Lighter Barges: An Alternative to Servicing Post-Panamax Vessels at the Port of Wilmington, NC

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1 INTRODUCTION

The North Carolina State Ports Authority recently proposed a costly plan to deepen and widen the Port of Wilmington's navigation channel in order to accommodate large post-Panamax vessels. This paper proposes that there is another, potentially more appealing and affordable alternative: shallow-draft lighter barges. Ports in areas like Hong Kong and the lower Mississippi River use variations of lighter barges to bring cargo to and from ships and ports. Wilmington's unique location and navigational challenges make lighter barges a viable option that deserves consideration.

American port facilities and channels have grown to accommodate Panamax sized vessels over the last century. The existing Panama Canal channels feature a depth of about 40 ft. The channel depth and the dimensions of the first two lock systems (106 ft. width) turned out to be the limiting factors for the Panamax vessel design and size. However, in June of 2016, the situation will change for U.S. harbors when the newly constructed Panama Canal expansion is completed. The project creates a new lane for ship traffic with larger locks than the original channels, allowing for wider ships with deeper drafts (Fig. 1). New construction is expected to double the canal's current capacity of 300 million tons per year (Dervarics 2015). The larger post-Panamax vessels have drafts as deep as 50 ft., widths to 160 ft., and correspondingly much longer ship lengths. Estimates are that by 2030 post-Panamax ships will carry 62 percent of the world's container tonnage, but only make up 27 percent of the container shipping fleet (Dervarics 2015). The cost efficiencies that come with employing post-Panamax ships will only lead to a dramatic increase in the utilization of post-Panamax ships in the future.

*- the views expressed in this paper are solely the authors' and do not represent the Marine & Coastal Ocean Policy Program or the University of North Carolina Wilmington.

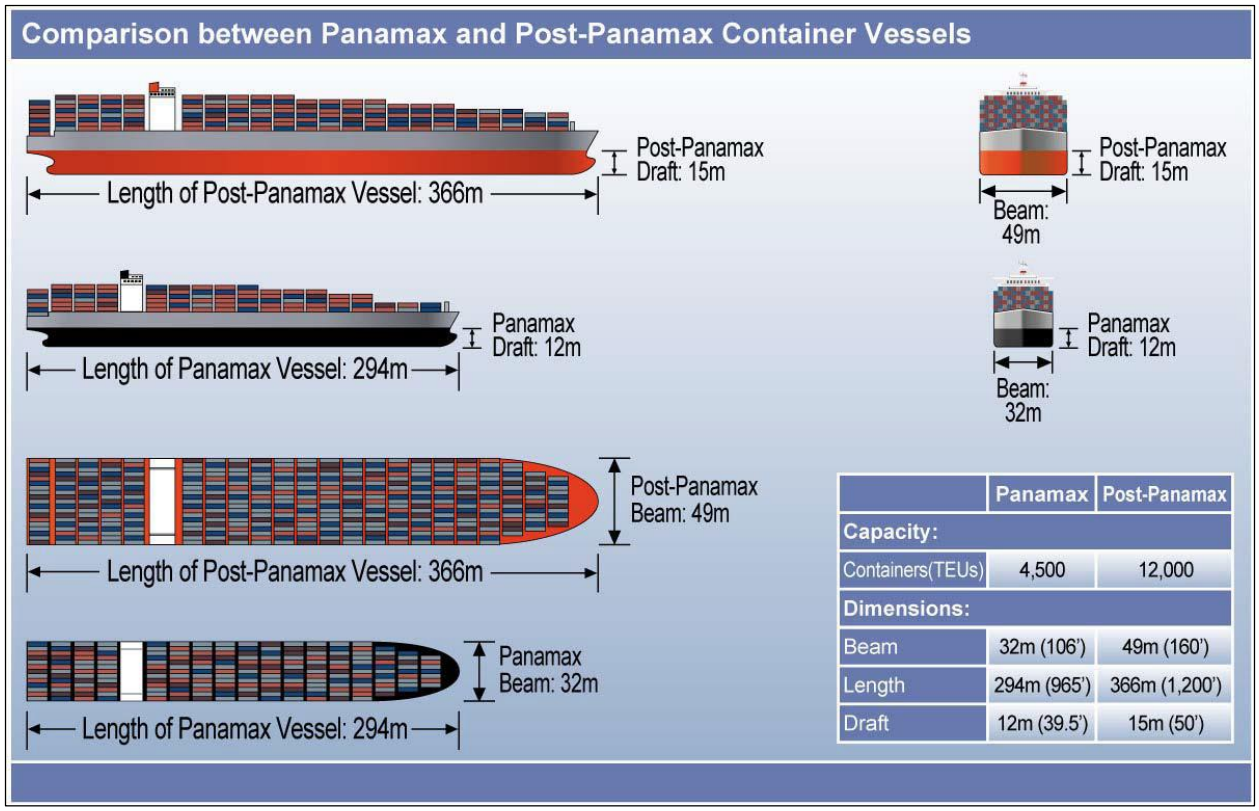

Figure 1: Comparison between Panamax and Post-Panamax Container Ships. Source: Knight 2008.

Port facilities in the U.S. started moving quickly after the mid-2000s to prepare for new post-Panamax ships (Holeywell 2012). Improvements to shipping channels involve dredging, blasting and infrastructure realignments to allow for deeper, wider, and longer vessels to utilize the channels and harbors. These improvements also include renovations to on-land facilities, such as increasing dock capabilities and expanding rail and truck capacity in order to accommodate increased port tonnage. Engineered navigation improvements are massive financial undertakings, and usually involve cost-sharing between federal and state governments to fund the improvements.

Without deepening the Port of Wilmington's channel and harbor, post-Panamax ships may only call upon the port when the vessel's displacement is lighter and capable of navigating the shallower channel. Light-loading ships is inefficient for all involved parties, and even while lightly loaded, the post-Panamax ships still require additional length and width accommodations in the navigation channel and turning basin area.

Many East Coast U.S. ports are beginning to dredge to the necessary channel depths, around 50-feet, to allow post-Panamax traffic. These ports include Norfolk, Baltimore,

and New York and New Jersey. Other ports, including Boston, Miami, Savannah, Charleston, and Jacksonville, Port Everglades, Mobile, New Orleans, and Port Freeport and Brownsville, are conducting feasibility studies or in some cases, beginning actual construction, on port and channel deepening projects to support larger vessels.

2 WILMINGTON HARBOR, NC BACKGROUND

Wilmington Harbor, NC recently completed its most recent deepening phase in 2012. The current project is designed and constructed for a maximum draft of 42-feet at the port facility. The harbor consists of a 26-mile long channel from offshore to the port facility in downtown Wilmington (Table 1). Annual tonnage at Wilmington Harbor in 2014 was 5.9 million short tons (U.S. Army Corps of Engineers 2015). The port handled roughly 298,000 TEUs during the 2015 NC State Ports Authority fiscal year (NCSPA 2016a). The twenty-feet equivalent (TEU) is the standard by which container volume is measured, and refers to a container with external dimensions of 8'x8'x20' (EURANS, Ltd. 2016). Nationally, Wilmington Harbor stands as the 77th ranked port by tonnage (considering both imports and exports) in the U.S. in 2014 (U.S. Army Corps of Engineers 2015). Due to its relatively small operational size, the Port of Wilmington is not as desirable an option as other U.S. ports for federally funded deepening projects. Wilmington is a "niche port," and is currently more of a regional port rather than a large U.S. import and export facility. Federal priorities for funding deepening projects would start with ports currently supporting the highest production of imports and exports. Additionally, the cost to deepen the channel to Wilmington would be astronomical, possibly near $1.5 to $3 billion, because of the amount of bedrock removal within the river and the need to dredge farther offshore.

Channel Name From Ocean to Upstream	Channel Length (ft)	Channel Width (ft)	Width[1] at Turning Basin	Maintained Channel Depth[2, 3] (ft)	Authorized Channel Depth + Overdepth
Baldhead Shoal Reach 3	26,658	500 - 900		44	46
Baldhead Shoal Reach 2	4,342	900		44	46
Baldhead Shoal Reach 1	4,500	700 - 785		44	46
Smith Island	5,100	650		44	46
Baldhead-Caswell	1,921	500		44	46
Southport	5,363	500		44	46
Battery Island	2,589	500		44	46
Lower Swash	9,789	400		42	44
Snows Marsh	15,775	400		42	44
Horseshoe Shoal	6,102	400		42	44
Reaves Point	6,531	400		42	44
Lower Midnight4	8,241	600		42	44
Upper Midnight4	13,736	600		42	44
Lower Lilliput4	10,825	600		42	44
Upper Lilliput	10,217	400		42	44
Keg Island	7,726	400		42	44
Lower Big Island	3,616	400		42	44
Upper Big Island	3,533	510 - 700		42	44
Lower Brunswick	8,161	400		42	44
Upper Brunswick	4,079	400		42	44
Fourth East Jetty	8,852	500		42	44
Between	2,827	400		42	44
Anchorage Basin Station 8+00 to 84+81	7,681	550 – 1,200	1,200	42	44
Anchorage Basin Station 0+00 to 8+00	3,970	450 - 550		38	44
Memorial Bridge – Isabel Holmes Bridge	9,573	400	850	32	40
Isabel Holmes Bridge - Hilton RR Bridge	2,559	200 - 300		32	40
Hilton RR Br. - Project Limit	6,718	200	700	25	36
Total Length in Feet	200,984				
Total Length in Miles	38.1				

[1] Width shown is widest point at basins, and includes the channel width.
[2] Channel depths are at mean lower low water.
[3] Allowable Overdepth is two feet
[4] This channel reach included the Passing Lane

Table 1: Dimensions of Wilmington Harbor Navigation Channel. (U.S. Army Corps of Engineers 2016).

The state of North Carolina and the U.S. Army Corps of Engineers began reconnaissance around 2008 on a possible port facility near Southport to support post-Panamax ships. The best argument for a Southport facility was the reduced transit distance from the open ocean to the port, however, after further investigation, going forward with the project's land infrastructure and new navigation channel would yield moderate environmental impacts and immense construction costs. These drawbacks caused the state to table any movement toward a Southport port facility (NCSPA 2016b).

Two important factors make using post-Panamax ships in Wilmington Harbor ill-advised. First, it would be unsafe, and impractical, for post-Panamax vessels to navigate the 90° turn at Battery Island (Figure 2), even with the widening improvements on the horizon. Second, as mentioned earlier, the use of post-Panamax vessels loaded to less than capacity is inefficient, and it's more likely that shipping lines would utilize a neighboring east coast harbor where maximum efficiency is achieved while fully-loaded. Also, inefficiencies and costs would grow if Wilmington Harbor river pilots needed to rely on tugboats and high tides to provide safe passage for light-loaded post-Panamax vessels through the Battery Island turn (Figure 2).

The State of North Carolina and the Port of Wilmington need to consider all the facts before committing to expensive channel and harbor modifications to accommodate fully loaded post-Panamax ships. First, the prospect of deepening the channel to either Southport or Wilmington in the near future is low and extremely expensive. Second, the navigational challenges including the Battery Island turn (Figure 2), the tide restrictions, and the long transit to the port make other east coast ports more desirable to post-Panamax shippers. Finally and most importantly, other regional port facilities are ahead of Wilmington because they are proven high capacity ports, and are actively deepening their harbors and channels in anticipation of post-Panamax ships. Considering the insurmountable competition from other ports and a nearly $3 billion deepening project, it is clear that the state Ports Authority should look for viable alternatives to prepare the Port of Wilmington for the era of post-Panamax ships.

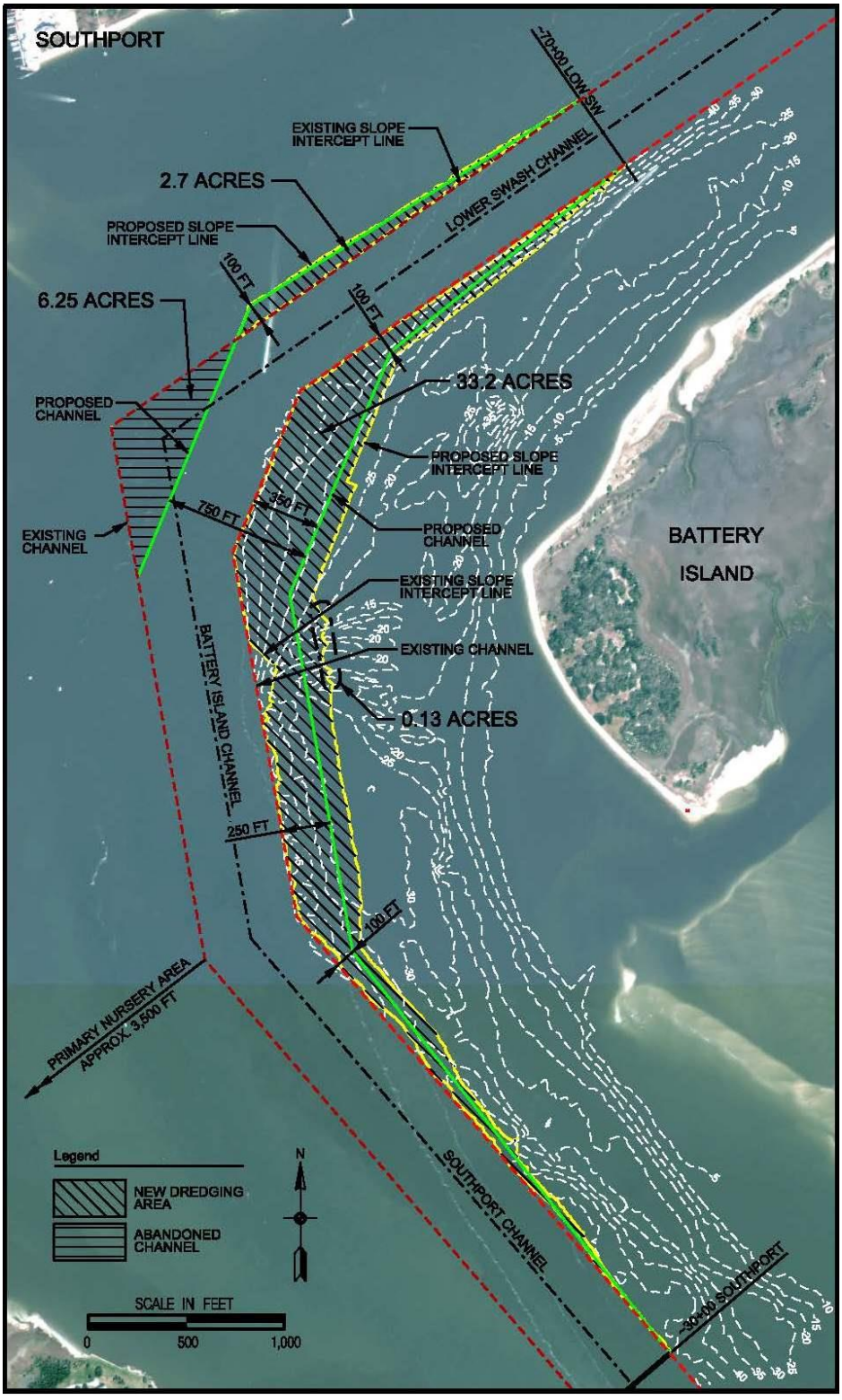

Figure 2: Area to be dredged at the Battery Island Turn (U.S. Army Corps of Engineers District 2016).

3 LIGHTERS

Lighter barges could be a cost effective alternative to a deepening project for the Port of Wilmington. Lighter barges are flat-bottomed with container handling cranes, and are either tug or self-powered. The barges are constructed to transport cargo from larger ships into and out of shallow ports. The amount of cargo carried by lighters is around 50 TEUs, depending on the size of the lighter. The maximum draft when fully loaded is under 40-feet. When operating more than one lighter barge, it's possible to attach multiple barges together to save on mobilization costs.

The transfer of cargo from larger vessels to lighter barges is completed in deep water, usually in relatively calm waters. The transfer operation uses cranes, which are normally fixed to the lighter barge, but may be operated separately from the barge on a more permanent offshore platform. A site located in protected waters is ideal to ensure limited schedule delays in the transfer process.

3.1 ALTERNATIVE FOR WILMINGTON HARBOR

Lighter barges, which have much smaller dimensions than seagoing Panamax ships and far smaller dimensions than post-Panamax vessels, could easily navigate the current channel to Wilmington Harbor. Negotiating the Battery Island turn (Figure 2) would not be navigationally challenging as it is for the larger ships. The post-Panamax ships could either remain offshore or drop anchor at a mooring yard inside the inlet, where the lighter barges could transfer the containers.

Environmentally, the harbor would benefit from use of lighter barges in a few ways. First, there would be no need to further deepen the navigation channel up to Wilmington. Therefore, the option to avoid deepening the harbor avoids any potential impacts to endangered species and possible alterations to the Castle Hayne aquifer. Lighters would also reduce the risk of accidental ballast water discharges within the riverine port. Ballast water is a major source of invasive species and in the past, caused invasion of the Cape Fear River Estuary's waters by *Gracilaria vermiculophylla*, a rhodophyte seaweed that has proliferated locally and fouls crab pots and trawl nets (Freshwater et al., 2006).

If the Port of Wilmington acquired a fleet of lighters, either through port ownership or private ownership, then the port could attract large vessels and increase cargo volumes when post-Panamax ships begin using the newly expanded Panama Canal. With either lighter barges or deepening of the port, the existing intermodal land transport network

could become the bottleneck that limits cargo volumes through the Port of Wilmington, potentially requiring expensive upgrades. The roadways in Wilmington are already congested and the major highway routes for trucks to travel out of Wilmington are over two busy bridges. Trains in and out of the Port of Wilmington travel through high traffic areas as well. The main rail line to the port travels across the Cape Fear railroad bridge just north of downtown, and snakes through the city for about 7.5 miles to the port's rail yard. The port needs more sophisticated train and road systems to handle higher cargo volumes through the port. These problems, however, are independent of the options available for attracting post-Panamax shipping traffic.

3.1.1 Case Studies

Lighter operations have occurred since 1987 in Hong Kong, and are also known as "mid-stream operations" (Figure 3). These operations began out of necessity to keep up with rapid growth in container vessel traffic in a setting of limited on-land port real estate. Hong Kong heavily utilized a large fleet of lighter barges; about 250 lighter vessels supported container operations. Most lighter barges were unpowered and relied on tugboats for positioning, and some lighter barges had derrick cranes to transfer cargo. The Hong Kong lighter barges were able to carry up to 48 TEUs at a time, and helped grow port operations from 780,000 TEUs in 1987 to 4.2 million TEUs in 2004 (Wong 2011; HKMOA 2016). The use of lighter barges and mid-stream operations declined following the recent construction of additional port terminals at Hong Kong.

Figure 3: Hong Kong lighter operation. Source: Wong 2011.

A container ship offloaded 12 TEUs of relief supplies in the Port-au-Prince harbor in Haiti through the use of lighter vessels in January 2010, during emergency operations supported by the U.S. Transportation Command in response to the 7.0 magnitude earthquake in Haiti (Crowley Cargo 2010). These specific lighter barges were designed and constructed to discharge cargo on the beach due to lack of safe pier space in Port-au-Prince. Subsequent cargo operations into Port-au-Prince utilized a makeshift dock, which consisted of two 400-foot long, 100-foot wide flat deck barges and two 230-ton crawler cranes.

Midstream operations of bulk cargo occur at the mouth of the Mississippi River. The company, Associated Terminals, transfers cargo to lighter barges from bulk cargo ships transiting the Mississippi River (Figure 4). The lighter operations on the Mississippi are very important to moving bulk cargo in that area and an excellent example of successful midstream operations in the U.S. (Associated Terminals 2016). The same operational premise can be used for moving containers from post-Panamax ships at the entrance of the Cape Fear River Estuary to the Port of Wilmington.

Figure 4: Midstream Operations, Lower Mississippi River. (Associated Terminals 2016).

3.2 U.S. Availability and Costs

The cost of lighter barges is expected to be higher in the U.S., because the cost of construction by U.S. shipyards is more expensive (McCain 2015). Information on the exact costs of lighter barges was unavailable for this report. The purchase of a fleet of lighters, with intent to transport tonnage continually up and down the river, would present a non-trivial initial cost to the port facility. Adding to the problem, there is not currently a high demand in the U.S. for lighter barges, as larger ports have opted for expansion projects. Cranes used to transfer materials from vessel to vessel pose another cost to the state Ports Authority and will vary based on the type of crane. Cranes fixed to the individual barges will require additional costs and maintenance due to exposure to salt water and sea spray. Additionally, heavy winds and seas offshore could hinder the ability of a lighter to safely transfer cargo. Predominant winds out of the west or southwest would be ideal for lighter operations offshore. Cranes affixed to a fixed platform at the estuary mouth might cost less overall but provide less flexibility in operations.

4 The Jones Act

The Merchant Marine Act of 1920, also known as the Jones Act, presents a challenge to the Port of Wilmington's potential use of lighter barges, as they are foreign built at this time. Foreign built vessels are not permitted by the Jones Act to conduct trade between United States ports. The Jones Act states that only ships built, registered, owned, and crewed by citizens of the U.S. may deliver cargo by water between ports of the U.S. (Weakley 2010; Oyedemi 2012; U.S. Customs and Border Protection 2009). The Jones Act applies to all vessels, even ones that operate within one port, such as harbor tugs, barges, and passenger vessels.

The Jones Act was originally created to retain and protect Merchant Marine jobs within the U.S. The idea was that the U.S. could successfully continue coastal trade in times of war and peace without relying upon foreign countries (Beason 2015). U.S. merchant mariners obtain most of their employment through U.S. shipping companies (American Maritime Officers Union 2015; Seafarers International Union 2014) and may lose their jobs if the Jones Act is modified or eliminated. Longshoreman and other U.S. port worker jobs do not fall under the Jones Act because port operations are not dependent on the flag of the vessel visiting the port (AAPA 2014).

The U.S. Congress is divided in their support for the Jones Act. Congress is the only entity that has the power to grant waivers, modify, or eliminate the Jones Act (Waldron

2014). Some coastal state officials aim to keep the Jones Act intact because they fear that modifying it or eliminating it will cause significant harm to their local economies, and it has acted as intended, to some degree, by protecting U.S. shipbuilders (Maritime Administration 2013). Several think tanks and foundations, on the other hand, insist that the Jones Act is causing economic distortions that could be relieved by eliminating the Act altogether (Hill 2013; Krepp 2015; Slattery et al. 2015). Despite their efforts, eliminating the Jones Act is politically unlikely because U.S. shipbuilders and merchant mariners rely on the requirements of the Jones Act, as intended.

Post-Panamax ships, which are foreign built, registered, owned, and operated, are able to make multiple stops in U.S. ports as long as the cargo they unload is foreign (U.S. Customs and Border Protection 2009). This means that any cargo picked up in another U.S. port must remain onboard while making consecutive U.S. stops. Despite post-Panamax ships' ability to make consecutive stops in U.S. ports, the size and turnaround time of the port will be important factors for companies deciding where their post-Panamax ships will stop in the U.S. Large port facilities that handle high amounts of container traffic efficiently are more desirable than small facilities like the Port of Wilmington (Knight 2008). Other factors considered by the companies are: the depth of the channel to the port, channel width, potential navigational challenges, and the distance to the port facility once the vessel is in restricted waters, all factors affecting turnaround time (Knight 2008; Rising Water Associates 2011).

Based on those factors, the Port of Wilmington is not ideal primarily due to the limited handling capacity and significant navigational challenges of its Cape Fear River location. The Port of Wilmington is a small port compared to several other U.S. ports along the east coast (Knight 2008). Navigationally, the Port is not deep enough for a post-Panamax ship to possibly navigate while fully loaded with cargo. The channel depth of the Cape Fear River is 42 feet, while the draft of a post-Panamax ship is 50 feet (Knight 2008; NCSPA 2012). Dredging the Cape Fear River an additional 8-feet to accommodate deeper draft vessels will be extremely costly, and require additional routine maintenance dredging due to a larger constructed channel and the river's natural shoaling (Rising Water Associates 2011). Additionally, the entrance to the Cape Fear River from the open-ocean has two challenging turns that pose a significant navigational hazard of potential grounding to larger ships attempting to enter the river. The grounding risk of entering the Cape Fear River combined with the distance to the Port may deter companies from making Wilmington one of their ports of choice in the U.S. (Knight 2008; Rising Water Associates 2011).

The simplest and most cost effective way to make the Port of Wilmington a competitive post-Panamax port is to request a foreign-built vessel waiver from Congress for lighter barges to serve the port. As noted earlier, the cost of foreign-built lighter barges is expected to be lower, which imposes lower capital costs. A vessel waiver is a politically feasible option and would allow the Port of Wilmington to operate foreign-built lighter barges. The idea of a Jones Act waiver is also supported by the consideration that lighter barges would be valued port assets that are strictly intended to increase national imports and exports at the Port of Wilmington. In the past, Congress has granted waivers for small passenger vessels, showing that Congress is capable of modifying the Jones Act specifically to grant waivers (Williams 2015). A waiver to operate foreign-built vessels does not impact or reduce the number of shipbuilding and merchant mariner jobs. In contrast, the Port would likely employ mariners to operate the lighter barges and make positive impacts on the local economy.

5 RECOMMENDATION

A realistic, navigationally safe and economical option for the Port of Wilmington to accommodate post-Panamax ships is to utilize lighter barges. In the port of Hong Kong, lighter barges were critical to continuing port operations while the port expanded its pier space (HKMOA 2005) (Figure 3). Although the circumstances are different for the Port of Wilmington, lighter barges are an option worth exploring. Although we have focused here on lighter barges specifically built to transfer containerized cargo, it is conceivable that lighters for transfer of bulk cargoes can also be built and used. Although the single trip capacity of lighter barges is relatively small (50 TEUs), the smaller size comes with overall cost savings and navigational advantages. Lighter barges have shallower drafts, offer better maneuverability, and do not require the container ships to make the long and risky transit up the Cape Fear River Estuary to the Port's facilities. Shallower drafts do not require the river to be deepened, nor would the turns coming into the Cape Fear River near Southport need to be widened. Lighter barges fit the needs of the Port of Wilmington and will cost less than dredging to accommodate post-Panamax container ships. The use of lighter barges also reduces the navigational and grounding risk to the post-Panamax ships because they will not need to transit the Cape Fear River Estuary. Large vessels would be able to remain offshore or at the Estuary mouth where the lighter barges would transfer the containers.

The major drawback with use of lighter barges is that only foreign shipbuilders currently build the vessels and therefore do not meet the Jones Act criteria (Mark R.

Miller 2016, personal communication; Weakley 2010). To combat this problem, the Port of Wilmington could request a waiver from Congress to have lighter barges built by foreign shipbuilders. A waiver would not actually impact U.S. shipbuilding jobs because lighter barges are not currently built in the U.S. However, if the demand for lighter barges becomes high enough, then U.S. shipbuilders might have incentive to start building them at a competitive cost. Even if that does not happen, operating lighter barges would be good for the local port economy because they could facilitate higher cargo throughputs and bring in more mariner and port jobs to manage the additional container traffic.

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