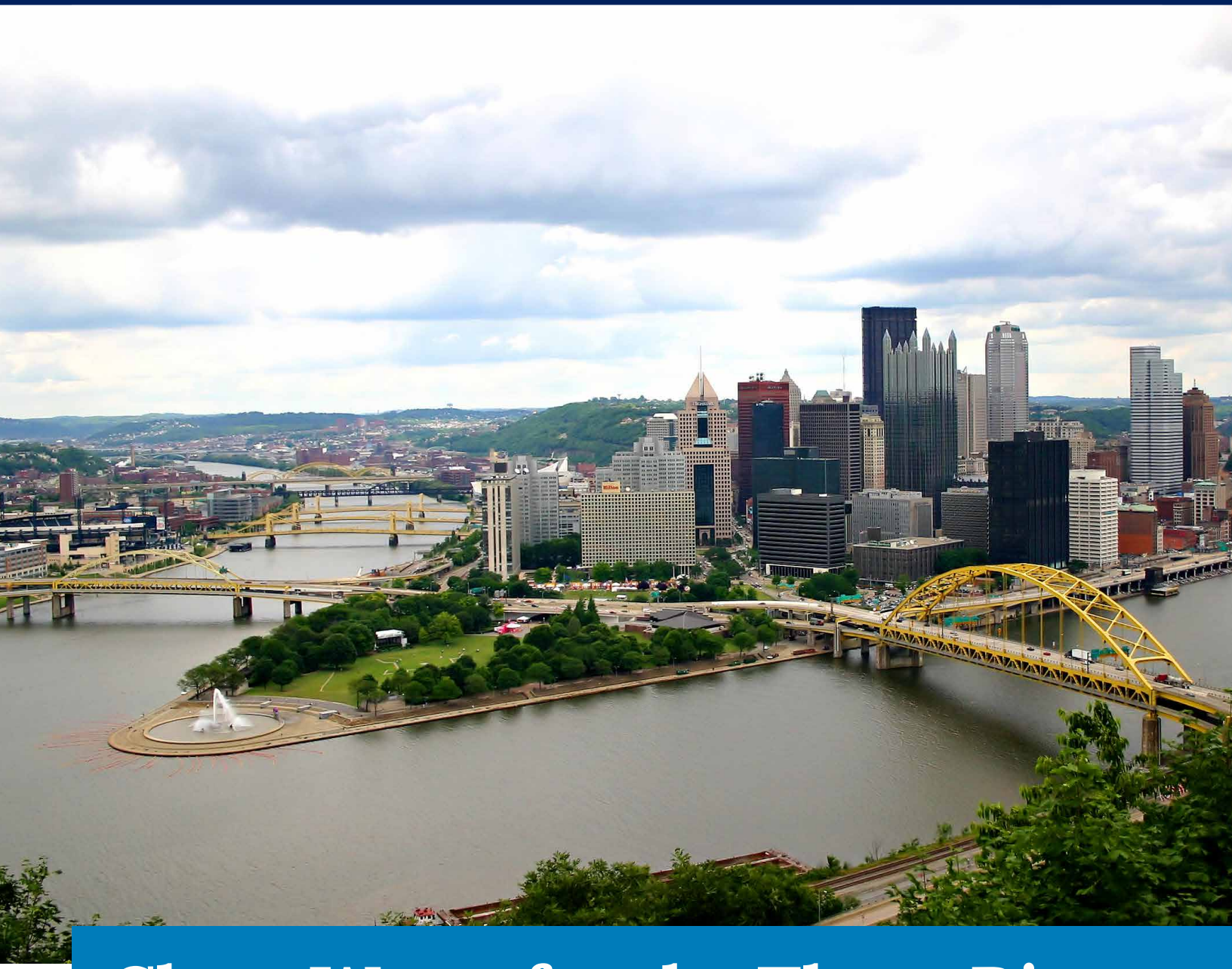

Clean Water for the Three Rivers

Speeding up solutions to sewage and runoff pollution in Allegheny County

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Executive summary

THE THREE RIVERS are a defining feature of southwestern Pennsylvania. They have shaped the region's history and provide recreation opportunities and drinking water to the region's residents today. The rivers and all of the region's waterways should be safe for swimming and fishing, as intended by the federal Clean Water Act adopted 50 years ago.

Today, the region's rivers and streams are far from clean, in part because of frequent overflows of raw sewage from the region's wastewater system – a system stressed as never before by intense rainfall and expanding pavement and rooftops from new development. As a result, untreated wastewater frequently overflows directly into the Three Rivers and their tributaries, polluting the water with raw sewage.

The Allegheny County Sanitary Authority (ALCOSAN) and the municipalities it serves have developed plans that will begin to address the problem of sewage overflows. However, it will take many years to implement these plans and, even when fully implemented, they will not end the problem of sewage overflows.

The region should reduce stormwater runoff and improve quality of life by investing in more green infrastructure and seeking to accelerate fixes to the region's sewer system. The availability of new federal funding for clean water and the adoption of additional local policies should be used to accelerate the cleanup of Allegheny County's waterways.

The problem: Currently, across Allegheny County, rain runs off impervious surfaces such as roads, parking lots and rooftops and into the wastewater system, where it mixes with raw sewage. This influx of stormwater, coupled with an aging sewer system, results in untreated sewage being frequently released into the region's streams and rivers and sometimes backing up into basements and city streets.

- In a typical year, overflows from the ALCOSAN system spill more than 9 billion gallons of sewage and stormwater into rivers and creeks.[1]
- Sewage overflows happen from dozens of locations across the county, and in some locations, those releases are frequent occurrences. Roughly 115 locations in the county release sewage-contaminated water to waterways 49 or more times per year.[2]

Unless changes are made, these pollution problems will only get worse in the years ahead. Continuation of current suburban development patterns will increase the amount of stormwater runoff, even from areas with new separate stormwater and sewer systems. This problem will be further exacerbated by increased precipitation as a result of climate change.

- Annual precipitation has already increased in Pennsylvania due to climate change. Annual precipitation totals from 2000 to 2020 were nearly 5 inches higher than during the 1971 to 2000

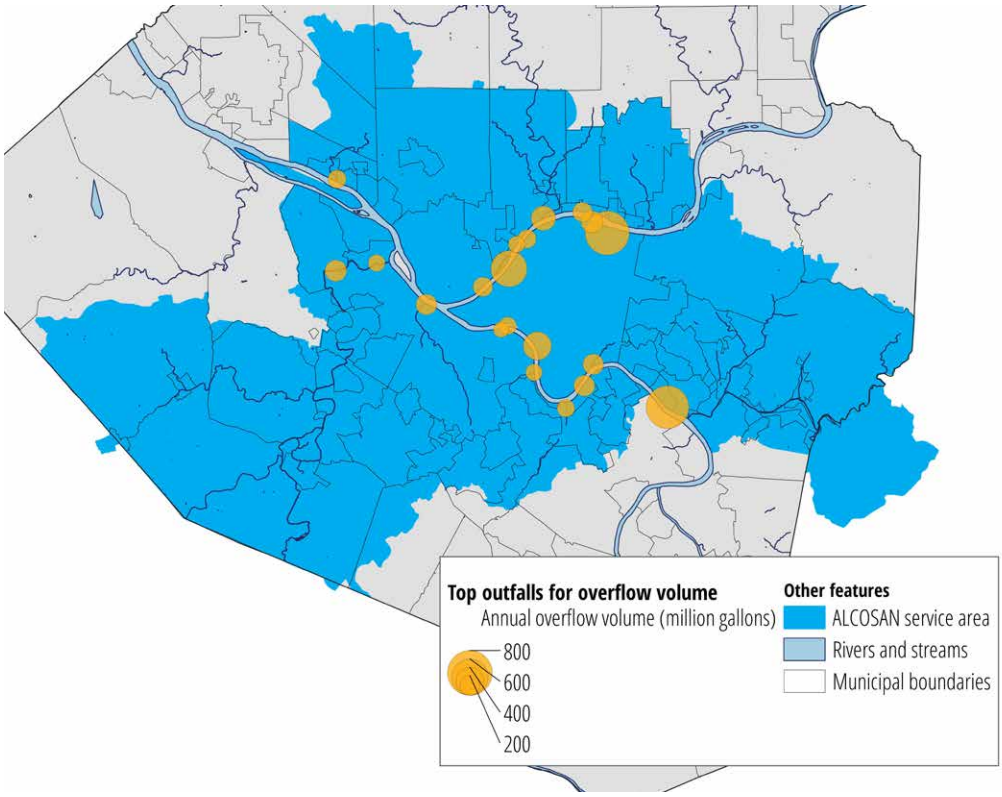


Figure ES-1. Locations that release the highest volume of untreated wastewater in a typical year[3]

period, and annual rainfall could increase by 8% by midcentury.[4] Researchers at the RAND Corporation estimated that the additional climate-related precipitation will cause a greater volume of sewage overflows.[5]

- Despite a declining population over the first decade of this century, Allegheny County added 20 square miles of developed area, including 9 square miles of impervious surfaces from 2001 to 2011.[6] Most of this development replaced forest, which can absorb tremendous volumes of precipitation, with impervious surfaces, which cause rainwater to flow directly into sewers and streams. With Allegheny County's population expected to increase by as much as 16% by 2046, continued development in formerly forested areas of the county could add even more impervious surfaces generating even greater flows of stormwater.[7]

ALCOSAN settled a water pollution lawsuit filed by the U.S. Environmental Protection Agency by signing a legally binding consent decree in 2008 to address sewage pollution in Allegheny County's waterways.[8] By 2020, ALCOSAN developed and received approval for a plan to reduce sewage overflows. The plan will reduce, but not eliminate, sewage overflows: Even after the plan has been implemented by 2036, ALCOSAN projects 2.7 billion gallons of sewage-contaminated water will still flow into the region's waterways annually.[9]

The Three Rivers – and the other waterways of southwest Pennsylvania – deserve better. Fortunately, there are policy solutions and new funding available for ALCOSAN and its member municipalities to take additional action toward ending sewage overflows as soon as possible. In particular, the region should strive to reduce pollution further by adding more "green infrastructure," which allows stormwater to soak into

the ground or to flow into streams over time. Recent increases in federal funding provide the opportunity to accelerate progress toward clean water.

- Pennsylvania allocated more than $200 million to the Water and Sewer program within the H2O PA Program and several million to stormwater management grants through the Department of Environmental Protection.[10] H2O PA's Water and Sewer program provides grants to help fund the construction of storm sewer, sanitary sewer and drinking water infrastructure.[11]
- The federal Infrastructure Investment and Jobs Act, also known as the Bipartisan Infrastructure Law, will provide supplemental funds to the Clean Water State Revolving Fund (CWSRF) general program.[12] From 2018 through 2021, Pennsylvania received approximately $63 million in capitalization funds annually for its CWSRF, allowing it to lend more money each year.[13] This amount could double in coming years as more federal funds are made available.

Municipalities should also accelerate rapid expansion of green infrastructure by creating or improving stormwater management fees. Under these policies, property owners would either adopt measures to stop runoff pollution from their own land or pay to fund stormwater infrastructure projects elsewhere.

- The Pittsburgh Water & Sewer Authority began collecting a stormwater fee in 2022 that will generate an estimated $21 million annually for infrastructure upgrades.[14] At least eight other communities in Allegheny County and served by ALCOSAN have adopted stormwater management fees.[15]
- The benefit of stormwater fees would be more far-reaching if municipalities offered rebates and advice to help owners of private property reduce runoff pollution, using rain barrels, rain gardens, permeable surfaces and other techniques.

Allegheny County and its municipalities should also change land use practices to reduce the volume of stormwater runoff polluting the region's rivers, creeks and streams.

- Land use and zoning policies should also be changed to prevent runoff pollution. Limiting the loss of forests and focusing development in a more compact manner or in already developed areas can reduce the amount of stormwater generated.
- The impact of regulations to curb stormwater runoff is partially dependent on how well they are enforced. Municipalities may need to strengthen enforcement to obtain the full benefit of new land use and zoning rules.

Introduction

IN LATE SUMMER 2021, Hurricane Ida made landfall in Louisiana and then moved north.[16] More than 4 inches of rain hit parts of southwestern Pennsylvania, causing communities in Allegheny County to declare disasters and close schools as flash flooding devastated the region.[17]

Overflowing creeks flooded basements.[18] Statewide, the storm caused more than $100 million of damage to public infrastructure.[19]

The stormwater that flooded into homes also overwhelmed the region's sewer system, filling pipes carrying raw sewage mixed with stormwater to beyond capacity and causing them to spill into local waterways. Several days before the hurricane arrived, ALCOSAN issued an alert to warn residents that the sewer system was overflowing and to minimize contact with waterways.[20] Even a week later, after the storm had passed and the overflows had ended, ALCOSAN noted that waterways could still be contaminated.

While Hurricane Ida was a disastrous event for the region, Allegheny County is no stranger to flooding and sewage overflows. A typical rainstorm can quickly produce so much water that it overwhelms the wastewater system, causing flooding into streets and homes.

The outdated state of Allegheny County's sewer system means that for nearly every major rainstorm, rain fills the sewer system, and bacteria-ridden effluent combined with the rushing rainwater flushes into the Three Rivers and local creeks, dumping sewage-contaminated water, threatening wildlife and Pennsylvanians alike.

Sewage overflows will likely continue to grow in volume as the area of the county that is covered in pavement expands and as climate-change-fueled precipitation events become more intense. To adapt, Allegheny County needs to modify its communities to provide ways for rain to soak into the ground or to enter the wastewater system over the course of days, not hours.

To ensure clean water in the Three Rivers and other waterways across the region, ALCOSAN and its member municipalities should move quickly to address the problem of runoff pollution, both from existing sources and from new development.

Frequent sewer overflows pollute our rivers and threaten public health

THE THREE RIVERS are a defining feature of Allegheny County. Pittsburgh has the second-largest number of registered recreational boats in the U.S.,[21] and thousands of Allegheny County residents can be found fishing, kayaking or enjoying the region's riverfront parks and trails on any nice day.[22]

However, river recreation can make people sick when waterways are contaminated with raw sewage, which happens all too often in Allegheny County because stormwater runoff mixes with sewage and overwhelms the region's sewage infrastructure. The Allegheny County Sanitary Authority (ALCOSAN) issues alerts about sewage contamination during the river recreation season. In 2021, ALCOSAN reported 55 "overflow in effect" alerts.[23] Since 1995, alerts have been in effect for nearly half of each recreational season – severely limiting western Pennsylvanians' ability to enjoy our waterways.[24]

In coming years, sewage overflows may become more common as climate change increases the severity of storms and suburban development increases the amount of stormwater runoff from each storm.

Sewage overflows are common in Allegheny County

Much of the rain that falls on hard surfaces such as roads and rooftops in Allegheny County flows straight into storm drains, and the region's largest sewage and stormwater system. The aging wastewater system cannot handle this volume of combined runoff and sewage. As a result, raw sewage is frequently released into the region's waterways.

Allegheny County's wastewater system

Cities must manage several types of wastewater, primarily sewage and stormwater. **Municipal sewage** includes waste from toilets, showers and sinks in homes and businesses, as well as industrial waste that may contain any number of toxic materials or other pollutants.[25] **Stormwater** runoff from rain or melting snow that doesn't soak into the ground also needs to moved away from buildings and streets. Stormwater can carry pollution such as fertilizers, fecal bacteria from animals, and oil.

Cities can handle these waste streams either separately or together. In **separated systems**, stormwater and sewage travel through separate pipes and are handled differently before being released into rivers or streams.[26] Municipal waste flows through sanitary sewer lines to a treatment plant while stormwater is released untreated to streams or rivers, or to stormwater detention systems that may delay the release of water to streams and/or allow some stormwater to soak into the ground.

In **combined systems**, stormwater and sewage flow through the same pipes beneath city streets and are sent to a wastewater treatment plant.

During wet weather or equipment failures, combined systems and separated systems may release untreated wastewater into rivers and streams. A **combined sewer overflow** (CSO) occurs when the combined sewer system cannot accept the incoming volume of water, and spills the mixed sanitary and stormwater effluent directly and untreated into a waterbody.[27] A **sanitary sewer overflow** (SSO) occurs when the sanitary sewage line of a separated system is blocked or damaged, resulting in the discharge of sewage to waterways. Raw sewage can make people who come into contact with it sick. (For more details, see "Untreated sewage harms human health and waterways," p. 10.)

ALCOSAN, the main wastewater system in Allegheny County, serves 83 municipalities, including Pittsburgh, and includes Monroeville and Penn Township in the east, Ross and Shaler townships in the north, North Fayette Township in the west, and Bethel Park and Whitehall in the south.[28] The vast majority of ALCOSAN's territory is in Allegheny County, extending only slightly into Westmoreland and Washington counties.[29]

ALCOSAN's network includes areas with a combined sewer system and areas with separate sewer and stormwater lines. Older municipalities in the ALCOSAN system are typically served by a combined sewer system, while newer portions of ALCOSAN's service territory typically have separate sewer and stormwater lines. Nearly one-third of the total miles of pipe in the network are combined sewer lines, covering just 17% of ALCOSAN's territory but serving 57% of customers.[30] ALCOSAN's system covers more than 300 square miles, about 40% of the county.[31]

Municipalities own and maintain many of the smaller sewer pipeline networks within their own boundaries, while ALCOSAN owns and operates the wastewater treatment plant, Woods Run, and 88.5 miles of the largest pipes.[32] Municipalities own and maintain 4,000 miles of wastewater lines that run to ALCOSAN's pipes.[33] This fragmented jurisdiction adds to the challenge of managing the region's wastewater and stormwater systems, but is not an excuse for continued pollution.

Stormwater runoff flowing into a storm drain.

Allegheny County's sewer system often dumps raw sewage

Extensive developed areas, steep topography, and heavy precipitation across ALCOSAN's service territory result in extensive stormwater runoff that overwhelms the wastewater system. As a result, untreated sewage frequently pollutes the region's streams and rivers. In a typical year, 9 billion gallons of sewage-contaminated water enter local waterways, though some estimates are higher.[34]

Rain and melting snow run off from roads, parking lots and other hard surfaces. Without unpaved land or other natural features to allow this water to soak into the ground, in areas served by combined sewer and wastewater lines, this rainwater flows into wastewater pipes, adding to the volume of sewage-contaminated water requiring treatment. Even worse, in at least 11 different locations in Allegheny County, sewage pipes were constructed so that entire streams were directed into the sewer.[35] (This is a vestige of an era when residents relied on open streams to carry away waste. When the sewer system was constructed, the entire stream was enclosed.) This inflow means the volume of stormwater entering the wastewater system surges during each precipitation event. In addition, aging pipes in the region are vulnerable to infiltration, in which groundwater is able to enter cracked or

damaged pipes, increasing the total volume of sewage-contaminated water that must be treated.[36]

Across the system, sewage pollution may be released from any of more than 400 sanitary sewer and combined sewer outfalls – discharge points where wastewater can overflow directly into streams or rivers.[37]

In a year with typical rainfall, combined system outfalls discharge 9 billion gallons of sewage and stormwater, while sanitary sewer outfalls release 0.7 billion gallons of sewage.[38] Roughly 115 outfalls have discharges 49 times or more annually.[39] More than two dozen sanitary sewer outfalls release sewage 13 or more times a year.[40] Overflows are not always of short duration, but can last for days. Nearly 40 combined system outfalls overflow for more than 480 hours (20 days) per year.[41]

The largest volume of overflow is discharged into the Main Rivers basin, which includes most of the city of Pittsburgh north of the Ohio and Monongahela rivers, as well as part of Pittsburgh's South Side, with 2.8 billion gallons released in a typical year.[43] The upper Allegheny and the upper Monongahela receive the next highest volumes, with approximately 2 billion gallons each. The greatest SSO overflow volume happens in the Lower Ohio River/Girty's Run.

Untreated sewage harms human health and waterways

The raw sewage released in combined or sanitary sewer overflows poses a health risk to humans and wildlife.

Untreated sewage can contain bacteria, viruses, parasites, chemicals, heavy metals and pharmaceuticals.[44] For example, *Cryptosporidium*, a microscopic parasite, is a common cause of waterborne disease in humans in the U.S., and is transferred to water bodies by human and animal waste.[45] People may be sickened by sewage after swimming in polluted rivers or otherwise coming into contact with untreated wastewater. Bacteria, parasites and viruses in sewage

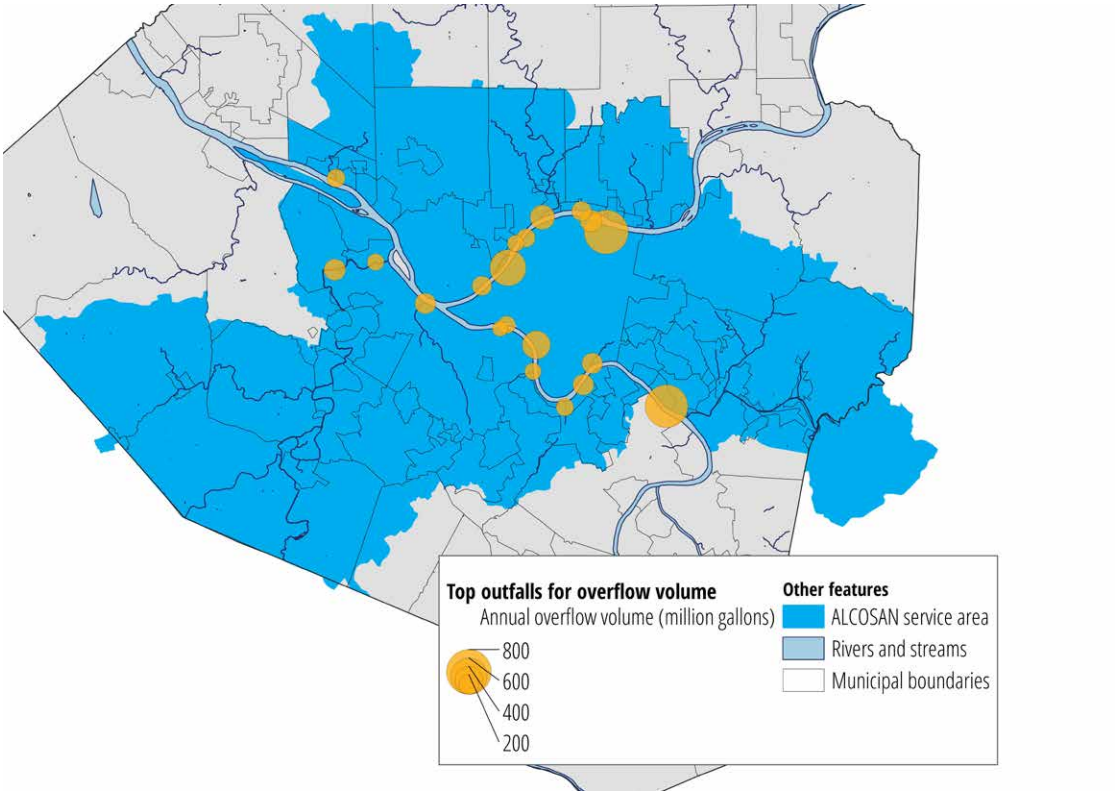


Figure 1. Locations that release the highest volume of untreated wastewater in a typical year[42]

can cause lung and intestinal infections; diarrhea, cramps, vomiting and loss of appetite; fever, headache and weakness; worsened allergies; and other illnesses.[46]

Waterways in ALCOSAN territory often contain high enough levels of sewage contamination to cause illness. The presence of fecal contamination in water is typically indicated by the existence of bacteria, including *E. coli*. In fresh water, the U.S. Environmental Protection Agency estimates that 190 colony-forming units (cfu) of *E. coli* per 100 mL of water will lead to 32 out of every 1,000 swimmers developing a gastrointestinal illness.[47] Water quality testing in the region's streams and rivers from 2006 to 2011 frequently found *E. coli*. During the recreational season (April through October), more than 50% of samples in the Three Rivers had more than 200 cfu/100mL.[48] Samples from some tributaries, especially Chartiers Creek and Saw Mill Run, had high *E. coli* levels even more often.

Sewage pollution can also contribute to algal outbreaks. Sewage treatment plants remove much of the nitrogen and phosphorus pollution in wastewater. When raw sewage is released into a river, however, these nutrients can lead to the growth of algae, which deplete the water of oxygen as they die and decompose.[49] The Allegheny, Monongahela and Ohio rivers all develop algal outbreaks in warm weather.[50] Nutrients from Allegheny County's sewage and stormwater runoff add to pollution from farms, contributing to algal outbreaks downstream – such as the Ohio River outbreak of 2015, which covered over 600 miles of the river from Pike Island, W.Va., to Cannelton, Ind.[51] That 2015 outbreak involved a toxin that can cause diarrhea, vomiting and liver damage, and that also can kill animals that drink the water.[52]

In total, 940 miles of streams and rivers in Allegheny County in 2017 were "impaired," too polluted for some designated uses such as swimming or fishing.[53] According to a 2014 analysis, urban runoff, storm sewers, combined sewer overflows, small residential runoff and road runoff are the leading causes of pollution for more than 250 of those miles.[54]

Photo: staff

Sewage overflows are common enough that ALCOSAN has posted signs warning people that they may need to avoid contact with river water.

Stormwater runoff also contributes to flooding

In Allegheny County, heavier storms can produce enough stormwater to flood streets, basements and businesses. For example:

- Two women and two children died in a flash flood in August 2011 when Washington Boulevard's thoroughfare filled with 9 feet of water.[55] From 2016 to 2020, the corridor was closed due to flooding approximately 10 times.[56]
- In September 2021, Hurricane Ida led to flooding streets and basements as overflowing sewer systems couldn't contain the volumes of rainfall.[57]
- Researchers at RAND estimated basement flooding and sewer backup rates for more than 900 homes along selected streets in the Homewood,

Belmar and East Hills neighborhoods. The researchers estimated that rainfall of 1.2 inches in an hour (which happens once every two years, on average) could cause water to enter basements for 19% of homes, and sewage to back up in 4%.[58]

Climate change and development will increase the risk of sewage overflows

More intense rainfall events that will result from climate change will increase the peak volume of stormwater the region's sewer system must handle. In addition, development that adds to impervious surfaces in the region will increase the amount of stormwater produced by even average storms. Both of these increase the likelihood of future sewage overflows and flooding.

Climate change will increase precipitation

The expected impacts of climate change include heavier rainfall events that will increase the potential for sewage overflows and flooding. Estimates of future stormwater management needs in Allegheny County are based on historical precipitation patterns and use 2003 data as a typical rainfall year, which likely does not accurately represent future patterns.[59]

Precipitation in Pennsylvania has already increased due to climate change. Annual precipitation totals from 2000 to 2020 were nearly 5 inches higher than during the 1971 to 2000 period.[60] Heavy rain events have also become more common.[61]

Annual precipitation in Pennsylvania is expected to increase by 8% by midcentury, and the magnitude, frequency and intensity of precipitation events will continue to increase as the planet warms.[62] Statewide, the number of days with "extremely heavy" precipitation events could increase by more than 40% by 2070, and the total precipitation that falls during the annual maximum three-day precipitation event could increase by 11%.[63]

Both greater annual rainfall and an increase in the amount of rain dropped by a single storm can make stormwater more challenging to manage and can increase sewage overflows. Flooding and sewage overflow projections include:

- Across the Northeast, the U.S. Climate Change Research Program projects that flooding will become more frequent because of more intense precipitation.[64]
- For Allegheny County, researchers at RAND estimated that additional climate-related precipitation will cause a greater volume of sewage overflows. CSO and SSO combined volumes will increase by an estimated 5% to 10%, depending on the precipitation scenario used.[65]
- For Negley Run, a large watershed in the eastern part of Pittsburgh, the amount of wastewater overflow may already be greater than what ALCOSAN modeled. Analysts at RAND compared the "typical year" rainfall that ALCOSAN used in its model to actual rainfall from 2003-2017. Actual rainfall has been higher than in the "typical year," and as a result RAND, in its modeling of how this affected Negley Run, estimated that sewer overflows have been 14% greater.[66]

More impervious surface will increase runoff

In addition to increased precipitation, converting more forests into hard surfaces – such as roads, parking lots or malls – will increase the volume of stormwater runoff, and thereby increase the risk of sewage overflows. The amount of the impervious surface in the region will increase if development continues to follow historical patterns. A greater increase in population will exacerbate the problem.

The amount of developed area in ALCOSAN's territory has increased in recent years even though the region's population has been relatively stable. Despite a declining population in the first decade of this century, Allegheny County added 20 square miles of developed area, including 9 square miles of impervious surfaces, from 2001 to 2011.[67] This development occurred primarily through the loss of forest, which has great capacity to absorb rainfall, prevent runoff and recharge groundwater.[68]

In contrast, impervious surfaces cause rainwater to flow directly into sewers and streams. With Allegheny County's population now growing again, continued development in forested areas of the county could add even more impervious surfaces generating even greater flows of stormwater.[69]

According to data from municipalities served by ALCOSAN and from the Southwestern Pennsylvania Commission, population in the ALCOSAN service territory is projected to increase by 13%-16% by 2046 compared to 2010.[70] The biggest percentage increases in population are projected to occur in the far eastern and western portions of ALCOSAN's territory, such as in North Fayette and Penn Township.[71] Overall, the number of square miles of sewershed served by ALCOSAN could increase by 9% as sanitary sewer lines for new developments are connected to the existing network.[72] Though new additions to ALCOSAN's sewershed will be served by separate stormwater and sewage systems, some amount of rainwater will nonetheless enter sewer lines, though roof gutter downspout connections, open or leaking pipe joints, and other points.[73] This population and sewershed growth are projected to cause CSOs and SSOs to increase by 8%, if no measures are adopted to reduce stormwater runoff.[74]

The stormwater impacts of this development will be greater than projected by ALCOSAN when combined with climate-related increases in precipitation. Already, in two recent years total stormwater pollution may have been as high as 15 billion gallons, far more than ALCOSAN's estimate of 9 billion gallons annually.[75] This is due to higher amounts of precipitation than the historic levels of rainfall ALCOSAN included in its model, plus more paved surfaces as a result of development.[76]

Better infrastructure is crucial to achieving clean water

MUNICIPALITIES CAN USE both "gray" and "green" infrastructure for managing stormwater and reducing the amount of untreated wastewater that is released into the environment.

Gray infrastructure

Wastewater has traditionally been managed by collecting it from roads, rooftops and other hard surfaces and carrying it away through pipes and tunnels to be treated at a wastewater treatment plant or discharged directly into a river or stream.[77] This type of infrastructure is known as "gray infrastructure" because it relies on curbs, gutters, pipes and other concrete collection and treatment systems.

As gray infrastructure moves stormwater, it picks up trash, bacteria and other pollution, increasing the need for treatment.[78] If the gray infrastructure is in poor repair, it may leak untreated wastewater into waterways. Furthermore, when gray infrastructure gets overwhelmed by the volume of wastewater entering the system, it can discharge untreated stormwater into rivers and streams, degrading water quality. Sufficient and well-maintained gray infrastructure is essential to keeping raw sewage out of waterways.

Green infrastructure

"Green infrastructure" is designed to reduce the amount of stormwater runoff by capturing rainfall close to where it lands. Green stormwater infrastructure can help to reduce inflow and infiltration into the sewer system and also reduce the need for gray infrastructure. Examples of green infrastructure include:

- Permeable pavement, such as pavers with spaces or porous concrete or asphalt perched above a gravel bed so that infiltrating water can collect below the surface and slowly infiltrate into the soil.[79]
- Bioswales and rain gardens, essentially basins with plants and other natural features intended to slow runoff, allowing it to filter into the ground or to enter the gray infrastructure system more slowly.[80]
- Trees and green space.
- Rain barrels, which store runoff from roofs.[81]

Measures to control the volume of stormwater running off impervious surfaces deliver multiple benefits. Reducing peak runoff during storm events and the overall volume of stormwater can reduce how much stormwater mixes with untreated sewage and contributes to overflow events.

Figure 2. Examples of green infrastructure[82]

In addition to reducing how much and how quickly stormwater flows into storm drains during precipitation events, infrastructure that increases the ability of water to soak into the ground also helps to recharge groundwater and improve water quality.[83]

Green infrastructure can also help reduce flooding, filter out pollution, counteract heat radiating off streets and buildings, and improve the appearance of a neighborhood.[84]

Current plans to reduce sewage overflows and flooding

THE PROBLEM OF SEWAGE overflows into Pittsburgh-area rivers and streams has been recognized for decades. In recent years, policymakers have developed plans to upgrade water conveyance, storage and treatment infrastructure and to reduce the amount of stormwater that runs off impervious surfaces and mingles with raw sewage.

Plans to address sewage overflows and reduce stormwater problems include the Clean Water Plan from ALCOSAN, as well as the Pittsburgh Green Infrastructure Plan, also known as the Green First Plan.

These green infrastructure and stormwater management plans can help achieve the interim goals of ALCOSAN's clean water plan, at the same time they reduce flooding. However, as currently drafted, none of these plans will fully address Pittsburgh's stormwater and associated sewage overflow problems. In addition, the progress that they anticipate will take many years.

ALCOSAN's Clean Water Plan

For decades, untreated sewage has polluted waterways in Allegheny County in violation of federal clean water laws, prompting the federal government to threaten to take enforcement action.[85] Finally, in 2008, after the U.S. Environmental Protection Agency, the Pennsylvania Department of Environmental Protection and the Allegheny County Health Department sued ALCOSAN, the regional sewer authority entered into a consent decree with environmental regulators that required it to create a plan for addressing sewage pollution in waterways.[86] The plan would need to address both wastewater collection and treatment to eliminate sanitary sewer overflows and reduce combined sewer overflows.[87] The initial agreement required that all infrastructure improvements be operational by late 2026. However, regulators agreed to a longer timeline and to allow ALCOSAN to implement its plan in phases.[88]

In developing its plan, ALCOSAN modeled multiple scenarios for reducing sewage overflows to a level that would make attainment of clean water standards possible.[89] ALCOSAN identified a plan that relied primarily on gray infrastructure upgrades such as expanding the Woods Run treatment plant and building new tunnels for storing stormwater, at a cost of $3.6 billion (in 2010 dollars).[90] However, ALCOSAN deemed this plan too expensive, and instead proposed an option that would provide less pollution control and on a longer timeline.[91]

The EPA rejected this option because it did not sufficiently reduce pollution. In addition, the city of Pittsburgh and community organizations advocated for the inclusion of green stormwater infrastructure and other measures to reduce the inflow of stormwater and the seepage of groundwater into wastewater pipes through cracks or broken pipes.[92] ALCOSAN responded with a revised plan that included a longer

timeline for more pollution reductions than it had originally proposed.[93]

Nonetheless, that revised plan, codified in a consent decree signed in 2020, will still leave the region with 2.7 billion gallons of sewage overflows by 2036 (assuming the continuation of historic precipitation patterns).[94]

To reduce pollution down to that level, the plan includes: expansion of the wastewater treatment facility's capacity to 480 million gallons per day (up from 250 million gallons currently); increased capacity to transport and store untreated wastewater; green infrastructure measures to reduce the amount of water that enters the sewer system; and improved maintenance of regional sewers.[95] To allow for more centralized management and maintenance of the system, ALCOSAN will seek to acquire more than 200 miles of sewage lines from municipalities.[96]

ALCOSAN plans to spend $2 billion (in 2010 dollars) for these measures.[97] Just $100 million is earmarked for the Green Revitalization of our Waterways (GROW) program, which funds grants for source reduction measures, including green infrastructure efforts and gray infrastructure projects.[98] The green infrastructure projects include creating spaces to capture stormwater and slowly release it or allow it to soak into the ground.[99] Gray infrastructure source control projects include lining sanitary sewer lines to reduce groundwater seepage into pipes and providing separate channels for streams to remove natural flows from the wastewater system.[100] As of early 2022, ALCOSAN had already spent $60 million in GROW funding.[101]

Only a small share of this funding has gone to green infrastructure projects. Approximately one quarter of this spending has been for green stormwater infrastructure.[102] The rest went to gray infrastructure projects.

ALCOSAN acknowledges that in some places, green infrastructure projects have the potential to reduce wastewater overflows more cheaply than gray infrastructure.[103] However, its plan calls for studying the immediate sewersheds of only five such overflow points as candidates for green infrastructure investments.

Photo: Wikimedia Commons, public domain. https://commons.wikimedia.org/wiki/File:Bioswale.jpg

A bioswale under construction.

Pittsburgh Green Infrastructure Plan

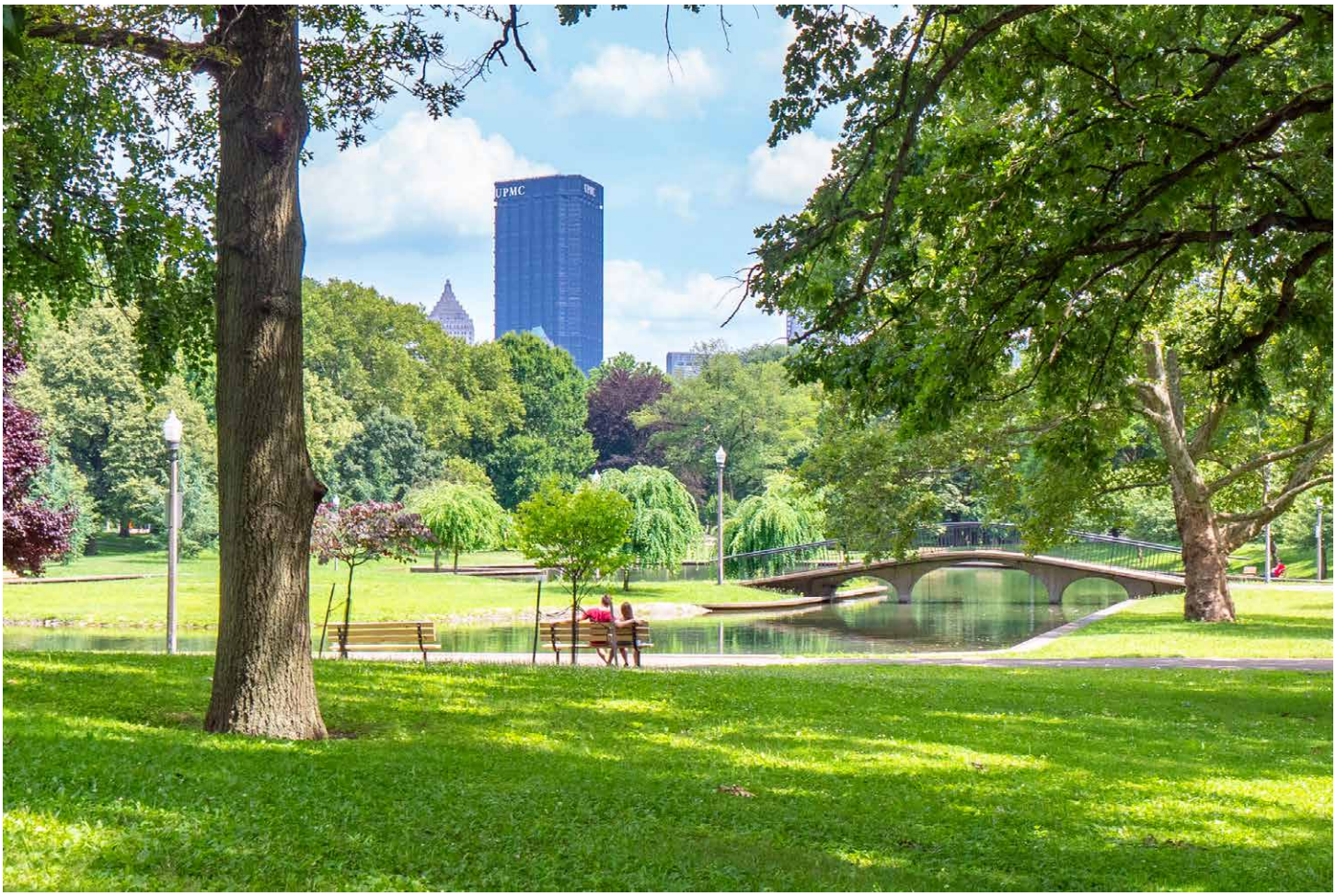
To better manage stormwater and thus reduce sewer overflows and flooding, the city of Pittsburgh and the Pittsburgh Water and Sewer Authority (PWSA) developed a "Citywide Green First Plan."[104] The plan focuses on using green infrastructure, in addition to regional efforts to increase the capacity of infrastructure to move and store more water, to reduce the amount of stormwater that flows into the wastewater system and to slow how quickly it enters the wastewater system.[105] ALCOSAN's plan incorporates some, but not all, of the opportunities identified in the Green First plan.

The plan, which is currently being updated, prioritizes sewersheds that have historically suffered from repeated flooding. These sewersheds are also responsible for one-third of the total combined sewer overflow volume in the ALCOSAN system.[106] Other priorities include the streams that add the most volume to the combined sewer system and areas that are repeatedly hazardous during floods.

The plan seeks to capture 85% of the stormwater flows, based on 2003 precipitation patterns.[107] Capturing 85% of stormwater flows means sewage overflows would be reduced but not eliminated. In addition, this estimate is based on historic patterns of precipitation and fails to anticipate the increases in precipitation being caused by climate change.

Of the 30 sewersheds that were modeled at the plan's creation in 2016, approximately half already capture 85% of the stormwater flow and thus were assumed to not necessarily need green infrastructure investments. In these sewersheds, the biggest impact of adding green infrastructure may be to help reduce road and basement flooding.[108] In the other sewersheds, green infrastructure will help reduce these problems and also curb sewage overflows. Green infrastructure may provide pollution reductions more quickly than gray infrastructure investments, and deliver ancillary benefits such as flood control.

Pittsburgh and PWSA have begun work on a number of green infrastructure projects. For example, a project on Thomas and McPherson boulevards will install bioretention systems, and use catch basins and permeable pavers to reduce stormwater runoff.[109] The project, funded with a mix of municipal and ALCOSAN funds, is projected to cut overflows by more than 3 million gallons.[110]



Clean water contributes to a better quality of life in Pittsburgh.

Increased funding can enable pollution reductions sooner

WHILE ALCOSAN, Allegheny County, the city of Pittsburgh and other municipalities are taking action to reduce sewer overflows, these actions will take roughly another decade-and-a-half to implement and will still leave the region with 2.7 billion gallons of sewage overflows. Additional funding from state and federal sources could allow southwestern Pennsylvania communities to complete infrastructure projects sooner and/or expand the scope of such projects to achieve cleaner water sooner than current plans will.

Federal funding of Pennsylvania's Clean Water State Revolving Fund has increased, expanding the number of projects that can receive funding. Both the state and local governments have received funding through federal coronavirus relief measures that can be applied to stormwater management solutions. In addition, municipalities can adopt dedicated stormwater management fees.

Clean Water State Revolving Fund

The Clean Water State Revolving Fund (CWSRF) is the main federal program for funding projects that curb sewage and runoff pollution. Thanks to the Bipartisan Infrastructure Law, Pennsylvania will receive twice as much federal funding into the CWSRF over the next five years compared with previous years.

New federal appropriations will be added to money already in the CWSRF. This funding, plus money from communities that have repaid some or all of their loans, combined with investment income, can all be loaned for new projects. In 2021, Pennsylvania had more than $400 million available for CWSRF projects.[111] The new federal funding will increase the amount available for lending in coming years. In addition, some will be available as grants or forgivable loans.[112]

Through the Bipartisan Infrastructure Law (BIL), Pennsylvania will receive $71 million in 2022 for the CWSRF and the projects it normally funds, plus millions more earmarked for lead service line replacement, drinking water projects, and efforts to deal with emerging contaminants such as per- and polyfluoroalkyl substances (PFAS).[113]

This Bipartisan Infrastructure Law funding will be in addition to funds distributed through the annual federal appropriations process. That normal funding cycle, from 2018 through 2021, sent approximately $63 million annually in new capital funds to Pennsylvania for its CWSRF, helping to grow the total amount available for lending.[114] Federal funding through this annual appropriations process in 2022 fell to approximately $45 million. Thus, the funding provided though the Bipartisan Infrastructure Law could approximately double the amount of new funds

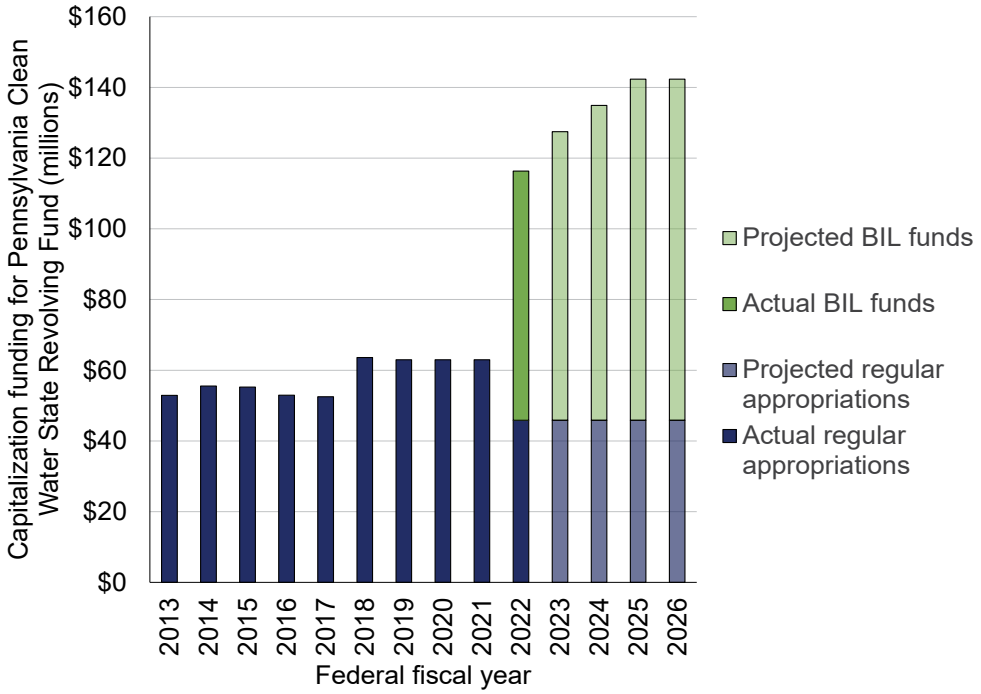


Figure 3. Historic and projected Clean Water State Revolving Fund allocations for Pennsylvania[115]

Pennsylvania has for the CWSRF compared with recent years. (See Figure 3.)

Though the grant process is competitive, Allegheny County communities that are members of ALCOSAN have demonstrated that they can qualify for funding.[116] Communities that have received funding in recent years from the CWSRF include:

- Bethel Park received a CWSRF loan of $1,367,000 in April 2019 for stormwater management to address flooding in residential areas and reduce pollution into a creek.[117] The project includes an underground detention tank, rain gardens and other improvements.
- Pittsburgh Water and Sewer Authority received $7.75 million in January 2021 to replace sewer lines that contribute to wet weather sewage overflows into the Monongahela and Ohio rivers.[118]
- In October 2021, Pittsburgh Water and Sewer Authority received a loan for more than $36 million to improve water quality by replacing nearly a mile of large-diameter sewer line and 22 miles of small-diameter sewer lines.[119]

Recovery funds

Pennsylvania has allocated several hundred million dollars of federal American Rescue Plan funding to water and sewer projects. The state dedicated more than $200 million to the Water and Sewer program within the H2O PA Program and several million to stormwater management grants through the Department of Environmental Protection.[120] H2O PA's Water and Sewer program provides grants to help fund the construction of storm sewer, sanitary sewer and drinking water infrastructure.[121]

In addition to money that went directly to the state, funds went to local and county governments in Pennsylvania, too.[122] This money can be used for stormwater infrastructure upgrades, and some municipalities have chosen this option to reduce water pollution. For example, Penn Hills will receive a total of $17.1 million, and will spend it on sewer and stormwater projects, among other things.[123] Bridgeville will spend nearly its entire $500,000 on a stormwater project.[124] Shaler Borough spent approximately $1.5 million, half of its total funding,

on sewer rehabilitation.[125] Allegheny County allocated $5.8 million to stormwater mitigation.[126] Dedicating unspent funds to green infrastructure to reduce stormwater runoff would help accelerate pollution reduction.

Stormwater fees

Municipalities in Allegheny County could establish or increase stormwater fees to increase funding for stormwater infrastructure, including green stormwater tools, on both public and private property.

The Pittsburgh Water & Sewer Authority began collecting a stormwater fee in 2022.[127] The fee is based on the total amount of impervious surface on a property, such as pavement and roofs.[128] Before implementation of the fee, stormwater management was funded through general wastewater rates. That meant that a property that did not have a water and sewer connection, such as a parking lot, did not pay anything to help manage stormwater, despite generating large amounts of runoff.[129]

The monthly fee in 2022 is $5.96 for a residential customer with 1,015 to 2,710 square feet of hard surface.[130] Residential customers who have less impervious surface on their property pay a lower fee. Commercial customers are charged at a similar rate. The stormwater fee will increase in 2023, generating an additional $21 million annually that PWSA can use for stormwater runoff reduction and infrastructure upgrades.[131]

In addition to Pittsburgh, other communities served by ALCOSAN that have adopted stormwater management fees include Dormont, Fox Chapel, Mount Lebanon, Monroeville, North Fayette, O'Hara, Plum and Whitehall.[132]

Stormwater fees provide a dedicated revenue source for the local stormwater authority to reduce and manage runoff. Pittsburgh uses revenue from its stormwater fee to build and maintain city stormwater projects, including green infrastructure.[133]

Photo: staff

Permeable pavers allow water to soak into the ground, reducing runoff.

Pittsburgh does not use stormwater fee revenue to help owners of private property reduce runoff, though other cities have such programs. Washington, D.C., for example, helps individual homeowners and select other property owners install rain barrels, trees, rain gardens, permeable surfaces and other green infrastructure to reduce runoff.[134] The RiverSmart program provides both advice and rebates, such as up to $100 per tree, up to $1,000 for rain barrels, and up to $2,200 for rain gardens. The programs are supported in part by the city's stormwater fee.[135] The RiverSmart program has helped fund green stormwater infrastructure on more than 4,000 properties.[136]

A stormwater fee should be accompanied by a robust public education campaign encouraging existing commercial and residential property owners to take steps to reduce the amount of runoff from their property, and with funding to encourage action. Installing rain barrels to store water for later use or release, planting trees, building vegetated buffers

on the edge of parking lots, or using permeable pavement in place of asphalt or concrete are relatively straightforward ways for homeowners or business owners to take responsibility for runoff flowing from their land, to alleviate local flooding, and to reduce stress on the region's stormwater system.

Stormwater fees have the potential to provide more funding in Allegheny County to reduce runoff pollution. The dozens of municipalities that are served by ALCOSAN that do not have stormwater fees could establish them. Communities that already have stormwater fees could increase them. Most Allegheny County municipalities with stormwater fees have rates roughly comparable to those charged by Pittsburgh.[137] However, this is far lower than the rate property owners pay in Washington, D.C., where the fee for a typical residential property is more than $18 per month, compared with less than $6 per month in Pittsburgh.[138] The gap between Washington, D.C.'s and Pittsburgh's commercial stormwater fee is similar.

Policies to reduce stormwater runoff can help reduce sewage overflows

CURBING THE AMOUNT of stormwater that flows off roads, roofs, parking lots and other hard surfaces is an important part of the region's efforts to reduce sewage overflows, as well as to reduce flood risk. Municipalities should ensure that new development does not increase stormwater volumes and that redevelopment projects reduce stormwater runoff.

Stronger land use regulations and building codes

Land use regulations, zoning codes and building codes can determine how much stormwater flows off new developments or redevelopment projects.

Land use and zoning policies that limit the loss of forest and focus development in already developed areas can reduce the amount of stormwater generated. For example, researchers with RAND analyzed the impact of potential population growth by 2046 just within ALCOSAN's combined sewer area (i.e., excluding areas where sewer and stormwater lines are separate). Focusing new growth in existing developed areas produces a lower volume of overflows than allowing growth to occur across the region as a whole. Specifically, if the population in areas served by combined sewers were to increase by 15%, impervious surface area would increase by 8% but produce only a 5% increase in overflow volume from combined sewer areas.[139] In contrast, if population growth occurs across the region, and especially in areas that are not already developed (as in ALCOSAN's baseline projection), the increase in overflow volume is greater (8%).[140]

Building codes and rules specific to stormwater management can also help to ensure that new homes, roads and other hard surfaces do not increase stormwater runoff and sewage overflow problems. Standards for new or rebuilt residential, commercial and industrial facilities can include requirements for reducing impervious surfaces and capturing stormwater onsite to increase infiltration or delay the release of stormwater.[141]

Improved enforcement of stormwater rules

The impact of regulations to curb stormwater runoff is partially dependent on how well they are enforced. According to researchers at RAND, enforcement of existing or new stormwater and land use ordinances "could help to limit or avoid increases in impervious cover" that influence how much stormwater is generated.[142]

While data are not available on stormwater regulation enforcement across ALCOSAN's service territory, recent action by the EPA indicates that oversight of stormwater management at construction sites has been inadequate. In 2021, the EPA required Pittsburgh and the Pittsburgh Water and Sewer Authority to improve their enforcement of stormwater management at construction sites.[143] The city and PWSA agreed to hire more inspectors and enforcement staff to monitor for erosion and sediment runoff from construction sites, and also to confirm compliance with stormwater management best practices after construction is complete.

States and municipalities across the country have adopted a variety of policies to address stormwater runoff

ALLEGHENY COUNTY and its municipalities can look to a range of policies adopted in other cities and states for ideas on additional approaches to protecting water quality, reducing stormwater runoff and controlling flooding.

Maryland has adopted statewide standards for development size subject to stormwater rules

In 2007, Maryland enacted the Stormwater Management Act to cut stormwater runoff from new development and major redevelopment projects. The standards apply statewide to any new project that disturbs 5,000 square feet or more of land.[144] In contrast, Pennsylvania's model stormwater management ordinance does not specify a minimum disturbance area – municipalities can determine this – but allows municipalities to decide if they want to exempt projects that disturb up to 1 acre (more than 40,000 square feet).[145] New development must be designed to manage runoff from at least a 0.9-inch rainfall event to the same degree that woods in good condition would.

In Maryland, redevelopment projects where existing impervious area is greater than 40% must reduce the amount of impervious cover by 50% or use environmental site design tools to provide water quality treatment for half of the existing covered area.[146] Pennsylvania's model ordinance does not seek a reduction of impervious cover during redevelopment.

Seattle has set a stormwater reduction goal

In 2013, Seattle adopted a goal of managing 700 million gallons of stormwater runoff with green infrastructure by 2025, up from just 100 million gallons in 2012.[147] The 700 million gallons of runoff that Seattle seeks to reduce or slow down on its way to waterways is less than 5% of the total amount of stormwater generated in the city.[148] By 2020, the city had built projects that managed more than 400 million gallons of stormwater. Slightly more than half of the total capacity was built by Seattle Public Utilities, approximately one-fifth was built by private

Continued on page 24

Photo: Seattle Parks and Recreation via Flickr, CC BY 2.0

A rain garden in Seattle.

Continued from page 23

entities to comply with code requirements, and almost all the remainder was built through public-private partnerships.[149] The majority of those public-private partnerships did not receive funding from Seattle Public Utilities or King County's Wastewater Treatment Division.

Seattle partnered with a variety of public, private, nonprofit, philanthropic and educational institutions to accelerate construction of green stormwater infrastructure across the city. Seattle has also sought to match green stormwater projects with other community goals, such as environmental justice, public health, workforce development, walkable neighborhoods, career opportunities for youth, and clean air and water.[150] In addition, the city has worked to remove barriers to adoption of green stormwater infrastructure, including policy, process, legal and regulatory obstacles.[151]

The city's efforts to reach its goals have included training in different languages for landscaping contractors on how to install green stormwater projects; providing grants and rebates to property owners to fully cover the cost of projects; targeting schools, fraternities, churches and other institutions whose buildings have big roofs; and partnering with researchers and large institutions to understand the benefits and opportunities of more ambitious stormwater projects.[152]

To reach its 2025 goal, Seattle is expanding its efforts. Because incentives are targeted at areas where new green stormwater infrastructure will have the biggest impact on reducing flooding and sewer overflows, a new online map will make it easier for residents, businesses and developers to understand what incentives are available to them.[153] A new public-private partnership will fund projects in public spaces such as schools and parking lots that are in areas identified by communities as suffering from poor drainage.[154]

Chicago renovates playgrounds to capture stormwater

Several nonprofits, working with the Metropolitan Water Reclamation District of Greater Chicago, Chicago Public Schools and the Chicago Department of Water Management, have renovated schoolyards to provide better space for outdoor recreation and to absorb stormwater.[155] The designs include a variety of green infrastructure features to capture water, reducing flooding, basement backups and wastewater flows.[156] Schoolchildren and members of the surrounding area gain an improved play area and gathering space. The first 15 renovation projects are capable of capturing more than 2.5 million gallons of water each time it rains.[157]

Massachusetts protects the ability of rivers and streams to absorb stormwater

The Massachusetts Rivers Protection Act helps protect water quality and control flooding by limiting development close to rivers and streams.[158] In most areas of the state, the law protects land within 200 feet of permanent rivers and streams from new development. In some more populated or more densely developed municipalities, the protected riverfront area is 25 feet to each side of a river. The protections of the act apply to nearly 9,000 miles of riverbanks in Massachusetts.[159] This protection allows rivers and their surrounding natural areas to continue to protect water quality, reduce flooding and limit damage from storms.

Policy recommendations

ALCOSAN AND ITS member communities have adopted a plan to reduce sewage overflows, but for the sake of public health and the environment, they should seek to implement that plan more quickly, plus add more green infrastructure projects to further reduce stormwater runoff and associated sewage overflows and flooding.

Increase funding to improve green and gray infrastructure

Eliminating sewage overflows and reducing runoff pollution are vital to the health of the Three Rivers and local creeks and streams. Preventing flooding is also important to the success and well-being of residents of Allegheny County and numerous other communities across Pennsylvania. Federal, state and local budgets should reflect these priorities.

State officials should increase funding for stormwater infrastructure in the state's annual budget. Pennsylvania allocated only slightly over $200 million of the $7.3 billion in federal relief funds it received for programs that could help reduce sewage overflows.[160] Future state budgets should include higher funding for solving the state's sewage problems.

Allegheny County municipalities should work with staff who administer the state's Clean Water State Revolving Fund to identify design or construction projects that might qualify for grants or loans in light of increased federal funding for the program. Though total sewage and stormwater spending needs are higher in the largest communities, the limited ability of smaller communities to finance projects may increase their eligibility for grant funding.

In addition, municipalities that have not yet adopted a dedicated stormwater management fee should do so, and those that already have fees should consider raising them. Not only can stormwater fees provide a reliable and dedicated source of funding for municipal projects to reduce stormwater volumes and to rehabilitate sewage infrastructure, if structured right such funds can also support the removal of impervious surfaces and installation of on-site stormwater control infrastructure on private property.

To further support Pennsylvania's efforts at addressing sewage pollution, Congress should increase funding for the Clean Water State Revolving Fund. While the Bipartisan Infrastructure Law makes some progress in this direction, federal funding is still short of the $271 billion that the EPA has estimated is needed to maintain and improve the nation's wastewater infrastructure.[161]

Adopt and enforce policies to reduce future stormwater runoff volumes

Better stormwater management can help reduce sewage overflows. Municipalities in ALCOSAN's territory should evaluate land use and zoning policies for how they will impact stormwater flows from new development or large redevelopment projects. Forested areas should be protected. New projects should be designed to minimize any increase in stormwater runoff that would increase potential sewage overflows and flooding. Municipalities should educate developers about stronger stormwater management rules and hire sufficient staff to ensure new projects comply with the requirements. To minimize impervious surfaces in the watershed, municipal policies should incentivize redevelopment over new development.

State officials should support local efforts by adopting a model stormwater management ordinance that recognizes the projected increases in rain intensity and total volume due to climate change. Pennsylvania leaders could also do more to limit development near waterways, maintaining the capacity of ecosystems to absorb and store water.

Commit to protecting clean water

Fundamentally, Pennsylvania leaders should embrace and act in support of ensuring clean water in every river, lake and stream. State officials should commit to achieving the Clean Water Act's goal of having all waterways be safe for swimming and fishing. Federal officials should ensure that the scope, permitting and enforcement of the act remain strong as well. Locally, municipalities and ALCOSAN should act as swiftly as possible to reduce sewage overflows by implementing current plans. At the same time, leaders should be developing new plans that will end all sewage overflows. Without that, the Three Rivers will remain polluted and residents of Allegheny County will not be able to fully enjoy the region's natural beauty.

Notes

1. ALCOSAN, *ALCOSAN's Clean Water Plan*, September 2019, archived at https://web.archive.org/web/20220303033238/https://www.alcosan.org/our-plan/plan-documents/clean-water-plan, p. ES-6.

2. Ibid., p. 4-25.

3. We mapped the location of the 20 outfalls that release the greatest volume of untreated wastewater in a typical year. Combined and sanitary sewer overflow annual frequencies, durations and volumes were obtained from the ALCOSAN 2019 Clean Water Plan (Allegheny County Sanitary Authority, *ALCOSAN's Clean Water Plan: Section 4*, September 2019, Table 4-4 through Table 4-28). Outfalls were sorted by annual overflow volume as determined from a typical year model simulation performed by ALCOSAN, and the 20 outfalls with the greatest annual volume of contaminated water were selected. The corresponding geographic coordinate data for the top 20 locations was obtained from the ALCOSAN 2020 consent decree, based on the outfall ID (U.S. District Court for the Western District of Pennsylvania, *Modified Consent Decree*, 15 May 2020, available at https://www.alcosan.org/docs/default-source/clean-water-plan-documents/2020-consent-decree.pdf). The identifiers for each outfall were not exact matches. For any outfall ID in the format *XX-##-OF*, the last three characters were removed. Other outliers were adjusted as follows: M-59-DT-IRO was mapped to M-59; C-13A-IRO was mapped to C-13A; and O-14-00-EAST-OF was mapped to O-14E. The points were sized respective to the annual volume of overflows.

4. ICF, for Pennsylvania Department of Environmental Protection, Pennsylvania Climate Impacts Assessment, 2021, revised 28 July 2021, archived at https://web.archive.org/web/20220101002442/https://www.depgreenport.state.pa.us/elibrary/GetDocument?docId=3667348&DocName=PENNSYLVANIA%20CLIMATE%20IMPACTS%20ASSESSMENT%202021.PDF%20%20%3cspan%20style%3D%22color:green%3b%22%3e%3c/span%3e%20%3cspan%20style%3D%22color:blue%3b%22%3e%28NEW%29%3c/span%3e%204/30/2023, p. 13.

5. Jordan Fischbach et al., RAND, *Robust Stormwater Management in the Pittsburgh Region: A Pilot Study*, 2017, archived at https://web.archive.org/web/20220121230528/https://www.rand.org/content/dam/rand/pubs/research_reports/RR1600/RR1673/RAND_RR1673.pdf, p. 45.

6. Population: Ryan Deto, "Allegheny County gains population for first time in six decades, says census," *Pittsburgh CityPaper*, 12 August 2021, archived at https://web.archive.org/web/20211203215610/https://www.pghcitypaper.com/pittsburgh/allegheny-county-gains-population-for-first-time-in-six-decades-says-census/Content?oid=20001909; developed area: Multi-Resolution Land Characteristics Consortium, *NLCD EVA Tool*, accessed 13 April 2022 at https://www.mrlc.gov/eva/.

7. See note 1, p. 7-6.

8. See note 1, p. ES-1.

9. ALCOSAN, *Regional Conveyance Facilities of the Interim Wet Weather Plan, Act 537 Plan Special Study*, March 2022, archived at https://web.archive.org/web/20220320011633/https://www.alcosan.org/docs/default-source/act537/alcosan-act-537-plan-special-study---iwwp-rcf-feb-2022.pdf, p. 1-1.

10. "Final State Budget Includes Nearly $700 Million In Funding To Support Local And State Environmental, Recreation Infrastructure Projects!," *PA Environment Digest*, 11 July 2022, archived at https://web.archive.org/web/20220822022921/http://www.paenvironmentdigest.com/newsletter/default.asp?NewsletterArticleID=55882&SubjectID=.

11. Commonwealth Financing Authority, *H2O Programs: Pennsylvania Water Projects and Programs*, accessed 21 August 2022, archived at https://web.archive.org/web/20220806091810/https://dced.pa.gov/programs-funding/commonwealth-financing-authority-cfa/h20-pa/.

12. U.S. Environmental Protection Agency, *Bipartisan Infrastructure Law: Water Infrastructure Investments*, accessed 16 April 2022, archived at https://web.archive.org/web/20220405133526/https://www.epa.gov/infrastructure/water-infrastructure-investments.

13. U.S. Environmental Protection Agency, *Clean Water State Revolving Fund (CWSRF) Allotments of Federal Funds to States*, accessed 30 June 2022, archived at https://web.archive.org/web/20220630032957/https://www.epa.gov/cwsrf/clean-water-state-revolving-fund-cwsrf-allotments-federal-funds-states.

14. Pittsburgh Water & Sewer Authority, *PWSA Announces Approval of New Rate Structure Including Stormwater Fee* (press release), 18 November 2021, archived at https://web.archive.org/web/20220303172842/https://www.pgh2o.com/news-events/news/press-release/2021-11-18-pwsa-announces-approval-new-rate-structure-including; Pittsburgh Water & Sewer Authority, *Understanding the New Stormwater Fee*, January 2022, archived at https://web.archive.org/web/20220402204144/https://www.pgh2o.com/news-events/news/newsletter/2022-01-28-understanding-new-stormwater-fee.

15. Dormont, Fox Chapel, Mount Lebanon, Monroeville, North Fayette, Plum, Whitehall: Southwestern Pennsylvania Commission Water Resource Center, *Developing a Stormwater Fee to Support Stormwater Management,* June 2020, archived at https://web.archive.org/web/20210124151206/https://spcwater.org/wp-content/uploads/2020/06/PD10006_24_Stormwater-Fee.pdf, p. 3; O'Hara: Township of O'Hara, *Why the Township Adopted a Stormwater Management Fee,* accessed 3 February 2022, archived at https://web.archive.org/web/20220401161759/https://www.ohara.pa.us/building-officialcode-enforcement/pages/why-township-adopted-stormwater-management-fee; ALCOSAN, *Who We Are: Service Area & Facilities*, accessed 31 August 2022 at https://www.alcosan.org/about-us/service-area-facilities.

16. "Hurricane Ida makes landfall as an 'extremely dangerous major' storm," *New York Times*, 14 September 2021, archived at https://web.archive.org/web/20220405211852/https://www.nytimes.com/article/tropical-storm-ida-hurricane.html.

17. Eric Heyl, "Ida in Pittsburgh: disasters declared after major flash flooding," *Patch*.com, 2 September 2021, archived at https://web.archive.org/web/20210905135110/https://patch.com/pennsylvania/pittsburgh/ida-pittsburgh-disasters-declared-after-major-flash-flooding.

18. "Remnants of Ida leave Oakdale streets filled with floodwater," *CBS2 KDKA-TV,* 2 September 2021, archived at

https://web.archive.org/web/20210902135614/https://pittsburgh.cbslocal.com/2021/09/02/oakdale-flooding-hurricane-ida/.

19. Justine McDaniel and Julia Terruso, "After Ida destroyed hundreds of Pa. homes and caused more than $100 million in damage, residents await disaster relief," *Philadelphia Inquirer,* 8 September 2021, archived at https://web.archive.org/web/20220408174012/https://www.inquirer.com/news/pennsylvania/hurricane-ida-damage-cost-pennsylvania-20210908.html.

20. ALCOSAN, *CSO Alert Data 2021*, accessed 15 April 2022, archived at https://web.archive.org/web/20220305161829/https://www.alcosan.org/docs/default-source/cso-advisories/cso_alerts_2021.pdf?sfvrsn=c13736fd_0, pp. 6-7.

21. "Fishing, Kayaking & Boating," *Visit Pittsburgh*, accessed 16 April 2022, archived at https://web.archive.org/web/20210123171956/https://www.visitpittsburgh.com/things-to-do/outdoor-adventure/fishing-boating/.

22. Ibid.

23. See note 20.

24. Upper Allegheny Joint Sanitary Authority, *Combined Sewer Overflow*, accessed 16 April 2022, archived at https://web.archive.org/web/20220202155735/https://uajsa.com/combined-sewer-overflow/.

25. U.S. Environmental Protection Agency, *National Pollution Discharge Elimination System: Combined Sewer Overflows*, 23 November 2021, archived at https://web.archive.org/web/20220413150927/https://www.epa.gov/npdes/combined-sewer-overflows-csos.

26. U.S. Environmental Protection Agency, *National Pollution Discharge Elimination System: Municipal Wastewater*, 11 March 2021, archived at https://web.archive.org/web/20220413151055/https://www.epa.gov/npdes/municipal-wastewater.

27. Ibid.

28. ALCOSAN, *Who We Are: Service Area & Facilities*, accessed 31 August 2022 at https://www.alcosan.org/about-us/service-area-facilities.

29. ALCOSAN, *Collection System Map*, January 2022, archived at https://web.archive.org/web/20220303033223/https://www.alcosan.org/docs/default-source/system-mapping/collection_system_-map_january2022_24x36_07012021_k.pdf.

30. See note 1, p. 3-5 and 3-6.

31. Ibid., p. ES-4 and p. 3-6.

32. Ibid., p. 3-2 and 3-6.

33. Ibid., p. 3-1.

34. See note 9, p. 1-1; Don Hopey, "Alcosan wet weather overflows much bigger than previously known," *Pittsburgh Post-Gazette*, 27 January 2020, archived at https://web.archive.org/web/20210417182732/https://www.post-gazette.com/news/environment/2020/01/27/Alcosan-wet-weather-overflows-bigger-than-previously-thought/stories/202001230142.

35. See note 1, p. 3-13.

36. ALCOSAN, *GROW/Source Control*, accessed 12 May 2022, archived at https://web.archive.org/web/20220512174639/https://www.alcosan.org/clean-water-plan/grow-program.

37. See note 1, p. ES-6.

38. Ibid., p. ES-6.

39. Ibid., p. 4-25.

40. Ibid., p. 4-26.

41. Ibid., p. 4-28.

42. See note 3.

43. See note 1, p. 4-30.

44. United Nations Environment Programme, *Wastewater, Sewage and Sanitation*, accessed 31 August 2022, archived at https://web.archive.org/web/20220621052256/https://www.unep.org/cep/wastewater-sewage-and-sanitation.

45. Maryland Department of Health, Prevention and Health Promotion Administration, *Cryptosporidium Fact Sheet*, accessed 14 April 2022, archived at https://web.archive.org/web/20220201052538/https://health.maryland.gov/phpa/pages/Cryptosporidiosis.aspx.

46. Delaware Health and Social Services, Division of Public Health, *Frequently Asked Questions: Sewage*, September 2014, archived at https://web.archive.org/web/20220128054111/https://dhss.delaware.gov/dhss/dph/files/sewagefaq.pdf.

47. U.S. Environmental Protection Agency, *National Beach Guidance and Required Performance Criteria for Grants, 2014 Edition*, 31 July 2014, archived at https://web.archive.org/web/20180706154821/https://nepis.epa.gov/Exe/ZyPDF.cgi/P100KZDK.PDF?Dockey=P100KZDK.PDF, p. 74.

48. See note 1, p. 5-35 and p. 5-57.

49. U.S. Environmental Protection Agency, *Nutrient Pollution: The Effects: Dead Zones and Harmful Algal Blooms*, accessed 15 April 2022, archived at https://web.archive.org/web/20220331130810/https://www.epa.gov/nutrientpollution/effects-dead-zones-and-harmful-algal-blooms.

50. See note 1, p. 5-8.

51. ORSANCO, *ORSANCO Harmful Algae Bloom Monitoring, Response and Communication Plan, Final*, February 2021, archived at https://web.archive.org/web/20210825145433/https://www.orsanco.org/wp-content/uploads/2021/02/FINAL-2021-HAB-Monitoring-and-Response-Plan.pdf, p. 4; Michael Wines, "Toxic algae outbreak overwhelms a polluted Ohio River," *New York Times*, 30 September 2015, archived at https://web.archive.org/web/20210511085255/https://www.nytimes.com/2015/10/01/us/toxic-algae-outbreak-overwhelms-a-polluted-ohio-river.html.

52. Michael Wines, "Toxic algae outbreak overwhelms a polluted Ohio River," *New York Times*, 30 September 2015, archived at https://web.archive.org/web/20210511085255/https://www.nytimes.com/2015/10/01/us/toxic-algae-outbreak-overwhelms-a-polluted-ohio-river.html.

53. See note 5, p. 10.

54. Michael Baker International and Allegheny County Department of Economic Development, *Allegheny County Stormwater Management Plan, Phase I Report*, December 2014, p. 12.

55. "4 dead in Pittsburgh flash flooding," *CBS News,* 20 August 2011, archived at https://web.archive.org/web/20220201212410/https://www.cbsnews.com/news/4-dead-in-pittsburgh-flash-flooding/.

56. Jordan Fischbach et al., RAND, *Managing Heavy Rainfall with Green Infrastructure: An Evaluation in Pittsburgh's Negley Run Watershed,* 2020, archived at https://web.archive.org/web/20210622010359/https://www.rand.org/content/dam/rand/pubs/research_reports/RRA500/RRA564-1/RAND_RRA564-1.pdf, p. 8.

57. "Millvale neighbors facing flooded basements, sewage backup after rain from Ida," *WTAE-TV,* 1 September 2021, archived at https://web.archive.org/web/20210902080623/https://www.wtae.com/article/millvale-neighbors-facing-flooded-basements-sewage-backup-after-rain-from-ida/37459130.

58. See note 56, p. 41; U.S. Environmental Protection Agency, *Addressing Green Infrastructure Design Challenges in the Pittsburgh Region: Abundant and Frequent Rainfall*, January 2014, archived at https://web.archive.org/web/20220420212133/https://www.epa.gov/sites/default/files/2015-10/documents/pittsburgh-united-abundant-rainfall-508.pdf, p. 7.

59. See note 5, p. 4 and p. 36.

60. See note 4.

61. Ibid., p. 16.

62. Ibid., p. 13 and p. 15.

63. Ibid., p. 20.

64. Lesley-Ann Dupigny-Giroux et al., "Northeast," *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II,* U.S. Global Change Research Program, archived at https://web.archive.org/web/20220211190130/https://nca2018.globalchange.gov/downloads/NCA4_Ch18_Northeast_Full.pdf, p. 697.

65. See note 5, p. 44.

66. See note 56, pp. xvii-xviii.

67. See note 6.

68. Loss of forest: Multi-Resolution Land Characteristics Consortium, *NLCD EVA Tool*, accessed 13 April 2022 at https://www.mrlc.gov/eva/; capacity: Vincent Cotrone, PennState Extension, *The Role of Trees and Forests in Healthy Watersheds*, 17 August 2015, archived at https://web.archive.org/web/20220323202230/https://extension.psu.edu/the-role-of-trees-and-forests-in-healthy-watersheds.

69. Ryan Deto, "Allegheny County gains population for first time in six decades, says census," *Pittsburgh CityPaper*, 12 August 2021, archived at https://web.archive.org/web/20211203215610/https://www.pghcitypaper.com/pittsburgh/allegheny-county-gains-population-for-first-time-in-six-decades-says-census/Content?oid=20001909.

70. See note 1, p. 7-1.

71. Ibid., p. ES-10, map.

72. Ibid., p. 7-13.

73. Ibid., p. 7-21.

74. Ibid., p. 7-2.

75. Don Hopey, "Alcosan wet weather overflows much bigger than previously known," *Pittsburgh Post-Gazette*, 27 January 2020, archived at https://web.archive.org/web/20210417182732/https://www.post-gazette.com/news/environment/2020/01/27/Alcosan-wet-weather-overflows-bigger-than-previously-thought/stories/202001230142.

76. Ibid.

77. U.S. Environmental Protection Agency, *Why You Should Consider Green Stormwater Infrastructure for Your Community,* 14 June 2021, archived at https://web.archive.org/web/20220121054436/https://www.epa.gov/G3/why-you-should-consider-green-stormwater-infrastructure-your-community.

78. Georgetown Climate Center, *Green Infrastructure Toolkit*, accessed 14 April 2022, archived at https://web.archive.org/web/20220327171936/https://www.georgetownclimate.org/adaptation/toolkits/green-infrastructure-toolkit/introduction.html?full.

79. Ibid.

80. Ibid.

81. U.S. Environmental Protection Agency, *Green Infrastructure Opportunities that Arise During Municipal Operations*, January 2015, archived at https://web.archive.org/web/20220307203726/https://www.epa.gov/sites/default/files/2015-09/documents/green_infrastructure_roadshow.pdf.

82. U.S. Environmental Protection Agency, *Soak up the Rain: Green Infrastructure Poster,* updated 10 February 2022, accessed 15 June 2022 at https://www.epa.gov/soakuptherain/soak-rain-green-infrastructure-poster.

83. Michael Baker International and Allegheny County Department of Economic Development, *Act 167 Phase 2, County-wide Stormwater Management Plan, Executive Summary*, 31 May 2018, archived at https://web.archive.org/web/20220301223138/https://alleghenycounty.us/economic-development/docs/allegheny-co-act-167-plan--executive-summary-5-31-18.aspx, p. ES-13.

84. See note 81, p. 3.

85. Don Hopey, "Consent decree 'best deal' possible, Alcosan says," *Pittsburgh Post-Gazette*, 22 May 2007, archived at https://web.archive.org/web/20210417124715/https://www.post-gazette.com/news/environment/2007/05/22/Consent-decree-best-deal-possible-Alcosan-says/stories/200705220181.

86. *United States of America, Commonwealth of Pennsylvania, Department of Environmental Protection, and Allegheny County Health Department vs. Allegheny County Sanitary Authority, United States' Notice of Lodging of Proposed Consent Decree and Motion for Stay of Litigation*, 23 May 2007, archived at https://www.epa.gov/sites/default/files/2013-09/documents/alcosan-cd.pdf; ALCOSAN, *ALCOSAN Announces Modified Consent Decree, Clean Water Plan* (press release), 16 September 2019, archived at https://web.archive.org/web/20220303033312/https://www.alcosan.org/news-and-events/featured-news/news/2019/09/16/alcosan-announces-modified-consent-decree-clean-water-plan.

87. See note 1, p. ES-1.

88. See note 9, p. 2-3.

89. See note 1, p. ES-11.

90. See note 5, p. 5.

91. Ibid.; Rick Wills, "EPA willing to consider renegotiating Alcosan consent decree," *TribLive*, 1 August 2012, archived at https://archive.triblive.com/local/pittsburgh-allegheny/epa-willing-to-consider-renegotiating-alcosan-consent-decree/.

92. See note 5, p. 5.

93. See note 9, p. 2-3.

94. See note 9, p. 1-1.

95. ALCOSAN, *ALCOSAN's Modified Consent Decree Clears Final Hurdle* (press release), 15 May 2020, archived at https://web.archive.org/web/20220303033138/https://www.alcosan.org/news-and-events/featured-news/news/2020/05/15/alcosan-s-modified-consent-decree-clears-final-hurdle.

96. ALCOSAN, *ALCOSAN's Modified Consent Decree & Clean Water Plan, Frequently Asked Questions*, September 2019, archived at https://web.archive.org/web/20211231013510/https://www.alcosan.org/docs/default-source/clean-water-plan-documents/cleanwaterplan_faqs.pdf.

97. See note 9, p. 2-6.

98. Oliver Morrison, "Sewage bills rise as a $2 billion project gets underway. A new committee is offering feedback," *WESA*, 1 August 2022, https://web.archive.org/web/20220808010114/https://www.wesa.fm/environment-energy/2022-08-01/sewage-bills-rise-as-a-2-billion-project-gets-underway-a-new-committee-is-offering-feedback.

99. See note 36.

100. Ibid.

101. See note 9, p. 6-11.

102. Total green stormwater infrastructure spending through GROW is slightly over $16 million, out of total spending of roughly $60 million. $16 million calculated as sum of GSI grants in GROW funding rounds 1-6. Spending in rounds 1-4 from: Oliver Morrison, "How much green infrastructure will be included in ALCOSAN's $2 billion upgrade to prevent sewage overflows?" *Public Source*, 5 December 2019, archived at https://web.archive.org/web/20220808061105/https://www.publicsource.org/how-much-green-infrastructure-will-be-included-in-alcosans-2-billion-upgrade-to-prevent-sewage-overflows/. Funding round 5:

ALCOSAN, *Previous GROW Program Grants*, archived 24 August 2022 at https://web.archive.org/web/20220824231248/https://www.alcosan.org/clean-water-plan/grow-program/previous-grow-program-grants. Funding round 6: See note 36.

103. See note 9, p. 6-13.

104. Pittsburgh Water & Sewer Authority, *Stormwater Plans*, 1 December 2016, archived at https://web.archive.org/web/20220308223426/https://www.pgh2o.com/your-water/stormwater/stormwater-plans.

105. Pittsburgh Water & Sewer Authority, *City-Wide Green Infrastructure Assessment, Public Summary*, 1 December 2016, archived at https://web.archive.org/web/20220121205237/https://www.pgh2o.com/sites/default/files/2019-11/PWSA-City-Wide-GI-Assessment-public-summary.pdf, p. 1.

106. Ibid., p. 3.

107. Pittsburgh Water & Sewer Authority, *PWSA City-wide Green Infrastructure Assessment, Executive Summary*, 27 October 2016, archived at https://web.archive.org/web/20220121205445/https://www.pgh2o.com/sites/default/files/2019-11/01_-_PWSA_City_Wide_Executive_Summary_Draft_10-27-16.pdf, p. ES-6 and p. 5.

108. See note 105, p. 7.

109. ALCOSAN, Green Revitalization of Our Waterways, *Thomas and McPherson Green Infrastructure,* March 2021, archived at https://web.archive.org/web/20220407043331/https://services8.arcgis.com/vXrmg6iOl1pzNz4z/arcgis/rest/services/Awarded_GROW_Projects_2020/FeatureServer/0/34/attachments/252; Pittsburgh Sewer & Water Authority, *PWSA Breaks Ground on Green Stormwater Infrastructure in North Point Breeze* (press release), 25 August 2021, archived at https://web.archive.org/web/20210930131246/https://www.pgh2o.com/news-events/news/press-release/2021-08-25-pwsa-breaks-ground-green-stormwater-infrastructure-north.

110. ALCOSAN, Green Revitalization of Our Waterways, *Thomas and McPherson Green Infrastructure,* March 2021, archived at https://web.archive.org/web/20220407043331/https://services8.arcgis.com/vXrmg6iOl1pzNz4z/arcgis/rest/services/Awarded_GROW_Projects_2020/FeatureServer/0/34/attachments/252.

111. Pennsylvania Infrastructure Investment Authority and Pennsylvania Department of Environmental Protection, *Clean Water State Revolving Fund Intended Use Plan, SFY2021-2022 Capitalization Grant*, April 2021, archived at https://web.archive.org/web/20220121235215/https://files.dep.state.pa.us/Water/BPNPSM/InfrastructureFinance/StateRevolvFundIntendUsePlan/2021/2021_Draft_Clean_Water_State_Revolving_Loan_Fund_Intended_Use_Plan.pdf, p. 5.

112. U.S. Environmental Protection Agency, *Frequent Questions about BIL State Revolving Funds*, 14 July 2022, archived at https://web.archive.org/web/20220811203216/https://www.epa.gov/dwsrf/frequent-questions-about-bil-state-revolving-funds.

113. U.S. Environmental Protection Agency, *Bipartisan Infrastructure Law: Environmental Protection Agency 2022 State Revolving Fund (SRF) Estimated Allotments to States, Tribes, and Territories by Program*, December 2021, archived at https://www.epa.gov/system/files/documents/2021-12/fy-2022-bil-srfs-allotment-summary-508.pdf; U.S. Environmental Protection Agency, *Factsheet: EPA & The Bipartisan Infrastructure Law*, 6 November 2021, archived at https://web.archive.org/web/20220817172247/https://www.epa.gov/infrastructure/fact-sheet-epa-bipartisan-infrastructure-law.

114. See note 13.

115. 2013-2022 actual regular allocations: Ibid. 2022 actual allocation from the IIJA from U.S. Environmental Protection Agency, *Bipartisan Infrastructure Law: Environmental Protection Agency 2022 State Revolving Fund (SRF) Estimated Allotments to States, Tribes, and Territories by Program*, December 2021, archived at https://www.epa.gov/system/files/documents/2021-12/fy-2022-bil-srfs-allotment-summary-508.pdf. Projected 2023-2026 regular appropriations assume Pennsylvania receives amount of federal funds annually as in 2022. Estimated 2023-2026 IIJA funding based on national data in Elena Humphreys and Johnathan Ramseur, Congressional Research Service, *Infrastructure Investment and Jobs Act (IIJA): Drinking Water and Wastewater Infrastructure*, 4 January 2022, p. 11, archived at https://web.archive.org/web/20220329230044/https://crsreports.congress.gov/product/pdf/R/R46892.

116. See note 28.

117. PENNVEST, *Governor Wolf Announces $69 Million Investment in Water Infrastructure Projects in 14 Counties* (press release), 17 April 2019, available at https://www.pennvest.pa.gov/Pages/Prior-Board-Meetings.aspx. Loan from the CWSRF: Robert Boos, Deputy Executive Director for Project Management, Pennsylvania Infrastructure Investment Authority, personal communication, 1 April 2022.

118. PENNVEST, *Governor Wolf Announces $178 Million Investment In Water Infrastructure Projects In 11 Counties* (press release), 20 January 2021, archived at https://web.archive.org/web/20210225052506/https://www.media.pa.gov/Pages/Pennvest-Details.aspx?newsid=61; PENNVEST, *PWSA – 2020 Small Diameter Sewer Rehabilitation*, accessed 1 April 2022 at https://www.pennvest.pa.gov/Information/Pages/Approved-Projects.aspx.

119. PENNVEST, *Governor Wolf Furthers Commitment to Lead-Free PA, Announces $186 Million Investment in Water Infrastructure Projects in 20 Counties* (press release), 20 October 2021, archived at https://web.archive.org/web/20211020193013/https://www.media.pa.gov/Pages/Pennvest-Details.aspx?newsid=67.

120. See note 10.

121. See note 11.

122. Pennsylvania Department of Community and Economic Development, *COVID-19 ARPA Local Fiscal Recovery Funding*, accessed 7 March 2022, archived at https://web.archive.org/web/20220305183358/https://dced.pa.gov/programs/covid-19-arpa-local-fiscal-recovery-funding/.

123. Charlie Wolfson, "Municipal governments are pouring COVID-19 relief money into infrastructure projects," *PublicSource*, 17 January 2022, archived at https://web.archive.org/web/20220129231540/https://www.publicsource.org/civic-briefs-arpa-allegheny-county-infrastructure/.

124. Ibid.

125. Ibid.; see note 122; Pennsylvania Department of Community and Economic Development, *Pennsylvania COVID-19 ARPA Local Fiscal Recovery Fund Allocations to Non-Entitlement Units of Local Government*, accessed 8 March 2022, archived at https://web.archive.org/web/20220308060047/https://dced.pa.gov/download/pennsylvania-neu-allocations/?wpdmdl=106179.

126. Allegheny County, *Allegheny County American Rescue Plan Fiscal Recovery Funds Spending Plan*, accessed 1 April 2022, available at https://tableau.alleghenycounty.us/t/PublicSite/views/AmericanRescuePlan/Budget?iframeSizedToWindow=true&:embed=y&:showAppBanner=false&:display_count=no&:showVizHome=no&:origin=viz_share_link#2.

127. See note 14.

128. Pittsburgh Water & Sewer Authority, *Stormwater Fee*, accessed 3 February 2022, archived at https://web.archive.org/web/20220203192521/https://www.pgh2o.com/your-water/stormwater/stormwater-fee.

129. Pittsburgh Sewer & Water Authority, *The Plan: PWSA's Strategy to Address Our Stormwater Issues*, accessed 3 February 2022, archived at https://web.archive.org/web/20220401160355/https://pgh2ostormwater.com/pwsa-stormwater-plan.

130. See note 128.

131. Pittsburgh Water & Sewer Authority, *PWSA Announces Approval of New Rate Structure Including Stormwater Fee* (press release), 18 November 2021, archived at https://web.archive.org/web/20220303172842/https://www.pgh2o.com/news-events/news/press-release/2021-11-18-pwsa-announces-approval-new-rate-structure-including.

132. See note 15.

133. Pittsburgh Water & Sewer Authority, *Stormwater Fee FAQ*, accessed 30 June 2020, archived at https://web.archive.org/web/20220701024154/https://www.pgh2o.com/your-water/stormwater/stormwater-fee/stormwater-fee-faq.

134. Washington, D.C., Department of Energy & Environment, *Get RiverSmart*, accessed 30 June 2022, archived at https://web.archive.org/web/20220514115010/https://doee.dc.gov/riversmart.

135. Adaptation Clearinghouse, *District of Columbia's RiverSmart Program*, accessed 30 June 2022, archived at https://web.archive.org/web/20220411000407/https://www.adaptationclearinghouse.org/resources/district-of-columbia-s-riversmart-program.html; Council of the District of Columbia, *§ 8-152.02. Stormwater Permit Compliance Enterprise Fund*, accessed 30 June 2022, archived at https://web.archive.org/web/20220617160117/https://code.dccouncil.us/us/dc/council/code/sections/8-152.02.

136. RiverSmart, *Restoring Our Rivers*, accessed 30 June 2022, archived at https://web.archive.org/web/20220701034331/https://www.riversmarthomes.org/about.

137. 3 Rivers Wet Weather, *Funding Stormwater Solutions,* accessed 3 February 2022, archived at https://web.archive.org/web/20211128233335/https://www.3riverswetweather.org/stormwater/funding-stormwater-solutions, "Table of Local Stormwater Management Fees."

138. DC Water, *Impervious Area Charge*, accessed 30 June 2022, archived at https://web.archive.org/web/20220701040155/https://www.dcwater.com/impervious-area-charge; see note 133.

139. See note 5, p. 47 and p. 50.

140. See note 1, p. 7-2 and 7-11.

141. See note 5, p. 25.

142. Ibid., p. 47.

143. U.S. Environmental Protection Agency, *EPA Settles with City of Pittsburgh, PWSA on Stormwater Violations* (press release), 5 February 2021, archived at https://web.archive.org/web/20210604012105/https://www.epa.gov/newsreleases/epa-settles-city-pittsburgh-pwsa-stormwater-violations.

144. U.S. Environmental Protection Agency, Office of Water, Office of Wastewater Management, Water Permits Division, *Summary of State Stormwater Standards*, 30 June 2011, archived at https://web.archive.org/web/20220329070144/https://www3.epa.gov/npdes/pubs/sw_state_summary_standards.pdf, pp. 39-40.

145. Pennsylvania Department of Environmental Protection, *2022 Model Stormwater Management Ordinance*, April 2018, archived at https://web.archive.org/web/20220513013443/https://www.depgreenport.state.pa.us/elibrary/GetDocument?docId=13879&DocName=10+2022+MODEL+STORMWATER+MANAGEMENT+ORDINANCE.PDF++%3Cspan+style%3D%22color%3Agreen%3B%22%3E%3C%2Fspan%3E+%3Cspan+style%3D%22color%3Ablue%3B%22%3E%3C%2Fspan%3E, p. 10.

146. See note 144, p. 40.

147. Creeks, Drainage & Wastewater Advisory Committee, Seattle Public Utilities, *Green Stormwater Infrastructure in Seattle: Implementation Strategy 2015-2020*, July 2015, archived at https://web.archive.org/web/20220120085204/https://www.12000raingardens.org/wp-content/uploads/2013/03/Overview-Expanded-Exec-SummarySMALLER.pdf, p. viii.

148. Ibid., p. 8.

149. Seattle Public Utilities and King County, *2020 Progress Report, Green Stormwater Infrastructure: The Road to 700 Million Gallons*, accessed 5 April 2022, archived at https://web.archive.org/web/20210325190849/https://700milliongallons.org/wp-content/uploads/2020/09/21_0324_GSI_AnnualReport_web_Final.pdf, p. 2.

150. Ibid., p. 2.

151. Ibid., p. 2.

152. Ibid., pp. 3, 4 and 8.

153. Ibid., p. 9.

154. Ibid., p. 9.

155. Metropolitan Water Reclamation District of Greater Chicago, *Space to Grow Green Schoolyard Partnership*, accessed 12 May 2022, archived at https://web.archive.org/web/20220513020553/https://legacy.mwrd.org/irj/servlet/prt/portal/prtroot/pcd%213aportal_content%212fMWRD%212fMWRDInternet%212fRoles%212fPublicInterest%212fIssues_Initiatives%212fSpace_to_Grow_Green_Schoolyard_Partnership%212fSpace_to_Grow_Green_Schoolyard_Partnership.

156. Metropolitan Water Reclamation District of Greater Chicago, *CPS Schools Selected for Schoolyard Transformations in 2019* (press release), 20 December 2018, archived at https://web.archive.org/web/20220513020651/https://legacy.mwrd.org/irj/go/km/docs/documents/MWRD/internet/News&Media/Newsroom/Media/Press_Releases/2018/18_1220_Space_to_Grow_2019_Schools_Selected.pdf.

157. See note 155.

158. Massachusetts Department of Environmental Protection, *Massachusetts Rivers Protection Act: Protecting the Commonwealth's Rivers, Streams and Adjacent Lands*, accessed 13 April 2022, archived at https://web.archive.org/web/20220123042325/https://www.mass.gov/doc/about-the-massachusetts-rivers-protection-act/download.

159. Ibid.

160. $200 million: See note 10; $7.3 billion: U.S. Department of the Treasury, *Coronavirus State and Local Fiscal Recovery Funds*, accessed 24 August 2022, archived at https://web.archive.org/web/20220823045154/https://home.treasury.gov/policy-issues/coronavirus/assistance-for-state-local-and-tribal-governments/state-and-local-fiscal-recovery-funds, data at https://web.archive.org/web/20220710115013/https://home.treasury.gov/system/files/136/fiscalrecoveryfunds-statefunding1-508A.pdf.

161. U.S. Environmental Protection Agency, *EPA Survey Shows $271 Billion Needed for Nation's Wastewater Infrastructure* (news release), 13 January 2016, archived at https://archive.epa.gov/epa/newsreleases/epa-survey-shows-271-billion-needed-nations-wastewater-infrastructure.html.