

GALVESTON DISTRICT O&M NAVIGATION MISSION & RESPONSE TO HURRICANE HARVEY

Christopher Frabotta
Chief, Navigation Branch
Galveston District
U.S. Army Corps of Engineers
31 OCT 2017

“The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation.”



**US Army Corps
of Engineers.**



NAVIGATION MISSION

Provide safe, reliable, efficient and environmentally sustainable waterborne transportation systems (channels, harbors, and waterways) for movement of commerce, national security needs, and recreation.



US Army Corps
of Engineers.



GALVESTON DISTRICT – NAVIGATION FACTS



- Monitor and maintain over 1,000 miles of navigation channels and waterways
- Dredge ~25 million cubic yards per year
- 10 Major Texas maritime Ports
- Gulf Intracoastal Waterway connects Ports
- 3 Strategic Ports
- Texas Ports and Waterways moved >600M tons of Commercial Cargo during 2015
- 21.8% of Nation's Tonnage through Texas Ports
- 25.4% of Nation's Imports through Texas Ports
- 9.5% of Nation's Tonnage through Port Houston

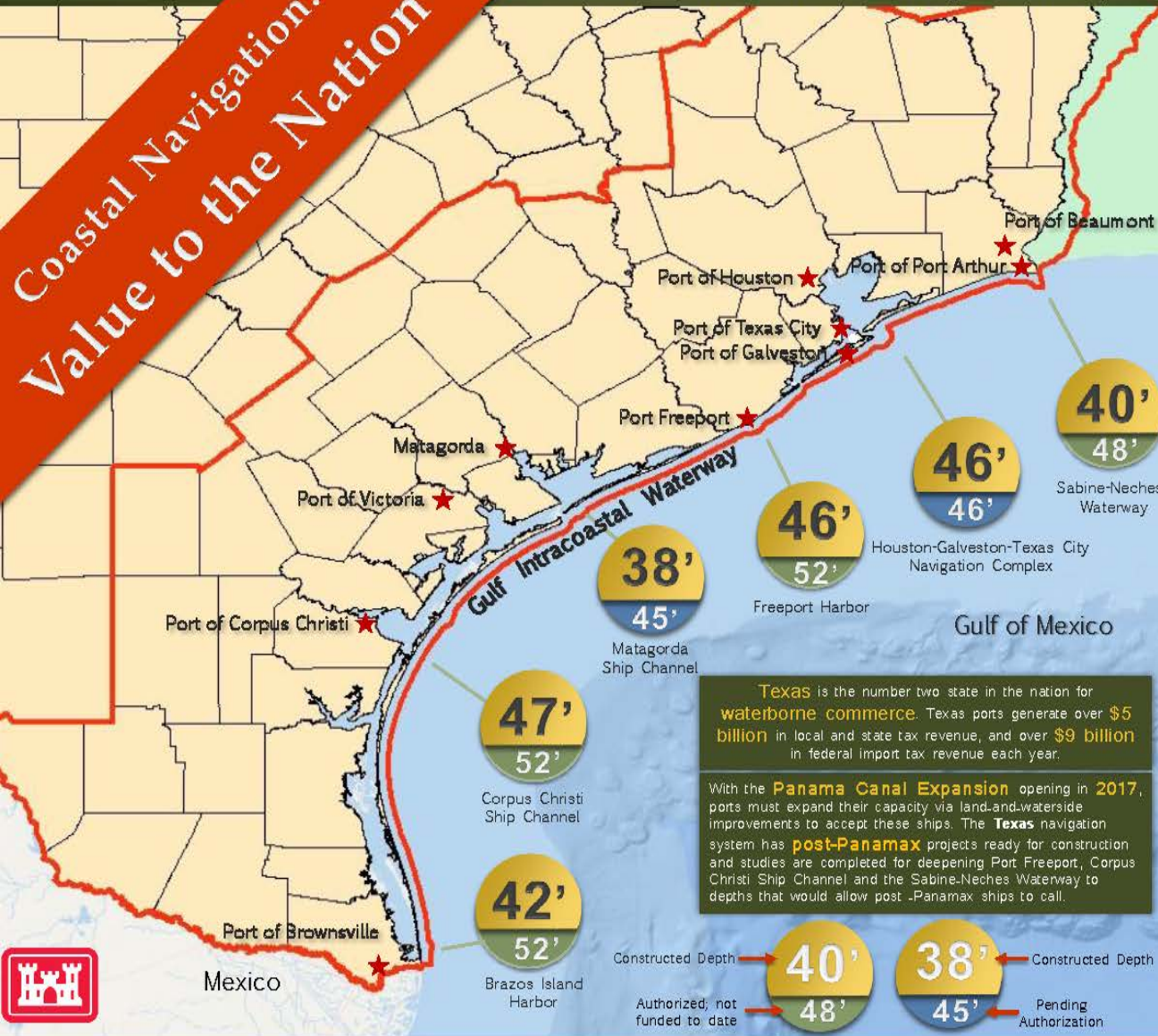


US Army Corps
of Engineers.



Coastal Navigation: Value to the Nation

USACE Southwestern Division Regional Priority



Texas is the number two state in the nation for **waterborne commerce**. Texas ports generate over \$5 billion in local and state tax revenue, and over \$9 billion in federal import tax revenue each year.

With the **Panama Canal Expansion** opening in 2017, ports must expand their capacity via land-and-waterside improvements to accept these ships. The **Texas** navigation system has **post-Panamax** projects ready for construction and studies are completed for deepening Port Freeport, Corpus Christi Ship Channel and the Sabine-Neches Waterway to depths that would allow post-Panamax ships to call.



LEADING U.S. PORTS (2015 Tonnage)

Houston #2 - 240.9 million tons
#1 Foreign Tonnage & #2 Total Tonnage

Beaumont #5 - 87.2 m.tons
#1 Military Port in World

Gulf Intracoastal Waterway (79 million tons - Texas portion)
#3 Inland Waterway

Corpus Christi #6 - 85.7 m.tons
America's Energy Gateway

Texas City #15 - 42.9 m.tons
Services Largest Petrochemical Complex

Port Arthur #19 - 35.8 m.tons
Vital Break-Bulk Port

Freeport #32 - 21.1 m.tons
Connecting Global Services Via Caribbean Relay Port

Matagorda to include Port of Port Lavaca and Port of Point Comfort #46 - 11.8 m. tons
Generates Annual Business Revenues of Nearly \$2 Billion

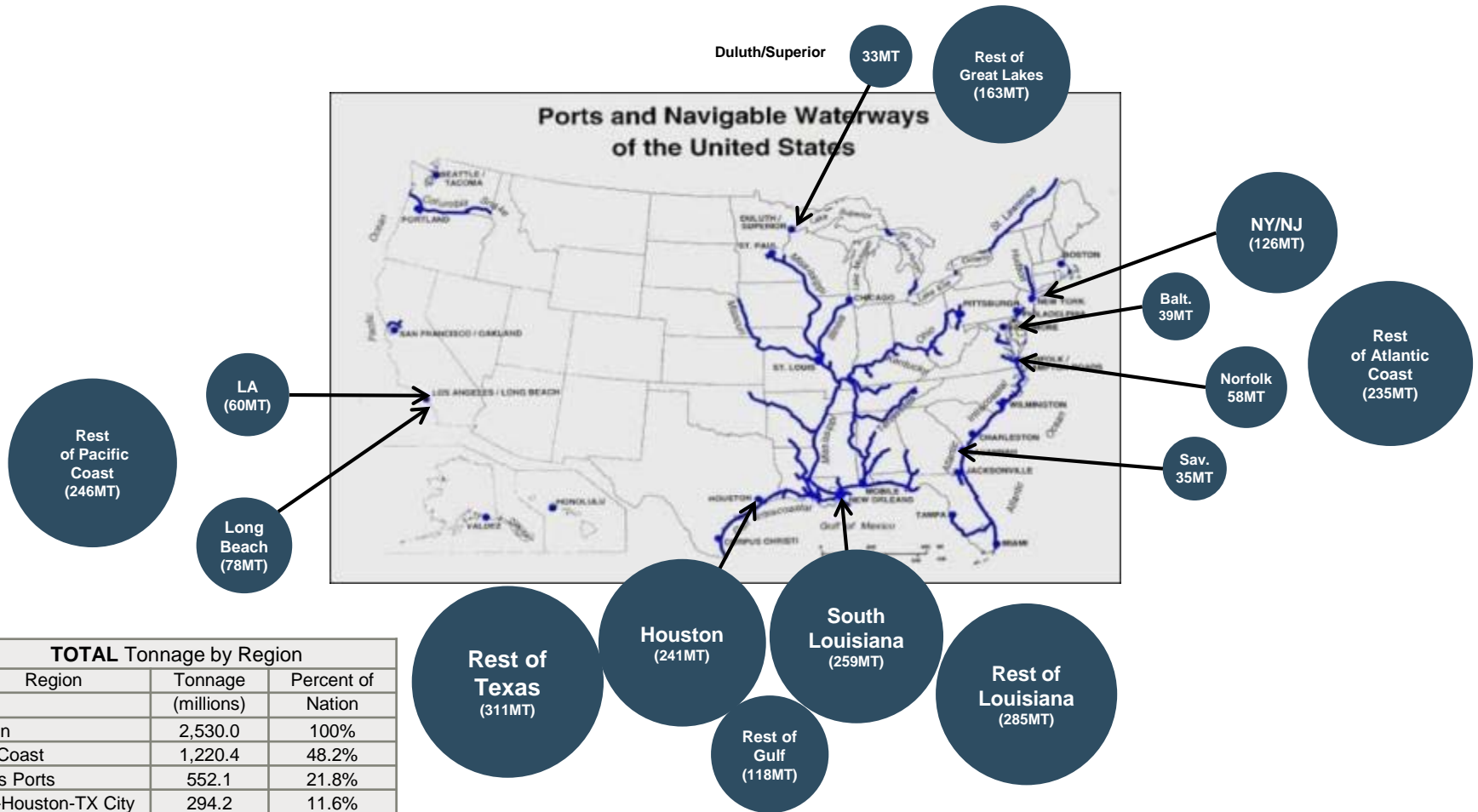
Galveston #51 - 10.4 m.tons
#4 Cruise Ship Port

Brownsville #66 - 7.7 m.tons
#1 Ship Recycling Port

Victoria (#70) - 6.7 m.tons
#2 Shallow-Draft Port for Domestic Crude Petroleum

- TEXAS PORTS ASSOCIATION
- GICA
- TEXAS DEPARTMENT OF TRANSPORTATION
- SABINE-NECHES WATERWAY DISTRICT
- PORT OF BEAUMONT
- PORT ARTHUR PUBLIC PORT
- PORT OF HOUSTON AUTHORITY
- PORT OF GALVESTON
- CALHOUN PORT AUTHORITY
- PORT OF TEXAS CITY
- PORT FREEPORT
- PORT OF CORPUS CHRISTI
- PORT OF GALVESTON
- NAVIGATION DISTRICT
- PORT OF BROWNSVILLE
- US ARMY CORPS OF ENGINEERS
- U.S. ARMY

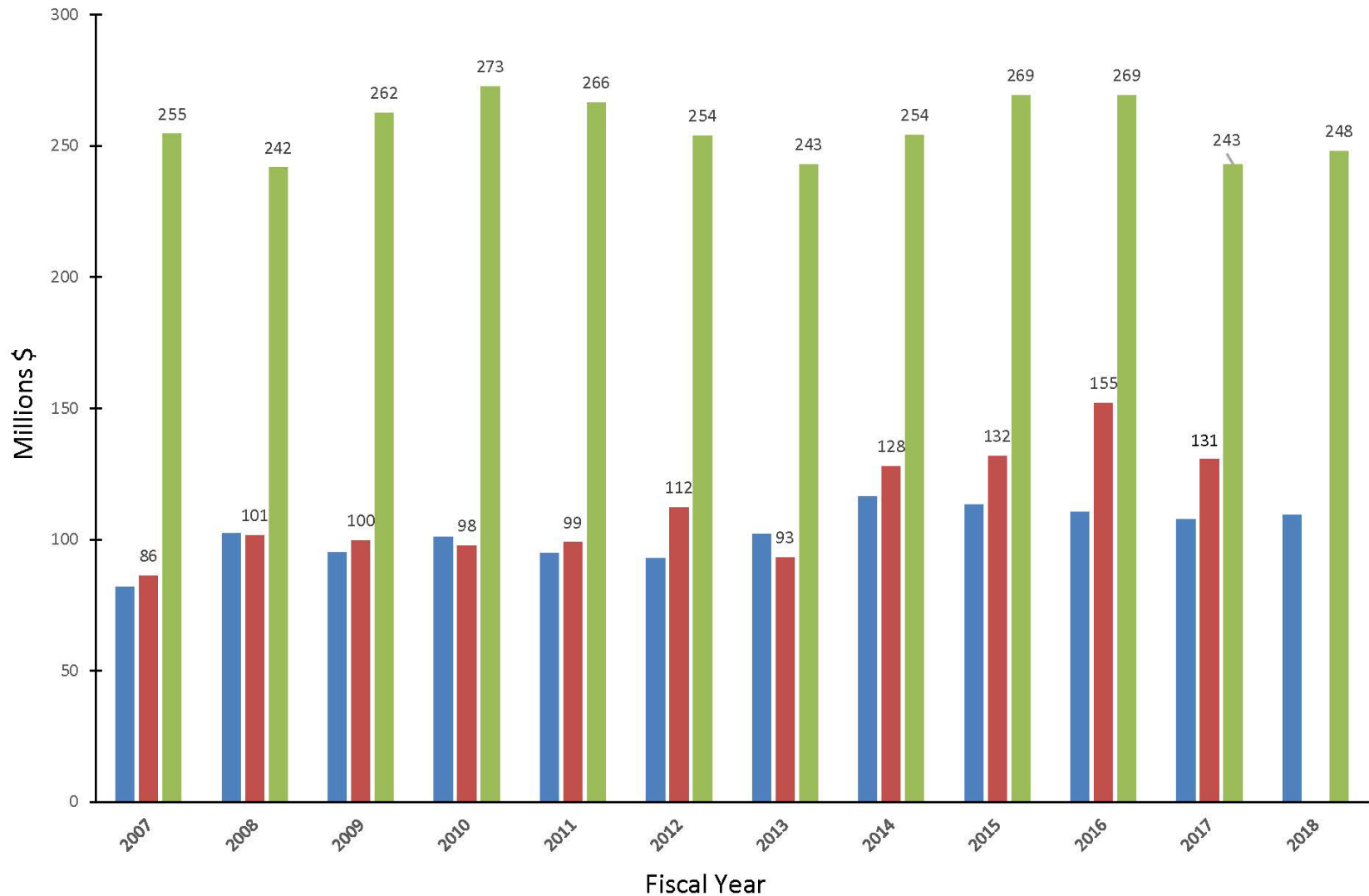
RELATIVE DEEP DRAFT TONNAGE



TOTAL Tonnage by Region		
Region	Tonnage (millions)	Percent of Nation
Nation	2,530.0	100%
Gulf Coast	1,220.4	48.2%
Texas Ports	552.1	21.8%
Galv-Houston-TX City	294.2	11.6%
SNWW	123.0	4.9%
Corpus Christi	85.7	3.4%



SWG O&M NAV PROGRAM PERFORMANCE AND FUNDING TRENDS

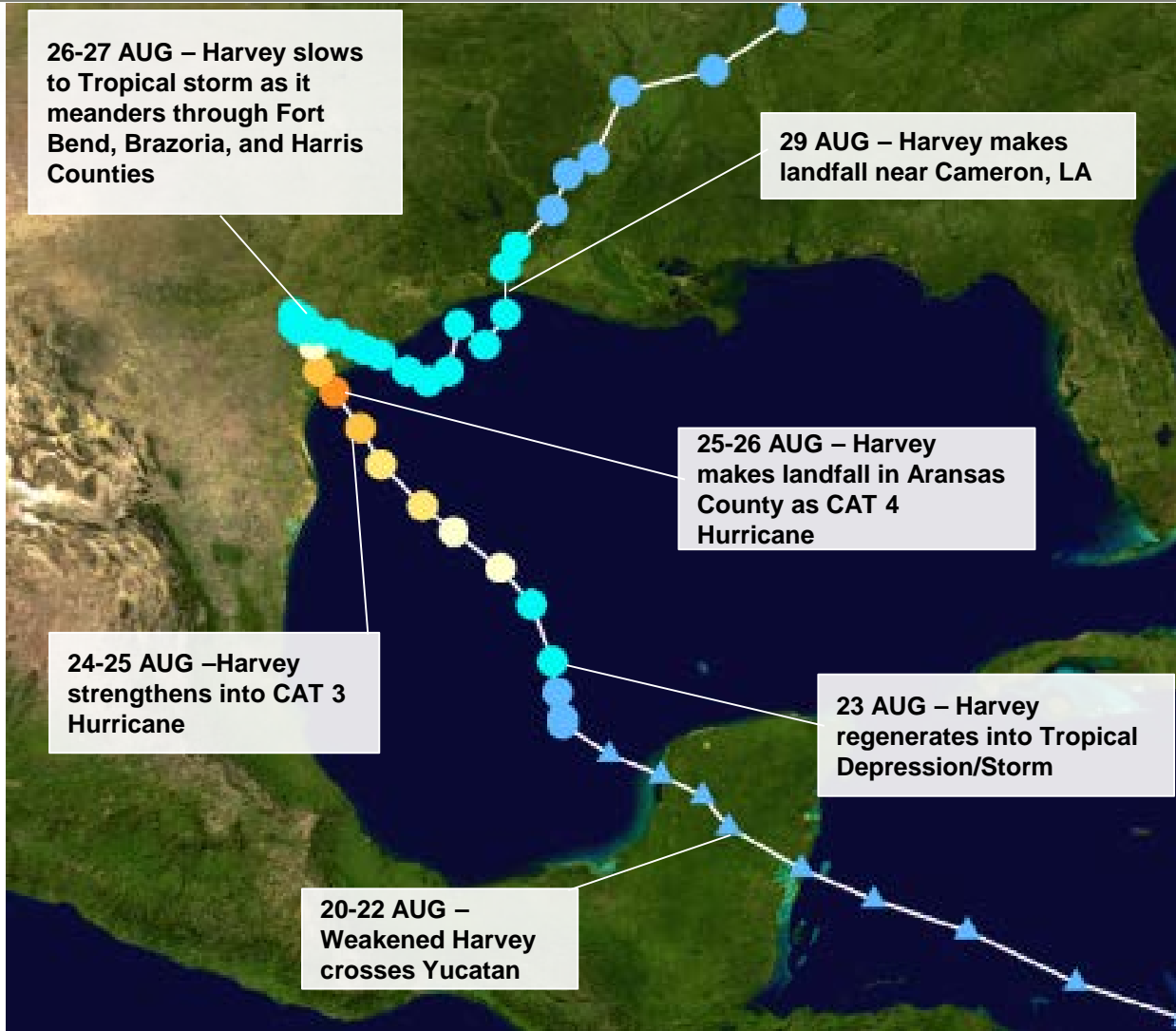


■ President's Budget NAV ■ Final Allocation NAV ■ Total Capability NAV





Hurricane Harvey and the Texas Coast



Flooding in Port Arthur, Jefferson County on 31 August

LEGEND

- Tropical Depression (≤ 38 mph)
- Tropical Storm (39 - 73 mph)
- Cat 1 Hurricane (74 - 95 mph)
- Cat 2 Hurricane (96 - 110 mph)
- Cat 3 Hurricane (111 - 129 mph)
- Cat 4 Hurricane (130 - 156 mph)
- Cat 3 Hurricane (≥ 157 mph)



US Army Corps of Engineers.



GULF COAST JOINT HURRICANE RESPONSE PROTOCOL

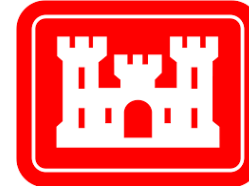
Port Coordination Teams (PCTs)

- Led by U.S. Coast Guard
 - USCG – Sector Corpus Christi
 - USCG – Sector Houston-Galveston
 - USCG – MSU Port Arthur
- Coordinates Vessel movements pre- and post-storm
- Sets Port Readiness Conditions; Whiskey, X-ray, Yankee, Zulu, Recovery



Navigation Restoration Team (NRT)

- Led by U.S. Army Corps of Engineers
 - USACE – Galveston District
 - USACE – New Orleans District
 - USACE – Mobile District
- Assesses and verifies Channel Conditions
- Reports Channel Conditions; *eHydro*
- Advises USCG on Channel Open, Close and/or Restrictions
- Issue Emergency Contracts for 'Dredging' & 'Obstruction Removal'





GULF COAST JOINT HURRICANE RESPONSE PROTOCOL

Port Coordination Team (PCT)



Facilities

Ports

Shippers



Pilots
Associations

Recreational
Boaters

Local Law
Enforcement



US Army Corps
of Engineers.





GULF COAST JOINT HURRICANE RESPONSE PROTOCOL

Navigation Restoration Team (NRT)



US Army Corps of Engineers.



Hydrographic Survey Assets as of Sept 3, 2017

Vessel Name	Office/Contractor	Survey Type(s)	Status	Survey Operations
NAO-1	USACE - Galveston District Office	Singlebeam	Operational	Colorado River to Brazos River 9/4; working hotspots in GIWW
CC-01	USACE - Corpus Christi Resident Office	Singlebeam	Operational	Colorado River to Brazos River 9/4; working hotspots in GIWW
CC-03	USACE - Corpus Christi Resident Office	Sidescan Sonar	Operational	BUS B Inspection
Vannoy	USACE - Corpus Christi Resident Office	Singlebeam	Operational	CCSC Entrance
DeLaHunt	USACE - Houston Resident Office	Singlebeam	Operational	Barbours Terminal tomorrow; Upper Houston 30-60 days
Tanner 2	USACE - Houston Resident Office	Singlebeam/Multibeam	Operational	CS at Freeport
Turpin	USACE - Port Arthur Resident Office	Singlebeam/Multibeam	Not Operational	Neches River
PAO-4	USACE - Port Arthur Resident Office	Singlebeam	Operational	Neches River
RGV-01	USACE - Rio Grande Valley Resident Office	Singlebeam	Operational	In route to Corpus Christi
OB-189 (MVN)	USACE - New Orleans District - USACE	Singlebeam	Operational	Colorado River to Brazos River 9/4; working hotspots in GIWW
OB-160	USACE - New Orleans District - USACE	Singlebeam	Operational	High Island to PA 9/4
OB-168	USACE - New Orleans District - USACE	Singlebeam	Operational	High Island to PA 9/4
NRT-4	NOAA	Multibeam/SideScan	Operational	Complete upper Houston with Obstructions; Upper Houston 30-60 days
Manta	NOAA	Singlebeam/Sidescan	Operational	Cross Section upper; Demob this week
Miss Brook	Contractor	Singlebeam/Sidescan	Operational	Matagorda Ship Channel
Orion	Contractor	Singlebeam/Sidescan	Operational	Surveying Freeport
Blake	Contractor	Multibeam/SideScan	Operational	Lower HSC Side Scan 9/4; Neches River
Brooks McCall	Contractor	Singlebeam/Sidescan	Operational	Galveston Entrance 9/2; San Jac Park North 9/4; CS on Redfish
Gerry Boardeleon	Contractor	Singlebeam/Sidescan	Operational	SNWW Entrance 9/2; Sabine-Neches River 9/3; Neches 9/4



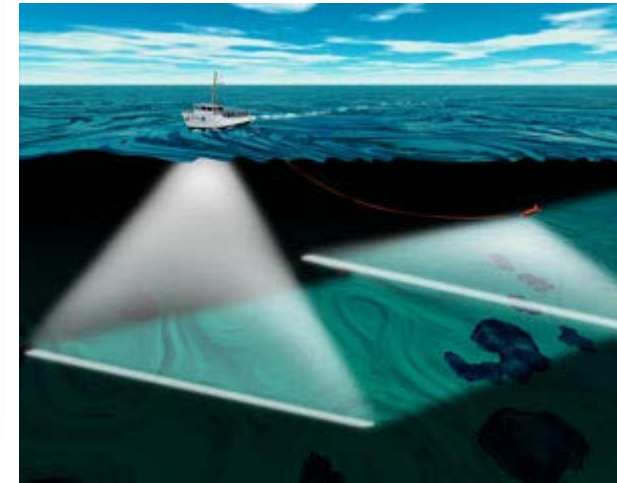
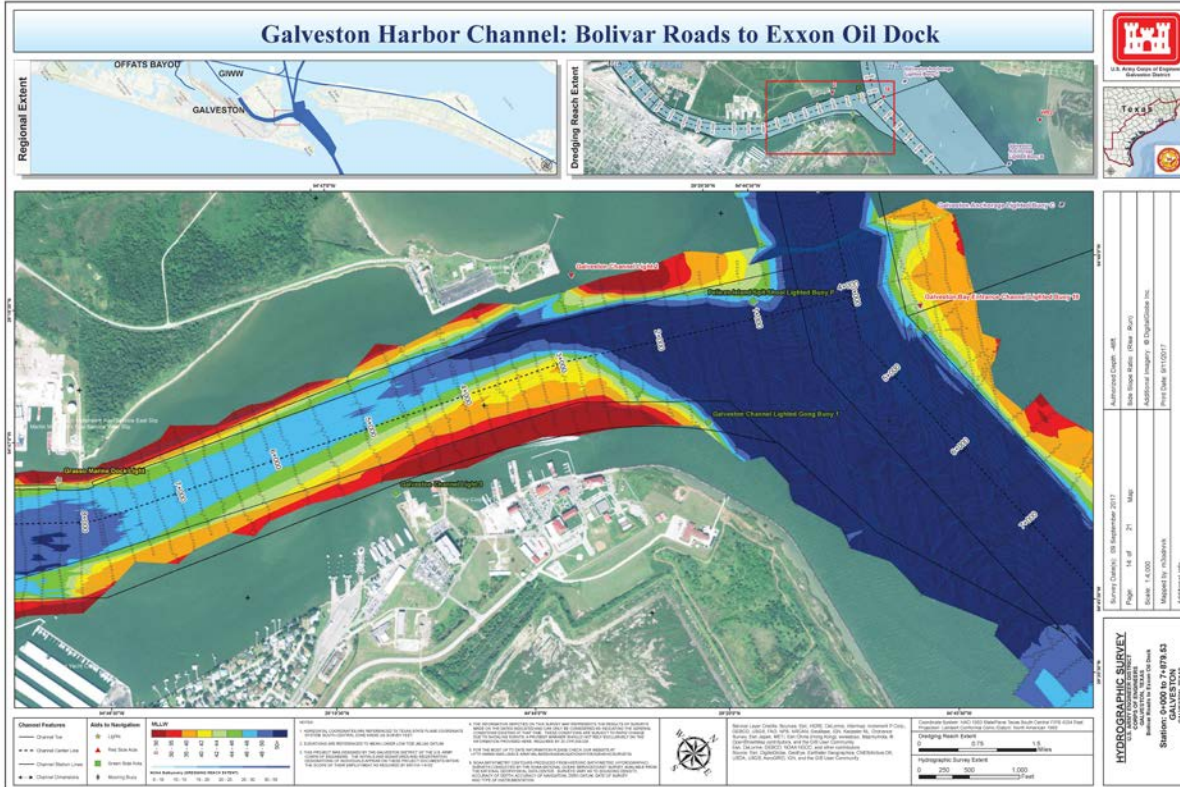
US Army Corps
of Engineers.



REPORTING CHANNEL CONDITIONS

USACE Enterprise Software eHydro

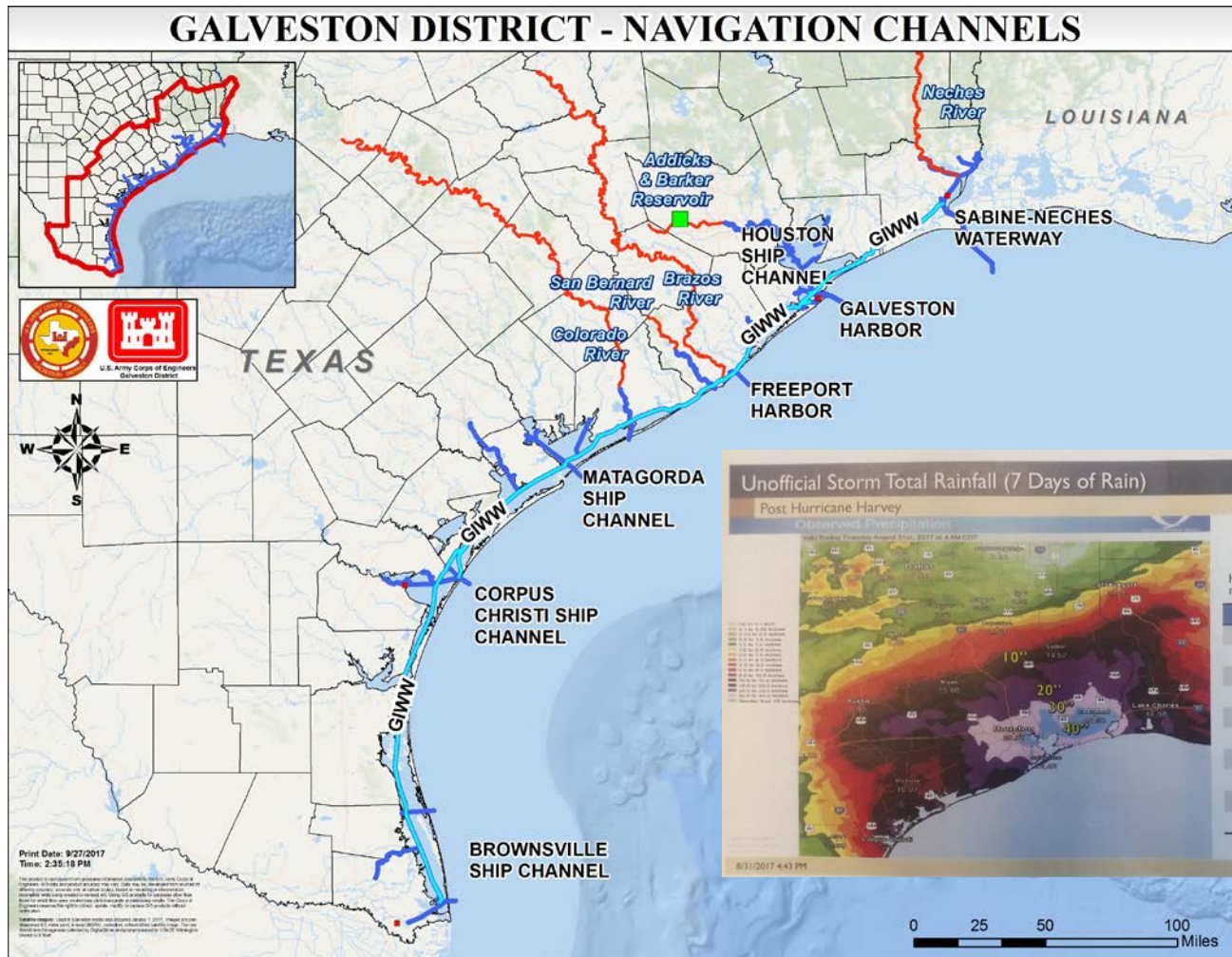
<http://www.swg.usace.army.mil/Missions/Navigation.aspx>



US Army Corps
of Engineers.



Historic Rainfall – Sediment Load



Historic Rainfall – Sediment Load



Historic Rainfall – Sediment Load on Colorado River



Historic Rainfall – Sediment Load on Colorado River



Shoaling at Colorado River Locks



US Army Corps
of Engineers.



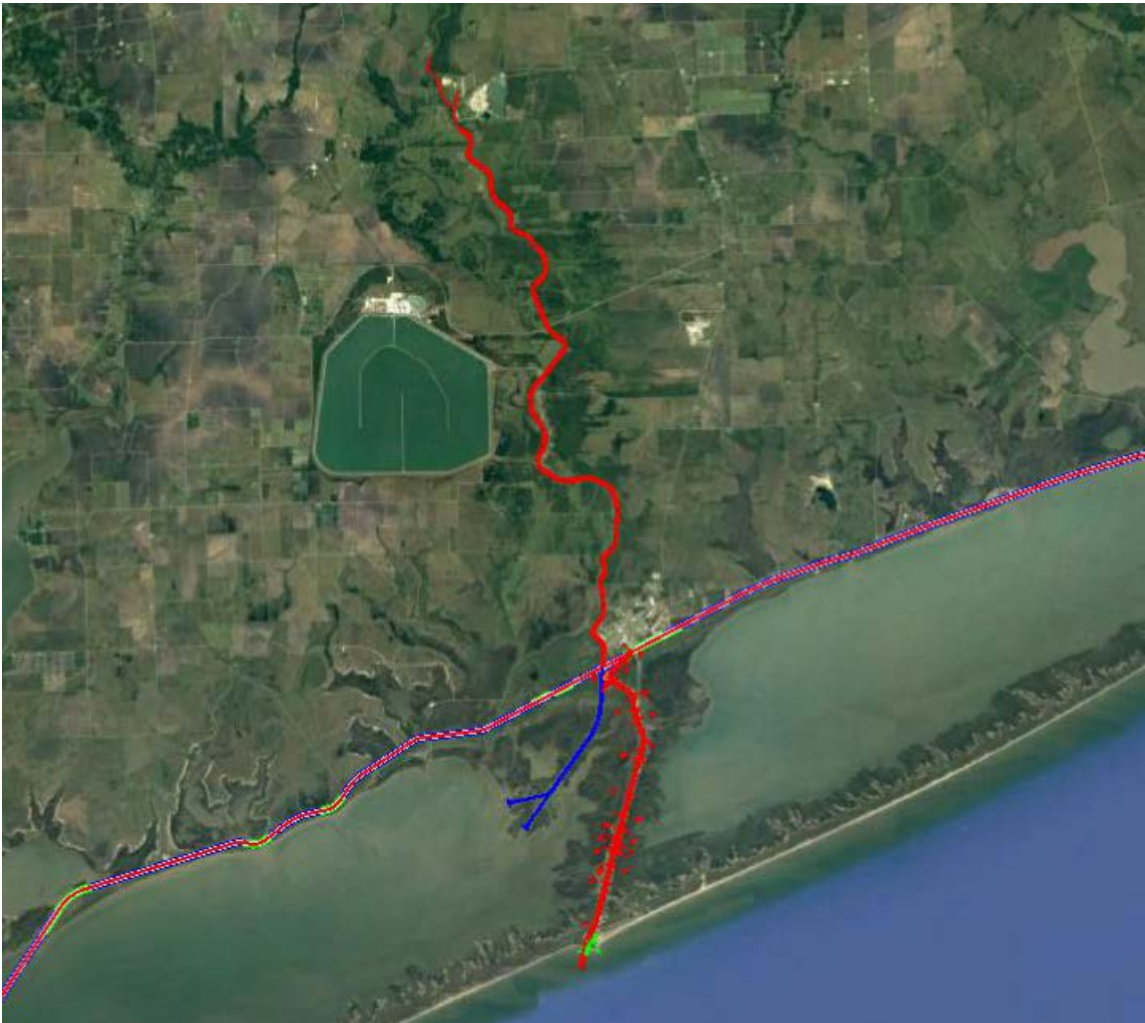
Shoaling at Colorado River Locks



US Army Corps
of Engineers.



Historic Rainfall – Sediment Load on Colorado River



US Army Corps
of Engineers.



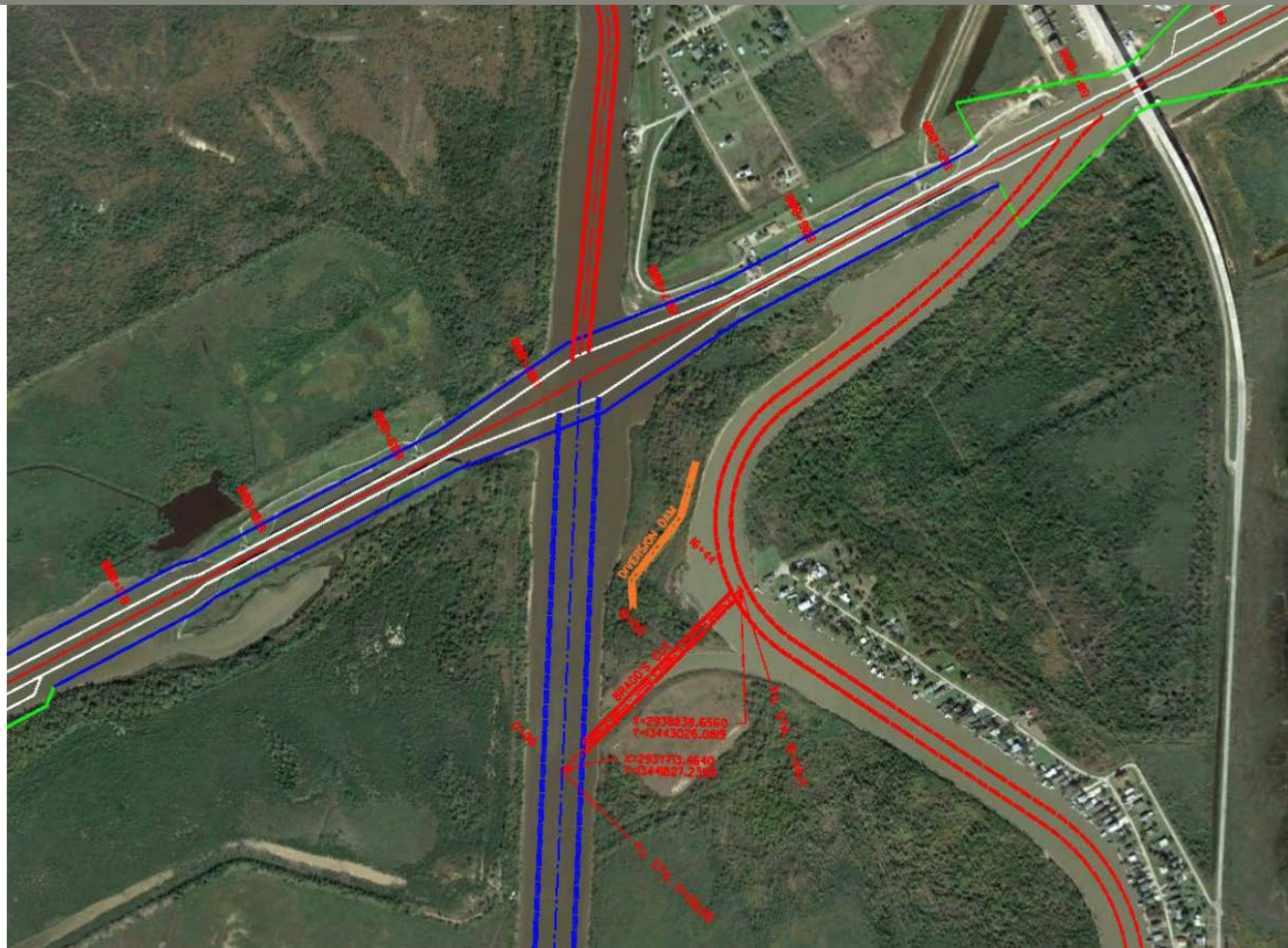
Historic Rainfall – Sediment Load on Colorado River



US Army Corps
of Engineers.



Historic Rainfall – Sediment Load on Colorado River



US Army Corps
of Engineers.



Historic Rainfall – Sediment Load on Colorado River



US Army Corps
of Engineers.

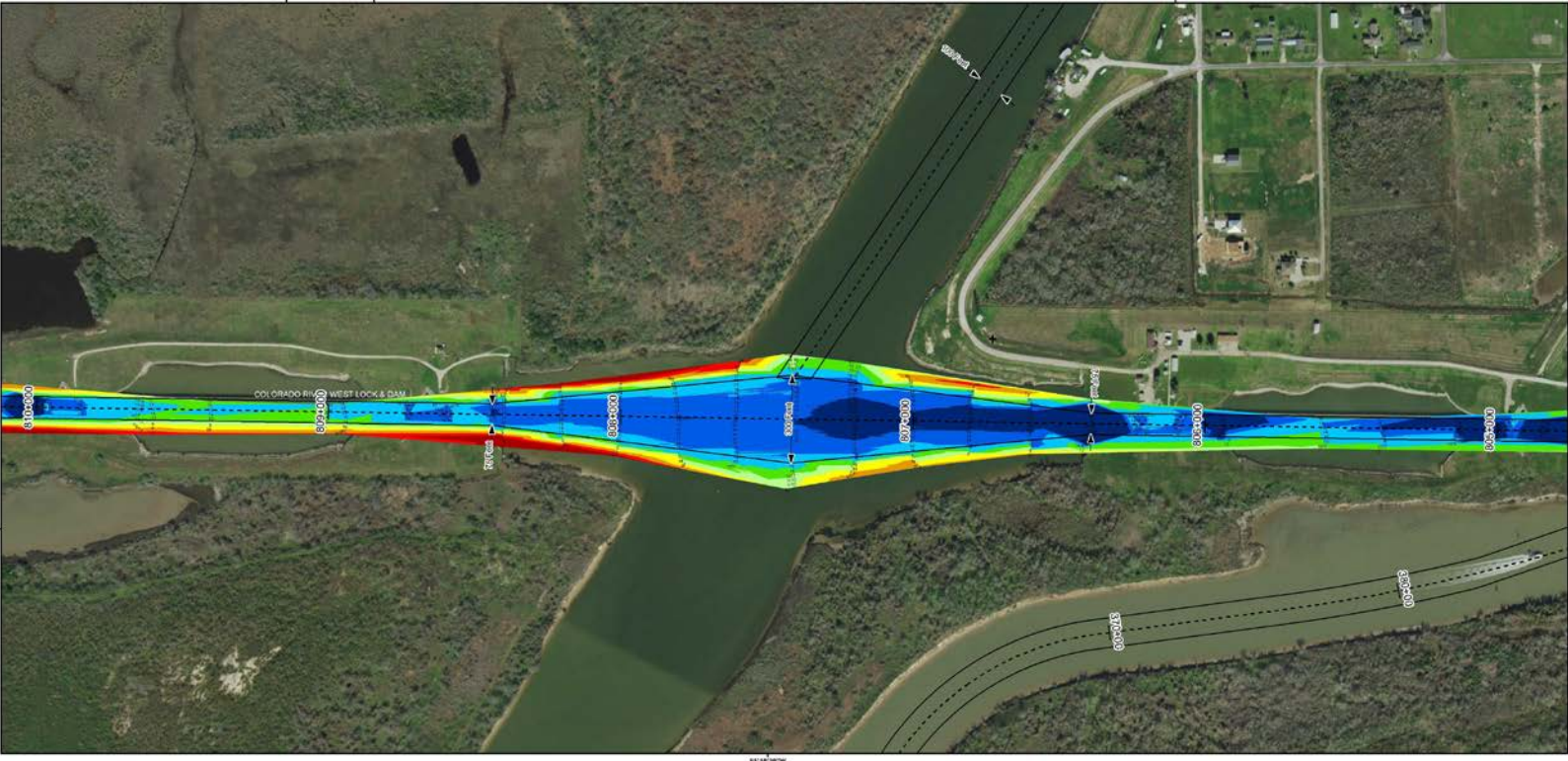


PRE-STORM SURVEY - Colorado River Locks

Gulf Intracoastal Waterway: Colorado River Crossing



U.S. Army Corps of Engineers
Gulf Region District



Channel Features
 --- Channel Top
 --- Channel Center Line
 --- Channel Station Lines
 --- Channel Dimensions

Aids to Navigation
 ☆ Lights
 ▲ Red Side Aids
 ■ Green Side Aids
 ◆ Mooring Buoys

MLLW
 MLLW
 4
 6
 8
 10
 12
 14
 16
 18
 20
 22
 24
 26
 28
 30

MSL Surveyway (Dredged Reach) (Feet)
 0-10 10-15 15-20 20-25 25-30 30-35

NOTES

- HORIZONTAL COORDINATES ARE REFERENCED TO THE STATE PLANE COORDINATE SYSTEM, SOUTH CAROLINA ZONE, USING NAD 83 DATUM.
- ELEVATIONS ARE REFERENCED TO MEAN LOWER LOW WATER (MLLW).
- THIS PROJECT WAS DESIGNED BY THE CONSULTOR UNDER THE CLOSE CONTRACT OF THE U.S. ARMY CORPS OF ENGINEERS. THE MAPPING AND SURVEYING WAS CONDUCTED BY THE CONSULTOR UNDER THE CLOSE CONTRACT OF THE U.S. ARMY CORPS OF ENGINEERS. THE MAPPING AND SURVEYING WAS CONDUCTED BY THE CONSULTOR UNDER THE CLOSE CONTRACT OF THE U.S. ARMY CORPS OF ENGINEERS.
- THE INFORMATION CONTAINED IN THIS SURVEY MAP REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATED HEREON AND IS NOT TO BE CONSIDERED AS A GUARANTEE OF ACCURACY. THE CONSULTOR ASSUMES NO LIABILITY FOR THE CONSEQUENCES OF ANY USE OF THIS INFORMATION FOR ANY PURPOSE OTHER THAN THAT FOR WHICH IT WAS PREPARED. THE CONSULTOR ASSUMES NO LIABILITY FOR THE CONSEQUENCES OF ANY USE OF THIS INFORMATION FOR ANY PURPOSE OTHER THAN THAT FOR WHICH IT WAS PREPARED.
- IN THE AREA OF THE DREDGING OPERATION, A BARGE DUNKER WAS USED AT THE APPROXIMATE LOCATION SHOWN ON THIS SURVEY MAP. THIS OPERATIONAL SUBJECT CONDUCTED THE BATHYMETRIC CHART SURVEYS UNDER THE CLOSE CONTRACT OF THE U.S. ARMY CORPS OF ENGINEERS. THE MAPPING AND SURVEYING WAS CONDUCTED BY THE CONSULTOR UNDER THE CLOSE CONTRACT OF THE U.S. ARMY CORPS OF ENGINEERS.

Service Layer Credits: Source: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeBCO, Swisstopo, IGN, Esri, Swisstopo, OpenStreetMap contributors, and the GIS User Community
 Esri, DeLorme, GEBCO, NOAA, NHD, and other contributors
 Source: Esri, DeLorme, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, AeroGRID, IGN, and the GIS User Community

Coordinate System: NAD 1983 StatePlane Texas South Central FIPS 4304 Feet
 Projected: Lambert Conformal Conic Datum: North American 1983

Dredging Reach Extent
 0 0.425 0.85
 Miles

Hydrographic Survey Extent
 0 125 250 500
 Feet

Survey Dates: 15 May 2017	Authorized Depth: +14ft
Page: 116 of 190	Map: Soli Slope Ratio (Riser, Run)
Scale: 1:2,000	Additional Imagery: © DigitalGlobe Inc.
Mapped by: M3CONPAC	Plot Date: 8/15/2017
Additional Info:	

HYDROGRAPHIC SURVEY
 50% COPIES OF ENCLOSURES
 100% COPIES OF ENCLOSURES
 100% COPIES OF ENCLOSURES

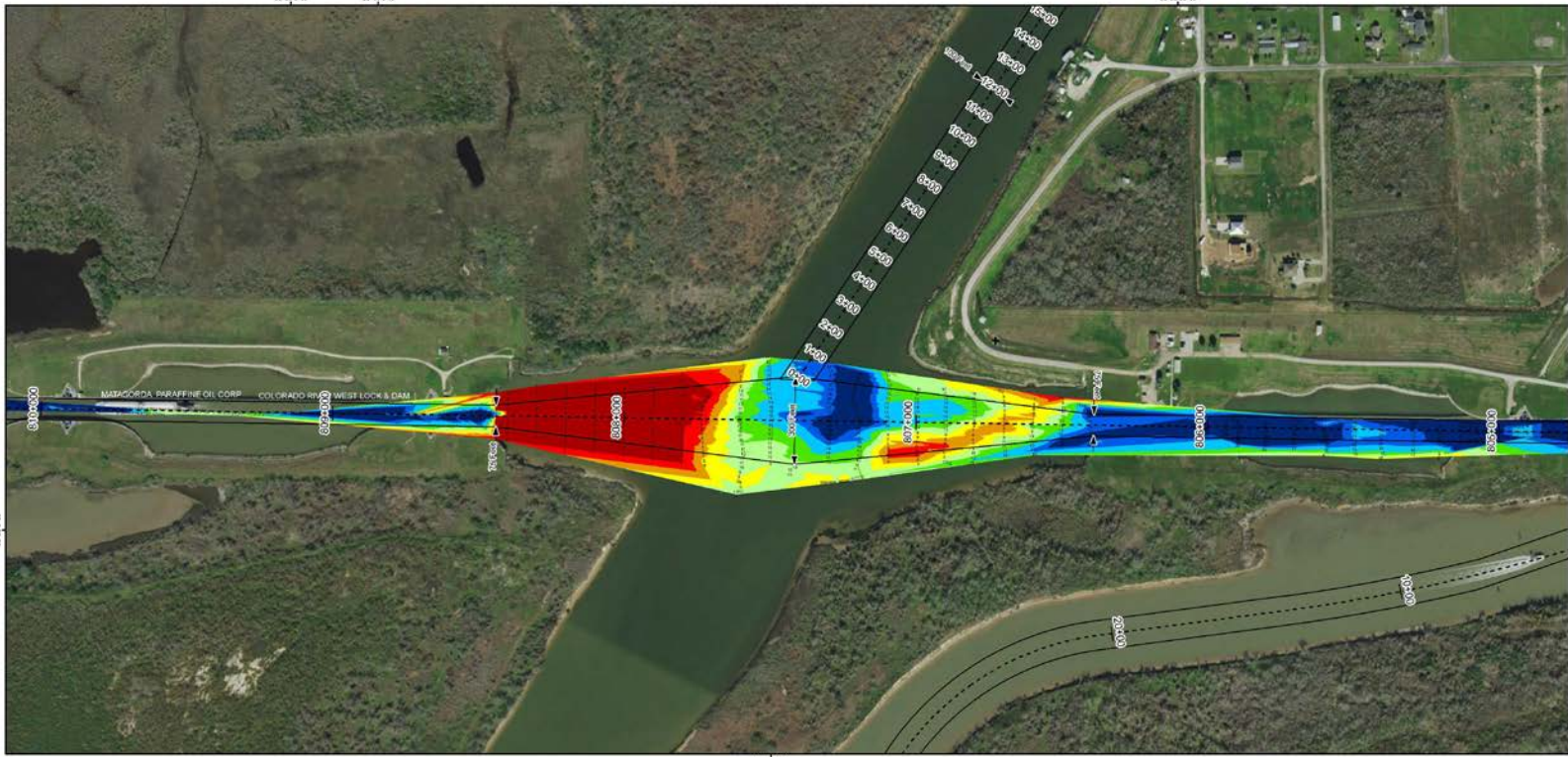
Station: 806+000 to 810+000
 GIWW
 TEXAS

POST-STORM SURVEY - Colorado River Locks – 9/3/2017

Gulf Intracoastal Waterway: Colorado River Crossing



U.S. Army Corps of Engineers
Galveston District



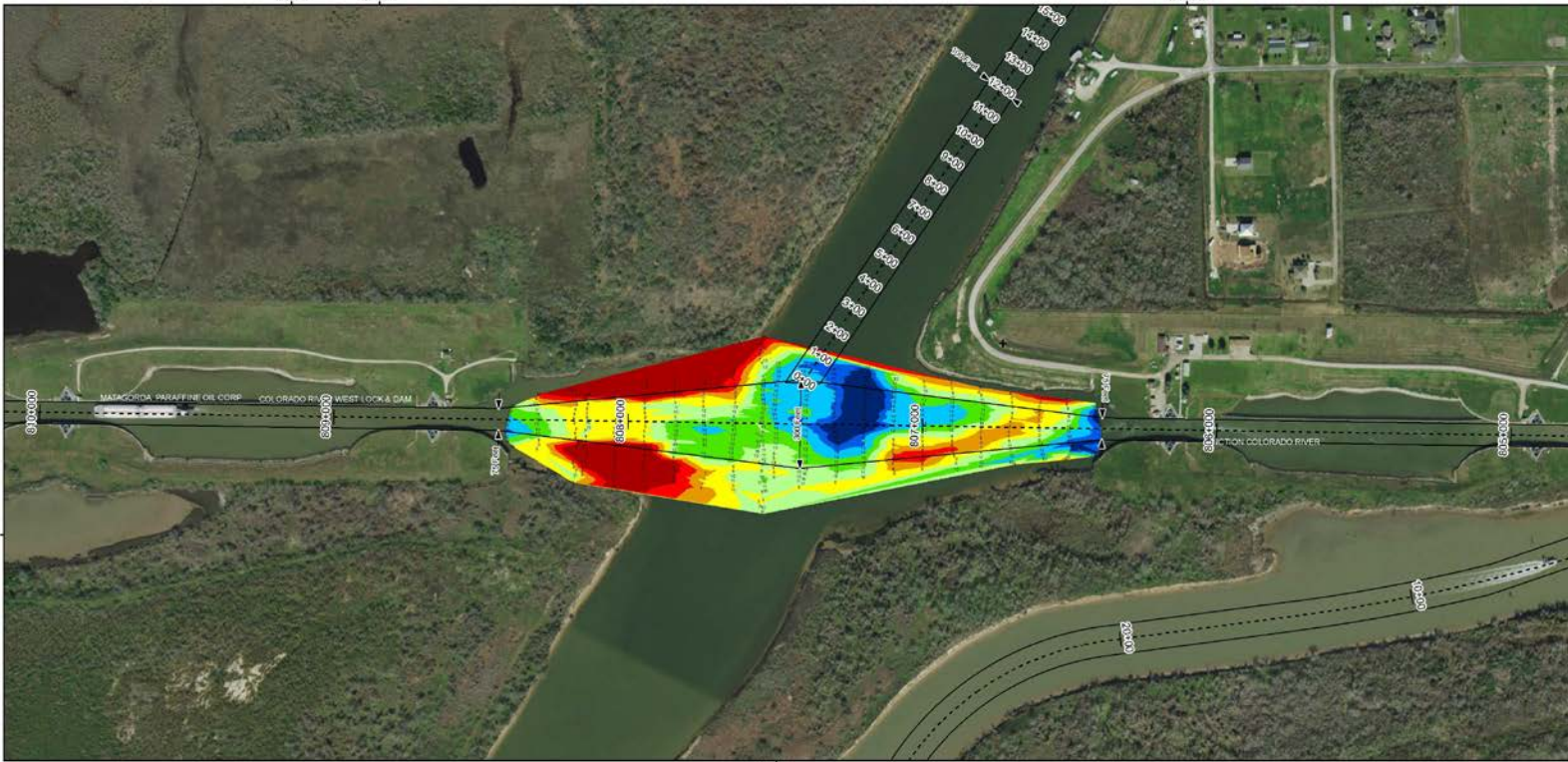
Survey Date(s): 05 September 2017	Authorized Depth: -14ft
Page: 110 of 160	Scale Ratio: (Rise / Run)
Map	Additional Imagery: © DigitalGlobe Inc.
Scale: 1:2,000	Print Date: 09/16/2017
Misspelled by: MOC/OPHC	Additional Info:

Survey Date(s): 05 September 2017	Authorized Depth: -14ft
Page: 110 of 160	Scale Ratio: (Rise / Run)
Map	Additional Imagery: © DigitalGlobe Inc.
Scale: 1:2,000	Print Date: 09/16/2017
Misspelled by: MOC/OPHC	Additional Info:

HYDROGRAPHIC SURVEY
U.S. ARMY CORPS OF ENGINEERS
Galveston District
Colorado River Crossing
Station: 805+000 to 810+000
GALVESTON, TEXAS

RECOVERY OPERATIONS - Colorado River Locks – 9/22/2017

Gulf Intracoastal Waterway: Colorado River Crossing



Authorized Depth: +1 ft
Scale Slope Ratio: (Rise: Run)
Additional Imagery: © DigitalGlobe, Inc.
Print Date: 9/22/2017

Survey Date(s): 22 September 2017
Page: 116 of 190
Map
Scale: 1:2,000
Mapped by: m30dtrnk
Additional Info:

Channel Features

- Channel Top
- Channel Center Line
- Channel Station Lines
- Channel Dimensions

Aids to Navigation

- Lights
- Red Side Aids
- Green Side Aids
- Moorings Buoy

MLLW

4'	4'-6"	6"	6'-10"	10'-12"	12'-14"	14'-16"	16'-18"	18'
----	-------	----	--------	---------	---------	---------	---------	-----

NECA Bathymetry CHARTING REGION BY STATE

1-19	19-25	25-30	30-35	35-40
------	-------	-------	-------	-------

NOTES:

1. COORDINATE COORDINATES ARE REFERENCED TO THE NATIONAL DATUM SYSTEM, SOUTH CENTRAL ZONE VARIATION OF 3.94 MINUTES.
2. ELEVATIONS ARE REFERENCED TO MEAN LOWER LOW WATER (MLLW).
3. THE ELEVATION DATA PROVIDED BY THE UNIVERSITY OF TEXAS AT AUSTIN FOR THIS PROJECT WAS OBTAINED FROM THE SURVEY DATA FOR THE COLORADO RIVER LOCKS PROJECT.

THE INFORMATION PROVIDED ON THIS SURVEY WAS PREPARED BY RESULTS OF SURVEYS MADE ON THE DATE INDICATED AND CONDUCTED BY THE SURVEYING ENGINEER IN CHARGE. THE SURVEYING ENGINEER IS NOT RESPONSIBLE FOR THE ACCURACY OF THE DATA PROVIDED BY THE USER OF THIS SURVEY DATA.

FOR THE MOST UP TO DATE INFORMATION PLEASE VISIT OUR WEBSITE AT: www.usace.army.mil

FOR A COMPLETE LIST OF SURVEYS CONDUCTED BY THE SURVEYING ENGINEER IN CHARGE, VISIT OUR WEBSITE AT: www.usace.army.mil

Service Layer Credits: Source: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NGA, Swatch, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Beijing), Swire, Mapbox, CN, OpenStreetMap contributors, and the GIS User Community

Esri, DeLorme, GEBCO, NOAA NGS, and other contributors

Source: Esri, DigitalGlobe, GeoEye, AeroGRID, IGN, Esri, Air Photo, USDA, USDA, AeroGRID, IGN, and the GIS User Community

Coordinate System: NAD 1983 StatePlane, Texas South Central FIPS 4204 Feet Projection, Lambert Conformal Conic, Datum: North American 1983

Dredging Reach Extent: 0 to 0.80 Miles

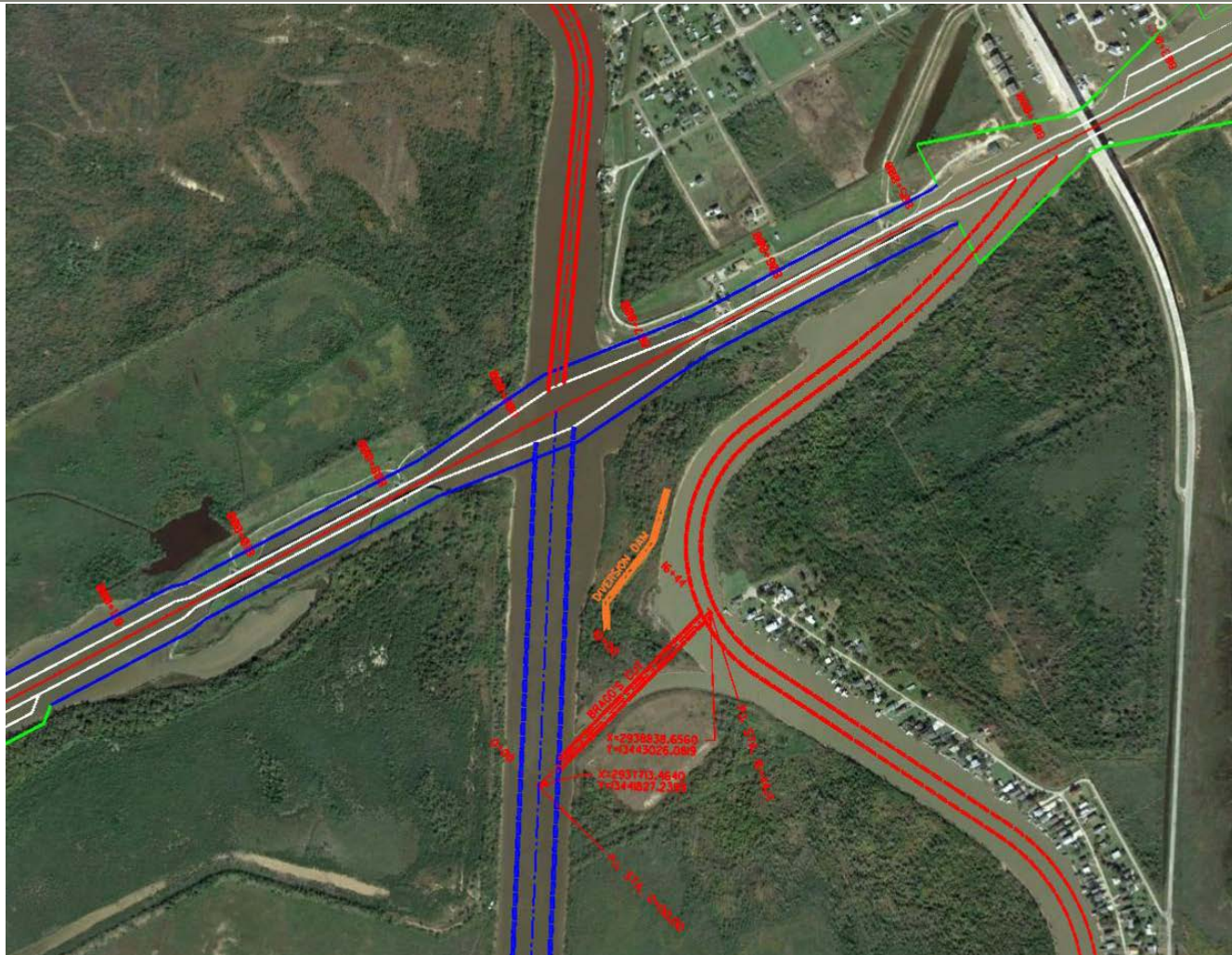
Hydrographic Survey Extent: 0 to 500 Feet

HYDROGRAPHIC SURVEY

U.S. ARMY ENGINEER DISTRICT
GALVESTON, TEXAS
Colorado River Crossing
GIWW
TEXAS

Station: 805+000 to 810+000

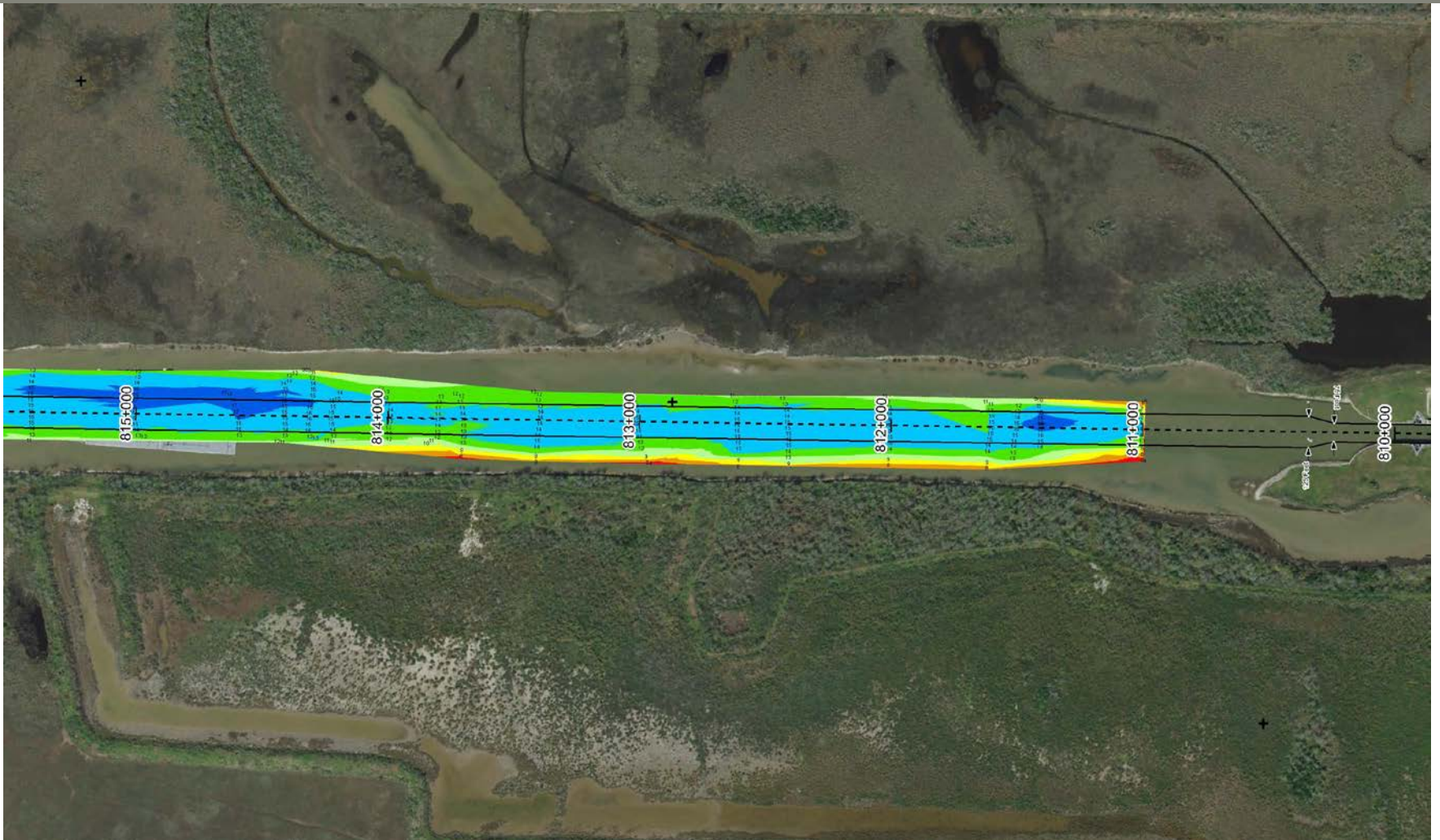
Historic Rainfall – Sediment Load on Colorado River



US Army Corps
of Engineers.



PRE-STORM – West of Colorado River Locks



US Army Corps
of Engineers.



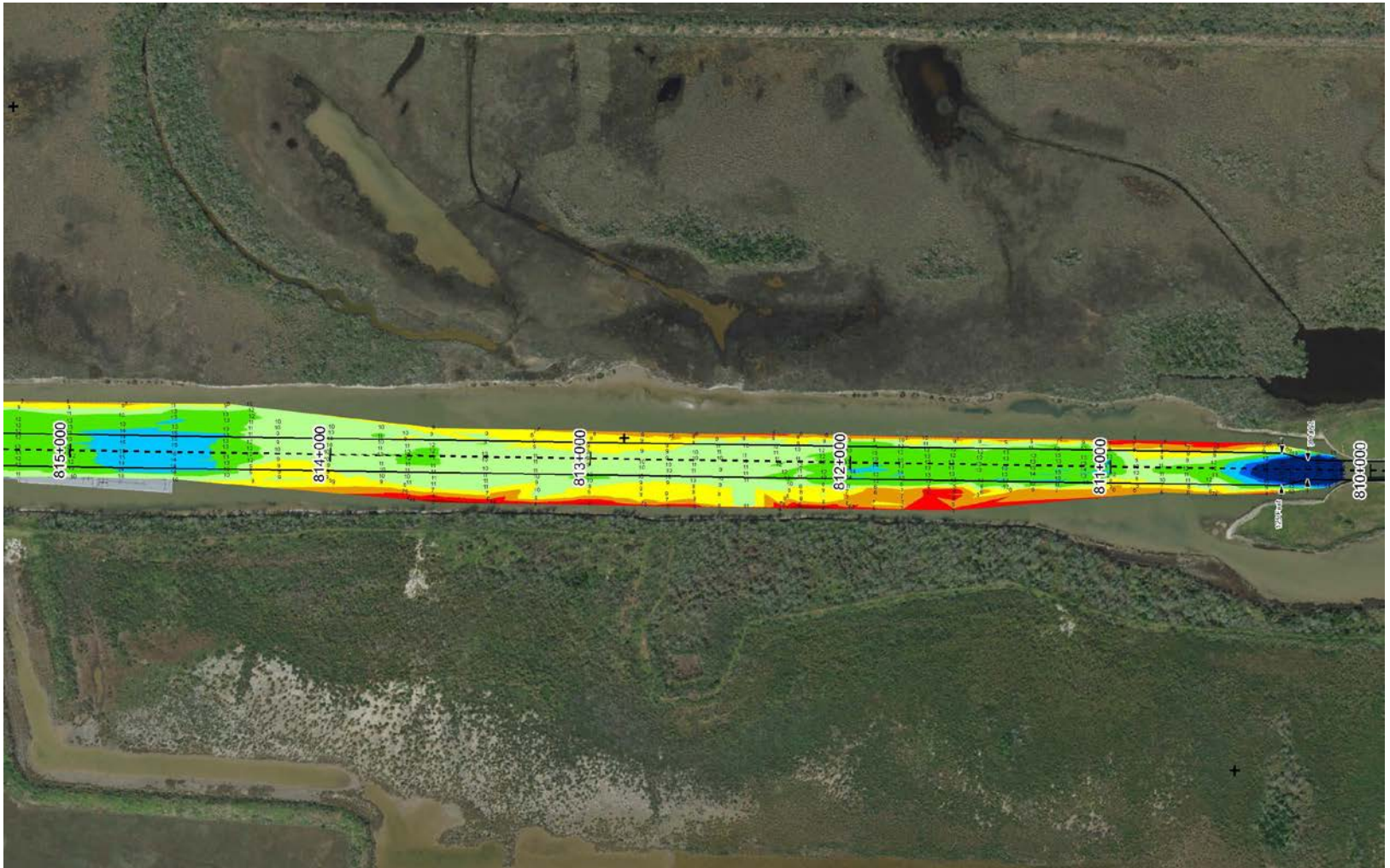
POST STORM – West of Colorado River Locks 9/3/2017



US Army Corps
of Engineers.



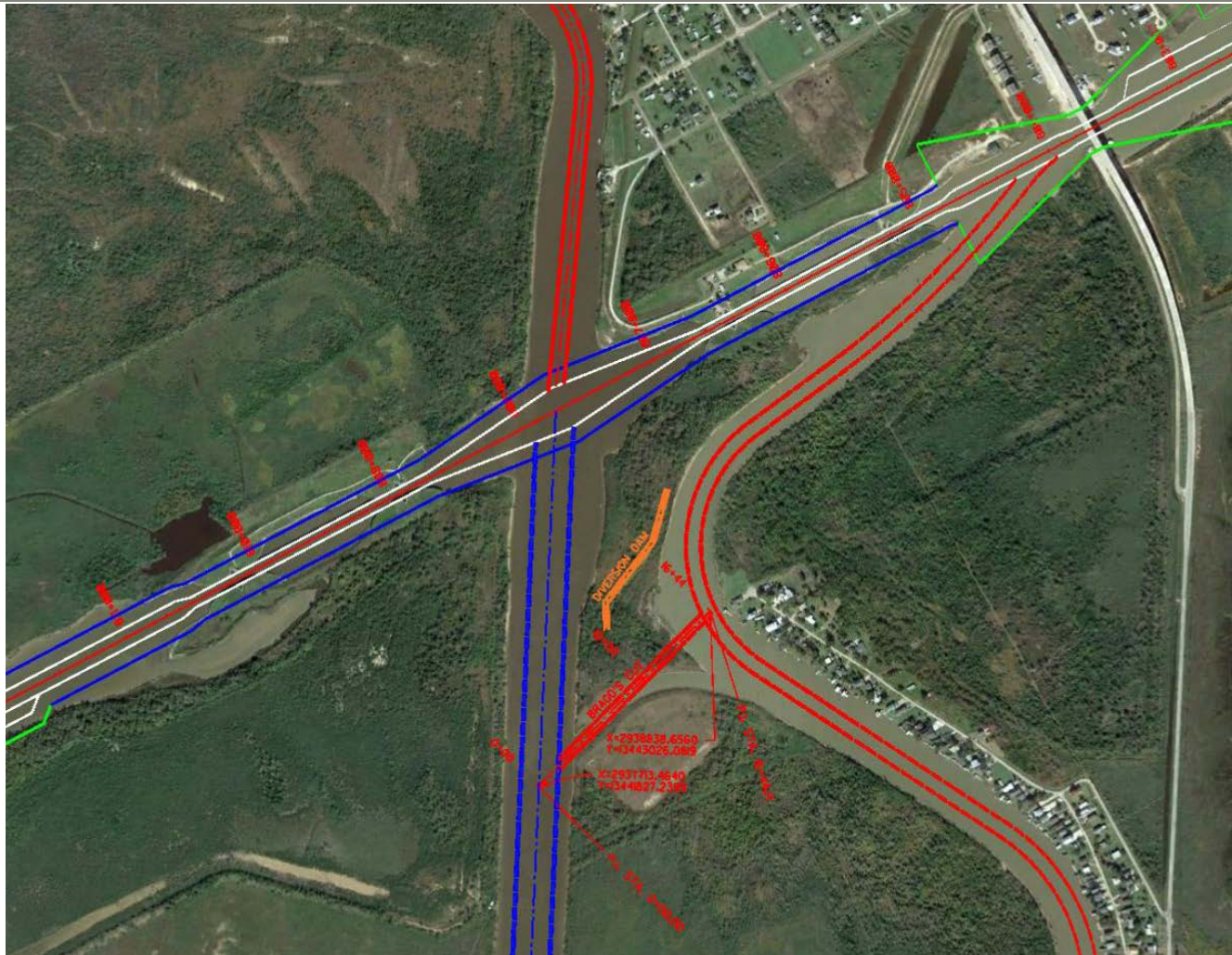
RECOVERY OPERATIONS – West of Colorado River Locks 9/30/17



US Army Corps
of Engineers.



Historic Rainfall – Sediment Load on Colorado River



US Army Corps
of Engineers.



GIWW Closure – West of Colorado River Locks



US Army Corps
of Engineers.



HURRICANE HARVEY

GALVESTON DISTRICT - NAVIGATION CHANNELS



Sept 26, 2017



U.S. Army Corps of Engineers.



Historic Rainfall – San Bernard R., Brazos River & Freeport Harbor



US Army Corps
of Engineers.



Historic Rainfall – Galveston Bay



US Army Corps
of Engineers.



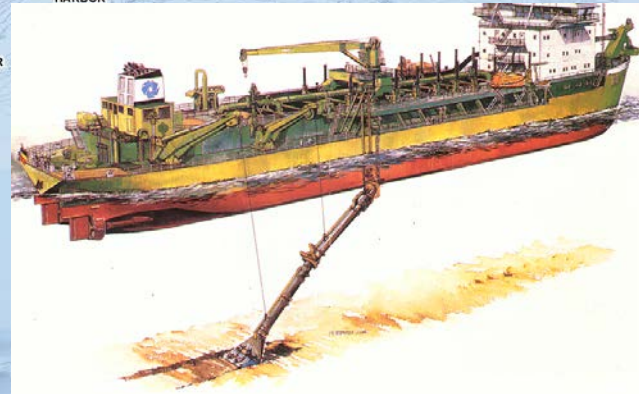
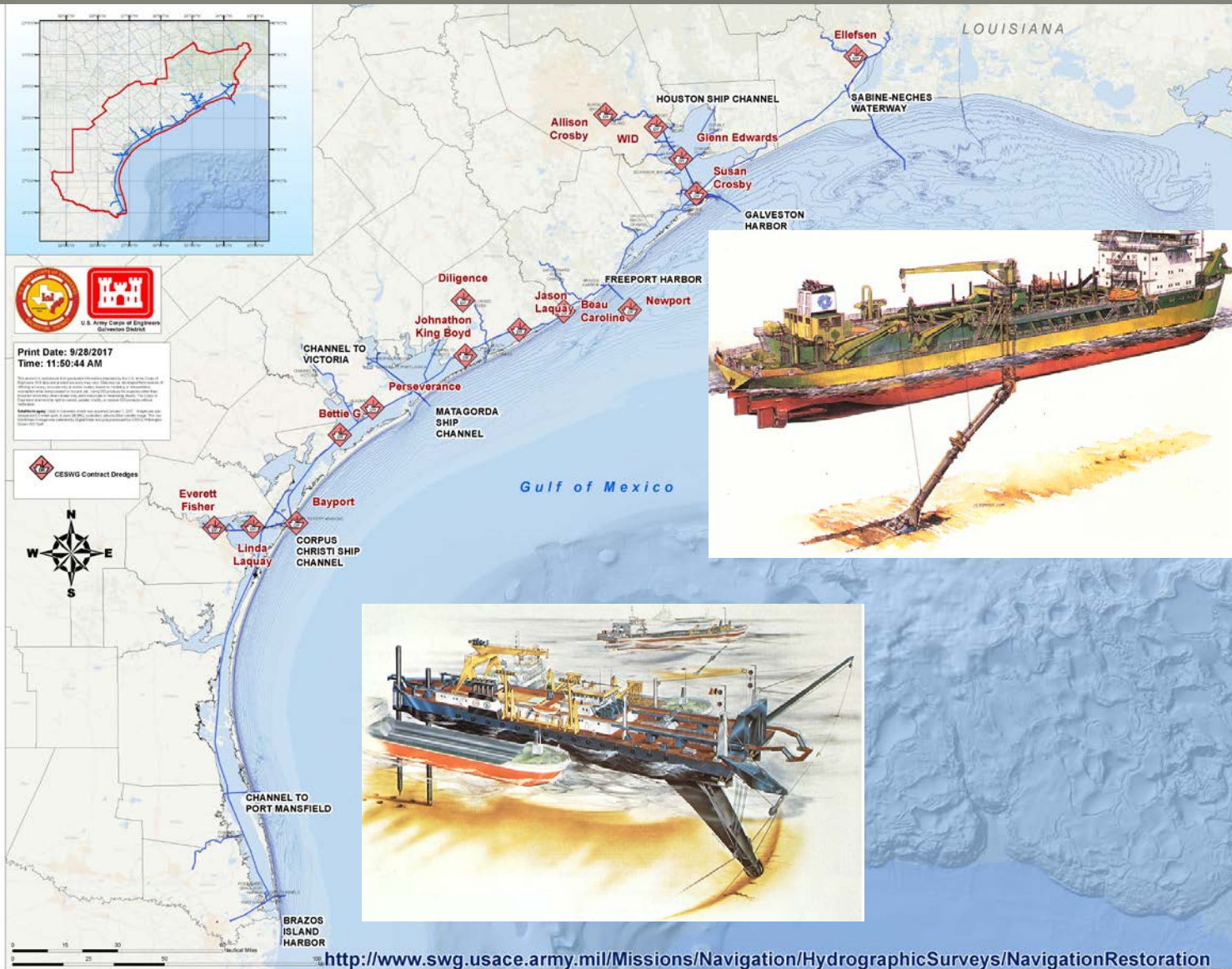
Historic Rainfall – Sediment Load



US Army Corps
of Engineers.



CONTRACT DREDGES – U.S. ARMY CORPS OF ENGINEERS



<http://www.swg.usace.army.mil/Missions/Navigation/HydrographicSurveys/NavigationRestoration>



HURRICANE HARVEY RELATED DAMAGES

FEDERAL PROJECT	RECEIVED TO DATE	REMAINING NEED	TOTAL
	(millions)	(millions)	(millions)
Channel to Port Bolivar	\$0.4	\$0.0	\$0.4
Channel to Victoria	\$0.0	\$2.0	\$2.0
Corpus Christi Ship Channel	\$5.0	\$28.0	\$33.0
Freeport Harbor	\$2.0	\$0.0	\$2.0
Galveston Harbor	\$2.0	\$0.0	\$2.0
Gulf Intracoastal Waterway	\$10.5	\$21.0	\$31.5
Houston Ship Channel	\$17.7	\$27.0	\$44.7
Matagorda Ship Channel	\$5.5	\$0.0	\$5.5
Mouth of the Colorado River	\$0.0	\$6.0	\$6.0
Sabine-Neches Waterway	\$5.6	\$2.0	\$7.6
TOTAL	\$48.7	\$86.0	\$134.7

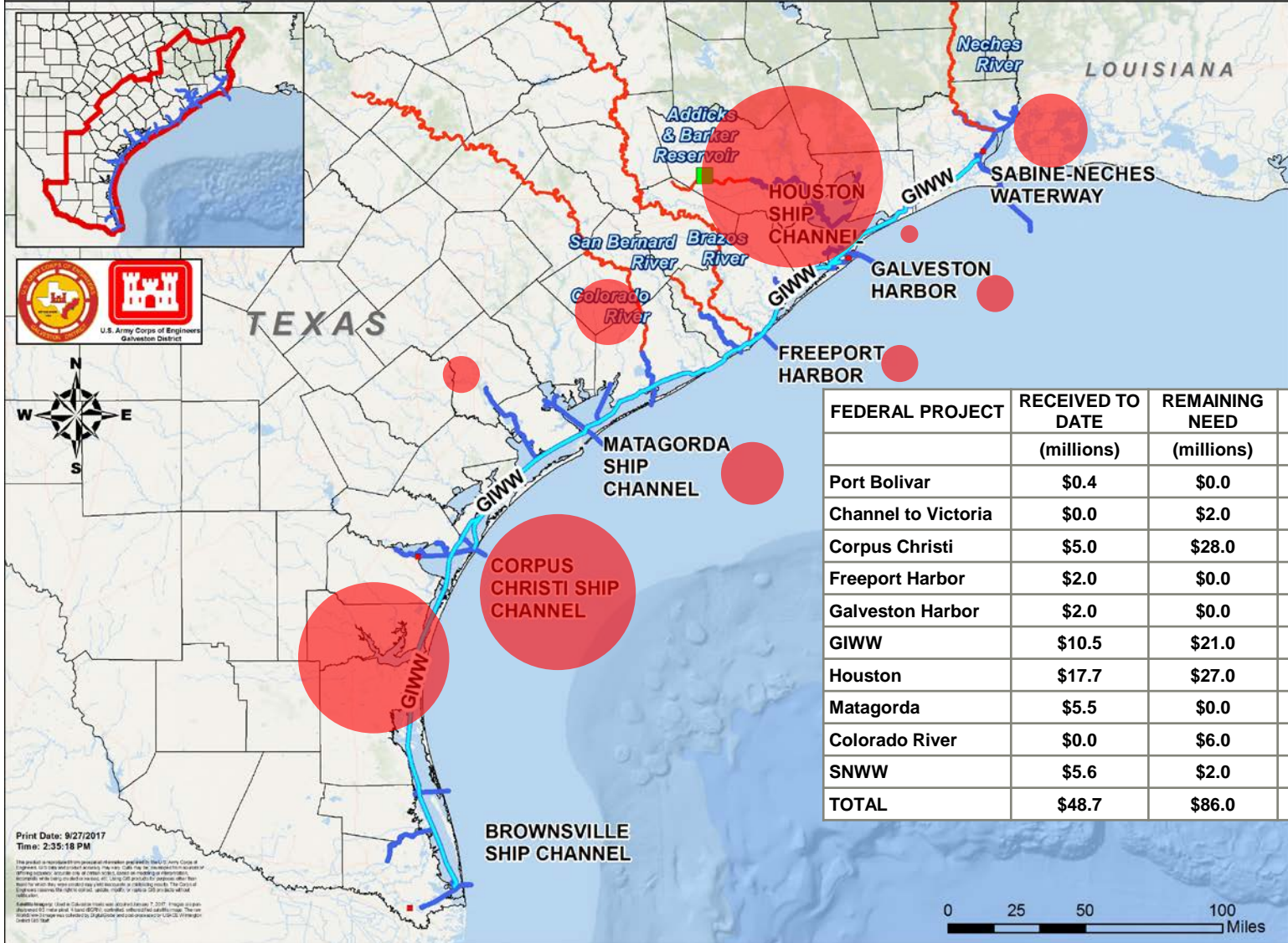


US Army Corps
of Engineers.



HURRICANE HARVEY

GALVESTON DISTRICT - NAVIGATION CHANNELS



HURRICANE HARVEY RELATED DAMAGES

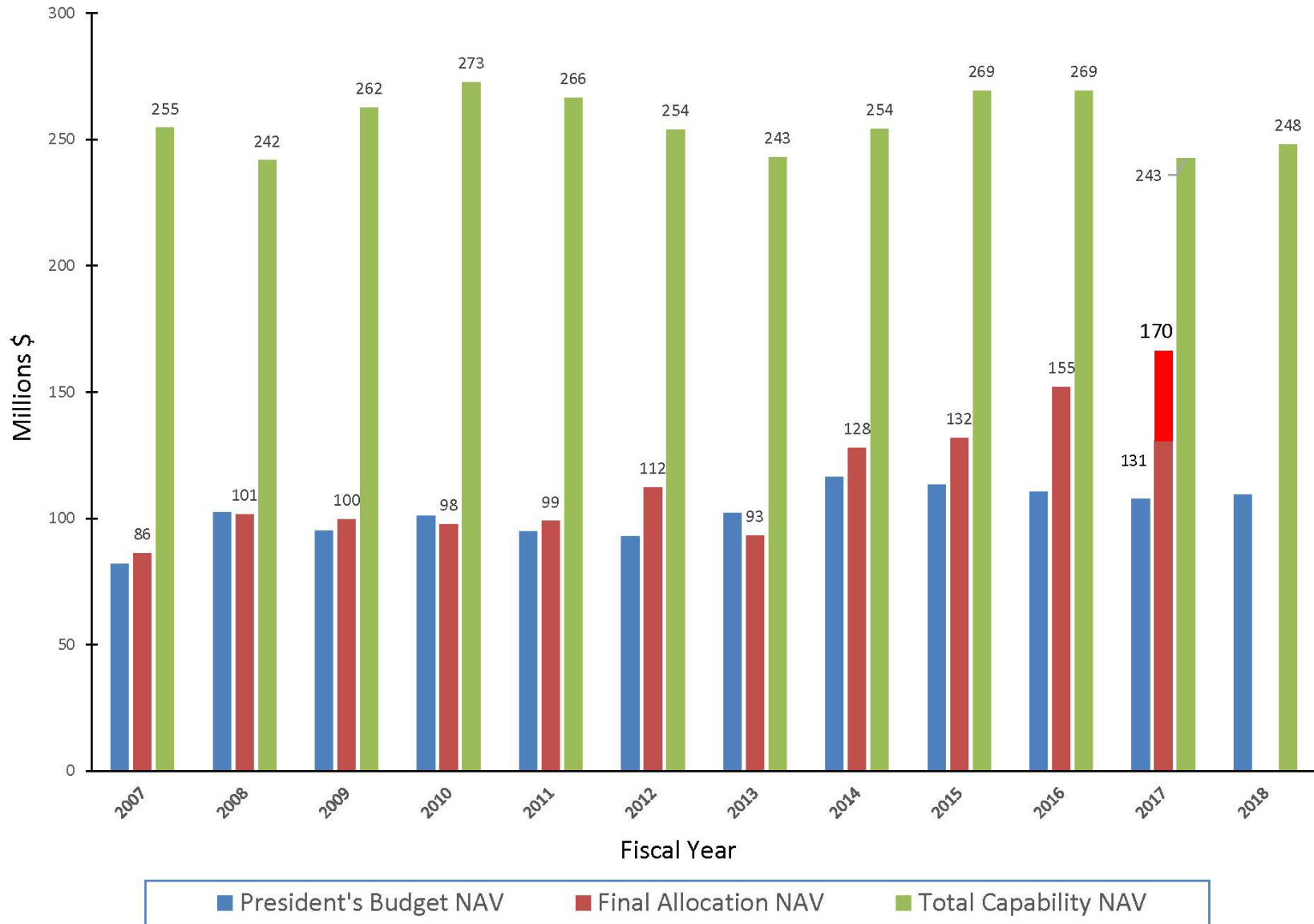
FEDERAL PROJECT	RECEIVED TO DATE	REMAINING NEED	TOTAL
	(millions)	(millions)	(millions)
Urgent Dredging Requirements	\$47.7	\$11.5	\$60.2
Dredging Requirement w/ Normal Maint.	\$0.0	\$18.5	\$18.5
Damaged Placement Areas	\$0.0	\$16.5	\$16.5
Additional PA Capacity	\$0.0	\$14.5	\$14.5
Navigation Structures	\$1.0	\$25.0	\$25.0
TOTAL	\$48.7	\$86.0	\$134.7



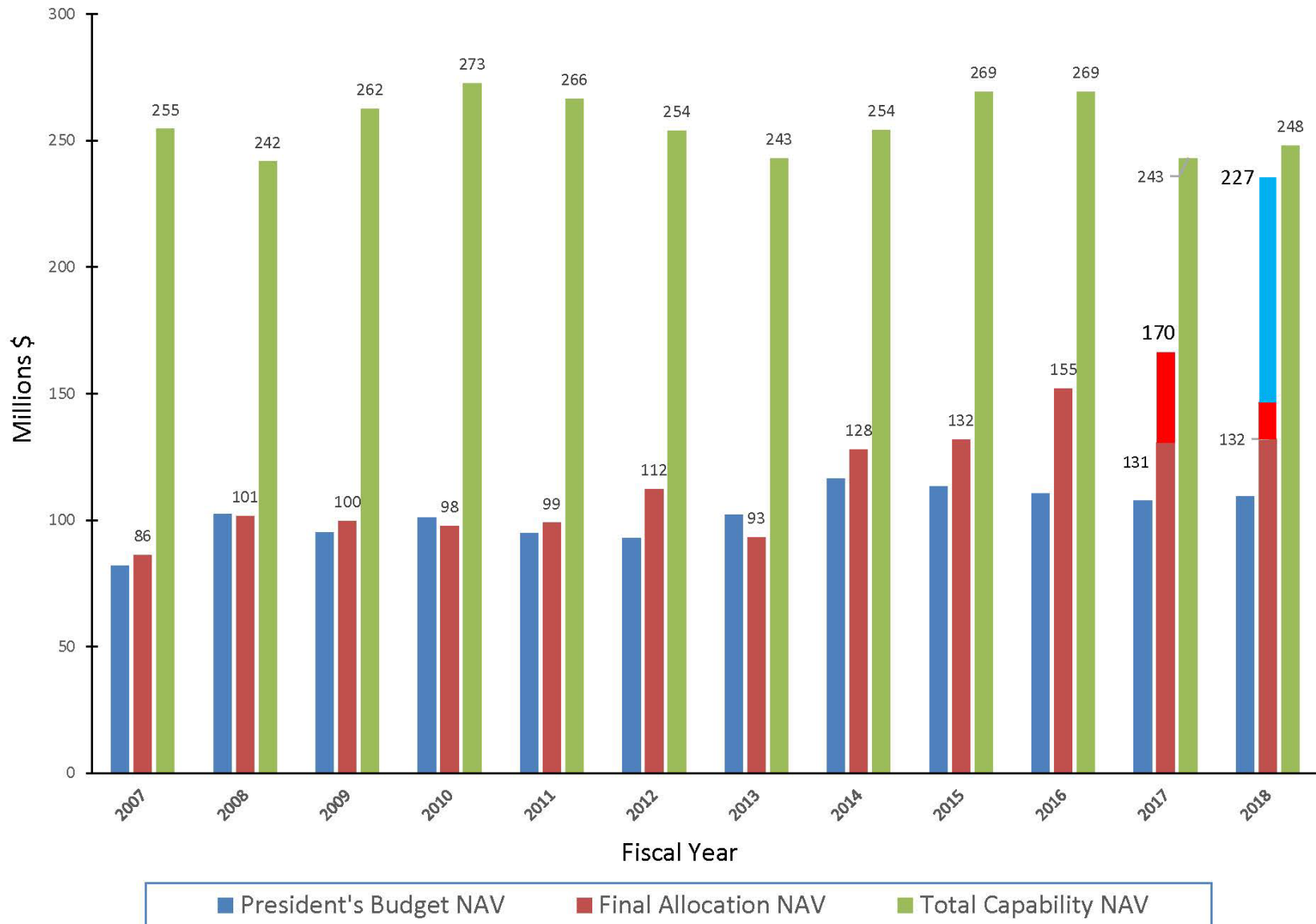
US Army Corps
of Engineers.



SWG O&M NAV PROGRAM PERFORMANCE AND FUNDING TRENDS



SWG O&M NAV PROGRAM PERFORMANCE AND FUNDING TRENDS



CHANNEL STATUS – TEXAS COAST

USACE FEDERAL NAVIGATION PROJECTS - PORT STATUS AS OF 29 OCT 2017 1700

PROJECT	Port	Restrictions	Project	Remarks
	Status		Depth	
CORPUS CHRISTI SHIP CHANNEL	OPEN	One Way Traffic	47'	Funding request includes damages to SNWW Jetty System.
MATAGORDA SHIP CHANNEL	OPEN	31' - Daylight	38'	Urgent & Compelling contract scheduled for awarded; Contractor scheduled to arrive on Nov 17.
FREEMPORT HARBOR	OPEN	41' - 24/7	46'	Dredge NEWPORT currently working Entrance and Jetty Channels. Anticipate to incrementally relieve draft restrictions by Nov 6.
GALVESTON HARBOR & CHANNEL	OPEN	41'6" to Pier 33; 40' Pier 33 to end of channel	46'	Dredge GLENN EDWARDS working through December
TEXAS CITY SHIP CHANNEL	OPEN	43' (Pilot restrictions)	46'	Dredge SUSAN CROSBY working through December
HOUSTON SHIP CHANNEL				
Bayport Ship Channel	OPEN	44' - 24/7	46'	Pipeline dredge ELLEFSEN scheduled to commence dredging first week of Nov
Barbours Terminal Cut	OPEN	44' - 24/7	46'	Pipeline dredge ELLEFSEN to perform work following Bayport dredging
Baytown Highlines through Beltway 8 Bridge	OPEN	41' - 24/7	46'	Awarded Urgent contract to Orion Marine; mobilizing
Beltway 8 Bridge to I-610 Bridge	OPEN	33' - 24/7	41'	Scheduled to advertise and award new contract in December 2017.
I-610 Bridge through Upper Turning Basin	OPEN	33' - 24/7	37'	Scheduled to modify existing contract to address Harvey related shoaling.
Greens Bayou				Unable to survey due to presence of barges in Federal Channel. Barge owners (Kirby Marine) undertaking recovery operations.
SABINE NECHES WATERWAY	OPEN	Upper Neches: 33' - 24/7 Lower Neches 40' -24/7	40'	Pipeline dredge ELLEFSON to complete 1st week of November.
<i>Neches River (Port of Beaumont)</i>				Pipeline dredge ELLEFSON commenced dredging on Sept 26, anticipated to complete work (and relieve draft restrictions) the 1st week of November.
GULF INTRACOASTAL WATERWAY				
CORPUS CHRISTI TO VICTORIA BARGE CANAL	OPEN	11' - 24/7	14'	JONATHON KING BOYD to recover channel to 12-ft draft by first week of November.
VICTORIA BARGE CANAL TO COLORADO RIVER	OPEN	10' - 24/7	14'	
COLORADO RIVER CHANNEL	OPEN	8' - 24/7	9'	Pipeline dredge DILIGENCE to restore to 11-ft by November 15.



US Army Corps
of Engineers.





ON FACEBOOK

www.facebook.com/GalvestonDistrict



ON TWITTER

www.twitter.com/USACEgalveston



ON YOUTUBE

[www.YouTube.com/Galveston District](http://www.YouTube.com/GalvestonDistrict)



ON DVIDS

www.dvidshub.net/units/USACE-GD



ONLINE

www.swg.usace.army.mil



US Army Corps
of Engineers.

