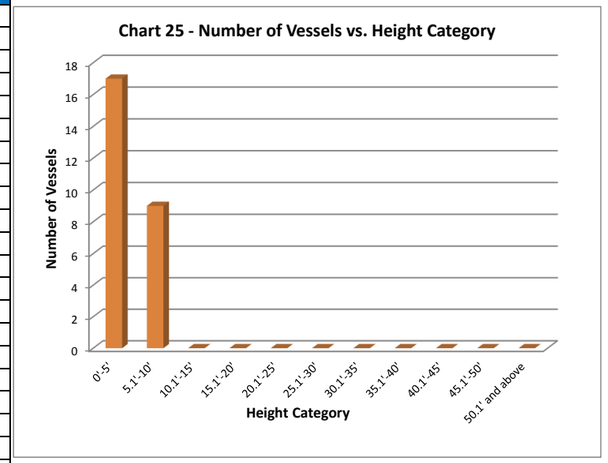


Table B-10 - Survey 1: Day 10 Vessel Survey Data (June 10, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	8:24 AM	783	Rec. Boat	EB												6.00	
	10:20 AM	784	Rec. Boat	EB												6.00	
	11:43 AM	785	Rec. Boat	EB												6.00	
	11:54 AM	786	Rec. Boat	WB												4.00	
	12:26 PM	787	Rec. Boat	WB												6.00	
	1:41 PM	788	Rec. Boat	WB												7.00	
	2:33 PM	789	Rec. Boat	EB												6.00	
	2:48 PM	790	Rec. Boat	WB												6.00	
	2:49 PM	791	Rec. Boat	EB												4.00	
	3:02 PM	792	Jet Ski	WB												2.00	
	3:02 PM	793	Jet Ski	WB												2.00	
	3:10 PM	794	Rec. Boat	WB												8.00	
	3:28 PM	795	Rec. Boat	EB												4.00	
	3:38 PM	796	Rec. Boat	WB												5.00	
	4:03 PM	797	Rec. Boat	EB												10.00	
	4:07 PM	798	Rec. Boat	WB												9.00	
	4:11 PM	799	Rec. Boat	WB												8.00	
	4:34 PM	800	Rec. Boat	WB												4.00	
	5:07 PM	801	Rec. Boat	EB												8.00	
	5:46 PM	802	Rec. Boat	WB												5.00	
	6:00 PM	803	Rec. Boat	EB												10.00	

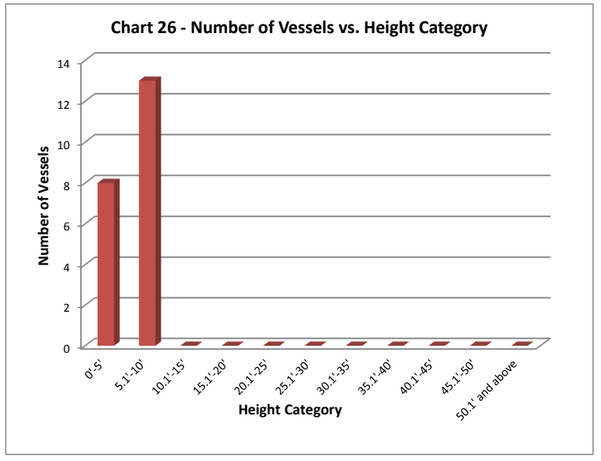
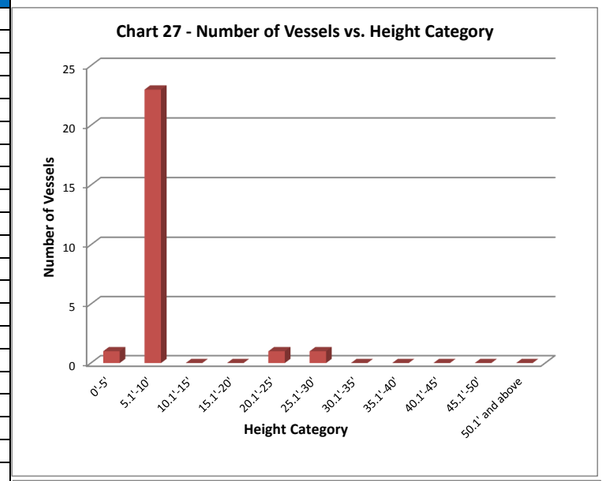
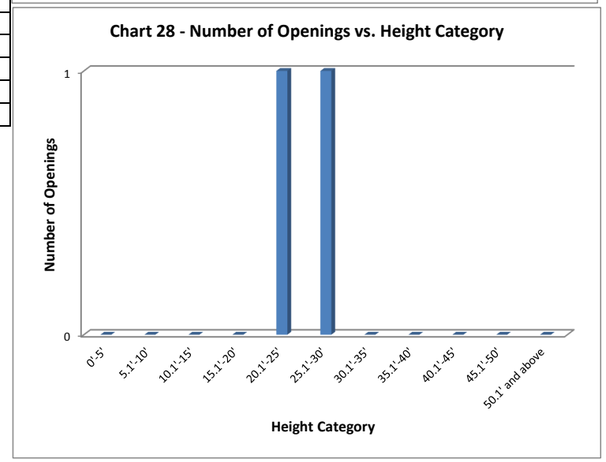


Table B-11 through Table B-15:
Survey 1 (July) Daily Vessel Survey Data

Table B-11 - Survey 1: Day 11 Vessel Survey Data (July 9, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:48 AM	804	Rec. Boat	EB												7.00	
	9:15 AM	805	Rec. Boat	EB												8.00	
	9:52 AM	806	Rec. Boat	WB												6.00	
	10:49 AM	807	Rec. Boat	EB												8.00	
	10:56 AM	808	Rec. Boat	WB												10.00	
	12:00 PM	809	Rec. Boat	EB												6.00	
	12:43 PM	810	Rec. Boat	EB												6.00	
	12:57 PM	811	Rec. Boat	WB												6.00	
	1:12 PM	812	Rec. Boat	EB												6.00	
	1:15 PM	813	Rec. Boat	WB												5.00	
	1:20 PM	814	Rec. Boat	WB												6.00	
	1:29 PM	815	Rec. Boat	EB												8.00	
	1:53 PM	816	Rec. Boat	EB												10.00	
	2:01 PM	817	Rec. Boat	EB												6.00	
	2:14 PM	818	Rec. Boat	WB												10.00	
	2:29 PM	819	Rec. Boat	WB												6.00	
	2:30 PM	820	Rec. Boat	WB												6.00	
	2:35 PM	821	Rec. Boat	EB												6.00	
	2:52 PM	822	Rec. Boat	WB												6.00	
	3:06 PM	823	Rec. Boat	EB												6.00	
	3:13 PM	824	Rec. Boat	WB												6.00	
	4:16 PM	825	Rec. Boat	WB												10.00	
	4:51 PM	826	Rec. Boat	WB												8.00	
1	4:58 PM	827	Comm. Fishing Boat	EB	346	32	35	89	12	39	475.86	89.21	6.55	24.88	-0.08	24.96	Lady Laura
	6:01 PM	828	Rec. Boat	EB												8.00	
2	6:02 PM	829	Comm. Fishing Boat	EB	346	59	38	89	6	40	476.19	89.11	7.39	25.72	0.42	25.30	Wade Willis





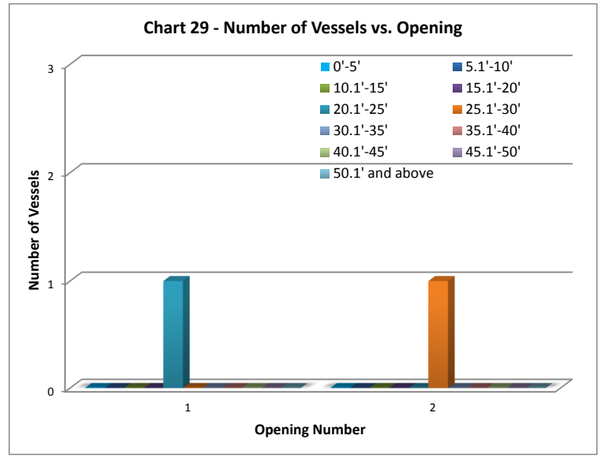
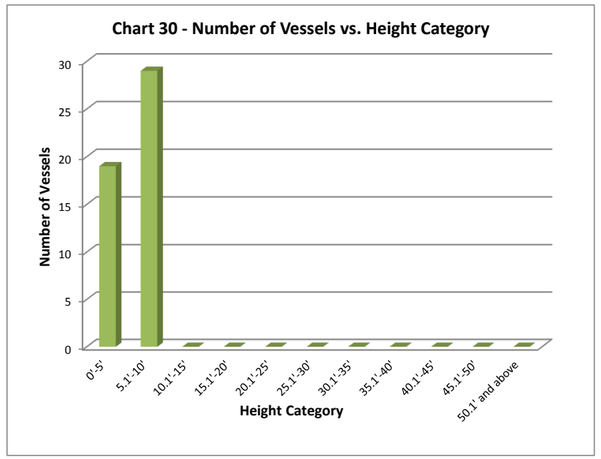
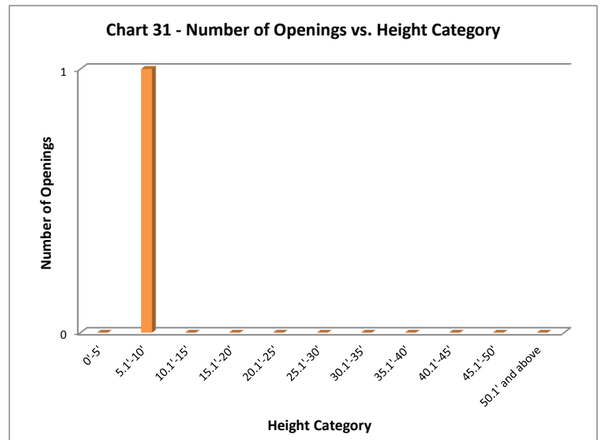


Table B-12 - Survey 1: Day 12 Vessel Survey Data (July 10, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:52 AM	830	Rec. Boat	EB												4.00	
	8:02 AM	831	Rec. Boat	WB												4.00	
	8:19 AM	832	Rec. Boat	WB												4.00	
	10:00 AM	833	Rec. Boat	EB												5.00	
1	10:12 AM	834	Tow Boat		Unable to measure due to NCDOT maintenance in survey area; estimated heights based on known elevations.											9.00	On-Water Service Vessel 1
		835	Rec. Boat													10.00	Rec. Vessel 11
	10:23 AM	836	Rec. Boat	EB												6.00	
	10:24 AM	837	Rec. Boat	WB												7.00	
	10:36 AM	838	Rec. Boat	WB												6.00	
	10:50 AM	839	Rec. Boat	WB												7.00	
	10:52 AM	840	Rec. Boat	WB												6.00	
	11:12 AM	841	Rec. Boat	EB												8.00	
	11:12 AM	842	Rec. Boat	WB												6.00	
	11:12 AM	843	Rec. Boat	WB												5.00	
	11:22 AM	844	Kayak	EB												2.00	
	11:41 AM	845	Rec. Boat	WB												6.00	
	11:55 AM	846	Rec. Boat	EB												6.00	
	12:05 PM	847	Rec. Boat	EB												8.00	
	12:05 PM	848	Rec. Boat	EB												6.00	
	12:43 PM	849	Kayak	WB												2.00	
	12:48 PM	850	Rec. Boat	WB												6.00	
	12:49 PM	851	Rec. Boat	EB												6.00	
	1:12 PM	852	Rec. Boat	EB												6.00	
	1:13 PM	853	Rec. Boat	EB												8.00	
	1:15 PM	854	Rec. Boat	EB												8.00	
	1:24 PM	855	Rec. Boat	WB												6.00	
	1:26 PM	856	Rec. Boat	EB												4.00	
	1:38 PM	857	Rec. Boat	EB												6.00	
	1:43 PM	858	Rec. Boat	WB												6.00	
	1:47 PM	859	Rec. Boat	EB												6.00	
	1:53 PM	860	Rec. Boat	WB												6.00	
	2:06 PM	861	Rec. Boat	WB												6.00	
	2:30 PM	862	Rec. Boat	WB												5.00	
	2:36 PM	863	Rec. Boat	EB												5.00	
	3:33 PM	864	Rec. Boat	EB												6.00	
	4:03 PM	865	Rec. Boat	EB												4.00	
	4:08 PM	866	Rec. Boat	WB												4.00	
	4:14 PM	867	Rec. Boat	EB												4.00	
	4:15 PM	868	Rec. Boat	WB												8.00	
	4:21 PM	869	Rec. Boat	WB												4.00	
	4:49 PM	870	Rec. Boat	EB												7.00	
	5:20 PM	871	Rec. Boat	EB												5.00	
	5:49 PM	872	Rec. Boat	WB												9.00	
	5:54 PM	873	Rec. Boat	EB												4.00	
	6:21 PM	874	Rec. Boat	EB												4.00	
	6:38 PM	875	Rec. Boat	EB												9.00	





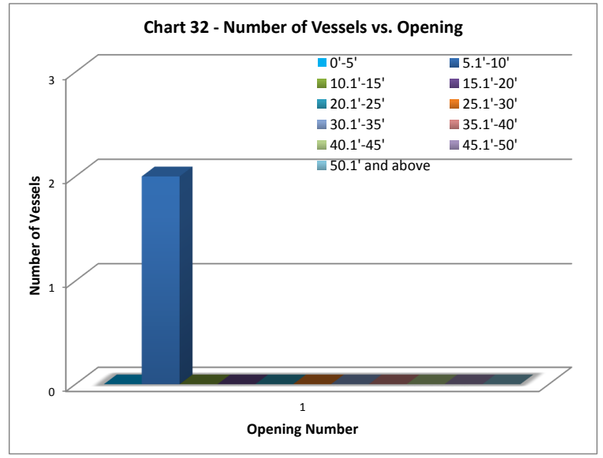
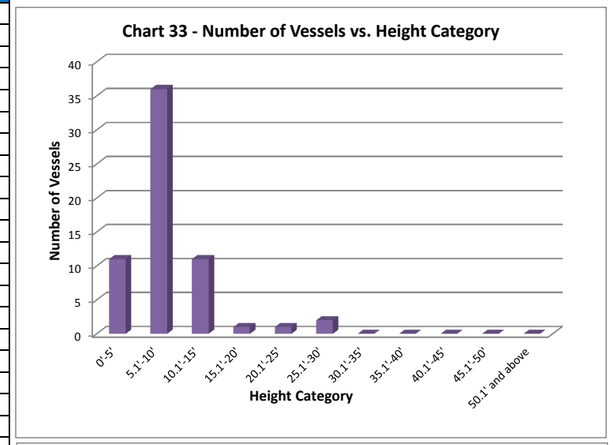
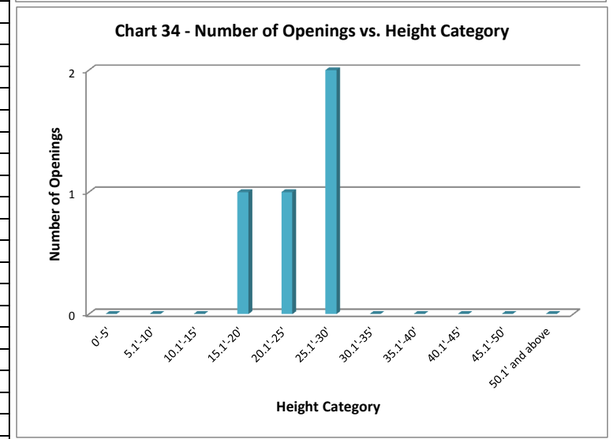


Table B-13 - Survey 1: Day 13 Vessel Survey Data (July 11, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:22 AM	878	Rec. Boat	EB												4.00	
	7:47 AM	879	Rec. Boat	WB												4.00	
	8:35 AM	880	Rec. Boat	EB												5.00	
	8:43 AM	881	Rec. Boat	WB												6.00	
	8:57 AM	882	Rec. Boat	WB												6.00	
	9:12 AM	883	Rec. Boat	EB												5.00	
	9:22 AM	884	Rec. Boat	WB												7.00	
1	9:28 AM	885	Rec. Boat	WB	347	58	51	88	49		543.76	88.82	11.23	29.43	0.42	29.01	Strike 1
	9:28 AM	886	Rec. Boat	EB												4.00	
	10:29 AM	887	Rec. Boat	EB												6.00	
	11:08 AM	888	Rec. Boat	WB												8.00	
	11:09 AM	889	Rec. Boat	EB												8.00	
	11:27 AM	890	Rec. Boat	EB												6.00	
	11:34 AM	891	Rec. Boat	EB												7.00	
	11:44 AM	892	Rec. Boat	EB												6.00	
	11:45 AM	893	Rec. Boat	WB												8.00	
	11:49 AM	894	Rec. Boat	EB												10.00	
	12:07 PM	895	Rec. Boat	EB												6.00	
	12:24 PM	896	Rec. Boat	EB												7.00	
	12:41 PM	897	Rec. Boat	WB												8.00	
	12:45 PM	898	Rec. Boat	WB												6.00	
	12:52 PM	899	Rec. Boat	WB												8.00	
	12:56 PM	900	Rec. Boat	WB												6.00	
	1:00 PM	901	Rec. Boat	WB												4.00	
	1:19 PM	902	Rec. Boat	EB												6.00	
	1:26 PM	903	Rec. Boat	WB												6.00	
	1:54 PM	904	Kayak	EB												2.00	
	2:03 PM	905	Rec. Boat	WB												6.00	
	2:11 PM	906	Sailboat	EB												12.00	
	2:11 PM	907	Sailboat	EB												12.00	
	2:13 PM	908	Rec. Boat	EB												6.00	
	2:14 PM	909	Sailboat	EB												12.00	
	2:14 PM	910	Sailboat	EB												12.00	
	2:15 PM	911	Sailboat	EB												12.00	
	2:17 PM	912	Sailboat	EB												12.00	
	2:18 PM	913	Sailboat	EB												12.00	
	2:19 PM	914	Rec. Boat	EB												7.00	
	2:21 PM	915	Sailboat	EB												12.00	
	2:23 PM	916	Sailboat	EB												12.00	
	2:28 PM	917	Rec. Boat	EB												6.00	
	2:31 PM	918	Rec. Boat	WB												12.00	
	2:31 PM	919	Rec. Boat	EB												6.00	
	2:48 PM	920	Rec. Boat	EB												6.00	
	2:50 PM	921	Rec. Boat	EB												7.00	
	2:54 PM	922	Rec. Boat	WB												6.00	
	3:21 PM	923	Rec. Boat	WB												8.00	
2	3:26 PM	924	Rec. Boat	WB	333	50	22	89	47	18	545.06	89.79	2.01	20.21	-1.73	21.94	Rec. Vessel 12
	3:26 PM	925	Rec. Boat	WB												8.00	
	3:36 PM	926	Rec. Boat	EB												8.00	
	3:41 PM	927	Rec. Boat	WB												6.00	
	3:49 PM	928	Rec. Boat	WB												10.00	
	3:50 PM	929	Rec. Boat	EB												11.00	
	4:11 PM	930	Rec. Boat	WB												5.00	
	4:18 PM	931	Rec. Boat	EB												9.00	
3	4:30 PM	932	Rec. Boat	EB	346	49	51	88	53	37	476.07	88.89	9.19	27.39	-1.18	28.57	Strike 1
4	4:47 PM	933	Rec. Boat	EB	347	42	48	89	58	14	476.79	89.97	0.25	18.45	-1.08	19.53	Rec. Vessel 13
	4:55 PM	934	Rec. Boat	EB												10.00	
	5:20 PM	935	Rec. Boat	WB												6.00	
	6:12 PM	936	Rec. Boat	EB												4.00	
	6:13 PM	937	Rec. Boat	WB												5.00	
	6:20 PM	938	Rec. Boat	WB												8.00	
	6:57 PM	939	Rec. Boat	EB												4.00	





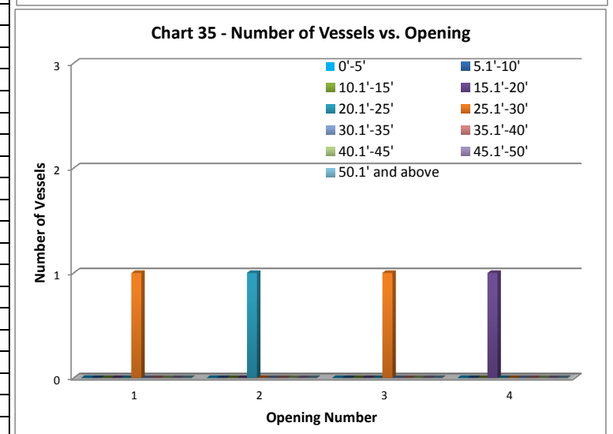
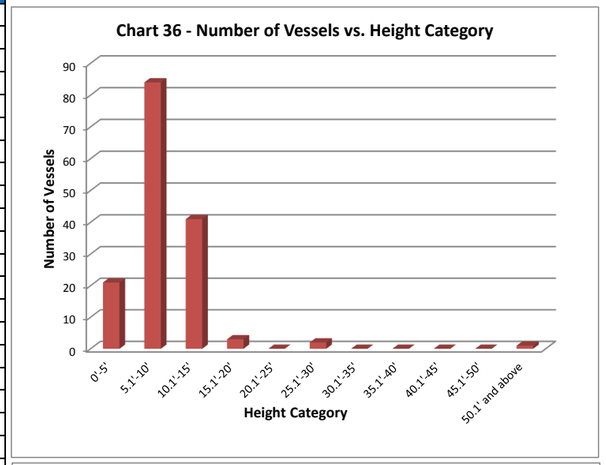
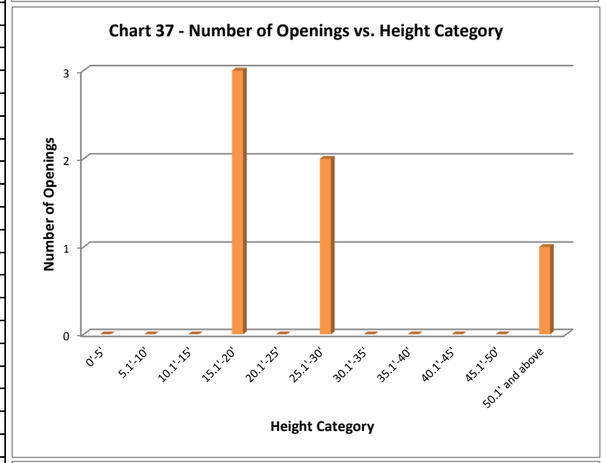


Table B-14 - Survey 1: Day 14 Vessel Survey Data (July 12, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:17 AM	940	Rec. Boat	WB												4.00	
	8:12 AM	941	Rec. Boat	WB												7.00	
	8:20 AM	942	Rec. Boat	EB												4.00	
	8:30 AM	943	Rec. Boat	WB												8.00	
	8:33 AM	944	Rec. Boat	EB												8.00	
	8:37 AM	945	Rec. Boat	EB												4.00	
	8:42 AM	946	Rec. Boat	EB												7.00	
	8:52 AM	947	Rec. Boat	EB												5.00	
	9:12 AM	948	Rec. Boat	WB												8.00	
	9:22 AM	949	Rec. Boat	WB												6.00	
	9:28 AM	950	Rec. Boat	EB												7.00	
	9:35 AM	951	Rec. Boat	WB												7.00	
	9:41 AM	952	Rec. Boat	EB												6.00	
	10:11 AM	953	Rec. Boat	EB												5.00	
1	10:19 AM	954	Comm. Fishing Boat	WB	356	7	58	84	54	57	558.45	84.92	49.68	68.03	0.22	67.81	Miss Melissa
	10:23 AM	955	Rec. Boat	WB												12.00	
	10:24 AM	956	Rec. Boat	EB												8.00	
	10:32 AM	957	Rec. Boat	EB												12.00	
	10:36 AM	958	Rec. Boat	WB												10.00	
	10:39 AM	959	Rec. Boat	WB												2.00	
	10:40 AM	960	Rec. Boat	WB												6.00	
	10:41 AM	961	Rec. Boat	EB												7.00	
	10:47 AM	962	Rec. Boat	WB												7.00	
	10:49 AM	963	Rec. Boat	EB												6.00	
	10:51 AM	964	Rec. Boat	WB												10.00	
	10:55 AM	965	Kayak	EB												3.00	
	10:55 AM	966	Kayak	EB												3.00	
	10:55 AM	967	Kayak	EB												3.00	
	10:56 AM	968	Kayak	EB												3.00	
	10:56 AM	969	Kayak	EB												3.00	
	10:56 AM	970	Kayak	EB												3.00	
2	10:59 AM	971	Rec. Boat	WB	348	45	16	90	1	1	544.65	90.02	-0.16	18.19	0.12	18.07	Rec. Vessel 14
	11:04 AM	972	Rec. Boat	EB												8.00	
	11:05 AM	973	Rec. Boat	WB												8.00	
	11:07 AM	974	Rec. Boat	WB												6.00	
	11:23 AM	975	Rec. Boat	WB												7.00	
3	11:28 AM	976	Rec. Boat	EB	349	11	8	89	10	34	478.26	89.18	6.88	25.23	-0.33	25.56	Rec. Vessel 15
	11:31 AM	977	Rec. Boat	EB												6.00	
	11:58 AM	978	Rec. Boat	WB												8.00	
	11:58 AM	979	Rec. Boat	WB												10.00	
	12:00 PM	980	Rec. Boat	EB												6.00	
	12:09 PM	981	Rec. Boat	WB												7.00	
	12:14 PM	982	Rec. Boat	WB												8.00	
	12:18 PM	983	Rec. Boat	WB												8.00	
	12:18 PM	984	Rec. Boat	EB												8.00	
	12:23 PM	985	Rec. Boat	WB												4.00	
	12:39 PM	986	Rec. Boat	EB												9.00	
	1:01 PM	987	Rec. Boat	WB												6.00	
	1:01 PM	988	Rec. Boat	WB												10.00	
	1:08 PM	989	Rec. Boat	EB												6.00	
	1:12 PM	990	Rec. Boat	WB												8.00	
	1:19 PM	991	Rec. Boat	EB												12.00	
	1:22 PM	992	Rec. Boat	WB												8.00	
	1:25 PM	993	Rec. Boat	EB												12.00	
	1:35 PM	994	Rec. Boat	WB												10.00	
	1:38 PM	995	Rec. Boat	EB												6.00	
	1:40 PM	996	Rec. Boat	EB												5.00	
	1:45 PM	997	Rec. Boat	EB												6.00	
	1:47 PM	998	Rec. Boat	WB												6.00	
	1:47 PM	999	Rec. Boat	EB												6.00	
	1:51 PM	1000	Rec. Boat	WB												5.00	





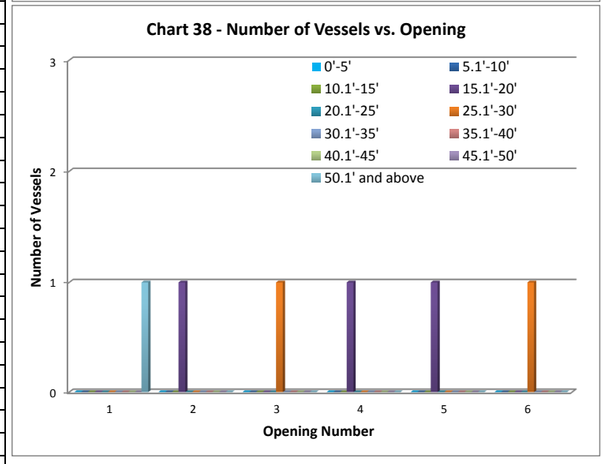


Table B-14 - Survey 1: Day 14 Vessel Survey Data (July 12, 2014)

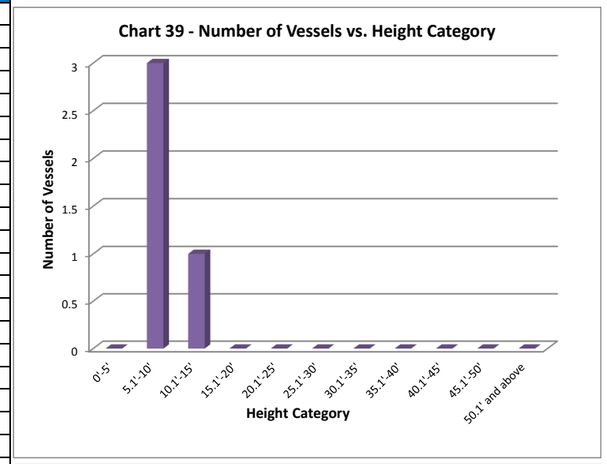
# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	1:58 PM	1001	Rec. Boat	WB												6.00	
	1:59 PM	1002	Rec. Boat	EB												8.00	
	2:03 PM	1003	Rec. Boat	WB												6.00	
	2:10 PM	1004	Rec. Boat	EB												8.00	
	2:12 PM	1005	Rec. Boat	EB												6.00	
	2:15 PM	1006	Rec. Boat	EB												8.00	
	2:16 PM	1007	Rec. Boat	WB												9.00	
	2:20 PM	1008	Sailboat	WB												12.00	
	2:21 PM	1009	Rec. Boat	EB												10.00	
	2:21 PM	1010	Sailboat	WB												12.00	
	2:21 PM	1011	Rec. Boat	WB												8.00	
	2:21 PM	1012	Rec. Boat	WB												7.00	
	2:22 PM	1013	Sailboat	WB												12.00	
	2:24 PM	1014	Sailboat	WB												12.00	
	2:24 PM	1015	Sailboat	WB												12.00	
	2:24 PM	1016	Sailboat	WB												12.00	
	2:24 PM	1017	Sailboat	WB												12.00	
	2:25 PM	1018	Sailboat	WB												12.00	
	2:26 PM	1019	Sailboat	WB												12.00	
	2:26 PM	1020	Sailboat	WB												12.00	
	2:27 PM	1021	Sailboat	WB												12.00	
	2:27 PM	1022	Rec. Boat	WB												7.00	
	2:27 PM	1023	Rec. Boat	EB												8.00	
	2:27 PM	1024	Sailboat	WB												12.00	
	2:27 PM	1025	Rec. Boat	EB												8.00	
	2:28 PM	1026	Sailboat	WB												12.00	
	2:29 PM	1027	Rec. Boat	WB												10.00	
	2:30 PM	1028	Sailboat	WB												12.00	
	2:31 PM	1029	Sailboat	WB												12.00	
	2:31 PM	1030	Sailboat	WB												12.00	
	2:31 PM	1031	Sailboat	WB												12.00	
	2:31 PM	1032	Sailboat	WB												12.00	
	2:31 PM	1033	Sailboat	WB												12.00	
	2:38 PM	1034	Sailboat	WB												12.00	
	2:38 PM	1035	Sailboat	WB												12.00	
	2:38 PM	1036	Sailboat	WB												12.00	
	2:39 PM	1037	Sailboat	WB												12.00	
	2:40 PM	1038	Sailboat	WB												12.00	
	2:40 PM	1039	Sailboat	WB												12.00	
	2:41 PM	1040	Rec. Boat	WB												8.00	
	2:42 PM	1041	Rec. Boat	EB												8.00	
	2:42 PM	1042	Rec. Boat	EB												10.00	
	2:43 PM	1043	Sailboat	WB												12.00	
	2:43 PM	1044	Sailboat	WB												12.00	
	2:43 PM	1045	Sailboat	WB												12.00	
	2:44 PM	1046	Sailboat	WB												12.00	
	2:44 PM	1047	Sailboat	WB												12.00	
	2:44 PM	1048	Sailboat	WB												12.00	
	2:44 PM	1049	Sailboat	WB												12.00	
	2:44 PM	1050	Sailboat	WB												12.00	
	2:45 PM	1051	Sailboat	WB												12.00	
	2:45 PM	1052	Sailboat	WB												12.00	
	2:46 PM	1053	Sailboat	EB												12.00	
	2:46 PM	1054	Rec. Boat	EB												6.00	
	2:47 PM	1055	Rec. Boat	EB												8.00	
	2:48 PM	1056	Rec. Boat	EB												8.00	
	2:55 PM	1057	Rec. Boat	WB												7.00	
	3:07 PM	1058	Rec. Boat	WB												6.00	
	3:08 PM	1059	Rec. Boat	EB												8.00	
	3:09 PM	1060	Rec. Boat	WB												6.00	
	3:11 PM	1061	Rec. Boat	EB												6.00	

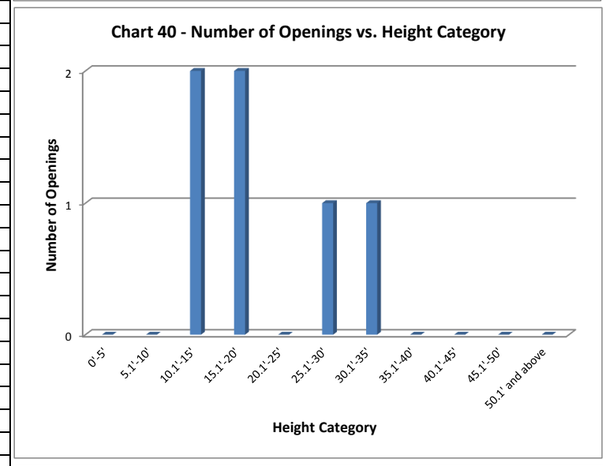
Table B-14 - Survey 1: Day 14 Vessel Survey Data (July 12, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	3:13 PM	1062	Rec. Boat	WB												6.00	
	3:14 PM	1063	Rec. Boat	EB												12.00	
	3:14 PM	1064	Rec. Boat	EB												7.00	
	3:15 PM	1065	Rec. Boat	WB												8.00	
	3:17 PM	1066	Rec. Boat	WB												6.00	
	3:19 PM	1067	Rec. Boat	WB												6.00	
	3:23 PM	1068	Rec. Boat	EB												8.00	
	3:29 PM	1069	Rec. Boat	WB												8.00	
	3:56 PM	1070	Rec. Boat	EB												6.00	
	4:18 PM	1071	Rec. Boat	WB												7.00	
	4:18 PM	1072	Rec. Boat	EB												8.00	
	4:23 PM	1073	Rec. Boat	EB												7.00	
	4:36 PM	1074	Rec. Boat	EB												6.00	
	4:42 PM	1075	Rec. Boat	WB												8.00	
	4:43 PM	1076	Rec. Boat	EB												5.00	
4	5:00 PM	1077	Houseboat	EB	353	7	55	90	10	8	483.81	90.17	-1.43	16.92	-1.08	18.00	Cruz-N
5	5:08 PM	1078	Rec. Boat	EB	346	1	17	89	57	37	475.51	89.96	0.33	18.68	-1.08	19.76	Rec. Vessel 16
	5:35 PM	1079	Rec. Boat	WB												6.00	
	5:42 PM	1080	Rec. Boat	WB												8.00	
	5:49 PM	1081	Rec. Boat	EB												8.00	
	6:00 PM	1082	Rec. Boat	EB												4.00	
	6:03 PM	1083	Rec. Boat	EB												8.00	
	6:16 PM	1084	Rec. Boat	EB												5.00	
	6:21 PM	1085	Rec. Boat	WB												7.00	
	6:21 PM	1086	Rec. Boat	WB												5.00	
	6:28 PM	1087	Rec. Boat	EB												5.00	
	6:31 PM	1088	Rec. Boat	WB												10.00	
	6:40 PM	1089	Rec. Boat	WB												4.00	
	6:40 PM	1090	Rec. Boat	WB												7.00	
6	6:58 PM	1091	Rec. Boat	EB	345	26	56	88	43	50	475.17	88.73	10.53	28.88	-0.03	28.91	Strike 1

Table B-15 - Survey 1: Day 15 Vessel Survey Data (July 13, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:39 AM	1092	Rec. Boat	EB												4.00	
	8:22 AM	1093	Rec. Boat	EB												5.00	
	8:24 AM	1094	Rec. Boat	EB												4.00	
	8:27 AM	1095	Rec. Boat	EB												5.00	
	9:03 AM	1096	Rec. Boat	WB												4.00	
	9:13 AM	1097	Rec. Boat	EB												8.00	
	9:28 AM	1098	Rec. Boat	WB												9.00	
	9:45 AM	1099	Rec. Boat	WB												8.00	
	9:48 AM	1100	Rec. Boat	WB												4.00	
	9:50 AM	1101	Rec. Boat	WB												8.00	
1	9:52 AM	1102	Houseboat	WB	346	29	21	89	58	53	542.33	89.98	0.18	18.38	0.82	17.56	Cruz-N
	9:53 AM	1103	Rec. Boat	EB												8.00	
	10:00 AM	1104	Rec. Boat	WB												8.00	
	10:02 AM	1105	Rec. Boat	WB												5.00	
2	10:12 AM	1106	Rec. Boat	WB	347	37	24	88	44	35	543.38	88.74	11.92	30.12	0.87	29.25	Miss Sherry
	10:28 AM	1107	Rec. Boat	WB												4.00	
	10:40 AM	1108	Rec. Boat	WB												5.00	
	10:48 AM	1109	Rec. Boat	EB												4.00	
	10:57 AM	1110	Rec. Boat	WB												4.00	
	10:58 AM	1111	Rec. Boat	EB												7.00	
	11:00 AM	1112	Rec. Boat	WB												8.00	
	11:17 AM	1113	Rec. Boat	EB												8.00	
	11:20 AM	1114	Rec. Boat	EB												4.00	
	11:38 AM	1115	Houseboat	WB												12.00	
	11:40 AM	1116	Rec. Boat	WB												5.00	
	11:40 AM	1117	Rec. Boat	WB												7.00	
	11:42 AM	1118	Rec. Boat	WB												7.00	
	11:57 AM	1119	Rec. Boat	WB												5.00	
	11:59 AM	1120	Rec. Boat	EB												4.00	
	12:13 PM	1121	Rec. Boat	WB												4.00	
	12:25 PM	1122	Rec. Boat	WB												8.00	
	12:29 PM	1123	Rec. Boat	WB												5.00	
	12:30 PM	1124	Rec. Boat	WB												7.00	
	12:33 PM	1125	Rec. Boat	WB												8.00	
	12:50 PM	1126	Rec. Boat	WB												7.00	
	12:57 PM	1127	Kayak	WB												3.00	
	12:57 PM	1128	Kayak	WB												3.00	
	1:00 PM	1129	Rec. Boat	EB												5.00	
	1:04 PM	1130	Rec. Boat	WB												6.00	
	1:05 PM	1131	Rec. Boat	WB												4.00	
	1:08 PM	1132	Rec. Boat	WB												6.00	
	1:08 PM	1133	Rec. Boat	EB												7.00	
	1:10 PM	1134	Rec. Boat	WB												6.00	
	1:15 PM	1135	Kayak	EB												3.00	
	1:15 PM	1136	Kayak	EB												3.00	
	1:16 PM	1137	Rec. Boat	WB												6.00	
	1:16 PM	1138	Rec. Boat	EB												6.00	
	1:18 PM	1139	Kayak	WB												3.00	
	1:18 PM	1140	Kayak	WB												3.00	
	1:20 PM	1141	Rec. Boat	WB												8.00	
	1:22 PM	1142	Rec. Boat	EB												8.00	
	1:23 PM	1143	Rec. Boat	EB												7.00	
	1:26 PM	1144	Rec. Boat	WB												7.00	
	1:27 PM	1145	Rec. Boat	EB												6.00	
	1:33 PM	1146	Rec. Boat	EB												10.00	
	1:35 PM	1147	Rec. Boat	WB												6.00	
	1:41 PM	1148	Rec. Boat	WB												9.00	
	1:44 PM	1149	Rec. Boat	WB												6.00	
	1:47 PM	1150	Rec. Boat	WB												7.00	
	2:03 PM	1151	Rec. Boat	WB												6.00	
	2:11 PM	1152	Rec. Boat	WB												8.00	





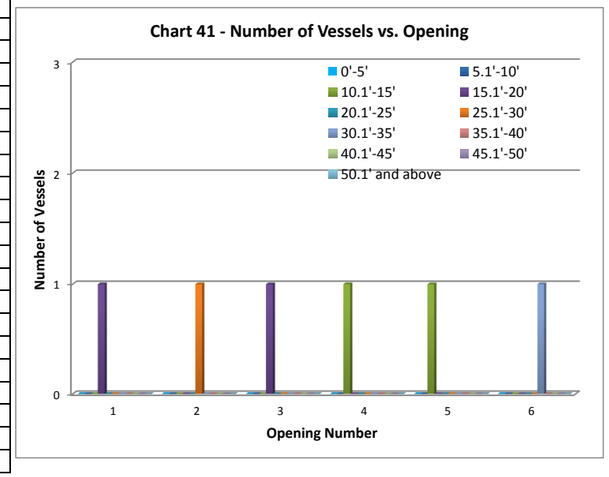


Table B-15 - Survey 1: Day 15 Vessel Survey Data (July 13, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	2:17 PM	1153	Rec. Boat	EB												10.00	
	2:17 PM	1154	Rec. Boat	WB												6.00	
	2:19 PM	1155	Rec. Boat	EB												8.00	
	2:27 PM	1156	Rec. Boat	EB												6.00	
	2:28 PM	1157	Rec. Boat	EB												10.00	
	2:34 PM	1158	Rec. Boat	WB												6.00	Fowl Play
	2:37 PM	1159	Rec. Boat	EB												6.00	
	2:39 PM	1160	Rec. Boat	WB												6.00	
	2:40 PM	1161	Rec. Boat	EB												6.00	
	2:48 PM	1162	Rec. Boat	EB												8.00	
	2:50 PM	1163	Rec. Boat	WB												6.00	
	2:51 PM	1164	Rec. Boat	EB												11.00	
	2:56 PM	1165	Rec. Boat	EB												6.00	
	2:58 PM	1166	Rec. Boat	WB												10.00	
	2:58 PM	1167	Rec. Boat	WB												8.00	
3	3:05 PM	1168	Houseboat	EB	346	41	30	90	21	5	475.97	90.35	-2.92	15.28	-1.13	16.41	Cruz-N
	3:05 PM	1169	Rec. Boat	EB												8.00	
	3:11 PM	1170	Rec. Boat	EB												6.00	
	3:21 PM	1171	Rec. Boat	WB												6.00	
	3:27 PM	1172	Rec. Boat	EB												6.00	
	3:30 PM	1173	Rec. Boat	WB												8.00	
	3:31 PM	1174	Rec. Boat	EB												6.00	
	3:32 PM	1175	Rec. Boat	EB												6.00	
	3:33 PM	1176	Rec. Boat	WB												4.00	
	4:09 PM	1177	Rec. Boat	EB												8.00	
	4:13 PM	1178	Rec. Boat	WB												4.00	
	4:14 PM	1179	Rec. Boat	EB												4.00	
	4:15 PM	1180	Rec. Boat	EB												6.00	
	4:20 PM	1181	Rec. Boat	EB												12.00	
	4:22 PM	1182	Rec. Boat	WB												12.00	
	4:26 PM	1183	Rec. Boat	EB												12.00	
4	4:36 PM	1184	Rec. Boat	WB	343	39	27	90	45	10	540.64	90.75	-7.10	11.10	-1.53	12.63	Isabell
	4:50 PM	1185	Rec. Boat	WB												8.00	
	4:50 PM	1186	Rec. Boat	EB												12.00	
	4:58 PM	1187	Rec. Boat	EB												8.00	
	5:07 PM	1188	Rec. Boat	EB												8.00	
5	5:09 PM	1189	Rec. Boat	EB	346	49	1	90	58	23	476.06	90.97	-8.09	10.11	-1.53	11.64	Isabell
	5:09 PM	1190	Rec. Boat	WB												4.00	
	5:20 PM	1191	Rec. Boat	EB												6.00	
	5:21 PM	1192	Rec. Boat	EB												6.00	
	5:24 PM	1193	Rec. Boat	EB												6.00	
	5:24 PM	1194	Rec. Boat	WB												6.00	
	5:28 PM	1195	Rec. Boat	WB												4.00	
	5:29 PM	1196	Rec. Boat	EB												6.00	
	5:30 PM	1197	Rec. Boat	EB												7.00	
	5:32 PM	1198	Rec. Boat	EB												4.00	
	5:32 PM	1199	Rec. Boat	EB												12.00	
	5:33 PM	1200	Rec. Boat	EB												8.00	
	5:34 PM	1201	Rec. Boat	EB												6.00	
	5:38 PM	1202	Rec. Boat	WB												10.00	
	5:39 PM	1203	Rec. Boat	WB												8.00	
	5:40 PM	1204	Rec. Boat	EB												6.00	
	5:43 PM	1205	Rec. Boat	EB												8.00	
	5:43 PM	1206	Rec. Boat	EB												8.00	
	5:47 PM	1207	Rec. Boat	WB												7.00	
	5:58 PM	1208	Rec. Boat	WB												7.00	
	5:58 PM	1209	Rec. Boat	WB												8.00	
	6:04 PM	1210	Rec. Boat	EB												6.00	
	6:10 PM	1211	Rec. Boat	WB												8.00	
6	6:10 PM	1212	Comm. Fishing Boat	EB	344	7	4	88	40	18	474.56	88.67	11.00	29.20	-1.28	30.48	Lady Jane
	6:11 PM	1213	Rec. Boat	EB												6.00	

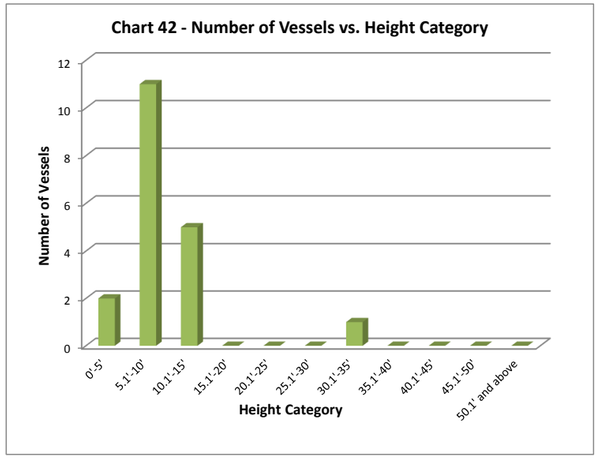
Table B-15 - Survey 1: Day 15 Vessel Survey Data (July 13, 2014)

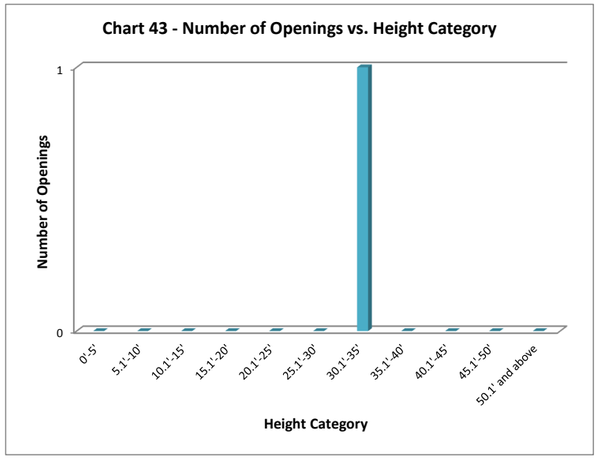
# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	6:13 PM	1214	Rec. Boat	WB												6.00	
	6:24 PM	1215	Rec. Boat	EB												6.00	
	6:27 PM	1216	Rec. Boat	EB												6.00	
	6:29 PM	1217	Rec. Boat	EB												6.00	
	6:31 PM	1218	Rec. Boat	EB												8.00	
	6:42 PM	1219	Rec. Boat	WB												6.00	
	6:45 PM	1220	Rec. Boat	EB												6.00	
	6:45 PM	1221	Rec. Boat	EB												8.00	
	6:50 PM	1222	Rec. Boat	EB												8.00	
	6:52 PM	1223	Rec. Boat	EB												6.00	
	6:58 PM	1224	Rec. Boat	EB												9.00	

Table B-16 through Table B-20:
Survey 1 (August) Daily Vessel Survey Data

Table B-16 - Survey 1: Day 16 Vessel Survey Data (August 20, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:33 AM	1225	Rec. Boat	WB												8.00	
	8:22 AM	1226	Rec. Boat	EB												7.00	
	9:06 AM	1227	Rec. Boat	EB												6.00	
	11:19 AM	1228	Rec. Boat	WB												8.00	
	11:33 AM	1229	Jet Ski	WB												4.00	
	11:57 AM	1230	Rec. Boat	EB												6.00	
	12:13 PM	1231	Rec. Boat	WB												12.00	
	1:19 PM	1232	Rec. Boat	WB												7.00	
	1:49 PM	1233	Jet Ski	EB												4.00	
	2:10 PM	1234	Rec. Boat	EB												12.00	
	2:20 PM	1235	Rec. Boat	WB												12.00	
	2:35 PM	1236	Rec. Boat	WB												6.00	
	2:45 PM	1237	Rec. Boat	EB												6.00	
	2:49 PM	1238	Rec. Boat	EB												12.00	
	2:57 PM	1239	Houseboat	WB												12.00	
	3:45 PM	1240	Rec. Boat	WB												8.00	
	5:30 PM	1241	Rec. Boat	EB												6.00	
	6:21 PM	1242	Rec. Boat	EB												6.00	
1	6:54 PM	1243	Comm. Fishing Boat	WB	349	12	45	88	34	20	545.22	88.57	13.59	32.08	1.42	30.66	Cameron T





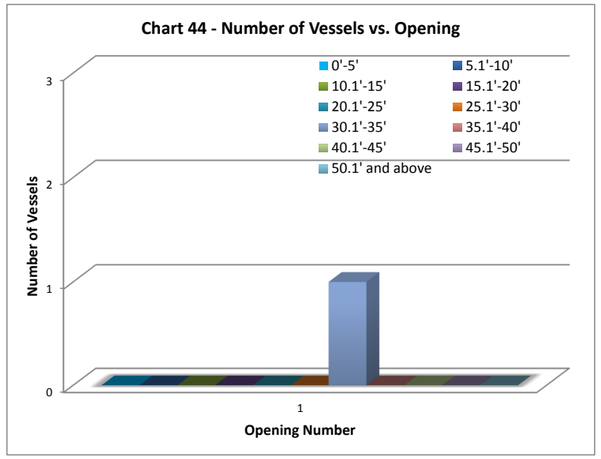


Table B-17 - Survey 1: Day 17 Vessel Survey Data (August 21, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:50 AM	1244	Rec. Boat	EB												10.00	
	9:08 AM	1245	Rec. Boat	EB												5.00	
	9:40 AM	1246	Rec. Boat	EB												5.00	
	9:59 AM	1247	Rec. Boat	WB												10.00	
	11:01 AM	1248	Rec. Boat	WB												7.00	
	11:03 AM	1249	Rec. Boat	WB												10.00	
	11:07 AM	1250	Rec. Boat	WB												10.00	
	11:10 AM	1251	Rec. Boat	WB												6.00	
	11:35 AM	1252	Rec. Boat	EB												8.00	
	1:12 PM	1253	Rec. Boat	EB												10.00	
	2:05 PM	1254	Rec. Boat	WB												7.00	
	2:08 PM	1255	Rec. Boat	EB												7.00	
	3:01 PM	1256	Rec. Boat	EB												10.00	
	3:19 PM	1257	Rec. Boat	EB												8.00	
	3:27 PM	1258	Rec. Boat	WB												10.00	
	3:54 PM	1259	Jet Ski	WB												4.00	
	4:05 PM	1260	Rec. Boat	WB												10.00	
	4:07 PM	1261	Rec. Boat	WB												6.00	
	5:43 PM	1262	Rec. Boat	EB												8.00	
	6:11 PM	1263	Rec. Boat	WB												7.00	
	6:16 PM	1264	Rec. Boat	WB												8.00	

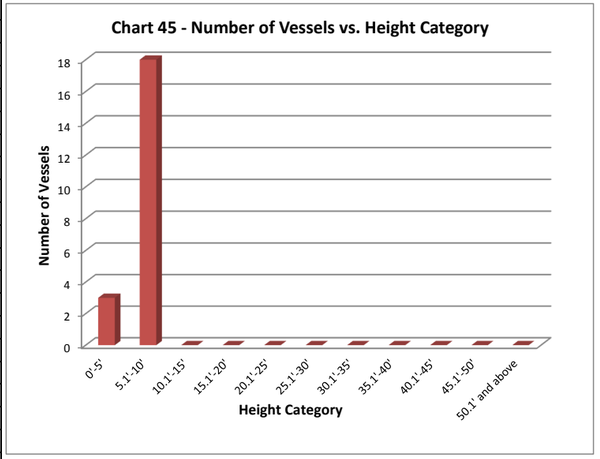
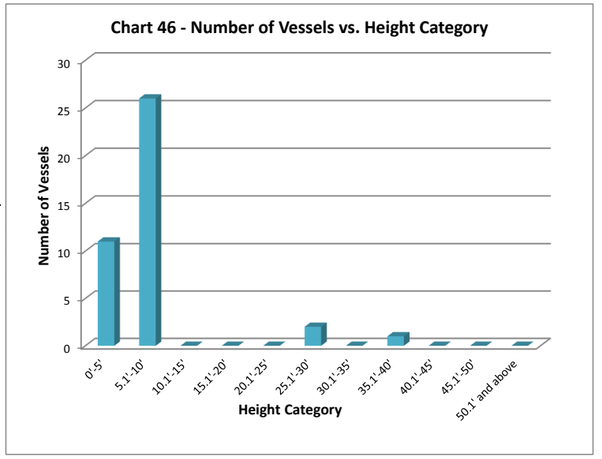
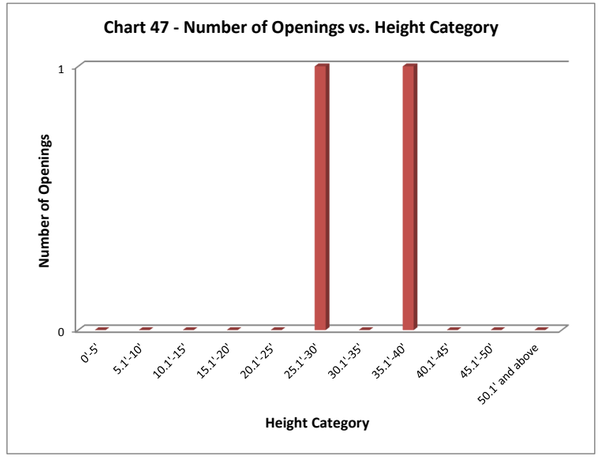


Table B-18 - Survey 1: Day 18 Vessel Survey Data (August 22, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:50 AM	1265	Rec. Boat	EB												5.00	
	9:06 AM	1266	Rec. Boat	EB												6.00	
	9:07 AM	1267	Rec. Boat	EB												4.00	
	9:59 AM	1268	Rec. Boat	WB												8.00	
	10:15 AM	1269	Rec. Boat	WB												6.00	
	10:20 AM	1270	Rec. Boat	WB												8.00	
	10:45 AM	1271	Rec. Boat	EB												10.00	
	10:48 AM	1272	Rec. Boat	EB												10.00	
1	11:05 AM	1273	Barge w/ Backhoe	WB	Unable to measure; estimated heights based on known elevations.											36.00	Captain Charlie
		1274	Barge w/ Backhoe	WB												27.00	Brooks
	11:35 AM	1275	Rec. Boat	WB												4.00	
	12:20 PM	1276	Rec. Boat	WB												7.00	
	12:45 PM	1277	Rec. Boat	EB												4.00	
	12:48 PM	1278	Rec. Boat	WB												5.00	
	12:51 PM	1279	Rec. Boat	WB												6.00	
	1:08 PM	1280	Rec. Boat	WB												10.00	
	1:22 PM	1281	Rec. Boat	EB												6.00	
	1:28 PM	1282	Rec. Boat	WB												6.00	
	1:33 PM	1283	Rec. Boat	WB												6.00	
	1:47 PM	1284	Jet Ski	EB												4.00	
	1:57 PM	1285	Rec. Boat	EB												8.00	
	2:22 PM	1286	Rec. Boat	EB												8.00	
	3:00 PM	1287	Rec. Boat	EB												8.00	
	3:03 PM	1288	Rec. Boat	WB												6.00	
	3:10 PM	1289	Rec. Boat	WB												8.00	
	3:19 PM	1290	Rec. Boat	WB												6.00	
	3:44 PM	1291	Rec. Boat	EB												7.00	
	3:49 PM	1292	Rec. Boat	EB												8.00	
	4:16 PM	1293	Rec. Boat	EB												7.00	
	4:33 PM	1294	Rec. Boat	EB												8.00	
	4:45 PM	1295	Rec. Boat	EB												4.00	
	4:55 PM	1296	Rec. Boat	EB												8.00	
	5:12 PM	1297	Rec. Boat	EB												4.00	
	5:51 PM	1298	Rec. Boat	WB												7.00	
	6:10 PM	1299	Rec. Boat	EB												6.00	
2	6:20 PM	1300	Rec. Boat	WB	349	15	24	88	48	6	545.28	88.80	11.41	29.97	0.82	29.15	Miss Sherry
	6:21 PM	1301	Rec. Boat	WB												4.00	
	6:41 PM	1302	Rec. Boat	EB												7.00	
	6:48 PM	1303	Rec. Boat	WB												4.00	
	6:59 PM	1304	Rec. Boat	EB												4.00	





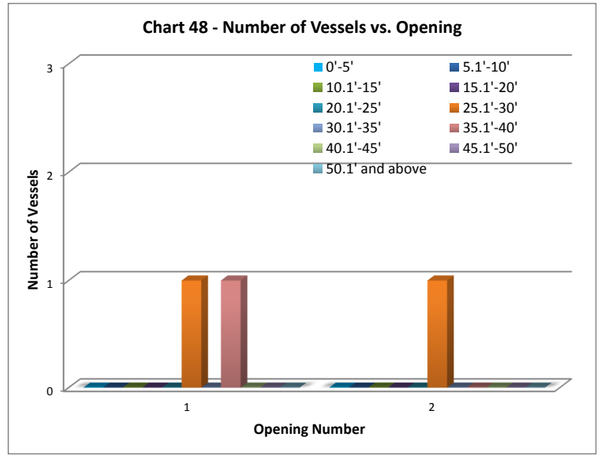
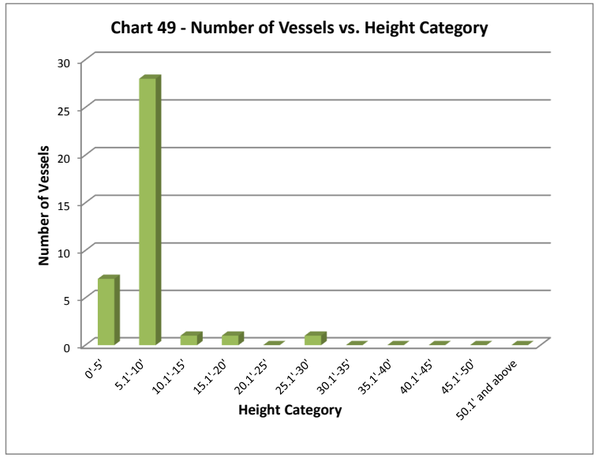
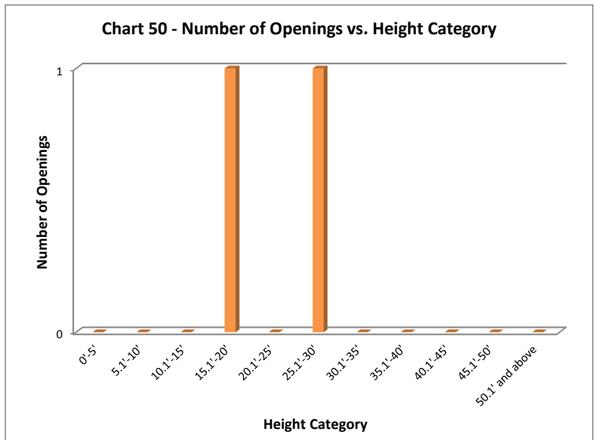


Table B-19 - Survey 1: Day 19 Vessel Survey Data (August 23, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:04 AM	1305	Rec. Boat	WB												10.00	
	8:05 AM	1306	Rec. Boat	EB												9.00	
1	9:42 AM	1307	Rec. Boat	EB	346	39	5	88	34	13	475.94	88.57	11.88	30.55	0.62	29.93	Miss Sherry
	9:44 AM	1308	Rec. Boat	EB												4.00	
	9:48 AM	1309	Rec. Boat	EB												10.00	
	9:59 AM	1310	Rec. Boat	WB												7.00	
	10:02 AM	1311	Rec. Boat	WB												11.00	
	10:44 AM	1312	Rec. Boat	WB												6.00	
	10:48 AM	1313	Rec. Boat	WB												6.00	
	10:49 AM	1314	Rec. Boat	WB												5.00	
	11:23 AM	1315	Rec. Boat	EB												6.00	
	11:26 AM	1316	Rec. Boat	WB												10.00	
	11:39 AM	1317	Rec. Boat	WB												6.00	
	11:56 AM	1318	Rec. Boat	EB												10.00	
	12:05 PM	1319	Rec. Boat	EB												10.00	
	12:35 PM	1320	Rec. Boat	WB												8.00	
	12:55 PM	1321	Rec. Boat	EB												6.00	
	1:03 PM	1322	Rec. Boat	EB												4.00	
	1:30 PM	1323	Rec. Boat	WB												8.00	
	1:39 PM	1324	Rec. Boat	EB												6.00	
	1:41 PM	1325	Rec. Boat	WB												6.00	
	1:44 PM	1326	Rec. Boat	EB												6.00	
	1:58 PM	1327	Rec. Boat	EB												10.00	
	2:13 PM	1328	Rec. Boat	WB												6.00	
	2:59 PM	1329	Rec. Boat	EB												6.00	
	3:12 PM	1330	Rec. Boat	EB												6.00	
	3:20 PM	1331	Rec. Boat	WB												8.00	
	3:27 PM	1332	Rec. Boat	EB												5.00	
	3:28 PM	1333	Rec. Boat	WB												6.00	
	3:29 PM	1334	Rec. Boat	EB												8.00	
	3:30 PM	1335	Rec. Boat	WB												6.00	
	3:37 PM	1336	Rec. Boat	WB												10.00	
	3:59 PM	1337	Rec. Boat	EB												8.00	
	4:03 PM	1338	Rec. Boat	WB												4.00	
2	4:17 PM	1339	Rec. Boat	WB	347	3	8	89	55	54	542.82	89.93	0.65	19.32	-0.18	19.50	Rec. Vessel 17
	4:30 PM	1340	Rec. Boat	EB												10.00	
	4:53 PM	1341	Rec. Boat	EB												4.00	
	5:22 PM	1342	Rec. Boat	EB												4.00	





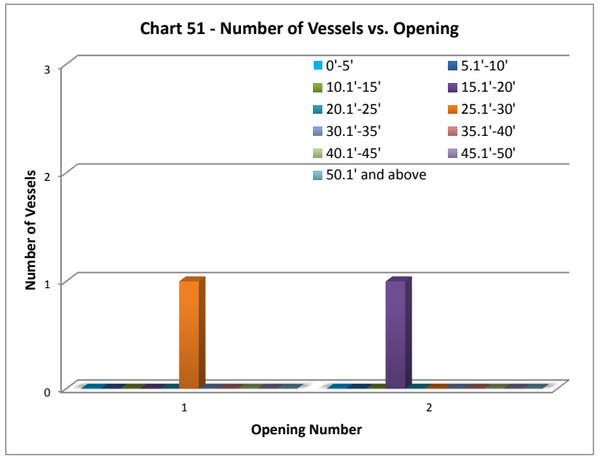
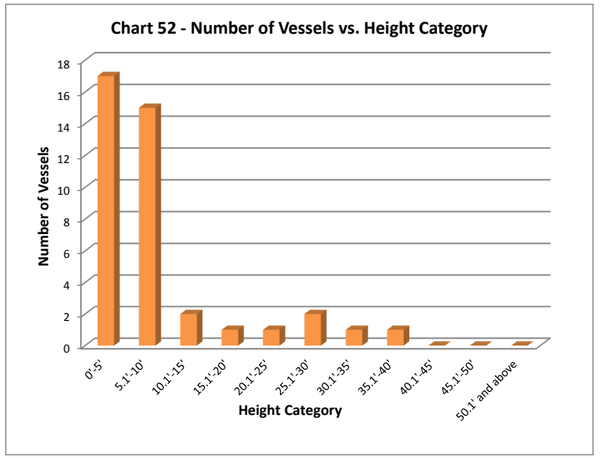
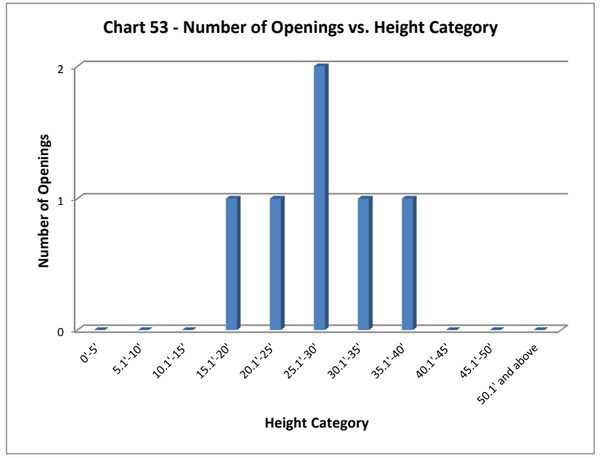


Table B-20 - Survey 1: Day 20 Vessel Survey Data (August 24, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:10 AM	1343	Rec. Boat	WB												4.00	
1	7:15 AM	1344	Rec. Boat	EB	Unable to measure; estimated height based on previous measurement of the same vessel (#1339).											19.50	Rec. Vessel 17
	7:40 AM	1345	Rec. Boat	EB												4.00	
	8:36 AM	1346	Rec. Boat	EB												4.00	
	9:21 AM	1347	Rec. Boat	EB												4.00	
	9:32 AM	1348	Rec. Boat	EB												4.00	
	9:39 AM	1349	Rec. Boat	WB												8.00	
	10:15 AM	1350	Rec. Boat	WB												12.00	
	10:22 AM	1351	Rec. Boat	EB												10.00	
	10:33 AM	1352	Rec. Boat	EB												10.00	
	10:58 AM	1353	Rec. Boat	EB												6.00	
	10:59 AM	1354	Rec. Boat	EB												10.00	
2	11:00 AM	1355	Rec. Boat	WB	344	35	40	89	20	16	541.05	89.34	6.25	24.47	0.87	23.60	Boss
	11:00 AM	1356	Rec. Boat	EB												12.00	
	11:04 AM	1357	Rec. Boat	WB												6.00	
	11:17 AM	1358	Rec. Boat	EB												5.00	
	11:32 AM	1359	Rec. Boat	WB												6.00	
	12:15 PM	1360	Rec. Boat	WB												4.00	
	1:08 PM	1361	Rec. Boat	WB												10.00	
	1:36 PM	1362	Rec. Boat	WB												6.00	
	1:37 PM	1363	Rec. Boat	WB												6.00	
	2:47 PM	1364	Rec. Boat	EB												4.00	
	2:48 PM	1365	Rec. Boat	WB												4.00	
	3:07 PM	1366	Rec. Boat	EB												5.00	
	3:11 PM	1367	Rec. Boat	EB												5.00	
	3:17 PM	1368	Rec. Boat	EB												6.00	
	3:18 PM	1369	Rec. Boat	EB												4.00	
3	3:32 PM	1370	Comm. Fishing Boat	WB	346	37	45	88	48	55	542.44	88.82	11.22	29.44	-0.48	29.92	Miss Gina
	3:31 PM	1371	Rec. Boat	WB												6.00	
4	3:38 PM	1372	Comm. Fishing Boat	WB	345	47	10	88	44	46	541.78	88.75	11.86	30.08	-0.48	30.56	Cameron T
5	4:10 PM	1373	Comm. Fishing Boat	WB	348	12	8	89	5	14	544.00	89.09	8.67	26.89	-0.33	27.22	Miss Sandy
	4:28 PM	1374	Rec. Boat	EB												4.00	
	4:29 PM	1375	Rec. Boat	EB												7.00	
	4:42 PM	1376	Rec. Boat	EB												8.00	
	4:44 PM	1377	Rec. Boat	EB												4.00	
6	5:19 PM	1378	Comm. Fishing Boat	WB	348	19	20	87	56	51	544.14	87.95	19.50	37.72	0.12	37.60	Captain Gunnar
	5:37 PM	1379	Rec. Boat	WB												4.00	
	6:03 PM	1380	Rec. Boat	EB												8.00	
	6:20 PM	1381	Rec. Boat	WB												4.00	
	6:50 PM	1382	Rec. Boat	EB												4.00	





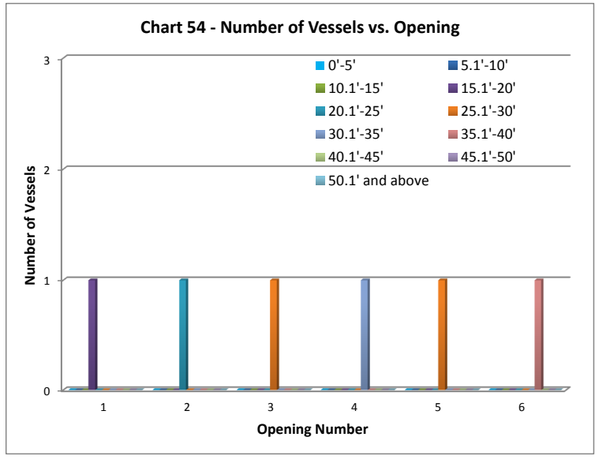
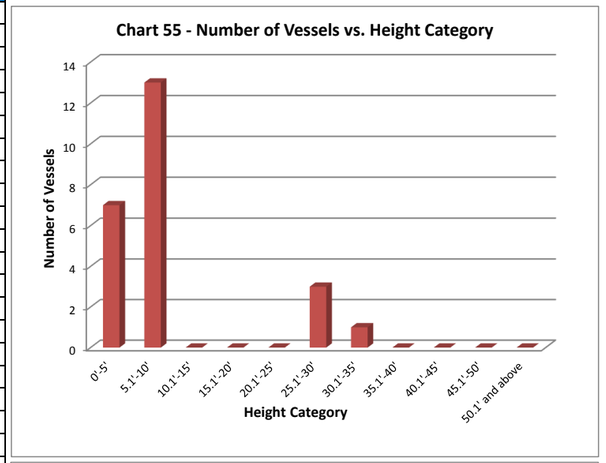
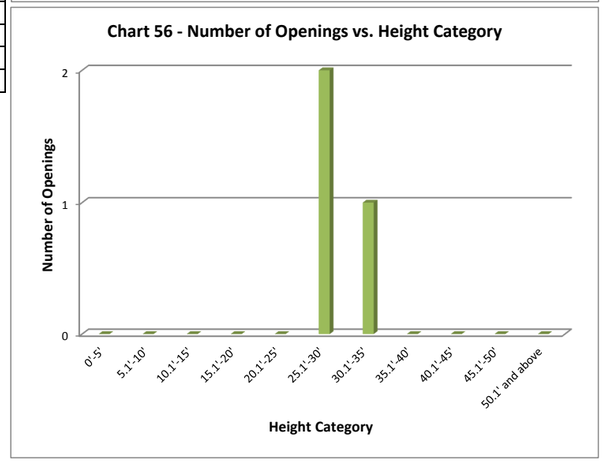


Table B-21 through Table B-25:
Survey 1 (September) Daily Vessel Survey Data

Table B-21 - Survey 1: Day 21 Vessel Survey Data (September 10, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	8:23 AM	1383	Rec. Boat	WB												6.00	
	8:24 AM	1384	Rec. Boat	WB												4.00	
	8:35 AM	1385	Rec. Boat	EB												4.00	
	8:38 AM	1386	Rec. Boat	WB												5.00	
1	9:30 AM	1387	Barge	EB	346	30	10	89	2	30	475.83	89.04	7.96	26.54	1.42	25.12	Whale Tale II
	9:38 AM	1388	Rec. Boat	EB												10.00	
	11:35 AM	1389	Rec. Boat	EB												8.00	
	12:39 PM	1390	Rec. Boat	WB												7.00	
	1:50 PM	1391	Rec. Boat	WB												6.00	
	2:29 PM	1392	Rec. Boat	EB												6.00	
	2:33 PM	1393	Rec. Boat	WB												6.00	
	2:36 PM	1394	Rec. Boat	EB												4.00	
	2:38 PM	1395	Rec. Boat	EB												6.00	
	3:16 PM	1396	Rec. Boat	WB												6.00	
	3:42 PM	1397	Rec. Boat	EB												5.00	
	4:10 PM	1398	Rec. Boat	EB												10.00	
	4:51 PM	1399	Rec. Boat	WB												10.00	
	5:17 PM	1400	Rec. Boat	EB												6.00	
	5:48 PM	1401	Rec. Boat	EB												4.00	
	5:55 PM	1402	Rec. Boat	EB												10.00	
	6:07 PM	1403	Rec. Boat	WB												5.00	
2	6:36 PM	1404	Comm. Fishing Boat	WB	346	24	3	88	39	36	542.25	88.66	12.68	31.26	-0.18	31.44	Mad Lady II
		1405	Comm. Fishing Boat	WB	345	2	47	89	7	30	541.30	89.13	8.27	26.85	-0.18	27.03	Miss Sandy
3	6:58 PM	1406	Comm. Fishing Boat	WB	346	25	42	88	48	31	542.28	88.81	11.28	29.86	0.02	29.84	Cameron D





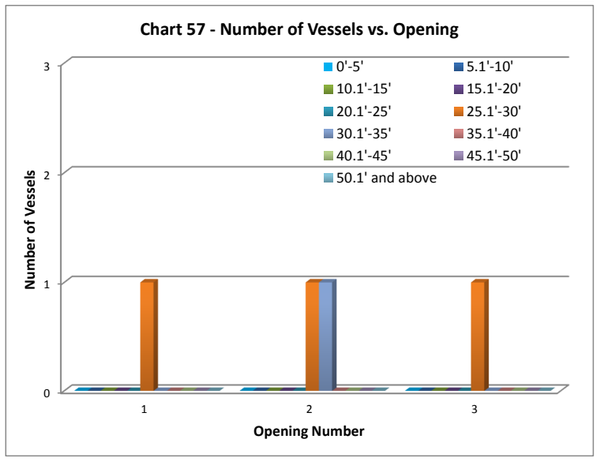
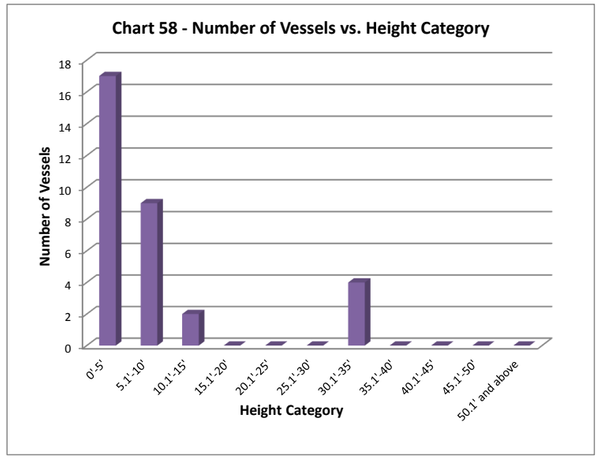
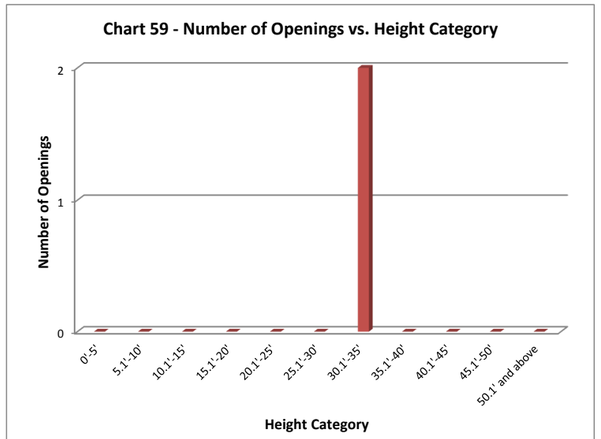


Table B-22 - Survey 1: Day 22 Vessel Survey Data (September 11, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:21 AM	1407	Rec. Boat	WB												5.00	
	8:00 AM	1408	Rec. Boat	WB												8.00	
	8:52 AM	1409	Rec. Boat	EB												4.00	
	9:17 AM	1410	Rec. Boat	WB												5.00	
	10:17 AM	1411	Rec. Boat	EB												7.00	
	10:45 AM	1412	U.S. Coast Guard	EB												11.00	
	10:48 AM	1413	Rec. Boat	WB												6.00	
	11:19 AM	1414	Rec. Boat	WB												4.00	
	11:34 AM	1415	Jet Ski	WB												4.00	
	11:40 AM	1416	Rec. Boat	EB												6.00	
	11:42 AM	1417	Rec. Boat	EB												4.00	
	11:56 AM	1418	U.S. Coast Guard	WB												13.00	
	12:09 PM	1419	Rec. Boat	EB												4.00	
	12:27 PM	1420	Rec. Boat	EB												5.00	
	2:25 PM	1421	Rec. Boat	EB												6.00	
	2:28 PM	1422	Rec. Boat	WB												6.00	
	2:50 PM	1423	Rec. Boat	WB												5.00	
	3:21 PM	1424	Tow Boat	EB												9.00	
	3:24 PM	1425	Jet Ski	EB												4.00	
	3:32 PM	1426	Rec. Boat	EB												6.00	
	4:17 PM	1427	Rec. Boat	WB												4.00	
	4:47 PM	1428	Rec. Boat	EB												6.00	
	5:08 PM	1429	Rec. Boat	EB												4.00	
1	5:25 PM	1430	Comm. Fishing Boat	WB	345	56	47	88	35	42	541.90	88.60	13.29	31.85	-0.68	32.53	Comm. Fishing Vessel 8
	6:15 PM	1431	Rec. Boat	EB												4.00	
	6:17 PM	1432	Rec. Boat	WB												4.00	
	6:17 PM	1433	Rec. Boat	WB												4.00	
2	6:24 PM	1434	Comm. Fishing Boat	WB	348	17	21	88	44	53	544.10	88.75	11.89	30.45	-0.73	31.18	Miss Gina
		1435	Comm. Fishing Boat	WB	347	2	36	88	41	24	542.81	88.69	12.41	30.97	-0.73	31.70	Mad Lady II
		1436	Comm. Fishing Boat	EB	347	19	22	88	33	9	476.46	88.55	12.04	30.60	-0.73	31.33	Captain Gunnar
	6:42 PM	1437	Rec. Boat	WB												5.00	
	6:48 PM	1438	Rec. Boat	EB												4.00	





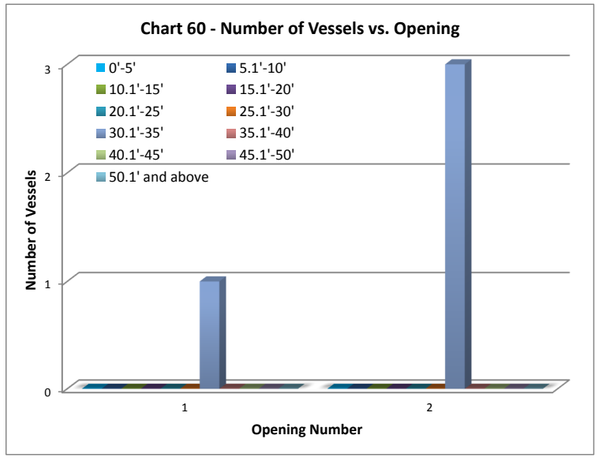
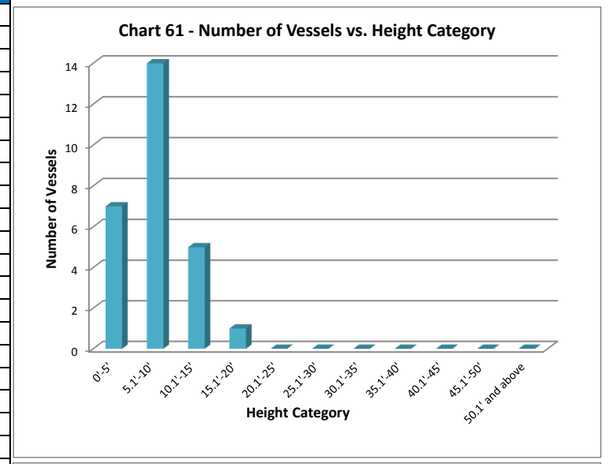
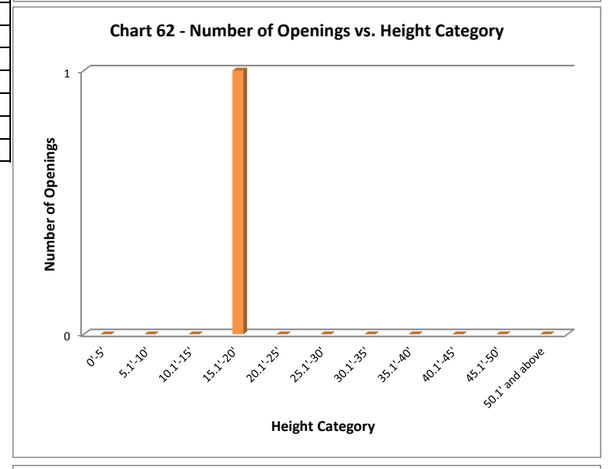


Table B-23 - Survey 1: Day 23 Vessel Survey Data (September 12, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:30 AM	1439	Rec. Boat	EB												4.00	
	7:55 AM	1440	Rec. Boat	EB												7.00	
	8:06 AM	1441	U.S. Coast Guard	EB												14.00	
1	9:02 AM	1442	U.S. Coast Guard	WB	346	40	46	90	16	4	542.49	90.27	-2.54	16.06	0.12	15.94	
	9:01 AM	1443	Rec. Boat	WB												4.00	
	9:49 AM	1444	Rec. Boat	EB												4.00	
	9:50 AM	1445	Rec. Boat	WB												8.00	
	9:51 AM	1446	Rec. Boat	WB												4.00	
	10:06 AM	1447	Rec. Boat	EB												8.00	
	10:06 AM	1448	Rec. Boat	EB												6.00	
	10:07 AM	1449	Rec. Boat	EB												11.00	
	10:07 AM	1450	Rec. Boat	EB												6.00	
	10:44 AM	1451	Rec. Boat	WB												10.00	
	11:23 AM	1452	Tow Boat	EB												12.00	
	11:33 AM	1453	Rec. Boat	WB												5.00	
	11:35 AM	1454	Tow Boat	WB												12.00	
	11:35 AM	1455	Rec. Boat	WB												6.00	
	12:39 PM	1456	Rec. Boat	WB												4.00	
	12:59 PM	1457	Rec. Boat	EB												12.00	
	1:01 PM	1458	Rec. Boat	EB												7.00	
	1:21 PM	1459	Rec. Boat	WB												7.00	
	1:46 PM	1460	Rec. Boat	WB												6.00	
	3:51 PM	1461	Rec. Boat	EB												7.00	
	4:14 PM	1462	Rec. Boat	EB												8.00	
	4:31 PM	1463	Rec. Boat	EB												7.00	
	5:44 PM	1464	Rec. Boat	WB												8.00	
	6:19 PM	1465	Rec. Boat	EB												4.00	





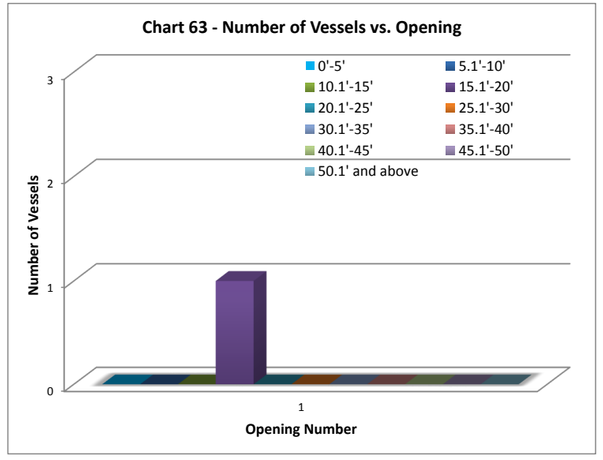
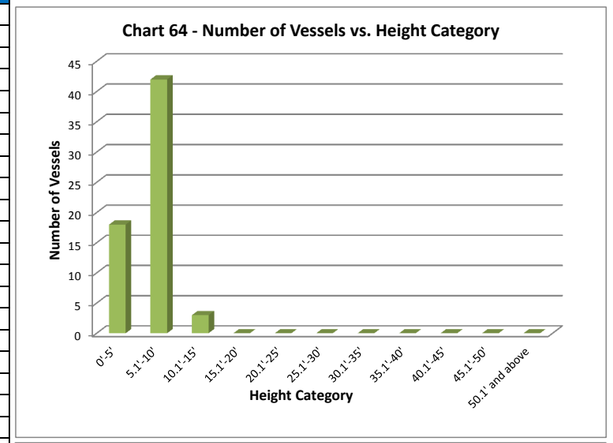
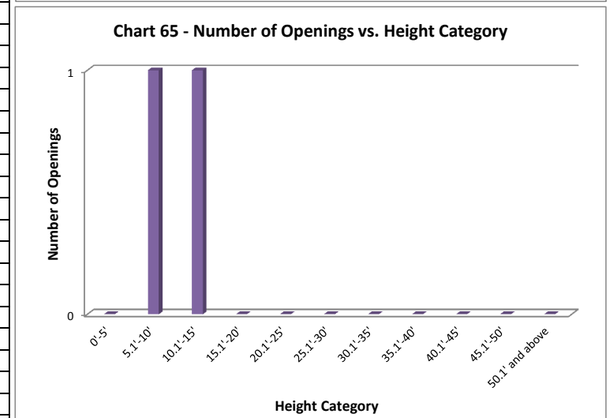


Table B-24 - Survey 1: Day 24 Vessel Survey Data (September 13, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:46 AM	1466	Rec. Boat	EB												9.00	
	8:27 AM	1467	Rec. Boat	EB												5.00	
	9:16 AM	1468	U.S. Coast Guard	EB												14.00	
	9:48 AM	1469	Rec. Boat	WB												7.00	
	9:48 AM	1470	Rec. Boat	WB												8.00	
	10:05 AM	1471	Rec. Boat	EB												7.00	
	10:06 AM	1472	Rec. Boat	WB												8.00	
	10:08 AM	1473	Rec. Boat	EB												5.00	
	10:15 AM	1474	Jet Ski	EB												4.00	
	10:15 AM	1475	Jet Ski	EB												4.00	
	10:24 AM	1476	Rec. Boat	WB												6.00	
	10:31 AM	1477	Rec. Boat	EB												8.00	
	10:41 AM	1478	Jet Ski	WB												4.00	
	10:41 AM	1479	Jet Ski	WB												4.00	
	10:41 AM	1480	Rec. Boat	EB												8.00	
	10:48 AM	1481	Rec. Boat	WB												8.00	
	11:04 AM	1482	Rec. Boat	WB												10.00	
	11:06 AM	1483	Rec. Boat	WB												8.00	
	11:35 AM	1484	Rec. Boat	WB												5.00	
	11:39 AM	1485	Rec. Boat	WB												6.00	
	11:41 AM	1486	Kayak	WB												3.00	
	11:42 AM	1487	Rec. Boat	WB												9.00	
	12:22 PM	1488	Rec. Boat	EB												9.00	
	12:22 PM	1489	Rec. Boat	EB												9.00	
	12:34 PM	1490	Rec. Boat	EB												6.00	
	12:51 PM	1491	Rec. Boat	WB												7.00	
	12:59 PM	1492	Rec. Boat	WB												6.00	
	1:19 PM	1493	Rec. Boat	WB												8.00	
	1:34 PM	1494	Rec. Boat	EB												6.00	
	1:43 PM	1495	Rec. Boat	WB												10.00	
	1:47 PM	1496	Rec. Boat	WB												6.00	
	1:48 PM	1497	Rec. Boat	WB												6.00	
	1:52 PM	1498	Rec. Boat	EB												6.00	
	2:06 PM	1499	Rec. Boat	WB												6.00	
	2:07 PM	1500	Rec. Boat	EB												12.00	
	2:07 PM	1501	Rec. Boat	EB												10.00	
	2:14 PM	1502	Rec. Boat	EB												8.00	
	2:27 PM	1503	Rec. Boat	EB												8.00	
	2:32 PM	1504	Jet Ski	WB												4.00	
	2:32 PM	1505	Jet Ski	WB												4.00	
	2:48 PM	1506	Rec. Boat	WB												8.00	
	3:06 PM	1507	Rec. Boat	EB												8.00	
	3:40 PM	1508	Rec. Boat	EB												9.00	
	3:51 PM	1509	Rec. Boat	EB												8.00	
1	4:04 PM	1510	Rec. Boat	WB	347	3	5	90	52	8	542.82	90.87	-8.23	10.49	0.72	9.77	Isabell
	4:19 PM	1511	Rec. Boat	WB												8.00	
	4:28 PM	1512	Rec. Boat	WB												8.00	
	4:28 PM	1513	Rec. Boat	WB												8.00	
	4:30 PM	1514	Rec. Boat	WB												5.00	
	4:34 PM	1515	Rec. Boat	EB												5.00	
	4:38 PM	1516	Rec. Boat	WB												8.00	
	4:40 PM	1517	Rec. Boat	EB												5.00	
	4:45 PM	1518	Rec. Boat	WB												7.00	
	4:54 PM	1519	Rec. Boat	WB												8.00	
	5:27 PM	1520	Rec. Boat	EB												7.00	
	5:30 PM	1521	Rec. Boat	EB												5.00	
	5:40 PM	1522	Rec. Boat	WB												4.00	
	5:49 PM	1523	Rec. Boat	EB												7.00	
	5:54 PM	1524	Rec. Boat	EB												7.00	
	6:10 PM	1525	Rec. Boat	WB												4.00	
2	6:30 PM	1526	Rec. Boat	EB	346	12	51	90	56	54	475.63	90.95	-7.87	10.85	-0.08	10.93	Isabell
	6:38 PM	1527	Rec. Boat	EB												4.00	
	6:39 PM	1528	Rec. Boat	EB												4.00	





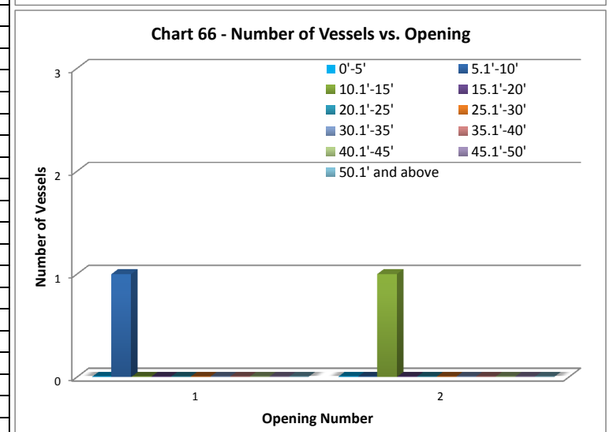
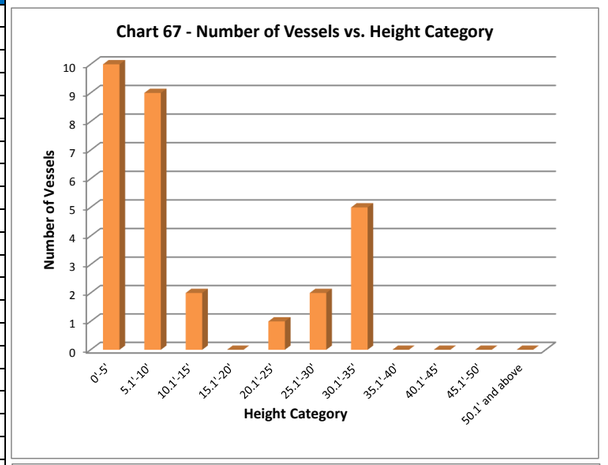
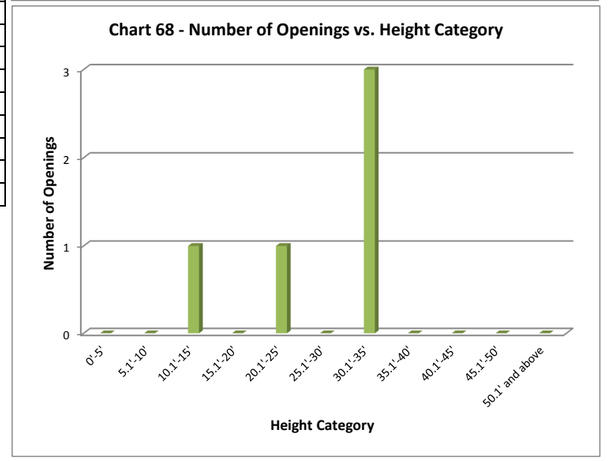


Table B-25 - Survey 1: Day 25 Vessel Survey Data (September 14, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:15 AM	1529	Rec. Boat	EB												7.00	
	8:50 AM	1530	Rec. Boat	EB												5.00	
	8:51 AM	1531	Rec. Boat	EB												5.00	
	9:32 AM	1532	Rec. Boat	EB												4.00	
	9:58 AM	1533	Rec. Boat	EB												8.00	
	9:58 AM	1534	Rec. Boat	EB												4.00	
	10:30 AM	1535	Rec. Boat	EB												10.00	
	10:44 AM	1536	Rec. Boat	WB												5.00	
	10:50 AM	1537	Rec. Boat	WB												4.00	
	11:17 AM	1538	Tow Boat	EB												10.00	
	11:44 AM	1539	Rec. Boat	WB												9.00	
	12:31 PM	1540	Rec. Boat	WB												4.00	
	12:57 PM	1541	Rec. Boat	EB												8.00	
1	1:07 PM	1542	Tow Boat	EB	346	35	33	90	34	10	475.89	90.57	-4.73	13.93	1.67	12.26	On-Water Service Vessel 2
	1:20 PM	1543	Rec. Boat	EB												4.00	
	1:57 PM	1544	Rec. Boat	EB												10.00	
	1:58 PM	1545	Rec. Boat	WB												4.00	
	2:43 PM	1546	Tow Boat	WB												12.00	
2	3:31 PM	1547	Comm. Fishing Boat	WB	348	28	11	89	10	1	544.31	89.17	7.91	26.57	1.32	25.25	Pissed Off Pearl
		1548	Comm. Fishing Boat	WB	345	29	53	88	35	17	541.58	88.59	13.35	32.01	1.32	30.69	Cameron T
		1549	Comm. Fishing Boat	WB	340	36	32	88	33	15	540.30	88.55	13.64	32.30	1.32	30.98	Miss Gina
3	3:52 PM	1550	Comm. Fishing Boat	WB	345	37	15	88	58	22	541.67	88.97	9.71	28.37	1.32	27.05	Miss Sandy
		1551	Comm. Fishing Boat	WB	345	15	54	88	28	22	541.43	88.47	14.44	33.10	1.32	31.78	Comm. Fishing Vessel 9
		1552	Comm. Fishing Boat	WB	347	41	35	88	17	2	543.45	88.28	16.28	34.94	1.32	33.62	Wanda Gale
4	4:07 PM	1553	Comm. Fishing Boat	WB	346	18	51	88	36	9	542.18	88.60	13.23	31.89	1.22	30.67	Comm. Fishing Vessel 10
	4:31 PM	1554	Rec. Boat	EB												8.00	
	5:04 PM	1555	Rec. Boat	EB												5.00	
5	6:05 PM	1556	Comm. Fishing Boat	EB	347	5	56	89	10	32	476.28	89.18	6.85	25.51	0.52	24.99	Comm. Fishing Vessel 11
	6:32 PM	1557	Rec. Boat	EB												8.00	





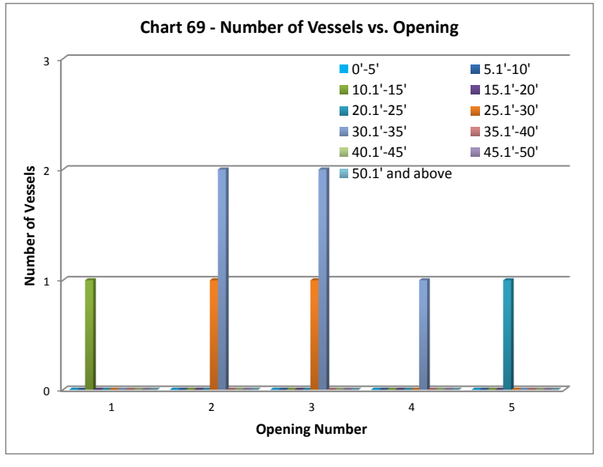
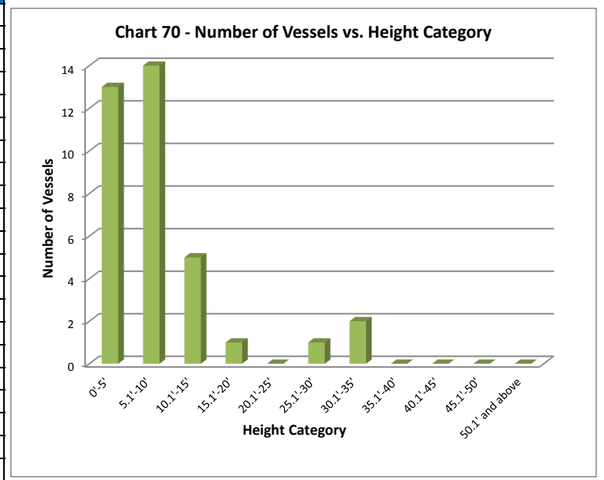
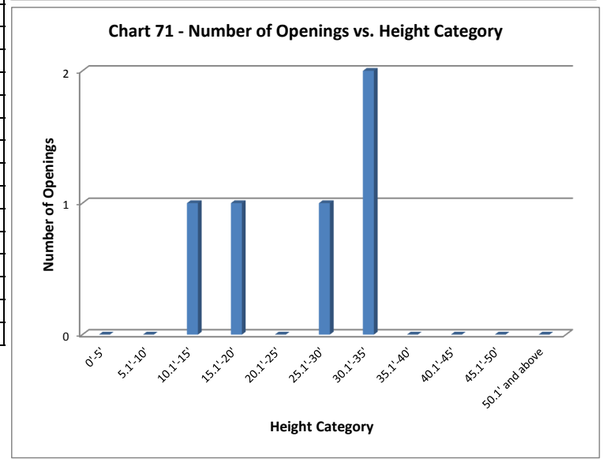


Table B-26 through Table B-30:
Survey 1 (October) Daily Vessel Survey Data

Table B-26 - Survey 1: Day 26 Vessel Survey Data (October 2, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	8:16 AM	1558	Rec. Boat	EB												7.00	
	8:19 AM	1559	Rec. Boat	WB												7.00	
	9:03 AM	1560	Rec. Boat	WB												5.00	
1	10:02 AM	1561	Houseboat	WB	345	18	8	90	50	10	541.46	90.84	-7.90	10.64	-0.73	11.37	Miss Darlene
		1562	Rec. Boat	EB	345	18	8	90	50	10	475.09	90.84	-6.93	11.61	-0.73	12.34	Rec. Vessel 18
	10:06 AM	1563	Rec. Boat	EB												4.00	
	10:11 AM	1564	Rec. Boat	WB												4.00	
	10:36 AM	1565	Rec. Boat	WB												8.00	
	11:02 AM	1566	Rec. Boat	WB												8.00	
	11:21 AM	1567	Rec. Boat	WB												9.00	
	11:22 AM	1568	Rec. Boat	EB												4.00	
	11:23 AM	1569	Rec. Boat	WB												6.00	
	11:29 AM	1570	Tow Boat	EB												12.00	
	11:32 AM	1571	Rec. Boat	WB												4.00	
	11:33 AM	1572	Tow Boat	WB												12.00	
	11:33 AM	1573	Rec. Boat	EB												4.00	
	12:27 PM	1574	Rec. Boat	WB												12.00	
	12:29 PM	1575	Rec. Boat	EB												6.00	
	12:41 PM	1576	Rec. Boat	WB												4.00	
	12:45 PM	1577	Rec. Boat	WB												6.00	
	1:07 PM	1578	Rec. Boat	WB												6.00	
	1:22 PM	1579	Rec. Boat	WB												4.00	
	1:22 PM	1580	Rec. Boat	EB												6.00	
	1:30 PM	1581	Rec. Boat	EB												7.00	
	2:39 PM	1582	Kayak	WB												4.00	
	2:57 PM	1583	Rec. Boat	EB												10.00	
	3:04 PM	1584	Rec. Boat	EB												8.00	
	3:43 PM	1585	Rec. Boat	EB												5.00	
	4:53 PM	1586	Rec. Boat	EB												5.00	
2	5:06 PM	1587	Rec. Boat	EB	348	22	1	88	38	3	477.40	88.63	11.38	29.92	1.32	28.60	Strike 1
3	5:22 PM	1588	Comm. Fishing Boat	WB	346	54	54	89	45	47	542.70	89.76	2.24	20.78	1.22	19.56	Little One
	5:26 PM	1589	Rec. Boat	WB												5.00	
	5:37 PM	1590	Rec. Boat	EB												8.00	
4	6:00 PM	1591	Comm. Fishing Boat	WB	345	20	8	88	37	58	541.48	88.63	12.92	31.46	1.02	30.44	Cameron T
5	6:10 PM	1592	Comm. Fishing Boat	WB	347	30	39	88	28	47	543.27	88.48	14.42	32.96	1.02	31.94	Mad Lady
	6:56 PM	1593	Rec. Boat	EB												4.00	





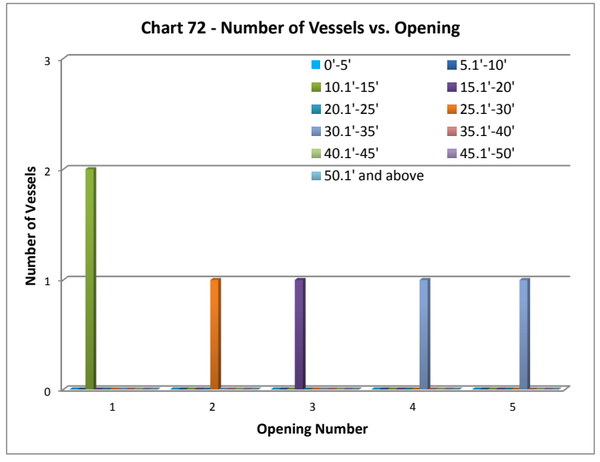
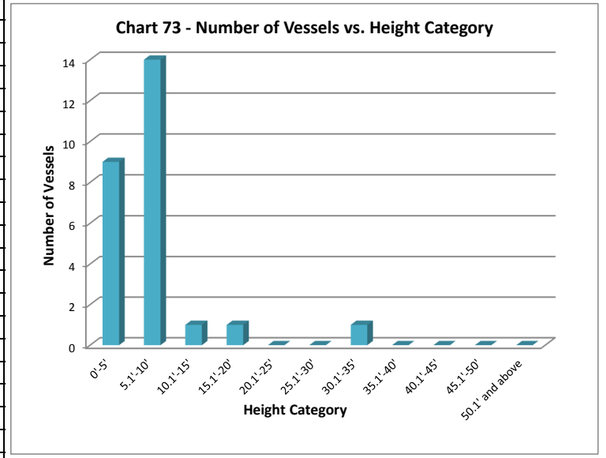
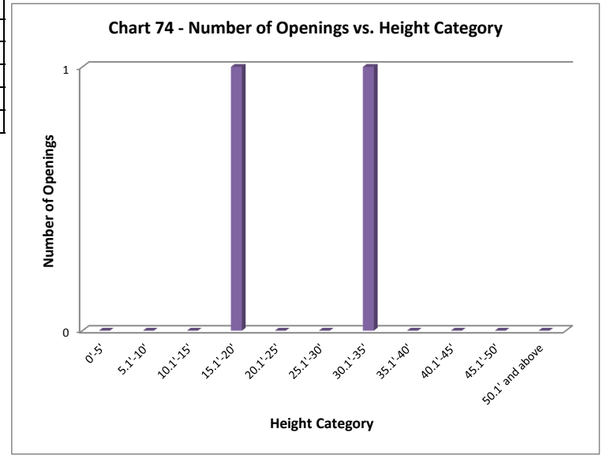


Table B-27 - Survey 1: Day 27 Vessel Survey Data (October 3, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:33 AM	1594	Rec. Boat	EB												8.00	
	8:09 AM	1595	Rec. Boat	WB												7.00	
	8:47 AM	1596	Rec. Boat	WB												5.00	
	8:51 AM	1597	Rec. Boat	EB												5.00	
	9:32 AM	1598	Rec. Boat	WB												9.00	
	10:32 AM	1599	Rec. Boat	WB												6.00	
	10:40 AM	1600	Rec. Boat	EB												9.00	
	11:29 AM	1601	Rec. Boat	EB												7.00	
	1:02 PM	1602	Rec. Boat	EB												12.00	
	2:24 PM	1603	Rec. Boat	EB												5.00	
1	2:46 PM	1604	Rec. Boat	EB	346	21	21	89	54	20	475.73	89.91	0.78	19.46	1.07	18.39	Cape Town Queen
	2:56 PM	1605	Rec. Boat	WB												6.00	
	2:57 PM	1606	Rec. Boat	WB												6.00	
	3:09 PM	1607	Rec. Boat	WB												7.00	
	3:29 PM	1608	Rec. Boat	EB												5.00	
	4:30 PM	1609	Rec. Boat	EB												5.00	
	4:33 PM	1610	Rec. Boat	WB												7.00	
	4:54 PM	1611	Rec. Boat	EB												4.00	
	5:01 PM	1612	Rec. Boat	WB												6.00	
	5:16 PM	1613	Rec. Boat	WB												8.00	
	5:27 PM	1614	Rec. Boat	EB												4.00	
	5:41 PM	1615	Rec. Boat	WB												4.00	
	6:09 PM	1616	Rec. Boat	EB												9.00	
2	6:15 PM	1617	Rec. Boat	WB	346	4	30	88	33	20	542.00	88.56	13.67	32.25	1.72	30.53	Cameron T
	6:47 PM	1618	Rec. Boat	WB												6.00	
	6:48 PM	1619	Rec. Boat	WB												4.00	





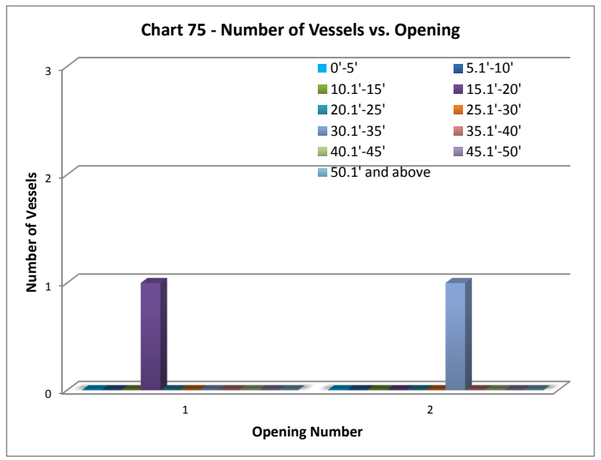
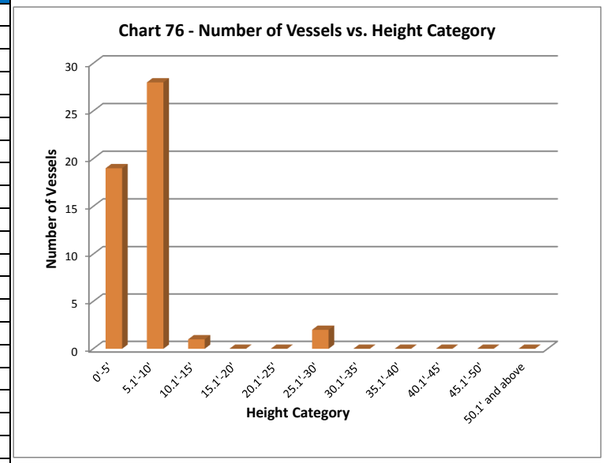
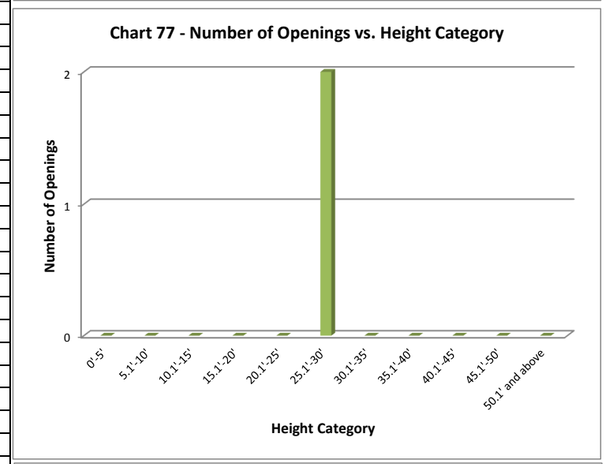


Table B-28 - Survey 1: Day 28 Vessel Survey Data (October 4, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	8:25 AM	1620	Rec. Boat	EB												4.00	
	9:14 AM	1621	Rec. Boat	EB												5.00	
	9:52 AM	1622	Rec. Boat	EB												5.00	
	9:54 AM	1623	Rec. Boat	WB												10.00	
	9:55 AM	1624	Rec. Boat	EB												5.00	
	10:04 AM	1625	Rec. Boat	WB												5.00	
1	10:41 AM	1626	Rec. Boat	WB	346	23	1	89	7	52	542.24	89.13	8.22	26.95	-0.38	27.33	Strike 1
	10:59 AM	1627	Rec. Boat	WB												6.00	
	11:16 AM	1628	Rec. Boat	WB												5.00	
	11:16 AM	1629	Rec. Boat	WB												9.00	
	11:34 AM	1630	Rec. Boat	WB												4.00	
	11:43 AM	1631	Rec. Boat	WB												9.00	
	11:58 AM	1632	Rec. Boat	EB												11.00	
	12:08 PM	1633	Rec. Boat	WB												10.00	
	12:23 PM	1634	Rec. Boat	EB												7.00	
	12:28 PM	1635	Rec. Boat	WB												7.00	
	12:35 PM	1636	Rec. Boat	EB												8.00	
	12:36 PM	1637	Rec. Boat	WB												6.00	
	12:40 PM	1638	Rec. Boat	EB												8.00	
	12:46 PM	1639	Rec. Boat	WB												9.00	
	12:50 PM	1640	Rec. Boat	WB												8.00	
	12:58 PM	1641	Rec. Boat	WB												9.00	
	1:00 PM	1642	Rec. Boat	EB												5.00	
	1:01 PM	1643	Rec. Boat	EB												10.00	
	1:11 PM	1644	Rec. Boat	EB												5.00	
	1:31 PM	1645	Rec. Boat	EB												8.00	
	1:36 PM	1646	Rec. Boat	WB												8.00	
	1:52 PM	1647	Rec. Boat	WB												6.00	
	2:04 PM	1648	Rec. Boat	WB												8.00	
	2:17 PM	1649	Rec. Boat	EB												7.00	
	2:19 PM	1650	Rec. Boat	EB												9.00	
	2:29 PM	1651	Rec. Boat	WB												10.00	
	3:15 PM	1652	Rec. Boat	WB												4.00	
	3:15 PM	1653	Rec. Boat	WB												5.00	
	3:26 PM	1654	Rec. Boat	EB												6.00	
	3:35 PM	1655	Rec. Boat	WB												9.00	
	3:40 PM	1656	Rec. Boat	WB												4.00	
	3:46 PM	1657	Rec. Boat	WB												8.00	
2	3:56 PM	1658	Rec. Boat	EB	343	21	35	88	41	15	474.33	88.69	10.87	29.60	1.02	28.58	Strike 1
	4:03 PM	1659	Rec. Boat	EB												6.00	
	4:07 PM	1660	Rec. Boat	EB												4.00	
	4:19 PM	1661	Rec. Boat	WB												4.00	
	4:26 PM	1662	Rec. Boat	WB												4.00	
	4:26 PM	1663	Rec. Boat	EB												5.00	
	4:42 PM	1664	Rec. Boat	WB												8.00	
	4:42 PM	1665	Rec. Boat	WB												8.00	
	5:12 PM	1666	Rec. Boat	EB												7.00	
	5:39 PM	1667	Rec. Boat	EB												4.00	
	6:14 PM	1668	Rec. Boat	EB												5.00	
	6:16 PM	1669	Rec. Boat	EB												4.00	





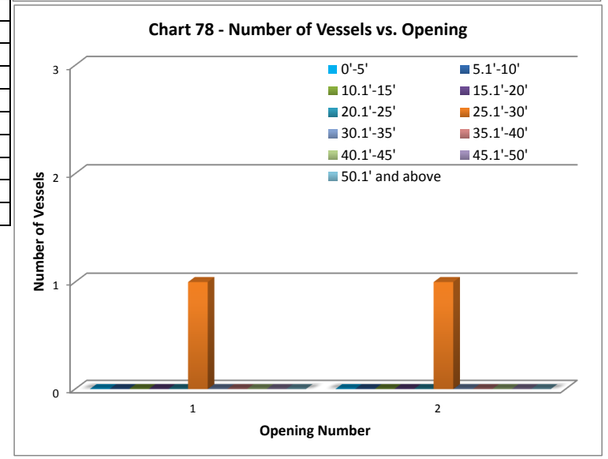
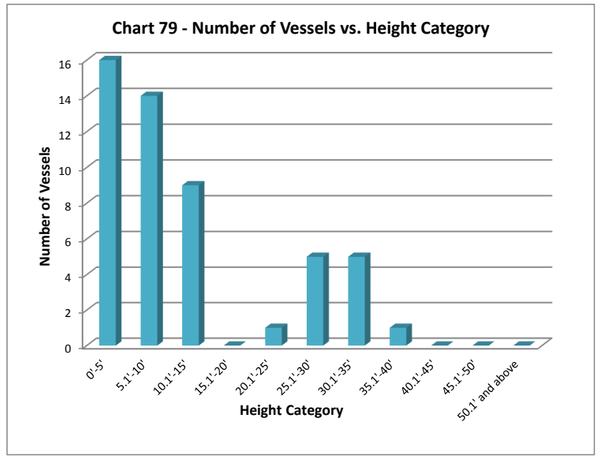
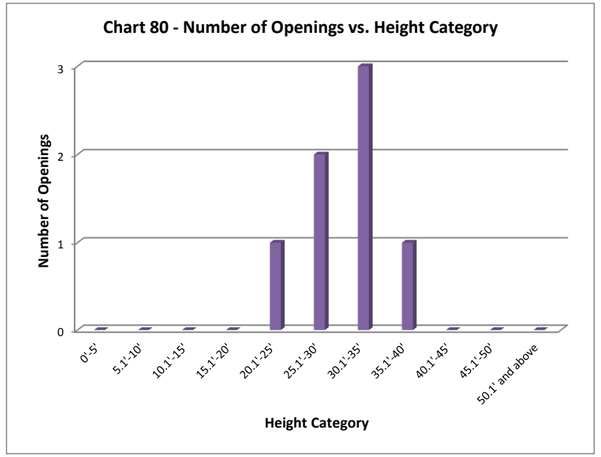


Table B-29 - Survey 1: Day 29 Vessel Survey Data (October 5, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
	7:00 AM	1670	Rec. Boat	WB												4.00	
	7:03 AM	1671	Rec. Boat	WB												4.00	
	8:22 AM	1672	Rec. Boat	EB												8.00	
	8:45 AM	1673	Rec. Boat	EB												5.00	
1	9:06 AM	1674	Comm. Fishing Boat	WB	347	46	10	88	39	50	543.53	88.66	12.68	31.17	1.02	30.15	Cameron T
		1675	Comm. Fishing Boat	WB	346	15	14	88	35	30	542.14	88.59	13.33	31.82	1.02	30.80	Comm. Fishing Vessel 12
		1676	Comm. Fishing Boat	WB	346	28	49	88	58	10	542.32	88.97	9.76	28.25	1.02	27.23	Miss Sandy
		1677	Comm. Fishing Boat	WB	347	7	11	89	11	55	542.89	89.20	7.59	26.08	1.02	25.06	Comm. Fishing Vessel 13
		1678	Comm. Fishing Boat	WB	345	28	45	88	29	8	541.57	88.49	14.32	32.81	1.02	31.79	Mad Lady II
	9:36 AM	1679	Rec. Boat	EB												8.00	
	10:07 AM	1680	Rec. Boat	WB												8.00	
	10:21 AM	1681	Rec. Boat	WB												5.00	
	10:26 AM	1682	Rec. Boat	EB												11.00	
	10:31 AM	1683	Rec. Boat	WB												11.00	
	10:54 AM	1684	Rec. Boat	WB												8.00	
	10:57 AM	1685	Rec. Boat	EB												5.00	
	10:58 AM	1686	Rec. Boat	WB												10.00	
	11:49 AM	1687	Rec. Boat	EB												5.00	
	12:16 PM	1688	Rec. Boat	WB												9.00	
2	12:26 PM	1689	Comm. Fishing Boat	EB	347	12	11	88	28	48	476.36	88.48	12.64	31.13	-0.33	31.46	Mad Lady II
3	12:37 PM	1690	Comm. Fishing Boat	EB	346	54	24	89		34	476.13	89.01	8.23	26.72	-0.33	27.05	Miss Sandy
	12:42 PM	1691	Rec. Boat	EB												9.00	
4	12:43 PM	1692	Comm. Fishing Boat	EB	346	5	0	89	12	12	475.55	89.20	6.61	25.10	-0.33	25.43	The Pearl
	12:45 PM	1693	Rec. Boat	EB												5.00	
	1:10 PM	1694	Rec. Boat	WB												11.00	
	1:17 PM	1695	Rec. Boat	EB												5.00	
	1:24 PM	1696	Rec. Boat	WB												5.00	
	1:34 PM	1697	Rec. Boat	WB												6.00	
	1:59 PM	1698	Rec. Boat	WB												4.00	
	2:13 PM	1699	Rec. Boat	EB												11.00	
	2:17 PM	1700	Rec. Boat	WB												6.00	
	2:18 PM	1701	Rec. Boat	WB												11.00	
	2:24 PM	1702	Rec. Boat	EB												10.00	
	2:24 PM	1703	Rec. Boat	EB												11.00	
	2:29 PM	1704	Rec. Boat	WB												11.00	
5	2:30 PM	1705	Comm. Fishing Boat	EB	346	26	53	88	0	26	475.79	88.01	16.55	35.04	-0.08	35.12	Miss Addie
	2:34 PM	1706	Rec. Boat	EB												11.00	
	2:37 PM	1707	Rec. Boat	WB												6.00	
	2:58 PM	1708	Rec. Boat	WB												11.00	
	3:04 PM	1709	Rec. Boat	WB												10.00	
	3:18 PM	1710	Rec. Boat	EB												9.00	
	3:26 PM	1711	Rec. Boat	WB												6.00	
	3:35 PM	1712	Rec. Boat	WB												4.00	
6	4:03 PM	1713	Comm. Fishing Boat	WB	345	51	21	88	30	30	541.83	88.51	14.11	32.60	0.82	31.78	Comm. Fishing Vessel 14
		1714	Comm. Fishing Boat	WB	345	51	21	88	55	0	541.83	88.92	10.25	28.74	0.82	27.92	Miss Sandy
	4:44 PM	1715	Rec. Boat	EB												4.00	
	4:50 PM	1716	Rec. Boat	EB												4.00	
	4:53 PM	1717	Rec. Boat	EB												5.00	
	5:27 PM	1718	Rec. Boat	WB												5.00	
7	5:55 PM	1719	Comm. Fishing Boat	EB	349	47	21	89	16	37	478.95	89.28	6.04	24.53	1.72	22.81	Miss Bertha
	6:03 PM	1720	Rec. Boat	WB												5.00	





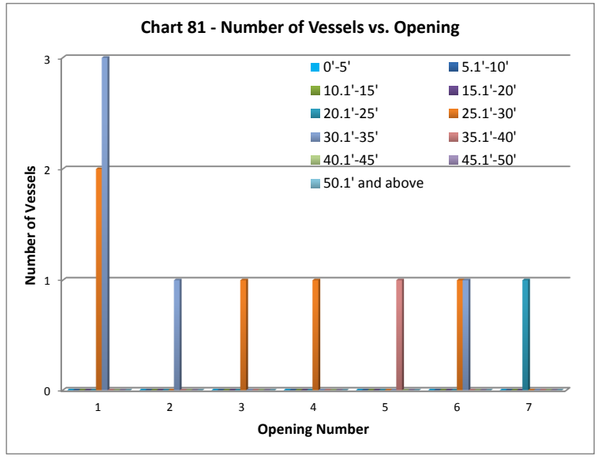
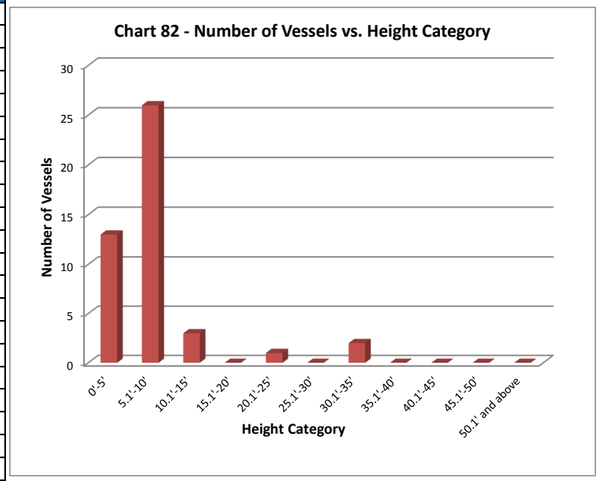
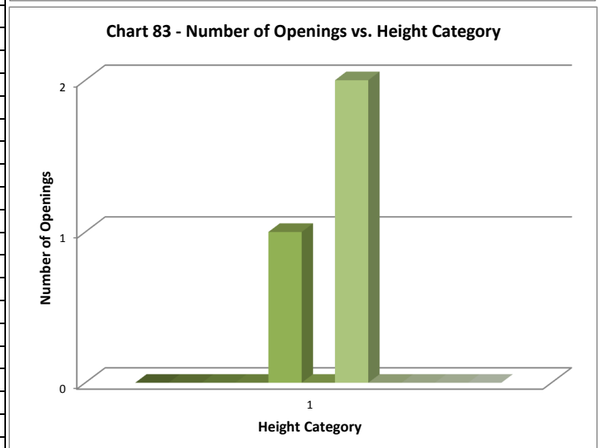
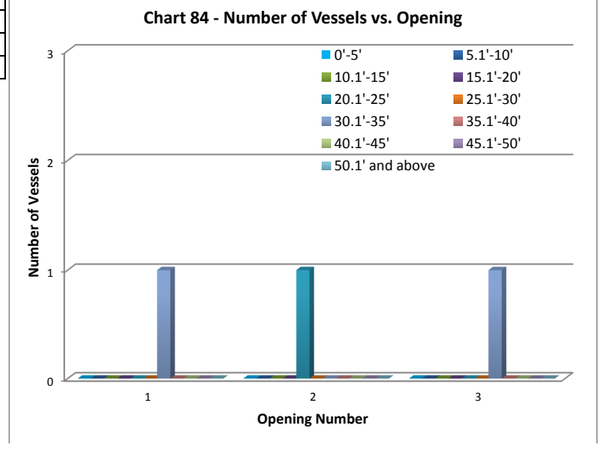


Table B-30 - Survey 1: Day 30 Vessel Survey Data (October 6, 2014)

# opening	Time	#	Vessel Type	Direction	Horizontal Angle			Zenith Angle			Horizontal Distance (D)	Zenith Angle (A)	Vertical Distance (VD= tan(90-A)*D)	Vessel Elevation (VE= VD+E+H_i)	Elev of Water (EW)	Vessel Height above Water (H=VE-EW)	Name
					D	M	S	D	M	S		Decimal Deg					
1	8:12 AM	1721	Comm. Fishing Boat	EB	349	4	25	88	24	46	478.13	88.41	13.25	31.67	1.62	30.05	Lady Jane
	8:13 AM	1722	Rec. Boat	EB												4.00	
	8:46 AM	1723	Rec. Boat	WB												9.00	
	9:03 AM	1724	Rec. Boat	WB												6.00	
	9:26 AM	1725	Rec. Boat	EB												8.00	
	9:40 AM	1726	Rec. Boat	WB												8.00	
	9:47 AM	1727	Rec. Boat	WB												5.00	
	10:04 AM	1728	Rec. Boat	WB												6.00	
	10:11 AM	1729	Rec. Boat	EB												5.00	
	10:22 AM	1730	Rec. Boat	EB												6.00	
	10:27 AM	1731	Rec. Boat	EB												7.00	
	10:28 AM	1732	Rec. Boat	EB												6.00	
	10:50 AM	1733	Rec. Boat	EB												5.00	
	11:11 AM	1734	Rec. Boat	WB												5.00	
	11:13 AM	1735	Rec. Boat	WB												7.00	
	11:15 AM	1736	Rec. Boat	EB												8.00	
2	11:21 AM	1737	Comm. Fishing Boat	WB	346	56	25	89	20	8	542.72	89.34	6.29	24.71	0.12	24.59	Jenny
	11:21 AM	1738	Tow Boat	WB												7.00	
	11:27 AM	1739	Rec. Boat	WB												7.00	
	11:33 AM	1740	Rec. Boat	WB												6.00	
	12:32 PM	1741	Rec. Boat	EB												12.00	
	12:35 PM	1742	Rec. Boat	EB												4.00	
	12:38 PM	1743	Rec. Boat	EB												7.00	
	12:57 PM	1744	Rec. Boat	EB												10.00	
	1:23 PM	1745	Rec. Boat	WB												12.00	
	1:30 PM	1746	Rec. Boat	WB												7.00	
	1:30 PM	1747	Rec. Boat	EB												12.00	
	2:41 PM	1748	Rec. Boat	EB												5.00	
	3:01 PM	1749	Rec. Boat	EB												6.00	
	3:02 PM	1750	Rec. Boat	EB												6.00	
	3:11 PM	1751	Rec. Boat	EB												7.00	
	3:33 PM	1752	Rec. Boat	EB												9.00	
	3:46 PM	1753	Rec. Boat	WB												5.00	
	4:07 PM	1754	Rec. Boat	EB												9.00	
	4:08 PM	1755	Rec. Boat	WB												4.00	
	4:13 PM	1756	Rec. Boat	EB												6.00	
	4:40 PM	1757	Rec. Boat	WB												8.00	
	4:46 PM	1758	Rec. Boat	WB												4.00	
	4:49 PM	1759	Rec. Boat	WB												8.00	
	5:32 PM	1760	Rec. Boat	WB												5.00	
	5:38 PM	1761	Rec. Boat	EB												8.00	
	5:56 PM	1762	Rec. Boat	EB												4.00	
3	6:00 PM	1763	Comm. Fishing Boat	WB	346	4	10	88	39	13	541.99	88.65	12.74	31.16	0.72	30.44	Cameron T
	6:16 PM	1764	Rec. Boat	EB												9.00	
	6:54 PM	1765	Rec. Boat	EB												4.00	







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