

## **A. INTRODUCTION**

The proposed Flushing Commons buildings—which would range from approximately 185 feet to 204 feet tall above average curb level (241 feet to 254 feet above average mean sea level)—and the proposed Macedonia Plaza project (approximately 149 feet above curb level) would cast new shadows on nearby public open spaces and historic resources with sunlight-dependent features. This chapter examines the project’s incremental shadows following the guidelines of the 2001 *New York City Environmental Quality Review (CEQR) Technical Manual*.

## **B. PRINCIPAL CONCLUSIONS**

The proposed buildings of the Flushing Commons project would cast incremental shadow on the arched windows of the Macedonia African Methodist Episcopal (AME) Church on all four analysis days: March 21 (or September 21, which is approximately equivalent), the equinoxes; June 21, the summer solstice, the longest day of the year, when shadows are shortest; May 6/August 6, the midpoints between the equinoxes and the summer solstice; and December 21, the winter solstice, the shortest day of the year, when shadows are longest. The Macedonia Plaza project, which requires a zoning override for building height, does not contribute to this shadow impact.

Incremental shadow durations would range from just over 4 hours in June to nearly 7 hours on the March 21/September 21 analysis day. The incremental shadow would significantly reduce the amount of direct sunlight that currently shines through these windows throughout the year, causing a significant adverse impact on the users of this potential historic resource.

No other significant adverse shadow impacts from the proposed Flushing Commons or Macedonia Plaza projects would result.

## **C. METHODOLOGY**

According to the *CEQR Technical Manual*, an adverse shadow impact would occur if shadow from a proposed structure falls on a publicly accessible open space, historic landscape or other sunlight-dependent historic resource, or an important natural feature and adversely affects its use, important landscaping or vegetation, or, in the case of historic resources, obscures the features that make the resource significant.

The *CEQR Technical Manual* identifies the following situations when a proposed action may result in a significant shadow impact:

- Substantial reduction in sunlight where a sensitive use is already subject to substandard sunlight (i.e., less than the minimum time necessary for plant survival);
- Reduction in sunlight available to a sensitive use from more to less than the minimum time necessary for plant survival;

## Flushing Commons

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- Substantial reduction in sunlight to a sun-sensitive use or feature; and
- Substantial reduction in the usability of the open space.

Following the guidelines of the *CEQR Technical Manual*, the assessment of a project's shadow impacts begins with a preliminary or screening analysis to determine whether project shadows might reach any open space or sunlight-sensitive architectural resources. If this analysis indicates they might, a more detailed analysis is undertaken, in which the extent and duration of project shadows are defined for each sun-sensitive resource.

Based on the methodology guidelines provided in the *CEQR Technical Manual*, the following techniques and considerations are used when defining the extent and duration of an incremental shadow:

- Due to seasonal variations in the extent and duration of solar shadows, four representative days of the year are used in the analysis. Three encompass the growing season (April-October), which is of primary interest for open spaces, and the fourth represents winter conditions. The four analysis days are: March 21 (or September 21, which is approximately equivalent), the equinoxes; June 21, the summer solstice, the longest day of the year when shadows are shortest; May 6/August 6, the midpoints between the equinoxes and the summer solstice; and December 21, the winter solstice, when shadows are longest and any users of open spaces rely most heavily on sunlight for warmth.
- According to CEQR, incremental shadows occurring within an hour and a half of sunrise or sunset are generally not considered significant, so the analysis period on each of the four representative days begins an hour and a half after sunrise and ends an hour and a half before sunset.
- Open spaces may contain both sun-sensitive areas and areas that are not sensitive to sunlight. Areas dedicated to passive use, such as benches or lawns used for sitting or sunning, or children's wading pools or sprinklers, are sun-sensitive. Areas containing vegetation require a certain amount of sunlight as well, often 4 hours per day or more during the growing season. On the other hand, other areas of open spaces may not be sun-sensitive, such as paved ball courts or areas containing no sitting areas or vegetation. The analysis focuses only on those uses that depend on sunlight.
- Existing buildings, buildings that are scheduled to be built by the analysis year, and proposed buildings are taken into account when modeling shadows. Shadows cast by existing buildings and buildings that are scheduled to be built by the analysis year form the baseline for the analysis, and the extent and duration of any project-generated shadows are calculated and displayed clearly as increments beyond this baseline shadow.

Once the extent and duration of project-generated incremental shadows have been described, their effects on open space uses and vegetation or on sunlight-sensitive features of architectural resources are then assessed, and it is determined whether any significant adverse impacts would occur.

The shadow diagrams and analysis presented below were developed using building form and topographical information from the New York City Department of Information Technology and Telecommunications and the New York City Department of City Planning (NYCDCP). Building height information was supplied by the Sanborn Map Company. Building data was further checked and augmented by AKRF, Inc. field surveys. Shadows were modeled using the solar rendering capabilities of MicroStation V8 software.

## D. SCREENING ANALYSIS

### METHODOLOGY

Geographical Information System (GIS) 3D modeling software was used to calculate and map the daily shadow sweep for each proposed structure on the four analysis days. The software was programmed with the following details of the proposed project: the height, shape, and location of any new structures (or additions to existing structures) resulting from the proposed action; a chart of shadow length factors for each shadow angle occurring at the latitude and longitude of the project site on the four analysis days; and a digital base map of the project area. The digital base map includes topographic information so that elevation of mapped features was taken into account. In coordination with the open space, historic resources, and natural resources analyses, a map of publicly accessible open spaces and historical and architectural landmarks was then superimposed on the shadow sweeps. Any shadow-sensitive open spaces or architectural resources that intersect the shadow sweeps required a more detailed analysis. If an open space or architectural resource contains no sun-sensitive features, it did not require further shadow assessment.

The proposed action would feature five buildings on the Flushing Commons project site ranging in height above average curb level from approximately 185 to 200 feet, including rooftop mechanical equipment. Additionally, the analysis includes the Macedonia Plaza affordable housing project on the northern portion of the municipal parking lot, which is assumed to be a 149-foot building at the corner of 37th Avenue and Union Street. To determine which open spaces and other sun-sensitive resources might potentially be affected by the proposed action's incremental shadows, the entire rezoning area including the Macedonia Plaza project was conservatively analyzed at 200 feet, and daily shadow sweeps were delineated for each analysis day. Figure 6-1 depicts the shadow sweeps and the sun-sensitive resources that would be potentially affected by the proposed action. These resources were added to the 3D model for the detailed analysis. This screening analysis did not take into account existing shadows cast by intervening buildings.

### SUN-SENSITIVE RESOURCES REQUIRING DETAILED ANALYSIS

#### *PUBLICLY ACCESSIBLE OPEN SPACES*

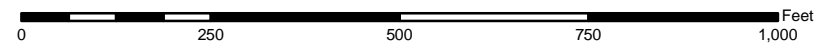
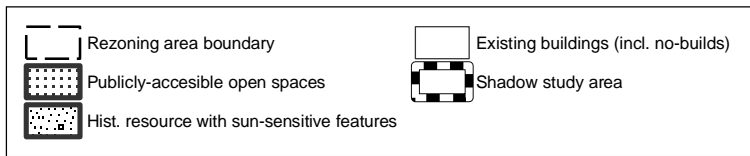
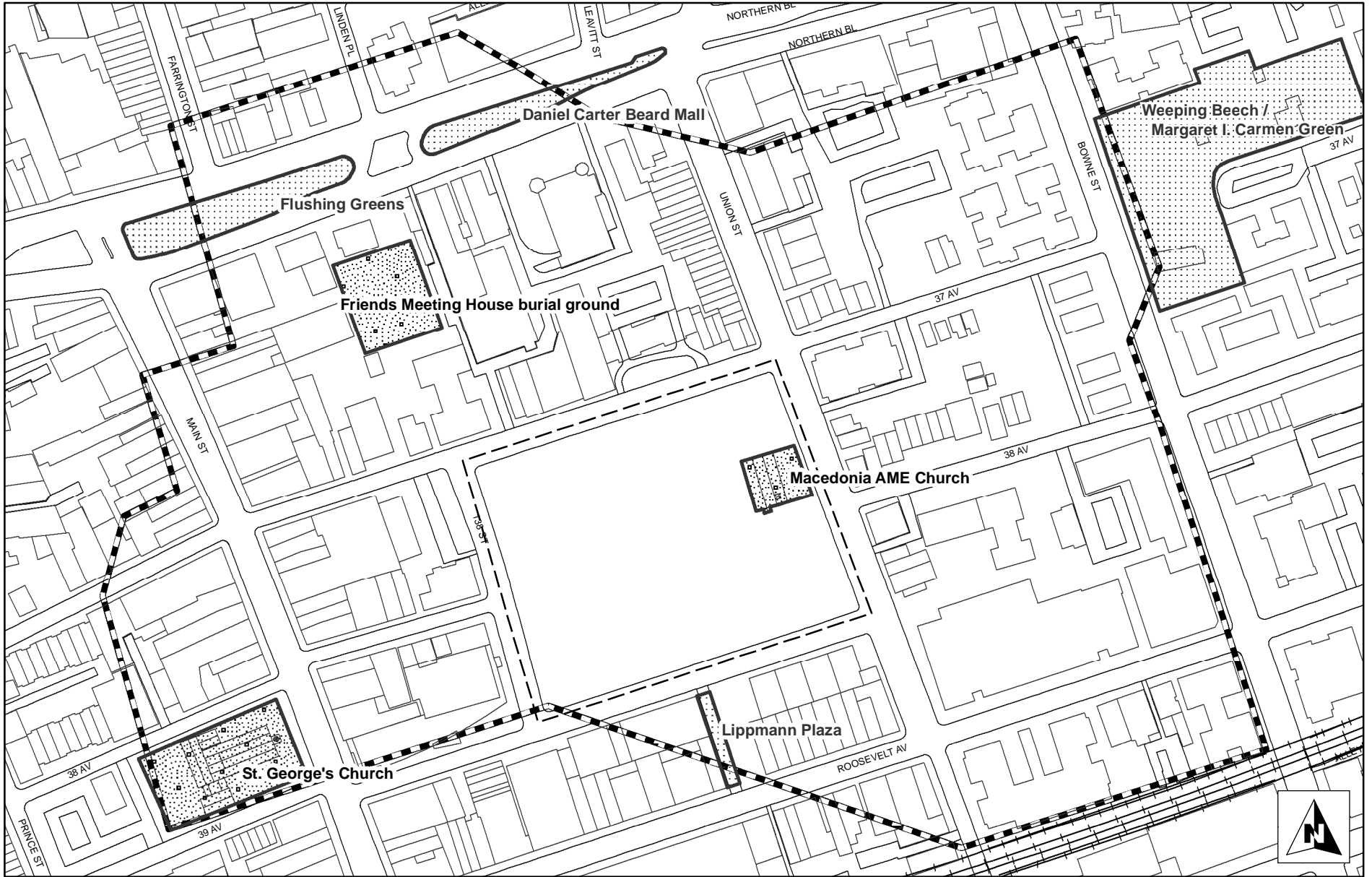
**Lippmann Arcade**, directly south of the project site, is a public pedestrian walkway connecting Roosevelt Avenue and 39th Avenue. The well-used arcade contains trees and benches. It was recently renovated and is in good condition.

**Daniel Carter Beard Mall** and **Flushing Greens** are malls in Northern Boulevard between Main Street and Union Street. They contain trees and benches.

The detailed shadow analysis found that incremental shadow from the proposed buildings on any analysis day would not reach **Weeping Beech/Margaret I. Carmen Green**, located two blocks northeast of the project site.

#### *PROPOSED OPEN SPACE*

The proposed Flushing Commons project would add a publicly accessible open space at the project site. The main portion of this **proposed open space** would be an elliptical green opening





onto 138th Street that is expected to contain a terraced lawn, formal plaza, trees, tables and chairs, additional seating, and a water feature.

### *HISTORIC RESOURCES WITH SUN-SENSITIVE FEATURES*

**The Macedonia AME Church**, located on the same block as the project site, is the third-oldest church in Flushing. As described in Chapter 7, “Historic Resources,” it is considered to be a potential historic resource due to its longstanding significance to the African American history of Flushing, including a potential, though undocumented, role as an Underground Railroad site. According to a history of the church published in 1977, the church structure that was built in 1837 on this lot appears to have been removed and rebuilt ca. 1900, with further renovations at other times during the 20th century. In a comment letter dated March 4, 2008, the New York City Landmarks Preservation Commission (LPC) determined that the church appears to be eligible for listing on the Registers. Several small arched windows face the project site on its western façade, and the church’s southern façade features a large arched window above the front entrance and two smaller arched windows. All of these arched windows are considered sun-sensitive architectural resources for the purpose of this analysis.

**The Friends Meeting House burial ground** occupies a portion of the property south of the Friends Meeting House building itself. The Friends Meeting House was the first house of worship in Flushing and is listed as a National Historic Landmark (NHL) and New York City Landmark (NYCL), and it is also on the State and National Register of Historic Places (S/NR). The burial ground is normally not publicly accessible.

The detailed shadow analysis found that incremental shadow from the proposed buildings would not reach **St. George’s Church, Old Parish House and Graveyard** (NYCL, S/NR-listed) on any analysis day, due to the recently completed 158-foot Queens Crossing building as well as the church’s location southwest of the project site.

## **E. ASSESSMENT OF SHADOW IMPACTS**

The sun rises in the east and casts its earliest (and longest) shadows toward the west. Later in the morning, the sun rises higher in the sky, casting shorter shadows toward the northwest. At noon, the sun is at its highest point in the sky and casts the shortest shadows of the day directly north. (During Daylight Savings Time, this occurs at 1:00 PM rather than at noon.) In the afternoon, the sun continues to move west and begins to descend, casting longer shadows toward the northeast and east. At the end of the day, just before the sun sets in the west, shadows are slightly shorter than just after sunrise.

In its yearly cycle, the height of the sun in the sky and the time and compass direction at which it rises and sets vary by season. In the winter, the sun travels in a low arc across the southern sky, rising late in the southeast and setting early in the southwest. Because it is so low in the sky, the sun casts longer shadows. In the spring and fall, the sun arcs through the sky at a somewhat higher angle, rises earlier in the east and sets later in the west. In these seasons, shadows are of moderate length. In the summer, the sun arcs through the sky at its highest angle, rising almost directly overhead at noon. For this reason, summer shadows are shortest. However, in the summer the sun rises at its earliest and sets at its latest, and it also travels farther from the northeast to the northwest. Therefore, the summer sun casts shadows in more directions than those seen in other seasons, and its late sunset and early sunrise create shadows earlier in the morning and later in the evening than in other seasons.

The extent and duration of the proposed project buildings' incremental shadow are summarized in Table 6-1 and illustrated in Figures 6-2 through 6-16. The shadow diagrams depict the extent of the project buildings' incremental shadow on the surrounding sun-sensitive resources at various times of each relevant analysis day; these "snapshots" were selected to illustrate the greatest potential impacts or other situations referred to in the text.

**Table 6-1**  
**Incremental Shadow Durations**

Sun-Sensitive Resource	March 21 8:36 AM-5:29 PM EDT	May 6 7:27 AM-6:18 PM EDT	June 21 6:57 AM-7:01 PM EDT	December 21 8:51 AM-2:53 PM EST
Lippmann Arcade	—	5:45 PM – 6:00 PM Total: 15m	5:30 PM – 7:01 PM Total: 1h 31m	—
Daniel Carter Beard Mall	—	—	—	—
Flushing Greens	—	—	—	8:51 AM – 9:30 AM Total: 39m
Friends Meeting House burial ground	—	—	—	8:51 AM – 10:30 AM Total: 1h 39m
Macedonia AME Church – west building, southern façade	9:45 AM – 1:30 PM Total: 3h 45m	10:30 AM – 12:30 PM Total: 2h	—	8:51 AM – 2:53 PM Total: 6h 2m
Macedonia AME Church – west building, western façade	12:30 PM – 2:00 PM 2:45 PM – 5:29 PM Total: 3h 59m	2:30 PM – 6:18 PM Total: 3h 48m	3:00 PM – 7:01 PM Total: 4h 1m	11:00 AM – 2:53 PM Total: 3h 53m
Macedonia AME Church – total	9:45 AM – 2:00 PM 2:45 PM – 5:29 PM Total: 6h 59m	10:30 AM – 12:30 PM 2:30 PM – 6:18 PM Total: 5h 48m	3:00 PM – 7:01 PM Total: 4h 1m	8:51 AM – 2:53 PM Total: 6h 2m
<b>Notes:</b> EST—Eastern Standard Time EDT—Eastern Daylight Time September 21 is the equivalent of March 21. August 6 is the equivalent of May 6.				

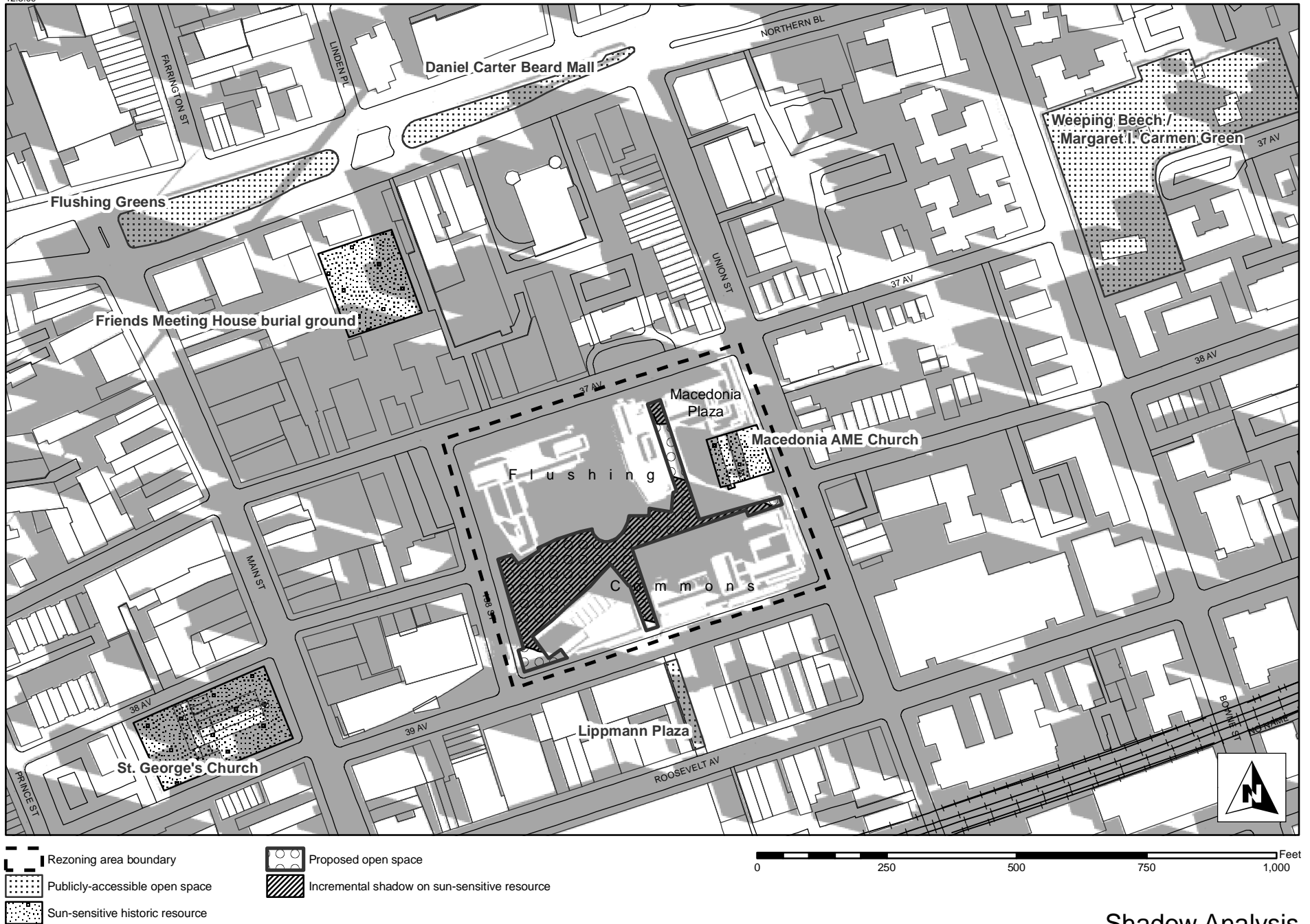
## SHADOW EFFECTS BY SEASON

### MARCH 21 / SEPTEMBER 21 (SEE FIGURES 6-2 THROUGH 6-5)

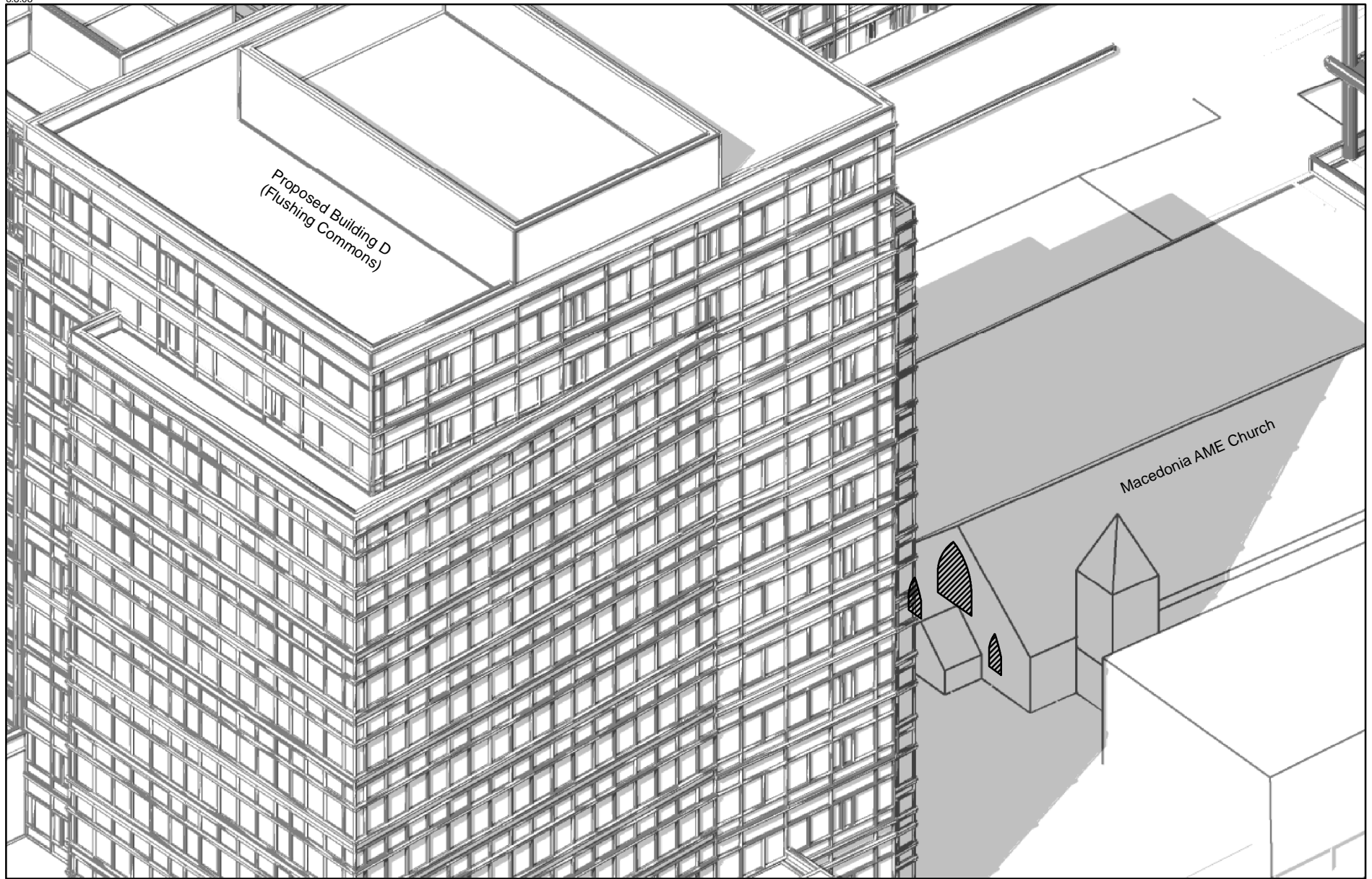
At 8:36 AM, the proposed buildings would cast shadow to the northwest, nearly reaching—but falling just south of—the Friends Meeting House burial ground (see Figure 6-2). The project buildings' incremental shadow would move eastward, across the windows of the southern façade of the Macedonia AME Church between 9:30 AM and 3:00 PM (see Figures 6-3 and 6-4), with shadow on the windows of its western façade for most of the afternoon (see Figure 6-5). The proposed Flushing Commons open space would be cast in various amounts of incremental shadow throughout the day.

### MAY 6 / AUGUST 6 (SEE FIGURES 6-6 THROUGH 6-10)

In May and August, shadows are shorter than they are in March and September, but they cover more angles to the southwest and southeast and the day is longer. Incremental shadow would cross the southern façade of the Macedonia AME Church between 10:30 AM and 12:30 PM (see Figures 6-6 and 6-7) and the western façade from mid-afternoon until the end of the day (see

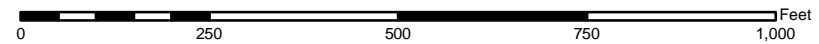


Shadow Analysis  
 March 21 / Sept. 21 - 8:36 AM EDT  
 Figure 6-2

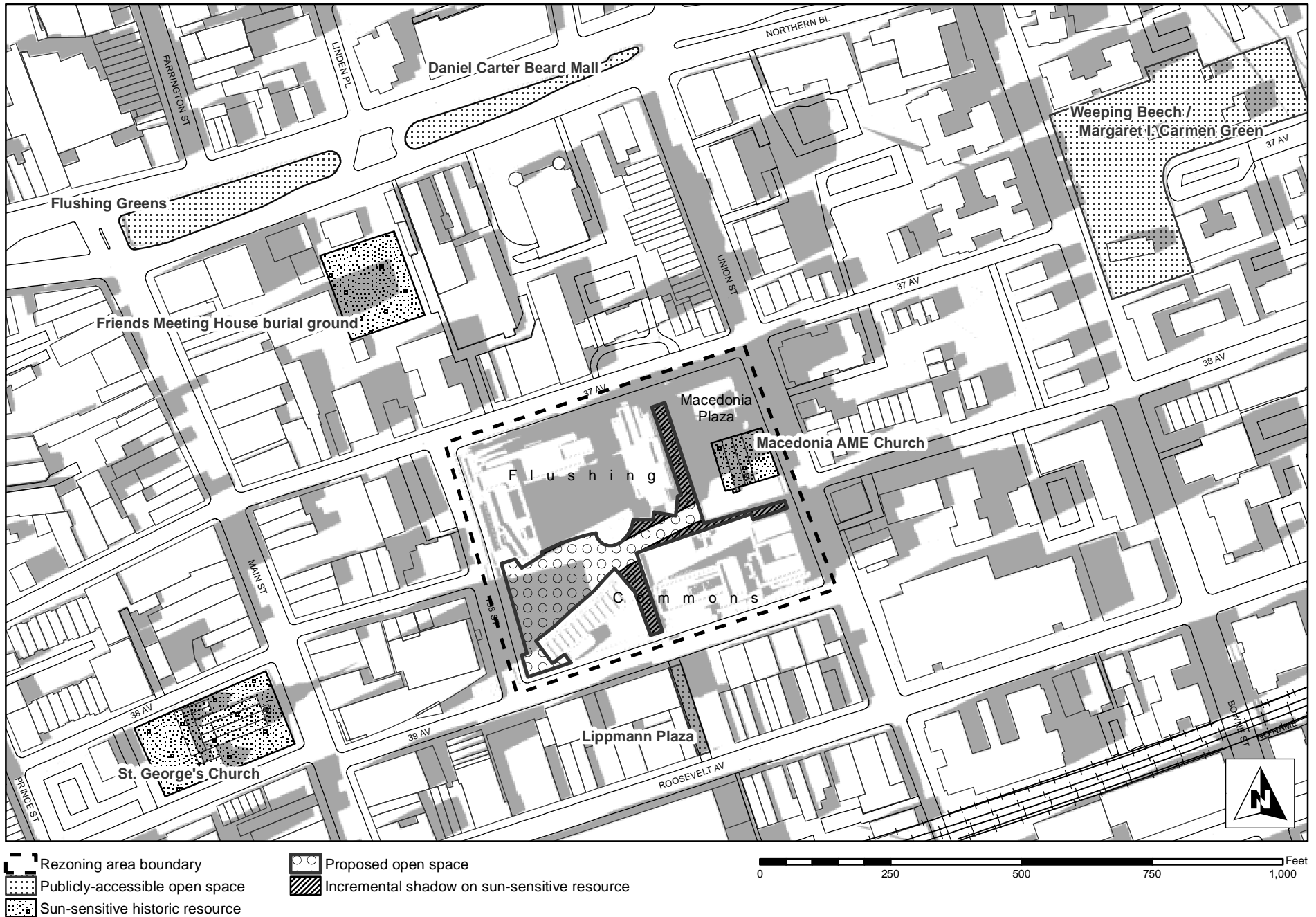


Incremental shadow on sun-sensitive features

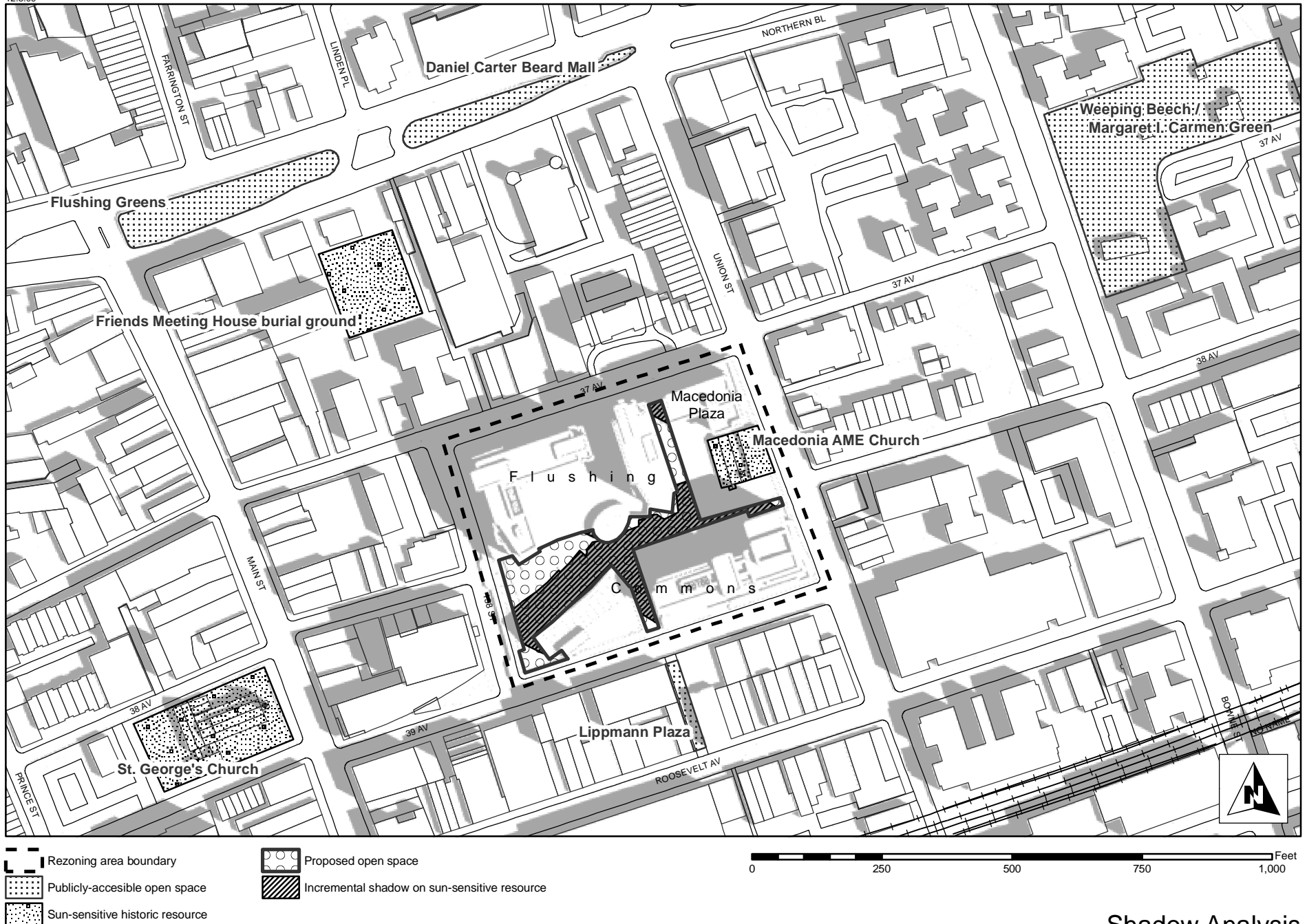
Shadow Analysis  
March 21 / Sept. 21 - 11:00 AM EDT  
View from Southeast  
Figure 6-3



Shadow Analysis  
March 21 / Sept. 21 - 12:45 PM EDT  
Figure 6-4

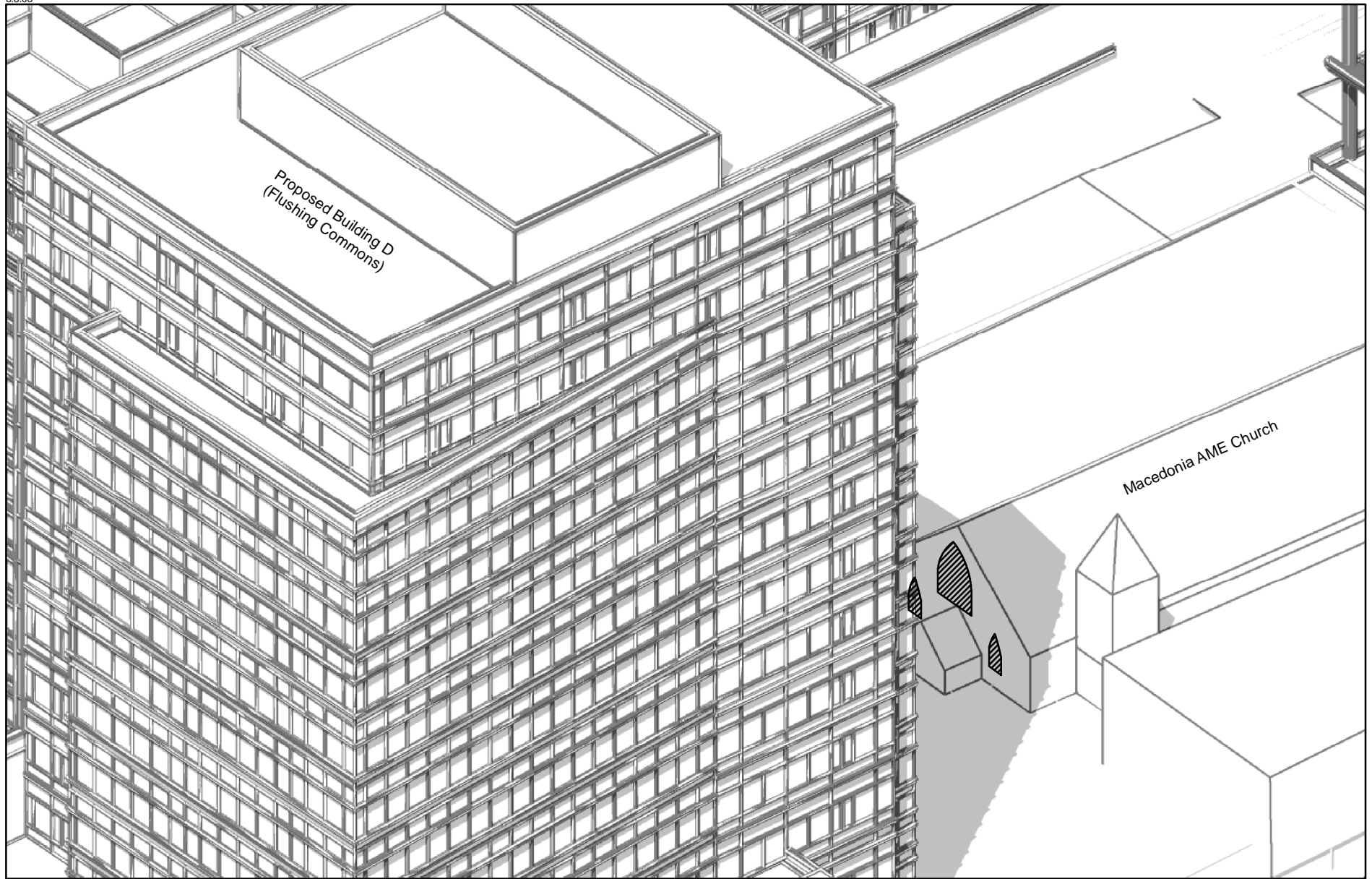



Shadow Analysis  
 March 21 / Sept. 21 - 4:30 PM EDT  
 Figure 6-5



Shadow Analysis  
May 6 / August 6 - 10:30 AM EDT  
Figure 6-6



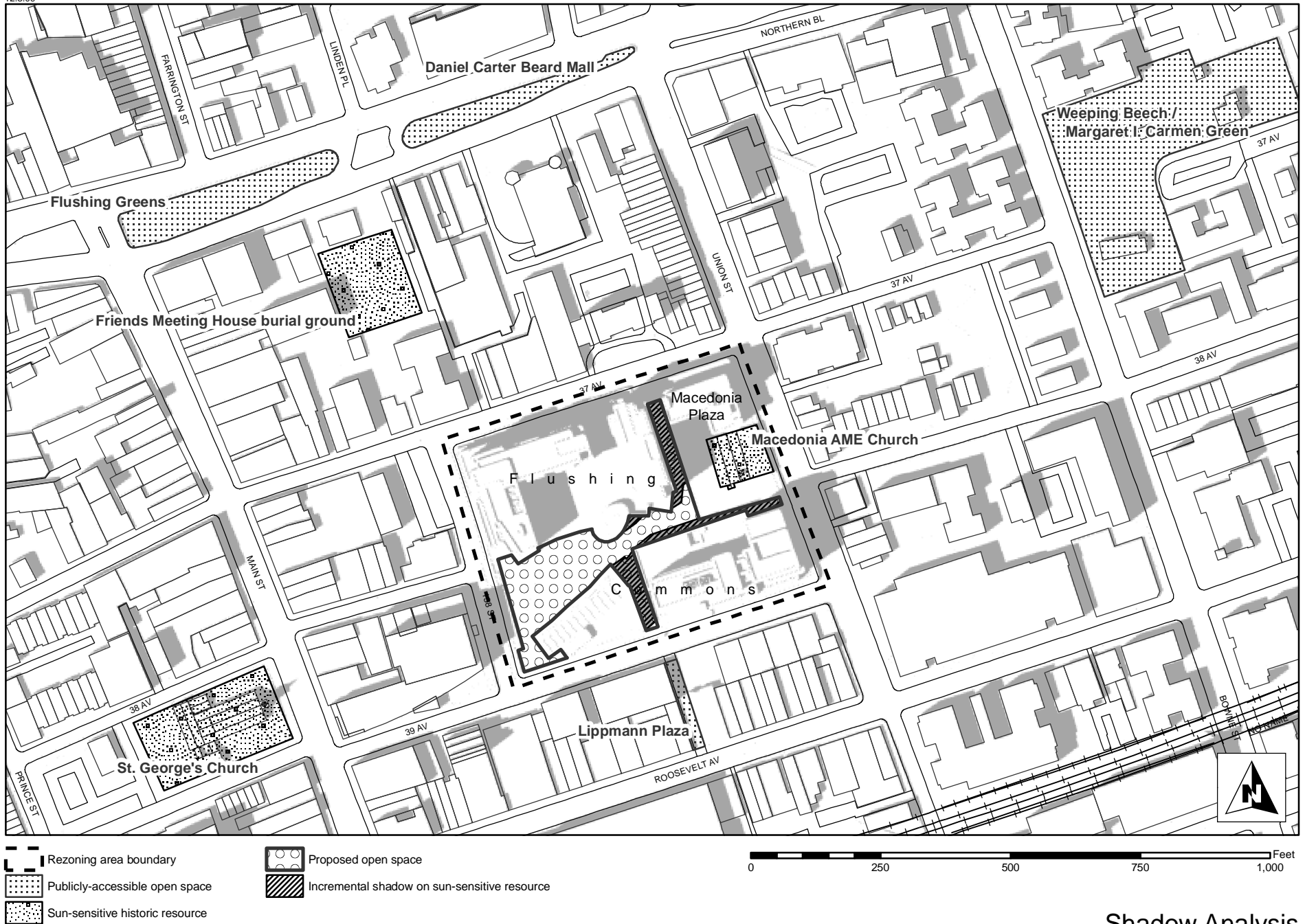


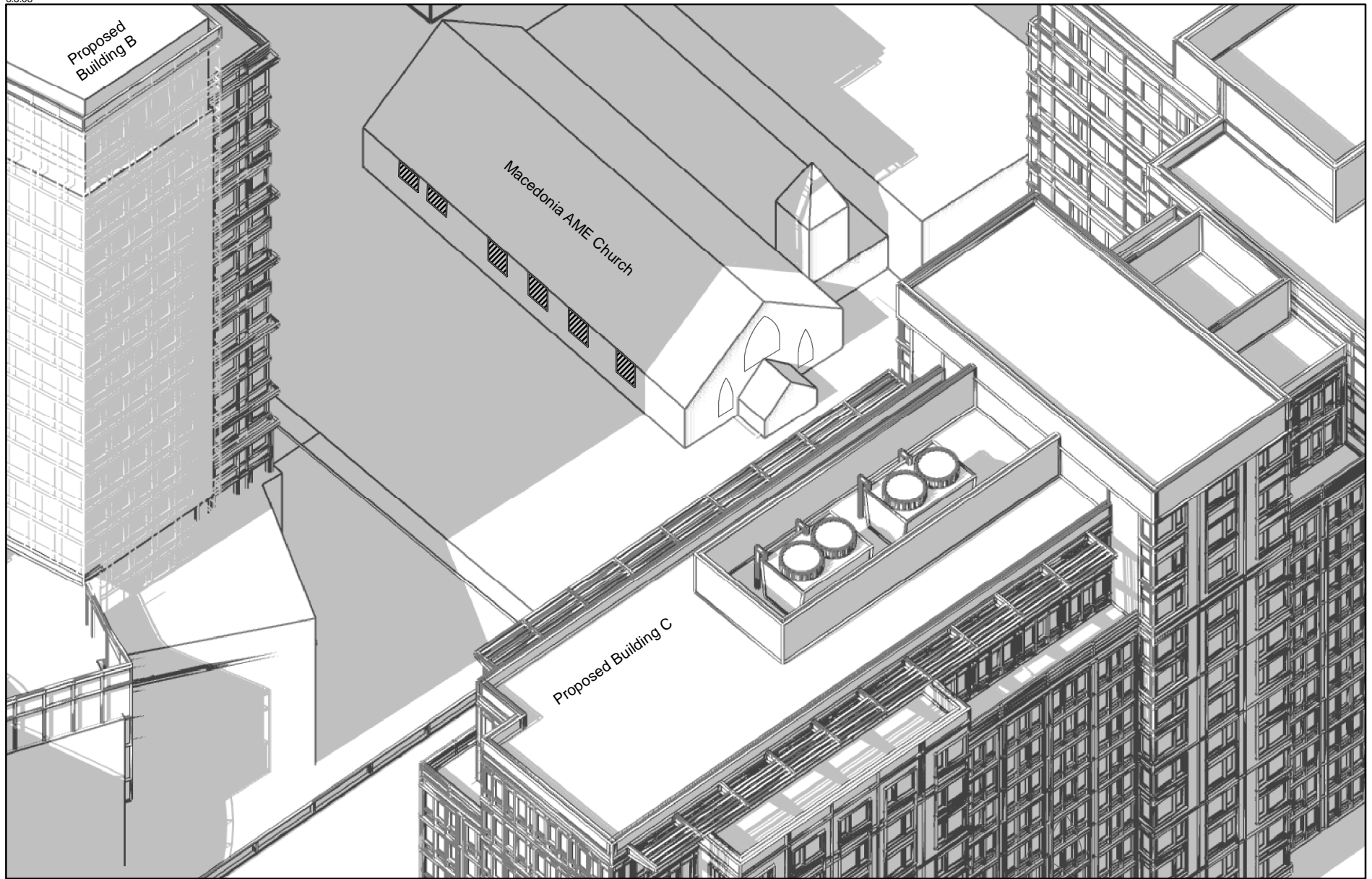
 Incremental shadow on sun-sensitive features

FLUSHING COMMONS

Shadow Analysis  
May 6 / August 6 - 11:00 AM EDT  
View from Southeast  
Figure 6-7

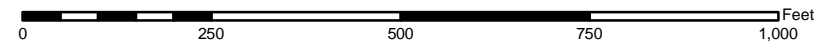
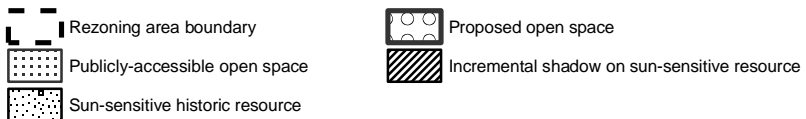




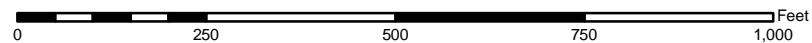


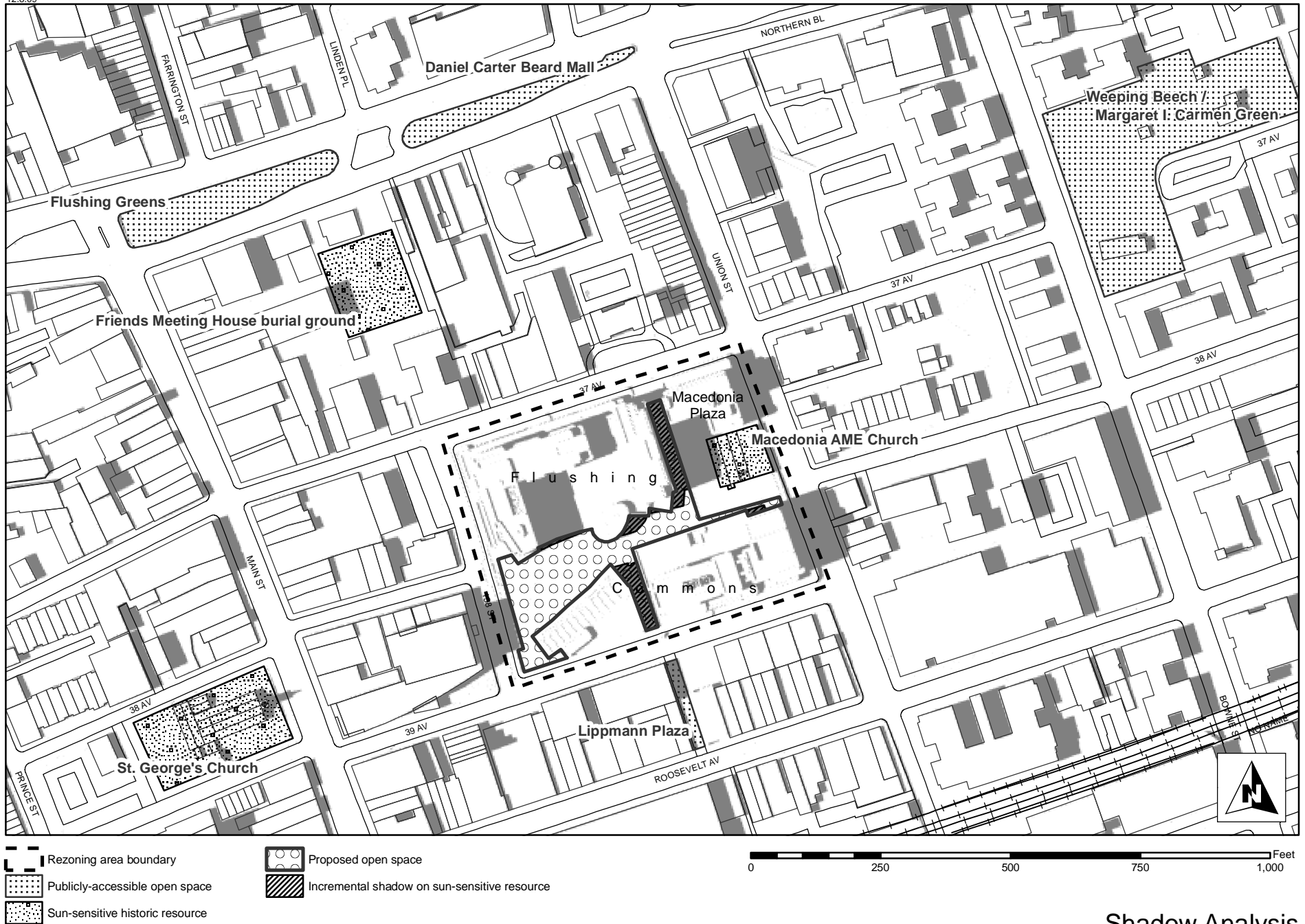
Incremental shadow on sun-sensitive features

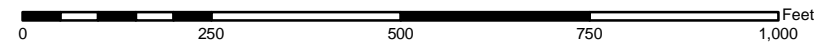
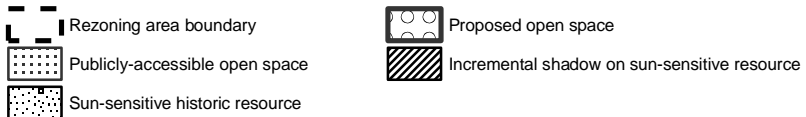
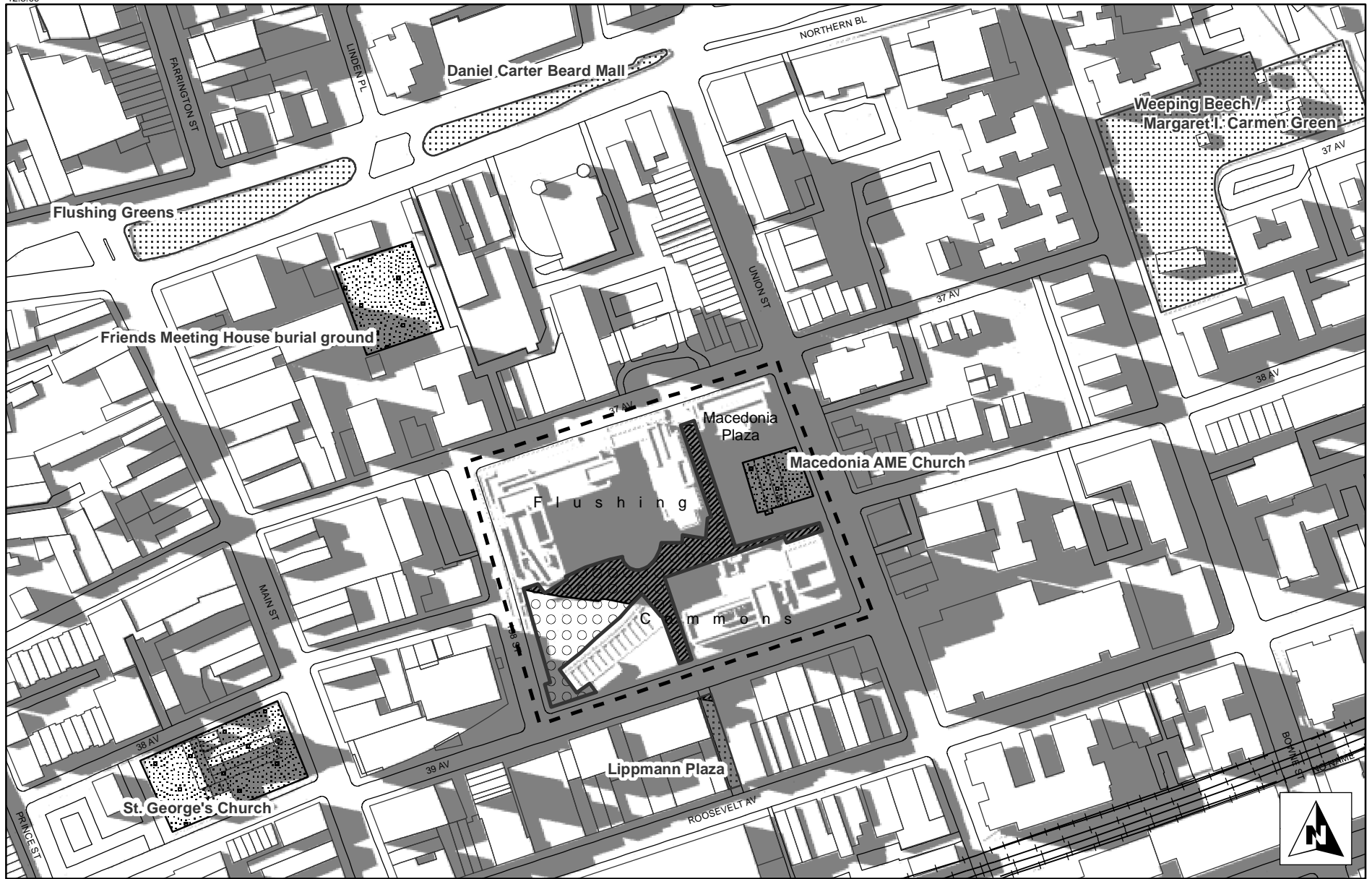
Shadow Analysis  
May 6 / August 6 - 4:00 PM EDT  
View from Southwest  
Figure 6-9



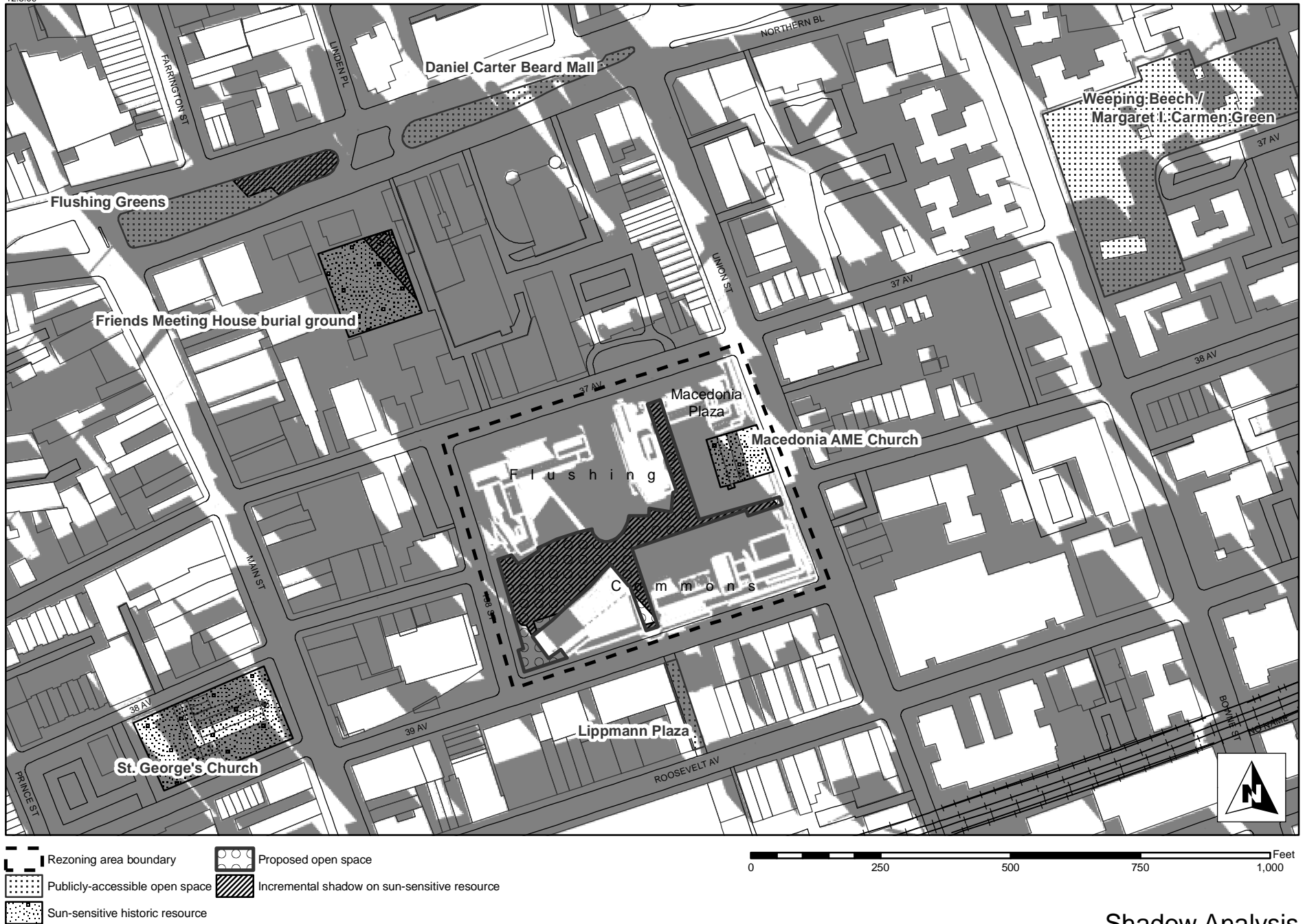
Shadow Analysis  
May 6 / August 6 - 6:00 PM EDT  
Figure 6-10





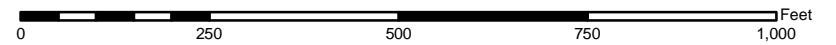






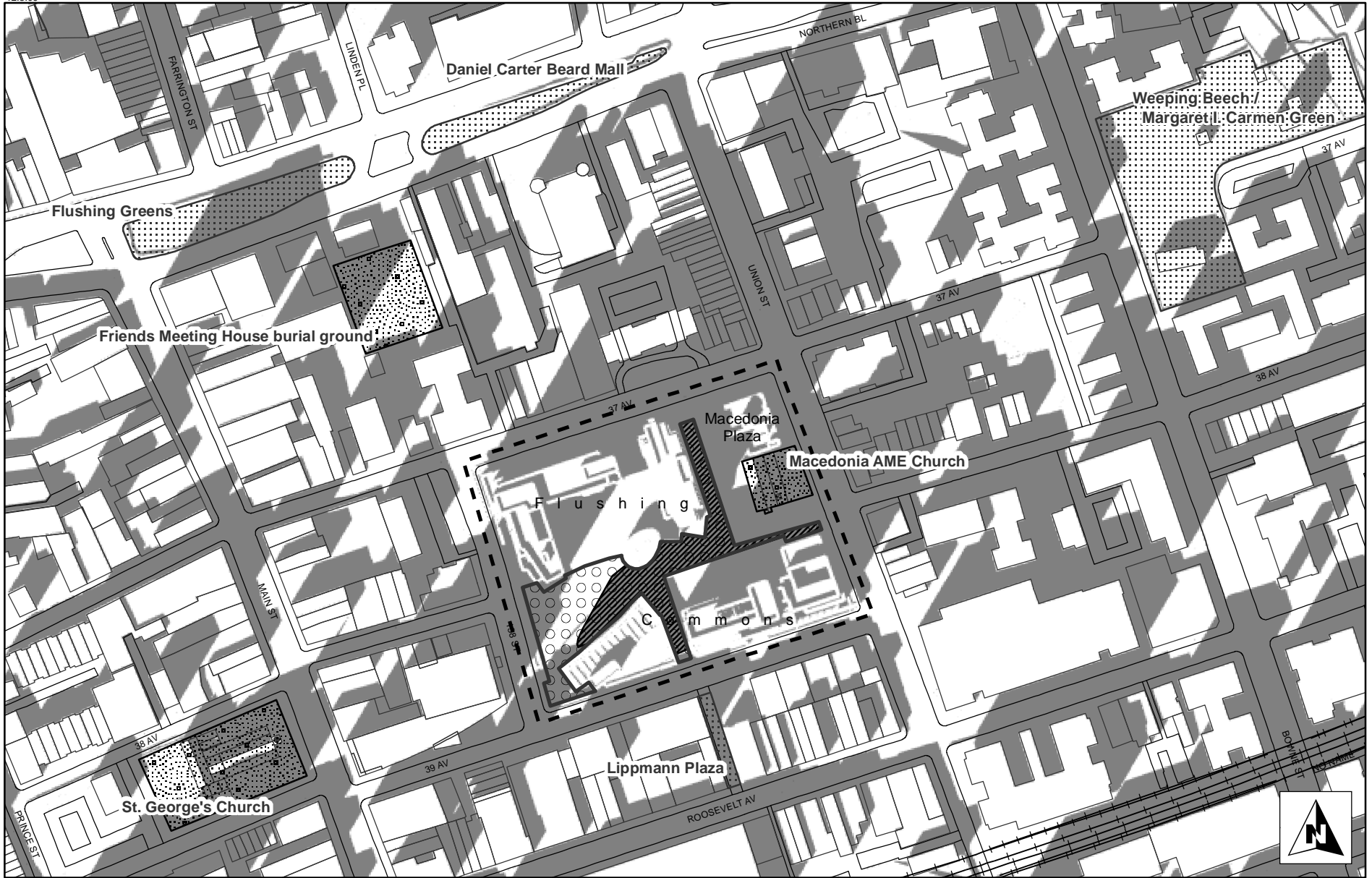


- Rezoning area boundary
- Incremental shadow on sun-sensitive resource
- Publicly-accessible open space
- Sun-sensitive historic resource
- Proposed open space

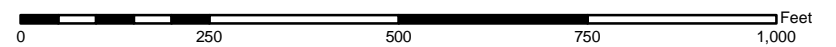


Shadow Analysis  
December 21 - 11:00 AM EST  
Figure 6-15





- Rezoning area boundary
- Publicly-accessible open space
- Sun-sensitive historic resource
- Proposed open space
- Incremental shadow on sun-sensitive resource



Shadow Analysis  
December 21 - 2:00 PM EST  
Figure 6-16

## **Flushing Commons**

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Figures 6-8 and 6-9). The incremental shadow would reach the northern tip of Lippmann Arcade for 15 minutes late in the afternoon, until existing shadow moves onto this spot (see Figure 6-10). Areas of the proposed Flushing Commons open space would be cast in shadow throughout the May/August analysis day.

### *JUNE 21 (SEE FIGURES 6-11 THROUGH 6-13)*

Shadows are shortest of all in late June, and the analysis day lasts approximately 12 hours. The shadow of the proposed buildings would be cast toward the southwest, in the direction of the recently completed Queens Crossing building (see Figure 6-11), at the start of the day. Project-generated shadows would be too short to reach the southern façade of the Macedonia AME Church on this day and would not reach any resource other than the proposed open space until 3:00 PM, when incremental shadow would move onto the windows of the western façade of the church (see Figure 6-12) and stay there until the end of the analysis day at 7:01 PM. Also, at 5:30 PM incremental shadow would reach the same small area of Lippmann Arcade and remain there until the end of the analysis day (see Figure 6-13).

### *DECEMBER 21 (SEE FIGURES 6-14 THROUGH 6-16)*

At 8:51 AM, the start of the analysis period, the proposed buildings would cast long shadows to the northwest. Incremental shadow would reach portions of the Friends Meeting House burial ground and Flushing Greens, and the windows of the southern façade of the Macedonia AME Church (see Figure 6-14). Winter shadows move quickly, however, and the incremental shadows would move off Flushing Greens in less than an hour and off the Friends Meeting House burial ground at 10:30 AM. The windows on the southern façade of the church would remain shaded by the proposed buildings for the entire day. Incremental shadow would also reach the windows on the western façade of the church beginning at 11:00 AM (see Figure 6-15) and remain there for the rest of the day as well (see Figure 6-16). Areas of the proposed Flushing Commons open space would be cast in shadow throughout the December analysis day.

## **SHADOW EFFECTS BY RESOURCE**

### *LIPPMANN ARCADE*

Beginning just after 5:45 PM on the May 6/August 6 analysis day, incremental shadow from the proposed office tower at the southwest corner of the site (the E building) would fall on a very small area at the northern tip of Lippmann Arcade (see Figure 6-10). However, existing shadow from the Queens Crossing building moves onto this area at a few minutes past 6:00 PM and remains until the end of the analysis day at 6:18 PM; the total duration of incremental shadow caused by the proposed project would be about 15 minutes.

On the June 21 analysis day, the proposed office tower's incremental shadow would move onto a very small area at the northern tip of Lippmann Arcade at 5:30 PM. It would remain there until the end of the analysis period at 7:01 PM (see Figure 6-13). However, the area cast in incremental shadow by the proposed project would remain very small, as the existing buildings along the western side of Lippmann Arcade cast shadow on most of Lippmann Arcade this late in the day. Unlike in May and August, the existing Queens Crossing shadow is too short to reach this area in June.

The incremental shadow would not reach Lippmann Arcade on the March/September and December analysis days.

Given the short durations and very small extents of its incremental shadows, the proposed project would not cause a significant adverse shadow impact on Lippmann Arcade.

#### *FLUSHING GREENS*

On the December 21 analysis day, incremental shadow from the proposed project would cover areas of the Flushing Greens from the beginning of the analysis period at 8:51 AM until 9:30 AM (see Figure 6-14). Incremental shadow would not reach this open space on any of the other three analysis days. Given the limited extent and duration of its incremental shadow, the proposed project would not cause a significant adverse impact on the Flushing Greens.

#### *PROPOSED OPEN SPACE*

The proposed Flushing Commons open space would be situated amidst the project's towers and would therefore receive incremental shadow throughout the day in all seasons. In spring, summer, fall, and winter substantial areas of shadow would fall on the open space in the mornings; in the afternoons, however, large areas of the open space would be sunlit from midday through late afternoon, due to the open section along the southwestern side of the project site. Further, the landscape design of these proposed open spaces would take into account the shadow conditions, and vegetation would be selected for its shade tolerance. The open spaces would include benches, lighting, and movable tables and chairs. Therefore, even with extensive shadows during certain times, the new open spaces would be a beneficial resource for this neighborhood, which is underserved in terms of passive open space amenities. Since this open space is part of the proposed project, the incremental shadow is not considered a significant adverse impact.

#### *FRIENDS MEETING HOUSE BURIAL GROUND*

Starting at 8:51 AM on the December 21 analysis day, incremental shadow from the proposed project's buildings would cover a portion of ground on the eastern side of the open area behind the Friends Meeting House (see Figure 6-14). The incremental shadow would move off the Friends Meeting House property at 10:30 AM. The burial ground would be partially or fully in sunlight for the rest of this analysis day. Incremental shadow would not reach this open space on any of the other three analysis days. Therefore, no significant adverse impact on this resource would occur.

#### *MACEDONIA AME CHURCH*

At 9:45 AM on the March 21/September 21 analysis day, incremental shadow cast by the proposed residential building south of the Macedonia AME Church would begin moving across the windows on the south facade of the church. These windows would be partially or completely shaded by the proposed building between 9:45 AM and 1:30 PM (see Figure 6-3). Between 12:30 PM and 2:00 PM, the same residential building would also fully shade one window on the western facade of the church (see Figure 6-4). The proposed building to the west of the church would begin casting incremental shadow on the western facade of the church at 2:45 PM. Only the northernmost window would be affected initially, but the shadow would grow southward throughout the afternoon, and by about 4:30 PM all seven windows would be shaded by the proposed building to the west (see Figure 6-5).

On the May 6/August 6 analysis day, the proposed building south of the church (the western portion of the C building that would be either hotel or office) would cast incremental shadow on

the windows of the church's southern façade from 10:30 AM until 12:30 PM (see Figures 6-6 and 6-7). The shadow would move across the façade from west to east, with the greatest impact occurring at 11:30 AM, when all the windows facing south would be fully shaded. At 2:30 PM, incremental shadow cast by the proposed residential tower (the Beech building) west of the church would move up onto the western façade, shading about half of the windows on that side (see Figure 6-8). By 4:00 PM, all of the windows (except the one on the front vestibule) would be shaded by the proposed residential building (see Figure 6-9) and would remain so until 6:18 PM.

On June 21, the shadow cast by the residential building to the south would be too short to reach the church at any time of the day. The residential tower (the Beech building) to the west would cast incremental shadow on the western façade beginning at 3:00 PM, shading four or five of the windows on that side (see Figure 6-12). By 4:00 PM, all the windows would be shaded and would remain so until the end of the analysis day at 7:01 PM.

On the December 21 analysis day, the proposed buildings to the south would cast a long incremental shadow on the windows of the southern façade of the church for the entire analysis period (8:51 AM to 2:53 PM). The proposed buildings to the west and south would cast incremental shadow on the windows of the western façade from 11:00 AM until 2:53 PM.

The proposed buildings would cast incremental shadow on the arched windows of the Macedonia AME Church on all four analysis days. Incremental shadow durations would range from just over 4 hours in June to nearly 7 hours on the March 21/September 21 analysis day. The incremental shadow would significantly reduce the amount of direct sunlight that currently shines through these windows throughout the year and would cause a significant adverse impact for the users of this place of worship. As described in Chapter 20, "Mitigation," mitigation measures would be designed to avoid or minimize any adverse shadow impacts on the sun-sensitive architectural resources of the Macedonia AME Church. \*