

*Pennsylvania's inland waterway infrastructure, which connects the Commonwealth to the national waterway system, was built over the last 150 years. Many of its locks and dams are in a severe state of disrepair due to lack of maintenance and capital improvements funding over several decades. The grade of D+ reflects the fact that none of Pennsylvania's navigation dams and only 18 percent of the locks have a "satisfactory" condition assessment rating, and delays at the most degraded facilities are frequent. While American Recovery and Reinvestment Act (ARRA) funding provided a much needed boost to construction and operations and maintenance budgets, the ongoing and significant Federal funding limitations have greatly delayed completion of major rebuild projects. A catastrophic failure within the inland waterway system, like any major infrastructure failure, would have serious effects on the industries that rely directly on river transport of heavy bulk commodities.*

## BACKGROUND

### ***Inland Waterways of Western Pennsylvania***

The navigable waterways of western Pennsylvania comprise the major commercial inland waterway system in Pennsylvania. The U.S. Army Corps of Engineers (USACE) owns, operates and maintains approximately 200 miles of navigable waterways and 17 navigation locks and dams on the Ohio, Allegheny and Monongahela Rivers in western Pennsylvania. In 2012, the Port of Pittsburgh was the second busiest inland port in the nation and the 17<sup>th</sup> busiest port of any kind (1). At 35 million tons of cargo per year, it accounted for 50 percent of the Commonwealth's waterborne commerce (2). The Pittsburgh Port District encompasses a 12-county area in southwestern Pennsylvania and supports more than 200 river terminals and barge industry service suppliers. The life and success of the Port is directly dependent on the efficient operation of the navigable waterway transportation system.

The USACE has a major construction project underway to replace major components of the Lower Monongahela River infrastructure. Although originally scheduled to be completed in 2004, significant funding constraints have caused the USACE to conduct the work in small, fundable pieces; at the current funding rate, completion is anticipated by 2023. This work will ultimately improve the efficiency of waterborne traffic through the region. One major component of the project is the replacement of the 90-year old locks at Charleroi and Elizabeth with one set of modern locks at Charleroi.

### ***Inland Waterways of Eastern Pennsylvania***

There are no commercial inland waterways in eastern Pennsylvania. All of the former commercial waterways, e.g., the Schuylkill Canal, the Lehigh Canal, the Delaware Canal, and others stopped operating many decades ago. Commercial navigation on the Susquehanna River stops at the Conowingo Dam which is in Maryland, just below the

Pennsylvania state line. Therefore, there is no commercial navigation on the Susquehanna River in Pennsylvania.

The facilities on the navigable portions of the Delaware and the Schuylkill Rivers in Pennsylvania are an integral part of the Ports of Philadelphia, PA, Camden, NJ, and Wilmington, DE. The Delaware and Schuylkill River navigation channels are sea-level channels with no locks and dams and can accommodate sea-going vessels. The conditions of these navigable waterways as they relate to port operations are discussed in the Ports section of the 2014 Report Card for Pennsylvania's Infrastructure (PA Report Card).

## CONDITIONS AND CAPACITY

Traffic through the region can be measured by overall traffic or by summing activity at individual locks. Overall commercial tonnage transported in 2012, the most recent year for which these data are available, is somewhat higher than 2010 levels, while remaining significantly lower than historic levels Figure 1. Clearly the region is capable of handling more river traffic than current levels.

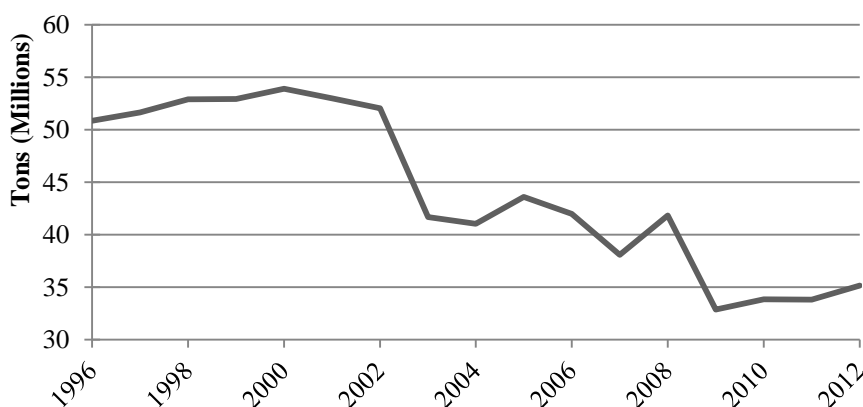


Figure 1. Waterborne commercial tonnage for the Port of Pittsburgh for 1996-2012 (3)

The capacity of the locks can also be characterized in terms of how many times the locks are used in a given year. The total number of lockages in all of the western Pennsylvania locks for each year from 2008 to 2012 is shown in Figure 2. Commercial lockages have been relatively steady at about 37,000 annual lockages over the past four years, and recreational lockages averaging about 12,000 lockages per year.

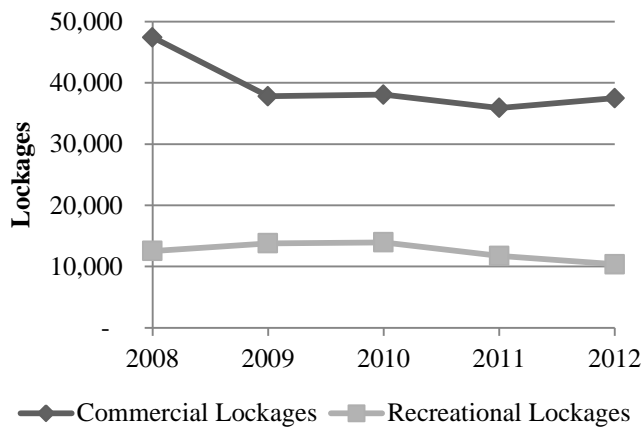


Figure 2. Port of Pittsburgh lockages for 2008-2012 (4)

**Physical condition**

The USACE has developed methods to measure reliability of components of the navigation infrastructure, as unscheduled maintenance closures of the locks are detrimental to the shipping industry and economic success of the inland waterways. Navigation dams and locks are evaluated separately.

The condition of navigation dams is evaluated in various ways, including ratings for the National Inventory of Dams (NID) condition assessment (5):

**SATISFACTORY** - No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria or tolerable risk guidelines.

**FAIR** - No existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range to take further action.

**POOR** - A dam safety deficiency is recognized for loading conditions which may realistically occur. Remedial action is necessary. This category may also be used when uncertainties exist as to critical analysis parameters which identify a potential dam safety deficiency. Further investigations and studies are necessary.

**UNSATISFACTORY** - A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.

**NOT RATED** - The dam has not been inspected, is not under state jurisdiction, or has been inspected but, for whatever reason, has not been rated.

According to the USACE Pittsburgh District Dam Safety Team (5), the 17 USACE navigation dams currently have the distribution of NID ratings shown in Table 1.

Table 1. Distribution of NID Ratings for 17 USACE Navigation Dams in Western Pennsylvania (5)

<u>NID Rating</u>	<u>Number of Navigation Dams</u>
Satisfactory	0
Fair	7
Poor	7
Unsatisfactory	3

Thus, current condition assessment of the 17 navigation dams in the western Pennsylvania inland water system reveals that none of the dams has a satisfactory rating.

The current operational condition of the 17 locks in the western Pennsylvania system, as assessed by the USACE Pittsburgh District Asset Management Team (6), is shown in Table 2.

Table 2. Distribution of Ratings for 17 USACE Locks in Western Pennsylvania (6)

<u>Rating</u>	<u>Number of Locks</u>
Satisfactory	3
Fair	4
Poor	4
Unsatisfactory	6

Thus, the current condition assessment of the locks indicates that only 18 percent of the locks have a satisfactory rating.

The condition of the locks is reflected in measures of their efficiency in processing vessels and tonnage. The locks on the Ohio River and the first lock on the Monongahela River are the largest in the Port of Pittsburgh, and thus can process more tonnage per lockage than the smaller up-river locks. The second and third locks on the Monongahela River are both almost 100 years old and are being replaced with a new set of larger locks at Charleroi. Completion of this project is significantly behind the original USACE schedule due to funding shortfalls. The locks on the Allegheny are the smallest of all the locks in the Port of Pittsburgh.

One measure of capacity and efficiency is the average tonnage per lockage over time. Figure 3 illustrates this metric, showing that the four largest capacity locks have similar average tonnage per lockage, with a slight downward trend in efficiency over the past five years. The Charleroi locks, when replaced, will have a capacity equal to the Maxwell locks, providing a 50 percent increase in efficiency as measured by tonnage per lockage. This improvement, however, may not be completed until 2023 under the current funding stream.

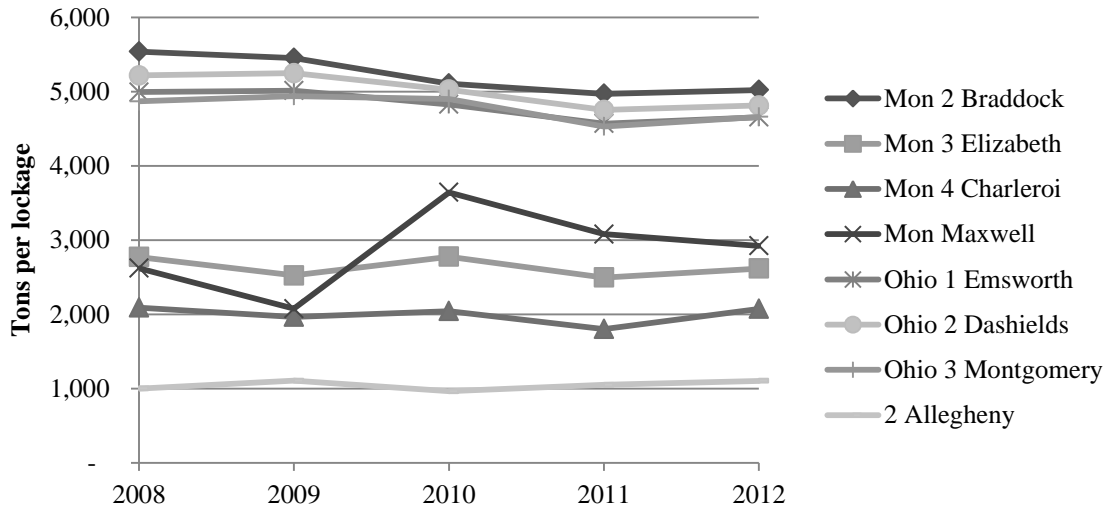


Figure 3. Commercial tonnage per lockage by lock in the Port of Pittsburgh for 2008-2012 (4)

The condition of the infrastructure is also measurable in terms of the number of closures that occur each year. Since the 2010 PA Report Card, there have been no instances of complete failure of major navigation facility components. However, regular, planned closures for maintenance and renovation have often restricted access to commercial and recreational users. The USACE tracks the number of closures that occur at each lock, as summarized in Figure 4. Some closures are short in duration for minor repairs, while others may last a month or more for major repairs. Scheduled closures are announced ahead of time; unscheduled closures may occur due to navigational accidents or equipment failure. Without differentiating between scheduled and unscheduled closures, Figure 4 shows that the number of closures varies from year to year and lock to lock, with the busiest locations (Montgomery, Dashields, Emsworth) generally being subject to the most closures. Closures appear to be markedly down in 2012, likely as a result of completion of ARRA-funded projects.

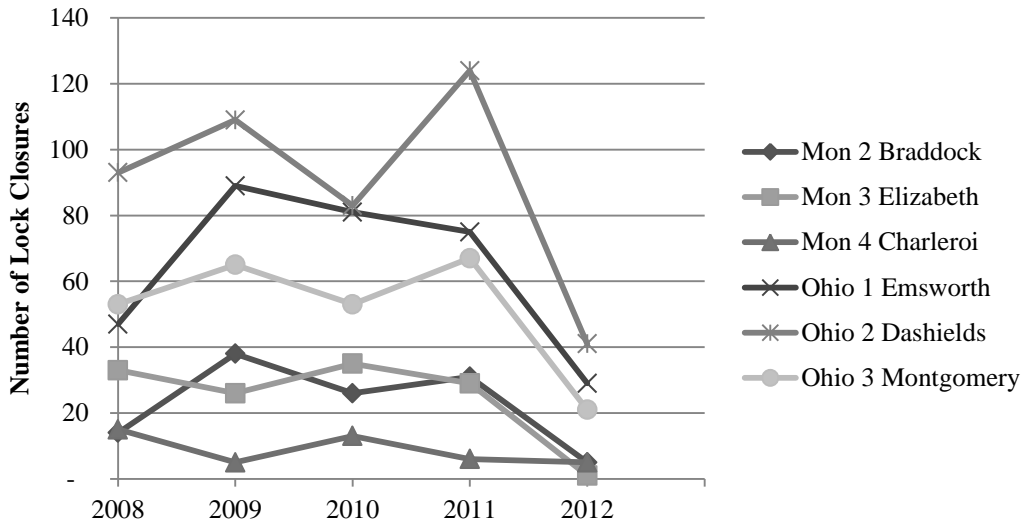


Figure 4. Number of lock closures at the six busiest locks in Port of Pittsburgh for 2008-2012 (4)

The USACE tracks data on the efficiency of the locks in terms of the amount of time delayed before passing through a lock chamber. Delays can be due to the operational status of the lock or traffic congestion. Figure 5 shows the percentage of commercial tows that were delayed from 2008-2012. The frequency of delays on the Ohio and Monongahela Rivers was higher than on the Allegheny River, reflective of their heavier traffic and tonnage patterns. All three rivers show an increase in the frequency of delays over the past four years, which likely resulted in additional costs borne by the regional economy.

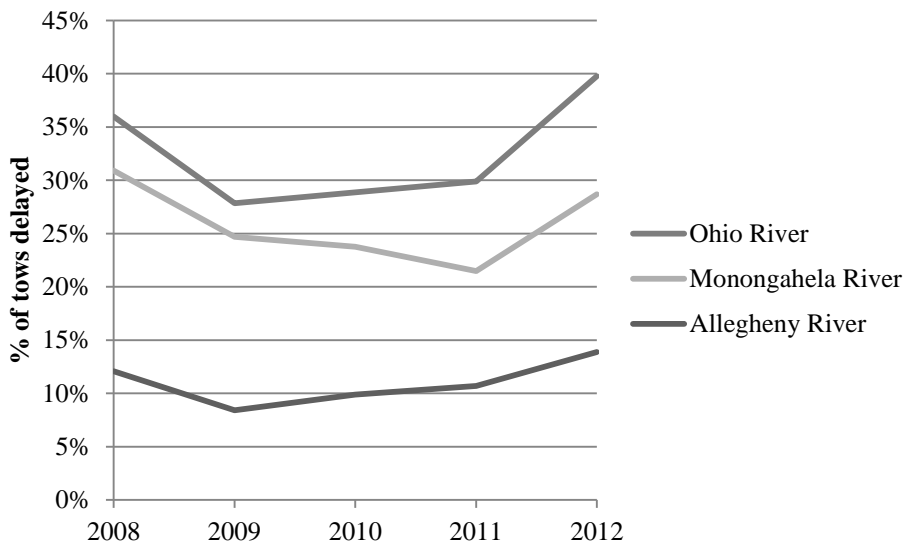


Figure 5. Percent of tows delayed in the Port of Pittsburgh for 2008-2012 (4)

When a tow is delayed at the six busiest locks, the typical hold up is between 20 and 80 minutes (see Figure 6). The spike in delays at Emsworth in 2010 was due to a major repair project that detoured all tows through Emsworth's auxiliary chamber for three

weeks (7). Delays in 2012 however were markedly higher at Elizabeth, Charleroi and Emsworth. During 2012, each of these three facilities had maintenance work done (8). The work required closure of one of the chambers and this would have increased the delay at each of these facilities.

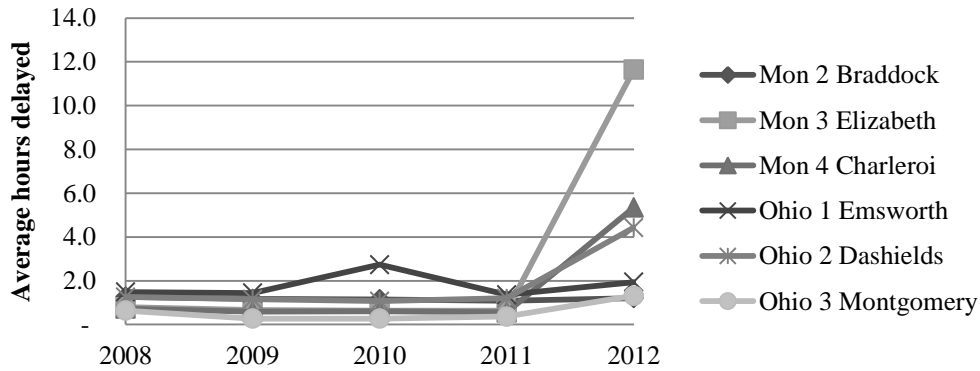


Figure 6. Average length of delay for delayed tows (hours) at six busiest Port of Pittsburgh locks for 2008-2012 (4)

### ***Operation and Maintenance***

The day-to-day operations of the Port of Pittsburgh's inland navigation system is funded through the USACE Operations and Maintenance (O&M) budget. Figure 7 summarizes funding over the past five years. Funding for O&M for the Monongahela and Allegheny River locks is currently reduced compared to 2010 levels. The USACE has accordingly reduced the level of service at the upriver locks as a means of stretching O&M dollars. The uppermost locks on both rivers have limited hours of operation, creating significant constraints on the ability of the local communities to use these stretches of river. The Pittsburgh District has been working with the communities to provide some level of service despite these funding constraints (9).

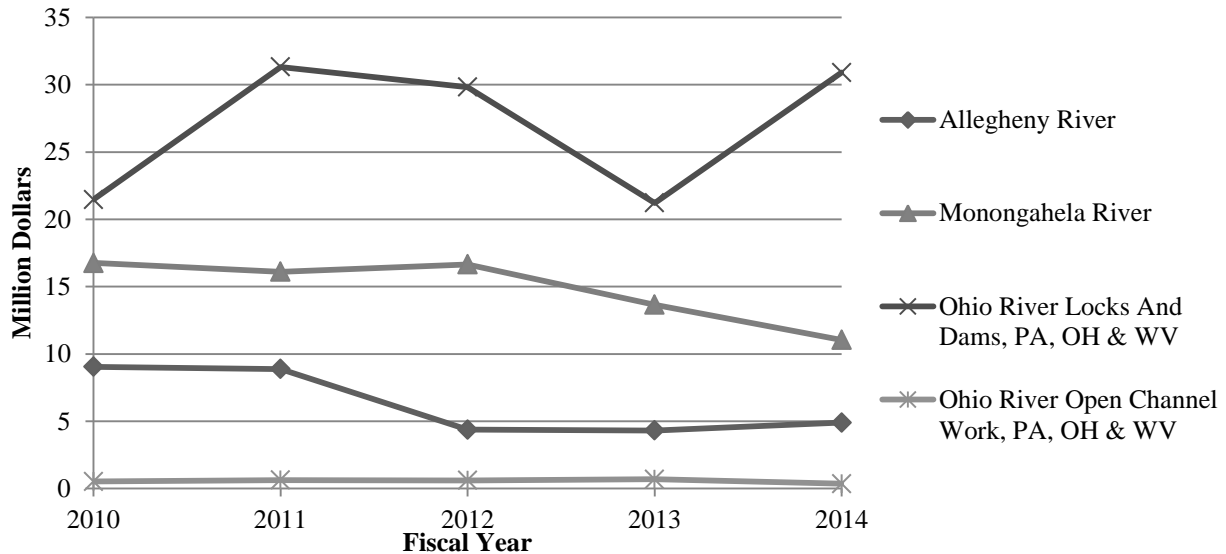


Figure 7. USACE O&M Budget for Port of Pittsburgh Projects for 2010-2014 (10) (11)

**Public Safety**

Data on commercial and recreational accidents that occur within the Port of Pittsburgh are not published by the U.S. Coast Guard. Several recreational fatalities, however, have occurred over the past five years in accidents near fixed-crest dams; these low profile dams do not project above the navigation pool water surface and can be difficult for boaters to see when approached from upstream.

**Funding**

The USACE budget for water resources infrastructure comprises three major components: Investigations, Construction, and O&M. USACE Pittsburgh District budgets over the past five years are summarized in Table 3.

The Upper Ohio Navigation Study was completed in 2013. This feasibility study examined the best ways to update the three Ohio locks and dams in the Port of Pittsburgh, all of which are at the end of their useful lives and subject to significant deterioration (12). The study will be incorporated into the Corps' annual Report to Congress; Congress then will determine whether to fund rehabilitation of these facilities.

President Obama's Fiscal Year (FY) 2014 budget includes \$110 million in new federal funding for the Pittsburgh District Civil Works Program, including \$47.1 million for O&M funds (10). The President's budget also includes \$1.9 million for the Lower Monongahela River Project, where the USACE continues the construction of new locks at Charleroi Locks and Dam.



Table 3. USACE Pittsburgh District Budgets (10) (11)

Corps of Engineers Work Plan Budgets (\$ millions)					
	2010	2011	2012	2013	2014 (proposed)
<b>Investigations</b>					
Upper Ohio Navigation Study, PA	1.255	1.347	1.588	0.998	
<b>Construction</b>					
Emsworth Locks and Dam, Ohio River	25.0	9.806	0	6.285	
Locks and Dams 2, 3 and 4, Monongahela River	6.21	8.1	1.2	22.2	1.96
Southeastern Pennsylvania			2.3		
<b>O&amp;M</b>					
Allegheny River	9.039	8.874	4.367	4.308	4.892
Monongahela River	16.758	16.1	16.648	13.658	11.035
Ohio River Locks and Dams, PA, OH & WV	21.470	31.320	29.862	21.221	30.905
Ohio River Open Channel Work, PA, OH & WV	0.516	0.625	0.607	0.681	0.359

In addition, ARRA funds were used for a number of Pittsburgh District projects: \$0.49 million was allocated for completion of the Upper Ohio Navigation Study; \$34.3 million was allocated for construction projects at Emsworth; \$63.8 million for completion of river and guard walls at Charleroi; and \$10.1 million for operations and maintenance funds for the Pennsylvania locks (13).

The 2013 Work Plan allocated \$6.34 million from the construction budget to the long-delayed Lower Monongahela River Project. Funding for possible work at Charleroi is restricted due to depletion of available non-federal cost-share funds. After taking into account the ARRA investment, at the current low funding rate, the USACE plans completion of this work in 2024 (14).

**Resilience**

Scheduled repair work can be planned for by users of the inland waterways, but this is not the case for catastrophic failure. Potential failure of the navigation dams at Elizabeth and Emsworth are of particular concern. These dams have been given the worst rating possible by USACE inspectors (14); their failure would result in loss of the navigation pools that they create and in consequence cause a complete halt of barge traffic through those stretches of river for an extended amount of time (15).

Barring catastrophic failure, the three Ohio River locks and three of the four busiest Monongahela River locks have two lock chambers, allowing for continued, albeit reduced, operation during repairs of one chamber. The Charleroi lock, however, has only had one functioning chamber since 2004 due to the ongoing (and delayed) construction of the replacement lock chambers.

### ***Innovation***

The USACE is incorporating several innovative design components to the ongoing Charleroi lock replacement project; the project is designed and sequenced to keep one chamber open throughout the replacement process (16).

## **POLICY OPTIONS**

The Inland Waterways Trust Fund (IWTF) was created in 1978 to provide funds for major lock and dam construction and rehabilitation projects. The fund is generated by a 20 cent-per-gallon tax on diesel fuel used by the tow industry. The tax rate has not changed since 1995 (12). The IWTF and matching federal funds are significantly insufficient to meet the current and backlogged requirements for construction and rehabilitation of the current inland waterways infrastructure (16).

A recent report prepared by the National Research Council, the research division of the National Academies, for the USACE (17) identified the following limitations and realities associated with funding the needed operations, maintenance and rehabilitation of the inland waterways:

- "Funding from Congress for project construction and rehabilitation has been declining steadily.
- Lockage fees on users/direct beneficiaries could be implemented. These are resisted by users and others.
- Parts of the system could be decommissioned or divested and the extent of the system decreased.
- The status quo is a likely future path, but it will entail continued deterioration of the system and eventual, significant disruptions in service. It also implies that the system will be modified by deterioration, rather than by plan."

As of March 2014, a new version of the Water Resources Development Act (known as the Water Resources Reform and Development Act (WRRDA)) is being finalized in a conference committee by the U.S. Congress. The House and Senate versions both have provisions for inland waterways construction and rehabilitation, including some funding for projects in western Pennsylvania but with emphasis on the important Olmsted Locks and Dam project on the Lower Ohio River between Illinois and Kentucky. It remains to be seen which provisions will be ultimately included, and if WRRDA will be passed.

## RECOMMENDATIONS

Recognizing that funding of the operation, maintenance and rehabilitation of the inland waterways is determined and prioritized by the U.S. Congress, the four Pennsylvania sections of the American Society of Civil Engineers (ASCE) recommend the following:

- Continue efforts by the Pennsylvania Congressional delegation to shape and promote effective WRRDA legislation to fund operation, maintenance and rehabilitation of the Western Pennsylvania inland waterway system appropriately. This is of great importance to the continued viability of the State's inland waterway infrastructure.
- Congress should enable additional financing for inland waterway projects, e.g., by increasing the barge fuel tax and/or implementing user fees.
- Congress should develop a coherent set of principles to prioritize capital projects, with consideration of risk, reliability, and economic benefits. As recommended by the National Research Council (17), decommissioning of parts of the system on the Allegheny River that no longer have commercial justification should also be considered, to enable limited funds for operation, maintenance and rehabilitation to be more effectively deployed.

## SOURCES

1. **U.S. Army Corps of Engineers, Navigation Data Center.** Tonnage for Selected U.S. Ports in 2012. *Waterborne Commerce Statistics Center*. [Online] <http://www.navigationdatacenter.us/wcsc/porttons12.html>.
2. —. CY 2012 Waterborne Tonnage by State. *Waterborne Commerce Statistics Center*. [Online] 2012. <http://www.navigationdatacenter.us/wcsc/statetnm12.htm>.
3. —. Waterborne Tonnage for Principal U.S. Ports and all 50 States and U.S. Territories. [Online] various. <http://www.navigationdatacenter.us/publications.htm>.
4. **U.S. Army Corps of Engineers.** Lock Use, Performance, and Characteristics. *Navigation Data Center*. [Online] various. <http://www.navigationdatacenter.us/lpms/pdf/2011%20&%202012.pdf>.
5. **Hoey, Jeanine.** Email from Jeanine Hoey, Chief, Programs and Program Management, USACE Pittsburgh District, to David Dzombak, Carnegie Mellon University. *National Inventory of Dams condition assessment ratings for 17 USACE navigation dams in Pennsylvania*. November 15, 2013.
6. —. Email from Jeanine Hoey, Chief, Programs and Program Management, USACE Pittsburgh District, to David Dzombak, Carnegie Mellon University. *Operational condition assessment ratings for the 17 USACE locks in Pennsylvania*. December 4, 2013.

7. **Pittsburgh Post-Gazette.** Repairs Reflect Dire Need to Replace River Locks. *Upper Monongahela River Association*. [Online] May 15, 2010. [Cited: November 7, 2013.] <http://www.uppermon.org/news/Pgh-Alleg/PPG-Repairs-15May10.html>.
8. **Hoey, Jeanine.** Email from Jeanine Hoey, Chief, Programs and Program Management, USACE Pittsburgh District, to David Dzombak, Carnegie Mellon University. *Additonal information about delay times experienced at busiest locks in 2012*. December 11, 2013.
9. **U.S. Army Corps of Engineers, Pittsburgh District.** Lock Service Levels. [Online] [Cited: November 11, 2013.] <http://www.lrp.usace.army.mil/Missions/Navigation/LockServiceLevels.aspx>.
10. —. President's 2014 Budget: \$110 Million for regional Corps projects. *News Releases*. [Online] April 10, 2013. <http://www.lrp.usace.army.mil/Media/NewsReleases/tabid/11552/Article/12674/presidents-2014-budget-110-million-for-regional-corps-projects.aspx>.
11. **Hoey, Jeanine.** Email from Jeanine Hoey, Chief, Programs and Program Management, USACE Pittsburgh District, to David Dzombak, Carnegie Mellon University. *Pittsburgh District inland waterway budget information, 2011-2013*. November 6, 2013.
12. **U.S. Army Corps of Engineers, Pittsburgh District.** Upper Ohio Navigation Study. [Online] [Cited: November 11, 2013.] <http://www.lrp.usace.army.mil/Portals/72/docs/UpperOhioNavStudy/Upper%20Ohio%20River%20Navigation%20Study.pdf>.
13. **U.S. Army Corps of Engineers.** Civil Works Project Lists. *Projects funded by the American Recovery and Reinvestment Act of 2009*. August 11, 2010.
14. **U.S. Army Corps of Engineers, Pittsburgh District.** Monongahela River Locks and Dams 2, 3, and 4 Project Fact Sheet (Lower Mon). [Online] June 2013. <http://www.lrp.usace.army.mil/Portals/72/docs/HotProjects/LMPJune2013.pdf>.
15. —. Emsworth Locks & Dams Major Rehabilitation Project. [Online] 2014. <http://www.lrp.usace.army.mil/Missions/Planning,ProgramsProjectManagement/HotProjects/EmsworthLocksDamsMajorRehabilitationProject.aspx>.
16. **Stolz, Steve R, Lisa R. Pierce, Dave A. Stensby.** Replacing Existing Lock 4 - Innovative Designs for Charleroi Lock . [Online] [http://www.canarysystems.com/papers/CharleroiLD\\_Stoltz.pdf](http://www.canarysystems.com/papers/CharleroiLD_Stoltz.pdf).
17. **National Academy of Science, Water Science and Technology Board.** *Corps of Engineers Water Resources Infrastructure: Deterioration, Investment, or Divestment?* . Washington, D.C. : National Academies Press, 2012.

## ASCE POLICY STATEMENTS

- ASCE Policy Statement 299: [Infrastructure Investment Policy \(PS 299\)](#)
- ASCE Policy Statement 302: [Cost Sharing in Water Resources Infrastructure Programs \(PS 302\)](#)
- ASCE Policy Statement 526: [Public-Private Partnerships \(PS 526\)](#)