Chapter 4: Shadows

A. INTRODUCTION

Sunlight and shadows affect people and their use of open space all day long and throughout the year, although the effects vary by season. Sunlight can entice outdoor activities, support vegetation, and enhance architectural features. Conversely, shadows can affect the growth cycle and sustainability of natural features, and the architectural significance of built features.

The purpose of this chapter is to examine whether the new buildings constructed as part of the proposed project would cast new shadows on any sunlight-sensitive resources and to assess the potential effects of any such new shadows. Public open spaces, historic, cultural, and natural resources are all potentially sunlight-sensitive resources and, therefore, this chapter is closely linked to the data and analyses presented in Chapter 3, "Open Space," Chapter 5, "Historic and Cultural Resources," and Chapter 6, "Natural Resources."

According to the 2010 *City Environmental Quality Review (CEQR) Technical Manual*, a shadows assessment is required if a project would result in structures (or additions to existing structures) of 50 feet or more, or be located adjacent to, or across the street from, a sunlight-sensitive resource.

As described in Chapter 1, "Project Description," two existing historic structures on the project site would be adaptively reused with the proposed project, and three new buildings would be developed. Since the adaptive reuse of the existing structures would not involve any additions of 50 feet or more, only the proposed new buildings could cast incremental shadows. The proposed retail building on Navy Street (referred to here and shown in **Figures 4-1** through **4-21** as Building E) would be approximately 49 feet tall, including rooftop mechanical space, but would be located across Navy Street from the Farragut Houses, a New York City Housing Authority (NYCHA) development with publicly accessible open spaces. Therefore, the shadow impacts of this building are assessed. The proposed retail building on Nassau Street (referred to here and shown in **Figures 4-1** through **4-21** as Building C) would be less than 50 feet in total height, but would be located across Nassau Street from Commodore Barry Park; therefore, its impacts are also assessed. The proposed supermarket and light industrial building (Building A) on Nassau Street would have a maximum height of approximately 100 feet, including rooftop mechanical space, and would be located across Nassau Street from Commodore Barry Park. Therefore, this building's shadow impacts are also assessed. As described more fully below, this chapter also assesses the effects of project shadows on two existing stands of mature trees that would be retained on the project site under the proposed project to the extent possible.

The shadows analysis consisted of three tiers of screening assessments and a detailed analysis. In summary, the analysis concluded that the proposed project would not result in new shadows that would be large enough, or of long enough duration, to significantly affect any sunlight-sensitive resources.

B. DEFINITIONS AND METHODOLOGY

CEQR TECHNICAL MANUAL TERMS USED IN THE ANALYSIS

Incremental shadow is the additional, or new, shadow that a structure resulting from a proposed project would cast on a sunlight-sensitive resource.

Sunlight-sensitive resources are those resources 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 spaces* (e.g., parks, beaches, playgrounds, plazas, schoolyards, greenways, landscaped medians with seating). Planted areas within unused portions of roadbeds that are part of the Greenstreets program also are considered sunlight-sensitive resources;
- *Features of architectural resources that depend on sunlight for their enjoyment by the public.* Only the sunlight-sensitive features of such resources 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; and
- *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.

Non-sunlight-sensitive resources include, for the purposes of CEQR:

- *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); and
- *Project-generated open space* cannot experience a significant adverse shadow impact from the project, according to *CEQR Technical Manual* methodologies, because without the project the open space would not exist. However, according to the *CEQR Technical Manual*, if the project-generated open space is included in a detailed qualitative analysis the extent and duration of shadows that fall on that open space must be assessed and documented in the same fashion as the other sunlight-sensitive resources.

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.

CEQR TECHNICAL MANUAL SHADOWS ANALYSIS METHODOLOGY

First, a preliminary screening assessment must 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(s) representing the longest shadow that could be cast. If there are

sunlight-sensitive resources within this radius (or radii), 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 can never be cast between a certain range of angles south of the project site 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 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 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.

C. PRELIMINARY SCREENING ASSESSMENT

A base map was developed that shows the location of the proposed project and the surrounding street layout (see **Figure 4-1**). In coordination with the open space, historic and cultural resources, and natural resources assessments presented in other chapters of this Environmental Impact Statement (EIS), potentially sunlight-sensitive resources were identified and shown on the map. Topographic information was added to the map in the form of spot elevations published in Geographic Information Systems (GIS) format by the New York City Department of Information Technology and Telecommunications.

Within the project site itself, four existing mature trees on Nassau Street would be retained to the extent possible as part of the proposed project, as described in Chapter 1, "Project Description" and Chapter 6, "Natural Resources." One stand of three trees, marked with a "W" for "western" on **Figure 4-1**, is located south of the Timber Shed and west of the proposed Building C. The fourth tree, marked with an "E" for "eastern" on **Figure 4-1**, is located adjacent to the southwest corner of the proposed Building A.

The two historic structures that would be retained on the project site as part of the proposed project (The Timber Shed and Building B) are not considered to be sunlight-sensitive resources for purposes of the shadows analysis. Both buildings are described in Chapter 5, "Historic and Cultural Resources" and neither structure contains sunlight-sensitive architectural features, as enumerated on page 8-2 of the 2010 *CEQR Technical Manual*, that would warrant a shadows analysis: design elements that depend on the contrast between light and dark; elaborate, highly carved ornamentation; stained glass windows; exterior materials and color that depend on direct sunlight for visual character; and features where the effect of direct sunlight plays a significant role in the structure's historic significance.

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 each proposed building. Anything outside these perimeters representing the longest possible shadow could

never be affected by project-generated shadow, while anything inside the perimeters needs additional assessment.

The longest shadow that a structure can cast occurs on December 21, the winter solstice, at the start of the analysis day, and is equal to 4.3 times the height of the structure (2010 *CEQR Technical Manual*, page 8-4).

The proposed Building E on Navy Street would be 49 feet tall including rooftop mechanical space and, therefore, the longest shadow it could cast would be 211 feet (49 x 4.3). The proposed Building C on Nassau Street would be 39 feet tall including rooftop mechanical space and the longest shadow it could cast would be 168 feet (39 x 4.3). Considering proposed Building A, the longest shadow that the shorter supermarket portion could cast would be 134 feet (31 x 4.3), while the taller light industrial portion could cast shadows up to 430 feet in length (100 x 4.3).

As shown in **Figure 4-2**, several potentially sunlight-sensitive resources are located within the longest shadow study area of one or more of the proposed buildings.

Within the Farragut Houses complex, two benches located along a walking path and a playground area lie within Building E's longest shadow study area perimeter. A portion of Commodore Barry Park lies within the longest shadow study area boundaries of the other two proposed buildings. The two existing mature tree stands within the project site that would be retained under the proposed project are located within the longest shadow study area of Building C and Building A, and the western mature tree stand is located within Building E's longest shadow study area boundary. Therefore, the analysis proceeded to a Tier 2 assessment.

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. The complementing area to the north within the longest shadow study area represents the remaining area that could potentially experience new project-generated shadow.

After calculating the triangular area south of each proposed building that could never receive project-generated shadow, the remaining complementing areas were examined. As shown in **Figure 4-3**, all of the potentially sunlight-sensitive resources identified in the Tier 1 assessment lie within the remaining longest shadow study area of one or more of the proposed buildings. Therefore, the assessment proceeded to a Tier 3 assessment.

TIER 3 SCREENING ASSESSMENT

The direction and length of shadows vary throughout the course of the day and also differ depending on the season. To determine if and when project-generated shadow could fall on a sunlight-sensitive resource, three-dimensional computer modeling software is used in the Tier 3 assessment to calculate and display the proposed project's shadows over the course of individual representative days of the year.

REPRESENTATIVE DAYS FOR ANALYSIS

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 full range of possible 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 are approximately the same.

TIMEFRAME WINDOW OF ANALYSIS

The shadow assessment only considers shadows occurring between 1.5 hours after sunrise and 1.5 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 tangential angles, diminishing the amount of solar energy and producing shadows that are long, move fast, and generally blend with shadows from existing structures until the sun reaches the horizon and sets. Consequently, shadows occurring outside this timeframe window of analysis are not considered significant under CEQR, and their assessment is not required.

TIER 3 SCREENING ASSESSMENT RESULTS

Figures 4-4 to **4-7** illustrate the range of shadows that would occur from the three proposed new buildings on the four representative days for analysis. The shadows are shown occurring approximately every two hours from the start of the analysis day (1.5 hours after sunrise) to the end of the analysis day (1.5 hours before sunset).

December 21 Analysis Day

Figure 4-4 shows that on December 21, project-generated shadow would not reach the playground area or the two benches in the Farragut Houses complex. Nor would project shadow reach far enough south to fall on Commodore Barry Park. Portions of the two stands of mature trees could both experience some project-generated morning shadow. However, in the winter, sun and shadow have only minimal effect on vegetation, and therefore no additional assessment is required for the December 21 analysis day.

March 21/September 21 Analysis Day

Figure 4-5 shows that on the March 21/September 21 analysis day, project-generated shadow would not reach the playground area or the two benches in the Farragut Houses complex. Nor would project shadow reach far enough south to fall on Commodore Barry Park. The western stand of retained trees would not be affected by shadow from the proposed Building C or any other proposed building. However, a part of the eastern retained tree stand would be shaded by the proposed supermarket/light industrial building for some period in the morning, and further assessment is required to determine the extent, duration, and potential effects of any incremental shadow on this tree.

May 6/August 6 Analysis Day

Figure 4-6 shows that shadow from the proposed Building E could reach the benches in the Farragut Houses complex briefly at the start of the May 6/August 6 analysis day. The playground area west of the benches would be too far away to be affected by project-generated shadow. Project shadow would not reach far enough south to fall on Commodore Barry Park. Both retained tree stands on the project site would be affected by project shadow and additional assessment is required to determine the extent, duration and potential effects of the new shadow.

June 21 Analysis Day

Figure 4-7 shows that shadow from the proposed Building E building could reach the benches in the Farragut Houses complex briefly at the start of the June 21 analysis day. The playground area west of the benches would be too far away to be affected by project-generated shadow. Shadow cast by the light industrial building would be long enough to reach a short distance into Commodore Barry Park at the start of the analysis day. Both retained tree stands on the project site would be affected by project shadow on June 21, and additional assessment is required to determine the extent, duration and potential effects of the new shadow.

To summarize, the Tier 3 assessment indicated that:

- The playground area in the Farragut Houses could never be reached by project shadow;
- Further assessment would be required for the two benches along the walkway in the Farragut Houses complex at the start of the May 6/August 6 and June 21 analysis days;
- Further assessment would be required for Commodore Barry Park at the start of the June 21 analysis day; and
- Additional assessment would be required for the western tree stand on the May 6/August 6 and June 21 analysis days, and for the eastern tree stand on the March 21/September 21, May 6/August 6 and June 21 analysis days.

D. DETAILED SHADOW ANALYSIS

A detailed analysis was performed to determine the extent and duration of incremental shadows on potentially sunlight-sensitive resources and to assess their effects. Existing buildings were added to the three-dimensional model, and shadows cast by the proposed new buildings were compared to shadows cast in the baseline future without the proposed project (No Action) condition to determine the extent and duration of incremental shadows.

Shadow analyses were performed for the window of analysis for each of the representative days indicated in the Tier 3 assessment. **Table 4-1** shows the entry and exit times and total duration of incremental shadows on each affected resource.

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
SUNLIGHT-SENSITIVE RESOURCES				
Farragut Houses benches	—	—	6:27 AM–6:32 AM Total: 5 min	5:57 AM–6:12 AM Total: 15 min
Commodore Barry Park	—	—	—	5:57 AM–6:05 AM Total: 8 min
Western tree stand	—	—	6:27 AM–9:30 AM Total: 3 hr 3 min*	6:45 AM–9:15 AM Total: 2 hr 30 min*
Eastern tree stand	8:51 AM–11:30 AM Total: 2 hr 39 min *Reduced:* *1:00 PM–2:53 PM* *Total: 1 hr 53 min*	7:36 AM–11:45 AM Total: 4 hr 9 min *Reduced:* *1:45 PM–4:29 PM* *Total: 2 hr 44 min*	6:27 AM–11:35 AM Total: 5 hr 8 min *Reduced:* *2:15 PM–5:18 PM* *Total: 3 hr 3 min*	5:57 AM–11:40 AM Total: 5 hr 43 min *Reduced:* *2:45 PM–6:01 PM* *Total: 3 hr 16 min*

Notes: Table indicates entry and exit times and duration of incremental shadow for each sunlight-sensitive resource. Daylight saving time is not used.

* Incremental shadow on western tree stand would fall primarily on lower trunk and lowest branches of canopy.

FARRAGUT HOUSES BENCHES

The proposed Building E would cast five minutes of new shadow on the two benches in the Farragut Houses complex identified in the preliminary assessment at the start of the May 6/August 6 analysis day. By 6:35 AM the shadow would move completely off the benches (see **Figure 4-8**). On June 21, the same proposed building would cast incremental shadow on these benches for fifteen minutes, exiting just before 6:15 AM (see **Figure 4-9**). This minimal duration of incremental shadow (of five minutes on the May 6/August 6 analysis day and fifteen minutes on the June 21 analysis day) would not cause a significant adverse impact to this resource.

COMMODORE BARRY PARK

Incremental shadow from the upper portion of the light industrial building would fall on a small area of Commodore Barry Park for the first eight minutes of the June 21 analysis day. It would exit at 6:05 AM (see **Figure 4-9** depicting 6:15 AM). No other incremental shadow would fall on Commodore Barry Park at any time of year, and the proposed project would therefore not cause a significant adverse shadow impact to this park.

EASTERN TREE STAND

Incremental shadow from the proposed Building A would fall on the eastern tree stand retained as part of the proposed project during the morning throughout the year. In the afternoons, less shadow would fall on this tree with the proposed project, due to the removal of the existing building located just west of the tree.

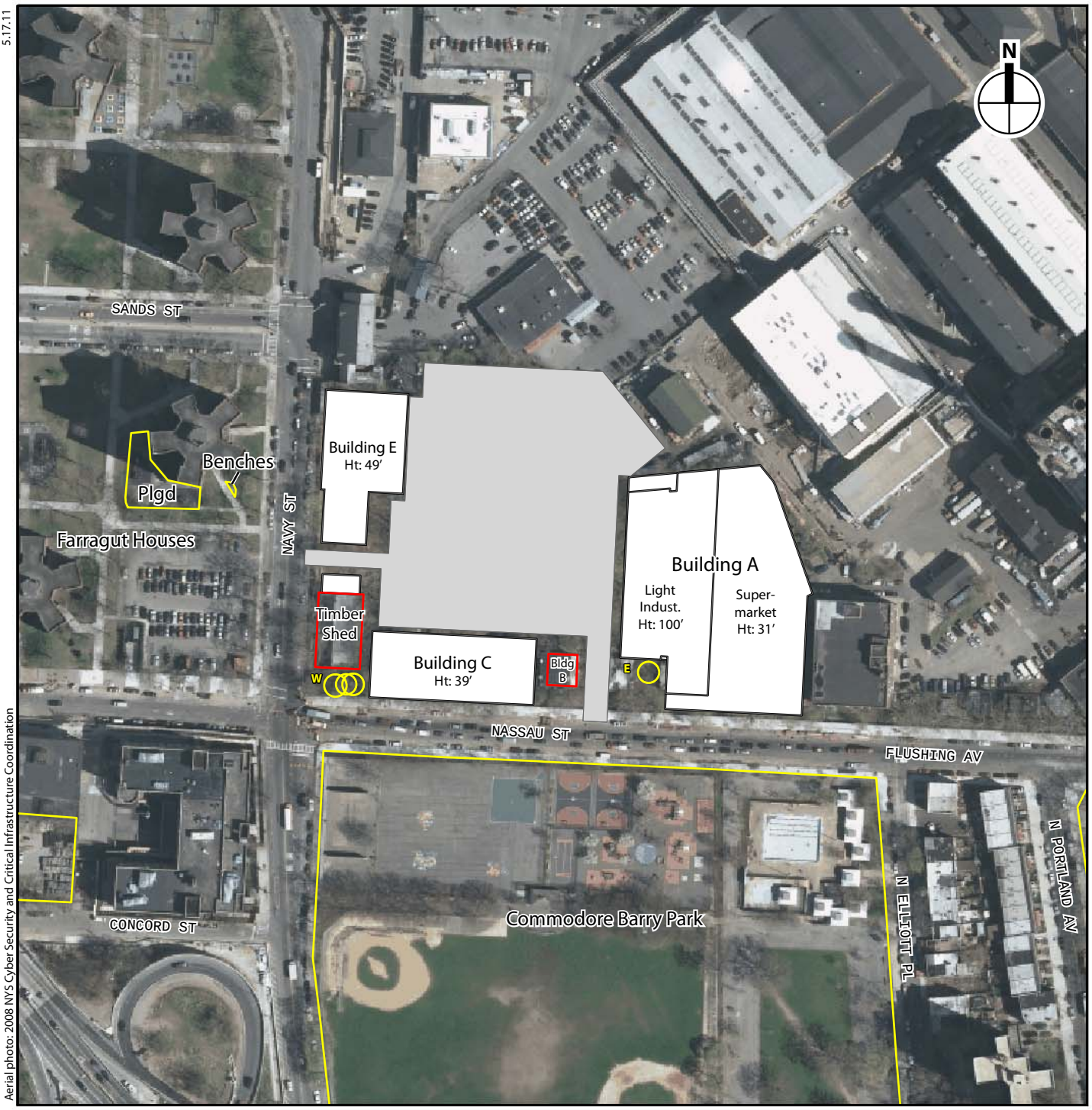
On the spring, summer and fall analysis days, between four and five and three-quarter hours of new shadow would fall on the tree, shading much of the tree canopy in the early morning and gradually moving eastwards and off the tree during the middle and late morning. In the late afternoons, a small area of the canopy and trunk on the western side would experience a reduction in shadow.

Figures 4-10 to **4-12** depict the extent of incremental shadow on the morning of March 21/September 21, and **Figure 4-13** shows 3:30 PM EST when there would be a reduction in shadow. **Figures 4-14** to **4-16** show incremental shadow on the May 6/August 6 morning, and **Figure 4-17** shows the late afternoon reduction in shadow on this analysis day. **Figures 4-18** to **4-20** show incremental shadow on June 21, and **Figure 4-21** shows the late afternoon reduction in shadow.

This mature tree would continue to receive four to six hours of direct sunlight throughout the spring, summer and fall, from late morning through late afternoon. This amount of sunlight meets the CEQR minimum requirement for direct sunlight on vegetation requiring direct sunlight and, therefore, the proposed project would not have a significant adverse impact on the eastern mature tree.

WESTERN TREE STAND

This stand of three trees located west of the proposed Building C would experience two and a half to three hours of incremental shadow on the late spring and summer analysis days (see **Figures 4-10** through **4-21**). The new shadow from the proposed Building C building would not be long enough to reach beyond the trunk and possibly the lowest branches of the easternmost tree of the stand, and would be off the trees by 9:30 AM at the latest. Incremental shadow would not fall on the tree canopy. Therefore, the new shadow of limited extent and duration would not result in a significant adverse impact to these trees. ✷



5.17.11

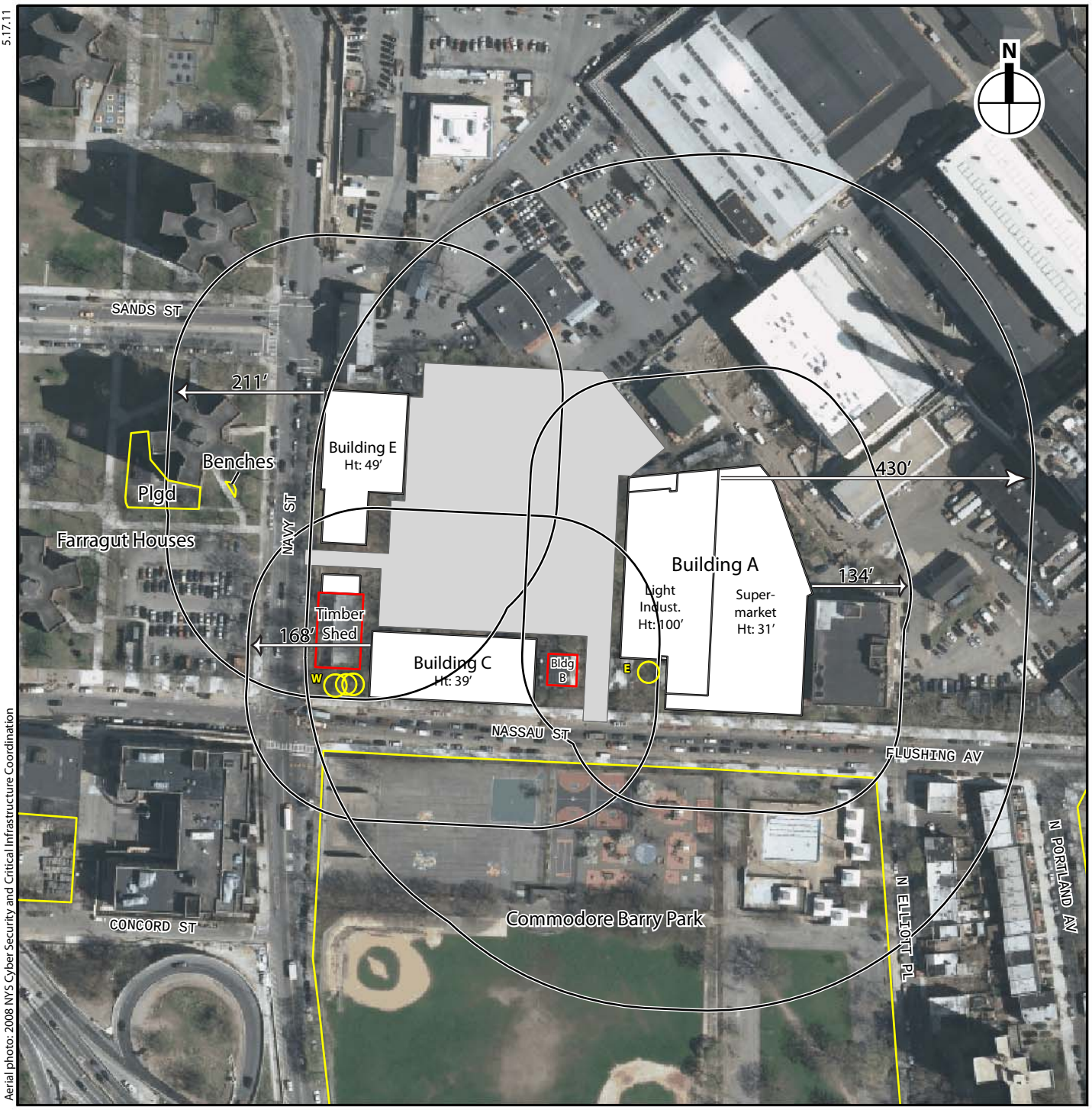
Aerial photo: 2008 NYS Cyber Security and Critical Infrastructure Coordination

- Proposed buildings (heights include rooftop mechanical space)
- Existing buildings to be adaptively reused
- Proposed parking lot
- Existing publicly accessible open space resources
- Mature trees to remain on project site

0 100 200 300 400 Feet

ADMIRALS ROW PLAZA

Base Map
Figure 4-1

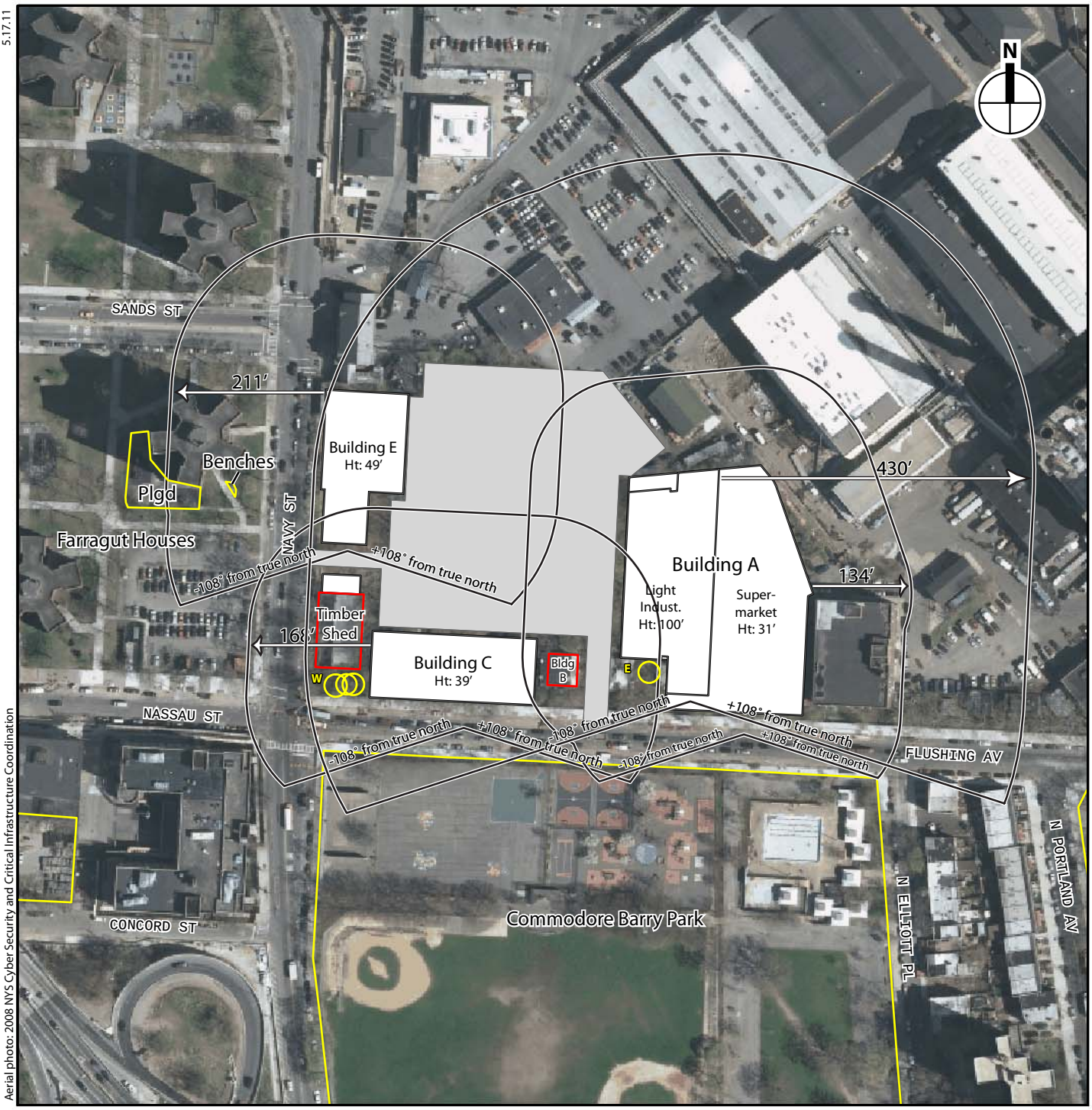


Aerial photo: 2008 NYS Cyber Security and Critical Infrastructure Coordination

5.17.11

- Proposed buildings
- Existing buildings to be adaptively reused
- Longest shadow study area boundaries
- Existing publicly accessible open space resources
- Mature trees to remain on project site

0 100 200 300 400 Feet



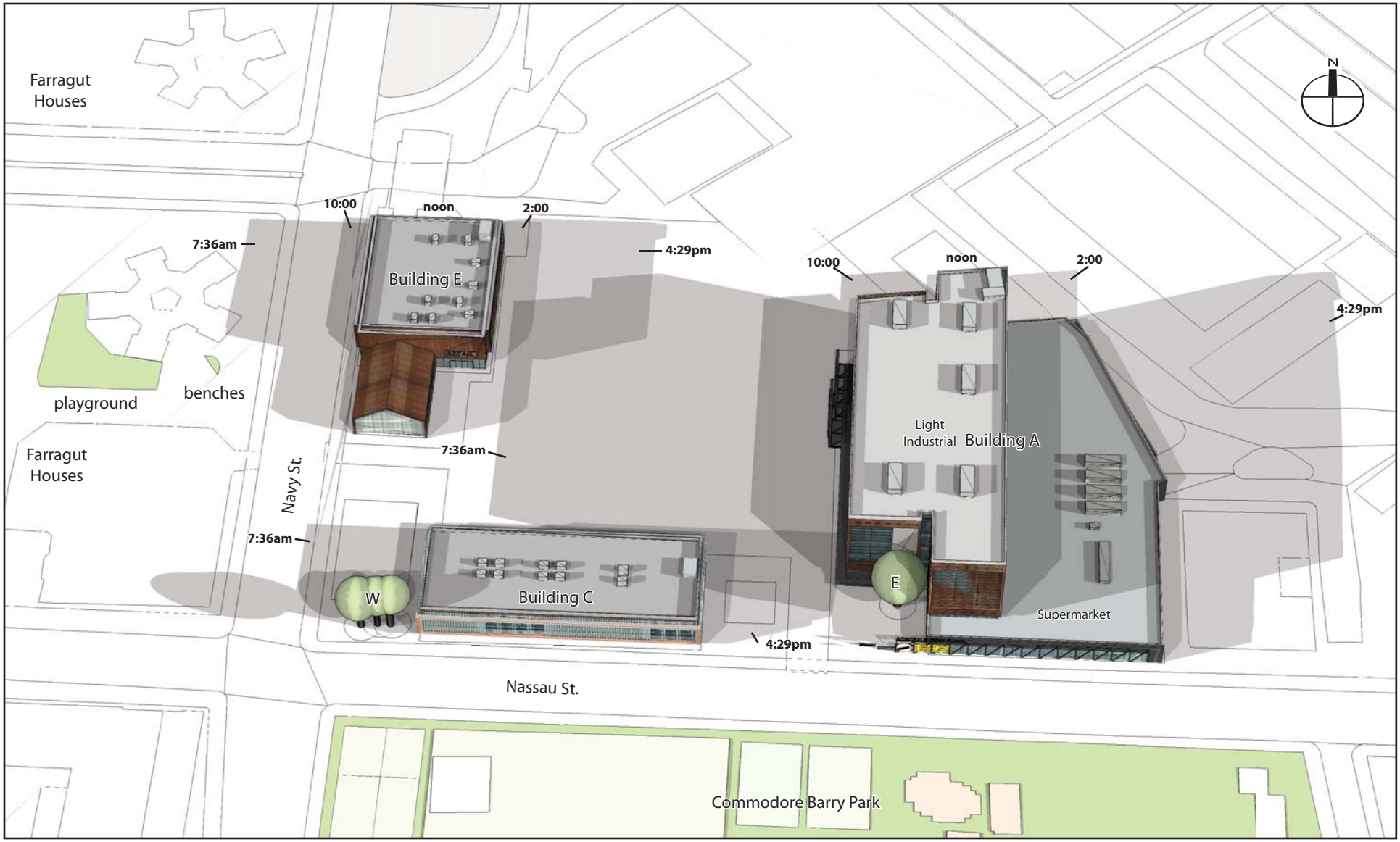
Proposed buildings
Existing buildings to be adaptively reused
Remaining longest shadow study area boundaries
Existing publicly accessible open space resources
Mature trees to remain on project site

0 100 200 300 400 Feet

5.23.11

Notes: Daylight Saving Time not used.
The Timber Shed and Building B are not new structures and therefore are not shown.

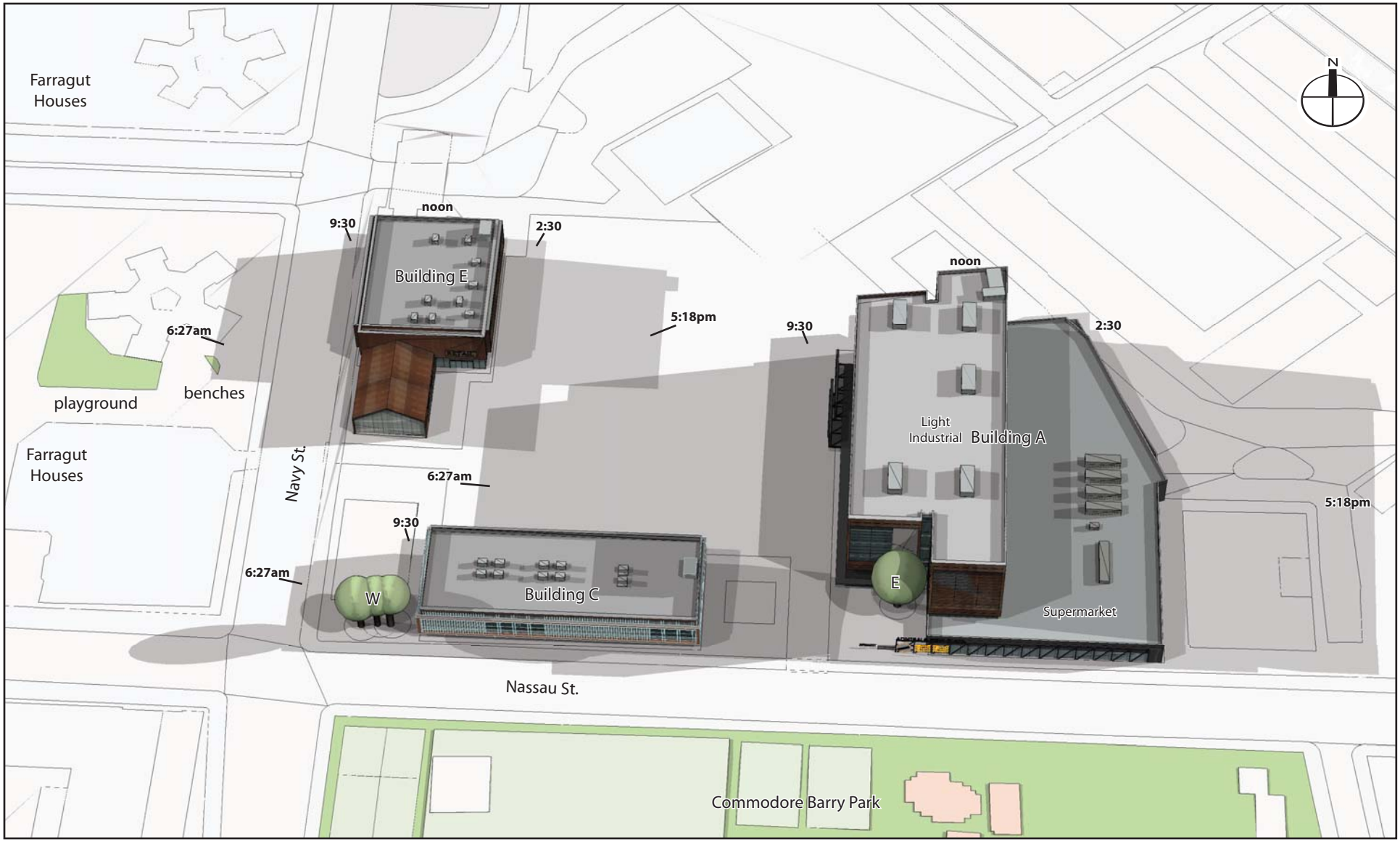
5.23.11



Notes: Daylight Saving Time not used.
The Timber Shed and Building B are not new structures and therefore are not shown.

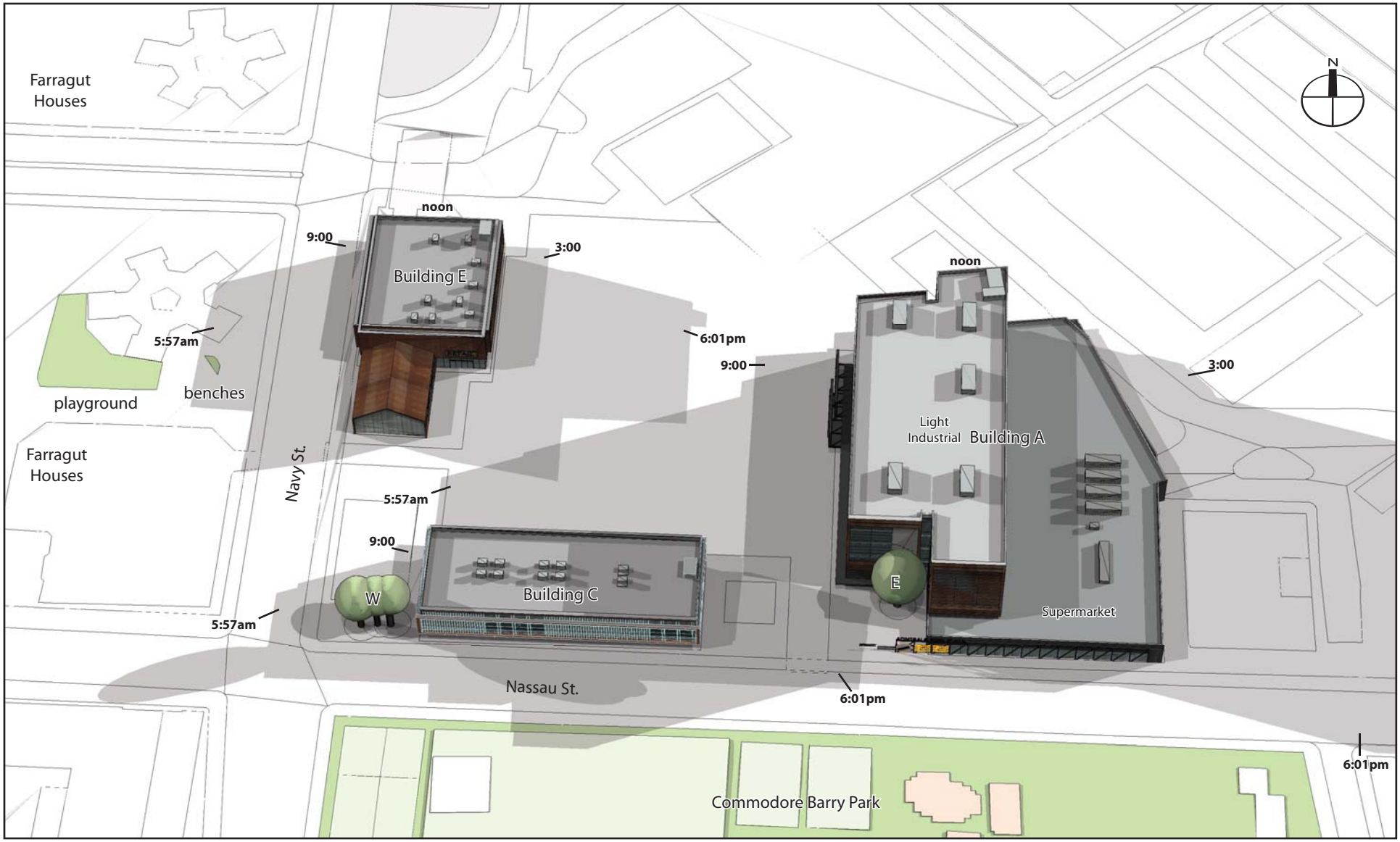
Tier 3 Assessment - March 21/September 21
Figure 4-5

5.23.11



Notes: Daylight Saving Time not used.
The Timber Shed and Building B are not new structures and therefore are not shown.

5.23.11



Notes: Daylight Saving Time not used.
The Timber Shed and Building B are not new structures and therefore are not shown.

5.23.11

Note: Daylight Saving Time not used.

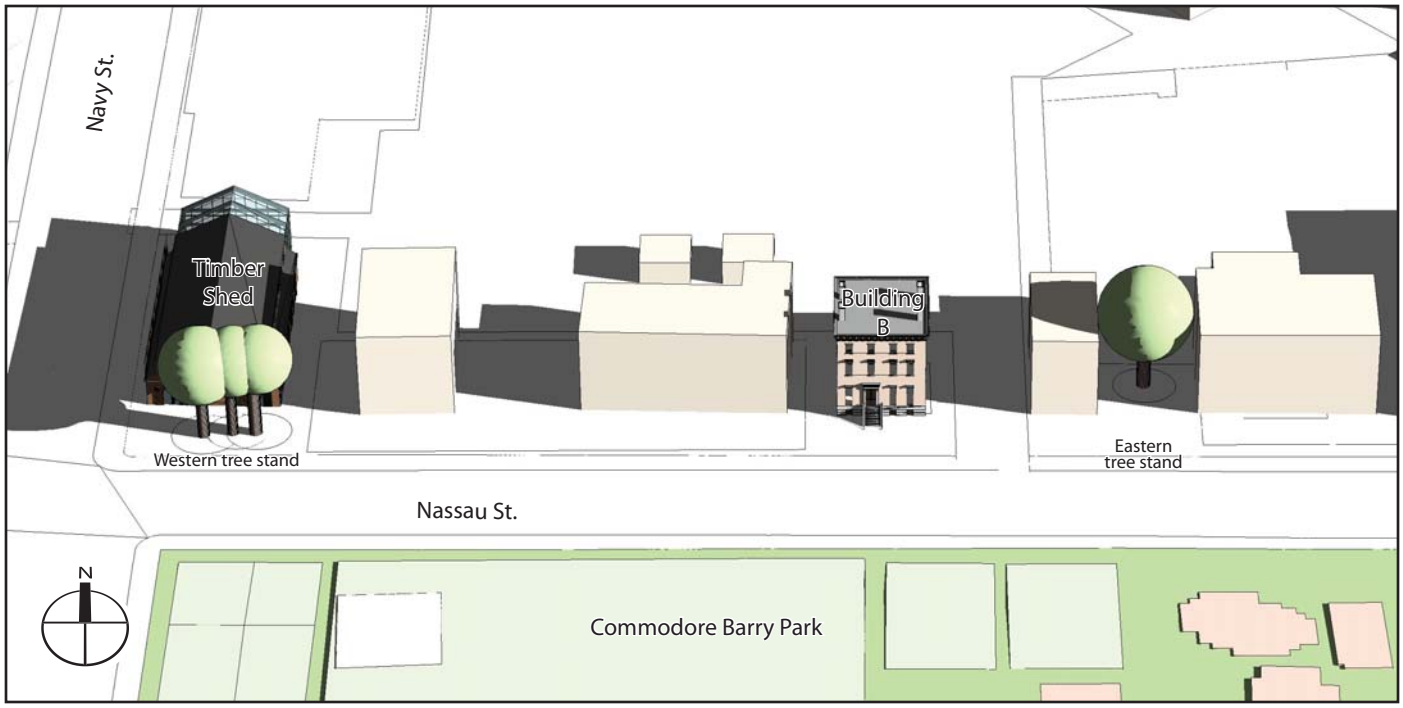
Farragut Houses Benches
May 6/August 6 - 6:35 AM
Figure 4-8

5.23.11

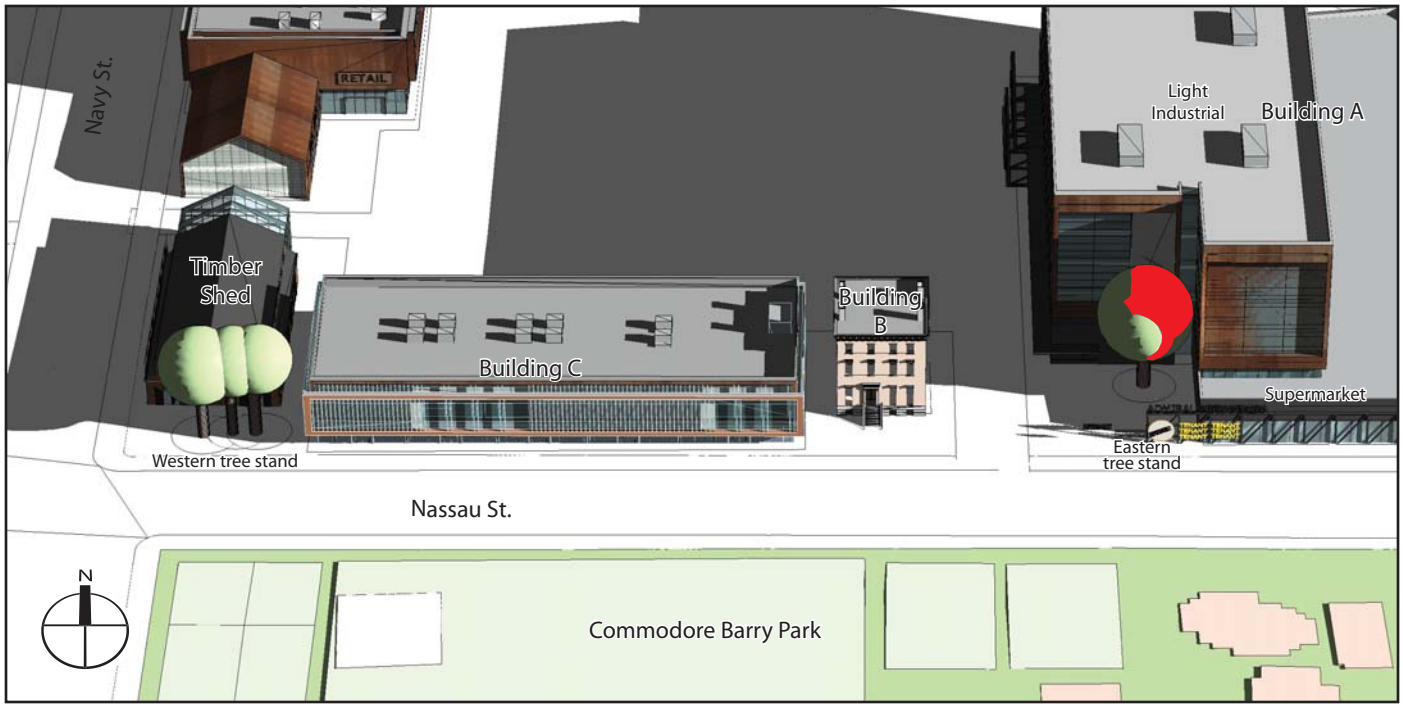
Note: Daylight Saving Time not used.

Farragut Houses Benches &
Commodore Barry Park
June 21 - 6:15 AM
Figure 4-9

5.23.11



No Action



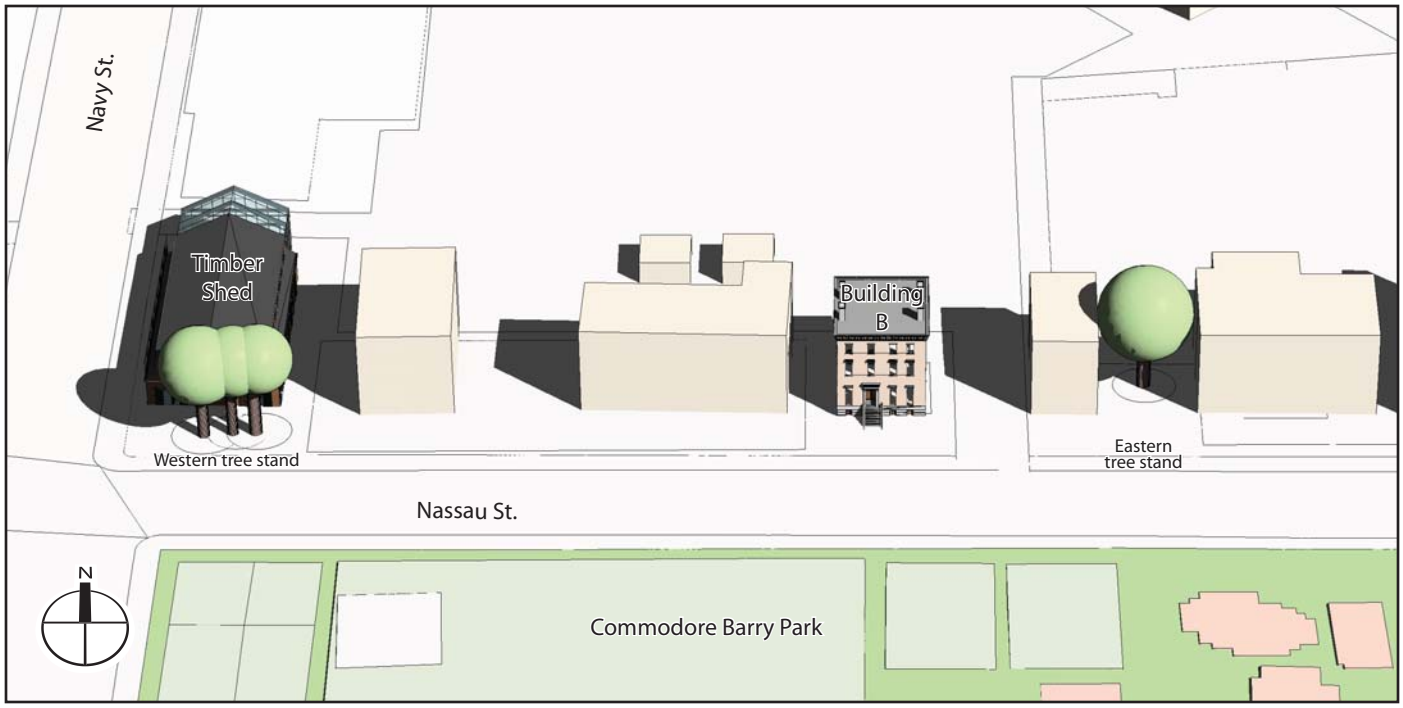
Incremental shadow on retained trees

Proposed Project

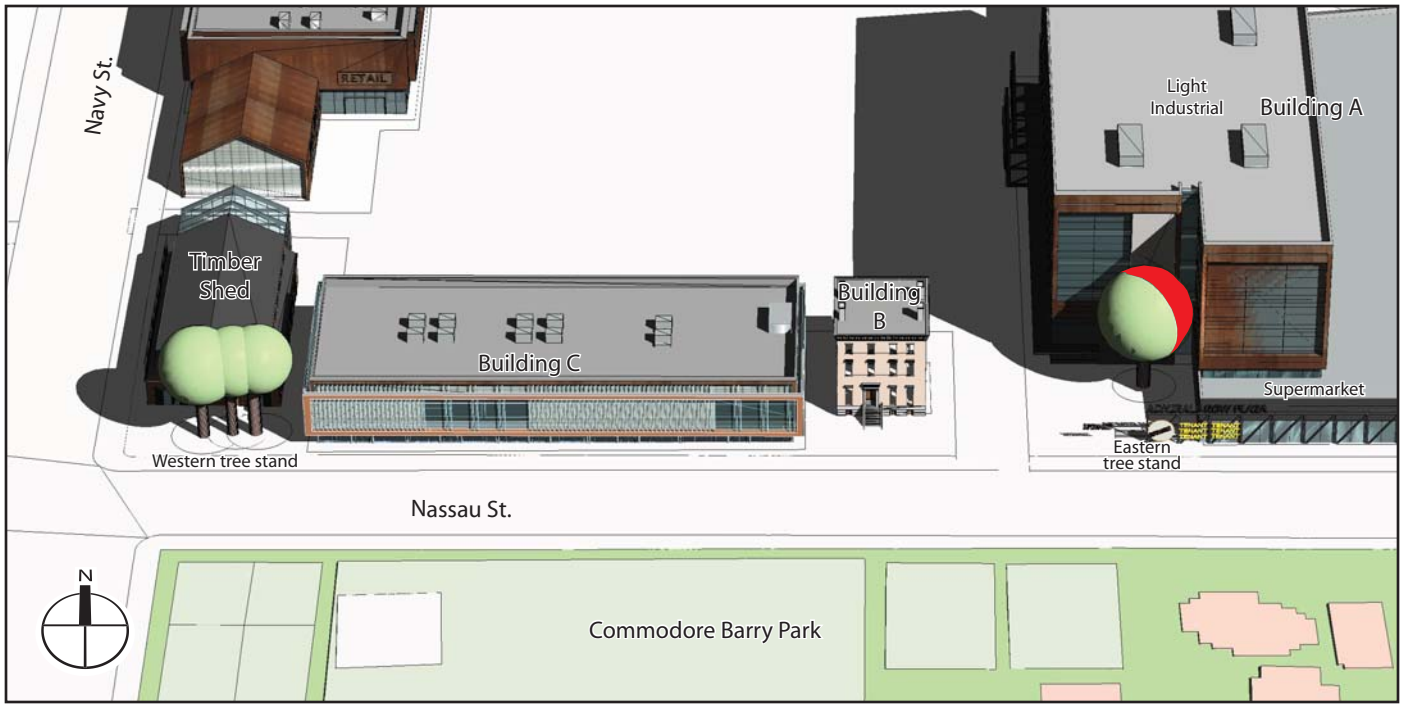
Note: Daylight Saving Time not used.

Retained Project Site Trees
March 21/September 21 - 7:45 AM
Figure 4-10

5.23.11



No Action



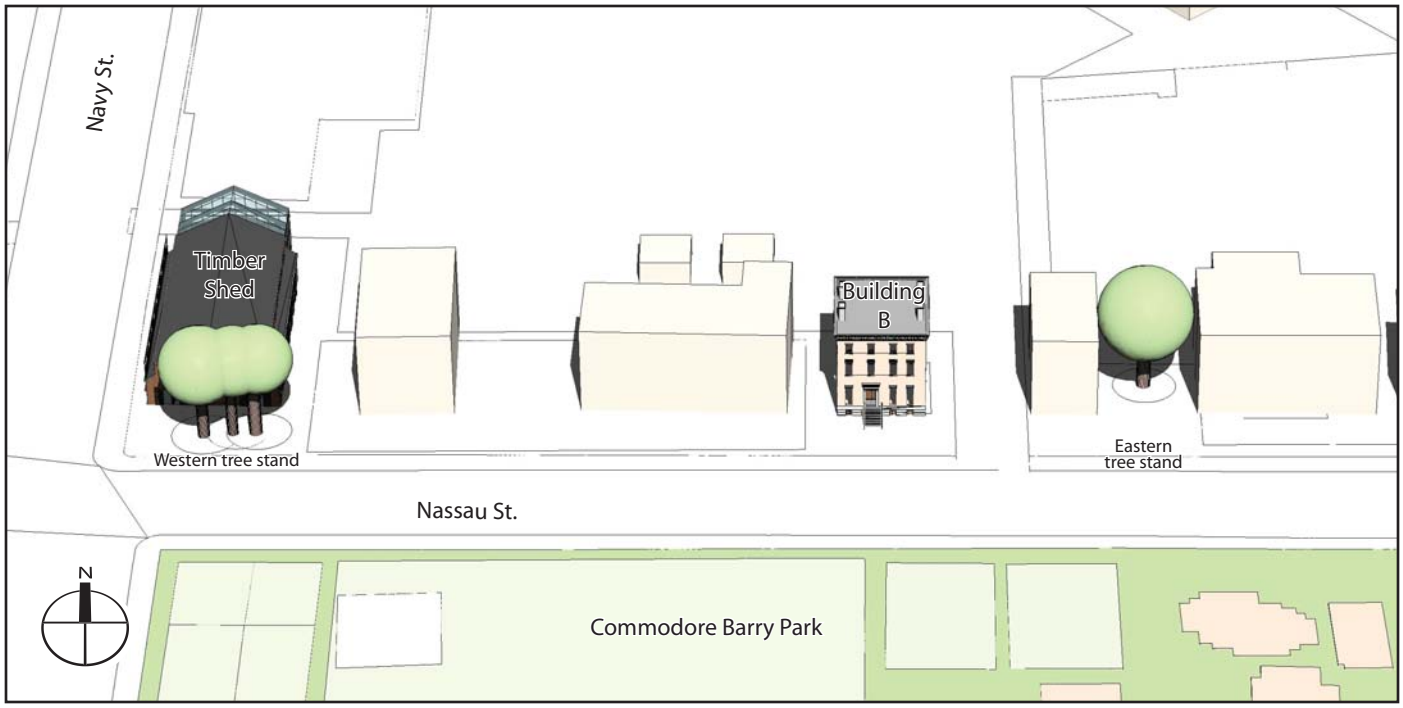
Incremental shadow on retained trees

Proposed Project

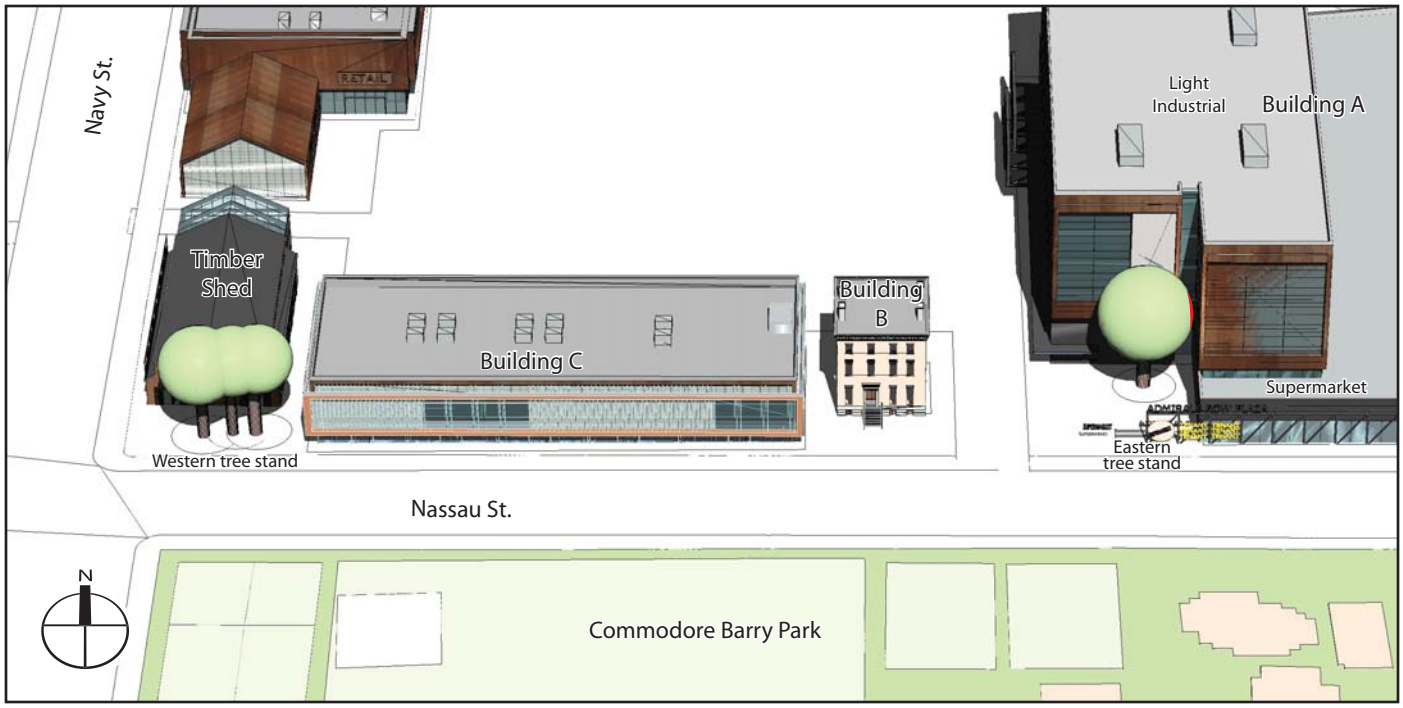
Note: Daylight Saving Time not used.

Retained Project Site Trees
March 21/September 21 - 9:45 AM
Figure 4-11

5.23.11



No Action



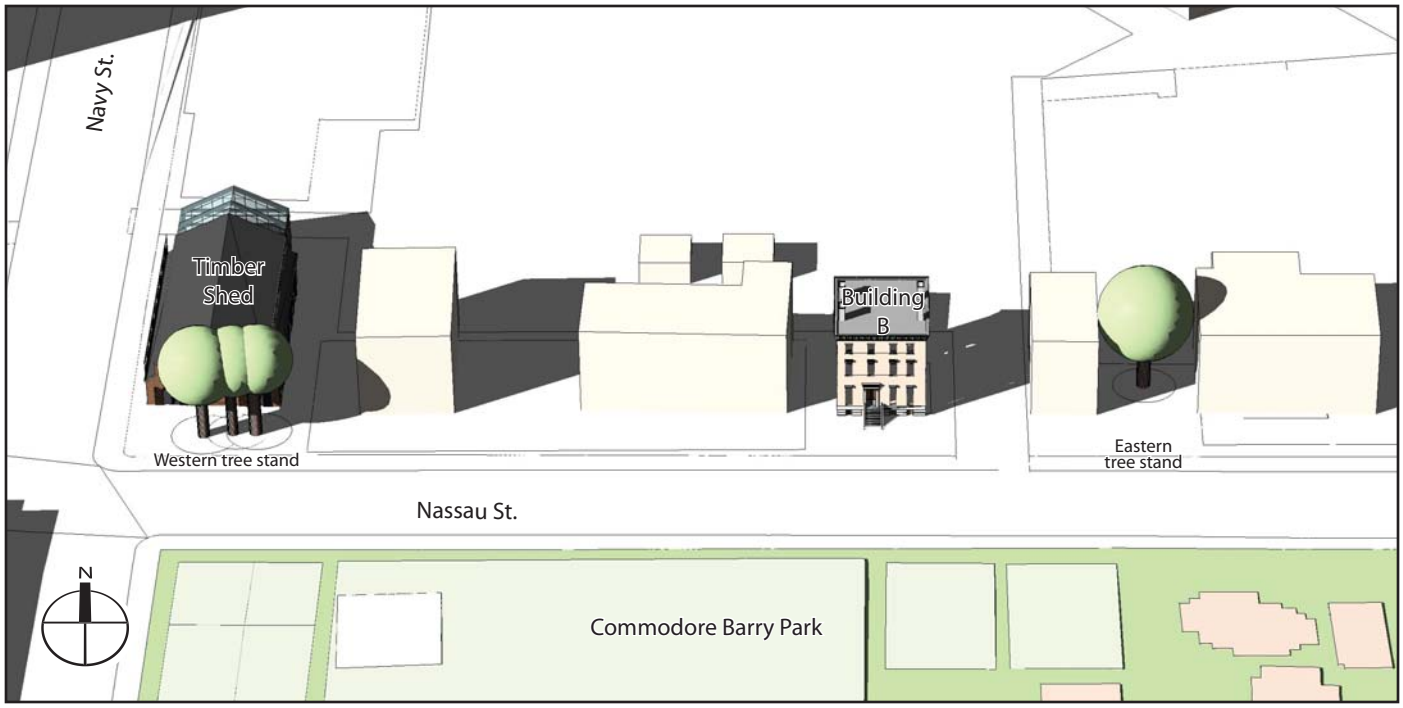
Incremental shadow on retained trees

Proposed Project

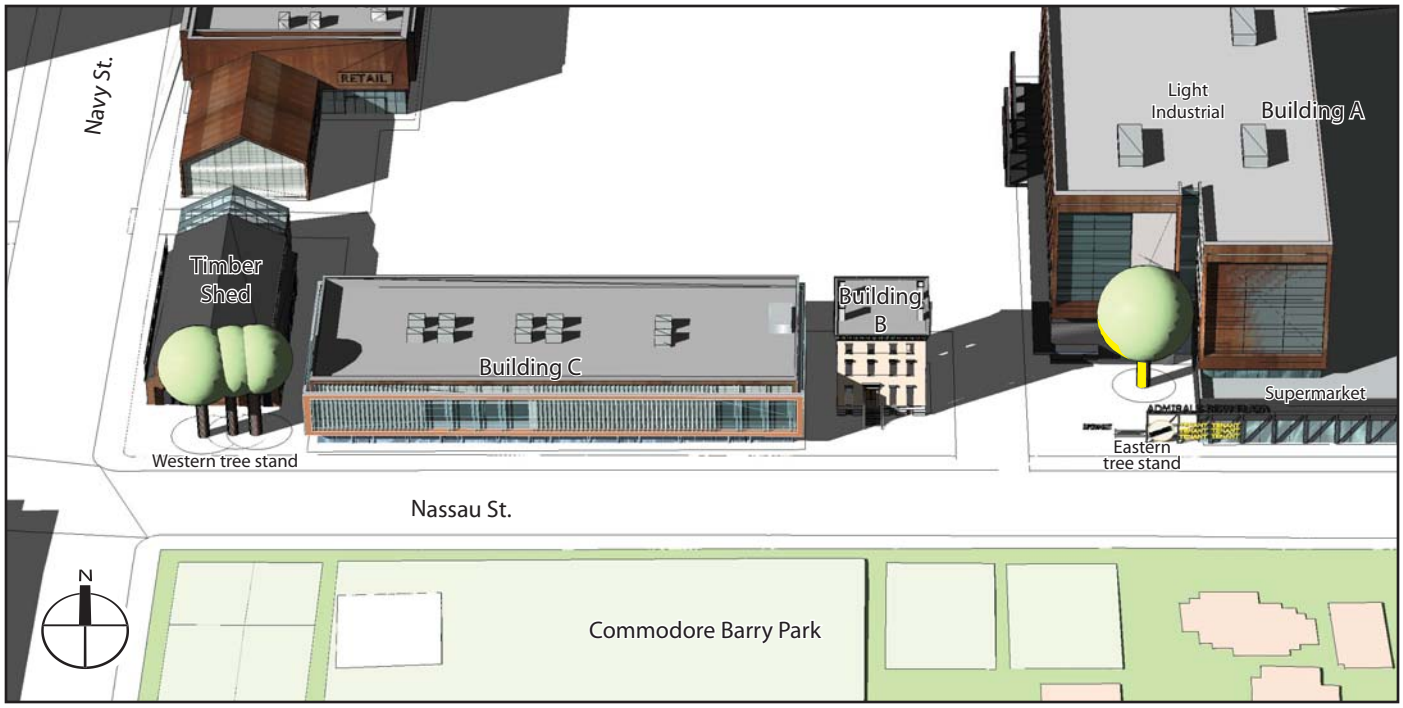
Note: Daylight Saving Time not used.

Retained Project Site Trees
March 21/September 21 - 11:45 AM
Figure 4-12

5.23.11



No Action



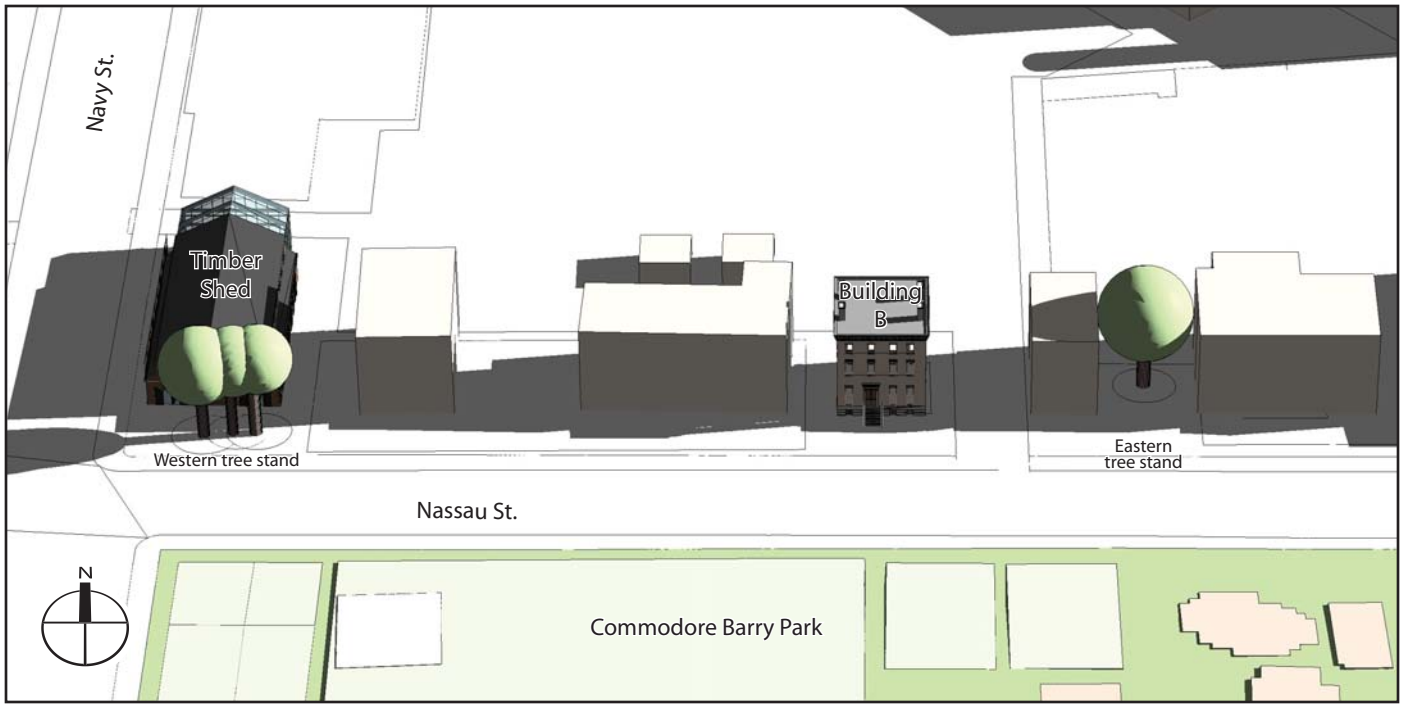
Reduction in shadow on retained trees

Proposed Project

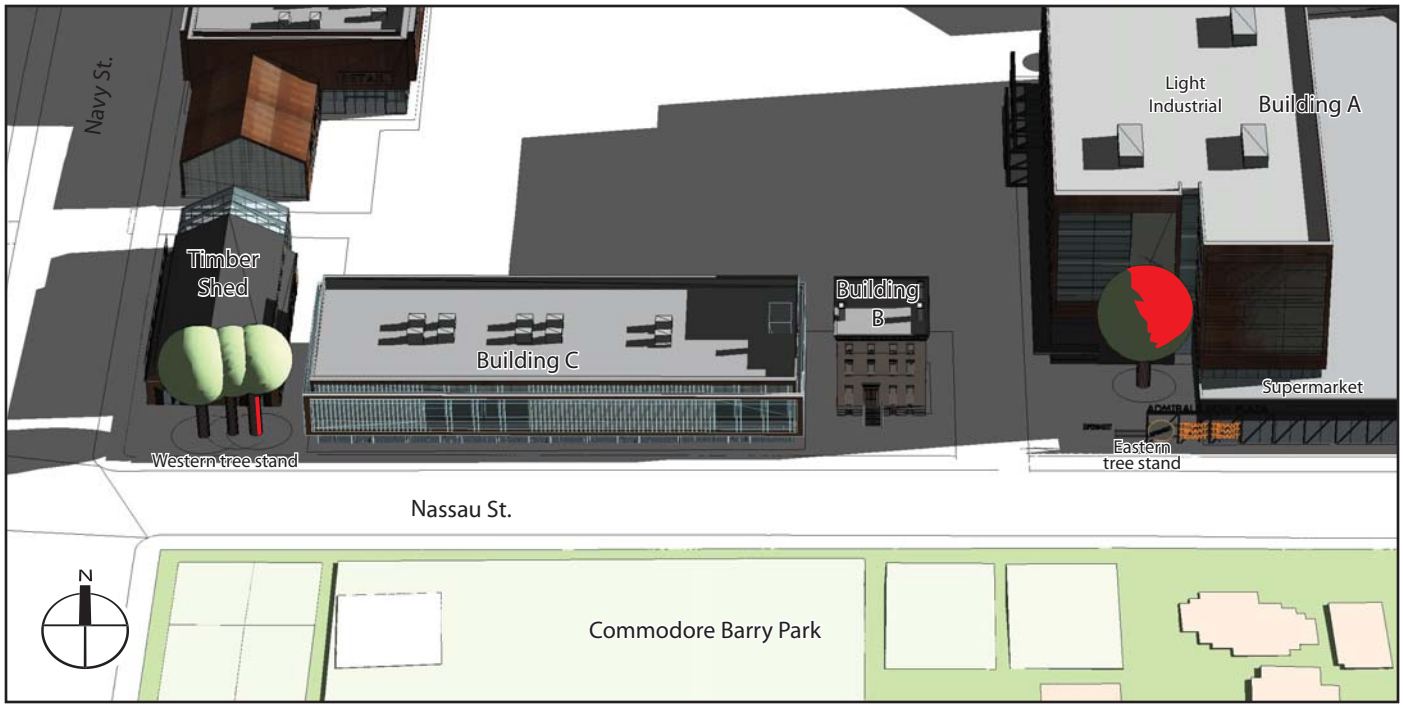
Note: Daylight Saving Time not used.

Retained Project Site Trees
March 21/September 21 - 3:30 PM
Figure 4-13

5.23.11



No Action



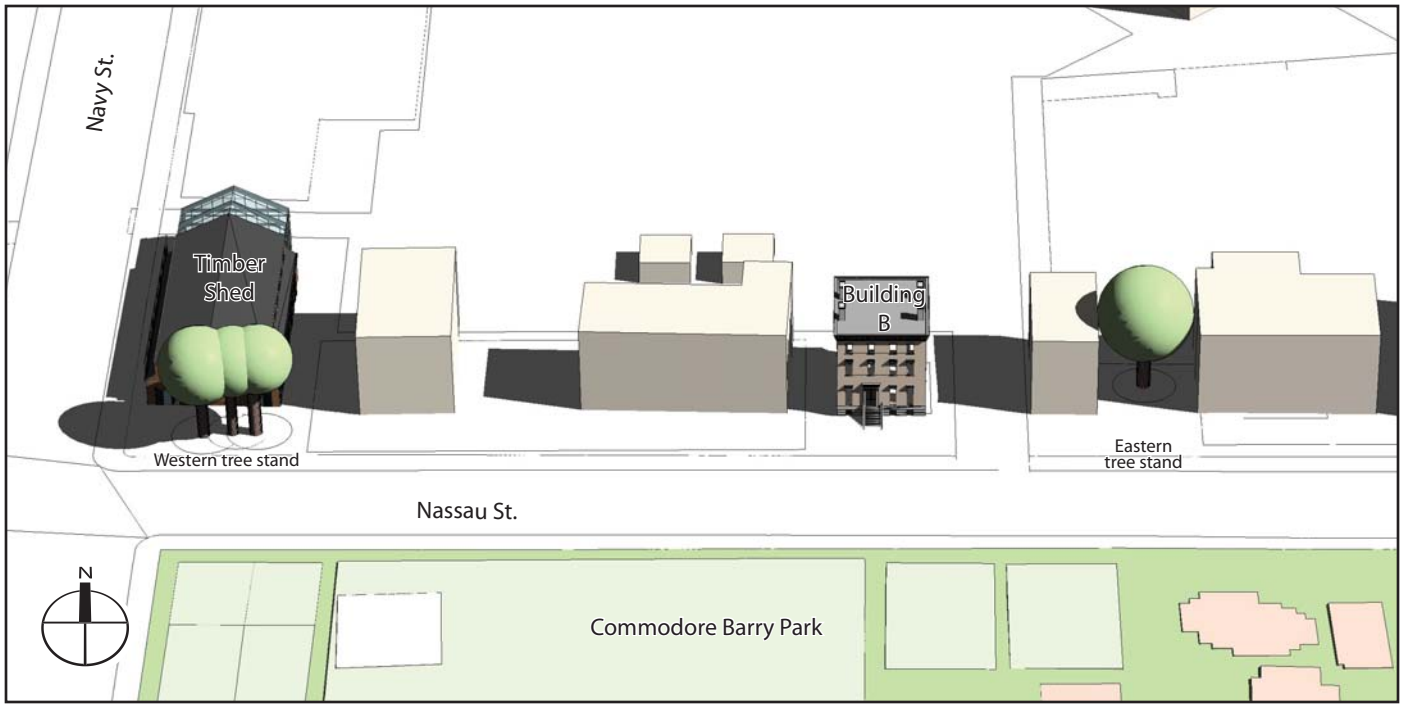
Incremental shadow on retained trees

Proposed Project

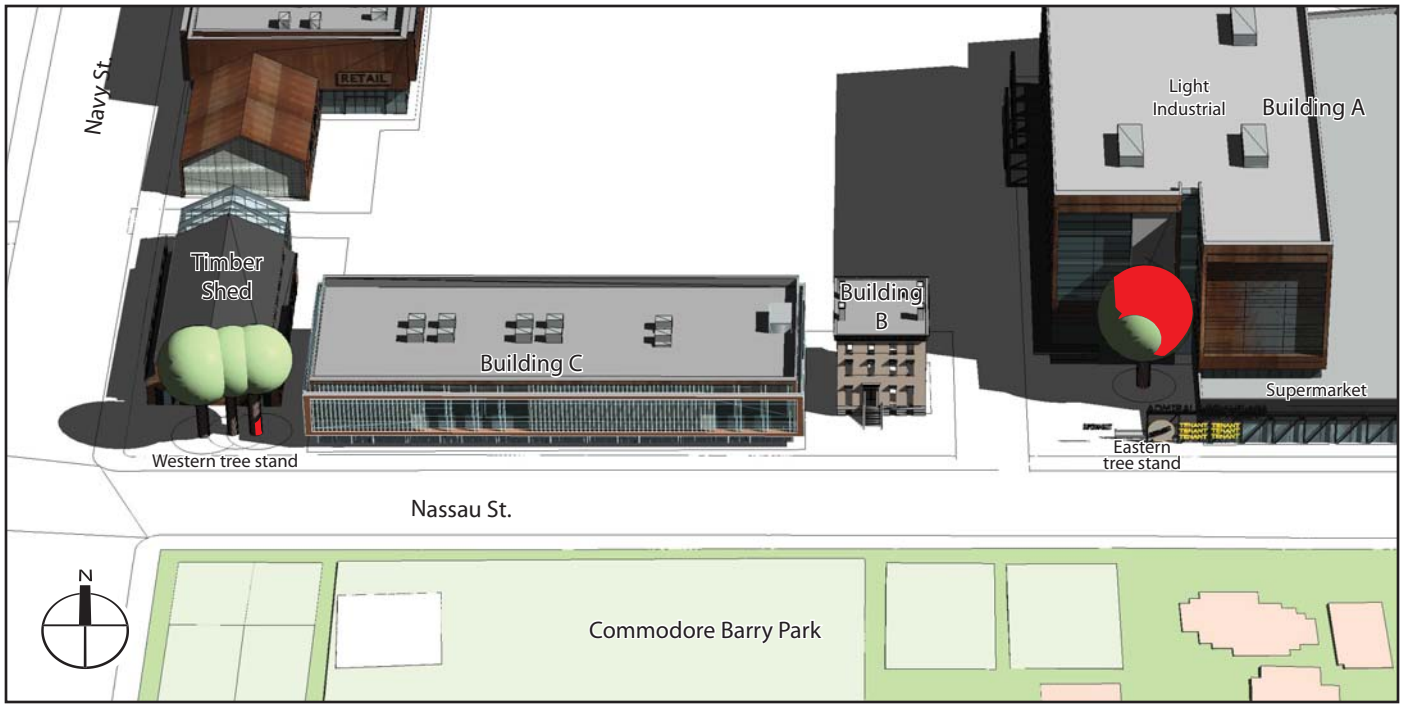
Note: Daylight Saving Time not used.

Retained Project Site Trees
May 6/August 6 - 6:45 AM
Figure 4-14

5.23.11



No Action



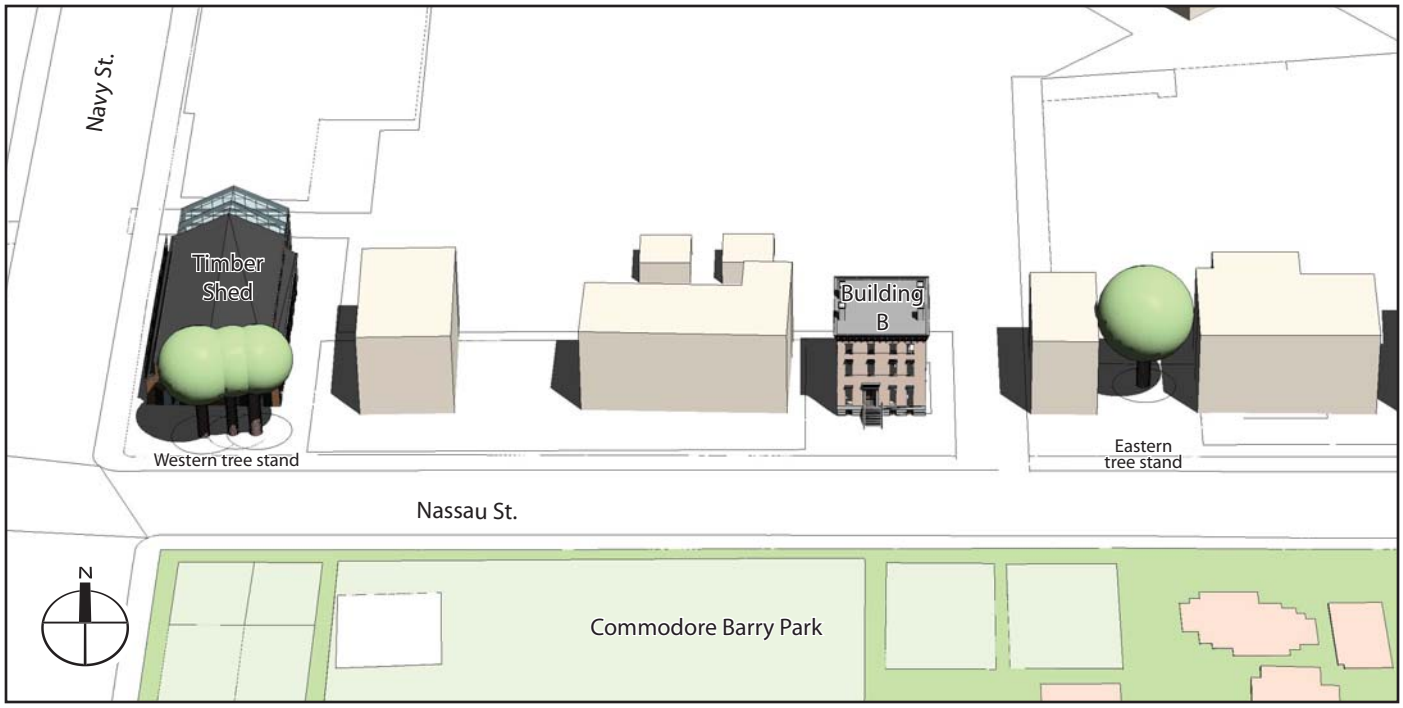
Incremental shadow on retained trees

Proposed Project

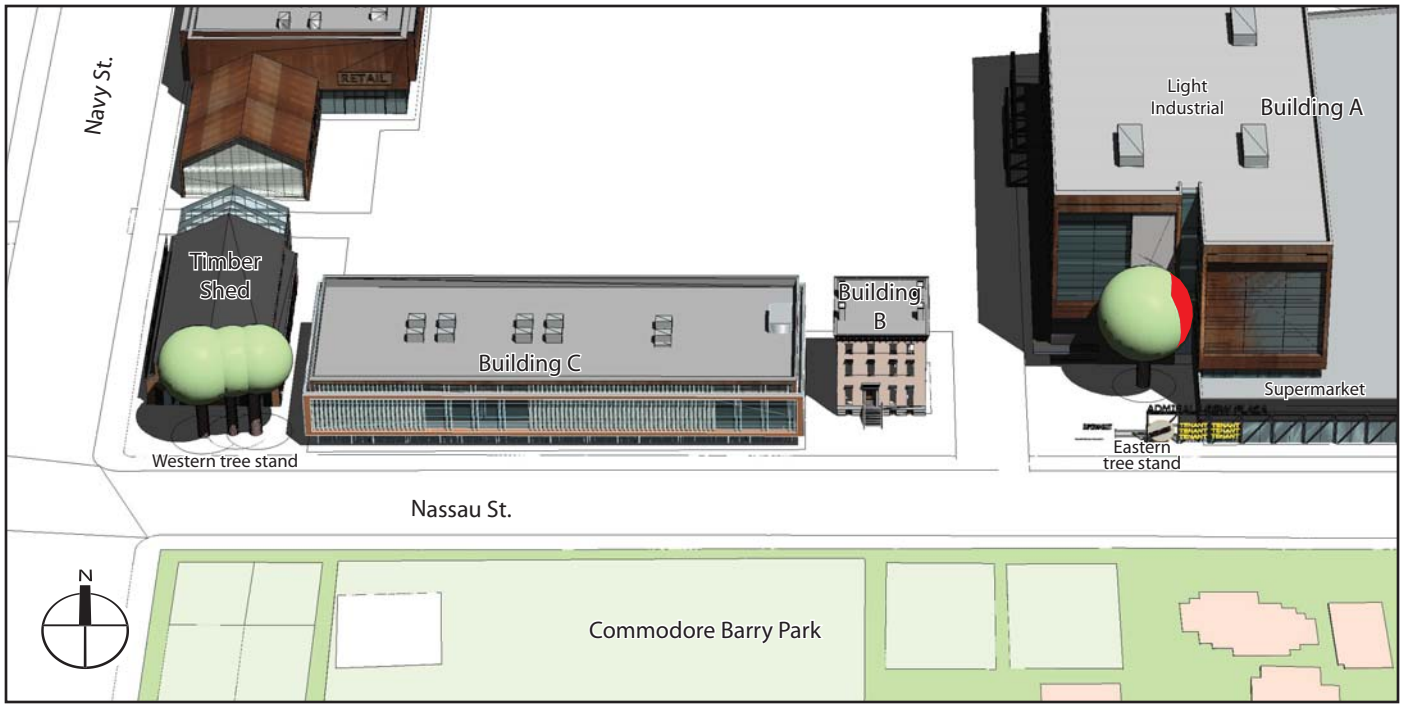
Note: Daylight Saving Time not used.

Retained Project Site Trees
May 6/August 6 - 8:45 AM
Figure 4-15

5.23.11



No Action



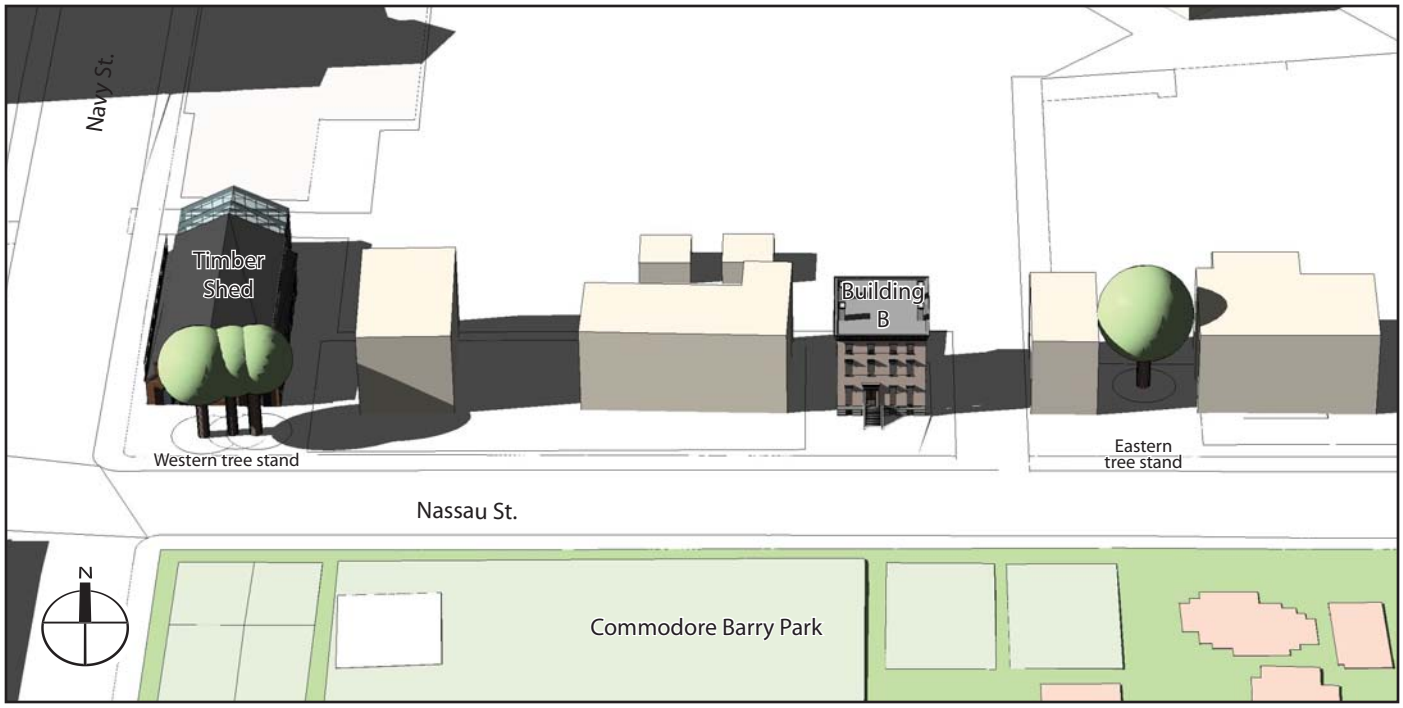
Incremental shadow on retained trees

Proposed Project

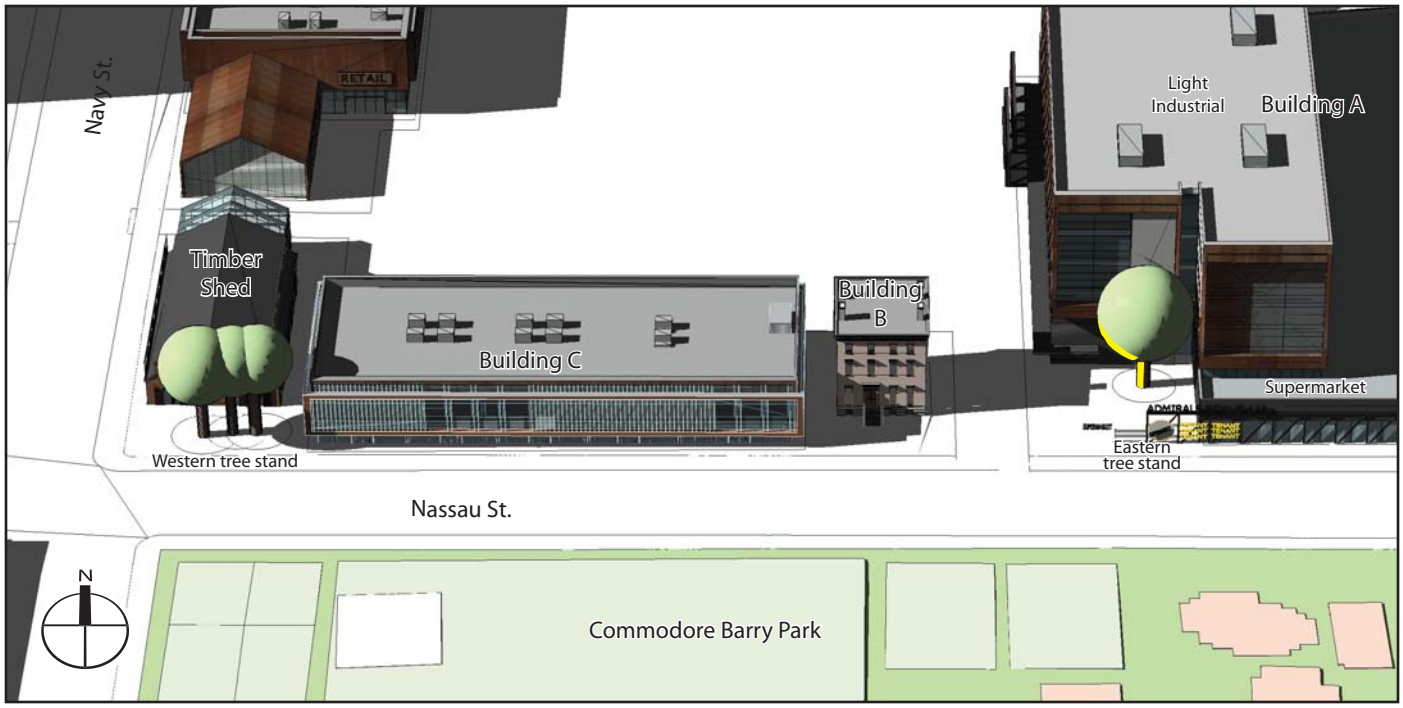
Note: Daylight Saving Time not used.

Retained Project Site Trees
May 6/August 6 - 10:45 AM
Figure 4-16

5.23.11



No Action



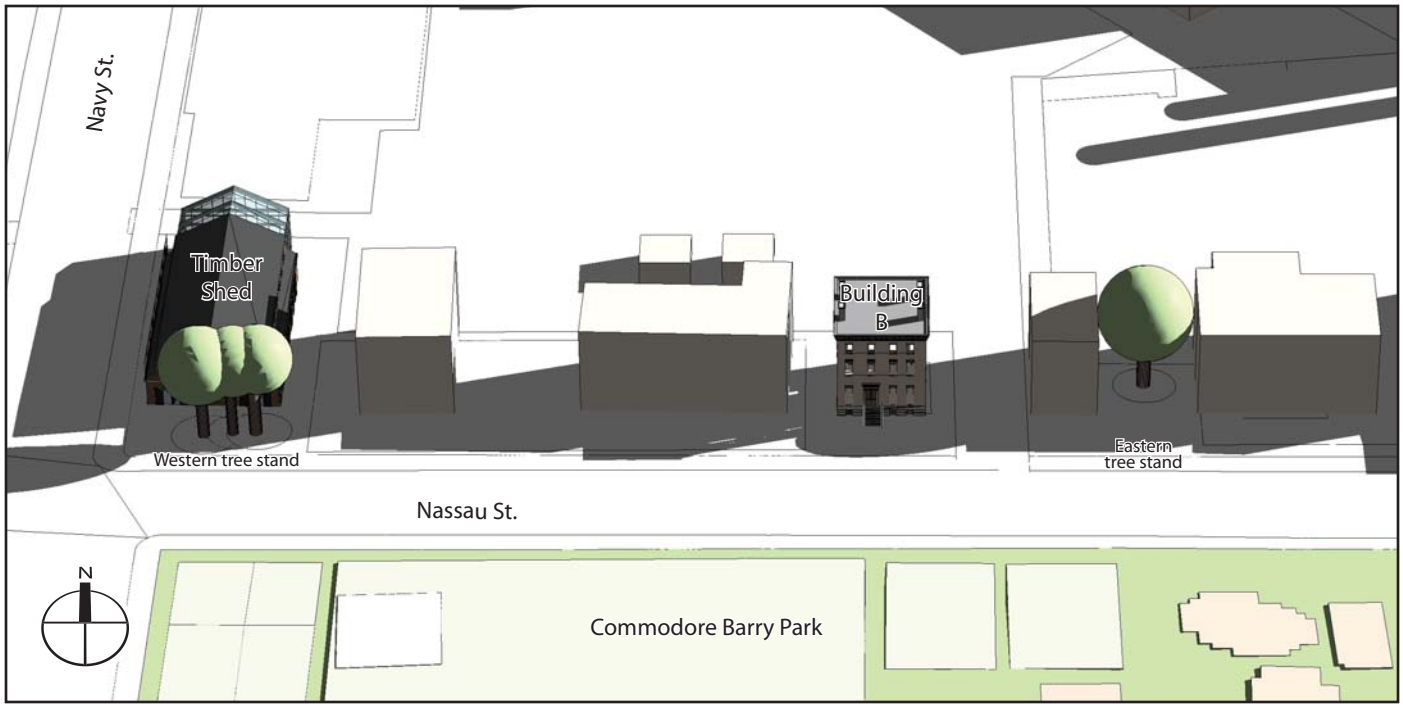
Reduction in shadow on retained trees

Proposed Project

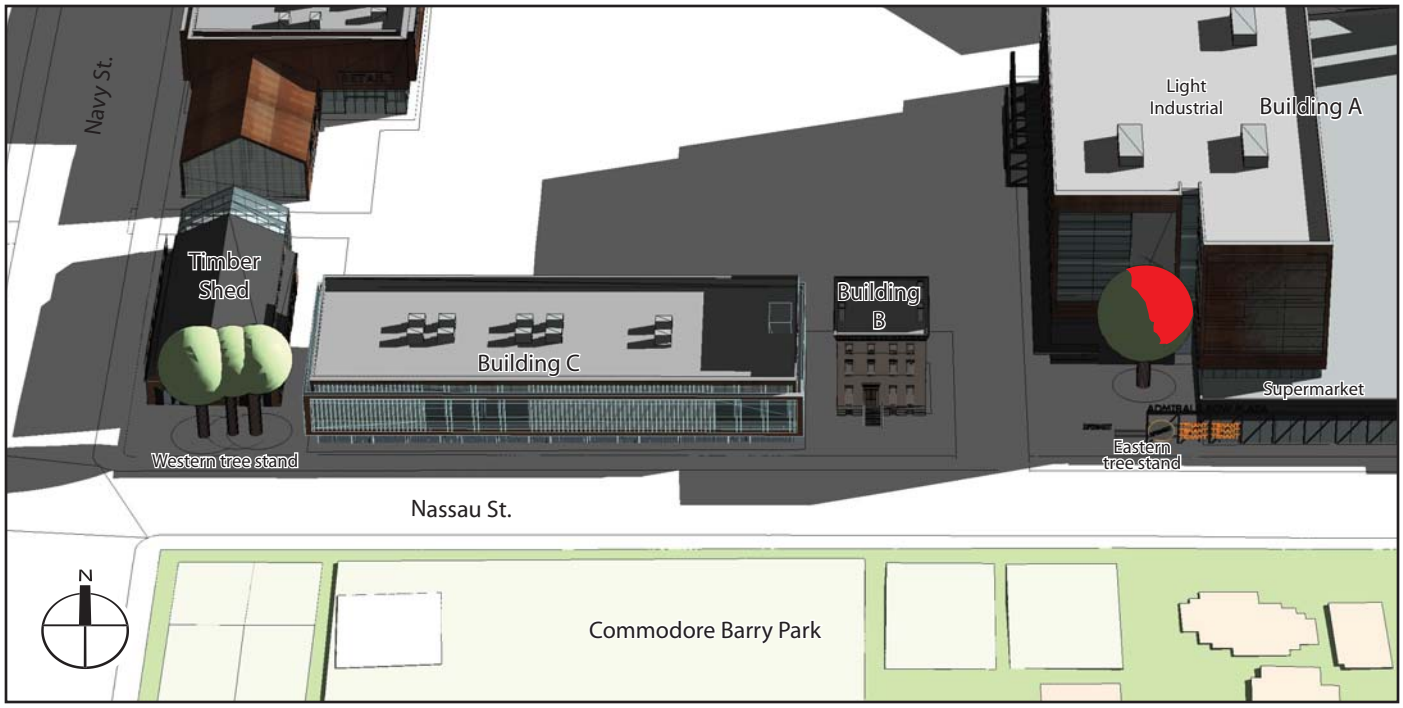
Note: Daylight Saving Time not used.

Retained Project Site Trees
May 6/August 6 - 4:00 PM
Figure 4-17

5.23.11



No Action



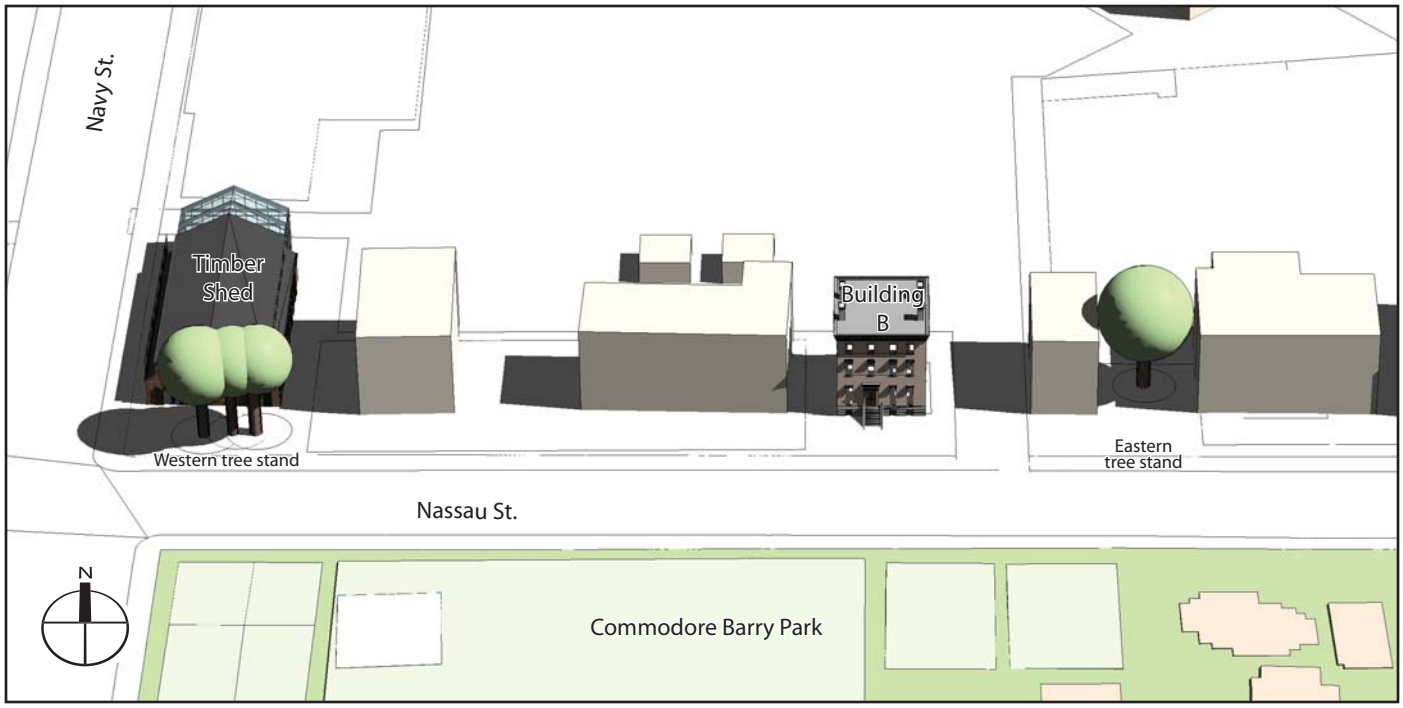
Incremental shadow on retained trees

Proposed Project

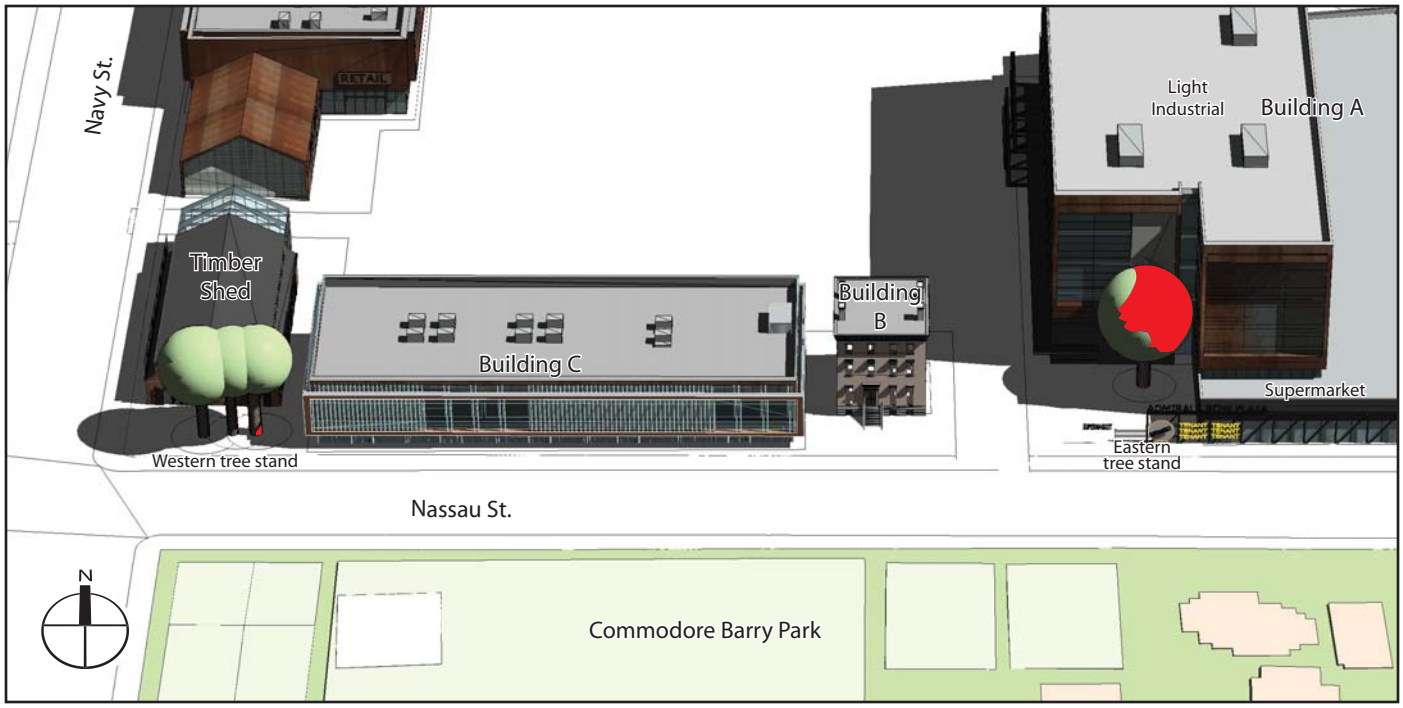
Note: Daylight Saving Time not used.

Retained Project Site Trees
June 21 - 6:30 AM
Figure 4-18

5.23.11



No Action



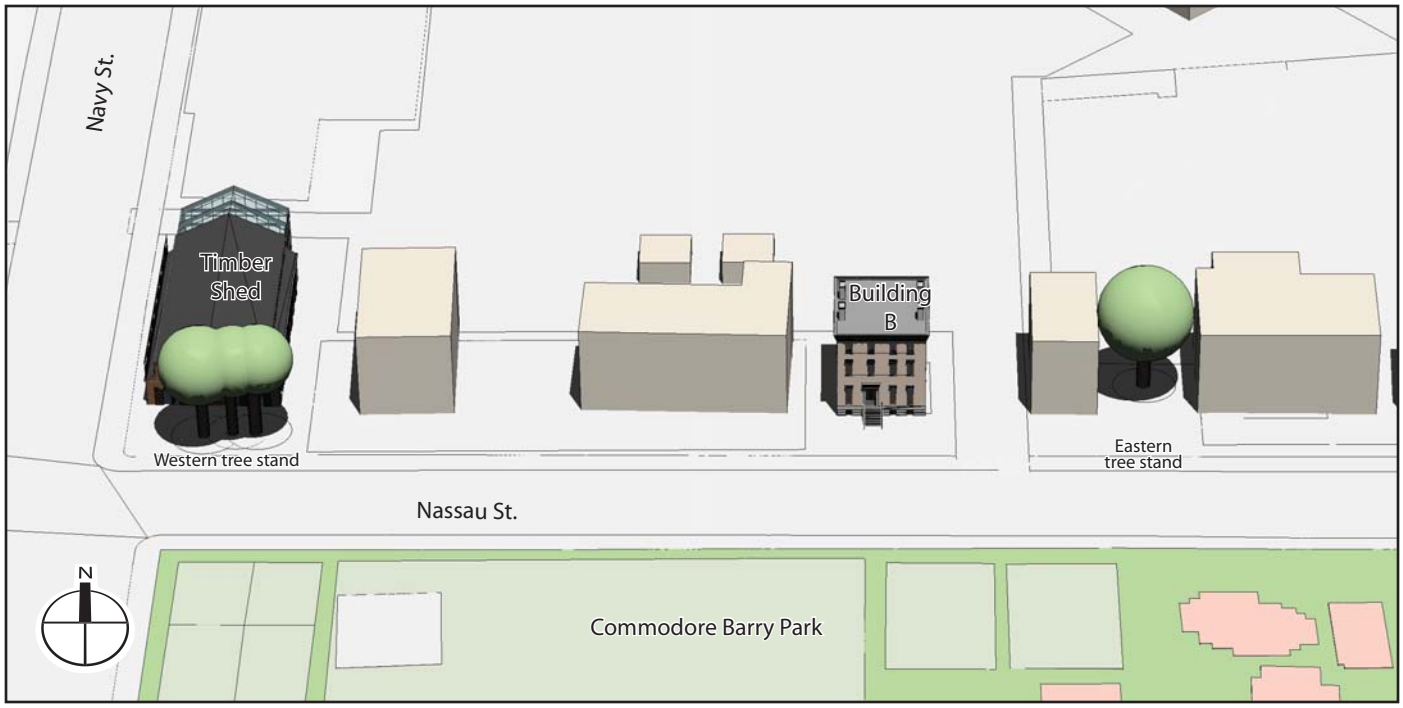
Incremental shadow on retained trees

Proposed Project

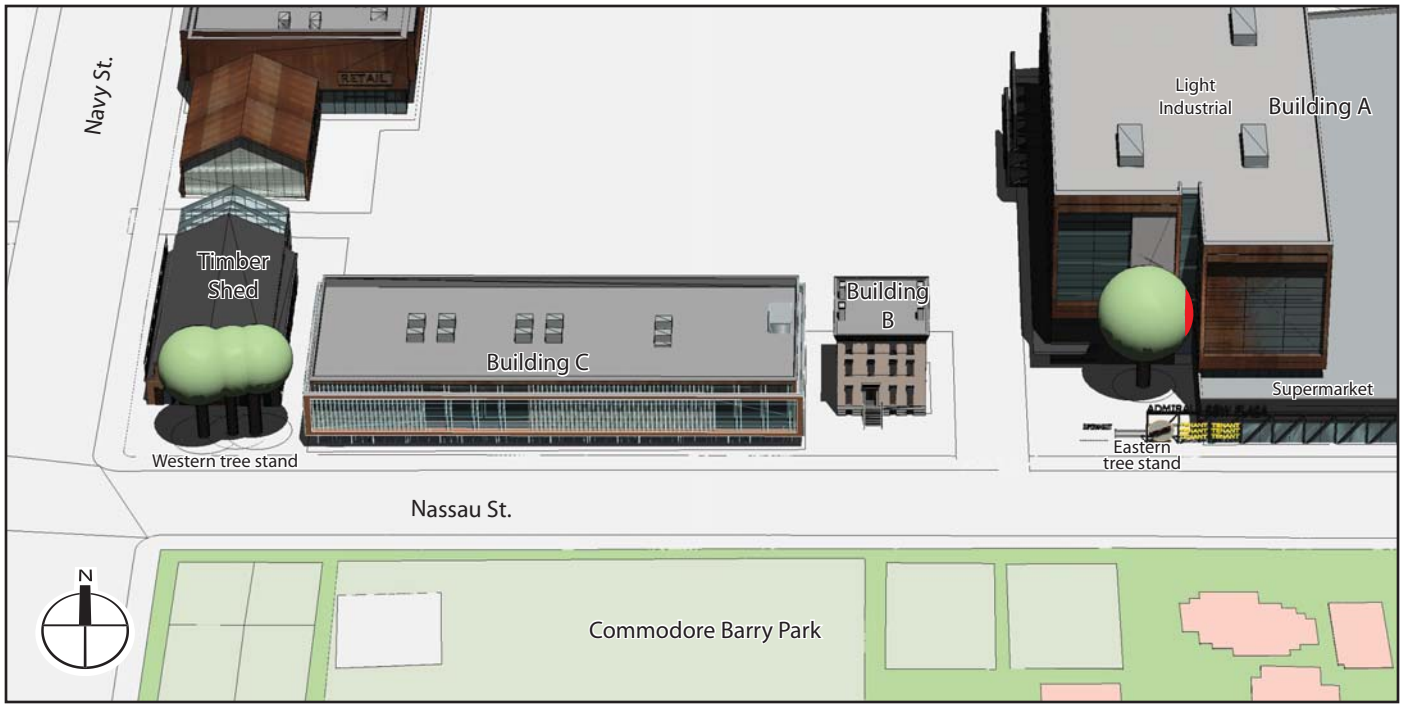
Note: Daylight Saving Time not used.

Retained Project Site Trees
June 21 - 9:00 AM
Figure 4-19

5.23.11



No Action



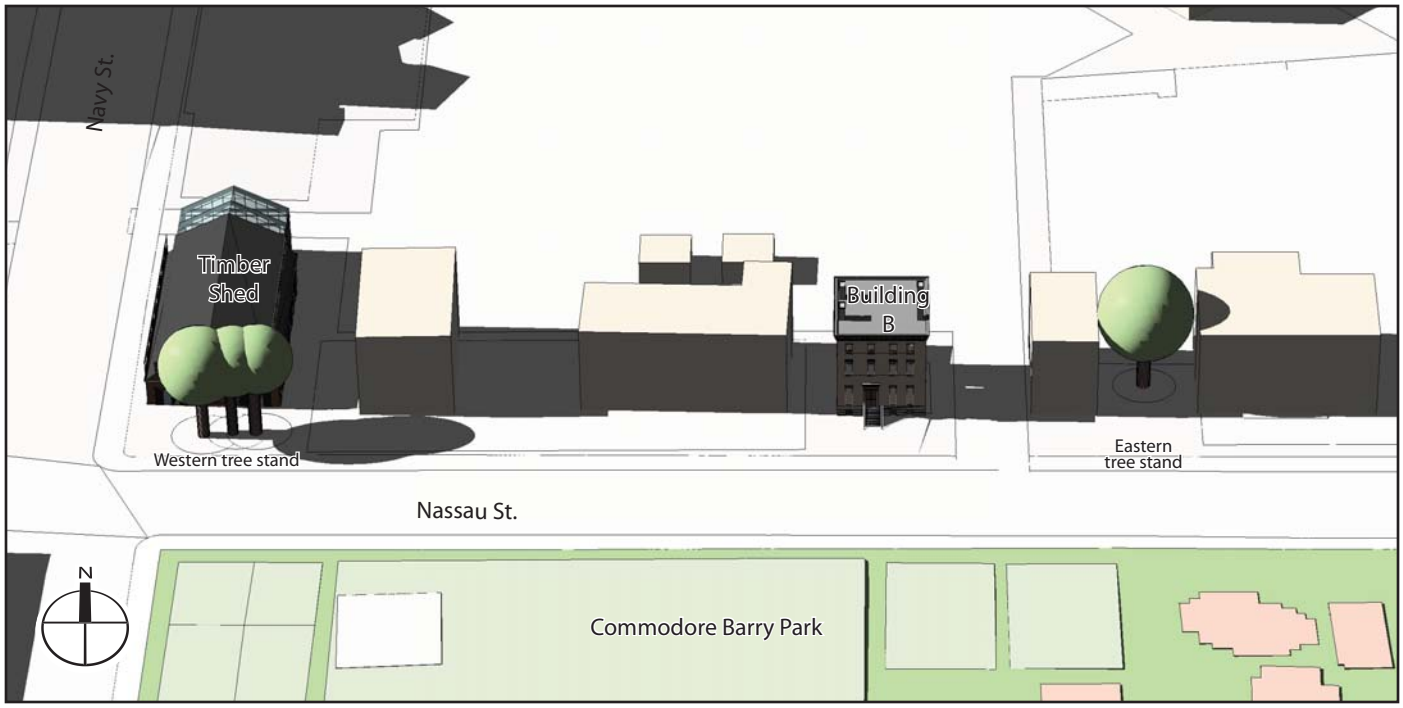
Incremental shadow on retained trees

Proposed Project

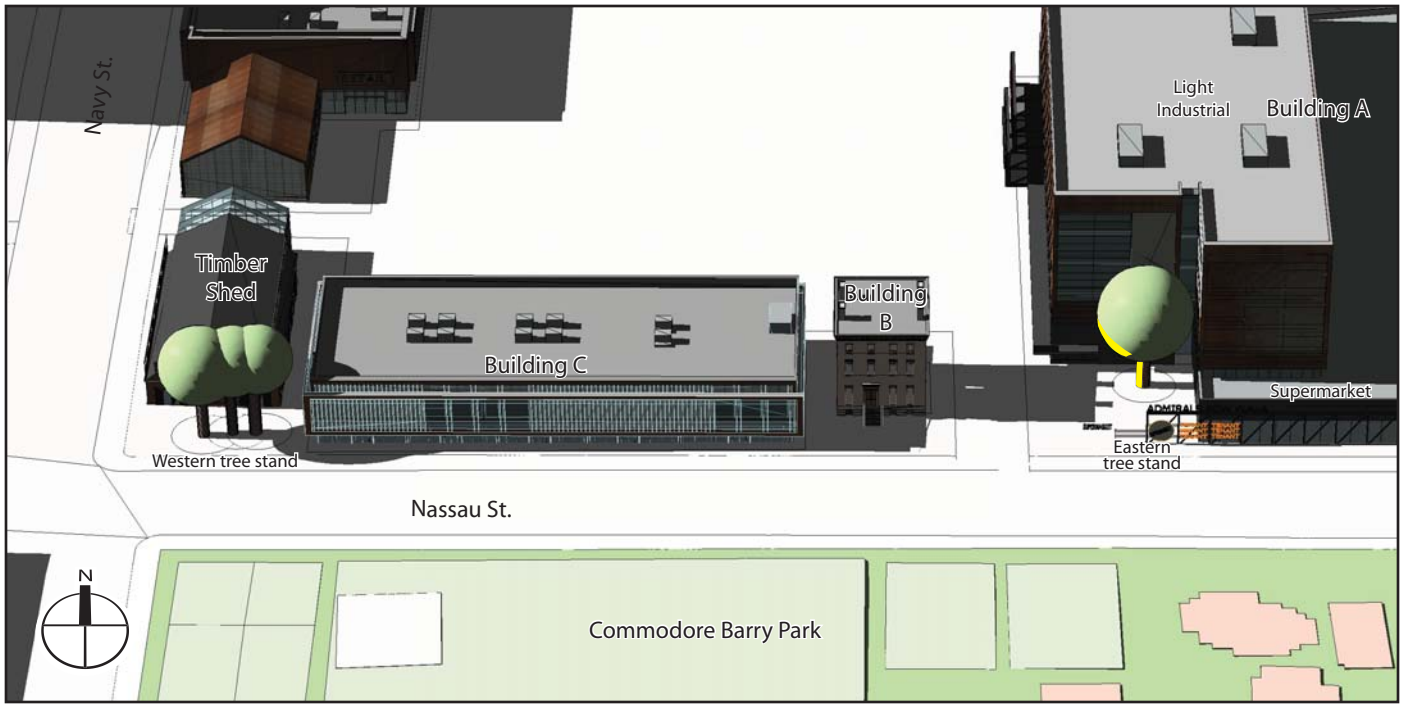
Note: Daylight Saving Time not used.

Retained Project Site Trees
June 21 - 11:30 AM
Figure 4-20

5.23.11



No Action



Reduction in shadow on retained trees

Proposed Project

Note: Daylight Saving Time not used.

Retained Project Site Trees
June 21 - 4:30 PM
Figure 4-21