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November 17, 2025

Via U.S. Mail and Email

US Army Corps of Engineers
Wilmington District
ATTN: Wilmington Harbor 403
69 Darlington Avenue
Wilmington, NC 28403
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Re: Wilmington Harbor 403 Draft Letter Report and Environmental Impact Statement, Wilmington Harbor Navigation Project, North Carolina

SUPPLEMENTAL COMMENTS SUBMITTED ON BEHALF OF THE VILLAGE OF BALD HEAD ISLAND REGARDING ECONOMIC ANALYSES:

This firm represents the Village of Bald Head Island ("**VBHI**") in connection with the proposed Wilmington Harbor Navigation Project ("**Project**") and the Notice of Draft Letter Report and Environmental Impact Statement ("**Notice**") for the Project issued by the United States Army Corps of Engineers ("**USACE**" or "**Corps**") on 19 September 2025. On 3 November 2025, we submitted comments ("**VBHI Comments**") on behalf of VBHI in response to the Notice.

On 27 Oct. 2025, the Corps granted VBHI an extension[1] until 17 Nov. 2025 to file comments, including those concerning the Draft Letter Report ("**DLR**") Attachment 5, Economic Considerations ("**2025 EC**"). At the same time, the Corps provided as additional background for the 2025 EC a PowerPoint, "403 Economic Considerations," attached as **Attachment L** ("**Corps PowerPoint**").[2] These **Supplemental Comments** incorporate by reference the earlier VBHI Comments and endeavor not to repeat their substance. It is our understanding that these Supplemental Comments will be shared with the Independent Expert Peer Review members.

I. OVERVIEW OF COMMENTS

The DLR's conclusion that this Project is feasible is unfounded and unsound. Considering the size of the projected expenditures ($1.36 billion), the environmental impacts, the

[1] *See* VBHI Comments, Attachment J.

[2] Attachment L is undated, but the pdf transmission labels the document as a November 2024 presentation. For clarity, VBHI continues the attachment lettering from the 3 November 2025 VBHI Comments, so that the first attachment to this letter is Attachment L.

prior criticisms of the ASA Review Assessment[3], and the time and expense of the new analysis ordered by the ASA, one would expect the 2025 EC to be thorough, well-documented, supported by available data, and based on sound, consistent analytical principles. It is none of those things, but instead:

- ignores the current market conditions, changes, and trends;
- applies inconsistent and contradictory analytical methods;
- relies on inaccurate, incomplete, and out-of-date data;
- relies on supposition and biased projections of interested parties; and
- fails to explain and support its analyses and conclusions.

These Supplemental Comments explore each of these deficiencies. In addition, VBHI retained Dr. Asaf Ashar, a well-known expert with extensive experience evaluating port projects and their impact on maritime traffic. Dr. Ashar has prepared a report: "Feasibility of Deepening the Port of Wilmington Channel (2025)" ("**Ashar Analysis**"), **Attachment M**. Dr. Ashar's relevant experience and education are summarized in **Attachment N**. The Ashar Analysis highlights the impact of the 2025 EC's deficiencies on the Project's benefit cost ratio ("**BCR**") and shows that the DLR and 2025 EC do not support a conclusion that the Project is "feasible."[4] Specifically, the BCR is not equal to or greater than 1.0.

Dr. Ashar's Analysis is limited to calculating Project *benefits*, which the 2025 EC overstates, thereby inflating the BCR above the feasibility threshold. The DLR[5] and Draft Environmental Impact Statement ("**DEIS**") also failed to consider all the Project *costs*—the impacts and mitigation therefor, which omission further inflates the BCR. Inclusion of these costs in the NED analysis will reduce the BCR even more, further showing that the Project is not feasible and that any final conclusion of feasibility would be arbitrary and capricious.

II. ANALYTICAL DEFICIENCIES

A. The 2025 EC ignores the current global market.

Fundamentally, the Corps fails to ground the 2025 EC in the real world by ignoring: (a) the current service patterns in Wilmington; (b) trends in service patterns globally that change how

[3] Assistant Secretary of the Army May 2020 Review Assessment of Wilmington Harbor, North Carolina Navigation Improvement Project Integrated Section 203 Study & Environmental (February 2020) ("**ASA Review Assessment**").

[4] The DLR Review is limited to technical feasibility, meaning the BCR must be >1, using FY 2025 Federal discount rate of 3.0%. 2025 EC, § 5.3.2.1, p. 48. As used herein, "feasible" refers to this technical standard and not the Corps' pragmatic funding policy standard, discussed below (Section IV), which applies a higher discount rate (7%) and was calculated at each previous analysis of this Project but curiously omitted in the DLR. The 7% discount rate reduces the BCR well below 1.0.

[5] Even costs resulting from the Project that do not *require* Corps DEIS mitigation are societal costs which the NED is required to include, discussed below in Section III A.

ports are being and will be served in the future; and (c) changes in global fleet composition.

1. Asian services

The 2025 EC forecast assumes Wilmington will be served by the four Asian shipping services that previously called there, despite the fact that all four services have, *for reasons unrelated to channel depth*, already stopped calling on Wilmington. Ashar Analysis IV.1-IV.5, pp. 11-14. Even the earlier 203 Report (Appendix C-Economics, Table 1-25, p. 32) recognized that only two Asian services were calling in 2020 (the base year selected by the Corps for its forecast, discussed below). The erroneous assumption that the prior level of Asian services reflects patterns that haven't been seen since 2019 is necessary to attain a BCR with a ratio greater than the feasibility threshold of 1.0. *Id*.,III.3, p. 9. Moreover, the 2025 EC does not analyze either the factors causing this change in service pattern or the reason for assuming they will revert to pre-2019 patterns. The impact on the DLR conclusion is significant: even assuming a 50% chance of a full return of four Asian services to Wilmington only raises the BCR to **0.65**. *Id*., IV.5, p. 14.

2. Feedering

Globally, maritime shipping is changing fundamentally in two way that the 2025 EC analysis does not take into account: (1) maritime shipping lines are commissioning ever-larger ships, which many ports cannot accommodate; and (2) as a result, feeder or hub-and-spoke operations ("**feedering**") are growing to facilitate distribution through ports that can accommodate the largest (i.e., newest) vessels. *Id*., IV.6-IV.7, pp. 14-16. Constraints in the Panama Canal and shifts to larger vessels using the Suez Canal serve only to increase this shift in service organization. *Id*., IX.2-3, p. 33. The increased reliance on feedering is already evident: 100% of Wilmington's Asian cargo is feedered (*id*., IV.8, p. 16)—a fact that the Corps' analysis ignores. As the Ashar Analysis explains (including through actual analysis of one other port already deepened), feedering provides significant benefits unrelated to depth that the 2025 EC ignores. But failing to account for feedering is both imprudent and contrary to rational economic planning. Indeed, the 2025 EC statistically assumes that feedering will not happen, even though it is plainly already happening. The Ashar Analysis tests the sensitivity of the BCR to this assumption by assuming fifty percent of Wilmington's future traffic will be feedered (even though 100% is currently feedered). Assuming only 50% feedering reduces the BCR to **0.65**. *Id*., IV.8, p. 16

3. Future fleet

The 2025 EC also assumes that, in the future, with or without the Project, Wilmington will be served by a substantial fleet of PPX1 vessels, the smallest class of post-Panamax vessels. *Id*., Table 4, p. 21. This assumption is critical to generating the benefit on which the inflated BCR depends, as the Ashar Analysis explains. *Id*., VI, pp. 21-26.

The PPX1 fleet assumption is factually unsupported and illogical. The PPX1 fleet has already stopped calling on Wilmington. *Id*., Figure 8, p. 23. And it is disappearing from the world fleet, probably due to its inefficiencies. *Id*.,VI.3, p. 24 and IX Appendix B, pp. 33-36. The 2025 EC provides no reason to conclude that this ghost fleet will reappear.

The 2025 EC (p.39) makes a single, unsupported statemen to justify including PPX1 in the forecast: "Significantly more PPX1 and PPX2 vessels would be required to fulfill the commodity forecast **without a project**." (emphasis added). This statement is contradicted in the ensuing EC Tables, which show that the number of PPX1 and PPX2 vessels in the **combined** fleet forecast (containerized plus commodity) (able 5.38, p. 48) is the same as the **containerized** cargo only forecast (Table 5.33, p. 44).[6] The combined forecast does not increase PPX1 (or PPX2) for the addition of commodity cargo. Nor does the explanation address why PPX1 will still comprise a significant part of the fleet in the With Project scenario, as shown in the 2025 EC.

Put simply, nothing shows that PPX1 vessels are currently or will become a market force. The 2025 EC offers no explanation for its assumption that they will return to service. Removing the assumption of the return of the ghost fleet lowers the BCR to **0.75**, **0.94**, or **1.1**, depending on other assumptions. *See* Ashar Analysis, VI.6, p. 26.

B. The 2025 EC applies inconsistent and unreliable methodologies.

The 2025 EC diverges from the usual Corps method of port project analysis without explanation. Perhaps as a result, it adopts unsound methods that systematically operate to inflate the BCR.

1. <u>Base data for forecasting</u>

The 2025 EC forecasts future East Asian containerized trade by starting with 2020 actual data as a base year. But 2020 historically is an outlier and an unrepresentative data point. *Id*., III.2, p. 8. Moreover, using a single year is analytically unsound: as the Ashar Analysis recommends, the forecast base should be either an average of recent historical data or a trend forecast, where a trend is evident. *Id*.

The Corps' PowerPoint (Attachment L), on p. 15, agrees: "5-year average of historical tonnage as a baseline for future projections--**Minimize effects of anomalies and fluctuations.**" (emphasis added). Without explanation, it employs the alternate suggested method (a trend forecast: linear regression) for the liquid and dry bulk forecasts. *Id.*, p. 16. The containerized *commodity* forecast applied "long-term growth rates" recognized for international seaborne trade, but don't discuss the base assumption. *Id.*, p. 17.

But when forecasting containership cargo—the sector that comprises almost all of the Asian import traffic creating the Project benefit—the Corps abandoned this analytical rigor and switched methods entirely. The 2025 EC reports five years of base data (2016-2020), showing high variability year-to-year, and calculates the five-year average, as recommended in the PowerPoint. EC Tables 5.16 and 5.17, p. 33. However, the 2025 EC rejects the 2016-2020 average and instead uses the final, highest year, 2020 "to represent the baseline form (*sic*) which forecasted commerce was conducted." 2025 EC, 5.3.1.1.1, p. 32. This is clearly an outlier data point: for Far East Imports (the largest category of potential Project benefits), 2020 was 38% higher than the

[6] The identical quoted statements and tables of fleet forecasts appear in the PowerPoint, Attachment L, pp. 21-22.

five-year average and 108% higher than the volume three years earlier. EC Table 5.16, p. 33. No methodological justification for this approach is offered, and it is not consistent with sound forecasting principles as described in the PowerPoint.

The sensitivity of the feasibility decision is significant: simply changing this calculation to the five-year average drops the BCR to **1.01**, even if all of the other 2025 EC assumptions remain the same. Ashar Analysis, III.2, p. 8.

2. Growth forecast assumptions

Perhaps most critical to the feasibility finding is the forecast projection of containerized imports growing at **25.5% annually** between 2030 and 2036. The starting point for the fifty-year benefit calculation (2036) was increased almost 4 times by this single assumption. *Id*., VIII.1, p. 27. Without this assumption, the BCR drops to **0.72**, and if both this assumption and the outlier base year assumption are rejected, the BCR drops to **0.55**. *Id*., III.6, p. 11.

This critical growth forecast assumption deviates from conventional and reliable forecasting norms in several ways: it assumes a sudden jump in imports because of an increased Port capacity, not import market forces; the actual market forces data contradict the assumption; the model rejects reliance on independently sourced economic projections analyzing market trends and, instead, adopts the Project sponsor's unverified "estimates."

a. 2025 EC explanation

The extraordinary six-year growth spurt from 2030 to 2036 is unexplained in the 2025 EC, beyond a vague reference (p. 34) to improved landside facilities. The PowerPoint provides more detail: "new or upgraded manufacturing and processing facilities" and "14 new storage and distribution facilities." Attachment L, p. 18. These facilities, the PowerPoint says, are then the basis for future TEU forecasts incorporating the extraordinary 2030-36 bump. *Id*. While the PowerPoint bases its growth spurt on $28.2 billion in landside improvements, the 2025 EC (p. 34) only cites $10 billion, but keeps the inflated forecast.

There is no evidence in the DLR, the 2025 EC, or the PowerPoint that imports are currently being restricted by the lack of those new facilities, which is the necessary inference that imports will jump dramatically when those facilities begin operations. Nor is there any explanation of how completion of these new facilities will result in dramatic and sudden increase in imports.

b. Empirical data contradict the 2025 EC's assumption

Dr. Ashar correctly observes that imports do not increase simply because a port builds facilities to handle them. *Id*., p. 31. He examined the literature and concluded the only logical source of a sudden increase in imports unique to Wilmington would be related to the EV batteries and vehicles market emerging in North Carolina. *Id*., VIII.6-VIII.12, pp. 31-32. However, he concludes that even the EV battery and vehicle market does not support a forecasted increase in imports, but rather a likely decrease. *Id.*

c. 2025 EC uniquely rejects independent economic principles

Instead of doing its own economic analysis of import trends and growth, the Corps relies entirely on the North Carolina State Ports Authority ("**NCSPA**"), which "estimated annual TEU volumes associated with each improvement." Attachment L, p. 18. NCSPA's economic forecasts were highly criticized by the ASA and ultimately shown to be unsound and biased.[7] Yet nearly the entire project benefit (Asian TEU imports) is based on those flawed NCSPA estimates.

As Dr. Ashar discusses, he has not seen another port project forecast depend almost entirely on an abrupt growth spurt based on a one-time development of a new industry. "The common methodology assumes a moderate and steady growth rate, derived from a national, macro-economic study by outside consultants." *Id.* VIII.3, p. 29. Indeed, the Corps' studies of seven other ports employed this method and applied growth rates similar to Wilmington's except for the extraordinary growth spurt attributable to a single industry. *Id.*, Table 8 and Figure 11, pp. 29-20. This distorting one-time jump is unique in Corps forecasting, compared to other ports. In addition, unlike the typical consideration of several forecast scenarios (low, moderate, high), the 2025 EC uniquely relies on only one forecast, as "estimated" by the Project sponsor. *Id.*, VIII.4, p. 30. The Corp here eschewed macro-economics, national trends, or independent analysis, and based its forecast on estimates made by the Project sponsor—NCSPA—which is not only not an independent consultant, but it was also the author of the 203 Report criticized in the ASA Review Assessment.

3. PPX1 call reduction versus larger vessels

Finally, the 2025 EC departs from the normal method of calculating benefit. Previous analyses of this Project assumed, like most port deepening projects, efficiencies stemming from reliance on larger vessels that the deepening will accommodate. *Id.*, VI.2, p. 23. The 2025 EC, without explanation, resurrects the PPX1 fleet and generates benefit by increasing the load per trip in a deeper channel and reducing the number of calls instead of the traditional vessel substitution analysis. The previous Wilmington analyses did not forecast *any* PPX1 usage. *Id.* Increased loads and call-dropping is a technique better suited to bulk shipping rather than containerized cargo, and has severe service implications which the EC does not address. *Id.*, V.4, pp. 20-21. Again, it appears that the Corps has employed a unique analytical construct to generate a project benefit, rather than conduct a rigorous analysis based in actual data and reasonable assumptions.

C. The 2025 EC relies on inaccurate and out-of-date information.

In addition to deviating from normal methodologies and utilizing unsound analytical tools, the Corps uses out-of-date data that ignores the most recent *actual* shipping activity and services at the Port. The 2025 EC does not incorporate current fleet composition data. It does not incorporate actual data about feedering in Wilmington and ignores the state of the current, evolving

[7] The BCR for this Project has dropped from the NCSPA original estimate of 5.4 to the current Corps estimate of 1.3, without considering the Ashar Analysis.

global maritime commerce market. As discussed below, it compounds these errors by also using unsupported supposition and biased preferences.

D. The 2025 EC relies on assumptions and biased conjecture.

1. Reliance on NCSPA estimates

As already discussed, the critical containerized cargo forecast is entirely based on NCSPA estimates. Returning to the flawed NCSPA analysis does not provide the independent and objective analysis that the ASA anticipated when he ordered a re-study of the unsupported economic justification proffered by NCSPA in the 203 Report.

2. Other biased input

At the public information session on 8 October 2025, Corps personnel explained that assumptions about port service patterns were based on USACE interviews with shipping representatives— interviews that are not available for review by the public.[8] Besides depriving the public of access to the basis for the critical analytical assumptions underlying 2025 EC (*see* Section II E, below), this approach has a built-in bias. The shipping lines are a sophisticated industry, and have faced many port deepening analyses. Any shipping line will prefer the flexibility of a deeper harbor, whether or not it always changes its future service choices. It may still choose to light-load or use a smaller vessel for any of a variety reasons (*e.g.*, feedering, frequency of service concerns, etc.), and it may do so on a regular basis for the market reasons discussed in the Ashar Analysis. But shipping lines will always prefer to have the option of large, fully loaded vessels in a deeper channel, and their forecast of how a deepening might affect future service choices is thereby inevitably colored. "Would you rather have more choice?" is hardly a question that will elicit reliably predictive answers about future conduct. Premising a fifty-year forecast on the preferences of shipping lines who cannot be harmed by the Project biases the analysis from the outset.

E. The 2025 EC fails to document support for its assumptions and conclusions.

As discussed in the VBHI Comments, Section IV B, pp. 14-16, the 203/403 process and the related NEPA review are required to be open to meaningful public involvement and disclosure of the bases for decisions. The NED analysis was originally done by NCSPA privately.[9] After the ASA Review Assessment severely criticized that analysis, USACE said it would revisit the

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[8] *Similarly, see* VBHI Attachment J (USACE extension email): "The author of our Economics Chapter and Appendix obtained the data used to create his forecasts from several subscription or proprietary sets of data, which he signed Non-Disclosure Agreements (NDAs) in order to access. … This data is not releasable subject to these non-disclosure agreements and licensure restrictions."

[9] The only avenue for public comment was via a website that NCSPA never activated. VBHI Comments, pp. 14-15.

analysis anew, and VBHI specifically asked that the public be involved in and informed of that new analytical approach, but that request was rejected. *Id.*, IV D, pp. 17-21. The 2025 EC is the first peek behind the curtain the public has had, and it is woefully short on detail or explanation. VBHI's comment extension and FOIA requests have produced only the Attachment J email explanation quoted above in footnote 7 and the PowerPoint, Attachment L. There is no background data or analysis supporting the 2025 EC critical assumptions discussed above. Under the Corps' own guidance, "The feasibility report should document the planning process **and all assumptions and rationale for decision making**." ER 1105-2-100 ("PGN"), Sec. 4-3(b)(2) (emphasis added). The 2025 EC report does not satisfy the PGN. Moreover, § 203 of WRDA requires the Secretary to review "whether or not the study, and the process under which the study was developed, each comply with Federal laws and regulations applicable to feasibility studies of water resources development projects." 33 U.S.C. § 2231(b). The DLR and 2025 EC fail to comply with these requirements.

F. Considering only Project benefits, the Project is not feasible.

The BCR is a ratio of the Project benefits to the Project costs. The Ashar Analysis considered only the benefit side of that calculation. Examining critical assumptions, it found that eight adjustments are necessary, five of which independently reduce the BCR below 1.0, and the other three reduce the BCR to near 1.0. Ashar Analysis, VII.1, pp. 26-27. As Dr. Ashar observes, because these factors are largely independent, combining any two of them by multiplying the discount factors together will reduce the BCR even farther—well below 1.0. *Id.*, VII.1, p. 27. For example, adjusting for the absence of Asian services, the outlier forecast base year, and the 25.5% six-year growth leap reduces the BCR to **0.25**.

Even these recalculations are generous. The stated BCR for this Project (1.3) has varied widely and is now marginal, meaning the conclusion of technical feasibility is highly sensitive to the underlying assumptions. *Id.*, II.2, pp. 6-7. Unlike large BCR projects, where forecasting errors or benefit estimates will not move the BCR below a feasibility ratio of 1.0, the opposite is true here: changing assumptions even slightly reverses the BCR feasibility decision, as demonstrated throughout the Ashar Analysis. In such circumstances, sensitivity testing (how does the outcome vary with adjustments to the assumptions) is critical and fundamental to sound economic analysis. The 2025 EC, however, includes no sensitivity analyses and is therefore arbitrary: it necessarily assumes that all assumptions (including those assumptions shown to be contradicted by facts) are correct **and** that, if any errors were made, they will not impact the final conclusion. The 2025 EC effectively applies a probability factor of 100% instead of some lower value—that would recognize uncertainty—for each assumption. Applying *any* reasonable reduction below certainty (100% probability) will necessarily reduce the BCR below 1.0.

As Dr. Ashar concludes:

> Altogether, I find the methodology, data, assumptions, and calculations of the BCR, the economic criteria employed by 2025 EC to assess Project feasibility,

> as **unreliable**. Moreover, based on my adjustments to the Project's BCR, I conclude that the Project, as presented in 2025 EC, is most likely **infeasible.**

Ashar Analysis, VII.2, p. 27 (emphasis in the original).

III. THE COSTS OMITTED FROM THE DEIS FURTHER DECREASE THE BCR

A. The DLR and 2025 EC Improperly Exclude Costs

In calculating the BCR, the DLR limits the costs to only "the total economic costs of constructing and maintaining the project." DLR p. 1, § 5.1. This formulation incorrectly excludes environmental and societal costs, contrary to the controlling Corps guidance:

> Calculations of NED are meant to include all environmental and social benefits and costs for which monetary values can be obtained.

ER 1105-2-103, p. 4, § 1-12(b)(1). *See also* ER 1105-2-100, App. D, Amendment #1, p. D-5, § D-3(d)(1): "Resources required or displaced to minimize adverse impacts and/or mitigate fish and wildlife habitat losses are also NED costs." While the Corps may dispute its NEPA mitigation obligation for many of the impacts identified below, they are nonetheless impacts that will fall on society and impact the NED, and therefore the BCR.

There are several categories of impacts which were either ignored, minimized, or explicitly deferred in the DEIS and DLR for later evaluation. The VBHI Comments and comments submitted by other members of the public[10] identify un-accounted for costs that should have been recognized in the DEIS and DLR, and would have impacted the BCR (if included). Some of the following costs may, individually, seem minor. But the BCR (even before considering Dr. Ashar's analysis) is marginal, and every dollar therefore matters. Those costs that cannot be immediately quantified with certainty call into doubt the feasibility conclusion, which is premised on it being absolutely certain that none of these costs will ever be incurred.

B. Sand and Beach Impacts

As discussed in the VBHI Comments, the DEIS failed to consider current and cumulative impacts on the sand transport system at the River mouth, directly impacting VBHI. A comprehensive study of that system is necessary, the cost of which has not been included. In addition, over the last twenty-five years, VBHI has spent an average of $2.87 million annually

[10] Filed in response to the Notice, the following public comments already filed with the Corps are cited herein: "**SELC Comments**," filed by the Southern Environmental Law Center on behalf of ten conservation and public interest organizations; "**Orton Comments**," filed by the owner of a historic property on the River directly invaded and impacted by the Project; "**Campbell Island Comments**," filed by the owners of an island damaged by past projects and threatened again; "**Audubon Comments**," filed by a conservation organization identifying species and habitat impacts.

addressing the prior project's impacts. *See* VBHI Comments, Attachment A, p. 3. Similar impacts are predicted (*see*, VBHI Comments, Attachment G), and over the fifty-year Project life would add $143.5 million in cost (present value $73.8 million, at 3% discount).

Additional sand impacts are identified in the SELC Comments, pp. 18-19, and the Audubon Comments, p. 8, ⁋⁋ 1, 2. If, as discussed in the VBHI Comments, any of those costs are required by WRDA as mitigation for impacts to fish or wildlife habitat, the cost therefor would have to be provided in advance and secured, negating the discount rate and adding the cost of the payment-security mechanism. *See* VBHI Comments, pp. 12-13, and 33 U.S.C. § 2283(a)(1).

C. BUDM

The DEIS includes discussion of the Corps' plans to employ beneficial use of dredge material ("**BUDM**") to reduce Project costs by using material in nearby marshes or to create islands. This method reduces disposal transport costs, thereby lowering the Project cost and, accordingly, raising the BCR. The Corps has not evaluated the suitability of the material, particularly the portions of the River where mud has accumulated for decades outside the traditional Channel maintained by annual dredging, despite specific concerns having been raised about this material. SELC Comments, pp. 9-11, 19-20. *See* Audubon Comments, p. 19, ⁋ 4, and pp. 19-33, regarding negative species impacts and other unsuitable uses. If the material is unsuitable, it could impact BUDM plans for the Project, increasing disposal cost and, where BUDM assists in meeting mitigation obligations, increasing the cost of such mitigation by requiring the Corps to adopt other mitigation plans.

D. Wetland impacts and mitigation

The DEIS understates the impact the Project will have on fresh and saltwater wetlands and the species dependent on them, and therefore understates the extent of necessary monitoring, mitigation, and the cost thereof. SELC Comments, pp. 16-17; Orton Comments; Audubon Comments, pp. 18-19, ⁋ 3; Campbell Island Comments.

E. Erosion

In addition to supporting VBHI's concerns about beach impacts, other commenters point out that the improper and incomplete analysis of wake impacts understates the shoreline impacts along the entire twenty-eight-mile channel. SELC Comments, pp. 18-19; Orton Comments, pp. 6-8 and attached expert reports; Audubon Comments, pp. 8-18, ⁋ 2; Campbell Island Comments (regarding historic cumulative impacts). Despite stating that "the consideration of localized impacts is crucial", B-294, the DEIS fails to specify the extent of those impacts even when they are identified: "the magnitude of bed shear stress exceeded the critical threshold at several observation areas" B-296 (§ B-11.3.7- River Lights). Thus, the DEIS finds that wake damage *will* occur, but does not "quantify" it, thereby avoiding quantification of the monetary impact on the affected shoreline owners. While observing generalized increased bed shear stress and water level increases ("observed bed shear stress suggests a potential for increased sediment resuspension and erosion" B-270; *see also* B-293-94), there is no recognition that even a slight increase in water

level or bed shear stress can have erosional impacts at specific shoreline segments. The cost of mitigating these impacts (living shorelines, revetments, bulkheads, etc.) are at least societal, if not Project mitigation, costs which should have been recognized.

The last deepening in 2000 demonstrated the extent of these impacts from passing ships. For example, the North Carolina Historic Site Brunswick Town/Fort Anderson ("BT?FA") experienced severe and sudden erosion caused by the primary wakes of the larger vessels transiting after completion of the 2000 WHP. BT/FA has expended $2 million to mitigation the impact.[11] The Campbell Island Comments and especially the Orton Comments, with their supporting expert analyses, demonstrate that the likelihood of the need for additional shoreline protection is high and will be expensive. The historic Orton site is directly threatened by this Project.

F. Groundwater

Groundwater impacts were incompletely and inadequately analyzed, and the mitigation costs therefore were not included. SELC Comments, pp. 21-22; Campbell Island Comments (regarding salt water intrusion impact on forestry); Orton Comments (impact of salt water intrusion on historic properties).

G. ESA and related issues

Inadequate analysis of the impacts to threatened and endangered species requires more thorough analysis and mitigation, including WRDA mitigation. SELC Comments, pp. 22-28, and Audubon Comments.

H. Cultural and historic properties.

Effects required to be analyzed under NEPA specifically includes historic and cultural effects. 40 CFR § 1508.1 (definition of effects). The DEIS fails to meet this requirement. Citing lack of time and money, the DEIS proposes to defer this mandated analysis until the pre-construction, engineering, and design phase, DEIS 3.21.3, p. 3-32 (2nd),[12] which presumes the Project is feasible. The result is elimination from cost analysis of any mitigation that may be identified and exclusion from the feasibility analysis.

The history of this navigation channel shows that such failures are inexcusable. Specifically, after the 2000 WHP, the historic BT/FA site was severely eroded, threatening pre-Revolutionary War structures. Orton is now similarly threatened. *See* Orton Comments, discussing the failure to examine that historic property and the threat presented by the Project. Even if NEPA provided the Corps with discretion to defer specific Project cost evaluation (i.e., where the feasibility decision could not be impacted because of the size of the BCR compared to the range of additional, deferred costs evaluations), there is no such license where the issue is evaluating the

[11] *See* Brooks Pierce letter for VBHI to USACE Wilmington District, 30 June 2023, discussion at p.8.

[12] The DEIS pagination re-starts after 3-90.

NED and assessing *all* costs of a marginal Project. Beyond the regulatory mandate, there is a demonstrated need here for such evaluation. *See* SELC Comments, pp. 28-29; Orton Comments.

I. Land, water, and mineral rights.

Comments show the Project will impact land, water, and mineral rights and the DEIS and DLR do not account for the associated costs, contrary to the specific guidance requirement to include these costs in the NED analysis. ER 1105-2-100, Appendix D, Amendment #1, Sec. D-3(e)(9), pp. D-7--8. The Orton Comments demonstrate how the Project not only directly invades Orton property, requiring an easement (for which compensation is due), it also threatens extensive damage to property the owners have invested millions to restore and protect. *See also* Campbell Island Comments.

J. Insufficient mitigation generally

There is no monitoring plan and woefully insufficient mitigation provided in the DEIS, considering the scope of actual and potential impacts, both analyzed and un-analyzed. Audubon Comments, P. 33, ⁋⁋ 5, 6. WRDA requires certain impacts to be assessed and provided as part of the Project costs, SELC Comments, pp. 30-33, but the 2025 EC fails to comply.

K. CZMA Concurrence Costs

As required by the Coastal Zone Management Act, 16 U.S.C. § 1456(c)(1)(A), the Corps has certified that this Project is consistent with North Carolina's Coastal Area Management Act ("CAMA"), DEIS App. N, p. 17, and has requested a consistency review by the North Carolina Department of Environmental Quality, Division of Coastal Management ("NCDCM"). That request was received by NCDCM on 17 Oct. 2025. Under 15 CFR 930.41, NCDCM has sixty days from receipt to complete its review and issue its concurrence or objections. On 7 Nov. 2025, NCDCM notified the public it would accept oral comments at a public meeting 17 November 2025 and written comments until 5 p.m., 5 Dec. 2025.

It is already clear the Project is not consistent with CAMA in several respects. *See,* Orton Comments, pp. 20-25 (specifically addressing CZMA). VBHI is still preparing its CZMA comments, but anticipates similar objections to those that it has raised to the Corps in the VBHI Comments. Specifically, VBHI anticipates noting the failure of the Project to evaluate and provide mitigation for impacts to important coastal and estuarine systems, particularly including the sand transport system and resulting threats to areas of environmental concern. These are largely identical to those concerns raised about the 2000 WHP. Indeed, NCDCM[13] also raised informal objections to the 2000 WHP, leading to the Corps' adoption of the 2000 Sand Management Plan ("SMP") and NCDCM's subsequent conditional CZMA concurrence—conditioned on the Corps complying with the SMP and its pledge to monitor and update it as needed. The Corps agreed to the conditions and incorporated them into the final FONSI. We now know that the Corps' pledge

[13] At that time the North Carolina Department of Environment and Natural Resources (NCDENR).

and FONSI conditions are not enforceable. *See* VBHI Comments, footnote 10, pp. 12-13. To protect North Carolina's interests, more will be required.

Ultimately, the Project presents the same risks that led to NCDCM's objections in 2000, plus new ones. If, as anticipated, NCDCM again raises these concerns, there will be additional costs necessary to address them: paper promises will not be sufficient. Some enforceable mechanism must be provided to assure the promises are caried out during the life of the Project. Such mechanisms entail additional costs that have not been accounted for so far.

L. Additional Costs will Further Reduce the BCR

Overlooking the foregoing costs is a DEIS deficiency and fails to satisfy the NEPA "hard look" requirement. In addition, it fails to satisfy the ASA mandate to re-examine the cost justification of this Project. In a Project with a large BCR, like Savannah, the foregoing costs may not materially affect the feasibility analysis. But where, as here, the BCR is at best marginal, it is arbitrary and capricious for the Corps to assume without investigation or data that such costs will not affect the final determination. And it is arbitrary and capricious for the Corps to conclude that the project is feasible when the margin is so close and so many costs have been simply ignored.

IV. THE IMPRACTICABILITY OF THIS PROJECT

As noted above and in Ashar Analysis, p. 7 footnotes 1 and 2, the prior analyses of this Project have always included an alternate BCR calculation applying a 7% annual present value discount. This is because under current Corps' guidance (EC 11-2-216, 31 Mar 18, D-2-2, Sub Appx. D-2), a funding recommendation requires a **BCR of 2.5, applying a 7% discount rate**. This Project only met this threshold in the NCSPA's initial Draft Report (2019), revised downward after the initial Corps critique to 1.3 (at 7%), before the ASA's additional criticism of the NCSPA economic assumptions in 2020. Now, the BCR has fallen to 1.3 using only a 3% discount, and the Corps has omitted the 7% discount calculation previously included. Mathematically, the BCR cannot exceed 1.0 (much less 2.5) if a 7% discount is applied[14] since the costs are almost entirely incurred initially (and hence not discounted) while the benefits are incurred gradually over fifty years and more steeply discounted at 7% than at 3%. Fiscally, this Project is irresponsible.

The context of this Project is also significant. The forecast of world maritime trade is that smaller, remote ports will continue to play a role, but an inevitably smaller and different role (feedering, instead of an alternate direct destination). Wilmington handles less than 1.5% of the containerized cargo on the East Coast.[15] By comparison, the Savannah deepening Project cost $973

[14] Precise recalculation is not possible by the public because the Corps' underlying documentation of calculations has not been included in the public materials or otherwise provided.

[15] 2025 EC, p. 14, Table 5.4 (East Coast Ports total 16.9 million TEU; Wilmington handles 231,452).

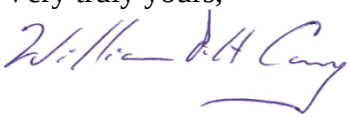
million and produced a BCR of **7.3**,[16] and Savannah handles 16 times more container cargo than Wilmington.[17] The disproportionate expenditure of public funds to impact efficiency at smaller ports like Wilmington, especially when premised on modeling extinct service paradigms, is not in the national economic interest.

Nor is this Project in the local, North Carolina, interest. Taxpayers in North Carolina apparently will bear twenty-five percent ($339 million)[18] of the Project cost. Contrary to the unsupported NCSPA assumption, which was the original premise for this Project, **the Project will have no impact on the volume of cargo moving through Wilmington**. 2025 EC, p. 32, Section 5.3.1.1. The entire project benefit is the supposed national benefit[19] of improved efficiency, which only the shipping lines will enjoy. Wilmington and North Carolina will receive no benefit for their $ 339 million contribution: no increased cargo, no increased jobs, and no increased revenue, either at the Port or in the State.

V. CONCLUSION

The decision that this Project is feasible is arbitrary and unsupported by the record.

Very truly yours,



William P. H. Cary
Counsel for Village of Bald Head Island

Cc: Peter Quinn, Mayor, Village of Bald Head Island
Justin McCorcle, Wilmington District Counsel, U.S. Army Corps of Engineers
Tancred Miller, Director, Division of Coastal Management, NC DEQ
Cameron Luck, Federal Consistency Coordinator,
Div. of Coastal Management, NC DEQ
Heather Coats, Beach & Inlet Management Project Coordinator,
Div. of Coastal Management, NC DEQ
George Kassler, Mayor, Town of Caswell Beach
Elizabeth White, Mayor, Town of Oak Island

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[16] USACE Savannah Harbor Expansion Project Frequently Asked Questions (8 Dec. 2021). https://www.sas.usace.army.mil/Portals/61/docs/SHEP/SHEP%20FAQs%20-%2008%20Dec%202021.pdf

[17] *Id.*; 3,701,297 TEU (Savannah)/321,452 TEU (Wilmington).

[18] DLR Section 5,Table 5-1.

[19] And even this national benefit is suspect: Is there any evidence that the supposed savings enjoyed by the shipping lines handling less than 1.5% of the East Coast TEU cargo will impact the national prices charged by those shipping lines?

Mike McIntyre, Ward & Smith
The Honorable Thom Tillis
The Honorable Ted Budd
The Honorable David Rouzer
Dr. Asaf Ashar

VILLAGE OF BALD HEAD ISLAND SUPPLEMENTAL COMMENTS

17 NOV. 2025

ATTACHMENTS

Attachment L:	Corps PowerPoint: 403 Economic Considerations
Attachment M:	Feasibility of Deepening the Port of Wilmington Channel (2025) for the Village of Bald Head Island, by Asaf Ashar, PhD, Ports and Shipping Consultant, November 14, 2025 ("Ashar Analysis")
Attachment N:	Summary of Education and Experience, Asaf Ashar, PhD

ATTACHMENT L

VILLAGE OF BALD HEAD ISLAND SUPPLEMENTAL COMMENTS

17 NOV. 2025

CORPS POWERPOINT:

403 ECONOMIC CONSIDERATIONS

403 ECONOMIC CONSIDERATIONS

Wilmington Harbor Section 403 Letter Report

Economic Analysis Overview

Prepared by Andrew Bazzle

Economist
Deep Draft Navigation
Planning Center of Expertise

PRESENTATION AGENDA

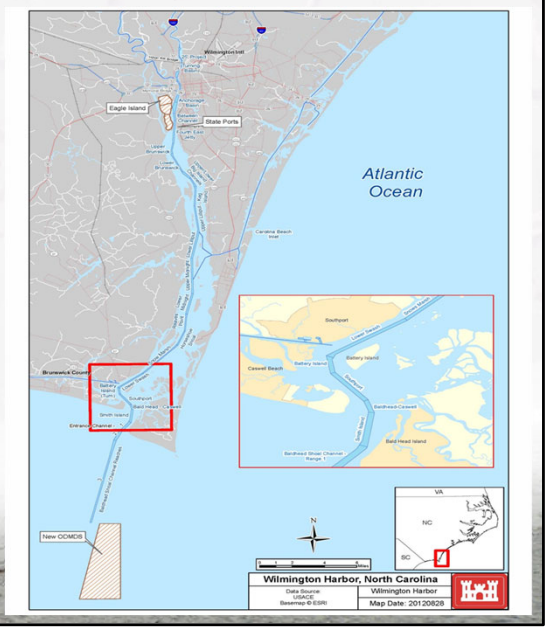
- Existing Conditions overview
  - Channels and Port
  - Cargo Details
  - Vessel Fleet Details
- Future Without-Project Economic Conditions
  - Commodity Forecast
  - Vessel Fleet Forecast
  - Multiport Considerations
- Future With-Project Condition
  - Assumptions
  - HarborSym Modeling
  - Load Factor Analysis
- Transportation Cost Savings Benefit Calculations

2

403 STUDY ECONOMIC CONSIDERATIONS

Existing port conditions

- 38-mile federal channel
- - 42 feet MLLW up to Cape Fear Memorial Bridge
- 23 different channel segments (reaches) of varying width
- 12 deep draft docks for liquid bulk, dry bulk, container cargo, general cargo, Ro/Ro
- Use of harbor pilots and tugs throughout
- Inherent limitations on traffic volume (continued next slide)
  - Captured in HarborSym economic model
  - Carried forward into Environmental Impact Statement (EIS)



All inform economic modeling later

403 ECONOMIC CONSIDERATIONS

Inherent Limitations on Traffic Volume
- One-way channels
- Safe Speeds
- Terminal Berth space
  - Container berths =>
  - Bulker/Tanker berths
    - Typically, 3-6 berths/terminal
    - Rarely all used at once
- Cargo handling capacity
  - Based on Commodity Transfer Rates per terminal by vessel class

Terminal	Ship Berths	Total Length (ft.)	Ship Berths	Vessel Capacity	Dwell Time (hrs)**	Max Calls/Year*	Vessel Capacity	Avg TEUs (Un)Loaded	Max TEU
NCSPA 7-9	3	2,700	SPX-PX (<=106' Beam)	3	15	520	2,000	540	280,800
			PPX (106'>Beam<=144')	2	15	520	6,000	772	401,440
			Super PPX (>144' Beam)	1	15	520	12,000	686	356,720
								Total Estimate	1,038,960

Terminal	Crane Size	Cranes	Working Hours	Sustainable Hours (80%)	Crane Capacity (TEUs)
NCSPA 7-9	PPX (17-19 Across/6k+ TEU)	2	8,000	6,400	275,200
	Super PPX (20-24 Across/12k+ TEU	5	20,000	16,000	688,000
	Total	**7**	**28,000**	**22,400**	**963,200**

All must be modeled in HarborSym
- Reasonably model a port's capacity
- Not create "artificial" congestion
- Reasonably capture effects of a deepened channel (capacity unchanged with a project)

4

*Limited to 5 calls per week per berth (520 per terminal)
**explore.dot.gov/views/VesselDwellTimes

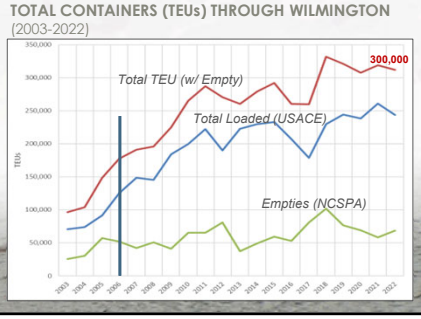
- 7 cranes @ max of 4,000 hrs/yr = 28,000 crane hours
- 80% = 22,400 sustainable crane hrs
- Max crane productivity of 35 containers per hr
- 80% = 28 cont./hr x 1.54 TEU/container = 43 TEU/hr
- Sustainable crane capacity = 43 x 22,400 = 965,888 TEU/yr

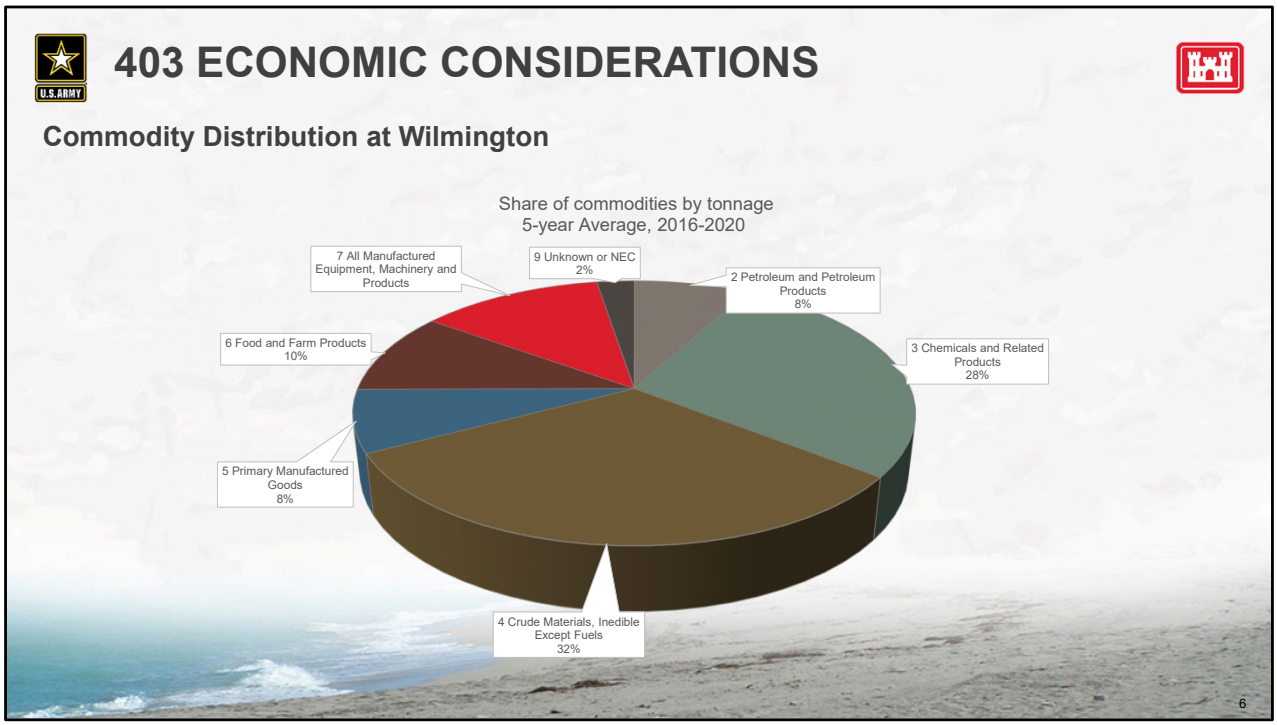
- Pilots prefer to keep speeds constant with deeper/wider channels and gain greater safety margin for environmental conditions and contingencies.

403 ECONOMIC CONSIDERATIONS

Commodity Movements

- 7.6 million tons throughput in 2022
  - 6.6 million tons foreign cargo
    - 3.7 million tons imports
      - 1.2 million tons containerized
    - 2.9 million tons exports
      - 1.1 million tons containerized
  - 1.0 million tons domestic cargo
- Total tonnage variable since 2004 (42-foot deepening complete in 2006)
  - Decline mainly due to petroleum products, coal changes
  - Containerized cargo climbed 2003-2011, plateaued since 2012





- Petroleum products: gasoline (26%), kerosene (13%), residual fuel oil (9%), distillate fuel oil (22%), asphalt, tar and pitch (13%) and petroleum coke (14%). The port does not handle crude petroleum.
- Chemicals: alcohols (29%), nitrogenous fertilizers (32%) and sodium hydroxide (9%).
- Crude materials: fuel wood (43%), wood in the rough (14%), pulp and wastepaper (14%), lumber (5.0%), and gypsum (10%).
- Primary manufactured goods: paper and paperboard (14%), cement and concrete (15%), misc. mineral products (11%), fabricated metal products (19%), and iron and steel plates and sheets (10%).
- Food and farm products: soybeans (19%), animal feed (10%), and fresh and frozen meat (38%).

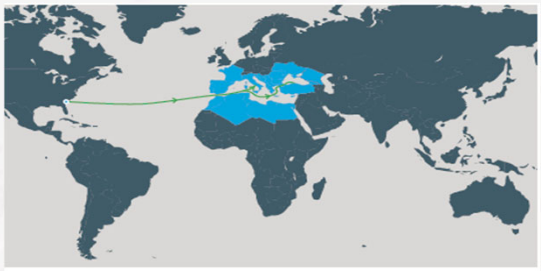
403 ECONOMIC CONSIDERATIONS

Commodity Movements

- Liquid Bulk (Tankers)
  - Origins: Europe, Middle East, India, Caribbean, S. Amer.
  - Destinations: U.S. ports via AIWW
- Dry Bulk (Bulkers)
  - Origins: Canada, S. Amer., Europe, Middle East
  - Destinations: Europe, U.S. ports, Asia, Africa
- Containers (Containerships)
  - Origins/Destinations (liner routes): Asia, Central America, Europe

Route distance X *vessel speed* = voyage time

Voyage time X *hourly operating cost* = transportation cost

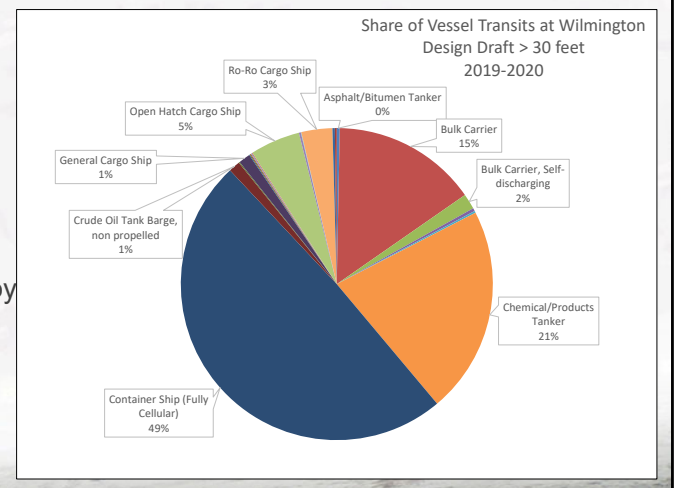


403 ECONOMIC CONSIDERATIONS

Vessel Fleet Operations

Multiple vessels transit with depth >38 feet, occasionally > 40 feet with tide

- Tankers:
  - Alcohols, fertilizers, sodium hydroxide hauled by small/medium tankers (< 35 feet)
  - Gasoline, kerosene, other chemicals hauled by larger tankers (< 44 feet)
- Bulkers:
  - Pulp, lumber, concrete, gypsum hauled by small/medium bulkers (< 37 feet)
  - Wood pellets, rough wood products hauled by larger bulkers (<50 feet)
- Containerships:
  - Raw materials, manufactured products, liquids, agricultural products, and refrigerated goods (38-51 feet)



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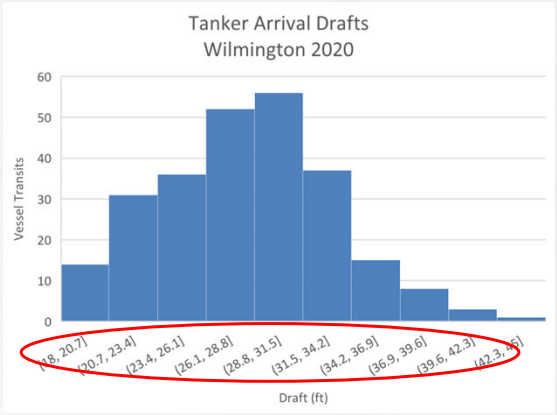
The resulting distribution is approximately 50% containerships, 25% tankers, and 25% general cargo vessels, including bulkers.

403 ECONOMIC CONSIDERATIONS

Tanker Transits by class, 2016-2021

Tanker Class	Size (DWT)	Design Draft Range (ft)	2016	2017	2018	2019	2020	2021	Grand Total
General Purpose (GP)	10,000-24,999	22.2-33.5	52	55	34	76	86	108	411
Medium Range (MR)	25,000-44,999	30.2-44.0	145	103	88	113	107	101	657
Large Range 1 (LR-1)	45,000-79,999	39.5-43.9	44	68	22	41	38	48	261
Grand Total			**241**	**226**	**144**	**230**	**231**	**257**	**1,329**



Liquid bulk cargo percentage of tonnage by class, 2016-2020

Vessel Class	2016	2017	2018	2019	2020	Average
GP	67	50	65	72	61	62
MR	33	50	35	26	27	35
LR-1	0	0	0	2	12	3
Total	100	100	100	100	100	100

By 2020, 39% of liquid bulk volume is carried on tankers that could be loaded deeper than the current channel (42 feet), but aren't doing so

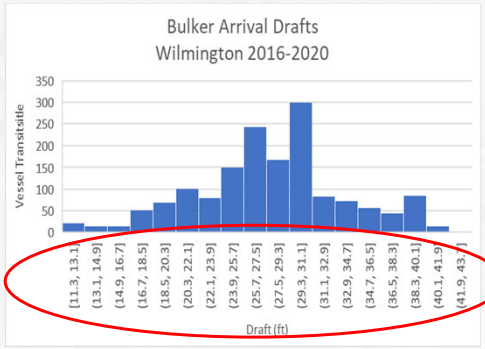
9

Over the past 5 years, tonnage has begun to shift from smaller to larger tankers. The more efficient use of larger LR-1 class tankers (60,000-80,000 DWT) would reduce transportation costs for the petroleum firms operating at Wilmington. Larger vessels are not frequently used due to the depth constraint of the Federal navigation channel. If greater channel depth were available, petroleum firms would likely increase the shift of cargo onto larger vessels already in the fleet of vessels calling to take advantage of the economies of scale.

403 ECONOMIC CONSIDERATIONS

Dry bulk cargo percentage of tonnage by class, 2016-2020

Bulker Size	Capacity Range (DWT)	Design Draft Range (feet)	2016	2017	2018	2019	2020	Average
Very Small	3,000–20,000	25–30	1	1	2	1	2	1
Small	20,001–30,000	31–35	2	3	2	0	0	1
Medium Small	30,001–40,000	36–37	15	12	20	14	19	16
Medium Large	40,001-–50,000	38–40	24	18	12	13	10	15
Large	50,001–60,000	41–43	21	27	21	20	11	19
Very Large	60,001–105,000	44–50	37	39	43	52	57	47
Total			100	100	100	100	100	100



By 2020, 68% of dry bulk volume is carried on bulkers that could be loaded deeper than the current channel (42 feet), but aren't doing so

10

Over the past 5 years, tonnage has begun to shift from smaller to larger tankers.
The more efficient use of Very Large Bulkers would be more efficient. It is likely they will shift to those more over time, given the width of the Panama Canal, and the shift in shipbuilding to these larger vessels.

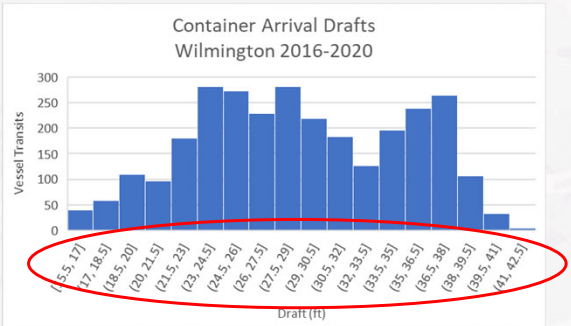
403 ECONOMIC CONSIDERATIONS

Containership Transits by class, 2016-2021

Tanker Class	Capacity Range (TEU)	Design Draft Range (ft)	2016	2017	2018	2019	2020	2021	Grand Total
Subpanamax	< 2,800	< 38	173	185	140	120	162	163	943
Panamax (PX)	2,801-4,800	31-45	43	64	62	37	32	73	311
Post-PX Gen1	4,801-6,800	35-48	51	43	28	4	1	1	128
Post-PX Gen2	6,801-9,900	39-49	6	17	21	25	4	1	74
Post-PX Gen3	9,901-15,000	< 51	3	16	19	69	85	83	275
Grand Total			**276**	**325**	**270**	**305**	**284**	**321**	**1,731**

Container cargo percentage of tonnage by class, 2016-2020

Vessel Class	2016	2017	2018	2019	2020
Sub Panamax	33	32	26	30	22
Panamax	25	32	34	14	13
PPX Generation I	39	16	10	1	0
PPX Generation II	3	10	13	13	3
PPX Generation III	0	10	17	42	61
Total	100	100	100	100	100



By 2020, 77% of container volume is carried on containerships that could be loaded deeper than the current channel (42 feet), but aren't doing so

PANAMA CANAL

Max beam: 106.2 ft (Panamax), 168.14 ft (Post-Panamax)

Max draft: 40 ft (Panamax), 50ft (Post-Panamax)

11

Over the past 5 years, tonnage has begun to shift from smaller to larger containerships. PPX3 has a beam of 168 feet, the largest supported by the expanded Panama Canal.

In 2021, PPX Gen III made up about 10% of the In-Service total containership world fleet but accounted for 21% of newbuilding's in the Orderbook. Its relatively new age supports more growth in the forecast period by 2050; rather than being outpaced by scrapping's.

Deepening could eliminate some smaller vessels on Asian and South American routes, and lower total PPX3 calls needed

403 ECONOMIC CONSIDERATIONS

Problem statements:

- Existing cargo shippers are experiencing increased operating costs due to light loading, congestion delays, and tidal delays;

- Light loading, congestion delays, and tidal delays will increase as present harbor users increase their annual tonnage throughput and as larger ships that require deeper channels replace older, smaller ones.

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403 ECONOMIC CONSIDERATIONS

Future Without-Project Conditions

Future Port Conditions Assumptions

- Total cargo throughput is expected to increase in the future, according to overall economic trends visible at this point. *Detailed forecast to follow*

- The port will see an increase in vessel traffic to accommodate this increase in volume.

- Expansion projects at the port will be completed, adding needed capacity to handle vessel and cargo increases
  - NCSPA terminal has container handling capacity of 750K TEUs now and 1.1M with future projects completed.
  - Resurfacing and upgrade of multiple areas
  - Reefer Phase II (704 additional plugs)
  - On-dock Intermodal Yard Redesign to double daily rail capacity (4 x 1,250' working track)
  - Berth 9 Crane upgrade to Neo-Panamax capability

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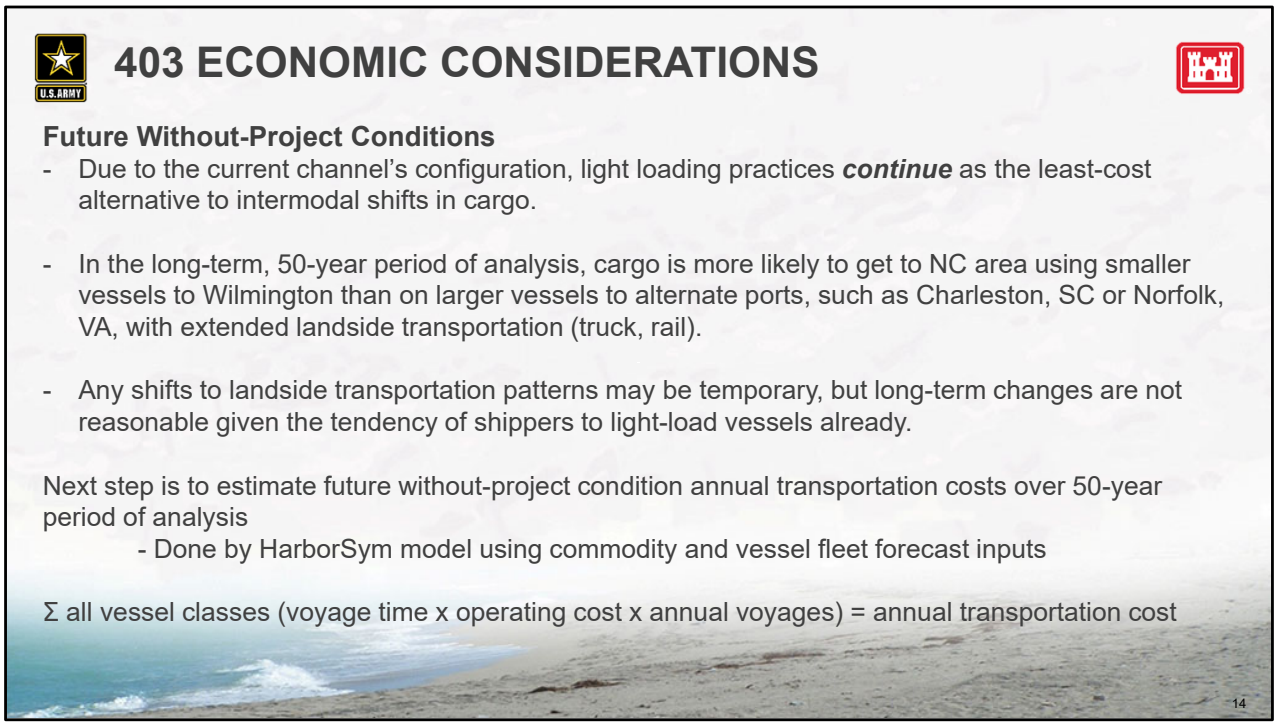

Market share between the Port of Wilmington and nearby regional ports like Charleston and Savannah is multi-faceted and very dynamic. Specific business relationships that drive the fluctuation of market share between them are the manufacturer-to-shipper relationships, shipper-to-port, or port-to-processor relationships. Some companies only ship to one port, others may ship to and from all three, depending on those involved. Given the relative closeness of these three ports geographically, it is likely that the market share will continue to fluctuate between the ports as capital improvements are made and the demand for goods change.

Ultimately, this economic analysis was conducted with the historical Wilmington cargo share remaining the same in both the future without-project and future with-project conditions. To restate the multiport considerations in another way, justification of the recommendation for this study is not based on the assumption that cargo will shift to Wilmington with deepening alone. The analysis assumes Wilmington receives the same share of regional cargo volumes with or without the widening of the waterway.

403 ECONOMIC CONSIDERATIONS

Commodity Forecast

- Forecasted benefiting commodities
  - Containerized cargo, liquid bulk, and dry bulk
  - Sets the requirement for future vessel fleet in modeling

- 5-year average of historical tonnage as baseline for future projections
  - Minimize effects of anomalies and fluctuations
  - Long-term forecast that captures economic prosperity and downturns

- Forecast period ran from Base Year of 2036 to 2056, or 20 years.

- Due to uncertainty in distant future, forecasted volumes and vessel traffic is held constant to the end of the 50-year period of analysis (2057-2085)

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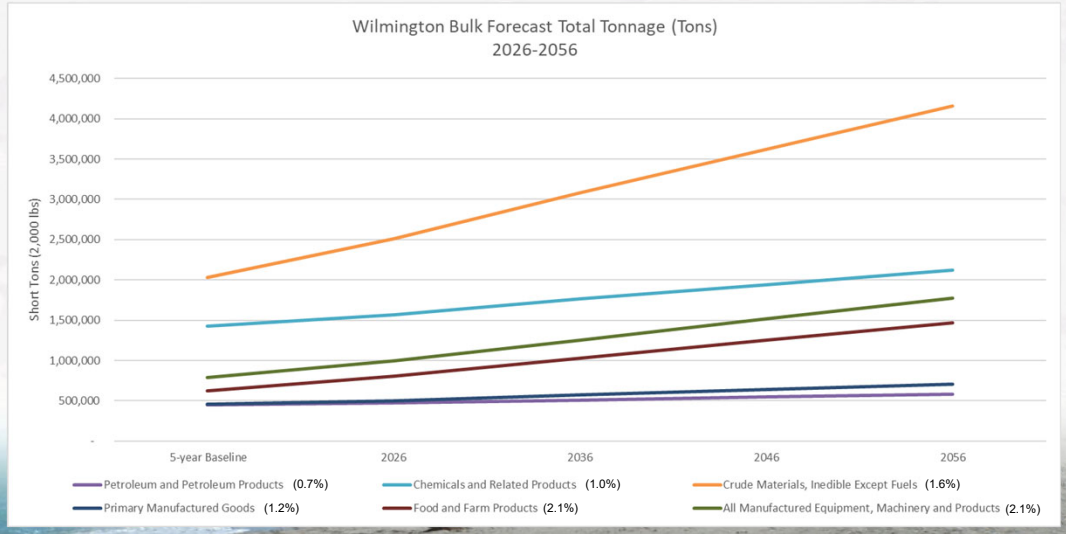
403 ECONOMIC CONSIDERATIONS

Liquid and Dry Bulk forecast



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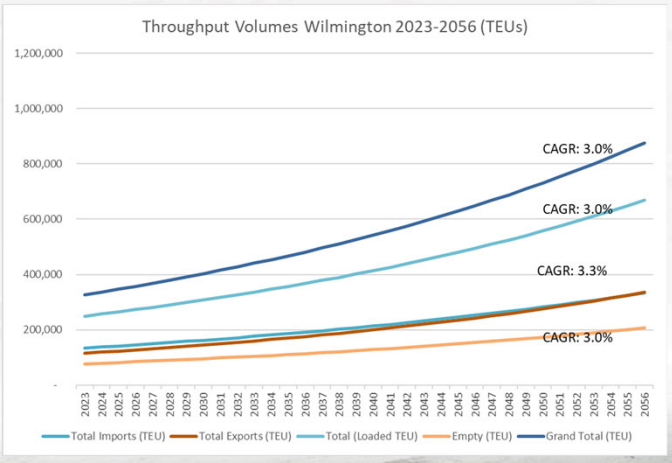
- Future volumes of liquid and dry bulk cargo were projected over the forecast period using a linear regression of the empirical data from 2016-2020.
- In the cases of petroleum products receipts, Food and Farm receipts, chemical shipments, and Primary Manufacture shipments, trends in tonnage were negative. In these cases, tonnages were held constant from the baseline over the forecast period. These no growth forecasts kept overall growth rates fairly conservative.

403 ECONOMIC CONSIDERATIONS

Containerized cargo forecast (step 1)

	Route Group	2023	2025	2030	2035	2040	2045	2050	2055
Imports									
	Far East	3%	3%	3%	3%	3%	3%	3%	3%
	Europe	2%	2%	2%	2%	2%	2%	2%	2%
	Caribbean	3%	3%	3%	3%	3%	3%	3%	3%
Exports									
	Far East	4%	4%	4%	4%	4%	4%	4%	4%
	Europe	2%	2%	2%	2%	2%	2%	2%	2%
	Caribbean	3%	3%	3%	4%	4%	4%	4%	4%



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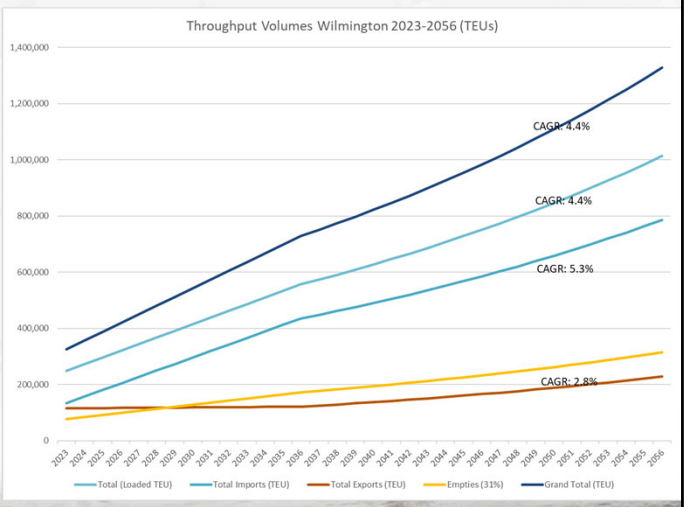
- From the containerized baseline, future volumes of containerized cargo were projected over the forecast period using long-term growth rates established by S&P Global (formerly IHS Global Insight) for international seaborne trade by World region. To validate that these growth rates were appropriate for the Port of Wilmington, forecasted containerized cargo for 2022 using these rates was compared to actual 2022 containerized volumes provided by the NCSPA. The difference was about 1.5%, so the growth rates were acceptable.

403 ECONOMIC CONSIDERATIONS

Containerized forecast (step 2)

- Qualitative factors
  - Local landside facility growth
    - $2.2 Billion in new storage and distribution facilities
    - $28.2 Billion in new/upgraded manufacturing and processing facilities
  - Most of this is under construction
  - Assumed to be operational by base year of 2036
  - NCSPA-provided estimates of increased cargo volume added to appropriate world region in step 1 forecast
- Port's future landside container capacity assumed to be 1.3 Million TEUs per year
- Will reach capacity by 2056 with this forecast



18

The last step of the forecast calculation is implementing qualitative factors, like COVID-19 impact factors, tariffs, infrastructure developments, and export/import restrictions. The area surrounding the Port of Wilmington is seeing significant growth in landside facilities. Over $28.2 Billion in new or upgraded manufacturing and processing facilities are planned over the next 10 years, as well as $2.2 Billion in the construction of 14 new storage and distribution facilities. In discussions with the NCSPA, about half these improvements are either permitted for construction, or currently under construction; therefore, the PDT assumed that most of those would be operational by the base year of the analysis. The NCSPA provided estimated annual TEU volumes associated with each improvement, based on discussions with the respective facility, or their own professional judgement. These estimates of new volumes were further grouped into their appropriate World region and direction (import/export) and added to the initial forecast.

The Port's landside container cargo capacity in the future without-project condition was estimated at 1.3 million TEUs per year, based on their planned facility upgrades as of the time of this report. As a result of the estimated additional volumes reported by the NCSPA as part of this forecast, that 1.3 million TEU capacity may be reached by 2056. Therefore, container growth was not capped for the remainder of the forecast period ending in 2056.

403 ECONOMIC CONSIDERATIONS

Bulker Vessel Fleet Forecast

- Using existing loading data from 2016-2020, developed an average tonnage per vessel, by vessel class.
- For the bulker fleet, loading practices were separated by commodity type; specifically crude materials (including wood pellets) from the rest of the dry bulk commodities, to accurately project future loading patterns for the bulker fleet.

- Bulk loading patterns small & sporadic
  Reasonable to assume patterns will continue; therefore, used to estimate the number of bulker vessel calls expected to move the forecasted levels of bulk commodities.

- Bulk Loading Tool (BLT) in HarborSym's Suite of Tools to estimate the number of bulker vessel calls needed to satisfy the commodity forecast, over the forecast period of 2036-2056

Commodity Type	**Crude Materials**		**Other Dry Bulk Cargo**	
Vessel Class	Receipts	Shipments	Receipts	Shipments
Very Small	9,792	0	10,338	0
Small	0	0	6,000	0
Medium	11,151	11,732	15,390	21,946
Large	0	27,394	19,844	27,394
Very Large	28,314	43,318	29,759	43,318

Vessel Class	**2036**	**2056**
Very Small Bulker	9	13
Small Bulker	1	1
Medium Bulker	71	93
Large Bulker	12	13
Very Large Bulker	71	97
Total Bulk Vessel Calls	**288**	**356**

403 ECONOMIC CONSIDERATIONS

Tanker Fleet Forecast

- Using existing loading data from 2016-2020, developed an average tonnage per vessel, categorized by vessel class.

– Only receipts were used in determining vessel calls effected by the depth of the channel.
  - Outbound tanker shipments are very small, domestic movements on AIWW, not modeled in this scenario.

– Additionally, the estimated share of liquid bulk cargo was adjusted over the forecast period from its existing share in 2020.
  - Shippers will continue to take advantage of available economies of scale in shipping by using an increasing share of LR-1 tankers to move their cargo. Given that most of the existing liquid cargo uses smaller, Medium Range tankers today, the most likely shift would be to the next larger class of Long-Range 1 tankers, and not all the way to Aframax class tankers, even with most of the world fleet containing Aframax tankers. This is reflected in a slight shift in cargo share over the forecast period.

– Bulk Loading Tool (BLT) in HarborSym's Suite of Tools to estimate the number of tanker vessel calls needed to satisfy the commodity forecast, over the forecast period of 2036-2056

		Share of liquid bulk cargo by vessel class		
Vessel Class	**2016-2020 Avg Receipts per call (metric tons)**	**2020 (existing)**	**2036**	**2056**
GP	6,353	18%	18%	18%
MR	15,990	49%	42%	32%
LR-1	29,085	33%	40%	50%

Vessel Class	2036	2056
General Purpose Tanker	49	57
MR Tanker	49	44
LR-1 Tanker	26	38

403 ECONOMIC CONSIDERATIONS

Containership Fleet Forecast

- Used an analysis of historical calls and forecasted share of capacity by vessel class to distribute forecasted tonnage.

– Considered new buildings and scrapping
  - Vessel Cascading

– Considered changes in the world containership fleet
  - Growth in Post-Panamax Generation III vessels(9k TEU+) is predicted to impact the Trans-Pacific trade (23-24,000 TEU vessels would impact the Asia to Europe trade, by contrast), and should provide significant additional capacity for services between the Far East and U.S. East Coast, such as the services currently calling the Port of Wilmington.

– Container Loading Tool (CLT) in HarborSym's Suite of Tools to estimate the number of containership vessel calls needed to satisfy the commodity forecast, over the forecast period of 2036-2056

FWOP Forecasted Shares of Containership Capacity

Route	Class	2036	2056
Far East	PPX1	24%	24%
Far East	PPX2	26%	26%
Far East	PPX3	50%	50%
Europe	SPX	53%	53%
Europe	PX	47%	47%
Caribbean	SPX	50%	50%
Caribbean	PX	50%	50%

World Containership Fleet by TEU band, 2013-2023			
TEU Band	**2013**	**2017**	**2023**
0.1 - 1.3 k TEU	1,600	1,553	1,497
1.3 - 2.9 k TEU	1,352	1,476	1,634
2.9 - 3.9 k TEU	303	271	294
3.9 - 5.2 k TEU	762	656	643
5.2 - 7.6 k TEU	519	468	447
7.6 - 12 k TEU	379	670	665
12 k TEU +	151	422	570
TOTAL	**5,066**	**5,516**	**5,750**

FWOP Forecast of Containerized Vessel Calls over forecast period			
Route Group	**Vessel Class**	**Without Project Year 2036**	**Without Project Year 2056**
Far East	PPX1	237	289
Far East	PPX2	157	186
Far East	PPX3	103	124
Europe	SPX	30	36
Europe	PX	102	111
Caribbean	SPX	29	34
Caribbean	PX	64	78
Total		**722**	**858**

As new, larger vessels become a greater percentage of the world fleet and are deployed to Wilmington, they replace smaller vessels which are redeployed to shorter routes, which may utilize the smaller vessels more efficiently

403 ECONOMIC CONSIDERATIONS

Combined FWOP Vessel Fleet Forecast

- Overall, vessel fleet is assumed to remain the same, burdened by the same set of problems and navigational constraints.
- Bulkers would shift towards larger sub-classes of Very Large Bulker vessels but remain draft constrained.
- Chemical tankers would shift cargo towards the larger classes of LR-1 tankers, away from smaller classes. LR-1 will continue to light-load because of the current channel depth.
- Containership calls will increase to accommodate the significant North Carolina landside development.
  - Since this will require more vessels than only a single class of container vessel can provide, the amount of liner services may increase from the two currently scheduled, and the fleet mix of vessels may grow to mirror those calling on other U.S. East Coast ports. Significantly more PPX1 and PPX2 vessels would be required to fulfill the commodity forecast without a project. These classes would continue to light-load over forecast period.

Vessel Class	2021	2036	2056
Sub-Panamax Containership (SPX)	163	59	70
Panamax Containership (PX)	73	166	189
Post-Panamax Containership 1 (PPX1)	1	237	289
Post-Panamax Containership 2 (PPX2)	4	157	186
Post-Panamax Containership 3 (PPX3)	83	103	124
GP Chemical Tanker	43	49	57
MR Chemical Tanker	54	49	44
LR Chemical Tanker	19	26	38
Very Small Bulker	5	9	13
Small Bulker	1	1	1
Medium Bulker	38	71	93
Large Bulker	12	12	13
Very Large Bulker	38	71	97
Total	**534**	**1,010**	**1,214**

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- New vessel classes are not assumed to arrive.
- 2036 and 2056 containership fleet mix is more like Charleston and Savannah than the 2021 fleet mix

403 ECONOMIC CONSIDERATIONS

Future With-project condition

- Navigation benefits generated from more efficient use of existing vessels and reductions in transit time
- By allowing deeper vessels, fewer voyages needed to move forecasted cargo
- Reducing delays for conditions makes existing voyages faster and more efficient

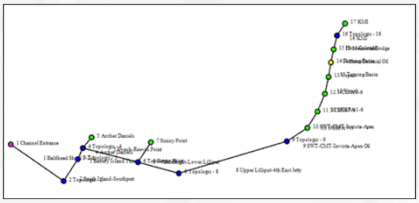
- **Multiport Analysis**
  - Assessed qualitatively as it relates to shifting of cargo from one port to another port based on deepening of a harbor. Wilmington will receive same cargo with or without a deepening.
  - Vessel loading alone does not drive growth for the harbor (see charts on slide 4)
  - Harbor dimensions are just one of many factors involved in determining growth and market share for a particular port. Other historical factors:
    - landside development and infrastructure
    - location of distribution centers for receipts
    - source locations for shipments
    - population and income growth and location
    - port logistics and fees
    - business climate and taxes
    - carrier preferences and business relationships
    - labor stability and volatility
  - Shipper inputs revealed that modifications at Wilmington alone will not be sufficient to change the vessel fleet servicing the U.S. (such as a shift to larger vessels).
    - Carriers visit multiple U.S. ports on a typical voyage. Even though Savannah and Charleston have completed large channel dredging projects in the last 20 years, more comprehensive change to the East Coast/ Gulf Coast port system would be needed to result in changes to the fleet (Panama Canal).

403 ECONOMIC CONSIDERATIONS

NED benefits were estimated by calculating the reduction in transportation cost at each alternative using the HarborSym Modeling Suite of Tools (HMST).

Capabilities:

- Incorporates existing traffic limitations and rules
- Creates forecasted vessel call lists with synthetic shipping based on fleet and commodity forecasts
  - Uses Bulk and Container Loading Tools (load factor analysis)
- Calculates vessel transiting time in harbor
- Captures inefficient delay times
- Calculates transportation cost from prior/next port and overseas distance
- Incorporates risk and uncertainty
  - discrete event Monte-Carlo simulation model (sampling)
- Transportation cost calculator
  - Hourly operating cost X vessel voyage duration = voyage transportation cost
  - Cumulative voyage transportation costs over a single simulated year
  - Sum of transportation costs over 50-year period of analysis



FWOP average annual transportation costs – FWP average annual transportation costs = Avg annual cost savings benefit

403 ECONOMIC CONSIDERATIONS

BLT/CLT Load factor analysis

- Commodity levels remain same as FWOP, load factors updated for deeper channels using:
  - Alternative depth
  - maximum loaded draft of each vessel class
  - the load factor percentage of each class
  - resulting increased capacity per their tons per inch immersion factor (BLT) or available container share (CLT)

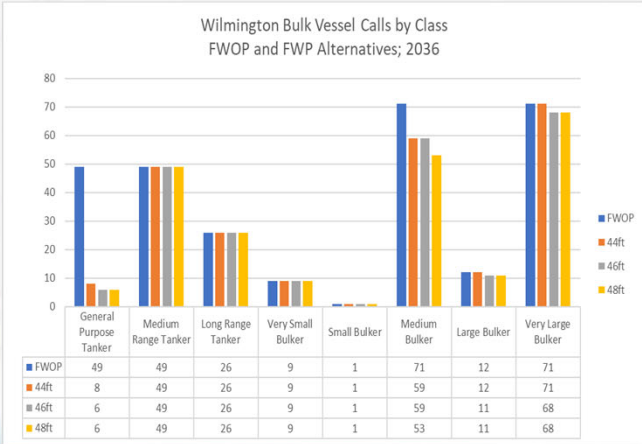
- Adjusts fleet's available capacity in each alternative scenario, then loads the largest vessel class completely, down to the smallest class, until the forecasted commodity volumes are satisfied.

Future Bulk Vessel Load Factors

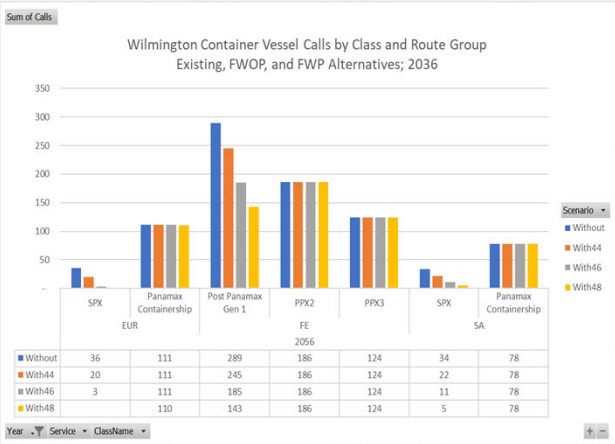
Vessel Class	FWOP Load factor Min/ML/Max	44 ft Load Factor	46 ft Load Factor	48 ft Load Factor
GP Tanker	10/50/90	10/55/90	10/55/90	10/55/90
MR Tanker	10/50/90	10/75/91	10/75/92	10/75/92
LR-1 Tanker	10/50/90	10/75/91	10/75/92	10/75/92
Very Small Bulker	63/71/90	63/75/91	63/75/91	63/75/91
Small Bulker	20/40/90	20/40/92	20/40/92	20/40/92
Medium Bulker	20/50/90	20/50/92	20/50/92	20/75/92
Large Bulker	20/40/90	20/55/90	20/55/92	20/75/92
Very Large Bulker	20/35/50	23/38/53	25/40/55	30/45/60

403 ECONOMIC CONSIDERATIONS

Vessel Calls Changes from BLT/CLT



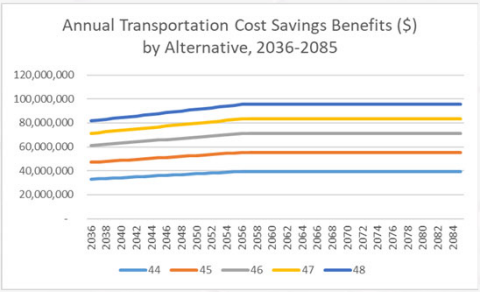
	General Purpose Tanker	Medium Range Tanker	Long Range Tanker	Very Small Bulker	Small Bulker	Medium Bulker	Large Bulker	Very Large Bulker
FWOP	49	49	26	9	1	71	12	71
44ft	8	49	26	9	1	59	12	71
46ft	6	49	26	9	1	59	11	68
48ft	6	49	26	9	1	53	11	68



	EUR		FE			SA	
Without	36	111	289	186	124	34	78
With44	20	111	245	186	124	22	78
With46	3	111	185	186	124	11	78
With48		110	143	186	124	5	78

403 ECONOMIC CONSIDERATIONS

- Transportation cost benefits estimated by summarizing and annualizing HarborSym results from multiple simulations
- Commodity and transportation cost growth is held constant after 2056 due to the uncertainty surrounding such long-term forecasts.
  - Benefit levels remain constant through the remaining period of analysis (2056-2085)
- The net present value (NPV) was estimated using interpolation between the modeled years and adding remaining years
- Transportation costs were annualized to determine average annual equivalent (AAEQ) cost savings by discounting the cost stream from year 2036 to 2085 with the FY 2023 Federal Discount rate of 2.5 percent.



Alternative/ Depth	Total Benefits (NPV) ($1,000s)	AAEQ Benefits ($1,000s)
Without Project	$0	$0
44 feet	$959,859	$31,834
45 feet	$1,352,151	$44,832
46 feet	$1,744,443	$57,831
47 feet	$2,040,667	$67,648
48 feet	$2,336,890	$77,465

403 ECONOMIC CONSIDERATIONS

Preliminary Economic Results
- Focused array of alternatives for Environmental Impact Statement analyses

		ALTERNATIVES				
		-44 FEET	-45 FEET	-46 FEET	-47 FEET	-48 FEET
SECTION 403	AAEQ Benefits	$31,834,000	$44,832,000	$57,831,000	$67,648,000	$77,465,000
	AAEQ Costs	$24,099,000	$31,072,000	$38,860,000	$47,719,000	$56,174,000
	Net Benefits	**$7,735,000**	**$13,760,000**	**$18,971,000**	**$19,929,000**	**$21,291,000**
	Net Benefit diff (%)		38%		5%	7%
	BCR @ 2.5% (@7%)	1.3 (0.6)	1.4 (0.7)	1.5 (0.7)	1.4 (0.6)	1.4 (0.6)
SECTION 203	AAEQ Benefits	$44,791,000	$62,121,000	$75,291,000	$85,161,000	$94,131,000
	AAEQ Costs	$18,434,000	$23,426,000	$28,838,000	$33,890,000	$41,512,000
	Net Benefits	**$26,357,000**	**$38,695,000**	**$46,453,000**	**$51,271,000**	**$52,619,000**
	BCR @ 2.75%	2.43	2.65	2.61	2.51	2.27

Section 902 limit based on WRDA 20 Authorized Cost: $1,599,557,000
Latest Project Cost Estimate for 47-foot Alternative: $1,271,520,000

Future Capacity Limits Future Forecast

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Thank you!

ATTACHMENT M

VILLAGE OF BALD HEAD ISLAND SUPPLEMENTAL COMMENTS

17 NOV. 2025

FEASIBILITY OF DEEPENING THE PORT OF WILMINGTON CHANNEL (2025)

FOR THE

VILLAGE OF BALD HEAD ISLAND

BY

ASAF ASHAR, PHD

PORTS AND SHIPPING CONSULTANT

NOVEMBER 14, 2025

("ASHAR ANALYSIS")

Feasibility of Deepening the Port of Wilmington Channel (2025)

For the

Village of Bald Head Island

By

Asaf Ashar, PhD

Ports & Shipping Consultant

November 17, 2025

Feasibility of Deepening the Port of Wilmington Channel (2025)

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Feasibility of Deepening Port of Wilmington Channel (2025)

I Introduction

I.1 Purpose of the Report

The following is a summary of a study prepared for the Village of Bald Head Island by Dr. Asaf Ashar, a consultant and emeritus research professor for ports, shipping and intermodal transportation, University of New Orleans.

The purpose of my study is to review the USACE's reports on the economic feasibility of the Port of Wilmington (**Wilmington**), NC channel-deepening project **(Project**), from its current depth of 42 ft to 47 ft. For this, I intend to critically examine the reliability of the methodology, data, assumptions and calculations of the economic criterion used to determine this project's feasibility, the Project's **Benefit-to-Cost ratio (BCR).** More specifically, I intend to test the reliability of the Project's calculated BCR of 1.3: 1 and, along with it, the feasibility of Wilmington's Project. My study only discusses the benefit side of the BCR, assuming that costs side is kept unchanged.

I.2 Reviewed Documents

My study includes the review and examination of the following documents:

- USACE 2025 403 Draft Letter Report, Attachment 5 -- Economic Considerations – hereafter referred to as **2025 EC**
- Assistant Secretary of the Army May 2020 Review Assessment of Wilmington Harbor, North Carolina Navigation Improvement Project Integrated Section 203 Study & Environmental (February 2020) – hereafter referred to as **ASA Review Assessment**
- USACE 2025 403 Draft Letter Report – hereafter referred to as **2025 Letter**
- June 2024 USACE Virtual Presentation (Scoping Public Meeting), summarizing the Wilmington Harbor 403 Letter Report & Environmental Impact Statement – hereafter referred to as **2024 Presentation**
- 2024 USACE "Economic Considerations" PowerPoint provided by Corps to VBHI counsel – hereafter referred to as **2024 PowerPoint**
- 2020 North Carolina Ports Section 203 Study Economic C – hereafter referred to as **2020 NCP**.

In addition, and for comparison only, I briefly reviewed the USACE Section 203 Study Economic Appendices of the Ports of Charleston, Savannah, Jacksonville, Mobile, Norfolk, Oakland and Coose Bay.

2025 EC, recently submitted for comments by USACE, is the main document reviewed in my study.

I.3 Summary of Findings

My analysis concludes that both the Project's cargo forecast and the related Project's savings are incorrectly calculated in the 2025 EC report and, therefore, in **need of adjustment**. My study identifies a total of eight (8) different adjustments required to address the assumptions in the 2025 EC that I consider as unsupported. Five (5) of those adjustments result, independently, in turning the Project infeasible (BCR < 1); the other three (3), very close to it. Because these adjustments are statistically independent, any two (or more) of them can turn the Project infeasible.

II Methodology

II.1 Benefit Cargo

My examination of the Project's BCR focuses on the expected **savings** to Wilmington's cargo that can be directly **attributed to the channel-deepening projects**. This so-called **benefit cargo** is carried by shipping lines employing large vessels that can benefit from the deeper channel. In the case of Wilmington, as will be further discussed later, the benefit cargo is Asian imports & exports, carried by direct Asia/USEC services employing post-Panamax vessels.

II.2 Project Benefits = Savings in Shipping Costs

The savings in shipping costs of the benefit cargo are defined as project benefits (**benefits**). The calculation of benefits is based on a simple formula:

- **Benefits ($) = Benefit Cargo (TEUs) x Cost Savings ($/TEU)**

With,

- **Cost Savings ($/TEU) = Costs Without-Project ($/TEU) – Costs With-Project ($/TEU)**

My report critically examines **both** the forecast of benefit cargo (TEU) and cost savings by this cargo attributed to the deeper channel ($/TEU). The benefit cargo (TEU) is addressed in Sections III Cargo (Commodity) Forecast and Section III Asian Shipping Services and Section IV Asian Shipping Services; the savings ($/TEU) in Section V Benefits due to Deeper Channel. Again, my study only addresses the benefit side of the BCR, assuming that the Project costs and the cost side of the BCR, are kept unchanged.

II.3 Wide Variability in BCR Calculations Mandates Sensitivity Testing

The 2025 EC calculates the BCR of Wilmington's channel-deepening Project at 1.3 : 1 (or simply 1.3), and, based on it, determines that the Project is feasible. A BCR of 1.3 is relatively small, indicating that the feasibility of the Project, even prior to my suggested adjustments, is marginal. My review of BCRs of other project-deepening assessment by USACE found that in the case of Savannah, which had a similarly long channel, it was 7.3; Charleston 3.89; Jacksonville 3.3 and Mobile 3.1. The advantage of a large BCR is that it allows for a wide margin of errors in the forecast and benefits assumptions. For

example, in the case of Savannah, even a mistake of 100% in estimating benefits will still keep the BCR>1 (7.3 / 2 = 3.65), and the Project feasible. In the case of Wilmington's 1.3, a misestimate of only 23% (1 / 1.3 = 0.77) can turn the Project from feasible to infeasible. In other words, in Wilmington's case, the determination of feasibility is highly sensitive to assumptions, eight of which I found unsupported by historical and current industry data and in need of adjustment.

Moreover, even in the BCR calculations of Wilmington there is a wide variability as seen below:

Evolution of the BCR of Wilmington Channel Deepening Project

Date	BCR	Discount Rate %
June 2019[1]	5.4	2.875
Feb. 2020[2]	2.5	2.750
Aug. 2025[3]	1.3	3.000

There is no indication in the 2025 EC that the wide range in Wilmington's BCRs, 1.3 – 5.4, is due to changes on the cost side of the BCR. The construction cost is mostly incurred during the first years of the Project (and therefore not affected by changes in discount rates), and USACE has multi-year experience in estimating them. The benefits extend 50 years and are the BCR's component most affected by present value discounting. The wide range (5.4 / 1.3 = 4.15, 415%) of BCR results demonstrates the high **uncertainty** inherent in calculating benefits, considered the most critical part of the assessment of the economic feasibility of channel deepening projects. This uncertainty, which calls into question the Project's feasibility, is not reflected in the BCR calculations in 2025 EC, since it has **no sensitivity testing** to its main assumptions.

III Cargo (Commodity) Forecast

III.1 Same Forecast for With and Without Project

The channel-deepening Project is not expected to affect the volume of cargo (throughput) handled by Wilmington. More specifically, 2025 EC (p.32, top) assesses that local cargo using competitive, nearby ports, e.g., Charleston and Norfolk, will not be repatriated following the channel deepening. Interestingly, Savannah, presumably one of Wilmington's main competitors, is not even mentioned there. The report predicts that "*In the without and in the future with project conditions, **the same volume of cargo is assumed to move through Wilmington Harbor**"*. *Id*. (emphasis in the original). I agree with the economic reasoning for this prediction: the efficiency of maritime transport will continue to drive cargo through the Port of Wilmington regardless of whether its channel is deepened. Accordingly, there is a need to prepare only one forecast, which is applicable to both the With and

[1] NCSPA Integrated Main Report-28 June 2019 Draft, p. ES-14, Table ES-7; that Table also calculates a BCR of 2.6, using a 7% discount rate.

[2] NCSPA Integrated Main Report-February 2020, p. 304 (following review of the Draft by the Office of the Secretary of the Army for Civil Works. *Id*., pp. 6-7). It also calculates a BCR of 1.2, using a 7% discount rate.

[3] 2025 EC, which does not do a BCR calculation using 7%.

Without cases. The effect of the Project is limited to *"allow for more efficient vessel use." (Id.,* p. 32). Later, in the fleet forecast, the 2025 EC anticipates that the deeper channel will have a significant impact on fleet composition. 2025 predicts the reappearance of PPX1, the smallest category of Post-Panamax (**PPX**) vessels although, in 2020, the two Asian services calling at Wilmington were already provided by vessels belonging to the larger category, PPX2&3. As will be discussed later, the PPX1 assumption, although it is unsupported in the 2025 EC, is critically important for determining the Project's feasibility.

III.2 BCR Adjustment to Base Year Assumption

The forecasting method employed by 2025 EC has two components: (a) **base year**, or a starting point for calculation of growth (tons, TEUs); and (b) **annual growth** (or decline) factors (% / year). In the case of a stable situation, to avoid the influence of short-term fluctuations, the base year is commonly selected as the average of the most recent period of 3 or 5 years. Alternatively, if the data exhibits clear, up or down trends, a regression line is fitted. The 2025 EC reports "Receipts" (imports) and "Shipments" (exports) (Tables 5.16 & 5.17, 2025 EC, p. 33) for the years 2016 through 2020 computes the average for that time period. However, despite the wide variability in that data and the absence of a trend (up or down), the 2025 EC rejects this average and selects for base year the highest (most recent) year in those Tables, 2020 -- but not 2024, the most recent information as of the time of the issuance of 2025 EC (discussed below in Section IV).

Table 1 below, based on the Far East Trade[4] figures in 2025 EC Tables 5.16 & 5.17, compares the impact on BCR of basing the forecast on 2020 as base year, with using the 2016 – 2020 average.

Table 1 Adjustment to 2016 – 2020 average instead of 2020

Period	2020	Average 2016 - 2020
Imports (MT)	563,937	387,411
Exports (MT)	804,171	671,597
Total (MT)	1,368,108	1,059,008
Average 2016-2020 / 2020		**0.77**
Report BCR		1.30
Modified BCR		1.01

As seen in Table 1, selecting the average as base year, which seems logical in light of the fluctuations during these years, reduces the Total (MT) to 0.77 of the value selected by 2020 EC – and reduces the cargo forecast and Project benefits accordingly. The effect on the Project's BCR is to reduce its value from 1.3 to 1.01.

[4] The bulk of the projected savings relates to the Far East Trade, which is entirely containerized.

III.3 BCR Adjustment to Past Termination of Direct Asian Services

Another adjustment of the 2025 EC's use of 2020 as base year would be to replace 2020 with more **updated** cargo throughput data. The data in 2025 EC Tables 5.16 & 5.17 ends at 2020. The 2025 EC asserts (p. 59, bottom): *"Ultimately, this economic analysis was conducted with the **historica**l Wilmington cargo share remaining the same in both the future without-Project and future with-Project conditions." (emphasis added)*. Presumably, a study on the feasibility of a $1.4 billion investment, submitted for evaluation in 2025, should include data for the years 2021 – 2024, or, if unavailable(?), consider an indirect method of updating the historical data. In the case of Wilmington, inclusion of the most recent cargo throughput data is critical, since during this period, especially during 2023 and 2024, it seems that there was a significant decline in Asian cargoes handled by direct Asian services (benefit cargo) due to partial or complete termination of their Wilmington calls. Moreover, my recent review of Wilmington's berthing schedule revealed that the termination trend has continued. For most of this year, 2025, there are **no direct Asian services calling at Wilmington.** This recent service termination calls into further question the assumption underlying the supposition of the outlier year 2020, the highest throughput year reported in 2025 EC, as the base year for the forecast calculation.

The termination of Asian services is likely to have a dramatic effect on the Project's BCR. If the base-year is calculated as the average of 5 years, during one of which there is no Asian cargo handled by direct Asian services (benefit cargo), this average is reduced by 4 / 5, or 0.8 which, in turn, reduces the BCR from 1.3 to 1.04 (1.3 x 0.8); if there are a total of 2 years with no Asian services, the BCR will be further reduced to 0.78 (1.3 x 0.6).

The past and present termination of Wilmington's Asian services raises the prospect of **future years with no direct Asian services and no benefit cargoes**. The critical issue of no direct Asian services is further discussed in Section IV.

III.4 Unexplained Increase in Asian Imports

As noted above, the second component of the cargo forecast is the annual growth rate. **Table 2**, based on Table 5.22 in 2025 EC, (p. 35), shows the forecast for the Asian imports & exports (benefit cargoes) for 5-year intervals during the period of 2020 – 2056, with my calculation of the average 5-year annual growth rates (%).

Table 2 Cargo Forecast Growth Rates

Far East	2020	2025	2030	2036	2042
Import (MT)	536,937	625,485	728,635	2,840,505	3,411,517
Annual Growth (%)		3.1%	3.1%	**25.5%**	3.1%
Export (MT)	804,171	985,946	1,205,332	1,557,351	1,935,507
Annual Growth (%)		4.2%	4.1%	4.4%	3.7%
Import+Export (MT)	1,341,108	1,611,431	1,933,967	4,397,856	5,347,024
Annual Growth (%)		3.7%	3.7%	14.7%	3.3%

The 3.1% for imports and the 4.2% - 3.7% for exports are based on the long-range, average growth rate projected for the US East Atlantic ports as presented in 2025 EC Table 5.19 (p. 34). The assumption of regional growth rates, instead of a port-specific ones, is common in USACE's studies, reflecting its focus on national and not port-specific benefits. USACE attempt to stay away from port competition on market share, an approach that I consider reasonable for a federal agency. **Appendix A** further discusses the issue of growth rates assumed in USACE studies of 6 USEC ports.

The 2025 EC's assumption of a dramatically-higher **average** annual growth rate of 25.5% (Table 2, in red) for 2030 – 2036 is apparently based on a specific industrial development expected in the Port of Wilmington catchment area (p. 34, middle): "*Over $10.0 Billion in new or upgraded manufacturing and processing facilities are planned over the next 10 years, as well as $523 Million in the construction of 10 new storage and distribution facilities.*" However, there is no detailed listing of specific projects with their cargo-generation projections. This lack of specification seems baffling to me, considering that this development is expected to increase Wilmington's Asian imports almost 4 times (2.8 / 0.7). **Appendix A** summarizes my research of Wilmington's potential increase in imports generated by the "*new or upgraded manufacturing and processing facilities.*"

III.5 BCR Adjustment to Steady Future Growth

The gross estimate in Appendix A of future cargo growth attributed to the above-mentioned economic developments is in the range of 20,000 - 80,000 TEUs. This estimate is way below the 2025 EC forecasted growth in Asian imports of 2.1 million ton (2.8 – 0.7), which according to Table 5.22 is equivalent to 306,068 TEUs. Hence, for the sake of analysis, I adjust the imports projection to the more realistic (in my opinion) growth rate of the previous and following year. I assume a continuation of the 3.1% growth rate during the 2030-2036 period. **Table 3** shows the cargo forecast for 2036, the base year, with USACE 25.5% vs. my assumption of 3.1%.

Table 3 Adjustment to Steady Growth

Base Year	**2036**	
Scenario	USACE	Adjusted
Import (MT)	2,840,505	875,109
Export (MT)	1,557,351	1,557,351
Total (MT)	4,397,856	2,432,460
Adjusted / USACE		**0.55**
Report BCR		1.30
Modified BCR		0.72

As seen in this table, the explosive growth rate assumed by 2025 EC for the 2030 – 2036 period has a critical impact on the cargo forecast. My adjusted forecast is for 2.4 million tons vs. 4.4 million tons in 2025 EC. The project benefits are directly related to these tonnages of Asian cargo (benefit cargo). Adjusting the cargo forecast to align with the historical growth rate results in an adjustment factor for the benefit cargo of 0.55 which, in turn, reduces the BCR from 1.3 to 0.72 (1.3 x 0.55).

To recap, **The BCR is highly sensitive to 2025 EC 25.5% annual growth assumption (Table 2), and even minor deviations significantly affects the feasibility determination.** It is unprecedented, in my experience, to assume such a major forecast shift ("jump"), on which the ultimate feasibility finding hinges, without a detailed support.

III.6 Combining BCR Adjustments

The adjustments discussed above are unrelated, so two or more of them could happen simultaneously. For example, the two adjustments, the first for assuming the average 2016 – 2020 instead of 2020 as based year, and the second for assuming steady growth instead of a one-time "jump" in new imports, could both simultaneously happen. Accordingly, their combined adjustment impact will be multiplied, resulting in BCR of 0.43 (0.77 x 0.55).

IV Asian Shipping Services

IV.1 Shipping Services Assumed in the Cargo Forecast

The above discussion of cargo forecast disregards the type of shipping (liner) services and size of vessels projected to handle this cargo. The implicit assumption of 2025 EC is that ALL the Asian imports and exports included in the cargo forecast is, and continue to be till 2056, handled by direct Asian all-water services employing post-Panamax (**PPX**) vessels (the "vessel" is omitted hereafter). Currently, as will be elaborated later, there are 3 generations and sizes of PPX: PPX1, PPX2 and PPX3, along with a slightly larger design of PPX3 called PPX3Max. The emphasis is on PPX, since smaller vessels can be efficiently served by the existing 42-ft channel. Indeed, the main justification for the Wilmington's $1.4 billion channel-deepening Project is the savings generated by allowing PPX to sail with deeper draft and respective higher capacity utilization during their Wilmington call.

IV.2 No Direct Asian Shipping Services Presently at Wilmington

The PPX calling at Wilmington are deployed on Asia/USEC (**Asian**) shipping services. My review of Wilmington's berthing plan indicates that presently, October 2025, there are no direct Asian services and/or PPX calling at the port. In contrast, 2025 EC, Table 5.12 (p. 28), assuming 2021 as a base year for predicting long-term trends in shipping, shows 4 Asian services employing PPX2 and PPX3: EC2, TP10, Amberjack and ZCP. Interestingly, the earlier 2020 NCS, Table 1-25, only mentions 2 Asian services calling at Wilmington with direct services: ZCP and EC2. The discrepancy between the two documents indicates the instability in Asia/USEC service structure during these years. The difference between the assumptions of 4, 2 or no weekly Asian service calling at Wilmington as a basis for future projections is significant. The number of services defines the **level of service** by Asian services offered to Wilmington shippers, a key factor in their decision to prefer this ports over its nearby and much better served competitor ports.

IV.3 Shipping Alliances, Port Rotations and Service Patterns

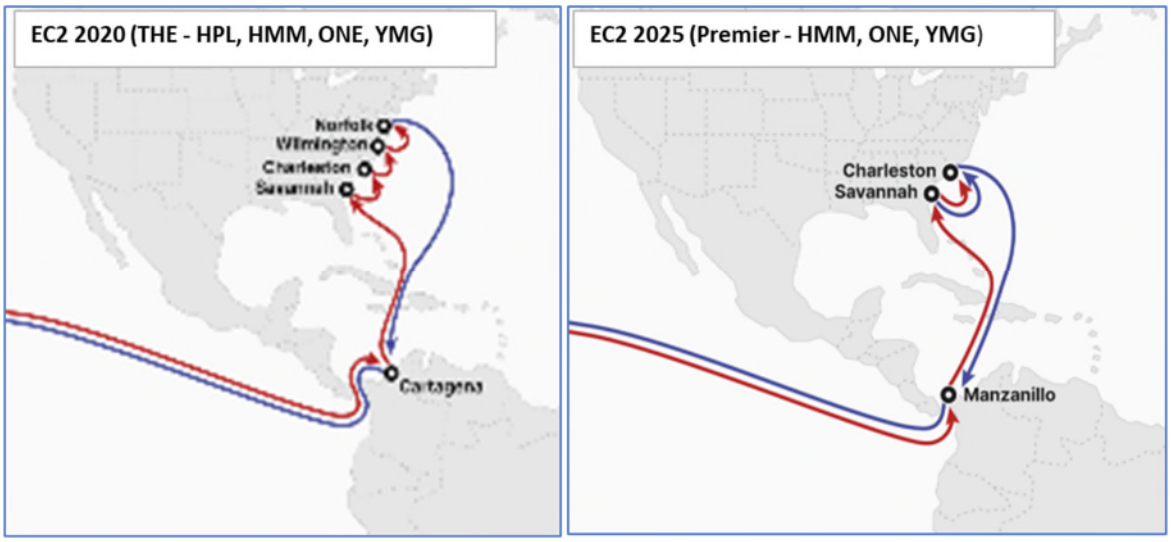
My review of professional media on Asia/USEC direct services indicates that the last call at Wilmington of EC2 service of the THE Alliance was on October 13, 2024, by the vessel YM Warranty, a PPX3 with

capacity of 14,220 TEU, operated by Yang Ming line. In 2024, the THE Alliance, the largest group at that time, was comprised of 4 lines: Hapag-Lloyd (HPL), HMM, Ocean Network Express (ONE), and Yang Ming (YMG). THE Alliance was restructured in February 2025, with HPL exiting to form the Gemini Cooperation with Maersk. The remaining members, ONE, HMM, and YMG, continued their cooperation under the name Premier Alliance. A parallel change was the dismantling of the 2M alliance of Maersk and MSC, leaving MSC, currently the largest line worldwide, as a standalone line. MSC, later on, began cooperation with Zim Line. **Figure 1** illustrates the profound restructuring in the world of liner shipping, which encompasses all the lines involved in Asia/USEC services (source: *https://market-insights.upply.com/en/the-recomposition-of-the-shipping-alliances-in-2025)*.

Figure 1 Restructuring Shipping Lines' Alliances

Following the restructuring, the Premier Alliance revised its network of Asian services, including the EC2 service that used to call at Wilmington. The updated EC2's port rotation dropped Wilmington and Norfolk, following a decline in the Asia/USEC trade route. **Figure 2** shows the route maps of the EC2 Asia/USEC service before and after restructuring. The service pattern of EC2 is through-Panama and it is operated by a mixture of PPX2 & 3 (see Table 9 in Appendix B).

Figure 2 Restructuring of Asia/USEC EC2 Service



The second Asian service that used to call Wilmington and is also mentioned in the 2020 NCS, is the ZCP, a joint service by Zim and the 2M alliance. The ZCP has a complicated history. My research yielded that in its final form, called Emerald, a joint service of MSC and Zim (also called Emerald/ZXB), ZCP dropped Wilmington in mid-2025. As is the case with EC2, Emerald presently only calls Savannah and Charleston in the South Atlantic. Unlike EC2, which was (and still) following a through-Panama service pattern, the pattern of Emerald is round-the-world (**RTW**), sailing through both Panama and Suez Canals. It also deploys PPX2 vessels. A third service pattern for the Asia/USEC is through-Suez. Unlike the two previous patterns, this service is not constrained by the Panama Canal and therefore can be provided by PPX4, the largest container vessel presently in service (see follow-up discussion).

IV.4 Temporary or Permanent Termination of Wilmington

Wilmington has gone from 4 direct Asian services in 2020 to none in 2025. During the 5-year, in-between period, there have been many "upheavals" in worldwide shipping and in the South Atlantic, including introduction and termination of Asian services in Wilmington. Will direct Asian services ever return to calling at Wilmington?

A more relevant question is whether the deepening project is critically important factor in shipping lines' decisions to renew direct Asian services in Wilmington. The main reasons given in professional media for the departure of Asian services in 2025 is a decline in local Asian cargo and restructuring of shipping alliances. It seems that the first reason, insufficient local generation of Asian cargo is the more critical. Would the deeper channel providing for the more efficient deployment of larger vessels enhance local generation of cargo? According to 2025 EC (p. 59, top): "*Larger vessels alone do not drive growth for the harbor…. Harbor dimensions are just one of many factors involved in determining growth and market share for a particular port.*" The report continues to list many factors that do drive growth.

Presently Wilmington does not generate sufficient Asian cargo to justify a weekly call by a PPX3, the vessels dominating Asia/USEC ports. What is the probability that Wilmington will reach the threshold volume of Asian cargo?

IV.5 BCR Adjustment to Future of No Asian Services

It is difficult to assess the probability of the decision by shipping lines to renew direct calls by Asia/USEC services at Wilmington following the channel-deepening project. It seems that the deeper channel will only have a limited effect, since PPX3 and even PPX3Max have already been calling Wilmington despite its 42-ft channel.

An indirect way to cope with the probability assessment is by defining the **minimum (threshold) probability** required to make the Project feasible. Accordingly, in order for the Project to be feasible, the probability of services return should exceed 77% (1/ 1.3 = 0.77); below 77% the Project is infeasible. The probability is for a **full return to the 2020 level-of-service**, the base year in the cargo forecast, or **4 weekly, direct services by PPX vessels** by 2036. In light of the never-ending changes in the shipping industry and the increase in vessel size (including PPX4, see later), a probability of 77% and higher seems to me an unrealistic expectation. A 50% chance of resuming 4 or more direct Asia/USEC services in Wilmington seems to me more realistic. In this case, the adjusted BCR is 0.65 (1.3 x 0.5).

IV.6 Feeder vs. Direct Services

There is a growing worldwide trend of converting the traditional liner shipping system based on direct calls to a hub & spoke (feedering, transshipment) model, based on a **network of feeder and mother (main) services.** Approximately 30 - 35% of the global containerized trade by volume (measured in TEUs) is currently transshipped worldwide, reaching 65 – 70% on the Asia/Europe trade lane, but still in its early stage on the Asia/USEC trade lane. The advantages of a hub & spoke system are: higher vessel utilization, shorter transit times, and wider coverage of regional ports; the disadvantage: extra port handling at the hub ports, and longer overall sailing distances, in case of a large deviation. Another advantage of the hub & spoke, often unmentioned, is the **savings in port investments** at smaller, regional ports that are only required to handle smaller feeder ships.

The hub & spoke system is expected to become more advantageous in the future due to the combination of increase in vessel size, enhanced port automation, growing pressure to reduce emissions, increased involvement of shipping lines in ports, and further consolidation in the shipping line industry.

Still, a hub & spoke system is difficult to develop. To facilitate a fast and efficient transfer of boxes between mother and feeder ships, a shipping line, or an alliance, needs to control feeder services and, especially, hub ports. While every shipping line already employs feedering system to a varying degree, for one alliance, Gemini, it is a declared strategy. Gemini owns or control 15 key hub terminals, giving it greater operational control to prioritize its vessels and manage capacity, which is crucial for making the hub-and-spoke model reliable. It is estimated that Gemini controls about 25% of the Asia/USEC

service capacity of which about 20% is feedered. MSC also is involved in feedering, but to a much lesser extent.

IV.7 Feeder & Regional Integrated Services

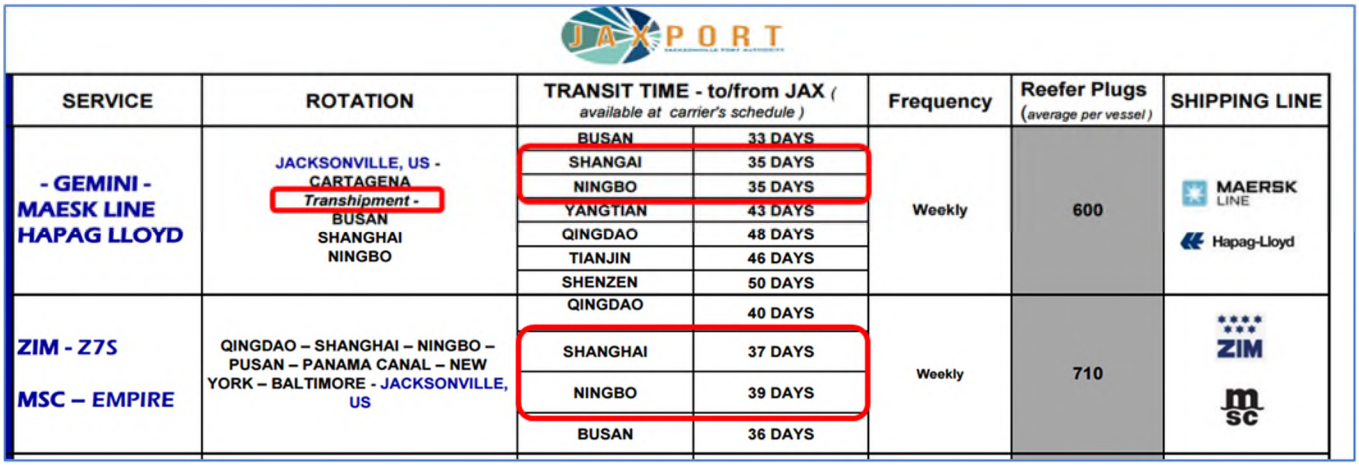
The geography of the Americas is especially supportive for feedering, since it provides for integrating the regional, inter-American trade with the Asian trade. Also, locating the hub ports outside the US significantly lowers the vessel-to-vessel transfer cost.[5] A case in point is Maersk's South Atlantic Express (SAE) service, operated by its regional brand Sealand, with vessels of 2,500 TEU. The SAE feeders the Asian trade of Wilmington, Port Everglades and Philadelphia and, in addition, serves the direct, Central American trade of these ports, and other USEC ports, including Savannah. The SAE's and Maersk use Manzanillo, at the northern entrance of Panama Canal, as its hub port. **Figure 3** shows the route map of SAE in the southbound direction. Other Maersk's feeder/regional services use Cartagena, Colombia as their hub.

Figure 3 Maersk's South Atlantic Express (SAE)

The decision on feedering is not dependent on channel depth. One example is Jacksonville, already with a deepened channel to 47 ft. Jacksonville's Asian trade is served by one direct and one feeder service. **Figure 4** shows part of the service matrix published by the Port of Jacksonville (Jaxport).

[5] A feeder service between US ports has to be provided by US-flagged vessels, which are prohibitively costly. Also, a mother-feeder transfer of containers in a US port is much more costly than in foreign port.

Figure 4 Jacksonville's Asia/USEC Services



SERVICE	ROTATION	TRANSIT TIME - to/from JAX (available at carrier's schedule)		Frequency	Reefer Plugs (average per vessel)	SHIPPING LINE
- GEMINI - MAESK LINE HAPAG LLOYD	JACKSONVILLE, US - CARTAGENA *Transhipment* - BUSAN SHANGHAI NINGBO	BUSAN	33 DAYS	Weekly	600	MAERSK LINE, Hapag-Lloyd
		SHANGAI	35 DAYS			
		NINGBO	35 DAYS			
		YANGTIAN	43 DAYS			
		QINGDAO	48 DAYS			
		TIANJIN	46 DAYS			
		SHENZEN	50 DAYS			
ZIM - Z7S MSC – EMPIRE	QINGDAO – SHANGHAI – NINGBO – PUSAN – PANAMA CANAL – NEW YORK – BALTIMORE - JACKSONVILLE, US	QINGDAO	40 DAYS	Weekly	710	ZIM, msc
		SHANGHAI	37 DAYS			
		NINGBO	39 DAYS			
		BUSAN	36 DAYS			

Jacksonville's feeder, which also calls at Miami, uses Cartagena, Colombia as its hub. Interestingly, as seen in this figure (emphasized by red squares), Gemini's feeder service, despite the transshipment in Cartagena, has shorter transit times to Asia's main ports than Zim/MSC direct service. My estimate is that in addition to shorter transit times, the feeder provides a much wider coverage of Asian ports (through Cartagena) than the direct service. Apparently, **feeder services can provide as good and perhaps better service then direct services to local shippers**.

IV.8 BCR Adjustment to Future Feedering

Wilmington's only all-water shipping service to Asia at the present is the SAE feeder. Hence, 100% of the Asian trade is presently transshipped. How much of Wilmington's future Asian services will be provided by feeders? Figure 1 above showed the shipping-line's worldwide market structure, consisting of 3 alliances and 1 standalone line, MSC. Maersk/Hapag's **Gemini** Cooperation has fully embraced the hub-and-spoke architecture; **MSC** is reported to begin building its own, hub-centered east/west network; the **Ocean Alliance** and the **Premier Alliance** are reported to prefer a blended approach rather than a pure "every-port direct" model.[6]

As I already calculated, for a BCR > 1, 77% of Wilmington's past-2036 trade has to be handled by PPX-based **direct** Asian services. Put differently, a future market share of feeders at 23% or larger is sufficient to knock down the BCR below 1. In lights of the worldwide trend toward hub & spoke and, especially, considering the emergence of Suez-routed, PPX4-based Asia/USEC services (see below), my expectation is that the future share of feeders of the Asian containerized trade of Wilmington, as well as other smaller USEC ports, is likely to be 50% or higher, resulting in BCR of 0.65 (1.3 x 0.5). It is worth

[6] The largest shipping lines already have their own, in-house (subsidiary) port operators. Maersk has APM; MSC has TIL; Cosco has Cosco Ports; and CMA CGM, the CMA-Terminals (recently negotiating to acquire Eurogate, the largest terminal in Germany). Moreover, Maersk is reportedly interested in having its own hub terminal in Panama; MSC almost completed the acquisition of Freeport, Bahama. MSC already feeders Asian cargo to USEC ports, including Savannah(!) in order to take advantage of PPX3Max full draft, since Savannah is still 47 ft. CMA CGM, through its subsidiary Kingston Freeport Terminal Limited (KFTL), is the operator of the Kingston Container Terminal (KCT). In its latest publication, Maersk, attributed some of its strong financial results for the 2025 to the efficiency of the hub & spoke model.

noting that 2025 EC totally disregards the prospects of feedering Asian trends, as if it is unaware that presently 100% of Wilmington's Asian trade is feedered.

IV.9 PPX4-based Asia/USEC Services

PPX4, also referred to as Ultra Large Container Vessels (ULCV), is the largest category of post-Panamax vessels, with capacity of (up to) 24,000 TEU, 50% larger than the PPX3Max, presently with 16,000 TEU. Both vessels are expected to continue growing in size, with the PPX3 reaching by 2036 18,000 TEU[7], and the PPX4 28,000 TEU.

PPX4s are too large to fit through the expanded Panama Canal locks and therefore their deployment on Asia/USEC must be Suez-routed. While no PPX4s are deployed on present Suez-routed Asia/USEC services, they already dominate Asia/Europe trades, accounting for approximately 70-75% of this route's total capacity.

For efficient operations, PPX4 require 52-ft and desirably 55-ft channel depth and about 215-ft air-draft clearance. Currently, on the USEC, only Halifax and Norfolk have 55-ft, followed by Charleston with 52-ft and New York with 50-ft. Savannah, currently with 47-ft, is pursuing a second harbor deepening to 52 ft, expected to be completed by the Project base year of 2036. Both Savannah and Charleston have low bridges that have to be raised. New York is pursuing a 55-ft channel, at a cost of $4 billion, also expected to be completed by 2036.[8]

It seems, therefore, that by 2036 the main USEC ports will be ready for PPX4. The PPX4 are too wide and long for Panama's new locks, so these services will have to be Suez-routed. Suez-routed services will get a further boost due the trade shift from North Asia (China) to Southeast Asia (Vietnam) and, especially, South Asia (India). **Appendix** B discusses the limitations of Panama Canal and the possible changes in service patterns of Asia/USEC services.

Based on the analysis in Appendix B, it is reasonable to expect a significant **conversion of Panama-routed/PPX3 to Suez-routed/PPX4 services** by 2036, the Project's base year. This conversion is likely to increase **load-centering** in USEC, with the larger ports, those with big cargo-base, deep channels, modern port and expansive intermodal facilities that can efficiently handle PPX4, to become even larger – at the expense of the smaller ports. The deployment of PPX4 will also enhance the trend of feedering the Asian trade of smaller USEC ports. An assessment of the BCR adjustment due to these trends is beyond the scope of my study. As before, it is worth noting that 2025 EC disregards the long-term trends in shipping patterns and shift in vessel size of the Asia/USEC trade.

[7] The largest Neo-Panamax (PPX3Max) vessels dimensions are 366 x 51.25 m and the largest vessel that transited through the Panama thus far is the MSC Fatma-Class, with nominal capacity of 17,640 TEUs.
[8] USACE's feasibility studies of these channel-deepening projects have not been published yet.

V Savings due to Deeper Channel

V.1 Benefit Vessels

As stated at the outset, my study focuses on the benefits side of the Wilmington's channel-deepening Project, generally defined as the savings in vessel costs that can be directly attributed to the Project. In our case, these savings and respective benefits are solely generated by the vessels deployed on Wilmington's direct Asia/USEC container services provided by PPX. The rest of Wilmington's services (e.g., to Europe, South America, etc.) and vessels deployed on them are not expected to reach the PPX size during the life of the Project, and will benefit very little or not at all from the increase in channel depth. The PPX of the Asian services are therefore defined as **benefit vessels** and the cargo handled by them to/from Wilmington, **benefit cargo**.

V.2 Two Categories of Savings in Vessel Costs

The benefits generated by savings in vessel costs due to the Projects can be divided into two categories, depending on the Project's influence on shipping lines' decisions regarding vessel deployment and vessel operations. In response to deepening of a port channel, a shipping line serving Wilmington could decide to:

- **Replace** existing vessels with l**arger** and more economical ones; and/or
- **Keep** the same vessels, but **increase their capacity** utilizations.

The traditional USACE method of calculating savings relates to the first category, vessel replacement. Indeed, savings due to replacement are much larger than those due to draft increase during a port call, since they relate to the entire vessel voyage costs along the 12,000 nautical-mile route between the USEC and Asia. **Figure 5**, taken from 2020 NCS, p. 38, Table 2-4 and, presumably, originally from USACE sources), shows vessel operating cost of PPX as a function of their sailing draft in $/1,000 mile (probably nautical mile).

Figure 5 Vessel Operating Costs(

Table 2-4
Operating Costs per TEU per 1,000 miles at Various Vessel Drafts

	40	42	44	46	48
PPX1	$57.35	$51.52	$46.76	$43.91	$43.91
PPX2	$55.75	$50.37	$45.94	$42.23	$41.64
PPX3	$52.68	$48.03	$44.[illegible]	$40.84	$39.28
PPX3Max	$39.81	$36.46	$33.63	$31.20	$29.11
PPX4	$30.59	$28.34	$26.40	$24.71	$23.22

I will use the cost data in Figure 5 to demonstrate the two saving categories. The per-1,000-mile savings generated by replacing PPX1 sailing at 40-ft draft with PPXMax3 sailing at 44-ft draft[9] (the diagonal red arrow) is $ 23.72 (57.33 – 33.63). The vessel replacement is usually considered for the entire Asia/USEC (or vice versa) voyage, typically around 12,000 miles. Hence the total replacement generates savings of $284.64/TEU (12 x 23.72). This is a considerable amount which, indeed, generates sufficient benefits to justify the deepening of Savannah, Jacksonville, Charleston and the rest of the ports in the USACE feasibility studies that I reviewed.

Vessel replacement, however, is NOT the case in Wilmington. Wilmington is typically the smallest port on the Asia/USEC rotation, and the size of its vessels is usually determined by the larger ports on the rotations involving Wilmington, typically Savannah, Charleston and Norfolk. To restate, **since for Asia/USEC services Wilmington is a secondary port in terms of local generation of Asian cargo, Wilmington's channel depth has little or no effect on vessel size, and Wilmington's deeper channel will not trigger replacing present vessel with larger ones**. Hence, the benefits of the deeper channel are confined to the second and much smaller category, the increase in vessel capacity utilization due to the deeper draft enabled by the deepen channel. Moreover, the savings will only relate to the portion of voyage directly associated with the port call, or the short in/out navigation leg. These savings in navigation are a small fraction of the total vessel's voyage cost from/to Asia. Assuming a service provided by PPX1, the per-1,000-mile savings generated by increasing the draft of PPX1 sailing at 40-ft to 44-ft is $10.59 (57.33 – 46.76), and assuming 200 miles of additional navigation sailing distance (including deviation), the total cost savings will only amount to $2.12/TEU (0.2 x 10.59). The difference between $284.64 and $2.12 is one reason why the BCR of Savannah, which has an equally long channel to Wilmington was much higher than Wilmington's. Another reason is the much higher volume of Savannah's benefit cargo.

V.3 Increase in vessel Capacity due to Additional Draft

The 2025 EC agrees with my claim above, that the second category is the **only** savings that can be attributed to the channel-deepening Project of Wilmington. The Project allows vessels presently sailing light-loaded to/from Wilmington to increase their sailing draft and carry more containers onboard. However, the 2025 EC does not provide data and/or show the calculations of the additional capacity that each type of vessel can carry. More important, 2025 EC does not provide any **explanation of methods, data and assumptions employed for determining the composition of the fleet, by PPX size that is forecasted to call at Wilmington**.

Figure 6, taken from Table 2-3 of 2020 NCP, p. 38, shows data (probably taken from USACE sources) on vessel capacity as a function of its sailing draft, with the latter determined by the channel depth and underkill safety clearance.

[9] A 47-ft channel minus 3 ft under keel

Figure 6 Vessel Capacity by Draft

Table 2-3
TEUs on Board at Various Vessel Drafts

	40	42	44	46	48
PPX1	3,931	4,376	4,821	5,135	5,135
PPX2	5,039	5,577	6,115	6,653	6,747
PPX3	5,936	6,509	7,082	7,654	7,958
PPX3Max	7,337	8,012	8,687	9,361	10,036
PPX4	10,346	11,166	11,987	12,808	13,629

Let's take for example the PPX3, presently the dominant vessel category of Asia/USEC services, including those calling Wilmington in the past. PPX3, sailing at a draft of 40 ft provided by Wilmington's present 42-ft channel, has capacity of 5,936 TEU; its capacity increases to 7,082 TEU if it sails at 44 ft provided by the 47-ft deepened channel, assuming 3 ft under keel (the horizontal red arrow). The additional volume of 1,136 TEU, a capacity increase of 19%, is the basis for the cost reductions shown in Figure 5 above.

V.4 Reduction in Number of Port Calls

The benefits included in 2025 EC are based on the second category of savings, the increase in vessel capacity due to the deeper channel. But instead of using Figure 5 to calculate savings, 2025 EC selects a cost savings methodology based on the reduction in the number of port calls per annum, and this assumption provides main source of benefits attributed to Wilmington's deeper channel. This reduced-call methodology is better suited to bulk shipping. Unlike liner shipping, based on fixed schedules and multi-port rotation, bulk shipping is contract-based (e.g., for X tons/year) and a port-to-port rotation, with no fixed schedule. The number of voyages in bulk shipping is calculated by dividing the total contracted volume by vessel capacity. 2025 EC disregards the fact that liner shipping is based on a fixed schedule (mostly weekly), and assumes that the larger capacity of deeper-draft vessels (additional TEUs/call) will be utilized to **reduce the number of calls** (calls/year) for carrying the same volume of cargo (TEUs/year). Accordingly, the above-calculated 19% increase in the deeper-drafting PPX3 capacity allows a respective reduction of 16% in the number of calls (1 - 1 / (1 – 0.19)), resulting in a respective reduction in vessel and port costs. To re-emphasize, my understanding is that this reduction in calls/year is the **sole source of benefits** considered in the 2025 EC. Unfortunately, 2025 EC does not explain its methodology of savings calculation.

The report does not specify **how** this elimination of vessel calls would be implemented. All Asia/USEC services (and most container services worldwide) are provided on a weekly basis, whereby all vessels follow a fixed, multiport rotation. This also was the case in the past with Wilmington, which due to its location and relatively small cargo base, was typically included as a mid-port. Theoretically, a future weekly service could occasionally skip Wilmington by calling it only every two (or more) weeks, or on an ad hoc basis. However, the assumption of **occasionally dropping the Wilmington call** seems to me

impractical considering its impact on the level of service offered to Wilmington's shippers. They would likely prefer nearby ports which offer a much higher service level e.g. Savannah with 14 weekly call or Charleston with 11 weekly calls (in 2025, and much more in 2036). Another option is to eliminate an entire service, which is possible when a shipping line has several services with overlapping rotations. However, this option also is impractical in the case of Wilmington considering its small number of Asian services even in 2036.

To restate, reduction in number of calls in response to higher capacity vessels is common in bulk shipping, but uncommon in liner shipping. There are cases that due to delays a port is dropped or a voyage is declared "blank". However, the assumption in 2025 EC, of a permanent reduction in vessel calls of existing services is unfounded. I do not know how to quantify this impracticality that could undermine the entire calculation of savings in 2025 EC. Hence, I did not include an adjustment to the Project's BCR to account for it.

VI Fleet Forecast 2036 - 2056

VI.1 Future Reappearance of PPX1

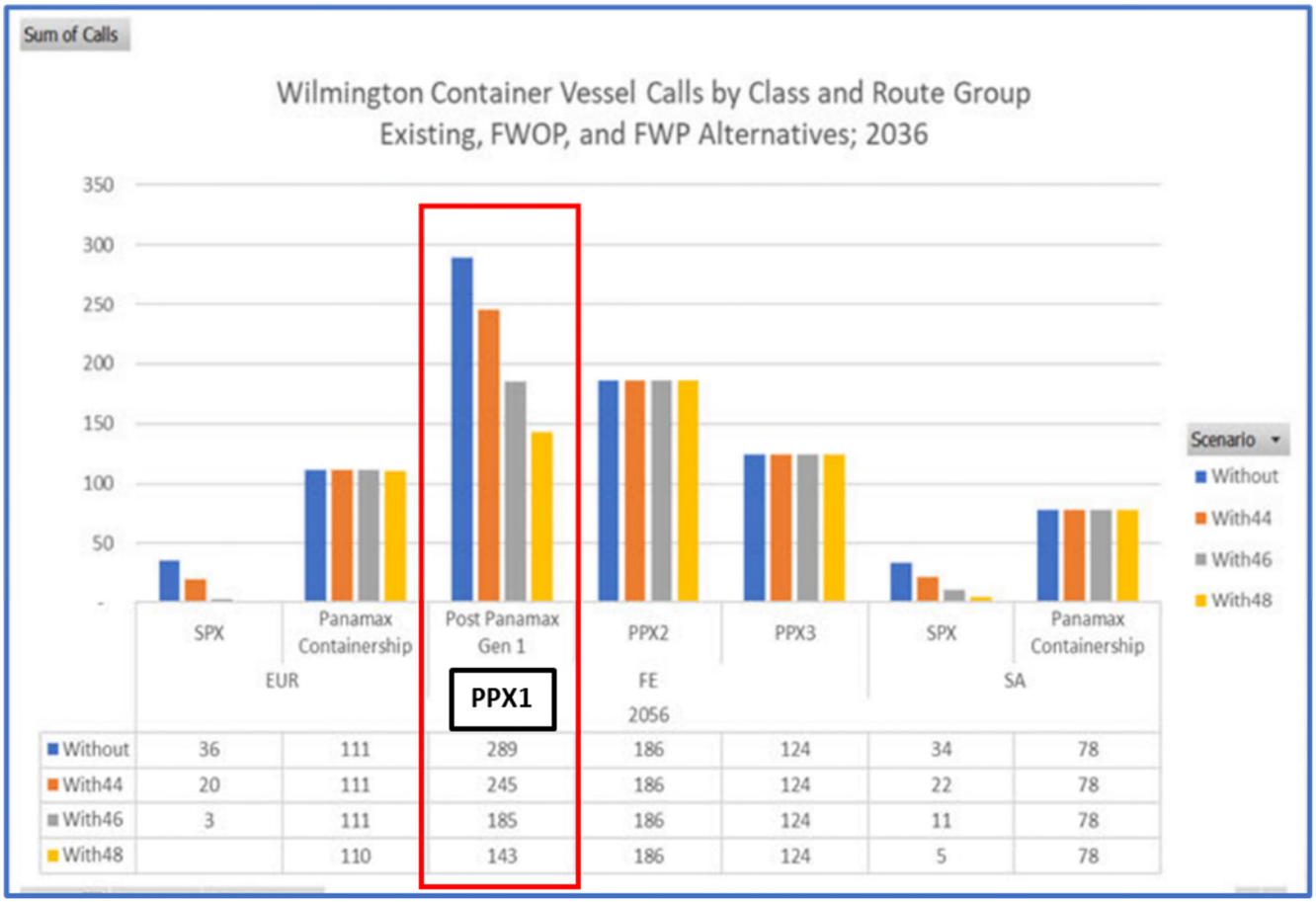
To calculate the future reduction in the number of calls, the report develops a fleet forecast for the years 2036 and 2056, using 2021 as a base year. The forecast relates to the number of calls of PPX1, PPX2 and PPX3 in the With and Without Project channel depths. PPX3Max are omitted, with no explanation given, although they are already deployed on Asia/USEC and have even called at Wilmington in the past. Moreover, this omission contradicts the fleet forecast in the earlier 2020 NCP report, which states: *"The future without-Project condition fleet forecast for vessels on the USEC-Asia services transiting the Panama Canal will consist of PPX3 and PPX3Max"* (p. 46).

As I already noted, 2025 EC does not present the method and the calculations in support of its fleet forecast. The report's Table 5.38 (2025 EC, p. 48) simply shows the distribution of ship calls by categories in the Without-Project base year (2021) and 2 forecast years (2036, 2056); and Table 5.41 (2025 EC, p. 55) shows the With-Project call distribution. **Table 4** summarizes these two tables and analyzes With/Without changes.

Table 4 Wilmington Calls Distribution by PPX Categories

Depth	Without 42 ft			With 46 ft		With 48 ft		48 ft -- 42 ft
Year	2021	2036	2056	2036	2056	2036	2056	2036
PPX1	1	237	289	148	185	115	143	**122**
PPX2	4	**157**	**186**	**157**	**186**	**157**	**186**	**0**
PPX3	83	**103**	**124**	**103**	**124**	**103**	**124**	**0**
Total	88	497	599	408	495	375	453	**122**

Figure 7 Wilmington's Calls Distribution by PPX Categories



	SPX	Panamax Containership	Post Panamax Gen 1	PPX2	PPX3	SPX	Panamax Containership
Without	36	111	289	186	124	34	78
With44	20	111	245	186	124	22	78
With46	3	111	185	186	124	11	78
With48		110	143	186	124	5	78

As seen in Table 4 and illustrated in Figure 7, the number of calls of PPX2 & 3 (in red) remained **unchanged,** despite the dramatic, 320% growth in cargo volume (Table 2) and the increase in channel depth in the With cases. **The only change is in the number of calls of PPX1**. It seems, that 2025 EC assumes that PPX1, which already in 2021 became extinct on Asia/USEC services, are expected to re-emerge 15 years later, in 2036 and remain fully deployed even in 2056. To re-emphasize, in 2021, the base year for the 2025 EC report, Wilmington had 2 Asian services: ZCP provided by PPX2 and EC2 PPX3 – **no PPX1**. Moreover, **Figure 8** below, taken from 2020 NCP, p. 29, shows that PPX1 had already become extinct in 2019 (red square).

Figure 8 Historical Composition of Wilmington's Fleet

Table 1-22
Vessel Class Distribution for Container Ships Asia Services Calling at the Port of Wilmington

Class	2009	2013	2018	2019
SPX	1%	1%	0%	0%
PX	99%	99%	33%	0%
PPX1	0%	0%	5%	0%
PPX2	0%	0%	41%	20%
PPX3	0%	0%	21%	74%
PPX3Max	0%	0%	0%	6%

Sources: www.lloydslistintelligence.con accessed 14Feb19; NCSPA Data; https://www.zim.com/schedules/schedule-by-port accessed 23Feb19; and https://www.one-line.com/ accessed 23Feb19

VI.2 No PPX1 in Previous Studies

2020 NCP also studies the future fleet composition of Wilmington stating: "*The future without-project condition fleet forecast for vessels on the USEC-Asia services transiting the Panama Canal will consist of PPX3 and PPX3Max vessels."* (p. 46) A follow up review of the existing (in 2020, EC2 & ZCP) Asian services indicates that "The *shift towards PPX3 Max vessels on the two Asia services in question is also supported by the historical trend in carriers reducing the transportation cost per TEU by shifting to larger more efficient vessels*" (p. 187). **Figure 9** taken from 2020 NCSPA Integrated Main Report, p. 124, Table 4-7, uses the USACE HaborSym to calculate the number of Wilmington's future vessel calls – **no PPX1 and PPX2, only PPX3 and PPX3Max.**

Figure 9 Fleet Forecast and Vessel Call

Table 4-7
Port of Wilmington Hinterland Asia Cargo Without-project Containership Fleet Forecast

Vessel Class	Port	2023	2028	2030	2040	2045-2076
PPX3 & PPX3Max	USEC Alternate	64	83	89	126	126

2020 NCP assumes that future fleet composition will be identical to the present (2020), i.e., PPX3 and PPX3Max. Hence, "*Deepening the existing channel would allow for deeper and more efficient loading of the existing fleet; and also allow for the efficient use of larger vessels which may not call on the Port under without project conditions*." NCSPA Integrated Main Report, p. 156, bottom. What is reason for the dramatic difference in future fleet composition between 2020 NCE and 2025 EC? What prompts the assumption of PPX1 reappearance in 2025 EC?

VI.3 Future World Fleet Has no PPX1

My review of professional literature did not yield any evidence supporting a future revival of PPX1, especially since PPX3 and PPX3Max already are the backbone of Asia/USEC services. PPX1 was an initial design, with capacity only slightly larger than Panamax. PPX were temporarily deployed on Asia/USEC services following the 2016 Canal expansion, and shortly after were replaced by PPX2. In fact, even the first, full-blown PPX-based Asia/USEC service, established in 2017, was already provided by PPX2 vessels of 10,000 TEU. Interestingly, this service's main East Coast port of call was Savannah, despite Savannah's constraining 42-ft channel. **Appendix B**, already mentioned above, shows the list of Asia/USEC services calling Charleston (and other USEC) – none of which is provided by PPX1. The Appendix also shows that PPX1 is likely to almost disappear in 2036 from the world's fleet. To recap, **2025 EC forecast of fleet composition, with PPX1 re-emerging to provide about third of Asia/USEC services, is evidently unfounded**.

VI.4 Call Reduction of PPX1 vs. PPX3Max

Table 4, already discussed above, summarizes Tables 5.38 & 5.51 of the 2025 EC report. The last column of this table shows the call reduction in 2036, assuming that the channel depth increases from 42 ft (the present depth) to 48 ft (the deepest in 2025 EC report). As noted above, the **ONLY change between the 2036 42-ft and the 48-ft cases is in the number of PPX1 calls**, 122 (237 – 115). In a more realistic case, all Asia/USEC services in 2036, and probably long before it, would be provided by PPX3Max. According to Figure 6 (vertical red arrow), at 44 ft, PPX3Max capacity is 1.83 that of PPX1 (8,867 / 4,821). If all the services in 2036 are based on PPX3Max, the equivalent reduction in the number of calls decreases from 122 to 66 (122 / 1.83). Because of scale economies of the larger vessel, this decrease in the number of calls also results in a reduction in savings as will be discussed below.

VI.5 Cost Savings due to Call Reduction for PPX1 and PPX3Max

Table 5 shows a rough estimate of vessel and port call costs of PPX1 and PPX3Max, based on published data.

Table 5 Port-Call Costs of PPX1 & PPX3Max

Vessel Category	Unit	PPX1	PPX3Max
Vessel Capacity	**TEU**	**5,800**	**12,450**
Vessel Cost			
OPEX	$/Day	47,000	68,000
Charter	$/Day	55,000	100,000
Total Vessel	$/Day	102,000	168,000
Port Costs			
Dockage	$/24-hr	12,300	14,950
Pilotage	$/Call	20,000	27,000
Tuggage	$/Call	30,000	42,500
Total Port	$/Call	62,300	84,450
Total Vessel + Port	$/Call	**164,300**	**252,450**
Calls Saved	Call/Year	122.00	56.84
Cost Savings	$/Year	20,044,600	14,348,082
PPX3Max / PPX1			**0.72**
Vessel Capacity 44 ft	**TEU**	**4,821**	**8,687**
Calls Saved	Call/Year	122.00	67.71
Cost Savings	$/Year	20,044,600	17,092,379
PPX3Max / PPX1			**0.85**

For simplicity, the assumption in the above comparative cost calculation is that a Wilmington call requires one vessel-day (24 hours), including channel navigation time. Accordingly, as seen in the Table 5, p. 25 above, the total call costs, including both the vessel and the port costs, are $164,300 and $252,450 for PPX1 and PPX3Max respectively. Vessel capacity (TEU) is calculated for two cases, the first assumes nominal vessel capacity and the second light-loading at 44 ft. In the nominal-capacity case, the ratio between the PPX3-based savings and PPX1-based savings is 0.72; in the light-loading case at 44 ft, the ratio is 0.85.

Another, indirect way to figure out the reduction in savings due to the replacement of PPX1 with PPX3Max, is to assume the vessel operating costs shown in Figure 5, based on Table 2-4 of 2020 NCS. My assumption is that the savings are directly proportional of the change in operating costs. **Table 6** shows the calculations. The per-TEU vessel cost figures in Table 6 are represented by the horizontal red arrows in Table 2-4. The PPX3Max costs reduction due to draft increase from 40 ft to 44 ft is about 0.58 of PPX1.

Table 6 Vessel TEU-1,000 Mile for PPX1 and PPX3Max

	$/ TEU-1,000 Mile	
Vessel Category	**PPX1**	**PPX3Max**
Vessel Draft		
40 ft	57.35	39.81
44 ft	46.76	33.63
Cost Difference	10.59	6.18
PPX3Max / PPX1		**0.58**

VI.6 BCR Adjustments to Future Asia/USEC Services by PPX3Max

The deeper channel in the With-Project case allows for better draft utilization for PPX vessels calling at Wilmington which, in turn, results in reduction in the number of vessel-calls and the respective costs. This cost reductions, or savings, are the Project benefits to be compared against its costs. 2025 EC assumes, that about one third of the vessels deployed on Wilmington service in the 2036 – 2056 period are PPX1, which is unfounded. A more realistic assumption is that future Asia/USEC will deploy PP3Max (and PPX4). Since 2025 EC does not provide data or explanation for the methods and assumptions underlying its calculation of savings, I resorted to three, indirect ways of estimating the **relative reduction** in savings caused by adjusting the fleet by replacing PPX1 with PPX3Max. My assumed deployment of PPX3Max instead of PPX1 is supported by: (a) Figure 7, showing that PPX1 was a bygone already in 2019, while the PPX3 was already dominant and PPX3Max just appeared; (b) Appendix B, showing that in 2025, most of the Asia/USEC employ PPX3, and none PPX1; and (c) the world's fleet composition. The benefit adjustment factors for fleet composition are 0.72, 0.85 and 0.58. Accordingly, the adjusted BCR should be 0.94, 1.10, and 0.75, meaning that at least in 2 scenarios, Wilmington's channel deepening Project is infeasible.

VII Summary Conclusion

VII.1 Adjusted BCRs

2025 EC determined that Wilmington's channel-deepening Project is feasibly based on its calculation of the Project's BCR as 1.3 > 1. However, a 1.3 BCR has a narrow, 23% margin of error. A relatively small downside change (risk) in the assumptions underlying the Project's benefits calculations can result in BCR < 1, turning the project status from feasible to infeasible. My study examines 8 such assumptions, for which I did not find a reliable basis in the 2025 EC. Therefore, for each assumption, I propose modifications and corrections based on my own study, resulting in adjustments to the benefits calculated in the 2025 EC.

Table 7 summarizes the impact of the modifications for the 8 assumptions along with their respective BCR's adjustment factors. The adjustment factors are, in fact, the risk factors of the Project, since they can determine the Project's feasibility.

Table 7 Summary of Adjusted BCRs

	Category	Risk Factor	Scenario Description	Adjustment Factor	Adjusted BCR
1	Benefit TEUs	Base Year	Based on Average 2016 - 2020 instead of just 2020	0.77	1.01
2		Base Year	Past Years with no Direct Asia/USEC Service	0.80	1.04
3		Growth Rate	Future Growth Rate Aligned with USEC Ports	0.55	0.72
4		Abandonment	Future Intermodal Replacing Direct Asia/USEC Services	0.50	0.65
5		Feedering	Future Feeder Replacing Direct Asia/USEC Services	0.50	0.65
6	Savings $/TEU	PPX3Max Instead of PPX1	Based on Call Cost at Nominal Capacity	0.72	0.94
7			Based on Call Cost at 44 ft	0.85	1.11
8			Based on Vessel Cost per 1,000 TEU-mile	0.58	0.75

As seen in Table 7, the 8 scenarios (each related to one assumption/risk factor) are grouped into two categories, according to their main impact, on benefit cargo (TEUs), and on savings ($/TEU). Then, in each category, the Table includes a description of the scenarios mandating adjustments, along with their respective adjustment factors and adjusted BCRs. The adjusted BCRs of 5 scenarios is negative (BCR<1), while the remaining 3, are very close to 1. Put differently, in 5 scenarios the Project is infeasible; in 3 barely feasible.

VII.2 Combining Risk Factors

The adjustment factors in Table 7 are mostly unrelated and therefore their combined effect can be calculated by multiplying them. For example, 50% of future Wilmington's Asian trade could be served by feeders (instead of direct services assumed in 2025 EC), while the other 50% provided by direct services employing PPX3Max (instead of PPX1 assumed in 2025 EC). The combined effect on the adjusted BCR is 0.47 (1.3 x 0.5 x 0.72). In addition, and at the same time, the cargo forecast could also be adjusted due to aligning Wilmington's growth rate with the rest of USEC ports (instead of the one-time "jump" assumed in 2025 EC), the resulting BCR due to the three adjustments is 0.25 (0.47 x 0.55).

Altogether, I find the methodology, data, assumptions, and calculations of the BCR, the economic criteria employed by 2025 EC to assess Project feasibility, as **unreliable**. Moreover, based on my adjustments to the Project's BCR, I conclude that the Project, as presented in 2025 EC, is most likely **infeasible.**

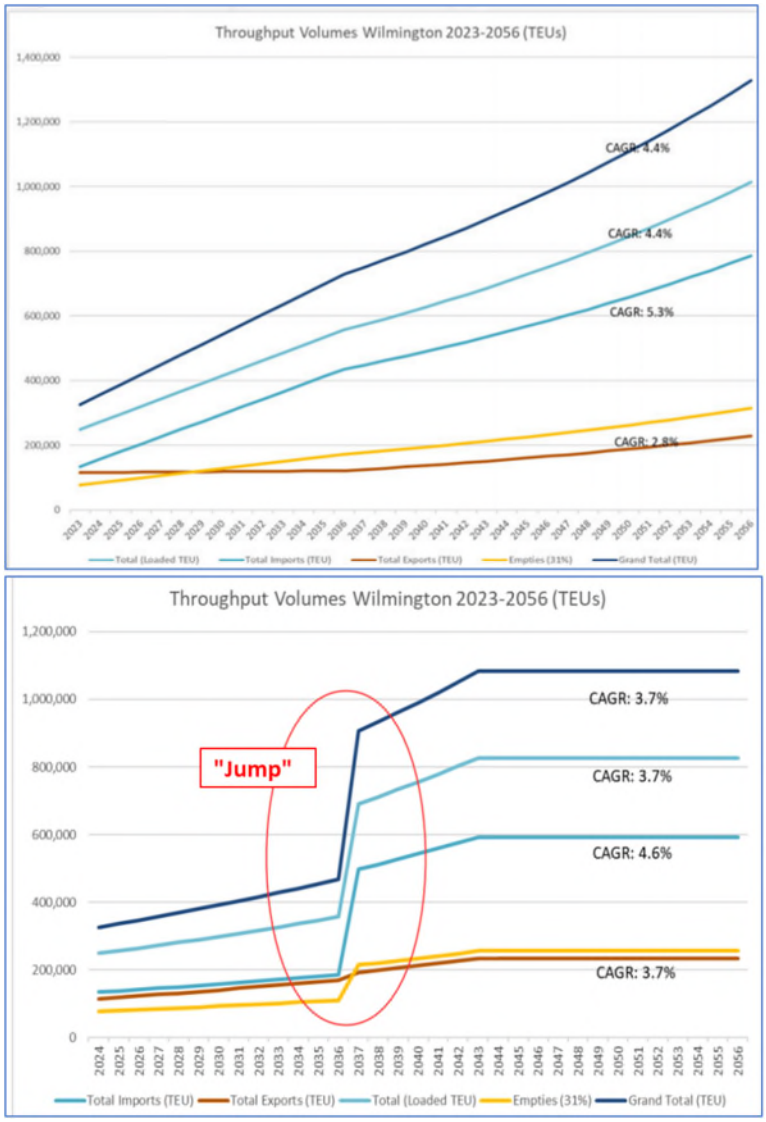
VIII Appendix A – The Forecasted Growth of Asian Container Imports

VIII.1 Sudden Increase in Asia Imports (2030 – 2036)

The cargo forecast presented in Table 2, based on Table 5.22 in 2025 EC (p. 35), shows a huge, one-time "jump" in Wilmington's imports during the 6-year period 2030 – 2036. This jump, which apparently ends right in 2035, the base year of the evaluation of the Project, is quite dramatic; the 2.8 million tons in 2036 is almost 4 times(!) the 0.7 million tons of 2030 (2.8 / 0.7). To facilitate the

discussion, I will convert the tonnage figures to TEUs. Accordingly, assuming the 6.9 tons/TEU used in 2025 EC, the increase in imports is by 306,000 TEUs, from 106,000 TEUs in 2030, to 412,000 TEUs in 2036. **Figure 10** shows two different growth charts, the upper one, taken from the 2024 PowerPoint, and the lower one from 2024 Presentation.

Figure 10 The "Jump" in Wilmington's Forecast



The upper part shows gradual and stable growth rates, with no bumps and no jumps, similar to the one presented below for the Port of Oakland in the following Figure 11, and similar to the many USACE channel studies I have reviewed in recent years. The lower part of Figure 8 shows the "jump" (red circle added by me). Interestingly, both charts were prepared and presented in 2024, perhaps by two separate researchers.

As I noted in Section II, 2025 EC does not offer an explanation for the "jump" or the emergence of these 306,000 TEUS, except for indicating, somewhat causally, that it is presumably the result of *"$10 billion investments planned for the next years"*. 2025 EC does not provide a list of the planned, new or expanded, local industries, and for each an estimate of tonnage and TEUs projections for each. There is also no reference to studies that discuss and explain this unusual growth in imports. In this appendix, I attempt to provide my own, although rough, estimate of Wilmington's expected growth in Asian imports, resulting from the above-mentioned investments.

VIII.2 Growth is Unrelated to Deeper Channel

2025 NC explicitly states that the growth in Asian imports is unrelated to the deeper channel, i.e., not the result of repatriating of Wilmington cargoes presently handled intermodally by nearby USEC ports. Accordingly, 2025 EC only includes one cargo forecast, unrelated to the channel depth. Put differently, the With and Without Project forecasts are the same.

To assess the "net" impact on Asian imports of the above investment, I deduct from the total growth the portion attributed to the "natural growth" of existing cargo. To calculate the natural growth of Wilmington's cargo, I assume that the growth rate of 3.1% during the period 2025 – 2030 remains unchanged in the following period 2030-2036, resulting in the addition of about 20,000 TEUs. Hence the net addition attributed to the above investment is about 286,000 TEUs (306,000 – 20,000).

VIII.3 Forecasting Methodology

The forecasting methodology applied by USACE in Wilmington is different from that assumed in the many USACE's channel studies that I have reviewed. That is, I do not recall a case of a long-term, 36-year forecast (2020 – 2056) prepared for a public container port, where the forecast is almost entirely driven by a one-time development of a new industry. The common methodology assumes a moderate and study growth rates, derived from a national, macro-economic study by outside consultants. This also is the assumption in 2025 EC, for the periods before and after the "jump".

Table 8 shows a compilation of growth rates taken from USACE port-channel studies of 6 USEC ports. As seen there, the growth rates are very similar among ports, and also are similar to those applied for Wilmington, except for the 2030 – 2036 one-time "jump".

Table 8 Growth Rates of USEC Ports

Port	Forecast Period		Annual Growth Rates		
	Begin	End	Low	Moderate	High
Boston	2020	2060	1.6%	2.7%	4.3%
New York/New Jercey	2020	2045	1.7%	2.8%	4.1%
Norfolk	2025	2065	1.9%	3.2%	4.7%
Charleston	2020	2050	1.8%	3.0%	4.5%
Savannah	2025	2030	2.1%	3.4%	4.8%
Jacksonville	2015	2050	2.0%	3.1%	4.6%

Figure 11 shows the Port of Oakland's forecast for 40 years, taken for USACE study of Oakland, CA. This figure shows steady growth rates similar also for a USWC port. Why does 2025 EC apply a different forecasting methodology to Wilmington?

Figure 11 Cargo Forecast for the Port of Oakland

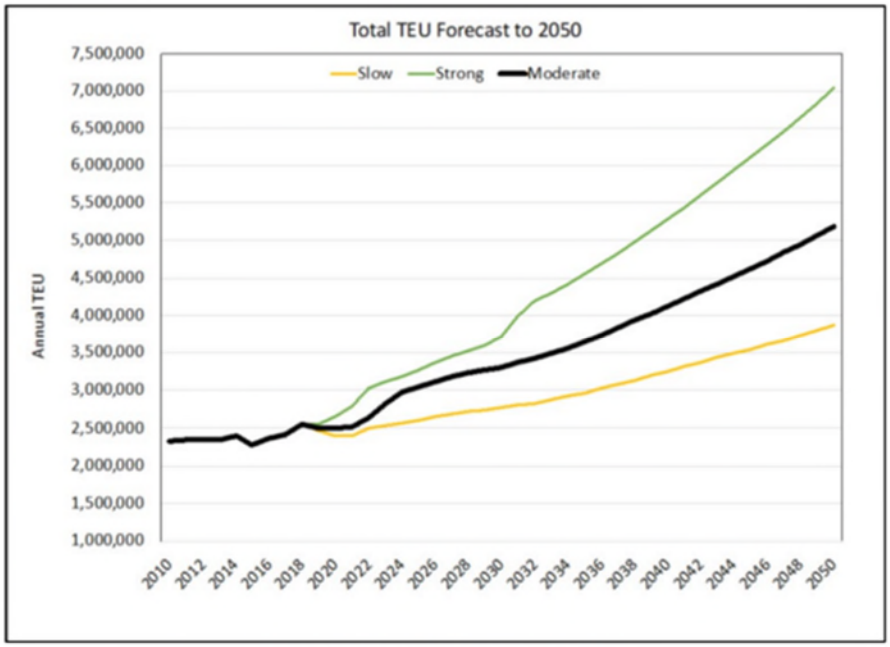


Figure 3-2. Total TEU Forecast to 2050

VIII.4 Forecasting Scenarios

In both Table 8 and Figure 11, the forecast includes 3 growth scenarios, low, moderate and high. This also is the case in Figure 10, upper part, that shows Wilmington's forecasts in 2024 PowerPoint. However, 2025 EC provides **only one scenario**, presumably the moderate growth, with no explanation given. As will be seen in the following sections devoted to a discussion of the specifics of the "jump", there also are no scenarios there. It seems that this avoidance of scenario-based assessment is in line with the overall analytical approach of 2025 EC, which for unknown reasons excludes sensitivity testing of its assumptions.

VIII.5 New and Expanded Industries

The four-fold jump in Asian cargo claimed in 2025 EC is because "*The area surrounding the Port of Wilmington is seeing significant growth in landside facilities. Over **$10.0 Billion** in new or upgraded manufacturing and processing facilities are planned over the next 10 years, as well as $523 million in the construction of 10 new storage and distribution facilities*" (p. 34, bottom). The earlier 2024 PowerPoint includes much larger investment figures, stating: *"The area surrounding the Port of Wilmington is seeing significant growth in landside facilities. Over **$28.2 Billion** in new or upgraded manufacturing and processing facilities are planned over the next 10 years, as well as $2 .2 billion in the construction of 14 new storage and distribution facilities."* (p. 18, bottom). The gap seems too wide, implying problems with the reliability of the data.

Storage and distribution facilities do not generate **new** cargo, but handle existing one, presumably more efficiently. Any new cargo which will be attracted to Wilmington because of these more efficient facilities, investments is presumably presently handled by adjacent ports and, accordingly, its diversion to Wilmington should not count as a new benefit cargo, from the national point of view (NED). Hence, my goal here is to identify and quantify only the new cargo generated by the new manufacturing and processing facilities above.

VIII.6 Toyota Battery Manufacturing (TB)

My review of public media indicates that the "jump" in Asian imports is likely related to planned investments in the production of EV batteries and vehicles. The main EV investors are 4 companies: Toyota Battery Manufacturing NC (Liberty), Epsilon Advanced Materials' graphite anode plant (Brunswick County, near Wilmington), VinFast EV manufacturing plant (Chatham County), and an unnamed EV battery factory (Brunswick).

A detailed assessment of the expected generation of Asian containerized imports of each of the above-mentioned companies, as well as many smaller ones, is beyond the scope of my study. I also assume that there is much similarity among them regarding Asian-imports generation. Hence, I chose to only assess the potential Asian imports of Toyota, being the largest by far and seemingly the more likely to follow on its investment plans.

According to Toyota publications, TB produces lithium-ion batteries. TB plant is located in Liberty, a small city in central NC. The total investment is $13.9 billion and the expected employment 5,100 people. The plant began production in April 2025. In its final, 2030 phase, TB's production will reach 2030 30 GWh, to be installed in 300,000 – 800,000 vehicles, pending on battery size.

VIII.7 Containerized Portion of Raw Materials

The raw materials of TB (and other battery manufacturers) include typical battery components such as: lithium (hydroxide/carbonate), nickel (sulfate), cobalt (sulfate), and related chemicals/precursors. The common method of estimating the volume of raw material is by using indicators of tons/GWh for each of the raw materials. This method is somewhat rough, since indicators have a wide range based on type and size of EV.

EV materials are transported in a mix of containerized and non-containerized cargo forms, optimized for density, value, and perishability. My understanding is that most of the imports are non-containerized, in bulk and breakbulk. For example, it seems that most of lithium will be imported in bulk, as brine (liquid) and hard-rock. The containerized portion includes processed lithium hydroxide/carbonate, nickel/cobalt sulfates, synthetic graphite powder, and battery chemicals/APIs.

VIII.8 Asian, Non-Asian and Domestic Sourcing

EV battery imports originate from geopolitically diverse sources, influenced by U.S. tariffs (e.g., 25% on Chinese batteries, 100% on EVs) and Foreign Entity of Concern (FEOC) rules under the Inflation Reduction Act, which restricts China-sourced materials for tax credits. China still dominates global

production (72% lithium hydroxide, 77% graphite), but diversification favors US allies like Australia, Chile, and Indonesia.

I reviewed 3 separate assessments of TB expected Asian containerized imports for full production level. The first assessment estimated that the Asian share of raw materials ranges 50 – 70%, resulting in a projected volume of 20,000 - 40,000 TEUs/year. The second assessment came up with a much smaller estimate, based on production batteries for 500,000 vehicles and 45% of raw materials sourced in Asia, resulting in 10,000 – 20,000 TEUs/year. Some of the imports include finished cells and packs. The third assessment was between the first two, at 26,000 – 30,000 TEUs/year.

All three assessments indicated that **future imports are likely to gradually decline** due to domestic sourcing, including a proposed Piedmont Lithium mine and Redwood Materials recycling.

VIII.9 Slowdown in EV

The development of the EV industry in the US, and especially in NC, is heavily dependent on a broad range of product subsidies and public investments, beginning with consumer incentives ($7,500 federal tax credit per EV), federal funding for charging stations, production incentives, etc., most of which have been terminated, adding to the cost of EVs. Another addition caused by tariffs on imported raw materials and components, particularly from Asian countries. The lower demand for EV and removal of incentives are reported to cause a reassessment of EV manufacturers' plans. A relevant example is the above-mentioned VinFast, that delayed the opening of its 2024-planned NC factory to 2028.

VIII.10 Competing USEC Ports

There are 4 gateway ports that compete on handling TB's Asian imports. Land distances from TB's location in Liberty to these ports are: Wilmington (210 miles), Norfolk (235 miles), Charleston (278 miles), and Savannah (320). Most TB's imported materials will be shipped by rail using Greensboro inland rail terminal, about 30 miles away from Liberty, presently served by both CSX and NS. These two Class I railroads connect to all 4 ports, and the differences in distances among them are not considered significant (for rail). Moreover, Wilmington's competitors are much larger and offer a much wider selection of Asian (and non-Asian) shipping services. Also, these ports have better rail connection to the Midwest, especially Savannah. It is reasonable to assume, that while Wilmington is the main gateway port for TB's imports, some of it will be using other ports. Perhaps this is the reason why Toyota hasn't yet announced a specific port of entry for its Asian imports.

VIII.11 Difficulties in Forecasting Methodology

As seen above, the methodology for forecasting Wilmington TB-related Asian container imports is based on the examination and estimation of 6 (at least) factors:

TB's Asian Imports through Wilmington =

f (Annual Production (GWh/year) x Raw Materials per unit (tons/GWh) x % sourced in Asia x % in containers x Stowage Factor (tons/TEU) x % through Wilmington gateway)

Accordingly, there is a wide uncertainty in calculating the Asian imports of TB. This probably is the reason for the wide range of results of the 3 above-mentioned assessments, from 10,000 – 40,000 TEUs, or 400% (!). This wide range only relates to TB, the manufacturer for which there is the most accurate information. It is much wider for the other manufacturers.

VIII.12 Wilmington's EV Forecast

TB is by far the largest EV manufacturer, and the one for which there is more detailed and reliable information than the other manufacturers. Nevertheless, for the sake of analysis, I assume that TB's Asian imports are equal to that of the rest of the planned NC plants. I also assume the highest forecast for TB, 40,000 TEUs. Accordingly, the forecast of total Wilmington's imports attributed to the EV industry is around 80,000 TEUs (40,000 x 2). This 80,000 TEU has to increase 3.5 times to reach the 285,000 TEUs (see first section) that 2025 NC ascribes to the EV-related, imports growth in the 2030 – 2036. For comparison, again, the BCR = 1.3 indicates that a downward deviation of 23% is sufficient to turn the project infeasible.

IX Appendix B – Asia/USEC Services with PPX1

IX.1 Current Asia/USEC Services

Table 9 shows a recent (October 2025) listing of Asia/USEC services published by the Port of Charleston. Charleston is the closest USEC to Wilmington, located only 134 nautical miles away or 8 sailing hours. The USEC port rotation of the direct Asian services that called in the past at Wilmington, also called at Charleston (see the EC2 rotation in Figure 2).

Table 9 Port of Charleston Asian Services

ade Route	Rotation	Alliance	Service	Participating Carriers	Avg TEU Size	First In	Last Out	Vessel Category	Routing Pattern
ASIA	Singapore / Cai Mep / Haiphong / Yantian / Kaohsiung / Cartagena / **CHARLESTON** / Savannah / NY/NJ / Boston / Singapore		Emerald / ZXB	MSC / ZIM	7,400	X		PPX2	RTW-EB
ASIA	Yantian / Xiamen / Ningbo / Shanghai / Busan / Manzanillo Mex / Kingston / Savannah / **CHARLESTON** / Norfolk / Kingston / Busan		Amberjack / ZCP	MSC / ZIM	14,600	X		PPX3Max	Panama
ASIA	Singapore / Haiphong / Ningbo / Shanghai / Lazaro Cardenas / **CHARLESTON** / Savannah / NY/NJ / Singapore	Gemini	TP11 / US1	Maersk / Hapag-Lloyd	13,100	X		PPX3Max	Panama
ASIA	Nansha / Yantian / Vung Tau / Tanjung Pelepas / Colombo / NY/NJ / Norfolk / Baltimore / **CHARLESTON** / Savannah / Colombo / Nansha	Gemini	TP16 / US4	Maersk / Hapag-Lloyd	13,100			PPX3Max	Suez
ASIA	Qingdao / Shanghai / Ningbo / Busan / Colon / Savannah / **CHARLESTON** / Boston / NY/NJ / Colon / Qingdao	OCEAN	Vespucci / NUE / AWE1 / ECC2	CMA CGM / COSCO / Evergreen / OOCL	11,200			PPX2	Panama
ASIA	Laem Chabang / Cai Mep / Hong Kong / Yantian / Xiamen / Shanghai / NY/NJ / Savannah / **CHARLESTON** / Laem Chabang	OCEAN	SAX / AWE4 / ECX1	CMA CGM / COSCO / Evergreen / OOCL	13,500		X	PPX3Max	Panama
ASIA	Kaohsiung / Yantian / Cai Mep / Singapore / Port Kelang / Colombo / Halifax / NY/NJ / Norfolk / Savannah / **CHARLESTON** / Port Kelang / Singapore / Laem Chabang / Cai Mep / Yantian / LA / Oakland / Kaohsiung / Yantian	OCEAN	Columbus JAX (CJX) / PE1 / AWE5 / SEA2 / SEAP	CMA CGM / COSCO / Evergreen / OOCL	14,000		X	PPX3Max	RTW-WB
ASIA	Port Kelang / Haiphong / Yantian / Ningbo / Shanghai / Busan / Yokohama / Norfolk / Savannah / **CHARLESTON** / Miami / Port Kelang	OCEAN	CBX / AWE7 / ECC3	CMA CGM / COSCO / Evergreen / OOCL	8,500			PPX2	RTW-EB
ASIA	Xiamen / Yantian / Ningbo / Shanghai / Busan / Manzanillo / Savannah / **CHARLESTON** / Manzanillo / Busan / Xiamen	Premier	EC2	HMM / ONE / Yang Ming	13,500		X	PPX3Max	Panama
ASIA	Laem Chabang / Cai Mep / Singapore / Colombo / Halifax / NY/NJ / Jacksonville / Savannah / **CHARLESTON** / Norfolk / NY/NJ / Halifax / Singapore / Laem Chabang	Premier	EC3	HMM / ONE / Yang Ming	14,000			PPX3Max	Suez
ASIA	Shanghai / Ningbo / Taipei / Yantian / Shekou / Cai Mep / Singapore / Colombo / NY/NJ / Norfolk / **CHARLESTON** / Savannah / Cristobal Panama / Shanghai		AA7	Wan Hai / Hapag-Lloyd	13,000			PPX3Max	RTW-WB

I have divided Charleston's 11 services first according to their vessel-size category and second, their service (routing) patterns. As seen in Table 9, **none of the present Asia/USEC services is provided by PPX1**. For comparison, 2025 NC assumes, as seen in the above Table 4, that PPX1 will be the largest vessel category (by the number of calls/year) in 2036, although in 2021, the base year for fleet projection in this Table, there was only 1 call of PPX1 in Wilmington.[10] The categorization by routing pattern is important since it affects vessel-size. As seen in Table 9, last column, out of 11 Asia/USEC services, 5 are routed through-Panama (**Panama),** 2 through-Suez **(Suez)** and 4 round-the-world (**RTW).** Due to the hostility at the entrance to the Red Sea, the actual routing of some of the Suez is around the Cape of Good Hope, which adds 2,100 nautical miles. Also, because of the hostility, some Suez services switched to Panama. Hence, it is quite likely that once the hostility ends, there will be shift of Panama back to Suez. The shift to Suez will be further boosted by Panama Canal's constraints as discussed below.

IX.2 Panama Canal Constraints

The first constraint of Panama Canal (**Panama**) is its lock's dimensions. The largest current vessel that can transit through the Canal is about 16,000 TEU, which will probably grow to 18,000 TEU in the future, while the dominant vessels already deployed on Asia/Europe trade are 24,000 TEU.

The second and rarely-mentioned constraint is the number of daily transits. The third lock (neo-lock) was designed specifically for post-Panamax vessels, both container and non-container (mainly tankers). It is estimated that the current utilization of the neo lock already reaches 60 – 70%. The combined effect of future increase in maritime trade and increase in vessel size is likely to increase the demand for this lock. Accordingly, the utilization in 2036 is expected to reach the range of 80 – 90%. At such a high utilization, vessel delays are unavoidable. While delays are common in bulk shipping, they disrupt operations of liner shipping, whereby vessels follow a strict schedule, including fixed berthing windows at ports. Panama also has problems with seasonal shortage in the supply of fresh water, resulting in draft limitations, which are expected to get worse in the future. The construction of a 4th lock is a very long and expensive prospect. In contrast to the Panama, the Suez Canal is a sea-level and sea-water canal, with no locks, no capacity constraints and no problems with water shortage.

IX.3 Future Shift from Through-Panama to Through-Suez Services

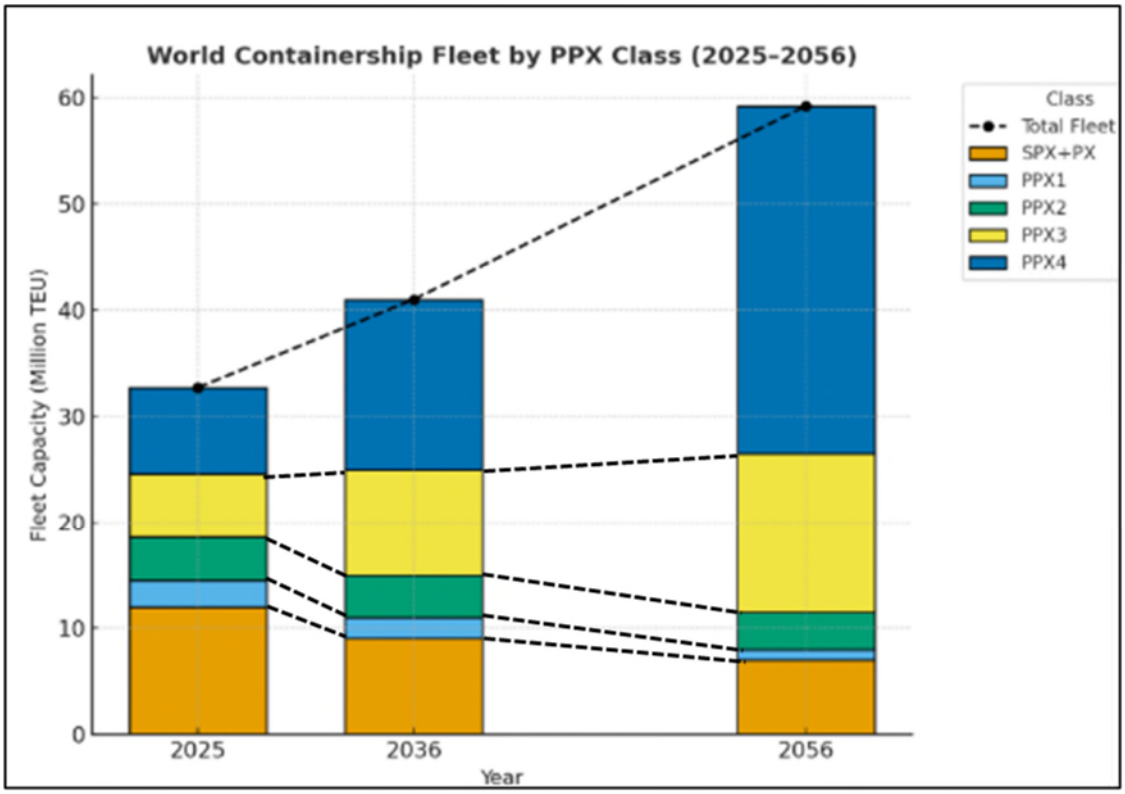
The first driver for a shift (or conversion) of Asia/USEC services from through-Panama to through-Suez pattern is the increase in vessel size, from 18,000 to 24,000 and eventually 28,000 TEU, as discussed in Section IV.9 on PPX4. The second driver, also mentioned in that section, is the shift of trade from North Asia to Southeast and South Asia. The third driver is the operational constraints of Panama Canal as discussed above. The combined effects of these drivers may take some time, but considering that the Project's first year is 2036 and extends till 2086, it certainly has to be taken into considerations. 2025 EC does not include an assessment of the above drivers and their possible impact on future fleet composition.

[10] It seems that the PPX1's 1 call in Table 4 is a typo or one-time event, since shipping services usually call on a weekly basis.

IX.4 Future Fleet Composition

Figure 12 shows the present (2025) and future (2036, 2056) fleet composition of container vessels by size category, based on public sources. The years 2036 and 2056 are selected to accord with Table 4, which shows the future fleet composition of Wilmington Asian services.

Figure 12 World Fleet by PPX Categories



As seen in Figure 12, PPX1, the dominant vessel in 2025 EC, and the main source of savings due to the predicted reduction in the number of calls, is bound to almost disappear. The largest category of the PPX in 2025, PPX3, is expected to further grow, while PPX2 remains unchanged. Another trend is the tremendous growth in PPX4. These 24,000-TEU vessels, already dominating the Asia/Europe trade are likely, eventually (2036?), following the next round of USEC-ports' deepening, to also dominate Asia/USEC services, which by then will mostly be through-Suez.

Another trend that favors larger newbuildings is decarbonization. Only 8% of the present fleet uses alternative fuels. However, most newbuildings, especially the ULCV, are dual-fuel. It is quite likely that carbon pricing will accelerate scrapping of older, dirtier vessels, including the first-generation of PPX, the PPX1.

IX.1 Special PPX1-Based, Asia/USEC Services for Secondary Ports

How can one predict the reappearance of PPX1-based services in 2036, when most of them are already bygone as seen in Figure 12?

It seems that there is confusion regarding the rejuvenation of PPX1-based Asian services in the various USACE publications. For example, the most recent one, 2024 PowerPoint, attempting to justify taking PPX3 as a design vessel, states: "*Deepening could eliminate some smaller vessels on Asian and South American routes, and lower total PPX3 calls needed" (p.11, bottom).* Then, apparently unaware of this statement, makes a contradictory prediction that *"**In the long-term**, 50-year period of analysis, cargo is more likely to get to NC area using **smaller vessels to Wilmington than on larger vessels to alternate ports, such as Charleston, SC or Norfolk, VA**, with extended landside transportation (truck, rail)*." (p.14, bottom). Put differently, a key assumption in the benefit calculation is the future emergence of Wilmington-special, Asia/USEC services based on PPX1. Presumably, according to USACE prediction, for some reason, in 2036 (Figure 12) there will be an "evolutionary split" in the Asia/USEC service pattern into big-port and small- port services. Let me examine this possibility.

USEC ports can roughly be categorized into main and secondary ports. To justify a call by a 15,000-TEU, PPX3 vessel with a USEC rotation of 4 ports, each of the main ports should generate about 5,000 TEUs in/out. This apparently is already the case since, as seen with Charleston above, the main ports are already served by PPX3 and PPX3Max vessels and, in 10 or so years, by PPX4. The smaller, secondary ports presumably can only generate 2,500 TEUs in/out, which is only sufficient to justify a call by PPX1. A hypothetical rotation of such a PPX1-based service could include Port Everglades, Wilmington NC, Wilmington DE and Philadelphia. However, the cost disadvantages of using PPX1 vs. PPX3Max are significant. As seen in Figure 5, at 44 ft, the PPX1 is 39% (46.76 / 33.63); at 48 ft, **PPX1 is 50% (43.91 / 29.11) more expensive than the PPX3**. The 48 ft is the more likely case since by 2030 the main ports' channel are likely to be deepen to 50+ ft. **In light of this huge cost disadvantage, a 2036 emergence of PPX1, small-port services is unlikely.**

Another hurdle for such a service is a severe shortage in PPX1. As seen in Figure 12 above, the availability of smaller PPXs will sharply decline in the future. The reason is simple, there is and will be a limited worldwide use for this historical, small-capacity vessel design.

As to the secondary USEC ports, the more reasonable prediction for their Asian services pattern is the hub & spoke model, or feedering, which already is the practice worldwide, including Wilmington.

ATTACHMENT N

VILLAGE OF BALD HEAD ISLAND SUPPLEMENTAL COMMENTS

17 NOV. 2025

SUMMARY OF EDUCATION AND EXPERIENCE

ASAF ASHAR, PHD

Summary of Education and Experience

Asaf Ashar, PhD

Research Professor (emeritus) and Independent Consultant, Ports, Shipping and Intermodal Transportation

Dr. Ashar is Research Professor (emeritus) with the National Ports & Waterways Institute (NPWI), USA, and independent consultant. NPWI is a maritime research program of The University of New Orleans and, previously, Louisiana State University, with offices in New Orleans, LA and Washington D.C. Dr. Ashar had been with NPWI for 30 years (1985 - 2015). Before that he was Senior Port Planner and Transportation Analyst with the Port of Seattle, WA, USA (1981 - 1985), and Senior Advisor for Operations with the Port and Rail Authority of Israel, Ports of Haifa & Ashdod (1972 - 1980). His academic background includes degrees in Industrial Engineering & Management (Technion, Israel, 1967), Marine System Management (Massachusetts Institute of Technology, USA,1982), and Maritime Studies and International Transport (University of Cardiff, United Kingdom,1993).

Relevant Assignments:

***Expert Witness, Port Concession Assessment**, for White and Case LLP (2021).*

***Expert Witness, Home Port vs. Port of Registration in Cruise Shipping,** for Palter, Stokley & Sims LLC, Houston, TX (2018).*

***Expert Witness, Prospect of Ferry Services in New York,** for Emery, Celli, Brinckerhoff & Abady LLP (2015).*

***Expert Witness, Patent Application for Ship Handling System, USA,** for Mintz, Levin, Cohn, Ferris, Glovsky & Popeco, P.C. (2015).*

Expert Witness, Port of Savannah's Channel Deepening, for Natural Resources Defense Council, Inc., New York, USA (2012).

Expert Witness, Port of Miami's Channel Deepening, for Natural Resources Defense Council, Inc., New York, USA (2012).

Expert Witness, Maher Terminals, Elizabeth, NJ, USA, for Winston & Strawn LLP, Washington DC, USA (2012).

***Expert Witness, Private Ports in USA and UK and their Relationships with Surrounding Communities,** for the Port of Los Angeles and Kaye Scholer LLP (2009).*

Expert Witness, Costs of Coal Shipping and Port Handling in Florida, for Michael Twomey Law Office, Gainesville, FL, USA (2004).