7.0 INTRODUCTION

This chapter considers the potential for shadows from the Proposed Actions—the implementation of one or more proposed initiatives intended to enhance coastal and social resiliency along the Tottenville shoreline of the South Shore of Staten Island—to affect sunlight-sensitive resources. These initiatives include the Living Breakwaters Project (Breakwaters Project) and the Tottenville Shoreline Protection Project (Shoreline Project). Sunlight-sensitive resources are defined in the 2014 *City Environmental Quality Review (CEQR) Technical Manual* as publically accessible open spaces, sunlight-dependent features of historic architectural resources, and natural resources that depend on sunlight.

7.0.1 SHADOW ASSESSMENT REQUIRMENT

Pursuant to *CEQR*, a shadow assessment is required for new project structures or additions 50 feet or taller in height or those that are adjacent to a sunlight-sensitive resource and taller than 10 feet in height. The Proposed Actions would result in the construction of new structures along the Tottenville shoreline of Staten Island that would be located adjacent to and within a publically accessible sunlight-sensitive open space, Conference House Park. The proposed Breakwaters Project includes the construction of an in-water breakwater system (within Raritan Bay), an area of shoreline restoration, a seasonal floating dock, an on-shore Water Hub within Conference House Park at one of two possible locations and an associated seasonal boat launch. The Shoreline Project would include a series of measures along the Conference House Park shoreline including an earthen berm, a hybrid dune system, an eco-revetment and a raised edge (revetment with trail). All of these project components would be adjacent to or within Conference House Park or Raritan Bay which are sunlight-sensitive resources.

The proposed seasonal floating dock and boat launch would be low-lying horizontal structures with a height of less than 10 feet and therefore a shadow assessment would not be required. However, a shading analysis for these project elements has been included in Chapter 9, “Natural Resources.” Although several of the proposed project elements (breakwaters system and shoreline measures) would be over ten feet in height from the base of the structure, the shadows they would cast would not extend beyond their construction footprints, preventing their shadows from affecting the adjacent resources. Therefore, a shadow assessment will not be required for the constructed elements of the proposed shoreline measures of the Shoreline Project or the breakwater segments of the Breakwaters Project.

As described in Chapter 1, “Purpose and Need and Alternatives,” one of two potential locations is under consideration for siting the Water Hub—Potential Location 1 would be in the vicinity of the southern terminus of Page Avenue (involving the construction of a new structure). Potential Location 2 would be in the north-western portion of Conference House Park (involving the rehabilitation and adaptive reuse of an existing New York City Department of Parks and Recreation [NYC Parks] building).

At Potential Location 1, there are two options for the construction of the Water Hub, both in the vicinity of the southern terminus of Page Avenue. The first, Page East Option, would locate the proposed Water Hub in an existing Conference House Park parking lot and surrounding wooded area immediately east of Page Avenue. The second, Page West Option, would use a grassy site west of Page Avenue that has previously contained a two-story NYC Parks building (which was demolished in 2016 due to substantial damage caused by Superstorm Sandy) At Potential Location 1, the proposed Water Hub would be a new structure, and at its highest, would be approximately 38 and 48 feet (for the Page West Option and Page East Option, respectively) above grade and located within a sunlight-sensitive resource, requiring a shadow assessment under CEQR.

At Potential Location 2, there are two options for the adaptive reuse of existing NYC Parks buildings for Water Hub programming. At this location, the Water Hub programming would either be accommodated at the existing Henry Hogg Biddle House or the existing Rutan-Beckett House. Although the two houses are adjacent to a sunlight-sensitive resource, Conference House Park, neither adaptive reuse would require structural addition to the existing building and therefore would not produce any new shadow.

However, should the Water Hub be located at Potential Location 2, a small structure for kayak storage would be included near the terminus of Page Avenue, smaller in size and height and within the footprint of one of the two Water Hub options for Potential Location 1.Since the proposed Water Hub building (at Potential Location 1) would be a larger structure than the proposed kayak storage structure in the same general location, the shadows analysis conservatively addresses shadows only from Potential Location 1 and with the larger Water Hub building.

7.1 PRINCIPAL CONCLUSIONS

At Potential Location 1, the Proposed Actions would facilitate the development of an on-shore Water Hub facility (under Alternatives 2 and 3) that would be constructed within Conference House Park at one of two possible sites on either side of the foot of Page Avenue (Page West Option or Page East Option). At either site, the proposed Water Hub would cast new shadow on portions of Conference House Park for the entirety of the four representative analysis days examined in the detailed shadow assessment. However, the relatively small extent of new shadow compared to Conference House Park's total size would not substantially alter the usability of the open space resources. Furthermore, all vegetation that would be affected by new shadow from either location of the proposed Water Hub would continue to receive enough direct sunlight to support plant vitality. Therefore, if the Water Hub were constructed at Potential Location 1, the Proposed Actions would not result in a significant shadows impact on Conference House Park or any other sunlight-sensitive resource.

At Potential Location 2, the Proposed Actions would facilitate the rehabilitation and adaptive reuse of an existing NYC Parks building. Since no new structures over 10 feet in height would be constructed at this location, no significant adverse shadows impacts would occur. A small structure for kayak storage that would be constructed near the terminus of Page Avenue would be smaller in size and height than the Water Hub building analyzed as part of Potential Location 1. Therefore, similar to the conclusions for the analysis at Potential Location 1, the structure for kayak storage would not substantially alter the usability of open space resources, and all vegetation that would be affected by new shadow from the structure would continue to receive enough direct sunlight to support plant vitality. Therefore, if the Water Hub were located at

Potential Location 2, with a small structure for kayak storage at Page Avenue, the Proposed Actions would not result in a significant shadows impact on Conference House Park or any other sunlight-sensitive resource.

7.2 DEFINITIONS AND METHODOLOGY

This analysis has been prepared in accordance with CEQR procedures and follows the guidelines of the 2014 *CEQR Technical Manual*.

7.2.1 DEFINITIONS

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 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.

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);
- *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.

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.

7.2.2 METHODOLOGY

Following the guidelines of the 2014 *CEQR Technical Manual*, a preliminary screening assessment is first 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 development site 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 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 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.

The following screening and detailed analysis has been performed to assess the potential for shadows impacts from the proposed Water Hub, a project component of the Breakwaters Project under Alternatives 2 and 3.

7.3 PRELIMINARY SCREENING ASSESSMENT AND DETAILED ANALYSIS

A base map was developed using Geographic Information Systems (GIS)[1] showing the location of the two proposed Water Hub locations requiring a shadow assessment and the surrounding street layout (see **Figure 7-1**). In coordination with the land use and historic and cultural resources assessments presented in other chapters of this environmental impact statement (EIS), potential sunlight-sensitive resources were identified and shown on the map.

7.3.1 TIER 1 SCREENING ASSESSMENT

The proposed Water Hub would be located in one of two proposed locations, labeled on **Figure 7-1** as Water Hub-Option West and Water Hub-Option East. For the Tier 1 assessment, the longest shadow that the proposed Water Hub in each potential location could cast is calculated, and, using this length as the radius, a perimeter is drawn around the development. Anything outside this perimeter representing the longest possible shadow could never be affected by project generated shadow, while anything inside the perimeter needs additional assessment.

[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.

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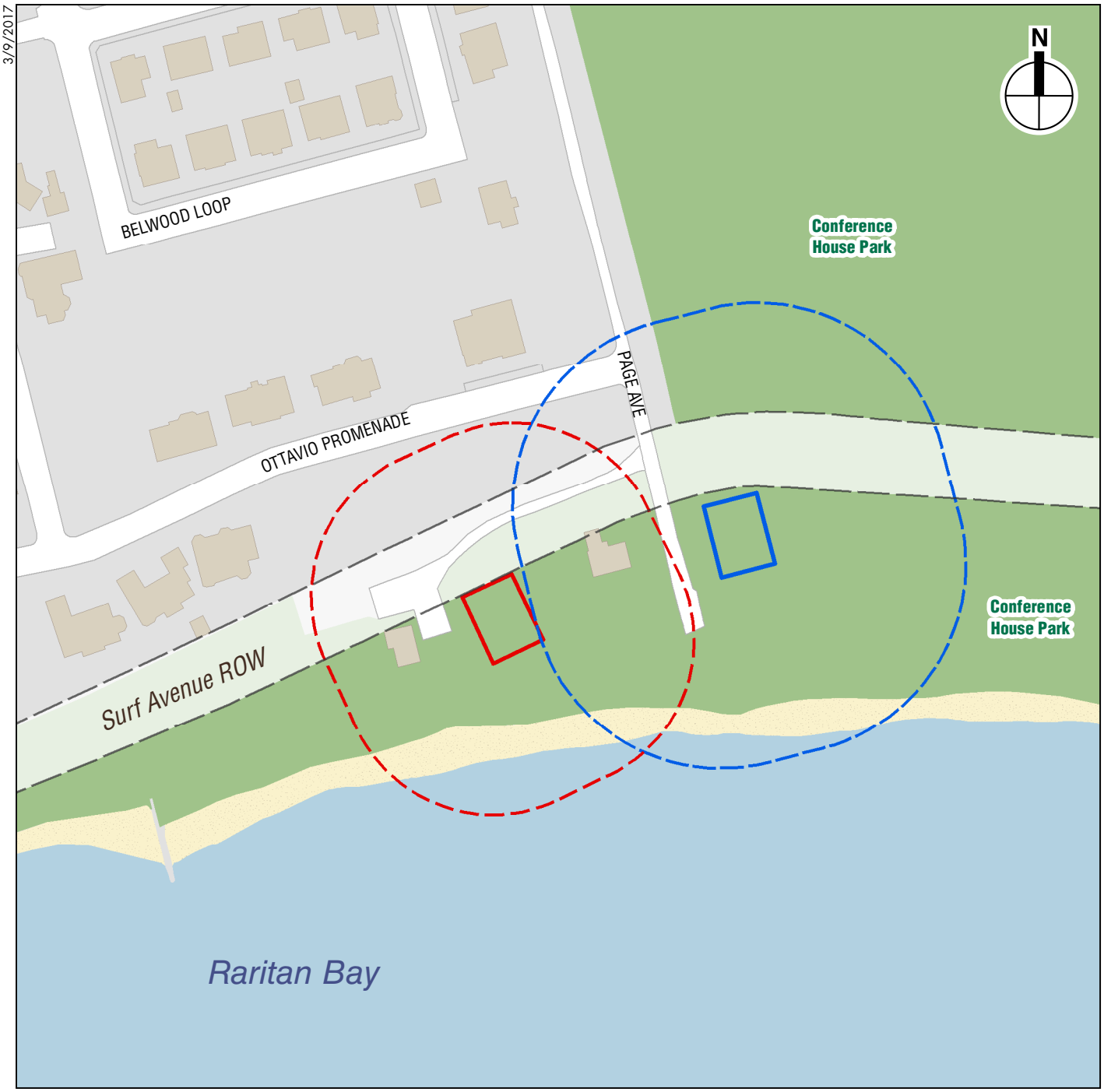


Proposed Water Hub Page West Option

Proposed Water Hub Page East Option

Page West Option Longest Shadow Study Area - 163 ft.

Page East Option Longest Shadow Study Area - 206 ft.

Publicly Accessible Open Space

0 400 FEET

Water Hub Potential Location 1
Tier 1 Assessment

Figure 7-1

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.

At maximum, the proposed Water Hub-Option West and Water Hub-Option East would reach 38 feet and 48 feet above ground elevation, respectively. At these heights, the maximum length of shadows would be 163 feet (38 x 4.3) and 206 feet (48 x 4.2). **Figure 7-1** illustrates the maximum shadow length of the two proposed Water Hub locations and the intersecting sunlight sensitive resources. For both proposed Water Hub locations, the longest shadow study areas intersect Conference House Park and Raritan Bay, therefore requiring a Tier 2 Assessment.

7.3.2 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 7-2** illustrates this triangular area south of the two proposed Water Hub locations. The complementing areas to the north within the longest shadow study area represent the remaining area that could potentially experience new project generated shadow. As illustrated in **Figure 7-2**, Raritan Bay is not within the area that could potentially experience new project-generated shadows from either the proposed West Option or East Option. However, Conference House Park remains within the areas that could potentially be affected by new shadow for both options. Therefore, a Tier 3 assessment is required for the proposed Water Hub-Option West and proposed Water Hub-Option East.

7.3.3 TIER 3 SCREENING ASSESSMENT

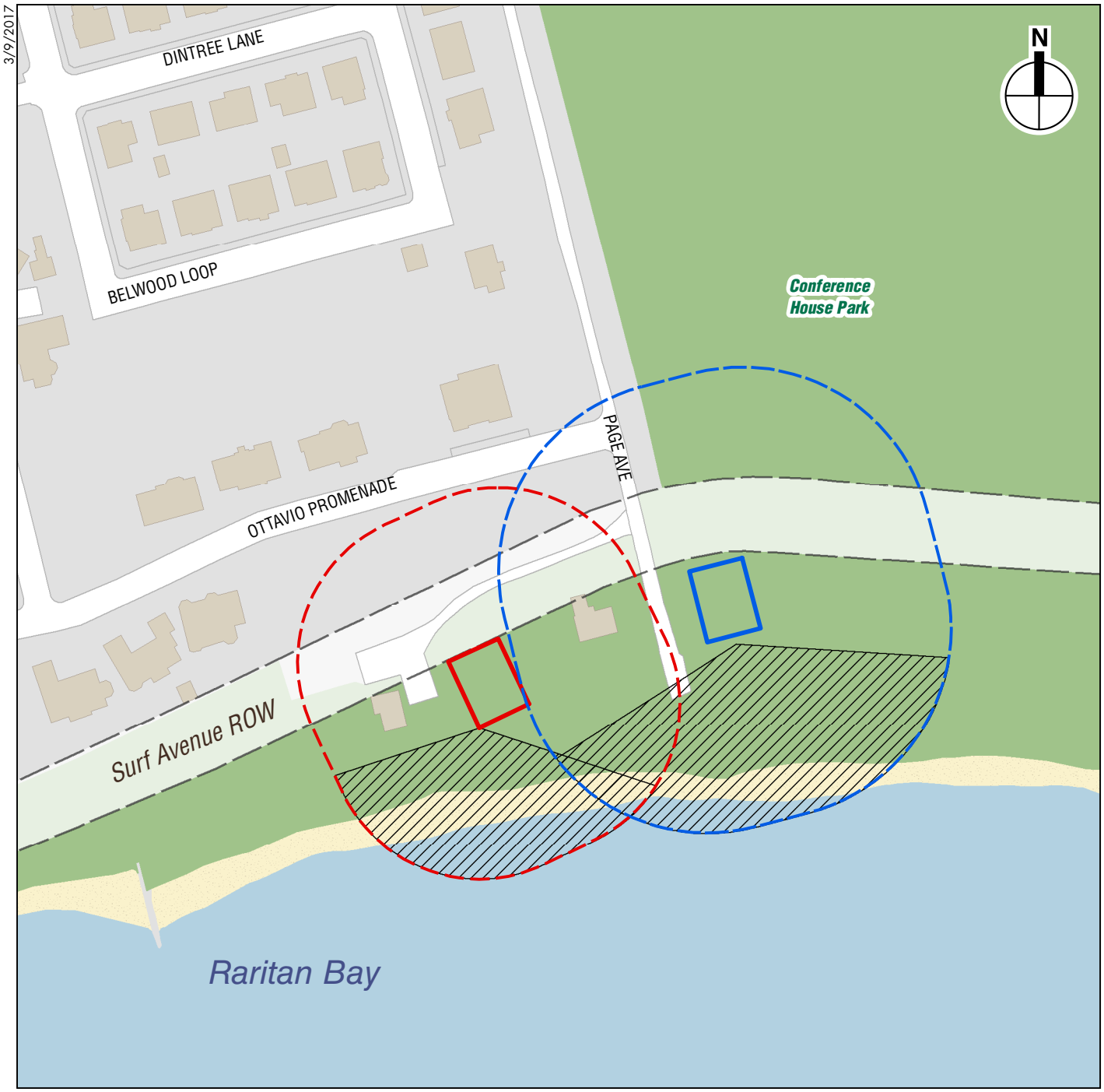
The direction and length of shadows vary throughout the course of the day and also differ depending on the season. Shadows move constantly but more quickly at the start and the end of the day than they do in the middle of the day. In order to determine whether project-generated shadow could fall on a sunlight-sensitive resource, three-dimensional computer mapping software is used in the Tier 3 assessment to calculate and display the incremental shadows from the proposed project developments 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 the massing of the proposed project.

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, the day halfway between the summer solstice and the equinoxes, i.e., May 6 or August 6, which have approximately the same shadow patterns.

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. Within the 90 minutes after sunrise and the 90 minutes before sunset, the sun is low on the horizon, and its rays reach the vicinity of the project site at low angles, producing shadows that are very long, move fast, and generally blend with shadows



Proposed Water Hub Page West Option

Proposed Water Hub Page East Option

Page West Option Longest Shadow Study Area - 163 ft.

Page East Option Longest Shadow Study Area - 206 ft.

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

Publicly Accessible Open Space

0 400 FEET

Water Hub Potential Location 1
Tier 2 Assessment

Figure 7-2

from existing structures until the sun reaches the horizon and sets. Consequently, shadows occurring in these two 90-minute periods are not considered significant under CEQR, and their assessment is not required.

TIER 3 SCREENING ASSESSMENT RESULTS

Figure 7-3 illustrates the range of shadows that would occur, in the absence of intervening buildings, from the both of the proposed Water Hub locations on the four representative days for analysis. The extent of shadow for the entire analysis day (one and a half hours after sunrise to one and a half hours before sunset) is illustrated in grey.

The Tier 3 assessment found that on all analysis days project-generated shadows from either Water Hub location could potentially affect the portions of Conference House Park in the immediate vicinity of the proposed Water Hub. Therefore, a detailed analysis was performed to provide additional information on the potential extent and duration of incremental shadow on Conference House Park.

7.3.4 DETAILED ANALYSIS

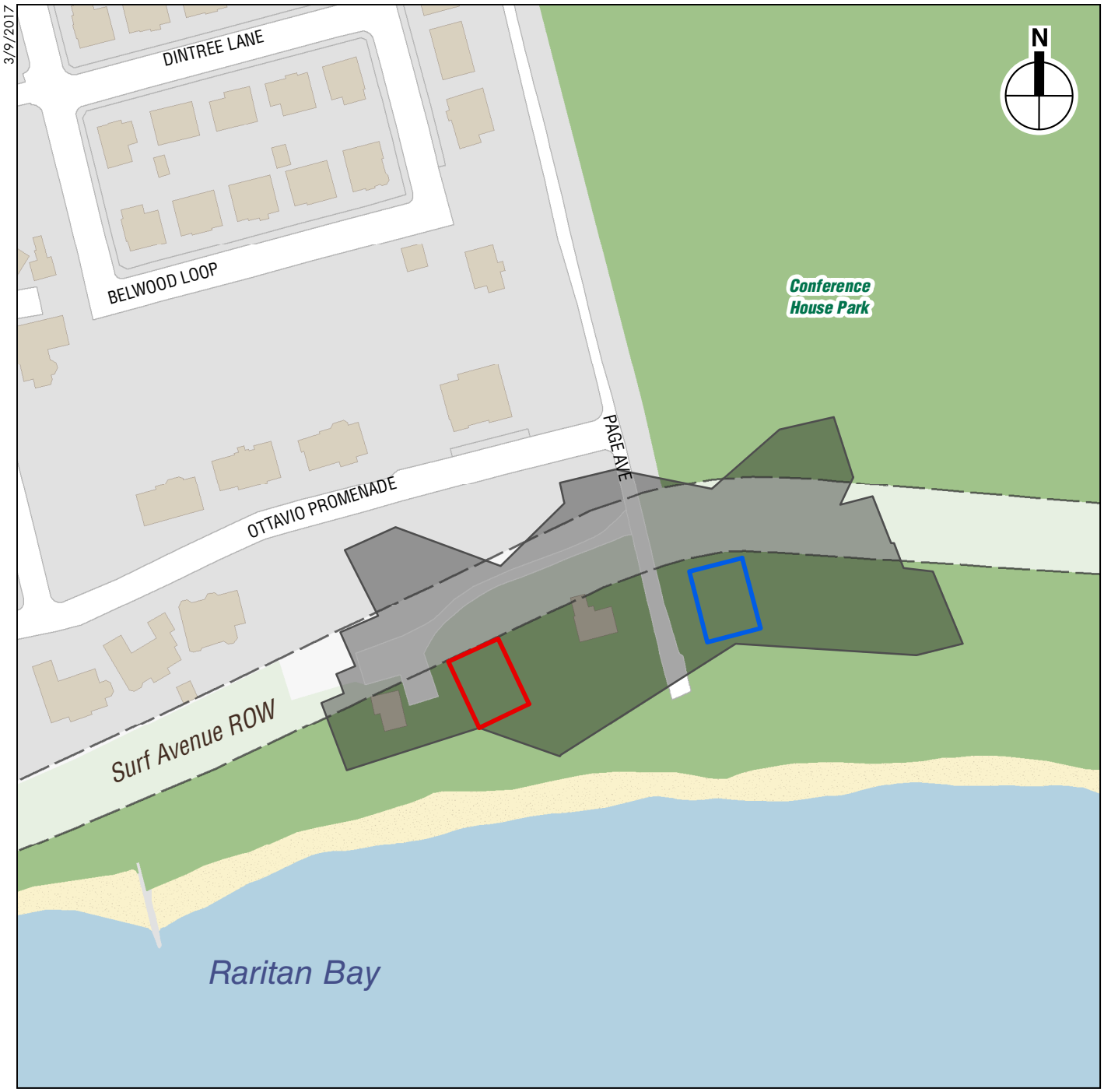
The purpose of the detailed analysis is to determine the extent and duration of *incremental* shadows that fall on sunlight-sensitive resources as a result of the proposed project and to assess their potential effects. To complete the assessment, a baseline or future condition without the Proposed Actions is established by appending three-dimensional representations of the existing buildings and planned future developments within the vicinity of the project site to the three-dimensional model used in the Tier 3 assessment. The future condition with the proposed Actions and its shadows can then be compared to the baseline condition to determine the incremental shadows that would result with the proposed project.

The future condition without the Proposed Actions assumes no development on the site of either proposed Water Hub Options. To perform a conservative shadow analysis, the proposed Water Hub has been modeled in each potential location as a rectangular box, rising to its maximum potential height without setbacks. Although the design is still being developed, it is anticipated that the Water Hub structure will include setbacks and would not cast shadows to the extent as those modeled in this analysis. **Figure 7-4** illustrates the computer models used in the detailed analysis of the future conditions with and without the Proposed Actions, for Water Hub-Option West and Water Hub-Option East.

7.4 EFFECTS ASSESSMENT

7.4.1 ALTERNATIVE 1—NO ACTION ALTERNATIVE

The No Action alternative assumes that no new structural risk reduction projects will be implemented in the project area and therefore no new shadows that could affect sunlight-sensitive resources would be created.



Proposed Water Hub Page West Option

Proposed Water Hub Page East Option

Tier 3 Assesment Area

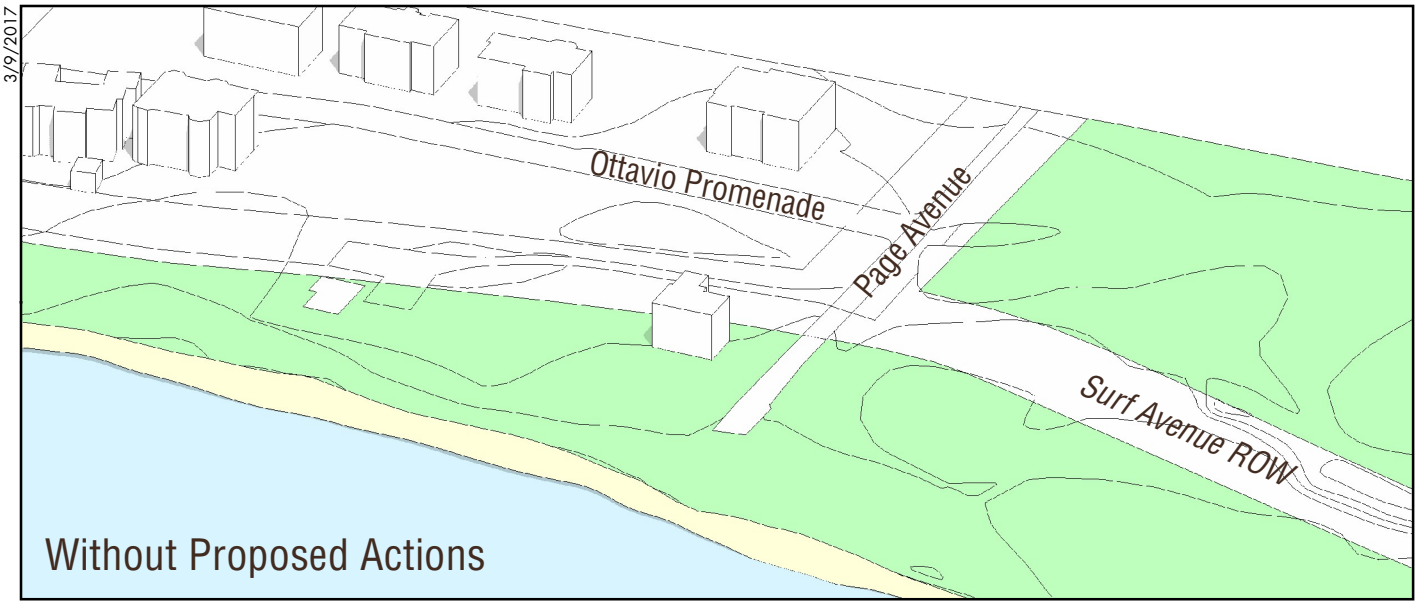
Publicly Accessible Open Space

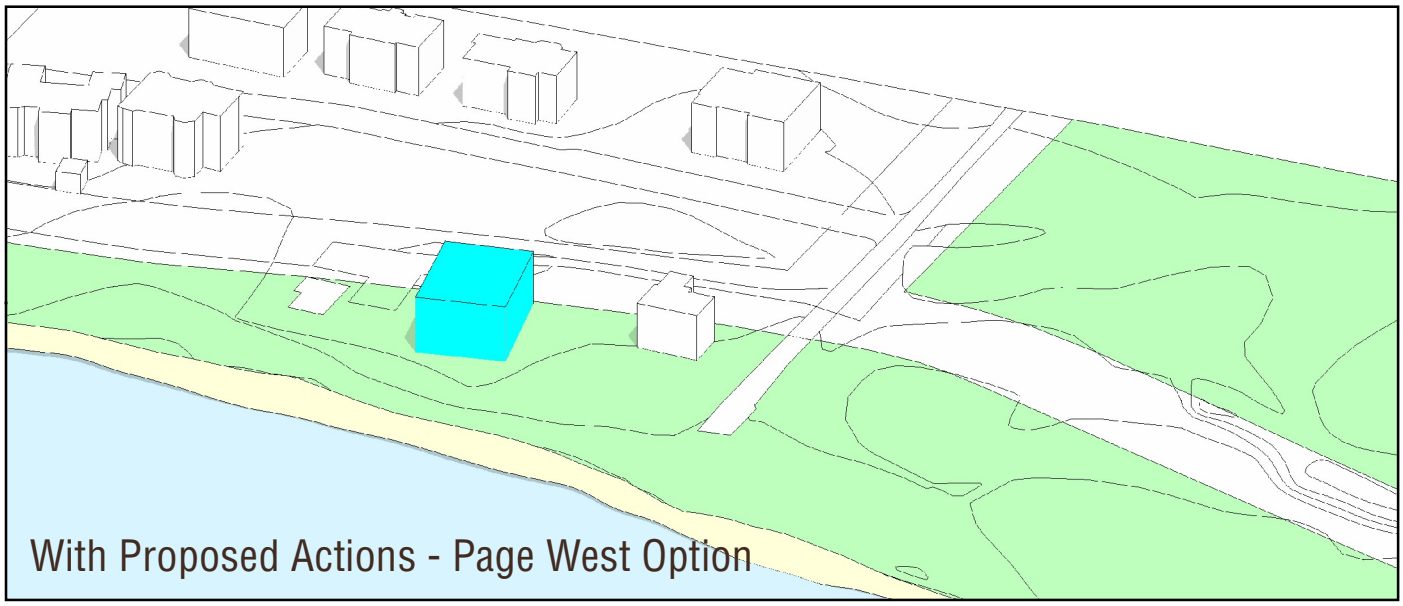
0 400 FEET

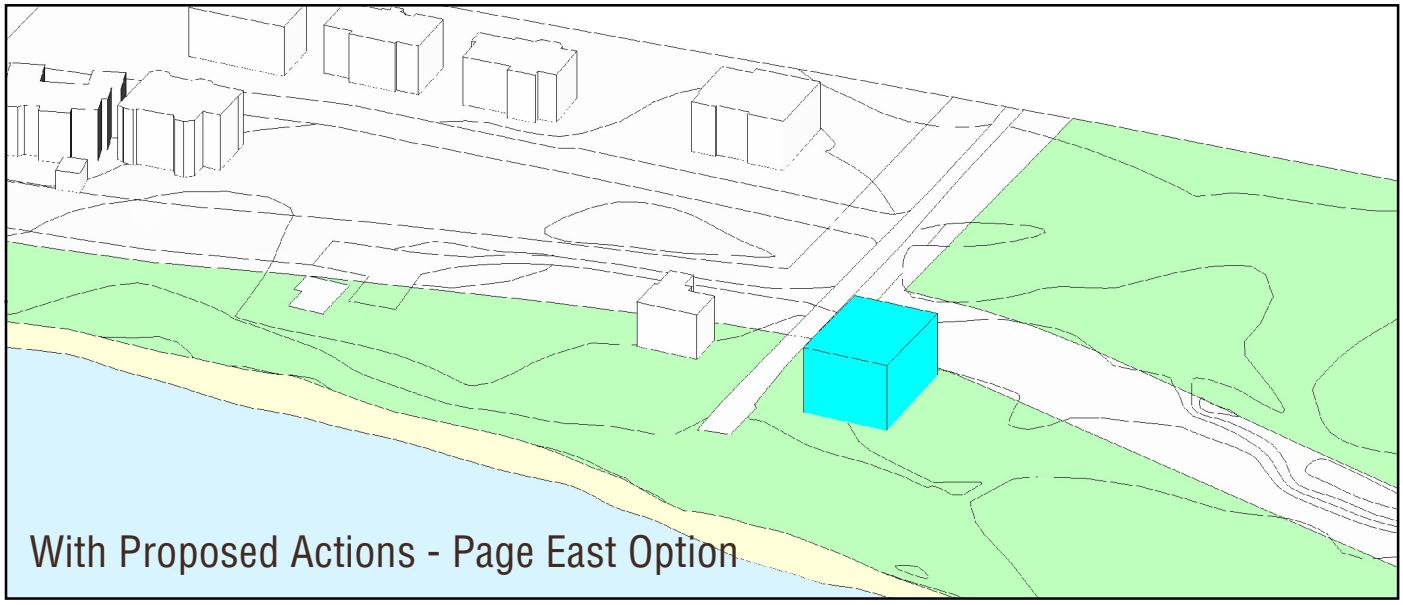
Water Hub Potential Location 1
Tier 3 Assessment

Figure 7-3

3/9/2017







Note: Proposed Water Hub massings are illustrative only, representing a worst case scenario for shadow analysis.

Water Hub Potential Location 1—Three-Dimensonal Model

7.4.2 ALTERNATIVE 2 (PREFERRED ALTERNATIVE)—THE LAYERED TOTTENVILLE SHORELINE RESILIENCY STRATEGY: LIVING BREAKWATERS AND TOTTENVILLE SHORELINE PROTECTION PROJECT (LAYERED STRATEGY)

As described in Chapter 1, "Purpose and Need and Alternatives," Alternative 2 comprises two project components—the Living Breakwaters Project (Breakwaters Project) and the Tottenville Shoreline Protection Project (Shoreline Project). Although several of the proposed project elements (breakwaters system and shoreline measures) would be over ten feet in height, the shadows they would cast would not extend beyond their construction footprints, preventing their shadows from affecting the adjacent resources. Therefore no significant adverse shadows impacts would occur from the implementation of these project elements.

As noted above, a detailed analysis was performed to assess the effects of shadows from the proposed Water Hub on portions of Conference House Park, a sunlight-sensitive resource. The analysis found that portions of Conference House Park in the immediate vicinity of the proposed Water Hub would receive incremental shadow originating from both potential Water Hub locations on all analysis days. **Table 7-1** shows the entry and exit times and total duration of project-generated incremental shadow on the affected resource.

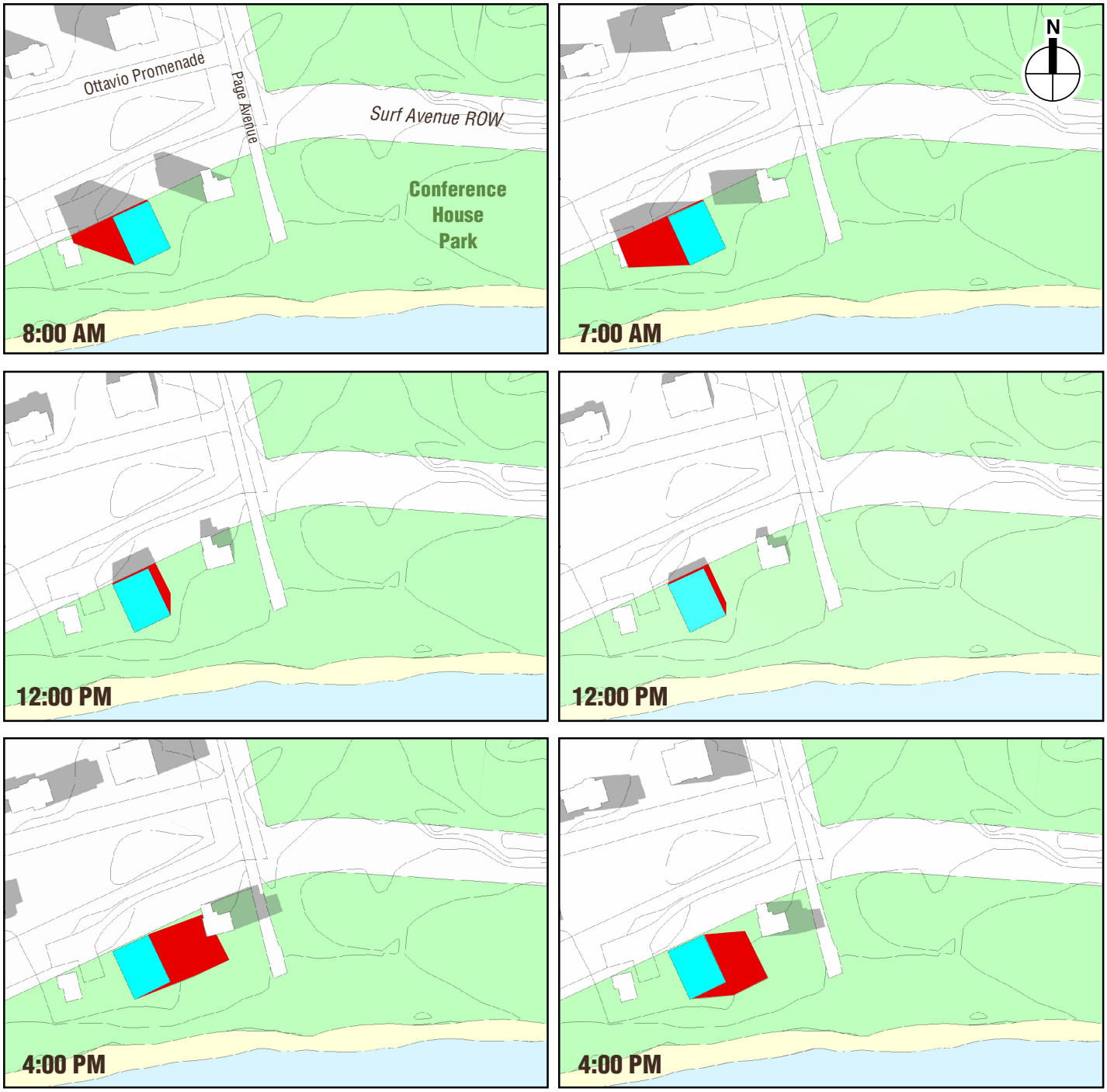
Table 7-1
Incremental Shadow Durations

	March 21 / Sept. 21 7:36 AM-4:29 PM	May 6 / August 6 6:27 AM-5:18 PM	June 21 5:57 AM-6:01 PM	December 21 8:51 AM-2:53 PM
Open Space Resources				
Conference House Park	7:36 AM–4:29 PM Total: 8 hrs 54 min	6:27 AM–5:18 PM Total: 10 hrs 52 min	5:57 AM–6:01 PM Total: 12 hrs 5 min	8:51 AM–2:53 PM Total: 6 hrs 3 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, in reality, Eastern Daylight Time is in effect for the March/September, May/August and June analysis periods. Therefore, add one hour to the given times to determine the actual clock time.

The results of the Water Hub-Option West and Water Hub-Option East detailed analysis are illustrated in **Figures 7-5 through 7-8.** Within the figures, incremental shadow is illustrated in red.

Conference House Park is an approximately 265-acre publically accessible open space stretching along the southernmost portion of Staten Island adjacent to Raritan Bay. The park contains forested areas, pathways, beaches and historic buildings. The portion of Conference House Park that would be affected by new shadow from either the West or East Water Hub Option includes grassy and wooded areas. None of the park's historic buildings, which are located within the western portion of the park, would be affected by new shadow from either proposed Water Hub location. The detailed shadow analysis shows that new shadow from either Water Hub Location would fall on the portions of Conference House Park in the immediate vicinity of the proposed Water Hub for the entirety of all four analysis days. For both proposed locations, incremental shadow extents would be largest in the beginning and ending of the analysis days when the sun is lower in the sky and shadows are longer.



Proposed Water Hub Page West Option

Incremental Shadow on Sunlight-Sensitive Resource

Publicly Accessible Open Space

Note: Proposed Water Hub massings are illustrative only, representing a worst case scenario for shadow analysis.

Detailed Analysis
Water Hub Potential Location 1—Page West Option

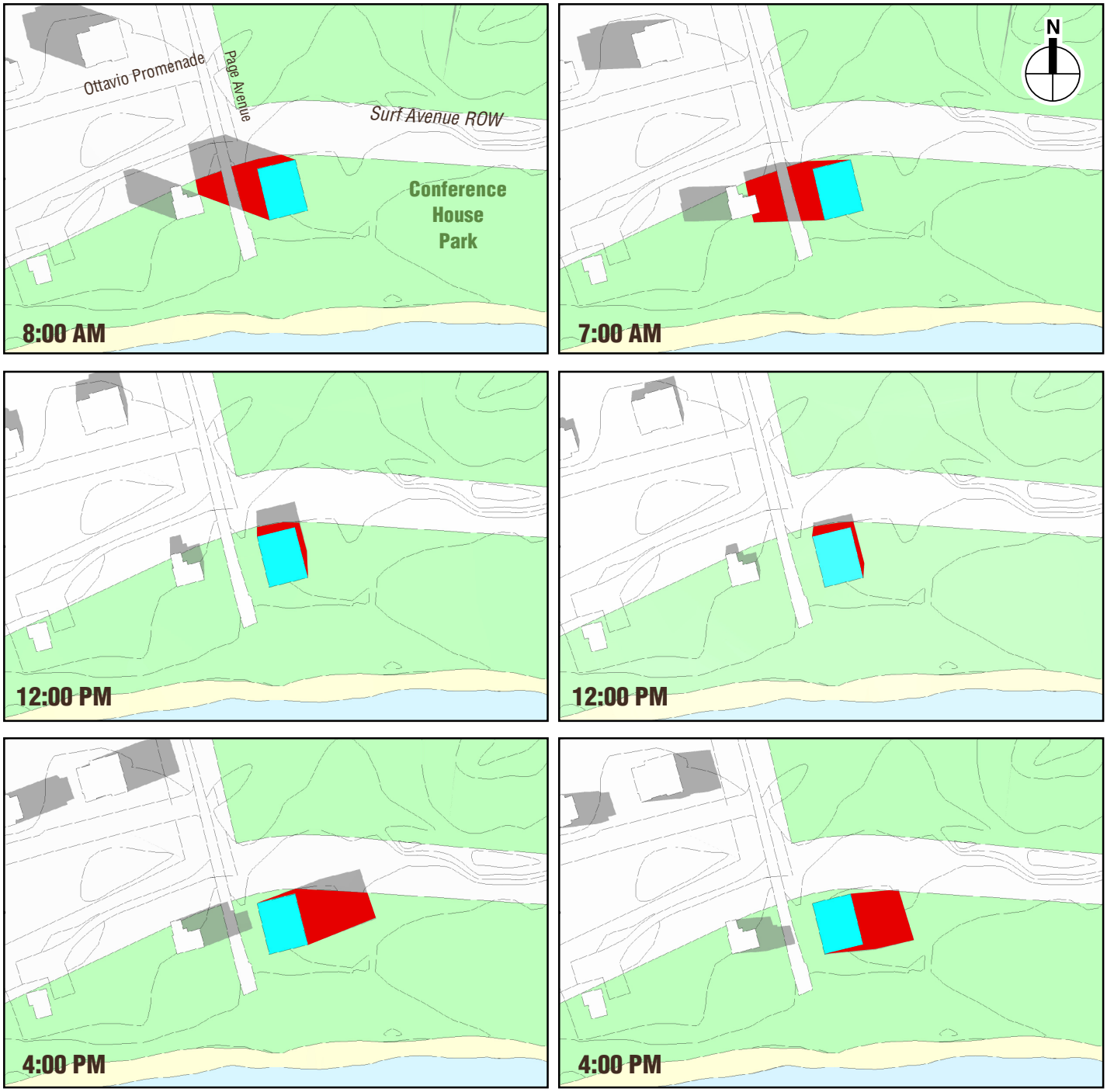
Proposed Water Hub Page West Option

Incremental Shadow on Sunlight-Sensitive Resource

Publicly Accessible Open Space

Note: Proposed Water Hub massings are illustrative only, representing a worst case scenario for shadow analysis.

Detailed Analysis
Water Hub Potential Location 1—Page West Option



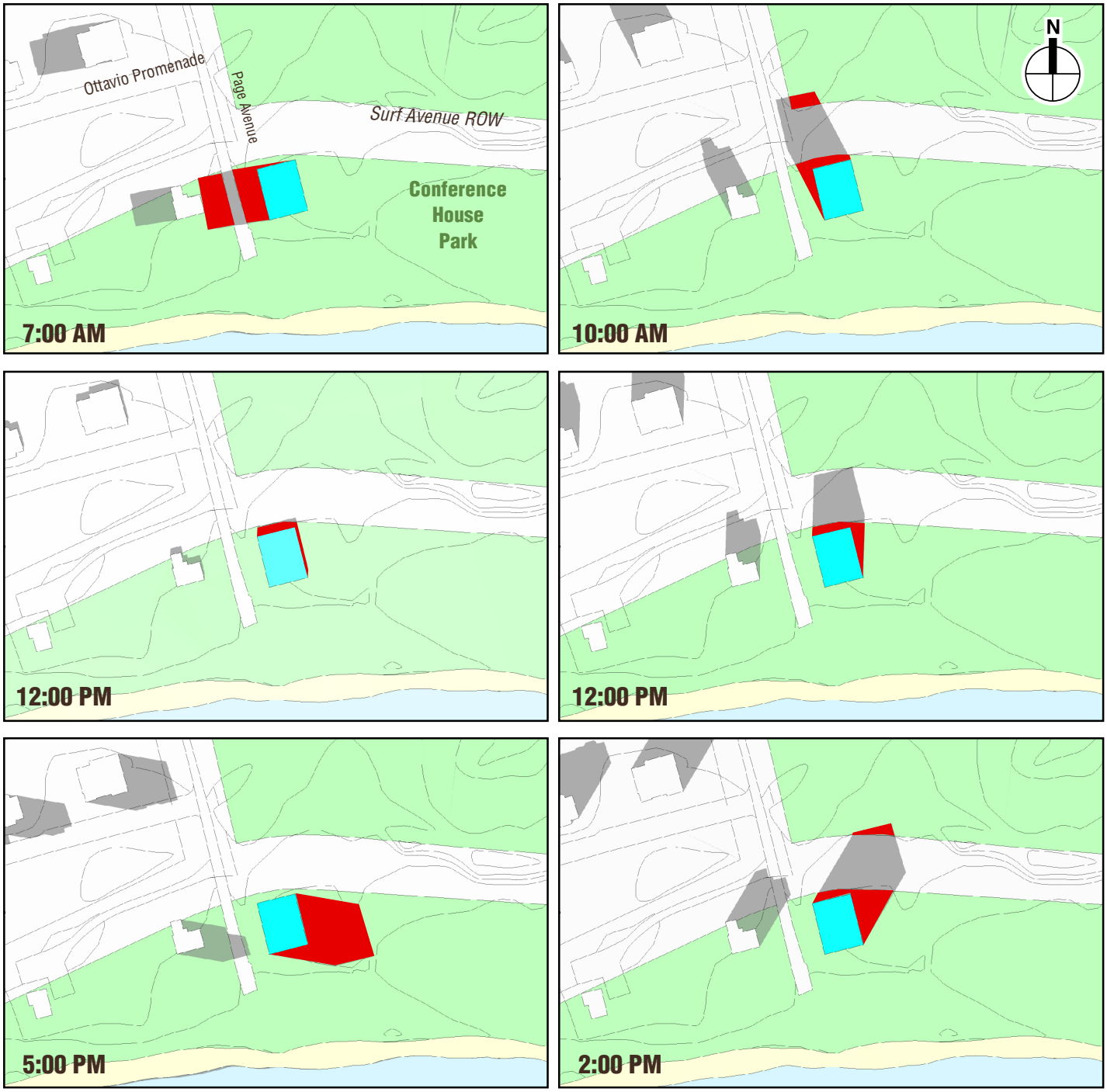
Proposed Water Hub Page East Option

Incremental Shadow on Sunlight-Sensitive Resource

Publicly Accessible Open Space

Note: Proposed Water Hub massings are illustrative only, representing a worst case scenario for shadow analysis.

Detailed Analysis
Water Hub Potential Location 2—Page East Option



June 21 December 21

Proposed Water Hub Page East Option

Incremental Shadow on Sunlight-Sensitive Resource

Publicly Accessible Open Space

Note: Proposed Water Hub massings are illustrative only, representing a worst case scenario for shadow analysis.

Detailed Analysis
Water Hub Potential Location 2—Page East Option

The incremental shadow identified in the detailed analysis would not adversely affect the usability of Conference House Park or its ability to support vegetation, or any landscaping proposed in the vicinity of the Water Hub. Although long in duration, the extent of new shadow from either Water Hub option would affect a relatively small portion of Conference House Park. Park visitors seeking passive recreation would find many nearby areas within the park in direct sunlight. Furthermore, the areas of the park affected by new shadow would continue to receive sufficient quantities of direct sunlight to support vegetation growth. Therefore, neither the proposed Water Hub-Option West nor Water Hub-Option East would result in a significant adverse shadows impact on Conference House Park.

7.4.3 ALTERNATIVE 3—BREAKWATERS WITHOUT SHORELINE PROTECTION SYSTEM

Alternative 3 would develop the Breakwaters Project components as described in Alternative 2, including the in-water breakwaters and the Water Hub. None of the Shoreline Project components would be developed under Alternative 3. As with Alternative 2, the development of the proposed Water Hub in either of the two potential locations would not result in a significant adverse shadows impact on Conference House Park.

7.4.4 ALTERNATIVE 4—SHORELINE PROTECTION SYSTEM WITHOUT BREAKWATERS

Under Alternative 4, the Shoreline Project components would be developed. No in-water breakwaters would be developed and the Water Hub would not be constructed. Therefore, there would be no potential for shadows impacts Under Alternative 4.

7.5 MINIMIZATION AND MITIGATION OF IMPACTS

The Proposed Actions would not result in significant adverse shadows impacts on sunlight-sensitive resources. Therefore, no mitigation with respect to shadows is required. ✷