Boston Children's Hospital Master Plan and Implementation Methods

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This investigation was conducted as part of the Landscape Architecture Foundation's 2024 *Case Study Investigation* (CSI) program. CSI matches faculty-student research teams with design practitioners to document the benefits of exemplary high-performing landscape projects. Teams develop methods to quantify environmental, social, and economic benefits and produce Case Study Briefs for LAF's *Landscape Performance Series*.

The full case study can be found at: https://landscapeperformance.org/case-study-briefs/boston-children's-hospital

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Acknowledgements

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Research Strategy

The research team took an immersive fieldwork approach, focusing on the social, aesthetic, and environmental ecologies of the sites; always asking how things could be better and what we can do to address our findings. The research strategies included Surveys + Interviews, Shadowing + Guided Walks (with staff from the hospital maintenance and arts programs), Site Observations + Notes, and Environmental Measurements. The team made multiple visits to the gardens over approximately six months. The approach to fieldwork was both descriptive and prescriptive.

Environmental Benefits

- **Creates 6,503 sf of habitat composed of 78 plant species within the three primary exterior roof gardens. Of these species, 26% are native, 86% have special value for pollinators, 19% provide food or habitat for birds, 64% provide food or habitat for bees or other beneficial insects, and 62% attract butterflies and moths. While most species bloom during the summer, there is a distribution of bloom periods across all seasons.**

Background:

Vegetated rooftops serve as a vital component of the urban fabric by fostering biodiversity and enhancing ecological connectivity, particularly within the context of children's hospitals. These green

spaces provide a sanctuary for various plant and animal species, creating microhabitats that contribute to the overall ecological health of urban environments. These green roofs are situated within a quarter mile from the Riverway, a park situated within the Emerald Necklace.

Quotes from field notes related to Vegetation:

> "The tall Karl Forester Reed Grasses wave gently in the wind and contribute to the gently curvilinear language of the garden. There are redbuds that provide a dappled shade and delicate sense of enclosure to the nook and the corner, which seems to be most popular. "
> -Garrett, Hale Roof, 1:31pm, August, 28th

> "Seasonal blooms add splashes of vivid purples, pinks, and whites, painting the landscape with the unmistakable energy of summer."
> -Shan, Longwood Ave West Entrance, 2:50pm, August 30th

> "Being on the second level, the indoor view to the outside is more like a moving painting—shadows of birch trees sway gently, their leaves rustling softly with the dance of sunlight. The ground is beautifully adorned with large, blue river rocks, adding texture and contrast to the greenery."
> -Shan, Longwood Ave West Entrance, 3:04pm, August 30th

> "The outdoor scene visible through the tall glass includes low, vibrant sedum plants, lush greenery, and towering shade structures."
> -Shan, Art Program Shadowing, 12 Hale Family Garden, 10:17am, Sep 10th

Method:

Plant species inventory was conducted in combination with a review of original plant lists. Species were analyzed for habitat benefits through field observations and by referencing online databases listed in the sources below. Refer to the calculations below and Appendix 03 for the plant list analysis table.

Calculations:

Vegetated Area
(Three primary exterior roof gardens)

Location	*Area (sq. ft.)*
Main 11	2,969.02 sq. ft.
Hale Rooftop	1,406.97sq. ft.
Wishingstone	6,330.03 sq. ft.
Total Vegetated Area	**10,706.02 sq. ft.**
Lawn	4,203 sq. ft.
Total Habitat Area	**6,503.03 sq. ft**

Sources:

Boston Children's Hospital Master Plan & Implementation 100% Construction Documents, Mikyoung Kim Design

Grownative Mass. "Great Resources: Plant Lists and Landscape Guides." Grownative Mass, https://grownativemass.org/Great-Resources/Plant-Lists-Landscape-Guides.

Holm, Heather. Native Perennials for Pollinators. Author & Educator, n.d.

Holm, Heather. Native Trees & Shrubs for Pollinators. Author & Educator, n.d.

Mass Audubon. "Native and Beneficial Plants." Mass Audubon, https://www.massaudubon.org/nature-wildlife/plants/native-beneficial-plants.

New England Wild Flower Society. Native Plants that Attract Pollinators. n.d.

Xerces Society for Invertebrate Conservation. Pollinator Plants for the Northeast Region. 2015.

Limitations:

- The plant species in the garden change due to occasional plant removal and replacement by hospital maintenance staff. As such, the current plant list does not strictly adhere the design intentions of the original planting plan. The change in plant species and plant layout was most significant in the Main 11 rooftop, which was constructed and opened first and thus has undergone more maintenance.
- Plant species inventories were conducted by a research assistant who has significant experience with plant identification but is not a professional horticulturalist. As such, there may be some errors or omissions in the surveys.
- Inventories took place primarily in the fall (November 5, 2024). As such, some foliage had died and significant pruning and removal had been undertaken by maintenance staff, creating limitations to on-site identification of plant species.

- ***Offers a diverse range of microclimatic conditions across the network of gardens, with a difference of about 0.5°C to 1°C, as compared to a single roof garden in the hospital.***

Background:

The design of the Boston Children's Hospital (BCH) Master Plan prioritized the creation of diverse microclimate conditions that evolve throughout the day and across the seasons, ensuring human comfort within the spaces. In evaluating the landscape's performance, the focus extends beyond thermal temperature alone, incorporating the Universal Thermal Climate Index (UTCI). The UTCI is a bioclimatic index that gauges the physiological comfort of the human body in response to specific meteorological conditions (Bröde et al., 2012). It considers not only ambient temperature but also

crucial factors such as humidity, wind, and solar radiation—each playing a significant role in how the body perceives thermal comfort. Through on-site observations done by the research assistants, we found that the garden network effectively provides a variety of climatic conditions throughout the day and across the year.

As noted in the field notes:

> "There is a gentle breeze, so the roof is comfortable in the shade" -- Garrett Craig-Lucas, Aug. 27, 2:15 pm
>
> "In the morning, the garden view is shaded and cool, while by afternoon, sunlight filters through, brightening the space." – Shan He, Sept. 10, 10:25am
> "Warm in sun, cool in shade, people mostly sitting in sun." – Garrett Craig-Lucas, Oct. 19, 1:30pm

Method:

A handheld digital psychrometer (ERAY) was used to measure temperature and air humidity, while a handheld anemometer (BTMETER BT-100) was used to assess air speed.
To analyze the environmental conditions of the rooftop gardens throughout the day, the garden's operating hours (6:00 AM to 9:00 PM) were divided into three time intervals:

- **Morning:** 6:00 AM to 12:00 PM
- **Noon:** 12:00 PM to 4:00 PM
- **Afternoon/Night:** 4:00 PM to 9:00 PM

For each of the three rooftop gardens, 10 evenly distributed measurement points were selected. To ensure data accuracy, measurements were taken at each point over three rounds, with 15-minute intervals between rounds. Each round lasted approximately 45 minutes, allowing sufficient time for thorough data collection across all points.
The average values for each garden and round (temperature, air humidity, air speed, and sun condition) were calculated. These averages were then input into the Universal Thermal Climate Index (UTCI) calculator to generate thermal comfort indices for each garden.

To evaluate and compare the thermal comfort conditions of the network of gardens versus a single garden, we calculated the average UTCI for each garden during the three-time intervals (morning, noon, and afternoon/night). The UTCI values at the 10 interest points were classified into the following categories:

- **Cold (<18°C)**
- **Cool (18–25°C)**
- **Comfortable (25–27°C)**
- **Warm (>27°C)**

Next, we calculated the spatial standard deviation (SD) for each garden. The spatial SD values were especially useful for comparing the diversity of thermal comfort within each scenario. The network of gardens, which included multiple gardens with varying layouts and microclimates, exhibited higher spatial SD, indicating a broader range of thermal conditions at different points. In contrast, a single garden tended to show lower spatial SD, suggesting more uniform thermal comfort across the 10 measurement points.

Calculations:

Wishingstone Garden

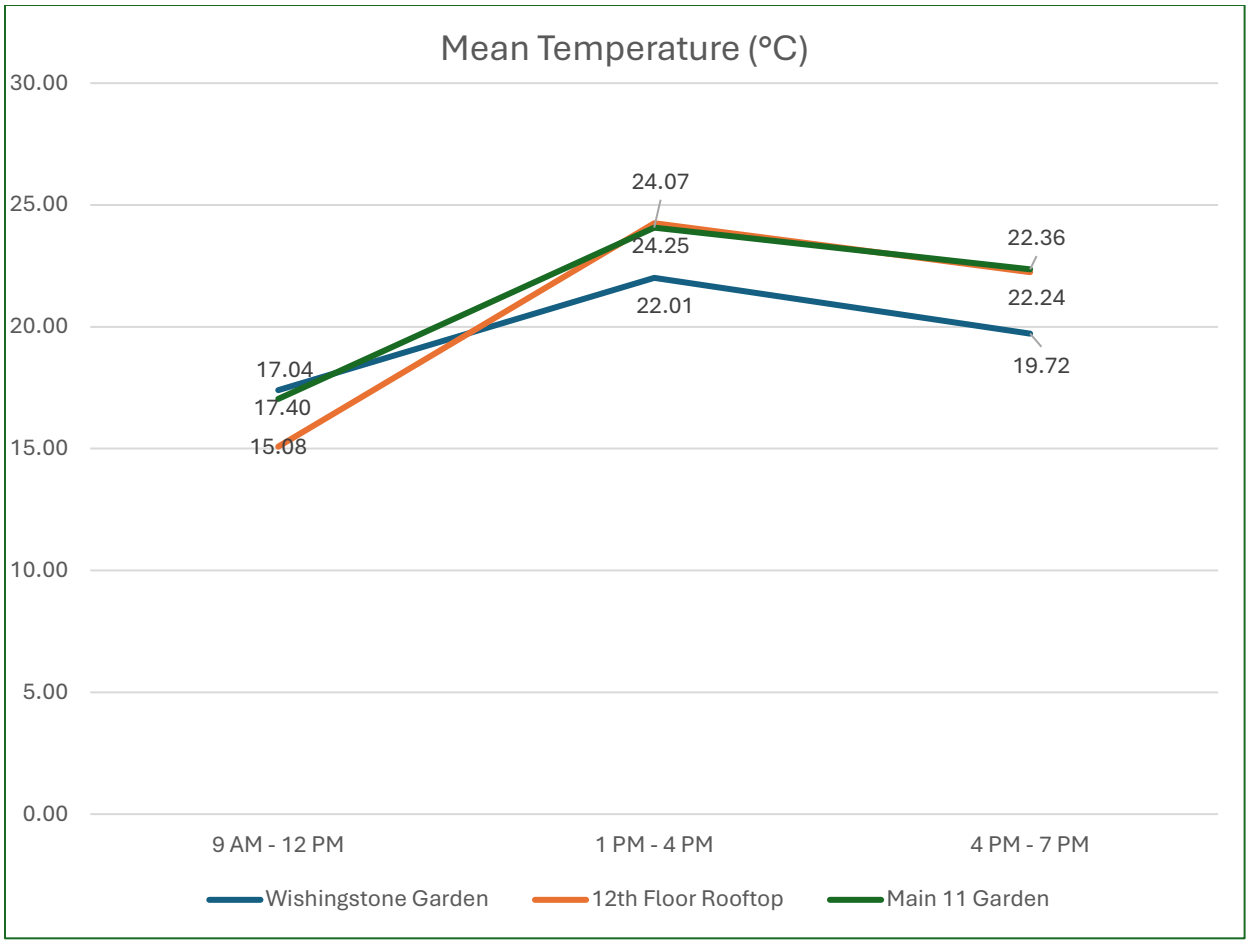
- 9 AM - 12 PM
    - Mean: 17.4°C
    - Spatial SD: 0.33
- 1 PM - 4 PM
    - Mean: 22.009°C
    - Spatial SD: 0.097
- 4 PM - 7 PM
    - Mean: 19.724°C
    - Spatial SD: 0.61

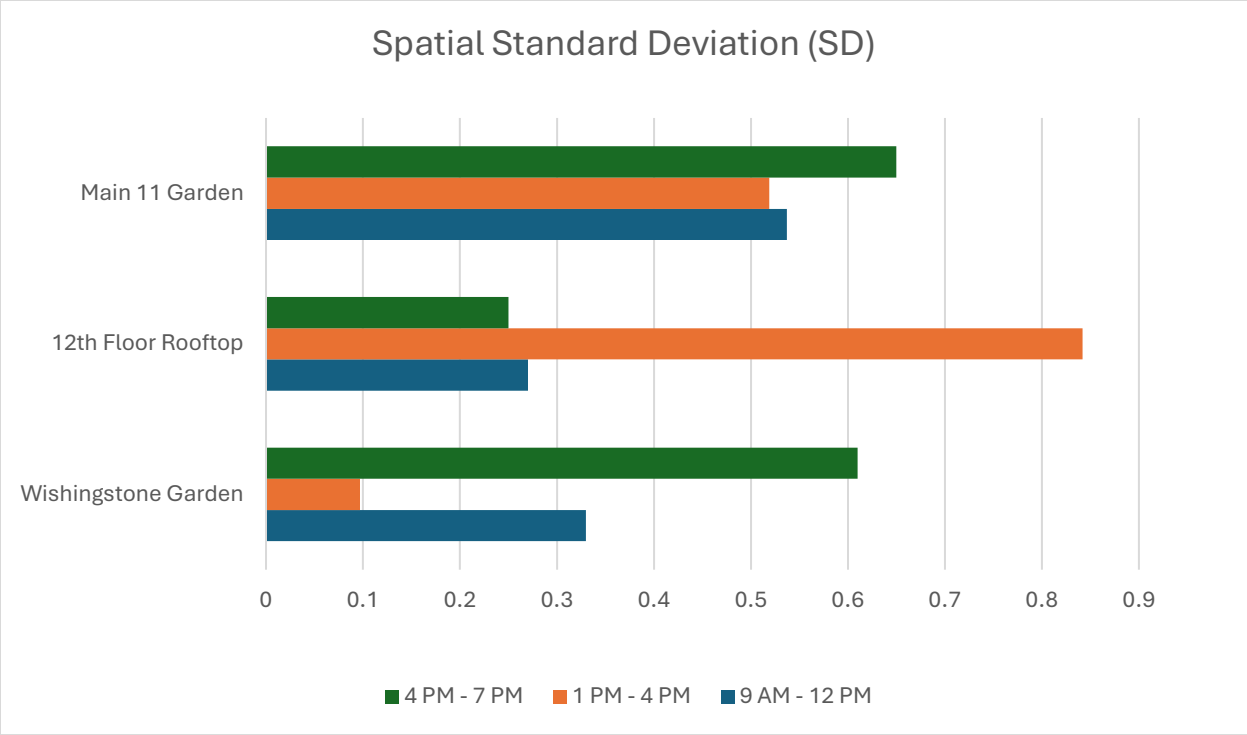
12th Floor Rooftop

- 9 AM - 12 PM
    - Mean: 15.082°C
    - Spatial SD: 0.27
- 1 PM - 4 PM
    - Mean: 24.252°C
    - Spatial SD: 0.842
- 4 PM - 7 PM
    - Mean: 22.24°C
    - Spatial SD: 0.25

Main 11 Garden

- 9 AM - 12 PM
    - Mean: 17.04°C
    - Spatial SD: 0.537
- 1 PM - 4 PM
    - Mean: 24.07°C
    - Spatial SD: 0.519
- 4 PM - 7 PM
    - Mean: 22.36°C
    - Spatial SD: 0.65


Mean Temperature (°C)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
24.07
24.25
22.36
22.24
22.01
19.72
17.04
17.40
15.08
9 AM - 12 PM
1 PM - 4 PM
4 PM - 7 PM
Wishingstone Garden
12th Floor Rooftop
Main 11 Garden



Analysis: Network of Gardens vs. Single Roof Garden (Main 11 Garden)

- **Varied Thermal Experience**:
  The **network of gardens** (comprising Wishingstone Garden, 12th Floor Rooftop, and Main 11 Garden) offers a **more varied thermal experience** compared to a single garden (Main 11 Garden). The mean temperatures across the network of gardens fluctuate more between time periods, with noticeable differences in the **morning**, **afternoon**, and **evening** temperature averages:
    - **Morning** (9 AM - 12 PM): The network of gardens shows an average temperature of **16.51°C**, slightly cooler than **Main 11 Garden** at **17.04°C**.
    - **Afternoon** (1 PM - 4 PM): The network of gardens has a mean of **23.44°C**, while **Main 11 Garden** is slightly warmer at **24.07°C**.
    - **Evening** (4 PM - 7 PM): The network of gardens has a lower mean of **21.44°C**, compared to **Main 11 Garden** at **22.36°C**.

The **difference in temperature** between the network of gardens and **Main 11 Garden** is typically between **0.5°C to 1°C** depending on the time of day. This variation is an indication that the network of gardens offers more **dynamic** and **diverse thermal conditions** across its spaces. This suggests that the **network of gardens** is generally **more consistent** in terms of thermal comfort during the day, especially in the evening, with fewer hot spots or cooler areas.

- **Comfortable Spaces and Variation**:
  The **network of gardens** likely offers a **greater diversity of thermal comfort zones**, as different parts of the network experience slightly different temperatures. For instance:
    - The **12th Floor Rooftop** in the afternoon has a significantly higher temperature (mean of **24.252°C**) compared to the other gardens in the network, leading to some spaces potentially feeling warmer than others.
    - In contrast, **Main 11 Garden** provides more consistent conditions with a more **uniform temperature** range, although it experiences **greater variability in the evening** (with a spatial SD of **0.65**), which could mean some areas are warmer while others are cooler.

This variability across the network of gardens offers opportunities for **diverse thermal experiences**, with some areas being slightly cooler or warmer depending on factors such as sun exposure, wind patterns, and garden layout. For example, **shaded areas** may feel more comfortable in the afternoon, while **sun-exposed areas** may become slightly warmer.

- **Thermal Comfort and Patient Experience**:
  In terms of **hospital roof gardens**, offering a network of gardens with **varied thermal conditions** may provide patients, staff, or visitors with the ability to **select spaces** that align with their preferred thermal comfort. For instance:
    - Those seeking **cooler areas** can gravitate toward spaces like **Wishingstone Garden** during the morning (with a mean of **17.4°C**).
    - **Warmer spaces** like the **12th Floor Rooftop** during the afternoon (with a mean of **24.252°C**) may appeal to those looking for a **sunnier** experience.
    - The **evening** temperatures in the **network of gardens** are **slightly cooler** (mean of **21.44°C**) than in **Main 11 Garden** (mean of **22.36°C**), offering a **calmer thermal environment** for relaxation.

Sources:

Temperature, air humidity, and air speed readings were conducted on-site by the research team

Limitations:

- Assumptions and simplifications: The digital model relies on assumptions and simplifications about material properties, solar radiation, and other variables, which may not fully represent real-world conditions.
- Measurements were taken on a breezy and sunny day in fall. To account for seasonal variations, we also included field notes from the summer and winter.

Social Benefits

Overall Methods

- **Field Observations**

Field observation is a non-intrusive research method used to collect data by observing behavior and interactions within a setting with minimal engagement with the subjects. The researcher tries not to interfere and records what they see and hear. In multiple sessions from August to October, three researchers visited the BCH gardens several times a month in pairs to observe and then document their findings. (Patton, M. 2002)

Patton, M. (2002). Qualitative Research and Evaluation Methods. 3rd Edition. Thousand Oaks, CA: Sage Publications.

- **Surveys**

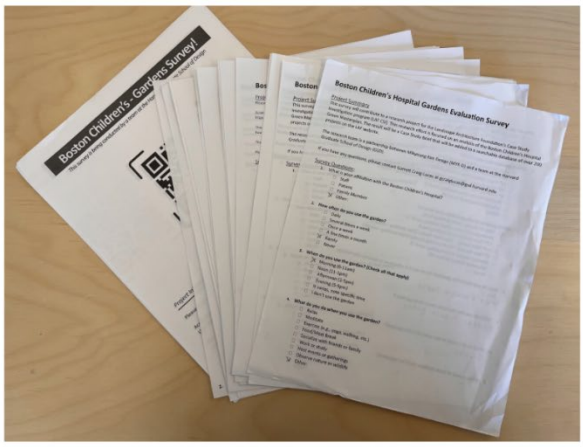
Surveys are a widely-used research method that allows researchers to collect standardized data from a large number of respondents. This method typically offers significant statistical power through larger sample sizes and can include various question types, from multiple-choice to rating scales and open-ended responses. (Jones, Baxter, & Khanduja, 2013) For our study, we initially planned to employ both online and paper-based survey formats, using the same set of questions that guided our interviews (Appendix 02).

However, during implementation, we encountered technical difficulties with the online survey link, rendering the digital responses inaccessible. To address this limitation, we adapted our methodology by focusing on paper surveys and supplementing our data collection with detailed field notes and quick interviews. Our research team conducted these in-person paper surveys during multiple site visits

throughout one week in October. The hospital management team provided valuable support by helping to administer paper surveys to both patients and staff. Through these efforts, we collected 25 physical survey responses during a week in late summer.

This adaptive approach, while different from our initial plan, allowed us to maintain data quality through a combination of standardized surveys, observational field notes, and brief interviews. This mixed-method strategy helped ensure we captured both quantitative and qualitative insights about user experiences, despite the technical challenges encountered.

Jones, T. L., Baxter, M. A. J., & Khanduja, V. (2013). A quick guide to survey research. Annals of The Royal College of Surgeons of England, 95(5), 5-7. https://doi.org/10.1308/003588413X13511609956372



- **Art Therapeutic Program Shadowing**

Shadowing, as defined by McDonald (2005, p. 456), is "a research technique which involves a researcher closely following a member of an organization over an extended period of time." This method entails figuratively trailing a participant as a "shadow" throughout their daily routines, enabling the researcher to document activities through continuous field notes later expanded into comprehensive reports (McDonald, 2005). Unlike interviews, which depend on retrospective accounts, or participant observation, which lacks direct participant commentary, shadowing uniquely combines real-time observation with impromptu interviews and debriefing sessions (Bartkowiak-Theron & Sappey, 2012; McDonald & Simpson, 2014). This dual focus grants access not only to observed events but also to participants' interpretations of their actions, fostering a reflexive process that can yield collaborative insights (Quinlan, 2008; McDonald, 2005).

In this study, shadowing was applied to investigate the role of garden design in the Art Therapeutic Program at Boston Children's Hospital. A member of the research team shadowed the Art Therapeutic Program Coordinator during indoor and outdoor art therapy sessions on September 10th and November 6th, 2023 (9:00 AM–2:00 PM). By accompanying the coordinator through their daily responsibilities—including interactions with pediatric patients and their families—the researcher documented the implementation of art programs and their integration into the hospital's rooftop garden spaces. Brief reflective exchanges with the participant during and after sessions, consistent with shadowing's

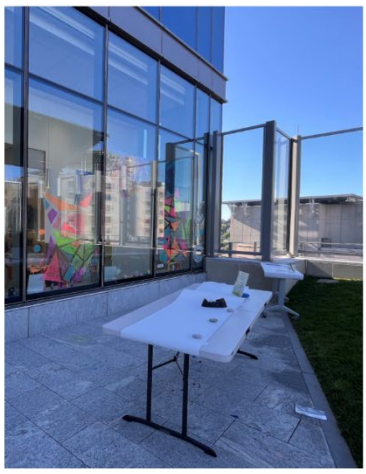
emphasis on collaborative meaning-making (Quinlan, 2008; Bartkowiak-Theron & Sappey, 2012), enriched the observational data, offering nuanced insights into the therapeutic and spatial dimensions of the program.

Bartkowiak-Theron, I., & Robyn Sappey, J. (2012). The methodological identity of shadowing in social science research. Qualitative Research Journal, 12(1), 7–16.

McDonald, S., & Simpson, B. (2014). Shadowing research in organizations: The methodological debates. Qualitative Research in Organizations and Management: An International Journal, 9(1), 3–20.

McDonald, S. (2005). Studying actions in context: A qualitative shadowing method for organizational research. Qualitative Research, 5(4), 455–473.

Quinlan, E. (2008). Conspicuous invisibility: Shadowing as a data collection strategy. Qualitative Inquiry, 14(8), 1480–1499.


While surveys provide valuable data, interviews offer deeper qualitative insights into user experiences. The research team conducted fifteen semi-structured interviews using the "walk-along" methodology (Yaneva, 2020), engaging participants in conversations as they moved through the ground-level gardens and hospital entrance. This approach, rooted in ethnographic practices of observing and interviewing while walking (Yaneva, 2020), allowed researchers to gather real-time observations and feedback as participants experienced the spaces firsthand.

The interview participants represented a diverse group, including staff members, patients, and visitors. Hospital administration assisted in coordinating interviews with staff based on availability, while additional participants were recruited through spontaneous encounters in indoor and outdoor food courts and common areas.

Yaneva, A. (2020). Crafting history: Archiving and the quest for architectural legacy. Cornell University Press.

- ***Provides a diverse range of activities and interaction opportunities, with 38% of 40 surveyed and interviewed visitors using the spaces for rest and relaxation, 23% for meals and breaks, and 11% engaging in activities like art programs and reading.***

Background

The gardens of Boston Children's Hospital (BCH) were redesigned by the Mikyoung Kim Design team to accommodate a variety of needs for hospital visitors. This program aimed to enhance the garden's therapeutic benefits, acknowledging its potential as a relaxing space for healthcare. The layout helps everyone involved—patients, family, and staff—by making it easier to engage in both active and passive engagements. (O'Connell, 2024). A wide range of activities, from eating and lounging to creating art and reading, were considered throughout the planning and building processes. Research showing that encounters with nature increase both patient healing and staff efficiency formed the basis of the design concept. Covered benches, open grass, interactive art displays, and wheelchair-accessible pathways all come together in the garden design to make for a warm and welcoming outdoor area. (Bengtsson & Grahn, 2014)

The research team used data to assess garden usage patterns and visitor preferences, which helped us to understand the garden layout and features. Surveys and informal interviews with visitors were used to acquire these ideas and represent garden users' requirements and BCH experiences.

Quotes from field notes related to garden activities:

> "A woman in a bright green dress passed by, while two others, engaged in conversation just behind me, wore matching pinks that stood out against the landscape" -Anne, August 27, 1:15pm, Wishingstone Garden
>
> "Sunlight streams through the vibrant hues and playful patterns crafted by children on the glass, casting enchanting shadows that dance upon the floor tiles." - Shan, Sep.10, 2024, 74.3°F, 11:34 AM , Hale Family Garden
>
> "The boy repeatedly misses his catch. Twice the ball rolls towards me and rolls under the table a nearby women having lunch. They smile, amused. One of the woman says, "The danger of coming up here for lunch is it is too nice outside and…" her voice trails off." - Garrett, August 28, 12:41pm, Main 11 Garden
>
> "On a bench with my back to the sun a woman to my left lies down on a bench, sunbathing. A young girl runs around and looks through the binoculars to my right, looking up at the sky."- Garrett, August 27, 11:00am, Main 11 Garden
>
> "There are many folks here for lunch – well, about 5-7. Inside, there are some children and families participating in the Arts Program."- Garrett, August 30, 1:31pm, Hale Family Garden

Method:

Over a week, the research team collected data through a user survey (Appendix 02) and informal conversations with garden visitors at Boston Children's Hospital. This approach combined quantitative survey data with qualitative insights from direct interactions, offering a well-rounded view of how people use the gardens. (We received 25 surveys and conducted 15 semi-structured interviews. While online Surveys due to website tech issues are not accessible)

Three members of the research team visited the gardens multiple times during the summer and fall seasons. The research team spent dozens of hours observing the behavior and activities of garden visitors and taking field notes, understanding their preferences and activities.

Calculations:

The research team conducted a survey analysis of garden usage among visitors at Boston Children's Hospital, focusing on how the redesigned garden spaces foster a diverse range of activities. The primary data collected came from 40 visitors through on-site methods:

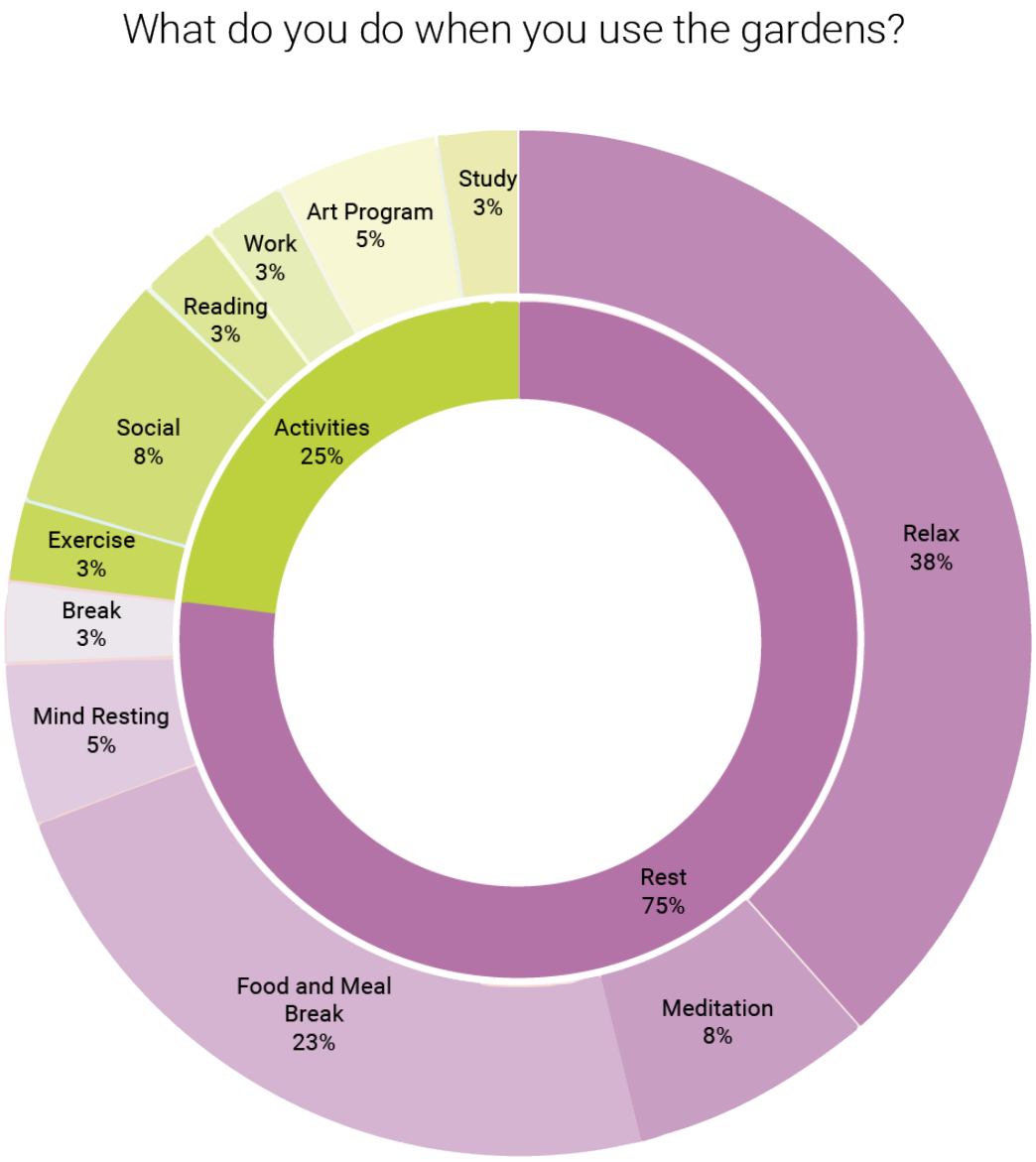
Rest and Relaxation: 15 visitors (38%) reported using the garden primarily for rest and relaxation, including specific activities such as meditation (8% of total) and taking mental breaks (5% of total).

Meals and Breaks: 9 visitors (23%) utilized the garden for consuming meals and taking breaks, demonstrating its utility as a space for nourishment and rest.

Active and Social Engagement: A total of 4 visitors (11%) engaged in activities that foster social interactions and personal enrichment, such as participating in art programs (3%) and reading (3%).

Exercise and Work: A smaller proportion of the surveyed population used the garden for exercise (3%) and work-related activities (5%).

The annual estimate of garden activities can be determined using these percentages, considering that Boston Children's Hospital experiences a significant volume of outpatient visits and inpatient admissions each year.



Sources:

Background Reference:

O'Connell, K. (2024, April). An expanding range of projects caps a year of milestones at Mikyoung Kim Design. Landscape Architecture Magazine.

Bengtsson, A., & Grahn, P. (2014). Outdoor environments in healthcare settings: A quality evaluation tool for use in designing healthcare gardens. Urban Forestry & Urban Greening, 13, 878-891. https://doi.org/10.1016/j.ufug.2014.09.007

Survey Data: Collected from 25 hard copy surveys and 15 quick interviews conducted on-site.

Informal Conversations: Additional qualitative insights gathered during casual interactions with garden visitors.

Limitations:

Sample Size and Representation: The relatively small sample size may not fully represent the entire population of hospital visitors.

Short Duration of Data Collection: Data was collected over a single week in summer, which may not capture the full range of activities throughout different seasons or times of the year.

Online Data Not Accessible: Online Surveys are not accessible due to website tech issues and have not been included in this analysis, which could adjust the percentages reported.

- ***Positively impacts the frequency and quality of outdoor interaction among visitors, with 35% of 40 surveyed visitors using the garden several times a week and an additional 15% using it daily, facilitating regular connection with nature in a hospital setting.***

Background:

When Mikyoung Kim Design redesigned the gardens at Boston Children's Hospital, they focused on creating spaces that encourage social interaction and frequent outdoor engagement. This strategy stemmed from recognizing how regular, meaningful contact with nature significantly benefits hospital visitors' well-being, especially in healthcare environments. (O'Connell, 2024).

By distributing gardens across different buildings and rooftops, the design team made these natural spaces more accessible to visitors, enabling easier and more frequent visits that support patients' recovery journey.

The project was guided by evidence-based design principles that recognize natural environments' vital role in improving mental health and physical healing. Post-implementation research, including surveys and observational studies, revealed high utilization rates, with many visitors accessing the gardens multiple times per week. These findings confirm that the gardens serve as essential wellness resources while successfully meeting the diverse needs of the hospital community. (Bengtsson & Grahn, 2014)

Quotes from field notes and quick interviews related to garden usage frequency:

> "One little boy was particularly enchanted by the process of painting on the glass. He and his father spent a long time working together, their laughter and concentration filling the garden with warmth."- Shan, Sep.10, 2:14 pm, Shadowing in Art Therapeutic program in Hale Family Garden
>
> "I had a chance to converse with a middle-aged woman walking her large Labrador—a 73-pound service dog she brings out 3-4 times a day. Her daughter is a patient at the hospital, and while there

are several parks around the hospital, she especially prefers this one and the Wishing Stone."- Shan, Aug 30th, 1:30 pm, Longwood Ave West Entrance

"As I came up the elevator, I overheard one woman taking another man up to the roof garden. She said something like, "You'll mainly be on 6,7, 8, perhaps 10. Whereas 6 garden people need to badge into, 10 is open. You can come up here when you want – for lunch, whatever."- Garrett Craig-Lucas, Aug. 27, 11:00 am, Main Roof

Method:

Data was gathered through a structured survey questionnaire (Appendix 02) distributed over a one-week period to visitors of Boston Children's Hospital gardens. The survey specifically asked visitors about the frequency of their garden use, aiming to quantify how often people engage with the garden spaces. This approach allowed the collection of generic, non-location-specific statements from respondents, ensuring broad applicability of the findings.

Calculations:

The research team surveyed a total of 40 visitors to the Boston Children's Hospital gardens regarding their frequency of garden use, and the following distribution of usage was noted:

Daily Use: 15% of visitors reported using the garden daily, signifying a strong daily engagement with the space.

Several Times a Week: The largest group, comprising 35% of the total survey participants, visits the garden multiple times a week.

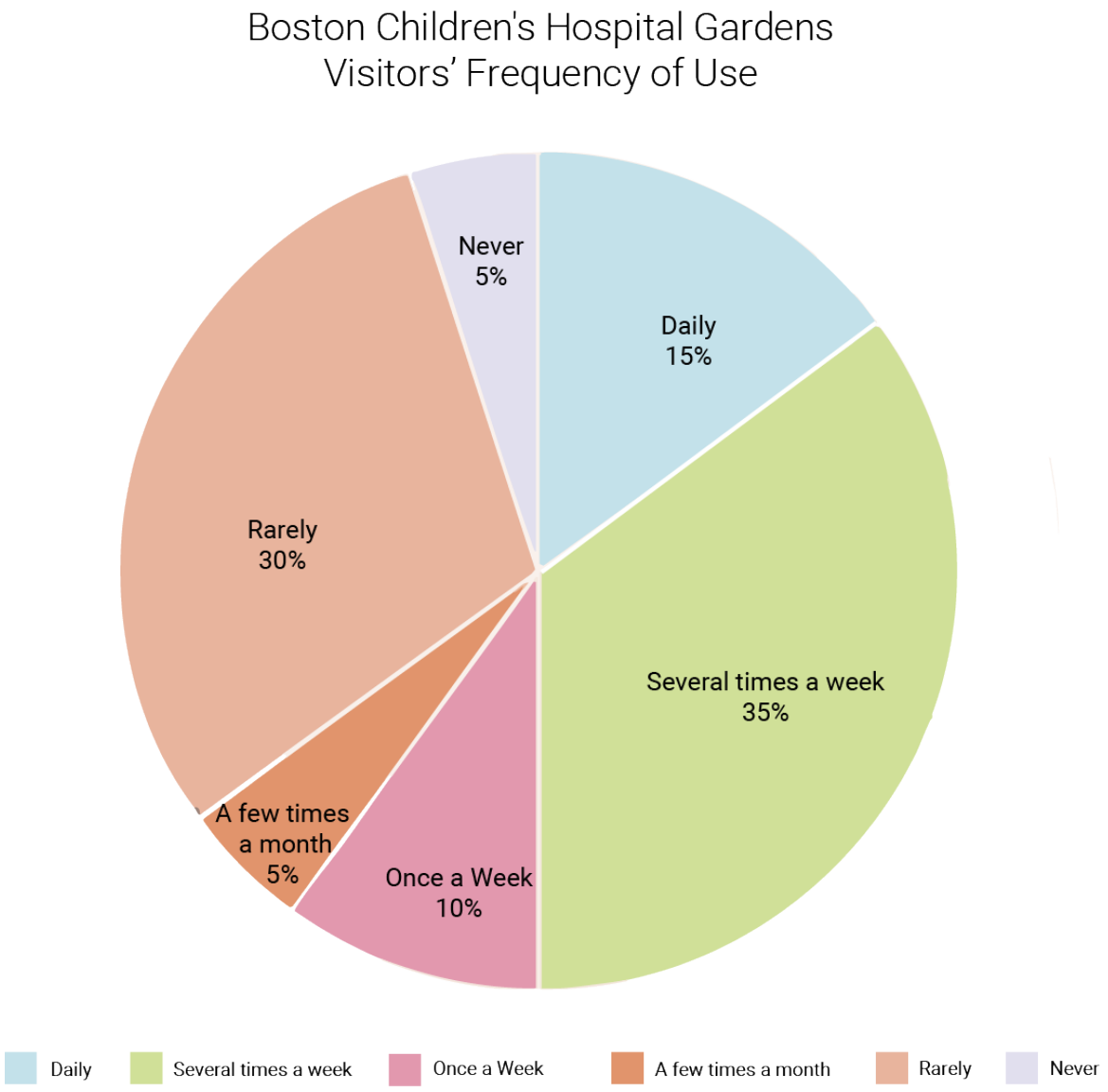
Once a Week: A smaller group, 10% of respondents, engages with the garden on a weekly basis.

A Few Times a Month: Only 5% of visitors reported using the garden a few times a month.

Rarely: 30% of the respondents rarely use the garden, indicating infrequent engagement.

Never: A minimal percentage, 5%, stated they never use the gardens.

The total annual estimate of garden visits can be calculated based on these percentages, given that Boston Children's Hospital has a large number of outpatient visits and inpatient stays annually.



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Survey Responses: Data collected from 40 respondents via hard copies of questionnaires and quick interviews filled out during visits to the garden.

Observational Notes: Informal observations noted by researchers during the survey period to supplement and corroborate survey findings.

Limitations:

Response Bias: Potential for bias in self-reported data, where visitors may overestimate their use of the garden.

Short Data Collection Period: Data collected over one week in summer may not fully represent typical usage patterns throughout different seasons or special events.

Sample Size: While 40 respondents provide initial insights, a larger sample size would help to confirm trends and provide more statistically significant results.

Generalizability: Results are specific to three hospital's roof garden and may not be directly applicable to other settings without similar environmental and design characteristics.

- ***Offers substantial emotional benefits according to descriptions from visitors, with the gardens frequently described as 'calming', 'peaceful', and 'relaxing' by 90% of 40 surveyed and interviewed visitors, thus promoting stress relief and enhancing mental well-being within the hospital environment.***

Background:

The integration of healing gardens into healthcare facilities, particularly in pediatric hospitals, represents a key confluence of therapeutic design and mental wellbeing. When Mikyoung Kim Design designed the Boston Children's Hospital gardens, they hoped they might be more than merely outdoor areas. Gardens in BCH could have a significant impact on emotional healing and psychological wellbeing. (O'Connell, 2024)

Our study focuses on **the emotional impact these gardens have on visitors, staff, and patients**. We explore how these thoughtfully designed areas aid the broader healing process. This is especially important in pediatric settings, where reducing stress and providing psychological comfort are key to recovery.

Systematic observations, interviews, and data gathering in our study have shown compelling evidence of the gardens' tremendous emotional effects. Most visitors use positive phrases to characterize these regions, showing that the gardens are accomplishing their therapeutic objectives. Notably, these places provide important breaks from the hospital's clinical ambiance, allowing periods of serenity and emotional refreshment in a tough environment like a pediatric hospital.

Method:

Data was collected through a structured questionnaire survey (Appendix 02) over a one-week period, targeting visitors to Boston Children's Hospital gardens. The survey asked participants to describe their emotional responses to the garden using 3-5 adjectives. This method was complemented by face-to-face conversations that provided deeper insights into the emotional impacts, ensuring that the findings reflect a broad range of experiences and are not confined to specific geographic or personal biases.

Calculations:

A total of 26 distinct adjectives were used by visitors to describe their experiences in the garden. The adjectives were used a total of 167 times across all feedback. These frequently used words highlight the positive emotional impact of the garden on visitors.

Positive Responses: Ninety percent of these adjectives were positive, indicating favorable emotional reactions to the garden.

Most Frequent Words: The words "peaceful," "calm," and "relaxing" were the most frequently used, each appearing over 30 times.

Secondary Frequent Adjectives: The words "happy," "refreshing," and "beautiful" also appeared frequently, each cited more than 20 times.

The respondents articulated their emotions and observations on the roof gardens, highlighting the beneficial effects on their emotional experience and overall well-being.

The following quotes are from quick interview notes:

"Sitting in the garden, watching the flowers, gives me a sense of peace that's hard to find anywhere else in the hospital," shared one hospital staff

"The sound of birds and bees and the sight of green space is genuinely soothing during stressful times," remarked a patient.

"I come here to clear my head and feel refreshed; it's like a sanctuary; I always feel rejuvenating." mentioned another outpatient.

"This garden helps my child relax before appointments. It's calm here, unlike the busy waiting rooms," a parent commented.

"I love having lunch in the garden. It lets me relax and forget work for a bit before I get back to my shift," says one of the nurses.

"My son really looks forward to our garden time. He just loves to watch the clouds as he lies in the sun. It helps him forget he's at the hospital," a parent comments.

"Last week's painting session in the garden was a hit, especially with the kids. Seeing them paint and have fun really brightened the day," mentions a hospital art therapist.

Sources:

Data gathered from forty participants by means of hard copy surveys and brief interviews conducted during site visits to the garden. Researchers made informal notes during the survey period to support and enhance the results.

Background Reference: O'Connell, K. (2024, April). An expanding range of projects caps a year of milestones at Mikyoung Kim Design. Landscape Architecture Magazine.

Limitations:

Response Bias: Emotional responses can be subjective and may be influenced by personal health conditions or specific experiences on the day of the visit.
Weather Influence: The survey was limited to one week in late summer, potentially missing varied emotional responses due to weather changes or different garden conditions.
Sample Diversity: The sample might not fully represent all demographics that visit the hospital gardens.

- ***Maintains comfortable noise levels, below 70 decibels, throughout 100% of outdoor garden spaces. 43% of the outdoor garden spaces offer a quieter experience compared to the overall average noise levels across the gardens.***

Background:

During the design process, Mikyoung Kim Design focused on integrating the sound conditions with the spatial programming, taking into account the hospital's restrictions on placing noisy machinery. This approach was key in ensuring a comfortable auditory experience for those within the garden. Through scientific measurements and on-site observations, including detailed field notes, we identified the diverse soundscape of the space and observed how people used the garden in response to these acoustic conditions. This revealed a pattern that contributed to the tranquil and welcoming atmosphere throughout the garden network.

Quotes from field notes related to sound:

> "Though the sound of the AC and ventilation is still noticeable, in the quieter moments I can hear cicadas or crickets in the background, adding a natural element that contrasts with the otherwise intense atmosphere." – Anne Tong, Aug. 27, 1:15 pm

> "Most visitors arrived alone, with one pair bringing lively conversation and laughter that rippled through the tranquil space." – Anne Tong, Sept. 10, 11:45am

> "The bench along the perimeter host two women laying on the back with their feet up, napping in the sun." – Garrett Craig-Lucas, Aug. 28, 12:41 pm

Method:
One iPhone was used to run the Decibel X V9.9.0(17537) app.

To analyze the sound conditions of the rooftop gardens throughout the day, the garden's opening hours (6:00 AM to 9:00 PM) were divided into three-time intervals:

- **Morning:** 9:00 AM to 12:00 AM
- **Noon:** 1:00 PM to 4:00 PM
- **Afternoon/Night:** 4:00 PM to 7:00 PM

For each of the three rooftop gardens, 10 evenly distributed measurement points were selected. To ensure data accuracy, measurements were taken at each point over three rounds, with 15-minute intervals between rounds. Each round lasted approximately 45 minutes, allowing time for thorough data collection across all points.

During each measurement period, the average noise level for each individual point within the garden was calculated. Additionally, the overall average noise level for the entire garden space was calculated as well. These averages served as benchmarks for comparison. Points of interest within the garden,

where the noise levels were consistently below the overall average, were then identified. These quieter zones were counted and analyzed to understand the proportion of the garden offering reduced noise levels. This approach allowed for a clear identification of areas with lower noise, which were then compared to the overall noise environment of the garden.

Calculations:

From 9 a.m. to 12 p.m., the average noise level across three outdoor garden spaces is 63.4 decibels. In Wishingstone Garden, 4 out of 10 points of interest have noise levels below this average. In the 12th Floor Garden, 7 out of 10 points fall below the average, while in the Main 11 Garden, 3 out of 10 points are below the average. Overall, 46.7% of the spaces provide a quieter experience, calculated as (4 + 7 + 3) / 30 * 100.

Wishingstone Garden

9am-12pm	
Location Point	**Noise (dB)**
1	64.27
2	65.63
3	63.93
4	61.50
5	63.17
6	63.27
7	63.87
8	62.77
9	63.78
10	63.99
Avg	**63.62**

4

12th Floor Garden

9am-12pm	
Location Point	**Noise (dB)**
1	60.57
2	61.27
3	60.55
4	61.20
5	61.87
6	62.10
7	64.53
8	67.20
9	63.32
10	64.88
Avg	**62.75**

7

Main 11 Garden

9am-12pm	
Location Point	**Noise (dB)**
1	63.03
2	66.17
3	65.00
4	63.73
5	63.53
6	61.47
7	63.77
8	63.97
9	62.73
10	64.83
Avg	**63.82**

From 1 p.m. to 4 p.m., the average noise level across the three garden spaces is 61.88 decibels. In Wishingstone Garden, 1 out of 10 points of interest has a noise level below the average. In the 12th Floor Garden, 7 out of 10 points fall below the average, and in the Main 11 Garden, 1 out of 10 points is below the average. This results in 30% of the spaces offering a quieter experience, calculated as (1 + 7 + 1) / 30 * 100.

Wishingstone Garden

1pm-4pm	
Location Point	**Noise (dB)**
1	63.57
2	66.13
3	64.07
4	61.20
5	62.57
6	62.80
7	63.17
8	63.23
9	63.97
10	63.43
Avg	**63.41**

5

12th Floor Garden

1pm-4pm	
Location Point	**Noise (dB)**
1	49.97
2	60.44
3	44.97
4	59.87
5	61.47
6	62.70
7	63.60
8	66.80
9	57.67
10	58.88
Avg	**58.64**

Main 11 Garden

1pm-4pm	
Location Point	**Noise (dB)**
1	62.27
2	66.90
3	65.07
4	63.83
5	63.73
6	61.57
7	63.14
8	63.30
9	62.83
10	63.40
Avg	**63.60**

From 4 p.m. to 7 p.m., the average noise level across the three garden spaces is 63.59 decibels. In Wishingstone Garden, 5 out of 10 points fall below the average. In the 12th Floor Garden, 7 out of 10 points fall below the average, and in the Main 11 Garden, 4 out of 10 points have noise levels below the average. Overall, 53.3% of the spaces provide a quieter experience, calculated as (5 + 7 + 4) / 30 * 100.

Wishingstone Garden

4pm-7pm	
Location Point	**Noise (dB)**
1	63.83
2	66.20
3	64.40
4	61.10
5	63.33
6	62.47
7	63.57
8	62.83
9	64.50
10	64.00
Avg	**63.62**

5

12th Floor Garden

4pm-7pm	
Location Point	**Noise (dB)**
1	59.97
2	61.17
3	60.20
4	60.83
5	63.64
6	61.63
7	64.50
8	67.43
9	62.93
10	64.53
Avg	**62.68**

Main 11 Garden

4pm-7pm	
Location Point	**Noise (dB)**
1	63.17
2	68.50
3	65.80
4	64.71
5	63.27
6	62.38
7	62.79
8	63.67
9	65.13
10	65.20
Avg	**64.46**

In summary, the average percentage of points with quieter noise levels across the three time periods is (46.7 + 30 + 53.3) / 3 = 43.3%. This indicates that, on average, 43.3% of the points in the garden network offer a quieter experience compared to the overall average noise levels across the gardens.

Sources:

Noise level readings were conducted on-site by the research team.

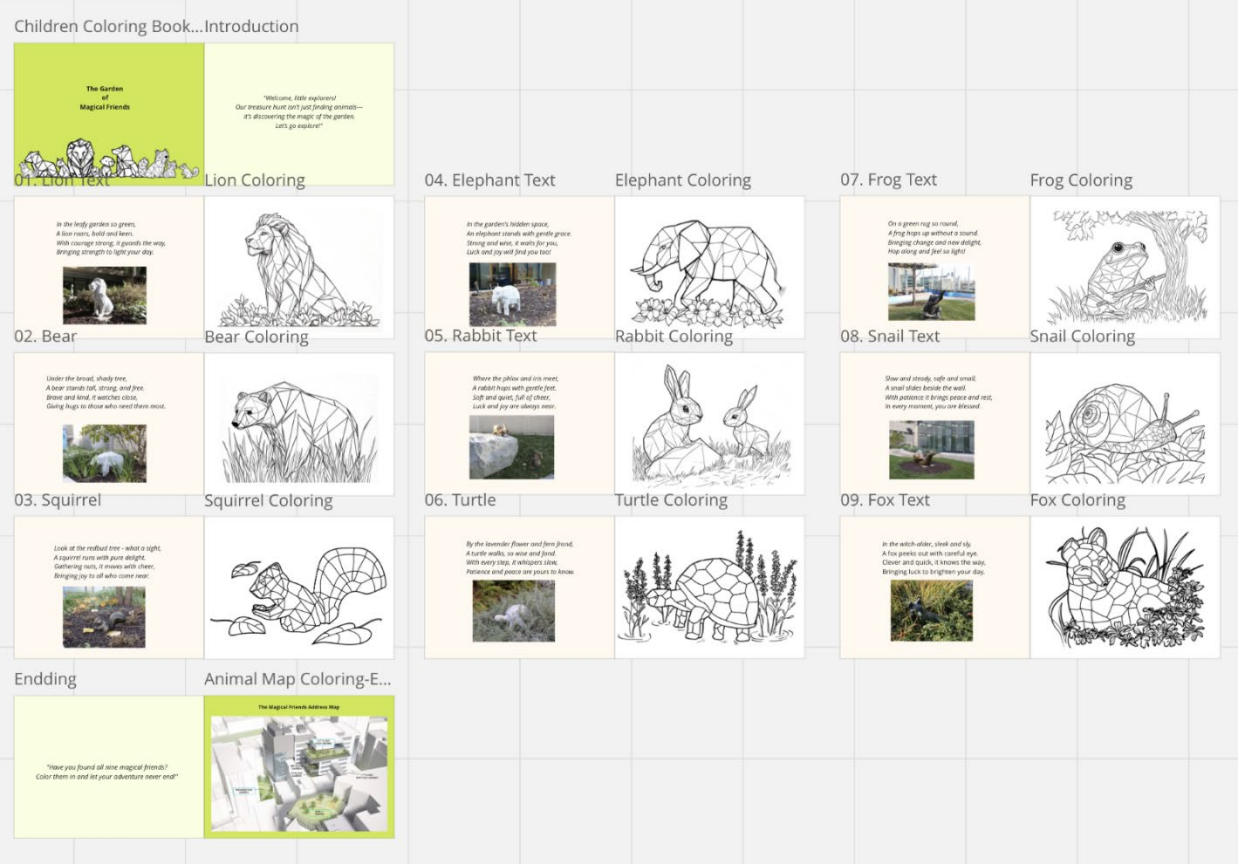
Limitations:

- Device Accuracy: The iPhone and Decibel X app may not provide the same level of accuracy as specialized, professional-grade sound measurement equipment.
- Sampling Time: Measurements were taken on a day with minimal visitors to focus primarily on the landscape's ability to mitigate hospital machinery noise. However, during peak hours (typically weekdays), the space experiences additional noise sources that were not accounted for in this study.

Appendix 00: Children's Coloring Book

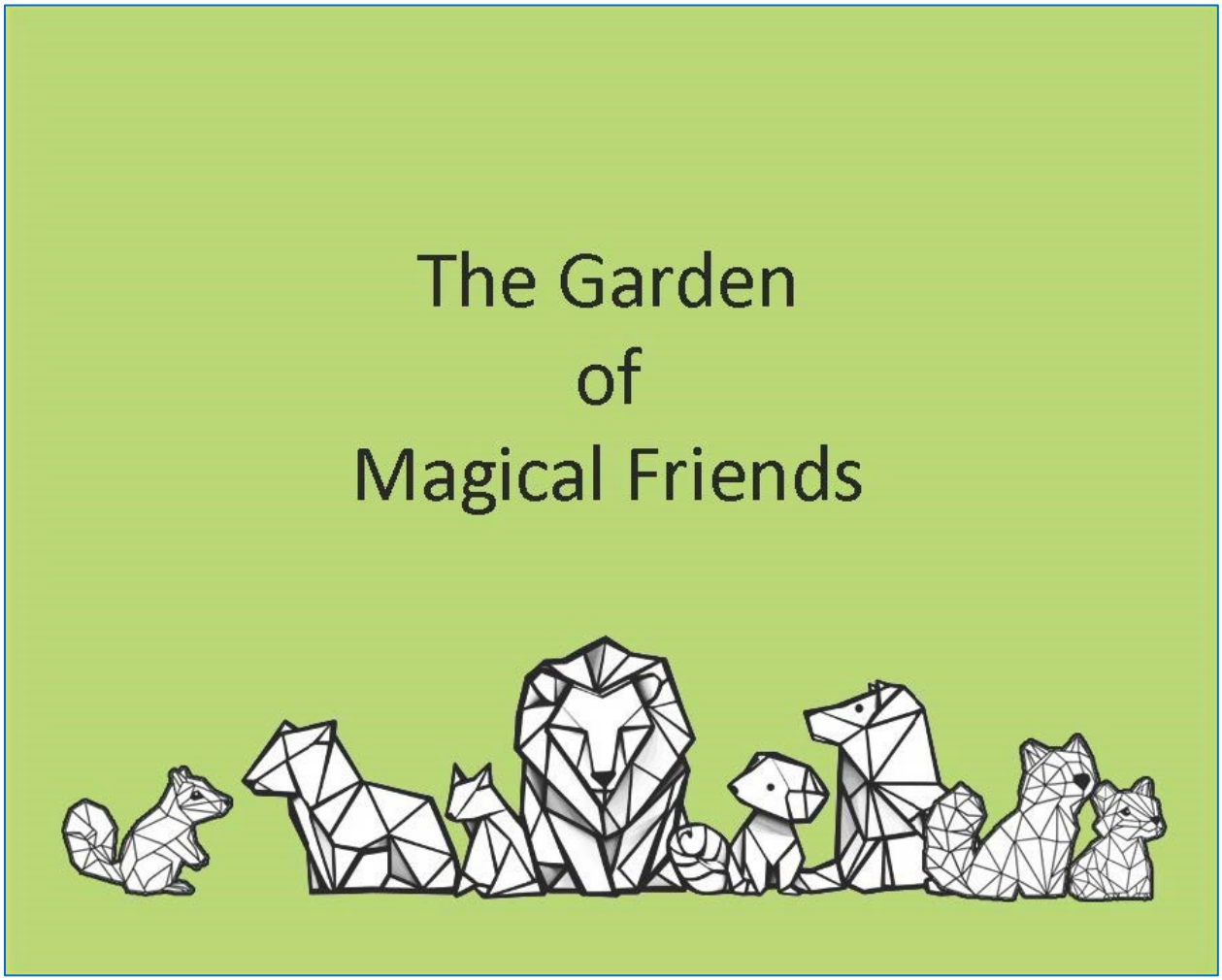
The research team compiled a coloring book, based on the animal sculptures from the gardens, to help familiarize patients with the gardens. The book has the following aims:

- **Educational Engagement:** offers children the opportunity to engage with the stories of the sculptures and the concept of healing gardens.
- **Emotional Healing:** offers a way to engage with and interpret the gardens to foster relaxation and joy, supporting children's recovery.
- **Cultural Enrichment:** connects children to stories behind the sculptures, enhancing their appreciation for art and nature.

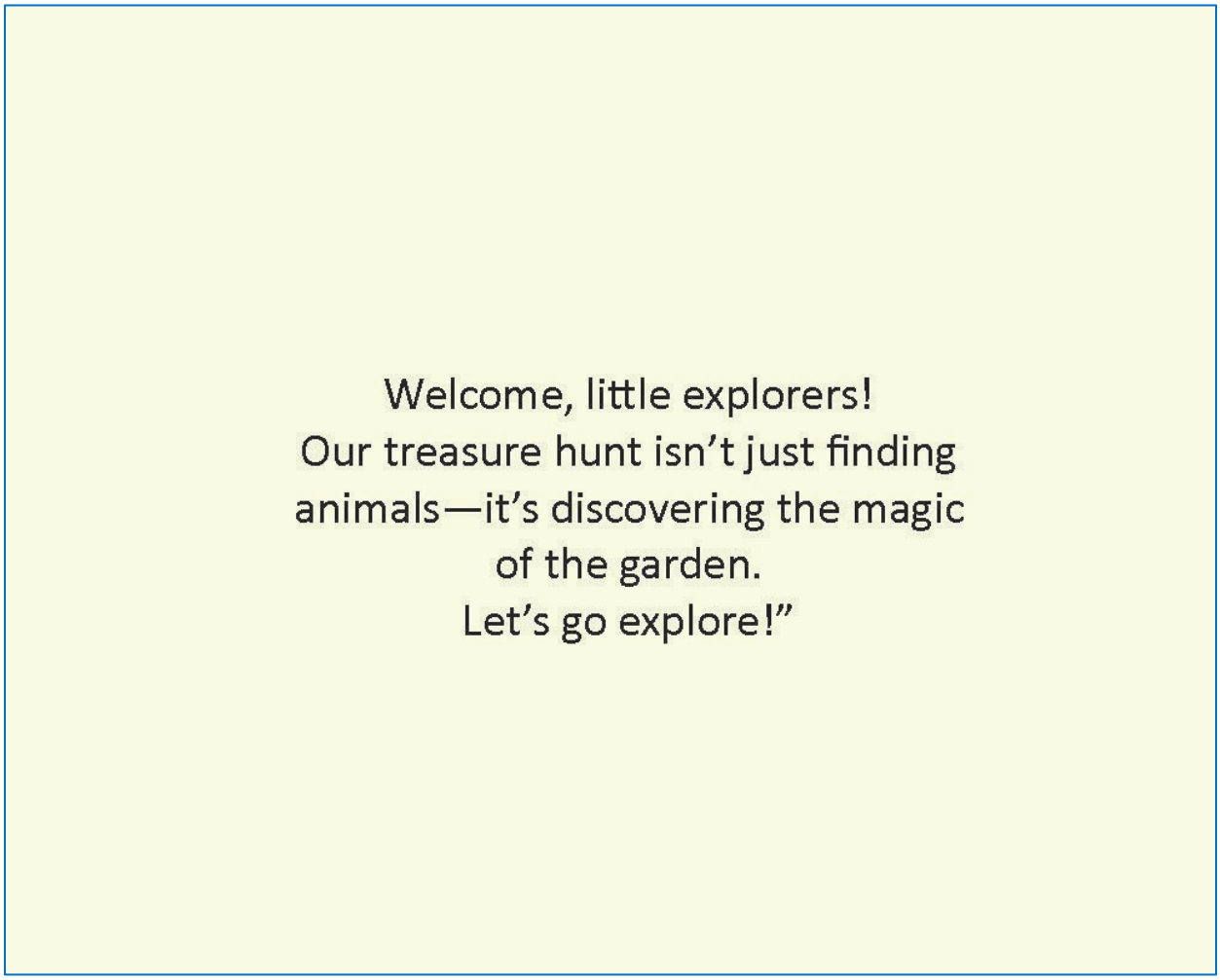


(Full Books are on following pages)

Cover Page 00:



Page 01:


Welcome, little explorers!
Our treasure hunt isn't just finding
animals—it's discovering the magic
of the garden.
Let's go explore!"

Page 02:

Three Gardens:

11 Floor Main Garden

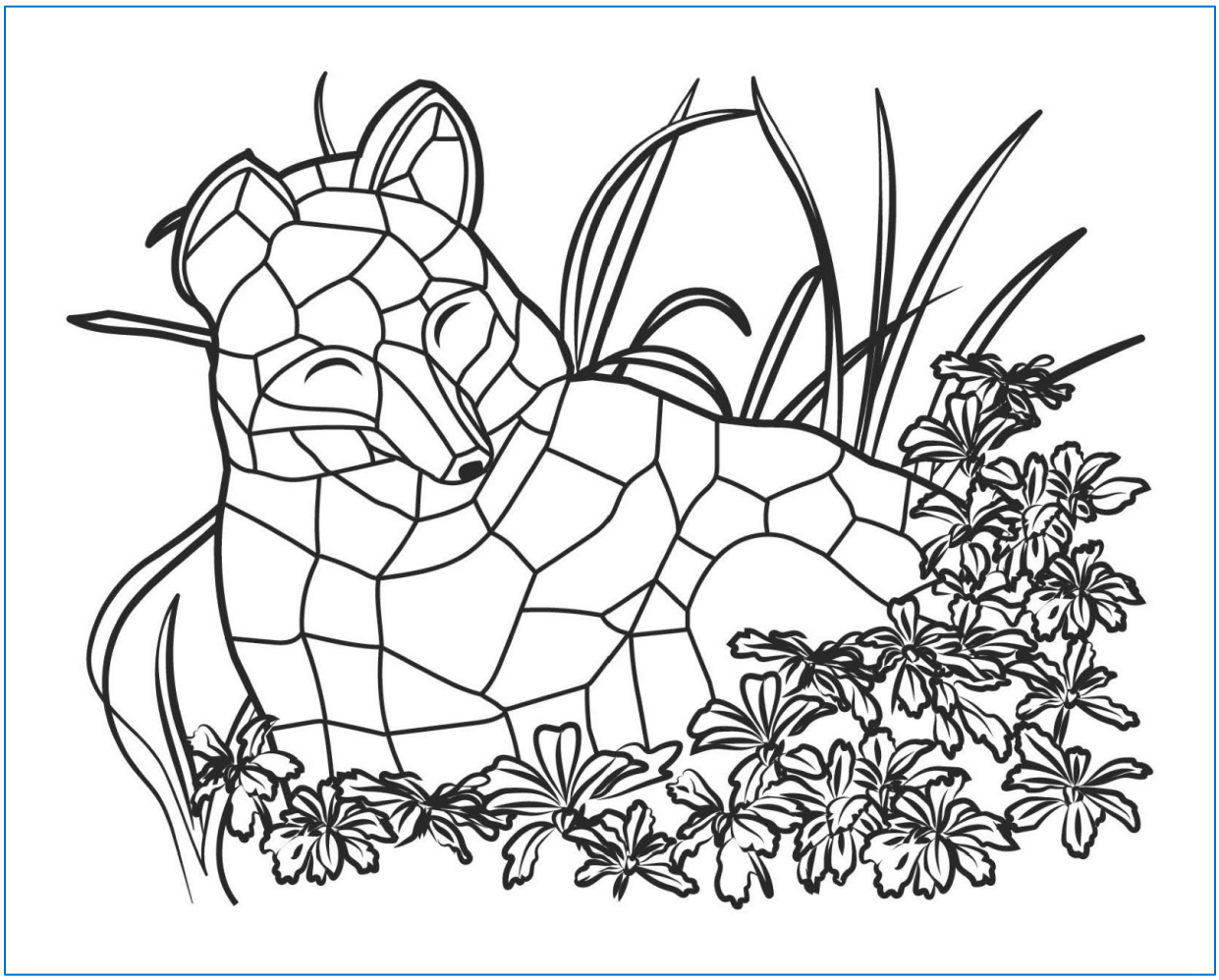
12 Floor Hale Garden

Wishing Stone Garden

Page 03.

In the witch-alder, sleek and sly,
A fox peeks out with careful eye.
Clever and quick, it knows the way,
Bringing luck to brighten your day.

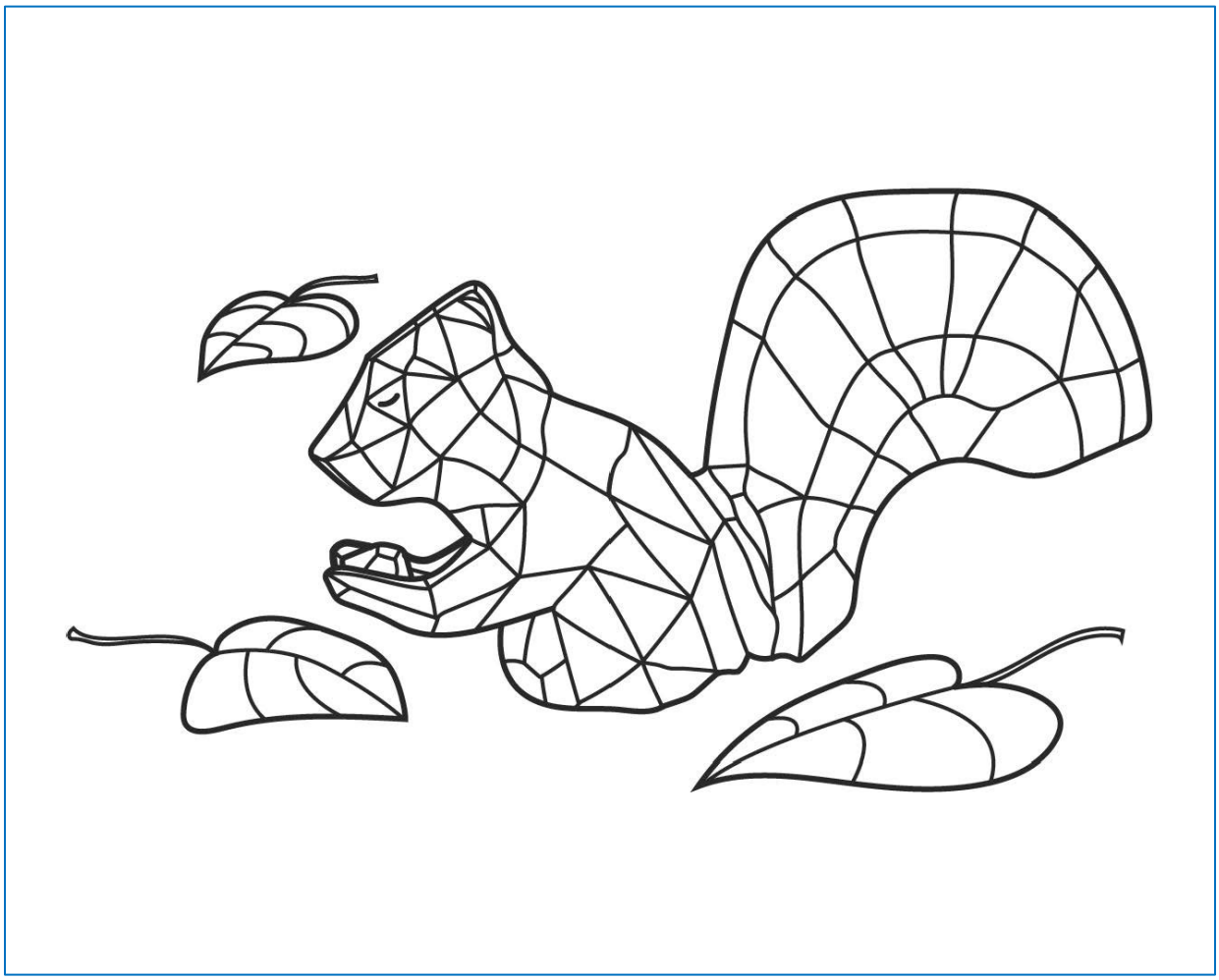
Page 04.



Page 05.

Look at the redbud tree - what a sight,
A squirrel runs with pure delight.
Gathering nuts, it moves with cheer,
Bringing joy to all who come near.

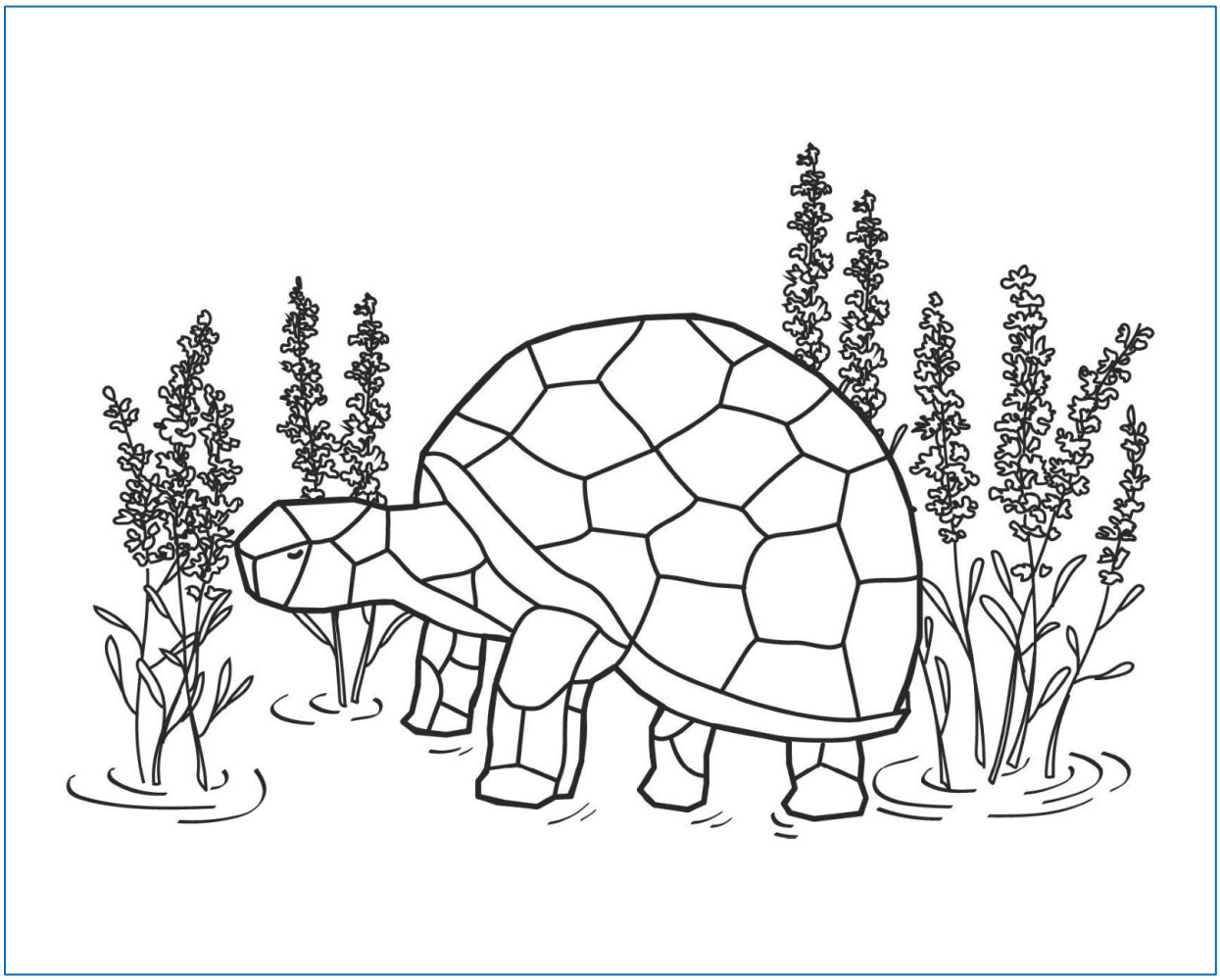
Page 06.



Page 07.

By the lavender flower and fern frond,
A turtle walks, so wise and fond.
With every step, it whispers slow,
Patience and peace are yours to know.

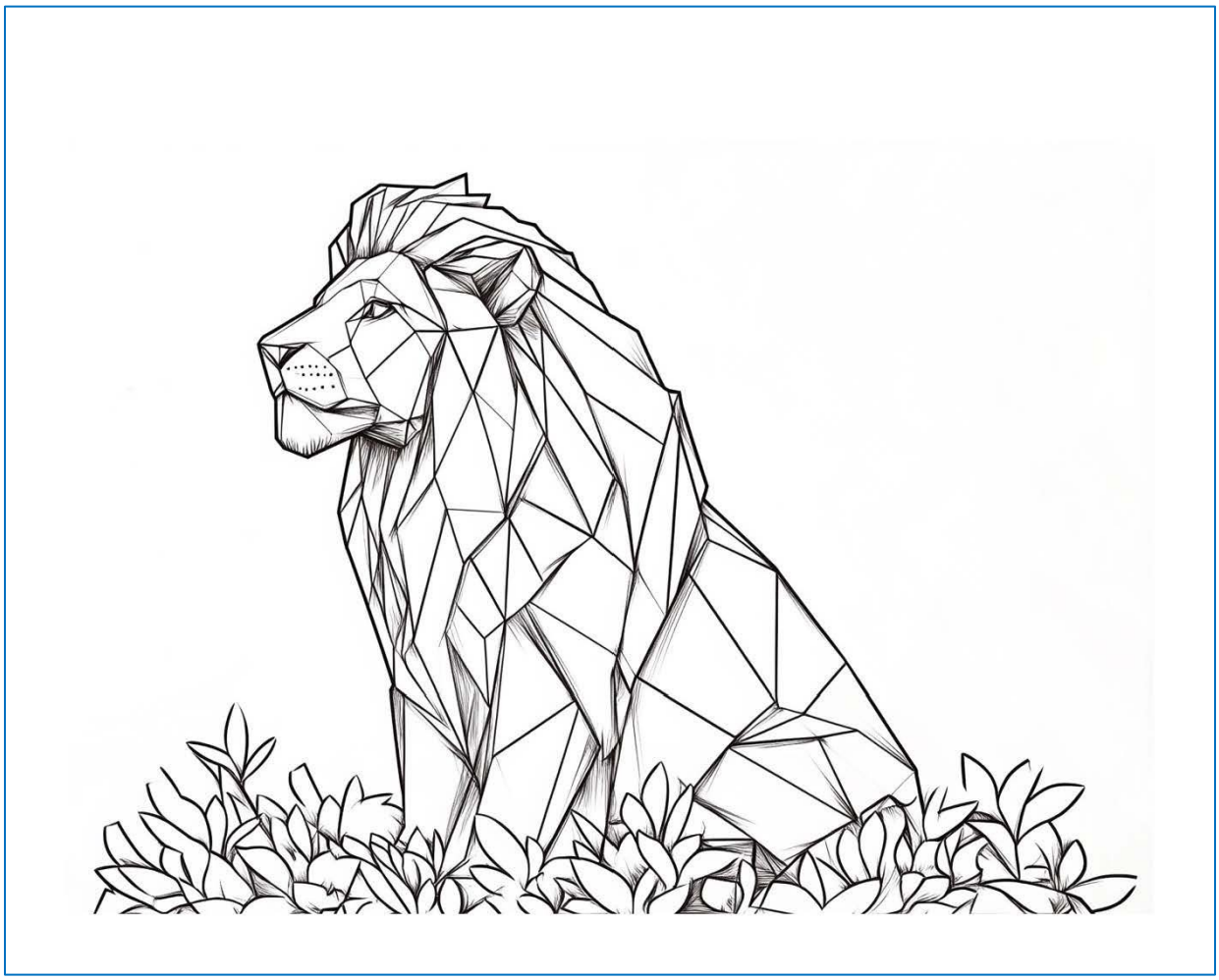
Page 08.



Page 09.

In the leafy garden so green,
A lion roars, bold and keen.
With courage strong, it guards the way,
Bringing strength to light your day.

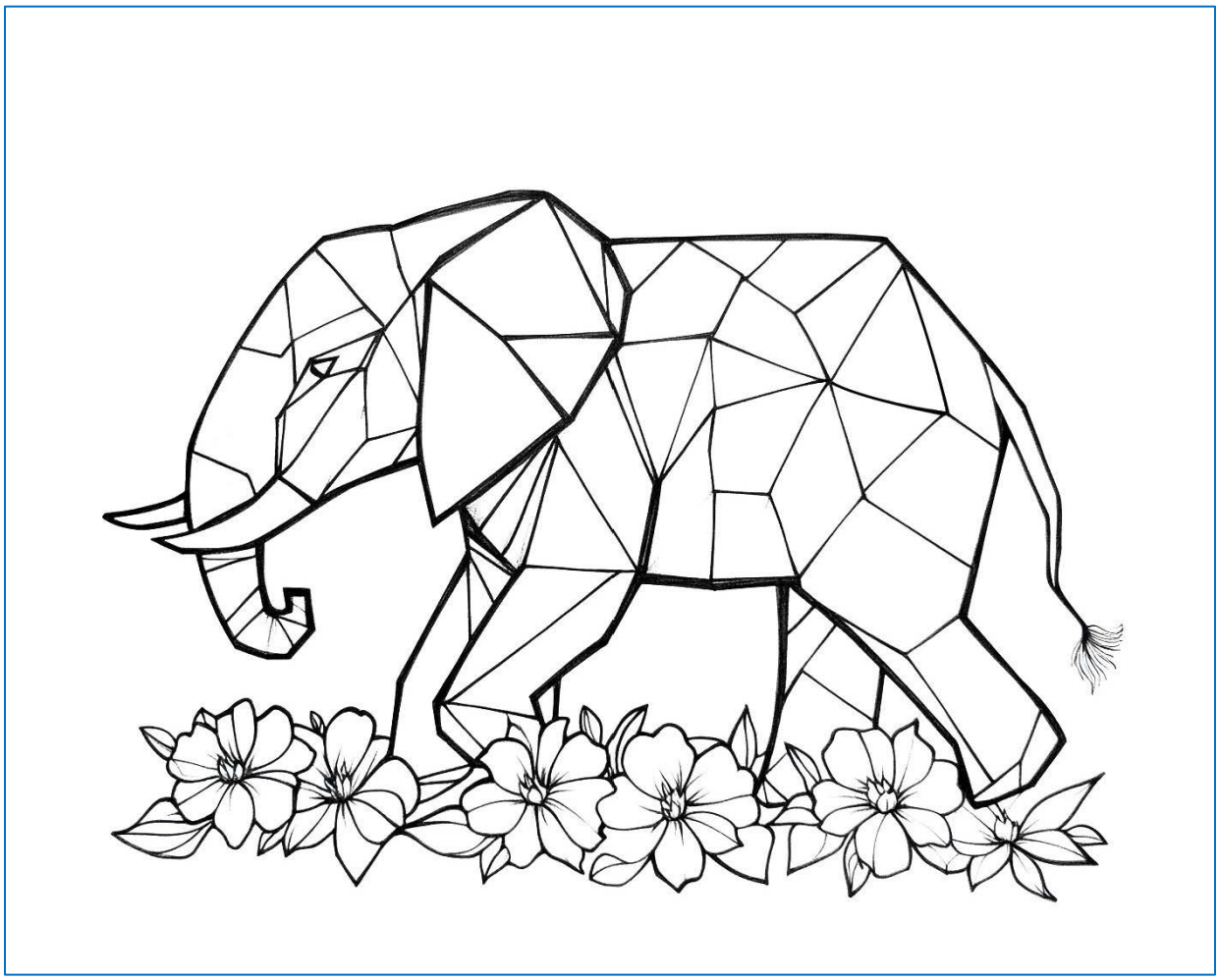
Page 10.



Page 11.

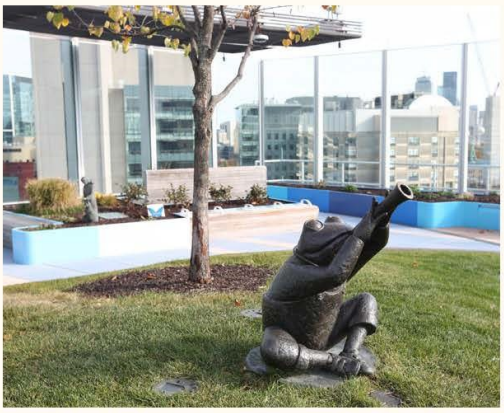
In the garden's hidden space,
An elephant stands with gentle grace.
Strong and wise, it waits for you,
Luck and joy will find you too!

Page 12.



Page 13.

On a green rug so round,
A frog hops up without a sound.
Bringing change and new delight,
Hop along and feel so light!

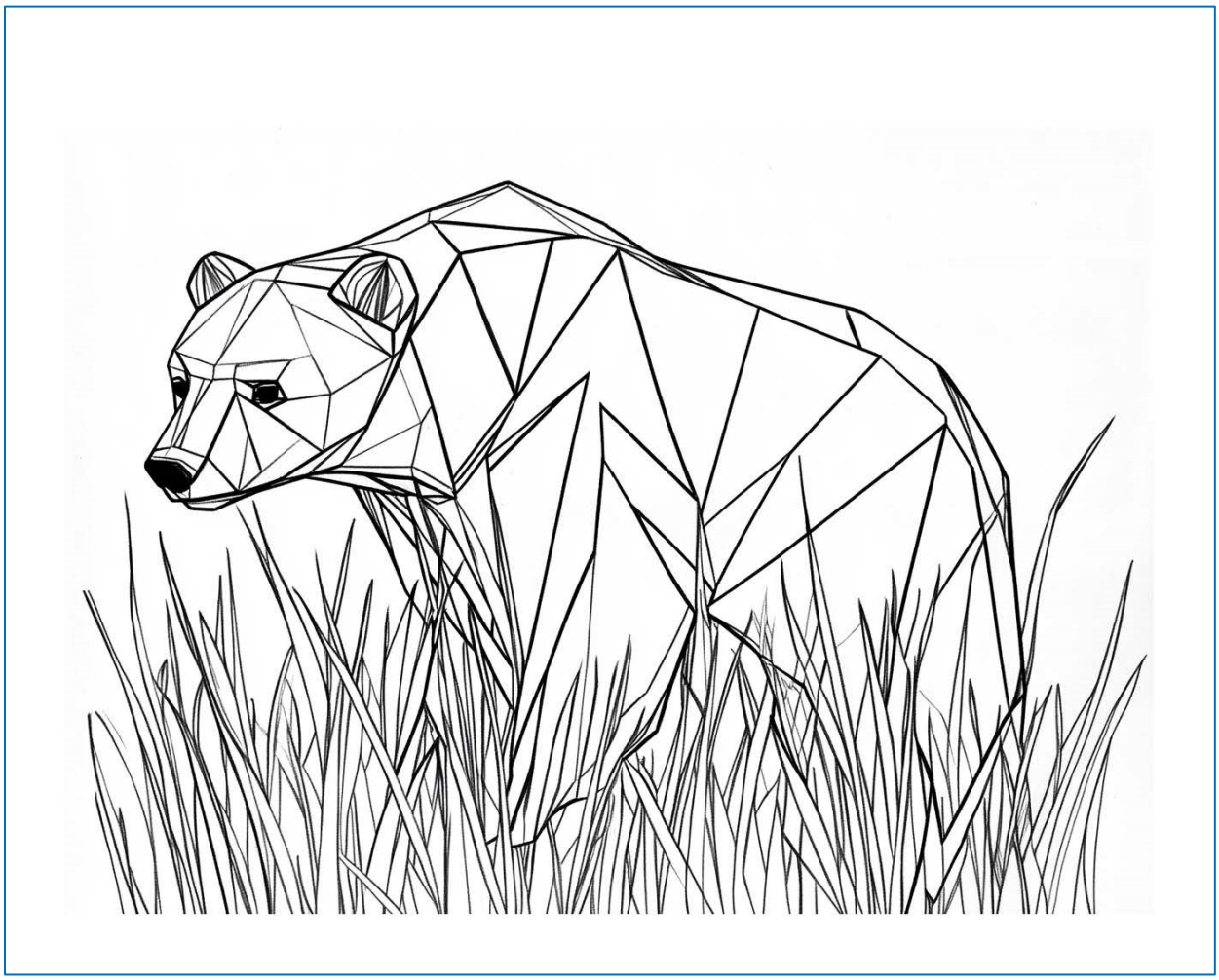


Page 14.

Page 15.

Under the broad, shady tree,
A bear stands tall, strong, and free.
Brave and kind, it watches close,
Giving hugs to those who need them most.

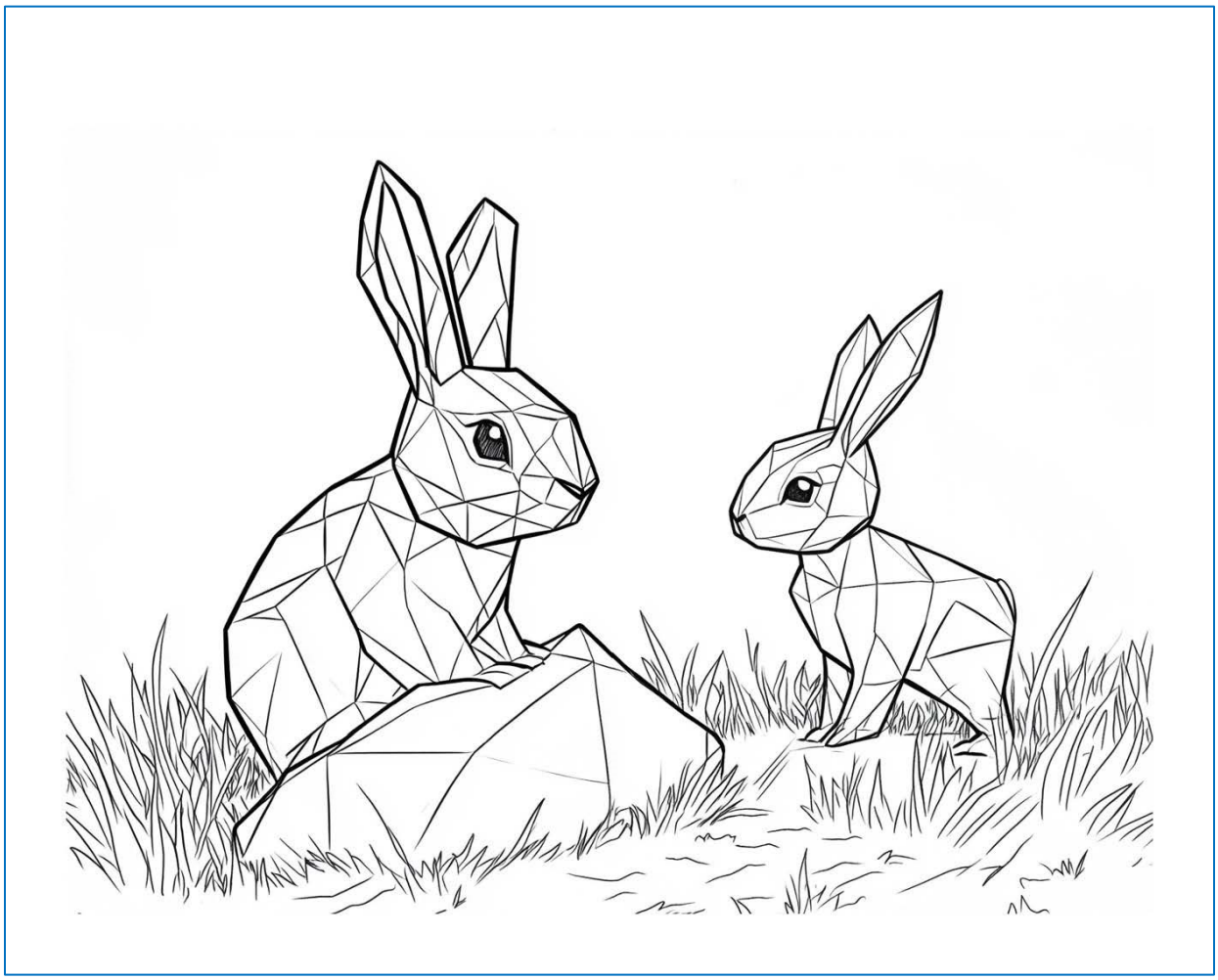
Page 16.



Page 17.

Where the phlox and iris meet,
A rabbit hops with gentle feet.
Soft and quiet, full of cheer,
Luck and joy are always near.

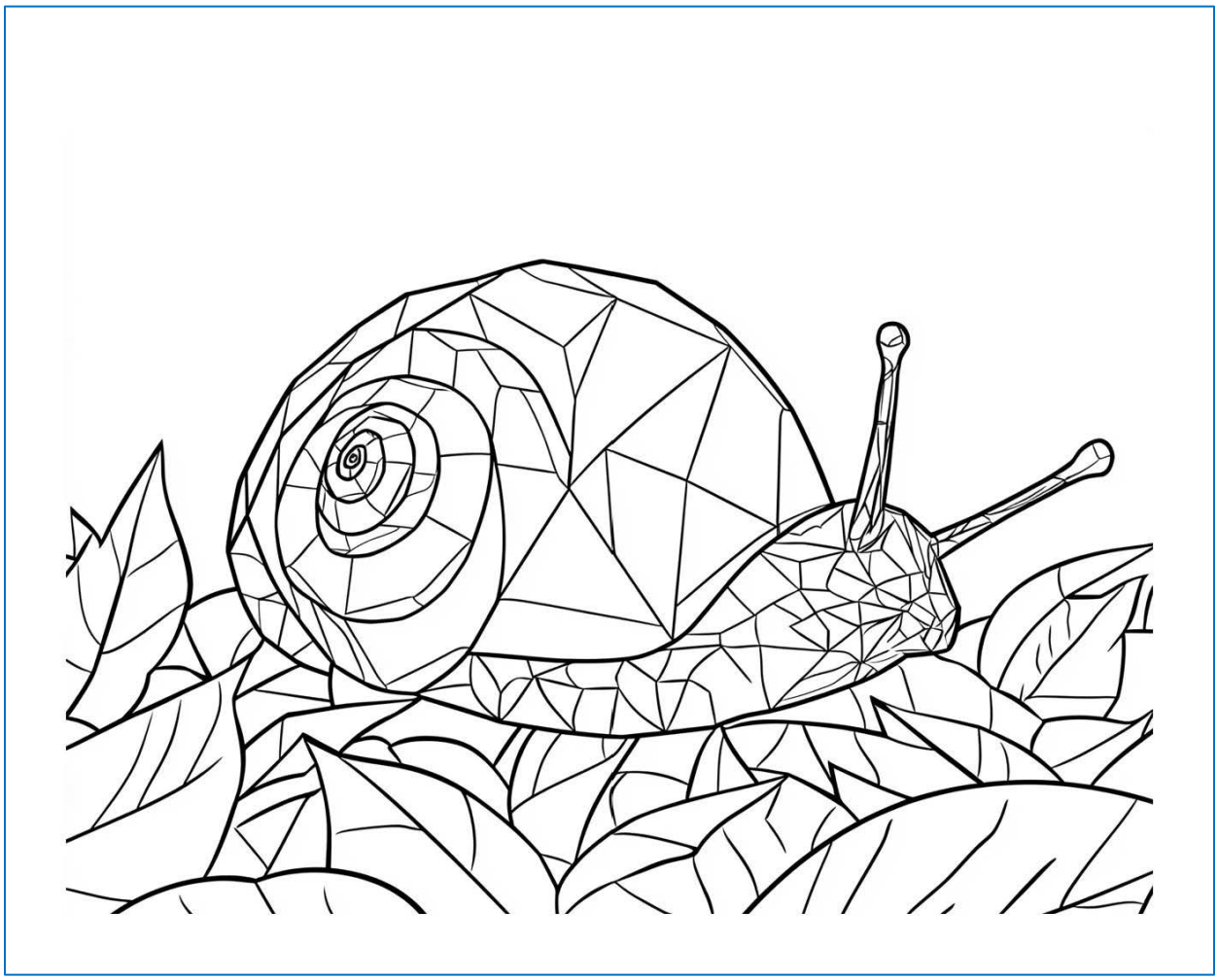
Page 18.



Page 19.

Slow and steady, safe and small,
A snail slides beside the wall.
With patience it brings peace and rest,
In every moment, you are blessed.

Page 20.



Page 21.

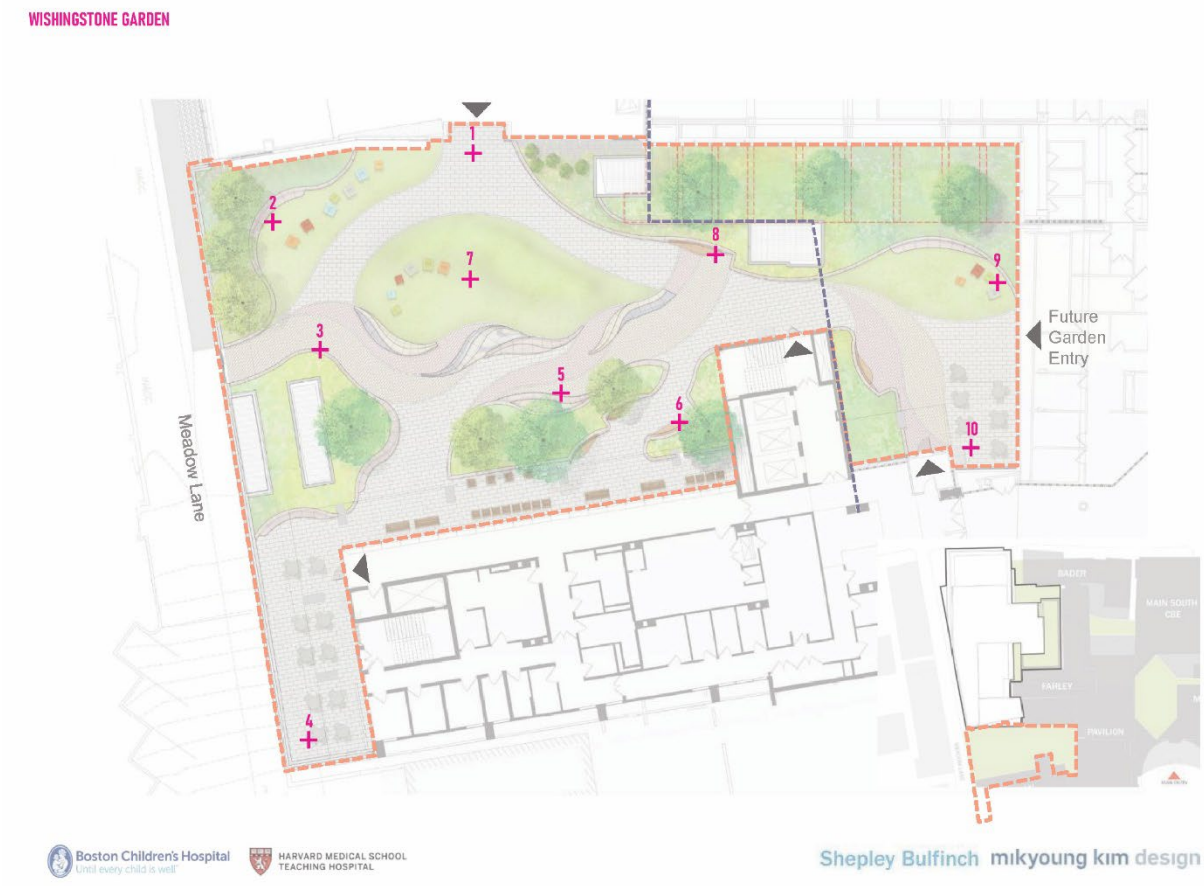
"Have you found all nine magical friends?
Color them in and let your adventure never end!"

Back Cover 22:

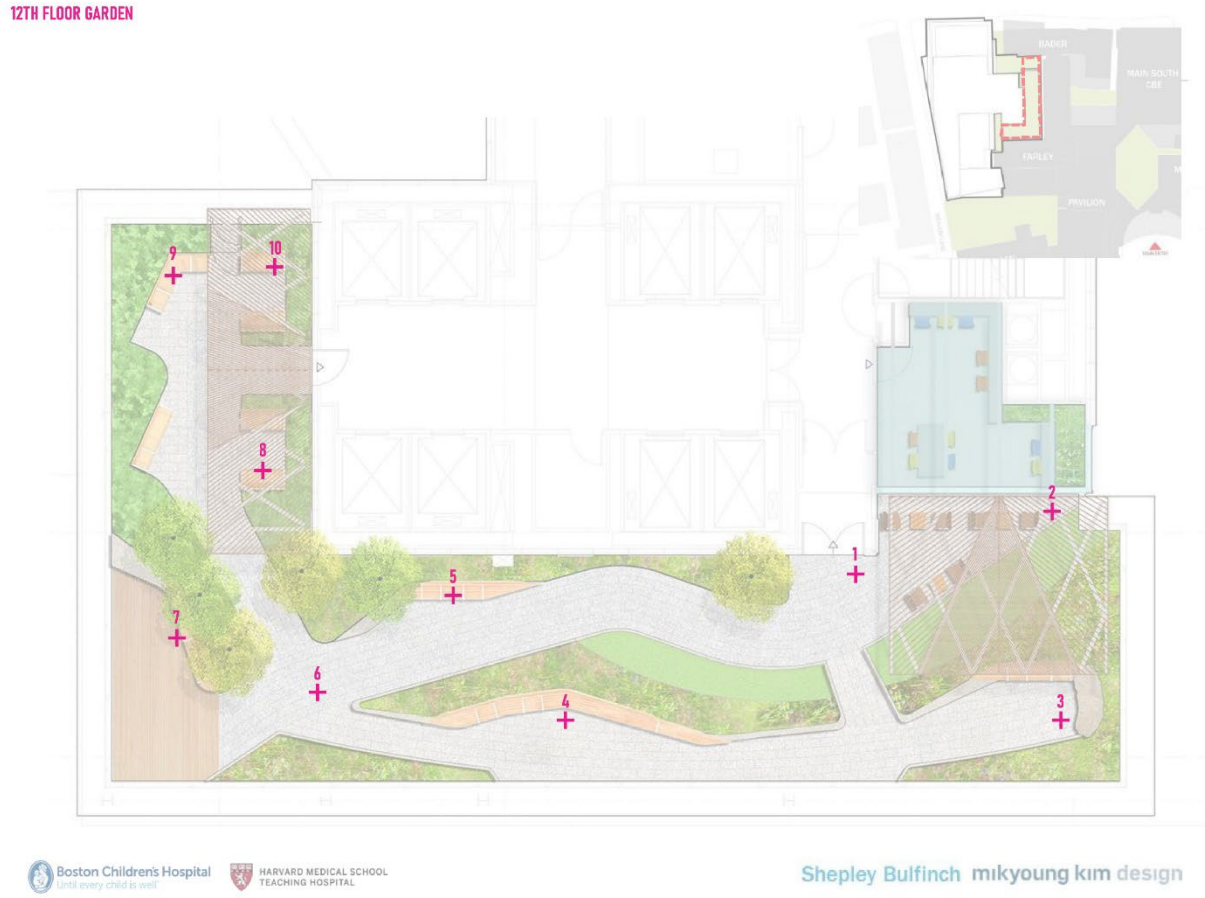
Appendix 01: Measurement Maps

To evaluate the environmental benefits of the project, the research team made these maps for on-site measurement. For each of the three rooftop gardens, 10 evenly distributed measurement points were selected. To ensure data accuracy, measurements were taken at each point over three rounds, with 15-minute intervals between rounds. Each round lasted approximately 45 minutes, allowing time for thorough data collection across all points.
(Maps are on following pages)

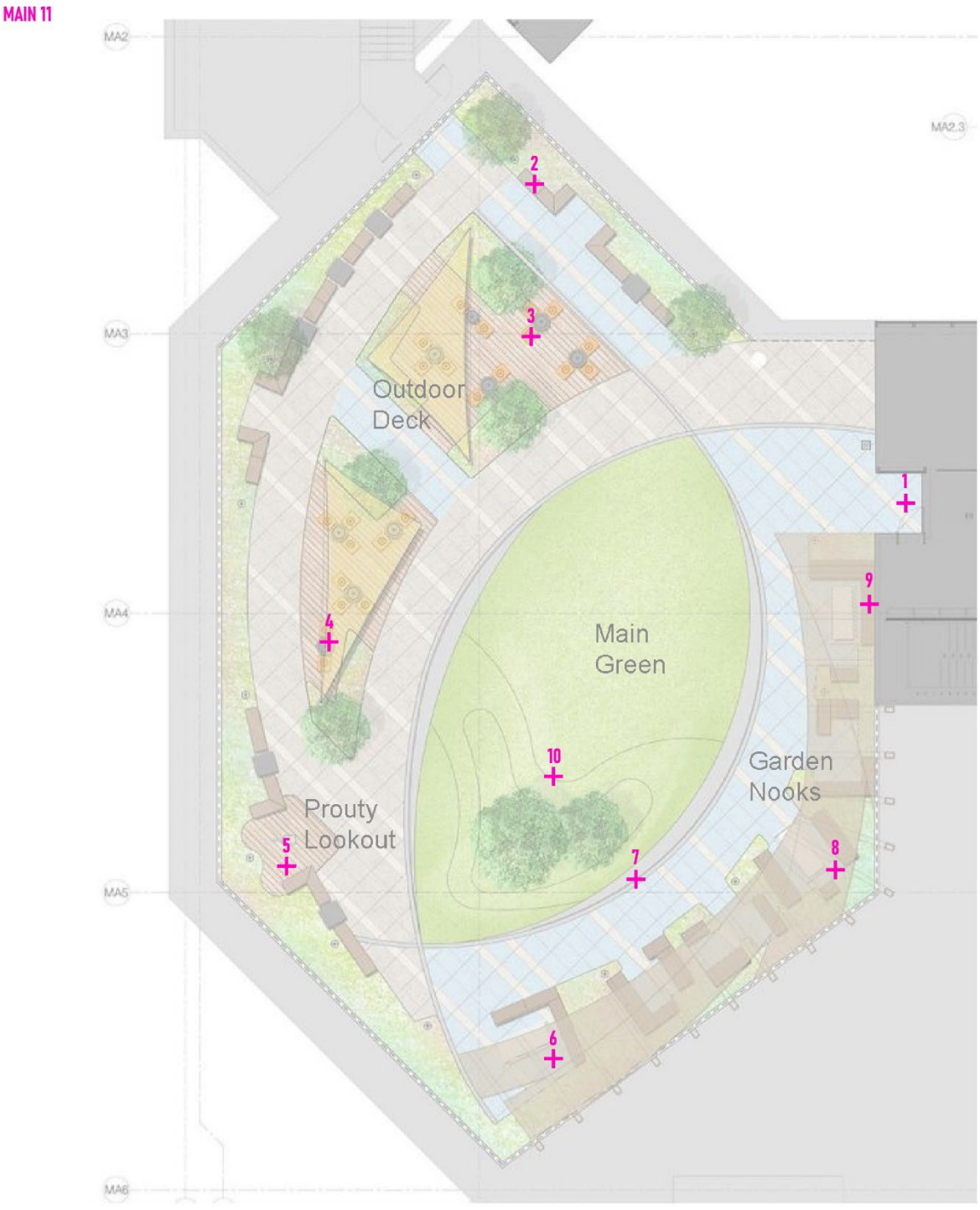
Map 1: Wishingstone Garden



Map 2: 12th Floor Garden



Map 3: Main 11 Garden



Boston Children's Hospital
Until every child is well

HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

Appendix 02: Boston Children's Hospital Gardens Evaluation Survey

Project Summary
Please share your feedback on the gardens at Boston Children's Hospital!

Access the short 11-question survey by scanning the QR code above, by clicking this survey link, or by typing the following URL: https://forms.gle/8wz6VoLFaqf7Y24e7

This survey will contribute to the analysis of the Boston Children's Hospital's Green Masterplan for the Landscape Architecture Foundation.

The survey will close on Friday, November, 15.

Please direct any questions to Garrett Craig-Lucas (graduate student/research team member) at gcraiglucas@gsd.harvard.edu

Survey Questions:

1. **What is your affiliation with Boston Children's Hospital?**
   - ☐ Staff
   - ☐ Inpatient
   - ☐ Outpatient
   - ☐ Family Member
   - ☐ Other:

2. **How often do you use the garden(s)?**
   - ☐ Daily
   - ☐ Several times a week
   - ☐ Once a week
   - ☐ A few times a month
   - ☐ Rarely
   - ☐ Never

3. **When do you use the garden(s)? *(Check all that apply)***
   - ☐ Morning (6-11am)
   - ☐ Noon (11-1pm)
   - ☐ Afternoon (1-5pm)
   - ☐ Evening (5-9pm)
   - ☐ It varies, note specific time
   - ☐ I don't use the garden

4. **What do you do when you use the garden(s)? *(Check all that apply)***
   - ☐ Relax
   - ☐ Meditate
   - ☐ Exercise (e.g., yoga, walking, etc.)
   - ☐ Food/Meal Break
   - ☐ Socialize with friends or family

- ☐ Work or study
- ☐ Host events or gatherings
- ☐ Observe nature or wildlife
- ☐ Other:

5. **Who do you go to the garden(s) with most frequently? *(Check all that apply)***
   - ☐ With patients
   - ☐ With friends
   - ☐ With pets
   - ☐ I typically go by myself

6. **Which garden(s) and spaces have you visited? *(Check all that apply)***
   - ☐ Main 11 Garden (Main Building Roof)
   - ☐ Wishingstone Garden (Hale Family Building, Level 1)
   - ☐ 12th Floor Garden (Hale Family Building Roof)
   - ☐ 10th Floor Garden - Stoneman Garden (Hale Family Building – Indoor)
   - ☐ 8th Floor Garden - The Friendship Garden (Hale Family Building – Indoor)
   - ☐ Shattuck Street Garden (Hale Building, Level 1)
   - ☐ Longwood Avenue Streetscape & Main Entry Drop Off
   - ☐ Perlmutter Dog Park
   - ☐ Other:

7. **Which garden(s) and spaces do you spend the most time in? *(Check all that apply)***
   - ☐ Main 11 Garden (Main Building Roof)
   - ☐ Wishingstone Garden (Hale Family Building, Level 1)
   - ☐ 12th Floor Garden (Hale Family Building Roof)
   - ☐ 10th Floor Garden - Stoneman Garden (Hale Family Building – Indoor)
   - ☐ 8th Floor Garden - The Friendship Garden (Hale Family Building – Indoor)
   - ☐ Shattuck Street Garden (Hale Building, Level 1)
   - ☐ Longwood Avenue Streetscape & Main Entry Drop Off
   - ☐ Perlmutter Dog Park
   - ☐ Other:

8. **How do you feel in the garden(s)? Try to use 3-5 adjectives to describe the feelings.**

9. **What do you like the most about these garden(s)?**

10. **What do you want to see more of in the garden(s)?**

11. **What aspect of these garden(s) could be improved?**

Appendix 03: Plant Inventory

Plant List Observations

Botanic Name	Common Name	On Plant List	Native	Pollinators	Birds	Bees	Butterflies	Spring	Summer	Fall
Main 11										
Botanic Name	**Common Name**	**On Plant List**	**Native**	**Pollinators**	**Birds**	**Bees**	**Butterflies**	**Spring**	**Summer**	**Fall**
Trees										
Amelanchier canadensis	Shadblow	✓	✓	✓	✓	✓	✓			
Cercis canadensis 'Ace of Hearts'	Eastern Redbud	✓	✓	✓		✓	✓			
Shrubs										
Chamaecyparus pisifera	Sawara cypress			✓		✓	✓	n/a		
Fothergilla major 'Mount Airy'	Mount Airy Fothergilla	✓		✓		✓	✓			
Hydrangea paniculata	Panicle hydrangea			✓		✓				
Ilex crenata	Japanese holly			✓	✓					
Myrica pensylvanica	Northern bayberry	✓	✓	✓	✓	✓				
Weigela florida	Weigela			✓	✓	✓	✓			
Perennials (all flowering)										
Achilea millefolium	Yarrow		✓	✓		✓	✓			
Alcea rosea	Hollyhock			✓		✓	✓			
Allium tuberosum	Garlic chives	✓		✓		✓				
Baptisia alba	White Wild Indigo			✓		✓				
Baptisia australis	Blue Wild Indigo	✓		✓		✓				
Buddleja davidii	Butterfly Bush	✓		✓		✓	✓			
Calluna vulgaris	Heather			✓		✓	✓			
Chrysanthemum x morifolium	Garden mum			✓		✓	✓			
Coreopsis verticillata	Thread leaf coreopsis	✓	✓	✓		✓	✓			
Dianthus 'Sangria Splash'	Sangria Splash Pinks	✓		✓		✓				
Echinacea purpurea	Purple coneflower	✓		✓		✓	✓			
Geranium himalayenese	Himalayan crane's-bill			✓		✓	✓			
Hylotelephium spectabile 'Autumn	Stonecrop	✓		✓		✓	✓			
Iris tenax	Toughleaf iris			✓		✓	✓			
Liriope muscari	Lilyturf			✓		✓	✓			
Nepeta faassenii	Catmint			✓			✓			
Perovskia atriplicifolia	Russian sage	✓		✓		✓	✓			
Phlox amplifolia	Largeleaf Phlox			✓	✓	✓	✓			
Phlox paniculata	Garden phlox		✓	✓		✓	✓			
Platycodon grandiflorus	Balloon flower	✓		✓	✓	✓	✓			
Rudbeckia fulgida	Orange coneflower	✓	✓	✓	✓	✓	✓			
Saliva nemorosa 'Amethyst'	Meadow sage	✓		✓		✓	✓			
Salivia x sylvestris May Night	Wood Sage	✓		✓		✓	✓			
Spiraea japnica	Japanese spiraea			✓		✓	✓			
Stachys byzantina	Lamb's-ear	✓		✓		✓				
Syringa villosa	Late Lilac			✓		✓	✓			
Veronica x 'Sunny Border Blue'	Sunny Border Blue Spee	✓		✓		✓	✓			
Groundcovers										
Pachysandra terminalis	Japanese pachysandra			✓						
Grasses										
Cenchrus setaceus	Crimson fountain grass			✓						
Ophiopogon japonicus	Mondo grass			✓						
Total Species	38	18	7	38	7	31	24			
Percantage Caculation		47%	39%	100%	18%	82%	63%			

Hale										
Botanic Name	**Common Name**	**On Plant List**	**Native**	**Pollinators**	**Birds**	**Bees**	**Butterflies**	**Spring**	**Summer**	**Fall**
Trees										
Cercis canadensis	*Eastern Redbud*	✓	✓	✓		✓	✓			
Acer griseum	Paperbark Maple	✓	N	✓						
Perennials (all flowering)										
Actaea racemosa	Black cohosh	✓	✓	✓			✓			
Aquilegia vulgaris	Columbine			✓		✓	✓			
Artemisia vulgaris	Mugwort			✓						
Dianthus gratianopolitanus	Cheddar pink			✓		✓	✓			
Echinacea purpurea	Purple coneflower			✓	✓	✓	✓			
Hylotelephium spectabile	Showy Stonecrop	✓		✓		✓	✓			
Iris ensata	Japanese Iris	✓		✓			✓			
Liriope muscari	Lilyturf	✓		✓		✓	✓			
Nepeta faassenii	Catmint	✓		✓		✓	✓			
Perovskia atriplicifolia	Russian sage			✓		✓	✓			
Rudbeckia fulgida	Orange coneflower		✓	✓	✓	✓	✓			
Salvia nemorosa	Woodland sage		✓	✓		✓	✓			
Veronica spicata 'Glory'	Royal Candles Speedwe	✓		✓		✓	✓			
Groundcovers										
Vinca minor	Common periwinkle	✓		✓			✓			
Grasses										
Calamagrostis acutiflora	Feather Reed Grass	✓			✓					
Ferns										
Polystichum acrostichoides	Christmas Fern	✓	✓	n/a	n/a	n/a	n/a	n/a		
Weeds										
Vicia cracca	Bird Vetch			✓	✓	✓	✓			
Alliaria petiolata	Garlic mustard			✓	✓	✓	✓			
Total Species	18	9	5	16	3	11	14			
Percantage Caculation		50%	56%	89%	17%	61%	78%			

Wishingstone										
Botanic Name	**Common Name**	**On Plant List**	**Native**	**Pollinators**	**Birds**	**Bees**	**Butterflies**	**Spring**	**Summer**	**Fall**
Trees										
Chionanthus virginicus	White Fringetree	✓	✓	✓		✓	✓			
Corylus avellana 'contorta'	Henry Lander Walking S	✓			✓					
Zelkova serrata	Japanese Zelkova	✓			✓			n/a		
Thuja occidentalis 'Emerald Green	Emerald Green Arborvit	✓	✓		✓			n/a		
Perennials (all flowering)										
Actaea racemosa	Black cohosh	✓	✓	✓			✓			
Aruncus dioicus	Goat's beard			✓						
Astilbe x arendsii 'Bridal Veil'	False spirea	✓		✓			✓			
Baptisia australis	False Indigo	✓		✓		✓				
Buddleja davidii 'Black Knight'	Butterfly Bush	✓		✓		✓	✓			
Iris ensata	Japanese Iris	✓		✓			✓			
Lavandula angustifolia	English Lavender	✓		✓		✓	✓			
Liriope spicata	Creeping Lilyturf	✓		✓						
Monarda didyma 'Blue Stocking'	Bee Balm	✓	✓	✓		✓	✓			
Nepeta fassennii	Catmint	✓		✓		✓	✓			
Salvia nemorosa 'Blue Hill'	Meadow Sage	✓		✓		✓	✓			
Veronicastrum virginicum	Culvert's Root	✓	✓	✓		✓	✓			
Grasses										
Pennisetum orientale 'Karley Rose	Fountain Grass	✓			✓					
Panicum virgatum	Switchgrass		✓		✓					
Ferns										
Matteuccia struthiopteris	Ostrich Fern	✓	✓	n/a	n/a	n/a	n/a	n/a		
Onoclea sensibilis	Sensitive fern	✓	✓	n/a	n/a	n/a	n/a	n/a		
Osmunda cinnamomea	Cinnamon Fern		✓	n/a	n/a	n/a	n/a	n/a		
Polystichum acrostichoides	Christmas Fern	✓	✓	n/a	n/a	n/a	n/a	n/a		
Weeds*										
Cardamine hirsuta	Hairy Bittercress			✓						
Cirsium arvense	Creeping thistle			✓		✓	✓			
Oxalis corniculata	Creeping Woodsorrel			✓						
Total Species	22	15	8	13	5	8	10			
Percantage Caculation		68%	53%	52%	23%	36%	45%			
Overall Species Caculation	78	42	20	67	15	50	48			
Overall Percantage Caculation		54%	26%	86%	19%	64%	62%			

Notes:

Plant list compiled from planting plans from Construction Documents and site observations on 11/5/2024

"Weeds" were included in inventory but not in calculations due to small quantity and limited presence on site