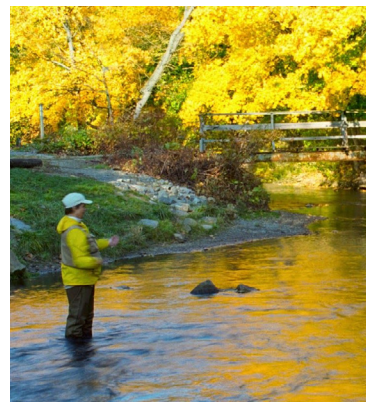


Green Stormwater Infrastructure (GSI)

A Tool for Economic
Recovery and Growth in
Pennsylvania

May 2021



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Advisory Group

- Michael DeVuono
- Shandor Szalay
- Jonathan Nuss
- Marc Cammarata
- Julia Hillengas
- Laura Hansplant
- Peter Johnson

Additional Interviews Conducted

- April Mendez
- Jennifer Nichols
- Sara Poindexter
- Domenic Rocco
- Sara Schuh
- Jerome Shabazz
- James Stitt



About the Sustainable Business Network of Greater Philadelphia

The Sustainable Business Network of Greater Philadelphia is building a just, green, and thriving economy. We empower the region's diverse independent businesses to do well by doing good; we advance industries critical to a vibrant, local, equitable, and climate resilient economy; and we advocate for an economic ecosystem that centers localism, serves community needs, shares wealth, and protects our environment.

SBN's members are local independent businesses that practice—and measure success by—the triple bottom line of people, planet, and profit. Our programming educates business owners about financially, socially, and environmentally responsible best practices; facilitates honest and supportive discussions among peers; and provides important opportunities for civic dialogue. Our advocacy focuses on solutions that advance a just, green, and thriving economy.

Since our founding in 2001, SBN has remained the region's only membership and advocacy organization playing the important role of serving Greater Philadelphia's independent values-driven business community.

www.sbnphiladelphia.org



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About this Report

For the past decade, the Sustainable Business Network of Greater Philadelphia (SBN) has been championing the growth of Pennsylvania's green stormwater infrastructure (GSI) industry because of the significant economic, social, and environmental benefits a nature-based approach to stormwater management provides. The GSI industry spans several sectors, including planning, design, engineering, construction, operations and maintenance, and material supply. Across these sectors, GSI projects favor local businesses and support local jobs.

Several crises demand our collective action: an economic recession triggered by a global pandemic, long-standing racial injustice, and an ongoing yet insufficient large-scale effort to both adapt to and mitigate further climate change. While the combination of these crises can feel overwhelming, they also present a unique opportunity to recognize their interdependence and embrace a holistic approach to problem-solving.

With this report, SBN makes the case that GSI is one such holistic solution. In the following pages, we measure the size and scale of the GSI industry in Pennsylvania, assess the trends over the last 10 years, evaluate the stormwater management needs and opportunities in urban and rural areas across the state, and provide recommendations to ensure communities across the Commonwealth can benefit from the economic, social, and environmental benefits that come with robust GSI infrastructure investments.



Trainees from Overbrook Environmental Education Center, JASTECH Development Services, Inc., Philadelphia.
Source: The Philadelphia Water Department



Permeable Pavers as part of a Green Stormwater Master Plan.
Source: The Philadelphia Water Department



Playground rain garden.
Source: The Philadelphia Water Department

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Green Stormwater Infrastructure (GSI)

A Tool for Economic Recovery and Growth in Pennsylvania

As increased costs of aging infrastructure put a strain on municipal budgets, communities across Pennsylvania are getting smarter about stormwater management. Many communities have found **innovative solutions implementing Green Stormwater Infrastructure (GSI).**

GSI is the use of **natural solutions** to reduce and treat stormwater at the source, as opposed to “gray” infrastructure which is designed to move urban stormwater away from the built environment. The **transition from gray to green has a proven track record in Pennsylvania.**

The combination of regulations, policy, and funding for stormwater management across the state have resulted in a vibrant and growing GSI industry. **Pennsylvania’s GSI industry has grown at a faster rate than the state’s overall economy.**

34,000
GSI Workers

There are up to 34,000 GSI workers across Pennsylvania, which is more GSI workers than middle school teachers.

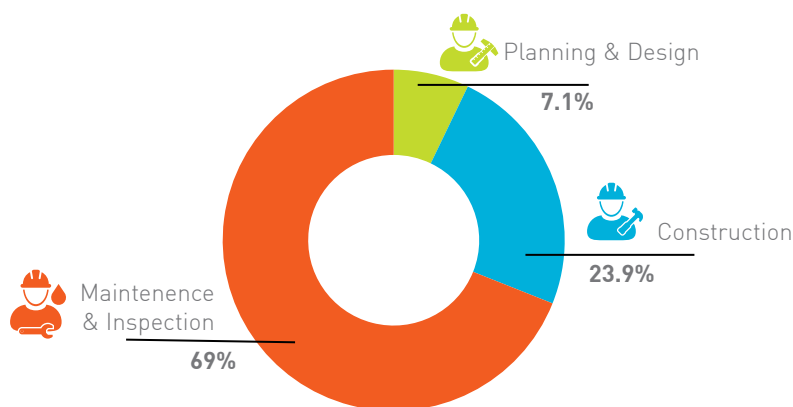
+9.2%
Growth

Jobs in Pennsylvania’s GSI industry are growing faster than the state’s overall jobs growth. From 2011 until 2019, PA’s GSI industry grew at 9.2%. During that same time period, Pennsylvania had 6.3% growth across all occupations statewide.

1 in 2
earn more
than \$15/hour

The GSI industry provides family supporting jobs and accessible opportunities for advancement for people with all levels of education and work experience. 52% of GSI workers earn at least \$15/hour, even without a high school diploma or equivalent.

Breakdown by Project Role



*See methodology for employment estimates. The GSI employment analysis counts employment for workers who are directly employed within planning, design, construction, and ongoing maintenance and inspection occupations. It is a conservative estimate that does not include secondary employment in upstream sectors like the landscape material supply chain or retailers of landscape equipment, nor does it include employment in downstream sectors like administrative and legal which manage billing and contract requirements for projects.

Beyond the Big Cities: GSI Workforce throughout the State



55%

Of Pennsylvania’s GSI workforce is located outside the Pittsburgh and Philadelphia metro areas

4th

Pennsylvania has the 4th largest certified GSI workforce in the U.S., with 353 certified professionals

170

Cities and townships across Pennsylvania—many in rural areas—where Certified GSI professionals live

Green Stormwater Infrastructure (GSI) Provides Triple Bottom Line Benefits

GSI delivers significant economic, social, and environmental benefits. Smart stormwater regulations and policies, and sufficient funding for all phases of green stormwater infrastructure are necessary to tackle the growing need for stormwater management, economic recovery, equity, and climate resilience.



Good for Workers

GSI provides family-supporting jobs and accessible career advancement opportunities for people with all levels of education and work experience.



Good for Water Quality

GSI is an effective tool for managing agricultural runoff, erosion control, and stream restoration—key to the state's \$3 billion in agricultural exports and \$8 billion in recreation tourism.



Good for Local Business

GSI projects create important opportunities for small businesses and support a strong local supply chain.



Good for Equity

GSI can help improve public health outcomes in low income communities and communities of color.



Good for Communities

GSI is a cost-effective, adaptable, and climate resilient tool to meet both rural and urban stormwater management needs, while catalyzing local economic activity.

Smart Policy is Key for Future Growth

Policymakers must drive investments in GSI to simultaneously address stormwater runoff, create jobs, advance equity, and further climate resilience—ensuring Pennsylvania's workers, small businesses, and communities can thrive over the next decade.

1. Ensure substantive funding and incentives for public and private investments in GSI.
 - Restore funding for PA Act 167
 - Increase funding for Clean Water State Revolving Fund grants
 - Expand grants, low- to no-cost financing, and other incentives to promote GSI investments on private property
2. Ensure that state stormwater regulations incorporate climate resilience.
3. Streamline approval processes and procedures for GSI projects.

Investment in GSI Pays Dividends

\$8.4B Gap

in funding for stormwater management needs in Pennsylvania over the next 10 years. Available funding over that time is estimated to be only \$900 million, just 10% of the required investment.

1.5x ROI

on infrastructure investments in the economic recovery following the Great Recession, with every dollar invested in infrastructure improvements resulting in a \$1.50 return on investment in terms of GDP growth.

+13.3%

in GSI jobs from 2011-2019 in Philadelphia, which is a leader in GSI investment. If the state matched that rate, Pennsylvania would have created an additional 600 GSI jobs, adding \$149 million in wages across the decade and generating \$4.6 million in state income tax revenue.

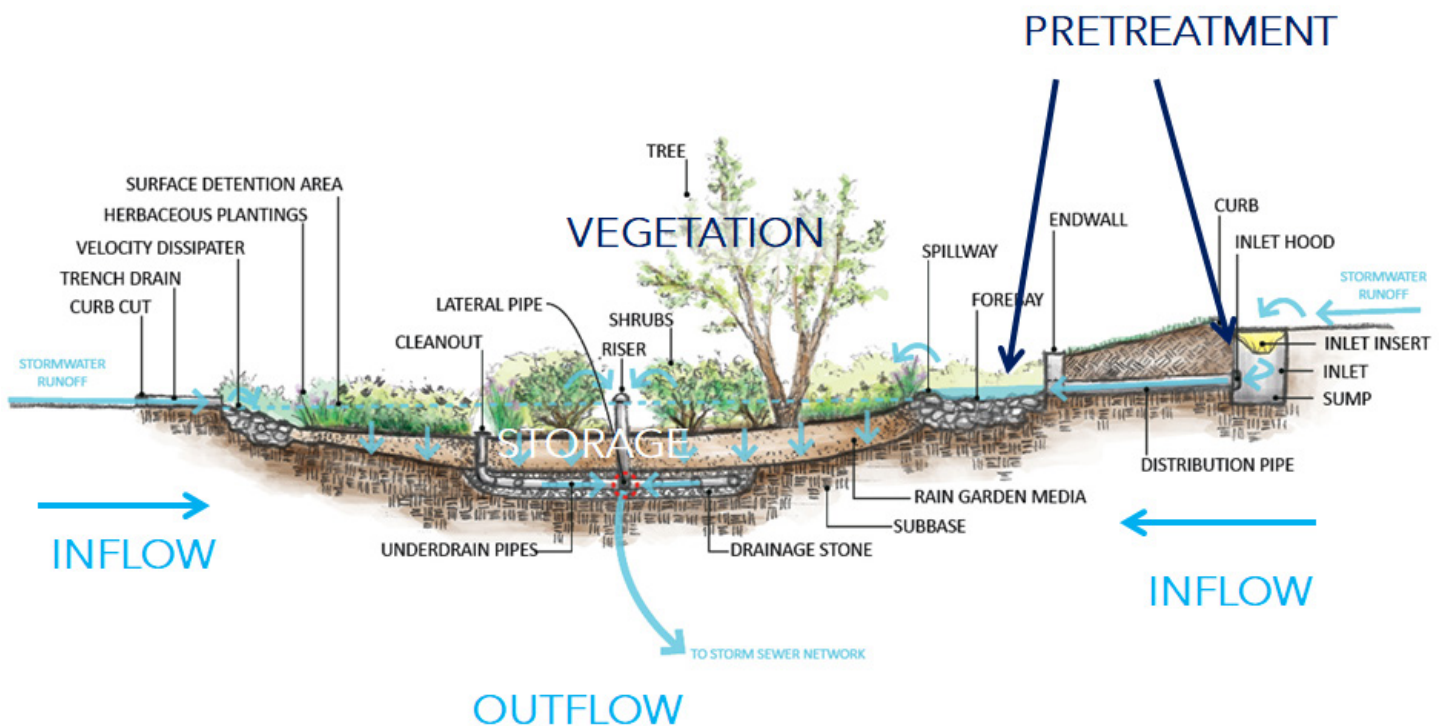
What is Green Stormwater Infrastructure (GSI)?

The U.S. Clean Water Act defines green stormwater infrastructure (GSI) as plant and soil systems designed to reduce the flow of stormwater before it pollutes our waterways.¹ Examples of green stormwater infrastructure include green roofs, rain gardens, bioswales, and tree trenches.

Stormwater is one of the biggest threats to water quality in the United States. When it rains in a natural area like a forest, the rain is captured by the trees and other vegetation, and absorbed by the soil. However, when it rains in developed areas like cities, suburbs, rural towns, and farmland, the water cannot be absorbed in the same way, so it “runs off,” carrying all the trash, bacteria, chemicals, heavy metals, and other pollutants from our streets, roofs, and farmland

directly into our rivers and streams. In many places across the state, this polluted water combines with raw sewage before overflowing directly into our rivers and streams.

Because of the threat that stormwater poses to water quality, it's regulated at the federal level by the Environmental Protection Agency (EPA) and at the state level, such as by Pennsylvania's Department of Environmental Protection (PA DEP). It can also be regulated at the local level, such as in Philadelphia, Pittsburgh, and Lancaster.² The regulations aim to reduce the pollution that enters our waterways during a wet weather event.



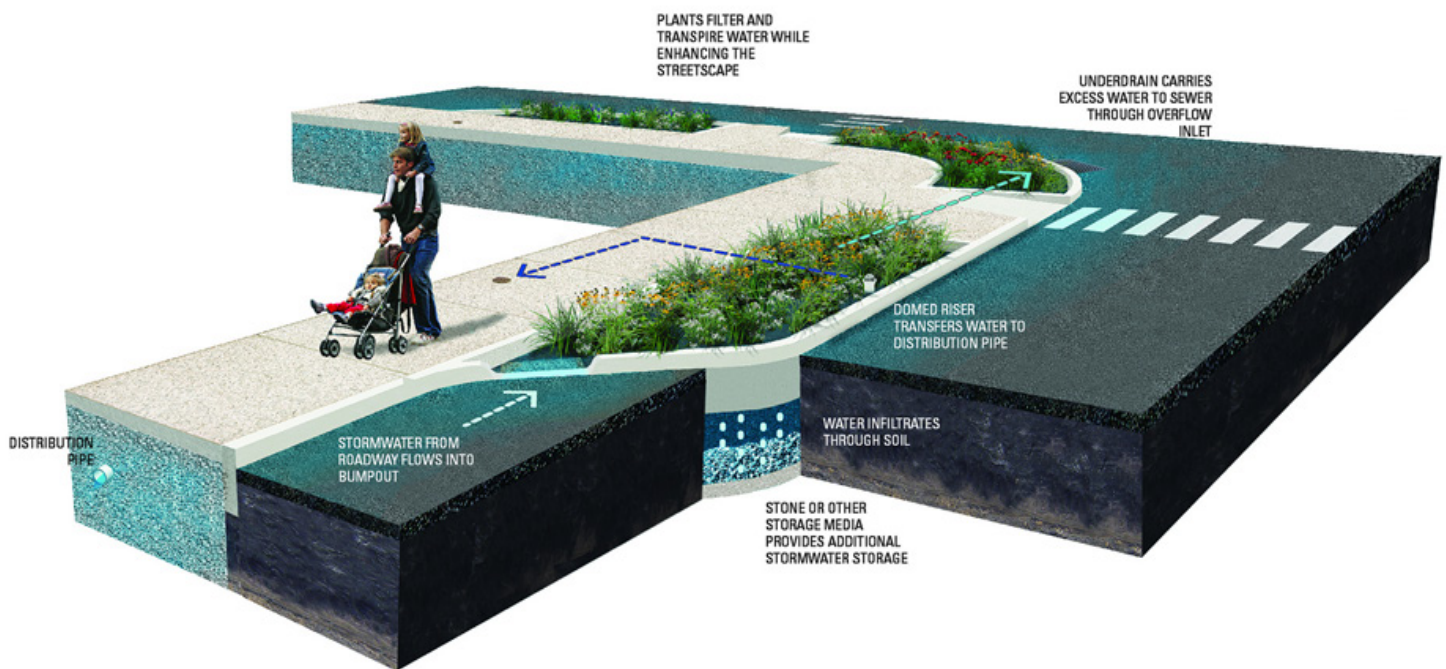
Source: Sustainable Business Network of Greater Philadelphia's GSI O+M Course Curriculum

In addition to the environmental impetus for protecting our rivers, streams, and other waterways, there are public health, equity, and economic reasons as well. Clean rivers and streams are critical to all Pennsylvanians for safe and healthy drinking water, agricultural products, and recreation opportunities.

As Pennsylvania navigates the impacts of climate change, leadership across the Commonwealth must respond.³ Green stormwater infrastructure offers not only a cost-effective approach to meeting necessary statewide stormwater regulations but also serves as a proven tool that can adapt to the needs of a changing climate while providing significant community and economic benefits.

The GSI industry, like all infrastructure industries, includes sectors that range from labor and

manufacturing to professional services. Projects require planning, engineering and design, construction, and inspections, monitoring, and maintenance for safety and performance. GSI projects also require materials such as geo-fabrics, stone, mulch, and native plants. Some projects also incorporate innovative products and technologies that further help control water flow and filter out pollutants. The products and services needed for GSI projects create important opportunities for small businesses and support a strong local supply chain. The industry provides family-supporting jobs and accessible career advancement opportunities for people with all levels of education and work experience. However, the industry is faced with both the need and opportunity to make improvements in its racial and gender diversity through STEM (Science, Technology, Engineering, and Math) and other targeted workforce programs.



Source: Sustainable Business Network of Greater Philadelphia's GSI O+M Course Curriculum

Transition from Gray to Green

Key Milestones in the Development of the Green Stormwater Infrastructure (GSI) Industry

The combination of regulations, policy, and funding for stormwater management across the state has resulted in a vibrant and growing GSI industry. The GSI industry in Pennsylvania has grown at a rate faster than the state's overall economy.

GSI is the use of nature-based solutions to reduce and treat stormwater at the source, as opposed to "gray" infrastructure which is designed to move stormwater away from the built environment. The transition from gray to green has a proven track record in Pennsylvania.

Smart stormwater management regulations are driving economic growth not only because they catalyze direct investments in GSI to meet water quality requirements, but also because investments in GSI have positive indirect benefits like opportunities for local businesses, creation of local jobs, improved recreation amenities, and positive community-scale public health outcomes.

The U.S. Clean Water Act, PA Act 167, and other regulations set the stage for regulating pollutant discharges and stormwater. In 2013, the Pennsylvania Municipal Authorities Act was amended by Act 68 to permit the creation of stormwater authorities. By setting up stormwater authorities, municipalities are better able to develop strategies and dedicated sources of funding for GSI.

1972

U.S. Clean Water Act

Provides basic structure for regulating pollutant discharges

1978

PA Act 167

PA DEP first engaged in stormwater with a focus on flooding

2002

PA Growing Greener
From 2002 to 2020, \$34 million has been awarded to fund 149 projects to clean up waters in PA

2009

American Recovery Act

Makes investments in infrastructure a key piece of the recovery effort from the 2008 Recession. Provides \$4B to the Clean Water State Revolving Fund

2009

PENNVEST Investments

PENNVEST awarded the City of Philadelphia a low-interest loan of \$30M for green stormwater infrastructure projects

1937

Pennsylvania Clean Streams Law of 1937

1990s

PA DEP adds regulatory focus on water quality

2000s

PA DEP adds regulatory focus on water volume

2006

PA DEP issues stormwater best management practices that address infiltration

2005

PA Act 167 funding zeroed out

2010

PA DEP added stormwater management erosion control and post-construction stormwater management

A Proven Track Record

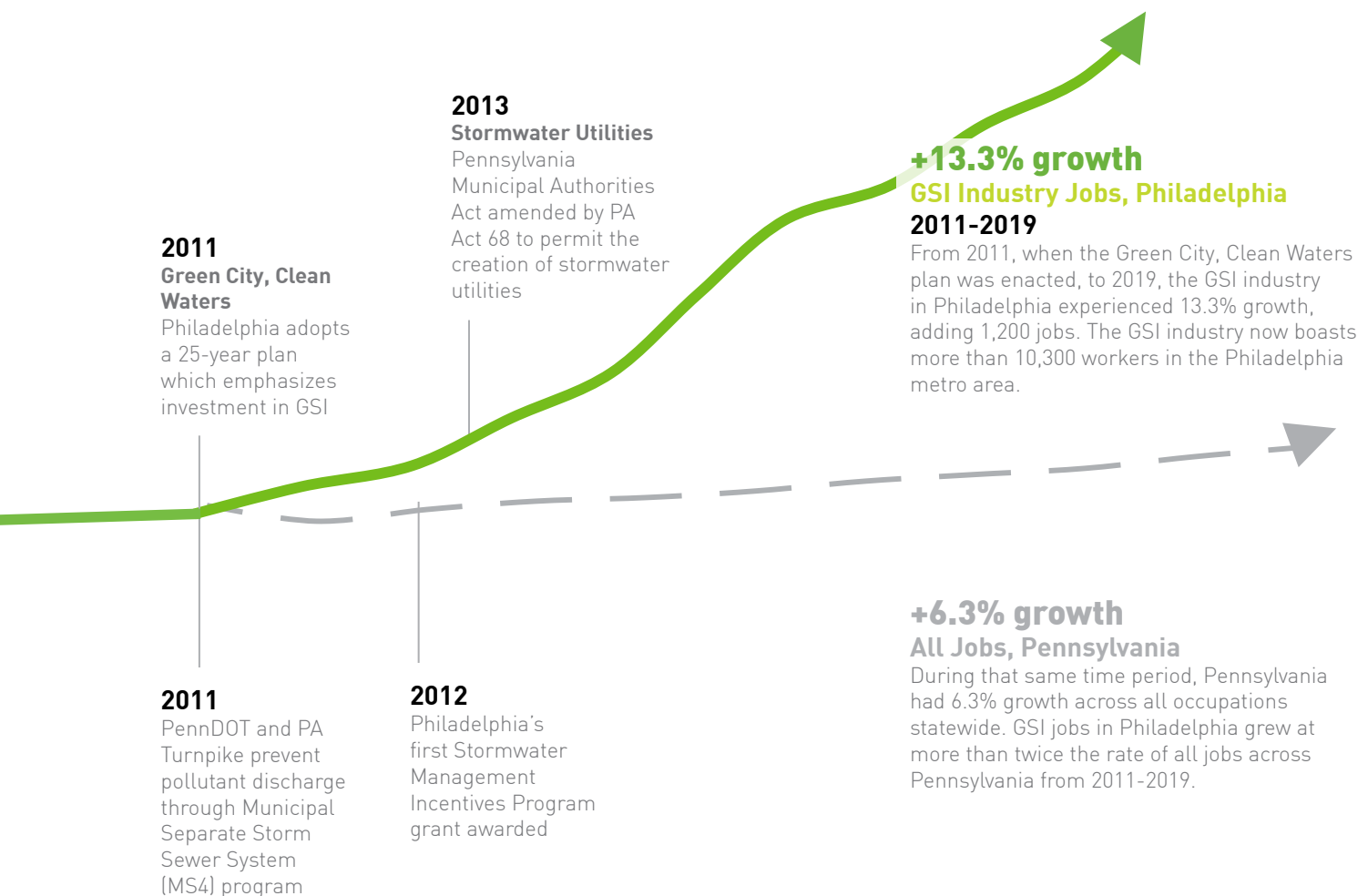
Smart Regulation Catalyzes Investments and Results in Economic Growth

Key infrastructure investments from the American Recovery Act (2009) and the Pennsylvania Infrastructure Investment Authority (PENNVEST), in addition to regulatory provisions like PA Act 167 and PA Act 62, have spurred municipalities throughout the Commonwealth to enact green stormwater management plans.

Since launching Green City, Clean Waters in 2011, the city of Philadelphia has installed more than 2,800 green tools at nearly 800 sites, keeping more than 2.7 billion gallons of polluted water out of local waterways. As of March 1, 2021, the City has managed—or “greened”—1,829 acres through public projects, private

development regulations, and incentivized private retrofits. This activity has resulted in GSI Industry growth of 13.3% from 2011 to 2019. Philadelphia serves as a model to other municipalities throughout the state, many of which are beginning to increase investments in GSI.

All indicators point to future growth: Early job growth in the GSI industry comes from planning, design, and construction of GSI projects. Permanent job gains within the GSI industry will increasingly come from ongoing infrastructure inspection and maintenance.



Green Stormwater Infrastructure (GSI) Offers Pathways to Family-Supporting Jobs

Green stormwater infrastructure provides family-supporting jobs and accessible career advancement opportunities for people with all levels of education and work experience. Many GSI jobs require only a high school diploma, and the vast majority are accessible to those without a four-year college degree. According to a national study, more than half of infrastructure jobs require a high school degree or less, and 40% pay more than \$55,000 a year.⁴ 52% of GSI workers in

Pennsylvania earn more than \$31,200 (\$15/hour).⁵ In Pennsylvania, 9 out of 10 GSI jobs require a high school diploma or less (see table below). Considering that 7 out of 10 Pennsylvania residents 25 or older lack a four-year college degree, the GSI industry is a viable career path for many workers.⁶

Table 1: **GSI Wages by Employment Level, Pennsylvania**

Entry-Level Education Level	GSI Employment High Estimate	Typical Entry Level Wage Lowest paid 25% of workers	Median Wage	High Wage Jobs Highest paid 25% of workers
No formal educational credential	20,062	\$21,010	\$36,800	\$68,730
High school diploma or equivalent	11,476	\$25,150	\$47,120	\$90,700
Associate’s degree	600	\$32,320	\$50,545	\$64,290
Bachelor’s degree or higher	1,878	\$42,970	\$67,890	\$113,350

Source: Data from BLS Occupational Employment Statistics.

Below are the typical wage ranges for GSI occupations that require no more than a high school diploma or its equivalent by their role in GSI work. Wage ranges are presented as the lowest-paid 25% of workers and highest-paid 25% of workers



Planning & Design
\$37,320 to \$57,820

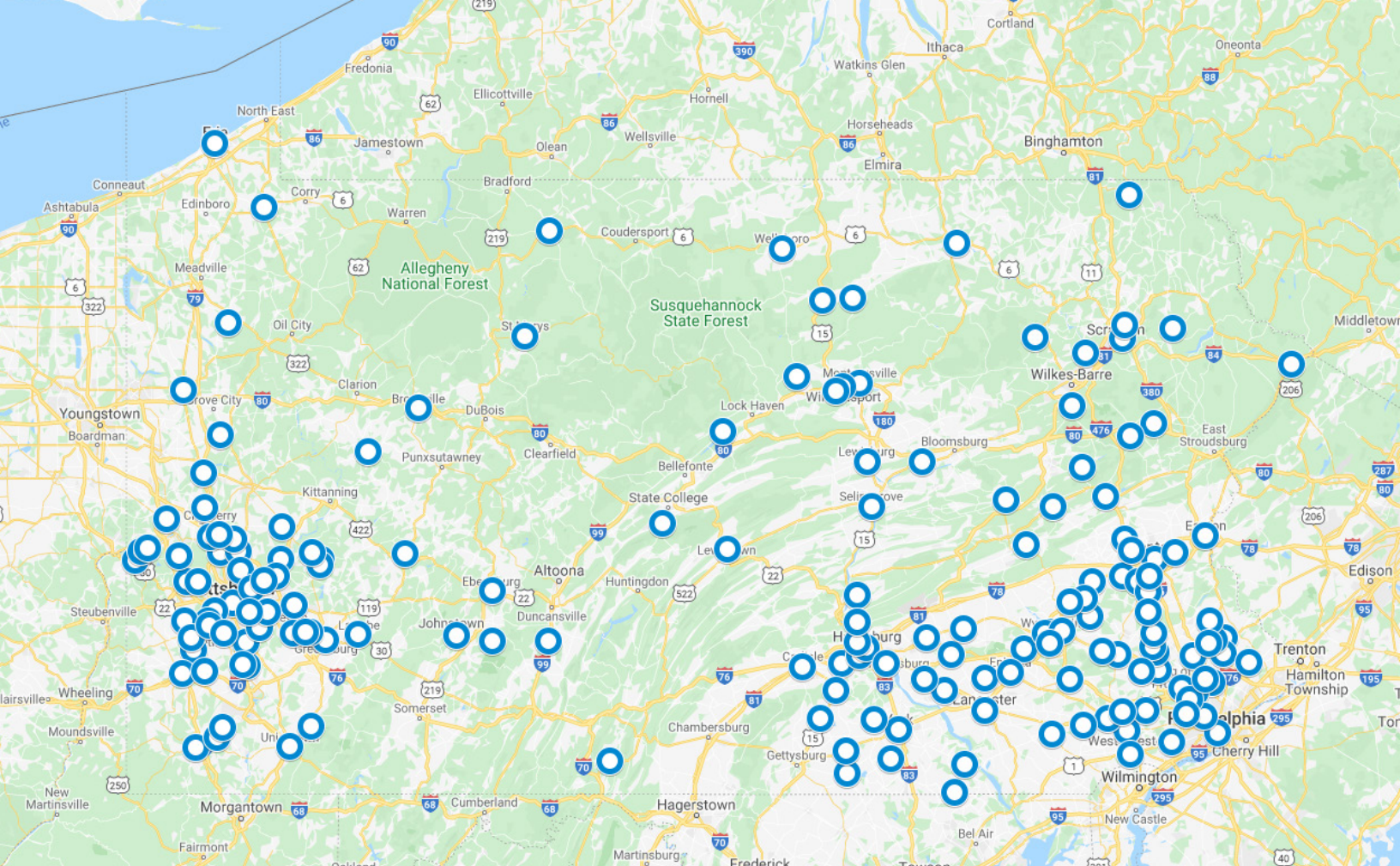


Construction
\$26,720 to \$90,700



Maintenance & Inspection
\$25,150 to \$71,580

Source: Data from BLS Occupational Employment Statistics.



Map: Pennsylvania's GSI Certified Workers

With 353 certified GSI professionals, Pennsylvania has the largest certified GSI workforce of any state outside of California, Texas, and New York. 170 cities and townships throughout the commonwealth boast certified GSI professionals.

Sources: National Green Infrastructure Certification Program and EnviroCert. Certifications include National Green Infrastructure Certification Program (NGICP), StormWater Quality (CPSWQ), Erosion and Sediment Control (CPESC), Municipal Stormwater Management (CPMSM), StormWater Inspections (CESSWI), and Industrial Stormwater Management (CPISM).

An emerging White House initiative, the Civilian Climate Corps, would employ workers to tackle climate change and its impacts, such as by restoring our waterways. Inspired by the New Deal-era Civilian Conservation Corps, the program's goal is to reduce unemployment while mitigating climate change.⁷

The American Society of Civil Engineers (ASCE) consistently rates Pennsylvania's infrastructure poorly, in part because it does not fully meet the needs of a changing climate. GSI offers a proven tool to increase jobs while restoring our waterways and addressing climate change. As communities throughout the Commonwealth continue to address climate change, Pennsylvanians would benefit from the long-term jobs at family-supporting wages that GSI provides.

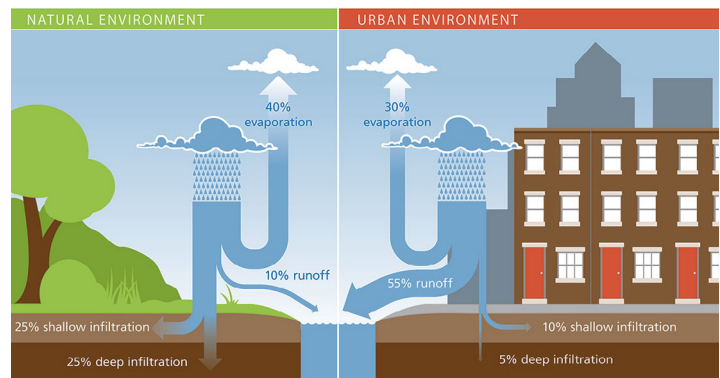
Workforce development programs can also help train GSI workers. PowerCorpsPHL, Philadelphia's signature workforce development program, is an example of a successful workforce development program. PowerCorpsPHL focuses its efforts in underserved communities through a partnership with EducationWorks, an organization experienced in supporting young people growing up in historically disinvested communities. Working closely with Philadelphia's Department of Parks and Recreation, the Philadelphia Water Department, and partners in the private sector, PowerCorpsPHL connects young people to promising careers in GSI and other environmental stewardship roles.⁸

Rural and Urban Communities

Different Challenges, Different Opportunities

Stormwater runoff is an issue everywhere; however, urban and rural communities have unique challenges. In urban areas, water pollution related to stormwater runoff tends to be a mix of raw sewage and trash, oils, heavy metals, and other chemicals from motor vehicles and commercial and industrial sites. In rural areas, water pollution related to stormwater runoff is primarily agricultural runoff, which carries pesticides, livestock manure, and fertilizers that contain nitrogen and phosphorus. Nearly half the land in the U.S. is farmland.⁹ Additionally, clearing natural land for the development of homes, roads, and farms contributes to erosion. Sediment from erosion is another major water pollutant.¹⁰

Drinkable, fishable, and swimmable rivers, streams, and other waterways are critical for all Pennsylvanians. Yet, in 2016, the PA DEP designated approximately 19,000 miles (20%) of the state's 83,000 miles of rivers and streams as impaired for water supply, aquatic life, recreation, or fish consumption, with pollution from stormwater runoff as a major contributor.^{11 12} Protecting our rivers and streams from both urban and rural stormwater runoff is not only an environmental imperative, it's also necessary for maintaining public health, equitable communities, and a strong economy.

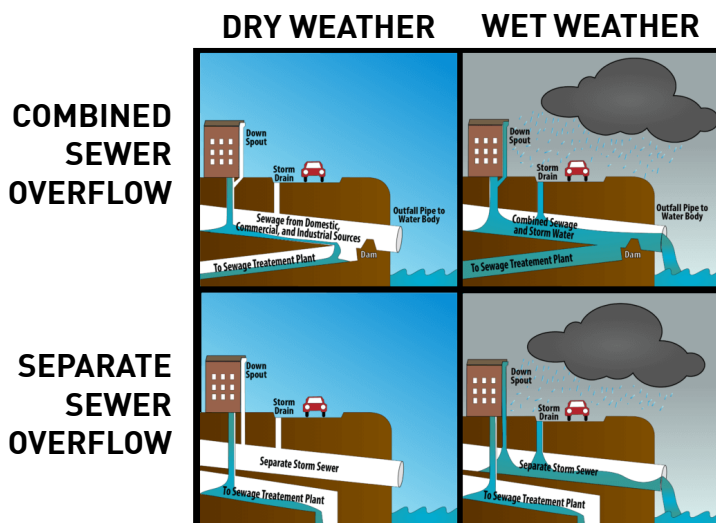


Source: City of Philadelphia [n.d.] Natural vs. Urban Runoff

Urban Communities

Managing Sewer Overflows

Cities such as Harrisburg, Scranton, Erie, Pittsburgh, and Philadelphia have different stormwater runoff challenges than the rural parts of the state. In natural areas like forests and meadows, the trees, plants, and soils act like a sponge, capturing and absorbing rainfall. However, in highly developed metropolitan areas that are dominated by streets, buildings, and other impervious surfaces, the rain cannot be absorbed. The sewer systems in these areas were designed and built decades before the cities were so densely developed and, as such, cannot withstand the volume of water they now receive during an average rain event.¹³ Because of this lack of sewer system capacity in urbanized areas, a rain event as little as 1/4 inch can cause a combination of untreated stormwater and untreated sewage to overflow directly into rivers and streams.¹⁴



Source: Adapted from Sewer Equipment Company of America. [n.d.] Sanitary vs. Combined Sewer Systems

Nearly 20% of PA's rivers and streams are impaired. Pollution from stormwater runoff is a major contributor.

GSI should be a significant strategy for municipalities to reduce combined and separate sewer overflows, and every opportunity to incorporate GSI into public projects - from streets to recreation centers - should be taken. According to an EPA study, "Green infrastructure has been shown to be more cost-effective when compared with traditional gray infrastructure approaches."¹⁵

Compared to gray infrastructure, GSI has beneficial long-term maintenance and replacement costs. The vegetation in many green infrastructure installations is enhanced over time, while the engineered materials used in gray infrastructure deteriorates. Maintenance required for green infrastructure practices typically does not require heavy equipment, whereas maintaining gray infrastructure's pipes, forebays, basins, and embankments can be more costly."¹⁶ GSI is a cost-effective tool that is proven to help reduce separate and combined sewer overflows and meet other U.S. Clean Water Act regulations, while also providing significant economic and social benefits.

CASE STUDY

Using GSI to Reduce Combined Sewer Overflows

Location: Philadelphia, PA

To meet state and federal regulations, Philadelphia adopted Green City, Clean Waters, a 25-year plan to "reduce the volume of stormwater entering combined sewers using green infrastructure."¹⁷ The plan, enacted in 2011, outlines the strategy to meet long-term water quality standards established by EPA Consent Agreement. To achieve these goals, Philadelphia's Green City, Clean Waters plan uses green stormwater infrastructure as the primary mechanism to manage combined sewer overflows.¹⁸

The plan estimates \$2.4 billion in public investments over 25 years, and also catalyzes private investments in GSI in both combined and separate sewer areas through City-wide regulations and incentives. The plan is projected to have a \$4 billion economic impact in Philadelphia—including through health benefits, avoided costs, and wages for workers—while also supporting 1,160 jobs per year.¹⁹

As of 2019, 65% of public GSI projects installed have been in low- and moderate-income census blocks.²⁰ GSI projects have been shown to provide a wide range of quality of life benefits at a neighborhood scale, as well as stabilize home values, grow the municipal property tax base, and incentivize additional private investment. A 2016 report estimated that within a quarter-mile of GSI projects installed in Philadelphia, property values increased by \$1.3 billion, representing

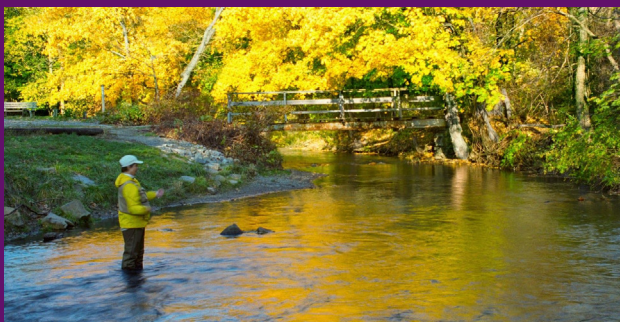


Source: Philadelphia Water Department

not only increased wealth for the homeowner but also \$18 million in increased annual tax revenue for the City and School District.²¹

Activities of Philadelphia's plan include, "large-scale implementation of green stormwater infrastructure to manage runoff at the source on public land and reduce demands on sewer infrastructure, requirements and incentives for green stormwater infrastructure [for private property], and preserved open space utilized to manage stormwater at the source."²²

As of March 1, 2021, the City has managed—or "greened"—1,829 acres through public projects, private development regulations, and incentivized private retrofits; and has 687 additional acres in active construction and 1,422 acres in design or completed design.²³ After a decade of tracking milestones, Philadelphia exceeded their 10-year pollution reduction goal with green infrastructure that has kept "nearly three billion gallons of stormwater runoff and sewer overflow out of local waterways."²⁴



Source: Photo retrieved on April 26, 2021 from Pinterest, available at <https://i.pinimg.com/originals/f6/0a/c4/f60ac4add8554e74ac1a4ab51b7be736.jpg>

Using GSI to Stimulate Outdoor Recreation and Tourism

Location: Carlisle, PA

The Cumberland Valley is a mecca for outdoor tourism, with world-renowned fly-fishing and access to the Appalachian Trail. Each year, thousands of visitors enjoy streams, rivers, and wildlife amenities, with spending on recreation and tourism as a key driver of the region's economy. In Cumberland County, tourism brought \$897.2 million in direct visitor spending in 2019, with \$157.4 million (nearly 18%) of that total from recreation spending, and more on food and lodging. An estimated 6,592 jobs in Cumberland County were connected to the tourism industry in 2019.³¹

However, stormwater runoff from rain events jeopardizes the assets that draw visitors. The runoff in Cumberland County carries agricultural runoff and additional surface pollutants, like trash, oils, and other chemicals, before entering the local rivers and streams. Flooding from rain events also causes erosion. The combination of the pollution from the stormwater runoff, agricultural runoff, and erosion creates health and safety concerns.

Carlisle's leadership understood both the need to meet the state's regulatory requirements for water quality and the opportunity to beautify and strengthen their community using GSI, so the township created a stormwater utility to enable them to design, build, and maintain GSI projects. They also adopted a stormwater management fee, which creates a sustainable funding stream for GSI projects.³² Additionally, Carlisle has received funding from the PA DEP for GSI projects, including a "green street," which manages an estimated 40,000 gallons of runoff.³³

Rural Communities

Managing Agricultural Runoff

Pennsylvania is a worldwide leader in agricultural, food, and lumber production. Pennsylvania exports more than \$2 billion annually in animal and plant products, and another \$1 billion in lumber and wood products annually.²⁵ While a key part of the economy, agricultural activity results in significant water pollution after a rain event or irrigation.²⁶

This agricultural runoff carries pesticides, fertilizer, livestock manure, and sediment into our rivers and streams. These pollutants also get into groundwater, which is another risk to public health. Groundwater, in addition to rivers and streams, is a drinking water source in Pennsylvania, where there are more than one million domestic water wells.²⁷ GSI can be used to reduce agricultural runoff, but farmers need support to implement GSI and other water protection practices.

Stream Restoration and Tourism

Pennsylvania's rural tourism is an important part of the state's economy. For example, a study for the Pennsylvania legislature found that 3.6 million people participated in wildlife-watching activities in Pennsylvania in 2011.²⁸ A recent report found that the 211 million domestic and international travelers to and within Pennsylvania in 2019 spent a combined total of \$46 billion in Pennsylvania; \$8 billion (nearly 18%) of that direct spending was on recreation.

Recreation spending grew nearly 5% in 2019, leading all other travel and tourism categories and making it a lynchpin in the overall tourism sector that supports more than 521,000 jobs statewide.²⁹ Because outdoor recreation results in day and overnight trips, spending on food and lodging add to the economic impact of the sector. A recent Department of Conservation and Natural Resources report that compiled data from 115 of Pennsylvania's State Parks underscores these trends. June 2020 saw over one million more park visitors than June of 2019, representing an 18.6% total increase; six of those parks saw a 100% increase and 24 parks saw a 50% increase from the previous year. Data from the Pennsylvania Fish & Boat Commission showed that as of July 2020, fishing license sales were up roughly 19% from the prior year.³⁰

Protecting natural lands and maintaining healthy waterways are vital to ensuring outdoor recreation remains such a strong and growing piece of Pennsylvania's economy, especially in rural areas. As more Pennsylvania residents and out-of-state travelers take advantage of the state's beauty and plentiful outdoor recreation amenities, it is increasingly important to prevent erosion and maintain the integrity of our waterways. GSI is a cost-effective and effective tool for erosion control and stream restoration that catalyzes additional economic activity in the Commonwealth; however, rural areas need support to implement GSI and other water protection practices.

Pennsylvania's 211 million tourists spent a combined total of \$46 billion in 2019; \$8 billion (nearly 18%) was on recreation alone

Using GSI to Reduce Agricultural Runoff

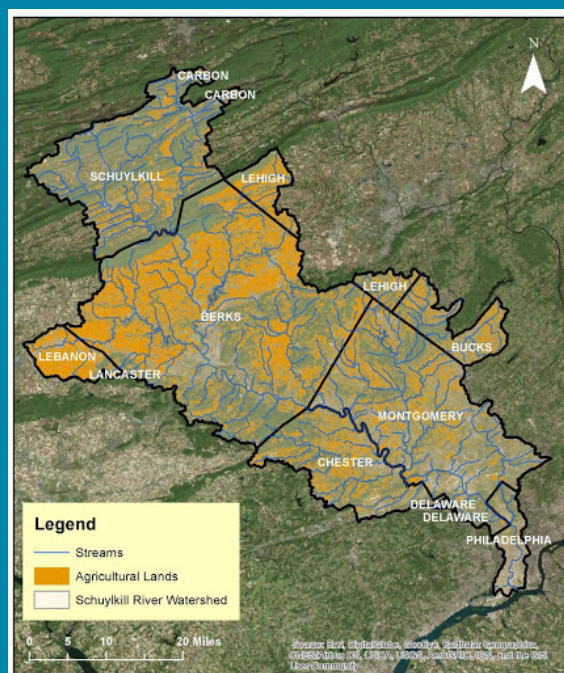
Location: Schuylkill River Watershed, PA

Agricultural runoff is a major threat to the health of the Schuylkill River Watershed, where farms represent over 25% of the land area in the watershed. Polluted runoff containing pesticides, fertilizers, and animal excrement from the 800 operating farms in the watershed have resulted in 258 miles of impaired streams.³⁴

To address this public health and economic issue, the Schuylkill Action Network (SAN) Agriculture Workgroup identified priority farms based on established criteria for water quality. The Berks County Conservancy, the Berks County Conservation District, and the Penn State Cooperative Extension then conducted outreach to the owners of those farms about the problem and proposed the solution of installing certain types of agricultural-specific interventions. These interventions included GSI features such as bioswales to capture farm runoff before it reaches the streams, as well as stream and river bank restorations to minimize erosion and filter pollutants before they enter the waterways.

Since the effort was initiated in 2004, conservation plans, GSI, and other best practices have been implemented at more than a dozen priority farms.³⁵ Entire tributary streams have been improved and protected by clustering projects on adjacent land. The

CASE STUDY



Source: Schuylkill Action Network Agriculture (n.d.)

effort is funded by a \$1.15 million watershed grant from the U.S. Environmental Protection Agency for a suite of water quality improvement demonstration projects in the Schuylkill River Watershed. The Schuylkill River terminates in Philadelphia and feeds directly into the Delaware River, making the Partnership for the Delaware Estuary and the Philadelphia Water Department logical partners to manage the grant. With this initial funding, these two partners have leveraged an additional \$3 million for water quality improvements in the Schuylkill River Watershed.

Equity Considerations

Everyone has the right to clean water and the opportunity to live, work, and play in healthy communities regardless of race, ethnicity, gender, age, or economic status. 2021 marks nearly 30 years since Executive Order 12898 was issued to focus federal attention on environmental and human health effects in low-income communities and communities of color with the goal of achieving environmental protection for all communities.³⁶ Yet, significant environmental justice challenges in both urbanized and rural areas remain, such as flooding and urban heat islands, which are areas where temperatures are significantly hotter than surrounding areas as a result of having a high density of buildings, asphalt, and concrete, and little greenery. These challenges disproportionately impact low-income communities and communities of color.³⁷

Water quality impairments from inadequate stormwater management have long-term effects on public health and safety, and flooding related to stormwater runoff can have immediate impacts on the health, safety, and property of Pennsylvania's residents. Flash flooding from rain events caused an estimated \$91.6 million per year in property losses from 1996 to 2014, according to the National Oceanic and Atmospheric Association (NOAA). The frequency of heavy rain events is increasing, and these storms flood roadways and properties, causing road closures and trapping people. These events may require water rescues of residents from rising floodwaters, though not all rescue efforts are successful.³⁸ Black and Latinx people and people with low incomes are more likely to live in high-risk flood zones.³⁹ Flood damage is often more acute in these areas than in wealthier

CASE STUDY

Using GSI as a Quality of Place Investment

Location: Philadelphia, PA

The Jose Manuel Collazo Playground, located in the Fairhill neighborhood in North Philadelphia, was an under-used outdoor recreation site with nearly 99% impervious cover. In a section of the city where many residents still consider Puerto Rico "home," the Trust for Public Land, Philadelphia Parks and Recreation, and the Philadelphia Water Department collaborated in 2017 to transform this site into an attractive community asset that reflects the cultural heritage of the neighborhood and creates a welcoming space for families and youth to enjoy.

According to the Preservation Alliance for Greater Philadelphia, "Fairhill is the poorest zip code in the city of Philadelphia," with a main commercial corridor, "in great need of revitalization."⁴⁴ By investing in areas that have historically faced underinvestment, GSI projects can help address issues of equity. In the case of the Jose Manuel Collazo Playground, GSI was deployed to create a quality of life amenity that benefits the surrounding neighborhood and a step towards community revitalization.

In addition to public meetings, the comprehensive and creative community engagement process included conducting bilingual interviews, recording



Source: Stantec (n.d.) Jose Manuel Collazo Playground.

personal stories, and creating a mobile storytelling station. The station is now used in the community hub space adjacent to the rain garden during community celebrations and events. Mahogany and steel seatbacks engraved with images of fruits and flowers of Puerto Rico were fabricated and installed on the concrete seat walls at the rain garden, adding an additional layer of artistic and community expression. The new playground and recreation space features a rain garden and provides an area for a variety of species of plants to grow. Green areas with vegetative borders were added around the basketball and handball courts. This project enhances climate resilience through solutions that offer multiple benefits and are geographically and culturally suitable, while also creating a safe haven for play in the community.

geographies, making flooding a public health, equity, and economic issue.⁴⁰ GSI can help alleviate negative impacts from flooding, and lead to healthier, safer, more equitable, and more resilient communities.

GSI can also be used to add green space to neighborhoods in urban and rural communities. Green spaces and green streets are positively correlated with improved physical and mental health, and social cohesion.⁴¹ They are also important for reducing heat islands. A 2020 study conducted by the Hispanic Access Foundation and the Center for American Progress found that 70% of low-income communities live in nature-deprived areas, and people of color are as much as three times more likely to live in nature-deprived areas, putting already-vulnerable communities at higher risk of harm from excessive heat and poor air quality.⁴² In communities across the state where flooding and heat islands are also issues,

GSI can help mitigate these problems while also improving community wellbeing and equity outcomes. A key component of financial independence and individual wealth-building is stable employment that pays a family-supporting wage. As highlighted earlier in this report, the GSI industry supports pathways to these types of jobs, although there is a need for the GSI industry to diversify by race and gender. For example, in Pennsylvania in 2019, 82% of the jobs in three largest sectors in the GSI industry were held by white people. In these same sectors, 70% of the jobs are held by men.⁴³ Workforce development programs like PowerCorpsPHL have focused their outreach and training on increasing the amount of women and people of color in the GSI industry. Diverse representation in GSI occupations is key to equitable economic opportunity.

CASE STUDY

Using GSI for Equitable Community Development

Location: Pittsburgh, PA

The award-winning Centre and Herron Stormwater Project in Pittsburgh's Hill District was completed in the spring of 2018 and cost \$1 million to design and construct. A 585 foot-long bioswale (the longest in Pennsylvania) was designed to mimic a natural waterway, and annually absorbs an estimated one million gallons of stormwater runoff from surrounding streets. Excess stormwater is held in underground cisterns and slowly released into the sewer system for treatment.⁴⁵

The 1.2-acre site now occupied by the bioswale was previously a vacant lot owned by the City that was prone to flooding. The Pittsburgh Water and Sewer Authority (PWSA) gained access to the lot as part of the implementation of its Citywide Green First Plan, which outlines Pittsburgh's intent to use cost-effective GSI solutions to manage stormwater, reduce local street flooding and sewer backups, comply with EPA stormwater mandates, and improve water quality.⁴⁶

Not only is this GSI project helping to meet those goals and protecting the Monongahela River, but it also transformed a vacant lot into an amenity for a



Source: [Western Pennsylvania Conservancy](#). [n.d.] Community Gardens and Greenspace: Stormwater Solutions

historically Black neighborhood where 37% of the residents currently live below the poverty line.⁴⁷ PWSA, Allegheny County Sanitary Authority, the City of Pittsburgh, and the Western Pennsylvania Conservancy partnered on the project, which generated significant community engagement. Over 200 local volunteers planted more than 13,000 perennials, 87 shrubs, and 25 trees to complete the bioswale. Conservancy staff and volunteers maintain the project to ensure it remains an asset to the community.⁴⁸

Pennsylvania's Stormwater Infrastructure Need

There is an immense need to upgrade the nation's stormwater management infrastructure, with Pennsylvania being no exception. As discussed in a previous section, Rural and Urban Communities: Different Challenges, Different Opportunities on page 14, both separate and combined sewer systems directly contribute to water pollution as a result of stormwater runoff. In 2018, the American Society for Civil Engineers (ASCE) rated the state's current stormwater management infrastructure between a "D" and a "D-," which they based on capacity, condition, funding, future need, operations and maintenance, public safety, resilience, and innovation.⁴⁹

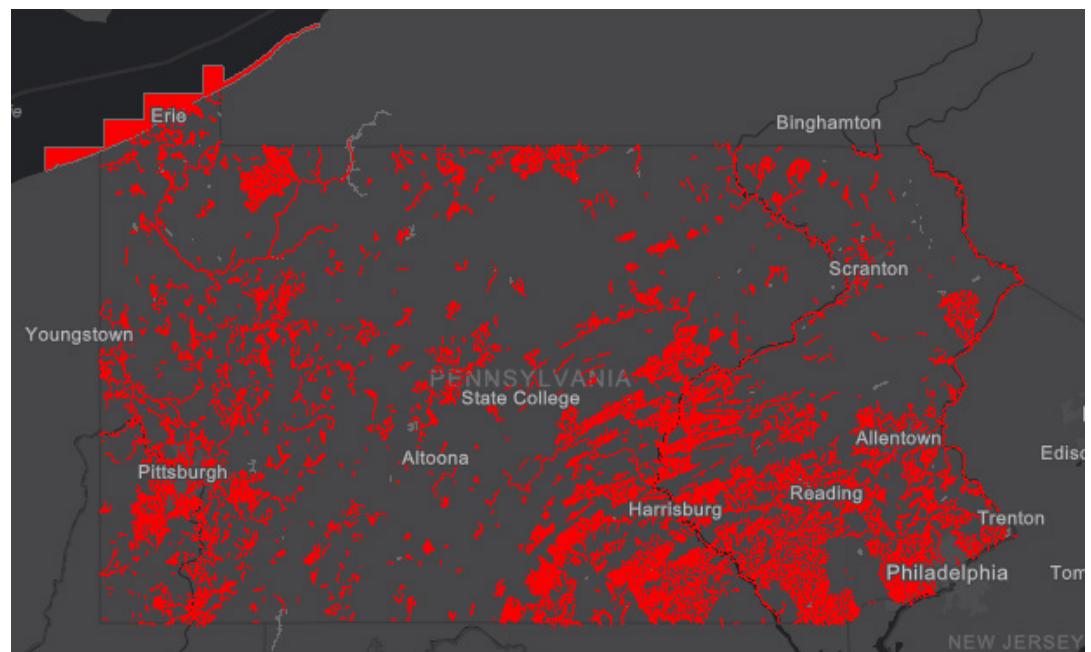
Most of Pennsylvania's current stormwater management infrastructure consists of large pipe and tunnel systems, also known as "gray" infrastructure. Most are over 100-years-old and have not been adequately maintained over that time frame due to lack of funding. Additionally, they were designed and built to meet different criteria than are used today. Many of these systems are not capable of providing the level of service needed regarding flow rate control,

volume management, water quality, and climate resilience. Pennsylvania has an estimated funding gap of \$8.4 billion over the next 10 years to repair and upgrade existing systems to meet regulatory requirements, control combined sewer overflows, and otherwise meet increasing demands. Available funding over that time is estimated to be \$900 million, approximately 10% of the required investment.⁵⁰

The state's stormwater management infrastructure must also meet the needs of a changing climate, which, in turn, impacts our economy. For example, from 2010 to 2020, Pennsylvania experienced 37 extreme weather events, costing the state upwards of \$10 billion in damages.⁵¹

As underscored throughout this report, green stormwater infrastructure is a cost-effective, adaptable, and climate-resilient tool to meet both rural and urban stormwater management needs, while catalyzing local economic activity.

Pennsylvania has an estimated funding gap of \$8.4 billion over the next 10 years to meet its stormwater management needs. Available funding over that time is estimated to be \$900 million, just 10% of the required investment.



Map: Pennsylvania's priority impaired and/or threatened waters

Impaired waterways are in every corner of the Keystone state. According to the ASCE's 2018 Infrastructure Report Card, Pennsylvania holds the undesirable title of most combined sewer overflows (CSO) in the country. On average, the state's CSOs release 26 billion gallons of mixed sewage and stormwater annually into local waterways.⁵² Agricultural runoff—which carries pesticides, livestock manure, and fertilizers that contain nitrogen and phosphorus—is another leading cause of impairment. These waterways supply drinking water for the 10 million people in Pennsylvania, while another 1.4 million people rely on private wells that are not regulated by the PA DEP.⁵³

Source: Pennsylvania Department of Environmental Protection

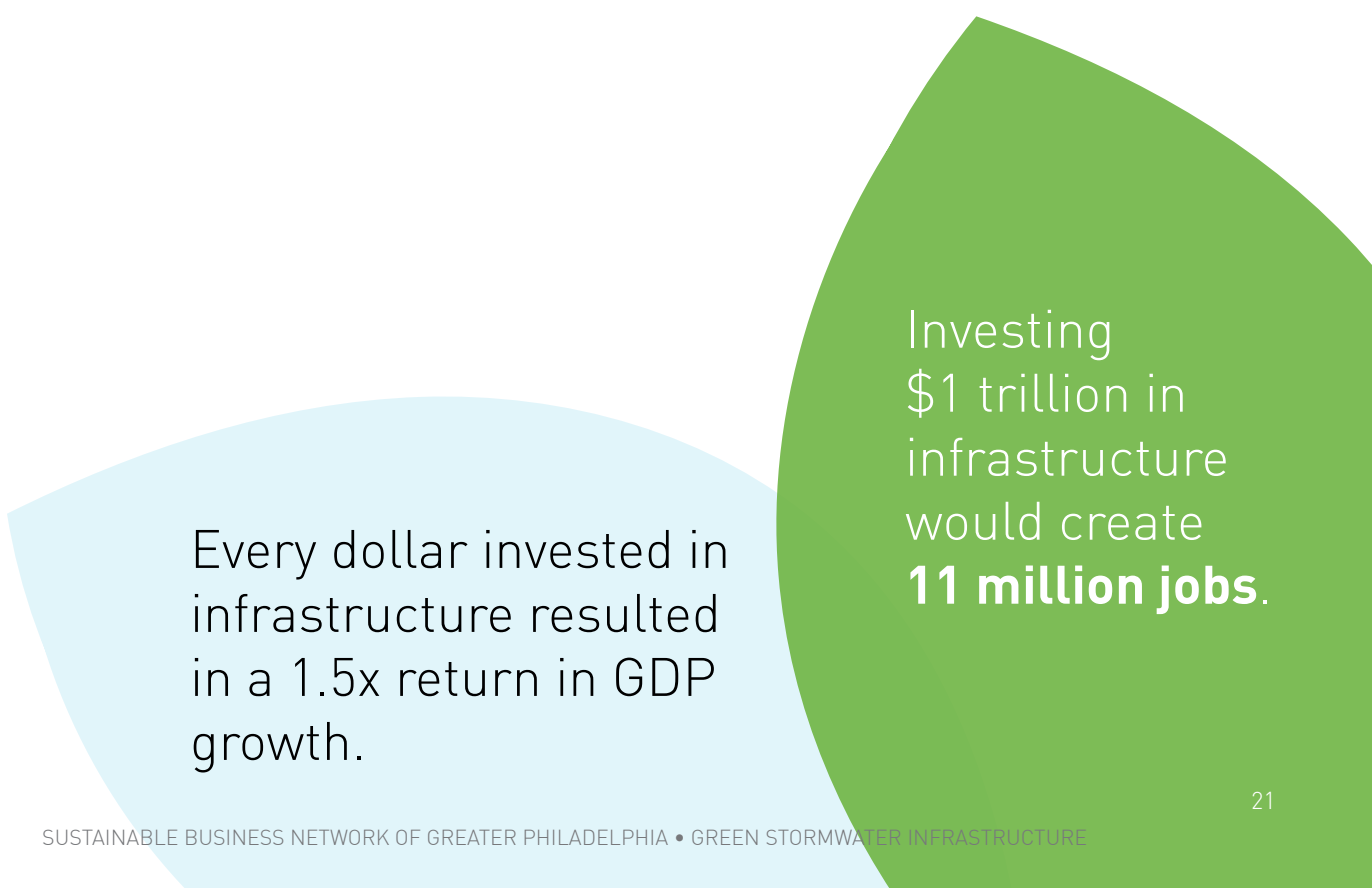
Investing in Green Stormwater Infrastructure (GSI) for Pennsylvania's Economic Recovery and Growth

To meet Pennsylvania's stormwater management needs—and the needs of a changing climate more broadly—major investments must be made. As previously noted, the ASCE estimates at least \$8.4 billion is needed in Pennsylvania over the next 10 years.⁵⁴ Investing in infrastructure is a proven strategy for economic recovery and growth. The necessity of cost-effective investments in stormwater management and climate resilience, combined with the urgency for economic recovery from the impacts of COVID-19, creates a clear opportunity to leverage GSI.

A key driver of economic recovery from the 2008 recession was the American Recovery and Reinvestment of 2009 (ARRA). As a result of the ARRA, \$4 billion was allocated to the long-standing Clean Water State Revolving Fund (CWSRF), 20% of which was designated “Green Reserve” for projects like GSI.⁵⁵ State revolving funds are an important tool for stormwater management projects because they provide an ongoing source of capital, creating a direct revenue stream for eligible recipients like municipalities, state agencies, and certain private and nonprofit entities. In 2009, Pennsylvania received

\$44.6 million in federal stimulus from these programs and leveraged more than \$66 million for green infrastructure projects.⁵⁶

Infrastructure investments proved a successful strategy for economic recovery from the Great Recession, with every dollar invested in infrastructure resulting in a 1.5x return in GDP growth.⁵⁷ Looking forward, an analysis by Georgetown University's Center on Education and the Workforce found that investing \$1 trillion in infrastructure would create 11 million jobs.⁵⁸ Because infrastructure projects often last three years, they are an effective strategy to mitigate economic fallout in the short term. In addition, because planning and design, construction, and ongoing operations and maintenance are key elements of successful GSI projects, investments in GSI also position the Commonwealth for long-term economic benefits. As federal plans progress for approximately \$2 trillion in stimulus for infrastructure—part of a wider economic recovery effort from COVID-19's impacts—Pennsylvania must be ready to leverage that funding with plans to deploy green stormwater infrastructure projects across the state.



Every dollar invested in infrastructure resulted in a 1.5x return in GDP growth.

Investing \$1 trillion in infrastructure would create **11 million jobs.**

Policy Recommendations

As the nation rebuilds from the economic impacts of the pandemic, government leadership must encourage the expansion of proven growth industries, particularly those that create opportunities for diverse small businesses, provide family-supporting wages, support equitable community development, and advance climate resilience. The green stormwater infrastructure (GSI) industry is one such proven growth industry.

Pennsylvania has shown leadership in smart stormwater management policies and regulations, including through PA Act 167;⁵⁹ increased regulatory focus on water quality, volume, erosion, and infiltration; allowing for the creation of local stormwater utilities; and high-demand grant programs like Growing Greener.⁶⁰ As a result, the GSI industry has grown steadily across Pennsylvania over the last decade. However, there is more that Pennsylvania's leadership can do to ensure the GSI industry continues to grow in all corners of the Commonwealth.

The Legislature and the Administration can strengthen GSI in Pennsylvania by taking the following actions:

1. Ensure substantive funding and incentives for public and private investments in GSI.

Municipalities across the Commonwealth are best able to leverage federal and state funding for GSI when they have current stormwater management plans, and when those plans include GSI as a strategy.⁶¹ PA's Act 167, which requires municipalities to develop comprehensive watershed-based stormwater management plans, was defunded in 2005, leaving many municipalities across the state without stormwater management plans, and limiting their ability to implement or even encourage GSI through direct investments or local ordinances and regulations.

Private lands, be they residential, commercial, industrial, or agricultural, are significant contributors to stormwater runoff and thus critical to the solution. Regulations and incentives that ensure private properties are properly managing stormwater, instead of passing the problem downstream, are vital for a lasting solution.

Both the federal and state governments must provide financial support for local municipalities to plan, implement, and maintain comprehensive stormwater management plans with clear guidelines that prioritize GSI and other nature-based solutions and encourage investments in vulnerable communities. Local stormwater management plans should not only include substantive public investments in GSI, but also local regulations, creative financing models, and other incentives to support strong private investment in GSI. Governments at all levels must also ensure sufficient funding for monitoring, operations, and maintenance of GSI, which are all critical for ongoing water quality and economic growth.

Specific recommendations include:

- Restore funding for PA Act 167 and otherwise fund municipal stormwater management planning and implementation.
- Increase funding through Clean Water State Revolving Fund grants and other low- to no-cost financing for public GSI projects, with guidelines that prioritize nature-based solutions and investments in vulnerable and underserved communities
- Expand grants, low- to no-cost financing, and other incentives to promote GSI investments on private property.

2. Ensure that state stormwater regulations incorporate climate resilience.

Municipalities across the Commonwealth continue to face the challenges and costs of a changing climate and must adapt. The PA DEP must incorporate climate resilience outcomes into their stormwater regulations, which will ensure that both public and private investments in GSI advance water quality goals as well as long-term resilience.

3. Streamline processes and procedures.

In addition to meaningful incentives and financing tools to support private sector implementation of GSI, processes and procedures must also support private investments in GSI. GSI projects must be made easy and cost-effective for private developers and property owners to increase the likelihood of adoption. State and local governments must eliminate administrative barriers that discourage investment in GSI on private property, including but not limited to ensuring alignment of codes; fast tracking approval processes for GSI best practices; allowing for innovative designs and project delivery methods; and ensuring clear and effective guidance for design, construction, and maintenance.



Trench drains and rain gardens add to the streetscape in Etna, Pennsylvania. Source: Etna Borough

Conclusion

GSI is key to economic recovery.

There is an immense need to upgrade Pennsylvania's stormwater management infrastructure, yet the state has an estimated funding gap of \$8.4 billion over the next 10 years to do so.⁶²

Investing in climate-resilient infrastructure like GSI is a proven strategy for economic recovery and growth. Infrastructure investments proved successful during the Great Recession, with every dollar invested in infrastructure resulting in a 1.5x return in GDP growth.⁶³ Current forecasts show that investing \$1 trillion in infrastructure would create 11 million jobs.⁶⁴

Pennsylvania's investment in GSI will pay dividends for decades.

Pennsylvania has everything to gain from fostering further growth of the GSI industry: billions of dollars of economic activity; opportunities for small businesses; job creation; meaningful employment and advancement opportunities for people with a wide range of educational backgrounds and work experience; equitable access to well-maintained public spaces; healthy rivers and streams; and enhanced climate-resilience.

GSI is a proven, ready, cost-effective solution for water quality, climate resilience, and equity.

GSI not only offers a cost-effective alternative to reducing stormwater runoff and improving water quality, but also serves as a proven tool that can adapt to the needs of a changing climate while also providing significant community and economic benefits to rural and urban areas across the Commonwealth.

Stormwater is one of the primary threats to water quality in the United States. Pennsylvania is no exception, with 20% of the state's 83,000 miles of rivers and streams impaired as a result of stormwater runoff.⁶⁵ In rural areas, water pollution related to stormwater runoff is led by agricultural runoff, which carries pesticides, livestock manure, and fertilizers. In urban areas, water pollution related to stormwater runoff is a mix of raw sewage and trash, oils, heavy metals, and other chemicals from motor vehicles and commercial and industrial sites.

Despite their differences, rural and urban areas both share significant environmental justice challenges, including flooding, water quality, and the heat island effect, all of which disproportionately impact low-income communities and communities of color.⁶⁶ The state's stormwater management efforts must address these environmental, public health, and equity challenges while also meeting the needs of a changing climate. GSI is a proven tool to address these challenges and needs.

Pennsylvania is positioned to lead on GSI.

The necessity of cost-effective investments in stormwater management, combined with the urgency for economic recovery, equity, and climate action, presents a clear opportunity to leverage GSI as a cost-effective and adaptable solution that provides many economic, social, and environmental benefits to communities across the Commonwealth.

There are four pillars that support the argument for GSI in Pennsylvania:

1. The size, scale, and growth potential of Pennsylvania's current GSI industry;
2. The demonstrated evidence that smart policy and regulations combined with focused investments in nature-based solutions have been driving this growth;
3. The documented need for substantive investments to improve water quality while advancing both climate resilience and environmental justice; and
4. The clear opportunity to promote an economic recovery that provides equitable, local, and sustainable jobs.

These factors create a powerful case to leverage GSI as a tool that delivers on a range of beneficial social, environmental, and economic outcomes.

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Appendix: Defining the Green Stormwater Infrastructure (GSI) Workforce Methodology

This section provides an overview of the data sources and analytical methods used by Fourth Economy in this study. A brief description of key data sources follows, as well as details on the specific methods used to identify the GSI occupations and conduct the workforce analysis.

The identification of GSI occupations was based upon Standard Occupational Classification (SOC) System codes. Using the SOC schema, all workers are classified into one of more than 800 detailed occupations, each of which is given a unique six-digit code (for example, the code for Landscaping and Groundskeeping Workers is 37-3011). To learn more about SOC codes, visit: <http://www.bls.gov/soc/>.

Statewide detailed occupational data for Pennsylvania and its metropolitan areas was retrieved from Occupational Employment and Wage Statistics tables provided by the Bureau of Labor Statistics. To learn more, visit: <https://www.bls.gov/oes/tables.htm>

To identify and refine the occupations associated with the GSI workforce, Fourth Economy reviewed a number of national studies and worked with staff from the Sustainable Business Network of Greater Philadelphia (SBN), interviews with private industry leaders, as well as members of the project advisory group to provide feedback, input and recommendations to guide our analysis and the development of this report. The 2017 report, “Exploring the Green Infrastructure Workforce,” released by Jobs for the Future, identified a number of occupations associated with green stormwater maintenance and inspection, as well as an estimate of how much work in each occupation was GSI-related.⁶⁷ In addition to the installation, maintenance, and inspection occupations, SBN and the project advisory group identified GSI-related design and planning occupations to include in the analysis.

The GSI employment analysis counts employment for workers who are directly employed within planning, design, construction, and ongoing maintenance and inspection occupations. It is a conservative estimate that does not include secondary employment in

upstream sectors like the landscape material supply chain or retailers of landscape equipment, nor does it include employment in downstream sectors like administrative and legal which manage billing and contract requirements for projects.

In total, 43 occupations were used as the basis for the workforce analysis. Each occupation was cross-referenced with the U.S. Department of Labor’s O*Net database description of work activities, vetted by GSI professionals and certification providers, and confirmed through interviews with municipal officials, nonprofit industry groups, and GSI businesses throughout Pennsylvania. To provide a conservative estimate for the GSI industry, only the GSI-related portion of employment for each occupational data was included, rather than the total employment for that occupation. Each occupation was assigned a percentage for the GSI-related work, with concentrations that ranged from a low of 5% or less to a high of 15% to 25% of work within each detailed occupation being associated with GSI work. More information about the GSI occupations is included in the following appendices. **Appendix A** is the list of detailed occupations by occupation group. **Appendix B** shows the involvement in GSI activities and the percentage concentration used in the estimates for GSI employment. **Appendix C** identifies the occupations by role and project phase. **Appendix D** lists GSI Occupations, Education Requirements and Wage Ranges.

Appendix A

GSI Related Occupations by Occupational Group

Building and Grounds Cleaning and Maintenance

- 37-1012 First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers
- 37-3011 Landscaping and Groundskeeping Workers
- 37-3012 Pesticide Handlers, Sprayers, and Applicators, Vegetation
- 37-3013 Tree Trimmers and Pruners

Transportation and Materials Moving

- 47-5022 Excavating and Loading Machine and Dragline Operators
- 53-7051 Industrial Truck and Tractor Operators
- 53-7062 Laborers and Freight, Stock, and Material Movers, Hand
- 53-7072 Pump Operators, Except Wellhead Pumps

Installation, Maintenance, and Repair

- 49-9012 Control and Valve Installers and Repairers, Except Mechanical Door
- 49-9071 Maintenance and Repair Workers, General
- 49-9098 Helpers--Installation, Maintenance, and Repair Workers

Construction

- 47-1011 First-Line Supervisors of Construction Trades and Extraction Workers
- 47-2051 Cement Masons and Concrete Finishers
- 47-2061 Construction Laborers
- 47-2071 Paving, Surfacing, and Tamping Equipment Operators
- 47-2073 Operating Engineers and Other Construction Equipment Operators
- 47-2151 Pipelayers
- 47-2181 Roofers
- 47-3015 Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters
- 47-3016 Helpers--Roofers
- 47-4011 Construction and Building Inspectors
- 47-4071 Septic Tank Servicers and Sewer Pipe Cleaners
- 47-4091 Segmental Pavers
- 47-5097 Earth Drillers, Except Oil and Gas

Fishing, Farming, and Forestry

- 45-1011 First-Line Supervisors of Farming, Fishing, and Forestry Workers
- 45-2092 Farmworkers and Laborers, Crop, Nursery, and Greenhouse
- 45-4011 Forest and Conservation Workers Production
- 51-8031 Water and Wastewater Treatment Plant and System Operators

Life, Physical, and Social Science

- 19-1013 Soil and Plant Scientists
- 19-2043 Hydrologists
- 19-3051 Urban and Regional Planners
- 19-4042 Environmental Science and Protection Technicians, Including Health
- 19-4045 Geological and Hydrologic Technicians
- 19-4071 Forest and Conservation Technicians

Architecture and Engineering

- 17-1012 Landscape Architects
- 17-1021 Cartographers and Photogrammetrists
- 17-1022 Surveyors
- 17-2051 Civil Engineers
- 17-2081 Environmental Engineers
- 17-3011 Architectural and Civil Drafters
- 17-3022 Civil Engineering Technicians
- 17-3025 Environmental Engineering Technicians
- 17-3031 Surveying and Mapping Technicians

Appendix B

GSI Related Occupations by Involvement in GSI activities

5% or less

47-1011 First-Line Supervisors, Construction Trades and Extraction Workers
47-2051 Cement Masons and Concrete Finishers
47-2061 Construction Laborers
47-2071 Paving, Surfacing, and Tamping Equipment Operators
47-2073 Operating Engineers and other Construction Equipment Operators
47-2181 Roofers
47-3015 Helpers—Pipelayers, Plumbers, Pipefitters, and Steamfitters
47-3016 Helpers—Roofers
47-5097 Earth Drillers, Except Oil and Gas
49-9012 Control and Valve Installers and Repairers, Minus Mechanical Door
51-8031 Water and Wastewater Treatment Plant and System Operators
53-7051 Industrial Truck and Tractor Operators
53-7062 Laborers and Freight, Stock, and Material Movers, Hand
53-7072 Pump Operators, Except Wellhead Pumpers
17-1021 Cartographers and Photogrammetrists
17-2081 Environmental Engineers
17-3011 Architectural and Civil Drafters
17-3022 Civil Engineering Technicians
19-3051 Urban and Regional Planners
19-4042 Environmental Science and Protection Technicians, Including Health

5% to 10%

17-3025 Environmental Engineering Technicians
45-1011 First-Line Supervisors of Farming, Fishing, and Forestry Workers
47-2151 Pipelayers
47-4071 Septic Tank Servicers and Sewer Pipe Cleaners
47-4091 Segmental Pavers
49-9071 Maintenance and Repair Workers, General
49-9098 Helpers—Installation, Maintenance, and Repair Workers
47-5022 Excavating and Loading Machine and Dragline Operators
17-1022 Surveyors
17-2051 Civil Engineers
17-3031 Surveying and Mapping Technicians
19-1013 Soil and Plant Scientists
19-4045 Geological and Hydrologic Technicians

10% to 15%

37-1012 First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers
37-3012 Pesticide Handlers, Sprayers, and Applicators, Vegetation
45-2092 Farmworkers and Laborers, Crop, Nursery, and Greenhouse
47-4011 Construction and Building Inspectors

15% to 25%

19-4071 Forest and Conservation Technicians
37-3011 Landscaping and Groundskeeping Workers
37-3013 Tree Trimmers and Pruners
45-4011 Forest and Conservation Workers
17-1012 Landscape Architects
19-2043 Hydrologists

Appendix C

GSI Related Occupations by Project Phase

Planning and Design

17-1012 Landscape Architects
17-1021 Cartographers and Photogrammetrists
17-1022 Surveyors
17-2051 Civil Engineers
17-2081 Environmental Engineers
17-3011 Architectural and Civil Drafters
17-3022 Civil Engineering Technicians
17-3025 Environmental Engineering Technicians
17-3031 Surveying and Mapping Technicians
19-1013 Soil and Plant Scientists
19-2043 Hydrologists
19-3051 Urban and Regional Planners

Construction

45-1011 First-Line Supervisors of Farming, Fishing, and Forestry Workers
45-2092 Farmworkers and Laborers, Crop, Nursery, and Greenhouse
45-4011 Forest and Conservation Workers
47-1011 First-Line Supervisors of Construction Trades and Extraction Workers
47-2051 Cement Masons and Concrete Finishers
47-2061 Construction Laborers
47-2071 Paving, Surfacing, and Tamping Equipment Operators
47-2073 Operating Engineers and Other Construction Equipment Operators
47-2151 Pipelayers
47-2181 Roofers
47-3015 Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters
47-3016 Helpers--Roofers
47-4011 Construction and Building Inspectors
47-4071 Septic Tank Servicers and Sewer Pipe Cleaners
47-4091 Segmental Pavers
47-5097 Earth Drillers, Except Oil and Gas
47-5022 Excavating and Loading Machine and Dragline Operators
53-7051 Industrial Truck and Tractor Operators

Maintenance and Inspection

19-4042 Environmental Science and Protection Technicians, Including Health
19-4045 Geological and Hydrologic Technicians
19-4071 Forest and Conservation Technicians
37-1012 First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers
37-3011 Landscaping and Groundskeeping Workers
37-3012 Pesticide Handlers, Sprayers, and Applicators, Vegetation
37-3013 Tree Trimmers and Pruners
49-9012 Control and Valve Installers and Repairers, Except Mechanical Door
49-9071 Maintenance and Repair Workers, General
49-9098 Helpers--Installation, Maintenance, and Repair Workers
51-8031 Water and Wastewater Treatment Plant and System Operators
53-7062 Laborers and Freight, Stock, and Material Movers, Hand
53-7072 Pump Operators, Except Wellhead Pumps

Appendix D

GSI Occupations, Education Requirements and Wage Ranges

			Wage Range for the Lowest Paid 25% of Workers	
GSI Role	Entry-Level Education	High GSI Employment Estimate	Lowest	Highest
Planning and Design	High school diploma or equivalent	147	\$37,320	\$57,820
	Associate's degree	403	\$39,640	\$64,290
	Bachelor's degree	1,811	\$42,970	\$113,350
	Master's degree	67	\$51,110	\$84,620
Planning and Design Total		2,428	\$37,320	\$113,350
Construction	No formal educational credential	4,540	\$21,010	\$68,730
	High school diploma or equivalent	3,588	\$26,720	\$90,700
Construction Total		8,128	\$21,010	\$90,700
Maintenance and Inspection	No formal educational credential	15,522	\$24,990	\$38,580
	High school diploma or equivalent	7,741	\$25,150	\$71,580
	Associate's degree	197	\$32,320	\$61,720
Maintenance and Inspection Total		23,459	\$24,990	\$71,580

Source: Data from BLS Occupational Employment Statistics.

