ECONOMICS APPENDIX

New York and New Jersey Harbor Anchorages
Final General Reevaluation Report and Environmental Assessment

APPENDIX B

April 2020

U.S. Army Corps of Engineers
Norfolk District

THE PORT AUTHORITY OF NY & NJ

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1. Introduction

The U.S. Army Corps of Engineers (USACE) Deep Draft Navigation Planning Center of Expertise (DDNPCX) conducted an economic analysis to determine the feasibility of improvements to the Federal anchorages at New York and New Jersey (NYNJ) Harbor.

1.1 Background

The Port of New York and New Jersey is the largest port on the East Coast and the third largest in the nation. In 2017, the port captured nearly 32 percent of the total market share[1]. In 2016, the Port provided almost 400,000 port-related jobs in the region and generated $64.8 billion in business activity.

The purpose of this investigation is to identify whether anchorage modifications that would improve the operational efficiency of commercial vessels that currently use and are expected to use the New York and New York Anchorages are in the Federal interest.

The need for this investigation became apparent from inefficiencies currently experienced by commercial vessels at the Port of NYNJ. These inefficiencies are projected to continue in the future as more vessels are expected to use the harbor and anchorages.

1.2 Economic Appendix Overview

The purpose of this economic appendix is to determine whether the National Economic Development (NED) benefits of accomplishing the study planning objectives exceed the NED costs and to determine which planning alternative most reasonably maximizes net NED benefits. The objective of Corps deep draft navigation improvements is to lower transportation costs for carriers and consumers to share. This is typically done through better utilization of existing and projected vessels that call the port. During scoping, it was identified that containerships over a certain length experience inefficiencies due to anchorage capacity. Therefore, goods moved in containers are identified to benefit and containerships are the focus of the analysis.

The period of analysis is 50 years, 2025 through 2074. The analysis uses the vessel operating cost from the Economic Guidance Memorandum (EGM), 17-04, Deep Draft Vessel Operating Costs FY 2016 Price Levels. The initial analysis used the Federal discount rate from EGM, 19-01, Federal Interest Rates for Corps of Engineers Projects for Fiscal Year (FY) 2019 of 2.875 percent, while the final benefit-cost analysis used EGM 20-01, FY 2020 of 2.750 percent. The benefits in the economic analysis are derived from transportation cost savings.

1.3 Data Sources and Uses

Data was collected from multiple sources for the purpose of characterizing existing conditions for the analysis and reporting purposes. All data were collected for a variety of reasons and may be subject to error, gaps, and limitations. The following data sources were used:

- Waterborne Commerce Statistics Center
- National Navigation Operation & Management Performance Evaluation & Assessment

[1] http://www.panynj.gov/port/about-port.html accessed 4/30/2019

System
- Port Authority New York and New Jersey
- Sandy Hook Pilots Association

For the purposes of economic analysis, the NYNJ Harbor system was represented in the HarborSym model. HarborSym is a planning-level simulation model designed to assist in the economic analyses of coastal harbors. It was developed as a data-driven, Monte Carlo simulation model which allows users to evaluate the difference between study alternatives. The model calculates vessel interactions within the harbor with user provided input data such as the port layout, vessel calls, and transit rules. Using this model, analysts can calculate the cost of any changes in overall transportation costs that result from proposed modifications to the anchorage's physical dimensions.

1.4 Appendix Layout

Section 1: The first section provides introductory information on the background, need, data sources, and a layout of the appendix.

Section 2: The second section provides detail of the existing conditions as they relate to the economic analysis.

Section 3: The third section explains the relationship between the significant consideration described in Section 2 and the measures designed to alleviate problems and realize opportunities. This section provides a description of the methods and assumptions used for the economic analysis, and an evaluation and comparison of the NED benefits and costs of the different measures.

Section 4: The fourth section describes the transportation cost savings benefit analysis

Section 5: The fifth section describes the Tentatively Selected Plan.

2. Inventory of Existing Condition

2.1 Hinterland Description

NYNJ Harbor is the third largest container port in the U.S., and the largest U.S. container port on the Atlantic Coast. The container terminals at the harbor serve two import markets: the primary, local truck market and the secondary, inland discretionary market. The latter is referred to as discretionary because it requires the port to compete with other Atlantic Coast ports for market share. As of 2016, nearly 85 percent of NYNJ Harbor's container market was a captive local truck market. The remaining balance consists of railing containers to inland discretionary markets that are also being served by other Atlantic Coast ports, as well as some Pacific and Gulf Coast ports. Figure 1 shows the local truck market area.

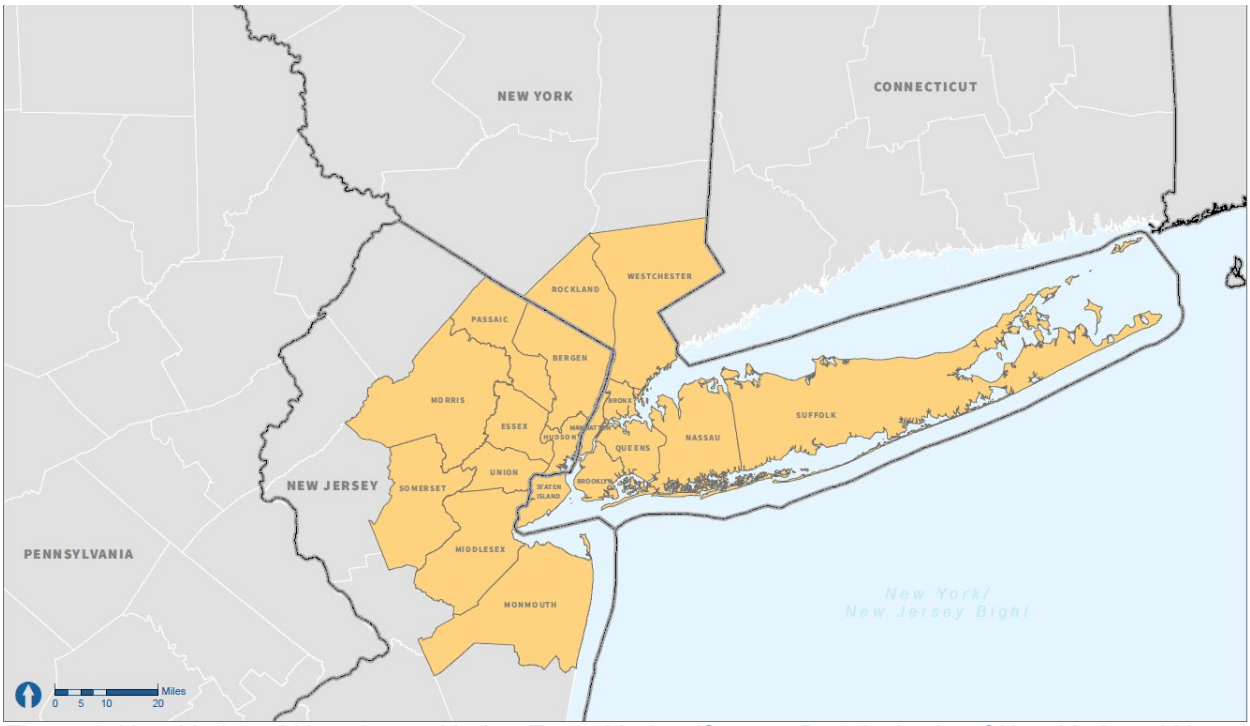


Figure 1: New York and New Jersey Harbor Truck Market (Source: Port Authority of New York and New Jersey)

2.2 Socio Economics

The socioeconomics of the community area are summarized in this section. The parameters used to describe the demographic and socioeconomic environment include recent trends in the population, the United States as a whole, the states of New Jersey and New York, and the selected counties of Bergen and Hudson Counties in New Jersey and Kings, Richmond and New York Counties in New York.

2.2.1 Population

As of 2017, New York is ranked as the 3rd largest state in the U.S. in terms of resident population with 19,378,102 million residents; and New Jersey is ranked as the 11th largest with 8,791,894 resident population. Between the years of 1990 and 2010, New York's and New Jersey's populations combined increased by 8 percent, from 26 million to 28 million persons, as shown in Table 1. All counties within the immediate economic region have seen a population growth during this period.

Table 1: NYNJ Population Trends 1990 to 2017

Geography	Population				Percent Change		
	1990	2000	2010	2017	1999 to '00	2000 to '10	1990 to '10
Bergen County, NJ	825,517	884,118	905,116	937,920	7.09%	2.37%	9.64%
Hudson County, NJ	552,990	608,975	634,266	679,756	10.12%	4.15%	14.69%
Kings County, NY	2,299,000	2,465,326	2,504,700	2,635,121	7.32%	1.59%	8.94%

Geography	Population				Percent Change		
	1990	2000	2010	2017	1999 to '00	2000 to '10	1990 to '10
Richmond County, NY	378,977	443,728	468,730	475,948	17.08%	5.63%	23.68%
New York County, NY	1,487,536	1,537,195	1,585,873	1,653,877	3.38%	3.16%	6.61%
New Jersey	7,757,000	8,414,350	8,791,894	8,960,161	8.47%	4.48%	13.34%
New York	18,280,000	18,976,457	19,378,102	19,798,228	3.8%	2.11	6%
United States	248,709,873	281,421,906	308,745,538	321,004,407	13.15%	7.48%	24.14%

2.2.2 Employment

New York and New Jersey's employment in 2017 averaged 11.6 million as shown in Table 2. Statewide the service-providing and trade industries comprise 44% of employment between the two states, transportation and utilities comprise 10% of total employment, followed by education and health services with 10% of total employment.

Within the region, New York County makes up 41% of employment for the entire state of New York and Bergen and Hudson counties comprise 17% and 9% of employment in New Jersey, respectively. Within New York County, New York, service-providers make up 32% of employment, followed by 8% in the professional and business services sector. For New Jersey, service-providing in Bergen County comprises 28% of all employment, with trade, transportation and utilities at 8% and leisure and hospitality at 1%.

Table 2: New York and New Jersey Private Sector Employment - 2017

NAICS Industry Sector		Bergen County, NJ	Hudson County, NJ	Kings County, NY	New York County, NY	Richmond County, NY	NY	NJ	US
101	Goods-producing	48,332	14,302	52,818	67,188	10,893	861,630	410,235	21,211,110
1011	Natural resources and mining	315	75	130	211	N/A	30,834	12,853	1,885,246
1012	Construction	16,270	5,094	32,531	41,401	9,699	386,615	154,907	6,919,107
1013	Manufacturing	31,747	9,133	20,156	25,577	N/A	444,182	242,476	12,406,757
102	Service-providing	350,765	206,746	560,612	2,129,254	86,131	7,038,168	3,024,904	101,175,455
1021	Trade, transportation, and utilities	101,388	62,205	126,331	255,632	23,718	1,562,385	872,180	27,252,395
1022	Information	8,915	7,940	10,748	165,022	1,384	269,233	70,379	2,793,429
1023	Financial activities	21,388	42,326	34,924	375,055	3,297	708,995	241,026	8,088,405
1024	Professional and business services	73,596	34,132	55,314	575,863	8,138	1,314,408	663,584	20,339,284
1025	Education and health services	88,039	31,052	241,424	347,056	34,222	1,847,585	644,049	22,146,912
1026	Leisure and hospitality	39,379	20,801	58,879	303,368	10,107	944,545	372,798	15,900,633
1027	Other services	15,739	6,360	29,670	103,829	4,898	369,805	136,480	4,434,678
	Total, Private and Government	422,456	228,120	492,125	2,280,092	10,893	8,340,732	3,735,703	127,820,442

Source: U. S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages (QCEW)

2.2.3 Wage Earnings by Sector

New York employees earned an average annual wage of $74,447 in 2017 as shown in Table 3. New Jersey follows with an average annual wage of $66,472. Consistent between both states,

the highest paying employment sector is Financial Activities which has average annual wages of $189,559 and $111,862 for New York and New Jersey respectively. Financial activities is the highest paying sector in Hudson and New York counties followed by Information in Kings County.

Table 3: New York and New Jersey Average Annual Wage Earnings per Employee – 2017

NAICS Industry Sector	Bergen County, NJ	Hudson County, NJ	Kings County, NY	Richmond County, NY	New York County, NY	New York	New Jersey	U.S
Goods-producing	73,110	67,623	53,333	69,658	95,563	67,426	74,616	63,961
Natural resources and mining	31,158	69,287	37,927	N/A	106,560	39,487	37,279	56,859
Construction	69,818	81,634	59,749	71,815	103,821	71,408	71,145	60,735
Manufacturing	75,213	59,796	43,078	N/A	82,106	65,899	78,813	66,840
Service-providing	62,747	77,086	41,466	42,888	126,400	72,408	62,225	53,530
Trade, transportation, and utilities	56,644	55,008	39,860	43,910	75,324	50,389	52,631	46,151
Information	123,751	108,227	79,790	66,563	145,548	119,508	108,638	105,722
Financial activities	96,142	155,171	66,432	55,820	284,393	189,559	111,862	92,923
Professional and business services	88,383	83,775	47,273	47,217	127,177	92,549	88,404	72,525
Education and health services	55,292	45,167	40,128	48,150	70,242	51,932	52,138	49,201
Leisure and hospitality	28,428	26,356	29,587	20,307	48,089	32,365	24,851	23,188
Other services	33,063	31,722	29,328	25,782	64,308	40,436	35,059	37,320

Source: U. S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages (QCEW)

2.2.4 Median Household Income for Selected Counties

The median household incomes for the selected counties in 2017 are shown in Table 4, with Bergen County, New Jersey showing the highest median household income at $91,572 which is higher than the state median income of $76,475. Richmond County, New York showed an average median household income of $76,244 which is also above the state median household income of $62,675.

Table 4: New York and New Jersey Median Household Income for Selected Counties - 2017

Geography	Median Household Income	% of State/US* Median Household Income
Bergen County, NJ	$91,572	119%
Hudson County, NJ	$62,681	81.96%
Kings County, NY	$52,782	84.21%
Richmond County, NY	$76,244	121.65%

New York County, NY	$64,971	103.66%
New York	$62,765	108.87%*
New Jersey	$76,475	132.65%*
US	$57,652	

Source: U. S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages (QCEW)

As shown below in Table 5, the 2017 unemployment rate in for New York is at 6.8% and New Jersey at 7.0%, both above the US unemployment rate of 6.6%. Kings County, New York has the highest unemployment rate of 8.1% which is 1.3% above the state average while Richmond County has an unemployment rate of 5.5% which is 1.1% below the state average. Hudson County, New Jersey has the highest unemployment in New Jersey at 7.1%, which is slightly above the state average by 0.1%. New York County is 0.6% below the state unemployment for New York and Bergen County is 1.8% below the state average. Both are below the US average.

Table 5: New York and New Jersey Unemployment for Selected Counties - 2017

Geography	Unemployment Rate
Bergen County, NJ	5.2%
Hudson County, NJ	7.1%
Kings County, NY	8.1%
Richmond County, NY	5.5%
New York County, NY	6.2%
New York	6.8%
New Jersey	7.0%
US	6.6%

Source: Bureau of Labor Statistics

2.3 Port Facilities

The Port of NYNJ currently has six container terminals. The existing total container throughput capacity for New York and New Jersey Harbor is 9.5 million twenty equivalent units (TEUs). In the following sections additional detail about container throughput capacity at New York and New Jersey Harbor is provided.

Port Newark Container Terminal (PNCT)

The Port Newark Container Terminal (PNCT) is a 272-acre facility at the Port Newark in New Jersey. It has 13 Post-Panamax Class ship-to-shore cranes; seven accommodating the Super Post-Panamax vessels with an outreach of up to 225 feet and six accommodating the Post-Panamax vessels with an outreach of up to 200 feet. Moreover, PNCT has a total berthing area of 4,400 linear feet.

At its current configuration, PNCT has a throughput capacity of 1.3 million TEUs. Currently, it leads the Port of NYNJ, moving 25% of its vessel container volume via rail. Additional improvements are planned for the terminal, including opening of a new gate complex, increasing

the terminal capacity, and increasing the peak crane handling. Moreover, PNCT plans to expand the terminal by developing 50 additional acres, deepening the berthing area, and upgrading the container handling equipment, including additional super post-Panamax ship-to-shore cranes. It has a long-term lease agreement with the Port Authority of NYNJ, through the year 2050.

Global Container Terminals (GCT) Bayonne, New Jersey

The Global Container Terminals (GCT) Bayonne is a 167-acre facility located outside the Bayonne Bridge in New Jersey, making it the closest container terminal to the entrance of NYNJ Harbor. It has 8 Post-Panamax ship-to-shore cranes; two of which are able to accommodate the Super Post-Panamax vessels with an outreach of up to 203 feet, and six are able to handle the Post-Panamax vessels with an outreach of up to 185 feet. GCT Bayonne has a total berthing length of 2,678 feet.

Maher Container Terminal

The Maher Container Terminal is a 450-acre facility located at the Elizabeth Port Authority Marine Terminal in Elizabeth, New Jersey. It has 24 ship-to-shore Post-Panamax cranes; among them, eight are Super Post-Panamax cranes with an outreach of up to 225 feet and 16 are Post-Panamax cranes with an outreach of up to 200 feet. In addition, it has a total berthing length of 10,128 feet. The Maher Container Terminal is immediately adjacent to the ExpressRail Elizabeth (EMT), which has 18 working tracks totaling 43,000 linear feet.

APM Terminals

The APM Terminal is a 350-acre facility located at the Elizabeth Port Authority Marine Terminal in Elizabeth, New Jersey. It has 15 ship-to-shore Post-Panamax cranes; four Super Post-Panamax cranes with an outreach of 206 feet and 11 Post-Panamax cranes with an outreach of up to 140 feet. It has a berthing length of 6,001 feet. Like the Maher Terminal, APM terminal is also adjacent to the ExpressRail Elizabeth (EMT).

Global Container Terminal (GCT) New York

The Global Container Terminal (GCT) New York is a 187-acre facility located at the Howland Hook Marine Terminal, near the Goethals Bridge, in Staten Island, New York. It has 6 ship-to-shore Post-Panamax cranes, with an outreach of up to 135 feet. It has a berthing length of 3,012 feet. This terminal is uniquely equipped with an expanded on-dock rail transfer service, by ExpressRail Staten Island (ESI), which has 5 tracks totaling 6,000 linear feet.

Red Hook Container Terminal

The Red Hook Container Terminal is a 65.6-acre facility located in Brooklyn, New York. It has five cranes with an outreach of up to 150 feet, and the length of ship berth is 2,080 feet. The Red Hook Terminal connects to Express Rail Elizabeth via barge service.

Figure 2: Containerized Cargo Terminals (Source: Port Authority of New York and New Jersey)

2.4 Cargo Types and Commodities

The main constraint at the anchorage is the inability to accommodate containerships that are over a certain length. For this reason, the analysis will focus on containerized commodities and vessels. As of 2016, approximately 15 shipping lines were calling NYNJ Harbor. Detailed analysis of trade routes was not conducted since the change in transportation costs are attributed to a change within-harbor operations.

Based on the data for 2007 through 2016, container tonnage averaged approximately 36 million metric tons. Within container shipments, average imports accounted for 72 percent of total metric tonnage while exports accounted for 28 percent. Figure 3 shows the historical import and export volumes of metric tons moving in containers from 2007 to 2016.

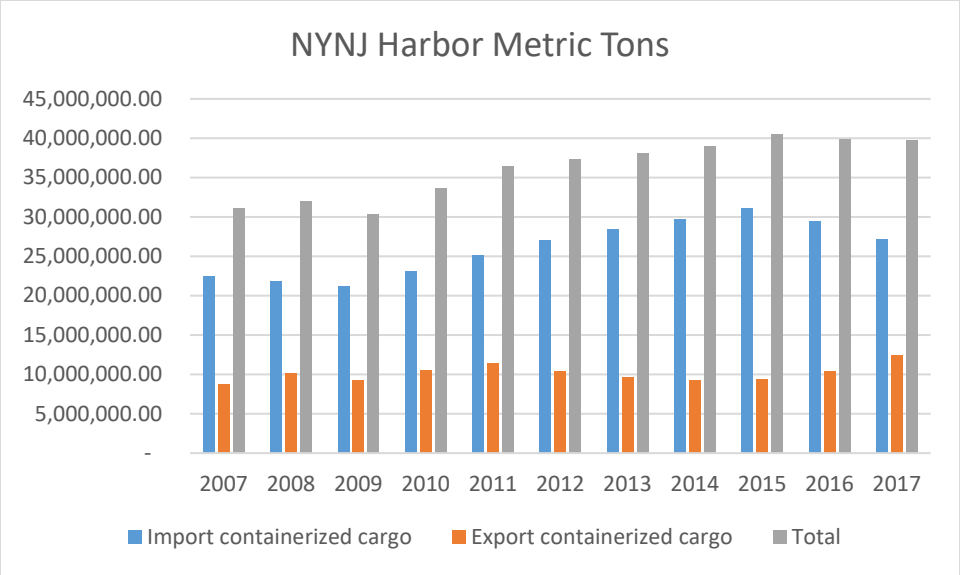


Figure 3: NYNJ Harbor Metric Tons

In 2017, NYNJ Harbor handled approximately 4.7 million loaded TEUs. Imports accounted for approximately 70 percent, and exports accounted for approximately 30 percent. Imports were higher overall than exports in terms of TEUs. Figure 4 shows the import and export TEUs from 2007 to 2017. In terms of percent of loaded containers verses empty for imports, 99 percent were loaded and 1 percent empty. With respect to exports, 44% were loaded and 56% were empty.

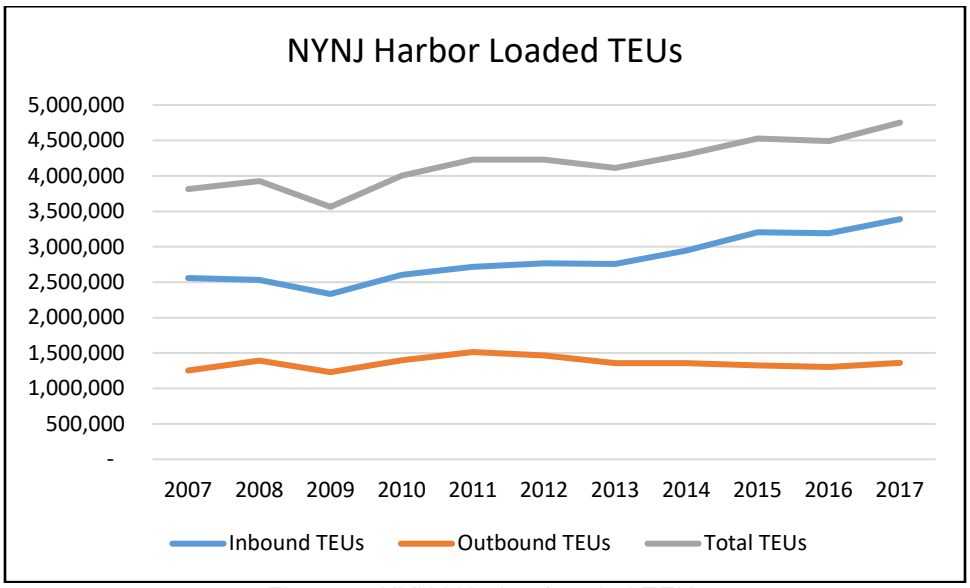


Figure 4: NYNJ Harbor Loaded TEUs

Data from 2012 to 2016 is presented in Figure 5 and Figure 6 to determine a five-year average for inbound and outbound metric tons to be used as a baseline for the forecast.

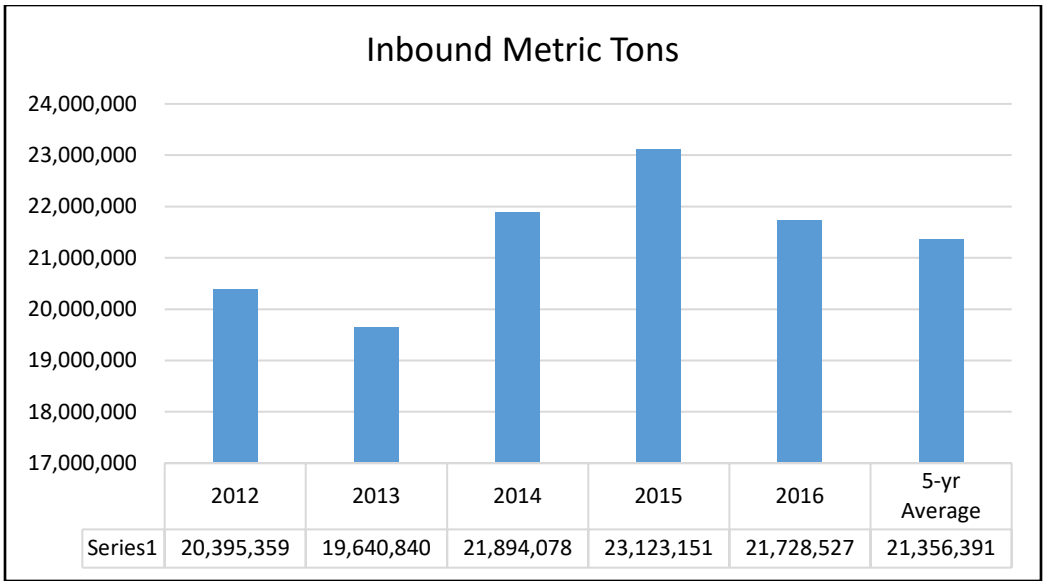


Figure 5: Inbound Metric Tons 2012-2016

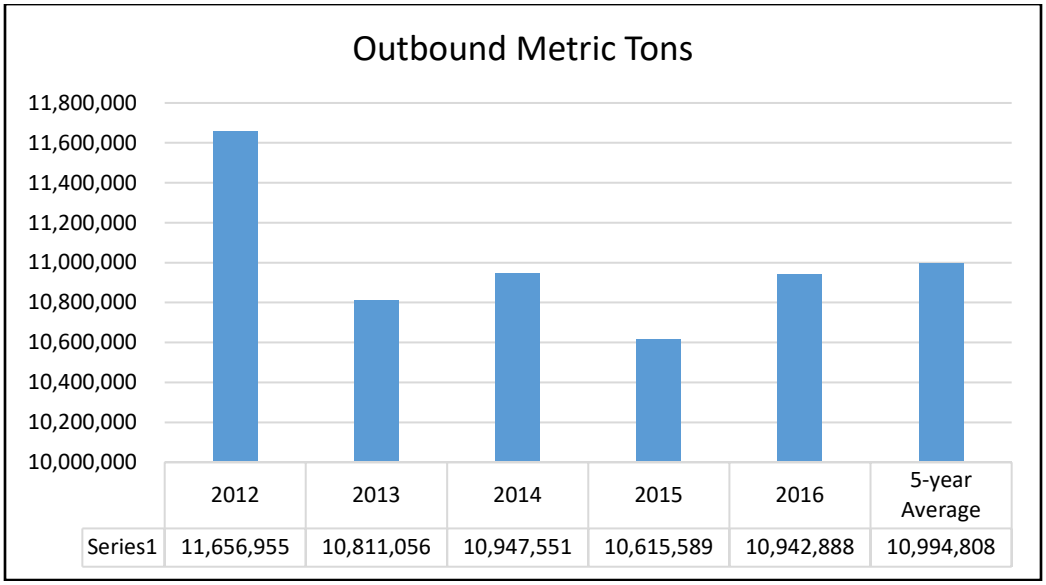


Figure 6: Outbound Metric Tons 2012-2016

2.5 Vessel Fleet Composition

Data was acquired from the Waterborne Commerce Statistics Center and NNOMPEAS to determine the containership characteristics of the fleet calling NYNJ Harbor. A variety of containership classes call NYNJ Harbor. For the purposes of detailed analysis, the containership classes were divided in relation to the vessel operating cost classes. Containership classes overlap in all facets of dimensions, such as length, beam, depth and TEU capacity. For the purposes of this analysis, beam width was the characteristic that separated the classes. Table 6 shows the characteristics of each containership class.

Table 6: Containership Classes

Class	DWT (metric tons)	LOA (feet)	Beam (feet)	Design Draft (feet)
Subpanamax (SPX)	6,500 – 40,000	390 - 730	65 - 102	20 - 40
Panamax (PX)	24,000 – 69,000	558 - 930	105 - 107	27 - 45
Post-Panamax Generation 1 (PPX1)	71,200 – 80,900	930 – 1,000	108 - 133	45 - 47
Post-Panamax Generation 2 (PPX2)	80,901 – 105,000	1,026 – 1,100	134 - 148	46 - 49
Post-Panamax Generation 3 (PPX3)	117,500 – 144,500	1,100 – 1,200	149 - 177	49 - 51
Post-Panamax Generation 4 (PPX4)	150,000 – 194,600	1,201 – 1,300	178 - 194	51 – 52.5

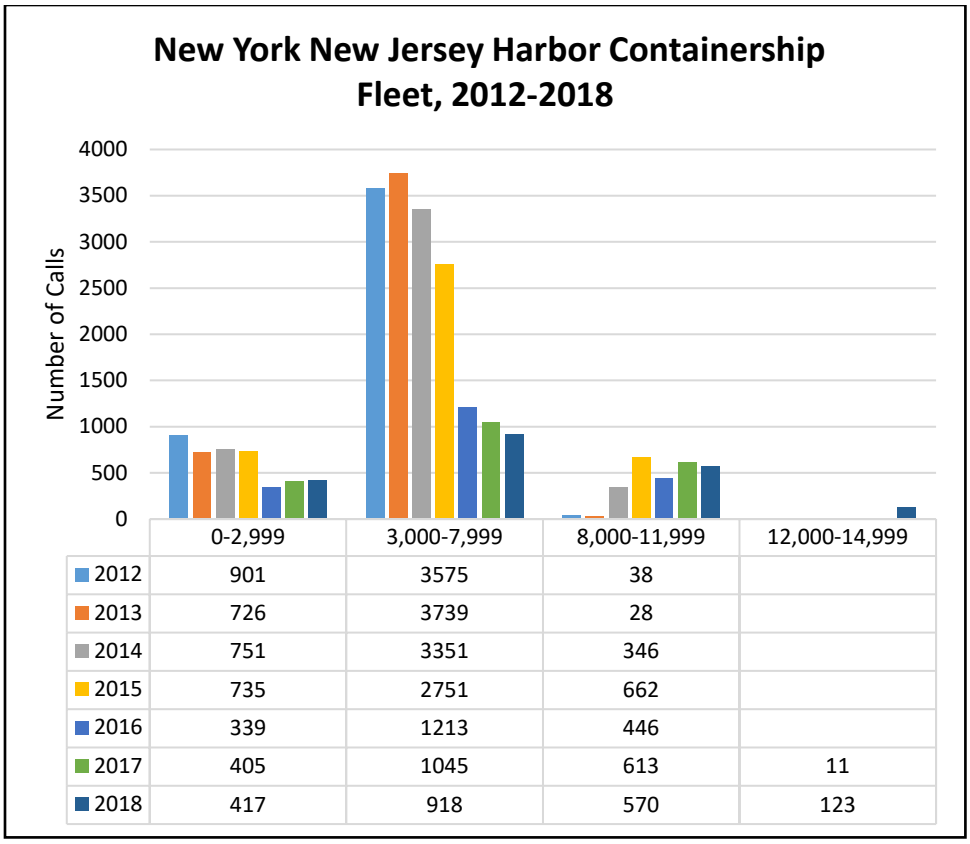
In June 2016, the Panama Canal Expansion was completed and a new set of locks with chambers of 1,400 feet long, 180 feet wide, and 60 feet deep, creating a third lane of traffic. The lock expansion provides the capacity to accommodate vessels up to 1,200 feet long, 161 feet wide and 50 feet deep. The Panama Canal's Expansion paves the way for larger ships to be deployed to the U.S. Gulf Coast and East Coast from Asia, Oceana, and West Coast of South America.

Another improvement was the raising of the Bayonne Bridge. The bridge is located over the Kill Van Kull segment of the channel (see Figure 9) and the air draft is now 215 feet above mean high water. It was raised to allow the passage of larger vessels through the Port of NYNJ. The Port Authority of New York and New Jersey shared containership data for 2017 and part of 2018 since the data captured changes in the fleet since the improvements to the Panama Canal and Bayonne Bridge. Table 7 shows the largest containership to call NYNJ Harbor based on port data.

Table 7: Largest Containership Calls

Call Year	Name	Length overall	Beam Width	Design Draft	TEUs
2018	CMA CGM G Washington	1,200'	158'	52.4	14,414
2018	Madrid Bridge	1,200'	167'	50.8	13,900

Figure 7 shows the historical fleet trends from 2012 through November of 2018 in terms of TEU capacity at NYNJ Harbor. The fleet in the 3,000 – 7,999 TEU capacity is trending downward, while the 8,000 to 15,000 TEU classes are trending upward.



	0-2,999	3,000-7,999	8,000-11,999	12,000-14,999
2012	901	3575	38	
2013	726	3739	28	
2014	751	3351	346	
2015	735	2751	662	
2016	339	1213	446	
2017	405	1045	613	11
2018	417	918	570	123

Figure 7: Historical Containership Fleet

2.6 Existing and Future Without-Project Condition Operations

Engineering Regulation 1105-2-100 states that the without-project condition is the more likely condition expected to exist in the future absent a proposed water resources project. The future without-project condition constitutes the benchmark against which plans are evaluated. Three Federal anchorages exist at NYNJ Harbor. Figure 8 is a map of the existing Federal anchorages considered for improvement. The anchorages are starting from the north Red Hook Flats, Stapleton and Gravesend Bay.

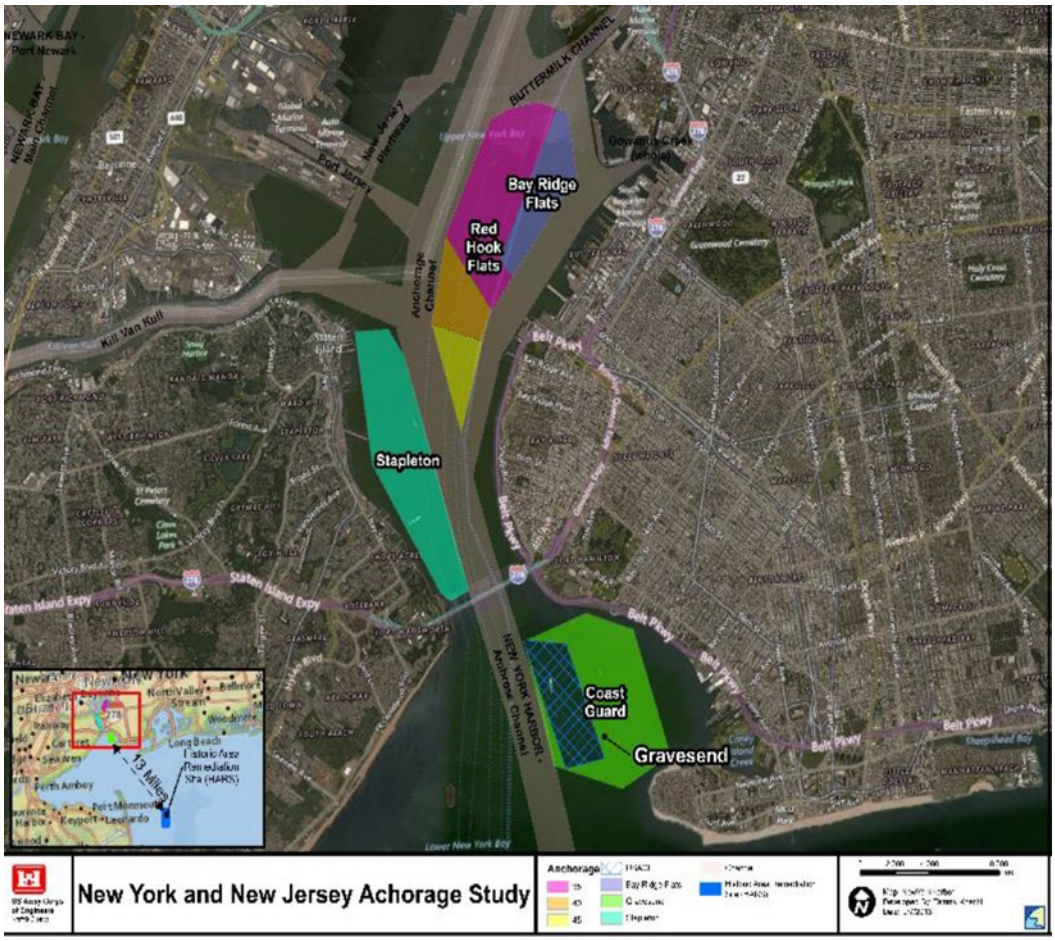


Figure 8: Federal Anchorages

2.6.1 Harbor Operations

The Sandy Hook Pilots Association along with the Coast Guard have safety guidelines that vessels should adhere to for safe operation in the channel. The guideline that is pertinent for this analysis is that vessels with lengths of 1,100 feet or greater cannot use the anchorages in the harbor.

Tidal changes cause a shift in the direction of water flow. During these tidal changes, containerships with a length overall greater than 850 feet using Gravesend Bay Anchorage will swing into the adjacent Ambrose Channel. Vessels with lengths 1,100 feet or greater pose too great of a risk for this operation and must return to the ocean if the vessel cannot continue to transit to the dock.

Reasons containerships need to anchor once inbound are closures at Bergen Point due to environmental reasons or delays caused by an outbound vessel transiting the one-way traffic Kill Van Kull. Vessel Traffic Services provided Bergen Point restrictions for calendar year 2017 which was a typical year for the harbor and closures. The environmental zone restrictions were enforced a total of 53 times in 2017 due to visibility restrictions and wind restrictions navigating Bergen Point due to the sharp angle of the turn. Detailed Bergen Point closures as follows:

- 17 times to all traffic with the exception of light tugs and vessels less than 300 gross tons

due to ½ nautical mile visibility restriction.

- 26 times to vessels 700 feet in length or greater due to 1 nautical mile visibility restriction.
- 3 times to ultra large containerships due to 30 knot wind restriction.
- 7 times to car carriers, cargo ships, container barges, tankers in ballast and astern tows due to 34 knot wind restriction.

For vessels greater than 1,100 feet long, there is no “bail out” spot for the vessel in the event of inclement weather conditions or a vessel outbound in the Kill Van Kull Reach. Figure 9 shows a map of the area.

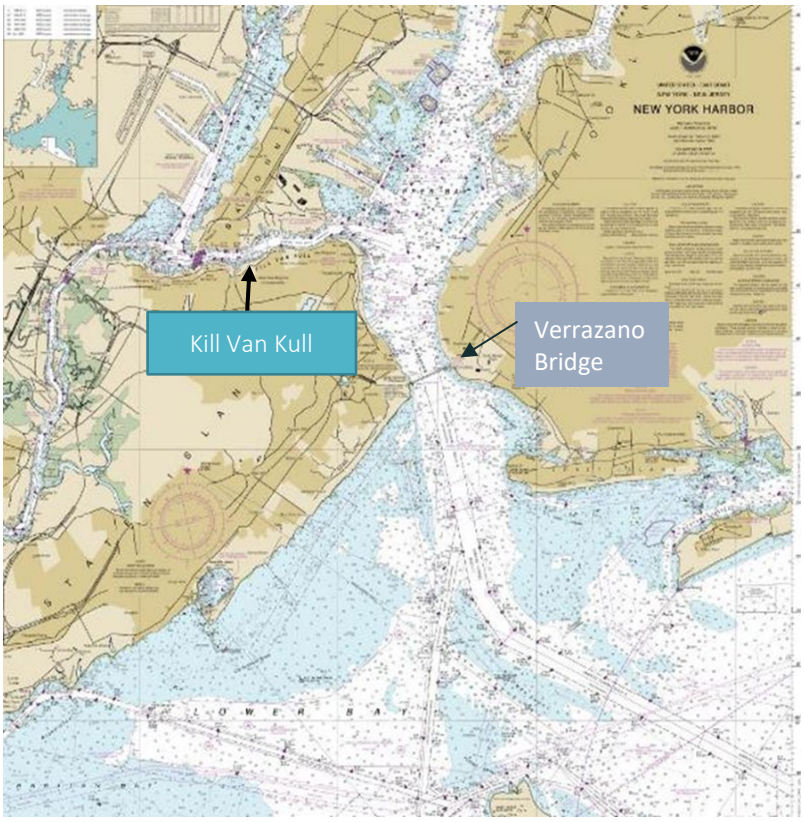


Figure 9: NYNJ Harbor Map

The port, coast guard or pilots do not keep track of how often vessels must return to the ocean due to aforementioned reasons. However, a pilot for the New Jersey Sandy Hook Pilots Association estimated that 24 containerships were impacted in 2017 which was considered a good representation of annual occurrence.

The Automatic Identification System Analysis Package (AISAP) developed by ERDC was used to validate the estimate. AISAP is a web-based tool for acquiring, analyzing and visualizing near-real-time and archival data from the U.S. Coast Guard. The tool can be used to search for any/all vessels in an area during a specific time. Based on AISAP containerships data, 21 vessels returned to the ocean after entering the harbor. It should be noted, vessels lose coverage at some times and all occurrences may not be accounted for in the AISAP data.

In the future without-project condition, Bergen Point closures are still expected to occur as well as outbound vessel delays creating the potential for vessels needing to return to the ocean.

2.6.2 Underkeel Clearance

The measure of underkeel clearance (UKC) for economic studies was applied according to the planning guidance. According to this guidance, UKC is evaluated based on actual vessel operator and pilot practices within a harbor and subject to present conditions, with adjustment as appropriate or practical for with-project conditions. The practices for UKC were determined through interviews with harbor pilots and analysis of actual past and present practices. For purposes of this analysis, the UKC used in the existing condition for the current channel depth was used with a modified anchorage. The UKC is designed to match the nominal channel depth of the upper harbor which is a minimum of two feet.

3. Future Conditions

3.1 Commodity Forecast

Estimates of NYNJ Harbor's future commerce for the period of analysis are linked to the port's hinterland and the extent to which it shares commodity flows with other ports. Trends in cargo history can offer insights into a port's long-term trade forecasts and thus the estimated cargo volume upon which future vessel calls are based. Under future without- and future with- project conditions, the same volume of cargo is assumed to move through NYNJ Harbor. However, anchorage improvements will allow vessels to transit the harbor more efficiently. This efficiency translates into cost savings and is the main driver of NED benefits. The port's share of the commodity projections remain the same as existing condition. Cargo projections ultimately drive vessel fleet projections in terms of the numbers and sizes of vessels for without- and with-project conditions.

The methodology to determine the forecast of import and export tonnage involved three steps. First, the baseline was established using an average of historical data. Second, the rates of change for each commodity were established. Third, the rates of change were applied to the baseline to determine the total import and export trade volumes for NYNJ Harbor.

3.1.1 Cargo Baseline

Empirical data and historical trends were established to serve as a baseline for the commodity forecast. To minimize the impact of potential variances in trade volumes on long-term forecast, five years of data were used to establish the baseline for the commodity forecast. Empirical data from 2012 to 2016, the latest years of data available at the time of commodity forecasting, were used to develop a baseline.

3.1.2 Growth Rates

The long-term trade forecast for NYNJ Harbor used data from IHS Global Insights, the Port Authority of New York and New Jersey, and U.S. Gross Domestic Product (GDP). The forecast was developed by applying the rates of change from these sources to the commodity baseline tonnage. This methodology is consistent with the approach used to perform long-term commodity forecasting for other USACE deep-draft navigation analyses.

In 2018, IHS Global Insight provided a U.S. national forecast for containerized tons and TEUs for imports and exports through the year 2025 to the Institute of Water Resources (IWR). The rates of change for the national forecast were compared to NYNJ Harbor's historical rates of change to determine if the national forecast could inform the NYNJ Harbor commodity forecast.

Global Insight's projections are based on the IHS World Trade Service (WTS) Model. The WTS real value trade model uses a three-level process.

Level I forecasts a country's imports of a commodity individually, without any exporter-level detail. The forecast at this stage is a bottom-up approach, which reflects heterogeneous behaviors of countries importing goods in each commodity group.

Level II forecasts a country's imports of a commodity from an exporting country under the assumption that the country's aggregated imports of the commodity from all the exporting countries is controlled by this country's imports of the commodity forecasted at Level I. The second stage forecast can be described as a top-down controlled approach and conforms to the WTS demand-driven approach to trade. The IHS World Industry Service (WIS) and IHS other sectoral forecasts are utilized at this level to address the competitiveness and supply capacity of an exporting country. The WIS provides both historical and forecasted industry data by Standard Industrial Classification category across 78 countries.

Level III forecasts and makes adjustments to individual commodity flows between importing and exporting countries given the most updated monthly and quarterly trade statistics collected from a variety of national and international sources, including the U.S. Census Bureau and Eurostat, to capture the most recent trade developments during the current year. At this stage, Global Insight also takes into account the most up-to-date high-frequency macro data. After the adjustments, the forecasting procedures produce final globally consistent commodity-level trade forecasts between 106 countries/regions for 201 commodity categories.

The graphs in Figure 10 and Figure 11 show how the historical national tonnage tracked with historical tonnage at NYNJ Harbor. With the exception of 2013 for exports, they tracked similarly. For this reason, it seemed reasonable to use the forecasted growth rates.

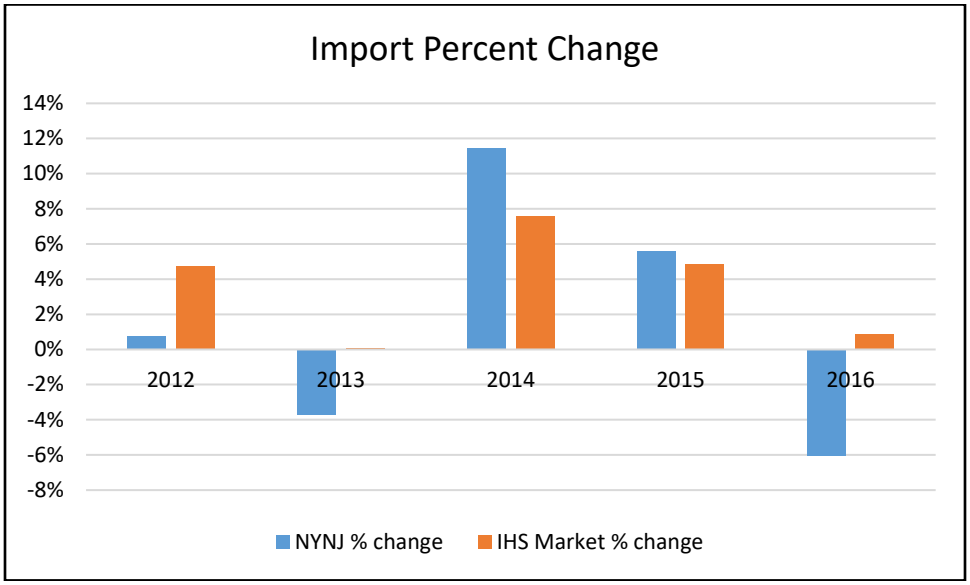


Figure 10: Containerized Imports Percent Change

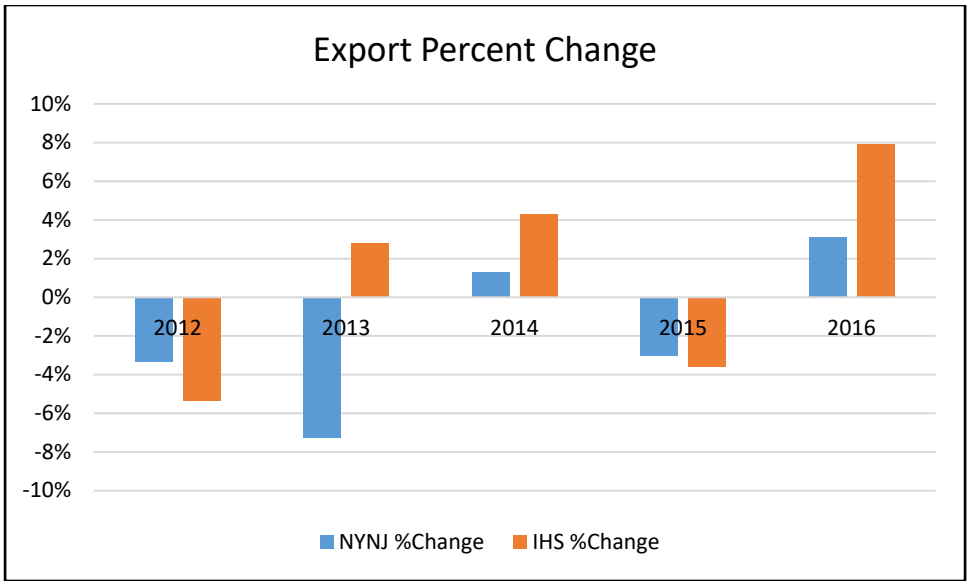


Figure 11: Containerized Export Percent Change

NYNJ Port Authority provided their growth rates for containerized imports and exports through 2030. The Port Authority developed a long-range port master plan that includes a market analysis to determine the market potential for maritime. To complete the market analysis, the maritime industry trends were analyzed, market area identified and a comparison of port facilities with other competing port facilities. Based on this assessment, projected regional growth in cargo was estimated. These growth rates were used for years 2026 through 2030. From 2030 to 2045, historical average annual U.S. GDP growth from 2010 to 2017 of 2 percent was used. The growth rate falls in line with the estimated GDP forecasted growth rate from the Federal Reserve. The forecast was held constant from 2045 through 2074. A summary of growth rates used for the analysis is provided in Table 8.

Table 8: Growth Rate Summary

IMPORT CONTAINER ANNUAL GROWTH RATES					
	2018-2025	**2025-2030**	**2030-2035**	**2035-2040**	**2040-2045**
New York New Jersey Harbor	5%	3%	2%	2%	2%

EXPORT CONTAINER ANNUAL GROWTH RATES					
	2018-2025	**2025-2030**	**2030-2035**	**2035-2040**	**2040-2045**
New York New Jersey Harbor	4%	3%	2%	2%	2%

3.1.3 Forecasts

Using the baseline estimated commerce volumes, the growth rates determined in the preceding section were applied to forecast total import and export tonnage for NYNJ Harbor over the period of analysis. For purposes of the analysis, forecasts are held constant after year 2045

through 2074. Table 9 shows the forecasted metric tons for the period of analysis.

Table 9: Container Trade Forecast

Container Trade Forecast (metric tons)				
	Baseline	**2025**	**2035**	**2045 - 2074**
Imports	21,356,400	30,564,700	40,021,400	48,785,900
Exports	10,994,800	15,055,400	19,457,000	23,718,000
Total	**32,351,200**	**45,620,100**	**59,478,400**	**72,503,900**

Inbound and outbound data for 2016 containership calls were analyzed to determine the weight per TEU. The metric tons imported or exported were divided by the number of TEUs imported or exported to determine an average weight per TEU for import and export. Results are shown in Table 10. The assumed two-ton tare weight for all boxes was not included in this total.

Table 10: TEU Weights

Route Group	TEU Weight Import	TEU Weight Export
All	8.6	8.5

3.2 Vessel Fleet Forecast

In addition to the commodity forecast, a forecast of the future fleet is required when evaluating navigation projects.

3.2.2 Design Vessel

Generally, waterway improvements should be designed for optimization across the entire forecasted fleet. On a world fleet basis, containership designs continue to change with respect to size and cargo carrying capacity and have not reached a limiting threshold.

The design vessels are defined per USACE guidance from EM 1110-2-1613 stating: "…*the design ship or ships are selected on the basis of economic studies of the types and sizes of the ship fleet expected to use the proposed navigation channel over the project life*…" The design ship is defined by EM 1110-2-1613 as "…*the largest ship of the major commodity movers expected to use the project improvements on a frequent and continuing basis*…"

According to the port data, Table 11 shows the largest containerships to call NYNJ Harbor as of 2018. In analyzing the historical fleet trends, two observations were made. First, an 8,000 – 11,999 TEU class first appeared during the year 2010. Second, the 12,000 – 14,999 TEU class started to call NYNJ during the year 2017.

Table 11: Largest Vessels to Call NYNJ

Call Year	Name	LOA	Beam	Design Draft	TEUs
2018	CMA CGM G Washington	1,200'	158'	52.4'	14,414
2018	Madrid Bridge	1,200'	167'	50.8'	13,900

Table 12 displays the design vessel's characteristics. The design draft of a vessel is the

maximum draft a vessel a vessel could potentially reach fully loaded.

Table 12: Design Vessel Characteristics

	LOA	Beam	Design Draft
Design Vessel	1,200 feet	158 feet	50.5 feet

3.2.3 World Fleet

To develop projections of the future fleet calling NYNJ Harbor, the study used world fleet data for containerships. The Institute of Water Resources provided general estimates for world fleet containerships based on Clarkson data and Lloyd's Registry-Fairplay through 2025. Sea-web data was also used as a source for world containership estimates.

3.2.4 Container Fleet Forecast

Using the empirical data for NYNJ Harbor and data sources in Section 3.2.3, the forecast was adapted for NYNJ Harbor to determine the expected fleet composition over the period of analysis. The forecast introduces a post-Panamax Generation 4 containership vessel based on the historical transition of the fleet; however, it was not chosen as the design vessel for this anchorage study. It was decided during project formulation, the PPX3 vessel would be the largest vessel to use the anchorage due to project cost. Table 13 shows the percent calling capacity by vessel size from 2025 to 2045. One trend worth noting is that the percentages of total capacity allocated to Sub-Panamax and Panamax container ships both decline in almost all forecasted years. However, neither drop to zero, suggesting that there are some services for which the use of smaller vessels may be preferable even when larger vessel options exist. PPX3 and PPX4 vessels see growth throughout the forecasted period.

Table 13: NYNJ Forecasted Calling Capacity

	Sub Panamax	PX/PPX1	PPX2	PPX3	PPX4
2025	2%	30%	42%	19%	8%
2035	2%	19%	38%	31%	11%
2045	2%	10%	31%	41%	16%

For containerships, cargo is often loaded and unloaded simultaneously before calling at a string of other ports. As previously mentioned, the weight of cargo can vary greatly by trade route, whereas vessel operators can also carry large number of empty containers or sail with vacant slots.

This study assumes the anchorage depth will be the authorized channel depth. Therefore, detailed loading analysis was not needed because the depth of the vessel is not a factor in determining if a vessel can use the anchorage. Inbound containership calls were analyzed from the National Navigation Operation & Management Performance Evaluation and Assessment System (NNOMPEAS) to determine the average metric tons per call and weight in tons per TEU by vessel class. The number of calls were estimated by dividing the average metric tons by the tonnage allotment per class based on calling capacity. Average metric tons from the PPX3 class was used for the PPX4 vessel class since it is projected to call in the future. Table 14 shows the fleet forecast in terms of vessel size.

Table 14: Fleet Forecast

	SubPX	Panamax/PPX1	PPX2	PPX3	PPX4
2025	177	858	704	302	121
2035	201	711	834	645	220
2045-2074	232	456	829	1,040	406

3.3 Alternatives for Economic Evaluation

Alternative plans were developed to address the inefficiencies of the anchorages. The alternatives were anchorage modifications at Gravesend Bay, Red Hook Flats or Stapleton Anchorage. It was determined that the benefits associated with each anchorage location are relatively similar due to minimal nautical mile differences between anchorage locations and project implementation cost would be the driver to determine the location of improvements and justification of a project. The pilots stated if a vessel needed to turn around to return to the ocean, the turn must occur south of the Verrazano Bridge (see Figure 9). Therefore, no matter which anchorage was improved, the time returning to the ocean then transiting to the dock was about the same. Therefore, the savings in transportation cost would be relatively the same.

In the with-project condition, Bergen Point closures and one-way restrictions would remain. However, with an anchorage modification, vessels with lengths up to 1,200 feet would have a place to anchor and not need to turn in the channel to return to the ocean.

4. Transportation Cost Savings Benefits Analysis

The purpose of this analysis is to describe the benefits associated with anchorage improvements at NYNJ Harbor. NED benefits were estimated by calculating the reduction in transportation cost using the HarborSym Modeling Suite of Tools (HMST) developed by IWR. The HMST reflects USACE guidance on transportation cost savings analysis.

4.1 Methodology

Anchorage improvement modifications result in reduced transportation cost by allowing the larger containerships in the fleet to use the anchorage as opposed to returning to the ocean once inbound. With a larger anchorage, vessels with lengths up to 1,200 feet can anchor if needed, thereby reducing the need to transit back to the sea buoy for unforeseen weather or congestion reasons. In the future, carriers are anticipated to replace smaller, less efficient vessels with larger more efficient vessels on NYNJ routes as demonstrated in Table 14. Under such presumption, the likelihood of needing to anchor these larger vessels increases. The increase in anchorage capacity can result in fewer vessels returning to the ocean in the event they need to anchor.

A vessel returning to the ocean to anchor increases congestion in the harbor. With anchorage improvements, a vessel could anchor adjacent to the channel instead of returning to the ocean just to “re-transit” the channel once restrictions are gone.

4.1.1 HarborSym Model

The Institute of Water Resources (IWR) developed HarborSym as a planning level, general-purpose model to analyze the transportation costs of various waterway modifications within a harbor. HarborSym is a Monte Carlo simulation model of vessel movements at a port for use in economic analyses. While many harbor simulation models focus on landside operations, such

as detailed terminal management, HarborSym instead concentrates on specific vessel movements and transit rules on the waterway, fleet and loading changes, as well as incorporating calculations for both within harbor costs and costs associated with the ocean voyage.

HarborSym represents a port as a tree-structured network of reaches, docks, anchorages, and turning areas. Vessel movements are simulated along the reaches, moving from the bar to one or more docks, and then exiting the port. Features of the model include intra-harbor vessel movements, tidal influence, the ability to model complex shipments, incorporation of turning areas and anchorages, and within-simulation visualization. The driving parameter for the HarborSym model is a vessel call at the port. A HarborSym analysis revolves around the factors that characterize or affect a vessel movement within the harbor.

HarborSym version 1.5.8.3 was used for harbor simulations to determine transportation cost in the without- and with-project conditions. In the year 2017, it was estimated 24 vessels returned to the ocean to anchor. These vessels had started inbound, but needed to anchor to wait for weather conditions to improve at Bergen Point or an outbound vessel using Kill Van Kull reach. Given the 2017 fleet mix, the 24 vessels was 13 percent of fleet that is 1,100 in length or greater. To capture the time of a vessel returning to the ocean and then re-entering the harbor to transit to the dock, a synthetic dock was used. Figure 14 is the existing condition NYNJ HarborSym graphic. The green dock titled “topologic – 14” is the synthetic dock used to capture the additional within-harbor time and cost. The Sandy Hook Harbor pilot stated the transit time from the sea buoy to Gravesend Bay Anchorage was approximately 1.5 hours. The model was calibrated to account for a three hour difference in the without- and with-project condition, the amount of time it would take to return to the sea buoy and then re-enter and transit to Gravesend Bay anchorage.

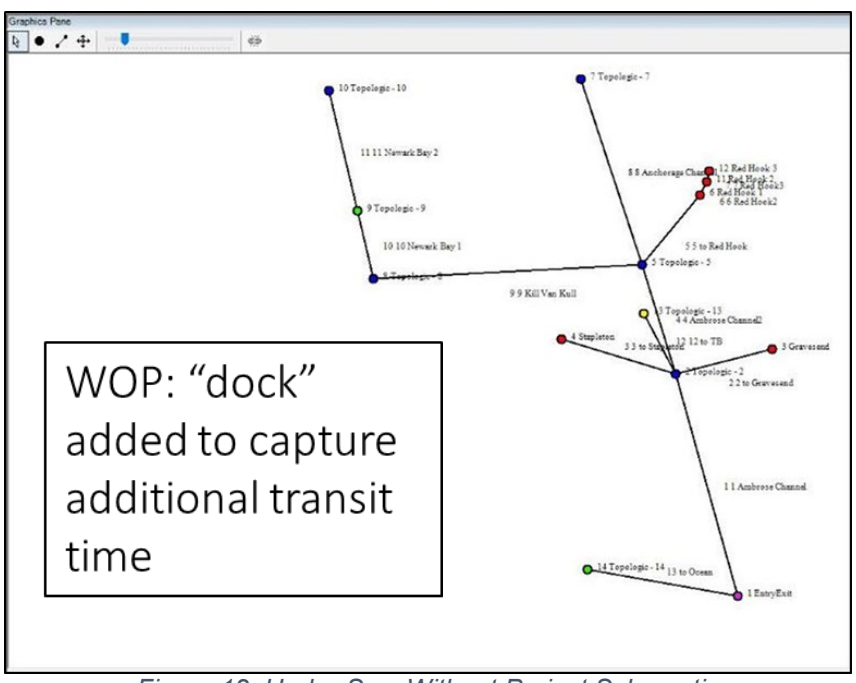


Figure 12: HarborSym Without Project Schematic

Figure 15 shows the with-project condition in which a containership can transit straight to the destination dock.

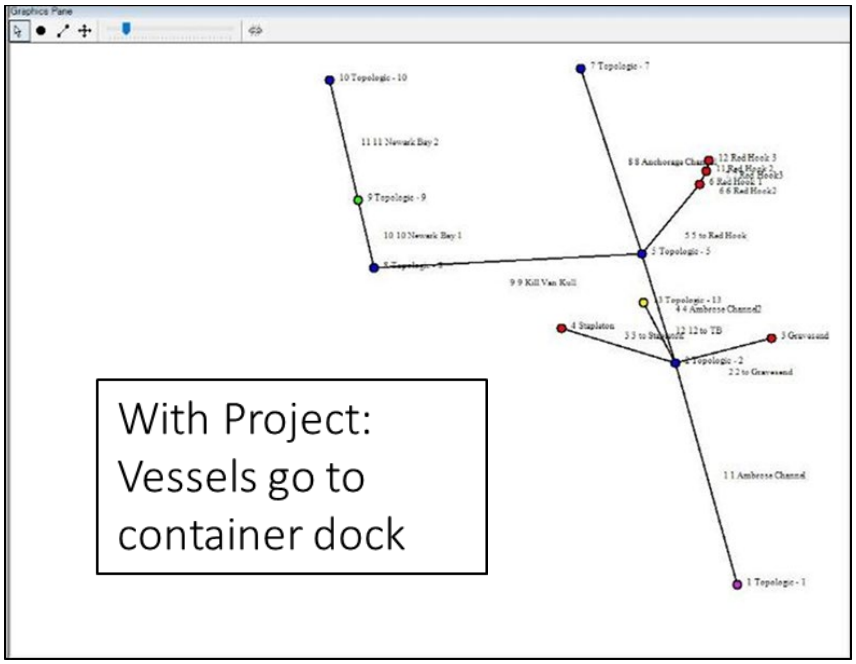


Figure 13: HarborSym With-Project Schematic

4.1.2 Containerized Vessel Calls

The containerized commodity forecast for NYNJ Harbor was allocated to the future fleet using the method previously described. The 13 percent of the fleet impacted assumption in the without-project condition was used in the future without project call list as well for vessels with lengths 1,100 feet or greater. Empirical data for NYNJ Harbor show some vessels in the PPX2 class are 1,100 feet in length, therefore the impacted calls were divided between PPX2 and PPX3. Calls impacted by class are shown in Table 15.

Table 15: FWOP Condition Vessel Calls Assumed Impacted

FWOP Condition Vessel Calls Impacted				
Year	Total Calls	PPX2 Calls Impacted	PPX3 Calls Impacted	Total Impacted Calls
2025	2,162	23	39	62
2035	2,612	27	84	111
2045	2,970	27	135	162

4.2 Transportation Cost Savings

The objective of USACE deep draft navigation projects is to lower transportation costs. Future cost of commodity movements, given the projected vessel fleet composition for each commodity and the vessel operating costs, are estimated using price levels at a common point in time. The goal is to improve the efficiency by allowing the anchorage to appropriately accommodate larger vessels, ultimately minimizing unnecessary transits back out to the ocean and re-entering.

Transportation cost benefits were estimated using the HarborSym Economic Reporter, a tool that summarizes and annualizes HarborSym results from multiple simulations. This tool collects the transportation costs from various model run output files and generates the transportation cost reduction for all project years, and then produces an Average Annual Equivalent (AAEQ).

Using HarborSym, transportation costs were estimated for the years 2025, 2035 and 2045; and they were held constant beyond 2045. The present value was estimated by interpolating between the modeled years and discounting at the FY 2019 Federal Discount rate of 2.875 percent for the 50-year period of analysis, 2025 through 2074. Estimates from the economic reporter were compared with the HarborSym output files to determine accuracy and consistency.

The analysis included summaries of total transportation costs, transportation cost savings and AAEQ transportation cost savings. The overall reduction in time associated with additional transiting cost was the driving force behind the within-harbor benefits.

Table 16 provides the annual transportation costs for at-sea and within-harbor. There were no changes for the at-sea cost because the focus of this study was to calculate the cost changes within-harbor. The transportation cost savings and AAEQ cost savings benefits are provided in Table 17 and Table 18. The years in-between 2025, 2035 and 2045 were modeled via interpolation of the transportation cost associated with these years. Transportation cost were held constant from 2045 to 2074.

Table 16: Transportation Cost

Year	Without Project	With Project Condition
2025	**$30,520,000**	**$29,990,000**
2035	**$41,663,000**	**$40,671,000**
2045	**$52,989,000**	**$51,552,000**

Table 17: With-Project Transportation Cost Savings

Year	Transportation Cost Savings
2025	**$530,000**
2035	**$992,000**
2045	**$1,437,000**

Table 18: AAEQ Transportation Cost by Alternative

Alternative	AAEQ Transportation Cost
Without Project	$45,624,000
With Project Condition	$44,481,000

Benefits for the PPX2 containerships were approximately 16 percent of total benefits and benefits for PPX3 containerships were approximately 84 percent of total benefits. Table 19 shows the AAEQ transportation cost statistics for anchorage improvements.

Table 19: AAEQ Transportation Cost Reduction Benefits

Alternative	AAEQ Transportation Cost Reduction Benefit
With Project Condition	$1,143,000

4.3 Project Costs

In the evaluation and comparison of project depth alternatives, which is necessary to arrive at the selected plan, NED costs play a critical role. NED costs include both the financial and economic costs associated with a project throughout its lifecycle. Each of these types of costs and their sources are discussed in this section of the report. Additionally, the NED costs for the depth and width alternatives being considered in this analysis will be identified.
Financial costs of the proposed project consist of the construction and mitigation costs accrued during construction of the project and over its lifecycle. More specifically these costs can include:

- Land Construction Costs
- Dredging Costs
- Planning, Engineering, and Design Costs (PE&D)
- Supervision and Administration Costs (S&A)
- Contingency Costs
- Supervision, Inspection, and Overhead Costs (SIOH)
- Mitigation Costs

The sum of these costs is used to determine Interest During Construction (IDC), which represents the economic cost of building a project. The next section defines IDC and provides an explanation as to how it is calculated and included in the analysis. Together, these costs represent the estimated first cost of construction. New York District Cost Engineering prepared the cost estimates for the proposed anchorage modifications for use in the economic analysis.

Another economic cost not included above is the annual cost accrued over the life of a project due to Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) activities that represent an increase over the current OMRR&R costs to maintain the channel. OMRR&R was excluded from the list of financial costs above because it is not included in the calculation of IDC. IDC takes into account only those costs incurred during construction.

IDC represents an economic cost of building a project that is considered in the selection of the recommended plan, but does not factor in as a paid cost. IDC is the cost of the foregone opportunity to invest the money required to construct a project for another use. The hypothetical return on another investment, measured as IDC, is counted as an NED cost. As an economic, rather than a financial cost, IDC is not considered in the determination of cost-sharing responsibilities.

IDC reflects that project construction costs are not incurred in one lump sum, but as a flow over the construction period. This analysis assumes that construction expenditures are incurred at a constant rate over the period of construction, an assumption which is supported by the *NED Manual for Deep Draft Navigation*.

Due to natural scouring, Engineering has stated there is not an increase in operation and maintenance (O&M) costs in the with-project condition. Therefore, future without-project and future with-project O&M cost are the same.

Table 20 contains the project costs associated with anchorage improvements at Gravesend Bay evaluated in this analysis. The costs were annualized at the FY19 discount rate of 2.875 percent over 50 years.

Table 20: Project Alternative Cost

Alternative	Project First Cost	Construction Duration (months)	IDC	AAEQ Project Cost	Annual O&M	Total AAEQ Cost
Alternative 1	23,250,000	2	55,000	$ 884,000	$0	$ 884,000
Alternative 2	27,256,000	2	64,500	$ 1,037,000	$0	$ 1,037,000
Alternative 3	30,557,000	2	72,300	$ 1,162,000	$0	$ 1,162,000
Alternative 4	34,085,000	3	121,000	$ 1,298,000	$0	$ 1,298,000

4.4 Benefit Cost Analysis

Net NED benefits are NED benefits reduced by NED costs. NED costs are essentially the costs to the Nation for a specific project implementation. The comparison of NED benefits and costs is generally expressed as a ratio of benefits to costs. Economic justification requires that benefits exceed costs and therefore the benefit/cost ratio must exceed 1.0. The most efficient use of resources is when benefits exceed costs by the maximum amount. Therefore, maximum net NED benefits were used as the primary determinant of the most efficient plan.

Table 21: Benefit Cost Analysis

	Alt 1	Alt 2	Alt 3	Alt 4
Total AAEQ Benefits	$1,205,000	$1,205,000	$1,205,000	$1,205,000
Total AAEQ Costs	$884,000	$ 1,037,000	$ 1,162,000	$ 1,298,000
Net Benefits	$321,000	$168,000	$43,000	-$93,000

5. Tentatively Selected Plan

The Gravesend Bay Anchorage Alternative 1 has the highest net benefits and is economically justified. Therefore the Tentatively Selected Plan (TSP) includes deepening the Gravesend Bay Anchorage to match the authorized channel depth of 50 feet mean lower low water. Table 22 displays the TSP benefits, costs, net benefits and benefit-to-cost ratio (BCR).

Table 22: TSP Benefit Cost Analysis

TSP Benefit Cost Analysis	
AAEQ Benefits	$1,205,000
Total First Cost	$23,250,000
Interest During Construction	$55,000

Economic Investment Cost	$23,305,000
Average Annual Cost	$884,000
Annual O&M	$0
Total Average Annual Cost	$884,000
Net Benefits	$321,000
Benefit-to-Cost Ratio	1.36

6. Recommended Plan

After the TSP was identified, further refinement of the cost and benefits were completed. Cost refinements included optimal positioning of the anchorage expansion at Gravesend and fine-turning the design. The benefits were calculated using the FY20 discount rate. Table 23 shows the updated benefits and cost at FY20 price levels and discount rate.

Table 23: Recommended Plan Cost Benefit Analysis – FY20

TSP Benefit Cost Analysis	
AAEQ Benefits	$1,148,000
Total First Cost	$25,250,000
Interest During Construction	$86,000
Economic Investment Cost	$25,336,000
Average Annual Cost	$938,000
Annual O&M	$0
Total Average Annual Cost	$938,000
Net Benefits	$210,000
Benefit-to-Cost Ratio	1.22

6. Sensitivity Analysis

Risk and uncertainty techniques are required to be used in deep draft navigation studies in the form of sensitivity analysis. Three variables were changed to capture the uncertainty in the analysis. The anchorage modification remains justified with each scenario using the FY20 discount rate.

The three areas of uncertainty addressed in this analysis are:

1. Commodity growth
2. Anchorage use
3. Baseline data

6.1 Commodity Projections of 3 percent growth

To account for uncertainty in the commodity forecast, projections are three percent instead of an average of 5 percent as in the analysis shown in Section 3. A summary of growth rates used for the sensitivity analysis is shown in Table 24.

Table 24: Container Annual Growth Rates

IMPORT CONTAINER ANNUAL GROWTH RATES					
	2018-2025	2025-2030	2030-2035	2035-2040	2040-2045
New York New Jersey Harbor	3%	3%	2%	2%	2%

EXPORT CONTAINER ANNUAL GROWTH RATES					
	2018-2025	2025-2030	2030-2035	2035-2040	2040-2045
New York New Jersey Harbor	3%	3%	2%	2%	2%

Using the baseline estimated commerce volumes, the growth rates in the preceding section were applied to forecast total import and export tonnage for NYNJ Harbor over the period of analysis. For purposes of the analysis, forecast are held constant after year 2045 through 2074. Table 25 shows the forecasted metric tons for the period of analysis using the 3 percent growth rate until year 2025.

Table 25: Sensitivity 1 Container Trade Forecast

Container Trade Forecast (metric tons)				
	Baseline	**2025**	**2035**	**2045 - 2074**
Imports	21,356,400	27,054,000	35,236,000	42,952,000
Exports	10,994,800	13,928,000	18,000,000	21,942,000
Total	**32,351,200**	**40,982,000**	**53,236,000**	**64,894,000**

TEU weights in Table 10 were used in the sensitivity analysis to determine the number of vessel calls and the subsequent number of call impacted. The 13 percent of the fleet impacted was used for this sensitivity as well. Table 26 shows the number of call impacted for sensitivity 1.

Table 26: FWOP Condition Vessel Calls Impacted - Sensitivity 1

FWOP Condition Vessel Calls Impacted				
Year	Total Calls	PPX2 Calls Impacted	PPX3 Calls Impacted	Total Impacted Calls
2025	1,913	20	35	55
2035	2,299	24	74	98
2045	2,609	24	119	143

Table 27 provides the annual transportation costs for at-sea and within-harbor. There were no changes for the at-sea cost because the focus of this study was to calculate the cost changes within-harbor. The transportation cost savings and AAEQ cost savings benefits are provided in Table 28 and Table 29. The years in-between 2025, 2035 and 2045 were modeled via interpolation of the transportation cost associated with these years. Transportation cost were held constant from 2045 to 2074.

Table 27: Transportation Cost

Year	Without Project	With Project Condition
2025	**$27,075,000**	**$26,613,000**
2035	**$36,520,000**	**$35,675,000**
2045 - 2074	**$46,826,000**	**$45,555,000**

Table 28: Transportation Cost Savings

Year	Transportation Cost Savings
2025	**$462,000**
2035	**$845,000**
2045	**$1,271,000**

Table 29: AAEQ Transportation Cost Savings

Alternative	AAEQ Transportation Cost
Without Project	$40,254,000
With Project Condition	$39,254,000

Table 30: AAEQ Transportation Cost Reduction Benefits

Alternative	AAEQ Transportation Cost Reduction Benefit
With Project Condition	$1,005,000

Table 31: Sensitivity Scenario 1 Cost and Benefit Analysis

TSP Benefit Cost Analysis	FY20
AAEQ Benefits	$1,005,000

TSP Benefit Cost Analysis	FY20
Average Annual Cost	$938,000
Annual O&M	$0
Total Average Annual Cost	$938,000
Net Benefits	$28,900
Benefit-to-Cost Ratio	1.03

6.2 Frequency of Vessels Impacted Reduced to 10 percent

The second sensitivity scenario, the vessels impacted in the forecasted years use 10 percent of the vessels forecasted to call for post-Panamax Generation 2 and Generation 3 containerships. Table 32 shows the total number of impacted calls for the reduction to 10 percent reduction of impacted calls.

Table 32: FWOP Condition Vessel Calls Impacted - Sensitivity 2

FWOP Condition Vessel Calls Impacted				
Year	Total Calls	PPX2 Calls Impacted	PPX3 Calls Impacted	Total Impacted Calls
2025	2,162	18	30	48
2035	2,611	21	65	86
2045	2,969	21	104	125

Table 33 provides the annual transportation costs for at-sea and within-harbor. There were no changes for the at-sea cost because the focus of this study was to calculate the cost changes within-harbor. The transportation cost savings and AAEQ cost savings benefits are provided in Table 34 and Table 35. The years in-between 2025, 2035 and 2045 were estimated via interpolation of the transportation cost associated with these years. Transportation cost were held constant from 2045 to 2074.

Table 33: Transportation Cost

Year	Without Project	With Project Condition
2025	**$30,502,000**	**$29,990,000**
2035	**$41,509,000**	**$40,671,000**
2045 - 2074	**$52,912,000**	**$51,552,000**

Table 34: Transportation Cost Savings

Year	Transportation Cost Savings
2025	**$512,000**
2035	**$838,000**
2045	**$1,360,000**

Table 35: AAEQ Transportation Cost Savings

Alternative	AAEQ Transportation Cost
Without Project	$45,537,000
With Project Condition	$44,481,000

Table 36: AAEQ Transportation Cost Reduction Benefits

Alternative	AAEQ Transportation Cost Reduction Benefit
With Project Condition	$1,056,000

Table 37: Sensitivity Scenario 2 Cost and Benefit Analysis

TSP Benefit Cost Analysis	**FY20**
AAEQ Benefits	$1,061,000
Average Annual Cost	$938,000
Annual O&M	$0
Total Average Annual Cost	$938,100
Net Benefits	$123,000
Benefit-to-Cost Ratio	1.13

6.3 New York and New Jersey Source of Tonnage

The initial analysis was completed using data from NNOMPEAS and Waterborne Commerce. The data contained in these sources are typically lower than actual port data. For that reason, the third sensitivity uses the Port data to determine the benefits of the anchorage improvement. Table 38 shows the historical metric tonnage according to the Port Authority records for imports and exports. Table 39 shows the five year average of the tonnage that is used as a baseline the tonnage forecast for imports and exports.

Table 38: Port Authority NYNJ Source Data

	2012	**2013**	**2014**	**2015**	**2016**
Imports	27,053,700	28,406,200	29,758,600	31,111,100	29,491,900

Exports	10,309,600	9,639,800	9,224,400	9,439,400	10,449,100
Total	37,363,300	38,046,000	38,983,000	40,550,500	39,941,000

Table 39: Forecasted Tonnage

	Baseline/2017	2025	2035	2045 2074
Imports	29,164,300	41,470,800	54,013,500	65,842,100
Exports	9,812,500	13,556,900	17,520,400	21,357,200
Total	38,976,800	55,027,700	71,533,900	87,199,300

Since the Port Authority data was used to estimate the initial future fleet distribution, the fleet forecast remained the same. The same factors were used as the original analysis to estimate the number of import calls for the sensitivity scenario. Table 40 shows the number of forecasted calls using the volume of tonnage in Table 39 and the number of impacted vessels by class in the future without project condition.

Table 40: FWOP Calls and Impacted Vessels

FWOP Condition Vessel Calls Impacted Sensitivity Scenario 3				
Year	Total Calls	PPX2 Calls Impacted	PPX3 Calls Impacted	Total Impacted Calls
2025	2,933	31	53	84
2035	3,525	37	113	150
2045	4,000	36	183	219

Table 41 provides the annual transportation costs for at-sea and within-harbor. There were no changes for the at-sea cost because the focus of this study was to calculate the cost changes within-harbor. The transportation cost savings and AAEQ cost savings benefits are provided in Table 42 and Table 43. The years in-between 2025, 2035 and 2045 were estimated via interpolation of the transportation cost associated with these years. Transportation cost were held constant from 2045 to 2074.

Table 41: Transportation Cost

Year	Without Project	With Project Condition
2025	**$42,823,000**	**$42,073,000**
2035	**$57,440,000**	**$56,109,000**
2045 - 2074	**$71,282,000**	**$69,287,000**

Table 42: Transportation Cost Savings

Year	Transportation Cost Savings
2025	**$750,000**
2035	**$1,331,000**
2045	**$1,995,000**

Table 43: AAEQ Transportation Cost Savings

Alternative	AAEQ Transportation Cost
Without Project	$62,095,000
With Project Condition	$60,518,000

Table 44: AAEQ Transportation Cost Reduction Benefits

Alternative	AAEQ Transportation Cost Reduction Benefit
With Project Condition	$1,583,000

Table 45: Sensitivity Scenario 3 Cost and Benefit Analysis

TSP Benefit Cost Analysis	**FY20**
AAEQ Benefits	$1,583,000
Average Annual Cost	$938,000
Annual O&M	$0
Total Average Annual Cost	$938,000
Net Benefits	$645,000
Benefit-to-Cost Ratio	1.69

7. Regional Economic Development

The U.S. Army Corps of Engineers (USACE) Institute for Water Resources, Louis Berger, and Michigan State University have developed a regional economic impact modeling tool, RECONS (Regional ECONomic System), that provides estimates of jobs and other economic measures such as labor income, value added, and sales that are supported by USACE programs, projects, and activities. This modeling tool automates calculations and generates estimates of jobs, labor income, value added, and sales through the use of IMPLAN®'s multipliers and ratios, customized impact areas for USACE project locations, and customized spending profiles for USACE projects, business lines, and work activities. RECONS allows the USACE to evaluate the regional economic impact and contribution associated with USACE expenditures, activities, and infrastructure.

Table 46: Project Information

Project Name	NEW YORK HARBOR
Project ID	12490
Type of Analysis	Civil Works Budget Data and Work Activities

Table 47: Economic Impact Area

Local Impact Area	Bergen (NJ), Essex (NJ), Hudson (NJ), Hunterdon (NJ), Middlesex (NJ), Monmouth (NJ), Morris (NJ), Ocean (NJ), Passaic (NJ), Somerset (NJ), Sussex (NJ), Union (NJ), Bronx (NY), Dutchess (NY), Kings (NY), Nassau (NY), New York (NY), Orange (NY), Putnam (NY), Queens (NY), Richmond (NY), Rockland (NY), Suffolk (NY), Westchester (NY), Pike (PA)
Counties included	Bergen (NJ), Essex (NJ), Hudson (NJ), Hunterdon (NJ), Middlesex (NJ), Monmouth (NJ), Morris (NJ), Ocean (NJ), Passaic (NJ), Somerset (NJ), Sussex (NJ), Union (NJ), Bronx (NY), Dutchess (NY), Kings (NY), Nassau (NY), New York (NY), Orange (NY), Putnam (NY), Queens (NY), Richmond (NY), Rockland (NY), Suffolk (NY), Westchester (NY), Pike (PA)
State Impact Area	New Jersey, New York, Pennsylvania

Table 48: Project Expenditure

Business Line	Navigation
Expenditure	$25,250,000

Table 49: Spending Profile

	Spending Category	Percentage (%)
1	Dredging -- Fuel	9%
2	Metals and Steel Materials	3%
3	Dredging Consumables -- Textiles, Lubricants, and Metal Valves and Parts	4%
4	Insurance (bond) and Workman's Comp	2%
5	Cement Materials	1%
6	Machinery Materials	1%
7	Dredge Equipment (Depreciation and Capital Expenses)	11%
8	Construction of Other New Nonresidential Structures	9%
9	Electrical Materials	2%
10	Environmental Compliance, Planning, and Technical Services	1%
11	Industrial Machinery and Equipment Repair and Maintenance	17%
12	Dredging Consumables -- Restaurants	1%
13	Dredging Consumables -- Food and Beverages	3%

	Spending Category	Percentage (%)
14	USACE Overhead	7%
15	USACE Wages and Benefits	13%
16	Private Sector Labor or Staff Augmentation	16%

Table 50: Local Purchase Coefficients

IMPLAN Code	Industry	Expenditure ($000)	Local Purchase Coefficients		
			Local	State	US
58	Construction of other new nonresidential structures	$2,273	100%	100%	100%
105	All other food manufacturing	$475	26%	35%	91%
156	Petroleum refineries	$1,879	16%	27%	81%
205	Cement manufacturing	$198	13%	76%	87%
217	Iron and steel mills and ferroalloy manufacturing	$625	7%	37%	74%
254	Valve and fittings, other than plumbing, manufacturing	$863	11%	18%	52%
271	All other industrial machinery manufacturing	$229	7%	18%	69%
334	Switchgear and switchboard apparatus manufacturing	$431	6%	15%	54%
363	Ship building and repairing	$2,724	31%	34%	98%
395	Wholesale trade	$774	99%	99%	100%
399	Retail - Building material and garden equipment and supplies stores	$136	77%	86%	100%
408	Air transportation	$16	80%	80%	80%
409	Rail transportation	$28	67%	71%	99%
410	Water transportation	$15	99%	99%	100%
411	Truck transportation	$150	69%	78%	99%
413	Pipeline transportation	$42	15%	42%	100%
437	Insurance carriers	$505	86%	86%	87%
455	Environmental and other technical consulting services	$253	59%	61%	100%
462	Office administrative services	$1,768	99%	99%	100%
502	Limited-service restaurants	$253	75%	77%	100%
507	Commercial and industrial machinery and equipment repair and maintenance	$4,293	91%	91%	100%
535	Employment and payroll of federal govt, non-military	$3,283	100%	100%	100%
5001	Private Labor	$4,040	100%	100%	100%
	Total	**$25,250**			

Table 51: Overall Summary

Area	Local Capture ($000)	Output ($000)	Jobs*	Labor Income ($000)	Value Added ($000)
Local					
Direct Impact		$18,528	149.2	$11,673	$14,861
Secondary Impact		$12,846	69.6	$4,832	$8,115
Total Impact	$18,528	$31,374	218.8	$16,505	$22,976
State					
Direct Impact		$19,346	164.6	$11,849	$15,118
Secondary Impact		$15,959	87.9	$5,697	$9,586
Total Impact	$19,346	$35,305	252.5	$17,546	$24,704
US					
Direct Impact		$23,862	189.0	$13,335	$16,984
Secondary Impact		$36,046	183.8	$11,252	$19,170
Total Impact	$23,862	$59,908	372.9	$24,587	$36,154

* Jobs are presented in full-time equivalence (FTE)

Table 52: Local Impacts

		Output ($000)	Jobs*	Labor Income ($000)	Value Added ($000)
	Direct Impacts				
58	Construction of other new nonresidential structures	$2,273	12.8	$1,005	$1,307
105	All other food manufacturing	$125	0.3	$22	$27
156	Petroleum refineries	$293	0.1	$14	$78
205	Cement manufacturing	$25	0.0	$3	$8
217	Iron and steel mills and ferroalloy manufacturing	$42	0.0	$4	$6
254	Valve and fittings, other than plumbing, manufacturing	$95	0.3	$25	$37
271	All other industrial machinery manufacturing	$16	0.1	$6	$7
334	Switchgear and switchboard apparatus manufacturing	$26	0.1	$6	$8
363	Ship building and repairing	$858	3.3	$295	$338
395	Wholesale trade	$770	2.5	$292	$525
399	Retail - Building material and garden equipment and supplies stores	$105	0.8	$47	$71
408	Air transportation	$13	0.0	$3	$6
409	Rail transportation	$19	0.1	$6	$7

410	Water transportation	$15	0.0	$2	$5
411	Truck transportation	$103	0.6	$36	$42
413	Pipeline transportation	$6	0.0	$2	$4
437	Insurance carriers	$434	0.7	$117	$280
455	Environmental and other technical consulting services	$149	1.5	$160	$95
462	Office administrative services	$1,756	10.9	$1,486	$1,555
502	Limited-service restaurants	$189	1.5	$49	$124
507	Commercial and industrial machinery and equipment repair and maintenance	$3,896	16.3	$1,940	$3,008
535	Employment and payroll of federal govt, non-military	$3,282	15.4	$2,113	$3,283
5001	Private Labor	$4,040	82.2	$4,040	$4,040
	Direct Impact	**$18,528**	**149.2**	**$11,673**	**$14,861**
	Secondary Impact	**$12,846**	**69.6**	**$4,832**	**$8,115**
	Total Impact	**$31,374**	**218.8**	**$16,505**	**$22,976**

* Jobs are presented in full-time equivalence (FTE)

Table 53: State Impacts

		Output ($000)	Jobs*	Labor Income ($000)	Value Added ($000)
	Direct Impacts				
58	Construction of other new nonresidential structures	$2,273	13.6	$1,005	$1,307
105	All other food manufacturing	$164	0.4	$29	$36
156	Petroleum refineries	$514	0.1	$24	$136
205	Cement manufacturing	$151	0.3	$25	$59
217	Iron and steel mills and ferroalloy manufacturing	$229	0.2	$22	$38
254	Valve and fittings, other than plumbing, manufacturing	$152	0.4	$40	$60
271	All other industrial machinery manufacturing	$40	0.1	$14	$17
334	Switchgear and switchboard apparatus manufacturing	$67	0.2	$17	$22
363	Ship building and repairing	$930	3.6	$320	$367
395	Wholesale trade	$770	2.7	$292	$525
399	Retail - Building material and garden equipment and supplies stores	$117	1.0	$53	$79
408	Air transportation	$13	0.0	$3	$6
409	Rail transportation	$20	0.1	$7	$8
410	Water transportation	$15	0.0	$2	$5
411	Truck transportation	$117	0.7	$43	$50
413	Pipeline transportation	$18	0.0	$11	$12

		Output ($000)	Jobs*	Labor Income ($000)	Value Added ($000)
437	Insurance carriers	$436	0.8	$118	$282
455	Environmental and other technical consulting services	$153	1.6	$165	$98
462	Office administrative services	$1,756	12.9	$1,486	$1,555
502	Limited-service restaurants	$194	1.6	$50	$127
507	Commercial and industrial machinery and equipment repair and maintenance	$3,896	18.1	$1,940	$3,008
535	Employment and payroll of federal govt, non-military	$3,283	17.2	$2,144	$3,283
5001	Private Labor	$4,040	89.0	$4,040	$4,040
	Direct Impact	**$19,346**	**164.6**	**$11,849**	**$15,118**
	Secondary Impact	**$15,959**	**87.9**	**$5,697**	**$9,586**
	Total Impact	**$35,305**	**252.5**	**$17,546**	**$24,704**

* Jobs are presented in full-time equivalence (FTE)

Table 54: U.S. Impacts

		Output ($000)	Jobs*	Labor Income ($000)	Value Added ($000)
	Direct Impacts				
58	Construction of other new nonresidential structures	$2,273	14.6	$1,005	$1,307
105	All other food manufacturing	$433	1.2	$77	$94
156	Petroleum refineries	$1,516	0.3	$72	$492
205	Cement manufacturing	$171	0.3	$28	$70
217	Iron and steel mills and ferroalloy manufacturing	$463	0.4	$45	$85
254	Valve and fittings, other than plumbing, manufacturing	$449	1.2	$117	$179
271	All other industrial machinery manufacturing	$158	0.6	$56	$65
334	Switchgear and switchboard apparatus manufacturing	$232	0.6	$60	$81
363	Ship building and repairing	$2,681	10.5	$938	$1,057
395	Wholesale trade	$774	2.8	$294	$528
399	Retail - Building material and garden equipment and supplies stores	$136	1.2	$61	$92
408	Air transportation	$13	0.0	$3	$6
409	Rail transportation	$28	0.1	$9	$15
410	Water transportation	$15	0.0	$2	$5
411	Truck transportation	$148	0.8	$54	$63

		Output ($000)	Jobs*	Labor Income ($000)	Value Added ($000)
413	Pipeline transportation	$42	0.1	$32	$30
437	Insurance carriers	$442	0.9	$120	$285
455	Environmental and other technical consulting services	$253	2.7	$271	$162
462	Office administrative services	$1,768	17.9	$1,495	$1,565
502	Limited-service restaurants	$253	2.4	$65	$166
507	Commercial and industrial machinery and equipment repair and maintenance	$4,293	22.6	$2,137	$3,315
535	Employment and payroll of federal govt, non-military	$3,283	18.5	$2,353	$3,283
5001	Private Labor	$4,040	89.6	$4,040	$4,040
	Direct Impact	**$23,862**	**189.0**	**$13,335**	**$16,984**
	Secondary Impact	**$36,046**	**183.8**	**$11,252**	**$19,170**
	Total Impact	**$59,908**	**372.9**	**$24,587**	**$36,154**