NEW HAVEN HARBOR
CONNECTICUT
NAVIGATION IMPROVEMENT PROJECT

DRAFT INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL IMPACT STATEMENT

APPENDIX C
ECONOMICS

New Haven Harbor

Navigation Improvement Project

Integrated Feasibility Report and Environmental Impact Statement

Appendix C - Economic Analysis

New Haven, Connecticut

September 2018

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Introduction

This document presents the economic evaluations performed for the New Haven Harbor deepening and widening project, also known as the New Haven Harbor Navigation Improvement Study. The current federally authorized channel depth of New Haven Harbor is -35 feet mean lower low water (MLLW) with authorized channel widths of 400 feet. In December 2015, the U.S. Army Corps of Engineers (USACE) New England District signed a cost-sharing agreement with the New Haven Port Authority to begin the multi-year feasibility study to determine if deepening New Haven Harbor is both economically beneficial and environmentally acceptable to the nation. The USACE New England District together with the Deep Draft Navigation Planning Center of Expertise performed the economic analyses contained within this document in support of the feasibility study.

Economic Evaluation: Overview

Deep draft navigation policies allow projects to account for transportation cost reduction benefits in several ways. In the case of New Haven Harbor, the basis for the economic benefits are primarily captured in two ways. First, a project can reap benefits by achieving savings in loading practices. These type of benefits are common in a channel deepening project. With a deeper channel, the vessel can load more product and/or shift to a larger vessel class, also allowing for additional product per load. The heavier loading allows fewer vessels to transport the same amount of product, thereby reducing the number of round trips. The ocean-going portion of transportation cost savings typically consists of approximately 90 percent of project benefits in a channel deepening project. In other words, multiplying the number of vessel call reductions by round-trip transportation costs will yield the vast majority of benefits of a deepening project.

Key factors affecting the magnitude of loading practices benefits are:

- Miles applied in a round-trip route
- Vessel operating costs
- Vessel speeds
- Tons per vessel in both the future without-project condition (FWOP) and future with-project condition (FWP)

The tons per vessel analysis requires the following inputs:

- Specific commodities and their future growth rates
- Future loading practices by route and vessel class

The second category of benefits for this project is in-port time savings. These types of benefits are typically accrued by the reduction of transportation costs within a harbor. Reduced transportation costs may consist of a reduction in delays due to congestion, berth modifications affecting time at dock, and safety concerns, to name a few. Widening projects, including turning basins and bend easings, may influence both loading practices and time savings.

Key factors affecting the magnitude of in-port time savings benefits include:

- Pilot rules
- Channel dimensions and configuration
- Congestion

Data Sources and Key Assumptions

Data from Waterborne Commerce and the National Navigation Operations and Management Performance Evaluation and Assessment System (NNOMPEAS) was used to derive study assumptions and complete the economic analysis. A summary of key assumptions is provided below:

- For the economic analysis, route groups were assumed to service the same world regions currently begin served by the Port.

Existing Conditions

This section provides a summary of existing conditions for the hinterland, commodities, vessel traffic, and vessel size guidelines/pilot rules. The existing conditions are defined in this report as the project conditions that exist today plus any changes that are expected to occur prior to project year one, anticipated in 2023, which is referred to as the base year for comparison of alternatives to the without project condition and among proposed alternatives. It is the year the project is expected to be operational and accrue benefits.

Hinterland

New Haven, Connecticut is at the head of New Haven Harbor, a bay on the northern side of Long Island Sound. New Haven is about 68 nautical miles northeast of New York City and 179 nautical miles southeast of Boston, Massachusetts via the Cape Cod Canal. Three detached breakwaters protect the entrance of New Haven Harbor from Long Island Sound. The main ship channel extends from deep water in Long Island Sound to the head of the harbor near the Tomlinson Bridge. The main ship channel passes between the Ludington Rock Breakwater and the East Breakwater at the entrance to the harbor.

The port area of New Haven includes the portion of New Haven Harbor extending from Sandy Point on the west side and Fort Hale on the east to the head of the harbor and the navigable portions of the Mill, Quinnipiac and West Rivers. The Mill and Quinnipiac Rivers empty into the head of the harbor through a common mouth, and the West River enters the west side of the harbor about 1 mile below its head. New Haven Harbor is 4.5 miles long and varies from 1 to 4 miles in width.

The primary tributary area served by the harbor is the south central Connecticut region, encompassing 767 square miles and includes 46 cities and towns. The largest city is New Haven. The most significant natural resources in south central Connecticut are the harbor itself, the coastal terrain, the Quinnipiac, West and Mill Rivers that flow into New Haven Harbor, and Long Island Sound. The irregular coastline provides many fine beaches and sheltered covers for a variety of waterside recreation.

The Port of New Haven serves a hinterland including the greater New Haven region, the state of Connecticut, and much of the American Northeast. The port is a crucial import location for refined petroleum products, which supplies demand within Connecticut and the broader Northeast region. The Northeast maintains a large refinery production deficit and must rely heavily on imported volumes of petroleum products in order to meet demand. The majority of the landside acreage at the Port of New Haven is devoted to energy-related uses. This represents a long-term economic asset for the economy of the State of Connecticut.

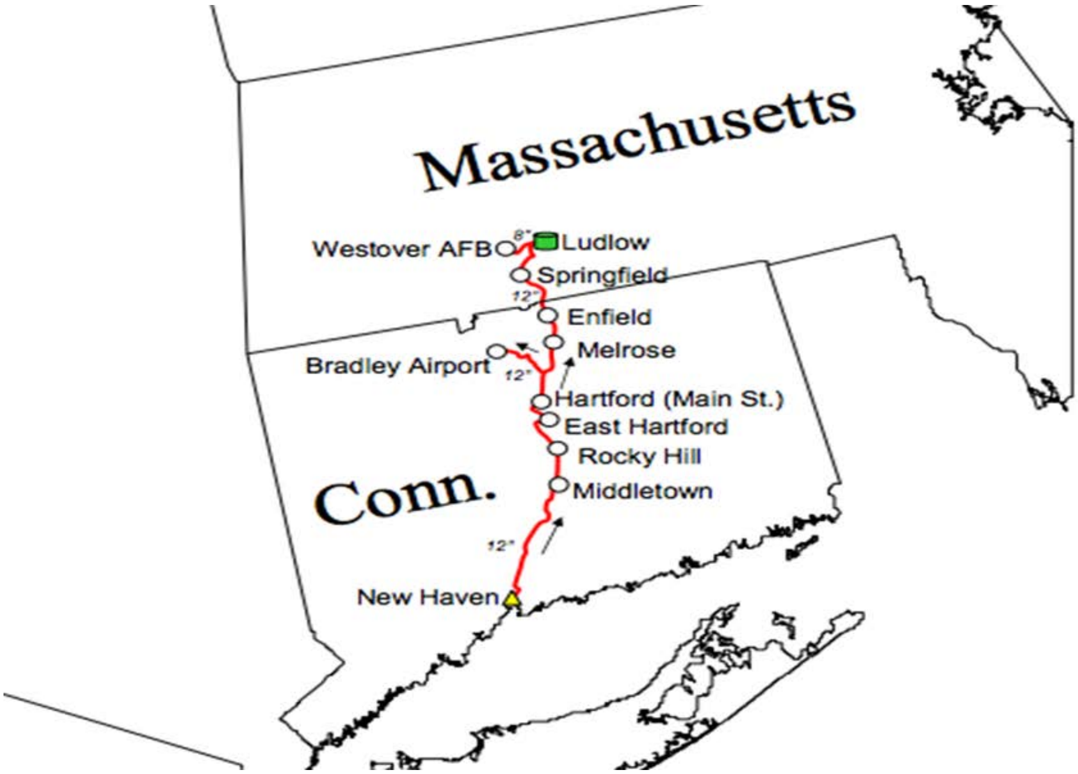
The highlighted areas in Figure 1 represent approximately 254 acres in or near the Port of New Haven – a majority of the landside acreage in the Port of New Haven area. These liquid bulk facilities provide aviation fuel, gasoline, ethanol and other petroleum products to Connecticut and the larger New England marketplace.

Figure 1 New Haven Energy & Liquid Bulk Facilities

New Haven also provides dry bulk and break bulk services. Salt, sand, and cement imports are the dominant bulk cargoes and virtually all volumes are for immediate local use. Scrap metal is Connecticut's largest single export commodity by weight. Approximately 1 million tons of scrap metal are produced annually within the State, with a large portion of that amount exported through the Port of New Haven. Scrap metal, by nature, is in a constant stage of production as it is the waste product of a variety of common goods or materials, including construction, automobiles, and household appliances. Therefore, in terms of future availability, it is likely to continue to be in good supply. Export volumes of scrap metal at New Haven have demonstrated sustained growth with volumes destined primarily to Turkey, Peru, and most recently, to Egypt and Saudi Arabia.

The port's proximity to deep water provides efficient transportation to the state of Connecticut and beyond via highway, rail, and pipeline. The port is accessible from the landside by Interstate 95, a transcontinental highway stretching from the northern border of Maine to the Florida Atlantic Coast, and Interstate 91, whose southern limit is the intersection with Interstate 95 and the northern terminus in Vermont. The Port is serviced by the Genesee and Wyoming Railroad, which connects with CSX, Norfolk Southern, and Canadian National Railroads. The Buckeye Pipeline currently serves Connecticut and Massachusetts through an approximately 100-mile long, 62,000 b/d pipeline that carries refined petroleum products from New Haven through central Connecticut and into Massachusetts. Running north from New Haven, the pipeline has Connecticut delivery locations in Middletown, Rocky Hill, East Hartford, Bradley International Airport, Melrose, and Enfield. It continues into Massachusetts with locations in Springfield, Ludlow, and the Westover Air Force Base (home to the Massachusetts Air National Guard). A map of Buckeye's Connecticut and Massachusetts pipeline is shown in Figure 2.

Figure 2 Buckeye Pipeline Connecticut/Massachusetts



Facilities and Infrastructure

The New Haven Port District currently encompasses 366 acres of waterfront land and nearby properties including six privately owned terminals.

Motiva Terminal

Motiva Terminal, located on the west side of New Haven Harbor approximately 1 mile south of the Tomlinson Bridge, handles commodities such as gasoline, diesel fuel, jet fuel, and ethanol that are imported by tankers and barges with the occasional export of petroleum products by barge. The 32-acre terminal includes an irregularly shaped timber pile and concrete-decked offshore wharf with a 900 foot by 20 foot pipeline trestle and timber walkway approach extending to two 22 foot by 29 foot concrete-pile breasting dolphins. There are two mooring dolphins on each side at the rear connected by catwalks. One 18 inch, one 16 inch, two 14 inch, four twelve inch, and two ten inch pipelines extend from the wharf to 21 steel storage tanks approximately 1,600 feet in the rear of the facility with a total capacity of 1.8 million barrels. The tankage is connected by a 12-inch inland pipeline owned by Jet Lines, Inc.

New Haven Terminal

New Haven Terminal is a bulk liquid petroleum storage terminal with a capacity of 2.5 million barrels. The terminal also features 184,500 square feet of warehouse storage space as well as land leased to a dry cargo stevedoring company and biodiesel production facility for their own businesses. One of New Haven Terminal's liquid bulk storage facilities (the New Haven facility) is located on the side of New Haven Harbor, approximately a half mile south of the Tomlinson Bridge. The other liquid storage facility (the East Haven facility) is 1.5 miles inland and is located in the town of East Haven. Both facilities provide direct access to I-91 and I-95. The New Haven facility is a 21.7-acre terminal consisting of 7.8 acres dedicated to a bulk liquid tank farm, 11.7 acres for dry cargo, and 2.2 acres primarily for truck access through the facility. The finger pier is approximately 650 feet long by 60 feet wide and extends westward into New Haven Harbor. The finger pier is also known as Harbor Terminal. Product pipelines run eastward, consisting of 15 docklines ranging in size from 4 inches to 16 inches in diameter. Two 16" pipelines are the supply lines to the East Haven inland facility. The pier can accommodate 2 ships, 2 barges, or one ship and one barge concurrently. The New Haven Facility also has a marginal wharf approximately 650 feet long that can only be used for dry cargo. This wharf is directly next to a paved lay down/storage area capable of holding all or part of a ship's cargo. A tank farm is situated on a land area of approximately 7.8 acres consisting of 22 above-ground storage tanks with a total capacity of 765,605 barrels. The New Haven terminal tank farm primarily handles fuel oils, diesel fuels, and kerosene. Commodities are transported to the terminal by vessel, barge, rail, truck, Buckeye Pipeline, and a local pipeline transfer between New Haven Terminal and neighboring facilities (Gateway, Gulf Oil, and Magellan). Dry Cargo warehouse space at the New Haven facility includes three buildings that offer a total of 184,500 square feet of storage.

The tank farm located at the East Haven facility comprises nearly 18.6 acres of the total 63.1 acre land area. A truck rack area in the southwest corner of the property occupies nearly 2.8 acres, while the remainder of the property is generally undeveloped. The tank farm includes 15 above-ground storage tanks, totaling 1.76 million barrels. Petroleum products currently handled at this facility are fuel oils, diesel fuels, and kerosene.

Magellan Waterfront Street Terminal

The Magellan facility located on Waterfront Street receives and ships petroleum products by barge and occasionally receives tankers carrying petroleum products. This facility has four 12-inch pipelines and one 8-inch pipeline extending from the wharf to 16 steel storage tanks at the rear of the facility that can store up to 770,000 barrels. There are 8 additional pipelines that extend to Forbes Avenue Pier and an inland pipeline.

Gateway Terminal

Gateway Terminal, the most active terminal in the port, is located on the western shore of New Haven Harbor, approximately 1,100 feet south of the Tomlinson Bridge, and is situated on eight acres with access to over 60 acres of indoor and outdoor storage area. Gateway operates four main dry and liquid berths for vessels and three berths for barges. Gateway Terminal handles over one million gallons of heating oil daily, supplying local schools, universities, hospitals, businesses, homes, and government facilities within Connecticut and southern New England. The North and South berths are located on Gateway Terminal's main finger pier. The finger pier was designed to accommodate vessels up to 70,000 DWT with a 36' draft at MLLW and LOA of 735 feet. Two high-speed gantry cranes are available to load and unload a variety of dry cargoes at a rate of up to 1,000 tons per hour. In addition, two 300' docks and a 225' wharf are available to use for the loading and unloading of dry bulk commodities for transport by tug and barge. Gateway currently stores approximately 500,000 tons per year for customers at its facility, storage yards, and warehouses. The terminal currently has over 200,000 square feet of warehouses. Products, such as salt, are received at the terminal and then trucked to all of Connecticut's DOT facilities. Gateway Terminal receives dry cargo such as aggregates, coal, steel billets, steel rail, rebar, scrap metal, and pumice. Gateway Terminal then delivers these commodities to customers in the Northeast, Midwest, and Eastern Canada by truck, rail or barge. Foreign shipments of these commodities are primarily delivered via Bulk Carriers, General Cargo Vessels, and Tankers. Gateway Terminal also operates a 650,000 barrel petroleum tank farm consisting of seven above-ground storage tanks. Liquid products handled included asphalt, diesel fuel, kerosene, diesel oils, and biofuels. A cement storage complex is also located at Gateway Terminal, consisting of three silos with an aggregate capacity of 27,000 tons.

Gulf Oil Terminal

Gulf Oil Terminal, located approximately 600 feet south of Tomlinson Bridge on the western shore, is a 9.3 acre facility operated by Gulf Oil Limited Partnership, a national branded supplier of motor fuels throughout the United States and one of the Northeast's largest wholesalers of refined petroleum products. Gulf Oil Terminals receives petroleum products by tankers and barges which are then transferred via pipeline to thirteen steel storage tanks in the rear of the terminal. The storage tanks are capable of storing up to 580,000 barrels of petroleum products. A 20-inch pipe line extends from the wharf to storage tanks. In addition, a 12-inch common carrier oil pipeline (Buckeye) is connected to the storage tanks and extends from New Haven northward to Hartford, Connecticut and Springfield, Massachusetts.

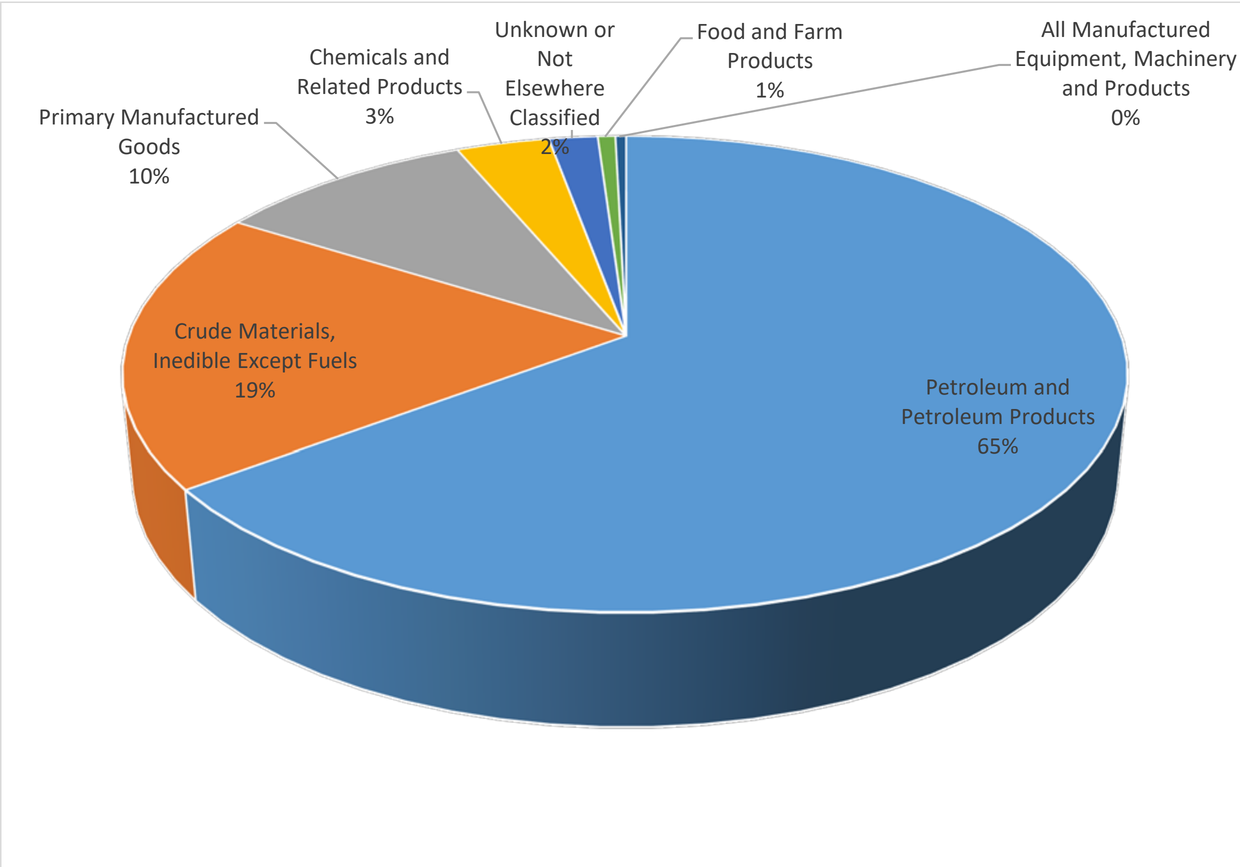
Magellan East Street Terminal

The Magellan facility on East Street receives petroleum products by barge and tanker and also ships petroleum products by barge. Two 12-inch pipelines and one 8-inch pipeline extend from the pier to 22 steel storage tanks located at the rear of the terminal. The storage tanks can store up to 1.4 million barrels of petroleum products. The tanks are connected to Westover Air Force Base, Massachusetts by a 12-inch inland pipeline owned by Jet Lines, Inc.

Commodities

In terms of total tonnage shipped and received, the Port of New Haven was the largest port in Connecticut and was the 2nd largest port in New England in 2016, ranking only behind the port of Boston. In 2016, its total freight traffic of 8.8 million tons represented about 24 percent of all waterborne commerce in New England and about 81 percent of all waterborne commerce in Connecticut. Figure 3 shows the distribution of tonnage by commodity for New Haven in 2016. Petroleum products imports have historically constituted approximately 66 percent of the channel tonnage.

Figure 3 Commodity Mix



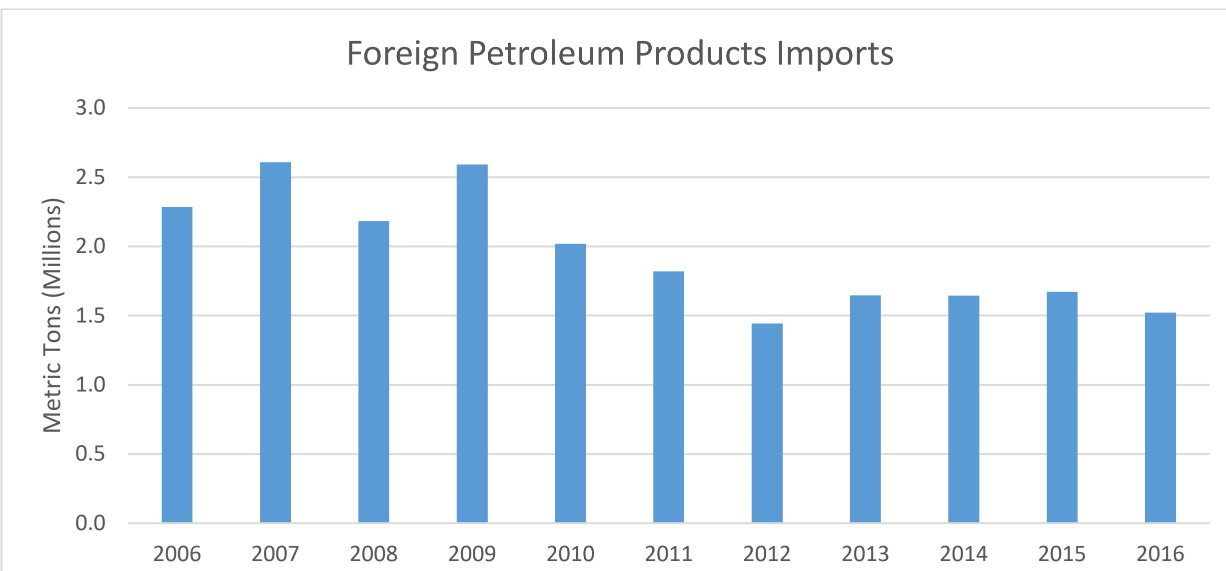
Source: Waterborne Commerce, 2016

Petroleum Products

New Haven Harbor is essentially a receiving port for petroleum products. During the 2012-2016 time period, petroleum products accounted for 81 percent of all waterborne commerce. These products were gasoline, jet fuel, kerosene, fuel oils, asphalt, and petroleum coke. The remaining 19 percent of waterborne commerce was comprised of coal, chemicals, crude materials, primary manufactured goods, food and farm products, manufactured equipment and machinery, and goods not elsewhere classified. Petroleum products are shipped to New Haven by shallow-draft coastal tankers and barges from Northeastern U.S. ports and by ocean-going, deep-draft tankers from foreign ports. In 2016, about 21 percent of inbound petroleum products were foreign imports and the remaining 79 percent were domestic receipts. Outbound domestic shipments of petroleum products from New Haven are generally carried in shallow draft coastal tankers and barges to other Long Island Sound ports. Inbound and outbound domestic shipments of petroleum products are not included in this analysis as the vessels would not benefit from channel improvements.

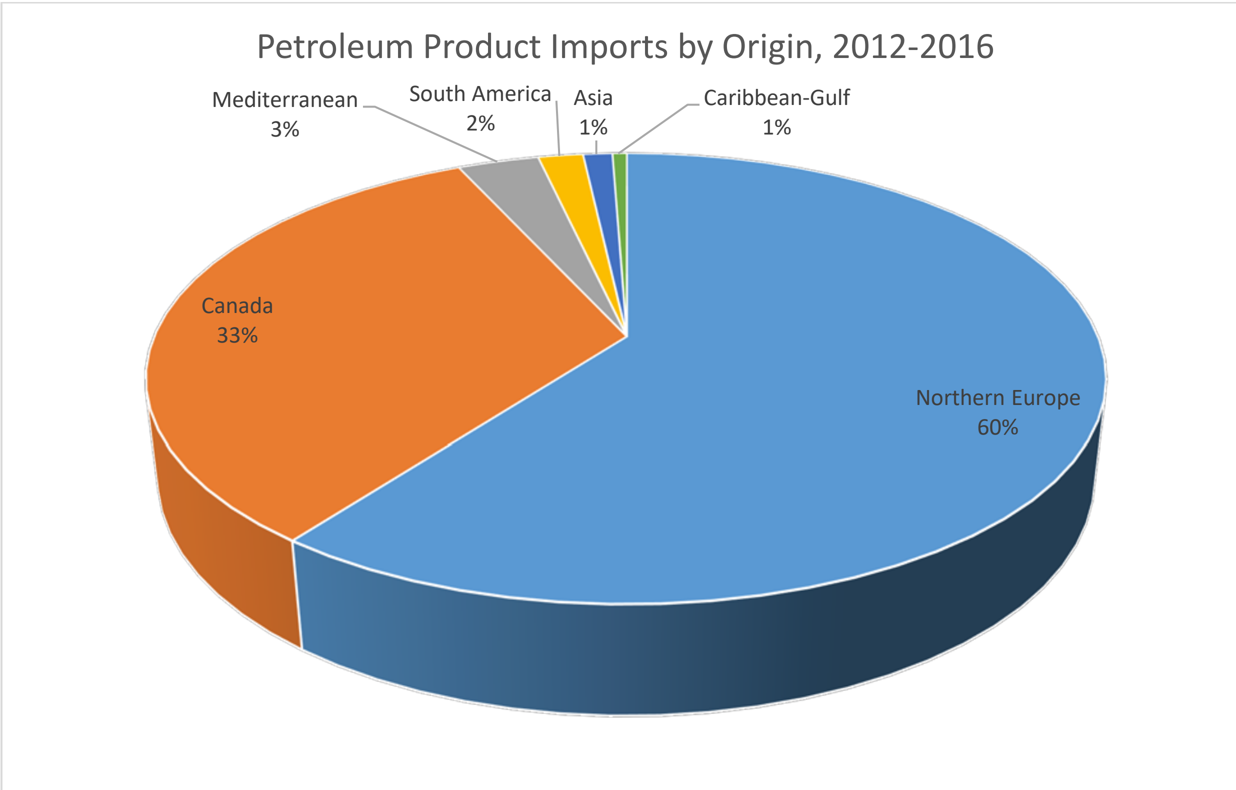
Table 1 shows foreign petroleum products import tonnage at New Haven. The Port of New Haven experienced a slight decrease in foreign petroleum product imports in 2016 but this is expected to be short-term. Figure 4 displays petroleum product import tonnage by origin.

Table 1 Foreign Petroleum Products Imports



Source: Waterborne Commerce

Figure 4 Petroleum Product Imports by Origin, 2012-2016



Source: Waterborne Commerce

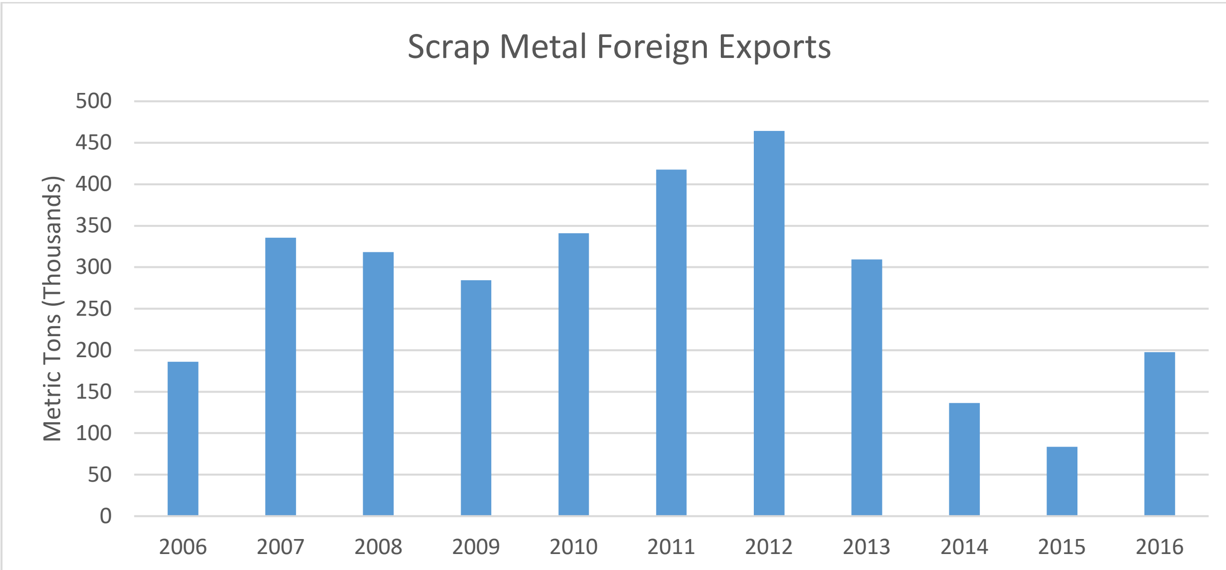
Scrap Metal

Scrap metal is Connecticut's largest single export commodity by weight. The market for scrap metal is highly competitive with few large producers (shredders) accounting for the majority of production volume/sales. An estimated 1 million tons of scrap metal are produced annually in the State of Connecticut, with a large portion exported through the Port of New Haven to destinations in Turkey, Peru, Egypt, and Saudi Arabia. The balance is exported, largely by truck, through New Jersey, Rhode Island and Philadelphia.

U.S exports of scrap metal dropped by 19 percent in 2014, a reflection of lesser quantities and a greater proportion of less costly scrap types in the export mix. Other factors included devaluation of foreign currencies against the U.S. dollar, and less robust demand for U.S. product in key scrap-consuming countries. However, U.S. scrap metal exports rebounded in 2017 and grew by over 23 percent year-on-year since 2014.

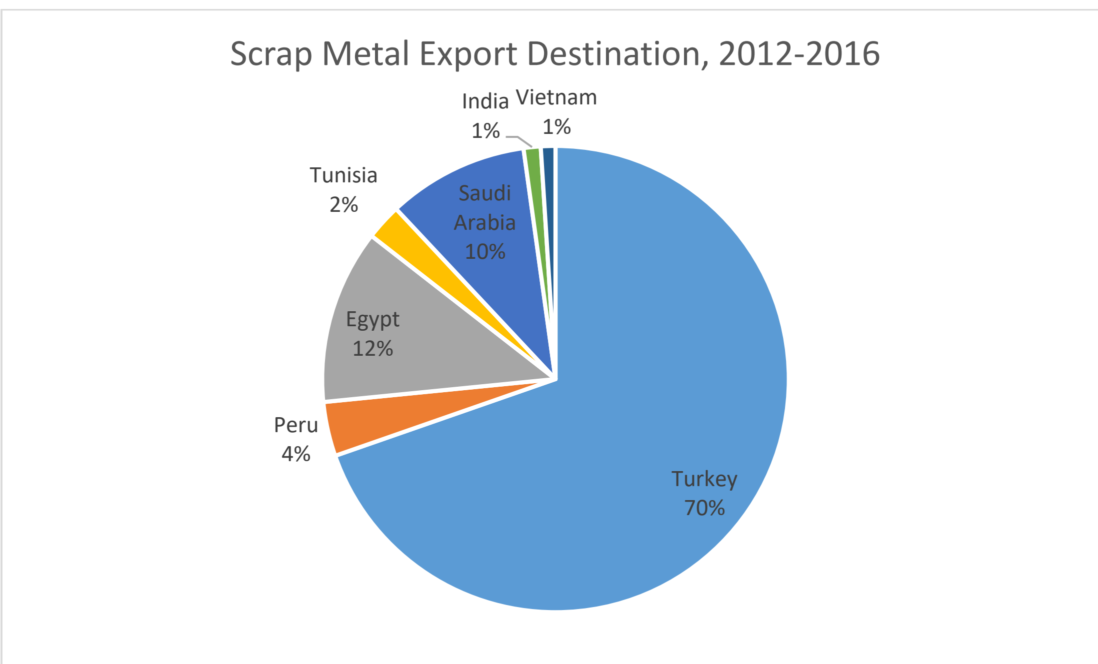
Table 2 and Figure 5 include historical scrap metal export data.

Table 2 Scrap Metal Foreign Exports



Source: Waterborne Commerce

Figure 5 Scrap Metal Foreign Exports by Destination

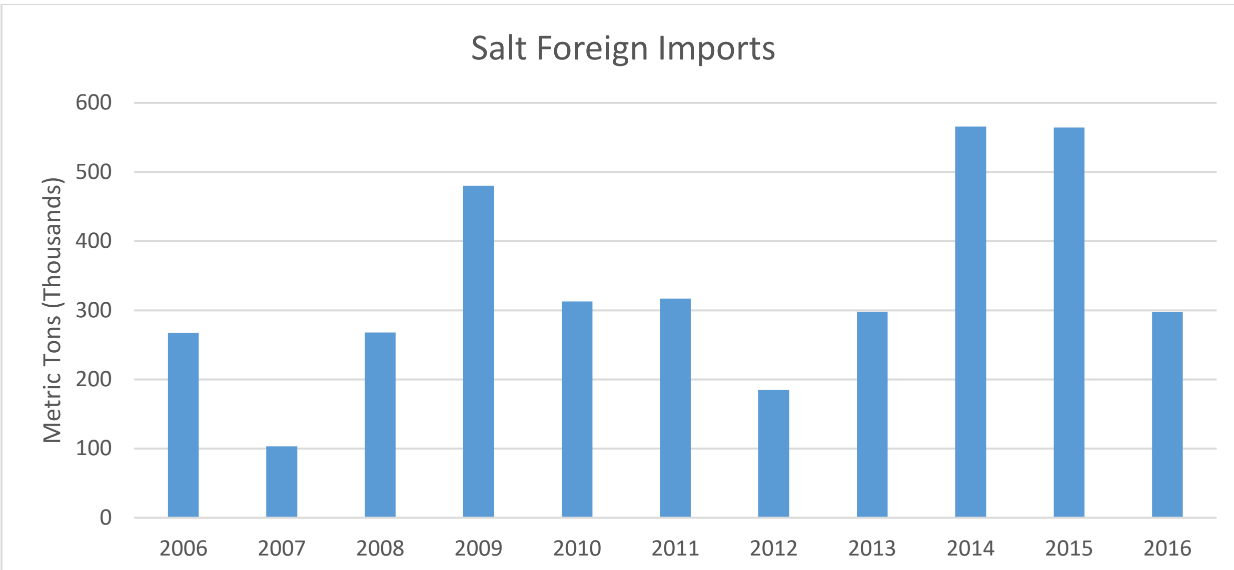


Source: Waterborne Commerce

Salt

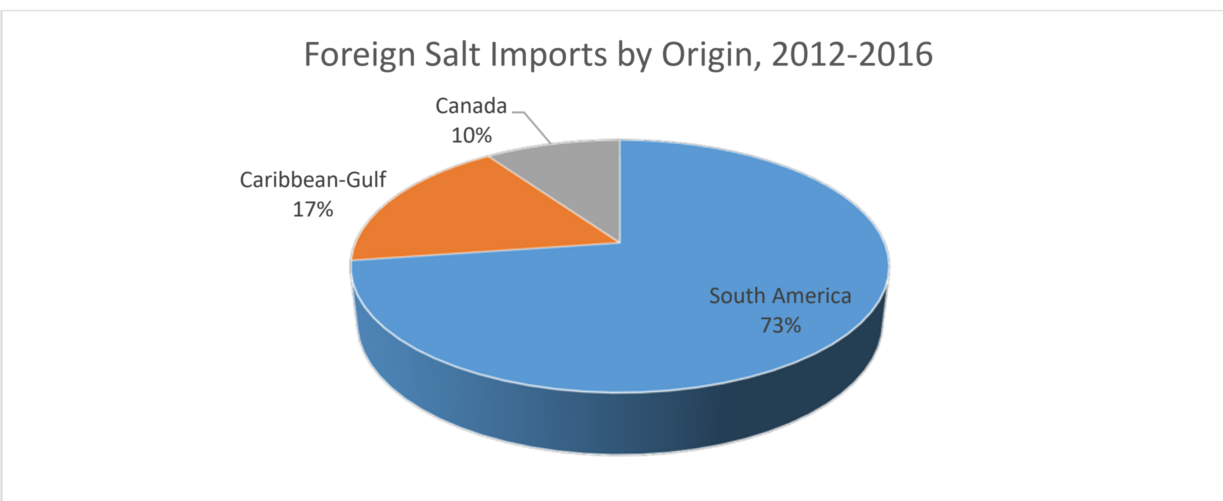
Salt is a major import at the port of New Haven, much of which is road salt used mostly by municipalities but also by commercial retailers for winter use. Gateway terminal built a storage facility for salt imports from Chile through Morton Salt. Table 3 shows inbound foreign salt import tonnage at New Haven. Figure 6 displays foreign salt imports by origin.

Table 3 Salt Foreign Imports



Source: Waterborne Commerce

Figure 6 Foreign Salt Imports by Origin, 2012-2016



Source: Waterborne Commerce

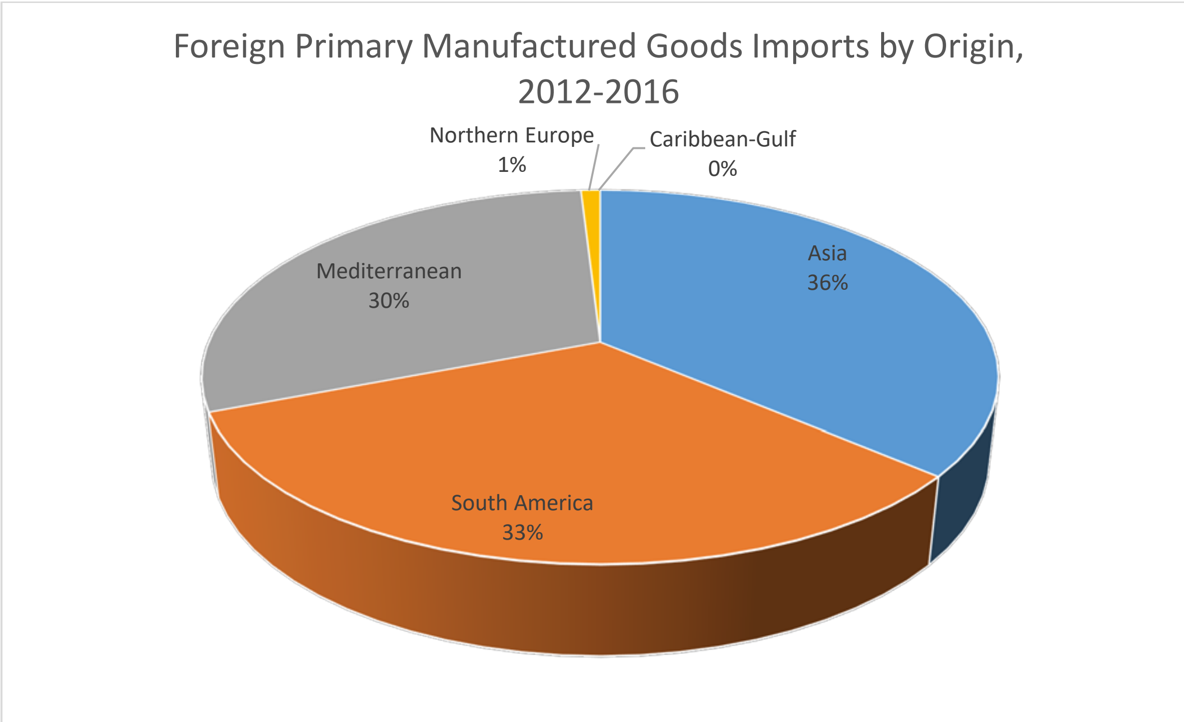
Primary Manufactured Goods

The Port of New Haven receives foreign imports of primary manufactured goods consisting of iron and steel products (primary forms, sheets, shapes, pipe & tube), aluminum, and fabricated metal products. Table 4 below displays inbound foreign primary manufactured goods import tonnage at New Haven. Figure 7 displays foreign primary manufactured goods imports by origin.

Table 4 Primary Manufactured Goods Foreign Imports

Source: Waterborne Commerce

Figure 7 Foreign Primary Manufactured Goods Imports by Origin, 2012-2016

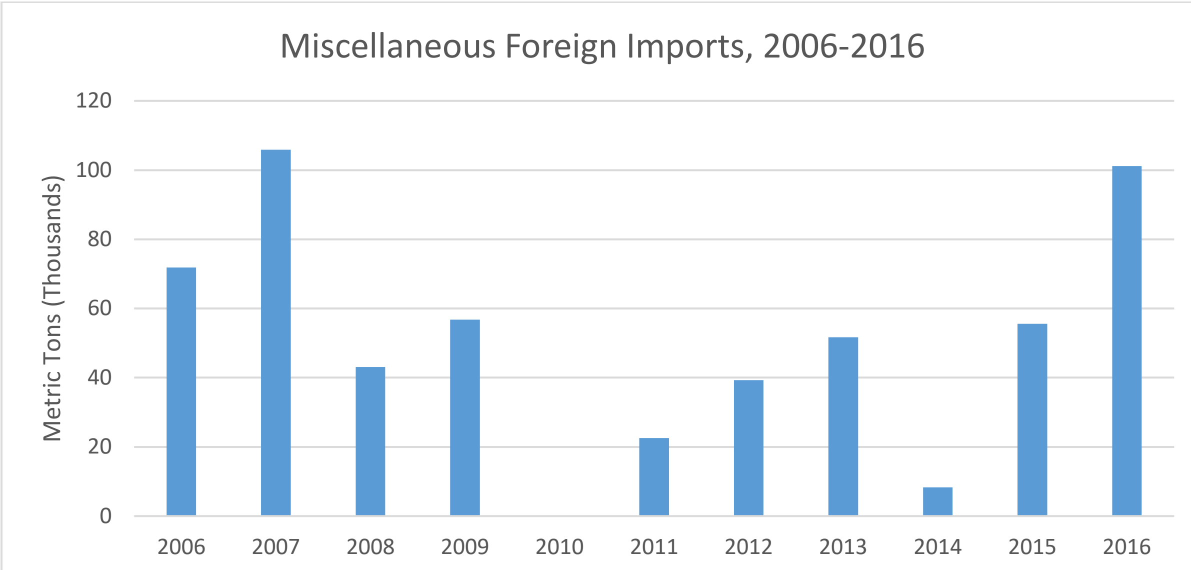


Source: Waterborne Commerce

Miscellaneous

The miscellaneous category of commodities includes all remaining tonnage (excludes petroleum products, scrap metal, salt, and primary manufactured goods.) Commodities in this category include all manufactured equipment and machinery, forest products, agricultural products, chemicals, and commodities that are unknown or not elsewhere classified. During the 2006-2016 timeframe, miscellaneous foreign imports represented only 2% of foreign import tonnage on average at the Port of New Haven. Table 5 displays foreign miscellaneous import tonnage.

Table 5 Miscellaneous Foreign Imports



Source: Waterborne Commerce

Vessel Traffic

The current depth of New Haven Harbor is -35 feet MLLW, and pilot rules in the channel require that each vessel must have four feet of underkeel clearance. With this configuration, inbound vessels with a draft of 31 feet or greater must either light-load, wait for the tide, or perform lightering operations in the Long Island Sound. The maximum tide range at New Haven is six feet, meaning that inbound vessels can have a maximum draft of 37 feet at high tide. If a vessel cannot wait on the tide or has a draft greater than 37 feet, then the vessel must anchor in the Long Island sound and unload cargo onto barges until its draft is shallow enough to transit the channel. In addition, weather conditions must be favorable for any lightering to take place at all. In the existing condition, five vessels were lightered (three Bulk Carriers and two Tankers). According to the harbor pilots, the lightering process can take up to 24 hours.

New Haven Harbor receives three vessel types: Tankers, Bulk Carriers, and General Cargo Ships. For this study, vessel classes were assigned for each vessel type based on deadweight tons. Bulk Carriers and General Cargo Ships are only handled at Gateway Terminal. Tankers are handled at all docks in New Haven Harbor. Figure 8 below displays average vessel class dimensions, the commodities carried by vessel class, and the number of calls per vessel class in the existing condition. The existing condition was developed using 5-year historical averages for commodities and vessel calls. Barges were modeled in HarborSym to analyze lightering practices.

Figure 8 Vessel Types and Classes

Vessel Type	Vessel Class	Avg. LOA	Avg. Beam	Avg. Design Draft	Capacity (metric tons)	Commodities	Number of Calls
Bulk Carrier	BLK-1	463.3	81.3	28.3	15-25k	Primary Manufactured Goods	4
Bulk Carrier	BLK-2	573.6	92.3	35.7	25-32k	Primary Manufactured Goods	8
Bulk Carrier	BLK-3	601.8	94.7	44.8	32-37k	Primary Manufactured Goods, Miscellaneous	6
Bulk Carrier	BLK-4	637.1	103.1	38.9	37-46k	Primary Manufactured Goods, Miscellaneous, Scrap Metal	7
Bulk Carrier	BLK-5	626.9	105.7	43.2	46k-55k	Scrap Metal, Salt, Primary Manufactured Goods, Miscellaneous	25
Bulk Carrier	BLK-6	656.0	105.3	43.3	55-60k	Salt	2
General Cargo Ship	GCC-1	467.0	70.0	26.5	5-15k	Miscellaneous, Primary Manufactured Goods	4
General Cargo Ship	GCC-5	519.0	86.0	33.0	20-27k	Primary Manufactured Goods	1
General Cargo Ship	GCC-6	599.0	94.0	35.6	27-35k	Miscellaneous, Primary Manufactured Goods	2
Tanker	TK-1	438.2	71.8	28.2	5-20k	Petroleum Products	13
Tanker	TK-4	600.3	101.0	40.2	30-45k	Petroleum Products, Miscellaneous	44
Tanker	TK-5	603.4	105.9	42.7	45-50k	Petroleum Products, Miscellaneous	14
Barge	Dry Cargo Barge	240.0	66.0	14.6	1-10k	Salt	3
Barge	Liquid Barge	459.0	72.6	28.6	2-30k	Petroleum Products	2

Vessel Traffic Distribution

The following Table 6 and Table 7 show the distributions of historic traffic under existing conditions. Table 6 displays the distribution of foreign tonnage by commodity type and year. Table 7 displays the import and export tonnage for 2016.

Table 6 Tonnage Distribution by Commodity Type

	2012	2013	2014	2015	2016
Miscellaneous	39,323	56,456	19,160	67,025	162,703
Petroleum Products	1,460,873	1,646,900	1,644,393	1,672,753	1,521,437
Primary Manufactured Goods	4,350	23,828	149,949	184,385	228,766
Salt	184,430	297,778	565,570	602,902	238,123
Scrap Metal	464,168	309,452	136,264	83,479	197,816
Total	2,153,144	2,334,414	2,515,336	2,610,544	2,348,845

Source: Waterborne Commerce, 2012-2016 (foreign metric tons)

Table 7 Imports and Exports Tonnage Distribution by Commodity Type

	2016 Imports	2016 Exports
Miscellaneous	162,703	0
Petroleum Products	1,521,437	0
Primary Manufactured Goods	228,766	0
Salt	238,123	0
Scrap Metal	0	197,816
Total	2,151,029	197,816

Source: Waterborne Commerce, 2016 (foreign metric tons)

Table 8 displays the number of transits and tonnage for commodities at New Haven Harbor.

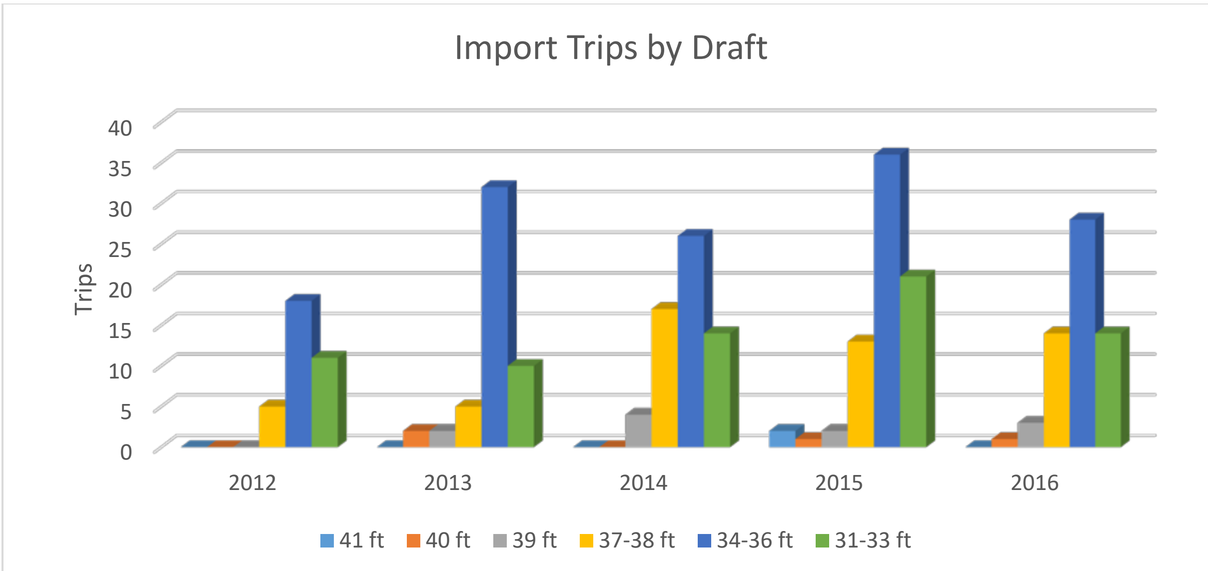
Table 8 Transit and Tonnage Distribution by Vessel Type

Vessel Type	Transits	Tonnage
Total Vessel Calls	**130**	**2,348,845**
Bulk Carrier	52	741,835
General Cargo Ship	7	13,760
Tanker	71	1,593,251
Import Calls	**121**	**2,151,029**
Bulk Carrier	43	544,019
General Cargo Ship	7	13,760
Tanker	71	1,593,251
Export Calls	**9**	**197,816**
Bulk Carrier	9	197,816
General Cargo Ship	0	0
Tanker	0	0

Source: Waterborne Commerce, 2016

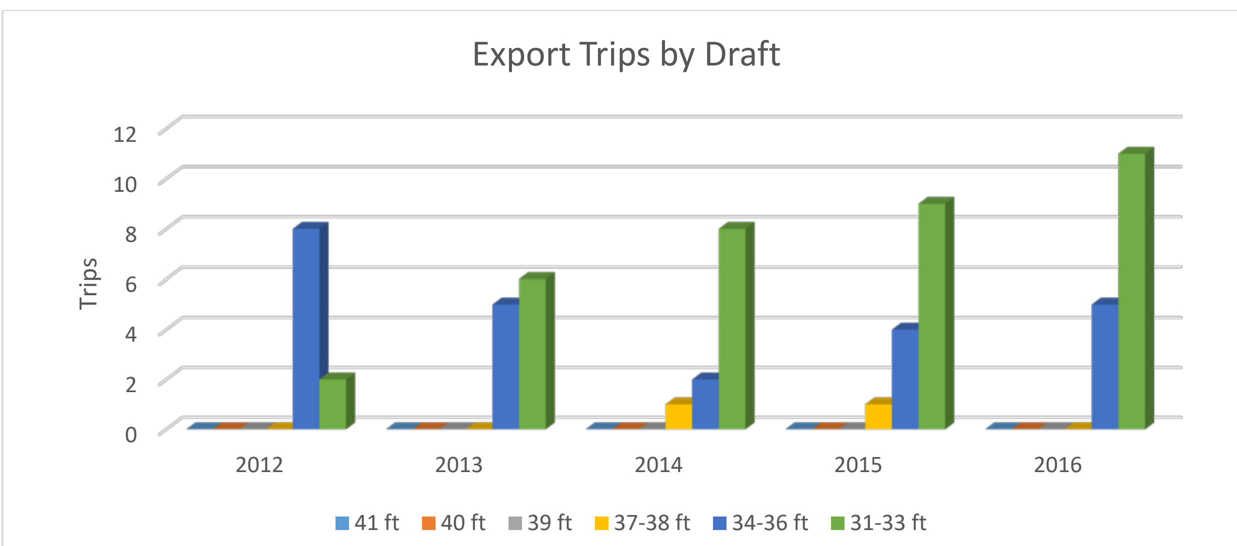
The following graphs show the number of trips by loaded draft.

Figure 9 Import Trips by Draft



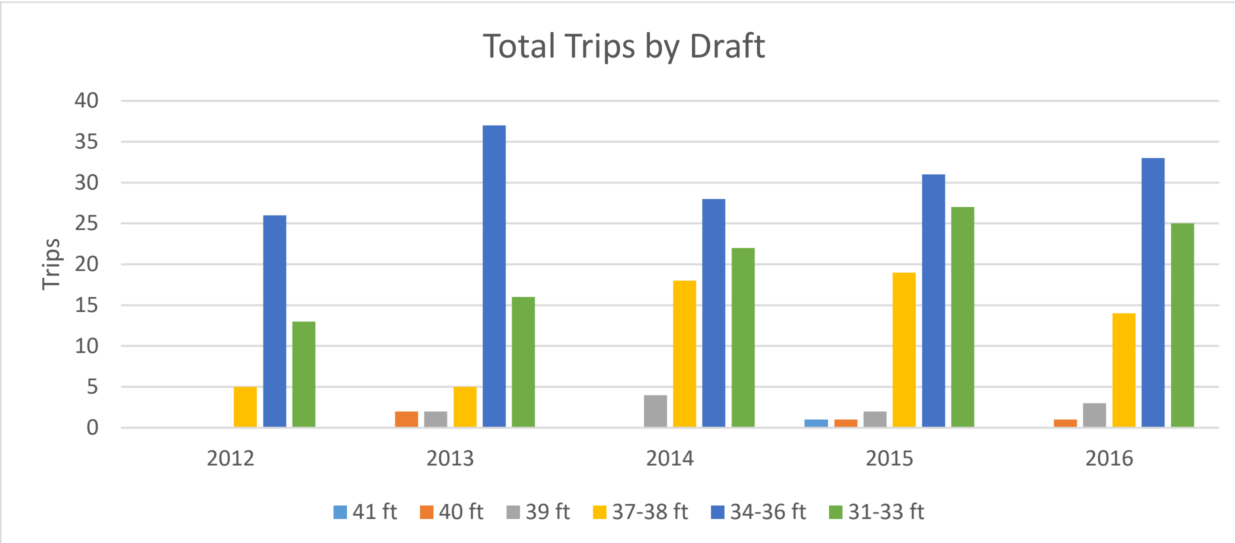
Source: Waterborne Commerce

Figure 10 Export Trips by Draft



Source: Waterborne Commerce

Figure 11 Total Trips by Draft



Source: Waterborne Commerce

Vessel Size Guidelines and Pilots Rules

Traffic at New Haven Harbor is limited to one-way traffic, according to the Connecticut Pilot Commission.

Underkeel clearance is determined by the discretion of the Pilots within the range recommended by the industry. For New Haven Harbor, vessels must have four feet of underkeel clearance.

As previously mentioned, the maximum tide range at New Haven Harbor is approximately six feet. A vessel may not transit the channel if its draft exceeds the depth of the channel using tide and underkeel clearance.

Pilots reserve the right to deny movement of any vessel during times of excessive wind, excessive current or at times of low water.

Future Without-Project Conditions

Commodities

Much of the commodities mix in the existing condition is expected to continue in the future without-project condition, as New Haven has a long history of importing petroleum products, salt, and primary manufactured goods.

The export of scrap metal is also a staple of New Haven Harbor, and is expected to continue in the future without-project condition.

Vessel Traffic

Discussion with shipping interests indicates that the most likely future if a project is not implemented is a continued use of vessels with current dimensions for the foreseeable future. In the long run, it is likely that smaller ships will be retired and New Haven shippers and receivers will be forced to use larger vessels, since it is projected that fewer small vessels will be built. The use of larger vessels would force implementation of nonstructural techniques by users of the Port because under ordinary conditions these large vessel would not be able to navigate the 35-foot channel. The fact that shipping interests did not point out a desire to increase use of nonstructural measures over the short run seems to indicate that these measure are already used to a maximum degree, are uneconomical to use, or are prohibited by institutional, logistical, or other constraints.

Several nonstructural measures are already being utilized at New Haven Harbor, such as waiting for the tide to increase the channel depth, light-loading, and lightering. Vessel operators use higher tides to allow movement of vessel that could not pass through the channel at low stages of the tide. Currently, almost all traffic moves within a few hours of high tide. Vessels with drafts in excess of 31 feet must wait for higher tide to move in the main channel.

At times, vessel operators lighter a portion of cargo to barges in Long Island Sound prior to entering the port. This technique is used because vessel draft would not allow passage over the 35-foot channel even at high stages of the tide. After offloading, both lightered vessels and barges deliver their cargos to harbor terminals that are located about 5 miles north of the harbor entrance. The lighterage requirements of a given vessel are dependent on the difference between the depth of the Sound offshores and the depth of the port's channel and the usable height of tide. Although added expenses are involved, lightering does allow for economies of scale through the use of larger vessels.

With continued use of larger vessels, these activities are expected to continue in the future.

Vessel Size Guidelines and Pilots Rules

Vessel size guidelines and Pilot rules are not expected to change in the future without-project condition.

Future With-Project Conditions

In the future with-project condition, vessels will load more efficiently when calling at New Haven Harbor. By utilizing deeper channel depths, it will require less vessels to transport the same amount of goods, thereby decreasing at-sea transit costs. Deeper channel depths will also reduce vessel waiting time for the tide, frequency of lightering events, or the amount of cargo that needs to be unloaded from a lightered vessel in order to transit the channel.

Hinterland

New Haven is expected to continue to serve the same hinterland in the future with-project condition and will continue to compete for the market with other Northeastern ports. Many factors influence the growth of a particular harbor: land side development and infrastructure, location of distribution centers for imports, source locations for exports, population and income growth and location, port logistics and fees, business climate and taxes, carrier preferences, labor stability and volatility, and business relationships. Harbor depth is just one of the many factors involved.

Commodities

Commodity Forecast

Commodity forecasts were prepared for petroleum products, scrap metal, salt, and primary manufactured goods. Due to uncertainty in the miscellaneous commodity group, the tonnage was held constant in the future without-project and future with-project condition at a 1-year average (2016 tonnage).

National forecast data and general indicators were assessed in relationship to the study area's historical commodity-specific tonnage flows for the purpose of evaluating the relationship between historical U.S. tonnage volumes and study area tonnage.

The outputs of the commodity projections were based on forecasts published by Global Insight, The U.S. Economy, The 30-Year Focus, 2018; and from indices developed from historical trend data. The commodity forecasts presented in this document were prepared in 2018.

The commodity forecast for petroleum products imports was derived using Global Insight's 30-Year Focus Report on the U.S. Economy. Salt and primary manufactured goods tonnages were derived from trend analysis. The forecast for scrap metal was derived based on trend analysis and data published by the World Steel Association. The growth rates derived and rooted in the published forecasts listed above were applied to baseline tonnages to compute tonnage by commodity for 2023, 2033, 2043, and 2053. Baseline tonnages were developed using 5-year historical data for petroleum products. These tonnages were applied to the loading pattern distributions to determine the number of calls needed to transport each commodity in the given years. These call lists were loaded into HarborSym to calculate transportation costs for the FWOP and FWP conditions.

Petroleum Products

The State of Connecticut does not have any petroleum reserves and does not produce or refine petroleum. More than two-thirds of the petroleum consumed in Connecticut is used in the transportation sector, primarily as motor gasoline. The residential sector, where nearly half of Connecticut households use fuel oil or other petroleum products as the primary energy source for home heating, consumes much of the rest of the petroleum used in the state.

The New England region is a net consumer of fuels, as there are no refineries operating in the area. The vast majority of New England's petroleum products are delivered to the region via tanker and barge from domestic and foreign supply sources. Import volumes, primarily received at coastal New England ports from eastern Canadian refineries, meet just over 45 percent of New England's total transportation fuels consumption.

Distillate fuel oil consumption in New England is driven primarily by on-highway use, as well as and residential and commercial use. Households in the New England are much more reliant on distillate fuel oil for space heating than in the rest of the country. In 2017, approximately 39% of homes in New England used heating oil as their primary fuel for space heating, and the residential and commercial sectors typically account for more than half of the region's total annual distillate consumption. Seasonal consumption of heating oil is met from a number of sources, including increased foreign imports, increased marine and truck deliveries from the Central Atlantic region, and drawdowns from inventory. New England distillate suppliers typically build heating oil inventories in the summer and fall months and draw down inventories during the coldest winter months—typically January and February. The unpredictability of winter weather and heating oil consumption makes New England more vulnerable to shortages.

Scrap Metal

U.S. exports of scrap metal have grown significantly over the past decade as the balance of steel production has shifted globally to the North Asia and Mediterranean regions. Global GDP and global steel production are a highly correlated economic-to-commodity pairing. Since 1990, the average 2.9% global GDP growth has been met by an average 2.8% increase in global steel production. As global demand for steel continues to grow, roundly in line with global GDP, this should continue to support a long-term average of 2-3% annual growth of U.S. scrap metal exports. Scrap metal, by nature, is in a constant stage of production as it is the waste product of a variety of common goods or materials, including construction, automobiles, and household appliances. Therefore, in terms of future availability, it is likely to continue to be in good supply.

U.S exports of scrap metal dropped by 19 percent in 2014, a reflection of lesser quantities and a greater proportion of less costly scrap types in the export mix. Other factors included devaluation of foreign currencies against the U.S. dollar, and less robust demand for U.S. product in key scrap-consuming countries. However, U.S. scrap metal exports rebounded in 2017 and grew by over 23 percent year-on-year since 2014. New Haven scrap metal exports increased by 60 percent between 2014 and 2016.

Salt

Salt is an important commodity for the Northeast, as it is used to deice roads and make them safer to travel on. As shown in Table 3, salt import tonnage varies year-by-year depending on weather conditions. During harsh winters, the Department of Transportation uses most of its salt inventory and has to order more. During warmer winters, the salt inventory is replenished in order to prepare for the next winter. In 2014 and 2015, the Northeast experienced very low temperatures and high snow fall, resulting in an increase in salt imports. In February 2018, the State of Connecticut experienced the coldest month on record.

Primary Manufactured Goods

New Haven Harbor has experienced significant growth in steel imports since 2012, primarily due to infrastructure projects occurring statewide. Between 2012 and 2016, New Haven Harbor foreign steel imports grew by an average annual growth rate of 256 percent. The majority of steel imports comes from China and Brazil and consists mostly of flat-rolled steel products.

Miscellaneous

A commodity forecast for the miscellaneous commodity group was not developed due to uncertainty in the commodity mixture and the historically low tonnage (approximately 2 percent of total foreign imports.) The amount of tonnage in the miscellaneous category was kept constant throughout the period of analysis.

Summary of Commodity Forecasts

The projected growth rates and tonnages are shown in Table 9 below. Fluctuations in the growth rates are subject to oil price variability, macroeconomic policies, exchange rate fluctuations, and a number of other factors. Commodity growth rates were developed using IHS Global Insight for petroleum products. Historical trend analysis was used to develop commodity growth rates for scrap metal, salt, and primary manufactured goods based on data provided by Waterborne Commerce Statistics. The miscellaneous commodity growth was held constant throughout the period of analysis. The growth rates were applied to baseline tonnages to compute tonnage by commodity for 2023, 2033, 2043, and 2053. These tonnages were applied to the loading pattern distributions to determine the number of calls needed to transport each commodity in the given years. These call lists were loaded into HarborSym to calculate transportation costs for the FWOP and FWP conditions.

Table 9 Commodity Forecast (Metric Tons)

Commodity Name	2016	2023	2033	2043	2053	CAGR 2016-2053
Petroleum Products Imports	1,521,437	1,665,406	1,895,023	2,156,299	2,453,598	1.3%
Scrap Metal Exports	197,816	227,228	276,990	337,649	411,593	2.0%
Salt Imports	238,123	284,992	368,389	476,190	615,537	2.6%
Primary Manufactured Goods Imports	228,766	255,651	299,630	351,174	411,584	1.6%
Miscellaneous Imports	162,703	162,703	162,703	162,703	162,703	0.0%
Total	**2,348,845**	**2,595,981**	**3,002,735**	**3,484,015**	**4,055,015**	**1.5%**

Vessel Traffic

Vessel Fleet

For this analysis, the fleet forecast distributions were derived using Waterborne Commerce data for the 2011-2016 time period for New Haven Harbor. The fleet for petroleum products is projected to have a maximum 50,000-DWT tankership with dimensions of 700 feet LOA, 106 feet beam, and 43 feet maximum summer load-line draft. The fleet for salt imports is projected to have a maximum 60,000-DWT bulk carrier with dimensions of 700 feet LOA, 106 feet beam, and 43.6 feet maximum summer load-line draft.

It is felt that utilization of vessels larger than 60-70,000 DWT would generally not occur because storage capacity and dock facilities at most terminals do not appear to be adequate for ships of this size. At this point in time, there are no firm commitments to substantially expand and improve facilities to handle such ships on a regular basis. The one exception is Gateway Terminal that has a berth designed to handle a 70,000 DWT vessel with 735 foot LOA and 110 foot beam.

Design Vessel

Per EM 1110-2-1613, the design vessel is defined as "…the largest ship of the major commodity movers expected to use the project improvements on a frequent and continuing basis." The design vessels for New Haven Harbor are assumed to be a 50,000-DWT tankership with dimensions of 700 feet LOA, 106 feet beam, and 43 feet maximum summer load-line draft and a 60,000 DWT bulk carrier with dimensions of 700 feet LOA, 106 feet beam, and 43.6 feet maximum summer load-line draft. The design vessel was chosen to ensure the designed channel with improvements would be able to safely accommodate the larger vessels that are likely to use the harbor, although in rare cases an even larger vessel could use the harbor. This selection is based on analysis of the world and regional fleet of tankerships and bulk carriers most likely to use New Haven Harbor over the study period. This is echoed in data from similar vessels that visit ports along the Northeastern Coast, including New York Harbor and Philadelphia Harbor.

Route Groups

Trade routes were grouped based on general world regions. Distances were calculated using Origin-Destination nautical miles data from NNOMPEAS. A prior port/next port depth analysis was conducted to determine if vessels calling at New Haven also called on other ports during its transit that could potentially impact loading practices at New Haven. It was found that only smaller, non-benefitting vessel classes called on ports with depths less than 40 feet MLLW.

Table 10 Nautical Miles by Route Groups

	Distance (Nautical Miles)		
Route Group	**Minimum**	**Most Likely**	**Maximum**
Default Route Group	1	1	1
Asia	17,714	23,014	25,730
Canada	946	1,403	18,564
Caribbean-Gulf	2,482	6,197	9,874
Mediterranean	6,180	9,801	11,030
Northern Europe	2,538	6,780	8,532
South America	4,558	8,861	14,172

Note: Canada route group includes distances for vessels transiting from the west coast of Canada to New Haven Harbor.

Alternatives for Economic Evaluation

Alternative plans were developed to address vessel delays and inefficient vessel loading issues throughout the channel. Alternatives analyzed were channel depths of 37 feet, 38 feet, 40 feet, and 42 feet. Costs were provided for the Federal Base Plan (the least costly dredged material placement option) to achieve these depths. In addition, a Beneficial Use Plan for some of the dredged material that is not a least-cost option was identified during the feasibility study. The Beneficial Use plan includes the Sandy Point Salt Marsh Creation as a dredged material placement option. The concept of this disposal alternative is to beneficially reuse dredged sediment for the purpose of creating new tidal wetland (salt marsh) area and shoreline erosion mitigation at Sandy Point. The Sandy Point project site is located along the western shore of the inner New Haven Harbor, just north and in the lee of a spit of land known as Sandy Point, in the vicinity of the West Haven Water Pollution Control Facility at 1 First Avenue, West Haven. The spit that extends along the southern boundary is currently undeveloped and is identified as a bird sanctuary. The Beneficial Use Plan is discussed in more detail in the main report and is not included in this economic analysis to identify the plan that reasonably maximizes net economic development benefits.

Calculation of Costs

The main report and engineering appendix should be referenced for specific details and assumptions regarding construction and O&M costs. Interest during construction (IDC) was calculated based on the Project First Cost and construction schedule.

Table 11 Project Cost Summary

Alternative	Project Costs	IDC	Total Investment	AAEQ Total Investment	AAEQ OMRR&R	Total AAEQ	Incremental AAEQ Costs
37 Feet	$61,113,000	$1,152,000	$62,265,000	$2,306,000	$126,000	$2,432,000	
38 Feet	$76,367,000	$1,775,000	$78,142,000	$2,894,000	$166,000	$3,060,000	$364,000
40 Feet	$92,355,000	$2,402,000	$94,757,000	$3,510,000	$254,000	$3,764,000	$536,000
42 Feet	$112,089,000	$3,098,000	$115,187,000	$4,267,000	$343,000	$4,610,000	$572,000

Transportation Cost Savings Benefit Analysis

The following section describes the economic analysis completed to determine the national economic development (NED) benefits of the proposed study measures. For the purposes of Deep Draft Navigation Economic Analysis per ER 1105-2-100, an NED benefit may include the following:

- Reduced cost of transportation through use of vessels (modal shift) , through safer or more efficient operation of vessels and/or use of larger and more efficient vessels (channel enlargement), and through use of new or alternate vessel routes (new channels or port shift)
- Increased net return to producers from access to new sources of lower cost materials, or access to new and more profitable markets (shift of origin or destination)
- Increased production through new or greater production opportunity (commercial fishing and offshore minerals), or new economic activities involving new commodity movements (induced movements)

The benefits described above are meant to increase shipping efficiency, leading to a reduction in the total cost of commodity transit. The reduction in transportation costs becomes a national economic benefit when the savings are passed on to the consumer.

The purpose of this analysis is to describe the benefits associated with the channel modification improvements for the project alternatives under consideration for New Haven Harbor. NED benefits were estimated by calculating the reduction in transportation cost for each alternative using the HarborSym Modeling Suite of Tools (HMST) developed by IWR. The HMST reflects USACE guidance on transportation cost savings analysis.

Within this section, the HMST and its application in the study are described in detail.

Methodology

Channel improvements result in reduced transportation cost by allowing a more efficient future fleet mix, resulting in at-sea and in-port cost savings. The HMST was designed to allow users to model these benefits. With a deepened channel, vessel fleet owners allocate their largest vessels to routes that have adequate traffic and reliable project depth. As New Haven Harbor is deepened, the reliability of the channel depth increases. The increased reliability is expected to encourage shippers to replace smaller less efficient vessels with the larger more efficient vessels on New Haven Harbor route services.

There are three primary effects from channel deepening that lead to changes in the future fleet at the Port of the New Haven. The first is an increase in a vessel’s maximum practicable loading capacity. Channel restrictions limit a vessels capacity by limiting its draft. Deepening the channel reduces this constraint and the vessel’s maximum practicable capacity increases towards its design capacity. This increase in vessel capacity results in fewer required vessel trips to transport the forecasted cargo. The second effect of increased channel depth is the increased reliability of water depth, which encourages the deployment of larger vessels to New Haven. The third effect is a consequence of the second. The increase in larger vessels displaces the less economically efficient vessels.

To begin, HarborSym was setup with the basic required variables. To estimate origin-destination (OD) cost saving benefits (or the reduction in transit costs associated with a drop in the total number of port calls caused by deeper loading or the use of a more efficient fleet mix), the HMST was used to generate a vessel call list based on the commodity forecast at New Haven for a given year and available channel depth under the various alternatives. The resulting vessel traffic was simulated using HarborSym, producing average annual vessel OD transportation costs. The Tentatively Selected Plan (TSP) was identified by considering the highest net benefit based on the OD transportation cost saving benefits.

HarborSym Model Overview

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 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.

Model Behavior

HarborSym is an event driven model. Vessel calls are processed individually and the interactions with other vessels are taken into account. For each iteration, the vessel calls for an iteration that falls within the simulation period are accumulated and placed in a queue based on arrival time. When a vessel arrives at the port, the route to all of the docks in the vessel call is determined. This route is comprised of discrete legs (contiguous sets of reaches, from the entry to the dock, from a dock to another dock, and from the final dock to the exit). The vessel attempts to move along the initial leg of the route. Potential conflicts with other vessels that have previously entered the system are evaluated according to the user-defined set of rules for each reach within the current leg, based on information maintained by the simulation as to the current and projected future state of each reach. If a rule activation occurs, such as no passing allowed in a given reach, the arriving vessel must either delay entry or proceed as far as possible to an available anchorage, waiting there until it can attempt to continue the journey. Vessels move from reach to reach, eventually arriving at the dock that is the terminus of the leg.

After the cargo exchange calculations are completed and the time the vessel spends at the dock has been determined, the vessel attempts to exit the dock, starting a new leg of the vessel call; rules for moving to the next destination (another dock or an exit of the harbor) are checked in a similar manner to the rule checking on arrival, before it is determined that the vessel can proceed on the next leg. As with the entry into the system, the vessel may need to delay departure and re-try at a later time to avoid rule violations and, similarly, the waiting time at the dock is recorded.

A vessel encountering rule conflicts that would prevent it from completely traversing a leg may be able to move partially along the leg, to an anchorage or mooring. If so, and if the vessel can use the anchorage (which may be impossible due to size constraints or the fact that the anchorage is filled by other vessels), then HarborSym will direct the vessel to proceed along the leg to the anchorage, where it will stay and attempt to depart periodically, until it can do so without causing rule conflicts in the remainder of the leg. The determination of the total time a vessel spends within the system is the summation of time waiting at entry, time transiting the reaches, time turning, time transferring cargo, and time waiting at docks or anchorages. HarborSym collects and reports statistics on individual vessel movements, including time in system, as well as overall summations for all movements in an iteration.

HarborSym was initially developed as a tool for analyzing channel widening projects, which were oriented toward determining time savings for vessels transiting within a harbor. It did not allow for assessing changes in vessel loading or in shipping patterns. The most recent release of HarborSym was designed to assist analysts in evaluating channel-deepening projects, in addition to the original model capabilities. The deepening features consider fleet and loading changes, as well as incorporating calculations for both within harbor costs and costs associated with ocean voyage.

Each vessel call has a known (calculated) associated cost, based on time spent in the harbor and ocean voyage and cost per hour. Also for each vessel call, the total quantity of commodity transferred to the port (both import and export) is known, in terms of commodity category, quantity, tonnage and value. The basic problem is to allocate the total cost of the call to the various commodity transfers that are made. Each vessel call may have multiple dock visits and multiple commodity transfers at each visit, but each commodity transfer record refers to a single commodity and specifies the import and export tonnage. Also, at the commodity level, the "tons per unit" for the commodity is known, so that each commodity transfer can be associated with an export and import tonnage. As noted above, the process is greatly simplified if all commodity transfers within a call are for categories that are measured in the same unit, but that need not be the case.

When a vessel leaves the system, the total tonnage, export tonnage, and import tonnage transferred by the call are available, as is the total cost of the call. The cost per ton can be calculated at the call level (divide total cost by respective total of tonnage). Once these values are available, it is possible to cycle through all of the commodity transfers for the vessel call. Each commodity transfer for a call is associated with a single vessel class and unit of measure. Multiplying the tons or value in the transfer by the appropriate per ton cost, the cost totals by class and unit for the iteration can be incremented. In this fashion, the total cost of each vessel call is allocated proportionately to the units of measure that are carried by the call, both on a tonnage and a value basis. Note that this approach does not require that each class or call carry only a commensurate unit of measure.

The model calculates import and export tons, import and export value, and import and export allocated cost. This information allows for the calculation of total tons and total cost, allowing for the derivation of the desired metrics at the class and total level. The model can thus deliver a high level of detail on individual vessel, class, and commodity level totals and costs.

Either all or a portion of the at-sea costs are associated with the subject port, depending on whether the vessel call is a partial or full load. The at-sea cost allocation procedure is implemented within the HarborSym Monte-Carlo processing and utilizes the estimate total trip cargo (ETTC) field from the vessel call information along with import tonnage and export tonnage. In all cases the ETTC is the user's best estimate of total trip cargo. Within the BLT and CLT, the ETTC field is estimated as cargo on board the vessel at arrival plus cargo on board the vessel at departure, in tons. ETTC can also be expressed as:

ETTC = 2*Cargo on Board at Arrival – Import tons + Export tons

There is a basic algorithm implemented to determine the fraction of at-sea costs to be allocated to the subject port. First, if ETTC for a vessel call is equal to zero or null, then none of the at-sea costs are associated with the port. The algorithm then checks if import or export tons are zero for a vessel call. If either are zero, then the following equation is applied to determine the at-sea cost allocation fraction associated with the subject port:

At-Sea Cost Allocation Fraction = (Import tons + Export tons)/ETTC

Finally, when both import and export tons are greater than zero, the following equation is applied to determine the at-sea cost allocation fraction associated with the subject port:

At-Sea Cost Allocation Fraction = 0.5 * (Import tons/Tonnage on board at arrival)

+ 0.5 * (Export tons/Tonnage on board at departure)

Where: Tonnage on board at arrival = (ETTC + Imports – Exports)/2

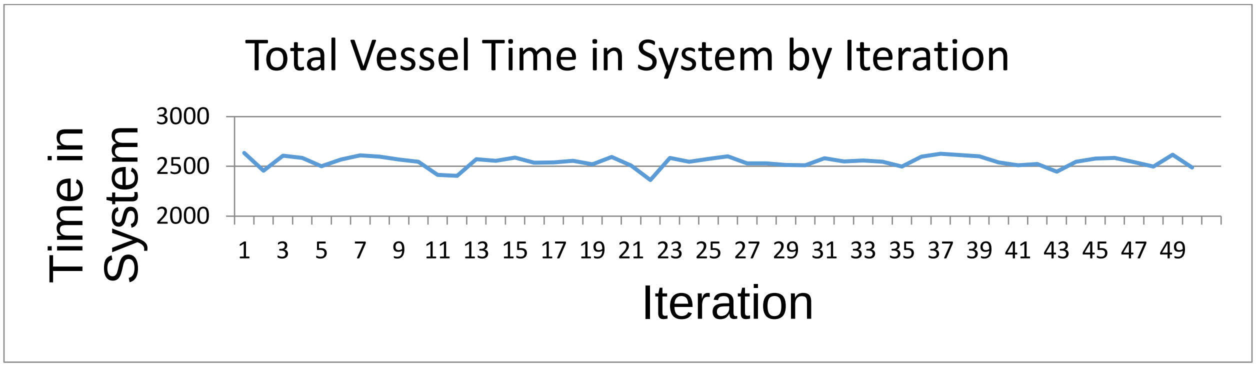
Tonnage on board at departure = Tonnage on board at arrival – Imports + Exports

HarborSym Data Inputs

Data requirements for running HarborSym are separated into six categories, as described below. Key data for New Haven Harbor are provided.

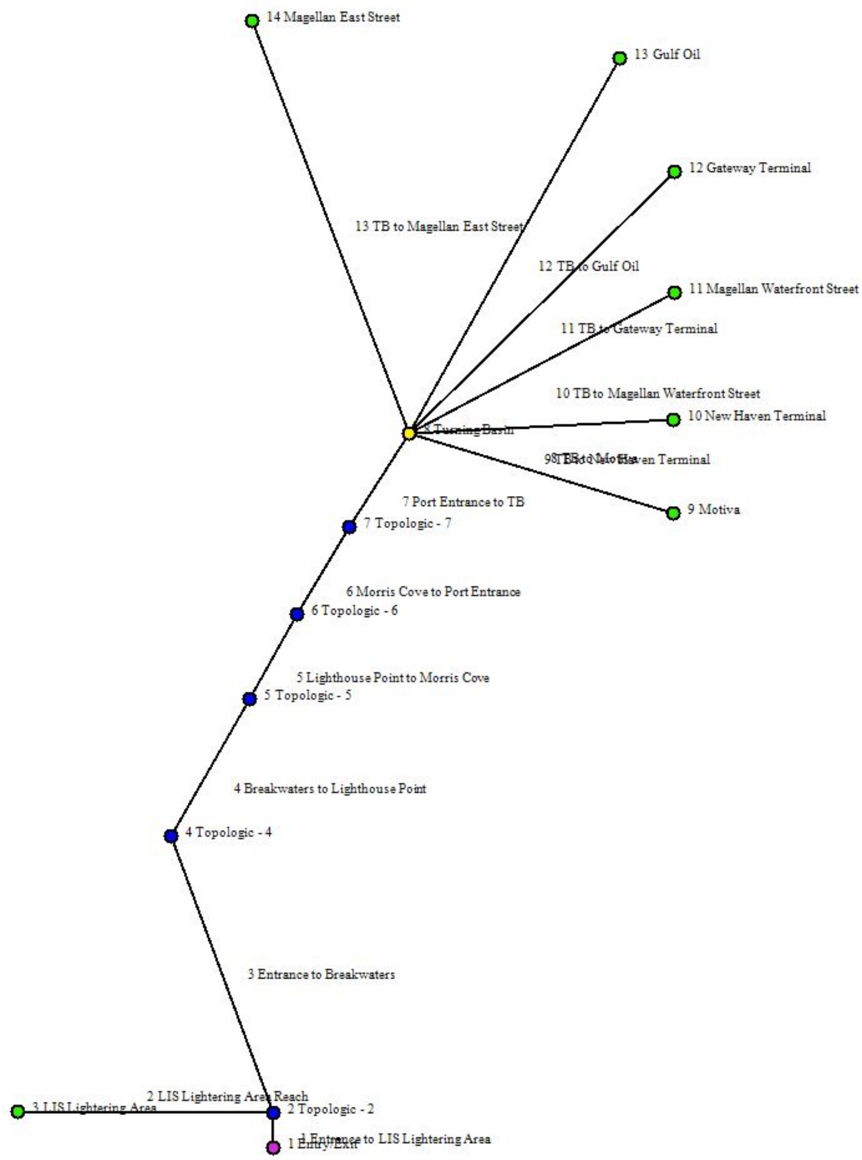
Simulation Parameters. Parameters include start date, the duration of the iteration, the number of iterations, the level of detail of the result output, and the wait time before rechecking rule violations when a vessel experiences a delay. The base year for the model was 2023. Model runs at 50 iterations were performed for the following years: 2023, 2033, 2043, and 2053. Model runs of forecast year 2023 showed a standard deviation of total vessel time in system of 57 hours through 50 iterations (Figure 12).

Figure 12 Total Vessel Time in Model by Iteration



Physical and Descriptive Harbor Characteristics. These data inputs include the specific network of New Haven Harbor such as the node location and type, reach length, width, and depth, in addition to tide and current stations. This also includes information about the docks in the harbor such as length and the maximum number of vessels the dock can accommodate at any given time. Figure 13 provides an overview of the reach-node network developed for this study.

Figure 13 HarborSym Node Network



General Information. General information used as inputs to the model include: specific vessel and commodity classes, route groups, specifications of turning area usage at each dock, and specifications of anchorage use within the harbor. Distances between the route groups were developed by evaluating the trade routes calling on New Haven Harbor. Those routes were separated into trade lanes based on their world region. The route group distance included in the analysis for each trade lane is calculated from the average distance for each trade route that was identified for the specific trade lane, as shown in Table 13.

Table 12 Nautical Miles by Route Group

	Distance (Nautical Miles)		
Route Group	**Minimum**	**Most Likely**	**Maximum**
Default Route Group	1	1	1
Asia	17,714	23,014	25,730
Canada	946	1,403	18,564
Caribbean-Gulf	2,482	6,197	9,874
Mediterranean	6,180	9,801	11,030
Northern Europe	2,538	6,780	8,532
South America	4,558	8,861	14,172

Note: Canada route group includes distances for vessels transiting from the west coast of Canada to New Haven Harbor.

Vessel Speeds. Table 14 presents the average vessel speed by reach group for all vessels. These speeds in reach were provided by the Connecticut Pilot's Association.

Table 13 Vessel Speed by Reach

Reach	Speed in Reach, Light (knots)	Speed in Reach, Loaded (knots)
Entrance to LIS Lightering Area	8	7
LIS Lightering Area Reach	8	7
Entrance to Breakwaters	8	7
Breakwaters to Lighthouse Point	8	7
Lighthouse Point to Morris Cove	8	7
Morris Cove to Port Entrance	8	7
Port Entrance to TB	6	5
TB to Motiva	3	2
TB to New Haven Terminal	3	2
TB to Magellan Waterfront Street	3	2
TB to Gateway Terminal	3	2
TB to Gulf Oil	3	2
TB to Magellan East Street	3	2

Vessel Operations. Hourly operating costs while in-port and at-sea were determined for all vessel classes. These are based on the most recent vessel operating costs developed by the Institute for Water Resources (IWR). The IWR data also includes inputs for at-sea speed by vessel class. These values are entered as a triangular distribution and presented in Table 15.

Table 14 Vessel Speed at Sea

Description	Vessel Speed at Sea, Min (knots)	Sea, Most Likely (knots)	Vessel Speed at Sea, Max (knots)
BLK-1	11	12	13
BLK-2	11.3	12.3	13.3
BLK-3	11.5	12.5	13.5
BLK-4	11.7	12.7	13.7
BLK-5	11.8	12.8	13.8
BLK-6	11.9	12.9	13.9
GCC-1	11.4	12.4	13.4
GCC-3	11.9	12.9	13.9
GCC-5	12.9	13.9	14.9
GCC-6	13.4	14.4	15.4
TK-1	12.2	13.2	14.2
TK-3	12.1	13.1	14.1
TK-4	12.4	13.4	14.4
TK-5	12.2	13.2	14.2

Reach Transit Rules. Vessel transit rules for each reach reflect restrictions on one-way traffic and draft constraints to simulate actual conditions in the port. The most significant changes to transit rules for this study are related to the allowance for deeper loading for all vessels.

Vessels Calls. The vessel call lists are made up of forecasted vessel calls for a given year. Each vessel call list contains the following information: arrival date, arrival time, vessel name, entry point, exit point, arrival draft, import/export, dock name, dock order, commodity, units, origin/destination, vessel type, Lloyds Registry, net registered tons, gross registered tons, dead weight tons, capacity, length overall, beam, draft, flag, tons per inch immersion factor, ETTC, and the route group for which it belongs.

The forecasted commodities for New Haven Harbor were allocated to the future vessel fleet. Historical loading data was used to inform a Load Factor Analysis which was used in determining the future vessel fleet's total number of calls, total cargo onboard, import and export totals, arrival and departure drafts, as well as at-sea cost allocations. A separate vessel fleet forecast was completed for each alternative plan. Vessel calls by vessel class for the Future Without-Project and recommended plan are shown in Table 16.

Table 15 Vessel Calls by Class

Vessel Class	Future Without Project	37 Feet	38 Feet	40 Feet	42 Feet
			2023		
BLK-1	4	1	0	1	0
BLK-2	8	6	6	4	4
BLK-3	6	5	4	4	4
BLK-4	7	6	6	5	4
BLK-5	26	25	24	21	20
BLK-6	3	3	3	3	3
GCC-1	4	2	2	2	2
GCC-5	1	0	0	0	0
GCC-6	2	1	1	1	0
TK-1	16	14	12	11	11
TK-4	49	41	41	38	36
TK-5	14	14	14	14	15
Dry Cargo Barge	4	1	0	0	0
Liquid Barge	2	0	0	0	0
Total	**145**	**119**	**113**	**104**	**99**
			2033		
BLK-1	4	1	1	1	0
BLK-2	10	8	8	6	7
BLK-3	6	5	4	4	4
BLK-4	8	7	7	5	4
BLK-5	28	27	27	24	22
BLK-6	4	4	4	4	4
GCC-1	4	2	2	2	2
GCC-5	1	0	0	0	0
GCC-6	2	1	1	1	1
TK-1	16	14	13	11	11

TK-4	54	49	49	41	40
TK-5	16	16	17	15	16
Dry Cargo Barge	5	1	0	0	0
Liquid Barge	3	0	0	0	0
Total	**161**	**135**	**132**	**114**	**110**
		2043			
BLK-1	4	2	1	1	0
BLK-2	14	12	12	7	9
BLK-3	6	5	4	4	4
BLK-4	8	8	8	6	4
BLK-5	28	28	27	24	24
BLK-6	7	7	7	7	7
GCC-1	5	2	2	2	2
GCC-5	1	0	0	0	0
GCC-6	2	1	1	1	1
TK-1	16	14	13	11	11
TK-4	57	51	52	45	42
TK-5	19	19	20	18	19
Dry Cargo Barge	6	1	0	0	0
Liquid Barge	3	0	0	0	0
Total	**175**	**150**	**146**	**125**	**123**
		2053			
BLK-1	4	1	1	1	0
BLK-2	19	15	15	9	8
BLK-3	8	7	6	6	6
BLK-4	8	8	8	8	7
BLK-5	28	28	27	24	23
BLK-6	10	10	10	10	10
GCC-1	5	2	2	2	2
GCC-5	1	0	0	0	0
GCC-6	2	1	1	1	1
TK-1	17	14	12	12	12
TK-4	64	55	56	48	46
TK-5	22	22	23	22	23
Dry Cargo Barge	8	1	0	0	0
Liquid Barge	3	0	0	0	0
Total	**198**	**164**	**160**	**142**	**138**

Origin Destination Transportation Cost Savings

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).

Transportation costs were estimated for a 50-year period of analysis for the years 2023 through 2072. Transportation costs were estimated using HarborSym for the years 2023, 2033, 2043, and 2053. The present value was estimated by interpolating between the modeled years and discounting at the current FY 2018 Federal Discount Rate of 2.75 percent. Estimates were determined for each alternative project depth.

Table 17 provides the annual transportation costs. For the Origin-Destination (OD) costs, at-sea costs comprise approximately 96 percent of the total costs. The transportation cost saving benefit summary is provided in Table 18. The AAEQ transportation cost saving benefits are provided in Table 19.

Table 16 Annual Transportation Cost Allocated to Port

Year	Future Without Project	37 Feet	38 Feet	40 Feet	42 Feet
2023	**$51,398,000**	**$48,641,000**	**$47,718,000**	**$44,345,000**	**$46,011,000**
2024	$52,084,000	$49,401,000	$48,607,000	$45,075,000	$46,508,000
2025	$52,770,000	$50,162,000	$49,497,000	$45,805,000	$47,005,000
2026	$53,456,000	$50,922,000	$50,386,000	$46,535,000	$47,501,000
2027	$54,142,000	$51,682,000	$51,275,000	$47,265,000	$47,998,000
2028	$54,828,000	$52,443,000	$52,165,000	$47,995,000	$48,495,000
2029	$55,514,000	$53,203,000	$53,054,000	$48,725,000	$48,992,000
2030	$56,200,000	$53,964,000	$53,943,000	$49,455,000	$49,488,000
2031	$56,886,000	$54,724,000	$54,833,000	$50,185,000	$49,985,000
2032	$57,572,000	$55,484,000	$55,722,000	$50,915,000	$50,482,000
2033	**$58,258,000**	**$56,245,000**	**$56,611,000**	**$51,646,000**	**$50,979,000**
2034	$59,069,000	$56,979,000	$57,406,000	$52,393,000	$51,779,000
2035	$59,880,000	$57,714,000	$58,200,000	$53,141,000	$52,580,000
2036	$60,690,000	$58,448,000	$58,995,000	$53,888,000	$53,381,000
2037	$61,501,000	$59,183,000	$59,789,000	$54,636,000	$54,182,000
2038	$62,312,000	$59,917,000	$60,584,000	$55,384,000	$54,982,000
2039	$63,123,000	$60,652,000	$61,379,000	$56,131,000	$55,783,000
2040	$63,933,000	$61,386,000	$62,173,000	$56,879,000	$56,584,000
2041	$64,744,000	$62,120,000	$62,968,000	$57,627,000	$57,385,000
2042	$65,555,000	$62,855,000	$63,762,000	$58,374,000	$58,186,000
2043	**$66,365,000**	**$63,589,000**	**$64,557,000**	**$59,122,000**	**$58,986,000**
2044	$67,385,000	$64,565,000	$65,531,000	$60,161,000	$59,990,000
2045	$68,404,000	$65,540,000	$66,504,000	$61,199,000	$60,995,000
2046	$69,423,000	$66,515,000	$67,478,000	$62,238,000	$61,999,000
2047	$70,442,000	$67,490,000	$68,452,000	$63,277,000	$63,003,000
2048	$71,462,000	$68,465,000	$69,425,000	$64,316,000	$64,007,000
2049	$72,481,000	$69,440,000	$70,399,000	$65,354,000	$65,011,000
2050	$73,500,000	$70,415,000	$71,373,000	$66,393,000	$66,015,000
2051	$74,519,000	$71,391,000	$72,346,000	$67,432,000	$67,020,000
2052	$75,539,000	$72,366,000	$73,320,000	$68,471,000	$68,024,000
2053-2072	**$76,558,000**	**$73,341,000**	**$74,294,000**	**$69,509,000**	**$69,028,000**

Table 17 Annual Transportation Cost Saving Benefit

Year	37 Feet	38 Feet	40 Feet	42 Feet
2023	**$2,757,000**	**$3,680,000**	**$7,053,000**	**$5,387,000**
2024	$2,683,000	$3,477,000	$7,009,000	$5,576,000
2025	$2,608,000	$3,274,000	$6,965,000	$5,766,000
2026	$2,534,000	$3,070,000	$6,921,000	$5,955,000
2027	$2,460,000	$2,867,000	$6,877,000	$6,144,000
2028	$2,385,000	$2,664,000	$6,833,000	$6,333,000
2029	$2,311,000	$2,460,000	$6,789,000	$6,523,000
2030	$2,237,000	$2,257,000	$6,745,000	$6,712,000
2031	$2,162,000	$2,054,000	$6,701,000	$6,901,000
2032	$2,088,000	$1,850,000	$6,657,000	$7,090,000
2033	**$2,014,000**	**$1,647,000**	**$6,613,000**	**$7,280,000**
2034	$2,090,000	$1,663,000	$6,676,000	$7,290,000
2035	$2,166,000	$1,679,000	$6,739,000	$7,300,000
2036	$2,242,000	$1,696,000	$6,802,000	$7,309,000
2037	$2,319,000	$1,712,000	$6,865,000	$7,319,000
2038	$2,395,000	$1,728,000	$6,928,000	$7,329,000
2039	$2,471,000	$1,744,000	$6,991,000	$7,339,000
2040	$2,547,000	$1,760,000	$7,054,000	$7,349,000
2041	$2,623,000	$1,776,000	$7,117,000	$7,359,000
2042	$2,700,000	$1,792,000	$7,180,000	$7,369,000
2043	**$2,776,000**	**$1,808,000**	**$7,243,000**	**$7,379,000**
2044	$2,820,000	$1,854,000	$7,224,000	$7,394,000
2045	$2,864,000	$1,900,000	$7,204,000	$7,409,000
2046	$2,908,000	$1,945,000	$7,185,000	$7,424,000
2047	$2,952,000	$1,991,000	$7,165,000	$7,439,000
2048	$2,996,000	$2,036,000	$7,146,000	$7,454,000
2049	$3,041,000	$2,082,000	$7,126,000	$7,470,000
2050	$3,085,000	$2,128,000	$7,107,000	$7,485,000
2051	$3,129,000	$2,173,000	$7,087,000	$7,500,000
2052	$3,173,000	$2,219,000	$7,068,000	$7,515,000
2053-2072	**$3,217,000**	**$2,264,000**	**$7,048,000**	**$7,530,000**

Table 18 AAEQ Transportation Cost and Cost Savings

Alternative	AAEQ Transportation Cost	AAEQ Transportation Cost Reduction Benefit
Future Without Project	$64,740,000	
37 Feet	$62,033,000	$2,707,000
38 Feet	$62,484,000	$2,257,000
40 Feet	$57,771,000	$6,970,000
42 Feet	$57,704,000	$7,036,000

Economic Summary

The table below shows the summary for this economic analysis in 2018 dollars.

Table 19 Summary of Benefits and Costs

Alternative	Total AAEQ Costs	Total AAEQ Benefits	Total Net Benefits	Incremental Net Benefits	Benefit/Cost Ratio
37 Feet	$2,432,000	$2,707,000	$275,000		1.1
38 Feet	$3,060,000	$2,257,000	-$804,000	-$1,079,000	0.7
40 Feet	$3,764,000	$6,970,000	$3,206,000	$4,010,000	1.9
42 Feet	$4,610,000	$7,036,000	$2,427,000	-$779,000	1.5

NED Plan

The National Economic Development (NED) plan is that plan that reasonably maximizes net annual benefits. The net annual benefits of an improvement plan are equal to its annual benefits minus its annual costs. The annual benefits, annual costs, benefit to cost ratio (BCR), and annual net benefits for each alternative were evaluated and compared using outputs calculated at the FY18 discount rate of 2.75 percent.

Table 20 above shows the summary for this economic analysis in 2018 dollars. The alternative that reasonably maximizes net annual benefits is the 40 foot alternative and is the NED plan. Net benefits equal $3,206,000 and return a benefit cost ratio around 1.9 at the FY18 discount rate.

Refined 40 Foot Plan Design

Following identification of the NED plan, the USACE refined the design based on a ship simulation study conducted by the USACE's Engineer Research and Development Center (ERDC), Coastal Hydraulics Laboratory (CHL). See Appendix K and discussion in the Coastal Engineer Appendix. Design refinements for the ship simulation study were additional widening of the bend at the breakwater (800 feet versus initial proposal of 700 feet) and widening the existing turning basin 200 feet to the north rather than moving it fully to the north. Costs for the refined plan are provided in Table 21 below. The refined design resulted in a construction cost increase that reduces the net benefits for the project. Net benefits for the refined design are $2,634,000 with a BCR of 1.6.

Table 20 Refined Design Cost Summary

Alternative	Project Costs	IDC	Total Investment	AAEQ Total Investment	AAEQ OMRR&R	Total AAEQ
40 Feet	$92,355,000	$2,402,000	$94,757,000	$3,510,000	$254,000	$3,764,000
40 Feet Refined Design	$100,553,000	$2,744,000	$103,297,000	$3,826,000	$510,000	$4,336,000

Risk and Uncertainty

There is uncertainty that could potentially affect the BCR, primarily that commodity growth rates are uncertain. The projected growth rates published by the Department of Energy varies each year based on the policies of the current administration coming to fruition. It is possible that the current administration will have more favorable views toward the production and consumption of petroleum products.

Sensitivity Analysis

The Principle & Guidelines and subsequent ER1105-2-100 recognize the inherent variability to water resources planning. Navigation projects in particular are fraught with uncertainty about future conditions given ever-changing market conditions. Therefore, this economic evaluation includes a sensitivity analysis in which the most consequential assumptions pertaining to commodity and vessel traffic were adjusted to test the robustness of the final benefit evaluation. The HarborSym model used in the basic evaluation included variations or ranges for many of the variables involved in the vessel costs, loading, distances, etc. However, it used only one commodity and fleet forecast, a key area of potential uncertainty. A sensitivity analysis will be conducted prior to the final report to present results of a potentially different forecast of future commodity traffic at New Haven Harbor.

Socioeconomic and Regional Analysis

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 population for New Haven County and 27 towns that make up the immediate economic study area of New Haven Harbor.

Overview

Population

The New Haven-Milford Metropolitan Statistical Area (MSA) includes New Haven County and 27 towns. The MSA includes approximately 606 square miles of land. Table 22 provides population data for the United States, Connecticut and the New Haven-Milford MSA. The population has increased over the past 25 years, with the New Haven MSA increasing by approximately 6.9 percent, or an average growth rate of .3% per year from 1990 to 2015.

Table 21 Population

Area	Land Area (sq. miles)	1990	2000	2010	2015
United States	3,531,905	248,765,000	281,422,000	308,745,538	321,418,820
Connecticut	4,842	3,287,116	3,405,565	3,574,097	3,590,886
New Haven MSA	606	804,219	824,008	862,477	859,470

Employment and Income

In 2015, approximately 66.2 percent of the New Haven MSA population was in the labor force. The unemployment rate for the MSA was 5.3 percent as of December 2015, lower than the Connecticut employment rate and higher than the United States employment rate. The median household income of the New Haven MSA was $61,640, lower than Connecticut, but higher than the United States national average. The per capita income was $32,852, lower than the average for Connecticut and higher than the national average. Table 23 displays information about Employment and Income.

Table 22 Employment and Income

Area	Population in Labor Force (%)	Unemployment Rate	Median Household Income	Per Capita Income
United States	63%	5.0	$53,889	$28,930
Connecticut	67%	5.4	$70,331	$38,803
New Haven MSA	66%	5.3	$61,640	$32,852

Environmental Justice

An environmental justice analysis was conducted to assess whether the populations currently residing in the vicinity of the proposed New Haven Harbor Navigation Improvement Project can be defined as minority and/or low-income populations. Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, provides that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority populations and low-income populations."

The proposed New Haven Harbor Navigation Improvement project is located in New Haven County, Connecticut. According to the U.S. Bureau of Census 2017, New Haven County had an estimated population of 860,435. Minorities comprise approximately 22.1 percent of the population, most of whom are African Americans. Most of the Port related infrastructures are in the City of New Haven. The median household income was $62,715 for New Haven County residents.

Any individual with total income less than an amount deemed to be sufficient to purchase basic needs of food and shelter, clothing, and other essential goods and services is classified as poor. The amount of income necessary to purchase these basic needs is the poverty line or threshold and is set by the Office of Management and Budget (U. S. Census 2010). The 2010 poverty line for an individual under 65 years of age is $12,060. The poverty line for a three-person family with one child and two adults is $20,420. For a family with two adults and two children the poverty line is $24,600 (U. S. Census 2010).

The proposed harbor deepening would not increase the number of vessels moving through the port on a given year. Although vessel fleet forecast predicts an increase in the number of vessels moving through the port over time as a result of increasing demand, that increase is expected to occur in the Without Project Condition – independent of a harbor deepening project. With deepening of the harbor to a 52-foot depth, the total number of vessels would decrease (when compared to without project conditions) as vessels would be able to load more deeply under the improved conditions.

Since the number of vessels per year is not predicted to increase as a result of the deepening, no landside changes in emissions would occur as a result of the deepening. The Corps predicts a reduction in the number of vessels used to transport cargo for each year (when compared to without project conditions) if the harbor is deepened. As a result, total emissions would decrease in a given year if the harbor is deepened (when compared to without project conditions). Since overall air emissions in the port would decrease slightly as a result of the project (when compared to without conditions), there is no technical need for the project to conduct a detailed analysis of the how those emissions disperse. Additionally, since there would be an overall decrease in emissions (including air toxins when compared to without project conditions), the Corps does not expect any National Ambient Air Quality Standards (NAAQS) violations as a result of harbor deepening. Therefore, a risk-based assessment of the health effects associated with the proposed action is not warranted. Any potential adverse effects of the presently permitted air emissions would be reduced if the harbor is deepened because of the reduction in vessels (when compared to without project conditions).

The Corps evaluated potential project impacts of the proposed harbor deepening and found that the information shows that the proposed action would not cause disproportionately high and adverse impacts to minority populations, low-income populations, or children.

Regional Economic Development Analysis

This report provides estimates of the economic impacts of Civil Works Budget Analysis for the New Haven Harbor, CT Navigation Improvement Project.

The U.S Army Corps of Engineers (USACE) Institute for Water Resources, the Louis Berger Group and Michigan State University has developed a regional economic impact modeling tool called RECONS (Regional ECONomic System) to provide estimates of regional and national job creation, and retention and other economic measures such as income, value added, and sales. This modeling tool automates calculations and generates estimates of jobs and other economic measures, such as income and sales associated with USACE's ARRA spending, annual Civil Work program spending and stem-from effects for Ports, Inland Water Way, FUSRAP and Recreation. This is done by extracting multipliers and other economic measures from more than 1,500 regional economic models that were built specifically for USACE's project locations. These multipliers were then imported to a database and the tool matches various spending profiles to the matching industry sectors by location to produce economic impact estimates. The tool will be used as a means to document the performance of direct investment spending of the USACE as directed by the American Recovery and Reinvestment Act (ARRA). The Tool will also allow the USACE to evaluate project and program expenditures associated with the annual expenditure by the USACE.

Table 24 provides the project information while Table 25 provides the economic impact regions for the New Haven Harbor Navigation Improvement analysis.

Table 23 Project Information

Project Name:	NEW HAVEN HARBOR, CT
Project ID:	23540
Division:	NAD
District:	NEW ENGLAND DISTRICT
Type of Analysis:	Civil Works Budget Analysis
Business Line:	Navigation
Work Activity:	CWB - Navigation

Table 24 Economic Impact Regions

Regional Impact Area:	New Haven-Milford, CT MSA
Regional Impact Area ID:	181
Counties included	New Haven/
State Impact Area:	Connecticut
National Impact:	Yes

Results of the Economic Impact Analysis

The RED impact analysis was evaluated at three geographical levels: Local, State, and National for the 40-foot alternative. The local analysis represents the New Haven impact area which includes approximately 606 square miles of land. The State Level analysis includes the State of Connecticut. The National level includes the 48 contiguous United States.

Table 26 displays the overall spending profile that makes up the dispersion of the total project construction cost among the major industry sectors. The spending profile also identifies the geographical capture rate, also called Local Purchase Coefficient (LPC) in RECONS, of the cost components. The geographic capture rate is the portion of USACE spending on industries (sales) captured by industries located within the impact area. In many cases, IMPLAN's trade flows Regional Purchase Coefficients (RPC's) are utilized as a proxy to estimate where the money flows for each of the receiving industry sectors of the cost components within each of the impact areas.

Table 25 Input Assumptions (Spending and LPCs)

Category	Spending (%)	Spending Amount	Local LPC (%)	State LPC (%)	National LPC (%)
Dredging Fuel	6%	$3,660,000	12%	14%	**90%**
Metals and Steel Materials	4%	$2,580,000	24%	38%	**90%**
Textiles, Lubricants, and Metal Valves and Parts (Dredging)	2%	$1,260,000	14%	24%	**65%**
Pipeline Dredge Equipment and Repairs	5%	$3,120,000	20%	30%	**100%**
Aggregate Materials	3%	$1,740,000	79%	79%	**97%**
Switchgear and Switchboard Apparatus Equipment	0%	$180,000	17%	33%	**80%**
Hopper Equipment and Repairs	2%	$1,140,000	1%	10%	**97%**
Construction of Other New Nonresidential Structures	14%	$8,160,000	100%	100%	**100%**
Industrial and Machinery Equipment Rental and Leasing	7%	$4,380,000	79%	95%	**100%**
Planning, Environmental, Engineering and Design Studies and Services	5%	$2,760,000	88%	88%	**100%**
USACE Overhead	7%	$3,960,000	100%	100%	**100%**
Repair and Maintenance Construction Activities	4%	$2,460,000	100%	100%	**100%**
Industrial Machinery and Equipment Repair and Maintenance	11%	$6,300,000	72%	79%	**100%**
USACE Wages and Benefits	13%	$7,980,000	75%	100%	**100%**
Private Sector Labor or Staff Augmentation	15%	$9,180,000	100%	100%	**100%**
All Other Food Manufacturing	2%	$1,140,000	21%	22%	**90%**
Total	**100%**	**$60,000,000**	**-**	**-**	**-**

The USACE is planning on expending approximately $60,000,000 on the project. Of this total project expenditure $43,652,260 will be captured within the regional impact area. The rest will be leaked out to the state or the nation. The expenditures made by the USACE for various services and products are expected to generate additional economic activity in that can be measured in jobs, income, sales and gross regional product as summarized in the following table and includes impacts to the region, the State impact area, and the Nation. Table 27 is the overall economic impacts for this analysis.

The labor income represents all forms of employment earnings. In IMPLAN's regional economic model, it is the sum of employee compensation and proprietor income. The Gross Regional Product (GRP) which is also known as value added, is equal to gross industry output (i.e., sales or gross revenues The GRP, which is also known as value added, is equal to gross industry output (i.e., sales or gross revenues) less its intermediate inputs (i.e., the consumption of goods and services purchased from other U.S. industries or imported). The number of jobs equates to the labor income.

Table 26 Overall Summary Economic Impacts

Impact Areas Impacts		Regional	State	National
Total Spending		$60,000,000	$60,000,000	**$60,000,000**
Direct Impact				
	Output	$43,652,260	$47,731,676	**$58,666,676**
	Job	439.77	462.21	**501.77**
	Labor Income	$28,186,050	$30,731,601	**$33,918,715**
	GRP	$32,226,704	$35,338,656	**$39,945,750**
Total Impact				
	Output	$80,255,823	$89,949,522	**$156,177,308**
	Job	697.90	752.82	**1,089.28**
	Labor Income	$41,353,718	$46,442,284	**$65,740,782**
	GRP	**$55,277,398**	**$62,495,148**	**$95,063,273**

Tables 28, 29, and 30 present the economic impacts by industry sector both for each geographical region. Note that Labor -5001- is the largest impact area at the regional, state, and national levels, implying that all the labor demand can be met at the regional level.

Table 27 Economic Impact at Regional Level

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
115	Petroleum refineries	$0	0.00	$0	**$0**
171	Steel product manufacturing from purchased steel	$229,781	0.46	$42,947	**$51,656**
198	Valve and fittings other than plumbing manufacturing	$25,788	0.08	$6,770	**$12,730**
201	Fabricated pipe and pipe fitting manufacturing	$37,098	0.10	$12,531	**$19,434**
26	Mining and quarrying sand, gravel, clay, and ceramic and refractory minerals	$851,266	4.03	$409,552	**$508,996**
268	Switchgear and switchboard apparatus manufacturing	$3,791	0.01	$911	**$1,957**
290	Ship building and repairing	$43	0.00	$18	**$22**
319	Wholesale trade businesses	$1,263,006	5.50	$531,469	**$973,660**
322	Retail Stores - Electronics and appliances	$4,661	0.04	$1,987	**$2,753**
323	Retail Stores - Building material and garden supply	$319,521	3.18	$151,388	**$221,595**
324	Retail Stores - Food and beverage	$7,941	0.12	$3,960	**$5,781**
326	Retail Stores - Gasoline stations	$91,765	0.68	$31,903	**$61,059**
332	Transport by air	$574	0.00	$183	**$300**
333	Transport by rail	$49,938	0.11	$16,146	**$28,922**
334	Transport by water	$17,413	0.03	$2,263	**$7,616**
335	Transport by truck	$497,841	3.33	$241,206	**$287,800**
337	Transport by pipeline	$511	0.00	$213	**$208**
36	Construction of other new nonresidential structures	$8,160,000	48.45	$3,268,283	**$4,074,269**
365	Commercial and industrial machinery and equipment rental and leasing	$3,470,368	6.57	$597,184	**$1,855,717**
375	Environmental and other technical consulting services	$2,430,466	22.80	$1,508,181	**$1,516,754**
386	Business support services	$3,953,593	53.82	$2,714,844	**$2,685,977**
39	Maintenance and repair construction of nonresidential structures	$2,457,558	16.80	$1,087,483	**$1,334,439**
417	Commercial and industrial machinery and equipment repair and maintenance	$4,521,025	28.06	$2,893,017	**$3,388,857**
439	* Employment and payroll only (federal govt, non-military)	$5,985,000	45.35	$5,471,077	**$5,985,000**
5001	Labor	$9,180,000	199.99	$9,180,000	**$9,180,000**
69	All other food manufacturing	$93,314	0.26	$12,534	**$21,204**
	Total Direct Effects	$43,652,260	439.77	$28,186,050	**$32,226,704**
	Secondary Effects	$36,603,563	258.13	$13,167,669	**$23,050,694**
	Total Effects	**$80,255,823**	**697.90**	**$41,353,718**	**$55,277,398**

Table 28 Economic Impact at State Level

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
115	Petroleum refineries	$0	0.00	$0	**$0**
171	Steel product manufacturing from purchased steel	$605,181	1.21	$113,111	**$136,049**
198	Valve and fittings other than plumbing manufacturing	$134,991	0.40	$35,438	**$66,635**
201	Fabricated pipe and pipe fitting manufacturing	$332,658	0.97	$112,369	**$174,263**
26	Mining and quarrying sand, gravel, clay, and ceramic and refractory minerals	$851,266	4.03	$409,552	**$508,996**
268	Switchgear and switchboard apparatus manufacturing	$32,117	0.07	$8,131	**$16,847**
290	Ship building and repairing	$104,159	0.35	$43,568	**$51,632**
319	Wholesale trade businesses	$1,315,458	5.73	$554,566	**$1,014,501**
322	Retail Stores - Electronics and appliances	$4,885	0.04	$2,095	**$2,894**
323	Retail Stores - Building material and garden supply	$319,521	3.18	$151,388	**$221,595**
324	Retail Stores - Food and beverage	$7,941	0.12	$3,960	**$5,781**
326	Retail Stores - Gasoline stations	$91,765	0.68	$31,903	**$61,059**
332	Transport by air	$884	0.00	$282	**$461**
333	Transport by rail	$49,938	0.11	$16,146	**$28,922**
334	Transport by water	$17,523	0.03	$2,288	**$7,670**
335	Transport by truck	$497,841	3.33	$241,206	**$287,800**
337	Transport by pipeline	$12,185	0.02	$5,074	**$4,948**
36	Construction of other new nonresidential structures	$8,160,000	48.45	$3,268,283	**$4,074,269**
365	Commercial and industrial machinery and equipment rental and leasing	$4,172,754	7.89	$793,081	**$2,273,470**
375	Environmental and other technical consulting services	$2,430,466	22.80	$1,508,181	**$1,516,754**
386	Business support services	$3,953,593	53.82	$2,714,844	**$2,685,977**
39	Maintenance and repair construction of nonresidential structures	$2,457,558	16.80	$1,087,483	**$1,334,439**
417	Commercial and industrial machinery and equipment repair and maintenance	$4,964,366	30.88	$3,176,712	**$3,721,176**
439	* Employment and payroll only (federal govt, non-military)	$7,941,314	61.01	$7,259,405	**$7,941,314**
5001	Labor	$9,180,000	199.99	$9,180,000	**$9,180,000**
69	All other food manufacturing	$93,314	0.26	$12,534	**$21,204**
	Total Direct Effects	$47,731,676	462.21	$30,731,601	**$35,338,656**
	Secondary Effects	$42,217,845	290.61	$15,710,682	**$27,156,491**
	Total Effects	**$89,949,522**	**752.82**	**$46,442,284**	**$62,495,148**

Table 29 Economic Impact at National Level

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
115	Petroleum refineries	$2,731,838	0.31	$110,302	**$500,078**
171	Steel product manufacturing from purchased steel	$1,868,884	3.76	$349,302	**$420,137**
198	Valve and fittings other than plumbing manufacturing	$646,120	1.96	$169,618	**$318,942**
201	Fabricated pipe and pipe fitting manufacturing	$2,464,019	8.46	$832,327	**$1,290,778**
26	Mining and quarrying sand, gravel, clay, and ceramic and refractory minerals	$859,492	4.08	$413,836	**$514,167**
268	Switchgear and switchboard apparatus manufacturing	$112,543	0.29	$28,633	**$59,123**
290	Ship building and repairing	$1,090,598	4.29	$456,179	**$540,611**
319	Wholesale trade businesses	$1,394,790	6.19	$589,500	**$1,076,272**
322	Retail Stores - Electronics and appliances	$5,760	0.05	$2,516	**$3,445**
323	Retail Stores - Building material and garden supply	$322,129	3.21	$152,649	**$223,418**
324	Retail Stores - Food and beverage	$7,980	0.12	$3,980	**$5,810**
326	Retail Stores - Gasoline stations	$98,818	0.77	$34,831	**$65,996**
332	Transport by air	$3,488	0.01	$1,112	**$1,821**
333	Transport by rail	$71,166	0.17	$23,645	**$41,611**
334	Transport by water	$20,037	0.04	$2,857	**$8,913**
335	Transport by truck	$899,072	6.42	$435,604	**$519,751**
337	Transport by pipeline	$40,246	0.07	$17,752	**$17,077**
36	Construction of other new nonresidential structures	$8,160,000	48.45	$3,268,283	**$4,074,269**
365	Commercial and industrial machinery and equipment rental and leasing	$4,373,601	9.43	$849,098	**$2,392,927**
375	Environmental and other technical consulting services	$2,759,634	25.89	$1,743,320	**$1,752,767**
386	Business support services	$3,958,750	53.91	$2,718,416	**$2,689,512**
39	Maintenance and repair construction of nonresidential structures	$2,459,299	16.81	$1,088,253	**$1,335,385**
417	Commercial and industrial machinery and equipment repair and maintenance	$6,297,867	43.31	$4,030,023	**$4,720,738**
439	* Employment and payroll only (federal govt, non-military)	$7,979,999	61.32	$7,294,769	**$7,979,999**
5001	Labor	$9,180,000	199.99	$9,180,000	**$9,180,000**
69	All other food manufacturing	$860,546	2.46	$121,909	**$212,202**
	Total Direct Effects	$58,666,676	501.77	$33,918,715	**$39,945,750**
	Secondary Effects	$97,510,632	587.51	$31,822,067	**$55,117,523**
	Total Effects	**$156,177,308**	**1,089.28**	**$65,740,782**	**$95,063,273**

Total New Haven Harbor Navigation Improvement Project economic impact for the State of Connecticut (Table 29) is composed of $89,949,522 in sales, approximately 753 jobs, $46 million in labor income and a contribution of $63 million to GRP.

Table 31 presents the demographic data of the impact region. In 2008, the combined metropolitan impact area of New Haven had a population of 848,827 with an area of 619 square miles and a total personal income of $40 billion.

Table 30 Impact Region Definition (2008)

Regional Impact Area ID:	**181**
Regional Impact Area Name:	New Haven-Milford, CT MSA
Impact Area Type	Metropolitan Impact Area
State Impact Region::	Connecticut

County	FIPS	Area (sq. mi)	Population	Households	Total Personal Income (in millions)
New Haven	09009	619	848,827	329,253	**$40,184**
Total		**619**	**848,827**	**329,253**	**$40,184**

Table 32 shows the impact region for 19 selected sectors. It displays the geographical capture amounts for the New Haven-Milford MSA, which is that portion of USACE spending that is captured in the impact area. The labor income represents all forms of employment earnings (in IMPLAN's regional economic model, it is the sum of employee compensation and proprietor income). The GRP is equal to gross industry output (i.e., sales or gross revenues) less its intermediate inputs (i.e., the consumption of goods and services purchased from other U.S. industries or imported). The number of jobs equates to the labor income. The total New Haven-Milford MSA is composed of $75 billion in output (sales), 462,559 employment, $26.5 billion in labor income and a contribution of $40.5 billion to GRP.

Table 31 Impact Region Profile (2008)

Regional Impact Area ID:	**181**
Regional Impact Area Name:	New Haven-Milford, CT MSA
Impact Area Type	Metropolitan Impact Area
State Impact Region::	Connecticut

Section	Output (millions)	Labor Income (millions)	GRP (millions)	Employment
Accommodations and Food Service	$1,871	$685	$1,017	**28,764**
Administrative and Waste Management Services	$1,672	$829	$1,072	**24,368**
Agriculture, Forestry, Fishing and Hunting	$170	$27	$130	**1,590**

Arts, Entertainment, and Recreation	$412	$130	$176	**6,895**
Construction	$3,997	$1,647	$1,804	**27,184**
Education	$3,943	$2,836	$3,120	**49,790**
Finance, Insurance, Real Estate, Rental and Leasing	$5,870	$1,638	$3,801	**28,219**
Government	$3,108	$2,241	$2,561	**30,210**
Health Care and Social Assistance	$6,544	$3,674	$4,280	**69,122**
Imputed Rents	$5,572	$764	$3,639	**26,552**
Information	$4,639	$868	$2,052	**10,564**
Management of Companies and Enterprises	$795	$386	$517	**2,902**
Manufacturing	$20,557	$4,111	$6,237	**43,472**
Mining	$90	$31	$49	**304**
Professional, Scientific, and Technical Services	$5,344	$2,662	$3,325	**32,045**
Retail Trade	$4,101	$1,682	$2,825	**50,415**
Transportation and Warehousing	$1,259	$542	$777	**10,246**
Utilities	$893	$140	$396	**1,409**
Wholesale Trade	$4,180	$1,608	$2,752	**18,508**
Total	**$75,017**	**$26,500**	**$40,529**	**462,559**

The following table shows the top ten industries that typically benefit from the types of expenditures made for this project by the USACE. This analysis was conducted at the national level and thus it cannot be guaranteed that these industries would be present in the regional impact area as analyzed.

Table 32 Top Ten Industries Affected By Work Activity (2008)

Rank	**Industry (millions)**	**IMPLAN No.**	**% of Total Employment**
1	* Employment and payroll only (federal govt, non-military)	439	**8 %**
2	Business support services	386	**7 %**
3	Construction of other new nonresidential structures	36	**6 %**
4	Food services and drinking places	413	**5 %**
5	Commercial and industrial machinery and equipment repair and maintenance	417	**4 %**
6	Real estate establishments	360	**3 %**
7	Wholesale trade businesses	319	**3 %**
8	Employment services	382	**3 %**
9	Maintenance and repair construction of nonresidential structures	39	**3 %**
10	Offices of physicians, dentists, and other health practitioners	394	**2 %**
			43 %