



McClellan-Kerr Arkansas River Navigation System (MKARNS) Mooring Modernization Project

*Rebuilding American Infrastructure with Sustainability and
Equity Discretionary Grant Application*

Applicant: Oklahoma Department of Transportation (ODOT)

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Supporting information can be found at:

<https://oklahoma.gov/odot/progress-and-performance/federal-grant-awards/raise-grants/mkarns-mooring-modernization-project.html>

RAISE Request Amount: \$15,510,800 (75.6%)

Local Match: \$5,000,000 (24.4%)

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1 PROJECT DESCRIPTION

The McClellan-Kerr Arkansas River Navigation System (MKARNS) plays a vital role to the regional, state and national economy. It serves the primary navigable waterway in the State of Oklahoma. The MKARNS waterway originates in northeastern Oklahoma and flows southeast to the Mississippi River. The **MKARNS Mooring Modernization Project** (the Project) will construct new mooring structures in the waterway that will **replace existing obsolete** anchors at the Tulsa Port of Catoosa, the Port of Muskogee and Oakley’s Terminal Muskogee. **The modernized mooring infrastructure** will enable safe harbor for mariners, increase reliability of structures in the event of a flood, and ensure the Oklahoma segment of the MKARNS **can continue to support the over 22,000 full and part-time jobs it provides.**¹

The primary goal of the Project is to implement reliable mooring infrastructure to ensure safe and efficient freight movement, protect Oklahoma’s road and bridges, and promote long-term vitality of the waterway.



Oklahoma’s Marine Highway
MKARNS
M-40

The Project will replace existing barge tie down structures which were not designed for the type of major flood events the region has experienced in recent years and enhance harbor safety by eliminating risk of loose barges and damage to infrastructure. The Project will **expand much needed capacity** for vessels within the waterway and prepare ports for the forecasted increases in freight demand through the MKARNS. Freight movement by waterway in Oklahoma is forecasted to grow by 35 percent through 2045 and reach 8.5 million of tons in 2045.²

New mooring infrastructure will be an investment in long-term strength, security, and resiliency for Oklahoma to continue to be a major player in the U.S. and global markets. The MKARNS waterway links Oklahoma to a 12-state service area with various domestic ports of the U.S. inland waterways system and foreign ports by way of New Orleans and the Gulf Intracoastal waterway.

In 2020, Oklahoma’s waterborne commerce on the MKARNS totaled 4.9 million tons with a value of \$2.2 billion. In addition, more than 10.3 million tons traversed the entire MKARNS waterway with a value of more than \$4.1 billion, which included a variety of United States manufactured exports and imports. It is important to note that shipping cargo by water is the most energy efficient and the most competitive form of transportation.³

The Port of Muskogee, Tulsa Port of Catoosa, and Oakley’s Terminal Muskogee combined total 3,100 acres of industrial park, **employ nearly 9,000 workers**, and serves 72 percent of the tonnage inland of Webbers Falls Lock and Dam on the MKARNS Oklahoma segment.⁴

¹ [MKARNS Update \(2020\)](#)

² [Oklahoma Freight and Transportation Plan \(2018-2022\)](#)

³ [Waterway Fact Sheet \(2021\)](#)

⁴ Tonnage information was informed by each Port location associated with this Project.

The Port of Muskogee, Tulsa Port of Catoosa, and Oakley’s Terminal Muskogee (the Port Partners) are an important economic engine for the State of Oklahoma, making them a key component of the regional and national freight transportation system. The Project will invest in necessary mooring technologies to preserve the waterway’s economic vitality and prepare for future freight traffic demand within the larger U.S. economy. Since the official opening of the MKARNS in 1971, the Port Authorities and State of Oklahoma have made strategic infrastructure investments to maintain ports and channel infrastructure in a state of good repair, promote the development of jobs, and improve transportation land access to ports.



The modernized mooring system will create a more safe, efficient, and resilient industry standard to secure vessels and will be designed to accommodate normal navigation conditions as well as extreme flooding conditions that have been encountered over the last several years and are expected to increase in frequency and intensity.⁵

CHALLENGES & OPPORTUNITIES

ODOT and the Port Partners all agree that this project is top priority for the MKARNS. The Project will:

- **Expand limited capacity at existing ports and prepare the inland waterway for forecasted freight demands;**
- **Reduce safety risks by replacing obsolete anchorage systems;**
- **Protect Oklahoma’s infrastructure and economy during flooding events; and**
- **Better maintain a state of good repair in the waterway by minimizing operations and maintenance costs.**



⁵ [MKARNS Update \(2020\)](#)

LIMITED CAPACITY AT EXISTING PORTS

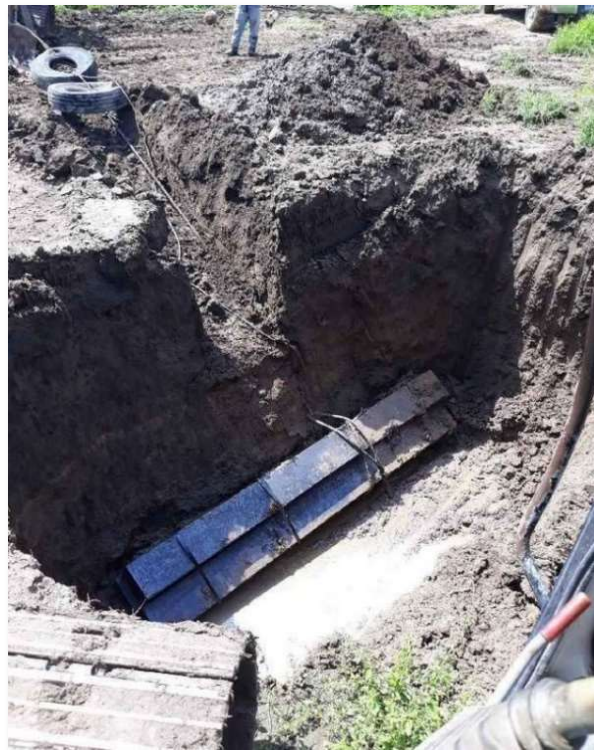
The Project will replace existing obsolete anchors at the Tulsa Port of Catoosa, Port of Muskogee, and Oakley’s Terminal Muskogee, which will simultaneously expand capacity for large and heavy vessels. Existing anchorage structures at these port terminals are limited and cannot support the incoming growth of barges and vessels that move freight. Because capacity is limited, some vessels today are deadman⁶ anchored along the banks of the waterway creating congestion. The Tulsa and Little Rock Districts of the Army Corps of Engineers have identified a Critical backlog of maintenance needs on the MKARNS. Any one of these items has a 50 percent probability of failure within the next 5 years, and a failure of any sort will affect or shut down the entire MKARNS.⁷



June 2021: Mooring Infrastructure – Tulsa Port of Catoosa

SAFETY RISKS DURING FLOODING EVENTS

Historic flooding in 2019 was devastating for ports and industries along the MKARNS of Oklahoma and Arkansas. Prior to 2019, all events were compared to the 1986 flood on the MKARNS which yielded water flows of 375,000 cubic feet per second (cfs), a standard measurement of the volumetric flow rate of water. However, the 2019 flood flows **nearly doubled the 1986 flood reaching flows more than 675,000 cfs**, which led to infrastructure damage.⁸ The current anchorage system has not changed since the inception of the ports 50 years ago and the existing structures were not designed for major flood events that will potentially increase in severity and frequency due to climate change.⁹



Deadman anchor at Oakley’s Terminal Muskogee

During the barrage of floodwater flow in 2019, two barges broke loose and floated downstream striking a dam structure before they sank. While the dam structure properly maintained its integrity, obsolete anchoring structures pose a risk to infrastructure in the waterway including dams and bridges. For 2.5 months the MKARNS system was closed because of high water flooding, unsafe water flows and dredging needs. Once the water flow normalized, the system remained closed

⁶ An object, such as an anchor, piling, or concrete block, buried on shore that contains a tie to secure barges.

⁷ [The McClellan-Kerr Navigation System is in Danger](#)

⁸ [National Waterways Conference \(2019\) - Page 8](#)

⁹ [Peak Streamflow and Stages at Selected Stream Stages on the Arkansas River in Oklahoma \(2019\)](#)

for an additional 1.5 months while the excavation and salvage of the barges occurred.¹⁰ The flood event resulted in an immense time delay for the system and highlighted the need for new infrastructure able to withstand future flood events. Complete disruption of operations on the MKARNS costs its beneficiaries **\$2 million per day and a maximum daily loss of \$20.7 million in Gross Domestic Product within the State of Oklahoma.**¹¹

In 2002, a barge struck an I-40 bridge pier and the bridge collapsed resulting in **14 deaths, 11 injuries, and \$27 million in bridge reconstruction costs.**¹² While this the situation did not arise from failed anchoring, loose barges during flooding events can result in catastrophic events. Investments in mooring construction will provide a safe and reliable tie down method that is designed to accommodate extreme conditions during significant flooding events. Proper tie down infrastructure will allow the MKARNS in Oklahoma to be prepared to handle potential future flooding events and to support continuous growth on the “marine highway”.

STATE OF GOOD REPAIR

While the MKARNS currently offers strong performance and high reliability, it faces a significant maintenance backlog. The Army Corps of Engineers does not have a sufficient budget to maintain the infrastructure of the inland waterway system. The current cost of the **Critical backlog of maintenance needs on the MKARNS alone are now approaching \$93 million dollars.**¹³ Modernized mooring structures provided by the Project will reduce and **nearly eliminate the ongoing operating and maintenance costs** of existing structures at the associated Port locations.



¹⁰ Cleaning process that takes place to remove debris, mud, weeds or other materials from the riverbed.

¹¹ [MBTC Final Research Report](#)

¹² [10 Years Later: Survivor Remembers I-40 Bridge Collapse](#)

¹³ [The McClellan-Kerr Navigation System is in Danger](#)

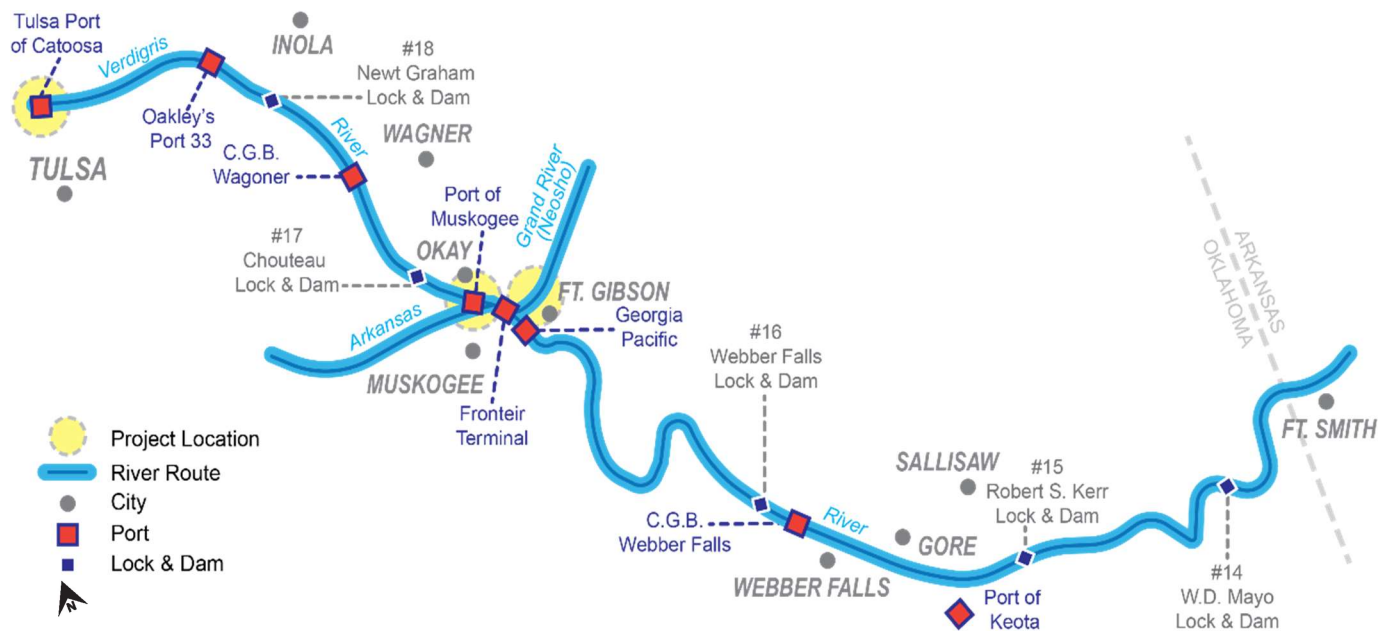
PROJECT OVERVIEW

Requested RAISE funding will be used to construct mooring structures at three locations: the Tulsa Port of Catoosa, the Port of Muskogee, and in the Grand River to support Oakley’s Terminal Muskogee. The three locations have varied existing structures including deadman anchors and dolphin moorings. Deadman anchors (located at the Grand River location) consist of lines connected to buried timbers or bridge beams which are installed on dry land and buried to make use of earth pressure to resist pull forces. Dolphin moorings in the waterway today (located at the Tulsa Port of Catoosa and Port of Muskogee) consist of a combination of vertical and horizontal “batter” wood piles.

The Project includes the following improvements:

- Tulsa Port of Catoosa – The Project will remove and replace 6 dolphin structures with new mooring structures with associated gangway¹⁴ and platforms.
- Port of Muskogee – The Project will remove and replace 20 dolphin structures with new mooring structures with associated gangway and platforms.
- Oakley’s Terminal Muskogee – The Project will remove and replace 6 deadman anchors with new mooring structures with associated gangway and platforms.

FIGURE 1: OKLAHOMA PORTS



¹⁴ Merriam-Webster defines a gangway as a passageway or walkway.

FUNDING REQUEST

The RAISE grant funding request for the Project is \$15,510,800. ODOT is committed to \$5,000,000 million dollars in additional funding for this Project. Because this Project is not in the ODOT 8-year work plan and does not have a dedicated revenue source outside of the \$5,000,000 million dollar commitment, the Project in its entirety would not be able to be constructed without the additional 15,510,800 RAISE funding. The funds will create the ability to construct 6 new modernized mooring structures with associated gangway and platforms at the Tulsa Port of Catoosa, 20 structures at the Port of Muskogee, and 6 structures in the Grand River used by Oakley’s Terminal Muskogee.

TABLE 1: PROJECT FUNDING

Funding Source	\$ Amount (%)
ODOT	\$5,000,000 (24.4%)
U.S. DOT RAISE	\$15,510,800 (75.6%)
Total Project Cost	\$20,510,800 (100%)

The MKARNS is a unique and vital commercial transportation corridor in Oklahoma. Strategic investment in the Project and waterway network is a priority for Oklahoma. The Oklahoma Department of Transportation (ODOT) is committed to leverage federal dollars with local investment. ODOT will leverage \$5,000,000 million in funding (a 24.4 percent local match).

There have been \$1,393,100 million dollars in previously incurred costs for this project as of 2021. These costs were used for the ODOT contract with CONSOR, a construction engineering company, who developed the infrastructure cost estimate for this Project as well as costs associated with environmental analysis. The RAISE funding request of \$15,510,800 million dollars will strictly be for construction of this Project.

PROJECT PARTNERS

The Project boasts numerous supporters including State and Federal Congressional delegation, industry representatives, local business owners, tribal leaders, and other stakeholders. These partners understand the importance of leveraging the “marine highway” as a solution to the congested National Highway Freight Network (NHFN) corridors. Project supporters understand the importance of the Project to the long-term vitality of the MKARNS.

A snapshot of Project partners is shown below and a complete list of project supporters is provided in the Partnership section of the application.

FIGURE 2: PRIMARY PROJECT PARTNERS



**Oklahoma
Department of
Transportation**



**Tulsa Port of
Catoosa**



Port of Muskogee



**Oakley’s Terminal
Muskogee**

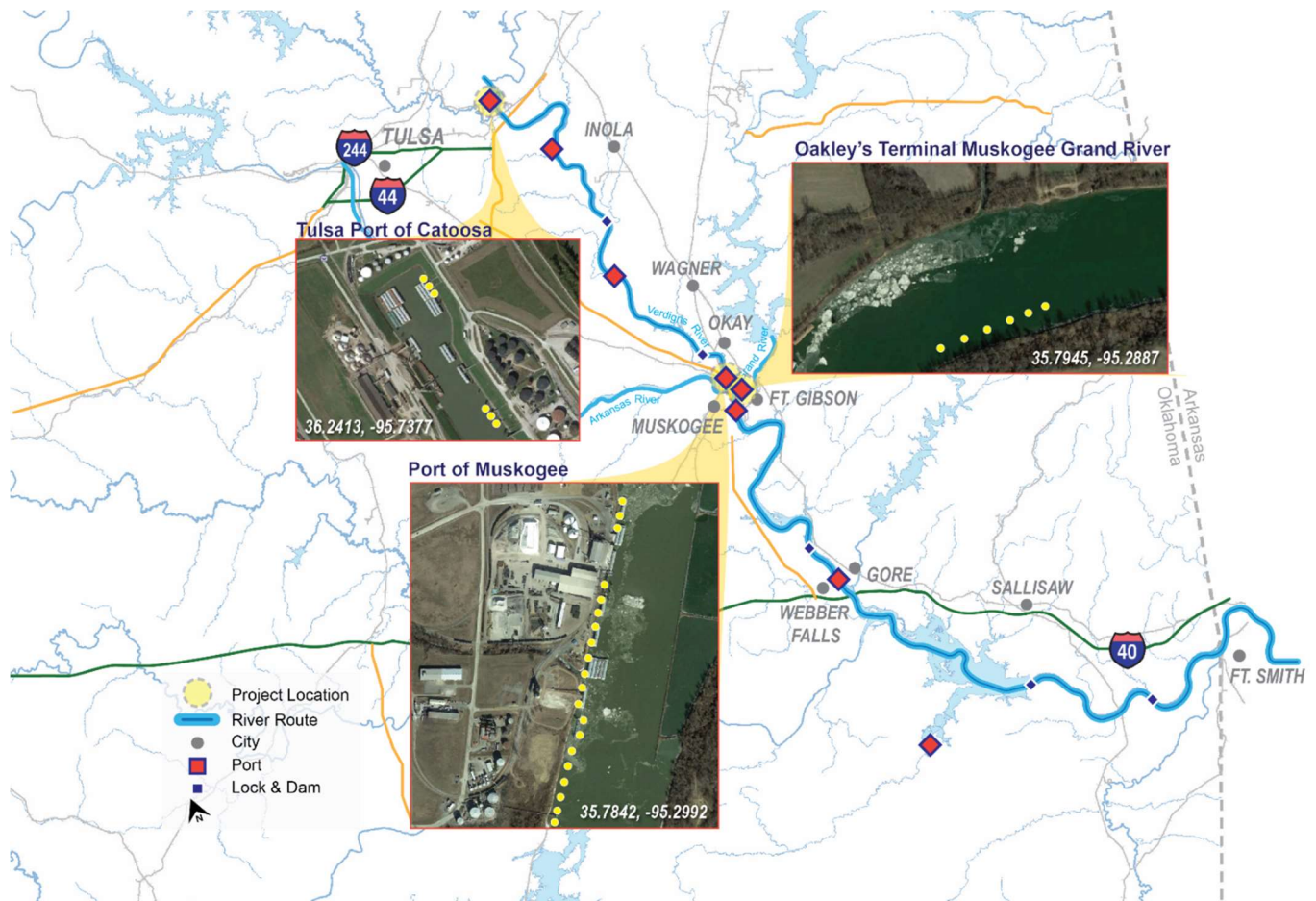


2 PROJECT LOCATION

The MKARNS is 445-mile long marine highway which consists of the Verdigris, Arkansas, and White Rivers. The MKARNS serves a 12-state region and is the most westerly inland ice-free waterway system in the Country. As such, the waterway provides access to port terminals to transfer freight from barge to either rail or truck. The MKARNS is synonymous with the Arkansas River in Oklahoma from the Port of Muskogee downstream to the State of Arkansas border. Upstream from the Port of Muskogee, MKARNS leaves the Arkansas River to join the Verdigris River and terminates at Tulsa Port of Catoosa.

The Project will consist of constructing 32 mooring structures at the Tulsa Port of Catoosa, Port of Muskogee and the Grand River which will serve Oakley’s Terminal Muskogee, all of which are located in Northeast Oklahoma’s 2nd Congressional District. These three ports include the two largest public ports (Tulsa Port of Catoosa and Port of Muskogee) and the largest private port (Oakley’s Terminal Muskogee) along the MKARNS waterway in Oklahoma. The specific geospatial coordinates of proposed mooring structures.

FIGURE 3: PROJECT LOCATION



The three port locations that will benefit from this Project are all considered to be rural.¹⁵ One Project location, the Port of Muskogee, is designated as an area of Persistent Poverty (Muskogee County, Tract 4: YES). The remaining two port locations, the Tulsa Port of Catoosa and Oakley’s Terminal Muskogee are not classified as Areas of Persistent Poverty.

3 GRANT FUNDS, SOURCES, AND USES

The cost of the project is \$20.5 million. ODOT is committed to leverage federal dollars with local investment. Table 2 shows a complete cost breakdown for each mooring structure and Table 3 shows the total project budget including mobilization and de-mobilization. All obligated RAISE funds would be used for project construction and construction contingency. The table provides a breakdown of sources and uses of funds for each project component. In total, ODOT requests \$15,510,800 million in RAISE funding, 75.6 percent of total project costs. ODOT’s 24.4 percent local match will come from dedicated annual state appropriations.

TABLE 2: MOORING STRUCTURE COST

Item	Quantity	Unit Cost	Total
5 ft Diameter Monopile	80 FT	\$3,765	\$301,200
Pile Tremie Concrete Cubic Yards	55 CY	\$500	\$27,500
Grout and Misc. Outfitting	Lump Sum	\$70,000	\$70,000
Rock Anchors / Rock Socket	Lump Sum	\$32,250	\$32,250
Sub Total			\$430,950
30% Construction Contingency			\$130,000
Total Cost Per Structure			\$560,950

TABLE 3: PROJECT COST

Item	Quantity	Unit Cost	Total
Mooring Structures	32 structures	\$560,950	\$17,950,400
Mobilization and De-mobilization	Lump Sum	\$1,923,400	\$1,923,400
Demolition	26 structures	\$24,500	\$637,000
Total Cost Per Structure			\$20,510,800

TABLE 4: PROJECT FUNDING

Funding Source	\$ Amount (%)
ODOT	\$5,000,000 (24.4%)
U.S. DOT RAISE	\$15,510,800 (75.6%)
Total Project Cost	\$20,510,800 (100%)

¹⁵ Federal Register Notice of Funding – Page 4

4 SELECTION CRITERIA

SAFETY

IMPROVED SAFETY CONDITIONS

The MKARNS opened as an official navigable waterway nearly 50 years ago. Ports constructed around this time included mooring technology that is now outdated and in need of significant upgrades to remain operational.

The Project will replace existing obsolete anchorage structures and enhance harbor safety by eliminating risk during extreme weather conditions. Existing infrastructure was unable to safely anchor barges during the recent flood event in Oklahoma in 2019.

Historic flooding in 2019 was devastating for ports and industries along the MKARNS of Oklahoma and Arkansas. The waterway reached river stages, elevations, and flows never previously experienced during the lifetime of the MKARNS. The waterway reached more than 675,000 cubic feet per second (cfs). Typically, at Muskogee, flows are about 8,000 cfs under normal conditions.¹⁶

The existing anchorage system, unchanged since its inception in the early 1970s, is not designed to support recently experienced flows or water elevations.

During the barrage of floodwater flow in 2019, two barges broke loose from the Port of Muskogee and floated downstream. After catching the barges and re-securing the vessels to trees along the soggy riverbank, they broke free again and struck a dam structure at the Webbers Falls Lock and Dam before they sank. The dam structure properly maintained its integrity, but obsolete anchoring structures pose a risk to infrastructure in the waterway. Hundreds of barges were left at risk because of deadman anchors and other fixed mooring structures that were up to ten feet below the water's surface.



May 2019 flooding near Muskogee
Source: Tulsa World



MKARNS dam near Webbers Falls
Source: The Waterways Journal

¹⁶ [National Waterways Conference \(2019\)](#)

In total, the damages to the dam structure cost more than \$310,000 in repairs, however, the damage could have been much worse. The Oklahoma community experienced the potential risk to infrastructure when in 2002, a barge struck an I-40 bridge pier. While this situation did not arise from failed anchoring, it illustrates the potential devastating effects that may result from failed mooring structures. The event resulted in 14 deaths, 11 injuries, \$24 million in bridge reconstruction, a 64-day closure of the waterway, and a major impact on freight commerce and travel.¹⁷



Port of Muskogee in normal conditions

The existing structures were not designed to withstand flood flows yielded by the 2019 flood event. Existing conditions create potential safety risks if no alternative tie down solution is constructed. There is a risk for future infrastructure collisions, flood damage to port infrastructure, local homes, and potential loss of product to market. Because much of the bulk commodity transported along the MKARNS system includes chemical fertilizer, this poses an environmental hazard to the waterway system for water supply and fish and wildlife that use these rivers as their home.



Port of Muskogee in 2019 flood event

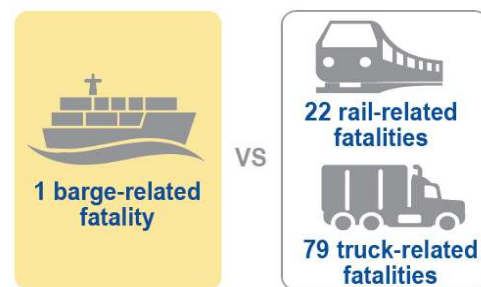
Investments in mooring construction will provide a safe, reliable tie down method that is designed to accommodate increased extreme flooding conditions. The design solution also considers detail by the Army Corps of Engineers (USACE) for proper tie down infrastructure on navigable rivers and includes detail to properly secure both loaded and unloaded barges. Modern tie down infrastructure will allow the MKARNS in Oklahoma to be prepared to handle potential future extreme flooding events and to support continuous growth on the “marine highway”.

CONTINUE TO SUPPORT SAFE MOVEMENT OF FREIGHT

The MKARNS is an integral part of the regional and national movement of freight and goods. By safely moving America’s cargo at the lowest cost, barge transportation plays a vital role to not only the nation’s economy, but in limiting truck traffic congestion, and reducing safety risks on our nation’s roads.¹⁸

Inland waterway transportation has a low fatality and injury record compared to rail or truck freight movement. Compared to each barge related fatality, there are 21.9 fatalities related to rail and 79 truck-related fatalities.¹⁹ For each injury involving barge transportation, there are 80 injuries related to rail and 824 truck-related injuries.²⁰ Inland waterways are one of the safest ways to move freight in our nation.

Ratio of **fatalities** in freight transportation



Source: National Waterway Foundation

¹⁷ [Tulsa World](#)

¹⁸ [Waterways System](#)

¹⁹ [Sustainability of Barge Transportation](#)

²⁰ [Sustainability of Barge Transportation](#)

IMPROVED WORKER SAFETY

Modernized moorings will improve worker safety and minimize risk during mooring procedures. Mooring infrastructure provided by this Project require less skill and physical force by Captains and deckhands. Mooring infrastructure such as a monopile or dolphin mooring would allow Captains to maneuver a barge alongside the mooring structure as the deckhand throws a line around the pipe to secure the barge, which is an easier and safer process than what is required to secure to a deadman anchor. Securing a deadman anchor requires the Captain to maneuver the barge towards to the river bank as the deckhand uses a long (approximately 20 ft) pike pole to retrieve a floating cell connected to the deadman anchor cable. The deckhand then must physically pull the cable to the deck to secure the barge. The process to secure a barge using a deadman anchor is physically strenuous for both the Captain and deckhand. During the securing process the deckhands eyes are in front of the barge which can also be strained during the night, high wind conditions, or pouring rain.



Existing Dolphin at the Port of Muskogee



Existing Deadman Anchor wire at Oakley's Terminal Muskogee

EXISTING VANDALISM AND SAFETY CONCERNS

The general public has access to the MKARNS waterway and riverbanks as it is a recreational asset for the community. While many use the waterway for recreation, boating, and fishing, the ports do encounter vandalism, particularly to the deadman anchors which are set on the dry shore. Oakley's Terminal Muskogee has encountered reoccurring vandalism that ruins anchors by burning tires, cutting cables or shooting floating cells. Acts of vandalism cost the ports money and pose a risk to the integrity of the moorings. The updated moorings will be constructed in the water, which will greatly improve the safety and minimize the existing risk posed by deadman anchors on the shore.

ENVIRONMENTAL SUSTAINABILITY

Environmental sustainability is a priority and key aspect of goods movement by waterway. Maintaining air quality standards, investing in infrastructure to reduce the risk of loss of goods and improving congestion related emissions at each port will further improve the quality of life for regional economies. The Project provides improvements to ensure the long-term vitality of the waterway, ports, and mooring system. By providing new moorings, the ports will gain capacity that will support future growth of waterway freight movement. Freight movement by waterway produces significantly less emissions than other modes of transport (truck and rail), which reduces climate change impacts.

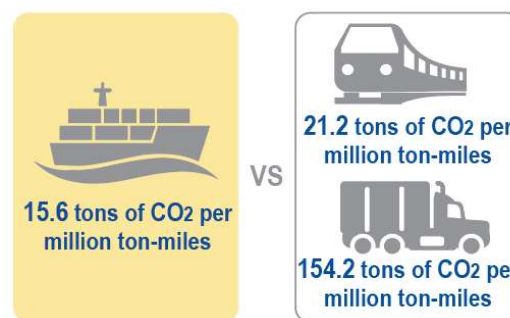
EFFICIENT GOODS MOVEMENT WITH REDUCED EMISSIONS

Agricultural commodities accounted for 73 percent of the total product moved on the Oklahoma segment of the MKARNS in 2015.²¹ Use of waterway freight movement is the most energy efficient and least damaging mode of transportation for the environment.

- **More energy efficiency per gallon of fuel.** Transporting freight by water is the most energy efficient choice. Barges can move one ton of cargo 647 miles per gallon of fuel. A rail car would move the same ton of cargo 477 miles and a semi-truck only 145 miles.²²
- **Small carbon footprint.** Barges have the smallest carbon footprint among other modes including rail and truck. To move an identical amount of cargo by rail generates 30 percent more carbon dioxide, and 10 times more emissions by trucks.²³
- **Fewer vessels or vehicles required.** To fill one barge full of dry commodities it would require an equivalent of 15 jumbo rail cars or 60 large semi-trucks.²⁴
- **Reduced emissions and air pollution.** Barges emit 35 to 60 percent fewer emissions than locomotives or trucks which aids in decreased pollution.²⁵

The Project will replace and expand mooring capacity, thus reducing vessel idling time and mooring efficiency. Investing in the Project will further encourage use of barges for the transport of goods and contribute to sustainable outcomes including reduced fuel consumption, reduced carbon emissions and pollutants, and improved air quality.

Barges have the **smallest carbon footprint** among other transportation modes



Source: National Waterway Foundation

²¹ [MKARNS Update \(2020\)](#)

²² [Sustainability of Barge Transportation](#)

²³ [Sustainability of Barge Transportation](#)

²⁴ [Waterway Fact Sheet \(2021\)](#)

²⁵ [Waterway Fact Sheet \(2021\)](#)

FLOOD PROTECTION

The MKARNS is a multi-beneficiary system that includes water supply, navigation, fish and wildlife, recreation, hydropower generation, and flood control. The MKARNS is part of the Arkansas River Basin which includes upstream reservoirs that control when and how water flows. It is estimated that flood damages prevented by the Arkansas River Basin (under control of the U.S. Army Corps of Engineers Tulsa District) totaled roughly \$552 million in 2015. Cumulative damages prevented through 2015 equate to an estimated \$11 billion.²⁶ Ensuring safe mooring for vessels will minimize risks to infrastructure, such as bridge piers, along the waterway.

RIVERBANK STABILITY

The Project will improve the riverbank stability by removing the deadman anchors at the existing Grand River location. Deadman anchor construction (and repair) requires digging holes along the riverbank to place buried steel beams and timbers. Cables are attached to the foundations which are used as ties for barges and vessels. Continual repair, maintenance, and replacement of deadman anchors can lead to riverbank erosion as cables dig into the shore soil and as tension shifts or vibrates the anchor over time. In addition, there are several endangered species within the Project area that include, but are not limited to, the American Burying Beetle, Piping Plover, and Whooping Cranes. The mooring infrastructure implemented for this Project will be constructed in the river and eliminate further disturbance to the riverbank and minimize disturbance to habitats at the Grand River location of the Project. The Project will eliminate the need disturb the shoreline and riverbank during routine maintenance, repair, or replacement.

CLEAN ENERGY

The Oklahoma segment of the MKARNS includes two hydropower plants with a total of 7 power generating units. In 2018, these units provided clean energy and power to approximately 636,500 end users.²⁷ If the MKARNS were to become inoperable, as it was in 2019 for 104 days, the hydropower plants would have to be supplemented by other means of power generation. A study completed in 2015 describes the impacts that would occur if the MKARNS Oklahoma segment were to become inoperable:

- Sales would decrease by \$72 million;
- Nearly 470 full time and part time jobs would be lost;
- Business tax incomes would decrease by \$3 million and;
- Oklahoma (GDP) would decrease by nearly \$38 million

This highlights the importance of investments to ensure the MKARNS remains in a state of good repair.²⁸ Minimizing risk to infrastructure in the waterway, including hydropower facilities, is a key benefit of modernized mooring infrastructure investment.



²⁶ [MKARNS Update \(2020\)](#)

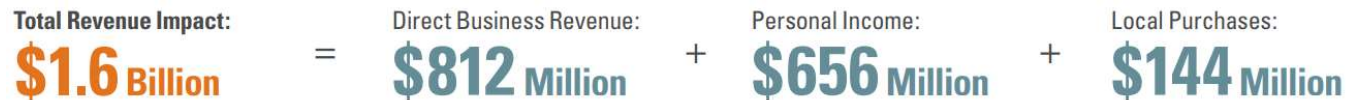
²⁷ [MKARNS Update \(2020\)](#)

²⁸ [MBTC Final Research Report – Page 24](#)

QUALITY OF LIFE

JOBS AND LOCAL RURAL VITALITY

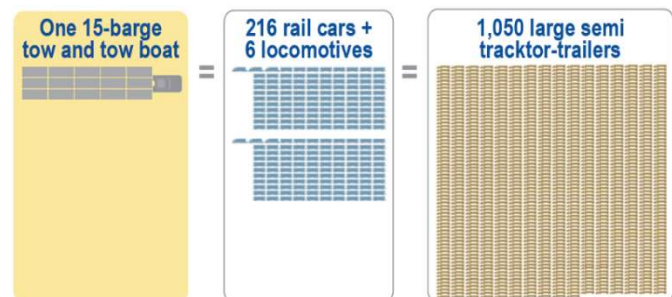
The waterway is an important contributor to jobs in the surrounding rural areas. In total, the Oklahoma MKARNS segment and ports support more than 9,000 jobs and directly contribute \$1.6 billion to Oklahoma’s economy.²⁹ Of that estimated \$1.6 billion, approximately \$812 million is from direct business revenue, \$656 million is through personal income, and \$144 million is through local purchases.³⁰



The Project will improve the quality of life in the region by supporting the ports ability to continue to provide jobs, encourage outside markets to use Oklahoma Ports for trade, and provide a safer way for workers to secure barges in the waterway.

IMPROVED TRANSPORTATION FOR INDIVIDUALS

Waterway is an efficient way to move large amounts of freight. It would take the equivalent of 15 jumbo rail cars or 60 large semi-trucks to carry the amount that could be supported by 1 barge.³¹ Efficiencies in waterway travel on the MKARNS allow lower shipment prices (approximately 15 percent), and thus identifies waterway freight movement as the preferred method over rail or truck.



Source: National Waterway Foundation

If Oklahoma’s 4.9 million tons of waterborne commerce were transported by an alternative method it would require 197,847 trucks to carry such a load.³² This would be not only require more energy and generate more emissions, but it would also vastly change the local roadway transportation network for residents in the surrounding rural areas and Tulsa metropolitan area. Fuel use and CO₂ emissions are reduced by 40 percent when waterway shipment is compared to rail and are reduced by 270 percent when comparing this method of freight movement to truck.

Investments in the Project will enhance mooring structure capabilities in the waterway to ensure that tie off structures can continue to support this competitive system in Oklahoma and continue support of freight movement by waterway.

²⁹ [MKARNS 50th Anniversary](#)

³⁰ [Inland Marine Highway](#)

³¹ [Waterway Fact Sheet \(2021\)](#)

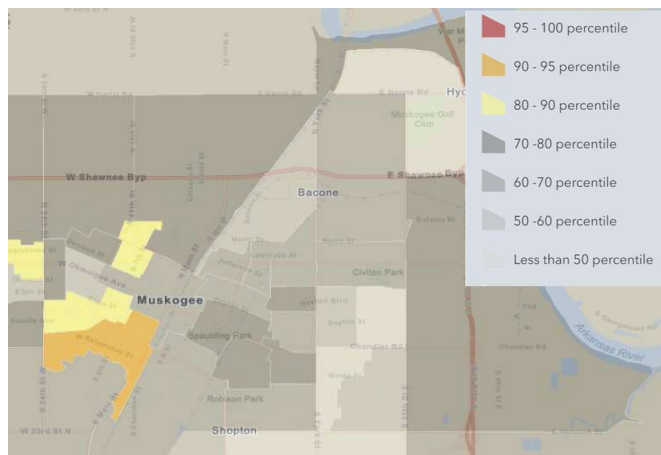
³² [Waterway Fact Sheet \(2021\)](#)

RACIAL EQUITY

The Project is strongly supported by the nearby Indian Nations. The Port of Muskogee is located within the historic tribal boundaries of the Cherokee and Muscogee Nations. Letters of Support for this Project have been received by each of these Indian Nations.

The Project is predominately located in Muskogee County, Oklahoma which has an estimated population of 68,000 according to the United States Census Bureau. Of this population, 46.8 percent are nonwhite.³³ The Environmental Justice Screening Map for People of Color that are located within Muskogee county is displayed to the right.³⁴ These

populations as well as the surrounding community will benefit from the successful construction of this Project because it will continue to provide for current and future jobs with the waterway and local businesses that utilize it to ship commodities.



Source: Environmental Justice People of Color Map (2020)

ACCESS TO ENERGY AND WATER SUPPLY

The MKARNS in Oklahoma benefits approximately 700,000 end users by supplying them with clean hydropower energy. There are two hydropower plants in Oklahoma that include a total of seven power generating units.³⁵ Hydroelectricity qualifies as clean energy because it uses running water to produce electricity. Hydroelectricity is a key contributor to residents and businesses located in the Project area because it provides efficient, low-cost electricity to users.

Operability of the MKARNS system is vital for Oklahoma’s hydroelectric plants to be able to continue to provide for local users that rely on electricity supplied from these plants for their work, homes, and other needs. This Project will ensure that the vessels that use this waterway daily can be safely secured and harbored.

EFFICIENT MOVEMENT OF GOODS WITH REDUCED COSTS

Goods movement is essential for creating a high quality of life. Communities cannot thrive without effective movement of goods. Waterways provide significant cargo capacity and move freight more safely and efficiently than truck or rail. This generates valuable cost savings for businesses, farmers, consumers and shippers.³⁶ The Project will implement new tie down structures to improve efficiency and further support investment in the waterway which will help keep costs low for energy, manufactured goods, and food for everyday U.S. consumers. The Project will aid in continuation of the state’s economic growth and ability to compete with the country wide market.

³³ [Muskogee County, Oklahoma U.S Census Bureau](#)

³⁴ [Environmental Justice Mapping Tool \(2020\)](#)

³⁵ [MKARNS Update \(2020\)](#)

³⁶ [Regional Economic Impact Study \(2015\)](#)

ECONOMIC COMPETITIVENESS

The primary goal of the Project is to ensure safe and efficient freight movement, as well as to provide long-term vitality of the waterway. Modernized mooring structures will replace obsolete anchors and ensure the Oklahoma segment of the waterway is prepared for flooding events, today’s freight demand, and future projected increases in demand for large and heavy vessels.

ODOT is committed to ensuring compliance with domestic preference laws, promoting the hiring of local contractors, and facilitating participation by socially and economically disadvantaged businesses. ODOT will not be pursuing a waiver for relevant domestic preference laws. Additionally, ODOT will promote the hiring of local contractors, and facilitate participation by socially and economically disadvantaged businesses. Programs like ODOT’s [On-Boarding Program](#) provide resources to DBE’s, Small Businesses, and Women Owned Businesses, for the purpose of development into viable, self-sufficient businesses capable of competing for and performing on, federally assisted highway projects. Area contractors are well experienced in construction techniques required for the Project.

This Project directly aligns with **Executive Order 14008, Tackling the Climate Crisis at Home and Abroad (86 FR 7619)**, by delivering modern and sustainable infrastructure that promotes the use of the marine highway that can deliver goods in a reduced carbon footprint compared to freight-truck or rail. Additionally, given the volume of goods that pass through the MKARNS, **an average of 11 tons of cargo or \$4 billion each year**, this presents an opportunity for good ‘paying jobs’ for those working the boats, docks, and nearby facilities. Overall, this MKARNS Oklahoma segment supports over 22,761 full and part-time jobs.

REGIONAL SIGNIFICANCE

There are three Foreign Trade Zones on the MKARNS at the ports of Little Rock, Muskogee, and Catoosa and at least 42 countries have commercial transactions via the MKARNS. In 2015, the waterway changed from a “moderate” to a “high-use” designated waterway which upgraded the “Marine Highway M40” from a “Connector” to a “Corridor” due to its five-year average of more than 3.3 billion-ton miles traveled. As of 2020, the MKARNS waterborne commerce totaled 4.9 million tons.

Oklahoma supplies agricultural products throughout the U.S. and internationally. In total, Oklahoma shipped \$5.4 billion worth of goods around the globe in 2017.³⁷



Eastern U.S. Marine Highways

³⁷ [World's Top Exports, Oklahoma's Top 10 Exports](#)

The MKARNS and Oklahoma ports provide an efficient flow of goods from production to the U.S. and foreign markets. In addition to Oklahoma-produced goods, surrounding great plain states bring products to the MKARNS for shipment because it is an economical and efficient way to bring goods to market. In 2017, approximately half of the tonnage traversing Oklahoma ports was directly related to Kansas shipments (approximately 2.9 million tons).³⁸ Top commodities traded on the MKARNS include, but are not limited to, iron, steel, chemical fertilizer, and soybeans.³⁹



MKARNS Barges

Current maintenance has not kept up with the growing freight demand. Investments in the Project is key for Oklahoma’s future waterway growth and economic vitality in the global and national trade market.

FLOOD IMPACTS ON ECONOMY

The flood event of 2019 brought record water levels along the MKARNS in Oklahoma. The event required a four-month closure of waterway, ultimately costing Oklahoma businesses and industry a total of \$20 million in state gross domestic product (GDP).⁴⁰ That event was categorized by the USGS to have an Annual Exceedance probability (AEP) of 0.6 percent, which defines the probability that a peak flood of this magnitude would occur at a given location in a given year. Changes in land use, construction of new dams, and changes to climate patterns can cause the designated AEPs and recurrence intervals for floods to change over time.⁴¹ As climate patterns continue to change, the 100-year flood of yesterday may not equate to the 100-year flood of today.⁴² The Project will replace mooring structures which have a combined probability of failure in a 100-year flood of approximately 1 percent. The new mooring structures are expected to reduce this risk of a barge breaking loose to a combined 0.01 percent during a similar flood. Infrastructure improvements are vital for the MKARNS to be more resilient and sustainable as flood events become more regular overtime.

EFFICIENCIES IN DOING BUSINESS

Waterways provide great cargo capacity and move freight more safely and efficiently than truck or rail. This generates valuable cost savings for businesses, farmers, and consumers.⁴³ Waterway transportation in Oklahoma helps to save money for farmers, manufactures and consumers which encourages future growth and trade.⁴⁴ As of 2020, the Port of Catoosa, Muskogee, and Oakley’s Terminal Muskogee serviced 72 percent of the total tonnage shipped inland of the Webbers Falls Lock and Dam on the MKARNS Oklahoma segment. Infrastructure improvements at these port locations are vital for cargo to continue to be able to be shipped efficiently.

³⁸ [MKARNS Presentation](#)

³⁹ [Waterway Fact Sheet \(2021\)](#)

⁴⁰ [Webbers Falls \(2019\)](#)

⁴¹ [Peak Streamflow and Stages at Selected Stream Stages on the Arkansas River in Oklahoma \(2019\)](#)

⁴² [Floods and Recurrence Intervals](#)

⁴³ [Regional Economic Impact Study \(2015\)](#)

⁴⁴ [Waterway Fact Sheet \(2021\)](#)


The Project will implement new tie down structures to improve efficiency and reduce wait times, which will save time and money for businesses that trade along the MKARNS system. Improved mooring structures will sustain a lowered risk factor during extreme weather conditions and allow vessels to remain secured. Overall, investments in modernized mooring structures will create long-term strength and security for Oklahoma’s economy and preparation for the U.S. to remain competitive in the global goods movement market.⁴⁵

LOCAL ECONOMY

Local industries along the MKARNS manufacture bulk commodities that provide direct access to global markets. Oklahoma is a major energy and agriculture producer, as well as a producer of manufactured goods. Northeast Oklahoma is home to the largest Maintenance, Repair, and Operation (MRO) facility in the world used to maintain American Airline airplanes. The facility alone employs more than 6,000 employees while the aerospace and defense industries in Oklahoma employ more than 120,000 employees statewide.⁴⁶ The aerospace industry is growing in Oklahoma and the manufactured goods needed to maintain this industry is commonly shipped on the MKARNS. The U.S. Chamber of Commerce identifies several essential commodities that are shipped to and from Oklahoma through the MKARNS including electronic products and equipment, agricultural and food products, and basic chemicals.

 **\$6 Billion**
of manufactured goods including computers and electronic products, appliances, machinery, electrical equipment and clothing

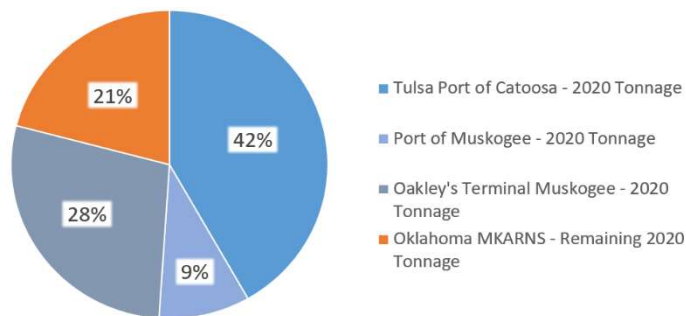
 **\$2.4 Billion**
of agricultural and food products destined for American supermarkets and for export

 **\$1.8 Billion**
of basic chemicals used in hundreds of consumer products from appliances to toys, from soap to cosmetics

FORECASTED GROWTH

The Project’s design of mooring infrastructure will allow for storage of empty or full barges at any elevation, including the extreme conditions and elevations experienced in the 2019 flood event. A total of 32 newly constructed moorings will accommodate future growth by increasing the capacity that each mooring structure can hold (number of barges), as well as adding to total mooring structures in the waterway.

The three Port locations that will receive mooring modernization from this Project make the majority of the total tonnage shipped on the Oklahoma MKARNS segment. In 2020, the three ports totaled 72 percent of the total tons of cargo shipped inland of Webbers Falls Lock and Dam.⁴⁷ Freight movement by waterway is expected to grow 35 percent by 2045, making mooring structure improvements at these port locations vital for the Oklahoma system to continue to operate efficiently and support future growth.⁴⁸



Oklahoma's 2020 Waterway Commerce

⁴⁵ [Waterway Fact Sheet \(2021\)](#)

⁴⁶ [Aerospace and Industrial](#)

⁴⁷ [Waterway Fact Sheet \(2021\)](#)

⁴⁸ [Oklahoma Freight Transportation Plan \(2018-2022\)](#)

STATE OF GOOD REPAIR

Each port has its own individual needs, but there is an overwhelming agreement that the single most important priority is to preserve the safe, reliable, and productive operation of the MKARNS itself. While the MKARNS currently offers strong performance and high reliability, it faces significant maintenance backlog. Critical maintenance needs are now approaching \$230 million dollars. Critical maintenance is described by the U.S. Army Corps of Engineers (USACE) as having a 50 percent chance of failure during the next five years.⁴⁹

Oklahoma freight traffic along the system has fluctuated between 3.8 and 6.2 million tons annually.⁵⁰ In current conditions, barges are moored to either monopile or dolphin moorings with ropes that are secured to kevels or bitts on the barge. Deadman anchors are also used to tie down barges with a wire cable. The existing structures do not accommodate current capacity needs, are obsolete during extreme flooding events, and require substantial maintenance and repair in their current condition.

The Tulsa Port of Catoosa completed a replacement study in 2019 which found that **all the evaluated dolphin structures showed signs of deterioration, with some in need of immediate repair or decommissioning.**⁵¹

The existing structures do not meet the standards defined to measure the state of good repair for capital assets as defined in 49 CFR § 625.41. Existing structures are no longer able to perform their designed function and no longer support water flows, elevations, and freight capacities experienced in the waterway today. The use of the existing structures poses an identified safety risk to the waterway and its infrastructure. During flood events, hundreds of barges will be at risk due to failing mooring structures. In addition to extreme events, the existing conditions also cost the ports significant annual maintenance costs.

On an average year without extreme flooding and weather events, ports incur approximately \$9,750 in the annual maintenance of the current mooring systems. However, these structures will be deemed obsolete as of 2025, which will leave the system without means to operate. The Ports are experiencing critical failures that will continue to lower capacity if no updated infrastructure is provided. Placing newly designed mooring structures at each designated project location will greatly reduce and nearly eliminate ongoing operations and maintenance costs associated with existing infrastructure repairs yielding a reduction of \$6,550 in annual savings. The new mooring structures will have a lifespan of 75 years, thus investing in a long-term solution.



Tower dolphin structure in disrepair at Tulsa Port of Catoosa



Tulsa Port of Catoosa – Platform Critical Failure

⁴⁹ [MKARNS Non-Routine Maintenance Items](#)

⁵⁰ [MKARNS Update \(2020\)](#)

⁵¹ [Mooring Dolphin Report \(2019\)](#)

PARTNERSHIP

ODOT and the Port Partners involved in this project including the Tulsa Port of Catoosa, Port of Muskogee, and Oakley’s Terminal Muskogee are committed to improving infrastructure conditions along the MKARNS to provide increased safety, reduced maintenance costs, and ensure operability of the waterway. ODOT has and will continue coordinating with the U.S. Army Corp of Engineers as their involvement and input will be key in successful delivery of this Project. The Tulsa District of U.S. Army Corps of Engineers has provided a letter in support of the Project which identifies that the Project directly aligns with their mission to support and improve commercial navigation on the MKARNS, and that the Project enhances their ability to succeed in their mission.

ODOT and the Port Partners work closely with regional organizations and local municipalities, businesses and freight stakeholders. More than a dozen entities have shown their support for the project by providing letters of support. This includes the regional planning agency, Oklahoma Chamber of Commerce, USACE, local municipalities, and various industry stakeholders. The Project is also strongly supported by the nearby Indian Nations. The Port of Muskogee is located within the historic tribal boundaries of the Cherokee and Muscogee Nations. The Cherokees, in fact, own the bed and banks of the Waterway and in 1985, the Port entered into a riverbed use agreement which authorized use of the riverbed property. Letters of Support can be found in the Letters of Support section on the [Project website](#).

TABLE 5: PROJECT PARTNERS

Project Partners					
					
Oklahoma Department of Transportation	Tulsa Port of Catoosa	Port of Muskogee	Oakley’s Terminal Muskogee		
Congressional Delegation					
					
U.S. Senator Jim Inhofe	U.S. Senator James Lankford	U.S. Representative Frank Lucas	U.S. Representative Tom Cole	U.S. Representative Kevin Hern	U.S. Representative Markwayne Mullin
Indian Nations					
Creek Nation • Cherokee Nation • Chickasaw Nation					

To take best advantage of economies of scale, ODOT will coordinate and let the project for all three port locations. ODOT will enter into contractual agreements with each of the Port Partners. Upon completion of construction, each respective Port Partner will take over operations and maintenance of the new mooring structures in perpetuity.

ODOT'S COMMITMENT TO WATERWAYS

The importance of the MKARNS to Oklahoma's economy is undeniable. ODOT and the Arkansas Waterways Commission jointly worked on a Regional Economic Impact Study that was conducted by the University of Arkansas Little Rock, Oklahoma State University and the University of Arkansas Mack-Blackwell Rural Transportation Center in Fayetteville. The study illustrates the estimated economic impact of the MKARNS to not only Oklahoma's and Arkansas' economies, but also the nation.

Due to the commitment of the Department to support the ports and the freight and shipping opportunities that are provided for the state, numerous transportation system improvement projects have been completed and are scheduled in their vicinities. Since 2000, the Department has awarded 186 contracts, including right-of-way and utility relocation efforts, totaling in excess of \$621.4 million within a 10-mile radius of the Port of Catoosa and Oakley's Terminal Muskogee. Further, within that same area an additional 40 projects totaling nearly \$266 million are scheduled for award in FFY 2019 through 2026, of which \$240.3 million are included in the 8 Year Construction Work Plan. Similarly, since 2000, the Department has awarded 53 contracts, including right-of-way and utility relocation efforts, totaling almost \$100.7 million within a 10-mile radius of the Port of Muskogee. An additional 22 projects totaling over \$147.3 million are scheduled for award in FFY 2019 through 2026, of which \$125.1million are included in the 8 Year Construction Work Plan for that same area.

Port of Catoosa & Oakley's Terminal Muskogee



Awarded Projects (since 2000)

\$701,689,672

Port of Catoosa & Oakley's Terminal Muskogee



Active Projects (between 2021 and 2028)

\$247,245,251

Port of Muskogee



Awarded Projects (since 2000)

\$116,719,585

Port of Muskogee



Active Projects (between 2019 and 2026)

\$127,471,698

INNOVATION

Maintenance needs along the waterway system in Oklahoma have continued to grow in value as infrastructure becomes obsolete or nears the end its design life. The Project will include innovations in corrosion protection systems and precast concrete structures which together will reduce capital and maintenance costs and increase safety. The use of these innovations methods and how they will each be incorporated into delivery of the Project is highlighted below.

INNOVATIVE TECHNOLOGIES

Corrosion Protection Systems

The Verdigris River and The Arkansas River intersect southeast of the Port of Muskogee. The Arkansas River flows are stronger than that of the Verdigris River and can speed up the deterioration process of infrastructure. To achieve a 50-year design life, corrosion protection systems will be considered during preliminary design for mooring structures to counteract damage that could be caused by each river’s chemistry. Corrosion protection coatings that will be considered include polypropylene cladding along with active and passive anode protection.

Precast Concrete

Precast concrete is a method of casting concrete structures using a reusable form and cured in a controlled environment. The structures are then transported and placed at the construction site.⁵² Use of precast concrete streamlines the construction process and often reduces costs. Concrete is the ideal material for this Project because it provides long-term performance in each river environment.

River Monitoring & Technology

Powered monopiles can support remote operated cameras including infrared monitors. The project will deploy a combination of waterway flow monitoring devices and technologies including lights, river gauge monitors, signage and other instrumentation. Lights and signage will increase waterway safety and waterway monitoring will improve information communications and awareness for port operators. Infrared remote cameras will increase safety and awareness of anchored vessels during extreme weather conditions and at night, particularly at the Grand River location.

Vessel Tracking Technology

The Project will implement GPS tracking technology, building on previous pilots in the waterway. GPS tracking of vessels will use GIS software for real time display of vessel locations. This technology can also enable automated alarms when vessels enter or leave specified geographic regions. This technology will further ensure navigational safety and security, especially in poor weather conditions.

⁵² [American Concrete Institute](#)

5 ENVIRONMENTAL RISK REVIEW

PROJECT SCHEDULE

A detailed project schedule that includes all major project milestones has been prepared anticipating RAISE funding.

FIGURE 4: PROJECT SCHEDULE



The Environmental and Permitting (NEPA) process is set to begin in Quarter 2 of 2021. The Executive Agreement (EA) process will follow a similar time frame beginning in the latter half of Quarter 2 of 2021 and ending in the beginning of Quarter 2 in 2022. An EA is required for this project because construction will occur in the waterway, which will require coordination with the Federal Highway Administration (FHWA). Because this Project will be replacing existing infrastructure, it will not be a complicated project to obtain this EA approval. The State Transportation Improvement Program (STIP) and Transportation Improvement Program (TIP) will start at the end of Quarter 2 in 2022 and end in Quarter 3 of 2022.

The schedule includes sufficient time to complete all reviews and approvals for RAISE funds to be obligated by the statutory deadline (September 30, 2024). Additionally, the schedule allows for construction to begin quickly upon obligation of funding with funds expended well in advance of the September 30, 2029 deadline. The project schedule will sufficiently accommodate all environmental reviews and permitting, state and local planning approvals, final design, and construction.

APPROVALS

Over the past year, ODOT has had multiple discussions with the Maritime Administration (MARAD) and FHWA to discuss the approach on how to proceed with the EA and who would be the lead agency. With these discussions, ODOT has made strides to better understand the

NEPA process while balancing the relationship to utilize FHWA Surface Transportation funds and having MARAD as a concurring agency on an FHWA Executive Agreement. There have been no approvals completed to date and further coordination with FHWA will be required for the Executive Agreement approval required for this project. This approval is set to begin in Quarter 2 of 2021.

TECHNICAL FEASIBILITY

ODOT and its partners have extensive experience in the MKARNS waterway. The technical feasibility of the monopile design is evidenced by decades of use on navigable rivers in the United States for mooring barges near bridges, locks, and dams. Monopiles have performed under high flow conditions and flood conditions at sites across the nation. Design of the monopiles will be in conformance to USACE engineering standards for navigation and flood risk reduction structures. The standards for design from the USACE include provisions and standards for safe design of the line hooks and check posts, corrosion protection, and the uncertainty of hydraulic loads. USACE has guidance in the form of Engineering Manuals (EM’s) that will be used for foundation design and reinforced concrete design of the monopiles. The engineering standards for design will include USACE publication EM 1110-2-2906 Design of Pile Foundations, EM 1110-2-2104 Design of Hydraulic Concrete Structures, and EM 1110-2-1604 Hydraulic Design of Navigation Locks.

ASSESSMENT OF PROJECT RISKS AND MITIGATION STRATEGIES

ODOT and the MKARNS Port Partners have carefully assessed and documented the potential Project risks and identified mitigation strategies for each:

TABLE 6: PROJECT RISKS AND MITIGATION STRATEGIES

Project Risk	Mitigation Strategy	Risk Category
Financial risk related to commitment of local match	ODOT and the Port partners have committed sufficient funds for the local Project match. Historically, ODOT has met every funding obligation for pervious grant applications. It is important to note that no additional reviews or approvals are needed from State legislature once note of the award has been granted.	Low
USACE Coordination	ODOT and the Port partners have closely coordinated with USACE and will continue to throughout the design and construction process. Permits for the Project will be obtained through the Army Corp of Engineers.	Low
Environmental Risk	ODOT has selected a consultant to complete the NEPA documentation and requirements and final design plans. As a port improvement project, it is anticipated that the NEPA class of action will be an environmental assessment (EA); however, there are minimal environmental risks and/or resource impacts because the project includes replacement of older existing mooring infrastructure in the same sites. The Project would also require State Historic	Medium

	Preservation Office (SHPO) review and concurrence with the adjacent Indian Nations.	
Cost of Materials	With COVID-19, the cost of construction and materials have increased. Historical construction cost tables demonstrate changes in costs. Completing this Project in a timely fashion will ensure the least amount of impact to costs over time.	Medium
Schedule	The Project has an aggressive schedule to receive necessary approvals and permits before obligation of funding can be provided, which will then lead to the construction of the project.	Low

6 BENEFIT COST ANALYSIS

The Project boasts a strong benefit-cost ratio (BCR) of **5.38** and an **internal rate of return of 19.39 percent**. At this rate, the proposed **total capital project cost of \$21.9 million (2019\$)** will produce a **positive net user benefit of about \$61.6 million (NPV)** over 20 years.

The Benefit Cost Analysis (BCA) shows that the Project will significantly improve safety in the event of a flood, reduce operations and maintenance (O&M) costs overtime, and provide loss of use savings. The categories that demonstrate these savings are defined as follows:

Operations & Maintenance: Accounts for the duties and labor associated with yearly operations and repairs of the existing structures at each port location compared to the savings that would occur once the modernized mooring infrastructure is constructed.

Flood Damage Savings: Includes analysis and probability of the risk of flood or damage from a barge breaking loose in a flood event, the environmental impacts associated with the diversion of waterway cargo to rail or truck, and travel time impacts of a detour route if the waterway were inoperable due to a flood event.

Loss of Use Savings: The savings calculated for this category of the BCA, include analysis of savings associated with total loss of use of the waterway. This accounts for the impacts to safety, environment, and the local economy.

Over the life of the Project, investment will produce the following benefits:

- **Operations & Maintenance** **\$205,793 net present value (NPV)**
- **Flood Damage Savings** **\$57,833 (NPV)**
- **Loss of Use Savings** **\$75,364,058 (NPV)**

If the Project is not constructed, the MKARNS risks a loss of barge capacity due to degraded mooring structures. Under this assumption, diverted goods (either to rail or truck) incur additional safety costs (crashes) and spillage.

The BCA was prepared in accordance with the 2021 FHWA BCA Guidance for Discretionary Grant Programs. The BCA dollar amounts were discounted by 7 percent to reflect the time value of money. Additional detail on the BCA methodology and results is located on the [Project website in the BCA Technical Memorandum](#).

7 APPENDICES

Additional Project resources are included on the project website at:

<https://oklahoma.gov/odot/progress-and-performance/federal-grant-awards/raise-grants/mkarns-mooring-modernization-project.html>

Specific items referenced in the application and uploaded onto the project website include:

2021 Waterway Fact Sheet

2020 MKARNS Update

MBTC 4001 MKARNS Final Research Report AHTD - Regional Economic Impact Study

Sustainability of Barge Transportation

Mooring Dolphin report 2019

MKARNS Non-Routine Maintenance Items

USGS Characterization of Peak Stream Flow (2020)

National Waterways Conference (2019)

Tulsa World

Waterways System

MKARNS 50th Anniversary (2021)

Regional Economic Impact Study (2015)

World's Top Exports, Oklahoma's Top 10 Exports

MKARNS Presentation (2019)

Webbers Falls (2019)

Peak Streamflow and Stages at Selected Stream Stages on the Arkansas River in Oklahoma (2019)

Floods and Recurrence Intervals

Aerospace and Industrial

Oklahoma Freight Transportation Plan (2018-2022)

American Concrete Institute - Definition of Precast Concrete

The McClellan-Kerr Navigation System is in Danger

10 years Later: Survivor Remembers I-40 Bridge Collapse

Federal Register Notice of Funding

Inland Marine Highway

Muskogee County, Oklahoma U.S Census Bureau

Environmental Justice Mapping Tool (2020)

2021 BCA Guidance