960 Franklin Avenue Rezoning EIS
Chapter 6: Shadows

A. INTRODUCTION

This attachment assesses the potential for the Proposed Project to result in incremental shadows long enough to reach any nearby publicly accessible open spaces or other sunlight-sensitive resources. According to the *City Environmental Quality Review* (CEQR) *Technical Manual*, a shadows assessment is required if a proposed project would result in structures (or additions to existing structures) of 50 feet in height or greater, or those that would be located adjacent to, or across the street from, a sunlight sensitive resource. As discussed in Chapter 1, "Project Description," the Proposed Project would comprise two new buildings greater than 50 feet in height compared to the No-Action condition. As such, a detailed shadows analysis was prepared to determine the potential for the Proposed Project to result in significant adverse impacts on sunlight-sensitive resources.

B. PRINCIPAL CONCLUSIONS

The Proposed Development would result in incremental shadow coverage (i.e. additional, or new, shadow coverage) on portions of four sunlight-sensitive open space resources (Brooklyn Botanic Garden, Prospect Park, the Jackie Robinson Playground, and the P.S. 375 – K Community Playground). As the extent and duration of incremental shadows would (1) significantly reduce or completely eliminate direct sunlight exposure on sunlight-sensitive features found within two of these resources; and (2) would significantly alter the public's use or enjoyment of the playgrounds, gardens, or parks, or threaten the viability of vegetation or other elements located within these two open spaces, incremental shadows from the Proposed Development on Brooklyn Botanic Garden and the Jackie Robinson Playground would be considered a significant adverse impact, in accordance with *CEQR Technical Manual* methodology. Based on the duration of incremental shadows on Prospect Park and the P.S. 375 – K Community Playground, the Proposed Actions would not result in any significant adverse impacts on these two open spaces resources. Incremental shadows from the Proposed Development would be cast on several individual resources within the Brooklyn Botanic Garden. Greenhouses within the Brooklyn Botanic Garden are used to propagate plants for desert, tropical, and warm temperate climates that require full, year-round sun including sunlight during the important winter months. Therefore, any incremental shading of these greenhouses, specifically during the winter months, would have a significant adverse impact on the plants in these greenhouses. Though the *CEQR Technical Manual* states that 4-6 hours of sunlight is necessary for plant survival, the Brooklyn Botanic Garden contains over 18,500 kinds of plants, with globally rare species and native rare species. The minimum sunlight needed to constitute survival may not be enough to promote healthy growth of these rare plants. Therefore, due to the incremental shadows created by the Proposed Development, significant adverse impacts are likely on the natural resources found within Brooklyn Botanic Garden.

In Jackie Robinson Playground, incremental shadows from the Proposed Development are expected to cast shadow on a passive area for seating and an area for active uses such as a playground area and basketball court. Based on the guidance of the *CEQR Technical Manual,* these areas would be considered sunlight-sensitive. Therefore, due to the duration and coverage of incremental shadows on the Jackie Robinson Playground, the Proposed Actions would cause a significant adverse impact on the open space.

Potential measures to mitigate in full or part these impacts are discussed in **Chapter 21, "Mitigation."**

C. METHODOLOGY

According to the *CEQR Technical Manual*, the longest shadow a structure will cast in New York City, except for periods close to dawn or dusk, is 4.3 times its height. For projects or actions resulting in structures less than 50 feet tall, a shadow assessment is generally not necessary, unless the site is adjacent to a park, historic resource, or important natural feature (if the feature that makes the structure significant depends on sunlight).

First, a preliminary screening assessment must be conducted to ascertain whether shadows resulting from a project could reach any sunlight-sensitive resource at any time of year. The *CEQR Technical Manual* defines sunlight-sensitive resources as those resources that depend on sunlight or for which direct sunlight is necessary to maintain the resource's usability or architectural integrity. The following are considered to be sunlight-sensitive resources[1]:

- *Public open space* (e.g., parks, playgrounds, plazas, schoolyards, greenways, and landscaped medians with seating). Planted areas within unused portions or roadbeds that are part of the Greenstreets program are also considered sunlight-sensitive resources. Sunlight sensitivity is assessed for both (1) warm-weather dependent features, like wading pools and sandboxes, or vegetation that could be affected by loss of sunlight during the growing season (i.e., March through October); and (2) features, such as benches, that could be affected by a loss of winter sunlight. Uses that rely on sunlight include: passive use, such as sitting or sunning; active use, such as playfields or paved courts; and such activities as gardening, or children's wading pools and sprinklers. Where lawns are actively used, the turf requires extensive sunlight. Vegetation requiring direct sunlight includes the tree canopy, flowering plants, and plots in community gardens. Generally, four to six hours a day of sunlight, particularly in the growing season, is a minimum requirement.
- *Features of historic architectural resources that depend on sunlight for their enjoyment by the public.* Only the sunlight-sensitive features of an architectural resource are considered in a shadows analysis. Sunlight-sensitive features include the following: design elements that are part of a recognized architectural style that depends on the contrast between light and dark (e.g., deep recesses or voids, such as open galleries, arcades, recessed balconies, deep window reveals, and prominent rustication); elaborate, highly carved ornamentation; stained glass windows; exterior building materials and color that depend on direct sunlight for visual character (e.g., the polychromy [multicolored] features found on Victorian Gothic Revival or Art Deco facades); historic landscapes, such as scenic landmarks, including vegetation recognized as an historic feature of the landscape; and structural features for which the effect of direct sunlight is described as playing a significant role in the structure's importance as an historic landmark.
- *Natural resources where the introduction of shadows could alter the resource's condition or microclimate.* Such resources could include surface water bodies, wetlands, or designated resources, such as coastal fish and wildlife habitats.

[1] According to the *CEQR Technical Manual*, city streets, sidewalks, and private open spaces (such as private residential front and back yards, stoops, and vacant lots) are not considered to be sunlight-sensitive resources.

The preliminary screening assessment consists of three tiers of analysis. The first tier determines a simple radius around the proposed buildings representing the longest shadow that could be cast. If there are sunlight-sensitive resources within the radius, the analysis proceeds to the second tier, which reduces the area that could be affected by project-generated shadows by accounting for a specific range of angles that can never receive shade in New York City due to the path of the sun in the northern hemisphere. If the second tier of analysis does not eliminate the possibility of new shadows on sunlight-sensitive resources, a third tier of screening analysis further refines the area that could be reached by new shadows by looking at specific representative days of the year and determining the maximum extent of shadow over the course of each representative day.

If the third tier of analysis does not eliminate the possibility of new shadows on sunlight-sensitive resources, a detailed shadow analysis is required to determine the extent and duration of the incremental shadow (i.e. the additional, or new, shadow) resulting from the project. The detailed shadow analysis establishes a baseline condition (the No-Action condition) that is compared to the future condition resulting from the Proposed Project (the With-Action condition) to illustrate the shadows cast by existing or future buildings and distinguish the additional (incremental) shadows cast by the Proposed Project. In accordance with the *CEQR Technical Manual*, shadows on sunlight-sensitive resources of concern were modeled for four representative days of the year. For the New York City area, the months of interest for an open space resource encompass the growing season (i.e., March through October) and one month between November and February representing a cold-weather month (usually December). Representative days for the growing season are generally the March 21 vernal equinox (or the September 21 autumnal equinox, which is approximately the same), the June 21 summer solstice, and a spring or summer day halfway between the summer solstice and equinoxes, such as May 6 or August 6 (which are approximately the same). For the cold- weather months, the December 21 winter solstice is included to demonstrate conditions when open space users rely most heavily on available sunlight warmth. As these months and days are representative of the full range of possible shadows, they are also used for assessing shadows on sunlight-sensitive historic and natural resources.

The *CEQR Technical Manual* defines the temporal limits of a shadow analysis period to fall from an hour and a half after sunrise to an hour and a half before sunset.

The detailed analysis provides the data needed to assess the shadow impacts. The effects of incremental shadows on the sunlight-sensitive resources are described, and their degree of significance is considered. The result of the analysis and assessment are documented with graphics, a table of incremental shadow durations, and narrative text. As described in the *CEQR Technical Manual*, an incremental shadow is generally not considered significant when its duration is no longer than ten minutes at any time of year and the resource continues to receive substantial direct sunlight. A significant shadow impact generally occurs when an incremental shadow of ten minutes or longer falls on a sunlight-sensitive resource and results in one of the following:

- *Vegetation:* a substantial reduction in sunlight available to sunlight-sensitive features of the resource to less than the minimum time necessary for its survival (when there would be sufficient sunlight in the future without the project) or a reduction in direct sunlight exposure where the sensitive feature of the resource is already subject to substandard sunlight (i.e., less than the minimum time necessary for its survival).
- *Historic and cultural resources:* a substantial reduction in sunlight available for the enjoyment or appreciation of the sunlight-sensitive features of an historic or cultural resource.

- *Open space utilization:* a substantial reduction in the usability of open space as a result of increased shadow, including information regarding anticipated new users and the open space's utilization rates throughout the affected time periods.
- *For any sunlight-sensitive feature of a resource:* complete elimination of all direct sunlight on the sunlight- sensitive feature of the resource, when the complete elimination results in substantial effects on the survival, enjoyment, or, in the case of open space or natural resources, the use of the resource.

In general, a significant adverse shadow impact occurs when the incremental shadow added by a proposed project falls on a sunlight-sensitive resource and substantially reduces or completely eliminates direct sunlight exposure, thereby significantly altering the public's use of the resource or threatening the viability of vegetation or other resources.

D. PRELIMINARY SCREENING

Tier 1 Screening Assessment

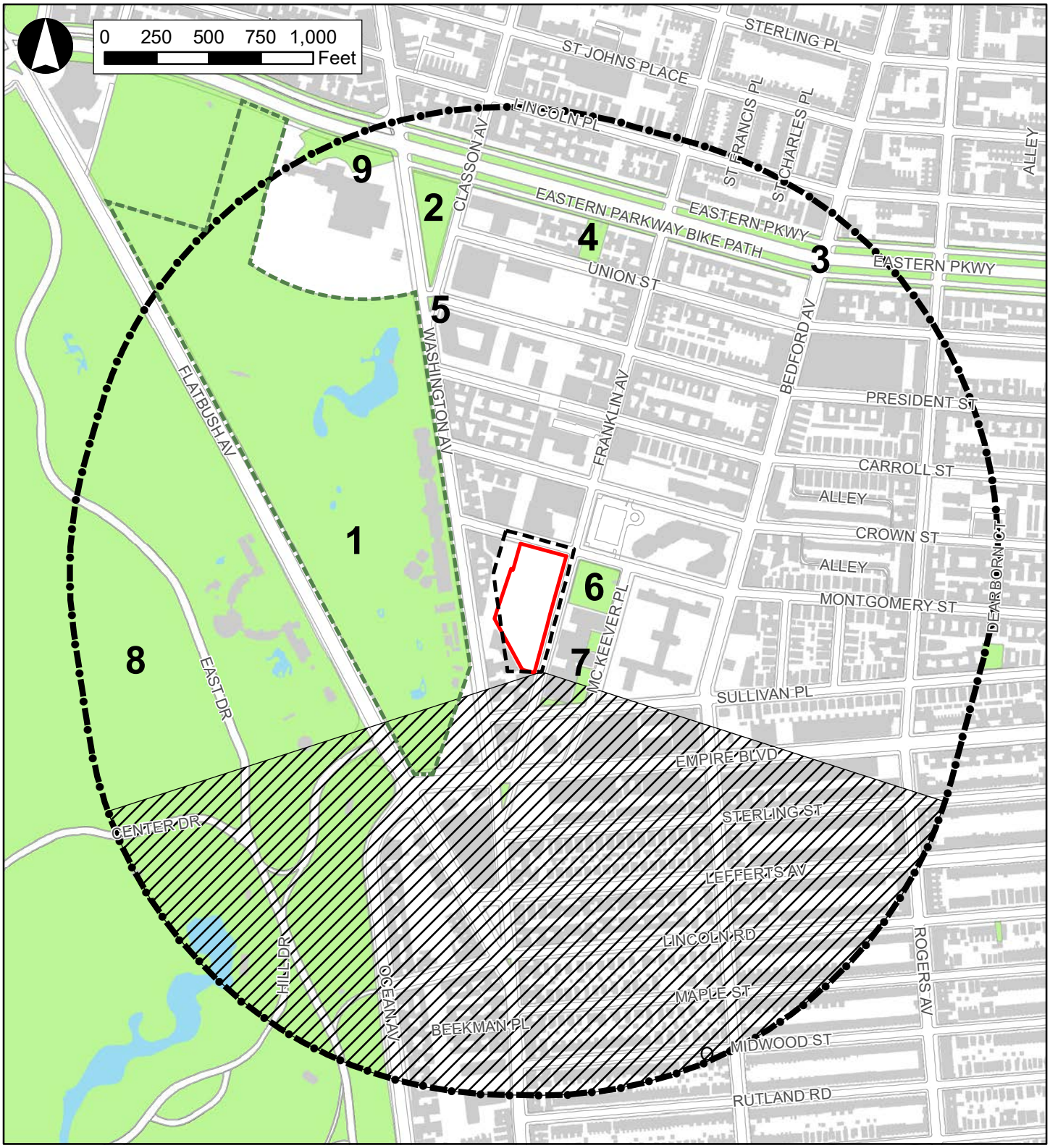
According to the *CEQR Technical Manual*, the longest shadow that a structure will cast in New York City, except for periods close to dawn or dusk, is 4.3 times its height. The maximum height of the tallest Proposed Project buildings, including mechanical bulkhead (424 feet plus 40 feet of mechanical bulkhead), was used to determine the maximum shadow radius of 1,995 feet (Tier 1 Assessment – shown in **Figure 6-1**). Within this longest shadow study area, there are a number of potentially sunlight-sensitive open spaces. Therefore, further screening was warranted in order to determine whether any resources could be affected by project-generated shadows.

Tier 2 Screening Assessment

Due to the path of the sun across the sky in the northern hemisphere, no shadow can be cast in a triangular area south of any given site. In New York City, this area lies between -108 and +108 degrees from true north. The purpose of the Tier 2 screening is to determine whether the sunlight-sensitive resources identified in the Tier 1 screening are located within portions of the longest shadow study area that can receive shade from the Proposed Project.

Figure 6-1 provides a base map illustrating the results of the Tier 1 and Tier 2 screening assessments (i.e., the portion of the longest shadow study area lying within -108 degrees from the true north and +108 degrees from true north as measured from the southernmost corner of the Proposed Project buildings). A total of nine open space resources that could potentially be shaded as a result of the Proposed Actions were identified as sunlight-sensitive and are provided in **Table 6-1** below.

Tier I and Tier II Shadow Assessment



Legend

- Project Site
- Proposed Rezoning Area
- Tier I: Longest Shadow Study Area
- Tier II: Area That Cannot Be Shaded
- 1 Open Space (refer to Table 6-1)
- Brooklyn Botanic Garden Boundary

TABLE 6-1
Potentially Sunlight-Sensitive Resources Warranting Further Analysis Based on Tier 1 and 2 Screening

No.[1]	Open Space Resources
1	Brooklyn Botanic Garden
2	Dr. Ronald McNair Park
3	Eastern Parkway[2]
4	Eastern Parkway Coalition Garden
5	Greenstreet
6	Jackie Robinson Playground
7	P.S. 375K Community Playground
8	Prospect Park[2]
9	Brooklyn Museum Plaza

Notes:
[1] Numbers keyed to **Figure 6-1.**
[2] Eastern Parkway and Prospect Park are considered both sunlight-sensitive open space resources and potentially sunlight-sensitive historic resources.

Tier 3 Screening Assessment

According to the *CEQR Technical Manual*, a Tier 3 screening assessment should be performed to determine if, in the absence of intervening buildings, shadows resulting from a proposed project can reach a sunlight-sensitive resource, thereby warranting a detailed shadow analysis. The Tier 3 screening assessment is used to determine if shadows resulting from a proposed project can reach a sunlight-sensitive resource at any time between 1.5 hours after sunrise and 1.5 hours before sunset on representative analysis dates.

As project-generated shadows could reach a number of sunlight-sensitive resources, a Tier 3 assessment was performed using three dimensional (3D) computer mapping software. A 3D model of the Proposed Project was used to calculate and display project-generated shadows on individual representative analysis dates. The model contained 3D representations of the elements in the base map used in the preceding assessments and a 3D model of the Proposed Project. At this stage of the assessment, surrounding buildings within the study area were not included in the model so that it may be determined whether project-generated shadows would reach any sunlight sensitive resources.

TABLE 6-2
Potentially Sunlight-Sensitive Resources Warranting Further Analysis Based on Tier 3 Screening

No.[1]	Name	March 21/Sept. 21 7:36 AM - 4:29 PM	May 6/August 6 6:27 AM - 5:18 PM	June 21 5:57 AM - 6:01 PM	December 21 8:51 AM - 2:53 PM	Number of Analysis Days
Open Space Resources						
1	Brooklyn Botanic Garden	YES	YES	YES	YES	4
2	Dr. Ronald McNair Park	NO	NO	NO	NO	0
3	Eastern Parkway	NO	NO	NO	YES	1
4	Eastern Parkway Coalition Garden	NO	NO	NO	NO	0
5	Greenstreet	NO	NO	NO	NO	0
6	Jackie Robinson Playground	YES	YES	YES	YES	4
7	P.S. 375K Community Playground	YES	YES	YES	NO	3
8	Prospect Park	YES	YES	YES	NO	3
9	Brooklyn Museum Plaza	NO	NO	NO	NO	0

Notes:
[1] Numbers keyed to **Figure D-1.**

As shown in **Table 6-2** above, the Tier 3 results determined that of the nine sunlight-sensitive open space resources, Dr. Ronald McNair Park (location 2 in **Figure 6-1**), Eastern Coalition Garden (location 4 in **Figure 6-1**), the Greenstreet south of Dr. Ronald McNair Park (location 5 in **Figure 6-1**), and Brooklyn Museum Plaza (location 9 in **Figure 6-1**) would not receive project-generated shadows on any of the four analysis days and, therefore, did not require any further analysis. **Table 6-2** presents a summary of the Tier 3 assessment, showing the remaining five sunlight-sensitive open space resources[2] that could, in the absence of intervening buildings, receive project-generated shadows, and on which analysis days the new shadows could occur. As presented in **Table 6-2**, the Proposed Project has the potential to cast new incremental shadows on the Brooklyn Botanic Garden on all four analysis days, on Jackie Robinson Playground on four analysis days, on Prospect Park (LPC-designated and S/NR-listed)on three analysis days, the P.S. 375K Community Playground on three analysis days, and Eastern Parkway (LPC-designated) on one analysis day. Therefore, a detailed shadows analysis is warranted for these five resources and has been provided below.

E. DETAILED ANALYSIS OF SHADOW IMPACTS

Open Space Resources Affected by Project-Generated Shadows

Brooklyn Botanic Garden

The Brooklyn Botanic Garden (also referred to in this chapter as "the Botanical Garden") is an approximately 52-acre passive open space resource extending along the west side of Washington Avenue between Empire Boulevard, Flatbush Avenue, and Eastern Parkway. The open space includes a number of unenclosed gardens, including the Cranford Rose Garden, the Children's Garden, the Discovery Garden,

[2] It should be noted that Eastern Parkway is considered both a sunlight-sensitive open space resource and a sunlight-sensitive LPC-designated historic resource, and Prospect Park is considered a sunlight-sensitive open space resource, a sunlight-sensitive LPC-designated historic scenic landmark, and a S/NR-listed historic resource.

Figure 6-2a
Tier 3 Screening

MARCH 21/SEPTEMBER 21

MAY 6/AUGUST 6

Proposed Development | 1 Open Space | Project-Generated Shadow

Note: Resources keyed to Table 6-1

Figure 6-2b
Tier 3 Screening

JUNE 21

DECEMBER 21

Proposed Development | 1 Open Space | Project-Generated Shadow

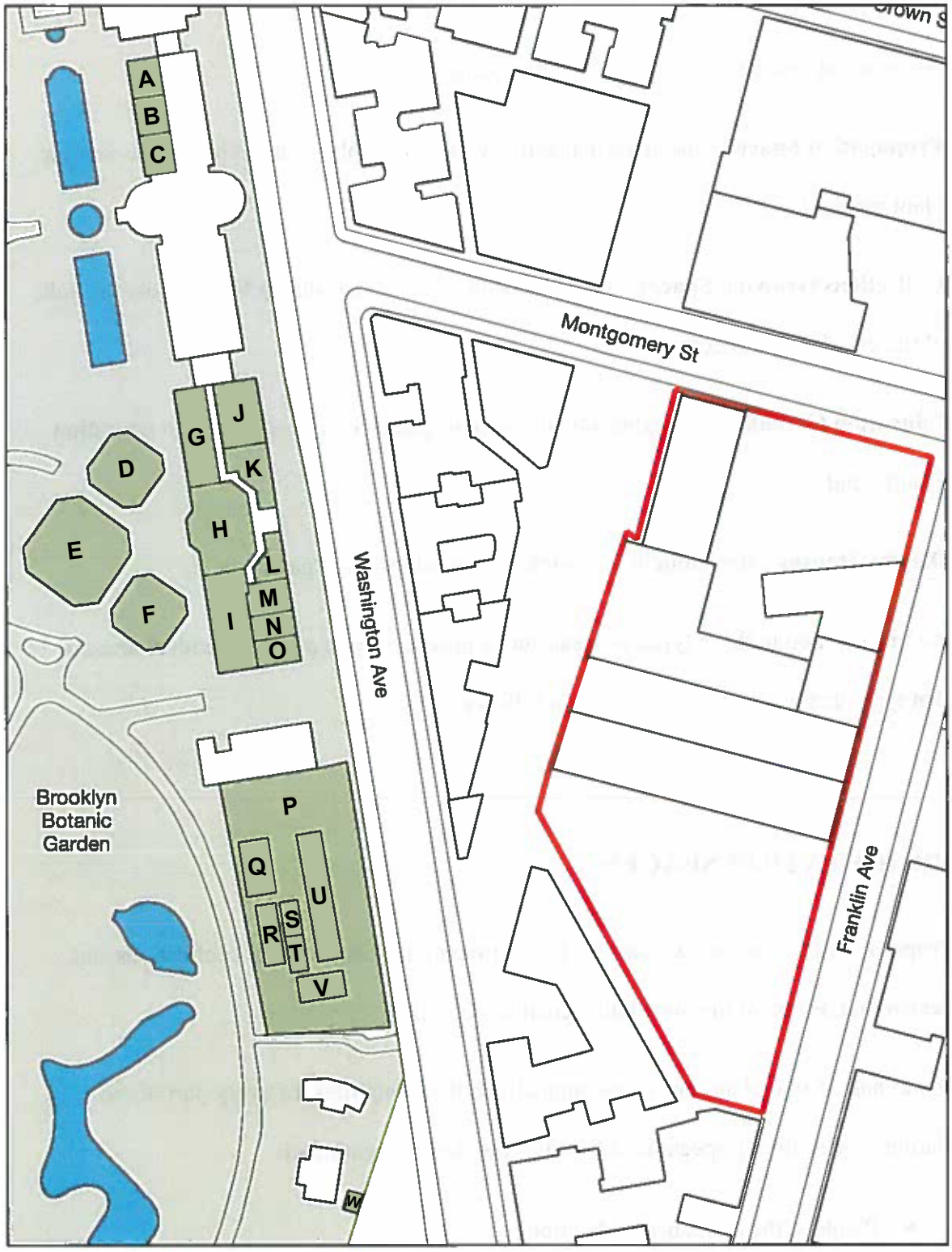
Note: Resources keyed to Table 6-1

the Fragrance Garden, the Herb Garden, the Japanese Hill-and-Pond Garden, the Native Flora Garden, the Osborn Garden, the Rock Garden, the Shakespeare Garden, and the Shelby White and Leon Levy Water Garden. In addition, the open space contains a number of trees, ponds (such as the Lily Pool Terrace), grassy lawn areas, benches, plazas (such as the Magnolia Plaza, the Perennial Border, and the Annual Border), and walking paths (such as the Cherry Esplanade and the Celebrity Path). The Brooklyn Botanic Garden also contains the Steinhardt Conservatory, a 25,510 sf complex of display and support greenhouses built in 1988, made up of several pavilions, greenhouses, and propagation houses (described in greater detail below) containing plants that are staged in realistic environments that simulate a range of global habitats. The domed pavilions feature a diverse collection of plants native to the American Southwest, Central America, the deserts and scrublands of Africa, China, the Mediterranean, Australasia, southern Africa, the western United States, the Amazon Basin, the African rainforest, and tropical eastern Asia. Other collections held in the Steinhardt Conservatory, including orchids and bonsai, art exhibits, and historical displays, are presented in rotation during the year.

As presented in **Table 6-3** and **Figure 6-3** below, the Brooklyn Botanic Garden hosts 23 enclosed conservatories, greenhouses, propagation spaces, and nurseries that have each been designed to maximize natural sunlight due to the high sensitivity of certain plants' growth and/or propagation needs, and are. Each conservatory, greenhouse, propagation, and nursery facility is described in greater detail below.

The areas of the Brooklyn Botanic Garden that would experience incremental shadow coverage feature the Plant Family Collection, which includes an assortment of ferns, conifers, ginkgos, magnolias, shrubs, roses, legumes, honeysuckles, composites, and monocots, as wells as elms, oaks, and walnut trees; the Rock Garden, which includes an assortment of woodland plants (e.g., maples, pines, spruces, and viburnums), acid-loving plants (e.g., heaths, azaleas, and rhododendrons), scree, drought-tolerant plants (e.g., succulents), evergreens (e.g., yew, juniper, spruce, fir, and false cypress), and shade-tolerant plants (e.g., azaleas, rhododendrons, bulbs, hostas, anemones, and hellebores); the Herb Garden, which includes an assortment of herbs, vegetables, fruit trees, and grains; the Lily Pool Terrace, which includes an assortment of sacred lotus, hardy water-lily, and tropical water-lily cultivars; the Water Garden, which includes an assortment of diverse water-based trees, shrubs, bulbs, and ferns; the Discovery Garden, which includes planting beds for flowers, vegetables, and herbs, as well as meadow, woodland, and marsh areas that are utilized for youth educational programs; the Rose Garden, which includes a variety of roses; the Cherry Esplanade, which includes an assortment of scarlet oak trees, Liberty Oaks, and double-flowered *Prunus* 'Kazan' trees (aka 'Cherry Blossoms'); the Japanese Hill-and-Pond Garden, which includes an assortment of evergreen plants (e.g., white pine, American beech, and bald cypress), Japanese irises, wisteria, Japanese maples, and azaleas; the Shakespeare Garden, which includes a variety of plants referenced in William Shakespeare's work; the Celebrity Path, which includes an assortment of Austrian pines, rhododendrons, and daffodils; the Fragrance Garden, which includes an assortment apple geranium, Corsican mint, fumitory, Indian patchouli, lantana, lavender, lemon verbena, peppermint geranium, rose geranium, sage, southernwood, candytuft, garden verbena, heliotrope, marigold, Mexican evening primrose, ornamental flowering tobacco, petunia, red valerian, snow-in-summer, sweet alyssum, and wallflower; Daffodil Hill, which includes various species of daffodils; Magnolia Plaza, which includes various species of magnolias; the Annual and Perennial Borders, which include various species of annuals and perennials such as tulips; the Desert Plants, Warm Temperate Plants, and Tropical Plants Education Greenhouses, which contain a collection of cacti and succulents, warm temperate ornamental, culinary, and medicinal plants, and tropical ornamentals and crop plants, respectively; the Hardy Plant Nursery Yard, which contain a plant collection of hardy wood and herbaceous perennials; the Temperate Bonsai Tunnel and Tropical Bonsai House, which contain a plant collection of hardy wood perennials, broadleaf, and conifers, and tropical, woody perennials, respectively; the Production House, which contains a wide

Figure 6-3
Brooklyn Botanic Gardens Facilities



A Brooklyn Botanic Gardens Sunlight-Sensitive Facility

**Keyed to Table 6-3*

Project Site

variety of annual and biennial plants; the Auxiliary House, which contain a plant collection of tender and tropical perennials; the New York-Native Flora and Temperate Plant Propagation Tunnel, which contains a plant collection of regional U.S. native plants, rare New York State flora, and temperate woody and herbaceous perennials; the Mediterranean Display Plants Tunnel, which contain a plant collection of citrus and olive plants; the Compost Exhibit, which includes various trees and shrubs; and the Steinhardt Conservatory's Helen Mattin Warm Temperate Pavilion, Tropical Pavilion, Desert Pavilion, C.V. Starr Bonsai Museum, Aquatic House and Orchid Collection, Conservatory Entry House, Arid Workhouse, Humid Tropics Workhouse, Lowland and Highland Moist Tropical Orchid Workhouses, Tropical Plant Propagation House, and Tropical and Desert Plant Propagation House, which all contain an assortment of orchids, mangroves, papyrus, water hyacinth, aroids, carnivorous plants, pond-apple trees, cacti, succulents, wildflowers, vines, ground covers, and bonsai, as well as various trees and shrubs.

TABLE 6-3
Potentially Sunlight-Sensitive Resources Warranting Further Analysis Based on Tier 1 and 2 Screening

ID[1]	Brooklyn Botanic Gardens Facility	ID[1]	Brooklyn Botanic Gardens Facility
A	Education Greenhouse: Desert Plants	M	Highland Moist Tropical Orchid Workhouse
B	Education Greenhouse: Warm Temperate Plants	N	Tropical Plant Propagation House
C	Education Greenhouse: Tropical Plants	O	Tropical and Desert Plant Propagation House
D	Helen Mattin Warm Temperate Pavilion	P	Hardy Plant Nursery Yard
E	Tropical Pavilion	Q	Temperate Bonsai Tunnel
F	Desert Pavilion	R	Production House
G	C.V. Starr Bonsai Museum	S	Tropical Bonsai House
H	Conservatory Entry House	T	Auxiliary House
I	Aquatic House and Orchid Collection	U	New York-Native Flora and Temperate Plant Propagation Tunnel
J	Desert, Mediterranean, South African Bulb	V	Mediterranean Display Plants Tunnel
K	Humid Tropics Workhouse	W	Children's Garden Production House
L	Lowland Moist Tropical Orchid Workhouse		

Notes:
[1] **K**eyed to **Figure 6-3.**

EDUCATION GREENHOUSES (PALM HOUSE)

The Education Greenhouses are where plants are propagated for school visits and other education groups (including children and adults with sensory and cognitive disabilities), and are the only spaces that house and display "touchable" plants in service of hands-on, experiential learning and experimentation.

Desert Plants Education Greenhouse

The Desert Plants Education Greenhouse is an approximately 900-sf glazed conservatory space open to school groups and other workshop participants. The growing environment is climate controlled between 70 and 80°F to simulate arid regions and is home to a plant collection of cacti and succulents. Its plant collection comprises approximately 400 individual plants. Additionally, approximately 3,000 seasonal plants are produced in this space annually for educational use. Major plant families represented in this collection are the Cactaceae, Asphdelaceae, Asparagaceae, and Euphorbiaceae families.

Warm Temperate Plants Education Greenhouse

The Warm Temperate Plants Education Greenhouse is an approximately 900-sf glazed conservatory space

adjacent to the Desert Plants Education Greenhouse that is also open to school groups and other workshop participants. The growing environment is climate controlled between 60 and 75°F to simulate warm temperate climates, and is home to a plant collection of warm temperate ornamental, culinary, and medicinal plants. Its plant collection comprises approximately 380 individual plants. Additionally, approximately 1,100 plants are produced in this space annually for educational use. Major plant families represented in this collection are the Geraniaceae, Lamiaceae, Fabaceae, Solanaceae, and Droseraceae families.

Tropical Plants Education Greenhouse

The Tropical Plants Education Greenhouse is an approximately 900-sf glazed conservatory space adjacent to the Warm Temperate Plants Education Greenhouse that is open to school groups and other workshop participants. The growing environment is climate controlled between 80 and 85°F to simulate tropical and sub-tropical climates and is home to a plant collection of tropical ornamentals and crop plants. The plant collection comprises approximately 400 individual plants. Additionally, approximately 150 seasonal plants are produced in this space annually for educational use. Major plant families represented in this collection are the Rutaceae, Zingiberaceae, Rubiaceae, Bromeliaceae, and Musaceae families.

STEINHARDT CONSERVATORY

The Steinhardt Conservatory is a 25,510-sf complex that supports several collections growing spaces, propagation spaces, and display houses. The facility's collections growing spaces contain rare and endangered species, are actively used for *ex-situ* plant conservation, and hold custody of rare plants protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) for the Federal Government. The facility's display houses include pavilions and conservatories intended to grow and exhibit long- and short-term plantings on rotation from the collections growing spaces. Long-term plantings may be planted directly into beds and are typically replaced at the end of their natural life or when they have outgrown their space, using plant material held in the collections growing and propagation spaces. Collections in these spaces are fully labelled, including education interpretation, and are included in educational tours and programming. The Steinhardt Conservatory's propagation spaces include the Tropical Plant and Tropical and Desert Plant Propagation houses, and are the areas within the conservatory that actively grown new plants and repropagate existing plant material.

Helen Mattin Warm Temperate Pavilion

The Helen Mattin Warm Temperate Pavilion is an approximately 2,890-sf glasshouse open to the public. The growing environment is climate controlled between 60 and 70°F to simulate warm temperate and Mediterranean regions of Africa, Australasia and Asia, and western coastal North and South America. The pavilion is home to a plant collection of warm temperate herbaceous and woody perennials, bulbs, and ferns. The plant collection comprises approximately 63 plant families, 181 taxa, 195 plant accessions, and 311 individual plants. Major plant families represented in this collection are the Lamiaceae, Amaryllidaceae, Dryopteridaceae, Asparagaceae, and Myrtaceae families. Nine of the taxa featured in this pavilion are at-risk protected species on the *International Union for Conservation of Nature (IUCN) Red List of Threatened Species*. The current collection includes plant material introduced to the Brooklyn Botanic Garden over the last 104 years, from 71 individual sources.

Tropical Pavilion

The Tropical Pavilion is an approximately 5,840-sf nonpublic glasshouse pavilion. The growing environment is climate controlled between 80 and 86°F to simulate the tropical forests of the Amazon

Basin, African Rainforest, and tropical Eastern Asia. The pavilion is home to a plant collection of palms, aroids, bromeliads, gingers, and economic crop plants. This plant collection comprises approximately 61 plant families, 245 taxa, 252 plant accessions, and 716 individual plants. Major plant families represented in this collection are the Araceae, Zingiberaceae, and Asparagaceae families. Of the taxa found within this pavilion, 14 are at-risk protected species on the *IUCN Red List of Threatened Species*. The current collection includes plant material introduced to the Brooklyn Botanic Garden over the last 105 years from 89 individual sources.

Desert Pavilion

The Desert Pavilion is an approximately 2,890-sf glasshouse open to the public. The growing environment is climate controlled between 65 and 85°F to simulate arid regions of the Europe, Asia, Africa, and the Americas, and is home to a plant collection of shrubs, cacti, succulents, wildflowers, and living stones. The desert plant collection comprises approximately 31 plant families, 275 taxa, 288 plant accessions, and 423 individual plants. Of the taxa found within the Desert Pavilion, 20 are at-risk protected species on the *IUCN Red List of Threatened Species*. Major plant families represented in this collection are the Cactaceae, Asphodelaceae, Crassulaceae, Aizoaceae, and Euphorbiaceae families. The current collection includes plant material introduced to the Brooklyn Botanic Garden over the last 103 years from 87 individual sources. It should be noted that the plant species featured in the Desert Pavilion generally require higher levels of direct sunlight; as such, any oversized plantings are frequently replaced to ensure high light levels reach down to the soil level.

C.V. Starr Bonsai Museum

The Bonsai Museum is an approximately 2,280-sf glazed conservatory open to the public. The growing environment is climate controlled between 36 and 42°F to simulate temperate and Mediterranean to tropical and subtropical climates. The Bonsai Museum is home to a plant collection of tropical and temperate woody perennials. The space's plant collection comprises approximately 46 plant families, 261 taxa, 496 plant accessions, and 529 individual plants. Major plant families represented in this collection are the Cupressaceae, Rosaceae, Pinaceae, Sapindaceae, and Ulmaceae families. 19 of these taxa are at-risk protected species on the *IUCN Red List of Threatened Species*. The current collection includes plant material introduced to the Brooklyn Botanic Garden over the last 93 years from 55 individual sources, which feature some of the garden's oldest trees. The oldest specimen, a Rocky Mountain juniper, is 509 years old.

Conservatory Entry House

The Conservatory Entry House is an approximately 3,760-sf glazed conservatory open to the public. The growing environment is climate controlled between 77 and 83°F to simulate tropical and subtropical climates, and is home to a plant collection of aroids, cycads, and palms. The Conservatory Entry House plant collection comprises approximately 75 plant families, 274 taxa, 292 plant accessions, and 548 individual plants. Major plant families represented in this collection are the Araceae, Zamiaceae, and Arecaceae families. Of the taxa found in this display house, 35 are at-risk protected species on the *IUCN Red List of Threatened Species*. The current collection includes plant material introduced to the Brooklyn Botanic Garden over the last 104 years from 92 individual sources.

Aquatic House and Orchid Collection

The Aquatic House is an approximately 2,960-sf glazed conservatory open to the public. The growing environment is climate controlled between 75 and 82°F to simulate tropical and subtropical aquatic and

moist environments, and is home to a plant collection of aquatics, orchids, aroids, carnivorous plants, ferns, and mosses. The Aquatic House plant collection comprises approximately 28 plant families, 227 taxa, 308 plant accessions, and 616 individual plants. Major plant families represented in this collection are the Orchidaceae, Araceae, and Alismataceae families. One of these taxa is an at-risk protected species on the *IUCN Red List of Threatened Species*. The current collection includes plant material introduced to the Brooklyn Botanic Garden over the last 39 years from 54 individual sources. It should be noted that the plant species featured in the Aquatic House generally require higher levels of direct sunlight.

Desert, Mediterranean, South African Bulb (Arid) Workhouse

The Arid Workhouse is an approximately 2,080-sf nonpublic glazed conservatory space. The growing environment is climate controlled between 60 and 75°F to simulate arid regions of the New and Old World, and is home to a plant collection of cacti, succulents, living stones, and bulbs. This workhouse plant collection comprises approximately 61 plant families, 589 taxa, 633 plant accessions, and 946 individual plants. Major plant families represented in this collection are the Iridaceae, Asparagaceae, Asphodelaceae, Cactaceae, Amaryllidaceae, Euphorbiaceae, Ocalidaceae, and Crassulaceae families. Of the taxa in the Arid Workhouse, 33 are at-risk protected species on the *IUCN Red List of Threatened Species*. The current collection includes plant material introduced to the Brooklyn Botanic Garden over the last 52 years from 60 individual sources.

Humid Tropics Workhouse

The Humid Tropics Workhouse is an approximately 1,480-sf nonpublic glazed conservatory space. The growing environment is climate controlled between 72 and 80°F to simulate the moist tropics, and is home to a plant collection of tropical palms, bulbs, and ferns. This workhouse plant collection comprises approximately 55 plant families, 141 taxa, 147 plant accessions, and 284 individual plants. Major plant families represented in this collection are the Apocynaceae, Arecaceae, Euphorbiaceae, and Amaryllidaceae families. Seven of these taxa are at-risk protected species on the *IUCN Red List of Threatened Species*. The current collection includes plant material introduced to the Brooklyn Botanic Garden over the last 51 years from 94 individual sources.

Lowland Moist Tropical Orchid Workhouse

The Lowland Moist Tropical Orchid Workhouse is an approximately 860-sf nonpublic glazed conservatory space. The growing environment is climate controlled between 68 and 76°F to simulate lowland moist tropics, and is home to a plant collection of epiphytic orchids. This plant collection comprises approximately five plant families, 1,177 taxa, 2,000 plant accessions, and 2,038 individual plants. Of the taxa, 48 are at-risk protected species on the *IUCN Red List of Threatened Species*. The major plant family represented in this collection is the Orchidaceae family. The current collection includes plant material introduced to the Brooklyn Botanic Garden over the last 60 years from 100 individual sources.

Highland Moist Tropical Orchid Workhouse

The Highland Moist Tropical Orchid Workhouse is an approximately 1,020-sf nonpublic glazed conservatory space. The growing environment is climate controlled between 68 and 78°F to simulate highland moist tropics, and is home to a plant collection of epiphytic orchids. This plant collection comprises approximately 11 plant families, 2,483 taxa, 4,880 plant accessions, and 5,198 individual plants. The major plant family represented in this collection is the Orchidaceae family. Of the taxa found in the Highland Moist Tropical Orchid Workhouse, 61 are at-risk protected species on the *IUCN Red List of Threatened Species*. The current collection includes plant material introduced to the Brooklyn Botanic

Garden over the last 63 years from 102 individual sources.

Tropical Plant Propagation House

The Tropical Plant Propagation House is an approximately 790-sf nonpublic glazed conservatory space. The growing environment is climate controlled between 75 and 85°F as an adaptable, specialist growing space, and is home to a plant collection of tropical perennials. This space is used to propagate plants for all the tropical glasshouse spaces within the Brooklyn Botanic Garden. This plant collection comprises approximately eight plant families, nine taxa, 20 plant accessions, and 30 individual plants. Major plant families represented in this collection are the Araceae and Araucariaceae families. Three of these taxa are at-risk protected species on the *IUCN Red List of Threatened Species*. The current collection includes plant material introduced to the Brooklyn Botanic Garden over the last 39 years, from eight individual sources. It should be noted that the propagation of the plant species found in the Tropical Plant Propagation House generally require higher levels of direct sunlight.

Tropical and Desert Plant Propagation House

The Tropical and Desert Plant Propagation House is an approximately 840-sf nonpublic glazed conservatory space. The growing environment is climate controlled between 70 and 85°F as an adaptable, specialist growing space, and is home to a plant collection of bromeliads, orchids, and carnivorous plants. Its plant collection comprises approximately 26 plant families, 127 taxa, 157 plant accessions, and 232 individual plants. Major plant families represented in this collection include the Bromeliaceae, Sarraceniaceae, Orchidaceae, and Apocyncaceae families. Of the taxa in the Tropical and Desert Plant Propagation House, 19 are at-risk protected species on the *IUCN Red List of Threatened Species*. The current collection includes plant material introduced to the Brooklyn Botanic Garden over the last 47 years, from 48 individual sources. It should be noted that the propagation of the plant species found in the Tropical and Desert Plant Propagation House generally require higher levels of direct sunlight.

HARDY PLANT NURSERY YARD

The Brooklyn Botanic Garden's Hardy Plant Nursery Yard is an approximately 18,000-sf nonpublic exterior growing space that is home to a plant collection of hardy wood and herbaceous perennials, as well as six propagation houses and collections growing spaces, including the Temperate Bonsai Tunnel, the Production House, the Tropical Bonsai House, the Auxiliary House, the New York-Native Flora and Temperate Plant Propagation Tunnel, and the Mediterranean Displace Plants Tunnel (which are described in greater detail below). The exterior nursery's plant collection comprises approximately 56 plant families, 202 taxa, 207 plant accessions, and 2,358 individual plants. Major plant families represented in the unenclosed portions of the nursery include the Asphodelaceae, Rosaceae, and Paeoniaceae families. Nine of these taxa are at-risk protected species on the *IUCN Red List of Threated Species*. The nursery's current collection includes plant material introduced to the Brooklyn Botanic Garden over the last 84 years, from 78 individual sources.

Temperate Bonsai Tunnel

The Temperate Bonsai Tunnel is an approximately 1,190-sf nonpublic growing tunnel. The growing environment is climate controlled between 38 and 45°F to simulate temperate regions, and is home to a plant collection of hardy wood perennials, broadleaf, and conifers. The Temperate Bonsai Tunnel serves as a nursery area for growing cold-hardy bonsai trees when they are not on display in the C.V. Starr Bonsai Museum.

Production House

The Production House is an approximately 930-sf nonpublic glasshouse. The growing environment is climate controlled between 60 and 80°F as an adaptable, specialist growing space. This house is used year-round to grow over 25,000 annual and biennial plants that are featured throughout the Brooklyn Botanic Garden. As the Production House serves as a greenhouse for propagating and growing collection and seasonal plants from seedlings, the facility generally requires higher levels of direct sunlight.

Tropical Bonsai House

The Tropical Bonsai House is an approximately 456-sf nonpublic glasshouse. The growing environment is climate controlled between 70 and 80°F to simulate tropical and subtropical climates, and is home to a plant collection of tropical, woody perennials. Similar to the Temperate Bonsai Tunnel described above, the Tropical Bonsai House serves as a nursery area for growing and housing tropical climate bonsai trees when they are not on display in the C.V. Starr Bonsai Museum.

Auxiliary House

The Auxiliary House is an approximately 465-sf nonpublic glasshouse. The growing environment is climate controlled between 60 and 80°F as an adaptable, specialist growing space, and is home to a plant collection of tender and tropical perennials. Its plant collection comprises approximately 10 plant families, 22 taxa, 22 plant accessions, and 49 individual plants. The major plant family represented in this collection is the Araceae family. The current collection includes plant material introduced to the Brooklyn Botanic Garden over the last 30 years from 10 individual sources. It should be noted that the plant species that grow in the Auxiliary House generally require higher levels of direct sunlight.

New York-Native Flora and Temperate Plant Propagation Tunnel

The New York-Native Flora and Temperate Plant Propagation Tunnel is an approximately 2,320-sf nonpublic growing tunnel. The growing environment is climate controlled between 55 and 80°F to simulate temperate regions and is home to a plant collection of regional U.S. native plants, rare New York State flora, and temperate woody and herbaceous perennials. This greenhouse tunnel serves as a temporary storage facility for plants that will eventually be planted throughout the Brooklyn Botanic Garden. The plant collection comprises approximately 84 plant families, 326 taxa, 348 accessions, and 3,820 individual plants. Major plant families represented in this collection include the Salicaceae, Asphodelaceae, and Oleaceae families. Of the taxa found within this greenhouse tunnel, 19 are at-risk protected species on the *IUCN Red List of Threatened Species*. The current collection includes plant material introduced to the Brooklyn Botanic Garden over the last 53 years from 96 individual sources.

Mediterranean Display Plants Tunnel

The Mediterranean Display Plants Tunnel is an approximately 870-sf nonpublic growing tunnel. The growing environment is climate controlled between 35 and 45°F to simulate the Mediterranean and is home to a plant collection of citrus and olive plants. This tunnel serves as a greenhouse for primarily growing citrus and olive trees when they are not on public display. This plant collection comprises approximately four plant families, 26 taxa, 28 plant accessions, and 30 individual plants. Major plant families represented in this collection include the Rutaceae and Oleaceae families. The current collection includes plant material introduced to the Brooklyn Botanic Garden over the last 29 years from 12 individual sources. It should be noted that the plant species that grow in the Mediterranean Display Plants Tunnel generally require higher levels of direct sunlight.

Jackie Robinson Playground

Jackie Robinson Playground is a primarily active use park located on the northern half of the block bounded by Franklin Avenue to the west, McKeever Place to the east, and Montgomery Street to the north. The 1.0-acre playground includes basketball and handball courts, playgrounds, fitness equipment, spray showers, game tables, benches, and tree plantings (see **Figure 6-4a**).

Prospect Park

Prospect Park is a 526-acre park bounded by Flatbush Avenue to the north, Prospect Park West to the west, Prospect Park Southwest and Caton Avenue to the south, and Ocean Avenue to the east. The park was designed and constructed over a thirty-year period (1865-1895) by Frederick Law Olmsted and Calvert Vaux, and includes a zoo (see **Figure 6-4b** for more details on zoo features), an ice rink, barbecuing areas, band-shell, carousel, baseball fields, tennis courts, fitness equipment, playgrounds, spray showers, public bathrooms, fishing areas, historic buildings (including the Lefferts Historic House), bicycle paths and greenways, hiking trails, horseback riding trails, nature centers, and dog-friendly areas. The park also includes the first urban-area Audubon Center in the nation. In addition to being a sunlight-sensitive open space resource, Prospect Park is also designated as a historic scenic landmark by the LPC and listed on the State and National Register of Historic Places (S/NR-listed).

P.S. 375K Community Playground

P.S. 375K Community Playground is a 0.45-acre open space located on the block bounded by Franklin Avenue, McKeever Place, Montgomery Street, and Sullivan Place. The open space is generally divided into three separate open space areas. The southwestern portion of the open space fronting Franklin Avenue and Sullivan Place is a mostly paved area featuring bench seating and several tree plantings; the southeastern portion of the open space fronting Sullivan Place and McKeever Place is also paved and features a small running track and two basketball courts; and the northeastern portion of the open space fronting McKeever Place features raised garden beds, bench seating, tables, and trees.

Eastern Parkway

Eastern Parkway is a parkway designed by Frederick Law Olmsted constructed in 1870. The parkway consists of a broad, bidirectional avenue of six lanes, separated by a median from a narrow parallel side street on both the north and south side. Both medians have trees, benches, subway entrances, and paths for pedestrians, including a bike path on the southern median, which is part of the Brooklyn-Queens Greenway – a 40-mile continuous pedestrian and cyclist route from Coney Island in Brooklyn to Fort Totten, on the Long Island Sound, in Queens. In addition to being a sunlight-sensitive open space resource, Eastern Parkway is also designated as a historic individual landmark by the LPC.

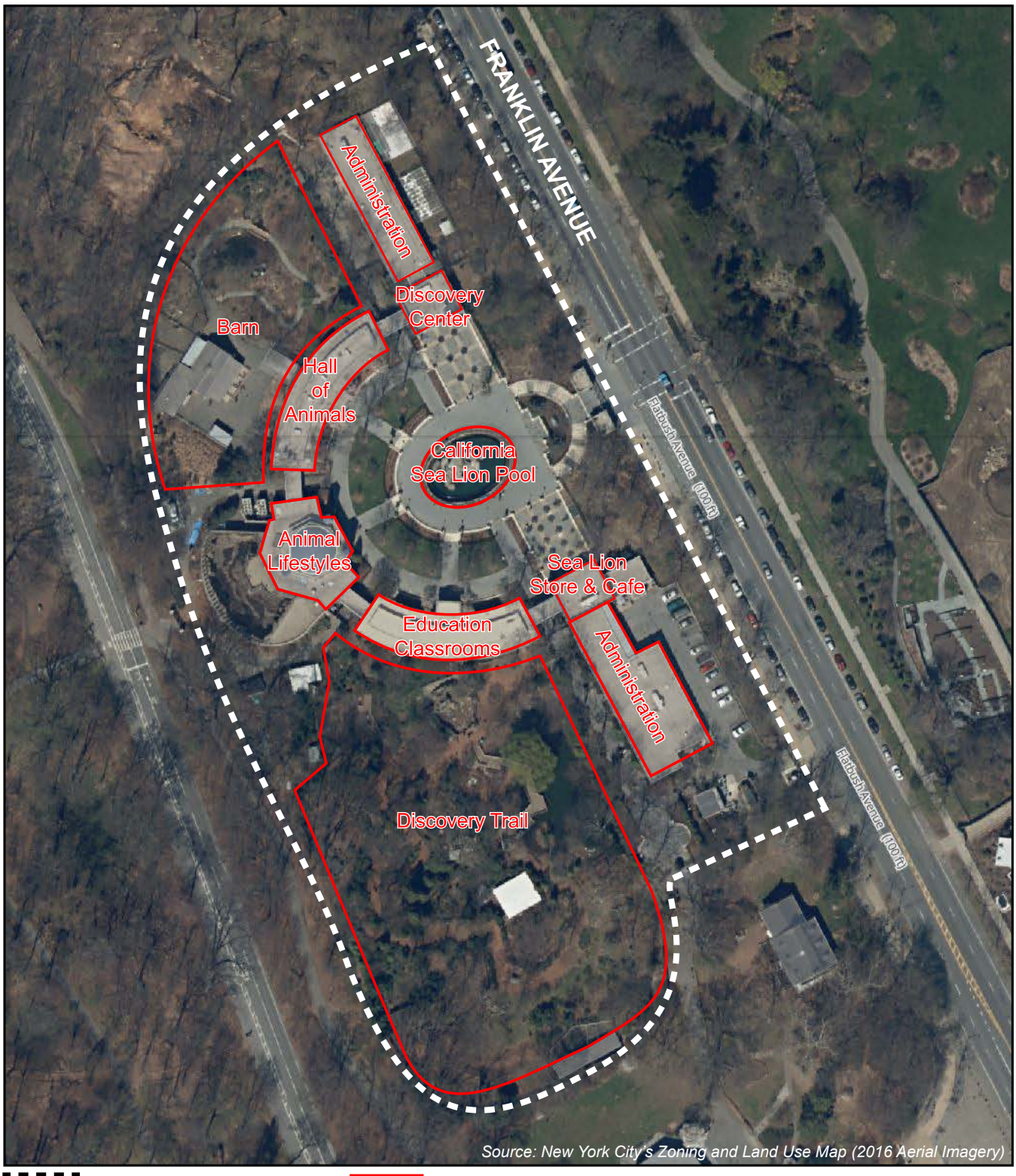
Detailed Shadows Analysis

Per *CEQR Technical Manual* guidelines, shadow analyses were performed for the five sunlight-sensitive resources identified above on four representative days of the year: March 21/September 21, the equinoxes; May 6, the midpoint between the summer solstice and the equinox (and equivalent to August 6); June 21, the summer solstice and the longest day of the year; and December 21, the winter solstice and shortest day of the year. These four representative days indicate the range of shadows over the course of the year. *CEQR Technical Manual* guidelines define the temporal limits of a shadow analysis period to fall from 1.5 hours after sunrise to 1.5 hours before sunset. As discussed above, the results of

Figure 6-4a
Jackie Robinson Playground Aerial Site Map

Jackie Robinson Playground Boundary Jackie Robinson Playground Features

Figure 6-4b
Prospect Park Zoo Aerial Site Map



the shadows analysis show the incremental difference in shadow impact between the No-Action and With-Action conditions, the results of which are summarized in **Table 6-4**. In addition, it should be noted that 23 of the Brooklyn Botanic Garden's conservatories, greenhouses, propagation spaces, and nurseries were analyzed separately in order to more accurately measure the incremental shadow impacts on the sunlight-sensitive features found within these structures, the results of which are summarized in **Table 6-5**.

As shown in **Table 6-4**, incremental project-generated shadows would reach four of the five sunlight-sensitive open space resources identified in the Tier 3 assessment (incremental project-generated shadows would not reach Eastern Parkway on any of the four representative analysis days). Of the 23 conservatories, greenhouses, propagation spaces, and nurseries studied separately within the Brooklyn Botanic Garden, the detailed shadows analysis determined that project-generated incremental shadows would reach 22 of these sunlight-sensitive resources located within the Brooklyn Botanic Garden (incremental project-generated shadows would not reach the Children's Garden Production House) (refer to **Table 6-5**). Increases in shadow coverage would occur at the Brooklyn Botanic Garden and Jackie Robinson Playground on all four representative analysis days (March 21/September 21, May 6/August 6, June 21, and December 21); increases in shadow coverage would occur at Prospect Park on three of the four representative analysis days (March 21/September 21, May 6/August 6, and June 21); and increases in shadow coverage would occur at the P.S. 375K Community Playground on only one of the four analysis days (June 21).

Within the Brooklyn Botanic Garden, incremental shadow coverage would occur at the Helen Mattin Warm Temperate Pavilion, C.V. Starr Bonsai Museum, Conservatory Entry House, Desert, Mediterranean, South African Bulb (Arid) Workhouse, and Humid Tropics Workhouse on all four representative analysis days; increases in shadow coverage would occur at the Tropical Pavilion, Desert Pavilion, Aquatic House and Orchid Collection, Tropical Plant Propagation House, Tropical and Desert Plant Propagation House, Hardy Plant Nursery Yard, Temperate Bonsai Tunnel, Production House, Tropical Bonsai House, and New York-Native Flora and Temperate Plant Propagation Tunnel on three of the four representative analysis days; and increases in shadow coverage would occur at the Education Greenhouse's Desert Plants, Warm Temperate Plants, and Tropical Plants facilities, as well as the Auxiliary House and Mediterranean Display Plants Tunnel on two of the four analysis days. **Figures 6-5** through **6-7**, provided at the end of this chapter, show representative shadow views for the five sunlight-sensitive resources (as well as the 22 sunlight-sensitive conservatories, greenhouses, propagation spaces, and nurseries within the Brooklyn Botanic Garden) of concern on each of the representative analysis days.

TABLE 6-4
Duration of Shadows on Potentially Sunlight Sensitive Resources (Increment Compared to No-Action)

Resource	Analysis Day	March 21/Sept. 21 7:36 AM – 4:29 PM	May 6/August 6 6:27 AM – 5:18 PM	June 21 5:57 AM – 6:01 PM	December 21 8:51 AM – 2:53 PM
Brooklyn Botanic Garden	Shadow enter-exit time	7:36 – 10:41 AM	6:27 – 10:29 AM	5:57 – 10:19 AM	8:51 – 10:45 AM
	Incremental shadow duration	3 hours 5 minutes	4 hours 2 minutes	4 hours 22 minutes	1 hour 54 minutes
Jackie Robinson Playground	Shadow enter-exit time	1:26 – 4:29 PM	1:12 – 5:18 PM	1:16 – 6:01 PM	1:38 – 2:53 PM
	Incremental shadow duration	3 hours 3 minutes	4 hours 6 minutes	4 hours 45 minutes	1 hour 15 minutes
Prospect Park	Shadow enter-exit time	7:36 – 7:56 AM	6:27 – 7:17 AM	5:57 – 7:09 AM	
	Incremental shadow duration	20 minutes	50 minutes	1 hour 12 minutes	
P.S. 375K Community Playground	Shadow enter-exit time			3:33 – 3:58 PM	
	Incremental shadow duration			25 minutes	

Note: All times are Eastern Standard Time; Daylight Savings Time was not accounted for per *CEQR Technical Manual* guidelines.
Table indicates the entry and exit times and total duration of incremental shadow for each sunlight-sensitive resource.

TABLE 6-5
Duration of Shadows on Brooklyn Botanic Garden's Sunlight-Sensitive Conservatories, Greenhouses, Propagation Spaces, and Nurseries (Increment Compared to No-Action)

ID[1]	Resource	Analysis Day	March 21/Sept. 21 7:36 AM – 4:29 PM	May 6/August 6 6:27 AM – 5:18 PM	June 21 5:57 AM – 6:01 PM	December 21 8:51 AM – 2:53 PM
A	Education Greenhouse: Desert Plants	Shadow enter-exit time	9:14 - 9:44 AM	-	-	8:51 - 10:01 AM
		Incremental shadow duration	30 minutes	-	-	1 hour 10 minutes
B	Education Greenhouse: Warm Temperate Plants	Shadow enter-exit time	8:27 - 9:33 AM	-	-	8:51 - 9:56 AM
		Incremental shadow duration	1 hour 5 minutes	-	-	1 hour 5 minutes
C	Education Greenhouse: Tropical Plants	Shadow enter-exit time	8:29 - 9:51 AM	-	-	8:51 - 9:52 AM
		Incremental shadow duration	1 hour 22 minutes	-	-	1 hour 1 minute
D	Helen Mattin Warm Temperate Pavilion	Shadow enter-exit time	7:36 - 9:41 AM	6:27 - 9:15 AM	7:28 - 8:48 AM	8:51 - 8:56 AM
		Incremental shadow duration	2 hours 5 minutes	2 hours 48 minutes	1 hour 20 minutes	5 minutes
E	Tropical Pavilion	Shadow enter-exit time	7:36 - 9:18 AM	6:27 - 9:19 AM	6:05 - 8:47 AM	-
		Incremental shadow duration	1 hour 42 minutes	2 hours 52 minutes	2 hours 42 minutes	-
F	Desert Pavilion	Shadow enter-exit time	7:36 - 9:08 AM	6:27 - 9:40 AM	5:57 - 9:12 AM	-
		Incremental shadow duration	1 hour 32 minutes	3 hours 13 minutes	3 hours 15 minutes	-
G	C.V. Starr Bonsai Museum	Shadow enter-exit time	7:36 - 10:10 AM	6:27 - 9:27 AM	7:38 - 8:08 AM 8:28 - 9:01 AM	8:51 - 9:17 AM
		Incremental shadow duration	2 hours 34 minutes	3 hours	30 minutes 33 minutes	26 minutes
H	Conservatory Entry House	Shadow enter-exit time	7:36 - 9:53 AM	6:27 - 9:45 AM	5:57 - 9:14 AM	8:51 - 9:05 AM
		Incremental shadow duration	2 hours 17 minutes	3 hours 18 minutes	3 hours 17 minutes	14 minutes
I	Aquatic House & Orchid Collection	Shadow enter-exit time	7:36 - 9:32 AM	6:27 - 9:53 AM	5:57 - 9:45 AM	-
		Incremental shadow duration	1 hour 56 minutes	3 hours 26 minutes	3 hours 48 minutes	-
J	Desert, Mediterranean,	Shadow enter-exit time	7:36 - 10:25 AM	7:02 - 9:46 AM	8:09 - 8:32 AM 9:01 - 9:20 AM	8:51 - 9:34 AM

	South African Bulb (Arid) Workhouse	Incremental shadow duration	2 hours 49 minutes	2 hours 44 minutes	23 minutes 19 minutes	43 minutes
K	Humid Tropics Workhouse	Shadow enter-exit time	7:36 - 10:14 AM	6:27 - 9:47 AM 9:55 - 10:01 AM	6:27 - 9:32 AM	8:51 - 9:23 AM
		Incremental shadow duration	2 hours 38 minutes	3 hours 20 minutes 6 minutes	3 hours 5 minutes	32 minutes
L	Lowland Moist Tropical Orchid Workhouse	Shadow enter-exit time	7:36 - 9:57 AM	6:27 - 10:10 AM	5:57 - 9:35 AM	8:51 - 9:07 AM
		Incremental shadow duration	2 hours 21 minutes	3 hours 43 minutes	3 hours 38 minutes	16 minutes
M	Highland Moist Tropical Orchid Workhouse	Shadow enter-exit time	7:46 - 9:45 AM	6:27 - 8:42 AM 8:53 - 10:14 AM	5:57 - 9:15 AM 9:34 - 9:53 AM	8:51 - 8:54 AM
		Incremental shadow duration	1 hour 59 minutes	2 hours 15 minutes 1 hour 21 minutes	3 hours 18 minutes 19 minutes	3 minutes
N	Tropical Plant Propagation House	Shadow enter-exit time	7:36 - 9:32 AM	6:27 - 8:18 AM 8:38 - 10:09 AM	5:57 - 8:53 AM 9:12 - 9:57 AM	-
		Incremental shadow duration	1 hour 56 minutes	1 hour 51 minutes 1 hour 31 minutes	2 hours 56 minutes 45 minutes	-
O	Tropical & Desert Plant Propagation House	Shadow enter-exit time	7:36 - 9:23 AM	6:27 - 8:03 AM 8:21 - 10:00 AM	5:57 - 8:38 AM 8:54 - 10:01 AM	-
		Incremental shadow duration	1 hour 47 minutes	1 hour 36 minutes 1 hour 39 minutes	2 hours 41 minutes 1 hour 7 minutes	-
P	Hardy Plant Nursery Yard	Shadow enter-exit time	7:36 - 9:05 AM	6:27 - 9:26 AM	5:57 - 9:39 AM	-
		Incremental shadow duration	1 hour 29 minutes	2 hour 59 minutes	3 hours 42 minutes	-
Q	Temperate Bonsai Tunnel	Shadow enter-exit time	7:36 - 8:18 AM	6:27 - 8:22 AM	5:57 - 8:49 AM	-
		Incremental shadow duration	42 minutes	1 hour 55 minutes	2 hours 52 minutes	-
R	Production House	Shadow enter-exit time	7:36 - 7:39 AM	6:27 - 7:50 AM	5:57 - 8:16 AM	-
		Incremental shadow duration	3 minutes	2 hours 23 minutes	2 hours 19 minutes	-
S	Tropical Bonsai House	Shadow enter-exit time	7:36 - 7:44 AM	6:27 - 7:57 AM	5:57 - 8:21 AM	-
		Incremental shadow duration	8 minutes	1 hour 30 minutes	2 hours 24 minutes	-
T	Auxiliary House	Shadow enter-exit time	-	6:27 - 8:03 AM	5:57 - 7:57 AM	-
		Incremental shadow duration	-	1 hour 36 minutes	2 hours	-
U	New York-Native Flora & Temperate Plant Propagation Tunnel	Shadow enter-exit time	7:36 - 8:36 AM	6:27 - 8:32 AM	5:57 - 9:01 AM	-
		Incremental shadow duration	1 hour	2 hours 5 minutes	3 hours 4 minutes	-
V	Mediterranean Display Plants Tunnel	Shadow enter-exit time	-	6:42 - 8:11 AM	6:07 - 7:49 AM	-
		Incremental shadow duration	-	1 hour 29 minutes	1 hour 42 minutes	-

Note: All times are Eastern Standard Time; Daylight Savings Time was not accounted for per *CEQR Technical Manual* guidelines.
Table indicates the entry and exit times and total duration of incremental shadow for each sunlight-sensitive resource.
[1] Keyed to **Figure 6-3**.

It should be noted that, per the *CEQR Technical Manual*, all times reported herein are Eastern Standard Time and do not reflect adjustments for daylight savings time that is in effect from mid-March to early November. As such, the times reported in this attachment for March 21/September 21, May 6/August 6, and June 21 need to have one hour added to reflect the Eastern Daylight Saving Time.

BROOKLYN BOTANIC GARDEN

MARCH 21/SEPTEMBER 21

On March 21/September 21, the time period for shadows analysis begins at 7:36 AM and continues until 4:29 PM. March is considered the beginning of the growing season in New York City, and September 21, which has the same shadow patterns as March 21, is also within the growing season.

The Proposed Project would cast incremental shadows on portions of the Brooklyn Botanic Garden for a total of three hours and five minutes on the March 21/September 21 analysis day. Incremental shadows would enter the garden at 7:36 AM and continue until 10:41 AM. After 10:41 AM the Brooklyn Botanic Garden would not experience any incremental shadow coverage. As indicated in **Figures 6-5a, 6-5e,** and **6-5h**, during the early morning hours, shadow coverage would be concentrated on the southern portion of the open space fronting Washington and Flatbush avenues, which includes portions of the Plant Family Collection, the Rock Garden, the Shelby White and Leon Levy Water Garden, the Compost Exhibit, the Lily Pool Terrace, the Hardy Plant Nursery Yard, the Temperate Bonsai Tunnel, the Tropical Bonsai House, the Production House, the New York-Native Flora and Temperate Plant Propagation Tunnel, and the Steinhardt Conservatory. As shown in **Figures 6-5a, 6-5e,** and **6-5h**, by 8:00 AM, incremental shadow coverage would decrease, moving in an easterly direction and would continue to cast incremental shadows on portions of the Plant Family Collection, the Rock Garden, Shelby White and Leon Levy Water Garden, the Compost Exhibit, the Lily Pool Terrace, the Hardy Plant Nursery Yard, the Temperate Bonsai Tunnel, the New York-Native Flora and Temperate Plant Propagation Tunnel, and the Steinhardt Conservatory.

As shown in **Figures 6-5b, 6-5f,** and **6-5i**, by 8:30 AM, incremental shadow coverage would continue to decrease, moving in an easterly direction and would cast incremental shadows on portions of the Plant Family Collection, the Lily Pool Terrace, the Tropical Plants Education Greenhouse, the Hardy Plant Nursery Yard, the New York-Native Flora and Temperate Plant Propagation Tunnel, and the Steinhardt Conservatory. By 9:00 AM incremental shadow coverage would continue to decrease, moving in an easterly direction, and would only cast incremental shadows on portions of the Lily Pool Terrace, the Warm Temperate Plants and Tropical Plants Education Greenhouses, the Steinhardt Conservatory, and a small, northeastern portion of the Hardy Plant Nursery Yard (see **Figures 6-5b, 6-5f, 6-5i,** and **6-5j**).

As shown in **Figures 6-5c, 6-5g, 6-5j,** and **6-5k,** by 9:30 AM, incremental shadow coverage would continue to decrease, moving in an easterly direction and would only cast incremental shadows on the Lily Pool Terrace, the Desert, Warm Temperate Plants, and Tropical Plants Education Greenhouses, and portions of the Steinhardt Conservatory (incremental shadows would no longer affect the Tropical Pavilion, the Desert Pavilion, and the Tropical and Desert Plant Propagation House at this period). By 10:00 AM, incremental shadow coverage would continue to decrease, only affecting the Steinhardt Conservatory's C.V. Starr Bonsai Museum, Arid Workhouse, and Humid Tropics Workhouse, as well as a small portion of landscaping located between the Steinhardt Conservatory and Washington Avenue which contains trees and shrubs (refer to **Figures 6-5c** and **6-5g**). By 10:30 AM, incremental shadow coverage would continue to decrease, only affecting a small portion of landscaping located between the Steinhardt Conservatory and Washington Avenue which contains trees and shrubs (refer to **Figure 6-5d**). At 10:41 AM, incremental shadows would completely exit the Brooklyn Botanic Garden, and the majority of the open space would continue to receive direct sunlight for the remainder of the analysis day. The maximum area of incremental shadow coverage that would cover the Brooklyn Botanic Garden on this analysis day (which would occur at 7:36 AM) would be approximately 230,500 sf, or approximately 10.2 percent of added coverage; the maximum total shadow coverage from both existing buildings and the proposed

Figure 6-5a

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on March 21/September 21

7:36 AM

8:00 AM

Proposed Development
Open Space
Historic Resource
Greenhouse Facility
Incremental Shadow
Water Feature

Figure 6-5b

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on March 21/September 21

8:30 AM

9:00 AM

Proposed Development
Open Space
Historic Resource
Greenhouse Facility
Incremental Shadow
Water Feature

Figure 6-5c

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on March 21/September 21

9:30 AM

10:00 AM

Proposed Development
Open Space
Historic Resource
Greenhouse Facility
Incremental Shadow
Water Feature

Figure 6-5d

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on March 21/September 21

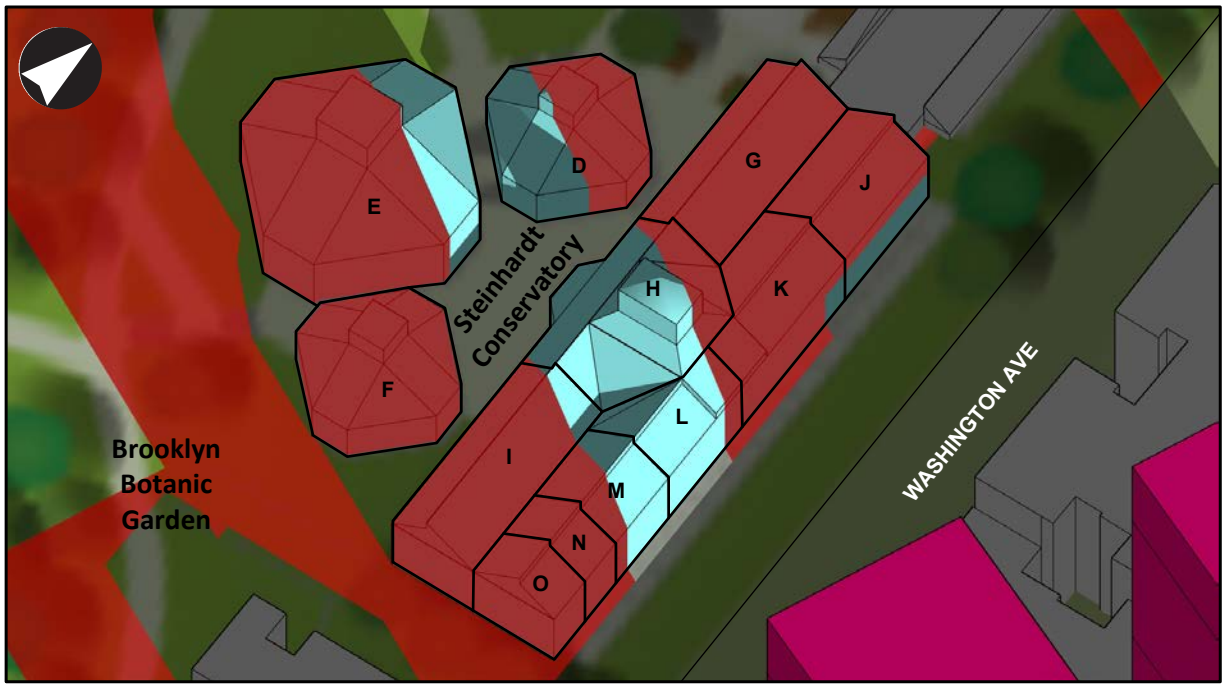
10:30 AM

Proposed Development
Open Space
Historic Resource
Greenhouse Facility
Incremental Shadow
Water Feature

Figure 6-5e

Brooklyn Botanic Garden - Steinhardt Conservatory
Incremental Shadows on March 21/September 21

7:36 AM



8:00 AM

Proposed Development

Open Space

Historic Resource

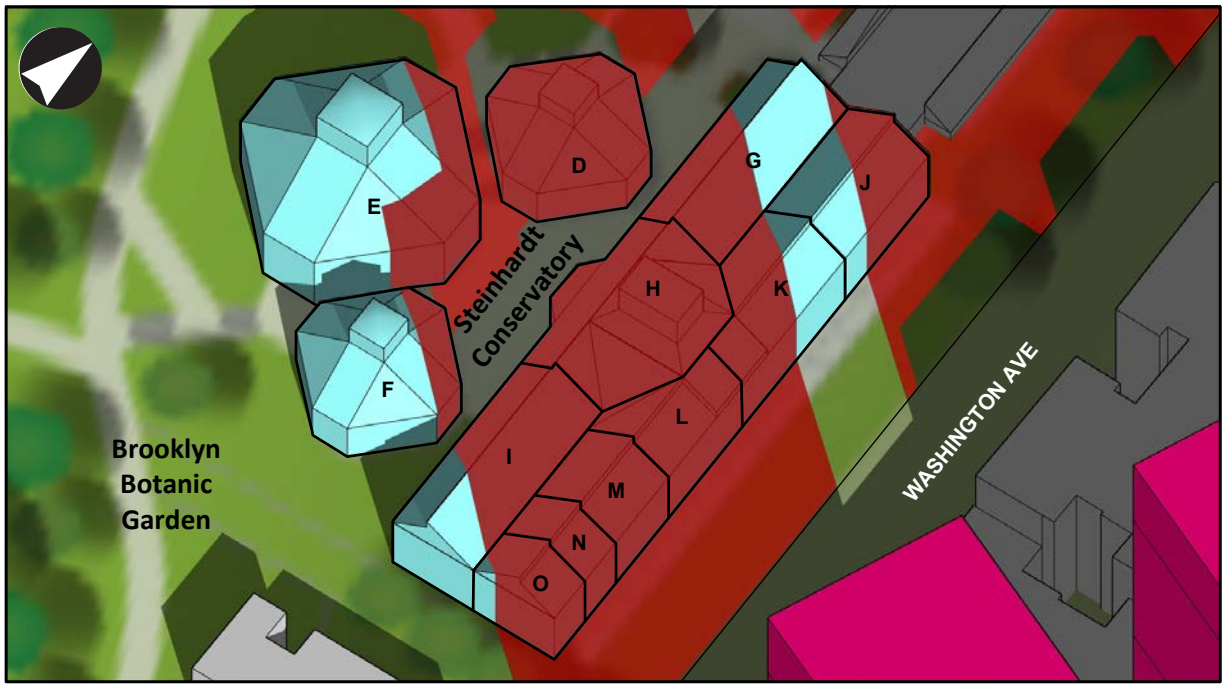
D **Greenhouse Facility**
**Keyed to Table 6-5*

Incremental Shadow

Figure 6-5f

Brooklyn Botanic Garden - Steinhardt Conservatory
Incremental Shadows on March 21/September 21

8:30 AM



9:00 AM

Proposed Development

Open Space

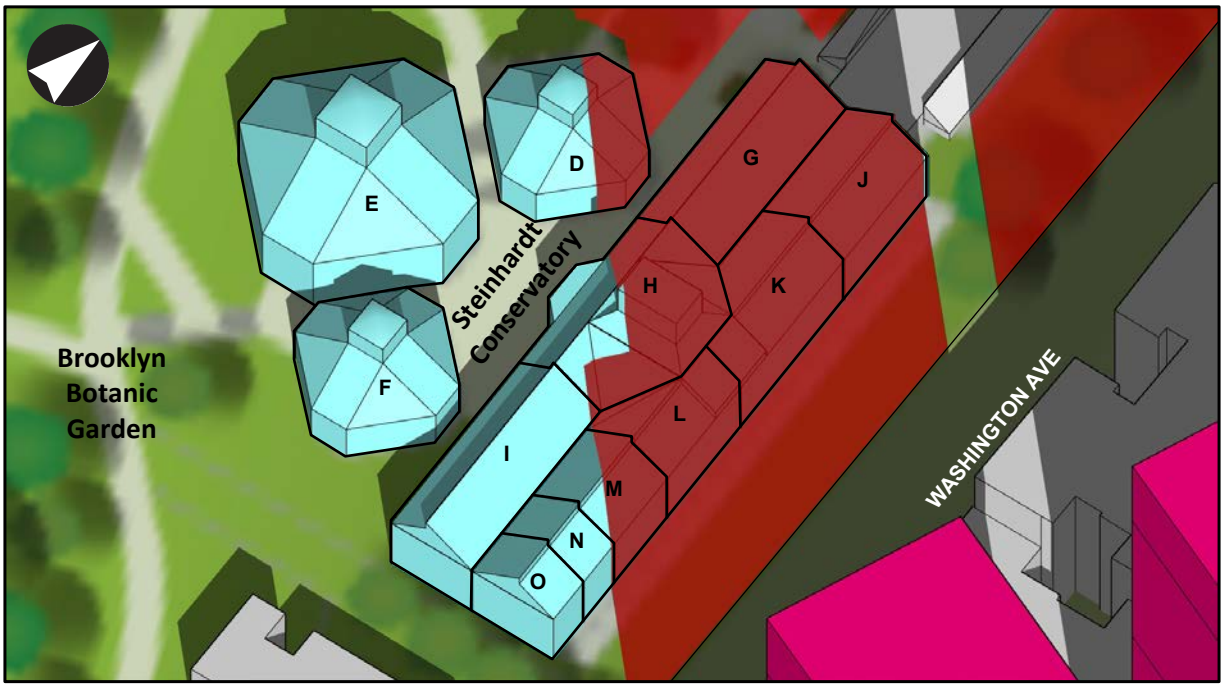
Historic Resource

D **Greenhouse Facility**
**Keyed to Table 6-5*

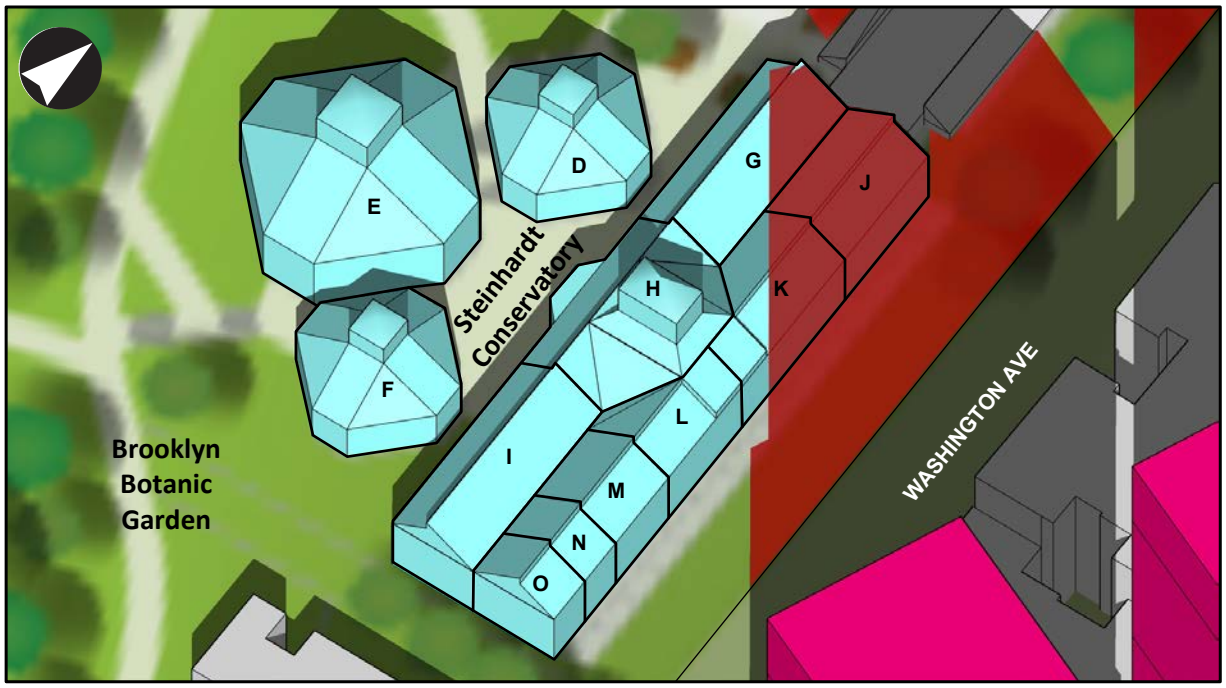
Incremental Shadow

Figure 6-5g

Brooklyn Botanic Garden - Steinhardt Conservatory
Incremental Shadows on March 21/September 21



9:30 AM



10:00 AM

Proposed Development

Open Space

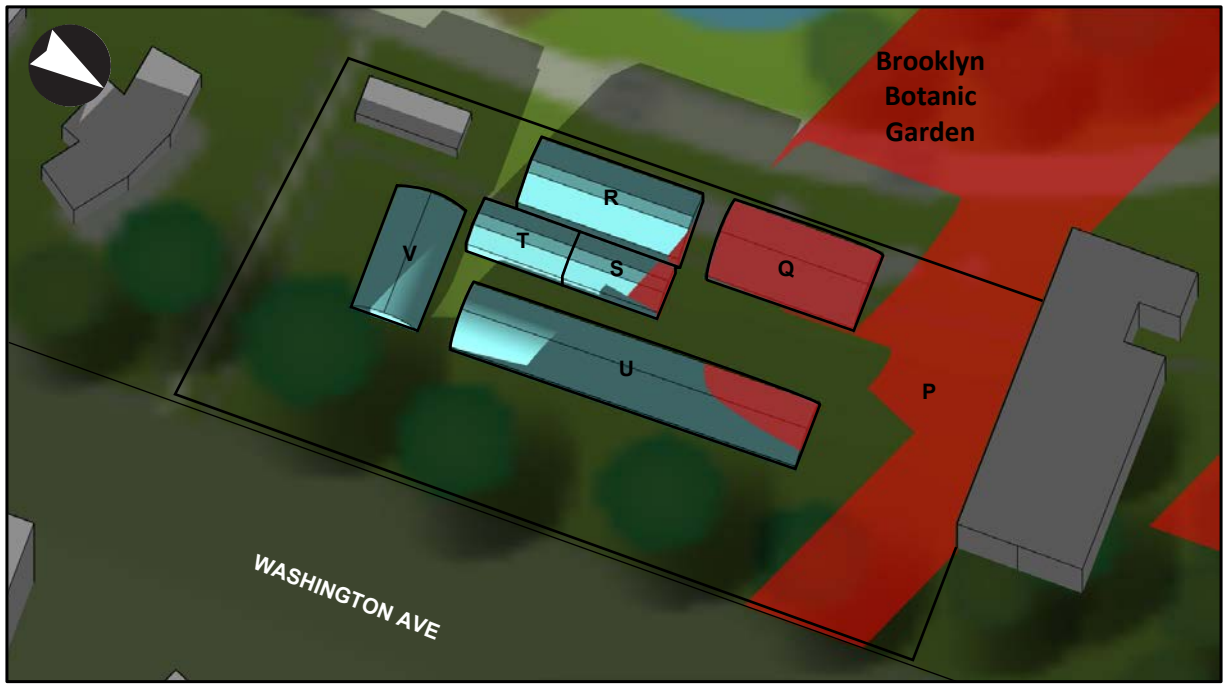
Historic Resource

D **Greenhouse Facility**
**Keyed to Table 6-5*

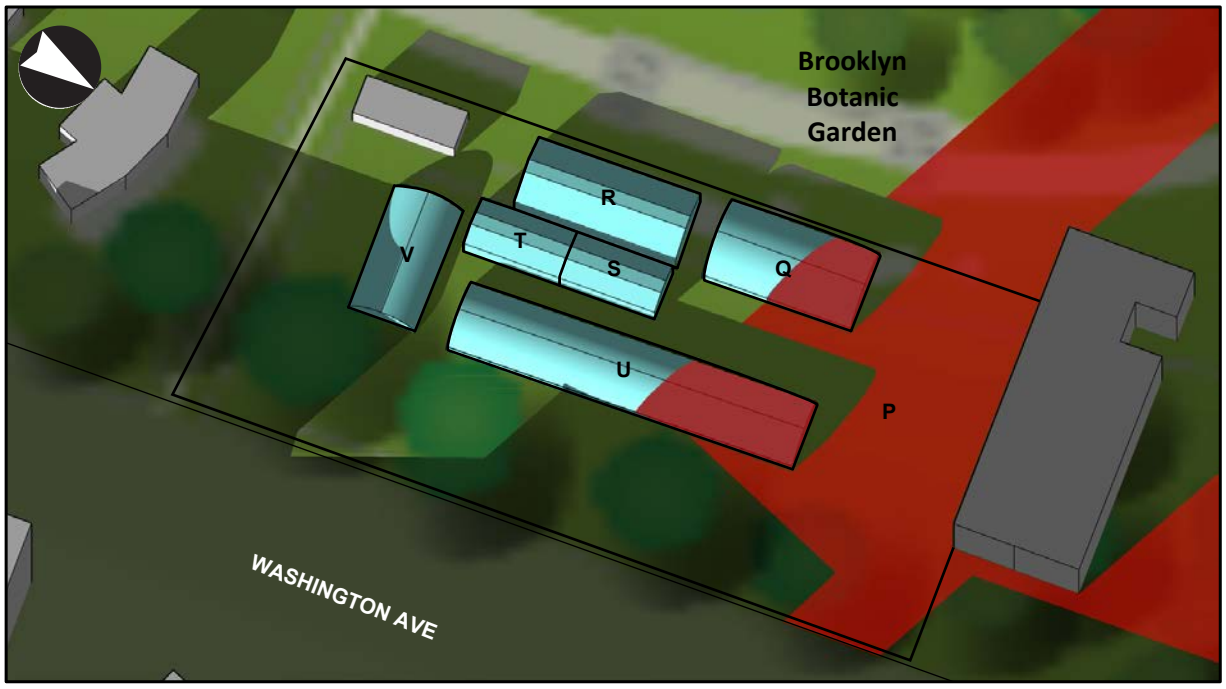
Incremental Shadow

Figure 6-5h

Brooklyn Botanic Garden - Hardy Plant Nursery Yard
Incremental Shadows on March 21/September 21



7:36 AM



8:00 AM

Proposed Development

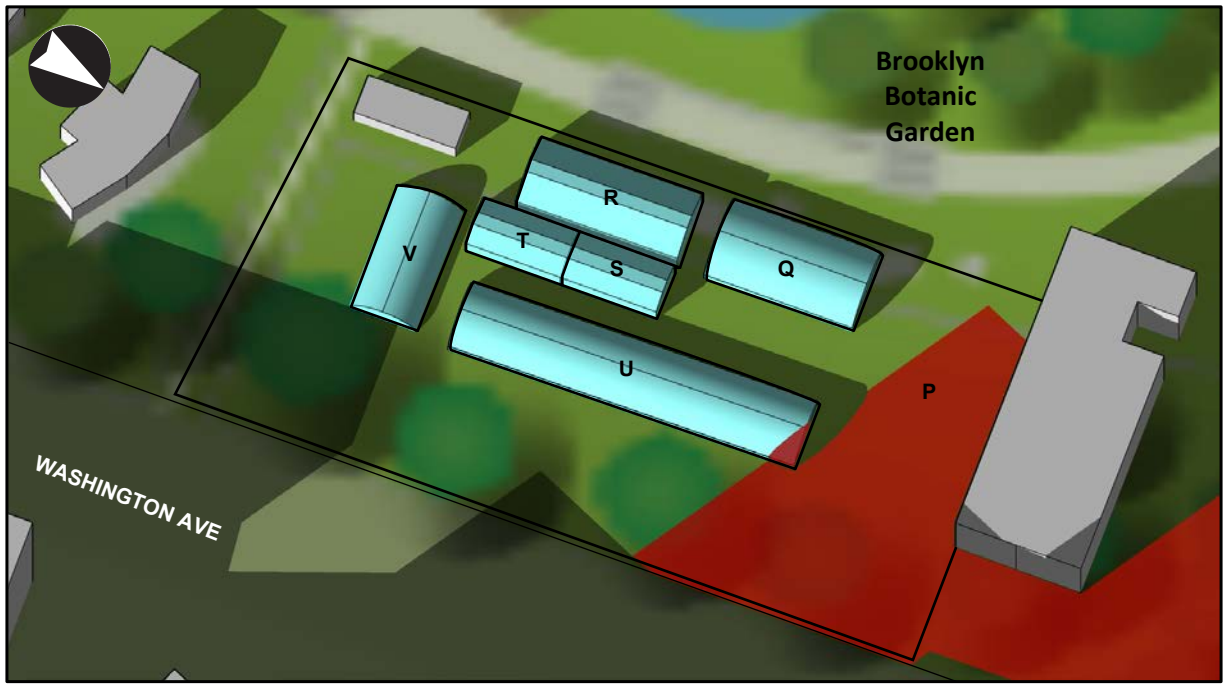
Open Space

Historic Resource

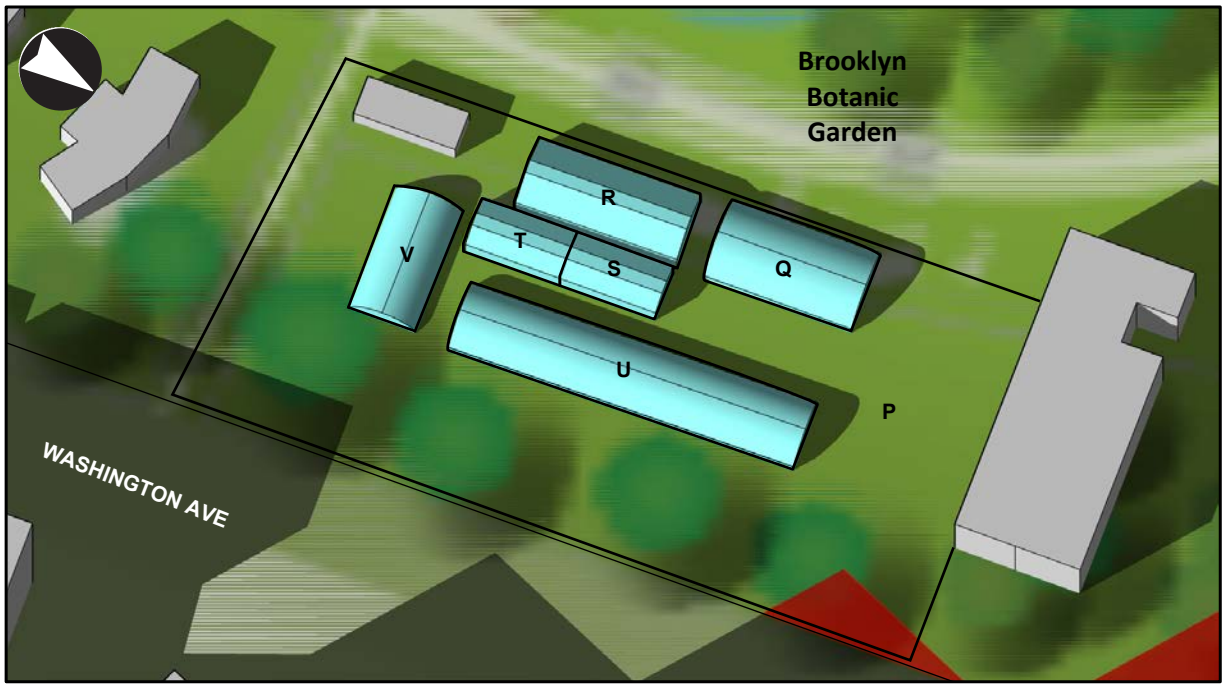
P **Greenhouse Facility**
**Keyed to Table 6-5*

Incremental Shadow

Brooklyn Botanic Garden - Hardy Plant Nursery Yard
Incremental Shadows on March 21/September 21



8:30 AM



9:00 AM

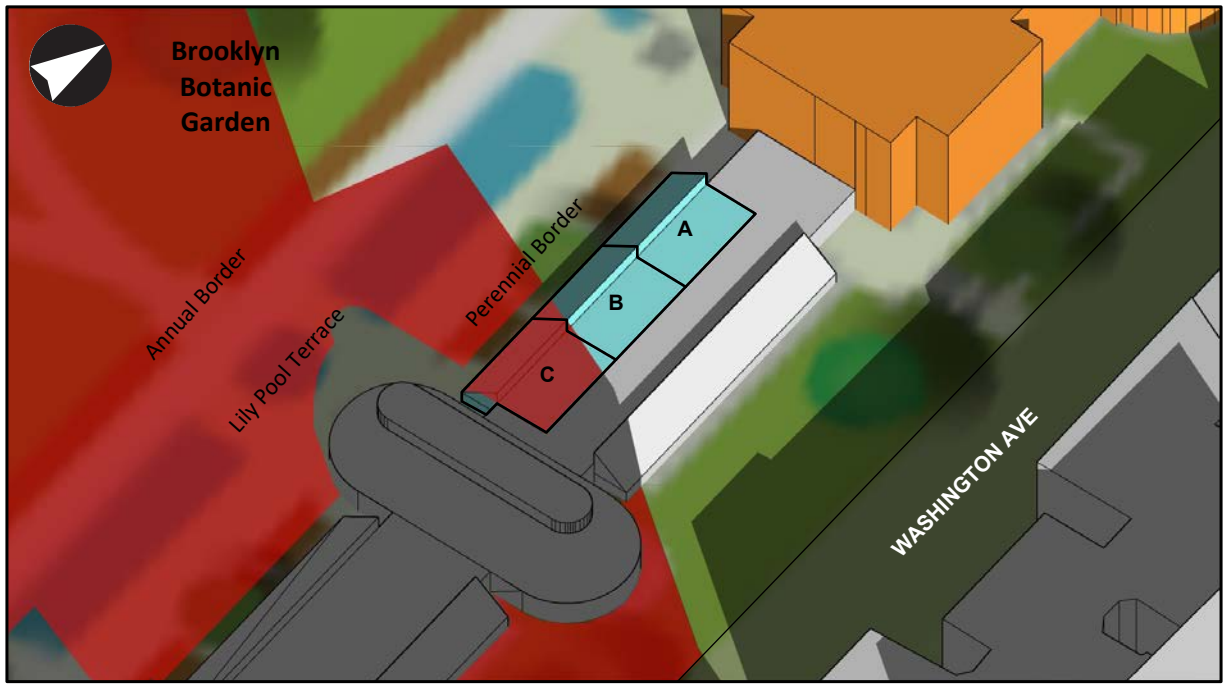
Proposed Development **Open Space** **Historic Resource**

P **Greenhouse Facility**
**Keyed to Table 6-5*

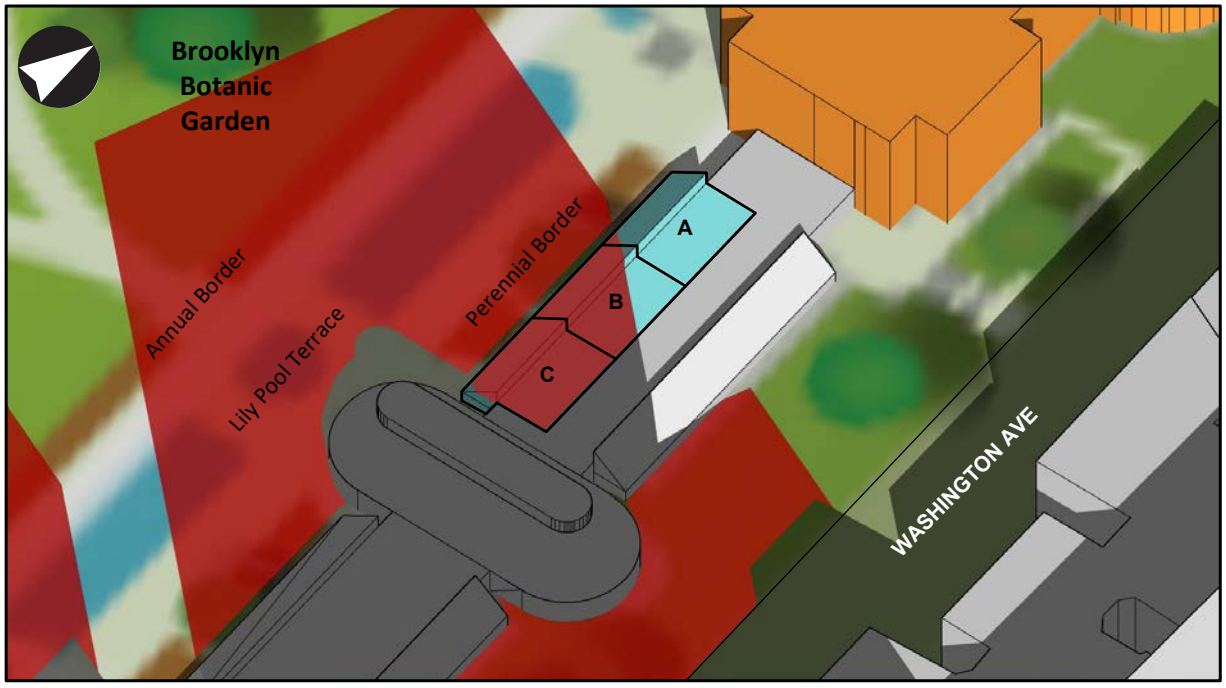
Incremental Shadow

Figure 6-5j

Brooklyn Botanic Garden - Education Greenhouses
Incremental Shadows on March 21/September 21



8:45 AM



9:15 AM

Proposed Development

Open Space

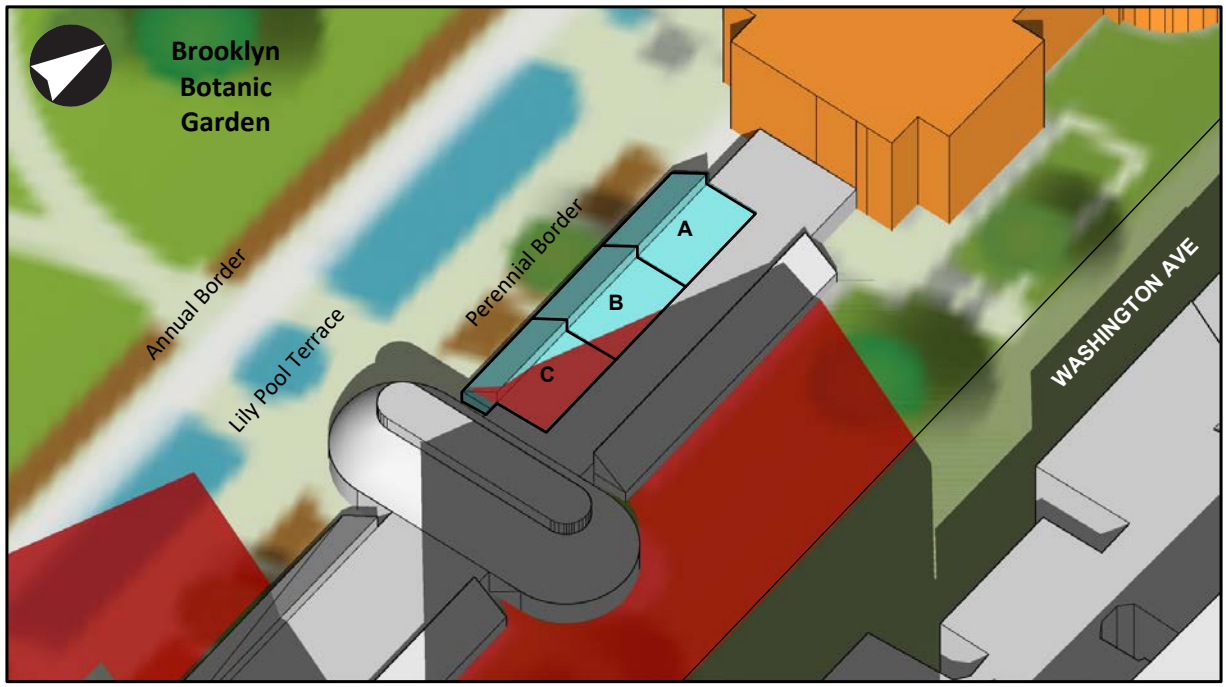
Historic Resource

A **Greenhouse Facility**
**Keyed to Table 6-5*

Incremental Shadow

Figure 6-5k

Brooklyn Botanic Garden - Education Greenhouses
Incremental Shadows on March 21/September 21



9:45 AM

Proposed Development

Open Space

Historic Resource

A **Greenhouse Facility**
**Keyed to Table 6-5*

Incremental Shadow

development would be approximately 524,000 sf, or approximately 23.1 percent of the total Brooklyn Botanic Garden area.

While these areas, combined, would experience incremental shadows for a total of three hours and five minutes, no single feature of the Brooklyn Botanic Garden would be cast in incremental shadows for an extended period of time due to the speed and movement of these shadows across the open space. Specifically, the Brooklyn Botanic Garden's unenclosed sunlight-sensitive areas (i.e., the Plant Family Collection, the Rock Garden, the Water Garden, the Lily Pond Terrace, and the Hardy Plant Nursery Yard) would experience incremental shadows ranging between 35 minutes (the Water Garden) and two hours and 30 minutes (the Lily Pond Terrace). The Brooklyn Botanic Garden's enclosed, climate-controlled facilities (i.e., the Desert Plants, Warm Temperate Plants, and Tropical Plants Education Greenhouses, the Steinhardt Conservatory's individual greenhouse facilities, the Temperate Bonsai Tunnel, the Production House; the Tropical Bonsai House, and the New York-Native Flora and Temperate Plant Propagation Tunnel), would experience incremental shadows ranging between 30 minutes (the Desert Plants Education Greenhouse) and two hours and 49 minutes (the Arid Workhouse) (see **Table 6-5** and **Figures 6-5a** through **6-5k**). Though incremental shadow coverage would reach the open space's various plants, conservatories, greenhouses, propagation spaces, and nurseries for a total of three hours on the March 21/September 21 analysis day, no single plant is expected to receive direct sunlight for less than four to six hours, which, according to the *CEQR Technical Manual,* is the general minimum requirement for the survival of vegetation during the growing season. However, several plant species within the Botanic garden require six to eight hours of direct sunlight, and in some cases more than eight hours of direct sunlight, for survival.

MAY 6/AUGUST 6

On May 6/August 6 (the midpoint between the equinoxes and solstices), the time period for shadows analysis begins at 6:27 AM and continues until 5:18 PM.

The Proposed Project would cast incremental shadows on portions of the Brooklyn Botanic Garden for a total of four hours and two minutes on the May 6/August 6 analysis day. Incremental shadows would enter the garden at 6:27 AM (the beginning of the analysis day) and continue until 10:29 AM. After 10:29 AM the Brooklyn Botanic Garden would not experience any incremental shadow coverage. As indicated in **Figures 6-5l, 6-5q,** and **6-5u**, during the early morning hours, shadow coverage would be concentrated on the southern portion of the open space fronting Washington and Flatbush avenues, which includes portions of the Plant Family Collection, the Rock Garden, the Herb Garden, the Shelby White and Leon Levy Water Garden, the Compost Exhibit, the Hardy Plant Nursery Yard, the Temperate Bonsai Tunnel, the Production House, the Tropical Bonsai House, the Auxiliary House, the New York-Native Flora and Temperate Plant Propagation Tunnel, the Mediterranean Display Plants Tunnel, and the Steinhardt Conservatory. As shown in **Figure 6-5l, 6-5q,** and **6-5u**, by 7:00 AM, incremental shadow coverage would decrease, moving in a northeasterly direction and would continue to cast incremental shadows on portions of the Plant Family Collection, the Rock Garden, the Herb Garden, the Shelby White and Leon Levy Water Garden, the Compost Exhibit, the Hardy Plant Nursery Yard, the Temperate Bonsai Tunnel, the Production House, the Tropical Bonsai House, the Auxiliary House, the New York-Native Flora and Temperate Plant Propagation Tunnel, the Mediterranean Display Plants Tunnel, and the Steinhardt Conservatory.

By 7:30 AM incremental shadow coverage would continue to decrease, moving in a northeasterly direction, and would cast incremental shadows on the Plant Family Collection, the Herb Garden, the Water Garden, the Compost Exhibit, the Hardy Plant Nursery Yard, the Temperate Bonsai Tunnel, the Production

House, the Tropical Bonsai House, the Auxiliary House, the New York-Native Flora and Temperate Plant Propagation Tunnel, the Mediterranean Display Plants Tunnel, and the Steinhardt Conservatory (see **Figures 6-5m, 6-5r,** and **6-5v**). As shown in **Figures 6-5m, 6-5r,** and **6-5v,** by 8:00 AM, incremental shadow coverage would continue to decrease and would cast incremental shadows on portions of the Plant Family Collection, the Water Garden, the Compost Exhibit, the Hardy Plant Nursery Yard, the Temperate Bonsai Tunnel, the Auxiliary House, the New York-Native Flora and Temperate Plant Propagation Tunnel, the Mediterranean Display Plants Tunnel, and the Steinhardt Conservatory (at 8:03 AM, incremental shadows would temporarily exit the Tropical and Desert Plant Propagation House before reentering the propagation house at 8:21 AM).

As shown in **Figures 6-5n, 6-5s**, and **6-5w**, by 8:30 AM, incremental shadow coverage would continue to decrease and would only cast incremental shadows on the Steinhardt Conservatory (at 8:18 AM, incremental shadows would temporarily exit the Tropical Plant Propagation House before reentering at 8:38 AM), as well as small portions of the Plant Family Collection, the Compost Exhibit, the Hardy Plant Nursery Yard, and the New York-Native Flora and Temperate Plant Propagation Tunnel. By 9:00 AM, incremental shadow coverage would continue to decrease and would only cast incremental shadows on portions of the Steinhardt Conservatory (at 8:42 AM, incremental shadows would temporarily exit the Highland Moist Tropical Orchid Workhouse before reentering the workhouse at 8:53 AM), and a small, northeastern portion of the Hardy Plant Nursery Yard (see **Figures 6-5n, 6-5s**, and **6-5w**).

By 9:30 AM, incremental shadow coverage would be minimal, only affecting portions of the Steinhardt Conservatory (incremental shadows would no longer affect the Helen Mattin Warm Temperate Pavilion, the Tropical Pavilion, and the C.V. Starr Bonsai Museum at this period) and a small portion of landscaping located between the Steinhardt Conservatory and Washington Avenue which contains trees and shrubs (refer to **Figure 6-5p** and **6-5t**). By 10:00 AM, incremental shadow coverage would continue to decrease, only affecting small portions of the Steinhardt Conservatory's Humid Tropics Workhouse (at 9:47 AM, incremental shadows would temporarily exit the Humid Tropics Workhouse before reentering at 9:55 AM), the Lowland and Highland Moist Tropical Orchid Houses, and the Tropical Plant Propagation House, as well as a small portion of landscaping located between the Steinhardt Conservatory and Washington Avenue which contains trees and shrubs (refer to **Figure 6-5p** and **6-5t**). At 10:29 AM, incremental shadows would completely exit the Brooklyn Botanic Garden, and the majority of the open space would continue to receive direct sunlight for the remainder of the analysis day. The maximum area of incremental shadow coverage that would cover the Brooklyn Botanic Garden on this analysis day (which would occur at 6:27 AM) would be approximately 208,500 sf, or approximately 9.2 percent of added coverage; the maximum total shadow coverage from both existing buildings and the proposed development would be approximately 562,500 sf, or approximately 24.8 percent of the total Brooklyn Botanic Garden area.

While these areas, combined, would experience incremental shadows for a total of four hours and two minutes, the duration of incremental shadows on individual resources in the Botanic Garden would range between one hours and 29 minutes (Mediterranean Display Plants Tunnel) and three hours and 46 minutes (Lowland Moist Tropical Orchid Workhouse). Specifically, the Brooklyn Botanic Garden's unenclosed sunlight-sensitive areas (i.e., the Plant Family Collection, the Rock Garden, the Herb Garden, the Water Garden, and the Hardy Plant Nursery Yard) would experience incremental shadows ranging from one hour and 15 minutes (the Rock Garden) to two hours and 50 minutes (the Hardly Plant Nursery Yard). The Brooklyn Botanic Garden's enclosed, climate-controlled facilities (i.e., the Steinhardt Conservatory's individual greenhouse facilities, the Temperate Bonsai Tunnel, the Production House, the Tropical Bonsai House, the Auxiliary House, the New York-Native Flora and Temperate Plant Propagation Tunnel, the Mediterranean Display Plants Tunnel) would experience incremental shadows ranging from one hour and

Figure 6-5l

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on May 6/August 6

6:27 AM

7:00 AM

Proposed Development
Open Space
Historic Resource
Greenhouse Facility
Incremental Shadow
Water Feature

Figure 6-5m

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on May 6/August 6

7:30 AM

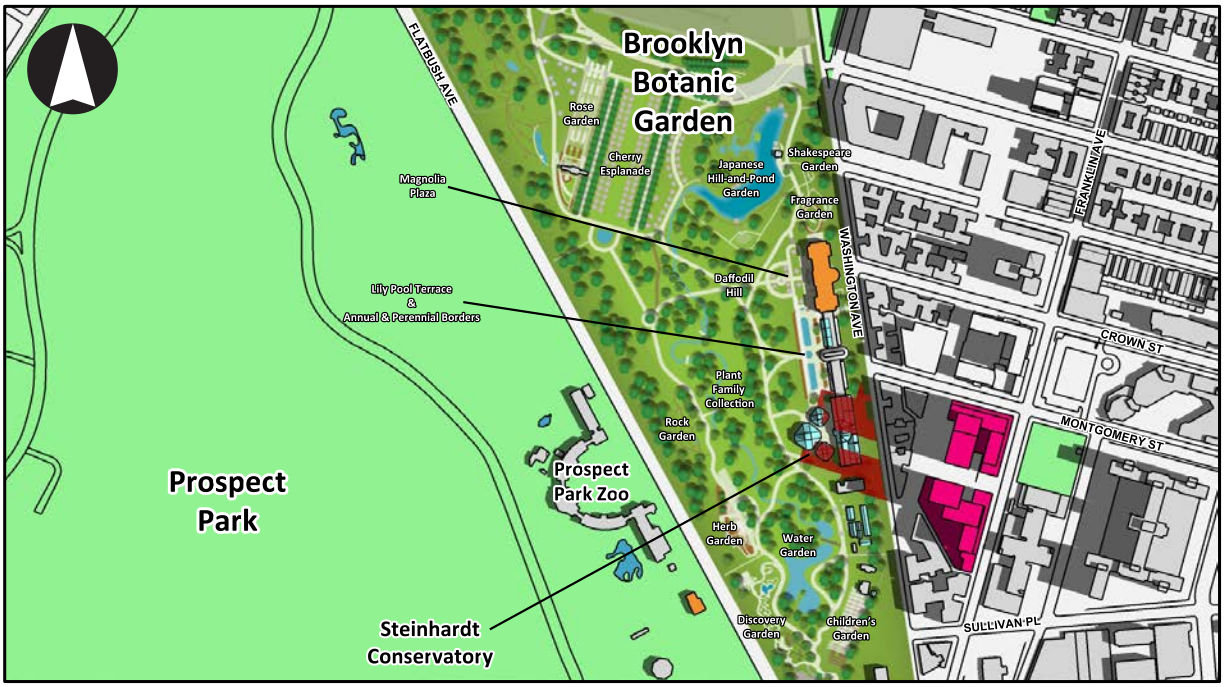
8:00 AM

Proposed Development
Open Space
Historic Resource
Greenhouse Facility
Incremental Shadow
Water Feature

Figure 6-5n

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on May 6/August 6

8:30 AM



9:00 AM

Proposed Development
Open Space
Historic Resource
Greenhouse Facility
Incremental Shadow
Water Feature

Figure 6-5p

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on May 6/August 6

9:30 AM

10:00 AM

Proposed Development
Open Space
Historic Resource
Greenhouse Facility
Incremental Shadow
Water Feature

Figure 6-5q

Brooklyn Botanic Garden - Steinhardt Conservatory
Incremental Shadows on May 6/August 6

6:27 AM

7:00 AM

Proposed Development

Open Space

Historic Resource

D **Greenhouse Facility**
**Keyed to Table 6-5*

Incremental Shadow

Figure 6-5r

Brooklyn Botanic Garden - Steinhardt Conservatory
Incremental Shadows on May 6/August 6

7:30 AM

8:00 AM

Proposed Development

Open Space

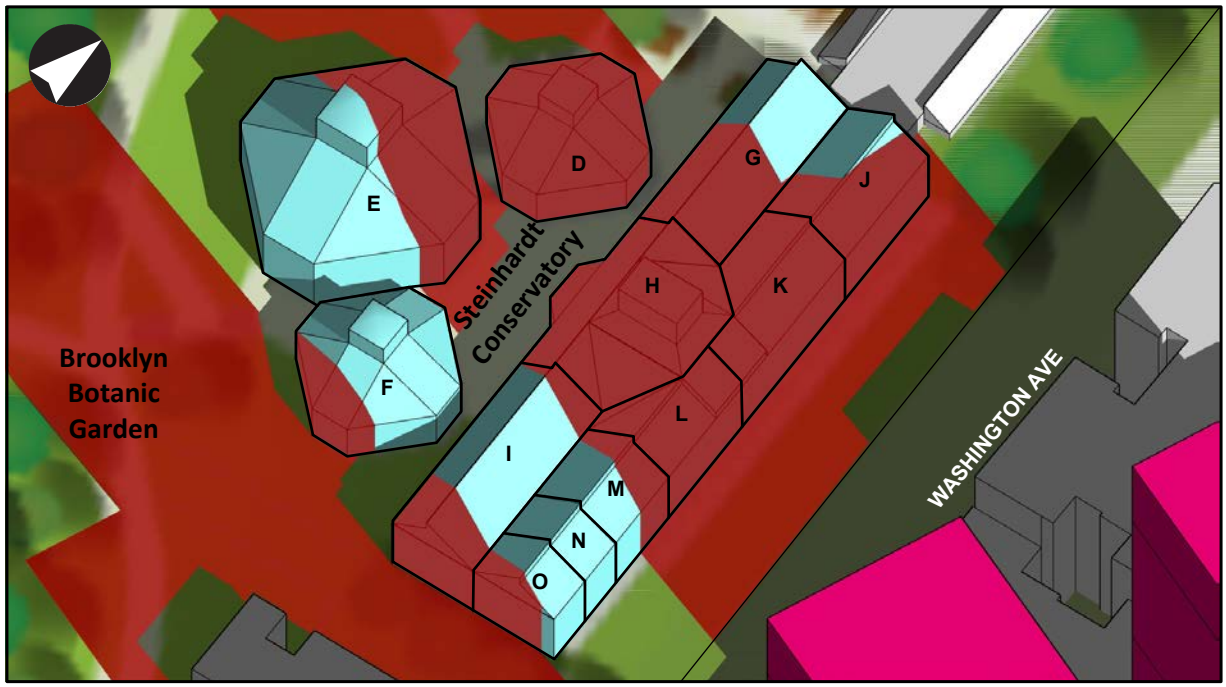
Historic Resource

D **Greenhouse Facility**
**Keyed to Table 6-5*

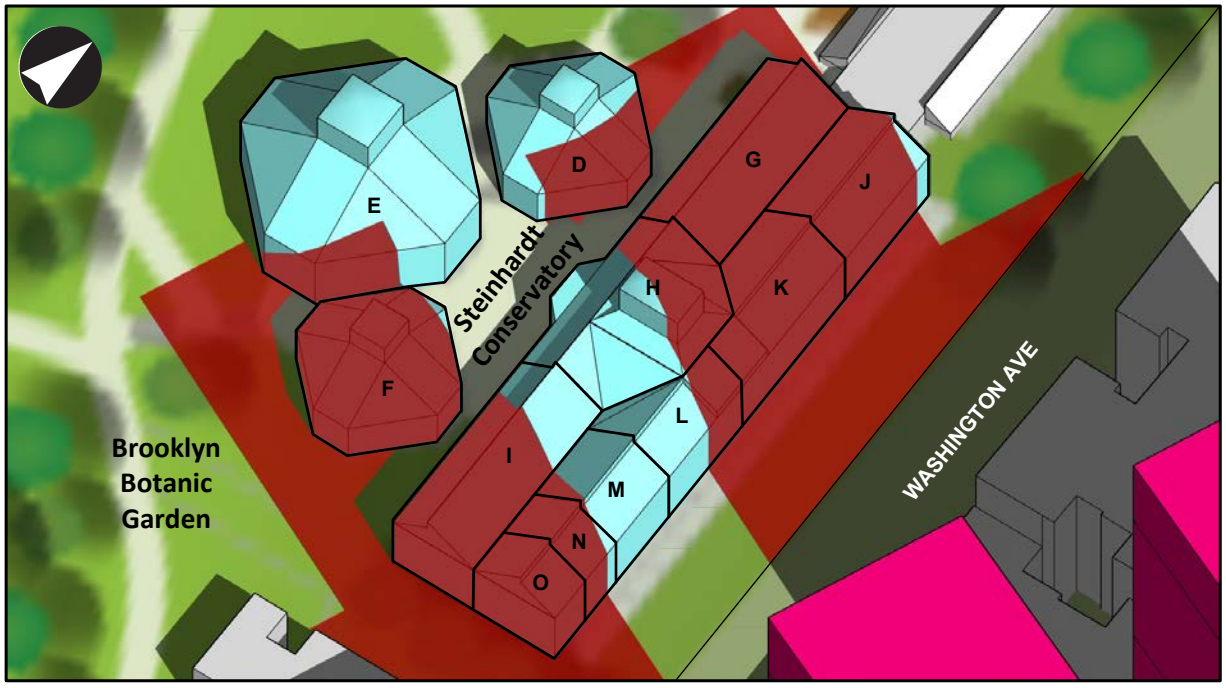
Incremental Shadow

Figure 6-5s

Brooklyn Botanic Garden - Steinhardt Conservatory
Incremental Shadows on May 6/August 6



8:30 AM



9:00 AM

Proposed Development

Open Space

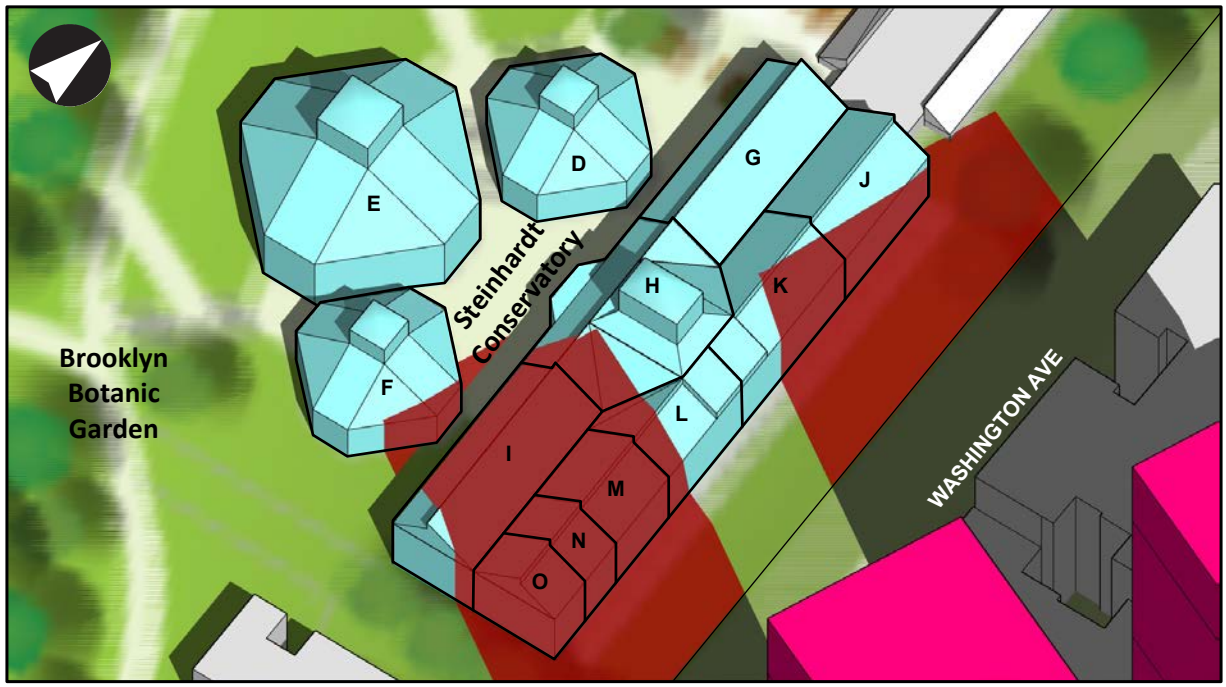
Historic Resource

D **Greenhouse Facility**
**Keyed to Table 6-5*

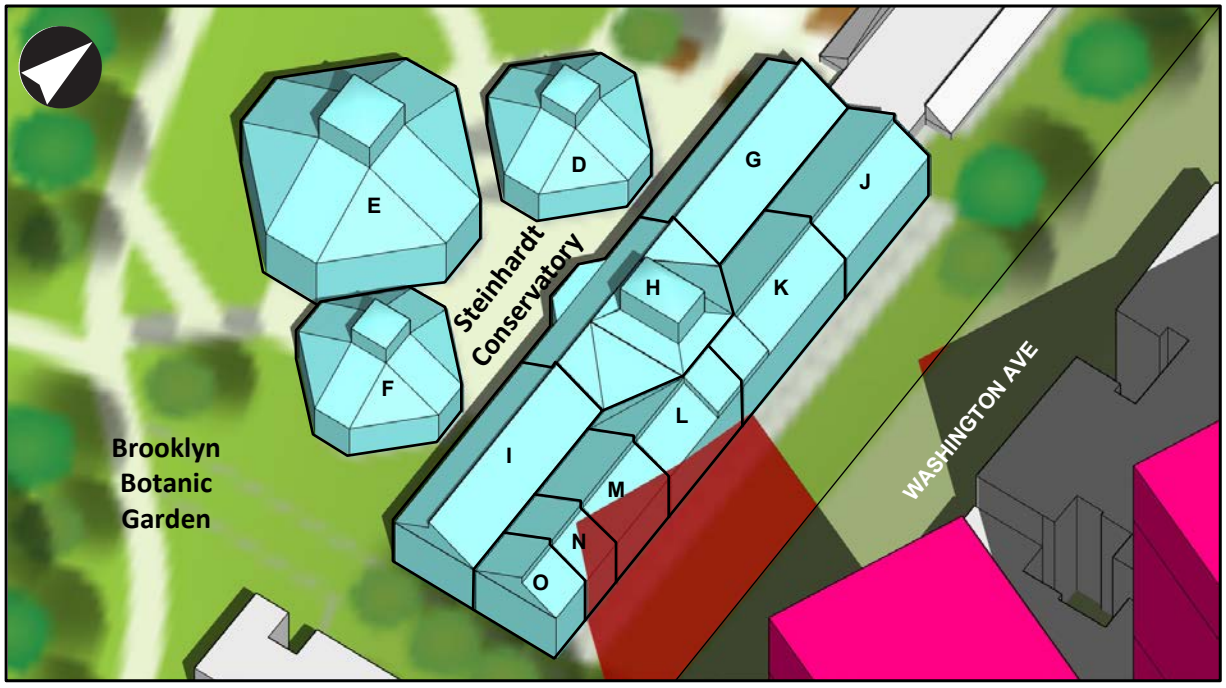
Incremental Shadow

Figure 6-5t

Brooklyn Botanic Garden - Steinhardt Conservatory
Incremental Shadows on May 6/August 6



9:30 AM



10:00 AM

Proposed Development

Open Space

Historic Resource

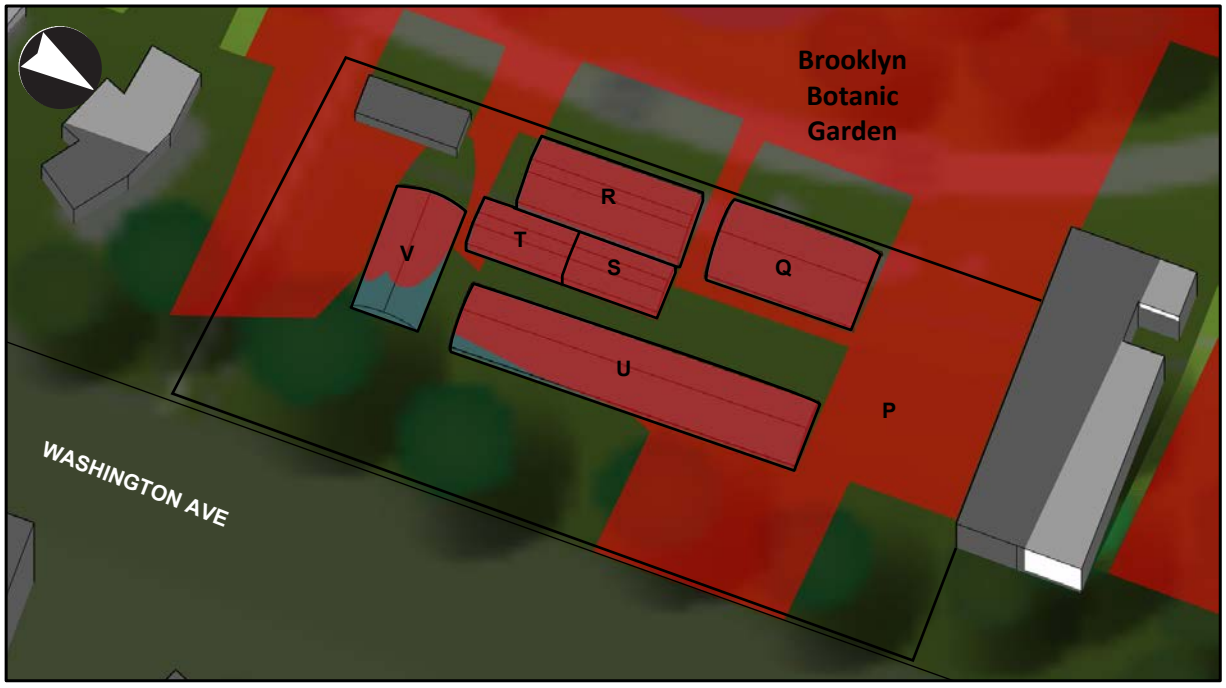
D **Greenhouse Facility**
**Keyed to Table 6-5*

Incremental Shadow

Figure 6-5u

Brooklyn Botanic Garden - Hardy Plant Nursery Yard
Incremental Shadows on May 6/August 6

6:27 AM



7:00 AM

Proposed Development

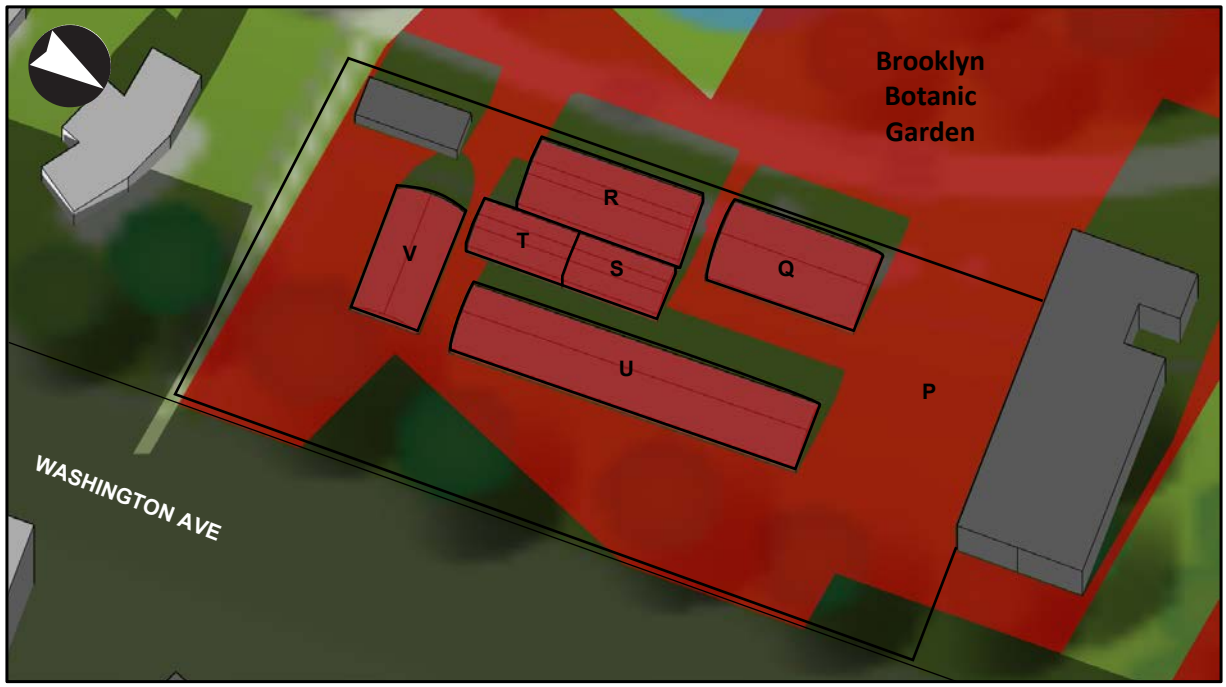
Open Space

Historic Resource

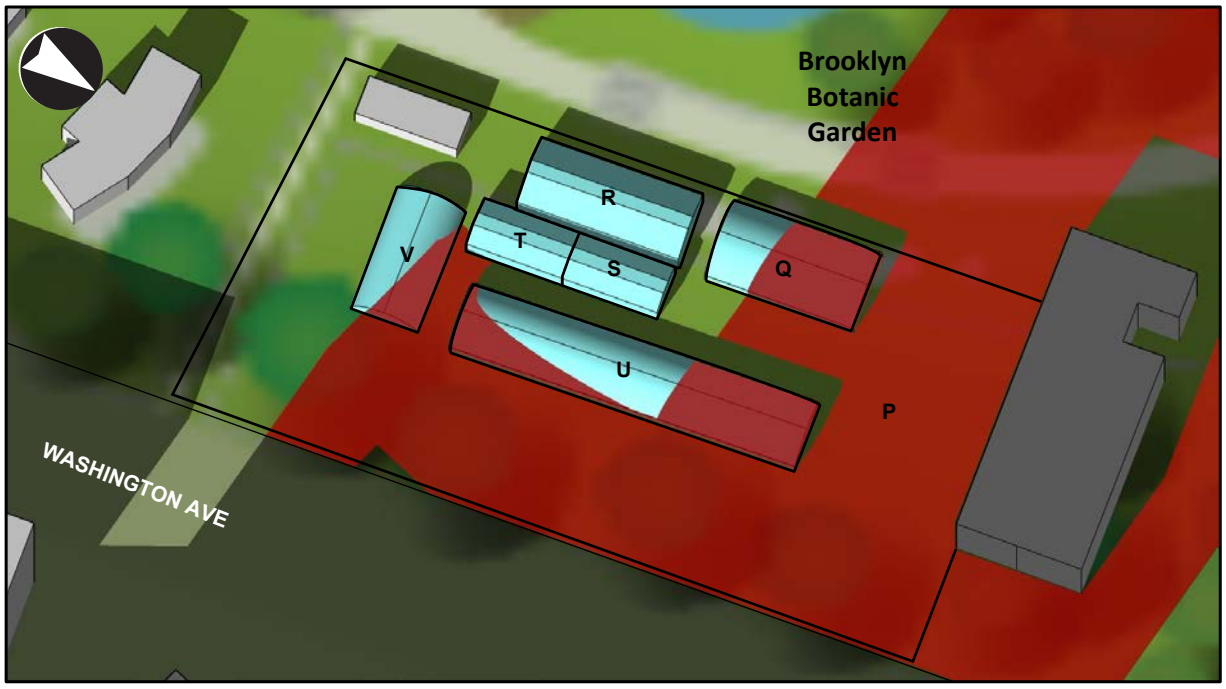
P **Greenhouse Facility**
**Keyed to Table 6-5*

Incremental Shadow

Brooklyn Botanic Garden - Hardy Plant Nursery Yard
Incremental Shadows on May 6/August 6



7:30 AM



8:00 AM

Proposed Development

Open Space

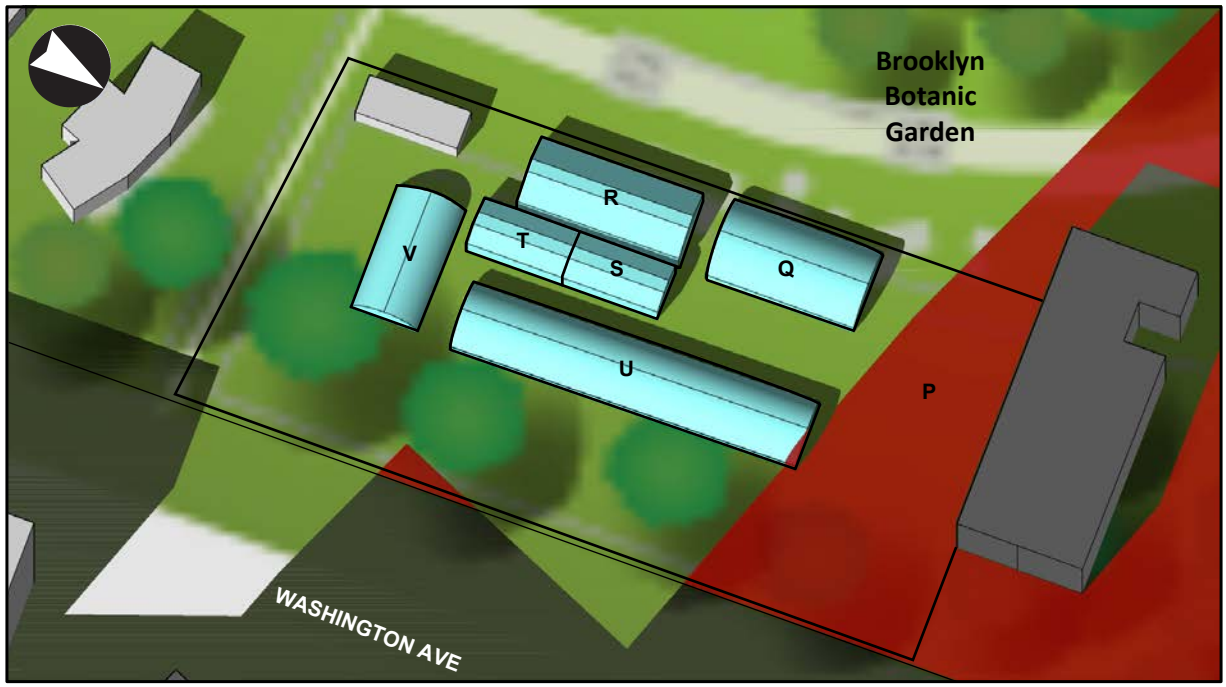
Historic Resource

P Greenhouse Facility
*Keyed to Table 6-5

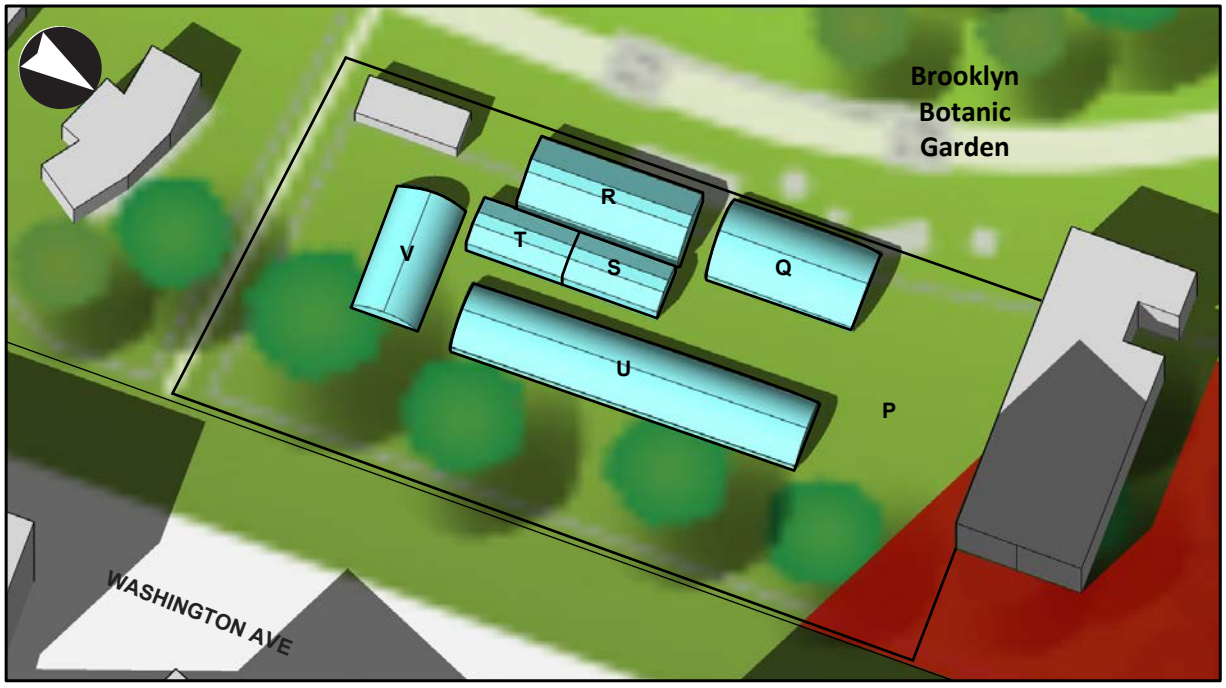
Incremental Shadow

Figure 6-5w

Brooklyn Botanic Garden - Hardy Plant Nursery Yard
Incremental Shadows on May 6/August 6



8:30 AM



9:00 AM

Proposed Development

Open Space

Historic Resource

P **Greenhouse Facility**
**Keyed to Table 6-5*

Incremental Shadow

29 minutes (the Mediterranean Display Plants Tunnel) to three hours and 43 minutes (the Lowland Moist Tropical Orchid Workhouse) (see **Table 6-5** and **Figures 6-5l** through **6-5w**). Though incremental shadow coverage would reach the open space's various plants, conservatories, greenhouses, propagation spaces, and nurseries for a total of four hours and two minutes on the May 6/August 6 analysis day, no single plant is expected to receive direct sunlight for less than four to six hours, which, according to the *CEQR Technical Manual,* is the general minimum requirement for the survival of vegetation during the growing season. However, as discussed above, several plants within the Botanic Garden require six to eight hours of sunlight, and in some cases more than eight hours of direct sunlight.

JUNE 21

On June 21 (the summer solstice), the time period for shadows analysis begins at 5:57 AM and continues until 6:01 PM. On the summer solstice, which is the day of the year with the longest period of daylight, the sun is most directly overhead and generally shadows are shortest and move across the widest angular range from west to east.

The Proposed Project would cast incremental shadows on portions of the Brooklyn Botanic Garden for a total of four hours and 22 minutes on the June 21 analysis day. Incremental shadows would enter the garden at the beginning of the analysis day (5:57 AM) and continue until 10:19 AM. After 10:19 AM the Brooklyn Botanic Garden would not experience any incremental shadow coverage. As indicated in **Figures 6-5x, 6-5bb,** and **6-5ff**, during the early morning hours, shadow coverage would be concentrated on the southern portion of the open space fronting Washington and Flatbush avenues, which includes portions of the Plant Family Collection, the Herb Garden, the Shelby White and Leon Levy Water Garden, the Discovery Garden, the Hardy Plant Nursery Yard, the Temperate Bonsai Tunnel, the Production House, the Tropical Bonsai House, the Auxiliary House, the New York-Native Flora and Temperate Plant Propagation Tunnel, and the Compost Exhibit, as well as portions of the Steinhardt Conservatory, including the Desert Pavilion, the Aquatic House and Orchid Collection, the Conservatory Entrance House, the Lowland and Highland Moist Tropical Orchid Workhouses, the Tropical Plant Propagation House, and the Tropical and Desert Plant Propagation House. As shown in **Figures 6-5x, 6-5bb,** and **6-5ff**, by 6:30 AM, incremental shadow coverage would decrease, moving in a northeasterly direction, and would cast incremental shadows on the Plant Family Collection, the Rock Garden, the Herb Garden, the Shelby White and Leon Levy Water Garden, the Hardy Plant Nursery Yard, the Temperate Bonsai Tunnel, the Production House, the Tropical Bonsai House, the Auxiliary House, the New York-Native Flora and Temperate Plant Propagation Tunnel, the Mediterranean Display Plants Tunnel, and the Compost Exhibit, as well as portions of the Steinhardt Conservatory, including the Tropical Pavilion, the Desert Pavilion, the Aquatic House and Orchid Collection, the Conservatory Entrance House, the Humid Tropics Workhouse, the Lowland and Highland Moist Tropical Orchid Workhouses, the Tropical Plant Propagation House, and the Tropical and Desert Plant Propagation House.

As shown in **Figures 6-5y, 6-5cc**, and **6-5gg**, by 7:00 AM, incremental shadow coverage would continue to decrease, moving in a northeasterly direction, and would cast incremental shadows on the Plant Family Collection, the Rock Garden, the Herb Garden, the Shelby White and Leon Levy Water Garden, the Hardy Plant Nursery Yard, the Temperate Bonsai Tunnel, the Production House, the Tropical Bonsai House, the Auxiliary House, the New York-Native Flora and Temperate Plant Propagation Tunnel, the Mediterranean Display Plants Tunnel, and the Compost Exhibit, as well as portions of the Steinhardt Conservatory, including the Tropical Pavilion, the Desert Pavilion, the Aquatic House and Orchid Collection, the Conservatory Entrance House, the Humid Tropics Workhouse, the Lowland and Highland Moist Tropical Orchid Workhouses, the Tropical Plant Propagation House, and the Tropical and Desert Plant Propagation House. By 7:30 AM incremental shadow coverage would continue to decrease, moving in a northeasterly

direction, and would cast incremental shadows on the Plant Family Collection, the Herb Garden, the Water Garden, the Hardy Plant Nursery Yard, the Temperate Bonsai Tunnel, the Production House, the Tropical Bonsai House, the Auxiliary House, the New York-Native Flora and Temperate Plant Propagation Tunnel, the Mediterranean Display Plants Tunnel, the Compost Exhibit, and the Steinhardt Conservatory (only the Arid Workhouse and C.V. Starr Bonsai Museum would not be affected by incremental shadows at this period) (see **Figures 6-5y, 6-5cc**, and **6-5gg**).

As shown in **Figures 6-5z, 6-5dd**, and **6-5hh**, by 8:00 AM, incremental shadows would continue to decrease, moving in a northeasterly direction, and would cast incremental shadows on the Plant Family Collection, the Water Garden, the Hardy Plant Nursery Yard, the Temperate Bonsai Tunnel, the Production House, the Tropical Bonsai House, the New York-Native Flora and Temperate Plant Propagation Tunnel, the Compost Exhibit, and the Steinhardt Conservatory (only the Arid Workhouse would not be affected by incremental shadows at this period; at 8:08 AM, incremental shadows would temporarily exit the C.V. Starr Bonsai Museum before reentering the space at 8:28 AM). By 8:30 AM, incremental shadow coverage would continue to decrease and would only cast incremental shadows on the Steinhardt Conservatory (at 8:38 AM, incremental shadows would temporarily exit the Tropical and Desert Plant Propagation House before reentering the propagation house at 8:54 AM), the Hardy Plant Nursery Yard, the Temperate Bonsai Tunnel, the New York-Native Flora and Temperate Plant Propagation Tunnel, the Compost Exhibit, and a small portion of the Water Garden (see **Figures 6-5z, 6-5dd**, and **6-5hh**).

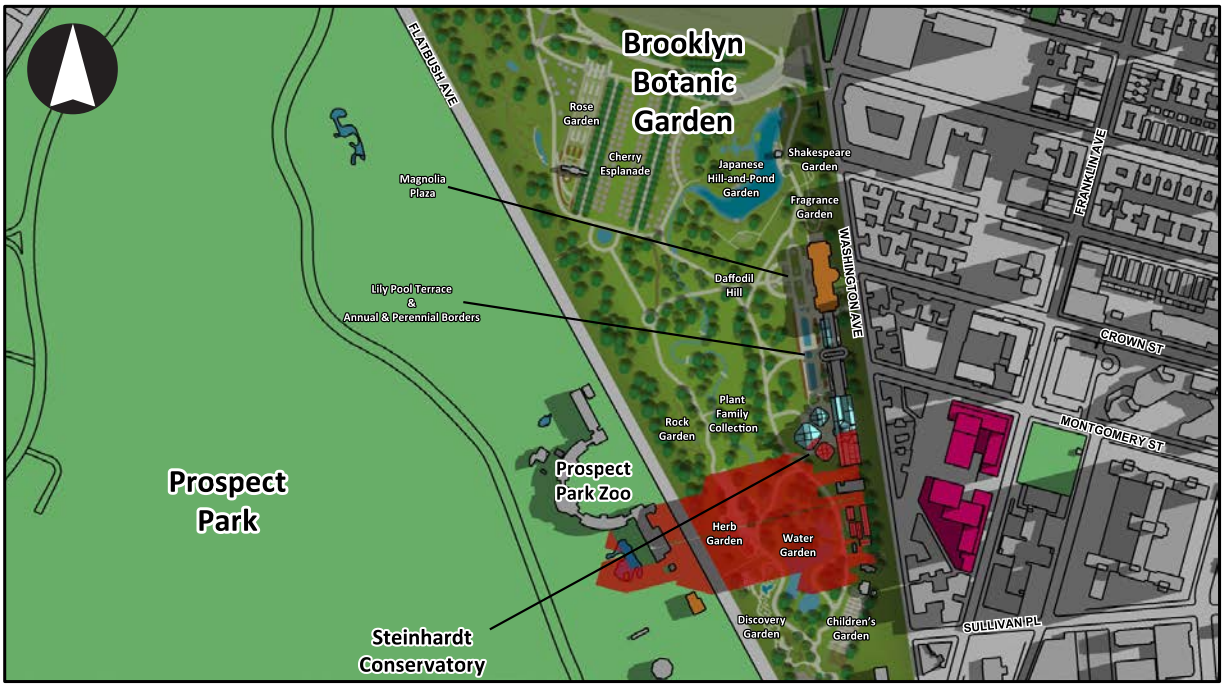
As shown in **Figures 6-5aa, 6-5ee,** and **6-5ii**, by 9:00 AM, incremental shadow coverage would continue to decrease and would only cast incremental shadows on portions of the Steinhardt Conservatory (incremental shadows would no longer affect the Helen Mattin Warm Temperate Pavilion and Tropical Pavilion; also, at 8:32 AM, incremental shadows would temporarily exit the Arid Workhouse before reentering the workhouse at 9:01 AM; and at 8:53 AM, incremental shadows would temporarily exit the Tropical Plant Propagation House before reentering the propagation house at 9:12 AM), as well as a small portion of the Hardy Plant Nursery Yard, the Compost Exhibit, and a small portion of landscaping located between the Steinhardt Conservatory and Washington Avenue which contains trees and shrubs. By 9:30 AM, incremental shadow coverage would be minimal, only affecting small portions of the Steinhardt Conservatory's Aquatic House and Orchid Collection, Humid Tropics Workhouse, Lowland and Highland Moist Tropical Orchid Workhouses, Tropical Plant Propagation House, and Tropical and Desert Plant Propagation House, as well as small portions of both the Hardy Plant Nursery Yard and landscaped area located between the Steinhardt Conservatory and Washington Avenue which contains trees and shrubs (refer to **Figures 6-5aa, 6-5ee,** and **6-5ii**). By 10:00 AM, incremental shadow coverage would continue to decrease, only affecting a very small portion of the Steinhardt Conservatory's Tropical and Desert Plant Propagation House, as well as a small portion of landscaping located between the Steinhardt Conservatory and Washington Avenue which contains trees and shrubs (refer to **Figure 6-5aa**). At 10:19 AM, incremental shadows would completely exit the Brooklyn Botanic Garden, and the majority of the open space would receive direct sunlight. The maximum area of incremental shadow coverage that would cover the Brooklyn Botanic Garden on this analysis day (which would occur at 5:57 AM) would be approximately 198,500 sf, or approximately 8.8 percent of added coverage; the maximum total shadow coverage from both existing buildings and the proposed development would be approximately 562,500 sf, or approximately 28.8 percent of the total Brooklyn Botanic Garden area.

While these areas, combined, would experience incremental shadows for a total of four hours and 22 minutes, incremental shadow coverage on individual features of the Botanic Garden would range between 42 minutes (Desert, Mediterranean, South African Bulb (Arid) Workhouse) and three hours 48 minutes (Aquatic House & Orchid Collection). Specifically, the Brooklyn Botanic Garden's unenclosed sunlight-sensitive areas (i.e., the Plant Family Collection, the Herb Garden, the Water Garden, the Discovery

Figure 6-5x

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on June 21

5:57 AM



6:30 AM

Proposed Development
Open Space
Historic Resource
Greenhouse Facility
Incremental Shadow
Water Feature

Figure 6-5y

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on June 21

7:00 AM

7:30 AM

Proposed Development
Open Space
Historic Resource
Greenhouse Facility
Incremental Shadow
Water Feature

Figure 6-5z

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on June 21

8:00 AM

8:30 AM

Proposed Development
Open Space
Historic Resource
Greenhouse Facility
Incremental Shadow
Water Feature

Figure 6-5aa

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on June 21

10:00 AM

Proposed Development

Open Space

Historic Resource

Greenhouse Facility

Incremental Shadow

Water Feature

Figure 6-5bb

Brooklyn Botanic Garden - Steinhardt Conservatory
Incremental Shadows on June 21

5:57 AM

6:30 AM

Proposed Development

Open Space

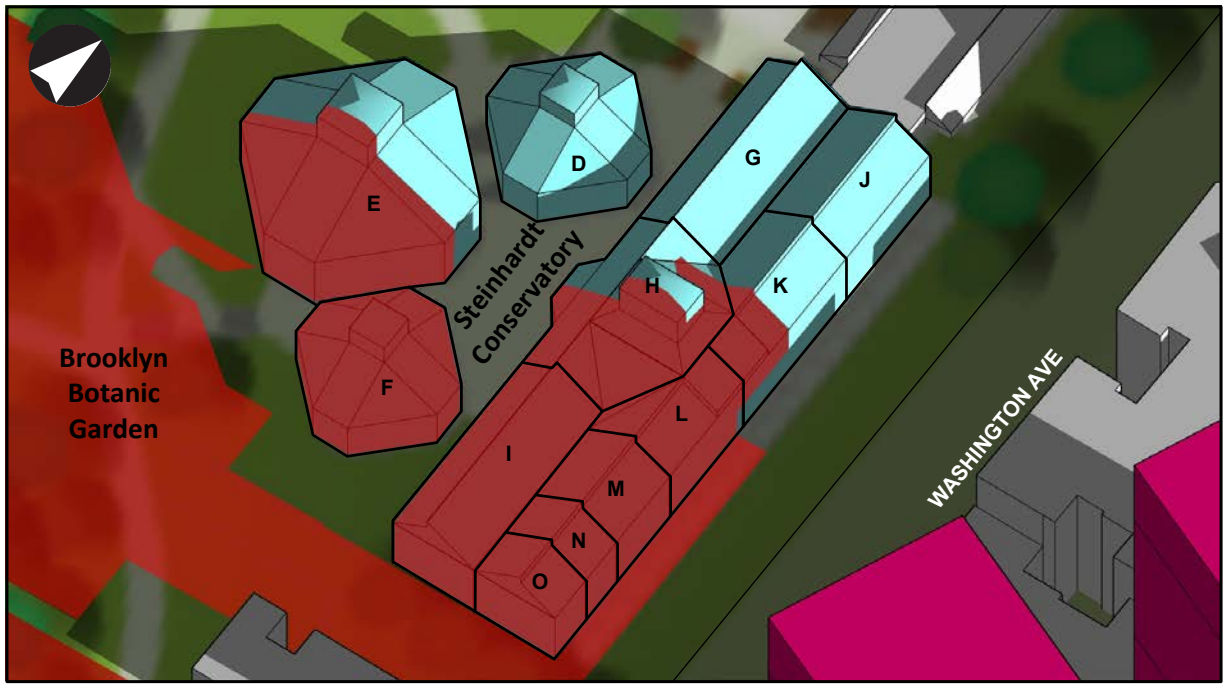
Historic Resource

D **Greenhouse Facility**
**Keyed to Table 6-5*

Incremental Shadow

Figure 6-5cc

Brooklyn Botanic Garden - Steinhardt Conservatory
Incremental Shadows on June 21



7:00 AM

7:30 AM

Proposed Development

Open Space

Historic Resource

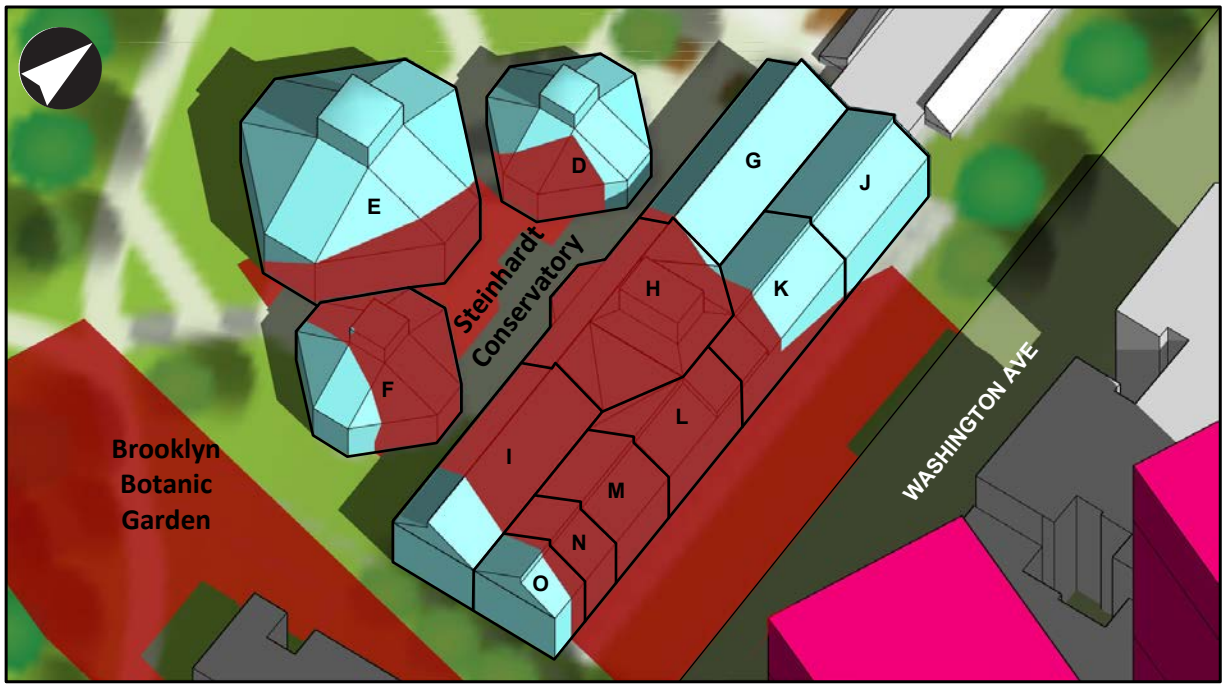
D Greenhouse Facility
*Keyed to Table 6-5

Incremental Shadow

Figure 6-5dd

Brooklyn Botanic Garden - Steinhardt Conservatory
Incremental Shadows on June 21

8:00 AM



8:30 AM

Proposed Development

Open Space

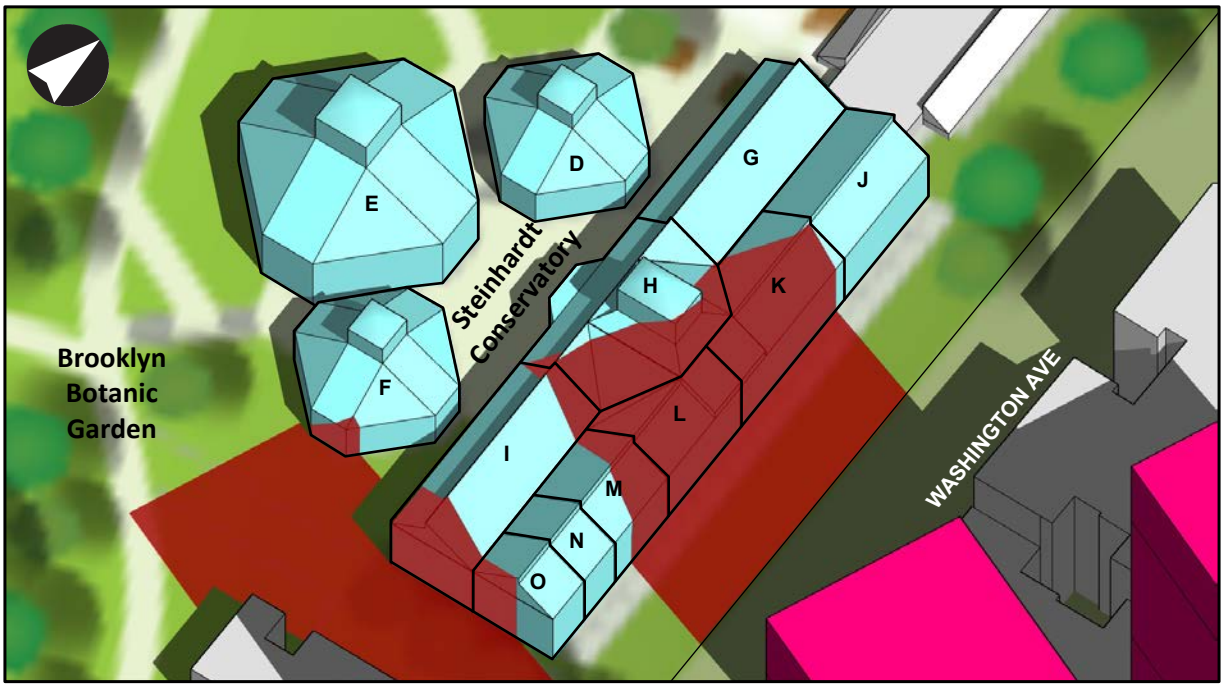
Historic Resource

D **Greenhouse Facility**
**Keyed to Table 6-5*

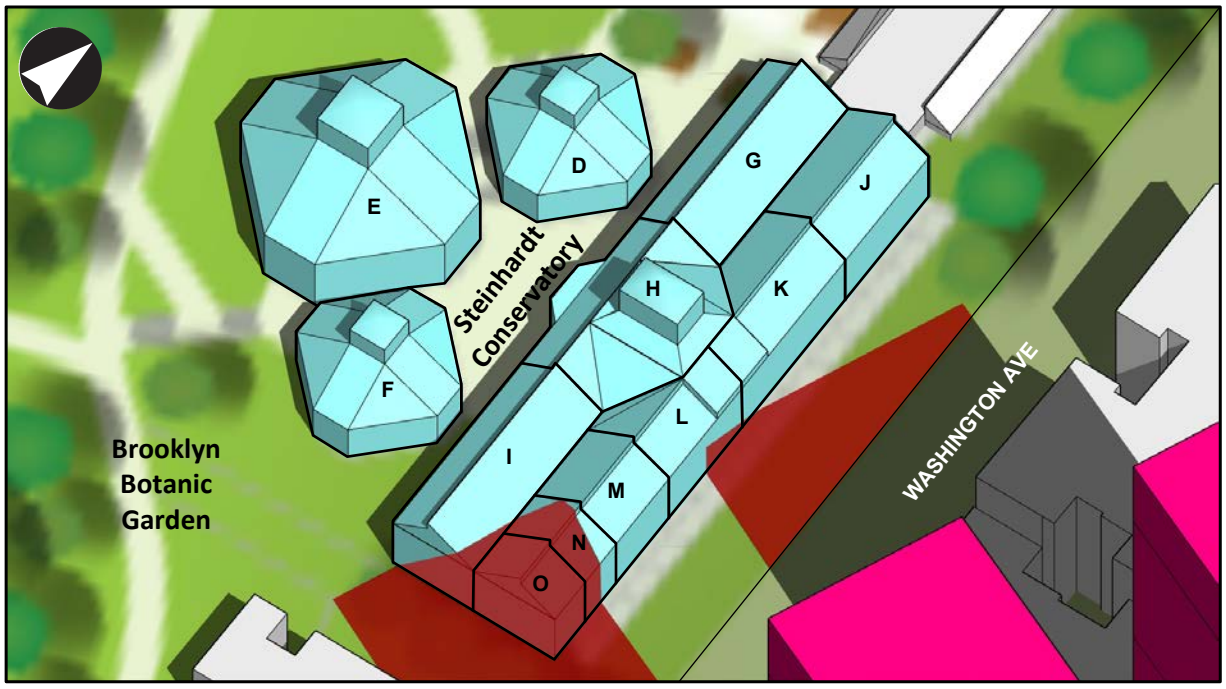
Incremental Shadow

Figure 6-5ee

Brooklyn Botanic Garden - Steinhardt Conservatory
Incremental Shadows on June 21



9:00 AM



9:30 AM

Proposed Development

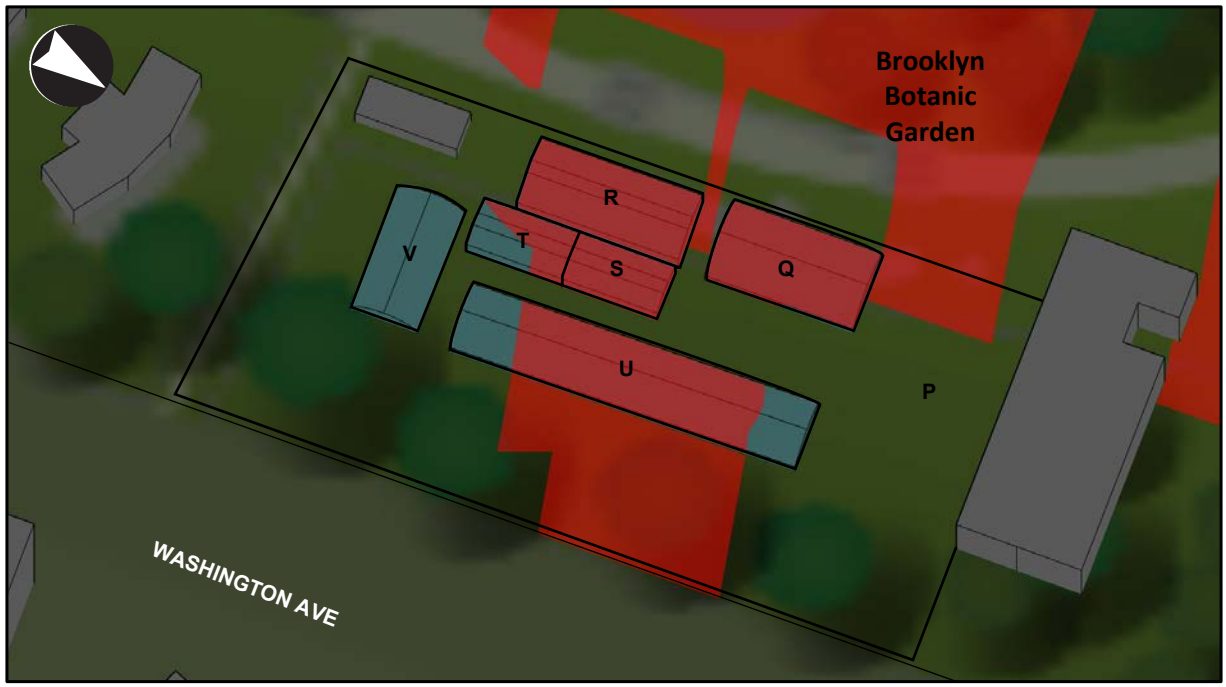
Open Space

Historic Resource

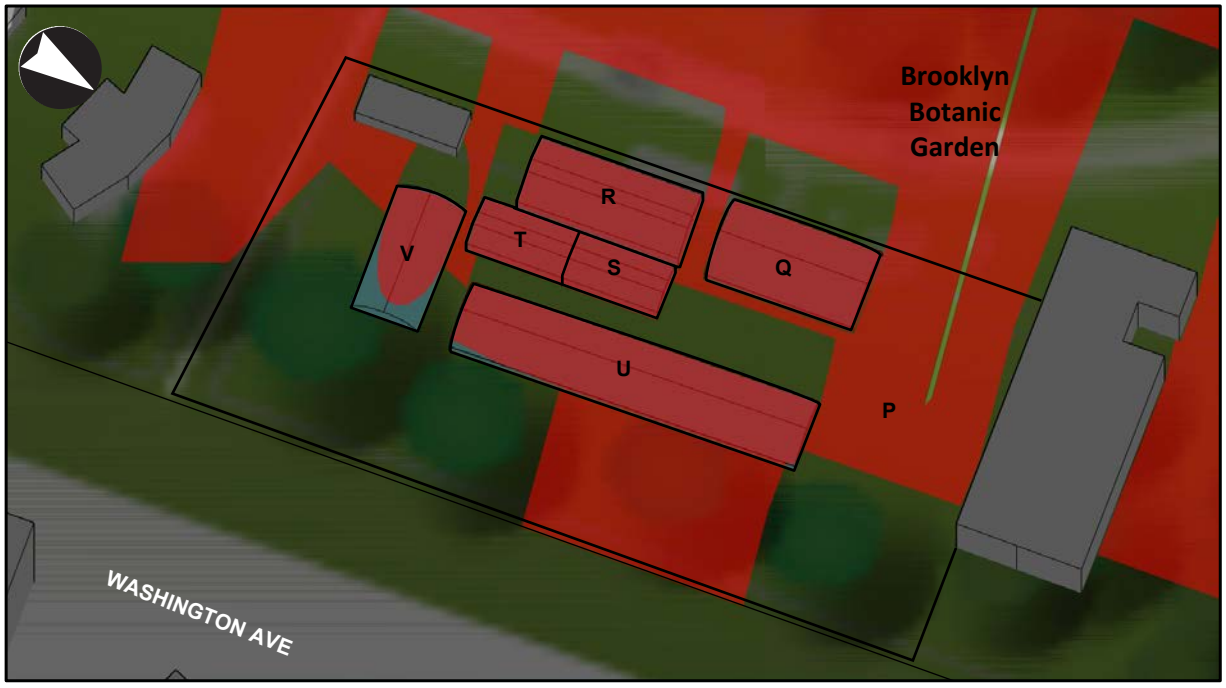
D **Greenhouse Facility**
**Keyed to Table 6-5*

Incremental Shadow

Brooklyn Botanic Garden - Hardy Plant Nursery Yard
Incremental Shadows on June 21



5:57 AM



6:30 AM

Proposed Development

Open Space

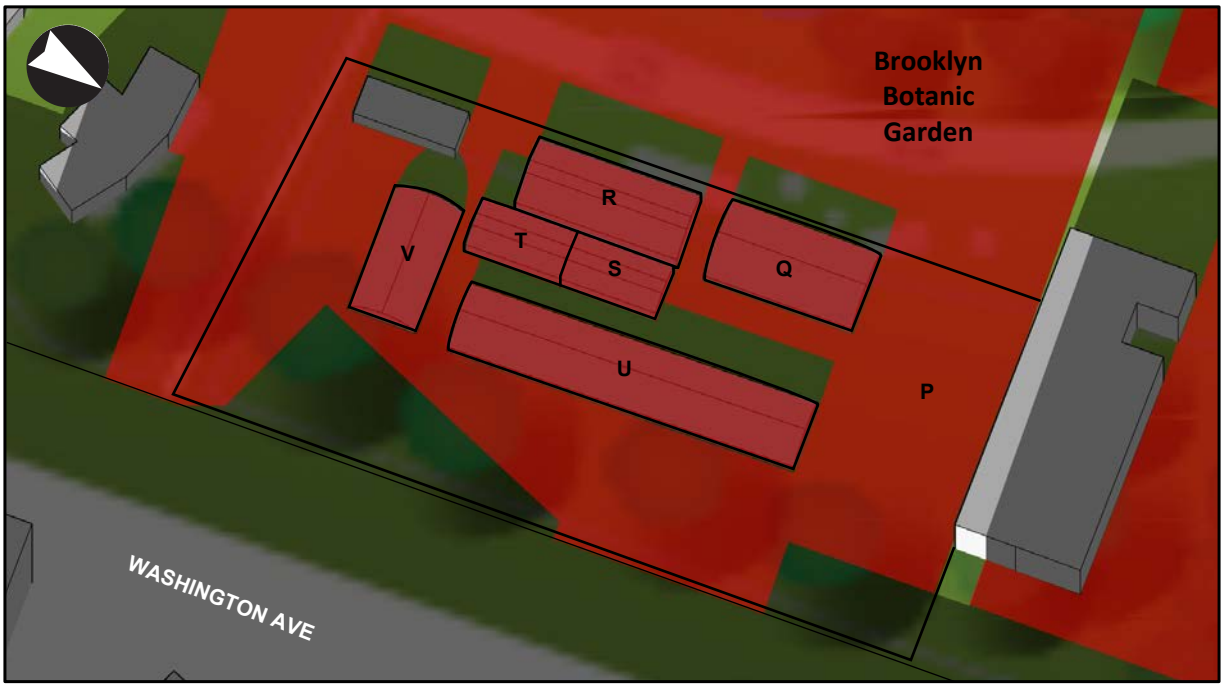
Historic Resource

P **Greenhouse Facility**
**Keyed to Table 6-5*

Incremental Shadow

Figure 6-5gg

Brooklyn Botanic Garden - Hardy Plant Nursery Yard
Incremental Shadows on June 21



7:00 AM

7:30 AM

Proposed Development

Open Space

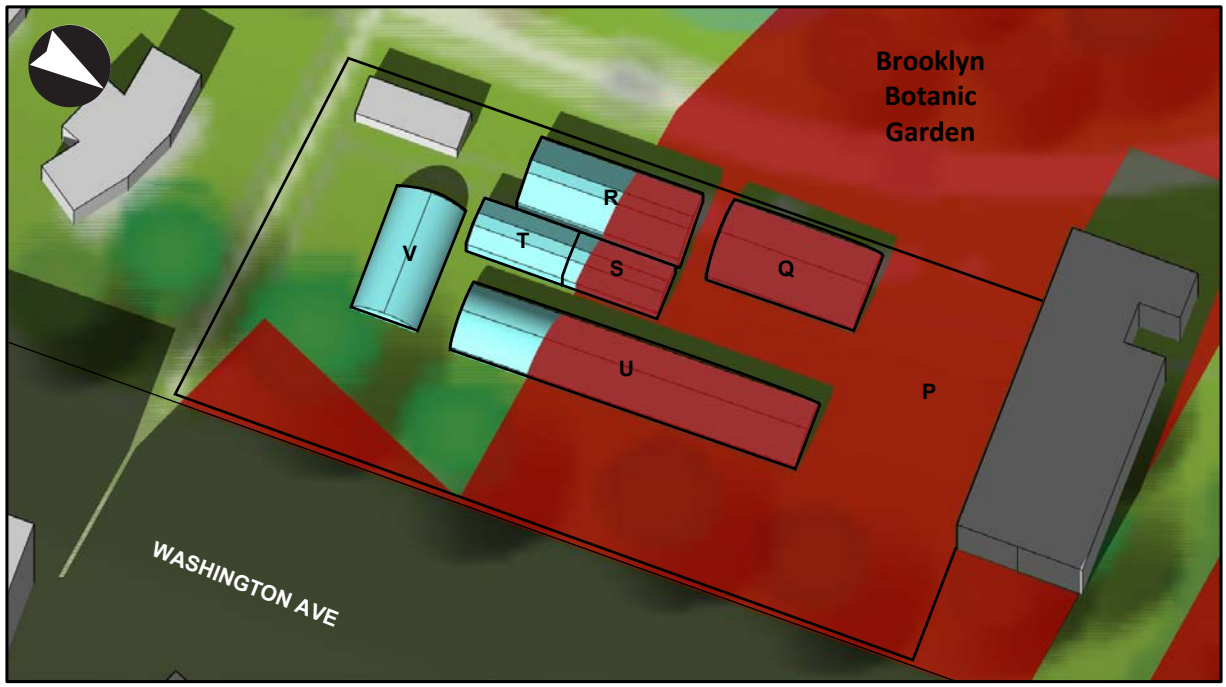
Historic Resource

P **Greenhouse Facility**
**Keyed to Table 6-5*

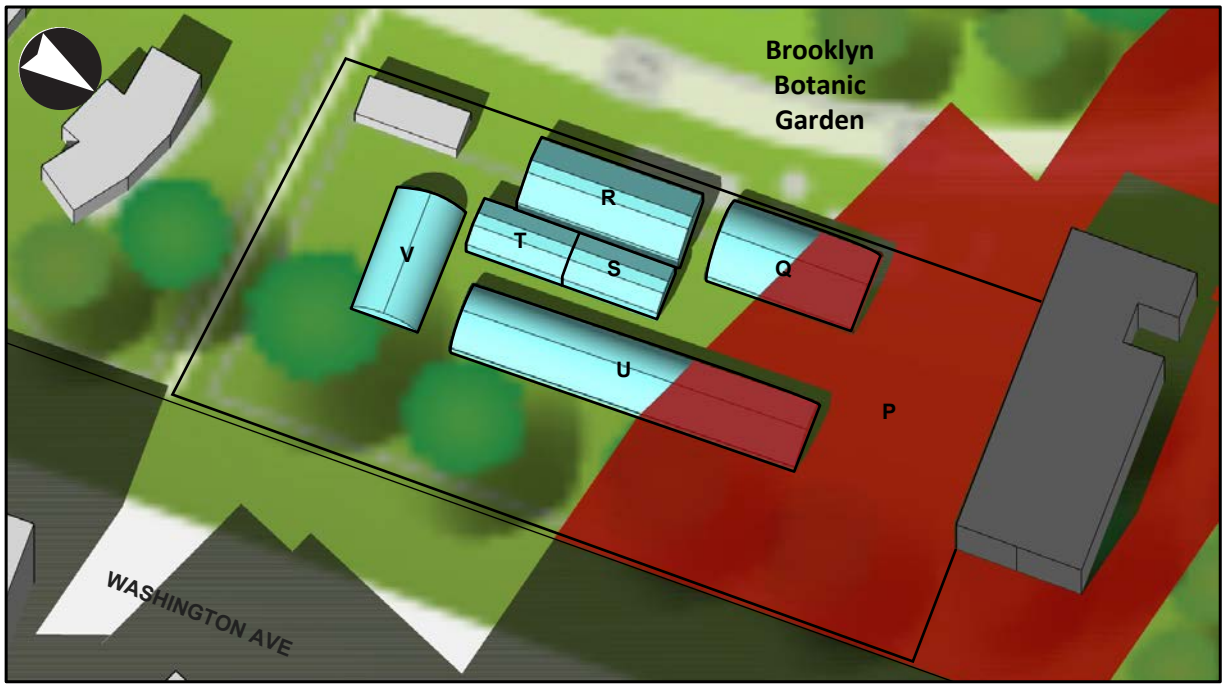
Incremental Shadow

Figure 6-5hh

Brooklyn Botanic Garden - Hardy Plant Nursery Yard
Incremental Shadows on June 21



8:00 AM



8:30 AM

Proposed Development

Open Space

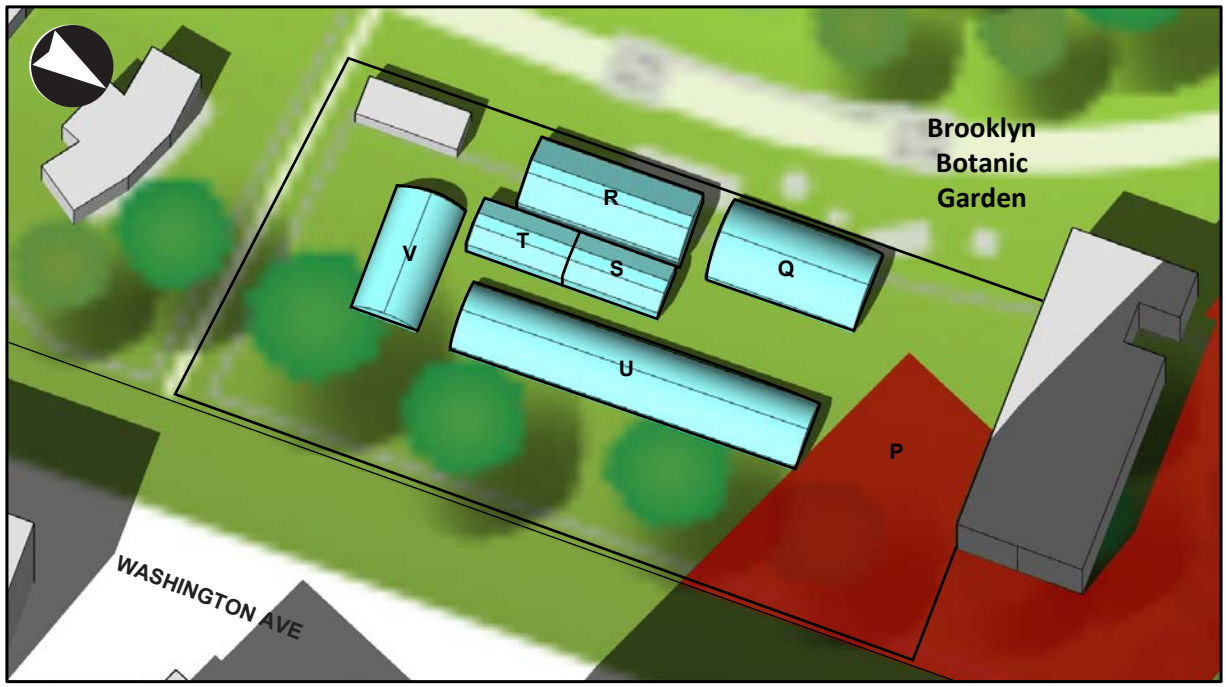
Historic Resource

P **Greenhouse Facility**
**Keyed to Table 6-5*

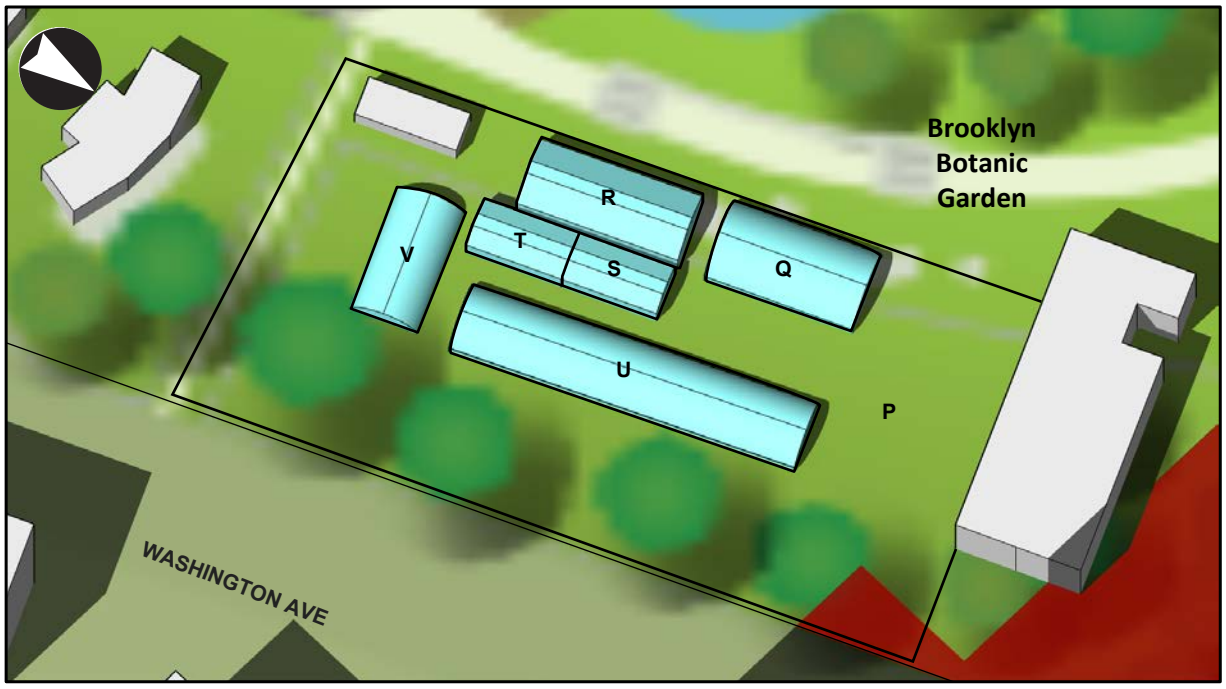
Incremental Shadow

Figure 6-5ii

Brooklyn Botanic Garden - Hardy Plant Nursery Yard
Incremental Shadows on June 21



9:00 AM



9:30 AM

Proposed Development

Open Space

Historic Resource

P **Greenhouse Facility**
**Keyed to Table 6-5*

Incremental Shadow

Garden, and the Hardy Plant Nursery Yard) would experience incremental shadows ranging from one hour and 10 minutes (the Discovery Garden) to three hours (the Water Garden and the Hardy Plant Nursery Yard). The Brooklyn Botanic Garden's enclosed, climate-controlled facilities (e.g., the Steinhardt Conservatory's individual greenhouse facilities, the Temperate Bonsai Tunnel, the Production House, the Tropical Bonsai House, the Auxiliary House, the New York-Native Flora and Temperate Plant Propagation Tunnel, and the Mediterranean Display Plants Tunnel) would experience incremental shadows ranging from 42 minutes (the Arid Workhouse) and three hours and 48 minutes (the Aquatic House and Orchid Collection and the Tropical and Desert Plant Propagation House) (see **Table 6-5** and **Figures 6-5x** through **6-5ii**). Though incremental shadow coverage would reach the open space's various plants, conservatories, greenhouses, propagation spaces, and nurseries for a total of four hours and 22 minutes on the June 21 analysis day, no single plant is expected to receive direct sunlight for less than four to six hours, which, according to the *CEQR Technical Manual,* is the general minimum requirement for the survival of vegetation during the growing season. As discussed above, several plants within the Botanic Garden require six to eight hours, and in some cases more than eight hours, of direct sunlight.

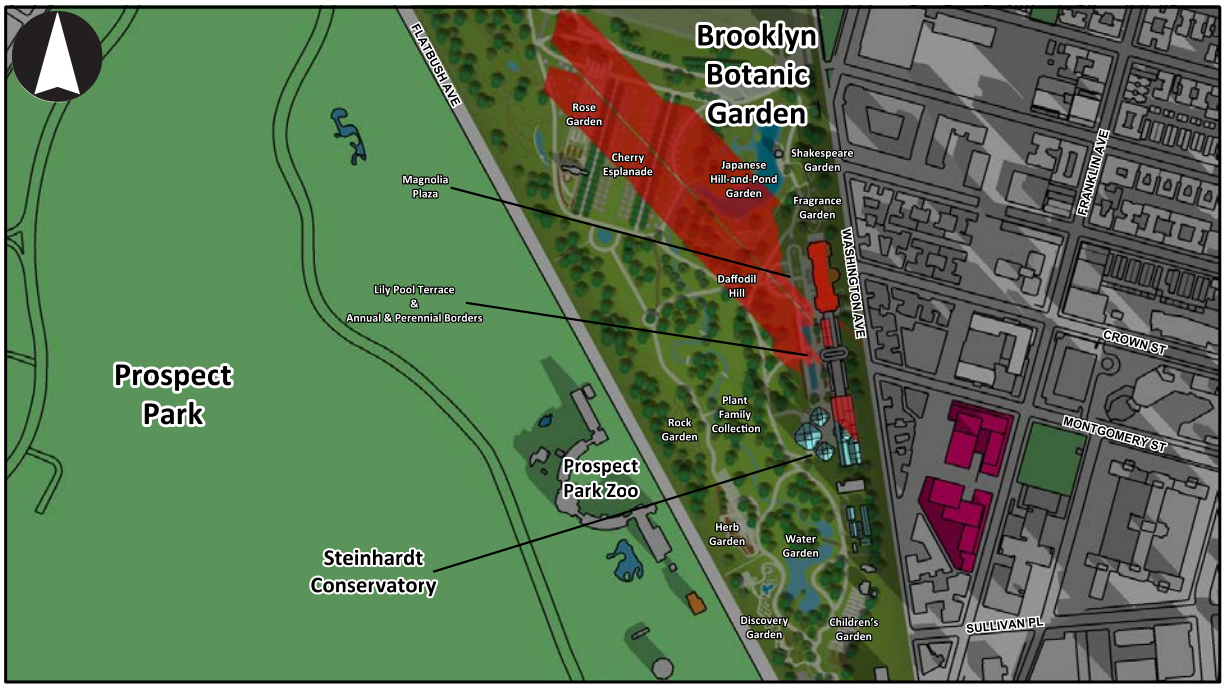
DECEMBER 21

On the winter solstice (December 21), the day of the year with the shortest period of daylight, the sun is low in the sky and shadows are at their longest but move rapidly.

The Proposed Project would cast incremental shadows on portions of the Brooklyn Botanic Garden for a total of one hour and 54 minutes on the December 21 analysis day. Incremental shadows would enter the garden at the beginning of the analysis day (8:51 AM) and continue until 10:45 AM. After 10:45 AM the Brooklyn Botanic Garden would not experience any incremental shadow coverage. As indicated in **Figures 6-5jj, 6-5ll,** and **6-5nn**, during the early morning hours, shadow coverage would be concentrated on the northeastern portion of the open space fronting Washington, just south of the Brooklyn Museum, which includes portions of the Rose Garden, the Cherry Esplanade, the Japanese Hill-and-Pond Garden, the Celebrity Path, Daffodil Hill, Magnolia Plaza, the Annual and Perennial Borders, the Lily Pool Terrace, and the Education Greenhouses, as well as portions of the Steinhardt Conservatory, including the Helen Mattin Warm Temperate Pavilion, the C.V. Starr Bonsai Museum, the Conservatory Entry House, the Arid Workhouse, the Humid Tropics Workhouse, and the Lowland and Highland Moist Tropical Orchid Workhouses. As shown in **Figures 6-5jj, 6-5mm,** and **6-5nn**, by 9:30 AM incremental shadow coverage would decrease, moving in a southeasterly direction, and would cast incremental shadows on portions of the Japanese Hill-and-Pond Garden, the Celebrity Path, the Fragrance Garden, the Shakespeare Garden, Magnolia Plaza, the Lily Pool Terrace, the Annual and Perennial Borders, the Education Greenhouses, and the Steinhardt Conservatory's Arid Workhouse. By 10:00 AM, incremental shadow coverage would continue to decrease, moving in a southeasterly direction, and would cast incremental shadows on portions of the Japanese Hill-and-Pond Garden, the Celebrity Path, the Fragrance Garden, the Shakespeare Garden, Magnolia Plaza, and the Desert Plants Education Greenhouse (refer to **Figures 6-5kk** and **6-5pp**). By 10:30 AM, incremental shadow coverage would continue to decrease and would be minimal, only affecting a small portion of the Fragrance Garden and the landscaping located between the Laboratory Administration Building and Washington Avenue which contains trees and shrubs (refer to **Figure 6-5kk**). At 10:45 AM, incremental shadows would completely exit the Brooklyn Botanic Garden, and the majority of the open space would receive direct sunlight. The maximum area of incremental shadow coverage that would cover the Brooklyn Botanic Garden on this analysis day (which would occur at 8:51 AM) would be approximately 389,000 sf, or approximately 17.2 percent of added coverage; the maximum total shadow coverage from both existing buildings and the proposed development would be approximately 562,500 sf, or approximately 29.7 percent of the total Brooklyn Botanic Garden area.

Figure 6-5jj

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on December 21



8:51 AM

9:30 AM

Proposed Development
Open Space
Historic Resource
Greenhouse Facility
Incremental Shadow
Water Feature

Figure 6-5kk

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on December 21

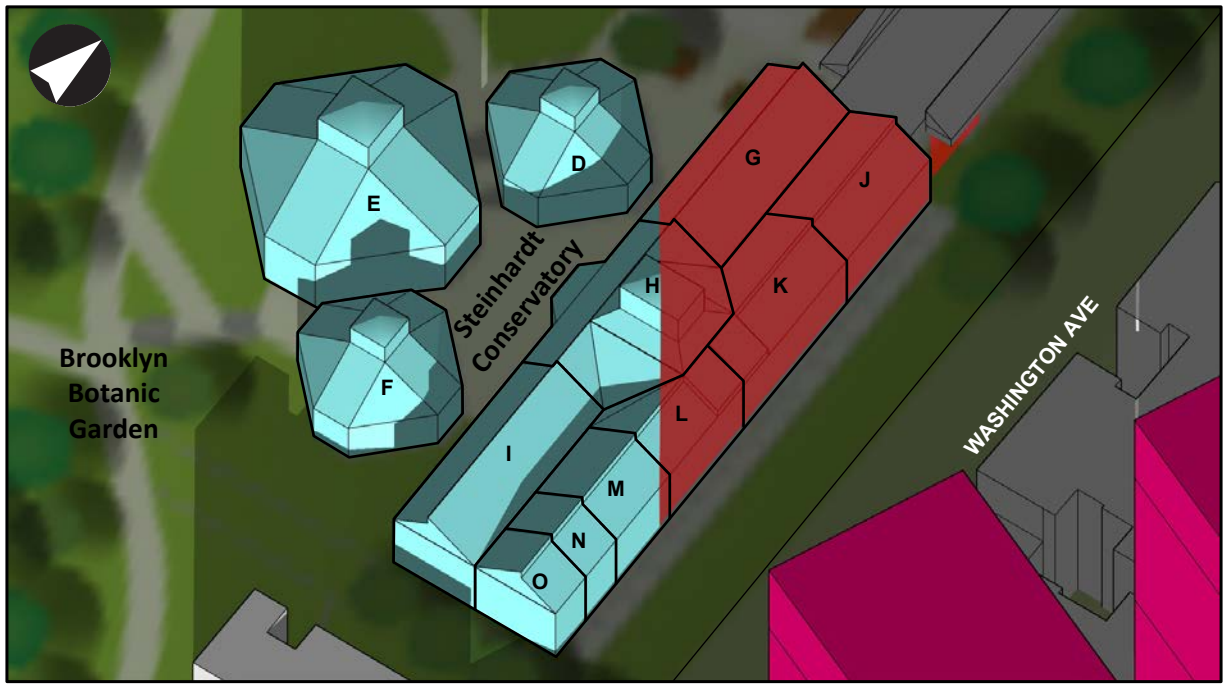
10:00 AM

10:30 AM

Proposed Development
Open Space
Historic Resource
Greenhouse Facility
Incremental Shadow
Water Feature

Figure 6-5II

Brooklyn Botanic Garden - Steinhardt Conservatory
Incremental Shadows on December 21



8:51 AM

9:10 AM

Proposed Development

Open Space

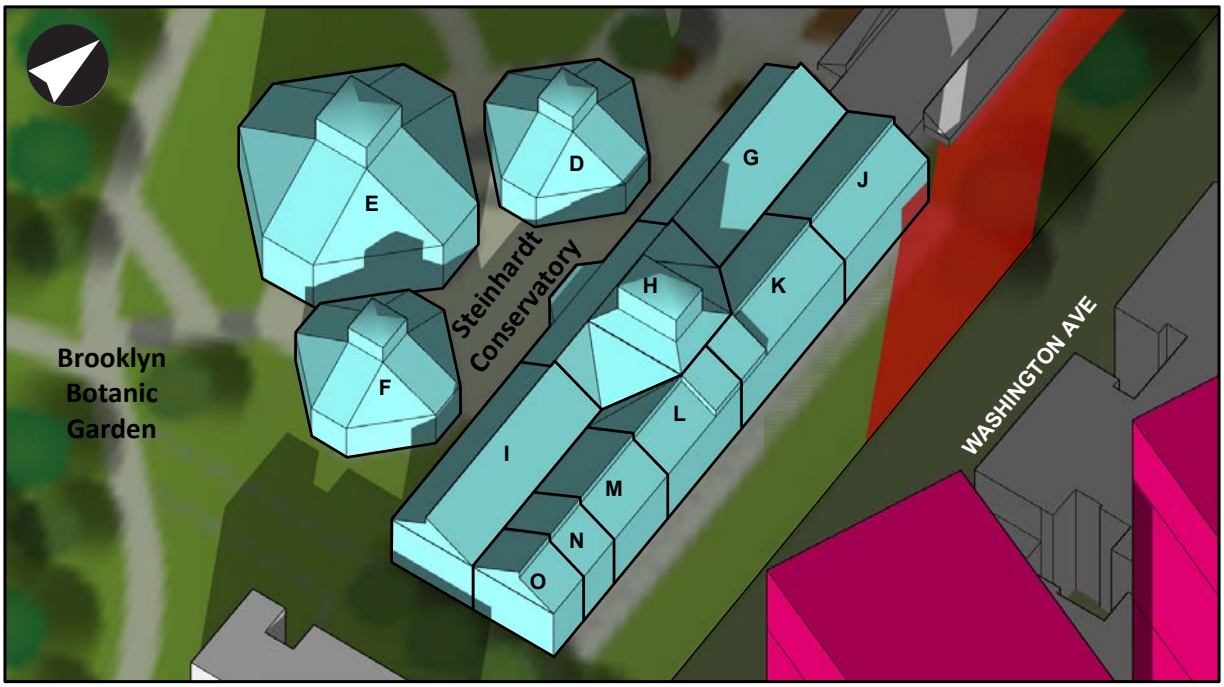
Historic Resource

D **Greenhouse Facility**
**Keyed to Table 6-5*

Incremental Shadow

Figure 6-5mm

Brooklyn Botanic Garden - Steinhardt Conservatory
Incremental Shadows on December 21



9:30 AM

Proposed Development

Open Space

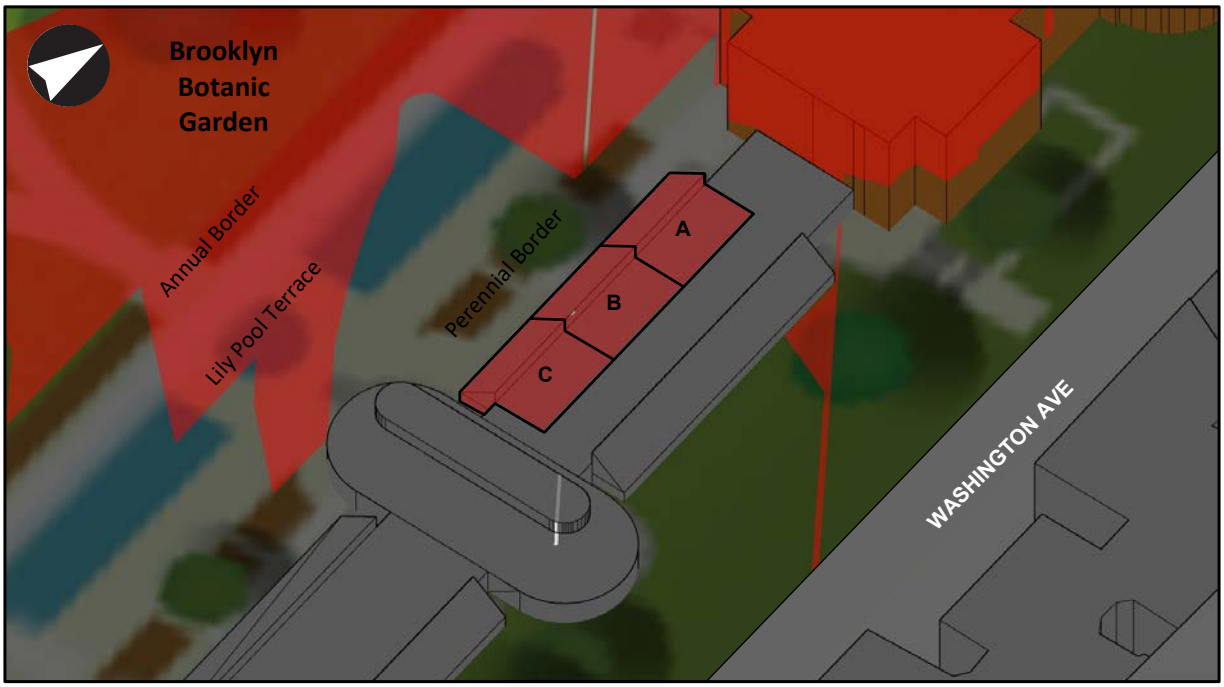
Historic Resource

D **Greenhouse Facility**
**Keyed to Table 6-5*

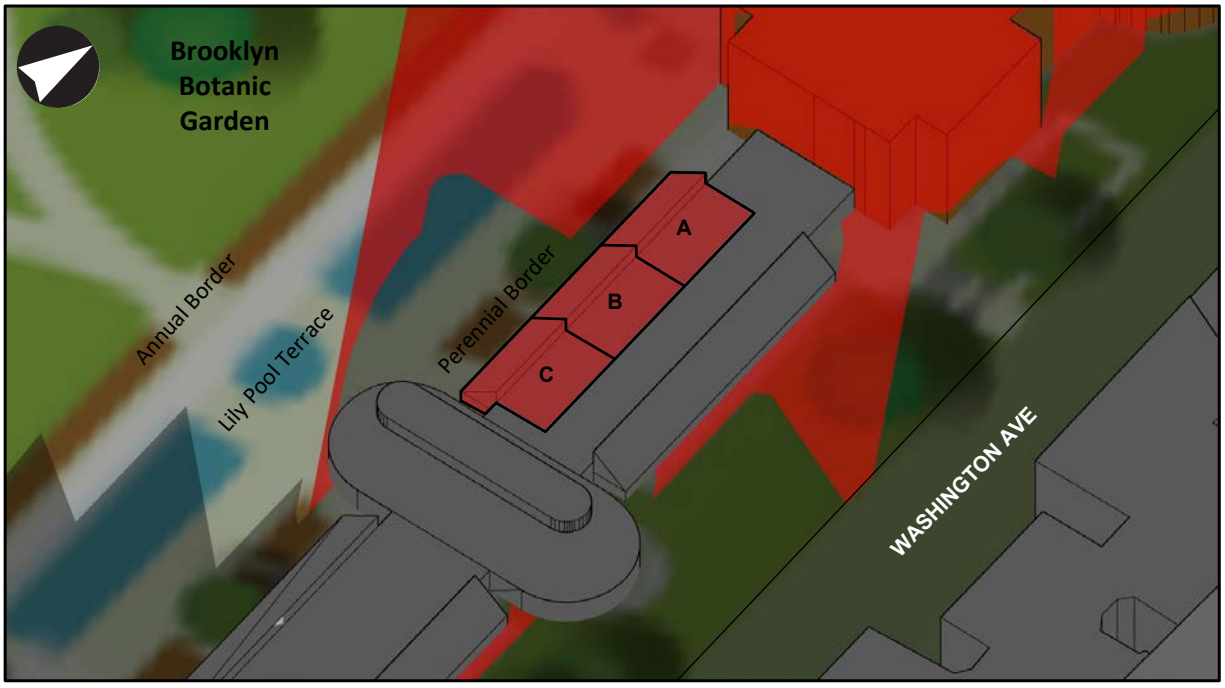
Incremental Shadow

Figure 6-5nn

Brooklyn Botanic Garden - Education Greenhouses
Incremental Shadows on December 21



8:51 AM



9:20 AM

Proposed Development

Open Space

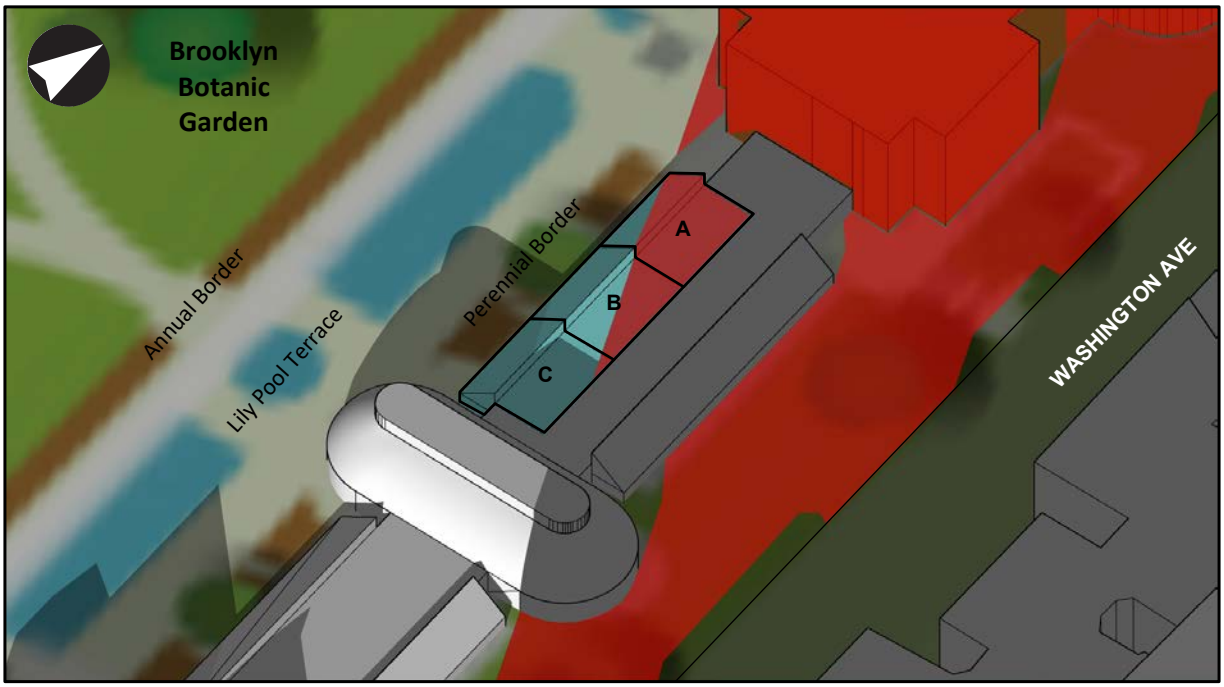
Historic Resource

A **Greenhouse Facility**
**Keyed to Table 6-5*

Incremental Shadow

Figure 6-5pp

Brooklyn Botanic Garden - Education Greenhouses
Incremental Shadows on December 21



9:50 AM

Proposed Development

Open Space

Historic Resource

A **Greenhouse Facility**
**Keyed to Table 6-5*

Incremental Shadow

While these areas, combined, would experience incremental shadows for a total of one hour and 54 minutes, it should be noted that – though the December 21 analysis day is not considered to be part of the plant growing season –several individual facilities within the Botanic Garden provide enclosed habitats for vegetation to grow during the winter months. Therefore, vegetation within these enclosed facilities requires direct sunlight for their survival. The Brooklyn Botanic Garden's affected unenclosed sunlight-sensitive areas (i.e., the Rose Garden, the Cherry Esplanade, the Japanese Hill-and-Pond Garden, the Shakespeare Garden, the Celebrity Path, the Fragrance Garden, Daffodil Hill, Magnolia Plaza, the Annual and Perennial Borders, and the Lily Pool Terrace) would experience incremental shadows ranging from 10 minutes (the Rose Garden) to one hour and 45 minutes (the Fragrance Garden). The Brooklyn Botanic Garden's enclosed, climate-controlled facilities (i.e., the Steinhardt Conservatory's individual greenhouse facilities and the Education Greenhouses) would experience incremental shadows ranging from three minutes (the Highland Moist Tropical Orchid Workhouse) and one hour and 10 minutes (the Desert Plant Education Greenhouse) (see **Table 6-5** and **Figures 6-5jj** through **6-5pp**). Though incremental shadow coverage would reach the open space's various plants, conservatories, greenhouses, propagation spaces, and nurseries for a total of one hour and 45 minutes on the December 21 analysis day, no single plant located in an enclosed greenhouse facility is expected to receive direct sunlight for less than four to six hours, which, according to the *CEQR Technical Manual,* is the general minimum requirement for the survival of vegetation, though several plants would require between six to eight, and possible more than eight hours of direct sunlight.

ASSESSMENT

The Proposed Project would cast incremental shadows on portions of the Brooklyn Botanic Garden on all four of the representative analysis days. Incremental shadow duration would range from one hour and 45 minutes on December 21 to four hours and 22 minutes on June 21 and would generally occur during the early morning hours. Incremental shadow coverage would generally be limited to southeastern and northeastern portions of the Botanic Garden. As shown in **Table 6-5,** incremental shadow coverage on individual resources within the Botanic Garden would vary. (see **Figures 6-5a** through **6-5pp**).

The areas affected by incremental shadows consist of gardens, including the Cranford Rose Garden, the Discovery Garden, the Fragrance Garden, the Herb Garden, the Japanese Hill-and-Pond Garden, the Rock Garden, the Shakespeare Garden, and the Shelby White and Leon Levy Water Garden; ponds such as the Lily Pool Terrace, the Japanese Hill-and-Pond Garden, and the Water Garden; plazas such as the Magnolia Plaza, the Perennial Border, and the Annual Border; conservatories and greenhouses, such as the Steinhardt Conservatory (which include the Helen Mattin Warm Temperate Pavilion, Tropical Pavilion, Desert Pavilion, C.V. Starr Bonsai Museum, Conservatory Entry House, Aquatic House and Orchid Collection, Desert, Mediterranean, South African Bulb [Arid] Workhouse, Humid Tropics Workhouse, Lowland Moist Tropical Orchid Workhouse, Highland Moist Tropical Orchid Workhouse, Tropical Plant Propagation House, and Tropical and Desert Plant Propagation House), the Desert Plants, Warm Temperate Plants, and Tropical Plants Education Greenhouses, the Temperate Bonsai Tunnel, the Production House, the Tropical Bonsai House, the Auxiliary House, the New York-Native Flora and Temperate Plant Propagation Tunnel, and the Mediterranean Display Plants Tunnel; and walking paths such as the Cherry Esplanade and the Celebrity Path. The affected areas of the garden are predominantly used for passive recreation, with various walkways lined with benches, grassy lawns, and various plant exhibits. As outlined above, each section of the Botanic Garden would experience no more than three hours and 48 minutes (the Aquatic House and Orchid Collection and the Tropical and Desert Plant Propagation House on the June 21 representative analysis day) on any given feature; however, most sections of the Botanic Garden would experience incremental shadows ranging between 30 minutes and two hours and 30 minutes. At the points of maximum total shadow coverage on the March 21/September

21, May 6/August 6, June 21, and December 21 analysis days (including incremental shadows and shadows cast by existing area buildings), a minimum of approximately 77 percent, 75 percent, 71 percent, and 70 percent of the Brooklyn Botanic Garden, respectively, would continue to receive uninterrupted sunlight. Furthermore, as shadows are not static and move from west to east throughout the day, all vegetation requiring direct sunlight – including those within enclosed conservatories, greenhouses, propagation spaces, and nurseries – would continue to receive the CEQR recommended minimum of generally 4 to 6 hours of direct sunlight per day, which is generally the minimum requirement for vegetation requiring direct sunlight, per the *CEQR Technical Manual*. However, throughout the year, project-generated shadows would be cast on several Greenhouses used to propagate plants for desert, tropical, and warm temperate climates that require full, year-round sunlight including during the important winter months. Therefore, any incremental shading of these greenhouses, specifically during the winter months, would have a significant adverse impact on the plants in these greenhouses. Though the *CEQR Technical Manual* states that 4-6 hours of sunlight is necessary for plant survival, the Brooklyn Botanic Garden contains over 18,500 kinds of plants, with globally rare species and native rare species. The sunlight needed to constitute survival may not be enough to promote healthy growth of these rare plants. Therefore, due to the incremental shadows created by the Proposed Project, significant adverse impacts are likely on the natural resources found within Brooklyn Botanic Garden. Potential measures to mitigate in full or part this impact are discussed in Chapter 21, "Mitigation."

PROSPECT PARK

MARCH 21/SEPTEMBER 21

The Proposed Project would cast incremental shadows on portions of Prospect Park for a total of 20 minutes on the March 21/September 21 analysis day. Incremental shadows would enter the park at the beginning of the analysis day (7:36 AM) and continue until 7:56 AM. After 7:56 AM the park would not experience any incremental shadow coverage. As indicated in **Figure 6-5a**, during the early morning hours, incremental shadows would be limited to a small eastern portion of the park fronting Flatbush Avenue. By 7:45 AM, incremental shadow coverage would decrease, moving in an easterly direction throughout the morning until exiting the open space at 7:56 AM. The maximum area of incremental shadow coverage that would cover Prospect Park on this analysis day (which would occur at 7:36 AM) would be approximately 31,000 sf, or approximately 0.1 percent of added coverage.

The areas experiencing shadow coverage would include portions of the Prospect Park Zoo and would be limited to landscaped areas containing trees and shrubs just north of the zoo's main entrance. Incremental shadows would not affect any of the zoo's exhibits (such as the California Sea Lion Pool or the "Discovery Trail") on the March 21/September 21 analysis day. As the incremental shadow coverage and duration on Prospect Park would be minimal on this analysis day, no single tree or shrub would receive direct sunlight for less than four to six hours, which, according to the *CEQR Technical Manual*, is the general minimum requirement for the survival of vegetation during the growing season.

MAY 6/AUGUST 6

The Proposed Project would cast incremental shadows on portions of Prospect Park for a total of 50 minutes on the May 6/August 6 analysis day. Incremental shadows would enter the park at the beginning of the analysis day (6:27 AM) and continue until 7:17 AM. After 7:17 AM the park would not experience any incremental shadow coverage. As indicated in **Figure 6-5l**, during the early morning hours, incremental shadows would be limited to the eastern portion of the park fronting Flatbush Avenue that contains the Prospect Park Zoo. By 7:00 AM, incremental shadow coverage would continue to decrease,

Figure 6-5a

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on March 21/September 21

7:36 AM

8:00 AM

Proposed Development
Open Space
Historic Resource
Greenhouse Facility
Incremental Shadow
Water Feature

Figure 6-5l

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on May 6/August 6

6:27 AM

7:00 AM

Proposed Development
Open Space
Historic Resource
Greenhouse Facility
Incremental Shadow
Water Feature

moving in an easterly direction throughout the morning until exiting the open space at 7:17 AM. The maximum area of incremental shadow coverage that would cover Prospect Park on this analysis day (which would occur at 6:27 AM) would be approximately 98,500 sf, or approximately 0.4 percent of added coverage.

The areas experiencing shadow coverage would include portions of the Prospect Park Zoo and would affect the California Sea Lion Pool located at the zoo's entrance, as well as the zoo's "Discovery Trail" which includes exhibits that feature tufted deer, red pandas, dingos, black-tailed prairie dogs, emus, and North American river otters. However, the Proposed Project would cast incremental shadows on the zoo's "Discovery Trail" for a duration of no longer than 20 minutes on any given feature during the May 6/August 6 analysis day. Incremental shadows would also reach the "Animal Lifestyles," "Education Classrooms," Sea Lion Store and Café, and Administration buildings; however, as these buildings do not contain sunlight-sensitive features, and as the exhibits within them are not dependent on sunlight, these buildings would not be adversely affected by incremental shadows resulting from the Proposed Project. Additionally, as the Prospect Park Zoo is operational and open to the public from 10:00 AM to 5:00 PM, incremental shadows would not affect the public's use or enjoyment of the zoo on this analysis day. Furthermore, as the incremental shadow coverage and duration on Prospect Park and Prospect Park Zoo would be minimal on this analysis day, no single tree or shrub or wetland feature is expected to receive direct sunlight for less than four to six hours, which, according to the *CEQR Technical Manual*, is the general minimum requirement for the survival of vegetation during the growing season.

JUNE 21

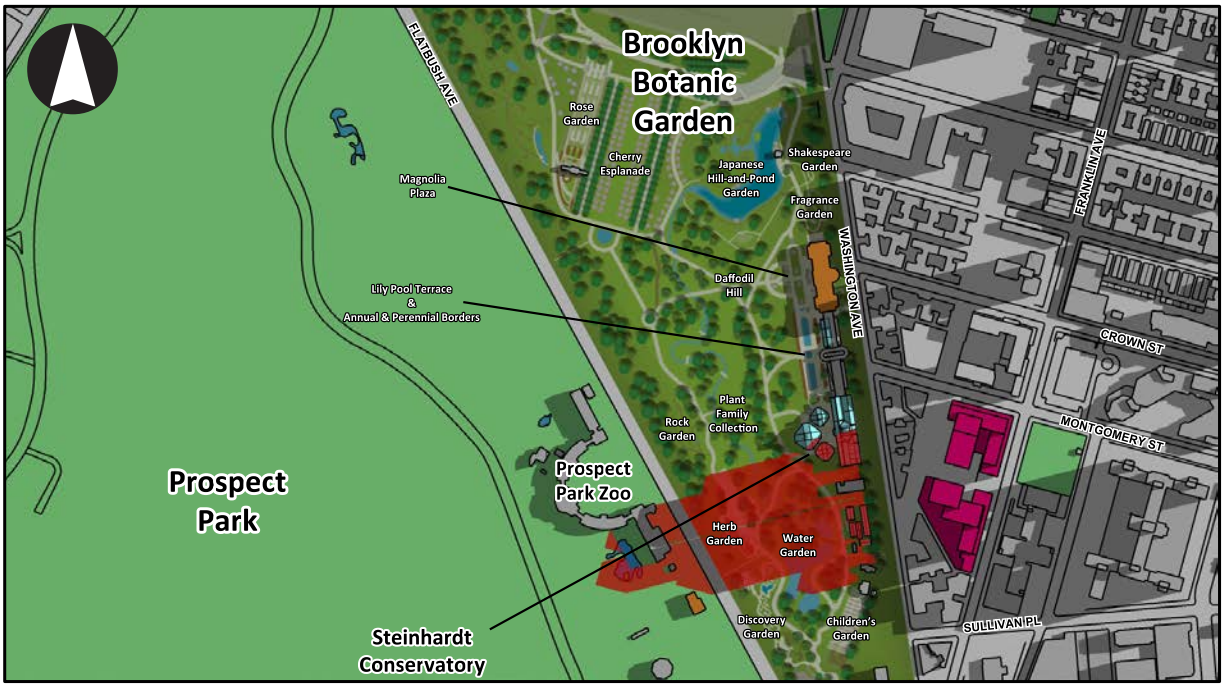
The Proposed Project would cast incremental shadows on portions of Prospect Park for a total of one hour and 12 minutes on the June 21 analysis day. Incremental shadows would enter the park at the beginning of the analysis day (5:57 AM) and continue until 7:09 AM. After 7:09 AM the park would not experience any incremental shadow coverage. As indicated in **Figure 6-5x**, during the early morning hours, incremental shadows would be limited to the eastern portion of the park fronting Flatbush Avenue that contains the Prospect Park Zoo. By 6:30 AM, incremental shadow coverage would continue to decrease, moving in an easterly direction throughout the morning until exiting the open space at 7:11 AM. The maximum area of incremental shadow coverage that would cover Prospect Park on this analysis day (which would occur at 5:57 AM) would be approximately 243,500 sf, or approximately 1.1 percent of added coverage.

The areas experiencing shadow coverage would include portions of the Prospect Park Zoo and would affect the California Sea Lion Pool located at the zoo's entrance, as well as the zoo's "Discovery Trail" which includes exhibits that feature tufted deer, red pandas, dingos, black-tailed prairie dogs, emus, and North American river otters. However, the Proposed Project would cast incremental shadows on the zoo's "Discovery Trail" for a duration of no longer than 50 minutes on any given feature during the June 21 analysis day. Incremental shadows would also reach the Sea Lion Store and Café and Administration buildings; however, as these buildings do not contain sunlight-sensitive features, and as the exhibits within them are not dependent on sunlight, these buildings would not be adversely affected by incremental shadows resulting from the Proposed Project. Additionally, as the Prospect Park Zoo is operational and open to the public from 10:00 AM to 5:00 PM, incremental shadows would not affect the public's use or enjoyment of the zoo on this analysis day. Incremental shadows would also reach a small portion of Prospect Park directly west of the Prospect Park Zoo, affecting a small woodland area featuring various trees and shrubs. However, the duration of these incremental shadows on this portion of Prospect Park would be no longer than 15 minutes. Furthermore, as the incremental shadow coverage and duration on Prospect Park and Prospect Park Zoo would be minimal on this analysis day, no single tree or shrub or

Figure 6-5x

Brooklyn Botanic Gardens & Prospect Park
Incremental Shadows on June 21

5:57 AM



6:30 AM

Proposed Development
Open Space
Historic Resource
Greenhouse Facility
Incremental Shadow
Water Feature

wetland feature would receive direct sunlight for less than four to six hours, which, according to the *CEQR Technical Manual*, is the general minimum requirement for the survival of vegetation during the growing season.

ASSESSMENT

The Proposed Project would cast incremental shadows on portions of Prospect Park on three of the four representative analysis days (March 21/September 21, May 6/August 6, and June 21). Incremental shadow duration would be minimal, ranging from 20 minutes on March 21/September 21 to 1 hour and 12 minutes on June 21 and would generally occur during the early morning hours. Incremental shadow coverage would generally be limited to the eastern portions of the park and would not be cast on a single part of the open space for an extended period of time, allowing the open space's sunlight sensitive resources to continue to receive adequate direct sunlight throughout the day (see **Figures 6-5a, 6-5l, 6-5x,** and **6-5y**).

The areas experiencing shadow coverage would include portions of the Prospect Park Zoo, including the California Sea Lion Pool located at the zoo's entrance and the zoo's "Discovery Trail," as well as the "Animal Lifestyles," "Education Classrooms," Sea Lion Store and Café, and Administration buildings. However, as these buildings do not contain sunlight-sensitive features, and as the exhibits within them are not dependent on sunlight, these buildings would not be adversely affected by incremental shadows resulting from the Proposed Project. In addition, on the June 21 analysis day, incremental shadows would reach a small portion of Prospect Park directly west of the zoo, that features a woodland area consisting of various trees and shrubs. However, incremental shadows on both the zoo and the park's woodlands would be minimal, as the maximum incremental shadow duration would be no longer than 50 minutes (the "Discovery Trail" on June 21) on any given feature. It should also be noted that the Prospect Park Zoo – which experiences a majority of the incremental shadows compared to the rest of the park – is generally open to the public between the hours of 10:00 AM and 5:00, and that daily admission to the zoo ranges between $8 and $10; as incremental shadow coverage on the zoo generally does not continue past 8:00 AM, impacts to the public's use and enjoyment of the zoo are minimal. Furthermore, as shadows are not static and move from west to east throughout the day, all vegetation located within both the zoo and surrounding park requiring direct sunlight would continue to receive the CEQR recommended minimum of 4 to 6 hours of direct sunlight per day.

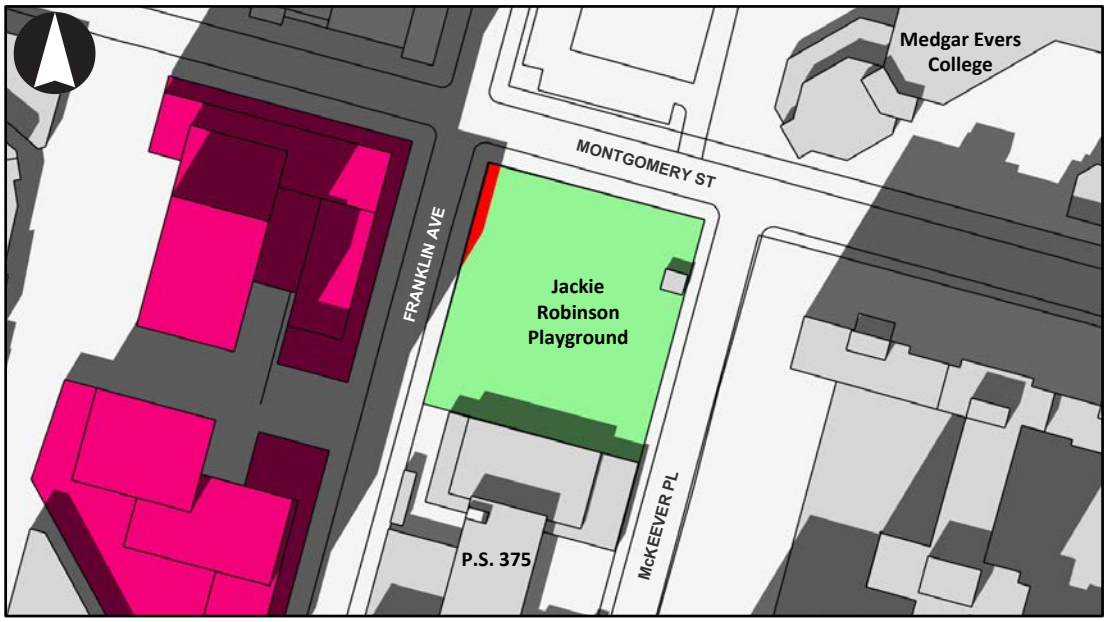
Therefore, as the extent and duration of the incremental shadows would (1) not significantly reduce or completely eliminate direct sunlight exposure on any of the sunlight-sensitive resources found within this open space; (2) would not significantly alter the public's use of the park; and (3) would not threaten the viability of vegetation or other resources located within this open space, incremental shadows from the Proposed Project on Prospect Park would not be considered a significant adverse impact, in accordance with *CEQR Technical Manual* methodology.

JACKIE ROBINSON PLAYGROUND

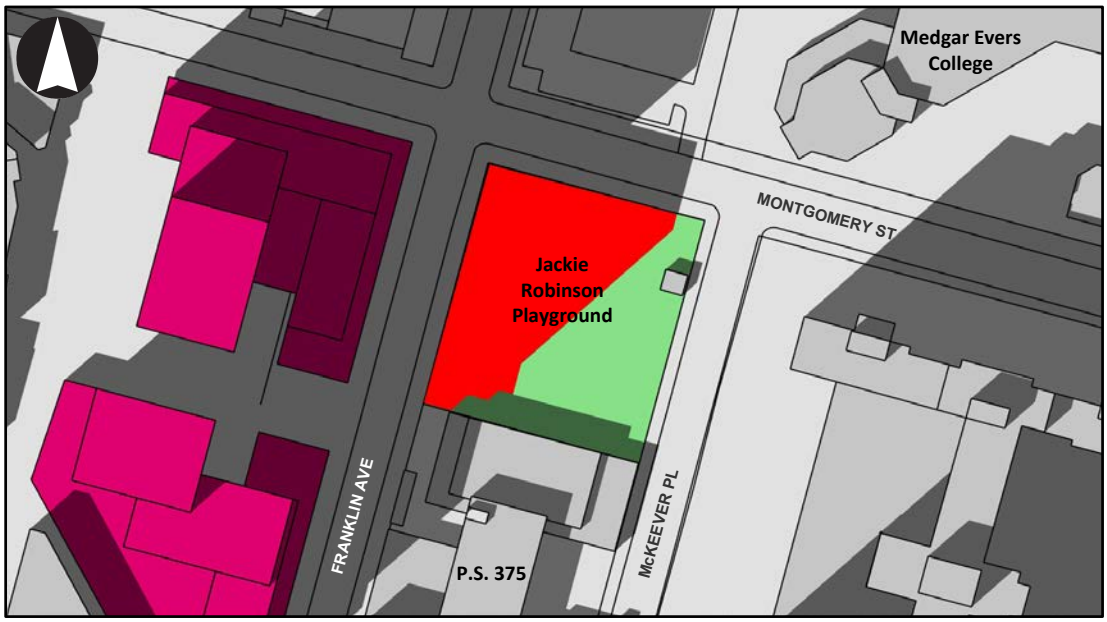
MARCH 21/SEPTEMBER 21

The Proposed Project would also cast incremental shadows on portions of the Jackie Robinson Playground for a total of three hours and three minutes on the March 21/September 21 analysis day. Incremental shadows would enter the playground at 1:26 PM and continue until the end of the analysis day (4:29 PM). Prior to 1:26 PM the playground would not experience any incremental shadow coverage. As indicated in **Figure 6-6a**, during the afternoon hours, incremental shadows would be limited to the northwestern

Figure 6-6a
Jackie Robinson Playground
Incremental Shadows on March 21/September 21



1:30 PM

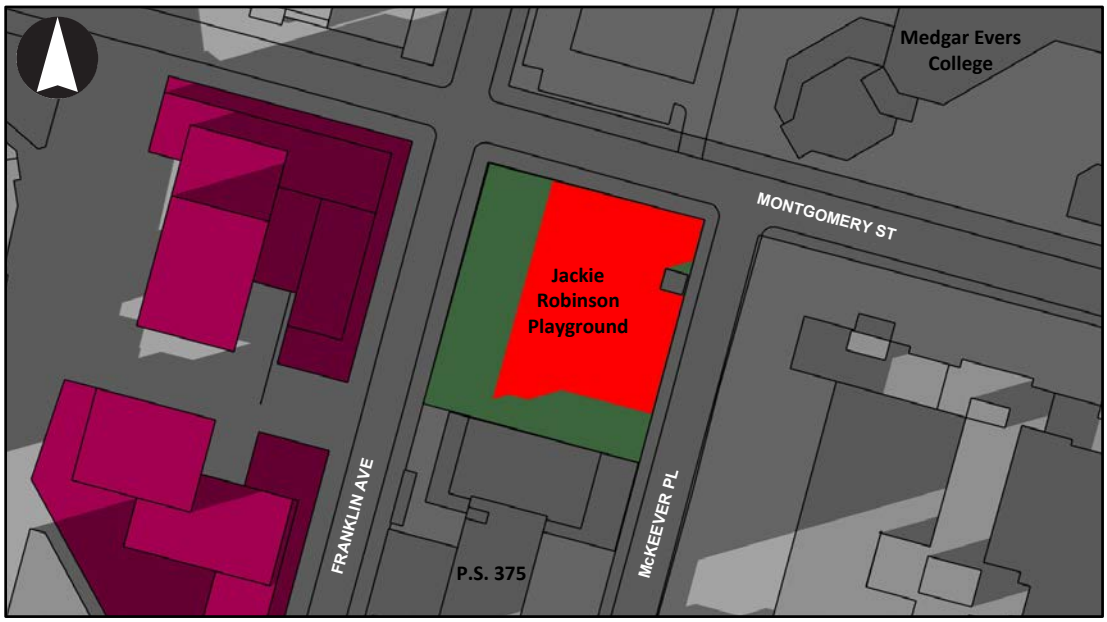


2:30 PM

Proposed Development **Open Space** **Incremental Shadow**

Figure 6-6b
Jackie Robinson Playground
Incremental Shadows on March 21/September 21

3:30 PM



4:29 PM

Proposed Development **Open Space** **Incremental Shadow**

portion of the playground fronting Franklin Avenue and Montgomery Street. By 2:30 PM, incremental shadow coverage would increase, moving in an easterly direction throughout the late afternoon up until the end of the analysis day (refer to **Figures 6-6a** and **6-6b**). It should be noted that between 3:23 PM and 4:29 PM, incremental shadows would completely eliminate direct sunlight exposure on the sunlight-sensitive resources found within this playground for a duration of one hour and six minutes, which would constitute a significant adverse impact.

The areas experiencing shadow coverage include basketball and handball courts, playgrounds, fitness equipment, spray showers, game tables, benches, and trees; while these areas, combined, would experience incremental shadows for a total of three hours and three minutes. The full-court basketball courts located on the southeastern portion of the playground would experience incremental shadows for no longer than two hours. Additionally, though incremental shadow coverage would reach the playground's trees in the northern portion of the playground for a total of three hours and six minutes on the March 21/September 21 analysis day, no single tree would receive direct sunlight for less than four hours, which, according to the CE*QR Technical Manual*, is the general minimum requirement for the survival of vegetation during the growing season.

MAY 6/AUGUST 6

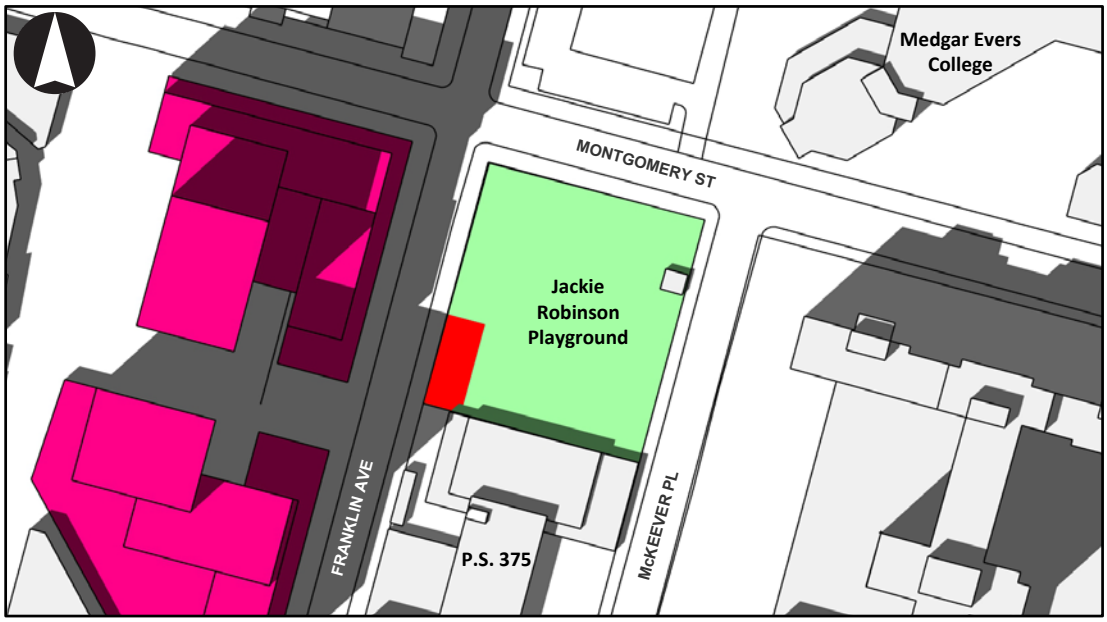
The Proposed Project would also cast incremental shadows on portions of the Jackie Robinson Playground for a total of four hours and six minutes on the May 6/August 6 analysis day. Incremental shadows would enter the playground at 1:12 PM and continue until the end of the analysis day (5:18 PM). Prior to 1:12 PM the playground would not experience any incremental shadow coverage. As indicated in **Figure 6-6c**, during the early afternoon hours, incremental shadows would be limited to the southwestern portion of the playground fronting Franklin Avenue. By 2:45 PM, incremental shadow coverage would increase, moving in a northeasterly direction throughout the late afternoon. By 5:15 PM, incremental shadow coverage would decrease, moving in a southeasterly direction up until the end of the analysis day (refer to **Figure 6-6d**). The maximum area of incremental shadow coverage that would cover Jackie Robinson Playground on this analysis day (which would occur at 3:17 PM) would be approximately 43,750 sf, or approximately 99.2 percent of added coverage.

The areas experiencing shadow coverage include basketball and handball courts, playgrounds, fitness equipment, spray showers, game tables, benches, and tree plantings; while these areas, combined, would experience incremental shadows for a total of four hours and six minutes. The full-court basketball courts located on the southeastern portion of the playground would experience incremental shadows for no longer than three hours. Additionally, though incremental shadow coverage would reach the playground's trees in the northern portion of the playground for a total of approximately three hour and 30 minutes on the May 6/August 6 analysis day, no single tree would receive direct sunlight for less than four hours, which, according to the CE*QR Technical Manual*, is the general minimum requirement for the survival of vegetation during the growing season.

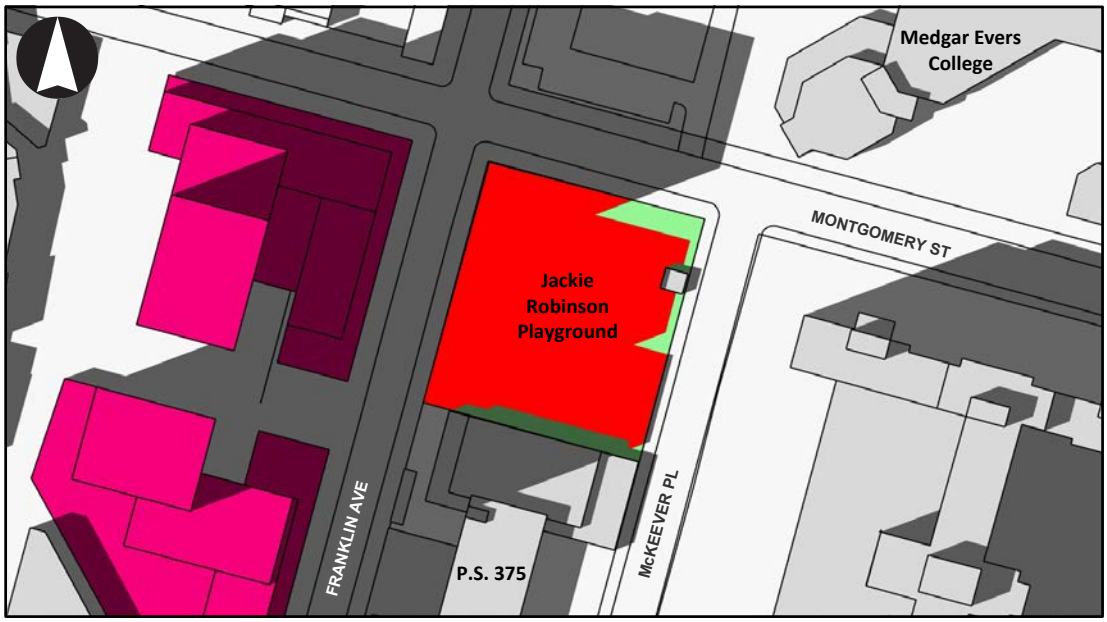
JUNE 21

The Proposed Project would cast incremental shadows on portions of the Jackie Robinson Playground for a total of four hours and 45 minutes on the June 21 analysis day. Incremental shadows would enter the playground at 1:16 PM and continue until the end of the analysis day (6:01 PM). Prior to 1:16 PM the playground would not experience any incremental shadow coverage. As indicated in **Figure 6-6e**, during the early afternoon hours, incremental shadows would be limited to the southwestern portion of the playground fronting Franklin Avenue. By 3:00 PM, incremental shadow coverage would increase, moving

Figure 6-6c
Jackie Robinson Playground
Incremental Shadows on May 6/August 6



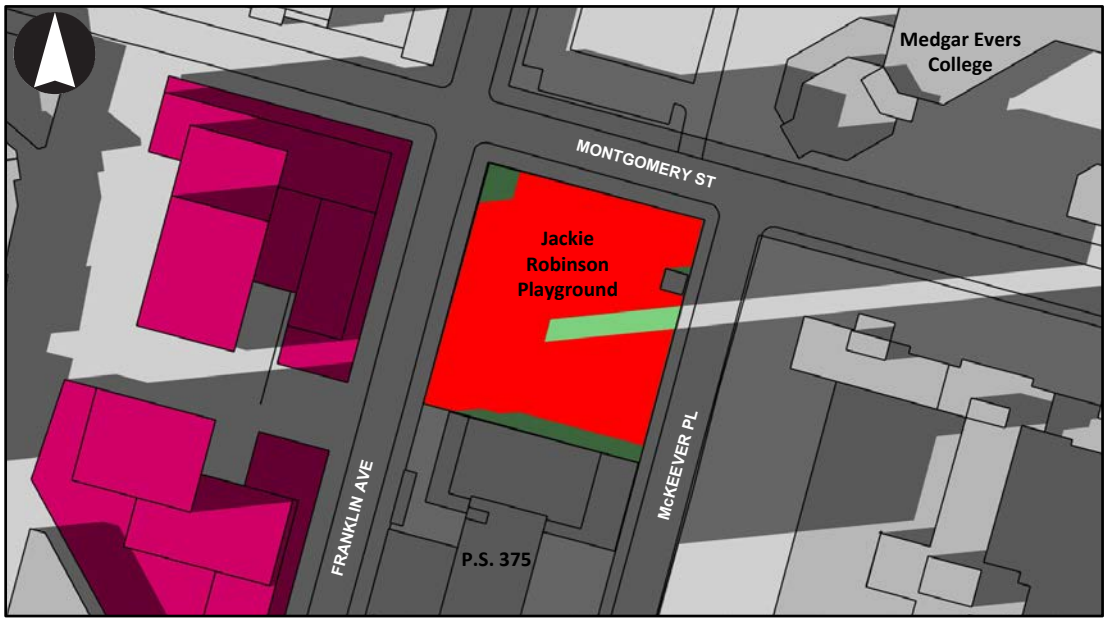
1:30 PM



2:45 PM

Proposed Development **Open Space** **Incremental Shadow**

Figure 6-6d
Jackie Robinson Playground
Incremental Shadows on May 6/August 6

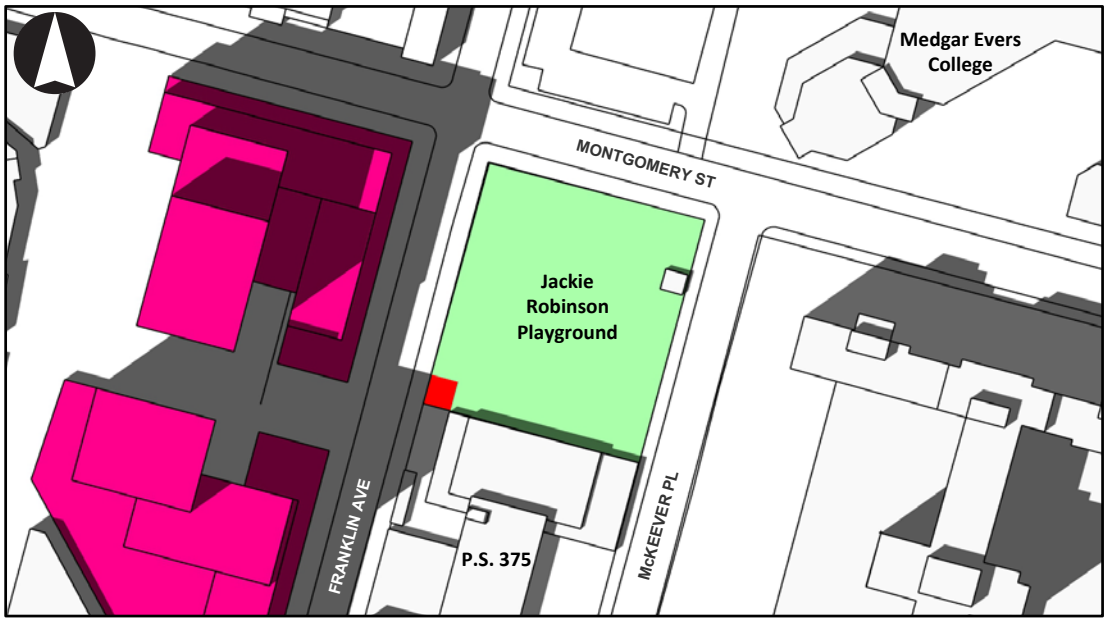


4:00 PM

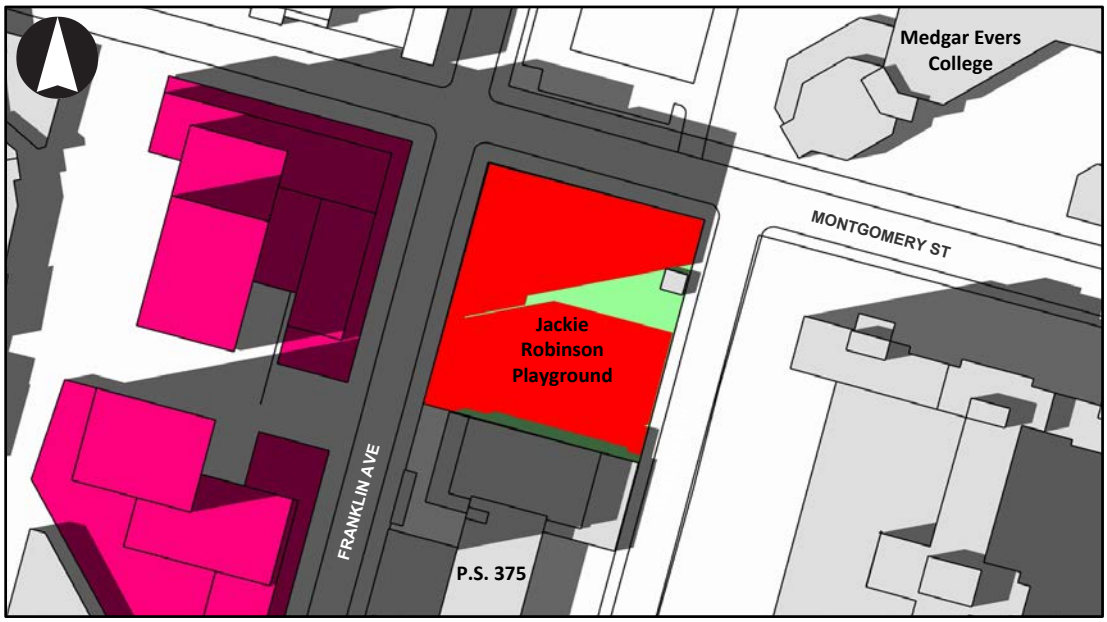
5:15 PM

Proposed Development **Open Space** **Incremental Shadow**

Figure 6-6e
Jackie Robinson Playground
Incremental Shadows on June 21



1:30 PM



3:00 PM

Proposed Development **Open Space** **Incremental Shadow**

in an easterly direction throughout the late afternoon. By 4:30 PM, incremental shadows would continue to increase, now moving in a southeasterly direction until the end of the analysis day (refer to **Figure 6-6f**). It should be noted that between 5:34 PM and 5:42 PM, incremental shadows would completely eliminate direct sunlight exposure on the playground for a duration of eight minutes. The maximum area of incremental shadow coverage that would cover Jackie Robinson Playground on this analysis day (which would occur at 5:43 PM) would be approximately 44,000 sf, or approximately 99.8 percent of added coverage.

The areas experiencing shadow coverage include basketball and handball courts, playgrounds, fitness equipment, spray showers, game tables, benches, and tree plantings; while these areas, combined, would experience incremental shadows for a total of four hours and 45 minutes. Additionally, though incremental shadow coverage would reach the playground's trees in the northern portion of the playground for a total of approximately four hours and 30 minutes on the June 21 analysis day, no single tree would receive direct sunlight for less than four to six hours, which, according to the CE*QR Technical Manual*, is the general minimum requirement for the survival of vegetation during the growing season.

DECEMBER 21

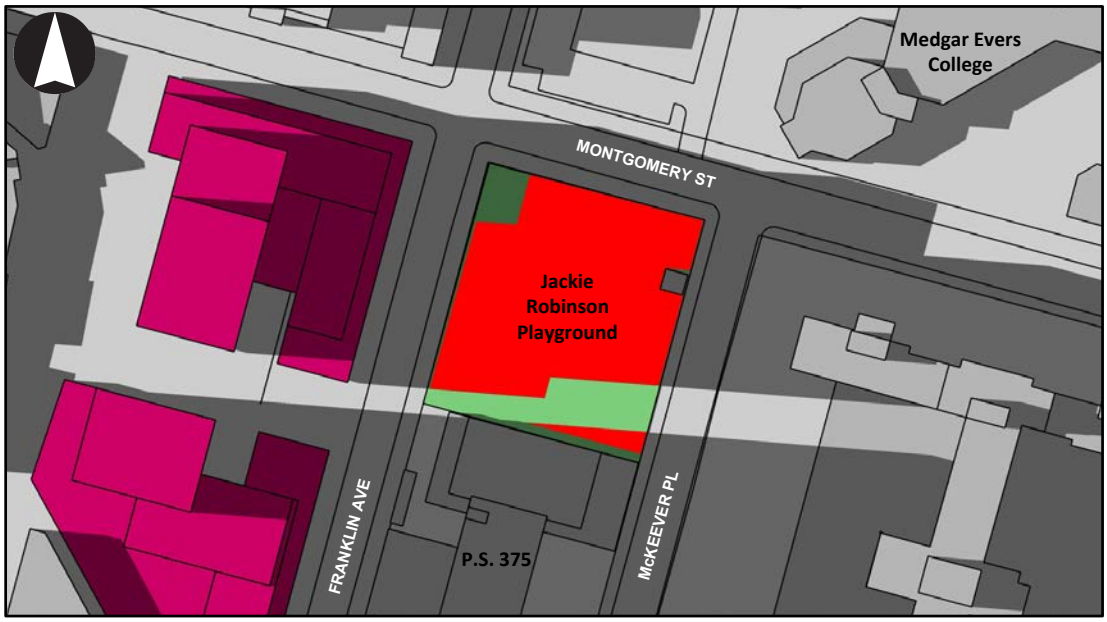
The Proposed Project would cast incremental shadows on portions of Jackie Robinson Playground for a total of one hour and 15 minutes on the December 21 analysis day. Incremental shadows would enter the playground beginning at 1:38 PM and continue until the end of the analysis day (2:53 PM). As indicated in **Figure 6-6g**, incremental shadows would be limited to the northwestern portions of the playground during the afternoon hours, moving very quickly in an easterly direction until the end of the analysis day (2:53 PM). The maximum area of incremental shadow coverage that would cover Jackie Robinson Playground on this analysis day (which would occur at 2:53 PM) would be approximately 15,500 sf, or approximately 35.2 percent of added coverage.

The areas of Jackie Robinson Playground experiencing shadow coverage feature basketball and handball courts, playgrounds, fitness equipment, spray showers, game tables, benches, and tree plantings; while these areas, combined, would experience incremental shadows for an accumulative total of one hour and 15 minutes, no single feature of the open space would be cast in incremental shadows for an extended period of time due to the speed and movement of these shadows across the open space. In addition—though the December 21 analysis day is not considered to be part of the plant growing season—it should be noted that no single tree located in the northern portion of the playground would experience an incremental shadow of more than one hour and 15 minutes during this representative analysis day.

ASSESSMENT

The Proposed Project would cast incremental shadows on portions of the Jackie Robinson Playground on each of the four representative analysis days. Incremental shadow durations would range from one hour and 15 minutes on December 21 to four hours and 45 minutes on June 21. Shadow coverage would generally cover large portions of the playground and would enter the open space from the western sections of the playground (which generally feature handball courts, playground equipment, benches, and tree plantings) (see **Figures 6-6a** through **6-6g**). As discussed above, the playground would experience a complete loss of sunlight on the March 21/September 21 and June 21 analysis days (one hour and six minutes and eight minutes, respectively Comparing **Figure 6-4a** to **Figures 6-6a** through **6-6g**, incremental shadows from the Proposed Project would be primarily cast on the checker tables and bench seating area, the playground area, and the northern portion of the basketball courts. Based on guidance from the *CEQR Technical Manual,* uses that rely on sunlight include passives uses, such as sitting or sunning, and active

Figure 6-6f
Jackie Robinson Playground
Incremental Shadows on June 21

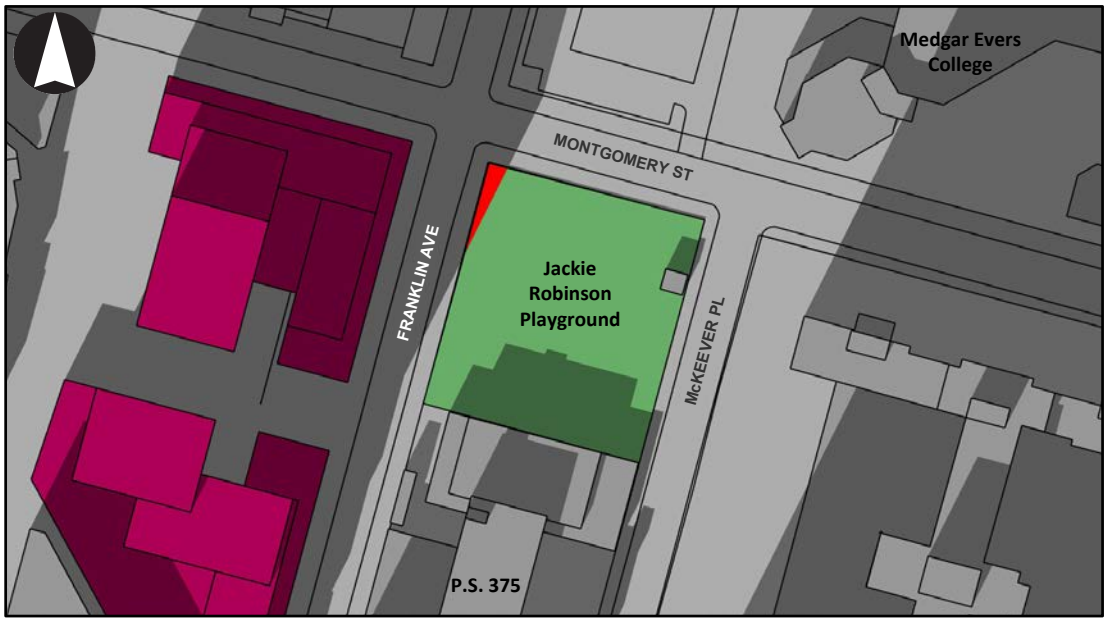


4:30 PM

6:00 PM

Proposed Development **Open Space** **Incremental Shadow**

Figure 6-6g
Jackie Robinson Playground
Incremental Shadows on December 21



1:45 PM

2:45 PM

Proposed Development **Open Space** **Incremental Shadow**

uses including paved courts. The uses affected by incremental shadow are therefore considered sunlight-sensitive.

Therefore, as the extent and duration of the incremental shadows would (1) significantly reduce or completely eliminate direct sunlight exposure on any of the sunlight-sensitive resources found within this open space; and consequentially (2) may significantly alter the public's use of the park, incremental shadows from the Proposed Project on Jackie Robinson Playground would be considered a significant adverse impact, in accordance with *CEQR Technical Manual* methodology. Potential measures to mitigate in full or part this impact are discussed in Chapter 21, "Mitigation."

P.S. 375K Community Playground

JUNE 21

The Proposed Project would cast incremental shadows on portions of the P.S. 375K Community Playground for a total of 25 minutes on the June 21 analysis day. Incremental shadows would enter the historic resource at 3:33 PM and continue until 3:58 PM. Prior to 3:33 PM and after 3:58 PM the open space resource would not experience any incremental shadow coverage. As indicated in **Figure 6-7**, during the afternoon hours, incremental shadows would be minimal, covering a small northeastern portion of the playground. The maximum area of incremental shadow coverage that would cover the P.S. 375K Community Playground on this analysis day would be approximately 60 sf, or approximately 0.3 percent of added coverage.

The areas of the P.S. 375K Community Playground experiencing shadow coverage feature raised garden beds, bench seating, tables, and tree plantings. As incremental shadow coverage and duration would be minimal, no single feature of the open space would be cast in incremental shadows for an extended period of time due to the speed and movement of these shadows across the open space. Additionally, though incremental shadow coverage would reach the playground's garden beds and trees in the northeastern portion of the playground for a total of approximately 25 minutes on the June 21 analysis day, no single garden bed or tree would receive direct sunlight for less than four to six hours, which, according to the CE*QR Technical Manual*, is the general minimum requirement for the survival of vegetation during the growing season.

ASSESSMENT

The Proposed Project would cast incremental shadows on the P.S. 375K Community Playground on the June 21 analysis day. Incremental shadow duration would be minimal (25 minutes) and would generally be limited to the afternoon hours between 3:33 and 3:58 PM. Shadow coverage would be minimal, affecting a small northeastern portion of the playground that features raised garden beds, bench seating, tables, and trees. Incremental shadows would also not be cast on a single part of the playground for an extended period of time, allowing the playground's sunlight-sensitive resources to receive adequate direct sunlight throughout the day (see **Figures 6-7**). The Proposed Project would not result in substantial effects to the survival, enjoyment, or use of the resource, and, therefore, incremental shadows are not expected to have a significant effect on any of the open space's sunlight sensitive resources.

Therefore, as the extent and duration of the incremental shadows would not significantly alter the public's use or enjoyment of the open space resource, incremental shadows from the Proposed Project on the P.S. 375K Community Playground would not be considered a significant adverse impact, in accordance with *CEQR Technical Manual* methodology.

Figure 6-7
P.S. 375K Community Playground
Incremental Shadows on June 21

3:45 PM

Proposed Development **Open Space** **Incremental Shadow**