Intermodal Logistics Consulting Inc.

Reliable and Resilient Transportation Networks

Draft Final Report

for

Marine Traffic Study of the Okeechobee Waterway (St. Lucie River)
70Z02823CMIAM0028

Prepared for

US Coast Guard, Department of Homeland Security

Administered By: 70Z028 Regional Support Team (RST-07) Miami
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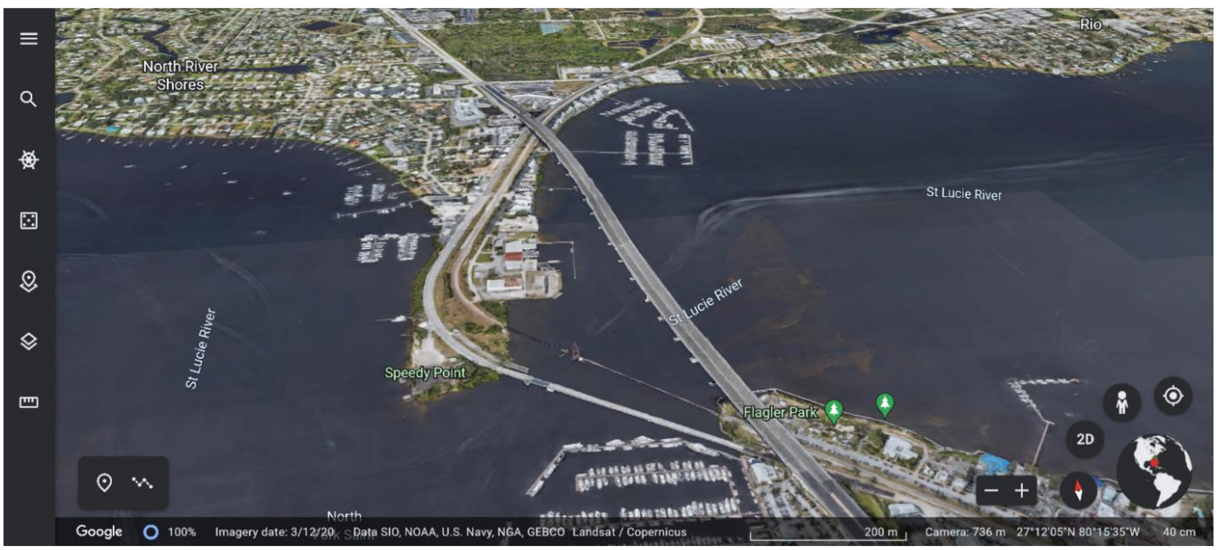

SOURCE: Google Earth, as of September 20, 2022.

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1. TASK 1: PROJECT SCOPE & PLAN

Scoping and Kickoff Meeting

On August 28, 2023, IML Consulting met with the US Coast Guard to refine and finalize the scope of work for this study. The US Coast Guard staff in attendance were Mr. Randall Overton, Ms. Jennifer Zercher and Mr. Leonard Newsom.

The group discussed options for data collection and the Coast Guard shared information about an existing camera that had been installed on the Hudson's on the River restaurant by the Marine Industries Association of the Treasure Coast (MIATC). Their setup consists of

- A camera, and a network video recorder (NVR) that stores the data on-site, and a communication line provided by Comcast with a static IP address. Their camera is mounted on a restaurant in the vicinity and so did not require any permission request from Florida DOT.
- They use a vendor called Vista Webcam to provide the live-feed to the public.
- Though data has been archived on their NVR since June of this year, they do not process that data. Hence, they have no vessel traffic counts.

Their camera is set up to store and archive data when a vessel is detected moving in the field of view of the camera. Due to a flashing light from the construction equipment in the vicinity of the railroad bridge their system is triggered and records several video clips at night that is unrelated to vessel traffic. They have had a few outages when inclement weather has impacted the Comcast line but so far none have lasted more than a few hours. Their equipment has not been impacted by any hurricanes so far.

At the end of the meeting, it was agreed IML Consulting will conduct a site visit and come up with an enhanced setup for data collection for this project.

US Coast Guard offered to assist as follows:

- Introduce IML Consulting via email to Florida DOT staff to speed up requests to access/attach equipment to the bridge.
- Introduce IML to MIATC an Association that had on-going camera and data collection setup at the site to share their experience with IML Consulting.
- Introduce IML Consulting to Martin County to explore reviewing the 15 months of historical video data the County collected during their 2016 data collection study at the project site.

Key Data Metrics

During the kickoff meeting Jennifer presented IML Consulting with a data collection table that listed key metrics the US Coast Guard was interested in obtaining during this study. Once data collection began and IML Consulting presented preliminary results, the US Coast Guard updated the data collection table. The table of metrics is listed in

Appendix B: Data Collection Matrix.

Site Visit

IML Consulting conducted the site visit August 31, 2023 (through September 2). An initial plan was developed that involved installing three cameras at two locations.

Initial Proposed Camera Locations: Install three cameras for data collection as follows:

- ***Camera 1*** on the Hudson-on-the-River restaurant (see Figure 1) or one of the light poles under the Rosevelt bridge walkway (see). Permission will be required from City of Stuart to mount equipment on light poles. The restaurant is willing to allow an additional camera on their building.
- ***Camera 2 & 3*** on the tender building that is used to operate the drawbridge on the Old Dixie Highway (see Figure 3). Permission will be required from Florida Department of Transportation (FDOT) to mount any equipment on the bridge.

Figure 1. Existing Camera on Hudson on the River Restaurant Roof

Figure 2. Streetlamps under Rosevelt Bridge (alternate camera mount locations)

Figure 3. Florida DOT Bridge Tender / Guardhouse Building

Camera 1 was to provide a view of all vessels on both sides of the Roosevelt and between the Rosevelt bridge and the FEC railroad bridge. Cameras 2 and 3 were to provide a view of all vessels approaching the Old Dixie Highway bridge and vessels between that bridge and the FEC railroad bridge.

2. TASK 2: CONDUCT VESSEL & BRIDGE SURVEY

Camera Setup: Installation & Location:

Final Camera Installations: We experienced excessive delays getting permission from Florida DOT to install the cameras on their guardhouse. The final decision made was to install a second camera next to the MIATC camera (so there are two cameras at the Hudson on the river restaurant), and a third camera was installed at the Sunset Marina instead of the guardhouse. Three cameras were installed at the two locations as follows:

- **Location 1:** Two cameras at the Hudson-on-the-river restaurant building to capture vessels traveling westwards from the Rosevelt bridge toward the FEC bridge. Camera 1 (Figure 4) pointed toward the space between the Rosevelt Bridge and the FEC bridge, while Camera 2 (Figure 5) was oriented to capture vessels traveling westwards toward the Rosevelt Bridge.
    - Cameras are connected via cable to a Network Recording Device (NVR) in a server room at the Hudson's on the River restaurant
    - The NVR is connected online via a Comcast phone line so data stored on the device can be accessed
- **Location 2** A third camera was installed at the Sunset Marina Bay. This location was designed to capture vessels traveling eastwards. That is, vessels going beneath the North Dixie Highway headed toward the FEC railroad bridge. The camera view is shown in Figure 6.
    - This camera was also connected to an NVR for data storage
    - The NVR was connected online via a T-mobile hotspot device

When data analysis commenced, we realized Camera 1 at Location 1 had a clear view of the FEC bridge that enabled us to record all closings and openings of the drawbridge. We were also able to count and document all vessel activity eastbound and westbound through the FEC bridge from this camera. Finally, the algorithm developed to measure the level of vessel congestion and crowding worked well during testing using video imagery from Camera 1. Hence the data analysis only required use of video imagery from Camera 1. The data from all three cameras was still collected and archived and is available if needed for validation tasks.

Data Download & Retrieval

NVR's can be setup to either record videos when motion is detected in range of view of the camera or record continuously. Due to the sensitive nature of this project, we opted for the continuous recording mode to ensure we did not miss any vessel movements or drawbridge activity. However, this resulted in very large video files that rapidly used up the NVR storage capacity. When the NVR storage capacity is full the system continues to record videos but overrides the oldest files on the NVR drive.

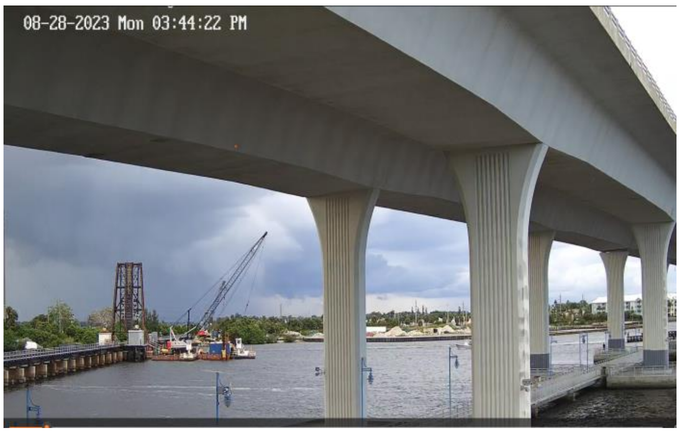

Figure 4. Camera 1 View

Figure 5. Camera 2 View

Figure 6. Camera 3 View

The initial project plan was to access the two NVR's periodically online and download and store the data. This, however, proved challenging due to the large file sizes and the number of files from the continuous recording process adopted. We resolved this by visiting the site each month and downloading the data from the NVR to an external hard-drive and conducting the analysis using the content on the hard drive.

The goal of the project was to collect at least three months of data. Due to the logistics of visiting the site to collect data for a few days was overwritten at the beginning of the project. We extended the data collection window of the project to ensure we had more than ninety days of data to compensate for the data download challenges and the days missed at the beginning of the project.

The data was collected from November 1, 2023 through April 7, 2024. Only the data from Camera 1 was used for the analysis presented in this report. After data compilation, cleaning and extraction we have a total of 110 days of data as shown in Table 1 below.

Table 1. Summary of Days of Data Collected

Year	Month	Day of the Week							Total
		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	
2023	Nov		2	3			2	1	8
	Dec	1	1	1	1	1	1	2	8
2024	Jan	4	4	4	3	4	4	4	27
	Feb	4	4	4	5	4	4	4	29
	Mar	4	4	4	4	5	5	5	31
	Apr	1	1	1	1	1	1	1	7
Total Days		**14**	**16**	**17**	**14**	**15**	**17**	**17**	**110**

All the raw data collected has been compiled on external hard drives and will be delivered to the US Coast Guard.

3. TASK 3: DATA ANALYSIS PROCESS

A summary of the metrics extracted from the raw video files is provided in a Microsoft Excel file attached submitted with this report.

Analysis Procedure

Detecting Bridge Openings/Closing

The bride closure times and durations were computed by analyzing video footage frame by frame. YOLOv8, a state-of-the-art object detection model was utilized to detect bridge openings, as openings are more easily recognizable. If no openings were detected for consecutive five frames, the bridge was considered closed. Bridge closure time and durations were logged into a CSV file for further analysis, providing a clear and detailed record of bridge operations.

Detecting & Counting Marine Vessels

An enhanced YOLOv8 model with an additional detection head specifically designed for small objects was developed to detect and count marine vessels. The original YOLOv8 structure has three detection heads: P3/8, P4/16, and P5/32, with corresponding detection feature map sizes of 80×80, 40×40, and 20×20, respectively. This structure was improved by adding a new detection head, P2, with a detection feature map size of 160×160, significantly increasing the detection accuracy of smaller vessels. To capture multiple vessels effectively, we integrated this enhanced YOLOv8 model with the OC-SORT multi-object tracking algorithm. This algorithm was chosen for its robust performance in maintaining object identities over time, offering advantages such as high accuracy and efficiency in tracking multiple objects simultaneously.

The algorithm for determining whether a vessel is entering or exiting the monitored area involves analyzing the movement of vessel centroid point across a defined screen line. For each frame, the position of the vessel's centroid point was calculated, and its movement was tracked. If the centroid point crossed the defined screen line from left to right, it was recorded as an exit. Conversely, if the centroid point crossed the screen line from right to left, it is recorded as an entry. This method ensures that each vessel was accurately tracked and counted as it moved through the monitoring area. Vessel ID and time of entry/exit were logged into a CSV file.

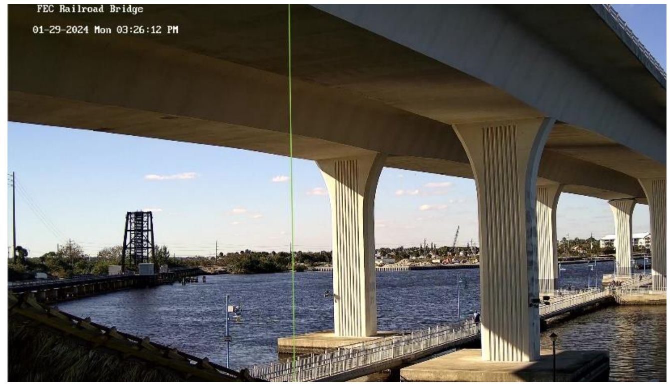

Figure 7 Video Screenshot with Screenline

Estimating Marine Vessels Heights

Marine vessel heights were estimated by analyzing the sizes of vessel detection bounding boxes. The YOLOv8 model provided the bounding boxes for each vessel, from which the height in pixels was extracted. This pixel height was then converted to feet using the calibrated ratio of 1 foot equal to 5.5 pixels. Vessels were classified into three size categories: small (< 6 feet), medium (6-16 feet), and large (> 16 feet). To validate the height estimates, the histograms of the height distribution were plotted. This allowed us to visually inspect the data and identify any anomalies.

Marine Vessel Congestion Algorithm

To assess marine vessel congestion, vessel queuing caused by bridge closures was analyzed. An algorithm was devised to count vessels for five minutes after the bridge reopened. If the initial count exceeded ten vessels, the counting time window was extended by an additional 2.5 minutes. If the count during the additional 2.5 minutes exceeded five vessels, another 2.5-minute extension was granted to ensure thorough capture of queue dissipation. The lengths of entering queues and exiting queues were distinguished based on the movement directions of the vessels.

4. TASK 4. RESULTS & SUMMARY TABLES

Vessel Traffic Pattern

The number and types of vessels passing the bridge for each hour on each study day are compiled in the Hourly Count Data table in the Excel spreadsheet. From the summary in Table 2 it is clear most of the vessels are in the 6-to-16-foot height range.

Table 2. Summary of Hourly Vessel Traffic (by Height and Direction of Travel)

Hour	Inbound			Outbound		
	Sum of Small (<6 ft)	Sum of Medium (6-16 ft)	Sum of Large (>16 ft)	Sum of Small (<6 ft)	Sum of Medium (6-16 ft)	Sum of Large (>16 ft)
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	3	0	0	182	3
7	0	32	0	1	365	4
8	0	97	0	1	616	5
9	1	190	0	6	1083	15
10	1	309	4	7	1567	13
11	0	467	4	5	**1746**	12
12	3	623	1	3	1639	8
13	2	696	2	2	1302	8
14	1	**766**	3	9	1026	3
15	3	638	1	11	744	1
16	1	488	0	0	585	1
17	1	307	0	2	395	1
18	0	127	2	3	243	2
19	0	3	0	0	10	1
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0
Grand Total	**13**	**4746**	**17**	**50**	**11503**	**77**
Total %	0%	99%	0%	0%	99%	1%

Figure 8 below is based on data in Table 2. It shows the outbound traffic peaks earlier during the day close to 11 AM, while the inbound traffic peaks closer to 3 PM.

Figure 9 show the vessel breakdown by day of the week. As expected, Friday, Saturday and Sunday are the busiest, with Saturdays being the busiest days.

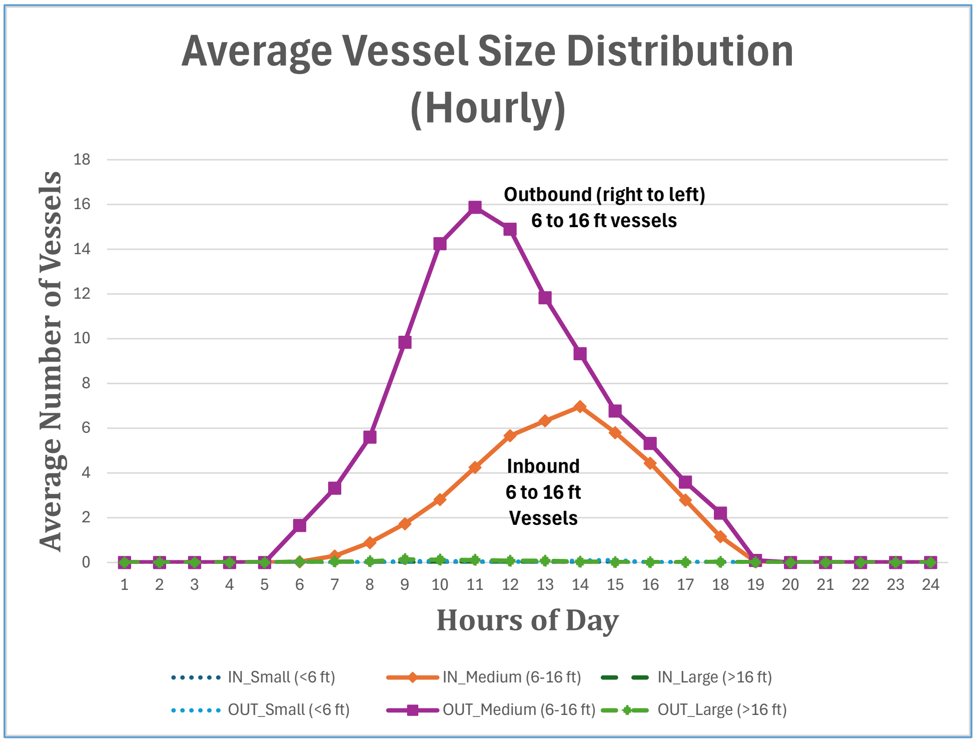

Figure 8. Hourly Distribution of Vessels by Height and Direction

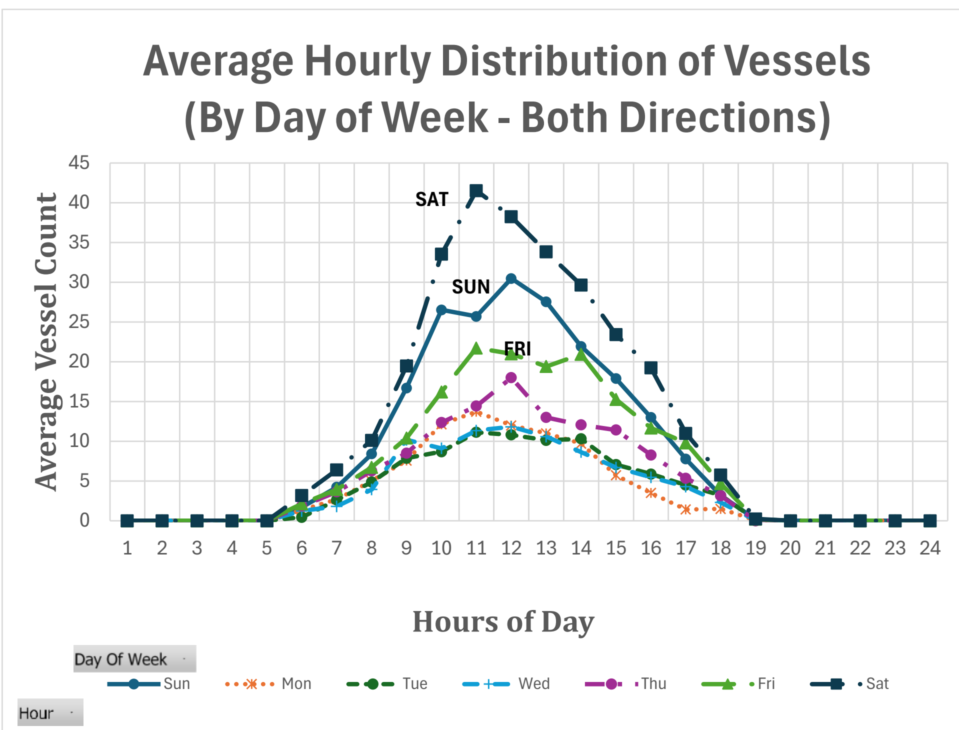

Figure 9. Vessel Traffic Hourly Variation by Day of the Week

Bridge Operation Pattern

The estimate on bridge closing durations in Table 3 were generated by dividing the sum of all the bridge closings for each day (and hour) by the total number of bridge closings during that period. We also extracted the maximum closing to get an understanding of which periods the vessel owners were likely to be impacted by bridge operations. The data indicates bridge closing durations peak during the weekdays. The highest average in Table 3 is on Thursday morning, while the maximum is on Wednesday morning (Table 4).

Table 3. High-level Estimate of Duration of Bridge Closings (by hour and day of the week)

Estimated Average Bridge Closure Duration (Minutes)								
Hour	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Average
6	15	15	17	16	13	14	14	15
7	21	21	14	22	25	18	19	20
8	17	23	23	28	35	21	19	23
9	19	16	20	20	21	22	18	19
10	16	19	20	23	25	22	15	20
11	15	24	21	19	28	20	17	20
12	19	21	20	20	24	19	22	21
13	21	21	21	22	22	21	22	21
14	20	19	22	23	28	22	19	22
15	19	16	24	18	21	19	23	20
16	15	17	23	18	17	19	20	18
17	17	17	22	22	19	23	15	19
18	14	27	23	26	21	28	19	21
19					18			18
Average	18	20	21	21	23	21	19	

Table 4. Maximum Bridge Closing Durations (by hour and day of the week)

Max of Closure Duration (Minutes)								
Hour	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Maximum
6	29	19	26	35	18	20	18	35
7	42	43	24	36	39	36	38	43
8	37	41	38	68	49	39	35	68
9	43	30	30	31	37	44	35	44
10	29	37	29	40	51	40	37	51
11	27	42	32	34	43	37	37	43
12	37	30	40	35	39	31	41	41
13	35	37	39	43	39	38	40	43
14	27	31	35	44	41	37	43	44
15	32	23	37	29	30	33	36	37
16	28	25	51	28	38	29	35	51
17	26	32	45	32	44	45	24	45
18	24	38	36	39	38	35	34	39
19					**18**			**18**
Maximum	**43**	**43**	**51**	**68**	**51**	**45**	**43**	**68**

5. LEVEL OF SERVICE

The average delay vessels that are impacted due to bridge closure is used as a quantitative indicator of Level of Service. We estimate the delay during each bridge closure as the product of number of vessels queued and half of the bridge closure time. A sample computation for April 1, 2024, is shown in Table 5.

Table 5. Computing Average Delay for Each Bridge Closure

Date	Bridge Closure StartTime	Bridge Closure EndTime	Closure Duration (Minutes)	Vessels Queued	Average Delay (Minutes)
4/1/2024	8:14:05	8:41:17	28	6	84
4/1/2024	9:24:02	9:47:52	24	1	12
4/1/2024	10:14:43	10:47:28	33	8	132
4/1/2024	11:20:56	11:42:48	22	4	44
4/1/2024	12:24:13	12:38:42	15	6	45
4/1/2024	13:15:02	13:43:37	29	8	116
4/1/2024	14:12:22	14:34:38	23	9	103.5
4/1/2024	14:48:49	15:04:01	16	0	0
4/1/2024	15:15:50	15:26:09	11	2	11
4/1/2024	15:36:09	15:54:19	19	1	9.5
4/1/2024	16:19:47	16:40:15	21	3	31.5
4/1/2024	17:19:03	17:28:59	10	0	0
4/1/2024	17:41:59	18:04:25	23	0	0
4/1/2024	18:13:08	18:46:06	33	0	0

Using the computed delays per bridge closure we generated the cumulative percentile plot shown in Figure 10.

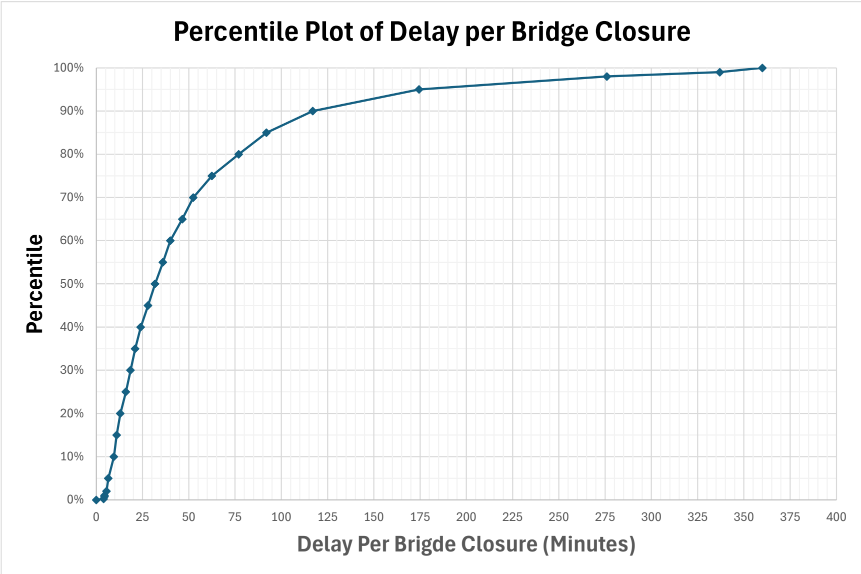

Figure 10. Percentile Plot of Bridge Closure Delay

To develop the Level of Service measure we use a qualitative scale from A to F. With Level of Service A indicating minimal to no impact of bridge operations on water vessels/boats, and F being significant delay and congestion. Using the percentile information, we generate the proposed Level of Service ranges shown in Table 6.

Table 6. Proposed Level of Service Ranges (based on delay per bridge closure)

Percentile	Delay (Minutes)	LOS
0%-10%	0-10	A
10%-35%	11-20	B
35%-50%	21-30	C
50%-75%	31-60	D
75%-95%	61-175	E
>95%	>176	F

Table 7 presents the average delay per bridge closure each hour and by day of the week. Using the information in Table 6 and 7, Level of Service values can be assessed for different scenarios. Specifically:

- The average delay over the survey period for all times 35.2 minutes, corresponding to Level of Services D.
- The hour with the highest delay during the survey period was noon, with an averaged delay of 69 minutes which corresponds to Level of Service E.
- The maximum delay of 197 minutes occurs at noon on Saturday, and corresponds to Level of Service F.

Table 7. Average Delay per Bridge Closure

Delay Estimate per Bridge Closure (Averaged)								
Hour	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Average
6	5.9	0.0	5.2	0.0	0.7	5.5	11.4	**3.5**
7	4.4	10.6	7.0	18.8	51.0	8.0	16.3	**13.6**
8	21.5	15.3	19.9	19.4	31.2	24.0	26.1	**22.3**
9	36.0	12.2	20.8	28.4	23.9	41.4	54.5	**31.5**
10	91.3	38.8	26.5	23.8	37.9	53.9	65.3	**50.5**
11	69.3	42.9	29.6	29.2	57.6	63.8	108.0	**60.9**
12	85.3	29.8	23.7	23.0	57.0	54.6	193.2	**69.0**
13	53.8	31.4	17.7	41.0	33.9	74.8	136.2	**56.7**
14	73.8	23.4	18.8	19.8	66.3	65.4	71.5	**47.1**
15	44.7	9.3	27.9	14.4	32.7	34.7	66.4	**32.9**
16	21.3	4.8	10.6	12.3	11.2	25.5	43.9	**18.6**
17	14.9	1.1	15.9	7.9	14.6	26.2	13.7	**13.4**
18	1.6	2.1	7.9	3.4	3.5	18.5	11.0	**6.5**
Average	**43.4**	**17.3**	**19.1**	**20.2**	**31.4**	**40.7**	**66.1**	**35.2**

Table 8 is the Level of Service for different hours over each day. It can be used by the Coast Guard as a planning resource in managing the operation of the drawbridge.

Table 8. Representative Level of Service Table (based on Delay per Bridge Closure)

LOS Estimate per Bridge Closure (Averaged)								Average
Hour	Sun	Mon	Tue	Wed	Thu	Fri	Sat	
6	A	A	A	A	A	A	B	**A**
7	A	B	A	B	D	A	B	**B**
8	C	B	B	B	D	C	C	**C**
9	D	B	C	C	C	D	D	**D**
10	E	D	C	C	D	D	E	**D**
11	E	D	C	C	D	E	E	**E**
12	E	C	C	C	D	D	F	**E**
13	D	D	B	D	D	E	E	**D**
14	E	C	B	B	E	E	E	**D**
15	D	A	C	B	D	D	E	**D**
16	C	A	B	B	B	C	D	**B**
17	B	A	B	A	B	C	B	**B**
18	A	A	A	A	A	B	B	**A**
Average	**D**	**B**	**B**	**C**	**D**	**D**	**E**	**D**

6. RESULTS AND CONCLUSIONS

All the data for the table below is in “DataGoals.xlsx”. Period of Record: November 1, 2023, through April 7, 2024.

Table 9. Reference Table for Metrics requested by US Coast Guard

Information Requested	*Comment*	*Sheet Name*
Vessel Counts by Day of Week (Total boats counted, average per day)	*Included*	*1_VesselCounts*
Average Hourly Boat Traffic Totals (Average boat traffic by time of day)	*Included*	*2_AverageBoatTrafficByTOD*
Monthly Boat Count Totals (Month, days observed, total boats counted, average per day)	*Included*	*3_BoatTotal_MonthPerDay*
Total Vessels Counted per Month	*Included*	*4_TotalVesselsPerMonth*
Average Boats Counted by Day of Week	*Included*	*5_AverageBoat_ByWeekday*
Boats Counted by Day of Week Distribution by Hour	*Included*	*6_BoatDistrib_Hour_Weekday*

Information Requested	*Comment*	*Sheet Name*
Total Vessels Pass through open bridge Distribution by Vessel Height	*N/A*	*N/A*
Total Vessels Pass under closed bridge Distribution by Vessel Height	*N/A*	*N/A*
Total Vessels Pass Under Closed bridge per day	*N/A*	*N/A*
Total Vessel Pass Under Closed bridge Distribution by Hour	*N/A*	*N/A*
Total Vessels Pass through open bridge per day	*N/A*	*N/A*
Total Vessel Pass through open bridge Distribution by Hour	*N/A*	*N/A*
Number of Vessels Waiting for Opening (at primary and secondary bridges)	*Included*	*13_QueuedVessels*
Average Wait Time of vessels[1]	*Included*	*14_EstimatedQueueTime*
Number of Bridge Operations per Day (opening / closing)	*Included*	*15_BridgeOpeningsPerDay*
Number of Bridge Operations per Day Distribution by Hour (opening / closing)	*Included*	*16_HourlyBridgeOperations*

[1] Represents lower bound of Wait time the first boat that is queued will spend waiting. Time to discharge queue needs to be added.

7. APPENDICES

Appendix A: Raw Data

Summited in attached Microsoft Excel file "RawData.xlsx".

Appendix B: Data Collection Matrix

Metrics US Coast Guard wants to collect during the study

NOTE:

- Primary bridge – FEC Railroad Bridge
- Secondary bridge – SR707 (Old Dixie Hwy) Bridge
- Tertiary bridge – US1 Hwy Bridge

Data Collection

DAILY – Primary bridge is open to navigation

1. Number and types of vessels passing bridge per hour. *(Estimated height of each vessel)*
2. Amount of time bridge is open per hour. *(minutes)*

DAILY – Primary bridge in the closed (down) position

1. Number and types of vessels passing through primary bridge that don't need an opening per hour. *(Estimated height of each vessel)*
2. Number and types of vessels which are delayed/unable to pass when primary bridge is down. *(Observation will be vessels on the east side of the primary bridge and on the west side between the primary and secondary bridges)*
3. Number and types of vessels that are delayed/unable to pass at the secondary bridge when the primary bridge is down. *(Observation will be vessels on the west side of the secondary bridge)*
5. Amount of time the bridge is closed per hour. *(minutes)*

ADDITIONAL DATA

1. Observed navigational issues/challenges/hazardous around bridge. *(Multiple vessels in close quarters, inclement weather, vessels allisions)*
2. Log each time the bridge opens per hour. *(As it begins to open)*
3. Log each time the bridge closes per hour. *(As it begins to lower)*
4. When bridge is lowered, how long before train passes (if one passes) and how long before the bridge raises again after train has cleared the bridge. *[Train is considered as passing the bridge as it approaches the bridge abutment (first span either northside or southside of the bridge), and it is considered cleared when it completely clears the opposite abutment (last span of the bridge).]*
5. When bridge is lowered, type of train traffic crossing. *(Freight train, passenger train, maintenance vehicle, or if people are walking on the bridge)*

METHODS OF DATA COLLECTION

1. Camara observations during the hours of 6 a.m. until 10 p.m. daily.
2. If possible, in person data collection during hours of 8 a.m. – 7 p.m. on Columbus Day weekend (October 7-9, 2023)

FINAL REPORT

1. Include an Executive Summary – "Coast Guard seeks to better understand the level of boating traffic at and around the FEC Railroad Bridge to include the operation of the railroad bridge and it's effect on marine traffic."

2. Analysis of observed data and the follow tables shown:

    - Period of Record
    - Vessel Counts by Day of Week *(Total boats counted, average per day)*
    - Average Hourly Boat Traffic Totals *(Average boat traffic by time of day)*
    - Monthly Boat Count Totals *(Month, days observed, total boats counted, average per day)*
    - Total Vessels Counted per Month
    - Average Boats Counted by Day of Week
    - Boats Counted by Day of Week Distribution by Hour
    - Total Vessels Pass through open bridge Distribution by Vessel Height
    - Total Vessels Pass under closed bridge Distribution by Vessel Height
    - Total Vessels Pass Under Closed bridge per day
    - Total Vessel Pass Under Closed bridge Distribution by Hour
    - Total Vessels Pass through open bridge per day
    - Total Vessel Pass through open bridge Distribution by Hour
    - Number of Vessels Waiting for Opening *(at primary and secondary bridges)*
    - Average Wait Time of vessels
    - Number of Bridge Operations per Day *(opening / closing)*
    - Number of Bridge Operations per Day Distribution by Hour *(opening / closing)*

3. Determine the Level of Service provided by the waterway segments of the Okeechobee Waterway (St. Lucie River). The Level of Service (LOS) is measured in relative terms between the unencumbered operations of marine vessels on the waterway (LOS A) and the condition where congestion or other impediments effectively bring the marine traffic on the waterway to a standstill (LOS F).