



Connecting People with Nature

Audubon Society of Rhode Island

Providence Stormwater Innovation Center

Final Report: January 2022

Contract #: SNEPWG-19-1-ASRI

Executive Summary

Roger Williams Park is in the southern part of Providence and contains 435 acres of landscaped areas including Roger Williams Park Zoo and an extensive pond system. Built from an 1878 plan, the park now sees over one million visitors per year, many coming from the Elmwood, Washington Park, and South Providence neighborhoods adjacent to the park. The water quality of the Park ponds is severely degraded, suffering from impacts associated with the development of dense urban areas that drain into the ponds. The ponds were first listed in the Rhode Island Department of Environmental Management's (DEM) impaired water bodies report in 1992 and remain a problem today. The ponds experience regular cyanobacteria blooms that can be harmful to humans and pets and illustrate the ongoing and urgent need for pollution abatement in the ponds. These water quality challenges are similar to issues in urban waterways throughout the SNEP region.

In 2017, the City of Providence signed a consent agreement with DEM and agreed to bring the city's stormwater management system into compliance with its Municipal Separate Storm Sewer System (MS4) permit. In response to their permit and this agreement, the City of Providence has installed more than 40 nature-based stormwater practices in Roger Williams Park with a goal to reduce phosphorus pollution by 85%.

Municipal departments of public works (DPWs) and other project managers are often reluctant to reduce stormwater pollution with nature-based stormwater solutions. Their concerns often stem from a lack of familiarity with the cost of green practices, management of construction contracts, long term maintenance, residents' preference for frequent mowing of public spaces, and lack of locally tested information accurately estimating water quality improvements.

The Providence Stormwater Innovation Center (Center) was launched in 2020 to address these concerns and provide municipal leaders and industry professionals across the region with the knowledge, experience and support they need to be confident installing and maximizing the benefits from innovative stormwater management practices. The Center uses the nature-based infrastructure projects installed in Roger Williams Park to provide training, test innovative strategies and host public education programming on stormwater and green infrastructure.

The Center's full-time staff position and project activities are funded by a 2019 grant to the Audubon Society of Rhode Island from Southeast New England Program (SNEP) Watershed Grants. SNEP Watershed Grants are funded by the U.S. Environmental Protection Agency (EPA) through a collaboration with Restore America's Estuaries (RAE). Additional funding has been provided by the Robbins de Beaumont Foundation, the SNEP Network, the Rhode Island Department of Transportation, the City of Providence and Audubon Society of Rhode Island members.

Project Results: During the past 2 years, the Providence Stormwater Innovation Center has grown from an idea to a robust organization adding knowledge and value to the growing community of stormwater managers in

Southeast New England. The work of the Center is described in great detail on the Center's website: <https://www.stormwaterinnovation.org>.

The Center has researched and developed economically sustainable best practices for installing and maintaining natural infrastructure.

Technical data on the City's 40 BMPs including information on structures, maintenance best practices, GIS maps and video clips during and after rain events are available on the Center's [website](#). The information provides viewers with best practices and lessons learned and the content has been incorporated into Center trainings. Innovative aspects of the practices like permeable paver forebays are documented and tested. The Center has developed and applied visual assessment protocols and picture posts throughout the Park to provide low-cost assessments of performance.

The Center has developed an ESRI-based GIS maintenance [web app](#) to be used for training. The app showcases 5 BMPs in Roger Williams Park, contains videos, photos, diagrams, and as-built plans to instruct users on various inlet, forebay, basin, vegetation and overflow function and maintenance procedures.

The Center has explored innovative approaches to combining trees with stormwater practices. With funding from the SNEP Network, Horsley Witten has produced a plug-and-play tree filter design manual, providing information on tree filters with and without storage, modeled after the tree filters in the RIDOT Linear Design Manual. Groundwork RI and the Providence Parks Department will work together to install two projects, following the Horsley Witten guidance.

In 2021, the Center began seriously exploring installation of stormwater treatment practices newly approved by RIDEM. Plans are currently underway with RIDOT, RIDEM and Wood Engineering on the design of a treatment train including a Jellyfish Filter and biochar, to be installed in the pipe that brings water from Mashapaug Pond to Roosevelt Lake.

In partnership with the University of New Hampshire and the University of Rhode Island, the Center has conducted water quality monitoring, research and analysis to document environmental benefits of installed green infrastructure in Roger Williams Park.

BMP Performance monitoring. Regular inspection of stormwater best management practices (BMPs) is critical to ensure they are functioning as designed. If stormwater isn't being diverted off roadways and into the structures, pollutants can't be removed from the contaminated water.



Jamie Houle of UNH and Art Gold of URI install pressure transducer loggers in the forebay of an infiltration basin in RWP

BMPs need to remain free of trash, leaves, sediment and debris that would obstruct stormwater from flowing into and out of the structure and slow down proper drainage rates. If stormwater isn't draining into the ground within 48 hours after a rain event, there is likely a problem with the performance of soils in the structure. Healthy and proper vegetation plays a critical role in BMPs' success, soaking up and filtering nutrients from stormwater runoff.

Photo and video documentation of BMPs over time is also essential to tracking their

long-term effectiveness. The Center has found that videos taken during and after rain events provide invaluable feedback to BMP performance: How much water is the BMP taking in? How quickly is the system draining post-storm?

Over the past 2 years (2020 - 2021), PSIC monitored and assessed 24 structural green infrastructure projects in Roger Williams Park. Only eleven practices were found to be fully functioning after routine maintenance. The remaining 13 BMPs were not fully functional. Four practices were installed correctly, but often fail to perform according to their design specifications due to inadequate maintenance. These sites require maintenance practices that quickly overwhelm the capabilities of Park maintenance staff such as removing and cleaning sediment from river rock in a long pretreatment swale. Regular maintenance is not performed. Nine of the BMPs were not fully functioning due to a design or construction issue, unrelated to maintenance. In general, these BMPs do not collect the polluted runoff from their drainage areas.

Cyanobacteria monitoring. The Providence Stormwater Innovation Center participates in the Cyanobacteria Monitoring Collaborative by teaching community volunteers how to collect and report cyanobacteria data to state and federal agencies using bloomWatch, cyanoScope and fluorometer analysis.



Volunteers analyze and process cyanobacteria water samples collected in RWP.

The chart below shows average monthly phycocyanin and chlorophyll concentrations in the Roger Williams Park pond system. Phycocyanin concentrations above 20 ug/L were found to be a fair threshold for visually indicating the presence of blooms. In 2020-2021 blooms in Roger Williams Park were first observed in August and peaked in October. Small localized blooms were still observed into November.

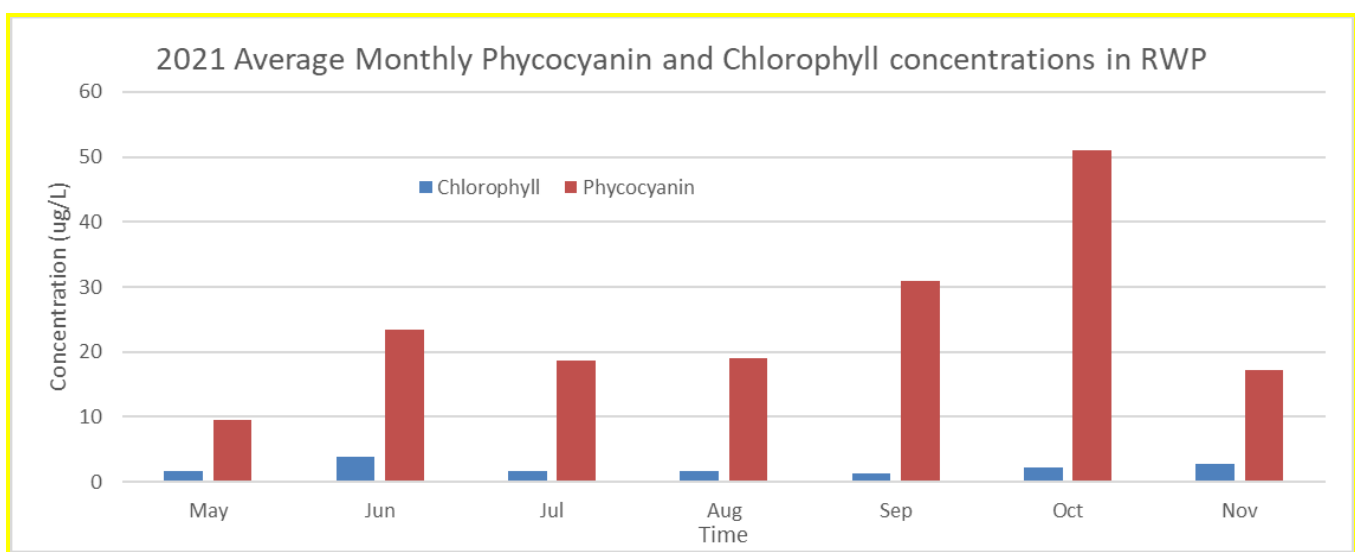


Chart: Data exported from PSIC GIS Cyanobacteria Dashboard.

Water Quantity and Water Quality. The Providence Stormwater Innovation Center, in partnership with URI and the University of New Hampshire, performs continuous monitoring at the inflow and outflow sites for nitrate, phosphate, total phosphate, and fluorescent dissolved organic matter. This data, measured at one-hour intervals, will be coupled with continuous discharge (streamflow) data to calculate load estimates for each water quality parameter.



Ryan Kopp (Audubon Society of RI), Kelly Addy (URI) and Elizabeth Buschert (UNH) install intake tubing for a continuous nutrient monitoring system.

In 2021, continuous nutrient data was collected at the inlet (Seal House) and outlet (Cunliff dam) to the Roger Williams Park Pond system. Discrete sampling was also done by Watershed Watch volunteers at six locations in each individual pond in 2020-2021. Inlet phosphorus concentrations were found to be higher than outlet concentrations, while the opposite was true for nitrogen. In general, flows were higher at Cunliff Dam (leaving the pond system) than the inlet discharges. Since phosphorus inputs from groundwater are unusual, the consistency in phosphorus concentrations at the outlet could be an indication of internal loading driven

by anoxic sediments releasing phosphorus into the water column.

Comparing 2021 continuous data summaries for inlet and outlet locations to historic Watershed Watch monitoring data, there has been a 50% reduction in the summer average total phosphorus concentrations at the outlet versus historic data. Average concentrations for the summer inlet and fall outlet locations appeared similar to historic trends whereas average fall inlet concentrations recorded a 27% increase from historic trends. It is difficult to compare grab sampling to continuous monitoring data, which is statistically more robust, however the 50% reduction in summer TP averages seems significant and is likely due to the major in-park installations of stormwater management controls. Very high pulses of TP during storm events are seen at the inlet and indicate periods of external contributions from the large subwatershed areas outside of the park's control. There are also elevated levels of DOC indicating biomass production within the park ponds that lead to a slight reduction in average TP concentrations between the inlet at the outlet monitoring locations. Although phosphorus and nitrogen concentrations have been reduced, they are still above the TMDL thresholds.

Training, outreach and education to share and promote best practices across Southern New England.

The COVID pandemic necessitated changing the delivery of trainings from in-person to virtual. SNEP Network is providing supplemental support for the Center's training program. Jamie Houle with the UNH Stormwater Center is helping to develop and deliver the training content and the SNEP Network is hosting the on-line virtual training. Ryan Kopp has developed video content showcasing BMPs to provide the local context for the trainings. The Center's trainings have been publicized through DEM's watershed listserv (managed by Ernie Panciera), the Green Infrastructure Coalition listserv and through the SNEP Network's lists. On November 22, 2001 the Providence Stormwater Innovation Center was presented in an EPA Soak Up the Rain webinar. The Center's website includes a video library with all the on-line trainings.



Festival attendees help paint a green infrastructure themed mural designed by local artist Andrew Oesch.

Rain Harvest Arts Festival.

The Center created the Rain Harvest Arts Festival to engage students and the public in stormwater management. The festival was held in 2020 on October 3 with local artists Holly Ewald (coordinator), Dawn Spears and Andrew Oesch creating murals at Roger Williams Park celebrating water. The 2021 festival coordinated with three schools - Sophia Academy, Eden Park Elementary, and New Urban Arts HS. Teaching artists worked with students to create murals near the schools and the work was featured in a documentary video of the process to be

displayed during the Rain Harvest Arts festival on June 12, 2021. Photos of the festivals are on the Center web site and press from the event is included in Appendix A.



Volunteers plant shrubs along the banks of Bellefonte Brook at the outflow to RWP.

Buffer Restoration.

Volunteers planted 150 riparian shrubs along Bellefonte Creek in 2020 and 500 plants on the shores of Bellefonte Brook on May 14th, 2021 to improve water quality and habitat.

Next Steps & Recommendations:

Center leaders met in the fall of 2021 to evaluate the project and consider future directions. Despite several unsuccessful grant proposals, the Center is fully funded for 2022 with support from the SNEP Network, RI DOT, and the City of Providence. Fundraising efforts continue to be a top priority.

Compliance:

QAPP completed and approved by EPA.

Project Partners:

Audubon Society of Rhode Island: Priscilla De La Cruz, Senior Director of Government Affairs, Ryan Kopp, Stormwater Coordinator, Meg Kerr (retired, consultant).

City of Providence Parks Department: Wendy Nilsson and Brian Byrnes. The Providence Stormwater Innovation Center (PSIC) is centered in Roger Williams Park which is managed by Wendy and Brian. They hold the vision for using the City's substantial investment in stormwater management as a learning opportunity for the state and region.

The Nature Conservancy: Sheila Dormody and Will Helt. TNC is a key partner in the Green Infrastructure Coalition. Sheila and Will are leading the development of the PSIC with Audubon and the City. University of Rhode Island. Art Gold, Kelly Addy and Elizabeth Herron are partners in the monitoring program. They have assisted with sampling site selection, installation of equipment and will assist with data analysis. University of New Hampshire Stormwater Center: Jamie Houle and Elizabeth Buschert are partners in the monitoring program. They have assisted with sampling site selection, installation of equipment and will assist with data analysis. They are also assisting with the development and delivery of training. RI DEM (Eric Beck, Ernie Panciera, Jenny Paquet) serve on the Advisory Committee and have assisted with promoting and planning trainings. We are partnering with RI DEM to develop training on newly approved stormwater technologies. RI DOT (Alisa Richardson, Heather Hamilton, Joe Baker) serve on the Advisory Committee and provide assistance on training and public outreach and communication. RI DOT has a MOU with Audubon Society of RI for collaboration around stormwater training and public engagement. SNEP Network. Elizabeth Scott serves on the Advisory Committee representing the SNEP Network. Chris Shea (Wood Environmental) and Brian Kutcher (Horsley Witten) serve on the advisory board. Members of the Green Infrastructure Coalition (GIC): The development of the PSIC fits with the GIC goal of promoting sustainable funding for stormwater management, prioritizing green, nature based stormwater solutions and building a local workforce for stormwater and climate resiliency.

Volunteer and Community Involvement:

Assessing environmental conditions through the use of volunteer monitoring programs is a unique opportunity to engage community members about issues within their watershed. The Providence Stormwater Innovation Center participated in 3 volunteer monitoring programs to collect water quality, cyanobacteria and green infrastructure data and information within Roger Williams Park.



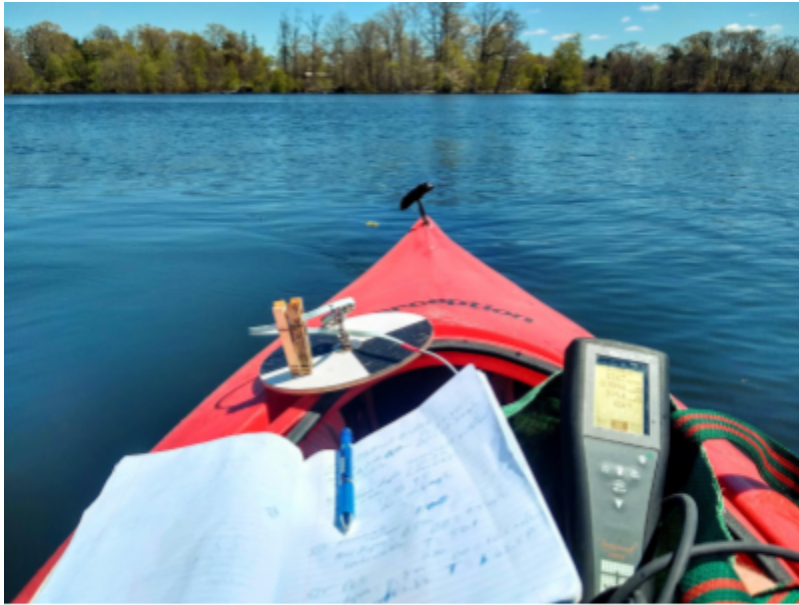
Will Helt of the Nature Conservancy collects a water sample of a cyanobacteria bloom in RWP.

Watershed Watch is a state-wide volunteer water quality monitoring program organized by the University of Rhode Island. In 2020 and 2021, we had 12 volunteers monitor 6 different pond locations in Roger Williams Park. Volunteers collected temperature, chlorophyll, dissolved oxygen, nutrients, bacteria, alkalinity and pH data at these sites. This data will provide good baseline water quality information to evaluate long term changes to the ponds after the implementation of green infrastructure practices surrounding the park.

The Cyanobacteria Monitoring Collaborative is a volunteer monitoring program dedicated to better understand

the spatial and temporal distribution of different cyanobacteria types throughout the nation. In 2020 and 2021 we had 20 volunteers collecting cyanobacteria bloom photographs, uploading microscopic cyanobacteria photos to a national database and analyzing water samples for phycocyanin and chlorophyll concentrations. With this information, the Providence Stormwater Innovation Center was also able to provide valuable information to the Rhode Island Department of Health and the Rhode Island Department of Environmental Management that

helped detect and respond to the presence of cyanobacteria blooms, evaluate the potential risks to the public, and, when necessary, issue health advisories notifying the public of health concerns.



A Watershed Watch volunteer collects a water quality sample on Cunliff Lake

Volunteers also participated in the Picture Post green infrastructure monitoring program in Roger Williams Park. A bi-weekly 360 degree set of photographs were collected at 10 locations around the park to monitor long term changes to green infrastructure vegetation, sedimentation and erosion.

In total, volunteers dedicated over 700 hours of their time towards these 3 programs in 2020-2021.

Outreach and Communications:

Outreach and communications can be found on the Center's web site:

<https://www.stormwaterinnovation.org>

Facebook Page: <https://www.facebook.com/stormwaterinnovation/>

And on Instagram: <https://www.instagram.com/stormwaterinnovationcenter/>

Project Budget Report:

Date Submitted January	Period covered Nov-Dec				Contract #SNEPWG-19-			
Providence Storm water Innovation Center								
Invoice Cost Table								
	Total Budgeted Funds	Total Budgeted Match	Source	Grant Funds Expended	Grant Funds Expended	Match Funds Expended	Match Funds Expended	Match Funds Source
Personnel								
ASRI Project Coordinator -	\$70,000	\$11,900	ROB	\$4,960.00	\$70,000.00	\$0.00	\$15,570.00	ROB
Audubon Policy Director -	\$8,000	\$10,285	ASRI	\$0.00	\$8,000.00	\$1,147.00	\$14,134.00	ASRI
Audubon CFO - salary	\$3,000	\$3,628	ASRI	\$0.00	\$3,000.00	\$407.00	\$4,884.00	ASRI
Water quality monitors -	0	\$7,407				\$3,911.02	\$17,628.38	
Total Personnel	\$81,000	\$33,220		\$4,960.00	\$81,000.00	\$5,455.02	\$52,216.38	
Finance								
ASRI Project Coordinator -	\$12,356	\$7,300	ROB	\$647.35	\$12,349.30	\$0.00	\$5,092.40	ROB
Audubon Policy Director -	\$2,000	\$4,217	ASRI	\$0.00	\$2,092.92	\$470.27	\$5,688.95	ASRI
Audubon CFO - finance	\$977	\$349	ASRI	\$0.00	\$890.78	\$40.70	\$529.10	ASRI
Total Finance	\$15,333	\$11,866		\$647.35	\$15,333.00	\$510.97	\$12,310.45	
Travel								
SNEP Workshops travel	\$48	\$160	TNC/ASRI	\$0.00	\$0.00	\$0.00	\$85.10	TNC/ASRI
BAF conference 6	\$2,970			\$0.00	\$1,375.00			
Registration for BAF	\$580			\$0.00	\$75.00			
Total Travel	\$3,598	\$160		\$0.00	\$1,450.00	\$0.00	\$85.10	
Supplies								
Water level data logger		\$897	ROB			\$0.00	\$897.00	ROB
Rain gauges	\$420			\$0.00	\$420.00			
HOBOWare Pro Logger	\$75			\$0.00	\$75.00			
Shuttle for upload on data	\$249			\$0.00	\$511.52			
Freezer for sample	\$500			\$0.00	\$358.01			
Food and event supplies	\$2,000	\$3,200	ROB	\$1,692.73	\$2,329.38	\$0.00	\$1,896.00	ROB
Communications and	\$1,056	\$2,400	ROB	\$398.10	\$1,140.73	\$0.00	\$742.11	ROB
Picture posts and signage	\$500	\$1,000	ROB	\$0.00	\$0.00	\$0.00	\$0.00	ROB
Total Supplies	\$4,799	\$7,497		\$2,040.83	\$4,834.64	\$0.00	\$3,535.11	
Contractual								
URI Analytical Support	\$21,080	\$13,000	URI	\$0.00	\$21,080.00	\$0.00	\$12,309.00	URI
QAPP consultant	\$10,000			\$0.00	\$10,000.00			
Groundwork RI Tree Pit	\$10,000			\$10,000.00	\$10,000.00			
Watershed Watch	\$3,000	1500	ROB	\$0.00	\$3,000.00	\$0.00	\$1,200.00	ROB
TNC Cities Manager	\$10,000	\$12,854	TNC	\$0.00	\$7,519.46	\$0.00	\$6,906.63	TNC
TNC Restoration	\$2,695	1200	ROB	\$0.00	\$5,175.54	\$0.00	\$6,677.48	ROB/TNC
PWD Dep. Parks		\$10,913	PWD			\$1,508.00	\$15,834.00	PWD
PWD Sustainability		\$3,809	PWD			\$516.00	\$5,418.00	PWD
Providence Parks labor		\$1,000	PWD			\$150.00	\$1,575.00	PWD
GIC Communications		\$2,000	GIC			\$0.00	\$2,000.00	GIC
Rain Harvest Festival	\$0			\$0.00	\$2,000.00			
Total Contractual	\$56,775	\$46,276		\$10,000	\$58,775	\$2,174	\$51,920	
Other								
Office space at RWP		\$5,400				\$400.00	\$8,600.00	
Total Other		\$5,400				\$400	\$8,600	
Total Direct	\$161,505	\$104,419		\$17,848.18	\$181,392.64	\$8,139.99	\$120,067.15	
Indirect	\$16,027			\$1,764.82	\$16,139.26			
Total	\$177,532	\$104,419		\$19,613.00	\$177,531.90	\$8,139.99	\$120,067.15	

Providence Stormwater Innovation Center

Final Report: January 2022
Contract #: SNEPWG-19-1-ASRI

1. Cover Information

Date: January 6, 2022

Project Name: Providence Stormwater Innovation Center

Contract Number: SNEPWG-19-1-ASRI

Grant Period: September 1, 2019 – February 28, 2022

Grantee Organization: Audubon Society of Rhode Island

Report Contact Person, with telephone & email: Meg Kerr, (c) 401-714-2313, mkerr@asri.org

Reporting Period: September 1, 2019 – December 31, 2021

Report Type and Number: Final Report

2. Project Report Narrative

2.A. Project Results

During the past 2 years, the Providence Stormwater Innovation Center has grown from an idea to a robust organization adding knowledge and value to the growing community of stormwater managers in Southeast New England. The work of the Center is described in great detail on the Center's website: <https://www.stormwaterinnovation.org>.

Project oversight: Ryan Kopp was hired by the Audubon Society of Rhode Island as the full-time stormwater coordinator. He began in the position on January 7, 2020.

The work to create the Providence Stormwater Innovation Center (Center) is managed by a team of professionals, organized into two tiers of oversight. 1) Project leaders (Ryan Kopp, Priscilla De La Cruz, Meg Kerr (Audubon Society of RI), Sheila Dormody and Will Helt (TNC), Kevin Essington (RW Parks Conservancy) and Brian Byrnes, (Providence Parks)) meet weekly to discuss the project. Wenley Ferguson (Save The Bay) joins when she can. 2) The Providence Stormwater Innovation Center Advisory Committee meets quarterly to ensure the work is coordinated with ongoing state and regional activities. Members of the Advisory Committee include representatives from the RI Department of Environmental Management (RIDEM), RI Department of Transportation (RIDOT), SNEP Network, University of Rhode Island, University of New Hampshire and selected consulting engineers who have worked on projects at Roger Williams Park. A monitoring team is responsible for developing the water quality monitoring program for the Center. This team includes Art Gold, Kelly Addy (URI), Jamie Houle, Elizabeth Buschert (UNH), Will Helt (TNC), Ryan Kopp (Audubon).

1. Research and development of economically sustainable best practices for installing and maintaining natural infrastructure: The City has completed the installation of 40 structural and non-structural BMPs at Roger Williams Park. Technical data on the structures, maintenance best practices, GIS maps and video clips during and after rain events have been researched and compiled and are available on the Center's web site. The information provides viewers with best practices and lessons learned and has been incorporated into Center trainings. Innovative aspects of the practices like permeable paver forebays are documented and tested. The Center has developed and applied visual assessment protocols and picture posts throughout the Park to provide low-cost assessments of performance.

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2) Water quality monitoring, research and analysis to document environmental benefits

A. Picture Posts: Ten Picture Posts are installed around Roger Williams Park. Some of them overlook green infrastructure installations to document changes to vegetation and sedimentation over time. Other posts are installed near ponds known to be affected by algal blooms in order to visually assess their timing and extent. We have learned that the Picture Post program has been successful in engaging community members, but the timelapse videos haven't provided the level of detail we had hoped for. Issues related to the ideal location, photo glare and the need to keep the post in a horizontal plane have all contributed to flawed results. Our belief is that inexpensive time lapse video equipment would provide clearer photographs of the documented subject matter with greater frequency.



Map showing the location of the Picture Posts.



Here is an example of a timelapse series of photos from a Picture Post showing changes over time.

B. Cyanobacteria.

The Providence Stormwater Innovation Center participates in the Cyanobacteria Monitoring Collaborative by teaching community volunteers how to collect and report cyanobacteria data to state and federal agencies using bloomWatch, cyanoScope and fluorometer analysis.



The smartphone app, bloomWatch, allows easy reporting of blooms by taking pictures as instructed. The cyanoScope project helps scientists and water resource managers learn more about where and when blooms occur and what types of cyanobacteria are present across the region. With the appropriate gear and training, cyanoScope participants collect water samples of possible blooms, view the samples under a microscope, take photos of cyanobacteria, and upload the photos and sighting details to the

Hilary Snook of EPA gives a demonstration about cyanobacteria and monitoring protocols to volunteers and PSIC staff in RWP.

cyanoScope project on iNaturalist.org. The cyanoScope community then helps to identify the cyanobacteria present.

During the 2020-2021 sampling seasons, volunteers met every other Tuesday to collect 2 water samples and bloomWatch photos at 3 sites on Roosevelt, Cunliff and Pleasure lakes. If other areas of high density algae blooms were observed in the park, additional samples were collected. One sample was collected at 0.5-1.0 meter depth, the other was a concentrated surface sample. The depth sample was used for fluorometric analysis of chlorophyll and phycocyanin. The concentrated surface sample was used for Cyanoscope observations and photo upload.



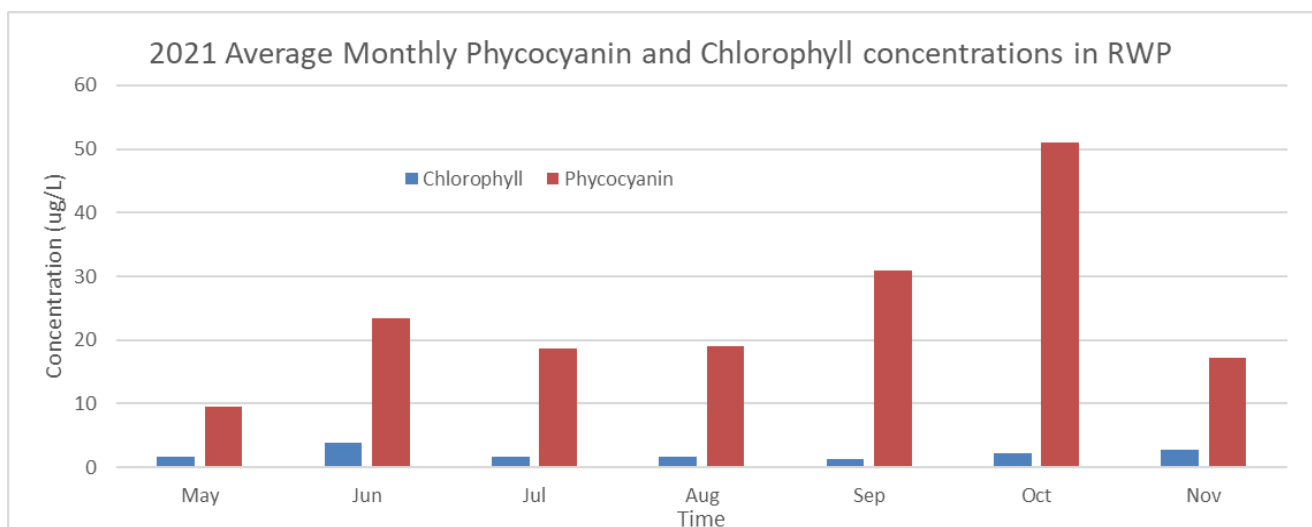
Volunteers examine water samples with a Cyanoscope and upload photos to the Cyanobacteria Monitoring Collaborative database

In the past 2 years, 81 bloomWatch photos were submitted by volunteers to the Cyanobacteria Monitoring Collaborative, RIDEM and RIDOH staff. Of the 81 submissions, 20 submissions contained pictures of potential cyanobacteria blooms which were used by RIDEM and RIDOH to assess whether a formal laboratory sample was necessary.

With our Cyanoscope observations in Roger Williams Park, we identified at the “research grade” level 4 different genres of Cyanobacteria. Aphanizomenon, Woronichinia, Microcystis and Dolichospermum

were all identified. Thirty eight “research grade” identifications were classified on samples collected through the PSIC monitoring program in Roger Williams Park. A total of 247 photos were uploaded to the Cyanoscope Project through PSIC volunteer efforts. A [GIS dashboard](#) was created for data visualization purposes.

The chart below shows average monthly phycocyanin and chlorophyll concentrations in the Roger Williams Park pond system. Phycocyanin concentrations above 20 ug/L were found to be a fair threshold for visually indicating the presence of blooms. In 2020-2021 blooms in Roger Williams Park were first observed in August and peaked in October. Small localized blooms were still observed into November.



C. Performance monitoring.

Regular inspection of stormwater best management practices (BMPs) is critical to ensure they are functioning as designed. If stormwater isn't being diverted off roadways and into the structures, pollutants can't be removed from the contaminated water.



An infiltration basin in Roger Williams Park, functioning as designed, during a rain event in 2021.

BMPs need to remain free of trash, leaves, sediment and debris that would obstruct stormwater from flowing into and out of the structure and slow down proper drainage rates. If stormwater isn't draining into the ground within 48 hours after a rain event, there is likely a problem with the performance of soils in the structure. Healthy and proper vegetation plays a critical role in BMPs' success, soaking up and filtering nutrients from stormwater runoff.

Photo and video documentation of BMPs over time is also essential to tracking their long-term effectiveness. The Center has found that videos taken during and after rain events provide invaluable feedback to BMP performance: How much water is the BMP taking in? How quickly is the system draining post-storm?



A dry infiltration basin in Roger Williams Park during a large rain event that is not functioning as designed.

Over the past 2 years (2020 - 2021), PSIC monitored and assessed 24 structural green infrastructure projects in Roger Williams Park. Only eleven practices were found to be fully functioning after routine maintenance. The remaining 13 BMPs were not fully functional. Four practices were installed correctly, but often fail to perform according to their design specifications due to inadequate maintenance. These sites require maintenance practices that quickly overwhelm the capabilities of Park maintenance staff such as removing and cleaning sediment from river rock in a long pretreatment swale. Regular maintenance is not performed. Nine of the BMPs were not fully functioning due to a design or construction issue, unrelated to maintenance. In general, these BMPs do not collect the

polluted runoff from their drainage areas.

D. Water quantity.

Stage/Discharge: We measure the volume of water flowing into and out of the park pond system. This information, combined with data on the concentration of pollutants in the water, allows us to calculate the total

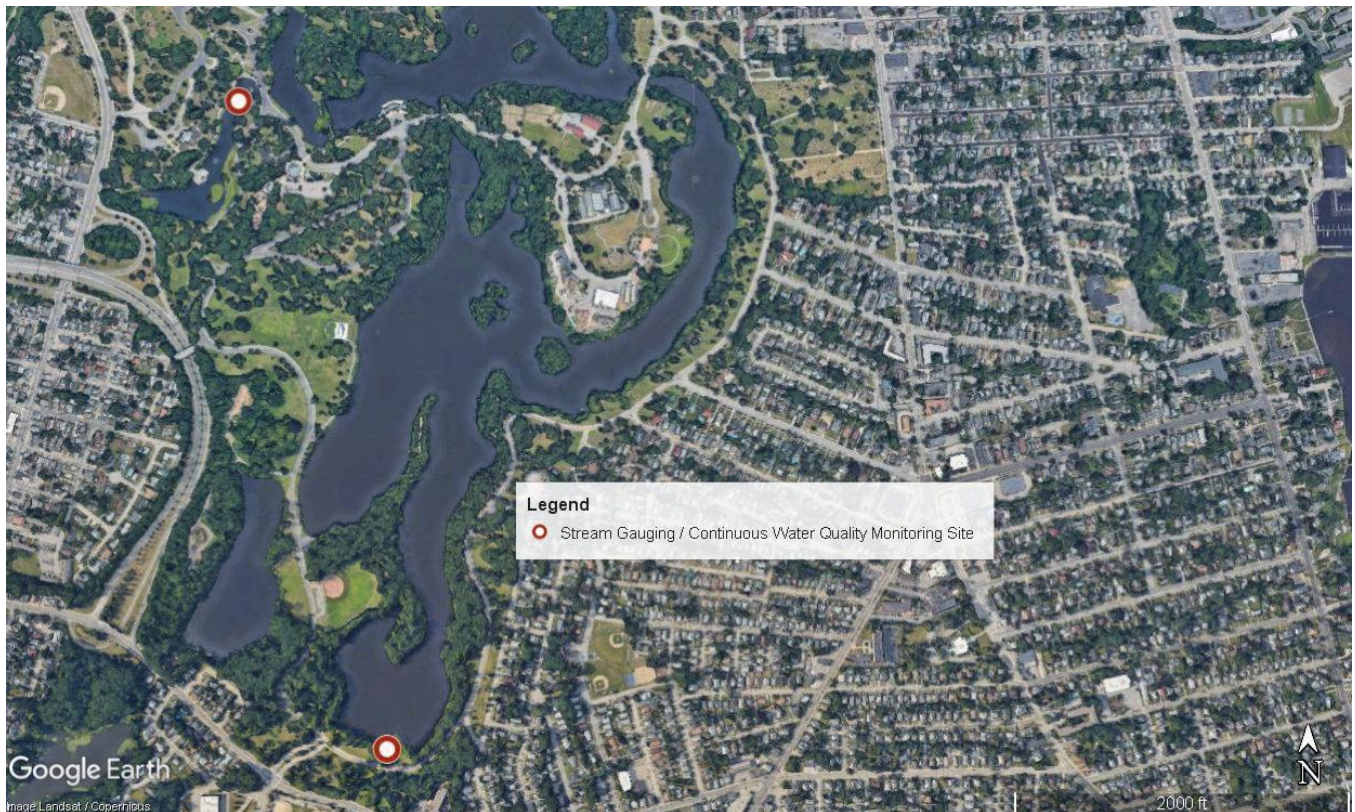
amounts of pollutants entering and leaving the system. By comparing these two amounts, we can assess how well the park's green infrastructure is filtering polluted stormwater.



Will Helt of the Nature Conservancy installing a pressure transducer to measure water level at the outflow of RWP.

Two key variables in water quantity calculations are stage and discharge. Stage refers to water level (i.e. the height of the water above the pond floor). Discharge refers to streamflow (i.e. the amount of water that passes through a stream in a fixed amount of time). Discharge is what we're interested in for the next part of our calculations, but it requires manual measurements, while stage is easy to measure continuously with pressure sensors. We therefore graph the two variables against each other to find a mathematical relationship between them. From this relationship, one can easily estimate discharge values for any given stage value.

Nitrogen and phosphorus concentrations can be measured from park water samples using a [spectro::lyser](#) sensor. By coupling streamflow and sensor data, we can calculate nitrogen and phosphorus fluxes into and out of the park. If there is a lower nutrient load leaving the park than entering it, then the green infrastructure is likely helping to filter out the pollutants along the way.



The map above shows the two locations that have been identified near the inflow and outflow of the ponds to continuously monitor stage (water level) and associated discharge (streamflow).

Precipitation: Measuring rainfall is an important parameter in estimating the volume of stormwater treated and pollutants removed by stormwater BMPs. PSIC uses a tipping bucket rain gauge to measure rainfall in Roger Williams Park. Having a rain gauge in the park provides better accuracy of precipitation by monitoring localized rain events.

E. Water Quality.

Managing stormwater is critical to the health of the water bodies that receive it, including the ponds in Roger William Park, which have been identified as being impaired (RIDEM 2007). The PSIC established a water quality monitoring program to assess ambient conditions in the ponds, to document the impacts of ongoing restoration efforts, and to confirm the benefits of green infrastructure as a strategy in stormwater management.

Discreet Water Quality Sampling: The Providence Stormwater Innovation Center works closely with the University of Rhode Island by participating in Watershed Watch, a scientist-led volunteer water quality monitoring program.



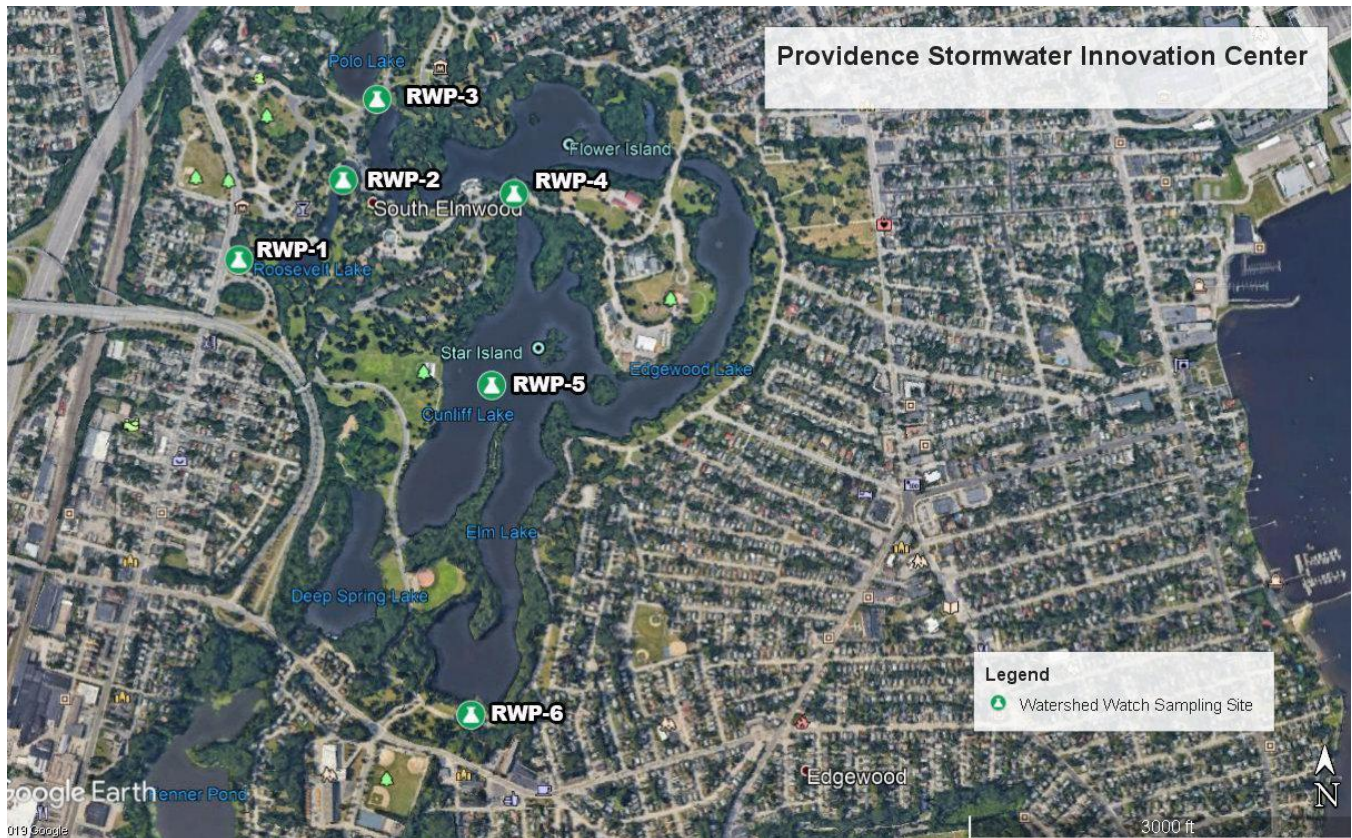
Elizabeth Herron of URI training Watershed Watch volunteers in various water quality sampling protocols and procedures.

Through Watershed Watch, we recruit citizen scientists from the local community to monitor six pond sites in Roger Williams Park. Monitoring is conducted according to the standard URI Watershed Watch Lake and Ponds monitoring schedule, except we encourage volunteers to complete more intensive weekly DO measurements to better account for stormwater impacts in this urbanized watershed.

Citizen scientists sample weekly for dissolved oxygen and temperature, bi-weekly for chlorophyll-a, and 3 times per year for nutrients, bacteria, alkalinity, and pH.

A [GIS Dashboard](#) was created specifically for Roger Williams Park

to visualize current and historic Watershed Watch data.



Map showing Watershed Watch sampling locations in Roger Williams Park

Continuous Water Quality Monitoring: Time-dense data and information improves our understanding of hydrology and water quality and can lead to more effective resource management. Continuous monitoring of water quality data captures seasonal, diurnal, and event-driven fluctuations within a water system. Continuous water quality data also improves concentration and load estimates.



Jamie Houle and Elizabeth Buschert installing continuous nutrient monitoring equipment in the Seal House at RWP

The Providence Stormwater Innovation Center, in partnership with URI and the University of New Hampshire, performs continuous monitoring at the inflow and outflow sites for nitrate, phosphate, total phosphate, and fluorescent dissolved organic matter. This data, measured at one-hour intervals, will be coupled with continuous discharge (streamflow) data to calculate load estimates for each water quality parameter.

In 2021, continuous nutrient data was collected at the inlet (Seal House) and outlet (Cunliff dam)

to the Roger Williams Park Pond system. Discrete sampling was also done by Watershed Watch volunteers at six locations in each individual pond in 2020-2021. Inlet phosphorus concentrations were found to be higher than outlet concentrations, while the opposite was true for nitrogen. In general, flows were higher at Cunliff Dam (leaving the pond system) than the inlet discharges. Since phosphorus inputs from groundwater are unusual, the consistency in phosphorus concentrations at the outlet could be an indication of internal loading driven by anoxic sediments releasing phosphorus into the water column.



Continuous nutrient monitoring and flow cell system at the outflow of Roger Williams Park

Comparing 2021 continuous data summaries for inlet and outlet locations to historic Watershed Watch monitoring data, there has been a 50% reduction in the summer average total phosphorus concentrations at the outlet versus historic data. Average concentrations for the summer inlet and fall outlet locations appeared similar to historic trends whereas average fall inlet concentrations recorded a 27% increase from historic trends. It is difficult to compare grab sampling to continuous monitoring data, which is statistically more robust, however the 50% reduction in summer TP averages seems significant and is likely due to the major in-park

installations of stormwater management controls. Very high pulses of TP during storm events are seen at the inlet and indicate periods of external contributions from the large subwatershed areas outside of the park's control. There are also elevated levels of DOC indicating biomass production within the park ponds that lead to a slight reduction in average TP concentrations between the inlet and the outlet monitoring locations. Although phosphorus and nitrogen concentrations have been reduced, they are still above the TMDL thresholds.

3) Training, outreach and education to share and promote best practices across Southern New England.

A. Training.



Presentation about biofiltration systems during the EJ Prescott Field Day in Roger Williams Park.

The COVID pandemic necessitated changing the delivery of trainings from in-person to virtual. SNEP Network is providing supplemental support for the Center's training program. Jamie Houle with the UNH Stormwater Center is helping to develop and deliver the training content and the SNEP Network is hosting the on-line virtual training. Ryan Kopp has developed video content showcasing BMPs to provide the

local context for the trainings. The Center's trainings have been publicized through DEM's watershed list serve (managed by Ernie Panciera), the Green Infrastructure Coalition list serve and through the SNEP Network's lists. On November 22, 2001 the Providence Stormwater Innovation Center was presented in an EPA Soak Up the Rain webinar.

The Center's website includes a video library with all the on-line trainings.

The Center has delivered the following trainings during the grant period. All trainings were virtual except the EJ Prescott training event on October 27, 2021, which was held in the field.

1. [Stormwater 101](#): June 26, 2020 and attended by over 70 people. Evaluations of the training were very positive.
2. [Designing GSI](#): July 31, 2020. The training utilized the expertise of Jamie Houle with the UNH Stormwater Center in partnership with Brian Byrnes and Ryan Kopp with the Center.
3. [GSI Construction Oversight](#): October 23, 2020 and March 26, 2021. The training was led by Brian Byrnes (City of Providence), Heather Hamilton and Alisa Richardson (RI Department of Transportation) and Chris Beaulieu-Shea with Wood Environmental & Infrastructure.
4. [GSI Maintenance](#): March 5, 2021. This training was designed for supervisors and field staff responsible for maintaining green stormwater infrastructure projects. Without appropriate operation and maintenance activities GSI projects will not continue to function properly and yield expected water quality and environmental benefits, meet legal standards, and protect the communities' financial investment. This training includes an overview of GSI function and maintenance issues, how design and construction decisions affect future maintenance, lessons learned from the field and the importance of routine inspections and tracking changes over time.
5. [Residential Green Infrastructure/Stormwater](#): May 12, 2021. This training targeted homeowners and neighborhoods and described how they could reduce polluted runoff from their property. Presenters were from the Providence Botanical Center, Groundwork Rhode Island and the Woonasquatucket River Watershed Council. A Spanish interpreter provided real time translation. 40 people attended the webinar.
6. Showcasing technical components of stormwater practices with EJ Prescott manufacturers was held on October 27, 2021 at 4 sites in Roger Williams Park. This training was held in conjunction with the Green Infrastructure Coalition's Stormwater Expo on October 26, 2021.

B. Outreach and Education

The Center has a [website](#), blog and social media accounts and creating content to engage and inform the public.

Content in [online video library](#), educates the public about the stormwater structures in RWP.
Created a GIS Story Map summarizing the monitoring in RWP.

We have funding from RIDOT to support installation of public information at the Seal House and have been working on content with a RISD professor, Emily Vogler.

Rain Harvest Arts Festival:



A stormwater-themed mural painted by Dawn Spears at the Rain Harvest Arts Festival in Roger Williams Park

The Center created the Rain Harvest Arts Festival to engage students and the public in stormwater management. The festival was held in 2020 on October 3 with local artists Holly Ewald (coordinator), Dawn Spears and Andrew Oesch creating murals at Roger Williams Park celebrating water. The 2021 festival coordinated with three schools - Sophia Academy, Eden Park Elementary, and New Urban Arts HS. Teaching artists worked with students to create murals near the schools and the work was featured in a documentary video of the process to be displayed during the Rain Harvest Arts festival on June 12, 2021. Photos of the festivals are on the Center web site and press from the event is included in Appendix A.



Volunteers planting shrubs along the riparian area of Bellefonte Brook at the outflow to RWP

Buffer Restoration:

Volunteers planted 150 riparian shrubs along Bellefonte Creek in 2020 and 500 plants on the shores of Bellefonte Brook on May 14th, 2021 to improve water quality and habitat.

2.B. Next Steps & Recommendations

Despite several unsuccessful grant proposals, the Center is fully funded for 2022 with support from the SNEP Network, RI DOT, and the City of Providence. Fundraising efforts continue to be a top priority.

Center leaders met in the fall of 2021 to evaluate the project and consider future directions. Highlights of the strategic planning are listed below:

Providence Stormwater Innovation Center (PSIC): Strategic Direction 2022 - 2023

Audience: RIDEM, EPA and entities with MS4 permits (cities and towns and RIDOT) — and build our strategic partnerships with these partners and the private sector.

MONITORING: Continue Watershed Watch monitoring. Continue to do the other monitoring at the park as resources allow and start to offer trainings on how to do the low-tech monitoring to assess BMP performance. Continue the cyanobacteria monitoring and explore opportunities to expand the users of the app to folks

monitoring in other lakes. Incorporate the cyanobacteria monitoring, BMP performance monitoring into future trainings.

TRAINING: Continue to focus on maintenance training - developing in person training that is offered several times a year - in the park and at other locations. Expand the maintenance app to include other BMP types starting with projects in the RWP watershed and in the Providence metro area. We will work with partners to identify successes and challenges with other BMPs and feature the lessons in training and in our on-line content. Future training to focus on helping RIDOT (jellyfish filter once installed), training to showcase DEM new technologies and field demos like the EJ Prescott training held in November 2021. We will participate in and evaluate the SNEP Network Stormwater Planning training and identify a role for us moving forward once the training is delivered. Explore opportunities for partnering more with NBNERR (Jen West) as they have expertise on curriculum development. Explore when/how to begin charging a fee for the training workshops. Explore partnership with SNEP, UNH, URI on certification training program.

PUBLIC OUTREACH: Focus on the school murals, Rain Harvest Arts Festival, Seal House with some tours thrown in from time to time as requested.

INNOVATION: This is an area for future growth, but we do not currently have the capacity to do a lot more.

Areas to explore include:

- Working with engineering firms to document projects and monitoring,
- Explore how to build requirements into grants so others receiving money to build green infrastructure provide PSIC with pertinent data,
- Install all new technology under consideration at RIDEM at RWP and document construction and maintenance.

2.C. Compliance

QAPP completed and approved by EPA.

2.D. Project Partners

Audubon Society of Rhode Island: Priscilla De La Cruz, Senior Director of Government Affairs, Ryan Kopp, Stormwater Coordinator, Meg Kerr (retired, consultant).

City of Providence Parks Department: Wendy Nilsson and Brian Byrnes. The Providence Stormwater Innovation Center (PSIC) is centered in Roger Williams Park which is managed by Wendy and Brian. They hold the vision for using the City's substantial investment in stormwater management as a learning opportunity for the state and region.

The Nature Conservancy: Sheila Dormody and Will Helt. TNC is a key partner in the Green Infrastructure Coalition. Sheila and Will are leading the development of the PSIC with Audubon and the City.

University of Rhode Island. Art Gold, Kelly Addy and Elizabeth Herron are partners in the monitoring program. They have assisted with sampling site selection, installation of equipment and will assist with data analysis.

University of New Hampshire Stormwater Center: Jamie Houle and Elizabeth Buschert are partners in the monitoring program. They have assisted with sampling site selection, installation of equipment and will assist with data analysis. They are also assisting with the development and delivery of training.

RI DEM (Eric Beck, Ernie Panciera, Jenny Paquet) serve on the Advisory Committee and have assisted with promoting and planning trainings. We are partnering with RI DEM to develop training on newly approved stormwater technologies.

RI DOT (Alisa Richardson, Heather Hamilton, Joe Baker) serve on the Advisory Committee and provide assistance on training and public outreach and communication. RI DOT has a MOU with Audubon Society of RI for collaboration around stormwater training and public engagement.

SNEP Network. Elizabeth Scott serves on the Advisory Committee representing the SNEP Network, a collaboration whose mission is, “Empowering communities to achieve healthy watersheds, sustainable financing and long term climate resiliency through management of stormwater and restoration projects.” SNEP Network funding is supporting UNH Stormwater Center participation in this project. The PSIC has also received supplemental funding from the SNEP Network to design two non-proprietary tree filters for installation at the park.

Chris Shea (Wood Environmental) and Brian Kutcher (Horsley Witten) serve on the advisory board.

Members of the Green Infrastructure Coalition (GIC): The development of the PSIC fits with the GIC goal of promoting sustainable funding for stormwater management, prioritizing green, nature based stormwater solutions and building a local workforce for stormwater and climate resiliency.

2.E. Volunteer and Community Involvement

Assessing environmental conditions through the use of volunteer monitoring programs is a unique opportunity to engage community members about issues within their watershed. The Providence Stormwater Innovation Center participated in 3 volunteer monitoring programs to collect water quality, cyanobacteria and green infrastructure data and information within Roger Williams Park.

Watershed Watch is a state-wide volunteer water quality monitoring program organized by the University of Rhode Island. In 2020 and 2021, we had 12 volunteers monitor 6 different pond locations in Roger Williams Park. Volunteers collected temperature, chlorophyll, dissolved oxygen, nutrients, bacteria, alkalinity and pH data at these sites. This data will provide good baseline water quality information to evaluate long term changes to the ponds after the implementation of green infrastructure practices surrounding the park.

The Cyanobacteria Monitoring Collaborative is a volunteer monitoring program dedicated to better understand the spatial and temporal distribution of different cyanobacteria types throughout the nation. In 2020 and 2021 we had 20 volunteers collecting cyanobacteria bloom photographs, uploading microscopic cyanobacteria photos to a national database and analyzing water samples for phycocyanin and chlorophyll concentrations. With this information, the Providence Stormwater Innovation Center was also able to provide valuable information to the Rhode Island Department of Health and the Rhode Island Department of Environmental Management that helped detect and respond to the presence of cyanobacteria blooms, evaluate the potential risks to the public, and, when necessary, issue health advisories notifying the public of health concerns.

Volunteers also participated in the Picture Post green infrastructure monitoring program in Roger Williams Park. A bi-weekly 360 degree set of photographs were collected at 10 locations around the park to monitor long term changes to green infrastructure vegetation, sedimentation and erosion.

In total, volunteers dedicated over 700 hours of their time towards these 3 programs in 2020-2021.

The Center has had Brown University IBES student interns assisting with the Center during the summer of 2020 and 2021.

2.F. Outreach & Communications

The PSIC has an active [web site](#), and presence on social media ([Facebook](#), [Instagram](#) and [YouTube](#)). Press received to date is included in Appendix A.

3. Project Budget Report: Summary Budget Table 1: Expenditure by Federal Cost Category

Date Submitted January	Period covered Nov-Dec				Contract #SNEPWG-19-			
Providence Stormwater Innovation Center								
Invoice Cost Table								
	Total Budgeted of Funds	Total Budgeted Match	Source	Grant Funds Expended	Grant Funds Expended	Match Funds Expended	Match Funds Expended	Match Funds Source
Personnel								
ASRI Project Coordinator -	\$70,000	\$11,900	ROB	\$4,960.00	\$70,000.00	\$0.00	\$15,570.00	ROB
Budubon Policy Director -	\$8,000	\$10,285	ASRI	\$0.00	\$8,000.00	\$1,147.00	\$14,134.00	ASRI
Budubon CEO - salary	\$3,000	\$3,628	ASRI	\$0.00	\$3,000.00	\$407.00	\$4,884.00	ASRI
Water quality monitors -	0	\$7,407				\$3,901.02	\$17,628.38	
Total Personnel	\$81,000	\$33,220		\$4,960.00	\$81,000.00	\$5,455.02	\$52,216.38	
Fringe								
ASRI Project Coordinator -	\$12,356	\$7,300	ROB	\$647.35	\$12,349.30	\$0.00	\$6,092.40	ROB
Budubon Policy Director -	\$2,000	\$4,217	ASRI	\$0.00	\$2,092.92	\$470.27	\$5,688.95	ASRI
Budubon CEO - fringe	\$977	\$349	ASRI	\$0.00	\$890.78	\$40.70	\$529.10	ASRI
Total Fringe	\$15,333	\$11,866		\$647.35	\$15,333.00	\$510.97	\$12,310.45	
Travel								
SNEP Workshops travel	\$48	\$160	TNC ASRI	\$0.00	\$0.00	\$0.00	\$85.10	TNC ASRI
RAE conference 6	\$2,970			\$0.00	\$1,375.00			
Registration for RAE	\$580			\$0.00	\$75.00			
Total Travel	\$3,598	\$160		\$0.00	\$1,450.00	\$0.00	\$85.10	
Supplies								
Water level data logger		\$897	ROB			\$0.00	\$897.00	ROB
Rain gauges	\$420			\$0.00	\$420.00			
HOBOware Pro Logger	\$75			\$0.00	\$75.00			
Shuttle for unloading data	\$249			\$0.00	\$511.52			
Freezer for sample	\$500			\$0.00	\$358.01			
Food and event supplies	\$2,000	\$3,200	ROB	\$1,682.73	\$2,329.38	\$0.00	\$1,895.00	ROB
Communications and	\$1,055	\$2,400	ROB	\$358.10	\$1,140.73	\$0.00	\$742.11	ROB
Picture posts and signage	\$500	\$1,000	ROB	\$0.00	\$0.00	\$0.00	\$0.00	ROB
Total Supplies	\$4,799	\$7,497		\$2,040.83	\$4,834.64	\$0.00	\$3,535.11	
Contractual								
URI Analytical Support	\$21,080	\$13,000	URI	\$0.00	\$21,080.00	\$0.00	\$12,309.00	URI
QAPP consultant	\$10,000			\$0.00	\$10,000.00			
Groundwork RI Tree Pl	\$10,000			\$10,000.00	\$10,000.00			
Watershed Watch	\$3,000	1,500	ROB	\$0.00	\$3,000.00	\$0.00	\$1,200.00	ROB
TNC Cities Manager	\$10,000	\$12,854	TNC	\$0.00	\$7,519.46	\$0.00	\$6,906.63	TNC
TNC Restoration	\$2,695	1,200	ROB	\$0.00	\$5,175.54	\$0.00	\$6,677.48	ROB/TNC
PWD Dep. Parks		\$10,913	PWD			\$1,508.00	\$15,834.00	PWD
PWD Sustainability		\$3,809	PWD			\$516.00	\$5,418.00	PWD
Providence Parks labor		\$1,000	PWD			\$150.00	\$1,575.00	PWD
GIC Communications		\$2,000	GIC			\$0.00	\$2,000.00	GIC
Rain Harvest Festival	\$0			\$0.00	\$2,000.00			
Total Contractual	\$56,775	\$46,276		\$10,000.00	\$58,775	\$2,174	\$51,920	
Other								
Office space at RWP		\$5,400				\$400.00	\$8,600.00	
Total Other		\$5,400				\$400	\$8,600	
Total Direct	\$161,505	\$104,419		\$17,648.18	\$181,392.84	\$8,139.99	\$120,087.15	
Indirect	\$16,027			\$1,764.82	\$16,139.26			
Total	\$177,532	\$104,419		\$19,413.00	\$177,531.80	\$8,139.99	\$120,087.15	

	Total Budgeted Funds	Expended Prgress Period 1	Expended Prgress Period 2	Expended Prgress Period 3	Expended Prgress Period 4	Expended Prgress Period 5	Actual Expended to Date
Budget Category							
Task 1. Project oversight	\$30,004	\$546	\$7,858	\$10,460	\$3,677	\$7,463	\$30,004
Task 2. Build and document BMPs	\$22,000		\$6,639	\$8,211	\$3,147	\$4,003	\$22,000
Task 3. Design and deliver training	\$28,000		\$8,637	\$9,379	\$3,796	\$6,517	\$28,329
Task 4. Design, collect, analyze water quality data	\$66,375		\$7,501	\$23,485	\$3,674	\$34,437	\$69,097
Task 5. Outreach and public engagement	\$31,153		\$7,423	\$10,406	\$2,924	\$7,348	\$28,101
Total	\$177,532	\$546	\$38,058	\$61,941	\$17,218	\$59,768	\$177,531

3.B. Budget Narrative

Monies have been expended in accordance with the budgets included in the Subrecipient Agreement.

4. Supporting Materials

Photographs are included in the report. Additional content can be found on the Center's web site:

<https://www.stormwaterinnovation.org>

Facebook Page: <https://www.facebook.com/stormwaterinnovation/>

And on Instagram: <https://www.instagram.com/stormwaterinnovationcenter/>

5. Certification

The undersigned verifies that the descriptions of activities and expenditures in this progress report are accurate to the best of my knowledge; and that the activities were conducted in agreement with the grant contract. I also understand that matching fund levels established in the grant contract must be met.

Grantee Signature: 

Name: Kolby Purcell

Job Title: Senior Director for Finance

Date: 1/31/22

Organization: Audubon Society of RI

Appendix A: Press Coverage of the Providence Stormwater Innovation Center

A stormwater solution: Roger Williams Park project a model for other communities

<https://www.providencejournal.com/news/20200621/stormwater-solution-roger-williams-park-project-model-for-other-communities>

**By [Alex Kuffner](#)
Journal Staff Writer**

Posted Jun 21, 2020 at 6:47 PM Updated Jun 21, 2020 at 7:29 PM

PROVIDENCE — A woman called Brian Byrnes the other day to compliment him on the new patio in Roger Williams Park where she had set up a table and chairs for a Friday food-truck night at the Carousel Village.

It took a minute for Byrnes, the deputy superintendent of the Providence Parks and Recreation Department, to realize that she was talking about the permeable pavers in one of the many new projects in the park designed to capture and filter contaminated stormwater.

“All she needed was a firepit,” Byrnes said with a laugh.

The woman, for good reason, mistook the water treatment project for a garden to lounge in and enjoy a meal. With its curving berms and native plants, it’s designed to look as natural as possible while still doing a critical job for the park.

The project next to Willow Lake and 41 others like it were built over the past two years as part of a larger effort to clean up the park’s waters. All of them adhere to a similar design philosophy that is becoming more common in public works projects across the nation. It embraces eco-friendly elements and frowns upon the use of concrete that is the hallmark of traditional stormwater infrastructure.

The work in Roger Williams Park is already attracting attention as a model for other communities. With [the help of federal funds](#), the parks department has partnered with the Audubon Society of Rhode Island, The Nature Conservancy, the University of Rhode Island and the University of New Hampshire to turn it into a [stormwater innovation center](#).

Roger Williams Park totals 435 acres but nearly a quarter of it is covered by water. Eight interconnected lakes make up 100 acres of the park. When he was asked why improving the water quality is so important, Byrnes talked about getting more people out kayaking on the lakes or fishing in the waters. They should not have to worry about toxic algae blooms or silted-up coves in a park that, he emphasized, was designed to be an oasis for the city’s residents.

“We want more people to be able to use it,” Byrnes said as he gave a tour of the stormwater projects on a recent morning.

The efforts have a larger impact, too. Controlling and treating stormwater is critical to everything from protecting precious drinking-water supplies around Rhode Island to keeping the state’s beloved beaches and commercially important shellfish beds open in the summer.

Stormwater is one of the biggest threats to water quality in bays, rivers and streams. When it runs off roads and other impermeable surfaces, it can carry oils, chemicals and heavy metals into waterways. And when it runs off lawns and gardens, it can pick up nutrients from fertilizers and animal waste and spur unwanted algae growth that

can reduce dissolved oxygen levels in water and, in some cases, cause fish kills such as the infamous one in Greenwich Bay in 2003.

There is a growing urgency to tackle the problem because climate change is not only increasing the amount of rain that falls on Rhode Island on an annual basis but also ramping up the frequency of extreme precipitation events that can overwhelm decades-old catch basins and pipe systems designed to handle stormwater.

“These projects that help capture and filter stormwater and help reduce pollution ... are even more important now as we confront climate change,” said Janet Coit, director of the Rhode Island Department of Environmental Management.

The largest infrastructure scheme in Rhode Island history — [the ongoing construction of tunnel networks under Providence and East Providence at a cost of \\$1.5 billion to store untreated stormwater and sewage during heavy rainfalls](#) — is aimed at addressing the problem in the Providence River and Narragansett Bay.

But smaller projects that cost far less money and don’t require huge amounts of concrete also can be effective. Known as “green infrastructure,” they incorporate natural elements to collect stormwater, screen out sediments and then channel it to a place where the water and any contaminants can percolate harmlessly into the ground.

They include things like rain gardens that fill up with water during heavy rains and then eventually dry out, swales that direct water down a rocky path that allows it to filter underground or manmade pools that let water slowly flow out after contaminants and sediments settle.

Such projects aren’t uncommon in Rhode Island. There are [a range of them at Providence College](#). A decade ago, the Rhode Island Public Transit Authority installed a permeable parking lot in Elmwood that was the largest in New England at the time. An artificial wetlands was built in Middletown to control runoff into Bailey Brook, which feeds into drinking water reservoirs for Aquidneck Island.

But the large number and variety in Roger Williams Park makes it ideal as a demonstration site, said Ryan Kopp, the inaugural coordinator of the stormwater innovation center. The park’s old Seal House, which has fallen into disuse, is set to be renovated as a place for school groups, planners and anyone else who’s interested to see real-time monitoring of the water quality in the park and learn about green infrastructure. Information signs have been set up around the park and “picture posts” were installed for people to shoot photos of the new projects during storms to show how they’re faring.

“Everybody is learning through this whole process here,” Kopp said during the tour with Byrnes.

Providence was required to make the improvements in Roger Williams Park because of a consent agreement it signed with the DEM in 2017. But Byrnes said the parks department had been working for years before the agreement to do what it could to clean up the waterways in Roger Williams Park.

The first major green infrastructure project in the park dates to the early 2000s with the closure of Roosevelt Road, the removal of much of the roadway and its transformation into a walking path flanked by rain gardens that leads to the Carousel Village and Japanese Garden. The parks department followed up in 2012 with a river-rock bioswale next to Polo Lake.

If anything, Byrnes said, the agreement with the DEM was welcomed by parks staff because it guaranteed a good chunk of money would be channeled into fixing the water-quality problems in the park. That has largely been the case. The city spent \$1.5 million on all the projects in the park.

But more needs to be done to make deeper changes. The lakes in the park are part of a larger watershed that flows into the Pawtuxet River and on into Narragansett Bay. To the north of the park are Tongue, Spectacle and Mashapaug ponds, which are surrounded by development and whose waters are polluted. The ponds are all connected and, from Mashapaug, eventually empty into the park through a pipe under Route 95 that follows the historic course of a bygone stream.

“These impaired waterways here are being fed by those impaired waterways,” Byrnes said.

So taking care of the sources of contamination in the park can only go so far. The city is in talks with the state Department of Transportation, which owns the outlet pipe from Mashapaug Pond, to build a filtration system that would address the contamination coming from outside the park.

Providence Mayor Jorge Elorza looks at the ongoing improvements in Roger Williams Park through a social-equity lens. For the people of South Providence, the park may be their only access to green space in the city. The same can be said for other parks elsewhere in the city.

“As a matter of racial justice and social justice, this is a priority for us,” he said. “To many of our residents, the parks are their backyards.”

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Park's Stormwater Innovation Centered On Reducing Polluted Runoff

July 02, 2020



The ponds of Roger Williams Park in Providence have long been polluted by stormwater runoff containing nitrogen, phosphorus, and other contaminants. (Grace Kelly/ecoRI News photos)

By GRACE KELLY/ecoRI News staff

When it rains, it often pours pollution.

Stormwater runoff pollution is a big problem for cities like Providence, where asphalt and pavement reign supreme. More than 30 percent of Providence is covered in impervious surfaces, according to a 2007 study, which means that stormwater runoff rarely gets the filtration it needs.

But in Roger Williams Park, the newly launched Providence Stormwater Innovation Center (SIC) hopes to change that.

The 435-acre park, in addition to housing a zoo, carousel, and tended green space, is now home to a project designed to reduce pollution from stormwater runoff and provide valuable insight into the methods and maintenance of these sites.

The installations, which include rain gardens, bioretention systems, infiltration basins, and sand filters, among other methods, were originally required as part of a consent agreement signed with the Rhode Island Department of Environmental Management (DEM) in 2017.

The water quality of the ponds in the city-owned park have long been a concern. Twenty-five percent of the total acreage of Roger Williams Park is ponds. Because of the park's location within a highly urbanized setting, the ponds have become polluted with nitrogen and phosphorus. They are typically included on DEM's list of impaired waters.

"Due to the elevated bacteria measurements...the Roger Williams Park Ponds do not meet Rhode Island's bacteria water quality standards," according to a DEM document on the health of the park's watershed.

On a recent Monday, Brian Byrnes, deputy superintendent of parks and recreation for the city of Providence, and Ryan Kopp, Stormwater Innovation Center coordinator, gave a tour of some of the 42 eco-friendly stormwater filtration sites that were installed during the past two years.

"This one is called an infiltration basin, so the manhole cover over there used to be a catch basin that would take in stormwater off the street and it would flow directly into the pond through a pipe," said Kopp, pointing to what looks like a shallow dirt well sparsely populated with a few small plants.

He went on to explain how it was modified so the stormwater runoff comes into the basin, slows down on a weir, and sediment drops out.

"We want to get rid of the contaminants and pollutants, but also the sediment, because it fills up the pond and makes it shallower and more susceptible to algae," Kopp said.

Byrnes noted that maintenance crews can drive by, and from the seat of their truck, see if there is sediment present.



The Stormwater Innovation Center has implemented a number of different stormwater-mitigation strategies at Roger Williams Park.

We walked onward, as Kopp and Byrne rattled off the different kinds of stormwater-mitigation techniques.

“Wet swale, dry swale, infiltration basin, bioretention, vegetated swale ... ” said Kopp, counting on his fingers.

“There’s like eight or nine kinds,” said Byrnes, as we reached a lush overlook on the banks of Polo Lake. “But the work continues. We’re going to add a tree filter, which is a very common one, and we’re also going to do a tree trench.”

While installation of these physical projects is essential to stormwater treatment, Byrnes and Kopp noted that maintenance is a key piece of the puzzle that is often overlooked. It’s why the University of Rhode Island and the [University of New Hampshire Stormwater Center](#) were excited to be a part of the project.

“I think one of the things that attracted the UNH Stormwater Center was a missing a piece in the data, and that piece was the cost of construction and maintenance of these things,” Byrnes said. “How do

you design them so they're less expensive to construct and maintain? And when the people from UNH came down and saw this, they said this is the piece we're missing."

The SIC will also enlist volunteers through URI's Watershed Watch program to help collect water data, and as part of their partnership with URI and the UNH Stormwater Center, the park's closed Seal House is being converted into SIC's unofficial headquarters.

"We want to take the Seal House and turn it into an information kiosk, and that's where we will house some of URI and UNH's water-quality monitoring equipment," Kopp said. "We're going to be able to measure real-time water quality and have it displayed."

Byrnes, Kopp, and the project's slew of other collaborators hope that over time others will look to Roger Williams Park as a model of what works, what doesn't, and what it takes to commit to better stormwater management.

As we finished the recent tour, Byrnes pointed to a group of people cruising on swan boats on Willow Lake.

"That's why we're doing this," he said.

<https://pbn.com/providence-stormwater-innovation-center-using-park-to-experiment/>

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Stormwater Innovation

by STUDIO 10
Friday, July 10th 2020



Volume 90%

There's enough going on in our area right now, and the last thing you want to worry about is your water supply, right?! Well, the City of Providence and the Audubon Society have teamed up to keep our waterways safe and clean!

The Details on the Rain Harvest Festival in Providence

It's a free, outdoor, family-friendly celebration of water, life, science, art and community.

June 9, 2021

Tim Lehnert



Courtesy of Stormwater Innovation Center/Wolf Matthewson.

The Rain Harvest Arts Festival is a free, outdoor, family-friendly celebration of water, life, science, art and community in [Roger Williams Park](#) on June 12 from 2 to 6 p.m. The festival's theme is caring for water, and home base is the area around the Boat House. The park has long been plagued by contaminated storm runoff, which fouls its lakes and ultimately flows into Narragansett Bay. Over the last several years, more than forty green infrastructure projects have been implemented in and around RWP; if you've walked through the park lately, you've probably passed berms, bioswales and other installations — some of which look like patios and gardens — whose function is to combat flooding and water pollution. The festival is sponsored by the Providence Stormwater Innovation Center, and will teach kids and adults about the science behind reducing stormwater runoff. "It's making the invisible

systems visible,” says Providence teaching-artist Andrew Oesch, one of the event’s orchestrators. Oesch and fellow artist and organizer Holly Ewald note that storytellers, musicians and artists will help forge these links. “The goal is to connect the dots about where the water goes,” says Oesch. Among the artists are a team from Central High School’s New Urban Arts Knights program who will paint a mural designed by local students. Hands-on activities include a scavenger hunt, chalk-drawing and decorating flags adorning a trail that links activities. Renewal figures strongly in the day’s events, which will also include water-quality testing, a ritual power-washing of the previous year’s mural and a finale mixing science, art, conservation and a bit of magic. stormwaterinnovation.org/rainharvestartsfestival

Rain Harvest Arts Festival Celebrates Commitment to Clean Water in Providence

Wednesday, June 9, 2021 8:00 AM by **Thomas Patti**

After months of virtual meetings on frigid afternoons, what better way to kick off the summer season than with a community celebration of art, education and our shared environment?

To spotlight the community's commitment to clean water in **Roger Williams Park** and surrounding neighborhoods, the **Providence Stormwater Innovation Center** is hosting the second annual Rain Harvest Arts Festival on **Saturday, June 12** from 2–6 p.m. Join friends, family and neighbors in the park to enjoy science, art, music and food, all while showing your support for a healthy and beautiful Providence. The event is free — just check in at the Boathouse Lawn to receive a map and schedule of the day's activities!

At the festival, you'll hear from local scientists, artists, students and educators about the environmental topics that inspire them. Hands-on activities throughout the park will extend the learning (and fun!) even further — chalk drawings, scavenger hunts, stormwater project tours and water testing demonstrations are just a few ways you'll be able to engage with the park and its passionate stewards. **Red's Food Truck** and **Atomic Blonde Ice Cream Van** will be available near the Boat House from 4–7 p.m.



New to this year's festival, are performances by internationally acclaimed storyteller Len Cabral, Narragansett storyteller and cultural educator Sherenté Harris, and spoken word poet Sussy Santana. Their stories will provide cultural and historical context to the land and environment at the focus of the Stormwater Innovation Center's conservation efforts.

This year, the Stormwater Innovation Center collaborated with local schools to teach kids about stormwater issues and coordinate a series of storm-drain murals, designed by students and executed by teaching artists. One mural will be created at the Festival by the New Urban Arts program at Central High School (NUA Knights) in Providence. In addition, a video will be available for viewing that documents recent student murals from NUA Knights, Sophia Academy in Providence and Eden Park Elementary School in Cranston. These murals will raise public awareness about the effects of stormwater management on people and wildlife

At 5:30 p.m. on the Boat House lawn, a performance finale by art educator Lisa Abbatomarco and the Extraordinary Rendition Band will end the day in style — with music, celebration and public participation.



The festival is being held in conjunction with the Roger Williams Park Conservancy's "Art for the People's Park" celebration and sponsored by the Rhode Island Department of Transportation, Wood Environmental, Horsley Witten Group, Restore America's Estuaries, SNEP Network, and the Robbins-De Beaumont Foundation.

Rain Harvest Arts Festival

by STUDIO 10

Wednesday, June 9th 2021

The Rain Harvest Arts Festival community celebration is combining water, science and art! Lindsay talked to Holly Ewald and Ryan Kopp who've organized the event to learn all about it.