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The Race to Fifty Feet: An Effort to Determine the Benefits of Deepening the Mississippi River

Brian Miles
University of New Orleans, bmiles@uno.edu

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An Effort to Determine the Benefits of Deepening the Mississippi River

A Thesis

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Brian S. Miles

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Glossary of Terms and Acronyms

LMR- Lower Mississippi River; The Mississippi River from Baton Rouge to the Mouth of the River

MT- Metric Ton- 2,205 pounds

NT- Net Ton- 2,000 pounds

USCG- United States Coast Guard

USACE- United States Army Corps of Engineers

NOLA- New Orleans, Louisiana

MM- Mile Marker- Used as a navigational location on the US river system

LOA- Length Overall- the length of the vessel

LOI- Letter which indemnifies the shipping company against claims when there is a discrepancy with the Bill of Lading.

LPG- Liquid Petroleum Gas

Beam- The width of the vessel

GT- Gross Ton- 2,240 pounds

GRT- Gross Registered Tons- A volumetric measurement of the enclosed space of a vessel which provides the carrying capacity tonnage of a vessel.

Draft- 1) The depth of the water for navigation purposes; 2) The act of determining the weight of a vessel in the water.

MLW- Mean Low Water- The average of all the low water heights observed.

NOAA- National Oceanic and Atmospheric Administration

DWT- Deadweight Tons- A measure of how much weight a ship can carry including the

weights of cargo, fuel, fresh water, ballast water, provisions, passengers, and crew.

LOOP- Louisiana Offshore Oil Platform

CHS- Cenex Harvest States

USG- United States Gulf of Mexico loading ports

UNECE- United Nations Economic Commission of Europe

ECOSOC- The United Nations Economics and Social Council

US-United States

USG- United States Gulf

COA- Contract of Affreightment- Contracts used for the movement of ocean freight.

TCE- Time Charter Equivalent- Used by shipping companies to measure period-to-period changes in fees and costing.

DWCC- Deadweight Cargo Capacity- The net deadweight of a vessel, i.e., how much pure cargo can be loaded

K- 1,000

SW- Salt Water

SSW- Summer Saltwater- the draft of a vessel loaded during the summertime in salt water.

AHP- Above Head of Passes- Mile 0 of the LMR

Chief Mate- The second in command on a vessel

Bill of Lading- A shipping document used for the sale and purchase of products.

Brackish- A mixture of salt and freshwater.

Air Draft- The distance from the surface of the water to the highest point of a vessel

Minor Bulks- Steel products, forest products, agricultural products in bulk, fertilizers, cement, petroleum coke, bauxite, alumina, and scrap.

Zero River Stage- A reading of zero on the gauge used for river depth measurement.

Dictating Draft- The depth a vessel can be safely loaded to in a port.

Empty or Light Draft- The drafting of a vessel to determine a starting point for loading activities.

Loaded Draft- The drafting of a vessel to determine the weight loaded on to a vessel.

P & I Club- Protection and Indemnity Insurance- Risk pooling and representation for members.

Master- The captain of the vessel.

Post Panamax- Any vessel larger than a standard Panamax.

MOU- Memorandum of Understanding- A document between two or more parties that explains a proposed agreement.

IWR- Institute for Water Resources- A center within the United States Corps of Engineers that provides navigation decision support.

Abstract

This research examined the benefits and drawbacks of deepening the Lower Mississippi River to fifty feet. It established that the deepening of the Lower Mississippi River will impact not only the local area but also the inland regions that rely on the river systems and lower river ports for product movement. The perspectives of vessel operators, maritime industry experts and charterers are provided to offer insight. The sources for the research include educational literature, maritime research and interviews of industry experts. Based on this research, it is clear that this project will benefit many parties. The beneficiaries will include both local and international interests. These benefits will include new land as a result of using the dredged material and better economies of scale by allowing more heavily loaded vessels to transit the area. The findings associated with this research make it abundantly clear that the project will indeed benefit many.

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Introduction

This research sought to answer the question, "Are there any benefits to deepening the Mississippi River?" Of the vessels that call the Lower Mississippi River (LMR), there are three types that arrive with regularity and could potentially feel the impact of a draft increase. Those vessels are dry bulk vessels, liquid vessels, and container vessels. Of these three, the bulk carriers are the most likely to see the most benefit since dry bulk cargoes can and do move in larger quantities and the deepening of the draft can bring economic efficiencies to their movements. As for the liquid vessels, the draft of the river changing will likely have limited impact due to the Louisiana Offshore Oil Port (LOOP). This liquid handling facility sits 18 miles off the coast of Louisiana and can handle vessels with drafts up to 85 feet. These larger vessels will pump their products through submerged pipelines for inland storage. The LOOP will limit the number of larger liquid carriers that would have a need to come into the LMR ports. As for the container vessels, the largest container vessels have a draft of just over 53 feet. The issue for the container vessels will likely be air draft. Some of the larger container ships have an air draft of 173.9 feet. The Crescent City Connection (formerly the Greater New Orleans Bridge) air draft is 170 feet at a zero-river gauge. When high water happens, container vessels have been impacted. Although some larger liquid carriers and container ships could see benefits with the draft deepening of the LMR, dry bulk carriers will most likely see the biggest benefits. The research will provide data on the dredging itself which will include how it is done, where it will be done, and what happens to the dredge spoils that are produced. Finally, some concluding thoughts on the research findings will be provided.

The discussion of deepening the river has been going on for decades. Little movement was seen until a memorandum of understanding (MOU) was signed on August 25, 2012. Even

with this MOU, progress has been slow. As larger vessels are built and markets continue to become more global, competition continues to become fiercer. From a competitive standpoint, the necessity for an increased draft has never been more evident. With buy-in from the Louisiana governor, as well as local and federal backing, it seems this long process may finally become reality.

How would a fifty-foot draft benefit the shippers, ocean carriers and local businesses in the New Orleans area? First, it would allow for larger vessels to transit the river without risk of touching bottom or light loading as they have done in the past. Light loading means that a vessel is loaded to a tonnage figure below its maximum tonnage capabilities. Second, it would allow the vessels, which typically call the river to load to a deeper draft when cargo is available. Third, it will allow for savings on freight for the shippers and charterers of the vessels due to economies of scale. Finally, it would benefit all parties involved. This would be accomplished by loading more tons per vessel than in the recent past, thereby saving money, time, and positively impacting the environment by limiting the number of vessels per year. Most of the ships calling the river currently are not in the cape-sized class. This is because the LMR is not in a typical cape trade lane. Typically, cape size vessels are used in the transportation of coal, iron ore, and commodity raw materials. With the draft moving to fifty feet, the LMR can become part of an origin destination pairings that will bring the larger vessels to the area. This will eventually happen and when it does, the benefits could be even more significant.

Background Information about the Lower Mississippi River

The dictating draft of the river has been an ongoing debate for well over 100 years. When the Port of New Orleans was founded in 1718, it started an era of unprecedented trade in the region (Port of New Orleans Review, n.d.). At this point, the sailing ships were much

smaller, and the cargoes provided considerably less volume by today's standards. According to World Port Source, "The modern Port of New Orleans was born in 1879 when jetties were constructed in South Pass, creating an approach channel of some 12 meters that allowed sea-going vessels to enter and leave the Mississippi River" (Ibid.) Since then, the draft has continued to be a battle to maintain. "….impermeable and permeable dikes have been used to successfully create and maintain the navigation channels throughout the Mississippi River Basin (MRB)*"* (Alexander, et. al, 2012, p. 11). "Dikes are used for river-flow contraction and training and alignment of the wide meandering river channels of the MRB" (Ibid, p. 11). Over the last ten years, there has been an ongoing effort to deepen the dictating draft to 50 feet. In 2018, the Louisiana's Governor's office offered a press release that shined a glimmer of hope that this would be accomplished. This project is also to coincide with the rebuilding of Louisiana's deltas and wetlands. The press release highlighted this point, "The project will provide a draft of 50-feet from the Gulf of Mexico upriver 256 miles to the Port of Greater Baton Rouge. In addition, the material dredged from thirty miles of the project near the Mouth of the Mississippi River will be used to create an estimated 1,462 acres of new marsh habitat" ("Governor," 2018, p.1). Part of the reasoning behind the draft deepening was for an economic benefit to the region. This is highlighted by the press release, as well, "The Corps' report identified the benefit-to-cost ratio at 7.2 to 1, calling the project one of national and international significance" (Ibid, p. 1). The Corps referenced is the United States Army Corps of Engineers.

Literature Review

Drafting of Vessels

To draft a vessel is essentially the age-old way of determining the weight of a vessel by the displacement of said vessel in the water. When a vessel is drafted, a surveyor will go out to the vessel and check it for a variety of things including but not limited to, the amount of fuel currently on the vessel, the amount of sundries and equipment on the vessel, the amount of water in its bilge tanks or in the holds of the vessel and any other specifics of the vessel that make it unique. The surveyor must also determine the salinity of the water in which the vessel will be loaded. Vessel owners and charterers must take the salinity of the water into account not only in the loading port but also in the discharge port to avoid unwanted surprises such as changes in draft of the vessel, which could result in discrepancies of weight. Once these factors are determined, the surveyor can do what is termed an "empty" or "light draft" of the vessel. This tells the loading facility, customer, and other associated vendors what volume of product can be placed aboard the vessel. Empty surveys are coordinated by the surveyor and the crew of the vessel who can and do provide insight to the vessel that may not be easily understood.

Once a vessel has been light or empty drafted, loading of the vessel may commence. Whether the vessel is loading grain, fertilizer, oil, coal or any variety of other products, the process is quite similar. The vessel master and his agent will be coordinating with the loading facility and using the onshore scales or gauges to provide "ballpark" figures as the loading progresses. Oftentimes, an intermediate survey will be required to determine the progress and can be used for planning purposes of both the loading facility and vessel itself. As the vessel nears completion, the chief mate of the vessel will begin doing preliminary drafts to determine when to stop loading. These preliminary drafts are not official but are used to get as close as

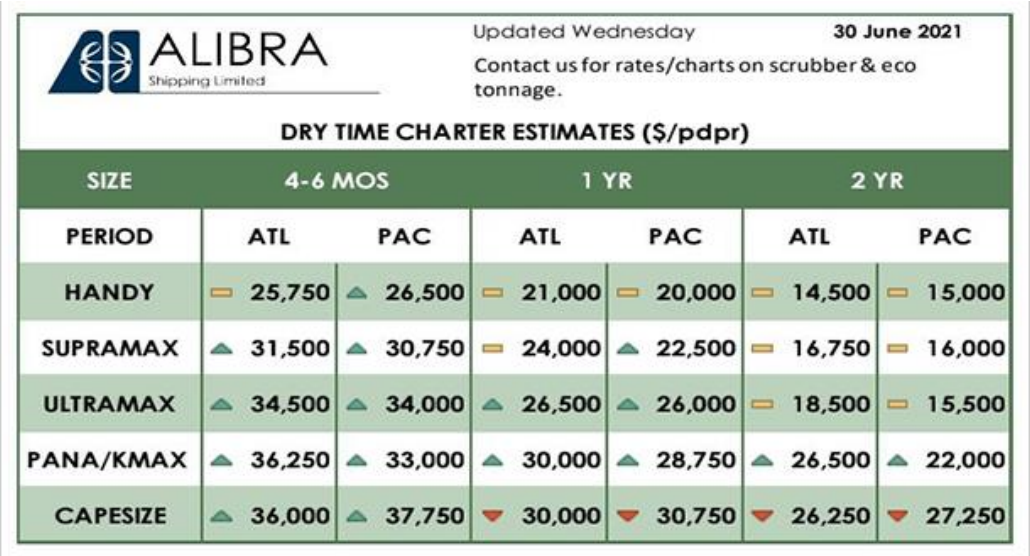
possible to the desired tonnage. Once loading is complete, a final draft survey is done by the surveyor. The surveyor will work directly with the ship's crew and the loading facility. This loaded draft survey is then used for billing purposes and will become the official weight as recorded on the bills of lading, and for all government official documentation. Improper reporting of weights and tonnages can cause significant issues not only for the shipping of the product but can result in fines and other legal actions against the vessel owner and charterer. Draft surveys are not the only way of measuring the weight on vessels; there are other options with determining weight. Most are shore side determinations, which rely on certified belt scales and/or gauges.

Vessel Sizing Details

As mentioned previously, shipping larger volumes can and does help with the cost of shipping in most cases. That said, there are a lot of dynamics that have an impact on shipping costs. Examples of the impacts include but are not limited to the following: lack of vessel capacity, limited demand for smaller vessels, trading lanes, port restrictions which limit the possible destinations, and limited product. Also stated previously, loading more tons into larger vessels can and does lead to economic efficiency gains. These efficiency gains can lower costs for the vessel and, in turn, the charterer. Of this, "The operational profile for these vessels will generally be a function of their size; the largest vessels will do the longest voyage and the smallest will do the shortest and hence more voyages per year. This reflects that tonmile work of transport is most efficiently done by larger vessels while the docking, loading and unloading at each end are actually better done by smaller ones" (Lindstad and Eskeland, 2021). Low carbon maritime transport: How speed, size and slenderness amounts to substantial capital energy

substitution) (Ibid, p. 4). Figure 1(below) is a snapshot in time of what the ocean freight market looks like.

Figure 1. Current Vessel Pricing



ALIBRA Shipping Limited

Updated Wednesday 30 June 2021

Contact us for rates/charts on scrubber & eco tonnage.

DRY TIME CHARTER ESTIMATES ($/pdpr)

SIZE	4-6 MOS		1 YR		2 YR	
PERIOD	ATL	PAC	ATL	PAC	ATL	PAC
HANDY	25,750	26,500	21,000	20,000	14,500	15,000
SUPRAMAX	31,500	30,750	24,000	22,500	16,750	16,000
ULTRAMAX	34,500	34,000	26,500	26,000	18,500	15,500
PANA/KMAX	36,250	33,000	30,000	28,750	26,500	22,000
CAPESIZE	36,000	37,750	30,000	30,750	26,250	27,250

Note. From https://www.hellenicshippingnews.com/weekly-dry-time-charter-estimates-june-30-2021.

Below is a description of the typical sized vessels that call the Lower Mississippi River region, as well as the United States as a whole. These vessels are: Handy sized, Handymax, Supramax, Panamax, and Cape.

- Handysize – 10,000 tons < DW < 35,000 tons
- Handymax – 35,000 tons < DW < 50,000 tons
- Supramax – 50,000 tons ≤ DW < 60,000 tons
- Panamax – 60,000 tons < DW < 80,000 tons
- Capesize – ships larger than Panamax or Suezmax (they cannot cross the canals), and that use the route of Cape Horn or the route of the Cape of Good Hope to sail between oceans, with 80,000 tons < DW < 200,000 tons. A snapshot of the bulk vessel fleet, which is represented in the sizing above, can be found in Figure 2.

Figure 2. Global Dry Bulk Operating Fleet, December 2012-2018

Type of vessel	Size (dwt)	2012		2013		2014		2015		2016		2017		2018*		2019*	
		No. of Vessels	Capacity mdwt	No. of Vessels	Capacity mdwt	No. of Vessels	Capacity mdwt	No. of Vessels	Capacity mdwt	No. of Vessels	Capacity mdwt	No. of Vessels	Capacity mdwt	No. of Vessels	Capacity mdwt	No. of Vessels	Capacity mdwt
Handysize	10,000-40,000	3,000	84.3	3,002	84.9	3,114	88.5	3,246	91.8	3,317	93.9	3,373	96.4	3,430	98.4	3,472	99.9
Handymax/Supamax*	40,000-65,000	2,654	137.9	2,973	157.5	3,118	166.1	3,310	178.4	3,431	187.4	3,550	195.8	3,601	199.1	3,647	202.1
Panamax	65,000-85,000	1,481	107.7	1,917	146.3	2,023	155.2	2,059	158.8	2,047	159.0	2,107	164.3	2,158	168.4	2,221	173.6
Post-Panamax	85,000-120,000	798	69.8	503	48.8	530	51.5	530	51.4	544	52.7	554	53.6	566	54.7	572	55.3
Capesize	120,000-220,000	1,165	197.2	1,257	223.2	1,312	234.2	1,293	233.1	1,313	238.8	1,352	247.4	1,357	248.7	1,354	248.6
Vloc	220,000+	306	77.7	203	59.7	212	62.1	209	61.1	212	62.0	217	63.3	240	72	249	75.6
Total		9,404	674.6	9,855	721	10,309	757.6	10,647	774.6	10,864	793.8	11,153	820.8	11,352	841.2	11,515	855.1

Note. From "Grain Transport Report." *Home | Agricultural Marketing Service*, www.ams.usda.gov/. https://www.ams.usda.gov/sites/default/files/media/GTR07252019.pdf.

There are certainly many other sized vessels that fall into the smaller and larger categories. For reference, the graph below (see Figure 3) shows the largest vessels in the world. Most of the vessels in the graph will never be able to call any ports on the LMR due to their size and the necessary infrastructure.

Figure 3. Dimensions of Largest Ships in Different Ship Types

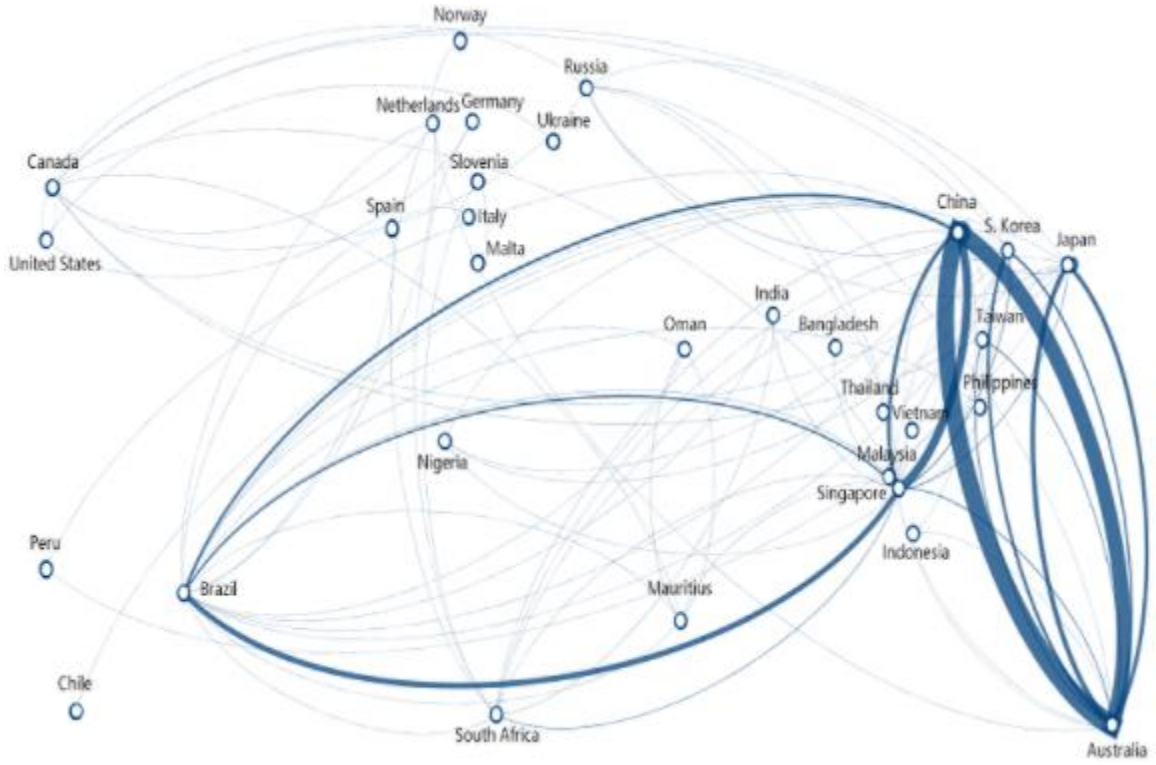
Ship type	Name	LOA	Beam	DWT	GT	Draft	Since
Container	MSC Oscar	394	59	197,362	193,000	16	2015
Container	CSCL Globe	400	59	184,320	187,541	16	2014
Oil tanker	TI class	380	68	441,893	234,006	24.5	2002
Bulk carrier	Valemax	362	65	400,000	200,000	23	2011
Cruise ship	Oasis class	360	60.5	15,000	225,282	9.3	2009

Note. From "The Impact of Mega-Ships." *International Transport Forum Policy Papers*, 2015, doi:10.1787/5jlwvzcm3j9v-en., p. 16.

One of the issues facing the LMR is that the trade lanes for vessel movements are very well set and will take time to change. Typically, capesize vessels are used in the transportation of raw materials such as coal and iron ore. Although the US produces, uses, exports, and imports a

variety of these products, the movements of these products are only a small percentage of the global trade. The trade lanes are most common between Australia and China and Brazil and China. The figure below (Figure 4) highlights the trade lanes for cape size vessels. The thicker lines indicate significantly more transits of these larger vessels.

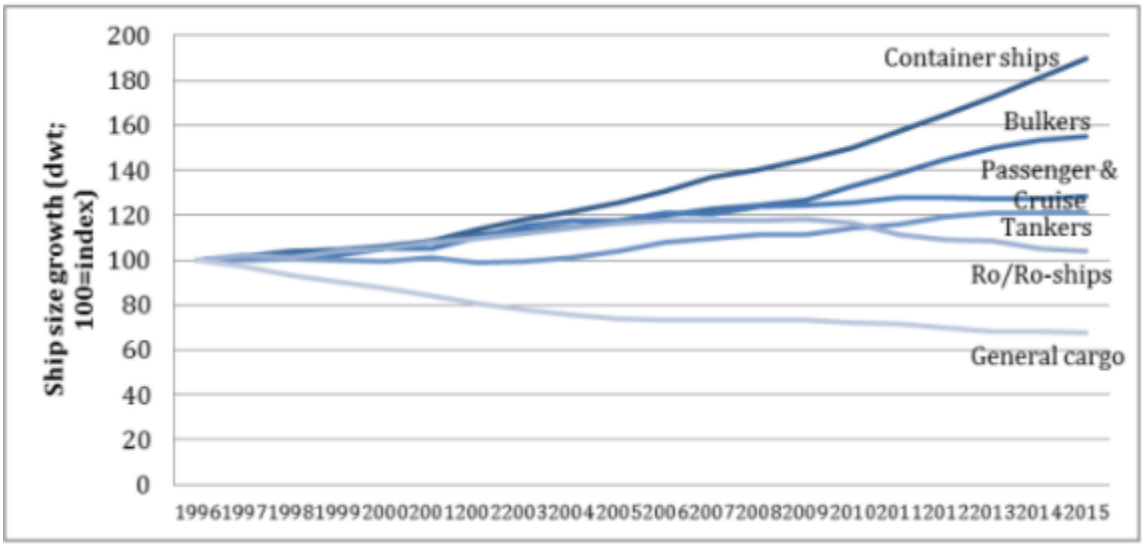
Figure 4. Typical Cape Dry Bulk Origin/Destination Pairs



Note. From Li, Ned. "Capesize Bulkers Connect 121 Ports in 31 Countries." *The Maritime Executive*, The Maritime Executive, 11 Apr. 2019.

Another point to make about these ships and even the smaller ones that call the LMR is that they are ever evolving. The engineering of ships and the maritime industry has profoundly changed the way product is loaded, handled, and shipped. Figure 5 shows some of the changes made in recent years to the ships being built.

Figure 5. Ship Size Development of Various Ship Types, 1996 – 2015



Note. From "The Impact of Mega-Ships." *International Transport Forum Policy Papers*, 2015, doi:10.1787/5jlwvzcm3j9v-en. p. 17.

Background on Drafting

So why are draft surveys the most common way to determine weights? The maritime industry is still somewhat archaic in the way it does things. Draft surveys take a lot of time and cost a lot of money to provide a reasonably accurate depiction of the amount of tonnage on a vessel. This type of survey is only done on maritime shipments: vessels and barges. All other types of shipping use other weight measurements. For example, truck and rail use scale weights to provide the weights of their products. It is still an uncommon practice to load product to barge where certified belt scales are used for determining the weight of the loaded barge. In the export and terminal loading world, draft surveys are still the standard regarding determining the amount of product loaded. About surveying vessels, "The ship's method of determining the amount of cargo loaded is by means of draft surveys taken before and after the loading is carried out. With the data so obtained the ship's displacement (the volume and therefore the weight of water displaced by the ship) before and after loading can be calculated" (Isbester, 2013, p. 161). This

quote sheds a significant amount of light on the practice itself. Captain Isbester goes on to tell us that the captain and surveyor must work closely together, "...the surveyor will have the benefit of equipment and instruments not found aboard the normal bulk carrier, but in most instances the ship's master or officer with careful attention to accuracy and procedure can obtain results quite as good as those of the surveyor" (Ibid, p. 161). Of course, no matter how good the shore equipment is or the draft surveyor themselves, there will occasionally be problems. To this point, "Occasionally it will be found that the results obtained from a draft survey are unexpected. The constant may be found to be much larger than the normal for that ship, or a negative constant may be calculated. The ship's figure for the tonnage of cargo lifted may differ from the shore figure by an unusually large amount. If the ship's officer and surveyor work independently, but compare figures at each stage of the calculation, then calculation errors are minimized" (Ibid, p. 166). These mistakes can and do happen and when they do, significant amounts of money are at risk.

Lower Mississippi River Port Details

Some of the larger vessels calling the LMR simply will not fit. The LMR being a river port region must deal with a variety of navigational issues. Two of the main issues other than river draft are air draft and beam. Air draft simply means how high out of the water the vessel reaches. The beam of a vessel is the width and can cause issues if the vessel is too wide and will stick out into the channel when berthed. This was highlighted quite clearly in a presentation for the International Transport Forum as follows, "The transport costs due to larger ships could be substantial. There are size-related fixes to existing infrastructure, such as bridge height, river width/depth, quay wall strengthening, berth deepening, canals/locks, and port equipment (crane height, outreach). Mega-ships also require expansion of infrastructure to cater to the higher peaks

related to mega-ships; as a result, more physical yard and berth capacity is needed" (Ibid, p. 9). Each of these things listed above has an impact on the loading capabilities of the stevedore as well as the receiving ability of the ships themselves.

The LMR and the New Orleans region make up four of the top ten ports in the United States by tonnage. These ports are the Port of New Orleans, the Port of Baton Rouge, the Port of Plaquemines, and the Port of South Louisiana. The data provided below (Figure 6) offers a glimpse of the typical tonnages that they each handle while the map (Figure 7) offers a good representation of the locations of the ports in the Lower Mississippi River.

Figure 6. Ports of Lower Mississippi River Tonnages

Ports	Rank	Total tons (Millions)	Rank	Total tons (Millions)	Rank	Total tons (Millions)	change 2017-2018	change 2008-2018
South Louisiana, LA, Port of	1	275.5	1	275.1	1	224.0	0.2%	23.0%
New Orleans, LA	6	93.3	4	96.3	6	73.0	-3.1%	27.8%
Baton Rouge, LA	8	82.2	8	77.0	14	51.8	6.8%	58.7%
Plaquemines, LA, Port of	13	56.9	12	54.5	10	63.7	4.4%	-10.8%

Note. From "Tonnage of Top 50 U.S. Water Ports, Ranked by Total Tons." *Tonnage of Top 50 U.S. Water Ports, Ranked by Total Tons | Bureau of Transportation Statistics*.

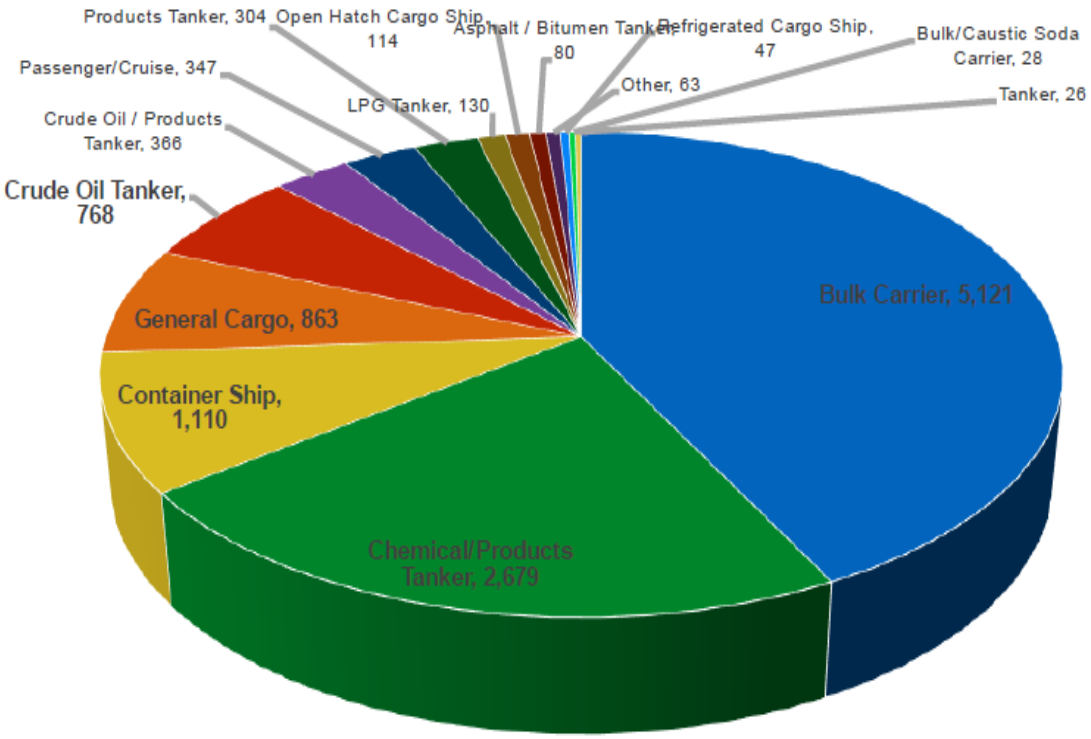
Figure 7. Ports of the LMR Locations Map

Note. From US Army Corps of Engineers. (2016). Draft integrated general reevaluation report & supplemental environmental impact statement Mississippi River ship Channel Gulf to Baton Rouge, LA, Retrieved from https://www.mvn.usace.army.mil/Portals/56/docs/Projects/Miss%20Deep/MRSC_%20Main%20Report.pdf

The Port of South Louisiana is by far the largest tonnage port with 258.7 million tons in 2019 (Port of South Louisiana Review, n.d.). Part of the reason for this is the significant number of grain elevators for export, which are located in the Port of South Louisiana. The region handled hundreds of millions of tons in 2019 (https://www.bts.gov/content/tonnage-top-50-us-water-ports-ranked-total-tons). During this time frame, the river was to be maintained at a 45-foot draft. On occasion, the maximum draft a vessel could be loaded to was increased to 47 feet. At times, the draft for the river fell well below this number. In 2019, due to unprecedented highwater, the draft dropped briefly to 41 feet. Each of the tonnage figures includes both

imports and exports as well as a variety of commodities. Not all docks in the LMR can handle the larger vessels. Even some of the ones that can currently handle them have issues with air draft of the vessels during periods of high water. These docks and buoy locations can load the larger vessels and, therefore, would be the first to benefit from the increased volumes during normal operating conditions. To enjoy these benefits, many grain elevators would need infrastructure upgrades to load larger vessels. That said, with only a handful of foreign grain ports being able to accept the larger vessels, the infrastructure upgrade may be for naught. The ports located on the LMR are truly diverse and handle a variety of products. Figure 8 provides a good snapshot of the different products that come in and out of the river.

Figure 8. Number of Port Calls per Vessel Type into LMR, 2019



Note. From Advocating for a Mightier Mississippi River; National Waterways Conference, www.bigrivercoalition.org; p. 5.

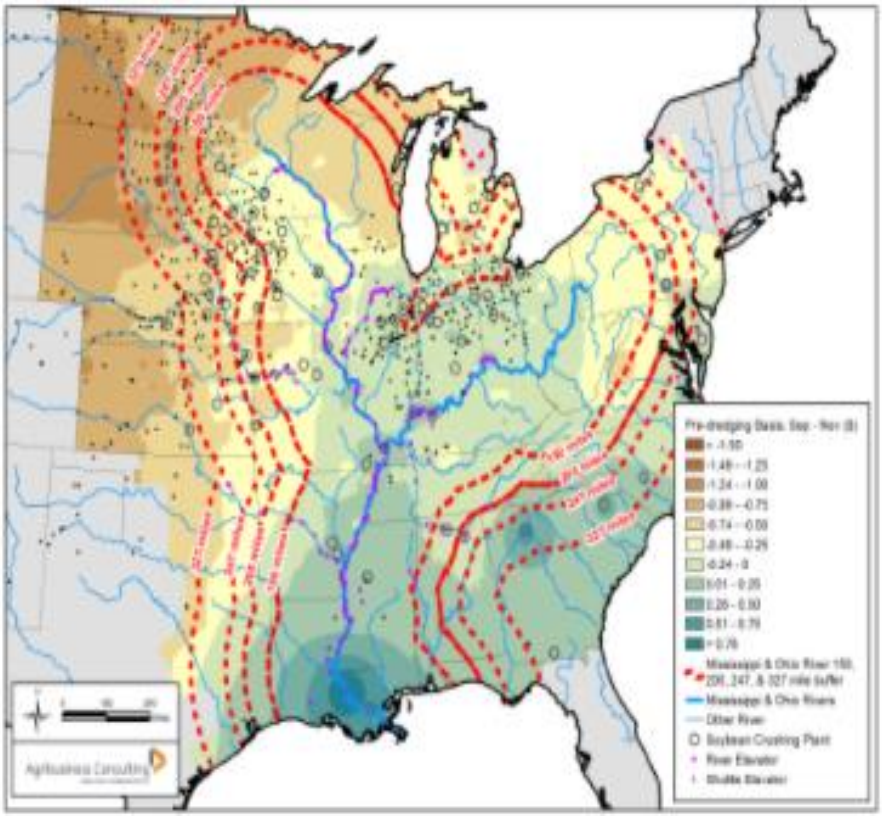
Vessel Savings

Grain is by far the largest bulk product to move out of the LMR. When strong demand couples with good harvests, over three hundred million tons can move via the LMR. This dwarfs all other imports and exports on the dry bulk side of the business. Informa Economics, Inc., which provides a variety of insights into the world of shipping, produced a presentation entitled "Impact on Crops and Product Export Flows of Dredging the Lower Mississippi River to 50 Feet" for the Soy Transportation Coalition in May of 2018. This document provided a wealth of information on the benefits not only to the localized areas in and around New Orleans, but also to those much further inland that will economically benefit being able to load more tons. Expanding on the benefits of larger vessel loadings, it was noted "If the project depth is 50 feet, a small Capesize vessel can be loaded to 99,000 metric tons and a large Capesize vessel can be loaded to 120,000 metric tons" (Informa Economics, 1) The need for a deeper draft also impacts the United States' ability to compete on a world scale. "Brazil is improving its transportation system; especially the grain and soybean export facilities. The US needs to maintain and improve its transportation system or the US farmer base will erode as Brazil improves. A deeper draft on the lower Mississippi River increases the competitiveness of the US versus South America by effectively lowering the ocean freight cost with heavier average loading volume" (Ibid, p. 1). As the data shows elsewhere in the document, Informa points out that there can and will be some issues with loading larger vessels. "Air draft (draught) is a term used to describe the distance from the top of a vessel's highest point to its waterline. Vertical clearance is the distance in excess of the air draft that allows a vessel to pass safely under a bridge or object. The consequences of failing to consider air draft and to properly calculate a vessel's vertical clearance under bridges, power lines, and other obstructions encountered during a passage can be

catastrophic" (Ibid, p. 9). Informa's insight into what deepening the draft entails is noted in the following quote, "Port capability and capacity depends upon channel depths and widths, turning basin size, sufficient bridge heights, and port support structures such as dock and crane capacity to offload and onload cargo. The deepest channel requirements are likely to be driven by "weight trade" services. Vessels can be filled to their weight capacity or their volume capacity. Vessels loaded to their weight capacity sail at their maximum design draft. For volume trade routes, channel width and turning basin size may be of greater importance than additional channel depth at some ports, as vessels loaded to their volume capacity often sail at significantly less than their design draft. Careful consideration is needed when determining channel depth requirements at US ports, especially on the Mississippi River from Baton Rouge, LA to the Gulf of Mexico" (Ibid, p. 9). The savings associated with loading larger vessels to deeper drafts is impacted drastically when origin and destination pairs line up. Import cargoes will need to be found to make this make sense. Informa suggests, "The ability to bring in large oceangoing vessels with larger volumes of fertilizer will allow importing fertilizer more economical. Conceivably the impact will be lower fertilizer costs to farmers" (Ibid, p. 118). This savings could be significant; in some estimates, it could cut rates and fees by up to $20 per ton. In smaller incremental bumps and more conservative estimates, the number drops. "The impact of the deeper draft on the lower Mississippi River will save $5 per metric ton in ocean freight as the average weight loaded onto ocean going vessels increases from 66,000 metric tons to 78,000 metric tons" (Ibid, p. 50). This jump in tonnage increases the distance that soybeans can travel and still be economically feasible. "Currently the draw area is estimated to be 205 miles based on an average load of 66,000 metric tons. Increasing to 78,000 metric tons per load will extend the draw area to 245

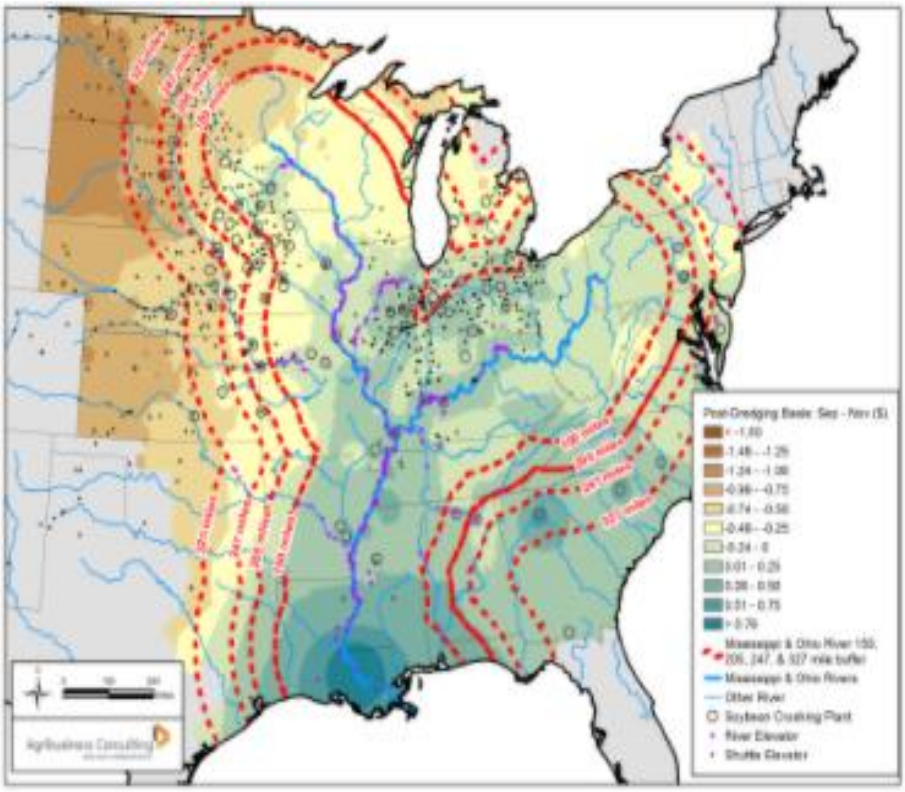
miles" (Ibid, p. 51). This is clearly illustrated in the graphics below (See Figure 9 and Figure 10).

Figure 9. US Soybean Basis pre LMR Deepening (September – November)



Note. Ibid, p. 53.

Figure 10. US Soybean Basis Post LMR Deepening (September – November)



Note. Ibid, p. 53.

Air Draft Explanation

Although the information provided by Informa focused on soybeans and the associated transportation, important issues and concerns of all interested parties when moving products from the LMR were also noted. Two things highlighted in the interviews/discussions with Oldendorff and Torvald Klaveness as well as the Informa data are high water and air draft issues. While it is easy to see the connection between the two issues, it is important to point out that drops in the draft of the LMR occur during periods of high water. This is due to the speed and volume of the river running into a stationary Gulf of Mexico, which can lead to the creation of sand or mouth bars. "A mouth bar is created when the distributary channel ends and water speed decreases, resulting in deposition of sediment" (Mississippi River Delta. Org, n.d).

Air draft can be a significant issue for larger vessels. The graph below (Figure 11) shows the specifics of the various bridges in the LMR.

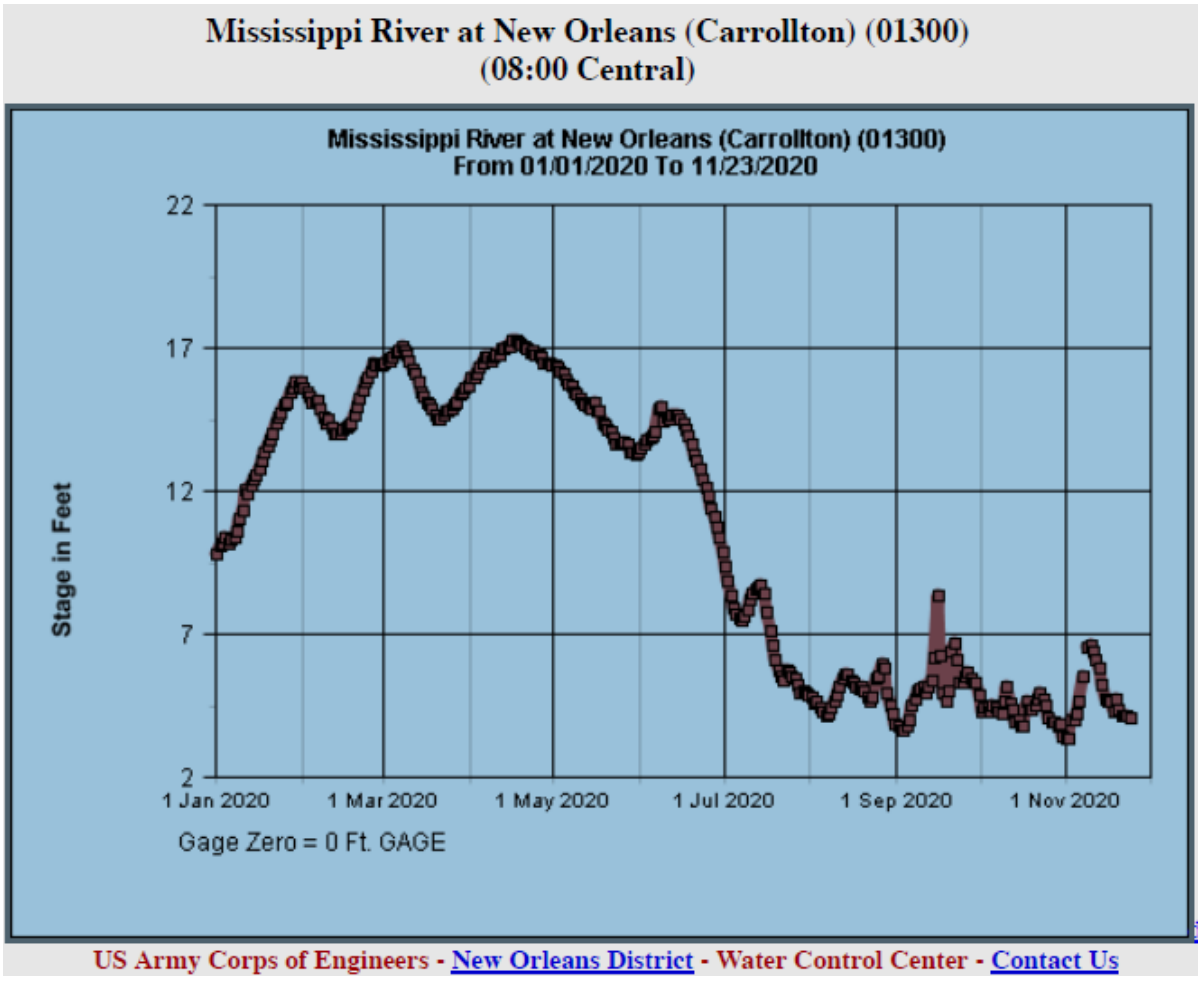
Figure 11. LMR Air Drafts by Bridge Location

Bridge Name	River Mile	Reference Gage	Veritcal Clearance (feet)
Cresent City Connection Lower	95.7	Carrolton (NOLA)	171
Cresent City Connection Upper	95.8	Carrolton (NOLA)	171
Huey P Long	106.1	Carrolton (NOLA)	152
Hale Boggs - Luling	121.6	Reserve	158
Gramercy	145.9	Reserve	164
Sunshine Bridge	167.4	Donaldsonville	171
Baton Rouge I-10	229.3	Pot Allen (BR)	174
Baton Rouge Hwg 90/Railroad	233.9	Pot Allen (BR)	111

Note. Informa Economics IEG, Ïmpact on Crops and Product Export Flows of Dredging the Lower Mississippi River to 50 Feet.
https://www.soytransportation.org/newsroom/STCLowerMississippiRiver50-FootDraftStudy.pdf

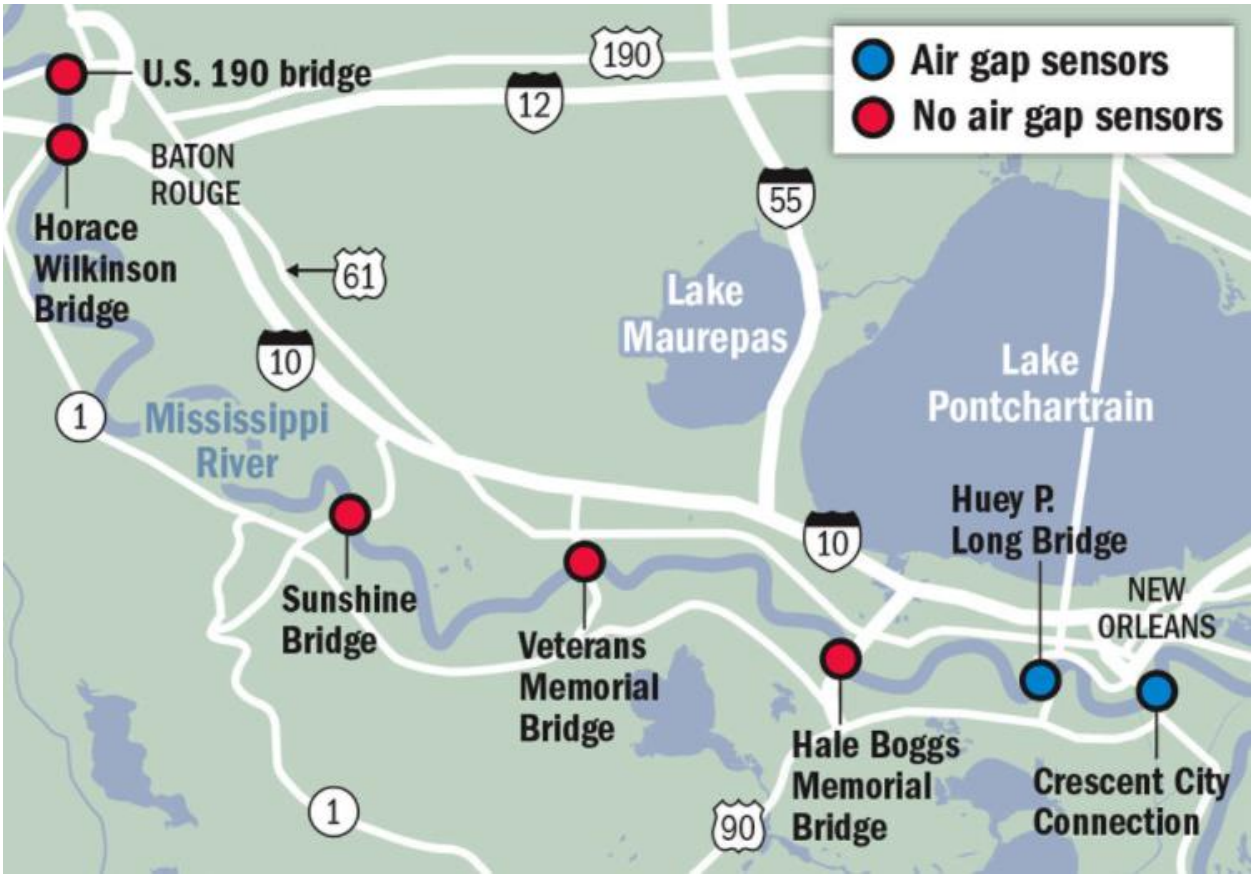
Figure 12 clearly highlights the concerns that Chris Schuck of Oldendorff pointed out above. The Huey P. Long can be a deterrent during certain times of the year for larger vessels to transit beneath it. High water typically occurs in the spring and early summer. When river levels rise, it can make for hazardous conditions and often leads to restrictions imposed by the United States Coast Guard. Over the last two years, there has been historic flooding and extended periods of high water. This is highlighted in the graph below (See Figure 12). Figure 13 provides the locations of the bridges, which span the LMR while Figure 14 shows the air gap of the Huey P. Long Bridge. Further information on the seven bridges spanning the LMR from Baton Rouge to New Orleans can be found in Appendix F.

Figure 12. Mississippi River at New Orleans (Carrollton)



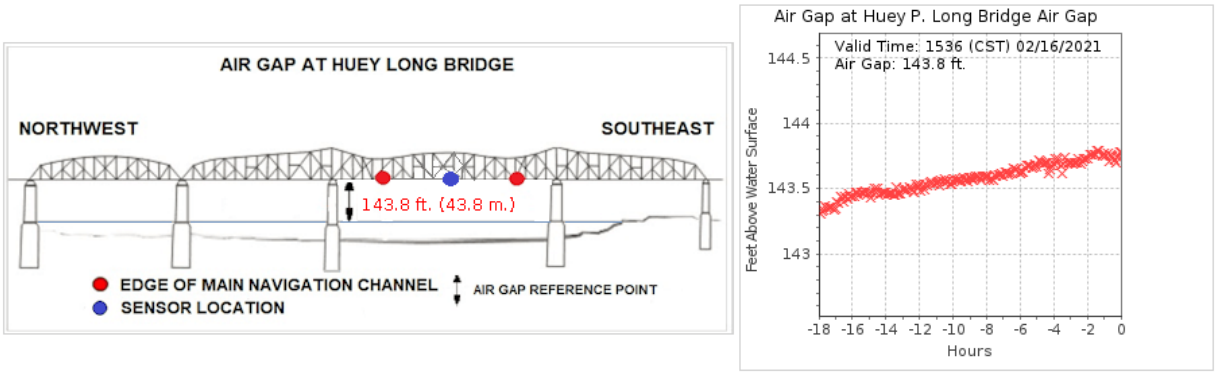
Note. From https://rivergages.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=01300&fid=NORL1 *(n.d)*

Figure 13. Locations of LMR Bridges



Note. From Mitchell, David J. (2008. November 4). After sunshine bridge crash, interest renewed in sensors alerting pilots to bridge clearances. *The Advocate*, 4 Nov. 2018, Retrieved from www.theadvocate.com/baton_rouge/news/article_eb65ee6c-ddfe-11e8-b32c-6fc953ece458.html.

Figure 14. Example of Air Draft



Note. From https://tidesandcurrents.noaa.gov/ports/ports.html?id=8762002&mode=airgap (n.d.)

The Powers That Be

The dictating draft of Southwest Pass in the LMR is subject to change. But how is the dictating draft determined? As mentioned elsewhere, the Corps of Engineers is responsible for the dredging and spoil recovery at the pass. They work hand in hand with the National Oceanic and Atmospheric Administration (NOAA) to provide data and updates on the channels and charts for transit. "The US Army Corps of Engineers and the National Oceanic and Atmospheric Administration (NOAA) share hydrographic and charting responsibilities for the lower Mississippi" (Armstrong, 2021, p. 1). Although the pass has been improved by infrastructure such as jetties and dikes, the river pilots and vessel operators must use caution and calculation to transit in and out of the river. The pilots, based on vessels loaded to or near the max draft at the current time, will make recommendations for draft changes when they deem them appropriate. The Corps of Engineers will work with the pilots and use the Corps equipment to gauge draft and determine where dredging needs to occur. "These survey vessels are equipped with Differential Global Positioning Systems for positioning and single-beam echo sounders equipment for depth measurement" (Ibid, p. 1). The Corps of Engineers also operates eight additional survey vessels for further guidance and necessary data retrieval. On occasion, sunken vessels or other

obstructions can impair vessel transit. When this happens, the Corps of Engineers employ other special equipment. “Side scan sonar and magnetometer are also used to locate wrecks and obstructions in the river” (Ibid, p. 1). This allows them to find and remove the obstruction and thereby minimize delays. These surveys are provided to the river pilots and other required parties, but the Corps of Engineers primary work is “to determine when, where and how much dredging is required” (Ibid, p. 2). Nearly constant surveying and dredging is required near the mouth of the river to maintain the required channel depth. This dredging is required due to the shoaling and the river attempting to form a delta. During normal river conditions, the area is resurveyed every three to four days. In high water conditions, this increased to a daily occurrence. “About 33 million cubic metres of sediment are dredged from the lower Mississippi River each year to maintain the navigational channel” (Ibid, p. 2). As many as nine dredges working at the same time can be required to maintain the channel. Although this is typically in periods of high water, as we move toward 50 feet, the number will likely be a full-time basis. “Without constant hydrographic surveying and dredging, the ports of the lower Mississippi could not remain open and the products of the US interior would have to find less efficient means to reach the sea” (Ibid, p. 2).

Another point of contention in the LMR is how the draft of the river is determined and who exactly governs the depth. There are four entities who have some say or policing ability regarding the draft of the river, the United States Army Corp of Engineers, the National Oceanic and Atmospheric Administration (NOAA), the United States Coast Guard and the National Transportation Safety Board. The Corp of Engineers is responsible for the dredging and maintenance of the channel as well as the silt recovery used for building new land. The NOAA produces nautical charts of the Mississippi River from the Gulf of Mexico to Baton Rouge. The

Coast Guard acts as law enforcement on the river and would have jurisdiction over any/all issues with vessels entering or exiting the river. The National Transportation Safety Board, although not a governmental body, does have involvement from a safety oversight perspective. Each of these four organizations play a role in the draft of the river but rarely offer any guidance on the actual changes in water depth that happen throughout the year. Typically, the Associated Branch (BAR) Pilots offer guidance on this subject as they are the pilot group responsible for moving the vessels in from the gulf to the river and out from the river to the gulf. When they notice draft levels dropping or rising, they will offer a memo suggesting the draft changes to the various concerned parties. The concern here is that the BAR pilots have no authority from the state or federal government to make these changes.

Who Benefits?

So, who benefits? This is a noticeably short sentence with an exceptionally long and tangled answer. Many believe in the long run the LMR will benefit significantly from the deepening of the river. The issue will be adjusting the trading lanes to offer more movement of product into and out of the suitable ports. One expert on this topic is Dr. Tim Ryan. On an annual basis he offers words of wisdom at the Mississippi Valley Trade and Transport annual conference. The information and data offer insight and a better grasp and understanding of the market and economic conditions. In 2012, he offered a presentation that was very much in tune with what is taking place today. Although his topic and the research provided herein are slightly different, it seems that his data is relevant in supporting my point.

In his presentation, "The Economic Impact of Reduced Dredging of the Mississippi River"(January 2012), Dr. Ryan offered his thoughts and insights on maintaining a 45-foot draft vs the idea of going to a 38-foot draft, highlighting costs, benefits, losses, and other relevant

topics, and provided a clear picture of the marine economy and the benefit of maritime transportation when he stated, "Over 20% of United States waterborne commerce passes through the Lower Mississippi River and the Louisiana economy. Shipping is big business in Louisiana. Millions of dollars of business and thousands of jobs are related to the handling, financing, processing, and transporting that cargo. The ship movements create many economic opportunities related to the servicing of the vessels that call on the ports along the LMR. The LMR also acts as a magnet for attracting warehousing and manufacturing firms that use the River to import raw materials into the area or export finished products out of the area" (Ibid, p. 5). He took it to a national level, when he said, "In addition, the nation's economy could stand to lose 2,720 jobs as a result of the losses in production and $136.02 million in lost income for American workers. These are losses that would be even more significant in the current weak economy. Finally, when the private sector declines through lost production and lost jobs, state, local, and federal governments suffer losses in revenue. The economic losses resulting from the reduced dredging could cost state and local governments $8.77 million in lost revenues and the federal government would lose $15.04 million in lost personal income tax revenues alone. The total loss to all levels of government could be $23.81 million" (Ibid, p. 7). He further stated that each level of government could have loss of tax revenues when he noted, "...federal, state and local governments could also lose tax revenue. In total, all governments could lose $387.19 million or $115.13 million in tax revenues to save $45 million" (Ibid, p. 10).

At this point, Dr. Ryan turned his attention to the local business economy of New Orleans by stating, "Hundreds of firms are located in the New Orleans area simply because of the existence of the maritime industry. These firms include large steamship companies; firms providing longshoremen services; railroads, tugboat, barge, and trucking companies that ship the

goods to and from the port; freight forwarding companies; law firms that hire maritime attorneys to handle legal work for the maritime industry, and insurance companies that write marine insurance. These firms are referred to as the port industry" (Ibid, p. 29).

To tie this all together on a larger scale, Dr. Ryan said, "In addition to the loss to the Louisiana economy in the handling and processing of the inbound and outbound cargo that will be lost, the national economy will suffer losses as well. There are basically two kinds of losses that will be suffered nationally. First is the loss of production that will result from the higher costs of transporting American made goods for export. Second is the loss to American consumers that will result from higher prices for imported goods into the United States" (Ibid, p. 34). Although Dr. Ryan's discussion and the research found in this paper are targeting two different things, the arguments are remarkably similar. The higher the draft number the better the benefit and more possibilities for enterprise within our local region.

Method of Research

Research Context

Research for this study took place across a broad spectrum of individuals. This group consisted of seven participants with significant background and understanding of the topic from unique vantage points. Although not large in number, the research is sufficient, as it is qualitative by design and implementation.

Selection of Participants

Participants were selected based on their backgrounds and willingness to participate in the project. Each participant is a seasoned expert in their field and able to provide relevant real-world experience-based answers. No additional participants were identified during the course of the interviews and, thus, the snowball sample was deemed complete.

Participants

David Pereiera- Sabine Surveyors

Sarah Fakhari- CHS Grain Elevator

Christian Zirelli- MT Maritime Management USA

Tommy Bradley- Biehl Agency

Sean Duffy- Big Rivers Coalition

Christopher Schuck- Oldendorff Carriers

Peter Lars Michael Lindstrom- Torvald Klaveness

Methods

Research for this paper is a qualitative design and was conducted through a literature review and via seven interviews. These interviews were accomplished via verbal communication and email communication. Questions were sent via email to each of the

participants prior to the actual interview. Clarification discussions took place with some of the participants. Transcripts of the interviews are provided in the appendices attached to this document. No participant was compensated for their participation in their interview. Approval from the he University of New Orleans Institutional Review Board was obtained for this research.

Line of Questioning

Each participant received a list of eight to ten open-ended questions unique to them and their experiences. The questions were considered and purposefully written to determine the best data and information to provide real world insight into this research. Each participant answered all questions asked of them and provided responses based upon their expertise and background.

Organizing the Data

The data was organized to offer insights to the focus of the research at the point in which it was inserted. It was also strategically placed to provide ease of flow for the reader.

Findings

To provide different vantage points on draft, operations, savings and benefits, the research allowed for interviews of some industry leaders. In the following paragraphs, you will find the questions and answers asked of each person.

Summary of Captain David Pereira Interview

Captain David Periera provided a detailed background on the history of drafting vessels. He began by saying that this centuries old practice has been accepted as an accurate and convenient means of establishing the weight of bulk cargoes since its inception over 2,200 years ago. The drafting of vessels is necessary to determine the weight of the cargo, which is then used to determine the fees of the vessel and the exchange of monies between all parties involved. The basic principle upon which the draught survey methodology is based can be traced back to Archimedes' Law of Buoyancy. Over the years, the application of this law of physics to ships was further refined by formulas developed by European naval architects in the nineteenth century. He then provided a working understanding of the United Nations Economic Commission for Europe's involvement to standardize the process even further. This process and the science of conducting these surveys and development of technology over the last 40 years has improved accuracy.

Captain Periera then provided details on the tools of the trade, which include hydrometers, steel measuring tapes and the various electronics of today's world. Hydrometers for measuring specific gravity of ballast water and in place water that the ship is floating in are required for the desired accurate results of the survey. Steel measuring tapes are necessary for measuring depth of ballast water inside ships' tanks and, when necessary, are required to measure freeboards. In today's world, laptops, tablets, and software applications are commonly

used for accurate and timely calculations. He also provided insight into how these tools are used and what the surveyor is looking for to ensure accuracy of the survey itself.

Captain Periera then offered insight to the accuracy of draft surveys and things which can have an impact on their accuracy. He stated that a good draft survey can have a variance of up to one centimeter of immersion (40-60 tons). This, of course, depends on good conditions. He said that the salinity of the water will have an impact on the draft and proper calculations must be made to achieve accurate surveys. Weather conditions such as rain, snow, fog, and choppy seas can make it difficult to read drafts. Currents in rivers can also have an impact on the survey. These types of challenges must be overcome by the skill of the surveyor.

When asked about the future of draft surveys, Captain Pereira stated that he believes at some point, technology will offer a better solution and improve the process of draft surveys. He went on to state that finding consensus on new technology could be difficult and that no tools of this type are available at this time. Having said that, even with the best technology and calibrated tools there will always be a margin of error. The interview in its entirety can be found in Appendix A. (Pereira, David. email interview. September 15, 2021).

Summary of Tommy Bradley Interview

To garner further information about the maritime industry and some of the issues facing it, an interview with Tommy Bradley was conducted. Mr. Bradley, who serves as the President of the Louisiana Maritime Association (LAMA), is the Vice President of Operations at Biehl & Co. Biehl is a full-service steamship agency, which handles import and export documentation for ships entering and leaving the US ports. Biehl handles roughly 4000 vessels per year throughout the Gulf and East Coast ports. Mr. Bradley believes that the deepening of the river will affect the bulk cargo market the most, both import and export. It could also have an impact

on the container market but only if a deal could be struck with a new container port in St. Bernard. This is due to air draft issues with Post Panamax Container vessels getting under the Crescent City Connection. He went on to state that bigger vessels will mean less vessels, therefore, he sees a big impact on limiting congesting in certain areas. Regarding tonnage, he believes it will have an impact but not a significant impact.

Mr. Bradley believes that there would be more Capesize vessels in general and not just baby Capes loading the LMR due to the deepening draft. There could be some potential VLCCs going to some of the downriver refineries below the Sunshine bridge. No matter what, he believes draft will remain an issue in Baton Rouge.

In his opinion, a 50-foot draft will have major impacts on Coal & Pet coke markets. This is due to river draft fluctuations during high river conditions. The deepening of the river will ensure that we keep at least 45 ft. to 47 ft. in silting situations.

Mr. Bradley provided insight into how charterers and sellers work together during draft restriction/reduction times by noting that the two entities will work together in the event that lower quantities must be loaded to the vessel.

He goes on to tell us that infrastructure will need to change at the facilities that load and unload vessels. In his opinion, terminals will happily make these changes so that additional tonnage and revenue can be gained. Regarding "bad" draft surveys, Mr. Bradley stated that on occasions this does happen but went on to state that it is rare. He added that this is due to the surveying companies and vessel officers working together to get the information correct.

Mr. Bradley believes that the deepening will have a major impact on the Mississippi River, especially if it is done right. He is also advocating for a consistent dredge schedule to be implemented. The interview in its entirety can be found in Appendix B.
(Bradley, 2021).

Ocean Carrier Insights

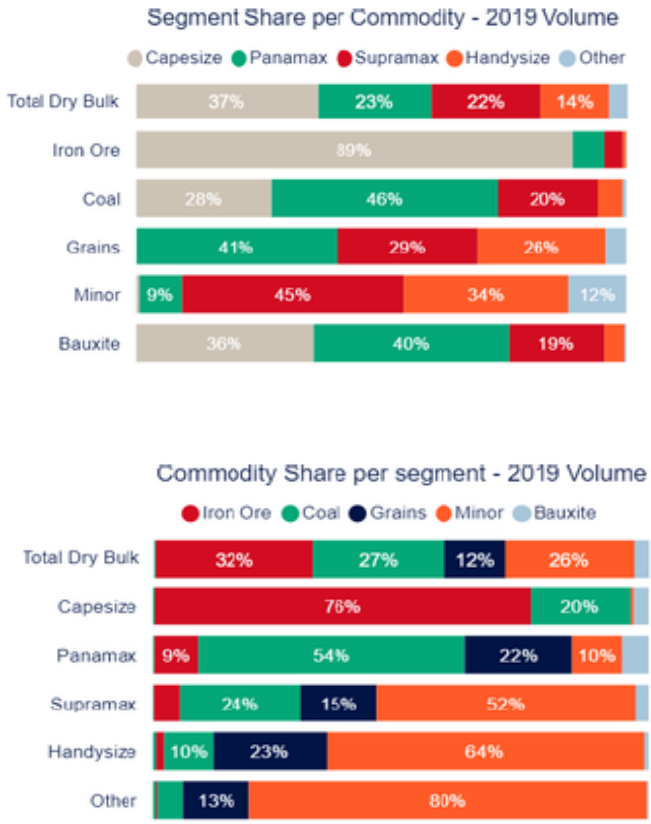
Oldendorff Carriers and Torvald Klaveness are two of the largest vessel owner/operator groups in the world. These companies offer a variety of vessel sizes and operations. Chris Schuck of Oldendorff and Peter Lars Michael Lindstrom of Torvald Klaveness offered insight into the draft questions raised. Chris believes that any cape movements coming to the LMR will be sporadic. This is due to the Origin/Destination pairs in which cape vessels typically move. A fifty-foot draft, according to Chris, was also not something that would have a significant impact on bringing capes into the mix. He also suggested that there could be an air draft issue with the Huey P. Long Bridge. Finally, he voiced his frustrations with the costs of loading in the river for a cape. The cleaning, pilotage, dockage, and other ancillary fees would make it less than attractive for new business. The cleaning and costs associated would certainly have an impact on grain loadings, most of which, according to Chris, rarely load in cape-sized vessels. On the positive side, he did say that the deepening of the LMR would lead to more tons on the larger vessels that are currently calling the LMR. He echoed others' sentiments that operators would see benefit from not having to be concerned with the draft following below a 47-48’ draft.
(Schuck, 2021).

Peter Lindstrom offered further insight on a broader and worldwide scale. Most of the data found below came from their website and newsletters. Torvald Klaveness provides data that highlights some of the benefits about loading heavier products to deeper drafts versus lighter

cargoes to shallower drafts. In this example, one of the concerns with loading grain is highlighted. “As an example, let’s say we use a Kamsarmax with a dead weight tonnage (DWT) of 82,000 on a voyage from Santos to Yantai with soybeans. Due to the high stowage factor of soybeans, the vessel would only be able to load about 71,350 tonnes. However, if the cargo instead had been iron ore, then the intake would be about 80,500. Thus, everything else equal you would need 13% more vessel capacity measured in dwt if the cargo is soybeans than if the cargo is iron ore” (Torvald Klaveness, 2020, Nov.). This is not specific to the LMR, but it does offer insight into the thinking behind vessel movements. Torvald Klaveness, as well as all other vessel owner operators, must look at all sizings of cargoes and ships to determine the best opportunities for their fleets. Just like all logistics providers, some moves do not make sense while others do. The competition for these moves can come in all shapes and sizes and typically certain products move in certain vessel sizes with little to no deviation. “As minor bulks represent the lion’s share of the demand for geared vessels the link between the minor bulk trade and dry bulk freight rates in these segments is direct and clear. The minor bulk also impacts earnings in the Panamax and Capesize segments indirectly through substitution effects. Due to economies of scale the larger sizes can normally offer the cheapest freight on a per ton basis” (Ibid.). (Lindstrom, 2021).

Specifics on vessel sizes and products moved are highlighted in the two graphs below (see Figure 15).

Figure 15. Klaveness Segment Share per Commodity and Commodity Share by Segment



Note. From Torvald Klaveness. (2020, November 20). "2021 Dry bulk outlook - minor bulks." Retrieved from www.klaveness.com/news/2020/11/20/2021-dry-bulk-outlook-minor-bulks.

Summary of Sarah Fakhari Interview

To garner information from the seller's perspective, an interview with Sarah Fakhari was conducted. Ms. Fakhari is the General Manager of Cenex Harvest States grain facility (CHS). CHS is part of a grain conglomerate and loads grain to vessels at their location in Plaquemines Parish. They typically load ocean barges, handy sized vessels, Handymaxes, Panamaxes and Post Panamaxes. The largest vessel size they can load is a Cape. The loading of Capes is rare for them. This is mainly due to the destinations and the vessel market. Draft restrictions and shoaling also can cause them to light load capes or larger vessels. About vessel draft surveys, Ms. Fakhari

stated that there are issues with the surveys and that there is nearly always a discrepancy with draft surveys. In her opinion, a fifty-foot draft would have the biggest impact for CHS due to shipments of yellow corn and soybean shipments. Her final comment on the draft regarded the upriver supply chain. She believes it will need to be adjusted as well, allowing for more barges and rail volume to transit to the Gulf. The interview in its entirety can be found in Appendix C. (Fakhari, 2021).

Summary of Christian Zirelli Interview

Christian Zerilli began his interview by providing a detailed background on himself as well as his employer, MT Maritime. MT Maritime, founded in 1980, is an owner and operator of vessels and a broker of various ocean freight and vessel trades around the world of various sizes and types. They trade in both dry bulk and liquid cargoes. They also have a ship management division, which is responsible for the training / staffing of its owned tonnage as well as providing crewing for third party vessels. Christian's role as chartering manager makes him responsible for all their dry cargo chartering/trading activity for Europe, Baltic Sea and Mediterranean markets. The types of cargo they focus on includes, but are not limited to grains, salt, sulphur, pet coke, fertilizers, steels, wood pellets and various minerals.

Christian then provided a background on how they book their business and an understanding of the business. He explained voyage cargoes in which they enter into an agreement with a charterer where they pay on the basis tons loaded on to the vessel. He then provided detail on the alternative, which is time chartering a vessel. This is when someone charters a vessel and pays a daily fee for the vessel until the voyage is completed.

About the impact of draft and draft surveys on his business, Christian stated that these each have a direct impact on the earnings of the vessel. He went on to say, that in most cases,

the more cargo you can load, the better return for the owner and the lower the freight rate for the charterer. There are some exceptions, but this is the general rule. Bad information on drafts or poor surveys can and do have an impact on his risk and their fee structures. In the event that draft changes just prior to loading, it can cause a profitable voyage to become a losing voyage. Each of these components factor into how Christian and his colleagues at MT Maritime calculate freight rates.

Christian also offered insight into his experiences with overloaded cargoes, under loaded cargoes and bad draft surveys. He stated that his experience with vessels that have overloaded often lead to serious and expensive issues. This problem can be exasperated if there is no way to easily discharge the overloaded cargo. The issue with under loaded cargo is that everyone along the chain has based their business for that day on a specific amount of tonnage. When less is loaded, the entire chain is impacted to a certain degree based on how their fee structures are set up. Most of these issues are caused by the vessel itself or the loading facility. As for draft surveys, Christian stated bad surveys can have an impact on the vessel loadings. This would impact everyone along the chain as well. Fortunately, he has not had a lot of issues with this problem.

When asked about new technology and its impact on draft surveys, Christian believes that change, for the time being, would be limited. He does not believe that draft surveys will become a thing of the past anytime soon, as they really are the most accepted and "impartial" way to determine the quantity loaded onboard the vessel since both the owner and charterers are party to it. The interview in its entirety can be found in Appendix D. (Zirelli, 021).

Summary of Sean Duffy Interview

Beyond the benefit to ship owners, shippers and charterers, there is also the possible benefit of added land production. This is done by using the dredge spoils collected during the dredging process and using them to build new land. This land production is working and is not only something that should continue but should have been done years ago. One of the foremost experts not only on the river system but the dredging options specifically is Sean Duffy. Sean is the President of the Big Rivers Coalition and involved in a variety of boards and organizations. The following is a summary of the interview with Mr. Duffy.

The idea of dredging the river to a deeper draft has been around for decades. Originally, the discussions had been to dredge to fifty-five feet, but there were too many issues to garner movement. An MOU was put into place on August 25, 2012 which began the current push toward the goal of obtaining a draft of fifty feet for the LMR.

The biggest impact from dredging to 50 feet will be seen in the dry bulk side of the business. Grain, fertilizer, coal, and petroleum coke shippers will benefit directly. The liquid, break bulk, passenger and container side will likely see limited impact, at least initially. Larger vessels will be able to be loaded, but the deeper draft will likely lead to the ships that have been loaded for the last few years simply being able to load to deeper drafts. Loading larger vessels will necessitate some infrastructural changes especially on the grain side. These changes and the ability to load larger vessels will gradually allow for loading more tons out of the river.

As for repurposed dredged materials, an estimated 80% is used below Venice, LA. Upriver dredging is not resulting in large numbers of repurposed materials being used. The dredging below Venice should be accomplished in late 2021. The next phase after the deepening below Venice, is not counted as a USACE phase since it must be done by the pipeline owners

and the LADOTD. Deepening is expected to be completed by 2024/2025. As for environmental concerns, there are none that he is aware of at this time. Politics could impact the dredging, but nothing has changed yet.

Final thoughts on the project are that it will be a very good thing for the LMR and the shippers and companies who do business in the area. The interview in its entirety can be found in Appendix E. (Duffy, 2021).

Discussion

Tasks and Benefits of Dredging

The task of the dredging of the LMR falls squarely on the shoulders of the Corps of Engineers. The Corps will be responsible for determining where to dredge and what dredges will be used. Over 256 miles of river will ultimately be maintained to a 50-foot draft. This will stretch from the Gulf of Mexico to Baton Rouge. The dredge spoils from the area around Southwest Pass will be used to build new land and restore critical marsh habitat. A variety of different dredges will be used near the pass as well as upriver. Cutterhead dredges, like the "Captain Frank" (Figure 16) are utilized for each of these services. The number of dredges used daily changes throughout the year and is impacted by high and low water scenarios. These dredges work in different ways, but the result is very similar. Dredging relies upon submerged pumps to move the debris and sediment from the floor of the river to the surface. The product is then moved from the dredge itself to its ultimate destination.

Figure 16. Captain Frank

Note. From www.bigrivercoalition.org/Captain Frank. (n.d.)

One of the benefits of dredging that has only briefly been touched on until this point is the reclamation effort of the dredge spoils. The New Orleans District of USACE has the largest operations and maintenance program in the United States. On average they dredge seventy-seven million cubic yards of material per year during maintenance dredging. According to their website, USACE fully supports the use of dredged material when it is practical and cost effective (US Army Corps., n.d.)

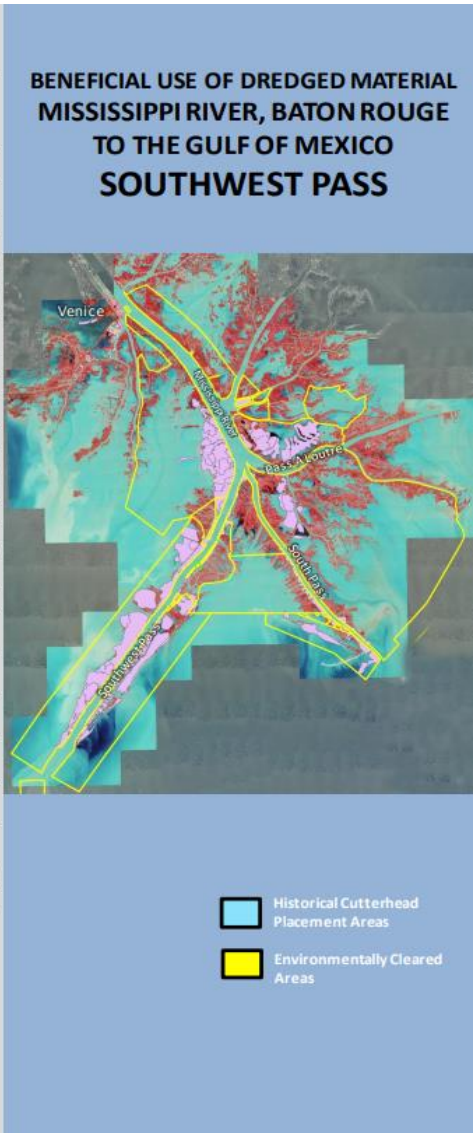
USACE is obliged to follow federal and state guidelines and laws as they apply to the reclamation process. To date, USACE has used dredged materials to build over sixty-eight miles of land (US Army Corps., n.d.). This is done with the use of only forty-two percent of the dredged material due to suitability and cost effectiveness. Figure 17 below clearly shows the progress made by USACE.

Figure 17. Beneficial Use of Dredged Material

Fiscal Year	Contract No.	Disposal Area	Dredging Quantity (CY)	Acres
Pre-1985		WD/BS		8,670
1985-93		WD/BS	73,551,651	1,895
1994	94-C-0036	WD/BS	5,748,715	273
1995	95-C-0061	WD/BS	3,300,751	259
1996	96-C-0045	WD/BS	4,080,055	199
1997	97-C-0030	WD/BS	1,427,610	114
	97-C-0039		2,835,803	166
1998	98-C-0037	WD/BS	2,675,616	214
1999	99-C-0023	WD	1,691,935	97
2000	NO CUTTERHEAD DREDGING			
2001	01-C-0032	WD/BS	3,194,981	62
2002	02-C-0037	WD/BS	1,529,439	71
2003-08	NO CUTTERHEAD DREDGING			
2009	09-C-0025	WD/BS	2,896,991	100
2010	10-C-0028	WD/BS	3,192,431	67
2011	11-C-0024	WD/BS	3,586,342	200
2012	12-C-0014	WD/BS	5,660,955	615
	12-C-0021			
2013	13-C-0021	WD/BS	5,656,851	773
2014	14-C-0023	WD	5,011,355	396
	14-C-0028		2,966,585	176
2015	15-C-0005	WD	4,989,906	52
	15-C-0012		5,983,584	312
2016	16-C-0016	WD	5,890,176	467
	16-C-0019		2,610,033	506
2017	17-C-0013	WD	12,233,573	1,064
2018	18-C-0014	WD	2,853,602	117
2018	18-C-0023	WD	3,828,432	230
2019	19-C-0010	BS	9,614,193	720
	19-C-0056	BS	5,117,947	498

WD = Wetland Development
BS = Bank Stabilization

Estimated 18,313 Acres Created



Note. From www.mvn.usace.army.mil/About/Offices/Operations/Beneficial-Use-of-Dredged-Material/. pg. 2. (n.d.)

Based on the research that has been done for this paper, the majority of the sixty-eight square miles was done prior to the actual movement to the 50 feet draft requirement. With this increase, the benefits are becoming more evident in the areas surrounding our lower river region. The picture below (figure 18) was taken in 2018. The left side of the picture shows the river in 1985 in which the deterioration is astonishing. The right side is from 2018 and shows a

significant amount of new land formations. With the new plan of dredging to 50 feet as well as a concerted effort to use the spoils from the dredging, this will hopefully lead to a considerably larger number of acres created than was referenced by USACE.

Figure 18. LMR New Wetlands Created

Note. From https://westerndredging.org/phocadownload/2018_Norfolk/Big%20River%20Coalition.pdf (n.d.)

Pictures tell a thousand stories and the above picture certainly does that well. Statistics also tell stories and shed further light where pictures cannot. This is evident from the graph below (see figure 19). As it clearly shows, the growth of new land from 2009-2020 was significant in several areas.

Figure 19. Largest Wetlands Restoration Projects in the World

LARGEST WETLANDS RESTORATION PROJECT IN THE WORLD

FISCAL YEAR	SWP CUTTERHEAD MCY	SWP BU ACRES	HDDA MCY	HDDA BU ACRES	TOTAL SWP CUTTERHEAD + HDDA MCY	TOTAL SWP and HDDA ACREAGE
2009	2.9	100	0	0	2.9	100
2010	3.2	67	6.8	403	10.0	470
2011	3.6	200	1.5	60	5.1	260
2012	5.7	615	0.8	0	6.5	615
2013	5.7	773	7.2	644	12.9	1,417
2014	8.0	572	0	0	8.0	572
2015	11.3	364	9.7	677	21.0	1,041
2016	8.5	973	0	0	8.5	973
2017	12.2	1064	8.5	404	20.7	1,468
2018	6.7	347	4.9	378	11.6	725
2019	14.7	1,218	9.5	506	24.2	1,724
2020	11.5	1,000*	3.9	300*	15.4	1,300*
TOTALS:	94.0	7,293*	52.80	3,372*	146.80	10,665*

Note. From "Largest Wetlands Restoration Project in the World." *Louisiana Maritime,* https://online.louisianamaritime.org/Files/publicFileStore/Dredging/2%20USACE%20Beneficial%20Use%20Table%20UnConfirmed%20for%20FY%202021.pdf.

Negatives of Dredging

Of course, there can be and are negatives to dredging. Many environmentalists argue that pulling the dredge spoils from the bottom of the river and using them to build land can introduce foreign materials into our delicate ecosystem. This can lead to issues with not only the new land produced but could possibly prove harmful to the wildlife that inhabit our shorelines. "A review of impacts of marine dredging activities on marine mammals" highlights this when the author tells us, "Dredging impacts marine organisms negatively through entrainment, habitat degradation, noise, remobilization of contaminants, sedimentation, and increases in suspended sediment concentrations" (Todd, Victoria L.G. et al.; (2014). Another point to make is that saltwater intrusion could cause issues if proper implementation does not occur. Of this, we are told, "But dredging has its downsides. ...saltwater intrusion caused by the deeper channel and by

relative sea level rise will likely result in a loss of more than 833 1/2 acres of the new wetlands over 50 years, based on loss rates for the area between 1932 and 2010" (Schleifstein, 2016). These are just two examples of potential problems with dredging the river. The pros certainly seem to outweigh the cons.

Conclusion

Dredging the LMR to 50 ft will be a monumental task. The Corps of Engineers will need to push beyond the norm regarding the dredging itself but also in relation to the reclamation of the silt. The politics at play will need to continue to swing in the direction of this plan and if this happens, the benefits will not be far behind. These benefits include the ability to load larger vessels to deeper drafts. The ability to load the typical/current loading and discharging vessels in the river to deeper drafts and avoid the negative impacts of reduced draft will likely have the biggest impact of all. Benefits also include better economies of scale for imports and exports alike. These increases can and will likely lead to additional infrastructure, business opportunities and regional growth. The economic benefits will not only benefit the local area but will also allow for better returns for locations considerably further inland. The reclamation of dredge spoils and the associated land production will also benefit the local areas and ultimately regional and national interests as well. It is clear that the benefits of this draft increase will be viewed much more as a positive than a negative. The data, research, interviews, and perceived benefits of this topic certainly support the need to continue the project without delay.

The research found here-in adds to the "need to dredge" discussion and shines a light on the entire process. It provides data on both the shipping side of the discussion as well as the new land building process. Finally, it offers the views of experts in the field who agree that it is a necessity for the industry and community.

Future research on the topic should include further details on the use of dredged materials from not only an environmental standpoint but also the standpoint of successes found on the new land build out. It should also dig deeper into supply chain drawbacks, offer solutions and the

impacts of the movements of products as a whole. Finally, it should review the economies of scale to verify that the funds being spent on the dredging have the proper return on investment.

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Appendix A. David Pereira Interview

What is the history of vessel drafting? How has it changed over the years? *For over a century draught surveys have been accepted as an accurate and convenient means of establishing the weight of bulk cargoes. They have been the basis for the preparation of bills of lading and assessing various charges and port fees. The basic principle upon which the draught survey methodology is based is over 2,200 years old tracing back to Archimedes' Law of Buoyancy. The application of this law of physics to ships was further refined by formulas developed by European naval architects in the nineteenth century. While this principle is the basis for the work of draught surveyors throughout the world, the procedures by which they are applied vary considerably from country to country and even from port to port. The United Nations Economic Commission for Europe (UNECE) was set up in 1947 by ECOSOC. It is one of five regional commissions of the United Nations. Under the auspices of the then UNECE Working Party on Coal, the Code of Uniform Standards and Procedures for the Performance of Draught Surveys of Coal Cargoes Code was elaborated by experts from major coal exporting and importing countries. (A company we bought in the 90's, Rees Marine, owner Gerry Rees, was one of these experts. He taught me a lot and was my primary mentor, not Tim.) The Code was completed in October 1991. The Code was adopted by the UNECE Working Party on Coal at its session in October 1991 (ENERGY/WP.1/2, paragraph 42) and endorsed by the UNECE Committee on Energy at its annual session in November 1991 (ECE/ENERGY/18, paragraph 23 (e)). It was agreed that the maintenance and application of the Code was to be monitored by the former ECE Meeting of Experts on Coal Trade, Statistics and Transport, in cooperation with other interested international organizations.*

This code remains in effect. The science of conducting these surveys and development of technology has over the last 40 years has improved accuracy

What tools does a surveyor use to perform the draft surveys? *Hydrometers for measuring specific gravity of ballast water and in place water that the ship is floating in is required for the desired accurate results of the survey. Steel measuring tapes are necessary for measuring depth of ballast water inside ships tanks and, when necessary, to measure freeboards are required. In today's world, laptops, tablets and software applications are commonly used for accurate and timely calculations*

What does the surveyor look for/inspect on the vessel to ensure the most accurate drafts? *Clearly labeled draft marks on the ship's hull are essential for reading accurate drafts. Ships tables which have been approved by a classification society are necessary to correct the drafts for the trim of the vessel. It is desirable to read drafts where the surveyor is standing at a level nearest to the surface of the water in order to reduce parallax.*

How does salinity impact the drafts of vessels? *The salinity and temperature of the water determine the specific gravity (density) of the water. Ship's hydrostatic tables are calibrated to the density of seawater, typically 1.025. Some ships built in Black Sea and other large inland seas can be up to 1.033*

How accurate are draft surveys? *Draft survey variations can vary up to 1 centimeter of immersion (40-60 tons) under good sea and weather conditions when conducted with strict adherence to the code*

How does weather and rough waters impact vessel draft surveys? *Weather conditions such as rain, snow and fog can make it difficult to read drafts. Choppy sea conditions and swell can*

affect the accuracy of drat surveys. Skilled mariners and surveyors typically have the seasoned eye that it takes to estimate the draft under these conditions.

What other external sources could have impact on the accuracy of draft surveys? *Strong current in river and estuarine ports where the under keel clearance to the seabed is a factor, a condition defined as "squat" can increase the ship to sit lower in the water than it would in other conditions thus creating an artificial draft. Again, experience, a seasoned eye, and good communication between ship's crew is essential to using the correct drafts for displacement calculation.*

Do you envision new tools that could make surveying easier or more accurate? *In my opinion, it is inevitable that technology will make the process better at some point. There is no electronic tool that is universally acceptable at this time that I know of. Lidar, scanners, and satellite technology may ultimately produce a very accurate way to read drafts more accurately.*

Are there any other pertinent questions/thoughts I should consider for vessel drafting? Please feel free to provide your thoughts as you see fit.

Even with the best technology and calibrated tools there will always be a margin of error. The best practice is to follow the code and don't take short cuts. Experience and training is essential. I once had a utility customer that you may know tell me that his calibrated scales were much better than surveyors that he had used in the past. My answer was – We calibrate our surveyors, the companies you've used in the past didn't.

(Pereira, David. email interview. September 15, 2021).

Appendix B. Tommy Bradley Interview

Could you provide a brief description of your company and your role within LAMA?

I am Vice President of Operations at Biehl & Co, the oldest Steamship Agency in the United States of America. At Biehl we handle 4000 vessels per year throughout the Gulf and East Coast ports. I am on the Executive Board of Louisiana Maritime Association, I have also held positions of Chairman, Vice Chairman, and Treasurer.

What customers/terminals do you envision the deepening draft impacting the most? *I really seeing the deepening of the river affecting the bulk cargo market the most, both import and export. I also see it affecting the container market if a deal could be struck with a new container port in St Bernard. Air draft will be an issue with Post Panamax Container vessels getting under the GNO bridge*

What is the largest vessel that can be loaded in the river? *I would think that we would see more Capesize vessels in general and not just baby Capes. In some rare cases you could see Very Large Crude Carriers (VLCC) going to some of the downriver refineries below the Sunshine bridge. Draft will remain an issue in Baton Rouge.*

Will the move to 50 feet allow shippers to ship more cargo in and out of the river? *Absolutely, a 50-foot draft will have major impacts on Coal & Petcoke markets. Our typical Mississippi river draft fluctuates during high river conditions, the deepening of the river will ensure that we keep at least 45 ft to 47 ft in silting situations*

Have you ever had an instance where you could not load to the desired tonnage rate due to fluctuations in the draft of the river? What happened? *Yes, this happens every year during high river conditions. All cargo contracts have a minimum and maximum amount of cargo*

contracted to be loaded. With large draft reductions it is common that minimum or below minimum tonnages are loaded. Typically, what happens is that both owner and charter agree to maximum amount basis current draft restrictions, this of course disrupts contracts, meaning that LOI's have to be issued.

Do you think terminals will consider adjusting infrastructure to load large vessels if the river does reach feet of draft? *Great question, but I would think that most terminals would not want to undertake such steps.*

Have you ever had or heard of a bad experience with a draft survey? *Of course, things happen, but this is rare, most times survey companies and vessel officer double and triple check making sure that figures are accurate.*

In your opinion, do you envision the fifty-foot draft mark having an impact on the river tonnage as a whole? *I do see it having a major impact. Bigger vessels will mean less vessels, therefore I see a big impact on limiting congesting in certain areas. In regard to tonnage, it will have an impact but not a significant impact.*

Any other thoughts/comments or ideas you might be able to suggest would be greatly appreciated. *I personally believe that the deepening will have a major impact on the Mississippi River, especially if it is done right. I would also hope that with deepening comes widening of the channel. I also would hope that a consistent dredge schedule be implemented, problem we have now is that we dredge when there is a problem, we need to dredge with preventive care in mind.* (Bradley, Tommy, email interview, September 15, 2021).

Appendix C. Sarah Fakhari Interview

Could you provide a brief description of your company and your role? *Cenex Harvest States grain facility General Manager*

What size vessels do you typically load? *Ocean barge (5-10%), Handy (30%-40%), Handymax (50% - 60%), Panamax (10%), Post Panamax (<5%)*

What is the largest vessel you can load? *Capesize*

Will the move to 50 feet allow you to ship more cargo? *Yes, with modifications to dock and concrete revetment. Depends on the vessel market.*

Have you ever had an instance where you could not load to the desired tonnage rate due to fluctuations in the draft of the river? What happened? *Yes, not due to dock depth, but due to SWP restrictions with shoaling*

Would your company consider adjusting infrastructure to load large vessels if the river does reach 50 feet of draft? *Yes, this needs to be considered for potential opportunities*

Have you ever had a bad experience with a draft survey? *There is nearly always a discrepancy on draft.*

In your opinion, do you envision the fifty-foot draft mark having an impact on grain shipments as a whole*? Yes, this would impact Yellow Corn and Soybean shipments, end destination needs to be considered, most product will go to deep port in Asia/Pacific*

Any other thoughts/comments or ideas you might be able to suggest would be greatly appreciated. *Curious to know how it will affect dredging in SWP, will we be able to maintain it, 47ft is difficult enough to maintain during high water events. The supply chain upriver will need to adjust as well, allowing for more barges and rail volume to transit to the Gulf.*

(Fakhari, Sarah, email interview, September 15, 2021).

Appendix D. Christian Zirelli Interview

Could you provide a brief description of your company and your role? *Christian Zerilli; my role in a nutshell: my title is chartering manager and I'm responsible for all our dry cargo chartering/trading activity for Europe, Baltic sea and Mediterranean markets. This means finding business for our own tonnage, risk management, booking forward cargo and COAs with various customers and new business development. I also look for arbitrage opportunities to take market cargo and book market tonnage to net a profit. To give you a brief introduction, we are MT Maritime Management USA. We are an owner & operator of dry bulk carriers as well as chemical and product tankers. We also have a ship management division which is responsible for the training / staffing of our owned tonnage as well providing crewing for third party vessels. Our larger liquid division, which was established in the late 1980s, owns and operates a fleet of 36 stainless steel chemical tankers & 6 product tankers. The Dry cargo division is known in the marketplace as Strategic Bulk Carriers (SBC), dry bulk operators in the handy to ultramax space. SBC was started in 1994 and has been on a steady growth path ever since, establishing ourselves as a reliable, customer focused freight provider with a truly entrepreneurial mindset. Our areas of focus include, but are not limited to: grains, salt, sulphur, petcoke, fertilizers, steels, wood pellets and various minerals. In addition to our operating activities, we have transitioned into the vessel owning space with the acquisition of fifteen handy size vessels, ranging between 33-40,000 DWT. Although completely controlled here in the U.S.A., these ships are operating around the world with a focus on the Atlantic and Mediterranean markets. You can find more on us here: https://mtmaritime.com/*

How does draft impact the freight rates of vessels? Meaning in the event you cannot load to your desired tonnage; how do you adjust your rate to compensate? *Just to establish some basic theory here- there are mainly two ways for a shipowner / operator to make money - take a voyage cargo or put your ship on time charter.*

*Voyage cargo- we entered an agreement with a charterer where they pay us basis tonnes loaded as ascertained typically (but not always) via draft survey. Formula is as follows - say the order is bss 30,000 +/- 10% in owner's option - our vessel can load the full quantity so 33,000 mt - we agree on a rate of $20.00/mt so $20.00 * 33,000 MT =$660,000 less any address commission (2.5-3.75% typical) & broker commission (1.25% typical) Now I could also put my vessel out on time charter- where someone will pay us for the use of our vessel - depending on the time charter- typically for a "single trip" or "1 tct" we get a gross rate - say $10,000 day over the agreed time period (something like 20-60 days depending on the underlying voyage cargo)*

Owners think in "time charter value per day" and voyage charterers think in $/mt. for voyage business the owner converts this $/mt number into something called a TCE or time charter equivalent figure so they can compare apples to apples. The reason for this is that an owner has x overhead costs per day or they are being judged basis an index or something like that and need to know how the business looks basis the market for their ship. on the other hand, you also have to see what the profit or loss is on an absolute basis- can have a business that shows nice t/c bss the market, but you lose too much money. So, when a ship owner prices out a freight rate- it is to work back to a certain TCE or profit level given the market.

So how does draft impact the freight rate of vessels? *it has a direct impact basis the amount of cargo that the vessel can intake determines the vessel's earning ability. In most cases, the more cargo you can load, the better return for the owner and the lower the freight rate for the charterer - there are some exceptions, but this is the general rule.*

In the event you cannot load to your desired tonnage, how do you adjust your rate to compensate? *in many cases you can't. it's the owner's risk on voyage cargo.*

Normally, the owner is to satisfy themselves to restrictions of any ports they may call, meaning it's up to them to contact an agent and understand what the draft might be before you fix the cargo. How you price yourself is largely depending on how aggressive you want to be to win the business or what your chances are of finding a vessel that works with the intake you require. for example, our delta design 39k dwt vessel that make up the backbone of our fleet can load a lot of cargo on a shallow draft, abt 38,500 mt DWCC on a ssw draft of 10.5 M SW, but they most likely more expensive , due to the fact they can take in more cargo and there might not be as many around in the market at a given time as say a 33,000 dwt ship that can load abt 31,500 mt of cargo on a draft of 10.2 m sw. One way, would be to price the cargo intake basis the lowest draft you think you might encounter, i.e. taking in the least amount of cargo, so you are conservative on making any restrictions - i.e. if you know the mean low water (mlw)draft of a port is 10M but there could be tides of up to 2m giving more draft, just price yourself (other to a certain t/c rate or profit/loss margin on what you expect to pay for a given vessel, based the 10m to be safe. this is not always the best, as others may know the port better and know they can get more cargo on or that the tides are regular and calculate basis mlw draft + any tides and give a lower freight rate since they think they can load more cargo. there are limits for this both ways and it becomes an art, as if you price basis to small a quantity you will likely not win the business or if your

price thinking a larger vessel - they tend to have deeper drafts and tend to be more expensive - in both hire rate and in fuel consumption - so the sweat spot is generally somewhere in the middle.

Another way to get around the issue of draft / cargo intake is to give a rate on a lumpsum basis - this is done regularly in the scrap trade for example where, the stowage factor on the cargo changes and which could be either good or bad for both the owner or charterer. owner knows they will be getting x payment for the voyage so their downside is hedged and if the charterer can get more cargo on, they might be getting a break on the rate (depending on the profit/tce the lumpsum rate is based on) There is also the issue of dead freight, so if the charter's get a draft of x amount, and the vessel shows up and calls for cargo bss this draft but it is unable to load, it could claim the charterers, but is more unlikely these days as in most cases the draft is on the owners acct.

When draft changes unexpectedly (as it often does in the river) how do you recoup costs or pass along losses? *In dry cargo, in most cases, this risk is for the owners acct. For example when loading in the river plate of Argentina ports like San Nicolas or San Lorenzo, where the draft is highly impacted by rain fall, it helps to have an idea of what the avg drafts are what the weather is like and price according to what you think you could stand to lose / achieve basis the scenarios outlined above. in the case of the river plate- the max draft is 10.5 m fresh water/brackish water - the channel entrance- so really you are trying to figure out what your downside is if the draft falls, since you know the upside is capped. this could be different in other areas, say Houston or miss river where with dredging you might not restrictions such as beam or LOA so having more draft could let you move up in vessel size from an ultramax- 60k dwt to maybe even a baby cape 90k dwt. If the market is really in the owner's favor- perhaps you could*

agree on a guaranteed minimum draft- where if the draft drops below this, the owners can claim dead freight on the reduced intake quantity.

In the event you do not have a vessel in the general vicinity of a potential lifting terminal, how is costing handled with regard to the empty leg of the shipment? *in dry cargo- if you don't have owned tonnage around to make a lifting, you will have to take tonnage out of the market, by finding a vessel that can make the given laycan and has the best cargo intake/speed & bunker consumption /cost (daily hire) matrix around - which should yield the best profit / smallest loss possible. If you don't do this, it will be considered non- performance and have a very bad impact on your company's reputation. Many charterers might not fix you again directly.*

In the case of missing a laycan with a ship you already own or have on hire, it will count as ballast leg cost to whatever business you fix next on the vessel and erode the profit/loss of the next voyage or time charter business (the distance steamed and the daily hire/overhead costs).

Is there a point where ballasting to another location just does not make sense? Is there a point when you will do it simply for relocation of the vessel? *Yes, you need look at the overall return on the business and different companies handle such costs differently, it also depends on the size of the vessel. For example. if you have a vessel open in west Africa, in many cases- depending on how firm the grain trade is in East Coast South America (ecsa) or alumina trade in north brazil, you will likely get a better return from business from these areas, so would make sense to ballast the vessel from wharf to make business there- but if there are a lot of vessels in the load port area or if the business is not paying well, it might be better for you to look at business from Morocco or a shorter ballast location or take lower paying business from w Africa that would reposition you in a loading market such as the USG. This works for handy and supra tonnage, for large tonnage like baby capes or panamaxes, you don't have as many cargo options*

and would likely have to ballast. For us at SBC, we would look for what action would yield the greatest overall return on the business.

How are the freight rates on the vessels calculated? I realize the market plays into this question… *it can get as complicated or as simple as one would like to make it- for complicated, you can look at it as a multi-factor calculus formula of bunker prices, commodity prices vessel prices, new building prices etc. (can give you more info on this if you would like have some papers on it at home), or simply - charter x is willing pay $21.25/mt to ship their wheat Liepaja, Latvia to Laffuteau, Haiti. and you don't see any business around, so you take it, and the return is what it is. Or.... You see this order for Baltic wheat to Haiti- the current time charter market is around $12,000 a day for a large handy from the continent (Europe) to USG from what you gather talking to brokers, market gossip and what you see printed in the Baltic indexes. It's a October cargo, so you make your allowances for bunkers (do you think they will go up or down) - risk (do you think Haiti is more risky to call as Houston or the risk is the same)- you think that it should pay $1,000 over what the index is- so you plug in your bunkers, what you expect your intake will be (are there draft issues, what is stow factor of the cargo) and work back to a price that will yield you a given TCE level of $13,000 or given profit over what you think it will cost to get a ship out of the market to do the trip. the terms - loading / discharging also play a factor as it determines how long the vessel is expected to stay in port. in purest sense its cargo quantity x rate = revenue less fuel, overhead, commission, hire cost = net return; net return / number days of trip = Time Charter Equivalent*

Dry cargo shipping is basically a purely elastic market, meaning that there are many alternatives to my particular vessel out there, and other ships can do the same trade as yours and in practice pricing is largely dependent on this supply/demand activity.

What are your experiences with vessels that have loaded too much cargo in one port and are unable to either a) leave the port due to draft changes or b) cannot reach their destination port? *My experience with vessels that have overloaded is that it becomes a very serious and expensive issue. It really depends on where you are, where you are going and who the customer is (shippers/ receivers and charterers). Hopefully, if it happens, there are the means within the port to lighten the vessel to make the needed draft depending on the type of cargo this can be difficult. I've had situations where because of good relations with the customer the issue was resolved- the master was not paying attention- and the vessel loaded more than the contractual amt of cargo. -we almost had to lighten, but customer's traders were able to sell the additional cargo and the vessel proceeded without incident. If they were unable to sell the additional cargo, the cost of lighterage and any delays would likely be for the owners acct.*

In most situations, if the vessel could not lighten at the load port berth the vessel would need to go out to a different berth or out to anchorage and lighten into barges. and then proceed to berth either at the load port or discharge port. These costs and time would likely be for the owner's acct, as it is the master's responsibility to make sure the vessel is loaded to the correct draft.

I've also seen situations where a vessel loaded upriver in south America and the draft changed suddenly, and the vessel just had to sit for a month until the draft improved and she could get out. it becomes a pain as you need to hire divers to see if the vessel touched bottom and if there are any issues, damage, and have P&I club involved.

In the US- Oceanport in Delaware, touching bottom is a regular occurrence- there is a very small box to berth the vessel at the given draft and in most cases she will bottom - it tends to be soft mud so not a big issue, but still need to notify the coast guard, divers etc.

In your opinion, how does weather and rough seas impact draft surveys performed on vessels? *It can def have an impact- but I haven't really had big issues that I can think of with it.*

With all the new equipment and "smart" technology coming online, do you envision a time when draft surveys are a thing of the past or that vessels will be able to do their own depth soundings for port arrivals and departures? *In my opinion, I don't think draft surveys will become a thing of the past anytime soon, as they really are the most accepted and "impartial" way to determine the quantity loaded onboard the vessel since, both the owner and charterers are party to it. whenever you have one party taking action unilaterally you have the basis of commercial disagreement, so I can see charterers being ok with the figures from the vessel alone. also, in cases like grain, you have the b/l weight many times bss shore scale and owners need to run the draft survey as protection and the fact that it is carried out by a third party adds to its legitimacy in legal cases.*

Any other thoughts or comments you may want to add would be greatly appreciated.

If you have any questions on anything or if I did not explain myself well. pls let me know!

(Zirelli, Christian, email interview, September 15, 2021).

Appendix E. Sean Duffy Interview

What customers/terminals do you envision the deepening draft impacting the most? *The biggest impact will be seen in the dry bulk side of the business. Grain, fertilizer, coal and petroleum coke. The liquid, break bulk, passenger and container side will likely see limited impact at least initially.*

Will the move to 50 feet allow shippers to ship more cargo in and out of the river? *Yes, but I am not sure we will see it being loaded in capes. The deeper draft will likely lead to the ships we have seen loaded for the last few years simply being able to load to deeper drafts.*

Do you think terminals will consider adjusting infrastructure to load large vessels if the river does reach 50 feet of draft? *Yes, on the grain side. Most of the other dry bulk facilities can already handle the larger vessels. The grain side will likely adjust their infrastructure if the need to load the larger vessels becomes necessary and relevant.*

In your opinion, do you envision the fifty-foot draft mark having an impact on the river tonnage as a whole? *Yes. It will be gradual, but the economics should work in the favor of loading more tons out of the river.*

What percentage of dredge spoils is used to build new land? *Percentage on deepening is all related to the work below Venice, so I would estimate about 80% as a solid ballpark number. On the Crossings we have not been able to figure out how to do BU so none of that material will be used in fact it is a leaf blower project to blow the sediment downstream.*

How many acres have been built? *See Corps data listed below. (Largest Wetlands Restoration Project In The World).*

Is there a timeline/goal you could share? *I would say the phase of deepening below Venice would be done by late 2021 or early 2022. The next phase after the deepening below Venice, is not counted as a USACE phase since it must be done by the pipeline owners and the LADOTD. They are in initial phases of working on that, but the effort would need to be done from the southernmost identified pipelines up to clear the way as the USACE will dredge from the lower Crossings up. Deepening expected to be completed by 2024/2025 to the upper extent of the Port of BR, the pipelines are not counted in Phase 2,3, and 4 that is all broken down until a number of crossings going up.*

Any environmental concerns? *No environmental concerns, in fact multiple environmental benefits because without the BU these areas of the lower river would be part of the Gulf.*

Any idea when the discussion to dredge to 50 feet began? *August 25, 2012 the day after I got the Memorandum from the Institute of Water Resources. They talked of 55 feet for years but there were way too many problems*.

Do you envision the change in administration having an impact? *Administration change could have impact, hard to say, Congress is key too, Republican majority in the Senate would be helpful but I hope this cat is out the bag.*

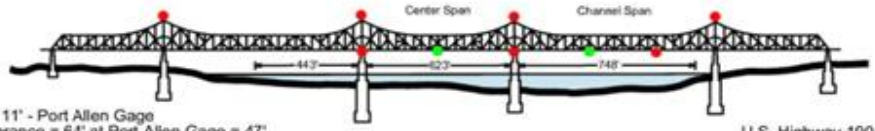
Any other thoughts/comments or ideas you might be able to suggest would be greatly appreciated. *This will be a very good thing for the LMR and the shippers and companies who do business in the area.*

(Duffy, Sean, verbal interview, September 15, 2021).

Appendix F. Bridge Details of the LMR

Louisiana
West Bank

Louisiana
East Bank



Channel Span
Vertical Clearance = 111' - Port Allen Gage
Minimum Vertical Clearance = 64' at Port Allen Gage = 47'

Center Span
Vertical Clearance = 111' - Port Allen Gage
Minimum Vertical Clearance = 64' at Port Allen Gage = 47'

U.S. Highway 190 and Railroad Bridge
Baton Rouge, LA
Lower Mississippi River
Mile 233.9 AHP
Clearance Data

NOT TO SCALE
VIEW LOOKING UPRIVER

Louisiana
West Bank

Louisiana
East Bank

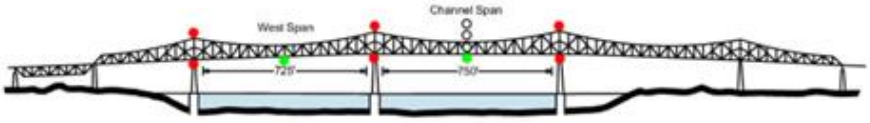
Channel Span - Center 500'
Vertical Clearance = 174' - Port Allen Gage
Minimum Vertical Clearance = 127' at Port Allen Gage = 47'

I-10 Highway Bridge
Baton Rouge, LA
Lower Mississippi River
Mile 229.3 AHP
Clearance Data

NOT TO SCALE
VIEW LOOKING UPRIVER

Louisiana
West Bank

Louisiana
East Bank



Channel Span
Vertical Clearance = 171' - Donaldsonville Gage
Minimum Vertical Clearance = 135' at Donaldsonville Gage = 36'

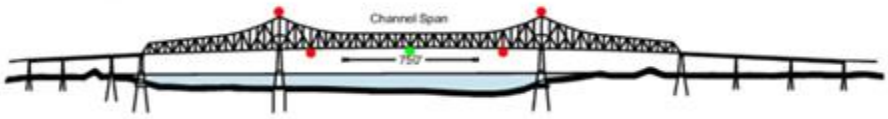
West Span
Vertical Clearance = 147' - Donaldsonville Gage
Minimum vertical Clearance = 111' at Donaldsonville Gage = 36'

LA State Highway 70 - Sunshine Bridge
Burnside, LA
Lower Mississippi River
Mile 16.4 AHP
Clearance Data

NOT TO SCALE
VIEW LOOKING UPRIVER

Louisiana
West Bank

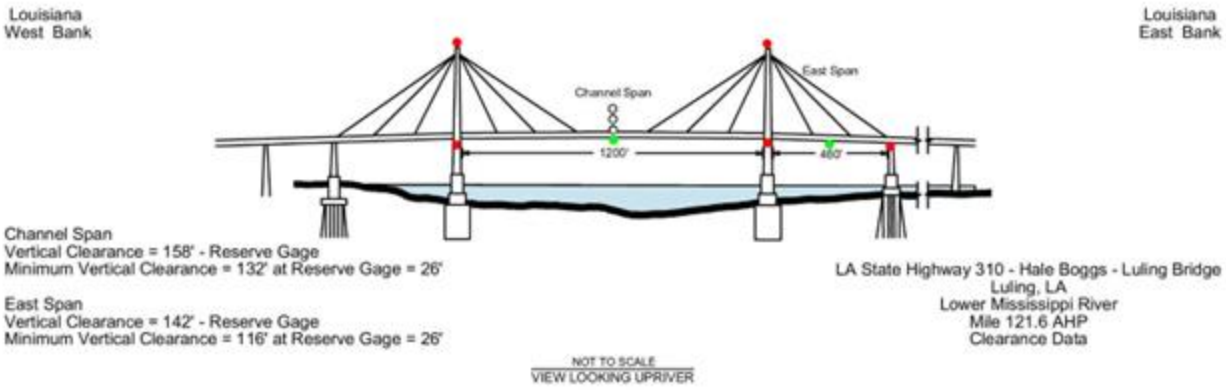
Louisiana
East Bank

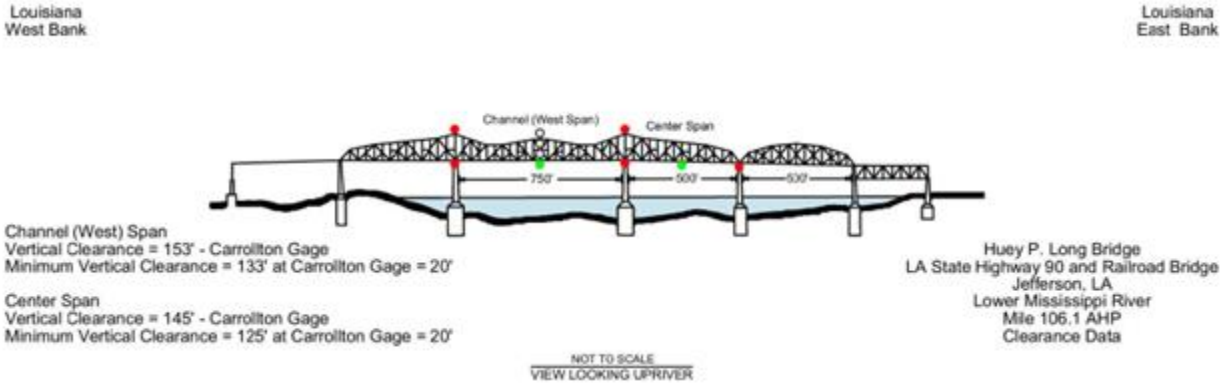


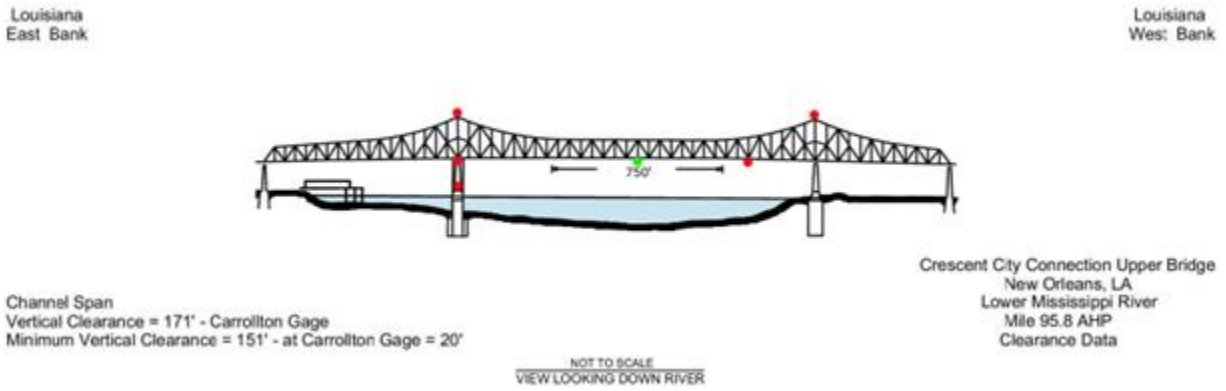
Channel Span - Center 750'
Vertical Clearance = 164' - Reserve Gage
Minimum Vertical Clearance = 138' at Reserve Gage = 26'

LA State Highway 3213 - Gramercy Bridge
Gramercy, LA
Lower Mississippi River
Mile 145.9 AHP
Clearance Data

NOT TO SCALE
VIEW LOOKING UPRIVER







2015 flood control and navigation maps, Mississippi River, Cairo, Illinois to the Gulf of Mexico, mile 953 A.H.P. to mile 22 B.H.P.
(https://usace.contentdm.oclc.org/digital/collection/p16021coll10/id/10939/)

Vita

The author has worked in multiple logistics roles throughout his 29-year career. He has been in his current position with Biehl Agency/Biehl Logistics for four years. His start in logistics began in the United States Air Force in 1992. He spent three years on active duty and six years in the Louisiana Air National Guard. After leaving active duty, he finished his degree at Southeastern Louisiana University.

After graduation from Southeastern, he began his career in marine transportation working for New Orleans-based barge line, National Marine, Inc. From there, he worked for MG Transport barge line as their Director of Sales. His next stop was at Electro-Coal Transfer (now known as United Bulk Terminals Davant) in 2001. He was responsible for the sales of Marquard & Bahls' bulk handling business unit - United Bulk Terminals - domestically and abroad. Finally, he landed at Biehl and Co in February of 2017. He is a current board member for The Coal Institute and a former member of the Mississippi Valley Trade and Transport Council Board of Directors, as well as the American Coal Council and is involved in several other industry organizations.

Achieving his goal of a master's degree has been on the calendar for well over twenty years. He will achieve this goal by receiving his Masters of Transportation degree through the University of New Orleans' MST program.

The author resides with his wife in Estelle, Louisiana. His sons are both cadets at the United States Air Force Academy.