Restoring the Ponds in Roger Williams Park: Executive Summary

October 2013

Horsley Witten Group

Land & Coastal Services

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Narragansett Bay Estuary Program

Providence Parks & Recreation

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1.0 Introduction

Since the first plan for Roger Williams Park was developed in 1878 by landscape architect Horace Cleveland, the Park ponds have been essential visual and recreational elements in the Park's design. Over the years, the ponds have provided boating opportunities, a place to fish, a home for wildlife, and a visual refuge for urban dwellers looking for relief from crowded city streets.

The Park ponds, however, suffer from algae, aquatic weeds, and road sand sedimentation. In 1982 Park officials dredged three of the ponds in the Park, but it didn't solve the water quality problems, as phosphorous-laden storm water and road sand continued to flow into the ponds.

The ponds were first listed in the Rhode Island Department of Environmental Management's (RIDEM) impaired water bodies list in 1992. The algae and aquatic weed problems in the ponds have gotten worse in the last 10 years. In 2007 RIDEM released a report, Total Maximum Daily Load Report (TMDL), analyzing nine ponds in Rhode Island with the most challenging phosphorous problems. The Roger Williams Park pond system was highlighted by RIDEM for its deteriorating water quality.

In 2010 in cooperation of the Narragansett Bay Estuary Program (NBEP), the Parks Department applied for and received an EPA Region 1 matching grant to examine the pond's pollution problems, to suggest remedies, and to provide a plan for restoring the ponds' water quality.

With the assistance of a Technical Steering Committee**,** a team of consultants lead by Horsley-Witten Group (HW) was selected to develop a Water Quality Management Plan (WQMP) for the Park ponds. The Committee has helped guide the work of HW which began in July 2011.

Roger Williams Park Ponds Restoration Project Technical Steering Committee

- *Providence Parks & Recreation*
- *Narragansett Bay Estuary Program*
- *U.S. EPA, Region 1*
- *US EPA Atlantic Ecology Division*
- *RI Coastal Resources Management Council*
- *RI Department of Health*
- *RI Department of Environmental Management*
- *RI Department of Transportation*
- *Save the Bay*
- *Save the Lakes*
- *US Fish & Wildlife Service*
- *USDA Natural Resources Conservation Service*
- *University of Rhode Island Watershed Watch*
- *RI Bass Federation*
- *Environmental Justice League of Rhode Island*
- *Serve Rhode Island*
- *Pawtuxet River Authority*
- *RI Natural History Survey*
- *Urban Ponds Procession*

The Steering Committee established the following goals for the project:

Roger Williams Park Ponds Project Goals

- **Improve water quality, habitat, and biodiversity within the ponds**
- **Improve the overall environmental quality and user experience of the Park**
- **Identify health risks associated with fish consumption; increase public awareness as warranted**
- **Foster watershed awareness and environmental stewardship among Park users and surrounding residents through a public outreach campaign**

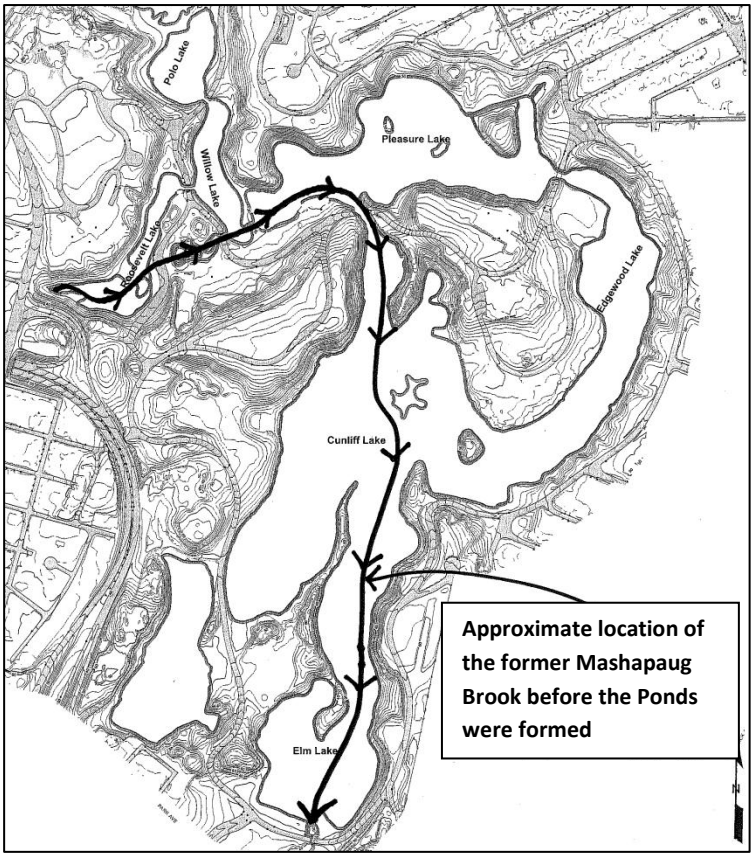
Water quality restoration is central to the project's success. The team of consultants undertook extensive investigations and completed a water quality model and draft management plan. As a result of this work, it became clear that a significant reduction in phosphorus pollution entering the ponds is necessary to achieve water quality improvement. The City and Technical Steering Committee established the following targets for phosphorus pollution reduction in the Ponds, to improve water quality, pond habitat, and Park aesthetics:

Water Quality Restoration—Phosphorus Reduction Targets

- **Reduce phosphorous in the ponds by 20% in five years**
- **Reduce phosphorous loadings in the ponds by 40% in ten years**
- **Over the long term continue to work towards the reduction of phosphorus loadings by up to 70%, a reduction which RI Department of Environmental Management suggests would allow the Park ponds to achieve a water quality that would significantly reduce seasonal algae and aquatic weed growth.**

2.0 The Roger Williams Park Pond System

With the exception of Deep Spring Lake, the Park pond system is man-made, and consists of a series of interconnected ponds. As the Park was developed in the latter years of the 19th century, Mashapaug Brook that ran from Mashapaug Pond was used as the primary water source to create the Park ponds. This former location of the Brook in the area that now is the Park is shown in the accompanying graphic.



The Brook was dammed near present day Park Avenue at the southern end of what is now Elm Pond. In conjunction with considerable dredging done in the 19th century, several of the ponds were literally carved out of the landscape. Bridges were built to allow the ponds to flow continuously from one to the other. The general pattern of flow through the Park ponds is from the southern end of Roosevelt Lake, where a 48 inch diameter pipe from Mashapaug Pond is located, to the dam at the southern end of Elm Pond. As the water leaves the Park, it flows into Bellefont Brook, to the Pawtuxet River, and to Narragansett Bay.

Inflow pipe into Roosevelt Pond from Mashapaug Pond

Outflow waterfall at Elm Pond leading to Bellefont Brook

Roger Williams Park Ponds Characteristics

Pond	*Average Depth (feet)*	*Area (Acres)*	*Direction of Flow*
Roosevelt	1.3	3.8	West to East then North to South
Willow	2.0	3.4	South to North and North to South
Polo	2.3	3.6	South to North
Pleasure	2.6	18.6	West to East
Edgewood	3.0	19.3	North to South
Cunliff	4.3	32.3	North to South
Elm	4.3	21.7	North to South

3.0 The Park Ponds are in Trouble Today

For six months each year the Park ponds are free of algae and weeds and reasonably normal in color and clarity. But those six months are from November to April when the ponds are not actively used, and there are fewer Park visitors.

Beginning in May every year, the shallow ponds begin to heat up and turn a pea soup green color culminating with floating algae and acres of weeds in July-October, this is known as eutrophic or hypereutrophic conditions.

Scientists typically look at a few key parameters to help assess water quality conditions, including Chlorophyll a, total phosphorus concentration, and Secchi dish depth (a measure of water clarity). As seen below, water quality data reflect the extent of water quality degradation in the ponds.

Summary of Water Quality Data for Roger Williams Park Ponds (URI Watershed Watch 1993-2012)

Water Quality Parameter	Typical Threshold for Eutrophic Conditions	Average Value in Ponds by Year												
		Pleasure Lake						Roosevelt Lake			Cunliff Lake		Elm Lake	
		1993	1994	2001	2002	2005	2012	1993	1994	2012	2003	2012	2005	2012
Chlorophyll a (ppm)	7.2 to 30	22	28	20	***46***	***57***	***55***	17	26	***31***	***54***	***55***	***56***	***58***
Total P (ppm)	25 to 65	***85***	***105***	***76***	64	***140***	***100***	65	***69***	***76***	***120***	***87***	***97***	***82***
Secchi Depth (ft)	6.5 to 2.5	5.2	4.6	3.0	***2.0***	***1.6***	2.6	5.2	5.2	***1.6***	***2.3***	2.6	***2.0***	3.0

Italic font = value exceeds outside range of Eutrophic Threshold

Why should we care about the poor water quality in the Park ponds?

The degraded water quality condition of the ponds is troublesome for many reasons:

- The **boating experience** on the ponds is diminished
- **Biodiversity**, particularly fish species, in the ponds is reduced
- **Shoreline activities, such as picnicking and gatherings,** are unpleasant
- The overall **perception of the park as an enjoyable family place** to visit is negative
- Finally, Roger Williams Park is the primary recreational area for thousands of Providence families who do not have access to the state's beaches, and the restoration of the Park's water resources is a matter of **environmental justice.**

What is causing the water quality problems in the Park ponds?

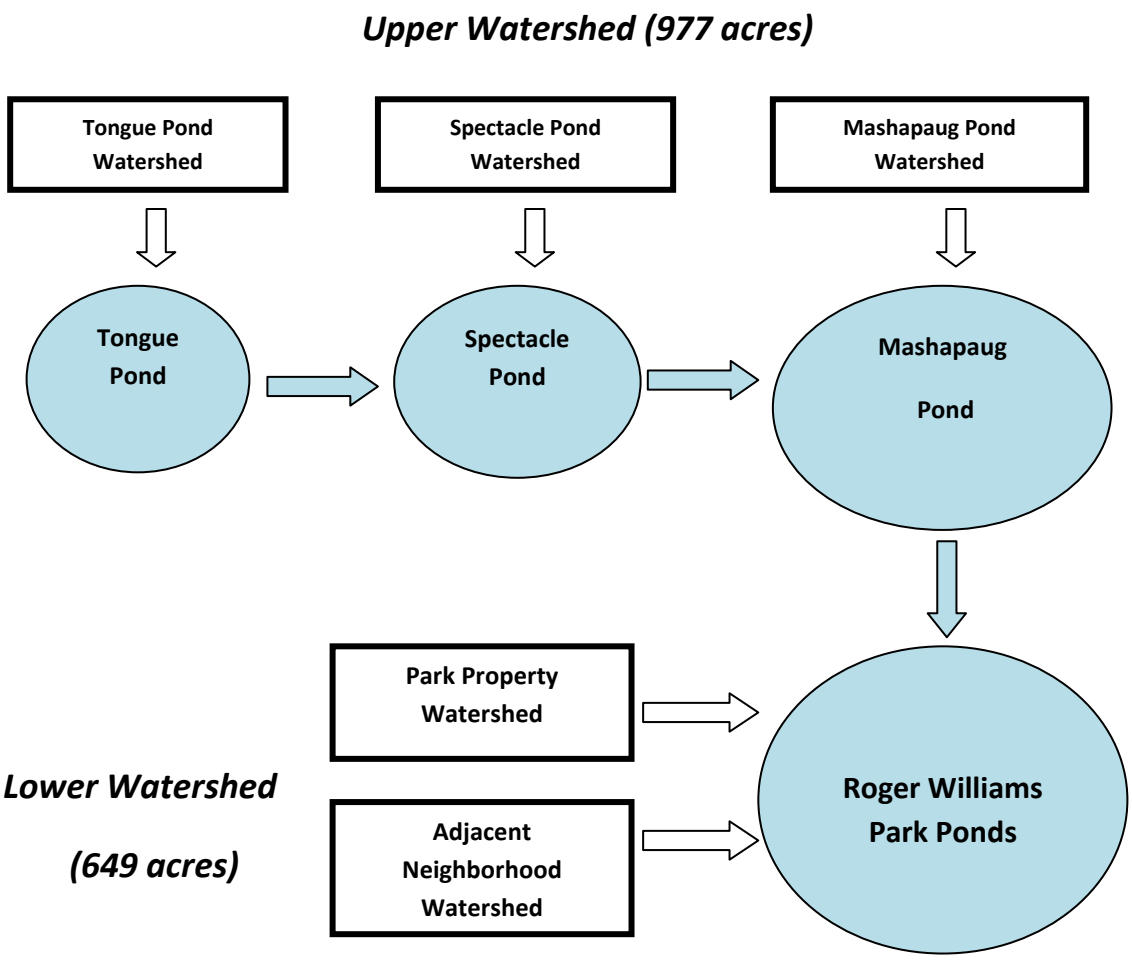
The answer to that question is both simple and complex. To understand what is happening to the ponds, we should remember that the ponds are man-made and shallow. They are not natural, geologically-formed deep lakes such as those that exist in other parts of Rhode Island. And because the Park ponds are shallow, they heat up quickly during the warm weather months of the summer.

When initially constructed in the 1880's and 1890's, the ponds did not exhibit today's water quality problems. The Park at that time was at the southern end of Providence largely surrounded by vacant land. As the city's population grew, the areas around the park were developed into dense residential neighborhoods. Hundreds of acres of vacant land became houses, businesses, streets, sidewalks, driveways, and parking lots.

City engineers provided these nearby neighborhoods with storm drainage systems with storm water outfalls, many of which drained into the Park ponds. Even the Park's principal source of flow—the Mashapaug Brook—was channeled into a large storm pipe before it entered Roosevelt Pond. Throughout the 20th century, engineers also drained Park roads and parking lots into a storm drainage system which today flows into the Park ponds through many outfall pipes.

Not only did the areas around the Park develop, but the area around Mashapaug Pond (and its feeder ponds: Spectacle Pond and Tongue Pond) also was built up. Mashapaug Pond was relatively pristine when its outflow, Mashapaug Brook, was used to form the Park ponds. Indeed, as late as the early 20th century, Mashapaug Pond was a source of block ice for hundreds of Providence homes.

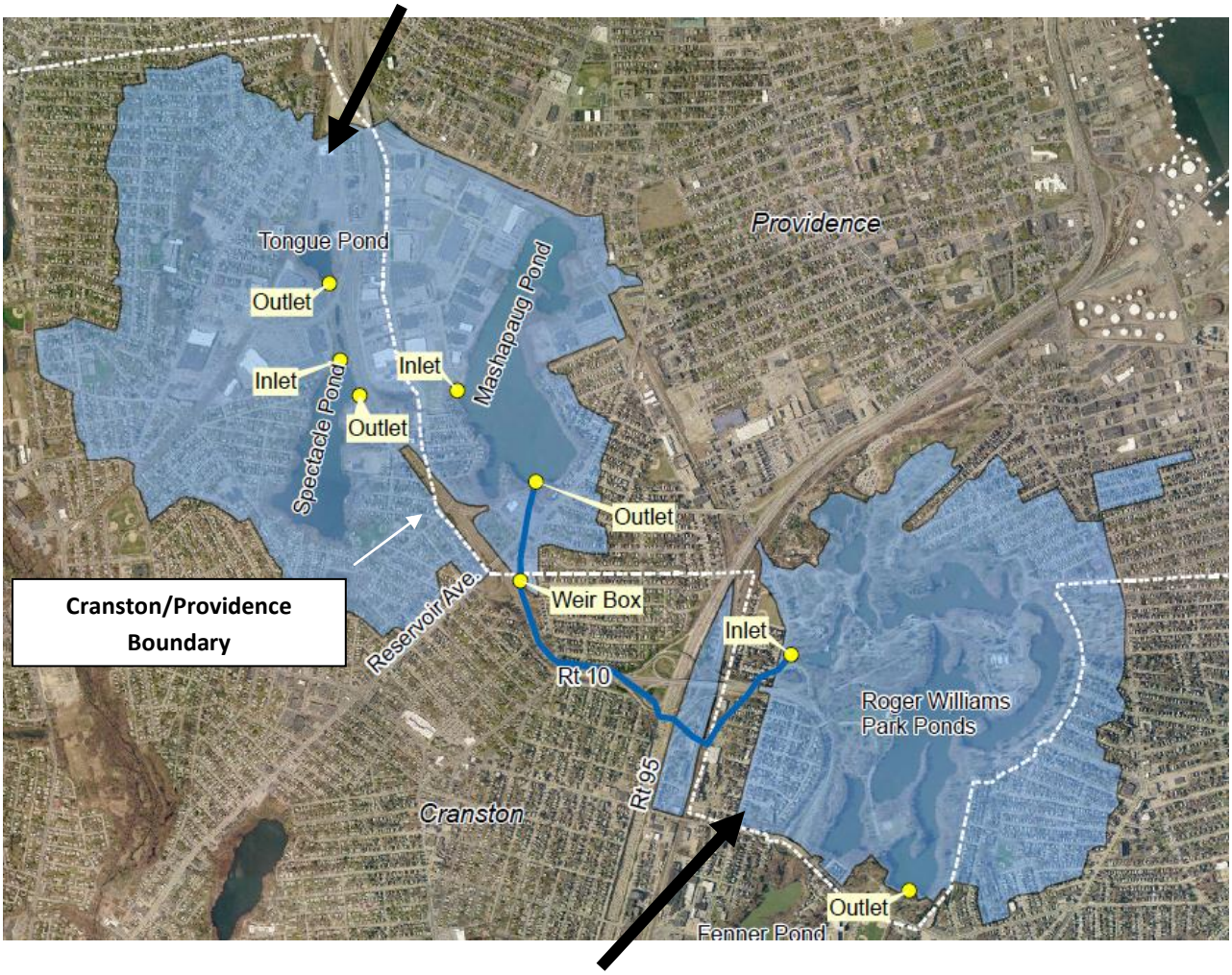
The **accompanying aerial photograph** shows the Park's two main watershed areas—these are the sources of storm water flowing into the Park ponds. The extent of development in the two watersheds is dramatic. The graphic below illustrates the relationship of the Park ponds to its watersheds.



Once dependent solely on the clean water of Mashapaug Brook, the Park ponds have become convenient receptacles for storm water from hundreds of acres of two nearby watersheds. Every time it rains, this polluted storm water drains into the Park ponds. Anything on the impervious surfaces that drains into the Park ponds—dirt, bird waste, pet waste, car chemicals, fertilizer, trash—is carried by the storm water into the Park ponds.

Roger Williams Park Ponds Watersheds

Upper Watershed (977 acres)

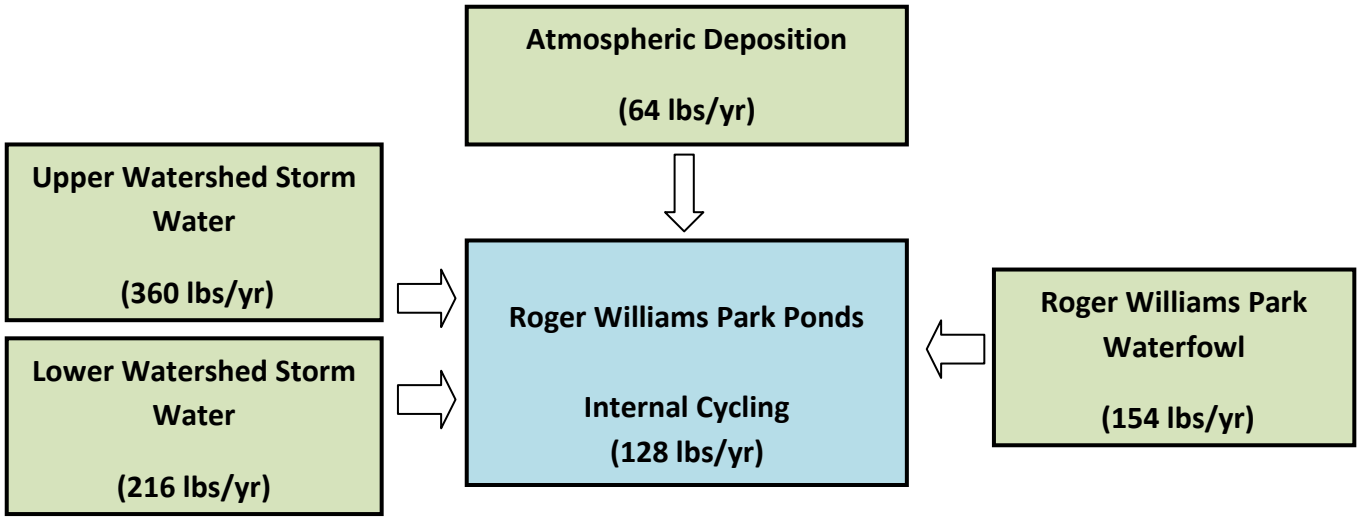


Lower Watershed (649 acres)

Phosphorous is a major concern in the storm water flowing into the Park ponds.

A modest increase in phosphorous in a shallow pond can, under the right conditions, set off a chain of undesirable biological events that can accelerate algal blooms, undesirable plant growth, depletion of dissolved oxygen, and the death of oxygen dependent fish. This process is called eutrophication. This process may take centuries to occur in undeveloped areas, but in the Park ponds eutrophication is accelerated by the storm water entering the ponds after every rain event. **The shallow warm Park ponds provide a perfect situation for phosphorus to stimulate algal blooms and plant growth.** See graphic below for the sources of phosphorous in the Park ponds.

Estimated Annual Amounts and Sources of Phosphorous in the Roger Williams Park Ponds



Source: Horsley Witten Group, 2013

Storm water flowing over impervious surfaces is the major source of phosphorous in the ponds. But there are two other significant source of phosphorous: 1) the **number of resident Canada geese <u>in the Park.</u>** As the resident geese population increased, park visitors unfortunately began to feed them throughout the year. While well-intentioned, public feeding of the geese in the Park is misguided and as recently as July 2012 there were over 600 resident geese living in the Park. Unknown to most of the Park visitors, the gaggles of geese in the Park have been an environmental and public health disaster because of the sheer volume of fecal matter produced by the geese on park lawns and in the park ponds. Park officials began a comprehensive geese management strategy in 2012, including signs instructing the public not to feed the geese.

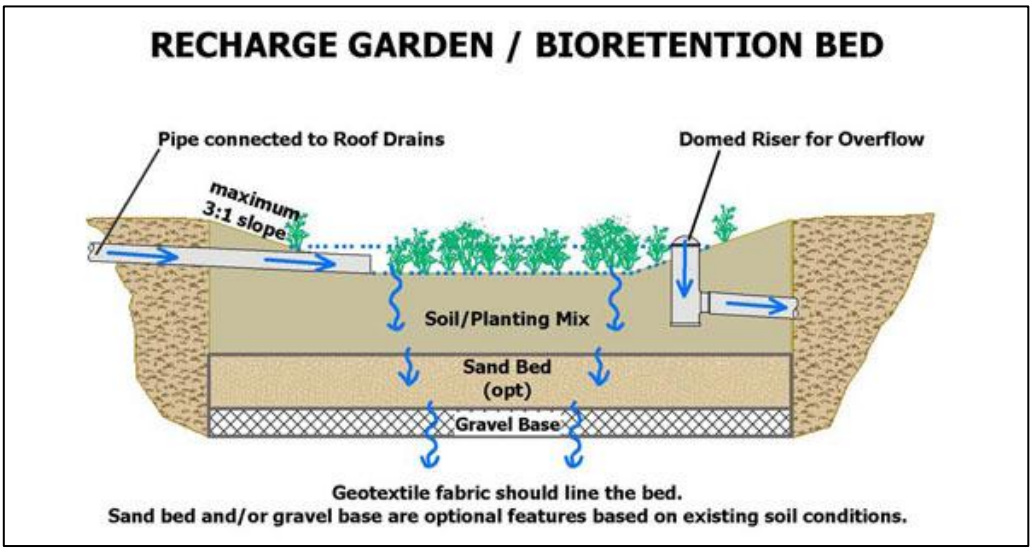
2) A second major source of phosphorous <u>within the park</u> is the **accumulated sediment** in the Park ponds that has settled into the bottom of the ponds from decades of storm water runoff. This sediment is rich in phosphorous and is subject to a process called **"internal cycling**". According to DEM, "it is entirely probable that sediments (in the Park ponds) release phosphorus into the water column" and that this release occurs in the summer months.

4.0 What Can Be Done: Best Management Practices

The WQMP for the Park ponds developed scores of potential remedies to reduce phosphorous loadings entering the ponds. Outlined below are some of the **principal categories of best management practices** that potentially may improve the water quality of the Roger Williams Park ponds:

4.1 Structural Storm Water System Changes

- **Storm Water System Retrofits**— the WQMP examined over 30 locations in the Park where the existing storm water pipes could be diverted and re-engineered to enable storm water to flow into bio-retention vegetated areas and swales before entering the groundwater into the ponds. **This technique essentially allows the storm water to be intercepted and to be treated before it enters the pond system**. The graphic below illustrates a typical storm water treatment design. Park officials and the Technical Steering Committee selected several sites to begin implementing storm water retrofit projects. Projects were selected based on phosphorous removal, cost, ease of implementation, and other factors like public education benefits. These sites are shown in **Exhibit 4-1.**



Park staff will continue to design and install additional storm water retrofit facilities over the next five years, focusing in particular on the priority outfalls identified in the 2007 RI Department of Environmental Management TMDL report on the Park ponds**. See Appendix A for a list of these priority outfalls.**

Exhibit 4-1: 2012-13 Storm Water Retrofit Projects in Roger Williams Park

Site 3B: Carousel Parking Lot

Constructed bio retention garden to intercept and treat flows from a 1.4 acre area of the park.

Site 6: Roosevelt Pond

Removed 40,000 sf of road paving; installed walkway and rain gardens and shoreline planting to intercept and treat flows from 3.4 acres of the Park.

Site 17/18: Polo Lake (DEM Priority site)

Modified existing inlet structures and diverted storm flows to bio retention area to intercept and treat flows from 3.8 acres of the Park.

Site 24: Cunliff Pond Removed 15,000 sf of road paving; intalled flumes directing storm water from 3.15 acres of the Park to a bio retention area.

Site 28: Elm Lake at Edgwood Blvd. and FC Greene Memorial Blvd. (DEM priority site)

Removed 15,000 sf of pavement and created a bio retention area and infiltration basin to intercept and treat flows from 22.2 acres from a residential area east of the Park.

- **Disconnecting Building Downspouts**—Many of the Park buildings have downspouts which disconnect directly into the street drainage system. The roof areas in the Park total over 100,000 sq. ft. and they send storm water into the ponds. These downspouts can be disconnected relatively easily from the underground pipes and the downspouts can be altered to divert the storm water into adjacent planting areas. This has been successfully done in a demonstration at the Botanical Center already as seen in the accompanying photo at right.

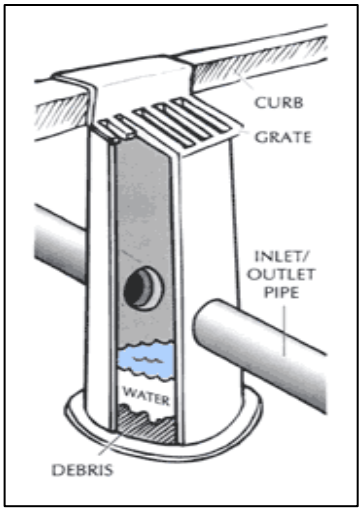
  This practice also offers significant potential in the upper and lower watersheds where **neighborhoods, according the WQMP, have generally 50-60% of houses with downspouts directly connected to underground storm water pipes that lead to water bodies.**

4.2 Non Structural Practices

While some of the above structural practices will involve considerable capital costs, there are scores of nonstructural practices, much less costly, that can be implemented in the Park and in the nearby watersheds to reduce storm water loadings flowing into the Park ponds.

- **Park Operations and Maintenance Practices**—Daily operations in Roger Williams Park and the abutting watersheds can be altered and adjusted to reduce storm water pollution. Here are the most significant practices that should be considered:

  --Catch Basin Cleaning: Catch basins in the street "catch" storm water flowing on the street and then discharge the storm water flows from the catch basin through a pipe into a nearby water body. As seen in the accompanying sketch, catch basins are designed to settle out solids before the storm water flows into the discharge pipe. Catch basins can potentially be a significant method for reducing storm water pollution flowing into the Park ponds, if the catch basins are periodically cleaned of the settled solids.



If the catch basin solids are not regularly cleaned, they eventually fill up the catch basin and storms will flush the solids into the discharge pipe into the nearby water body. Roger Williams Park has approximately 45 catch basins and there are several hundred in the upper and lower watersheds outside of the park. The Parks Department does not have its own vacuum truck to clean out catch basins—it depends on an already burdened Providence Department of Public Works (DPW) to periodically clean Park catch basins as well as the catch basins in the upper and lower watersheds. Catch basin cleaning does not consistently occur in the Park due to the City's limited resources to maintain 20,000 catch basins in the city.

Park officials are examining how to develop an internal catch basin cleaning program within the Parks and Recreation Department.

--Street Sweeping: One way to reduce the amount of solids and trash on Park and watershed streets from flowing into the storm water drainage system is to sweep the streets more frequently. The Parks Department does not own a street sweeper and depends on Providence DPW to sweep the 10 miles of roads in Roger Williams Park twice a year. Park officials need to determine how to supplement the DPW services with private vendors to **ensure a minimum of 4 street sweepings/year in the Park and watershed.**

--Turf Mowing Operations: When the Park was designed in the late 19th century, Park design emphasized grass lawns coming right to the edge of the water. Several thousand feet of shoreline in the Park have shorelines with mowed grass. This design and practice presents an aesthetically pleasing appearance, but it is not a compatible water quality management practice: it allows geese to easily go between the ponds and the shoreline; it provides no natural vegetative buffer to absorb pond nutrients. Park officials need to commit to a "natural shoreline".

Willow Pond shoreline

--Maintenance Operations "Hot Spots": The WQMP identified several areas in Park maintenance areas where better housekeeping operations by Park staff will minimize pollution from entering the ponds after rain events. The Grounds Maintenance Yard and the Mounted Command facility on Noonan Island need to develop management practices to avoid pollutants from flowing into the ponds.

- **Pavement Reduction**—This activity involves reducing storm water pollution in the ponds by **reducing the area of impervious surfaces**—primarily parking lots and roadways—in the Park. The Park has many wide roads that could be narrowed, but this type of structural change needs to consider parking and traffic issues very carefully. Thus, Park staff will examine where pavement can be reduced at a reasonable cost without affecting normal Park use. For example, **the current storm water retrofit project along Roosevelt Pond also involves the removal of almost 40,000 sq. ft of road area.**

- **Curb Removal**—Roger Williams Park, unlike the large state parks in Rhode Island, has miles of curbing along its roads. This curbing is a legacy of work done by the Works Progress Administration in the 1930's and was a well intentioned effort to channel storm water into catch basins to flow into the ponds.

  There are many opportunities in the Park to selectively remove curbing and to allow storm water to flow into existing grass areas and to be absorbed into groundwater.

- **Geese Management**—As pointed out in Section 2, the resident Canada geese contribute to the phosphorous loads that are harming the Park ponds. In 2012 the first steps to manage comprehensively the resident geese were undertaken: addling all of the geese eggs in the Park nests; removing several hundred geese under contract with the US Department of Agriculture; installing "geese education signs" in key geese feeding areas of the Park; and public education of park visitors by summer high school interns. This comprehensive effort needs to continue for several years to keep the resident geese population in check.

- **Shoreline Buffer Planting**—To accelerate natural vegetation along the shorelines, it will be useful to **pro-actively plant native plant species along many of the Park shorelines**. This will have many water quality management benefits as discussed above under **"Mowing Operations".**

- **Steep Slope Stabilization—**Most of the sediment that is in the Park ponds is the result of sand washed into the ponds from the upper and lower watershed storm drainage systems, a some pond sediment is from erosion of sloped lawn areas that have lost their grass cover for one reason or another. These steep slopes with bare soil should be re-seeded systematically with appropriate erosion control matting in September of each year.

- **Public Education and Outreach—**Clean water in Roger Williams Park is not just a municipal or public sector responsibility, and it will not occur if total responsibility is left with government actions. Park users, and particularly upper and lower watershed residents, need to do their part to improve the ponds' water quality. The WQMP indicates that upwards of **60-65% of the phosphorous loads coming into the Park ponds problems come from outside the Park**. Watershed residents and businesses will need to be continually engaged to learn what they do on their properties affects the storm water flowing into the Park. Park officials also need to ramp up efforts to inform and inspire Park visitors to create a constituency for clean ponds.

Lake identification signs will be installed to promote awareness by Park visitors

4.3 In-Pond Options

While the land-based options and public outreach will significantly reduce pollution loads entering the pond, many of the actions will be expensive and will make a major difference in the ponds only in the long term. The following are some in-pond management options identified in the WQMP that to be considered for implementation.

- **Chemical Treatment of Aquatic Weeds and Algae**—Park officials have been chemically treating aquatic weeds and algae, under RI DEM permit procedures, for approximately 20 years. Aquatic herbicides are used to treat rooted aquatic weeds and copper sulfate is used to treat algal blooms. The doses for these applications are governed by time of year and water temperature, are relatively inexpensive--about $5,000-7,000 per year, and provide temporary relief for algae and aquatic plants during the Park's busy time of year.

- **Dredging of Pond Sediment**—In the early 1980's Park officials dredged Roosevelt Pond, Willow Pond, and Polo Pond to address water quality problems that existed in the ponds at that time. While well-intentioned, dredging was a very expensive short-term solution. Because nothing was done to control the sediment and phosphorous coming in from the upper watershed into Roosevelt Pond, all three ponds have long since lost the pond depth that was achieved in 1982. In addition, Pleasure Pond has also lost considerable pond depth.

The lesson from this early 1980's dredging effort is that water quality improvements have to be sequenced properly or the benefit of these actions will be limited. Dredging will be needed again in at least 3 or 4 of the Park ponds, but land based efforts and upper watershed efforts need to be done first.

- **Chemical Treatment of Exiting Sediment in the Ponds**—One of the issues unresolved by the WQMP is the extent to which existing sediment in the ponds releases phosphorous into the water column under certain depth and dissolved oxygen conditions. This phenomenon is called "internal recycling" and it may be a significant contributor to phosphorous in the Park's deeper ponds, i.e., Cunliff, Elm and Edgewood. When existing phosphorous loads coming into those ponds from the lower watershed are substantially reduced, water quality testing will need to determine if internal recycling is an issue. At that point Park officials may consider treating the sediment with aluminum sulfate or sodium sulfate. This is a relatively expensive treatment—about $1,500/acre, however, and will require careful dosing to not harm existing fish in the ponds.

4.4 Mashapaug Pond Flow into the Park: Options

The WQMP recognized that the goal of reducing phosphorous in the Park ponds from the upper watershed that flows into the Park ponds from Mashapaug Pond will be daunting to achieve. Two cities are involved; three water bodies; scores of dense residential neighborhoods with no common identity or track record of working together; one industrial park; and hundreds of stand-alone businesses.

While all of the above discussed structural, non-structural, and public outreach efforts need to be started and pushed forward, the pace of implementation in the upper watershed will likely be far more challenging than the efforts in the lower watershed.

In the meantime, phosphorous loads from Mashapaug Pond—the major source of pollution for Roger Williams Park—will continue to limit the efforts in the lower watershed to reduce storm water pollution in the Park ponds. What can be done in the interim, before scores of pollution reduction actions are implemented in the upper watershed? The WQMP suggests three important small scale solutions that will need more study, but which appear to be promising.

- **Chemical Dosing Station—**The 48" pipe that carries the Mashapaug Brook and the storm water flows from the upper watershed is essentially a point source of pollution for the Park ponds. The WQMP suggests chemical treatment of the water coming from this point source should be considered as an interim measure until long-term solutions in the upper watershed to reduce pollution are implemented. The suggestion: a dosing station that would treat the phosphorous and suspended solids.

  One or more aluminum compounds would be fed into the storm pipe during storm events, either at the discharge point in Roosevelt Pond or upstream of the Park and would bind up the phosphorous and suspended solids precipitating a floc that would fall out of the flow. Park officials recognize the need for extensive study to examine the permitting for such a dosing station, operational requirements, maintenance requirements, treatment protocol, and disposal of the precipitated floc.

- **Mashapaug Brook Weir Box Re-engineering**—When Route 10 was constructed, some of the storm flows from Mashapaug Pond were altered to go through a weir box (just east of RT 10 and south of the Calart Building) into a 72" pipe that bypasses the Park ponds. Currently all of the low flows and smaller storm flows are directed towards the Park ponds through the 48" pipe into Roosevelt Pond. The WQMP indicates that if the weir box is modified to divert more of the storm events into the 72" pipe that bypasses the Park ponds that this may reduce the phosphorous loads that come into Roosevelt pond after storms. **However, smaller storms with relative clean flow might then bypass entry into RWP ponds.** A detailed engineering study to examine the desirability/feasibility of any weir box modification is needed. Finally, a hydrologic study should examine if **sewer separation is warranted in the upper watershed to provide historic water flows to the park.**

- **Chemical Treatment of Sediment in Mashapaug Pond**—The RI Department of Environmental Management indicates in its 2007 report on Mashapaug Pond that "internal recycling" of phosphorous in Mashapaug Pond maybe a a major contributor to the phosphorous loads originating from Mashapaug Pond and flowing into the Park ponds during the summer months. The conditions in Mashapaug Pond in the summer months—relatively deep pond, high water temperatures, and low dissolved oxygen levels—allow the release of phosphorous into the water column. Thus, treating portions of Mashapaug Pond sediment during summer months with an aluminum or sodium sulfate compound may be able to inactivate phosphorous and bind it to the pond sediment impinging the ability of the phosphorus to be released. A detailed study of this treatment is needed since it may require several acres of Mashapaug Pond to be treated.

5.0 What Can Be Done: Recommendations & Actions

The WQMP outlines an array of best management practices for reducing storm water pollution in the Park ponds. Some key findings and principles should guide Park officials in deciding how to proceed during the next eight to ten years.

- **A Long-Term Commitment to Managing the Water Quality in the Park Ponds Is Needed.** A year-by-year set of cos- effective solutions for the next several years will be required that take advantage of available scarce resources. There are no quick and easy solutions. Park officials need to plug away each year targeting a sequence of activities to reduce storm water pollution entering the ponds.

- **Engineering Solutions Alone Will Not Clean Up the Park Ponds—Public Attitudes Need to be Changed.** The WQMP looked at 35 structural storm water retrofit projects to address the storm water pollution from existing storm water outfalls in the Park (not including the pipe from Mashapaug Pond) and the total cost was estimated at around $1.8-2.0 million. The Park can't simply buy its way out of the pollution problem in the ponds--first because these infrastructure projects are expensive, and secondly they will not address all of the phosphorous loads flowing into the ponds. Many of the sources of phosphorous coming into the Park ponds are the result of human behavior, such as feeding geese and residential fertilizer used in watershed areas near the Park. A consistent public outreach program is needed to change public behavior and attitudes about the Park ponds.

- **Water Quality Management Improvements Start at Home in the Parks Department.** There are a number of **operational and maintenance tasks** that Park staff need to focus on to help reduce pond pollution, including:
    - systematic catch basin cleaning
    - educating park visitors about geese feeding and littering
    - allowing and providing shoreline buffer vegetation
    - allowing leaves to remain in wooded hillside areas
    - diligently addressing slope erosion issues as they develop each year.
- **We Will Need Additional Study to Determine Long Term Solutions for Some of the Pond Water Quality Issues.** We not only need to provide an annual water quality sampling program in the ponds to monitor the effectiveness of our on-going efforts, we also need to look at the following un-resolved and/or on-going storm water issues:

1. **Is it possible to treat the storm water coming into Roosevelt Pond from the Mashapaug Pond** watershed to reduce phosphorous? What are the costs?

2. To what extent is the existing sediment that is in the Park ponds releasing phosphorous into the ponds and under what conditions? **Is it cost-effective to selectively treat the sediment in some of the ponds?**

3. What would it **cost to dredge selective Park ponds** and what will be the pollution reduction from such an effort?

4. **Can some storm flows (and the resulting phosphorous loads) from Mashapaug Pond be diverted away from the 48" pipe entering Roosevelt Pond Would such a diversion have a positive impact or RWP pond water quality?**

5. Is it feasible for the City to develop an overall **Regional Storm Water Management District** to fund city wide storm water flow and pollution reduction?

The following Roger Williams Park Pond restoration actions are recommended to be implemented during the 2013 – 2020 period. Depending on the number of actions implemented and the ability to reduce phosphorous from the Mashapaug Pond inflow into Roosevelt Pond, these actions will reduce the phosphorous loads into the Park ponds by 20 to 50% and significantly improve the water quality of the Park ponds. Recommendations are sorted by:

-- Roger Williams Park: LWP recommendations

--Lower Watershed outside of Roger Williams Park: LWN recommendations

--Upper Watershed: UW recommendations

Appendix A: DEM Priority Outfalls in Roger Williams Park

Identified in 2007 TMDL Report for Eutrophic Ponds

Table 4. 4 Priority Outfalls for Roger Williams Park Ponds. Outfall ID	Diameter (in)	Location	Ownership *
RWP-Q	48	Eastern end of Roosevelt Lake	RIDOT/City of Providence/Cranston
RWP-S	48	Eastern shore of Willow Lake	City of Providence
RWP-V	74" x 24" box culvert	Eastern shore of Polo Lake	City of Providence
RWP-H	30" x 42" oval culvert	Southern end of Edgewood Lake	City of Providence
RWP-A	24	Northern end of Pleasure Lake	City of Providence
RWP-D	24	Eastern end of Pleasure Lake	City of Providence
RWP-I	24	Southern end of Edgewood Lake	City of Providence
RWP-U	24	Northern end of Polo Lake	City of Providence

2013 Status of DEM Priority Outfalls

Outfall RWP-Q (977 acres watershed): This is the main City of Providence outfall in Roger Williams Park conducting storm water flows from Mashapaug Pond and the Upper Watershed. This water quality management plan for Roger Williams Park calls for a 20-year effort to reduce phosphorous loads in the upper watershed.

Outfall RWP-S: This is non-functioning storm water outfall and is no longer a priority.

Outfall RWP-V (3.8 acre watershed in RWP): A new bio retention area (Site 17/18) was built in 2013 to intercept and treat this storm water.

Outfall RWP-H (22.2 acre watershed east of RWP in Cranston): A new infiltration basin (Site 28) was built in 2013 to intercept and treat this storm water.

Outfall RWP-A (7.6 acre watershed in RWP): This outfall flow will be addressed in series of best management practices in the Museum of Natural History area in 2014.

Outfall RWP-D (28.5 acre watershed in RWP): This outfall will be treated via a Wet Vegetation Treatment System in 2015.

Outfall RWP-I (26.7 acre watershed east of RWP in Cranston): This watershed and outfall need further assessment scheduled for 2014.

Outfall RWP-U (24.9 acre watershed in RWP): This outfall will be addressed in a series of best management practices in 2016.

ROGER WILLIAMS PARK PONDS RESTORATION RECOMMENDATIONS: SUMMARY

Lower Watershed: Roger Williams Park

#	RECOMMENDATION	Type[1]	Short-Term 2013	2014	2015	2016	2017	Mid-Term 2018	2019	2020	2021	2022	COMMENTS
LWP-1	Water quality sampling	M	$4K	$5K	$5K	$5K	$5K	$3K	$3K	$3k			
LWP-2	Public Outreach	PE	$5K	$10K	$5K	$5K	$5K	$10K	$10K	$10K			Cash/ in-kind
LWP-4	Park Landscape	NS											
	-New Master Plan		$5K	$10K									
	-Revised Mowing Operations												
	-Shoreline Buffer Planting			$20K	$20K	$30K							Cash/ in-kind
	-Parkwide Planting				$20K	$20K	$20K	$20K	$20K				Cash/ in-kind
	-Erosion Control Actions			$10K	$10K	$5K	$5K						
LWP-5	RWP Conservancy	PE											
	- Stratgegic Planning		$5K										
	-Organizational Development			$10K									
	-Advocacy and Fundraising												
LWP-6	Chemically Treat: Weeds & Algae	IP	$10K	$10K	$10K	$10K	$5K	$5K	$5K				
LWP-7	Operations & Maintenance	NS											
	-Purchase Vacuum Truck			$15K	$15K	$15K	$15K	$15K					5-yr lease purchase
	-Ccatch basin cleaning												In-kind/park staff
	-Enhanced street sweeping			$2.5K	$2.5K	$2.5K	$2.5K	$2.5K	$2.5K				
LWP-8	Curb and pavement removals	NS		$20K	$20K	$20K	$20K						
LWP-9	Downspout Disconnections	NS	$10K	$10K									
LWP-10	Storm Water Retro-fits	S			$75K	$75K	$75K						
LWP-11	Dredging Studies	AD											Cost to be determined
LWP-12	Selective In-Pond Sediment Treatment	AD											Cost to be determined

Lower Watershed: Neighborhoods Adjacent to Roger Williams Park

#	RECOMMENDATION		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	COMMENTS
LWN-1	Public Education	PE	$5K	$10K	$5K	$5K	$5K	$10K	$10K	$10K			Cash/ in-kind
LWN-2	Operations & Maintenance	NS											
	-Purchase Vacuum Truck												SEE RWP-7
	-Catch basin cleaning												In-kind/park staff
	-Enhanced street sweeping			$2.5K	$2.5K	$2.5K	$2.5K	$2.5K	$2.5K	$2.5K			
LWN-3	Downspout Disconnections	NS		$3K	$3K	$3K	$3K	$3K	$3K				
LWN-4	Environmental & Storm Water Reg. Enforcement												City staff
Upper Watershed													
UW-1	Public Working Group												Crans./Prov.officials
UW-2	Tongue, Spectacle & Mashapaug Ponds Watersheds Plan	AD		$10K									Match $ w/Cranston $
UW-3	Downspout Disconnection Program	NS											Park staff/in-kind
UW-4	Watershed Public Education	PE		$3K	$3K	$3K	$3K	$3K	$3K	$3K			
UW-5	Industrial Park Working Group												
UW-6	Design Services for Prototype Projects for Industrial Park and Downspout Disconnections	S		$15K	$15K	$15K							
UW-7	Additional Studies: Weir Box, Mash. Pond Treatment Options	AD		$20K	$20K	$20K							

[1]Abbreviations:

S=	Structural BMP	IP=	In -pond	M=	Water Quality Monitoring
NS=	Non Structural BMP	PE=	Public Eductaion	AD=	Additional Studies

LWP-1 RECOMMENDATION: *Provide On-going Water Quality Sampling*

PURPOSE:
- o To measure effectiveness of on-going water quality improvement actions
- o To provide additional data on storm outfall pipe flows
- o To provide data necessary for additional studies

DESCRIPTION: This activity should partner with Watershed Watch of URI and the EPA Region 1 laboratory to develop an annual sampling program that will allow Park officials to evaluate water quality changes and to make decisions on future strategies.

TIME FRAME: 2013 - 2020

ESTIMATED COSTS: $5,000 per year

FUNDING: Rental fees from Park paddleboat concession

LWP-2 RECOMMENDATION: *Provide a Public Outreach Program in the Park*

PURPOSE:
- o To raise awareness of Park users about the ponds as an important aesthetic, recreational, and ecological resource
- o To instill respectful behavior from Park users towards the Ponds and the Park environment

DESCRIPTION: Park signage; social media; web site info on water quality; annual Parks Pond Festival.

TIME FRAME: 2013 - 2020

ESTIMATED COSTS: $5,000-10,000 per year + in-kind

FUNDING Rental fees from Park permits

LWP-3 RECOMMENDATION: *Continue Geese Management Program*

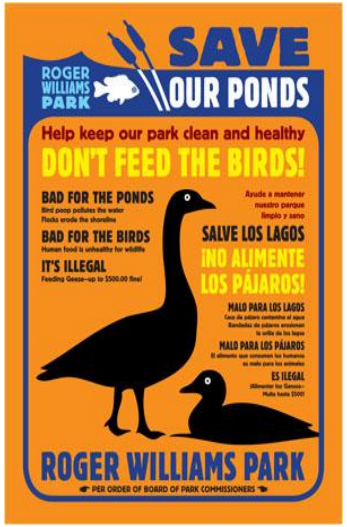
PURPOSE: o To restrict number of permanent resident Canada geese in the Park to less than 75 geese

DESCRIPTION: Continue comprehensive program begun in 2012 to include geese egg addling program, signage, park ranger enforcement of no feeding of geese. Coordinate w/recommendation RWP-4 (shoreline buffer planting).

TIME FRAME: 2013 - 2020

ESTIMATED COSTS: $5,000-10,000 per year for 2013 - 2015;

FUNDING: Rental fees from Park permits



LWP-4 RECOMMENDATION: *Implement Park Landscape Changes*

PURPOSE: o To revise Park mowing operations to conserve shoreline natural vegetation;
o To install annual plantings to enhance shoreline buffer areas, to prevent turf erosion, and to enhance the park aesthetics

DESCRIPTION: Develop a new Parkwide Landscape Plan to guide landscape operations and plantings for the next eight years. Utilize native plantings and trees for landscape plantings. Provide staff training

TIME FRAME: 2013 - 2020

ESTIMATED COSTS: Master Plan: $25,000;
Planting: $160,000; Erosion Control: $30,000

FUNDING: Charles H. Smith Trust Fund

LWP-5 RECOMMENDATION: *Develop a Roger Williams Park Conservancy*

PURPOSE:
- **To develop and cultivate a non profit organization to promote and raise funds for the Park**
- **To develop a constituency to support the Park**
- **To network with in-Park and regional organizations to assist improvements in the Park**

DESCRIPTION: **Park officials should seek consultant services to develop and organize the Conservancy, including the development of a strategic mission and plan for the organization. Starting in 2015, the RWP Conservancy will hopefully be a partner organization providing advocacy and fundraising services.**

TIME FRAME: **Strategic planning and organizational development in 2013-14;**

ESTIMATED COSTS: **$15,000 for 2013-14;**

FUNDING: **Grant funding supplemented by park permit fees**

LWP-6 RECOMMENDATION: *Chemically Treat Algae and Aquatic Weeds*

PURPOSE:
- **To diminish and control annual algae and aquatic weed growth that occurs every summer in the ponds**

DESCRIPTION: **Coordinate with RWP-1.**

TIME FRAME: **2013 - 2020**

ESTIMATED COSTS: **$10,000/per year**

FUNDING: **Rental fees from Park paddleboat concessions**

LWP-7 RECOMMENDATION: Upgrade Operations and Maintenance

PURPOSE: o To prevent solids and debris from catch basins and roads from being washed into the Park storm drains and into the Ponds after rain events

DESCRIPTION: Parks officials would lease purchase a trailer vacuum catch basin cleaner with a 6 cy capacity and do its own catch basin cleaning without relying on DPW. Supplement DPW street sweeping with contracted services.

TIME FRAME: 2013 - 2020

ESTIMATED COSTS: $22,500/year for 2014-2018; $2.5K/year 2019-2020

FUNDING: Lease purchase program for CB cleaner; park permit fees.

LWP-8 RECOMMENDATION: *Remove Selected Curbs and Pavement*

PURPOSE: o To reduce amount of storm water and related pollutants entering the Park ponds from park roads

DESCRIPTION: Curb removal in the Park will be more cost effective than pavement removal. This recommendation will focus on removing curb in areas where storm water could flow on to existing vegetated areas.

TIME FRAME: 2014 - 2017.

ESTIMATED COSTS: $15,000-20,000/year from 2014 on

FUNDING: Charles H. Smith Trust Fund

LWP-9

RECOMMENDATION: *Disconnect Building Downspouts*

PURPOSE: o To reduce amount of storm water and related pollutants from Park building roofs from entering the Park storm water system

DESCRIPTION: Develop alternative places for downspout rain water to go without going into the Park storm system. This initiative would target the main Park buildings.

TIME FRAME: 2013 - 2014.

ESTIMATED COSTS: $10,000/year for 2013-2014

FUNDING: Charles H. Smith Trust Fund

LWP-10

RECOMMENDATION: *Install Additional Storm Water Retro-fits*

PURPOSE: o To intercept storm water and related pollutants from existing storm drainage system and re-direct it to swales, rain gardens, and bio-retention areas for treatment

DESCRIPTION: The Park will complete 4 sites in 2013 that were begun <u>in 2012. Approximately 3 more high priority DEM sites will be done in 2015-2017.</u>

TIME FRAME: 2015 - 2017

ESTIMATED COSTS: $75,000/year for 3 years supplemented with in-kind.

FUNDING: Charles H. Smith Trust Fund

LWP-11

RECOMMENDATION: *Study Dredging in Selected Park Ponds*

PURPOSE: o To restore pond depth in selected ponds to enhance recreational boating, to improve pond aesthetics, and to diminish aquatic weed growth.

DESCRIPTION: A detailed study and permit application would be completed in 2018 if it appears that efforts to reduce road sand from getting into the inflow pipe in Roosevelt Pond have been successful. The ponds to be dredged will be dependent on costs. Roosevelt Pond would be the highest priority.

TIME FRAME: 2018-2020

ESTIMATED COSTS: To be determined

FUNDING: To be determined

LWP-12

RECOMMENDATION: *Study Sediment Treatment in Selected Ponds*

PURPOSE: o To prevent release of phosphorous in summer months when dissolved oxygen levels are low

DESCRIPTION: This action would be targeted to Elm Pond, Cunliff Pond, and Edgewood Pond after phosphorous loads entering these ponds have been substantially reduced.

TIME FRAME: 2018-2020

ESTIMATED COSTS: $1,500 - $2,000 acre

FUNDING: To be determined

LWN-1

RECOMMENDATION: *Provide Public Outreach to Nearby Residents about the Park Ponds*

PURPOSE:
- **To raise awareness of Park neighbors about the ponds as an important resource**
- **To let Park neighbors know how they as homeowners can prevent pollution in the Park**

DESCRIPTION: **Fliers; door-to-door educational effort with student interns; invitations to Park events.**

TIME FRAME: **2013 - 2020**

ESTIMATED COSTS: **$5,000-10,000/year**

FUNDING: **Summer jobs program; park permits fees; in-kind**

LWN-2

RECOMMENDATION: *Provide Catch Basin Cleaning/Street Sweeping in Neighborhood Watershed*

PURPOSE:
- **To prevent solids and debris from catch basins and roads from being washed into the Park storm drains into the Ponds after rain events from neighborhood streets adjacent to the Park**

DESCRIPTION: **Parks would supplement DPW street sweeping in selected adjacent neighborhood streets to ensure 2/year service. Parks would do catch basin cleaning in selected streets adjacent to the Park.**

TIME FRAME: **2014 - 2020**

ESTIMATED COSTS: **$2,500/year for street sweeping; catch basin cleaning would be done in-kind by park staff**

FUNDING: **Park permits fees; in-kind**

LWN-3

RECOMMENDATION: *Develop and Provide Homeowner Downspout Disconnection Program in Neighborhood Watershed*

PURPOSE: o To reduce amount of storm water and related pollutants from homeowner building roofs from entering the Park storm water system

DESCRIPTION: Park officials will develop a manual with a menu of downspout disconnect options for homeowners with varying types of yard configurations. Annual demonstrations will be held on local streets. Park officials will supply downspout diversion devices as needed.

TIME FRAME: 2014 - 2020

ESTIMATED COSTS: $3,000/year

FUNDING: Park permits fees; in-kind

LWN-4

RECOMMENDATION: *Advocate Enforcement of Environmental and Site Design Regulations for Neighborhood Commercial Development*

PURPOSE: o To ensure that businesses comply with environmental regulations for property conditions
o To ensure that businesses in the commercial area comply with site design regulations for storm water when businesses seek re-design permits.

DESCRIPTION: Park officials will develop a data base of business property owners and develop a relationship with DPW environmental officials and with the city Planning Department.

TIME FRAME: 2013 - 2020

ESTIMATED COSTS: in-kind/park staff

FUNDING:	**in-kind**

UW-1 RECOMMENDATION: *Develop a Joint Cranston-Providence Working Working Group on Storm Water Management in the Upper Watershed*

PURPOSE:	**o To develop and sustain a working relationship and coordinated effort to reduce storm water runoff pollution in the Mashapaug Pond Watershed**
DESCRIPTION:	**This working group will include Cranston DPW officials, Providence DPW officials, Providence Park officials, and the Environmental Justice League of RI. Efforts will focus on drainage system analysis, public education efforts, and municipal actions related to catch basin cleaning and street sweeping.**
TIME FRAME:	**2013 – 2020**
ESTIMATED COSTS:	**in-kind/park staff**
FUNDING:	**in-kind**

UW-2 RECOMMENDATION: *Develop Storm Water Strategy for the Watershed*

PURPOSE:	**o To develop a priority schedule for te next 8 years for reducing storm water pollution in the Watersheds**
DESCRIPTION:	**A $20,000 engineering study would be completed to analyze the drainage system, to estimate phosphorous loadings by sub-watershed, to recommend priority actions, and to estimate costs.**
TIME FRAME:	**2014**
ESTIMATED COSTS:	**$20,000**
FUNDING:	**$10,000-Cranston; $10,000-Providence (source to be determined)**

UW-3 RECOMMENDATION: *Implement Downspout Disconnection Program in the Watersheds*

PURPOSE:

- **To reduce amount of storm water and related pollutants from homeowner building roofs from entering Tongue, Spectacle, and Mashapaug ponds**

DESCRIPTION: **The Working Group will develop a manual with a menu of downspout disconnect options with varying types of yard configurations. Annual demonstrations will be held on local streets.**

TIME FRAME: **2014 - 2020**

ESTIMATED COSTS: **in-kind**

FUNDING: **in-kind**

UW-4 RECOMMENDATION: *Implement a Public Outreach Program for the Watershed Property Owners*

PURPOSE:

- **To raise awareness of residents about the ponds as an important resource**
- **To let residents know how they as homeowners can prevent pollution in the ponds**

DESCRIPTION: **Fliers; door-to-door educational effort with student interns; other activities to be determined. Coordinate with UW-1**

TIME FRAME: **2014 - 2020**

ESTIMATED COSTS: **Annual costs: $3,000-Cranston; $3,000-Providence, supplemented by in-kind**

FUNDING: **To be determined**

UW-5

RECOMMENDATION: *Help to Form a Huntington Industrial Park Association*

PURPOSE:

- **To raise awareness of business about Mashapaug Pond as an important resource**
- **To let businesses know how they as property owners can prevent pollution in Mashapaug Pond**

DESCRIPTION: **Park officials have begun working with the City Department of Planning and the Environmental Justice League of RI to re-activate an association. Park officials will focus on the storm water issue and the cleanup of Mashapaug Pond**

TIME FRAME: **2013 - 2020**

ESTIMATED COSTS: **in-kind, Park staff**

FUNDING: **in-kind**

UW-6

RECOMMENDATION: *Develop Prototypical Designs for Managing Storm Water on the Properties in the Huntington Industrial Park*

- **To provide engineering guidance, cost estimates, and typical design solutions to Industrial Park property owners to stimulate action by individual property owners**

DESCRIPTION: **Park officials will hire an engineering firm to develop prototypical design solutions for a variety of existing properties in the industrial park**

TIME FRAME: **2014 - 2016**

ESTIMATED COSTS: **$15,000/year for 3 years**

FUNDING: **To be determined**

UW-7

RECOMMENDATION: *Implement Studies on Weir Box Re-engineering, Sediment Treatment, and a Potential Chemical Dosing Station*

PURPOSE:

o To determine the feasibility, advisability, and cost of Horsley Witten suggestions for major reductions in phosphorous entering Roger Williams Park ponds from Mashapaug Pond

DESCRIPTION: **Park officials will hire an engineering firm to perform these starting with the Weir Box Re-engineering study.**

TIME FRAME: **2014 - 2016**

ESTIMATED COSTS: **$20,000/year for 3 years**

FUNDING: **To be determined**