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Vicksburg District Mat Sinking Unit

Mat Sinking Unit Supply Study

Mississippi River Revetment

Julie A. Hicks, Laurin I. Yates, and Jackie S. Pettway

September 2021

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Prepared for USACE, Vicksburg District
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Under MIPR W807PM91017173

Abstract

The Mississippi Valley Division (MVD) has maintained the Mississippi River banks for over 80 years. The Mat Sinking Unit (MSU), built in 1946, was considered state-of-the-art at the time. This system is still in operation today and has placed over 1,000 miles of Articulated Concrete Mats along the Mississippi River from Head of Passes, LA, to Cairo, IL. A new MSU has been designed and is expected to be fully mission capable and operational by the 2023 season, which is expected to increase the productivity from 2,000 squares/day up to 8,000 squares/day with double shifts and optimal conditions.

This MSU supply study identifies and optimizes the supply chain logistics for increased production rates from the mat fields to the MSU. The production rates investigated for this effort are 2,000 squares/day, 4,000 squares/day, and 6,000 squares/day. RiskyProject® software, which utilizes a Monte Carlo method to determine a range of durations, manpower, and supplies based on logical sequencing is used for this study. The study identifies several potential supply and demand issues with the increased daily production rates. Distance to casting fields, number of barges, and square availability are the major issues to supply increased placement rates identified by this study.

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Preface

This study was conducted for the US Army Corps of Engineers, Vicksburg District, under MIPR W807PM91017173.

This work was performed by the Structural Mechanics Branch of the Geosciences and Structures Division of the US Army Engineer Research and Development Center (ERDC), Geotechnical and Structures Laboratory (ERDC-GSL) the Navigation Division of the ERDC Coastal and Hydraulics Laboratory (ERDC-CHL), and the Software Engineering and Informatics Division of the ERDC Information Technology Laboratory (ERDC-ITL).

At the time of publication of this report, Mr. Bradford A. Steed was Chief, Structural Mechanics Branch, and Mr. James L. Davis was Chief, Geosciences and Structures Division. The Deputy Director of ERDC-GSL was Mr. Charles W. Ertle II, and the Director was Mr. Bartley Durst. Mr. Chad Bounds was Chief, Harbors, Entrances, and Structures Branch. Ms. Ashley Frey was Chief, Navigation Division. The Deputy Director of ERDC-CHL was Mr. Keith Flowers, and the Director was Dr. Ty V. Wamsley. The Deputy Director of ERDC-ITL was Dr. Jackie S. Pettway, and the Director was Dr. David A. Horner.

COL Teresa A. Schlosser was the Commander of ERDC, and the Director was Dr. David W. Pittman.

1 Introduction

1.1 Background

The Mississippi Valley Division (MVD) has been maintaining the Mississippi River banks for over 80 yr[1]. This is accomplished by armoring the riverbanks with a protective material. Early armoring consisted of willow fascine or lumber framework mattresses wired together to form a protected mat that was placed on a graded slope. A silt backfill and rock armoring held the mattresses in position (Figure 1–Figure 3). The invention of the Articulated Concrete Mat (ACM) occurred in 1914 and was patented in 1916. The configuration of these mats and placement techniques were modified until the 1940s (Figure 4 and Figure 5). These mats provide channel stability and prevent cutting of new channels, breaching of levee systems, destruction of property, threatening of populations, interruption of navigation and commerce, disruption of agricultural interests, and endangerment of natural habitats. This allows for some control of the mighty Mississippi River. Figure 6 shows the changing Mississippi River from 1765 to present.

[1] For a full list of the spelled-out forms of the units of measure used in this document, please refer to *US Government Publishing Office Style Manual, 31st ed.* (Washington, DC: US Government Publishing Office 2016), 248-52, https://www.govinfo.gov/content/pkg/GPO-STYLEMANUAL-2016/pdf/GPO-STYLEMANUAL-2016.pdf.

Figure 1. Willow mats being constructed by weaving the material (courtesy of Vicksburg District [MVK]).

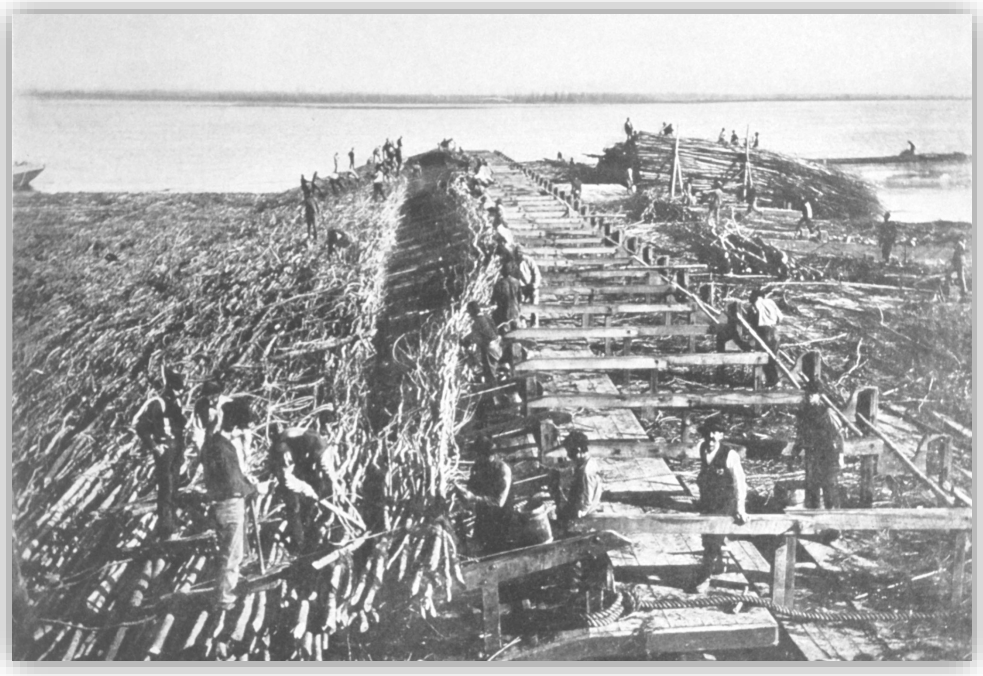


Figure 2. Willow mats being constructed by weaving the material (courtesy of MVK).

Figure 3. Wood and stone material used for bank protection in 1939 (courtesy of Memphis District [MVM]).

Figure 4. Concrete slabs placed along the bank (courtesy of MVK).

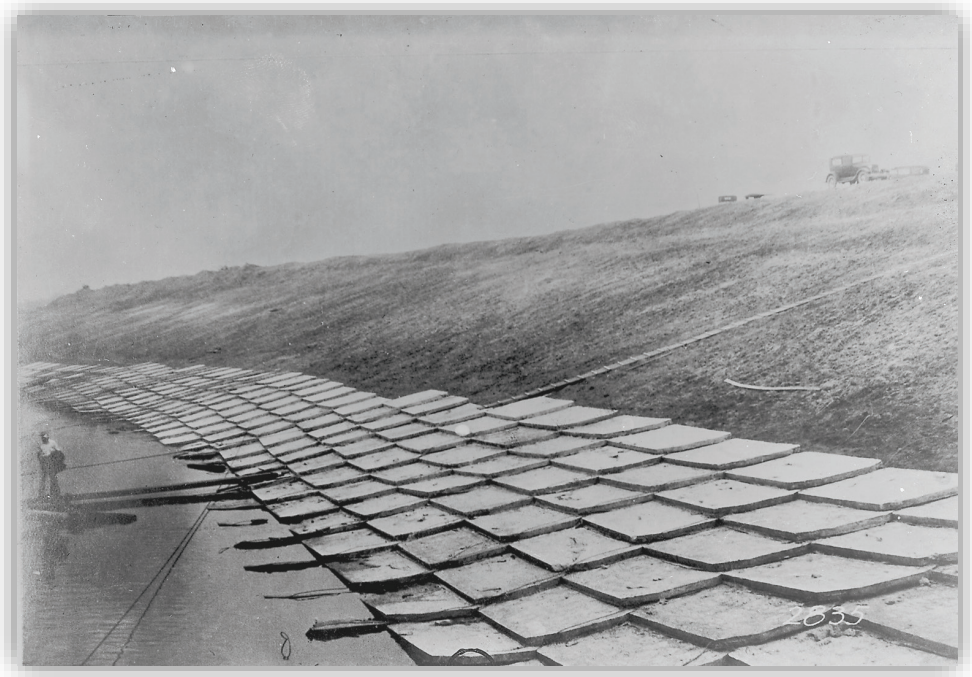
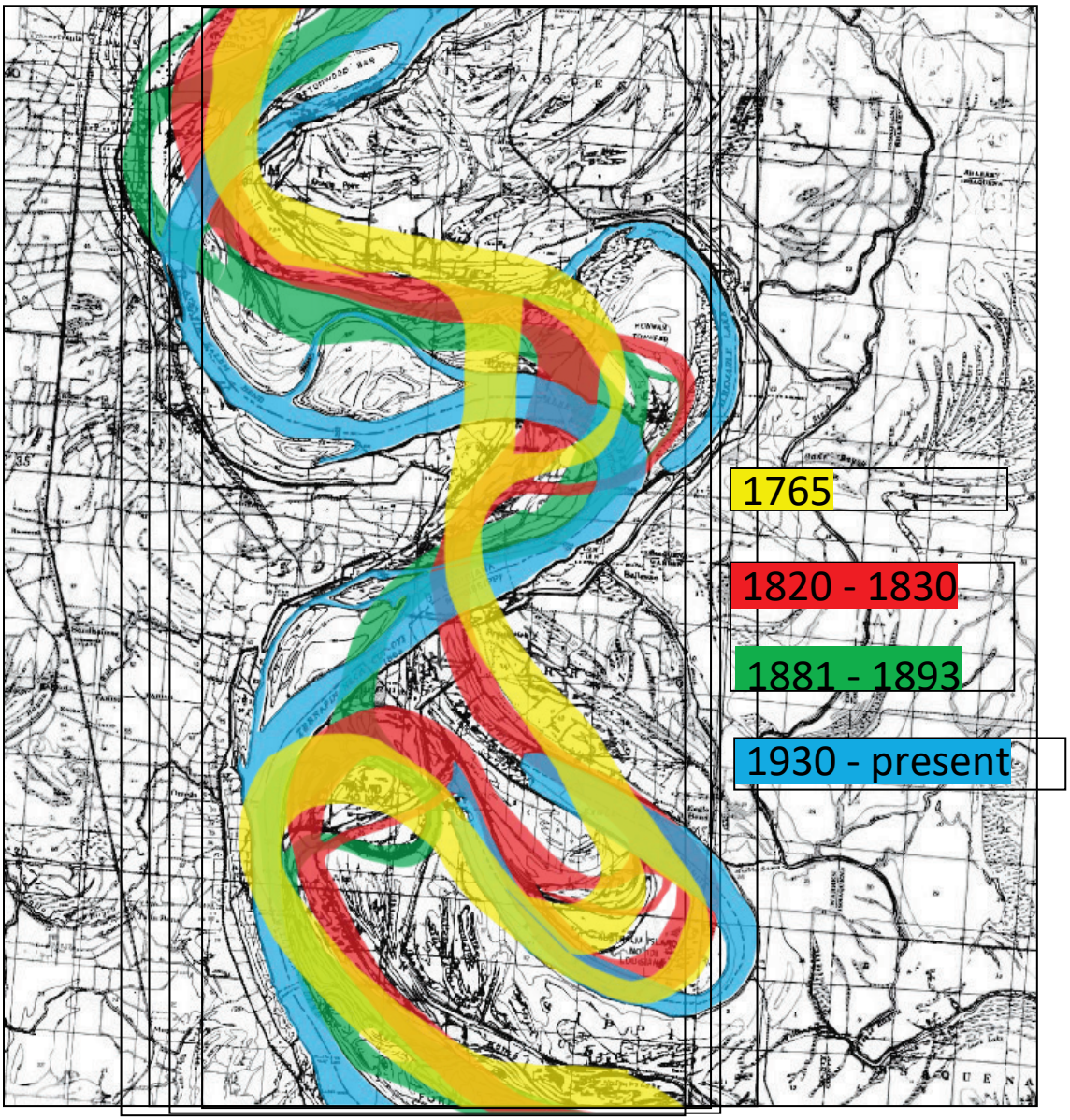


Figure 5. Personnel assist with placement of concrete slabs (courtesy of MVK).

Figure 6. Mississippi River course changes.



As the techniques for assembling and placing the ACM were fully developed, design began for a vessel that could be used to place the mats from the river. The Mat Sinking Unit (MSU) was built in 1946 and was considered state-of-the-art at the time. This system is still in operation today and has placed over 1,000 mi of ACM along the Mississippi River from Head of Passes, LA, to Cairo, IL (Figure 7). The operation of the MSU requires approximately 325 personnel and unique equipment such as the tying tools used to connect the ACM into the mattresses. The MSU has a mission to lay concrete mats, which form a protective overcoat to shield the riverbank from erosion and sloughing caused by channel currents and

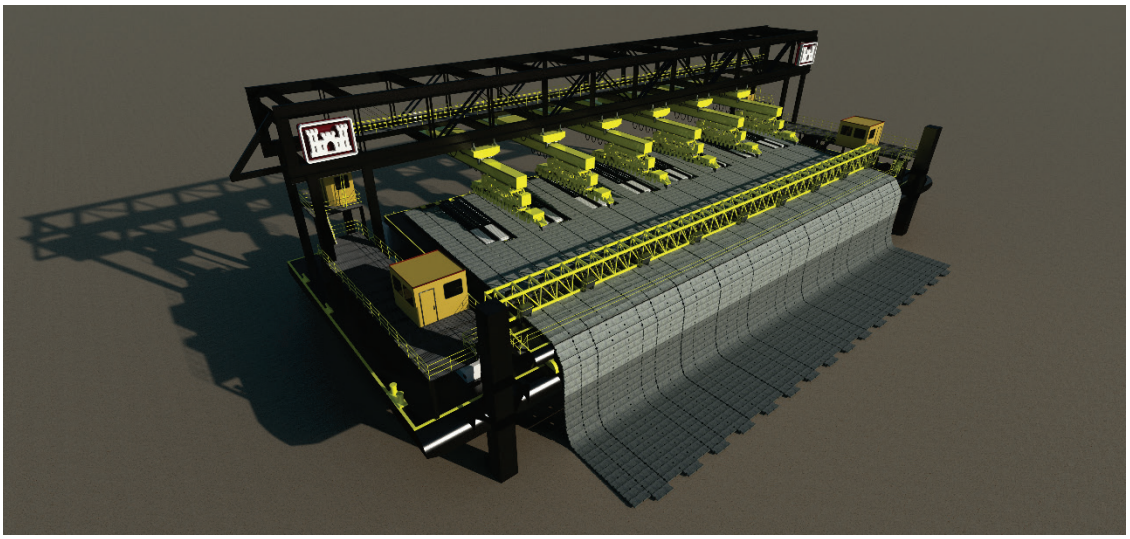
turbulent water associated with river flood stages (Figure 8 and Figure 9). However, there are issues with safety, labor intensity, and reliability. Though this system is still utilized today, there are designs underway to develop an updated system including automation where appropriate to improve productivity and safety. A new MSU is in the fourth and final stage of design and is expected to be fully mission capable and operational by the 2023 season (Figure 10). The goal is to automate much of the work through robotics, thereby improving safety and increasing the productivity from 2,000 squares/day (on production days) to a minimum of 4,000 squares/day and possibly as high as 8,000 squares/day with double shifts and optimal conditions.

Figure 7. MSU area of responsibility (AOR) along the Mississippi River.

Figure 8. View of the current MSU from landside prior to anchoring of mats for placement.

Figure 9. Workers tying mats during placement.

Figure 10. Graphic of new MSU (ARMOR 1) courtesy of MVK.



1.2 Purpose

The purpose of this MSU Resource Assessment study is to identify and optimize the logistics of increased production rates from the mat fields to the MSU, factoring various scenarios and variables. The production rates investigated for this effort are 2,000 squares/day, 4,000 squares/day, and 6,000 squares/day.

1.3 Objective

The objective of this study is to provide the MVK with an estimate of the potential demand within the supply chain of squares to the new ARMOR 1 mat sinking unit. The system consists of a support fleet for movement of concrete squares to include barges and tows, mechanisms including cranes for loading and offloading the squares, fleet positioning requirements, and unexpected downtime. Some possible bottlenecks or drivers include, but are not limited to, manpower requirements, mobilization requirements, operational equipment, dependability and resilience of system materials, training requirements, storage requirements (including distance from stored location and equipment needed to move them), inclement weather, and maintenance and replacement tasks. Productivity limitations with recommendations for required resources are provided in this report.

1.4 Approach

1.4.1 Data collection and information

In April 2019, personnel from the US Army Engineer Research and Development Center (ERDC) held a kick-off meeting with MVK team members to discuss the MSU process. The current MSU was constructed in 1948. There currently are issues with safety, labor intensity, and reliability. The new MSU is in the fourth and final stage of design and expected to be fully mission capable and operational by the 2023 season. Robotics will automate much of the work, thereby reducing the needed labor force and increasing the productivity from 2,000 squares/day (on production days) to a minimum of 4,000 squares/day and possibly as high as 6,000 squares/day with double shifts and optimal conditions. As the new MSU comes online, there will be increased requirements on the supply logistics of the revetment process that must be analyzed. The meeting provided an opportunity for expert elicitation to gain understanding of any potential bottlenecks to the current process and identify potential pinch points as daily production is increased. An initial list of steps in the supply processes and potential risk drivers was developed by ERDC and provided to the MVK for comment. Over the following several months, historical data including revetment schedules from previous seasons and boat orders, as well as additional expert elicitations including discussion with boat captains were collected. A site visit to the MSU was requested and tentatively scheduled.

Due to river conditions, the site visit to the MSU to observe operations could not occur until 23 October 2019. Four ERDC team members traveled to Bougere in Louisiana to observe operations and conduct additional expert elicitation. Figure 11 through Figure 15 show operations observed during the site visit.

Figure 11. Vessel moving loaded stack barge to MSU.

Figure 12. Dozer landside anchoring ACMs.

Figure 13. Supply stack barge for MSU operations.

Figure 14. Operations on MSU for ACM placement.

Figure 15. ACM being offloaded from supply barge.

1.4.2 MSU operation descriptions

The process for river revetment with the MSU includes several components for success. Figure 16 provides a graphic of the MSU operation and components during ACM placement. The operation, including supply logistics, requires several vessels, barges, and ACM fields. Table 1 describes the components of the MSU operation, the capacities, and the functions. Figure 17 shows the Motor Vessel (MV) *William James* leaving the Port of Vicksburg with the MSU and support barges. There are five river vessels used to perform various tasks under the current conditions. US Army Corps of Engineers (USACE) vessels MV *Mississippi*, MV *Benyaurd*, MV *William James*, and MV *Harrison* are depicted in Figure 18, Figure 19, Figure 20, and Figure 21, respectively. There are currently 43 vessels utilized for ACM transport from the three current mat fields to supply squares for the MSU operations. These mat fields are located in Richardson Landing, TN; Delta, LA; and St. Francisville, LA.

Figure 16. Aerial view of the MSU operations during ACM placement.

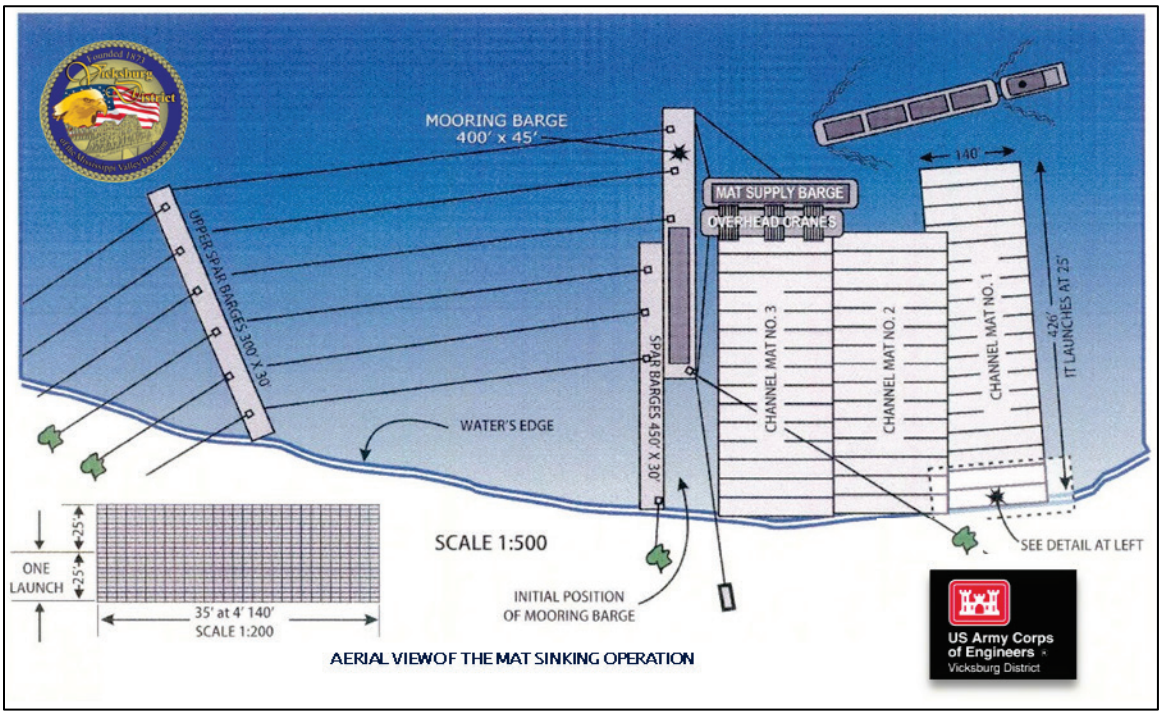


Table 1. MSU supply logistics support.

Component	Size/No.	Function
MV *Mississippi*	6,000 hp	Dedicated to moving stack barges to and from the MSU. The MV *Mississippi* is replaced by a contract vessel when not available such as during annual low water inspection trip.
MV *Benyaurd*	4,300 hp	Moves the quarter boat fleet but does help move stack loads if they can be dedicated to that task for a specific trip.
MV *William James*	3,300 hp	Dedicated to the MSU, typically.
MV *Harrison*	1,200 hp	Labor barge. When used to move stack barges, the max capacity is limited to four barges. Stays local with plant and shuttles stack barges between plant and local anchor fleet.
Mary Wepfer	1,400 hp	Contracted vessel primarily used for fleet tender
Anchor Barges	4	Holds barges in the current as an alternative to tying to trees. Allows barge anchorage closer to the plant. Fleet number: MVK = 2, MVM = 2.

Component	Size/No.	Function
Quarter Barges	1	Provided housing and other provisions for employees
Stack Barges	43	Barges for transporting squares. Each barge can hold 585 squares, which are stacked 113 high. Typical load operations is 3-4 per day with a maximum of 7. Loading unit shifts will often work weekends to keep up with production.
Richardson Landing, TN, casting field	1	Casts squares and loads barges for transport to MSU. Within the MVK AOR.
Delta, LA, casting field	1	Casts squares and loads barges for transport to MSU. Within Vicksburg District AOR.
St. Francisville, LA, casting field	1	Casts squares and loads barges for transport to MSU. Within New Orleans District AOR.

Figure 17. MV *William James* leaving Port of Vicksburg with the MSU and support barge.

Figure 18. MV *Mississippi*.

Figure 19. MV *Benyaurd*.

Figure 20. MV *William James.*

Figure 21. MV *Harrison.*

2 Methodology

A software package named RiskyProject® was used for the supply logistics analysis. This software package is an advanced project management software used for planning, scheduling, and determining how risks and uncertainties can impact project schedules or milestones. This software package was utilized in previous applications within USACE (Myrick et al. 2020).

2.1 Supply chain analysis

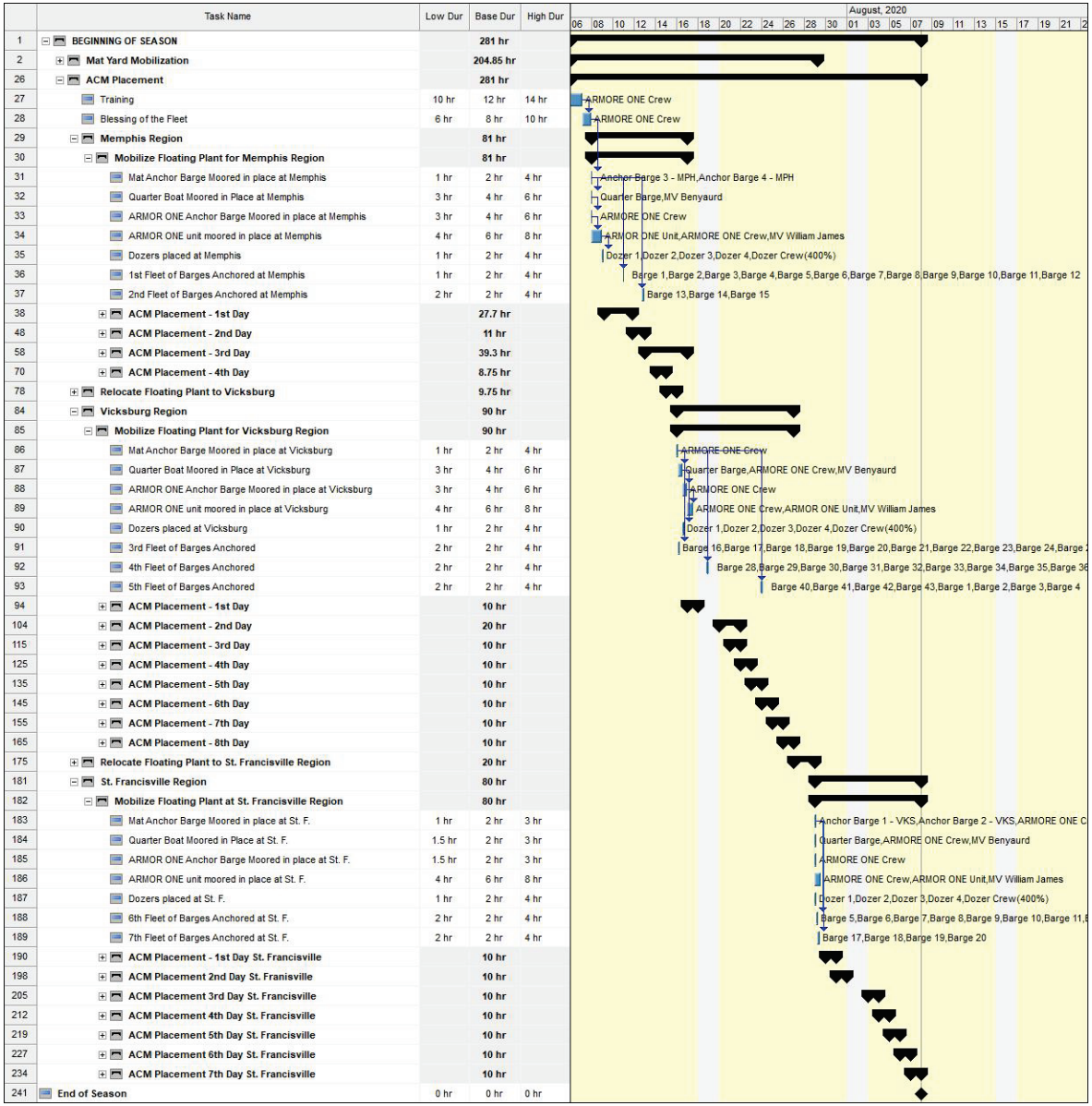
2.1.1 Inputs and assumptions

Analysis of historical revetment schedules and initial analysis of supply logistics resulted in the selection of three placement locations from the 2019 season farthest from the mat fields supplying the squares. Those locations are Gravolet, Rescue, and Lee Towhead. For the analysis, Gravolet was supplied by the St. Francisville mat yard, Rescue was supplied by the Delta, LA, mat yard, and Lee Towhead was supplied by the Richardson Landing mat yard. The total number of ACM placed per location was based on the actual ACM placement during the 2019 season. These three locations were used to develop a placement route to analyze the expected increase in productivity and were used as a baseline from the actual placement time to validate the initial models.

A base duration was established based on the actual time required to place the specified squares during the 2019 season at the three locations. Total squares placed at Gravolet, Rescue, and Lee Towhead during the 2019 season were 9,224; 18,694; and 8,663, respectively. The three placements were input into the model as a complete season to capture relocation of equipment and transfer of supply locations and equipment. The low and high duration is the time that it could plausibly take without any potential delays applied to the schedule and are based on experience and knowledge of the operation and environment. A reason for the low and high durations is to account for other factors that may affect the project, such as staff production levels, and an acknowledgement that the times are just estimates. These estimates are given with the understanding that future modifications to the operation or other factors not considered at this time could alter the supply logistics schedule and in turn increase probably of delays.

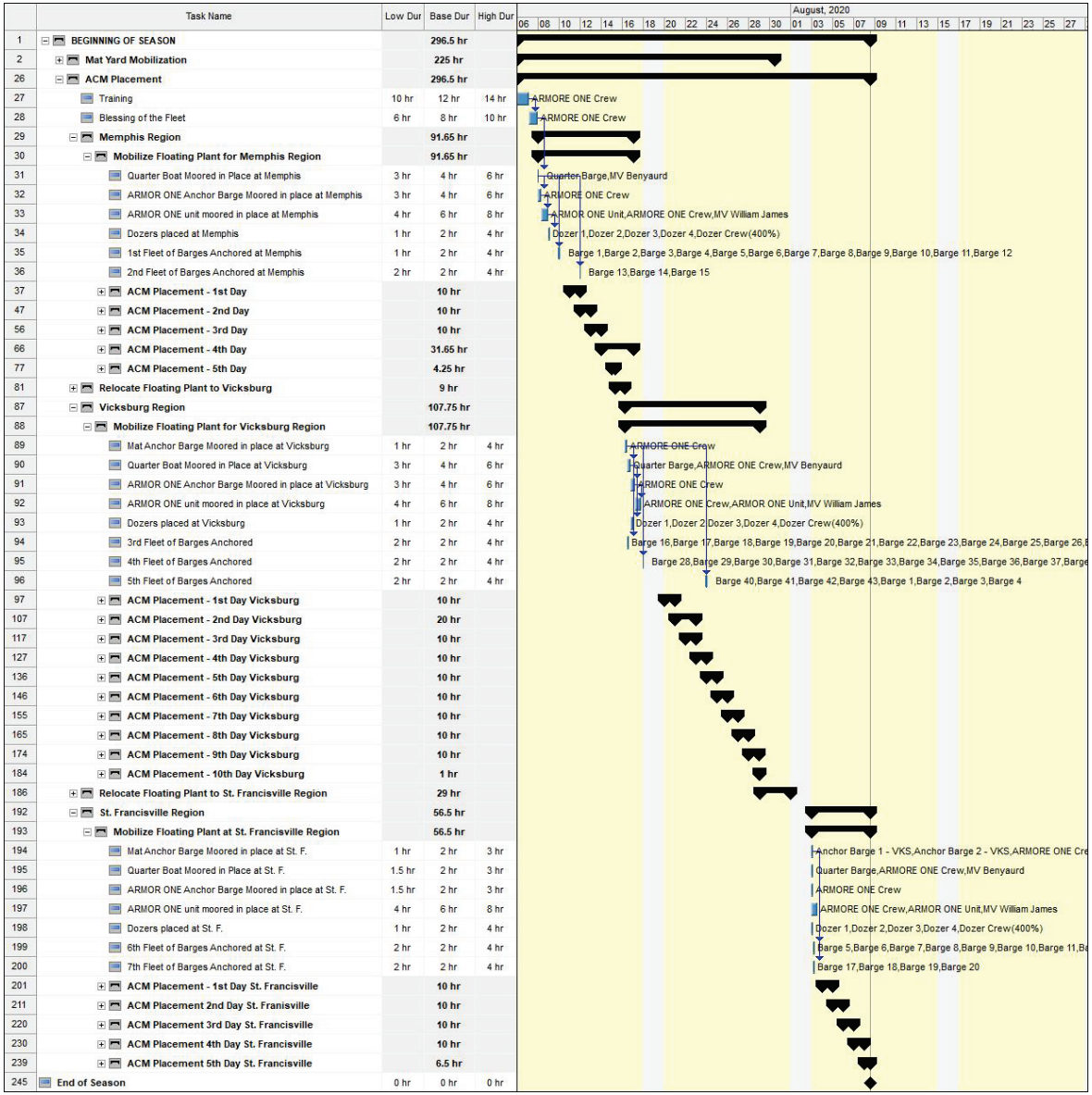
Figure 22 – Figure 25 show the high-level schedules for the season with placement in three locations. See Appendix A for full schedules showing all tasks and sub-tasks. The schedule shows the base duration as well as the low and high durations for the operations. Also included in the schedule are any applicable lag times. In addition to the three placement locations mentioned above, the analysis includes mobilization at the three mat yards, training, Blessing of the Fleet, and relocation between placement locations. The supply barges are captured in 12-barge tows for the analysis, and the empty barges are towed to the mat yards in 4-barge to 8-barge tows for reloading. The complete logistics process from loaded barges at the mat yards, to towing to the MSU operations, to breaking tows, moving loaded barges into place, and transporting empty barges back to the mat yards are analyzed.

Figure 22. Schedule of MSU operations for 2019 current schedule.



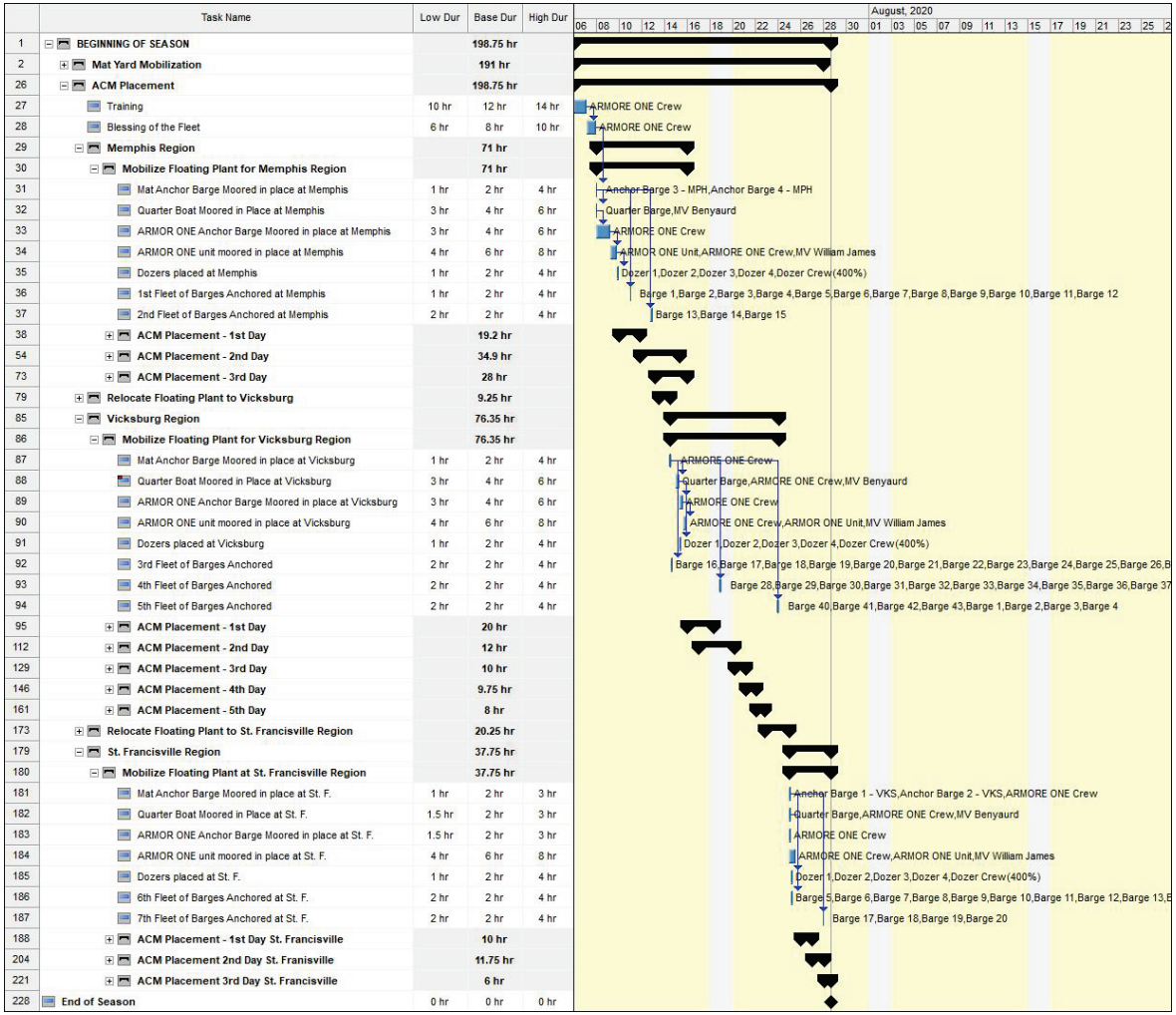
	Task Name	Low Dur	Base Dur	High Dur
1	BEGINNING OF SEASON		281 hr	
2	Mat Yard Mobilization		204.85 hr	
26	ACM Placement		281 hr	
27	Training	10 hr	12 hr	14 hr
28	Blessing of the Fleet	6 hr	8 hr	10 hr
29	Memphis Region		81 hr	
30	Mobilize Floating Plant for Memphis Region		81 hr	
31	Mat Anchor Barge Moored in place at Memphis	1 hr	2 hr	4 hr
32	Quarter Boat Moored in Place at Memphis	3 hr	4 hr	6 hr
33	ARMOR ONE Anchor Barge Moored in place at Memphis	3 hr	4 hr	6 hr
34	ARMOR ONE unit moored in place at Memphis	4 hr	6 hr	8 hr
35	Dozers placed at Memphis	1 hr	2 hr	4 hr
36	1st Fleet of Barges Anchored at Memphis	1 hr	2 hr	4 hr
37	2nd Fleet of Barges Anchored at Memphis	2 hr	2 hr	4 hr
38	ACM Placement - 1st Day		27.7 hr	
48	ACM Placement - 2nd Day		11 hr	
58	ACM Placement - 3rd Day		39.3 hr	
70	ACM Placement - 4th Day		8.75 hr	
78	Relocate Floating Plant to Vicksburg		9.75 hr	
84	Vicksburg Region		90 hr	
85	Mobilize Floating Plant for Vicksburg Region		90 hr	
86	Mat Anchor Barge Moored in place at Vicksburg	1 hr	2 hr	4 hr
87	Quarter Boat Moored in Place at Vicksburg	3 hr	4 hr	6 hr
88	ARMOR ONE Anchor Barge Moored in place at Vicksburg	3 hr	4 hr	6 hr
89	ARMOR ONE unit moored in place at Vicksburg	4 hr	6 hr	8 hr
90	Dozers placed at Vicksburg	1 hr	2 hr	4 hr
91	3rd Fleet of Barges Anchored	2 hr	2 hr	4 hr
92	4th Fleet of Barges Anchored	2 hr	2 hr	4 hr
93	5th Fleet of Barges Anchored	2 hr	2 hr	4 hr
94	ACM Placement - 1st Day		10 hr	
104	ACM Placement - 2nd Day		20 hr	
115	ACM Placement - 3rd Day		10 hr	
125	ACM Placement - 4th Day		10 hr	
135	ACM Placement - 5th Day		10 hr	
145	ACM Placement - 6th Day		10 hr	
155	ACM Placement - 7th Day		10 hr	
165	ACM Placement - 8th Day		10 hr	
175	Relocate Floating Plant to St. Francisville Region		20 hr	
181	St. Francisville Region		80 hr	
182	Mobilize Floating Plant at St. Francisville Region		80 hr	
183	Mat Anchor Barge Moored in place at St. F.	1 hr	2 hr	3 hr
184	Quarter Boat Moored in Place at St. F.	1.5 hr	2 hr	3 hr
185	ARMOR ONE Anchor Barge Moored in place at St. F.	1.5 hr	2 hr	3 hr
186	ARMOR ONE unit moored in place at St. F.	4 hr	6 hr	8 hr
187	Dozers placed at St. F.	1 hr	2 hr	4 hr
188	6th Fleet of Barges Anchored at St. F.	2 hr	2 hr	4 hr
189	7th Fleet of Barges Anchored at St. F.	2 hr	2 hr	4 hr
190	ACM Placement - 1st Day St. Francisville		10 hr	
198	ACM Placement 2nd Day St. Franisville		10 hr	
205	ACM Placement 3rd Day St. Francisville		10 hr	
212	ACM Placement 4th Day St. Francisville		10 hr	
219	ACM Placement 5th Day St. Francisville		10 hr	
227	ACM Placement 6th Day St. Francisville		10 hr	
234	ACM Placement 7th Day St. Francisville		10 hr	
241	End of Season	0 hr	0 hr	0 hr

Figure 23. Schedule of MSU operations for 2,000 squares/day.



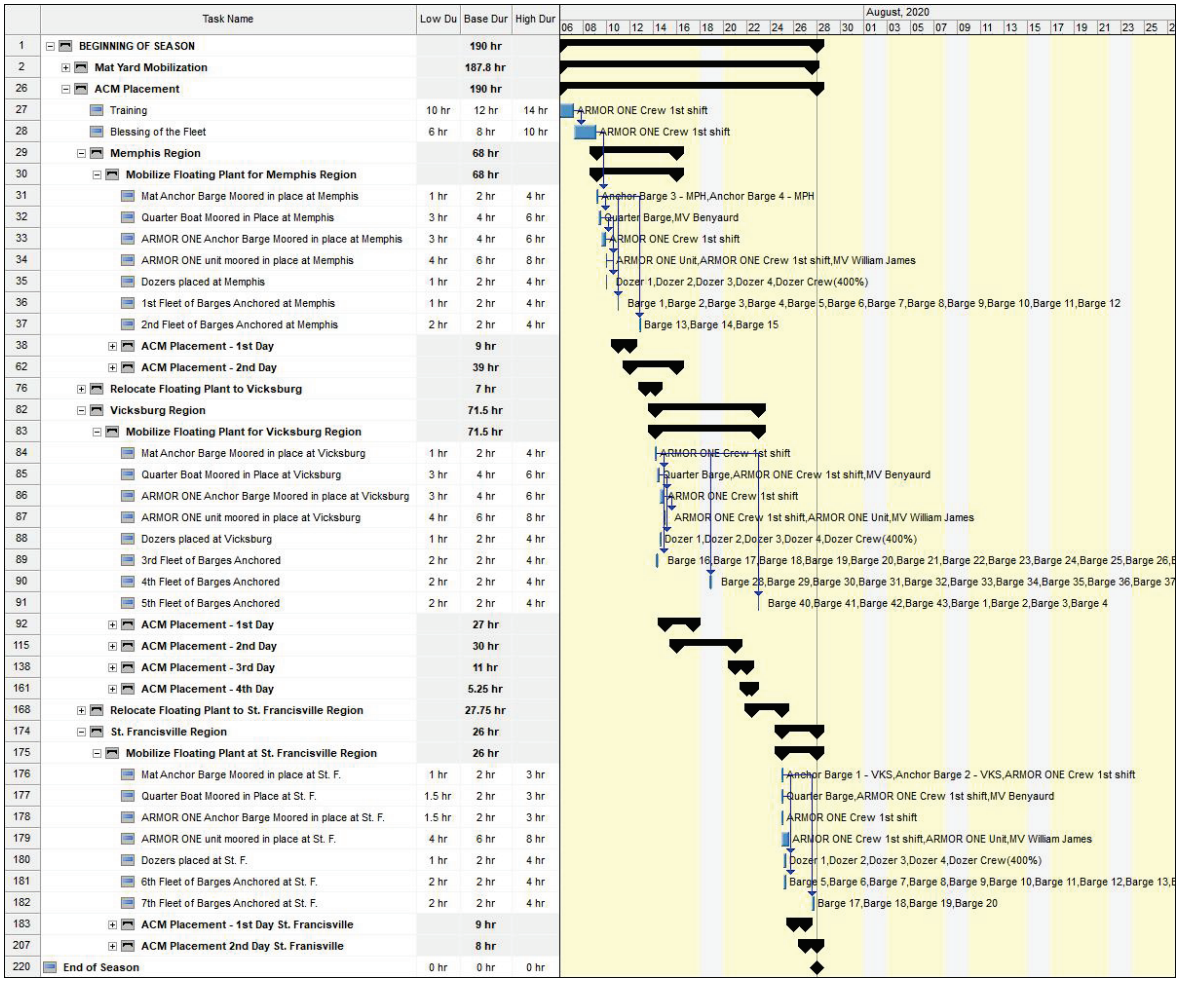
	Task Name	Low Dur	Base Dur	High Dur
1	BEGINNING OF SEASON		296.5 hr	
2	Mat Yard Mobilization		225 hr	
26	ACM Placement		296.5 hr	
27	Training	10 hr	12 hr	14 hr
28	Blessing of the Fleet	6 hr	8 hr	10 hr
29	Memphis Region		91.65 hr	
30	Mobilize Floating Plant for Memphis Region		91.65 hr	
31	Quarter Boat Moored in Place at Memphis	3 hr	4 hr	6 hr
32	ARMOR ONE Anchor Barge Moored in place at Memphis	3 hr	4 hr	6 hr
33	ARMOR ONE unit moored in place at Memphis	4 hr	6 hr	8 hr
34	Dozers placed at Memphis	1 hr	2 hr	4 hr
35	1st Fleet of Barges Anchored at Memphis	1 hr	2 hr	4 hr
36	2nd Fleet of Barges Anchored at Memphis	2 hr	2 hr	4 hr
37	ACM Placement - 1st Day		10 hr	
47	ACM Placement - 2nd Day		10 hr	
56	ACM Placement - 3rd Day		10 hr	
66	ACM Placement - 4th Day		31.65 hr	
77	ACM Placement - 5th Day		4.25 hr	
81	Relocate Floating Plant to Vicksburg		9 hr	
87	Vicksburg Region		107.75 hr	
88	Mobilize Floating Plant for Vicksburg Region		107.75 hr	
89	Mat Anchor Barge Moored in place at Vicksburg	1 hr	2 hr	4 hr
90	Quarter Boat Moored in Place at Vicksburg	3 hr	4 hr	6 hr
91	ARMOR ONE Anchor Barge Moored in place at Vicksburg	3 hr	4 hr	6 hr
92	ARMOR ONE unit moored in place at Vicksburg	4 hr	6 hr	8 hr
93	Dozers placed at Vicksburg	1 hr	2 hr	4 hr
94	3rd Fleet of Barges Anchored	2 hr	2 hr	4 hr
95	4th Fleet of Barges Anchored	2 hr	2 hr	4 hr
96	5th Fleet of Barges Anchored	2 hr	2 hr	4 hr
97	ACM Placement - 1st Day Vicksburg		10 hr	
107	ACM Placement - 2nd Day Vicksburg		20 hr	
117	ACM Placement - 3rd Day Vicksburg		10 hr	
127	ACM Placement - 4th Day Vicksburg		10 hr	
136	ACM Placement - 5th Day Vicksburg		10 hr	
146	ACM Placement - 6th Day Vicksburg		10 hr	
155	ACM Placement - 7th Day Vicksburg		10 hr	
165	ACM Placement - 8th Day Vicksburg		10 hr	
174	ACM Placement - 9th Day Vicksburg		10 hr	
184	ACM Placement - 10th Day Vicksburg		1 hr	
186	Relocate Floating Plant to St. Francisville Region		29 hr	
192	St. Francisville Region		56.5 hr	
193	Mobilize Floating Plant at St. Francisville Region		56.5 hr	
194	Mat Anchor Barge Moored in place at St. F.	1 hr	2 hr	3 hr
195	Quarter Boat Moored in Place at St. F.	1.5 hr	2 hr	3 hr
196	ARMOR ONE Anchor Barge Moored in place at St. F.	1.5 hr	2 hr	3 hr
197	ARMOR ONE unit moored in place at St. F.	4 hr	6 hr	8 hr
198	Dozers placed at St. F.	1 hr	2 hr	4 hr
199	6th Fleet of Barges Anchored at St. F.	2 hr	2 hr	4 hr
200	7th Fleet of Barges Anchored at St. F.	2 hr	2 hr	4 hr
201	ACM Placement - 1st Day St. Francisville		10 hr	
211	ACM Placement 2nd Day St. Franisville		10 hr	
220	ACM Placement 3rd Day St. Francisville		10 hr	
230	ACM Placement 4th Day St. Francisville		10 hr	
239	ACM Placement 5th Day St. Francisville		6.5 hr	
245	End of Season	0 hr	0 hr	0 hr

Figure 24. Schedule of MSU operations for 4,000 squares/day.



	Task Name	Low Dur	Base Dur	High Dur
1	BEGINNING OF SEASON		198.75 hr	
2	Mat Yard Mobilization		191 hr	
26	ACM Placement		198.75 hr	
27	Training	10 hr	12 hr	14 hr
28	Blessing of the Fleet	6 hr	8 hr	10 hr
29	Memphis Region		71 hr	
30	Mobilize Floating Plant for Memphis Region		71 hr	
31	Mat Anchor Barge Moored in place at Memphis	1 hr	2 hr	4 hr
32	Quarter Boat Moored in Place at Memphis	3 hr	4 hr	6 hr
33	ARMOR ONE Anchor Barge Moored in place at Memphis	3 hr	4 hr	6 hr
34	ARMOR ONE unit moored in place at Memphis	4 hr	6 hr	8 hr
35	Dozers placed at Memphis	1 hr	2 hr	4 hr
36	1st Fleet of Barges Anchored at Memphis	1 hr	2 hr	4 hr
37	2nd Fleet of Barges Anchored at Memphis	2 hr	2 hr	4 hr
38	ACM Placement - 1st Day		19.2 hr	
54	ACM Placement - 2nd Day		34.9 hr	
73	ACM Placement - 3rd Day		28 hr	
79	Relocate Floating Plant to Vicksburg		9.25 hr	
85	Vicksburg Region		76.35 hr	
86	Mobilize Floating Plant for Vicksburg Region		76.35 hr	
87	Mat Anchor Barge Moored in place at Vicksburg	1 hr	2 hr	4 hr
88	Quarter Boat Moored in Place at Vicksburg	3 hr	4 hr	6 hr
89	ARMOR ONE Anchor Barge Moored in place at Vicksburg	3 hr	4 hr	6 hr
90	ARMOR ONE unit moored in place at Vicksburg	4 hr	6 hr	8 hr
91	Dozers placed at Vicksburg	1 hr	2 hr	4 hr
92	3rd Fleet of Barges Anchored	2 hr	2 hr	4 hr
93	4th Fleet of Barges Anchored	2 hr	2 hr	4 hr
94	5th Fleet of Barges Anchored	2 hr	2 hr	4 hr
95	ACM Placement - 1st Day		20 hr	
112	ACM Placement - 2nd Day		12 hr	
129	ACM Placement - 3rd Day		10 hr	
146	ACM Placement - 4th Day		9.75 hr	
161	ACM Placement - 5th Day		8 hr	
173	Relocate Floating Plant to St. Francisville Region		20.25 hr	
179	St. Francisville Region		37.75 hr	
180	Mobilize Floating Plant at St. Francisville Region		37.75 hr	
181	Mat Anchor Barge Moored in place at St. F.	1 hr	2 hr	3 hr
182	Quarter Boat Moored in Place at St. F.	1.5 hr	2 hr	3 hr
183	ARMOR ONE Anchor Barge Moored in place at St. F.	1.5 hr	2 hr	3 hr
184	ARMOR ONE unit moored in place at St. F.	4 hr	6 hr	8 hr
185	Dozers placed at St. F.	1 hr	2 hr	4 hr
186	6th Fleet of Barges Anchored at St. F.	2 hr	2 hr	4 hr
187	7th Fleet of Barges Anchored at St. F.	2 hr	2 hr	4 hr
188	ACM Placement - 1st Day St. Francisville		10 hr	
204	ACM Placement 2nd Day St. Franisville		11.75 hr	
221	ACM Placement 3rd Day St. Francisville		6 hr	
228	End of Season	0 hr	0 hr	0 hr

Figure 25. Schedule of MSU operations for 6,000 squares per day.



	Task Name	Low Du	Base Dur	High Dur
1	**BEGINNING OF SEASON**		**190 hr**	
2	**Mat Yard Mobilization**		**187.8 hr**	
26	**ACM Placement**		**190 hr**	
27	Training	10 hr	12 hr	14 hr
28	Blessing of the Fleet	6 hr	8 hr	10 hr
29	**Memphis Region**		**68 hr**	
30	**Mobilize Floating Plant for Memphis Region**		**68 hr**	
31	Mat Anchor Barge Moored in place at Memphis	1 hr	2 hr	4 hr
32	Quarter Boat Moored in Place at Memphis	3 hr	4 hr	6 hr
33	ARMOR ONE Anchor Barge Moored in place at Memphis	3 hr	4 hr	6 hr
34	ARMOR ONE unit moored in place at Memphis	4 hr	6 hr	8 hr
35	Dozers placed at Memphis	1 hr	2 hr	4 hr
36	1st Fleet of Barges Anchored at Memphis	1 hr	2 hr	4 hr
37	2nd Fleet of Barges Anchored at Memphis	2 hr	2 hr	4 hr
38	**ACM Placement - 1st Day**		**9 hr**	
62	**ACM Placement - 2nd Day**		**39 hr**	
76	**Relocate Floating Plant to Vicksburg**		**7 hr**	
82	**Vicksburg Region**		**71.5 hr**	
83	**Mobilize Floating Plant for Vicksburg Region**		**71.5 hr**	
84	Mat Anchor Barge Moored in place at Vicksburg	1 hr	2 hr	4 hr
85	Quarter Boat Moored in Place at Vicksburg	3 hr	4 hr	6 hr
86	ARMOR ONE Anchor Barge Moored in place at Vicksburg	3 hr	4 hr	6 hr
87	ARMOR ONE unit moored in place at Vicksburg	4 hr	6 hr	8 hr
88	Dozers placed at Vicksburg	1 hr	2 hr	4 hr
89	3rd Fleet of Barges Anchored	2 hr	2 hr	4 hr
90	4th Fleet of Barges Anchored	2 hr	2 hr	4 hr
91	5th Fleet of Barges Anchored	2 hr	2 hr	4 hr
92	**ACM Placement - 1st Day**		**27 hr**	
115	**ACM Placement - 2nd Day**		**30 hr**	
138	**ACM Placement - 3rd Day**		**11 hr**	
161	**ACM Placement - 4th Day**		**5.25 hr**	
168	**Relocate Floating Plant to St. Francisville Region**		**27.75 hr**	
174	**St. Francisville Region**		**26 hr**	
175	**Mobilize Floating Plant at St. Francisville Region**		**26 hr**	
176	Mat Anchor Barge Moored in place at St. F.	1 hr	2 hr	3 hr
177	Quarter Boat Moored in Place at St. F.	1.5 hr	2 hr	3 hr
178	ARMOR ONE Anchor Barge Moored in place at St. F.	1.5 hr	2 hr	3 hr
179	ARMOR ONE unit moored in place at St. F.	4 hr	6 hr	8 hr
180	Dozers placed at St. F.	1 hr	2 hr	4 hr
181	6th Fleet of Barges Anchored at St. F.	2 hr	2 hr	4 hr
182	7th Fleet of Barges Anchored at St. F.	2 hr	2 hr	4 hr
183	**ACM Placement - 1st Day St. Francisville**		**9 hr**	
207	**ACM Placement 2nd Day St. Franisville**		**8 hr**	
220	**End of Season**	0 hr	0 hr	0 hr

As the schedules for each run are examined, it is apparent that there are tasks that cannot commence until previous tasks are complete or are at least partially complete. For example, placement in a location cannot begin until the equipment has been relocated to the placement areas. Lag time is the length of time after one event occurs before the second event occurs and is listed as either start-to-start or finish-to-finish.

2.1.2 Resources

Table 2 provides the resources being used in setting the schedules for the three placement location seasons. With the exception of the ARMOR 1 Crew, all resources are assumed to have 24 hr availability. The ARMOR 1 Crew assumes 10 hr shifts for current and 2,000 squares/day conditions and 12 hr shifts for 4,000 squares/day. For the 6,000 squares/day conditions, two 8 hr shifts are operated per day.

Table 2. List of resources used for scheduling.

Resource Name	Initials
ARMOR 1 Unit	A1
ARMOR 1 Crew (current, 2,000, and 4,000 squares/day)	A1C
ARMOR 1 Crew 1st Shift (6,000 squares/day)	A1C1
ARMOR 1 Crew 2nd Shift (6,000 squares/day)	A1C2
Anchor Barge 1 – Vicksburg (VKS)	AB1
Anchor Barge 2 – VKS	AB2
Anchor Barge 3 – Memphis (MPH)	AB3
Anchor Barge 4 – MPH	AB4
MV *Mississippi*	M
MV *Harrison*	MVH
MV *Benyaurd*	MVB
MV *William James*	MVWJ
Mary Wepfer	MW
Quarter Barge	QB
Barge 1	B1
Barge 2	B2
Barge 3	B3
Barge 4	B4

Resource Name	Initials
Barge 5	B5
Barge 6	B6
Barge 7	B7
Barge 8	B8
Barge 9	B9
Barge 10	B10
Barge 11	B11
Barge 12	B12
Barge 13	B13
Barge 14	B14
Barge 15	B15
Barge 16	B16
Barge 17	B17
Barge 18	B18
Barge 19	B19
Barge 20	B20
Barge 21	B21
Barge 22	B22
Barge 23	B23
Barge 24	B24
Barge 25	B25
Barge 26	B26
Barge 27	B27
Barge 28	B28
Barge 29	B29
Barge 30	B30
Barge 31	B31
Barge 32	B32
Barge 33	B33
Barge 34	B34
Barge 35	B35
Barge 36	B36
Barge 37	B37

Resource Name	Initials
Barge 38	B38
Barge 39	B39
Barge 40	B40
Barge 41	B41
Barge 42	B42
Barge 43	B43
Dozer 1	D1
Dozer 2	D2
Dozer 3	D3
Dozer 4	D4
Dozer Crew	D
Memphis Mat Yard Crew	MYCW
Mat Yard Crane	MYC
Delta Mat Yard Crew	DYC
St. Francisville Mat Yard Crew	SFC

2.1.3 Potential delay events to schedule

A potential delay, for purposes of this analysis, is any event that may cause delays in the mat sinking unit operations. A list of potential impacts to supply logistics was developed based on historical events and expert elicitation and are provided in Table 3. Probability of occurrence for each potential delay that would result in a minor delay, moderate delay, serious delay, and critical delay. The probability of no delay was then calculated by subtracting all possible delay percentages from 100% probability.

Table 4 provides the percent probabilities for minor, moderate, serious, critical, and no delays for each possible delay.

Table 3. Potential delay register.

Possible Delays to Schedule	Description	Cause	Trigger
Barge Wreck in Tow	Barge(s) separate from tow and sink.	Lashings loosed, commercial vehicle wreck, tow strikes bridge, etc.	
Commercial Wreck	A commercial vessel wrecks in the river in the tug tow zone, shutting down river traffic.	High current, other mishap/accident causing a commercial wreck not involving USACE MSU vessels.	
Ice in River Impeding Navigation	Ice causing hazards on river leading to slowdown/stopping of tow.	Cold weather in northern reach of river.	Winter weather
Ice on Boat Deck	Ice on boat decks causing hazardous operation for personnel	Low temperatures	Weather
Issue with Barge	Barge(s) become in operable.	Damage to barge(s) rendering it in operable until repair.	
Lightning	Sustained lightning in work area.	Thunderstorm, etc.	Inclement weather warning.
Low Fuel	Vessels low on fuel, necessitating delay		
Mats Not Available	Squares not available for loading onto barges.	Production down at square-pouring plant.	
Mechanical Problems at Yard	Problems with production/loading machinery at Mat yard.	Machinery malfunction	
Mechanical Problems with ARMOR 1	Problems with ARMOR 1 unit's machinery.	Malfunctioning engines, motors, etc.	Improper usage, maintenance, force of nature, etc.
Mechanical Problems with Tow Vessel	Problems with tow vessels machinery.	Malfunctioning engines, motors, etc.	Improper usage, maintenance, force of nature, etc.
Not Enough Employees	Not enough employees to successfully operate tows, ARMOR 1 unit, or other vessels.	Weather or other delay causing employees not to arrive on time, or insufficient crews available.	

Possible Delays to Schedule	Description	Cause	Trigger
Reduced Speeds on River	Coast Guard reduces river speeds.		Wrecks, water levels, currents, etc.
Riverbank Slope/Landscape Not Complete	Delays as a result of site prep.	Additional clearing and/or bank preparation needed.	Higher than expected water elevation or failed communication with clearing and snagging
River Currents/High Water Elevation	Major delays possible with requirement to construct healing points, toggling for swift current or remote parking for quarter boat fleet	Unanticipated rise in river stages, or decision to mitigate high water with additional construction.	Weather
River Impediments to Navigation			
River Low water Elevation	Water surface elevations less than Low Water Reference Plane (LWRP) +5 for revetment design.	Seasonal drought	Weather
River Navigation Shut Down	Coast Guard stops traffic on river.	Coast Guard stops traffic from moving on river for period of time.	Wrecks, water levels, currents, etc.
Unattended Barge	Barge comes loose from tow or anchorage and travels away from site, necessitating vessels to retrieve it and re-position it.	Loosed lashings, etc. causing barge to break away from tow/anchorage/etc.	
Wind			

Table 4. Percentage of probaility of occurrence.

Possible Delays to Schedule	Minor =< 1 hr Delay	Moderate =< 3 hr Delay	Serious =< 6 hr Delay	Critical > 6 hr Delay	No Delay (100% - All total % off all delays)
Barge Wreck in Tow	5%	2%	1%	1%	91.00%
Commercial Wreck	1%	1%	2%	10%	86%
Ice on Boat Deck	2%	1%	1%	5%	91%
Issue with Barge	10%	2%	1%	1%	86%
Lightning	5%	1%	1%		93%
Low Fuel	1%	1%	1%	1%	96%
Squares Not Available	1%	1%	1%	1%	96%
Mechanical Problems at Yard	5%	2%	2%	2%	89%
Mechanical Problems with ARMOR 1	5%	1%	1%	1%	92%
Mechanical Problems with Tow Vessel	5%	1%	1%	1%	92%
Not Enough Employees	10%	5%	5%	5%	75%
Riverbank Slope/Landscape Not Complete	5%	5%	2%	1%	87%
River Currents/High Water Elevation	20%	10%	5%	2%	63%
River Low Water Elevation	10%	5%	2%	2%	81%
River Navigation Shut Down	5%	1%	1%	1%	92%
Unattended Barge	2%	1%	1%	0%	97%
Wind	5%	1%	1%	1%	92%
Mission Priority Changes*				2%	98%

* The risk of a Mission Priority Change has the potential to stop work of all future tasks when the risk is applied to a schedule. Therefore, for the purpose of determining risks to suppling ACMs for placement, it will not be used in the analysis.

The outcome of that delay is input as a probability of occurrence and given a delay in minimum and maximum hours. For this study, multiple percentages were input with varying hours of delay ranging from a "minor" delay of less than 1 hr, a "moderate" delay of between 1 and 3 hr, a "serious" delay of between 3 and 6 hr, and a "critical" delay of more than 6 hr. A possible source of delay could have different outcomes applied to multiple tasks.

2.2 Program

Risky Project software was used to analyze the risk events on the deployment schedule.

2.2.1 Potential delay impact

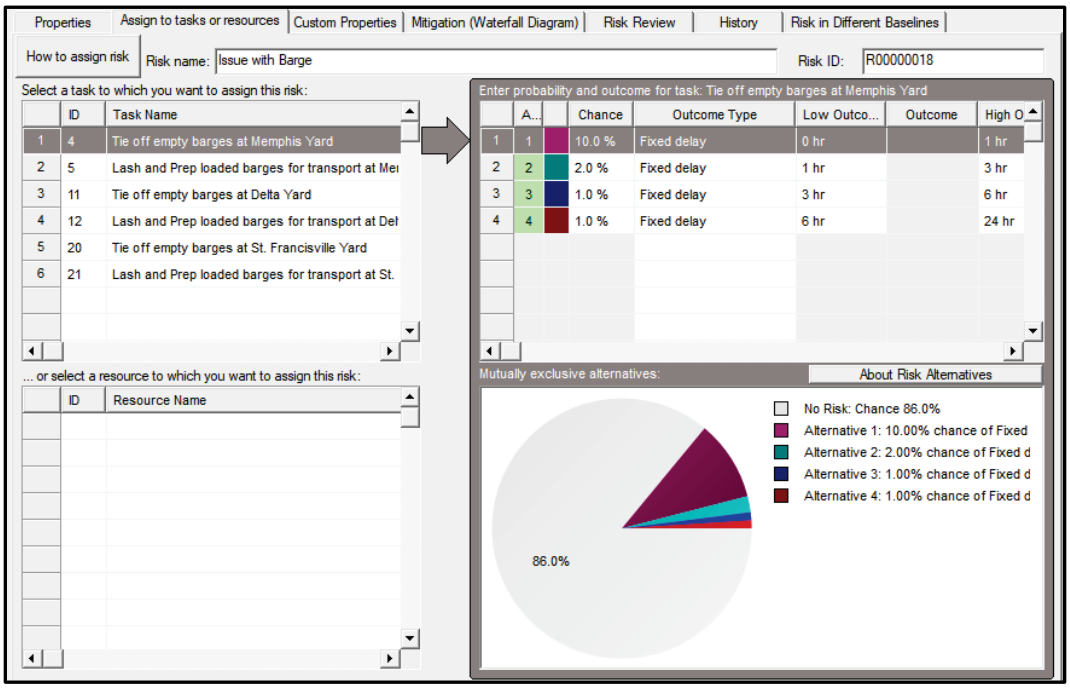
For the potential causes of delays identified for this project, a fixed delay was assigned to each of the tasks. There is no set length of delay that such an event would produce. The authors therefore asked MVK to indicate the probability that each event would cause a minor delay, moderate delay, serious delay, or critical delay. For purposes of this analysis, a minor delay was defined as a delay of less than 1 hr; moderate delay was more than 1 hr but less than 3 hr; serious delay was more than 3 hr but less than 6 hr; and a critical delay was defined as more than 6 hr.

2.2.2 Application of potential causes of delay percentages

For each identified potential cause of delays, a set of probabilities is entered into the database. Each potential cause is then assigned to tasks that it has a potential to impact. Additionally, the potential cause of delay is also assigned to the appropriate resources. There are several possible outcomes from the potential delay. Possible types of outcomes that could be relevant to this type schedule are Fixed delay (most likely), Relative Delay (less likely), Restart Task, End Task, Cancel Task, Cancel Task plus all successors, Safety Risk, Environmental Risk, Quality Risk, Performance Risk, and Technology Risk. For the purposes of this study and its inherent types of risks, a Fixes delay was chosen. Any delay that would cause the schedule to stop or for tasks to be canceled would not show where the appropriate choke points in the schedule would occur.

The outcomes are assigned a percent probability of a specified outcome. Further, mutually exclusive alternative probabilities are also assigned. The potential delay register for barge issues is given in Figure 26.

Figure 26. Potential delay register for issue with barge.



Each task in the schedule has multiple possible delays assigned to it. Each possible delay has multiple probabilities that are assigned to the associated task(s). A task that has two mechanisms for delay assigned will actually have eight possible delay probabilities assigned. These eight probabilities are what will be used in the Monte Carlo Analysis. However, the analysis will only use one probability of a risk per 1 run out of 800.

For each task in the schedule, a potential cause of delay can be assigned to be analyzed as a Parallel Risk. That is, it will always be run parallel to the other potential causes of delay assigned to that particular task and not sequentially during the analysis calculations. This can lessen the chance of an artificially high duration outcome in the analysis.

Potential causes of delays can also be assigned to the entire schedule as a "Global Risk." The Global Risks are applied to each (sub-) task in the schedule but will not show up in the number of potential causes of delays counted for each task.

2.3 Analysis

The Monte Carlo simulations are a probabilistic calculation based on the distribution of each risk on each assigned task in the schedule. For each of the individual calculations run on the schedule, a different outcome was chosen by the program and applied to either a low, base, or high duration for that alternative. Each answer is averaged through the entire number of specified simulations. Each simulation in this study was run 800 times.

The simulations were not stopped if convergence was reached before all the simulations had been completed, giving a higher level of confidence in the results.

The Monte Carlo analysis can pick multiple potential delays assigned to a task that may or that may not ever happen simultaneously, even though they could all happen to a particular task. For instance, when a barge is being offloaded onto ARMOR 1, there are four potential delays assigned to it. Those delays are fog on the river, ice on the boat deck, lightning, and mechanical problems on ARMOR 1. The four potential delays assigned during barge offloading may not all happen simultaneously. Additionally, assignment of weather type risks may be more important based on the time of day a task is scheduled to be performed. While the weather delays have been assigned based on when the task is scheduled to occur, in the outcome of the analysis, that task may then occur later in the day when there is less potential for that particular weather delay. This may slightly increase the calculated duration.

2.4 Sensitivity analysis

Although it is not possible to quantify the accuracy of the duration estimates on the probability of a delay for a task, it is possible to measure the sensitivity of the results. One measure of sensitivity would be to repeat a series of simulations where all of the times are doubled. That is, a minor delay would be 1.0 hr to 2 hr, a moderate delay would be 2.0 hr to 6 hr, etc.

Another option is to change the likelihood of a delay occurring. Because many of the potential delays already total 100% across the range of delays, it is not possible to double the estimated chance of occurrence as provided by MVK. It is, however, possible to cut the chance of occurrence in half.

The base duration was established by the 2019 current condition analysis based on the known information. A sensitivity analysis was conducted to establish the sensitivity to changes in delay durations and chance of occurrence of the probable delays for the 2,000 squares/day analysis for ACM placement at Gravolet, Rescue, and Lee Towhead.

The resulting times for the sensitivity analysis, given in Table 5, show less than a 13% deviation in total time when doubling the delay times and less than a 7% deviation in total time when the chance of occurrence is reduced by half. The reduction in the percent probabilities when reducing the input probabilities to half is a good indicator that the 2,000 squares/day, as well as the 4,000 squares/day and 6,000 squares/day, duration of delays has a high percentage of accuracy.

Table 5. Sensitivity analysis of reduction of risk percentage and increase in delay times.

	2,000 Squares/Day (hr)	One-Half Risk % (hr)	Double Delay Time (hr)
No Risk	296.5	296.5	296.5
Minimum	285	305	300
Median	425	370	525
Maximum	2,420	2,300	2,800
% Probability			
1	310	310	330
5	332	305	345
10	343.27	305.43	356.88
20	357.72	310.9	373.98
50	415.98	336.35	481.17
80	617.13	439.25	768.25
90	936.6	621.08	1,373.48
95	2,093.67	923.27	2,429.65
99	2,234.82	2,177.13	2,606.25

2.5 Analyzed conditions

Three production rates were analyzed to simulate conditions of 2,000 squares/day, 4,000 squares/day, and 6,000 squares/day. The season consisted of placement of ACM at three locations chosen from the 2019

season based on their remoteness from the nearest mat yard in their AOR. The base duration for the placement was compared to the actual placement times for the three locations during the 2019 season serving as a validation for the supply logistics process.

The four schedules analyzed in this study are based on the three site locations and the relocation time to travel and set up the MSU. The travel time is based on information from expert elicitation and vessel capacity. Barges are scheduled to travel to the square casting yards in the AOR that they will be working in next. The time to re-load the barges at the next yard and travel time to the next site are included in the schedules. Risks causing delay to these scheduled barge transport activities can have an impact on the continuation of work at each production site.

The Current Conditions schedule was input based on the average number of squares that could have been laid during the known duration at each of the three sites in 2019. Calculations were then made to determine the number of days that would be spent at each site and the number of barges needing to be off-loaded based on the total number of squares to be placed per day. Table 6 shows the results of those calculations.

Table 6. Days required at mat field.

Days at Mat Site				
	Current Condition (days/average squares/day)	2,000	4,000	6,000
Memphis	4/2,340	4.33	2.1	1.44
Vicksburg	9/2,077	9.35	4.67	3.12
St. Francisville	7/1,320.5	4.62	2.3	1.54

The results of the risk analysis are shown in Table 7 below. Included in the table are the estimated base durations without risk applied and the low, mean, and high durations when risks are applied.

Table 7. Estimated durations for base, minimum, mean, and maximum durations.

Duration to Complete Schedule in Hours				
	Current Condition	2,000 squares/day	4,000 squares/day	6,000 squares/day
Base	281.0	296.5	198.8	190.0
Minimum	281.1	302.8	230.8	275.0
Mean	574.1	574.6	471.0	503.0
Maximum	2,482.9	2,427.5	2,189.1	2,260.0

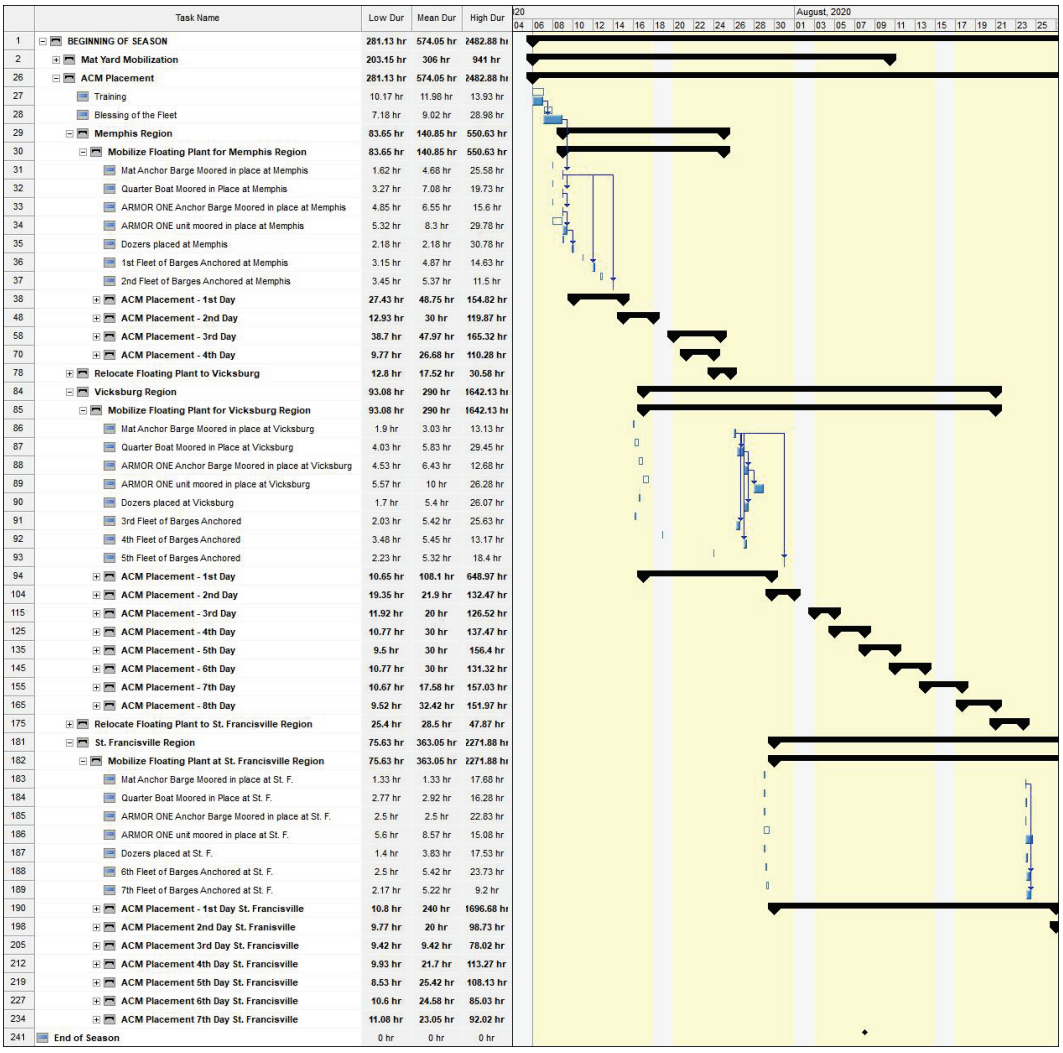
2.6 Current Condition

The schedule for the Current Condition model was input based on the number of squares laid at the site divided by the number of days the MSU was on site in 2019. This gave an average number of squares laid per day for use in comparing actual production to the three simulated production rate schedules. The base duration for the Current Conditions and the 2,000 squares/day schedule are mathematically similar for the Memphis and Vicksburg locations, with the St. Francisville location being significantly less in duration.

The total duration is 281.0 hr. The Mat Yard Mobilization components happen concurrently with mat placement and require a total of 204.85 hr to supply the ACM for the operations. Each task includes a low, base, and high duration for completion as well as a probability for success and probability of delay. The number of possible delays is captured for each task. For further review of the full schedules and Gantt charts with risks applied, see Appendix B.

The simulated results for the current rate including base duration with probable delays applied is shown in Figure 27. With all possible delays applied, the low duration time is 281.13 hr. The mean duration time is 574.05 hr. The high duration time is 2,482.88 hr. The colored columns show the number of total possible risks impacting the tasks with colors going from dark red for tasks with the most-assigned risks to white for those with no risks.

Figure 27. Results for Current Condition placement.



	Task Name	Low Dur	Mean Dur	High Dur
1	BEGINNING OF SEASON	281.13 hr	574.05 hr	2482.88 hr
2	Mat Yard Mobilization	203.15 hr	306 hr	941 hr
26	ACM Placement	281.13 hr	574.05 hr	2482.88 hr
27	Training	10.17 hr	11.98 hr	13.93 hr
28	Blessing of the Fleet	7.18 hr	9.02 hr	28.98 hr
29	Memphis Region	83.65 hr	140.85 hr	550.63 hr
30	Mobilize Floating Plant for Memphis Region	83.65 hr	140.85 hr	550.63 hr
31	Mat Anchor Barge Moored in place at Memphis	1.62 hr	4.68 hr	25.58 hr
32	Quarter Boat Moored in Place at Memphis	3.27 hr	7.08 hr	19.73 hr
33	ARMOR ONE Anchor Barge Moored in place at Memphis	4.85 hr	6.55 hr	15.6 hr
34	ARMOR ONE unit moored in place at Memphis	5.32 hr	8.3 hr	29.78 hr
35	Dozers placed at Memphis	2.18 hr	2.18 hr	30.78 hr
36	1st Fleet of Barges Anchored at Memphis	3.15 hr	4.87 hr	14.63 hr
37	2nd Fleet of Barges Anchored at Memphis	3.45 hr	5.37 hr	11.5 hr
38	ACM Placement - 1st Day	27.43 hr	48.75 hr	154.82 hr
48	ACM Placement - 2nd Day	12.93 hr	30 hr	119.87 hr
58	ACM Placement - 3rd Day	38.7 hr	47.97 hr	165.32 hr
70	ACM Placement - 4th Day	9.77 hr	26.68 hr	110.28 hr
78	Relocate Floating Plant to Vicksburg	12.8 hr	17.52 hr	30.58 hr
84	Vicksburg Region	93.08 hr	290 hr	1642.13 hr
85	Mobilize Floating Plant for Vicksburg Region	93.08 hr	290 hr	1642.13 hr
86	Mat Anchor Barge Moored in place at Vicksburg	1.9 hr	3.03 hr	13.13 hr
87	Quarter Boat Moored in Place at Vicksburg	4.03 hr	5.83 hr	29.45 hr
88	ARMOR ONE Anchor Barge Moored in place at Vicksburg	4.53 hr	6.43 hr	12.68 hr
89	ARMOR ONE unit moored in place at Vicksburg	5.57 hr	10 hr	26.28 hr
90	Dozers placed at Vicksburg	1.7 hr	5.4 hr	26.07 hr
91	3rd Fleet of Barges Anchored	2.03 hr	5.42 hr	25.63 hr
92	4th Fleet of Barges Anchored	3.48 hr	5.45 hr	13.17 hr
93	5th Fleet of Barges Anchored	2.23 hr	5.32 hr	18.4 hr
94	ACM Placement - 1st Day	10.65 hr	108.1 hr	648.97 hr
104	ACM Placement - 2nd Day	19.35 hr	21.9 hr	132.47 hr
115	ACM Placement - 3rd Day	11.92 hr	20 hr	126.52 hr
125	ACM Placement - 4th Day	10.77 hr	30 hr	137.47 hr
135	ACM Placement - 5th Day	9.5 hr	30 hr	156.4 hr
145	ACM Placement - 6th Day	10.77 hr	30 hr	131.32 hr
155	ACM Placement - 7th Day	10.67 hr	17.58 hr	157.03 hr
165	ACM Placement - 8th Day	9.52 hr	32.42 hr	151.97 hr
175	Relocate Floating Plant to St. Francisville Region	25.4 hr	28.5 hr	47.87 hr
181	St. Francisville Region	75.63 hr	363.05 hr	2271.88 hr
182	Mobilize Floating Plant at St. Francisville Region	75.63 hr	363.05 hr	2271.88 hr
183	Mat Anchor Barge Moored in place at St. F.	1.33 hr	1.33 hr	17.68 hr
184	Quarter Boat Moored in Place at St. F.	2.77 hr	2.92 hr	16.28 hr
185	ARMOR ONE Anchor Barge Moored in place at St. F.	2.5 hr	2.5 hr	22.83 hr
186	ARMOR ONE unit moored in place at St. F.	5.6 hr	8.57 hr	15.08 hr
187	Dozers placed at St. F.	1.4 hr	3.83 hr	17.53 hr
188	6th Fleet of Barges Anchored at St. F.	2.5 hr	5.42 hr	23.73 hr
189	7th Fleet of Barges Anchored at St. F.	2.17 hr	5.22 hr	9.2 hr
190	ACM Placement - 1st Day St. Francisville	10.8 hr	240 hr	1696.68 hr
198	ACM Placement 2nd Day St. Franisville	9.77 hr	20 hr	98.73 hr
205	ACM Placement 3rd Day St. Francisville	9.42 hr	9.42 hr	78.02 hr
212	ACM Placement 4th Day St. Francisville	9.93 hr	21.7 hr	113.27 hr
219	ACM Placement 5th Day St. Francisville	8.53 hr	25.42 hr	108.13 hr
227	ACM Placement 6th Day St. Francisville	10.6 hr	24.58 hr	85.03 hr
234	ACM Placement 7th Day St. Francisville	11.08 hr	23.05 hr	92.02 hr
241	End of Season	0 hr	0 hr	0 hr

2.7 2,000 squares/day condition

The total duration of the analyzed schedule for 2,000 squares/day is 302.8 hr. The Mat Yard Mobilization components happen concurrently with mat placement and require a total of 223.4 hr to supply the ACM for the operations. Each task includes a low, base, and high duration for completion as well as a probability for success and probability of delay. The analysis showed that there were extended delays caused by limited resources, distance to mat yard, and impact of risk-delay durations. Figure 28 shows the results for the 2,000 squares/day rate.

Delays in the schedule are factored in before any risks are applied. The chart below lists the inherent delays in the base schedule with no risks applied. When risks are applied to the schedule, task durations are

lengthened, and delays are then compounded further. Table 8 lists only the inherent schedule delays and what happens to that task when the risks are analyzed. For further review of the full schedules and Gantt charts with risks applied, see Appendix B.

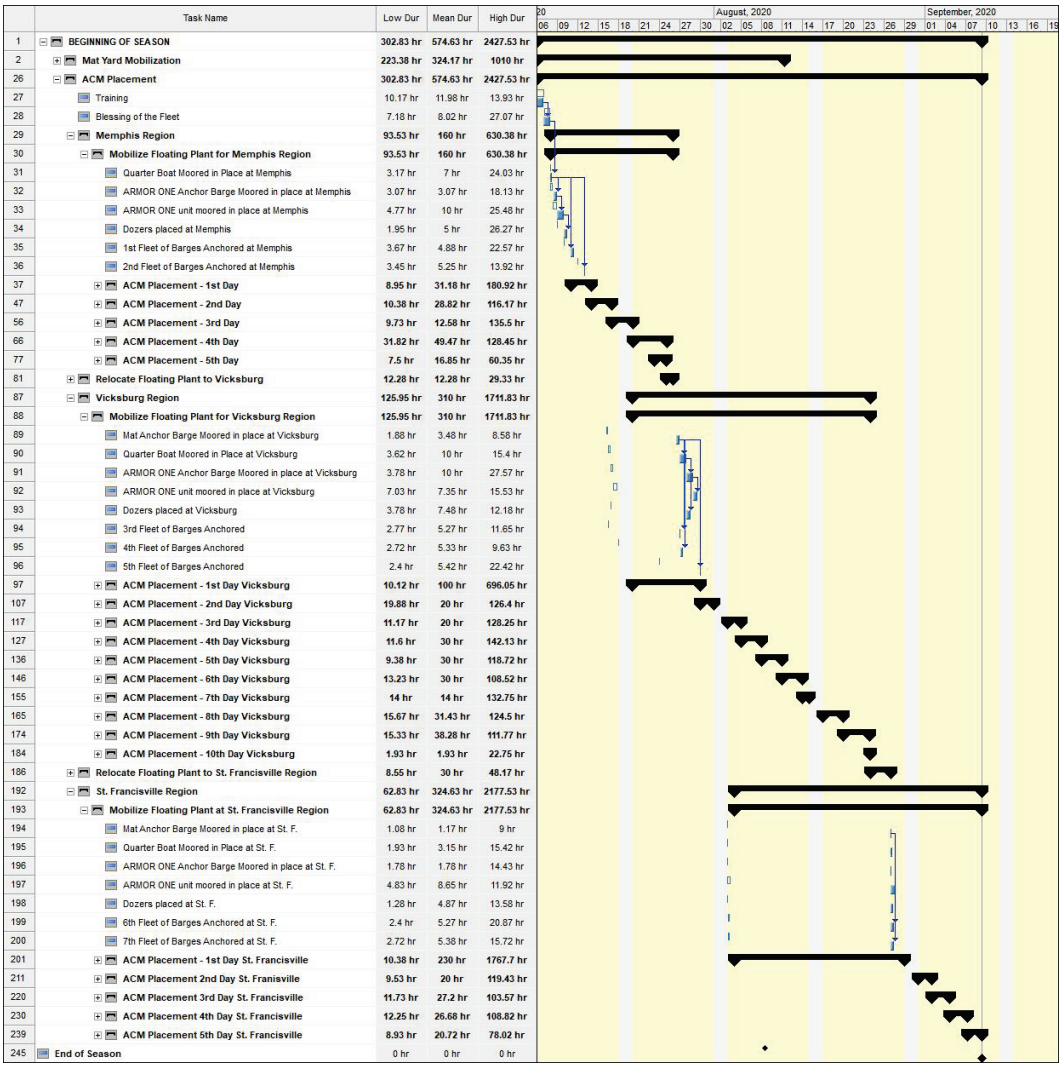
Table 8. Identified delays in schedule for 2,000 squares/day.

Where	#	Task	When	Why	Mitigation	With Risks Applied
St. Francisville	1	Load Squares on Barges 5-16 at St. Francisville Yard	Day 18	Barges 5-16 cannot be loaded at St. Francisville until they arrive from the Memphis site.	Had more barges been available, they could have been loaded 12-13 days sooner (if pre-cast).	
Memphis	2	1st Fleet of Barges Anchored at Memphis	Day 4	Waiting arrival of Barges 1-12 from Richardson Landing.	Coordination with square casting yard needed.	Adds additional 1 day of delay.
Vicksburg	3	Land Anchors Installed - D1V	Day 14	The MSU crew has a regularly scheduled weekend off as soon as the plant arrives at the Vicksburg site. Work does not begin until the Monday morning of their return. Net 2.5-day loss.	No recommendation.	Mean duration of task is extended 5.35 hr. Subsequent tasks are delayed due to risks applied to third fleet of barges being delayed by nearly 7 days.
St. Francisville	4	Stack Anchor Barge Moored at St. Francisville	Day 29	The MSU crew has a regularly scheduled weekend off as soon as the plant arrives at the St. Francisville site. Work does not begin until the Monday morning of their return. Net 2-day loss.	No recommendation.	Delay further compounded by risks associated with relocating MSU plant to St. Francisville site. Delay of 24 days.

In Table 8, the third instance of delay during this simulation occurs on the second day of ACM placement at the Rescue location. The schedule is delayed due to the stack barge tow not arriving in time to carry out subsequent tasks. In addition, the late arrival coincides with the scheduled off days for the mat-laying crew. This effectively delays the schedule by

approximately 2–3 days without any other possible delays being applied. While this study is based on only three locations on the river being scheduled for armoring, it does show how the arrival time of stacks from the yards (especially from farthest points) can negatively affect the schedule even without risks.

Figure 28. Results for 2,000 squares/day placement.



	Task Name	Low Dur	Mean Dur	High Dur
1	BEGINNING OF SEASON	302.83 hr	574.63 hr	2427.53 hr
2	Mat Yard Mobilization	223.38 hr	324.17 hr	1010 hr
26	ACM Placement	302.83 hr	574.63 hr	2427.53 hr
27	Training	10.17 hr	11.98 hr	13.93 hr
28	Blessing of the Fleet	7.18 hr	8.02 hr	27.07 hr
29	Memphis Region	93.53 hr	160 hr	630.38 hr
30	Mobilize Floating Plant for Memphis Region	93.53 hr	160 hr	630.38 hr
31	Quarter Boat Moored in Place at Memphis	3.17 hr	7 hr	24.03 hr
32	ARMOR ONE Anchor Barge Moored in place at Memphis	3.07 hr	3.07 hr	18.13 hr
33	ARMOR ONE unit moored in place at Memphis	4.77 hr	10 hr	25.48 hr
34	Dozers placed at Memphis	1.95 hr	5 hr	26.27 hr
35	1st Fleet of Barges Anchored at Memphis	3.67 hr	4.88 hr	22.57 hr
36	2nd Fleet of Barges Anchored at Memphis	3.45 hr	5.25 hr	13.92 hr
37	ACM Placement - 1st Day	8.95 hr	31.18 hr	180.92 hr
47	ACM Placement - 2nd Day	10.38 hr	28.82 hr	116.17 hr
56	ACM Placement - 3rd Day	9.73 hr	12.58 hr	135.5 hr
66	ACM Placement - 4th Day	31.82 hr	49.47 hr	128.45 hr
77	ACM Placement - 5th Day	7.5 hr	16.85 hr	60.35 hr
81	Relocate Floating Plant to Vicksburg	12.28 hr	12.28 hr	29.33 hr
87	Vicksburg Region	125.95 hr	310 hr	1711.83 hr
88	Mobilize Floating Plant for Vicksburg Region	125.95 hr	310 hr	1711.83 hr
89	Mat Anchor Barge Moored in place at Vicksburg	1.88 hr	3.48 hr	8.58 hr
90	Quarter Boat Moored in Place at Vicksburg	3.62 hr	10 hr	15.4 hr
91	ARMOR ONE Anchor Barge Moored in place at Vicksburg	3.78 hr	10 hr	27.57 hr
92	ARMOR ONE unit moored in place at Vicksburg	7.03 hr	7.35 hr	15.53 hr
93	Dozers placed at Vicksburg	3.78 hr	7.48 hr	12.18 hr
94	3rd Fleet of Barges Anchored	2.77 hr	5.27 hr	11.65 hr
95	4th Fleet of Barges Anchored	2.72 hr	5.33 hr	9.63 hr
96	5th Fleet of Barges Anchored	2.4 hr	5.42 hr	22.42 hr
97	ACM Placement - 1st Day Vicksburg	10.12 hr	100 hr	696.05 hr
107	ACM Placement - 2nd Day Vicksburg	19.88 hr	20 hr	126.4 hr
117	ACM Placement - 3rd Day Vicksburg	11.17 hr	20 hr	128.25 hr
127	ACM Placement - 4th Day Vicksburg	11.6 hr	30 hr	142.13 hr
136	ACM Placement - 5th Day Vicksburg	9.38 hr	30 hr	118.72 hr
146	ACM Placement - 6th Day Vicksburg	13.23 hr	30 hr	108.52 hr
155	ACM Placement - 7th Day Vicksburg	14 hr	14 hr	132.75 hr
165	ACM Placement - 8th Day Vicksburg	15.67 hr	31.43 hr	124.5 hr
174	ACM Placement - 9th Day Vicksburg	15.33 hr	38.28 hr	111.77 hr
184	ACM Placement - 10th Day Vicksburg	1.93 hr	1.93 hr	22.75 hr
186	Relocate Floating Plant to St. Francisville Region	8.55 hr	30 hr	48.17 hr
192	St. Francisville Region	62.83 hr	324.63 hr	2177.53 hr
193	Mobilize Floating Plant at St. Francisville Region	62.83 hr	324.63 hr	2177.53 hr
194	Mat Anchor Barge Moored in place at St. F.	1.08 hr	1.17 hr	9 hr
195	Quarter Boat Moored in Place at St. F.	1.93 hr	3.15 hr	15.42 hr
196	ARMOR ONE Anchor Barge Moored in place at St. F.	1.78 hr	1.78 hr	14.43 hr
197	ARMOR ONE unit moored in place at St. F.	4.83 hr	8.65 hr	11.92 hr
198	Dozers placed at St. F.	1.28 hr	4.87 hr	13.58 hr
199	6th Fleet of Barges Anchored at St. F.	2.4 hr	5.27 hr	20.87 hr
200	7th Fleet of Barges Anchored at St. F.	2.72 hr	5.38 hr	15.72 hr
201	ACM Placement - 1st Day St. Francisville	10.38 hr	230 hr	1767.7 hr
211	ACM Placement 2nd Day St. Franisville	9.53 hr	20 hr	119.43 hr
220	ACM Placement 3rd Day St. Francisville	11.73 hr	27.2 hr	103.57 hr
230	ACM Placement 4th Day St. Francisville	12.25 hr	26.68 hr	108.82 hr
239	ACM Placement 5th Day St. Francisville	8.93 hr	20.72 hr	78.02 hr
245	End of Season	0 hr	0 hr	0 hr

2.8 4,000 squares/day condition

For the 4,000 squares/day condition, the ARMOR 1 crew moved to one 10 hr shift. The total duration is 198.8 hr. The Mat Yard Mobilization components happen concurrently with mat placement and require a total of 291 hr to supply the ACM for the operations. Each task includes a low, base, and high duration for completion as well as a probability for success and probability of delay.

The simulated results for the 4,000 squares/day rate are shown in Figure 29. With all possible delays applied, the low duration time is 230.8 hr. The mean duration time is 471.0 hr. The high duration time is 2,189.1 hr. This analysis showed that there were extended delays caused by limited resources, distance to mat yard, and impact of risk-delay durations.

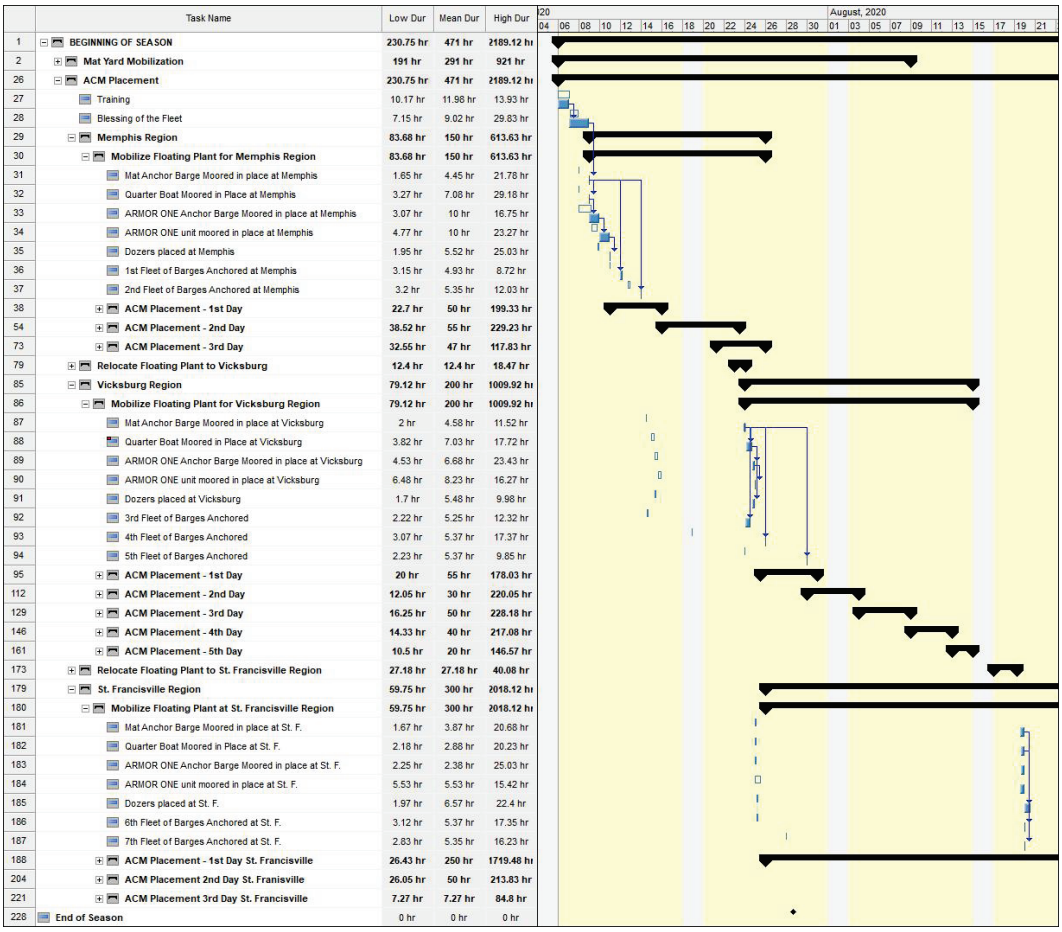
Delays in the schedule are factored in before any risks are applied. The chart below lists the inherent delays in the base schedule with no risks applied. When risks are applied to the schedule, task durations are lengthened, and delays are then compounded further. Table 9 lists only the inherent schedule delays and what happens to that task when the risks are analyzed. For further review of the full schedules and Gantt charts with risks applied, see Appendix B.

Table 9. Identified delays in schedule for 4,000 squares/day.

Where	#	Task	When	Why	Mitigation	With Risks applied
St. Francisville	1	Load Stacks on Barges 5-16 at St. Francisville Yard	Day 15	Barges 5-16 cannot be loaded at St. Francisville until they arrive from the Memphis site.	Had more barges been available, they could have been loaded 9-10 days sooner (if pre-cast).	
Memphis	2	T1-B1 towed in place	Day 5	The first fleet of barges does not arrive until the day after the plant and dozer arrive and are setup. Work cannot begin on mat placement until barges are delivered to site. Net 1-day loss.	Suggest longer hours or additional resources at square casting field to load squares on barges.	Mean duration of task is extended approximately 2.5 hr. Task is delayed 1 day.
Memphis	3	T2-B13 towed in place	Day 7	Work delayed until arrival of the second fleet of barges. Barges 13-15 do not arrive until end of day. Work begins at regular shift next morning. Net loss of 2.5 hr at end of day.	No recommendation. Loss is negligible and may vary with travel times.	Mean duration of task is extended 4.25 hr. Task is delayed 7 days due to previous tasks of barge arrival and off-loading risk delays.

Where	#	Task	When	Why	Mitigation	With Risks applied
Memphis	4	T4-B28 towed in place	Day 14	Compounded delay. The fourth fleet of barges does not arrive to finish out day 2 at Memphis site. Loss of 2 hr at end of workday. Barges arrive on Sunday. Crew begins regularly scheduled weekend off same day that barges are delayed. Work resumes the next Monday morning.	Suggest longer hours or additional resources at square casting field to load squares on barges.	Mean duration of task is extended approximately 0.2 hr. Task is delayed 15 days due to previous tasks of barge arrival and off-loading risk delays.
St. Francisville	5	T7-B17	Day 22	Work delayed until arrival of the seventh fleet of barges. Barges 17-20 do not arrive until end of day. Work begins at regular shift next morning. Net loss of 2 hr at end of day.	No recommendation. Loss is negligible and may vary with travel times.	Mean duration of task is extended 3.75 hours. Task is delayed 32 days due to previous tasks of barge arrival and off-loading risk delays.

Figure 29. Results for 4,000 squares/day placement.



	Task Name	Low Dur	Mean Dur	High Dur
1	BEGINNING OF SEASON	230.75 hr	471 hr	2189.12 hr
2	Mat Yard Mobilization	191 hr	291 hr	921 hr
26	ACM Placement	230.75 hr	471 hr	2189.12 hr
27	Training	10.17 hr	11.98 hr	13.93 hr
28	Blessing of the Fleet	7.15 hr	9.02 hr	29.83 hr
29	Memphis Region	83.68 hr	150 hr	613.63 hr
30	Mobilize Floating Plant for Memphis Region	83.68 hr	150 hr	613.63 hr
31	Mat Anchor Barge Moored in place at Memphis	1.65 hr	4.45 hr	21.78 hr
32	Quarter Boat Moored in Place at Memphis	3.27 hr	7.08 hr	29.18 hr
33	ARMOR ONE Anchor Barge Moored in place at Memphis	3.07 hr	10 hr	16.75 hr
34	ARMOR ONE unit moored in place at Memphis	4.77 hr	10 hr	23.27 hr
35	Dozers placed at Memphis	1.95 hr	5.52 hr	25.03 hr
36	1st Fleet of Barges Anchored at Memphis	3.15 hr	4.93 hr	8.72 hr
37	2nd Fleet of Barges Anchored at Memphis	3.2 hr	5.35 hr	12.03 hr
38	ACM Placement - 1st Day	22.7 hr	50 hr	199.33 hr
54	ACM Placement - 2nd Day	38.52 hr	55 hr	229.23 hr
73	ACM Placement - 3rd Day	32.55 hr	47 hr	117.83 hr
79	Relocate Floating Plant to Vicksburg	12.4 hr	12.4 hr	18.47 hr
85	Vicksburg Region	79.12 hr	200 hr	1009.92 hr
86	Mobilize Floating Plant for Vicksburg Region	79.12 hr	200 hr	1009.92 hr
87	Mat Anchor Barge Moored in place at Vicksburg	2 hr	4.58 hr	11.52 hr
88	Quarter Boat Moored in Place at Vicksburg	3.82 hr	7.03 hr	17.72 hr
89	ARMOR ONE Anchor Barge Moored in place at Vicksburg	4.53 hr	6.68 hr	23.43 hr
90	ARMOR ONE unit moored in place at Vicksburg	6.48 hr	8.23 hr	16.27 hr
91	Dozers placed at Vicksburg	1.7 hr	5.48 hr	9.98 hr
92	3rd Fleet of Barges Anchored	2.22 hr	5.25 hr	12.32 hr
93	4th Fleet of Barges Anchored	3.07 hr	5.37 hr	17.37 hr
94	5th Fleet of Barges Anchored	2.23 hr	5.37 hr	9.85 hr
95	ACM Placement - 1st Day	20 hr	55 hr	178.03 hr
112	ACM Placement - 2nd Day	12.05 hr	30 hr	220.05 hr
129	ACM Placement - 3rd Day	16.25 hr	50 hr	228.18 hr
146	ACM Placement - 4th Day	14.33 hr	40 hr	217.08 hr
161	ACM Placement - 5th Day	10.5 hr	20 hr	146.57 hr
173	Relocate Floating Plant to St. Francisville Region	27.18 hr	27.18 hr	40.08 hr
179	St. Francisville Region	59.75 hr	300 hr	2018.12 hr
180	Mobilize Floating Plant at St. Francisville Region	59.75 hr	300 hr	2018.12 hr
181	Mat Anchor Barge Moored in place at St. F.	1.67 hr	3.87 hr	20.68 hr
182	Quarter Boat Moored in Place at St. F.	2.18 hr	2.88 hr	20.23 hr
183	ARMOR ONE Anchor Barge Moored in place at St. F.	2.25 hr	2.38 hr	25.03 hr
184	ARMOR ONE unit moored in place at St. F.	5.53 hr	5.53 hr	15.42 hr
185	Dozers placed at St. F.	1.97 hr	6.57 hr	22.4 hr
186	6th Fleet of Barges Anchored at St. F.	3.12 hr	5.37 hr	17.35 hr
187	7th Fleet of Barges Anchored at St. F.	2.83 hr	5.35 hr	16.23 hr
188	ACM Placement - 1st Day St. Francisville	26.43 hr	250 hr	1719.48 hr
204	ACM Placement 2nd Day St. Franisville	26.05 hr	50 hr	213.83 hr
221	ACM Placement 3rd Day St. Francisville	7.27 hr	7.27 hr	84.8 hr
228	End of Season	0 hr	0 hr	0 hr

2.9 6,000 squares/day condition

There was a change to the resources of the work crew on ARMOR 1 for the 6,000 squares/day condition. Instead of working one 10 hr shift, there are two 8 hr shifts. The total duration is 190 hr. The Mat Yard Mobilization components happen concurrently with mat placement and require a total of 187.8 hr to supply the ACM for the operations. Each task includes a low, base, and high duration for completion as well as a probability for success and probability of delay. The number of possible delays is captured for each task.

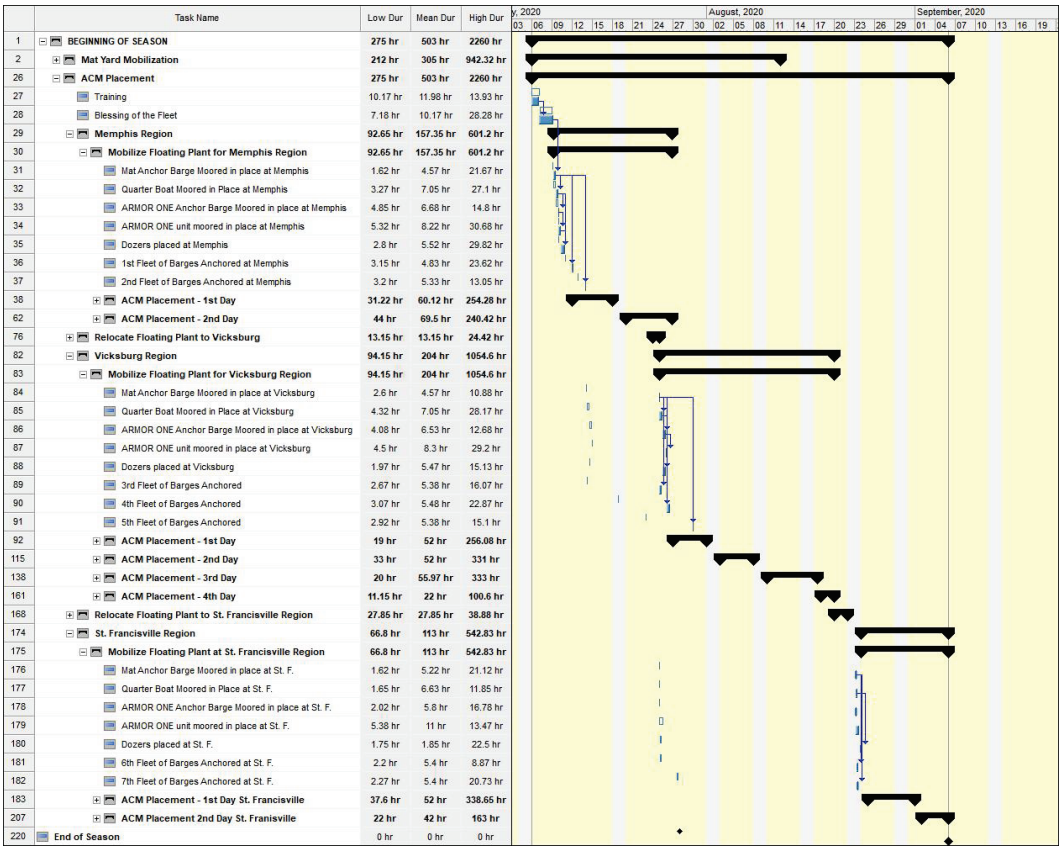
The simulated results for the 6,000 squares/day rate with probable delays applied is shown in Figure 30. With all possible delays applied, the low duration time is 275.0 hr. The mean duration time is 503.0 hr. The high duration time is 2,260.0 hr.

Delays in the schedule are factored in before any risks are applied. The chart below lists the inherent delays in the base schedule with no risks applied. When risks are applied to the schedule, task durations are lengthened, and delays are then compounded further. Table 10 lists only the inherent schedule delays and what happens to that tasks when the risks are analyzed. For further review of the full schedules and Gantt charts with risks applied, see Appendix B.

Table 10. Identified delays in schedule for 6,000 squares/day.

Where	#	Task	When	Why	Mitigation	With Risks Applied
St. Francisville	1	Load squares on Barges 5-16 at St. Francisville Yard	Day 20	Barges 5-16 cannot be loaded at St. Francisville until they arrive from the Memphis site.	Had more barges been available, they could have been loaded 4-5 days sooner (if pre-cast).	
Memphis	2	First Fleet of barges anchored at Memphis	Day 5	Waiting arrival of barges 1-12 from Richardson Landing.	Coordination with square casting yard needed.	Mean duration of task is extended approximately 2.8 hr. Task is delayed 1 day.
Memphis	3	T2-B13 towed in place	Day 7	Work delayed until arrival of the second fleet of barges. Barges 13-15 do not arrive until end of day. Work begins at regular shift next morning. Net loss of 3.5 hr at end of day.	No recommendation. Loss is negligible and may vary with travel times.	Mean duration of task is extended 5.5 hr. Task is delayed 8 days due to previous tasks of barge arrival and off-loading risk delays.
Memphis	4	T4-B28 towed in place	Day 10	Compounded delay. The fourth fleet of barges does not arrive to finish out day 2 at Memphis site. Loss of 9 hr of a workday on a Thursday. Barges arrive on Sunday. Crew begins regularly scheduled weekend off same day that barges are delayed. Work resumes the next Monday morning. Net loss of almost 4 days.	Suggest longer hours or additional resources at square casting field to load squares on barges. More available barges to be pre-placed at site.	Mean duration of task is extended 2.3 hr. Task is delayed 16 days due to previous tasks of barge arrival and off-loading risk delays.

Figure 30. Results for 6,000 squares/day placement.



	Task Name	Low Dur	Mean Dur	High Dur
1	**BEGINNING OF SEASON**	**275 hr**	**503 hr**	**2260 hr**
2	**Mat Yard Mobilization**	**212 hr**	**305 hr**	**942.32 hr**
26	**ACM Placement**	**275 hr**	**503 hr**	**2260 hr**
27	Training	10.17 hr	11.98 hr	13.93 hr
28	Blessing of the Fleet	7.18 hr	10.17 hr	28.28 hr
29	**Memphis Region**	**92.65 hr**	**157.35 hr**	**601.2 hr**
30	**Mobilize Floating Plant for Memphis Region**	**92.65 hr**	**157.35 hr**	**601.2 hr**
31	Mat Anchor Barge Moored in place at Memphis	1.62 hr	4.57 hr	21.67 hr
32	Quarter Boat Moored in Place at Memphis	3.27 hr	7.05 hr	27.1 hr
33	ARMOR ONE Anchor Barge Moored in place at Memphis	4.85 hr	6.68 hr	14.8 hr
34	ARMOR ONE unit moored in place at Memphis	5.32 hr	8.22 hr	30.68 hr
35	Dozers placed at Memphis	2.8 hr	5.52 hr	29.82 hr
36	1st Fleet of Barges Anchored at Memphis	3.15 hr	4.83 hr	23.62 hr
37	2nd Fleet of Barges Anchored at Memphis	3.2 hr	5.33 hr	13.05 hr
38	**ACM Placement - 1st Day**	**31.22 hr**	**60.12 hr**	**254.28 hr**
62	**ACM Placement - 2nd Day**	**44 hr**	**69.5 hr**	**240.42 hr**
76	**Relocate Floating Plant to Vicksburg**	**13.15 hr**	**13.15 hr**	**24.42 hr**
82	**Vicksburg Region**	**94.15 hr**	**204 hr**	**1054.6 hr**
83	**Mobilize Floating Plant for Vicksburg Region**	**94.15 hr**	**204 hr**	**1054.6 hr**
84	Mat Anchor Barge Moored in place at Vicksburg	2.6 hr	4.57 hr	10.88 hr
85	Quarter Boat Moored in Place at Vicksburg	4.32 hr	7.05 hr	28.17 hr
86	ARMOR ONE Anchor Barge Moored in place at Vicksburg	4.08 hr	6.53 hr	12.68 hr
87	ARMOR ONE unit moored in place at Vicksburg	4.5 hr	8.3 hr	29.2 hr
88	Dozers placed at Vicksburg	1.97 hr	5.47 hr	15.13 hr
89	3rd Fleet of Barges Anchored	2.67 hr	5.38 hr	16.07 hr
90	4th Fleet of Barges Anchored	3.07 hr	5.48 hr	22.87 hr
91	5th Fleet of Barges Anchored	2.92 hr	5.38 hr	15.1 hr
92	**ACM Placement - 1st Day**	**19 hr**	**52 hr**	**256.08 hr**
115	**ACM Placement - 2nd Day**	**33 hr**	**52 hr**	**331 hr**
138	**ACM Placement - 3rd Day**	**20 hr**	**55.97 hr**	**333 hr**
161	**ACM Placement - 4th Day**	**11.15 hr**	**22 hr**	**100.6 hr**
168	**Relocate Floating Plant to St. Francisville Region**	**27.85 hr**	**27.85 hr**	**38.88 hr**
174	**St. Francisville Region**	**66.8 hr**	**113 hr**	**542.83 hr**
175	**Mobilize Floating Plant at St. Francisville Region**	**66.8 hr**	**113 hr**	**542.83 hr**
176	Mat Anchor Barge Moored in place at St. F.	1.62 hr	5.22 hr	21.12 hr
177	Quarter Boat Moored in Place at St. F.	1.65 hr	6.63 hr	11.85 hr
178	ARMOR ONE Anchor Barge Moored in place at St. F.	2.02 hr	5.8 hr	16.78 hr
179	ARMOR ONE unit moored in place at St. F.	5.38 hr	11 hr	13.47 hr
180	Dozers placed at St. F.	1.75 hr	1.85 hr	22.5 hr
181	6th Fleet of Barges Anchored at St. F.	2.2 hr	5.4 hr	8.87 hr
182	7th Fleet of Barges Anchored at St. F.	2.27 hr	5.4 hr	20.73 hr
183	**ACM Placement - 1st Day St. Francisville**	**37.6 hr**	**52 hr**	**338.65 hr**
207	**ACM Placement 2nd Day St. Franisville**	**22 hr**	**42 hr**	**163 hr**
220	**End of Season**	0 hr	0 hr	0 hr

3 Conclusion

In conclusion, the study shows that the three analyzed schedules for 2,000, 4,000, and 6,000 squares/day of production are feasible based on comparisons of actual production during the 2019 season in the three selected locations. However, when risks are applied to the schedules, the delays can become further compounded.

There are inherent schedule delays in the three analyzed schedules that are due to the current inventory of barges, vessels, and resources. The longest delays are seen when production levels at the site require more ACMs from a production facility. The normal wait time to load barges with ACMs at the square casting yards and transit time from the square casting yard to the site are the main driving factors for duration delays when risks are applied to higher production rate schedules. It is recommended that additional barges be added to mitigate negative impacts of inherent and applied risk delays.

While only three site locations were analyzed for this study, it can be inferred that additional square supply sites added to the schedules would reduce risks of delays. The production levels at the square casting yards and the number of barges available to be utilized are reasons for delay. This study assumed that the square casting yards would have a sufficient inventory of squares cast to load onto the barges as needed. Higher production rates at the field sites are going to require that more squares are available sooner for transportation to sites. If they are not cast and available, this will further increase the delay duration of the square loading and transportation tasks in the schedule. More sites along the river to armor will only increase the demand on the yards and the time to transport barges to and from sites and yards. It is recommended that additional mat yards and/or square storage locations may be required to mitigate inherent and applied risk delays, as well as additional resources to load barges at casting yards Also having more loaded barges available for pre-positioning at sites will decrease transportation delays due to the increased production levels.

To reduce delays due to travel time with loaded and unloaded barges, it is recommended that nearest mat yard supply be utilized rather than the AOR restriction.

The three analyzed production schedules showed some minor delays due to regularly scheduled weekend off days in conjunction with delays of stack barge transportation to sites. When the arrival of needed stack barges is delayed, this increases the non-productive hours for the crew(s) generally at the end of a workday before a weekend off, or at the beginning of the next regularly scheduled workday. Additional barges being added to the fleet and available for loading and pre-positioning will decrease these delays.

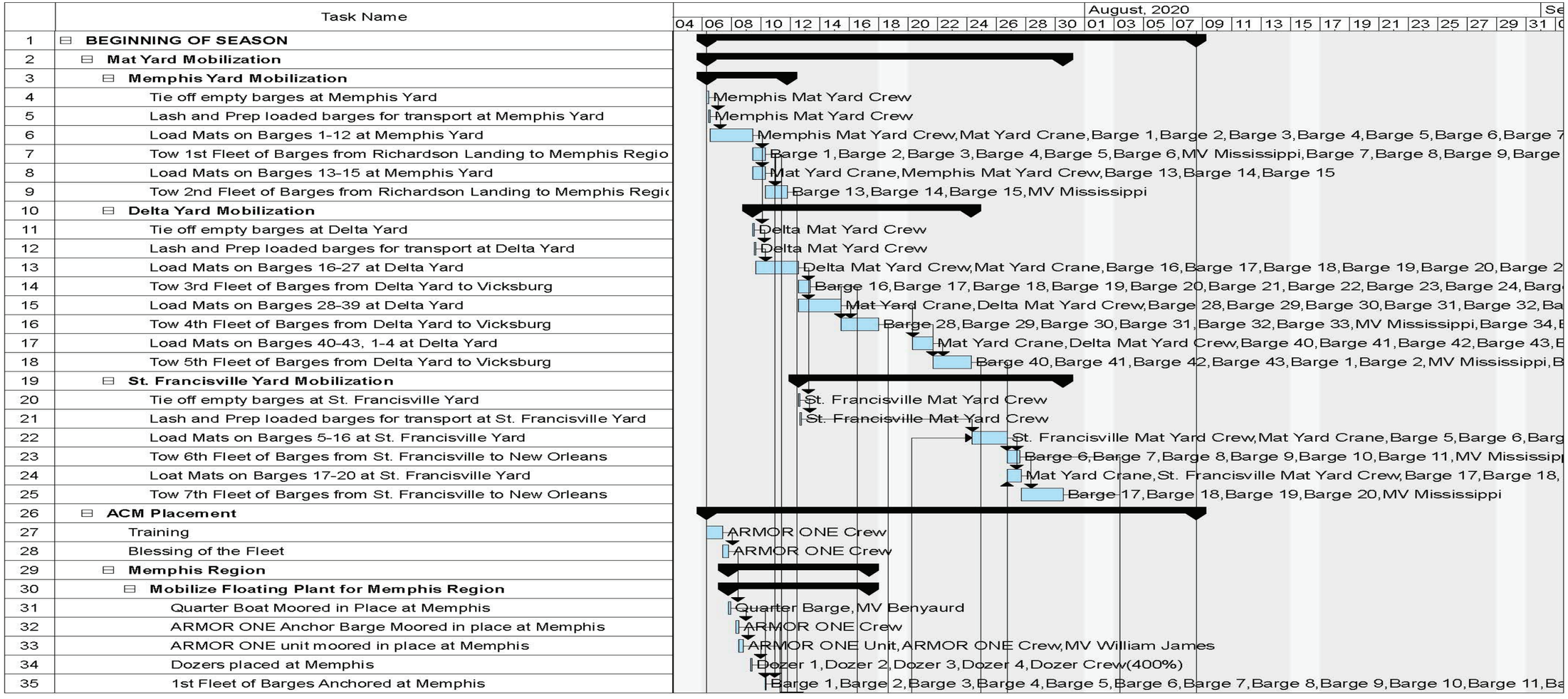
References

Myrick, G. B., J. A. Hicks, L. I. Yates, and M. C. Allison. 2020. *Operation and Deployment Risk Assessment Report (RAR) for the City of Cedar Rapids, IA; Alternative and Sequencing Optimization for Removable Flood Barriers*. ERDC TR-20-3. Vicksburg, MS: US Army Engineer Research and Development Center.

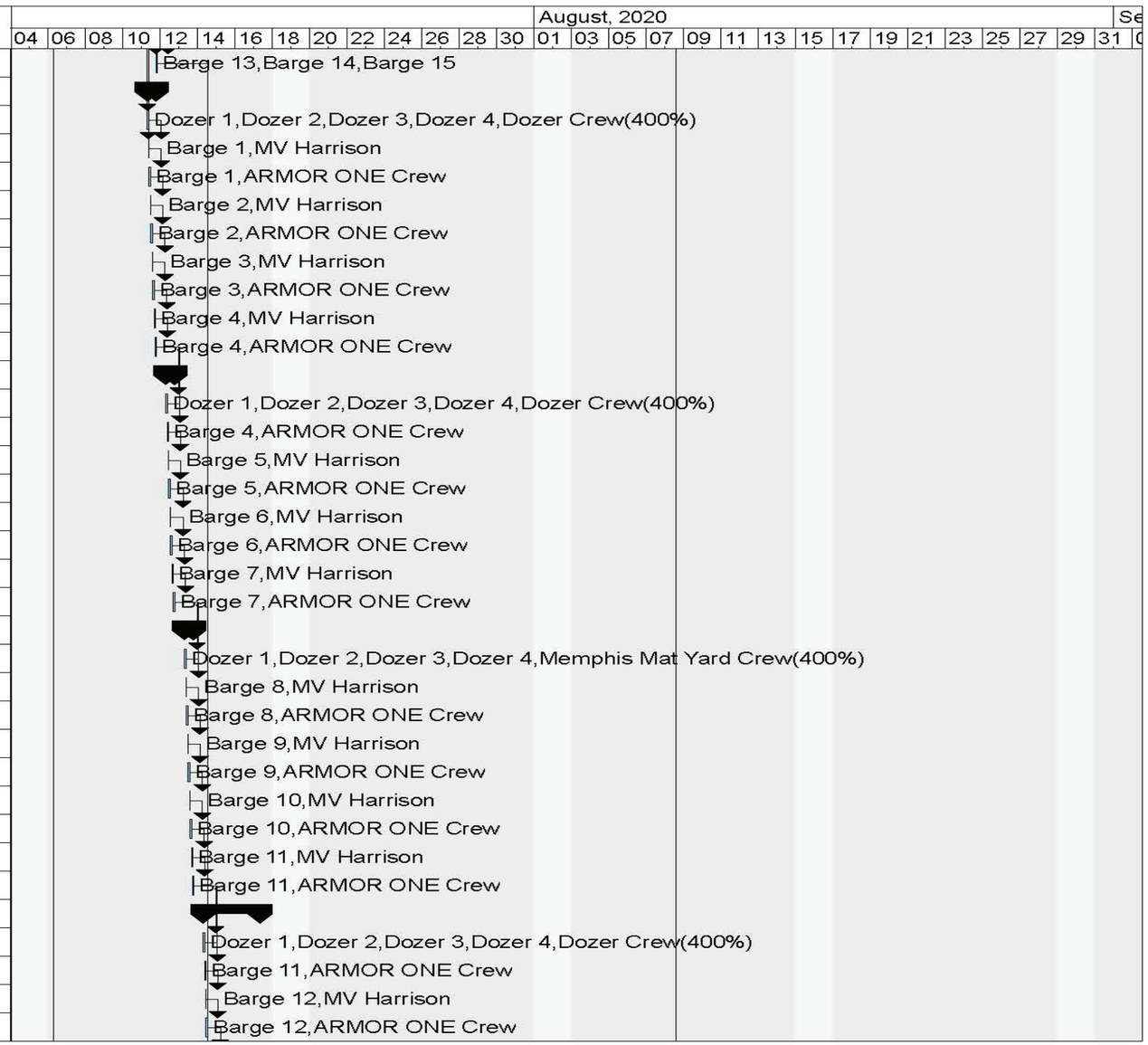
Appendix A: Logistics Schedules

Figure A-1 and Figure A-2 present the schedule of events for 2,000 squares/day and 4,000 squares/day, respectively. Figure A-3 presents the schedule of events for 6,000 squares/day.

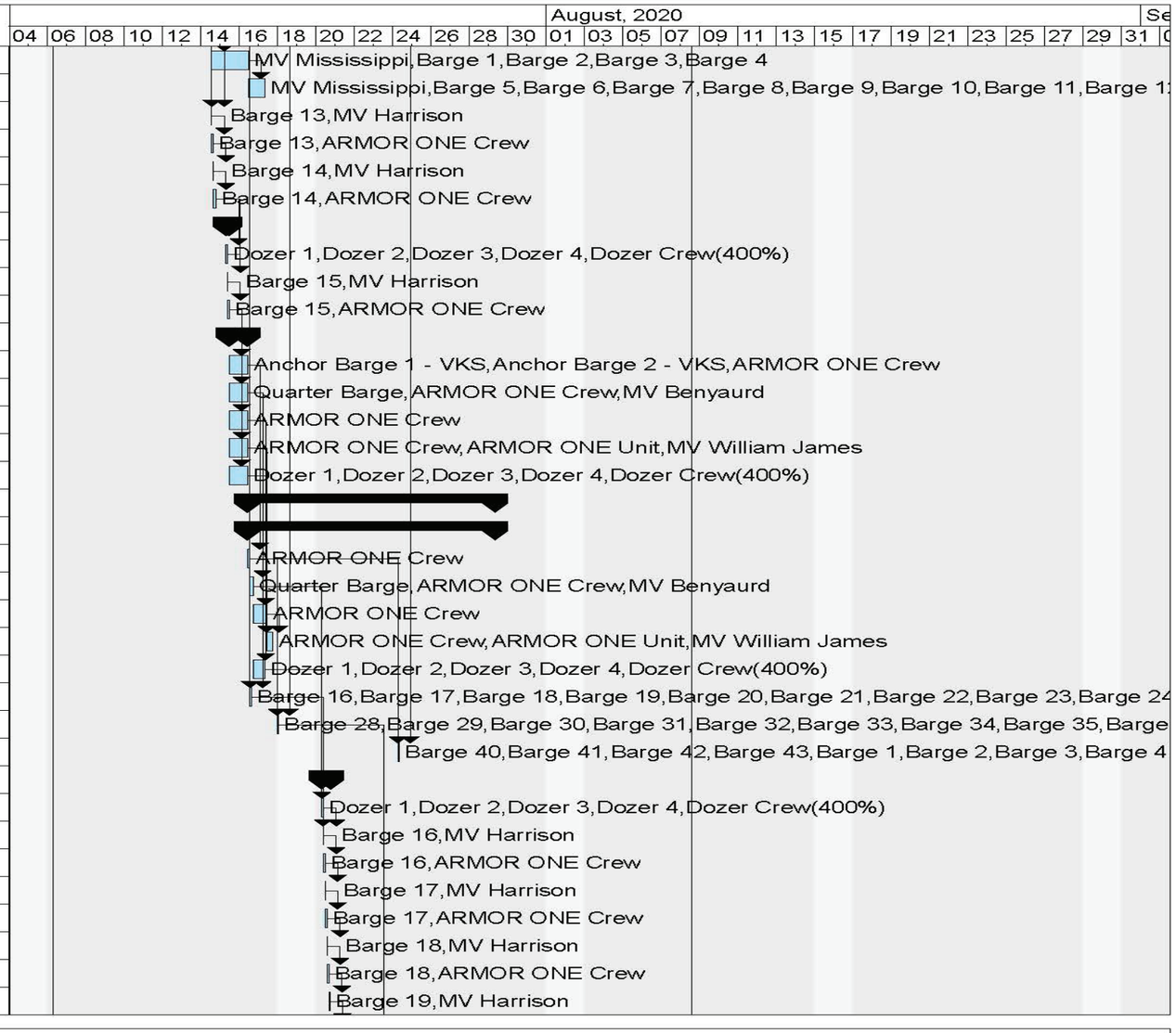
Figure A-1. Schedule of events for 2,000 squares/day.



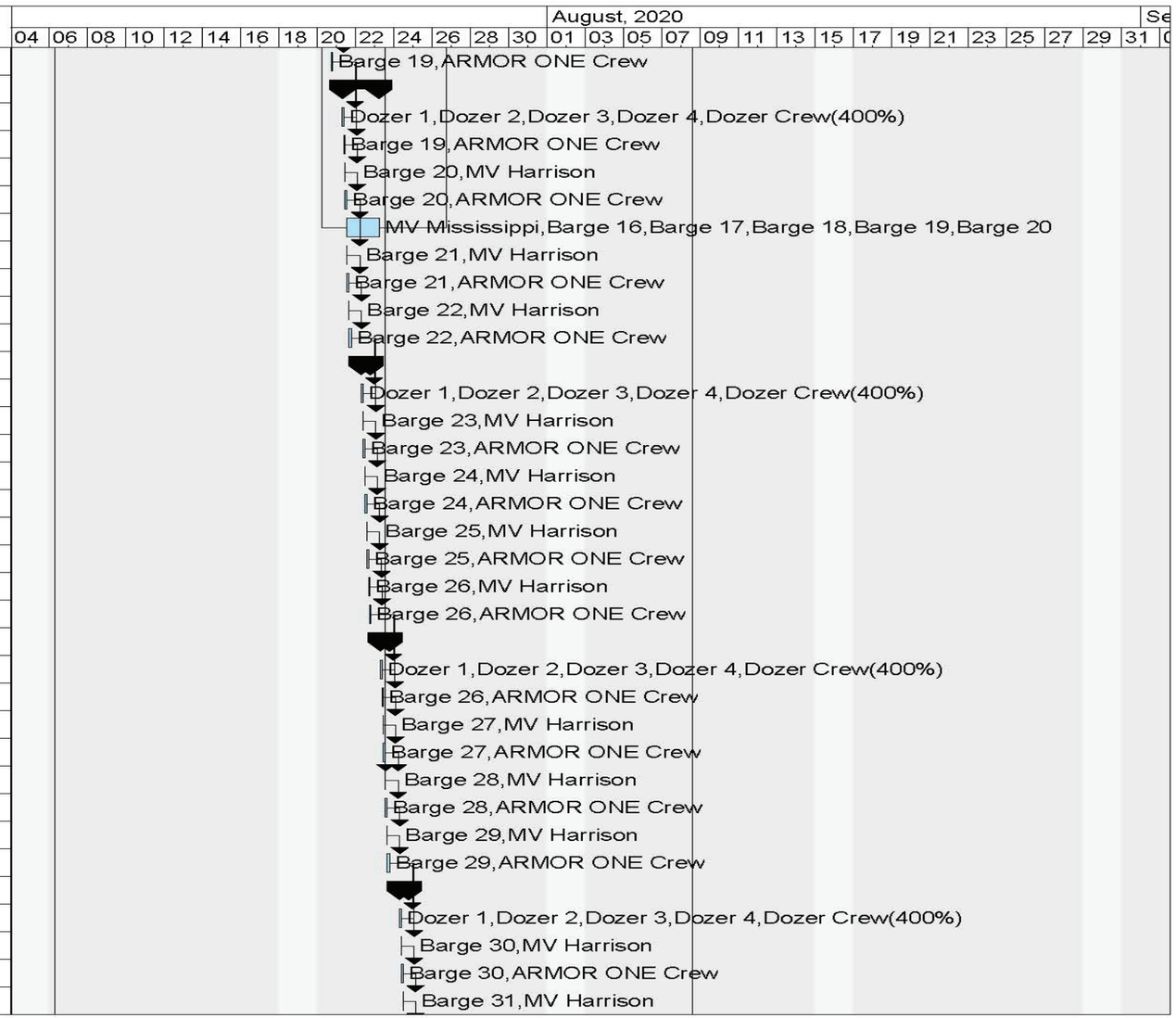
	Task Name
36	2nd Fleet of Barges Anchored at Memphis
37	**ACM Placement - 1st Day**
38	Land Anchors Installed - D1M
39	T1-B1 towed in place
40	T1-B1 Offloaded
41	T1-B2 towed in place
42	T1-B2 Offloaded
43	T1-B3 towed in place
44	T1-B3 Offloaded
45	T1-B4 towed in place
46	T1-B4 Offloaded (1/2)
47	**ACM Placement - 2nd Day**
48	Land Anchors Installed - D2M
49	T1-B4 Offloaded (1/2)
50	T1-B5 towed in place
51	T1-B5 Offloaded
52	T1-B6 towed in place
53	T1-B6 Offloaded
54	T1-B7 towed in place
55	T1-B7 Offloaded
56	**ACM Placement - 3rd Day**
57	Land Anchors Installed - D3M
58	T1-B8 towed in place
59	T1-B8 Offloaded
60	T1-B9 towed in place
61	T1-B9 Offloaded
62	T1-B10 towed in place
63	T1-B10 Offloaded
64	T1-B11 towed in place
65	T1-B11 Offloaded (1/2)
66	**ACM Placement - 4th Day**
67	Land Anchors Installed - D4M
68	T1-B11 Offloaded (1/2)
69	T1-B12 towed in place
70	T1-B12 Offloaded



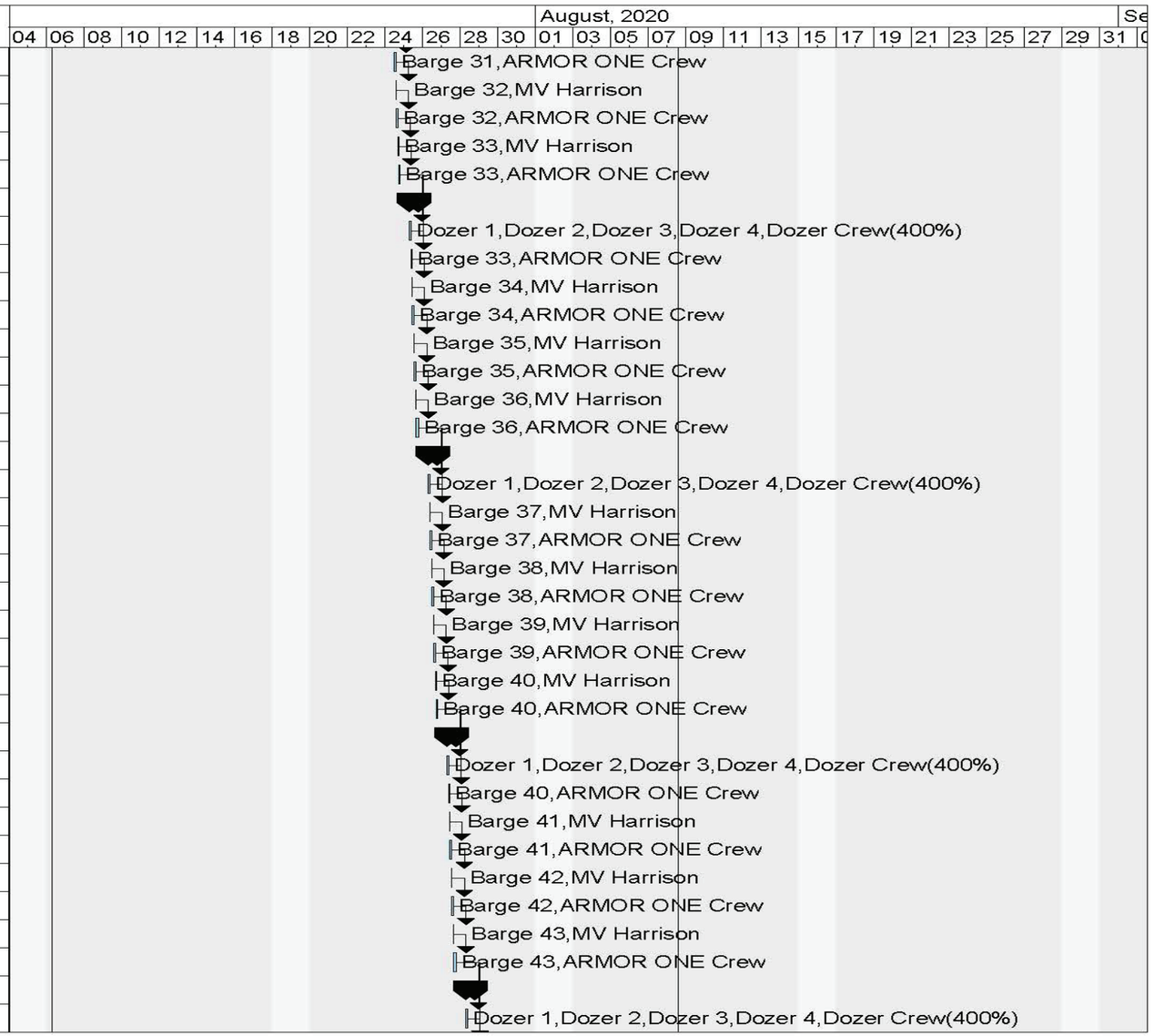
	Task Name
71	*Tow Barges 1-4 to Delta Yard*
72	*Tow Barges 5-12 to St. Francisville Yard from Delta Yard*
73	T2-B13 towed inplace
74	T2-B13 Offloaded
75	T2-B14 towed in place
76	T2-B14 Offloaded
77	**ACM Placement - 5th Day**
78	Land Anchors Installed - D5M
79	T2-B15 towed in place
80	T2-B15 Offloaded
81	**Relocate Floating Plant to Vicksburg**
82	Mat Anchor Barge towed to Vicksburg
83	Quarter Boat towed to Vicksburg
84	ARMOR ONE Anchor Barge towed to Vicksburg
85	ARMOR ONE Unit towed to Vicksburg
86	Dozers towed to Vicksburg
87	**Vicksburg Region**
88	**Mobilize Floating Plant for Vicksburg Region**
89	Mat Anchor Barge Moored in place at Vicksburg
90	Quarter Boat Moored in Place at Vicksburg
91	ARMOR ONE Anchor Barge Moored in place at Vicksburg
92	ARMOR ONE unit moored in place at Vicksburg
93	Dozers placed at Vicksburg
94	3rd Fleet of Barges Anchored
95	4th Fleet of Barges Anchored
96	5th Fleet of Barges Anchored
97	**ACM Placement - 1st Day Vicksburg**
98	Land Anchors Installed - D1V
99	T3-B16 towed in place
100	T3-B16 Offloaded
101	T3-B17 towed in place
102	T3-B17 Offloaded
103	T3-B18 towed in place
104	T3-B18 Offloaded
105	T3-B19 towed in place



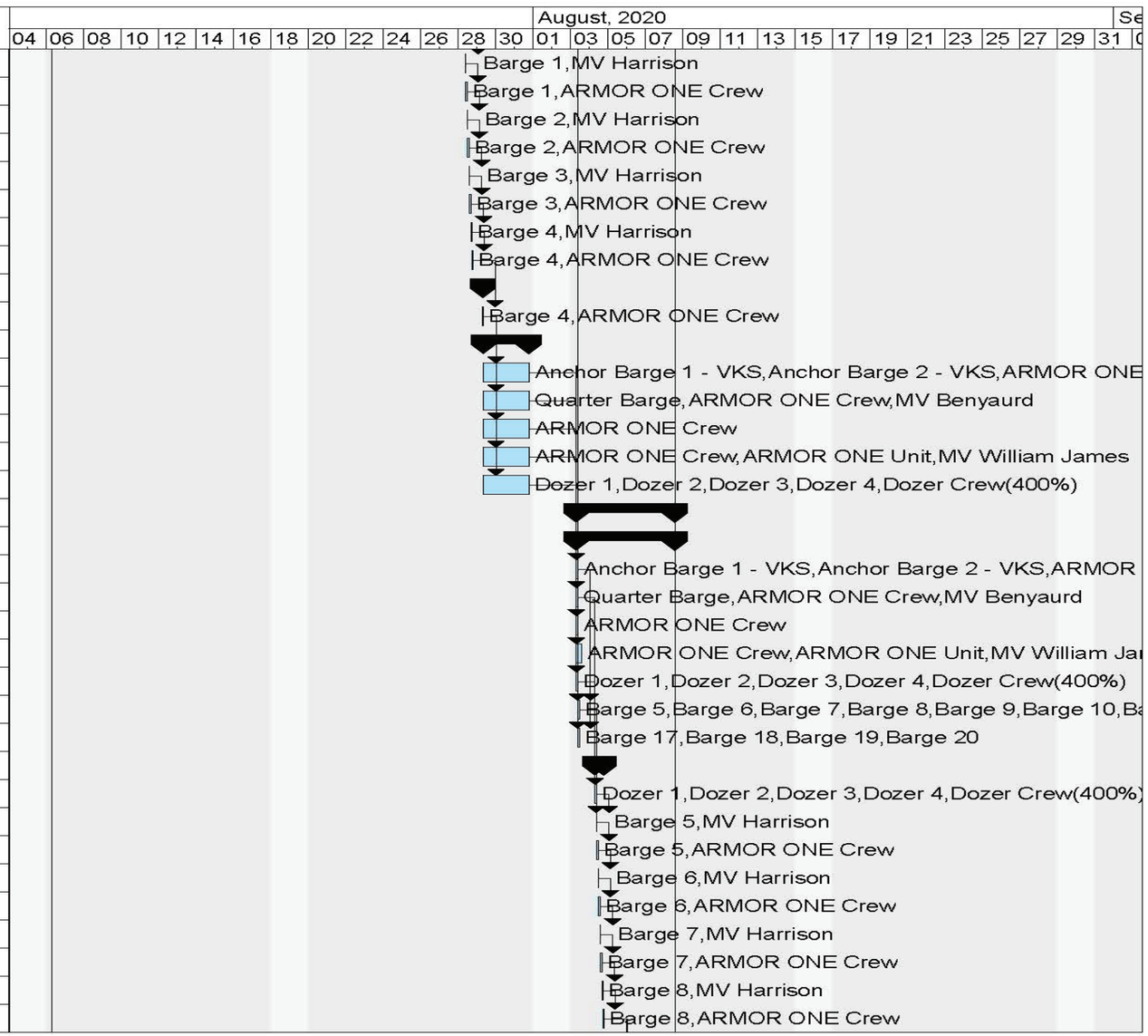
	Task Name
106	T3-B19 Offloaded (1/2)
107	**ACM Placement - 2nd Day Vicksburg**
108	Land Anchors Installed - D2V
109	T3-B19 Offloaded (1/2)
110	T3-B20 towed in place
111	T3-B20 Offloaded
112	*Tow Barges 16-20 to St. Francisville Yard*
113	T3-B21 towed in place
114	T3-B21 Offloaded
115	T3-B22 towed in place
116	T3-B22 Offloaded
117	**ACM Placement - 3rd Day Vicksburg**
118	Land Anchors Installed - D3V
119	T3-B23 towed in place
120	T3-B23 Offloaded
121	T3-B24 towed in place
122	T3-B24 Offloaded
123	T3-B25 towed in place
124	T3-B25 Offloaded
125	T3-B26 towed in place
126	T3-B26 Offloaded (1/2)
127	**ACM Placement - 4th Day Vicksburg**
128	Land Anchors Installed - D4V
129	T3-B26 Offloaded (1/2)
130	T3-B27 towed in place
131	T3-B27 Offloaded
132	T4-B28 towed inplace
133	T4-B28 Offloaded
134	T4-B29 towed in place
135	T4-B29 Offloaded
136	**ACM Placement - 5th Day Vicksburg**
137	Land Anchors Installed - D5V
138	T4-B30 towed in place
139	T4-B30 Offloaded
140	T4-B31 towed in place



	Task Name
141	T4-B31 Offloaded
142	T4-B32 towed in place
143	T4-B32 Offloaded
144	T4-B33 towed in place
145	T4-B33 Offloaded (1/2)
146	**ACM Placement - 6th Day Vicksburg**
147	Land Anchors Installed - D6V
148	T4-B33 Offloaded (1/2)
149	T4-B34 towed in place
150	T4-B34 Offloaded
151	T4-B35 towed in place
152	T4-B35 Offloaded
153	T4-B36 towed in place
154	T4-B36 Offloaded
155	**ACM Placement - 7th Day Vicksburg**
156	Land Anchors Installed - D7V
157	T4-B37 towed in place
158	T4-B37 Offloaded
159	T4-B38 towed in place
160	T4-B38 Offloaded
161	T4-B39 towed in place
162	T4-B39 Offloaded
163	T5-B40 towed in place
164	T5-B40 Offloaded (1/2)
165	**ACM Placement - 8th Day Vicksburg**
166	Land Anchors Installed - D8V
167	T5-B40 Offloaded (1/2)
168	T5-B41 towed in place
169	T5-B41 Offloaded
170	T5-B42 towed in place
171	T5-B42 Offloaded
172	T5-B43 towed in place
173	T5-B43 Offloaded
174	**ACM Placement - 9th Day Vicksburg**
175	Land Anchors Installed - D8V



	Task Name
176	T5-B1 towed in place
177	T5-B1 Offloaded
178	T5-B2 towed in place
179	T5-B2 Offloaded
180	T5-B3 towed in place
181	T5-B3 Offloaded
182	T5-B4 towed in place
183	T5-B4 Offloaded (1/2)
184	**ACM Placement - 10th Day Vicksburg**
185	T5-B4 Offloaded (1/2)
186	**Relocate Floating Plant to St. Francisville Region**
187	Mat Anchor Barge towed to St. Francisville Region
188	Quarter Boat towed to St. Francisville Region
189	ARMOR ONE Anchor Barge towed to St. Francisville Region
190	ARMOR ONE Unit towed to St. Francisville Region
191	Dozers towed to St. Francisville Region
192	**St. Francisville Region**
193	**Mobilize Floating Plant at St. Francisville Region**
194	Mat Anchor Barge Moored in place at St. F.
195	Quarter Boat Moored in Place at St. F.
196	ARMOR ONE Anchor Barge Moored in place at St. F.
197	ARMOR ONE unit moored in place at St. F.
198	Dozers placed at St. F.
199	6th Fleet of Barges Anchored at St. F.
200	7th Fleet of Barges Anchored at St. F.
201	**ACM Placement - 1st Day St. Francisville**
202	Land Anchors Installed - D1SF
203	T6-B5 towed in place
204	T6-B5 Offloaded
205	T6-B6 towed in place
206	T6-B6 Offloaded
207	T6-B7 towed in place
208	T6-B7 Offloaded
209	T6-B8 towed in place
210	T6-B8 Offloaded (1/2)



	Task Name
211	**ACM Placement 2nd Day St. Franisville**
212	Land Anchors Installed - D2SF
213	T6-B8 Offloaded (1/2)
214	T6-B9 towed in place
215	T6-B9 Offloaded
216	T6-B10 towed in place
217	T6-B10 Offloaded
218	T6-B11 towed in place
219	T6-B11 Offloaded
220	**ACM Placement 3rd Day St. Francisville**
221	Land Anchors Installed - D3SF
222	T6-B12 towed in place
223	T6-B12 Offloaded
224	T6-B13 towed in place
225	T6-B13 Offloaded
226	T6-B14 towed in place
227	T6-B14 Offloaded
228	T6-B15 towed in place
229	T6-B15 Offloaded (1/2)
230	**ACM Placement 4th Day St. Francisville**
231	Land Anchors Installed - D4SF
232	T6-B15 Offloaded (1/2)
233	T6-B16 towed in place
234	T6-B16 Offloaded
235	T7-B17 towed in place
236	T7-B17 Offloaded
237	T7-B18 towed in place
238	T7-B18 Offloaded
239	**ACM Placement 5th Day St. Francisville**
240	Land Anchors Installed - D4SF
241	T7-B19 towed in place
242	T7-B19 Offloaded
243	T7-B20 towed in place
244	T7-B20 Offloaded
245	**End of Season**

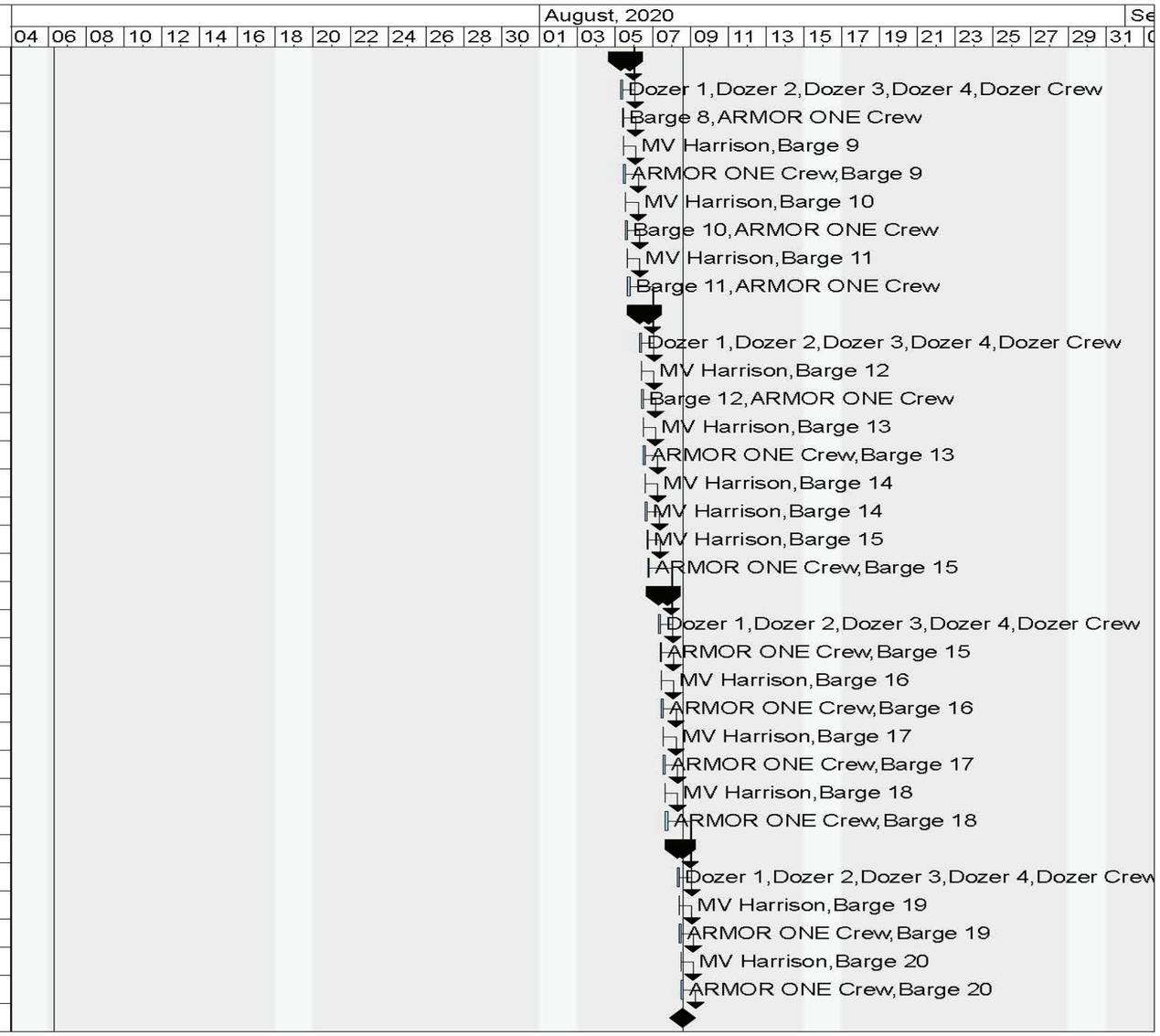
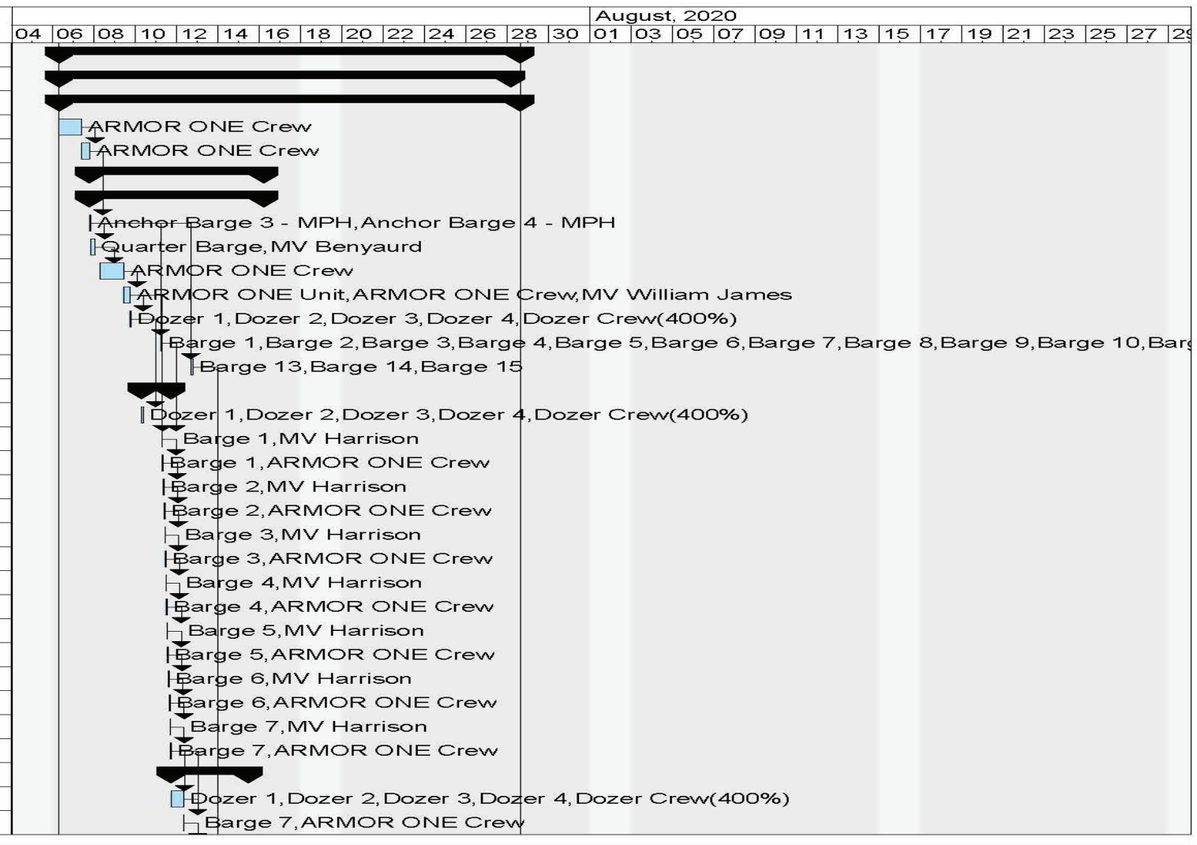


Figure A-2. Schedule of events for 4,000 squares/day.

Project Name Company	ARMOUR ONE - 4000mats per day	Date: 01/11/21 13:29

	Task Name
1	**BEGINNING OF SEASON**
2	**Mat Yard Mobilization**
26	**ACM Placement**
27	Training
28	Blessing of the Fleet
29	**Memphis Region**
30	**Mobilize Floating Plant for Memphis Region**
31	Mat Anchor Barge Moored in place at Memphis
32	Quarter Boat Moored in Place at Memphis
33	ARMOR ONE Anchor Barge Moored in place at Memphis
34	ARMOR ONE unit moored in place at Memphis
35	Dozers placed at Memphis
36	1st Fleet of Barges Anchored at Memphis
37	2nd Fleet of Barges Anchored at Memphis
38	**ACM Placement - 1st Day**
39	Land Anchors Installed - D1M
40	T1-B1 towed in place
41	T1-B1 Offloaded
42	T1-B2 towed in place
43	T1-B2 Offloaded
44	T1-B3 towed in place
45	T1-B3 Offloaded
46	T1-B4 towed in place
47	T1-B4 Offloaded
48	T1-B5 towed in place
49	T1-B5 Offloaded
50	T1-B6 towed in place
51	T1-B6 Offloaded
52	T1-B7 towed in place
53	T1-B7 Offloaded (3/4)
54	**ACM Placement - 2nd Day**
55	Land Anchors Installed - D2M
56	T1-B7 Offloaded (1/4)



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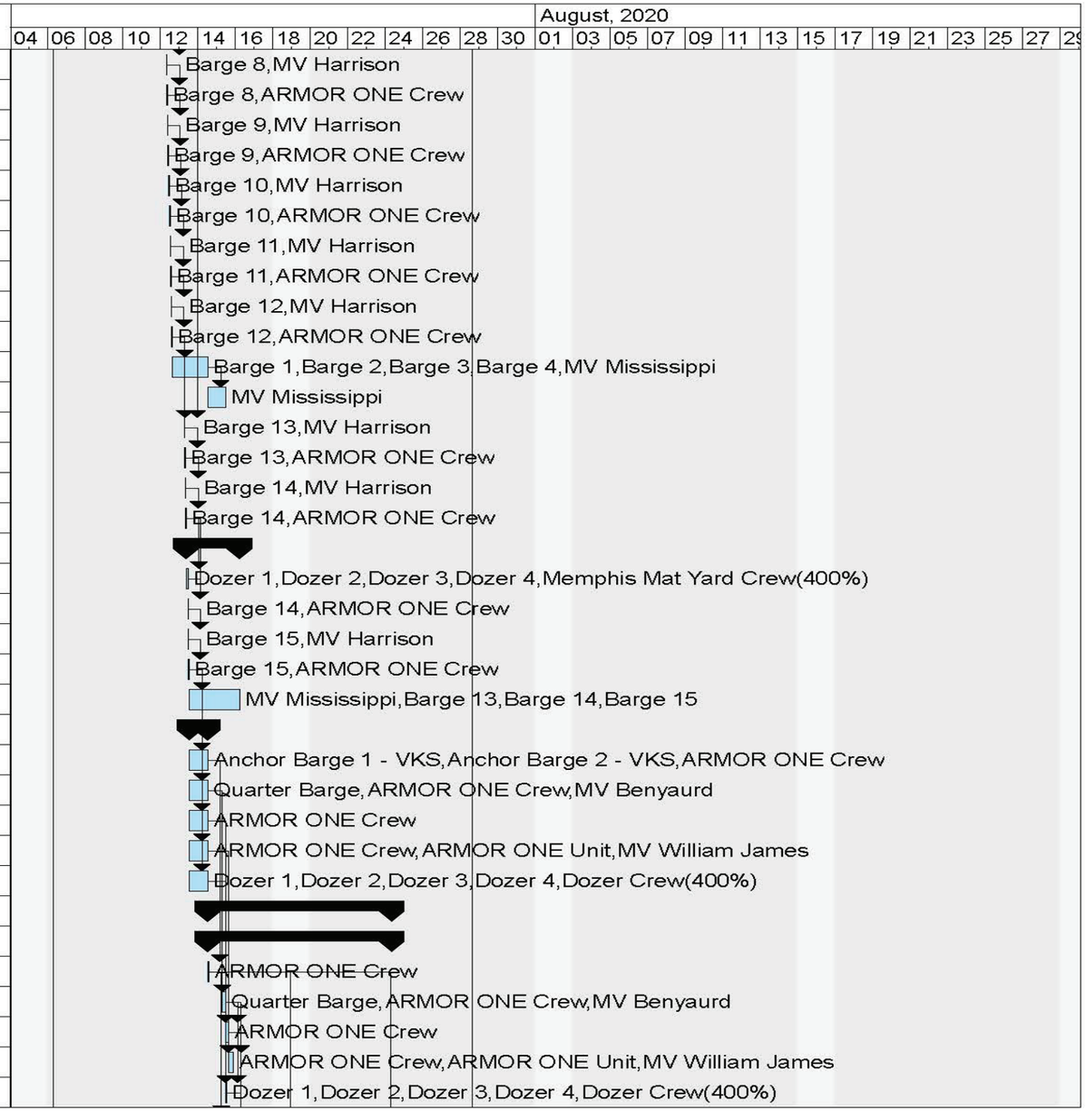
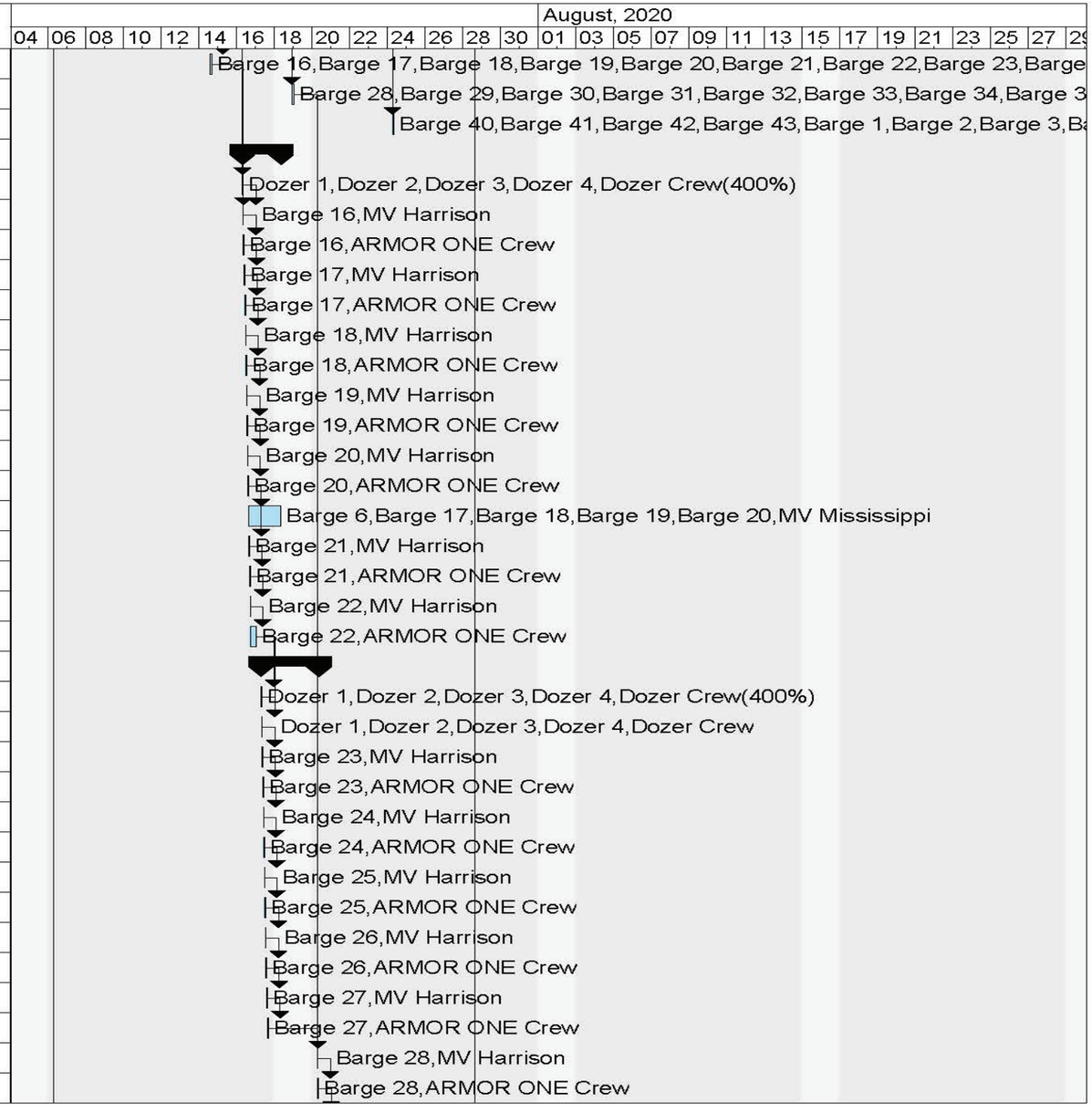
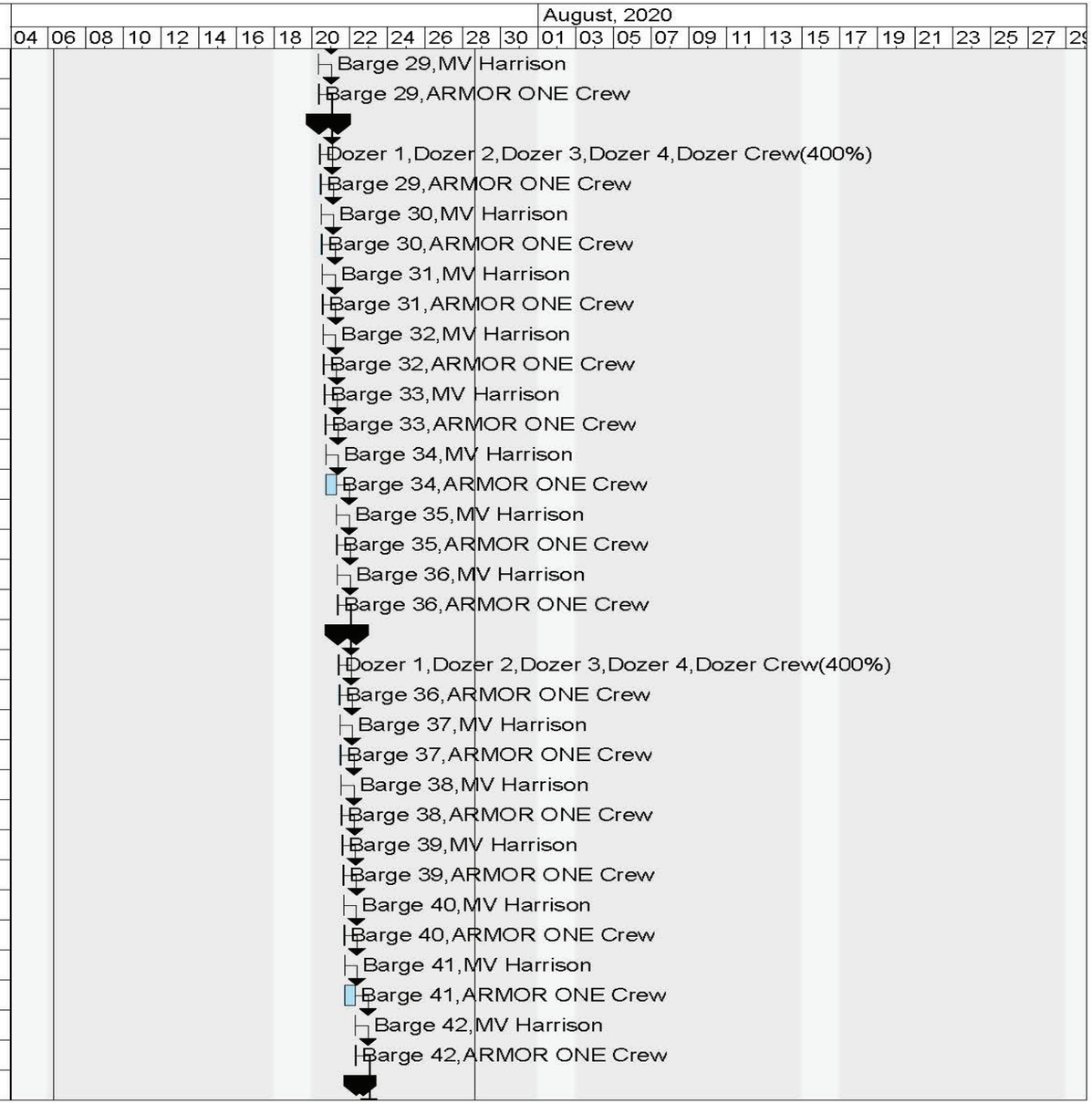
	Task Name
57	T1-B8 towed in place
58	T1-B8 Offloaded
59	T1-B9 towed in place
60	T1-B9 Offloaded
61	T1-B10 towed in place
62	T1-B10 Offloaded
63	T1-B11 towed in place
64	T1-B11 Offloaded
65	T1-B12 towed in place
66	T1-B12 Offloaded
67	*Tow Barges 1-4 to Delta Yard*
68	*Tow Barges 5-12 to St. Francisville Yard from Delta Yard*
69	T2-B13 towed in place
70	T2-B13 Offloaded
71	T2-B14 towed in place
72	T2-B14 Offloaded (1/2)
73	**ACM Placement - 3rd Day**
74	Land Anchors Installed - D3M
75	T2-B14 Offloaded (1/2)
76	T2-B15 towed in place
77	T2-B15 Offloaded
78	Tow Barges 13-15 to St. Francisville Yard from Memphis
79	**Relocate Floating Plant to Vicksburg**
80	Mat Anchor Barge towed to Vicksburg
81	Quarter Boat towed to Vicksburg
82	ARMOR ONE Anchor Barge towed to Vicksburg
83	ARMOR ONE Unit towed to Vicksburg
84	Dozers towed to Vicksburg
85	**Vicksburg Region**
86	**Mobilize Floating Plant for Vicksburg Region**
87	Mat Anchor Barge Moored in place at Vicksburg
88	Quarter Boat Moored in Place at Vicksburg
89	ARMOR ONE Anchor Barge Moored in place at Vicksburg
90	ARMOR ONE unit moored in place at Vicksburg
91	Dozers placed at Vicksburg



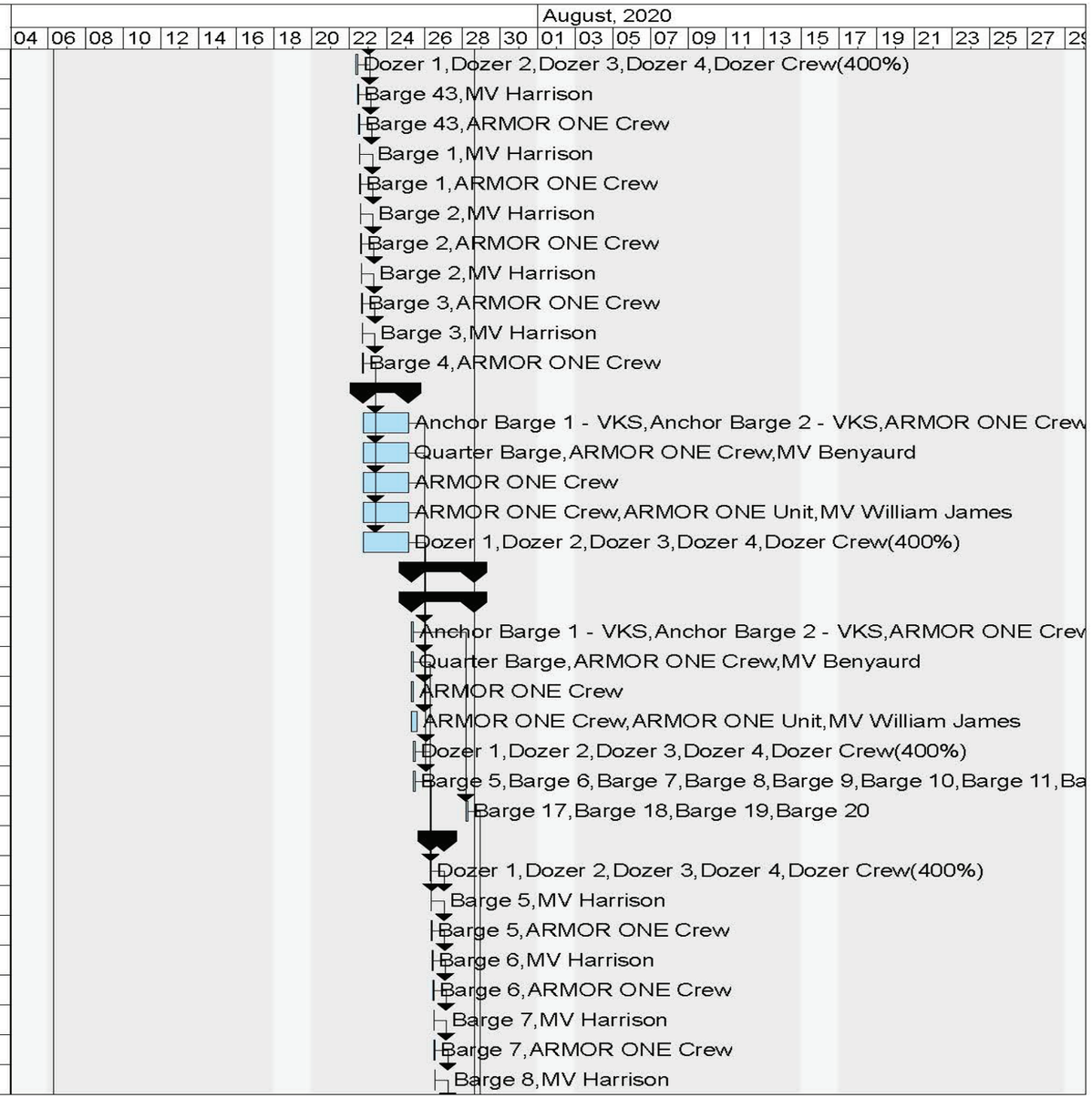
	Task Name
92	3rd Fleet of Barges Anchored
93	4th Fleet of Barges Anchored
94	5th Fleet of Barges Anchored
95	**ACM Placement - 1st Day**
96	Land Anchors Installed - D1V
97	T3-B16 towed in place
98	T3-B16 Offloaded
99	T3-B17 towed in place
100	T3-B17 Offloaded
101	T3-B18 towed in place
102	T3-B18 Offloaded
103	T3-B19 towed in place
104	T3-B19 Offloaded
105	T3-B20 towed in place
106	T3-B20 Offloaded
107	*Tow Barges 16-20 to St. Francisville Yard*
108	T3-B21 towed in place
109	T3-B21 Offloaded
110	T3-B22 towed in place
111	T3-B22 Offloaded (3/4)
112	**ACM Placement - 2nd Day**
113	Land Anchors Installed - D2V
114	T3-B22 Offloaded (1/4)
115	T3-B23 towed in place
116	T3-B23 Offloaded
117	T3-B24 towed in place
118	T3-B24 Offloaded
119	T3-B25 towed in place
120	T3-B25 Offloaded
121	T3-B26 towed in place
122	T3-B26 Offloaded
123	T3-B27 towed in place
124	T3-B27 Offloaded
125	T4-B28 towed in place
126	T4-B28 Offloaded



	Task Name
127	T4-B29 towed in place
128	T4-B29 Offloaded (1/2)
129	**ACM Placement - 3rd Day**
130	Land Anchors Installed - D3V
131	T4-B29 Offloaded (1/2)
132	T4-B30 towed in place
133	T4-B30 Offloaded
134	T4-B31 towed in place
135	T4-B31 Offloaded
136	T4-B32 towed in place
137	T4-B32 Offloaded
138	T4-B33 towed in place
139	T4-B33 Offloaded
140	T4-B34 towed in place
141	T4-B34 Offloaded
142	T4-B35 towed inplace
143	T4-B35 Offloaded
144	T4-B36 towed in place
145	T4-B36 Offloaded (1/4)
146	**ACM Placement - 4th Day**
147	Land Anchors Installed - D4V
148	T4-B36 Offloaded (3/4)
149	T4-B37 towed in place
150	T4-B37 Offloaded
151	T4-B38 towed in place
152	T4-B38 Offloaded
153	T4-B39 towed in place
154	T4-B39 Offloaded
155	T5-B40 towed in place
156	T5-B40 Offloaded
157	T5-B41 towed in place
158	T5-B41 Offloaded
159	T5-B42 towed in place
160	T5-B42 Offloaded
161	**ACM Placement - 5th Day**



	Task Name
162	Land Anchors Installed - D5V
163	T5-B43 towed in place
164	T5-B43 Offloaded
165	T5-B1 towed inplace
166	T5-B1 Offloaded
167	T5-B2 towed in place
168	T5-B2 Offloaded
169	T5-B2 towed in place
170	T5-B3 Offloaded
171	T5-B3 towed in place
172	T5-B4 Offloaded
173	**Relocate Floating Plant to St. Francisville Region**
174	Mat Anchor Barge towed to St. Francisville Region
175	Quarter Boat towed to St. Francisville Region
176	ARMOR ONE Anchor Barge towed to St. Francisville Region
177	ARMOR ONE Unit towed to St. Francisville Region
178	Dozers towed to St. Francisville Region
179	**St. Francisville Region**
180	**Mobilize Floating Plant at St. Francisville Region**
181	Mat Anchor Barge Moored in place at St. F.
182	Quarter Boat Moored in Place at St. F.
183	ARMOR ONE Anchor Barge Moored in place at St. F.
184	ARMOR ONE unit moored in place at St. F.
185	Dozers placed at St. F.
186	6th Fleet of Barges Anchored at St. F.
187	7th Fleet of Barges Anchored at St. F.
188	**ACM Placement - 1st Day St. Francisville**
189	Land Anchors Installed - D1SF
190	T6-B5 towed in place
191	T6-B5 Offloaded
192	T6-B6 towed in place
193	T6-B6 Offloaded
194	T6-B7 towed in place
195	T6-B7 Offloaded
196	T6-B8 towed in place



	Task Name
197	T6-B8 Offloaded
198	T6-B9 towed in place
199	T6-B9 Offloaded
200	T6-B10 towed in place
201	T6-B10 Offloaded
202	T6-B11 towed in place
203	T6-B11 Offloaded (3/4)
204	**ACM Placement 2nd Day St. Franisville**
205	Land Anchors Installed - D2SF
206	T6-B11 Offloaded (1/4)
207	T6-B12 towed in place
208	T6-B12 Offloaded
209	T6-B13 towed in place
210	T6-B13 Offloaded
211	T6-B14 towed in place
212	T6-B14 Offloaded
213	T6-B15 towed in place
214	T6-B15 Offloaded
215	T6-B16 towed in place
216	T6-B16 Offloaded
217	T7-B17 towed in place
218	T7-B17 Offloaded
219	T7-B18 towed in place
220	T7-B18 Offloaded (1/2)
221	**ACM Placement 3rd Day St. Francisville**
222	Land Anchors Installed - D3SF
223	T7-B18 Offloaded (1/2)
224	T7-B19 towed in place
225	T7-B19 Offloaded
226	T7-B20 towed in place
227	T7-B20 Offloaded
228	**End of Season**

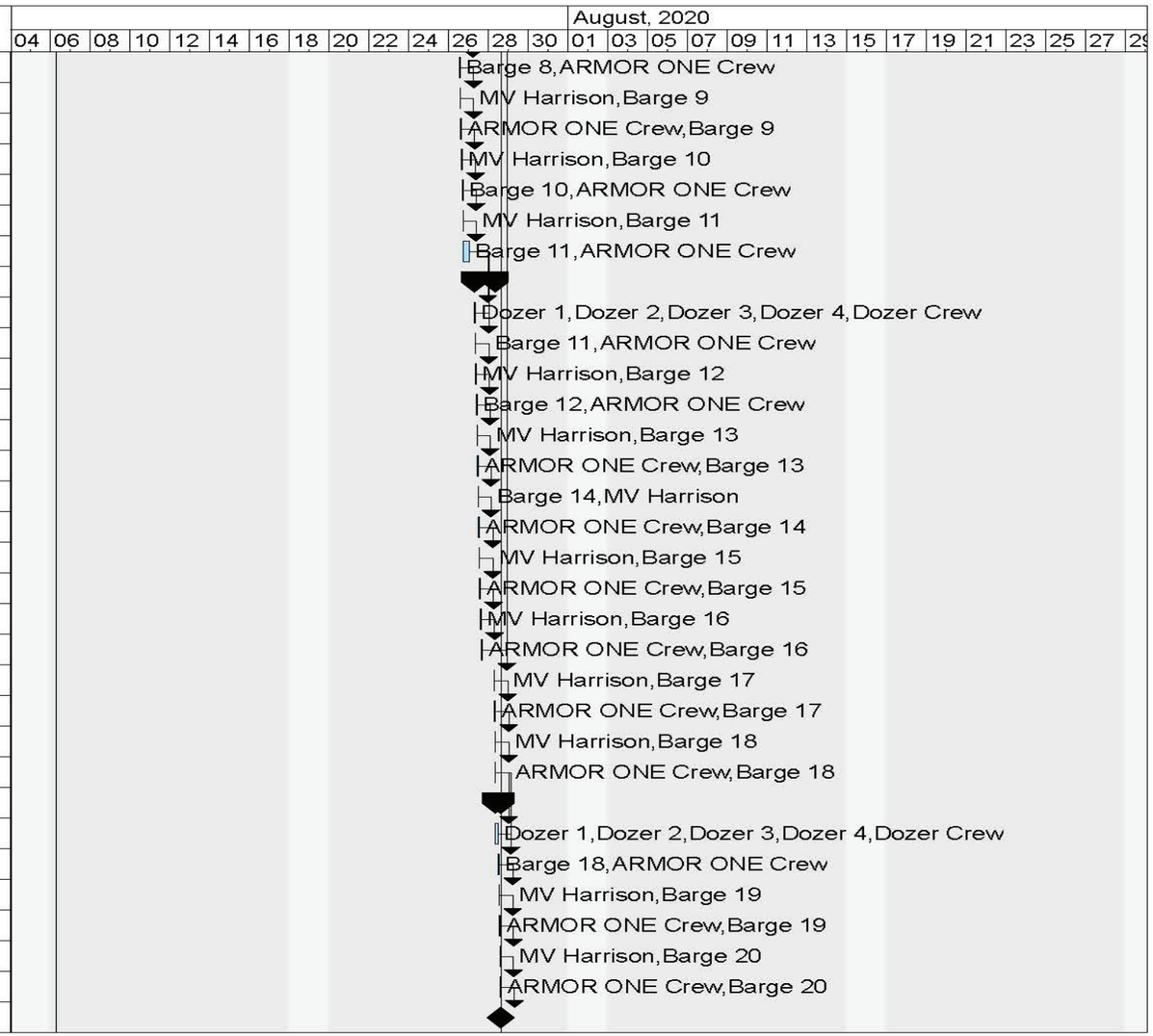
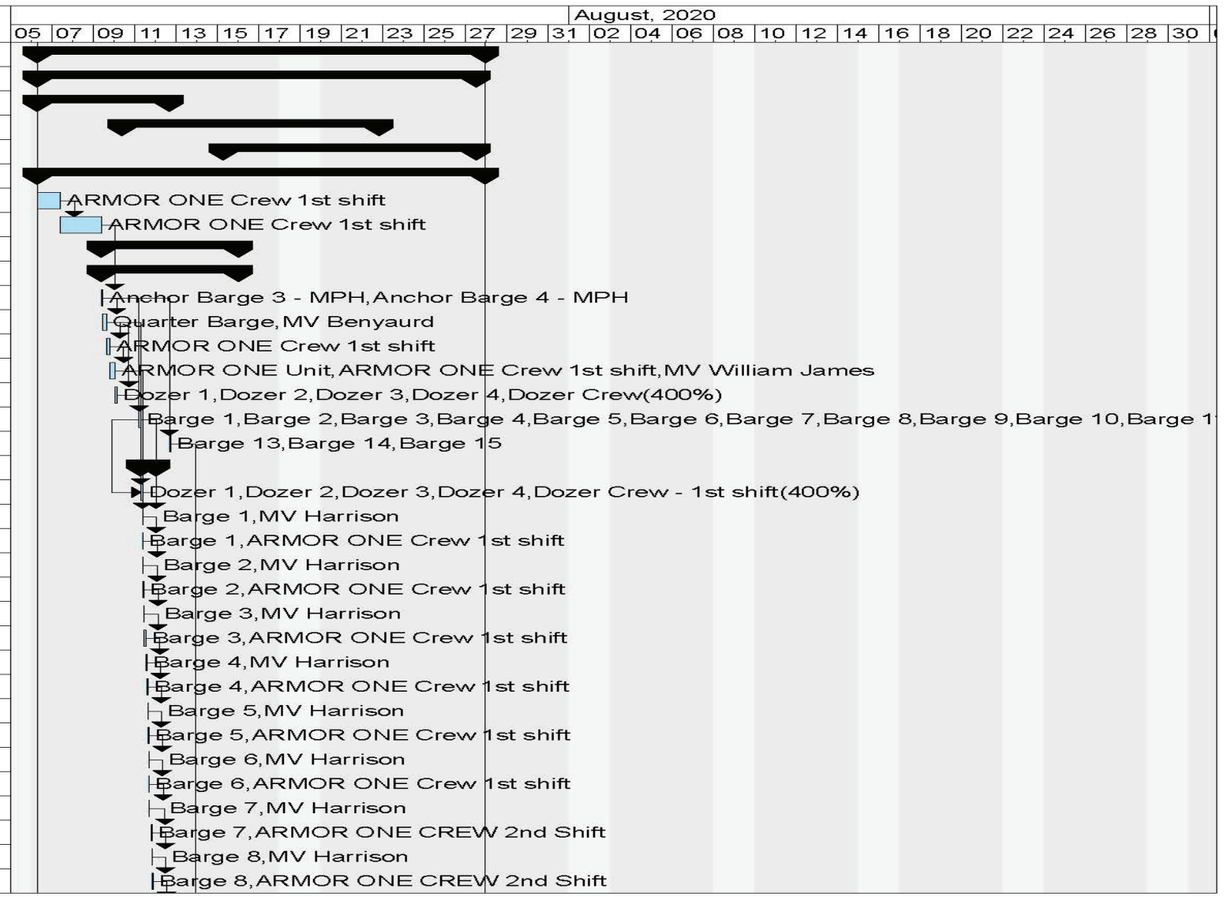


Figure A-3. Schedule of events for 6,000 squares/day.

Project Name	ARMOR 1 - 6000 Mats/day	Date: 01/11/21 13:30

	Task Name
1	**BEGINNING OF SEASON**
2	**Mat Yard Mobilization**
3	**Memphis Yard Mobilization**
10	**Delta Yard Mobilization**
19	**St. Francisville Yard Mobilization**
26	**ACM Placement**
27	Training
28	Blessing of the Fleet
29	**Memphis Region**
30	**Mobilize Floating Plant for Memphis Region**
31	Mat Anchor Barge Moored in place at Memphis
32	Quarter Boat Moored in Place at Memphis
33	ARMOR ONE Anchor Barge Moored in place at Memphis
34	ARMOR ONE unit moored in place at Memphis
35	Dozers placed at Memphis
36	1st Fleet of Barges Anchored at Memphis
37	2nd Fleet of Barges Anchored at Memphis
38	**ACM Placement - 1st Day**
39	Land Anchors Installed - D1M
40	T1-B1 towed in place
41	T1-B1 Offloaded
42	T1-B2 towed in place
43	T1-B2 Offloaded
44	T1-B3 towed in place
45	T1-B3 Offloaded
46	T1-B4 towed in place
47	T1-B4 Offloaded
48	T1-B5 towed in place
49	T1-B5 Offloaded
50	T1-B6 towed in place
51	T1-B6 Offloaded
52	T1-B7 towed in place
53	T1-B7 Offloaded
54	T1-B8 towed in place
55	T1-B8 Offloaded



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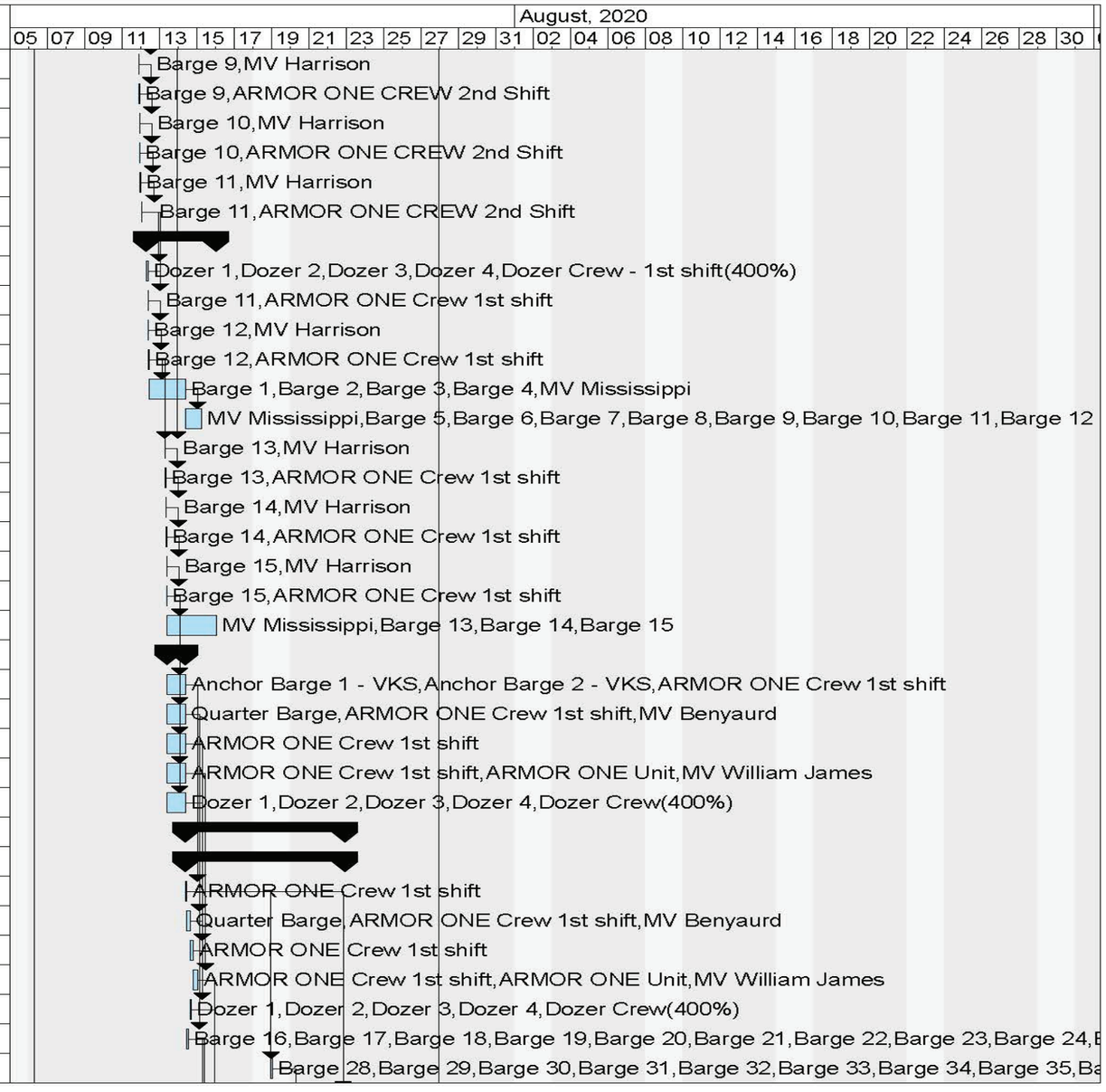
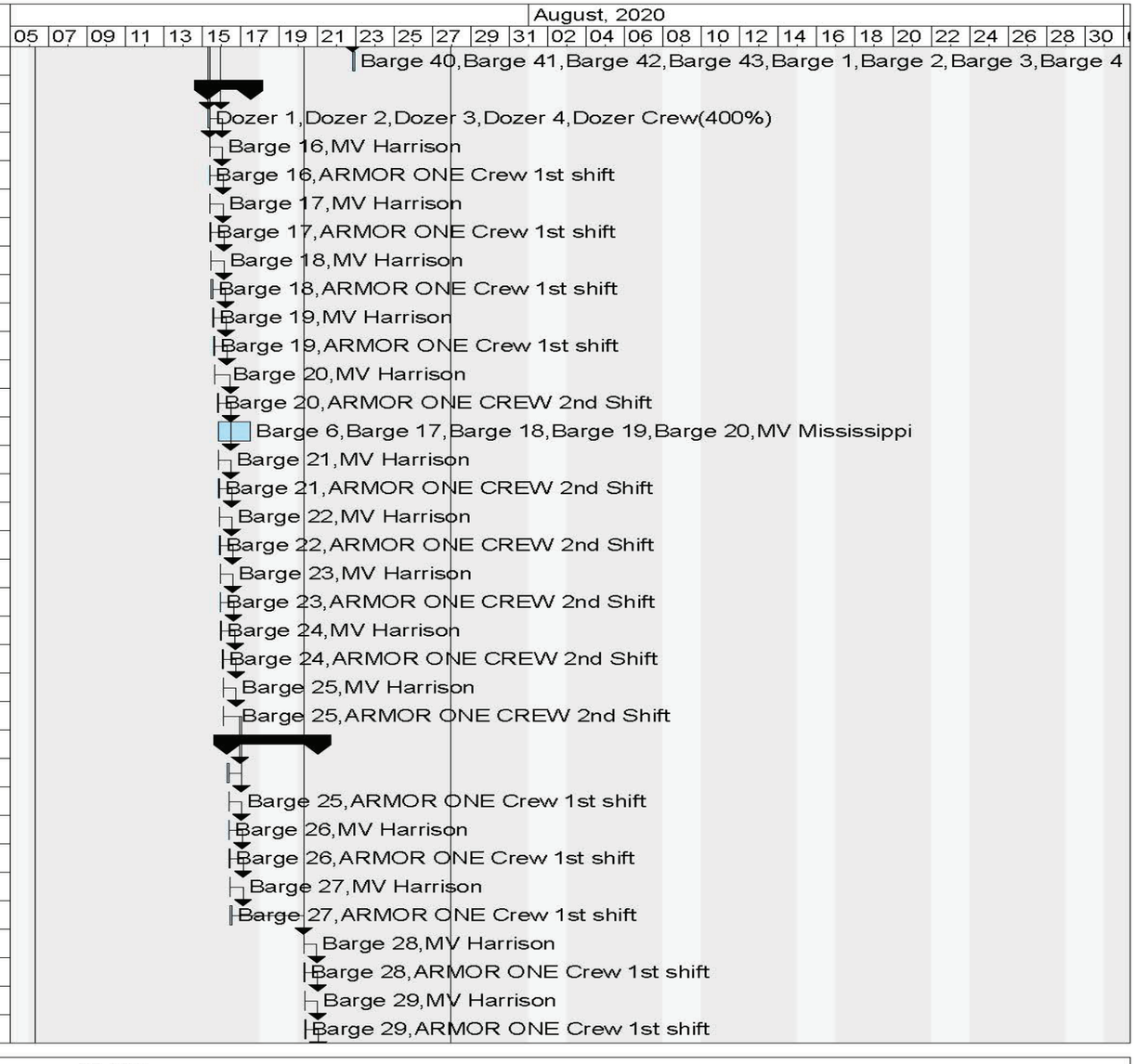
Project Name	ARMOR 1 - 6000 Mats/day	Date: 01/11/21 13:30

	Task Name
56	T1-B9 towed in place
57	T1-B9 Offloaded
58	T1-B10 towed in place
59	T1-B10 Offloaded
60	T1-B11 towed in place
61	T1-B11 Offloaded (1/4)
62	**ACM Placement - 2nd Day**
63	Land Anchors Installed - D2M
64	T1-B11 Offloaded (3/4)
65	T1-B12 towed in place
66	T1-B12 Offloaded
67	*Tow Barges 1-4 to Delta Yard*
68	*Tow Barges 5-12 to St. Francisville Yard from Delta Yard*
69	T2-B13 towed in place
70	T2-B13 Offloaded
71	T2-B14 towed in place
72	T2-B14 Offloaded
73	T2-B15 towed in place
74	T2-B15 Offloaded
75	*Tow Barges 13-15 to St. Francisville Yard from Memphis*
76	**Relocate Floating Plant to Vicksburg**
77	Mat Anchor Barge towed to Vicksburg
78	Quarter Boat towed to Vicksburg
79	ARMOR ONE Anchor Barge towed to Vicksburg
80	ARMOR ONE Unit towed to Vicksburg
81	Dozers towed to Vicksburg
82	**Vicksburg Region**
83	**Mobilize Floating Plant for Vicksburg Region**
84	Mat Anchor Barge Moored in place at Vicksburg
85	Quarter Boat Moored in Place at Vicksburg
86	ARMOR ONE Anchor Barge Moored in place at Vicksburg
87	ARMOR ONE unit moored in place at Vicksburg
88	Dozers placed at Vicksburg
89	3rd Fleet of Barges Anchored
90	4th Fleet of Barges Anchored



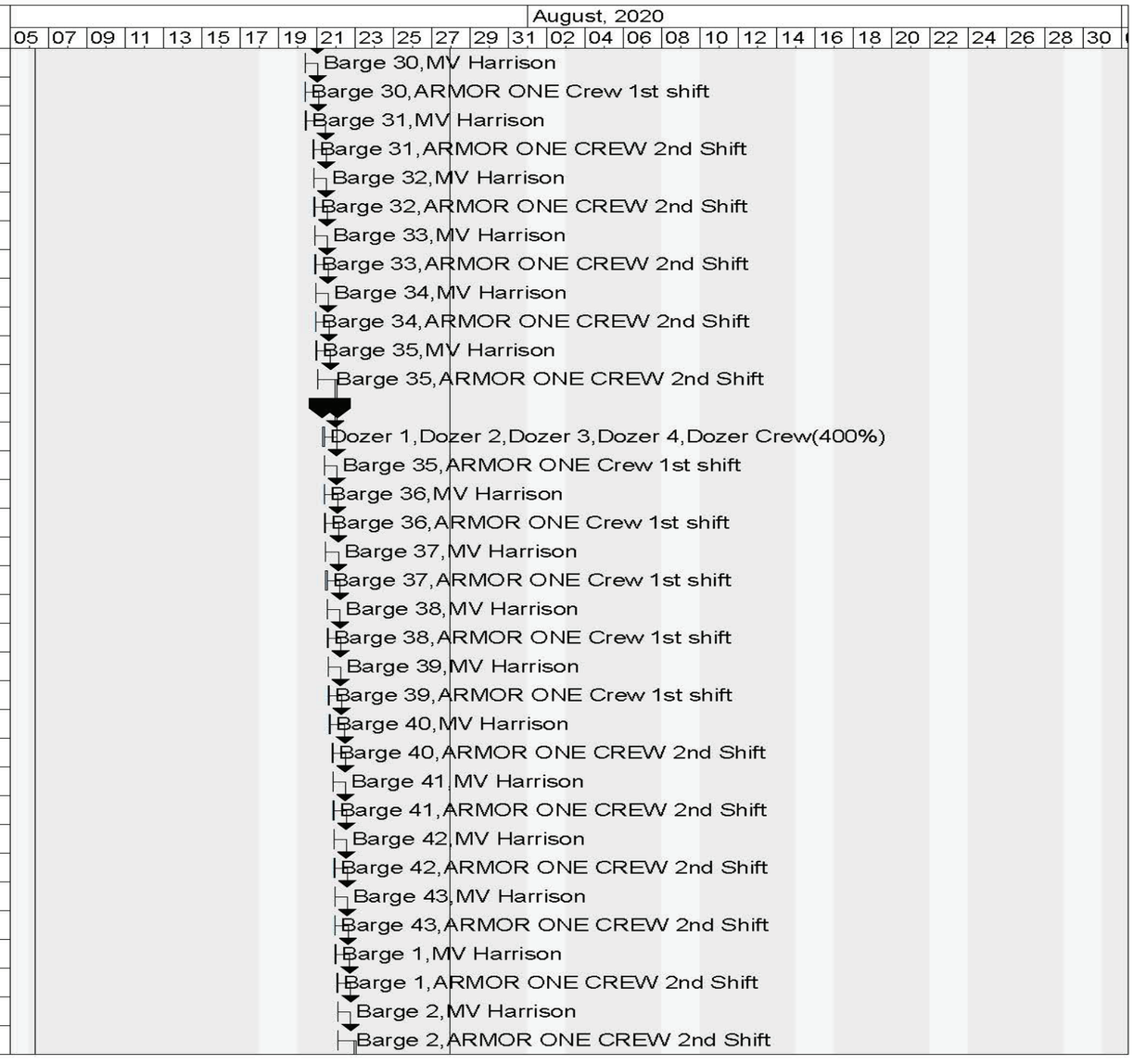
Project Name	ARMOR 1 - 6000 Mats/day	Date: 01/11/21 13:30

	Task Name
91	5th Fleet of Barges Anchored
92	**ACM Placement - 1st Day**
93	Land Anchors Installed - D1V
94	T3-B16 towed in place
95	T3-B16 Offloaded
96	T3-B17 towed in place
97	T3-B17 Offloaded
98	T3-B18 towed in place
99	T3-B18 Offloaded
100	T3-B19 towed in place
101	T3-B19 Offloaded
102	T3-B20 towed in place
103	T3-B20 Offloaded
104	*Tow Barges 16-20 to St. Francisville Yard*
105	T3-B21 towed in place
106	T3-B21 Offloaded
107	T3-B22 towed in place
108	T3-B22 Offloaded
109	T3-B23 towed in place
110	T3-B23 Offloaded
111	T3-B24 towed in place
112	T3-B24 Offloaded
113	T3-B25 towed in place
114	T3-B25 Offloaded (1/4)
115	**ACM Placement - 2nd Day**
116	Land Anchors Installed - D2V
117	T3-B25 Offloaded (3/4)
118	T3-B26 towed in place
119	T3-B26 Offloaded
120	T3-B27 towed in place
121	T3-B27 Offloaded
122	T4-B28 towed in place
123	T4-B28 Offloaded
124	T4-B29 towed in place
125	T4-B29 Offloaded



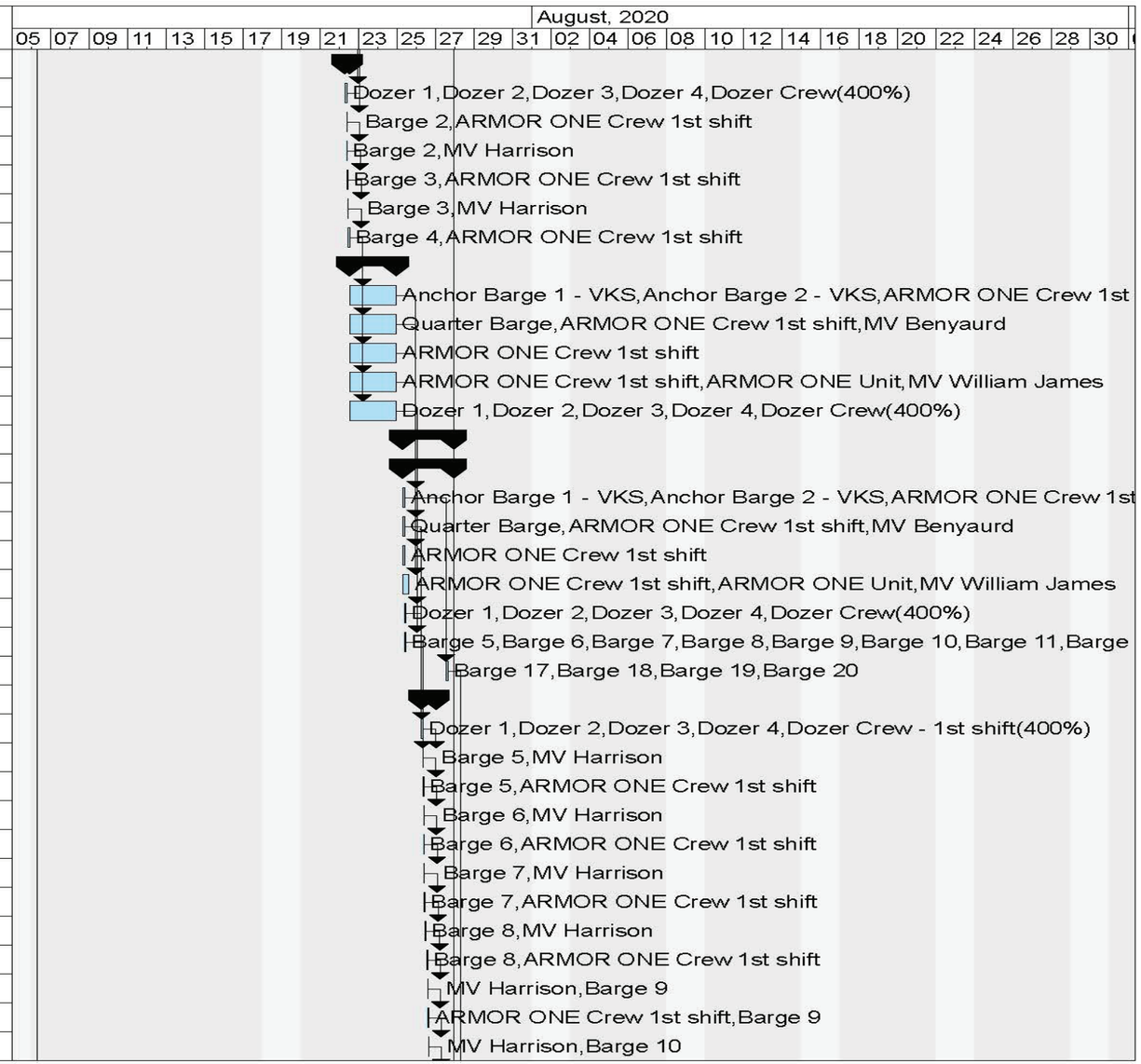
Project Name	ARMOR 1 - 6000 Mats/day	Date: 01/11/21 13:30

	Task Name
126	T4-B30 towed in place
127	T4-B30 Offloaded
128	T4-B31 towed in place
129	T4-B31 Offloaded
130	T4-B32 towed in place
131	T4-B32 Offloaded
132	T4-B33 towed in place
133	T4-B33 Offloaded
134	T4-B34 towed in place
135	T4-B34 Offloaded
136	T4-B35 towed inplace
137	T4-B35 Offloaded (1/4)
138	**ACM Placement - 3rd Day**
139	Land Anchors Installed - D3V
140	T4-B35 Offloaded (3/4)
141	T4-B36 towed in place
142	T4-B36 Offloaded
143	T4-B37 towed in place
144	T4-B37 Offloaded
145	T4-B38 towed in place
146	T4-B38 Offloaded
147	T4-B39 towed in place
148	T4-B39 Offloaded
149	T5-B40 towed in place
150	T5-B40 Offloaded
151	T5-B41 towed in place
152	T5-B41 Offloaded
153	T5-B42 towed in place
154	T5-B42 Offloaded
155	T5-B43 towed in place
156	T5-B43 Offloaded
157	T5-B1 towed inplace
158	T5-B1 Offloaded
159	T5-B2 towed in place
160	T5-B2 Offloaded (1/4)



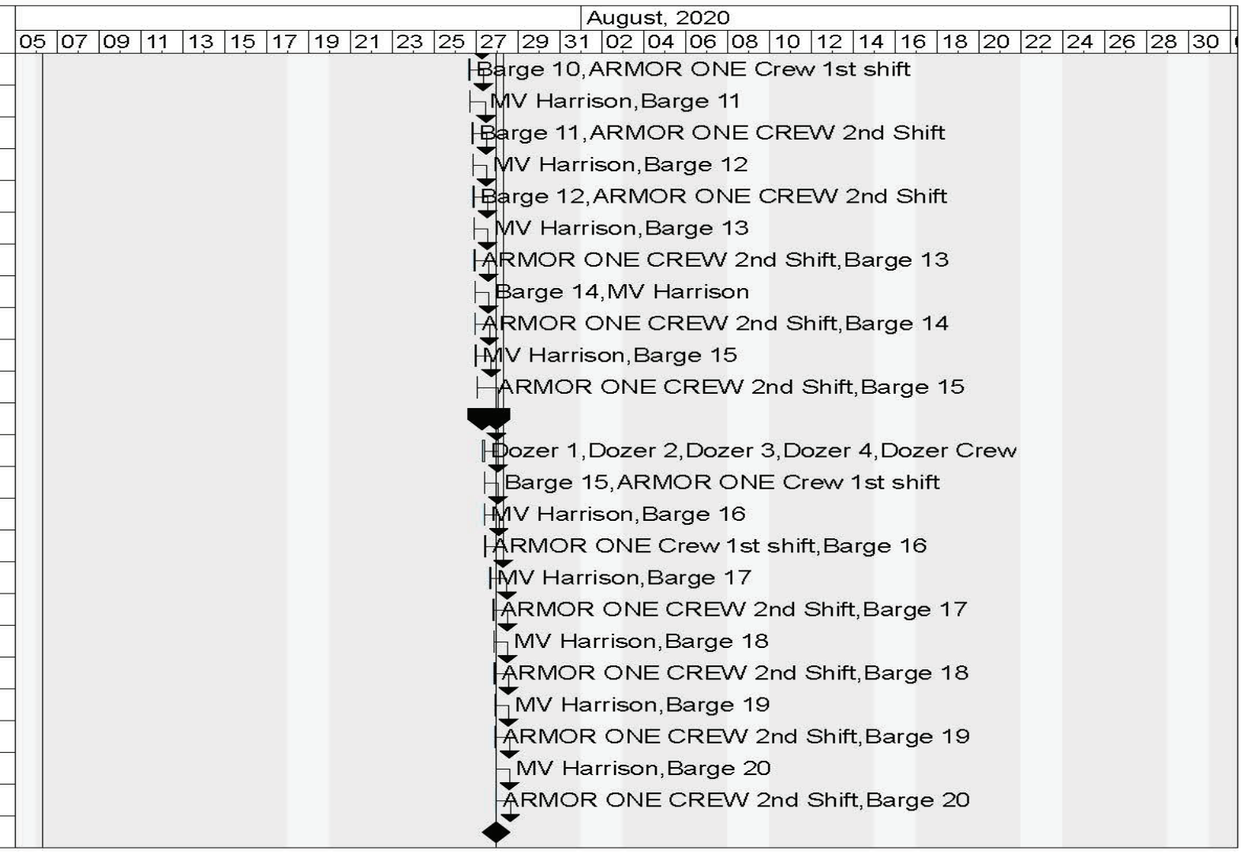
Project Name	ARMOR 1 - 6000 Mats/day	Date: 01/11/21 13:30

	Task Name
161	**ACM Placement - 4th Day**
162	Land Anchors Installed - D4V
163	T5-B2 Offloaded (3/4)
164	T5-B2 towed in place
165	T5-B3 Offloaded
166	T5-B3 towed in place
167	T5-B4 Offloaded
168	**Relocate Floating Plant to St. Francisville Region**
169	Mat Anchor Barge towed to St. Francisville Region
170	Quarter Boat towed to St. Francisville Region
171	ARMOR ONE Anchor Barge towed to St. Francisville Region
172	ARMOR ONE Unit towed to St. Francisville Region
173	Dozers towed to St. Francisville Region
174	**St. Francisville Region**
175	**Mobilize Floating Plant at St. Francisville Region**
176	Mat Anchor Barge Moored in place at St. F.
177	Quarter Boat Moored in Place at St. F.
178	ARMOR ONE Anchor Barge Moored in place at St. F.
179	ARMOR ONE unit moored in place at St. F.
180	Dozers placed at St. F.
181	6th Fleet of Barges Anchored at St. F.
182	7th Fleet of Barges Anchored at St. F.
183	**ACM Placement - 1st Day St. Francisville**
184	Land Anchors Installed - D1SF
185	T6-B5 towed in place
186	T6-B5 Offloaded
187	T6-B6 towed in place
188	T6-B6 Offloaded
189	T6-B7 towed in place
190	T6-B7 Offloaded
191	T6-B8 towed in place
192	T6-B8 Offloaded
193	T6-B9 towed in place
194	T6-B9 Offloaded
195	T6-B10 towed in place



Project Name	ARMOR 1 - 6000 Mats/day	Date: 01/11/21 13:30

	Task Name
196	T6-B10 Offloaded
197	T6-B11 towed in place
198	T6-B11 Offloaded
199	T6-B12 towed in place
200	T6-B12 Offloaded
201	T6-B13 towed in place
202	T6-B13 Offloaded
203	T6-B14 towed in place
204	T6-B14 Offloaded
205	T6-B15 towed in place
206	T6-B15 Offloaded (1/4)
207	**ACM Placement 2nd Day St. Franisville**
208	Land Anchors Installed - D2SF
209	T6-B15 Offloaded (3/4)
210	T6-B16 towed in place
211	T6-B16 Offloaded
212	T7-B17 towed in place
213	T7-B17 Offloaded
214	T7-B18 towed in place
215	T7-B18 Offloaded
216	T7-B19 towed in place
217	T7-B19 Offloaded
218	T7-B20 towed in place
219	T7-B20 Offloaded
220	**End of Season**

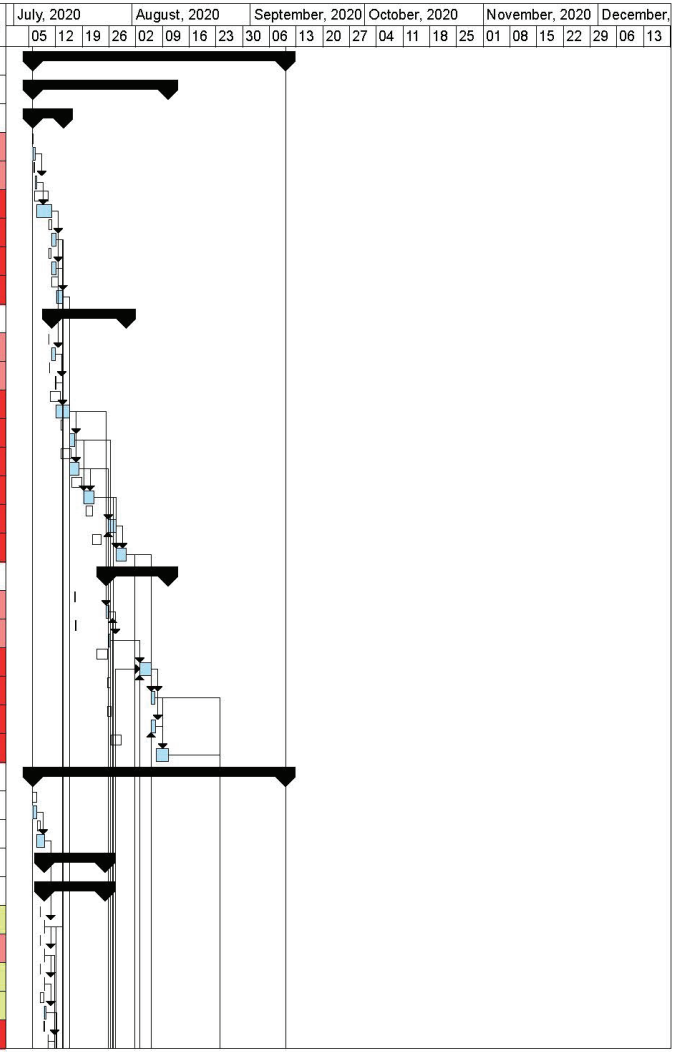


Appendix B: Schedules with Risks Calculated

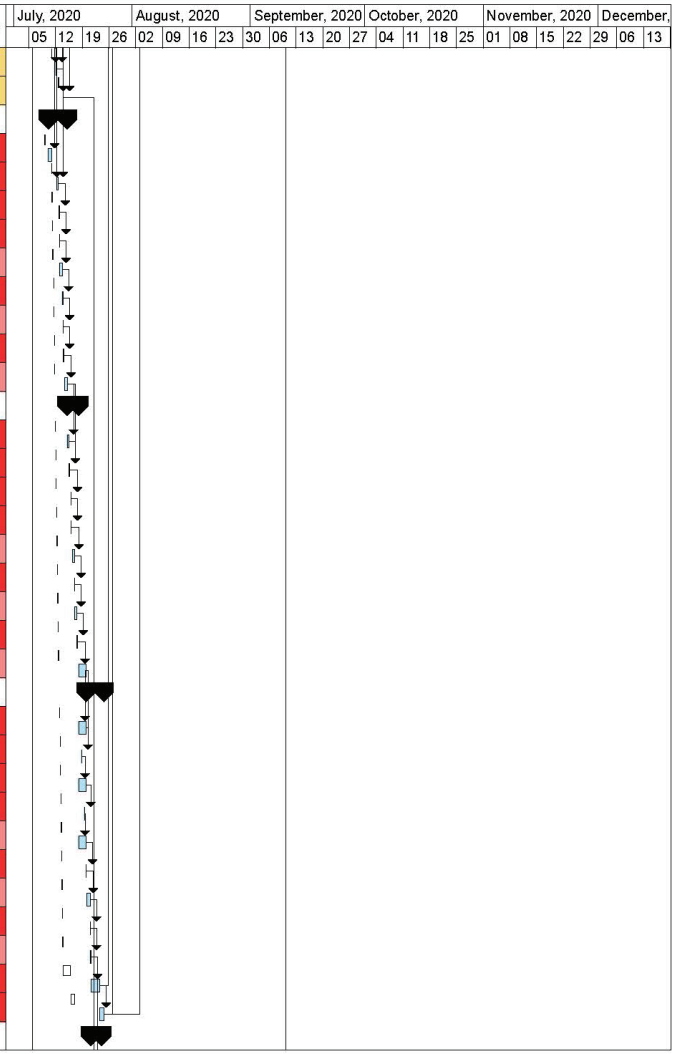
Figures B-1 through B-4 present schedules with risks calculated.

Figure B-1. Schedule of events with risks calculated for the current schedule.

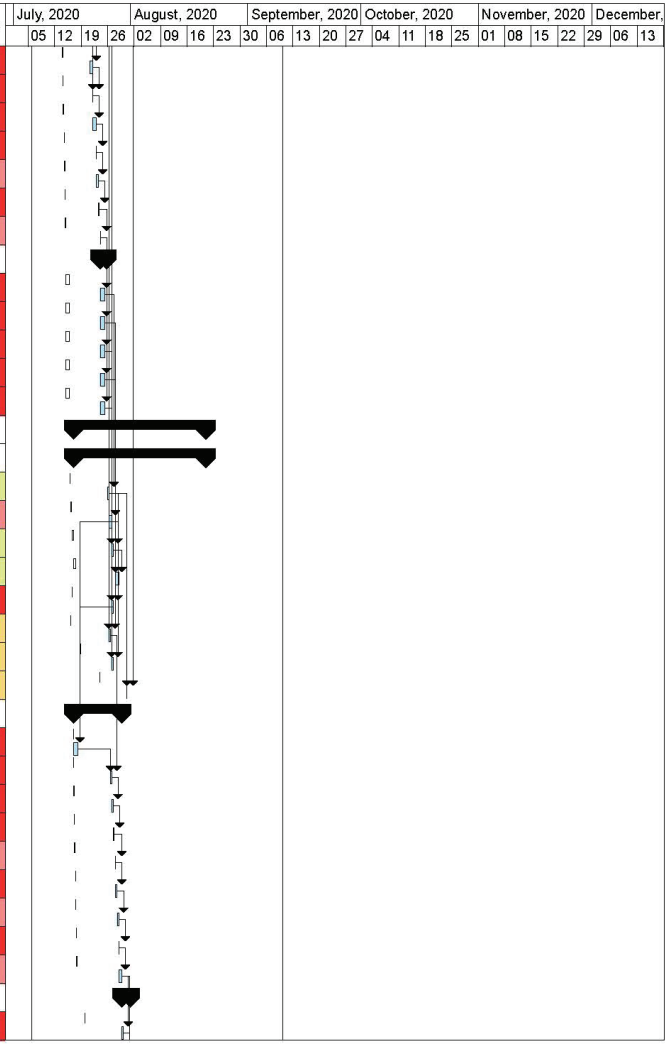
	Task Name	Low Dur	Mean Dur	High Dur	Risks
1	**BEGINNING OF SEASON**	**281.13 hr**	**574.05 hr**	**2482.88 hr**	**0**
2	**Mat Yard Mobilization**	**203.15 hr**	**306 hr**	**941 hr**	**0**
3	**Memphis Yard Mobilization**	**51 hr**	**71 hr**	**168.07 hr**	**0**
4	Tie off empty barges at Memphis Yard	2.1 hr	7.68 hr	34.68 hr	8
5	Lash and Prep loaded barges for transport at Memphis Yard	2.28 hr	2.3 hr	40.07 hr	8
6	Load Mats on Barges 1-12 at Memphis Yard	24.65 hr	31 hr	50.35 hr	18
7	Tow 1st Fleet of Barges from Richardson Landing to Memphis Re	20.75 hr	25.57 hr	29.58 hr	28
8	Load Mats on Barges 13-15 at Memphis Yard	6.58 hr	10 hr	18.97 hr	18
9	Tow 2nd Fleet of Barges from Richardson Landing to Memphis R	36.05 hr	39.92 hr	53 hr	28
10	**Delta Yard Mobilization**	**121.97 hr**	**175 hr**	**465.9 hr**	**0**
11	Tie off empty barges at Delta Yard	2.53 hr	9.85 hr	36.18 hr	8
12	Lash and Prep loaded barges for transport at Delta Yard	2.5 hr	2.5 hr	40.3 hr	8
13	Load Mats on Barges 16-27 at Delta Yard	28.2 hr	35.5 hr	58.25 hr	18
14	Tow 3rd Fleet of Barges from Delta Yard to Vicksburg	21.42 hr	26.47 hr	40.35 hr	28
15	Load Mats on Barges 28-39 at Delta Yard	27.6 hr	27.6 hr	49.4 hr	18
16	Tow 4th Fleet of Barges from Delta Yard to Vicksburg	61.35 hr	66.45 hr	73.47 hr	28
17	Load Mats on Barges 40-43, 1-4 at Delta Yard	16.1 hr	21.6 hr	31.33 hr	18
18	Tow 5th Fleet of Barges from Delta Yard to Vicksburg	59.08 hr	66.37 hr	93.28 hr	28
19	**St. Francisville Yard Mobilization**	**102.15 hr**	**141.07 hr**	**400 hr**	**0**
20	Tie off empty barges at St. Francisville Yard	2.15 hr	6.07 hr	10.45 hr	8
21	Lash and Prep loaded barges for transport at St. Francisville Yarc	2.68 hr	4.17 hr	37.02 hr	8
22	Load Mats on Barges 5-16 at St. Francisville Yard	28.1 hr	30 hr	45.83 hr	18
23	Tow 6th Fleet of Barges from St. Francisville to New Orleans	21.92 hr	25.78 hr	53.65 hr	28
24	Loat Mats on Barges 17-20 at St. Francisville Yard	8.7 hr	11.15 hr	24.78 hr	18
25	Tow 7th Fleet of Barges from St. Francisville to New Orleans	69.72 hr	73.47 hr	107.13 hr	28
26	**ACM Placement**	**281.13 hr**	**574.05 hr**	**2482.88 hr**	**0**
27	Training	10.17 hr	11.98 hr	13.93 hr	0
28	Blessing of the Fleet	7.18 hr	9.02 hr	28.98 hr	0
29	**Memphis Region**	**83.65 hr**	**140.85 hr**	**550.63 hr**	**0**
30	**Mobilize Floating Plant for Memphis Region**	**83.65 hr**	**140.85 hr**	**550.63 hr**	**0**
31	Mat Anchor Barge Moored in place at Memphis	1.62 hr	4.68 hr	25.58 hr	4
32	Quarter Boat Moored in Place at Memphis	3.27 hr	7.08 hr	19.73 hr	8
33	ARMOR ONE Anchor Barge Moored in place at Memphis	4.85 hr	6.55 hr	15.6 hr	4
34	ARMOR ONE unit moored in place at Memphis	5.32 hr	8.3 hr	29.78 hr	4
35	Dozers placed at Memphis	2.18 hr	2.18 hr	30.78 hr	12



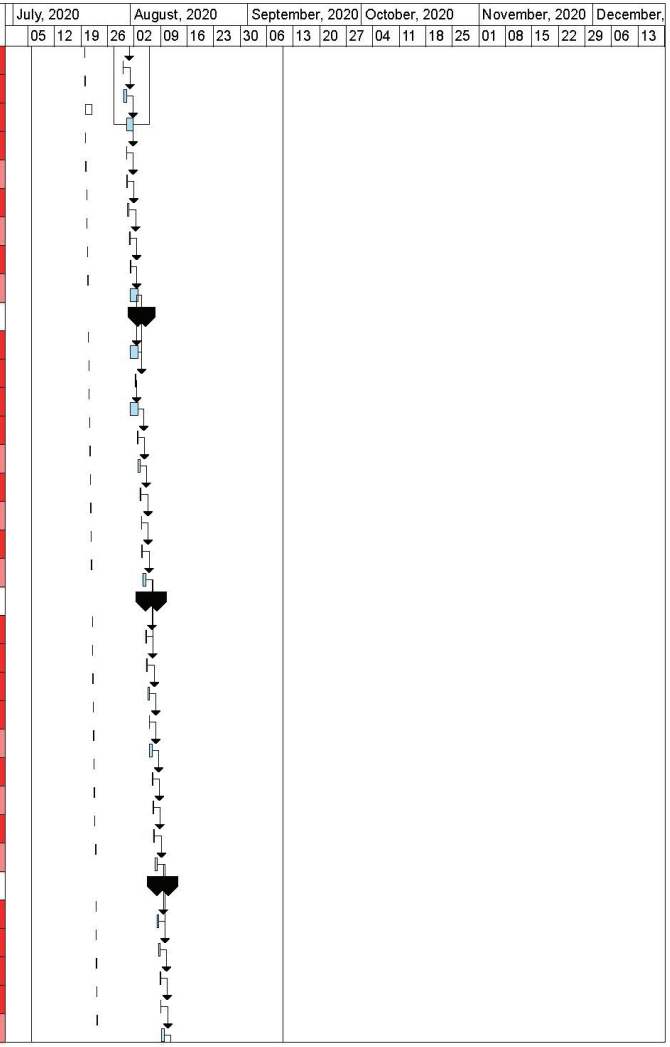
	Task Name	Low Dur	Mean Dur	High Dur	Risks
36	1st Fleet of Barges Anchored at Memphis	3.15 hr	4.87 hr	14.63 hr	6
37	2nd Fleet of Barges Anchored at Memphis	3.45 hr	5.37 hr	11.5 hr	6
38	**ACM Placement - 1st Day**	**27.43 hr**	**48.75 hr**	**154.82 hr**	**0**
39	Land Anchors Installed - D1M	0.62 hr	8.38 hr	38.92 hr	19
40	T1-B1 towed in place	0.3 hr	3.58 hr	24.27 hr	14
41	T1-B1 Offloaded	2.32 hr	2.32 hr	20.97 hr	10
42	T1-B2 towed in place	0.28 hr	3.48 hr	15.2 hr	12
43	T1-B2 Offloaded	1.68 hr	7.12 hr	25.68 hr	8
44	T1-B3 towed in place	0.25 hr	3.52 hr	9.68 hr	12
45	T1-B3 Offloaded	3.32 hr	3.32 hr	11.1 hr	8
46	T1-B4 towed in place	0.47 hr	3.73 hr	23.22 hr	12
47	T1-B4 Offloaded	1.82 hr	5.55 hr	24.82 hr	8
48	**ACM Placement - 2nd Day**	**12.93 hr**	**30 hr**	**119.87 hr**	**0**
49	Land Anchors Installed - D2M	0.82 hr	5 hr	16.8 hr	19
50	T1-B5 towed in place	0.27 hr	3.75 hr	19.98 hr	14
51	T1-B5 Offloaded	3.22 hr	3.22 hr	21.03 hr	10
52	T1-B6 towed in place	0.25 hr	3.53 hr	8.97 hr	12
53	T1-B6 Offloaded	1.52 hr	5.05 hr	15.1 hr	8
54	T1-B7 towed in place	0.33 hr	3.53 hr	24.27 hr	12
55	T1-B7 Offloaded	2.83 hr	5 hr	22.1 hr	8
56	T1-B8 towed in place	0.32 hr	3.57 hr	22.8 hr	12
57	T1-B8 Offloaded	3.38 hr	3.38 hr	9.42 hr	8
58	**ACM Placement - 3rd Day**	**38.7 hr**	**47.97 hr**	**165.32 hr**	**0**
59	Land Anchors Installed - D3M	0.25 hr	0.25 hr	16.33 hr	19
60	T1-B9 towed in place	0.27 hr	3.63 hr	22.8 hr	14
61	T1-B9 Offloaded	2.4 hr	2.4 hr	15.98 hr	10
62	T1-B10 towed in place	0.25 hr	3.55 hr	21.93 hr	12
63	T1-B10 Offloaded	3.18 hr	3.18 hr	21.13 hr	8
64	T1-B11 towed in place	0.45 hr	3.53 hr	11.42 hr	12
65	T1-B11 Offloaded	2.88 hr	7.12 hr	16.1 hr	8
66	T1-B12 towed in place	0.45 hr	3.47 hr	27.38 hr	12
67	T1-B12 Offloaded	2.03 hr	3.3 hr	12.27 hr	8
68	*Tow Barges 1-4 to Delta Yard*	46.05 hr	51.93 hr	86.65 hr	*28*
69	*Tow Barges 5-12 to St. Francisville Yard from Delta Yard*	20.23 hr	25.73 hr	47.45 hr	*28*
70	**ACM Placement - 4th Day**	**9.77 hr**	**26.68 hr**	**110.28 hr**	**0**



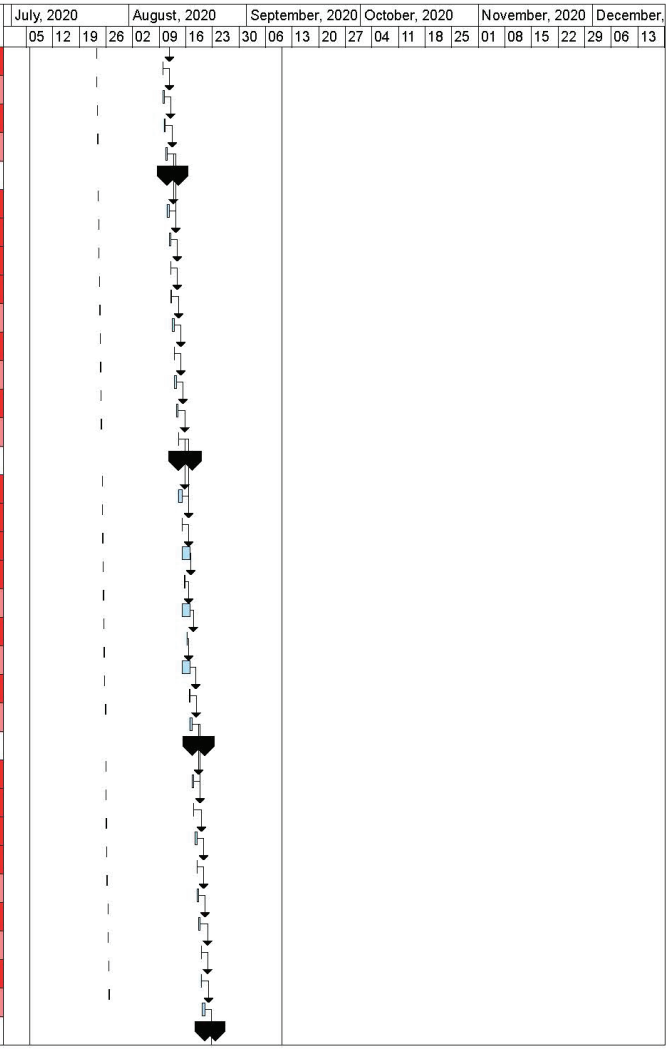
	Task Name	Low Dur	Mean Dur	High Dur	Risks
71	Land Anchors Installed - D4M	1.5 hr	6.68 hr	16.93 hr	19
72	T2-B13 towed inplace	0.28 hr	3.62 hr	29.03 hr	14
73	T2-B13 Offloaded	2.72 hr	9.52 hr	17.42 hr	10
74	T2-B14 towed in place	0.38 hr	3.58 hr	40.97 hr	12
75	T2-B14 Offloaded	2.88 hr	5 hr	24.07 hr	8
76	T2-B15 towed in place	0.37 hr	3.67 hr	43.35 hr	12
77	T2-B15 Offloaded	1.88 hr	1.88 hr	10.75 hr	8
78	**Relocate Floating Plant to Vicksburg**	**12.8 hr**	**17.52 hr**	**30.58 hr**	**0**
79	Mat Anchor Barge towed to Vicksburg	22.28 hr	29.1 hr	72.58 hr	22
80	Quarter Boat towed to Vicksburg	18.28 hr	29.1 hr	69.35 hr	22
81	ARMOR ONE Anchor Barge towed to Vicksburg	19.93 hr	28.77 hr	56.63 hr	18
82	ARMOR ONE Unit towed to Vicksburg	19 hr	29.1 hr	54.92 hr	22
83	Dozers towed to Vicksburg	22.02 hr	29.25 hr	54.05 hr	22
84	**Vicksburg Region**	**93.08 hr**	**290 hr**	**1642.13 hr**	**0**
85	**Mobilize Floating Plant for Vicksburg Region**	**93.08 hr**	**290 hr**	**1642.13 hr**	**0**
86	Mat Anchor Barge Moored in place at Vicksburg	1.9 hr	3.03 hr	13.13 hr	4
87	Quarter Boat Moored in Place at Vicksburg	4.03 hr	5.83 hr	29.45 hr	8
88	ARMOR ONE Anchor Barge Moored in place at Vicksburg	4.53 hr	6.43 hr	12.68 hr	4
89	ARMOR ONE unit moored in place at Vicksburg	5.57 hr	10 hr	26.28 hr	4
90	Dozers placed at Vicksburg	1.7 hr	5.4 hr	26.07 hr	12
91	3rd Fleet of Barges Anchored	2.03 hr	5.42 hr	25.63 hr	6
92	4th Fleet of Barges Anchored	3.48 hr	5.45 hr	13.17 hr	6
93	5th Fleet of Barges Anchored	2.23 hr	5.32 hr	18.4 hr	6
94	**ACM Placement - 1st Day**	**10.65 hr**	**108.1 hr**	**648.97 hr**	**0**
95	Land Anchors Installed - D1V	0.23 hr	10 hr	38.87 hr	19
96	T3-B16 towed in place	0.25 hr	3.63 hr	30.23 hr	14
97	T3-B16 Offloaded	2.13 hr	5 hr	20.52 hr	10
98	T3-B17 towed in place	0.32 hr	3.5 hr	26.78 hr	12
99	T3-B17 Offloaded	2.95 hr	2.95 hr	11.38 hr	8
100	T3-B18 towed in place	0.28 hr	3.63 hr	43.63 hr	12
101	T3-B18 Offloaded	2.28 hr	4.08 hr	11.82 hr	8
102	T3-B19 towed in place	0.27 hr	3.6 hr	30.42 hr	12
103	T3-B19 Offloaded	1.93 hr	8.1 hr	11.73 hr	8
104	**ACM Placement - 2nd Day**	**19.35 hr**	**21.9 hr**	**132.47 hr**	**0**
105	Land Anchors Installed - D2V	0.77 hr	1.9 hr	8.48 hr	19



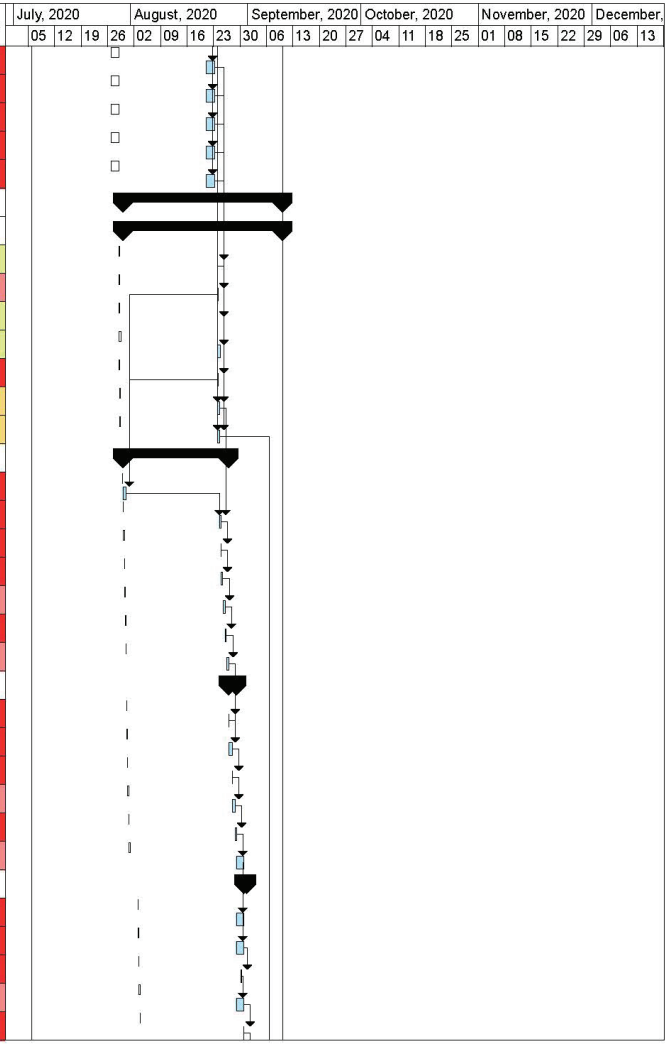
	Task Name	Low Dur	Mean Dur	High Dur	Risks
106	T3-B20 towed in place	0.37 hr	3.52 hr	40.58 hr	14
107	T3-B20 Offloaded	1.68 hr	7.93 hr	24.6 hr	10
108	*Tow Barges 16-20 to St. Francisville Yard*	40.47 hr	45.48 hr	70.9 hr	28
109	T3-B21 towed in place	0.38 hr	3.5 hr	32.92 hr	12
110	T3-B21 Offloaded	2.9 hr	2.9 hr	23.68 hr	8
111	T3-B22 towed in place	0.4 hr	3.67 hr	32.72 hr	12
112	T3-B22 Offloaded	1.65 hr	2.32 hr	9.48 hr	8
113	T3-B23 towed in place	0.35 hr	3.63 hr	27.7 hr	12
114	T3-B23 Offloaded	2.32 hr	2.32 hr	11.43 hr	8
115	**ACM Placement - 3rd Day**	**11.92 hr**	**20 hr**	**126.52 hr**	**0**
116	Land Anchors Installed - D3V	0.13 hr	0.13 hr	15.33 hr	19
117	T3-B24 towed in place	0.43 hr	3.65 hr	36.95 hr	14
118	T3-B24 Offloaded	1.65 hr	1.65 hr	20.23 hr	10
119	T3-B25 towed in place	0.38 hr	3.62 hr	32.57 hr	12
120	T3-B25 Offloaded	2.57 hr	5.42 hr	11.85 hr	8
121	T3-B26 towed in place	0.3 hr	3.48 hr	28.48 hr	12
122	T3-B26 Offloaded	3.37 hr	3.37 hr	13.62 hr	8
123	T3-B27 towed in place	0.42 hr	3.6 hr	28.5 hr	12
124	T3-B27 Offloaded	2.67 hr	6.17 hr	10.83 hr	8
125	**ACM Placement - 4th Day**	**10.77 hr**	**30 hr**	**137.47 hr**	**0**
126	Land Anchors Installed - D4V	0.37 hr	2.42 hr	21.33 hr	19
127	T4-B28 towed inplace	0.33 hr	3.52 hr	34.83 hr	14
128	T4-B28 Offloaded	2.48 hr	2.48 hr	16.62 hr	10
129	T4-B29 towed in place	0.3 hr	3.5 hr	28.43 hr	12
130	T4-B29 Offloaded	1.62 hr	7.77 hr	17.78 hr	8
131	T4-B30 towed in place	0.43 hr	3.6 hr	40.68 hr	12
132	T4-B30 Offloaded	3.22 hr	3.22 hr	9.23 hr	8
133	T4-B31 towed in place	0.27 hr	3.58 hr	38.58 hr	12
134	T4-B31 Offloaded	1.75 hr	3.8 hr	15.42 hr	8
135	**ACM Placement - 5th Day**	**9.5 hr**	**30 hr**	**156.4 hr**	**0**
136	Land Anchors Installed - D5V	1.15 hr	5 hr	20.63 hr	19
137	T4-B32 towed in place	0.33 hr	3.75 hr	44.1 hr	14
138	T4-B32 Offloaded	1.18 hr	1.18 hr	24.52 hr	10
139	T4-B33 towed in place	0.27 hr	3.65 hr	42.67 hr	12
140	T4-B33 Offloaded	1.87 hr	6.73 hr	19.65 hr	8



	Task Name	Low Dur	Mean Dur	High Dur	Risks
141	T4-B34 towed in place	0.4 hr	3.58 hr	32.57 hr	12
142	T4-B34 Offloaded	1.27 hr	3.95 hr	20.45 hr	8
143	T4-B35 towed in place	0.33 hr	3.63 hr	37.78 hr	12
144	T4-B35 Offloaded	2.7 hr	2.7 hr	11.82 hr	8
145	**ACM Placement - 6th Day**	**10.77 hr**	**30 hr**	**131.32 hr**	**0**
146	Land Anchors Installed - D6V	0.77 hr	7.05 hr	10 hr	19
147	T4-B36 towed in place	0.35 hr	3.7 hr	38.98 hr	14
148	T4-B36 Offloaded	1.92 hr	1.92 hr	8.75 hr	10
149	T4-B37 towed inplace	0.27 hr	3.55 hr	39.7 hr	12
150	T4-B37 Offloaded	1.8 hr	5.32 hr	12.23 hr	8
151	T4-B38 towed in place	0.45 hr	3.45 hr	37.53 hr	12
152	T4-B38 Offloaded	3.42 hr	5.78 hr	19.07 hr	8
153	T4-B39 towed in place	0.25 hr	3.63 hr	26.92 hr	12
154	T4-B39 Offloaded	1.55 hr	1.55 hr	23.13 hr	8
155	**ACM Placement - 7th Day**	**10.67 hr**	**17.58 hr**	**157.03 hr**	**0**
156	Land Anchors Installed - D7V	0.43 hr	10 hr	21.9 hr	19
157	T5-B40 towed in place	0.28 hr	3.7 hr	43.12 hr	14
158	T5-B40 Offloaded	2.18 hr	2.18 hr	22.72 hr	10
159	T5-B41 towed in place	0.32 hr	3.65 hr	29.03 hr	12
160	T5-B41 Offloaded	2.18 hr	2.18 hr	19.22 hr	8
161	T5-B42 towed in place	0.28 hr	3.62 hr	43.32 hr	12
162	T5-B42 Offloaded	2.25 hr	2.25 hr	16.98 hr	8
163	T5-B43 towed in place	0.28 hr	3.6 hr	28.42 hr	12
164	T5-B43 Offloaded	2.58 hr	7.58 hr	25.33 hr	8
165	**ACM Placement - 8th Day**	**9.52 hr**	**32.42 hr**	**151.97 hr**	**0**
166	Land Anchors Installed - D8V	0.17 hr	2.42 hr	11.4 hr	19
167	T5-B1 towed in place	0.42 hr	3.62 hr	39.13 hr	14
168	T5-B1 Offloaded	1.82 hr	5.77 hr	25.48 hr	10
169	T5-B2 towed in place	0.25 hr	3.52 hr	29.13 hr	12
170	T5-B2 Offloaded	2.2 hr	4.67 hr	9.07 hr	8
171	T5-B3 towed in place	0.42 hr	3.57 hr	40.13 hr	12
172	T5-B3 Offloaded	1.77 hr	1.77 hr	21.9 hr	8
173	T5-B4 towed in place	0.37 hr	3.5 hr	32.67 hr	12
174	T5-B4 Offloaded	2.47 hr	6.87 hr	22.13 hr	8
175	**Relocate Floating Plant to St. Francisville Region**	**25.4 hr**	**28.5 hr**	**47.87 hr**	**0**



	Task Name	Low Dur	Mean Dur	High Dur	Risks
176	Mat Anchor Barge towed to St. Francisville Region	60.72 hr	61.9 hr	89.68 hr	22
177	Quarter Boat towed to St. Francisville Region	47.9 hr	62.23 hr	89.1 hr	22
178	ARMOR ONE Anchor Barge towed to St. Francisville Region	49.82 hr	62.12 hr	107.68 hr	22
179	ARMOR ONE Unit towed to St. Francisville Region	57.42 hr	62.2 hr	79.83 hr	22
180	Dozers towed to St. Francisville Region	56.12 hr	62.2 hr	100.35 hr	22
181	**St. Francisville Region**	**75.63 hr**	**363.05 hr**	**2271.88 hr**	**0**
182	**Mobilize Floating Plant at St. Francisville Region**	**75.63 hr**	**363.05 hr**	**2271.88 hr**	**0**
183	Mat Anchor Barge Moored in place at St. F.	1.33 hr	1.33 hr	17.68 hr	4
184	Quarter Boat Moored in Place at St. F.	2.77 hr	2.92 hr	16.28 hr	8
185	ARMOR ONE Anchor Barge Moored in place at St. F.	2.5 hr	2.5 hr	22.83 hr	4
186	ARMOR ONE unit moored in place at St. F.	5.6 hr	8.57 hr	15.08 hr	4
187	Dozers placed at St. F.	1.4 hr	3.83 hr	17.53 hr	16
188	6th Fleet of Barges Anchored at St. F.	2.5 hr	5.42 hr	23.73 hr	6
189	7th Fleet of Barges Anchored at St. F.	2.17 hr	5.22 hr	9.2 hr	6
190	**ACM Placement - 1st Day St. Francisville**	**10.8 hr**	**240 hr**	**1696.68 hr**	**0**
191	Land Anchors Installed - D1SF	0.33 hr	8.32 hr	30.2 hr	19
192	T6-B5 towed in place	0.45 hr	3.67 hr	29.68 hr	14
193	T6-B5 Offloaded	2.43 hr	2.43 hr	17.7 hr	10
194	T6-B6 towed in place	0.32 hr	3.55 hr	37.77 hr	12
195	T6-B6 Offloaded	2.48 hr	4.17 hr	25.25 hr	8
196	T6-B7 towed in place	0.33 hr	3.43 hr	27.98 hr	12
197	T6-B7 Offloaded (1/4)	0.95 hr	4.63 hr	17.45 hr	8
198	**ACM Placement 2nd Day St. Franisville**	**9.77 hr**	**20 hr**	**98.73 hr**	**0**
199	Land Anchors Installed - D2SF	0.88 hr	1.83 hr	23.62 hr	19
200	T6-B7 Offloaded (3/4)	2.43 hr	8.15 hr	23.48 hr	10
201	T6-B8 towed in place	0.4 hr	3.58 hr	37.18 hr	12
202	T6-B8 Offloaded	2.98 hr	7.78 hr	9.32 hr	8
203	T6-B9 towed in place	0.27 hr	3.53 hr	33.6 hr	12
204	T6-B9 Offloaded (1/2)	2.8 hr	2.8 hr	15.42 hr	8
205	**ACM Placement 3rd Day St. Francisville**	**9.42 hr**	**9.42 hr**	**78.02 hr**	**0**
206	Land Anchors Installed - D3SF	0.37 hr	0.37 hr	10.25 hr	19
207	T6-B9 Offloaded (1/2)	2.68 hr	2.68 hr	11.38 hr	10
208	T6-B10 towed in place	0.25 hr	3.7 hr	39.02 hr	14
209	T6-B10 Offloaded	3.43 hr	3.43 hr	16.23 hr	8
210	T6-B11 towed in place	0.25 hr	3.62 hr	39.97 hr	12



	Task Name	Low Dur	Mean Dur	High Dur	Risks
211	T6-B11 Offloaded (3/4)	2.43 hr	8.27 hr	13.43 hr	8
212	**ACM Placement 4th Day St. Francisville**	**9.93 hr**	**21.7 hr**	**113.27 hr**	**0**
213	Land Anchors Installed - D4SF	0.87 hr	1.7 hr	13.68 hr	19
214	T6-B11 Offloaded (1/4)	1 hr	5.8 hr	21.37 hr	10
215	T6-B12 towed in place	0.3 hr	3.7 hr	41.3 hr	14
216	T6-B12 Offloaded	3.65 hr	3.65 hr	25.87 hr	8
217	T6-B13 towed in place	0.33 hr	3.65 hr	37 hr	12
218	T6-B13 Offloaded	3.78 hr	3.78 hr	26.7 hr	8
219	**ACM Placement 5th Day St. Francisville**	**8.53 hr**	**25.42 hr**	**108.13 hr**	**0**
220	Land Anchors Installed - D4SF	0.48 hr	10 hr	20.95 hr	19
221	T6-B14 towed in place	0.25 hr	3.73 hr	39.85 hr	14
222	T6-B14 Offloaded	2.98 hr	5 hr	23.85 hr	10
223	T6-B15 towed in place	0.38 hr	3.52 hr	36.05 hr	12
224	T6-B15 Offloaded	3.08 hr	3.08 hr	16.78 hr	8
225	T6-B16 towed in place	0.27 hr	3.57 hr	39.92 hr	12
226	T6-B16 Offloaded (1/4)	1.08 hr	5.42 hr	14.83 hr	8
227	**ACM Placement 6th Day St. Francisville**	**10.6 hr**	**24.58 hr**	**85.03 hr**	**0**
228	Land Anchors Installed - D5SF	0.92 hr	4.58 hr	10 hr	19
229	T6-B16 Offloaded (3/4)	3.62 hr	8.42 hr	16.33 hr	10
230	T7-B17 towed in place	0.32 hr	3.58 hr	29.78 hr	12
231	T7-B17 Offloaded	3.73 hr	3.73 hr	24.03 hr	8
232	T7-B18 towed in place	0.25 hr	3.58 hr	38.92 hr	12
233	T7-B18 Offloaded (3/4)	1.77 hr	1.77 hr	7.97 hr	8
234	**ACM Placement 7th Day St. Francisville**	**11.08 hr**	**23.05 hr**	**92.02 hr**	**0**
235	Land Anchors Installed - D6SF	0.32 hr	6.88 hr	24.78 hr	19
236	T7-B18 Offloaded (1/4)	2.52 hr	3.02 hr	12.73 hr	10
237	T7-B19 towed in place	0.37 hr	3.62 hr	38.7 hr	12
238	T7-B19 Offloaded	3.57 hr	10 hr	14.75 hr	8
239	T7-B20 towed in place	0.32 hr	3.6 hr	29.2 hr	12
240	T7-B20 Offloaded	4.32 hr	4.32 hr	27.13 hr	8
241	**End of Season**	0 hr	0 hr	0 hr	**0**

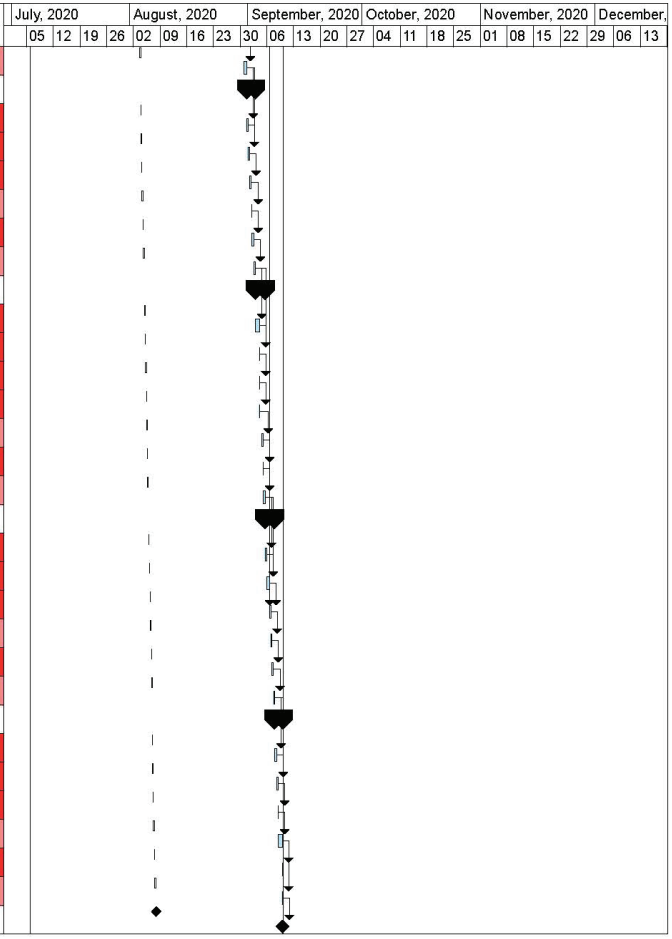
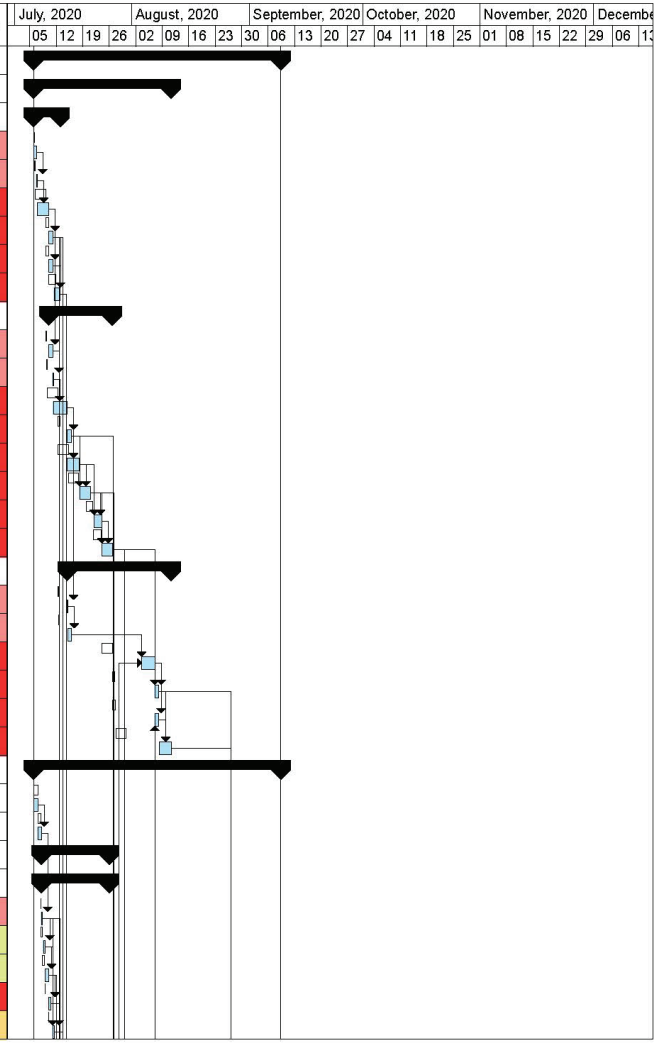
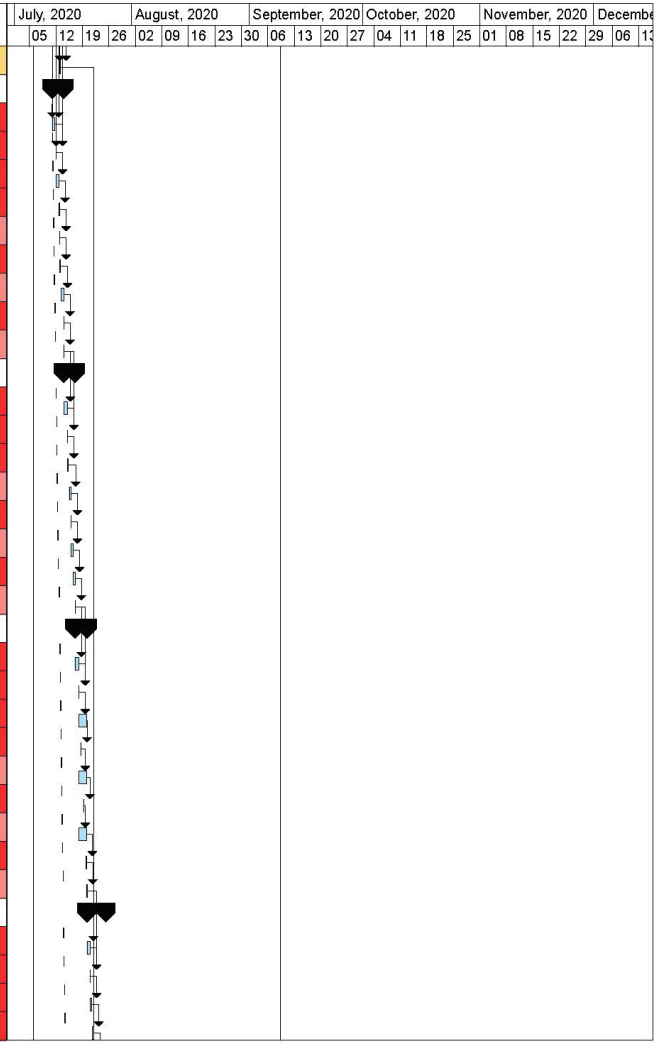


Figure B-2. Schedule of events with risks calculated for 2,000 squares/day.

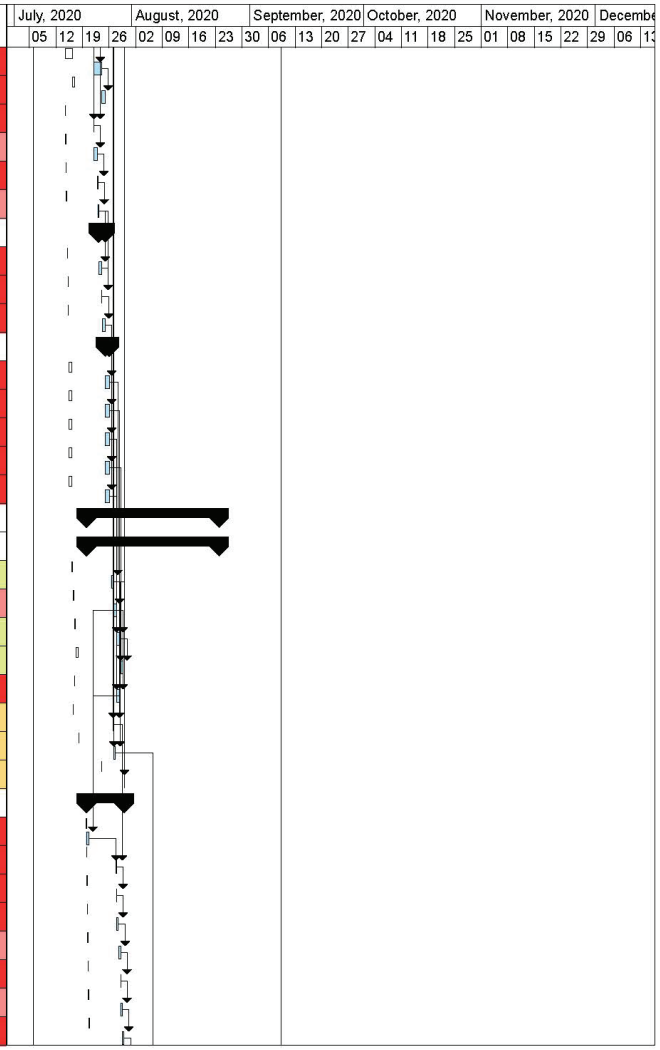
	Task Name	Low Dur	Mean Dur	High Dur	Risks
1	**BEGINNING OF SEASON**	**302.83 hr**	**574.63 hr**	**2427.53 hr**	**0**
2	**Mat Yard Mobilization**	**223.38 hr**	**324.17 hr**	**1010 hr**	**0**
3	**Memphis Yard Mobilization**	**50 hr**	**70 hr**	**166.5 hr**	**0**
4	Tie off empty barges at Memphis Yard	2.1 hr	7.07 hr	42.07 hr	8
5	Lash and Prep loaded barges for transport at Memphis Yard	2.28 hr	2.93 hr	35.1 hr	8
6	Load Mats on Barges 1-12 at Memphis Yard	24.65 hr	30 hr	35.47 hr	18
7	Tow 1st Fleet of Barges from Richardson Landing to Memphis Regi	20.95 hr	25.52 hr	36.73 hr	28
8	Load Mats on Barges 13-15 at Memphis Yard	6.58 hr	10 hr	26.38 hr	18
9	Tow 2nd Fleet of Barges from Richardson Landing to Memphis Reg	36.05 hr	39.9 hr	69.48 hr	28
10	**Delta Yard Mobilization**	**130.97 hr**	**148.2 hr**	**287.37 hr**	**0**
11	Tie off empty barges at Delta Yard	2.53 hr	10 hr	37.6 hr	8
12	Lash and Prep loaded barges for transport at Delta Yard	2.5 hr	2.75 hr	45.73 hr	8
13	Load Mats on Barges 16-27 at Delta Yard	28.2 hr	36.33 hr	47.25 hr	18
14	Tow 3rd Fleet of Barges from Delta Yard to Vicksburg	21.42 hr	26.4 hr	36.2 hr	28
15	Load Mats on Barges 28-39 at Delta Yard	27.6 hr	30.85 hr	40.9 hr	18
16	Tow 4th Fleet of Barges from Delta Yard to Vicksburg	61.35 hr	66.43 hr	81.28 hr	28
17	Load Mats on Barges 40-43, 1-4 at Delta Yard	22.52 hr	22.52 hr	41.57 hr	18
18	Tow 5th Fleet of Barges from Delta Yard to Vicksburg	61.07 hr	66.38 hr	86.35 hr	28
19	**St. Francisville Yard Mobilization**	**161.12 hr**	**235.02 hr**	**766.78 hr**	**0**
20	Tie off empty barges at St. Francisville Yard	2.17 hr	2.17 hr	31.33 hr	8
21	Lash and Prep loaded barges for transport at St. Francisville Yard	2.85 hr	10 hr	46.1 hr	8
22	Load Mats on Barges 5-16 at St. Francisville Yard	25.75 hr	35 hr	37.87 hr	18
23	Tow 6th Fleet of Barges from St. Francisville to New Orleans	21.92 hr	25.82 hr	48.87 hr	28
24	Loat Mats on Barges 17-20 at St. Francisville Yard	8.7 hr	10.32 hr	18.93 hr	18
25	Tow 7th Fleet of Barges from St. Francisville to New Orleans	68.58 hr	73.37 hr	102 hr	28
26	**ACM Placement**	**302.83 hr**	**574.63 hr**	**2427.53 hr**	**0**
27	Training	10.17 hr	11.98 hr	13.93 hr	0
28	Blessing of the Fleet	7.18 hr	8.02 hr	27.07 hr	0
29	**Memphis Region**	**93.53 hr**	**160 hr**	**630.38 hr**	**0**
30	**Mobilize Floating Plant for Memphis Region**	**93.53 hr**	**160 hr**	**630.38 hr**	**0**
31	Quarter Boat Moored in Place at Memphis	3.17 hr	7 hr	24.03 hr	8
32	ARMOR ONE Anchor Barge Moored in place at Memphis	3.07 hr	3.07 hr	18.13 hr	4
33	ARMOR ONE unit moored in place at Memphis	4.77 hr	10 hr	25.48 hr	4
34	Dozers placed at Memphis	1.95 hr	5 hr	26.27 hr	12
35	1st Fleet of Barges Anchored at Memphis	3.67 hr	4.88 hr	22.57 hr	6



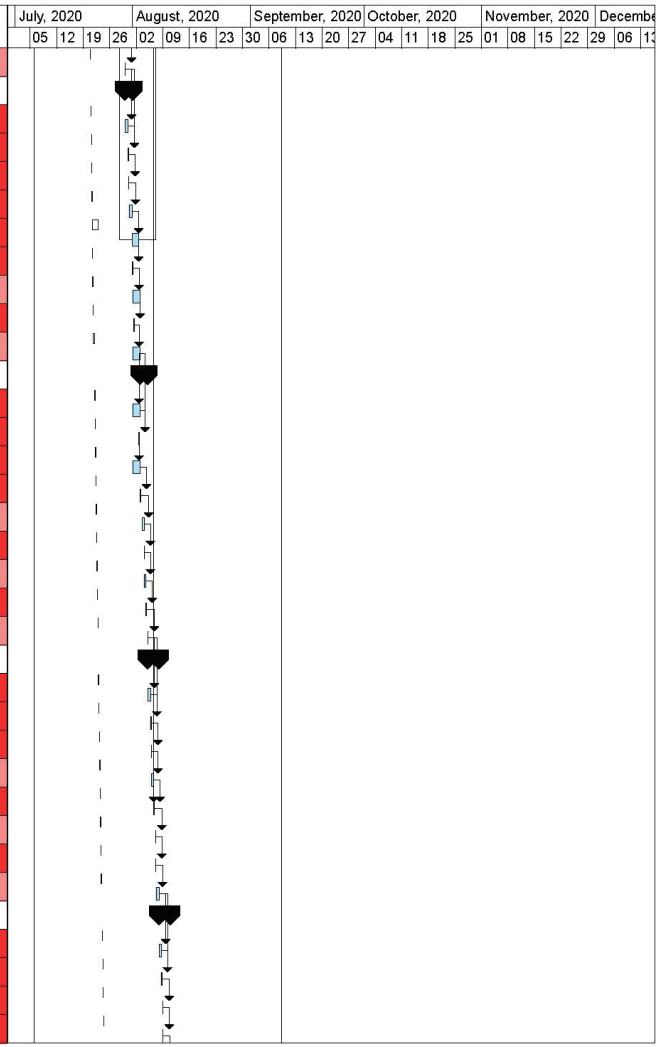
	Task Name	Low Dur	Mean Dur	High Dur	Risks
36	2nd Fleet of Barges Anchored at Memphis	3.45 hr	5.25 hr	13.92 hr	6
37	**ACM Placement - 1st Day**	**8.95 hr**	**31.18 hr**	**180.92 hr**	**0**
38	Land Anchors Installed - D1M	0.28 hr	7.3 hr	39.53 hr	19
39	T1-B1 towed in place	0.28 hr	3.7 hr	16.68 hr	14
40	T1-B1 Offloaded	2.1 hr	7.2 hr	25.42 hr	10
41	T1-B2 towed in place	0.32 hr	3.63 hr	24.45 hr	14
42	T1-B2 Offloaded	1.88 hr	1.88 hr	24.02 hr	8
43	T1-B3 towed in place	0.27 hr	3.7 hr	20.92 hr	12
44	T1-B3 Offloaded	2.48 hr	5.87 hr	14.13 hr	8
45	T1-B4 towed in place	0.3 hr	3.6 hr	18.53 hr	12
46	T1-B4 Offloaded (1/2)	1.17 hr	1.18 hr	17.83 hr	8
47	**ACM Placement - 2nd Day**	**10.38 hr**	**28.82 hr**	**116.17 hr**	**0**
48	Land Anchors Installed - D2M	0.55 hr	8.82 hr	18.35 hr	19
49	T1-B4 Offloaded (1/2)	1.98 hr	1.98 hr	18.95 hr	10
50	T1-B5 towed in place	0.3 hr	3.65 hr	32.2 hr	14
51	T1-B5 Offloaded	1.72 hr	5 hr	11.63 hr	8
52	T1-B6 towed in place	0.48 hr	3.58 hr	15.15 hr	12
53	T1-B6 Offloaded	1.42 hr	6.65 hr	14.07 hr	8
54	T1-B7 towed in place	0.25 hr	3.62 hr	36.53 hr	12
55	T1-B7 Offloaded	3.68 hr	3.68 hr	17.08 hr	8
56	**ACM Placement - 3rd Day**	**9.73 hr**	**12.58 hr**	**135.5 hr**	**0**
57	Land Anchors Installed - D3M	0.55 hr	10 hr	15.88 hr	19
58	T1-B8 towed in place	1.13 hr	3.33 hr	16.08 hr	14
59	T1-B8 Offloaded	2.27 hr	2.27 hr	14.85 hr	10
60	T1-B9 towed in place	0.33 hr	3.52 hr	26.95 hr	14
61	T1-B9 Offloaded	2.42 hr	2.42 hr	16.25 hr	8
62	T1-B10 towed in place	0.4 hr	3.6 hr	29.13 hr	12
63	T1-B10 Offloaded	2.38 hr	2.38 hr	19.07 hr	8
64	T1-B11 towed in place	0.35 hr	3.65 hr	41 hr	12
65	T1-B11 Offloaded (1/2)	0.92 hr	2.58 hr	22.33 hr	8
66	**ACM Placement - 4th Day**	**31.82 hr**	**49.47 hr**	**128.45 hr**	**0**
67	Land Anchors Installed - D4M	0.77 hr	7.35 hr	25.97 hr	19
68	T1-B11 Offloaded (1/2)	0.77 hr	0.77 hr	10.33 hr	10
69	T1-B12 towed in place	2.13 hr	3.48 hr	23.93 hr	14
70	T1-B12 Offloaded	2.98 hr	3.93 hr	26.32 hr	10



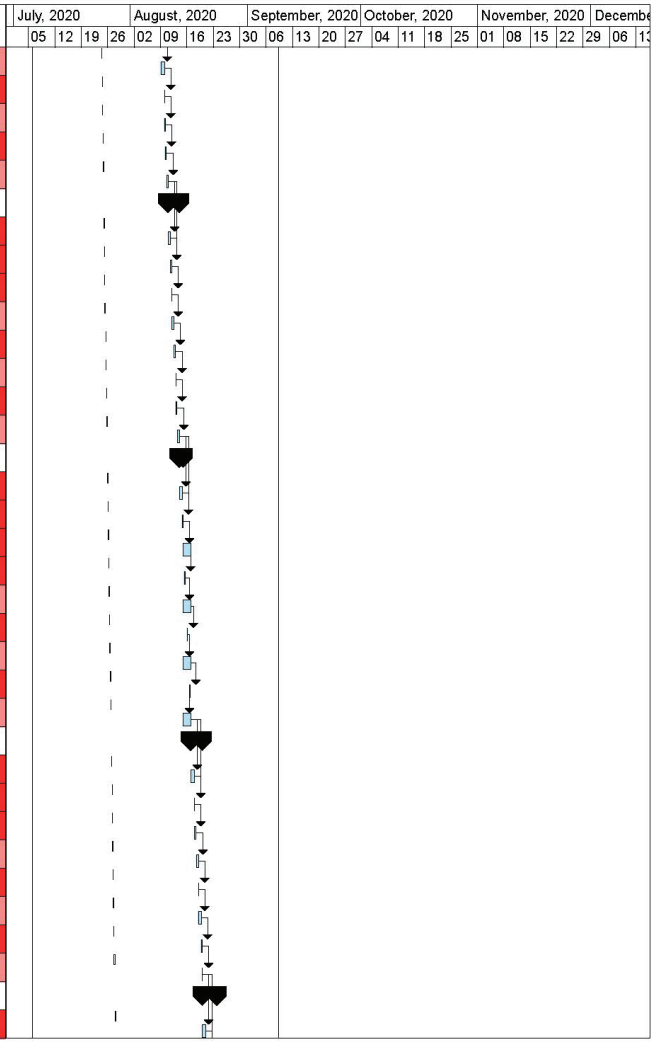
	Task Name	Low Dur	Mean Dur	High Dur	Risks
71	*Tow Barges 1-4 to Delta Yard*	46.08 hr	51.75 hr	59.53 hr	*28*
72	*Tow Barges 5-12 to St. Francisville Yard from Delta Yard*	20.08 hr	25.22 hr	39.33 hr	*28*
73	T2-B13 towed inplace	0.42 hr	3.65 hr	28.05 hr	12
74	T2-B13 Offloaded	2.32 hr	8.4 hr	12.98 hr	8
75	T2-B14 towed in place	0.25 hr	3.57 hr	44.27 hr	12
76	T2-B14 Offloaded	1.52 hr	3.12 hr	11.03 hr	8
77	**ACM Placement - 5th Day**	**7.5 hr**	**16.85 hr**	**60.35 hr**	**0**
78	Land Anchors Installed - D5M	5.3 hr	6.85 hr	24.18 hr	19
79	T2-B15 towed in place	0.27 hr	3.33 hr	24.35 hr	14
80	T2-B15 Offloaded	1.93 hr	6.3 hr	25.82 hr	10
81	**Relocate Floating Plant to Vicksburg**	**12.28 hr**	**12.28 hr**	**29.33 hr**	**0**
82	Mat Anchor Barge towed to Vicksburg	21.78 hr	29.07 hr	59.58 hr	22
83	Quarter Boat towed to Vicksburg	20.83 hr	29.1 hr	61.93 hr	22
84	ARMOR ONE Anchor Barge towed to Vicksburg	22.23 hr	28.83 hr	71.33 hr	18
85	ARMOR ONE Unit towed to Vicksburg	21.15 hr	29.17 hr	50.72 hr	22
86	Dozers towed to Vicksburg	20.1 hr	29.12 hr	64.82 hr	22
87	**Vicksburg Region**	**125.95 hr**	**310 hr**	**1711.83 hr**	**0**
88	**Mobilize Floating Plant for Vicksburg Region**	**125.95 hr**	**310 hr**	**1711.83 hr**	**0**
89	Mat Anchor Barge Moored in place at Vicksburg	1.88 hr	3.48 hr	8.58 hr	4
90	Quarter Boat Moored in Place at Vicksburg	3.62 hr	10 hr	15.4 hr	8
91	ARMOR ONE Anchor Barge Moored in place at Vicksburg	3.78 hr	10 hr	27.57 hr	4
92	ARMOR ONE unit moored in place at Vicksburg	7.03 hr	7.35 hr	15.53 hr	4
93	Dozers placed at Vicksburg	3.78 hr	7.48 hr	12.18 hr	12
94	3rd Fleet of Barges Anchored	2.77 hr	5.27 hr	11.65 hr	6
95	4th Fleet of Barges Anchored	2.72 hr	5.33 hr	9.63 hr	6
96	5th Fleet of Barges Anchored	2.4 hr	5.42 hr	22.42 hr	6
97	**ACM Placement - 1st Day Vicksburg**	**10.12 hr**	**100 hr**	**696.05 hr**	**0**
98	Land Anchors Installed - D1V	0.4 hr	7.35 hr	39.18 hr	19
99	T3-B16 towed in place	0.3 hr	3.62 hr	29.5 hr	14
100	T3-B16 Offloaded	2.53 hr	2.53 hr	14.63 hr	10
101	T3-B17 towed in place	0.33 hr	3.65 hr	41.83 hr	12
102	T3-B17 Offloaded	1.6 hr	4.52 hr	13.95 hr	8
103	T3-B18 towed in place	0.45 hr	3.52 hr	27.9 hr	12
104	T3-B18 Offloaded	2.05 hr	5.53 hr	9.58 hr	8
105	T3-B19 towed in place	0.28 hr	3.5 hr	29.52 hr	12



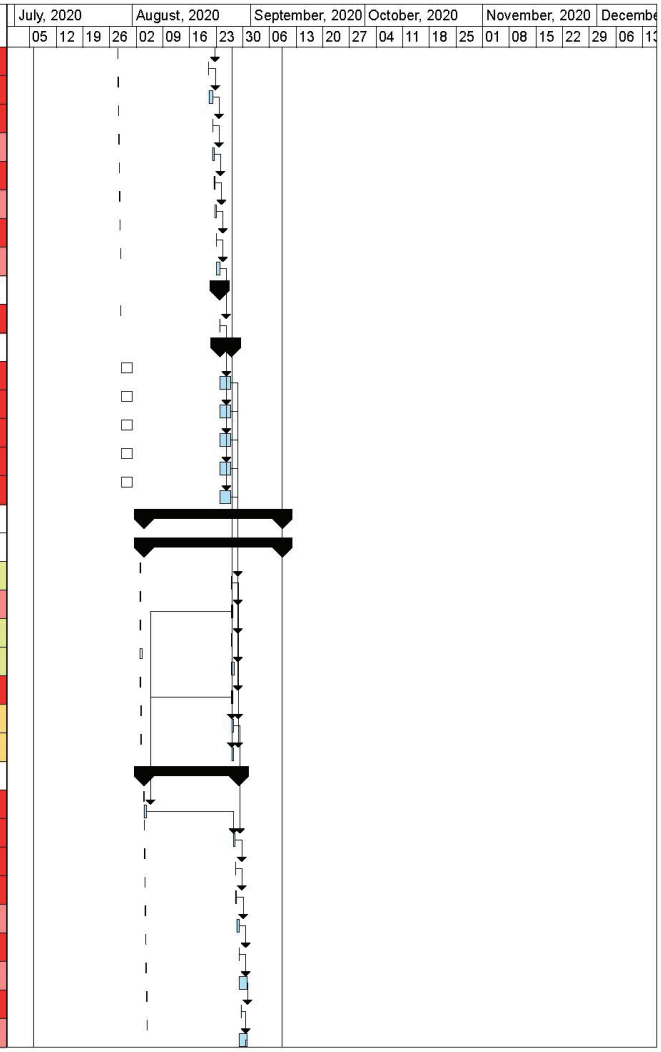
	Task Name	Low Dur	Mean Dur	High Dur	Risks
106	T3-B19 Offloaded (1/2)	1.9 hr	1.9 hr	16.05 hr	8
107	**ACM Placement - 2nd Day Vicksburg**	**19.88 hr**	**20 hr**	**126.4 hr**	**0**
108	Land Anchors Installed - D2V	2.03 hr	8.98 hr	18.85 hr	19
109	T3-B19 Offloaded (1/2)	1.23 hr	1.23 hr	19.08 hr	10
110	T3-B20 towed in place	0.3 hr	3.53 hr	32.55 hr	14
111	T3-B20 Offloaded	1.65 hr	8.18 hr	10.7 hr	10
112	*Tow Barges 16-20 to St. Francisville Yard*	39.2 hr	45.42 hr	69.78 hr	*28*
113	T3-B21 towed in place	0.37 hr	3.67 hr	32.02 hr	12
114	T3-B21 Offloaded	1.37 hr	1.37 hr	10.4 hr	8
115	T3-B22 towed in place	0.28 hr	3.57 hr	28 hr	12
116	T3-B22 Offloaded	1.78 hr	1.78 hr	22.45 hr	8
117	**ACM Placement - 3rd Day Vicksburg**	**11.17 hr**	**20 hr**	**128.25 hr**	**0**
118	Land Anchors Installed - D3V	2.87 hr	2.87 hr	16.28 hr	19
119	T3-B23 towed in place	0.48 hr	3.25 hr	14.72 hr	12
120	T3-B23 Offloaded	1.75 hr	1.75 hr	9.53 hr	10
121	T3-B24 towed in place	0.45 hr	3.63 hr	35.13 hr	14
122	T3-B24 Offloaded	2.8 hr	5 hr	23.63 hr	8
123	T3-B25 towed in place	0.25 hr	3.63 hr	26.77 hr	12
124	T3-B25 Offloaded	1.53 hr	5 hr	21.22 hr	8
125	T3-B26 towed in place	0.3 hr	3.57 hr	33.83 hr	12
126	T3-B26 Offloaded (1/2)	0.73 hr	0.73 hr	20.7 hr	8
127	**ACM Placement - 4th Day Vicksburg**	**11.6 hr**	**30 hr**	**142.13 hr**	**0**
128	Land Anchors Installed - D4V	2.18 hr	7.07 hr	25.57 hr	19
129	T3-B26 Offloaded (1/2)	2.25 hr	2.93 hr	26.65 hr	10
130	T3-B27 towed in place	0.4 hr	3.35 hr	22.85 hr	14
131	T3-B27 Offloaded	1.37 hr	5 hr	19.07 hr	8
132	T4-B28 towed inplace	0.33 hr	3.75 hr	32.57 hr	12
133	T4-B28 Offloaded	1.9 hr	1.9 hr	20.75 hr	8
134	T4-B29 towed in place	0.3 hr	3.53 hr	37.9 hr	12
135	T4-B29 Offloaded	3 hr	7.07 hr	12.83 hr	8
136	**ACM Placement - 5th Day Vicksburg**	**9.38 hr**	**30 hr**	**118.72 hr**	**0**
137	Land Anchors Installed - D5V	1.27 hr	5 hr	10.27 hr	19
138	T4-B30 towed in place	0.4 hr	3.8 hr	27.08 hr	14
139	T4-B30 Offloaded	1.75 hr	1.75 hr	9.25 hr	10
140	T4-B31 towed in place	0.3 hr	2.87 hr	19.73 hr	12



	Task Name	Low Dur	Mean Dur	High Dur	Risks
141	T4-B31 Offloaded	2.12 hr	8.22 hr	11.98 hr	8
142	T4-B32 towed in place	0.38 hr	3.58 hr	37.63 hr	12
143	T4-B32 Offloaded	2.07 hr	2.22 hr	18.48 hr	8
144	T4-B33 towed in place	0.33 hr	3.65 hr	26.72 hr	12
145	T4-B33 Offloaded (1/2)	0.77 hr	2.12 hr	21.55 hr	8
146	**ACM Placement - 6th Day Vicksburg**	**13.23 hr**	**30 hr**	**108.52 hr**	**0**
147	Land Anchors Installed - D6V	3.37 hr	6.55 hr	22.87 hr	19
148	T4-B33 Offloaded (1/2)	0.95 hr	3.45 hr	23.85 hr	10
149	T4-B34 towed in place	0.35 hr	3.83 hr	21.88 hr	14
150	T4-B34 Offloaded	1.95 hr	6.05 hr	12.43 hr	8
151	T4-B35 towed in place	0.45 hr	3.57 hr	17.37 hr	12
152	T4-B35 Offloaded	3.57 hr	3.57 hr	25.67 hr	8
153	T4-B36 towed in place	0.33 hr	3.55 hr	35.33 hr	12
154	T4-B36 Offloaded	2.27 hr	4.73 hr	10.07 hr	8
155	**ACM Placement - 7th Day Vicksburg**	**14 hr**	**14 hr**	**132.75 hr**	**0**
156	Land Anchors Installed - D7V	3.57 hr	7.63 hr	23.93 hr	19
157	T4-B37 towed in place	0.35 hr	3.55 hr	10.5 hr	14
158	T4-B37 Offloaded	2.25 hr	2.25 hr	21.3 hr	10
159	T4-B38 towed in place	0.27 hr	3.93 hr	24.37 hr	14
160	T4-B38 Offloaded	4.57 hr	4.57 hr	13.8 hr	8
161	T4-B39 towed in place	0.27 hr	3.9 hr	7.87 hr	12
162	T4-B39 Offloaded	1.35 hr	1.35 hr	22.12 hr	8
163	T5-B40 towed in place	0.42 hr	3.57 hr	40.07 hr	12
164	T5-B40 Offloaded (1/2)	0.97 hr	0.97 hr	12.82 hr	8
165	**ACM Placement - 8th Day Vicksburg**	**15.67 hr**	**31.43 hr**	**124.5 hr**	**0**
166	Land Anchors Installed - D8V	2.22 hr	10 hr	22.17 hr	19
167	T5-B40 Offloaded (1/2)	2.87 hr	2.87 hr	19.03 hr	14
168	T5-B41 towed in place	0.25 hr	3.37 hr	18.27 hr	12
169	T5-B41 Offloaded	2.05 hr	4.52 hr	24.3 hr	8
170	T5-B42 towed in place	2.75 hr	3.23 hr	10.7 hr	12
171	T5-B42 Offloaded	2.57 hr	8.85 hr	21.55 hr	8
172	T5-B43 towed in place	0.25 hr	3.5 hr	15.53 hr	12
173	T5-B43 Offloaded	2.72 hr	2.72 hr	17.32 hr	8
174	**ACM Placement - 9th Day Vicksburg**	**15.33 hr**	**38.28 hr**	**111.77 hr**	**0**
175	Land Anchors Installed - D8V	4.45 hr	8.4 hr	23.4 hr	19



	Task Name	Low Dur	Mean Dur	High Dur	Risks
176	T5-B1 towed in place	0.3 hr	4.1 hr	10.37 hr	14
177	T5-B1 Offloaded	2.02 hr	8.33 hr	17.42 hr	10
178	T5-B2 towed in place	1.25 hr	3.45 hr	21.92 hr	14
179	T5-B2 Offloaded	1.18 hr	4.12 hr	8.97 hr	8
180	T5-B3 towed in place	0.3 hr	2.9 hr	13.37 hr	12
181	T5-B3 Offloaded	3.5 hr	3.5 hr	13.23 hr	8
182	T5-B4 towed in place	0.7 hr	4.13 hr	14.92 hr	12
183	T5-B4 Offloaded (1/2)	1.63 hr	8.37 hr	19.08 hr	8
184	**ACM Placement - 10th Day Vicksburg**	**1.93 hr**	**1.93 hr**	**22.75 hr**	**0**
185	T5-B4 Offloaded (1/2)	1.93 hr	1.93 hr	22.75 hr	10
186	**Relocate Floating Plant to St. Francisville Region**	**8.55 hr**	**30 hr**	**48.17 hr**	**0**
187	Mat Anchor Barge towed to St. Francisville Region	54.02 hr	61.82 hr	79.18 hr	22
188	Quarter Boat towed to St. Francisville Region	56.07 hr	62.33 hr	87.47 hr	22
189	ARMOR ONE Anchor Barge towed to St. Francisville Region	54.85 hr	62.2 hr	107.75 hr	22
190	ARMOR ONE Unit towed to St. Francisville Region	58.77 hr	62.25 hr	90.53 hr	22
191	Dozers towed to St. Francisville Region	57.7 hr	62.23 hr	98.73 hr	22
192	**St. Francisville Region**	**62.83 hr**	**324.63 hr**	**2177.53 hr**	**0**
193	**Mobilize Floating Plant at St. Francisville Region**	**62.83 hr**	**324.63 hr**	**2177.53 hr**	**0**
194	Mat Anchor Barge Moored in place at St. F.	1.08 hr	1.17 hr	9 hr	4
195	Quarter Boat Moored in Place at St. F.	1.93 hr	3.15 hr	15.42 hr	8
196	ARMOR ONE Anchor Barge Moored in place at St. F.	1.78 hr	1.78 hr	14.43 hr	4
197	ARMOR ONE unit moored in place at St. F.	4.83 hr	8.65 hr	11.92 hr	4
198	Dozers placed at St. F.	1.28 hr	4.87 hr	13.58 hr	16
199	6th Fleet of Barges Anchored at St. F.	2.4 hr	5.27 hr	20.87 hr	6
200	7th Fleet of Barges Anchored at St. F.	2.72 hr	5.38 hr	15.72 hr	6
201	**ACM Placement - 1st Day St. Francisville**	**10.38 hr**	**230 hr**	**1767.7 hr**	**0**
202	Land Anchors Installed - D1SF	0.55 hr	7.67 hr	33.4 hr	19
203	T6-B5 towed in place	0.27 hr	3.63 hr	30.67 hr	14
204	T6-B5 Offloaded	2.85 hr	2.85 hr	14.93 hr	10
205	T6-B6 towed in place	0.3 hr	3.68 hr	40.73 hr	14
206	T6-B6 Offloaded	1.78 hr	5.38 hr	24.1 hr	8
207	T6-B7 towed in place	0.37 hr	3.65 hr	41.82 hr	12
208	T6-B7 Offloaded	1.78 hr	1.78 hr	18.5 hr	8
209	T6-B8 towed in place	0.32 hr	3.5 hr	22.53 hr	12
210	T6-B8 Offloaded (1/2)	2.08 hr	2.08 hr	20.67 hr	8



	Task Name	Low Dur	Mean Dur	High Dur	Risks
211	**ACM Placement 2nd Day St. Franisville**	**9.53 hr**	**20 hr**	**119.43 hr**	**0**
212	Land Anchors Installed - D2SF	0.65 hr	0.65 hr	22.22 hr	19
213	T6-B8 Offloaded (1/2)	0.98 hr	0.98 hr	22.13 hr	10
214	T6-B9 towed in place	0.27 hr	3.63 hr	36.12 hr	14
215	T6-B9 Offloaded	1.95 hr	5.53 hr	16.68 hr	10
216	T6-B10 towed in place	0.37 hr	3.3 hr	19.97 hr	12
217	T6-B10 Offloaded	2 hr	2 hr	14.87 hr	8
218	T6-B11 towed in place	0.35 hr	3.32 hr	7.62 hr	12
219	T6-B11 Offloaded	2.97 hr	7.92 hr	17.13 hr	8
220	**ACM Placement 3rd Day St. Francisville**	**11.73 hr**	**27.2 hr**	**103.57 hr**	**0**
221	Land Anchors Installed - D3SF	0.53 hr	2.8 hr	12.95 hr	19
222	T6-B12 towed in place	3.35 hr	3.58 hr	21.47 hr	14
223	T6-B12 Offloaded	2.37 hr	2.37 hr	20.97 hr	10
224	T6-B13 towed in place	0.42 hr	3.72 hr	6.6 hr	14
225	T6-B13 Offloaded	2.3 hr	7.55 hr	25.17 hr	8
226	T6-B14 towed in place	1.15 hr	3.6 hr	11.7 hr	12
227	T6-B14 Offloaded	1.48 hr	3.88 hr	20.47 hr	8
228	T6-B15 towed in place	0.3 hr	3.77 hr	10.98 hr	12
229	T6-B15 Offloaded (1/2)	1.65 hr	4.62 hr	10.7 hr	8
230	**ACM Placement 4th Day St. Francisville**	**12.25 hr**	**26.68 hr**	**108.82 hr**	**0**
231	Land Anchors Installed - D4SF	2.12 hr	2.8 hr	23.92 hr	19
232	T6-B15 Offloaded (1/2)	0.72 hr	5 hr	16.67 hr	10
233	T6-B16 towed in place	0.33 hr	4.03 hr	18.48 hr	14
234	T6-B16 Offloaded	2.47 hr	2.47 hr	20.78 hr	8
235	T7-B17 towed in place	0.35 hr	3.42 hr	18.43 hr	12
236	T7-B17 Offloaded	3.4 hr	6.65 hr	12.32 hr	8
237	T7-B18 towed in place	0.82 hr	3.7 hr	16.23 hr	12
238	T7-B18 Offloaded	2.05 hr	3.88 hr	9.52 hr	8
239	**ACM Placement 5th Day St. Francisville**	**8.93 hr**	**20.72 hr**	**78.02 hr**	**0**
240	Land Anchors Installed - D4SF	3.62 hr	6.08 hr	8.02 hr	19
241	T7-B19 towed in place	0.27 hr	3.52 hr	39.88 hr	14
242	T7-B19 Offloaded	2.98 hr	8.47 hr	20.67 hr	10
243	T7-B20 towed in place	0.35 hr	4.18 hr	24.15 hr	14
244	T7-B20 Offloaded	1.72 hr	4.63 hr	26.3 hr	8
245	**End of Season**	0 hr	0 hr	0 hr	**0**

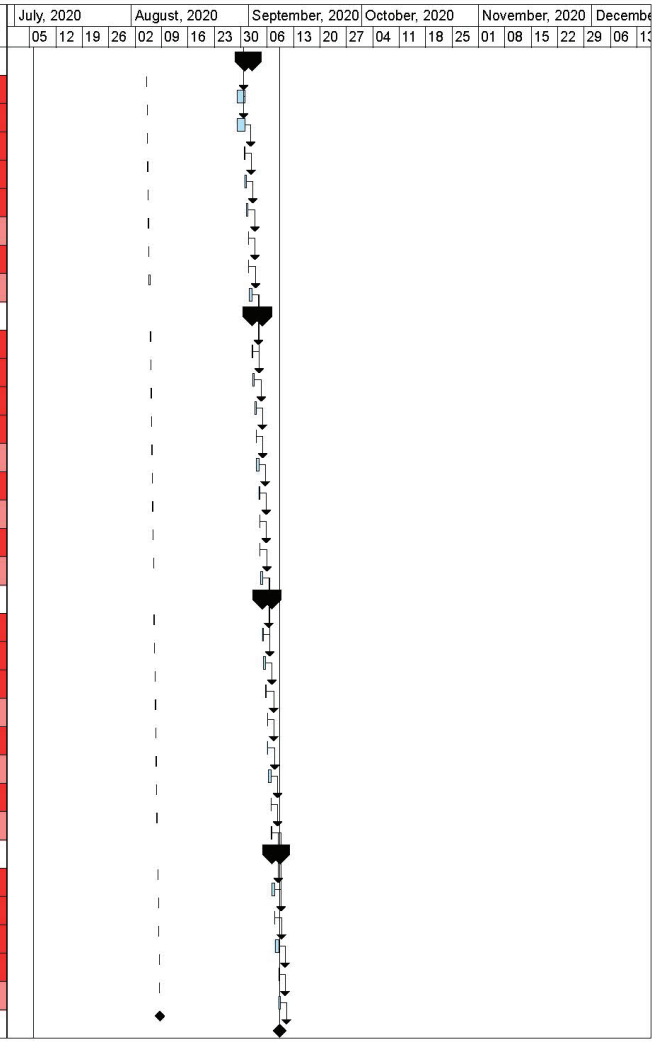
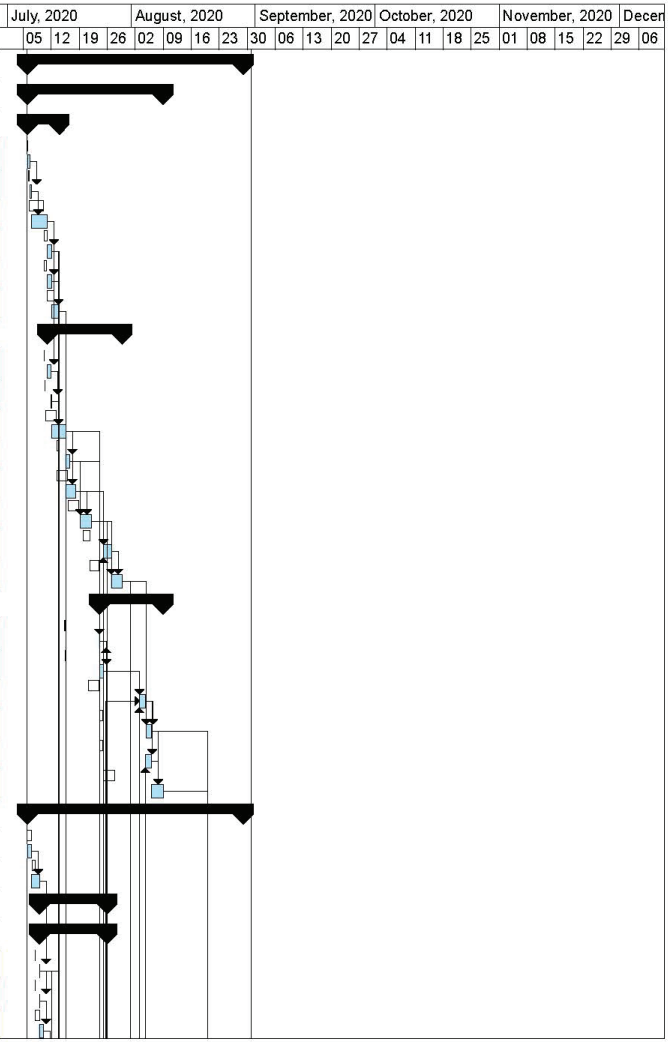
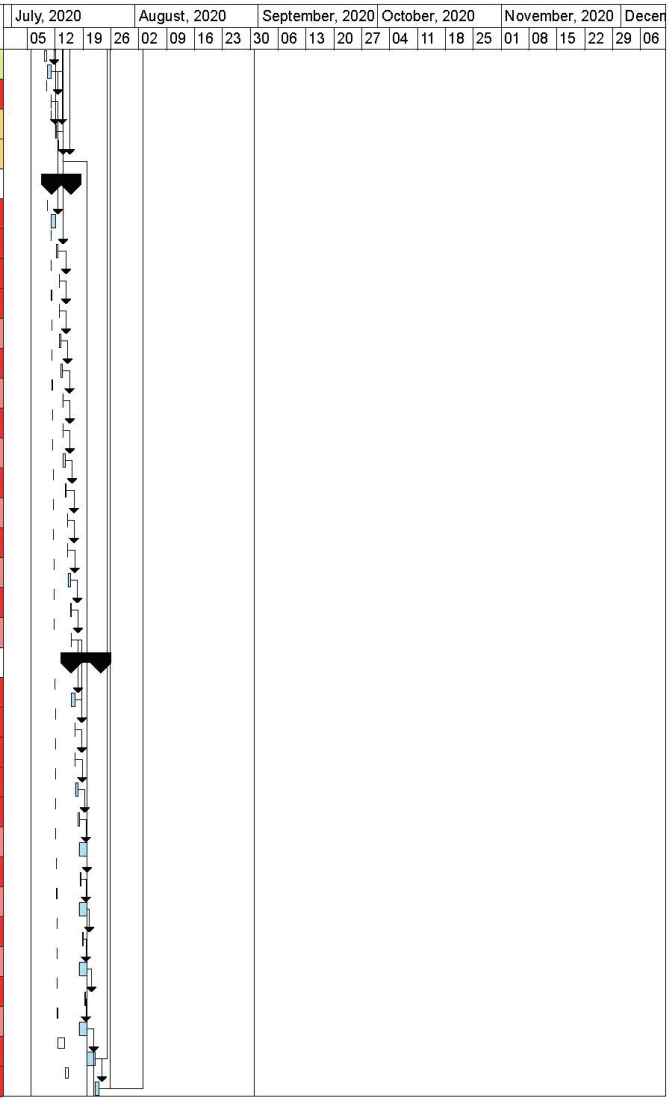


Figure B-3. Schedule of events with risks calculated for 4,000 squares/day.

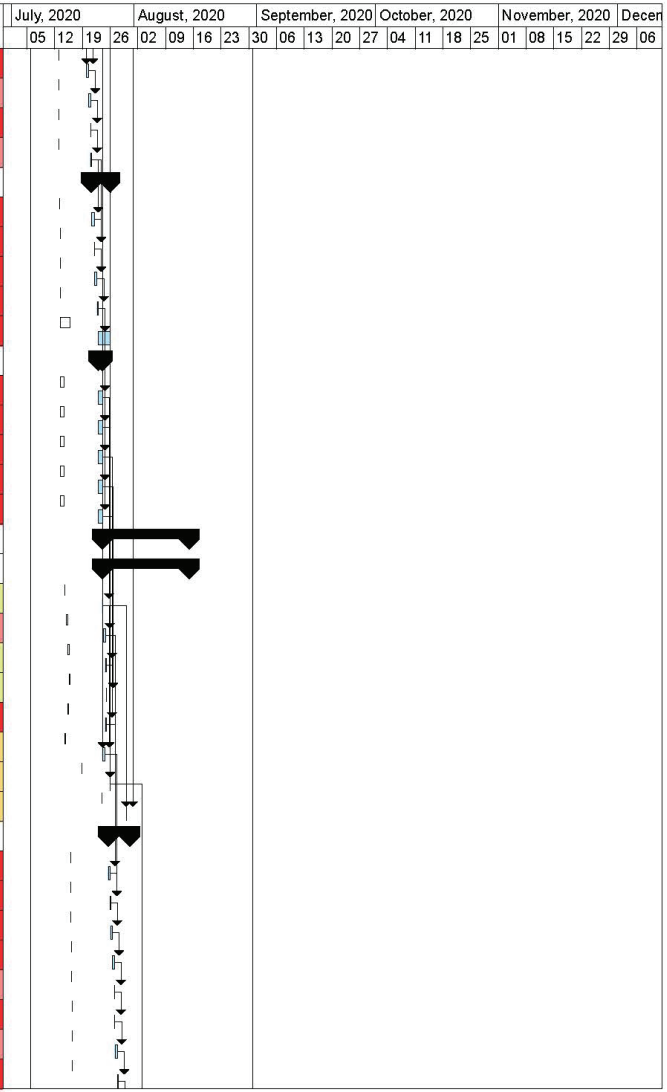
	Task Name	Low Dur	Mean Dur	High Dur	Risks
1	**BEGINNING OF SEASON**	**230.75 hr**	**471 hr**	**2189.12 hr**	**0**
2	**Mat Yard Mobilization**	**191 hr**	**291 hr**	**921 hr**	**0**
3	**Memphis Yard Mobilization**	**51 hr**	**71 hr**	**181 hr**	**0**
4	Tie off empty barges at Memphis Yard	2.1 hr	7.6 hr	46.03 hr	8
5	Lash and Prep loaded barges for transport at Memphis Yard	2.28 hr	2.37 hr	41.25 hr	8
6	Load Mats on Barges 1-12 at Memphis Yard	24.65 hr	31 hr	46.25 hr	18
7	Tow 1st Fleet of Barges from Richardson Landing to Memphis	20.75 hr	25.43 hr	42.38 hr	28
8	Load Mats on Barges 13-15 at Memphis Yard	6.65 hr	10 hr	22.47 hr	18
9	Tow 2nd Fleet of Barges from Richardson Landing to Memphis Reg	36.05 hr	39.97 hr	56.7 hr	28
10	**Delta Yard Mobilization**	**121.97 hr**	**168.53 hr**	**407.47 hr**	**0**
11	Tie off empty barges at Delta Yard	2.53 hr	9.22 hr	34.13 hr	8
12	Lash and Prep loaded barges for transport at Delta Yard	2.5 hr	2.58 hr	36.08 hr	8
13	Load Mats on Barges 16-27 at Delta Yard	28.2 hr	34.88 hr	43.12 hr	18
14	Tow 3rd Fleet of Barges from Delta Yard to Vicksburg	19.7 hr	24.15 hr	30.53 hr	28
15	Load Mats on Barges 28-39 at Delta Yard	26.58 hr	26.58 hr	49.58 hr	18
16	Tow 4th Fleet of Barges from Delta Yard to Vicksburg	59.23 hr	66.37 hr	70.75 hr	28
17	Load Mats on Barges 40-43, 1-4 at Delta Yard	16.32 hr	20 hr	34.43 hr	18
18	Tow 5th Fleet of Barges from Delta Yard to Vicksburg	60.38 hr	66.43 hr	81.2 hr	28
19	**St. Francisville Yard Mobilization**	**100 hr**	**140 hr**	**430 hr**	**0**
20	Tie off empty barges at St. Francisville Yard	2.15 hr	2.15 hr	28.95 hr	8
21	Lash and Prep loaded barges for transport at St. Francisville Yard	2.68 hr	8.42 hr	40.92 hr	8
22	Load Mats on Barges 5-16 at St. Francisville Yard	27.82 hr	27.82 hr	40.57 hr	18
23	Tow 6th Fleet of Barges from St. Francisville Yard to New Orleans	18.95 hr	25.93 hr	42.37 hr	28
24	Load Mats on Barges 17-20 at St. Francisville	8.95 hr	15 hr	17.13 hr	18
25	Tow 7th Fleet of Barges from St. Francisville to New Orleans	66.15 hr	73.42 hr	92.35 hr	28
26	**ACM Placement**	**230.75 hr**	**471 hr**	**2189.12 hr**	**0**
27	Training	10.17 hr	11.98 hr	13.93 hr	0
28	Blessing of the Fleet	7.15 hr	9.02 hr	29.83 hr	0
29	**Memphis Region**	**83.68 hr**	**150 hr**	**613.63 hr**	**0**
30	**Mobilize Floating Plant for Memphis Region**	**83.68 hr**	**150 hr**	**613.63 hr**	**0**
31	Mat Anchor Barge Moored in place at Memphis	1.65 hr	4.45 hr	21.78 hr	4
32	Quarter Boat Moored in Place at Memphis	3.27 hr	7.08 hr	29.18 hr	8
33	ARMOR ONE Anchor Barge Moored in place at Memphis	3.07 hr	10 hr	16.75 hr	4



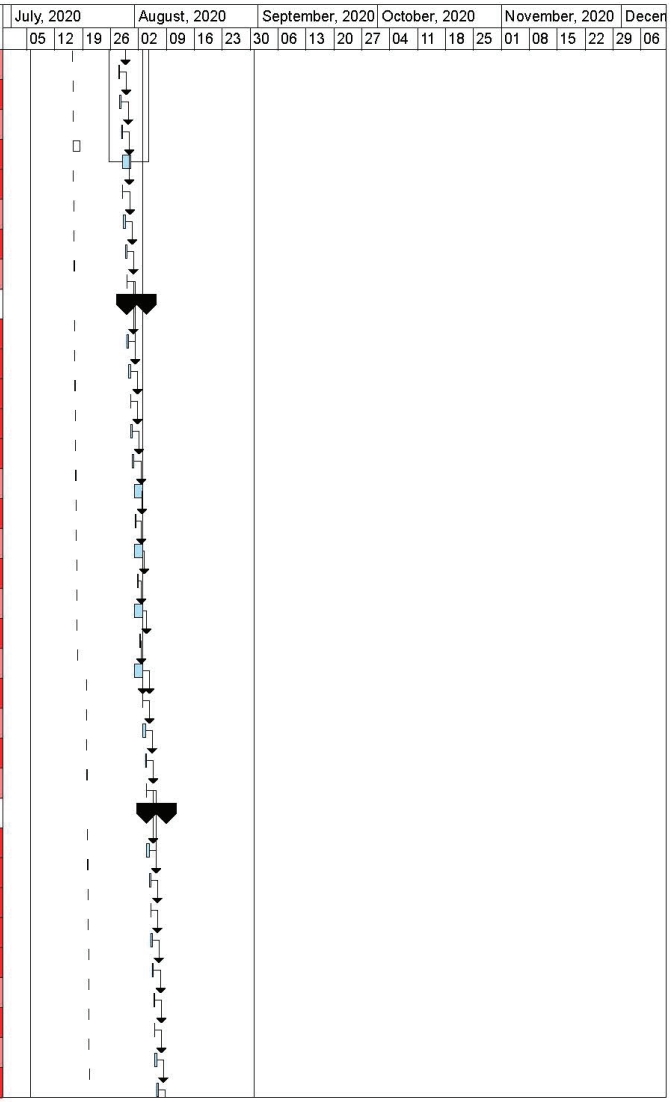
	Task Name	Low Dur	Mean Dur	High Dur	Risks
34	ARMOR ONE unit moored in place at Memphis	4.77 hr	10 hr	23.27 hr	4
35	Dozers placed at Memphis	1.95 hr	5.52 hr	25.03 hr	12
36	1st Fleet of Barges Anchored at Memphis	3.15 hr	4.93 hr	8.72 hr	6
37	2nd Fleet of Barges Anchored at Memphis	3.2 hr	5.35 hr	12.03 hr	6
38	**ACM Placement - 1st Day**	**22.7 hr**	**50 hr**	**199.33 hr**	**0**
39	Land Anchors Installed - D1M	1.5 hr	9.08 hr	23.92 hr	19
40	T1-B1 towed in place	0.3 hr	3.7 hr	8.92 hr	14
41	T1-B1 Offloaded	1.47 hr	1.47 hr	18.22 hr	10
42	T1-B2 towed in place	0.28 hr	3.67 hr	12.82 hr	14
43	T1-B2 Offloaded	0.95 hr	4.92 hr	10.13 hr	8
44	T1-B3 towed in place	0.27 hr	3.58 hr	20.88 hr	12
45	T1-B3 Offloaded	2.53 hr	2.53 hr	14.78 hr	8
46	T1-B4 towed in place	0.57 hr	3.85 hr	13.28 hr	12
47	T1-B4 Offloaded	1.17 hr	5 hr	9.52 hr	8
48	T1-B5 towed in place	0.28 hr	3.9 hr	21.82 hr	12
49	T1-B5 Offloaded	1.78 hr	1.78 hr	20.87 hr	8
50	T1-B6 towed in place	0.28 hr	3.65 hr	17.15 hr	12
51	T1-B6 Offloaded	1.48 hr	7.1 hr	18.13 hr	8
52	T1-B7 towed in place	0.25 hr	3.55 hr	21.78 hr	12
53	T1-B7 Offloaded (3/4)	1.93 hr	1.93 hr	23.42 hr	8
54	**ACM Placement - 2nd Day**	**38.52 hr**	**55 hr**	**229.23 hr**	**0**
55	Land Anchors Installed - D2M	2.3 hr	10 hr	16 hr	19
56	T1-B7 Offloaded (1/4)	0.7 hr	0.7 hr	21.03 hr	10
57	T1-B8 towed in place	0.3 hr	3.63 hr	21.98 hr	14
58	T1-B8 Offloaded	1.3 hr	6.62 hr	9.6 hr	10
59	T1-B9 towed in place	0.25 hr	3.63 hr	11.18 hr	12
60	T1-B9 Offloaded	1.18 hr	1.18 hr	16.18 hr	8
61	T1-B10 towed in place	0.33 hr	3.65 hr	21.02 hr	12
62	T1-B10 Offloaded	1.98 hr	1.98 hr	19.38 hr	8
63	T1-B11 towed in place	0.33 hr	3.52 hr	31.1 hr	12
64	T1-B11 Offloaded	1.47 hr	1.47 hr	16.38 hr	8
65	T1-B12 towed in place	0.43 hr	3.48 hr	46.73 hr	12
66	T1-B12 Offloaded	1.82 hr	1.82 hr	13.92 hr	8
67	*Tow Barges 1-4 to Delta Yard*	46.95 hr	51.3 hr	60.17 hr	*28*
68	*Tow Barges 5-12 to St. Francisville Yard from Delta Yard*	21.1 hr	26.53 hr	40.37 hr	*28*



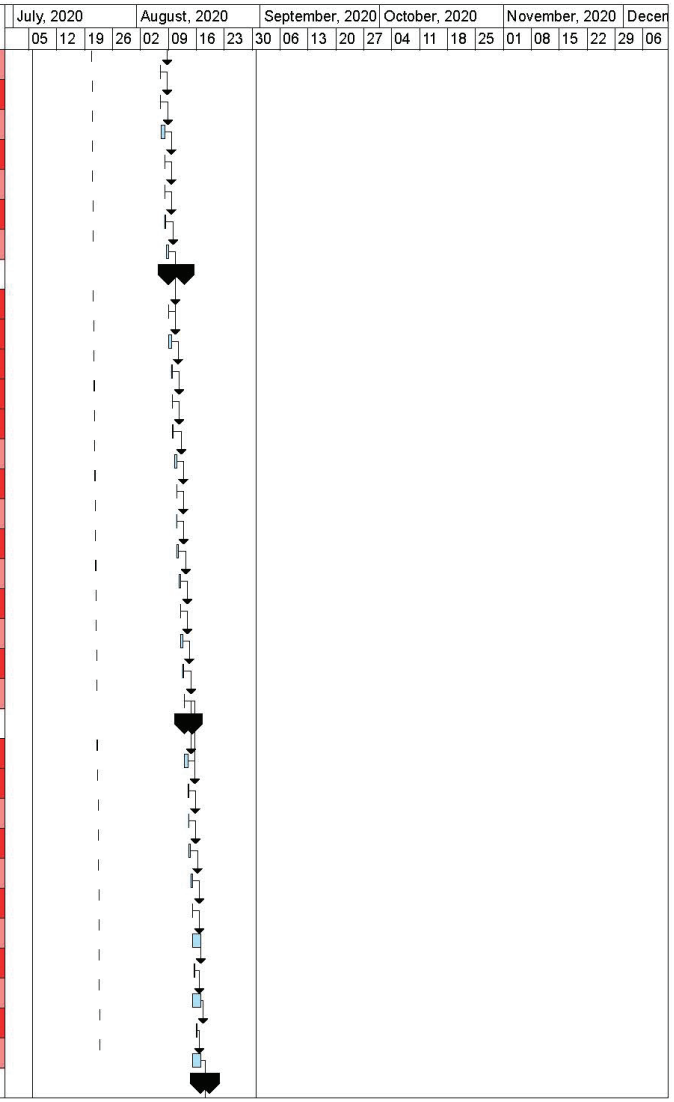
	Task Name	Low Dur	Mean Dur	High Dur	Risks
69	T2-B13 towed in place	0.38 hr	5 hr	45.12 hr	12
70	T2-B13 Offloaded	1.37 hr	5 hr	14.52 hr	8
71	T2-B14 towed in place	0.45 hr	3.82 hr	8.95 hr	12
72	T2-B14 Offloaded (1/2)	1.53 hr	3 hr	8.57 hr	8
73	**ACM Placement - 3rd Day**	**32.55 hr**	**47 hr**	**117.83 hr**	**0**
74	Land Anchors Installed - D3M	2.92 hr	7 hr	25.88 hr	19
75	T2-B14 Offloaded (1/2)	0.73 hr	1.52 hr	25.68 hr	10
76	T2-B15 towed in place	0.3 hr	3.63 hr	12.3 hr	14
77	T2-B15 Offloaded	1.2 hr	2.87 hr	21.53 hr	10
78	Tow Barges 13-15 to St. Francisville Yard from Memphis	61.73 hr	67.42 hr	77.87 hr	22
79	**Relocate Floating Plant to Vicksburg**	**12.4 hr**	**12.4 hr**	**18.47 hr**	**0**
80	Mat Anchor Barge towed to Vicksburg	22.28 hr	29.08 hr	42.45 hr	22
81	Quarter Boat towed to Vicksburg	18.18 hr	29.12 hr	43.67 hr	22
82	ARMOR ONE Anchor Barge towed to Vicksburg	21.88 hr	28.88 hr	41.28 hr	18
83	ARMOR ONE Unit towed to Vicksburg	18.38 hr	29.08 hr	29.8 hr	22
84	Dozers towed to Vicksburg	21.92 hr	29.22 hr	31.1 hr	22
85	**Vicksburg Region**	**79.12 hr**	**200 hr**	**1009.92 hr**	**0**
86	**Mobilize Floating Plant for Vicksburg Region**	**79.12 hr**	**200 hr**	**1009.92 hr**	**0**
87	Mat Anchor Barge Moored in place at Vicksburg	2 hr	4.58 hr	11.52 hr	4
88	Quarter Boat Moored in Place at Vicksburg	3.82 hr	7.03 hr	17.72 hr	8
89	ARMOR ONE Anchor Barge Moored in place at Vicksburg	4.53 hr	6.68 hr	23.43 hr	4
90	ARMOR ONE unit moored in place at Vicksburg	6.48 hr	8.23 hr	16.27 hr	4
91	Dozers placed at Vicksburg	1.7 hr	5.48 hr	9.98 hr	12
92	3rd Fleet of Barges Anchored	2.22 hr	5.25 hr	12.32 hr	6
93	4th Fleet of Barges Anchored	3.07 hr	5.37 hr	17.37 hr	6
94	5th Fleet of Barges Anchored	2.23 hr	5.37 hr	9.85 hr	6
95	**ACM Placement - 1st Day**	**20 hr**	**55 hr**	**178.03 hr**	**0**
96	Land Anchors Installed - D1V	1.2 hr	5 hr	21.47 hr	19
97	T3-B16 towed in place	0.25 hr	1.47 hr	9.4 hr	14
98	T3-B16 Offloaded	1.17 hr	5.48 hr	16.13 hr	10
99	T3-B17 towed in place	0.33 hr	3.63 hr	22.2 hr	14
100	T3-B17 Offloaded	0.9 hr	0.9 hr	12.65 hr	8
101	T3-B18 towed in place	0.47 hr	3.58 hr	12.5 hr	12
102	T3-B18 Offloaded	1.22 hr	6.5 hr	17.8 hr	8
103	T3-B19 towed in place	0.27 hr	3.55 hr	10.88 hr	12



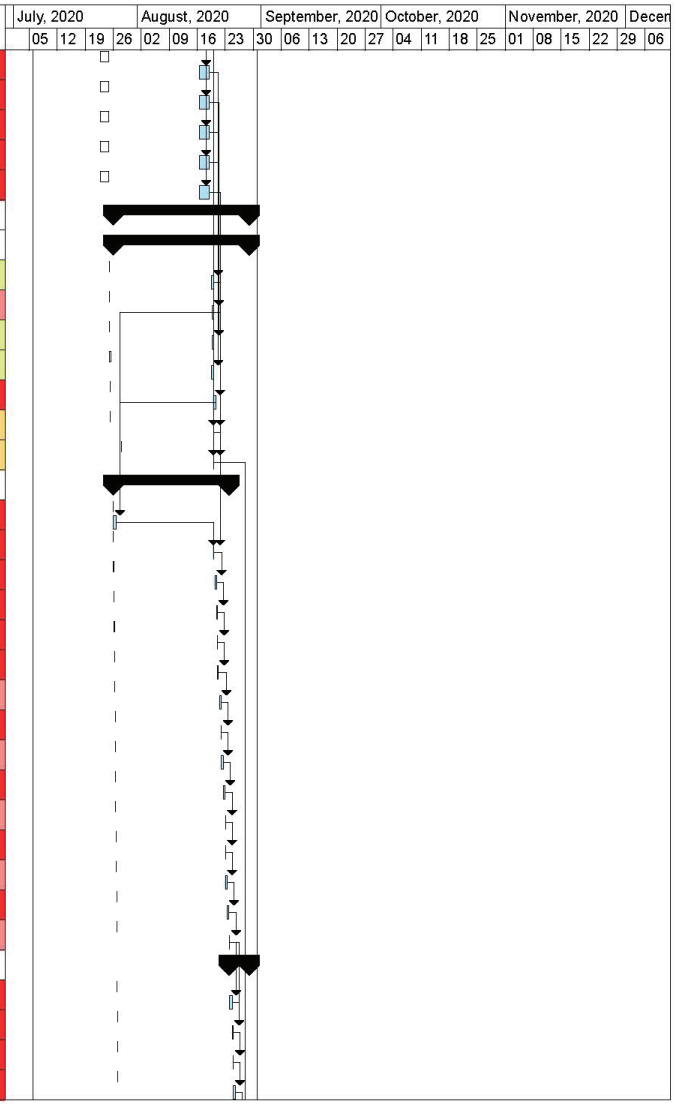
	Task Name	Low Dur	Mean Dur	High Dur	Risks
104	T3-B19 Offloaded	1.9 hr	2.4 hr	17.57 hr	8
105	T3-B20 towed in place	0.32 hr	3.6 hr	24.17 hr	12
106	T3-B20 Offloaded	1.57 hr	2.37 hr	19.48 hr	8
107	*Tow Barges 16-20 to St. Francisville Yard*	39.37 hr	45.52 hr	58.87 hr	28
108	T3-B21 towed in place	0.35 hr	3.63 hr	11.77 hr	12
109	T3-B21 Offloaded	1.02 hr	6.73 hr	20.42 hr	8
110	T3-B22 towed in place	0.28 hr	3.57 hr	12.1 hr	12
111	T3-B22 Offloaded (3/4)	1.42 hr	1.42 hr	8.03 hr	8
112	**ACM Placement - 2nd Day**	**12.05 hr**	**30 hr**	**220.05 hr**	**0**
113	Land Anchors Installed - D2V	1.52 hr	5.85 hr	9.53 hr	10
114	T3-B22 Offloaded (1/4)	0.8 hr	4.12 hr	10.23 hr	10
115	T3-B23 towed in place	0.3 hr	3.52 hr	33.02 hr	14
116	T3-B23 Offloaded	0.85 hr	4.97 hr	23.65 hr	10
117	T3-B24 towed in place	0.37 hr	3.62 hr	32.78 hr	14
118	T3-B24 Offloaded	1.98 hr	1.98 hr	9.27 hr	8
119	T3-B25 towed in place	0.27 hr	3.58 hr	27.6 hr	12
120	T3-B25 Offloaded	0.87 hr	0.87 hr	10.23 hr	8
121	T3-B26 towed in place	0.32 hr	3.55 hr	34.65 hr	12
122	T3-B26 Offloaded	1.35 hr	1.35 hr	17.9 hr	8
123	T3-B27 towed in place	0.37 hr	3.7 hr	37.18 hr	12
124	T3-B27 Offloaded	1.13 hr	1.13 hr	13.42 hr	8
125	T4-B28 towed in place	0.3 hr	0.4 hr	29.27 hr	12
126	T4-B28 Offloaded	1.15 hr	6.98 hr	9.55 hr	8
127	T4-B29 towed in place	0.35 hr	3.6 hr	32.1 hr	12
128	T4-B29 Offloaded (1/2)	0.4 hr	0.4 hr	8.75 hr	8
129	**ACM Placement - 3rd Day**	**16.25 hr**	**50 hr**	**228.18 hr**	**0**
130	Land Anchors Installed - D3V	1.93 hr	8.57 hr	9.17 hr	19
131	T4-B29 Offloaded (1/2)	0.63 hr	1.43 hr	21.23 hr	10
132	T4-B30 towed in place	0.33 hr	3.6 hr	34.9 hr	14
133	T4-B30 Offloaded	1.28 hr	4.72 hr	15.87 hr	10
134	T4-B31 towed in place	0.37 hr	3.63 hr	28.4 hr	14
135	T4-B31 Offloaded	1.2 hr	1.2 hr	17.2 hr	8
136	T4-B32 towed in place	0.3 hr	3.7 hr	40.55 hr	12
137	T4-B32 Offloaded	1.33 hr	5.78 hr	8.55 hr	8
138	T4-B33 towed in place	0.33 hr	3.62 hr	38.55 hr	12



	Task Name	Low Dur	Mean Dur	High Dur	Risks
139	T4-B33 Offloaded	1.03 hr	1.03 hr	14.58 hr	8
140	T4-B34 towed in place	0.33 hr	3.65 hr	39.98 hr	12
141	T4-B34 Offloaded	1.47 hr	7.2 hr	25.9 hr	8
142	T4-B35 towed inplace	0.28 hr	3.28 hr	23.27 hr	12
143	T4-B35 Offloaded	3.78 hr	3.78 hr	23.07 hr	8
144	T4-B36 towed in place	0.33 hr	3.72 hr	18.02 hr	12
145	T4-B36 Offloaded (1/4)	1.3 hr	5 hr	13.02 hr	8
146	**ACM Placement - 4th Day**	**14.33 hr**	**40 hr**	**217.08 hr**	**0**
147	Land Anchors Installed - D4V	2.08 hr	2.08 hr	20.13 hr	19
148	T4-B36 Offloaded (3/4)	1.27 hr	6.27 hr	19.4 hr	10
149	T4-B37 towed in place	0.37 hr	3.77 hr	30 hr	14
150	T4-B37 Offloaded	1.28 hr	1.28 hr	10.55 hr	10
151	T4-B38 towed in place	0.45 hr	3.58 hr	39.08 hr	12
152	T4-B38 Offloaded	1.45 hr	5 hr	8.12 hr	8
153	T4-B39 towed in place	0.33 hr	4.02 hr	19.83 hr	12
154	T4-B39 Offloaded	1.45 hr	1.45 hr	16.3 hr	8
155	T5-B40 towed in place	0.32 hr	3.82 hr	17.67 hr	12
156	T5-B40 Offloaded	1.68 hr	2.47 hr	22.97 hr	8
157	T5-B41 towed in place	0.42 hr	3.77 hr	6.75 hr	12
158	T5-B41 Offloaded	1.5 hr	5.07 hr	21.35 hr	8
159	T5-B42 towed in place	0.3 hr	3.7 hr	34.37 hr	12
160	T5-B42 Offloaded	1.43 hr	1.43 hr	23.92 hr	8
161	**ACM Placement - 5th Day**	**10.5 hr**	**20 hr**	**146.57 hr**	**0**
162	Land Anchors Installed - D5V	2.5 hr	9.97 hr	23.23 hr	19
163	T5-B43 towed in place	0.35 hr	3.85 hr	18.05 hr	14
164	T5-B43 Offloaded	1.7 hr	1.82 hr	19.77 hr	8
165	T5-B1 towed inplace	0.3 hr	3.38 hr	23.43 hr	12
166	T5-B1 Offloaded	0.97 hr	3.35 hr	16.45 hr	8
167	T5-B2 towed in place	0.27 hr	3.45 hr	8.43 hr	12
168	T5-B2 Offloaded	1.93 hr	1.93 hr	24.85 hr	8
169	T5-B2 towed in place	0.28 hr	3.48 hr	10.37 hr	12
170	T5-B3 Offloaded	1.08 hr	1.08 hr	19.42 hr	8
171	T5-B3 towed in place	0.3 hr	3.63 hr	24.25 hr	12
172	T5-B4 Offloaded	0.95 hr	0.95 hr	10.25 hr	8
173	**Relocate Floating Plant to St. Francisville Region**	**27.18 hr**	**27.18 hr**	**40.08 hr**	**0**



	Task Name	Low Dur	Mean Dur	High Dur	Risks
174	Mat Anchor Barge towed to St. Francisville Region	61.68 hr	61.8 hr	79.07 hr	22
175	Quarter Boat towed to St. Francisville Region	56.87 hr	62.23 hr	90.85 hr	22
176	ARMOR ONE Anchor Barge towed to St. Francisville Region	56.27 hr	62.12 hr	105.25 hr	22
177	ARMOR ONE Unit towed to St. Francisville Region	48.57 hr	62.3 hr	81.67 hr	22
178	Dozers towed to St. Francisville Region	68.18 hr	68.18 hr	101.47 hr	22
179	**St. Francisville Region**	**59.75 hr**	**300 hr**	**2018.12 hr**	**0**
180	**Mobilize Floating Plant at St. Francisville Region**	**59.75 hr**	**300 hr**	**2018.12 hr**	**0**
181	Mat Anchor Barge Moored in place at St. F.	1.67 hr	3.87 hr	20.68 hr	4
182	Quarter Boat Moored in Place at St. F.	2.18 hr	2.88 hr	20.23 hr	8
183	ARMOR ONE Anchor Barge Moored in place at St. F.	2.25 hr	2.38 hr	25.03 hr	4
184	ARMOR ONE unit moored in place at St. F.	5.53 hr	5.53 hr	15.42 hr	4
185	Dozers placed at St. F.	1.97 hr	6.57 hr	22.4 hr	16
186	6th Fleet of Barges Anchored at St. F.	3.12 hr	5.37 hr	17.35 hr	6
187	7th Fleet of Barges Anchored at St. F.	2.83 hr	5.35 hr	16.23 hr	6
188	**ACM Placement - 1st Day St. Francisville**	**26.43 hr**	**250 hr**	**1719.48 hr**	**0**
189	Land Anchors Installed - D1SF	0.48 hr	7.17 hr	40.32 hr	19
190	T6-B5 towed in place	0.27 hr	3.57 hr	30.38 hr	14
191	T6-B5 Offloaded	1.05 hr	5.17 hr	15.1 hr	10
192	T6-B6 towed in place	0.25 hr	3.67 hr	41.87 hr	14
193	T6-B6 Offloaded	1.15 hr	1.15 hr	9.13 hr	10
194	T6-B7 towed in place	0.27 hr	3.65 hr	32.77 hr	12
195	T6-B7 Offloaded	2.2 hr	3.9 hr	10.4 hr	8
196	T6-B8 towed in place	0.28 hr	3.18 hr	14.77 hr	12
197	T6-B8 Offloaded	1.23 hr	5.13 hr	18.5 hr	8
198	T6-B9 towed in place	0.25 hr	3.97 hr	39.9 hr	12
199	T6-B9 Offloaded	1.97 hr	1.97 hr	10.5 hr	8
200	T6-B10 towed in place	0.28 hr	3 hr	16.65 hr	12
201	T6-B10 Offloaded	1.8 hr	5.43 hr	23.27 hr	8
202	T6-B11 towed in place	0.33 hr	3.78 hr	21.38 hr	12
203	T6-B11 Offloaded (3/4)	0.57 hr	0.57 hr	18.83 hr	8
204	**ACM Placement 2nd Day St. Franisville**	**26.05 hr**	**50 hr**	**213.83 hr**	**0**
205	Land Anchors Installed - D2SF	1.08 hr	8.22 hr	8.7 hr	19
206	T6-B11 Offloaded (1/4)	1.27 hr	1.78 hr	23.27 hr	10
207	T6-B12 towed in place	0.27 hr	3.7 hr	30.4 hr	14
208	T6-B12 Offloaded	2.22 hr	6.02 hr	8.55 hr	10



	Task Name	Low Dur	Mean Dur	High Dur	Risks
209	T6-B13 towed in place	7.2 hr	7.2 hr	11.03 hr	12
210	T6-B13 Offloaded	1.93 hr	1.93 hr	19.7 hr	8
211	T6-B14 towed in place	1.17 hr	4 hr	13.92 hr	12
212	T6-B14 Offloaded	1.68 hr	5.55 hr	23 hr	8
213	T6-B15 towed in place	0.4 hr	3.78 hr	10.68 hr	12
214	T6-B15 Offloaded	2.47 hr	2.47 hr	14.23 hr	8
215	T6-B16 towed in place	0.25 hr	3.43 hr	20.67 hr	12
216	T6-B16 Offloaded	1.25 hr	3.83 hr	23 hr	8
217	T7-B17 towed in place	2.82 hr	3.9 hr	26.85 hr	12
218	T7-B17 Offloaded	1.22 hr	3.47 hr	18.68 hr	8
219	T7-B18 towed in place	0.3 hr	3.57 hr	22.52 hr	12
220	T7-B18 Offloaded (1/2)	2.1 hr	2.1 hr	20.37 hr	8
221	**ACM Placement 3rd Day St. Francisville**	**7.27 hr**	**7.27 hr**	**84.8 hr**	**0**
222	Land Anchors Installed - D3SF	3.33 hr	3.33 hr	23.28 hr	19
223	T7-B18 Offloaded (1/2)	0.73 hr	0.73 hr	21.22 hr	10
224	T7-B19 towed in place	1.13 hr	3.83 hr	16.43 hr	14
225	T7-B19 Offloaded	0.98 hr	0.98 hr	15.35 hr	8
226	T7-B20 towed in place	0.37 hr	3.87 hr	19.98 hr	12
227	T7-B20 Offloaded	0.72 hr	0.72 hr	14.53 hr	8
228	**End of Season**	0 hr	0 hr	0 hr	**0**

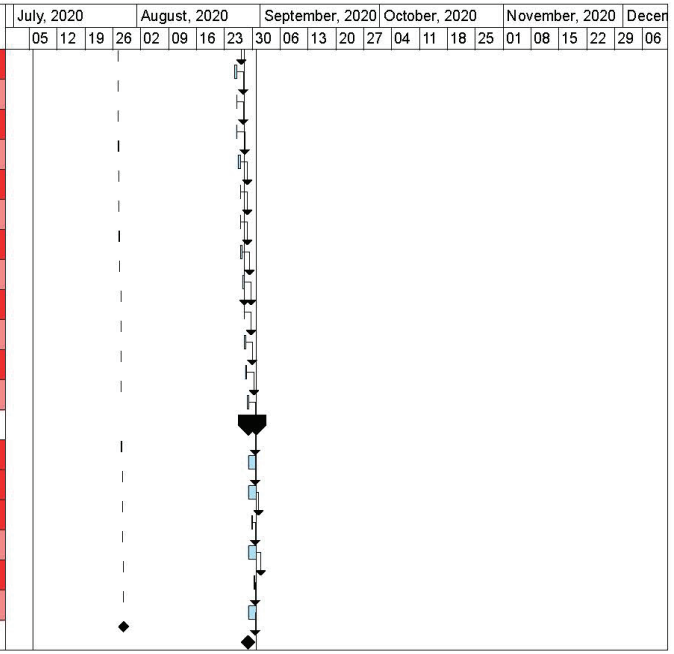
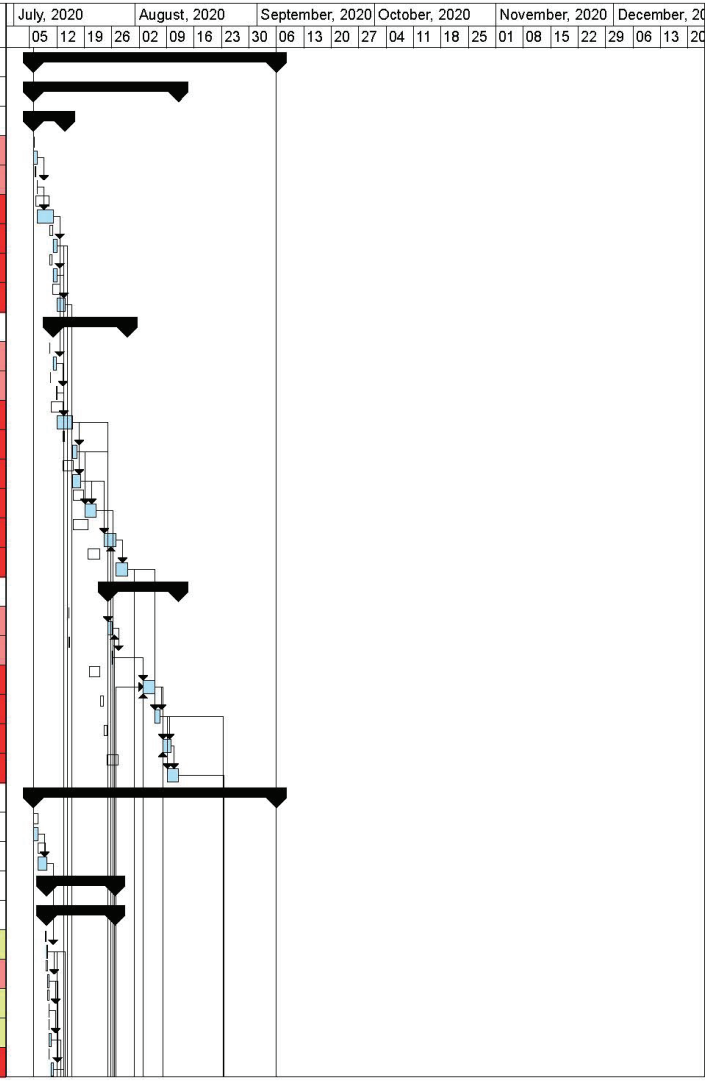
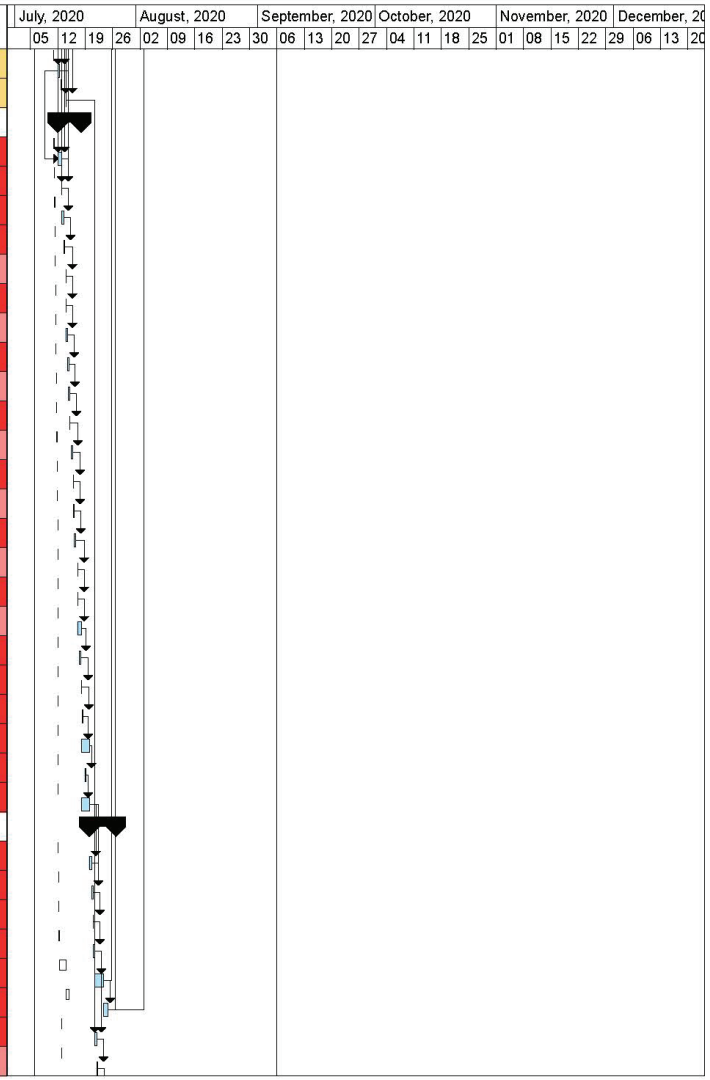


Figure B-4. Schedule of events with risks calculated for 6,000 squares/day.

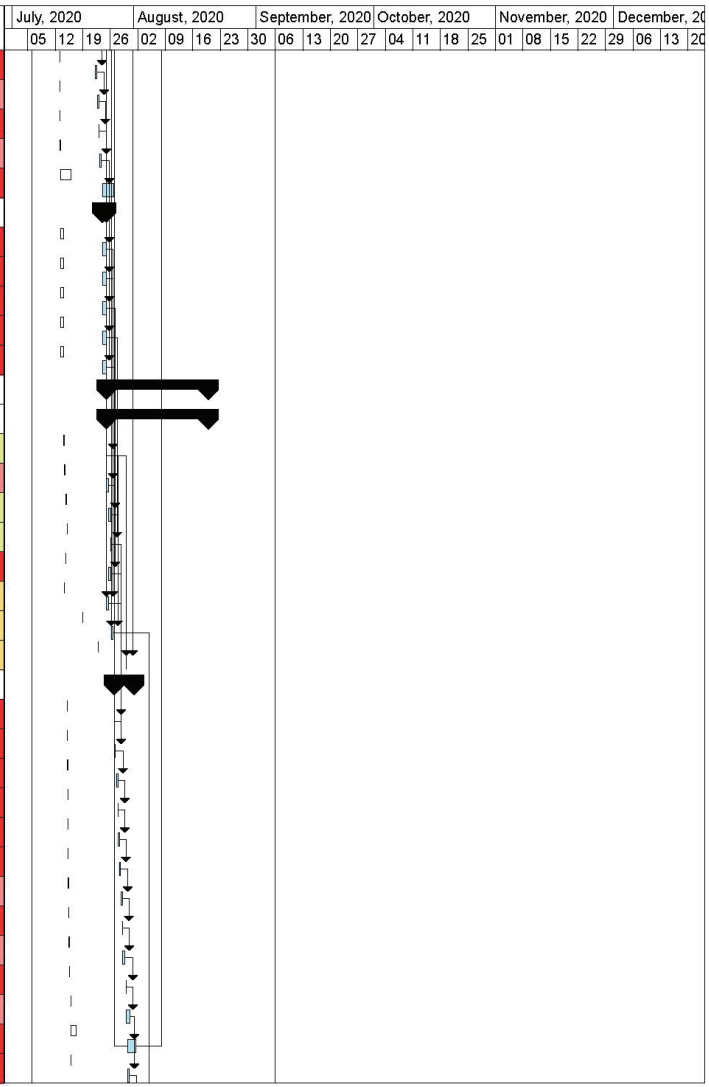
	Task Name	Low Dur	Mean Dur	High Dur	Risks
1	**BEGINNING OF SEASON**	**275 hr**	**503 hr**	**2260 hr**	**0**
2	**Mat Yard Mobilization**	**212 hr**	**305 hr**	**942.32 hr**	**0**
3	**Memphis Yard Mobilization**	**51 hr**	**68 hr**	**190 hr**	**0**
4	Tie off empty barges at Memphis Yard	2.1 hr	8 hr	46.13 hr	8
5	Lash and Prep loaded barges for transport at Memphis Yard	2.28 hr	2.28 hr	47.93 hr	8
6	Load Mats on Barges 1-12 at Memphis Yard	24.65 hr	34 hr	46.45 hr	18
7	Tow 1st Fleet of Barges from Richardson Landing to Memphis	20.75 hr	25.57 hr	39.2 hr	28
8	Load Mats on Barges 13-15 at Memphis Yard	6.65 hr	9 hr	30.12 hr	18
9	Tow 2nd Fleet of Barges from Richardson Landing to Memphis R	36.05 hr	39.93 hr	50.07 hr	28
10	**Delta Yard Mobilization**	**85.68 hr**	**170 hr**	**464.48 hr**	**0**
11	Tie off empty barges at Delta Yard	2.53 hr	8.33 hr	38.62 hr	8
12	Lash and Prep loaded barges for transport at Delta Yard	2.5 hr	2.5 hr	39.22 hr	8
13	Load Mats on Barges 16-27 at Delta Yard	28.2 hr	38.8 hr	57.55 hr	18
14	Tow 3rd Fleet of Barges from Delta Yard to Vicksburg	19.7 hr	24.02 hr	30.37 hr	28
15	Load Mats on Barges 28-39 at Delta Yard	26.58 hr	26.58 hr	45.63 hr	18
16	Tow 4th Fleet of Barges from Delta Yard to Vicksburg	59.23 hr	66.43 hr	83.6 hr	28
17	Load Mats on Barges 40-43, 1-4 at Delta Yard	19.53 hr	27.77 hr	37.67 hr	18
18	Tow 5th Fleet of Barges from Delta Yard to Vicksburg	62.95 hr	66.55 hr	87.17 hr	28
19	**St. Francisville Yard Mobilization**	**112.92 hr**	**140.68 hr**	**392.1 hr**	**0**
20	Tie off empty barges at St. Francisville Yard	2.07 hr	8.68 hr	11.2 hr	8
21	Lash and Prep loaded barges for transport at St. Francisville Yar	2.82 hr	2.82 hr	31.72 hr	8
22	Load Mats on Barges 5-16 at St. Francisville Yard	27.75 hr	30.02 hr	38.05 hr	18
23	Tow 6th Fleet of Barges from St. Francisville Yard to New Orlean	24.75 hr	28.45 hr	39.27 hr	28
24	Load Mats on Barges 17-20 at St. Francisville	10.17 hr	10.17 hr	28.67 hr	18
25	Tow 7th Fleet of Barges from St. Francisville to New Orleans	64.57 hr	73.6 hr	73.6 hr	28
26	**ACM Placement**	**275 hr**	**503 hr**	**2260 hr**	**0**
27	Training	10.17 hr	11.98 hr	13.93 hr	0
28	Blessing of the Fleet	7.18 hr	10.17 hr	28.28 hr	0
29	**Memphis Region**	**92.65 hr**	**157.35 hr**	**601.2 hr**	**0**
30	**Mobilize Floating Plant for Memphis Region**	**92.65 hr**	**157.35 hr**	**601.2 hr**	**0**
31	Mat Anchor Barge Moored in place at Memphis	1.62 hr	4.57 hr	21.67 hr	4
32	Quarter Boat Moored in Place at Memphis	3.27 hr	7.05 hr	27.1 hr	8
33	ARMOR ONE Anchor Barge Moored in place at Memphis	4.85 hr	6.68 hr	14.8 hr	4
34	ARMOR ONE unit moored in place at Memphis	5.32 hr	8.22 hr	30.68 hr	4
35	Dozers placed at Memphis	2.8 hr	5.52 hr	29.82 hr	12



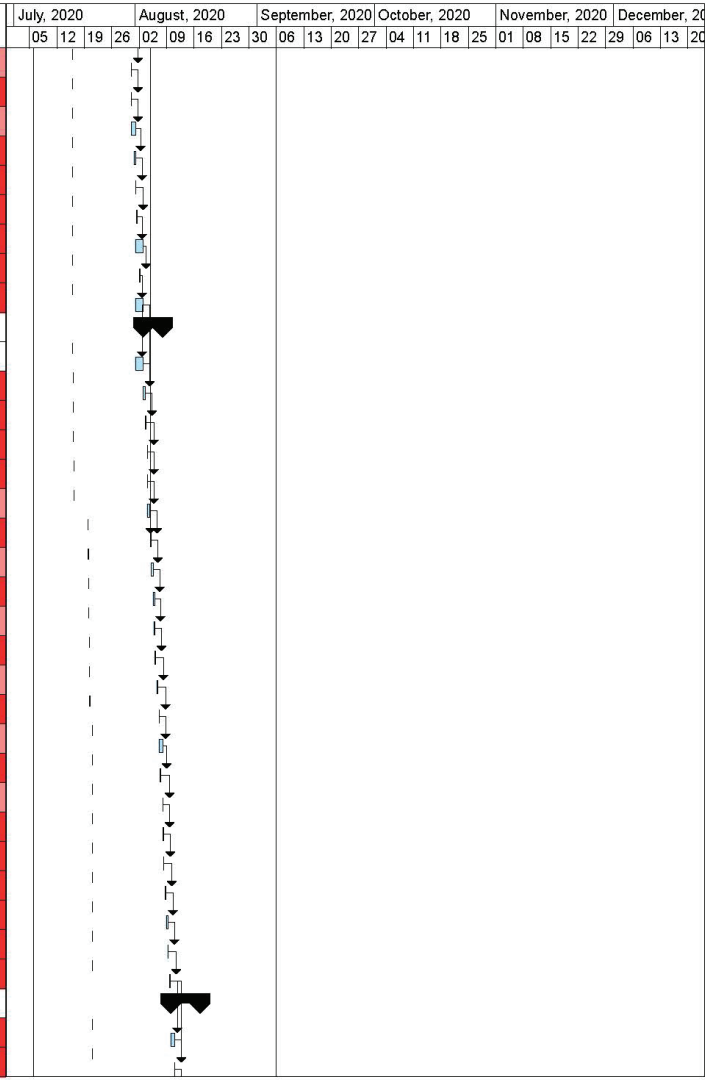
	Task Name	Low Dur	Mean Dur	High Dur	Risks
36	1st Fleet of Barges Anchored at Memphis	3.15 hr	4.83 hr	23.62 hr	6
37	2nd Fleet of Barges Anchored at Memphis	3.2 hr	5.33 hr	13.05 hr	6
38	**ACM Placement - 1st Day**	**31.22 hr**	**60.12 hr**	**254.28 hr**	**0**
39	Land Anchors Installed - D1M	0.28 hr	9.12 hr	11.43 hr	19
40	T1-B1 towed in place	0.3 hr	3.62 hr	22.92 hr	14
41	T1-B1 Offloaded	1.47 hr	4.22 hr	16.68 hr	10
42	T1-B2 towed in place	0.28 hr	3.7 hr	11.12 hr	14
43	T1-B2 Offloaded	0.95 hr	0.95 hr	12.82 hr	8
44	T1-B3 towed in place	0.25 hr	3.55 hr	15.17 hr	12
45	T1-B3 Offloaded	2.53 hr	5.9 hr	11.78 hr	8
46	T1-B4 towed in place	0.57 hr	3.82 hr	8.1 hr	12
47	T1-B4 Offloaded	1.48 hr	1.48 hr	8.48 hr	8
48	T1-B5 towed in place	0.67 hr	3.78 hr	18.27 hr	12
49	T1-B5 Offloaded	1.6 hr	3 hr	24.37 hr	8
50	T1-B6 towed in place	0.28 hr	3.58 hr	44.15 hr	12
51	T1-B6 Offloaded	0.88 hr	2.43 hr	7.98 hr	8
52	T1-B7 towed in place	9.05 hr	9.05 hr	13.88 hr	12
53	T1-B7 Offloaded	1.95 hr	4.73 hr	12.15 hr	8
54	T1-B8 towed in place	0.42 hr	3.52 hr	12.73 hr	12
55	T1-B8 Offloaded	3.17 hr	3.17 hr	15.42 hr	8
56	T1-B9 towed in place	0.35 hr	3.7 hr	10.97 hr	12
57	T1-B9 Offloaded	1.28 hr	2.92 hr	20.67 hr	10
58	T1-B10 towed in place	0.4 hr	3.57 hr	23.1 hr	14
59	T1-B10 Offloaded	2.1 hr	2.1 hr	16.88 hr	10
60	T1-B11 towed in place	0.72 hr	3.73 hr	12.07 hr	14
61	T1-B11 Offloaded (1/4)	0.7 hr	0.7 hr	11.43 hr	10
62	**ACM Placement - 2nd Day**	**44 hr**	**69.5 hr**	**240.42 hr**	**0**
63	Land Anchors Installed - D2M	0.3 hr	5 hr	36.32 hr	19
64	T1-B11 Offloaded (3/4)	0.65 hr	3 hr	16.15 hr	10
65	T1-B12 towed in place	1.48 hr	3.52 hr	8.25 hr	14
66	T1-B12 Offloaded	0.83 hr	5.17 hr	20.02 hr	10
67	*Tow Barges 1-4 to Delta Yard*	41.45 hr	50.35 hr	65.75 hr	22
68	*Tow Barges 5-12 to St. Francisville Yard from Delta Yard*	13.37 hr	25.52 hr	39.45 hr	22
69	T2-B13 towed in place	0.25 hr	5.75 hr	21.68 hr	12
70	T2-B13 Offloaded	1.75 hr	2.78 hr	18.58 hr	8



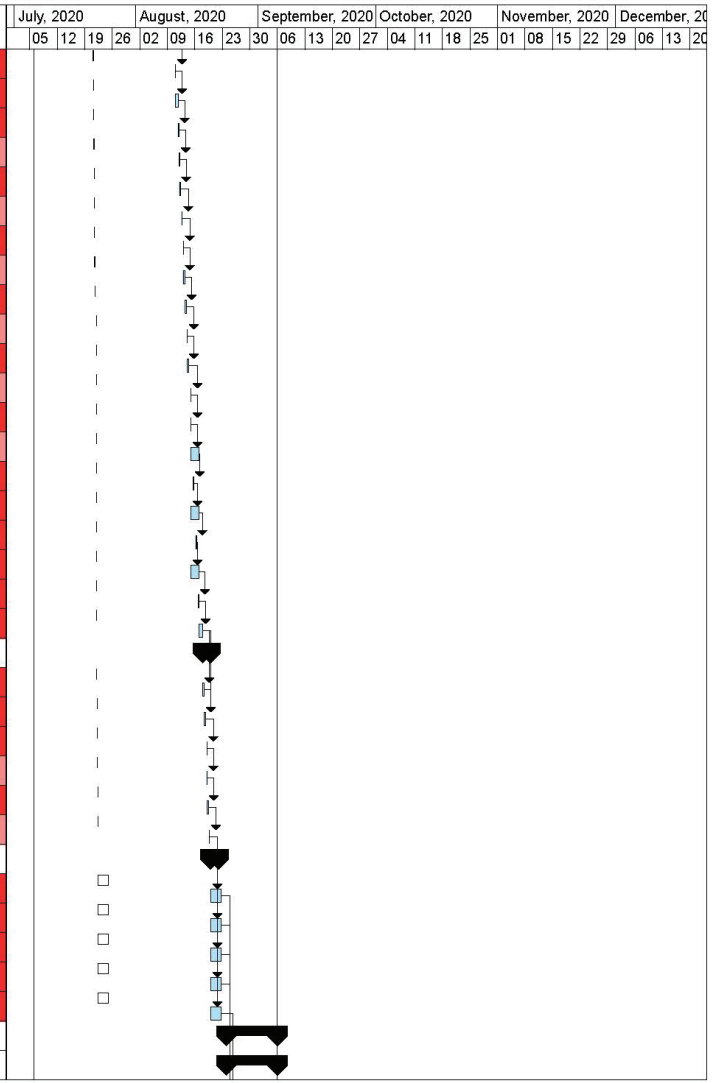
	Task Name	Low Dur	Mean Dur	High Dur	Risks
71	T2-B14 towed in place	0.48 hr	3.93 hr	18.6 hr	12
72	T2-B14 Offloaded	1.67 hr	1.67 hr	25.9 hr	8
73	T2-B15 towed in place	0.27 hr	3.37 hr	23.35 hr	12
74	T2-B15 Offloaded	0.93 hr	4.02 hr	16.25 hr	8
75	*Tow Barges 13-15 to St. Francisville Yard from Memphis*	62.13 hr	67.12 hr	79.03 hr	22
76	**Relocate Floating Plant to Vicksburg**	**13.15 hr**	**13.15 hr**	**24.42 hr**	**0**
77	Mat Anchor Barge towed to Vicksburg	20.83 hr	29.02 hr	41.6 hr	22
78	Quarter Boat towed to Vicksburg	19.12 hr	29.12 hr	37.62 hr	22
79	ARMOR ONE Anchor Barge towed to Vicksburg	17.73 hr	28.9 hr	55.42 hr	18
80	ARMOR ONE Unit towed to Vicksburg	18.22 hr	29.18 hr	38.05 hr	22
81	Dozers towed to Vicksburg	20.52 hr	29.1 hr	48.32 hr	22
82	**Vicksburg Region**	**94.15 hr**	**204 hr**	**1054.6 hr**	**0**
83	**Mobilize Floating Plant for Vicksburg Region**	**94.15 hr**	**204 hr**	**1054.6 hr**	**0**
84	Mat Anchor Barge Moored in place at Vicksburg	2.6 hr	4.57 hr	10.88 hr	4
85	Quarter Boat Moored in Place at Vicksburg	4.32 hr	7.05 hr	28.17 hr	8
86	ARMOR ONE Anchor Barge Moored in place at Vicksburg	4.08 hr	6.53 hr	12.68 hr	4
87	ARMOR ONE unit moored in place at Vicksburg	4.5 hr	8.3 hr	29.2 hr	4
88	Dozers placed at Vicksburg	1.97 hr	5.47 hr	15.13 hr	12
89	3rd Fleet of Barges Anchored	2.67 hr	5.38 hr	16.07 hr	6
90	4th Fleet of Barges Anchored	3.07 hr	5.48 hr	22.87 hr	6
91	5th Fleet of Barges Anchored	2.92 hr	5.38 hr	15.1 hr	6
92	**ACM Placement - 1st Day**	**19 hr**	**52 hr**	**256.08 hr**	**0**
93	Land Anchors Installed - D1V	1.2 hr	1.2 hr	20.93 hr	19
94	T3-B16 towed in place	0.38 hr	3.62 hr	14.45 hr	14
95	T3-B16 Offloaded	0.85 hr	3.08 hr	9.75 hr	10
96	T3-B17 towed in place	0.37 hr	3.62 hr	19.02 hr	14
97	T3-B17 Offloaded	0.92 hr	3.48 hr	20.68 hr	10
98	T3-B18 towed in place	0.27 hr	3.72 hr	12.72 hr	12
99	T3-B18 Offloaded	2.22 hr	2.22 hr	13.3 hr	8
100	T3-B19 towed in place	0.37 hr	3.73 hr	17.75 hr	12
101	T3-B19 Offloaded	1.37 hr	6.03 hr	22.4 hr	8
102	T3-B20 towed in place	0.3 hr	3.52 hr	13.48 hr	12
103	T3-B20 Offloaded	1.17 hr	1.17 hr	8.48 hr	8
104	*Tow Barges 16-20 to St. Francisville Yard*	37.15 hr	44.9 hr	44.9 hr	22
105	T3-B21 towed in place	0.3 hr	3.65 hr	15.48 hr	12



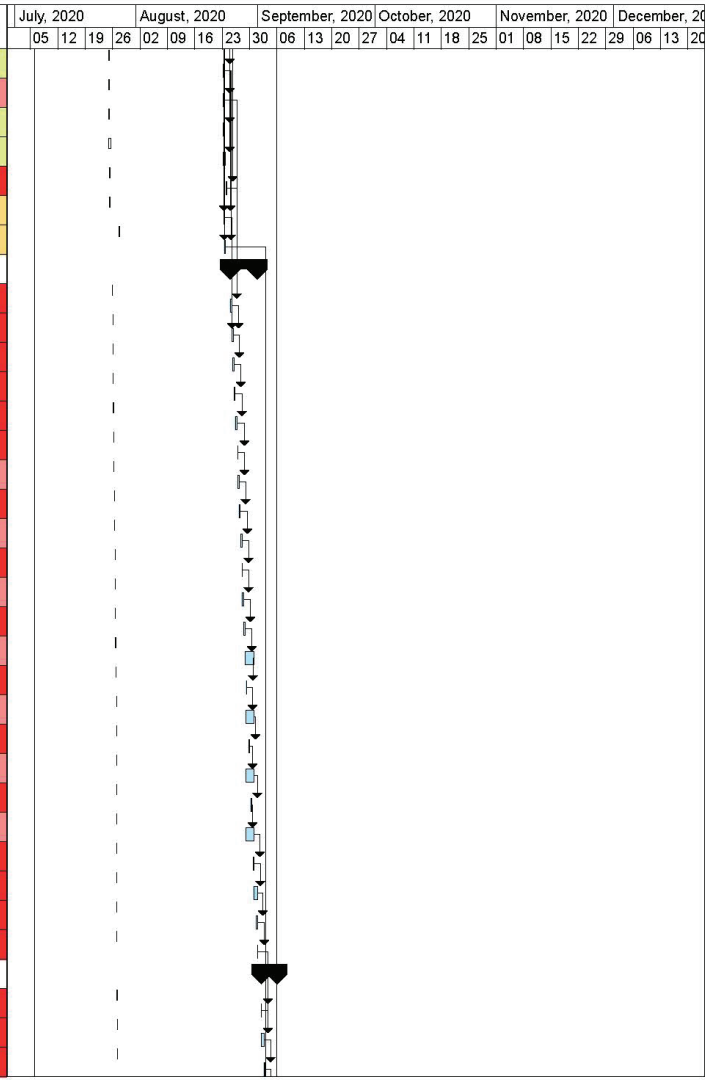
	Task Name	Low Dur	Mean Dur	High Dur	Risks
106	T3-B21 Offloaded	1.47 hr	5.38 hr	14.82 hr	8
107	T3-B22 towed in place	0.43 hr	3.6 hr	9.17 hr	12
108	T3-B22 Offloaded	1.12 hr	1.12 hr	19.13 hr	8
109	T3-B23 towed in place	0.43 hr	4.08 hr	27.5 hr	12
110	T3-B23 Offloaded	1.25 hr	1.73 hr	18.15 hr	10
111	T3-B24 towed in place	0.48 hr	3.25 hr	39.32 hr	14
112	T3-B24 Offloaded	1.58 hr	1.58 hr	12.13 hr	10
113	T3-B25 towed in place	0.4 hr	3.5 hr	18.88 hr	14
114	T3-B25 Offloaded (1/4)	0.78 hr	0.78 hr	20.28 hr	10
115	**ACM Placement - 2nd Day**	**33 hr**	**52 hr**	**331 hr**	**0**
116	Land Anchors Installed - D2V	1.92 hr	1.92 hr	23.7 hr	0
117	T3-B25 Offloaded (3/4)	1.05 hr	4.13 hr	8.98 hr	14
118	T3-B26 towed in place	0.4 hr	3.62 hr	9.18 hr	14
119	T3-B26 Offloaded	0.98 hr	0.98 hr	13.38 hr	10
120	T3-B27 towed in place	0.28 hr	3.52 hr	11.12 hr	12
121	T3-B27 Offloaded	1.83 hr	7.5 hr	13.45 hr	8
122	T4-B28 towed in place	0.27 hr	0.42 hr	43.15 hr	12
123	T4-B28 Offloaded	1.13 hr	6.9 hr	10.67 hr	8
124	T4-B29 towed in place	0.33 hr	3.55 hr	33 hr	12
125	T4-B29 Offloaded	1.3 hr	1.3 hr	24.12 hr	8
126	T4-B30 towed in place	0.43 hr	3.7 hr	12.82 hr	12
127	T4-B30 Offloaded	1.1 hr	3 hr	8.93 hr	8
128	T4-B31 towed in place	0.45 hr	3.85 hr	20.18 hr	12
129	T4-B31 Offloaded	0.88 hr	0.88 hr	10.27 hr	8
130	T4-B32 towed in place	0.4 hr	3.57 hr	33.87 hr	12
131	T4-B32 Offloaded	1.78 hr	5 hr	20.03 hr	8
132	T4-B33 towed in place	0.4 hr	3.85 hr	20.98 hr	12
133	T4-B33 Offloaded	1.65 hr	1.65 hr	13.5 hr	10
134	T4-B34 towed in place	0.28 hr	3.97 hr	9.22 hr	14
135	T4-B34 Offloaded	0.78 hr	6.57 hr	9.95 hr	10
136	T4-B35 towed inplace	2 hr	3.82 hr	12.48 hr	14
137	T4-B35 Offloaded (1/4)	0.6 hr	1.77 hr	9.98 hr	10
138	**ACM Placement - 3rd Day**	**20 hr**	**55.97 hr**	**333 hr**	**0**
139	Land Anchors Installed - D3V	1.43 hr	7.62 hr	13.95 hr	19
140	T4-B35 Offloaded (3/4)	1.13 hr	1.13 hr	17.08 hr	10



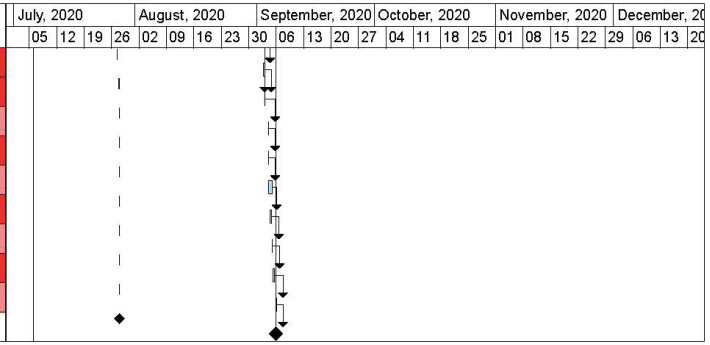
	Task Name	Low Dur	Mean Dur	High Dur	Risks
141	T4-B36 towed in place	0.4 hr	3.77 hr	14.8 hr	12
142	T4-B36 Offloaded	1.03 hr	8 hr	15.55 hr	10
143	T4-B37 towed in place	0.3 hr	3.85 hr	15.23 hr	14
144	T4-B37 Offloaded	0.85 hr	1.37 hr	15.97 hr	8
145	T4-B38 towed in place	0.93 hr	3.37 hr	20.55 hr	12
146	T4-B38 Offloaded	3.9 hr	3.9 hr	10.07 hr	8
147	T4-B39 towed in place	0.42 hr	4.35 hr	23.63 hr	12
148	T4-B39 Offloaded	1.42 hr	6.98 hr	22.63 hr	8
149	T5-B40 towed in place	0.28 hr	3.52 hr	20.37 hr	12
150	T5-B40 Offloaded	0.65 hr	2.87 hr	16.48 hr	8
151	T5-B41 towed in place	0.38 hr	3.87 hr	23.68 hr	12
152	T5-B41 Offloaded	1.2 hr	2.72 hr	25.4 hr	8
153	T5-B42 towed in place	0.25 hr	3.82 hr	18.13 hr	12
154	T5-B42 Offloaded	1.7 hr	1.7 hr	25.9 hr	8
155	T5-B43 towed in place	0.42 hr	3.7 hr	17.72 hr	12
156	T5-B43 Offloaded	1.47 hr	1.47 hr	21.73 hr	10
157	T5-B1 towed inplace	0.33 hr	3.65 hr	13.45 hr	14
158	T5-B1 Offloaded	1.05 hr	1.05 hr	12.63 hr	10
159	T5-B2 towed in place	2.22 hr	3.92 hr	22 hr	14
160	T5-B2 Offloaded (1/4)	0.78 hr	0.78 hr	21.38 hr	10
161	**ACM Placement - 4th Day**	**11.15 hr**	**22 hr**	**100.6 hr**	**0**
162	Land Anchors Installed - D4V	2 hr	4.2 hr	25.65 hr	19
163	T5-B2 Offloaded (3/4)	0.68 hr	3.12 hr	17.53 hr	10
164	T5-B2 towed in place	9.43 hr	9.43 hr	9.43 hr	12
165	T5-B3 Offloaded	0.75 hr	2.1 hr	14.73 hr	8
166	T5-B3 towed in place	0.28 hr	3.57 hr	36.03 hr	12
167	T5-B4 Offloaded	1.12 hr	1.12 hr	12.6 hr	8
168	**Relocate Floating Plant to St. Francisville Region**	**27.85 hr**	**27.85 hr**	**38.88 hr**	**0**
169	Mat Anchor Barge towed to St. Francisville Region	57.98 hr	61.83 hr	70.98 hr	22
170	Quarter Boat towed to St. Francisville Region	58.32 hr	62.18 hr	73.38 hr	22
171	ARMOR ONE Anchor Barge towed to St. Francisville Region	54.05 hr	62.15 hr	67.57 hr	22
172	ARMOR ONE Unit towed to St. Francisville Region	54.77 hr	62.3 hr	78.88 hr	22
173	Dozers towed to St. Francisville Region	63.23 hr	63.23 hr	69.97 hr	22
174	**St. Francisville Region**	**66.8 hr**	**113 hr**	**542.83 hr**	**0**
175	**Mobilize Floating Plant at St. Francisville Region**	**66.8 hr**	**113 hr**	**542.83 hr**	**0**



	Task Name	Low Dur	Mean Dur	High Dur	Risks
176	Mat Anchor Barge Moored in place at St. F.	1.62 hr	5.22 hr	21.12 hr	4
177	Quarter Boat Moored in Place at St. F.	1.65 hr	6.63 hr	11.85 hr	8
178	ARMOR ONE Anchor Barge Moored in place at St. F.	2.02 hr	5.8 hr	16.78 hr	4
179	ARMOR ONE unit moored in place at St. F.	5.38 hr	11 hr	13.47 hr	4
180	Dozers placed at St. F.	1.75 hr	1.85 hr	22.5 hr	16
181	6th Fleet of Barges Anchored at St. F.	2.2 hr	5.4 hr	8.87 hr	6
182	7th Fleet of Barges Anchored at St. F.	2.27 hr	5.4 hr	20.73 hr	6
183	**ACM Placement - 1st Day St. Francisville**	**37.6 hr**	**52 hr**	**338.65 hr**	**0**
184	Land Anchors Installed - D1SF	1.93 hr	6.22 hr	24.47 hr	19
185	T6-B5 towed in place	0.48 hr	3.75 hr	18.78 hr	14
186	T6-B5 Offloaded	1.53 hr	1.53 hr	16.57 hr	10
187	T6-B6 towed in place	0.25 hr	3.67 hr	30.07 hr	14
188	T6-B6 Offloaded	1.25 hr	3.43 hr	13.5 hr	10
189	T6-B7 towed in place	0.37 hr	3.62 hr	27.63 hr	12
190	T6-B7 Offloaded	0.83 hr	3.92 hr	13.53 hr	8
191	T6-B8 towed in place	0.72 hr	3.2 hr	19.92 hr	12
192	T6-B8 Offloaded	2.37 hr	2.37 hr	13.6 hr	8
193	T6-B9 towed in place	0.38 hr	4.08 hr	15.45 hr	12
194	T6-B9 Offloaded	1.57 hr	6.57 hr	14.98 hr	8
195	T6-B10 towed in place	0.43 hr	3.03 hr	18.58 hr	12
196	T6-B10 Offloaded	1.78 hr	1.78 hr	16.78 hr	8
197	T6-B11 towed in place	4.08 hr	4.08 hr	33.95 hr	12
198	T6-B11 Offloaded	0.65 hr	0.65 hr	19.12 hr	8
199	T6-B12 towed in place	0.38 hr	3.57 hr	20.08 hr	12
200	T6-B12 Offloaded	2.75 hr	2.75 hr	8.73 hr	8
201	T6-B13 towed in place	1.6 hr	4.28 hr	20.08 hr	12
202	T6-B13 Offloaded	0.88 hr	0.88 hr	16.83 hr	8
203	T6-B14 towed in place	0.33 hr	3.63 hr	20.73 hr	12
204	T6-B14 Offloaded	2.37 hr	2.37 hr	18.78 hr	10
205	T6-B15 towed in place	2.65 hr	3.83 hr	18.9 hr	14
206	T6-B15 Offloaded (1/4)	1.23 hr	6.45 hr	18.48 hr	10
207	**ACM Placement 2nd Day St. Franisville**	**22 hr**	**42 hr**	**163 hr**	**0**
208	Land Anchors Installed - D2SF	1.47 hr	1.47 hr	21.03 hr	19
209	T6-B15 Offloaded (3/4)	0.9 hr	6.32 hr	7.5 hr	10
210	T6-B16 towed in place	0.35 hr	3.45 hr	17.55 hr	14



	Task Name	Low Dur	Mean Dur	High Dur	Risks
211	T6-B16 Offloaded	1.98 hr	1.98 hr	14.73 hr	10
212	T7-B17 towed in place	0.25 hr	3.88 hr	22.42 hr	12
213	T7-B17 Offloaded	2.4 hr	2.55 hr	11.2 hr	8
214	T7-B18 towed in place	2.92 hr	4.97 hr	17.58 hr	12
215	T7-B18 Offloaded	3.1 hr	3.1 hr	19.9 hr	8
216	T7-B19 towed in place	0.33 hr	4.85 hr	19.73 hr	12
217	T7-B19 Offloaded	0.92 hr	5.15 hr	27.88 hr	8
218	T7-B20 towed in place	0.27 hr	3.93 hr	13.48 hr	12
219	T7-B20 Offloaded	1.65 hr	4.02 hr	9.37 hr	8
220	**End of Season**	0 hr	0 hr	0 hr	**0**



Appendix C: Risk Matrices

Figures C-1 through C-3 present risk matrices.

Figure C-1. Risk matrix for 2,000 squares/day.

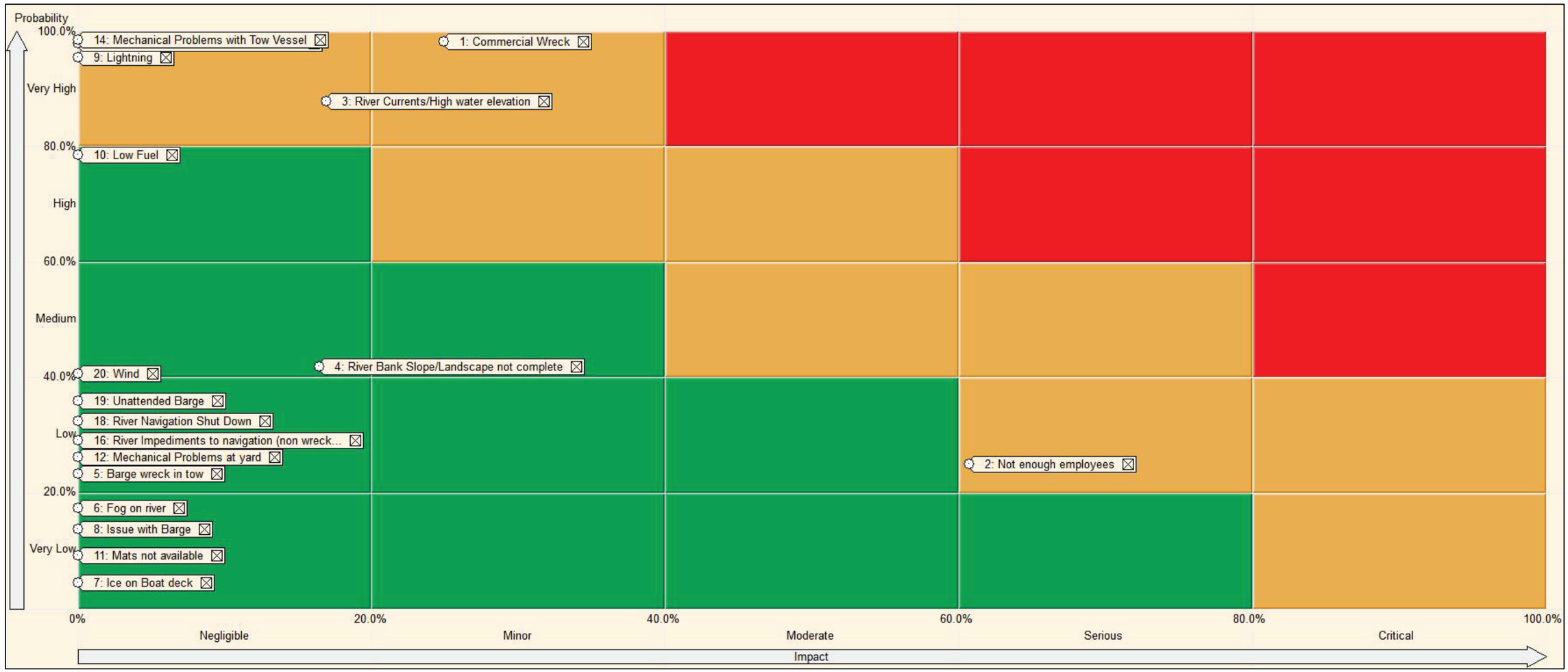


Figure C-2. Risk matrix for 4,000 squares/day.

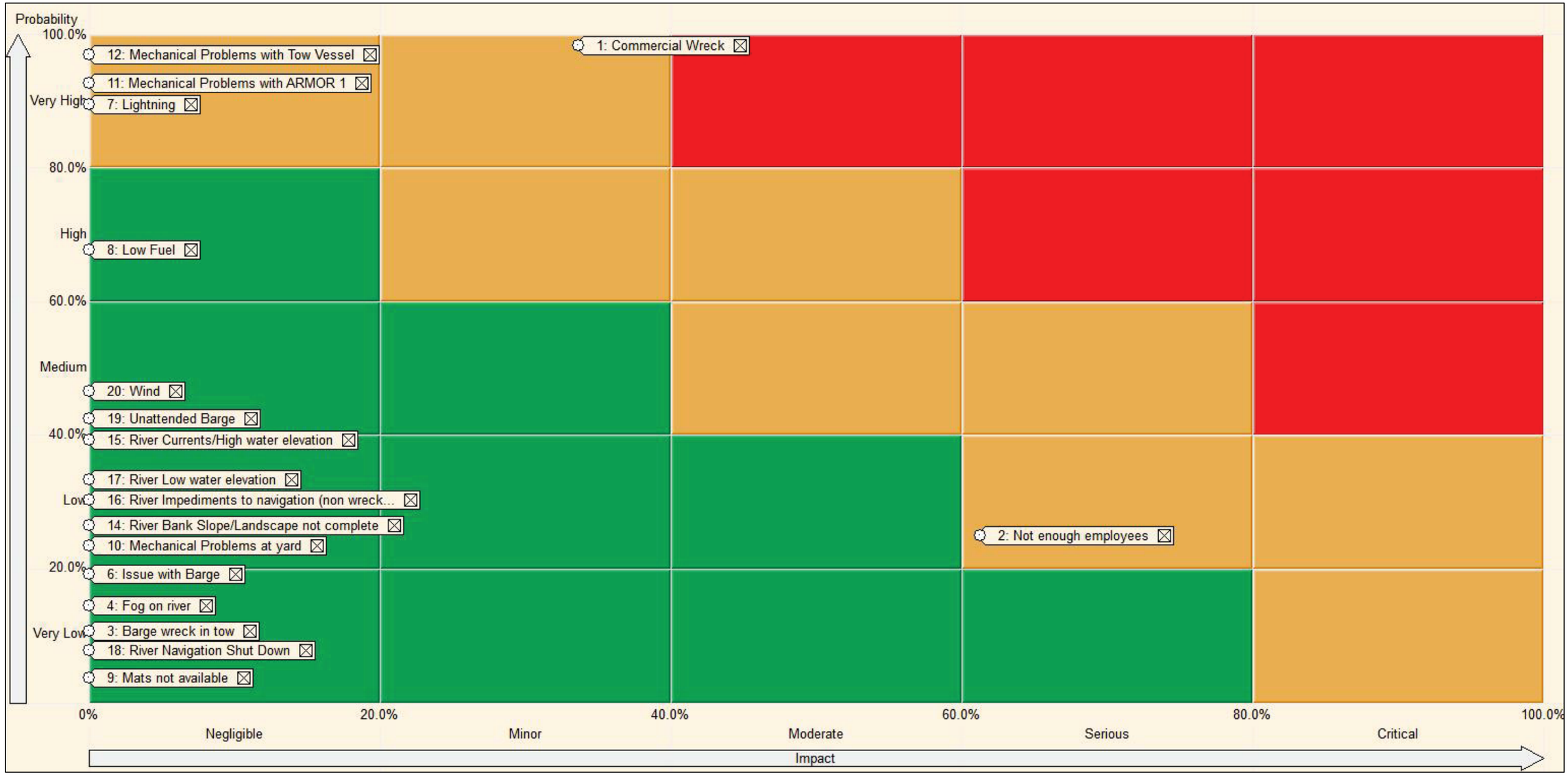
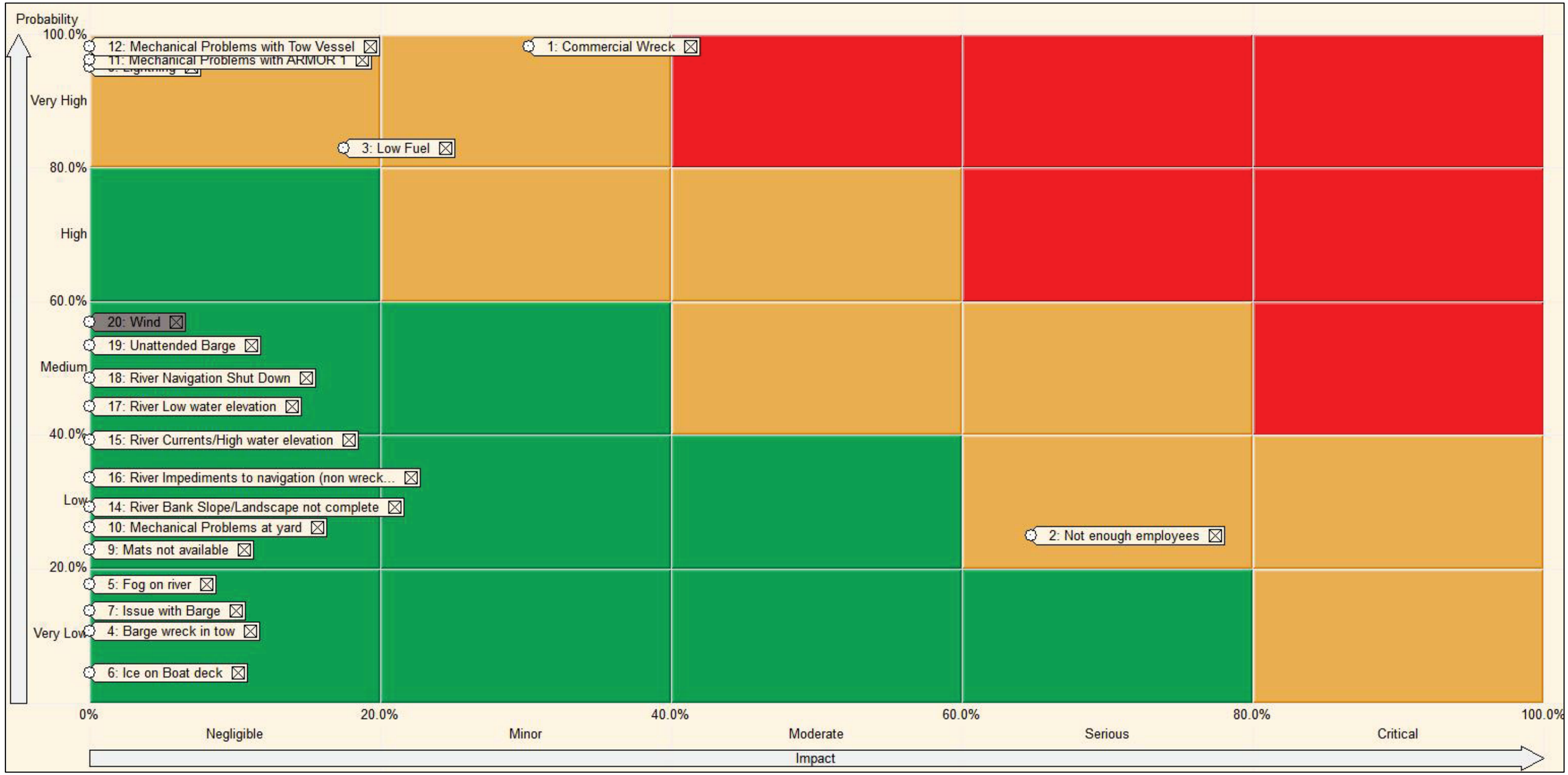


Figure C-3. Risk matrix for 6,000 squares/day.



Appendix D: Potential Delay Probabilities

Table D-1 and Table D-2 present the potential delay register and the percentage of probability of occurrence, respectively.

Table D-1. Potential delay register.

Possible Delays to Schedule	Description	Cause	Trigger
Barge Wreck in Tow	Barge(s) separate from tow and sink.	Lashings loosed, commercial vehicle wreck, tow strikes bridge, etc.	
Commercial Wreck	A commercial vessel wrecks in the river in the tug tow zone, shutting down river traffic.	High current, other mishap/accident causing a commercial wreck not involving USACE MSU vessels.	
Ice in River Impeding Navigation	Ice causing hazards on river leading to slowdown/stopping of tow.	Cold weather in northern reach of river.	Winter weather
Ice on Boat Deck	Ice on boat decks causing hazardous operation for personnel.	Low temperatures	Weather
Issue with Barge	Barge(s) become in operable.	Damage to barge(s) rendering it inoperable until repair.	
Lightning	Sustained lightening in work area.	Thunderstorm, etc.	Inclement weather warning.
Low Fuel	Vessels low on fuel, necessitating delay		
Squares Not Available	Squares not available for loading onto barges.	Production down at square-pouring plant.	
Mechanical Problems at Yard	Problems with production/loading machinery at square yard.	Machinery malfunction	

Possible Delays to Schedule	Description	Cause	Trigger
Mechanical Problems with ARMOR 1	Problems with ARMOR 1 unit's machinery.	Malfunctioning engines, motors, etc.	Improper usage, maintenance, force of nature, etc.
Mechanical Problems with Tow Vessel	Problems with tow vessels machinery.	Malfunctioning engines, motors, etc.	Improper usage, maintenance, force of nature, etc.
Not Enough Employees	Not enough employees to successfully operate tows, ARMOR 1 unit, or other vessels.	Weather or other delay causing employees not to arrive on time, or insufficient crews available.	
Reduced Speeds on River	Coast Guard reduces river speeds.	Coast Guard reduces speed on river.	Wrecks, water levels, currents, etc.
Riverbank Slope/Landscape Not Complete	Delays as a result of site preparation.	Additional clearing needed.	Higher than expected water elevation or failed communication with clearing and snagging
River Currents/High Water Elevation	Major delays possible with requirement to construct healing points, toggling for swift current or remote parking for quarter boat fleet.	Unanticipated rise in river stages, or decision to mitigate high water with additional construction.	Weather
River Impediments to Navigation			
River Low water Elevation	Water surface elevations less than LWRP +5 for revetment design.	Seasonal drought.	Weather
River Navigation Shut Down	Coast Guard stops traffic on river.	Coast Guard stops traffic from moving on river for period of time.	Wrecks, water levels, currents, etc.
Unattended Barge	Barge comes loose from tow or anchorage and travels away from site, necessitating vessels to retrieve it and re-position it.	Loosed lashings, etc., causing barge to break away from tow/anchorage/etc.	
Wind			

Table D-2. Percentage of probability of occurrence.

Possible Delays to Schedule	Minor =< 1 hr Delay	Moderate =< 3 hr Delay	Serious =< 6 hr Delay	Critical > 6 hr Delay	No Delay (100% - all total % off all delays)
Barge Wreck in Tow	5%	2%	1%	1%	91%
Commercial Wreck	1%	1%	2%	10%	86%
Ice on Boat deck	2%	1%	1%	5%	91%
Issue with Barge	10%	2%	1%	1%	86%
Lightning	5%	1%	1%		93%
Low Fuel	1%	1%	1%	1%	96%
Squares Not Available	1%	1%	1%	1%	96%
Mechanical Problems at Yard	5%	2%	2%	2%	89%
Mechanical Problems with ARMOR 1	5%	1%	1%	1%	92%
Mechanical Problems with Tow Vessel	5%	1%	1%	1%	92%
Not Enough Employees	10%	5%	5%	5%	75%
Riverbank Slope/Landscape not Complete	5%	5%	2%	1%	87%
River Currents/High Water Elevation	20%	10%	5%	2%	63%
River Low Water Elevation	10%	5%	2%	2%	81%
River Navigation Shut Down	5%	1%	1%	1%	92%
Unattended Barge	2%	1%	1%	0%	97%
Wind	5%	1%	1%	1%	92%
Mission Priority Changes				2%	98%

Unit Conversion Factors

Multiply	By	To Obtain
cubic feet	0.02831685	cubic meters
cubic inches	1.6387064 E-05	cubic meters
cubic yards	0.7645549	cubic meters
feet	0.3048	meters
horsepower (550 foot-pounds force per second)	745.6999	watts
inches	0.0254	meters
knots	0.5144444	meters per second
miles (nautical)	1,852	meters
miles (US statute)	1,609.347	meters
miles per hour	0.44704	meters per second
pounds (force)	4.448222	newtons
square feet	0.09290304	square meters
square inches	6.4516 E-04	square meters
square miles	2.589998 E+06	square meters
tons (2,000 pounds, mass)	907.1847	kilograms
tons (2,000 pounds, mass) per square foot	9,764.856	kilograms per square meter
yards	0.9144	meters

Acronyms and Abbreviations

ACM	Articulated Concrete Mat
AOR	Area of Responsibility
ERDC	US Army Engineer Research and Development Center
LWRP	Low Water Reference Plane
MPH	Memphis
MSU	Mat Sinking Unit
MV	Motor Vessel
MVD	Mississippi Valley Division
MVK	US Army Corps of Engineers, Vicksburg District
MVM	US Army Corps of Engineers, Memphis District
USACE	US Army Corps of Engineers
VKS	Vicksburg

Glossary

chance: Possibility or probability of a given outcome in a situation that is uncertain. See also *Probability*.

critical risk: Any risk that may endanger the project from completion.

delay: A duration in time that would be added to a schedule should a risk event occur.

duration: The amount of time associated with completing an activity, task, or element of work in a given schedule.

failure: Exceedance of a defined performance threshold or performance indicator.

mat: Sewn-together squares.

mat yard: Locations for fabrication of concrete squares.

mean duration: The average of a set of numbers, or the average of the probabilistic outcomes of durations from a Monte Carlo analysis.

mobilization: The process of communication of the warning trigger (action) level to the deployment team and the transportation of all resources required for the commencement of erection or closure operations.

Monte Carlo analysis: A simulation-driven, iterative statistical analysis of possible outcomes that generates a curve to reflect the likelihood of given time and cost parameters based on the outcomes of multiple iterations.

probability: A mathematical expression of the possibility or likelihood of occurrence, normally expressed as a percentage.

performance: The creation or achievement of something that can be valued against some stated initial aim or objective.

risk: Any event that may cause a delay in construction. Expressed as a written summary of the event, its implications, and impacts.

square: The 4 ft × 25 ft × 3 in. concrete cast with 16 linked blocks cast in repetitive courses with the final as a thirteenth course

stack: 13 squares.

trigger: An indicator of the imminent occurrence of a given risk event that serves as an immediate precursor to the occurrence of the risk.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED *(From - To)*
September 2021	Final Report	

4. TITLE AND SUBTITLE
Mat Sinking Unit Supply Study: Mississippi River Revetment

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Julie A. Hicks, Laurin I. Yates, and Jacqueline S. Pettway

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) (see reverse)

8. PERFORMING ORGANIZATION REPORT NUMBER
ERDC TR-21-13

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
USACE, Vicksburg District
Vicksburg, MS 39180-3435

10. SPONSOR/MONITOR'S ACRONYM(S)
USACE MVK

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES
MIPR W807PM91017173; USACE Vicksburg District

14. ABSTRACT
The Mississippi Valley Division (MVD has maintained the Mississippi River banks for over 80 years. The Mat Sinking Unit (MSU), built in 1946, was considered state-of-the-art at the time. This system is still in operation today and has placed over 1,000 miles of Articulated Concrete Mats along the Mississippi River from Head of Passes, LA, to Cairo, IL. A new MSU has been designed and is expected to be fully mission capable and operational by the 2023 season, which is expected to increase the productivity from 2,000 squares/day up to 8,000 squares/day with double shifts and optimal conditions.
This MSU supply study identifies and optimizes the supply chain logistics for increased production rates from the mat fields to the MSU. The production rates investigated for this effort are 2,000 squares/day, 4,000 squares/day, and 6,000 squares/day. RiskyProject® software, which utilizes a Monte Carlo method to determine a range of durations, manpower, and supplies based on logical sequencing is used for this study. The study identifies several potential supply and demand issues with the increased daily production rates. Distance to casting fields, number of barges, and square availability are the major issues to supply increased placement rates identified by this study.

15. SUBJECT TERMS
Concrete construction, Embankments—Mississippi River, Flood control—Mississippi River, Hydraulic engineering, Logistics, Revetments, River engineering, Shore protection—Mississippi River

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Jacqueline S. Pettway
Unclassified	Unclassified	Unclassified	SAR	115	19b. TELEPHONE NUMBER *(Include area code)* 601-634-2288

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) (continued)

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