Mapping Green Stormwater Infrastructure Careers to Improve Diversity and Inclusivity

Elodie Marlet, PhD
Kathleen Carson, PhD

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Seattle Jobs Initiative

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EXECUTIVE SUMMARY

This report presents an overview of the workforce ecosystem involved in the Green Stormwater Infrastructure (GSI) sector. The Green Stormwater Infrastructure Workforce Collaborative[1] commissioned this work to map gaps and opportunities to increase access and equity within the GSI field in the Puget Sound Region.

This report's findings are based on a review of the literature, labor market data analysis, and interviews with policymakers, educational institutions, contractors, and nonprofit organizations operating in this space.

GSI LIFECYCLE AND OCCUPATIONS

First, the career ecosystem within the GSI space is broad, as the GSI lifecycle has five distinct phases embedded in the ongoing work of urban forestry and habitat restoration. Each of these phases requires different skill sets and workers.

Policymakers, community outreach coordinators, and land surveyors are typically involved in the planning and design phases. They interact with foresters and conservation biologists, who manage urban forests and wildlife habitats. Landscape architects, landscape businesses, construction contractors, plumbers, and pipelayers are the primary occupations involved in the implementation phase. Maintenance workers and tree trimmers are engaged in the maintenance and stewardship phase. Environmental experts help monitor the effectiveness of the new GSI. Finally, several city departments, tribal governments, and community engagement committees continuously work together to ensure smooth stewardship of urban forestry components of GSI projects if applicable.

CAREER PATHS AND ACCESSIBILITY

Despite the wide range of occupations involved in each phase of a GSI project, most positions in the field paying a living wage require more than two years of post-secondary education. In most cases, there is a disconnect between entry-level and more advanced positions, as no clear pathway exists for workers to move up without having to go back to school for an extended period to acquire a bachelor's degree, graduate degree, or obtain a professional license.

In contrast to the credentialing required for most occupations in the field, or possibly because of the credentialing required, there is no widely recognized GSI training or certification. Some local training programs prepare contractors to work on residential-scale projects. These are well-regarded among program managers and other experts. However, no GSI-specific training or credential has significant traction in the labor market.

WORKFORCE DEMOGRAPHICS

As these occupations have high barriers to entry and are primarily in traditionally male-dominated fields, the GSI field has been lacking diversity with some notable exceptions. First, BIPOC workers are over-represented in manual labor occupations, and both women and BIPOC workers have varying levels of representation among technicians. However, outside urban planners and community outreach workers, women, BIPOC workers, and those facing socioeconomic disparities and prejudice (e.g., disabled, LGBTQIA+, justice-impacted) are

underrepresented in occupations that significantly influence planning and design.

RECOMMENDATIONS

There are three primary recommendations for improving diversity and representation in the GSI field:

- Increase wages among entry-level occupations that do not require post-secondary credentials. Higher wages improve the field's visibility and allow workers to persist in the field and pursue additional training and certification.
- Identify or create pathways from construction labor and maintenance occupations to technician and design occupations. Collaborate with community colleges and employers to ensure that workers in the field have the opportunity to and support to advance in the field.
- Include dedicated funding in GSI projects and programs for community outreach and education positions to ensure that community priorities are reflected in all stages of the GSI lifecycle. Community members should inform the positions' qualifications, recruiting, and hiring to ensure that the positions attract a diverse pool of candidates and that the role reflects the community's needs.

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DASHBOARD

An interactive dashboard mapping the Green Stormwater Infrastructure Career Ecosystem can be found here: https://tinyurl.com/gsiworkforce

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INTRODUCTION

Stormwater runoff typically occurs after rainfalls when water collects on impervious surfaces that do not let it soak into the ground, such as buildings, roads, and parking lots. This water collects pollution, dust, gravel, and other debris as it flows away from these surfaces and toward nearby streams, ponds, wetlands, and other natural ecosystems.

Gray stormwater infrastructure is typically used throughout public and private facilities to help manage and direct stormwater. Gray infrastructure includes gutters, drains, curbs, and storm or combined* sewers. The purpose of gray infrastructure is to redirect the runoff flow away from urban environments and into nearby water bodies as quickly as possible to prevent flooding and damage and potentially treat it. Unfortunately, following heavy downpours, this management method leads to erosion, flooding, and the contamination and destruction of the nearby aquatic ecosystems.[2]

Climate change is increasing the incidence of extreme weather events, including heavy rainfall. The impacts of these weather events are borne disproportionately by some communities, and these frontline communities are more likely to be communities of color. They are also more likely to be low-income, have a higher incidence of chronic illness and disability, and speak a language other than English in the home, meaning they have fewer resources to adapt and respond to these extreme events (Figure 1).[3]

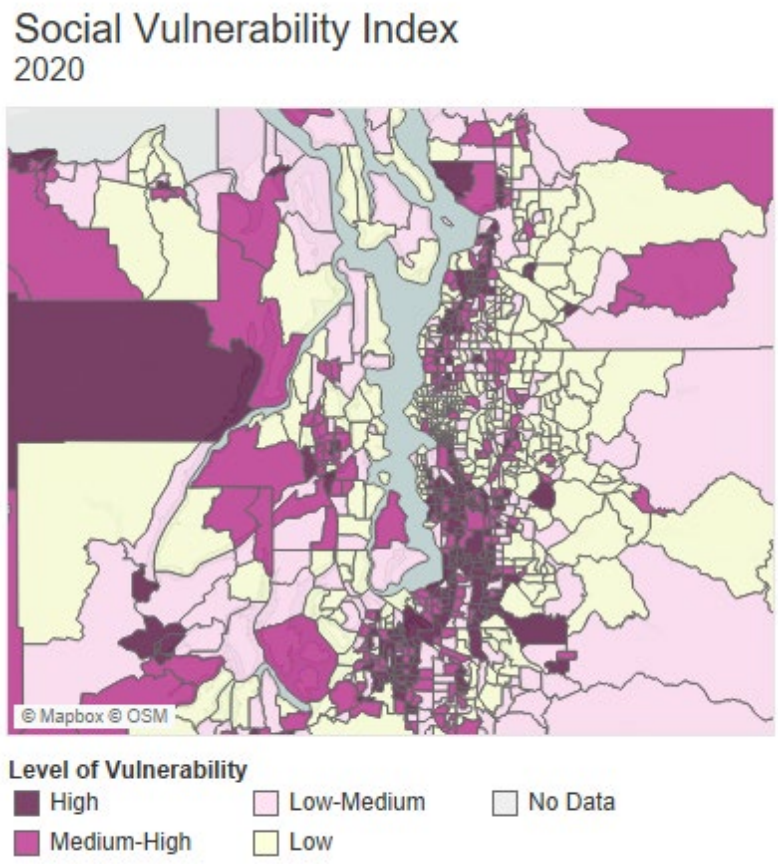

Figure 1. Social Vulnerability Index, 2020

* Combined sewers contain sanitary sewage (i.e., wastewater from toilets, showers, sinks, washers, etc.) and stormwater runoff. All the sewage is routed through wastewater treatment plants. Larger-than-average volumes of stormwater can overwhelm combined sewers and wastewater treatment plants, leading to combined sewer overflows when untreated sewage is released into waterways.

Green stormwater infrastructure (GSI) helps mitigate these destructive environmental consequences by mimicking and preserving the local native vegetative cover and using topography to slow and retain precipitation.

Green stormwater infrastructure projects have become more diverse in recent years. This report follows the Green Stormwater Infrastructure Workforce Collaborative's GSI definition[3]:

> *Green Stormwater Infrastructure (GSI) are types of infrastructure specifically designed to mitigate the harmful impacts of stormwater quantity and quality.* ***GSI comprises discrete stormwater runoff-mitigating interventions that use natural ecohydrological processes to manage urban stormwater runoff*** *quantity and quality in a spatially distributed manner close to the source of runoff generation.*

GSI projects often include multiple elements like rain gardens, urban forests, and permeable pavements. For example, tree canopy dramatically slows the rate at which precipitation reaches the ground. Areas designed to pond and hold water allow water to infiltrate the soil on site. Native plant roots further facilitate water infiltration and capture pollutants, decreasing pollution, flooding, and erosion downstream. At the same time, many of these elements provide other ecosystem services.[4] For example, the cooling capacity of green urban infrastructure, including urban forestry and other vegetation-focused GSI that increases tree canopy cover and shape, is significant, [5,6] saving Washington residents $56 million in energy costs and preventing $11.8 million of power plant emissions.[7] At the same time, this vegetation absorbs pollutants like CO_2, CO, nitrogen oxides, methane, and particulate matter less than 2.5 and 10 microns. It is estimated that Washington's green infrastructure removes 16,400 tons of air pollution annually.[7]

Municipalities are increasingly installing and encouraging the installation of green in addition to gray stormwater infrastructure.[8] Washington state was the first to require GSI to be integrated into stormwater management.[4] Cities in the Puget Sound region (see Appendix A for map), in particular, have been actively engaged in this process in recognition of the impact that urban stormwater is having on the Sound and connected waterways' ecosystems. For example, Green Stormwater Infrastructure in Seattle is currently managing 270 million gallons of stormwater per year, up from 86 million gallons of stormwater in 2011, and aiming for 700 million by 2025.[9]

GREEN VERSUS GRAY PROJECTS

One initial question in this research is the difference between gray stormwater infrastructure (SI) projects and green SI (Table 1). The process of planning, designing, implementing, and maintaining gray infrastructure is quite well established, as is the set of occupations involved. We needed to understand how these projects differ to develop a list of occupations for green SI.

GRAY STORMWATER INFRASTRUCTURE PROJECTS

Gray infrastructure is gray simply because it is made overwhelmingly of concrete: curbs, gutters, drains, and storm and combined sewers. As noted above, the purpose of gray infrastructure is to move water as rapidly as possible away from the built environment to prevent flooding and the hazards posed to both life and property that flooding brings. Though every building has some elements of gray SI (e.g., gutters and downspouts), gray SI projects tend to be utility-scale. Gray infrastructure is often unseen, even in plain sight, and only noticed when it fails because, as the infrastructure deteriorates, its performance is typically consistent until sudden failure. This invisibility, paired with the expense, makes it easy to defer maintenance.

The occupations involved in gray infrastructure are the conventional building and construction trades, civil engineering, and urban planning.

Table 1. Gray versus Green Stormwater Infrastructure

	Gray Stormwater Infrastructure	Green Stormwater Infrastructure
Aim	Quickly move water away from the built environment	Prevent precipitation from becoming stormwater when possible and manage stormwater close to the source when it does form
Typical components	Curbs, gutters, drains, storm sewers, combined sewers	Urban forestry and native plants, cisterns, splash boxes, grading, engineered soils, permeable pavement
Project scale	Utility-scale	Individual site to utility-scale
Visibility	Largely unseen as part of the built environment	Highly visible because not conventionally part of the built environment
Maintenance	Expensive, often deferred	Regular maintenance required
Typical Failure	Sudden	Gradual decline in performance
Common Occupation	Construction trades, civil engineering, urban planning	Construction trades, civil engineering, urban planning, landscapers, landscape architects, ecologists, plant and soil specialists, urban foresters, habitat restoration specialists, community outreach specialists

GREEN STORMWATER INFRASTRUCTURE PROJECTS

Green SI projects, in contrast, are much more varied in both what they involve and their size. Green SI is integrated into the natural environment using landscaping, urban forestry, and habitat restoration practices and through obvious green elements like native plantings in rain gardens. But it is also integrated into the gray SI so that the gray SI can take the excess and prevent flooding when the green SI capacity is reached during extraordinarily heavy rain events.

Green SI ranges in size from site-specific facilities commissioned by private land owners to regional facilities done at a utility-scale. It is also typically very visible, largely because they are different from what we expect in urban environments. Green SI elements require regular maintenance for optimal performance, though the performance often degrades gradually rather than suddenly failing.

As green SI is still infrastructure, it involves the same planning and engineering as gray SI. However, workers in these roles require new and specialized skills and knowledge. Green SI also involves the same construction and building trades as gray SI. Because green SI is integrated with or mimics the natural environment, green SI also involves occupations related to ecology, including plant and soil scientists.

Integration into the community is the third element of green SI. Because it changes how a neighborhood looks and how water moves through it, and it requires regular maintenance, it changes how people interact with the infrastructure. As a result, community engagement and education are a core part of green SI implementation.

Green SI projects draw from three main occupation areas: conventional infrastructure, ecology, and community engagement (Figure 2). Workers in those occupations can and do transition to and from working on green SI, often on a project-by-project basis.

Figure 2. Green Stormwater Infrastructure Occupations Categories

PURPOSE OF STUDY

As GSI projects become more integrated into urban planning and stormwater management, identifying and understanding related equity impacts is crucial. Policymakers should also ensure that communities most impacted by water runoff benefit from GSI projects and are not displaced or experience additional negative impacts stemming from new infrastructure.

This concept is at the root of environmental justice, defined by the EPA as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income concerning the development, implementation, and enforcement of environmental laws, regulations, and policies.[9] However, true equity and environmental justice demand that these interventions benefit the communities most impacted and are implemented and led by people from frontline communities, especially those who are both highly exposed to climate risks and are less equipped to respond to those risks[10] (Figure 3). Workforce development is critical to ensuring that the workforce supporting greening stormwater infrastructure is diverse and inclusive and people lead that work from frontline communities.

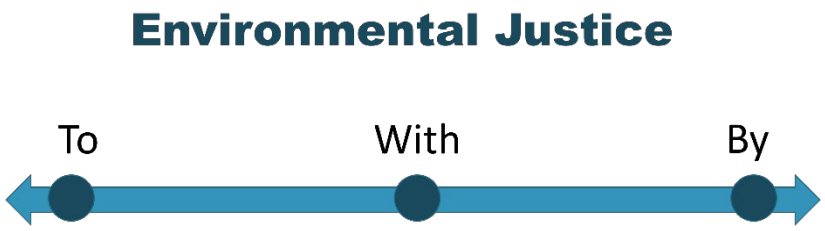

Figure 3. Environmental Justice Continuum

The difference between green and gray stormwater infrastructure is significant enough to require specialized skills. However, green and gray stormwater are part of an integrated whole and work together. As a result, the lists of occupations that work on these projects overlap, and individual workers also work on both types of projects. The construction of future GSI projects depends on an overall greening of the workforce to provide an adequate supply of workers with these specialized skills to help design, implement and monitor these projects. However, the skills required at each step of these projects vary significantly by education and work experience requirements. Understanding whether occupations in GSI lead to living wages and strong career pathways is a crucial equity step to make sure all workers can participate in the protection of their local environment.

The Green Stormwater Infrastructure Workforce Collaborative (Appendix B) was formed in 2020 to identify and address the challenges associated with developing "sustainable, equitable, and inclusive career pathways within the green stormwater infrastructure field." In the Puget Sound Region (Appendix A) [1] This report addresses the first of the coalition's four main goals:

1. Mapping the current landscape of the GSI workforce development
2. Building coordination and collaboration around different GSI efforts
3. Focusing on "in-the-ground" project implementation jobs
4. Building a cohesive and equitable workforce from training to employment to long-term careers

METHODS

This report is based on industry partner insights from interviews with 12 local field experts, a literature review, and a labor market data analysis. It aims to provide an overview of

- The various occupations in GSI
- Their entry requirements
- If they lead to stable career pathways
- Equity gaps stemming from advanced entry requirements, a lack of accessible training programs, or unclear career advancement moves.

OVERVIEW OF ANALYSIS

The team interviewed people representing GSI employers, public agencies, nonprofit organizations, and GSI-related training programs. These experts are involved in various parts of the GSI project lifecycle. They provided deep insights into the differences between gray and green stormwater infrastructure, the occupations and skills required at each stage of a GSI project, and which training programs and professional certifications are available to help entry-level workers enter the GSI field.

A set of occupations was created from these interviews and used to collect job-level labor market and training program data in Washington state counties in the Puget Sound area.

TYPICAL GSI PROJECTS PHASES

Green stormwater infrastructure projects tend to follow a set of project phases (Figure 4):

1) **Planning:** During this phase, policymakers, tribal governments, or private landowners seek funding and decide the location of the future GSI project. The location is informed by flooding risks, erosion levels, pollution concentrations, and regulations to ensure that the GSI will have the needed impact. Equity should be a prime consideration in the process. Are those most impacted and at risk due to runoff considered or involved in the decision-making? Do projects reflect community priorities?

2) **Design:** In this stage, the type of green stormwater infrastructure to be installed is determined. It depends on budget, area, topography, soil, existing vegetation, the placement within the urban water infrastructure network and its interaction with the broad watershed, expected amount of water runoff and contaminants, and maintenance workload. In addition, to these considerations, designers can engage with community members to determine what elements fit best within the community and if the project could serve other purposes (e.g., provide shade). Examples of GSI projects include retention basins, rainwater harvesting, rain gardens, bioswales, urban forests, and wildlife habitats.

3) **Implementation:** The work and the occupations involved in implementing the GSI project will depend on the GSI components and location. This phase often involves preparing the land at the project location, installing pipes, removing pavement, and selecting and planting vegetation.

4) **Maintenance and Stewardship:** As the new infrastructure absorbs or processes precipitation, the debris carried by the water can degrade the performance if not cleared out regularly. Elements like rain gardens', urban woodlands', or engineered wetlands' capacity to absorb and clean the water runoff may decline thanks to invasive species or the normal accumulation of dead plant matter. As a result, debris must be cleared regularly, and plants and trees must be pruned.

5) **Monitoring:** Finally, the amount and quality of water runoff must also be monitored regularly to ensure that the GSI has been properly installed, efficiently manages stormwater, and minimizes environmental pollution.

In addition to urban forestry and habitat restoration being themselves GSI projects, GSI installations interact with **urban forestry** and aquatic **habitat restoration** projects elsewhere in the watershed.

Figure 4. Green Stormwater Infrastructure Lifecycle

WORKFORCE NEEDS BY PHASE

Each phase of the GSI lifecycle involves a different set of occupations. These occupations can be grouped into six categories:

- Maintenance & Ground Workers
- Technicians & Assistants
- Specialists, Scientists & Inspectors
- Operators
- Engineers & Designers
- Managers & Supervisors

The most well-established career paths, from entry-level to advanced, and the easiest transitions between occupations for workers are within the categories.

OCCUPATIONS IN THE PLANNING PHASE

Planning is the first phase of a green stormwater infrastructure project. The goal of this phase is to identify where to target the implementation of GSI. The factors included in this planning are:

- The community's sustainability goals,
- The current and projected amount and pollution levels of runoff and flooding, and the
- Technical feasibility of installing new infrastructure given the site conditions and existing infrastructure network.

The occupations in this phase include professionals involved in these decisions, including policymakers in charge of their city's urban water systems and sustainability office. In particular, urban planners can guide which neighborhoods and plots are priorities and facilitate community engagement. Environmental project managers, ecologists, wetlands specialists, water quality testers, and other technicians may advise on pollution level goals and help identify the areas and ecosystems under the greatest flooding and pollution risks. Landscape architects and maintenance crew chiefs are also essential players in this phase as they provide critical input about the technical feasibility of the proposed projects (Table 2).

Other important considerations include understanding how equitable is the current stormwater infrastructure network:

- How does the community prioritize infrastructure needs?
- Can GSI effectively address the community's highest priorities?
- Is there a plan to mitigate the potential negative consequences, including displacement driven by green gentrification?[4,11]
- Is there a plan to meaningfully engage the community in GSI planning and design?

Community Outreach Specialists should work closely with the technical team to identify impacted communities and include their feedback in the GSI project design and implementation plans.

Table 2. Planning Phase Occupations by Category

Maintenance & Ground Workers	Technicians & Assistants	Specialists, Scientists & Inspectors	Operators	Engineers & Designers	Managers & Supervisors
Maintenance crew chiefs	None	Community outreach coordinators Ecologists Arborists Foresters Environmental Project Specialists Wetlands Specialists Water Quality Testers	None	Landscape Architects	Urban & Environmental Planners Environmental Project Managers Operations Managers

OCCUPATIONS IN THE DESIGN PHASE

Once the location of the new GSI project has been determined, the type of infrastructure will depend on local environmental variables and landscape attributes. Who is involved in this phase depends on the scale and complexity of the project (Table 3).

Large and complex projects can involve a range of scientists and engineers.[12] Hydrologists may analyze the area's water table and flow. Soil scientists may assess the soil mineral composition and recommend soil amendments or develop engineered soil solutions.

Landscape architects and civil and environmental engineers may lay out the site, identify materials, and determine how the project connects to the gray infrastructure or waterways. Each of these occupations may work with related technicians. Other entry-level occupations involved in this project phase are Surveying and Mapping technicians.

Construction managers or landscape contractors with expertise may be the primary lead on small or residential-scale projects.

Table 3. Design Phase Occupations by Category

Maintenance & Ground Workers	Technicians & Assistants	Specialists, Scientists & Inspectors	Operators	Engineers & Designers	Managers & Supervisors
Maintenance crew chiefs Gardeners	CAD Technicians Land surveyor	Community Outreach Coordinators Ecologists Environmental Project Specialists Hydrologists Soil Scientists Materials Scientists Horticulturalists Arborists Foresters		Water Resources Engineers Environmental Engineers Civil Engineers Hydraulics Engineers Environmental Engineers/Scientists Drainage Engineers Water Resources Project Engineers Civil/Environmental Engineers Geotechnical Engineers Landscape Architects	Urban & Environmental Planners Environmental Project Managers

OCCUPATIONS IN THE IMPLEMENTATION PHASE

Once the GSI project location and type have been determined, the appropriate team is engaged to carry it out. For larger private or utility-scale projects involving engineered solutions, project managers and construction contractors work with design professionals to build the infrastructure.[13] Heavy equipment operators excavate and grade the site, and pipelayers and plumbers will set pipes and connect them to the existing gray stormwater infrastructure. Landscapers and laborers will install other elements (Table 4).

Urban forestry projects and smaller-scale projects such as rain gardens or rainwater harvesting entail carefully selecting and planting specific vegetation by hand. While foresters, landscape architects, and others with advanced degrees may inform this work, selecting the individual plants and planting can also be done by horticulturalists, landscapers, and laborers.

While these occupations do not typically require an advanced post-secondary degree, entry-level workers often need to complete an apprenticeship or short-term training program to advance. They can enter the field as construction or utility laborers to acquire experience and enough savings to support themselves throughout the first year of an apprenticeship program or a college certificate.

Table 4. Implementation Phase Occupations by Category

Maintenance & Ground Workers	Technicians & Assistants	Specialists, Scientists & Inspectors	Operators	Engineers & Designers	Managers & Supervisors
Maintenance crew chiefs Maintenance and Ground Workers	Surveyor	Arborists Foresters Community Outreach Coordinators Ecologists Horticulturalists Landscapers Landscape Business Owners Pollinator Specialists	General Laborers Pipelayers Pipelayers/Laborers Journeyman Plumbers Pipe Layers Laborers Plumbers Utility Laborers Heavy Equipment Operators Equipment Operators Landscapers	Civil (Project) Engineers Land Development Civil Engineers Project Engineers (Civil) Engineering Technicians Civil (3D) Designers Principal Engineers Staff Engineers Design Engineers City Engineers Improvement Engineers Civil Engineering Specialists Development Engineers	Project Managers Construction Managers Landscaping business owners & crew supervisors

OCCUPATIONS IN THE MAINTENANCE & STEWARDSHIP PHASE

In the GSI sector, entry-level occupations are most commonly found in the Maintenance and Stewardship phase, specifically in the maintenance portion of this phase (

Table 5). Maintenance Workers and Aides perform routine maintenance and clear out debris obstructing the GSI components. These positions tend to be entry-level as they typically do not require a post-secondary degree.

More involved maintenance and repair may require more specialized workers to be involved. Arborists, horticulturalists, plumbers, and landscapers may need to revisit projects to troubleshoot specific problems.

Table 5. Maintenance & Stewardship Phase Occupations by Category

Maintenance & Ground Workers	Technicians & Assistants	Specialists, Scientists & Inspectors	Operators	Engineers & Designers	Managers & Supervisors
Maintenance Workers Public Works Maintenance Workers Maintenance Mechanics Maintenance Aides Janitors	Maintenance Technicians	Arborists Foresters Horticulturalists Ecologists	Plumbers Landscapers		Maintenance Superintendents

OCCUPATIONS IN THE MONITORING PHASE

The final phase of the GSI lifecycle is the monitor phase. This phase runs concurrently with the maintenance and stewardship phase, and monitoring activities may also be integrated into the planning, design, and implementation phases. Maintenance workers may perform basic monitoring. However, scientists and technicians perform more specialized monitoring to ensure that the GSI has the intended impact (Table 6). The kind of technicians and scientists working in this phase depends on the type and goals of the GSI project or program. Monitoring could include water quality, plant health, the impact on biodiversity, absorption rates, or the performance of the design and engineered materials. Workers typically need two years of post-secondary education to start on these career paths.

Table 6. Maintenance & Stewardship Phase Occupations by Category

Maintenance & Ground Workers	Technicians & Assistants	Specialists, Scientists & Inspectors	Operators	Engineers & Designers	Managers & Supervisors
Maintenance Workers Public Works Maintenance Workers Maintenance Mechanics Maintenance Aides Janitors	Stormwater Technicians Maintenance Technicians Environmental Technicians Forestry Technicians Wastewater Technicians Environmental Health and Safety Technicians Water Resources Technicians	Arborists Foresters Horticulturalists Ecologists Environmental Health and Safety Specialists Water Quality Specialists			Maintenance Supervisors

CAREER PATHS

There were three key goals for mapping career paths:

- Identify sustainable career paths, which we define as career paths that include middle-wage jobs or jobs that do not require a college degree and have a median wage of at least 80% of the region's median wage.[14]
- Identify what training and education are part of these career paths, including GSI-specific training and credentials.
- Identify gaps in equity within these career paths. The following section outlines the pathways and provides additional detail about the wages and demographics of workers in those occupations.

In the following section, we go into detail addressing these elements. We have identified four categories of career pathways:

- Public Policy & Community and Outreach
- Construction Contractors & Trades
- Maintenance Workers
- Environmental Experts & Technicians

PUBLIC POLICY & COMMUNITY OUTREACH

The first category of career path is public policy and community outreach. These roles are frequently integrated into design and management occupations, particularly engineers and project and construction managers. However, social and community service assistants and managers are solely dedicated to community engagement and education. Urban and regional planners are involved in both public policy and community engagement.

OCCUPATIONAL DETAILS

Community engagement and public policy roles are often rolled into the jobs of workers in other occupations (

Table 7). There are few occupations dedicated to either. The workers who perform these roles are most engaged in this work in the early stages of a GSI project, often during the planning and design phases. Environmental Division Directors and Project Managers guide strategic planning and implantation plans of new green stormwater infrastructure. Urban and regional planners and engineers further shape such policy while facilitating community engagement by deciding where the infrastructure will be located to meet environmental and economic development goals. Community outreach coordinators also play a crucial role in presenting the project to nearby communities, developing public engagement, and collecting and integrating constituent feedback. But this work often falls to project and construction managers when the resources are not made available for dedicated community outreach positions.

Public policy occupations engaged in GSI projects vary by education and work requirements. Still, most jobs listed in the table below require at least a bachelor's degree for entry-level positions. Additionally, stepping stones are limited for workers who do not have a post-secondary degree. The lack of stackable credentials in this sector means these workers must invest time and financial resources into long-term degrees. There are two exceptions: construction manager and community outreach coordinators. It is possible to become a construction manager with little financial burden by completing an apprenticeship program in a related

construction field and acquiring enough work experience to become a manager.

Similarly, becoming a community outreach coordinator is possible by starting as a social and human service assistant (which requires an associate degree or less) and eventually going back to university to obtain a Bachelor's or Master's degree in Social Work. Community outreach positions are prime examples of positions often advertised as requiring a bachelor's degree. However, when a Diversity, Inclusion, and Equity lens is used, it is often determined that experience, relationships within the communities being served, and being bi- or multilingual should be prioritized over post-secondary credentials.

General operations managers and construction managers have the largest projected growth over the next decade. However, this is misleading, particularly for general operations managers, because a very small percentage of workers in these jobs work in green stormwater or adjacent fields.

The same is true of community relations coordinators, social and community service managers, and first-line supervisors of office administrative support workers. The difference is that with these latter two occupations, the skills and specialized knowledge for these roles are readily transferrable in and out of working on green stormwater infrastructure projects. In contrast, the other managerial and professional roles demand more technical knowledge about green stormwater infrastructure.

Table 7. GSI-Related Occupations in Public Policy and Community Outreach in Puget Sound Counties

	Occupation	Typical Entry-Level Education	Standard Occupation Classification Description[15]	Job Titles
	First-Line Supervisors of Office and Administrative Support Workers	High school diploma or equivalent	These supervisors directly supervise and coordinate the activities of clerical and administrative support workers.	Office Manager Team Lead
	General and Operations Managers	Bachelor's degree	These managers plan, direct, or coordinate the operations of public or private sector organizations, overseeing multiple departments or locations. Their duties and responsibilities include formulating policies, managing daily operations, and planning the use of materials and human resources.	Director of Public Works Field Operations Manager Director of Operations General Manager

	Occupation	Typical Entry-Level Education	Standard Occupation Classification Description[15]	Job Titles
	Construction Managers	Bachelor's degree	Managers plan, direct, or coordinate, usually through subordinate supervisory personnel, activities concerned with constructing and maintaining structures, facilities, and systems. They participate in the conceptual development of a construction project and oversee its organization, scheduling, budgeting, and implementation. Includes managers in specialized construction fields, such as carpentry or plumbing.	Construction Manager Project Manager
	Civil Engineers	Bachelor's degree	These workers perform engineering duties in planning, designing, and overseeing the construction and maintenance of building structures and facilities, such as roads, railroads, airports, bridges, harbors, channels, dams, irrigation projects, pipelines, power plants, and water and sewage systems.	Civil Engineer Design Engineer Project Engineer
	Social and Community Service Managers	Bachelor's degree	These managers plan, direct, or coordinate the activities of a social service program or community outreach organization. They oversee the program or organization's budget and policies regarding participant involvement, program requirements, and benefits. Their work may involve directing social workers, counselors, or probation officers.	Community Outreach Manager Program Manager
	Environmental Engineers	Bachelor's degree	These specialists research, design, plan, or perform engineering duties in the prevention, control, and remediation of environmental hazards using various engineering disciplines. Their work may include waste treatment, site remediation, or pollution control technology.	Environmental Engineer Water/Wastewater Engineer
	Urban and Regional Planners	Master's degree	These professionals develop comprehensive plans and programs for land use and physical facilities of jurisdictions, such as towns, cities, counties, and metropolitan areas.	Urban Planner City Planner Regional Planner Urban Designer

OCCUPATION WAGES AND DEMOGRAPHICS

All occupations in this category have a median wage greater than 80% of the state[16†] and the Seattle-Tacoma-Bellevue Metropolitan Statistical Area's[17‡] median wage. However, only first-line supervisors of office and administrative support workers are considered middle-wage as those jobs typically require only a high school diploma (Figure 5).

Women are under-represented[18] in all of the occupations in this category except first-line supervisors of office and administrative support workers, social and community service managers, and urban and regional planners. Women are particularly underrepresented among construction managers and civil engineers.

BIPOC workers[19] are underrepresented in all of the occupations in this category except first-line supervisors of office and administrative support workers and social and community service managers. They are particularly under-represented among construction managers, which has downstream implications for the trades, and people tend to hire, advance, and promote people who resemble them.[20] Diversifying leadership and management is a crucial strategy for improving equity.

PUBLIC POLICY CAREER PATH

Figure 6 below presents the occupations in the public sector most likely to support the planning and implementation of GSI projects. It shows how professionals wishing to work on green stormwater infrastructure in the public sector may enter and advance in this career pathway.

Occupations are organized by education and work experience levels required to enter an entry-level position. The higher up an occupation on the career pathway, the more likely a worker must possess an advanced educational credential (bachelor's or graduate degree) to enter this occupation. Similarly, the further to the right an occupation is on the career pathway, the greater the years of work experience required to enter the position.

Entry-level workers with an associate degree or less can often start their careers in public policy as administrative assistants or in community engagement roles in local government. However, civil engineers and urban planners participate more actively in GSI projects and can work their way up to public works directors (Figure 6). This career path does not have any middle-wage jobs. Engineering typically requires a bachelor's and urban planners typically have a master's degree.

† Washington state's median wage was $24.25/hour in 2021, 80% of this is $19.40/hour. A full-time position is 2080 hours/year, making the annualized median wage $50,440, 80% of this is $40,352.

‡ Seattle-Tacoma-Bellevue MSA's median wage was $36.62 in 2021, 80% of this is $29.30. Annualized at 2080 hours/year, the median wage is $75.421, 80% of this is $60,935.

Policy Occupations

	General and Operations Managers	First-Line Supervisors of Office and Administrative Support Workers	Construction Managers	Civil Engineers	Social and Community Service Managers	Urban and Regional Planners	Environmental Engineers
2021 Jobs	37,995	22,652	11,048	9,434	2,966	1,749	1,179
Percent Growth 2021-2032	17%	4%	19%	7%	28%	8%	3%

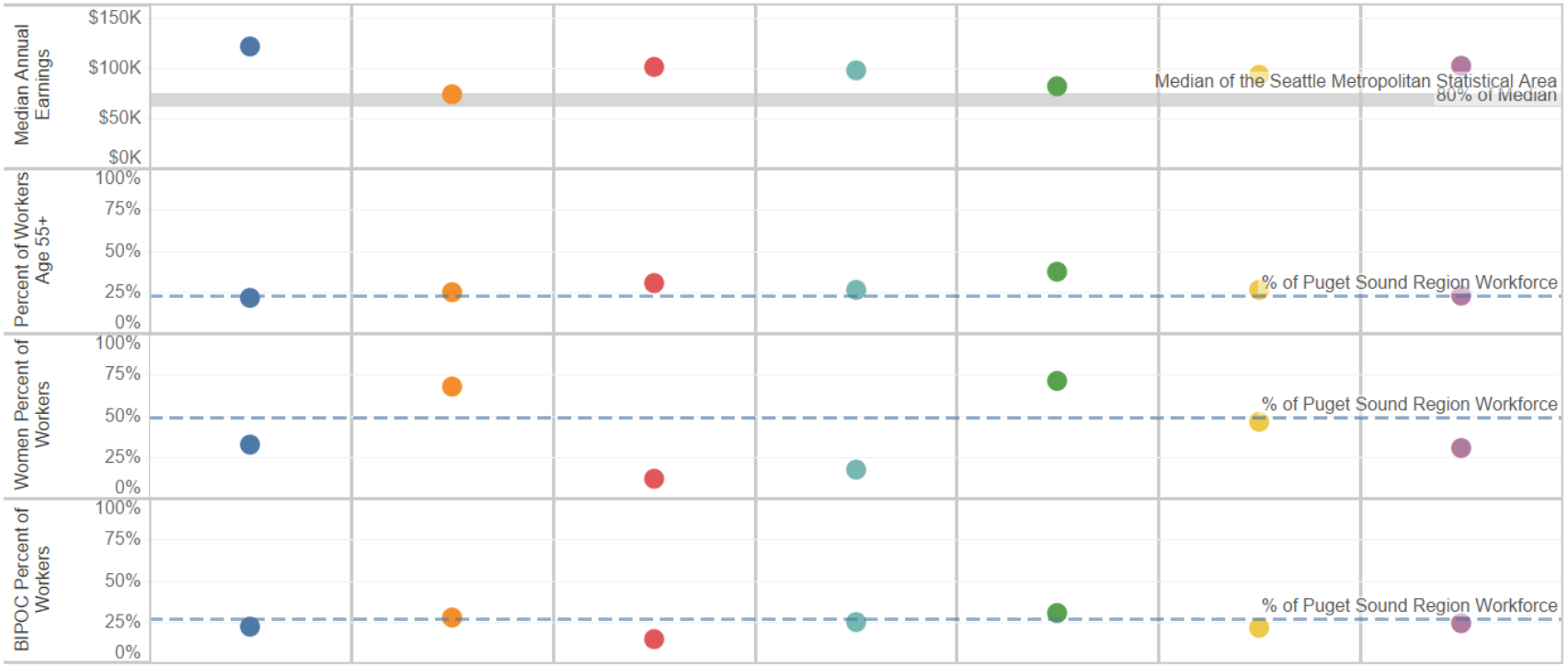

Figure 5. Policy Occupations Jobs, Growth, Wages, and Demographics[18,21]

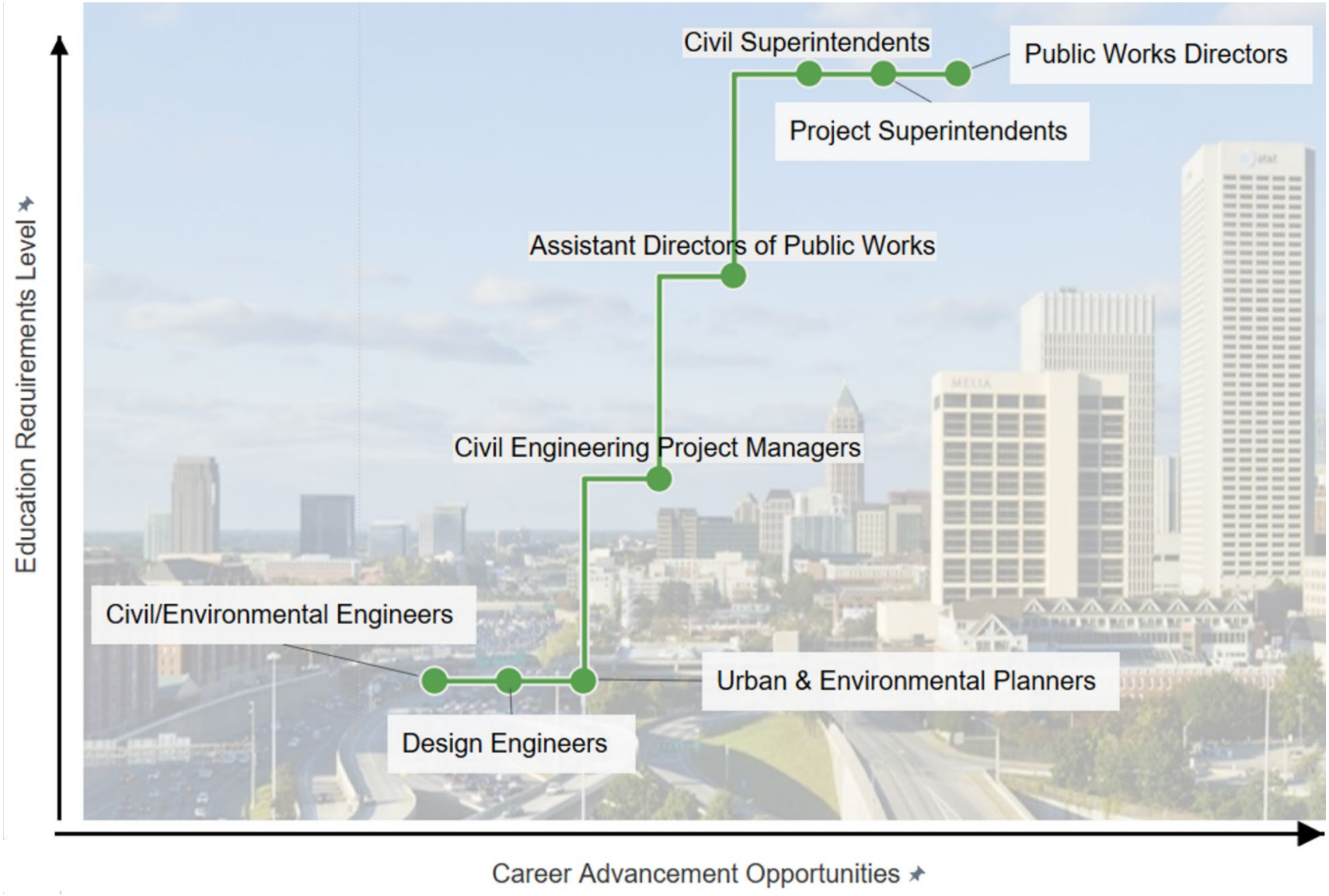

Figure 6. GSI-Related Public Policy Career Pathway

COMMUNITY OUTREACH CAREER PATH

The community outreach career paths are more varied. There is a pathway from social to human services assistants to community and social service directors and one through public relations and community engagement (Figure 7). These paths can offer opportunities to those without a college degree because, in these paths, experience can be more valuable than specific credentials.

Someone may be able to enter and move along this career path if they have experience in the field, for example, as a laborer, are part of or have relationships with target communities, or have language skills to serve targeted communities. There are no stackable credentials to move through the pathway without pursuing a four-year degree; however, short-term certificates that indicate individuals gained technical skills to complement expertise gained through experience.

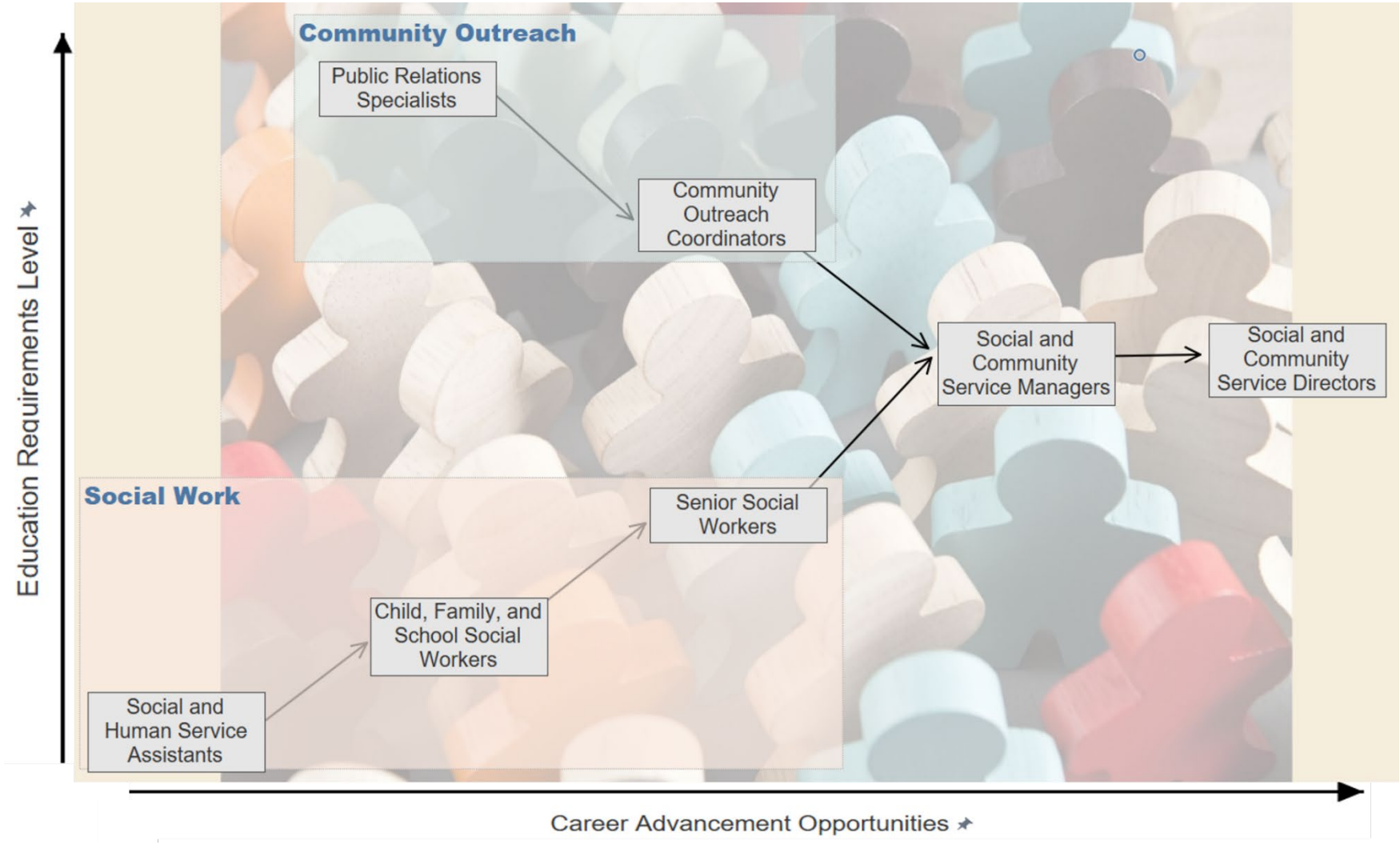

Figure 7. GSI-Related Community Outreach Career Pathway

CONSTRUCTION CONTRACTORS & TRADES

The next category of career paths is in the construction trades and occupations. The design and implementation phase of a GSI project depends on construction management and trades occupations and skills. Engineers, drafters, technicians, and surveyors collaborate to design the GSI installations based on the project goal and the site-specific conditions. They work with sales representatives for components and engineered materials used in the installation. In the implementation phase, construction trades and equipment operators are the primary drivers.

OCCUPATIONAL DETAIL

Among the phases of a GSI project, implementation has the best job opportunities for workers without a post-secondary degree (Table 8). These workers can start as Construction Laborers with no required education. They can also enroll in an apprenticeship program leading to being a licensed equipment operator, plumber, or pipefitter.

The largest growth is in construction laborers, the occupation with the largest headcount. The rest of the trade occupations are also projected to grow. In contrast, architectural and engineering managers, geological engineers, and mechanical drafters have negative projected growth. These occupations' negative projected growth may be an artifact of the recent disruption in the labor market. However, it also may reflect changes in the sectors where these workers are primarily employed.

Table 8. GSI-Related Occupations in Construction and Trades in Puget Sound Counties

	Occupations	Typical Entry-Level Education	Standard Occupation Classification Description[15]	Job Titles
	Construction Laborers	No formal educational credential	Laborers perform tasks involving physical labor at construction sites. They may operate hand and power tools of all types (such as air hammers, earth tampers, cement mixers, small mechanical hoists, surveying and measuring equipment, and various other equipment and instruments). They may also clean and prepare sites, dig trenches, set braces to support the sides of excavations, erect scaffolding, and clean up rubble, debris, and other waste materials.	Construction Laborer Handyman General Laborer Construction Worker

	Occupations	Typical Entry-Level Education	Standard Occupation Classification Description[15]	Job Titles
	Construction and Building Inspectors	High school diploma or equivalent	These specialists inspect structures using engineering skills to determine structural soundness and compliance with specifications, building codes, and other regulations. Those inspections may be general or limited to a specific area, such as electrical systems or plumbing.	Construction Inspector Building Inspector
	Operating Engineers and Other Construction Equipment Operators	High school diploma or equivalent	These specialists operate one or several types of power construction equipment, such as motor graders, bulldozers, scrapers, compressors, pumps, derricks, shovels, tractors, or front-end loaders. They used this equipment to excavate, move, grade earth, erect structures, or pour concrete or other hard surface pavement. They may repair and maintain equipment in addition to other duties.	Heavy Equipment Operator Operating Engineer
	Pipelayers	Short-term on-the-job training	These workers lay pipes for storm or sanitation sewers, drains, and water mains. They perform any combination of the following tasks: grade trenches or culverts, position pipes, or seal joints.	Pipelayer Stormwater Technician Underground Utility Locator
	Plumbers, Pipefitters, and Steamfitters	Apprenticeship	These workers assemble, install, alter, and repair pipelines or pipe systems that carry water, steam, air, or other liquids or gases. They may install heating and cooling equipment and mechanical control systems.	Plumber Pipefitter
	Architectural and Civil Drafters	Associate degree	These workers prepare detailed drawings of architectural and structural features of buildings or drawings and topographical relief maps used in civil engineering projects, such as highways, bridges, and public works. They use building materials, engineering practices, and mathematics knowledge to complete drawings.	Civil Designer CAD Drafter Plumbing Designer Drafter

	Occupations	Typical Entry-Level Education	Standard Occupation Classification Description[15]	Job Titles
	Mechanical Drafters	Associate degree	These specialists prepare detailed working diagrams of machinery and mechanical devices, including dimensions, fastening methods, and other engineering information.	Mechanical Designer CAD Drafter Drafting Technician Piping Designers
	Civil Engineering Technologists and Technicians	Associate degree	These workers apply the theory and principles of civil engineering in planning, designing, and overseeing the construction and maintenance of structures and facilities under the direction of engineering staff or physical scientists.	Engineering Technician Field Technician Engineering Technologist Stormwater Technician
	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	Bachelor's degree	These sales representatives sell goods for wholesalers or manufacturers where technical or scientific knowledge is required in biology, engineering, chemistry, and electronics, typically obtained from at least two years of post-secondary education.	Sales Executive Technical Sales Representative Field Marketer
	Architectural and Engineering Managers	Bachelor's degree	These professionals plan, direct, or coordinate architecture and engineering activities or research and development in these fields.	Engineering Manager Project Engineer
	Surveyors	Bachelor's degree	Surveyors make exact measurements and determine property boundaries. They also provide data relevant to the shape, contour, gravitation, location, elevation, or dimension of land or land features on or near the earth's surface for engineering, mapmaking, mining, land evaluation, construction, and other purposes.	Registered Professional Land Surveyor Land Surveyor

	Occupations	Typical Entry-Level Education	Standard Occupation Classification Description[15]	Job Titles
	Mining and Geological Engineers, Including Mining Safety Engineers	Bachelor's degree	These engineers conduct subsurface surveys to identify the characteristics of potential land or mining development sites. They may specify the ground support systems, processes, and equipment for safe, economical, and environmentally sound extraction or underground construction activities. They may also inspect areas for unsafe geological conditions, equipment, and working conditions.	Geological Engineer

OCCUPATION WAGES AND DEMOGRAPHICS

All but the architectural and civil drafters in this category meet the wage threshold for middle-wage jobs in the Seattle MSA (Figure 8 and Figure 9).[17§] However, all occupations meet the state's wage threshold.[16**] However, sales representatives, architectural and engineering managers, geotechnical engineers, and surveyors require a bachelor's degree.

Women are under-represented[18] in all occupations in this category. They are best represented in the drafting and sale representative category, though only a small percentage of sales representatives are working on green stormwater infrastructure-related sales. They are particularly under-represented in plumbing, pipefitting, and operator occupations.

BIPOC representation[18] is somewhat more even across this category and closer to representative of the region. However, BIPOC workers are still under-represented in all occupations in this category except construction laborers. BIPOC workers are slightly over-represented among construction laborers.

§Seattle-Tacoma-Bellevue MSA's median wage was $36.62 in 2021, 80% of this is $29.30. Annualized at 2080 hours/year, the median wage is $75.421, 80$% of this is $60,935.

** Washington state's median wage was $24.25/hour in 2021, 80% of this is $19.40/hour. A full-time position is 2080 hours/year, making the annualized median wage $50,440, 80% of this is $40,352.

Construction Occupations

	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	Architectural and Engineering Managers	Civil Engineering Technologists and Technicians	Surveyors	Mining and Geological Engineers, Including Mining Safety Engineers
2021 Jobs	7,121	3,821	1,018	560	125
Percent Growth 2021-2032	7%	-9%	5%	5%	-3%

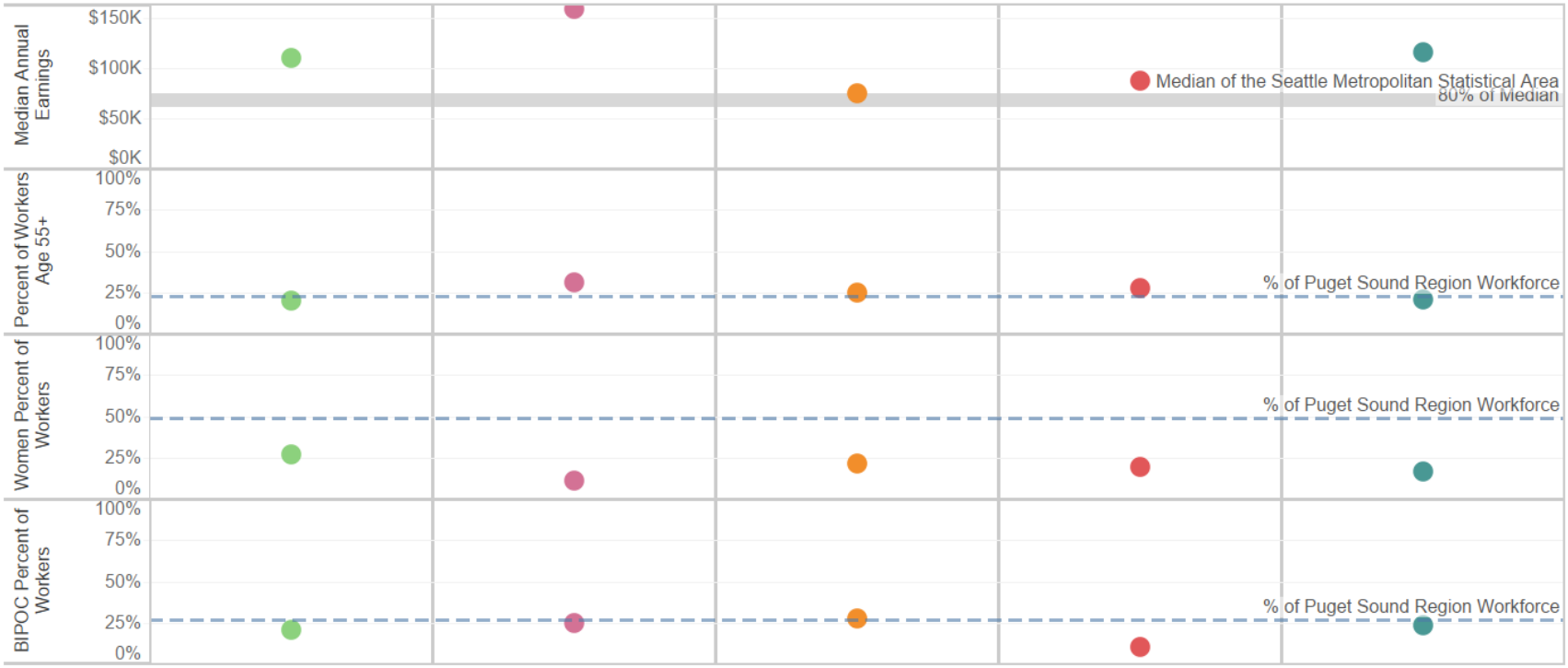

Figure 8. Construction Jobs, Wages, and Demographics[18,21]

Construction Occupations

	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	Architectural and Engineering Managers	Civil Engineering Technologists and Technicians	Surveyors	Mining and Geological Engineers, Including Mining Safety Engineers
2021 Jobs	7,121	3,821	1,018	560	125
Percent Growth 2021-2032	7%	-9%	5%	5%	-3%

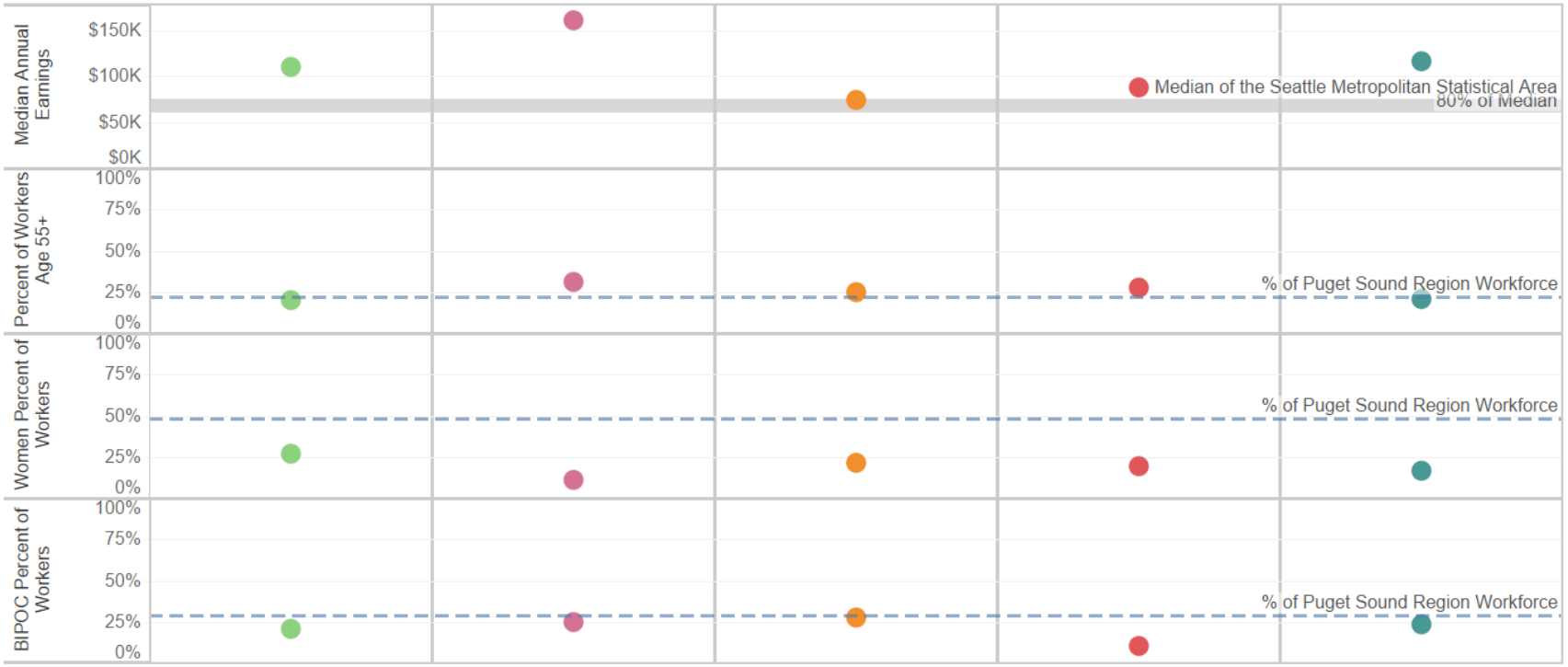

Figure 9. Construction Jobs, Wages, and Demographics - Continued[18,21]

CONSTRUCTION CAREER PATH

Figure 10 and Figure 11 below show how professionals wishing to work on the design and implementation phases of green stormwater infrastructure may enter and advance in a related Construction or Trades career pathway. Occupations are organized by education and work experience levels required to enter an entry-level position. The higher up an occupation on the career pathway, the more likely a worker must possess an advanced educational credential (bachelor's or graduate degree) to enter this occupation. Similarly, the further to the right an occupation is on the career pathway, the greater the years of work experience required to enter the position.

The construction occupation career path offers several pathways from construction laborer, which does not have formal education requirements, to construction manager or engineer (Figure 10). However, both of those endpoints typically require a bachelor's degree.

Multiple two-year degree programs in construction management at community and technical colleges in the state can offer an entry point to the occupation and a stepping stone to a four-year degree.

There are also multiple two-year drafting and engineering technician degrees at community and technical colleges that can offer a stepping stone to a four-year degree and a job as an engineer. However, they do not offer a direct entryway into those positions in the same way that it is possible for a two-year degree in construction management can.

In both cases, these are not stackable credentials,[22] [††] which are designed for students to complete a series of short-term programs that build on each other, but two-year programs prepare students to pursue a four-year degree in the same field.

TRADES CAREER PATH

The trades and operator career paths are very well-defined (Figure 11). Individuals can start as helpers or laborers. These positions typically do not require any education credentials. From these positions, these workers can use their experience in the field to enter an apprenticeship to advance to a licensed operator, journey worker, or master tradesperson.

[††] Stackable credentials break up much longer programs into smaller steps. Students can pause between short-term programs if needed and have credentials they can use to apply for or advance in their job.

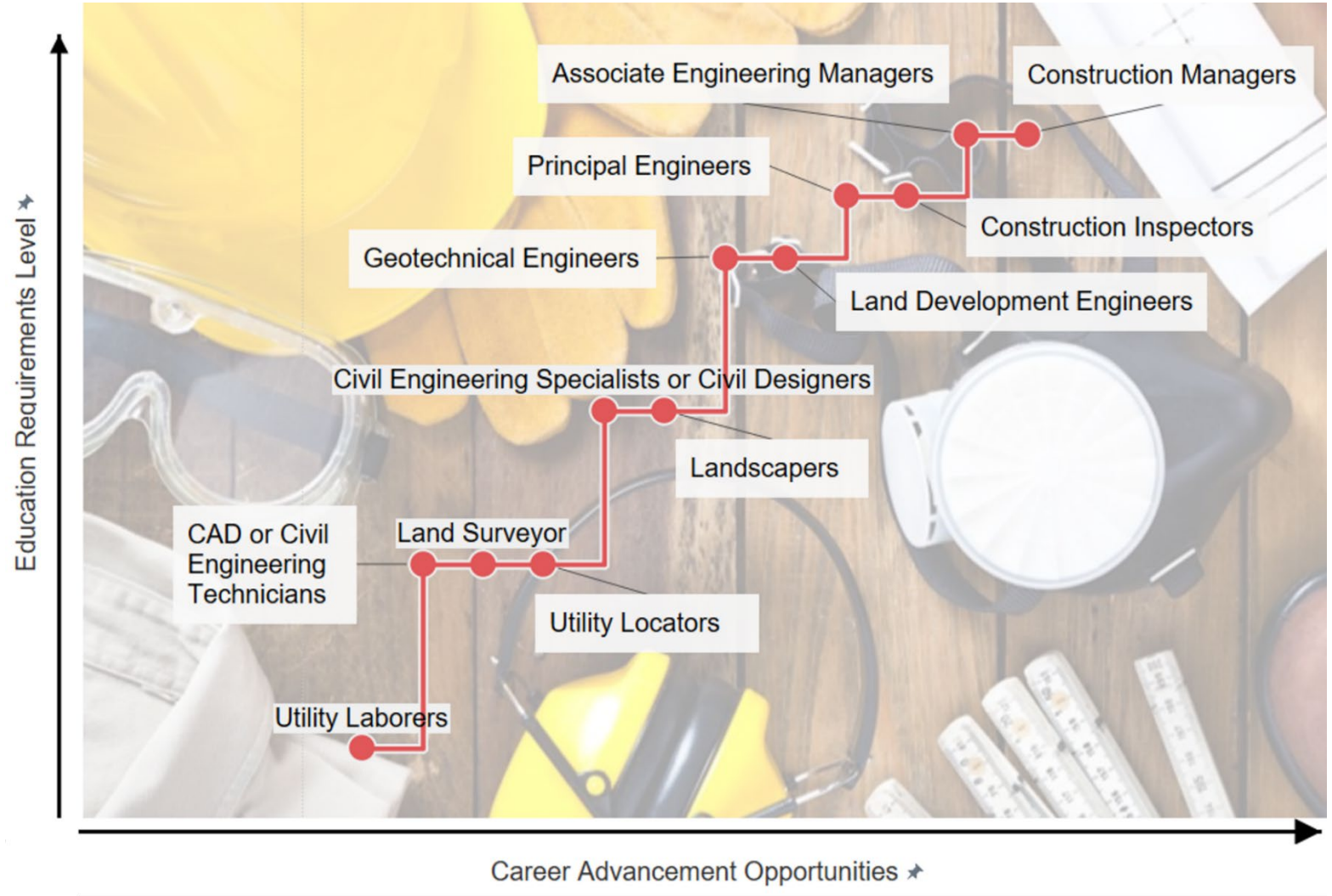

Figure 10. GSI-Related Construction Career Pathway

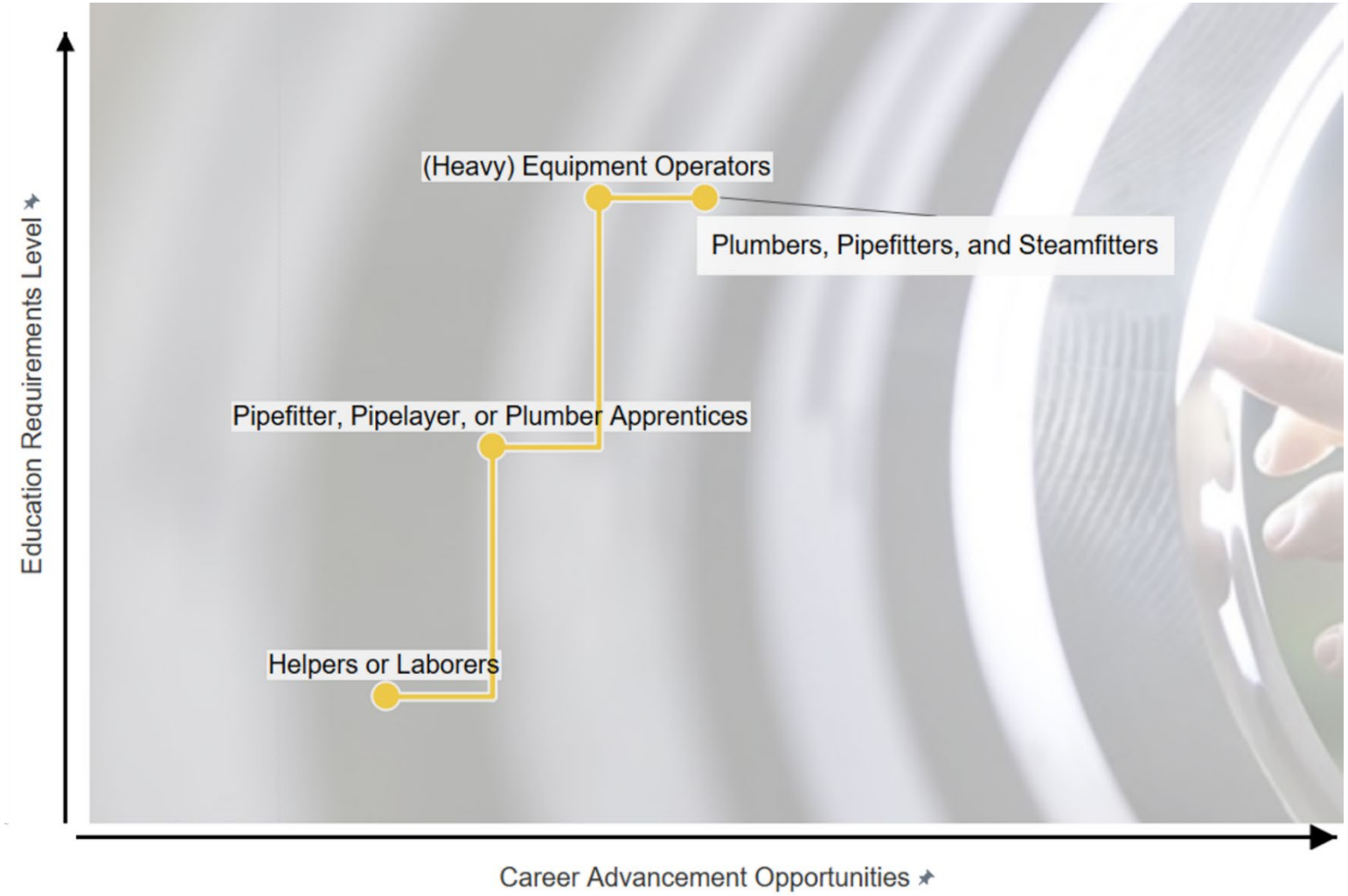

Figure 11. GSI-Related Trades Career Pathway

MAINTENANCE WORKERS

After a new GSI project is built and installed, regular maintenance is necessary to ensure that the infrastructure will absorb the targeted amount of water runoff and efficiently process contaminants. Most occupations at this project stage are entry-level and do not require advanced tertiary education, except for landscape architects. Still, even though entry-level workers can quickly become janitors or maintenance workers at GSI sites, career advancement opportunities are limited without additional education.

OCCUPATIONAL DETAILS

Except for landscape architects, occupations at this project stage only require a high school diploma or equivalent or less (Table 9). However, even though entry-level workers can quickly become janitors or maintenance workers at GSI sites, career advancement opportunities are limited without additional education.

At the same time, none of these occupations meet the criteria for middle-wage jobs.[‡‡] The maintenance occupations do not meet the wage threshold, and landscape architecture requires a bachelor's degree.

Janitors and Cleaners are projected to have the largest growth. In contrast, the number of first-line supervisors of landscaping and groundskeeping workers is projected to remain flat over the next decade.

OCCUPATION WAGES AND DEMOGRAPHICS

Women are under-represented in all of the occupations in this category. Maintenance and repair workers have the lowest percentage of women, while landscape architects have the largest percentage (Figure 12).

BIPOC workers are well-represented among janitors and first-line supervisors of landscape and groundskeeping workers. They are slightly underrepresented among maintenance workers and moderately underrepresented among landscape architects.

While BIPOC workers are represented in the GSI sector via this project phase, the positions are low-paid without solid career paths. These positions also have little to no input or influence over project planning and design. So, the over-representation of BIPOC workers in these roles does not translate into meaningful input to planning and design. These BIPOC workers do not typically have direct input themselves, and they do not engage with and support the involvement of their or other marginalized communities.

[‡‡] Seattle-Tacoma-Bellevue MSA's median wage was $36.62 in 2021; 80% of this is $29.30. Annualized at 2080 hours/year, the median wage is $75,421, and 80$% of this is $60,935. Washington state's median wage was $24.25/hour in 2021; 80% of this is $19.40/hour. A full-time position is 2080 hours/year, making the annualized median wage $50,440; 80% of this is $40,352.

Table 9. GSI-Related Occupations in Maintenance in Puget Sound Counties

	Occupations	Typical Entry-Level Education	Standard Occupation Classification Description[15]	Job Titles
	Janitors and Cleaners	No formal educational credential	These workers keep buildings and parks clean and orderly and perform heavy cleaning duties, such as cleaning floors, shampooing rugs, washing walls and glass, and removing rubbish. Their duties may include performing routine maintenance activities, notifying management of the need for repairs, and cleaning snow or debris from sidewalks and other public spaces.	Custodians Janitors Maintenance Janitors
	Maintenance and Repair Workers, General	High school diploma or equivalent	These workers perform work involving the skills of two or more maintenance or craft occupations to keep machines, mechanical equipment, or the structure of a building in repair. Their duties may involve pipe fitting; HVAC maintenance; insulating; welding; machining; carpentry; repairing electrical or mechanical equipment; installing, aligning, and balancing new equipment; and repairing buildings, floors, or stairs.	Maintenance Technician Field Service Technician Service Technician Maintenance Worker
	First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	High school diploma or equivalent	These supervisors directly supervise and coordinate the activities of workers engaged in landscaping or groundskeeping activities. Their work may involve reviewing contracts to ascertain service, machine, and workforce requirements; answering inquiries from potential customers regarding methods, material, and price ranges; and preparing estimates according to labor, material, and machine costs.	Landscape Construction Foreman Landscape Crew Leader Grounds Supervisor
	Landscape Architects	Bachelor's degree	These architects plan and design land areas for projects such as parks and other recreational facilities, airports, highways, hospitals, schools, land subdivisions, and commercial, industrial, and residential sites.	Landscape Designers Landscape Architects

Maintenance Occupations

	Janitors and Cleaners, Except Maids and Housekeeping Cleaners	Maintenance and Repair Workers, General	First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	Landscape Architects
2021 Jobs	32,929	22,525	2,320	639
Percent Growth 2021-2032	7%	6%	0%	8%

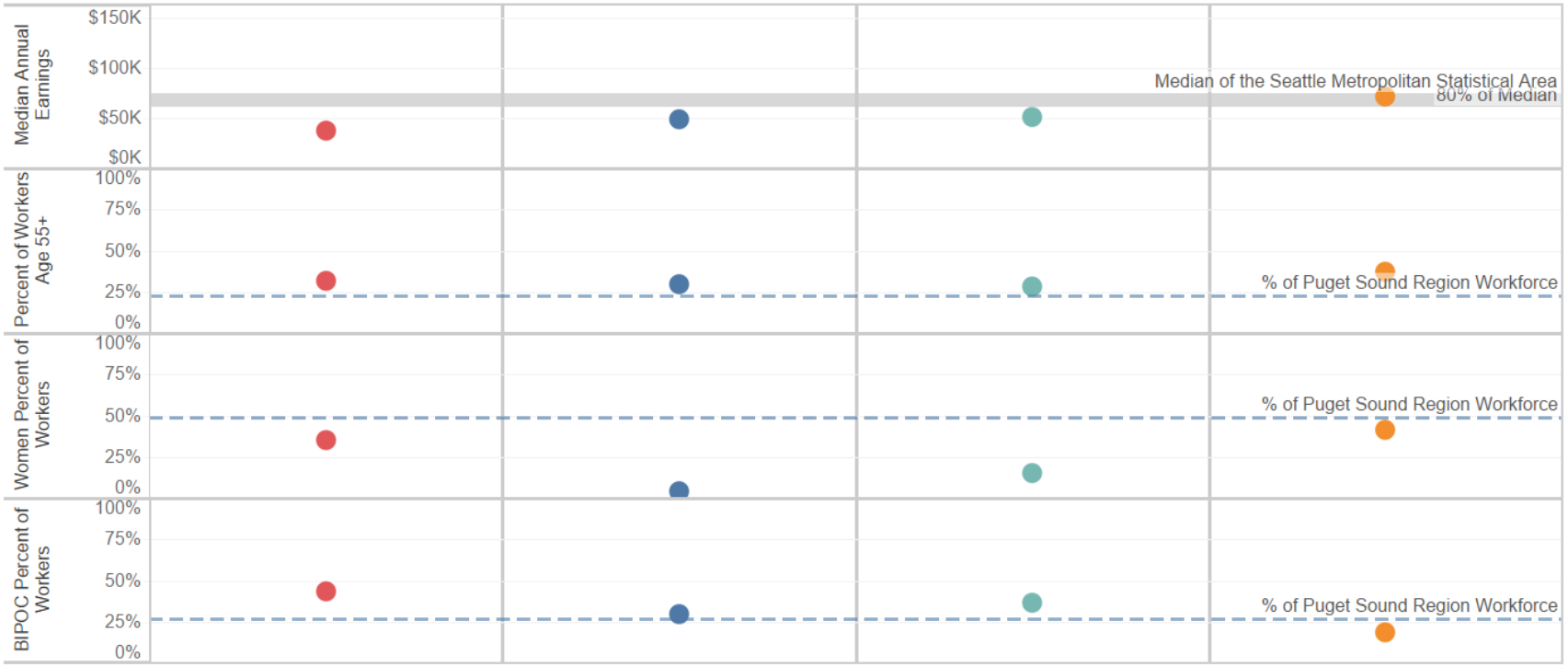

Figure 12. Maintenance Jobs, Wages, and Demographics[18,21]

MAINTENANCE CAREER PATH

There is a career path for maintenance workers that is clear but limited (Figure 13). Individuals can start as maintenance aides and move from maintenance technicians or maintenance mechanics to crew chiefs and supervisors. General maintenance workers do not require education credentials, but community and technical colleges have maintenance technician and maintenance mechanics programs.

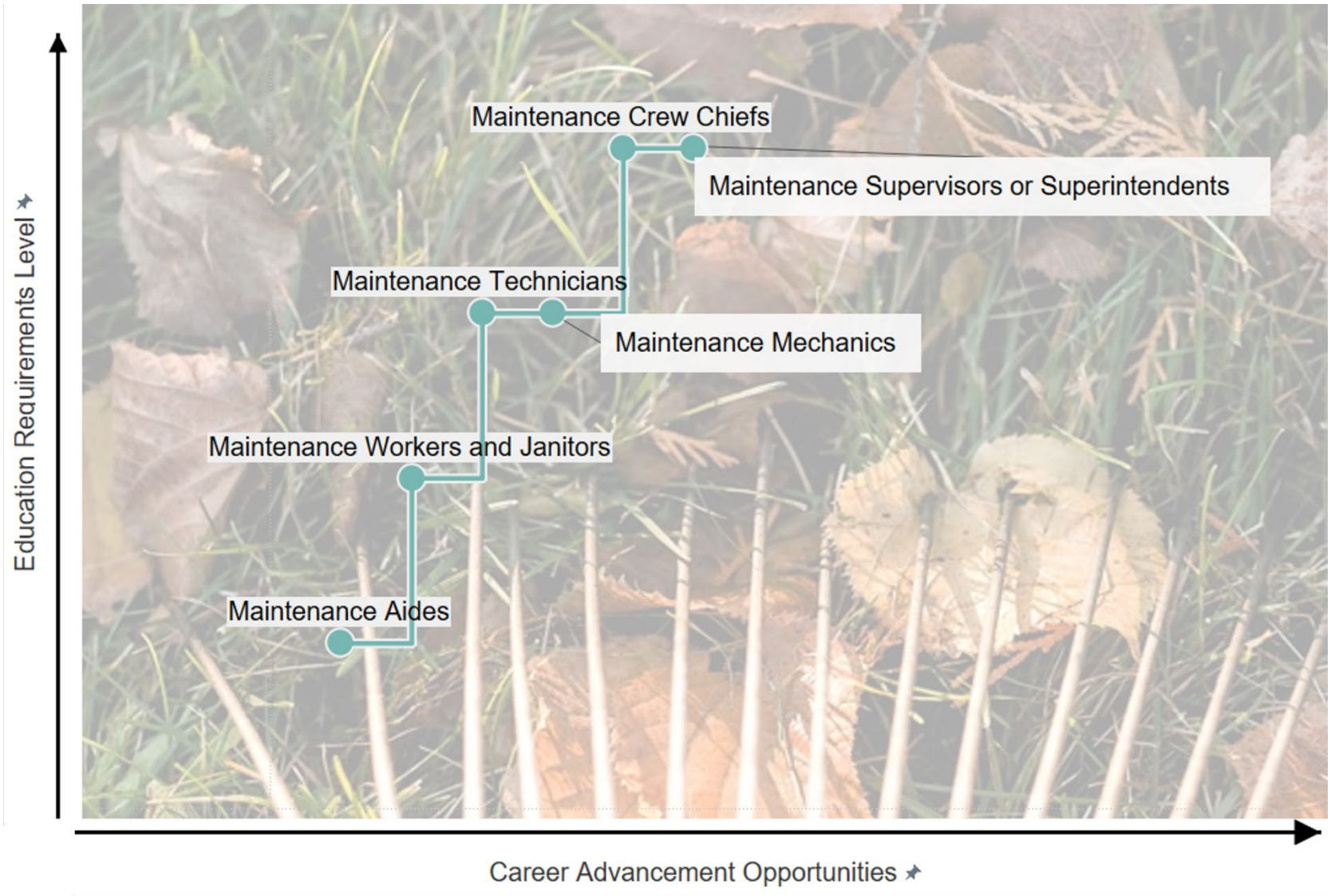

Figure 13. GSI-Related Maintenance Work Career Pathway

ENVIRONMENTAL EXPERTS AND TECHNICIANS

The next category of career path is environmental experts and technicians. These experts may be involved in all phases of the project, lending expertise to planning, design, implementation, monitoring, and stewardship. Arborists and foresters lead urban forest planning and maintenance. Conservation scientists and technicians lead habitat protection and restoration. This work protects and restores natural systems that are as essential for GSI projects to connect to as the connections to gray infrastructure.

OCCUPATIONAL DETAILS

Environmental experts typically require advanced degrees even for entry-level positions, while technicians typically require a two-year degree (Table 10). Some, such as foresters, hydrologists, or soil scientists, may require, at a minimum, a bachelor's degree, with many workers opting to continue their studies and obtain a master's or a doctoral degree. The ability to climb the career ladder solely by acquiring work experience remains limited if the worker lacks the scientific knowledge and credentials obtained during these advanced degrees.

Workers without a post-secondary degree interested in environmental careers can start as tree trimmers and pruners, which typically doesn't require a post-secondary degree, and later acquire an associate degree in forestry, environmental sciences, or conservation. The Society of American Foresters also offers continuing education and a certification process for current forestry professionals.

Alternate routes require at least a two-year degree that can lead to a four-year or advanced degree (e.g., environmental science technician to an environmental scientist). However, these are not well-supported career paths.

Few occupations in this category qualify as middle-wage jobs. While several occupations have a median wage of at least 80% of the median wage for the state and Seattle MSA[§§], and five of the 13 require less than a four-year degree, only hydrologic technicians meet both criteria.

Environmental compliance inspector is the largest occupation in the category and has substantial projected growth. The occupation with the largest project growth is the closely related environmental science technicians. Conservation scientists, environmental scientists, and foresters also have strong projected growth over the next decade.

[§§] Seattle-Tacoma-Bellevue MSA's median wage was $36.62 in 2021, 80% of this is $29.30. Annualized at 2080 hours/year, the median wage is $75.421, 80$% of this is $60,935.

Table 10. Environmental Expert and Technician Occupational Details in Puget Sound Counties

	Occupation	Typical Entry-Level Education	Standard Occupation Classification Description[15]	Job Titles
	Tree Trimmers and Pruners	High school diploma or equivalent	Using sophisticated climbing and rigging techniques, these workers cut away dead or excess branches from trees or shrubs to maintain right-of-way for roads, sidewalks, or utilities or improve trees' appearance, health, and value. They prune or treat trees or shrubs using handsaws, hand pruners, clippers, and power pruners. They can work off the ground in the tree canopy and use truck-mounted lifts.	Arborist Tree Trimmer Tree Climber
	Hydrologic Technicians	Associate degree	These technicians collect, organize, and report data about the ground and surface water's physical, chemical, and biological properties, distribution, and circulation. They install and maintain field equipment, collect water samples, and process samples for transportation to laboratories. The technicians may work with hydrologists, engineers, developers, government agencies, or agriculture.	Materials Technician Field Scout Hydrologic Field Technician
	Forest and Conservation Technicians	Associate degree	These technicians assist in conserving soil, water, forests, or related natural resources. They may compile data about the size, content, condition, and other characteristics of forest tracts under the direction of foresters or train and lead forest workers in forest propagation, fire prevention, and suppression. They may also assist conservation scientists in managing, improving, and protecting rangelands and wildlife habitats.	Forestry Technician Natural Resources Technician Resource Technician Park Rangers Forestry Aid
	Environmental Science and Protection Technicians, Including Health	Associate degree	These technicians perform laboratory and field tests to monitor the environment and investigate sources of pollution, including those that affect health, under the direction of an environmental scientist, engineer, or other specialists. They may collect samples of gases, soil, water, and other materials for testing.	Environmental Field Laborer Water Restoration Technician Wastewater Treatment Operators

	Occupation	Typical Entry-Level Education	Standard Occupation Classification Description[15]	Job Titles
	Hydrologists	Bachelor's degree	Hydrologists research the distribution, circulation, and physical properties of underground and surface waters; and study the form and intensity of precipitation and its rate of infiltration into the soil, movement through the earth, and return to the ocean and atmosphere.	Hydrogeologist Hydrologist
	Environmental Scientists and Specialists, Including Health	Bachelor's degree	These professionals conduct research or investigate to identify, abate, or eliminate sources of pollutants or hazards that affect the environment or public health. Using knowledge of various scientific disciplines, they may collect, synthesize, study, report, and recommend action based on data derived from measurements or observations of air, food, soil, water, and other sources.	Environmental Planner Environmental Specialist Environmental Scientist
	Environmental Compliance Inspectors	Bachelor's degree	These professionals inspect and investigate sources of pollution to protect the public and environment and ensure conformance with Federal, State, and local regulations and ordinances.	Compliance Specialist Compliance Analyst Regulatory Affairs Specialist Compliance Coordinators
	Soil and Plant Scientists	Bachelor's degree	These scientists conduct research in breeding, physiology, production, yield, and management of crops and agricultural plants or trees, shrubs, and nursery stock, their growth in soils, and control of pests; or study the chemical, physical, biological, and mineralogical composition of soils as they relate to plant or crop growth. They may classify and map soils and investigate the effects of alternative practices on soil and crop productivity.	Botanist Agronomists
	Conservation Scientists	Bachelor's degree	These scientists manage, improve, and protect natural resources to maximize their use without damaging the environment. They may conduct soil surveys and develop plans to eliminate erosion or protect rangelands. They may also advise about the best ways to use crop rotation, contour plowing, or terracing to conserve soil and water.	Ecologist Park/Wildlife Ranger Soil Conservationist Restoration Specialist Conservationist

	Occupation	Typical Entry-Level Education	Standard Occupation Classification Description[15]	Job Titles
	Materials Scientists	Bachelor's degree	These scientists study the structures and chemical properties of various natural and synthetic or composite materials, including metals, alloys, rubber, ceramics, semiconductors, polymers, and glass. They determine ways to strengthen or combine materials or develop new materials with new or specific properties for use in various products and applications.	Materials Scientist Research and Development Chemist
	Water Resource Specialists	Bachelor's degree	These specialists design or implement programs and strategies related to water resource issues such as supply, quality, and regulatory compliance.	Water Treatment Plant Operator Water Technician
	Water/Wastewater Engineers	Bachelor's degree	These specialists design or oversee projects involving the provision of potable water, disposal of wastewater and sewage, or prevention of flood-related damage. They prepare environmental documentation for water resources, regulatory program compliance, data management and analysis, and fieldwork. They can also perform hydraulic modeling and pipeline design.	Water/Wastewater Engineer Environmental Engineer Civil Engineer
	Foresters	Bachelor's degree	These workers manage public and private forested lands for economic, recreational, and conservation purposes. They may determine how to conserve wildlife habitats, creek beds, water quality, and soil stability and how best to comply with environmental regulations. They may also devise plans for planting and growing new trees, monitor trees for healthy growth, and determine optimal harvesting schedules.	Forester Natural Resources Specialist

OCCUPATION WAGES AND DEMOGRAPHICS

As this category contains scientists and technicians, there is also a mix of whether jobs meet the criteria for being middle-wage jobs (Figure 14 and Figure 15). Only hydrologic technicians make at least 80% of the Seattle MSA median wage among the technician occupations requiring less than a four-year degree.

The representation of women in these occupations is mixed. Women are well-represented among environmental compliance inspectors and environmental science and protection technicians. However, they are poorly represented among tree trimmers and foresters.

BIPOC workers are also well-represented in entry-level technician and specialist roles. Approximately the same percentage of environmental compliance inspectors, water resource specialists, and environmental science and protection technicians are BIPOC, as are in the workforce at large. They are over-represented among tree trimmers and pruners and forest and conservation technicians. However, BIPOC workers are under-represented among scientists and foresters.

FORESTRY CAREER PATH

A career path (Figure 16) to the forester and arborist roles can start with groundworkers and tree trimmers, which do not require post-secondary credentials, or forestry technicians, which typically require a two-year degree. Individuals can move up through various interim steps but must pursue additional credentials to become an arborist or a four-year degree to become a forester.

MONITORING CAREER PATH

There are also career paths (Figure 17 and Figure 18) in the monitoring field, starting as environmental and health technician and moving up to environmental health and safety managers. The technicians start with a two-year degree. However, they will have to pursue a four-year degree or more in a related science to advance through their career path.

Environmental Expert & Technician Occupations

	Environmental Compliance Officers	Environmental Scientists and Specialists, Including Health	Tree Trimmers and Pruners	Water Resource Specialists	Forest and Conservation Technicians	Environmental Science and Protection Technicians, Including Health	Hydrologic Technicians
2021 Jobs	6,213	2,523	1,585	1,132	443	334	71
Percent Growth 2021-2032	9%	10%	2%	4%	8%	28%	4%

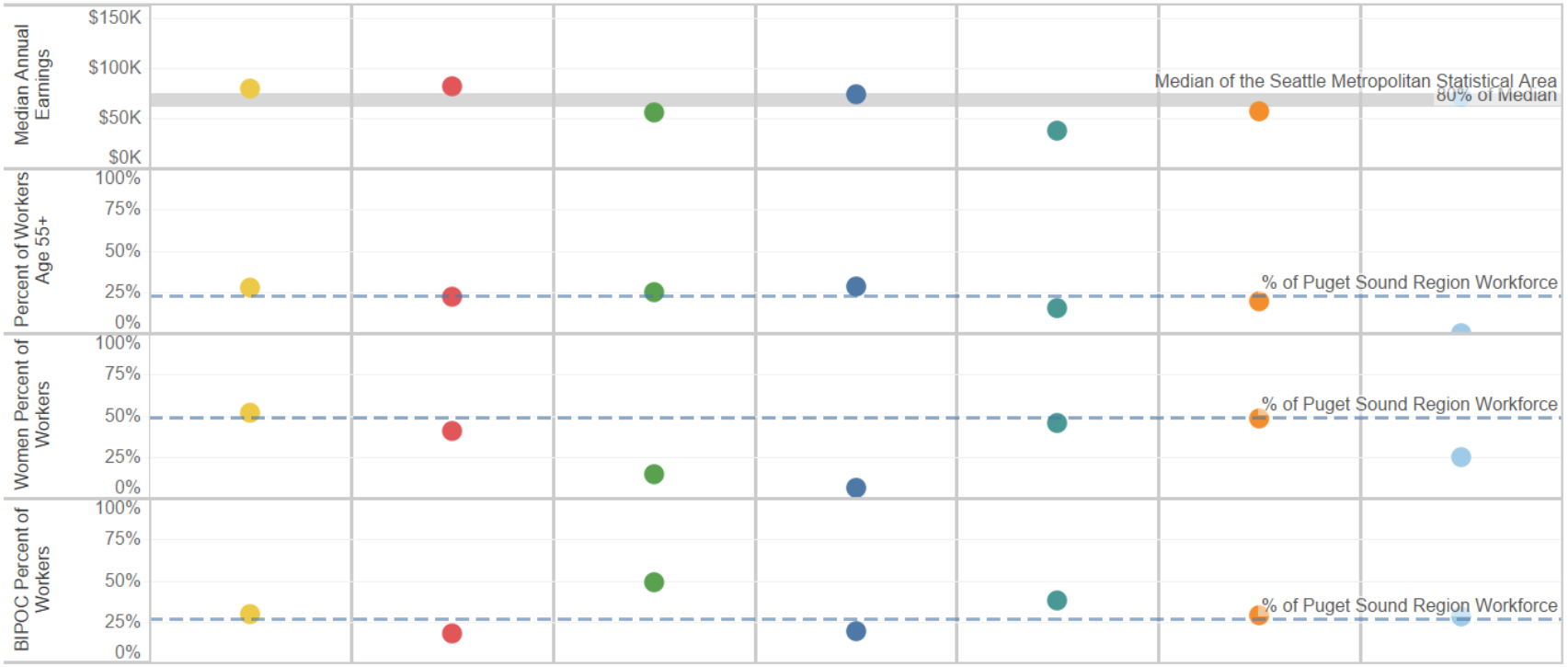

Figure 14. Environmental Experts and Technicians Jobs, Wages, and Demographics[18,21]

Environmental Expert & Technician Occupations

	Conservation Scientists	Soil and Plant Scientists	Geoscientists, Except Hydrologists and Geographers	Foresters	Materials Scientists	Hydrologists
2021 Jobs	751	580	557	242	216	188
Percent Growth 2021-2032	12%	8%	8%	11%	-13%	7%

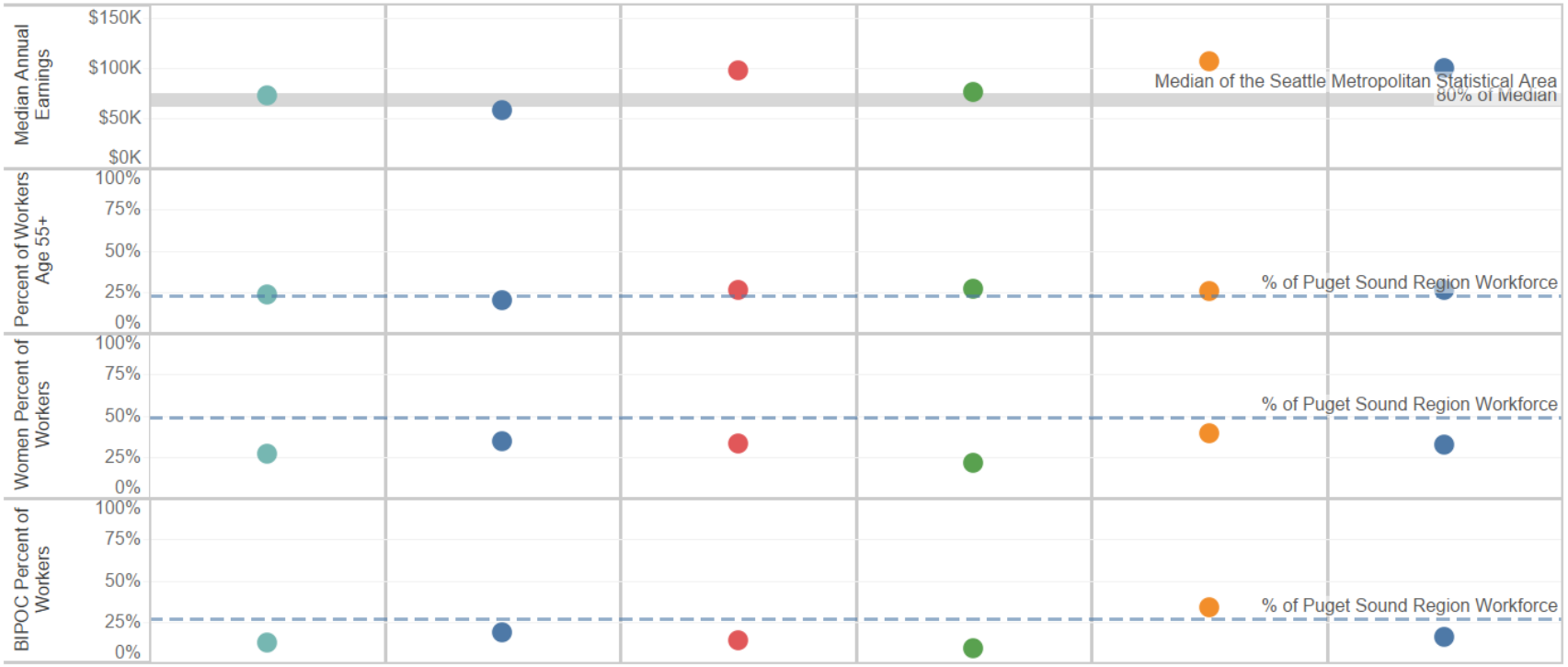

Figure 15. Environmental Experts and Technicians Jobs, Wages, and Demographics - Continued[18,21]

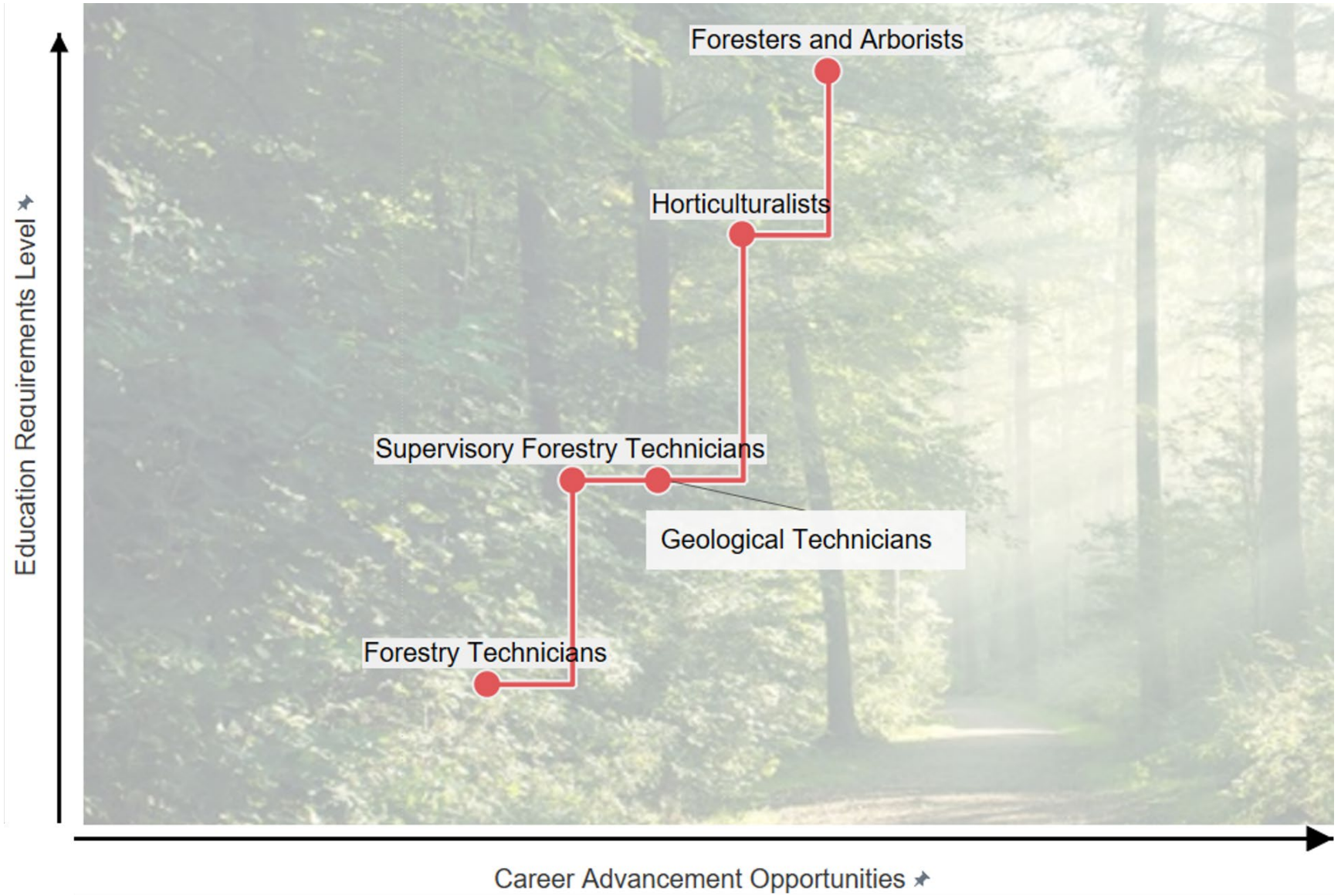

Figure 16. GSI-Related Forestry Career Pathway

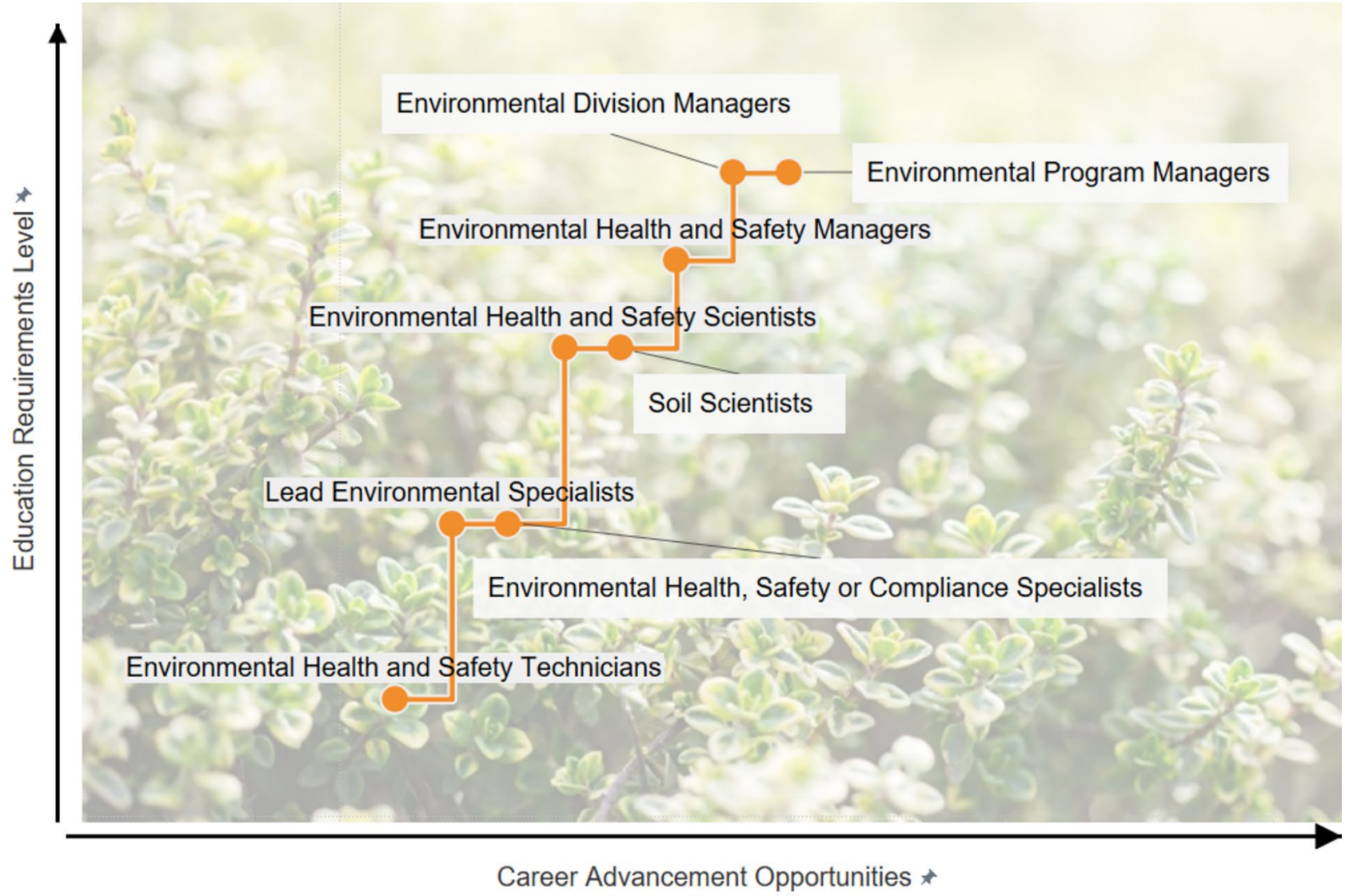
Environmental Division Managers
Environmental Program Managers
Environmental Health and Safety Managers
Environmental Health and Safety Scientists
Soil Scientists
Lead Environmental Specialists
Environmental Health, Safety or Compliance Specialists
Environmental Health and Safety Technicians
Education Requirements Level
Career Advancement Opportunities

Figure 17. GSI-Related Environmental Sciences Career Pathway

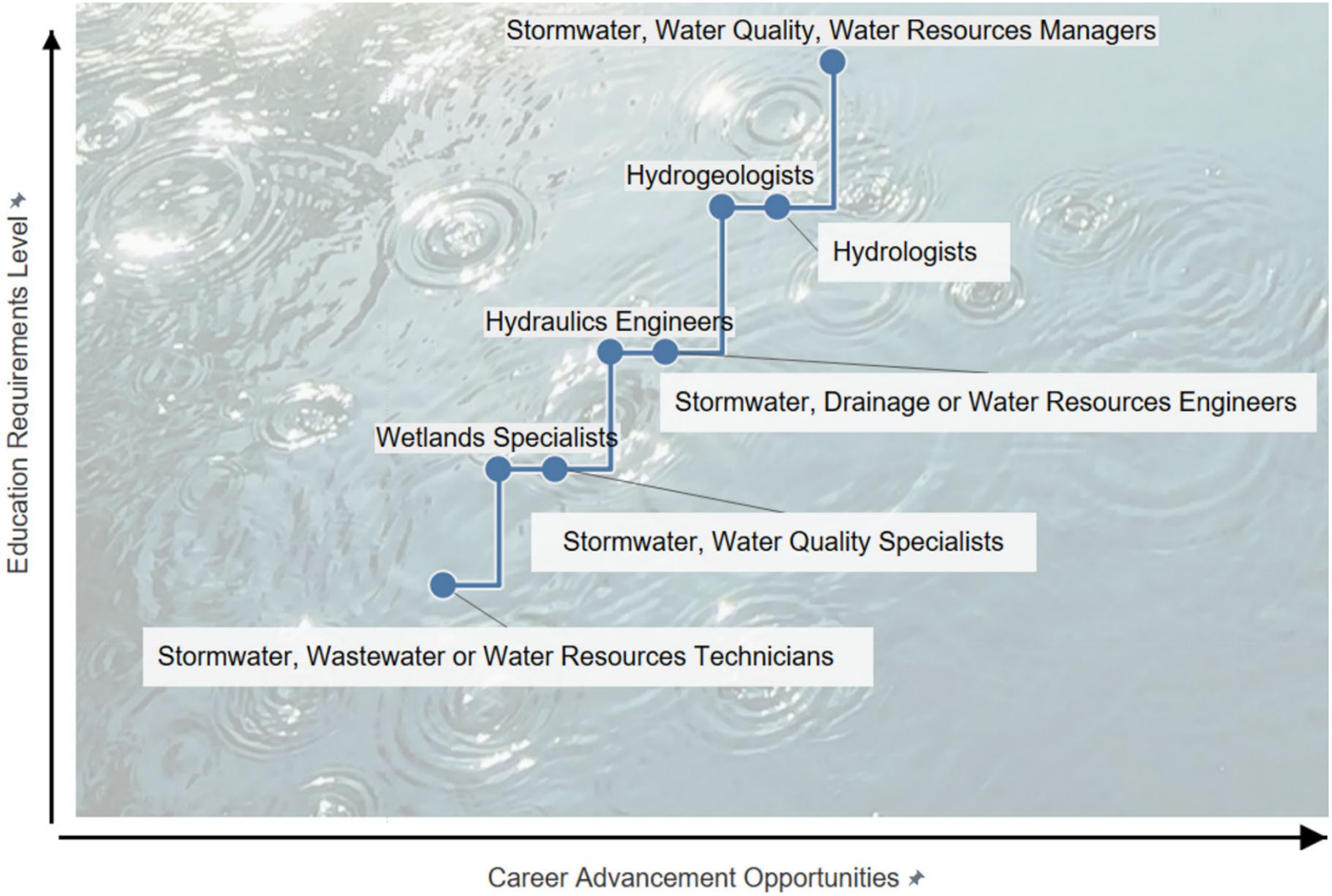

Figure 18. GSI-Related Water Quality-Related Sciences Career Pathway

EQUITY IN GREEN STORMWATER INFRASTRUCTURE

LACK OF OPPORTUNITIES FOR ENTRY-LEVEL WORKERS

Occupations engaged in GSI depend on the project phase. The positions least likely to require an advanced post-secondary degree are primarily found in the Implementation and Maintenance phases. These occupations require either a high school diploma or the equivalent (maintenance workers and tree trimmers), an apprenticeship (pipelayers, plumbers), or an associate degree (environmental and forestry technicians). Trade workers can become independent contractors or advance to union agency roles with enough work experience. The remaining occupations in this field require a bachelor's degree or graduate degree and professional licensure.

GSI-related entry-level occupations are seldom integrated into an established career pathway. Advancing to supervisory or more technical positions often requires workers to return to a post-secondary educational institution and obtain a bachelor's or graduate degree.

Additionally, most of these entry-level occupations do not provide a middle-wage job.[***] These combined factors (relatively low wages and a lack of career advancement opportunities) limit the positive outcomes for entry-level workers in the GSI sectors. This is particularly true for workers from underserved communities as they are more likely to be impacted by flooding and stormwater pollution but unable to benefit from the labor opportunities in the sector.

CAREER-CONNECTED LEARNING

In contrast to the limited opportunities for entry-level workers to enter the GSI field and advance up the career ladder, there are several career-connected learning opportunities in K-12 and higher education. The programs expose students to GSI-related occupations and allow early skill development. These opportunities focus on conservation, environmental science, related occupations, and civil and environmental engineering.

In the K-12 arena, various STEM-focused programs give students exposure to and hands-on experience with conservation science and engineering. For example, the Washington STEM Network has partnerships to connect students to opportunities in their communities. Student success centers around the state offer hands-on learning opportunities with engineering drafting.

In higher education, students pursuing relevant degrees can get hands-on experience either during their schooling or immediately afterwards through various corps programs, including AmeriCorps,

[***] The Brookings Institute define middle-wage jobs as having a median hourly wage of at least 80% of the metropolitan's median hourly wage. For reference, King County's median hourly wage was $40.48 in 2021 (WA ESD, 2022).

Washington Service Corps, and the Student Conservation Association.

While these corps programs offer valuable experience and are often grounded in community, they do not increase the accessibility to these degrees and occupations for marginalized communities in a substantial way. Though some offer an education award and other assistance with student loans and childcare costs, they are volunteer positions with subsistence stipends. The small stipend makes these programs unfeasible for many individuals from low-income households.

GSI-SPECIFIC CREDENTIALS

COMMUNITY-BASED/-FOCUSED TRAINING

In recent years, there have been a handful of initiatives aimed at formalizing the work experience acquired in green stormwater infrastructure to help workers better market their skills on the labor market. Interviewees identified four programs that have some connection to GSI training:

- **Dirt Corps** has an excellent reputation for how well it trains and prepares people to work on residential-scale GSI projects.
- **Seattle Conservation Corps** offers stormwater maintenance training and work experience to Seattle residents experiencing homelessness. However, few participants work in the GSI sector after exiting the program.
- King County's and Seattle Public Utilities **RainWise Contractor Program** is an incubator program training small GSI contractors and helping private owners install rain gardens and cisterns on their property. In 2021, there were 2,189 RainWise projects and 59 active RainWise contractors.
- The Washington State University Stormwater Center offers a certificate program in **Low Impact Development** with technical training on specific types of green stormwater infrastructure (bioretention, green roofs, permeable pavements, etc.).

These community-based and community-focused training programs offer a non-degreed and non-apprenticed pathway into the GSI field. As such, they provide access to individuals who otherwise may not be able to access training. However, the data is not available to characterize if and how individuals who take part in these training programs reliably leverage it into a career with a family-sustaining wage or if that was even their intent in taking part in these training opportunities.

UNIVERSITY-BASED AND PROFESSIONAL TRAINING

Other workforce development projects in GSI focused on helping students and workers acquire knowledge relevant to GSI. For example, multiple universities offer in-person and online credentials on stormwater management, urban forestry, or even rain gardens. National certification programs are also available in several professional sectors supporting the implementation of GSI projects: Green Plumbers, Green Roofs for Healthy Cities, Watershed and Stormwater Training at the Center for Watershed Protection.[23]

CREDENTIALS' LACK OF LABOR MARKET VALUE

However, none of the interviewees identified a GSI-specific credential that had reliable traction in the labor market. This gap may be due to a few different factors. First, many of these occupations require a bachelor's degree or more and a professional license or certification. Interviewees indicated they rely on or hope that the skills and some GSI principles are integrated into the university instruction and continuing education like those listed above. As one interviewee noted, these are not new skills; they are old skills applied differently.

Secondly, the market for a standalone credential that teaches the specifics of design or maintenance is very limited. First, the yearly hiring in the sector is still relatively low. Second, GSI design heavily depends on local climate, geological, and ecological factors. One interviewee indicated that a GSI design and maintenance training that met their needs would be useless to a GSI professional in Arizona.

CONCLUSION AND RECOMMENDATIONS

CONCLUSIONS

Green stormwater infrastructure workforce demands are more varied and complex than conventional gray stormwater because the implementation of GSI is more varied. In addition, the successful adoption of GSI requires that environmental justice is at its core. This offers both an opportunity and an obligation to improve the diversity of the GSI workforce. The current labor force pool is disproportionately male and white and does not represent the Puget Sound Region. In addition, BIPOC workers are concentrated in GSI-related occupations that do not require post-secondary credentials.

The current entry-level positions are in the trades (plumbing, pipelaying), ground maintenance, and technician roles. The trades and ground maintenance roles require apprenticeships or short-term certificates, while the technician roles typically require an associate degree.

Half of these occupations are not middle-wage jobs, and most are not integrated into a clear career pathway. Thus, do not lead to more advanced positions within the GSI sector. The limited wage opportunities and the necessity to obtain a bachelor's degree or more to advance within the field prevent workers from underserved communities from entering the GSI sector.

RECOMMENDATIONS

To address this imbalance, the field must contend with the following:

WAGES

Organizations and policymakers must first address the question of low wages for entry-level positions to make the GSI sector more equitable. It is also essential to support workers moving between GSI and other sectors, improving the sector's visibility on the labor market.

Improving entry-level wages is also the first step in creating sustainable pathways. Family-sustaining wages allow workers to

persist in the field and invest time and effort in training and credentials.

PATHWAYS

The second recommendation is to identify or create opportunities for individuals to leverage experience with GSI in entry-level occupations to more advanced positions. For example, identify and strengthen pathways for a construction laborer or maintenance worker to advance to technicians or design and policy professionals. Alternatively, engineering and landscape architecture offer a rarely used pathway in which one can apply experience working in the field under the supervision licensed professional in place of completing an accredited degree program to meet the requirements of sitting for the licensure exams.[24,25]

LABORER-TO-TECHNICIAN

These laborer/worker-to-technician opportunities will require collaboration with colleges and universities as these positions typically require degrees. It will also likely require employer support and engagement to ensure that GSI maintenance and construction labor jobs are not dead-end jobs but the first step into GSI careers.

Given the structure of these fields, maintenance worker-to-technician pathways would be the easiest to navigate. There are already maintenance training programs through community colleges. Technician pathways could be identified as “next steps,” and employers could support maintenance personnel pursuing those steps.

ALTERNATIVE PATHS TO LICENSURE

Increasing visibility and, importantly, support for the pathways to licensed landscape architects or engineers could also open up these positions to experienced laborers and maintenance workers.

This report could not explore why these pathways are not more widely used. We hypothesize there is a combination of factors starting with the fact that this pathway is not well-known, particularly among those who have or will accumulate the necessary experience. Second, finding a job with a licensed professional willing to document their supervision over six to eight years may be difficult, even more so if this pathway carries a stigma. Getting hired as a licensed professional without a degree may also be challenging, reducing the license’s value. Finally, the expense and challenges of preparing for licensure exams without the support and structure that comes from a degree program are significant.

COMMUNITY ENGAGEMENT

Finally, the importance of community engagement and education was a prominent theme in the interviews with experts in the field. Community engagement and education is a clear example of an instance with the benefits of representation in the workforce has immediate and tangible benefits. Yet, there is often no dedicated role to community outreach and education in GSI projects, and it falls to scientists and engineers.

Dedicated, well-resourced community engagement positions staffed by people from underserved communities would help ensure that communities impacted by the GSI projects are engaged throughout the design, implementation, and maintenance phases. Such positions should be regularly included in project or program

budgets, and the qualifications, recruiting, and hiring for these positions must reflect the local community's priorities and needs. For example, the communities served may prioritize representation, lived experience, language skills, and relationships in the community over academic credentials.

FUTURE RESEARCH

This report raised several questions that call for additional research:

- What are the medium- and long-term outcomes for graduates of programs like Dirt Corps and RainWise? Have these program participants employed the knowledge and skills gained through those programs? Have these skills and knowledge or their association with the program assisted them on the job market or in marketing their business?
- Are there roles that can or may move away from credential-based hiring? How does the field ensure that a move away from requiring academic credentials helps to diversify the workforce rather than reinforce barriers to entry?
- What is employers' role in supporting workers moving along their chosen career path?
- How can apprenticeships more effectively diversify the field?
- Why are alternative pathways to licensure in landscape architecture and engineering not more widely used? What can be done to expand their use?

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APPENDIX A

MAP OF THE SALISH SEA AND PUGET SOUND WATERSHED

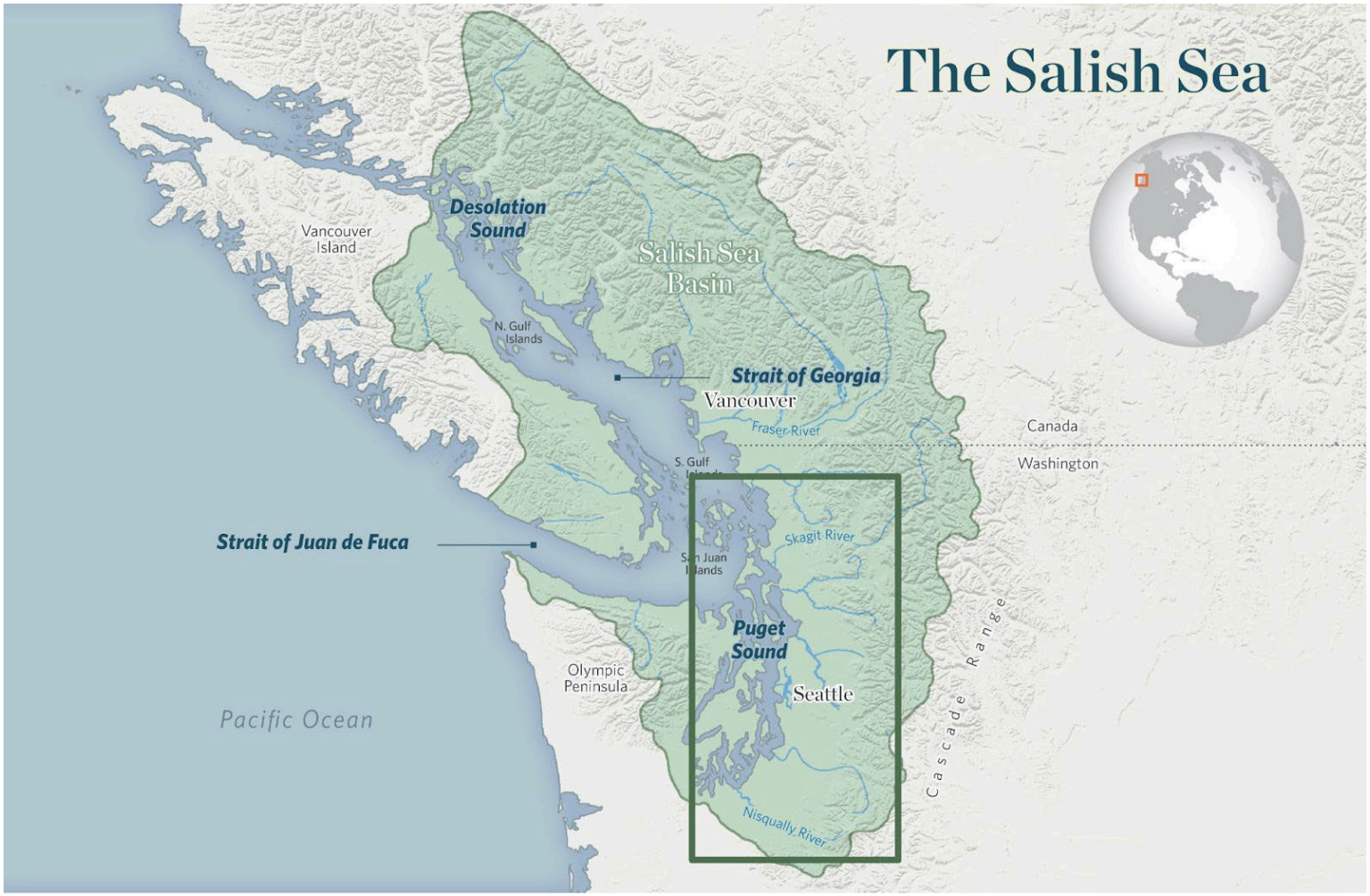

Figure 19. Map of the Salish Sea, credit © Erica Simek Sloniker / TNC

Seattle Jobs Initiative

APPENDIX B

GREEN STORMWATER INFRASTRUCTURE WORKFORCE COLLABORATIVE

Participants in 2022

WORKING GROUP

Hannah Kett, The Nature Conservancy

Aaron Clark, Stewardship Partners

Bob Spencer, Seattle Public Utilities, City of Seattle

Jo Sullivan, Dept of Natural Resources, King County

Lisa Ciecko, Seattle Parks and Recreation

COLLABORATIVE PARTICIPANTS

CONSERVATION DISTRICTS

Melissa Buckingham, Pierce Conservation District

Derek Hann, Snohomish Conservation District

UTILITY AGENCIES

Mike Carey, Environmental Services, City of Tacoma

Lisa Ciecko, Green Seattle Partnership

Cindy Haverkamp, Tacoma-Pierce County Health Dep

Bob Spencer, Seattle Public Utilities, City of Seattle

Jo Sullivan, Dept of Natural Resources, King County

ACADEMIA

Martha Groom, University of Washington

Derek Faust, Clover Park Technical College

Ani Jayakaran, WSU Extension

NONPROFIT

Aaron Clark, Stewardship Partners

Ashley Mocorro Powell

Heather Spalding, Pacific Education Institute

BUSINESS

Roseann Barnhill, Dirt Corps

Debra Guenther, Mithun

Jake Harris, Stone Soup Gardens

Jim Keller, SiteWorkshop

Andrew Schiffer, Dirt Corps

Cari Simson, Urban Systems Design

APPENDIX C

PUGET SOUND REGION WORKFORCE DEMOGRAPHICS

Table 11. Puget Sound Region Workforce Demographics by County[18]

	Workers	Average Annual Wage	BIPOC Workers	Percent BIPOC Workers	Women Workers	Percent Women Workers	Workers 55+	Percent Workers 55+
Clallam County	22,000	$47,836	3260	15%	11,589	53%	6215	28%
Grays Harbor County	21,939	$48,976	3050	14%	10,943	50%	5,857	27%
Island County	15,278	$49,530	2,382	16%	8,298	54%	4,104	27%
Jefferson County	7,399	$48,696	755	10%	3,813	52%	2,248	30%
King County	1,395,940	$115,436	423,750	30%	652,096	47%	288,975	21%
Kitsap County	68,145	$62,059	13,332	20%	36,093	53%	17,095	25%
Mason County	13,203	$48,957	2,061	16%	6,841	52%	3,440	26%
Pierce County	307,852	$61,050	74,268	24%	158,495	51%	73,132	24%
San Juan Island County	5,955	$46,428	561	9%	3,085	52%	1,617	27%
Skagit County	48,309	$57,326	6,348	13%	23,908	49%	12,414	26%
Snohomish County	277,191	$69,125	60,976	22%	130,385	47%	69,343	25%
Thurston County	116,463	$62,155	20,888	18%	62,149	53%	28,676	25%
Puget Sound Region	2,249,780	$96,676	611,631	27%	1,107,695	49%	513,116	23%

CONTACT

AUTHORS

Elodie Marlet, PhD
Senior Research Analyst
Seattle Jobs Initiative
emarlet@seattlejobsinit.com

Kathleen Carson, PhD
Managing Researcher
Seattle Jobs Initiative
kcarson@seattlejobsinit.com

PROJECT MANAGER

Hannah Kett
Urban Program Director
The Nature Conservancy
Washington Field Office
hannah.kett@tnc.org