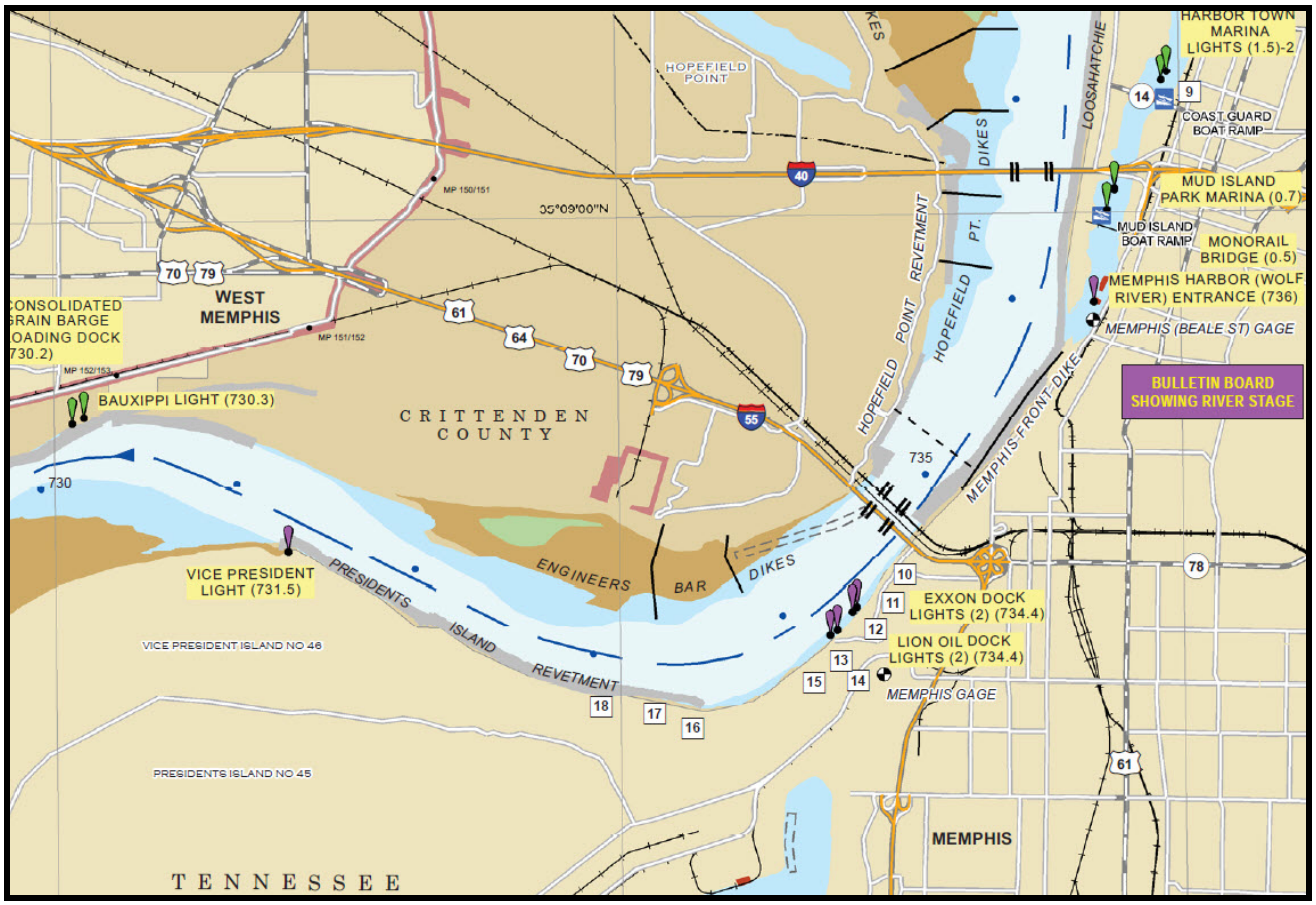
Ports and Waterways Safety Assessment

Workshop Report

Memphis, Tennessee



United States Coast Guard
Marine Transportation Systems Directorate

Providing Navigation Safety Information
for America's Waterways Users

Background

The United States Coast Guard (USCG), Marine Transportation System Directorate, is responsible for developing and implementing policies and procedures that facilitate commerce, improve safety and efficiency, and inspire dialogue with port and waterways users with the goal of making waterways as safe, efficient, and commercially viable as possible.

Through the 1997 Coast Guard Appropriations Act, the Coast Guard was directed to establish a process to identify minimum user requirements for new Vessel Traffic Service (VTS) systems in consultation with local officials, waterways users and port authorities, and also to review private / public partnership opportunities in VTS operations. The Coast Guard convened a National Dialogue Group (NDG) comprised of maritime and waterway community stakeholders to identify the needs of waterway users with respect to Vessel Traffic Management (VTM) and VTS systems. The NDG was intended to provide the foundation for the development of an approach to VTM that would meet the shared government, industry, and public objective of ensuring the safety of vessel traffic in U.S. ports and waterways, in a technologically sound and cost effective way.

From the NDG came the development of the ***Ports and Waterways Safety Assessment (PAWSA) Waterways Risk Model,*** and the ***PAWSA workshop process***. PAWSA is a disciplined approach designed to identify major waterway safety hazards, estimate risk levels, evaluate potential mitigation measures, and set the stage for the implementation of selected risk reduction strategies. The process involves convening a select group of waterway users and stakeholders and facilitating a structured workshop agenda to meet the risk assessment objectives. A successful workshop requires the participation of professional waterway users with local expertise in navigation, waterway conditions, and port safety. In addition, stakeholders are included in the process to ensure that important environmental, public safety, and economic consequences are given appropriate attention as risk interventions are identified and evaluated.

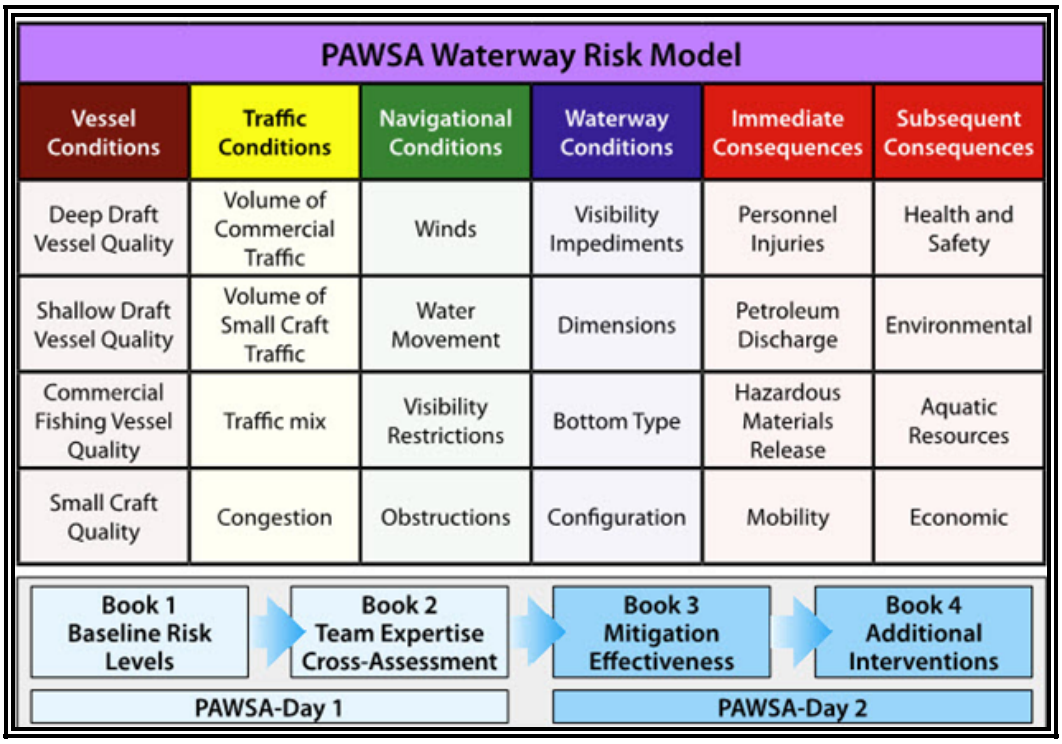
The long-term goals of the PAWSA process are to:

1) Provide input when planning for projects to improve the safety of navigation,
2) Further the Marine Transportation System (MTS) goals of improved coordination and cooperation between government and the private sector, and involving stakeholders in decisions affecting them,
3) Foster development and/or strengthen the roles of Harbor Safety Committees within each port, and
4) Support and reinforce the role of Coast Guard Sector Commanders/Captains of the Port (COTP) in promoting waterway and vessel traffic management activities within their geographic areas of responsibility.

56 ports/waterways have been assessed using the PAWSA process. The risk assessment process represents a significant part of joint public-private sector planning for mitigating risk in waterways. When applied consistently and uniformly in a number of waterways, the process is expected to provide a basis for making best value decisions for risk mitigation investments, both on the local and national level. The goal is to find solutions that are cost effective and meet the needs of waterway users and stakeholders.

PAWSA Waterway Risk Model and Workshop process

The PAWSA Waterway Risk Model includes variables dealing with both the causes of waterway casualties and their consequences. In the Waterway Risk Model, risk is defined as a function of the probability of a casualty and its consequences. The risk model includes variables associated with both the causes and effects of vessel casualties. The diagram below shows the six general risk categories, and corresponding risk factors, that make up the Waterway Risk Model.



- ***Vessel Conditions*** – The quality of vessels and their crews that operate on a waterway.
- ***Traffic Conditions*** – The number of vessels that use a waterway and how they interact with each other.
- ***Navigational Conditions*** – The environmental conditions that vessels must deal with in a waterway.
- ***Waterway Conditions –*** The physical properties of the waterway that affects vessel maneuverability.
- ***Immediate Consequences*** – The instantaneous impacts to the port as a result of a vessel casualty.
- ***Subsequent Consequences*** – The longer-term impacts felt days, months, and even years afterwards.

Workshop activities include a series of discussions about the port/waterway attributes and the vessels that use the waterway, followed by completion of survey books to establish baseline risk levels, evaluate the effectiveness of existing risk mitigations, and identify additional risk intervention strategies to further reduce risk in the port / waterway. Survey book 1 is used to numerically evaluate the baseline risk levels using pre-defined qualitative risk descriptions for pre-defined risk factors. Survey book 2 is used to assess the expertise of each other with respect to the risk categories in the model. Those expertise assessments are used to weight inputs obtained during the other steps in the workshop process. Survey book 3 is used to evaluate how effective the mitigation strategies are at reducing risks, and to determine if the risks are well balanced or not. For those risk factors where risk is judged to be not well balanced by existing mitigations, participants use survey book 4 to identify additional risk intervention strategies and then evaluate how effective those new strategies could be at reducing risks.

Executive Summary

A PAWSA workshop for the Lower Mississippi River, from mile markers 725 to 795, was held in Memphis, Tennessee on 1-2 August, 2017. The workshop was attended by 13 participants, representing waterway users, regulatory authorities and stakeholders with an interest in the safe and efficient use of the Mississippi River from both a commercial and recreational perspective. Over the course of the 2-day workshop, participants discussed and evaluated each of the 24 risk factor that make up the Waterways Risk Model.

Participants discussed the challenges commercial vessels encounter when navigating the Mississippi River. For each of the 24 risk factors evaluated, participants discussed and then numerically evaluated the baseline risk levels using pre-defined qualitative risk descriptions for each risk factor. Participants then discussed existing risk mitigation strategies, evaluated how effective the mitigation strategies were at reducing risk, and then determined if the risks are well balanced. Because no deep draft commercial vessels operate in the assessment area, the Deep Draft Vessel Quality risk factor was changed to Barge Quality.

For 21 of the 24 risk factors evaluated, there was consensus (defined as 2/3 of the workshop participant teams being in agreement) that risks were well balanced by existing mitigations.

For 1 risk factor (Small Craft Quality) there was consensus that risks were NOT well balanced by existing mitigations.

For 2 risk factors (Heath and Safety and Economic) there was no consensus among the participants that risks were well balanced by existing mitigations.

For the three risk factors not balanced by existing mitigations, the participants engaged in further discussions to identify additional risk intervention strategies, and then evaluated how effective those new strategies could be at reducing risk.

To further reduce risks relating to Small Craft Quality, the participants recommended more active enforcement of existing rules and regulations, compliance with the navigation Rules of the Road, vessel inspection regulations, and industry accepted standards of care.

To further reduce risks relating to Health and Safety, and Economics, the participants recommended improved long-ranged contingency planning and better coordinated activities and dialogue between port stakeholders.

The results of the baseline risk level survey, existing risk mitigation strategies, and additional risk intervention strategies, and participant comments and observations are outlined in Appendix B of this report.

Conclusion

The goal of a PAWSA workshop is not only to further the Marine Transportation System objective of improved coordination and cooperation between government and the private sector, and involving stakeholders in decisions affecting them, but to provide the Coast Guard Sector Commanders and members of the waterway community with an effective tool to evaluate risk and work toward long term solutions tailored to local circumstances. The goal is to find solutions that are both cost effective and meet the needs of waterway users and stakeholders. In support of this goal, this report should be viewed as a starting point for continuing dialogue within the Lower Mississippi River maritime community.

The United States Coast Guard, Marine Transportation System Directorate, extends a sincere appreciation to the workshop participants for their contributions to the Memphis PAWSA workshop. Their expertise was critical to the success of the workshop, and their recommendations will greatly assist the Coast Guard as it continues to work with the maritime community to further improve navigational safety and efficiency.

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Section 1: Memphis PAWSA - Assessment Area

Figure 2: The area assessed encompassed the Mississippi River from mile marker 725 to 795.

Section 2: Baseline Risk Levels

The first step in the workshop was the completion of survey book 1 to determine a baseline risk level value for each risk factor in the Waterway Risk Model. To establish the baseline risks level, participants discussed each of risk 24 applicable factors in the Waterways Risk Mode and selected a qualitative description for each risk factor that best described the conditions in the ort. These qualitative descriptions were converted to discrete values using numerical scales that were developed during earlier PAWSA workshops.

On those scales, 1.0 represents low risk (best case) and 9.0 represents high risk (worst case), with 5.0 being the mid-risk value. Figure 3 below shows that 7 of 24 risk factors were scored at or above the mid-risk value. Risk values highlighted in red (values at or above 7.7) denote very high baseline risk levels; risk values highlighted in green (values at or below 2.3) denote very low baseline risk levels

Figure 3

Baseline Risk Levels					
Vessel Conditions	**Traffic Conditions**	**Navigational Conditions**	**Waterway Conditions**	**Immediate Consequences**	**Subsequent Consequences**
Barge Quality	Volume of Commercial Traffic	Winds	Visibility Impediments	Personnel Injuries	Health and Safety
5.7	3.9	2.1	5.2	6.5	8.8
Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
5.2	1.0	7.2	4.9	4.0	3.6
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
7.5	2.7	2.8	4.7	3.9	2.2
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic
9.0	3.1	4.6	5.1	8.0	8.8

As the participants discussed trends and observations for each of the 24 risk factors, their comments and observations were documented for inclusion in this workshop report. Appendix B is a summary of participant comments, existing risk mitigations, and recommended additional risk mitigation strategies for those risk factors not balanced by existing mitigations.

Section 3: Team Expertise Cross-assessment

The next second step in the workshop was the completion of a team expertise cross-assessment. The team expertise cross-assessment was conducted early in the workshop process and was used to weigh the relative strengths of each team with respect to the six risk categories. The results of the team expertise cross-assessments were used to weight the inputs that each team provided in the other workbooks completed during the workshop.

After being presented with the concepts underlying the model, each participant team was asked to discuss (among themselves) how their background and experience aligns with the model. They then verbally presented their conclusions to the other teams. These presentations gave all teams a sense of where everyone thought they were strong – or perhaps not so strong. After all teams had spoken, each team then evaluated whether they were in the top, middle, or lower third of all teams present with respect to knowledge and expertise in the six risk category areas.

The participants assessed their own and all the other participant teams' level of expertise for each of the six categories in the Waterway Risk Model. Overall, 39% of the participant teams were placed in the upper third, 37% in the middle third, and 24% in the lower third of all teams.

Appendix A is a list of the PAWSA workshop participants and the workshop facilitation team.

The below table further breaks down the participants' expertise for each risk category.

Figure 4

Team Expertise -- Distribution

Risk Category	Top 1/3	Mid 1/3	Lower 1/3
Vessel Conditions	41%	32%	27%
Traffic Conditions	44%	35%	21%
Navigational Conditions	44%	36%	20%
Waterway Conditions	46%	36%	19%
Immediate Consequences	31%	51%	19%
Subsequent Consequences	27%	35%	38%
All Categories Average	39%	37%	24%

Section 4: Existing Risk Mitigations

The third step in the workshop was for participants to evaluate the effectiveness of existing mitigation strategies in reducing the risk level for each risk factor. Participants discuss existing risk mitigations for all risk factors in the model, and then evaluated how effective they though the mitigations were at reducing risks.

For 21 risk factors (green), there was consensus that risks were well balanced by existing mitigations.

For 1 risk factor (red, there was consensus that risks were not balanced by existing mitigations.

For 2 risk factors (yellow), there was no consensus that risks were well balanced by existing mitigations.

Consensus is defined as 2/3 of the workshop participant teams being in agreement.

Figure 5

Mitigation Effectiveness												
Vessel Conditions		Traffic Conditions		Navigational Conditions		Waterway Conditions		Immediate Consequences		Subsequent Consequences	
Barge Quality		Volume of Commercial Traffic		Winds		Visibility Impediments		Personnel Injuries		Health and Safety	
5.7	3.3	3.9	3.1	2.1	2.5	5.2	4.2	6.5	5.3	8.8	7.6
Balanced		Balanced		Balanced		Balanced		Balanced		Maybe	
Shallow Draft Vessel Quality		Volume of Small Craft Traffic		Water Movement		Dimensions		Petroleum Discharge		Environmental	
5.2	3.1	1.0	1.0	7.2	5.3	4.9	4.1	4.0	3.8	3.6	4.3
Balanced		Balanced		Balanced		Balanced		Balanced		Balanced	
Commercial Fishing Vessel Quality		Traffic Mix		Visibility Restrictions		Bottom Type		Hazardous Materials Release		Aquatic Resources	
7.5	5.0	2.7	2.2	2.8	3.0	4.7	3.4	3.9	4.7	2.2	2.6
Balanced		Balanced		Balanced		Balanced		Balanced		Balanced	
Small Craft Quality		Congestion		Obstructions		Configuration		Mobility		Economic	
9.0	7.5	3.1	2.5	4.6	4.2	5.1	3.5	8.0	7.2	8.8	8.0
NO		Balanced		Balanced		Balanced		Balanced		Maybe	

Risk Factor	
Book 1 Score	Book 3 Score
Consensus Reached ?	

	EXPLANATION
Book 1	Baseline risk level
Book 3	Level of risk taking into account existing mitigations
Balanced	Consensus that risks are well balanced by existing mitigations
Maybe	No Consensus that risks are well balanced by existing mitigations
Not Balanced	Consensus that existing mitigations do NOT adequately balance risk

Section 5: Additional Risk Intervention Strategies

The workshop participants finally completed survey book 4 for those for those risk factors that were still not balanced by existing mitigations. Participants suggested additional risk intervention strategies to further reduce risk, and then evaluated how successfully a proposed risk intervention strategy could be at lowering risk levels for each these risk factors. Appendix C is a description of each risk intervention general strategy.

The table below shows the expected reduction in risk when taking the actions specified by the participants.

Figure 6

Additional Interventions					
Vessel Conditions	**Traffic Conditions**	**Navigational Conditions**	**Waterway Conditions**	**Immediate Consequences**	**Subsequent Consequences**
Barge Quality	Volume of Commercial Traffic	Winds	Visibility Impediments	Personnel Injuries	Health and Safety
Balanced	Balanced	Balanced	Balanced	Balanced	Coordination / Planning
					7.4
Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
Balanced	Balanced	Balanced	Balanced	Balanced	Balanced
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
Balanced	Balanced	Balanced	Balanced	Balanced	Balanced
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic
Enforcement	Balanced	Balanced	Balanced	Balanced	Coordination / Planning
6.9					7.8

Risk Factor
Intervention Category
Risk Improvement

	EXPLANATION
Intervention Category	Intervention general strategy that most participants selected for furthur risk mitigation actions.
Risk Improvement	The amount that present risk levels might be reduced if new mitigation measures were implemented

Caution – No Consensus Alert

When Caution is displayed, an intervention strategy other than the one displayed was judged to provide more risk reduction than the one displayed. This is an indicator that the teams were divided in their opinions about what actions should be taken to further reduce risk for that factor. It indicates there is a possibility of more than "one" best mitigation measure to achieve further risk reduction!

Appendix A Participants

Stephen Banet	Wepfer Marine
Sean Riley	Southern Towing
Pete Ciaramitaro	Southern Towing
Frank Johnson	Ingram Barge
BMC John Tatroe	Coast Guard Sector Lower Mississippi River - Enforcement
BOZN4 Tim Guy	Coast Guard Cutter Kankakee
Eric Washburn	Coast Guard District Eight - Bridge Management
David Delich	Coast Guard Auxiliary
Mike Armour	Coast Guard Auxiliary
LT Ryan Thomas	Coast Guard Sector Lower Mississippi River – Waterways Mgmt
BOZN2 Bryan Hoffman	Coast Guard Sector Lower Mississippi River – Waterways Mgmt
Evaene Jones	Tennessee Emergency Management/Homeland Security
Mike Brazell	Tennessee Emergency Management/Homeland Security

Facilitation team

LCDR Jamie Rickerson – facilitator	LTJG Curtis Hayes
BOZN2 Kris Franklin	Mr. Burt Lahn

Appendix B – Memphis PAWSA

Participant Observations, Existing Risk Mitigations and Additional Risk Mitigation Strategies

Barge Quality

Trends / Observations:

(For the purposes of the Memphis workshop, "Deep Draft Vessel" category was replaced with "Barge Quality")

- The majority of barges that transport cargo through the assessment area are uninspected and do not carry hazardous materials.
- The average age at which an uninspected barge is scrapped is approximately 25 years.
- Those barges that carry hazardous materials and certain dangerous cargoes are very heavily regulated and inspected by the Coast Guard on an annual basis.
- The overall quality of the inspected barges is very good, with the quality of construction on new barges increasing as the demand has decreased.

Existing Mitigations:

- Annual Coast Guard inspections for inspected barges.
- Fairly large number of new barges constructed each year allows towing vessel owners and operators to be more proactive in scrapping older, damage prone barges without major impacts to barge fleet numbers or cargo moving capabilities.
- River Industry Executive Task Force (RIETF) provides towing vessel owners and operators with a forum for voicing industry concerns and proving safety recommendations.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Shallow Draft Vessel Quality

Trends / Observations:

- Shallow draft vessel community discussions included the quality of a few large passenger vessels that utilize Memphis as an embarkation/debarkation port, but this category of vessels was mostly made up of the towing vessel industry.
- The majority (70%) of towing vessels are of high quality, and all of them are US flagged and manned. Poorer quality towing vessels are attributed to outlying companies with home base operations outside of the Mississippi River system (Gulf of Mexico ports).
- Pilots who operate the towing vessels are very experienced. However during slow or poor economic periods, the quality of vessels decreases as some operators take maintenance short cuts to reduce costs and increase profits.
- Harbor tugs operating in the area tend to be used the most, but they are maintained to a lesser standard that towing vessels operating on the river system.

Existing Mitigations:

- Very experienced Pilots (average age between 50-60 years old, with 35 plus years river operating experience).
- The towing vessel industry is managing their pilot recruitment and training programs in order to ensure a sufficient pool of experienced mariners/river pilots are available.
- Good bridge to bridge communications.
- American Waterways Operators (AWO) Responsible Carrier Program.
- Ship Inspection Report Program (SIRE) developed by industry adds another layer of safety to existing Coast Guard inspection requirements.
- Sub Chapter M inspection requirements for towing vessels.

- Sub Chapter T, K, and H inspection requirements for passenger vessels.
- Automatic Identification System (AIS) carriage requirements improve situational awareness.
- Information sharing, best practices, and networking at the annual Inland Waterways Conference.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Commercial Fishing Vessel Quality

Trends / Observations:

- There is not a large presence of commercial fishing vessels operating in the assessment area.
- A few small jon boat operators are exploring the feasibility of commercially fishing for Asian carp in the shallower waters.
- Most fishing vessel operators fish in shallow areas north of Memphis.
- No significant conflicts between towing vessels, fishing vessels, and small craft.

Existing Mitigations:

- Common practice for fishing vessel operators to fish in areas outside of the main river channels, which reduce conflicts with the tug/barge operations.
- Fishing vessel operations are regulated by the state.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Small Craft Quality

Trends / Observations:

- There continues to be a lack of knowledge regarding boating safety and obligations required by the Inland Navigation Rules.
- There are safety concerns with regards to small craft quality and operations; there is lack of an understanding of Rules of the Road, traffic awareness, and dangers when operating in close proximity to the larger up bound/down bound tows.
- Many small craft do not have VHF FM radios, which increases risk of collisions with commercial vessels.
- Paddle boarders and kayakers infrequently operate in the main river channel, but they do operate in the shallow waters and inside the Mudd Island channel in Memphis.

Existing Mitigations:

- Free vessel safety checks by the US Power Squadron and the Coast Guard Auxiliary.
- Free boating safety classes the US Power Squadron and the Coast Guard Auxiliary.
- Tennessee ha mandatory small boat training requirements (for boaters, not kayakers or paddleboards).

New Mitigations:

- More actively enforce existing rules, regulations and policies, such as compliance with the navigation rules and vessel inspection regulations, to ensure safety equipment required under Subchapter C is carried and in a useable condition.

Volume of Commercial Traffic

Trends / Observations:

- Grain exports are all seasonal starting in late summer extending into late fall; fertilizer shipments are predominant in the winter and early summer months.
- Fleeting areas are adequate for the barge traffic transiting the assessment area.

- There is a downward trend in the shipment of petroleum products.
- Tennessee Valley Authority (TVA) power plant now uses natural gas as the fuel supply; no longer using coal.
- The participants referenced an economic study by PricewaterhouseCoopers titled "Economic Contribution of the U.S. Tugboat, Towboat and Barge Industry". The study was developed through a cooperative agreement between American Waterways Operators and the Maritime Administration (MARAD) and outlines the industry's economic contributions to employment, gross domestic product, and taxes at the national and state levels. The study details the types and quantities of vital commodities transported on American waterways; and compares waterborne transport to other modes of freight transport in terms of efficiency, environmental impact and public safety. Highlights from the study include:
    - **Jobs and GDP.** The tugboat, towboat and barge industry supports over 300,000 jobs nationwide – including 50,000 in the industry itself, 38,000 of which are on board vessels – and has a total annual impact on GDP of $33.8 billion.
    - **Cargo moved.** The industry annually moves more than 760 million tons of cargo that fuels the American economy, including critical commodities like petroleum, agricultural products, chemicals, coal, and manufactured goods.
    - **Efficiency and environmental benefit.** One inland dry cargo barge can haul 1,750 tons of dry cargo, the equivalent of 16 bulk rail cars or 70 tractor trailers, with greater fuel efficiency and fewer greenhouse gas emissions.

Existing Mitigations:

- The volume of commercial traffic is not an issue, and the river system is not really a problem. The river is not saturated with traffic and allows for basically un-impeded traffic flow.
- The Lower Mississippi River Waterway Safety Advisory Committee works closely with the Coast Guard to establish traffic restrictions to minimize risks and traffic flow disruptions due to low water, high water and vessel casualty incidents.
- Very good Bridge to Bridge communication between the towing vessel industries greatly reduces the risk of collisions, allisions and groundings.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Volume of Small Craft Traffic

Trends / Observations:

- There are light volumes of small craft traffic that operate in the assessment area. Most small craft operate out of marinas located in the Mudd Island basin in Memphis.
- There are seasonal fluctuations/increases in small craft traffic during the waterfowl hunting season.

  Downward trend in small craft volumes including human powered craft.

Existing Mitigations:

- Low number of small craft operators drives down risks of collisions with other small craft traffic and towing vessels/barges.
- Safety zones help mitigate risk by controlling close quarter traffic situations and interactions during permitted marine events.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Traffic Mix

Trends / Observations:

- The Mississippi River is mostly a single-use waterway utilized predominately by the towing vessel industry.
- Limited numbers of small craft operate in the main river channels, and only a limited number of large passenger vessels utilize the river system.

Existing Mitigations:

- Great coordination between waterways users greatly reduces conflicts and risk of close quarters interactions.
- Day/night restrictions, regulated navigation areas (RNA), check-in points, and waterway action plans mitigate any issues with traffic mix. Again, these mitigations are usually triggered by an event (low/high water or a casualty).
- Aforementioned advisory groups have established not only reactionary mitigations, but also preventative mitigations. For example, "que" management when there is planned U.S. Army Corps of Engineers (USACE) maintenance/closures. They strive to keep the river open at all times.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Congestion

Trends / Observations:

- In the McKeller Lake and Wolf River areas, there is a significant amount of small vessel traffic merging with the larger towing vessel community. The participants felt that there were no vessel congestion issues within the assessment area.

Existing Mitigations:

- Due to city design, congested areas are out of the main river channel. McKeller Lake is off the river, and up bound/down bound commercial and recreational traffic does not interact or impact Memphis port activities.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Winds

Trends / Observations:

- South winds impact the river and influence how mariners navigate. Isolated storms have more of an impact in the spring and summer months. High winds impact barge fleeting areas and increase the likelihood of breakaways, especially for empty barges. Most commercial traffic will push into the bank and allow the severe weather to pass. Straight line winds associated with hurricanes or strong storms pose navigational hazards to larger vessel tows.

Existing Mitigations:

- Reliable and accurate weather forecasting is used to plan for and react to strong winds and storms. The towing vessel industry has well established preventative measures and procedures if strong winds are forecasted.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Water Movement

Trends / Observations:

- River current is stronger in the spring, and it's influenced by snow melt and heavy rains. Water movement varies seasonally and is widely recognized as being unpredictable.

Existing Mitigations:

- USACE dykes and bank stabilization help to produce somewhat predictable water movements. National Weather Service operated and maintained river gauges are internet accessible. USACE provides daily and 10 day water level forecasts. Air draft and other pertinent information are available on the river navigation charts. Industry routinely shares information about the impacts extreme water movements have on safe navigation. "Pilots Day" is a yearly meeting between commercial operators and the USACE to seek input and discuss planned river projects**.**

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Visibility Restriction

Trends / Observations:

- Fog is more common in the spring. Heavy storms pose a danger to safe navigation due to the negative impact the storms have on radar performance.

Existing Mitigations:

- AIS and Electronic Navigation Charts (ENS) can be a positive or a negative. Some new pilots depend on AIS, which leads to a false sense of security. Industry feels some pilots are "driving by the screen" and not using new technology as only a tool. Just because AIS doesn't show a boat around the bend, doesn't mean one isn't there. Company training and policy helps to prevent this dependence.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Obstructions

Trends / Observations:

- The participants all agreed that there are always risks to a vessel hull or propulsion systems due to floating debris in the river. Other risks include unmarked dikes, large floating/mostly submerged trees during high waters, and constantly shifting sand bars.

Existing Mitigations:

- Broadcast Notice to Mariners, vessel to vessel notifications, and local knowledge are all existing mitigations. In some cases, a pilot can utilize experience/local knowledge to avoid hitting debris. With respect to logs, several participants commented that when you go up the river, you just decide which ones (logs) you are going to hit because they cannot all be avoided. The comment was also made that encountering obstructions is way of life on the river, and everyone has learned to deal with it.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Visibility Impediments

Trends / Observations:

- Background lighting around bridges and city waterfronts pose a risk to safe navigation.
- Trees and brush also obscure Aid to Navigation (ATON).

Existing Mitigations:

- Bridge illumination lights are able to be turned off by vessels via VHF radio. Electronic charts create less dependency on seeing ATON lights that are obscured by shore-side background lights.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Dimensions

Trends / Observations:

- Low water conditions impact navigation by requiring one-way traffic in some areas. Dredging and mat laying operations impact channel dimensions but are only seasonal occurrences. Channel dimensions are constantly changing with river stages. Air gap is not an issue until extreme high water.

Existing Mitigations:

- Annual meetings between commercial operators and the USACE allows visibility on upcoming dredging operations. Mandatory restrictions are in place during low and high water conditions. The River Industry Executive Task Force (RIETF) provides towing vessel owners and operators with the latest information regarding the impacts of USACE projects.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Bottom Type

Trends / Observations:

- Channel bottom is sand, gravel, and mud. The dikes are hard rocks and easily identified visually and on radar. Sand bars and constantly shifting, heavy shoaling areas include Redman Bar and the I40 bridge crossing.

Existing Mitigations:

- Bottom surveys taken by the USACE are accurate, and the information is quickly released to the maritime community.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Configuration

Trends / Observations:

- The river configuration is such that there are several one-way traffic areas. There are configuration concerns from Well Point to Sound Point.

Existing Mitigations:

- Good communications between operators reduces risks associated with channel configurations. AIS was also identified as reducing risk by allowing mariners to see around blind bends and identify approaching traffic.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Personnel Injuries

Trends / Observations:

- The risk associated with personal injuries was determined to be low due to the very low number (5-6) of cruise ships that operate in the assessment area. Most cruise ships operate seasonally, further reducing the risk of personnel injuries.

Existing Mitigations:

- Occasional mass rescue drills. Drills are very detailed and include participants from all relevant state, federal, and private parties. The last mass rescue drill was in the summer of 2015 and resulted in valuable feedback and lessons learned. The Area Maritime Safety Committee (AMSC) is active and has table top drills/discussions. Port safety and security groups also participate in planning contingency actions.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Petroleum Discharge

Trends / Observations:

- The volume of oil transported via tank barges is decreasing due to market conditions. Petroleum products are placed in dedicated tows which reduce the risk of an oil spill.

Existing Mitigations:

- The U.S. Environmental Protection Agency (EPA) is the Federal On-Scene Coordinator for oil spills. EPA regions are hit or miss in terms of area contingency plans. Some regions don't even have an area contingency plan. Tank vessel response plans and non-tank vessel response plans reduce risk of a petroleum spill. If carrying petroleum products, the towing vessel is required to have a contract with a spill response company. If there is an incident, the response company is called immediately.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Hazardous Materials Release

Trends / Observations:

- Barges that carry Certain Dangerous Cargoes (CDC) are of the highest quality. In addition, many CDC's are only moved during daylight hours and good visibility.

Existing Mitigations:

- Memphis Fire Department and Tennessee Emergency Management involved with hazmat response. Every fire department in the county has a hazmat response team. The towing industry and fire department work together for planning a response to a marine incident. There's great coordination. Memphis Fire Department has a fire fighting barge. Memphis Police Department is getting a new patrol boat with fire fighting capability.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Mobility

Trends / Observations:

- No alternate routes to avoid groundings, collisions or allisions. The river may be closed for the duration of the grounding or mishap; industry acknowledges the impact of a major casualty and the subsequent impacts of shipping.

Existing Mitigations:

- There is great coordination and planning among commercial operators and committees. Salvage companies are available, but it may take some time for them to arrive on-scene with equipment. USACE salvage equipment can't be used for commercial purposes.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Health and Safety

Trends / Observations:

- The town of Fraser, a community in North Memphis, is located adjacent to a waterfront chemical facility; 30,000 people could be affected by an anhydrous ammonia leak/spill. Affected populations depend on wind direction, but it could be up to 1 million people. A large accident would create chaos and overwhelm emergency responders. Most hospitals are located within the high risk areas. Drinking water is from aquifers, not the river.

Existing Mitigations:

- Full scale drills, evacuation plans, and table top exercises. Facility response plans are in place, and there are regulations in place to reduce the risk of a health and safety incident.

New Mitigations:

- Continue exercises and drills. Increase number of these exercises and drills.
- Education: People could be taught the smells/signs of a spill and what to do if there is a spill. There are several schools within the high risk area.
- Improve and test emergency notification systems.
- Additional regulations would likely not improve this category.

Environmental

Trends / Observations:

- There are some protected/sensitive wetlands within the assessment area. Primary environmental groups are sportsmen such as Ducks Unlimited.

Existing Mitigations:

- Vessel response plans, training, and drills/exercises all reduce environmental impact risks and improve response operations for large spills and incidents.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Aquatic Resources

Trends / Observations:

- Commercial fishing is very limited. Waterfowl hunting on the river is important for the hunting and tourism markets.

Existing Mitigations:

- Commercial fishing is regulated at the State level. Fishing vessels are aware of the risks associated with navigating near the larger commercial towing vessels.

Additional Mitigations: Risk determined to be balanced by existing mitigations.

Economic

Trends / Observations:

- The AWO commissioned a study that was completed by PricewaterhouseCoopers. It discusses the economical importance of the inland rivers, which contributes billions to the economy. A bridge casualty/collapse would be disastrous for both waterborne commerce and the trucking industry. The probability of this happening is very low as the bridges always win these battles. Economic impact would be immediate. Impact increases with closure time. Salvage equipment takes three days minimum to arrive on scene in Memphis. People would arrive faster, but equipment takes time. Closure time depends on the location and type of casualty. The river usually reopens with mitigating restrictions within a few days.

Existing Mitigations:

- Alternate routes around Memphis are available via the Tombigbee River, although at a reduced capacity. Decisions are based on demands to use the alternate route. The Marine Transportation System Recovery Unit would stand-up and coordinate port recovery operations.

New Mitigations:

- More drills and exercises to improve response time and coordination.
- Improve the regulating agency's understanding (i.e. USCG) of the situation to decrease time required to make a decision. River conditions change so quickly that decisions may no longer be applicable once they are made. Delayed decisions make a bad situation worse. According to industry, this is a frequent occurrence.
- Clearly establish which agency is responsible for making a decision.
- Better utilization of local authorities and responders.
- Get all agencies to agree and receive information in one location.
- Continually emphasize coordination between all stakeholders.

Appendix C

Definitions – Risk Mitigation Strategies

Coordination / Planning	Improve long-range and/or contingency planning and better coordinate activities / improve dialogue between waterway stakeholders.
Voluntary Training	Establish / use voluntary programs to educate mariners / boaters in topics related to waterway safety (Rules of the Road, ship/boat handling, etc.)
Rules & Procedures	Establish / refine rules, regulations, policies, or procedures (navigation rules, pilot rules, standard operating procedures, licensing, required training and education, etc.).
Enforcement	More actively enforce existing rules / policies (navigation rules, vessel inspection regulations, standards of care, etc.).
Navigation / Hydro Info	Improve navigation and hydrographic information (Notice to Mariners, charts, Coast Pilots, Light Lists, Automatic Identification System (AIS), tides and current tables, etc.).
Radio Communications	Improve the ability to communicate bridge-to-bridge or ship-to-shore (radio reception coverage, signal strength, reduce interference & congestion, monitoring, etc.).
Active Traffic Mgmt	Establish / improve a Vessel Traffic Service: information / navigation / traffic organization.
Waterway Changes	Widen / deepen / straighten the channel and/or improve the aids to navigation (buoys, ranges, lights, DGPS, etc.).
Other Actions	Risk mitigation measures needed that do not fall under any of the above risk mitigation strategies.

Appendix D References / Best Practices

Vessel Operations	Navigation Safety	Statistics
Tennessee Wildlife Resource Agency https://www.tn.gov/twra/article/boating-safety-education	**U.S. Navigation Rules** http://www.navcen.uscg.gov/?pageName=navRuleChanges	**Recreational Boating Safety - Accident Statistics** http://www.uscgboating.org/statistics/accident_statistics.php
American Canoe Association http://www.americancanoe.org/	**USCG Auxiliary -Requirements -Recreational Boats** http://www.cgaux.org/boatinged/classes/2011/bss.php	**U.S. Army Corps of Engineers - Vessel Transit Statics** http://www.navigationdatacenter.us/
US Coast Guard - Vessel Inspection Regulations http://www.ecfr.gov/cgi-bin/ECFR?page=browse	**State-Specific Boating Safety Requirements** http://www.americasboatingcourse.com/lawsbystate.cfm	**The American Waterways Operators** http://www.americanwaterways.com/
U.S. Army Corps of Engineers **General Regulatory Policies - Permitting** http://www.usace.army.mil/Missions/Civil-Works/Regulatory-Program-and-Permits/Federal-Regulation/	**National Oceanic and Atmospheric Administration** **Safe Boating Weather Tips** http://www.nws.noaa.gov/om/brochures/safeboat.htm	
	Life Lines Brochure - Safety Tips That Could Save Your Life http://www.americanwaterways.com/commitment_safety/lifelines.pdf	