TEXAS DEPARTMENT OF TRANSPORTATION - MARITIME DIVISION

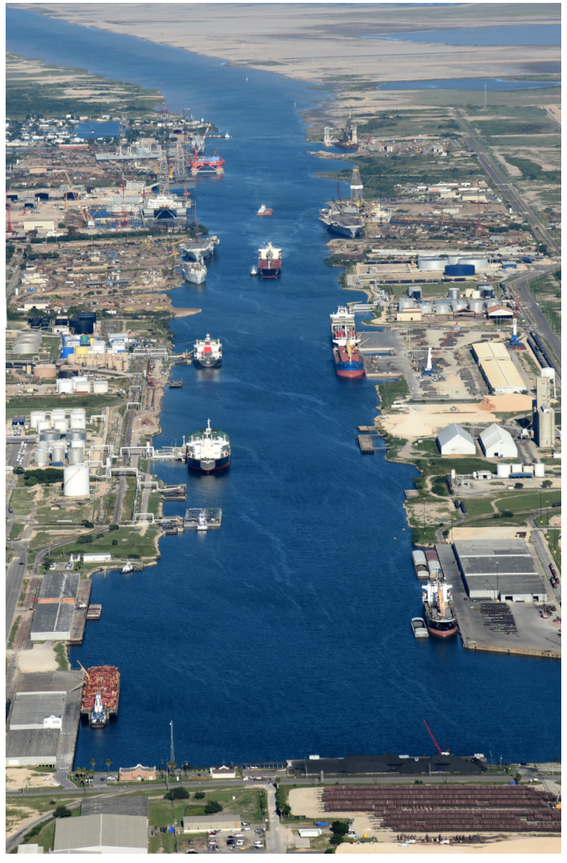
SHIP CHANNEL IMPROVEMENT REPORT

2020-2021 TEXAS PORT MISSION PLAN

Vessel moves on the Sabine-Neches Waterway near the Port of Port Arthur, passing under the Martin Luther King Bridge, which has one of the lowest vertical clearances of any bridge over Texas' deep draft channels.

The Corpus Christi Ship Channel is the only authorized waterway project in Texas to currently have federal appropriations.

Upon completion, Freeport Harbor Channel deepening and widening will increase vessel safety and capacity at Port Freeport.

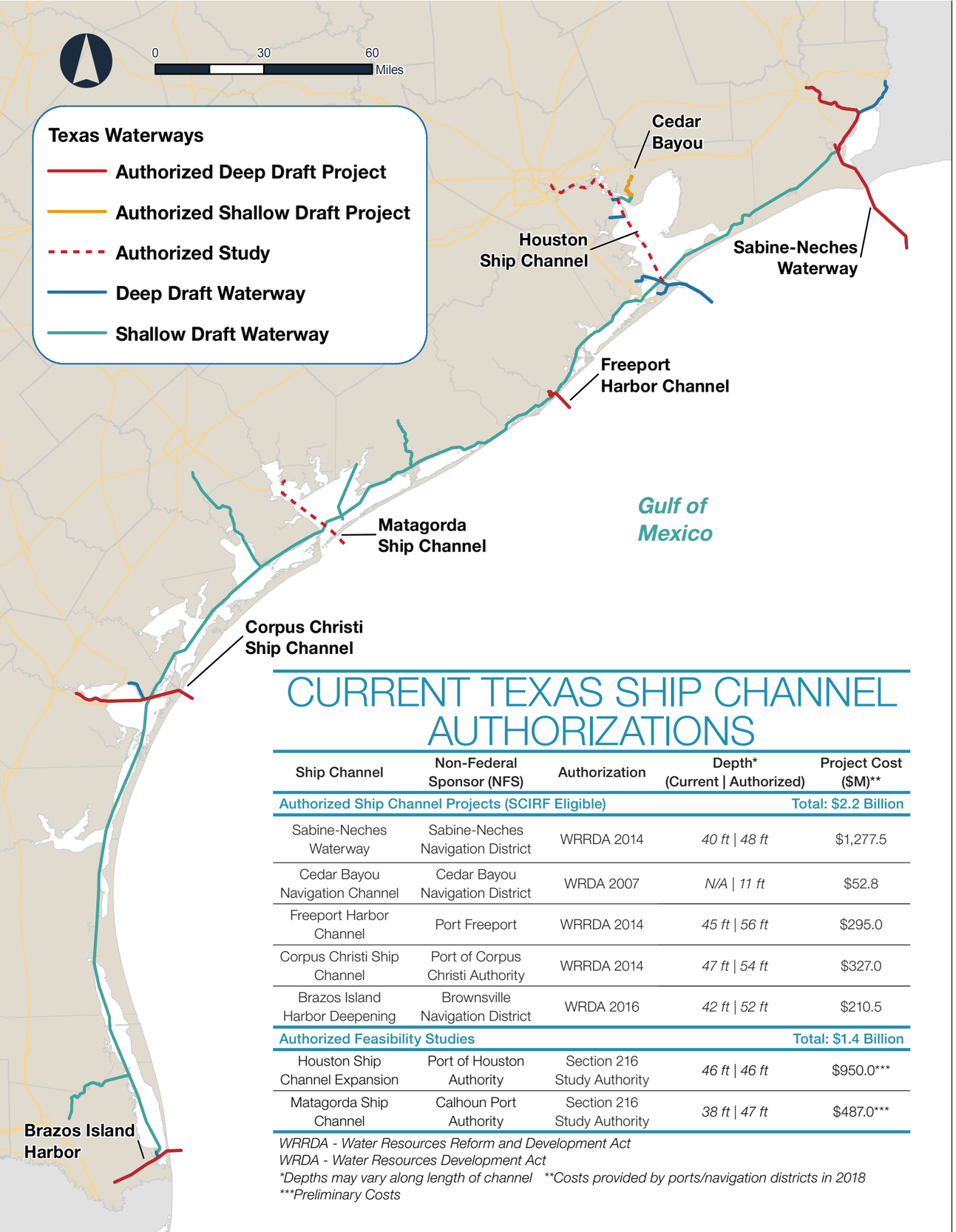


Brazos Island Harbor Channel is the only deep draft channel along the U.S.–Mexico border at the Port of Brownsville.

SHIP CHANNEL IMPROVEMENT REPORT

2020-2021 TEXAS PORT MISSION PLAN

TABLE OF CONTENTS



TEXAS SHIP CHANNELS

Any vessel entering or leaving a Texas seaport relies on well-maintained navigable waterways also known as ship channels. These waterways are the critical thoroughfares of trade, serving as marine "highways" that allow for the movement of goods and people in and out of ports. Texas has 270 miles of deep-draft channels that allow for the movement of large, ocean-going vessels carrying goods to and from both foreign and domestic markets to Texas ports. The 750 miles of shallow-draft channels in Texas support barge activity and smaller vessels that move goods around the Gulf of Mexico and other Texas waterways. The width, depth, and navigability of a waterway that serves a port directly affect the kinds of vessels and markets a port can serve. It is important to not only maintain Texas waterways so that vessels can continue to move in and out of ports safely and efficiently, but also deepen and widen certain channels so that they are equipped to receive the next generation of larger vessels to accommodate an anticipated increase in cargo tonnage.

Texas is home to 11 deep-draft ports with ship channels at least 30 feet deep and seven shallow-draft ports, all of which rely on their waterways to move goods in and out of the port. The U.S. Army Corps of Engineers (USACE) operates and maintains the federal ship channels with ports and navigation districts serving as Non-Federal Sponsors (NFS) that are responsible for funding a portion of channel improvement project costs. Securing federal funding for navigation projects remains a challenge. The congressional authorization and appropriation process for USACE projects, including ship channel improvement projects, can take decades, which has contributed to the nearly $96 billion backlog of federal water resources projects nationwide.

The Texas Department of Transportation (TxDOT) Maritime Division has completed this Ship Channel Report as part of the 2020-2021 Texas Port Mission Plan (PMP), the maritime mission plan required in Chapter 55 of the Texas Transportation Code. The PMP highlights the importance of investing in the port system in order to meet the growth potential of global trade opportunities. The Ship Channel Improvement Report identifies and summarizes congressionally authorized ship channel improvement projects and feasibility studies across the state. Ship channel improvement projects are investments that are costly and time-sensitive. Delays in funding and implementing navigation projects can lead to missed opportunities for attracting tenants, increases in overall project costs, and loss of returns on the overall investment.

WHAT IS THE SHIP CHANNEL IMPROVEMENT REVOLVING FUND?

The 85th Texas Legislature passed Senate Bill (SB) 28, establishing the Ship Channel Improvement Revolving Fund (SCIRF) and Loan Program. This creates a program to help finance congressionally-authorized ship channel deepening and widening projects. The SCIRF has not been previously capitalized, but should it receive funding, it will serve as a financial tool for Non-Federal Sponsors to advance projects while they await federal funding.

CURRENT TEXAS SHIP CHANNEL AUTHORIZATIONS

Ship Channel	Non-Federal Sponsor (NFS)	Authorization	Depth* (Current | Authorized)	Project Cost ($M)**
Authorized Ship Channel Projects (SCIRF Eligible)				**Total: $2.2 Billion**
Sabine-Neches Waterway	Sabine-Neches Navigation District	WRRDA 2014	*40 ft | 48 ft*	$1,277.5
Cedar Bayou Navigation Channel	Cedar Bayou Navigation District	WRDA 2007	*N/A | 11 ft*	$52.8
Freeport Harbor Channel	Port Freeport	WRRDA 2014	*45 ft | 56 ft*	$295.0
Corpus Christi Ship Channel	Port of Corpus Christi Authority	WRRDA 2014	*47 ft | 54 ft*	$327.0
Brazos Island Harbor Deepening	Brownsville Navigation District	WRDA 2016	*42 ft | 52 ft*	$210.5
Authorized Feasibility Studies				**Total: $1.4 Billion**
Houston Ship Channel Expansion	Port of Houston Authority	Section 216 Study Authority	*46 ft | 46 ft*	$950.0***
Matagorda Ship Channel	Calhoun Port Authority	Section 216 Study Authority	*38 ft | 47 ft*	$487.0***

WRRDA - Water Resources Reform and Development Act
WRDA - Water Resources Development Act
**Depths may vary along length of channel **Costs provided by ports/navigation districts in 2018*
****Preliminary Costs*

NEED FOR CHANNEL IMPROVEMENTS

Deepening and widening ship channels is important for safety. Deeper channels mean fewer ships having the risk of running aground when loaded. Wider channels allow for safer passing of vessels, making it easier for pilots to navigate the channel, and allowing more ships to move through the channel safely. This is especially important in Texas, as many of the vessels traveling to and from the ports are oil tankers and ships carrying hazardous materials.

The world vessel fleet is increasing both in number and vessel size. The Panama Canal, which had been the benchmark for vessel sizes traveling to the U.S. since its original construction in 1914, was expanded in 2016 to accommodate a newer, larger fleet connecting the Texas economy with countries across the Asian region. Even before the completion of the Panama Canal expansion, larger vessels were already calling on Texas ports via oceanic trade routes as the shipping industry began transitioning the maritime fleet operating along the U.S. coast to larger sizes.

Ships can only stop or "call" at ports with channels that are deep enough to accommodate their draft, which is the vertical distance between the waterline and the bottom of the ship. At ports where the current draft of the ship channel is not sufficient to support larger vessels, vessels must be light-loaded to allow ship bottom clearance into the channel. This process allows larger ships to call on Texas ports, but is inefficient and reduces the profit margins that the shipping industry would otherwise expect to see from upgrading to a larger vessel fleet.

Shipping lines enjoy substantially lower costs with larger vessels. Between technological advances that allow for the development and operation of larger ships and the growing global demand for goods, shippers reap the benefits of the economies of scale that larger ships provide. Even if these larger ships don't call at Texas ports now, there may be a cascade effect later as larger ships replace the current fleet, increasing the average size of ships calling at ports.

Panama Canal

In 2016, the Panama Canal Authority completed a major expansion project by constructing two new sets of locks that allow larger ships to transit the canal. Now container ships with nearly triple the previous capacity, as well as a new generation of liquefied natural gas (LNG) and bulk carriers, can safely transit the canal. As the Panama Canal is the most efficient trade route for Texas to import and export cargo to and from East Asia, these larger vessels will enable shippers in Texas to more competitively export the state's energy, chemical, and agricultural products worldwide. "Panamax" is a shipping industry term describing the maximum size vessel that could traverse the former Panama Canal. With the completed expansion, larger vessels such as New Panamax and Post-Panamax are now able to cross the Panama Canal, increasing the traffic of the world's largest vessel sizes entering and departing the Gulf of Mexico.

	PANAMAX[1]	NEW PANAMAX[1]
Length	965 ft	1,200 ft
Width	106 ft	160 ft
Draft	39.5 ft	50 ft

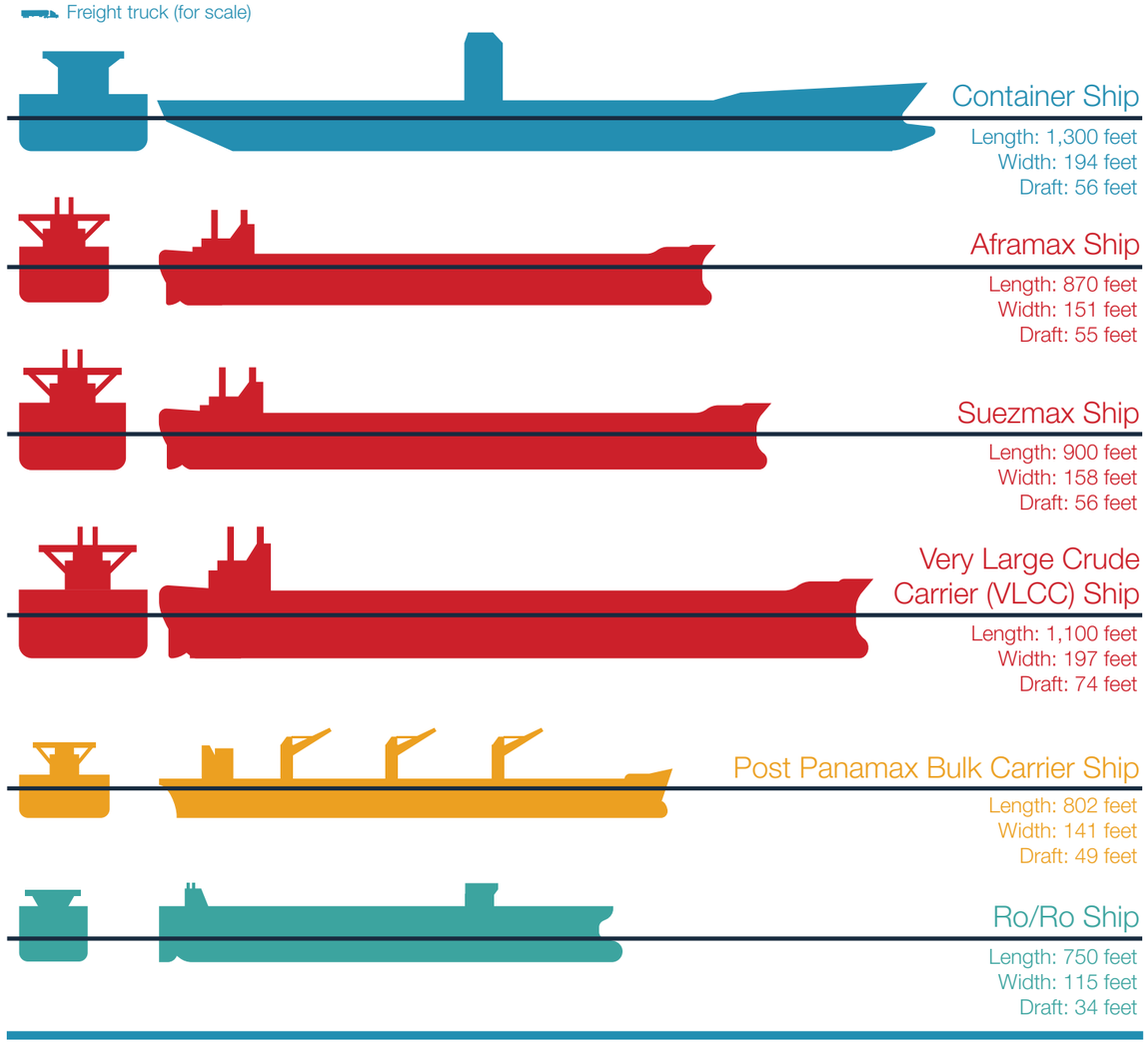
Vessel Trends

The range of vessels calling on Texas ports is highlighted on the following page[1]. As the leading exporting state in the nation, Texas is well-positioned to take advantage of the Panama Canal expansion to increase exports to new and existing markets across the globe. Increasing deep-draft channel capacity in Texas will help ensure that Texas ports will be better able to accommodate larger vessels and remain economically competitive. At their current channel depths and widths, Texas ports will not be able to accommodate the largest of the New Panamax vessels, which have a draft depth of 50 feet and maximum beam width of 160 feet.

MOST COMMON TYPES OF VESSELS:

- **CONTAINER SHIPS –** Cargo ships carrying their entire load in truck-size intermodal containers.
- **OIL TANKERS OR BULK LIQUID CARRIERS –** Ships fitted with tanks to carry liquid bulk cargo such as crude petroleum, petroleum products, chemicals, liquefied gasses, wine, molasses, and similar product tankers (e.g., Aframax, Suezmax, VLCC).
- **BULK CARRIER –** Vessels designed to carry various cargos in bulk quantities such as grain, fertilizers, ore, coal, and cement.
- **SPECIALIZED VESSELS –** Ro/Ro ships carrying cars, trucks, or wheeled containers; refrigerated "reefers" transporting insulated cargo; or heavy lift ships carrying oversized cargo.

SHIP SIZE COMPARISON



FEASIBILITY STUDY INITIATION

- Section 203 of WRDA 1986 and amendments from recent WRDA issuances allow the Non-Federal Sponsor to initiate the study through a Memorandum of Agreement
- Non-Federal Sponsor is obligated to fund, at a minimum, 50 percent of the feasibility study
- USACE funding and participation require allocations in their annual work plan budget for the specific study

FEASIBILITY STUDY

- Evaluates proposed solutions and alternatives
- Identifies plan that maximizes National Economic Development benefits
- Currently a standardized three year process, but many Texas ship channel studies have taken over a decade
- Upon USACE approval, culminates with signed Chief's Report (Assistant Secretary of the Army)
- Currently the Houston and Matagorda Ship Channel Projects are in this step of the process

CONGRESSIONAL PROJECT AUTHORIZATION

- An individual project requires federal authorization for construction through a signed bill or WRDA
- WRDA bills have been issued as frequently as biennially or as infrequently as once a decade

PROJECT FUNDING, DESIGN AND CONSTRUCTION

- A Project Partnership Agreement (PPA) provides a legally binding agreement between the Federal Government and a Non-Federal Sponsor for construction of a ship channel improvement project
- The PPA documents the required local match percentage designated in the approved Chief's Report which varies based on the identified improvements
- Federal funding is infrequent and volatile, presenting a need for local and state funds to initiate work and provide funds to leverage
- Over time, a project that has been inactive might need to be updated through a Limited Reevaluation, or worse, could be deauthorized and have to restart the Feasibility Study process
- The five authorized channel projects in Texas are awaiting federal funding; only the Corpus Christi Ship Channel Project has a PPA in place

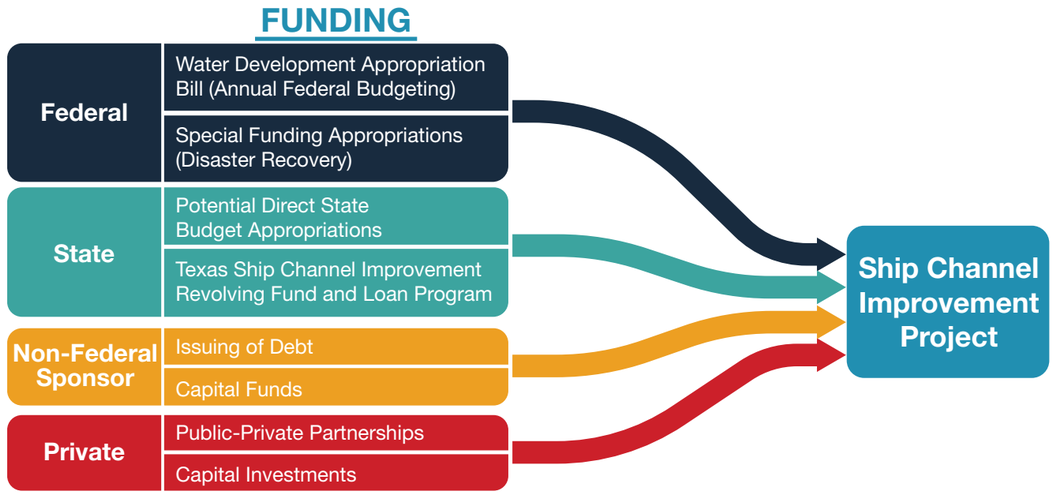
PROJECT DEVELOPMENT AND FUNDING

Ship channel improvement projects are required to go through a lengthy and costly federal process in order to be approved by the USACE and authorized by Congress. Under this process, a local entity can serve as the Non-Federal Sponsor (NFS) and can initiate a study to determine the feasibility of a ship channel improvement project, as permitted by past Water Resources Development Acts (WRDA) enacted by Congress, or the USACE can initiate the study through their annual work plan. While ship channel improvement projects are often viewed with a focus on construction costs or "hard costs", they also incur significant "soft costs" that relate to the feasibility study, planning, engineering and design elements of the projects. Failing to plan for these soft costs can cause schedule delays, ultimately delaying the economic benefits of implementing these improvements.

While up front costs can create challenges to advancing projects, it is necessary to meet requirements that are in place to justify authorization of federal funds. Once a ship channel improvement project is authorized for development, it is not guaranteed federal funding for the construction. Federal authorization of a project obligates federal funds to maintain the improved ship channel upon successful completion of the project. It is possible under WRDA Section 204(f) to have a ship channel improvement project constructed without federal funds while maintaining the federal obligation to fund and conduct maintenance dredging of the channel upon its deepening and/or widening.

Project Development

The project development required to get to project authorization takes many years and incurs significant costs to both the federal and NFS. Texas currently has five authorized projects including four deep-draft and one shallow-draft. These projects are further discussed in the project profiles at the end of this report. Since 2000, just four WRDAs have passed, including WRDA 2007, 2014, 2016, and 2018. Moreover, WRDA has provisions to de-authorize projects if construction funds are not obligated within a specified amount of time. The actual construction phase of the project begins once sufficient funding has been secured for the project through the federal government and the NFS. Once construction has started, it can still take many years to complete a project if there are delays in fully-funding the project.



Project Funding

Even after a lengthy authorization process, the project is not guaranteed to be constructed. While projects require funding both during the feasibility study and construction phases, the difference in scale between them results in frequent success in securing funds for studies and funding shortages and delays for the construction phase. For all projects, there is a federal and non-federal project cost share that can vary based on the ship channel improvement dimensions and magnitude, as outlined in the Chief's Report and subsequent Project Partnership Agreement (PPA). Once authorized, the project may get funding from any of the four funding arms to execute construction work: federal funding, state funding, the ports and navigation districts (typically serving as the NFS), and private investments.

Historically, Texas ship channel projects, once authorized, have been in a holding pattern for construction while awaiting federal funds to be designated within the annual USACE budget to the authorized project. The Corpus Christi Ship Channel Improvement Project is currently the only authorized project with an executed PPA and only three of the five authorized projects have received any federal funding for construction. The Corpus Christi Ship Channel Improvement Project has received the most funding to date, but has still received less than half of the federal funding share.

Because of the unpredictable and infrequent nature of securing federal funds for navigation construction projects, as outlined in the Federal Funding Challenges section later, it is important for Texas ports and navigation districts to identify other opportunities for funding these projects in order to ensure that the state can accommodate these larger vessels and remain competitive. Apart from federal funding, the three additional funding arms can contribute to the project cost in a variety of ways. When Non-Federal Share funds are made available by any of these entities, it may kick-start project implementation, but it also provides additional justification for getting federal funds allocated. Both the Port of Corpus Christi Authority and Port Freeport passed bonds in 2018 in excess of $100 million each to provide local funds to accelerate their associated ship channel projects.

FEDERAL APPROPRIATIONS FOR SHIP CHANNEL CONSTRUCTION

Corpus Christi Ship Channel	$95 M
Sabine-Neches Waterway	$18 M
Cedar Bayou Navigation Channel	$9.6 M

SCIRF FUNDING

Funding the SCIRF will help provide financing for eligible navigation projects that modernize waterways and allow for increased growth of waterborne commerce. There are five projects in Texas that are eligible to draw on the fund should it be capitalized. The PAAC voted to recommend a funding request in the amount of $450 million to cover the estimated drawdown for the eligible projects in Fiscal Years 2020-2021.

FUNDING REQUESTED: $450 MILLION

PROJECT IMPLEMENTATION CHALLENGES

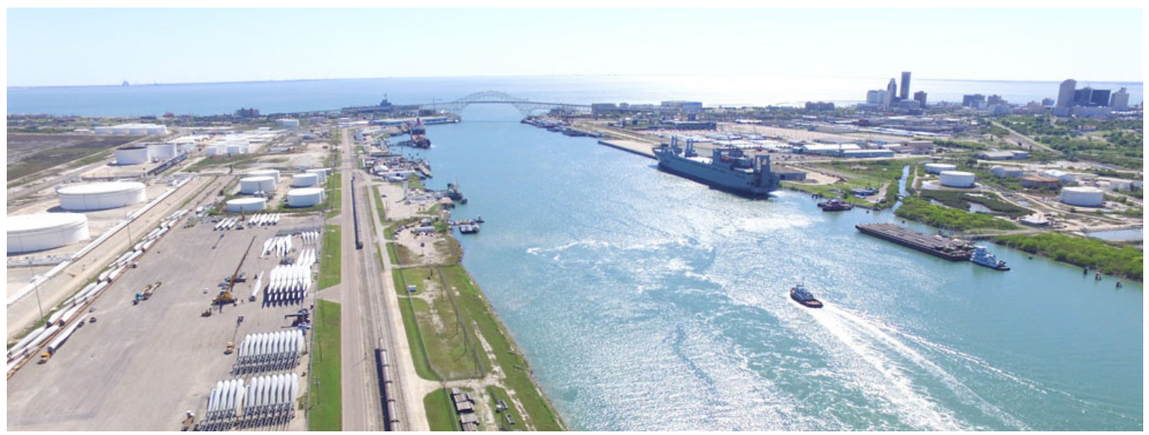
Federal Funding Challenges

WRDA is solely authorizing legislation; the funding to implement authorized studies and projects is provided separately under the annual appropriations budgetary process. The rate of authorizations typically exceeds the rate of annual appropriations; therefore, only a small number of authorized activities are included in the President's budget request and eventually funded.

Direct Congressional allocations are appropriated to the USACE. Annual USACE appropriations for civil works projects, including navigation projects, have remained steady or slightly increased during the last decade, ranging from $4.5 billion to just over $5 billion. About 30 to 40 percent of these funds are then appropriated to the navigation sector. The congressional authorization and appropriation process for ship channel improvement projects can take decades, which has contributed to the nearly $96 billion backlog of federal water resource projects nationwide.[2]

The USACE Civil Works Fiscal Year (FY) 2019 budget included nearly $3 billion for the study, design, construction, operation, and maintenance of inland and coastal navigation projects nationwide. While Texas has received anywhere from $60 million to $120 million in the last several years for navigation projects, the FY 2019 appropriations are significantly higher than previous years, with roughly $268.7 million in appropriations. This amount is due to a higher than usual appropriations level from Congress as part of its infrastructure funding initiative, but this level of funding cannot be expected in future years. The majority of navigation appropriations in Texas typically goes to Operations & Maintenance (O&M) at over 90%, with less than 10% for construction and studies. With the FY 2019 appropriations, nearly 40% of the Texas navigation funding will go to construction, approximately $99.5 million in funding. This represents a significant increase in federal appropriations for construction, yet this still accounts for only 5% of the construction costs of the authorized channel improvement projects.

Under the SCIRF system, Texas can be repaid through a loan process. As competition for federal appropriations has increased, so has interest in innovative financing, including private-sector investment in federal water infrastructure.



With $95 M of federal appropriations, the Corpus Christi Ship Channel has received the most federal appropriations of any authorized channel improvement project in Texas. Although Texas channels received a much higher level of appropriations for FY 19, it does not cover the total cost of the authorized ship channel improvement projects. While three of the five authorized projects received federal appropriations, all five projects will have to fight for additional federal funding in the upcoming fiscal years.

Impacts of Funding Delays to Projects

Ship channel improvement projects are investments in the nation's infrastructure that are time-sensitive. Delayed funding for projects can have many negative impacts on the project. Each cycle of funding authorization in which the project does not get funded can present the following consequences:

- **Post Authorization Change Report (PACR)** – If a previous ship channel project appraisal expires, the USACE will request an updated economic and cost analysis in what is known as a PACR. Each time a PACR is conducted, it costs the project another year or more and results in missed Congressional budget cycles.
- **Loss of Economic Benefit** – Delays in funding can cause a loss of economic benefits of the project to the port, the supported industry, and the communities.
- **Opportunity Cost** – There are increases in overall project costs between congressional authorization and execution of the PPA, as well as missed opportunities for attracting tenants ith improved channel access, both of which lessen the potential future earning capacity of the ship channel improvement project and the return on investment.
- **Deauthorization** – Approved projects can be deauthorized if the project has not started construction or signed a PPA within seven to ten years, depending on the authorizing WRDA (Section 6001, WRRDA 2014; Section 1302, WRDA 2016; and Section 1302, WRDA 2018), and must go through the lengthy process to become re-authorized.
- **Increase in Project Cost** - Due to inflation, growth of the U.S. economy, and increases in construction and material costs after the initial authorization of a project, the total project cost continues to increase while a project waits for funding.

Additionally, even if projects are included in the federal budget, the budget recommendations may fall significantly short of what is actually needed and continue to delay project construction.

CASE STUDY: THE CORPUS CHRISTI SHIP CHANNEL

- The Corpus Christi Ship Channel deepening and widening was authorized by Congress in 1990, but has taken nearly 30 years to complete its feasibility study and receive the federal funding necessary to begin construction.
- During the 10 years it took to go from authorization to execution of the PPA, the project costs increased from $188 million to $327 million.[3]
- As reported by the Port of Corpus Christi, through 2019 the federal government will appropriate $95 million for construction of the Corpus Christi Ship Channel, which is still less than half of the $230 million federal responsibility to construct the channel improvements.[4]

The Freeport Harbor Channel Deepening and Widening Project will not only provide port access for larger deep-draft vessels, but see signficant improvements in the ability for vessels to safely maneuver in the meandering channel layout.

The Brazos Island Harbor Channel was authorized under WRDA 2016 for implementation. This deepening project will improve the economy of deep-draft vessels calling on the Port of Brownsville.

The Houston Ship Channel Expansion Project is currently in the Feasibility Study phase.

BENEFITS OF SHIP CHANNEL IMPROVEMENTS

Texas' navigation industry is an economic engine for the nation. Like roadways, ship channels also require maintenance and upgrades so that Texas ports remain competitive and don't lose business to other states.

Ship channel improvements typically generate a positive return on investments. For instance, the proposed Corpus Christi Ship Channel Improvement Project would return $2.65 to the national economy for every $1.00 invested in the project, with all Texas ship channel projects exceeding a minimum of $1.50 returned to $1.00 invested based on the final USACE feasibility studies for each ship channel. These returns on investment are based on current port users and commodity movement. They do not account for new private investment to build new facilities or enhance existing ones as a result of the increased shipping efficiencies captured by ship channel improvement projects.

In 2017, Texas' robust maritime system ranked second in the nation in total tonnage (i.e. total tons handled) and first in total imports and exports.[5]

While most of the focus of this report is on deep-draft channels, shallow-draft channels are also a critical part of the freight network. Barge transport is a highly fuel-efficient means to transport bulk and liquid cargo that also reduces truck congestion on roadways. Barge shipments have significantly more cargo capacity than their land-based freight counterparts. A single barge ship can carry the equivalent of 70 to 144 trucks worth of cargo or 16-46 rail cars worth of cargo depending on the cargo type.[6] It is important to not only deepen and widen deep-draft channels, but also maintain and improve the shallow-draft channels and facilities such as floodgates.

The Matagorda Ship Channel at the Calhoun Port Authority is being studied for improvements to depth and width.

CASE STUDY: THE SABINE-NECHES WATERWAY

One study estimated the net benefits of deepening the Sabine-Neches Waterway, which serves the Port of Beaumont, Port of Port Arthur, and the Port of Orange, to be $103.2 billion in gross product and an additional 529,000 permanent jobs in the United States. In Texas, this accounts for $67.4 billion in gross product and an additional 336,000 permanent jobs. Despite this, the project took 17 years to gain congressional authorization and has only received a small portion of appropriations for the federal cost share. [7]

The Sabine-Neches Waterway provides deep-draft access to the Gulf of Mexico for the Port of Beaumont.

U.S. Trends for State-Funded Ship Channel Improvements

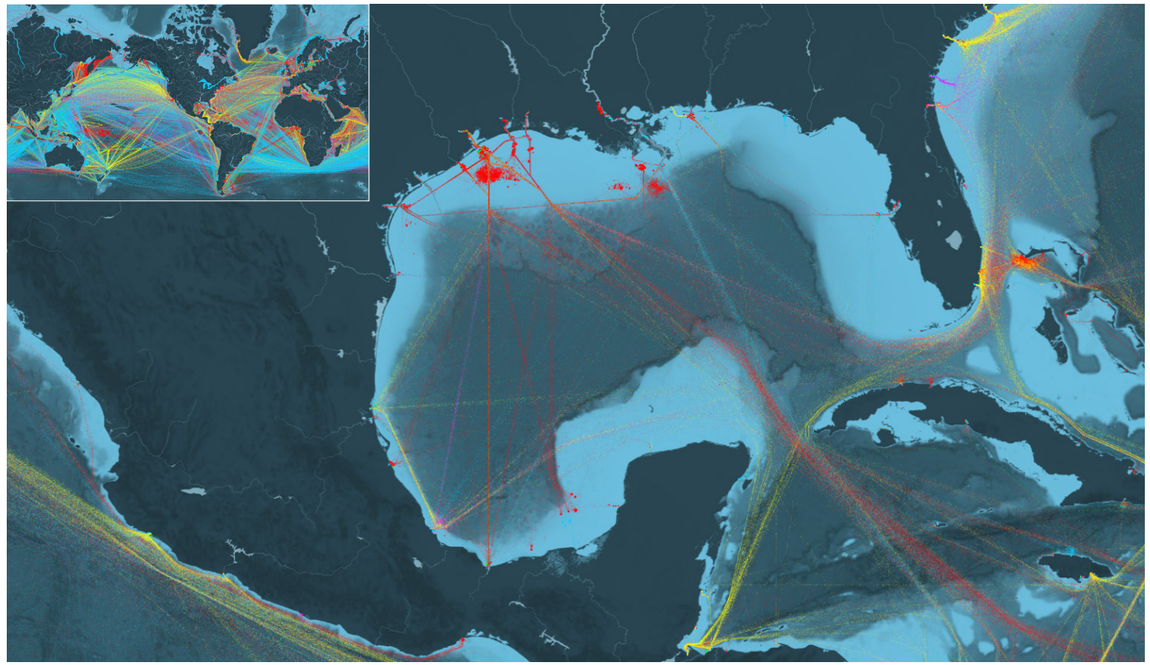
Other U.S. ports competing with Texas ports receive state-funded subsidies to attract new tenants and have access to grants or low-interest loans for their channel improvement projects through economic development funds, general revenue, tax incentives, or transportation programs. These revenues subsidize channel deepening and widening projects, dockside infrastructure, and cruise terminals.

Some states have appropriated funds for ship channel projects, apart from any ongoing programs. These subsidized port enhancements can make non-Texas ports more attractive to shippers and potential tenants, luring firms, trade, and jobs away from Texas. In order to remain competitive, Texas can invest in modernizing the port system as well as pursue public and private partners to generate a strong consensus to invest in navigation and shipping industries. Examples of state-funded ship channel improvements include:

- In 2018 the Port of Boston began a $350 million dredging project to deepen the channel, which is expected to take three years to complete. The federal government is funding $220 million and the state and Port of Massachusetts Authority are committing $130 million.[8]
- In 2015, the Port of Miami completed $205.6 million of improvements to deepen the main harbor to 52 feet and widen the entrance channel to 800 feet to more than double the size of ships the port can accommodate. The project was made possible through a combination of federal, state, and local funds that accelerated the project schedule on the order of years.[9]

Ship Channels Drive the Economy

Texas ship channels have a powerful impact on the Texas and U.S. economy, and help to transfer Texas' respected exports all over the world. Such an asset must be looked after to ensure it is meeting future demands to continue economic success. An investment in ship channel improvements is a guarantee to increase Texas' revenue and opens up opportunities for not just the state but the country as well.



Global Shipping Routes (Credit www.shipmap.org).

SHIP CHANNEL IMPROVEMENT COMPONENTS

Ship channels are the critical roadways of waterborne commerce between the open ocean and ports. To the casual onlooker, a ship channel may look like just water, but beneath the surface there is a complex infrastructure network that supports the movement of ships. Like roadways, ship channels are designed to move goods and users in a safe and efficient manner. Their design takes into consideration the types of markets they serve such as breakbulk or container and the vessels that use these channels now and anticipated future vessels.

Ships can only stop or "call" at ports with channels that are deep enough to accommodate their draft, which is the vertical distance between the waterline and the bottom of the ship. Both the size of the ship and the volume of cargo it carries affect the required draft. In order to call at certain ports, larger ships might have to reduce their draft by carrying less cargo, a practice known as "light loading." Even with light loading, some ports might not be accessible to larger ships.

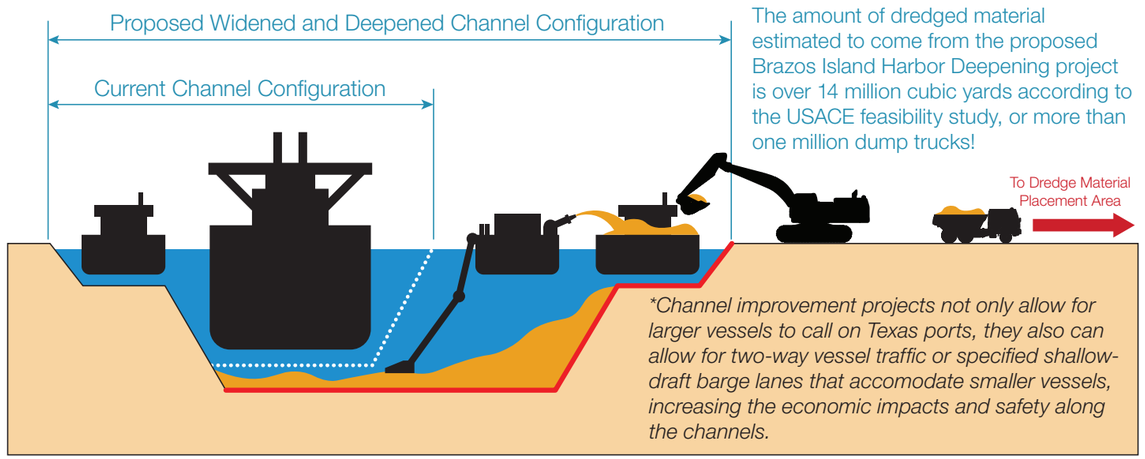
Because the depth of a channel has such a direct effect on the size of ships and quantity of cargo a port can receive, ports look to channel deepening as a way to remain economically competitive. However, a port alone is not able to deepen their channel and be assured of federal maintenance since the depth approved for federal maintenance of a ship channel is determined by USACE and requires authorization by Congress. There is a long federal process that the ports must embark on to be eligible to dredge and expand their channels.

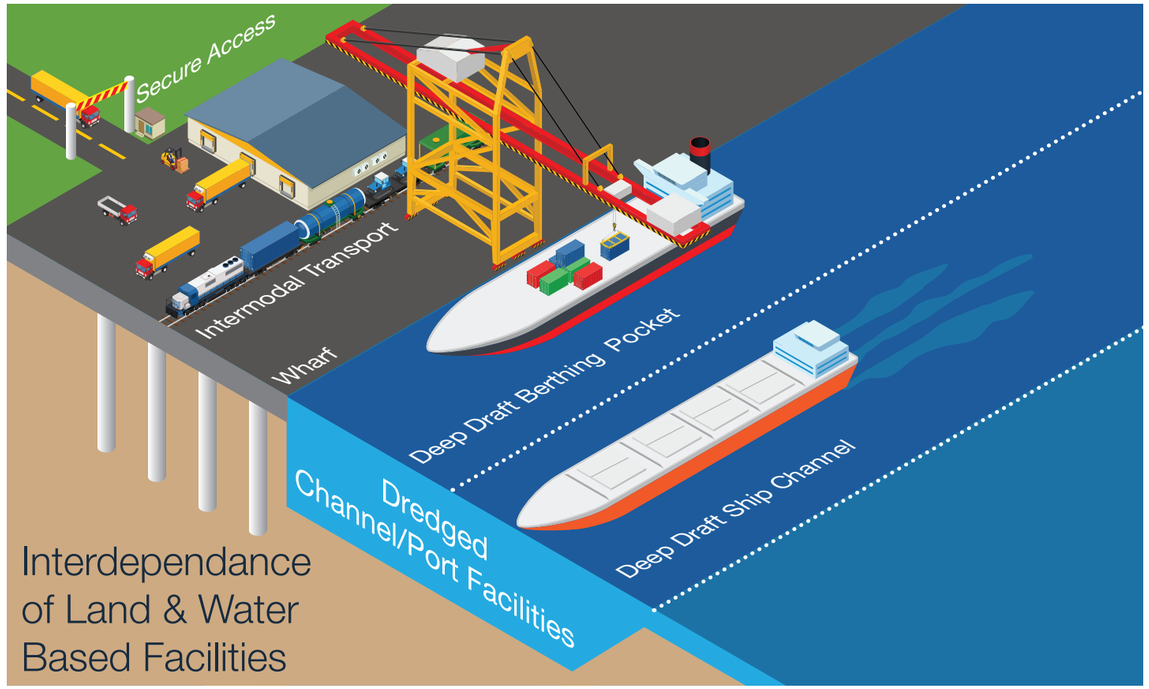
Channel Width and Depth

The depth and width of the ship channel determines the size of ships that can use it as well as the amount of cargo that the ships can carry. The depth should be adequate to safely accommodate the ship with the deepest draft expected to use the waterway. A ship needs enough water to safely move from the ocean to the port without touching the bottom of the channel. Deeper channels will reduce the risk of ships running aground when loaded.

Similar to needing adequate depth of channel, ships also need room to safely navigate in the channel, including passing other vessels and turning. Wider channels reduce the number of ships that have to wait to enter the channel based on channel capacity. This means a lower overall transit time for the ships and more goods moving in and out of the ports. The safety of wider channels is especially important in Texas where many of the vessels traveling to and from the ports are oil tankers and ships carrying hazardous materials.

The width of a ship channel is measured by the flat bottom of the channel and can be widened on one side or both. The minimum channel width for a specific project will depend on the size and maneuverability of the vessels, channel alignment, traffic congestion, current conditions, and wind conditions. The amount of ship traffic and the length of a channel determine whether one-way or two-way traffic is appropriate.



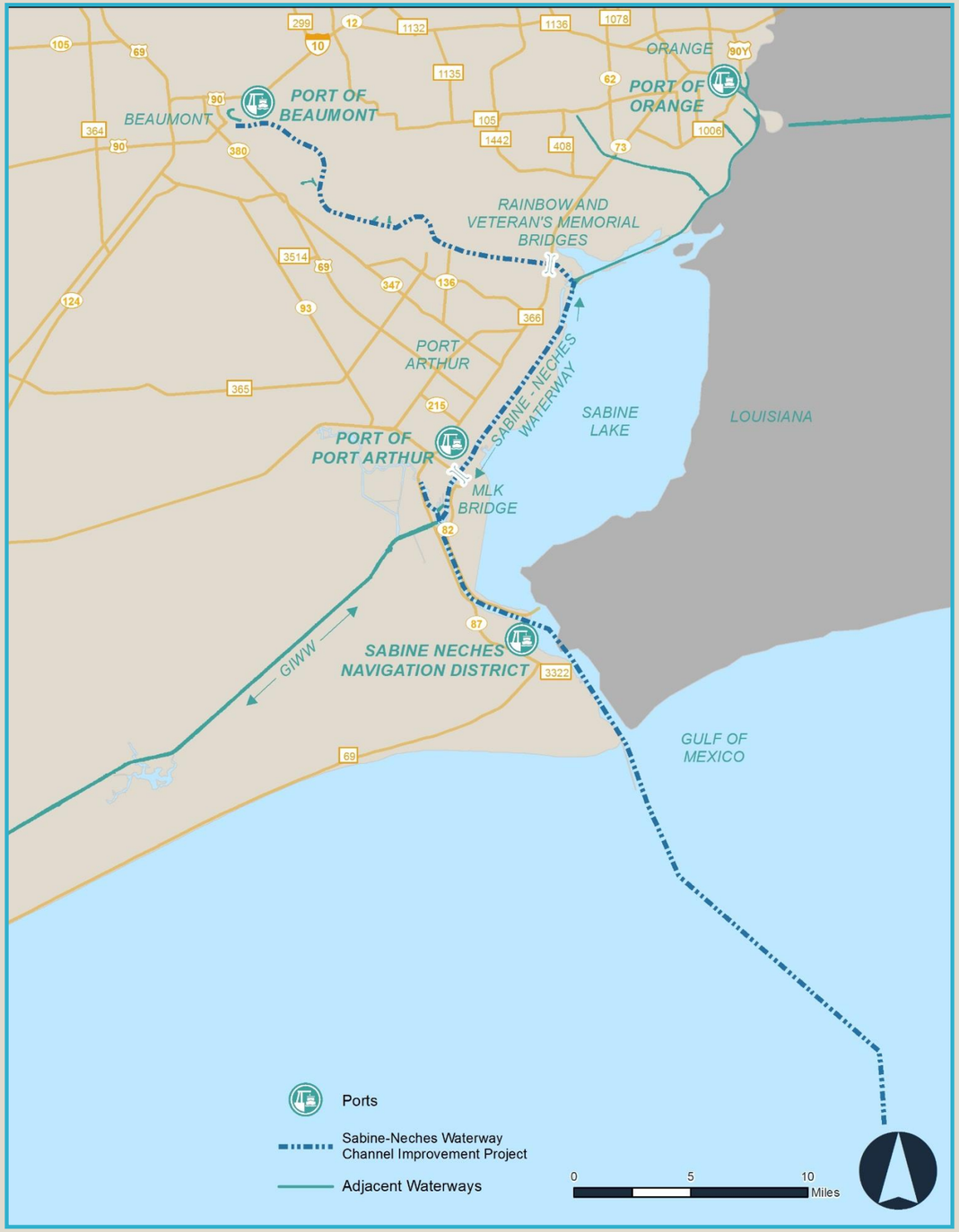


Ship Channel Typical Elements

In addition to channel deepening and widening, other navigation improvements help ships move to and from the port. Typical elements needing improvements include channels; jetties and breakwaters; locks and floodgatess; basins or water areas for vessel maneuvering, such as turning basins, anchorages, and mooring areas; removal of wrecks, obstructions, drift and debris; and bridge replacements or modifications.

Ship Channel Component	Description
Anchorage Area	An area where ships anchor to wait for berthing areas to become available or for more favorable transit conditions.
Barge Lane (or Shelves)	A narrower, shallower channel adjacent to the main channel for the purpose of separating the faster, deep-draft ship traffic from the slower, shallow-draft barge traffic.
Bend	An even curve that allows a channel to turn in a specific direction.
Berth, Dock, or Wharf	A designated location in a port or harbor where a vessel may be moored or anchored, usually for the purposes of loading and unloading.
Channel Limits	The location of the authorized channel as designated on project design documents and depicted on hydrographic survey sheets. Often provided as a channel width on navigation charts.
Entrance Channel	The main access channel into a bay, harbor, or port from the deeper ocean.
Harbor	A fully or partially enclosed body of water offering safe anchorage or reasonable shelter to vessels against adverse weather conditions.
Interior Channel	The access channel inside a bay or harbor that connects the entrance channel to port facilities.
Passing or Maneuvering Lane	A widened portion of channel where a vessel can safely pass an approaching vessel. The maneuvering lane should be wide enough to account for current, wind, and bank effect.
Turning Basin	A large, excavated area that provides for the complete turning of a ship in order to change direction, enter a dock or berth, or depart from the port. Turning basins are usually located at the upper end of the interior channel.

SABINE-NECHES WATERWAY CHANNEL IMPROVEMENT PROJECT



Project Details

Non-Federal Sponsor (NFS)	Sabine Neches Navigation District
Project Authorization	WRRDA 2014
Channel Length (Current | Authorized)	64 miles | 77 miles
Channel Depth [Ft, MLLW] (Current | Authorized)	40' | 48' 42' | 50' (Offshore)
Channel Width [Ft] (Typical Width)	700' | 700'

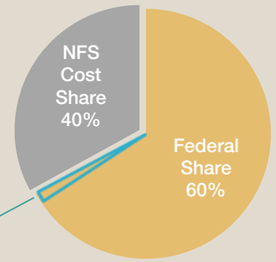
Waterway and Project Description

The Sabine-Neches Waterway (SNWW) is an approximately 64-mile federally authorized and maintained waterway located in Jefferson and Orange counties in southeast Texas. The area surrounding the waterway is generally referred to as the "Golden Triangle" and is delineated by the three major Texas ports of Port Arthur, Beaumont, and Orange.

The SNWW is a system of navigation channels that has been dredged and maintained in the Sabine-Neches region. The system includes Sabine Pass, the Port Arthur Ship Canal, the Sabine Neches Canal, and goes upstream along the Neches River. The Sabine Neches Canal portion that runs in front of the Port of Port Arthur can pose some additional navigational challenges because it is used by both large vessels and barge traffic that are using the GIWW. There are three bridges that cross over the waterway that can limit the vertical clearance of the vessels that can use the waterway. Sabine Pass is stabilized by jetties that extend 4.1 miles into the Gulf of Mexico.

The authorized project will deepen the waterway by eight feet and extend the channel 13 miles further into the Gulf of Mexico. Additional widening of Taylor Bayou Channel and existing turning and anchorage basins will enhance the safety of vessels transiting the waterway.

Project Cost: $1,277,500,000



Federal Appropriations as of 2019: $18 M

Key Waterway Facts

- #1 Bulk Liquid Cargo Waterway in the U.S.
- #3 Largest Waterway by cargo volume in the Nation
- Projected to be the Largest LNG Exporter in U.S.
- Refineries Produce 60% of the Nation's Commercial Jet Fuel
- $32+ Billion in Gross Product
- 280,000 Jobs Provided by the SNWW Currently

Project Benefits

The Sabine-Neches Waterway has grown tremendously since the last improvement project authorized in 1962, over 50 years ago. Expanding and deepening the channel eight feet will keep Texas competitive with other U.S. ports, and generate $186 billion in new business activity along with 176,000 permanent jobs. Additionally, the project will increase tax revenue, better manage waterway traffic, and stimulate further economic development by allowing larger vessels access to the ports and reducing the light loading of existing vessels.

Project Readiness and Implementation

This project was authorized in WRRDA 2014 and is currently seeking federal appropriations for construction. This project was awarded $18 million in federal appropriations in the USACE FY 19 Work Plan. The NFS is pursuing local and state funding options, including loan opportunities, while awaiting additional federal funds to be appropriated for the project. Pre-Construction Engineering and Design is underway. The project is on track to have an executed PPA and begin construction mid-summer 2019.

Waterway Supported Port Facilities

Ro/Ro | Bulk | Fishing

Energy | Break Bulk | Other

*Project information provided by USACE project reports, comments from USACE project managers, and the Non-Federal Sponsors.

CEDAR BAYOU CHANNEL IMPROVEMENT PROJECT

Project Details

Non-Federal Sponsor (NFS)	Cedar Bayou Navigation District
Project Authorization	WRDA 2007
Channel Length (Current | Authorized)	6 miles | 14 miles
Channel Depth [Ft, MLLW] (Current | Authorized)	Varies | 11’
Channel Width [Ft] (Current | Authorized)	Varies | 100’

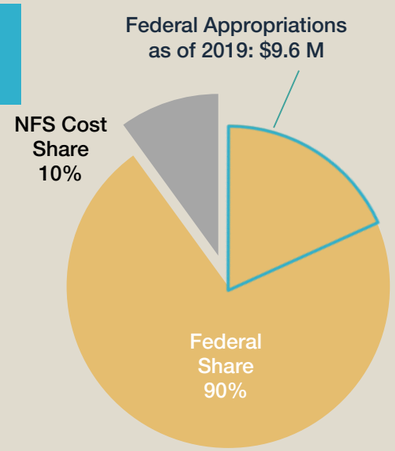
Waterway and Project Description

Cedar Bayou is a coastal waterbody that is navigable as it runs along the eastern portion of the City of Baytown. Upon its confluence with Galveston Bay, the Cedar Bayou Channel provides direct connection to the deep-draft Houston Ship Channel.

The previously authorized and improved portion of the channel extends from the junction with the Houston Ship Channel to the mouth of Cedar Bayou and upstream 3 miles. This shallow-draft channel is 11' x 100’.

This authorized project will extend the maintained channel upstream from mile 3 to mile 11 where it intersects with the Highway 146 bridge. While this section of the channel is currently navigable and is in use for barge transport, this project will standardize the channel so that it is also 11' x 100', enhancing barge access and improving navigation safety.

Project Cost: $52,800,000



Key Waterway Facts

- Carries more than 1.5 million tons of cargo per year
- The channel primarily serves chemical, aggregate, steel and asphalt industries
- Supports container-on-barge movement with connections to Port Houston container terminals

Project Benefits

Standardizing this portion of the channel and easing several of the bends will improve barge operations in the area. The cutoff of the bend at Devil's Elbow will also provide a safer route for transporting goods. Together, these improvements will improve navigability in the channel so that operators don't have to light load or slow down as much to navigate the currently unmaintained channel.

The final channel design was selected in order to minimize the environmental impact along the shoreline and placement areas. Land will be restored and set aside for conservation as part of this project.

Project Readiness and Implementation

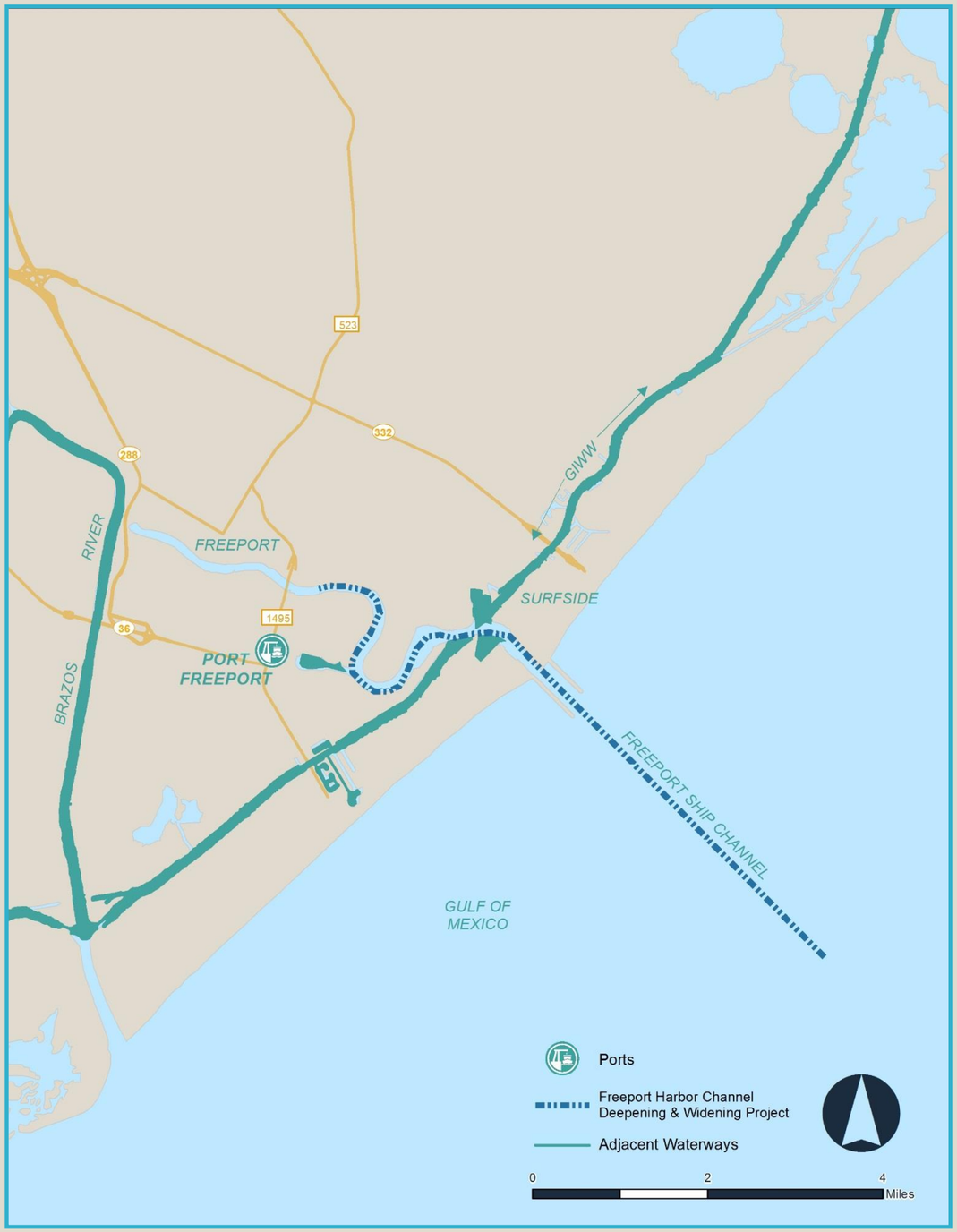
This project was authorized in WRDA 2007 and is currently seeking federal appropriations for construction. Pre-Construction Engineering and Design are complete and the project is ready to move into the construction phase. As of 2019, the federal government has appropriated approximately $9.6 million for project implementation.

Waterway Supported Port Facilities

Bulk **Container** **Break Bulk**

**Project information provided by USACE project reports, comments from USACE project managers, and the Non-Federal Sponsors.*

FREEPORT HARBOR CHANNEL DEEPENING & WIDENING PROJECT



Project Details

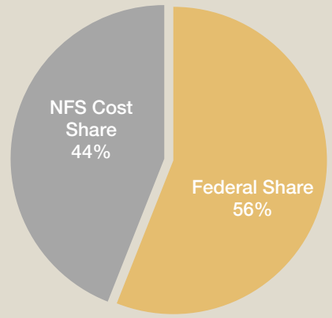
Non-Federal Sponsor (NFS)	Port Freeport
Project Authorization	WRRDA 2014
Channel Length (Current | Authorized)	9.2 miles | 11.9 miles
Channel Depth [Ft, MLLW] (Current | Authorized)	N/A | 26' (Reach 4) 46' | 51' (Reaches 2 and 3) 46' | 56' (Reach 1) 48' | 58' (Offshore)
Channel Width [Ft] (Current | Authorized)	400' | 400' 600' | 600' (Offshore)

Waterway and Project Description

The Freeport Ship Channel is a deep-draft navigation channel that connects industrial facilities in Freeport, Texas with the Gulf of Mexico. The main channel consists of multiple segments, with reduced channel widths and depths as the channel approaches the 180 degree turn around the Dow complex. The channel also provides barge access through multiple adjacent waterways.

The project extends the existing Outer Bar Channel 1.3 miles further into the Gulf of Mexico while deepening it by 10 feet. It also deepens the main channel by 10 feet, with widening at critical channel bends and at turning basins, while the main channel remains unchanged. The middle segments of the channel are deepened by 5 feet. The project will also reauthorize the upper portion of the channel, the section designated as Stauffer Channel.

Project Cost: $295,000,000



Key Waterway Facts

- $46.2 Billion of Economic Activity annually for Texas
- More than 900 vessel calls per year
- Serves the 21st Largest U.S. Port in Foreign Trade; 6th Largest Texas Port
- 122,000 Port-Related Jobs

Project Benefits

The Freeport Ship Channel supports a large oil and gas and petrochemical complex, which has invested over $27 billion in facility expansions. The project will support larger vessels and the expected 30%+ increase in vessels calling Freeport Harbor terminals. By increasing channel depth, vessels will be able to handle the growing import and export demand with greater efficiencies and more competitively serve Texas and Middle America.

Port Freeport has seen the jobs and economic impact from the facilities double in a span of four years, from 2012 to 2016. Providing waterway infrastructure to keep up with the growth will help attract additional economic investment and jobs in the region and state.

Project Readiness and Implementation

This project was authorized in WRRDA 2014 and is currently seeking federal appropriations for construction. In May 2018, the U.S. Army Corps of Engineers approved a reevaluation report for the project, adding additional project elements to address safety and navigation needs in addition to the 2012 approved feasibility study.

In May 2018, voters in the Port Freeport Navigation District approved a $130 million bond to support the implementation of this project.

Waterway Supported Port Facilities

*Project information provided by USACE project reports, comments from USACE project managers, and the Non-Federal Sponsors.

CORPUS CHRISTI SHIP CHANNEL IMPROVEMENT PROJECT

Project Details

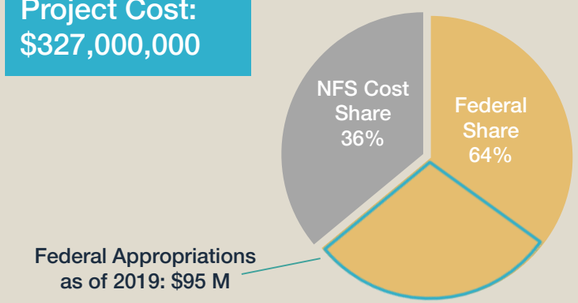
Non-Federal Sponsor (NFS)	Port of Corpus Christi Authority
Project Authorization	WRDA 2007 WRRDA 2014 (Project Re-Authorized at Updated Costs)
Channel Length (Current | Authorized)	36 miles | 38 miles
Channel Depth [Ft, MLLW] (Current | Authorized)	N/A | 14' (Barge Lanes) 47' | 54' 49' | 56' (Offshore)
Channel Width [Ft] (Current | Authorized)	400' | 530' (+400' for Barge Lanes) 700' | 700' (Offshore)

Waterway and Project Description

The Corpus Christi Ship Channel (CCSC) provides deep water access from the Gulf of Mexico to the Port of Corpus Christi via Port Aransas, Redfish Bay, and Corpus Christi Bay. Access points include the La Quinta Channel, the Gulf Intracoastal Waterway, and the Rincon Canal. The waterway extends from deep water in the Gulf of Mexico through the Port Aransas jettied entrance to the Corpus Christi Turning Basin and the landlocked industrial areas within the city known as the Inner Harbor. The La Quinta Channel extends from the CCSC near Ingleside, Texas, and runs parallel to the eastern shoreline of Corpus Christi Bay to the San Patricio Turning Basin. .

The authorized project will deepen the waterway by 7 feet and extend the channel 2 miles further into the Gulf of Mexico. The channel will be widened to 530 feet in the Upper and Lower Bay Reaches. Barge lanes will be constructed from the CCSC junction with the La Quinta Channel to the entrance of the channel at the Inner Harbor, which will be 200 feet wide and 14 feet deep on both sides of the CCSC.

Project Cost: $327,000,000



Key Waterway Facts

- $150 Billion of Economic Activity for the U.S.
- $50 Billion in Regional Investment
- 80,000 Port-Related Jobs
- Home to the Port of Corpus Christi Authority:
  - #1 U.S.-Produced Crude Oil Export Port; 2.3 Million Barrels/Day Forecasted for 2020
  - #4 Largest U.S. Port by Tonnage; Greater than 140 Million Tons Forecasted for 2021

Project Benefits

The Corpus Christi Ship Channel Improvement project is expected to add nearly $40 billion in incremental goods value exports, which will aid in reducing the rapidly expanding trade deficit. The project will provide over $100 million in annual transportation cost savings.

The proposed improvements to the Upper Bay Reach on the Main Channel include the construction of 2 200-foot barge shelves, reducing traffic conflicts between deep-draft vessels and barges while enabling more efficient movement of cargo.

Project Readiness and Implementation

This project was re-authorized in WRRDA 2014 and is currently seeking federal appropriations for construction. As of 2019, the federal government has appropriated $95 million for project implementation.

The Port of Corpus Christi has provided $78 million in funds to accelerate construction of the project, initiating contracting for work to be performed at the CCSC entrance. The Port of Corpus Christi Authority also sold $216.2 million in bonds in July of 2018 to provide funds for the deepening and widening project along with other port capital projects.

Waterway Supported Port Facilities

Ro/Ro

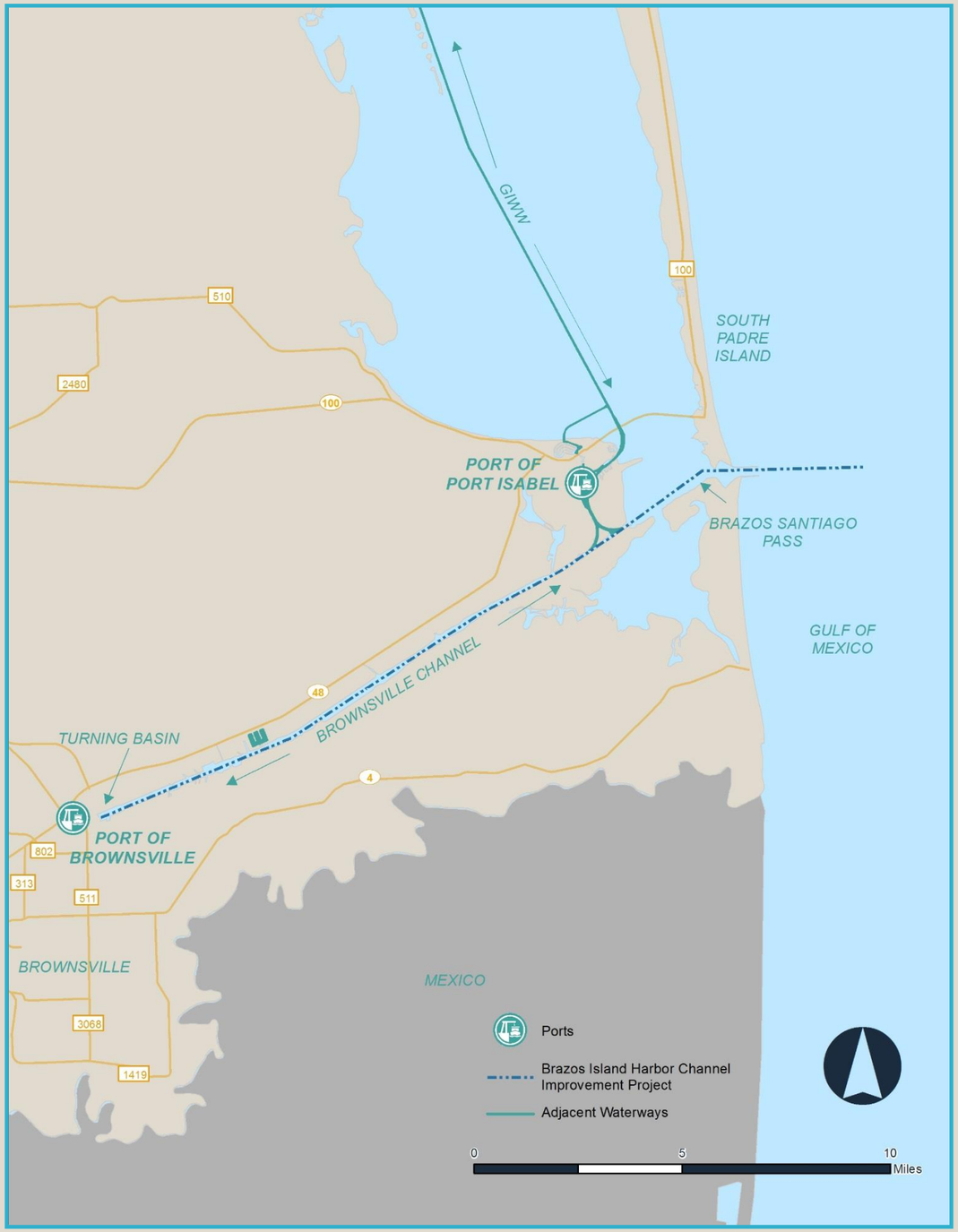
Bulk

Energy

Break Bulk

*Project information provided by USACE project reports, comments from USACE project managers, and the Non-Federal Sponsors.

BRAZOS ISLAND HARBOR CHANNEL IMPROVEMENT PROJECT



Project Details

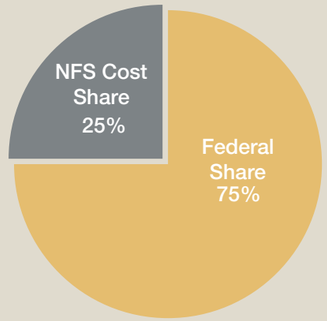
Non-Federal Sponsor (NFS)	Brownsville Navigation District
Project Authorization	WRDA 2016
Channel Length (Current | Authorized)	19.4 miles | 20.2 miles
Channel Depth [Ft, MLLW] (Current | Authorized)	42' | 52' 44' | 54' (Offshore)
Channel Width [Ft] (Current | Authorized)	250' | 250'

Waterway and Project Description

The Brazos Island Harbor Channel (BIH), also known as the Brownsville Ship Channel, is an existing deep-draft navigation project located on the lower Texas coast, serving as the southernmost navigation channel in Texas. The channel passes south of South Padre Island through the mile long jetties protecting the inlet at Brazos Santiago Pass. The BIH also serves as the southern origin of the Texas GIWW, which makes BIH the gateway for movement of goods in and out of Mexico, a key trade partner for Texas.

The BIH connects Brownsville and the Lower Rio Grande Valley to the Gulf of Mexico, as it is the only deep draft channel south of Corpus Christi. The authorized project will deepen the waterway by ten feet and extend the channel 0.8 miles further into the Gulf of Mexico. The first two miles of dredged material is identified as beneficial use material that will be placed to enhance the South Padre Island beach and dune system, providing additional recreational and tourism benefits to the region.

Project Cost: $210,500,000



Key Waterway Facts[11]

- #2 Foreign Trade Zone in the U.S. by Value of Exported Commodities
- 4 Million sq. ft. of Storage
- $3 Billion of Economic Activity for Texas
- 44,000 Port-Related Jobs

Project Benefits

The Brazos Island Harbor Channel has grown tremendously since the last improvement project authorized in 1980, over 30 years ago. Expanding and deepening the channel ten feet will keep Texas competitive with other U.S. ports, and greatly improve the navigation efficiency of deep draft vessels and offshore oil rigs. Additionally, the project will increase tax revenue, better manage waterway traffic, and stimulate further economic development by allowing larger vessels access to the ports and reducing the light loading of existing vessels.

Project Readiness and Implementation

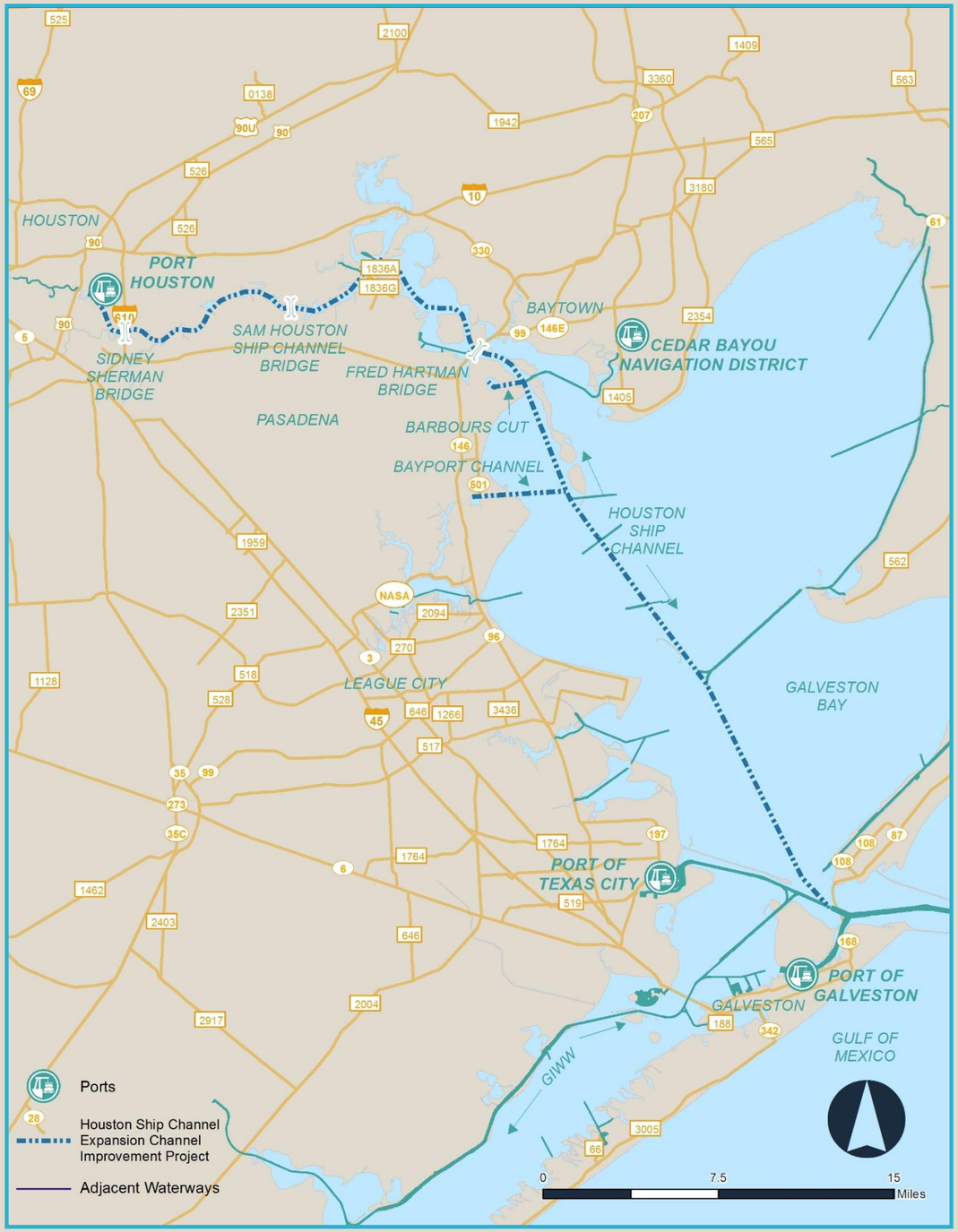
This project was authorized in WRDA 2016 and is currently seeking federal appropriations for construction. The NFS is pursuing local and state funding options, including loan opportunities, while awaiting federal funds to be appropriated for the project. Pre-construction engineering and design is underway and the project is anticipated to be permitted by June of 2019.

Construction of the authorized project will require dredging of an estimated 14.1 million cubic yards of new work material, or enough to fill over one million dump trucks.

Waterway Supported Port Facilities

*Project information provided by USACE project reports, comments from USACE project managers, and the Non-Federal Sponsors.

HOUSTON SHIP CHANNEL EXPANSION CHANNEL IMPROVEMENT PROJECT FEASIBILITY STUDY



Project Details

Non-Federal Sponsor (NFS)	Port of Houston Authority
Study Authority	Section 216 - Flood Control Act of 1970
Channel Length (Current | Proposed)	50 miles | 50 miles
Channel Depth [Ft, MLLW] (Current | Proposed)	37.5' | 41.5' 41.5' | 46.5' 46.5' | 46.5'
Channel Width [Ft] (Current | Proposed)	400' | 530' 530' | 700'

Waterway and Project Description

The Houston Ship Channel (HSC) is in southeast Texas, crossing portions of Harris, Galveston, and Chambers counties. The HSC is uniquely complex. In addition to the main 50-mile long channel, the HSC system facilitates four deep-draft tributary channels along with multiple shallow-draft channels and cuts.

The channel improvement project feasibility study does not include the Galveston Entrance Channel, or any of the tributaries outside of the main channel, with the exception of Barbours Cut Channel (BCC) and Bayport Ship Channel (BSC). The HSC itself has various width and depth configurations, with it reducing in both as the channel moves upstream of Boggy Bayou first, then Sims Bayou second, ultimately terminating at the Main Turning Basin immediately upstream of the I-610 Bridge. As a result, the feasibility study addresses the channel as six unique segments, with the main channel divided into four and each of the tributary channels as a single segment.

The Tentatively Selected Plan (TSP) proposes a wide range of channel improvements that can be summarized as:

- Widening of HSC channel segments from Bolivar Roads (Downstream end of the study) to BCC, with small segments of widening in key locations upstream of this
- Deepening of the HSC from Boggy Bayou to the Main Turning Basin
- Federalization of NFS improvements to BCC and BSC
- Various bend easings, flare expansions and new moorings

Project Cost: $950,000,000*

**Preliminary Costs*

Key Waterway Facts

- The HSC is the busiest waterway in the U.S.
- Receives 8,000 vessel calls annually
- Transporting more than 230 million tons of cargo
- Serves the largest petrochemical complex in the nation
- Serves Port Houston which provides:
  - $265 Million in Economic Impact
  - $5 Billion in Local & State Taxes
  - 1.2 Million Jobs Throughout Texas

Project Benefits

The HSC serves a large and diverse group of users, and as a result, provides transit access for a varied vessel fleet. This project would provide for a more safe and efficient transit of vessels. Examples of benefits that can be achieved through implementation of this project include:

- Very Large Crude Carriers reduce lightering
- Increased barge movement efficiency and safety
- Vessels longer than 1200-feet overall would have access, which they currently do not because of bend restrictions
- Vessels longer than 1100-feet would not be restricted to one-way traffic, which causes channel congestion

The expansion project will help alleviate these issues by improving the use and navigation for current and future vessels. This will help reduce delays, and increase safety and economic growth.

Project Readiness and Implementation

A feasibility study and environmental impact study have been initiated and are expected to be completed in late 2019. The study is being funded by a 50/50 cost split between the USACE and Port Houston for a total $10 million cost. The most recent study milestone was the Alternatives Decision Milestone (ADM) at which the TSP was confirmed for detailed analysis.

Waterway Supported Port Facilities

Ro/Ro
Bulk
Fishing
Energy
Break Bulk
Container

**Project information provided by USACE project reports, comments from USACE project managers, and the Non-Federal Sponsors.*

MATAGORDA SHIP CHANNEL IMPROVEMENT PROJECT FEASIBILITY STUDY

Project Details

Non-Federal Sponsor (NFS)	Calhoun Port Authority
Study Authority	Section 216 - Flood Control Act and Rivers and Harbors Act of 1970
Channel Length (Current | Proposed)	26 miles | 28.5 miles
Channel Depth [Ft, MLLW] (Current | Proposed)	38' | 47' 40' | 49' (Offshore)
Channel Width [Ft] (Current | Proposed)	200' | 300' 300' | 600' (Offshore)

Waterway and Project Description

The Matagorda Ship Channel (MSC) is a 26-mile federally authorized and maintained deep-draft waterway located in Calhoun and Matagorda counties in southeast Texas. The channel provides access to the Gulf of Mexico for the Calhoun Port Authority, as well as shallow-draft vessels from Port Lavaca and the Port of Palacios.

Under this study, deepening and widening of the main channel is being evaluated, along with the construction of a new 1,200-foot diameter turning basin in order to safely handle vessels upwards of 860 feet long by 130 feet wide. The majority of the deep-draft users are located in the vicinity of the Calhoun Port Authority facilities, which are located at the upstream terminus of the deep-draft federal channel.

The proposed project will deepen the waterway by 9 feet and widen the bay channel by 100 feet and the Entrance/Jetty Channel by 300 feet. To accommodate the channel deepening, the proposed project extends the Entrance Channel by 20,000 feet further into the Gulf of Mexico.

Project Cost: $487,000,000*

**Preliminary Costs*

Key Waterway Facts

- $12.3 Billion of Economic Activity
- $125 Million in State and Local Taxes
- $200 Million in Federal Taxes
- 48,000 Port-Related Jobs

Project Benefits

The existing channel was designed for vessels with loaded drafts of less than 38 feet mean low water level. Due to this, many larger vessels are forced to light load before entering the port. Deepening and widening the channel will fix this issue, reduce navigation costs, increase port efficiencies, and remove large amounts of sediments for beneficial use.

The existing channel was built to accommodate 25,000 – 30,000 deadweight ton (DWT) vessels, but under current use, the channel sees vessels up to 80,000 DWT access the channel. In the future with-project condition, it is expected that the port will begin to see mid-size Aframax tankers, which will provide nearly double the tonnage capacity of the existing lightered Panamax vessels for transporting crude oil and petroleum products.

Project Readiness and Implementation

The Feasibility Cost Sharing Agreement was signed in August, 2016 and the Feasibility Study and Environmental Impact Statement are scheduled for completion in August, 2019 in the form of a USACE Chief's Report. The $3 million cost of the Study is being funded 50/50 between the USACE and the Calhoun Port Authority.

Construction of the proposed project will require dredging of an estimated 20 million cubic yards of new work material, or enough to fill roughly 1.7 million dump trucks.

Waterway Supported Port Facilities

Energy **Break Bulk** **Bulk**

**Project information provided by USACE project reports, comments from USACE project managers, and the Non-Federal Sponsors.*

REFERENCES

1. Information Handling Services (HIS) Sea-Web Ships Database, June 2018.
2. Congressional Research Service, Army Corps of Engineers: FY2019 Appropriations, September 14, 2018. Retrieved https://fas.org/sgp/crs/natsec/IF10864.pdf.
3. Port of Corpus Christi, Statement of Sean Strawbridge, Chief Executive Officer of the Port of Corpus Christi Authority for the Subcommittee on Oversight and Government Reform on “Examining the U.S. Army Corps of Engineers,” 6 March 2018. Retrieved https://oversight.house.gov/wp-content/uploads/2018/03/Strawbridge_PCCA-Testimony.pdf.
4. Port of Corpus Christi, November 26, 2018. Retrieved http://portofcc.com/port-of-corpus-christi-secures-59-million-in-additional-funding-for-the-channel-improvement-project/.
5. Waterborne tonnage for principal U.S. ports and all 50 states and U.S. territories; Waterborne tonnages for domestic, foreign, imports, exports and intra-state waterborne traffic, Waterborne Commerce Statistics Center. United States Army Corps of Engineers, 2018. Retrieved https://usace.contentdm.oclc.org/digital/collection/p16021coll2/id/2969
6. A Modal Comparison of Domestic Freight Transportation Effects on the General Public: 2001-2009, Center for Ports and Waterways, Texas Transportation Institute. Retrieved http://www.nationalwaterwaysfoundation.org/study/FinalReportTTI.pdf.
7. The Impact of Deepening the Sabine-Neches Waterway on Business Activity in Jefferson County, the Surrounding Region, Texas, and the United States, The Perryman Group, June 2017. Retreived https://www.navigationdistrict.org/wp-content/uploads/2014/06/Perryman-Sabine-Neches-Impact-9-15-2017.pdf
8. Governor Baker, Federal and Local Officials, Massport Kick-Off $350 Million Boston Harbor Dredging Project, Governor’s Press Office, September 2017. Retrieved https://www.mass.gov/news/governor-baker-federal-and-local-officials-massport-kick-off-350-million-boston-harbor.
9. Miami Harbor Deepening, U.S. Army Corps of Engineers. Retrieved https://www.saj.usace.army.mil/Missions/Civil-Works/Navigation/Navigation-Projects/Miami-Harbor-Deepening/.

Photos shown are provided by the port unless otherwise indicated

The Brazos Island Harbor Channel also provides deep draft access for the Port of Port Isabel

Front Cover: Corpus Christi Ship Channel
Back Cover: Houston Ship Channel