# Reflection on Teaching Landscape Performance

Hongbing Tang, ASLA, PLA

As the new school year begins, I am reflecting on my experience teaching "Sustainable Landscape Performance" during Spring 2024 at the Boston Architectural College (BAC). This course, newly introduced to the curriculum, attracted 6 MLA students, who were very enthusiastic about studying landscape performance.

Last year, the BAC research team, led by myself and our former dean, María Bellalta, FASLA (now department head of Landscape Architecture + Environmental Planning at NC State), conducted a landscape performance case study on the Spaulding Rehabilitation Hospital. Sponsored by a LAF CSI grant, this project provided valuable insights and practical lessons on applying landscape performance metrics in real-world settings, enhancing our understanding of the tangible benefits and challenges of sustainable landscape design.

My landscape performance course includes lectures on research methods and hands-on case study projects. I found the LAF Case Study Briefs website and LAF landscape performance evaluation Guidebook are very valuable resources for teaching. My hands-on experience from the Spaulding Rehab Hospital CSI study was also very helpful. I guided students to use Boston as a city lab to conduct their own case studies. Each student selected a project site in Boston, including parks, urban plazas, mixed-use development, and university campus. By the end of the semester, they produced six case study reports on diverse locations: Christian Science Plaza, Harvard Science and Engineering Complex, Boston Chinatown Park, The Wharf District Parks, Fan Pier Park, and Pier 4 Phase 3. A variety of methods were used by students to assess environmental, social and economic benefits, including field observation, behavior mapping, hydrologic modeling, document reviews, surveys, interviews, social media study, etc.

Teaching this sustainable landscape performance class at the BAC has been a rewarding experience. The course enhanced learning through real-world application of sustainable design principles in our city. It helped students develop critical skills in performance assessment and gain networking opportunities. I assisted students reach out to the design firms and invite lead designers from several firms to talk about their projects in class. A student also visited their firm liaisons in the design office to gain more insights. Our class, as a whole, conducted multiple field trips to visit the projects and meet with the designers on-site. One of the most fulfilling moments was seeing students apply performance metrics to assess their projects, showing a better understanding of the ecological and social benefits of sustainable landscape design.

Students were very enthusiastic throughout, hoping their studies would provide valuable insights to the participating firms and support their future work.

One of the challenges in our landscape performance class is the considerable time commitment it requires. Moving forward, I plan to address this by organizing students into teams, allowing them to work on fewer projects but carry out more in-depth studies. It will make it easier for them to manage their time and focus. Additionally, we will incorporate more tools and resources to facilitate the assessment of landscape performance, streamlining the process and enhancing the learning experience. This approach will help students achieve deeper insights without overwhelming them with extensive time commitments.

Another challenge for this course is collaborating with design firms, which is essential for its success. This collaboration demands proactive engagement from the instructor, as design firms are often very busy. For instance, we once reached out to a firm that took two months to respond. We ended up not working with them. Additionally, coordination with firms can be complex. For example, in order to use photos from a firm website, we need to obtain authorization. I suggest starting the process early and planning the course ahead of time to fit guest talks, designer-led site visits into the class schedule.

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# COURSE

| | |
|---|---|
| Title: | **Sustainable Landscape Performance** |
| Faculty: | Hongbing Tang, hongbing.tang@the-bac.edu |
| Course number: | TSM2200_1 |
| Course credits: | 3.0 |
| Time: | Spring 2024 |
| | Weekday 7:15-10:15pm online synchronous meeting |
| | Saturday 9:00-12:00pm field trip |
| Prerequisites: | None |



Photos by H. Tang, L. Chen & J. Kozikowski

# COURSE OVERVIEW

Landscape performance is a vital part of landscape architectural research, education, and practice. Landscape performance evaluation is used to assess the impact of a multi-benefit landscape solution by quantifying environmental, social, and economic outcomes of a built project related to its goals and objectives. Evaluating the performance of built projects and learning from those past impacts can inform goals and design on future projects.

This course will provide students with an understanding of landscape performance and help them gain the basic skills they need to plan for, assess, and convey the impact of landscape projects. Students will be introduced to the concept of landscape performance and methodology in measuring various outcomes. They will examine Landscape Architecture Foundation (LAF)'s Case Study Investigation (CSI) series as precedent studies. Subsequently, students will gain knowledge and learn methods on how to measure environmental, social, and economic benefits of built projects. Throughout the semester, students will work on exemplary built projects in the Boston context to conduct landscape performance evaluation and produce a final project report. They will take human research protection training prior to the start of the term project.

# REQUIRED MATERIALS AND SKILLS

Computer with internet connection
Software and apps used for landscape performance evaluation, such as GIS, AutoCAD, i-Tree, iNaturalist, etc.
Filed trip essentials (Digital camera or phone camera, sketchbook, pens, measuring tape, thermometer for temperature measurement, etc.)
Human subject research protection training

# BOOKS AND REFERENCES


ARUP. *Cities Alive: Rethinking Green Infrastructure*, 2014. https://www.arup.com/perspectives/publications/research/section/cities-alive-rethinking-green-infrastructure

Calkins, Meg*. The Sustainable Sites Handbook: A Complete Guide to the Principles, Strategies, and Best Practices for Sustainable Landscapes*. Hoboken, NJ: Wiley, 2012.

Calkins, Meg. *Materials for Sustainable Sites*: *A Complete Guide to the Evaluation, Selection, and Use of Sustainable Construction Materials:.* Hoboken, NJ: Wiley, 2009. eBook https://reserves-the-bac-edu.proxy.the-bac.edu/Permanent_Reserve/Materials_for_Sustainable_Sites.pdf

Conrad, Pamela. "Climate Positive Design: Going Beyond Neutral". BAC 2023 Spring Lecture Series. https://www.youtube.com/watch?v=1WQWNwsnMWM

Landscape Architecture Foundation. *Landscape Performance Series*. http://lafoundation.org/research/landscapeperformance-series.

Landscape Architecture Foundation. *Evaluating Landscape Performance: A Guidebook for Metrics and Methods Selection*. 2018*.* https://www.landscapeperformance.org/sites/default/files/LAF-Evaluating-Performance-Guidebook.pdf

Landscape Architecture Foundation. *Landscape Performance Series* Reading & Resource List. https://www.landscapeperformance.org/sites/default/files/Resources-for-Educators-Combined-Readings.pdf

Sorvig, Kim, and J. William Thompson. 2018*. Sustainable Landscape Construction: A Guide to Green Building Outdoors*. Third Edition. Washington, DC: Island Press. https://reserves-the-bac-edu.proxy.the-bac.edu/Permanent_Reserve/PrintReplacement/Sustainable_Landscape_Construction__A_Guide_to_Green_Building_Outdoors2007.pdf


Note:
Weekly readings will be posted on Moodle.

# COURSE EXPECTATIONS

**Participation:** Participation is expected regularly in class discussions. Participation can be shown through engagement and questioning during lectures, by sharing research work and discussing with the instructor about projects, homework, and course ideas.

**Deliverables:** Upload weekly assignments and final project as PDF files to Moodle by the deadlines.

**Attendance** is mandatory. Only one excused absence will be considered, with prior notification and consideration to the instructor. Additional absences will be reflected in your performance and grade.

**Four unexcused absences result in class failure.**

# PROFESSIONAL CRITERIA

**LAAB CRITERIA:**

Note: items in grey are not covered in this course

**History, theory, philosophy, principles, and values**

- design history
- design theory
- criticism
- sustainability, resiliency, stewardship
- health, safety, welfare

**Design processes and methodology**

- critical thinking
- analysis
- ideation
- synthesis
- site program
- iterative design development
- design communication

**Systems and processes—natural and cultural (related to design, planning, and management)**

- plants and ecosystems sciences
- built environment and infrastructure
- human factors and social and community systems
- human health and well-being

**Communication and documentation**

- written communication
- oral communication
- visual and graphic communication
- design and construction documents
- numeracy, quantitative problem-solving, and communication
- community and client engagement

**Implementation**

- construction technology and site engineering
- site materials
- use and management of plants and vegetation
- policies and regulation

**Computer applications and advanced technologies**

- visualization and modeling
- communication (conceptual and construction drawings)
- geospatial analysis

**Assessment and evaluation**

- site assessment
- pre-design analysis
- landscape performance
- post-occupancy evaluation
- visual and scenic assessment

**Professional practice**

- values
- ethics
- practice
- construction administration

**Research and scholarly methods (for master's-level degree programs)**

- quantitative and qualitative methods
- establishing a research hypothesis
- framing research questions
- literature/case study review/precedent review
- research integrity and protection of human subjects
- communication of research

# COURSE GOALS

The primary goal of this course is to provide students with an understanding of the importance of landscape performance and explore landscape performance evaluation methods to demonstrate the environmental, social, and economic benefits of sustainable landscapes.

# COURSE OBJECTIVES & LEARNING OUTCOMES

- To understand the concept and implications of landscape performance for the contemporary practice of landscape architecture

- To be aware of successfully built projects and design practices demonstrating exemplary landscape performance

- To demonstrate proficiency in developing landscape performance assessment strategies and researching eco-technology processes

- To explore both qualitative and quantitative methods in evaluating landscape performance

- To communicate landscape performance assessment in effective visual and written representation

- To be prepared to advocate for sustainable planning and design strategies, operative landscapes in academic and professional work

## WEEKLY SCHEDULE subject to change

**Week 1: Wednesday, Jan. 24**
- Course introduction and expectations
- Class introduction
- Introduction to Landscape Performance Assessment

**Week 2: Wednesday, Jan. 31**
- Research Methods Overview - Qualitative and Quantitative
- Introduction the “case study” method for course learning
- Landscape performance assessment LAF CSI precedent studies
- Introduction to term project for landscape performance
- Reading discussion

**Week 3: Wednesday, Feb. 7**
- Guest Lecture - Megan Barns (Landscape Architecture Foundation)
- Social benefit assessment
- Precedent studies
- Reading discussion

**Week 4: Wednesday, Feb. 14**
- Economic benefit assessment
- Precedent studies
- Reading discussion
- Term Project Progress1 due before class & in-class review

**Week 5: Wednesday, Feb. 21**
- Guest Lecture – Rick Lawless (Complete Streets USA)
- Environmental benefit assessment
- Precedent studies
- Reading discussion

**Week 6: Wednesday, Feb. 28**
- Special Topic: Human Subject Research

- IRB overview and application process
- Human subject protection training
- Consent forms
- Reading discussion

**Week 7: Wednesday, Mar. 6**

- Special Topic: Survey & Interview Designs
- Survey & interview questions
- Discussion

**Week 8: Wednesday, Mar. 13**

- Guest Lecture - Public Space Public Life (PSPL) method - Sarah Yasuda (BAC librarian)
- Discussion on PSPL
- Term Project Progress2 in-class review

**Week 9: Wednesday, Mar. 20**

**No Class. Spring Break**

**Week 10: Wednesday, Mar. 27**

- Guest Lecture - Skip Burke on Fan Pier Parks (Richard Burke Associates)
- Guest Lecture - John Amodeo on Christian Science Plaza (Arcadis/IBI Group)
- Reading discussion

**Week 11: Wednesday, April. 3**

- Special Topic: Sustainable Stormwater Management Assessment
- Stormwater runoff estimate models, design details, and real-life examples
- In-class Exercises
- Reading discussion

**Week 12: Field Trip 1 - Saturday, April 13**

Boston Seaport District and Rose F. Kennedy Greenway Parks

- Field trip report (extra credits)

**Week 13: Wednesday, April 17**

- Special Topic: Therapeutic and Restorative Environments
- Theoretical perspective & assessment
- Student-led precedent studies
- Reading discussion
- Term Project Progress3 due

**Friday, April 19**

Boston City Hall Plaza site visit (led by Mauricio Gomez from Sasaki)

**Week 14: Field Trip 2 - Saturday, April 27**

- Christian Science Plaza site visit (led by James Kros from Arcadis/IBI Group)

- Spaulding Rehab Hospital site investigation
  Field trip report (extra credits)

**Week 15: Wednesday, May 1**

- Term Project Progress3 Review
- Working Session

**Week16: Wednesday, May 8**

- Term Project Final Review
- Conclusions/summations/takeaways
- Term Project Final Report due

# COURSE GRADING CRITERIA:

| | |
|---|---|
| Class Participation and Effort | 20% |
| Assignments (precedent studies & student-led lecture) | 25% |
| Reading | 15% |
| Term Project Progress Work | 15% |
| Term Project Final Report | 25% |

# COURSE/BAC EXPECTATIONS AND POLICIES:

Attendance Policy

- Students are expected to attend all classes
- A student's grade will be lowered for unexcused absences. An unexcused absence is defined as an absence for which the student did not receive permission in advance from the instructor.
- For 15-Session classes, four unexcused absences are grounds for failing the course.
- In the event of illness or other situation resulting in excessive absences, the student must notify the Office of Student Affairs.
- Work-related obligations and/or deadlines are not valid excuses for absence or incomplete work.

Grading

The BAC's Grade Definition Chart is included in this Syllabus. Students should note that in order to maintain Satisfactory Educational Progress (SEP), MLA students are required to maintain minimum GPAs of 2.7 overall and 2.7 for studio courses and BLA students are required to maintain minimum GPAs of 2.5 overall and 2.5 for studio courses. Failure to maintain SEP may result in additional work assigned, repeating a course or semester, or withdrawal from the program.

**BAC Grade Definitions**

| Grade | 4.0 Scale | 0-100 Scale | Definition |
|---|---|---|---|
| **A** | **4.0** | **94 – 100** | **Excellent**<br>The work exceeds the requirements of the course and demonstrates complete understanding of course goals. In addition, assignments exhibit a level of critical thinking that has allowed the student to demonstrate creative problem solving. Ideas and solutions are communicated clearly, showing a high level of attention and care. |
| **A-** | **3.7** | **90 – 93** | |
| **B+** | **3.3** | **87 – 89** | |
| **B** | **3.0** | **84 – 86** | **Good**<br>The work meets the requirements of the course and demonstrates understanding of course goals. The assignments reflect an ability to solve problems creatively, but solutions demonstrate inconsistent depth and critical thinking ability. Ideas and solutions are communicated effectively, but may lack the clarity and depth one sees in excellent work. |
| **B-** | **2.7** | **80 – 83** | |
| **C+** | **2.3** | **77 – 79** | |
| **C** | **2.0** | **74 – 76** | **Fair**<br>The work meets the minimum requirements of the course and reflects understanding of some course goals but is lackluster. The assignments exhibit a basic problem-solving ability, but the process and solutions lack sufficient depth and demonstrate a need for greater critical thinking. Ideas are communicated ineffectively, showing a lack of attention to detail and a decided lack of clarity or depth. |
| **C-** | **1.7** | **70 – 73** | |
| | | | |
| **D** | **1.0** | **60 – 69** | **Poor**<br>The work barely meets the minimum requirements of the class. Assignments lack depth and a display a minimal understanding of course goals. Ideas are presented with little or no detail or elaboration. Course guidelines are often not followed. |
| | | | |
| **RF** Repeat/ Fail | **0.0** | **0 - 59** | **Unacceptable or missing work**<br>**Repeat/Fail.** The work neither satisfies the requirements of the class nor demonstrates understanding of course objectives. The presentation of work is unprofessional and/or incomplete. Overall, the student shows insufficient understanding of the course requirements. Poor attendance or violation of academic integrity policy may also be factors. |
| **I** | | | **Incomplete** |
| **NF** | **0.0** | | **Failure due to non-attendance** |
| **W** | | | **Withdrawn** |

Course Policies and Procedures

Late Policy
Assignments are due no later than the date and time assigned. Students should contact the instructor in advance if, for a valid reason work will be submitted late.

Student Responsibility
A student should…

… complete assignments to the best of his or her ability, and submit them on time. In the event that circumstances require a late submission, the student should contact the instructor before the assignment is due and appropriate accommodation may be considered. In the event of an emergency (e.g., medical, personal), the instructor and student advisor should be contacted at the earliest possible time.

… engage actively with the ideas presented and with fellow students. Wide-ranging opinions and ideas are encouraged, and a civil, respectful courtesy for everyone else is required.

… think deeply. This course addresses challenging subjects and thought-provoking material, and everyone should be prepared to reflect and consider deeply-held assumptions.

Mid-Semester Warning

Students will receive a progress assessment at mid-semester. Students who do not perform up to expectations will receive a Mid-Semester Warning; a copy of the warning will be kept in the student's file.

Writing Standards

Writing in this course should meet the standard of accuracy and clarity of expression that is expected of design professionals. Appropriate grammar, correct spelling, and the ability to construct a clear and well-organized statement or argument are expected.

To Document Correctly:

Be sure to attribute all outside pieces of information to their original sources. In addition, students should keep in mind that even if it is required to paraphrase, there is a need to cite that material. Use appropriate bibliographic and webliographic references for quoted and paraphrased material. An excellent resource for proper format and usage guidelines is Kate L. Turabian's *A Manual for Writers of Term Papers, Theses, and Dissertations*.

Samples for a Bibliography:
http://www.press.uchicago.edu/books/turabian/turabian_citationguide.html A Guide for Writing Research Papers: https://owl.english.purdue.edu/owl/

The Learning Resource Center can provide professional writing advice in structuring an argument and in correct documentation. Students can make an appointment with a writing tutor at writingcenter@the- bac.edu or by calling 617.585.0174. Several downloadable guides to writing, research, and citation are available at http://www.the-bac.edu/resources/academic-services/learning-resource-center.

Plagiarism

Plagiarism is representing someone else's words or ideas as their own. On occasion students violate, often innocently, rules for citing and referencing source material; this is still plagiarism. This problem has been exacerbated by the ready availability and frequent use of online resources. To report on research, it is incumbent on the student to know the difference between a direct quotation and paraphrasing (both are appropriate, but require citation), and paraphrasing and plagiarism.

There are two types of plagiarism: intentional and accidental. Each is serious and will not be tolerated.

*Intentional Plagiarism* is the deliberate attempt to submit someone else's work as their own. This includes turning in:

- A paper copied from a book or magazine
- A paper written (in total or in part) by another person

The first time a student commits this level of plagiarism, they will receive an "F" for the assignment.

The second offense will receive an “F” in the course. This policy covers all assignments, including discussion board posts.

*Accidental Plagiarism* is the result of misunderstanding or misapplying the rules of documentation. It includes using an idea from a source without naming the source, using the exact words of a source without quotation marks, or following the words and structure of the source too closely as one is paraphrasing. Errors resulting from a misapplication or unawareness of the rules of documentation may result in the grade of “F” for the paper in question.

Academic Integrity

As stated in the Campus Compact, the BAC expects intellectual activities to be conducted with honesty and integrity. Work submitted or presented as part of a BAC course:

- Shall be the original creation of its author;
- Is allowed to contain the work of others so long as there is appropriate attribution; and
- Shall not be the result of unauthorized assistance or collaboration.

Failure to adhere to these guidelines is academic dishonesty, and calls into question the student and the college. Visit the BAC Academic Integrity Statement for additional information: http://the-bac.edu/resources/academic- services/learning-resource-center/academic-integrity-statement

Copyright Compliance Notice

Courses may contain material used in compliance with the U.S. Copyright Law, including the TEACH Act and principles of "fair use." These materials are made available for the educational purposes of students enrolled at the Boston Architectural College. No further reproduction, transmission, or electronic distribution of this material is permitted.

Course materials may not be saved, copied, printed, or distributed without permission other than as specified to complete course assignments. Use of the course materials is limited to enrolled class members for the duration of the course only.

Diversity Statement

The Boston Architectural College is committed to promoting a community that celebrates, affirms, and vigorously pursues inclusiveness in all its forms. (Full text at: http://the-bac.edu/about-the-bac).

Disability Services

The BAC offers reasonable accommodations to students who otherwise cannot reach their academic potential due to a learning disability, physical impairment, medical/psychological condition, or unforeseen circumstances that may arise during the course of their studies. All forms of accommodation are tailored specifically to the individual student and meet guidelines for educational benefit and academic consistency. Accommodations must maintain academic integrity and a realization of required learning objectives. Students who are eligible for accommodations are strongly encouraged to notify the instructor. Students must have appropriate documentation on-file.

The Boston Architectural College complies with the Americans with Disabilities Act and Section 504 of the Rehabilitation Act. If you are a student who is seeking accommodations based on a documented disability and/or diagnosis, please contact Disability Services to discuss reasonable accommodations. The Disability Services Coordinator can be reached by emailing DisabilityServices@the-bac.edu. The Disability Services office is located in 320 Newbury Street on the first floor. While you may activate accommodations at any time during your academic career at the BAC, it is highly encouraged to schedule a meeting as soon as possible.

More information can be found at this link: http://www.the-bac.edu/students/offices-and-resources/academics/academic-advising/disability-services.

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# SUSTAINABLE LANDSCAPE PERFORMANCE: BOSTON CASE STUDIES

Mustafa Kaplan • Hannah Osborn • Ashley Pepen • Samer Samarani • Zijie Zhu • Jillian Ziegler

Boston Architectural College
School of Landscape Architecture
TSM2200 Spring 2024
Instructor: Hongbing Tang, ASLA, PLA, LEED AP

# Acknowledgments

Our sustainable landscape performance case study project sites in Boston are located on the ancestral territory of the Massachusett Tribe, the original occupants of what is now known as Boston (hunap.harvard.edu n.d.). We pay our respects to the past and present Massachusett Tribal members, as well as the land itself, which remains sacred to the Massachusett People.

The class is grateful for the following firms' great support in providing connections and resources for collecting information of our case studies in Boston:

- Arcadis - Boston Chinatown Park
- Arcadis - Christian Science Plaza
- Copley Wolff Design Group - Wharf District Parks
- Reed Hilderbrand - Pier 4
- Richard Burke Associates – Fan Pier Park
- STIMSON – Harvard Science & Engineer Complex

The students would also like to thank Megan Barns from the Landscape Architectural Foundation, Margarita Iglesia, the BAC program director, their course instructor this semester, Hongbing Tang, all the guest speakers and landscape architects who led our field trips.

Image: H. Tang

# Project Areas

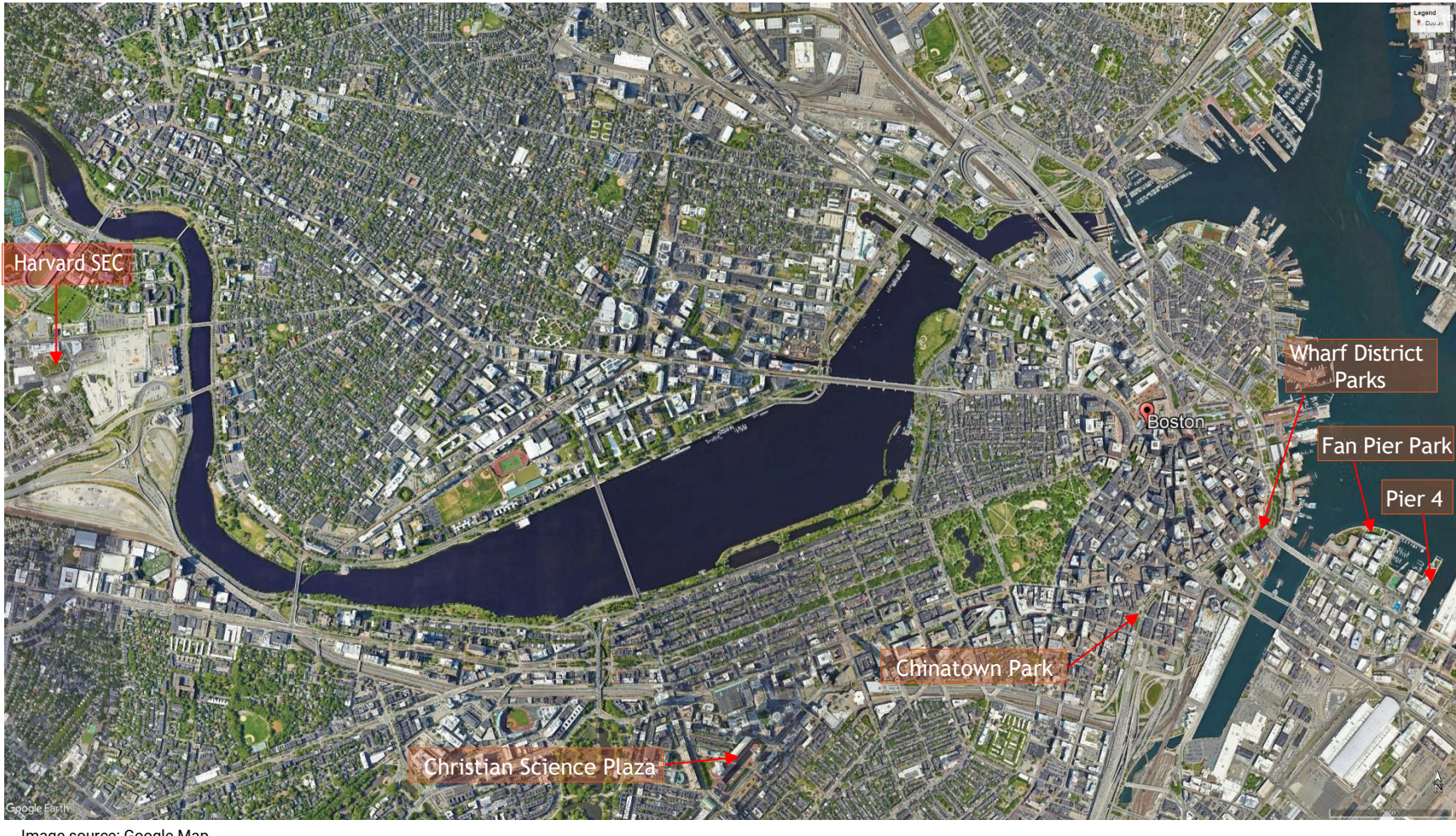



Image source: Google Map

## Objectives & Learning Outcomes

- To understand the concept and implications of landscape performance for the contemporary practice of landscape architecture
- To be aware of successfully built projects and design practices demonstrating exemplary landscape performance
- To demonstrate proficiency in developing landscape performance assessment strategies and researching eco-technology processes
- To explore both qualitative and quantitative methods in evaluating landscape performance
- To communicate landscape performance assessment in effective visual and written representation
- To be prepared to advocate for sustainable planning and design strategies, operative landscapes in academic and professional work

## Project List

Mustafa Kaplan | **Fan Pier Park**

Hannah Osborn | **Wharf District Parks**

Ashley Pepen | **Christian Science Plaza**

Samer Samarani | **Pier 4 Phase 3**

Zijie Zhu | **Boston Chinatown Park**

Jill Ziegler | **Harvard Science and Engineering Complex (Harvard SEC)**

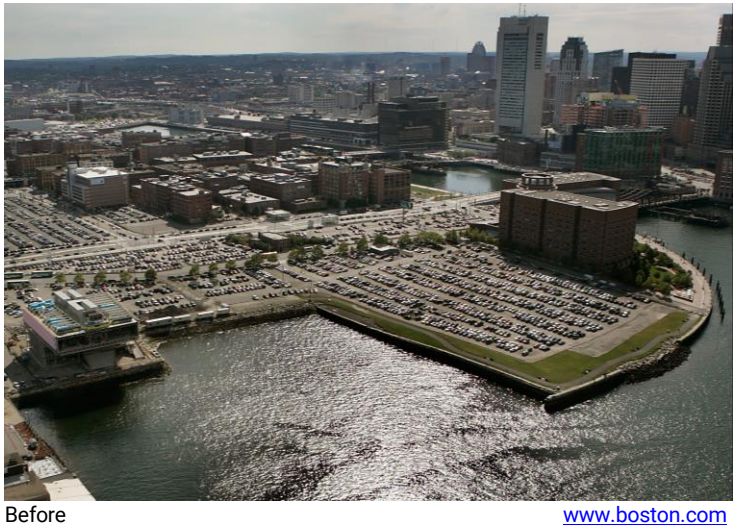
# Fan Pier Park

25 Fan Pier Boulevard, Boston, MA

Mustafa Kaplan

## Overview

Located in Boston's Seaport District, Fan Pier Park is a two-acre, publicly accessible waterfront park, developed in two phases. Capturing the iconic views of Boston and its bustling Harbor stands as the key design theme of the park. Angular granite terraces gracefully cascade from a central lawn, honoring the waterfront as a dynamic stage for the active harbor. At the heart of Fan Pier Park lies the majestic Tidal Well, strategically positioned along the axis of Fan Pier Boulevard. Fan Pier Park beckons both moments of expansive wonder and tranquil reflection, harmonizing the grandeur of the harbor vistas with inviting spaces for leisure and repose.



Before www.boston.com

After www.fanpierboston.com

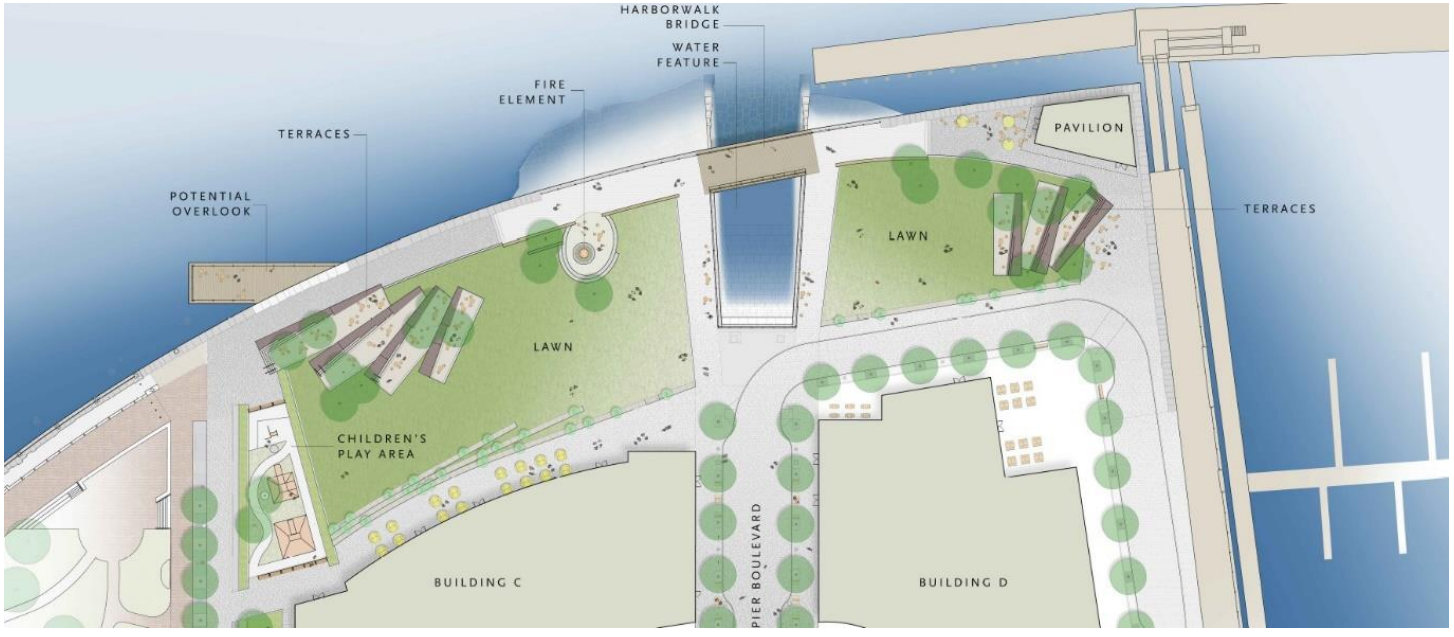
## At a Glance

| | | | |
|---|---|---|---|
| **Designer:** | Richard Burck Associates (RBA) | **Project Type:** | Waterfront Park |
| **Former Land Use**: | Parking lot | **Size:** | 2 acres |
| **Completion Date:** | 2019 | **Budget:** | $ 9,800,000 |

## Project Goals

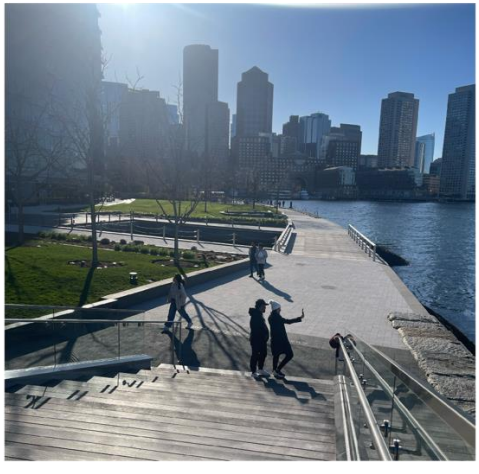
- Create public open spaces and continue Harbor walk along the water to maximize waterfront access and enhance the quality of life for residents and visitors.
- Incorporate the dramatic views of Boston and its Harbor into the park design.
- Integrate the development with transit infrastructure to enhance accessibility and reduce reliance on private vehicles, thereby promoting sustainable urban mobility.
- Promote a variety of activities along the waterfront.

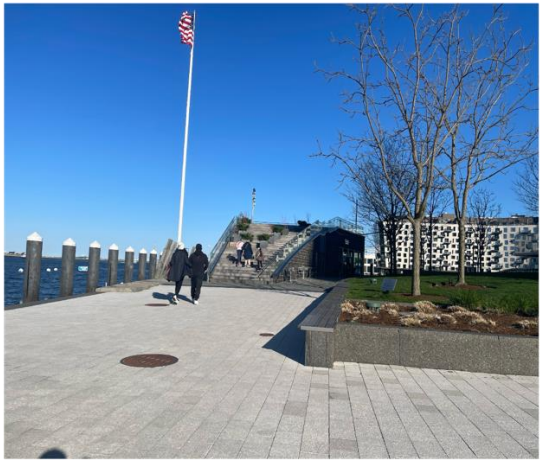
# Site Plan

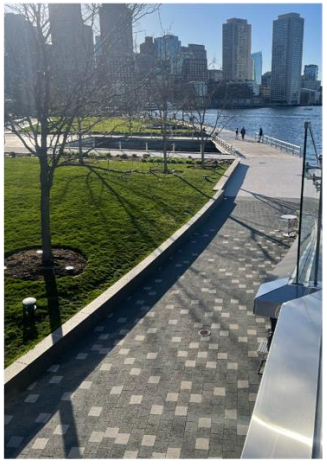


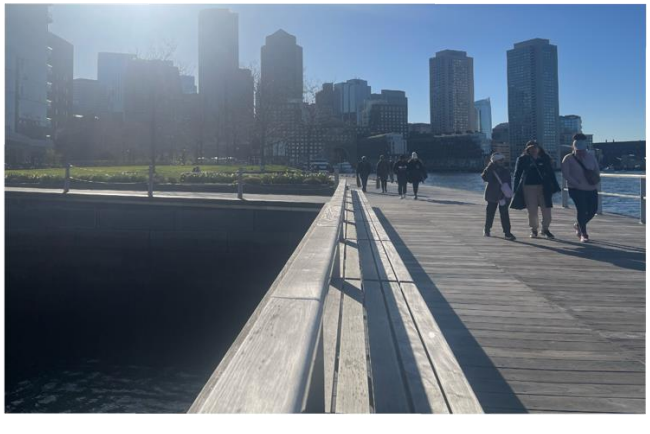

**Source:** Richard Burck Associates

# Site Images







by Mustafa Kaplan

# Landscape Performance Benefits

## Environmental Benefits

• ***Reduces peak runoff rate for a 100-year storm by an estimated 57.80% and reduces runoff volume by 178,440 gallons for a 100-year, 24-hour storm as compared to pre-development conditions.***

**Methods:**

Landscape plan provided by RBA to estimate the peak runoff rate for a 100-year storm. AutoCAD was used to calculate the areas of each different surface cover. Modified rational method was adopted as it is a simplified model of the hydrologic process.

**Calculation:**

**Peak runoff rate reduction:**
**Modified Rational Method Formula: Qp = CCaiA**
Qp = peak runoff rate, cubic feet per second (cfs)
C = runoff coefficient (unitless)
CA = antecedent precipitation factor (unitless)
i = rainfall intensity, inches per hour (iph), for storm duration = the time of concentration (Tc)
A = drainage area, acres (ac)

**Pre-Development Site Land Cover**
Parking surface material: concrete, 100% impervious
Runoff coefficient for concrete: C = 0.95
A = Total site area = 83653.01 sf = 1.920 acres

| Landcover | Area (SF) | Acre (ac) | Runoff Coefficient (C) | Adjusted Area C*A |
|---|---|---|---|---|
| Lawn | 29103.1 | 0.66 | 0.3 | 0.198 |
| Stone paving | 11642 | 0.267 | 0.7 | 0.1869 |
| Concrete | 18164 | 0.41 | 0.95 | 0.3895 |
| Crush stone paving | 3753 | 0.08 | 0.3 | 0.024 |
| **TOTAL** | 62662.1 | 1.357 | | 0.7984 |

**Weighted Runoff Coefficient:**
C weighted = Adjusted Area / Total Site Area = 0.7984/1.920= 0.40

**100-year storm frequency**
The rainfall intensity is 5.4 iph for a 100-year storm frequency from the Rainfall Intensity Chart for Boston, MA

We use 15 minutes for the time of concentration Tc based on the common practice noted in Site Engineering for Landscape Architects (Strom, Nathan, and Woland 2013): "Since it takes several minutes for rain to wet a surface thoroughly, many municipalities permit the use of minimum times of concentration, such as 10 or 15 minutes. This will reduce the intensity used for the computation of the runoff rate" (Strom, Nathan, and Woland 2013, 266).

Formula: Qp = CCAiA
Qpre-development = 0.95 x 1.25 x 5.4 iph x 1.92ac = 12.312cfs
Qpost-development = C average x CA x i x A = 0.40 x 1.25 x 5.4 x 1.92 ac =5.184 cfs
Reduction rate: (12.312 – 5.184)/ 12.312 = **57.80%**
**In Summary, 100-year design storm calculations show a 57.80% reduction in peak runoff rate comparing the pre- and post-development conditions.**

**Reduction of runoff volumes for a 100-year, 24-hour storm**

**Pre-development site runoff water in gallons:**
The pre-project site was 100% impervious and covered with concrete (CN=98) Using the WinTR-55 software developed by NRCS, when inputting the Rainfall Distribution Type (Type III for Massachusetts) and choosing Suffolk County where Boston is located, a table of storm data is shown. For the 100-year storm return period, the 24-hour rainfall amount is 6.6 inches.

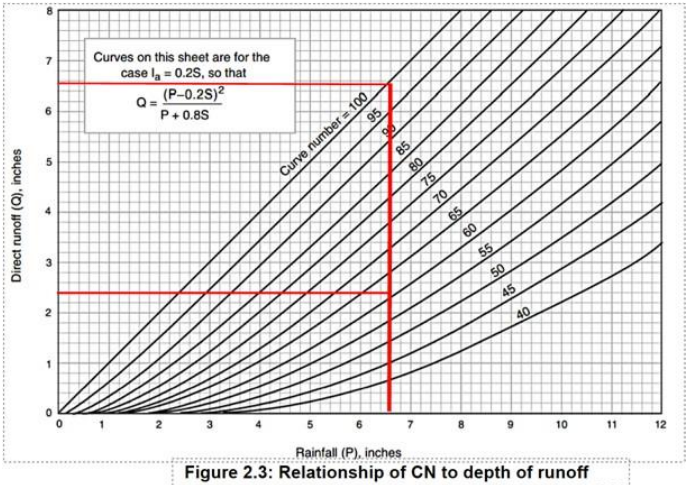


**Figure 2.3: Relationship of CN to depth of runoff**
*Source: 210-VI-TR-55; Strom, Nathan, Woland 2013, 228*

Runoff from 6.6-in rainfall on surface with Runoff Curve Number (CN)=98 is 6.55-in

Pre-development Runoff Volume = 6.55in x 1 ft /12 in x 83653.01sf = 45,660 cf
45,660 cf x 7.48 gallons/cf = **341,541 gallons**

| Land cover | Curved number | Area (sf) | Runoff generated(inch) |
|---|---|---|---|
| Impervious urfaces | 98 | 29185.2 | 6.55 |
| Pervious surfaces | 61 | 29620.8 | 2.38 |

Runoff Vol. = (6.55 in x 1 ft/ 12 in x 29,185.2sf) + (2.38 in x 1 ft/12 in x 29620.8 sf)

= 15,930.2+5,874.7 = 21,804.9 cf

21,804.9 sf x 7.48 = 163,101.3 gallons

**Runoff volume reduction for a 100-year, 24-hour storm: 341,541 – 163,101.3 = 178,440 gallons**

**Limitation:**

Individual errors were conceivable, limiting the accuracy of the calculations.

**Sources:**

Massachusetts Highway Department. 2006. “Chapter 8: Drainage and Erosion Control.” In 2006 Project Development and Design Guide, 2006th edition, 8-1 to 8-144. https://www.mass.gov/lists/design-guides-and-manuals.
Strom, Steven, Kurt Nathan, and Jake Woland. 2013. Site Engineering for Landscape Architects, 6th edition, 147–56. Hoboken, New Jersey: Wiley

- ***Sequesters an estimated 1,788 lbs of atmospheric carbon annually with the presence of 47 (phase 1+ Phase 2) newly planted trees***

## Background:

Before the park's establishment, the site was occupied by a parking lot devoid of trees. In response, initiatives were undertaken during the new construction phase to plant trees, resulting in the presence of 47 newly planted trees on-site. Overall, the park now boasts a total of 47 trees, enhancing its environmental and aesthetic appeal.

## Method:

To quantify the $CO_2$ sequestration capacity of the trees, the i-Tree app was used. This tool necessitated the measurement of the trunk diameter at breast height (DBH) for each tree. Subsequently, these DBH measurements were inputted into the i-Tree software, which furnished insights into stormwater management and $CO_2$ absorption capabilities. Upon inputting the data for all new 47 trees into i-Tree, the analysis revealed that these trees collectively sequester approximately 1,788 lbs of $CO_2$ annually (see Figure X). This year alone, the trees are projected to mitigate

atmospheric carbon dioxide (CO2) by 1,788 pounds. Looking ahead, after 50 years, the cumulative sequestration is estimated to reach 62,184 pounds of CO2, equivalent to carbon (refer to Figure Y). In essence, the trees on-site serve a dual purpose. Firstly, they significantly sequester CO2 over a 50-year period, with an estimated total of 109,048 lbs. Additionally, they contribute to the area's well-being by providing emotional benefits such as shade and aesthetic enhancement.

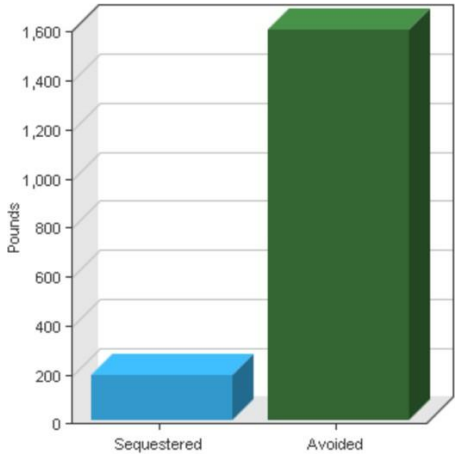



Figure X

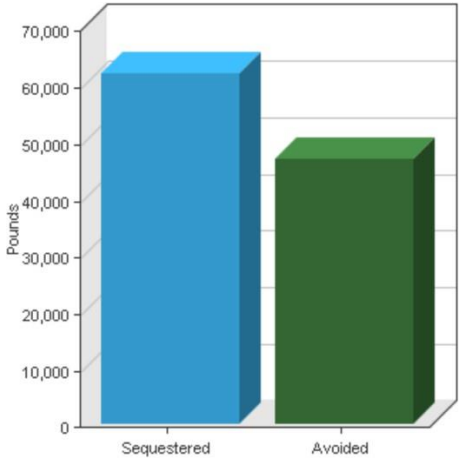



Figure Y

**Limitation:**

I created the table using measurements taken from the trees on the site, providing descriptions of the existing trees found on the site.

**Sources:**

i-Tree Tools.

- ***Removes 2,793 lbs of air pollutants over 50 years to improve air quality. It underscores the long-term benefits of planting and maintaining green spaces. 47 newly planted trees help filter out pollutants, improving the overall air quality and creating a healthier environment for everyone in the area.***

**Background:** Planting trees, perennials, and hedges not only beautifies the landscape but also enhances the environment by providing habitat for wildlife and improving air quality. The fact that 47 trees were added demonstrates a significant commitment to revitalizing the site and creating an ecologically sensitive and sustainable space for people to enjoy.

**Trees**

***GYMNOCLADUS DIDICA***
KENTUCKY COFFEETREE

***GLEDITSIA TRIACANTHOS 'SKYLINE'***
HONEY LOCUST

***PLATANUS X ACER***
LONDON PLANE

***MALUS SARGENTII 'TINA'***
TINA SARGENT CRABAPPLE

**Hedges**

***CORNUS SERICEA 'BAILEY!'***
RED TWIG DOGWOOD

***FOTHERGILLA GARDENII***
DWARF FOTHERGILLA

***MYRICA PENSYLVANICA***
NORTHERN BAYBERRY

**Perennials**

***AMSONIA HUBRICHTII***
BLUE STAR

***ALCHEMILLA MOLLIS***
LADY'S MANTLE

***COREOPSIS GRANDIFLORA 'EARLY SUNRISE'***
TICKSEED

***GERANIUM 'JOHNSON'S BLUE'***
CRANESBILL

***LAVANDULA ANGUSTIFOLIA 'HIDCOTE'***
ENGLISH LAVENDER

***SALVIA NEMOROSA 'CARADONNA'***
CARADONNA SALVIA

**Trees**

***GYMNOCLADUS DIICA 'ESPRESSO'***
KENTUCKY COFFEETREE

***GLEDITSIA TRIACANTHOS 'SKYLINE'***
HONEY LOCUST

**Perennials**

***ECHINACEA PURPUREA 'WHITE SWAN'***
WHITE SWAN CONEFLOWER

***HELENIUM 'SHORT N' SASSY'***
SHORT N' SASSY SNEEZEWEED

***SALVIA NEMOROSA 'MAY NIGHT'***
MAY NIGHT SALVIA

**Grasses**

***CALAMAGROSTIS ACUTIFLORA 'KARL FOERSTER'***
FEATHER REED GRASS

***PANICUM VIRGATUM 'SHENANDOAH'***
SHENANDOAH RED SWITCH GRASS

***PENNISETUM ALOPECURIODES 'HAMELN'***
DWARF FOUNTAIN GRASS

***BULBS: COLORBLEND, ITEM SPRING LOADED®***
BULBS

**Method:**

To quantify air pollution removal of the plants, the i-Tree app was used. This tool necessitated the measurement of the trunk diameter at breast height (DBH) for each tree. Subsequently, these DBH measurements were inputted into the i-Tree software.

**Limitations:**

The air pollution calculation relied on modeling rather than direct measurements, thus there is a possibility of inaccuracies in the results.

Sources: i-Tree Tools.

## Social Benefits

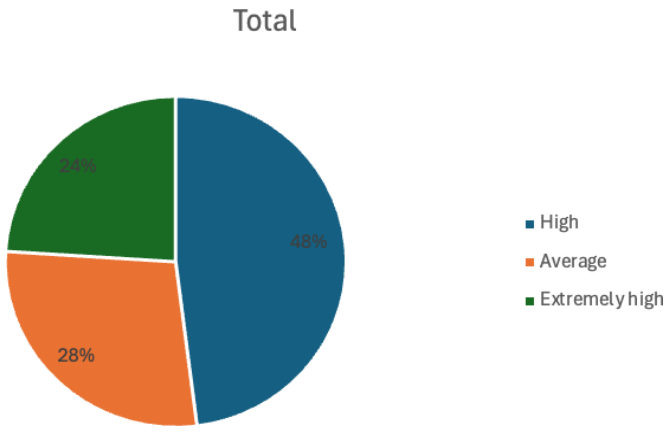
Scenic Quality & Views Improving the visual quality of an area.

- ***Provides high aesthetic value according to 70% of 30 surveyed users reporting they are satisfied or highly satisfied with the Park experience.***

**Background:**
The Fan Pier location is highly popular and appealing, particularly for those who enjoy walking and visiting the Seaport area in Boston. It's a frequent destination for pet owners, who often stroll through the park with their furry companions. This presents a valuable opportunity to conduct surveys and gather insights from park visitors.

**Method:**

The evaluation method entails conducting on-site surveys to gather insights from individuals who have visited the park. Participants are asked to respond to question on its aesthetic value. The question utilizes a rating scale ranging from 'Extremely low', 'Low', 'Average', 'High', and 'Extremely high' (refer to Table 1) to evaluate the aesthetic value of the Fan Pier Park.




Source: The survey

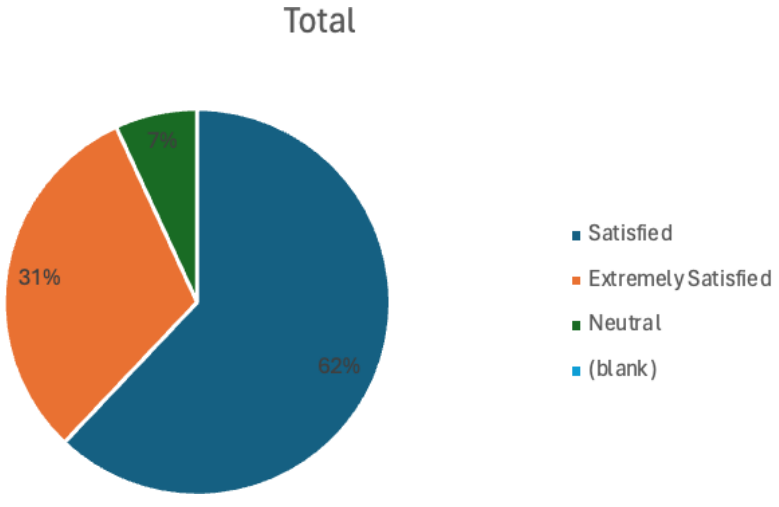
Recreational & Social Value Promoting play, relaxation, and interaction

- ***Provides satisfaction experience amongst 80% of 30 survey participants***

**Method:**

The evaluation method includes on-site surveys to collect insights from individuals who have visited the park. Participants are prompted to respond to six questions aimed at gauging their overall -user experience with

the park. One of the questions specifically focuses on satisfaction levels, with response options ranging from ‘Extremely dissatisfied’, ‘ Dissatisfied’, ‘ Neutral’, ‘ Satisfied’ and 'Extremely satisfied.'

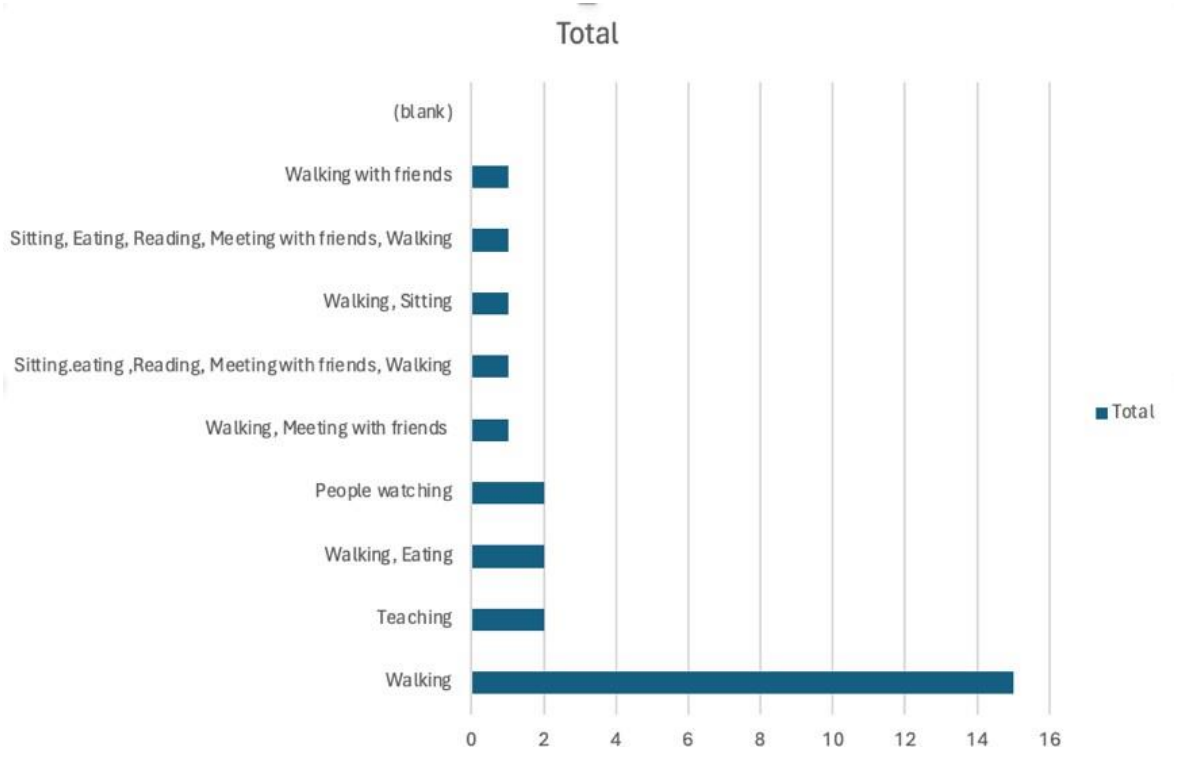



Source: The survey

- ***Provides a range of activity spaces with 10 activity types observed on-site through behavior mapping, and 7 activity types reported by users through 30 surveys. Walking is the most common type of activity, with 53.85% of 31 surveyed users reporting that they often walk in the park. People watching is the 2nd most common type of activity 7.69%, followed by eating outside (7.69%).***

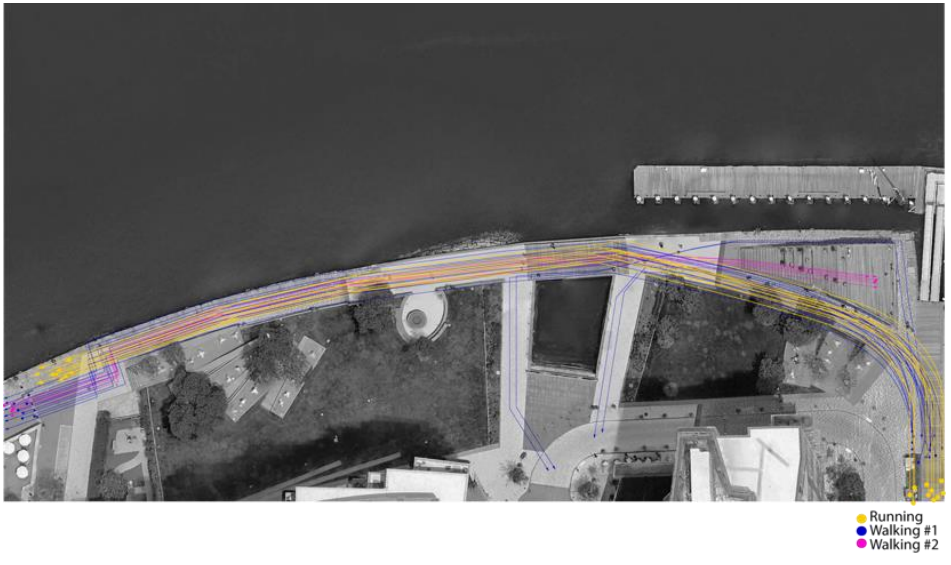
**Method:**

The evaluation method involves conducting on-site surveys and the site observation to gather insights from individuals who have visited the park. Participants are asked to respond to six questions aimed at understanding the activities they engaged in during their visit. One question specifically focuses on the types of activities people typically do in the park, such as walking, sitting, eating, meeting with friends, reading, running, and watching. This evaluation is conducted with a specific focus on the activities at Fan Pier Park in Boston.




Source: The survey

During a sunny Saturday between 12 PM and 2 PM, it is conducted observations at the Park, which is part of the Sea Port Harbor walk. It is observed 50 people passing by and noted whether they were walking or running. The results indicate that the majority of people were walking, with running being the second most common activity. To determine the percentage of people walking and running, It will be calculated the proportion of walkers and runners out of the total number of observed individuals. Out of the 50 individuals observed, 40 were walking and 10 were running. This indicates that 80% of the people were walking and 20% were running during that time frame.




Additionally, analyzing Google reviews offers a unique window into people's experiences and perceptions of a park landscape. By understanding and reviewing individuals' intentions and experiences shared in these reviews, we gain valuable insights into what shapes their overall impressions. Through the words used in

these reviews, we can paint a vivid picture of how visitors depict the park (refer to picture C), providing valuable context for assessing its impact and appeal.

*(Picture A)*

*Picture A: The Tidal Well Bridge draws (and supports) a crowd during a summer fireworks display over Boston Harbor [Photo: Biruk Belay/Richard Burck Associates]*


(Picture B)

## References & Sources

"Fan Pier Park". https://www.richardburck.com/projects/fan-pier-park/
"Boston Development Project: Fan Pier". https://www.falloncompany.com/projects/fan-pier
Boston Society of Landscape Architects: 2022 Merit Award

## Project Team:

**Owner:** The Fallon Company
**Architects:** Tsoi/Kobus & Associates, Elkus Manfredi Architects
**Landscape Architect:** Richard Burke Associates, Inc.
**Civil Engineer:** Nitsch Engineering
**Contractor:** Turner Construction Company

**LA Firm Contact Person**

Skip Burck
rburck@richardburck.com

## Lesson Learned

Fan Pier Park has truly excelled in its versatility, offering a space that seamlessly caters to a wide range of needs and activities throughout the day and across various seasons. Its consistent heavy usage stands as a testament to the success of its thoughtful design. By effortlessly adapting to different purposes and embracing seasonal changes, the park has become important node on Boston Harbor walk. Boston are enamored with the Harbor Walk, particularly praising the design of Fan Pier Park. Its thoughtful layout and scenic beauty have garnered widespread acclaim and admiration.

# Wharf District Parks

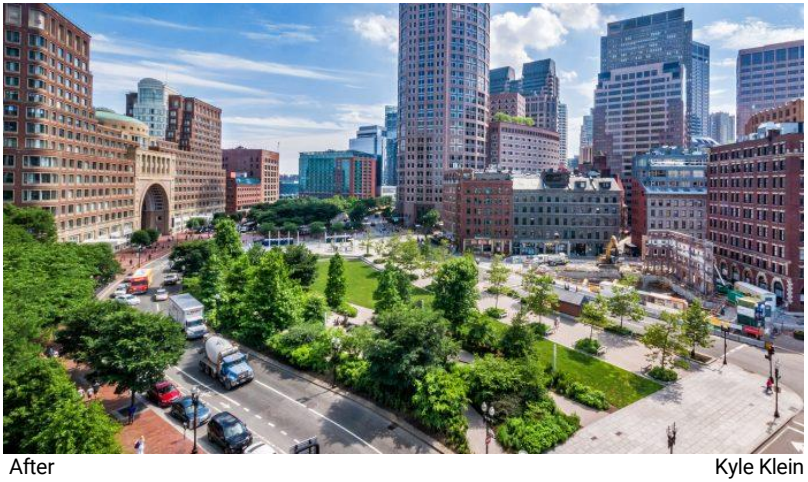
Atlantic Avenue & Milk Street, Boston, MA

Hannah Osborn, MLA Candidate

## Overview

The Wharf District Parks project is the central one-third of the Rose Kennedy Greenway park system in Boston, MA. The Greenway replaced what was known as the Central Artery, an elevated highway that bisected downtown Boston from the waterfront and divided neighborhoods, which was demolished during the “Big Dig” project and replaced with an underground tunnel below the new 30-acre park system. The Wharf District Parks were designed for public event use and local pedestrian activity to encourage people to interact with one another and connect with other civic programming. The edge that abuts Downtown Boston features geometric planters and orthogonal lines, while the side closer to the waterfront features curved pedestrian paths and organic shapes to mimic the shoreline. This new, vibrant park system has become a busy and beloved landmark for the City, frequented by locals, students, families and tourists since 2008.

Before — Massachusetts Turnpike Authority



After — Kyle Klein

## At a Glance

| | | | |
|---|---|---|---|
| **Designer:** | Copley Wolff Design Group | **Project Type:** | Urban Park |
| **Former Land Use**: | Elevated Highway | **Size:** | 5 acres |
| **Completion Date:** | 2008 | **Budget:** | $16 million |

## Project Goals

- Create a safe and visually interesting pedestrian-focused space that is not defined by vehicular constraints.
- Offer seasonal experiences through outdoor events and visual experiences, connecting people to civic spaces.
- Collaborate with neighboring communities to achieve high public approval.
- Encourage people to experience and revisit the site multiple times.
- Plant a variety of hardy, urban trees to avoid losing trees to disease.

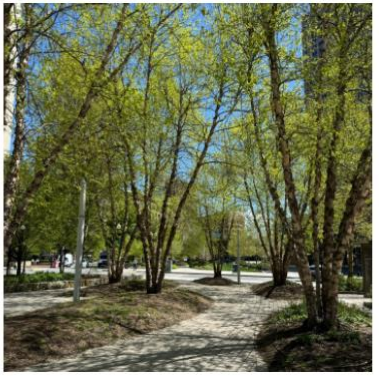
## Site Plan

**Image:** bslanow.org

## Site Images

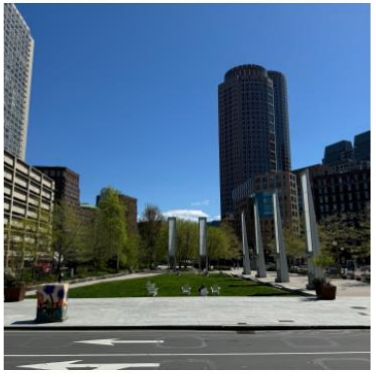

House Sparrow


Harbor Fog sculpture


River Birch forest


Rings Fountain


Rowes Wharf Plaza Park


Color Commons


Red Admiral Butterfly


Bench

photos by H. Osborn

# Landscape Performance Benefits

## Environmental Benefits

- ***Improves habitat quality by introducing to the site 16 species of bulbs, 21 species of ferns and grasses, 25 species of trees, 70 species of perennials, and 32 species of shrubs.***

**Background:**
The predevelopment of the site was devoid of an ecosystem, consisting mainly of impervious surfaces and a small number of street trees. There was insignificant biodiversity on site, allowing the addition of the park to make a substantial increase in biodiversity and habitat quality for small mammals, birds, and insects.

**Methods:**
The Rose Kennedy Greenway website features a PDF containing photos of all species of plants located on site.

**Calculation:**
Bulbs


***Chionadoxa forbessii* 'Blue Giant'**
Glory-of-the-snow


***Crocus tommasinianus* 'Lilac Beauty'**
Crocus


***Crocus vernus* 'Flower Record'**
Crocus


***Crocus vernus* 'Grand Maitre'**
Crocus


***Erythronium americanum***
Dog-tooth Violet


***Erythronium* 'Pagoda'**
Trout Lily


***Galanthus elwesii***
Giant Snowdrop


***Galanthus nivalis***
Snowdrop


***Galanthus nivalis* 'Flore Pleno'**
Double Snowdrop


***Narcissus* 'Jack Snipe'**
Cyclamineus Daffodil


***Narcissus* 'Jetfire'**
Cyclamineus Daffodil


***Narcissus* 'Minnow'**
Miniature Daffodil


***Narcissus* 'Sailboat'**
Jonquilla Daffodil


***Narcissus* 'Sun Disc'**
Miniature Daffodil


***Narcissus* 'Tete-a-tete'**
Miniature Daffodil


***Scilla siberica* 'Spring Beauty'**
Squill

## Ferns & Grasses

***Andropogon gerardii***
Big Bluestem

***Calamagrostis canadensis***
Blue Joint

***Carex pensylvanica***
Pennsylvania Sedge

***Carex platyphylla***
Silver Sedge

***Deschampsia flexuosa***
Wavy Hairgrass

***Dryopteris marginalis***
Marginal Wood Fern

***Eragrostis spectabilis***
Purple Love Grass

***Matteucia struthyopteris***
Ostrich Fern

***Muhlenbergia capillaris***
Pink Muhlygrass

***Panicum virgatum* 'Heavy Metal'**
Switchgrass

***Panicum virgatum* 'Prairie Fire'**
Switchgrass

***Panicum virgatum* 'Rostrahibusch'**
Northern Switchgrass

***Panicum virgatum* 'Ruby Ribbons'**
Switchgrass

***Panicum virgatum* 'Shenandoah'**
Switchgrass

***Polystichum acrostichoides***
Christmas Fern

***Schizachyrium scoparium***
Little Bluestem

***Schizachyrium scoparium* 'Carousel'**
Little Bluestem

***Schizachyrium scoparium* 'The Blues'**
Little Bluestem

***Sisyrinchium angustifolia* 'Lucerne'**
Stout Blue-eyed Grass

***Sorghastrum nutans* 'Sioux Blue'**
Indian Grass

***Sporobolus heterolepsis***
Prairie Dropseed

## Trees

***Acer rubrum* 'Franksred'**
Red Maple

***Acer rubrum* 'October Glory'**
Red Maple

***Amelanchier canadensis***
Shadblow Serviceberry

***Amelanchier laevis***
Allegheny Serviceberry

***Betula nigra* 'Cully' HERITAGE**
River Birch

***Betulus nigra* 'Dura-Heat'**
River Birch

***Carpinus caroliniana***
American Hornbeam

***Cornus alternifolia***
Pagoda Dogwood

***Crataegus crus-galli* var. *inermis***
Thornless Cockspur Hawthorn

***Gleditsea triacanthos* var. *inermis***
Honey Locust

***Gymnocladus dioicus***
Kentucky Coffeetree

***Juniperous virginiana***
Eastern Red Cedar

***Liquidambar styraciflua* 'Moraine'**
Sweetgum

***Liriodendron tulipifera***
Tulip Tree

***Magnolia virginiana***
Sweetbay Magnolia

***Magnolia virginiana* 'Green Shadow'**
Green Shadow Sweetbay Magnolia

***Nyssa sylvatica***
Black Gum

***Ostrya virginiana***
Ironwood

***Platanus x acerfolia* 'Bloodgood'**
London Planetree



***Quercus bicolor***
Swamp White Oak



***Quercus macrocarpa***
Bur Oak



***Quercus palustris***
Pin Oak



***Quercus rubra***
Red Oak



***Sassafras albidum***
Sassafras



***Ulmus americana* 'Valley Forge'**
American Elm

Perennials

***Actaea racemose***
Black Cohosh

***Agastache foeniculum* 'Golden Jubilee'**
Anise Hyssop

***Agastache scrophulariifolia* 'Blue Licorice'**
Purple Giant Hyssop

***Amsonia 'Blue Ice'***
Blue Star

***Amsonia hubrichtii***
Hubricht's Bluestar

***Amsonia tabernaemontana***
Common Bluestar

***Anemone canadensis***
Canada Anemone

***Anemone virginiana***
Thimbleweed

***Antennaria plantaginifolia***
Plantain Pussy-toes

***Aquilegia canadensis* 'Little Lanterns'**
Canada Columbine

***Asclepias tuberosa***
Butterfly Weed

***Asclepias verticillata***
Whorled Milkweed

***Baptisia* 'Purple Smoke'**
False Indigo

***Baptisia australis***
False Indigo

***Baptisia tinctioria***
Yellow Wild Indigo

***Boltonia asteroides***
Bolton's White Aster

***Boltonia asteroides* 'Snowbank'**
False Aster

***Campanula rotundifolia* 'Olympica'**
Harebell

***Coreopsis rosea***
Pink Tickseed

***Echinacea purpurea* 'Virgin'**
Cone Flower

***Echinecea purpurea* 'Powwow White'**

***Eurybia divaricata***
White Wood Aster

***Eutrochium dubium* 'Little Joe'**
Joe Pye Weed

***Eutrochium maculatum***
Joe Pye Weed

***Geranium maculatum***
Wild Geranium

***Geranium x cantabrigiense* 'Biokova'**
Hardy Geranium

***Helenium 'Rubinzwerg'***
Sneezeweed

***Helianthus decapetalus***
Thinleaf Sunflower

***Helianthus strumosus***
Paleleaf Woodland Sunflower

***Heliopsis helianthoides* 'Summer Nights'**
Oxeye

***Heuchera villosa* 'Autumn Bride'**
Hairy Alumroot

***Hibiscus moscheutos***
Swamp Rose Mallow

***Houstonia caerulea***
Bluets

***Iris versicolor***
Northern Blue Flag

***Liatris aspera***
Blazing Star

***Liatris pycnostachya***
Prairie Blazing Star

***Liatris spicata***
Dense Blazing Star

***Liatris spicata* 'Floristan Violet'**
Gay Feather

***Liatris spicata* 'Floristan White'**
Marsh Blazing Star

***Liatris spicata* 'Kobald'**
Marsh Blazing Star



***Lobelia cardinalis***
Cardinal Flower



***Monarda didyma* 'Jacob Cline'**
Bee Balm



***Onoclea sensibilis***
Sensitive Fern



***Opuntia humifusa***
Eastern Prickly Pear



***Parthenium integrefolium***
Wild Quinine



***Penstemon digitalis* 'Husker Red'**
Foxglove Beardtongue



***Porteranthus trifoliata***
Bowman's Root



***Pycnanthemum muticum***
Short-toothed Mountain Mint

***Rudbeckia laciniata***
Cutleaf Coneflower

***Rudbeckia nitida* 'Herbstsonne'**
Cutleaf Coneflower

***Sedum ternatum* 'Larinem Park'**
Wild Stonecrop

***Senna hebecarpa***
Northern Wild Senna

***Silphium laciniatum***
Compass Plant

***Solidago caesia***
Blue-stemmed Goldenrod

***Solidago rugosa* 'Fireworks'**
Rough-stemmed Goldenrod

***Solidago sempervirens***
Seaside Goldenrod

***Solidago sphacelata* 'Golden Fleece'**
Short-pappus Goldenrod

***Symphyotrichon ericoides* 'Snow Flurry'**
Heath Aster

***Symphyotrichum laeve* 'Bluebird'**
Smooth Aster

***Symphyotrichum novae-angliae***
New England Aster

***Symphyotrichum novae-angliae* 'Alma Potschke'**
New England Aster

***Symphyotrichum novae-angliae* 'Purple Dome'**
New England Aster

***Symphyotrichum novi-belgii* 'Alert'**
New York Aster

***Symphyotrichum novi-belgii* 'Wood's Pink'**
New York Aster

***Symphyotrichum oblongifolium* 'October Skies'**
Aromatic Aster

***Symphyotrichum oblongifolius* 'Raydon's Favorite'**
Aromatic Aster

***Symphyotrichum puniceum***
Purplestem Aster

***Vernonia glauca***
Upland Ironweed

***Vernonia noveboracensis***
New York Ironweed

***Veronicastrum virginicum* 'Roseum'**
Pink Culver's Root

***Viola labradorica***
Labrador Violet

***Waldsteinia fragarioides***
Barren Strawberry

## Shrubs

***Amelanchier nantucketensis***
Nantucket Shadblow

***Arctostaphylos uva-ursi* 'Massachusetts'**
Bearberry

***Clethera alnifolia* 'Compacta'**
Compact Summersweet

***Clethera alnifolia* 'Hummingbird'**
Compact Summersweet

***Clethra alnifolia* 'Ruby Spice'**
Summersweet

***Comptonia peregrina***
Sweet Fern

***Cornus sericea* 'Kelseyi'**
Red-osier Dogwood

***Diervilla lonicera***
Bush Honeysuckle

***Fothergilla gardenii***
Dwarf Fothergilla

***Fothergilla gardenii* 'Mount Airy'**
Dwarf Fothergilla

***Gaylussacia bacatta***
Black Huckleberry

***Hamamelis virginiana***
Witch Hazel

***Ilex glabra* 'Densa'**
Ink Berry

***Ilex verticillata* 'Jim Dandy'**
Winterberry

***Ilex verticillata* 'Red Sprite'**
Winterberry

***Juniperus virginiana* 'Grey Owl'**
Eastern Red-cedar



***Lonicera sempervirens* 'Major Wheeler'**
Trumpet Honeysuckle



***Myrica pennsyvanica***
Northern Bayberry



***Prunus pumila depressa* 'Gus Melquist'**



***Rhus aromatica* 'Gro-Low'**
Fragrant Sumac



***Rhus typhina* 'Laciniata'**
Staghorn Sumac



***Rosa virginiana***
Virginia Rose



***Salix bebbiana***
Bebb's Willow



***Vaccinium angustifolium***
Lowbush Blueberry



***Vaccinium angustifolium* mix ('Little Crisp' and 'Ruby Carpet')**
Lowbush Blueberry



***Vaccinium* 'Chippewa'**
Blueberry



***Vaccinium corymbosum* 'Patriot'**
Highbush Blueberry



***Vaccinium* 'Northsky'**
Blueberry



***Viburnum dentatum* 'Blue Muffin'**
Arrowwood



***Viburnum opulus* var. *americanum* 'Spring Green Compact'**
American Cranberrybush



***Viburnum trilobum* 'Alfredo'**
Alfredo Viburnum



***Xanthorhiza simplicissima***
Yellowroot

**Limitation:**

- It cannot be known how many varieties of plants were on site in 1991 to make an accurate comparison between past and present habitats. An estimation can be made but would not be reliable.
- Time of year made on-site observation problematic, as many perennials had not grown in, were cut back, or had died, making plant identification difficult and unreliable.

**Sources:**

Plants & Landscapes. The Rose Kennedy Greenway. (2024, April 22). https://www.rosekennedygreenway.org/visit/plants-landscapes/

---

- ***Sequesters 165,204 pounds of carbon over 20 years with 135 trees.***

**Methods:**

I used the planting list provided by Copley Wolff Design Group to find the quantity of tree species planted on site. I then applied this data to iTree's Planting Tool to estimate the amount of carbon sequestered over a 20-year period.

**Calculation:**

| Group Identifier | Initial Numberof Trees | Species | CO2 Sequestered (pounds) |
|---|---|---|---|
| 1 | 10 | Magnolia spp(Magnolia) | 10,270.50 |
| 2 | 8 | Red maple(Acer rubrum) | 18,688.60 |
| 3 | 13 | River birch(Betula nigra) | 26,389.90 |
| 4 | 11 | American hornbeam(Carpinus caroliniana) | 6,225.70 |
| 5 | 4 | Dogwood spp(Cornus) | 4,034.00 |
| 6 | 3 | Honeylocust(Gleditsia triacanthos) | 6,367.90 |
| 7 | 5 | Tulip tree(Liriodendron tulipifera) | 8,101.10 |
| 8 | 5 | Black tupelo(Nyssa sylvatica) | 5,424.30 |
| 9 | 55 | London planetree(Platanus x hybrida) | 41,073.80 |
| 10 | 5 | Common chokecherry(Prunus virginiana) | 11,987.30 |
| 11 | 4 | Scarlet oak(Quercus coccinea) | 8,100.30 |
| 12 | 5 | Northern red oak(Quercus rubra) | 6,173.00 |
| 13 | 7 | American elm(Ulmus americana) | 12,367.90 |
| SUM | 135 | | 165,204.30 |

Figure 1.1: iTree Sequestered Carbon Table

**Limitation:**

- iTree asks for the diameter of the trunk to calculate maturity of the tree species. Copley Wolff Design Group provided the diameter of the trees as they were planted, but current tree diameter information was not collected.
- iTree assumes perfect conditions for its calculations.
- iTree database does not have data for all species of trees, out of 25 species planted on-site, iTree could only calculate data for 13 species.

**Sources:**
https://www.itreetools.org/

## Social Benefits

**Overall Methods:**
Surveys were handed out to people who had recently visited the park. Of the thirty people who were surveyed, 28 of which were paper surveys and two were digitally completed. See appendix for survey questions. Behavior mapping was completed by recording photos and videos of the site during a time window to understand how people use and move through the site.

- ***Provides satisfaction amongst 73.3% of 30 survey participants.***

**Calculation:**
Out of 30 surveys, one user rated their satisfaction of the park a score of 2 (Dissatisfied), seven users rated the park a score of 3 (Neutral), fifteen users rated the park a score of 4 (Satisfied), and seven users rated the park a score of 5 (Extremely Satisfied).

Twenty-two total users were Satisfied or Very Satisfied with the park.

$$15\ satisfied + 7\ extremely\ satisfied = 22\ users \qquad \frac{22}{30} = 73.3\%$$


Figure 2.1: Satisfaction Chart

**Limitation:**

- Small survey sample size, many participants were of the same age group.

**Sources:**

Data came from survey.

- ***Provides aesthetic value to 73.3% of 30 survey participants.***

**Calculation:**
Out of 30 surveys, one user rated the aesthetic value of the park a score of 2 (Low), seven users rated the park a score of 3 (Neutral), sixteen users rated the park a score of 4 (High), and six users rated the park a score of 5 (Extremely High).

Twenty-two total users rated the park either High or Extremely High.

$$16\ high + 6\ extremely\ high = 22\ users \qquad \frac{22}{30} = 73.3\%$$

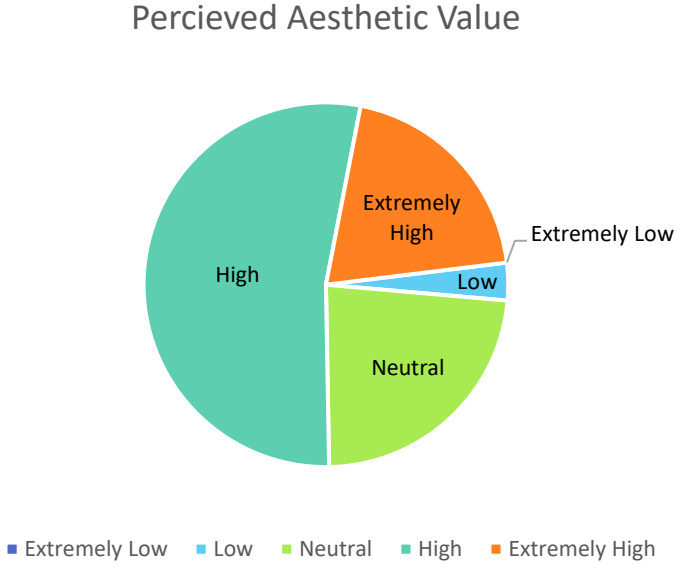



Figure 2.1: Aesthetic Value Chart

**Limitation:**

- Small survey sample size, many participants were of the same age group.

**Sources:**
Data came from survey.

---

- ***Provides a range of activities for park users. 12 activity types were observed across both on-site observation and survey responses, with walking being the most common activity (78.8%), followed by sitting (16.2%).***

**Methods:**
Utilized survey data along with on-site observation to calculate the amount of activities seen on site. Photos and videos were taken of the site across one seven-minute period and one thirty-three-minute period to gather information on site users. Users in these videos and images were then counted and organized according to their activity.

**Calculation:**
Out of 30 surveys, there were 23 users reports of walking in the park, 5 reports of sitting, 5 reports of eating food, 5 users reports of meeting with friends, 2 reports of reading, 1 report of teaching, and 1 report of looking at the water. Survey participants could report more than one activity.

Of on-site observations on 4/13/2024, there were 43 users walking through the park, 3 users sitting, 2 users walking dogs, one user jogging, and one user playing in the grass.

Of on-site observations on 5/7/2024, there were 39 users walking through the park, 14 users sitting, 5 users standing and talking, 3 users walking dogs, 1 user eating, and 1 user laying down in the grass.

The total number of people surveyed or observed on-site was 142. Out of this number, 112 users walked on site, 23 users sat, 6 users walked dogs, 5 users stood, 1 user jogged, 1 user played in the grass, 1 user laid in the grass, and 1 user ate food.

| Date: 4/13/2024 | | | | Weather: Overcast | | | | | | Temperature: 50'F |
|---|---|---|---|---|---|---|---|---|---|---|
| group | M | F | dog | Age | | | | | | Time |
| | | | | 0-6 | 7-18 | 18-34 | 35-50 | 51-65 | 65+ | |
| 1 | 1 | | X | | | X | | | | |
| 2 | 1 | 1 | | | | X | | | | 10:50AM |
| 3 | 1 | | | | | X | | | | 10:50AM |
| 4 | 3 | 5 | | 2 | 1 | 2 | 2 | 1 | | 10:50AM |
| 5 | 1 | 1 | | | 2 | | | | | 10:50AM |
| 6 | 5 | 3 | | | | 8 | | | | 10:50AM |
| 7 | 1 | 1 | | | | 2 | | | | 10:50AM |
| 8 | | 1 | | | | | 1 | | | 10:50AM |
| 9 | 1 | | | | | 1 | | | | 10:50AM |
| 10 | | 1 | | | | 1 | | | | 10:50AM |
| 11 | 2 | 2 | | | | 2 | 2 | | | 10:50AM |
| 12 | 1 | | | | | 1 | | | | 10:50AM |
| 13 | 1 | 1 | | | | 2 | | | | 10:50AM |
| 14 | 1 | 2 | | | | 1 | | 2 | | 10:55AM |
| 15 | 1 | 1 | | | | | 2 | | | 10:55AM |
| 16 | | 3 | | | | 3 | | | | 10:55AM |
| 17 | 1 | 1 | | | | 2 | | | | 10:56AM |
| 18 | 1 | | | | | 1 | | | | 10:56AM |
| 19 | | 2 | | | | 1 | | | | 10:56AM |
| 20 | 1 | 1 | | | | 2 | | | | 10:57AM |
| 21 | 1 | | X | | | | 1 | | | 10:57AM |
| Total: | 24 | 26 | | 2 | 3 | 29 | 8 | 3 | 0 | |

Figure 3.1: 4/13/2024 Observation Data


Figure 3.2: Behavior Mapping

| Date: 5/7/2024 | | | | Weather: Sunny | | | | | | Temperature: 72'F |
|---|---|---|---|---|---|---|---|---|---|---|
| group | M | F | dog | Age | | | | | | Time | |
| | | | | 0-6 | 7-18 | 18-34 | 35-50 | 51-65 | 65+ | | |
| 1 | 1 | 1 | | | | 2 | | | | 2:22PM | |
| 2 | 2 | 1 | X | | | | 2 | | | 2:22PM | |
| 3 | | 1 | X | | | 1 | | | | 2:22PM | |
| 4 | 1 | 1 | | | | 2 | | | | 2:22PM | |
| 5 | 1 | | | | | | 1 | | | 2:23PM | |
| 6 | 1 | 1 | | | | | 2 | | | 2:23PM | |
| 7 | 1 | 1 | | | | | 2 | | | 2:23PM | |
| 8 | 1 | 1 | | 1 | | 1 | | | | 2:23PM | |
| 9 | 1 | | | | | 1 | | | | 2:23PM | |
| 10 | | 1 | | | | | | 1 | | 2:23PM | |
| 11 | 1 | | | | | | 1 | | | 2:23PM | |
| 12 | 1 | 1 | | | | 2 | | | | 2:24PM | |
| 13 | 1 | | | | | | 1 | | | 2:24PM | |
| 14 | | 1 | | | | 1 | | | | 2:24PM | |
| 15 | 1 | | | | | 1 | | | | 2:24PM | |
| 16 | 2 | 2 | | | | 3 | 1 | | | 2:25PM | |
| 17 | 1 | | | | | 1 | | | | 2:25PM | |
| 18 | 1 | | | | | 1 | | | | 2:25PM | |
| 19 | 1 | | | | | 1 | | | | 2:26PM | |
| 20 | 2 | | | | | 2 | | | | 2:26PM | |
| 21 | | 1 | | | | 1 | | | | 2:26PM | |
| 22 | | 1 | X | | | 1 | | | | 2:26PM | |
| 23 | | 3 | | | 1 | | 2 | | | 2:26PM | |
| 24 | 1 | | | | | 1 | | | | 2:26PM | |
| 25 | | 1 | | | | 1 | | | | 2:26PM | |
| 26 | 1 | | | | | | 1 | | | 2:28PM | |
| 27 | | 2 | | | | 2 | | | | 2:28PM | |
| 28 | 2 | | | | | 1 | | 1 | | 2:28PM | |
| 29 | 2 | | | | | | 2 | | | 2:28PM | |
| 30 | 1 | | | | | 1 | | | | 2:38PM | |
| 31 | 1 | 1 | | | | | | 2 | | 2:38PM | |
| 32 | | 2 | | | | 2 | | | | 2:40PM | |
| 33 | 1 | | | | | | 1 | | | 2:40PM | |
| 34 | 1 | | | | | 1 | | | | 2:40PM | |
| 35 | 1 | | | | | | 1 | | | 2:40PM | |
| 36 | 1 | 1 | | | | | 2 | | | 2:40PM | |
| 37 | 1 | | | | | 1 | | | | 2:43PM | |
| 38 | 1 | | | | | | 1 | | | 2:43PM | |
| 39 | | 1 | | | | | 1 | | | 2:43PM | |
| 40 | 1 | | | | | | 1 | | | 2:45PM | |
| 41 | 1 | 1 | | | | 2 | | | | 2:45PM | |

Figure 3.3: 5/7/2024O Observation Data


Figure 3.4: Behavior Mapping

**Limitation:**

- One observation period was much shorter than the other and was on an overcast day, while the other period took place during more enjoyable weather.
- Both observation periods took place on weekdays.
- I stayed in one location for the first observation period and observed users across all parcels during the second period.
- There is no singular vantage point to observe the entire park so the number of users in the park is lower than the actual value.
- When observing, some people would appear quickly and you could not understand where they exactly arrived from, and some people would disappear from sight before you knew where they went.

**Sources:**
Data came from survey and on-site observations.

## Economic I Benefits

- ***Raised property values of parcels adjacent to the park by an average of 8.5% compared to non-adjacent parcels that decreased by 4.4% two years post-park completion.***

**Methods:**
I used the City of Boston's Assessing On-Line tool to find the assessed value history of parcels adjacent and non-adjacent to the site. Property values were taken at the end of the Central Artery deconstruction in 2006, at the end of park construction in 2008, and two years post-completion in 2010. Adjacent properties were considered to be parcels that are located within 100 feet of the park. Non-adjacent parcels were located at least 100 to 300 feet from the park. For each adjacent property there was a non-adjacent property chosen from the same street or block of buildings to compare the change in value due to proximity to the park.

**Calculation:**

| Property | Value in 2006 | Value in 2008 | Value in 2010 | Change from 06 to 08 | Change from 08 to 10 |
|---|---|---|---|---|---|
| Group 1 | $990,081.00 | $1,292,463.00 | $1,338,405.00 | 30.5% | 3.6% |
| Group 2 | $2,735,003.00 | $3,625,119.00 | $3,386,378.00 | 32.5% | -6.6% |
| | | | | | |
| Group 3 | $2,759,587.00 | $3,602,395.00 | $3,730,448.00 | 30.5% | 3.6% |
| Group 4 | $450,000.00 | $459,500.00 | $432,000.00 | 2.1% | -6.0% |
| | | | | | |
| Group 5 | $846,000.00 | $1,073,000.00 | $1,140,500.00 | 26.8% | 6.3% |
| Group 6 | $1,545,693.00 | $2,170,887.00 | $2,106,150.00 | 40.4% | -3.0% |
| | | | | | |
| Group 7 | $3,009,500.00 | $3,813,500.00 | $4,808,000.00 | 26.7% | 26.1% |
| Group 8 | $387,500.00 | $536,000.00 | $524,000.00 | 38.3% | -2.2% |
| | | | | | |
| Group 9 | $2,793,500.00 | $3,698,500.00 | $3,812,500.00 | 32.4% | 3.1% |
| Group 10 | $2,819,000.00 | $3,722,000.00 | $3,566,500.00 | 32.0% | -4.2% |
| | | | Adj. Average Increase | 29.4% | 8.5% |
| | | | Non-Adj. Average Increase | 29.1% | -4.4% |

Figure 4.1: Assessed Value Table

Properties that are both adjacent and non-adjacent to the park had similar increases in assessed value between 2006 and 2008, however following the impacts of the 2008 Recession, the properties closest to the park retained value compared to non-adjacent properties.

**Limitation:**

- The Assessment On-Line tool lacked values for some properties before 2007, removing some adjacent properties from consideration due to lack of data.
- The calculations do not consider the land-use of the building, but only its assessed value.

**Sources:**

Assessing online. City of Boston. (n.d.). https://www.cityofboston.gov/assessing/search/

## Lessons Learned

Wharf District Parks plays its part in encouraging the people of Boston to use their outdoor spaces by providing a visually interesting oasis that wraps itself around Downtown Boston.  The park provides a break in infrastructure, softening the pedestrian experience as one moves from the center of the city to the waterfront.

## Project Team:

**Client:** MassDOT (formerly Massachusetts Turnpike Authority)
**Engineers:** Fay, Spofford, & Thorndike, Inc.; FST/HNTB, A Joint Venture
**Structural Engineer:** LIM Consultants, Inc.
**Water Display:** WET Design
**Irrigation:** EDAW, Inc.

## Special Thanks:

Copley Wolff Design Group

Appendix 1:

**Boston Parks/Open Spaces Survey**

**Part 1: Questions on the user experience of selected Boston parks & open spaces**

1. **How often do you come to the following parks and open spaces in Boston? A. Only once; B. More than once but only occasionally; C. Once a month; D. Several times a month; D. Several times a week; E. Daily F. Other (please specify)**
   Pier 4 _____
   Fan Pier Park_____
   Wharf District Parks_____
   Chinatown Park_____
   Christian Science Plaza_____
   Harvard Science & Engineering Complex_____

2. **What kind of activities do you do in the following parks and open spaces? e.g., walking, sitting, eating, meeting with friends, reading, phone calling, etc.**
   Pier 4 _____
   Fan Pier Park_____
   Wharf District Parks_____
   Chinatown Park_____
   Christian Science Plaza_____
   Harvard Science & Engineering Complex_____

**3. What are your feelings or emotional status when you are in the following parks and open spaces? Try to use 2-3 adjectives to describe your feelings.**

Pier 4 _____
Fan Pier Park_____
Wharf District Parks_____
Chinatown Park_____
Christian Science Plaza_____
Harvard Science & Engineering Complex_____

**4. Please rate the aesthetic value of the following parks and open spaces in Boston. 1. Extremely low 2. Low 3. Average 4. High 5. Extremely high**

Pier 4 _____
Fan Pier Park_____
Wharf District Parks_____
Chinatown Park_____
Christian Science Plaza_____
Harvard Science & Engineering Complex_____

**5. Rate your satisfaction with your experience in the following parks/open spaces. 1. Extremely dissatisfied; 2. Dissatisfied; 3. Neutral; 4. Satisfied; 5. Extremely Satisfied**

Pier 4 _____
Fan Pier Park_____
Wharf District Parks_____
Chinatown Park_____
Christian Science Plaza_____
Harvard Science & Engineering Complex_____

**6. Any comments/suggestions on the landscape design and/or maintenance of the following parks and open spaces in Boston?**

Pier 4 _____

Fan Pier Park_____

Wharf District Parks_____

Chinatown Park_____

Christian Science Plaza_____

Harvard Science & Engineering Complex_____

**Part 2: Demographic Information**

1. Which age group do you belong to?

A. 18-29 years old

B. 30-49 years old

C. 50-64 years old

D. 65 years old and above

**2. What is your gender? _____**

**3. What is your zip code? _____**

# Christian Science Plaza Restoration & Repair

210 Massachusetts Avenue, Boston, MA

Ashley Pepén

## Overview

The Christian Science Plaza is one of Boston's most iconic landscapes designed in the 1970s by architects I. M. Pei and Araldo Cosutta. The plaza is recognized as a protected landmark by the Boston Landmarks Commission. However, after fifty years, it deteriorated. The plaza restoration and repair work was led by the Arcadis IBI Group. The project focused on revitalizing the plaza's iconic features. Central to the endeavor was the reconstruction of the reflecting pool, coupled with improvements to its basin paving for enhanced reflectivity and seasonal allure. Additionally, efforts were directed toward making entrances more inviting, improving wayfinding, and integrating amenities to facilitate year-round usage. The restoration showcased a harmonious blend of meticulous design and technical innovation, ensuring the plaza's enduring legacy as a cherished urban oasis.

Before renovation

After renovation

**Source:** Arcadis IBI Group

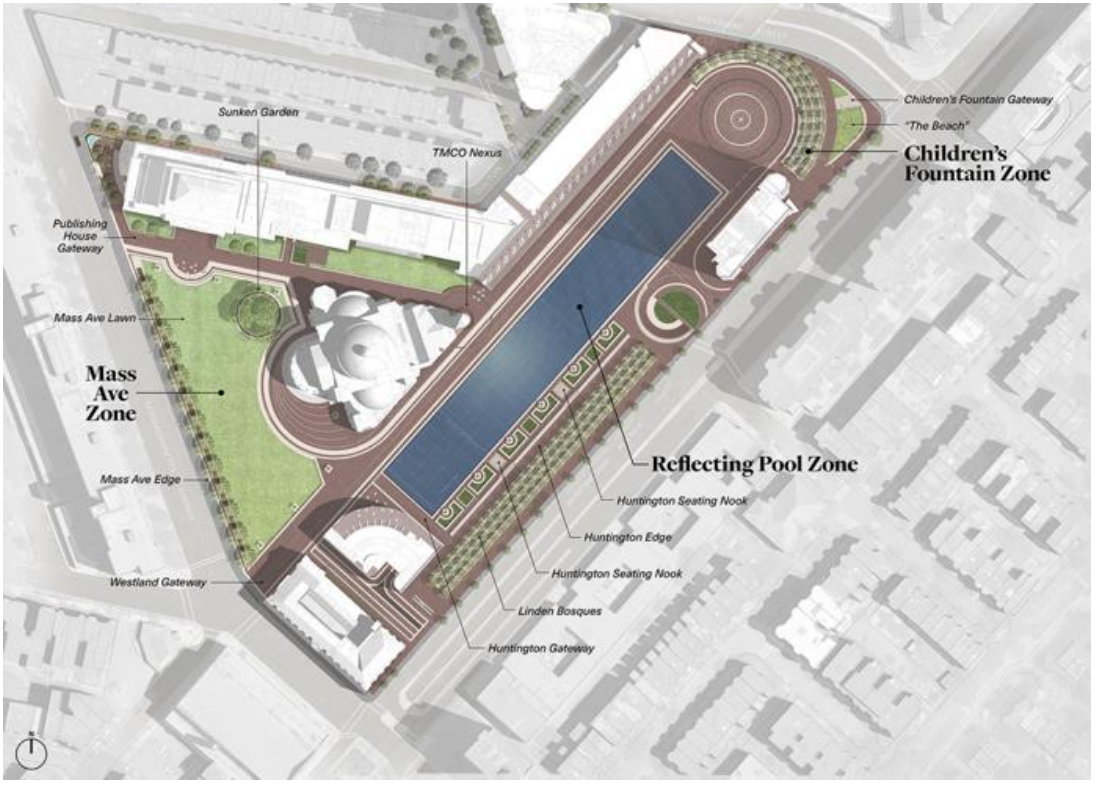
## At a Glance

| | | | |
|---|---|---|---|
| **Designer:** | Arcadis IBI Group | **Project Type:** | Restoration & Repair |
| **Former Land Use**: | Public Plaza | **Size:** | Approximately 14 acres |
| **Completion Date:** | 2022 | **Budget:** | |

## Project Goals

- Preserve, repair, and restore the character-defining features of this landmark landscape.
- Enhance the plaza's welcoming ambiance by creating inviting gateways with additional seating areas.
- Implement sustainable practices to improve the plaza's environmental impact.
- Support real estate development around the plaza to generate additional revenue streams.
- Mitigate the risk of groundwater contamination and groundwater depletion.
- Foster community engagement and participation in the restoration process.

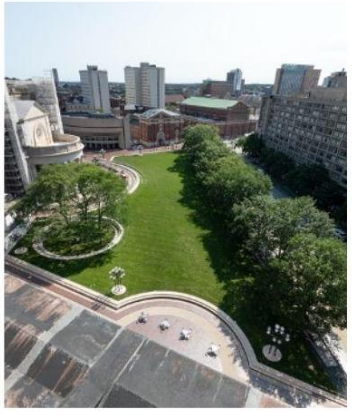
# Site Plan




**Source:** Arcadis IBI Group Site Plan

# Site Images

Mass Ave. Lawn



Mass Ave. Sitting Areas

Huntington Ave. View

eflecting Pool and Huntington Ave. edge

Planters along Reflecting Pool

Christian Science Reflecting Pool

**Source:** Arcadis IBI Group | Landscape Forms

# Landscape Performance Benefits

## Environmental Benefits

- ***Reduces stormwater runoff by 70%, decreasing the burden on municipal drainage systems and mitigating the risk of urban flooding. By promoting infiltration and groundwater recharge, the restoration project helps replenish local aquifers and maintain ecological balance in the surrounding ecosystem.***

**Methods:**
To assess the effectiveness of the stormwater management strategy, we employed a data collection method focused on measuring the volume of stormwater runoff before and after implementing stormwater management measures.

**Calculations:**
Utilizing the data provided by the design firm, we quantified the reduction in stormwater runoff and the increase in infiltration rates achieved through the implementation of green infrastructure. By comparing the volume of stormwater runoff before and after the introduction of stormwater management measures, we were able to determine the tangible impact of these interventions.

**Limitation:**
Second hand data from the design firm

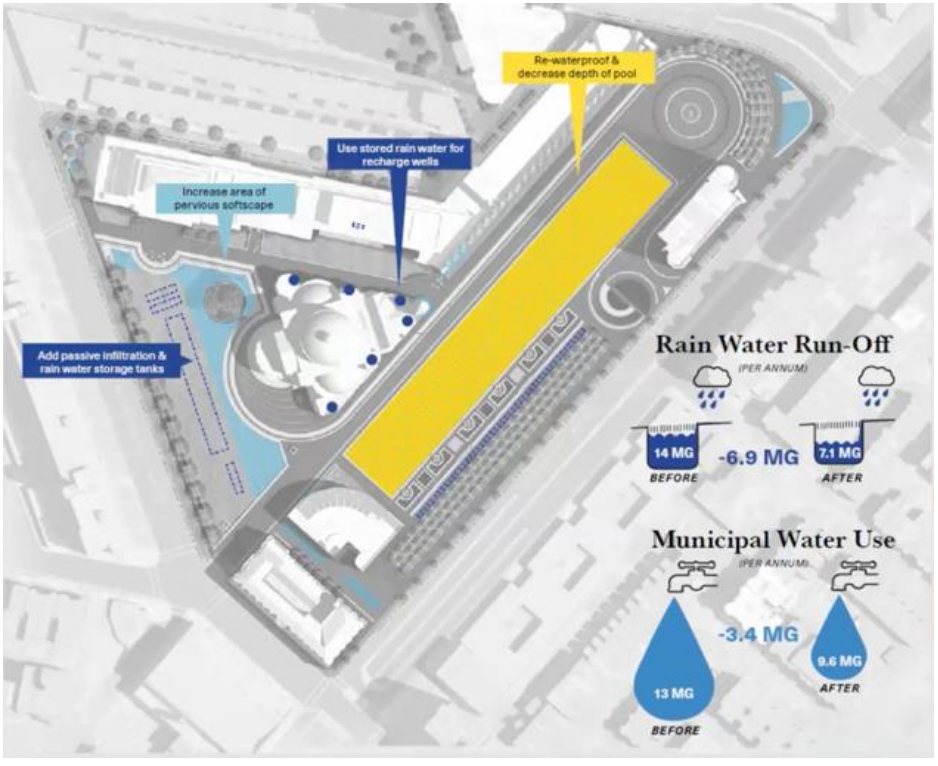
**Source:**
Arcadis IBI Group

- ***Reduces the Municipal Water Use Strategy resulted in a remarkable by two-thirds of the amount of water required annually, equating to an impressive saving of 14million gallons of water annually. By shortening the length of the 213-m (700-ft) pool by 4.8 m (16 ft) on the southwestern end and minimizing reliance on potable water for landscaping and irrigation purposes, the restoration project contributes to conserving valuable freshwater resources and mitigates the environmental impact associated with municipal water extraction and distribution.***

**Methods:**
The data collection involved monitoring water consumption patterns within the plaza both before and after the implementation of water-saving technologies and practices.

**Calculations:**
Utilizing the data provided by the design firm, we adopted water-saving measures such as water-efficient landscaping and irrigation systems. By quantifying the decrease in water consumption post-implementation, we were able to attribute the savings directly to the implemented strategies.

**Analysis:**
Our analysis centered on scrutinizing the water consumption data collected throughout the study period. By employing analytical methods, we quantified the savings achieved through the implementation of water conservation measures. This analysis provided insights into the effectiveness of the strategies in reducing municipal water use within the plaza.




**Source:**
Arcadis IBI Group

**Limitation:**
Second hand data from the design firm

## Social Benefits

***Overall Methods:***

Field Observations
Field observation is a type of field research method that involves collecting data by observing the behavior, actions, or interactions of people or animals in a natural setting. The researcher does not interfere with the subjects or manipulate any variables but simply records what they see and hear.

Behavior Mapping or PSPU method

Surveys

- ***Provides a range of activities for park users. A total of 20 activity types were observed on-site and reported by 39 survey respondents, with walking being the most common (accounting for 82% of responders), followed by sitting (21%), meeting with friends (21%), and jogging (13%). Other activities include dog walking, biking, eating, people watching, water bird watching, calling, reading, baby strolling, kids playing with water, watching kids playing, participating in a group event, guiding tour group and talking, photo taking, contemplating, scootering, and waiting.***

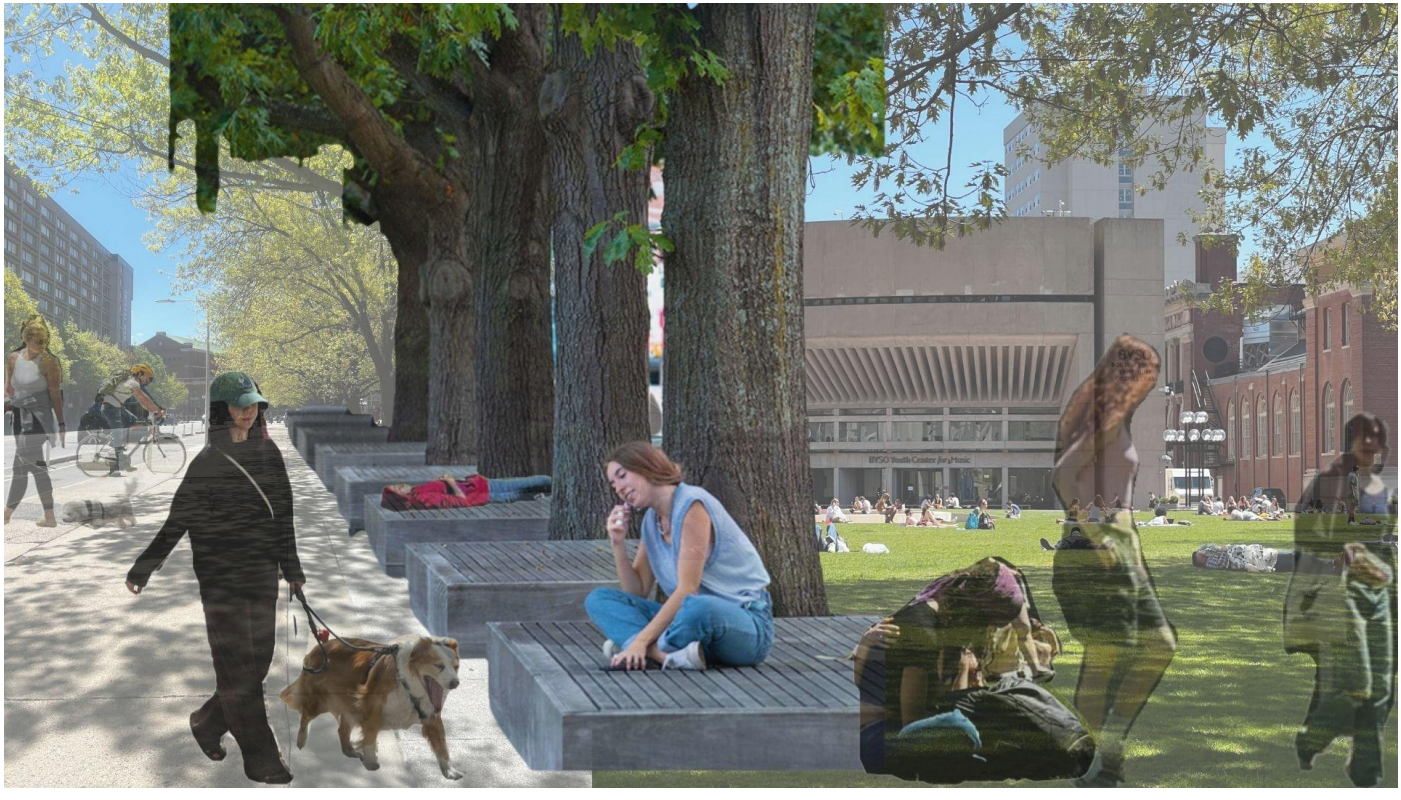
**Calculation:**
Out of 39 surveys, the following activities were reported: 32 users reported walking, 8 users reported sitting, 8 users reported meeting with friends, 4 users reported eating food, 2 users reported reading, 1 user reported talking on the phone, and 1 user reported looking at the water. Please note that survey participants could report multiple activities.

During the observation period, various activities were noted. Among them, 43 users were observed walking, 3 users were seen sitting, 2 users were walking dogs, 1 user was jogging, and 1 user was playing in the grass.

**Limitation:**
Limited survey sample size, particularly the small sample size of 39 survey respondents, which may not fully represent the diversity of park users and their experiences. Also, I was located at the Mass. Avenue.

**Source:** Data came from class surveys and my own field observations.


Collage of Social Behaviors
**Source:** Photos by Ashley Pepén



**Source:** Collage by Ashley Pepén

**Date: 4/23/24 Weather: Temperature:** ID: S=staff P=patient V=visitor N=can't tell

| group | M | F | dog | race | ID | Age | | | | | | Time | Notes: W=whiye B=Black, A=Asian |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 0-6 | 7-18 | 18-34 | 35-50 | 51-65 | 65+ | | |
| 1 | x | | | | v | | | x | | | | 11:00 | |
| 2 | x | | | | v | | | x | | | | 11:00 | |
| 3 | x | | | | v | | | x | | | | 11:00 | |
| 4 | x | | | | v | | | x | | | | 11:00 | |
| 5 | x | | | | v | | | x | | | | 11:00 | |
| 6 | x | | | | v | | | x | | | | 11:00 | |
| 7 | | x | | | N | | | | x | | | 11:00 | |
| 8 | | x | | | v | | | x | | | | 11:00 | |
| 9 | x | | | | v | | | x | | | | 11:00 | |
| 10 | | x | | | v | | | x | | | | 11:30 | |
| 11 | | x | | | v | | | x | | | | 11:30 | |
| 12 | | x | | | v | | | x | | | | 12:00 | |
| 13 | | x | | | N | | x | | | | | 12:00 | |
| 14 | | x | | | v | | | x | | | | 12:00 | |
| 15 | | x | | | v | | | x | | | | 1:00 | |
| 16 | | x | | | v | | | x | | | | 1:00 | |
| 17 | | x | | | v | | | | x | | | 1:00 | |
| 18 | x | | | | v | | | x | | | | 1:00 | |
| 19 | x | | | | v | | | x | | | | 1:00 | |
| 20 | x | | | | v | | | x | | | | 1:00 | |
| 21 | x | | | | v | | | x | | | | 1:00 | |
| 22 | x | | | | v | | | x | | | | 1:00 | |
| 23 | x | | | | v | | | x | | | | 1:00 | |
| 24 | x | | | | v | | | x | | | | 1:00 | |
| 25 | | x | | | v | | | x | | | | 1:00 | |
| 26 | | x | | | v | | | x | | | | 1:00 | |
| 27 | | x | | | v | | | x | | | | 1:00 | |
| 28 | | x | | | v | | | x | | | | 2:00 | |
| 29 | | x | | | v | | | x | | | | 2:00 | |
| 30 | | x | | | v | | | x | | | | 2:00 | |
| 31 | | x | | | v | | | x | | | | 2:00 | |
| 32 | | x | | | v | | | x | | | | 2:00 | |
| 33 | | x | | | v | | | x | | | | 2:00 | |
| 34 | | x | | | v | | | x | | | | 2:00 | |
| 35 | | x | | | v | | | x | | | | 2:00 | |
| 36 | | x | | | v | | | x | | | | 2:00 | |
| 37 | | x | | | v | | | x | | | | 2:00 | |
| 38 | | x | | | v | | | x | | | | 2:00 | |
| 39 | x | | | | v | | | x | | | | 2:00 | |
| 40 | x | | | | v | | | x | | | | 2:00 | |
| 41 | | x | | | v | | | x | | | | 2:00 | |
| 42 | | x | | | v | | | x | | | | 2:00 | |
| 43 | | x | | | v | | | x | | | | 2:00 | |
| Total: | 16 | # | | | | | 1 | 40 | 2 | | | | |

| Activity Types | Percentage |
|---|---|
| Walking | 82% |
| Sitting | 21% |
| Meeting with friends | 21% |
| Jogging | 13% |
| Dog Walking | 13% |
| Biking | 8% |
| Eating | 8% |
| People watching | 8% |
| Water bird watching | 8% |
| Calling | 3% |
| Reading | 3% |
| Baby strolling | 3% |
| Kids playing with water | 3% |
| Watching kids playing | 3% |
| Participating in a group event | 3% |
| Guiding tour group and talking | 3% |
| Photo taking | 3% |
| Contemplating | 3% |
| Scootering | 3% |
| Waiting | 3% |

**Source:** Data came from class surveys and templates and my own field observations.

**Boston Parks/ Open Spaces User Expereince Survey - Christian Science Plaza**

| Survey File Name (Quantity: 39 Surveys) | Survey Date | 1. How often do you come to the park(s) / open spaces in Boston? A. Only once; B. More than once but only occasionally; C. Once a month; D. Several times a week; E. Daily F. Other (please specify) | 2. What kind of activities do you do in the park(s) and open spaces? e.g., walking, sitting, eating, meeting with friends, reading, phone calling, etc. | 3. What are your feelings or emotional status when you are in the park(s) and open spaces? Try to use 2-3 adjectives to describe your feelings. | 4. Please rate the aesthetic value of the park(s) and open spaces in Boston. 1. Extremely low 2. Low 3. Average 4. High 5. Extremely high | 5. Rate your satisfaction with your experience in the park(s)/open spaces. 1. Extremely dissatisfied; 2. Dissatisfied; 3. Neutral; 4. Satisfied; 5. Extremely Satisfied | 6. Any comments/suggestions on the landscape design and/or maintenance of the park(s) and open spaces in Boston? | Demographic Info 1. Which age group do you belong to? A. 18-29 years old B. 30-49 years old C. 50-64 years old D. 65 years old & above | Demographic Info 2. What is your gender? | What is your zip code? |
|---|---|---|---|---|---|---|---|---|---|---|
| Ashley-1 | 4/12/2024 | A. Only once | Walking | Inspired | 3. Average | 3. Neutral | N/A | 18-29 years | Female | 01002 |
| Ashley-2 | 4/12/2024 | F. Tourist | Walking | Nice | 5. Extremely high | 5. Extremely Satisfied | N/A | 18-29 years | Female | 01003 |
| Ashley-3 | 4/12/2024 | B. More than once but only occasionally | Walking | Happy | 5. Extremely high | 5. Extremely Satisfied | N/A | 30-49 years old | Female | 01862 |
| Ashley-4 | 4/12/2024 | D. Several times a week | Sitting, Walking, Talking | Relax, Happy | 5. Extremely high | 3. Neutral | N/A | 18-29 years | Female | 02131 |
| Ashley-5 | 4/24/2024 | C. Once a month | Walking, Eating, Meeting with friends | Calming, connected | 4. High | 4. Satisfied | N/A | 18-29 years | Female | N/A |
| Ashley-6 | 4/24/2024 | F. Several times at month | Walking, looking water | N/A | 4. High | 4. Satisfied | N/A | 18-29 years | Female | N/A |
| Ashley-7 | 4/24/2024 | F. Several times at month | Walking | Contempt | 5. Extremely high | 5. Extremely Satisfied | N/A | 18-29 years | Female | N/A |
| Ashley-8 | 4/24/2024 | D. Several times a week | Walking | Calming, connected | 4. High | 5. Extremely Satisfied | N/A | 18-29 years | Female | N/A |
| Ashley-9 | 4/24/2024 | F. Several times at month | Walking | Happy | 4. High | 4. Satisfied | N/A | 18-29 years | Female | N/A |
| Ashley-10 | 4/24/2024 | D. Several times a week | Walking | Connected | 4. High | 4. Satisfied | N/A | 18-29 years | Female | N/A |
| Ashley-11 | 4/24/2024 | C. Once a month | Walking | Happy, calm, jovial | 4. High | 4. Satisfied | N/A | 18-29 years | Female | N/A |
| Ashley-12 | 4/24/2024 | D. Several times a week | Walking | Calm | 4. High | 4. Satisfied | N/A | 18-29 years | Female | N/A |
| Ashley-13 | 4/24/2024 | D. Several times a week | Walking | Inspiring | 4. High | 4. Satisfied | N/A | 18-29 years | Female | N/A |
| Ashley-14 | 4/24/2024 | F. Several times at month | Walking | Happy | 4. High | 4. Satisfied | N/A | 18-29 years | Female | N/A |
| Ashley-15 | 4/24/2024 | D. Several times a week | Walking, sitting and relaxing, meeting with friends | Calm | 4. High | 4. Satisfied | N/A | 30-49 years old | Male | N/A |
| Ashley-16 | 4/24/2024 | F. Several times at month | Walking, sitting and relaxing, meeting with friends, eating outside | Happy, Charming site | 4. High | 4. Satisfied | N/A | 18-29 years | N/A | N/A |
| Ashley-17 | 4/24/2024 | D. Several times a week | Walking, Sitting, Reading, meeting with friends | Relax, Calm | 4. High | 5. Extremely Satisfied | N/A | 18-29 years | N/A | N/A |
| Ashley-18 | 4/24/2024 | D. Several times a week | Walking, sitting and relaxing, meeting with friends | Contempt, Calm, Peaceful, Serene, Happy | 5. Extremely high | 5. Extremely Satisfied | N/A | 18-29 years | Female | N/A |
| Ashley-19 | 4/24/2024 | F. Several times at month | Walking, Eating | Happy, connected | 4. High | 4. Satisfied | N/A | 18-29 years | N/A | N/A |
| Ashley-20 | 4/24/2024 | F. Everyday | Walking | Calm | 5. Extremely high | 5. Extremely Satisfied | N/A | 18-29 years | N/A | N/A |
| Ashley-21 | 4/24/2024 | F. Several times at month | Walking | N/A | 5. Extremely high | 5. Extremely Satisfied | N/A | 18-29 years | N/A | N/A |
| Ashley-22 | 4/24/2024 | F. Several times at month | Walking, Eating | Relax | 4. High | 4. Satisfied | N/A | 30-49 years old | N/A | N/A |
| Ashley-23 | 4/24/2024 | F. Several times at month | Walking, Reading | Calm | 4. High | 4. Satisfied | N/A | 18-29 years | N/A | N/A |
| Ashley-24 | 4/24/2024 | C. Once a month | Walking, Sitting, Eating, using phone | Happy, Serene | 4. High | 4. Satisfied | N/A | 18-29 years | N/A | N/A |
| Hannah-1 | 4/12/2024 | Check mark | Walking | Strange | 2. Low | 3. Neutral | N/A | 50-64 years old | Male | 01060 |
| Hannah-2 | 4/12/2024 | C. Once a month | Walking, meeting with friends | Neutral | 3. Average | 4. Satisfied | Could be more colorful | 18-29 years | Female | 02215 |
| Hannah-3 | 4/12/2024 | A. Only once | Mapparium | Not so much | 1. Extremely Low | 2. Dissatisfied | N/A | 65 years old & above | Male | 01002 |
| Hongbing-3 | 4/12/2024 | A. Only once | N/A | N/A | N/A | N/A | N/A | 18-29 years | Male | 02038 |
| Hongbing-4 | 4/12/2024 | A. Only once | Walking, taking photos | Fun, elegant | 4. High | 4. Satisfied | N/A | 50-64 years old | Female | 01002 |
| Hongbing-5 | 4/12/2024 | A. Only once | Driving | Play | 5. Extremely high | 5. Extremely Satisfied | N/A | 18-29 years | Male | 01002 |
| Hongbing-8 | 4/12/2024 | B. More than once but only occasionally | Walking, Sitting | Peace | 2. Low | 4. Satisfied | N/A | 50-64 years old | Male | 01075 |
| Hongbing-10 | 4/12/2024 | B. More than once but only occasionally | Walking | Good, cool | 4. High | 4. Satisfied | N/A | 18-29 years | Female | 02100 |
| Hongbing-13 | 4/12/2024 | A. Only once | Walking | Happy | 4. High | 3. Neutral | N/A | 18-29 years | Female | 01003 |
| Hongbing-14 | 4/12/2024 | A. Only once | Landscape viewing | Calming, Peaceful | 5. Extremely high | 4. Satisfied | N/A | 65 years old & above | Male | 01002 |
| Jill-1 | 4/12/2024 | B. More than once but only occasionally | Walking, meeting with friends | Open | 3. Average | 3. Neutral | N/A | 18-29 years | Male | 02022 |
| Jill-2 | 4/12/2024 | A. Only once | Sitting | N/A | 5. Extremely high | 1.Extremely dissatisfied | N/A | 30-49 years old | N/A | 02110 |
| Zijie-3 | 4/12/2024 | F. Tourist | Walking, Sitting, Reading | Severed, Stimulated, Energized | 5. Extremely high | 4. Satisfied | N/A | 18-29 years | Female | 01002 |
| Zijie-4 | 4/12/2024 | B. More than once but only occasionally | Meeting with friends | Peaceful, content | 5. Extremely high | 5. Extremely Satisfied | N/A | 18-29 years | Female | 03106 |
| Zijie-5 | 4/12/2024 | B. More than once but only occasionally | Walking | N/A | 4. High | 4. Satisfied | N/A | 65 years old & above | Female | N/A |

**Source:** Data came from class surveys and my own field observations.


**Source:** Data came from class surveys and Words Cloud Generator

## Economic l Benefits

- ***Reduced the reflecting pool's water demand from 3 million gallons to 800,000 gallons at the Christian Science Plaza, considering the largest water bill amount per 1,000 gallons is $11,501 they Saved 2,200,000 gallons which is $25,302.20.***

**Calculation:**

Assume the Christian Science Plaza saved 2,200,000 gallons of water by reducing the reflecting poll from 3 million gallons to 800,000 gallons.

1. Total Water Savings: 2,200,000 gallons
2. Rate per 1,000 Gallons: $11.501

Total Saving = (Total Annual Water Savings/1,000) x Rate per 1,000 Gallons
Total Savings = (2,200,000/1,000) x 11.501
Total Savings = 2,200 x 11.501
Total Savings = $25,302.20

**Limitation:**
The calculation assumes a specific volume of water savings. Actual savings may vary based on weather conditions, effectiveness of water-saving measures, and usage patterns. Also, water rates can change annually. This calculation is based on the 2024 rates and may not be accurate for future years without adjustment.

## Lessons Learned

The lessons learned from the Christian Science Plaza Restoration & Repair project are that preserving and restoring the character-defining features of landmark landscapes, along with adding modern innovations for sustainability and functionality, are of utmost importance. The focus of the project on improving the inviting ambiance of the plaza and supporting community engagement demonstrates the importance of public spaces within urban environments. Besides, the implementation of sustainable practices that go beyond only reducing the environmental impact but also contribute to the conservation of resources and resilience to urban challenges such as stormwater runoff and water scarcity. The project's reduction of stormwater runoff and reduction of municipal water use proves the effectiveness of green infrastructure and water-saving technologies in the management of urban landscapes. Also, the social benefits of providing different activities for park users point out the importance of inclusive design and user-centered planning to create vibrant and inclusive public spaces. However, the limitations encountered were relatively small sample sizes of surveys since this was a one person’s project, this underline the use of solid data collection methodologies and comprehensive stakeholder involvement for project outcome evaluation. In general, the case of the Christian Science Plaza Restoration & Repair presents a powerful case study on the intersection of heritage preservation, sustainable design, and community revitalization in urban landscape management.

## References & Sources


The Christian Science Plaza Official Website.
[https://www.christianscienceplaza.org/](https://www.christianscienceplaza.org/)
(Accessed February 4, 2024).

Arcadis IBI Group Official Website. [https://www.ibigroup.com/](https://www.ibigroup.com/)
(Accessed February 5, 2024).

## Project Team:

Arcadis IBI Group
Simpson Gumperts & Heger
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Jaros Baum & Bolles
Preservation Technologies Associates, Inc.
LAM Partners, AM Fogarty & Associates, Inc.
Roll Barresi & Associates, DEW Inc.
Bartlett Tree Experts
Irrigation Consulting, Inc.
GEI Consultants, Inc.
Engineered Systems, Inc.

## Special Thanks:

John Amodeo, FASLA and James Kros, Arcadis IBI Group
Professor Hongbing Tang

# Pier 4 Phase III

300 Pier 4 Boulevard, Boston, MA

Samer Samarani

## Overview

The Pier 4 project in Boston's Seaport district revitalizes a historic site, once home to Anthony's Pier 4 restaurant, buried under layers of asphalt and structures. Embracing the area's coastal heritage, the project incorporates granite seawalls, wood pilings, and stone revetments, while also addressing the challenges of rising sea levels by intentionally breaking down seawalls to allow water movement. The design creates a dynamic waterfront experience with tidal terraces, panoramic viewpoints, and public plazas, bridging the gap between historic downtown Boston and the emerging waterfront neighborhood.

The Pier 4 development includes 2.5 acres of public open space, including a one-acre public park along Boston’s waterfront (the largest public park along Boston’s waterfront). Additionally, the development served to reconnect the Harbor Walk between the ICA and Seaport Boulevard, adding approximately one-half mile of new Harbor Walk along the perimeter of the site.

Before bostonproperrealestate.com/pier-4/


After www.broadboutique.com/buildings/300-pier-4/

## At a Glance

**Project**: PIER 4 / PHASE 3
**Project Type**: RESIDENTIAL / PUBLIC SPACE / WATERFRONT
**Location (Google Maps address)**: MAP HERE
**Budget:**
**Awards**: LEED Gold

**Designer**: REED HILDERBRAND LLC
**Former Land Use:** HARBOR/PARKING LOT
**Size**: 1 ACRE
**Completion Date**: 2019

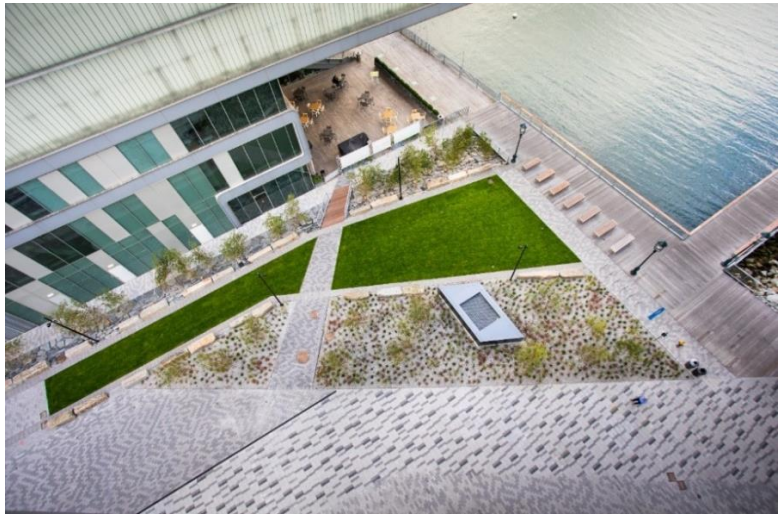
## Project Goals

- Revitalize a historic site in Boston's Seaport district.
- Incorporate passive recreation and education for people to experience the Pier, its natural habitat, and views of the surrounding neighborhoods.
- Address the challenges of rising sea levels and coastal dynamics.
- Create a dynamic waterfront experience for visitors and residents.
- Bridge the gap between historic downtown Boston and the emerging waterfront neighborhood.
- Enhance public access and interaction with the water's edge.
- Transform a privately developed landscape into a public-facing plaza and park while supporting residential and commercial needs.

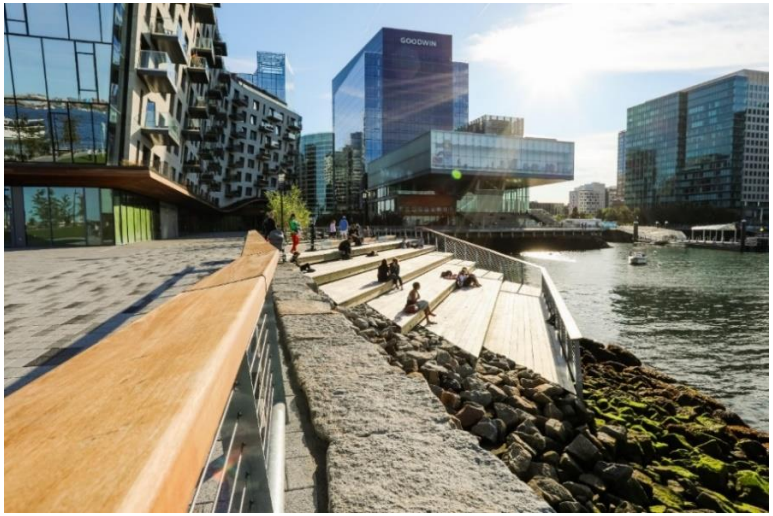
## Site Plan

Source: REED HILDERBRAND

## Site Images

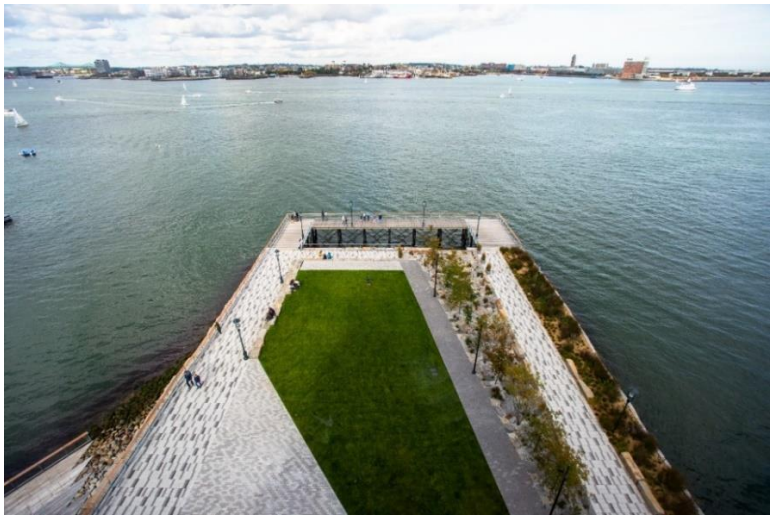


Pedestrian Path between ICA and Pier4



Tidal terraces

Pier 4 Entrance



Slopped Lawn and Harbor Walk

Images: REED HILDERBRAND

# Landscape Performance Benefits

## Environmental Benefit

- ***Reduces peak runoff rate for a 100-year storm by an estimated 26% and reduces runoff volume by 278,619 gallons for a 100-year, 24-hour storm as compared to pre-development conditions.***

**Methods:**
Use historic satellite imagery of the site from 2002, and the implemented landscape plan provided by Reed Hildebrand to estimate the peak runoff rate for a 100-year storm (Time of Concentration Tc = 15 min). AutoCAD was used to calculate the areas of each different surface cover. The modified Rational Method was adopted as it is a simplified model of the hydrologic process. It can be used to estimate the peak runoff rate for an area of less than 20 acres based on a design rainfall intensity.

**Calculations:**

**Peak runoff rate reduction:**
**Modified Rational Method Formula: Qp = CCAiA**

Qp = peak runoff rate, cubic feet per second (cfs)
C = runoff coefficient (unitless)
CA = antecedent precipitation factor (unitless)
i = rainfall intensity, inches per hour (iph), for storm duration = the time of concentration (Tc)
A = drainage area, acres (ac)
The post-development conditions are the result of the site design using LID techniques, which include rain gardens, street planters, perennial planting, and green roofs. The pre-development condition was 100% impervious concrete surface as part of the former shipyard.

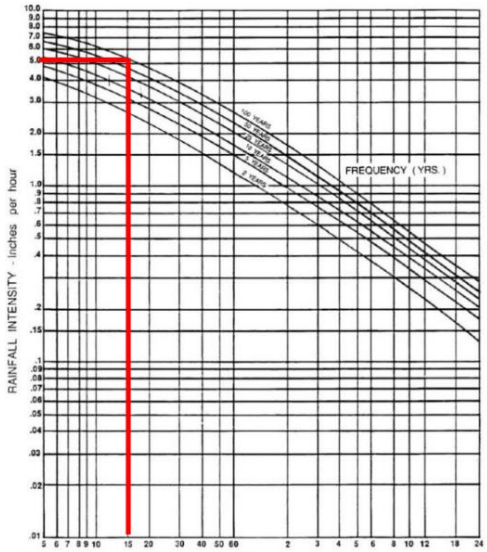
● **Pre-Development Site Land Cover**
Parking surface material: concrete, 100% impervious
Runoff coefficient for concrete: C = 0.95
A = Total site area = 236,475 sf = 5.43 acres

● **Post-Development Site Land Cover**

| **Landcover** | Area (SF) | Acre (ac) | Runoff Coefficient (C) | Adjusted Area C*A |
|---|---|---|---|---|
| Lawn / Ground Garden | 23,590 | 0.54 | 0.1 | 0.054 |
| Green Roof | 3,620 | 0.08 | 0.3 | 0.024 |
| Regular Roof | 54,256 | 1.25 | 0.95 | 1.187 |
| Hardscape | 10,000 | 0.24 | 0.95 | 0.228 |
| Stone Paving | 145,009 | 3.32 | 0.7 | 2.324 |
| **Subtotal** | **236,475** | **5.43** | | **3.817** |

**Weighted Runoff Coefficient:**
C weighted = Adjusted Area / Total Site Area = 3.817/5.43= 0.70

**100-year storm frequency**
The rainfall intensity is 5.4 iph for a 100-year storm frequency from the Rainfall Intensity Chart for Boston, MA




**100 storm rainfall intensity (Tc=15 min.)**
**Figure 2.2: Rainfall intensity Chart for Boston, MA**
Source: Mass. Highway Department 2006

We use 15 minutes for the time of concentration Tc based on the common practice noted in Site Engineering for Landscape Architects (Strom, Nathan, and Woland 2013): "Since it takes several minutes for rain to wet a surface thoroughly, many municipalities permit the use of minimum times of concentration, such as 10 or 15 minutes. This will reduce the intensity used for the computation of the runoff

rate" (Strom, Nathan, and Woland 2013, 266).

Modified Rational Method formula was used with a recommended CA antecedent precipitation factor = 1.25 for 100-year storm (Strom, Nathan, and Woland 2013, 218).

Formula: Qp = CCAiA
Qpre-development = 0.95 x 1.25 x 5.4 iph x 5.43 ac = 34.81 cfs
Qpost-development = $C_{average}$ x CA x i x A = 0.70 x 1.25 x 5.4 x 5.43 ac =25.65 cfs
Reduction rate: (34.81 – 25.65)/34.81 = **26.40%**
In Summary, 100-year design storm calculations show a **26.40%** reduction in peak runoff rate comparing the pre- and post-development conditions.

**Reduction of runoff volumes for a 100-year, 24-hour storm**
**A. Calculations of pre-development site runoff water in gallons:**
The pre-project site was 100% impervious and covered with concrete (CN=98) Using the WinTR-55 software developed by NRCS, when inputting the Rainfall Distribution Type (Type III for Massachusetts) and choosing Suffolk County where Boston is located, a table of storm data is shown. For the 100-year storm return period, the 24-hour rainfall amount is 6.6 inches.

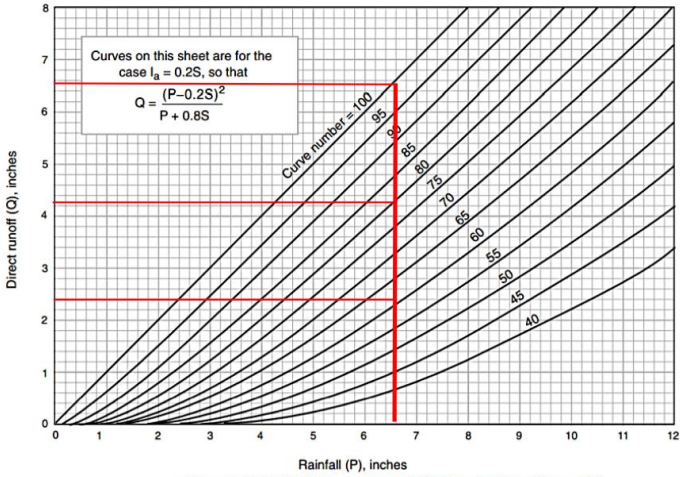


**Figure 2.3: Relationship of CN to depth of runoff**
*Source: 210-VI-TR-55; Strom, Nathan, Woland 2013, 228*

Runoff from 6.6-in rainfall on the surface with Runoff Curve Number (CN)=98 is 6.55-in
Pre-development Runoff Volume = 6.55in x 1 ft /12 in x 236,475 sf = 129,075 cf
129,075 cf x 7.48 gallons/cf = **965,481 gallons**

**B. Calculation of post-development site stormwater runoff in gallons:**

| Land Cover | Curved Number | Area (sf) | runoff generated (inch) |
|---|---|---|---|
| Impervious surfaces | 98 | 64,256 | 6.55 |
| Pervious surfaces | 61 | 27,210 | 2.38 |
| Environmental plaza rough stone paving | 79 | 145,009 | 4.25 |

Post-development site (236,475 sf) is 71.60% impervious (64,256 sf).
Runoff Vol. = (6.55 in x 1 ft/ 12 in x 64,256 sf) + (2.38 in x 1 ft/12 in x 27,210 sf) + (4.25 x 1 ft/12 in x 145,009)
= 35,073+5,396 +51,357 = 91,826 cf
91,826 sf x 7.48 = 686,861 gallons
Runoff volume reduction for a 100-year, 24-hour storm: 965,481 – 686,861 = **278,619 gallons**

**Limitation:**
When doing stormwater runoff estimation, AutoCAD was used to trace and measure areas of various land covers based on the construction documents provided by the design firm and the client. Human errors were conceivable, limiting the accuracy of the calculations.

**Sources:**
Massachusetts Highway Department. 2006. “Chapter 8: Drainage and Erosion Control.” In 2006 Project Development and Design Guide, 2006th edition, 8-1 to 8-144. https://www.mass.gov/lists/design-guides-and-manuals.
Strom, Steven, Kurt Nathan, and Jake Woland. 2013. Site Engineering for Landscape Architects, 6th edition, 147–56. Hoboken, New Jersey: Wiley

**● Provides habitat for at least 10 bird species observed in the ground-level outdoor spaces and immediately adjacent areas.**

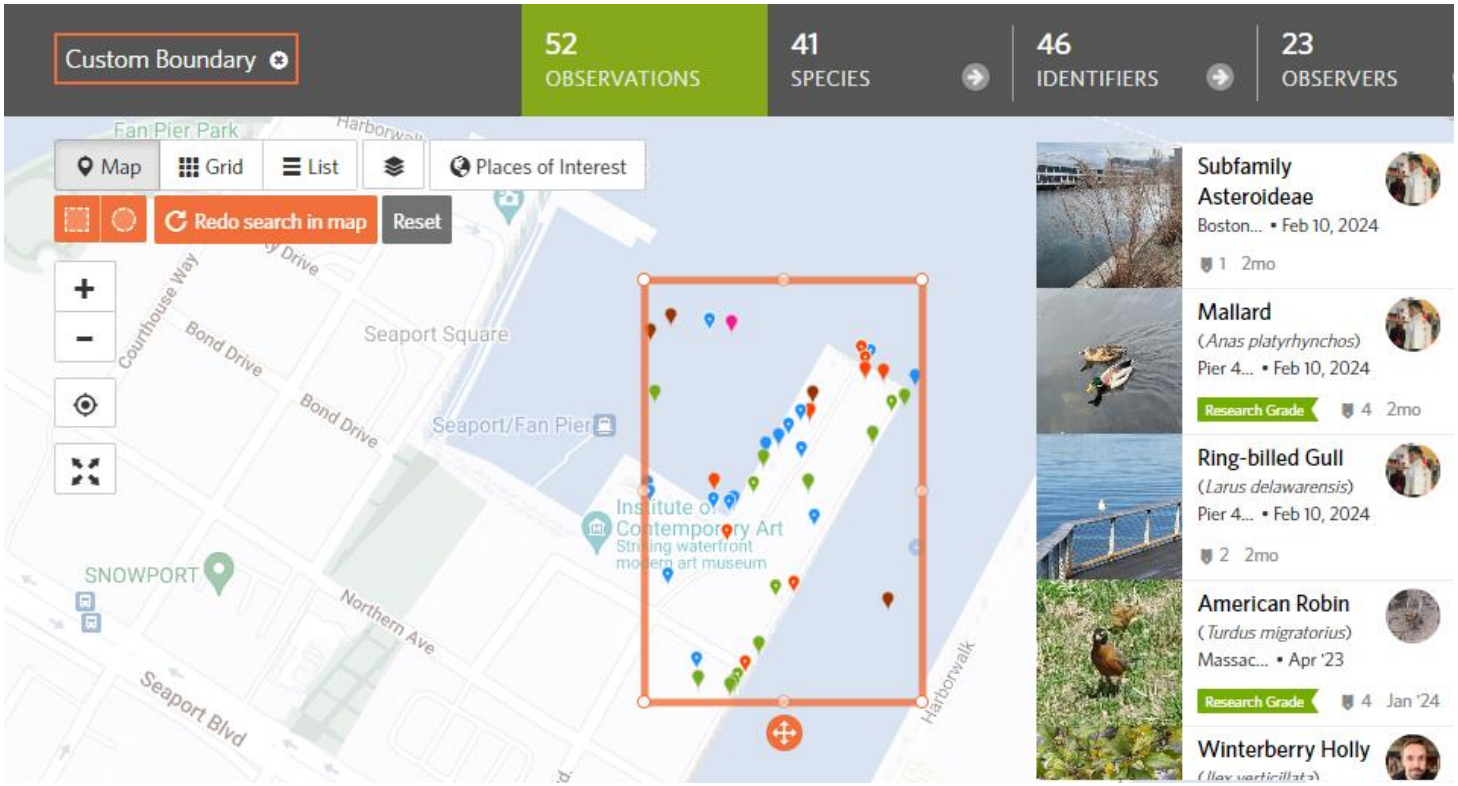
**Background:**
Pier 4 is situated on the harbor of Boston, offering panoramic views of the Boston Harbor. People living along Boston's shoreline are frequently affected by the repercussions of climate change. Urban biodiversity supports ecosystem services and processes, many with direct benefits and value to human beings (Ahern 2013). Promoting biodiversity can help lessen the detrimental effects of climate change. Pier 4 was a brownfield with contaminated soil and insignificant biodiversity. There has been a significant increase in urban biodiversity since the project was built in 2020 with brownfield remediation and landscape design implementation.

**Methods:**

1- **Observations from iNaturalist.org**

One useful tool for studying biodiversity is iNaturalist,. Observers from the seaport community have recorded and identified more than 55 species around the Pier 4 project.
Link: Pier 4 - Inaturalist.org

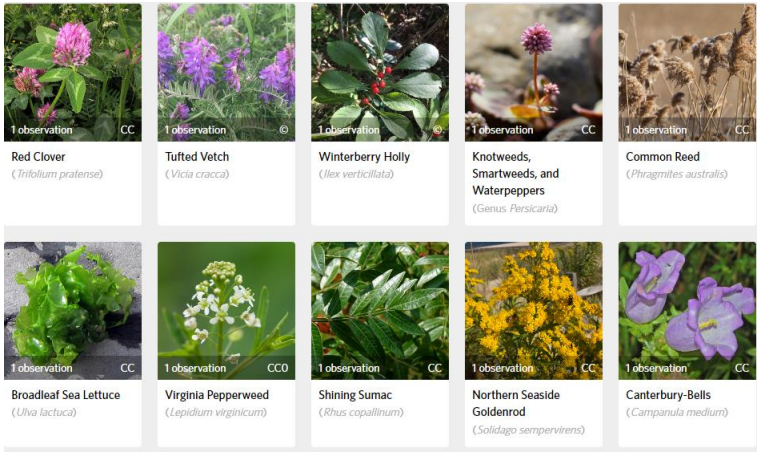
Figure below shows total 23 observations with 41 plant and animal species identified by 23 observers within an approximate 1500 x 900 ft area. 20 of them are in the immediately adjacent locations with date, location, common and Latin names provided.



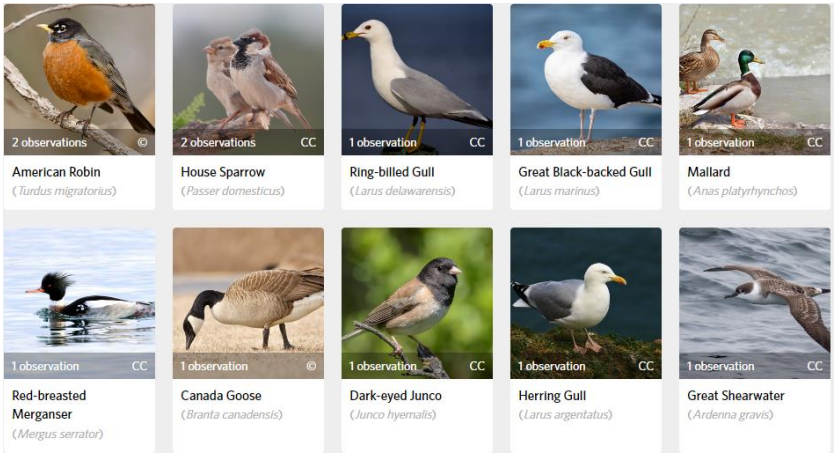

Source: inaturalist.org

**Calculation:**

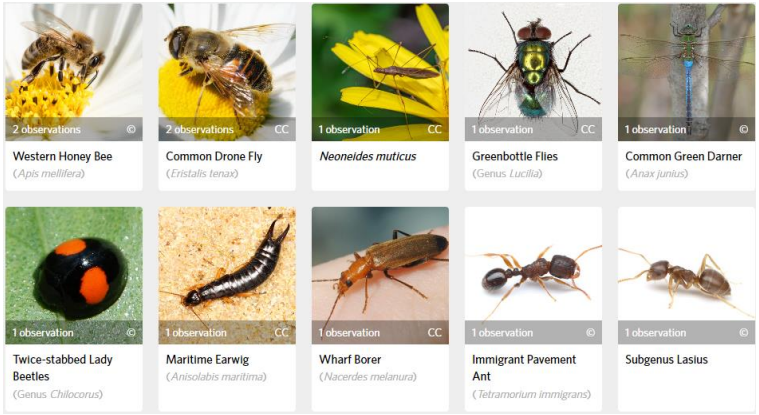
Plantae:




Aves:




Insecta:




**Limitation:**

- Our wildlife and plant inventories were limited due to time constraints. Second-hand information came from iNaturalist.
- The usefulness of the iNaturalist tool is limited by the number of observations people happen to submit from a given location. The absence of observations does not mean the absence of species.

**Sources and references:** iNaturalist.org

- ***Sequesters 334,882 pounds of CO2 over 20 years with 120 tree plantings compared to conventional planting***

**Calculations**

**PLANTING LEGEND - PLAZA**

**TREES**

| SYMBOL | KEY NAME | BOTANICAL NAME | COMMON NAME | SIZE | QUANTITY | DESCRIPTION |
|---|---|---|---|---|---|---|
| | BP-M | BETULA POPULIFOLIA "WHITESPIRE" | GRAY BIRCH | 14' - 16' HT | 36 | B&B, MULTI-STEM, 3-4 STEMS PER TREE, UPRIGHT HABIT |
| 2 | BP-S1 | BETULA POPULIFOLIA "WHITESPIRE" | GRAY BIRCH | 14'-16' HT | 6 | B&B, SINGLE TRUNK, PRUNED IN FIELD. AS DIRECTED BY L.A. DO NOT PRUNE WITHOUT APPROVAL |
| | BP-S2 | BETULA POPULIFOLIA "WHITESPIRE" | GRAY BIRCH | 12' - 14' HT | 12 | B&B, SINGLE TRUNK, PRUNED IN FIELD AS DIRECTED BY L.A. DO NOT PRUNE WITHOUT APPROVAL |

**PLANTING LEGEND - NORTH CUT**

| SYMBOL | KEY NAME | BOTANICAL NAME | COMMON NAME | SIZE | QUANTITY | DESCRIPTION | DETAIL REFERENCE | SPEC REFERENCE |
|---|---|---|---|---|---|---|---|---|
| | NS-1 | NYSSA SYLVATICA | BLACKGUM | 2.5" | 1 | B&B, (LOW BRANCHING) | 7/L803 | 329300 |
| | NS-2 | NYSSA SYLVATICA | BLACKGUM | 3.5" CAL | 1 | B&B, (LOW BRANCHING) | 7/L803 | 329300 |
| | QP-1 | QUERCUS PALUSTRIS | PIN OAK | 2" CAL | 2 | B&B, (LOW BRANCHING) | 7/L803 | 329300 |
| | QP-2 | QUERCUS PALUSTRIS | PIN OAK | 4" CAL | 4 | B&B, (LOW BRANCHING) | 7/L803 | 329300 |
| | QS | QUERCUS ILLICIFOLIA | BEAR OAK | #2 CONT. | 2 | B&B, (LOW BRANCHING) | 7/L803 | 329300 |
| | RT | RHUS TYPHINA | STAGHORN SUMAC | #10 CONT. | 8 | MULTI-STEM, UPRIGHT HABIT | 7/L803 | 329300 |
| | AL-1 | AMALANCHIER LAEVIS | ALLEGHENY SERVICEBERRY | 10'-12' | 3 | B&B, MULTI-STEM, 3-4 STEMS PER TREE, UPRIGHT HABIT | 7/L803 | 329300 |

**SHRUBS**

| | | | | | | |
|---|---|---|---|---|---|---|
| | BH-1 | BACCHARIS HALIMIFOLIA | GROUNDSELBUSH | 24" - 30" HT | 5 | #7 CONTAINER |
| | IVS | ILEX VERTICILLATA 'SOUTHERN GENTLEMAN' | WINTERBERRY | 30"-36" HT | 1 | #7 CONTAINER |
| | IVW | ILEX VERTICILLATA 'WINTER RED' | WINTERBERRY | 30"-36" HT | 6 | #7 CONTAINER |

Source: REED HILDERBRAND

**Limitation:**

- iTree requires the diameter of the trunk as an input. While Reed Hilderbrand architects provided the diameter measurements of the trees when they were initially planted, updated diameter measurements reflecting the current sizes of the trees were not collected.

- The calculations performed by iTree are based on an assumption of ideal or perfect growing conditions for the trees, which may not accurately reflect the actual conditions the trees have experienced.

**Source: MyTree/Itreetools.**
https://mytree.itreetools.org/#/benefits/total
Construction Design Set -

## SOCIAL BENEFITS

***Overall Methods:***

**Behavior mapping**

Behavior mapping, also known as activity mapping, is a type of field observation method. In this process, the researcher observes who (a particular user type) is acting in a certain way (behavior), when (certain times of the year/month/day), and where (certain locations in space) (Sachs, 2017). Behavior mapping entails the research team observing users onsite and recording their behavior on a site map. The research team performed behavior mapping across 2site visits over 2 different days to estimate the organic use of the site visitors.

**Surveys**

Surveys have the advantage of having a larger sample size and thus providing more statistical power (Jones, Baxter, and Khanduja 2013). The research team conducted most in-person paper surveys on-site during multiple field trips in April. The Class team also assisted in the administration of paper surveys for the visitors.

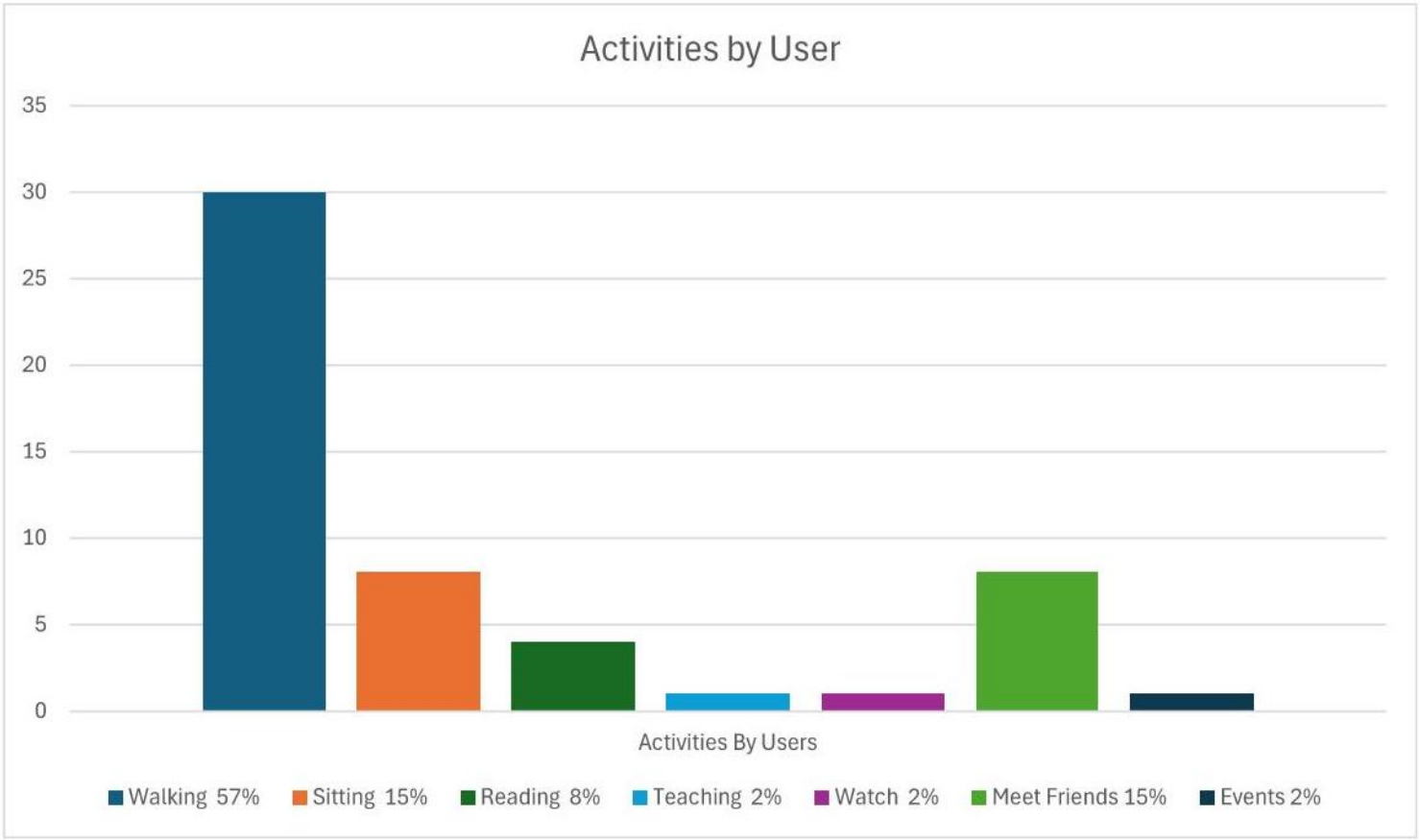
**Limitations:**

- Behavior mapping can be inaccurate when conducted by a single party covering a large space.
- Surveys can suffer from low response rates, which can affect the representativeness and generalizability of the results. On a voluntary basis, people may skip certain questions. Some answers may contain false or incomplete information. This can introduce bias and errors in data collection.

1. ***Promotes outdoor space occupancy by supporting a variety of activities, with 15 activity types observed on-site in the spring and 7 activity types reported by users through 41 surveys. Most common activities include walking (57% of 41 surveyed users), Meeting Friends (15%), and Reading (8%).***

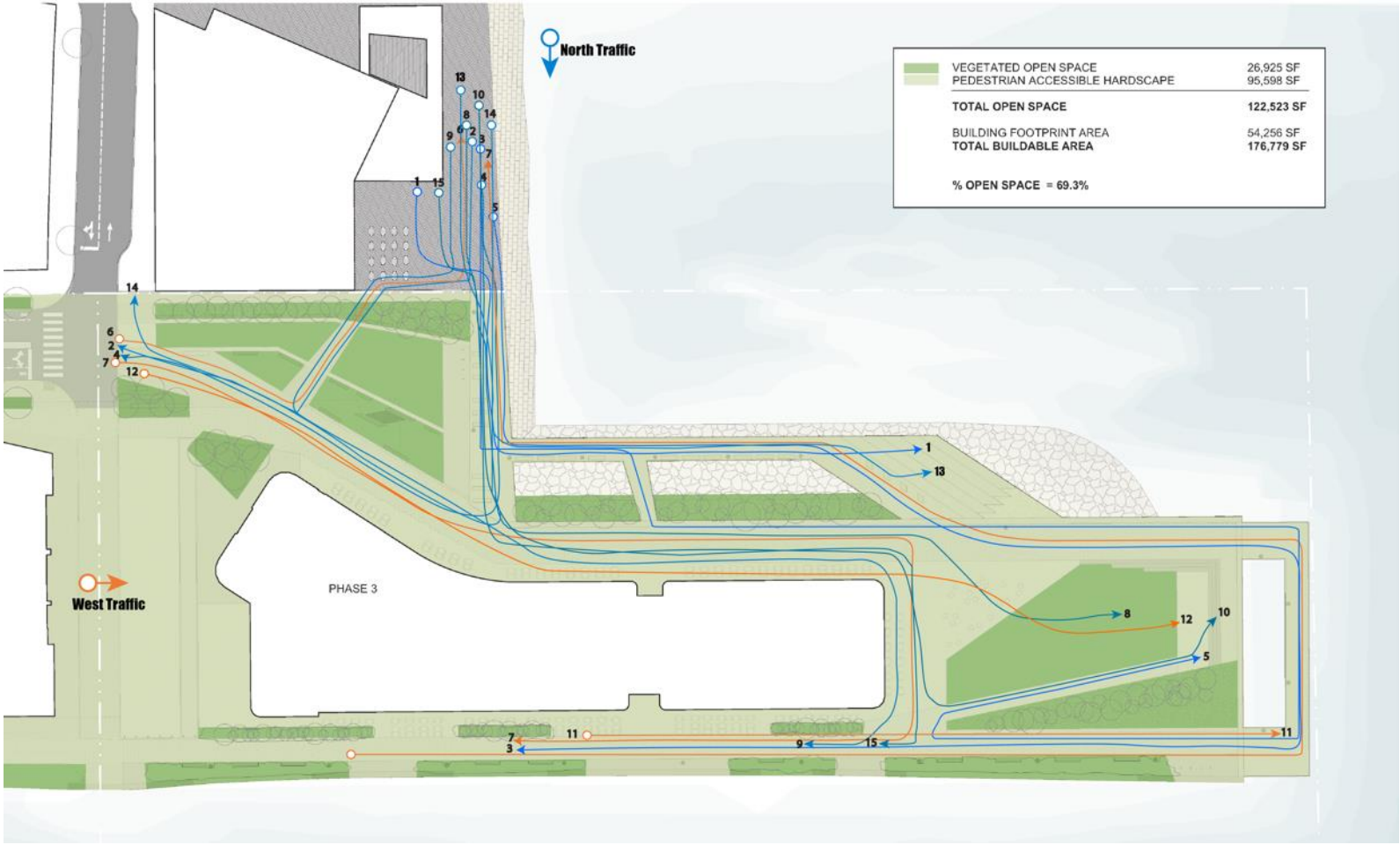
**Calculations:**

**Activities learned from surveys.**
A total of 7 activity types were reported by survey participants. Most significant activities include walking (57%), meeting friends (15%), and Reading (8%).



**Behavior mapping**

One behavior mapping exercise was recorded at 12:00 pm on April 28th 2024. The session lasted approximately 45 minutes and focused on the movement of users through space.




Date: 04/28/2024
Weather: Sunny High 65*F
Air Quality: 68 ( Moderate)
Total 15 people

**Limitations:**

Most of the surveys were collected by people walking, sitting, or visiting. Many individuals were engaged in activities that could not be disturbed, such as jogging or meditating.

**Sources:**

Data came from surveys and my own field observations.

- ***Provides high aesthetic value at Pier 4 according to 71% of 41 surveyed users***

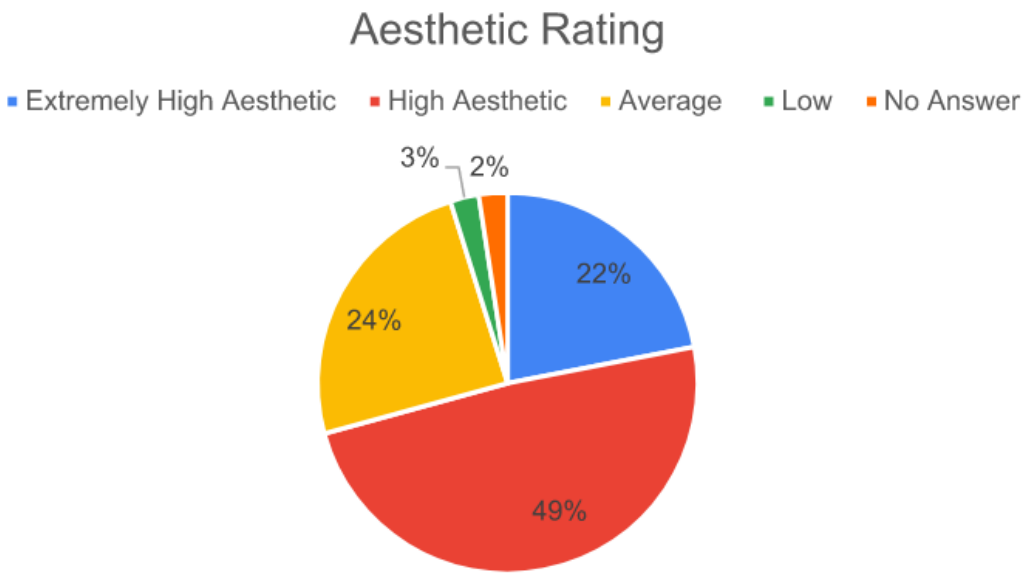
Calculations: 41 total participants were surveyed across two time periods. The first surveys were conducted off-cite during a field trip where students from another university were visiting Boston. The second survey session was conducted on site the same day as the behavior mapping. For both sessions, the same questions were used. Users were asked to answer the following questions:

4. Please rate the aesthetic value of the Harvard SEC open spaces
    1. Extremely Low 2. Low 3. Average 4. High 5. Extremely High

The following chart shows the results. 22% of surveyed users reported the site had Extremely high aesthetic value while 48.8% reported the site had High Aesthetic value.

**learned from surveys**

| | Extremely High Aesthetic | High Aesthetic | Average | Low | No Answer | Total |
|---|---|---|---|---|---|---|
| **Surveys** | 9 | 20 | 10 | 1 | 1 | 41 |
| **Percentage** | 22.0% | 48.8% | 24.4% | 2.4% | 2.4% | 100.0% |




**Limitations:**

Only 41 surveys were conducted on-site.

**Sources:**

Data came from surveys and my own field observations.

- ***Provides satisfactory experience with 73% of surveyed users recording they are satisfied or highly satisfied with the Pier 4 Harbor Walk and open spaces.***

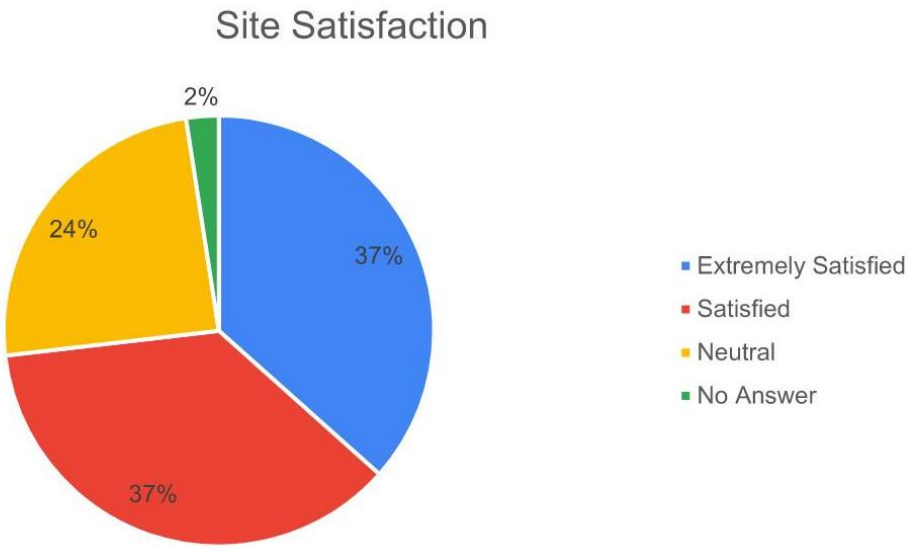
**Calculations:**

41 total participants were surveyed across two time periods. For both sessions the same questions were used. Users were asked to answer the following question:

6. Rate your satisfaction with your experience in the Harvard SEC open spaces.

1.Extremely dissatisfied 2. Dissatisfied 3. Neutral 4. Satisfied 5.Extremely Satisfied

| | Extremely Satisfied | Satisfied | Neutral | No Answer | Total |
|---|---|---|---|---|---|
| **Surveys** | 15 | 15 | 10 | 1 | 41 |
| **Percentage** | 36.6% | 36.6% | 24.4% | 2.4% | 100.0% |




**Limitations:**

Only 41 surveys in total were conducted on-site and offsite.

**Sources:**

Data came from surveys and my own field observations.

- **Promotes positive emotional status with most common feelings about the space including happy (30%), calm (17%), and relaxed (17%), with 81% of surveyed users reporting positive emotional status when on site.**

**Calculation:**
41 total participants were surveyed across two time periods. For both sessions the same questions were used. Users were asked to answer the following question:

**Word Cloud Map**

Survey Question 3. What are your feelings or emotional status when you are in the Harvard SEC open spaces? Try to use 2-3 adjectives to describe your feelings.


Source: Answers of Survey Question 3

## Lessons Learned

Over several weeks of research and check-ins, I gained insights into conducting surveys, behavior mapping, and stormwater analysis. I also learned how to use new tools to emphasize the social and economic benefits of a project. Working on the

report has enhanced my understanding of what a professional report should look like. My analysis of the site revealed that the most significant takeaway is the importance of collaboration. For a university project to yield extensive benefits, there must be close cooperation between the university, design firm, engineers, and the public.

## References & Sources


i-Tree Planting. i-Tree Software Suite v5.x. (n.d.). Web. Accessed 2nd of May. 2024. http://www.itreetools.org
https://www.inaturalist.org/
Reed Hilderbrand Landscape Architecture
Tishman Speyer
Shop Architects


## Project Team:

Gary Hilderbrand
Eric Kramer
Elizabeth Randall
Stephanie Hsia
Tishman Speyer
SHoP Architects
Elkus Manfredi Architects
CBT Architects

## Recognition

Living on the Edge," by Marni Elyse Katz, Boston Common, Winter 2017

Trying to dish up a friendlier waterfront park" by Tim Logan, Boston Globe, December 13, 2019

2022 Honor Award, Boston Society of Landscape Architects

# Chinatown Park

70 Beach St, Boston, MA

Zijie Zhou

## Overview

As the first park completed along Boston's Rose Fitzgerald Kennedy Greenway, Chinatown Park is in front of the traditional gate of the Chinatown neighborhood in Boston, Massachusetts. Occupying approximately 0.75 acres, the park is built on the site of an abandoned off-ramp from the Central Artery Dewey Square tunnel. The designers envision creating a space that combines the Chinese migrant's memory and prophecy with traditional Chinese cultural elements. As the most significant open space in Chinatown, the south portion of the park was designed to accommodate the bustling social life of the Asian community by creating an open plaza for everyday activities and large festivals and celebrations. The north portion of the park features a winding path through gardens with lush plants of Asian origin, offering a break from the city's busy streets. Chinatown Park is the culmination of a multi-year planning, design, and construction effort with active community engagement.

Before Hongbing Tang


After Zijie Zhou

## At a Glance

**Designer:** Arcadis IBI Group (Formerly Carol R. Johnson Associates)
**Former Land Use**: Highway off-ramp
**Completion Date:** 2007

**Project Type:** Park/Open Spaces
**Size:** 0.75 acres
**Budget:** 1.8 million USD

## Project Goals

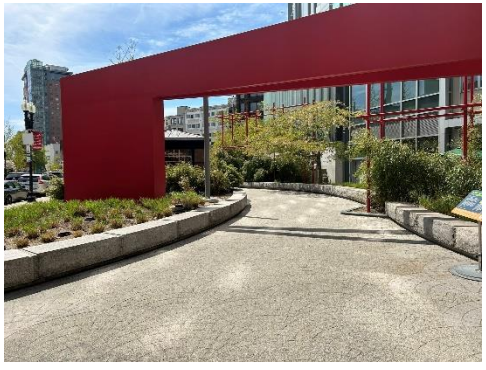
- Eliminate vehicular traffic and improve pedestrian mobility.
- Create greenway connections in Boston's downtown corridor.
- Create a space to accommodate festivals, celebrations, and daily activities for the Chinese communities.
- Create a visually appealing space that blends traditional Chinese design with contemporary elements.

## Site Plan

Source: Arcadis IBI Group

# Site Images

The Red Gate

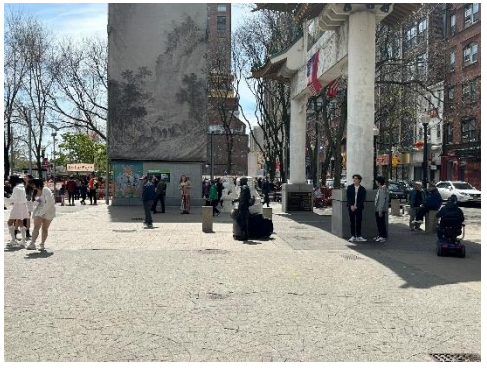


Water Fall

Ancient Lace Bark Pine

PlayCubes™

Entry Plaza



Winding Path

Photos by Zijie Zhou

# Landscape Performance Benefits

## Environmental Benefits

- ***Reduces peak runoff rate for a 100-year storm by an estimated 24% and reduces runoff volume by 23,667 gallons for a 100-year, 24-hour storm as compared to predevelopment conditions.***

**Methods:**
AutoCAD was used to calculate the areas of each different surface cover. Modified Rational Method was adopted as it is a simplified model of the hydrologic process. It can be used to estimate the peak runoff rate for an area of less than 20 acres based on a design rainfall intensity. The stormwater runoff volume comparison for pre- and post-development was calculated using the Natural Resources Conservation Service (NRCS) Method for a 100-year, 24-hour storm.

**Calculation:**

- **Pre-Development Site Land Cover highway surface material: concrete, 100% impervious**
  Runoff coefficient for concrete: C = 0.95
  A = Total site area = 32,228 sf = 0.74 ac

- **Post-Development Site Land Cover**

| **Land Cover** | **Area(sf)** | **Area(ac)** | **Runoff Coefficient C** | **Adjusted Area C*A** |
|---|---|---|---|---|
| Ground-level gardens | 8,709 | 0.199 | 0.1 | 0.019 |
| Stone paving | 782 | 0.018 | 0.7 | 0.013 |
| Hardscape | 22,737 | 0.523 | 0.95 | 0.500 |
| **Subtotal** | 32,228 | 0.74 | | 0.523 |

- **Weighted Runoff Coefficient:**
  Cweighted = Adjusted Area / Total Site Area = 0.523/0.74 = 0.72

- **Formula: Qp = CCAiA**
  Qpre-development = 0.95 x 1.25 x 5.4 iph x 0.74 ac = 4.745 cfs
  Qpost-development = Caverage x CA x i x A = 0.72 x 1.25 x 5.4 x 0.74 ac =3.596 cfs
  Reduction rate: (4.745 – 3.596)/4.745 = **24.21%**

  In Summary, 100-year design storm calculations show a 24.21% reduction in peak runoff rate comparing the pre- and post-development conditions.

- **Reduction of runoff volumes for a 100-year, 24-hour storm**
  1. Calculations of pre-development site runoff water in gallons:
     Pre-development Runoff Volume = 6.55in x 1 ft /12 in x 32,228 sf = 17,521 cf
     17,521 cf x 7.48 gallons/cf = 131,057 gallons

  2. Calculation of post-development site stormwater runoff in gallons:

| **Land Cover** | **Curved Number** | **Area (sf)** | **Runoff generated (inch)** |
|---|---|---|---|
| Impervious surfaces | 98 | 22,737 | 6.55 |
| Pervious surfaces | 61 | 8,709 | 2.38 |
| Environmental plaza rough stone paving | 79 | 782 | 4.25 |

  Post-development site (32,228 sf) is 70.55% impervious (22,737 sf).

  Runoff Vol. = (6.55 in x 1 ft/ 12 in x 22,737 sf) + (2.38 in x 1 ft/12 in x 8,709 sf) + (4.25 x 1 ft/12 in x 782) = 12,361+1,720 +276 = 14,357 cf
  14,357 sf x 7.48 = 107,390 gallons

  Runoff volume reduction for a 100-year, 24-hour storm: 131,057 – 107,390 = 23,667 gallons

**Limitation:**

- When doing stormwater runoff estimation, AutoCAD was used to trace and measure areas of various land covers based on the construction documents provided by the design firm and the client. Human errors were conceivable, limiting the accuracy of the calculations.

**Sources:**

- ***Provides biodiversity by creating habitats for at least 19 Perennials species, 33 Shrubs species, and 15 trees species observed in the ground-level outdoor spaces.***

**Background:**

Chinatown Park was formerly a highway off-ramp, so no vegetation was on-site before construction.

**Method:**

- Data collected from The Green Way, Rose Kennedy Greenway Conservancy Plant Identification Information website.

**Calculation:**

Perennials species

## Shrubs species

***Chaenomeles speciosa* 'Texas Scarlet'**
Flowering Quince

***Chaenomeles speciosa* 'Toyo Nishiki'**
Flowering Quince

***Fothergilla major* 'Mt Airy'**
Fothergilla

***Ilex crenata* 'Green Luster'**
Japanese Holly

***Ilex glabra* 'Densa'**
Inkberry

***Ilex glabra* 'Shamrock'**
Inkberry

***Ilex verticillata* 'Jim Dandy'**
Winterberry

***Ilex verticillata* 'Red Sprite'**
Winterberry

***Ilex verticillata* 'Winter Red'**
Winterberry

***Microbiota decussate***
Russian Arborvitae

***Neillia sinensis***
Chinese Neillia

***Paeonia suffruticosa* 'Hana-kisoi'**
Tree Peony

***Paeonia suffruticosa* 'Luoyang Red'**
Tree Peony

***Paeonia suffruticosa* 'Shin-jitsu-getsu-nishiki'**
Tree Peony

***Pinus strobus* 'Hillside Creeper'**
Eastern White Pine

***Rhododendron* (Indica Type) 'Macratha Pink'**
Macrantha Azalea

***Rhododendron* (Kurume Hybrid) 'Hino-crimson'**
Kurume Azalea

***Rhododendron* (Mezitt/Weston Hybrid) 'April Snow'**
P.J.M. Rhododendron

***Rhododendron* (Mezitt/Weston Hybrid) 'Olga Mezitt'**
P.J.M. Rhododendron

***Rhododendron* (Mezitt/Weston Hybrid) 'Weston's Vyking'**
Weston Azalea

***Rhododendron* (Satsuki Hybrid) 'Gumpo Pink'**
Satsuki Azalea

***Rhododendron* (Shammarello Hybrid) 'Yaku Prince'**
Shammarello Rhododendron

***Rhododendron* ['PJM' cultivar]**
P.J.M. Rhododendron

***Rhododendron* 'Mikkeli'**
Rhododendron

***Rhododendron mucronulatum* 'Cornell Pink'**
Korean Rhododendron

***Rhododendron* 'Nova Zembla'**
Koster Rhododendron

***Rhododendron* 'Purple Gem'**
Dwarf Azalea

***Rhododendron yedoense* var. *poukhanense***
Korean Azalea

***Rosa* 'Radrazz' (Knock Out Red)**
Knock Out Rose

***Rosa* 'Radcor' (Rainbow Knock Out)**
Knock Out Rose

***Rosa* 'Wekcisbako' PP18552**
*Home Run Rose*

***Rosa* x 'Noarre' P.P.#11308**
*Flower Carpet Rose*

***Viburnum carlesii* 'Compactum'**
Dwarf Korean Spice Viburnum

## Tree species

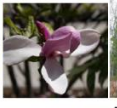
***Abies fraseri***
Frasier Fir

***Chamaecyparis obtusa* 'Gracilis Compacta'**
Compact Hinoki Cypress

***Cornus kousa***
Kousa Dogwood

***Ginkgo biloba***
Ginkgo

***Koelreuteria paniculata***
Goldenrain Tree



***Magnolia* 'Jane'**
Magnolia

***Pinus bungeana***
Lacebark Pine



***Pinus sylvestris* 'Hillside Creeper'**
Scotch Pine



***Prunus subhirtella***
Higan Cherry



***Prunus x yedoensis***
Yoshino Cherry



***Salix babylonica* 'Niobe'**
Weeping Willow



***Styphnolobium japonicum* 'Regent'**
Pagoda Tree



***Ulmus* 'Frontier'**
Elm



***Ulmus parvifolia* 'Dynasty'**
Chinese Elm



***Ulmus parvifolia* 'Emerald Vase'**
Chinese Elm

**Sources:**
The Rose Kennedy Greenway - Plants & Landscapes. http://www.rosekennedygreenway.org/visit/plants-landscapes/

- ***Sequesters an estimated 3,164.8 lbs of atmospheric carbon in planted trees in 2024.***

**Methods:**
i-Tree Canopy was used to estimate annual carbon sequestration of trees and shrubs.
First, the project area was defined in Google Earth through the i-Tree Canopy web application. Several classes of trees were added to the analysis to create an accurate data set.

**Calculation:**
- The diameter of trees was measured on-site. (Due to the condition of the park, some trees' diameters were estimated.)
- The i-Tree Canopy web application set a project area in Google Earth. In this case, the project area was set to be the boundaries of Boston Chinatown Park.
- Tree classes were added to the analysis.
- Insert the diameter of the trees.
- I-Tree calculated the amount of atmospheric carbon sequestered in 2024.
- According to the calculations of i-Tree, Chinatown Park sequestered an estimated 3,164.8 lbs of atmospheric carbon in 2024.

## MyTree Benefits

Tree Collection Totals, ()

**Serving Size:** 29 trees
**Estimated this year:** $1,390.36
Discover benefits of all your community trees!

| | Annual values: |
|---|---|
| **Carbon Dioxide Uptake** | **$269.88** |
| Carbon Sequestered[1] | 3,164.8 lbs |
| $CO_2$ Equivalent[2] | 11,604.26 lbs |
| **Storm Water Mitigation** | **$424.47** |
| Runoff Avoided | 47,501.01 gal |
| Rainfall Intercepted | 92,803.1 gal |
| **Air Pollution Removal** | **$668.51** |
| Carbon Monoxide | 18.18 oz |
| Ozone | 464.65 oz |
| Nitrogen Dioxide | 126.42 oz |
| Sulfur Dioxide | 10.81 oz |
| $PM_{2.5}$ | 16.31 oz |

**Figure 5.1: Result from i-Tree**

**Limitation:**

- The diameter of the trees is measured by hand. Human errors were conceivable, limiting the accuracy of the calculations.
- Although i-Tree is a scientifically developed tool, it is still an approximation for on-site conditions.

**Sources:**
i-Tree: https://mytree.itreetools.org/

## Social Benefits

***Overall Methods:***

**Field Observations**
Field observation is a type of field research method that involves collecting data by observing the behavior, actions, or interactions of people or animals in a natural setting. The researcher does not interfere with the subjects or manipulate any variables but simply records what they see and hear.

**Surveys**
Surveys are a common and simple research method. Surveys have the advantage of having a larger sample size and thus providing more statistical power. Surveys were conducted with the same set of questions as interview questions (Appendix 1).

**Interviews**
Interviews can provide more in-depth, qualitative data than a survey can offer.

- ***Provides a range of activity spaces with 13 activity types observed on-site through field observation and 6 activity types reported by users through 21 surveys and 9 interviews. Walking is the most common type of activity (50% of 30 surveyed and interviewed users), eating (30%), followed by visiting (20%).***

**Calculation:**

- 21 people in total were surveyed, and 9 people were interviewed.
- On-site observation with photos.

- Out of 21 surveys, 12 users report of walking in the park, 4 reports of eating, 2 reports of sitting, 1 user report of meeting with friends and phone calling. Out of 9 interviews, 6 users reports of visiting in the park, 5 reports of eating, 3 reports of walking, 2 reports of biking, and 1 report of meeting with friends.

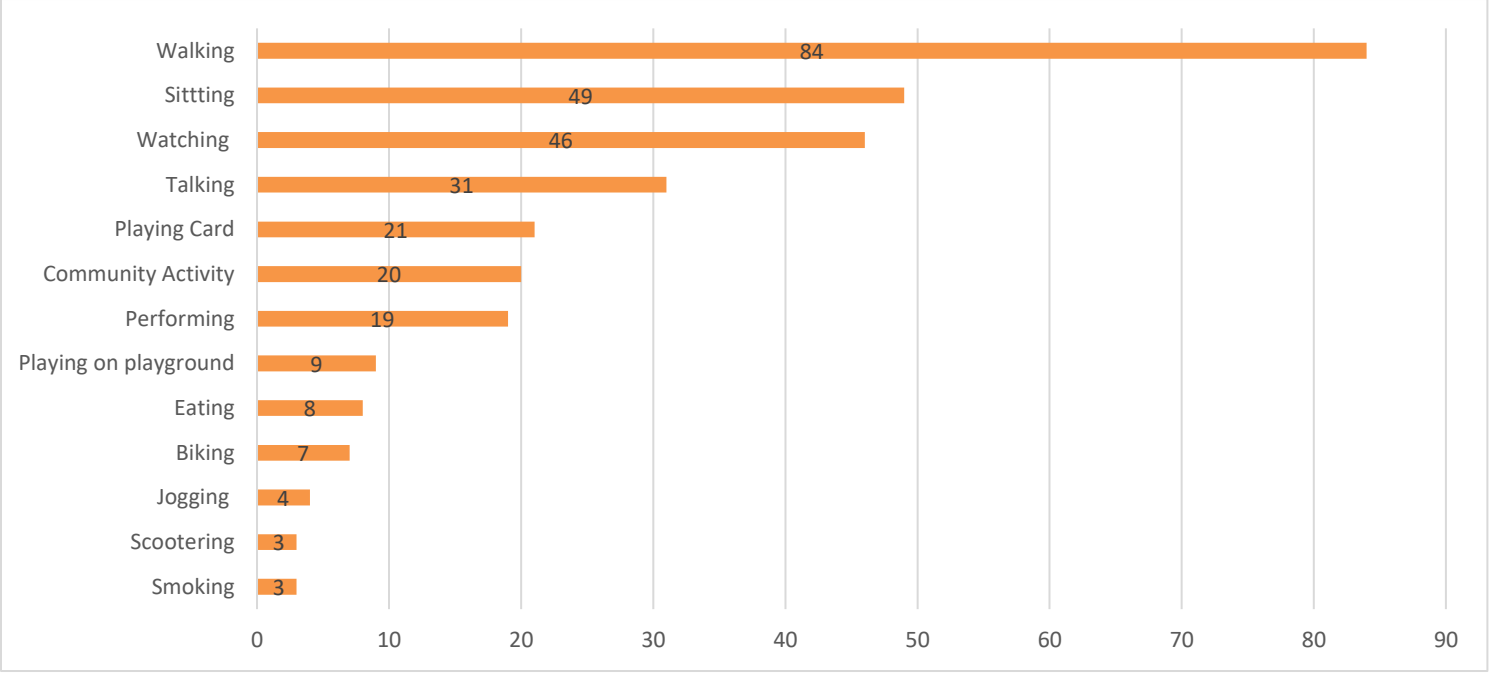



**Figure 5.2: On-site observation activities**.

Date: 4/27/2024 Weather: Sunny Temperature: 68F ID: S=staff P=patient V=visitor N=can't tell

| group | M | F | dog | race | ID | Age 0-6 | 7-18 | 18-34 | 35-50 | 51-65 | 65+ | Time | Notes: W=whiye B=Black, A=Asian |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | | A | | | 1 | | 1 | | | 12:44PM | Sitting |
| 2 | | 2 | | A | | | | | | 2 | | 12:48PM | Sitting |
| 3 | 3 | 2 | | A/W | | | | 5 | | | | 12:49PM | Sitting |
| 4 | | 3 | | A | | | | | 3 | | | 12:50PM | Sitting |
| 5 | 8 | | | A/W | | | | 1 | 7 | | | 12:52PM | Sitting |
| 6 | 1 | 2 | | A/W | | | | | 3 | | | 12:58PM | Performance |
| 7 | 3 | | | A | | | | | 2 | 1 | | 12:59PM | Watching |
| 8 | 1 | 2 | | W | | | | 3 | | | | 12:55PM | Walking |
| 9 | 1 | | | W | | | | 1 | | | | 12:55PM | Sitting |
| 10 | | 2 | | A | | | | | 2 | | | 12:57PM | Sitting |
| 11 | | 2 | | A | | | 1 | 1 | | | | 12:57PM | Sitting |
| 12 | 4 | 4 | | A | | | | | 4 | | | 12:58PM | Playing card |
| 13 | 1 | | | A | | | | | 1 | | | 12:58PM | Smoking |
| 14 | | 3 | | A | | | | 3 | | | | 1:00PM | Walking |
| 15 | 2 | | | A | | | | 2 | | | | 1:01PM | Meeting |
| 16 | 2 | | | A | | | | | 2 | | | 1:01PM | Sitting |
| 17 | 1 | 5 | | A | | | | 2 | 4 | | | 1:03PM | Walking |
| 18 | 5 | 1 | | B | | | 1 | 5 | | | | 1:05PM | Sitting |
| 19 | 37 | 5 | | A | | | | | 42 | | | 1:01PM | Playing card |
| 20 | | 20 | | A | | | 5 | 15 | | | | 1:10PM | Community Program |
| 21 | 1 | 2 | | A | | | | | | 3 | | 1:10PM | Sitting |
| 22 | | 2 | | A/W | | | | 2 | | | | 1:17PM | Biking |
| 23 | 3 | | | W | | | | 3 | | | | 1:15PM | Eating |
| 24 | 1 | 1 | | W | | | | | | 2 | | 1:17PM | Walking |
| 25 | 2 | 4 | | A/W | | | | 4 | 2 | | | 1:20PM | Performance |
| 26 | 4 | 9 | | A/W | | | | 8 | 5 | | | 1:24PM | Performance |
| 27 | 2 | | | W | | | | 2 | | | | 1:26PM | Walking |
| 28 | 1 | 2 | | W | | | | 3 | | | | 1:28PM | Walking |
| 29 | 8 | | | A | | | | | 9 | | | 1:30PM | Playing card |
| 30 | | 1 | | A | | | | 1 | | | | 1:31PM | Eating |
| 31 | 2 | 1 | | A/W | | 3 | | | | | | 1:33PM | Playing |
| 32 | 1 | 1 | | W | | | | 2 | | | | 1:35PM | Walking |
| 33 | 1 | 1 | | W | | | | 2 | | | | 1:38PM | Biking |
| 34 | 1 | 1 | | A | | | | 2 | | | | 1:40PM | Eating |
| 35 | 1 | 2 | | A/W | | | | 1 | 2 | | | 1:41PM | Watching performance |
| 36 | 1 | | | W | | | | | 1 | | | 1:42PM | Biking |
| 37 | 2 | | | W | | | | | | 2 | | 1:42PM | Sitting |
| 38 | 1 | 2 | | A | | 1 | | | 2 | | | 1:42PM | Eating |
| 39 | 1 | 1 | | W | | | | | | 2 | | 1:43PM | Walking |
| Total | 104 | 80 | | | | 4 | 8 | 65 | 89 | 12 | | | |

184

**Figure 5.3: Record of on-site observation.**

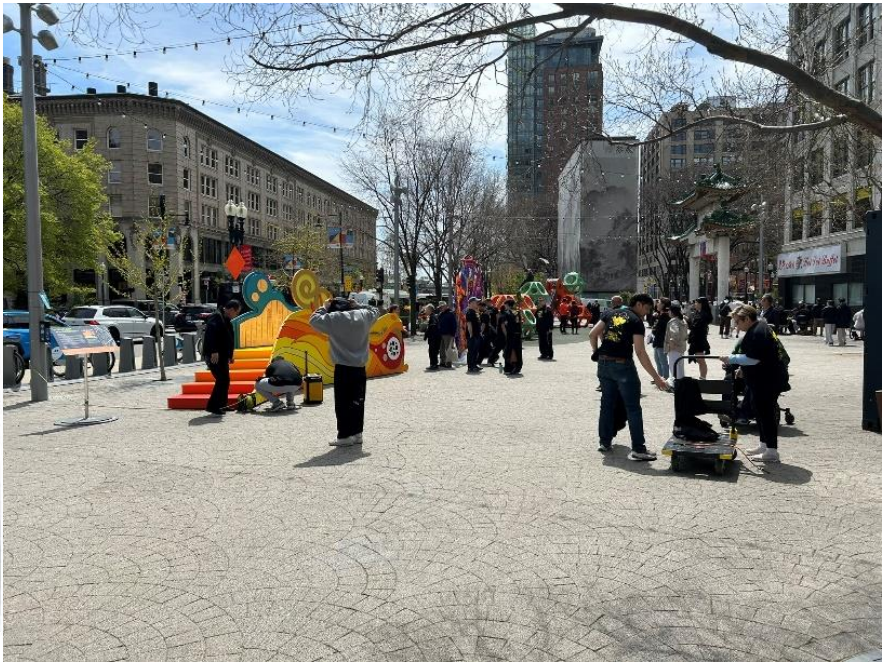


**Figure 5.4: On-site observation photo by Z. Zhu.**

**Limitation:**

- Human error may occur during field observations.
- Some survey and interview participants have only been to the park once, which may have resulted in limited on-site experience.

**Sources:**

Data came from class surveys and my own interviews and field observations.

- ***Provides high aesthetic value according to 80% of 30 survey and interview participants.***

**Calculation:**

- 21 people were surveyed, and 9 people were interviewed.
- The following table and chart show the results. 50% of the users rated the aesthetic value as very high, while 30% said the aesthetic value was extremely high.

| | Low | Average | High | Extremely high | Total |
|---|---|---|---|---|---|
| Surveyed | 1 | 5 | 9 | 6 | 21 |
| Interviewed | 0 | 0 | 6 | 3 | 9 |
| Percentage | 3% | 17% | 50% | 30% | 100% |

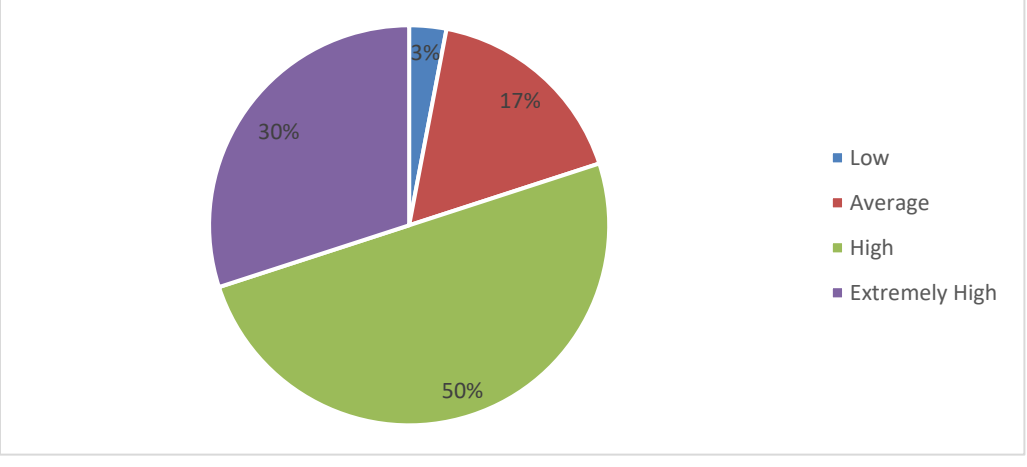



**Figure 5.5: Percentage of the aesthetic value.**

**Limitation:**

- Some survey and interview participants have only been to the park once, resulted in limited experience on-site.

**Sources:**

- Data came from surveys and interviews.

- ***Provides user satisfaction with 77% of 30 survey and interview participants recording they are satisfied or highly satisfied with Chinatown Park. The most common feelings about the space include cultural (10%), dirty (10%), and happy (7%).***

**Calculations:**

- 21 users in total were surveyed, and 9 people were interviewed.
- The following table and chart show the results. 63% of the total interviewees rated the experience in the park as satisfied, while 14% rated the experience in the park as extremely satisfied.

| | Dissatisfied | Neutral | Satisfied | Extremely Satisfied | Total |
|---|---|---|---|---|---|
| Surveyed | 1 | 4 | 13 | 3 | 21 |
| Interviewed | 0 | 2 | 6 | 1 | 9 |
| Percentage | 3% | 20% | 63% | 14% | 100% |

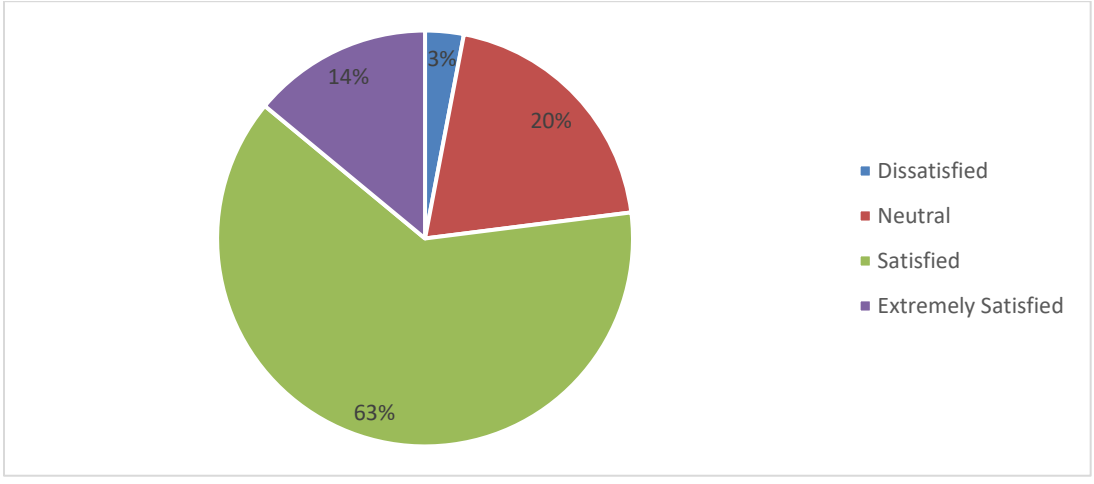



**Figure 5.6: Percentage of satisfaction with Chinatown Park**


**Figure 5.7: Word cloud compiling all the words people described their feelings.**

**Limitation:**

- Some survey and interview participants have only been to the park once, which may have resulted in limited experience on-site.

**Sources:**

- Data came from surveys and interviews.

## Economic I Benefit

- ***Average a 12% increase in adjacent property values of the park after three years of construction (2010), compared to pre-construction (2006).***

**Method:**
Gather adjacent property values of the park from the City of Boston. The pre-construction adjacent property values were compared to those after three years of construction. 6 adjacent property values were compared.

**Calculation:**
The table and bar chart below show the % of increased values of the adjacent property.

- Note: Property 1's property type had changed from industrial to commercial after the park's construction. The change has affected its values. In this case, Property 1 will be considered as an outlier, its value will not be included in the final calculation.
- % of increase = (property values of the park after 3 years of construction – property value pre-construction)/ property value pre-construction

| | 2006 | 2010 | % of increase |
|---|---|---|---|
| *Property 1 Value (Outlier)* | *$2,851,500.00* | *$4,029,000.00* | *41* |
| Property 2 Value | $2,674,000.00 | $2,924,000.00 | 9 |
| Property 3 Value | $3,758,500.00 | $4,440,500.00 | 18 |
| Property 4 Value | $872,000.00 | $930,500.00 | 6 |
| Property 5 Value | $547,500.00 | $572,500.00 | 4 |
| Property 6 Value | $2,287,000.00 | $2,536,500.00 | 10 |
| In total | $12,990,500.00 | $15,433,000.00 | 18 |
| In total (without property 1) | $10,139,000.00 | $11,404,000.00 | 12 |

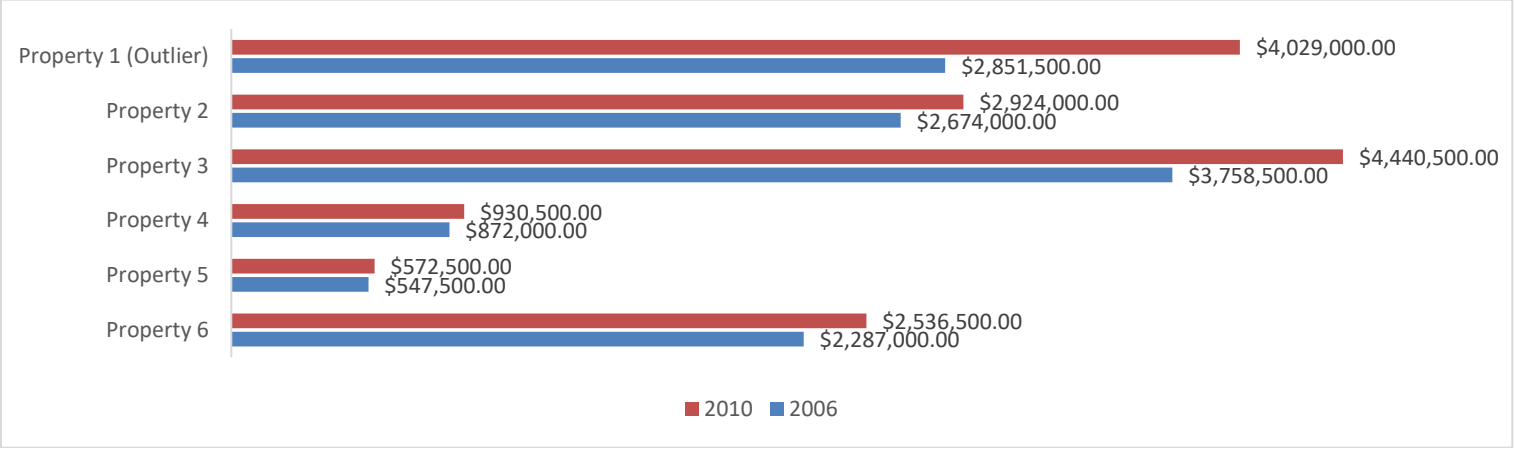



**Figure 5.8: Property value comparison.**


**Figure 5.9: Adjacent properties in Chinatown Park (from Boston Tax Parcel Viewer)**

**Limitation:**

- The increase in land values cannot exclusively be attributed to the introduction of Chinatown Park. Other forces across local, national, and global scales were at play during the study period, affecting the reported data.

**Sources:**

City of Boston: https://www.cityofboston.gov/assessing
Boston Tax Parcel Viewer: https://app01.cityofboston.gov/parcelviewer/

## Lessons Learned

The park's design reflects and respects the cultural heritage of its community. Incorporating Chinese symbolism and cultural elements creates a space that feels authentic and welcoming to residents and visitors alike.

Chinatown Park did a great job of being a versatile space, catering to various needs and activities throughout the day and across different seasons. The heavy usage of the park is a testament to its successful design.

Based on the feedback from the surveys and interviews, the lack of cleanliness in the park is a major concern for the users. Chinatown Park needs more maintenance from the public service.

## References & Sources


- Arcadis IBI Group Chinatown-park: https://www.ibigroup.com/ibi-projects/chinatown-park/
- The Rose Kennedy Greenway - Plants & Landscapes: http://www.rosekennedygreenway.org/visit/plants-landscapes/
- City of Boston: https://www.cityofboston.gov/assessing


## Project Team:

- Landscape Architecture: Arcadis IBI Group (Formerly as Carol R. Johnson Associates)
  Turenscape (sub-consultant at the design competition phase)
- Lighting: AECOM (2023)
- Playground: Richard Dattner and PlayCubes™ (2016 Playground)

# Harvard Science & Engineering Center

150 Western Avenue, Allston, Boston, MA

Jillian Ziegler

## Overview

Built on a former brownfield site, the Harvard Science and Engineering Complex is the first project in the evolution of Harvards Allston, Massachusetts campus. Designed as the new home for the School of Engineering and Applied Sciences (SEAS), the site features a variety of public green spaces, green roof terraces, and sunken courtyards. Sensitive to the nearby river and potential for flooding, an emphasis was placed on stormwater retention and large bioretention ponds were designed to mimic the salt marshes and hummocks of Allston's past. The stormwater system includes a 78,000-gallon reuse tank cutting the potable water needs on site by more than half by supplementing toilet, lab, and irrigation water.

Before Google Maps

After J.Ziegler

Before Google Earth Pro

After Google Earth Pro

## At a Glance

**Designer:** Stephen Stimson Associates
**Former Land Use**: Brownfield
**Completion Date:** 2021
**Awards:** LEED Platinum, Living Building Challenge
AIA COTE® Top Ten Award | 2023
BSLA Merit Award 2024
Best of Design Award in the category of 'Green Building' | 2021

**Project Type:** School/University
**Size:** 274,528 sq. ft.
**Budget:**

## Project Goals

- Retain the majority of the site's stormwater for reuse in the building and irrigation system.
- Provide enjoyable green space for Harvard students and community members.
- Reduce irrigation demand through Smart Irrigation technology and use of native plants.
- Collaborate with Harvard's Arnold Arboretum to sequester carbon and include unique plantings.

## Site Plan

**Source:** Stephen Stimson Associates

## Site Images

Seating Area by Entrance

Top Floor View

Pedestrian Path

Bike Path and Informational Plaque

**Images courtesy of Stephen Stimson Associates**

# Landscape Performance Benefits

## Environmental Benefits

- ***Sequesters 434,392 pounds of CO2 over 20 years with 440 tree plantings compared to conventional planting.***

**Method:**
i-tree is a peer-reviewed software site from the USDA Forest Service that provides various analysis and benefit assessment tools. The i-tree 'Planting' tool was designed to help estimate the long-term environmental benefits from a tree planting project in terms of carbon dioxide, air pollution, stormwater impacts, energy savings, and canopy cover. While it is advertised as a tool that can make a case to developers about planting more trees, it worked well as a simple tool to calculate the carbon savings of these specific species.

**Calculation:**

| TREES | | | | |
|---|---|---|---|---|
| **Scientific Name** | **Common Name** | **Count** | **Native/ Non-native/ Hybrid** | **Conserved** |
| *Amelanchier x grandiflora `Autumn Brilliance`* | `Autumn Brilliance` Serviceberry clump | 3 | Hybrid | |
| *Acer rubrum `October Glory` TM* | October Glory Maple | 4 | Native | |
| *Acer griseum* | Paperbark Maple | 1 | Non-native | yes |
| *Acer saccharum `Green Mountain` TM* | Green Mountain Sugar Maple | 1 | Native | |
| *Acer triflorum* | Three Flowered Maple | 3 | Non-native | |
| *Chamaecyparis thyoides* | Atlantic White Cedar | 15 | Native | |
| *Carpinus caroliniana* | American Hornbeam | 2 | Native | |
| *Celtis occidentalis* | Common Hackberry | 3 | Native | |

**Table 6.1. Sample of Tree Data Entered into i-tree Planting Tool. Source: Stephen Stimson Associates**

Using the tree planting information provided by STIMSON, information for Diameter at Breast Hight, Count, Direction and Distance from building, were entered for each species. Accounting for all the trees classified under Tree and Thicket, 440 trees were planted on site but only 427 were able to be entered for analysis. The i-tree tool processed this information and using the assumptions above, calculated the toal carbon sequestered over 20 years to be 434,392.10 pounds of CO2.

**Limitations:**

- Only 427 of the total 440 trees were accounted for since i-tree did not have the option to include *Heptacodium miconioides* Seven Sons Flower

- DBH provided in the planting list was used for calculations which may not reflect the current day DBH 3 years after project completion
- The i-tree Planting tool only allows for a city to be entered instead of an exact address, which could impact the calculations
- Emissions Factors and Annual Tree Mortality were kept at the standard provided by i-tree which may be inaccurate to this region and have an unknown effect on the total sequestered carbon

**Sources:**

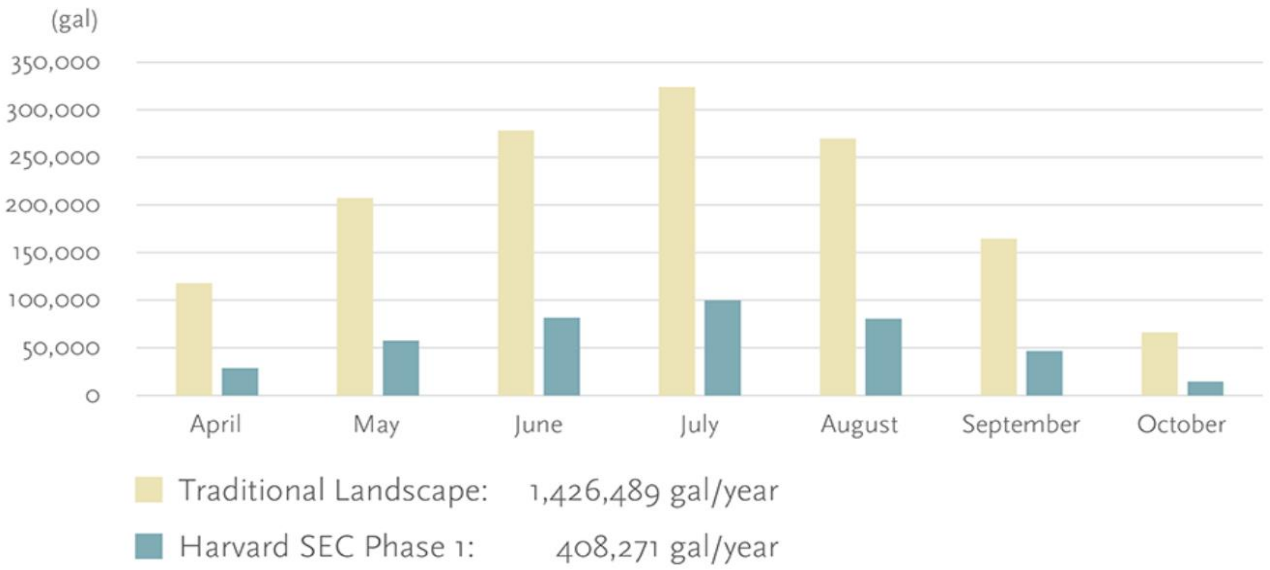
i-Tree Planting. i-Tree Software Suite v5.x. (n.d.). Web. Accessed 2nd of May. 2024. http://www.itreetools.org

- ***Saves an estimated 1,018,218 gallons of water anually by implementing water-conscious landscape design techniques. 42% of 60 species planted are native and 7% are conserved in partnership with the Arnold Arboretum.***

**Methods:**

In order to reduce water consumption on site various strategies were implemented, the most prominent being the 75,000 gallon cistern on site. In addition the the cistern, 5 stormwater basins are set in the landscape to collect and filter rainwater before it enters the cistern below ground (Figure 1). Because a major goal of the project is to reduce water consumption, irrigation demand was lessened by implementing a water-conscious design including reducing turf, planting native species, installing soil moisture and weather sensing, and adjusting watering for rainy/dry and hot/cool weather conditions. Stimson worked with the Arnold Arboretum to choose a variety of plants that would provide native species benefits, landscape interest, and include some popular hybrid or conserved species from the arboretum.

## Expected Irrigation Demand




Traditional Landscape:
Rain Sensor Only (Required by Law in Massachusetts):
Traditional Landscape (80% Turf, 20% Mixed Shrubs, Trees, Groundcovers)
No Smart Irrigation
No Soil Moisture or Weather Sensing,
Set to Apply Enough Water for Peak Summer Demand for minimum oversight

Harvard SEC:
Water-conscious landscape design for integration with stormwater features. Smart irrigation through soil-moisture sensing, allowing irrigation controller to automatically adjust watering for rainy/dry and hot/cool weather.

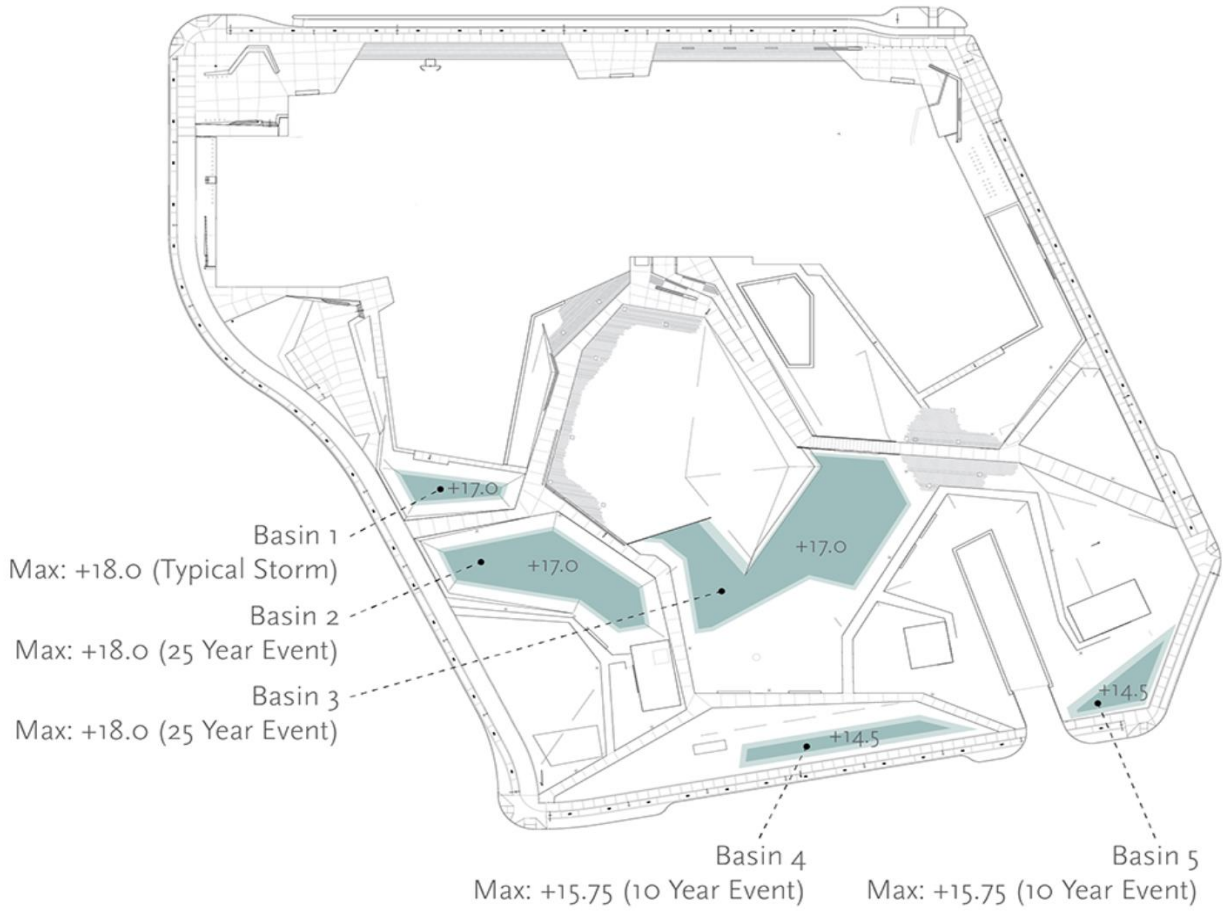



**Figure 6.1. Expected Irrigation Demand Graph and Basin Map.** **Source: Stephen Stimson Associates**

**Calculation:**
Using the graph provided in Figure 1. a traditional landscape is estimated to use 1,426,489 gallons per year on irrigation alone. With the introduction of smart irrigation and water-conscious design techniques the Harvard SEC phase 1 is estimated to use 408,271 gallons per year. This means an estimated 1,018,218 gallons of water savings annually or 71% reduction in irrigation water use.

1,426,489 - 408,271 = 1,018,218 / 1,426,489 = 0.7137 or 71%

One major aspect of the water-conscious design techniques is using lots of plantings instead of turf and making sure to use native species in those plantings. Using the table and chart below, we can see that of the 60 species planted on site

| Species Classification | Count | Percent |
|---|---|---|
| Native | 25 | 42% |
| Non-Native | 24 | 40% |
| Hybrids | 7 | 11% |
| Conserved | 4 | 7% |
| **TOTAL** | 60 | 100% |

**Table 6.2. Native Plant Species Distribution**

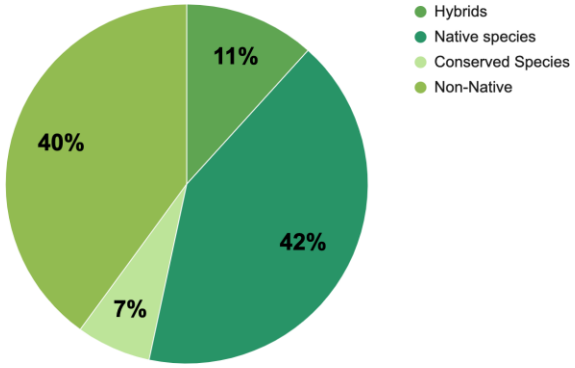



**Figure 6.2. Native Plant Species Distribution**

**Limitations:**
- Without access to the final irrigation savings calculations only the provided estimate can be used which may not reflect the final numbers found by the STIMSON team

**Sources:**
Stephen Stimson Associates for planting information and Figure 1. https://www.stimsonstudio.com/harvard-allston-science-and-engineering-complex

- ***Saved 395,770 gallons of water in 2022 by reusing captured rainwater for irrigation and toilet flushing, compared to conventional water systems.***

**Method:**
In order to reduce water consumption on site various strategies were implemented, the most prominent being the 75,000 gallon cistern on site. This collected rainwater can then be used on site for outdoor or indoor uses. The distribution of water to each of these uses can be tracked by various water sensors allowing the data to be recorded and compared year-to-year. Since the project's opening in late 2021, the first full year of water use was 2022 and that is the year we will be analyzing here. With the assumption that any collected rain water used would have been city water in a conventional system, we can easily compare the amount of water saved using the data below.

**Calculation:**

| Irrigation Water Data 2022 | | | | | | |
|---|---|---|---|---|---|---|
| MONTH | JAN | FEB | MAR | APR | MAY | JUN |
| City Water | 0 | 0 | 0 | 2,843 | 273,212 | 374,229 |
| Rain Water | 0 | 0 | 0 | 0 | 6,546 | 281,096 |
| Total (Gallons) | 0 | 0 | 0 | 2,843 | 279,758 | 655,325 |
| MONTH | JULY | AUG | SEP | OCT | NOV | DEC |
| City Water | 253,464 | 703,092 | 168,424 | 84,287 | 0 | 0 |
| Rain Water | 388,142 | 562,471 | 163,765 | 98,438 | 0 | 0 |
| Total (Gallons) | 641,606 | 1,265,563 | 332,189 | 182,725 | 0 | 0 |
| **Toilet Flush Water Use 2022** | | | | | | |
| MONTH | JAN | FEB | MAR | APR | MAY | JUN |
| City Water | 0 | 522 | 124 | 1,657 | 5,045 | 59 |
| Rain Water | 7,044 | 7,196 | 2,738 | 881 | 2,952 | 1,494 |
| Total (Gallons) | 7,044 | 7,718 | 2,862 | 2,538 | 7,997 | 1,553 |
| MONTH | JULY | AUG | SEP | OCT | NOV | DEC |
| City Water | 464 | 1,129 | 0 | 0 | 18,575 | 26,803 |
| Rain Water | 584 | 607 | 552 | 491 | 443 | 362 |
| Total (Gallons) | 1,048 | 1,736 | 552 | 491 | 19,018 | 27,165 |

**Table 6.3. Irrigation and Toilet Flushing Water Use Data for 2022** **Source: Stephen Stimson Associates**

Using the data provided in Table 4., the total annual savings for 2022 was calculated by finding the sum of rain water from each month from the irrigation sensors then the toilet sensors. The rain water use for each type was then totalled to find the annual savings that year. The total savings came out to 396,770 gallons for 2022.

| Water Savings 2022 | |
|---|---|
| Irrigation | 388,142 |
| Toilet flushing | 7,628 |
| **Total Savings (gallons)** | **395,770** |

**Table 6.4. Total Water Savings in 2022**

**Limitations:**

- Only data from 2022 was analyzed so it is difficult to make generalizations about the typical annual water savings
- It was noted that in the Fall of 2022 some of the toilet sensors experienced issues and were corrected. It is unclear how that impacted the data used in these calculations.

**Sources:**

Stephen Stimson Associates

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## Social Benefits

***Overall Methods:***

**Behavior Mapping**

Behavior mapping, also known as activity mapping, is a type of field observation method which enables real-time recording of how users interact with public spaces and their infrastructure. This can reveal what people do in these spaces, how users activities relate to one another, and how the space encourages or hinders certain activities. The data collected from this method can be used by designers to help articulate the social dimensions of any place, pre-and post-intervention (Bishop, 2024). Behavior mapping was performed once to get an estimate of how Harvard students/faculty/staff and community members interact with the site.

**Surveys**

Due to the sensitive nature of building a survey that avoids being leading or biased, all students went through Human Research Protection Training from the U.S. Department of Health and Human Services (HSS) Office for Human Research Protections (OHRP). The final survey questions were provided by the course instructor, Hongbing Tang, and any edits were approved by her before the

surveys could be conducted. 30 Surveys were conducted in person across two time frames using the set of questions in Appendix 1.

**References:**

Bishop, Kate, Nancy Marshall, Homa Rahmat, Susan Thompson, Christine Steinmetz-Weiss, Linda Corkery, Christian Tietz, and Miles Park. 2024. "Behavior Mapping and Its Application in Smart Social Spaces" *Encyclopedia* 4, no. 1: 171-185. https://doi.org/10.3390/encyclopedia4010015

**Limitations:**

- Since only 30 surveys were answered, low response rates can affect how well the data represents the general population. On a voluntary basis, people may skip certain questions and some answers may contain false or incomplete information. This can introduce bias and errors in data collection

- Behavior mapping should be done repeatedly in different conditions (day of week, weather, time of day). Due to the constraints of the class only one behavior mapping exercise was conducted.

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- ***Promotes outdoor space occupancy by supporting a variety of activities, with 13 activity types reported by: users through 30 surveys and personal observations. Most common activities include walking (32% of surveyed or observed activities), Sitting (21%), and eating outside (20%).***

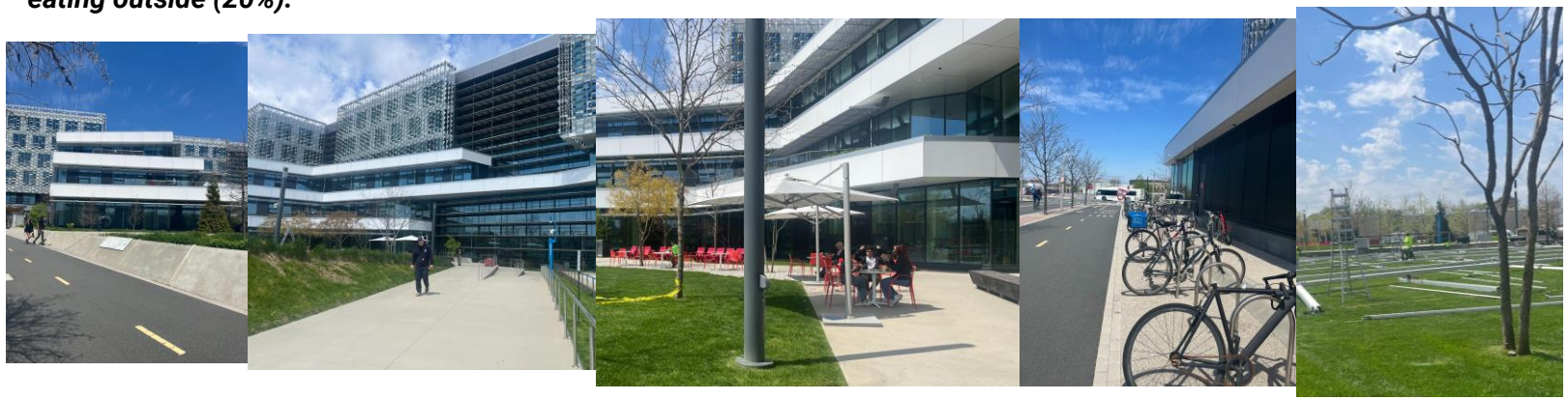

**Figure 6.3. Photos taken on Site May 2nd Showcasing Various Activities**

**Calculation:**

The Harvard SEC outdoor areas provide space for a variety of different activities. A total of 13 activity types was reported by the surveys and observation sessions. The most significant activities include Walking (32%), Sitting (21%), and eating outside (20%).

Additionally, 10% of individuals used the outdoor spaces for meeting friends or coworkers while 4% use the space for studying. Behavior mapping was conducted for a two hour period on May 2nd, 2024 between 11 am and 2 pm in partly cloudy weather with a high of 72 degrees Fahrenheit. During the session 7 activity types were observed

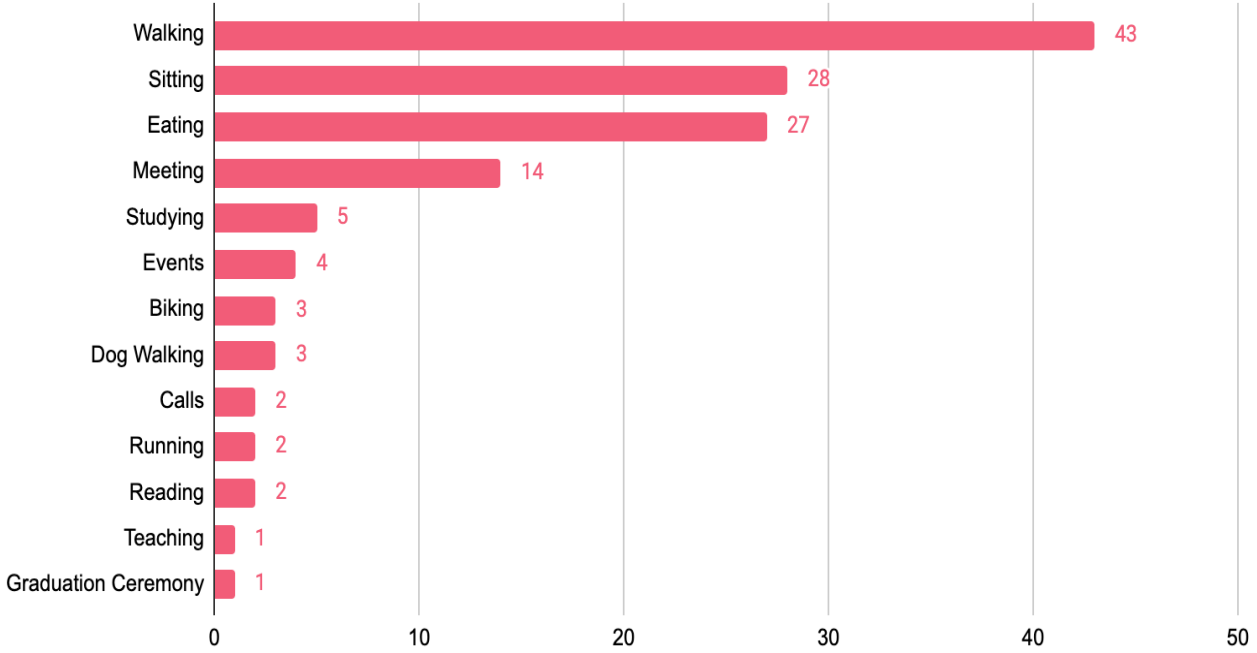


**Figure 6.4. Activity Types Recorded Through Surveys and Observations**

**Limitation:**

- Behavior mapping was only conducted on a single day for two hours when it was still chilly weather. This influences peoples behavior and different activities may have been observed during other sessions in other weather conditions.

**Sources:**
Data came from surveys and my own field observations.

- ***Provides aesthetic value with 83% of 30 surveyed users reporting high or extremely high aesthetic.***

**Calculation:**
30 total participants were surveyed across two time periods. The first surveys were conducted off-cite during a field trip where students from another university were visiting Boston. The second survey session was conducted on site the same day as the behavior mapping. For both sessions the same questions were used. Users were asked to answer the following question:

4. Please rate the aesthetic value of the Harvard SEC open spaces
    1. Extremely Low 2. Low 3. Average 4. High 5. Extremely High

The following chart shows the results. 24% of surveyed users reported the site had Extremely high aesthetic value while 60% reported the site had High Aesthetic value.

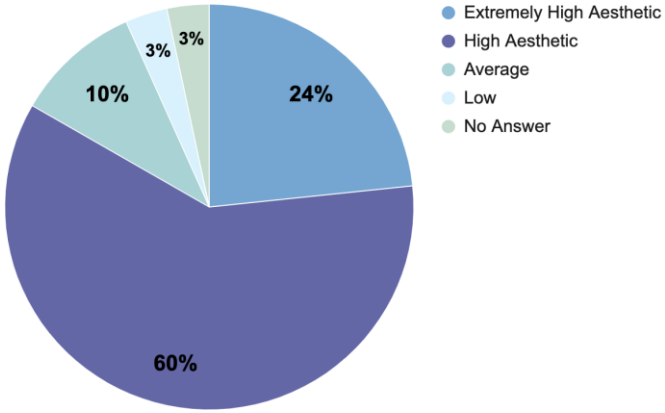


**Figure 5. Survey Results of Aesthetic Value**

**Limitation:**

- Surveys can have inaccuracies especially when conducted off-site as the first half of surveys were
- Only 30 total users were surveyed representing a small percentage of the population that uses the site daily

**Sources:**
Data came from class surveys and my own field observations.

- ***Provides satisfactory experience with 80% of surveyed users reporting they are satisfied or highly satisfied with the Harvard SEC open spaces.***

**Calculation:**
30 total participants were surveyed across two time periods. For both sessions the same questions were used. Users were asked to answer the following question:

6. Rate your satisfaction with your experience in the Harvard SEC open spaces.
    1. Extremely dissatisfied 2. Dissatisfied 3. Neutral 4. Satisfied 5. Extremely Satisfied

Out of the 30 surveyed users 17% reported being highly satisfied with the site while 63% reported being satisfied with the open spaces, 10% said neutral, and 10% did not provide an answer.

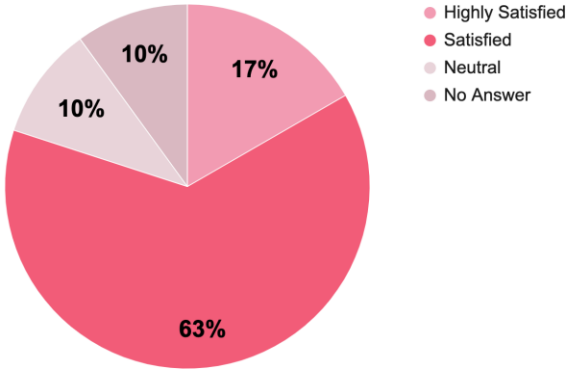


**Figure 6.5. Survey Results of Experience Satisfaction**

**Limitation:**
- Surveys can have inaccuracies especially when conducted off-site as the first half of surveys were
- Only 30 total users were surveyed representing a small percentage of the population that uses the site daily

**Sources:**
Data came from class surveys and my own field observations.

- ***Promotes positive emotional status with most common feelings about the space including happy (30%), calm (17%), and relaxed (17%), with 81% of surveyed users reporting positive emotional status when on site.***

**Calculation:**
30 total participants were surveyed across two time periods. For both sessions the same questions were used. Users were asked to answer the following question:

> 3. What are your feelings or emotional status when you are in the Harvard SEC open spaces? Try to use 2-3 adjectives to describe your feelings.

The following chart and word cloud shows the results. The word cloud shows that the most common word was Happy, with 9 surveyed users or 30% using the term, while Relaxing and Calm both had 5 users of 17% of people surveyed using those words to describe their emotional status at the site. The only negative words used were Cold (7%), Busy (3%), and Stressed (3%).


**Figure 6.6. Word Cloud of Words Users Used to Describe their Emotional Experience**

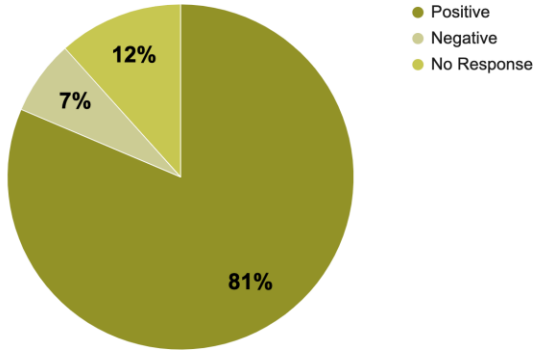


**Figure 6.7. Emotional Status of Surveyed Users while at the site**

By breaking down which emotional statuses mentioned were positive or negative, I was able to make this chart which shows 81% of terms used to describe feeling were positive while only 12% were negative and 7% had no response.

**Limitation:**

- Surveys conducted off site often left this questions blank as it is hard to feel emotions towards a site when not currently experiencing it

**Sources:**
Data came from class surveys and my own field observations.

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## Economic Benefits

- ***Contributed to increased property values in Harvard's Allston campus by an average 87% between 2018 and 2023, when adjusted for inflation.***

**Method:**
Property valuation data was retrieved from the City of Boston 'Boston Tax Parcel Viewer' map. Two periods were recorded to compare the trend in property values on Harvards Allston Campus.

Fiscal Year 2018 (FY2018) takes into account Lower Allston property values before construction of the Harvard SEC
Fiscal Year 2023 (FY2023) takes into account Lower Allston property values after construction of the Harvard SEC

Using the Boston Tax Parcel Viewer interactive map from the City of Boston Analytics Team, lots close to the site could be chosen and some property information would appear. Included in that information is a link to more information will provides the entire property value history for that lot. A total of 25 lots were chosen within a half-mile radius of the site. Each property was evaluated by the percent change in the Assesed Value (includes property and land value) of the lot. To consider inflation between 2018 and 2023, a US inflation rate was applied to the FY2018 values to normalize the data. According to usinflationcalculator.com the inflation rate between 2018 and 2023 was 21.3%. After averaging the percent change for each property, the approximate percent change on Harvards Allston campus showed an 87% Increase in property value from 2018 to 2023.

**Calculation:**
*Sample Data Entry and Calculation for One Property:*

| Parcel ID | Owner | Assessed Value (FY2018) | Assessed Value (FY2023) |
|---|---|---|---|
| 2200510000 | Harvard College | $4,582,000.00 | $5,113,400.00 |

**Table 6.7. Sample Data Entry for Parcel 220051000. Source: City of Boston**

Sample Percent Change Calculation for One Property:

| | | | | | | |
|---|---|---|---|---|---|---|
| $4,582,000.00 | X 1.21 | = | $5,544,220.00 | | | |
| *FY18 Assesed Value* | *X 21% for Inflation* | | *FY18 Adjusted* | | | |
| $5,113,400.00 | - $5,544,220.00 | | -$430,820.00 | | | |
| *FY23 Assessed Value* | *- FY18 Adjusted* | | *Difference* | | | |
| -$430,820.00 | / $5,544,220.00 | = | -0.0777 | X 100 | = | -7.77% |
| *Difference* | / *FY18 Adjusted* | | | percent conversion | | |

Parcel 2200510000, Owner: President and Fellows of Harvard College
Overall Property Value Change for all 20 properties was calculated by summing all the properties percent change and dividing by 20. The total change in property value across all properties is 87% increase.

**Limitation:**

- Only 20 lots surrounding the site were sampled
- This analysis does not account for any changes made to the sampled lots like new construction or change in ownership
- Property rate influx or deflux due to COVID-19 pandemic are likely and could not be accounted for in this small sample

**Sources:**

Boston Tax Parcel Viewer, accessed through the City of Boston Analytics Team website. https://app01.cityofboston.gov/parcelviewer/
US Inflation Calculator Websit

## Lessons Learned

In the process of creating this report we went on many site visits and got to hear about each design project from a firm representative. Through weeks of research and check-in's I learned about conducting surveys, behavior mapping, stormwater analysis, property value comparison and more. By working on the report I also feel more comfortable in my understanding of what a professional report can look like. Through the analysis of my site, the biggest takeaway is the power of collaboration. In order for a project of this type (university) to provide this many benefits, there must be intense collaboration between the university, design firm, engineers, and public. The result is the most sustainable building on Harvards campus

## References & Sources


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## Project Team:

Landscape Architect: Stephen Stimson Associates
Client: The President and Fellows of Harvard College
Architecture: Behnisch Architekten
Laboratory Planners: Jacobs Laboratory Planning Group
General Contractor: Turner Construction Company
Stormwater Design and Permitting: Nitsch Engineering

## Special Thanks:


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