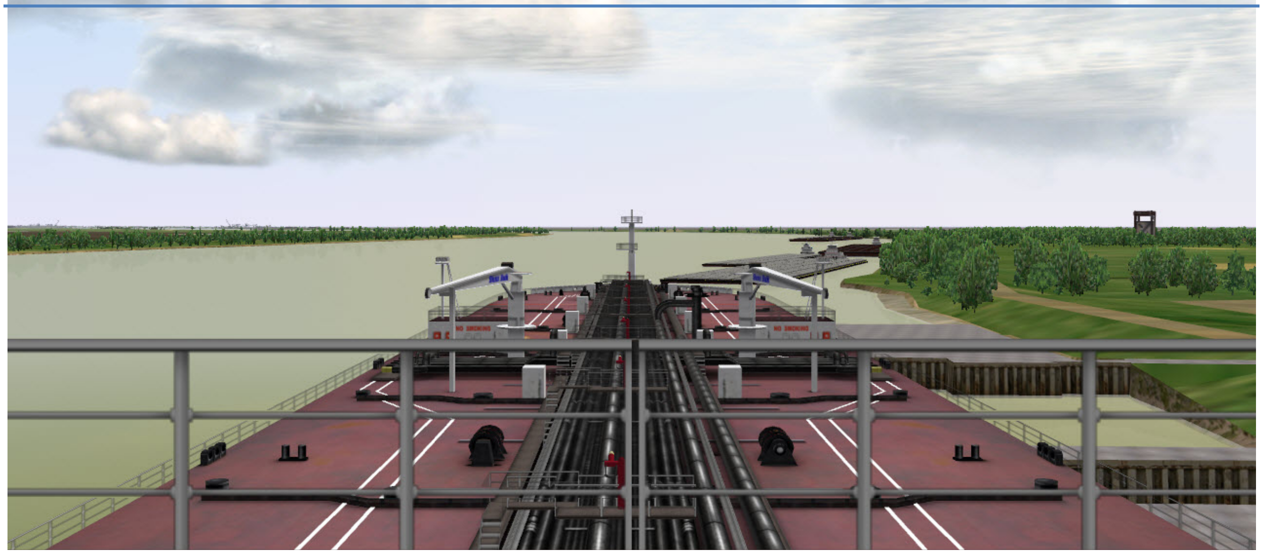
Appendix B. Mid-Barataria Sediment Diversion Project – Impact on the Navigation of Ships in the Mississippi River and Summary of Ship Simulation Observation Memorandum

Mid-Barataria Sediment Diversion Project – Impact on the Navigation of Ships in the Mississippi River



Study Performed for

Coastal Protection and Restoration Authority

State of Louisiana

and

HDR

by

Waterway Simulation Technology, Inc.

and

Maritime Institute of Technology and Graduate Studies

February 2,2014

1 Introduction and Background

1.1 Project Description

Land loss in the Mississippi River Delta has been a growing concern for many years. Reversal of this has become high priority matter following a series of catastrophic hurricanes for which wetlands in the delta are considered to be significant factors in reducing the strength of these hurricanes. Therefore, Increasing wetlands in the delta is a priority in an effort to reduce property damage and loss of life. Since the Mississippi River flood levees have been constructed to control flooding, the overflow of sediment bearing floodwaters into the wetlands of the delta has been constrained and replenishment of sediment in the wetlands reduced or eliminated. Therefore, in an effort to restore wetlands in the delta, a series of sediment diversion projects are being designed to allow sediment-bearing water to be diverted from the Mississippi River through control structures and into a distribution system that will carry these sediments and nutrients into wetlands where restoration is desired.

Figure 1: Location of the Mid-Barataria Sediment Diversion Project on the Lower Mississippi River.

The Mid-Barataria Sediment Diversion Project was authorized in the 2007 Water Resources Development Act. It is a medium size diversion intended to mimic natural land-building processes by reintroducing sediment into the basin from the Mississippi River. The receiving basin of this diversion, Barataria Bay, has experienced some of the highest rates of land loss in coastal Louisiana. The location of this project is shown in Figure 1 and is near Myrtle Grove, LA, along the western side of the Mississippi River (shown in the red box in Figure 1).

A partial project layout is shown in Figure 2 with the focus on the diversion canal location, size and orientation. The project involves cutting into and relocating the main levee on the western side of the Mississippi River, digging a diversion canal with levees along the canal, control structures at the river end of the canal and at the distribution end of the canal along with other features not pertinent to this study and report. This design is a preliminary conceptual design and the main focus for this study is the intake structure as it extends into the Mississippi River and the channel to the eastern control gate, shown in Figure 3. This drawing shows that the conveyance channel will be dredged to -40 ft Mean Lower Low Water Reference Plane (MLLW) to a gate structure that will be closed when the project is not in operation and will control the flow into the project behind the levee when the project is in operation.

Figure 2: Conceptual Mid-Barataria Sediment Diversion Canal with Control Structures

To predict the potential of this project's capability to build land, research was carried out to understand the river's bottom, water flow and sediment content at various discharges. It was found that the potential for carrying high levels of soil and sand was during periods of high river discharge, particularly at rates of 700,000 cfs or greater. It was also found that the location chosen for the intake channel had the highest levels of sediment during these flows on the western side of the river and would, therefore, produce the highest potential for capture of sediment bearing water.

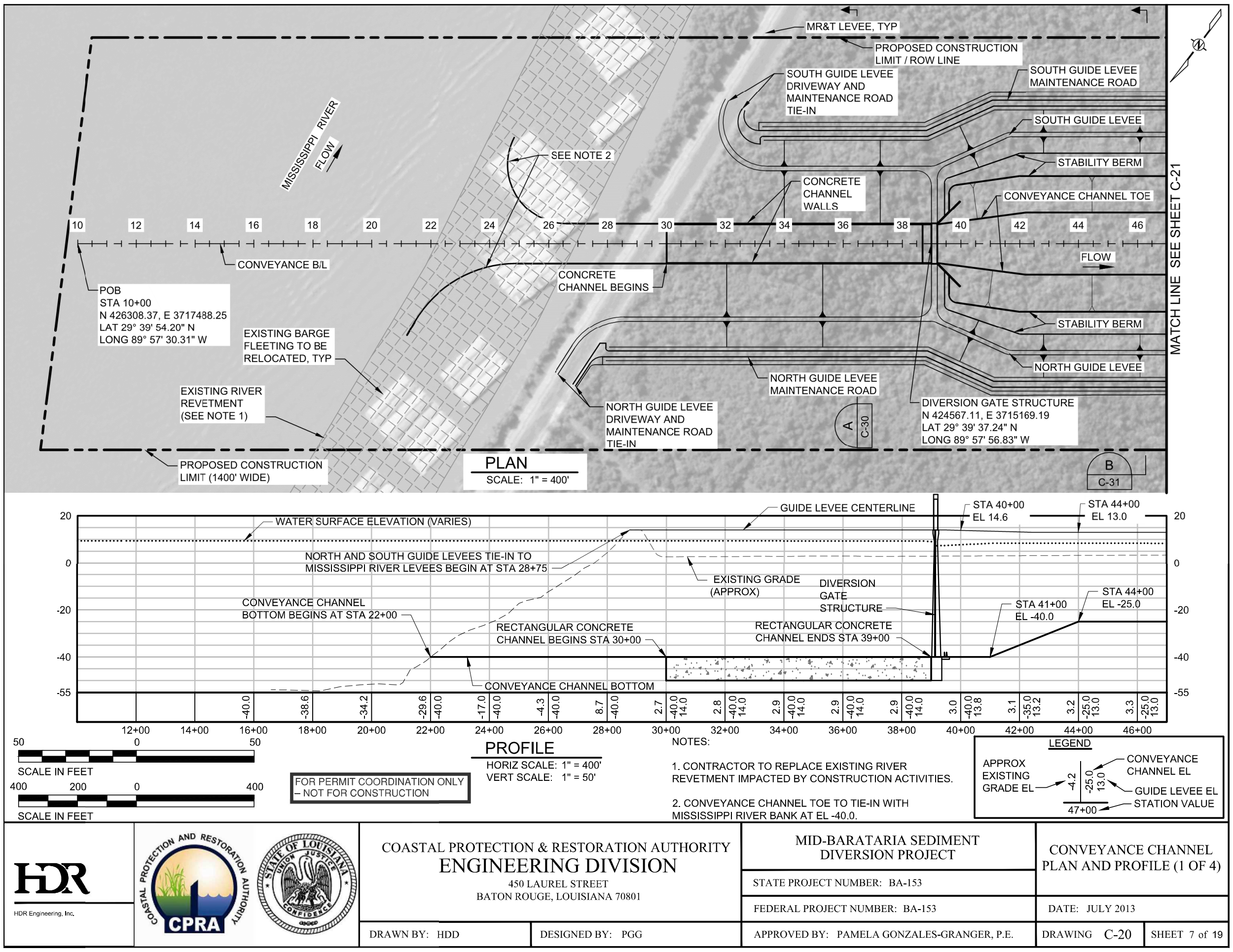


Figure 3: Preliminary Mid-Barataria Sediment Diversion Conveyance Channel Plan and Profile

The significance of this project has brought together governmental agencies and universities in a data collection and modeling effort. The Water Institute of the Gulf has developed a three-dimensional (3D) model of the Mississippi River reach and the project to study the hydrodynamics and transport characteristics of the proposed and initial concept of the project. The hydrodynamic model used is Flow3D, developed by Flow Science, Inc. A brief description from the official Flow-3D internet site is provided:

***FLOW-3D** is a powerful and highly-accurate CFD software that gives engineers valuable insight into many physical flow processes. With special capabilities for accurately predicting free-surface flows, **FLOW-3D** is the ideal CFD software to use in your design phase as well as in improving production processes. **FLOW-3D** is an all-inclusive package. No special additional* *modules for meshing or post-processing are needed. An integrated graphical user interface ties everything together, from problem setup to post-processing*[1].

The current model data for the ship simulation study was provided by The Water Institute of the Gulf.

1.2 Navigation in the Project Reach

Navigation in the project reach of the Mississippi River is performed in a Federal Navigation Channel for which the U.S. Army Corps of Engineers, New Orleans District (USACE), is responsible. Information about the channel, including hydrographic survey data, navigation markers, revetment locations, dock facilities, etc. as well as levee data was provided by the USACE. A meeting of navigation interests was held in New Orleans on August 16, 2013, to gather information about navigation on this reach of the river, understand the industry's thoughts about this proposed project, and how navigation functioned, and what should be included in a navigation study of the impacts of this project on ship and tow operations[2]. During this meeting it was learned that this reach of the Mississippi River has one of the nation's most dense volumes of ship and tow traffic. There are major terminals and marine facilities that receive and ship products, storing and transferring cargo between ships and tows in addition to the through traffic of ships and tows. All of the New Orleans to Baton Rouge ship traffic must pass through this reach and with an authorized 50-ft deep navigation channel and a wide maneuvering area within the river, ships of all sizes, including some of the largest, transit through this reach. This includes Suezmax tankers, Capesize bulk carriers, and large cruise passenger ships. Tow traffic is also heavy, bringing grains, petroleum products and chemicals to terminals for export. With large fleets in the area, fleeting activity is intense. As a result, determination of the impact on navigation operations in this reach by the intermittent operation of this proposed project is required. This ship maneuvering simulation study has been conducted to address the deep-draft shipping impacts.

2 Study Purpose

Therefore, the purpose of this ship maneuvering simulation study was to:

- Determine if the operation of the proposed diversion project will impact navigation adversely.
- These tests focus on deep-draft navigation.
- The study depends on the participating pilots evaluation of whether or not the diversion flows will affect the control of a ship as it passes the project during diversions.

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[1] http://www.flow3d.com/flow3d/flow3d-overview.html?gclid=CMf2vZnw77oCFRFo7AodbAwAPg

[2] Waterway Simulation Technology, Inc. Memo For Record dated August 27, 2013, **Subject: Meeting with Maritime Interests in New Orleans, LA, to Discuss the Ship and Tow Simulation Impacts of the Proposed Mid-Barataria Sediment Diversion Project**

3 Study Approach

The study approach was to perform a ship maneuvering study on a full bridge simulator using ships representative of the deep-draft traffic operating in this reach of the Mississippi River . The selected design ships would operate in a simulated channel with currents computed with the proposed diversion project in operation at the presently proposed withdrawal rates. These operational withdrawals will be taken at three different river discharge levels. Licensed, experienced, local pilots will conn the ships through simulated transits past the diversion project.

4 Simulation Study

4.1 Simulation Database

The ship simulation database consisted of several different parts which interact together with the ship bridge and controls and present visual, electronic display, and radar images of the ship model moving through the simulated navigation channel and reacting to the conning pilot's commands that are carried out by the helmsman and simulator operator working a the simulation instructor's console. The key databases making up the simulation are described below.

4.1.1 Visuals

Three-dimensional graphic images of the river, terminals, aids to navigation, trees and vegetation lining the banks of the river, towns and various buildings, and the diversion project were constructed in the geographically correct locations. These images are textured and change as the objects are approached. To add even more realism to the simulation, tows of various sizes were positioned in the locations where fleets of barges are normally secured. Since models of individual barges were not available on the simulator, tows were used which included the towboats; however, the pilots participating in the simulation approved the realism of this approach. One view of the simulated image is shown in Figure 4 and on the cover is a view from the grain terminal dock looking downstream towards the control gate structure.

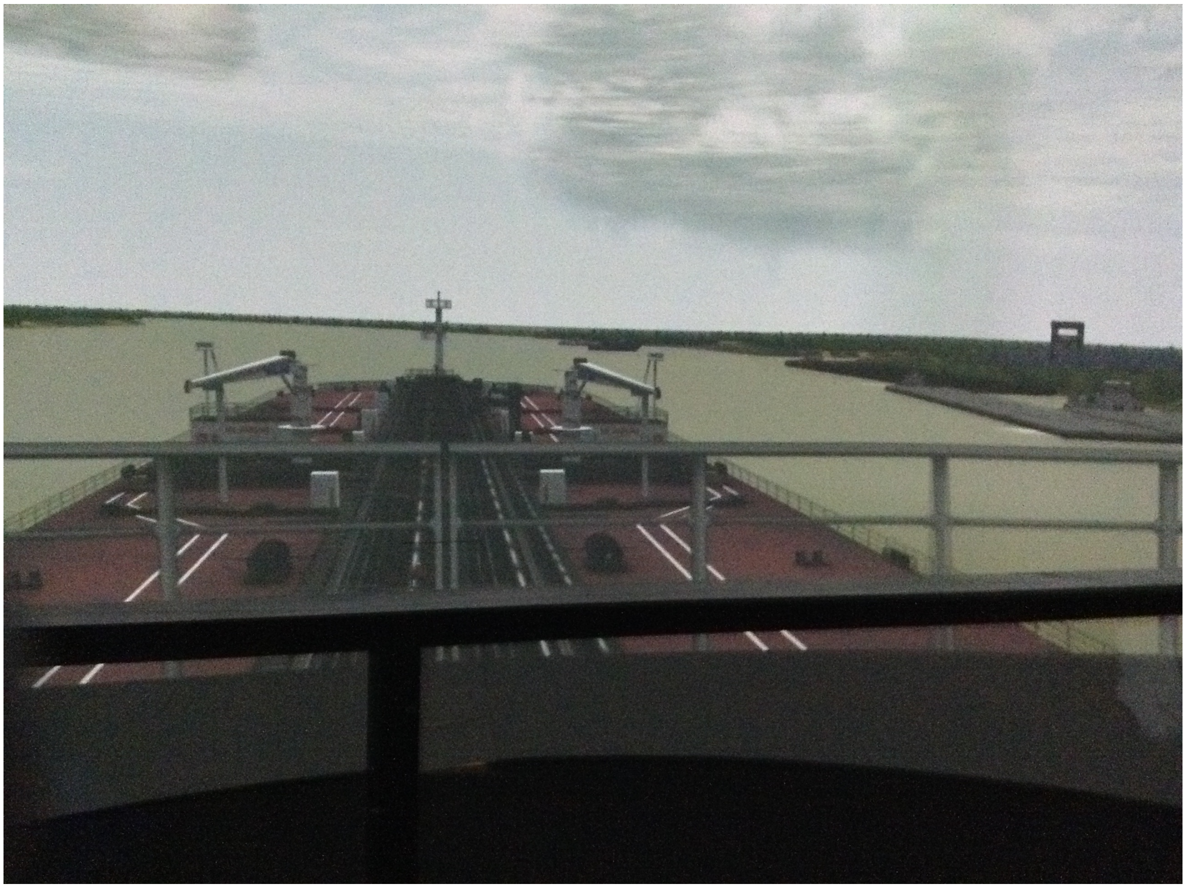


Figure 4: View from the Suezmax Ship's Bridge Downstream from the Grain Elevator Showing the Fleeting Area and the Project Control Gate Structure.

4.1.2 Channel

The simulated navigation channel was constructed from the 3D current model depth data provided by The Water Institute of the Gulf. The existing channel is shown in Figure 5 which shows that the deep part of the river is on the western side of the river near the refineries, crosses over to the eastern side of the river opposite the project site location and then comes back to the western side of the river just below the project on the outside of the bend near River Mile 59 and is very deep in this location. A relatively shallow shelf to about 50 ft is located at the project location and this is where the conveyance channel is to be dredged. The dredged channel is shown in Figure 6 and is from the 3D hydrodynamic model. These are the depths that defined the navigation channel in the simulator.

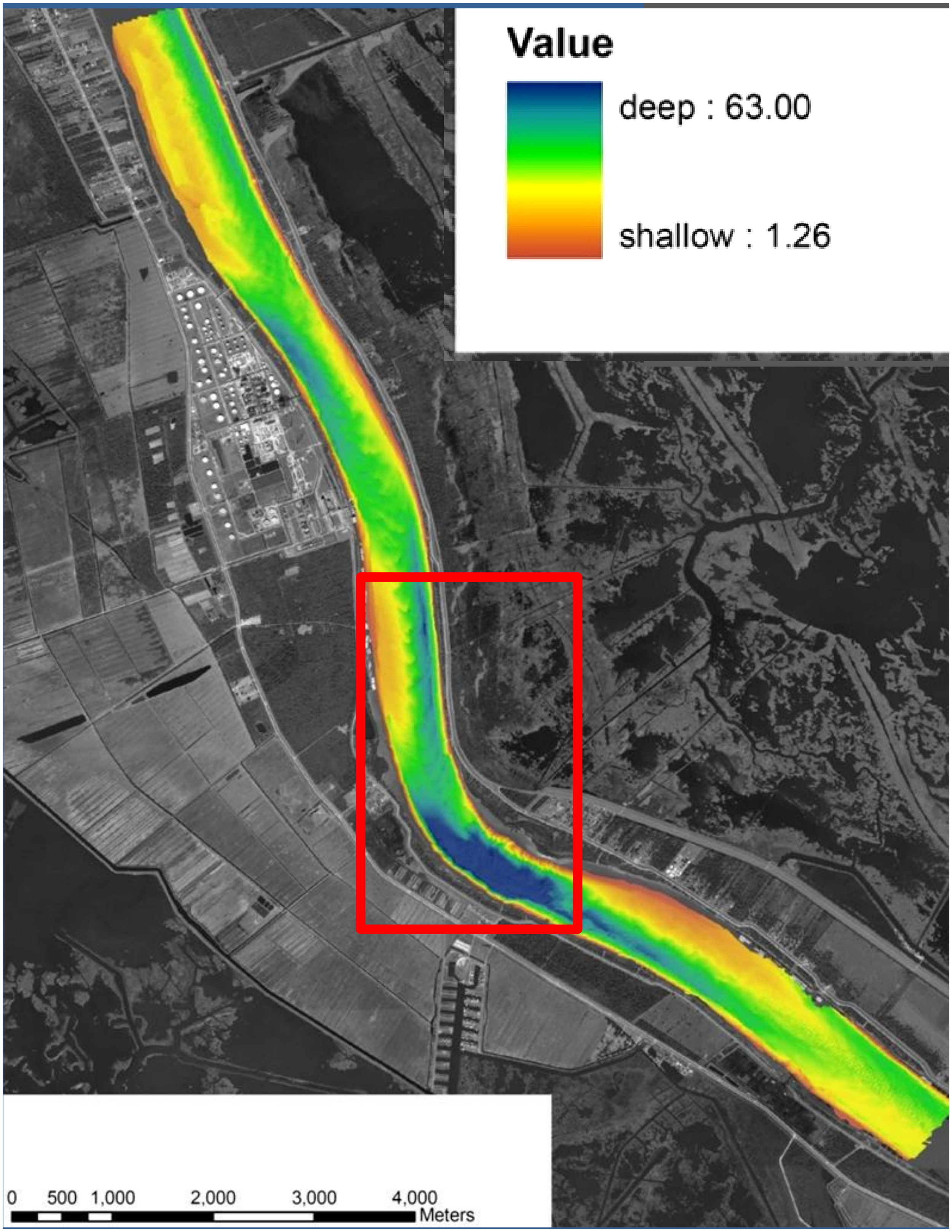


Figure 5: Measured Bottom Depths in Meters in the Proposed Diversion Project Reach

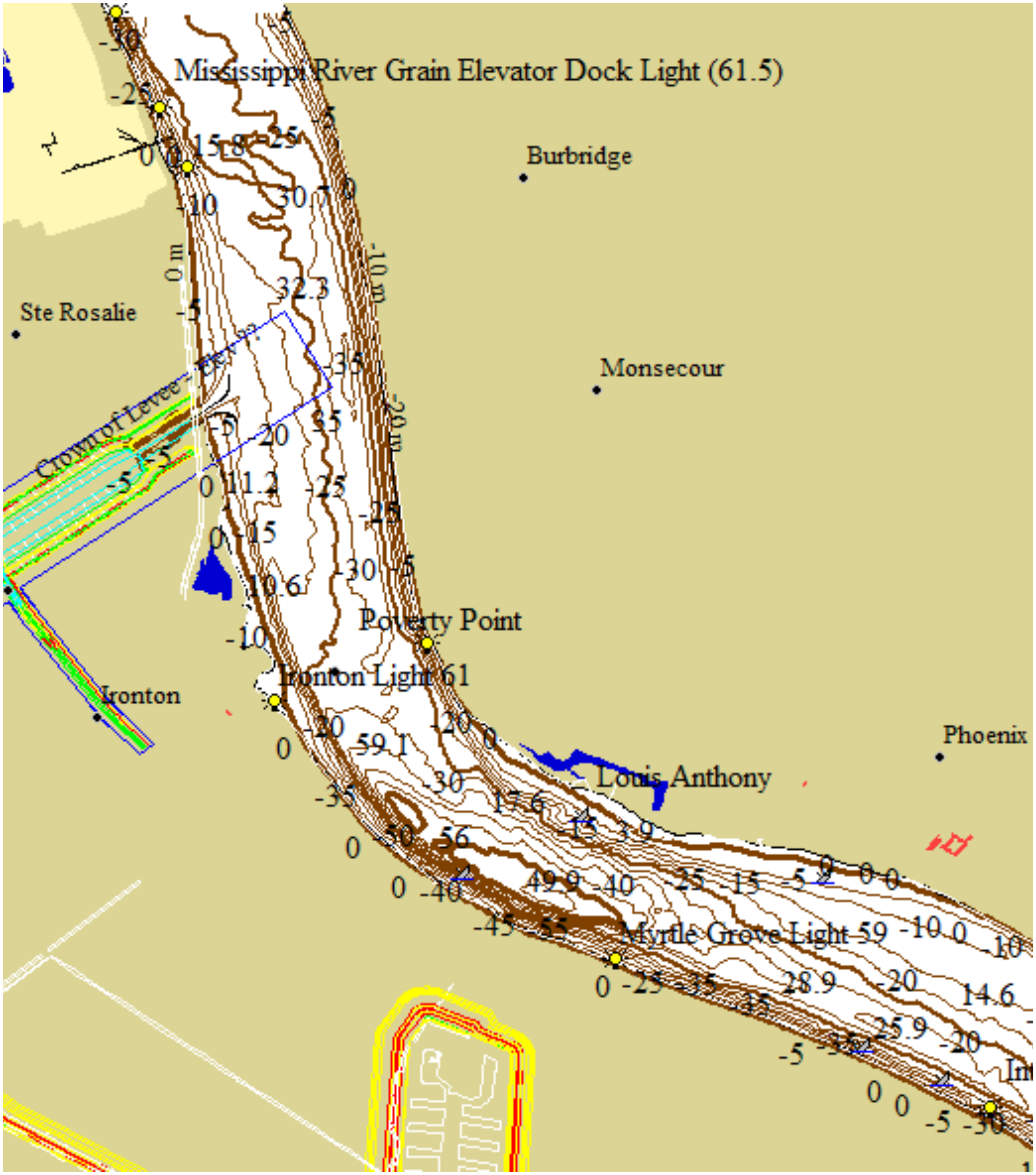


Figure 6: Depth Contours in Meters from The Water Institute of the Gulf 3D Model Including the Diversion Project Conveyance Channel

4.1.3 Currents

River current data for inclusion into the MITAGS simulator were generated using the three-dimensional cartesian-grid numerical model Flow3D[3]. Figure 7 shows an overview of the modeled area covered by the 3D model. The immediate river reach adjacent to the Mid-Barataria Sediment Diversion Canal was modeled in a significantly higher grid density in order to allow the numerics to accurately define the effect on the current caused by the portion of the flow diverted by the canal. The model was run for three flow rates: 600-, 700- and 975-kcfs. The project design identified this flow range as the bracket for future operation of the gate structure in the canal.

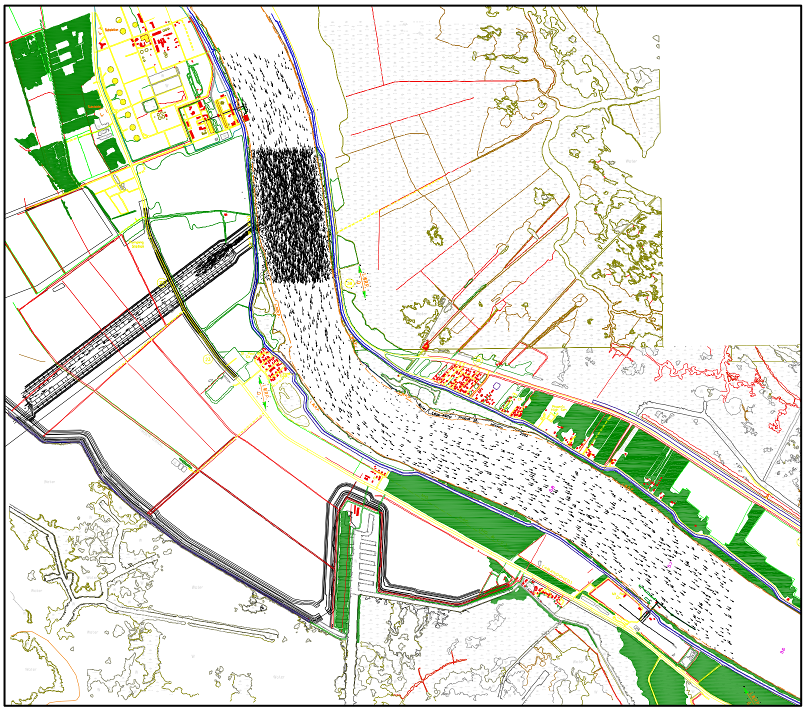


Figure 7: Extent of 3D Model Cartesian Grid – Mississippi River Miles 56.0 – 62.5

Table 1 shows the six different current conditions for the simulation tests of deep-draft vessels in the Mid-Barataria canal vicinity. The numeric values in the table represent nominal comparative measures of the strength of the current in the middle of the Mississippi River adjacent to the future diversion canal. Since the simulation design ships were both ballasted draft and loaded, the three-dimensional structure of the numerical model was exploited for the purpose of using only the portion of the currents in the vertical water column impinging on the hull of the ship for each of their respective drafts. Therefore, for example, the 50ft depth-averaged current was obtained by calculating the mean of the current vector components from the numerical model layers only down to the 50-ft depth. Similarly for the 30ft depth-average current. Figures 8 - 11 show vector plots of the low (600kcfs) and high (975kcfs) simulation-

[3] Department of Natural Systems: Modeling and Monitoring, The Water Institute of the Gulf, One American Plaza, 301 N. Main St., Suite 2000, Baton Rouge, Louisiana, 70825; Attn: Dr. Ehab Meselhe

study design river flows. The figures show the vectors in the entire test reach and higher detail of the inset grid in the canal vicinity. A vector plot of the medium flow of 700kcfs is not depicted; however, the current magnitude for this case can be considered intermediate to that for the high and low flows shown (see Table 1). Also, only the 30-ft depth-averaged case is shown. The vector direction of the various current flows showed little variation – not only in the vicinity of the canal but throughout the entire test reach. The reader should be able to note that the diverted flow into the canal, as predicted by the current model, penetrated only a small distance into the main part of the river.

Table 1: Nominal River Current Speeds at Mid-Barataria Sediment Diversion Canal

Flow Rate	Diverted Flow Rage	30ft Depth Averaged	50ft Depth Averaged
600,000cfs	50,967cfs	4.4 fps	4.3 fps
700,000cfs	60,918cfs	4.8 fps	4.8 fps
975,000cfs	74,190cfs	6.8 fps	6.5 fps

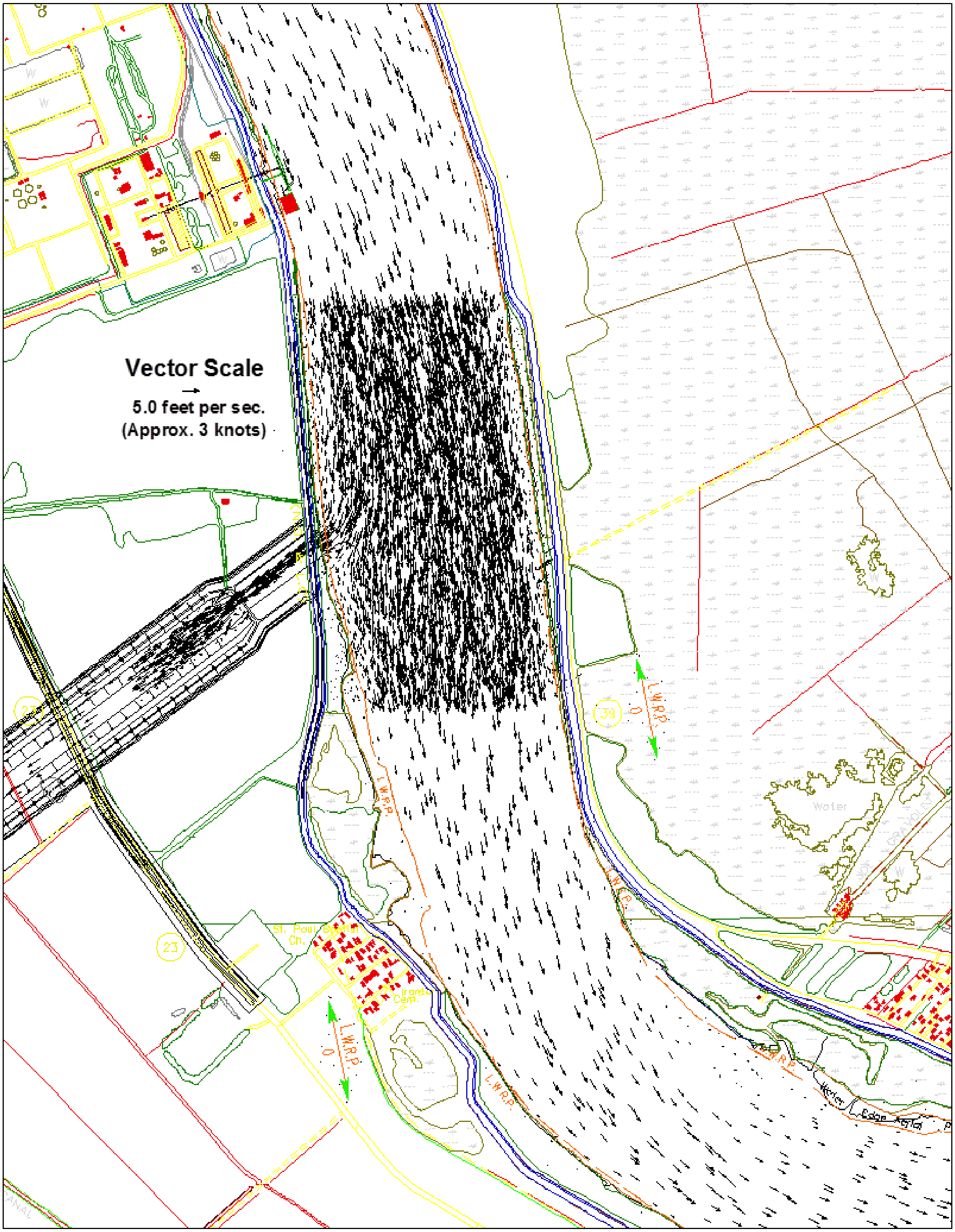


Figure 8: River Current at 600kcfs Flow Rate (30ft depth-averaged)

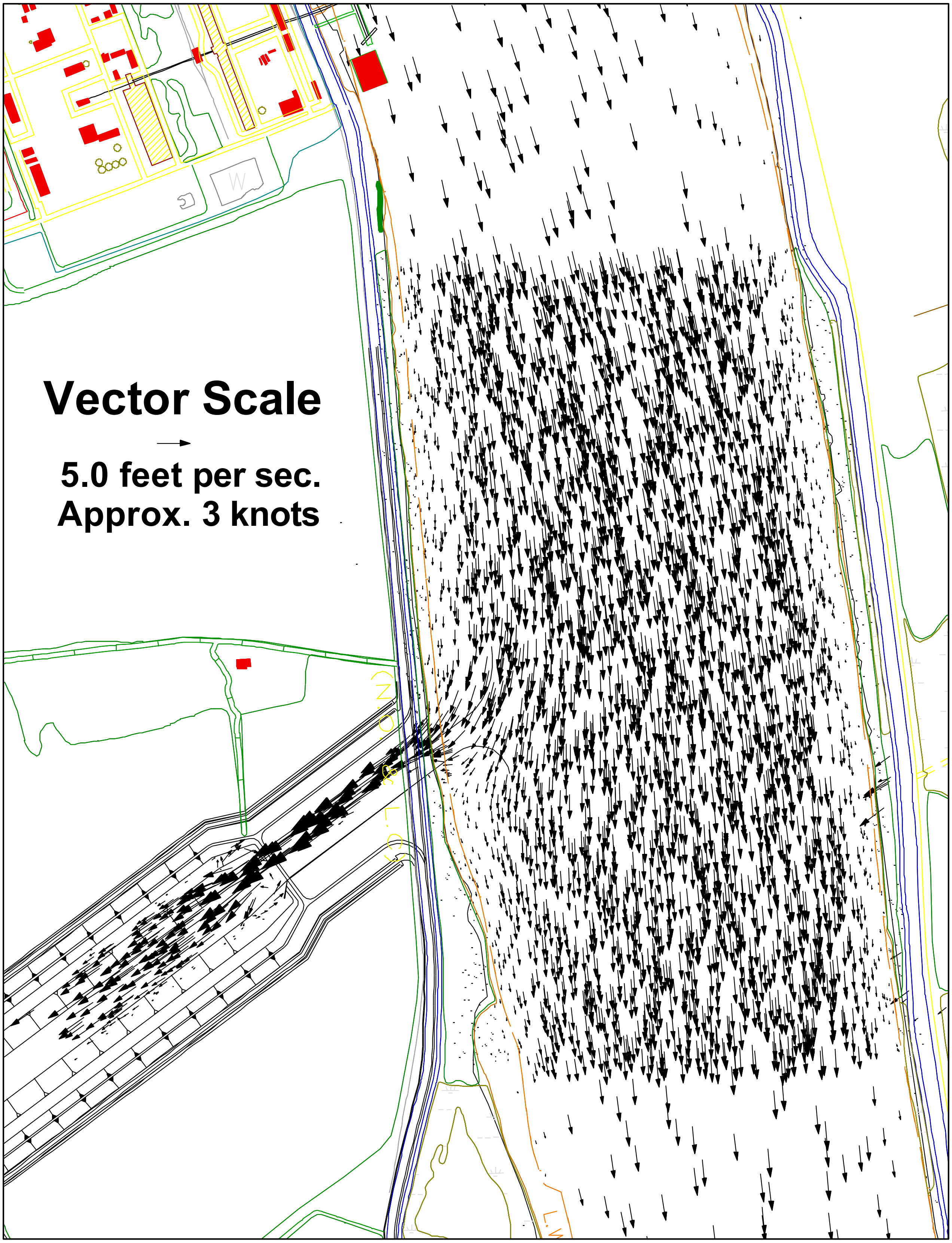


Figure 9: River Current at 600kcfs Flow Rate (30ft depth-averaged) (Inset)

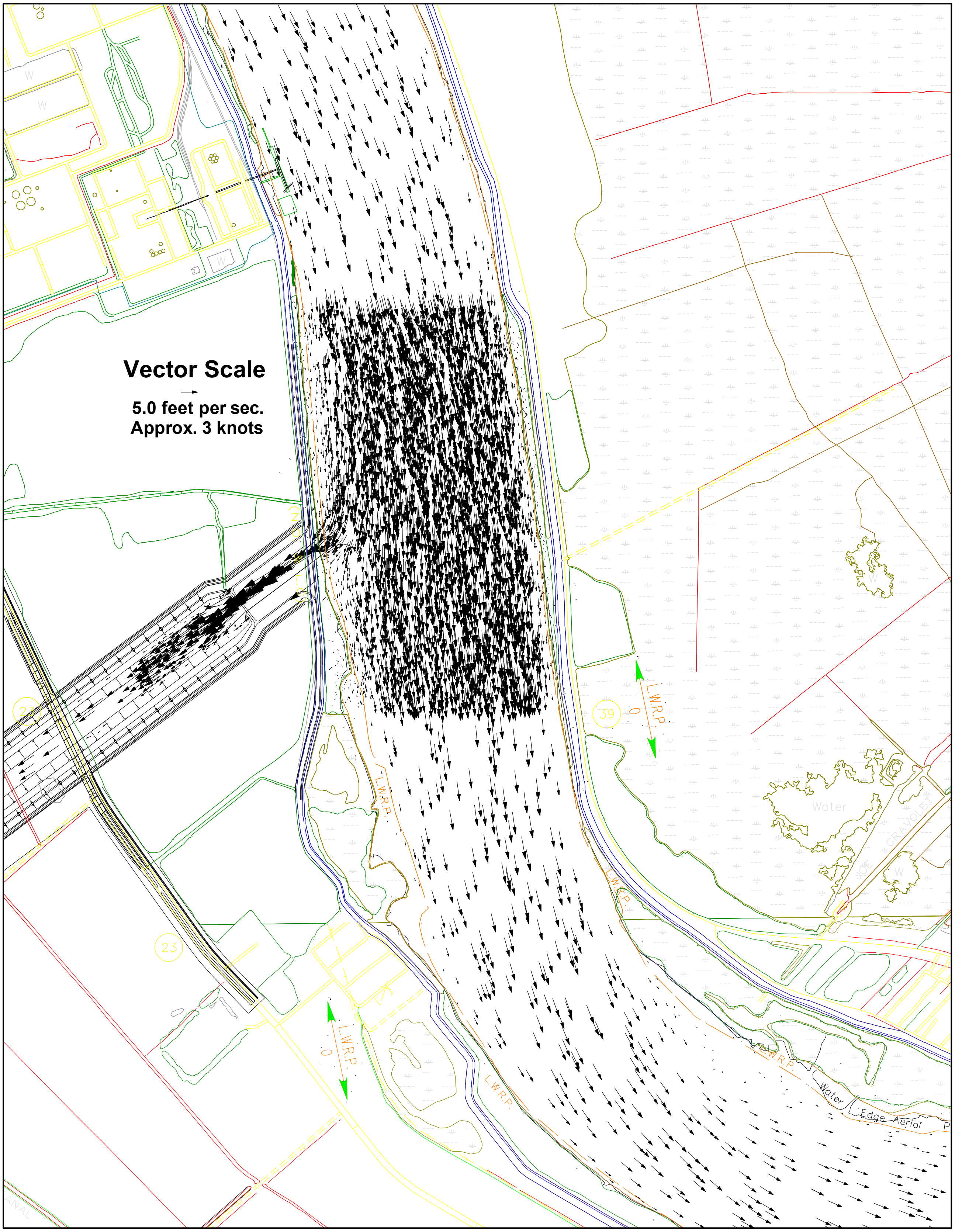


Figure 10: River Current at 975kcfs Flow Rate (30ft depth-averaged)

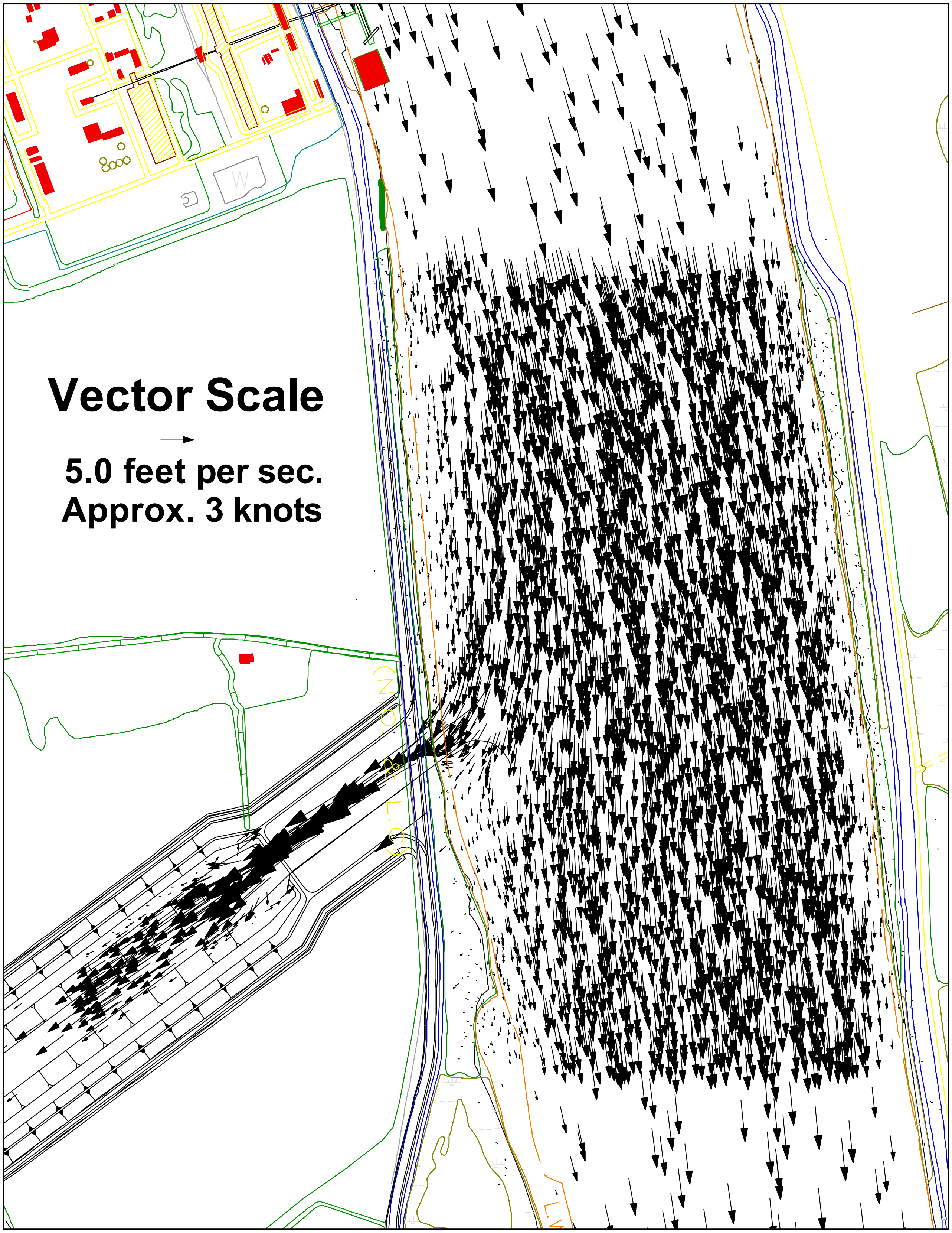


Figure 11: River Current at 975kcfs Flow Rate (30ft depth-averaged) (Inset)

4.1.4 Ships

Two ships were used to represent the shipping traffic through the project reach. A loaded and ballasted Suezmax tanker (47ft and 33ft draft, respectively) was used to represent the large class of ships and a loaded and ballasted Panamax bulk carrier (43ft and 33ft draft, respectively) represented a smaller class of vessels. These ships represented a wide variation in ship hull exposure to the currents as well as displacement. The pilot cards for these ships are presented in Appendix A.

4.1.5 Environment

Because the focus of this study was to determine if the currents generated by the diverted water from the Mississippi River would impact marine navigation through this reach, it was concluded that no other environmental conditions would be included in the testing program. Therefore, no wind or waves were included in the testing program.

4.2 Simulation Results

4.2.1 Ship Tracklines

During the simulations for deep-draft vessels in the Mid-Barataria simulation database twenty-six runs were completed. Table 1 lists these runs associated with critical tests conditions. Two Crescent City pilots conducted the simulations and they alternated between the helm and the con during the tests. The river flow conditions consisted of three discharge levels and two averaging depth values. The average currents for the averaging depths (30ft and 50ft) were obtained from the 3d numerical current model output provided by HDR and were calculated over these specific depths so as to most accurately account for the drafts of the ballasted and loaded ships tested.

Table 2: Mid-Barataria Deep-draft Vessel Simulations

Run	Trackplot	Ship	Load Cond.	Travel Dir.	River Discharge	Current Averaging Depth	Pilot
R01	Figure 12	Panamax	Ballast	Down	600kcfs	30ft	B
R02	Figure 12	Panamax	Ballast	Down	700kcfs	30ft	A
R03	Figure 12	Panamax	Ballast	Down	975kcfs	30ft	B
R04	Figure 12	Panamax	Loaded	Down	600kcfs	50ft	A
R05	Figure 12	Panamax	Loaded	Down	700kcfs	50ft	B
R06	Figure 12	Panamax	Loaded	Down	975kcfs	50ft	A
R07	Figure 13	Suezmax	Ballast	Down	600kcfs	30ft	B
R08	Figure 13	Suezmax	Ballast	Down	700kcfs	30ft	A
R09	Figure 13	Suezmax	Ballast	Down	975kcfs	30ft	B
R09A	Figure 13	Suezmax	Ballast	Down	975kcfs	30ft	A

R10	Figure 13	Suezmax	Loaded	Down	600kcfs	50ft	A
R11	Figure 13	Suezmax	Loaded	Down	700kcfs	50ft	B
R12	Figure 13	Suezmax	Loaded	Down	700kcfs	50ft	A
R13	Figure 13	Suezmax	Loaded	Down	975kcfs	50ft	B
R14	Figure 14	Panamax	Ballast	Up	600kcfs	30ft	A
R15	Figure 14	Panamax	Ballast	Up	700kcfs	30ft	B
R16	Figure 14	Panamax	Ballast	Up	975kcfs	30ft	A
R17	Figure 14	Panamax	Loaded	Up	600kcfs	50ft	B
R18	Figure 14	Panamax	Loaded	Up	700kcfs	50ft	A
R19	Figure 14	Panamax	Loaded	Up	975kcfs	50ft	B
R20	Figure 15	Suezmax	Ballast	Up	600kcfs	30ft	A
R21	Figure 15	Suezmax	Ballast	Up	700kcfs	30ft	B
R22	Figure 15	Suezmax	Ballast	Up	975kcfs	30ft	A
R23	Figure 15	Suezmax	Loaded	Up	600kcfs	50ft	B
R24	Figure 15	Suezmax	Loaded	Up	700kcfs	50ft	A
R25	Figure 15	Suezmax	Loaded	Up	975kcfs	50ft	B

Figures 12-15 show composite trackplots for the runs shown in Table 1. The first composite trackplot in Figure 12 shows loaded and ballasted Panamax bulk carriers passing the Mid-Barataria diversion canal downbound. After an initial simulation the starting position of the ship was shifted upstream based on pilot request. This placed the ship above the upper boundary of the hydrodynamic model and currents were approximated in accordance to the computed velocity distribution at the upper boundary, the river bathymetry and the experience of the pilots. The trackplot includes runs for all three river flows (600kcfs, 700kcfs, 975 kcfs). The applied river current for the ballasted vessel was obtained by averaging the x and y magnitude components from the top 30 ft of the layered 3d numerical model solution output. This averaging process was extended down to 50 ft for the loaded ship simulations. The pilots made note of no difficulties during the downbound transit past the diversion.

Figure 13 shows the loaded and ballasted Suezmax tanker transiting downstream through the study reach in the three river flows. The ship's starting position was shifted closer to the normal position in the channel after the first few simulations, per pilot request. The reader is referred to the depictions of the current vectors presented earlier for better understanding of the current magnitude and direction that the pilot was experiencing during the transits. The pilots made serveral runs specifically going close to the diversion conveyance channel to evaluate the effect of these currents on the handling of the ship. The pilots made note of no difficulties during the downstream pass.

Figure 14 shows the upbound loaded and ballasted Panamax bulk carrier passing the proposed Mid-Barataria diversion canal. The upstream runs were initiated at Poverty Point and the pilots followed their normal practice of staying closer to the east bank of the Mississippi River where deeper water existed. The runs were conducted in all three flows as before and the pilots stated that the ship had no reaction to the diverted flow of the canal on the other side of the river.

Figure 15 shows the composite trackplot of the loaded and ballasted Suezmax tanker upbound from Poverty Point past the proposed diversion canal. The swept path of the tanker was somewhat broader than that for the Panamax bulker shown previously. This was due to the physical characteristics of the ship and not due to influence of the canal outflow.

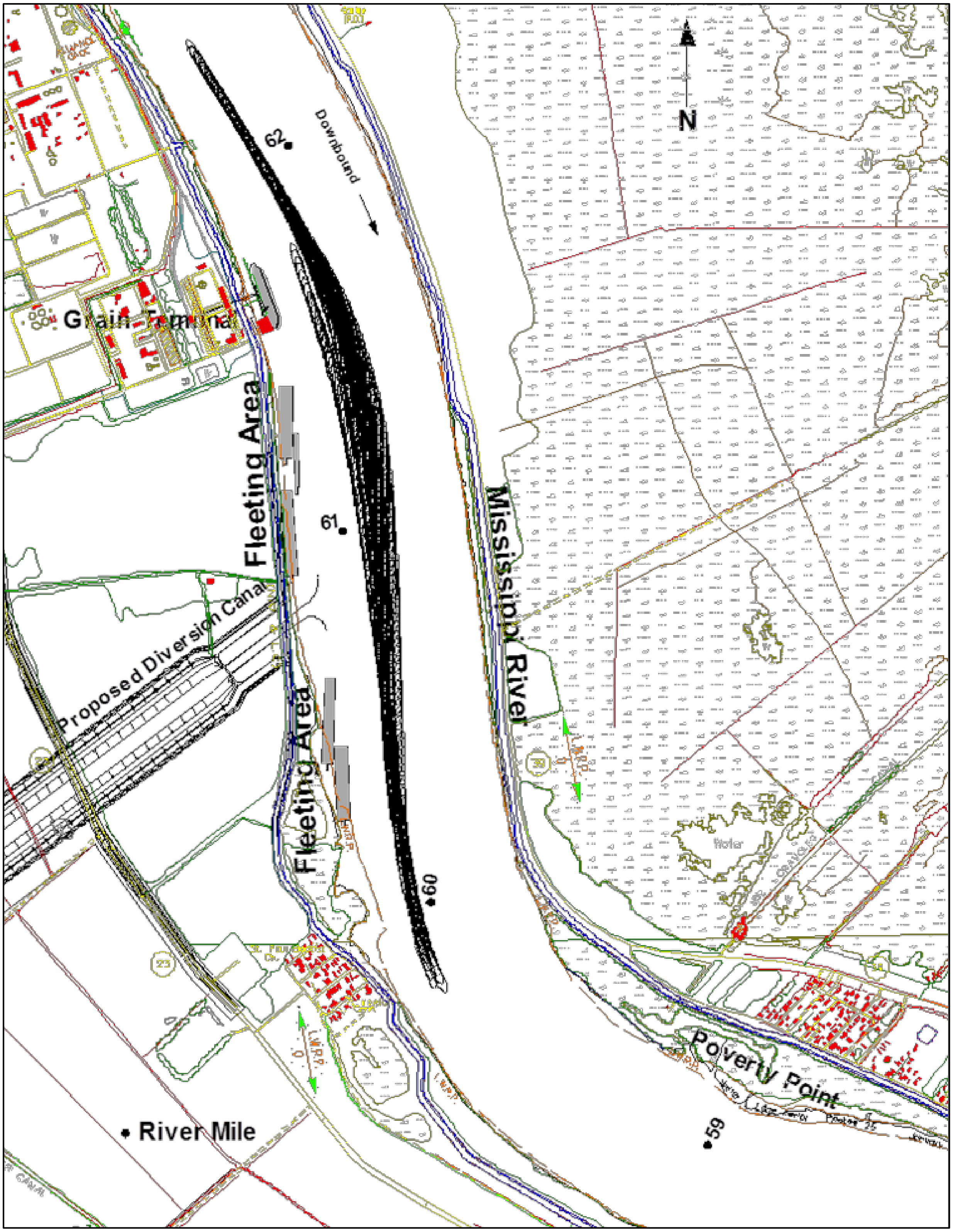


Figure 12: Downbound Ballasted and Loaded Panamax Bulker (794ft x 106ft x 33ft/43ft) 600/700/975-kcfs River Flows, Pilots A&B

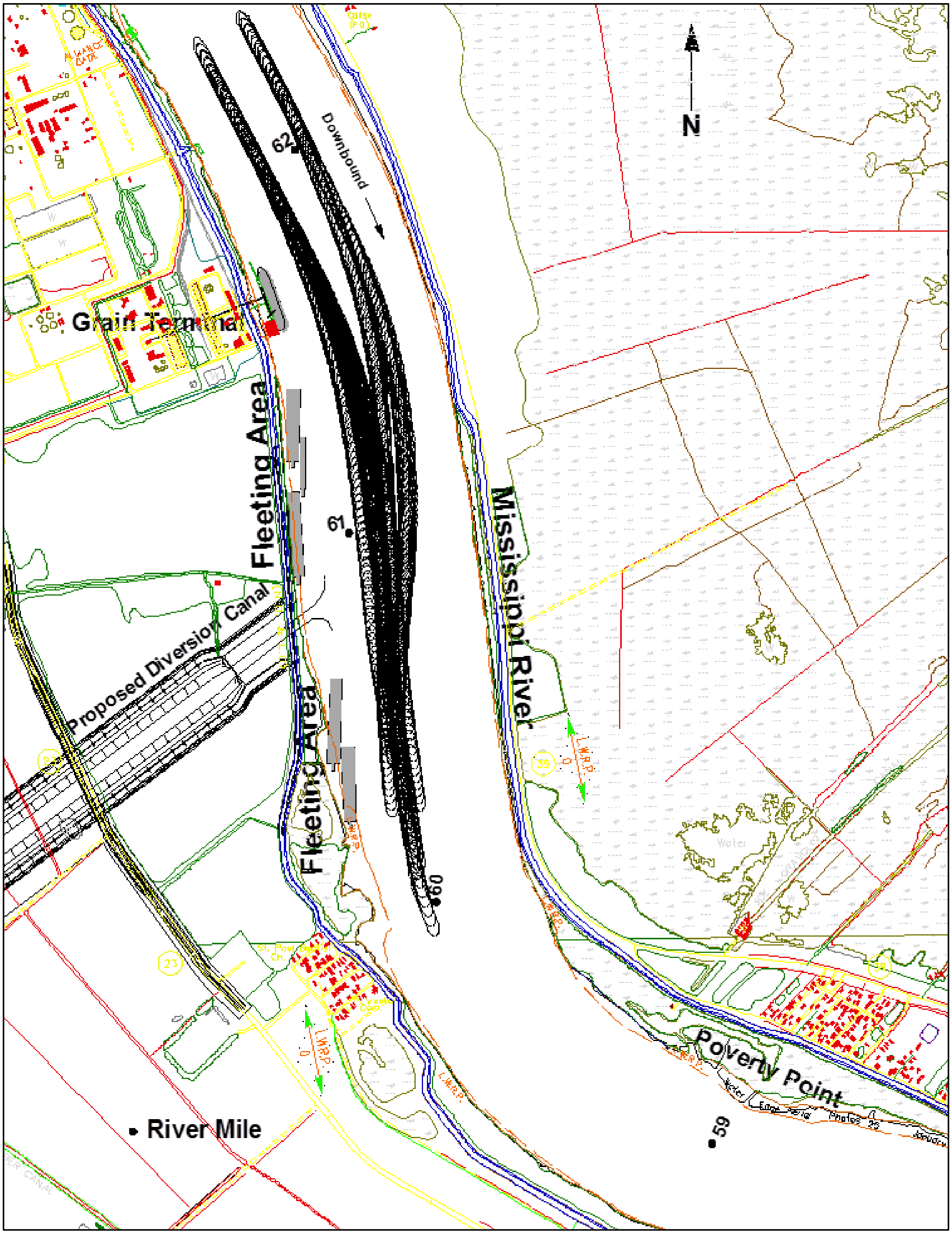


Figure 13: Downbound Ballasted and Loaded Suezmax Tanker (919ft x 164ft x 33ft/47ft) 600/700/975-kcfs River Flows, Pilots A&B

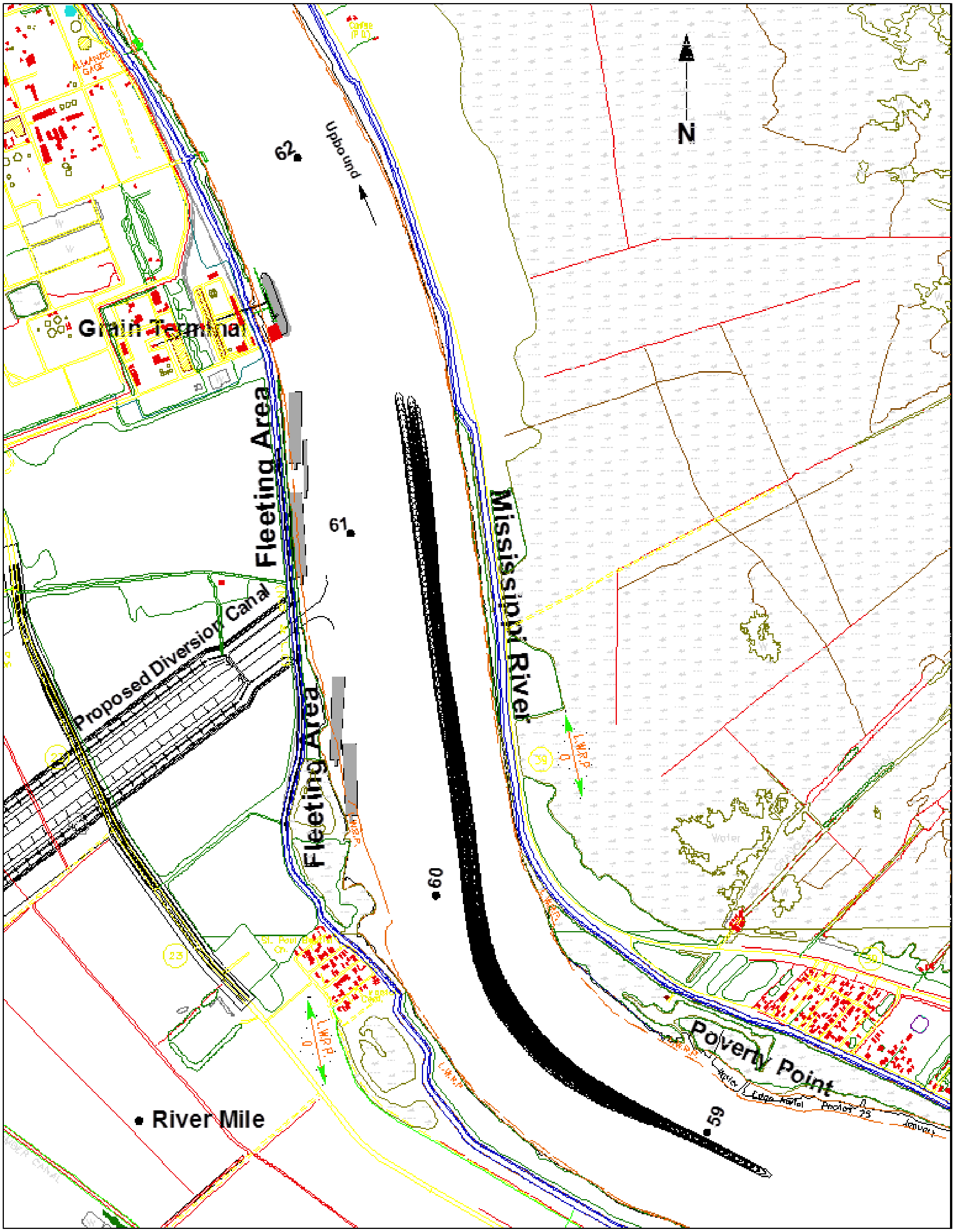


Figure 14: Upbound Ballasted and Loaded Panamax Bulker (794ft x 106ft x 33ft/43ft) 600/700/975-kcfs River Flows, Pilots A&B

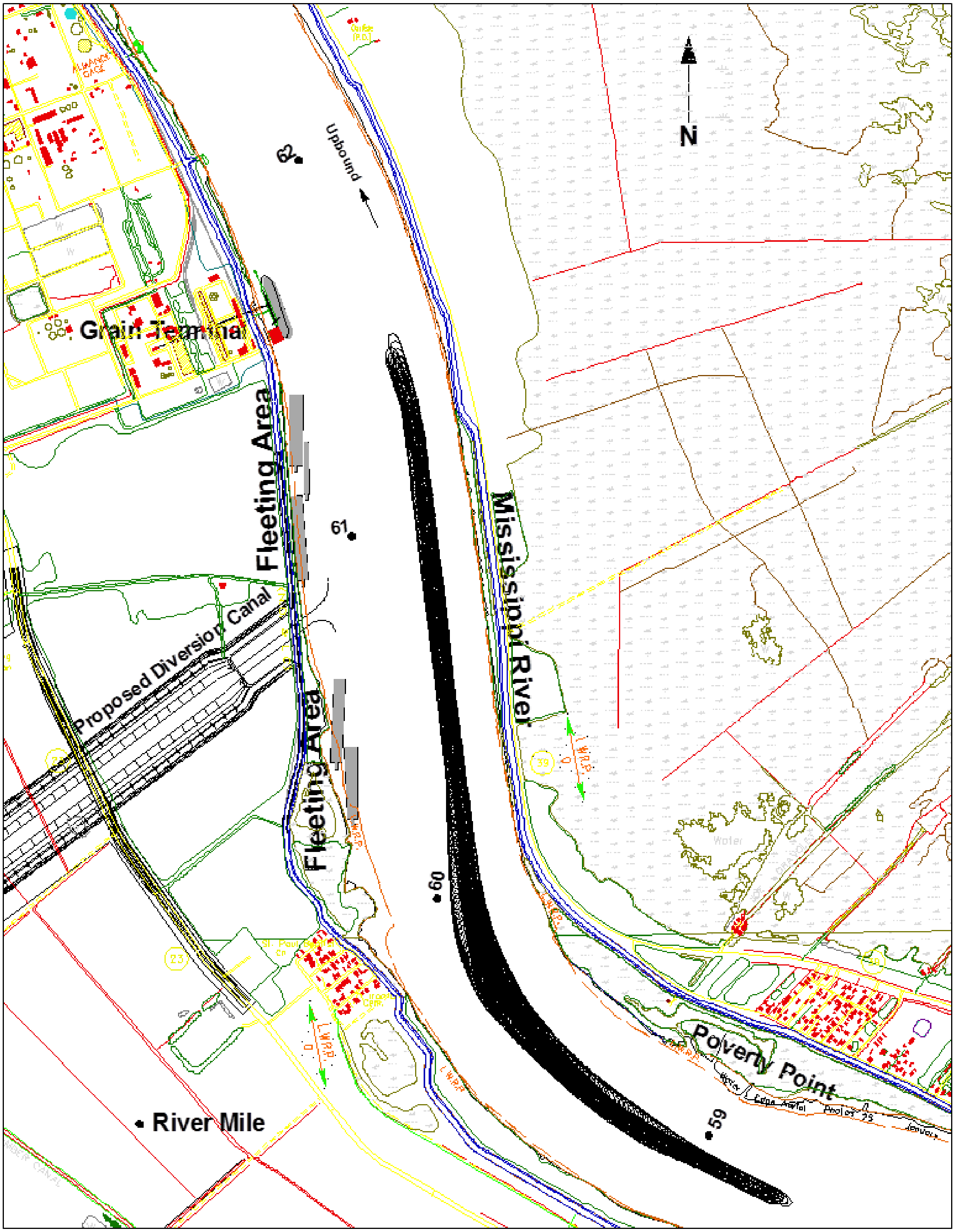


Figure 15: Upbound Ballasted and Loaded Suezmax Tanker (919ft x 164ft x 33ft/47ft) 600/700/975-kcfs River Flows, Pilots A&B

4.2.2 Pilot Questionnaires

4.2.2.1 Run Questionnaires

Following each simulated transit, the pilots were requested to complete a questionnaire designed to obtain the conning pilot's evaluation of the difficulty and safety of the transit and any specific thoughts that they had concerning the impacts of the diversion project on their ability to maintain control of the ship (see Appendix B for an example of the questionnaire). The results of these questionnaires are presented in Table 3. The pilots were advised to rate the difficulty and safety of the run with a value between 1 and 10; with 1 being very easy or safe, 5 indicating normal control and safety, and 10 being very difficult or unsafe. The pilot's response was that navigation conditions are average difficulty and safety according to their experience with existing conditions.

Table 3: Pilot's Response to Run Questionnaires

Run	Maintain Track	Impact of Diversion Flow	Difficulty	Safety	Safety Qualifiers	Perform in Real Life	Additional Comments/Recommendations
R01	I was able to maintain until I got near upriver side of opening and had to correct course once I got below opening; ship handled well	None	5	3	None	Yes	Really have no recommendations to change anything.
R02	Yes	Had to hold a small amount of port rudder to stay on track	5	5		Yes	No recommendations
R03	I was able to maintain my track	None	5	5	None	Yes, I would run same transit as normal	No recommendations
R04	Yes	None	5	5		Yes	None
R05	Yes, I was able to run maintain track line	No	5	5	No	Yes, I would	None
R06	Yes	No impact	5	5		Yes	None
R07	I was able to maintain course	None	5	5	None	Yes; would maneuver the same	None
R08	Yes	None	5	5		Yes	None
R09	Yes, until after opening bow went to starb when all other ships went to port. Think reason was due to ship.	None	5	5	No	Yes	None
R10	Yes	None	5	5		Yes	None
R11	Yes	None	5	5	None	Yes	None
R12	Yes	None	5	5		Yes	None
R13	Yes	None	5	5	None	Yes	No recommendations
R14	Yes	None	5	5	No	Yes	None
R15	Yes	None	5	5		Yes	None
R16	Yes	None	5	5	None	Yes	None
R17	Yes	None	5	5		Yes	None
R18	Yes, I was able to maintain track line	None	5	5	None	Yes	None
R19	Yes	None	5	5		Yes	None
R20	Yes	None	5	5		Yes	None
R21	Yes	None	5	5	None	Yes	None
R22	Yes	None	5	5		Yes	None
R23	Yes	None	5	5	None	Yes	None
R24	Yes	None	5	5		Yes	None
R25	Yes	None	5	5	None	Yes	None

4.2.2.2 Final Questionnaire

Following all simulations the pilots were requested to complete a final questionnaire to obtain their evaluation of the simulation experience and the project impacts on navigating through the project reach (see Appendix B for the final questionnaire). The results of this questionnaire are present in Table 4. The pilots were instructed to rate the items with numbers between 1 to 10 with 1 being very unrealistic or unsafe, 5 being average, and 10 being very realistic or safe.

Table 4: Pilot's Responses to the Final Questionnaires

	Pilot A	Pilot B
Realism of Ship Modleing		
Suezmax LD	8	9
Suezmax BL	8	9
Panamax LD	8	9
Panamax BL	8	9
Realism of Environmental Modeling		
Wind	--	9
River Currents	7	9
Visual Scene	8	8
Channel	9	9
Ship to Bank Interaction	7	8
Overall Safety		
Channel Adjacent to Proposed Diversion	8	9

In addition the pilots were asked to make statement about the project

Recommendations to increase safety and/or efficiency of the passage past the proposed diversion channel.

Pilot A None. From the simulations we ran I did not find any safety problems

Pilot B I don't see any problems with passing through the proposed diversion canal.

Additional Comments about this project

Piilot A None

Pilot B -----

5 Conclusions and Recommendations

5.1 Conclusions

- Downbound deep-draft ships transit through the western half of the river channel - fairly close to the diversion canal; however, the study pilots reported no navigation influence during the simulations due to the canal outflow.
- Upbound deep-draft ships transit close to the east bank of the river opposite the diversion canal at a distance which precludes all navigation influence of the canal outflow.
- In general, deep-draft vessel navigation passing the proposed Mid-Barataria Sediment Diversion Canal is safe when diversion canal gates are open in the river flow range of 600- to 975kcfs.

5.2 Recommendations

- Continue normal deep-draft vessel navigation following construction of diversion canal.

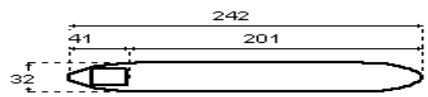
6 Appendix A: Ship Model Pilot Cards

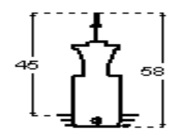
PILOT CARD

Ship name	Bulk Panamax_MMX 3.0.17.1 *			Date	21.08.2013
IMO Number	N/A	Call Sign	N/A	Year built	1995
Load Condition	Full Load				
Displacement	81960 tons	Draft forward	13 m / 42 ft 9 in		
Deadweight	70000 tons	Draft forward extreme	13 m / 42 ft 9 in		
Capacity		Draft after	13 m / 42 ft 9 in		
Air draft	45 m / 148 ft 0 in	Draft after extreme	13 m / 42 ft 9 in		

Ship's Particulars

Length overall	242 m	Type of bow	Bulbous
Breadth	32 m	Type of stern	Transom
Anchor(s) (No./types)	2 (PortBow / StbdBow)		
No. of shackles	15 / 15		(1 shackle =27.5 m / 15 fathoms)
Max. rate of heaving, m/min	9 / 9		





Steering characteristics

Steering device(s) (type/No.)	Semisuspended / 1	Number of bow thrusters	N/A
Maximum angle	35	Power	N/A
Rudder angle for neutral effect	0.14 degrees	Number of stern thrusters	N/A
Hard over to over(2 pumps)	24 seconds	Power	N/A
Flanking Rudder(s)	0	Auxiliary Steering Device(s)	N/A

Stopping

Description	Full Time	Head reach
FAH to FAS	669.6 s	9.25 cbls
HAH to HAS	820.6 s	9.07 cbls
SAH to SAS	1029.1 s	8.7 cbls

Turning circle

Ordered Engine: 100%, Ordered rudder: 35 degrees	
Advance	4.31 cbls
Transfer	1.96 cbls
Tactical diameter	5.01 cbls

Main Engine(s)

Type of Main Engine	Low speed diesel	Number of propellers	1
Number of Main Engine(s)	1	Propeller rotation	Right
Maximum power per shaft	1 x 11671 kW	Propeller type	FPP
Astern power	77.6 % ahead	Min. RPM	20
Time limit astern	N/A	Emergency FAH to FAS	16.2 seconds

Engine Telegraph Table

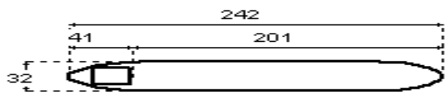
Engine order	Speed, knots	Engine power, kW	RPM	Pitch ratio
"100%"	14	10292	85	1.05
"80%"	11.7	6008	71	1.05
"60%"	9.4	3115	57	1.05
"40%"	7.1	1345	43	1.05
"20%"	4.8	417	29	1.05
"-20%"	-2.4	479	-28	1.05
"-40%"	-3.5	1384	-40	1.05
"-60%"	-4.4	2858	-51	1.05
"-80%"	-5.5	5375	-63	1.05
"-100%"	-6.5	9057	-75	1.05

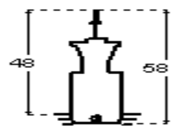
PILOT CARD

Ship name	Bulk Panamax_MMX 3.0.18.0 *			Date	21.08.2013
IMO Number	N/A	Call Sign	N/A	Year built	1995
Load Condition	Partial Loaded 1				
Displacement	55200 tons		Draft forward	10 m / 32 ft 10 in	
Deadweight	45820 tons		Draft forward extreme	10 m / 32 ft 10 in	
Capacity			Draft after	10 m / 32 ft 10 in	
Air draft	48 m / 157 ft 10 in		Draft after extreme	10 m / 32 ft 10 in	

Ship's Particulars

Length overall	242 m	Type of bow	Bulbous
Breadth	32 m	Type of stern	Transom
Anchor(s) (No./types)	2 (PortBow / StbdBow)		
No. of shackles	15 / 15		(1 shackle =27.5 m / 15 fathoms)
Max. rate of heaving, m/min	9 / 9		





Steering characteristics

Steering device(s) (type/No.)	Semisuspended / 1	Number of bow thrusters	N/A
Maximum angle	35	Power	N/A
Rudder angle for neutral effect	0.13 degrees	Number of stern thrusters	N/A
Hard over to over(2 pumps)	24 seconds	Power	N/A
Flanking Rudder(s)	0	Auxiliary Steering Device(s)	N/A

Stopping

Description	Full Time	Head reach
FAH to FAS	543.6 s	7.85 cbls
HAH to HAS	664.6 s	7.66 cbls
SAH to SAS	829.6 s	7.28 cbls

Turning circle

Ordered Engine: 100%, Ordered rudder: 35 degrees	
Advance	3.99 cbls
Transfer	1.91 cbls
Tactical diameter	4.87 cbls

Main Engine(s)

Type of Main Engine	Low speed diesel	Number of propellers	1
Number of Main Engine(s)	1	Propeller rotation	Right
Maximum power per shaft	1 x 11671 kW	Propeller type	FPP
Astern power	77.6 % ahead	Min. RPM	20
Time limit astern	N/A	Emergency FAH to FAS	16.2 seconds

Engine Telegraph Table

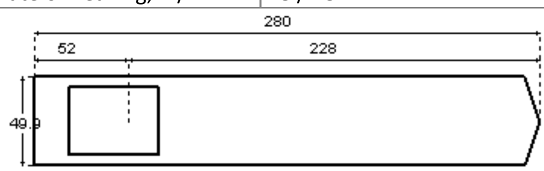
Engine order	Speed, knots	Engine power, kW	RPM	Pitch ratio
"100%"	14	10050	85	1.05
"80%"	11.7	5862	71	1.05
"60%"	9.4	3044	57	1.05
"40%"	7.1	1313	43	1.05
"20%"	4.8	410	29	1.05
"-20%"	-2.4	479	-28	1.05
"-40%"	-3.5	1384	-40	1.05
"-60%"	-4.4	2858	-51	1.05
"-80%"	-5.5	5375	-63	1.05
"-100%"	-6.5	9057	-75	1.05

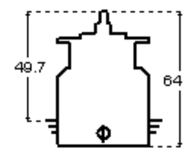
PILOT CARD

Ship name	VLCC 4_Suez_Statoil 3.0.22.0 *			Date	14.10.2013
IMO Number	N/A	Call Sign	N/A	Year built	N/A
Load Condition	Partial Loaded 1				
Displacement	157873.23 tons		Draft forward	14.3 m / 47 ft 0 in	
Deadweight	135770 tons		Draft forward extreme	14.3 m / 47 ft 0 in	
Capacity			Draft after	14.3 m / 47 ft 0 in	
Air draft	49.7 m / 163 ft 5 in		Draft after extreme	14.3 m / 47 ft 0 in	

Ship's Particulars

Length overall	280 m	Type of bow	Bulbous
Breadth	49.9 m	Type of stern	V-shaped
Anchor(s) (No./types)	2 (PortBow / StbdBow)		
No. of shackles	13 / 13		(1 shackle =27.5 m / 15 fathoms)
Max. rate of heaving, m/min	18 / 18		





Steering characteristics

Steering device(s) (type/No.)	Semisuspended / 1	Number of bow thrusters	N/A
Maximum angle	35	Power	N/A
Rudder angle for neutral effect	0.01 degrees	Number of stern thrusters	N/A
Hard over to over(2 pumps)	28 seconds	Power	N/A
Flanking Rudder(s)	0	Auxiliary Steering Device(s)	N/A

Stopping			Turning circle	
Description	Full Time	Head reach	Ordered Engine: 100%, Ordered rudder: 35 degrees	
FAH to FAS	1045.6 s	13.13 cbls	Advance	5.33 cbls
HAH to HAS	1270 s	12.46 cbls	Transfer	2.77 cbls
SAH to SAS	1691.3 s	11.97 cbls	Tactical diameter	6.53 cbls

Main Engine(s)

Type of Main Engine	Low speed diesel	Number of propellers	1
Number of Main Engine(s)	1	Propeller rotation	Right
Maximum power per shaft	1 x 26120 kW	Propeller type	FPP
Astern power	75 % ahead	Min. RPM	11.98
Time limit astern	N/A	Emergency FAH to FAS	35.2 seconds

Engine Telegraph Table

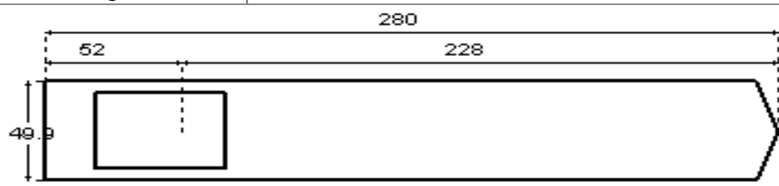
Engine order	Speed, knots	Engine power, kW	RPM	Pitch ratio
"FSAH"	16	20896	85	0.8
"FAH"	13.2	12076	70	0.8
"HAH"	10.4	6209	55	0.8
"SAH"	7.5	2663	40	0.8
"DSAH"	4.5	760	24	0.8
"DSAS"	-2.4	922	-24	0.8
"SAS"	-3.7	2773	-37	0.8
"HAS"	-5	6260	-50	0.8
"FAS"	-6.2	11409	-62	0.8
"FSAS"	-7.5	19590	-75	0.8

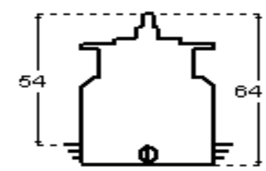
PILOT CARD

Ship name	VLCC 4_Suez_Statoil 3.0.22.0 *			Date	14.10.2013
IMO Number	N/A	Call Sign	N/A	Year built	N/A
Load Condition	Partial Loaded 3				
Displacement	110400.86 tons		Draft forward	10 m / 32 ft 10 in	
Deadweight	96050 tons		Draft forward extreme	10 m / 32 ft 10 in	
Capacity			Draft after	10 m / 32 ft 10 in	
Air draft	54 m / 177 ft 7 in		Draft after extreme	10 m / 32 ft 10 in	

Ship's Particulars

Length overall	280 m	Type of bow	Bulbous
Breadth	49.9 m	Type of stern	V-shaped
Anchor(s) (No./types)	2 (PortBow / StbdBow)		
No. of shackles	13 / 13		(1 shackle =27.5 m / 15 fathoms)
Max. rate of heaving, m/min	18 / 18		





Steering characteristics

Steering device(s) (type/No.)	Semisuspended / 1	Number of bow thrusters	N/A
Maximum angle	35	Power	N/A
Rudder angle for neutral effect	0.01 degrees	Number of stern thrusters	N/A
Hard over to over(2 pumps)	28 seconds	Power	N/A
Flanking Rudder(s)	0	Auxiliary Steering Device(s)	N/A

Stopping

Description	Full Time	Head reach
FAH to FAS	934.6 s	11.83 cbls
HAH to HAS	1132.5 s	11.18 cbls
SAH to SAS	1506.5 s	10.7 cbls

Turning circle

Ordered Engine: 100%, Ordered rudder: 35 degrees	
Advance	5.02 cbls
Transfer	2.55 cbls
Tactical diameter	6.03 cbls

Main Engine(s)

Type of Main Engine	Low speed diesel	Number of propellers	1
Number of Main Engine(s)	1	Propeller rotation	Right
Maximum power per shaft	1 x 26120 kW	Propeller type	FPP
Astern power	75 % ahead	Min. RPM	11.98
Time limit astern	N/A	Emergency FAH to FAS	35.2 seconds

Engine Telegraph Table

Engine order	Speed, knots	Engine power, kW	RPM	Pitch ratio
"FSAH"	16	20896	85	0.8
"FAH"	13.1	12076	70	0.8
"HAH"	10.3	6209	55	0.8
"SAH"	7.5	2663	40	0.8
"DSAH"	4.5	760	24	0.8
"DSAS"	-2.4	922	-24	0.8
"SAS"	-3.6	2773	-37	0.8
"HAS"	-4.9	6260	-50	0.8
"FAS"	-6.1	11409	-62	0.8
"FSAS"	-7.4	19590	-75	0.8

7 Appendix B: Pilot Questionnaires

Run #:	Date:	Bridge:	Pilot:

Circle Ship Used	Suez LD	Suez Empty	Pan LD	Pan Empty			Ship's Initial Speed:	Ship's Initial Heading:

Environmental Conditions	River Flow (kcfs)	Current Averaging Depth (ft)	Wind Dir. (from)	Wind Speed (knots)

Run Start Time:	Run End Time:
Start Location:	End Location:

Notes:	

1 Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

2 What was the navigation impact of the proposed diversion channel flow.

3 Rate the difficulty of this run with the number "5" indicating the difficulty level of an average transit in real-world pilotage conditions.

Increasing Difficulty →

1 2 3 4 5 6 7 8 9 10

4 Rate the overall safety of this run. Use “1” as unsafe and “5” as indicating average.

Increasing Safety →

1 2 3 4 5 6 7 8 9 10

Do you have any “qualifiers” to the above safety rating (senior pilot only, restricted to daylight transits, wind direction/speed limitations, current, etc.)?

5 Would you perform a similar transit / maneuver in a real-world situation? If not, why?

6 If applicable, what additional conclusion or recommendations do you have regarding the vessel, channel, under keel clearance, current, etc.?

Mid-Barataria Simulations
Final Pilot Evaluation of Deep-draft Simulation Tests
Thursday, October 24 to Friday, October 25, 2013

Date:		Pilot/Captain:	

SECTION A = REALISM	"REALISM" Rating Scale	1	Unrealistic	5	Average	10	Excellent

	Ship Model Realism	(Circle Choice)				Increasing Realism→→→					
1.	Suezmax Loaded	1	2	3	4	5	6	7	8	9	10
	Ship Model Realism	(Circle Choice)				Increasing Realism→→→					
2.	Suezmax Ballast	1	2	3	4	5	6	7	8	9	10
	Ship Model Realism	(Circle Choice)				Increasing Realism→→→					
3.	Panamax Loaded	1	2	3	4	5	6	7	8	9	10
	Ship Model Realism	(Circle Choice)				Increasing Realism→→→					
4.	Panamax Ballast	1	2	3	4	5	6	7	8	9	10
	Ship Model Realism	(Circle Choice)				Increasing Realism→→→					
5.		1	2	3	4	5	6	7	8	9	10

	Environmental Conditions Realism	(Circle Choice)				Increasing Realism→→→					
6.	Wind	1	2	3	4	5	6	7	8	9	10
	Environmental Conditions Realism	(Circle Choice)				Increasing Realism→→→					
7.	River Currents	1	2	3	4	5	6	7	8	9	10
	Database Realism	(Circle Choice)				Increasing Realism→→→					
8.	Visual Scene	1	2	3	4	5	6	7	8	9	10
	Database Realism	(Circle Choice)				Increasing Realism→→→					
9.	Channel	1	2	3	4	5	6	7	8	9	10
	Database Channel Designs Realism	(Circle Choice)				Increasing Realism→→→					
10.	Ship to Bank Interaction	1	2	3	4	5	6	7	8	9	10

Section B = Safety	Overall "SAFETY" Rating Scale	1	Unsafe	5	Average	10	Very Safe

	Overall Safety	(Circle Choice)				Increasing Safety→→→					
1.	Channel Adjacent to Proposed Diversion	1	2	3	4	5	6	7	8	9	10

Section C = Recommendations and Comments

2. Please describe any recommendations you have for increasing the safety and/or efficiency of the passage past the proposed diversion canal.

3. Please write additional comments you would like to make concerning this project.

To	Neil McLellan		
From	Erin Rooney		
Date	October 28, 2013	Job No.	BA 153-01

Re: Summary of Ship Simulation Observation

This memorandum documents information observed during the ship simulations conducted at the Maritime Institute of Technology and Graduate Studies (MITAGS) in Linthicum Heights, Maryland, on October 24, 2013, and October 25, 2013. The simulation was conducted by Waterway Simulation Technology, Inc. (WST), and was operated by two pilots from the Crescent River Port Pilots Association. A summary of observations noted is below.

- Pilots stated historically there have been issues with navigation due to sudden sediment deposition when water levels fall after a high water event.
- There were no existing condition simulations. Pilots were instructed to compare the level of difficulty to steer the ship in the simulation to real-world experiences.
- WST received flow field data for three river discharge rates generated by Dr. Ehab Meselhe in the Mississippi River near the proposed Mid-Barataria Sediment Diversion (MBSD) project location. The river discharge rates modeled were 600,000 cubic feet per second (cfs), 700,000 cfs, and 975,000 cfs. The number of model nodes was reduced to allow the simulation to upload in a reasonable amount of time.
- Depth-averaged velocities at each node were used in the simulation. The depth of averaged velocities varied based on the expected draft of the simulated ships.
- Twenty-four scenarios were simulated and are outlined in Table 1.
- Pilots commented that there were no noticeable effects on steering when traveling northbound.
- When traveling southbound, pilots simulated the route they would travel if passing another ship at the diversion location, which the pilots expect to be the worst-case scenario. There was no passing vessel in the simulation. The pilots noted that there was some noticeable influence from the MBSD when steering under these conditions, but the influence was not major and was not expected to be a concern for ship navigation.
- The pilots noted that they were only representing the ship pilots and not any other vessel type (e.g., tug/push boats).
- When traveling northbound, the ship often veered toward the east bank around river mile 61. This phenomenon was also experienced in pretesting and is likely a modeling issue. It is not expected to affect the results of the ship simulation as it relates to MBSD.
- WST will further analyze the results of the simulations and provide a report to HDR.
- Photographs of the ship simulation are included below.

Table 1. Summary of scenarios simulated

Ship dimensions	Load	Route direction	River discharges (diversion flow rates)
Panamax LOA = 242 m (794.0 ft) Beam = 32 m (105.0 ft)	Partial Load Draft = 10 m (32.8 ft)	Inbound	600,000 cfs (50,967 cfs)
			700,000 cfs (60,918 cfs)
			975,000 cfs (74,190 cfs)
		Outbound	600,000 cfs (50,967 cfs)
			700,000 cfs (60,918 cfs)
			975,000 cfs (74,190 cfs)
	Full Load Draft = 13 m (42.7 ft)	Inbound	600,000 cfs (50,967 cfs)
			700,000 cfs (60,918 cfs)
			975,000 cfs (74,190 cfs)
		Outbound	600,000 cfs (50,967 cfs)
			700,000 cfs (60,918 cfs)
			975,000 cfs (74,190 cfs)
Suezmax LOA = 280 m (918.6 ft) Beam = 49.9 m (163.7 ft)	Partial Load Draft = 10 m (32.8 ft)	Inbound	600,000 cfs (50,967 cfs)
			700,000 cfs (60,918 cfs)
			975,000 cfs (74,190 cfs)
		Outbound	600,000 cfs (50,967 cfs)
			700,000 cfs (60,918 cfs)
			975,000 cfs (74,190 cfs)
	Full Load Draft = 14.3 m (46.9 ft)	Inbound	600,000 cfs (50,967 cfs)
			700,000 cfs (60,918 cfs)
			975,000 cfs (74,190 cfs)
		Outbound	600,000 cfs (50,967 cfs)
			700,000 cfs (60,918 cfs)
			975,000 cfs (74,190 cfs)

Notes: ft = feet, cfs = cubic feet per second, LOA = length overall, m = meters

Figure 1. Inside ship simulator prior to tests

Figure 2. Inside ship simulator prior to tests

Figure 3. Simulated Mid-Barataria Sediment Diversion

Figure 4. Data collection area

Figure 5. Ship simulator during tests