LEVEES

EXECUTIVE SUMMARY

With two new levee systems in Bloomsburg and Mt. Carmel constructed since 2014, and five new systems and seven rehabilitations currently under design, Pennsylvania is expanding and modernizing its levee infrastructure. Meanwhile, the US Army Corps of Engineers (USACE) substantially improved its online National Levee Database and over the past four years has expanded the National Levee Safety Program to include inspections of non-state, non-Federal levees and a hazard potential classification system. Yet, there is a growing need to rehabilitate aging levee systems, an often-underappreciated threat to flood-prone communities, and a need to re-evaluate levee designs based on outdated flood frequency statistics. In addition, municipalities that own and manage most levees often lack expertise needed to expedite needed rehabilitations. With the average age of levees in Pennsylvania approaching the typical design life of a levee system, further action is needed to keep Pennsylvanians safe from flooding.
BACKGROUND

Prior to the mid-20th century, much of Pennsylvania’s population growth occurred in the floodplains of our state’s 45,000 miles of rivers and streams. Early communities and industrial sites were built in floodplains before our predecessors fully recognized flood risk. As these communities grew, engineering solutions to flood protection arose, including the construction of levees.

A levee is a man-made embankment, built to provide flood protection from temporary high water. Flood levees are typically linear structures constructed adjacent to a river for the purpose of preventing water from overflowing the river channel and spreading into the flood plain. They are typically complex systems, which include pump stations, roadway gates, and relief wells (which help protect levees from damaging seepage during floods). The average age of the approximately 163 miles of levee systems in Pennsylvania is over 50 years, the typical design life of a levee system. The most recent system, Bloomsburg (Figure 1), was completed in 2015. The oldest system, Morrisville (Figure 2), was constructed in 1939.

The National Flood Insurance Program (NFIP) was established by the Flood Insurance Act in 1968 to provide insurance coverage to flood-prone properties, which private insurers would not cover. In 1973, the NFIP adopted the “100-year floodplain” as the basis for insurance. The 100-year flood (i.e., an average recurrence interval of 100 years) has a 1% probability of being exceeded in any given year.

From 1978 through January 2018, the NFIP paid $1.2 billion in flood loss claims in Pennsylvania out of $67 billion worth of claims paid nationally. Among non-coastal states, Pennsylvania ranks first in flood loss claims. Municipalities in Pennsylvania with the largest claims are Bloomsburg, Columbia County ($31 million – Susquehanna River); Harrisburg, Dauphin County ($28 million – Susquehanna River); West Pittston Borough, Luzerne County ($27 million – Susquehanna River); and Yardley Borough, Bucks County ($25 million – Delaware River).

CONDITION AND CAPACITY

Levees and associated features such as pump stations deteriorate over time due to erosion, corrosion, weathering, scour, settlement, deformation, and degradation. Regular maintenance and periodic rehabilitation are needed to ensure that they retain their design level of protection and function. These can become expensive as a levee system ages.
The USACE has authority under Public Law 84-99 to financially supplement local efforts to repair/rehabilitate qualified public levees whether it is federally constructed or not. To be eligible for assistance, the levee must meet criteria set forth by the USACE and must be inspected and evaluated on a regular basis (approximately every two years).

In Pennsylvania, there are 117 levee systems in the USACE Portfolio constructed via the Federal or State Flood Protection Programs:

<table>
<thead>
<tr>
<th>LEVEE SYSTEM TYPE</th>
<th>NO. OF LEVEES</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Constructed, Locally Operated and Maintained *</td>
<td>74</td>
</tr>
<tr>
<td>Federally Constructed, Federally Operated and Maintained</td>
<td>13</td>
</tr>
<tr>
<td>Federally Constructed, Locally Operated and Maintained</td>
<td>30</td>
</tr>
</tbody>
</table>

There are also 64 levee systems within Pennsylvania not in the USACE Portfolio. These are mostly small and/or in poor condition. An exception is the new system in Bloomsburg, constructed by the municipality, using a variety of state and federal grants. The Bloomsburg Levee is in the process of being enrolled in the USACE Rehabilitation Program.

The status of the levee systems included in the USACE Portfolio are as follows:

<table>
<thead>
<tr>
<th>PORTFOLIO LEVEE STATUS</th>
<th>NO. OF LEVEES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable</td>
<td>6</td>
</tr>
<tr>
<td>Minimally Acceptable</td>
<td>59</td>
</tr>
<tr>
<td>Unacceptable</td>
<td>43</td>
</tr>
<tr>
<td>Data Not Available</td>
<td>9</td>
</tr>
</tbody>
</table>

The terms “Acceptable” or “Minimally Acceptable” state a condition that means the levee meets engineering and maintenance standards. The term “Unacceptable” indicates a condition that would prevent the levee segment or system from performing as intended, due to poor maintenance or features that have deteriorated due to age. The results shown are not readily comparable to the 2014 Pennsylvania Report Card results partly because increased use of video inspection has allowed inspectors to find more defects than in previous years.

**FUNDING AND FUTURE NEEDS**

Capital funding for flood control projects in Pennsylvania comes primarily from four sources:

- Federal legislative appropriations administered by the USACE;
- State legislative appropriations administered by the Departments of Environmental Protection (PADEP) and General Services (DGS);
- Pennsylvania Act 13 grants; and
- Local matches from municipalities, counties, or authorities.

Since the maintenance/operation responsibilities for most systems are borne by municipalities or counties, comprehensive data on the extent of needs and estimated costs of such needs is not readily available. Funding and rehabilitation decisions for these locally-owned levees are handled independently. The main exceptions are federally-operated systems in York, Mansfield, and Johnstown.

Available information on legislative appropriations in coming years indicates significant rehabilitation on at least two federal levee systems ($2.5 million for Johnstown and Punxatawney) and five state-funded levee systems ($20 million programmed for state systems). Additionally, $50 million in state funding is programmed for five new or expanded systems.

Independent of legislative funding, state grants are available for capital projects under Pennsylvania Act 13 of 2012. Act 13 uses a portion of unconventional oil and gas well impact fees to provide grants up to $500,000 with a minimum 15% match from local sponsors. In general,
rehabilitation or major repairs of a flood protection system easily exceed the $500,000 grant limit. The average grant size falls shy of the grant limit at $240,000. At these funding levels, it is difficult to provide needed improvements efficiently. Larger grants would provide a better economy of scale and result in a better return on investment.

In addition, many municipalities lack the specialized expertise needed to plan, fund, design, obtain permits, acquire right-of-way, and administer construction contracts for major levee rehabilitations. Such projects could occur more quickly and efficiently if assistance were available either through a state agency such as the Department of Environmental Protection or through formation of a levee managers’ association.

Adding to future flood risks are changing weather patterns and uncertainty in flood-frequency estimation. Unlike some parts of the country, statistics show flood magnitudes growing in eastern Pennsylvania while diminishing slightly in the western side of the state.

**PUBLIC SAFETY & RESILIENCE**

Emergency managers need accurate and early flood forecasting to protect citizens. Early warning depends on data collection and analysis performed by the National Oceanic and Atmospheric Administration, the U.S. Geologic Survey, and the USACE. It is imperative that these services continue to receive predictable, adequate funding. Local emergency managers also need periodic updates of complex Emergency Action Plans and training to be prepared for floods. Procedures to handle flooding emergencies should be addressed in Pennsylvania’s municipal and county Emergency Operations Plans in coordination with the Pennsylvania Emergency Management Agency. PADEP publishes guidelines for levee-specific Emergency Action Plans (EAPs) but there is no requirement to keep them updated. About half of EAPs for state projects have not been updated in over five years.

Failure of a levee exposes the community to risk of flood catastrophe each day the levee is out of service. The magnitude of risk and potential for catastrophe determine the urgency of making repairs. Progress is being made to consider resiliency in community planning and zoning.

**INNOVATION**

Many approaches can be taken to address flood risk in addition to or in place of levees. Measures such as watershed-wide stormwater management, floodplain protection/restoration, buyout/relocation of properties with high flood insurance risk, enlargement of bridge openings, ice jam mitigation structures, raising of flood prone structures/mechanical/electrical systems, and smart growth strategies to encourage relocation out of the floodplain should all be considered comprehensively.
RECOMMENDATIONS TO RAISE THE GRADE

- State legislation to establish a statewide levee safety program, which would allow for non-structural alternatives.
- Continue real-time updates of the National Levee Database to include inspection data and new systems as they are added or discovered.
- Continue state and federal legislation to provide capital funding for rehabilitation and needed expansion of flood protection projects including restoration of a line item for such in the state budget. Current funding levels for levee rehabilitation need to increase to bring a significant portion of the state’s levees into acceptable condition.
- Increase the size of Act 13 grants funding for levee engineering studies, improvements, upgrades, and non-routine maintenance.
- The Pennsylvania Emergency Management Agency should engage levee experts to help confirm that Emergency Action Plans are complete and up-to-date.
- Require operation/maintenance plans for non-state, non-federal levees. All aspects of levee systems should be addressed.
- The USACE 84-99 Rehabilitation Program and PADEP Completed Projects Section provides a critical public safety service to protect against extreme floods. State and Federal legislative bodies should seek comprehensive reporting from these agencies concerning long-term funding needs.
- Continue to implement the FEMA’s new levee mapping and analysis program as outlined in the National Flood Insurance Program reform bill. This remains to be fully funded.
- To reduce the need for levees, the Department of Environmental Protection should limit placement of fill in floodplains under the waterways permitting program.
- Locally-owned levee rehabilitation often lags because local governments lack expertise needed to acquire right-of-way, obtain permits, select appropriate consultants, administer contracts, and manage construction. Creating a levee manager’s association or making available staff from state agencies could help. It might also allow several owners to combine work into larger contracts to get better unit prices.
SOURCES


- Luzerne County Office of Chief Clerk, Levee Fee Review, 2009. Available at: http://www.luzernecounty.org/content/File/Levee%20Fee%20revised.pdf


- Pennsylvania Department of Environmental Protection, Levee Database, March 2018.


- United States Army Corps of Engineers, National Levee Database, 2018 Version. Available at: https://levees.sec.usace.army.mil/#/