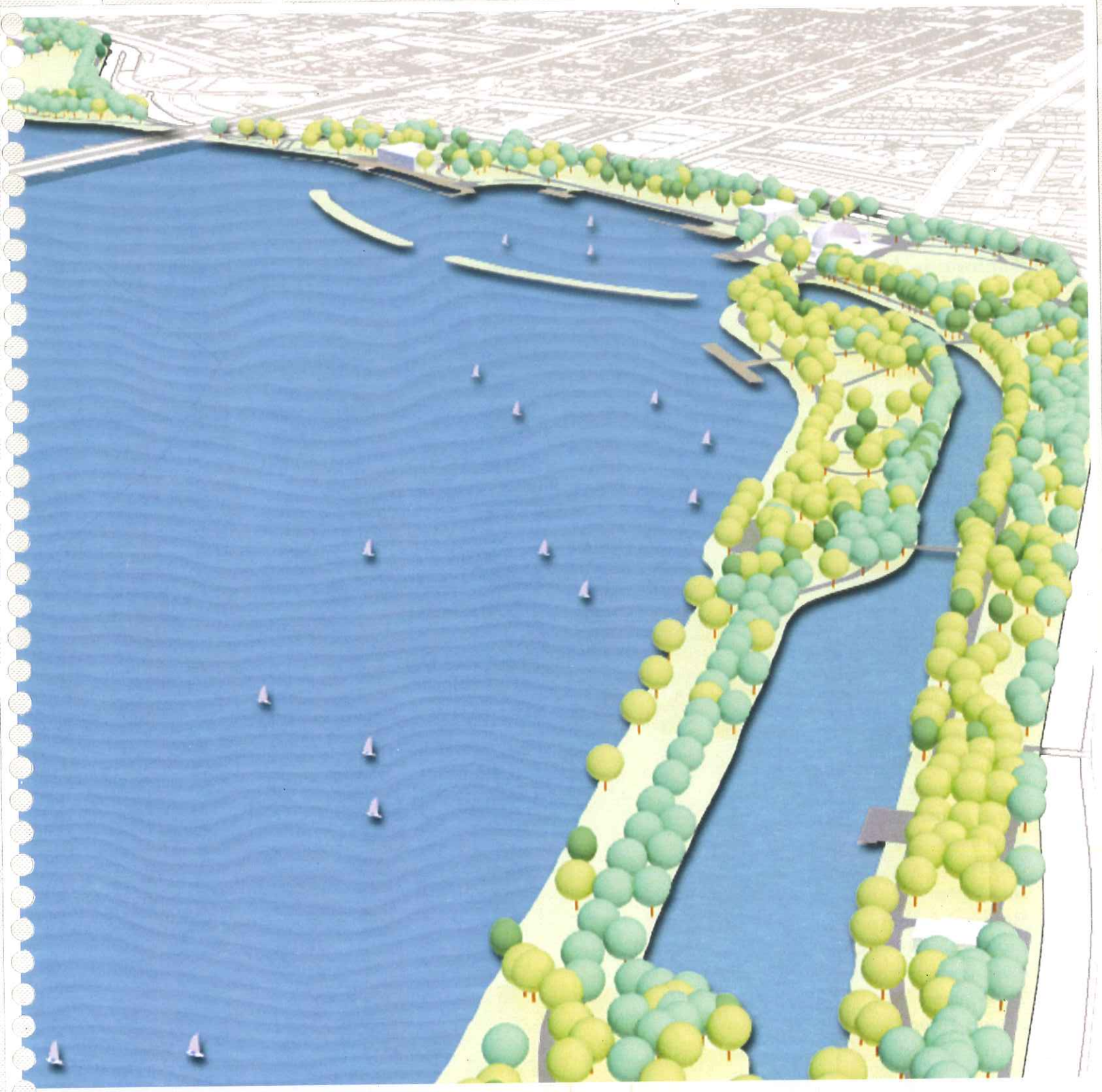

DRAFT 02.16.18

Esplanade Tree Management & Succession Plan

Prepared for The Esplanade Association and Department of Conservation & Recreation 2018

Acknowledgements

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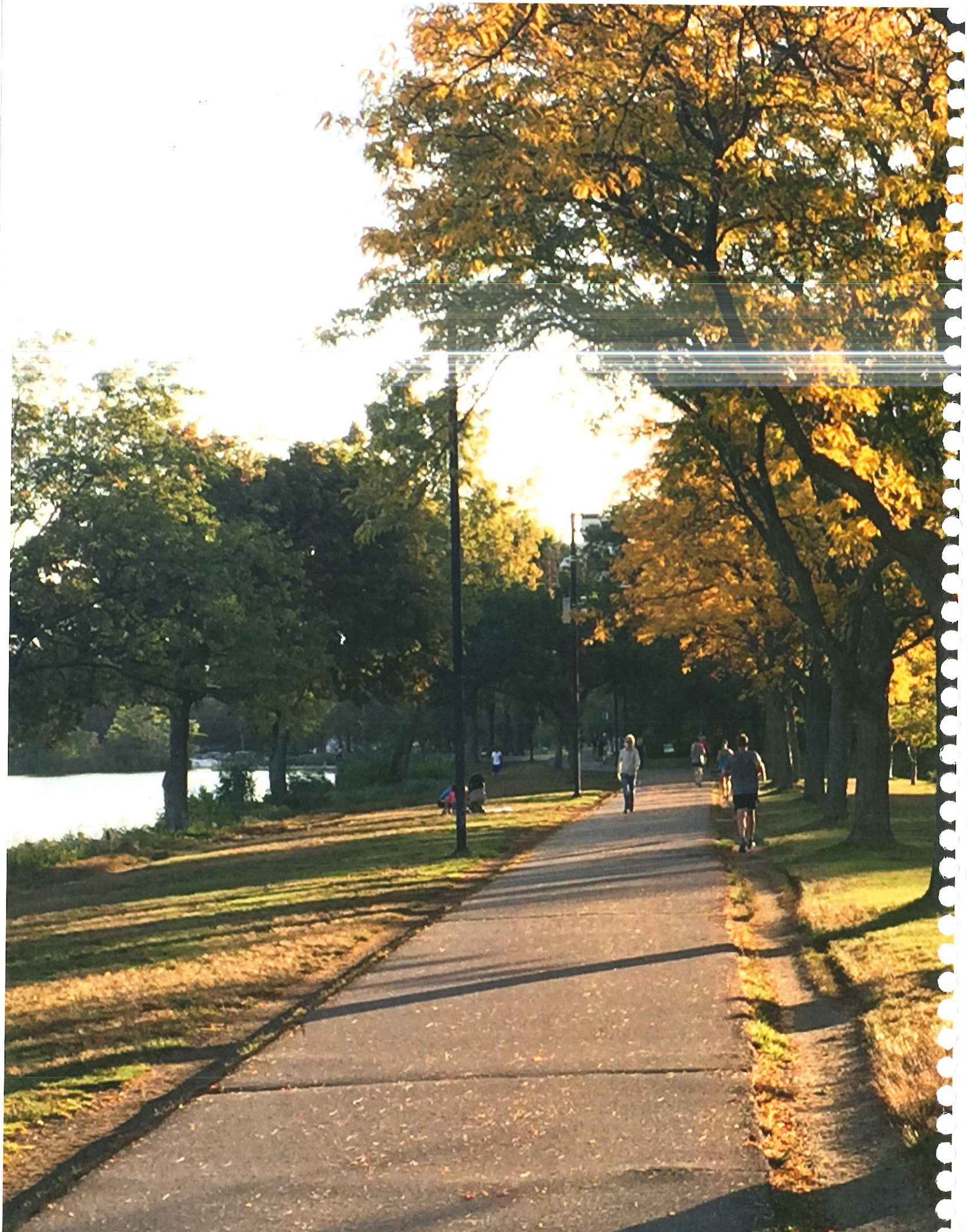


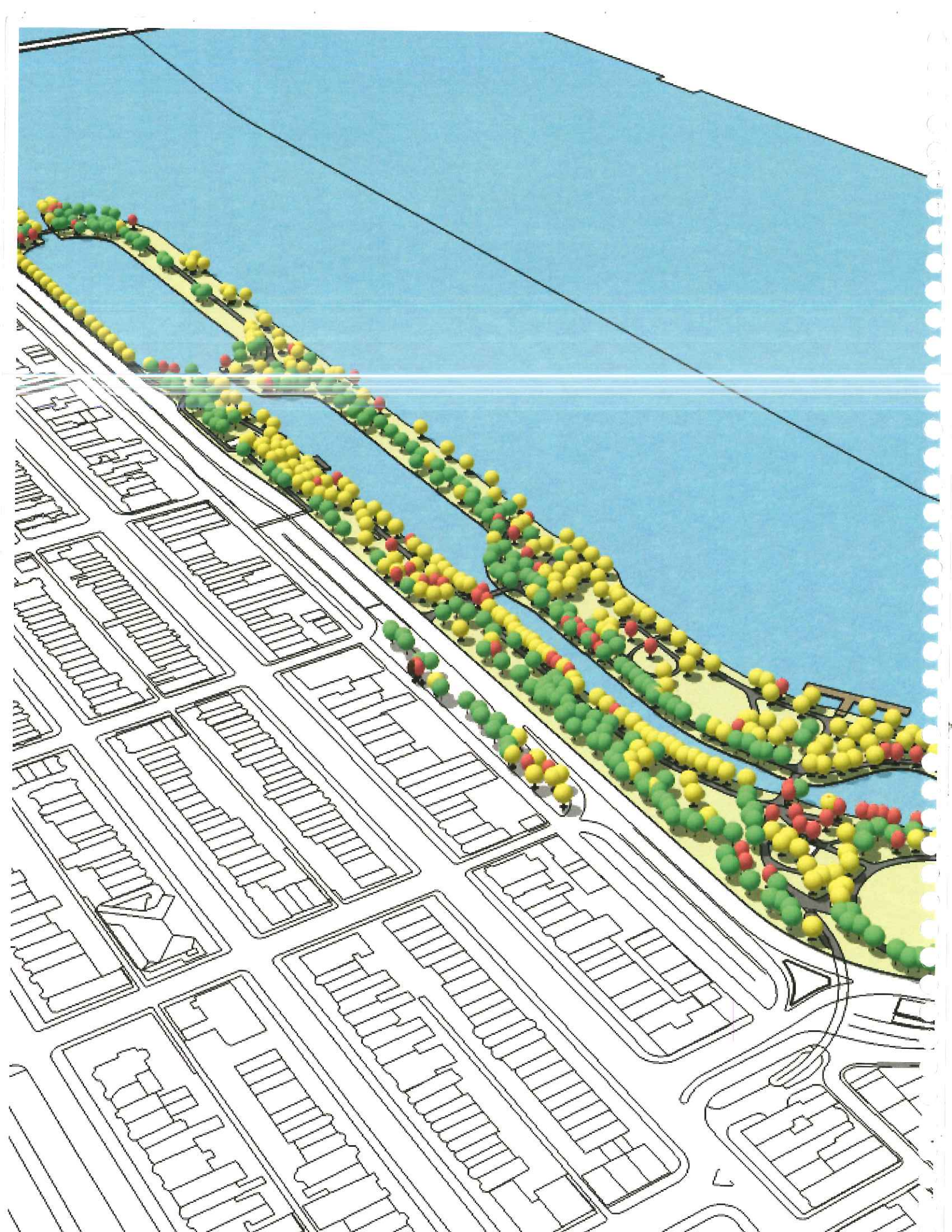
Executive Summary

To be developed

Key topics to discuss:

- The Esplanade- sense of place
- Purpose of the project
- Why recommendations are needed
- What has happened to the esplanade over time (since Shurcliff) and how KZLA will remediate any negative occurences
- KZLA report process - what steps were taken
- Methodology
- Why we reviewed and compared the existing intenvories
- General result of our findings
- major needs
- How will the report be used - to prioritize maintaince, etc.

To be developed



Conditions Assessment

Trees are one of the key character defining features of the Esplanade. The age of the Esplanade can be seen as a direct relation to the maturity of the canopy, and a few of the original design intents can still be found in the layout of many of the older trees.

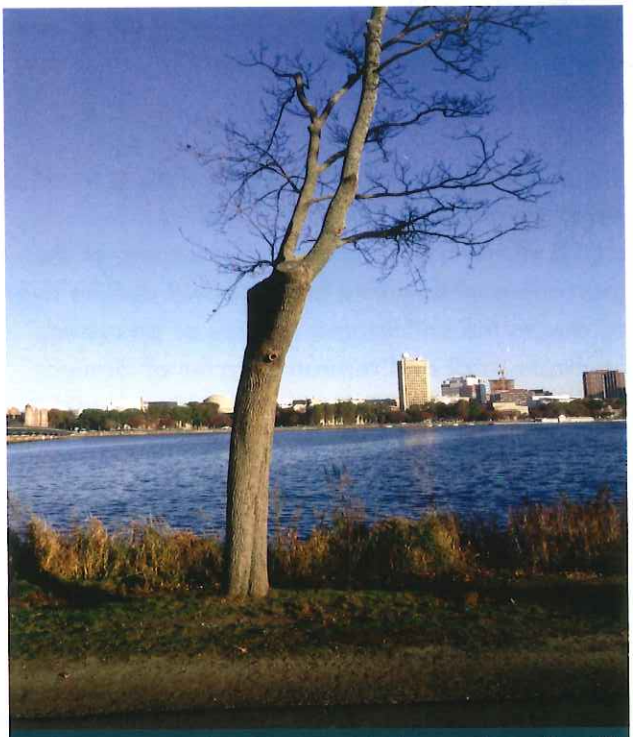
For the conditions assessment, KZLA compared tree inventories recorded in 2015 and 2004 which showed some major differences in tree condition over the span of a decade. Current data provided by Bartlett Tree Experts further helped to understand what type of care is being provided to these trees and what type of maintenance is still required. In addition to comparing this data, KZLA also looked at historic plans to see what influences still remain today and what design ideologies have been lost.

After comparing the inventory data, site reviews helped confirm some of the expectations of the conditions of the trees. More than half of the 1690 inventoried trees are considered to be in less than "good" condition. Some of these can be improved with preventive care such as pruning, but others are declining due to various health issues. Much of the Esplanade forest is mature, with little successional planting to negate the impacts of large tree removals. Most plantings consists of pockets of similar species.

As expected, most of the fair or poor condition trees can be found along paths that are heavily used. These trees likely experience higher levels of urban stresses including soil compaction and de-icing salt. Trees planted in areas that experience less use are often in better condition, however many groves are planted too densely which has resulted in difficult growing conditions.

Many of the trees that exist today are a result of the 1949 plan designed by Arthur Shurcliff. There are still a few original planting design elements that still exist today, such as tree lined paths, however there are areas where equally spaced trees have been infilled with volunteer species. These dense clusters have lost the formal planting pattern that was desired.

The following report further examines the existing trees and compares the current planting design to the historic planting plans.



Succession planting is needed to replace dead/ declining trees

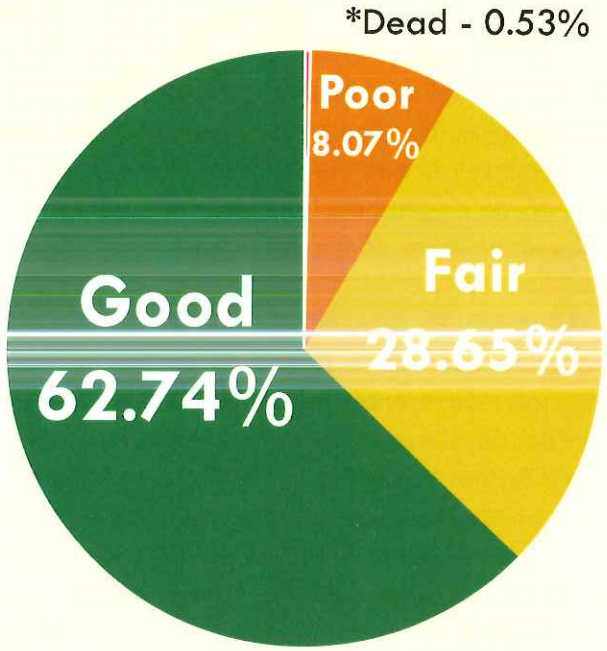
2004 vs. 2015 Data Comparison

The 2015 inventory data shows a few major condition differences since 2004. Of the total inventoried trees, good condition trees have decreased from 62.74% to 43.92% between the 2004 and 2015 inventories. Fair condition trees, meanwhile, increased from 28.65% of the total to 41.20%, though this could easily be due to the way the trees are evaluated by different arborists. Poor condition trees increased in 2015 by 5.8% since 2004. It is important to note the decrease of 200 trees not included in the 2015 inventory.

Overall the age of trees remains diverse, but the diversity has decreased since 2004. Most species are still present in the 2015 inventory however some species have seen a drastic decrease in numbers, for example, Pin oaks have decreased from 417 to 381. The 2004 inventory included a list of 44 trees that were recommended for removal, all of which were younger trees under 8" dbh.

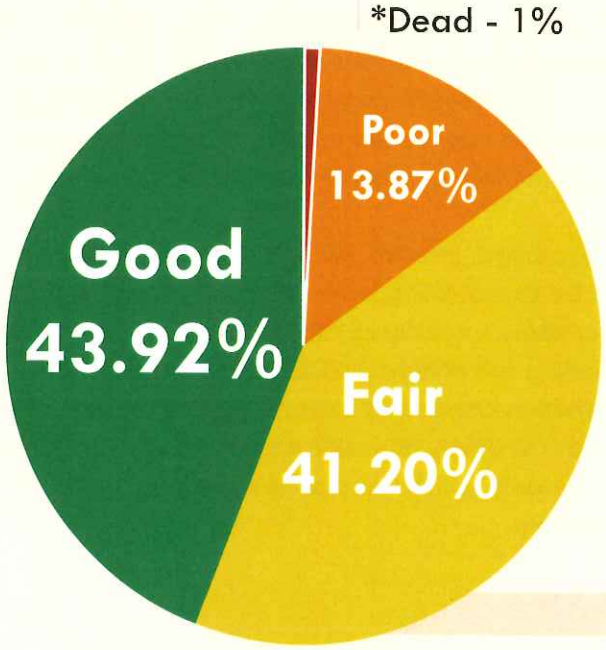
Overall, the data comparison helps show a trend for several areas where trees have declined over the past 10 years. The data also affirms some of the expectations of how tree health would decline over time due to the anticipated stresses of an urban, man-made park and repeated cycles of drought and level staffing or decrease in staffing for DCR.

2004 Inventory Data

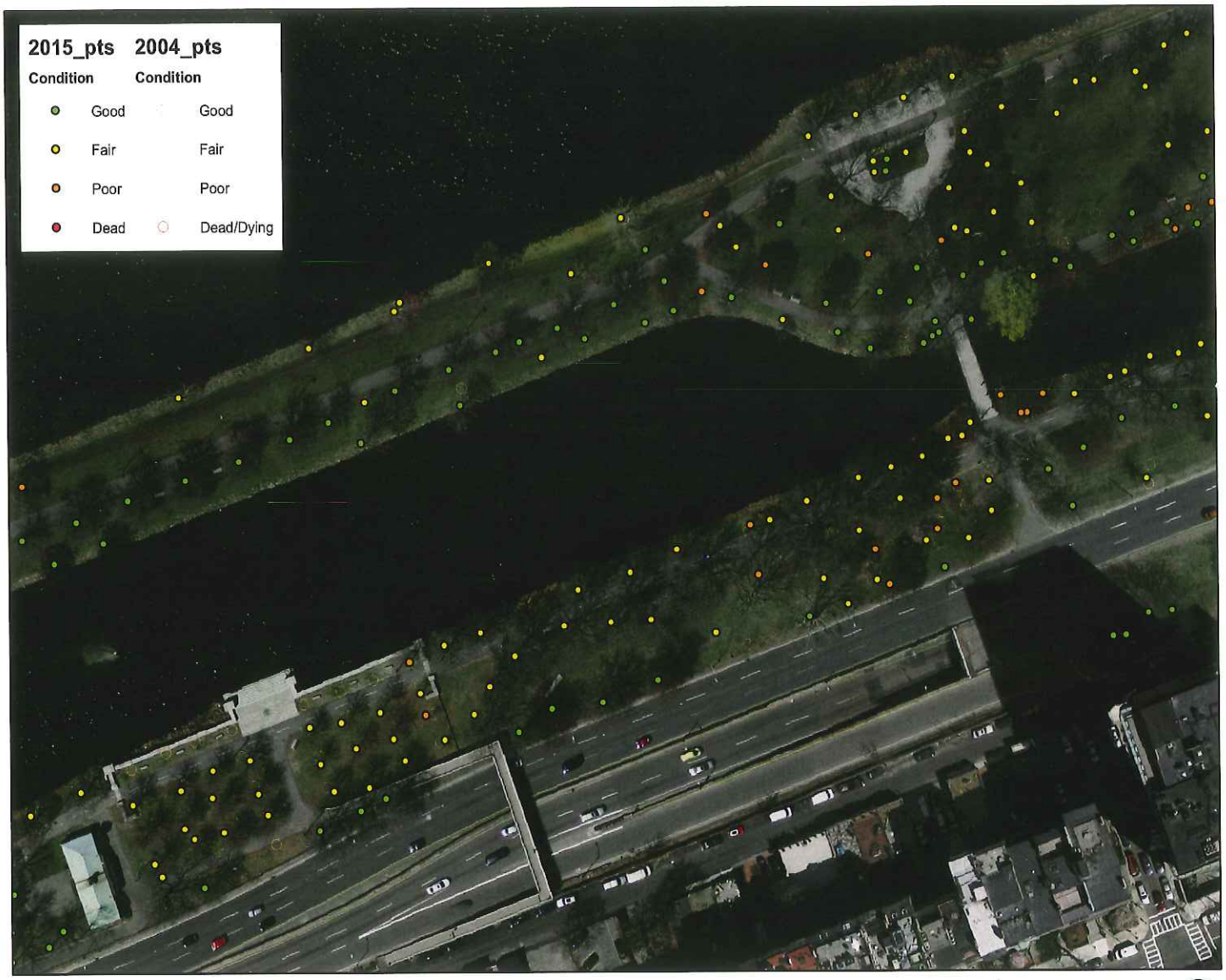


1895
trees inventoried

2015 Inventory Data



1690
trees inventoried



Changes in Condition

Good Condition

decrease since 2004

18.82%

of trees inventoried

Poor Condition

increase since 2004

5.8%

of trees inventoried

201

less trees

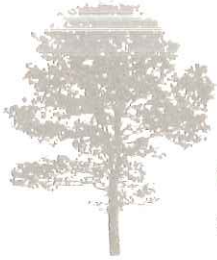
of trees inventoried

DBH Range & Condition by Size

2004 Inventory Data

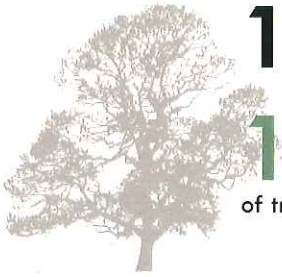
0-9"

35.67%
of trees inventoried



10-18"

41.10%
of trees inventoried



18-24"

13.83%
of trees inventoried

25-30"

6.07%
of trees inventoried

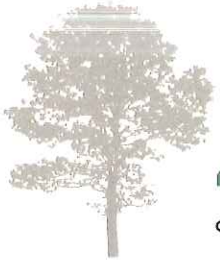
30"+

3.32%
of trees inventoried

2015 Inventory Data

0-9"

23.91%
of trees inventoried



10-18"

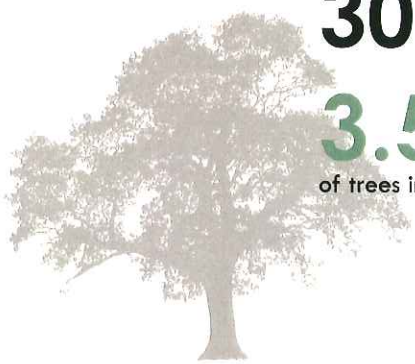
44.04%
of trees inventoried

18-24"

19.48%
of trees inventoried

25-30"

9.03%
of trees inventoried



30"+

3.54%
of trees inventoried

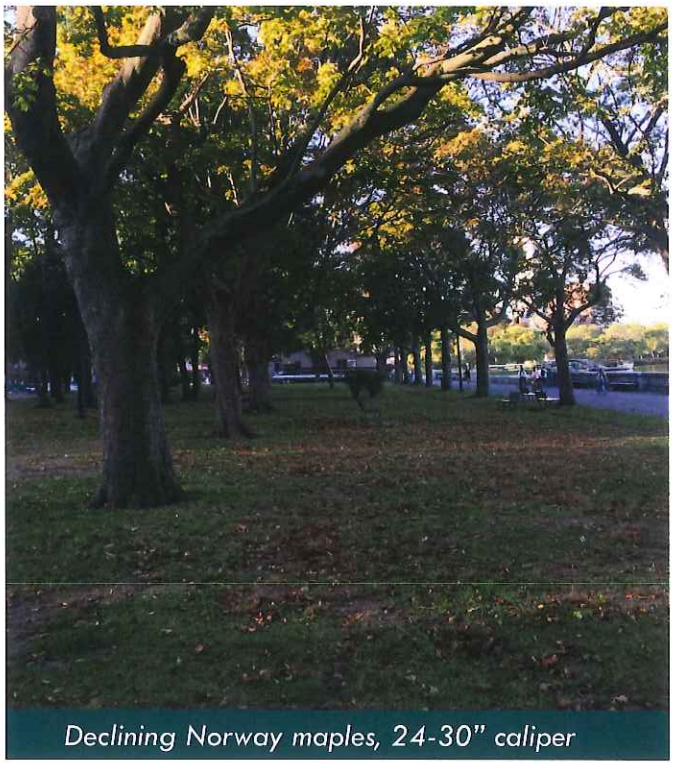
Interpreting DBH Changes

The highest percentage of trees fall within the 19-24" range category (19.48%), while the least amount of trees having a dbh greater than 36" (<1%).

The amount of smallest trees, 0-2", has stayed the same, while the count of trees between 2 and 12" has decreased, presumably because the trees have grown. The greatest decrease was in the 10-12" range. DBH's from 12-36" have all increased, with the greatest increase in the 19-24" category.

The data shows that most trees have grown since 2004 but there might not be enough succession planting to support a healthy age diversity. There has been more than a 16% decrease in the number of trees under 12" dbh. With 200 less trees inventoried since 2004, it can be assumed that the death of many younger trees might have attributed to the decrease in trees under 12" dbh. The largest group of "young" trees is near the Appleton footbridge that crosses Storrow Drive near MGH. There are a few other areas with groupings of new tree plantings.

Newly planted tree, <2" caliper



Declining Norway maples, 24-30" caliper

Inventoried Species

The following tree species were identified during the tree inventory:

Amelanchier species
American Elm
American Linden
Austrian Pine
Black Locust
Black Oak
Black Willow
Black/Wild Cherry
Callery Pear
Common/True Apple
Copper or Purple Beech
Eastern White Pine
English Hawthorn
European Beech
European White Birch
Flowering Crabapple
Flowering Dogwood
Goldenrain Tree
Green Ash
Grey Birch
Higan Cherry
Honeylocust
Horsechestnut
Ironwood
Japanese Flowering Cherry
Japanese Zelkova
Kousa Dogwood
Kwanzan Cherry
Littleleaf Linden
London Planetree
Mulberry
Norway Maple
Paper Birch
Pin Oak
Purpleleaf Plum
Red (Swamp) Maple
Red Oak
Red Pine
Redleaf Japanese Maple
River Birch
Sargent Cherry
Saucer Magnolia
Scholar Tree
Shadblow or Serviceberry
Silver Maple
Sugar Maple
Sycamore
Tree of Heaven
Tuliptree
Washington Hawthorn
Weeping Willow
White Ash
Yoshino or Mt Fuji Cherry

*American Beech
*European Buckthorn
*Sweet cherry
*Kentucky coffeetree
*Crimson King Maple
*Corneliancherry Dogwood
*Elm
*Siberian Elm
*Slippery Elm
*Hawthorn
*Common Honeylocust
*European Hornbeam
*Star magnolia
*Full moon maple
*Red Mulberry
*White Mulberry
*Scarlet Oak
*Swamp White Oak
*Japanese Pagodatree
*Viburnum
*Willow

Interpreting Species Changes

The species composition has remained relatively the same since 2004, however it is important to note the possibility of species being identified differently between the 2004 and 2015 inventory due to the use of different arborists. For example, "Kwanzan cherry" was identified (73) times and "Mt. Fuji cherry" was identified (16) times in the 2004 inventory however neither were not present in the 2015 inventory. These trees could have been re-labeled as "Japanese flowering cherry", which would explain the large increase of the Japanese flowering cherry numbers. It should also be noted that over 70 recently planted (2005) cherry trees were moved shortly after they were planted around the lagoon.

Observing the condition per specific species does not present any unexpected data. Pin oaks, the most common species found, consists of good (52%), fair (45%), poor (3%), and no dead. The 6 most commonly found species account for 66.4% of the overall tree inventory in 2015.

Many tree species are found in small groupings along the Esplanade and at important nodes. One specific problem area consisting of monoculture planting is the Storrow Memorial, where nearly 30 Norway maples are in declining health. In 2015, 19 of these trees were listed as "poor condition", due to issues such as girdling roots, stem lean, codominant leaders, and decay. These trees are planted in a formal grid pattern, forming continuous canopy coverage. It is important to note that Norway maples are declining across the Esplanade, with 35% being listed as poor condition in 2015.

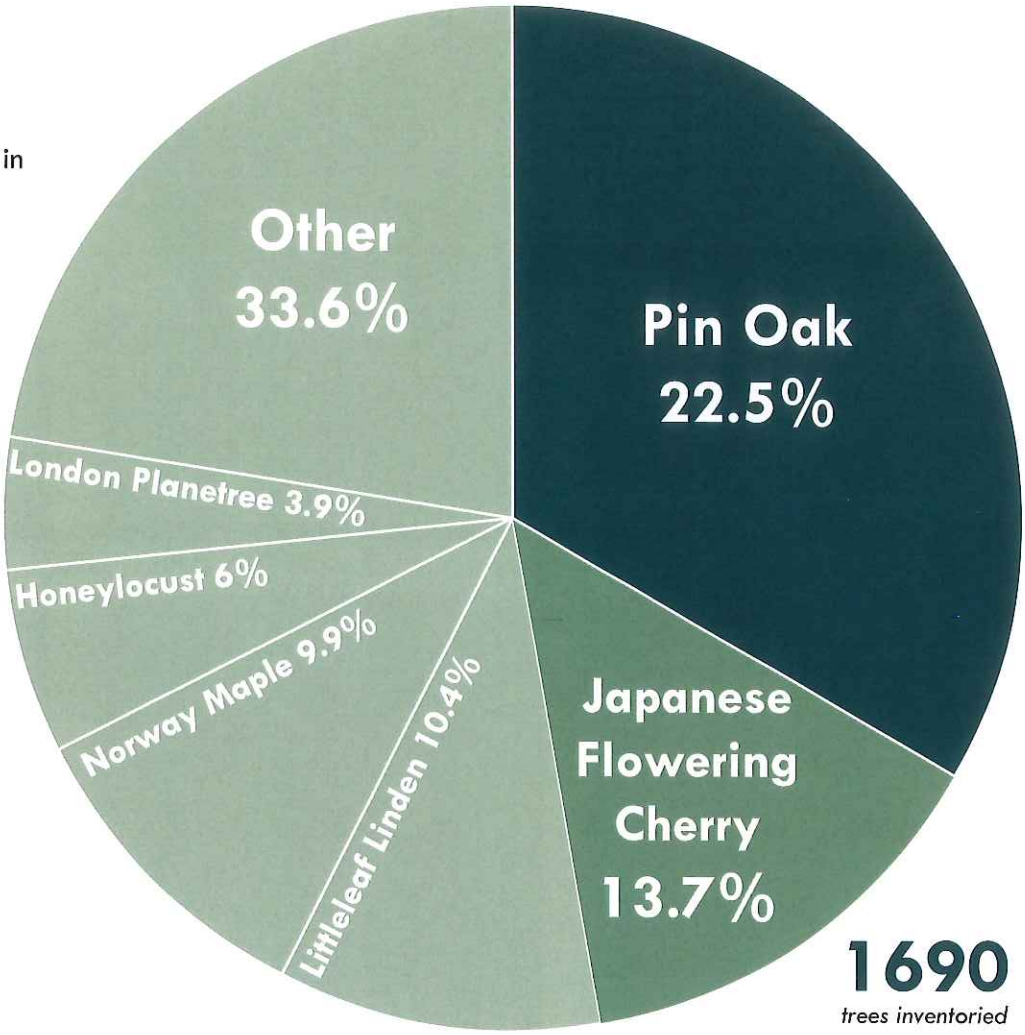
Species Composition

The listed species were included in the 2015 inventory.

There are 30 Genera and 59 species total. Approximately 50 species make up the "Other" category.

12 Most Common Species:

- (381) Pin Oak
- (232) Jap. Flowering Cherry
- (176) Littleleaf Linden
- (168) Norway Maple
- (102) Honeylocust
- (66) London Planetree
- (62) Green Ash
- (52) Flowering Crabapple
- (51) Red Oak
- (37) Austrian Pine
- (20) Black Cherry
- (20) Weeping Willow



Species Change Since 2004

Pin Oaks (381 trees)
36 Less trees
of trees inventoried

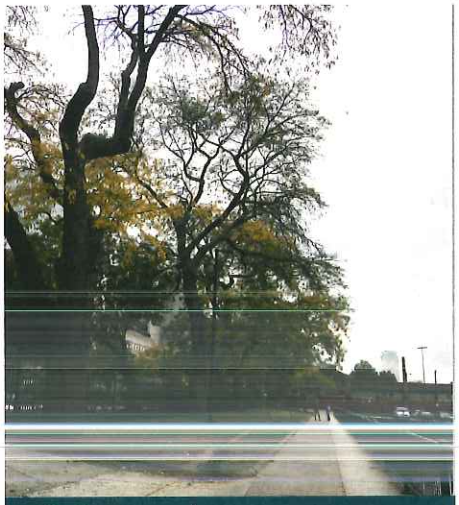
Norway Maple (168 trees)
96 Less trees
of trees inventoried

Japanese Flowering Cherry (232 trees)
104 More trees
of trees inventoried

Honeylocust (102 trees)
33 Less trees
of trees inventoried

1. Empty street tree site

2. Successful street trees



3. Promenade

4. Successful tree lined path

5. Grove of trees

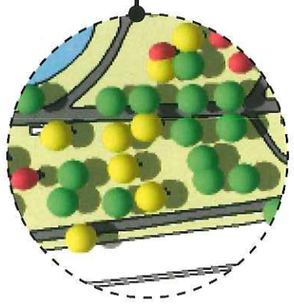
6. Gap in continuous canopy

7. Construction protection

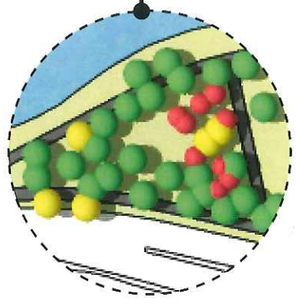
8. Charles Eliot Memorial

9. Declining mature trees

Difficult street tree planting conditions: salt line 3-4' off curb



Grove of mature Norway maples; average over 22" dbh.



Ornamental trees in this grove are declining, while large deciduous trees remain in "good" condition

Street tree condition is wider and has a swale - better growing conditions

Gap in London planetree street trees

Legend

Tree Condition

- Good Condition
- Fair Condition
- Poor Condition

Should overlook be accented with planting?

Magnolias at back of the Hatch Shell are incomplete

Should ornamental trees accent all footbridges and end of lagoons

Tree planting needed on edges

Otis grove: paper birch

1 2 3 4 5 6 7 8 9

Extremely challenging street tree growing conditions

The original trees still exist in this plaza, however the hardscape no longer exists

Overlook Plantings, 1934

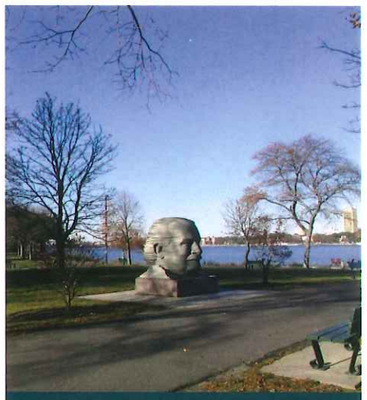
Abandoned asphalt paving still remains in portions of open lawn

Grove with significant pressure from paved area and high use

1. Promenade trees declining

2. Perimeter trees are even-aged

3. Cherries ring the basin



4. Trees accent sculpture

5. Open lawn shows compaction

6. Trees in pits

7. Promenade with open views

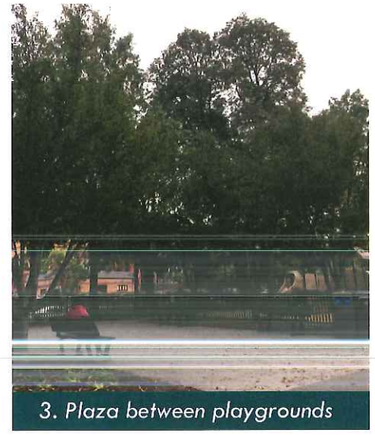
8. Otis Grove

9. Difficult street tree conditions

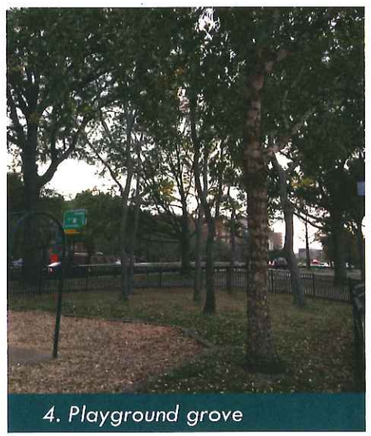
CONDITIONS ASSESSMENT

1. Formal grid of Norway maples

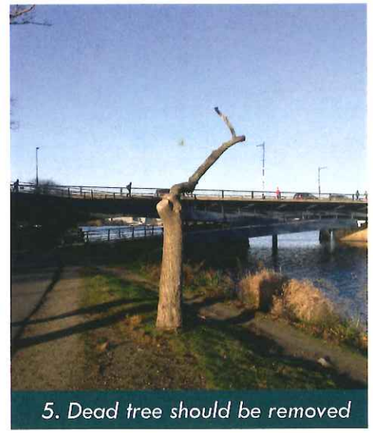
2. Storrow Memorial



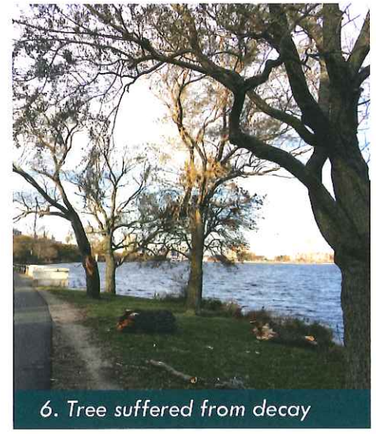
3. Plaza between playgrounds



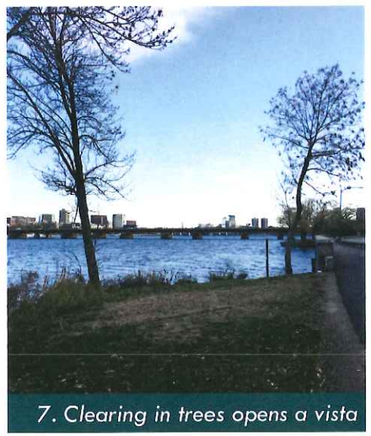
4. Playground grove



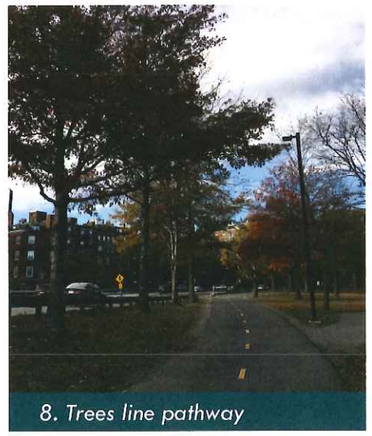
5. Dead tree should be removed



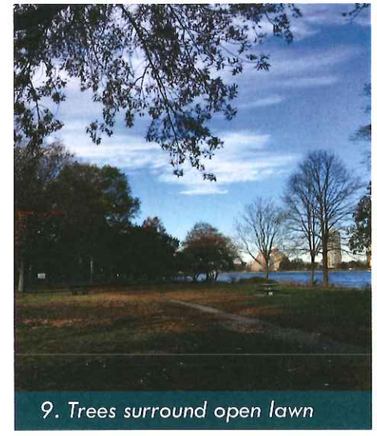
6. Tree suffered from decay



7. Clearing in trees opens a vista



8. Trees line pathway



9. Trees surround open lawn

Legend

Tree Condition

- Good Condition
- Fair Condition
- Poor Condition

Poor drainage in open lawn area

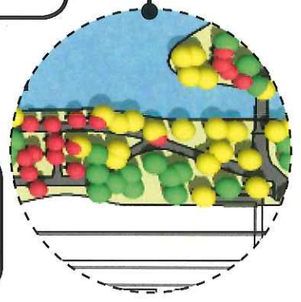
Wear pattern suggests vehicular use

Gap in tree planting

9 8 7 6 5 4 3 2 1

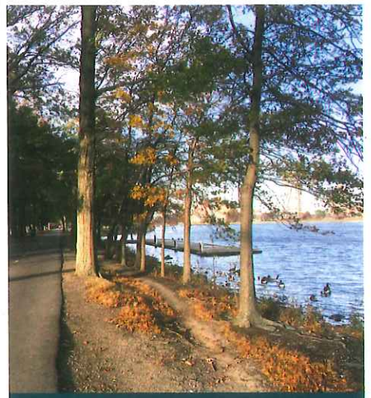
Bowker overpass has left only narrow buffers between hardscape, which has resulted in difficult growing conditions for trees on either side of the path.

The wide buffer allows a grove of mature trees to thrive along Storrow Drive.



The wide buffer allows a grove of mature trees to thrive along Storrow Drive.


Legend
Tree Condition
Good Condition
Fair Condition
Poor Condition
Character of this oval is very nice
Evergreen cluster
Dense planting of multi-leader trees. Trees were likely not planted with intent
Groves of trees are planted too close, restricting their canopy
Space between road and path has alternating clusters of ornamentals and evergreens
Evergreen cluster
1
2
3
4
5
6
7
8
9



1. Tightly planted trees

2. Cluster of trees

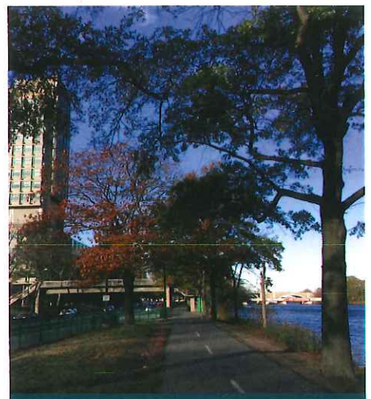
3. Tree lined path

4. Gaps in trees maintain views

5. Poor soil conditions

6. Dense grove of trees

7. Succession planting needed



8. Infill planting for both sides

9. Grove spaced appropriatley

Invasive Species

By Definition

Invasive plants are considered to be non-native species that, when not managed, can inflict economic or environmental harm due to their ability to spread and establish rapidly. This easy dispersal can result in dominating the landscape and limiting the available resources for native species, which is disruptive to the natural ecosystem. It should be noted that although most invasive species are non-native, not all non-native species are considered invasive.

Species to Avoid

Invasive species listed in the 2015 inventory are:

Acer platanoides - Norway Maple
Ailanthus altissima - Tree of Heaven
Robinia pseudoacacia - Black Locust
Morus alba - White Mulberry

Impact on The Esplanade

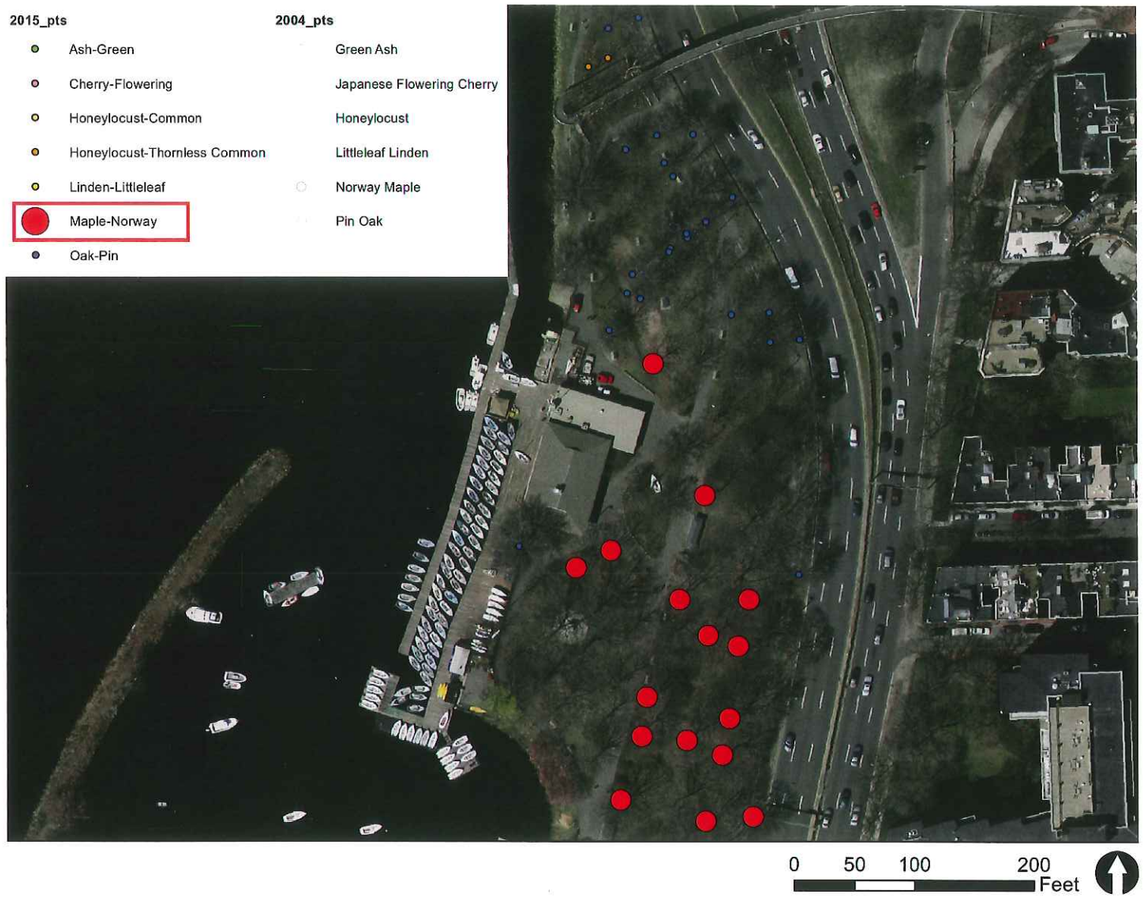
Fortunately, invasive species do not appear to be highly problematic to the Esplanade. Most trees within the park have been planted with intent, with only several pockets of invasive or volunteer species. The most commonly found invasive species found include Norway maple, Japanese zelkova, mulberry, tree of heaven, weeping willow, buckthorn, and black locust. Burning bush is also found planted as a vegetative screen, and phragmites can be found along the riparian/littoral zones of the Charles and Lagoon.

Invasive species along the paths and plazas are controlled, however there are some volunteer species that have seeded and grown along the Charles River edge. Invasive saplings can increase maintenance requirements, and can also establish in pavement cracks or other unwanted areas.

Buckthorns and tree of heaven exist close to the riparian/littoral zones, and were likely established by dispersed seeds. Weeping willows can be considered invasive due to their aggressive rooting structures; however it appears that the willows present are planted as specimens and do not appear to be causing any negative affects to pathway pavements or limiting the growth of other tree species.

Vegetative screen of burning bush

Volunteer species occupy and open space



Norway Maples

Norway maples are currently the most found invasive trees that is included in the 2015 inventory. As of 2015 there were 168 trees. Of those trees, only 33% are listed as being in "good" condition and 35% are considered to be in "poor" condition. Norway maples are found in formal plazas, lining paths, along Storrow Drive, and on the Charles Rivers edge. Some of these trees were part of the earlier planting plan, however there is a clear trend of the decline of the species health throughout the entire park.

Norway maples are planted in a formal grid

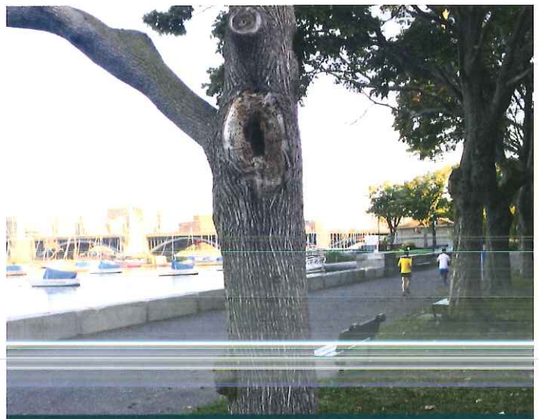
Tree Health Issues

The 2015 inventory includes an extensive list of tree health issues as well as documented care measures to work that should be done. Pruning recommendations were noted for nearly all trees inventoried. Many of the "fair" condition trees could likely be improved with additional pruning and branching structure improvements. Other common and more difficult issues to resolve included co-dominant stems, girdling roots, and buried root collars.

In 2015, Bartlett Tree Experts determined the risk of the trees by assigning numerical values relating to the "Risk Rating Matrix", prepared by the International Society of Arboriculture. These risks account for growth issues noted as well as the tree's proximity to high use areas such as playgrounds or branches overhanging pathways. Only three trees were identified as having a "high risk" factor, (37) trees have a "moderate risk", and (163) trees has a low risk factor. It is important to note that 96.45% of all inventoried trees, 1630, are listed as having defects, observations, or other structural issues. 127 trees, or 7.51%, are listed as recommended removals.

Other Issues (not pictured):

- Age of trees
- Exposure to salt (road salt)
- Declining health trend of certain species
- Damage from events/construction/animal
- Slime flux
- Phytophthora (suspected)
- Anthracnose
- Borers
- Adelgid
- Scale
- Leaf beetle
- Sapsucker
- Powdery mildew
- Gypsy moth
- Bleeding
- Fire blight
- Frost damage



Lost Limbs

Decay

Trunk Damage

Thorns/Hazardous Species

Girdling Roots

Large Pruned Limbs

Dead Tree to be Removed

Hazardous Hanging Branches

Codominant Stems

Compacted Root Zones

Tree Pits

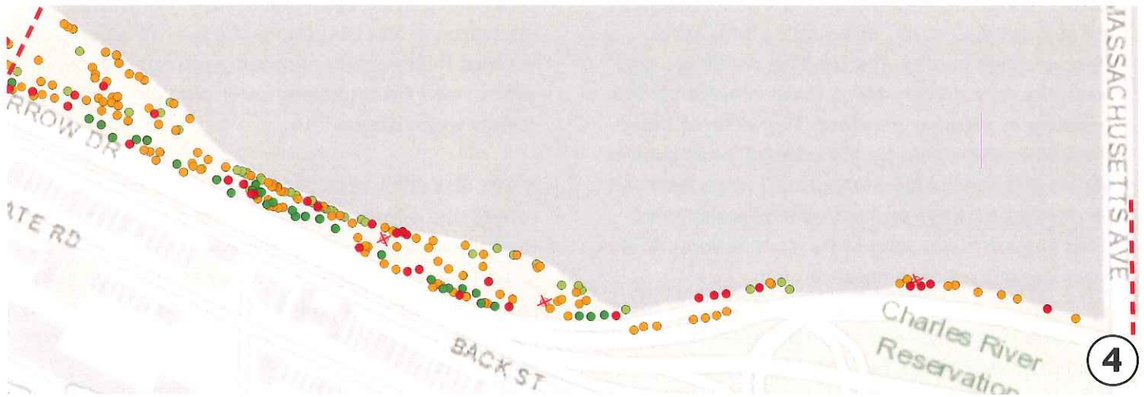
Buried Root Flare

Pruning and Removals

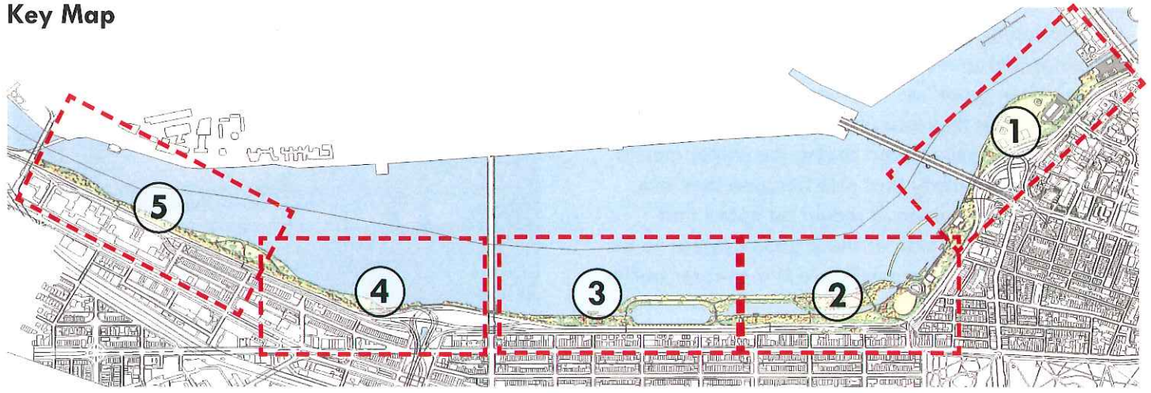
The following maps show trees that are either recommended to be pruned or removed. These recommendations were provided by Bartlett Tree Experts during the 2015 tree inventory. Pruning and removals that have been completed are shown as a comparison for what has been accomplished since 2015.

Recommendation / Work Completed

- Tree recommended for pruning
- Tree recommended for removal
- Removed/Inactive
- Tree has been pruned since 2015
- No recommendation noted



Key Map



Riparian/Littoral Zones

The riparian/littoral zones consist of the banks along the Charles River and the lagoons. These zones are important for providing wildlife habitat and support the growth of aquatic plants which improve water quality. The planting conditions and aesthetics vary greatly along these zones, with little continuity or planting standard. The width of these zones was determined by the edge of plant species that have formed a clear vegetated edge between the paved pathways and the water. Tree species found in these zones tend to be more favorable of water dependent conditions.

The 2015 inventory includes mature trees along the riparian/littoral zones, but does not include small vegetation. It should be noted that there appears to be saplings growing along portions of the bank that require routine cutting in order to restrict volunteer trees from reaching mature heights. These smaller trees have a significant impact on slope stabilization on the Charles River bank, and also restrict access to the water. Trees are not planted continuously along the riparian/littoral zones which leaves voids in the canopy, some of which are maintained purposefully to maintain views of the Charles River. There are several other openings at boat launches which provide access to the water.

The area of the lagoon closest to the Hatch Memorial Shell appears to be the most maintained portion of the riparian zone, and is lined regularly with flowering cherry trees with minimal understory plantings. Unfortunately, the majority of these trees are in either "poor" or "fair" condition, likely due to the fact that they are planted along an asphalt path that is heavily salted during the winter months for pedestrian safety and also because they are in such a high use area. It should be noted that trees on the island side of the lagoon appear to be healthier, possibly because there is a greater buffer from the pathway.

South of the Harvard Bridge, the trees tend to be less maintained with more unkept understory shrubs. Trees along this edge have a more naturalistic appearance and irregular pattern of spacing and species. The intermittent spacing provides frequent water views but maintains lower plantings that restrict water access.

It was Shurcliff's intent that these zones contain both formal and informal plantings. The paths along the lagoon and Charles River were originally designed to be formally lined with Norway maples, pin oaks, red oaks, and white willows. Intersections and nodes had contained pockets of ornamental trees, such as white willows.

Trees line the lagoon on both sides

Trees are not formally spaced along Charles River

Soils

In 2017 soil tests were taken from various locations to gain a better understanding of the physical properties of the soil and the suitability for vegetation. The chart below compares the average of the soil test results from summer 2017 versus the recommended optimal range as suggested by the University of Massachusetts Extension laboratory. These results show that many of the nutrients are considered suitable for tree growth, however there are a few nutrients that are excessively high. Potassium, for example, is much higher than the recommended level. Very high potassium levels are usually caused from excessive fertilizer, and can limit a plants ability to intake other nutrients.

Abandoned asphalt should be fully excavated

Soil Analysis	Optimum Range	Summer 2017 Results (Avg)*
pH	5.5-6.5	6.2
Phosphorus (P)	4-14	22.0
Potassium (K)	100-160	394.8
Calcium (Ca)	1000-1500	1619.5
Magnesium (Mg)	50-120	232.7
Sulfur (S)	>10	15.9
Boron (B)	0.1-0.5	0.2
Maganese (Mn)	1.1-6.3	4.2
Zinc (Zn)	1.0-7.6	7.8
Copper (Cu)	0.3-0.6	0.8
Iron (Fe)	2.7-9.4	4.7
Aluminum (Al)	<75	28.4
Lead (Pb)	<22	6.8
Cation Exch. Capacity, meq/100g		16.9
Exch. Acidity, meq/100g		5.8
Calcium Base Saturation	50-80	48.9
Magnesium Base Saturation	10-30	11.1
Potassium Base Saturation	2.0-7.0	5.9
Scoop Density, g/cc		0.9
Soil Organic Matter (LOI), %		10.3
Soluble Salts (1:2), dS/m	<0.6	0.02
Nitrate-N (NO3-N), ppm		4

* Averages account for (18) different testing locations

Concern
Less Concern
Good

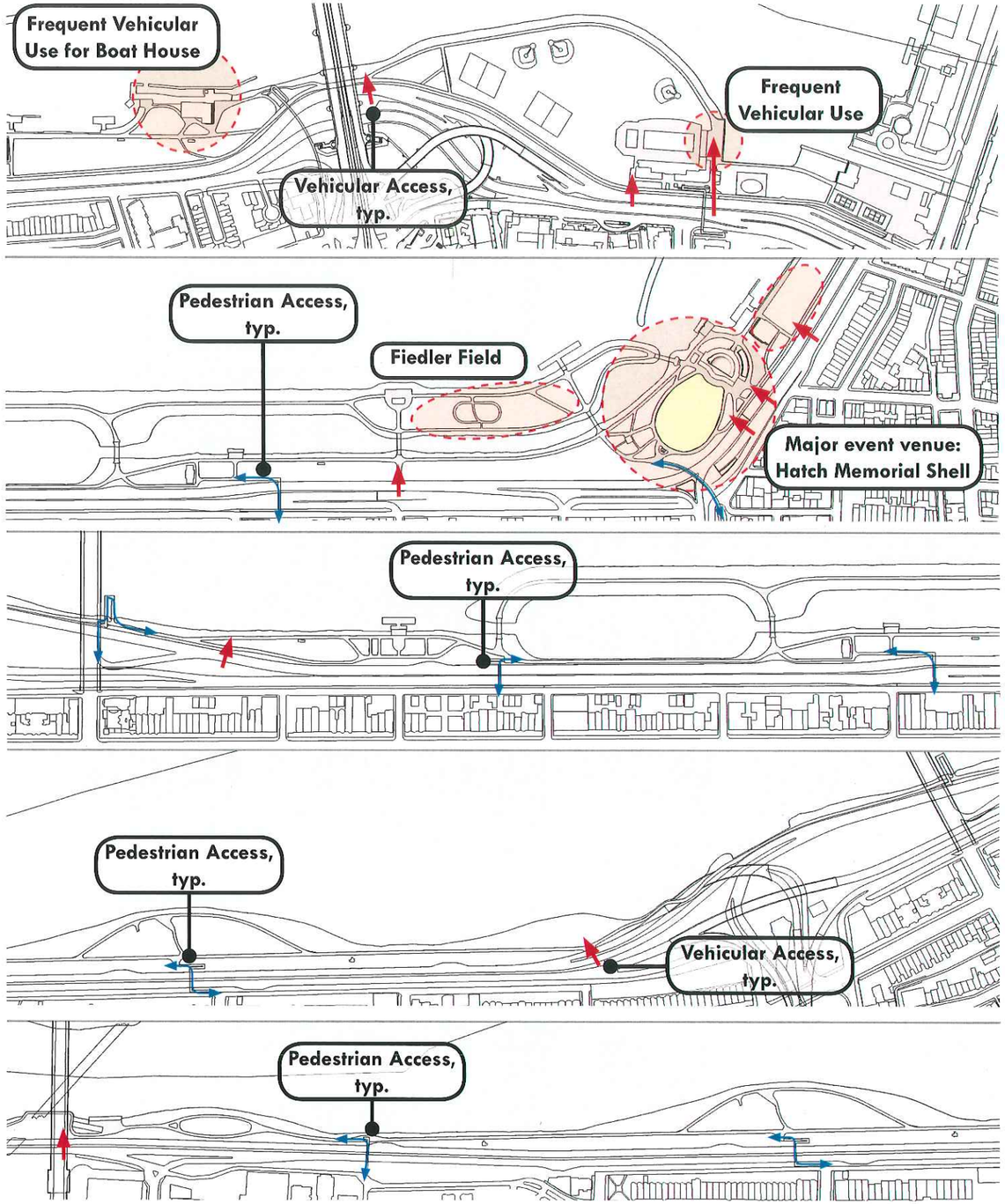
Event Planning/Construction

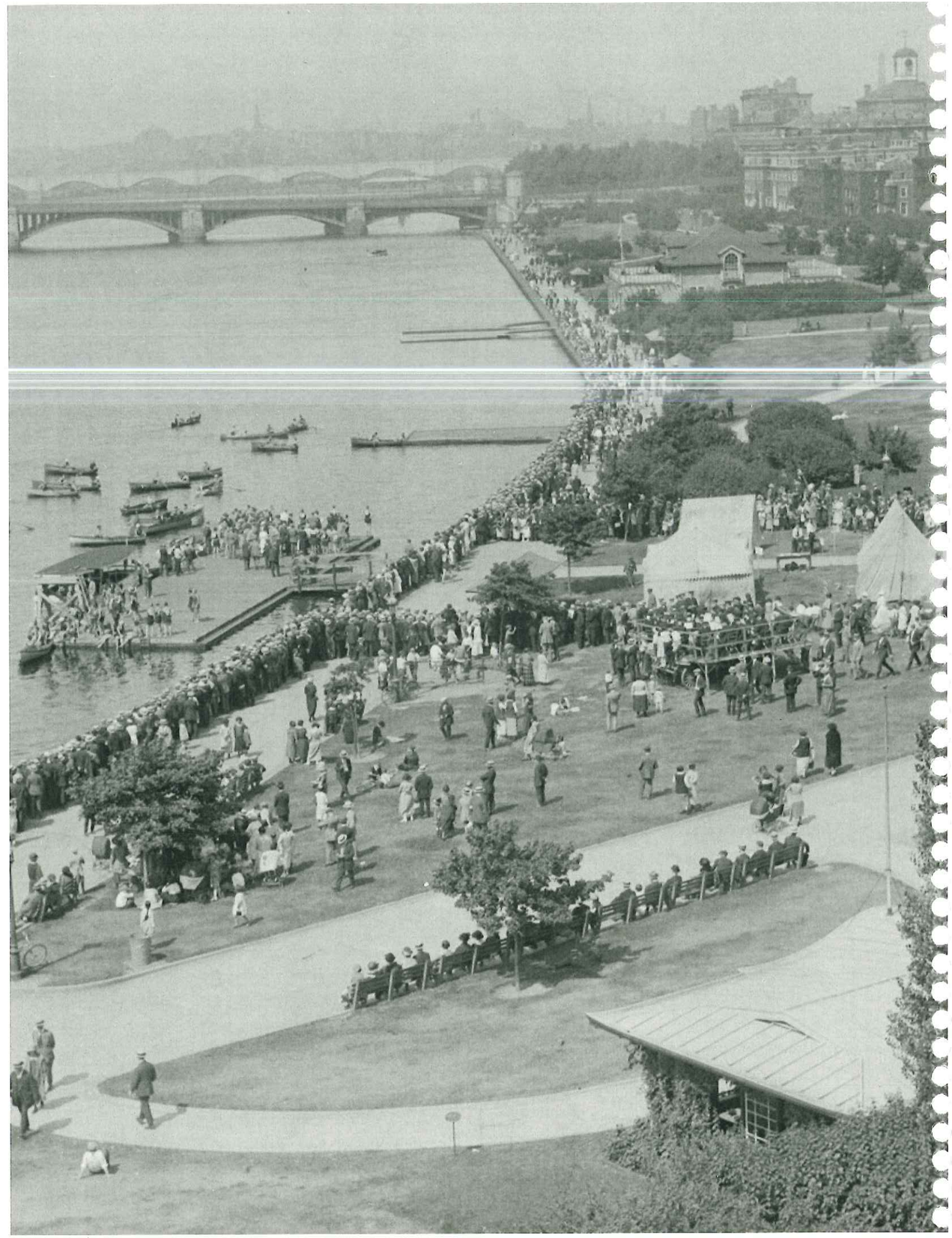
In addition to the high daily usage of the park, the Esplanade hosts a variety of special events. These events have high attendances, most notably during the Fourth of July celebration, which attracts hundreds of thousands of visitors each year. Urban trees, in general, are subject to stresses and difficult growing conditions, but hosting large events can have additional consequences in terms of tree health. This is particularly the case with the impacts from the high concentration of vehicles and pedestrians compacting the soil. This compaction reduces the tree's access to water, air, and nutrients.

For the Fourth of July event, vehicles park behind the Hatch Shell for as long as one-month duration. Administrators should coordinate before and after mitigation strategies to prevent the negative impacts of the events.

Protection fencing around the root zones

Events at the Hatchshell. Pictured: Mix Fest 2017


Frequent Vehicular Use for Boat House
Frequent Vehicular Use
Vehicular Access, typ.
Pedestrian Access, typ.
Fiedler Field
Major event venue: Hatch Memorial Shell
Pedestrian Access, typ.
Pedestrian Access, typ.
Vehicular Access, typ.
Pedestrian Access, typ.



Historical Influences

Much of what presently exists along the Esplanade is a result of the changing development and rapid growth of the surrounding Boston neighborhoods. The Esplanade, formerly called the Embankment, began to take form in the second half of the nineteenth century, when the new linear land mass was created by means of filling. This new landform was originally designed by Frederick Law Olmsted, as a wide promenade along the Charles River that included open grounds for active and passive recreation. The promenade included a granite seawall, long stretches of benches, and linear trees. Trees were planted formally along the perimeter, and then informal clusters and groves in the lawn panels that separated the recreational facilities. However the park was much different than it is today. The Charles River still fluctuated with the ocean tide, and the water was still saltwater. It wasn't until the early 1900's, when the construction of a dam would create a constant water level, forming what would then be called the Charles River Basin.

In the 1930 -1950s, the road infrastructure influenced the shape of the park as the roads widened to accommodate increasing traffic. New land was further filled to widen the park, and compensate for the land that was being turned into roads. Arthur Shurcliff created the foundation for the Esplanade that exists today with his 1949 design. His plan removed the vertical walls from Olmsted's plan and replaced them with a more naturalized edge. Sloped edges absorbed the waves created by the wind and reduced their intensity, thus creating a safer boating environment. Shurcliff's slope design used rounded water-worn stone and gravel to create a stabilized sloped edge.

Charlesbank

The park segment from the Craigie drawbridge to the Longfellow bridge is referred to as Charlesbank. Arthur Shurcliff's 1949 plan developed Charlesbank to include Storrow Drive and other road infrastructure improvements while maintaining active recreational field and passive use areas. Today this northern-most portion of the Esplanade currently still has active recreation fields and a playground. Trees in the 1949 plan were planted along the perimeter and paths in a scattered but linear layout, and a formal grid of trees where the Alfond memorial Spray Deck exists today. The current activities in this portion of the Esplanade still reflect Shurcliff's original intent, and the tree layout has also not changed much from the design. Trees are still planted along the street (Storrow Drive) in a single row and the path along the Charles River. There was likely some infill tree planting along the Charles River path, which has resulted in a more continuous canopy. There were a few clearings of trees along this path in Shurcliff's plans which were likely to maintain views. The grove of trees on the north side of Longfellow Bridge remains similar to what Shurcliff had designed.

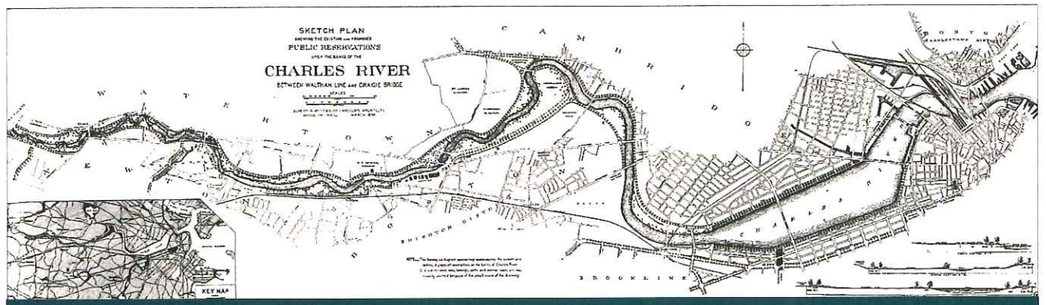
Storrow Lagoon, 1935

Back Bay

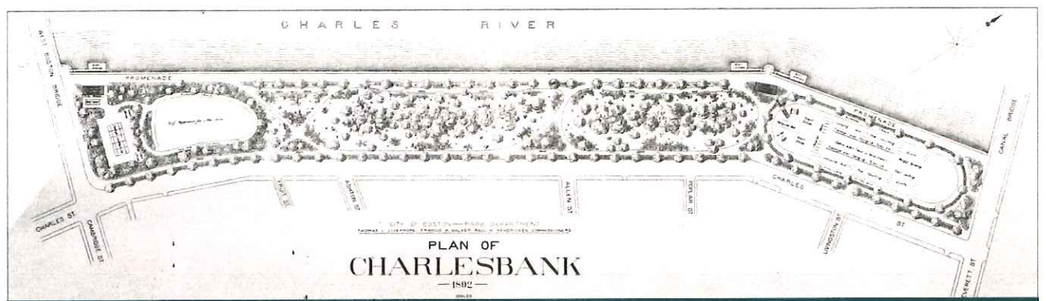
The park segment between Longfellow bridge and Harvard bridge is referred to as the Back Bay portion. The schematic plan for the Back Bay section included a hard edge along the Charles, and a formal double row of trees that continued almost the entire length. Shurcliff's 1929 schematic plan maintained the double row of trees but added a wide buffer of uniformly spaced trees along Embankment Road (now Storrow Drive). Shurcliff's 1949 plan incorporated Storrow Drive and the addition of the lagoon and islands. This plan is more reflected in today's current state. Trees were planted in scattered clusters along both Storrow Drive and the islands. The granite stairs (originally boat landings) included formal grids of trees. Shurcliff's intent was to add a formal character along the Esplanade. The grid of Norway maples still exists, however the majority of them are in poor condition. With the decline of these trees, gaps and irregularities make the spaces feel more like groves than formal plantings that accentuate the boat landings.

Charlesgate/Upper Park

The construction of Storrow Drive and the Bowker Overpass had an immense impact on this segment of the path. Currently, much of the Bowker Overpass dominates the space and extends over the Esplanade path with one portion being too restricted to plant any large trees. The Esplanade widens past the overpass area, with open areas where much of the tree plantings were designed to be planted in scattered clusters, with the exception of a formal boat landing shown in Shurcliff's conceptual 1949 plan. The bank along the Charlesgate/Upper Park segment is currently planted more densely with low vegetation which creates a more naturalistic appearance.



Charles Eliot's Conceptual Plan for the Charles River Dam and Parkways, 1894



Frederick Law Olmsted's "Plan of Charlesbank" Plan, 1892

"Shade is the first requisite. Trees should be planted in abundance to cool the sun-baked promenades and to soften the reflected light from the water and from parching the grass spaces. Plantings of this kind should be arranged as wind-breakers to modify the unhindered blasts of the basin shore, and to temper as far as possible the winds which endanger pleasure boating. Foliage of trees and shrubbery is also needed for pictorial effect, to frame lawns and vistas and to screen objectionable features from constant intrusions upon the park"

— Arthur Shurcliff,
"Development of the Charles River Basin"

Landscape Timeline

2009
Esplanade dedicated as a Boston landmark

2001
Esplanade Association formed

1965
Construction of Bowker Overpass

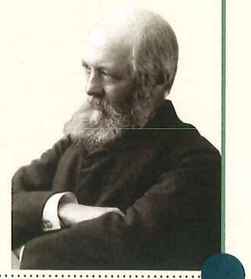
1950-1951
Construction of Storrow Drive

1949
Arthur Shurcliff's implemented plan, as part of the Storrow Drive construction, creates a sloped edge along the Charles River and introduces the Lagoon.

1929
Arthur Shurcliff's conceptual plan

1908
Damming of the Charles River

1894
Charles Eliot's influence creates a consistent water height, which would eventually lead to a safe boating haven.



1892
Frederick Law Olmsted begins designing "The Embankment"

Music Oval & Community Boating

Two of the most significant destination spaces of the Esplanade are the Hatch Memorial Shell and the Community Boating center. Early plans maintained several pockets of open lawn space with clusters of tree plantings, the largest area of open lawn being the "Music Oval". The "Music Oval", now the location of the Hatch shell, was edged with Linden trees, still present today. Shurcliff's intent was to provide temporary seating only. Trees planted around the Hatch Shell have grown and currently create a sense of enclosure around the oval lawn. The plantings around the perimeter of the oval are consistent, however many of the open spaces between paths have been infilled with tree plantings creating a much denser canopy.

There were originally 2 large lawn ovals, however the second oval was built upon and replaced with the Community Boating Center.

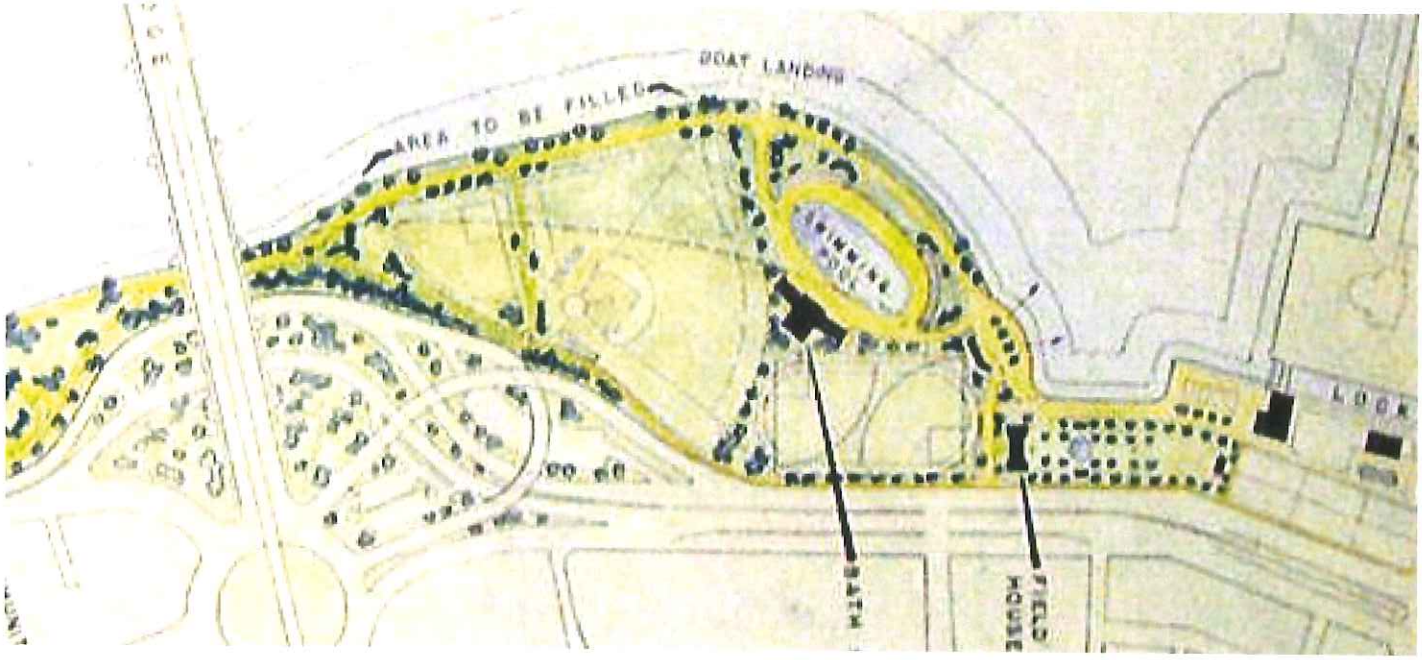
Aerial view looking south-west, 1934

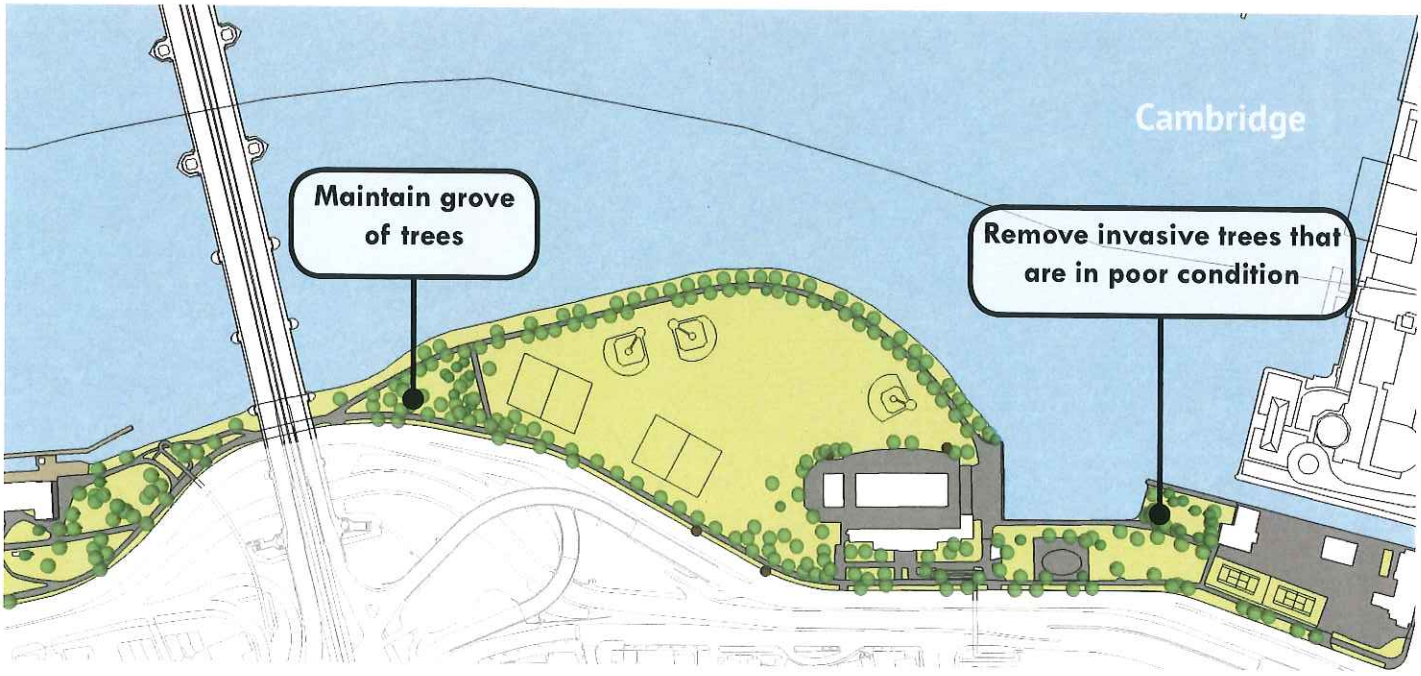
Aerial View, 2017

Aerial View looking north, 1935

Aerial View, 2017

Arthur Shurcliff's 1949 Plan

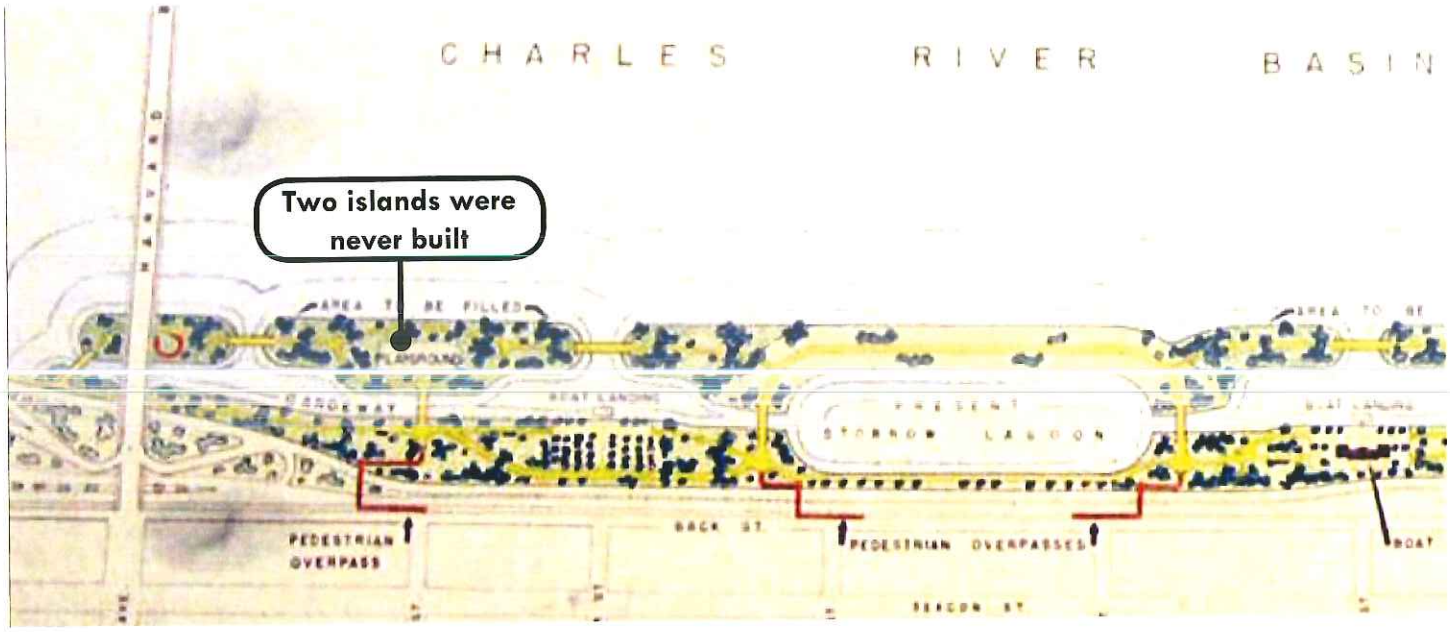


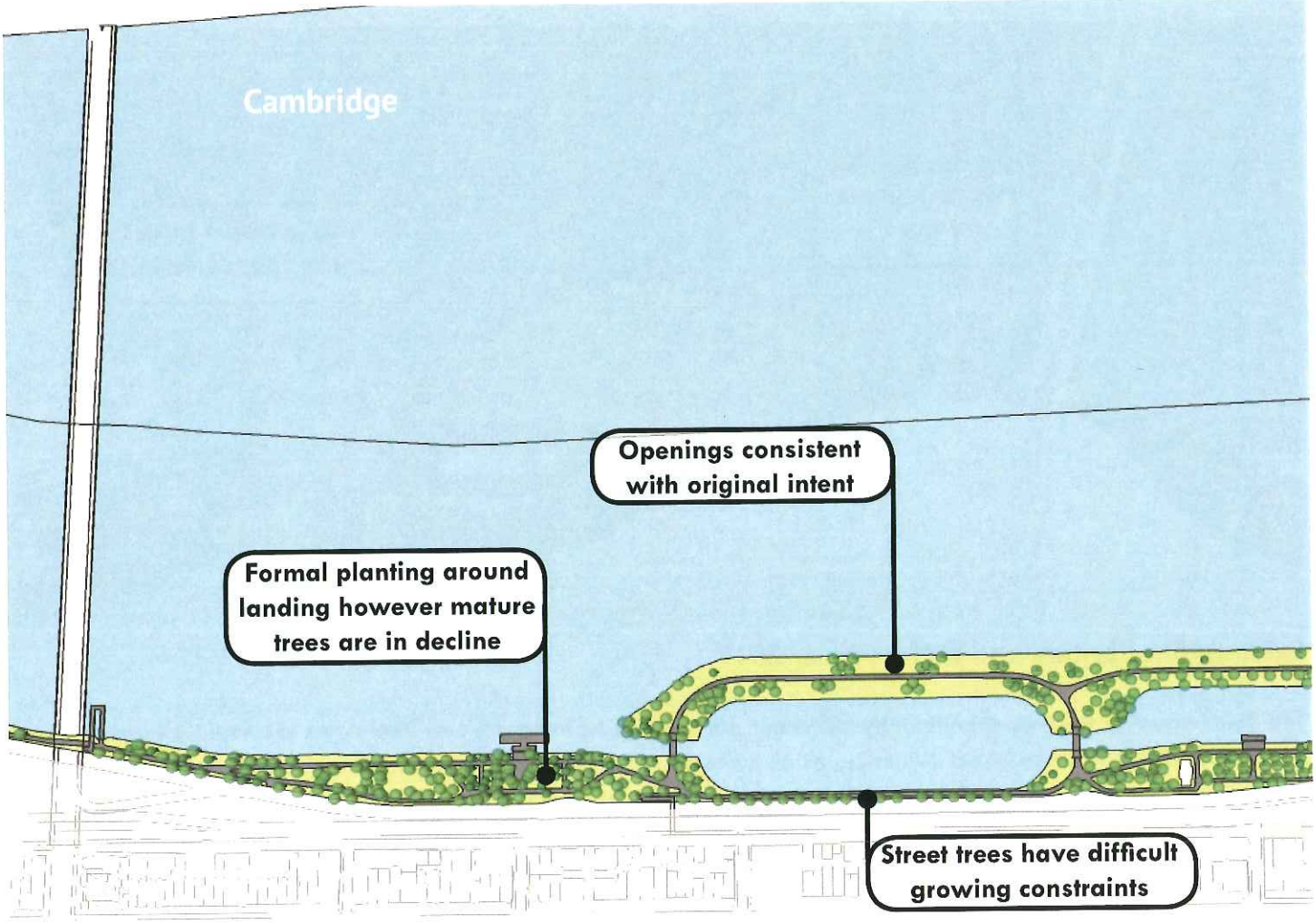


Existing Similarities and Differences, 2017

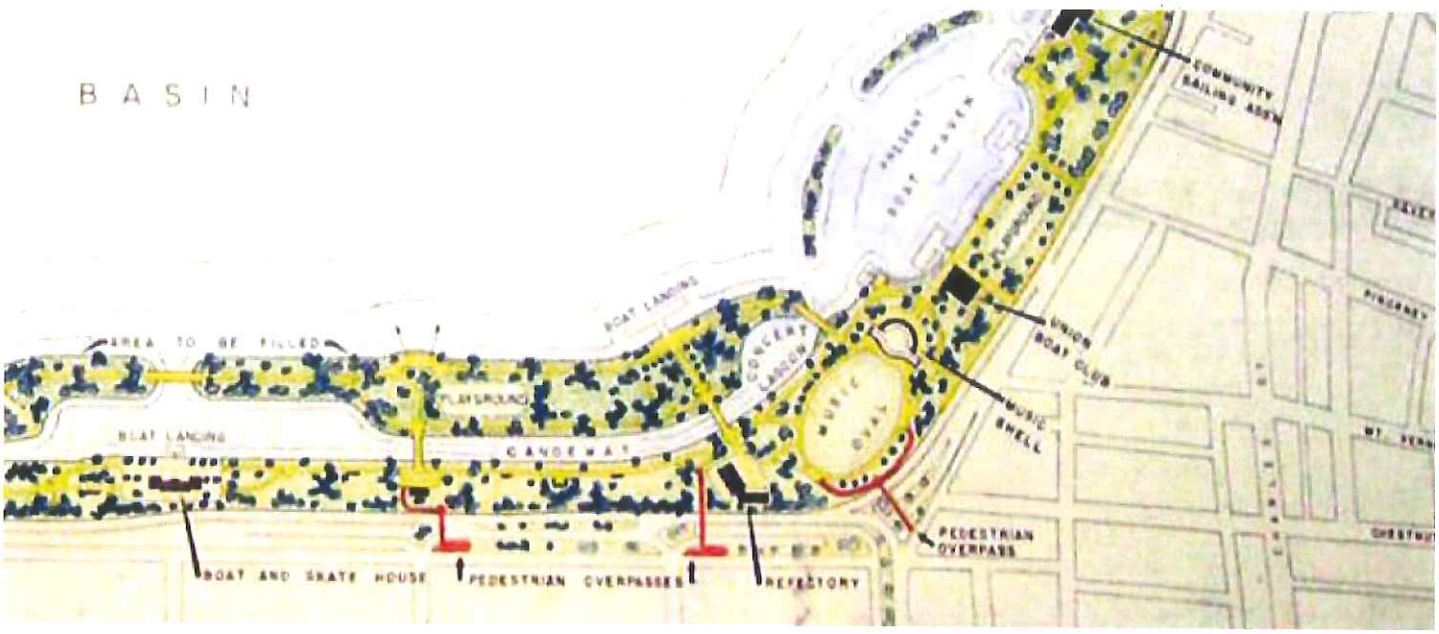
The "lock area" is the most significantly different portion of Charlesgate. Lee Pool Area is currently located near where Shurcliff had intended a swimming pool, however a parking lot has replaced one of the scenic overlooks. There is a small lawn area with many large mature trees to the north-west of the Charles Bank Playground. This area was originally designed to be left open but volunteer Tree of Heaven have become established. This connection to the Charles is one of the oldest surviving remnant of the original Olmsted design, which still has a granite seawall and a section of promenade with very large Common Honeylocust.

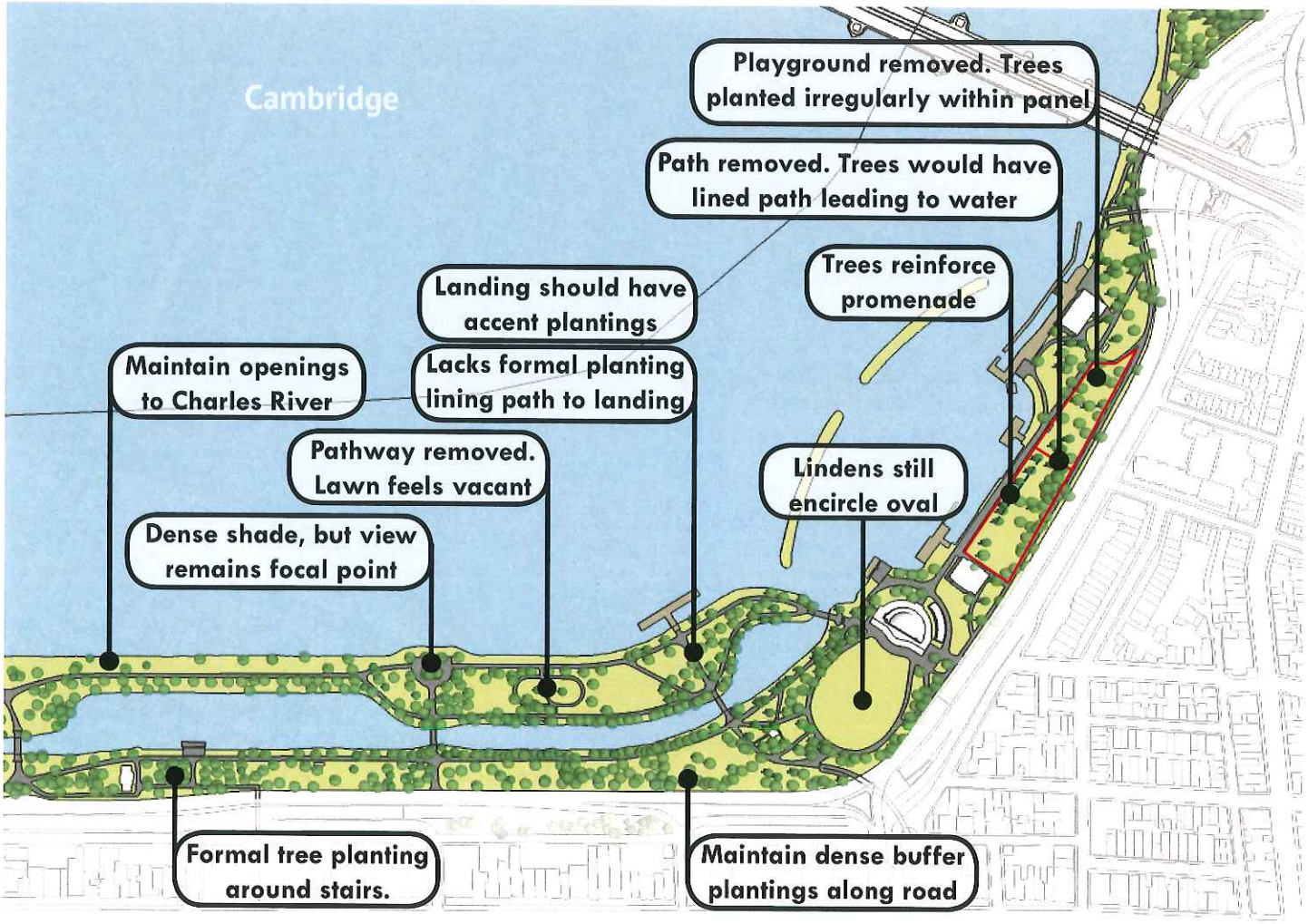
Arthur Shurcliff's 1949 Plan



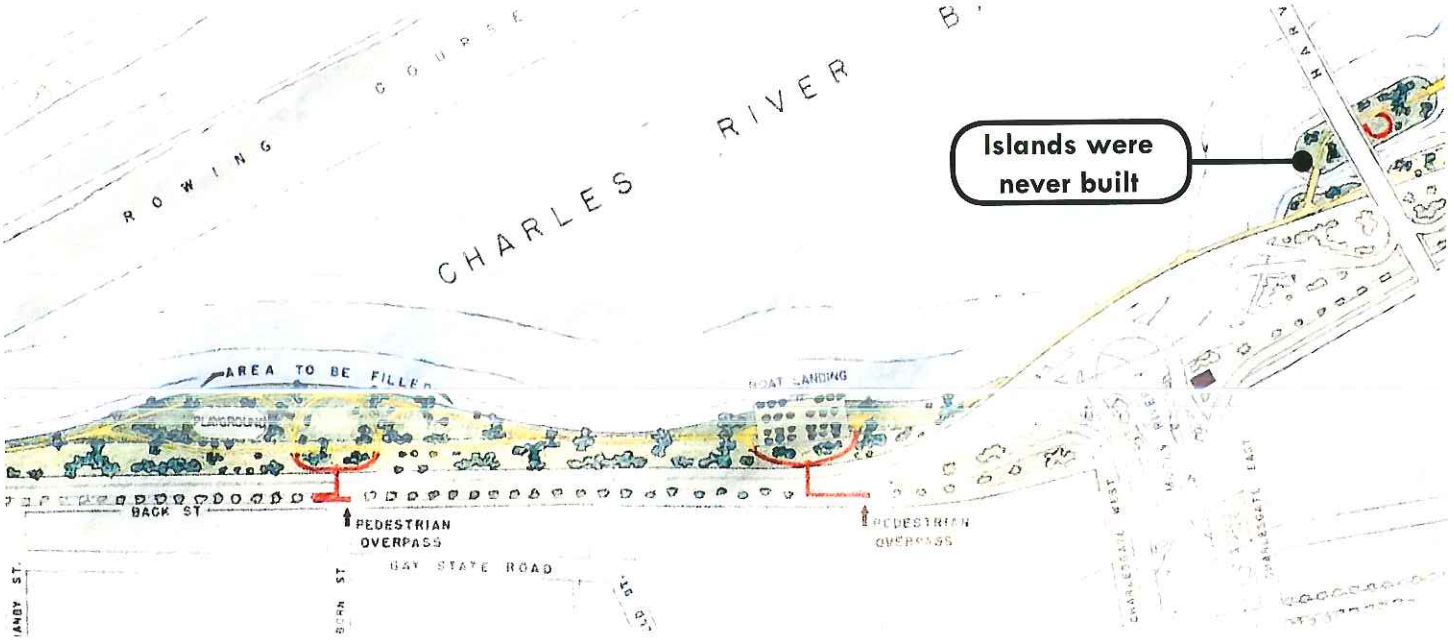


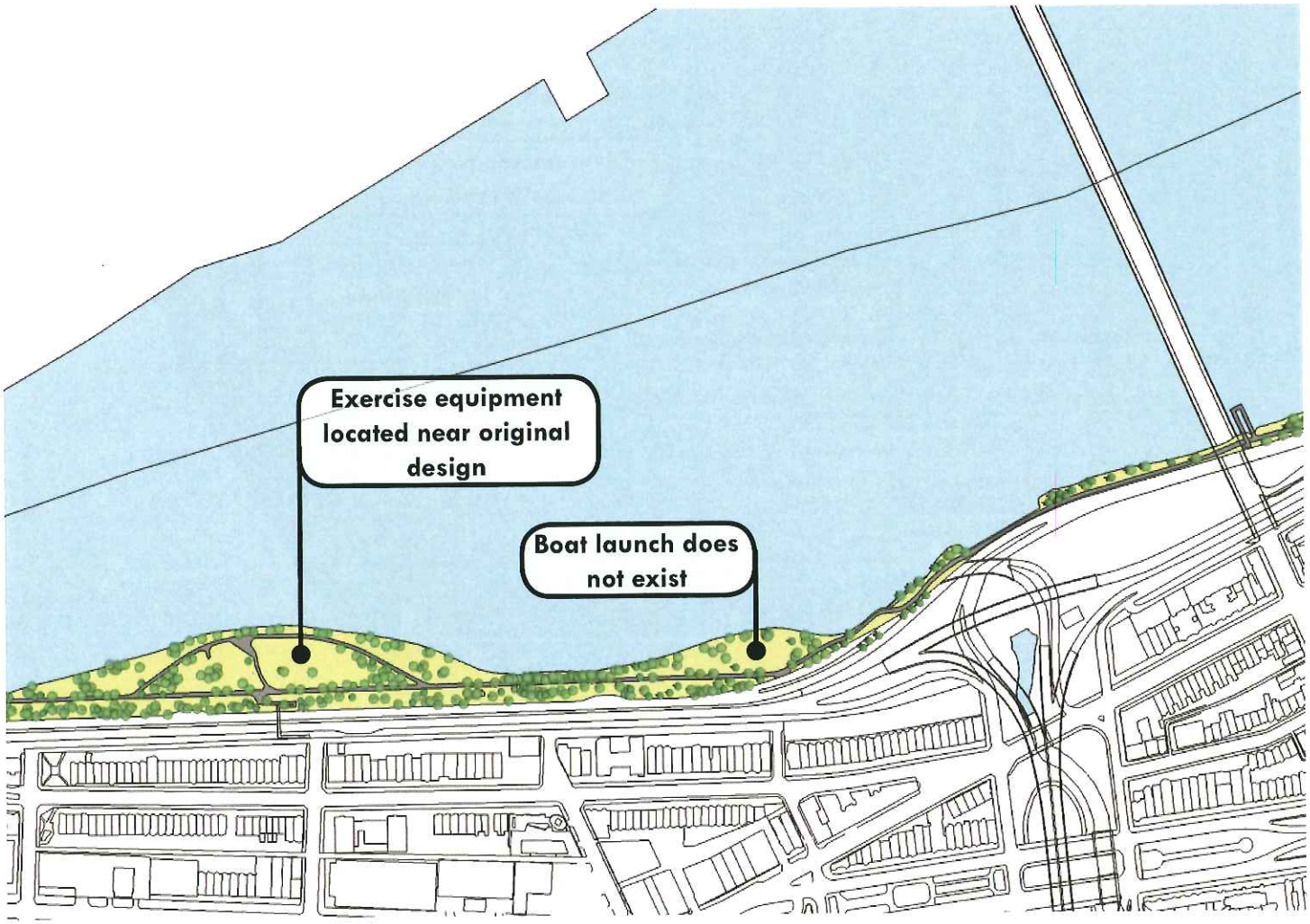
Arthur Shurcliff's 1949 Plan



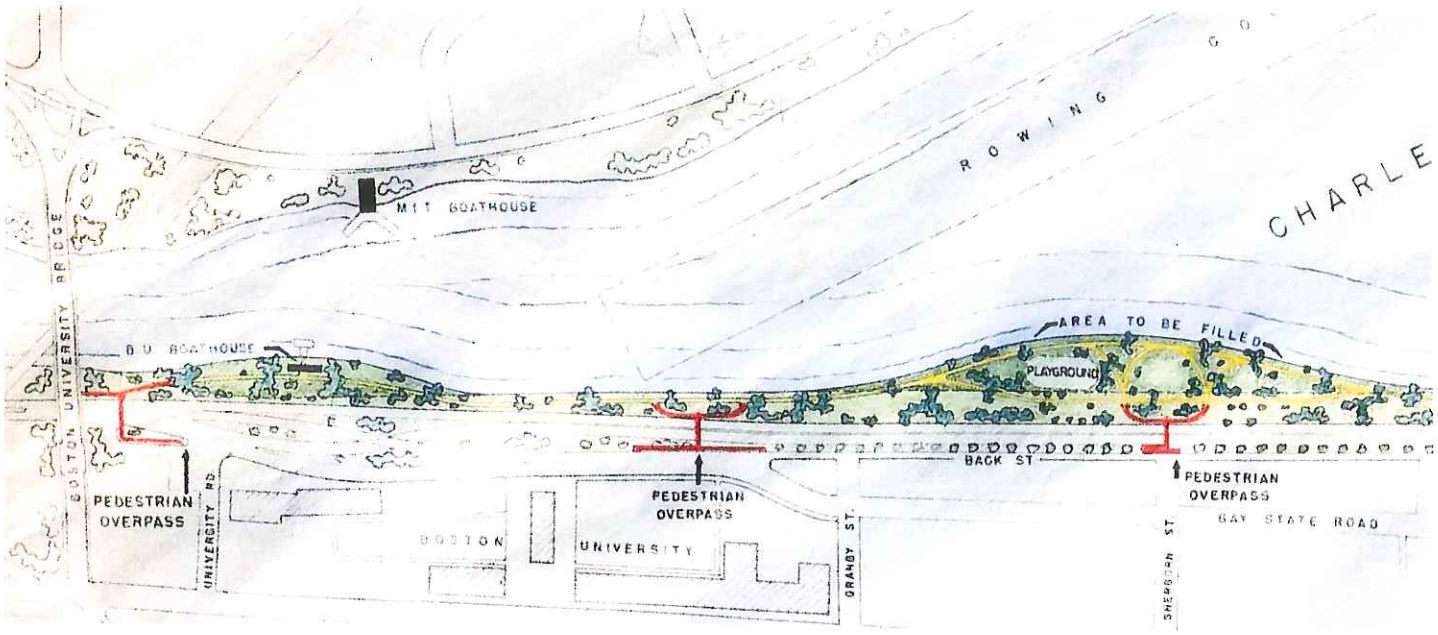


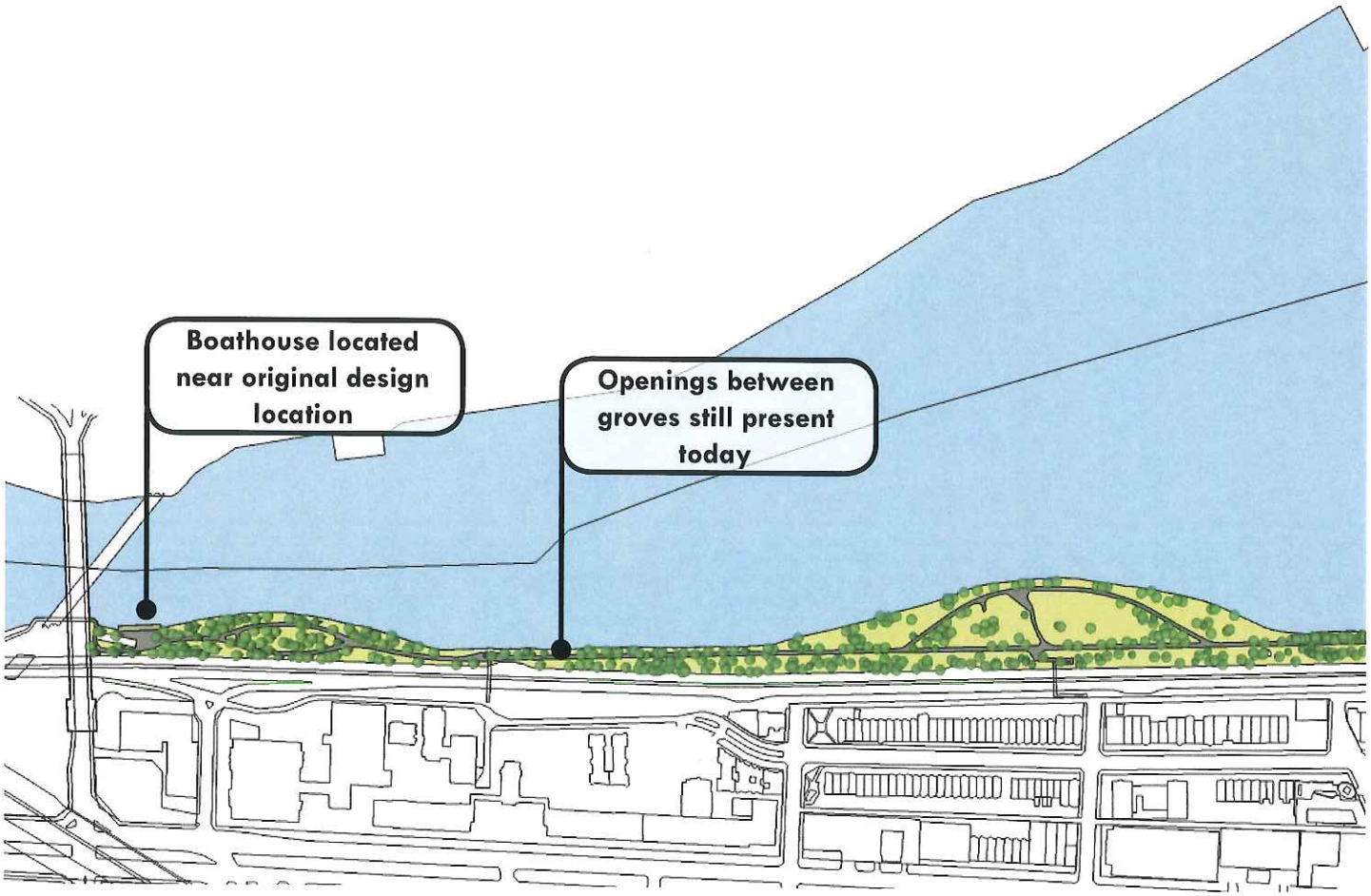
Arthur Shurcliff's 1949 Plan

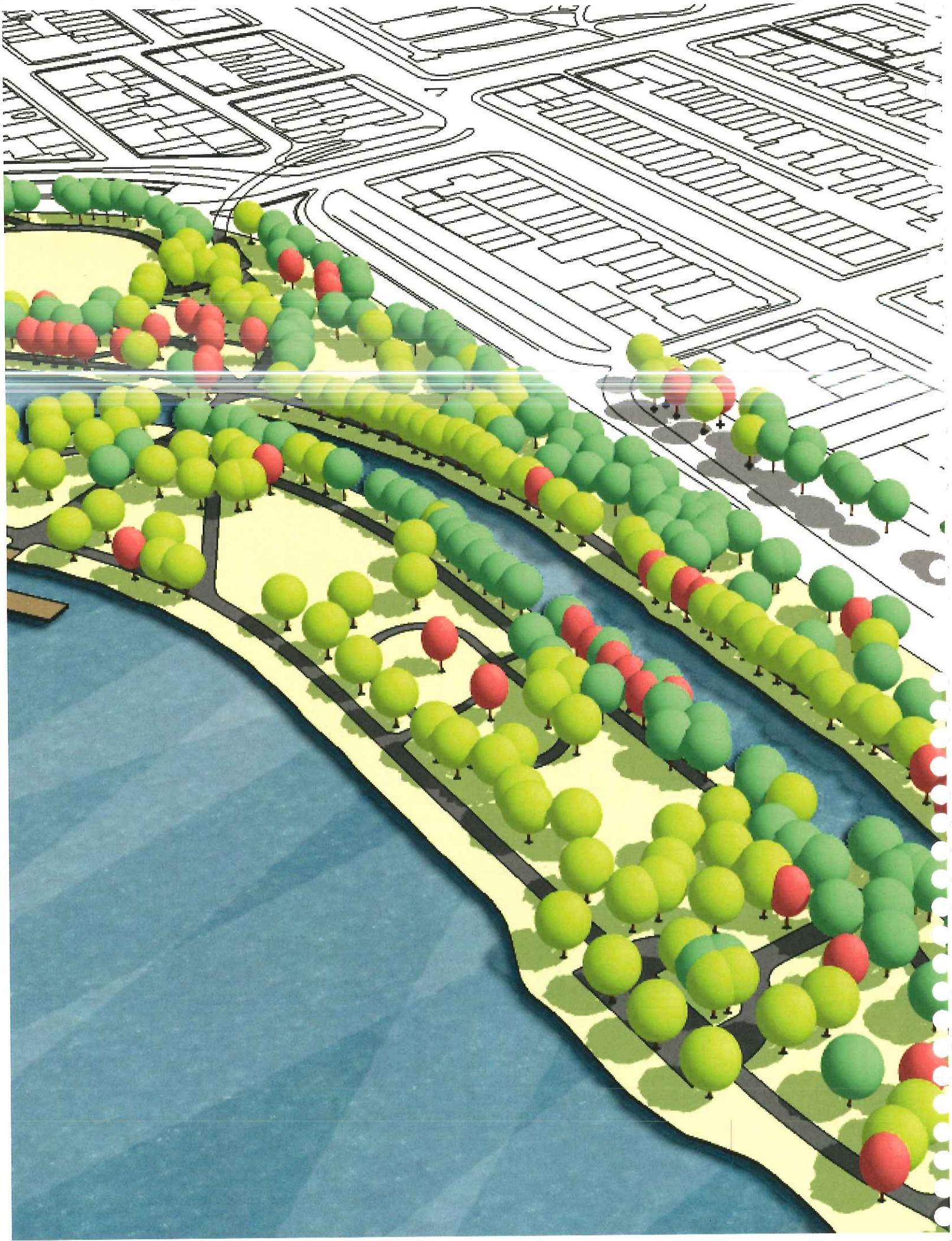




Arthur Shurcliff's 1949 Plan







Recommendations

The existing condition assessment provided the basis for establishing recommendations for addressing park needs and improving existing tree care. These decisions are aimed to improve the health of existing and proposed park trees, both as a unified urban forest and as individual trees. These recommendations are also intended to help the decision-making process regarding the maintenance of existing trees and the future of proposed trees.

The general structure of the recommendation section is as follows:

System-wide Recommendations
- Applicable to the urban forest as a whole

Typologies
- Recommendations for management zones

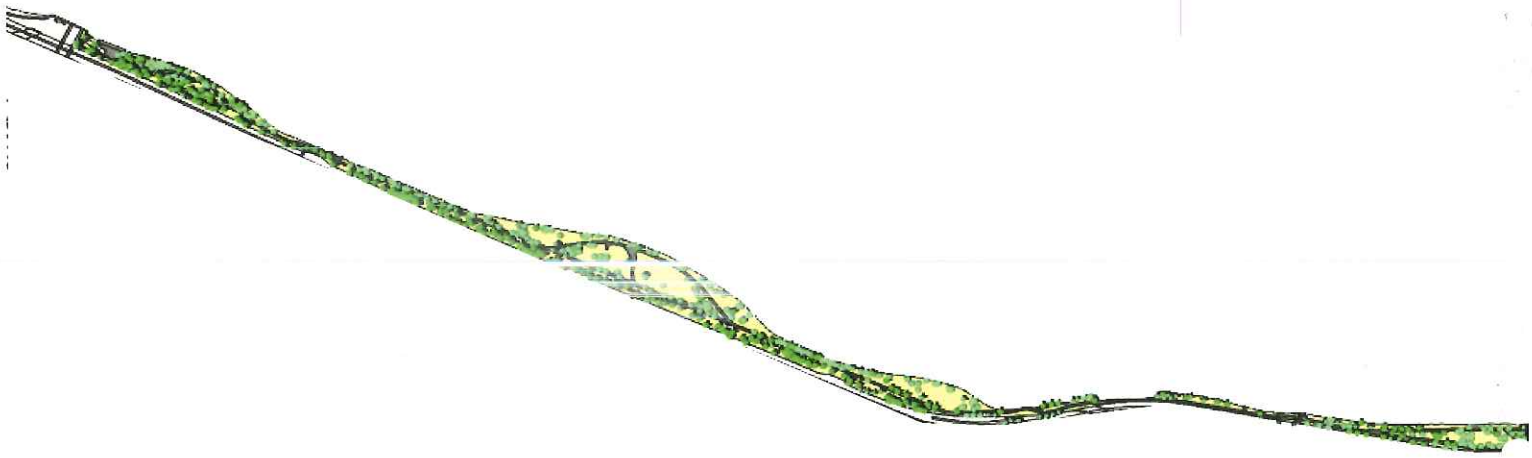
New Planting
- Site plans indicating infill planting, removals, and tree replacements

Recommendations By Topic
- Succession Planting
- Increasing Diversity
- Care of Existing Trees
- New Planting
- Event Mitigation
- Soil Recommendations
- Priorities, Phasing, and Costs

Recommendations were heavily influenced by the overall aesthetic of the park and the appropriateness relating to the historical designs. Shurcliff's 1949 plan was the primary reference for deciding on historical appropriateness, as it is the design that is most relevant today. One goal of the recommendations is to maintain a continuous and successful living canopy that shades the park as intended by the Shurcliff design.

In addition to the historic character of the landscape the desired function of the park, and safety, should be foremost considerations for maintaining existing trees and new plantings. Trees should improve the overall quality of the park and create the framework that allows the park to be used. Without healthy trees, the park would be rendered useless for many of the favorite activities.

A mature group of willow trees flank the granite wall

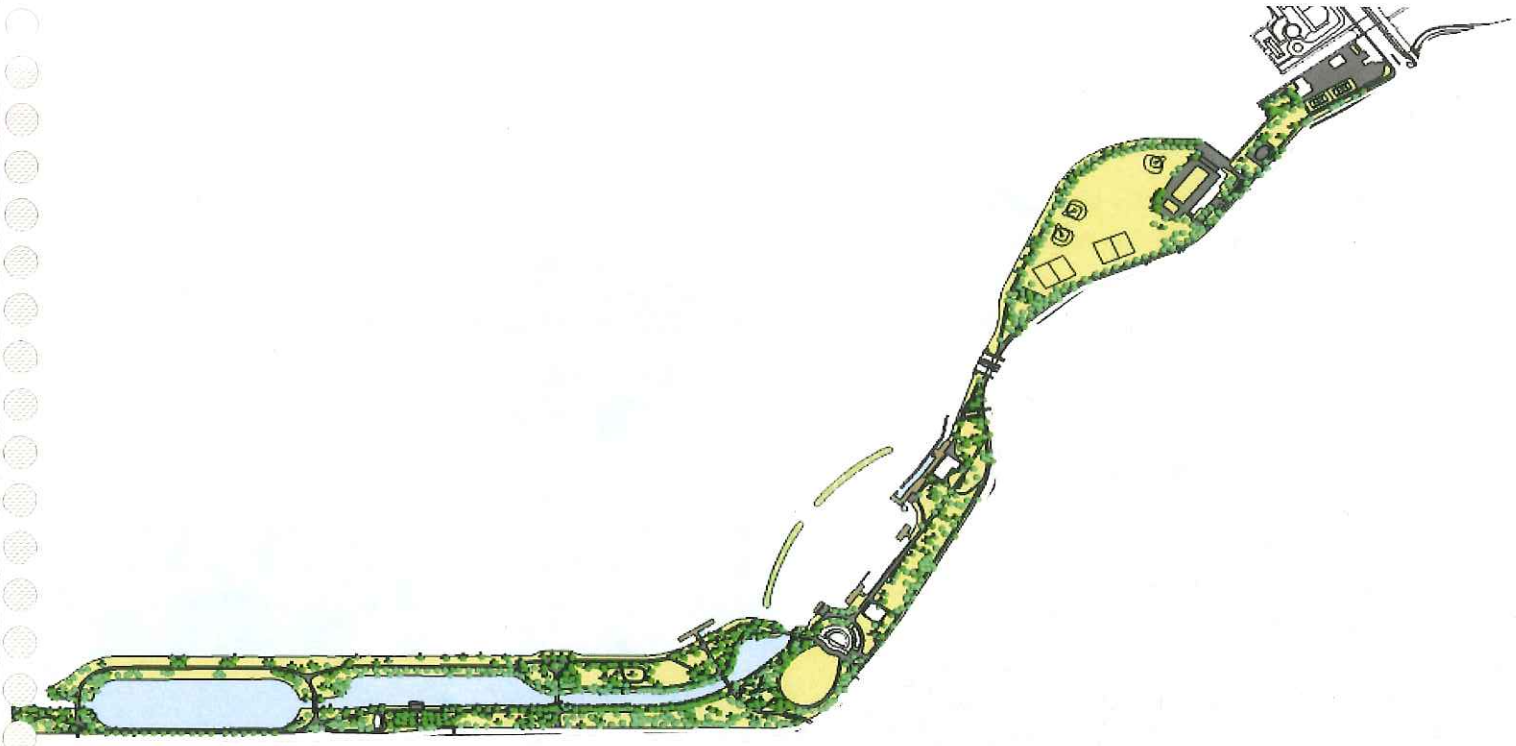


Recommendation Goals

The existing trees along the Esplanade are the key defining characteristics of the park. Without them, the park would lack any reprieve from the busy, impervious, and hard edge of the city. The reason the Esplanade is such a unique experience is because it gives a sense of removal from the city, despite the close proximity. Boston and Cambridge both provide urban backdrops for the park, yet it is easy to feel as though you have reached a destination space that is separate from urban life. In a city with such tall buildings and man-made structures, trees along the Esplanade provide a more human-scale design element that creates a comfortable and pleasurable park space.

As a whole, the Esplanade forest is generally successful in terms of providing an enjoyable escape from city life. However, as these trees have matured there has been an enormous increase in the need for maintenance, yet not an increase in the available resources to keep up with the demand. From a safety stand point many of the large trees need to receive routine pruning, particularly in high-use areas. Much of the park appears to have even-aged strands of trees which, although currently aesthetically pleasing, presents a potential future problem when trees start to decline and need to be removed.

System-wide recommendations are aimed at providing general suggestions for how to keep the park safe, aesthetic, and ecologically responsible. Safety is the top priority. Trees need to be carefully maintained and pruned routinely to eliminate any risk of tree inflicted injury. New trees need to be planted to ensure there will be a future generation of healthy trees. Soil conditions need to be monitored and amended in order to provide sufficient growing conditions for the trees. Management zones should be established and followed in order to easily know what tree species is appropriate in a given location based on historic plans, aesthetics, and function.



System-Wide Recommendations

Management

- Reflect the original Shurcliff design intent where possible and appropriate.
- Manage landscape by zones where specific strategies apply.
- Maintain GIS-based inventory, recording annual removals, pruning, and planting.

Tree Planting

- Succession tree planting to develop the next generation of trees.
- Increase species diversity.
- Infill pathway and street tree planting to maintain consistent spacing (where appropriate) and to create a continuous canopy.
- Improve groves/natural plantings that serve as natural habitat.
- Replace large removals with similar species, as appropriate.

Soil Improvements

- Improve soils to support healthy tree growth.
- Repair and prevent soil erosion along banks.
- Test soil seasonally

Maintenance

- Perform regular tree pruning to minimize risk to park users. Implement pruning and removals as recommended in the GIS-based inventory data provided by Bartlett Tree Experts.
- Provide tree care to improve quality of trees and extend life.
- Manage viewsheds, particularly across watercourses.
- Manage invasive plant species.

Typologies

Tree planting typologies identify how different planting design techniques define landscape spaces found along the Esplanade. Identifying the typologies helps organize the landscape and establish a way to appropriately manage the trees while keeping with the original design intent.

The use of tree types, species, and height should be determined by the style of landscape in which they are being planted. For example, trees planted along pathways should have a high enough canopy so that they provide shade to pedestrians but also do not restrict visibility or create obstacles with low branches. There is currently a vague sense of natural typologies in the park, however there are some inconsistencies with plant palette that cause a feeling of segmentation when traveling from one end of the park to the other. Creating a system of typologies will help enforce consistency of planting organization that will make the Esplanade feel like a continuous park. Trees planted in the appropriate location will help increase their longevity and contribute to the larger image of the Esplanade as a whole.

Street Trees

Trees were originally planted in a uniform double row along the Embankment. Storrow Drive prohibits the double row, however trees along the road should be planted at even spacing to provide shade for both the pathways and road as well as represent the formal aesthetic that was originally intended.

Pathways

Shurcliff's design intent was to provide plenty of shade for paths. Pathway trees should line paths and create a continuous canopy corridor.

Promenade

Trees along promenades should be spaced consistently and create a continuous line of trees on waterfront pathways.


Grove

Groves are defined clusters of trees of a single species or mixed species. Many of the existing groves consist of informally arranged, similarly-aged trees; the groves need new planting within gaps or on edges to diversify the ages of the trees and to perpetuate the lives of the groves.


Charles River Edge

Trees along the river should be tolerant of wet soil conditions and high winds. Planting strategy should consist of tall shade trees while maintaining open views of the Charles River.


Ornamental

Ornamental planting of small flowering trees should be used to highlight entries, play areas, paths, and other nodes. Shurcliff included several ornamental trees such as dogwoods and hawthorns that should continue to be planted.


Lagoon Edge

Trees planted along the lagoon should consider maintenance requirements. Trees should be native, as possible, to improve habitat along the waters edge. Trees should maintain open views of the lagoon, but limit water access. A goal for the lagoon edge would be to remove invasive species.


Memorial/Plaza

Memorial and plaza trees should help accentuate the spaces and can help create a backdrop. Trees can be ornamental or shade trees, but should limit fruiting trees that can cause a nuisance for maintenance. Original designs would place formally lined trees around important nodes such as boat launches.

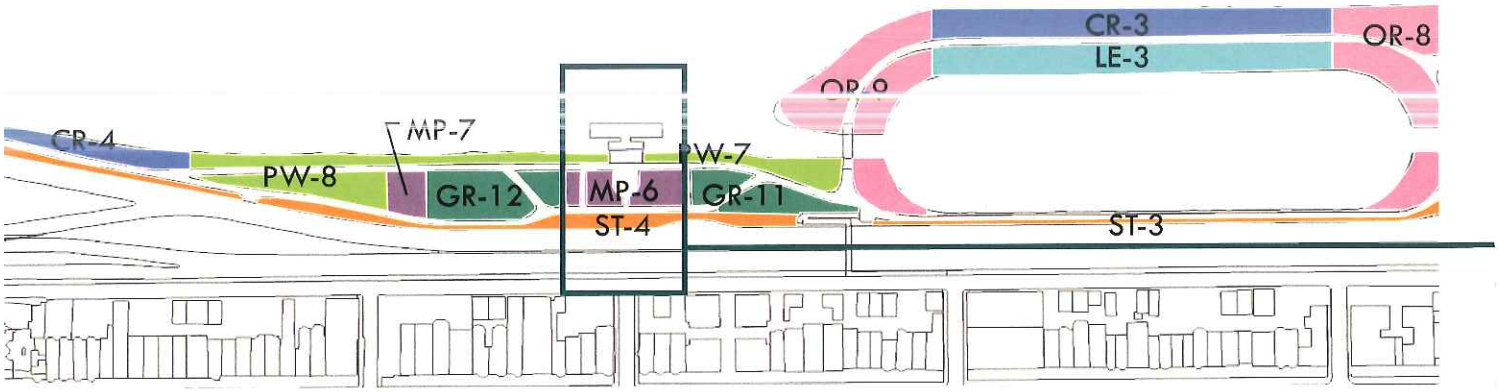

Open Lawn

Preserving open lawn areas is important in keeping with the original design intent of providing active and passive recreation. Trees should be planted on the perimeter of open lawn spaces, but not planted within them.

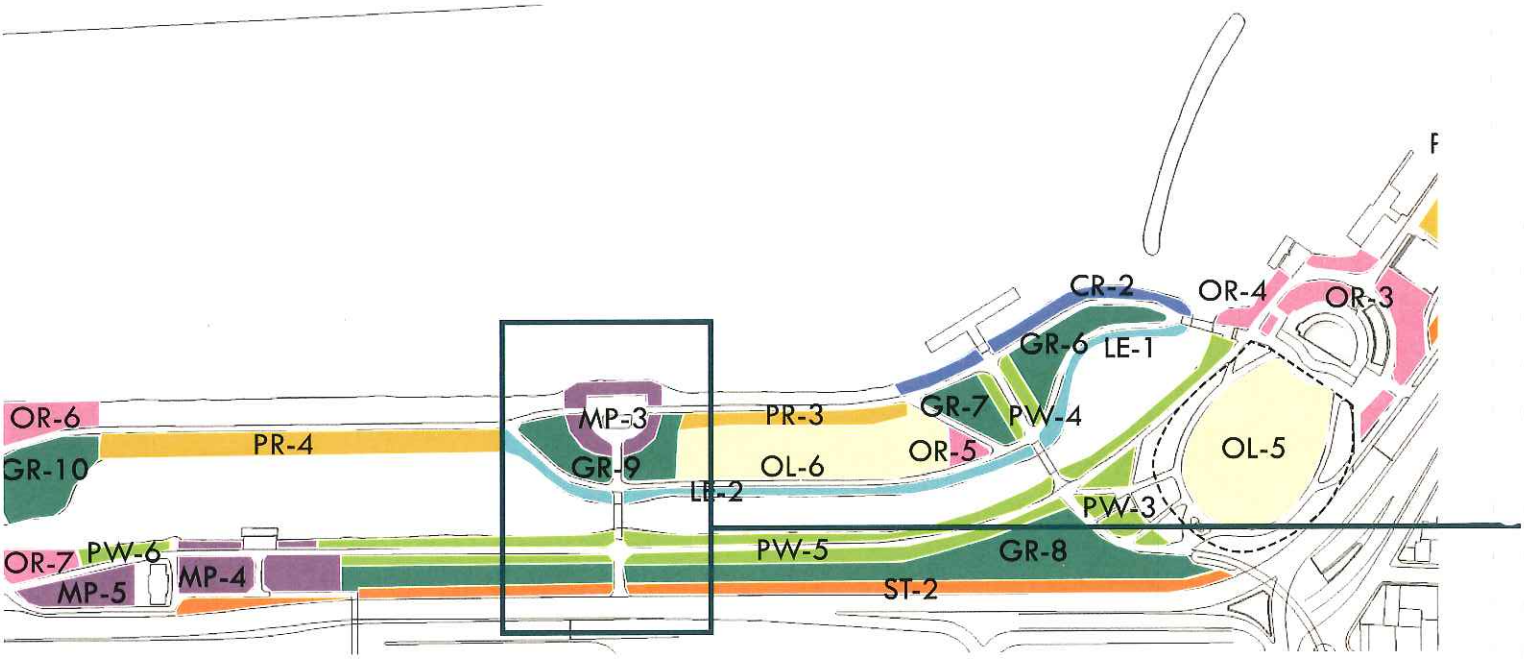
Typologies

Condition by Species

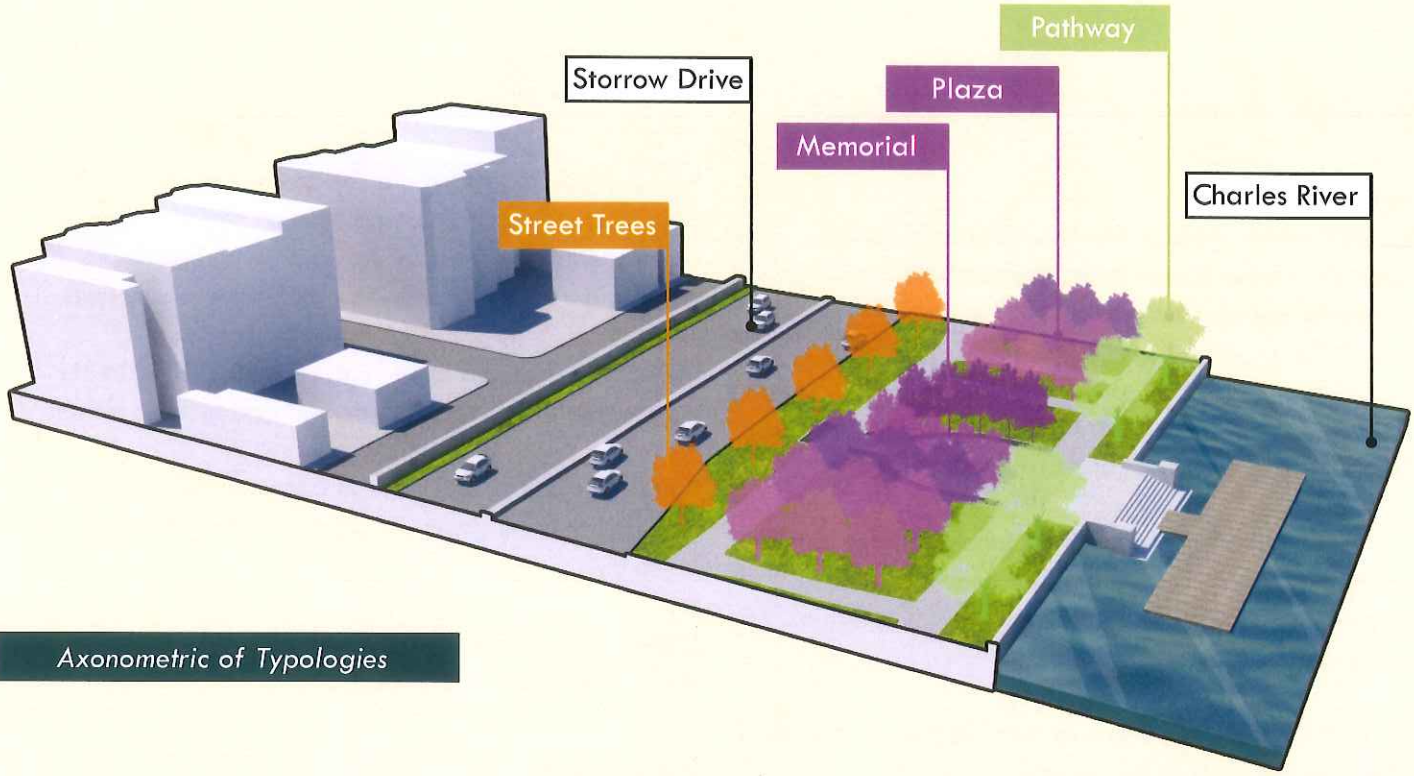
ST Street Trees	GR Grove	CR Charles River Edge
PW Pathway	OR Ornamental	LE Lagoon Edge
PR Promenade	MP Memorial/Plaza	OL Open lawn



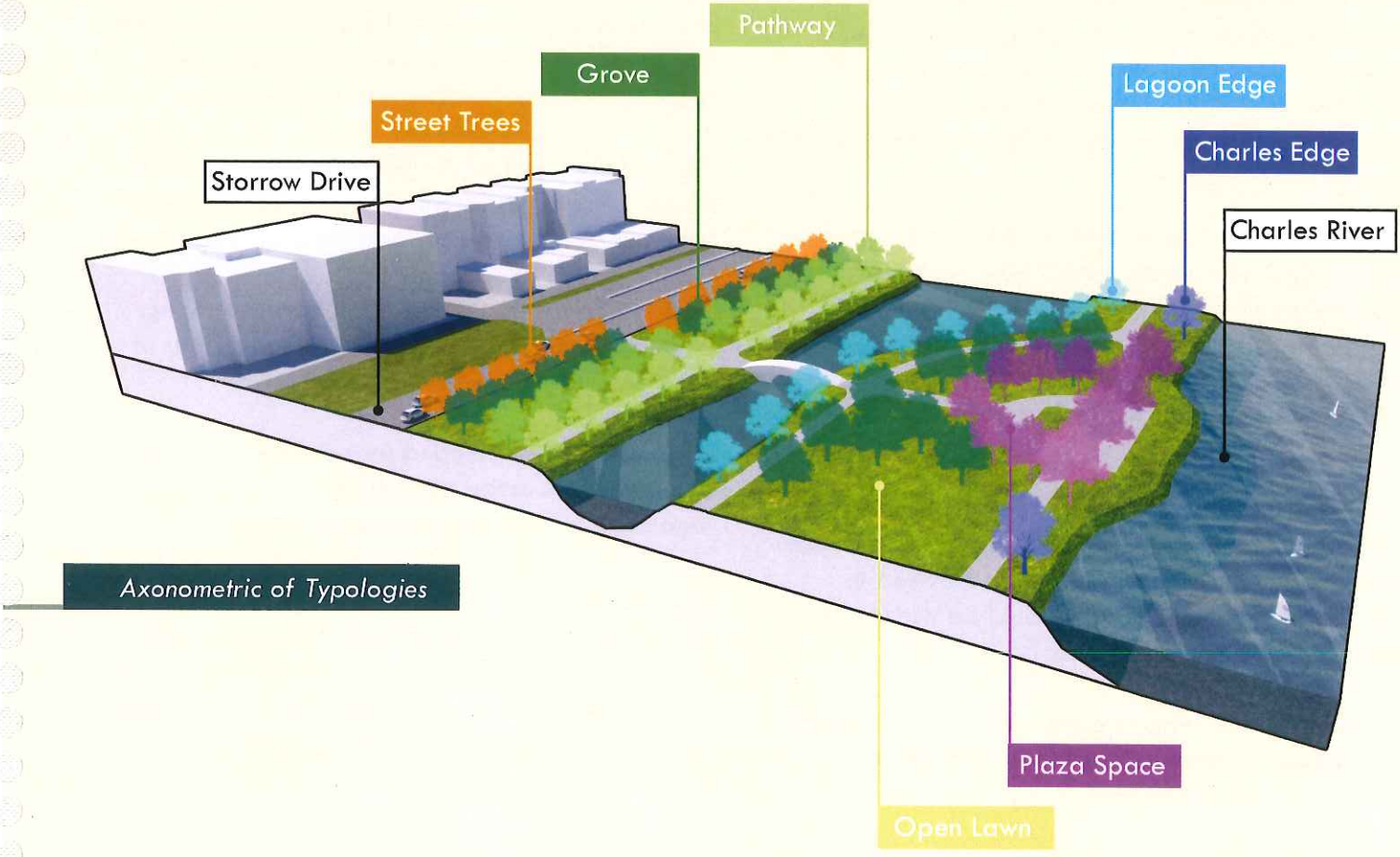
The Storrow Memorial plaza is an example of a narrow plaza space with minimal buffer from Storrow Drive and the Charles River. Trees in the plaza space should be limited to only a few species from the historic planting palette.



The Clarendon Street overlook is located on the park islands and is accessed by footbridge across the lagoon. It features an open plaza with seating adjacent to an area of open lawn. This stretch is an important node for both commuting traffic and passive park users.



Axonometric of Typologies



Axonometric of Typologies

Management Recommendations

Street Trees

ST-1: Infill where gaps exist. Tree planting should include deciduous shade trees, regularly spaced. Decompact soil and address likely high sodium levels. Maintain lawn ground plane.

ST-2: Infill where gaps exist. Tree species should match existing species along segment of Storrow Drive.

ST-3: Very difficult growing conditions. Prune existing trees as possible to ensure healthy growing habits. Replace dead trees as needed with highly resilient species such as honeylocust.

ST-4: Infill where gaps exist. Replace Norway maples as they decline with native species.

Pathway

PW-1: Infill where gaps exist. Tree planting should include deciduous shade trees, regularly spaced to match the existing allee. Species should consist of a few species. View down corridor should be maintained. Light fixture layout should be reconsidered to avoid tree canopies.

PW-2: Infill where gaps exist. Tree planting should include deciduous shade trees, regularly spaced. Norway maples should be removed as they begin to pose hazards and replaced with a native species. Large existing trees should be pruned on a regular schedule to avoid any hazardous branching over path.

PW-3: Difficult growing conditions due to high usage and amount of pavement. Mitigate negative impacts from events, and use protection fencing during future events. Permeable paving should be installed in this plaza area and tree pits should be widened to improve tree growing conditions.

PW-4: Plant infill trees to create an allee leading to dock as per original historic plans, with respect to accenting Fiedler Memorial.

PW-5: Heavily used route for commuting traffic. Plant only high canopy trees, and infill as needed. Cherry trees are not suitable for this pathway. Erosion control issues along the lagoon bank should be addressed.

PW-6: Trees should have high canopies to maintain pedestrian level views of lagoon and historic masonry.

PW-7: Trees should high high canopies to maintain pedestrian level views of lagoon inlet and historic masonry.

PW-8: Trees should be planted equally spaced to line both sides of path.

Promenade

PR-1: Maintain large deciduous trees on inland side of path. Views of water should be maintained. When existing honeylocusts begin to pose hazards, replacement species should be planted at the same time to allow for equal growing conditions. New species should be thornless and evenly spaced.

PR-2: Replace mature Norway maples with native species from historic planting plan. Trees should be replaced at same time to maintain even-age growth.

PR-3: Infill gaps as needed for consistent spacing. Opposite bank across path should remain clear of vegetation to maintain promenade views.

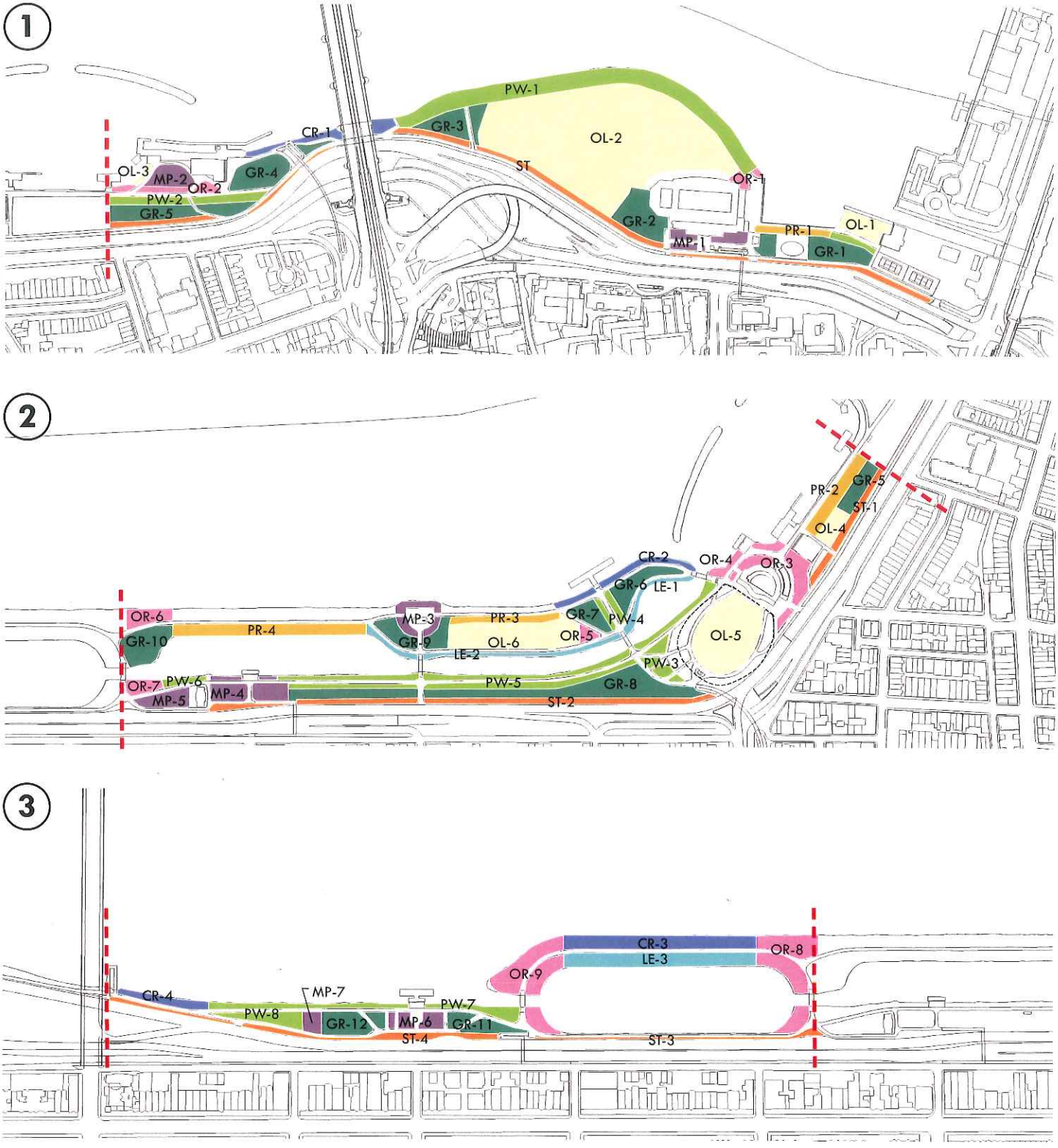
PR-4: Infill gaps as needed for consistent spacing. Opposite bank across path should remain clear of vegetation to maintain promenade views.

Groves

GR-1: Maintain mixed deciduous trees informally arranged around play area. Some ornamental trees are currently planted as accents. Prune frequently due to play area use. Maintain open views into playground for safety.

Condition by Species

ST Street Trees	GR Grove	CR Charles River Edge
PW Pathway	OR Ornamental	LE Lagoon Edge
PR Promenade	MP Memorial/Plaza	OL Open lawn



GR-2: Maintain mature stand of mixed deciduous trees, which provide buffer from active recreation fields. Prune frequently due to high use, and maintain lawn ground plane.

GR-3: Remove cluster of ornamental trees that are in poor condition. Plant mixed deciduous trees informally arranged to create buffer from active recreation fields. Some ornamental trees can be planted as accent. Prune frequently due to high use.

GR-4: Mitigate impacts from construction. Grove should consist of several species planted irregularly at different sizes for succession planning.

GR-5: Replace Norway maples with native species. Infill gaps as needed, but allow space for tree canopies. Transition landscape to remove burning bush and evergreen trees. This grove should consist of several species to improve diversity.

GR-6: Add soil amendments to improve drainage. Grove should consist of several species, but maintain views of Charles River and lagoon.

GR-7: Infill gaps as needed but maintain Fielder memorial as focal point.

GR-8: Playground trees should benefit playground by providing shade and buffer from Storrow Drive. Tree species should have high canopy to maintain visibility. Prune trees more frequently due to proximity to playground.

GR-9: Grove should consist of several species and provide backdrop for plaza space.

GR-10: Maintain Otis grove of paper birch. Infill with more ornamental trees such as willow or birch trees.

GR-11: Infill gaps as needed for succession and to provide buffer from Storrow Drive, but maintain sufficient canopy space. Understory trees can be planted for additional buffer from road.

GR-12: Playground trees should benefit playground by providing shade and buffer from Storrow Drive. Tree species should have high canopy to maintain visibility. Prune trees more frequently due to proximity to playground.

Ornamental

OR-1: Ornamental trees should be planted at entrance to accentuate path.

OR-2: Some ornamental trees should be maintained as accents to building and nearby memorial.

OR-3: Infill magnolia and ornamental plantings to create continuous screen of backside of Hatch Shell. Norway maples should be removed and infill trees should be planted behind Hatch Shell. Temporary fencing should be installed to protect trees from vehicular use and event parking.

OR-4: Plant willow or other wet tolerant species along Charles River bank.

OR-5: Infill ornamental species to accent path intersection.

OR-6: Ornamental grove should consist of willow trees, or other wet tolerant species, to accent path intersection and footbridge as per historic intent.

OR-7: Remove volunteer species and plant ornamental grove of willow trees, or other wet tolerant species, as per historic plans.

OR-8: Remove volunteer species and plant ornamental grove of willow trees, or other wet tolerant species, as per historic plans to accent footbridge and path intersections.

OR-9: Remove volunteer species and plant ornamental grove of willow trees, or other wet tolerant species, as per historic plans to accent footbridge and path intersections.

Memorial

MP-1: Entrance to building should consider future development plans.

MP-2: Trees around Eliot memorial should accent space and provide shade. Replace declining species as needed. Tree species should have high canopies to maintain water views.

MP-3: Trees should provide shade for plaza space. As trees decline, tree pits should be avoided since they create growth constraints.

MP-4: Replace monoculture of honeylocust with several species. Trees should be replaced at same time to maintain even-age growth.

MP-5: Trees around plaza space should accent masonry and provide buffer from Storrow Drive. Tall canopy trees should provide shade for the space.

MP-6: Replace monoculture of Norway maples with several species. Trees should be replaced at same time to maintain even-age growth. Ornamental trees should be removed as they decline, since they divide the plaza space.

MP-7: Ornamental trees should accent the plaza space but not to block visibility into the playgrounds.

Charles River Edge

CR-1: Infill where gaps exist. Tree planting should include deciduous trees to provide shade along path. Trees should have high canopies to maintain water views.

CR-2: Infill gaps as needed. Replace Norway maples and volunteer species with several native species.

CR-3: Gaps in trees should be maintained to maintain views as per historic plans.

CR-4: Infill gaps as needed. Trees should have high canopies to provide shade for path and to maintain pedestrian views of water.

Lagoon Edge

LE-1: Ornamental trees should line lagoon with consistent spacing, but maintain canopy clearance along path. Declining cherry trees should be replaced with similar.

LE-2: Ornamental trees should line lagoon with consistent spacing, but maintain canopy clearance along path. Declining cherry trees should be replaced with similar.

LE-3: Gaps should be maintained to preserve views. Pockets of ornamental trees can accent nodes.

Open Lawn

OL-1: Space currently exists as a grove. Most trees are considered to be "volunteer" plantings, and should be removed as they begin to pose hazards. Lawn space should be opened up to keep with the intent of creating a vista. This area can be transitioned into a designed grove while maintaining views of the river.

OL-2: Maintain flexible open lawn including, and inbetween, ball fields.

OL-3: Maintain open lawn space along river front to preserve open views.

OL-4: Lawn to be maintained clear of trees for event support. Structural support should be added to lawn to support temporary parking and event staging.

OL-5: Oval lawn to be maintained clear of trees. Perimeter trees to be replaced with similar species as they decline. All trees should be replaced at the same time for even-age growth. Infill trees may be planted to fill in canopy gaps. Ornamental trees should continue to be planted to accentuate memorials around the oval lawn.

OL-6: Trees should be kept in small clusters, as to not limit lawn usage.

Management Recommendations

Street Trees

ST-5: Infill where gaps exist. Tree planting should include deciduous shade trees, regularly spaced. Decompact soil and address likely high sodium levels. Maintain lawn ground plane.

ST-6: Infill where gaps exist. Trees should be planted at consistent spacing along Storrow Drive as per historic plans.

Pathway

PW-9: Pathway used heavily by commuting traffic. Infill trees should be tall canopy to provide shade. Trees on Charles River side of path should be selectively removed to increase space for canopy growth.

PW-10: Infill where gaps exist. Species should be consistent with existing palette along path.

PW-11: Remove invasive or volunteer species and replace with native species. Trees should be spaced consistently to allow room for canopy growth.

Groves

GR-13: Replace invasive species with native species.

GR-14: Amend soil between Storrow Drive and pathway. Selectively remove trees to allow more room for canopy growth. Understory canopy trees can be increased to buffer Storrow Drive.

GR-15: Amend soil between Storrow Drive and pathway. Selectively remove trees to allow more room for canopy growth.

GR-16: Plant corner of open lawn with pocket of informal canopy trees for shade. Address drainage issues and amend soil as needed.

GR-17: Prune grove as needed for canopy growth.

Ornamental

OR-10: Accent path intersection with ornamental trees. Remove invasive species, and maintain views.

OR-11: Accent path intersection with ornamental trees. Remove invasive species, and maintain views.

OR-12: Maintain ornamental tree at path intersection.

Charles River Edge

CR-5: Difficult growing condition. Replace weak-wooded trees, such as willow, with resilient species. Prune branches that overhang path.

CR-6: Replace weak-wooded trees such as willow, with resilient species. Prune branches that overhang path.

CR-7: Remove volunteer and invasive species and replace with native species. Selectively remove trees to allow room for canopy growth.

CR-8: Clear volunteer species and keep sapling growth cut below eye level. Plant pockets of wet-tolerant ornamental and canopy trees.

CR-9: Maintain low plantings for bank stabilization and wildlife habitat, but prune to maintain visibility. Selectively prune volunteer species.

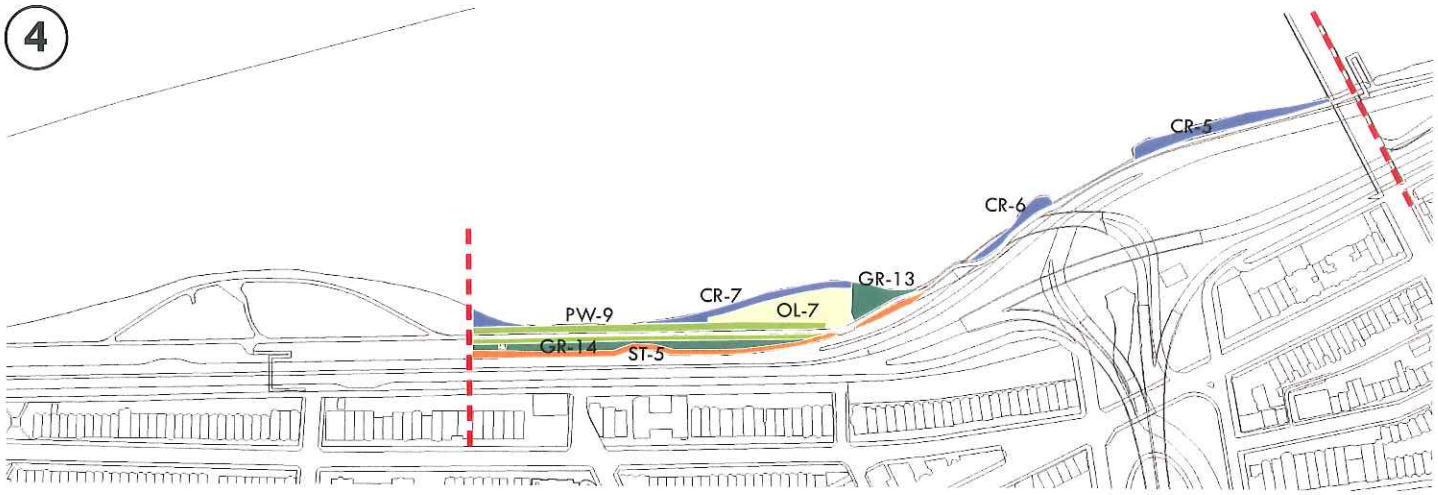
Open Lawn

OL-7: Address drainage issues in lawn. Also consider strategy to remediate social path that bisects lawn.

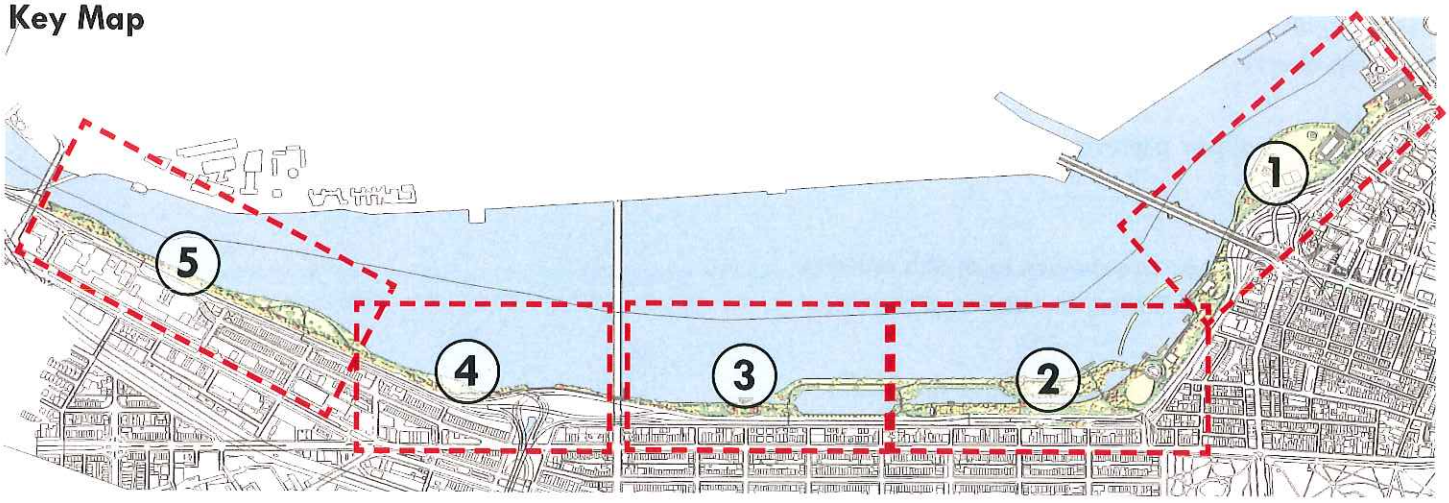
OL-8: Maintain open lawn with only select pockets of tree plantings for shade.

Condition by Species

ST Street Trees	GR Grove	CR Charles River Edge
PW Pathway	OR Ornamental	LE Lagoon Edge
PR Promenade	MP Memorial/Plaza	OL Open lawn



Key Map



Infill Planting, Removals, and Replacement Trees

A. Infill (2) 3" caliper street trees to match existing: London planetree or oak species.

B. Remove volunteer species. Plant pathway with line of trees but maintain open overlook, as per historic plans.

C. Infill (3) 3" caliper pathway trees to match existing: London planetree, littleleaf linden, or oak species.

D. Infill (3) 3" caliper pathway trees to match existing: London planetree, littleleaf linden, or oak species.

E. Infill (2) 3" caliper pathway trees to match existing: maple or oak species. Trees to be planted in a line on sportfield side of fence.

F. Infill (4) 3" caliper street trees to match existing: London planetree or oak species.

G. Infill (2) 3" caliper pathway trees to match existing: London planetree, littleleaf linden, or oak species.

H. Infill (2) 3" caliper Charles River Edge trees. Willow or other wet tolerant ornamental species.

I. Infill (4) 3" caliper pathway trees to match existing: flowering cherry.

J. Infill (3) 3" caliper pathway trees to match existing: littleleaf linden.

K. Infill (3) 3" caliper street trees to match existing: oak species, littleleaf linden, or London planetree..

L. Infill (3) 3" caliper pathway trees to line path.

M. Infill (1) 3" caliper pathway trees.

N. Infill (7) 3" caliper pathway trees to match existing: flowering cherry.

O. Infill (6) 3" caliper pathway trees.

P. Infill (5) 3" caliper pathway trees. Grove to be diverse collection of deciduous trees.

Q. Infill (5) 3" caliper grove trees. Grove to be diverse collection of deciduous trees.

R. Infill (3) 3" caliper grove trees to match existing: willow, birch, or other ornamental trees.

S. Infill (3) 3" caliper pathway trees to match existing: oak species, linden species, or red maples.

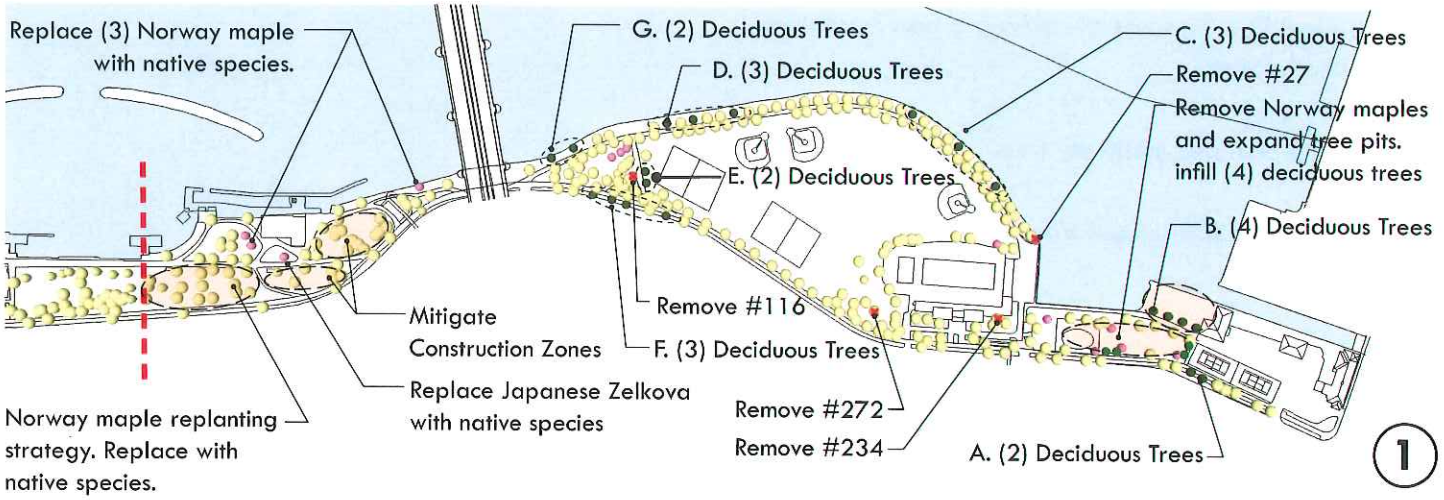
T. Infill (1) 3" caliper pathway trees to match existing: oak species, linden species, or red maples.

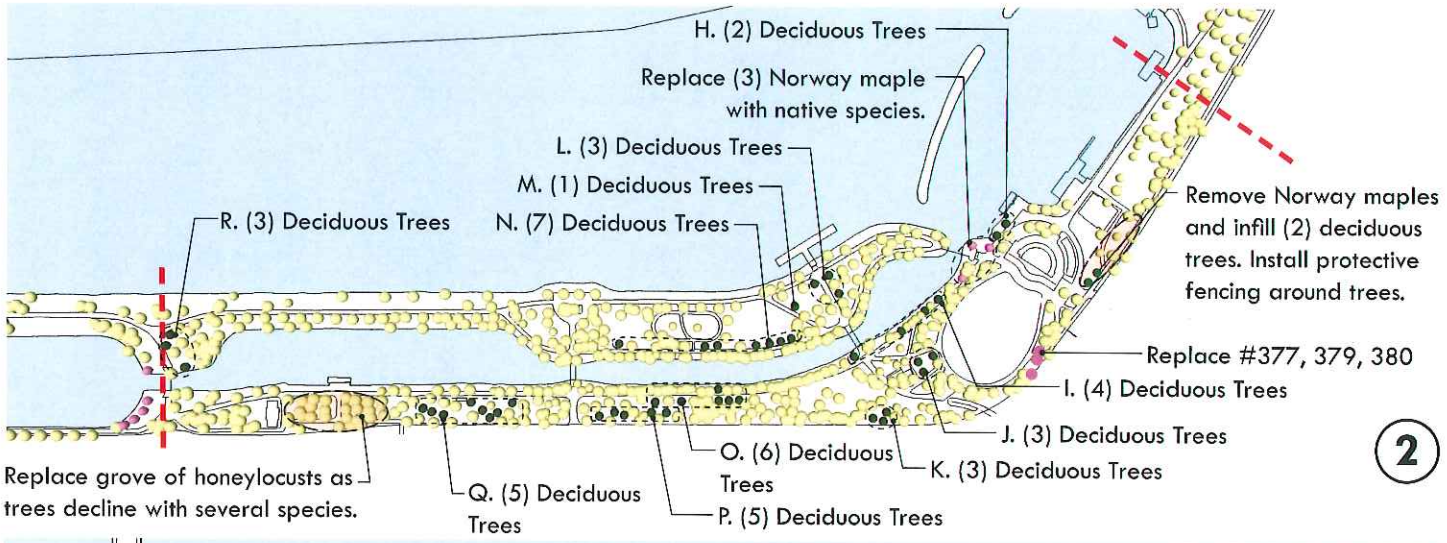
Norway Maple Replacement Strategy:

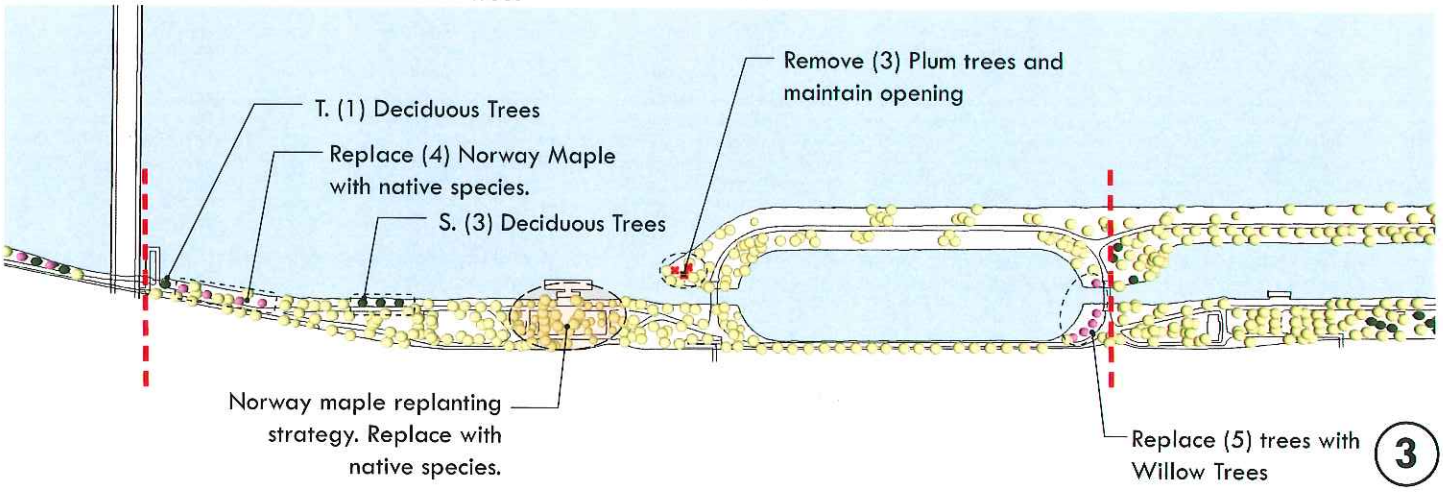
As trees begin to decline, Norway maples should be replaced with native species. Groves of Norway maples should be replaced at the same time to ensure even-aged growth. These groves should be replaced with several species such as linden species, oak species, elm species, and native maple species.

Planting Key

- Proposed Tree
- Existing Trees
- Remove
- Remove and Replace
- Same Planting Zone







Infill Planting, Removals, and Replacement Trees

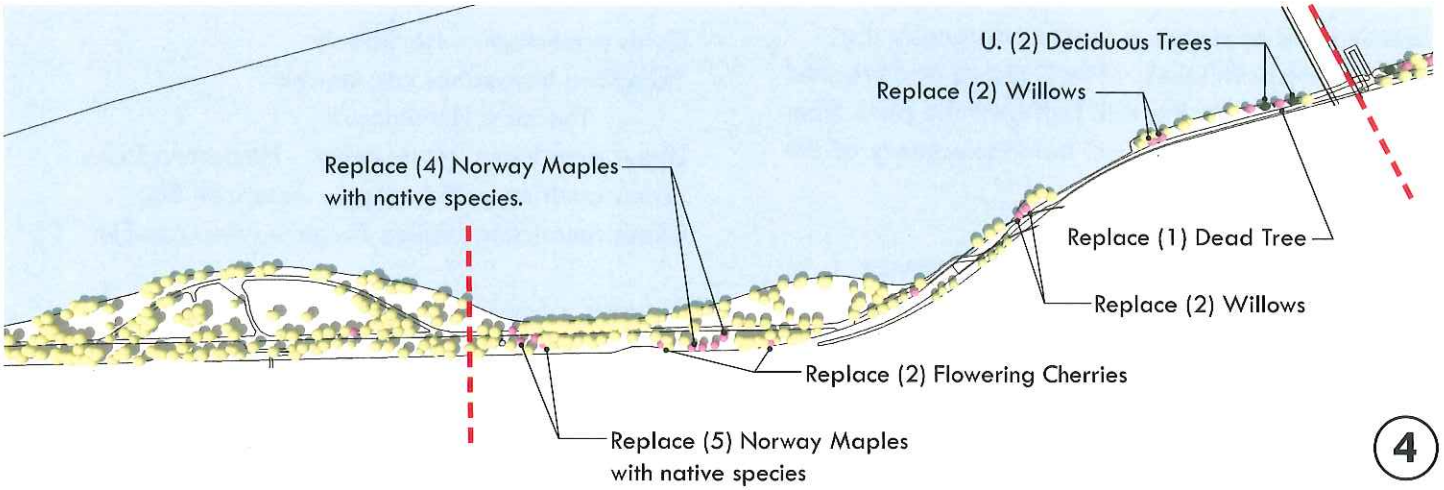
U. Infill (2) 3" caliper Charles River Edge trees. Species should be tolerant of difficult urban conditions, such as honeylocust.

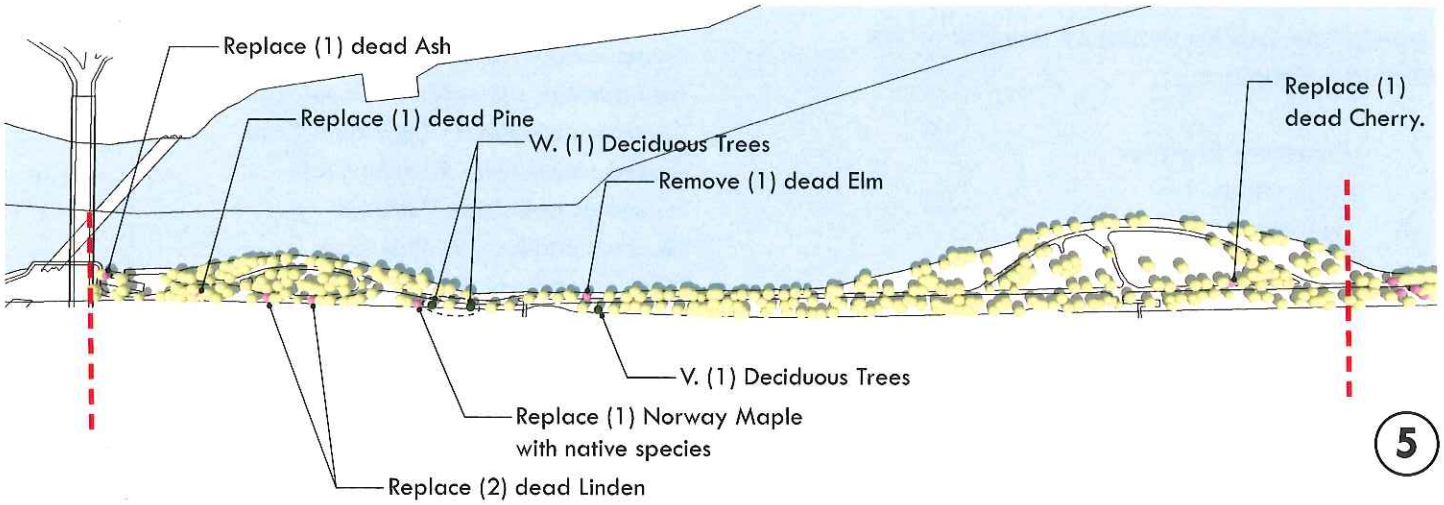
V. Infill (1) 3" caliper pathway tree.

W. Infill (2) 3" caliper street trees.

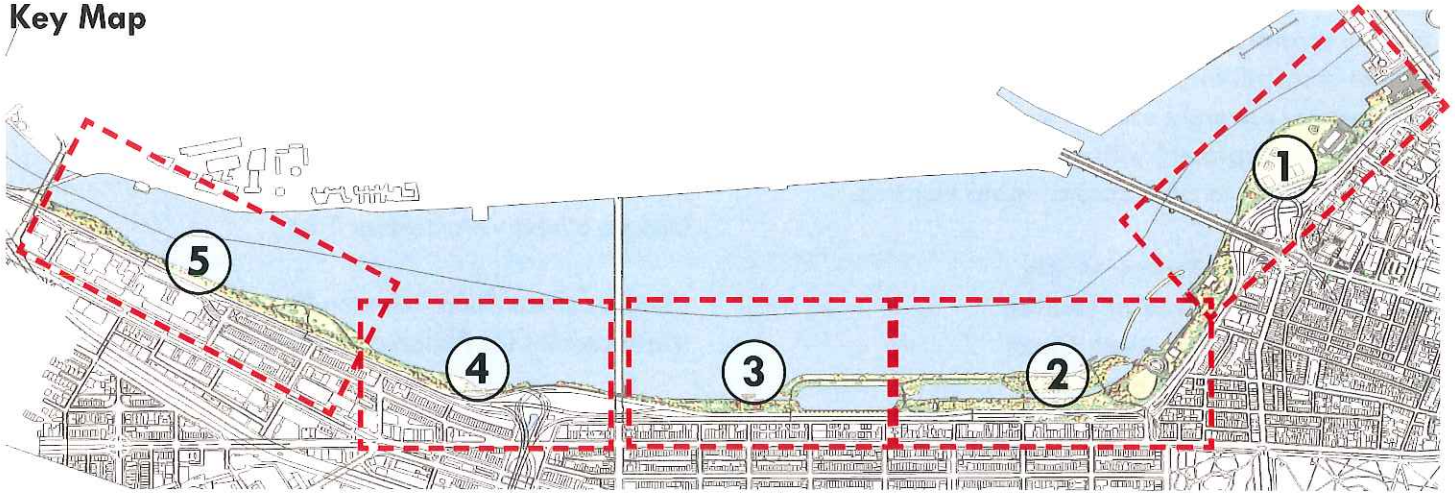
Planting Key

- Proposed Tree
- Existing Trees
- Remove
- Remove and Replace
- Same Planting Zone





Key Map



Species Selection

Proposed plantings should consider both environmental conditions and the original park ideologies of Shurcliff and Olmsted. Shurcliff's objective was to create a continuous canopy that would shade park users, while Olmsted had created a strong linear planting that buffered the park from the city but not as to distract from the scenery of the Charles River.

Proposed plantings should also aim to increase species diversity, while replacing invasive species and other species that have shown collective negative growth trends in the park. Increasing diversity will limit the potential for large-scale loss due to potential pests or diseases.

Environmental considerations:
Appropriate species should be tolerant of the following conditions:

- Proximity to water
- High winds
- Sun exposure
- Poor soil conditions
- Salt
- Urban conditions

Inappropriate Species

There are some species that should not be planted if they are considered invasive, weak-wooded, short-lived, or susceptible to pest and diseases. Some of these species currently exist on site, and should be removed and replaced with an appropriate species when they begin to pose considerable hazards.

Acer platanoides - Norway Maple
Ailanthus altissima - Tree of Heaven
Robinia pseudoacacia - Black Locust
Morus alba - White Mulberry

Appropriate Species

Appropriate Tree species for <u>Street Trees</u>

Celtis occidentalis - Hackberry
**Gleditsia triacanthos* var. inermis - Thornless Honeylocust
Ulmus americana 'Homestead' - Homestead Elm
Ulmus americana 'Princeton' - American Elm
Ulmus americana 'Valley Forge' - American Elm

Platanus x acerifolia - London Planetree (replacement for *Platanus occidentalis*)

Appropriate Tree species for <u>Pathway</u>

Acer rubrum - *Red Maple*
Gymnocladus dioicus - *Kentucky Coffeetree*
Liquidambar styraciflua - *Sweet Gum*
Quercus acutissima - Sawtooth Oak
Quercus coccinea - Scarlet Oak
**Quercus palustris* - Pin Oak
Quercus phellos - Willow Oak
**Quercus rubra* - Red Oak
Tilia americana - Basswood
**Tilia cordata* - Littleleaf Linden
Tilia tomentosa - Silver Linden
Ulmus americana 'Princeton' - Princeton Elm

Appropriate Tree species for <u>Promenade</u>

**Gleditsia triacanthos* var. inermis - Thornless Honeylocust
Liquidambar styraciflua - *Sweet Gum*
Ginkgo biloba - *Maidenhair Tree*

Platanus x acerifolia - London Planetree (replacement for *Platanus occidentalis*)

Appropriate Tree species for Grove

Betula nigra - River Birch
Cercidiphyllum japonicum - Katsura
Eucommia ulmoides - Hardy Rubber
Fagus grandifolia - American Beech
Ginkgo biloba - Maidenhair Tree
Gymnocladus dioicus - Kentucky Coffeetree
Halesia carolina - Carolina Silverbell
Liquidambar styraciflua - Sweet Gum
Liriodendron tulipifera - Tulip Tree
Maackia amurensis - Amur Maackia
Nyssa sylvatica - Black Tupelo
Ostrya virginiana - American hophornbeam
Pinus strobus - White Pine
**Quercus palustris* - Pin Oak
Quercus phellos - Willow Oak
**Quercus rubra* - Red Oak
Sassafras albidum - Sassafras

Appropriate Tree species for Ornamental

Amelanchier canadensis - Serviceberry
Betula populifolia - Gray Birch
Betula nigra - River Birch
**Cercis canadensis* - Eastern Redbud
**Cornus florida* - Flowering Dogwood
Cornus mas - Cornelian Cherry
***Cladrastis lutea* - Yellowwood**
**Crataegus crusgalli* (var. inermis) - Cockspur Hawthorn
Liquidambar styraciflua - Sweetgum
Prunus sargentii - Sargent Cherry
Prunus serrulata - Japanese Flowering Cherry
*Salix alba - White Willow
*Salix babylonica - Weeping Willow
Syringa reticulata - Japanese Tree Lilac

Appropriate Tree species for Memorial/Plaza

**Gleditsia triacanthos* var. inermis - Thornless Honeylocust
Acer rubrum - Red Maple

Appropriate Tree species for Charles River Edge

Acer rubrum - Red Maple
Acer saccharinum - Silver Maple
Nyssa sylvatica - Black Tupelo
Populus deltoides - Eastern Cottonwood
**Salix alba* - White Willow
**Salix babylonica* - Weeping Willow
Ulmus americana 'Valley Forge' - American Elm

Appropriate Tree species for Lagoon Edge

Nyssa sylvatica - Black Tupelo
Prunus serrulata - Japanese Flowering Cherry
Quercus bicolor - Swamp White Oak
**Salix alba* - White Willow
**Salix babylonica* - Weeping Willow
Taxodium distichum - Bald Cypress

* Found on historic tree and shrub lists for the Esplanade

Succession Planting

The Esplanade contains a wide variety of tree species that ranges from newly planted to mature. The highest percentage of inventoried trees fall within the 19-24" dbh range (330 trees), which means that most of the trees are considered mature. Even when following proactive maintenance actions and recom-mendations, it is inevitable that trees will eventually fail and need to be removed. With such a large number of mature trees, a replacement strategy should be carefully planned to avoid any large voids in the landscape.

Even-Aged Strands

For declining even-aged strands, trees should be replaced at the same time to avoid uneven growth habits and to keep consistent with the historical design intent. New trees should be strategically planted in areas with mature trees, to avoid any risk of a gap in the function that the mature trees may be contributing. For example, if trees are currently shading a plaza space their removal would create a drastic change in the environment unless another tree could soon be replacing that shade. Since trees grow at different rates, planting a variety of species will encourage continuous growth throughout the park, similarly to the natural growth and succession of a forest.

Replacing Historical Trees

Some trees might be considered historic, since they were likely planted during the Shurcliff design installation. When these large, historic trees are removed, new trees may be planted in their place to maintain the original design. Aside from replicating the same location of the previous tree, the new tree should function similarly as the previous tree was intended to. For instance, trees that were intended to frame views should be replanted with trees of similar form in order to serve the same purpose.

Risk Assessment

The inventory conducted by Bartlett Tree Experts included recommendations for nearly all existing trees. These recommendations were provided for trees that showed defects and that could be improved with proactive maintenance. Of the trees inventoried, 106 were listed as suggested removals. These trees are considered to pose, or will soon be posing, hazards to park users, vehicles, or structures. Trees located in high-use areas such as playgrounds or the bike path should more carefully monitored if they pose potential risks.

To evaluate the potential risk, Bartlett Tree Experts use a numeric matrix established by the International Society of Arboriculture (ISA). This assessment considers several factors such as the potential risk of a limb falling and the likelihood of the risk impacting potential targets (people, vehicles, structures). Of the trees inventoried, (3) trees are listed as having a high risk, (37) having a moderate risk, and (163) having a low risk. Other trees that do not have an attributed ISA rating do not appear to pose potential risks. Refer to appendix for ISA rating chart. Ultimately, tree removal should be based on several criteria but always resulting in what will provide the safest environment for park users.

Resistograph

A resistograph is a piece of equipment used for measuring decay within a tree. It uses a small diameter drill bit to penetrate the tree, and then record whether a tree has decay. The resistograph is helpful because it can determine the amount of decay, which can then be used to assess the strength of a tree. There are several trees in the Esplanade that show signs of possible decay, but not all decay is visible from the exterior of a tree. Larger trees that are in declining condition and are located in proximity to pathways or high-use areas should be tested to see if the presence of decay is enough reason for a precautionary removal.

Increasing Diversity

The lack of species diversity found in the Esplanade is a concern. A single species, pin oak, accounts for 22.5% of the overall inventoried trees. The six most common species account for 66.4% of the inventory. Increasing the diversity of tree species can provide environmental and economical benefits for the Esplanade. A diverse landscape reduces the risk of catastrophic tree loss due to pest of disease, and having a greater number of tree species allows for more ecological niches – such as the canopy/ understory growth relationship.

Diversity goals

Proposed infill and replacement trees should be different than existing species in order to increase species diversity. A common rule for suggested tree species diversity is known as the "10% rule", as published by Dr. Frank Santamour. This rule suggests that a single species should not contribute more than 10% of the population, 20% of any single genus, or 30% of any family. This is a difficult percentage to achieve since pin oaks currently account for over 20% of the existing population, however, as species with high contributing percentages begin to decline they should be replaced with either a new species or an existing species that contributes a low percentage to the overall tree population.

Cost of Monoculture

There are several areas on the Esplanade where it was the original design intent to plant only one tree species. Typically for a plaza space, such as the boat landing with Norway maples, using a single species palette makes the space feel like a unique location with a sense of uniformity. While this may have been the original design intent, areas with single-species planting should be limited to only a few specific locations for ecological reasons. Monoculture tends to become an issue when a pest or disease begins to spread. Diseases such as Dutch elm disease have caused large scale devastation in other landscapes by attacking the same tree species in a given area. Planting multiple species in areas is recommended to reduce the risk of pest or disease devastation. For areas where historic plans suggested a monoculture landscape, new species selection should try to incorporate several similar trees from the historic palette as appropriate.

Pin oaks account for more than 20% of the tree population

Care of Existing Trees

Current maintenance is primarily limited to pruning. The Esplanade Association has 2 full time staff, and the rest of the work that needs to be performed is either contracted or completed by DCR arborists. The majority of trees are on a 5-year pruning cycle, however trees in more heavily used areas are on 2-year cycles. Since many of these trees are mature and currently have dead wood, the pruning cycles should be shortened as possible. It is a good practice to prune trees that have a higher risk of causing hazards to pedestrians, however all trees need to be pruned repeatedly. Younger trees need to be pruned frequently to maintain a healthy branching structure to reduce hazardous limbs in the future.

In addition to pruning, care of existing trees needs to begin at the most critical, unseen portion of the tree: the roots. The future health of a tree begins during the planting phase, when improper installation can lead to long-term issues. Currently, many trees on the Esplanade have buried root flares which means the tree was planted too deep. This soil retains moisture at the base of the tree which can soften the tree bark, making it more susceptible to injury. Buried root flares can also hide possible issues such as girdling roots. Girdling roots limit the trees ability to uptake water, nutrients, and oxygen by restricting the growth of a healthy root system. It is recommended that buried root flares be exposed by removing excess soil, and girdling roots be cut or removed if possible. Refer to page number 65 for soil recommendations.

Tree Removal

Mature trees should be preserved for as long as reasonably possible, however there are some instances when their removal should be the preferred recommendation. If large trees are removed, there should be consideration of the role that tree played and how it related to the historical design intent. Specific trees should be studied to determine if a replacement of the same species is suitable. If the removal was ultimately due to inappropriate species selection, then a different species should be selected for replacement.

It should be noted that not all dead trees should be removed. Dead trees provide habitat for wildlife, particularly by bodies of water. If deemed safe to do so, dead trees can be left in areas that pose no potential risk to park users.

This willow tree recently lost a large limb due to decay. The wound is beyond what the tree could repair, and will likely result in the necessary removal of the tree.

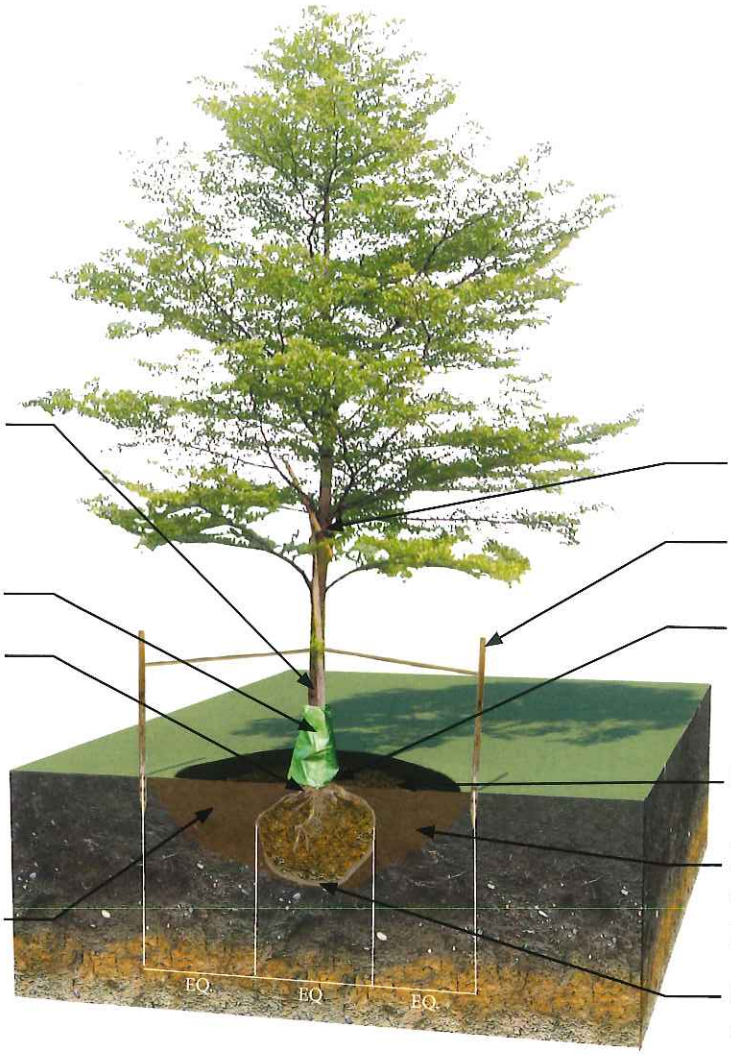
New Planting

When planting new trees participants should not only consider location, but also whether the species is suited for a site, if it is appropriate for this historic landscape, and if it contributes to greater species diversity across the parks. Also consider whether sufficient space and sunlight will be provided, the soil type, drainage, the specifications for planting that tree, and aftercare. Maintenance of bark mulch around newly planted trees should continue for five years after planting to prevent damage from mowers and weed trimmers.

Watering

Water sources are very limited throughout the Esplanade. Watering by water truck is currently the most feasible and reliable way to bolster supply and distribution needed for newly planted trees. It is recommended that water sources be installed at more regular intervals along the length of the Esplanade to improve availability. Watering bags should be installed around new trees, and be capable of releasing 20 gallons of water over a 24-hour period. Trees should be inspected at least twice a week for watering. It is recommended that trees with a 3-3 ½" caliper receive 80 gallons of water a week.

Tree Planting Detail



6" corrugated black pipe to protect against weed trimmers

Watering bag

Top of rootball shall bear same relationship to finished grade as to previous existing grade

Organic fertilizer, mychorrhizal inoculant, and biochar

Install tree plumb.

Stake only as needed based on location.

Root flare shall be exposed; Mulch should not touch tree trunk.

3" bark mulch

Excavate hole to diameter 3x wider than rootball. Backfill hole with planting soil mix.

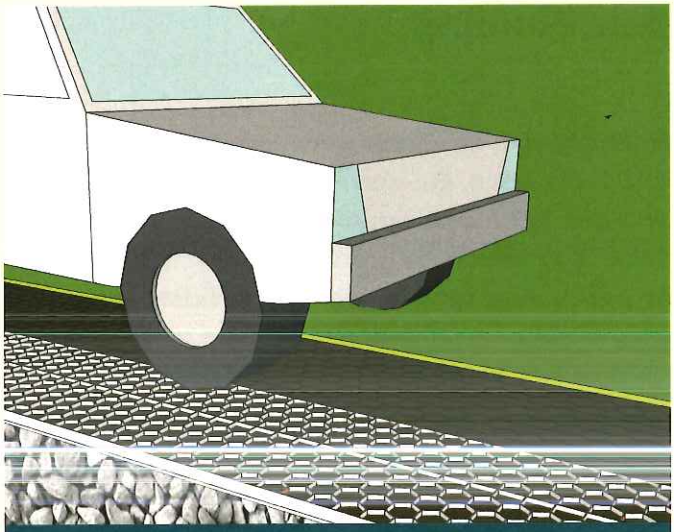
Place ball on subsoil. Remove and discard all synthetic soil wrapping materials (treated burlap, nylon twine, wire baskets, etc.).

Post Event/Construction Mitigation

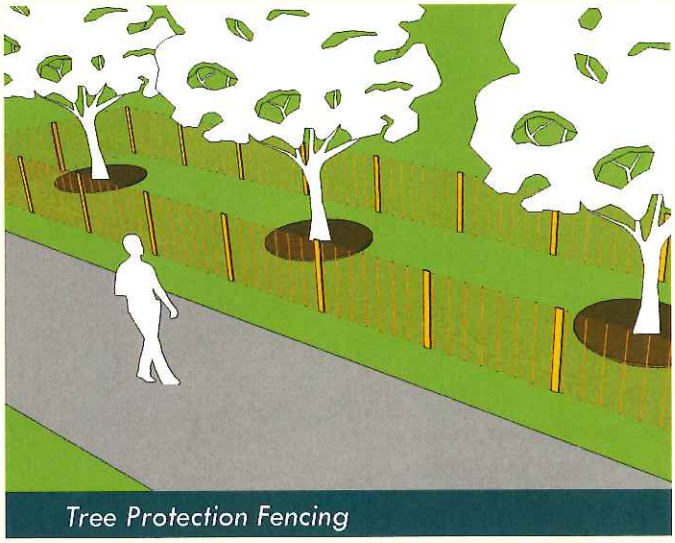
During special events, administrators and staff can help work to prevent the negative impacts on soils and trees by planning for the impact of heavy vehicles and high concentrations of people. One of the most concerning impacts induced by these large events is soil compaction. Soil compaction is often caused by vehicular use and equipment storage on lawn, or other unpaved surfaces. Event planning should incorporate all staging areas used for storing any temporary event infrastructure. These areas should be outside of any tree root zone and in a location that will not create stresses for nearby trees.

Simple preventative measures may include using turf protection mats or tree protection fencing. Turf mats can be used for driving over lawn or for storing equipment. More intensive protection measures include installing stabilized turf or structural soil. Stabilized turf incorporates a rigid grid that allows grass to grow through it and provides a reinforced surface that can be used for heavy equipment. Structural soil can withstand greater compaction levels, will still providing sufficient growing conditions for trees and vegetation. In areas where vehicles will be driving by low branching trees, it is recommended that lower limbs be pruned to reduce the risk of any damage to the tree.

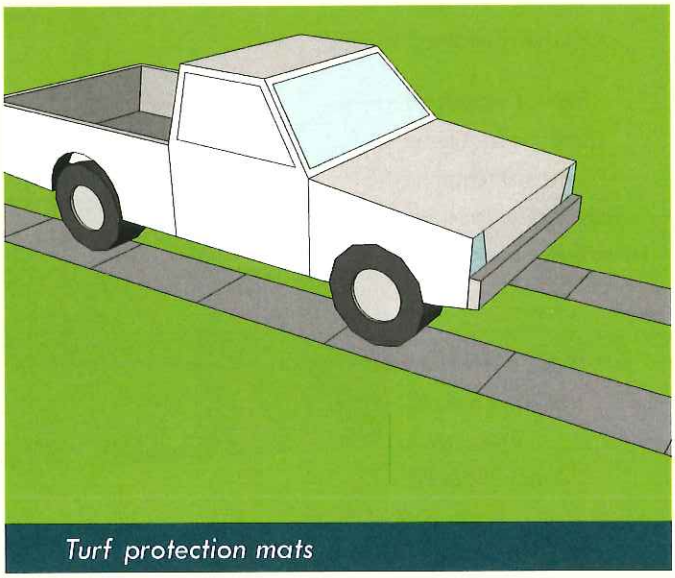
Repair and mitigation requirements can be reduced with efficient event planning. Restricting event equipment and vendors to planned staging areas will contain and minimize the mitigation efforts needed. Soil compaction can be repaired by air spading. Air spading breaks up the soil, allowing roots to have access to air and improved nutrient intake. For areas where lawn restoration is needed, panels of lawn should be fenced off during seed establishment. Panels can be closed during cycles, to allow some turf to be available to park users while other panels are repaired.



Stabilized Turf



Tree Protection Fencing



Turf protection mats

Soil Recommendations

Since most of the Esplanade was constructed using urban fill, it would be no surprise that maintaining healthy soil conditions is a difficult task. Urban fill is a very poor grade of soil that provides little nutritional value for trees. In addition, there are areas in the park where former abandoned pathways may not have been fully excavated and disposed of. This has resulted in a gravely mix of soil that is seen exposed in several lawn areas. Improving soil quality should be a top priority in order to provide optimal growing conditions for existing and proposed trees. Soil should also be tested before planting new trees to determine if the soil is lacking in nutrients which could impact the tree. It is recommended that nutrient deficiencies be amended as needed.

In addition to testing the chemistry of the soil, the compaction level of soil should be tested and amended. Soil can become overly compact from vehicular or heavy pedestrian use, which limits the ability for trees to intake water and air from the soil. Areas that are compacted may also experience flooding, which can negatively impact trees that might not be tolerant of wet conditions. Compacted soils should be aerated using either manual or mechanical equipment.

Lawn space that is used for equipment storage

Eco-Benefits

Urban trees provide a wide range of ecological benefits, including but not limited to:

- Supporting biodiversity and habitat for wildlife
- Storing stormwater and filtering runoff contaminants
- Stablizing soil which helps erosion control
- Improving air quality by trapping airborne contaminants
- Contributing to energy savings by cooling surface temperatures
- Providing noise and wind abatement
- Reducing the amount of CO2 in the atmosphere and combat global climate change.

Shown on the following page, the tree inventory data was uploaded into a program called OpenTreeMap, which calculated the ecological benefits of existing trees in the Esplanade. This information accounts for size, condition, species, location, and the price for the replacement of a similar size tree. Aside from benefiting park users, the Esplanade forest helps improve the environmental quality of the surrounding urban context.

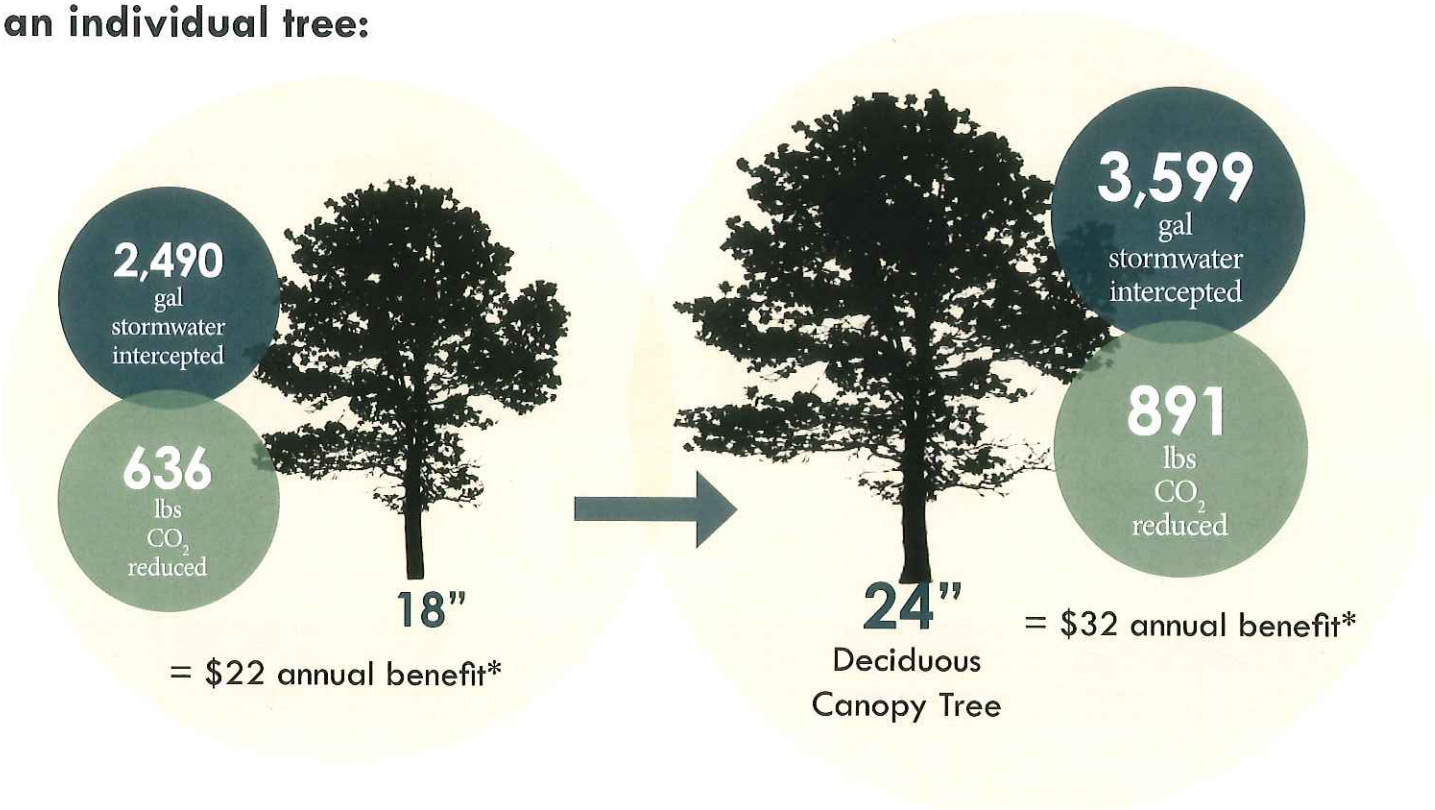
Environmental Goals

The Esplanade canopy currently offers an appropriate amount of shade coverage for park users, however the lack of succession trees is concerning when planning for the future. With the visible decline in tree condition over the past decade, now is the time to begin taking precautionary measures to maintain a healthy forest. The following environmental goals are intended to help set standards for short-term and long term planning to increase the environmental quality of the park and achieve a healthy, functioning landscape in the future:

- Plant trees to increase environmental benefits
- Expand tree canopy to improve shade coverage for pedestrian comfort
- Plant trees each year to achieve long term canopy coverage goals and succession
- Natural areas along the riparian and littoral zones should be managed as such, and include invasive
- Increase diversity to reduce the risk of massive tree lost (ex: pests or disease spread)

Screenshot of OpenTreeMap. Value of single tree

Annual benefits of an individual tree:



Total annual benefits

(1678 trees calculated)

Energy conserved:

1,805,088 kwh/year saved $101,204

Stormwater filtered:

2,903,863 gal/year saved $2,323

Air quality improved:

3,483 lbs/year saved $18,436

Carbon dioxide removed:

879,610 lbs/year saved $2,937

Carbon dioxide stored to date:

3,597,442 lbs saved $12,015

= $124,901 saved per year

*Stormwater and CO2 calculations determined through the National Tree Benefit Calculator. The calculator was conceived and developed by Casey Trees and Davey Tree Expert Co. It is based on the USDA Forest Service's i-Tree STREETS assessment tool.

According to the Environmental Protection Agency (EPA), a typical passenger vehicle emits about 10,500 pounds of carbon dioxide per year. According to OpenTreeMap.com, it is estimated that the existing tree inventory (1,678 trees) removes 879,610 pounds of carbon dioxide per year – the equivalent of nearly 84 cars.

Priorities & Phasing

To make the workload seem more conceivably manageable, a list of priorities and phases help rank tasks by how necessary they are in order to provide a safe and enjoyable landscape for park users. The following list or priorities and phases is intended to provide guidance for decision making when allocating the available resources in a way that provides the Esplanade with the most benefits. Priorities consider areas with the highest amount of park use, and place overall safety as the top concern.

Safety

- Hazardous Tree Removal
- Hazardous Tree Pruning

Preparation & Preservation

- Address and amend soil issues as needed
- Address compaction and poor drainage areas
- Remove excess soil from buried root collars
- Increase precautionary devices used to mitigate impacts from events and construction

Planting & Management

- Replace declining Norway maples with native species, as appropriate
- New tree planting (infill, succession, and replacement of hazardous trees)
- Routinely water and mulch recently planted trees as needed
- Shorter pruning cycle for existing trees
- Viewshed management (maintain views of Charles River and Lagoon)
- Canopy gap management/Infill and succession planting
- Invasive species management
- Maintain updated tree inventory to keep record of work performed and to reflect changes in condition (ex: fair condition to poor condition)

Priority 1

- Hazard mitigation: removal of hazardous trees and limbs.
- Soil improvements: add amendments, decompact, aerate, and remove excess soil at root collars.
- Data management: manage the GIS data and keep it current as work progresses.
- Shorter pruning cycles for existing trees.
- Implement event impact mitigation devices (fencing, mulch, decompaction, lawn mats, etc.).

Priority 2

- Infill planting: plant new trees where gaps exist in the canopy.
- Tree replacement: Replace hazardous trees with appropriate species. Refer to planting plans.
- Young tree care: mulch and water recently planted trees to protect investment.
- Replace declining Norway Maple groves with appropriate species.

Priority 3

- Viewshed management: Keep select views of Charles River and Lagoon clear of volunteer species.

Ongoing

- Routine preventative pruning
- Apply annual soil ammendments as needed
- Aerate soil as needed
- Mulch and water newly planted trees
- Invasive management
- Cut sapling growth along riparian edge to maintain views, but not to eliminate their benefit of slope stabilization

Estimated Costs - To Be Developed

The following cost estimates are intended to provide unit prices for miscellaneous projects and annual maintenance needs, as well as comprehensive estimates for several priority projects.

Unit Costs

Tree Removals

DBH	Cost per
1-11"	$250.00
12-19"	$500.00
20-29"	$900.00
~~30-39"~~	~~$1,100.00~~
40-49"	$1,500.00
50" +	$2,000.00
Stump	$300.00

Tree Planting/Infill

DBH	Cost per
1-2"	$200.00
3-3.5"	$800.00
*limited equipment access	

Soil Amendments

Unit (sf)	Cost per sf
	$0.05

Soil Decompaction (air spade)

Unit (sf)	Cost per sf
	$1.50

Mulch

Unit (per tree ring)	Cost per
	$50.00

Loam and Seed

Unit (sf)	Cost per sf
	$1.25

Seed (No Loam)

Unit (sf)	Cost per sf
	$0.15

Cut Sapling Growth/Invasive Management

Unit (sf)	Cost per sf
	$1.50

Event Planning/Protection

Tree Protection Fencing

Unit (lf)	Cost per lf
	$5.00
	Cost per tree
Unit (ea)	$100.00

Lawn Protection Mats

Unit (sf)	Cost per sf
	$10.00

Stabilized Turf

Unit (sf)	Cost per sf
	$15.00

Priority Projects - To Be Developed

Tree Pruning (as recommended by Bartlett)

Quantity (ea)	Cost per	Cost
837	$300.00	$251,100.00

Tree Removal (as recommended by Bartlett) + Replacement

Quantity (ea)	Cost per	Cost
106	$400.00	$42,400.00
3-3.5 DBH	Cost per	Cost
106	$800.00	$84,800.00
		$127,200.00

Tree Planting/Infill (as recommended by KZLA)

3-3.5 DBH	Cost per	Cost
67	$800.00	$53,600.00

Annual Tree Replacement Allowance - Anticipated Annual Tree Loss

3-3.5 DBH	Cost per	Cost
18	$2,000.00	$36,000.00

Air Spading (annual allowance)

Lump Sum	1	$20,000.00

Fiedler Field

Soil Amendments

Quantity (sf)	Cost per sf	Cost
80000	$0.05	$4,000.00

Soil Decompaction

Quantity (sf)	Cost per sf	Cost
80000	$1.50	$120,000.00

Pavement Excavation (8" depth)

Quantity (yd)	Cost Per yd	Cost
100	$20.00	$2,000.00

Event Staging Area (behind Hatch Shell)

Stabilized Turf

Quantity (sf)	Cost per sf	Cost
18000	$12.00	$216,000.00

Estimated Costs

Norway Replacement - Lawn Hatch Shell to Comm Boating

Tree Replacement

Quantity (ea)	Cost per	Cost
32	$2,000.00	$64,000.00

*Includes removal, site prep, and planting

Soil Amendments

Quantity (sf)	Cost per	Cost
56500	$0.05	$2,825.00

*Does not include area for stabilized turf

Soil Decompaction

Quantity (sf)	Cost per	Cost
56500	$1.50	$84,750.00

Tree Protection Fencing

Unit (ea)	Cost Per Tree	Cost
32	$100.00	$3,200.00

$154,775.00

Norway Replacement - Grainte Stairs/Boat Launch

Tree Replacement

Quantity (ea)	Cost per	Cost
31	$2,000.00	$62,000.00

*Includes removal, site prep, and planting

Soil Amendments

Quantity (sf)	Cost per	Cost
30000	$0.05	$1,500.00

Soil Decompaction

SF	Cost Per SF	Cost
30000	$1.50	$45,000.00

Tree Protection Fencing

Quantity (ea)	Cost per	Cost
31	$100.00	$3,100.00

$108,500.00

Permitting/Approvals

Conservation Commission

The site's proximity to the Charles River creates additional requirements and regulations that landscape modifications must conform to. Modifications in nearly all of the site will require approval from the Boston Conservation Commission and the Massachusetts Department of Environmental Protection (MassDEP). These areas are also protected under the federal and state Wetlands Protection Act and the Massachusetts Rivers Protection Act. Under the Wetlands Protection Act, cutting or removal of trees and understory vegetation shall not occur within 25 feet of the bank. This also restricts excavation or other methods of earth moving. Similar restrictions apply to work that is conducted within the wetland buffer, which is considered 100 feet from inland bank. Modifications within these buffer zones should also be reviewed by the public as appropriate.

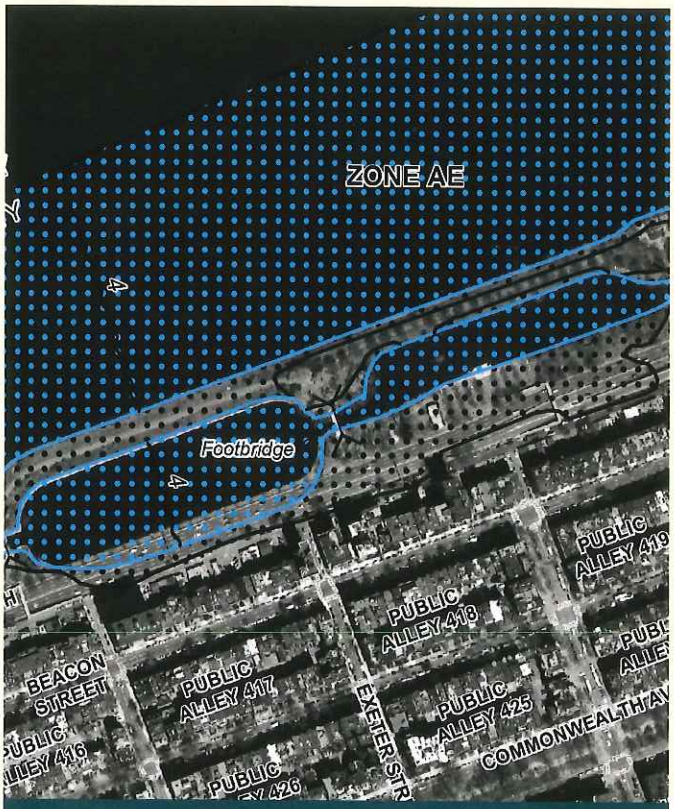
Landmarks Commission

The Esplanade was designated as a Boston Landmark by the Landmarks Commission in 2009. The Landmarks Commission evaluates any alterations to the property. Changes must be determined to maintain or enhance the viability of the Landmark designation. While this maintains the historical integrity of the site, it also creates limitations that must be abided by.

Routine maintenance such as routine pruning and removal of a dead tree are not subject to Landmarks Commission review, and do not require an application. Major vegetation clearing and/or planting should be presented to commission staff to determine if the work is eligible for a Certificate of Exemption or Administrative Review. Major planting projects might require an application and full Commission review.

Massachusetts Historical Commission

The Massachusetts Historical Commission (MHC) has review authority of alterations to the Esplanade since portions of the park are listed on the National Register of Historic Places as part of the Charles River Basin National Register District. Any alteration of any features that may have archeological value should be presented to the MHC for review. Proposed projects should aim to minimize the potential of any adverse effect of historical site features.



FEMA map shows floodplain boundary