A. INTRODUCTION

This chapter assesses the potential impact of new shadows that would be cast by the proposed Gilder Center on Theodore Roosevelt Park or any other nearby publicly accessible sunlight-sensitive resources. According to the 2014 *City Environmental Quality Review (CEQR) Technical Manual*, sunlight-sensitive resources of concern include public open space, sunlight-dependent features of historic architectural resources, and natural resources that depend on sunlight.

As described in Chapter 1, “Project Description,” the proposed project would result in a new building, the Richard Gilder Center for Science, Education, and Innovation, in a 105-foot-tall (five-stories above grade; 115 feet taking into account rooftop mechanical) addition to the American Museum of Natural History (AMNH or the Museum). The site for the proposed project is on the west side of the Museum complex facing Columbus Avenue, within Theodore Roosevelt Park. With the proposed project, three existing buildings within the Museum complex would be removed to accommodate a portion of the project, thereby minimizing the proposed building’s footprint on land that is now open space in Theodore Roosevelt Park to about 11,600 square feet (0.27 acres). Besides new construction in the Park, the project will result in a redesign of approximately 75,000 square feet in the western portion of Theodore Roosevelt Park.

PRINCIPAL CONCLUSIONS

The analysis found that the proposed project would cast new shadows on Theodore Roosevelt Park in all seasons. The new shadows would fall primarily on portions of the adjacent Columbus Avenue entrance area that would be re-landscaped and reconfigured as part of the proposed project. New shadow would also fall on portions of the Arthur Ross Terrace in all seasons, but would be limited in extent, and would briefly fall on a very small area of the west façade of the Rose Center for Earth and Space in certain seasons. The analysis concluded that project-generated shadows would not significantly alter public use of the park or threaten the viability of trees or other vegetation. Therefore, the proposed project would not result in any significant adverse shadow impacts.

B. DEFINITIONS AND METHODOLOGY

This analysis has been prepared in accordance with CEQR procedures and follows the guidelines of the *CEQR Technical Manual*.

DEFINITIONS

Shadow is the condition that results when a building or other built structure blocks the sunlight that would otherwise directly reach a certain area, space, or feature.

Incremental shadow is the additional, or new, shadow that a structure resulting from a proposed project would cast on a sunlight-sensitive resource. It should be noted that the shade created by trees and other natural features is not considered to be shadow of concern for the impact analysis; however, incremental shadow on a tree-shaded environment may create a significant impact as the incremental shadow is not redundant with tree shade, and the tree canopy may be considered a sunlight-sensitive resource.

Sunlight-sensitive resources are those that depend on sunlight or for which direct sunlight is necessary to maintain the resource's usability or architectural integrity. Such resources generally include:

- *Public open space* such as parks, beaches, playgrounds, plazas, schoolyards (if open to the public during non-school hours), greenways, and landscaped medians with seating. Planted areas within unused portions of roadbeds that are part of the Greenstreets program are also considered sunlight-sensitive resources.
- *Features of architectural resources that depend on sunlight for their enjoyment by the public.* Only the sunlight-sensitive features need be considered, as opposed to the entire resource. Such sunlight-sensitive features might include: design elements that depend on the contrast between light and dark (e.g., recessed balconies, arcades, deep window reveals); elaborate, highly carved ornamentation; stained glass windows; historic landscapes and scenic landmarks; and features for which the effect of direct sunlight is described as playing a significant role in the structure's importance as a 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.

Resources not subject to analysis under CEQR include:

- *City streets and sidewalks* (except Greenstreets);
- *Private open space* (e.g., front and back yards, stoops, vacant lots, and any private, non-publicly accessible open space);
- *Project-generated open space* cannot experience a significant adverse shadow impact from the project, according to CEQR, because without the project the open space would not exist. However, if the condition of project-generated open space is included in the qualitative analysis presented in the Open Space chapter of the Environmental Impact Statement (EIS), a discussion of how shadows would affect the new space may be warranted.

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, thereby significantly altering the public's use of the resource or threatening the viability of vegetation or other resources. Each case must be considered on its own merits based on the extent and duration of new shadow and an analysis of the resource's sensitivity to reduced sunlight.

METHODOLOGY

Following the guidelines of the *CEQR Technical Manual*, a preliminary screening assessment must first be conducted to ascertain whether a project's shadow could reach any sunlight-sensitive resources at any time of year. The preliminary screening assessment consists of three tiers of analysis. The first tier determines a simple radius around the proposed building representing the longest shadow that could be cast. If there are sunlight-sensitive resources within this radius, the analysis proceeds to the second tier, which reduces the area that could be affected by project shadow by accounting for the fact that shadows are not cast to the south between a certain range of angles due to the path of the sun through the sky at the latitude of New York City.

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 project shadow by looking at specific representative days in each season 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 resulting from the project. The detailed analysis provides the data needed to assess the shadow impacts. The effects of the new shadows on the sunlight-sensitive resources are described, and their degree of significance is considered. The results of the analysis and assessment are documented with graphics, a table of incremental shadow durations, and narrative text.

TREES AND SHADING

It should be noted that, as with any landscaped park, depending upon the season shading of varying intensity occurs on pathways and seating areas due to nearby trees. In warmer weather, shading from the Park's tree canopy may be a welcome refuge. The Park's large, mature trees are often referred to as "shade trees" by users and arborists alike. In cooler months, Park users will seek sunnier locations. From late fall through winter to early spring, tree canopies are sparse or nonexistent, which results in more direct sunlight reaching the park's benches and walkways.

As noted above in the Definitions section, CEQR methodology defines shadow as resulting from a built structure blocking the sun, and any tree canopy is considered a sunlight-sensitive resource rather than a source of shadow. Therefore, in the analysis presented in this chapter, the effects of incremental shadows that fall during the growing or "leaf-on" season onto areas occupied by the Park's dense tree canopy are primarily assessed in terms of how they might affect the health of the trees. Beneath the canopy, from the perspective of the Park's users during the "leaf-on" months, the effects of the proposed building's new shadow would likely be minimal, although not undetectable as small areas of sunlight do typically shine through small gaps in the leafy canopy. The photos in **Figures 4-1 and 4-2** show examples of sun and shading conditions on a sunny day in the Park during the leaf-on months.

C. PRELIMINARY SCREENING ASSESSMENT

A base map was developed using Geographic Information Systems (GIS)[1] showing the location of the proposed project and the surrounding street layout (see **Figure 4-3**). In coordination with the open space, historic and cultural resources, and natural resources assessments presented in other chapters of this EIS, potential sunlight-sensitive resources were identified and shown on the map.

[1] Software: Esri ArcGIS 10.3; Data: New York City Department of Information Technology and Telecommunications (DoITT) and other City agencies, and AKRF site visits.

Sept. 22, 2016

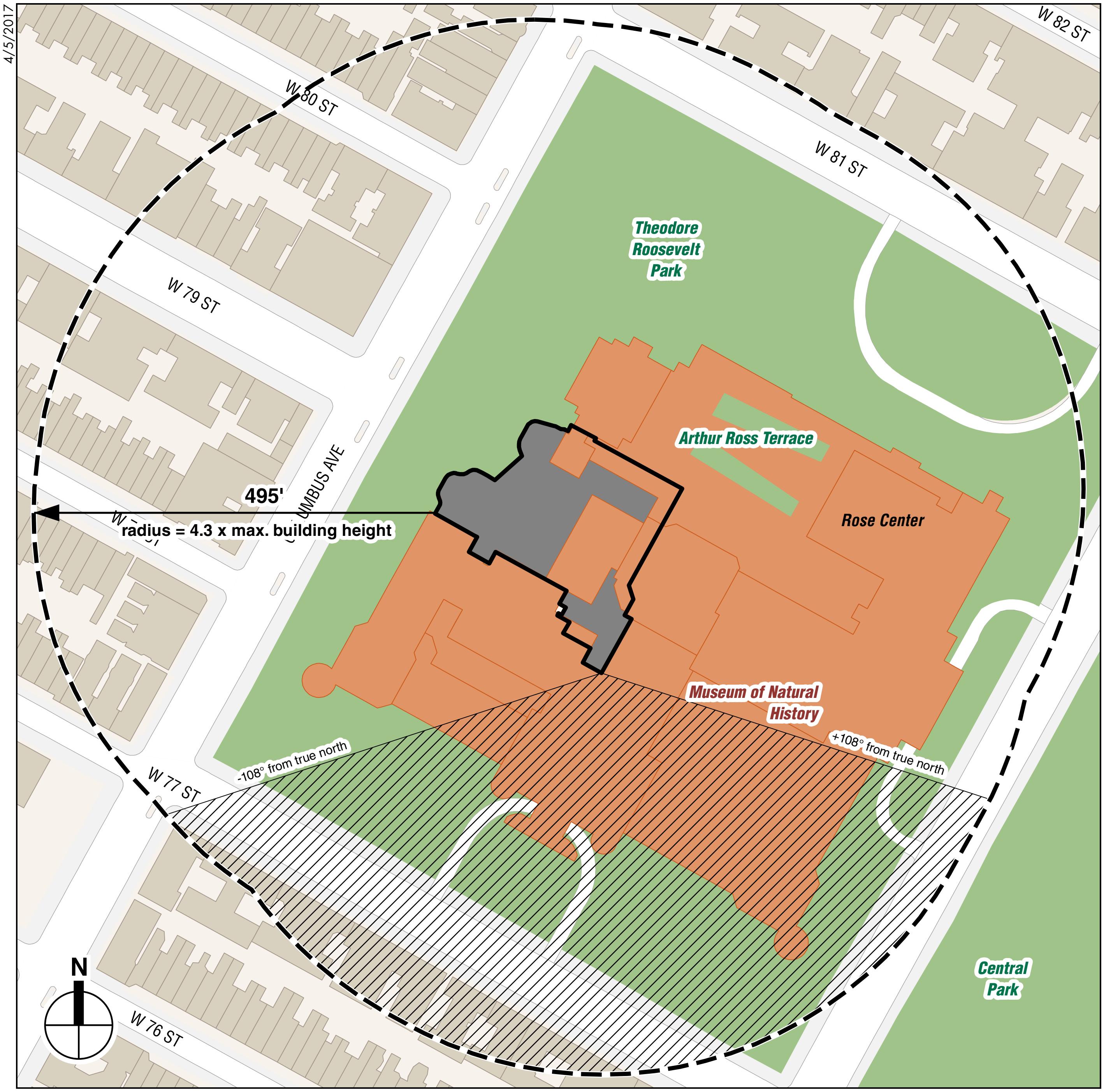
View North towards Nobel Monument, including Building 17. **1**

Sept. 22, 2016

View East to Weston Pavilion and Building 8. **2**

View of Nobel Monument Facing Northwest. **3**

View of Nobel Monument Facing North. **4**



Building Site

Portion of Development Site not currently occupied by existing buildings

Tier 1: Longest shadow study area boundary

Tier 2: Area south of site that could never be shaded by proposed building

Publicly-Accessible Open Space

Historic Resource with Sunlight-Sensitive Features

0 — 400 FEET

In coordination with the Historic Resources analysis presented in Chapter 5 of this EIS, it was determined that the museum building has a number of sunlight-sensitive features, and that two of them, the Arthur Ross Terrace and the west facing facade of the Rose Center for Earth and Space, could potentially be affected by project-generated shadows. Other sunlight-sensitive features of the museum such as the Central Park West facade face away from the project and could not be affected by it.

Tier 1 and Tier 2 Assessments

Figure 4-3

TIER 1 SCREENING ASSESSMENT

For the Tier 1 assessment, the longest shadow that the proposed buildings could cast is calculated and, using this length as the radius, a perimeter is drawn around the project site. Anything outside this perimeter representing the longest possible shadow would not be affected by project generated shadow, while anything inside the perimeter needs additional assessment.

According to the *CEQR Technical Manual*, the longest shadow that a structure can cast at the latitude of New York City occurs on December 21, the winter solstice, at the start of the analysis day at 8:51 AM, and is equal to 4.3 times the height of the structure.

Therefore, at a maximum height of approximately 115 feet above grade, to the top of the highest rooftop mechanical structure, the proposed Gilder Center could cast a shadow up to approximately 495 feet in length (115 x 4.3). Using this length as the radius, a perimeter was drawn around the project site (see **Figure 4-3**).

The assessment showed that the proposed addition could potentially cast shadow on parts of Theodore Roosevelt Park and the Arthur Ross Terrace, both of which are publicly accessible open space resources. In addition, the existing museum complex is a historic resource, and new shadow could potentially fall on a sunlight-sensitive feature of the complex that faces the proposed project, specifically the glass-walled Rose Center for Earth and Space, east of the building site.

New shadow would not be long enough to reach any other sunlight sensitive resources. A Tier 2 Assessment was undertaken to further assess potential shadows on Theodore Roosevelt Park, the Arthur Ross Terrace, and the Rose Center.

TIER 2 SCREENING ASSESSMENT

Because of the path that the sun travels across the sky in the northern hemisphere, no shadow can be cast in a triangular area south of any given project site. In New York City this area lies between -108 and +108 degrees from true north. **Figure 4-3** illustrates this triangular area south of the project site. The complementary area to the north within the longest shadow study area represents the remaining area that could potentially experience new project generated shadow.

Portions of Theodore Roosevelt Park as well as the Arthur Ross Terrace and the Rose Center are located in the remaining longest shadow study area. Therefore additional assessment was required.

TIER 3 SCREENING ASSESSMENT

According to the *CEQR Technical Manual* guidelines, a Tier 3 screening assessment should be performed to determine whether a proposed building's shadow could potentially, absent intervening and surrounding buildings, fall on a sunlight-sensitive resource. The analysis is performed utilizing a three-dimensional (3D) model, and shadows are modeled on four representative days of the year to represent the annual variation in shadow patterns in each of the four seasons. If the Tier 3 assessment shows that project-generated shadow could reach one or more sunlight-sensitive resources, a more rigorous detailed analysis is conducted utilizing a 3D model including existing buildings in the study area.

Given the fact that the proposed addition is situated within, and adjacent to, Theodore Roosevelt Park, adjacent to the Arthur Ross Terrace and near the Rose Center, it was apparent that project-generated shadow could potentially fall on these resources on at least one, if not all, of the representative analysis days. As such, this intermediate step in the assessment was skipped and the assessment proceeded directly to the more rigorous detailed analysis, as detailed below.

D. DETAILED SHADOW ANALYSIS

The direction and length of shadows vary throughout the course of the day and also differ depending on the season. In order to determine the extent and duration of project-generated shadow on the adjacent and nearby sunlight-sensitive resources, 3D computer mapping software[2] is used to calculate and display the proposed project's shadows on individual representative days of the year. A computer model was developed containing three-dimensional representations of the elements in the base map used in the preceding assessments, the topographic information of the study area, and a three-dimensional representation of the proposed addition. To complete the baseline or No Action condition, existing buildings in the study area were added to the model. The future condition with the proposed project and its shadows can then be compared to the baseline condition to determine the incremental shadows that would result with the proposed project.

Three-dimensional representations of the existing buildings in the study area were developed using data obtained from the New York City Department of Information Technology (NYC DoITT) and photos taken during project site visits. **Figure 4-4** shows a view of the computer model used in the analysis.

REPRESENTATIVE DAYS FOR ANALYSIS

Following the guidance of the *CEQR Technical Manual*, shadows on the summer solstice (June 21), winter solstice (December 21) and spring and fall equinoxes (March 21 and September 21, which are approximately the same in terms of shadow patterns) are modeled, to represent the range of shadows over the course of the year. An additional representative day during the growing season is also modeled, generally the day halfway between the summer solstice and the equinoxes, i.e., May 6 or August 6, which have approximately the same shadow patterns.

In summary, the summer and winter solstices represent the opposite extremes, and the spring and fall equinoxes the midpoint, of the yearly variation in the angles and length of shadows. Shadows on any other date will fall somewhere within the maximum extent circumscribed by the solstice and equinox shadows.

TIMEFRAME WINDOW OF ANALYSIS

The shadow assessment considers shadows occurring between one and a half hours after sunrise and one and a half hours before sunset. At times earlier or later than this timeframe window of analysis, the sun is down near the horizon and the sun's rays reach the Earth at very tangential angles, diminishing the amount of solar energy and producing shadows that are very long, move fast, and generally blend with shadows from existing structures until the sun reaches the horizon and sets. Consequently, shadows occurring outside the timeframe window of analysis are not considered significant under CEQR, and their assessment is not required.

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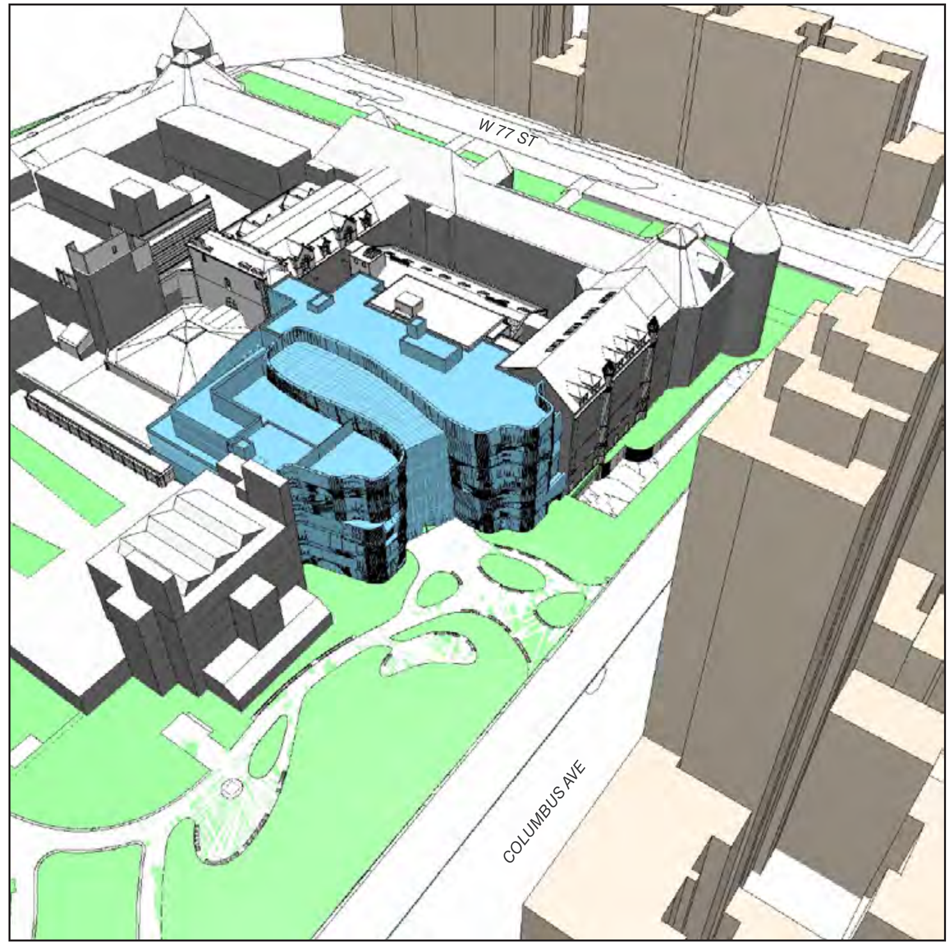
[2] Bentley MicroStation

No Action



Proposed

Publicly-Accessible Open Space or Historic Landscape

Comparative Views of 3D Computer Model, Looking South
Figure 4-4

RESOURCES OF CONCERN

Theodore Roosevelt Park contains bench-lined walking paths, fenced lawns and gardens, and a dog run.

As described in Chapter 3 "Open Space," a series of observations regarding park usage were conducted in the summer and the fall of 2015 in the western portions of the park in and around the building site. Of particular relevance for shadows were the benches located at intervals along the paths. The observations concluded that usage was generally found to be fairly high along the bench-lined paths, particularly in the summer, less so in October. The time of day experiencing highest usage was early afternoon.

The area of the park adjacent to the proposed Gilder Center and extending to the Columbus Avenue entrance would be re-landscaped as part of the proposed project. This area provides for primarily passive activities such as walking, gathering, and respite, as well as circulation. North of this entrance area, the Margaret Mead Green and other areas further north are used primarily for passive recreation, with bench-lined paths. To better understand the effects of any new shadows on these areas, the entrance area was considered as a distinct zone, referred to as Zone A in the following analysis and figures, and the Margaret Mead Green and areas of the park further north are referred to as Zone B (see **Figures 4-5 to 4-26**).

The Arthur Ross Terrace is part of the Museum complex and contains lawns, trees, seating, and water features. It is open to the public during regular Museum hours. Approximately 33,850 square feet of the approximately 35,000-square foot Ross Terrace is publicly accessible open space, and the remaining 1,150 square feet is for terrace dining.

The Rose Center for Earth and Space is a rectangular glass structure containing the Hayden Planetarium. Completed in 2000, the Rose Center is part of the overall AMNH complex that is designated as a landmark by the New York City Landmarks Preservation Commission (LPC) and is individually listed on the State and National Registers of Historic Places.

ANALYSIS METHODOLOGY

Shadows are in constant movement. The computer simulation software produces an animation showing the movement of shadows over the course of each analysis period. The analysis determines the time when incremental shadow would enter a resource, and the time it would exit.

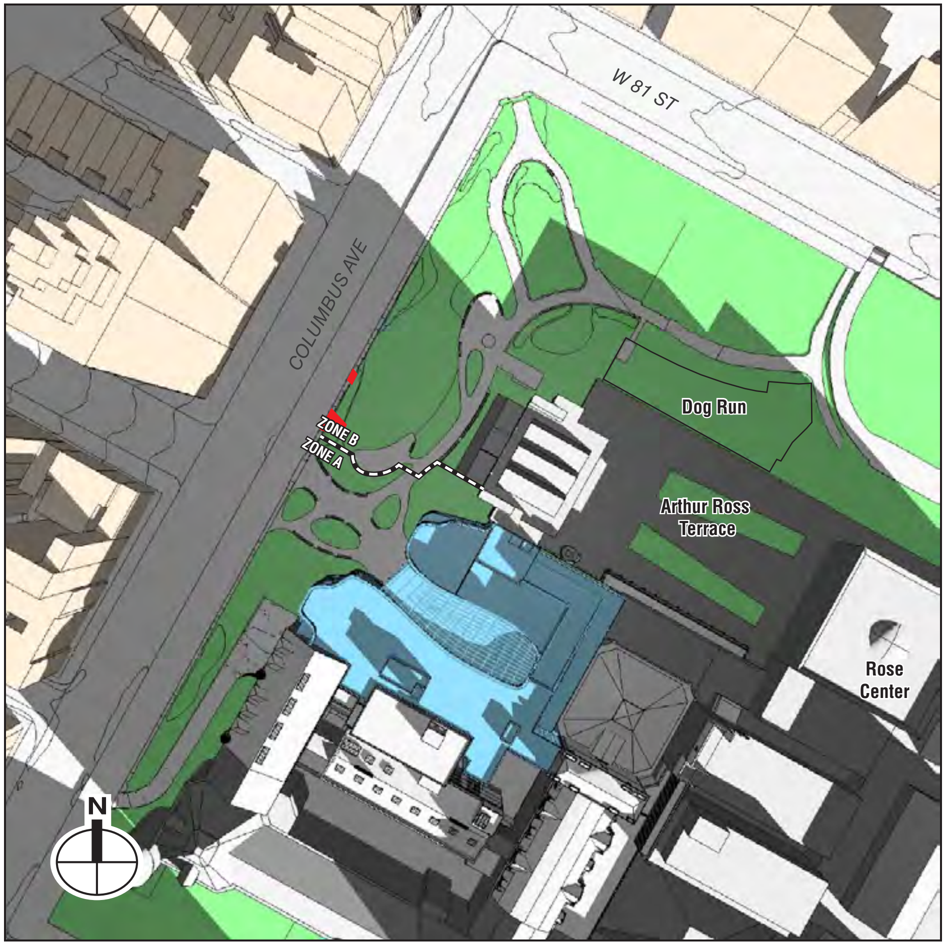
Following the analysis framework described in Chapter 1, "Project Description," the shadows assessment was performed for the analysis year of 2021, comparing the proposed project with the future No Action condition in which the site would remain as in the existing condition.

Shadow analyses were performed for each of the representative days and analysis periods indicated in the Tier 3 assessment.

ANALYSIS RESULTS

Table 4-1 summarizes the entry and exit times and total duration of incremental shadows on each affected sun-sensitive resource. **Figures 4-5 to 4-26** document the results of the analysis by providing graphic representations from the computer animation of times when incremental shadow would fall on a sun-sensitive resource. The figures illustrate the extent of additional, incremental shadow at that moment in time, highlighted in red, and also show existing shadow and remaining areas of sunlight.

7.14.17



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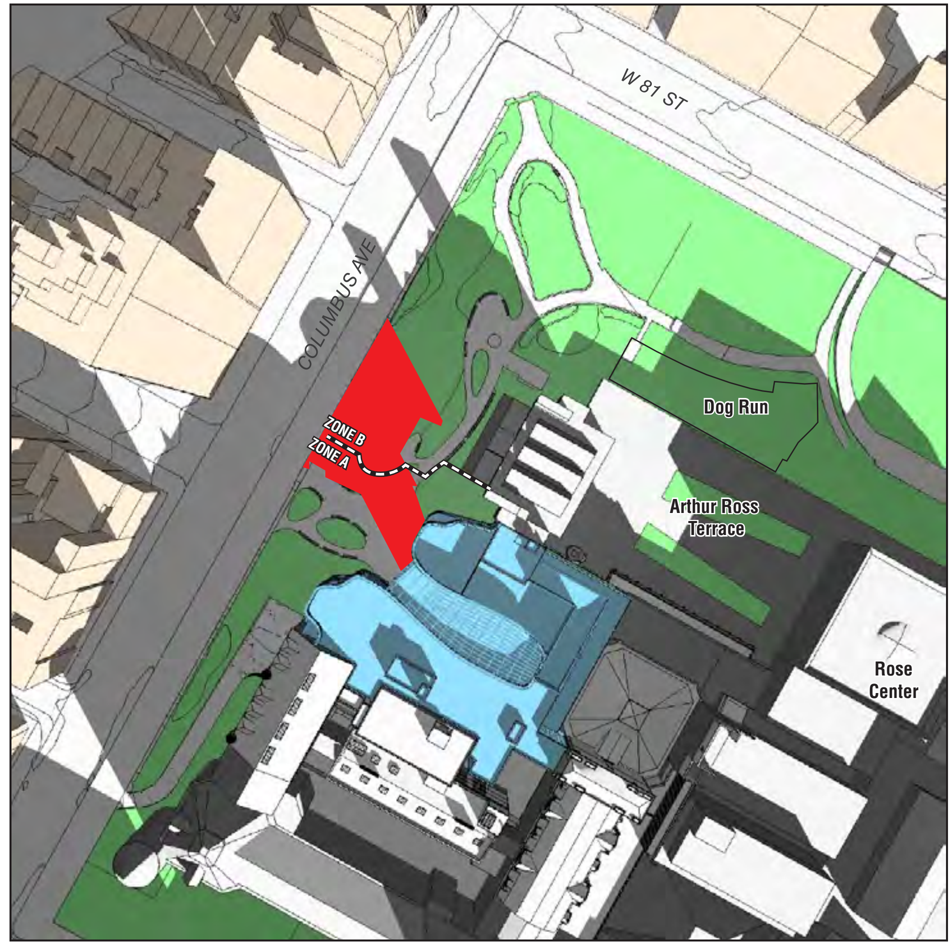


10:00AM

Publicly-Accessible Open Space or Historic Landscape

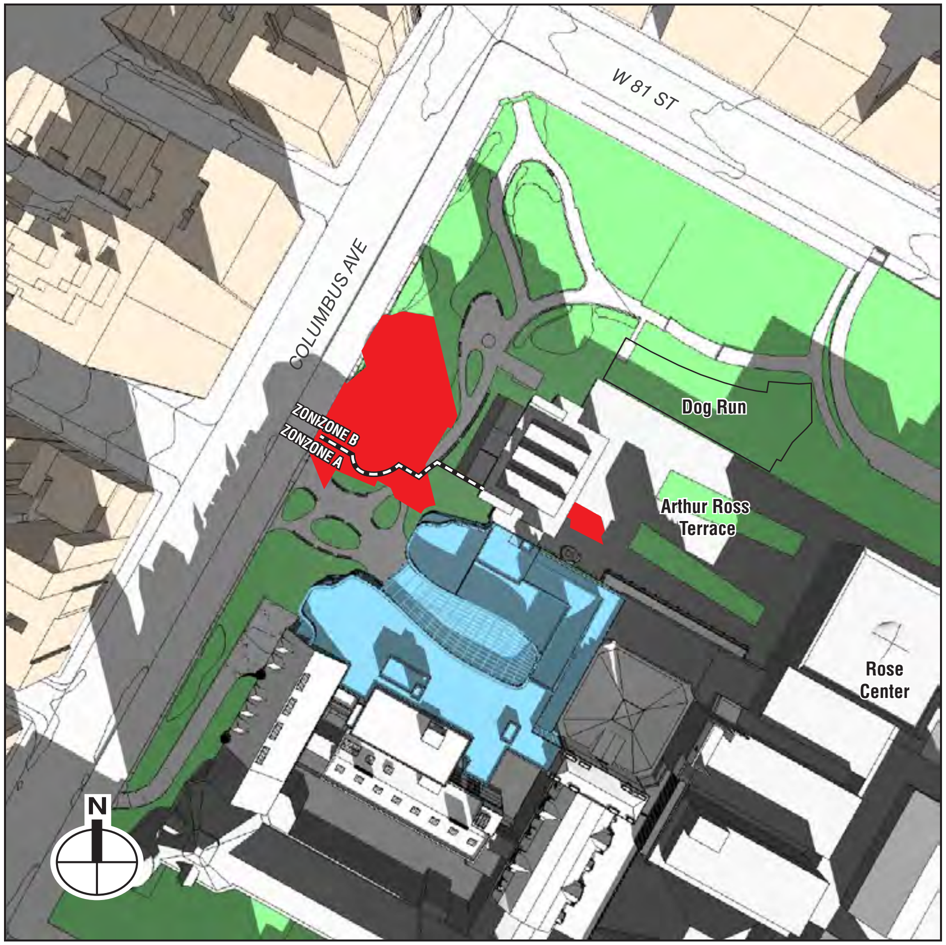
Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time.*

December 21

AMNH Gilder Center for Science, Education, and Innovation

Figure 4-5



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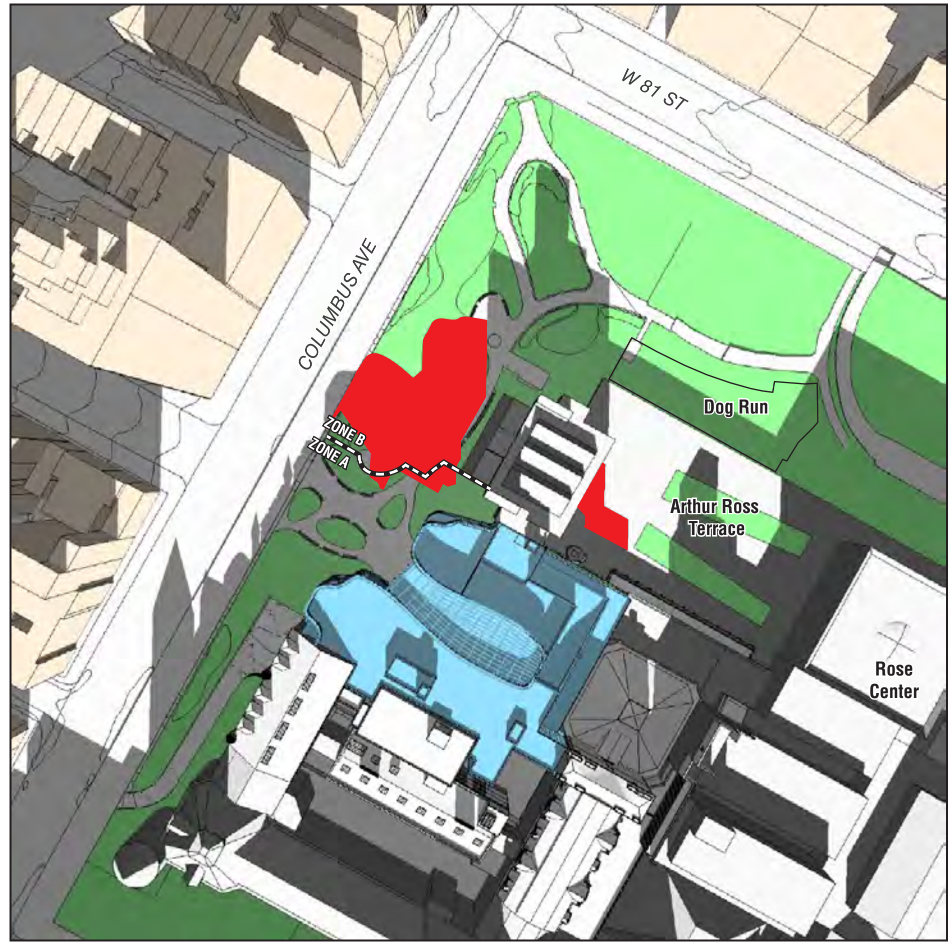


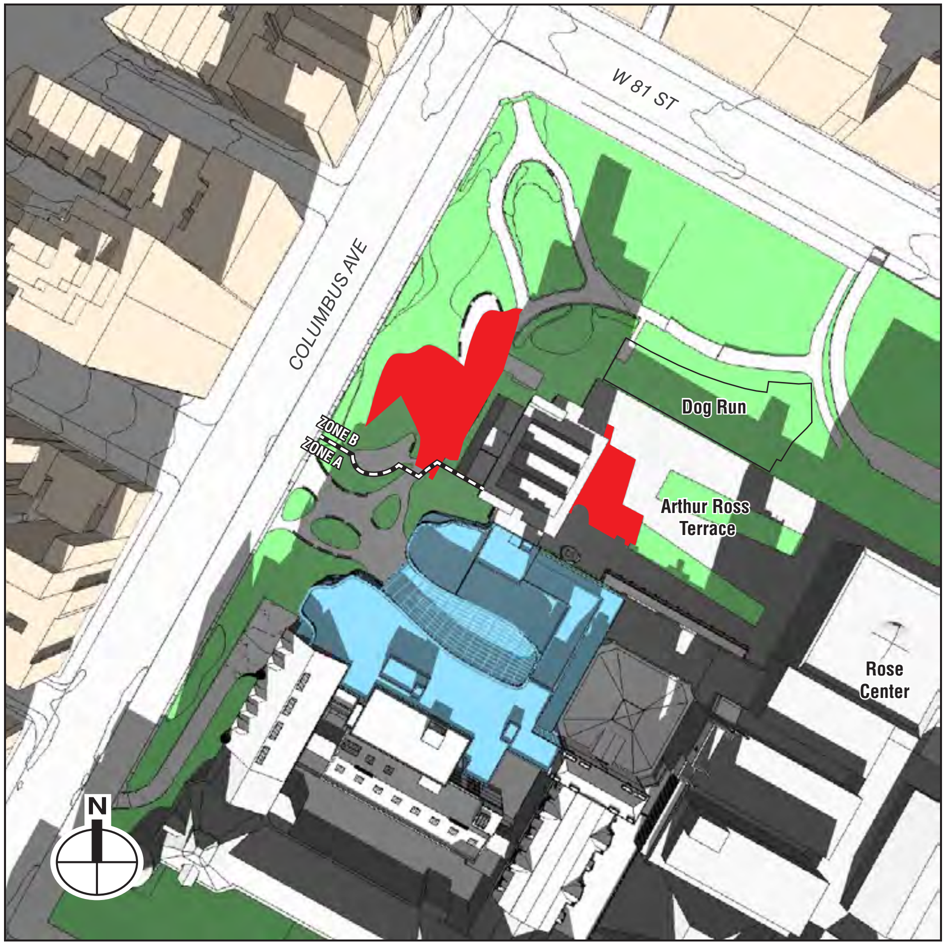
12:00PM

Publicly-Accessible Open Space or Historic Landscape

Incremental Shadow on Sun-Sensitive Resources

NOTE*: All times are Eastern Standard Time.*

7.14.17



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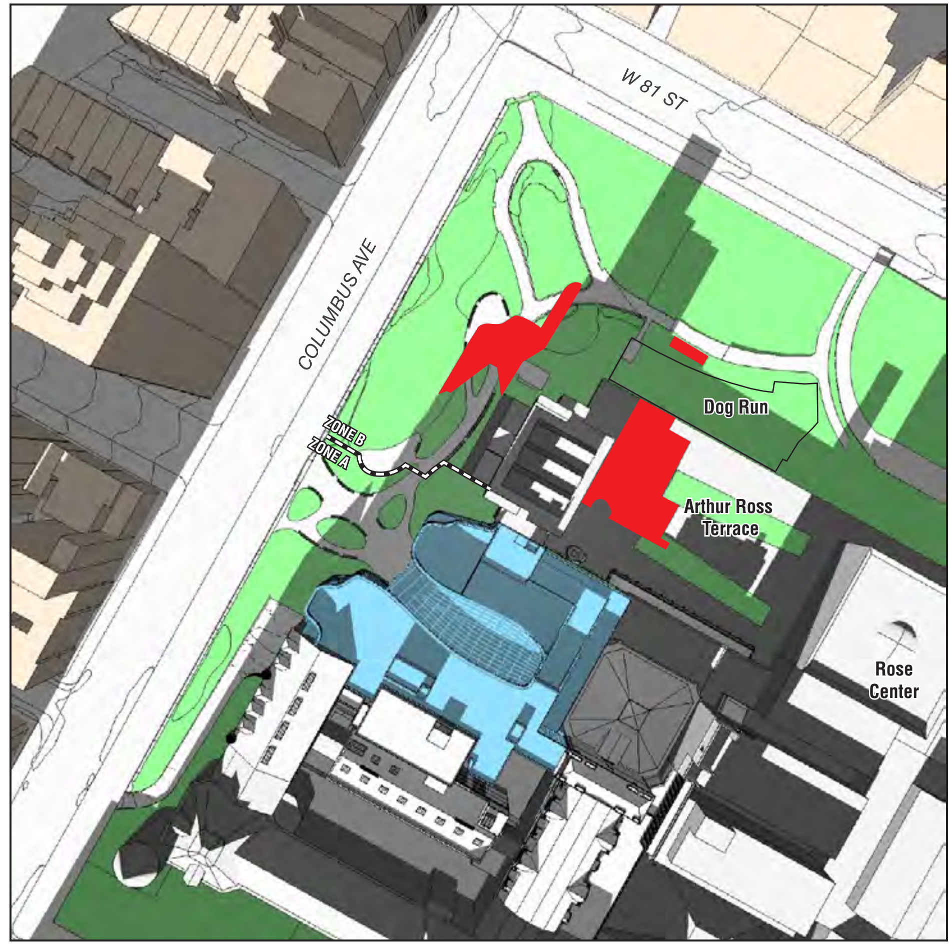


2:00PM

Publicly-Accessible Open Space or Historic Landscape

Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time.*

AMNH Gilder Center for Science, Education, and Innovation

December 21
Figure 4-7

2:53PM

Publicly-Accessible Open Space or Historic Landscape

Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time.*

7:36AM

8:30AM

Publicly-Accessible Open Space or Historic Landscape

Incremental Shadow on Sun-Sensitive Resources

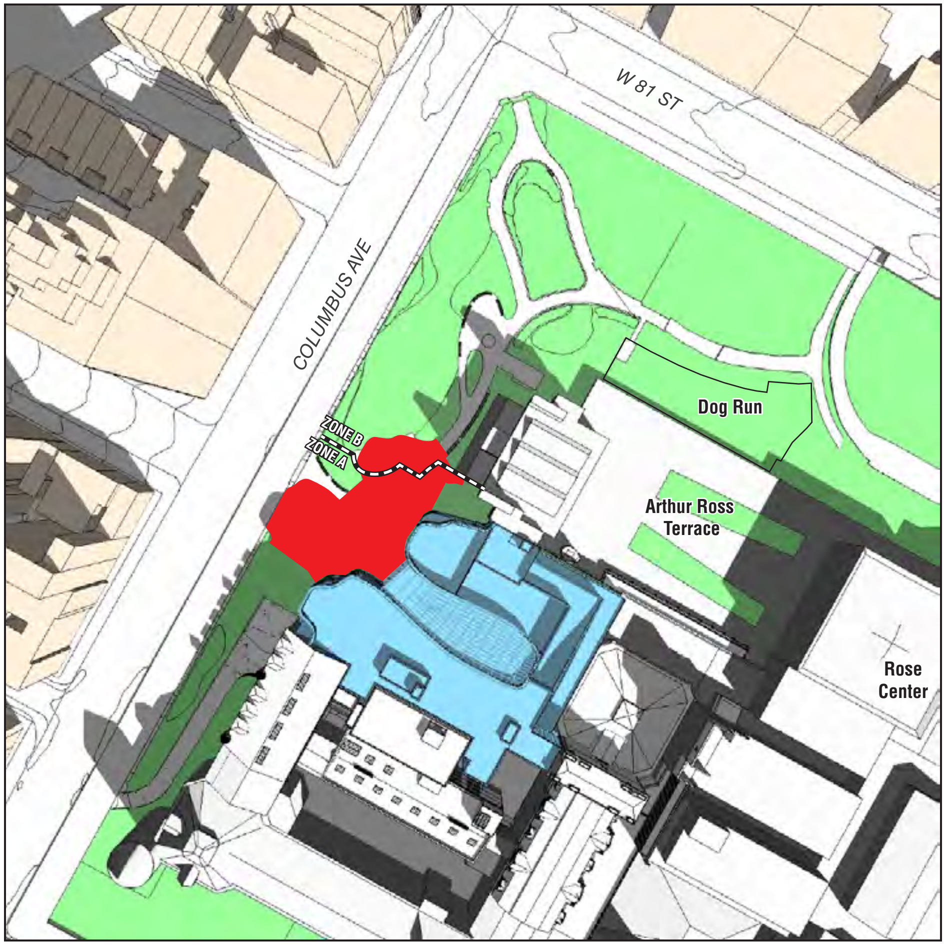
NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

March 21 / Sept. 21

Figure 4-9

7.14.17

9:30AM



10:30AM

Publicly-Accessible Open Space or Historic Landscape

Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

March 21 / Sept. 21

Figure 4-10

7.14.17

11:30AM

12:30PM

Publicly-Accessible Open Space or Historic Landscape

Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

Publicly-Accessible Open Space or Historic Landscape

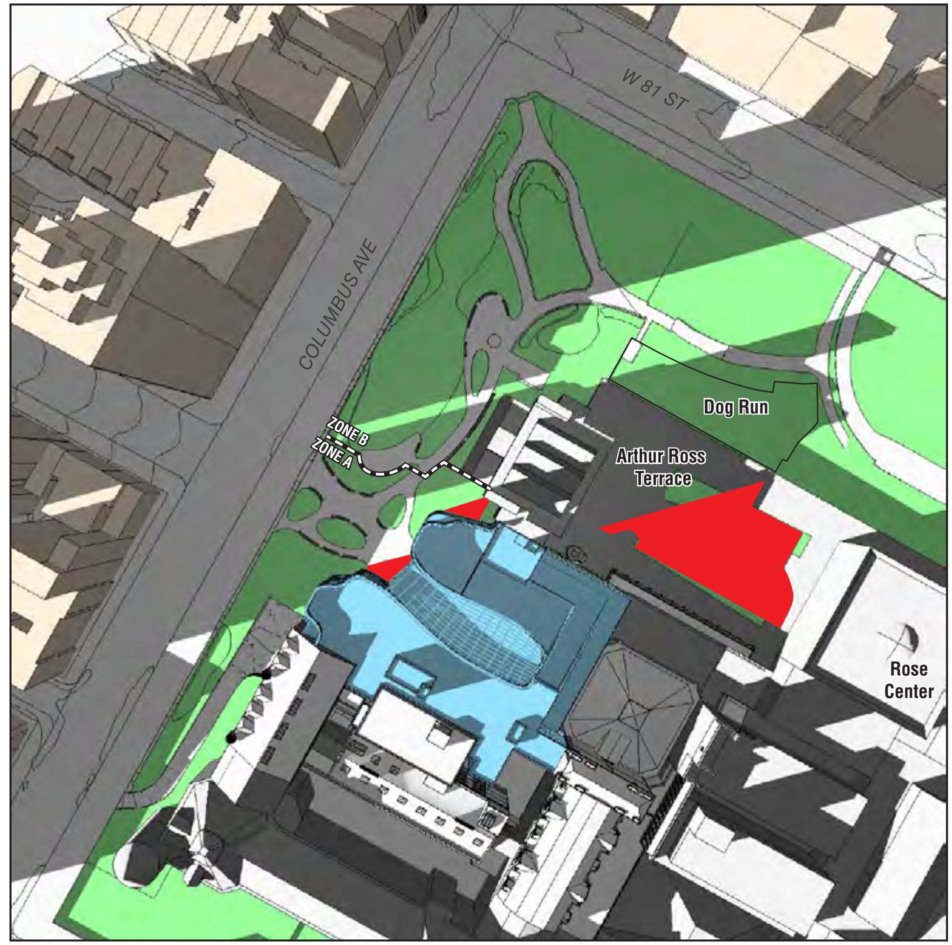
Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

March 21 / Sept. 21

Figure 4-12

3:30PM



4:29PM

Publicly-Accessible Open Space or Historic Landscape

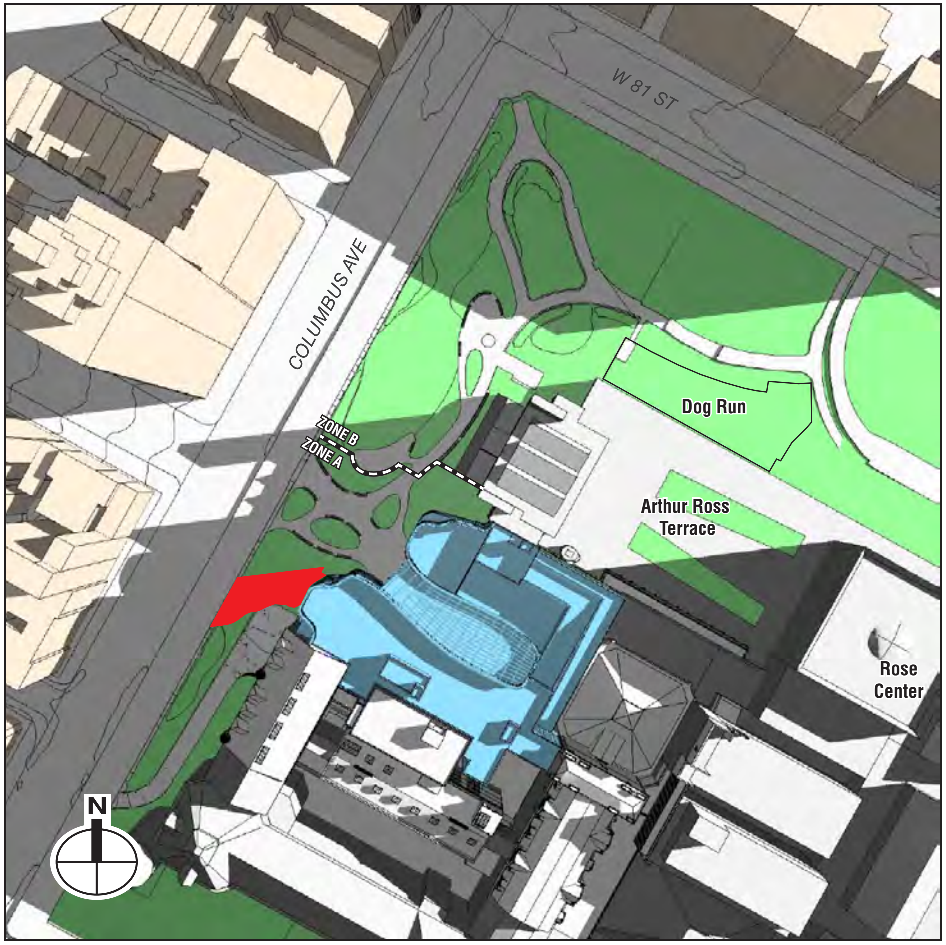
Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

March 21 / Sept. 21

Figure 4-13

7.14.17



6:30AM

7:30AM

Publicly-Accessible Open Space or Historic Landscape

Incremental Shadow on Sun-Sensitive Resources

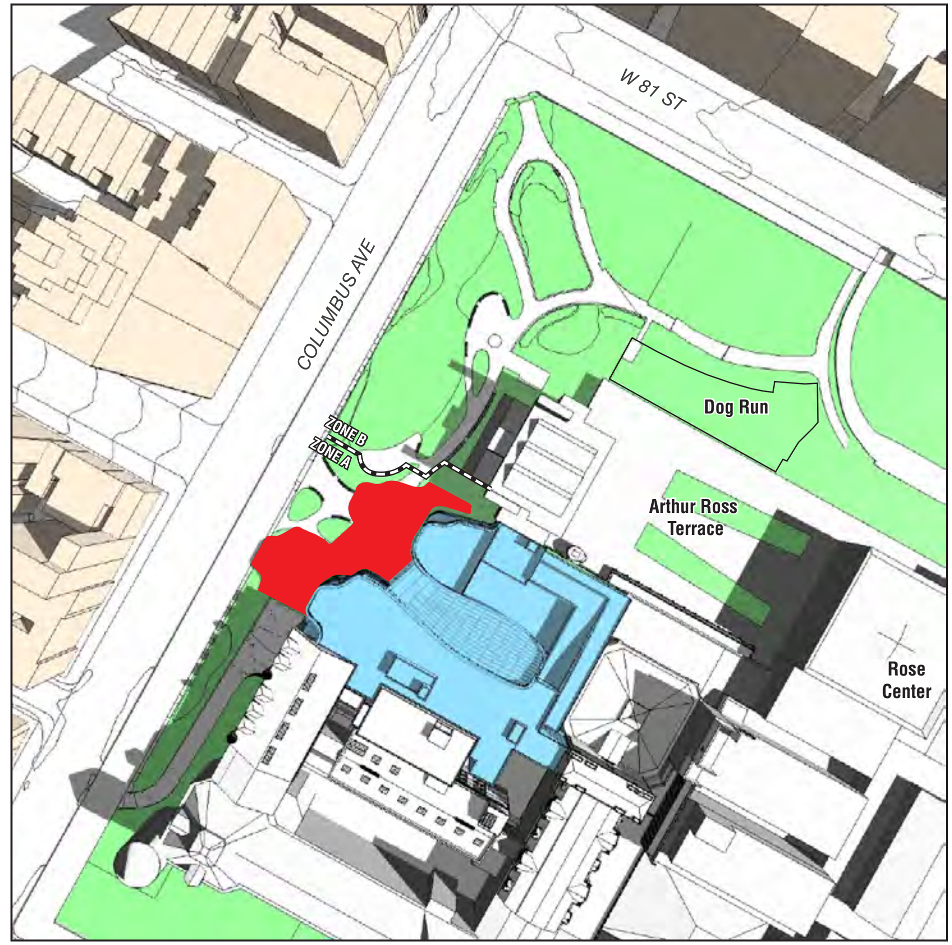
NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

May 6 / August 6

Figure 4-14

7.14.17

8:30AM



9:30AM

Publicly-Accessible Open Space or Historic Landscape

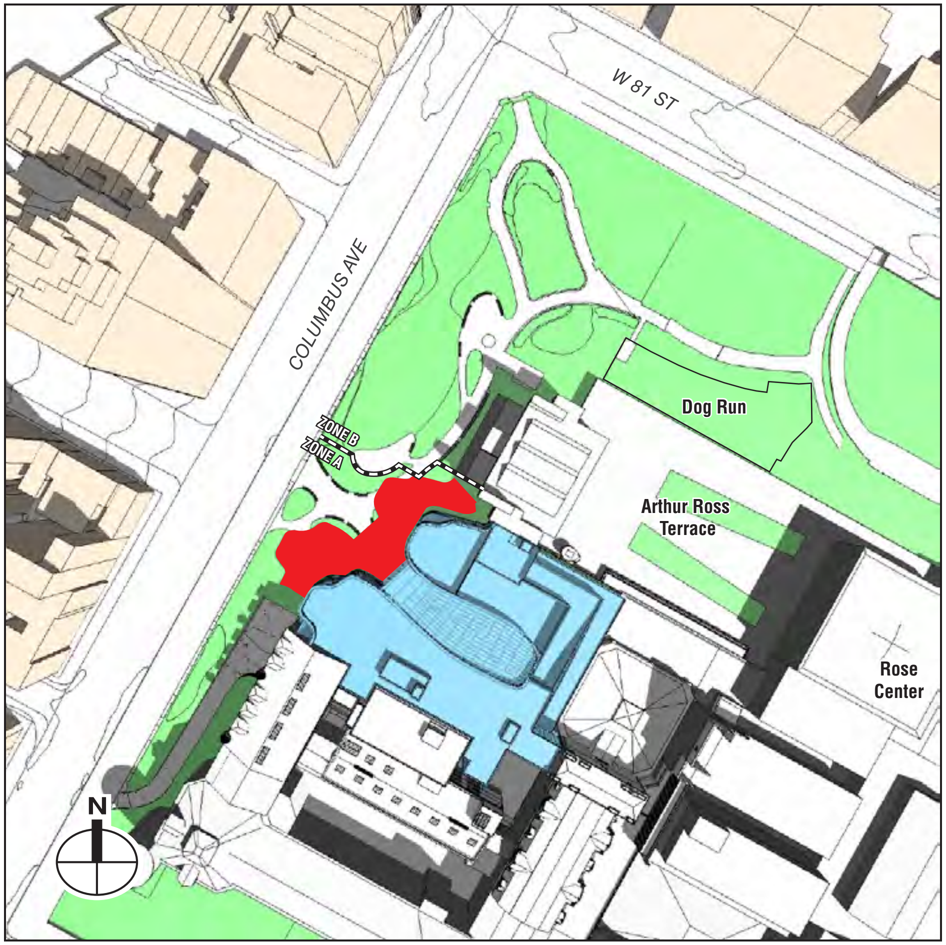
Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

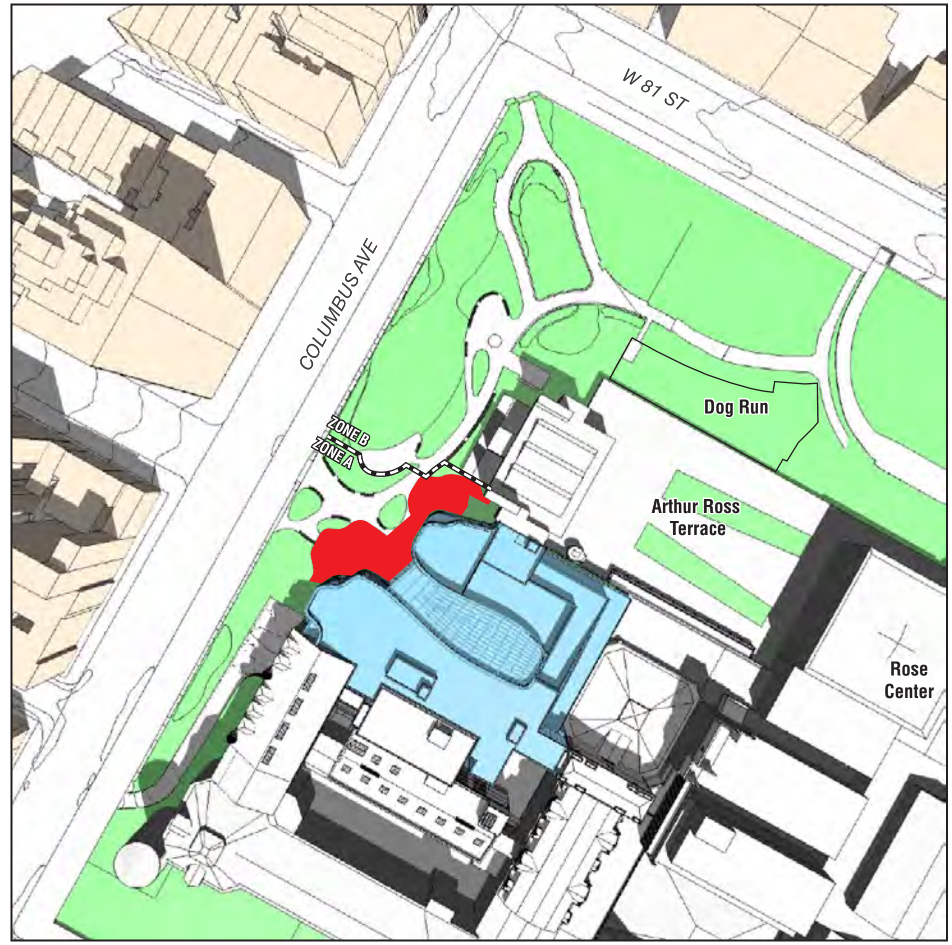
May 6 / August 6

Figure 4-15

7.14.17



10:30AM



11:30AM

Publicly-Accessible Open Space or Historic Landscape

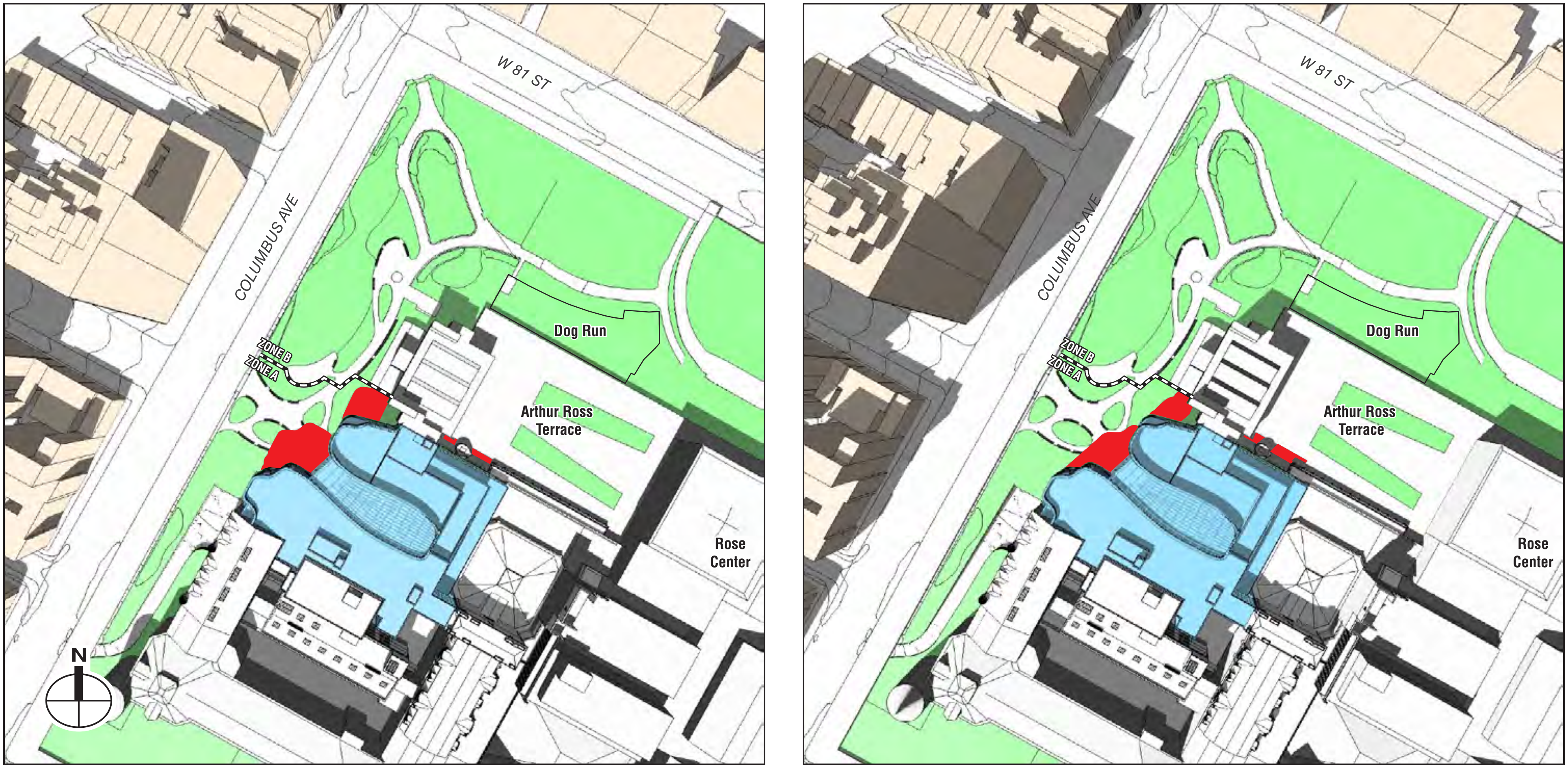
Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

May 6 / August 6

Figure 4-16

7.14.17



12:30PM

1:30PM

Publicly-Accessible Open Space or Historic Landscape

Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

May 6 / August 6

Figure 4-17

7.14.17

2:30PM

3:30PM

Publicly-Accessible Open Space or Historic Landscape

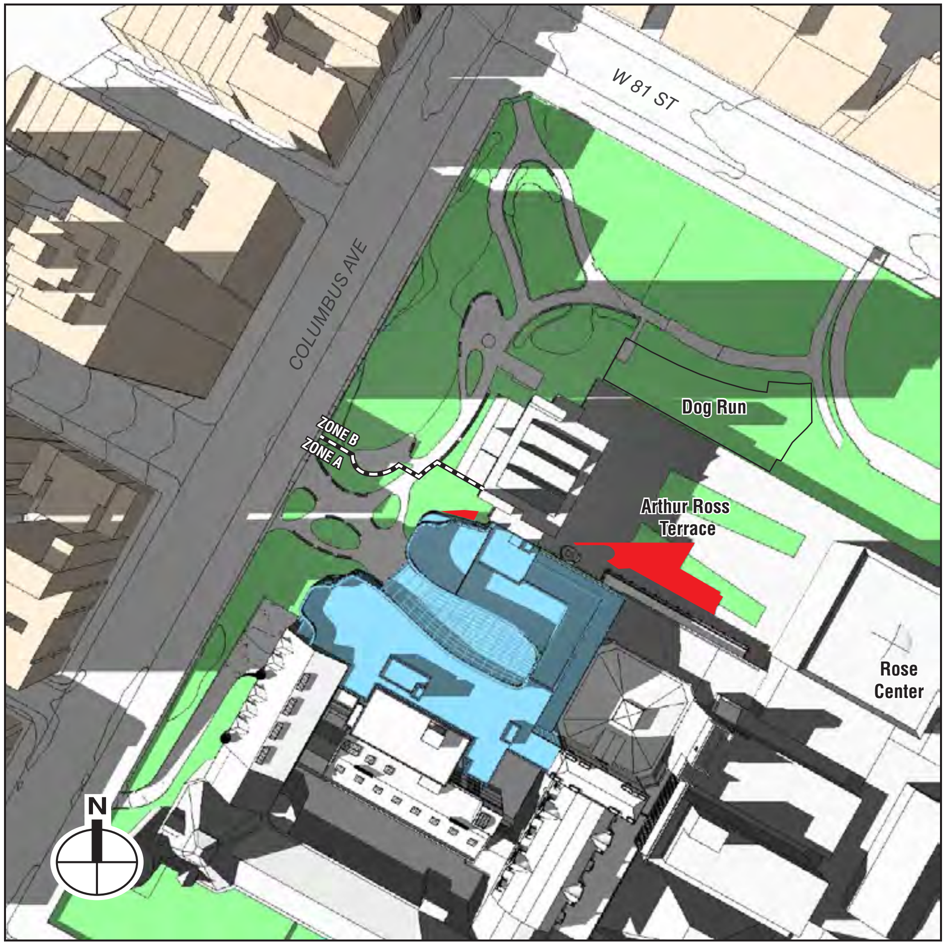
Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

May 6 / August 6

Figure 4-18

7.14.17



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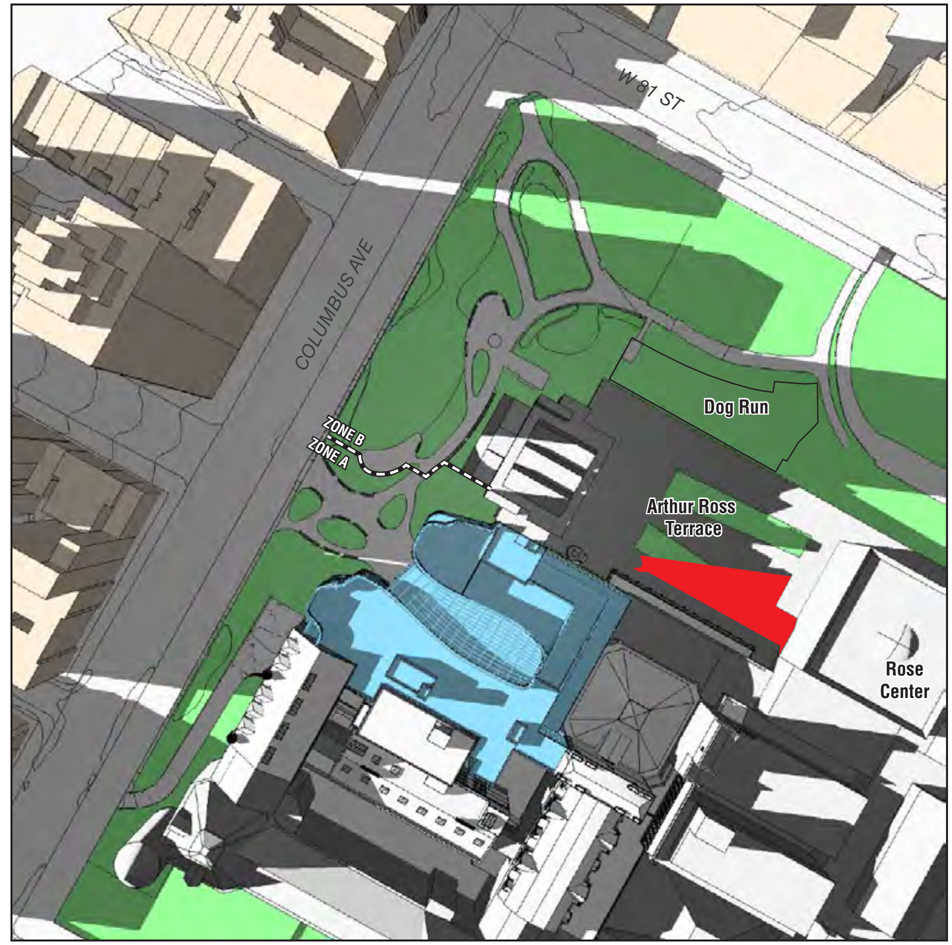


5:18PM

Publicly-Accessible Open Space or Historic Landscape

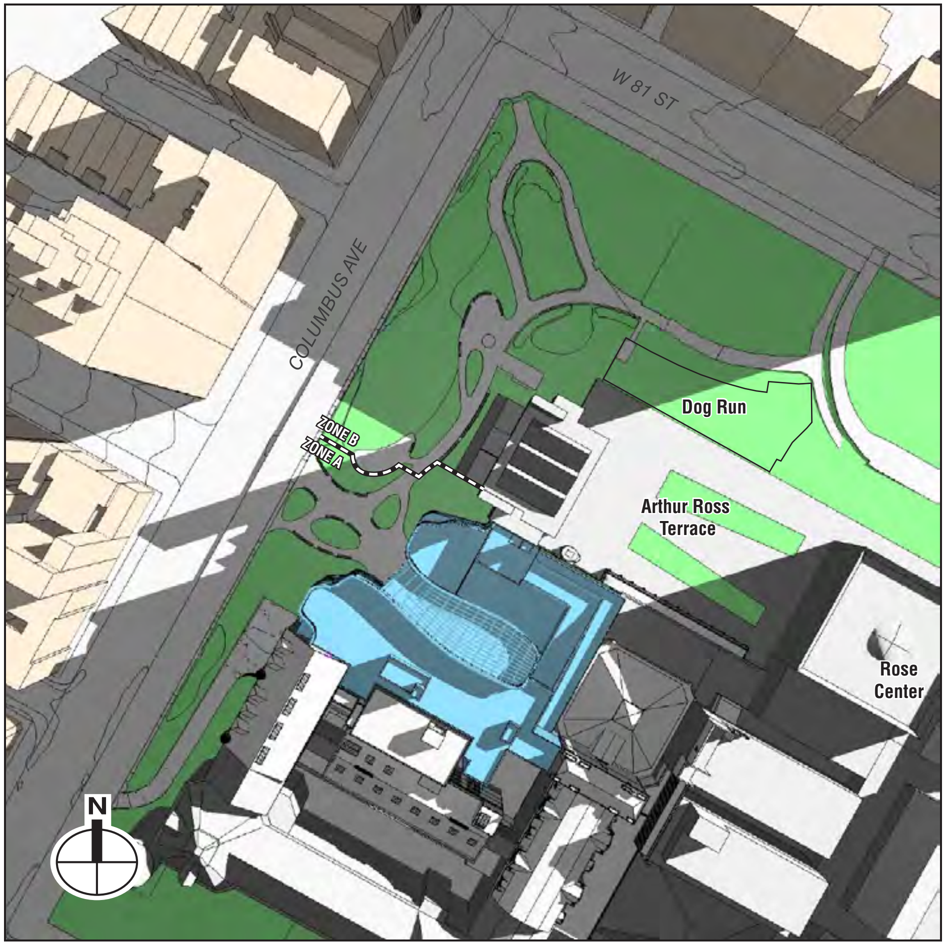
Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

May 6 / August 6

Figure 4-19

7.14.17



6:00AM

7:00AM

Publicly-Accessible Open Space or Historic Landscape

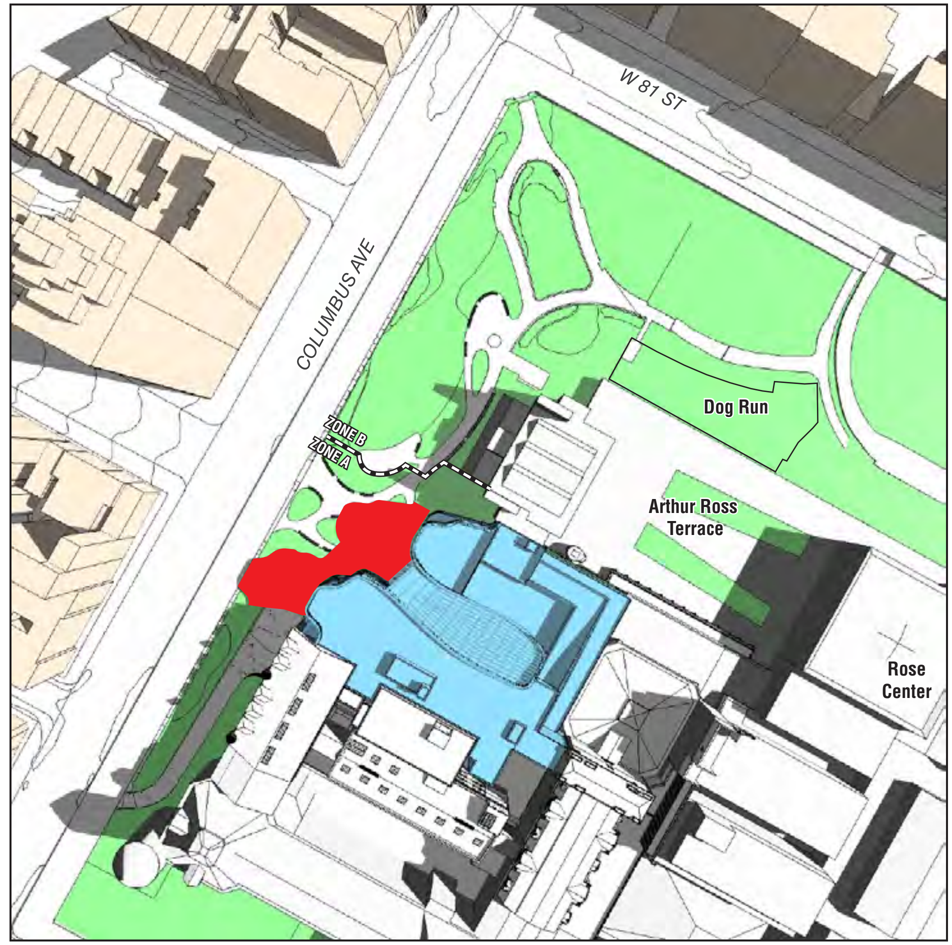
Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

June 21

7.14.17

8:00AM



9:00AM

Publicly-Accessible Open Space or Historic Landscape

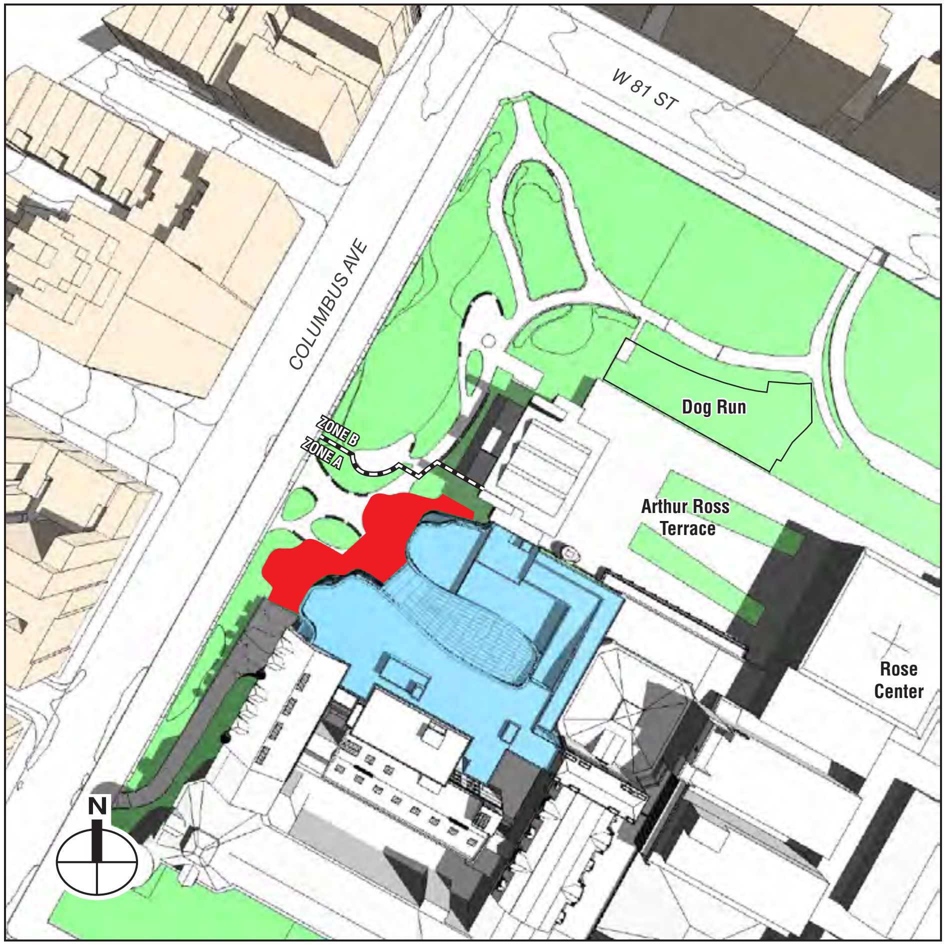
Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

June 21

Figure 4-21

7.14.17



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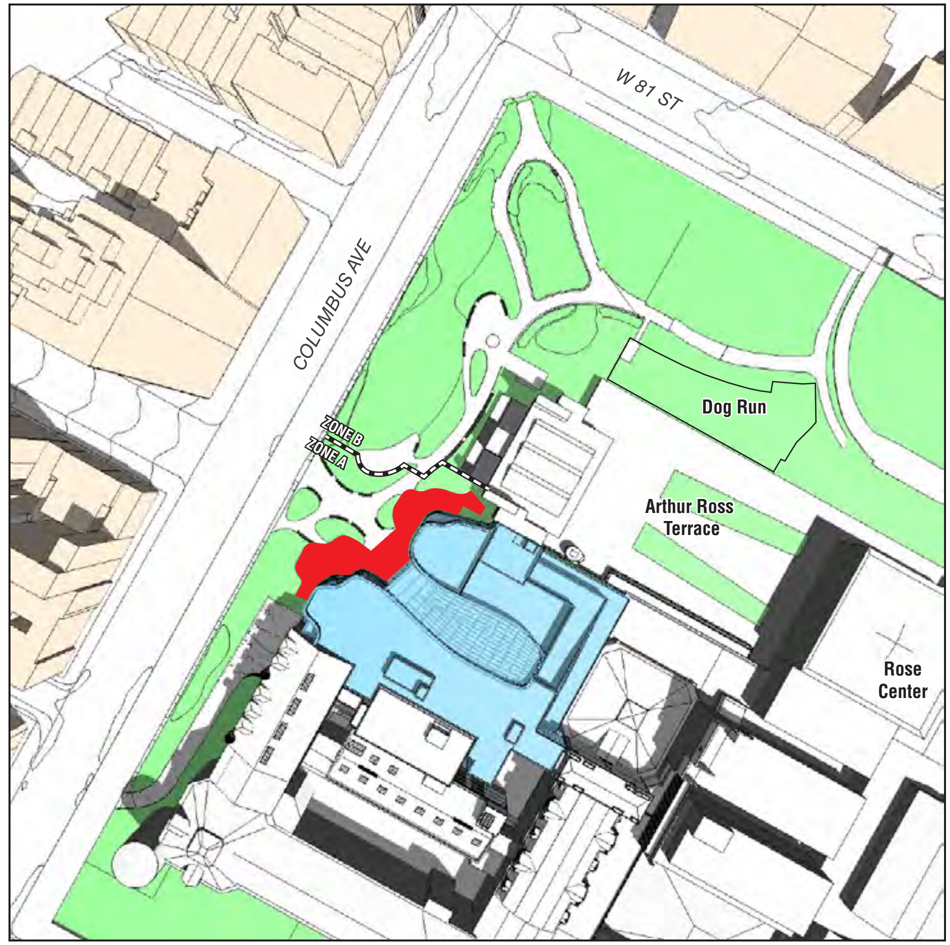


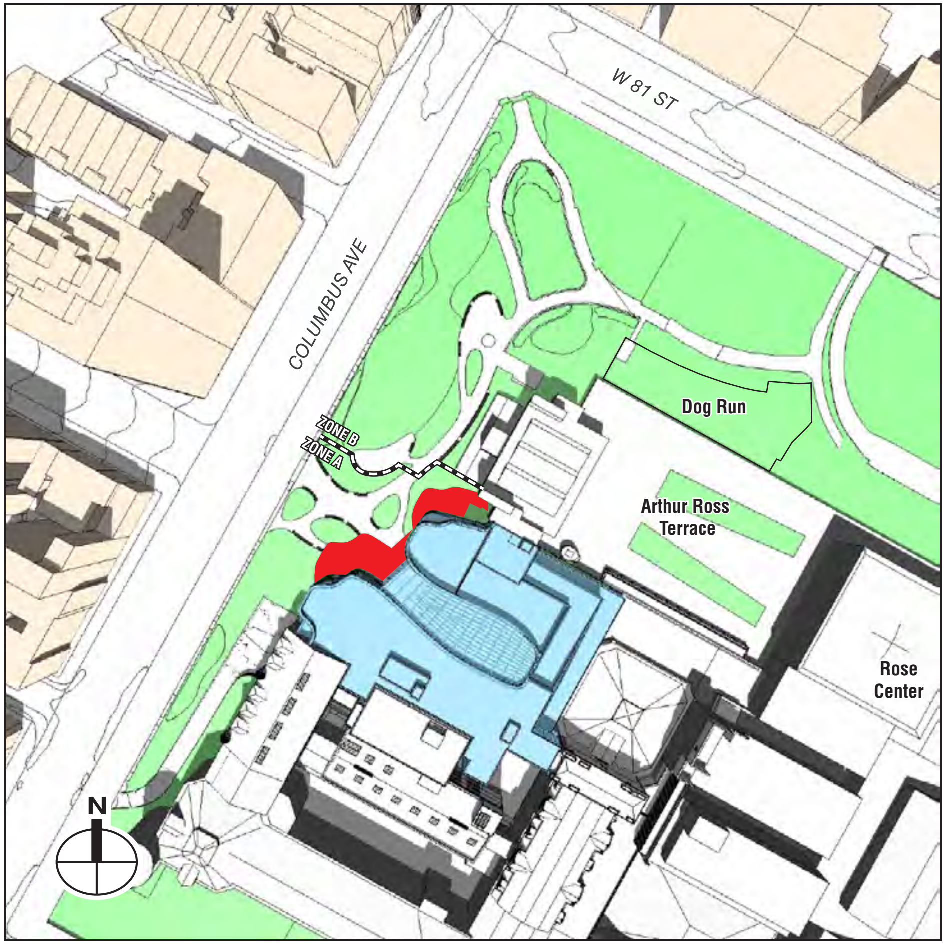
11:00AM

Publicly-Accessible Open Space or Historic Landscape

Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

7.14.17



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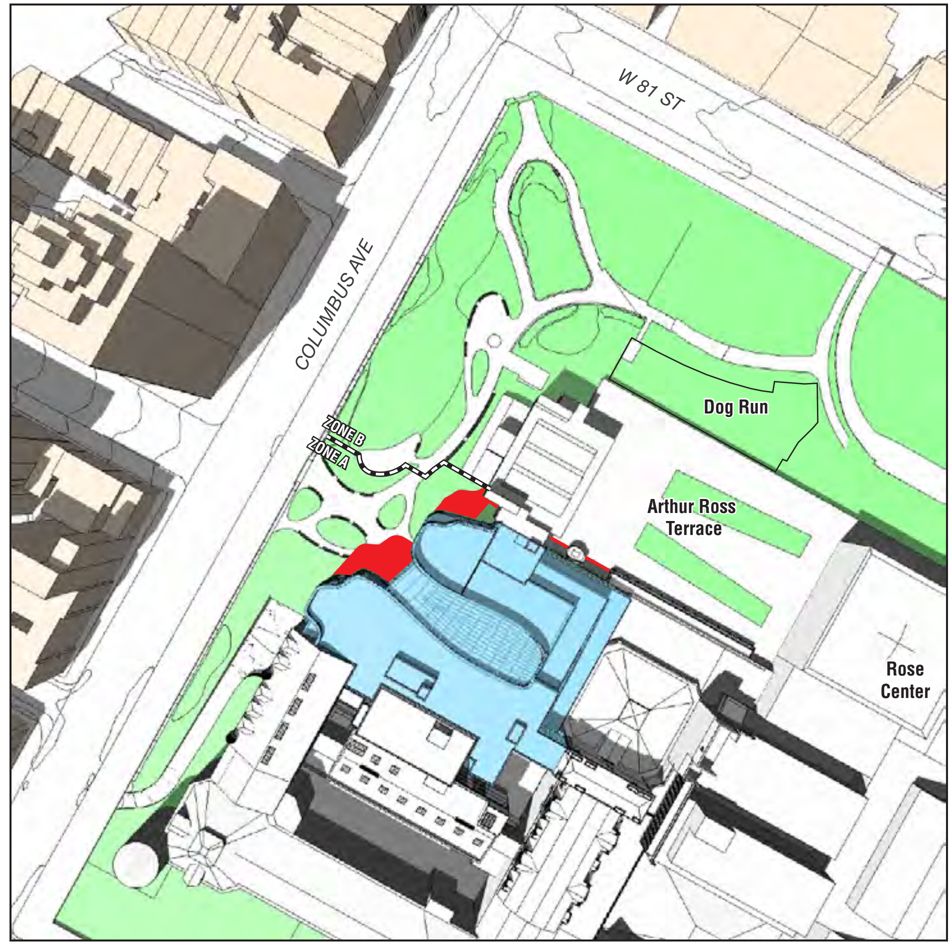


1:00PM

Publicly-Accessible Open Space or Historic Landscape

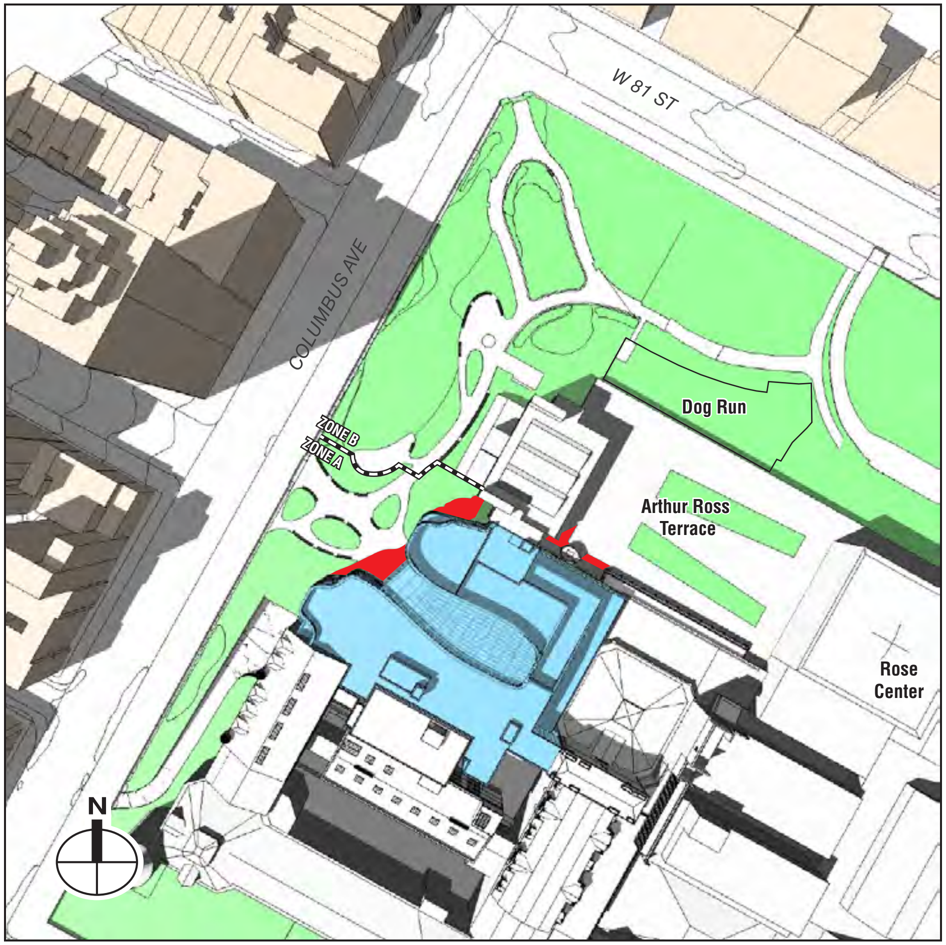
Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

June 21

Figure 4-23

7.14.17



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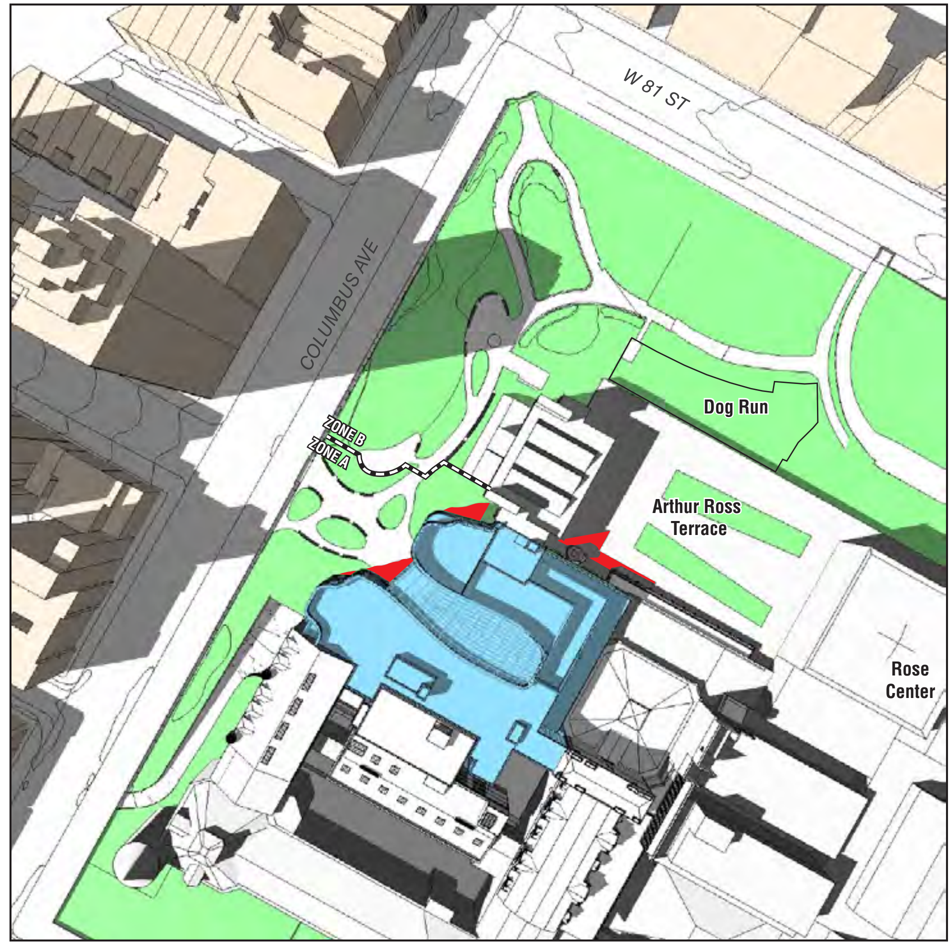


3:00PM

Publicly-Accessible Open Space or Historic Landscape

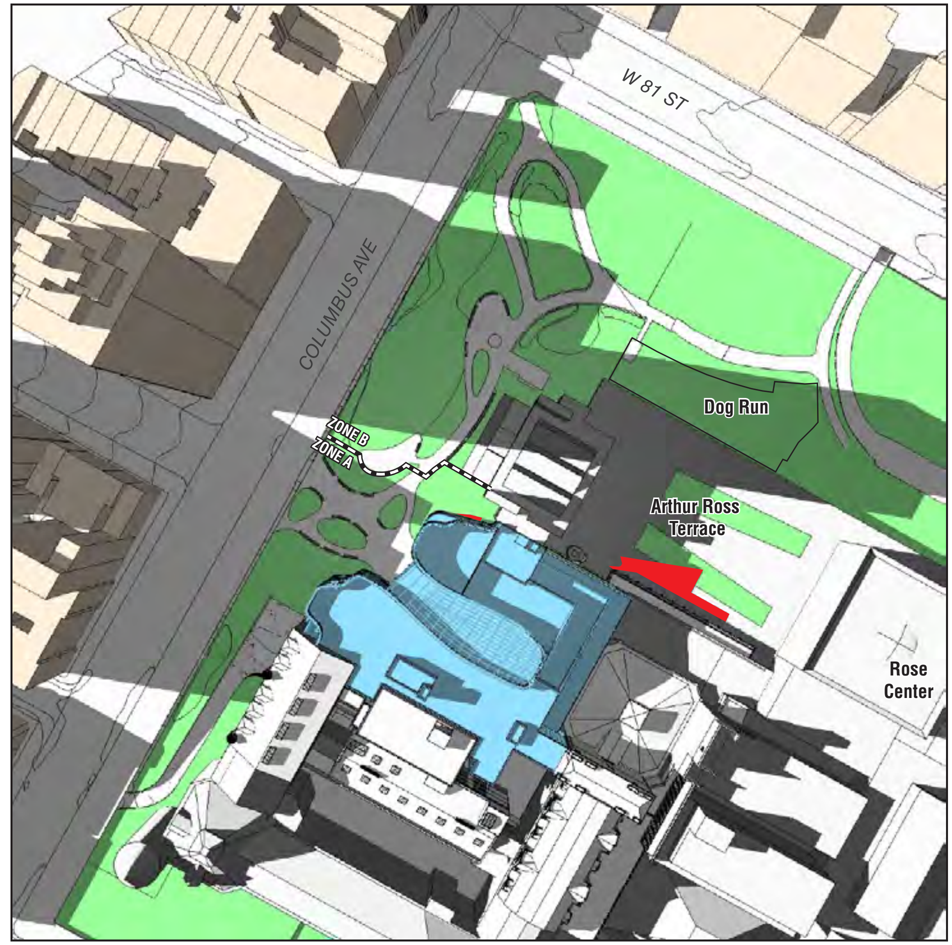
Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

June 21

7.14.17

4:00PM



5:00PM

Publicly-Accessible Open Space or Historic Landscape

Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

June 21

Figure 4-25

6:00PM

Publicly-Accessible Open Space or Historic Landscape

Incremental Shadow on Sun-Sensitive Resources

NOTE: *All times are Eastern Standard Time. Daylight Saving Time not used, per CEQR guidelines.*

Table 4-1
Incremental Shadow Durations

Analysis day and timeframe window	December 21 8:51 AM-2:53 PM	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
Theodore Roosevelt Park – Zone A	9:05 AM–1:15 PM Total: 4 hr 10 min	7:36 AM–4:29 PM Total: 8 hr 53 min	6:27 AM–4:55 PM Total: 10 hr 28 min	6:00 AM–5:00 PM Total: 11 hr
Theodore Roosevelt Park – Zone B	8:55 AM–2:53 PM Total: 5 hr 58 min	8:30 AM–1:20 PM Total: 4 hr 50 min	—	—
Arthur Ross Terrace	10:30 AM–2:53 PM Total: 4 hr 23 min	11:00 AM–4:29 PM Total: 5 hr 29 min	12:30 PM–5:18 PM Total: 4 hr 48 min	1:00 PM–6:01 PM Total: 5 hr 1 min
Rose Center – west façade	—	—	5:15 PM–5:18 PM Total: 3 min	5:45 PM–6:01 PM Total: 16 min

Notes:
Table indicates entry and exit times and total duration of incremental shadow for each sunlight-sensitive resource.
Daylight saving time is not used—times are Eastern Standard Time, per *CEQR Technical Manual* guidelines. However, as Eastern Daylight Time is in effect for the March/September, May/August and June analysis periods, add one hour to the given times to determine the actual clock time.

DECEMBER 21 (FIGURES 4-5 TO 4-8)

December 21, representing the winter months, does not fall within New York's growing season, according to the *CEQR Technical Manual*. Shadow falling on vegetation in winter is not generally considered to cause a significant adverse impact. However, winter shadow can adversely impact users of open space who may rely on sunlight for warmth.

THEODORE ROOSEVELT PARK

In the morning, the proposed project would cast incremental shadow on an area of the park to the northwest of the building site, straddling Zones A and B for the most part but falling primarily on Zone B, including a portion of Margaret Mead Green (see **Figures 4-5 and 4-6**). The new shadow would fall on landscaped areas and the bench-lined walkway between the Columbus Avenue entrance area and the Nobel Monument. In the afternoon, incremental shadow would exit Zone A at approximately 1:15 PM, but would remain on Zone B (see **Figure 4-7**). The area of incremental shadow would pass across the Nobel Monument and the park area around it from noon to 2:30 PM, and on areas of the park east of the monument until the end of the analysis day at 2:53 PM (see **Figures 4-7 and 4-8**).

ARTHUR ROSS TERRACE

Incremental shadow would move onto the terrace at 10:30 AM, The incremental shadow would be very small at first, and would be limited to the corner of the terrace closest to the building site. At noon, the area of new shadow would still be fairly small and limited to the area on the west end of the terrace (see **Figure 4-6**). From noon to the end of the analysis day at 2:53 PM, the area of incremental shadow would spread over a larger area but would still be limited to the western side of the terrace. Other areas of the terrace would remain in sunlight until the end of the analysis period (see **Figures 4-7 and 4-8**).

MARCH 21/SEPTEMBER 21 (FIGURES 4-9 TO 4-13)

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. Shadows on March 21 and September 21 are of moderate length.

THEODORE ROOSEVELT PARK

Incremental shadow would fall on a large portion of Zone A, the Columbus Avenue entrance area, from the start of the analysis day throughout the morning (see **Figures 4-9 through 4-11**). It would fall on a small portion of Zone B, adjacent to Zone A, beginning at 8:30 AM. Throughout the morning and midday, incremental shadow on Zone B would remain small and limited to an area adjacent to Zone A, and would exit completely at 1:30 PM. By early afternoon incremental shadow would be limited to a small area of Zone A adjacent to the proposed addition and would no longer be falling on Zone B (see **Figure 4-12**). Incremental shadow would remain on very small portions of Zone A until the end of the analysis day at 4:29 PM. Only areas abutting the proposed addition would be affected by new shadow (see **Figure 4-13**).

The two mature trees in Zone A that would be preserved during the re-landscaping would continue to receive approximately 4 to 6 hours of sunlight during the September 21/March 21 analysis day.

ARTHUR ROSS TERRACE

Incremental shadow would move onto the terrace at about 11:00 AM. The incremental shadow would be very small at first, and would be limited to the corner of the terrace closest to the building site (see **Figure 4-11**). The area of new shadow would remain small and limited to the corner of the terrace until mid-afternoon (see **Figure 4-12**). In the late afternoon the shadow would grow larger across the terrace, covering about a third of it at the very end of the analysis day at 4:29 PM (see **Figure 4-13**). Other areas of the terrace would remain in sunlight until the end of the analysis day.

MAY 6/AUGUST 6 (FIGURES 4-14 TO 4-19)

May 6 falls halfway between the March 21 equinox and the June 21 summer solstice. August 6 falls halfway between June 21 and the September 21 equinox, and has the same shadow patterns as May 6. The May 6/August 6 analysis day is representative of the growing season in the city. Shadows on this day are shorter than on the equinoxes, and the length of the day is longer.

THEODORE ROOSEVELT PARK

Incremental shadow would fall on small adjacent portions of the park in Zone A for nearly the entire day. No new shadow would reach Zone B at any time of day. Areas of new shadow in the afternoons would fall on only a few feet of abutting areas to the north and east of the proposed project. **Figures 4-14 to 4-19** show the incremental shadow moving across Zone A over the course of the day, covering larger areas in the morning and very small areas in the afternoon.

The two mature trees in Zone A that would be preserved during the re-landscaping would continue to receive approximately 4 to 6 hours of sunlight during the May 6/August 6 analysis day.

ARTHUR ROSS TERRACE AND ROSE CENTER

Incremental shadow would move onto the corner of the terrace closest to the building site at about 12:30 PM and would remain there in the corner for about two hours (see **Figures 4-17 and 4-18**). From 3:00 PM until the end of the analysis day at 5:18 PM the new shadow would move eastward and would largely be limited to the south side of the terrace. It would move across the center and then to the east side of the terrace by 5:18 PM, limited to just a portion of the terrace (see **Figures 4-18 and 4-19**). Other areas of the terrace would remain in sunlight until the end of the analysis day.

Incremental shadow would reach onto the base of the west façade of the Rose Center for the final three minutes of the analysis day (see **Figure 4-19**).

JUNE 21 (FIGURES 4-20 TO 4-26)

June 21 has the longest amount of daylight of the year, with an analysis period of 12 hours. Shadows fall to the southwest early in the morning and to the southeast late in the afternoon, and shadows at midday on June 21 are shorter than at any other time of year. June 21 is also in the growing season.

THEODORE ROOSEVELT PARK

Incremental shadows of some degree would fall on adjacent portions of the park in Zone A for nearly the entire day. As on the May 6/August 6 analysis day, no new shadow would fall on Zone B. Areas of new shadow in Zone A would be very small in the afternoons, falling on a few feet of abutting areas to the north and east of the addition (see **Figures 4-20 to 4-25**).

The two mature trees in Zone A that would be preserved during the re-landscaping would continue to receive approximately 4 to 6 hours of sunlight during the June 21 analysis day.

ARTHUR ROSS TERRACE AND ROSE CENTER

Incremental shadow would move onto the corner of the terrace closest to the building site at about 1:00 PM and would remain there for most of the afternoon (see **Figures 4-23 to 4-25**). By 5:00 PM the area of new shadow would have moved into the center of the terrace but would remain small and on the south side. At the end of the analysis day at 6:01 PM, the incremental shadow would continue to be small and still limited to the south side of the terrace (see **Figure 4-26**).

Incremental shadow would reach onto the base of the west façade of the Rose Center for the final 16 minutes of the analysis day (see **Figure 4-26**).

E. CONCLUSIONS BY RESOURCE

THEODORE ROOSEVELT PARK

Incremental shadow from the proposed Gilder Center would fall primarily on Zone A, the adjacent Columbus Avenue entrance area that would be re-landscaped and reconfigured as part of the proposed project. In the late spring and summer, from May to August, no new shadow would fall on Zone B, including the Margaret Mead Green and other areas of the park to the north. Earlier in the spring, and in the fall, incremental shadow would move across a small area of Zone B starting at 8:30 AM and ending at 1:20 PM. This area of Zone B currently contains fenced-off lawn and plantings and a section of bench-lined walkway. During this time of the March 21/September 21 morning and midday, most of the remaining bench-lined walkways in Zone B would not be shaded by the proposed building. In winter, project generated shadow would extend farther to the north into Zone B, passing across the Nobel Monument and areas around it in the early afternoon. At this time of year these amenities are typically not as well used, and other seating areas and bench-lined walkways would remain in sun during this time.

Therefore, on all four representative analysis days, sunlit areas with seating and bench-lined walkways would be available in Zone B, containing Margaret Mead Green and areas of the park farther north, particularly in the midday and afternoon hours, and the new shadows would therefore not substantially alter the usability of the park. The vegetation in Margaret Mead Green would receive sufficient sunlight each day during the growing season.

Regarding Zone A, the Columbus Avenue entrance area that would be re-landscaped as part of the proposed project, portions of this area would be in shadow from the proposed addition as well as from other parts of the museum complex for a part of the morning in all seasons. The landscape plan for this area would take project-generated shadows into consideration and would include shade-tolerant species in the portions that are most in shadow. The current features of this area between the museum and Columbus Avenue, including the terrace containing the *New York Times* Capsule, adjacent to the Weston Pavilion, experience similar shadow patterns from the existing Museum complex, i.e. shadows in the morning, sun in the midday and afternoon. Regarding the two mature trees that would be preserved during the re-landscaping of Zone A, the canopies of these trees would continue to receive a minimum of 4 to 6 hours of sun in March 21 and September 21 and substantially more than 4 to 6 hours from May through August when the days are longer and the sun is higher in the southern sky. Therefore the proposed project would not affect the health of these trees or any other vegetation during the growing season, and would therefore not cause significant adverse shadow impacts to the vegetation. For users, large areas of Zone A would be in incremental shadow in the mornings, particularly in the fall, winter and spring, but areas of the adjacent Zone B would not be in shadow during these times, with seating and bench-lined walkways available for those seeking such amenities. The proposed project's additional shadows would therefore not significantly alter the usability of Theodore Roosevelt Park.

ARTHUR ROSS TERRACE AND THE ROSE CENTER

Incremental shadow would fall on the terrace in the afternoons in all seasons. In the winter the new shadow would be limited to the western side of the terrace. Other areas of the terrace would remain in sun for any users that were present at this time and wanted direct sunlight. In the spring, summer and fall, incremental shadow would be limited to an area in the southwest corner of the terrace, adjacent to the proposed addition, until later in the afternoon. Near the end of the analysis day in these seasons the area of new shadow would be larger but still limited to a portion of the terrace while other areas would remain in sunlight. Therefore, the new shadows are not extensive and would not significantly impact the use of this terrace.

Shadow would reach a small area of the western façade of the Rose Center, near the base of the structure, for approximately 15 minutes or less at the end of the May 6/August 6 analysis day and at the end of the June 21 analysis day. This new shadow would be too limited in extent and duration to affect the Rose Center. ✷