3.4 | Stormwater Improvements

Stormwater System Objectives

The primary stormwater management goals for Herter Park are: resolving present drainage issues for improved park usage and diminishing environmental impact to the Charles River from stormwater discharges, such as sediment, phosphorus, and increased temperature. These goals can be accomplished through a design of a holistic stormwater system with the following objectives:

- Volume Management - reduce the volume of runoff that reaches the sewer system or the Charles River, through the use of green infrastructure and increase of porous surfaces.
- Peak Flow Reduction – reduce peak flow through the use of subsurface detention for water quality rain events.
- Quality Improvement of Stormwater Discharge
    - Total suspended solids (TSS) reduction
    - Total Phosphorus (TP) reduction
    - Discharge temperature reduction

Stormwater System Assumptions

- Existing subsoils are not suitable for infiltration.
- On-site runoff is primarily treated with surface and non-structural Best Management Practices (BMPs).
    - These BMPs were sized for a 1" Water Quality Volume, in accordance with the Massachusetts Stormwater Handbook.
- Off-site inputs are managed with underground detention with filtration and non-structural BMPs.
    - These inputs are anticipated to be directed to a stormwater detention system sized to fit under the parking lots, and designed to optimize the treatment levels.
    - This study does not examine the feasibility of directing off-site stormwater, from either Soldiers Field Road or the Boston Water & Sewer Commission input, into the Artesani subsurface detention system or the other proposed surface or subsurface BMPs.

Stormwater System "Kit of Parts"

The range of proposed measures - "Kit of Parts" - can each contribute in reaching the state stormwater system objectives. For the treatment of the park's surface stormwater, priority is placed on green infrastructure and nature-based solutions such as reduction of impervious surfaces, grading and soil improvements, creating vegetated swales and bioretention areas, as well as increasing the proportion of meadows and more varied vegetation over lawns.

However, in addition to the park runoff, the stormwater system needs to address additional off-site stormwater inputs. These include the Soldiers Field Road, as well as the Boston Water and Sewer Commission (BWSW) infrastructure, which presently discharge significant volumes of untreated stormwater into the Charles. Surface BMPs are not suitable for stormwater treatment of these off-site inputs, because they would take up large areas of the parkland.

Therefore, engineered subsurface structures are proposed to meet the system objectives while allowing that the recreational usage of the park is retained.

The "Kit of Parts" proposed application is shown on the following overall and area-specific diagrams.

1. Impervious Surface Reduction

The proposed Soldiers Field Road road diet - the removal of the westbound lane and eastbound separated slip lane pavement - greatly reduces the impervious area and the volume of polluted off-site road runoff requiring treatment. With the road diet alone, even with the widening of Dr. Paul Dudley White Greenway from the present 6 feet to the proposed 12 feet, the net impervious reduction is about 200,000 square feet, or 4.6 acres.

2. Vegetated Swales

The expanded parkland gained by the removal of the westbound Soldiers Field Road lane offers the opportunity to create vegetated swales to collect and filter the runoff from the adjacent pedestrian / bike path and possibly part of Soldiers field road, contributing to volume management, peak flow reduction, and quality improvements to the stormwater discharge.

Impervious Surface Reduction (Estimate)

Road paving reduction	=	240,000 sf	
			Minus
Ped-bike path widening	=	40,000 sf	
Total Imperv. Reduction	=	**200,000 sf**	(4.6 acres)

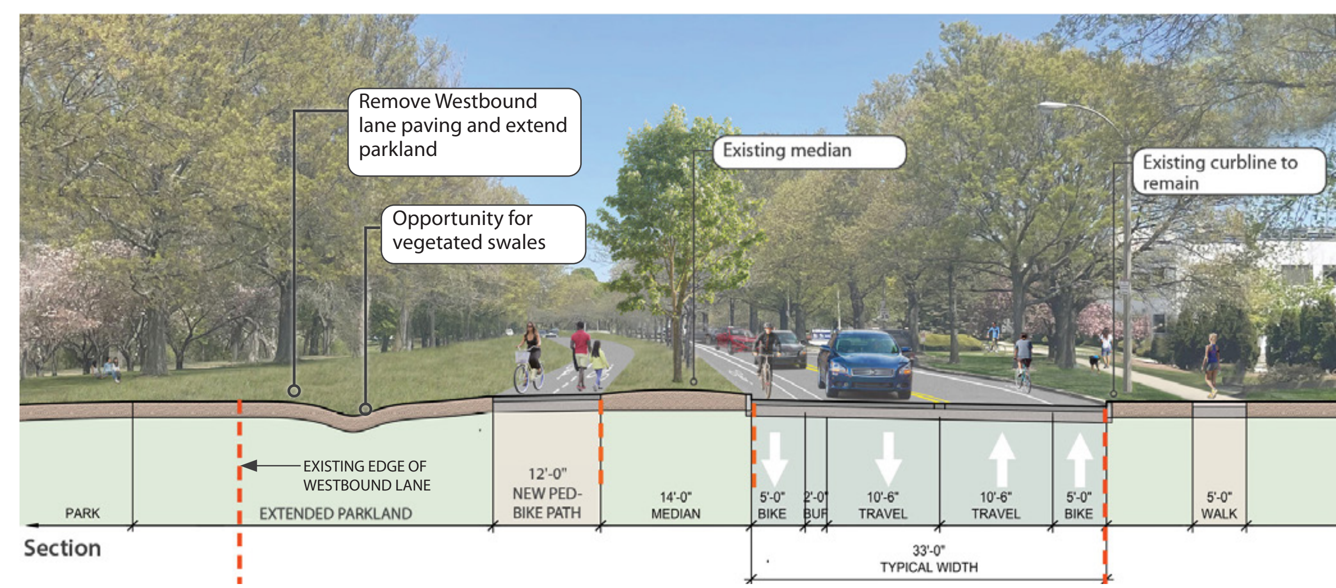


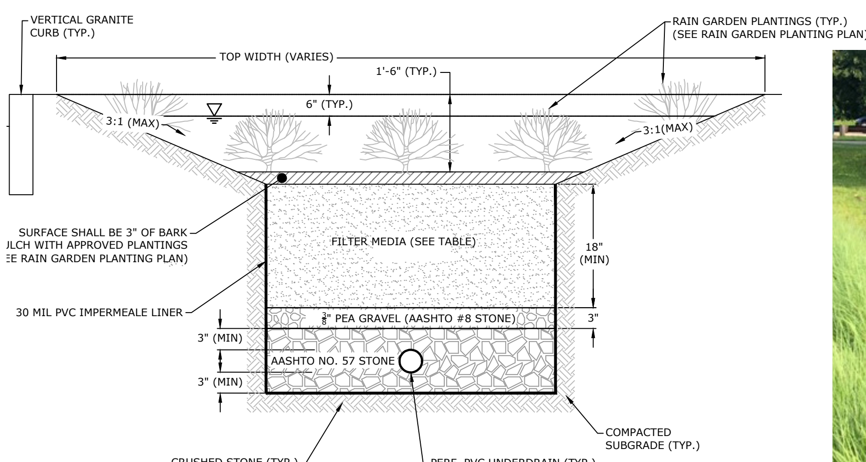
Figure 3-27. Stormwater benefits of the Soldiers Field Road road diet include significant reduction in impervious surface, and opportunities for vegetated swales in the gained open space.

3. Bioretention at Parking Lots

The stormwater management at the parking lots includes regrading for better drainage, and bioretention areas (bioswales) with surface runoff pretreatment best management practices (BMPs). Grading improvements are necessary at the Parking Lots #1 though #4, for better surface drainage and to alleviate the puddling from the existing surface conditions. The proposed pretreatment chambers, between the parking lots and the bioswales, help reduce trash and leaf litter from entering the bioswale. The planting and soil medium within the bioswales are designed to filter sediment, reduce pollutants, and lower the peak flow rate.

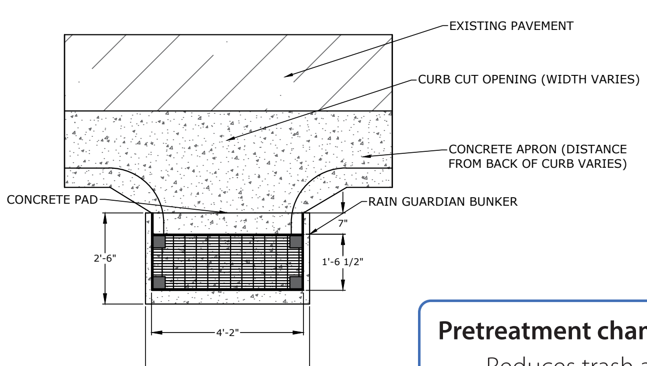
4. Surface treatment for Off-Site Stormwater

The plan proposes two areas where off-site stormwater from Soldiers Field Road could be treated with surface bioretention. One is in the area south of the moat, capturing and pretreating the stormwater, to reduce sedimentation and pollution discharges into the moat; and the other is east of Eliot Bridge, in an open space near the road reclaimed from the road diet.

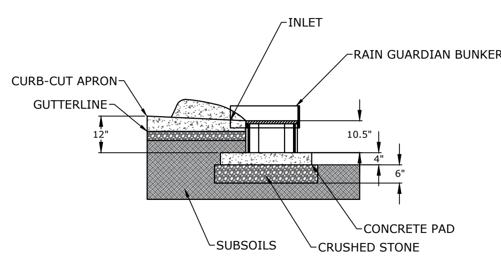


Bioswale cross section at parking, typical.

Bioretention area at DCR Community Rowing



Pretreatment chamber



Pretreatment chamber

- Reduces trash and leaf litter

Bioretention swale

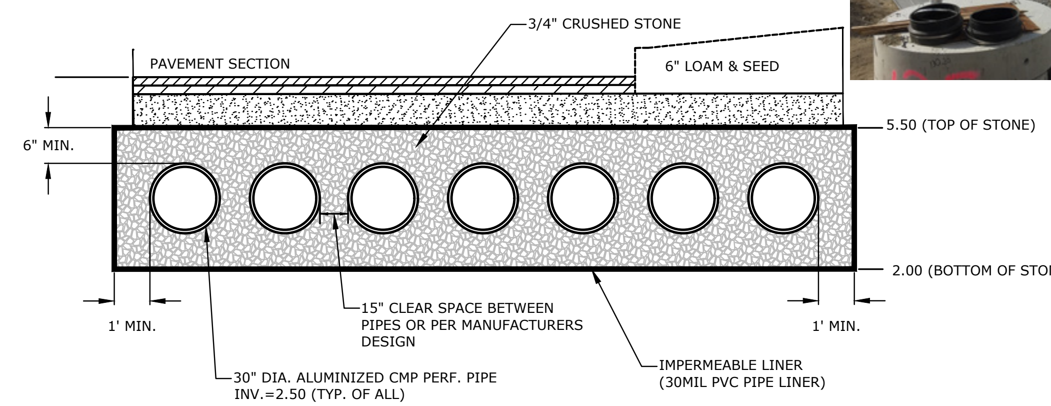
- Filters sediment
- Reduces TSS and other pollutants
- Reduces peak flow rate

Figure 3-28. Surface Runoff BMPs - Bioswales and Pretreatment Chambers

5. Subsurface Storage and Filtering for Off-Site Stormwater

The large expanse of Artesani Parking Lot, as well as the other parking lots, provides the opportunity for subsurface stormwater management of the off-site inputs. The challenge is that the Herter Park soils are not well suited for infiltration, and therefore a subsurface detention rather than infiltration system is proposed. Specifically, a lined corrugated pipe detention system is proposed, which is suitable for high ground water conditions and provides greater efficiency than a gravel filter.

The corrugated pipe detention system is to be used in combination with the Jellyfish Filter in order to achieve the Total Phosphorus removal targets. The Jellyfish Filter, by Contech Engineered Solutions, is a stormwater quality treatment technology featuring high flow pretreatment and membrane filtration in a compact stand-alone system; it removes floatables, trash, oil, debris, TSS, fine silt-sized particles, and a high percentage of particulate-bound pollutants; including phosphorus, nitrogen, metals and hydrocarbons.



Subsurface Corrugated Pipe Detention System

Jellyfish Filter

Corrugated Pipe Detention System

- Suitable for high ground water conditions, which are assumed to be present on site
- Used in combination w/ 'Jellyfish' filter for Phosphorus removal before discharge to river
- Greater efficiency than crushed stone filter

Figure 3-29. Subsurface Storage and Filtering BMPs: Underground Pipe Detention System and Jellyfish Filter

6. Grading and Soil improvements

The proposed Event Lawns at Herter Park are intended as the designated high-usage areas. High-usage lawns require soils that are not easily compacted, are well drained and have good nutrient and water holding capacity, in order to support a resilient grass growth. To improve the surface drainage, recommended grading improvements include raising the elevation in areas with frequent puddling, and sloping / crowning the finish grade. Amending the soil will achieve a better soil structure that can resist compaction, promote aeration and good draining within the root zone. Organic soil amendments (i.e. compost) as well as inorganic amendments (i.e. sand) can be used to improve drainage and aeration along with water and nutrient holding capacity.

7. Lawn Subsurface Drainage

In areas with poor subsurface drainage, such as the East Lawn area, it is recommended that the grading and soil amendments are accompanied with subsurface drainage. Sub-surface drainage systems assist in moving the water out of the soil profile by providing a drainage pathway, and can be effective during high rainfall events and for reducing the water table. There are a few commonly used systems to help improve sub-surface drainage including pipe drains, interceptor drains (also known as French drains), panel drains and sand-slit drains.

8. Moat Dredging

Dredging is recommended to restore the moat system that was degraded by decades of sedimentation, some of it contributed by the discharge of untreated stormwater from Soldiers Field Road. This restoration needs to be combined with pretreatment of future discharges, to slow down the sedimentation process; and with other measures such as subsurface aeration, to keep the moat water from becoming stagnant.

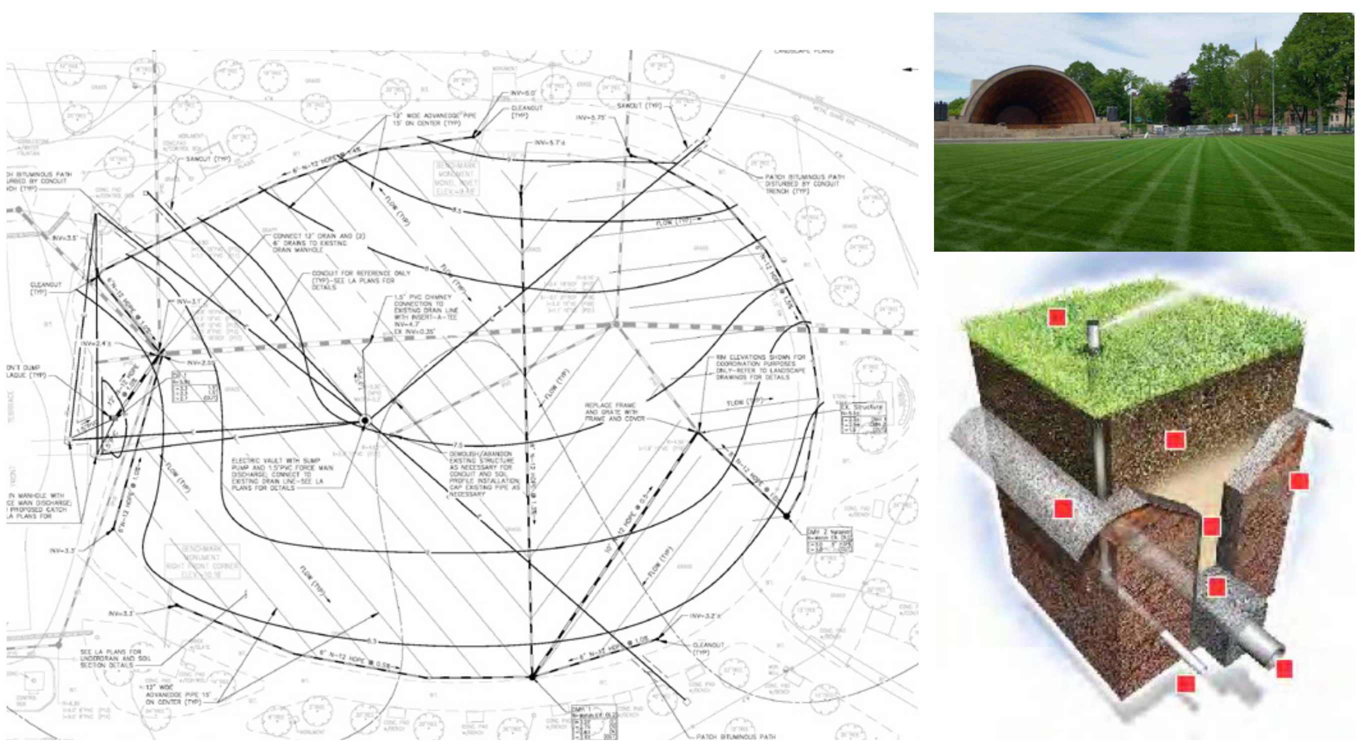


Figure 3-30. Surface grading, subsurface drainage, and lawn amendments are recommended for the high-use / event lawns. The example is from the DCR Hatch Shell Lawn, where surface grading and subsurface panel drains, along with soil amendments were used to create a resilient high use lawn.

West End Stormwater Improvements

The proposed stormwater improvements for the West End, illustrated on the following pages, include impervious surface reduction, vegetated swales, and bioretention swales for surface runoff from the nutrient-rich community garden. Unlike the other parking areas, the West End parking may be suitable for permeable pavement as it may be adequately above groundwater elevations.

Specific to the West End is the presence of compacted, poorly draining soils associated with the former Speedway facilities; it is therefore anticipated that the area of proposed meadow will require soil amendments and grading improvements. East of Henderson Boathouse, once the program is relocated and the garage removed, the soil should be decompacted and restored to lawn with trees; and the bank stabilized with vegetative measures.

Central Area Stormwater Improvements

The proposed subsurface storage facility for the Artesani parking lot is capable of over 160,000 cubic feet stormwater detention in a corrugated pipe system, which is suited to the high ground water conditions. Combining this system with a Jellyfish filter could help reach the target Phosphorus (TP) removal of 60%. It is assumed that this system could treat inputs from the BWSC's system, which currently discharges into the Charles via a nearby drainage line under the Artesani Playground; however the feasibility of directing these inputs into the Artesani subsurface detention system requires further study.

A bioretention area is proposed to treat the surface runoff from the Artesani Parking Lot. The restored event lawn nearby can benefit from grading and soil improvements, as well as improved subsurface drainage. Of special importance is the treatment of stormwater that discharges into the moat. Assuming that the moat will be restored by dredging, pretreatment of the stormwater inputs in surface BMPs will reduce the TSS and TP to target levels prior to discharge and slow down the future sedimentation process.

East Area Stormwater Improvements

In the East Lawn area that presently has some of the greatest drainage challenges, the stormwater treatment approach is to designate areas of higher use that should remain dry and well drained, and areas that can be allowed to remain less dry, where everyday usage will be discouraged. Therefore, the designated high-use lawns are to be improved with grading, sold amendments and subsurface drainage, while the area between the main path and the river can be maintained as a meadow, with designated access points to the river's edge. During events, ground protection mats and decks could be used in these areas to prevent soil compaction from vehicles and crowds.

Stormwater improvements for the three parking lots along the East Lawn include regrading and bioretention for surface runoff. Porous pavement is not recommended due to the high ground water; however, subsurface corrugated pipe detention system under each parking lot could provide storage and treatment for Soldiers Field Road inputs.

Eliot Bridge Area Stormwater Improvements

Stormwater improvements in the Eliot Bridge area include significant impervious surface reduction associated with the proposed reconfiguration of the roadway system, along with areas for surface treatment for the roadway stormwater. The proposed larger swaths of meadow and woodland will further reduce the runoff and provide a higher level of filtration.

Stormwater Improvements Overall Diagram

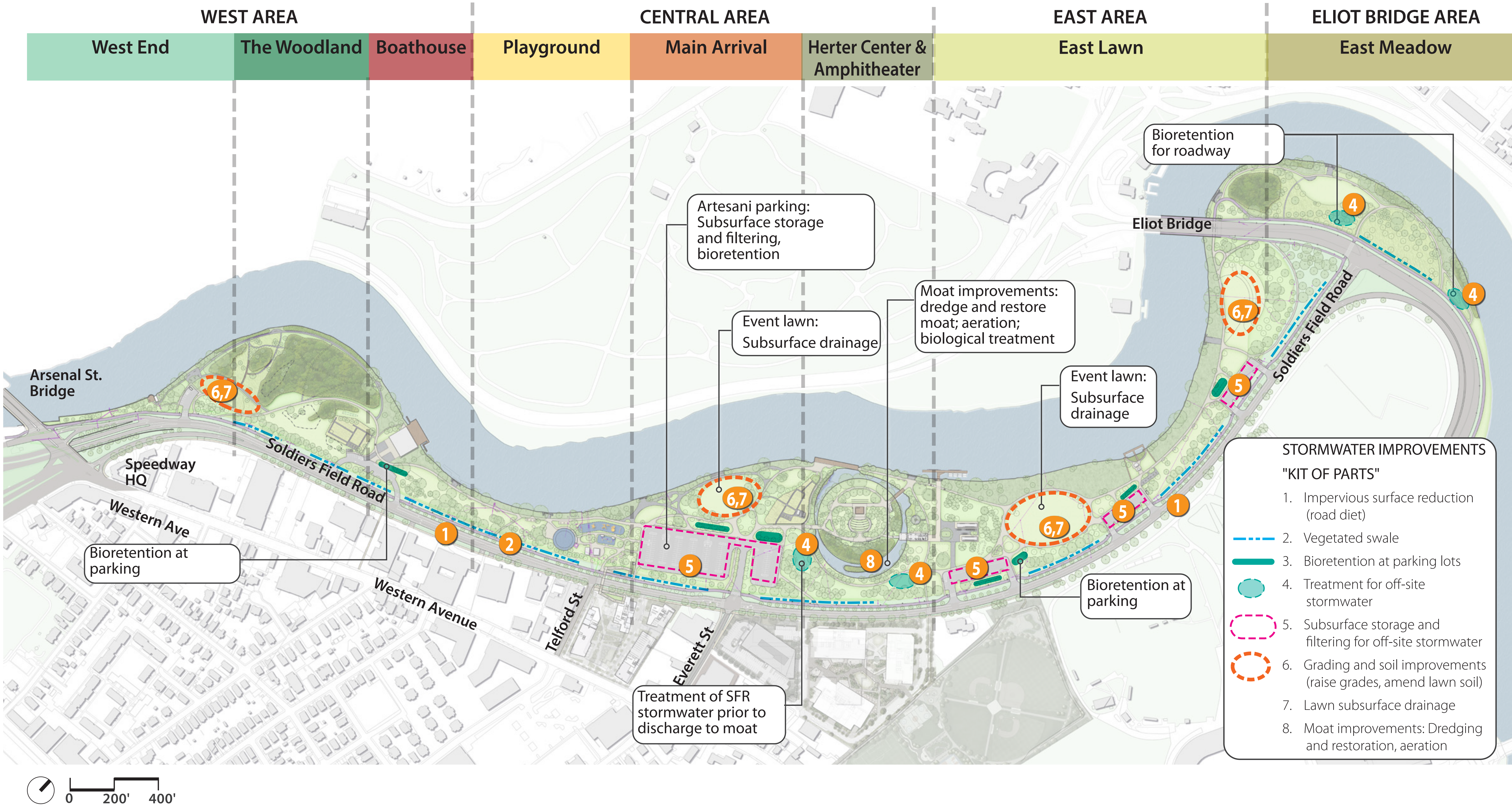


Figure 3-31. Stormwater Improvements Overall Diagram.

West Area Stormwater Improvements

Figure 3-32. West area stormwater improvements.

Central Area Stormwater Improvements

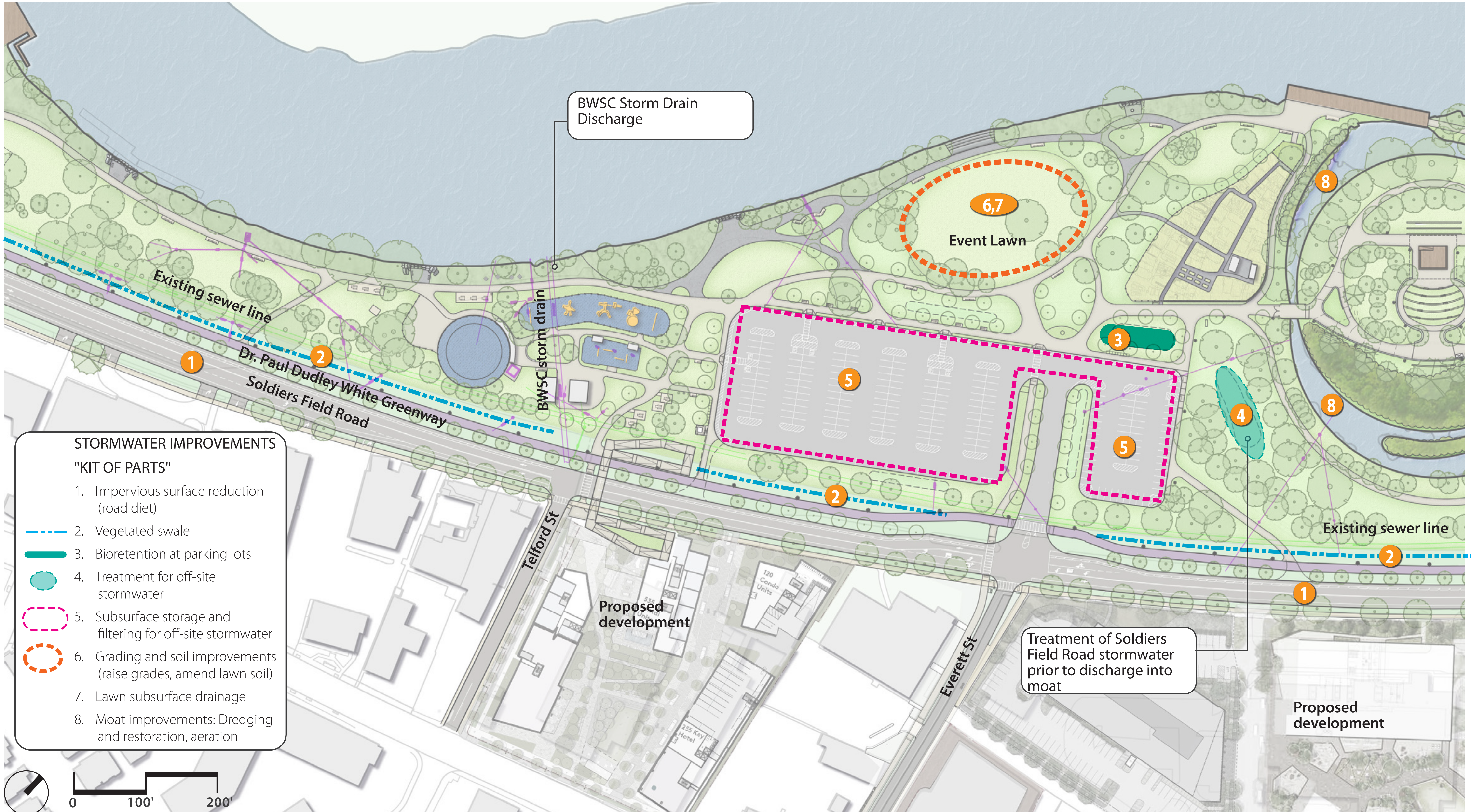


Figure 3-33. Central area stormwater improvements.

East Area Stormwater Improvements

Figure 3-34. East Area stormwater improvements: East Lawn.

Eliot Bridge Area Stormwater Improvements

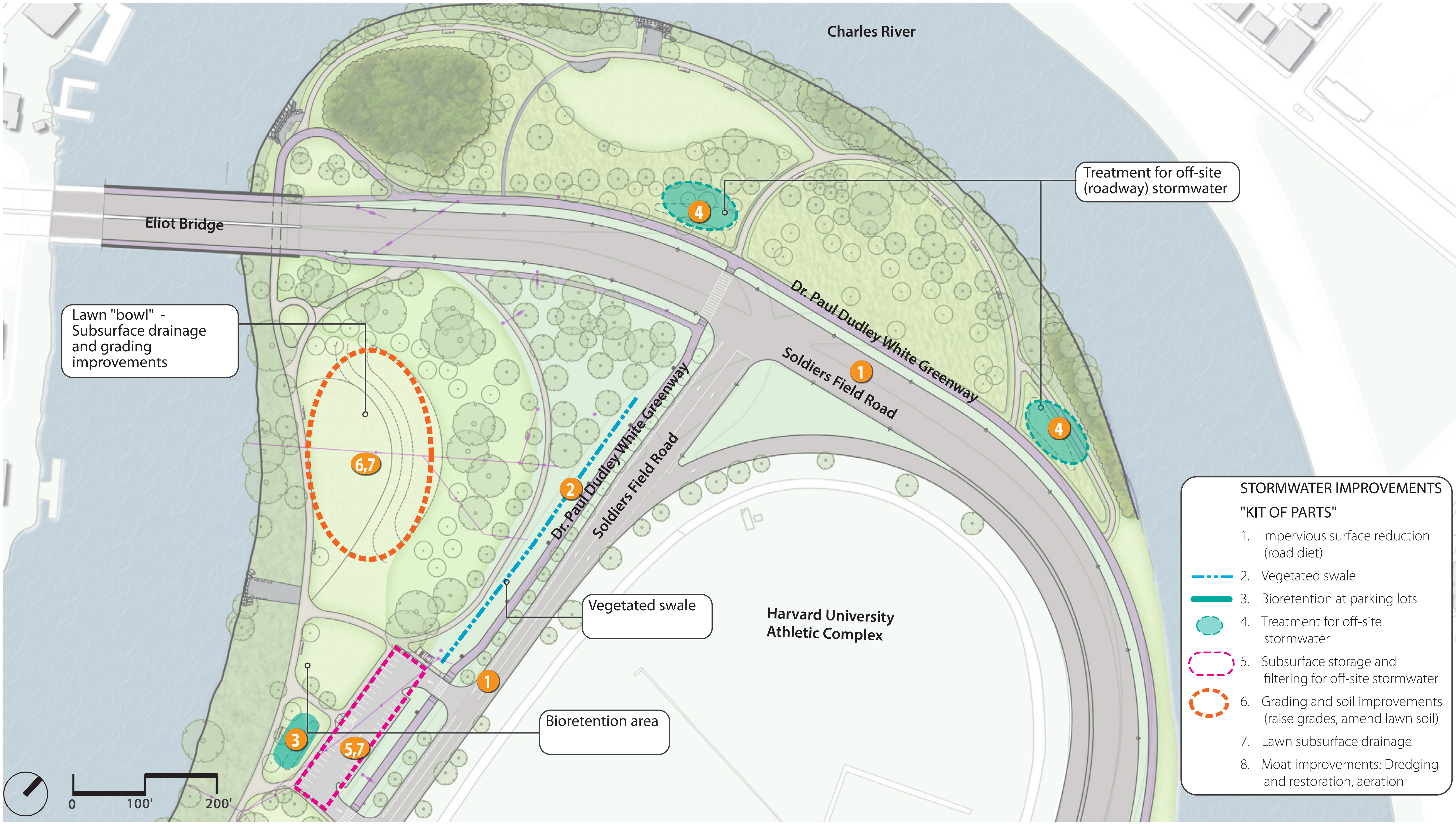


Figure 3-35. East Area stormwater improvements: East Meadow.

Summary of Treatment and Detention

The chart below illustrates the capacity of underground corrugated pipe detention systems. The total storage volumes in cubic feet are based on the 30-inch diameter of storage pipe, and the area under each parking lot. The volume shown in the chart equates to an estimated contributing watershed area, at 1" water quality depth.

Plan Key

Underground Corrugated Metal Pipe Detention Basins for Off-site Stormwater					
Parking Lot Description	Pipe Diameter (IN)	Pipe Length (FT)	Total System Area (SF)	Total Storage Volume (CF)	Watershed for 1" Water Quality Depth (AC)
Artesani	30	23,580	87,012	164,046	46.19
Lot 3	30	4,680	18,046	35,457	9.76
Lot 2	30	3,200	12,403	24,306	6.69
Lot 1	30	3,520	13,628	26,702	7.35

Figure 3-36. Summary of detention capacity for underground corrugated metal pipe systems under the various parking lots.

Summary of Phosphorus Removal

The chart below summarizes the measures required to meet the target Total Phosphorus removal of 60%. For parking lot runoff, this can be achieved with the use of bioretention BMPs, in combination with road sweeping and catch basin cleaning. Additionally, DCR conducts autumn leaf collections coordinated with street sweeping to remove leaves from parkways and parking lots. DCR quantifies the collected leaves and woody debris that are sent to compost facilities to achieve total maximum daily loads (TMDLs) for phosphorus as part of DCR's NPDES permit and stormwater management program in the Charles River watershed.

The off-site stormwater treated in underground detention corrugated pipe structures can achieve the target by using the Jellyfish filter in combination with a hydrodynamic separator.

Location:	Parking Lots - Bioretention for On Site Stormwater Treatment			
BMP	Total Phosphorus (TP) Removal Rate	Starting TP Load	Amount Removed	Remaining Load
Weekly Regenerative Air/Vacuum Street Sweeping[1]	0.08	1.00	0.08	0.92
Semi-annual Catch Basin Cleanouts[1]	0.02	0.92	0.02	0.90
Bioretention (Rain Garden)[2]	0.60	0.90	0.54	0.36
	Proposed Total Phosphorus Removal		64%	
	[3]Target Phosphorus Removal		60%	

Location:	Parking Lots - Underground Detention for Off Site Stormwater Treatment			
BMP	Total Phosphorus (TP) Removal Rate	Starting TP Load	Amount Removed	Remaining Load
Hydrodynamic Separator[4]	0.05	1.00	0.05	0.95
Jellyfish Filter[5]	0.59	0.95	0.56	0.39
	Proposed Total Phosphorus Removal		61%	
	[3]Target Phosphous Removal		60%	

1. TP Removal Rates from Appendix F, Massachusetts MS4 General Permit - Requirements of Approved Total Maximum Daily Loads
2. Rain Gardens Range From 30% to 90% TP removal per MassDEP Stormwater Handbook
3. Appendix F, MA MS4 General Permit, Table F-2
4. TP removal rates from Appendix B NHDES Stormwater Manual Volume 2
5. Jellyfish Filter TP Removal Rate per NJCAT Technology Verification of the Jellyfish Filter

Figure 3-37. Phosphorus Removal target can be achieved through a combination of proposed BMPs.

3.5 | Utilities Improvements

Objectives

The proposed utility improvements at Herter Park largely focus on site lighting and electrical infrastructure. Based on the findings described in Part Two of this reports, there were three main objectives considered: Transition of ownership of existing site lighting from Eversource to DCR, safety and enhanced use of the park facilities and circulation amenities, and Net Zero Goals.

Net Zero Goals

Reducing carbon emissions to achieve Net Zero by 2050 is the Commonwealth's most important line of defense against climate change threats. The electrical infrastructure recommendations strive to align with strategies highlighted in the '*Massachusetts 2050 Decarbonization Roadmap*', the most relevant of which are:

- Building envelope energy efficiency: the proposed new Aquatics Facility should be designed as a Net Zero building. The Herter Center, as a historic building, may be more challenging to bring up to high standards while preserving its cultural integrity, but Net Zero facility should be the goal, and all DCR energy conservation measures incorporated.
- Electrification of space heating and cooling: The Aquatics Facility and the Green Room structure will primarily have cooling needs because of their summer season usage. Herter Center's system should be designed to provide a year-round use.
- Generating renewable energy on site: Primarily photovoltaic energy generation and for solar lighting.
- Electric vehicle charging: To encourage more widespread EV use.

Site Lighting Improvements

1. Replace Existing Eversource-owned light fixtures:

- Replace the existing Eversource-owned lights around Artesani parking lot and east to Eliot Bridge with LED light fixtures that meet DCR and IDA-IES Model Lighting Ordinance standards to reduce light pollution. DCR to take over metering, care and control.
- The standard DCR park light fixture for this area is a 'shepherd's crook' luminaire, which can be combined with cylindrical solar panels. Other solar lights should be considered if they provide a better performance.

2. Expand the park lighting: Provide new fixtures along the main path, from Artesani Parking Lot all the way to the West End parking area, which are currently unlit. Provide lighting from Artesani Parking Lot to and around the Amphitheater. Secondary paths can remain unlit. Solar lighting should be used as much as possible, noting that it might not be reliable in some areas because the existing tall and dense trees could shade the solar panels.

3. Reset the ornamental roadway lights at realigned Eliot Bridge intersection: The existing ornamental fixtures can be removed and reset at new locations after the road realignment.

4. Remove 'cobra-heads': Along Soldiers Field Road, and along the Dr. Paul Dudley White Greenway, with phased improvement projects, convert existing park lights to solar-powered post-top light fixtures.

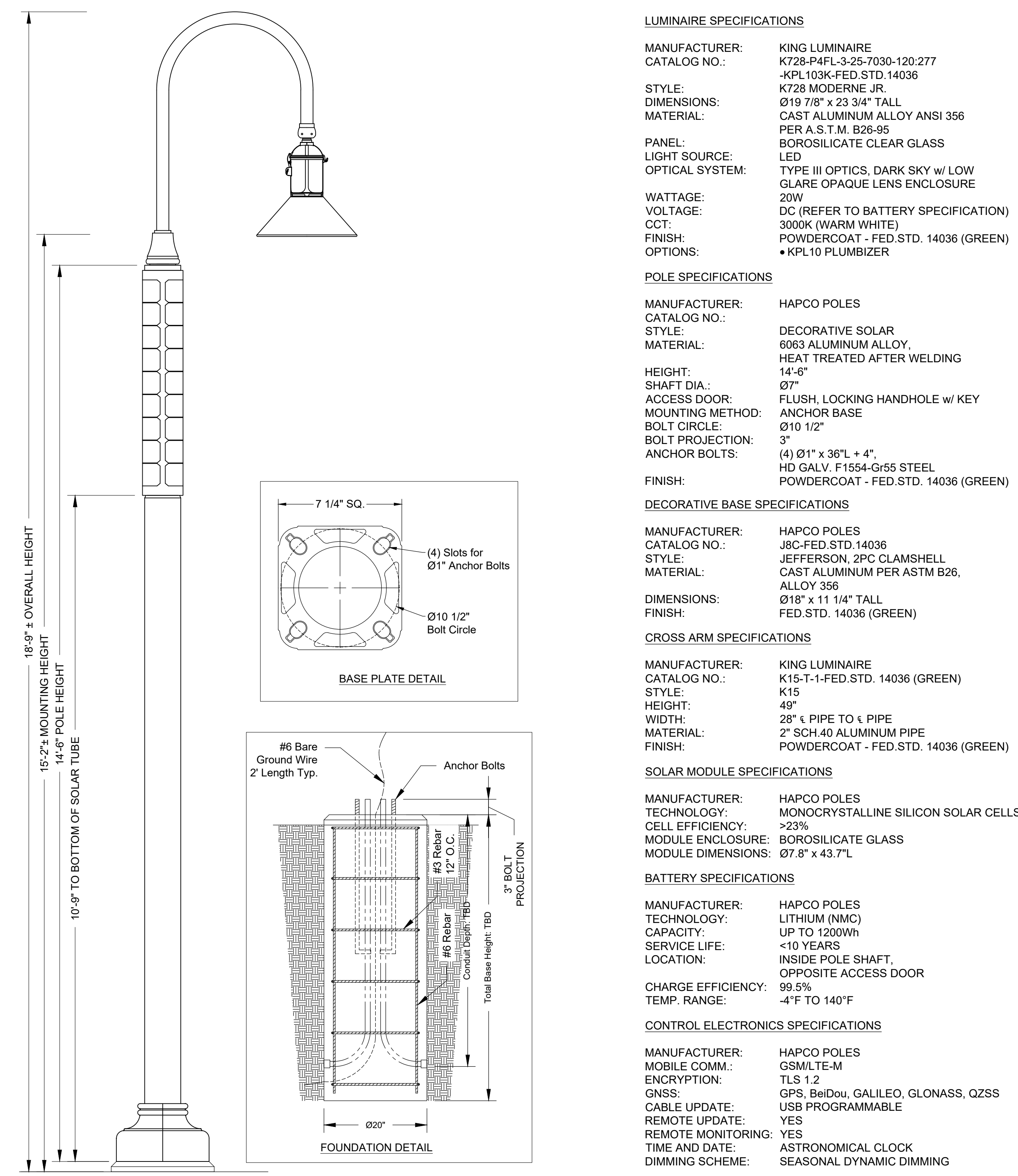


Figure 3-38. Specification sheet for a standard DCR luminaire with a decorative pole-mounted cylindrical solar unit.

Figure 3-39. Example of a shared use path with solar lighting.

Other Electrical Improvements

5. **Remove Overhead Lines** and utility poles; reconfigure the electrical system to place power lines underground.

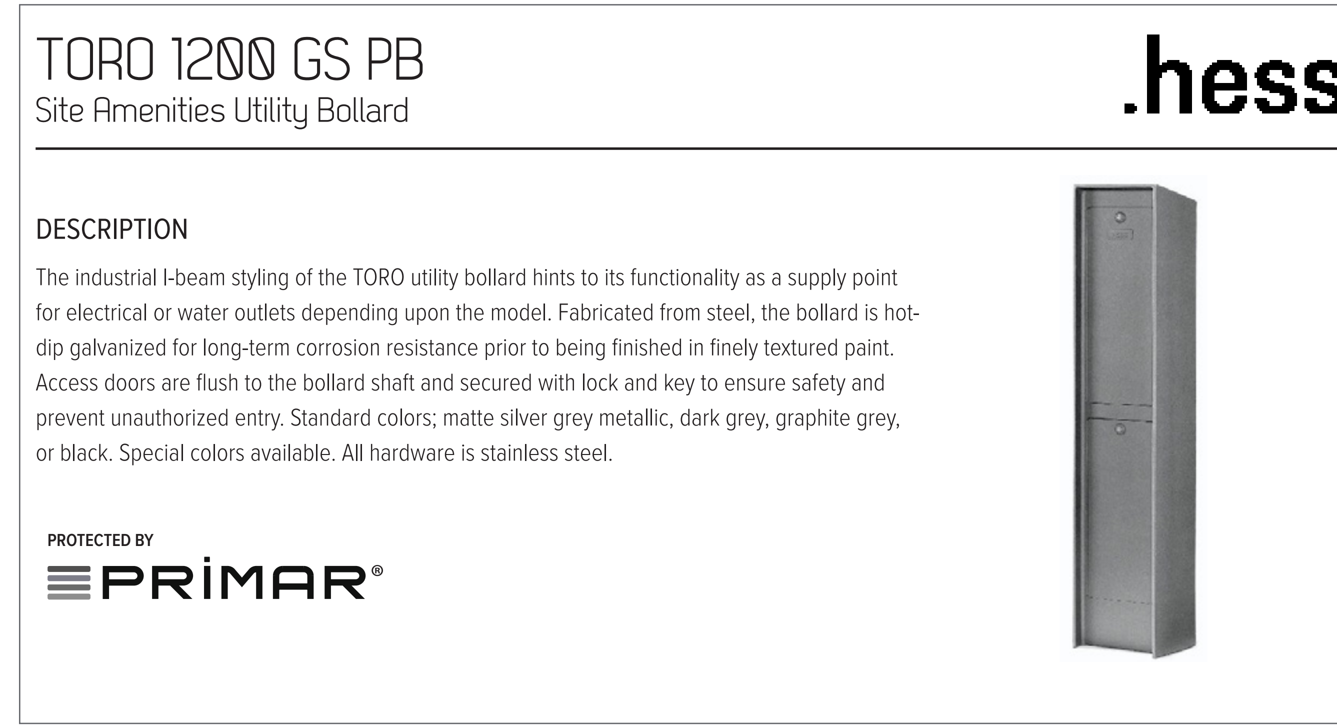
6. **Photovoltaic Panels** are proposed on the roofs of the rehabilitated Herter Center and the new High School Rowing boat storage structures. The boat storage structures can produce more energy that they will use, as they are not anticipated to require any heating or cooling.

7. **Power Bollards** with electrical outlets at several locations, as an amenity that will reduce the need to use gas-powered generators during events.

6. **New Stage Lighting for the Amphitheater,** ideally integrated into a truss canopy structure. Other electrical improvements in the area include power bollards for AV equipment and control cabinet.

9. **Electric Vehicle Charging Stations** at Artesani Parking lot could be provided in conjunction with Park & Ride designated spaces to encourage the use of alternative transportation.

The recommendations above are illustrated on the *Utility Improvements Overall Diagram* found on the following pages.



TORO 1200 GS PB

Site Amenities Utility Bollard

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DESCRIPTION

The industrial I-beam styling of the TORO utility bollard hints to its functionality as a supply point for electrical or water outlets depending upon the model. Fabricated from steel, the bollard is hot-dip galvanized for long-term corrosion resistance prior to being finished in finely textured paint. Access doors are flush to the bollard shaft and secured with lock and key to ensure safety and prevent unauthorized entry. Standard colors; matte silver grey metallic, dark grey, graphite grey, or black. Special colors available. All hardware is stainless steel.

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Figure 3-40. Specification sheet for a Power Bollard which has been used at another DCR park.

Utility Improvements Overall Diagram

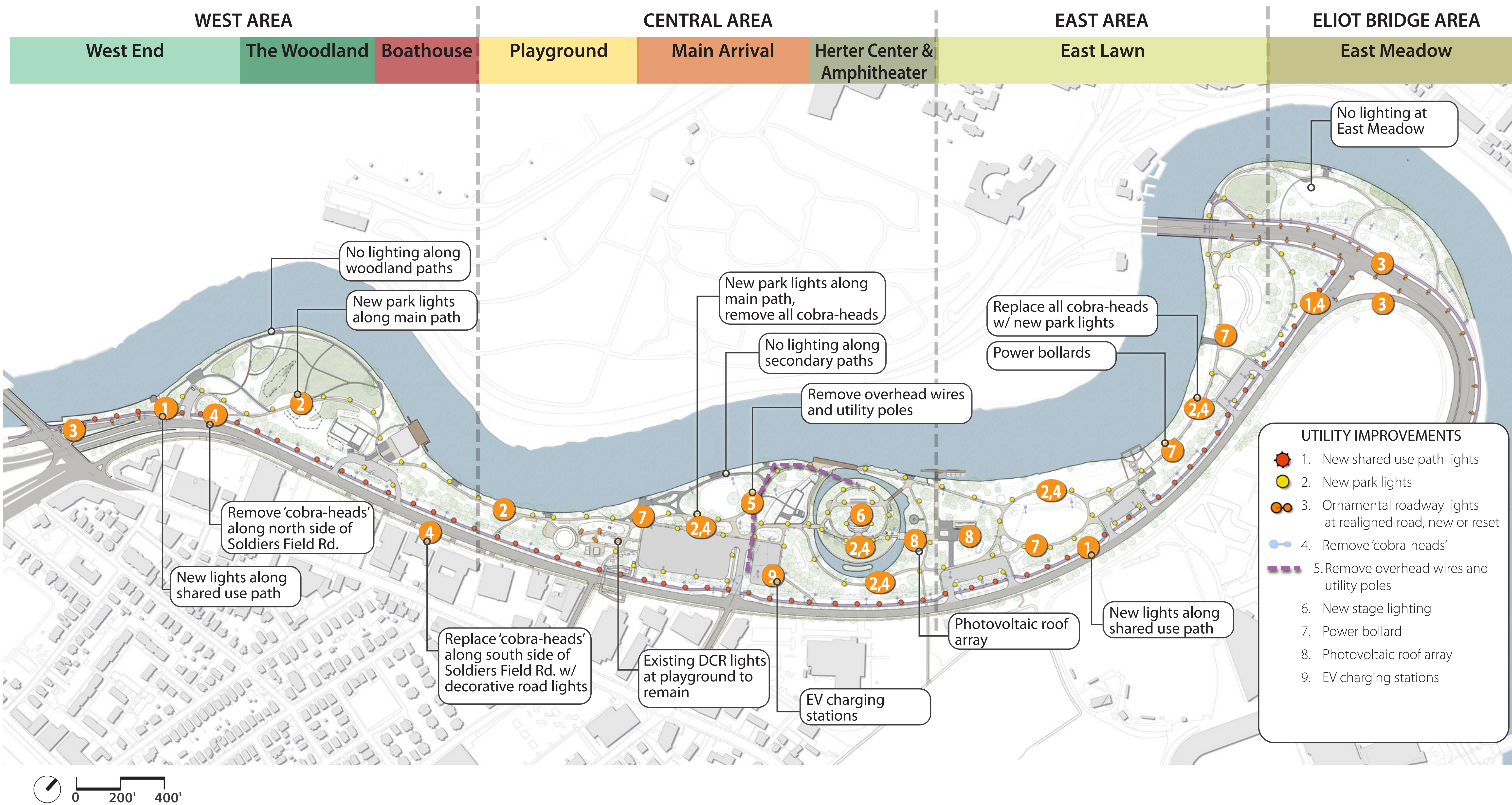

Figure 3-41. Utility Improvements Overall Diagram