



---

# APPENDIX A:

## BENEFIT-COST ANALYSIS SUMMARY

---

**BUILD Grant Application**



*CONTAINER  
TRANSFER YARD  
DEVELOPMENT  
PROJECT*

# Appendix: BENEFIT COST ANALYSIS SUMMARY

## Table of Contents

Summary and Findings .....	1
Introduction.....	9
Methodology .....	9
Project Overview .....	11
Base Case- “no build scenario” .....	11
Build Alternative.....	12
Assumptions.....	12
Current Situation.....	12
Future Situation.....	13
Project Cost and Schedule .....	13
Project Costs .....	13
Project Funding.....	14
Project Schedule .....	15
Long Term Outcomes .....	15
Summary of the Benefit Cost Analysis.....	15
Affected Populations and Types of Impacts .....	16
Quantified Costs and Benefits Measurement of Long-Term Outcomes.....	17
State of Good Repair.....	18
Economic Competitiveness Benefits .....	18
Quality of Life and Environmental Protection.....	20
Safety benefits.....	21
Sources .....	23

## List of Tables

Exhibit 1: America’s Marine Highway Routes.....	1
Exhibit 2: Project Location.....	2
Exhibit 3: 200-mile radius from PMCRA.....	3
Exhibit 4: 500-mile radius from PMCRA.....	3
Exhibit 5: Full Three-Phase Buildout.....	5
Exhibit 6: Phase I Container Yard.....	6
Exhibit 7: Project Benefit Table.....	7
Exhibit 8: Summary of Pertinent Data, Quantified Benefits and Costs.....	8
Exhibit 9: Summary of Benefit Cost Analysis.....	9
Exhibit 10: Example of a Hostler/ Bomb cart configuration.....	11
Exhibit 11: Example of a COB configuration.....	11
Exhibit 12: Total Project Budget.....	13
Exhibit 13: Detailed Cost Estimate for Phase I.....	14
Exhibit 14: Project Funding Sources.....	14
Exhibit 15: Project Schedule.....	15
Exhibit 16: Project Benefit to Cost Ratio Analysis Summary.....	16
Exhibit 17: Decreased road maintenance.....	18
Exhibit 18: Operational Savings.....	19
Exhibit 19: Gallons of Fuel Saved.....	20
Exhibit 20: Conversion of Collision Statistics.....	21
Exhibit 21: Prevention of Fatalities.....	22

## SUMMARY AND FINDINGS

This Benefit Cost Analysis (BCA) is for the Paducah- McCracken County Riverport Authority (PM CRA) Container on Barge Phase I Project. The Project, located at the Riverport, is at the confluence of the Ohio and Tennessee Rivers in Paducah, KY. The BCA is developed to support the BUILD FY18 Grant Funding application as required by USDOT in their federal funding guidance.

In July 2016, the PM CRA secured a MARAD project designation for a Container on Barge Service (COB) along the M-55 and M-65 of Marine Highway System. As of July 2018, the total cost of the three-phased development plan is estimated at \$27.5 million. The current BUILD FY18 grant application of \$10.7 million is for Phase I: Container Transfer Yard and Equipment needed for the initial start-up COB service. Phase I funding will be invested in the initial infrastructure required to initiate weekly COB service between PM CRA and the blue water ports in the Gulf. Phase I includes investing in a 9-acre secured container yard with a multi-lane truck gate and handling equipment.

*Exhibit 1: America's Marine Highway Routes*



### *About the Project*

The Paducah-McCracken County Riverport Authority (PM CRA) intends to create the first Container on Barge service in the Ohio watershed, and in the state of Kentucky. Container on Barge (COB) is straightforward: it is putting containerized cargoes on barges for transport along the marine highway system (Exhibit 1 above). The PM CRA is ideally located to bring COB service. It is located at the confluence of the Ohio and Tennessee Rivers, and only 40 miles northeast of the confluence of the Ohio River with the Mississippi River. It is also the northern most ice-free river port on the river.

### *Exhibit 2: Project Location*



The PM CRA will create a Container Transfer Yard on port property. The Container Transfer Yard project will allow containerized cargoes to be stored safely and efficiently. This will support the volumes for the new COB at the levels estimated for Phase I of the development plan. For this analysis, the start-up volume is estimated at a conservative 168 outbound containers per week. This volume will entail 5 barges per week that will be combined into a “tow” that will travel 6 days to the Gulf. The “tow” will be unloaded at the Port of New Orleans, LA. At this level, the estimated annual volume is 8,740 FEUs (forty-foot equivalent units). This equates to an estimated 260 barges per year (in weekly calls) during the first three years of service.

These volumes, which are considered conservative, were derived from current demand data, and cargo forecasts of a new industrial project, still considered confidential, that is relocating to Western Kentucky. That project will use COB service.

The Container Transfer Yard project will be constructed on nine acres of brownfield property that PM CRA currently owns. BUILD grant funding will be used to develop 27,150 square yards of 12” concrete paving, security fencing, lighting, a three-truck lane interchange – (expandable to five lanes to accommodate future volume growth), and the purchase of three reach stackers and three-yard hustlers with bomb carts. The yard is designed to hold 450 FEUs (equal to 12.5 barges) at one time with an annual capacity of 23,400 FEUs.

This project will have a significant and immediate impact on a four-state region (Kentucky, Illinois, Tennessee, and Missouri) and an indirect impact on surface transportation in a five-state region (Arkansas, Tennessee, Alabama, Mississippi, and Louisiana). Shippers will have the option of moving containerized cargo by safe, economical, and environmentally-friendly barge service to meet their international and domestic customer’s needs. The initiation of a COB service at PMCRA will have a positive economic impact across a 200-mile radius that encompasses 260 counties with a population of 14,166,390 people. The COB service will provide a cost-effective transportation option that will spur expansion of current and new

manufacturing, distribution centers and construction sectors in the Jackson Purchase region.

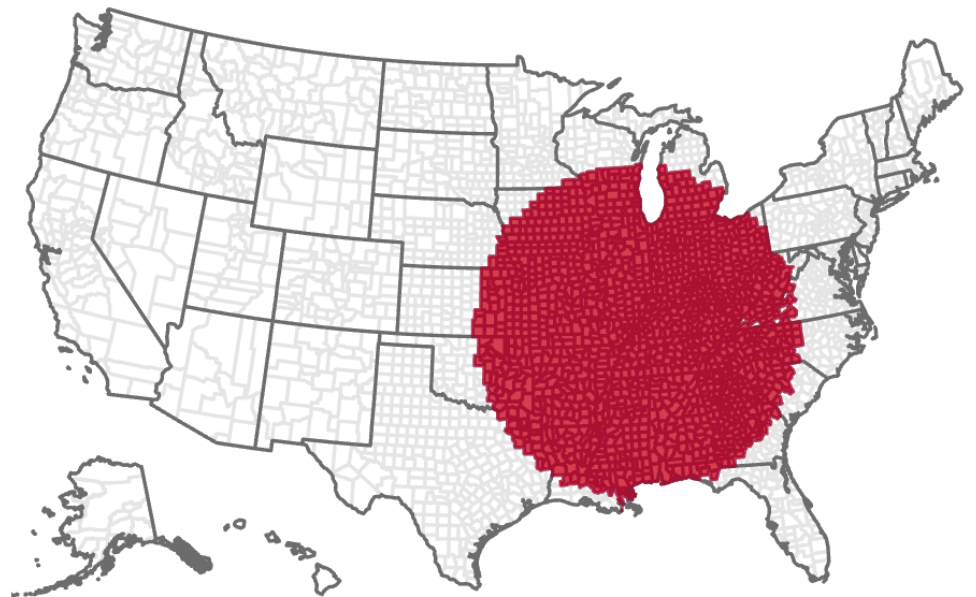
Economic development resulting from the investments in the River Port and Paducah Commons will improve the quality of life and generate jobs in this mostly rural area. New job opportunities will allow rural residents to create wealth. The project will catalyze new, family wage employment opportunities for under and un-employed residents in the region.



*Exhibit 3: 200-mile radius from PMCRA*

The benefits may well expand beyond the 200-mile catchment area. For example, there are 103,484,177 people living in 1415 counties within a 500-mile (1 day’s drive) catchment area. This is well within the area that will likely benefit from the project and encompasses roughly one-third of the US population. Major urban centers that could be accessed within that 500 miles include:

- Atlanta
- Chicago
- Columbus
- Detroit
- Indianapolis
- Kansas City
- Nashville
- Milwaukee
- St. Louis



*Exhibit 4: 500-mile radius from PMCRA*

The PMCRA Container Transfer Yard Project (Project) is a stand-alone project that creates independent utility to

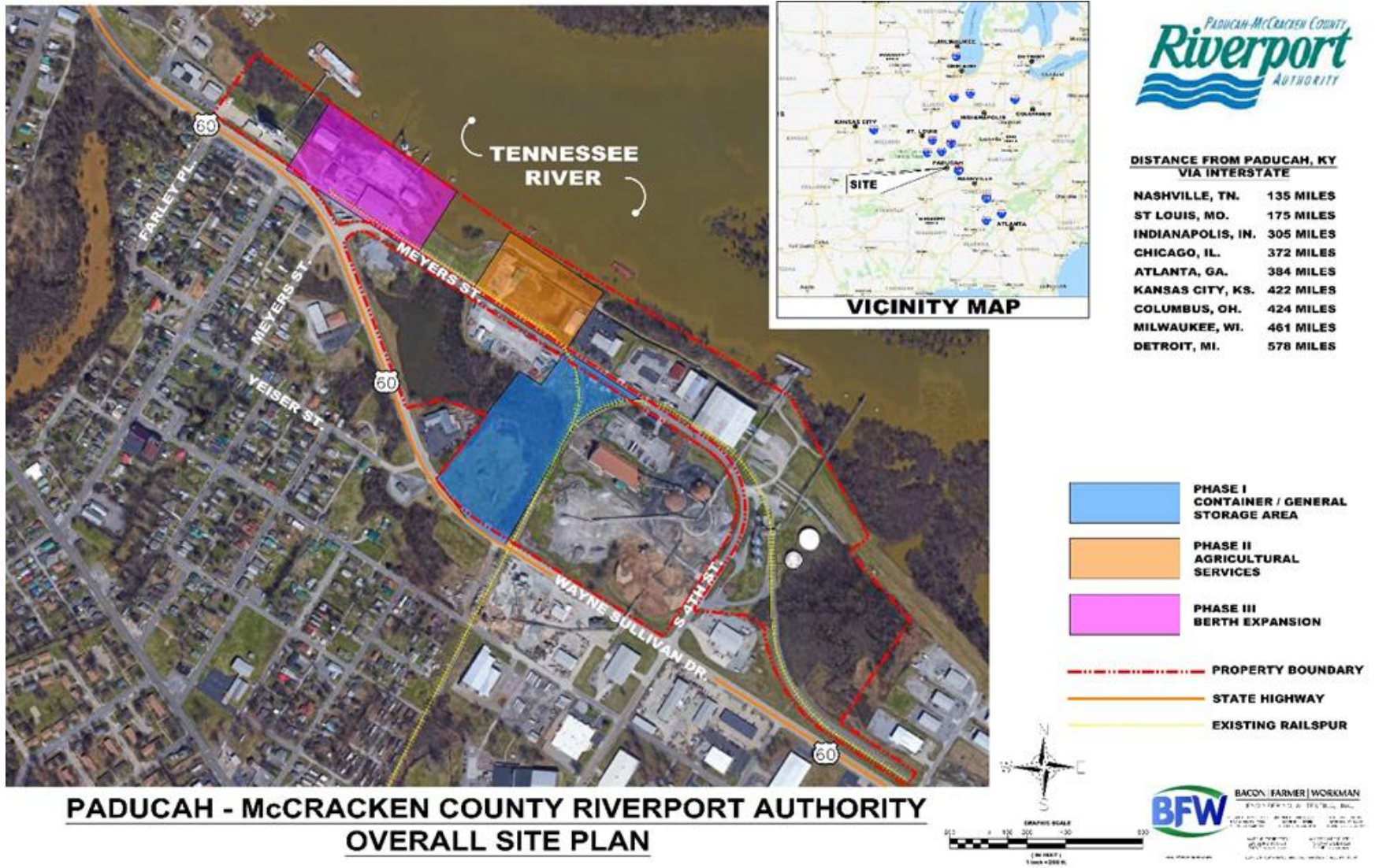
meet current and future river-dependent shipping needs of the region. This project is necessary for the region to meet the needs for increasing freight volumes generated from industrial areas in the region. And, it is a key element in retaining and growing new economic activity necessary to meet economic development goals.

The Project will provide regional economic prosperity well beyond the Paducah-McCracken County area. Expanded growth in freight traffic has heightened the need for modern improvements and transportation options. The project is designed to be multi-modal and accommodate efficient and cost-effective use of the local truck, rail and water transportation modes. It provides flexibility and options for the local and regional shippers.

The Project will:

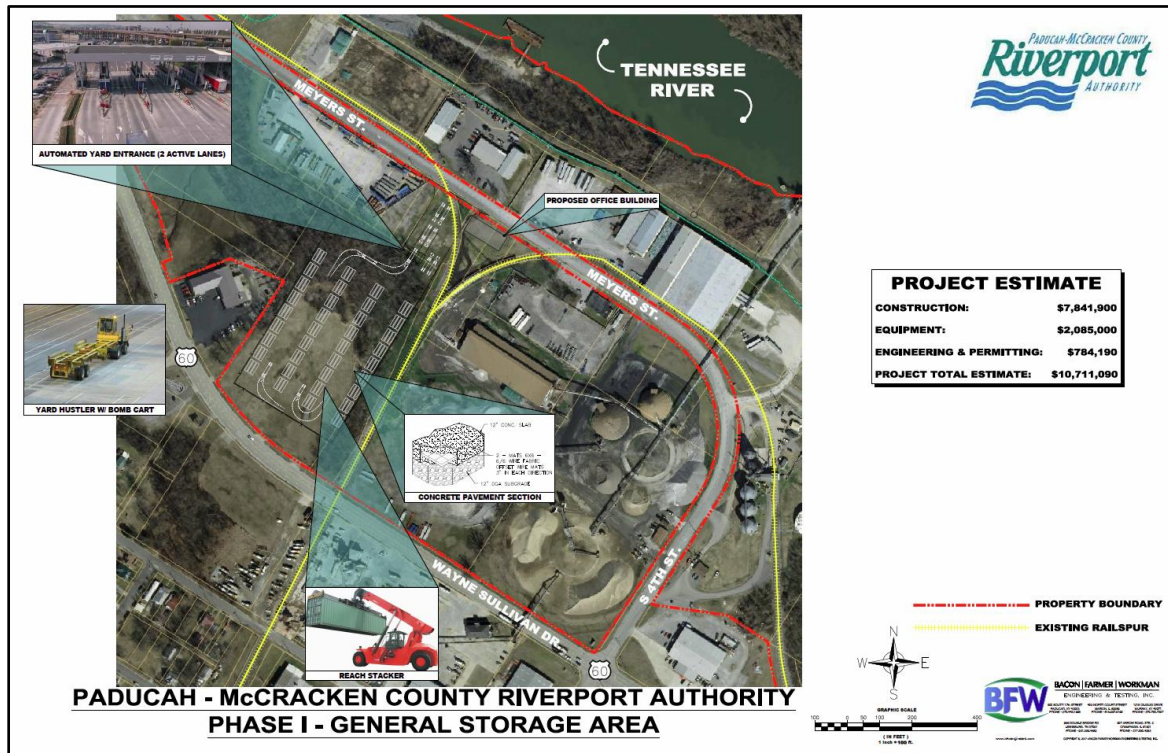
- Provide lower cost, reliable and environmentally friendly transportation options for the Paducah-McCracken and catchment area industries.
- Provide more reliable, predictable service impacts for moving containerized cargo to a deep water, international port.
- Reduce growing truck congestion on regional Interstate Highway system, reducing fuel usage, emissions and improving safety on the two key Interstate Highways.

Exhibit 5: Full Three-Phase Buildout





*Exhibit 6: Phase I Container Yard*



This analysis shows that the public benefits generated from the completion of this project will exceed the cost of this Project. Thus, the Project can be considered cost-effective.

The public benefits include: Shipper savings on transportation costs; reduced future costs to repair wear and tear on roads and highways due to fewer annual truck trips (reduced vehicle miles traveled); and reduction of fatal accidents due to diverting truck traffic to barge.

*Exhibit 7* (page 7) below summarizes the improvements and associated economic public benefits.

**Example Routing Chosen for the Analysis**

There are many possible origination or destinations for containerized volume moving through this improved container yard. One cannot model all potential destinations in this analysis. For analysis purposes, the No-BUILD route is 594 highway miles from Paducah, KY to the Port of New Orleans, LA. The BUILD water-route is the 905 miles from Paducah-McCracken to New Orleans. These two representative routes are used to calculate, and compare, the public benefits achieved when barge transportation is used to reduce vehicle miles travelled on the National Highway System.

Exhibit 7: Project Benefit Table

Project Matrix for PMCRP COB Phase I: Container Yard and Equipment Project						
Current Status/ Base line (No Build) & Problem to be Addressed	Change to Baseline/ Alternatives	Type of Impacts	Population Affected by Impacts	Economic Benefit	Summary of Results Undiscounted (Mill \$ 2017)	Tab and pg. in BCA Narrative
<p>Inefficient Transportation options for containerized cargo have caused the Paducah McCracken County Riverport Authority to request and be awarded a Project Designation for a new Container on Barge service between Paducah, KY and the blue water ports of Mobile, AL and New Orleans, LA. According to the U.S. Maritime Administration’s information on Marine Highway 70 and Marine Highway 65, which merge at Paducah, truck volumes are expected to reach 25,000 per day on each of those two highway corridors by 2035.</p>	<p>Building a 9-acre secured trans-load area for containers at Paducah-McCracken Riverport will allow future long-haul truck trips to be diverted to container on barge (COB). This landside investment of the container yard and equipment will allow the Port to efficiently and cost effectively move containers on a COB service to the gulf.</p>	Reduced VMT on highways and roadways	Vehicle drivers	Monetized value of reduced truck miles generating fuel savings	Estimated \$40 million of fuel savings included in Shipping cost differential	Gallons & MT CO2 Exhibit 19 Page 21
		Reduced pollutant emissions	Local, state, region and national populations	Monetized value of emission reductions due to reduced trucking	Not Monetized	Gallons & MT CO2 Exhibit 19 Page 22
		Improved efficiency in freight modal choice by switching freight to barge vs. truck	Freight Shippers utilizing the So. Terminal	Monetized value of reduced operational costs to shippers	Estimated \$80 million operational costs savings to shippers	Operational Savings Exhibit 18 Page 20
		Reduced road maintenance cost due to the reduction of VMT on highways	Government	Monetized value of reduced road maintenance costs to due to reduced VMT	Estimated \$18 million of Road maintenance savings to states and regions	Road Maintenance Exhibit 17 Page 19
		Reduced potential fatalities on highways	General public	Monetized value of the reduction of potential fatalities on roadways to due to reduced VMT	Estimated \$16 million of reduced fatalities from reduction of Vehicle Miles Traveled (1.64 lives saved)	Reduction in Fatalities Exhibit 21 Page 23

The analysis period used for estimating benefits and costs is 25 years. This includes the base year (2017), two years of funding /obligation, two years of construction and 20 years of operation after the completion of the Yard in 2021. It also includes a residual value after the final year. The \$10.7 million for this Phase is expected to be funded through federal sources. A summary of relevant data as well as the Total Benefits and Total Costs used to derive the benefit costs analysis for the project are shown in *Exhibit 8* below.

*Exhibit 8: Summary of Pertinent Data, Quantified Benefits and Costs*

Calendar Year	Total Direct Beneficiaries (Reduction in Truck VMT)	Total Direct Benefits (2017\$)	Total Initial Costs (2017\$)	Maintenance Costs (2017\$)	Residual	Undiscounted Net Benefits (2017\$)	Discounted Net Benefits (7%)
2017							
2018							
2019							
2020			(\$4,313,045)				
2021			(\$6,398,045)				
2022	5,191,560	\$4,070,553		(\$53,555)		\$4,070,553	\$2,902,248
2023	5,191,560	\$4,070,553		(\$53,555)		\$4,016,997	\$2,712,381
2024	5,191,560	\$4,070,553		(\$53,555)		\$4,016,997	\$2,534,936
2025	6,229,872	\$4,895,374		(\$53,555)		\$4,841,819	\$2,849,152
2026	6,229,872	\$4,895,374		(\$53,555)		\$4,841,819	\$2,662,759
2027	7,476,084	\$5,885,349		(\$53,555)		\$5,831,794	\$2,991,813
2028	7,476,084	\$5,885,349		(\$53,555)		\$5,831,794	\$2,796,087
2029	7,476,084	\$5,885,349		(\$53,555)		\$5,831,794	\$2,613,165
2030	7,476,084	\$5,885,349		(\$53,555)		\$5,831,794	\$2,442,211
2031	7,476,084	\$5,885,349		(\$53,555)		\$5,831,794	\$2,282,440
2032	8,223,930	\$6,479,428		(\$53,555)		\$6,425,873	\$2,348,443
2033	8,223,930	\$6,479,428		(\$53,555)		\$6,425,873	\$2,194,807
2034	8,223,930	\$6,479,428		(\$53,555)		\$6,425,873	\$2,051,221
2035	8,223,930	\$6,479,428		(\$53,555)		\$6,425,873	\$1,917,029
2036	8,223,930	\$6,479,428		(\$53,555)		\$6,425,873	\$1,791,616
2037	9,046,620	\$7,132,963		(\$53,555)		\$7,079,407	\$1,843,293
2038	9,046,620	\$7,132,963		(\$53,555)		\$7,079,407	\$1,722,704
2039	9,046,620	\$7,132,963		(\$53,555)		\$7,079,407	\$1,610,004
2040	9,046,620	\$7,132,963		(\$53,555)		\$7,079,407	\$1,504,676
2041	9,046,620	\$11,446,008		(\$53,555)	\$4,313,045	\$11,392,452	\$2,256,542
<b>Total</b>	<b>151,767,594</b>	<b>\$123,804,150</b>	<b>(\$10,711,090)</b>	<b>(\$1,071,109)</b>	<b>\$4,313,045</b>	<b>\$122,786,597</b>	<b>\$46,027,526</b>

The BCA presented below shows that, at a 7% discount rate, the project will generate \$46.4 million in discounted net benefits and \$8.7 million in discounted capital costs. Therefore, the Project generates a Net Present Value (NPV) of \$38.0 million and a Benefit/ Cost Ratio of 6:1 (at 7% discount rate).

Exhibit 9 below summarizes the Long-term Outcomes calculated in this BCA.

*Exhibit 9: Summary of Benefit Cost Analysis*

	Present Value of Capital Costs	PV of Total Benefits	Net Present Value	Benefit/ Cost Ratio
<b>PMRCA Phase I</b>				
Discounted at 7%	(\$8,401,767)	\$46,027,526	\$37,625,758	6:1

**Introduction**

This document provides detailed technical information on the economic analyses conducted in support of a grant application for the PMRCA Phase I project.

The Methodology section introduces the conceptual framework used in the BCA. The Project Overview provides an overview of the project, including a brief description of existing conditions and the proposed alternative. Assumptions describes the current and future situations used in the analysis. Project Cost and Schedule provides a summary of cost estimates and schedule. The Long-Term Outcomes section discusses the general assumptions used in the estimation of project costs and benefits, Specific data elements and assumptions pertaining to the long-term outcome selection criteria are summarized in this section. Estimates of the project’s Net Present Value (NPV), its Benefit/Cost ratio (BCR) and other project evaluation metrics are also discussed.

**Methodology**

A Benefit-Cost Analysis (BCA) is a conceptual framework that quantifies, in monetary terms, as many of the costs and benefits of a project as possible. Benefits are broadly defined. They represent the extent to which people impacted by the project are made better-off, as measured by their own willingness-to-pay. In other words, central to BCA is the idea that people are best able to judge what is “good” for them, i.e. what improves their well-being or welfare. A BCA also adopts the view that a net increase in welfare (as measured by the summation of individual welfare changes) is a good thing, even if some groups within society are made worse off. A project or proposal would be rated positively if the benefits to some are large enough to compensate the losses of others.

Finally, a BCA is typically a forward-looking exercise, seeking to anticipate the welfare impacts of a project or proposal over its entire life cycle. Future welfare changes are weighted against today’s changes through discounting, which is meant to reflect society’s general preference for the present, as well as broader inter-generational concerns.

The specific methodology developed for this application was designed using the above BCA principles and is consistent with the June 2018 Discretionary Grant BCA guidelines. The methodology involves:

- Establishing existing and future conditions under the build and no-build scenarios;
- Assessing benefits with respect to each of the five long-term merit criteria identified in the Notice of Funding Opportunity (NOFO): Safety, State of Good Repair, Economic Competitiveness, Environmental Protection and Quality of Life;
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement;
- Using U.S. Department of Transportation (USDOT) guidance for the valuation of travel time savings, safety benefits and reductions in air emissions, while relying on industry best practice for the valuation of other effects;
- Discounting future benefits and costs with the real discount rates recommended by the USDOT (7%).

## Project Overview

Requested BUILD funds of \$10.7 million are to construct and equip a 9-acre COB container yard at Paducah-McCracken County Riverport Authority. The project will enable the PMCRA to efficiently secure containers and provide Container on Barge service to multiple locations, including the Port of New Orleans. The flow of the cargo will include the trucks arriving at the truck gate to be checked into the new Container Yard, where the reach stackers will unload the truck and place the container in the appropriate container stack until it is ready to be loaded onto the barge. When the barge has arrived and is ready to be loaded, the reach stackers will load the container from the container stack onto the hostler/ bomb cart to be driven across the road to the side of the barge. Once at the barge, the PMRCA cranes will be utilized to load the container onto the barge. When all containers scheduled for the tow are loaded, the multiple barges will be assembled into a tow which the tug will then take down river and deliver to the Port of New Orleans.



Exhibit 10: Example of a Hustler/ Bomb cart configuration



Exhibit 11: Example of a COB configuration

When the Project is completed, cargo will be able to efficiently move by barge on the river systems instead of truck on the road network. This project will have a significant and immediate impact on a four-state region (Kentucky, Illinois, Tennessee, and Missouri).

*Project comparison is with the most likely alternative and a "no build" scenario*

### Base Case- “no build scenario”

The base case in the BCA represents the current “no build” state of the yard. Currently, there is not a secure yard to hold containers waiting to be loaded to barge for transit downriver to the Gulf. Accordingly, all containerized cargo must be moved by truck to the Gulf. The transport is usually by dry van which then must be trans-loaded in New Orleans to a container for export.

## **Build Alternative**

Currently, there is not a COB service in the Ohio watershed to access the Gulf of Mexico (through the Port of New Orleans). Nor is there any COB yard/ service in the state of Kentucky. The yard when built will have the capacity of 23,400 annual FEU's within the footprint. The yard will be supported by three reach stackers and three-yard hustler/bomb cart combinations. This equipment will be used to stack the boxes in the yard and delivery the outgoing boxes to dock side.

The Build alternative, accordingly, evaluates the costs and benefits of diverting the containerized freight that the new yard can handle from truck to barge (for transport to the Port of New Orleans).

To be conservative in the analysis, it is assumed that the yard will provide a storage capacity of 450 boxes with an estimated annual capacity of 23,400 boxes when the containers in the yard are turned each week. This capacity can increase if the boxes in the yard turn more quickly which can be easily accomplished by extending working hours (i.e. adding more shifts). For the analysis, the COB service starts in 2022 after construction is complete, with 168 containers per week loading onto 5 barges. Those barges are moved in one tow to New Orleans on a weekly basis. Volume is held at that level for years 1-3, increasing to 202 FEUS per week for years 4 and 5, increasing to 242 FEUs/ week in years 6-10, increasing to 266 per week in years 11-15 and to 293 containers per week in years 16-20.

## **Assumptions**

The proposed Project is compared with a no build alternative. The analysis includes total project costs of the remaining design, environmental documentation, permitting, construction and equipment purchase. The Project engineers July 2018 estimate of total project cost is \$10.7 million.

The BCA analysis period is 25 years, beginning with the base year of 2017 and including a residual value of \$4 million in 2041.

Estimation of costs and benefits are limited to the 2017 to 2041 period. The analysis incorporates assumptions based upon the availability of the new yard opening no later than January 2022. Yard personnel will be trained, and final placement of containers planned prior to opening of the yard.

The estimated barge loads use 36 FEUs per barge and were rounded up to include whole barges.

## **Current Situation**

The demand to move freight in and out of the region has been slower than the US average growth rate per year. Congestion is increasing, and reliability of moving truck freight has eroded. By 2035, without another alternative, it is estimated that sections of the regional Interstate Highway network will reach 25,000 trucks per day. Additional capacity for moving

freight is urgently needed to meet future demands of the region’s industries. Further, additional capacity is needed to foster economic growth and development goals.

### Future Situation

The ability to provide COB capacity in this service area, will provide shipper an option to move their containerized cargo by water to save the millions of dollars per year in transportation costs and allows the users to experience the cost per ton efficiency of barging. Moreover, the catchment area potentially served by the service could include an area with one-third of the U.S. population.

The barge move is estimated at an average of a 905-mile trip from the PMCRA to New Orleans, LA. This analysis should not be considered a modal conversion as it is in response to future demand for water service to PMCRA service area not a direct conversion of cargo from truck to barge.

### Project Cost and Schedule

#### Project Costs

*Exhibit 12: Total Project Budget*

Project Budget	in Millions	%
Construction	\$7.1	66%
Equipment	\$2.1	20%
FE/ CN Engineering	\$0.8	7%
Contingency	\$0.7	7%
<b>Total Cost</b>	<b>\$10.7</b>	<b>100%</b>

The PMCRA requests \$10.7 million in federal funding for project construction and equipment.



*Exhibit 13: Detailed Cost Estimate for Phase I*

<b>Paducah McCracken County Riverport Authority</b>				
Phase 1 - General Container Storage Area				
Preliminary Cost Estimate				
10-Jul-18				
Construction Item	Unit	Quantity	Unit Price	Extended Price
Earthwork	CY	20000	\$ 20.00	\$ 400,000.00
Storm Piping	LF	1500	\$ 110.00	\$ 165,000.00
Storm Inlets	Each	11	\$ 8,000.00	\$ 88,000.00
Concrete Paving	SY	27150	\$ 200.00	\$ 5,430,000.00
Container Anchors	Pair	9	\$ 4,000.00	\$ 36,000.00
Automated Yard Entrance	Each	2	\$ 450,000.00	\$ 900,000.00
Lighting	LS	1	\$ 70,000.00	\$ 70,000.00
Fencing	LF	2000	\$ 20.00	\$ 40,000.00
Sub Total Construction				\$ 7,129,000.00
Contingency				\$ 712,900.00
<b>Total Construction</b>				<b>\$ 7,841,900.00</b>

Equipment	Unit	Quantity	Unit Price	Extended Price
Yard Hustler w/ Bomb Cart	Each	3	\$ 160,000.00	\$ 480,000.00
Reach Stacker	Each	3	\$ 535,000.00	\$ 1,605,000.00
<b>Total Equipment</b>				<b>\$ 2,085,000.00</b>

Engineering and Permitting				\$ 784,190.00
----------------------------	--	--	--	---------------

Total Preliminary Project Estimate \$ 10,711,090.00

**Project Funding**

*Exhibit 14: Project Funding Sources*

Project Funding	in Millions	%
BUILD Request	\$10.7	100%
Local Match	\$0.0	0%
	<b>\$10.7</b>	<b>100%</b>

*Exhibit 14* above, shows the break out of the project funding. The grant application requests \$10.7 million (100%) in Federal support due to the economic condition of the Port district. The PMCRA intends to use Phase I to build a revenue stream that will allow the Riverport to self-fund Phases II and III. Due the investments that PMCRA has made recently in equipment and other needed improvements, the PMCRA does not currently have any available funds to provide a non-federal match to the Federal request.

## Project Schedule

### Exhibit 15: Project Schedule

Major Activity	2018					2019					2020					2021															
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	
BUILD Grant Application	■																														
BUILD Grant Award					■																										
Grant Agreement Activities						■	■	■	■	■	■	■	■	■																	
Final NEPA Approvals										■	■	■	■	■																	
Engineering Design										■	■	■	■	■																	
Construction Bidding															■																
Equipment Bidding																			■												
Construction Contract Award																			■												
Equipment Award																															
Pre-Construction Meeting																															
Construction																															
Equipment Delivery/ Training																															
Construction Closeout																															
Equipment Startup																															
Final Inspection and Closeout																															

## Project Completion

Federal grant funds will enable PMCRA to complete the Phase I Project. The schedule above has a place holder for funding award and obligation. It assumes that once awarded, and obligation discussion start, the environmental documents can be completed in a timely matter to obligate by November 2019. Based on discussions with PMCRA’s consulting engineers, it is believed that a Categorical Exclusion can be achieved for Phase I because the Project is on the dry side of the levee and surveys have shown no cultural or wetland issues.

The PMCRA is finalizing working design and engineering to be prepared for Project construction to start as early as April 2020. That assumes obligation of funds by November 30, 2019. The design team foresees no complicating or project ending factors. However, to mitigate any unforeseen risk, a \$0.7 million contingency fund has been budgeted and established for the Project. The project schedule illustrates that all contract bid documents will be finalized quickly.

With BUILD funding, the full Project can be completed by fall 2021, well within the 18-month window from obligation to construction required under BUILD guidelines.

## Long Term Outcomes

### Summary of the Benefit Cost Analysis

Exhibit 16 displays the summary of the BCA. Quantified benefits include the transportation cost savings of modal conversion to barge, reduced emissions due to reduced truck miles, better fuel efficiency, and improved safety by the reduction of potential accidents anticipated from the reduction of truck vehicle miles traveled when this Project is completed.

This BCA follows guidance set forth in the Benefit-Cost Analysis Resource Guide and the 2018 Benefit-Cost Analysis Guidance for Grant Applications.

A **discount rate of 7 percent** was used, following the Discretionary Grant BCA Resource Guide updated June 2018. Bottom line, the present value (PV) of capital costs in 2017 dollars is \$8.4

million and the PV of net benefits is \$46.4 million. This rate yields conservative estimates of NPV and benefit cost ratio. This is appropriate because funds are public and would be spent on other public projects. This analysis yields a NPV of \$38.0 million and a benefit-cost ratio of 6:1. The greatest share of benefits is Economic Competitiveness from operational savings as a result of the use of barges versus trucks for the forecasted freight shipments.

*Exhibit 16: Project Benefit to Cost Ratio Analysis Summary*

Benefit Cost Analysis Summary					
Long-term Outcomes	Social Benefit	Inputs	Value	Monetized Value	
				Discount Rate 7%	Discount Rate 3%
Quality of Life	Fuel savings due to reduced miles traveled by cargo using Rail from the terminal vs. Truck	Gallons of fuel saved	12.6 million gallons of fuel saved with modal shift to Barge Benefit not included as the fuel saving is accounted for in Econ. Comp.	\$ -	\$ -
Economic Competitiveness	Operational cost savings	Savings of barge transport vs. truck transport	\$339/ container	\$ 32,767,385	\$ 55,648,497
State of Good Repair	Reduction of maintenance on US Roads & Hwys, Consistent with State and Regional Plans	Maintenance, preservation and upgrade savings of Highways	152 million VMT reduced off the highways	\$ 6,889,850	\$ 11,700,958
Environmental Protection	Environmental Benefits from Reduced Emissions by modal change to barge	CO <sub>2</sub> cost savings	112,073 metric tons of CO <sub>2</sub> saved	\$ -	\$ -
Environmental Protection	Environmental Benefits from Reduced Emissions by modal change to barge	Non-CO <sub>2</sub> Emission cost savings	Not Calculated		
Safety	Reduced fatalities from reduction of VMT	Fatality cost savings of 1.64 fatalities	\$15.7 million saved	\$ 5,952,830	\$ 10,109,628
Total Cost				<b>(\$8,401,767)</b>	<b>(\$9,631,627)</b>
Total Benefits				\$46,027,526	\$ 78,872,896
<b>Net Present Value</b>				<b>\$ 37,625,758</b>	<b>\$ 69,241,268</b>
<b>Benefit to Cost Ratio</b>				<b>6:1</b>	<b>8:1</b>

The use of barge service for future cargo shipments eliminates at least 152 million commercial truck miles off the local roads and highways. This reduction in commercial vehicle miles reduces the probability of fatal accidents by 1.64 fatalities during the 20-year post construction analysis period.

### Affected Populations and Types of Impacts

Personal vehicle users, commercial carriers, and local residents are the three main groups benefiting from improved mobility due to fewer trucks on local and regional roads and highways. The following description and tables present costs and benefits for each type of impact that could be monetized:

Quantified benefits include:

- Improved economic competitiveness based upon the reduction of transportation costs for the Paducah- McCracken regional shippers;
- Reduction of gallons of fuel used to transport cargo;
- Improved state of repair of the roads and highways, due to the reduction of truck miles;
- Reduced emissions due to lower vehicle miles traveled by commercial trucks;
- Improved safety, resulting in reduced economic costs of potential fatalities on the highway due to the reduced VMT of the trucks.

Costs include construction and lifecycle costs. Construction costs are best available estimates at the 30% design level as of July 2018. This analysis anticipates general operations and maintenance costs. Operation cost of the yard will be covered by the \$90 / box throughput rate charged by the Port. Unquantified benefits include:

- Benefits to the regional community by increased job opportunities among the industries within the Port’s service area;
- Benefits to the area citizens of the increased mobility and connectivity within region for citizens and visitor trying access to work centers, educational sites, and daily services when road congestion is improved by the completion of the Project.

### **Quantified Costs and Benefits Measurement of Long-Term Outcomes**

The largest positive benefits at a 7% discount rate result is from the economic competitiveness criteria. The availability of COB service to aid industries in the region will reduce 3.8 billion-ton miles off the public roads and highways. The reduction in truck VMT results in an annual operating savings of approximately \$87 million from lower ton/mile transportation costs due to the energy efficiency of barges versus truck. This outcome accounts for 71% of the total benefits. Over the 20-year analysis period, it is estimated that 13 million gallons of fuel will be saved resulting in \$40 million in fuel savings. The monetized benefit of saving 1.64 fatalities due to the reduction of VMT generates a Safety benefit of \$16 million (13% of the benefits). Saving in road maintenance from the improvements account for the remaining \$18 million or 15% of the monetized benefits.

## State of Good Repair

### Exhibit 17: Decreased road maintenance

Decreased road maintenance due to construction of Project and use of barges			
Year	Truck Miles saved	Maintenance rate/ mile	Total savings
		\$ 0.12	
2020	-	\$ 0.12	\$ -
2021	-	\$ 0.12	\$ -
2022	5,191,560	\$ 0.12	\$ 622,987
2023	5,191,560	\$ 0.12	\$ 622,987
2024	5,191,560	\$ 0.12	\$ 622,987
2025	6,229,872	\$ 0.12	\$ 747,585
2026	6,229,872	\$ 0.12	\$ 747,585
2027	7,476,084	\$ 0.12	\$ 897,130
2028	7,476,084	\$ 0.12	\$ 897,130
2029	7,476,084	\$ 0.12	\$ 897,130
2030	7,476,084	\$ 0.12	\$ 897,130
2031	7,476,084	\$ 0.12	\$ 897,130
2032	8,223,930	\$ 0.12	\$ 986,872
2033	8,223,930	\$ 0.12	\$ 986,872
2034	8,223,930	\$ 0.12	\$ 986,872
2035	8,223,930	\$ 0.12	\$ 986,872
2036	8,223,930	\$ 0.12	\$ 986,872
2037	9,046,620	\$ 0.12	\$ 1,085,594
2038	9,046,620	\$ 0.12	\$ 1,085,594
2039	9,046,620	\$ 0.12	\$ 1,085,594
2040	9,046,620	\$ 0.12	\$ 1,085,594
2041	9,046,620	\$ 0.12	\$ 1,085,594
	151,767,594		\$ 18,212,111

It is anticipated that there will be a reduction of more than 152 million truck miles due to the use of barge transportation for just the volume created by the capacity in the Phase I Project. This is a total savings in road maintenance of \$18.2 million over the 20-year post-construction analysis period using \$0.12 per mile as the base maintenance and preservation cost. In addition to State of Good Repair for the road network, the analysis includes annual maintenance cost of the container yard and equipment to ensure their State of Good Repair as well.

### Economic Competitiveness Benefits

The Economic Competitiveness Benefits are achieved by monetizing the difference in operational costs to the shipper using barge transportation than trucking (to the Port of New Orleans). *Exhibit 18* (below) shows the operational savings to the shippers of using barges to transport their freight versus trucking to destination.

This chart shows the estimated operational cost saving based upon the differential cost of \$339 per FEU between Trucking and Barge from PMCRA and New Orleans. This adds up to a total of \$86.6 million over the analysis period. The analysis anticipates the new yard improvements and efficiencies provided by this Project will allow the Riverport to provide additional capacity to support growth in the PMCRA service area.

*Exhibit 18: Operational Savings*

Decreased Operational Costs due to use of the PMRPA COB project and conversion to barge				
Year	# Containers	Total Shipping Cost for Trucks	Total Shipping Cost for Barge	Reduction in shipping cost based upon differential rate between barge vs trucking
		\$ 1,639.00	\$ 1,300.00	\$ 339.00
2020				
2021				
2022	8,740	\$ 14,324,860	\$ 11,362,000	\$ 2,962,860
2023	8,740	\$ 14,324,860	\$ 11,362,000	\$ 2,962,860
2024	8,740	\$ 14,324,860	\$ 11,362,000	\$ 2,962,860
2025	10,488	\$ 17,189,832	\$ 13,634,400	\$ 3,555,432
2026	10,488	\$ 17,189,832	\$ 13,634,400	\$ 3,555,432
2027	12,586	\$ 20,628,454	\$ 16,361,800	\$ 4,266,654
2028	12,586	\$ 20,628,454	\$ 16,361,800	\$ 4,266,654
2029	12,586	\$ 20,628,454	\$ 16,361,800	\$ 4,266,654
2030	12,586	\$ 20,628,454	\$ 16,361,800	\$ 4,266,654
2031	12,586	\$ 20,628,454	\$ 16,361,800	\$ 4,266,654
2032	13,845	\$ 22,691,955	\$ 17,998,500	\$ 4,693,455
2033	13,845	\$ 22,691,955	\$ 17,998,500	\$ 4,693,455
2034	13,845	\$ 22,691,955	\$ 17,998,500	\$ 4,693,455
2035	13,845	\$ 22,691,955	\$ 17,998,500	\$ 4,693,455
2036	13,845	\$ 22,691,955	\$ 17,998,500	\$ 4,693,455
2037	15,230	\$ 24,961,970	\$ 19,799,000	\$ 5,162,970
2038	15,230	\$ 24,961,970	\$ 19,799,000	\$ 5,162,970
2039	15,230	\$ 24,961,970	\$ 19,799,000	\$ 5,162,970
2040	15,230	\$ 24,961,970	\$ 19,799,000	\$ 5,162,970
2041	15,230	\$ 24,961,970	\$ 19,799,000	\$ 5,162,970
	255,501	\$ 418,766,139	\$ 332,151,300	\$ 86,614,839

## Quality of Life and Environmental Protection

### Exhibit 19: Gallons of Fuel Saved

Gallons and CO2 MT Saved due to shift to Barge			
Year	Total gallons saved (reduced) in modal shift to barge	Fuel savings due to reduced VMT @\$3.176 / gal	CO2 Reduced (Metric Tons)
2020		not added to benefit since fuel is in shipping costs	
2021			
2022	429,377	\$1,363,701	3,834
2023	429,377	\$1,363,701	3,834
2024	429,377	\$1,363,701	3,834
2025	515,252	\$1,636,442	4,600
2026	515,252	\$1,636,442	4,600
2027	618,323	\$1,963,792	5,521
2028	618,323	\$1,963,792	5,521
2029	618,323	\$1,963,792	5,521
2030	618,323	\$1,963,792	5,521
2031	618,323	\$1,963,792	5,521
2032	680,174	\$2,160,234	6,073
2033	680,174	\$2,160,234	6,073
2034	680,174	\$2,160,234	6,073
2035	680,174	\$2,160,234	6,073
2036	680,174	\$2,160,234	6,073
2037	748,216	\$2,376,336	6,681
2038	748,216	\$2,376,336	6,681
2039	748,216	\$2,376,336	6,681
2040	748,216	\$2,376,336	6,681
2041	748,216	\$2,376,336	6,681
<b>Total</b>	<b>12,552,204</b>	<b>\$ 39,865,799</b>	<b>112,073</b>

Notes:

Diesel price: average Midwest (all grades)

Source: [http://www.eia.gov/dnav/pet/pet\\_pri\\_gnd\\_dcus\\_r40\\_w.htm](http://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_r40_w.htm)

\$3.176 average price

The use of barges to move cargo in the PM CRA service area will reduce truck use on public roads which should enhance the quality of life in the region. This modal choice improves the mobility and air quality of local and regional residents.

Fuel savings are calculated by comparing the differences in costs by using more energy efficient barges to transport cargo to and from the PM CRA service area. *Exhibit 19* (above) shows the

estimated number of gallons of fuel saved by the availability of barge to move the cargo. The Project will reduce fuel usage by almost 13 million gallons during the analysis period. At today's average mid-west diesel price of \$3.176/gallon (July 9, 2018), shippers will save approximately \$40 million over the analysis period. The analysis does not include this savings as a stand-alone monetized value as it is already included in the per box rate from Paducah to destination. This reduction in energy usage will save an estimated 112,073 MT in CO2 emissions, thus helping the regional air quality.

## Safety benefits

### Exhibit 20: Conversion of Collision Statistics

Conversion of Collision statistics based upon 100 Million miles travel by truck							
Collision Type					Annual Average	Current est. accident costs	
AIS Level	Severity	Fraction of VSL	Unit value (\$2017)*	Conversion of Truck Traffic	Accident Count by KABCO	Current Annual social cost of Accidents	Estimated Annual accident costs savings
AIS 0	no injury					\$0	
AIS 1	Minor	0.003	\$28,200			\$0	\$0
AIS 2	Moderate	0.047	\$451,200			\$0	\$0
AIS 3	Serious	0.105	\$1,008,000			\$0	\$0
AIS 4	Severe	0.266	\$2,553,600			\$0	\$0
AIS 5	Critical	0.593	\$5,692,800			\$0	\$0
AIS 6 reduction VMT	Unsurvivable	1.000	\$9,600,000	0.081955	0	\$786,763	\$786,763
Property Damage Only			\$4,327			\$0	\$0
						\$786,763	\$786,763

\*DISCRETIONARY GRANT BENEFIT COST ANALYSIS (BCA) RESOURCE GUIDE updated June 2018

Conversion of Collision statistics based upon 100 Million miles travel by truck			
US Traffic Fatalities Per 100 Million miles traveled on Roads			Annual
Total Truck miles reduced over the 20 years	151,767,594	/20	7,588,380
Total Truck miles divided by 100 million miles	1.51767594		0.075883797
Estimated Fatalities Per 100 million miles travel based upon average US's experience		1.08	0.081954501
2017 Unsurvivable value	\$9,600,000		
Annual life savings based upon reduced truck mileage			\$786,763
Total lives saved over 20 years			1.64
Dollars saved based upon estimated mileage saved per year			\$15,735,264

Safety benefits, shown on *Exhibit 20* (above), are estimated at \$15.7 million in total social benefit due to 1.64 lives saved over the analysis period. This result comes from reduced VMT due to the use of barges versus truck along sample routes.



*Exhibit 21: Prevention of Fatalities*

Prevention of Fatalities			
Year	VMT	Social Benefit of Reduced Fatalities	# lives Saved
		\$ 9,600,000	100 Million VMT
2017			
2018			
2009			
2020			
2021			
2022	5,191,560	\$538,261	0.056
2023	5,191,560	\$538,261	0.056
2024	5,191,560	\$538,261	0.056
2025	6,229,872	\$645,913	0.067
2026	6,229,872	\$645,913	0.067
2027	7,476,084	\$775,120	0.081
2028	7,476,084	\$775,120	0.081
2029	7,476,084	\$775,120	0.081
2030	7,476,084	\$775,120	0.081
2031	7,476,084	\$775,120	0.081
2032	8,223,930	\$852,657	0.089
2033	8,223,930	\$852,657	0.089
2034	8,223,930	\$852,657	0.089
2035	8,223,930	\$852,657	0.089
2036	8,223,930	\$852,657	0.089
2037	9,046,620	\$937,954	0.098
2038	9,046,620	\$937,954	0.098
2039	9,046,620	\$937,954	0.098
2040	9,046,620	\$937,954	0.098
2041	9,046,620	\$937,954	0.098
<b>Total</b>	<b>151,767,594</b>	<b>\$ 15,735,264</b>	<b>1.64</b>

Exhibit 21 above displays the annual saving of lives and the societal benefit of reducing trucks off the local roads and highways. Since the containers move through multiple states, the analysis uses the National Fatality Average (2016) of 1.08 per 100 Million miles traveled on roads to calculate the lives saved.

**Qualitative Benefits not Quantified.**

The reduction of potential fatalities has been monetized for this analysis; however, the benefits of reducing other less severe accidents is not included in this analysis. Additionally, the analysis does not include benefits from emission reductions per recent USDOT guidance.

## SOURCES

All sources and additional notes have been cited in the Benefit Cost Analysis excel workbook that can be found as an Application attachment: Appendix A PM CRA Phase I BCA Spreadsheet

The USDOT Discretionary Grant Benefit-Cost Analysis Guidelines were used in calculating safety benefits.

The following list additional sources used to gather metrics for the analysis

### **Distances:**

Barge: Paducah, KY to New Orleans, LA

<https://nauticalcharts.noaa.gov/publications/docs/distances.pdf>

Road: Paducah, KY to Savannah, GA

<https://www.google.com/search?q=driving+directions&oq=driving+&aqs=chrome.0.35i39j69i57j69i59j0l3.2919j0j7&sourceid=chrome&ie=UTF-8>

National Statistics on Highway Fatality Rates:

<http://www.iihs.org/iihs/topics/t/general-statistics/fatalityfacts/state-by-state-overview/2016>

### **Fuel Prices.**

[https://www.eia.gov/dnav/pet/pet\\_pri\\_gnd\\_dcus\\_r50\\_w.htm](https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_r50_w.htm)

7/9/18 PADD2 Midwest Diesel- All grades

### **Fuel usage:**

TTI report

<http://www.nationalwaterwaysfoundation.org/>

<https://tti.tamu.edu/news/tti-study-pinpoints-the-value-of-moving-cargo-by-barge/>

Truck fuel was calculated based upon the size of the containers not being 36 tons but 24 tons Thus, the fuel usage for truck was reduced to 156 ton miles per gallon (6.5 gallons per mile \*24 tons). We used 514 ton miles per gallon for fuel efficiency of a barge.

### **National Statistics on Highway Fatalities by State**

<http://www.iihs.org/iihs/topics/t/general-statistics/fatalityfacts/state-by-state-overview/2016>

Additional Sources can be found in the Assumptions page of the BCA Spreadsheet next to the factor.