

**Ports and Waterways Safety Assessment  
Workshop Report**

**Cleveland, Ohio**

**17 – 18 September 2025**



**Providing Navigation Safety Information  
for America's Waterways Users**

**Released By:**

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## Executive Summary

Coast Guard Marine Safety Unit (MSU) Cleveland sponsored a Ports and Waterways Safety Assessment (PAWSA) workshop in Cleveland, Ohio, from September 17, 2025, to September 18, 2025. Twenty-four participants and observers representing a range of waterway users, stakeholders, and federal, state, and local regulatory and public safety authorities met to collaboratively assess navigational safety on the waterways adjoining the port of Cleveland and the Cuyahoga River. This report provides a visual depiction of the study area and contains the full list of workshop participants and their associated organizations. The first day of the workshop included discussions about port and waterway attributes and vessel traffic in relation to the sixteen Waterway Risk Factors (WRFs) in the PAWSA Waterway Risk Model, which is described in more detail in this report. During this dialogue, participants identified specific port WRF issues to inform mitigations and facilitate the Focused Quantitative Risk Assessment (FQRA) conducted on the second day of the workshop. At the conclusion of WRF discussions, Risk Characterization for each WRF was established based on participants’ survey responses. Risk Characterization assesses the potential consequence, risk trend, risk tolerance, and effectiveness of existing mitigation strategies for a specific WRF. The metrics from the Risk Characterization quantitatively prioritized WRFs to inform discussions during the next phase of the workshop. During the second day, participants conducted a FQRA to approximate adverse economic impacts of prioritized WRF issues and engaged in follow-on discussions to identify and develop risk mitigation strategies. The output of the FQRA is called a Risk Index Number (RIN), a numerical value designed to quantify an issue's adverse monetary impact on a port to guide resource prioritization and decision-making. A value of one RIN is equivalent to one million dollars in economic loss to a port. A higher RIN value is indicative of larger projected annual economic loss due to a specific event type or issue. FQRA results for the average annual frequency for each type of event and its associated RIN Value for the workshop study area is provided in the table below.

Event Name	RIN	Avg Frequency
Collision	91.14	24.11
Traffic Restricted	33.48	60.76
Allision	31.12	27.60
Sinking	22.10	5.34
Infrastructure Failure	5.55	4.92
Fire/Explosion	4.69	1.42
Grounding	1.73	5.75
Oil Spill	1.04	2.00
HAZMAT Release	0.13	0.25
<b>Total</b>	<b>190.97</b>	<b>132.17</b>

FQRA results for the five issues with the highest RIN value and the associated numerical value are presented in Chapter 2.C. The RIN results, recommended mitigation strategies, and participant observations documented in this report will meaningfully facilitate continued collaboration between the Coast Guard and waterway stakeholders to improve safe and efficient navigation within the Marine Transportation System (MTS). The Director of Marine Transportation Systems (CG-5PW), the Coast Guard’s Navigation Center (CG NAVCEN), and CG MSU Cleveland extend their sincere appreciation to participants for their contributions to the Cleveland PAWSA workshop.

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## CHAPTER 1. GENERAL

### A. Background and Purpose

1. The Director of Marine Transportation Systems (CG-5PW) is responsible for developing and implementing policies and procedures that facilitate commerce, improve safety and efficiency, and maximize the commercial viability of the Marine Transportation System (MTS). In the late 1990s, the Coast Guard convened a national dialogue group (NDG) comprised of maritime stakeholders to identify the needs of waterway users with respect to Vessel Traffic Management (VTM) and Vessel Traffic Service (VTS) systems. A major outcome of the NDG was the development of the Ports and Waterways Safety Assessment (PAWSA) process, which the Coast Guard established as the formal model for facilitating stakeholder discussion to identify VTM improvements and determine candidate VTS waterways. The PAWSA methodology has been modernized several times by the CG NAVCEN and Office of Waterways & Ocean Policy (CG-WWM) since its original inception for purposes of creating a more adaptable tool available to Sector Commanders to engage the maritime community to monitor and improve the health of the MTS within their area of responsibility. The most recent PAWSA process update occurred in 2025.
2. The current PAWSA process convenes a select group of waterway users and stakeholders to facilitate a structured workshop agenda to meet pre-identified risk assessment objectives. A successful workshop involves the participation of professional waterway users with local expertise in navigation, waterway conditions, and port safety. Stakeholder involvement is central to ensuring that important environmental, public safety, and economic consequences receive appropriate attention as risk interventions are identified and evaluated. The workshop culminates in a written report that includes proposed risk mitigations developed by participants, which is made publicly available on the CG NAVCEN's website (<https://www.navcen.uscg.gov/ports-and-waterways-safety-assessment-final-reports>.)
3. The PAWSA process strives to achieve the following objectives:
  - a. Gather stakeholder input to identify major waterway trends, safety hazards, and potential mitigation strategies.
  - b. Bolster public-private partnership and enhance cooperation across the MTS.
  - c. Generate a stakeholder driven report that captures data gathered from the PAWSA to prioritize future projects impacting the MTS.

## B. Methodology

1. Waterway Risk Conditions and Waterway Risk Factors. The PAWSA process is designed to convert qualitative experience, observations, and opinions of participants into quantitative assessments. This method uses numerical comparison among sixteen WRFs to build consensus among participants to better inform conversations regarding risk mitigation strategies within an identified study area. The Waterway Risk Condition categories and associated WRFs are listed in Table 1 and further defined in Appendix B.

Navigation	Vessel Quality & Operation	Traffic	Waterway
Winds	Large Commercial Vessels	Volume of Commercial Traffic	Dimensions
Currents and Tides	Small Commercial Vessels	Volume of Recreational Traffic	Obstructions
Visibility Restrictions	Commercial Fishing Vessels	Waterway Use	Visibility Impediments
Bottom Type	Recreational Vessels	Congestion	Configuration

*Table 1 – The four Waterway Risk Condition categories and sixteen WRFs.*

2. PAWSA Workshop Structure. Each PAWSA workshop is a two-day facilitated process. The following sections detail the structure and goals for each day of a workshop. A maximum of 30 stakeholders divided into 15 two-person teams may participate.

- a. PAWSA Workshop - Day 1.

- (1) WRF Discussion. During the first day of a PAWSA, participants gain a comprehensive understanding of the workshop study area and are led through individual discussions for each WRF identified in Table 1. The purpose of these discussions is to provide a collaborative forum for stakeholders to generate a list of specific challenges unique to their respective port as related to each WRF. Participants identify and prioritize the top three issues for each WRF to facilitate

the Focused Quantitative Risk Assessment (FQRA) process and inform mitigation discussions during Day 2. These issues are documented in Appendix E.

(2) Risk Characterization Survey. Risk Characterization is a combined qualitative measure of the risk tolerance, risk trend, and effectiveness of existing mitigation strategies for a specific WRF. Surveys are completed at the end of Day 1 by the established two-person teams. The survey asks teams to evaluate the Current Risk Level, Current Risk Trend, and Current Risk Mitigations to characterize the risk associated with each WRF. Participants select from a set of qualitative descriptors that have weighted numeric values assigned to each answer to calculate Risk Characterization. Table 2 provides the available selections for each Risk Characterization question.

	<b>Available Selections</b>
<b>Current Risk Level</b>	We could accept more risk
	Balanced
	Unacceptable
<b>Current Risk Trend</b>	Decreasing
	Steady
	Increasing
<b>Current Risk Mitigations</b>	Acceptable
	Acceptable, but tenuous
	Unacceptable <i>*(If unacceptable select all that apply)</i>
	<i>Not Effective</i>
	<i>Too costly</i>
	<i>Slow operations</i>
	<i>Causes other issues</i>

Table 2 – WRF Survey, Risk Characterization categories.

After each team completes the Risk Characterization survey, their assessment of the Waterway Risk Factors is compiled into a Characterization Count. The Characterization Count is crucial because it reflects how each team perceives risk for each WRF. The selected values from the survey generate a color-coded classification that informs the overall WRF Risk Characterization for each team. The results from each team survey are then aggregated together to determine the Characterization Rating for each WRF that represents the average of the stakeholder group. The Characterization Rating informs the prioritization of

WRFs to guide mitigation development discussions and evaluation of WRF issues through the FQRA during Day 2 of the workshop.

(3) Characterization Count Color Designations. Individual team Characterization Count for a WRF is designated as red, orange, or green. For this scale, red represents high risk, orange represents intermediate risk, and green represents low risk. The following subsections outline the thresholds for each color-coded Risk Characterization designation for team Characterization Count.

(a) A WRF is designated with a red Risk Characterization when an individual team determines the WRF Current Risk Level is “unacceptable,” or the Current Risk Mitigations are “unacceptable.”

(b) A WRF is designated with an orange Risk Characterization when an individual team determines the Current Risk Trend is “increasing” and the Current Risk Mitigations are “weak.”

(c) A WRF is designated with a green Risk Characterization when an individual team’s combinations of answers do not meet the threshold for red or orange.

(4) Characterization Rating Color Designations. When the teams complete the Risk Characterization survey, their assessments are combined to calculate and assign the overall Characterization Rating for each WRF, as shown as an example in Table 3.

Category	RF Small	Characterization	Red	Orange	Yellow	Green
Traffic	Rec	Red	10	3		1
Vessel	Rec	Red	11	1		2
Vessel	Small	Red	9	3		2
Traffic	Congestion	Orange	6	6		2
Traffic	Usage	Orange	4	8		2
Navigational	Bottom	Green	1	1		12
Navigational	Tides	Green	2	4		8
Navigational	Vis	Green	1			13
Navigational	Winds	Green		1		13
Traffic	Commercial	Green		5		9
Vessel	Fishing	Green	1			13
Vessel	Large	Green	2	4		8
Waterway	Config	Green	4	2		8
Waterway	Dims	Green	4	2		8
Waterway	Obstr	Green	2	1		11
Waterway	Vis	Green	4	2		8

**Characterization Count - Individual Team**  
**Red.** The Risk Level is Unacceptable OR the Mitigations are Unacceptable.  
**Orange.** The Risk Trend is Increasing AND the Mitigations are Weak.  
**Green.** All others.

**Characterization Rating - Overall**  
**Red.** 60% or more teams rated as Red.  
**Orange.** 50% or more teams rated Yellow or higher.  
**Green.** 50% or more teams rated as Green.

Table 3 – Example Risk Characterization survey results.

Characterization Rating for a WRF is designated as red, orange, or green. The color-coded scale for the Characterization Rating is the same as Characterization Count, but the thresholds for attributing the color designation are different. In Table 3, the numbers below each of the header columns labeled red, orange, and green represent the number of individual teams that attribute a certain risk level to that specific WRF. The Characterization Rating for a WRF is determined by plurality. The following subsections outline the thresholds for each color-coded Risk Characterization Rating designation.

- (a) A WRF is designated with a red Characterization Rating if 60% or more of the teams select that specific rating.
- (b) A WRF is designated with an orange Characterization Rating if 50% or more of the teams select that specific rating.
- (c) A WRF is designated a green Characterization Rating if 50% or more of the teams select that specific rating.

(5) At the conclusion of Day 1, PAWSA facilitators present the Risk Characterization survey results and facilitate discussion among participants to determine and validate prioritization of WRFs for use in the FQRA and mitigation development.

b. PAWSA Workshop – Day 2. The second day of the workshop is focused on fulfilling two objectives. The first is to complete the FQRA to calculate the Risk Index Number (RIN) for the highest prioritized WRFs identified during Day 1. The second is to develop mitigations for issues associated with those WRFs. The following subsections provide more detail regarding the process and methodology for executing the FQRA and WRF mitigation development.

(1) Focused Quantitative Risk Assessment (FQRA). The FQRA is a process to conduct a normalized comparison between historical data and participant expertise to approximate the yearly adverse economic impact of individual WRFs on a port. The output from this calculation is called the RIN. The value of the RIN represents the annual average potential economic loss in millions of dollars based on the associated WRF. The FQRA uses existing historical data from Coast Guard vessel operational controls, waterways management operational controls, and incident investigation activities documented in the Coast Guard’s Maritime Information for Safety and Law Enforcement (MISLE) database. The MISLE database is the centralized repository for capturing and reporting the information required to support Coast Guard marine safety, security, environmental protection,

and law enforcement programs and for ensuring compliance with statutory and regulatory record keeping requirements. The FQRA is a two-pronged method derived from combining the distribution of historical outcomes for a local area and the multiplication product of the likelihood and consequence for a specific scenario. Figure 1 depicts a flow chart that visually represents the process used in the FQRA.

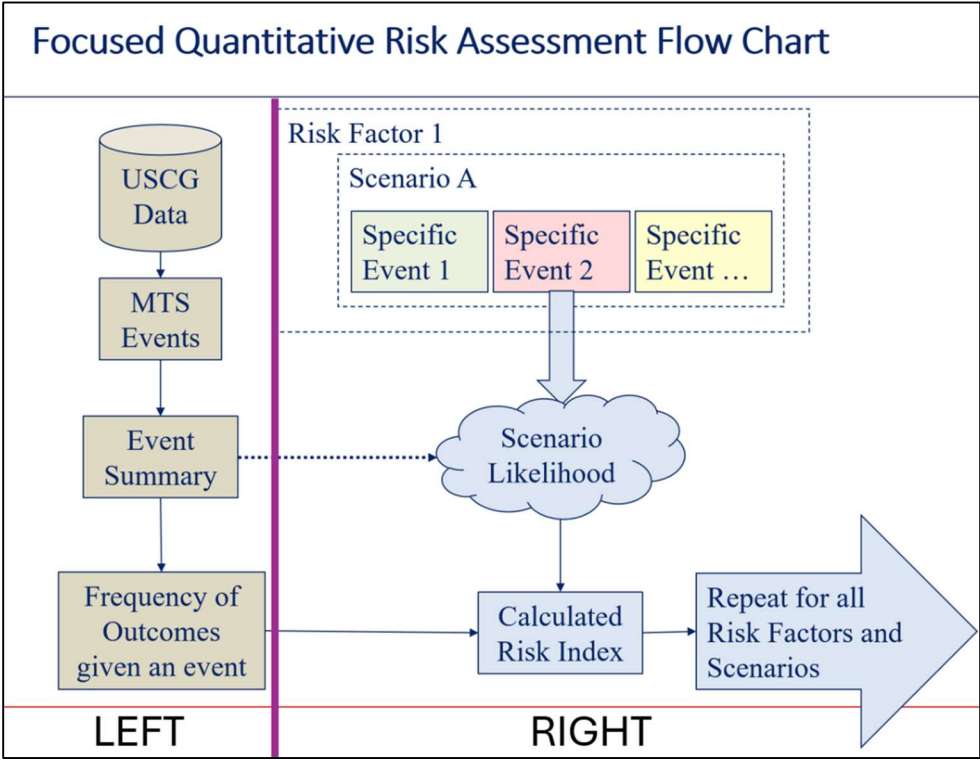


Figure 1 – FQRA Flow Chart.

- (a) During the first step of the FQRA, represented on the left side of Figure 1, Coast Guard MISLE data is synthesized to determine the historical frequency of events and their outcomes. The outputs from this first step guide the calculations used in the second step to convert qualitative stakeholder input into a quantitative metric. In this model, outcomes are unwanted consequences that are classified as safety, environmental, or economic. For more information on the Coast Guard established consequence types, severity categories, and fiscal equivalence, please see Table 1 in section B.1 of Appendix B.
- (b) During the second step of the FQRA, represented on the right side of Figure 1, participants provide qualitative data regarding the types and likelihood of an event occurring due to the issues identified for the top prioritized WRFs on

Day 1 of the workshop. To gather this information, facilitators provide participant teams with a Risk Event Form pre-populated with the prioritized WRFs and the associated top three issues for each factor that were determined during Day 1. The stakeholders use their local anecdotal knowledge of historical events to assign each issue up to three types of events that may occur due to the issue and the predicted frequency of the event. Available types of events on the Risk Event Form include allision, collision, fire/explosion, grounding, oil spill, sinking, or traffic restricted. For definitions of these event types, please see Appendix F. After selecting an event type, participants designate a predicted likelihood of the event, based on local knowledge and experience. Likelihood is the probability of an event based on local historical trends. Frequency thresholds for the likelihood designations used in the FQRA to calculate RIN are described in Table 4. The model standardizes the likelihood with incidents per fifty years to allow for easier understanding and comparison with historical numbers. The corresponding probability of each event is multiplied by the consequence value and normalized to millions of dollars, estimating the RIN to one million dollars in economic loss for an associated event.

<b>Likelihood</b>	<b>Frequency</b>	<b>Probability</b>
Very Unlikely	Once or twice in the history of the port / waterway	0.00055
Rare	Once every 50-100 years	0.006
Occasional	Once or twice every 10-20 years (2-20 every 50 years)	0.22
Probable	Once or twice every year or two (25-75 in 50 years)	1
Frequent	More than twice per year (100 in 50 years)	5

*Table 4 – Likelihood designations, frequency thresholds, and probability values used to calculate RIN.*

- (c) The model uses MISLE data, including vessel operational controls, waterways management operational controls and incident investigation activities, to group historical investigations into consequence categories. This allows normalization of stakeholder inputs using historical data. It is important to note that the data used in this model was selected for its quality and availability and is therefore limited. It does not include reports or data from all types of events reported or investigated by the Coast Guard. The historically synthesized national and local data is used to pre-assign specific values for

stakeholder qualitative input and create the frequency distribution used in the RIN calculation. During the FQRA, both the historical national events and local events are provided to stakeholders for review in handout form, prior to conducting the assessment. Please see Appendix F for the national and local event data provided to stakeholders during the PAWSA.

(d) For the FQRA, the stakeholders select a frequency for each event, which is then multiplied by the distribution of consequences. This is added together to calculate the RIN.

(2) FQRA Results. Facilitators use the qualitative data collected in the Risk Event Forms to conduct the FQRA. This generates a RIN and estimated annual frequency for each event type, which are sortable by WRF and issue. Table 5 and 6 provide examples of RIN results and data from the FQRA. A large volume of raw data is generated from the FQRA. To keep the report concise, only RIN results for all event types and the five issues with the highest RIN values are presented in this report and can be found in Chapter 2, Section C.3. Additional raw FQRA data, including the RIN results for all evaluated issues and associated event types, is available by request from the Coast Guard Navigation Center.

(a) The results summarized in Table 5 provide an example of the RIN and annual frequency for each event type as determined through the FQRA. The RIN represents a monetary quantification of identified risks. For the purposes of this assessment, a RIN value of '1' corresponds to a potential financial impact of \$1 million (e.g., 2.5 RIN = \$2.5 million). This quantification provides essential context for assessing the potential financial impact on the maritime system during an event.

Event Name	RIN	Avg Frequency
Collision	10.16	2.69
Traffic Restricted	7.72	14.01
Sinking	6.61	1.60
Infrastructure Failure	5.83	5.17
Allision	4.43	3.93
Grounding	1.08	3.60
Oil Spill	0.22	0.43
HAZMAT Release	0.04	0.08
Fire/Explosion	0.01	0.00
<b>Total</b>	<b>36.11</b>	<b>31.52</b>

Table 5 – Example RIN and annual frequency results by event.

(b) The results summarized in Table 6 provide an example of RIN values broken down by WRF, issue, and event type. Stakeholders can leverage the RIN to compare the costs associated with implementing mitigation measures against the potential cost of an incident and its subsequent cascading effects, thereby optimizing resource allocation for risk reduction. For example, in Table 6, if stakeholders reported that "Groundings throughout the study area can cause the waterway to shut down for an extensive amount of time," and associate a RIN of 1.02, this indicates that the issue is estimated to cost the local maritime system \$1,020,000 annually.

Risk_Factor	RIN	Avg Events
<b>Bottom Type</b>	<b>6.52</b>	<b>8.69</b>
<b>Groundings throughout the study area can cause the waterway to shut down for an extensive amount of time.</b>	<b>1.02</b>	<b>1.76</b>
Allision	0.09	0.08
Collision	0.00	0.00
Grounding	0.05	0.17
HAZMAT Release	0.00	0.00
Infrastructure Failure	0.10	0.08
Oil Spill	0.09	0.17
Sinking	0.00	0.00
Traffic Restricted	0.69	1.25

Table 6 – Example RIN by WRF, issue, and event type.

- (c) Normalizing the impact value in dollars provides the ability to update and localize the model as needed or desired. This enables comparison between past and current results of the same port and comparisons between different ports. Port specific results generated during a workshop can be compared to existing Coast Guard data of historical events to highlight local mariner knowledge of events captured through the RIN process. Chapter 2, Section C.3. contains participant issues with the top five RIN values extracted from the FQRA results.
- (3) **Mitigations.** Following completion of the FQRA, facilitators present the Risk Characterization survey results and facilitate discussion among participants to determine prioritization of WRF for mitigation development. Stakeholders collaboratively determine the top WRFs to focus dialogue for mitigation development during the remainder of the workshop. The development of mitigation strategies is guided by facilitators using the key issues identified during discussions from Day 1. These issues are used as the starting point for participants to brainstorm mitigations to address concerns and are the same issues used in the FQRA. Facilitators assist participants in developing risk mitigation strategies that are both impactful and feasible, ideally capturing those that are well-developed

proposals with clear delineation of ownership and predicted timelines to enact change. Through this invaluable process, stakeholders make recommendations to improve safe and efficient waterways usage within the port study area, creating a comprehensive list of action items for future implementation or reevaluation.

## CHAPTER 2. CLEVELAND PAWSA WORKSHOP

### A. PAWSA Study Area

1. The geographical area for the Cleveland PAWSA included Cleveland Harbor and Cuyahoga River as depicted in Figure 2. The coordinates bounding the Cleveland study area were: 41.558°N, 081.635°W and 41.461°N, 081.676°W. Graphic representations of this study area were used to facilitate discussion with participants. Additionally, geographically referenced comments were collected during the workshop and are documented as chartlets in Appendix D.

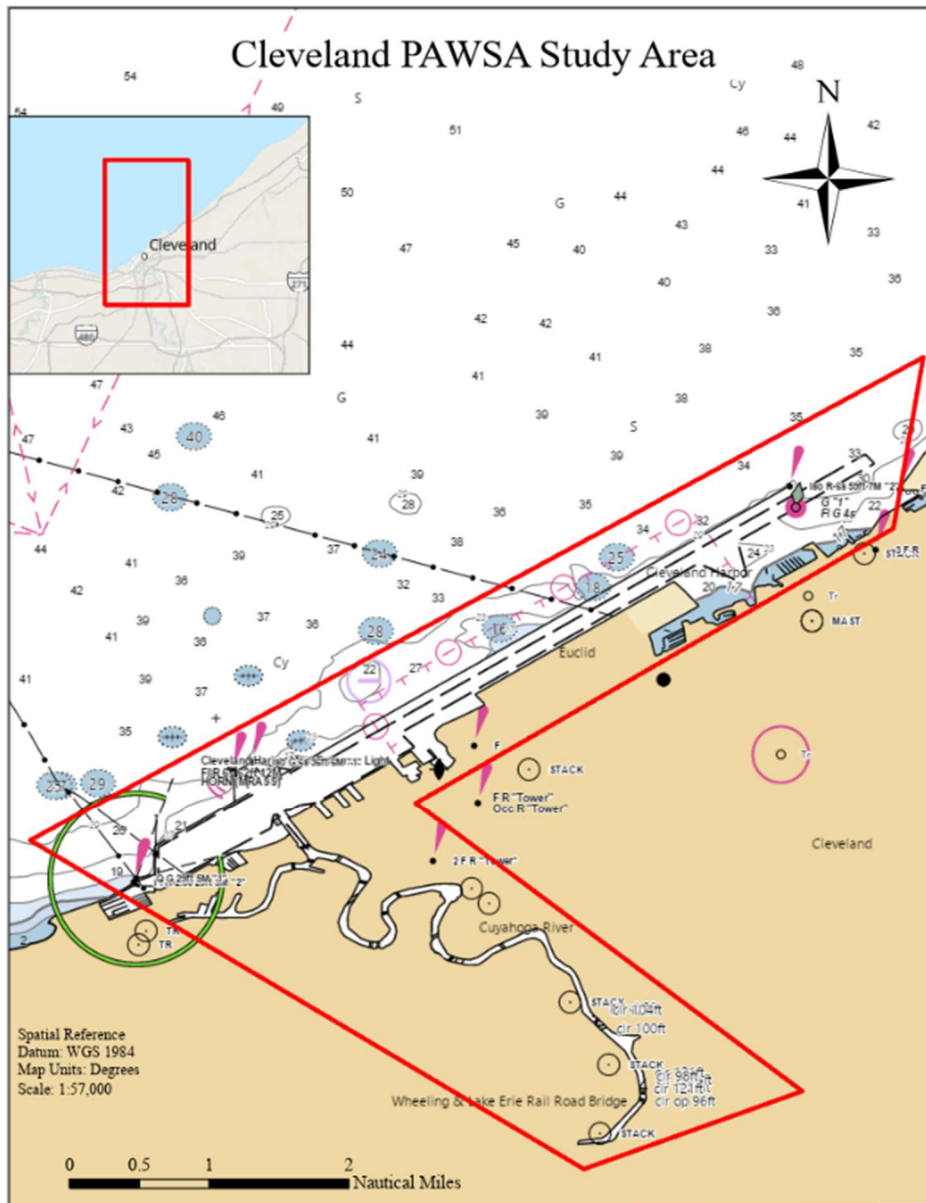


Figure 2 - Cleveland PAWSA workshop study area.

## B. Participant Validation of WRF Prioritization.

1. The Risk Characterization survey results are depicted below in Figure 3. The results are grouped by Risk Characterization. These results were presented to participants to validate the prioritization order of WRFs to facilitate the FQRA and for mitigation strategy development.
2. The Risk Characterization results indicated a generally low level of existing risk within the Cleveland PAWSA study area. Most WRFs were categorized as Green. This favorable risk profile appears to stem from the strong working relationships and proactive communication channels established among stakeholders within the port, preventing emerging issues from escalating into significant safety concerns.

Category	RF Small	Characterization	Red	Orange	Yellow	Green
Navigational	Bottom	Green	1	2		8
Navigational	Tides	Green	1	4		6
Navigational	Vis	Green	2	1		8
Navigational	Winds	Green	2	1		8
Traffic	Usage	Green	1	3		7
Vessel	Fishing	Green	1			10
Waterway	Obstr	Green	2	2		7
Waterway	Vis	Green	2			9
Traffic	Commercial	Orange	1	6		4
Traffic	Congestion	Orange	2	6		3
Traffic	Rec	Orange	5	3		3
Vessel	Large	Orange	3	4		4
Vessel	Small	Orange	1	5		5
Waterway	Config	Orange	2	5		4
Waterway	Dims	Orange	5	2		4
Vessel	Rec	Red	8	2		1

**Characterization Count - Individual Team**  
**Red.** The Risk Level is Unacceptable OR the Mitigations are Unacceptable.  
**Orange.** The Risk Trend is Increasing AND the Mitigations are Weak.  
**Green.** All others.

**Characterization Rating - Overall**  
**Red.** 60% or more teams rated as Red.  
**Orange.** 50% or more teams rated Yellow or higher.  
**Green.** 50% or more teams rated as Green.

Figure 3 - Risk Characterization survey results for all WRFs.

3. Following subjective evaluation, participants selected Small Commercial Vessels, Recreational Vessels, Volume of Recreational Traffic, and Congestion as the most significant WRFs that contributed to potential incidents in the Cleveland PAWSA study area. Notably, Small Commercial Vessels was initially characterized by several participants as an “unknown” due to variability in operator experience, oversight, and operational patterns. During discussion, the group emphasized that this variability itself represented a risk. Unlike larger inspected commercial vessels operating under structured safety management systems, small commercial vessels often operate seasonally, with mixed levels of professional training. Participants noted that their interaction with dense recreational traffic, particularly during peak summer months, increases the likelihood of close-quarters situations and decision-making under pressure. Ultimately, the group selected this WRF over others because of the combination of traffic density, operational

variability, and the potential for consequences in confined or congested areas of the study area. Similarly, Recreational Vessels and Volume of Recreational Traffic were prioritized due to the seasonal surge in traffic, wide range of operator proficiency, and frequent mixing with commercial vessels. Congestion was identified as a compounding factor, amplifying the effects of high traffic volume and limited maneuvering space, particularly in harbor approaches and near popular waterfront destinations. A consensus vote amongst participants determined the ranking of WRFs according to their level of concern. Table 7 presents WRFs in descending priority order from high to low.

<b>Waterway Risk Category</b>	<b>WRF</b>
Vessel Quality & Operation	Small Commercial Vessels
Vessel Quality & Operation	Recreational Vessels
Traffic	Volume of Recreational Traffic
Traffic	Congestion

*Table 7 - Validated and prioritized WRFs listed from high to low.*

### C. Risk Index Number Results

1. RIN Results by Frequency. As detailed in Table 7, participants validated and prioritized WRFs within the Cleveland PAWSA study area. Based on this prioritization, stakeholders completed Risk Event Forms (as described in Chapter 1.B.2.b.(1)(b)) for the top eight WRFs. Each form captured the top three validated issues that stakeholders deemed most pertinent for each of the eight highest prioritized WRFs. Appendix E contains a full list of these participant-presented and validated issues. The issues presented in this appendix are edited for clarity and syntax.
2. The average annual frequency for each type of event with its associated RIN value is listed from highest to lowest in Table 8.

Event Name	RIN	Avg Frequency
Collision	91.14	24.11
Traffic Restricted	33.48	60.76
Allision	31.12	27.60
Sinking	22.10	5.34
Infrastructure Failure	5.55	4.92
Fire/Explosion	4.69	1.42
Grounding	1.73	5.75
Oil Spill	1.04	2.00
HAZMAT Release	0.13	0.25
<b>Total</b>	<b>190.97</b>	<b>132.17</b>

*Table 8- RIN by event type*

3. RIN Results by Issue. The five issues with the highest RIN values as identified from stakeholder surveys completed during Day 2 of the PAWSA workshop are ordered from highest to lowest in Table 9. The verbiage for the issues in Table 9 is presented as agreed upon and used by participants during the FQRA. It has not been altered for clarity. Additional data and information for the Cleveland PAWSA RIN results is available by request from the Coast Guard Navigation Center.

<b>Issue #1</b>	There is a lack of knowledge and inadequate education for recreational boaters which leads to hazardous boating activity within the waterway.			
<b>Event Type</b>	<b>RIN</b>	<b>Event Type</b>	<b>RIN</b>	<b>Total RIN</b>
Allision	3.57	Infrastructure Failure	0.47	<b>21.77</b>
Collision	11.97	Oil Spill	0.26	
Fire/Explosion	0.28	Sinking	3.45	
Grounding	0.30	Traffic Restricted	1.47	
<b>Issue #2</b>	There is an increase in recreational traffic after holidays or special events resulting in congestion, which can often increase the possibility of marine casualties requiring emergency response. Additionally, there is a lack of coordination between resources/agencies to respond to these casualties.			
<b>Event Type</b>	<b>RIN</b>	<b>Event Type</b>	<b>RIN</b>	<b>Total RIN</b>
Allision	2.72	Infrastructure Failure	0	<b>19.45</b>
Collision	10.41	Oil Spill	0.04	
Fire/Explosion	0	Sinking	3.10	
Grounding	0.05	Traffic Restricted	3.12	
<b>Issue #3</b>	Recreational boaters lack equipment or equipment knowledge, increasing the risk of hazardous and unsafe situations requiring search and rescue response.			
<b>Event Type</b>	<b>RIN</b>	<b>Event Type</b>	<b>RIN</b>	<b>Total RIN</b>
Allision	1.50	Infrastructure Failure	0.19	<b>18.73</b>
Collision	5.04	Oil Spill	0.43	
Fire/Explosion	3.58	Sinking	7.24	
Grounding	0.33	Traffic Restricted	0.41	
<b>Issue #4</b>	There is a lack of enforcement within the waterway leaving recreational boating habits such as negative attitudes, invincibility, and inebriation while operating, unaddressed.			
<b>Event Type</b>	<b>RIN</b>	<b>Event Type</b>	<b>RIN</b>	<b>Total RIN</b>
Allision	3.48	Infrastructure Failure	0.56	<b>16.01</b>
Collision	8.19	Oil Spill	0.08	
Fire/Explosion	0.28	Sinking	2.42	
Grounding	0.18	Traffic Restricted	0.83	
<b>Issue #5</b>	There is consistent and frequent increase in congestion caused by Norfolk Southern Lift Bridge Number 1 delays.			
<b>Event Type</b>	<b>RIN</b>	<b>Event Type</b>	<b>RIN</b>	<b>Total RIN</b>
Allision	1.79	Infrastructure Failure	0	<b>11.74</b>
Collision	5.99	Oil Spill	0.04	
Fire/Explosion	0	Sinking	0.35	
Grounding	0.03	Traffic Restricted	3.90	

Table 9 – Highest five RIN values ranked by issue in descending order.

4. Summary of RIN Results. The data indicates that collisions, which have the highest RIN, occur most frequently on average. This finding is unsurprising, as the FQRA identified collisions as the most prevalent event type, driven by waterway and port-specific factors that contribute to the elevated RIN value. In Cleveland, this concern is amplified by stakeholder observations regarding high recreational vessel traffic and congestion in the vicinity of The Norfolk Southern Railroad Bridge, at Mile 0.76 (locally referred to as NS1). Operational delays and lift failures of the NS1 contribute to increased congestion and restriction of marine traffic. A combination of all events detailed in Table 8 occur on average 132.17 times per year in the Cuyahoga River and Port of Cleveland. The total annual RIN cost associated with these events is estimated at \$190.97 million.

## D. Risk Mitigation Strategies

1. The validated list of WRFs was used to prioritize discussion and development of risk mitigation strategies. Facilitators directed participants to capture potential mitigation strategies on sticky notes, which were then consolidated and grouped to identify major themes. From this bank of action items, participants were encouraged to generate mitigation strategies for Small Commercial Vessels, Recreational Vessels, and Congestion. Due to time constraints, risk mitigation strategies were not developed for all issues within some WRFs and no risk mitigation strategies were discussed for Volume of Recreational Traffic. Recommended mitigation strategies documented in this section received consensus among workshop participants. Mitigation strategies are documented in order of significance to participants.
2. Participant comments are listed in Appendix C of this report and are referenced throughout this subsection to provide support of documented developed mitigation strategies.
3. Appendix E of this report contains a full list of the issues that participants presented and validated, informing the development of mitigation strategies discussed below. The issues presented in Appendix E are edited for clarity and syntax.
4. WRF – Small Commercial Vessels.
  - a. Some small commercial vessels have poor radio etiquette which results in miscommunication, impedes port operations, and further exacerbates traffic-related issues. Participants recommended the following mitigation strategies:
    - (1) U.S. Coast Guard Great Lakes District is in the initial phase of gathering input from subordinate Coast Guard Sectors and MSUs to update the Code of Federal Regulations to move all bridge-related radio traffic from Very High Frequency (VHF) Channel 16 to VHF Channel 9. If this change is implemented, MSU Cleveland plans to coordinate with the Harbor Safety Committee (HSC) and local maritime stakeholders to ensure effective implementation of updated bridge radio communication protocol.
    - (2) Ensure compliance with 33 CFR 117.55, Posting of Requirements, by Great Lakes District and Coast Guard Station Cleveland to verify that all bridges display clear signage on both approaches and identify the correct radio channel for bridge communication. In parallel effort, engage the maritime community, waterfront property owners, businesses, and the City of Cleveland through the HSC to

promote awareness of signage requirements and facilitate installation of additional signs in high-traffic areas. Encourage mariners to report missing or improperly placed signs to the Coast Guard.

- (3) Establish a radio communications HSC subcommittee to liaise with the Federal Communications Commission to investigate VHF radio misuse within the study area. Work to establish updated communication standards, including shifting routine traffic to designated working channels and limiting transmission time on VHF Channel 16.
  - (4) Leverage the radio communications HSC subcommittee described in paragraph D.3.a.(3) to promote and monitor proper VHF radio communication practices across the boating community within the study area. Reinforce compliance with Marine Radio Operator Permit (MROP) requirements for inspected passenger vessels and implement an annual or biannual refresher course to improve radio etiquette and discipline.
- b. There is a sustained demand for qualified captains that has created a shortage of experienced operators. As a result, some small commercial vessels may be operated by individuals with limited training or experience, increasing the potential for operational errors and safety concerns within the study area. Participants recommended the following mitigation strategies:
- (1) Establish a HSC working group to develop a local familiarization course to educate new captains on safe operation principles unique to the Cuyahoga River. Topics addressed in the course will include radio etiquette and communications, locations of congested areas and safety zones, and bridge schedules. Review of the course will occur annually to ensure that content remains current and accurate.
  - (2) Endorse Argonaut by the HSC as a qualified training provider for new captains and mariners within the study area. Increase maritime education and certification offerings from Argonaut for qualified mariners, supported by local maritime business owners who sponsor employee training.
- c. Recent increases in the volume of small commercial vessels exceeds the availability of existing mooring locations within the study area. Participants recommended the following mitigation strategy:
- (1) Through the HSC Executive Board, formally engage with the City of Cleveland to address the longstanding harbormaster position vacancy. Fill this role to enhance

coordination of port operations, improve communication among stakeholders, and strengthen oversight of maritime safety and waterway management within the study area.

5. WRF – Recreational Vessels.

a. Lack of knowledge and inadequate education of recreational boaters contribute to increased hazardous activity within the waterway. Participants recommended the following mitigation strategies:

- (1) Coordinate between MSU Cleveland and Coast Guard Sector Eastern Great Lakes to request supplemental enforcement personnel during high-volume marine events. Leverage these additional personnel to enhance enforcement presence, ensure adequate coverage throughout the study area, and alleviate operational strain on Coast Guard Station Cleveland.
- (2) Draft and submit a formal proposal from the HSC to MSU Cleveland to recommend designation of the entire navigable Cuyahoga River as a federally regulated no-wake zone. Coordinate between the HSC and local, state, and federal government entities to install clearly visible no-wake signage along the river to enable law enforcement partners to more effectively enforce compliance.
- (3) Establish a collaborative, voluntary program between local law enforcement agencies and waterfront businesses to employ off-duty officers to monitor docks and boarding areas to prevent impaired individuals leaving shoreside bars and restaurants from boarding vessels with intent to get underway.
- (4) Flats Forward Inc. developed the Cuyahoga River Water Trail Camera Safety Program, which was vetted and is supported by city officials, property owners, and the Northeast Ohio Regional Sewer District. This program is designed to livestream real-time marine traffic footage directly to mariners' mobile devices to enhance situational awareness and navigational safety on the Cuyahoga River. To fully implement the program, additional funding is required. The HSC, in collaboration with Flats Forward Inc., should explore potential funding sources and identify potential partnerships to support the expansion and sustainment of this program.

6. WRF – Congestion.

a. Frequent delays of the NS1 cause recurring congestion on the Cuyahoga River. Participants recommended the following mitigation strategies:

- (1) Develop and post a Quick Response (QR) code at public boat ramps and waterfront facilities that links directly to the existing bridge delay report website, this will provide streamlined access to reporting instructions and submission forms.
- (2) Coordinate with local partners to publish the bridge delay report website link on relevant organizational websites and social media platforms to improve visibility and public awareness of the reporting process.
- (3) Incorporate information on bridge delay reporting procedures into the Coast Guard Auxiliary recreational boater safety courses to increase awareness and encourage proper reporting practices.
- (4) Through MSU Cleveland, engage with Norfolk Southern Railway to develop a bridge schedule for the NS1. The NS1 has a very low vertical clearance and is impassable to most recreational and commercial vessels when fully closed, requiring openings to facilitate vessel traffic. When there is no active or scheduled train traffic, the bridge can remain partially open to enable passage of recreational vessels and reduce the number of full openings required for larger commercial vessels.

## Appendix A. Workshop Participants

Participant	Organization
1. D. Andrew Ferguson	Argonaut
2. Jason Brothers	Argonaut
3. Jordan Kit	Argonaut
4. Eric Stoffer	Brew Boat Cleveland
5. Jerry Tucker	Cleveland Division of Police
6. Richard Kerber	Cleveland Division of Police
7. Kristen Runner	Cleveland Rowing Foundation
8. Nicolette Jaworski	Cleveland Rowing Foundation
9. Jim Haviland	Flats Forward Inc.
10. Ray Tanner	Grand River Navigation Company, Inc.
11. Paul Christensen	Interlake Steamship Company
12. Eric Peace	Lake Carriers Association
13. Lucy Hick	National Oceanic and Atmospheric Administration
14. Cappi Seidi	Norfolk Southern
15. Chad Kozan	Ohio Department of Natural Resources
16. Jim Ridge	Share the River
17. Stacey Payne	United States Army Corps of Engineers
18. Brian Hawkins	United States Coast Guard
19. Jared Boren	United States Coast Guard
20. Jennifer Stuart	United States Coast Guard
21. Joseph B. Kolb III	United States Coast Guard
22. Lee Soule	United States Coast Guard
23. Paul Markovic	United States Coast Guard
24. Sasha Queary	United States Coast Guard Auxiliary

## Appendix B. Waterway Risk Model Terms, Definitions, and Focused Quantitative Risk Assessment (FQRA)

**A. Waterway Risk Conditions and Waterway Risk Factor (WRF) Definitions.** The Ports and Waterway Safety Assessment (PAWSA) Waterway Risk Model utilizes sixteen WRFs categorized under four Waterway Risk Conditions. Definitions for each Waterway Risk Condition and their associated WRF are defined in this section.

1. Waterway Risk Condition - Navigation. The environmental conditions that affect vessel navigation, such as wind, currents, and weather.
  - a. WRF - Winds. The difficulty in maneuvering vessels resulting from increased and unpredictable winds, particularly if the wind is from abeam.
  - b. WRF - Tides and Currents. The difficulty in maneuvering vessels caused by water movement flow and speed, often affected by seasonal variations and sustained winds. Tide rips and whirlpools can be created by strong currents and affect the maneuverability of smaller vessels. The frequency of occurrence and the location of the strongest currents in the waterway are critical considerations (e.g., if current speed can exceed vessel speed, timing is critical when transiting the area).
  - c. WRF - Visibility Restrictions. The natural conditions that may prevent a mariner from seeing other vessels, aids to navigation, or landmarks, such as fog, severe rain squalls, etc.
  - d. WRF - Bottom Type. The material on the waterway bottom or just outside the channel, such as hard rock, mud, coral, etc.
2. Waterway Risk Condition - Vessel Quality and Operations. The quality of vessels and their crews that operate on a waterway. Each waterway has what are considered high risk vessels, such as old vessels, vessels with poor safety records, vessels registered in certain foreign countries, vessels belonging to financially strapped owners, vessels with inexperienced crews and operators, etc. When assessing risk, the following items should be considered (as appropriate) for each risk factor: maintenance, age, flag, class society, ownership, inspection record, casualty history, language barriers, fatigue related issues, and local area knowledge.
  - a. WRF - Large Commercial Vessels. The quality of the large commercial vessel itself and the proficiency and quality of the crew. Large vessels are those ocean-going vessels, often in international trade, that usually are constrained by their draft to use dredged channels where such channels exist. Large vessels include such things as oil tankers, container ships, break bulk cargo ships, and cruise liners.
  - b. WRF - Small Commercial Vessels. The quality of the small commercial vessel itself and the proficiency and quality of the crew. Small vessels include

all other commercial craft EXCEPT commercial fishing vessels. Examples include tugs and towboats, offshore supply vessels, charter fishing boats, and small passenger vessels (inspected under 46 CFR Subchapters T and K), such as dinner cruises and ferries.

- c. WRF - Commercial Fishing Vessels. The quality of the commercial fishing vessel itself and the proficiency and quality of the crew. These vessels are included because they are not required to undergo annual vessel inspections nor are the crewmembers required to hold USCG licenses; therefore, there may be a greater potential for increased incidents involving commercial fishing vessels.
  - d. WRF - Recreational Vessels. The quality of the recreational vessel itself and the proficiency and operating knowledge of the individuals who operate them. Recreational vessels include all boats used for noncommercial purposes (e.g., pleasure craft or craft used by indigenous people for transportation or subsistence fishing). They can be powered by an engine, the wind, or human exertion. Examples include yachts, personal watercraft (a.k.a., jet skis), and kayaks.
3. Waterway Risk Condition - Traffic Conditions. The number of vessels that use a waterway and their interactions.
- a. WRF - Volume of Commercial Traffic. The amount of commercial vessel traffic using the waterway (i.e., the more vessels there are on the water, the more likely that there will be a marine casualty). Deep draft and shallow draft commercial vessels as well as commercial fishing vessels are included in this risk factor. Shoreside infrastructure is also addressed in this risk factor (i.e., can it handle the volume of commercial traffic within the waterway).
  - b. WRF - Volume of Recreational Traffic. The amount of non-commercial vessel traffic using the waterway. The volume may vary depending on the time of day, the day of the week, the season of the year, or during a major marine event.
  - c. WRF - Waterway Use. The interaction between vessels or boats of different sizes using the same waterway and their maneuvering characteristics. Conflicts occur as risk increases with each type of vessel's maneuvering characteristics and actions that are often different and unpredictable (e.g. commercial mariners and recreational mariners using deep draft vessels and shallow draft vessels within the same waterway).
  - d. WRF - Congestion. The ability of the waterway to handle the volume and density of traffic. Risk increases when a large number of vessels uses a small geographic area for an extended period of time. Risk also increases substantially when you get a larger than normal number of vessels together for a short time (e.g., fishing tournament or short season commercial fishery).

4. Waterway Risk Condition - Waterway Conditions. The physical properties of the waterway that affect vessel maneuverability.
  - a. WRF - Visibility Impediments. The man-made objects (e.g., moored ships, condominiums, background lighting, etc.) or geographic formations (e.g., headlands, islands, etc.) that prevent a mariner from seeing aids to navigation or other vessels.
  - b. WRF - Dimensions. The room available for two vessels to pass each other within the waterway.
  - c. WRF - Obstructions. Floating objects in the water that impede safe navigation and could damage a vessel, such as ice, debris, fishing nets, etc. Fixed objects such as wrecks, pipelines, overhead wires, derelict piers, fixed bridges, and permanently moored vessels.
  - d. WRF - Configuration. The arrangement of a waterway, including elements such as waterway bends, multiple and converging channels, and perpendicular traffic flow.

**B. Focused Quantitative Risk Assessment (FQRA) Background.** As described in Chapter 1 Section B.2.b.(1), the Risk Index Number (RIN) is calculated for participant prioritized WRF issues using the FQRA process. Details are provided in the following sections regarding the consequence component of the FQRA.

1. Consequence. Table 1, as referenced in Chapter 1 Section B.2.b.(1).(a), displays the Coast Guard established consequence types, severity categories, and descriptions. Each consequence category is quantified in dollar value to allow comparison between consequence types. The fiscal equivalence for each consequence category provides economic weight for the RIN.

		Severity Categories				
		Cat I	Cat II	Cat III	Cat IV	Cat V
<b>Consequence Type</b>	<b>Safety</b>	Injuries up to permanent disability.	One to 5 Deaths	6 to 15 Deaths	16 to 50 Deaths	51 or more Deaths
	<b>Environmental (Oil)</b>	Minor releases (of less than 100 gal)	Medium releases (of 100 to 5000 gal) OR local marine resource stock collapse for 1 to 5 years.	Disruption of the ecosystem (of 5000 to 50k gal) OR local marine resource stock collapse for 5 to 10 years.	Serious disruption of the ecosystem (of 50k to 500k gal) OR local marine resource stock collapse for 10-50 years.	Catastrophic disruption of the ecosystem (of more than 500k gal) OR local marine resource stock collapse for more than 50 years.
	<b>Economic</b>	Vessel damage, structure damage, economic activity, or port disruptions that incur less than \$50k economic losses in total.	Between \$50k and \$250k economic losses in total.	Between \$250k and \$5M economic losses in total.	Between \$5M and \$250M of economic losses in total.	More than \$250M of economic losses in total.

Table 1 – Severity categories by consequence type.

- a. The following subsections explain how monetary values for different consequences are derived for each consequence type.
- (1) *Safety*. These estimates use the Department of Transportation value of statistical life. The guidance is intended for analyses assessing the benefits of preventing fatalities. Reflecting 2025 inflation, a single death is equivalent to \$12.5 million.
  - (2) *Environmental*. These estimates use the Environmental Protection Agency’s Basic Oil Spill Cost Estimation Model (BOSCM). This is an adaptable model that allows for customizable inputs regarding spill recovery methods and efficiency, oil type, cultural factors, and impacted ecosystem descriptors to predict cost of an oil spill. Each of these inputs modifies the cost calculation in a different way. Once customizations for the model are set, three functions are combined to get total cost. These consist of direct response costs, socioeconomic and secondary costs, and environmental damage costs. Due to the extensive prep work required to use BOSCM, the FQRA does not customize the model for individual

ports. Instead, very conservative factors are selected with a bias towards over-estimating the cost and accounting for inflation adjusted to 2025. The primary limitation of this method is that not all environmental damage is caused by oil. An analysis of environmental damage costs from all maritime incident sources is difficult to estimate. Oil spill costs are the proxy that was selected until better models are found.

- (3) *Economic*. This is the estimated dollar value for economic loss. It includes losses from vessel damage, facility damage, and economic activity.

## Appendix C. Participant Comments

### A. Background.

1. This appendix documents participant observations and recommendations expressed during the workshop with respect to specific issues of concern within the study area. Discussion during the first day of the workshop was recorded and subsequently transcribed using professional services. Comments were compiled and categorized by most applicable Waterway Risk Condition and WRF.

### B. Waterway Risk Condition - Navigation.

#### 1. WRF – Winds.

- a. Rapid wind shifts occur approximately once every five minutes. These shifts, although generally predictable, develop quickly and sometimes surprise mariners. The National Oceanic and Atmospheric Administration (NOAA) provides timely high-wind warnings, yet mariners need greater awareness and preparedness for these events. Operators must know their vessel limits and identify the nearest safe harbor in advance of sudden wind shifts.
- b. Winds significantly affect the maneuverability and navigational safety of vessels within the study area. The effects of wind are most severe inside Cleveland Harbor and lessen after vessels transit upriver past The Norfolk Southern Railroad Bridge, at Mile 0.76 (locally known as NS1). Vessels awaiting passage through NS1 are at a heightened risk because of persistent exposure to high winds at this location.

#### 2. WRF - Tides and Currents.

- a. Heavy rainfall causes strong currents which increase the volume of floating debris, such as logs, in the Cuyahoga River. This debris presents potential to damage the hulls, propulsion systems, and thrusters of vessels navigating the river.
- b. Rainfall events cause water levels and current speed fluctuations which reduce the maneuverability of large commercial vessels. Following major rainfalls, strong currents prevent large vessels from transiting upriver, causing a temporary halt in operations.

3. WRF – Visibility Restrictions.

- a. During the spring and fall, temperature differences between the lake and the air generate sea smoke and fog. This natural phenomenon reduces visibility and prevents larger vessels from detecting small human-powered crafts and recreational boats.

4. WRF – Bottom Type.

- a. The depth of the Cuyahoga River fluctuates due to seasonal precipitation. The U.S. Army Corps of Engineers (USACE) collects and archives real-time depth data within the Cuyahoga River but does not provide this information to mariners on a live and on-demand basis.
- b. Following major storm events, sediment accumulation in the upper Cuyahoga River, primarily in the vicinity of The Flats (which is the area where the Cuyahoga River and Old River meet), creates between 10 and 12 feet of infill and reduces the under-keel clearances of vessels navigating this portion of the river.
- c. The Cuyahoga River bottom contains obstructions and debris, including vehicles, pilings, steel, and shipwrecks. This debris creates hazardous conditions and increases the risk of vessel allisions and groundings. These conditions also contribute to localized shoaling at the mouth of the river.

C. Waterway Risk Condition - Vessel Quality and Operation.

1. WRF - Large Commercial Vessels.

- a. Movements and navigation of large commercial vessels disrupt port operations by blocking the Cuyahoga River, resulting in operational delays, standstills, and economic impacts. The confined configuration of the navigation channel exacerbates these events, because it is challenging to execute passing when another commercial vessel is disabled or experiencing delays.
- b. Due to the river's narrowness and limited maneuvering space, commercial vessels transiting the Cuyahoga River may temporarily restrict or block traffic, in the event the vessel has a material failure, arrives outside the scheduled transit windows, or experiences a weather-related limitation.
- c. There are limited options for staging or mooring vessels when unexpected delays or maneuverability issues occur. This highlights the need for improved planning and identification of alternative mooring locations to maintain safe and efficient port operations.
- d. The Port of Cleveland is one of the top ten busiest ports on the Great Lakes, supporting major industrial operations, including some of the region's largest steel mills. The port handles commodities such as aggregate, salt, steel, pipeline materials, and concrete. Most imported materials are transferred to trucks for

regional distribution. This high level of activity necessitates increased port oversight and coordination of vessel movements.

- e. Cruise ship traffic has increased in recent years. While the port accommodates these vessels effectively, the increase in cruise ship visits requires continued oversight and coordination to keep pace with industry growth.
  - f. Some foreign-flagged and domestic commercial vessel captains operating in the Great Lakes lack familiarity with local conditions, including weather patterns, obstructions, and Notice to Mariners (NTMs). This lack of local knowledge negatively affects navigation safety and port operations, causing delays, and interruptions.
  - g. Communication challenges stemming from language barriers between foreign vessel crews and local operators cause confusion and contribute to creating unsafe situations, particularly when vessels operate outside the buoy system without a pilot or during cargo transfer operations with limited translation support.
  - h. Differences in flag-state standards and training requirements create uncertainty about vessel reliability and crew proficiency. These factors collectively increase operational risk. Enhanced communication protocols, local familiarization efforts, and improved coordination with foreign vessels are necessary to ensure safe and efficient port operations.
2. WRF - Small Commercial Vessels.
- a. Small commercial vessel operators practice poor radio etiquette, resulting in excessive communication and interference on VHF channels used for port operations. Vessel operators fail to switch from VHF Channel 16 after hailing or use improper working channels, which creates confusion and reduces efficiency of communications.
  - b. Non-emergency VHF radio transmissions on channel 16 contribute to radio congestion and makes it difficult for small commercial vessels to clearly communicate with other traffic.
  - c. Small commercial vessels exhibit poor communication discipline. Sécurité calls from small passenger vessels, including water taxis, broadcast overtop of other communications, which hinders effective and safe port operations.
  - d. There is a growing shortage of qualified captains for vessels under 100 tons
  - e. There is an increase in observed unsafe operating practices among some small commercial vessels, including improper radio communication discipline and violations of the Navigation Rules.
  - f. A recent surge in small commercial vessel traffic, particularly near NS1, has caused congestion and interference with existing river activities. During bridge

closures, vessels maintain station on both sides of the bridge. When the bridge is opened chaotic vessel congestion can result due to an absence of a structured hierarchy to manage the flow of vessel traffic. Although the bridge operates on demand, higher volumes of traffic transiting through the bridge intensifies pressure on the current system. Despite these challenges, smaller vessels and bridge tenders effectively coordinate group transits to minimize disruption and improve efficiency during bridge openings.

- g. Small commercial passenger vessels operate inconsistent routes. These vessels are more difficult for crew teams to predict and maneuver around than larger commercial traffic. Small commercial vessel operators show limited awareness of paddle craft. Kayakers and paddlers have vocalized complaints regarding aggressive and unsafe interactions encountered with these vessels throughout the river.

### 3. WRF – Recreational Vessels

- a. Inadequate recreational boater education and knowledge enables hazardous boating behavior and contributed to an increase in search and rescue cases. Concerns specific to the recreational boater community include insufficient safety equipment (e.g., lack of radio or anchor), poor understanding of onboard gear, and lack of deference to weather conditions.
- b. Current regulations governing recreational vessel operation by private owners and renters are insufficient; individuals can purchase and operate vessels on the waterway with minimal or no training. In the state of Ohio, boaters born after 1981 are required to possess a boating license. Current state licensing training and testing requirements are inadequate and do not include evaluation of practical ship handling skills.
- c. The lack of law enforcement presence within the study area enables reckless boating, impaired operation, and sense of invincibility among recreational boaters. Impaired boating is an especially prevalent issue due to a limited maritime law enforcement presence within the study area. Increased law enforcement patrols and accountability measures at establishments serving alcohol or vessel mooring locations are necessary to stem impaired boating.
- d. Kayakers lack awareness of the dangers from operating near large commercial vessels. Kayakers have been observed navigating in between large vessels, entering propellor wash areas, attempting whitewater-style maneuvers in the vicinity of commercial traffic, and failing to stay on the starboard side of the Cuyahoga River.

#### D. Waterway Risk Condition - Traffic.

##### 1. WRF - Volume of Commercial Traffic.

- a. Commercial vessel traffic and docking for cargo transfers significantly restrict the navigable waterway. When vessels use the Marathon Petroleum Corporation transfer facility, the Cuyahoga River becomes blocked to all other large vessel traffic. Transfer operations serve vessels in order of arrival with no formal coordination. Vessel operators de-conflict operations through courtesy and ad-hoc communication. These closures have resulted in delays and financial losses amounting to thousands of dollars per hour.
- b. Aging infrastructure, including bridge bases, corroding pilings, and deteriorating bulkheads, pose navigational hazards to large commercial vessels. The overall condition of bridges and bulkheads is declining, with several bridge bases showing signs of rot and corrosion. These bridge bases are unlikely to withstand an allision. There are no current proactive measures to address or mitigate these effects on aging infrastructure. NS1, built in 1957, is one of the newer bridges and highlights the general concern regarding aging shoreside infrastructure in the study area.
- c. The Eagle Avenue Lift Bride is under the jurisdiction of the City of Cleveland and is approved and scheduled for removal. However, that the scope of the removal project does not include the bridge's bases and pilings. This is a recurring theme with other derelict structures along the river owned by both private parties and the City of Cleveland. The continued neglect of these structures raises concerns about the safe navigation of the waterway and the ultimate cost for managing these structures to maintain the navigability of the waterway.
- d. An increase in the volume of commercial vessels, container ships, and cruise ships contributes to congestion in the navigable channel and creates a growing demand for tugs to assist large commercial vessels with maneuvering due to capability and equipment limitations.

##### 2. WRF - Volume of Recreational Traffic.

- a. Poor communication and execution of marine events cause vessel traffic disruptions along the Cuyahoga River. There is a steady increase in weekend marine events that prompt waterway closures that interrupt their ability for commercial vessel operators to efficiently deliver cargo. Events such as the Annual Blazing Paddles Paddlefest and sailing regattas, trigger river closures. Event organizers misunderstand when activities constitute a river closure and when Coast Guard authorization is required to reopen the waterway. There is a need for clearer, real-time communication during marine events so vessels can safely transit through the areas without interfering with activities. Marine Safety Unit Cleveland is in the process of revising the marine event permit submission and approval process to minimize waterway closure periods and strengthen coordination with the Cleveland Harbor

Safety Committee and port partners to more effectively balance commercial and recreational demands on the waterway.

b. Land-based events, such as the annual Greater Cleveland Heart Walk, affect navigation by altering bridge lift schedules. During these types of events, bridge operators prioritize land-based crossings over vessel traffic and minimize bridge openings. These actions causes back-ups, delays, and vessel congestion throughout the waterway. However, bridge owners promptly post closures upon receiving approval from Coast Guard Great Lakes District.

c. Recreational vessel traffic on the Cuyahoga River follows a seasonal pattern from Memorial Day through Labor Day, with the highest volumes observed during weekends and holidays. Seasonal surges in recreational vessel traffic and human powered craft (HPC) impede navigation of large commercial vessels and exacerbate waterway congestion.

d. A 41-mile section of the Cuyahoga River that begins just north of the Gorge Dam in Summit County and extends to the river mouth in downtown Cleveland is designated as a National Water Trail by the U.S. Department of the Interior, which has led to an increase in HPCs and traffic density.

e. There is limited recreational vessel docking and launch infrastructure along the Cuyahoga River, which results in boaters waiting to access ramps or docks within active navigation areas. These vessels may cluster in the waterway while awaiting access, creating potential hazards to navigation. Participants also noted that plans were suspended to install an additional recreational boat launch near Collision Bend intended to alleviate congestion.

f. There is insufficient mooring infrastructure within safety zones, resulting in recreational boats and small commercial vessels congregating in the river while waiting to dock. Seasonal recreational traffic further exacerbates the limited pier and dock availability.

3. WRF - Waterway Use.

a. NS1 lift delays impede vessel transits and disrupt the flow commercial traffic. During the presence of adverse weather conditions, it is challenging for large vessels to maintain position while awaiting for the bridge to open. Bridge operators have improved in recent years; however, lift request responsiveness and reporting procedures continue to affect navigational safety and efficiency.

b. The Cuyahoga River is a multi-use waterway. Limited coordination between vessel operators drives congestion and elevates safety risks. The expansion of waterborne transportation services, including water taxis and passenger shuttles, serving shopping districts and sporting venues compounds traffic issues within an already congested area.

c. Autonomous surface and submersible vessels increasingly conduct activities such

as bottom surveys. Low draft and submersible vessels that are challenging to visually detect and operate near traffic lanes have resulted in near-miss incidents. The absence of standards governing autonomous vessel construction, visibility, and operational oversight challenge safe integration with existing vessel traffic.

d. There is a need for improved coordination among all waterway users. Recent efforts by local leaders and organizations, including Destination Cleveland, have promoted tourism growth and economic development along the waterfront. The absence of standardized procedures for scheduling and managing marine and shoreside events creates challenges for safe and efficient use on the Cuyahoga River. Recognizing the river's diverse commercial and recreational roles is essential to balancing safety with economic and community interests.

#### 4. WRF – Congestion

a. Recreational vessel traffic on the Cuyahoga River increases significantly during holidays, special events, and other high-activity periods, creating congestion and elevating the risk of marine casualties. In the event of an incident during these periods of congestion, emergency response may be further complicated by fragmented coordination and unclear agency responsibilities across sections of the river.

b. Future waterfront development projects, such as the Riverfront Cleveland project, cause an increase to vessel traffic and congestion along the Cuyahoga River.

c. Large recreational vessels rafting along the bulkhead, restrict maneuvering room for commercial vessels and tugs, and elevate the risk of collision. Effective management of this activity requires consistent enforcement of local and federal regulations, clear signage prohibiting rafting, and proactive traffic planning by local industry and port partners to maintain navigational safety amid increased waterfront use.

#### E. Waterway Risk Condition – Waterway.

##### 1. WRF – Dimensions.

a. The river's narrow dimensions and constant bends restrict large vessel movement to one-way traffic. However, two vessels can meet in the river if they plan accordingly and agree to meet near West 3<sup>rd</sup> Street. In these locations, primarily near West 3<sup>rd</sup> Street, there is sufficient width and depth for safe passing. In these areas, vessels typically do not pass underway simultaneously; instead, one vessel will tie up while the other transits.

- b. Recreational boaters limited local knowledge regarding the Cuyahoga River's dimensions, choke points, safe passing areas, and established safety zones undermine safe navigation in the waterway. The River's narrow width and frequent bends further complicate passing arrangements for recreational boaters who lack knowledge of vessel right-of-way responsibilities as determined by the Navigation Rules.
2. WRF – Obstructions.
- a. Remnants from the former Jefferson Avenue and Osbourne bridges remain in place under USACE approval following bridge removal. These structures receive no ongoing maintenance, and their continued deterioration introduces debris and obstructions that pose navigational hazards.
  - b. Seasonal ice and debris following heavy rains create significant hazards to navigation within the river. Debris such as deadheads, vehicles, and large objects (e.g., refrigerators) are frequently observed after storm events.
3. WRF – Visibility Impediments.
- a. Background lighting from restaurants, bars, clubs, fireworks, and waterfront events in The Flats, degrades visibility for vessels transiting at night. Vessels operating with light-emitting diode (LED) headlights and decorative lights add visual clutter that negatively impact mariners' situational awareness. The combination of background city lighting, and improper vessel lighting presents a notable safety concern for mariners while transiting.
  - b. Natural bends in the Cuyahoga River create blind turns that force operators to maneuver without clear visibility beyond each point. These bends heighten risk of collision and reduce vessel operators' ability to gauge oncoming traffic.
  - c. Vegetation growth around bridges and waterfront infrastructure obstructs sightlines to vessel navigation lights, degrades situational awareness, and elevates risk of collision.
4. WRF – Configuration.
- a. Bends in the Cuyahoga River generate localized, unpredictable currents that demand heightened awareness by vessel operators. Lack of mariner situational awareness of these currents elevates navigational risk throughout the river.
  - b. There is mooring infrastructure for recreational vessels located in safety zones established for transiting commercial vessels. Insufficient collaboration between city planners and waterways managers has resulted in conflicting waterway configurations that cause recreational mariners to inadvertently operate their vessels in these safety areas.

## Appendix D. Geospatial Participant Comments

Facilitators captured participant observations that made specific geographic references. Those observations were then transferred to an ArcGIS online web-application to generate chartlets reflecting the location and specific context of each comment. The chartlets, included below, are represented as Figures 1-4.

<b>Geospatial Comments</b>	
<b>Point</b>	<b>Comment</b>
1	Due to the lack of maintenance and ownership of the sand product dock in the Old River, shoaling has increased in that area and has diminished the actual depth in this position to less than the charted depth of 26 feet.
2	Inconsistent fulfillment of vessel requests to lift The Norfolk Southern Railroad Bridge, at Mile 0.76 (locally known as NS1) on demand increases the risk of vessel bridge allisions and collisions. Delays force vessels to hold a precarious position against wind and currents while navigating through small vessel traffic.
3	Heavy recreational vessel traffic in the summer causes waterway congestion near NS1 and the Historic Cleveland Coast Guard Station. Congestion obstructs the passage of large commercial vessels attempting to enter the Cuyahoga River.
4	Routine bridge operations in this position monopolize VHF Channel 16, which is a designated hailing and distress frequency, and interferes with search and rescue communications.
5	Wind in vicinity of the Historic Cleveland Coast Guard Station to Center Street Bridge predominantly impacts deep draft vessel traffic on the Cuyahoga River.
6	Background lighting from restaurants and waterfront businesses in this vicinity present a hazard to navigation to mariners at night by negatively impacting the ability to visually identify the navigation lights of other vessels.
7	Commercial maritime vessels have right of way over rail traffic; however, commercial vessels do not receive railway delay reports which impact bridge opening schedules.
8	Recreational boaters fail to report bridge issues in this location, compelling commercial vessels to report discrepancies on VHF Channel 16, further resulting in unnecessary radio traffic.
9	There are "Passing Zone" signs painted on bulkheads along river; however, there are limited passing areas between Superior Bend and Carter Bend. The practicality of passing within those zones is also dependent on weather and traffic conditions.
10	Increased volume of permitted marine events has increased the annual number of complete river closures to marine traffic. Closing the navigable waterway results in delayed delivery of raw material to the Port of Cleveland.
11	Vessels moored at commercial facilities in this position restrict other vessels from passing.
12	Vessels moored at commercial facilities in this position restrict other vessels from passing.
13	Remnants of the abandoned bridge south of the Hope Memorial Bridge increases the risk of vessel bridge allisions due to encroachment on the outer edges of the navigable channel.
14	Vessels moored at commercial facilities in this position restrict other vessels from passing.
15	Shoaling is developing at the Cliffs Upper Dock.

*Table 1 - Geospatial Comments.*



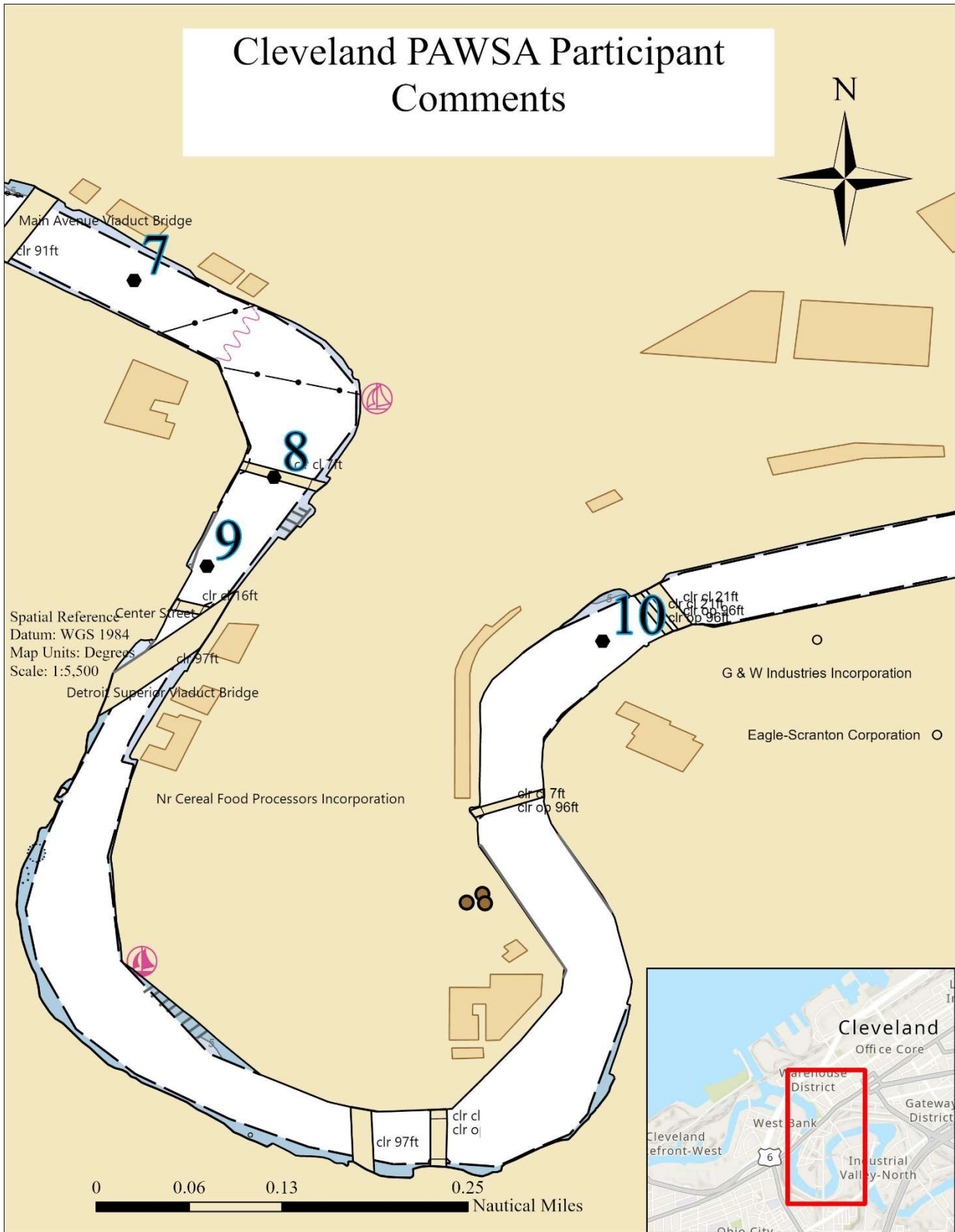


Figure 2 - Mapped location of geospatial participant comments 7-10.

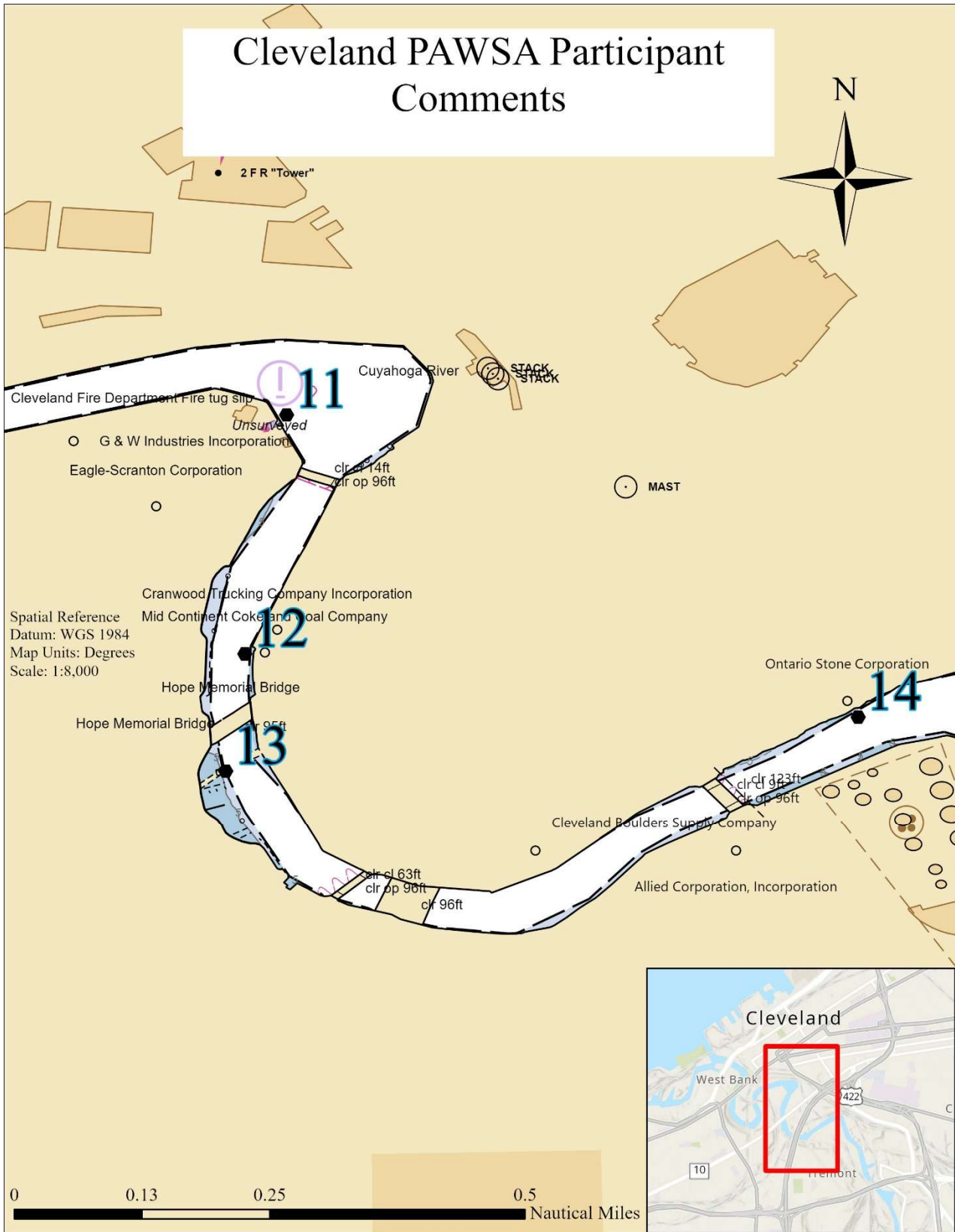


Figure 3 - Mapped location of geospatial participant comment 11-14.

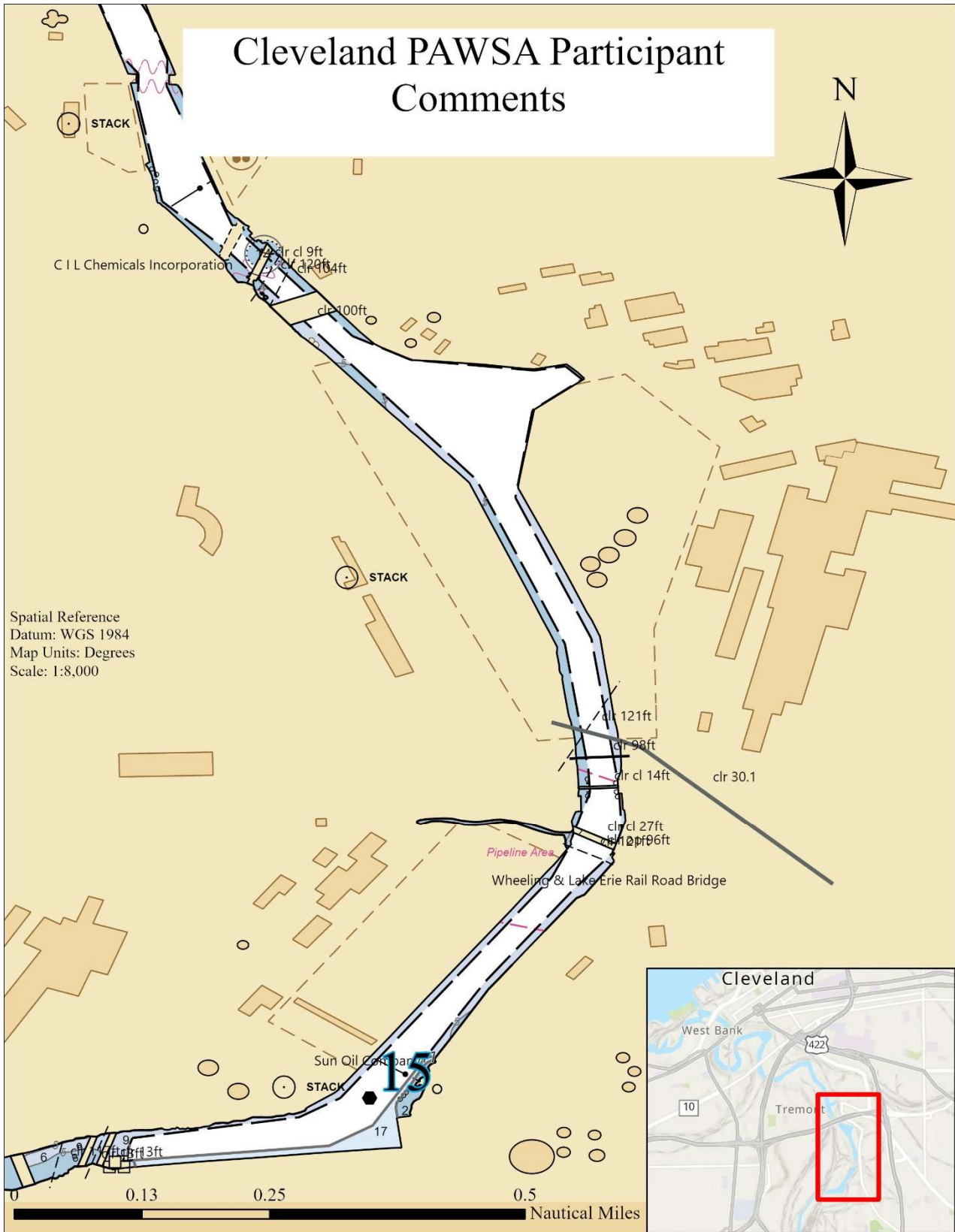


Figure 4 - Mapped location of geospatial participant comment 15.



## Appendix E. Risk Factor Issues

### A. Background

1. Following Day 1 workshop discussions, participants were asked to identify the most concerning issues for the highest prioritized and validated WRFs from the Risk Characterization survey. The following is a summary of the prioritized issues as selected by the participants. These issues are not listed in priority order and are also documented in Chapter 2.C preceding each mitigation strategy.

### B. Waterway Risk Condition - Navigation

#### 1. WRF – Winds

- a. Issue 1: Rapid changes in wind speed and direction occur without sufficient prediction for mariners.
- b. Issue 2: Highspeed winds create maneuverability and navigation safety risks that may result in damage to vessels and docks.
- c. Issue 3: Wind speed impacts port operations, including crane operations, bridge lifts, railway operations, and recreational boating activities.

#### 2. WRF – Currents and Tides

- a. Issue 1: Heavy precipitation events increase the speed and volume of water current within the study area and introduce debris into the waterway that present navigational hazards to mariners.
- b. Issue 2: Volume and current speed of increased water levels following heavy precipitation events decrease the maneuverability of vessels within the river.
- c. Issue 3: Seiches and rainfall are contributory factors that drive water levels, which impact the current speed and volume of water in the Port of Cleveland and Cuyahoga River study area.

#### 3. WRF – Visibility Restrictions

- a. Issue 1: Natural weather phenomena including sea smoke, fog, snow, and rain decrease visibility within the port and pose hazards to navigation.
- b. Issue 2: Adverse weather resulting in rough sea states obscure small vessels and increases the risk of collision.

#### 4. WRF – Bottom Type

- a. Issue 1: The depth of the Cuyahoga River consistently fluctuates. Real-time depth soundings to augment charted depths are unavailable as a digital download for vessel navigation systems.
- b. Issue 2: Shoaling occurs near industrial facilities because of rapid mud and sand buildup and poses additional challenges to dredge maintenance operators when they are attempting to navigate safely in and around the facilities to conduct operations.
- c. Issue 3: The bottom type within the study area contains obstructions and debris that create risks of vessel groundings.

C. Waterway Risk Condition – Vessel Quality and Operation

1. WRF – Large Commercial Vessels

- a. Issue 1: Movements and navigation of large commercial vessels block the entirety of the Cuyahoga River and disrupt port operations by causing delays and standstills which result in economic losses.
- b. Issue 2: Language barriers when communicating with foreign commercial vessel crews cause challenges that result in navigational conflicts, delays, and disruptions to port operations.
- c. Issue 3: Foreign commercial vessels or commercial vessels that do not frequent the Great Lakes lack local knowledge of the waterway including weather patterns, uncharted obstructions, or information published in the Local Notice to Mariners, which collectively increases operational risk.

2. WRF – Small Commercial Vessels

- a. Issue 1: Some small commercial vessels practice poor radio etiquette which results in miscommunication, impedes port operations, and further exacerbates traffic-related issues.
- b. Issue 2: There is a sustained demand for qualified captains that has created a shortage of experienced operators. As a result, some small commercial vessels may be operated by individuals with limited training or experience, increasing the potential for operational errors and safety concerns within the study area.
- c. Issue 3: Recent increases in the volume of small commercial vessels exceeds the availability of existing mooring locations within the study area.

3. WRF – Recreational Vessels

- a. Issue 1: Lack of knowledge and inadequate education of recreational boaters contribute to increased hazardous activity within the waterway.
- b. Issue 2: The lack of law enforcement presence within the study area enables unsafe boating behaviors, to include impaired operation and a sense of invincibility among recreational boaters.
- c. Issue 3: There is a variability in recreational boater knowledge of required safety equipment and prudent operating practices, which elevate risk during congested or close-quarters situations within the study area.

D. Waterway Risk Condition – Traffic

1. WRF – Volume of Commercial Traffic

- a. Issue 1: Commercial vessel traffic and docking for cargo transfers at the Marathon Petroleum Corporation transfer facility significantly restrict the navigable waterway.
- b. Issue 2: Aged infrastructure, including bridge bases, corroding pilings, and deteriorating bulkheads, poses navigational hazards to large commercial vessels.
- c. Issue 3: The growing volume of commercial vessels, container ships, and cruise ships transiting in the Cuyahoga River causes increased congestion the navigable channel.

2. WRF – Volume of Recreational Traffic

- a. Issue 1: Inconsistent execution and poor communication during marine events disrupt vessel navigation along the Cuyahoga River.
- b. Issue 2: Recreational vessel traffic on the Cuyahoga River peaks on weekends and holidays, causing surges in vessel traffic that impede the navigation of large vessels.
- c. Issue 3: Docking management along the Cuyahoga River lacks adequate coordination and infrastructure, including sufficient recreational vessel docking and launch facilities.

3. WRF – Waterway Use

- a. Issue 1: Delays in lifting The Norfolk Southern Railroad Bridge, at Mile 0.76 (locally known as NS1) impede vessel transits, disrupt commercial traffic flow, and strain vessel control for large vessels required to hold position to wait for the bridge to open during adverse weather conditions.

- b. Issue 2: Coordination among different vessel types on the multi-use Cuyahoga River is poor, and docking availability is insufficient.
  - c. Issue 3: A lack of regulation and management for autonomous vessels creates navigational hazards.
4. WRF – Congestion
- a. Issue 1: Recreational vessel traffic surges during and after holidays and special events, creating congestion and elevating the risk of marine casualties.
  - b. Issue 2: NS1 lift delays consistently and frequently cause waterway congestion.
  - c. Issue 3: Waterfront development projects, including the Riverfront Cleveland project, increase waterway traffic which introduces additional congestion to the waterway.
- E. Waterway Risk Condition – Waterway
1. WRF – Dimensions
- a. Issue 1: The Cuyahoga River’s narrow channel and continuous bends restrict large vessel movement to one-way traffic, limiting maneuvering space and increasing the potential for close-quarters situations. The absence of designated passing zones further reduces opportunities for vessels to safely coordinate opposing or overtaking traffic.
  - b. Issue 2: Limited recreational mariner local knowledge and education about the Cuyahoga River’s dimensions, choke points, safe passing areas, and established security zones undermine safe navigation.
2. WRF – Obstructions
- a. Issue 1: Derelict piers up and down the Cuyahoga River present hazards to navigation.
  - b. Issue 2: Remnants of the former Jefferson Avenue and Osbourne bridges present hazards to navigation.
  - c. Issue 3: Seasonal ice storm-driven debris create navigational hazards in the Cuyahoga River.
3. Visibility Impediments
- a. Issue 1: Background lighting from restaurants, bars, clubs, fireworks, waterfront events degrades visibility for vessels transiting at night.

- b. Issue 2: The Cuyahoga River's bends produce blind turns that force operators to maneuver without clear visibility beyond each point.
  - c. Issue 3: Vegetation growth around bridges and waterfront infrastructure obstructs sightlines to vessel navigation lights, degrades situational awareness, and elevates risk of collision.
4. WRF – Configuration
- a. Issue 1: Bends in the Cuyahoga River generate localized, unpredictable currents that demand heightened awareness by vessel operators.
  - b. Issue 2: In certain sections of the Cuyahoga River, the visual overlap of Aids to Navigation lighting and day boards creates confusion among vessel operators.
  - c. Issue 3: Mooring infrastructure for recreational vessels exists within established safety zones of transiting commercial vessels.

## Appendix F. National and Local Event and Consequence Data

**A. National and Local Event and Consequence Data.** As referenced in Chapter 1 Section B.2.b.(1)(c), the following section displays the tables and definitions for event types included in the handout provided to stakeholders prior to conducting the FQRA. The model uses national and local Coast Guard MISLE data that are updated as appropriate. The national event data in Table 1 contains information through September 2025. Table 2 and 3 contain the local event data for Marine Safety Unit (MSU) Cleveland that was derived prior to the workshop.

1. Event Types. During the FQRA process on the second day of the PAWSA, participants complete Event Forms that are pre-populated with issues validated during the first day of the PAWSA to enable RIN value calculations. An example of an event form completed by participants for this workshop is included below as Figure 1.

<b>PAWSA Location:</b> Cleveland	<b>Risk Factor:</b> Recreational Vessel Quality	
<b>Team Number:</b> 2		
Issue	Event	Frequency
There is a lack of knowledge and inadequate education for recreational boaters which leads to hazardous boating activity within the waterway.	Allision	Frequent
	Collision	Frequent
	Grounding	Frequent
	Sinking	Frequent
There is a lack of enforcement within the waterway leaving recreational boating habits such as negative attitudes, invincibility, and inebriation while operating, unaddressed.	Allision	Frequent
	Collision	Probable
	Grounding	Frequent
	Sinking	Probable
Recreational boaters lack equipment or equipment knowledge, increasing the risk of hazardous and unsafe situations requiring Search and Rescue (SAR) response.	Grounding	Probable
	Sinking	Frequent
	Fire/Explosion	Frequent
Populated by PAWSA facilitators based on Day 1	Completed by Participants on Day 2	

*Figure 1 – Example event form from the Cleveland PAWSA.*

2. For each issue listed, participants select up to three event types that may occur due to the associated issue. For example, if "Groundings throughout the study area can cause the waterway to shut down for an extensive amount of time," then allision, grounding, or traffic restricted are examples of three event types a participant may select that could occur because of this issue. Definitions for the nine event types available during the FQRA are provided below:

- i. **Allision:** Vessel runs into stationary structure.
- ii. **Collision:** Vessel runs into another vessel.

- iii. **Fire/Explosion:** Fire or explosion.
- iv. **Grounding:** Vessel draft exceeds water depth.
- v. **HAZMAT Release:** Hazardous Material container breached or no longer working as designed (tank, package, pipe, etc.)
- vi. **Infrastructure Failure:** Infrastructure stops working or damaged from non-vessel source.
- vii. **Oil Spill:** Oil container breached or no longer working as designed (tank, pipe, etc.)
- viii. **Sinking:** Vessel stops floating as designed. Capsizing is a sub-type of sinking.
- ix. **Traffic Restricted:** Traffic not flowing normally; NOT from any event listed.

3. National Events. Table 3 provides data capturing the record of the yearly average of national events used in the FQRA process.

National Events		
Event	Total Events	Yearly Avg
Allision	11,179	429.96
Collision	3,118	119.92
Fire/Explosion	2,442	93.92
Grounding	14,794	569.00
Oil Spill	77,603	2,984.73
Sinking	4,457	171.42
Traffic Restricted	6,816	262.15
<b>Total</b>	<b>120,409</b>	<b>4,631.12</b>

*Table 1 – Total and yearly average of national events.*

4. Local Events. The data capturing the record of local events used in the FQRA process is specific to the port for the PAWSA. Table 2 and 3 provide the local event and consequence data provided to stakeholders prior to conducting the FQRA for the MSU Cleveland PAWSA workshop.

Local Events		
Event	Total Events	Yearly Avg
Allision	56	2.2
Collision	12	0.5
Fire/Explosion	5	0.2
Grounding	29	1.1
Oil Spill	410	15.8
Sinking	24	0.9
Traffic Restricted	6	0.2
<b>Total</b>	<b>542</b>	<b>20.8</b>

Table 2 – Total and yearly average of local events for the Cleveland PAWSA workshop study area.

Local Event Consequences							
Type	Allision	Collision	Fire/Explosion	Grounding	Oil Spill	Sinking	Traffic Restricted
<b>Economic</b>							
Ec0	Probable	Occasional	Occasional	Probable	Frequent	Probable	
Ec1	Probable	Occasional	Occasional	Occasional	Occasional	Occasional	Occasional
Ec2	Occasional			Occasional			
Ec3	Occasional			Occasional			
<b>Environmental</b>							
En0	Frequent	Occasional	Occasional	Probable	Frequent	Probable	
En1	Rare	Rare	Rare		Frequent	Occasional	
En2	Rare				Occasional		
<b>Safety</b>							
Sa0	Frequent	Occasional	Occasional	Probable	Frequent	Probable	
Sa1	Occasional	Rare					
Sa2		Rare					

Table 3 – Local event consequences and likelihood for the Cleveland PAWSA workshop study area.