

Safe Clean Water Schools Education Program

Benchmarking Study

6/2/23

I. Introduction

This benchmarking document summarizes best practices in stormwater and watershed education to support the development of the Los Angeles Flood Control District Safe, Clean Water Program's (SCWP) Schools education and curriculum Program (School Program). The School Program, along with public education and engagement and local workforce training, is a requirement of *LAFCO Code Section 18.05.C*. The best practices and lessons learned are from a review of 31 existing stormwater and watershed education programs (13 in the Los Angeles region and 18 from other communities), 12 program documents, and expert interviews with 25 individuals working in this field. The research, further detailed in Appendix A, focused on educational and curriculum programs and programs that use green stormwater infrastructure (GSI) and other schoolyard greening as a form of multi-benefit education in watershed stewardship. Key takeaways include:

1. A great deal of high-quality stormwater and watershed education is already occurring in Los Angeles, and numerous opportunities exist for the SCWP to harness its investments to expand and broaden this existing work.
2. The SCWP can scale up its impact by creating an age-appropriate stormwater and watershed stewardship educational arc that follows students through their formal K-12 education and beyond by:
 - a. fostering an early emotional connection to the environment through nature play and exploration.
 - b. supporting citizen science and service learning beginning in grade school years.
 - c. continuing learning and stewardship through job training and apprenticeship opportunities for teens and young adults.
3. Stormwater schoolyards and school campuses that demonstrate best practices in water management can provide a tangible opportunity to reflect the community's commitment to fostering environmental stewardship and ecological literacy.
4. Stormwater schoolyards can be coupled with other greening efforts to use the space for outdoor learning, nature play, and community parks.
5. School districts, utilities, and stormwater management agencies can pool resources to address multiple community goals. Many major cities have adopted this approach. While it is challenging to collaborate, there are numerous examples to learn from and many potential benefits.

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6. There are numerous examples of communities that integrate their K-12 stormwater and watershed education with their capital investments, workforce development, and public education through the implementation and management of stormwater schoolyards. These can be effective models and resources for program development.

There were a few types of educational approaches not encountered in Los Angeles stormwater and watershed stewardship education that are used elsewhere. They include the following and are further described with examples in the next section.

- **Family education.** Proponents of family education argue that engaging whole families is a powerful way to reach students. Approaches include weekend guided walks, family days at museums or nature centers or family workdays at a garden or school.
- **Design based education** is rooted in the idea that engaging students in hands on design methods and spatial problem solving about real community issues.
- **Fellowships, internships, and apprenticeships** are periods of work experience offered by an employer to give students and graduates exposure to the working environment, often within a specific industry, which relates to their field of study.
- **Citizen juries** are assemblies of randomly selected citizens who learn about and deliberate about important public questions. It is a form of participatory action research that recruits a cross-section of the public to study selected issues.
- **Worldviews education.** Understanding worldviews is crucial for creating transformative education programs about water stewardship. A person’s worldviews shape how they understand and interact with the world, which includes our perceptions of water and its uses.

The best practices and findings for both curriculum-based and stormwater schoolyard programs were cataloged and assessed using a rubric inspired by the SCWP community engagement rubric. The tables below list those that exemplified practices identified as “good, better, best, and transformative.”

Stormwater& Watershed Education Practices Examples	
Good (Inform)	Worksheets, websites, presentations, videos, and in-class lesson plans Annual fieldtrips to museums or aquariums Career presentations
Better (Involve)	Fields trips with place-based exploration and learning Creek and beach clean ups Storm drain stenciling
Best (Empower)	One-time service-learning projects or action projects located in the school or neighborhood, i.e. beach clean ups, restoration projects School composting and water-conserving landscapes Some classes or students engage with green/stormwater schoolyard or garden with teachers, NGOs, and afterschool program activating the space Volunteers and/or students paid to maintain green/stormwater schoolyard space

<p>Transformative (Connect, Restore and Train)</p>	<p>The whole school uses the schoolyard and school systems as daily contact with nature and for teaching</p> <p>Classes are involved in activities that connect the school to the larger watershed and ecosystem (e.g., hatching butterflies, habitat gardening, composting, native seed propagation, etc.)</p> <p>School community has ongoing involvement with watershed restoration or stormwater management projects in neighborhood and/or nearby nature, such as data collection on the performance of GSI, water sampling, aquatic health monitoring or other watershed health metrics to support countywide performance tracking</p> <p>Student science activities include connections with academic institutions and SCWP scientific studies</p> <p>Students participate in schoolyard planning and design, construction, and maintenance, gaining job skills and mastery (i.e., SCWP work force development program)</p> <p>Students teach other students; students learn participatory planning and design and learn how to engage the larger community in SCWP project development (i.e., SCWP public education program)</p> <p>Whole families are involved in school and watershed stewardship activities (i.e., SCWP public education program)</p> <p>Students learn and perform maintenance, planting, and engineering activities as a school class. (i.e., SCWP workforce development program)</p> <p>Class connects to apprenticeships, internships, and job corps (i.e., SCWP workforce development program)</p> <p>Annual SCWP fellowships engage young adults in rotations within all the collaborating agencies to collaborate on research topics, learn from practitioners and contribute to system change needs. (i.e., SCWP workforce development program)</p>
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Figure 1. Examples of Watershed and Stormwater Education within the Good to Transformative scale

B. School Buildings & Schoolyards Examples

School Buildings & Schoolyards Examples	
Good (Inform)	Educational signs and murals about watersheds, water pollution and conservation
Better (Involve)	School gardens with food or native plants Trees or other passive green spaces designed by others on the schoolyard
Best (Empower)	Green buildings and landscapes that manage on-site runoff with GSI, collect stormwater in rain barrels and involve educators and students in implementation and management GSI components that involve educators and students in implementation and management
Transformative (Train, Restore)	School and schoolyard demonstrate best practices in stormwater management and water reuse, and are both local to the school and part of regional stormwater management systems Playable and explorable GSI is paired with shade native plantings and water reuse The schoolyard is open to the public as a park after school hours School is catalyst for change in neighborhood greening, traffic calming and cooling of streets and parks Schoolyard transformation is conceptualized, led, and managed with active engagement with school, educators, and students

Figure 2. Examples of School Building and Schoolyards within the Good to Transformative scale

These best practices are described in greater detail in the following sections, be used to reconnect citizens to their watersheds and educate the next generation of leaders and watershed stewards. The document ends with a sample narrative that illustrates the best practices using an educational arc for stormwater and watershed education that follows a student through their K-12 experience and beyond.

I. Stormwater & Watershed Education and Curriculum

The review of leading stormwater education programs, staff interviews and subject matter experts found several approaches to environmental (and stormwater) education. They included environmental outreach programs, formal in-class lessons, place-based learning, service learning, outdoor education, experiential learning, and citizen science. This section describes the different approaches and follows lessons learned in the design and deployment of these programs. The terms defined in the box below are used throughout the document to describe the program activities researched for this task.

Stormwater and Environmental Education Approaches

- Environmental outreach programs are typically delivered outside formal educational settings and are designed to reach wider audiences, including the public, communities, and organizations. They can take the form of workshops, community events, and community-based activities to inform the community to act on an environmental topic.
- Classroom education is typically delivered as part of a formal educational curriculum in a school setting. Teachers present information on environmental issues using various teaching methods, including lectures, discussion, and hands-on activities. The goal is to provide students with a comprehensive understanding of the environment and the challenges they inherit in a time of ecological uncertainty.
- Place-based learning takes place in a specific location and focuses on that area's environmental and cultural features. It often involves hands-on activities, field trips, and community engagement to help students understand the interconnectedness of human activities and their impacts on the environment.
- Service learning is a type of education that combines academic learning with community service. Students participate in action projects that benefit the environment and the local community, such as cleaning up a park, planting trees, or creating educational materials for their schools.
- Outdoor education takes place outdoors and typically involves activities like camping, hiking, and boating, as well as educational activities that help students understand the natural world and the importance and methods for its conservation. Research indicates that time spent in nature provides physical and psychological benefits.
- Experiential learning uses hands-on experiences and personal discovery. Students are given the opportunity to participate in activities like bird watching, wildlife observation, and field study to gain a deeper understanding of the environment.
- Citizen science involves the public or students in scientific research projects. Students can participate in projects such as monitoring water quality, counting birds or insect populations, or studying plant species, and can help gather data for environmental management and conservation efforts.

A. Education & Curriculum Program Models Overview

This section describes the various approaches to implementing stormwater education and program designs observed in this review of leading programs. Several programs use more than one of the educational approaches listed in the section above.

Agency Led Environmental Outreach Programs.

- For many municipal stormwater programs, stormwater education and outreach are required as part of their Phase II Municipal Separate Stormwater Systems (MS4s) permit requirements. These communities are required to educate the local community about the polluting impact of common activities and increase awareness of the direct relationship between land activities, rainfall-runoff, storm drains, and their local water resources. The education programs must include clear guidance on steps and specific actions to reduce stormwater pollution. Typical programs often target the public and K-12 education alike. Frequently used tactics range from storm drain stenciling, creek clean-ups, handouts, and worksheets to lessons on the hydrologic cycle or watersheds. A K-12 student may encounter this information via tabling at community events, a website, or a partnership with their schools or extracurricular activities. These activities reach children and youth across a variety of community settings, and all count toward the public engagement and education requirements of the NPDES permit.
- Regulated communities go about public engagement and education in numerous ways. They can create and deliver their own materials, collaborate with regional or national efforts, or purchase subscriptions with (inter)national programs like Project WET that provide low-cost digital tools, publications, and educational activities geared toward different age groups. These programs and materials can be used by an individual teacher for in-class lessons, experiential learning, or field trips, and are also appropriate for use by after-school programs and community groups to build awareness of how human activities impact watersheds and water quality. Examples include:
- The County of Orange H2OC Stormwater Education program provides a comprehensive website serving 34 cities. They provide stormwater education and lend out watershed models for community events or schools. They host an annual Water Education Festival for 3rd and 4th graders and partner periodically with educational institutions like the Ocean Institute or Pacific Marine Mammal Center. They also provide educational worksheets, websites, videos, and lessons for teachers to use in their classrooms. Such programs and educational methods have the potential to extend their effectiveness and scope by pooling knowledge, experience, and budgetary resources toward the development of fewer, better funded, and thoughtfully developed programs that effectively engage larger numbers of students and require less effort to develop and update.'
- The Los Angeles County Public Work's Earth Defenders program, implemented by TreePeople, is another program that reaches large audiences of K-5 students. They send groups of performers to schools and provide interactive demonstrations with music and dance performances about water quality and other environmental topics. This model offers periodic experiences that a school might offer annually or that students might encounter at a special event. The program also provides leave-behind activities or lesson plans for teachers to implement.

Informal Educational Approaches

- Museums, aquariums, zoos, arboretums, and State or National parks offer K-12 educational programming on stormwater and watersheds. These informal education institutions can partner with municipalities or utilities to provide support and engagement as part of their compliance

efforts or deploy them independently as part of the educational mission of the organization. targeting specific age groups, as well as professional development, educational materials for teachers, and interactive displays for visitors.

- The Heal the Bay Aquarium, affiliated with the non-governmental organization (NGO), Heal the Bay, offers numerous options for learning about watersheds, water quality, and the health and care of the ocean.

Non-Governmental Organization (NGOs) Led Programs

Several NGOs reviewed offer service learning, experiential programs, and or citizen science activities that both educate students on the same issues offered in other models, but layer in activities where students take direct action on the issues at hand. Counties, municipalities, and utilities can collaborate with these NGOs to deploy the programs, or it can be the mission of the NGO. Examples include:

- TreePeople's Generation Earth provides Los Angeles County environmental education for 6th-12th grade students and educators to learn about waste, water and forestry topics via environmental service-learning projects that benefit communities. They provide free environmental project support and bring topics directly to classrooms and guide environmental action projects on recycling, composting, waste in the fashion industry, native plants, and water pollution and prevention. Projects can vary in duration and scale and can include field trips. They also host free teacher workshops, resources, project models and personalized support. In 2021 Generation Earth guided over 240 environmental action projects in classrooms, schools, and communities across Los Angeles County, working with over 400 teachers and 15,000 students. impacting over 225,000 students.
- Heal the Bay offers hands-on service learning through beach cleanup projects and programs in the greater Los Angeles area. High school and middle school clubs team with Heal the Bay to earn service hours and special perks in a minimum of three Heal the Bay volunteer events per school year.
- The Watershed Project supports teachers and students in the San Francisco Bay Area, in rebuilding these relationships with local watersheds through experiential and academic programs outdoors, aligned with Next Generation Science Standards and the Common Core State Standards. They incorporate environmental science education, equity and inclusion, and social-emotional learning, through their community-based restoration sites that allow students to experience local watershed restoration firsthand. They use hands-on, place-based stewardship education both in the classroom and outdoors. Students gain the knowledge, tools, and local connections they need to advocate for equitable access to the benefits of a healthy environment.

Potential Gaps

There were a few types of educational approaches not encountered in Los Angeles stormwater and watershed stewardship education that are used elsewhere. They include the following and are further described below.

- **Family Education.** Proponents of family education argue that engaging whole families is a powerful way to reach students. Approaches include weekend guided walks, family days at museums or nature centers or family workdays at a garden or school. Through this approach, multiple generations are reached, and learning can be integrated and acted on in the home, community, or school settings. It also has the benefit of reaching and engaging families who may not feel comfortable in typical school settings. The Learning in Places program is a National Science Foundation funded program in Washington that seeks to cultivate equitable, culturally thriving,

socio-ecological systems learning and ethical decision-making. They use field-based science education in outdoor places, including gardens, for children and their families. Their three-part program centers on racial equity, ethical, evidence-based decision-making, and just relations with the natural world. They provide teaching materials that extend beyond classroom learning to include outdoor learning, and whole family engagement which could support SCWP's K-12 education and public education efforts. Their materials explore:

- Socio-Ecological Systems that focus on sense making and reasoning, the history of places, and ethical decision making.
- Culture, Families and Communities modules that include culture, learning and identities, families and communities, and places, land, and water.
- Feld Based Science learning includes observations, wanderings and questions, data collection modeling and analysis and explanations, discourse, and deliberations.
- **Design Based Education** is rooted in the idea that engaging students in hands on design methods and spatial problem solving about real community issues. This approach encourages creativity and higher-level thinking that supports self-expression and decision-making that transfers big ideas across the curriculum into multiple settings. The Trust for Public Land's participatory design process for the William Dick Elementary Schoolyard included 6-8th grade students in a ten-week design process that produced a final design schematic that was created based on the students' input and vision. It includes the largest rain garden in any Philadelphia school that will help manage stormwater runoff. At UCLA, the Design-Based Learning Project engages students in seeking and solving curriculum-based problems as they build a city, colony, civilization, or other small, models in the classroom. While not applied to stormwater management and watershed stewardship, it is structured around essential questions that encompass all subject areas and could be applied to the development of stormwater management projects. This could also easily dovetail K-12 education with SCWP goals around community engagement, public education, and workforce development.
- **Fellowships, Internships, and Apprenticeships** are periods of work experience offered by an employer to give students and graduates exposure to the working environment, often within a specific industry, which relates to their field of study. The Coro Fellowship and AmeriCorps Service years are models where leadership training and service are paired with real world experiences and problem solving. The Coro fellows are groups of diverse participants that are paired with organizations in the private, public, and non-profit sectors to explore real world problems finding resources and coming up with innovative solutions to the problems faced by their communities. They build skills necessary for successful careers in the public, private, and non-profit sectors. The Coro Fellows Program includes field placements, seminars, interviews, focus weeks, and community-based impact projects. Union apprenticeship programs are four-to-five-year paid programs that allow a trainee to work full time as an apprentice and take classes. Local unions host apprenticeships which graduate, and graduate as a journey member of the union. These educational models could also apply to workforce development goals.
- **Citizen Juries** are assemblies of randomly selected citizens who learn about and deliberate about important public questions. It is a form of participatory action research that recruits a cross-section of the public to study selected issues. Information is presented to provide a common set of facts; available options are considered, and recommendations are forwarded to the appropriate authority. Juries aim to increase public trust and connection between government and the people it serves. They provide citizens the opportunity to learn about an issue, deliberate together with a diverse group of their peers, and develop well-informed solutions to challenging public issues. The Center for New Democratic Processes supports juries in four key focus areas, Campaigns,

Governance & Media, Patient Engagement & Patient Policy, or Climate & Community Resilience. This educational model could apply to K-12 education and/or pair with workforce development and goals for public education and engagement.

- **Worldviews Education.** Understanding worldviews is crucial for creating transformative education programs about water stewardship. A person's worldviews shape how they understand and interact with the world, which includes our perceptions of water and its uses. Evergreen, Canada's national city and schools greening program, includes ethnobotany lesson modules that help student understand the First Nation's use of plants and cultural stewardship practices. Learning In Places includes exploration of the community's social and ecological relationships in a place. Other potential topics could explore how traditional cultures survive in arid climates around the world. These explorations help students think critically about their own viewpoints they bring to water stewardship and expand their understanding of what is possible for the future.

B. Lessons Learned: Education & Curriculum Program Design

All program staff interviewed made comments about how overburdened most teachers are and the importance of ensuring that an education program is intentionally designed for teachers to implement easily within their core curriculum. There are varying levels of focus and approaches to the development of curriculum in the environmental education programs reviewed. Some groups like TreePeople offer lesson plans, but not curriculum. Others, like Philadelphia's Green Futures and the SFPUC's Urban Watershed Management Program, focus on district-level curricula. Evergreen, Canada's national schoolyard greening program, focuses on teacher training. It does not provide formal stormwater or climate adaptation curriculum but instead offers lesson plans on these topics through professional development training. A few key learnings from the interviews and literature review are captured below.

1. **Align environmental education and curriculum with state standards.** Most programs used materials aligned with State educational standards such as California Common Core, Next Generation Science Standards, and the California Environmental Principles. This ensures teachers can demonstrate that their efforts meet the requirements while participating in a program.
2. **Work with professional curriculum writers.** Several interviewees mentioned that expecting teachers to create new lesson plans or develop curricula on the watershed is unrealistic. Professional curriculum development specialists can ensure that a stormwater and watershed curriculum align with relevant standards and will be knowledgeable of the most recent developments in education. The San Francisco Public Utilities Commission (SFPUC) contracted with the Center for EcoLiteracy to write a standard-aligned curriculum, and the San Mateo County stormwater program is working with the school district to create a stormwater curriculum to broaden K-12 environmental literacy and integrate it into schools throughout the district at a variety of grade levels.
3. **Train the teachers and pay them to participate.** Several programs provide professional development for teachers stating that many teachers are not experienced or confident in teaching outdoors and/or lack environmental education training. Heal the Bay, San Mateo County Stormwater program, and the Watershed Project offer paid training opportunities for teachers. San Mateo County is collaborating with the Office of Education's Environmental Literacy Program to fund and co-lead a paid teacher fellowship for K-12 teachers focused on

sustainable watersheds. They have funded 20 teachers from a variety of schools around the county and generated standards-aligned unit plans focused on water scarcity, wastewater management, watershed systems, climate change, drought, and stormwater engineering and community-based solutions.

4. **Provide free materials, field trips, and transportation.** Many teachers must pay for the necessities of their jobs out of pocket. Wherever possible, provide free curriculum and lesson materials and pay teachers to participate in teacher training. Most programs offer their materials for free to encourage their use. Securing and paying for buses for field trips were also noted as major barriers for many schools. TreePeople provides free transportation for environment-related field trips. Generation Earth mentioned that it is important to remember that you don't need to travel far for environmental education and that service learning can happen in school or in a local community park.
5. **Provide environmental education that follows a student through the arc of their educational life.** Several interviewees spoke of the importance of different lesson plans for different ages. Emily Harris of BSCS Science Learning spoke to the importance of age-appropriate environmental education that tracks the educational arc of a student. Best practices for the early elementary years focus on nature play and building an emotional connection to place. Later, introduce more place-based experiential learning that includes building some expertise and service learning that empowers a student to act as a community member. It is important that the content knowledge can be applied across settings and shared with others. The outcomes a program should be seeking include a sense of agency, and that students perceive themselves as contributors to change in the world and as participants in

making decisions. Later years can include job training and internships. Generation Earth find that in middle school, offering hands-on programs helps to build ownership. Evergreen approaches learning about water at different grade levels. They do not talk to K-6 graders about stormwater management formally, but rather provide lesson plans and teacher training that facilitates hands-on activities, such as experiments with filtration or exploring the water cycle in the schoolyard. They also emphasize translating environmental topics onto the school grounds. They include teaching infrastructure that supports data collection and interpretation in the classroom. Weather stations help students see patterns and changes in weather and can be integrated into an age-appropriate curriculum.

6. **Transform schoolyards for the most impactful environmental education.** Educator Patricia Buck argues that schoolyard transformation meets the essential ingredients of quality environmental education, implementing curricular best practices while transforming the permanent watershed function of the school, its neighborhood, and the land that the students call home. It provides long-lasting improvements in water quality and cooling. Schoolyard nature play and learning labs are a microcosm of nature at-large and can be used by families and community as a neighborhood park. Most students may only encounter natural areas or the outdoors on a few annual field trips and this offers daily access to nature and highly tangible local action on global environmental issues.
7. **Partner with non-profits to implement education programs.** Rather than relying on overburdened teachers to deliver an education program, there are several examples of stormwater agencies paying non-profits to implement an education and curriculum program on their

behalf. Environmental Educator, Patricia Buck, suggests that trained educators are needed to support and train teachers to lead sessions in appropriate care and behaviors in nature, to maintain the environment, to engage students' sense of wonder and curiosity, and to inspire caretaking skills. The SFPUC contracts with the Watershed Project (TWP) to implement the Cistern Maintenance Training Program. The SFPUC asserts the importance of finding the right NGO to deliver its environmental education program because it is a very specific skill set that the SFPUC does not possess. TWP was a crucial partner in the visioning of how to best develop and deploy the curriculum and roll it out. Kat Sawyer brought institutional knowledge and has worked with the school for ten years. The Portland Clean Rivers program guides teachers to connect ecology, health, clean water, and stormwater in the curriculum. They bring their STEM materials on stormwater to the classroom and frame major concepts through lessons and investigations, day trips, and overnight program field trips, as well as restoration learning projects in the classroom. TreePeople delivers the Generation Earth programs for Los Angeles County which facilitates students and teachers in developing service-learning activities in their schools and neighborhoods.

8. **When possible, provide in-person and hands-on learning, but virtual education works if needed.** The most effective programs combined experiential, inquiry-based, and project-based modalities, and feature a place-based interdisciplinary environmental education that facilitates creative inquiry, critical thinking, problem-solving, decision-making skills, and the experiences and the integration of outdoor experiences. This holistic approach contributes to the development of an ecological identity, i.e., how students

perceive themselves in reference to nature. Portland's Clean Rivers Education program includes student-led investigation, through which students learn about the watershed systems. The students carry out investigations, make arguments from evidence, and communicate their solutions. This organization's outdoor programs often focus on stewardship and nature connection and are held in local parks and natural areas. Their summer activities for kids and families include field trips, summer camps, and guided walks. Several of the program staff reported that they had to quickly pivot to offer their programs virtually during the COVID-19 pandemic. While many said virtual meetings were less effective, they learned how to conduct virtual educational programming and reach people. Heal the Bay, Environmental Defenders, and TreePeople all offered virtual programming during the pandemic.

9. **Citizen science and service learning are more impactful for students.** Wherever possible, it is more effective to engage students in tangible community actions to improve their environment. King County's Salmon in the Schools provides support for participating schools rearing salmon in their schools. Coordinators support students in rearing salmon eggs and rear and release salmon into local creeks. TreePeople's Generation Earth students take actions to improve the environment in their communities.
10. **Train youth with real job skills and when possible, employ youth.** Several programs like Northeast Trees link environmental stewardship and learning with youth employment. They train, educate, and employ local young adults in entry-level construction and urban forestry careers. Their crew members build their environmental leadership and stewardship skills as they transform their own neighborhoods with tree planting, habitat restoration, and community engagement. The Portland BES Clean Rivers Education program also

provides stewardship, nature education, and jobs in their natural areas.

11. **Train teachers on how to use the outdoors for teaching.** While they provide lesson plans, Evergreen prioritizes in-person teacher training and support to address significant barriers to using outdoor and hands-on learning. They train and motivate teachers to use the schoolyard for teaching using multifaceted methods. They help teachers get out, use the campus space, and build outdoor routines that fit into the classroom day as an alternative to occasional full-day field trips. They emphasize that teachers often have lesson plans that sit on shelves, so it is critical to support them in getting outside and using them for teaching. Evergreen's training help teachers realize how powerful, fun, and exciting outdoor learning can be. Educators like Patricia Buck remind us to seek the physical and mental health benefits of being outside. There are worldwide examples of the educational and mental health benefits of immersive outdoor experiences: Forest bathing in Japan, forest schools in Finland and Sweden where half the school day is spent outside in nature, and in more urban settings, parks, and community gardens. All show improved mental health and can be used as models and inspiration for learning approaches.
12. **Hire watershed educators and garden teachers** to support teachers in outdoor learning. While this is resource intensive, the most successful schoolyard greening and watershed stewardship programs don't rely solely on teachers. An on-site garden educator can facilitate connections to the schoolyard, watershed learning, and support classroom teachers. The SFUSD's program partnered with AmeriCorps and funded garden coordinators. The SCWP Watershed Coordinator Schools and Stormwater Working Group recommends that educators could teach about native

plant gardening, urban agriculture, watershed functions, and sustainable on-site stormwater management and reuse. They point to Rutgers's "Stormwater Management in Your Schoolyard" program as an example.

13. **Train youth to maintain green infrastructure and school yards.** Other programs that don't pay students to participate offer skill-building and training that can translate to jobs. The SFPUC's Youth Watershed Stewards is a cistern and GSI maintenance program that teams with a San Francisco Unified School District's (SFUSD) high school's construction program to teach students how to maintain the school district's rainwater harvesting cisterns. In this program, students receive in-classroom education on watershed stewardship curriculum and hands-on career training. The students teach the younger students about the system and implement a service-learning planting in the schoolyard. This approach teaches job skills while addressing the schools' need for cistern maintenance. San Mateo County hosts educational workshops for installing rain barrels and rain gardens at schools. Environmental educators, Patricia Buck and Emily Harris both speak to the benefits of mastery and self-actualization of a child (reaching the full potential of who they are) that comes from purposeful work; work that follows the child's interests and development. It gives them self-confidence and a sense of belonging and ownership. Schoolyards that engage students in this way can inspire them to become responsible citizens and stewards of the land.

C. Lessons Learned: Schoolyard Education & Curriculum Program Connections

The way we build, design, and manage our built environment largely determines the health of our watersheds. Designing the community's schools and landscapes to value water as a resource and connecting each school to its larger watershed and community has not only a material impact on water resources and community spaces; but, perhaps more importantly, communicates the communities' values and aspirations to the next generation. As school districts are some of the largest land managers in cities across the United States, they are often seen by stormwater management agencies as opportunities to provide on-site or regional stormwater management while providing tangible lessons in water quality, stewardship, and environmental education. There are numerous definitions and descriptions of these multi-benefit schoolyards that manage, treat, and/or collect stormwater, but the SFPUC defines stormwater schoolyards as "Schoolyards that prioritize multi-purpose infrastructure that delivers stormwater performance while enhancing children's learning and play opportunities." These greened schoolyards, when designed and programmed to operate as living infrastructure *become* the daily curriculum needed for transformative education. The following lessons illustrate best practices for connecting these spaces to education for maximum impact.

1. **Connect the school's design with outdoor learning and stewardship.**

Design school sites to connect with or augment their local parks and open space networks, clean and treat stormwater and provide outdoor learning and stewardship education for kids. The Los Angeles Unified School District (LAUSD) Drought Response Outreach Program (DROPS) campus improvement program addresses water quality, enhances native habitats, and creates new learning environments with direct connections to Science, Technology, Engineering, and Math (STEM) curricula, as well as creating new opportunities for student engagement and professional development for teachers.

2. **Engage students in the planning, design, and construction of the schoolyard.** The K-12 educational program can be hands-on and linked to design education and community engagement. The SCWP program's commitments to K-12 education, public education and job training can be linked to the planning, design, construction, and stewardship of a schoolyard. A well-designed program could harness the education and engagement of students in

hands-on community outreach, planning and stewardship. The ongoing tracking and stewardship could use citizen science to monitor and report on the program's progress and the performance of the projects. The rationale for on-site learning and maintenance of the site and its connection to the watershed could be the foundation of a County-wide curriculum that would provide place-based learning and teacher support for using those spaces.

3. **Designs that facilitate free, nature play in the schoolyard are important for children's social and emotional development.** Play is the primary way that young children learn, and numerous sources and interviewees include Green Schoolyards America, Amigos de Los Rios, and Evergreen named the importance of free play for children's emotional development.
4. **Create a district level curriculum that supports the use of the schoolyards.** The Philadelphia Green Futures has done this to support the learning and interpretation of the school site watershed and schoolyards. Specific, standard-aligned lessons that support green schoolyards and project-based learning are widely regarded

as best practice. The Boston Water and Sewer Commission created GSI curriculum for 5th and 7th grades and piloted professional development training for teachers and plans to roll this out across the Boston Public School District. In Philadelphia, the Fairmount Water Works (FWW), a non-profit education arm of the Philadelphia Water Department, developed the “Understanding the Urban Watershed Curriculum”, which is geared toward middle school grades. FWW worked with the school district on curriculum development to align with their requirements. Teachers were trained in outdoor instruction with the support of a three-year William Penn grant.

5. **Provide curriculum and professional development for teachers to use the schoolyards for teaching.** Multiple sources, including the Angelenos for Green Schoolyards, recommend teacher training to utilize the green schoolyards for educational purposes. Many educators need support to feel comfortable teaching outdoors. The Boston Schoolyard Initiative transformed every elementary and middle school in the district into a learning and play space between 1995 and 2013. They did this by developing science and reading curricula as part of the core programming while also designing schoolyards to facilitate the curricula. Professional development and a corollary guide were also developed to showcase what could be used in schoolyards to support student learning.
6. **Link the stormwater curriculum with university research.** The Philadelphia

School District’s GreenFutures connects their students with an aquaponics and horticulture program where students learn about food production and conduct research with local universities.

7. **Connect K-12 education with workforce development training for students and the maintenance or improvements of the school sites.** The SFPUC and SFUSD fund a stormwater schoolyards capital program and developed a green infrastructure Maintenance Training Program for high school students who are trained to maintain and fix cisterns on all the installed school cisterns. Students act as consultants to the schools, conduct routine maintenance, and facilitate elementary school students in a service-learning project. The San Mateo Countywide Water Pollution Prevention Program staff integrate lessons about stormwater management into workshops that plan and install rain barrels and cisterns at schools. The Washtenaw County GSI program implemented a Master Rain Gardeners program. Modeled after the Master Gardener program, it includes online and in-person training for community members.
8. **Build partnerships with outside groups such as community organizations, non-profits, and other local resources who specialize in outdoor education and service learning to develop programming.** The belief in a partnership approach is widely shared across multiple case studies including TreePeople and the Watershed Project.

D. Lessons Learned: Programs Tracking and Assessment

Ongoing tracking and assessment of educational programs helps to justify the investment of funders and, where applicable, public stakeholders. Data also informs adaptive management and continuous learning for program implementers. Examples include tracking changes in student understanding, behavioral changes as well as the sheer numbers of students participating in program activities. This can also apply to monitoring the physical performance of stormwater schoolyards to bolster the understanding of multi-benefit spaces. While some programs focus on internal measurements of changes in behaviors and

attitude, some interviewees caution that community-sourced stories of personal transformation communicate a program's outcome most powerfully. Others suggest that partnerships with educational researchers and universities are critical for making claims about long term academic and behavioral changes. The following lessons address both the tracking of educational and physical performance and of stormwater facilities.

1. **Practice ongoing assessment and adaptive management.** Earth Defenders, Generation Earth, and the SFPUC conduct pre- and post-program surveys to gauge student retention and practice regular focus groups with participating principals and teachers to metrics of the cohorts who receive their training. Evergreen recommends that programs modestly state performance and build partnerships with academia to build longitudinal studies, which are typically outside their realm as an educational NGO. TreePeople emphasizes collecting stories of personal transformation from participants when assessing their efforts. Generation Earth features videos of teachers and students describing how the program has made an impact on their lives adjust the program as needed. The CWH's conversations with DROPs schools' principals indicated that attracting and retaining students was an important consideration and that outdoor classrooms that connect to the curriculum are a positive driver for attracting and retaining students.
2. **Provide resources for tracking.** Several of the agencies and school district interviewees reported that there was a lack of resources to track performance. The CWH's monitoring of pre- and post-construction of the stormwater features at schools allowed them to better understand how rain gardens, swales, and native plantings perform in increasing the runoff water quality and the quantity infiltrated.

While they found that the features largely worked as designed, the post-construction monitoring period was too short. They recommended more long-term monitoring for school sites that have specific considerations and constituents.

3. **Right-size the assessment and tell stories.** Evergreen tracks motivational metrics of the cohorts who receive their training. They recommend that programs modestly state performance and build partnerships with academia to build longitudinal studies which are typically outside their realm as an educational NGO. TreePeople emphasizes the benefits of collecting the stories of personal transformation of participants when assessing their efforts. Generation Earth discussed the importance of storytelling and have a website that features videos of teachers and students on how their program has made an impact on their lives.
4. Evergreen recommends that it is always fair to state that every child attending school in a transformed schoolyard is impacted simply by spending time there. Programs can measure the scope and scale by assessing how large the space is and how many students use it during formal learning times. Another area for assessment is how the site is used after school. One can survey the school community and the school catchment area if students are being bussed. It is important to also include the neighbors as it is important to include the value of a green schoolyard if a school is being used as a neighborhood park.

II. Stormwater Schoolyards

While schoolyard stormwater management intersects with many school district and community drivers, how a site is designed or programmed has the potential to be either an asset or a liability to achieving a school's goals. Many of the stormwater schoolyard programs reviewed have addressed these challenges.

This section begins with a description of common program drivers and an overview of program models encountered in the research. It is followed by lessons learned from each of the stages of program implementation, including project initiation, program design, funding, site selection, project planning and design, maintenance strategies, and assessment and monitoring. Through this study, it was clear that transforming and programming schoolyards is highly complex but there are abundant strategies for success that the district can consider for all the various phases of program development for stormwater schools.

A. Stormwater Schoolyards Partnerships & Initiation Models

This section provides an overview of the major approaches in partnerships and initiation for schoolyard transformation programs and includes lessons learned. The programs found in this investigation range in scale from working at a citywide and/or school district level to those that work with individual schools and/or teachers. Some are initiated by NGOs and others are partnerships between utilities and school districts. This section describes some partnership models and lessons learned.

Program Drivers. There are many drivers and program models in the growing movement to transform asphalt schoolyards; and transforming these spaces and integrating the many stakeholder perspectives is a complex task. Schools, with their wide expanses of bare asphalt, are spaces onto which communities, advocates, and other agencies can project their diverse visions for the future. The following drivers and benefits are ascribed to schoolyard greening for stormwater management and other purposes.

1. **Nature Play.** Green schoolyards fill a gap for our diminishing natural spaces and children's opportunities for nature play. Nature, with its loose parts and open-ended activities fuel imagination and cooperation and provides students with gradients of risk that support their physical and emotional development while provide daily opportunities to connect children to their environment.
2. **Outdoor Classrooms** are a growing emphasis. Some programs focus on supporting teachers with new methods for teaching standard or adapted curriculum outside, while others focus on space planning to facilitate outdoor learning. This was a particular focus of Green Schoolyards America, the San Francisco Unified School District, and others when students were forced to learn online during the COVID-19 pandemic.
3. **Equity and Environmental Justice** drives the need for equitable access to community open space, improved air quality, and nutritional security for children experiencing the disproportionate environmental impacts. Underserved neighborhoods experience a disproportionate absence of shade and tree cover and exposure to urban heat.
4. **Schools as Demonstration Sites.** Schools can educate the next generation by serving as demonstration projects for environmental repair and resource efficiency. Whether large or small, the way a school is designed and managed communicates and teaches far more than abstracted learning about environmental issues. Solar panels, water conservation, green buildings, and on-site stormwater management are examples of the practices that are often accompanied by interpretive signs that educate children.
5. **Environmental Health** for children drives the desire to improve schoolyards by providing shade trees and structures to protect them from increasing urban heat, less toxic materials to address air and water pollution, increased active play to combat sedentary lifestyles, and/or improved access to gardens to grow food and support nutrition and garden education.
6. **Schools as Community Centers.** Public schools are the center of many neighborhoods and serve as spaces for gatherings, festivals, emergency planning, and voting. Green schoolyards, green streets, and multi-purpose open spaces serve many facets of the community beyond their primary educational value. Opening schoolyards after school hours and on the weekend can increase a community's access to parks and open space.
7. **Urban Environmental Resource Management.** Schools Districts are large systems within communities that consume water, food, power, and land, and produce waste and stormwater runoff. Some see green school buildings and landscapes as opportunities to catalyze systems change in the management of resources like stormwater. School sites are single owners with large patches of public land and major public investments and can serve as high impact sites for interventions.

NGO and Third-Party School District Schoolyard Transformation Programs

A few of the programs reviewed focus on NGOs and third-party entities working on systems change at the school district scale. They work to bring inspiration and technical resources to support the changes needed to facilitate these types of programs and projects at schools. Examples include:

- Evergreen, Canada's national schoolyard greening NGO, partners with school boards to transform school grounds for green learning and community activities. The schoolyards are redesigned with natural elements such as trees, rocks, and shade to create a diverse landscape for children to explore. They employ a national network of design consultants that provide policy development and technical assistance, child-friendly participatory design programs, district design guidelines, and teacher training in the use and care of the spaces and providing the motivation for engaging students in both.
- Green Schoolyards America provides technical assistance for transforming asphalt school grounds into park-like green spaces that improve children's well-being, learning, and play while contributing to their communities' ecological health and climate resilience. They aim to give children rich environments and access to the natural world in the places they already visit daily. They partner with districts to create large-scale programs that support the living schoolyard movement, build relationships that help it succeed, and infuse outdoor learning and ecological design into the PreK-12 education system.
- The Trust for Public Land's (TPL) Community Schoolyards™ initiative has transformed nearly 300 schoolyards in the US. Green schoolyards are open to the public outside of school hours through joint-use agreements between school districts and the city. They work with local school districts, educators, parents, children, and community members. Transformations take a systems-based approach to address environmental issues, improve educational and social-emotional outcomes, and strengthen local communities. In the Los Angeles area, they are partnering with school districts and local nonprofits to transform 28 asphalt playgrounds into high-quality green spaces for students and local communities by 2028.

School District and Utility/Stormwater Agency Partnerships

There are several larger urban utilities and stormwater agencies that have formal partnerships programs with their school district. Examples include stormwater programs that provide grant programs for schools and those that pool funding between agencies and schools to deliver capital programs and program implementation and maintenance. In many cases NGOs are also partners in these approaches. Examples include:

- The SFPUC's Urban Watershed Management Program has several programs and project development strategies for stormwater management on schoolyards. The program includes a Watershed Stewardship Curriculum for K-6, the Youth Watershed Stewards, a maintenance training and workforce development, and a Living Schoolyards as Stormwater Infrastructure Design Training Series, focused on education for engineers, designers, facilities managers, and educators on stormwater schoolyards. The training was used for a pilot project called the Robert Louis Stevenson Stormwater Schoolyard Project. The SFPUC also currently has two active grant programs which support stormwater funding on schoolyards: the Urban Watershed Stewardship Grant Program, which focuses on community driven projects on schoolyards, and the Green Infrastructure Grant Program, which targets large public and private property stormwater retrofits. The SFPUC and SFUSD are also currently exploring the potential for joint delivery of SFPUC capital green infrastructure projects on school property.

- The Philadelphia School District extending its greening efforts in the nation that extends beyond playgrounds to its buildings. The GreenFutures program is installing green schoolyards at 13 of the city's 218 public schools, with the intention of installing five more per year. They aim to make Philadelphia's schools—and the city at large—more environmentally friendly, from the ground up. They delineated 65 discrete actions the district plans to take starting in 2020 in five different areas—efficiencies, engagement, equity, environment, and education. The actions range from greening schoolyards and decreasing energy use to improving transportation, facilities, and fitness. They have a formal partnership with the Philadelphia Water Department.

Individual School Transformation Programs

While working at the district scale can be the most impactful approach, there are different entry points for engaging with schools. Programs can work with individual schools, teachers, or after-school programs. For example, if there is an unenthusiastic district or principal, an NGO can work directly with individual teachers or people leading environmental education. In addition to their district-level work, Evergreen also offers ways to work with one teacher or many at a school. They invest their efforts in individual culture shifts and support champions to build a bigger cohort, which builds momentum and tends to draw others along.

B. Lessons Learned: Stormwater Schoolyards Partnerships and Initiation

Collaboration between agencies and school districts can be challenging but is not insurmountable. Interviewees all emphasized the importance of building relationships, seeking shared visions, and addressing each partner's goals and needs. These lessons learned will support program designers in directly addressing challenges and bypassing common pitfalls.

1. **Be nimble when working with school districts and schools.** Heal the Bay reports that this is important because schools have many demands on them, and stormwater-related offerings need to be in alignment with what the school needs.
2. **Seek to understand and address the school districts' challenges and barriers.** TreePeople's LAUSD study and several interviewees indicated that the current SCWP program must be adjusted to work better with schools. Barriers to capturing off-site stormwater on schools highlight a need for new approaches to design and liability. Without this, the County will not harness the potential of schools for regional stormwater and educational benefits. Another area to address includes how the SCWP counts the population impacted by the project in the proposals. School populations should include the students there during the school week, the staff and the large number of community members who use schoolyards during non-school hours.
3. **When selecting the schools or districts to partner with, look for areas with pockets of activism and community support.** This is Evergreen's approach for building momentum and connections to the school board.
4. **Seek school district champions** whose roles or interests align with the goals of the schoolyard transformation. The Boston Water and Sewerage Commission worked with the Sustainability Director for the Boston Public Schools to start their green stormwater infrastructure conversation.
5. **Collaboration is difficult and relationship building takes time** and it is important to prepare adequate timelines to plan projects and develop relationships.

The San Francisco SFPUC and SFUSD committed to a robust planning and design process, allotting three years for planning, design, and construction. This process built interagency trust and provided a small-scale pilot to learn and test a joint project delivery process.

6. **Work with trusted partners and build real and non-transactional relationships.** Heal the Bay has long worked with the community and is seen as trusted partner who will deliver on what they commit to. Staff from the Watershed Project have been collaborating with the San Francisco Public Schools and SFPUC for nearly 20 years.
7. **Align the partner’s visions and seek solutions that benefit all parties.** Multiple resources reviewed emphasize the need to understand the school district’s vision and ensure that the utility or stormwater program design helps support that vision. The Philadelphia Water Department aligned with the School District’s Green Future Sustainability Plan to gain buy-in on on-site stormwater management. In Boston, the Water and Sewer Commission identified alignment between the schools’ 10-year capital plan and their areas of concern for phosphorus loading in the Charles River. The overlap in interests created a stronger argument for the installation of GSI with other features, such as playground equipment and outdoor classrooms, at five schools.

8. **Use “Clean Water Compliance” to encourage partnerships.** Sc Schools are increasingly being required to implement on-site stormwater management. The Power of Schools/LAUSD report suggests alternative compliance can be an incentive for collaborating with water agencies and utilities
9. **Engage with legal departments and unions early to avoid issues later in planning phases.** The Milwaukee Metropolitan School District staff helped to gain buy-in by incorporating their legal staff at the beginning allowing them to understand barriers early in the process. The Power of Schools Report indicates that liability is a major barrier to partnerships and that creating an “indemnification agreement” upfront may help with this. Union engagement is important for negotiating agreements around future maintenance needs. Utilities can also land-or easements purchases to reduce liability.
10. **Create dedicated staff to manage partnerships.** The Philadelphia Water Department had a dedicated manager assigned to oversee their school’s partnership. The SFUSD Green Schoolyards Manager supports their partnership with the SFPUC and Parks Department. This ensured ongoing connection between the facilities group and school sites to provide technical assistance to school sites/communities.

C. Lessons Learned: Stormwater Schoolyards Program Design

The following lessons in program design and development from early adopters provide strategies to support future programs with strategies and avoid common pitfalls.

- I. **Programs should engage students and the school community in planning, design, and maintenance.** This is widely seen as standard “best practice.” TPL’s campus redesign program includes an

environmental science curriculum and empowers its students to determine the design of their schoolyard throughout NYC’s community schoolyards. Stantec’s assessment of the different SCWP

schoolyard proposals called out the “Exemplary” proposals based on SWCP guidance and their engagement with students. The Power of Schools report recommends formally moderated charrette processes to help to build trust amongst disparate stakeholder groups. Pasadena’s monthly community events engage community members in planting green infrastructure. NGOs can support community engagement in the project planning phases. Amigos de los Rios engaged the community members extensively for over five years and worked closely with community stakeholders, local service clubs, and youth corps on-site in Pasadena.

2. **Engage with educators early in the program design process to understand how it can support their needs.** This is a recommendation from the GSI Leadership Exchange survey of many different GSI programs. Engaging all parties, educators, principals, and facilities teams will increase buy-in and shared understanding of the projects to ensure that the designs align with the school’s educational mission and are maintainable.

3. **Consider on-site garden educators.** In San Francisco, there were several NGOs funded by foundations that supported AmeriCorps Garden Educators at the green schoolyard schools. They oversaw activating the spaces and connecting students and teachers to the spaces. Some garden education NGOs provide nutritional education, and some teach about environmental justice with a focus on under-resourced neighborhoods. On-site garden educators can be expensive but can be important for success.

Don’t reinvent the wheel. Adapt materials from pioneering communities and organizations to save funding and time. Resources like the Children and Nature Network have peer-reviewed research on environmental education and schoolyards.

They have excellent materials, infographics, and conceptual schoolyard designs from other communities.

4. **Provide sufficient staff and resources for success.** Schoolyard transformation requires change on many fronts. Evergreen’s embedded design professionals are supported by a national team and network that provides design training annually. The embedded staff partner with educators to support school transformation and ongoing teacher training on topics both schoolyard design and operations, as well as teaching on the school grounds. The professionals support everything from developing approvals process, writing guidelines, directly supporting design at schools, training facility staff, and maintenance techniques. Their strong, long-term district relationships attract philanthropy and corporate funds. In the SFUSD, having dedicated staff who connected the schools, facilities staff, nonprofits, and other agencies was critical.

5. **Think big but start small.** The SFPUC started with small, flexible school grants, which built relationships and informed the development of a large property grant program. This allowed the SFPUC to bring more substantial funding to these types of projects. They continued with support and technical assistance as the SFUSD began to deliver stormwater compliance-based GSI triggered by the City’s Stormwater Management requirements. At the time of this writing, they are in the process of partnering to deliver capital investment on school yards. The Los Angeles Living Schoolyards + TreePeople selected 10 pilot schools as a starting point for larger collaborations.

6. **Invest in continuous learning and adaptive management.** The SFPUC created a database of documents highlighting processes and lessons that can be used on future projects, as many agreements involve multiple sites and

projects carried out over many years in their partnership with the SFUSD.

7. **Connect efforts between school districts and cities to solve multiple problems.** brokered a relationship with the City of Toronto with Canada's largest school board, (the Toronto District School Board) to support a Citywide organics management need with the use of compost on schoolyards.
8. **Collaboratively create schoolyard design guidelines.** Stormwater schoolyards are a new kind of hybrid landscape with very specific needs and require creativity to advance sustainable greening on school yards. The SFPUC's Living Schoolyards Pilot addressed design

barriers and rethought stormwater designs for the needs of the school to support programming, playable space, and maintenance. These were lower-impact design approaches that replaced asphalt with permeable surfaces rather than draining large impermeable areas into one GSI facility. They revised design requirements to allow for student interaction with GSI to preserve playable space, increase stormwater management and provide a better opportunity for greening. Chicago's Space to Grow program created internal design guidelines for contracted designers that met the needs of both programs and partners.

D. Lessons Learned: Stormwater Schoolyard Funding

Working with multiple agencies with different funding sources and rules can be complex and can introduce significant barriers to both the quality and number of multi-benefit stormwater/green schoolyard projects possible on school sites. Multiple sources were not able to produce specific funding information but mentioned that schools are struggling to qualify for SCWP funding due to the threshold scoring criteria and the preferences for large regional projects that capture offsite stormwater runoff. The following lessons learned address some of these issues, but it is a significant challenge that warrants its own investigation.

1. **Assess and address funding barriers encountered by schools.** There are numerous examples that make implementation in schools challenging. LAUSD provided an in the Division of the State Architect's (DSA) procurements requirements which cap the size of each contract and force district to contract projects separately to avoid exceeding caps. This results in a patchwork quilt of contractors and companies and a lack of ownership for the whole site. Another barrier is that grant funds sometimes require up-front funding from the grantee. Rebates are not possible for schoolyard projects. This was also raised as an issue both by schools and NGOs serving schools. Additionally, many critical aspects of this work, like collaboration and relationship building, are not covered by grants.
2. **Schools need support in seeking funding.** Many districts lack staffing capacity and need assistance in seeking grants to access funding. The Center for Watershed Health (CWH) has provided technical assistance and capacity building to small municipalities, school districts, and local community organizations to develop and implement multi-benefit projects that integrate stormwater capture and climate resiliency into their project priorities. They assist multiple disadvantaged communities (DAC) school districts throughout the state to increase the number of competitive grant applications by DAC school districts pursuing Drought Response Outreach

Program for Schools (DROPS) funding for school greening projects.

3. **Water agencies are often better positioned than schools to establish long-term funding sources for projects**, according to the Power of Schools Report study by TreePeople and LAUSD. Collaborative programs in San Francisco and Philadelphia are examples of water agencies dedicating their capital dollars to partnership projects at schools.
4. **Incentivize partnerships through grant programs.** The SFPUC's Green Infrastructure Grant Program incentivizes large landowners to retrofit their properties with GSI. This program is funded through SFPUC's capital budget and has a 20-year maintenance requirement. Projects will be able to receive \$765,000 per impervious acre managed, up to \$2 million per project. Grants should include funding for planning and design, as well as implementation.
5. **Allow funding for school programs to hire outside consultants.** The LAUSD team provides technical assistance for the bond-funded Sustainable Environment Enhancement Developments for Schools

(SEEDS) gardens because the funds cannot be used to hire outside expertise. Because they cannot hire engineers, they only allow rain gardens but not bioswales because they require civil engineering and percolation tests, and their funding is not sufficient for these. This limits what stormwater management happens on those sites. They can do this for third-party greening projects where the School District reviews the concept plans and uses outside landscape architects to ensure the use of approved new materials, etc.

6. **Consider outside philanthropic or corporate funding partners.** In Philadelphia, the Water Department (PWD) partners with the school district and the William Penn Foundation. For every dollar invested by the PWD, two dollars go toward a schoolyard transformation from either the school district or the foundation. The SFPUC Community Benefits program is a procurement program that requires in-kind donations and support from private firms seeking to do business with The City.

E. Lessons Learned: Project Prioritization & Planning

Schools are major landholders in a watershed and anchor institutions in communities. Systems planning for schoolyard transformation has the potential to amplify benefits by aligning school projects with watershed management, transportation, bike planning, pedestrian improvements, and community access to parks and open space and integrating equity considerations of the community. These lessons learned in schoolyard project prioritization and planning provide inspiration and guidance from other communities.

1. **Tie schoolyard transformation and stormwater management to whole-school transformation and other planned capital work.** Philadelphia's Green Futures District Plan connects green buildings and landscapes with children's health and addresses these topics as well as energy, waste, and water. The SFPUC

aligned its capital funding with the SFUSD's campus modernization bond programs budget for schoolyard greening.

2. **Align schoolyard greening with green streets and park infrastructure projects.** Collaborate to prioritize green streets with school sites. San Mateo's program prioritizes GSI with school

greening and Safe Routes to School projects. The CWH suggests integrating streetscape GSI upstream of schools for stormwater treatment could facilitate green, and cool streets along the routes to schools and transform whole neighborhoods. The SFPUCs Urban Watershed Assessment stakeholder feedback included schools as high-priority locations for co-investments.

- 3. Prioritize equity and environmental justice with other environmental factors in project identification.** Programs seek to prioritize projects in underserved communities, those with excessive asphalt, areas lacking tree canopy for shade, as well as by the amount of pollution, and the availability of green/park space. Most examples in Los Angeles use these metrics. Special strategies may be needed for middle-income schools. In San Francisco, Title I schools (schools that receive federal funding to support low-income students in their academic progress) are prioritized for investment because additional funding is typical in schools that higher-income schools that fundraise through their PTAs. It is the middle-income schools that are not benefiting from either funding stream in the same way, so having a

special strategy for those would be important.

- 4. Schoolyard master plans are a critical part of a successful program.** The SFUSD included funding for schoolyard master plans as part of their bond program. They funded collaborative master planning processes for the school campus that included components for bond-funded designs and construction projects. Master plans are living documents that evolve with a school's needs and address the school's needs, such as physical education, water access, temperature, shade, and play structures. Master Planning is also a best practice advocated by Green Schoolyards America.
- 5. Develop joint use of schools and parks.** The SFUSD's green schoolyards coordinator supported agency partnerships and coordination between SFUSD and other agencies like the SF Recreation and Park Department to allow the schools access to local parks for outdoor classrooms.
- 6. Standardize greening approaches and track progress.** The Philadelphia Green Futures program includes a registration framework that helps the schools complete all the steps for greening to get a certification.

F. Lessons Learned: Stormwater Schoolyard Project Design

Stormwater management project designs on schoolyards are highly variable. They range from tanks and infiltration galleries under artificial turf and asphalt that are designed to optimize stormwater management and minimize disturbance to the schoolyard, to habitat restoration, fruit orchards, meadows, and ponds that can serve as outdoor learning laboratories, and support the neighborhood after school hours with a park-like setting. The following is a summary of lessons learned and discusses best practices for harnessing the potential of managing stormwater on schoolyards while maximizing learning and community benefits.

- I. Provide guidance and training for the design of schoolyards that manage stormwater.** The SFPUC's Living Schoolyard Week provided training and design workshops for educators, engineers,

and landscape architects that produced Living Schoolyard Design Guidelines to address the specialized needs of stormwater management and the developmental needs of children. The

Center for Watershed Health suggests that project design teams include someone with expertise in understanding child/student development when designing green infrastructure projects and that the project connects to the curriculum. They contend that this is imperative to getting the projects right. Engineers and landscape architects' teams need expertise in designing for children to address the varying needs of the schools, teachers, as well as students' specific social and emotional needs.

2. **Project design teams must engage educators, principals, maintenance teams and the larger community in all project phases** to address barriers to long-term maintenance issues. This is a common theme for many school-based green infrastructure projects. The SFUSD had a process where multi-disciplinary stakeholders reviewed and approved which types of stormwater management would be acceptable at the school sites. They vetted stormwater designs based on their ability to be maintained and their alignment with schoolyard management needs. The ability to quickly rule out certain facility types based on these criteria increased efficiency and helped the designs be more realistic for school sites.
3. **Connect the school site to stormwater management within the larger watershed and neighborhood.** A common challenge to managing stormwater at schools is concern about the liability and safety of allowing offsite runoff onto a school site. The CWH recommends that the program create a hierarchy and approach for schools that includes first managing on-site stormwater followed by identifying opportunities to slow, spread and treat any water upstream of the school site. This could include a strategic partnership with a green streets network or a Safe Routes to School network that provides cooling, traffic calming, and

stormwater treatment along the route to school. This would be a potential way to treat stormwater flows and would allow schools to be the neighborhood catalyst for transformation.

4. **Design for nature play.** In San Francisco, nature play for students has been important for getting these projects built because space is their biggest constraint. In San Francisco, physical education activities, morning school gatherings, and fire access all need to be accommodated. In the design space, the SFPUC focuses heavily on making sure that the GSI installations themselves are playable and increase the value of the playable spaces.
5. **Connect schoolyard transformation with outdoor classrooms and learning laboratories.** Properly designed stormwater features can support outdoor classrooms and learning laboratories. The CWH's suggested hierarchy aims to manage site stormwater that first benefits students before using sites like parking lots or athletic fields. SFUSD emphasized low-cost elements like tree stumps for learning and eating lunch outdoors during the COVID-19 pandemic. Teachers and administrators are often concerned with having sight lines and naturalized space can be maintained with these concerns in mind by trimming up trees and plant material to promote visibility. Washington Elementary School in Berkeley has large trees giving shade and a forest floor that doesn't block the line of sight. It isn't just a design consideration, but also a maintenance one. Vegetation changes shape over time. The CWH suggests that green infrastructure features in parking lots are not supportive of school retention or teacher use in teaching.
6. **Stack uses to serve the whole community.** Multi-use schoolyards can serve learning, play, and the larger community. Monrovia's design process acknowledged the schoolyard's important role as community park outside school

hours, and they developed plans that served these needs. They also engaged the broader community with workshops and invitations to plant the site.

7. **Connect schoolyard designs to the larger watershed, global ecosystems, and climate change.** Eco-Schools USA is a member of the UNESCO Global Action Program, and the schoolyard habitat projects are connected to global ecosystem management issues and support place and project-based learning.
8. **Site designs should reveal the flow of water.** Too many schoolyards miss opportunities to be instructive. CWH advocates that stormwater project designs reveal the flow of runoff to reinforce stormwater education for students and communities. There are great examples of these “eco-revelatory designs” in other cities like Tucson, AZ, Seattle, WA, and Portland, OR.
9. **Use green infrastructure to convey and treat stormwater pollutants.** Most projects reviewed use design strategies such as recontouring the site to direct the flow of water away from drains, integrating permeable surfaces, and they include a network of rain gardens, bioswales, and infiltration planters to filter nutrients and remove trash, metals, and other pollutants.
10. **Promote the use of native and climate-appropriate plantings** to improve soil health and permeability to conserve water and capture stormwater and runoff.
11. **Infiltration galleries and tanks are best held below parking lots or playing fields** to allow for access during construction and maintenance. According to the TreePeople/LAUSD Power of Schools Report. Additionally, if needed, infiltration infrastructure can be constructed to support the structural weight of buildings and other improvements.
12. **All projects, materials, and processes need to be tailored to be appropriate for the school environment and the school’s limitations and standards.** School-specific materials and planting pallets, and design standards for typical stormwater features would support better decision-making and address needs specific to schools.
13. **New designs strategies are needed to address school needs and meet the SCWP funding criteria.** Topics to investigate include instances where schools prefer concrete surfaces over decomposed granite for durability, the need for staff to maintain sight lines for safety and creating habitat for undesirable pests and other visitors. Available pervious concretes are rough and hazardous for falls. Stormwater drains and filters can get clogged and can impose maintenance burdens. Other challenges to investigate include restrictions on funding concrete, which may be disallowed without consideration of the creative ways that it might be used for rain management.
14. **Use school and micro-climate-appropriate native plants.** The LAUSD is developing training and planting pallets of the appropriate native plants for the different ecological zones and microclimates to support their success.
15. **Use school and micro-climate appropriate native plants.** The LAUSD is developing training and planting pallets of the appropriate native plants for the different ecological zones and microclimates to support their success.
16. **Trees.** School micro-climates impact which trees will be successful on a schoolyard and an establishment period must be considered in a site plan. Shade studies ensure that a tree or shade structure will work as hoped. The SFUSD recommends investing in larger trees rather than shade structures. Proper watering and care regime must be in place immediately after planting.

G. Lessons Learned: Schoolyard Operations and Maintenance

Schoolyards are typically asphalt spaces because schools are chronically under-resourced for maintenance. Proper maintenance is critical for the success of green schoolyards and GSI. The following lessons learned section describes innovative strategies and partnerships used to address myriad maintenance challenges facing these types of landscapes.

1. Connect maintenance to education and workforce development.

CWH recommends investing in elevating, supporting, and training the LAUSD landscape maintenance crews and investigating the potential for creating a team of green infrastructure-certified operation and maintenance crews who would serve both as curricular and stewardship educators. Workforce development programs should be included for stormwater projects at schools. In Baltimore, MD, and Gary, IN, groups piloted a youth summer program to maintain green infrastructure on school grounds, giving students exposure to green infrastructure jobs and providing trained supervisors and staff to oversee grounds in the summer months when GSI maintenance often wanes. Evergreen in Canada engages students in designing and maintaining their schoolyards during class time and in after-school clubs.

2. Ensure that funding programs provide funds for maintenance. TPL reports that In California, funding and legislation such as State Proposition 68 and Los Angeles County Measure A, Measure W, and Measure RR provide funds that can be used to build and/or maintain green schoolyards. Green schoolyards used for learning environments are eligible for maintenance from The State of California.

3. Develop new strategies to address maintenance. Several of the programs working in the schools find that regardless of the quality of the designs, school district maintenance is a major constraint to greening schoolyards. The LAUSD programs rely on individual schools for

maintenance, but several interviewees report that this approach is challenging due to the high rates of turnover of principals, teachers, staff, parents, and garden advocates. They assert that it is not reasonable to expect teachers and school staff to have the time or capacity to do maintenance, and it is not a sustainable strategy. When building edible gardens, the LAUSD program staff encourages principals to work with two known maintenance providers, Enrich LA or the Garden School Foundation.

4. Elevate and fund the maintenance for schoolyards.

Several interviewees suggested that it would be ideal if the SCWP funded maintenance at school sites, thereby removing a current barrier for underground or on-site cisterns. There is also a concern about schools shouldering the liability of regional stormwater pollution on campus. The SFPUC is supporting site maintenance by aligning education and job training, which could be a model to emulate.

5. Build a school district's capacity for operations and maintenance of new facilities. The Center for Watershed Health, Seattle Public Utilities and Montgomery County, Maryland's Department of Environmental Protection has created site-specific maintenance guides for installed GSI. The City of Baltimore gave the Maryland Association of Environmental Outdoor Education and the National Wildlife Federation's Green Schools Program leadership over school district maintenance staff training. The LAUSD is developing training for their landscape maintenance teams. They are also working

to develop school and micro-climate-appropriate native plant pallets and training to support gardeners, the people purchasing the plants, and maintenance teams.

6. **Build maintenance into the initial program and project budget and create long term plans that define responsible parties.** Seattle Public Utilities dedicates sufficient and consistent staff time to support GSI in schoolyards long-term. The SFPUC created a maintenance model that was run to estimate the lifecycle maintenance requirements of their growing collection of GSI assets both on and off school sites.
7. **Partner with maintenance teams early in the planning and design process** to develop long-term plans and overcome any anticipated barriers. The SFPUC included a working group for operations and maintenance during the design and construction of its projects to

ensure that the maintenance and ongoing sustainability were considered throughout the process.

8. **Create an ongoing dialogue and partnership around maintenance that extends beyond implementation.** Southfield, Michigan committed to regular communications between partners and schools after the GSI was implemented. This included staff calling, emailing, and meeting with project participants regularly to understand the successes and challenges they might be facing.
9. **Partner with parks departments in maintaining school sites as parks after hours or for outdoor classrooms** and partner with local municipalities for joint-use agreements to cover maintenance needs and share costs. The Trust for Public Land does this in numerous communities

III. Analysis: Good, Better, Best, and Transformative

The collection of examples and best practices from this study paints a picture of what is possible in The collection of examples and best practices from this study paints a picture of what is possible in stormwater and watershed education. Borrowing from the SCWP’s Engagement Good, Better, and Best rubric, existing educational strategies and approaches were assigned to similar categories (Figure 4), and schoolyard and school building examples were included (Figure 5) to emphasize the point that the school design and management itself educates and demonstrates a great deal to the students. The good news is that there are many examples of best practices at work in the existing programs in the Los Angeles Region, and there are resources available to support the District in scaling up its impact. “Good, Better, and Best” programs can be made truly “Transformative” by coordinating the SCWP’s K-12 education with investments in Public Education and Outreach and Workforce Development with capital planning and shared projects between institutional partners.

A. Watershed and Stormwater Education Practices

Good (Inform)	Worksheets, websites, presentations, videos, in-class lesson plans Annual fieldtrips to museums or aquariums Career presentations
Better (Involve)	Fields trips with place-based exploration and learning Creek and beach clean ups, storm drain stenciling

<p>Best (Empower)</p>	<p>One-time service-learning projects or action projects located in the school or neighborhood, i.e. beach clean ups, restoration projects</p> <p>School composting, water-conserving landscapes</p> <p>Some classes or students engage with green/stormwater schoolyard or garden with teachers, NGOs, and afterschool program activating the space</p> <p>Volunteers and/or students paid to maintain space</p>
<p>Transformative (Connect, Restore and Train)</p>	<p>Whole school uses the schoolyard and school systems as daily contact with nature and for teaching.</p> <p>Classes are involved in hatching butterflies, habitat gardening, composting, native seed propagation, etc. that connect the school to the larger watershed and ecosystem</p> <p>School community has ongoing involvement with watershed restoration or stormwater management projects in neighborhood and/or nearby nature, such as data collection on the performance of the GSI, water sampling, aquatic health monitoring or other watershed health metrics to support countywide performance tracking</p> <p>Student science activities include connections with academic institutions and SCWP scientific studies</p> <p>Students participate in schoolyard planning and design, construction, and maintenance, gaining job skills and mastery (i.e., SCWP work force development program)</p> <p>Students teach other students; students learn participatory planning and design and learn how to engage the larger community in SCWP project development (i.e., SCWP public education program)</p> <p>Whole families are involved in school and watershed stewardship activities (i.e., place-based learning and SCWP public education program)</p> <p>Students learn and perform maintenance, planting, and engineering activities as a school class. Class connects to apprenticeships, internships, and job corps (i.e., SCWP workforce development program)</p> <p>Annual SCWP fellowships engage young adults in rotations within all the collaborating agencies to collaborate on research topics and learn from practitioners and contribute to system change needs. (i.e., SCWP workforce development program)</p>

Figure 4. Examples of Watershed and Stormwater Education within the Good to Transformative scale

B. School Buildings & Schoolyards

<p>Good (Inform)</p>	<p>Educational signs and murals about watersheds, water pollution and conservation</p>
<p>Better (Involve)</p>	<p>School gardens with food or native plants</p> <p>Trees or other passive green spaces designed by others on the schoolyard</p>
<p>Best (Empower)</p>	<p>Green buildings that manage on-site runoff with GSI, collect stormwater in rain barrels and involve educators and students in implementation and management</p> <p>GSI components that involve educators and students in implementation and management</p>
<p>Transformative (Train, Restore)</p>	<p>School and schoolyard demonstrate best practices in stormwater management and water reuse, and are both local to the school and part of regional stormwater management systems</p> <p>Playable and explorable GSI is paired with shade native plantings and water reuse</p> <p>The schoolyard is open to the public as a park after school hours</p> <p>School is catalyst for change in neighborhood greening, traffic calming and cooling of streets and park</p> <p>Schoolyard transformation is conceptualized, led and managed by the school, educators, and students</p>

Figure 5. Examples School Building and Schoolyards within the Good to Transformative scale

V. Conclusion

The goal of watershed and stormwater education is ultimately to shift the way our communities value and steward our precious water resources. This programming aims to teach students how we choose to build and live on the land permanently changes our ecosystems and waterways and affects the plants and animals we depend upon and with whom we share our lives. Thankfully, communities can have either a detrimental or a restorative effect on our landscapes and ecosystems. The best practices described here can help steer investments to reconnect citizens to their watersheds and educate the next generation of leaders and watershed stewards. The following hypothetical narrative illustrates the best practices and findings from this study in an educational arc for stormwater and watershed education program that follows a student through their K-12 experience and beyond.

Elementary School - A student safely walks or bikes to their first day of school with their family along a traffic-calmed, green street that provides safe crossings into a vegetated, shady, and explorable schoolyard. Several of their daily classes, lunch, and recess take place outside in a shaded environment that engages their head, heart, and hands. There they experience daily contact with local plants and animals. They learn about the traditional, indigenous uses of plants, collect, and propagate native seeds, foster local butterflies, and water their gardens and trees with harvested stormwater. They learn that their school is in a watershed and that their school's parking lot doubles as a regional stormwater collection site that recharges the aquifer. On the weekends, the students return with their friends and family to picnic and play at the school as it is opened as a neighborhood park. They have weekly walking field trips with their teachers to local parks and creeks, where they collect trash and seeds, count aquatic insects, and contribute by planting the plants they have propagated for restoration projects. They can also take those same walks with their families and explore the nearby nature together.

Middle School - When they move to their later elementary and middle school years, the students will still enjoy the shaded and vegetated schoolyard for lunch and classes, but interact using more science and measurement, using weather stations, measuring rainfall, collecting water samples in local creeks or the rain cisterns, counting plants and birds, collecting trash, and monitoring a restoration site. These students may teach the younger children and/or participate in a community design charrette in their local park or church about managing stormwater, sharing their ideas and observations about the local watershed and community. They may also participate in an SCWP outreach campaign where they get to practice public speaking or make videos to share with their neighbors and community. They may participate in a summer camp or after-school program that teaches more science, restoration, or service projects and participate in maintaining the green infrastructure on their campus.

High School - As that student moves into high school, they would take on more complex tasks. They would hang out with friends on their generously shaded campus that harvests and recharges stormwater. Their construction and engineering class learns about rainwater harvesting systems and treatment options. They take that learning and work with other schools to assess, maintain and repair their cisterns and green infrastructure. The class provides basic training in rainwater harvesting with plumbing education that includes service learning at local schools. They collect asset management data and upload the maintenance status to the School District's and SCWP shared databases. Once the class is done, they can learn more skills and earn money by joining the Plummer's Union SCWP apprenticeship program that works on school projects and more.

Young Adults - When a student graduates from high school with exposure to the City Building Education where they've learned about design charrettes, they can join the SCWP design Corps to support engagement professionals, landscape architects, and engineers in facilitating community design charrettes for projects. They can do this while going to college or to enhance their college applications.

After College - The young person could also join the SCWP fellowship program after college. There, they would have a rotational internship to give them exposure to the various forms of government and private sector experiences. They might work with the legal department and research precedents in developing shared-use agreements between parks and schools. In the engineering module, they would spend 6 weeks at an engineering firm that works on District projects and then 6 weeks with the non-profit running the service-learning projects. They would collaborate with the other fellows to conduct a specific research project that advances an important question for the program.