6

Shadows

A shadow is defined in the *2021 City Environmental Quality Review (CEQR) Technical Manual* as the condition that results when a building or other built structure blocks the sunlight that would otherwise directly reach a certain area, space, or feature. The purpose of this section is to assess whether new structures may cast shadows on sunlight-sensitive publicly accessible resources or other resources of concern such as natural resources, and to assess the significance of their impact.

Introduction

According to the *CEQR Technical Manual*, a shadows assessment is required for proposed actions that would result in new structures greater than 50 feet in height or located adjacent to, or across the street from, a sunlight-sensitive resource. Such resources include publicly accessible open spaces, important sunlight-sensitive natural features, or historic resources with sun-sensitive features. A significant adverse shadow impact occurs when the incremental shadow added by a proposed project falls on a sunlight-sensitive resource and substantially reduces or completely eliminates direct sunlight exposure, thereby significantly altering the public's use of the resource or threatening the viability of vegetation or other resources.

The Proposed Actions are expected to facilitate the construction of two new structures greater than 50 feet in height. As described in **Chapter 1, Project Description**, a single building envelope (the Maximum Envelope) encompasses both the Maximum Commercial Scenario and Maximum Residential Scenario for each Development Site. These zoning envelopes—the reasonable worst-case development scenario (RWCDS) massings—are used to represent each building's bulk, height, and massing for conservative analysis purposes in this assessment of project-generated shadows. The Proposed Actions

would facilitate the development of a building up to 550 feet tall (roof height) with a bulkhead height of up to 590 feet on Development Site 1 (Manhattan Block 1102, Lot 11) and a building up to 485 feet tall (roof height) with a bulkhead height of up to 525 feet on Development Site 2 (Manhattan Block 1103, Lot 36). Therefore, further assessment is warranted to understand the potential for the Proposed Actions to result in shadows impacts under *CEQR Technical Manual* criteria.

Principal Conclusions

A detailed shadows analysis was conducted based on the methodology set forth in the *CEQR Technical Manual* and determined that the Proposed Actions would not result in a significant adverse impact related to shadows. Because future development on the development sites is expected to exceed 50 feet in height, the CEQR threshold for a shadows analysis, Tier 1 through Tier 3 and detailed shadows analyses were undertaken for the Proposed Actions. Several sunlight-sensitive resources were identified within the potential Tier 3 shadow sweep that were advanced to a detailed analysis. These resources consist of four open space resources: DeWitt Clinton Park (O1), Hudson River Greenway (O2), Pier 96 at Hudson River Park (O3), and Pier 97 at Hudson River Park (O4), and one natural resource, the Hudson River (N1).

A detailed analysis was conducted for the resources that could receive incremental shadow on one or more of the analysis days. For the open space resources that were studied in the detailed shadows assessment, incremental shadows would be of limited duration and would occur on spaces that either receive uninterrupted sunlight during other periods of the analysis day or on spaces that do not receive uninterrupted sunlight under existing conditions. Thus, it was determined that incremental shadows would not adversely impair the public's enjoyment of the space or the viability of vegetation of these resources. Additionally, incremental shading would occur over limited portions of the Hudson River for brief periods of time during the morning hours, and the effects of incremental shadows on resident organisms within this natural resource would be minimal, temporary, and of limited duration. Further, any wildlife present in the area is tolerant of urban conditions and as incremental shadows on the Hudson River would be long, narrow, and fast-moving, no area of the Hudson River would be permanently in shade or shaded to a degree that would impact aquatic biota as a result of incremental shadows. Based on the foregoing, no adverse impacts to sunlight sensitive resources would occur due to shadows from future development under the Proposed Actions.

Methodology

According to the *CEQR Technical Manual*, the longest shadow a structure will cast in New York City, except for periods close to dawn or dusk, is 4.3 times its height. In accordance with the *CEQR Technical Manual*, a preliminary screening assessment is conducted to ascertain whether shadows resulting from a project could reach any sunlight-sensitive resource at any time of year; if the preliminary assessment indicates that, in the absence of intervening buildings, shadows from a project could reach sunlight-sensitive resources on any of the representative analysis days, a detailed analysis is typically warranted.

Sunlight-Sensitive Resources

The *CEQR Technical Manual* defines sunlight-sensitive resources as those resources that depend on sunlight or for which direct sunlight is necessary to maintain the resource's usability or architectural integrity. The following are considered to be sunlight-sensitive resources:[1]

- Public open space (e.g., parks, beaches, playgrounds, plazas, schoolyards, 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. The uses and vegetation in an open space establish its sensitivity to shadows. This sensitivity is assessed for both (1) warm-weather-dependent features like wading pools and sand boxes, or vegetation that could be affected by loss of sunlight during the growing season (i.e., March through October); and (2) features such as benches that could be affected by a loss of winter sunlight. Uses that rely on sunlight include passive uses, such as sitting or sunning; active uses, such as playfields or paved courts; and such activities as gardening, or children's wading pools and sprinklers. Where lawns are actively used, the turf requires extensive sunlight. Vegetation requiring direct sunlight includes the tree canopy, flowering plants, and plots in community gardens. Generally, 4 to 6 hours a day of sunlight, particularly in the growing season, is a minimum requirement for most vegetation. Consistent with *CEQR Technical Manual* methodology, private open spaces are not considered in a shadows analysis. Similarly, open spaces associated with residential buildings are not considered. In addition, historic resources that do not have sunlight-sensitive features are not considered in the shadows analysis.
- Features of historic architectural resources that depend on sunlight for their enjoyment by the public. Only the sunlight-sensitive features are considered, as opposed to the entire architectural resource. Sunlight-sensitive features include the following: design elements that are part of a recognized architectural style that depends on the contrast between light and dark (e.g., deep recesses or voids such as open galleries, arcades, recessed balconies, deep window reveals, and prominent rustication); elaborate, highly carved ornamentation; stained-glass windows; exterior building materials and color that depend on direct sunlight for visual character (e.g., the polychromic [multicolored] features found on Victorian Gothic Revival or Art Deco façades); historic landscapes, such as scenic landmarks including vegetation recognized as an historic feature of the landscape; and structural features for which the effect of direct sunlight is described as playing a significant role in the structure's importance as an historic landmark.
- Natural resources where the introduction of shadows could alter the resource's condition or microclimate. Such resources could include surface waterbodies, wetlands, or designated resources such as coastal fish and wildlife habitats.

Preliminary Assessment

The preliminary screening assessment consists of three tiers of analysis:

- **Tier 1 Screening:** The first tier determines a simple radius around the proposed buildings representing the longest shadow that could be cast. If there are sunlight-sensitive resources within the radius, the analysis proceeds to the second tier;

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

- **Tier 2 Screening:** The second-tier analysis reduces the area that could be affected by project-generated shadows by accounting for a specific range of angles that can never receive shade in New York City due to the path of the sun in the northern hemisphere. According to the *CEQR Technical Manual*, shadows can only be cast within New York City within 108 degrees from true north. Topographic lines are included to demonstrate the terrain of the area;
- **Tier 3 Screening:** If the second tier of analysis does not eliminate the possibility of new shadows on sunlight-sensitive resources, a third tier of screening analysis further refines the area that could be reached by new shadows by looking at specific representative days of the year and determining the maximum extent of shadow over the course of each representative day. For the Tier 3 screening, three-dimensional modeling software with the capacity to model shadows is used, and the Maximum Envelopes are modeled and geo-located within the program. Terrain, which has been included in the Tier 1 and Tier 2 Screenings, is also incorporated into the model to account for how changes in elevation throughout the study area can influence shadows that could be cast by the Maximum Envelopes. The representative days are December 21 (winter solstice), June 21 (summer solstice), March 21/September 21 (vernal/autumnal equinox), and May 6/August 6 (halfway between summer solstice and the equinoxes). The modeling software is also used to approximate times that shadows cast from the Maximum Envelopes could enter and exit a resource.

Detailed Assessment

If the Tier 3 screening indicates that, in the absence of intervening buildings, shadows from the Maximum Envelopes would reach a sunlight sensitive resource on any of the representative analysis days, a detailed shadow analysis would be warranted. Because existing buildings (or No-Action buildings) may already cast shadows on a sun-sensitive resource, the Proposed Actions may not result in additional (incremental) shadows upon that resource. The detailed shadow analysis models a baseline condition (future No-Action) that is compared to the future condition resulting from the Proposed Actions (future With-Action) to illustrate the shadows cast by the No-Action development and distinguish the additional (incremental) shadow cast by the project.

For the Proposed Actions, a preliminary assessment (Tiers 1 through 3) and detailed analysis was undertaken.

Determination of Significance

As described in the *CEQR Technical Manual*, an incremental shadow is generally not considered significant when its duration is no longer than 10 minutes at any time of year and the resource continues to receive substantial direct sunlight. A significant shadow impact can occur when an incremental shadow of 10 minutes or longer falls on a sunlight-sensitive resource and results in one of the following:

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

- Open space utilization: a substantial reduction in the usability of open space as a result of increased shadow, with consideration given to anticipated new users and the open space's utilization rates throughout the affected time periods as well as to the inventory of available open space resources in the study area.
- For any sunlight-sensitive feature of a resource: complete elimination of all direct sunlight on the sunlight-sensitive feature of the resource, when the complete elimination results in substantial effects on the survival, enjoyment, or, in the case of open space or natural resources, the use of the resource.

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

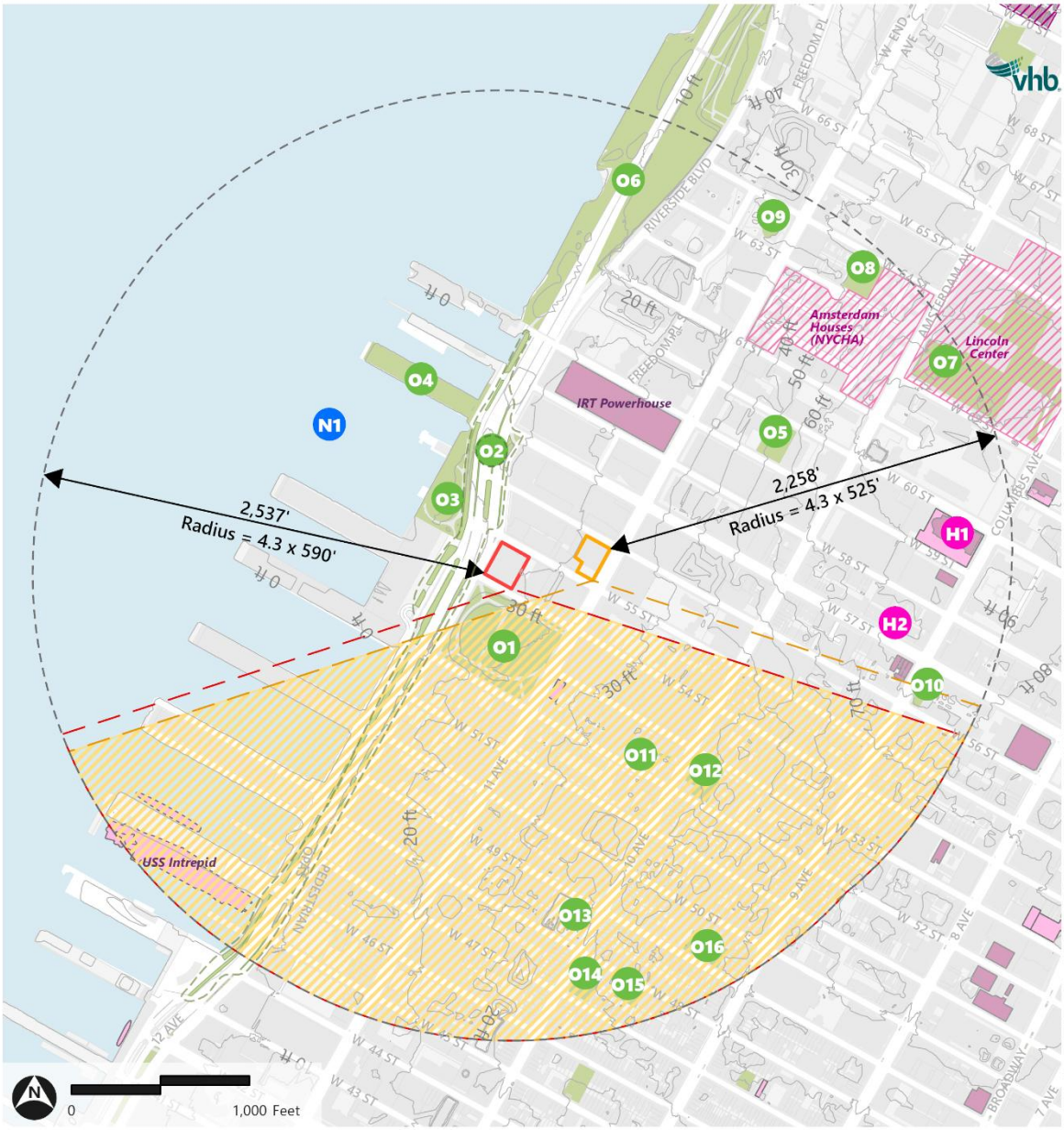
Preliminary Assessment

Tiers 1 and 2 Screening

As described above, the Maximum Envelope for each site is the Maximum Envelope for project-generated shadows under the Proposed Actions. The Maximum Envelope encompasses a 590-foot-tall building (including a 40-foot bulkhead) on Development Site 1, and a 525-foot-tall building (including a 40-foot bulkhead) on Development Site 2. The Tier 1 radius extends approximately 2,537 feet from Development Site 1 and 2,258 feet from Development Site 2. The area that cannot be shaded by the Maximum Envelope on each site was drawn from the southernmost portion of the respective development sites; the intersection of these areas (the Tier 2 area) cannot be shaded by development on either site. **Figure 6-1** and **Table 6-1** show the potential sunlight-sensitive resources identified in the Tier 1 and Tier 2 screening assessment. The figure also shows the current topographic elevation of the development sites and surrounding area, which ranges from sea level to 80 feet (NAVD88).

As shown in **Table 6-1**, there are 18 sunlight-sensitive resources wholly or partially within an area that can be shaded by the Maximum Envelope on either Development Site, including 15 open space resources, two historic resources, and one natural resource. Five of the open space resources (O11, O12, O13, O14, and O15) are excluded from the assessment, as these resources are within the Tier 2 area that cannot receive shading from the development sites.

Figure 6-1 Tiers 1 and Tier 2 Screening



Source: NYC LPC, NYS OPRHP SHPO, NYC Parks

Table 6-1 Sunlight-Sensitive Resources in the Study Area

Map ID	Resource Name	Resource Summary	Sunlight-Sensitive Elements
Open Space			
O1	DeWitt Clinton Park	Local park featuring a baseball field, playground, dog run, tennis and handball courts, restrooms, and a garden	Active recreation and vegetation
O2	Hudson River Greenway	Trail along the Hudson River waterfront that features a bike and running trail along with landscaping	Active recreation and vegetation
O3	Pier 96 at Hudson River Park	Waterfront open space including a landscaped lawn and a boat launch	Vegetation
O4	Pier 97 at Hudson River Park[1]	Planned recreational pier will include a playground with water spray features, an activity field and a gently sloping lawn	Active recreation and vegetation
O5	Gertrude Ederle Playground	Playground featuring spray showers, landscaping, and seating	Active recreation and vegetation
O6	Hudson River Park South[1]	Waterfront park along the Hudson River with lawns, trees, plazas, and playgrounds	Active recreation and vegetation
O7	Damrosch Park	Public plaza in Lincoln Center with landscaping, seating areas, and a bandshell	Vegetation and benches
O8	Samuel N. Bennerson Playground	Playground with trees, seating, and a basketball court	Active recreation and vegetation
O9	West End Park	Privately-owned public space (POPS) with a playground, trees, seating, and a garden	Active recreation and vegetation
O10	Balsley Park	POPS with landscaping and benches	Vegetation
O11	Oasis Garden	Community garden with trees, planting beds, and benches	Vegetation
O12	P.S. 111 Playground	School playground (regularly open to the public) with basketball courts, seating, and a play surface	Active recreation and vegetation
O13	Lorraine Hansberry Plaza[1]	Planned public plaza with landscaping and seating	Vegetation
O14	Hell's Kitchen Park	Playground with handball courts, an asphalt play field, trees, and seating	Active recreation and vegetation
O15	Clinton Community Garden	Community garden with trees, planting beds, and benches	Vegetation
O16	Gutenberg Playground	Local playground with basketball and handball courts, seating areas, and trees	Active recreation and vegetation
Historic Resource			
H1	St. Paul the Apostle Church	A Medieval Revival style church building constructed in 1875-85, designated as a landmark by NYC LPC in 2013	Stained-glass windows
H2	Catholic Apostolic Church (now Church of the City of New York)	A Victorian Gothic style church built in 1885-86, designated as a landmark by NYC LPC in 2001	Stained-glass windows
Natural Resource			
N1	Hudson River	Water body; tidal estuary of the Atlantic Ocean	Fish habitat

Source: New York City Department of Parks and Recreation, NYC Capital Planning Platform POPS map, New York Cultural Resource Information System (CRIS), New York City Landmarks Preservation Commission (LPC)

Notes:

[1] Resource is under construction but is anticipated to be complete by the analysis year for the Proposed Actions

Tier 3 Screening Assessment

In accordance with the *CEQR Technical Manual*, a Tier 3 screening assessment was performed because the Tier 1 and Tier 2 assessments identified several sunlight-sensitive resources within ±108 degrees of true north and within the area of the longest shadow that could be cast by the Maximum Envelopes.

The Tier 3 screening assessment was performed for the four representative days of the year set forth in the *CEQR Technical Manual*: December 21, the winter solstice and shortest day of the year; March 21/September 21, the equinoxes; May 6/August 6, the midpoints between the summer solstice and the equinoxes; and June 21, the summer solstice and the longest day of the year.

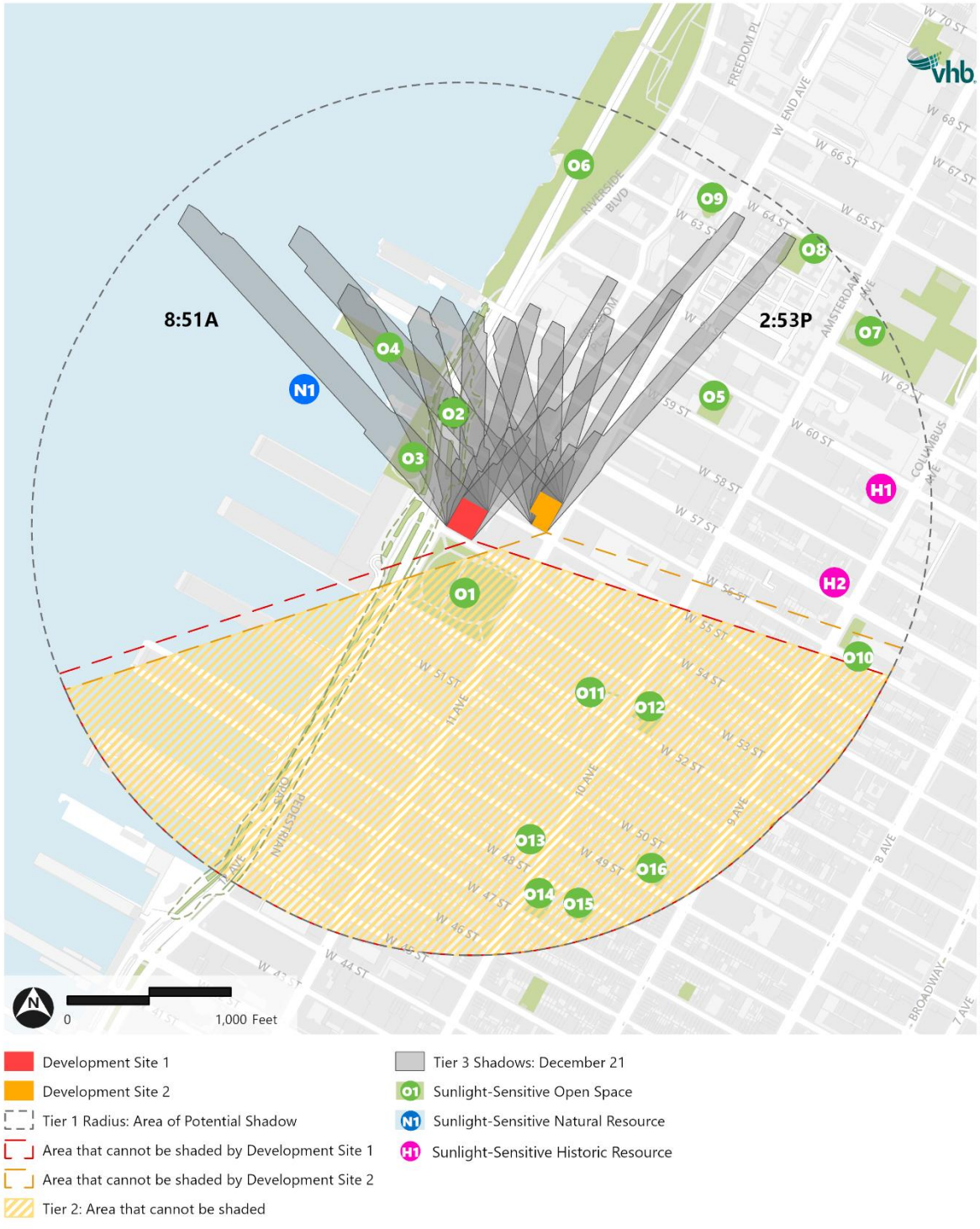
In accordance with the *CEQR Technical Manual*, a model of the buildings in the With-Action condition was developed in a three-dimensional computer program (Rhino/Grasshopper). The model was geo-located and the surrounding terrain was imported into the model to account for differences in topography. As noted above, the Tier 3 shadow screening shows the shadows that could be cast as a result of the Proposed Actions but does not account for existing buildings which may already cast shadows on the identified resources. **Figure 6-2** to **Figure 6-5** below show Tier 3 screening results.

The Tier 3 screening indicates that in the absence of intervening structures, the Maximum Envelopes would cast shadows on:

- DeWitt Clinton Park (O1)
- Hudson River Greenway (O2)
- Pier 96 at Hudson River Park (O3)
- Pier 97 at Hudson River Park (O4)
- Gertrude Ederle Playground (O5)
- Samuel N. Bennerson Playground (O8)
- Balsley Park (O10)
- Hudson River (N1)

Therefore, a detailed shadows analysis was provided for these resources and is provided below. The remaining resources (O6, O7, O9, H1, and H2) would not receive any shadow from the Maximum Envelopes during any of the analysis days. Therefore, further analysis of these resources is not warranted. See **Table 6-2** for a summary of the Tier 1 to Tier 3 screening results.

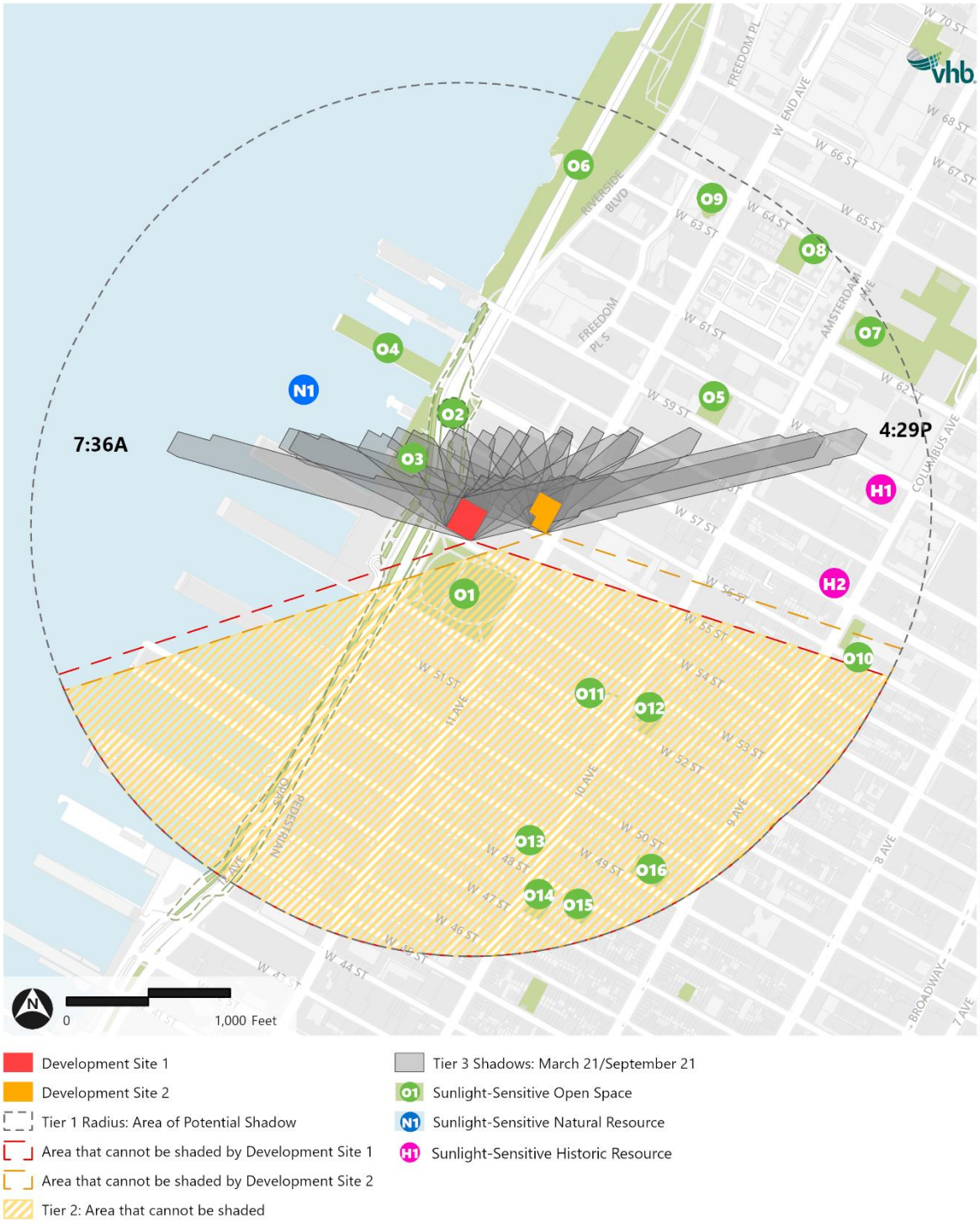
Figure 6-2 Tier 3 Screening December 21 Analysis Day



Source: NYC LPC; NYS OPRHP SHPO; NYC Parks

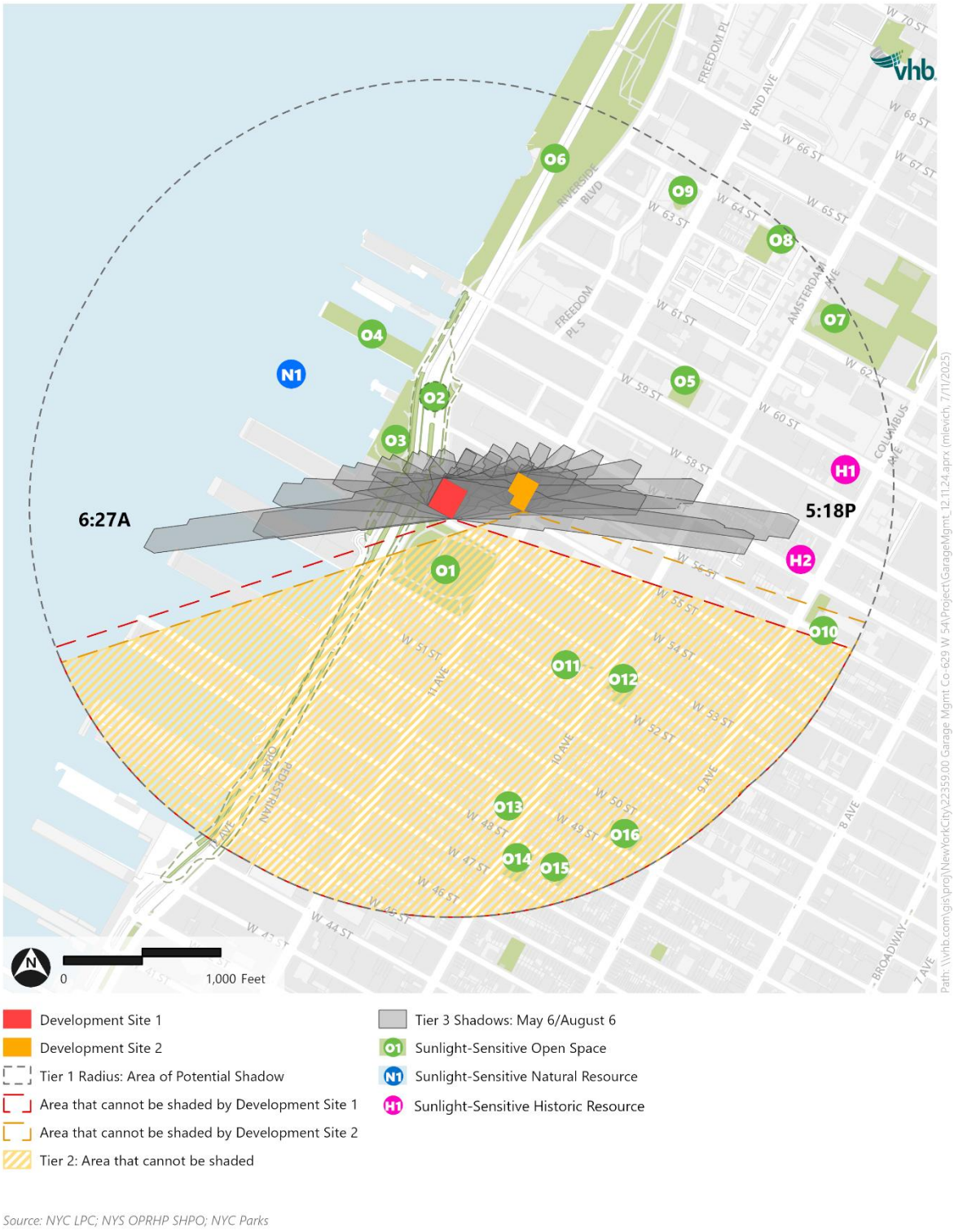
Source: NYC LPC, NYS OPRHP SHPO, NYC Parks

Figure 6-3 Tier 3 Screening March 21 Analysis Day



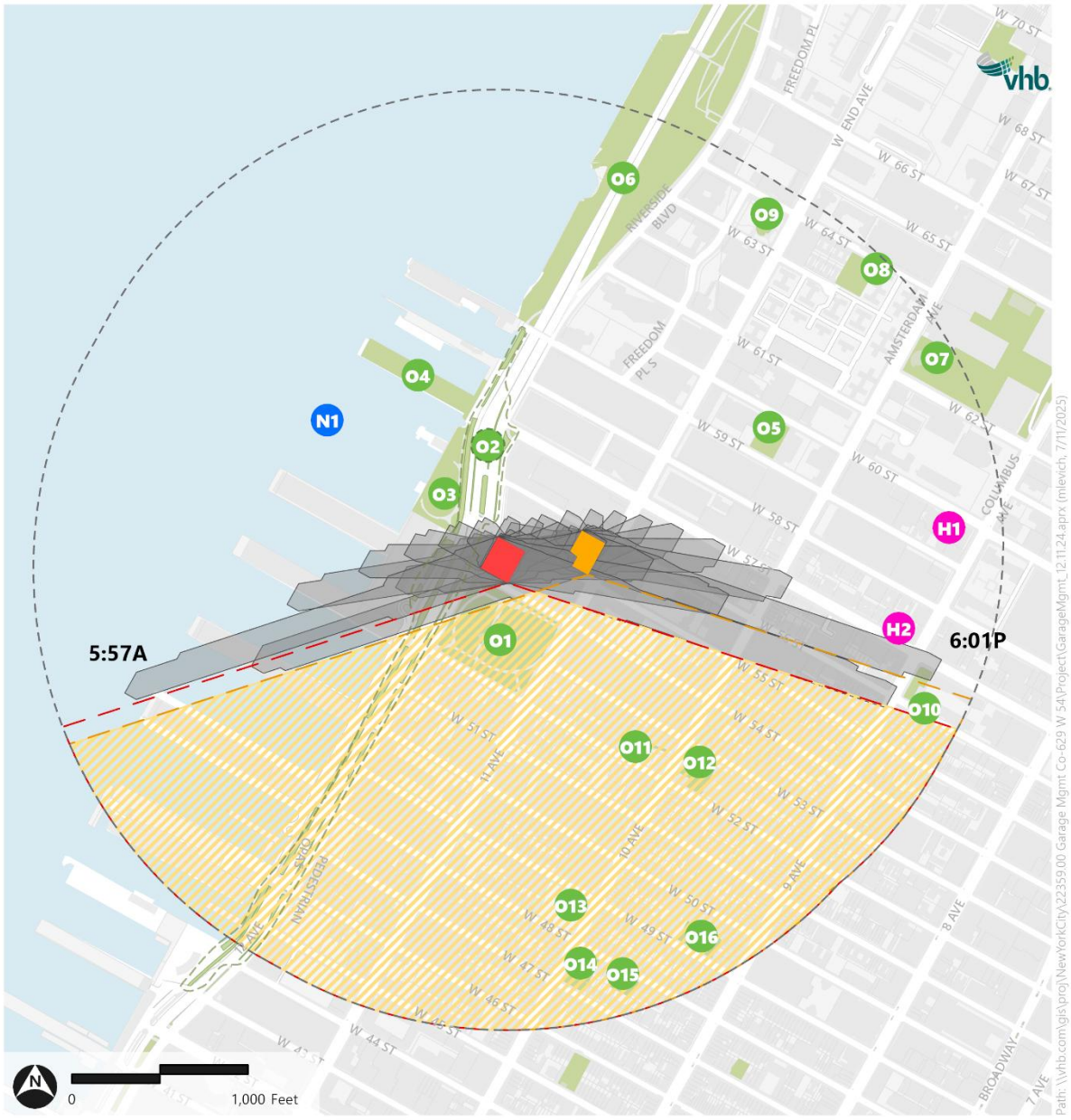
Source: NYC LPC, NYS OPRHP SHPO, NYC Parks

Figure 6-4 Tier 3 Screening May 6 Analysis Day



Source: NYC LPC, NYS OPRHP SHPO, NYC Parks

Figure 6-5 Tier 3 Screening June 21 Analysis Day



Source: NYC LPC, NYS OPRHP SHPO, NYC Parks

Table 6-2 Tier 1 through 3 Shadows Screening Results

Map ID	Resource Name	Screening Results
Open Space		
O1	DeWitt Clinton Park	Detailed analysis
O2	Hudson River Greenway	Detailed analysis
O3	Pier 96 at Hudson River Park	Detailed analysis
O4	Pier 97 at Hudson River Park	Detailed analysis
O5	Gertrude Ederle Playground	Detailed analysis
O6	Hudson River Park South	Screened at Tier 3
O7	Damrosch Park	Screened at Tier 3
O8	Samuel N. Bennerson Playground	Detailed analysis
O9	West End Park	Screened at Tier 3
O10	Balsley Park	Detailed analysis
O11	Oasis Garden	Screened at Tier 2
O12	P.S. 111 Playground	Screened at Tier 2
O13	Lorraine Hansberry Plaza	Screened at Tier 2
O14	Hell's Kitchen Park	Screened at Tier 2
O15	Clinton Community Garden	Screened at Tier 2
O16	Gutenberg Playground	Screened at Tier 2
Historic Resource		
H1	St. Paul the Apostle Church	Screened at Tier 3
H2	Catholic Apostolic Church (now Church of the City of New York)	Screened at Tier 3
Natural Resource		
N1	Hudson River	Detailed analysis

Detailed Assessment

No-Action Condition

In the future No-Action condition, the existing buildings would remain on both development sites, and no changes in building height or massing would occur.

With-Action Condition

In the With-Action condition, the Maximum Envelope establishes the limits within which development would occur on each Development Site. The Maximum Envelope on Development Site 1 would permit a building up to 590 feet tall (including a 40-foot mechanical bulkhead), and the Maximum Envelope on Development Site 2 would permit a building up to 525 feet tall (including 40-foot mechanical bulkhead). The detailed shadow analysis builds on the three-dimensional modeling used in the Tier 3 analysis to identify whether development under the With-Action condition could cast shadows on the identified resources of concern. Any new shadows projected to be cast onto the identified resources from the proposed buildings are considered "incremental shadows."

Table 6-3 provides the modeled incremental shadow entry/exit times for the sunlight-sensitive resources.

DeWitt Clinton Park (O1), Hudson River Greenway (O2), Pier 96 at Hudson River Park (O3), and Pier 97 at Hudson River Park (O4), along with the Hudson River (N1) would receive incremental shadow on some or all of the four analysis days: December 21st, March 21st/September 21st, May 6th/ August 6th, and June 21st. The detailed shadows modeling showed that Gertrude Ederle Playground (O5), Samuel N. Bennerson Playground (O8), and Balsley Park (O10) would not receive incremental shading from the Maximum Envelope; therefore, these resources do not warrant further analysis.

Table 6-3 Detailed Analysis Summary of Incremental Shadow Entry/Exit Times

	Analysis Day			
Resource	**December 21 8:51AM - 2:53PM**	**March 21/Sept 21 7:36AM - 4:29PM**	**May 6/Aug 6 6:27AM - 5:18PM**	**June 21 5:57AM - 6:01PM**
Open Space Resources				
O1 – DeWitt Clinton Park	No incremental shading	No incremental shading	No incremental shading[1]	7:30AM-8:45AM (1 hour 15 minutes)
O2 – Hudson River Greenway	9:20AM-12:18AM (2 hours 58 minutes)	7:36AM-12:10PM (4 hours 34 minutes)	6:27AM-11:55AM (5 hours 28 minutes)	5:57AM-10:37AM (4 hours 40 minutes)
O3 – Pier 96 at Hudson River Park	8:51AM-11:22AM (2 hours 31 minutes)	8:00AM-11:15AM (3 hours 15 minutes)	7:28AM-10:44AM (3 hours 16 minutes)	No incremental shading
O4 – Pier 97 at Hudson River Park	8:51AM-11:30AM (2 hours 39 minutes)	No incremental shading	No incremental shading	No incremental shading
O5 – Gertrude Ederle Playground	No incremental shading	No incremental shading	No incremental shading	No incremental shading
O8 – Samuel N. Bennerson Playground	No incremental shading	No incremental shading	No incremental shading	No incremental shading
O10 – Balsley Park	No incremental shading	No incremental shading	No incremental shading	No incremental shading
Natural Resources				
N1 – Hudson River	8:51AM-12:18PM (3 hours 27 minutes)	7:36AM-10:22AM (2 hours 46 minutes)	6:27AM-8:27AM (2 hours)	5:57AM-8:21AM (2 hours 24 minutes)

Notes:
Per the *2021 CEQR Technical Manual*, the selected time zone for the analysis is Eastern Standard Time and daylight-saving time was not used.
[1] There would be no incremental shadows on this resource due to intervening buildings

Detailed shadow analyses are discussed for each resource in the relevant sub-sections below.

Open Space Resources

O1 – DeWitt Clinton Park

DeWitt Clinton Park (O1) is a public park owned and operated by NYC Parks located directly south of Development Site 1 and southwest of Development Site 2. The western half of DeWitt Clinton Park features basketball and handball courts and a mature tree canopy, while the eastern half is occupied by a multi-use turf sports field.

Given that DeWitt Clinton Park is located to the south of the development sites, incremental shadows would be limited, and the Maximum Envelopes would not cast incremental shadow on the December 21, March 21/September 21, or May 6/August 6 analysis days. Incremental shadows cast by the Maximum Envelopes on the June 21 analysis day are described below and are shown in **Figure 6-6.**

June 21 Analysis Day

The detailed analysis indicates that the Maximum Envelopes would cast incremental shadows on DeWitt Clinton Park for 1 hour and 15 minutes in the morning of the June 21 analysis day. As shown in **Figure 6-6**, the extent of the incremental shadow would be limited to a small area at the northwestern corner of the park. June 21 is during the growing season, when the mature trees in this part of the playground could tolerate a minimum of 6 to 8 hours of direct sunlight a day. The trees in this area would continue to receive substantial sunlight on June 21. Given that the size and duration of the incremental shadow would be limited, and the vegetation in the northwestern corner of DeWitt Clinton Park would continue to receive sufficient sunlight, incremental shadows from the Maximum Envelopes would not affect the public use or enjoyment of this resource, and no significant adverse impacts would occur from project-generated shadows on DeWitt Clinton Park.

O2 – Hudson River Greenway

The Hudson River Greenway (O2) is a linear waterfront open space located between the Hudson River waterfront and the west side of Twelfth Avenue, directly west of Development Site 1. The Greenway consists of a protected bike and running path bordered by landscaped medians and traffic islands planted with a mix of shrubs and mature trees. The Maximum Envelopes would cast incremental shadows on the Greenway on all four analysis days. The incremental shadows would mainly occur in the morning because the Greenway is located west of both development sites. Incremental shadows cast by the Maximum Envelopes on the December 21, March 21/September 21, May 6/August 6, and June 21 analysis days are described below and are shown in approximately 1-hour intervals in **Figure 6-7** through **Figure 6-24**.

December 21 Analysis Day

The detailed analysis indicates that the Maximum Envelopes would cast incremental shadows on the Hudson River Greenway for 2 hours and 58 minutes on the December 21 analysis day (from 9:20 AM to 12:18 PM). As shown in **Figure 6-7** through **Figure 6-9**, incremental shadows would move from south to north and from west to east throughout the morning and early afternoon. Since shadows are long during the winter, the Maximum Envelopes would cast long, narrow shadows that would move relatively quickly, meaning that no specific area of the Greenway would experience incremental shadows for longer than roughly 1.5 hours. Since December 21 is outside the growing season for vegetation, incremental shadows on the planted medians of the Greenway during this analysis day would not interfere with the health of the vegetation. Shadows would move quickly through the bike and running path, and different sections of the path would be shaded throughout the morning. Incremental shadows on the path would not affect its use or enjoyment. Shadows from tall buildings in the morning are typical along the Hudson River Greenway given its location along the west side of Manhattan, and the incremental shadows from the Maximum Envelopes would be limited in their size and duration. Therefore, no significant adverse impacts would occur due to project-generated incremental shadows on the Hudson River Greenway during the December 21 analysis day.

March 21/September 21 Analysis Day

The detailed analysis indicates that the Maximum Envelopes would cast incremental shadows on the Hudson River Greenway for 4 hours and 34 minutes on the March 21/September 21 analysis day (from 7:36 AM to 12:10 PM). As shown in **Figure 6-10** through **Figure 6-14**, incremental shadows would move from south to north throughout the morning. The incremental shadow cast by the Maximum Envelope on Development Site 2 would exit the Greenway first, while the incremental shadow from Development Site 1 would last longer because of its proximity. The incremental shadows from each building would move relatively quickly through the Greenway, but some areas would experience a brief period of incremental shadow from Development Site 2, followed by a second brief period of shadow cast from Development Site 1. Although March 21 and September 21 are in the growing season for vegetation, the incremental shadows on the planted medians of the Greenway would be limited to very small areas between approximately W. 54th and W. 55th Streets, which are planted with mature trees. These medians and traffic islands would experience up to roughly 2 hours of additional shadow in the early morning. The shrubs and mature trees in these locations would still receive at least 4 to 6 hours of sunlight, which is sufficient for the growth of tree canopies, shrubs, and perennials. Incremental shadows on the bike and running path would be concentrated between approximately W. 55th and W. 56th Streets. Shadows from tall buildings in the morning are typical along the Hudson River Greenway given its location along the west side of Manhattan, and the incremental shadows from the Maximum Envelopes would be limited in their size and duration. Incremental shadows on the path would not affect its use or enjoyment. Therefore, no significant adverse impacts would occur due to project-generated incremental shadows on the Hudson River Greenway during the March 21/September 21 analysis day.

May 6/August 6 Analysis Day

The detailed analysis indicates that the Maximum Envelopes would cast incremental shadows on the Hudson River Greenway for 5 hours and 28 minutes on the May 6/August 6 analysis day (from 6:27 AM to 11:55 AM). As shown in **Figure 6-15** through **Figure 6-19**, incremental shadows would move from south to north throughout the morning. The Maximum Envelope on Development Site 1 would mainly cast incremental shadows on the Greenway on this analysis day, while shadows from the Maximum Envelope on Development Site 2 would exit the Greenway relatively quickly. Though the total duration of incremental shadows is longest on this analysis day, incremental shadows after roughly 10:30 AM are limited to two small traffic islands along Twelfth Avenue. May 6 and August 6 are in the growing season for vegetation. Medians and traffic islands planted with shrubs and mature trees would experience, at most, roughly 2 hours of additional shadow at any given location as the shadows travel throughout the morning, and since there are no tall buildings west of the Greenway, it would experience direct sunlight throughout the afternoon and evening. The shrubs and mature trees in these locations would still receive at least 4 to 6 hours of sunlight, which is sufficient for the growth of tree canopies, shrubs, and perennials. Incremental shadows on the bike and running path would be concentrated between approximately W. 53rd and W. 56th Streets. Shadows from tall buildings in the morning are typical along the Hudson River Greenway given its location along the west side of Manhattan, and the incremental shadows from the Maximum Envelopes would be limited in their size and duration. Incremental shadows on the path would not affect its use or enjoyment. Therefore, no significant adverse impacts would occur due to project-generated incremental shadows on the Hudson River Greenway during the May 6/August 6 analysis day.

June 21 Analysis Day

The detailed analysis indicates that the Maximum Envelope would cast incremental shadows on the Hudson River Greenway for 4 hours and 40 minutes on the June 21 analysis day (from 5:57 AM to 10:37 AM). As shown in **Figure 6-20** through **Figure 6-24**, incremental shadows would move from south to north throughout the morning. The Maximum Envelope on Development Site 1 would mainly cast incremental shadows on the Greenway on this analysis day. June 21 is in the growing season for vegetation. Medians and traffic islands planted with shrubs and mature trees would experience roughly three hours of additional shadow at most at any given location as the shadows travel throughout the morning. The shrubs and mature trees in these locations would still receive at least 4 to 6 hours of sunlight, which is sufficient for the growth of tree canopies, shrubs, and perennials. Since there are no tall buildings west of the Greenway, it would experience direct sunlight throughout the afternoon and evening. Incremental shadows on the bike and running path would be concentrated between approximately W. 53rd and W. 56th Streets. Shadows from tall buildings in the morning are typical along the Hudson River Greenway given its location along the west side of Manhattan, and the incremental shadows from the Maximum Envelopes would be limited in their size and duration. Incremental shadows on the path would not affect its use or enjoyment. Therefore, no significant adverse impacts would occur due to project-generated incremental shadows on the Hudson River Greenway during the June 21 analysis day.

O3 – Pier 96 at Hudson River Park

Pier 96 at Hudson River Park (O3) is a recreational waterfront park owned and operated by the Hudson River Park Trust (HRPT), located northwest of the development sites along the Hudson River waterfront. The park consists of two landscaped lawns surrounded by pedestrian pathways that are lined with trees and benches. The park includes a waterfront esplanade with benches and picnic tables.

The Maximum Envelopes would not cast incremental shadow on the June 21 analysis day. Incremental shadows cast by the Maximum Envelopes on the December 21, March 21/September 21, and May 6/August 6 analysis days are described below and are shown in approximately 1-hour intervals in **Figure 6-25** through **Figure 6-33**.

December 21 Analysis Day

The detailed analysis indicates that the Maximum Envelopes would cast incremental shadows on Pier 96 for 2 hours and 31 minutes (from 8:51 AM to 11:22 AM) on the December 21 analysis day. As shown in **0** to **0,** incremental shadows from the Maximum Envelope on Development Site 1 would cover the center of the park at the beginning of the analysis day and then move north. The southern lawn would generally receive incremental shadows for around 1.5 hours, while the northern lawn would receive incremental shadows for one hour or less. Since December 21 is outside the growing season for vegetation, incremental shadows on the landscaped lawn and trees during this analysis day would not interfere with the health of the vegetation. Incremental shadows cast for a limited duration in the morning during this analysis day would not affect the use or enjoyment of Pier 96 by the public. No significant adverse impacts would occur due to project-generated incremental shadows on Pier 96 at Hudson River Park during the December 21 analysis day.

March 21/September 21 Analysis Day

The detailed analysis indicates that the Maximum Envelopes would cast incremental shadows on Pier 96 for 3 hours and 15 minutes (from 8:00 AM to 11:15 AM) on the March 21/September 21 analysis

day. As shown in **Figure 6-28** to **Figure 6-30,** incremental shadows from both development sites would reach the park at the beginning of the day. Incremental shadows would be limited to the southern half of the park. The main users of the park at this time are joggers, cyclists, and pedestrians on the landscaped park paths and waterfront esplanade, while the lawn and seating areas are used relatively more in the afternoon and evening. The shadows from Development Site 2 would quickly exit the park to the east, while the shadows from Development Site 1 would travel from west to east across the southern lawn. Some areas would experience a brief period of incremental shadow from Development Site 2, followed by a second brief period of shadow cast from Development Site 1. Although March 21 and September 21 are in the growing season for vegetation, the grass and mature trees in the southern half of the park would still receive at least 6 to 8 hours of sunlight, which would be sufficient for their growth. Since there are no tall buildings west of the park, it would experience direct sunlight throughout the afternoon and evening. Incremental shadows cast for a limited duration in the morning during this analysis day would not affect the use or enjoyment of Pier 96 by the public. Additionally, the Maximum Envelope would not eliminate sunlight from the open space resource at any point, as the northern portions of the park would remain in sun at all times during periods of incremental shadow. No significant adverse impacts would occur due to project-generated incremental shadows on Pier 96 at Hudson River Park during the March 21/September 21 analysis day.

May 6/August 6 Analysis Day

The detailed analysis indicates that the Maximum Envelopes would cast incremental shadows on Pier 96 for 3 hours and 16 minutes (from 7:28 AM to 10:44 AM) on the May 6/August 6 analysis day. As shown in **Figure 6-31** to **Figure 6-33,** incremental shadows from both development sites would reach the park at the beginning of the day. Incremental shadows would be limited to a small portion at the southeast corner of the park. The shadows from Development Site 2 would quickly exit the park to the east, while the shadows from Development Site 1 would travel from west to east across a small section of the southern lawn. Although May 6 and August 6 are in the growing season for vegetation, the grass and mature trees in the southern half of the park would still receive at least six to eight hours of sunlight, which would be sufficient for their growth. The park would experience direct sunlight throughout the afternoon and evening. Incremental shadows cast for a limited duration in a very small area in the morning during this analysis day would not affect the use or enjoyment of Pier 96 by the public. Additionally, the Maximum Envelopes would not eliminate sunlight from the open space resource at any point, as the northern portions of the park would remain in sun at all times during periods of incremental shadow. No significant adverse impacts would occur due to project-generated incremental shadows on Pier 96 at Hudson River Park during the May 6/August 6 analysis day.

O4 – Pier 97 at Hudson River Park

Pier 97 at Hudson River Park (O4) is a recreational waterfront pier owned and operated by the Hudson River Park Trust (HRPT), located northwest of the development sites along the Hudson River waterfront. Extending roughly 650 feet into the Hudson River, the pier features landscaping and seating areas, a lawn towards the western end of the pier, a synthetic turf field east of the lawn, and a playground near the shoreline.

The Maximum Envelopes would not cast incremental shadow on the March 21/September 21, May 6/August 6, or June 21 analysis days. Incremental shadows cast by the Maximum Envelopes on the December 21 analysis day are described below and are shown in approximately 1-hour intervals in **Figure 6-34** through **Figure 6-36**.

December 21 Analysis Day

The detailed analysis indicates that the Maximum Envelopes would cast incremental shadows on Pier 97 for 2 hours and 39 minutes (from 8:51 AM to 11:30 AM) on the December 21 analysis day. As shown in **Figure 6-34** to **Figure 6-36,** incremental shadows from Development Site 2 would begin the day covering the eastern portion of the pier and quickly exit to the east at around 10:00 AM. Incremental shadows from Development Site 1 would enter from the west end of the pier and travel east before exiting the pier in the late morning. Since shadows are long during the winter, the Maximum Envelopes would cast long, narrow shadows that would move relatively quickly. Since December 21 is outside the growing season for vegetation, incremental shadows would not disrupt the growth of any plants to be located on the pier. Also, utilization of this open space resource is generally lower in the winter relative to other times of the year. Incremental shadows on the path would not affect its use or enjoyment. Shadows from tall buildings in the morning are typical along the waterfront in this area given its location along the west side of Manhattan, and the incremental shadows from the Maximum Envelopes would be limited in their size and duration. Therefore, no significant adverse impacts would occur due to project-generated incremental shadows on Pier 97 during the December 21 analysis day.

Natural Resources

N1 – Hudson River

The Hudson River (N1) is a surface waterbody located west of the development sites. The Hudson River would experience incremental shading on all four analysis days. Further assessment of this resource is provided in the sections below.

December 21 Analysis Day

Incremental shading would be cast on the Hudson River for 3 hours and 27 minutes (from 8:51 AM to 12:18 PM) on the December 21 analysis day (see **Figure 6-37** to **Figure 6-40**). The greatest extent of shading would occur near sunrise, with shadows moving from west to east and decreasing in size from the morning to the early afternoon. Most of the incremental shading throughout the analysis period would occur near the shoreline, but shadows would extend past the pierhead line in the early morning.

March 21/September 21 Analysis Day

Incremental shading would be cast on the Hudson River for 2 hours and 43 minutes (from 7:36 AM to 10:22 AM) on the March 21/September 21 analysis day (see **Figure 6-41** to **Figure 6-43**). The greatest extent of shading would occur near sunrise, with shadows moving from west to east and decreasing in size throughout the morning. The incremental shading throughout the analysis period would occur at the shoreline of the waterbody.

May 6/August 6 Analysis Day

Incremental shading would be cast on the Hudson River for 1 hour and 55 minutes (from 6:27 AM to 8:27 AM) on the May 6/August 6 analysis day (see **Figure 6-44** to **Figure 6-45)**. The greatest extent of shading would occur near sunrise, with shadows moving from west to east and decreasing in size. Most of the incremental shading throughout the analysis period would be limited to the shoreline of the waterbody.

June 21 Analysis Day

Incremental shading would be cast on the Hudson River for 2 hours and 24 minutes (from 5:57 AM to 8:21 AM) on the June 21 analysis day (see **Figure 6-46** to **Figure 6-47**). The greatest extent of shading would occur near sunrise, with shadows moving from west to east and decreasing in size. Most of the incremental shading throughout the analysis period would be limited to the shoreline of the waterbody.

Overall Assessment

The incremental shadow would occur over limited portions of the Hudson River. Relative to the overall size of the Hudson River, the areal extent of shading would be limited to a minimal portion of the resource. Additionally, due to their dynamic (i.e., constantly moving) nature, shadows impact at individual locations within the overall affected area of the Hudson River would be temporary and of limited duration. Incremental shading would be limited to the late afternoon hours during all analysis days and would not occur within the remaining sunlight hours of the respective analysis days, thereby allowing for substantial periods of direct sunlight to biological resources within the affected areas. By definition, surface waterbodies are not static; they are dynamic environments that are affected by natural processes such as currents, tides, wind, temperature gradients, etc. that move water. Therefore, resident organisms within the water column are in a constant state of movement and would be carried through areas impacted by incremental shading, resulting in only temporary exposure to such organisms. Further, many biological organisms that inhabit waterbodies are capable of locomotion and therefore can move from shaded to sunlit areas (or vice versa) of their own volition. For those organisms that are not moved by natural processes or capable of locomotion, the incremental shadows would be minimal, temporary, and of limited duration. Further, any wildlife present in the area is tolerant of urban conditions and as shadows are not static and move from west to east throughout the day, no area of the Hudson River would be permanently in shade or shaded to a degree that would impact aquatic biota as a result of incremental shadows. Therefore, significant adverse impacts are not anticipated as a result of the Proposed Actions.

O1 – DeWitt Clinton Park

Figure 6-6 June 21 – 8:00 AM



O2 – Hudson River Greenway

Figure 6-7 December 21 – 10:00 AM



Figure 6-8 December 21 – 11:00 AM

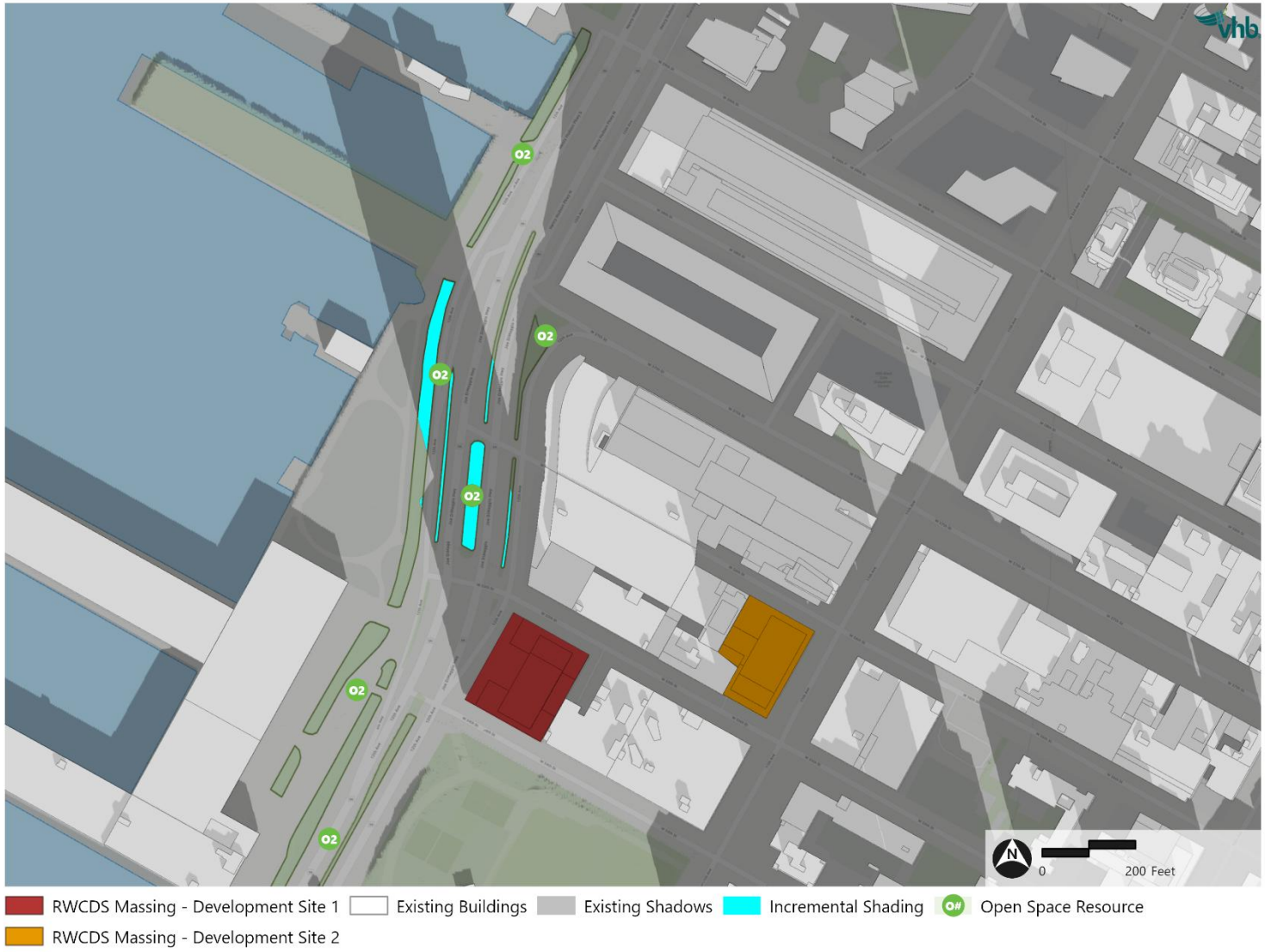


Figure 6-9 December 21 – 12:00 PM

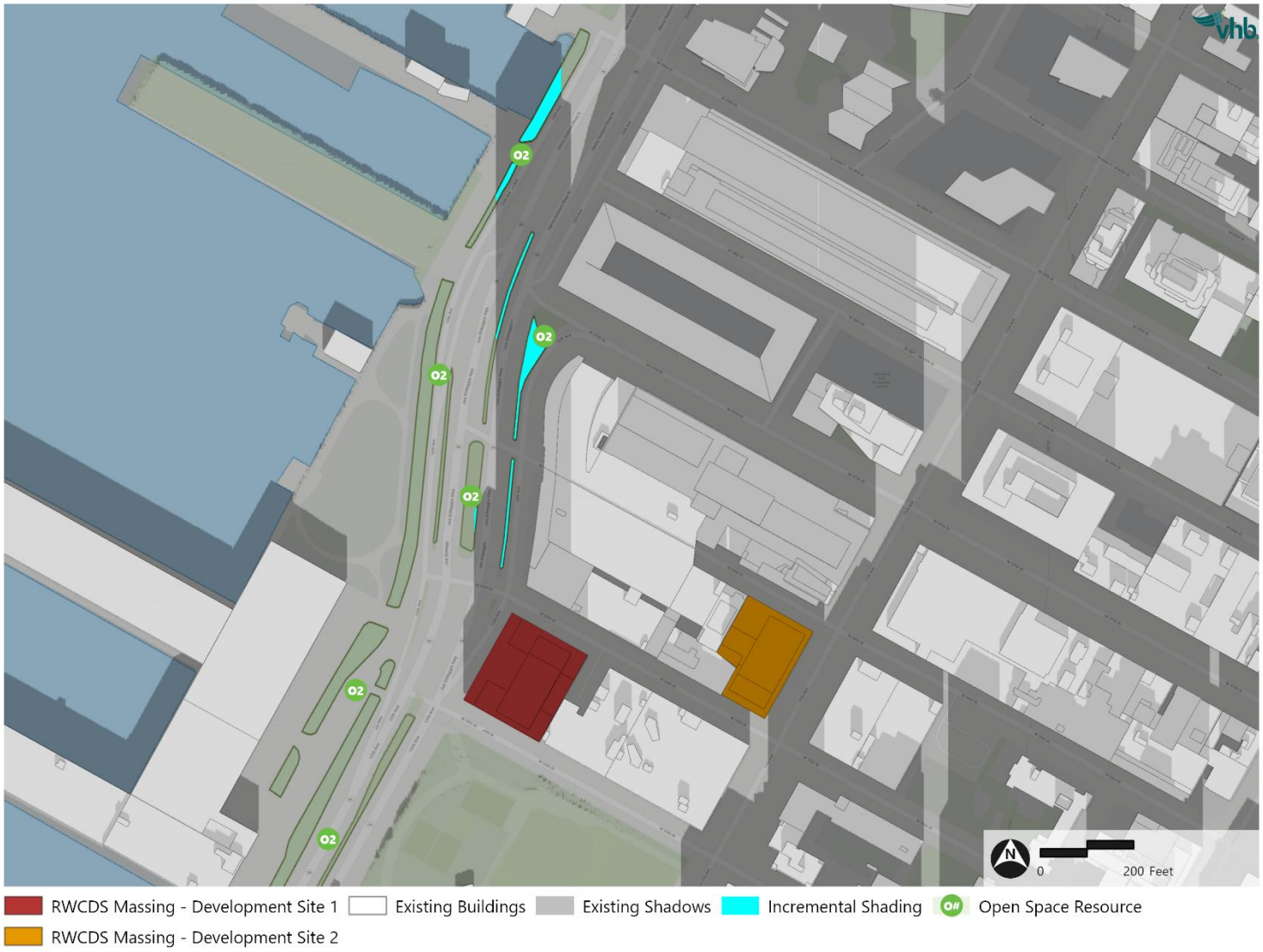


Figure 6-10 March 21/September 21 – 8:00 AM



Figure 6-11 March 21/September 21 – 9:00 AM

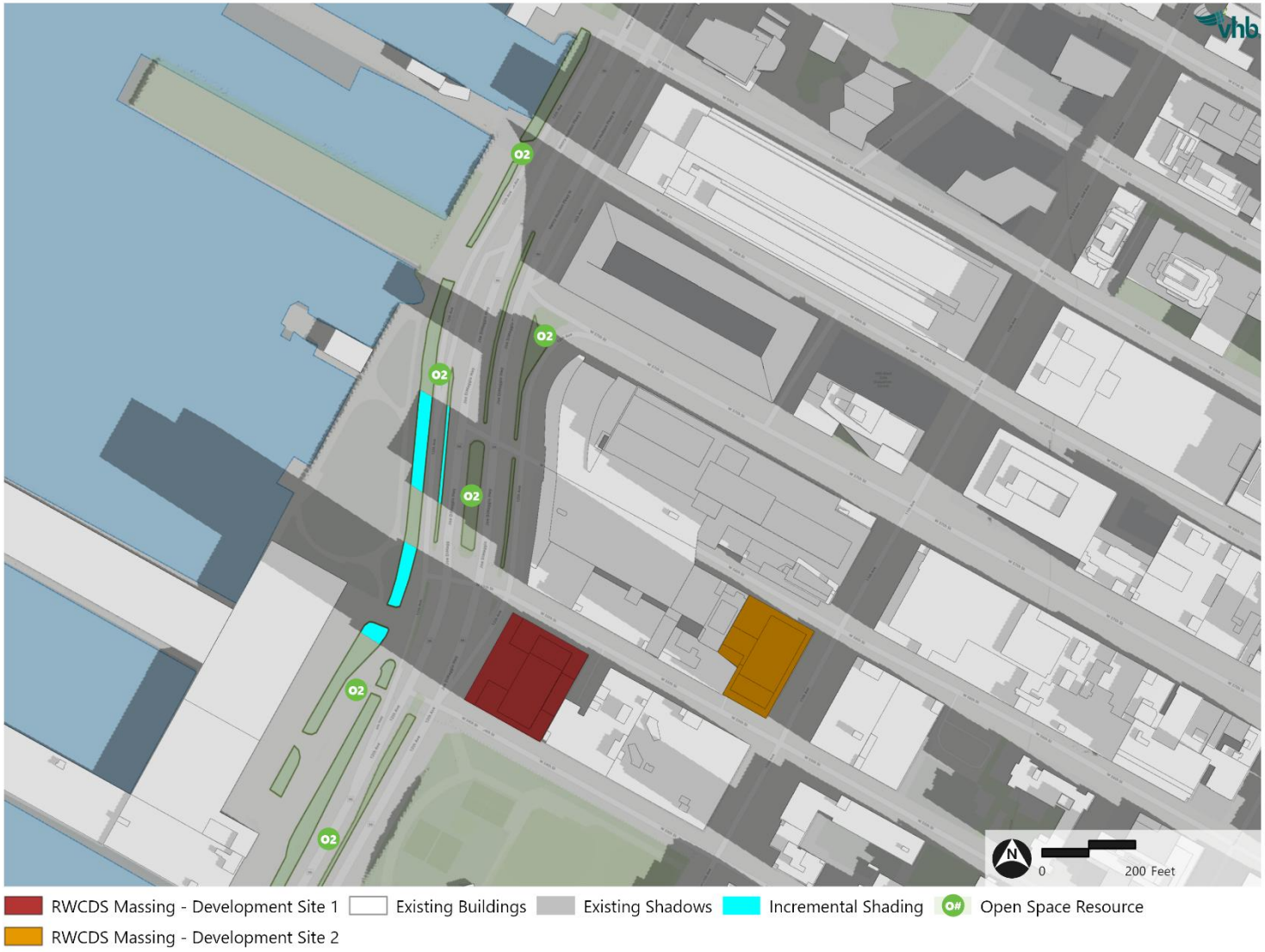


Figure 6-12 March 21/September 21 – 10:00 AM



Figure 6-13 March 21/September 21 – 11:00 AM

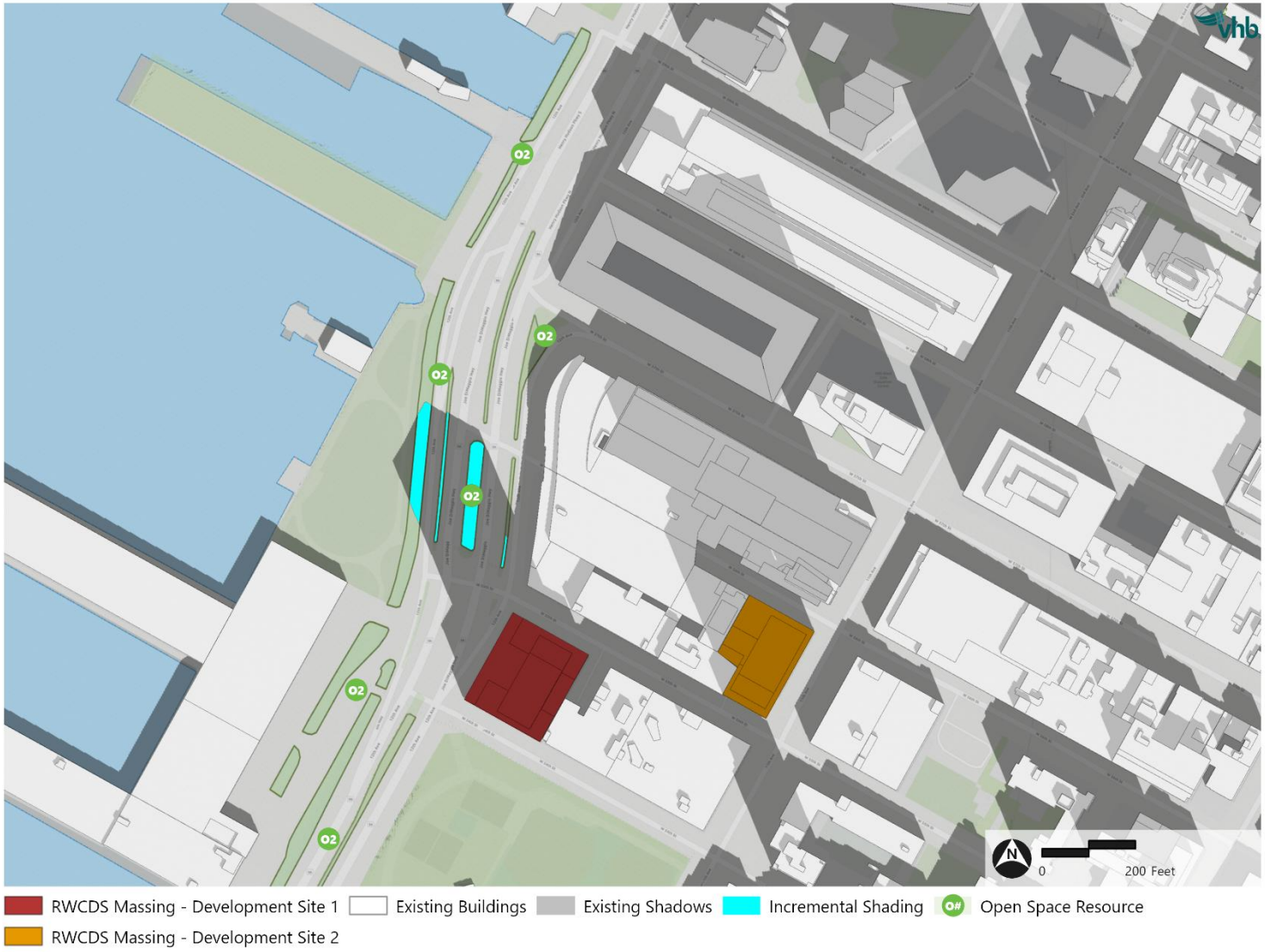


Figure 6-14 March 21/September 21 – 12:00 PM

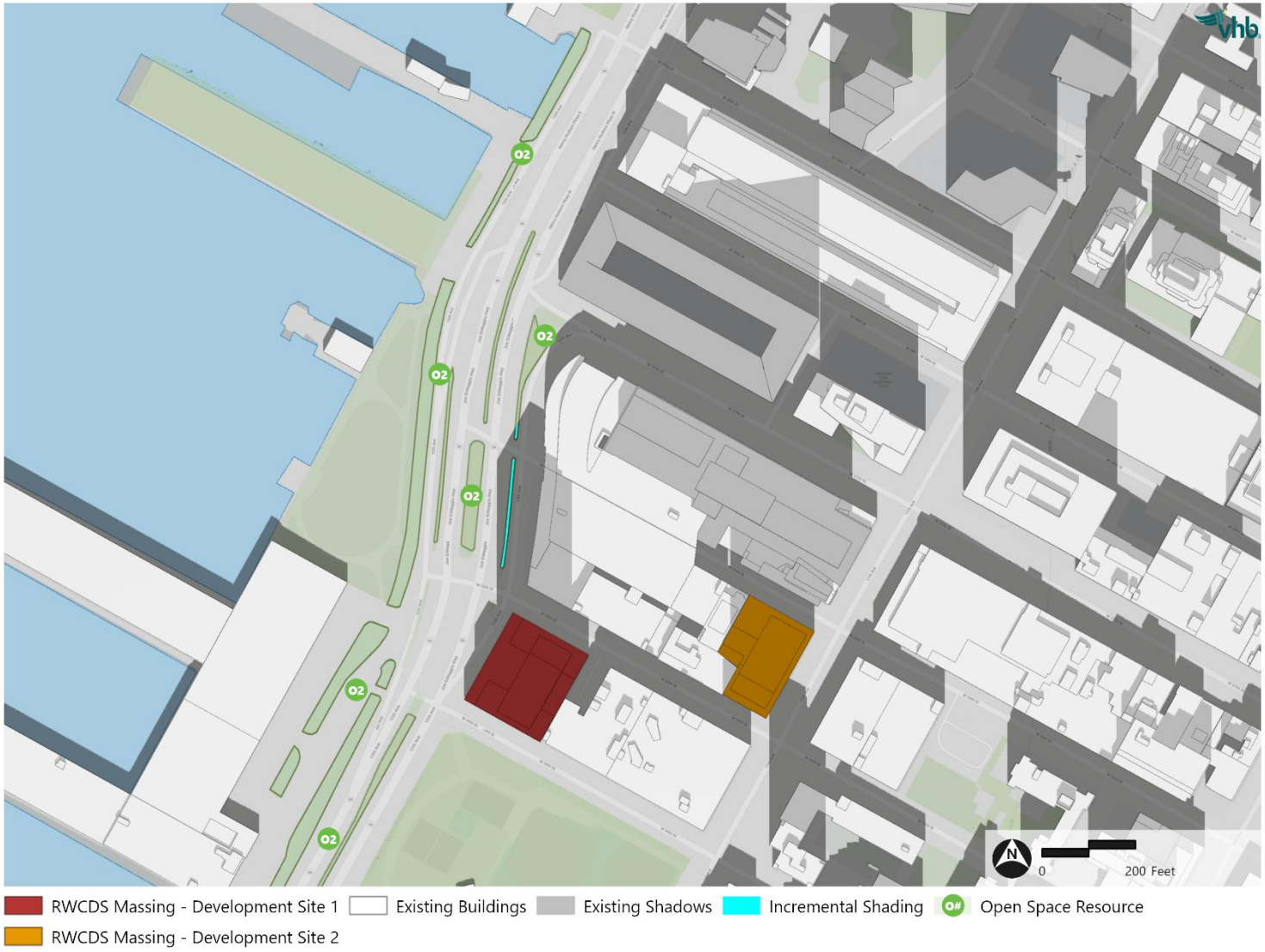


Figure 6-15 May 6/August 6 – 7:00 AM



Figure 6-16 May 6/August 6 – 8:00 AM



Figure 6-17 May 6/August 6 – 9:00 AM

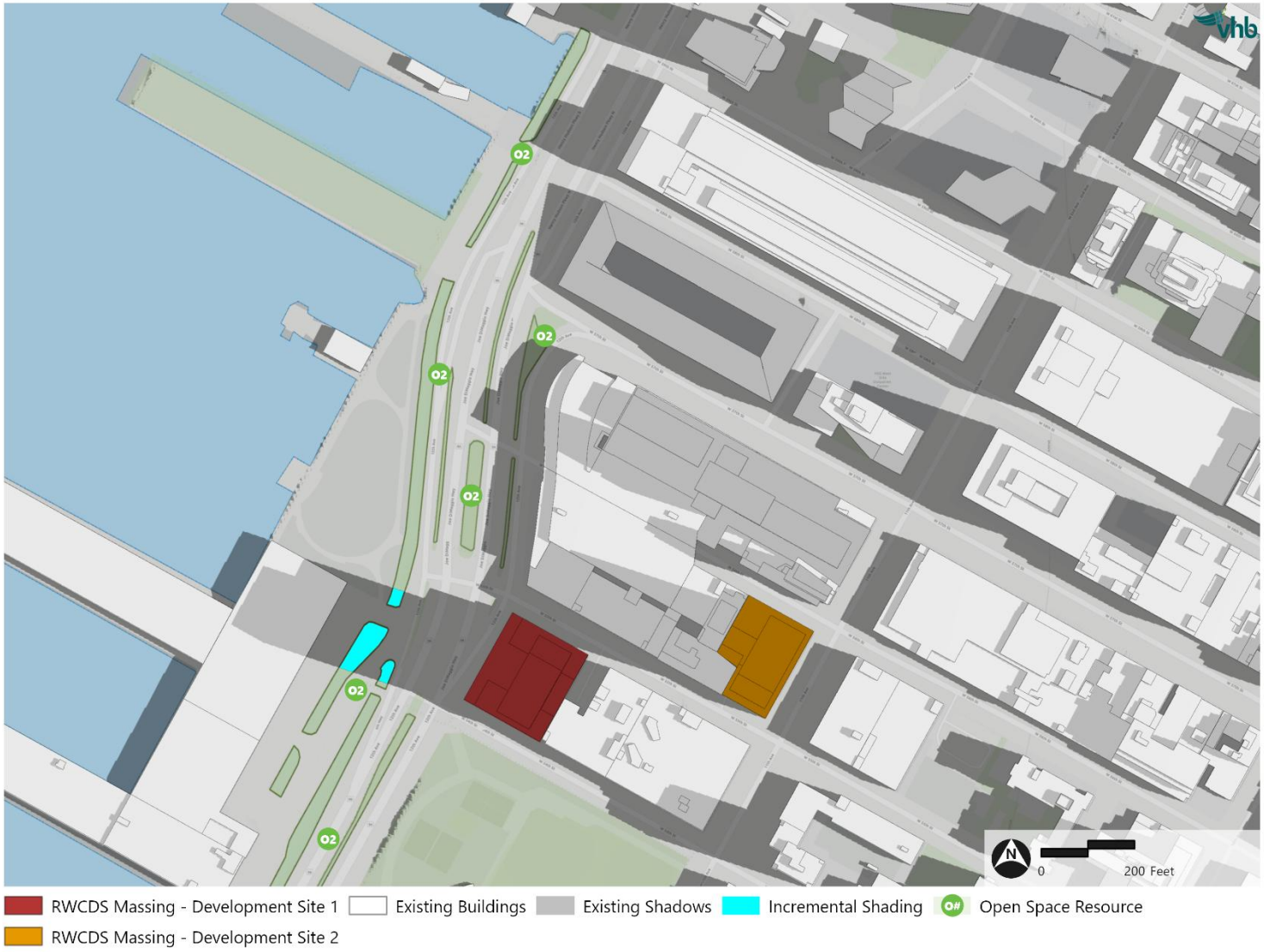


Figure 6-18 May 6/August 6 – 10:00 AM

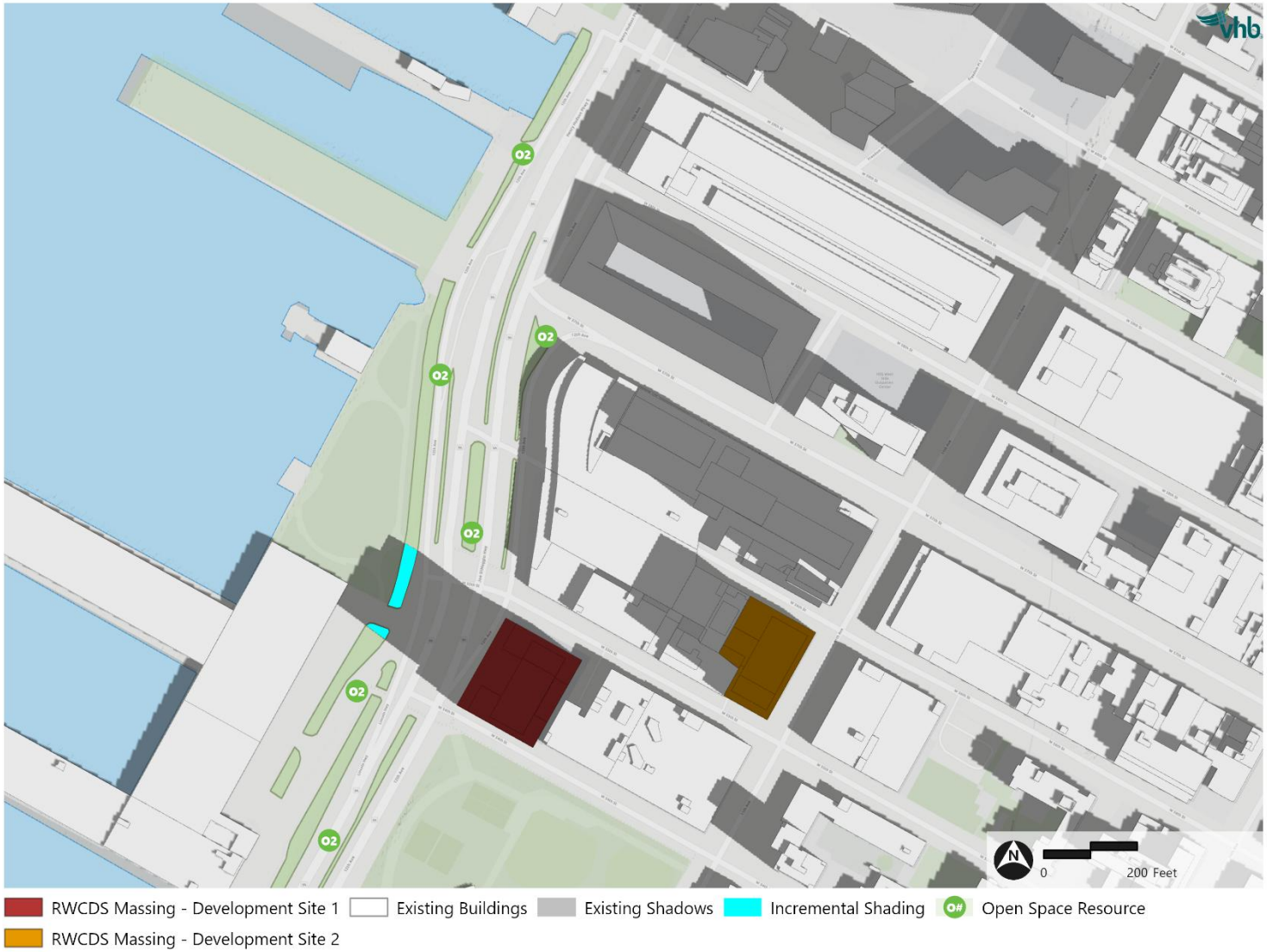


Figure 6-19 May 6/August 6 – 11:00 AM

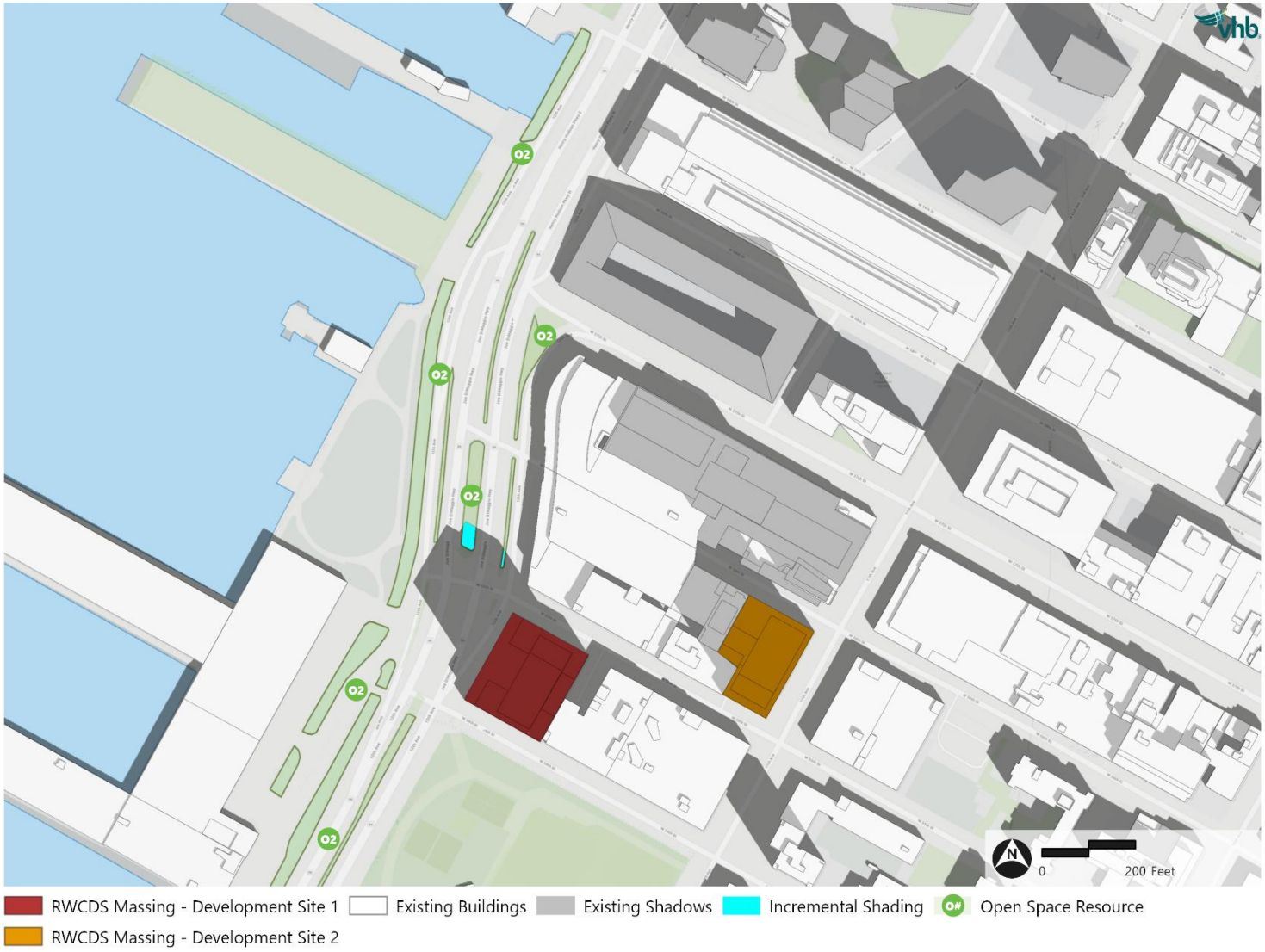


Figure 6-20 June 21 – 6:15 AM



Figure 6-21 June 21 – 7:15 AM



Figure 6-22 June 21 – 8:15 AM



Figure 6-23 June 21 – 9:15 AM

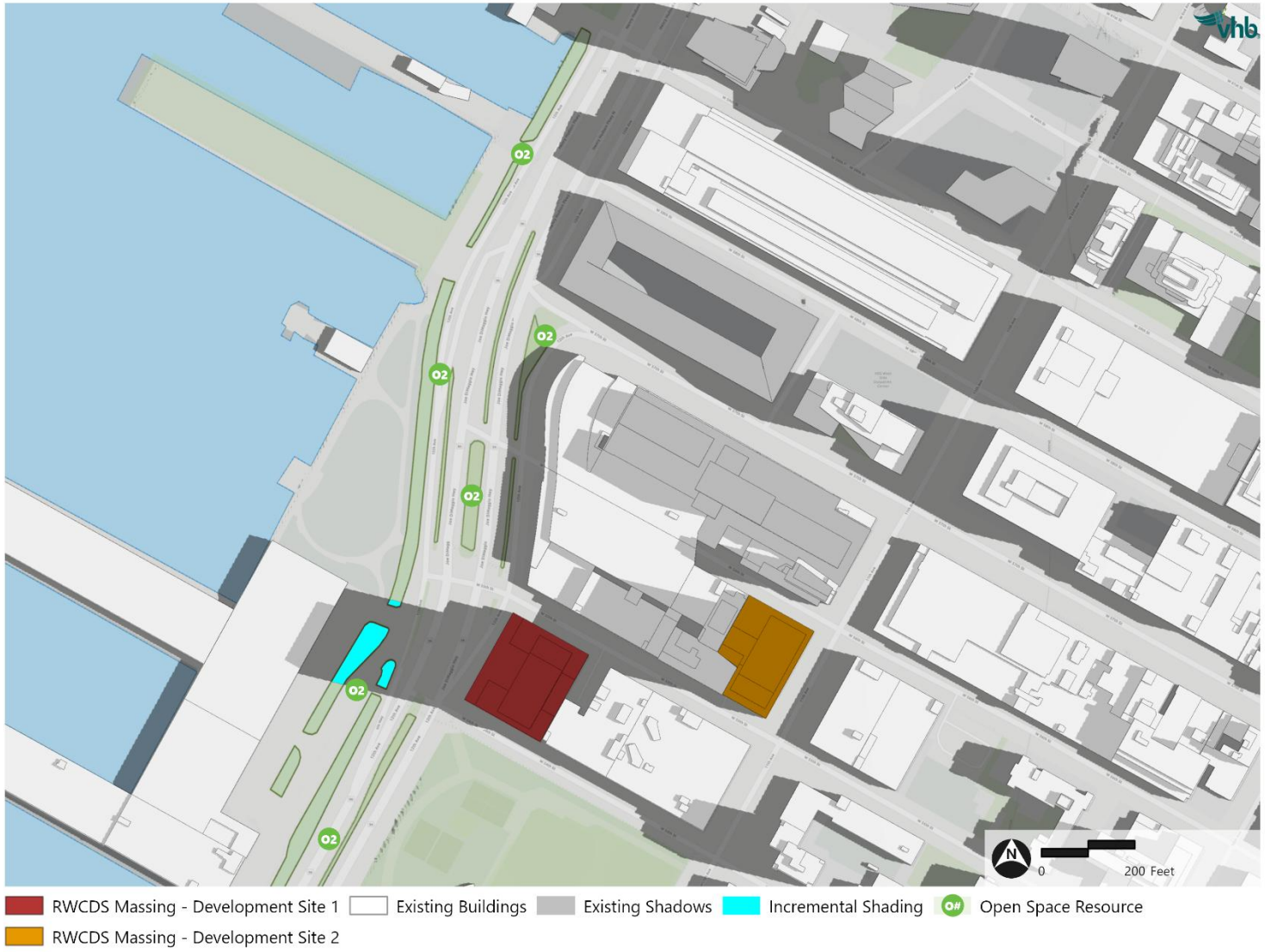
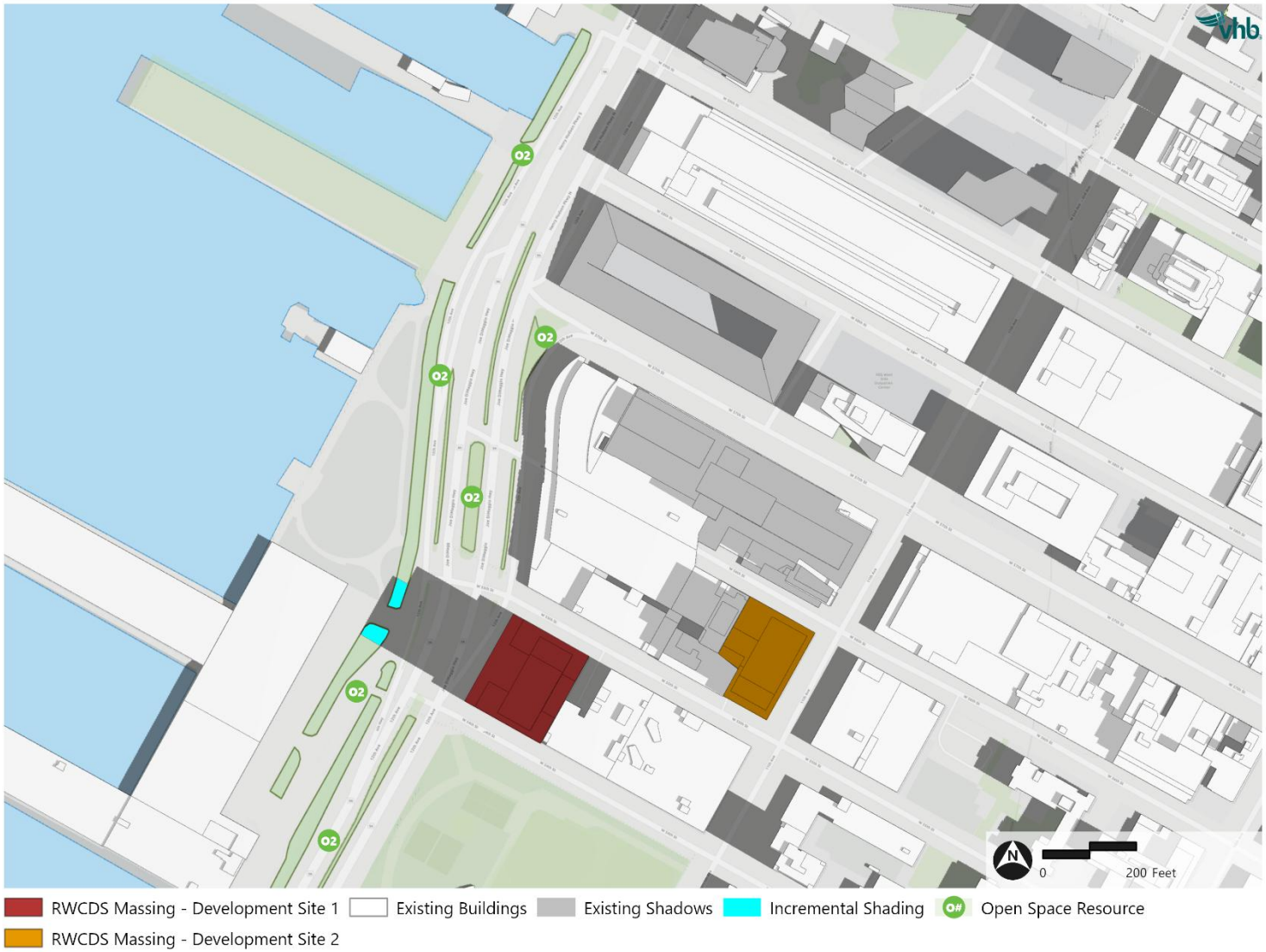


Figure 6-24 June 21 – 10:15 AM



O3 – Pier 96 at Hudson River Park

Figure 6-25 December 21 – 9:00 AM

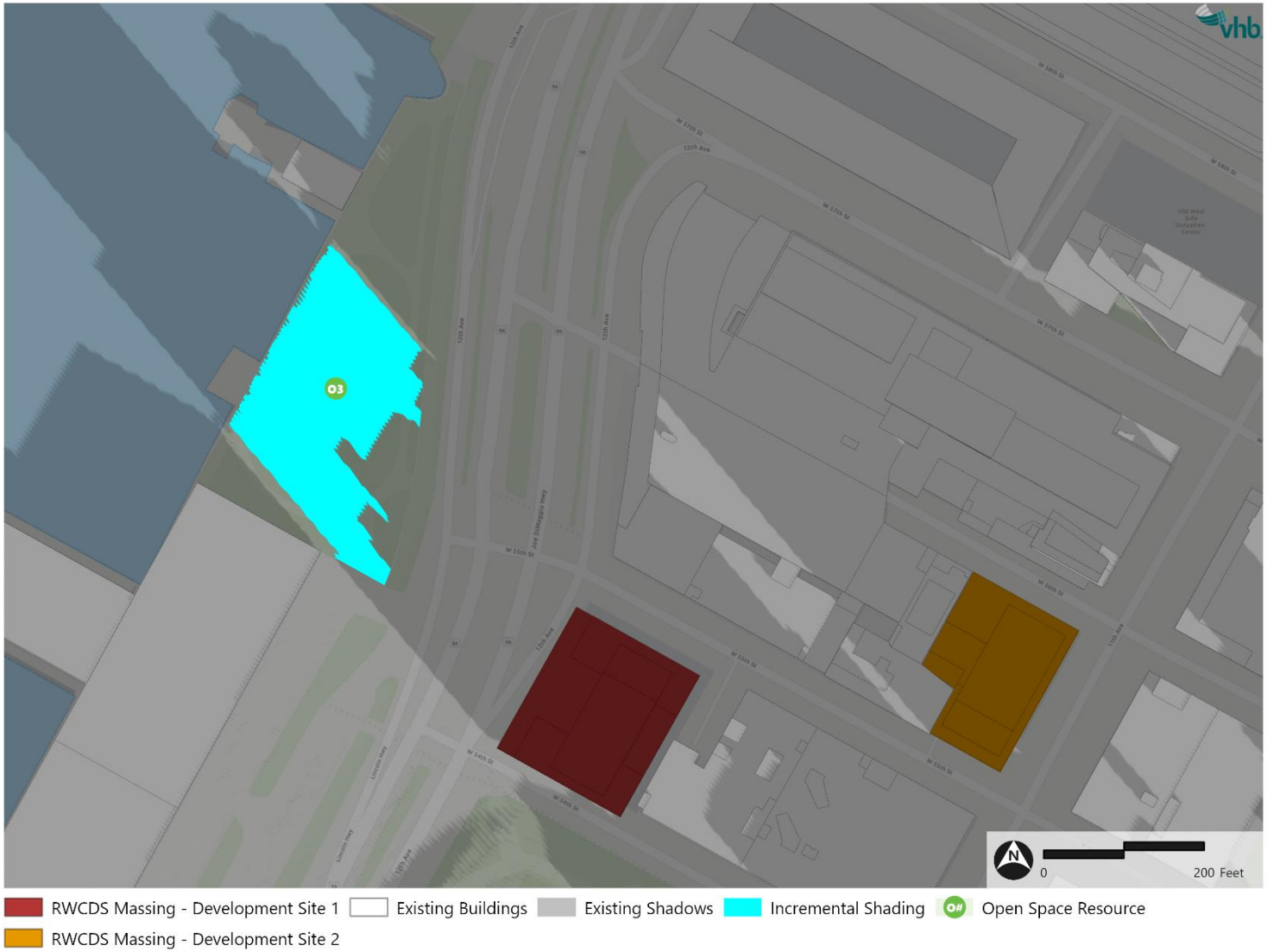


Figure 6-26 December 21 – 10:00 AM



Figure 6-27 December 21 – 11:00 AM

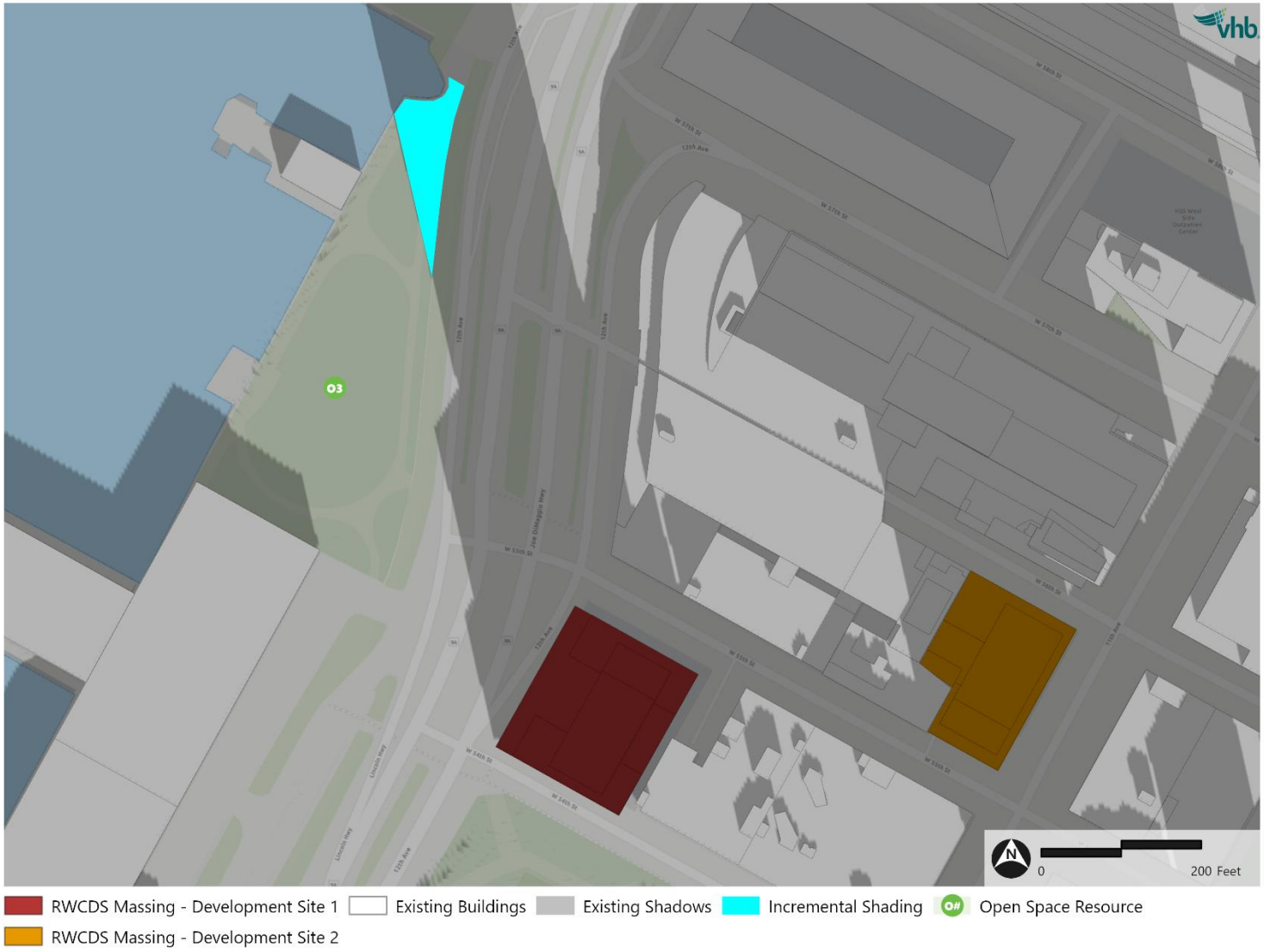


Figure 6-28 March 21/September 21 – 8:15 AM



Figure 6-29 March 21/September 21 – 9:15 AM

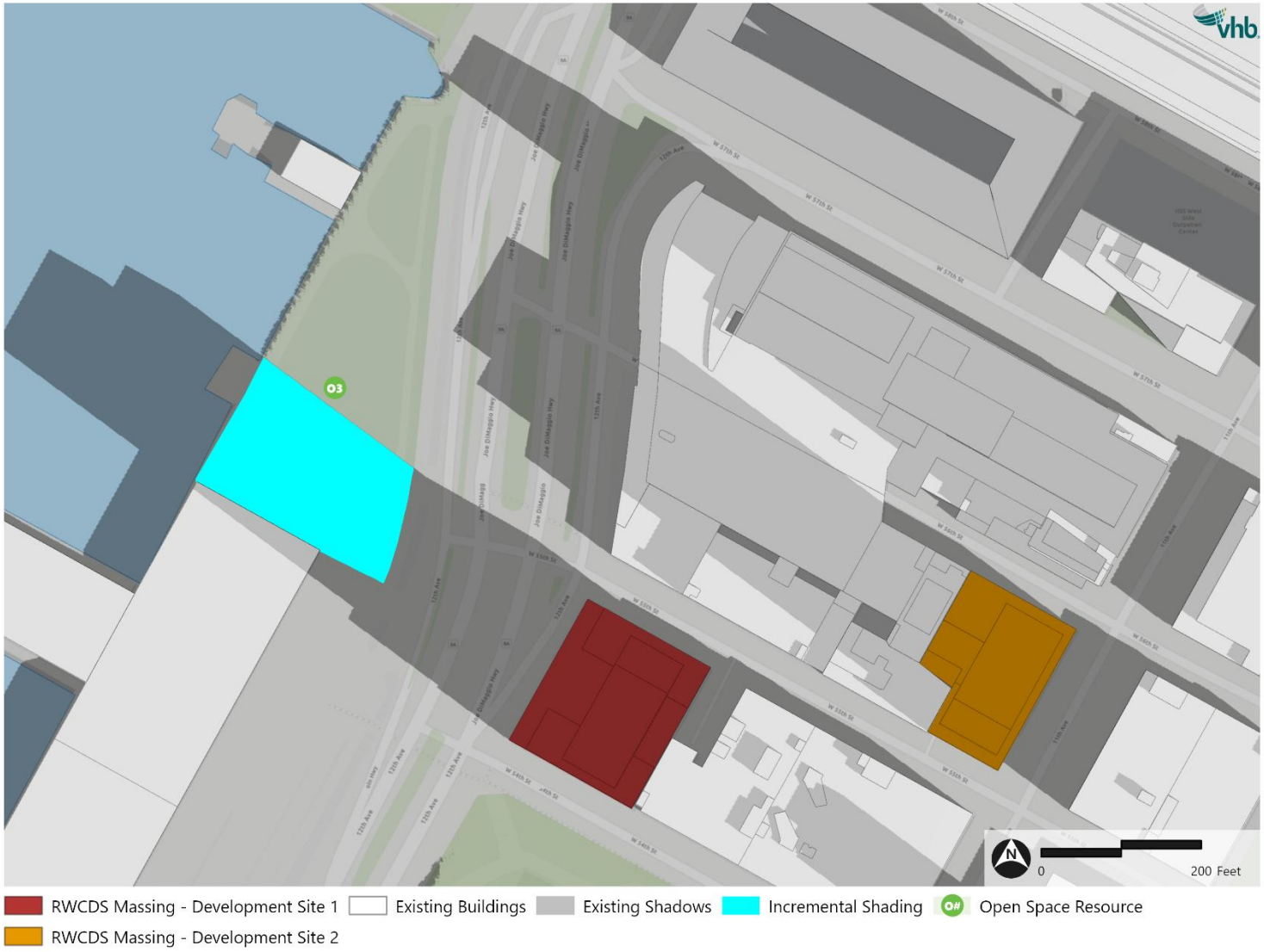


Figure 6-30 March 21/September 21 – 10:15 AM

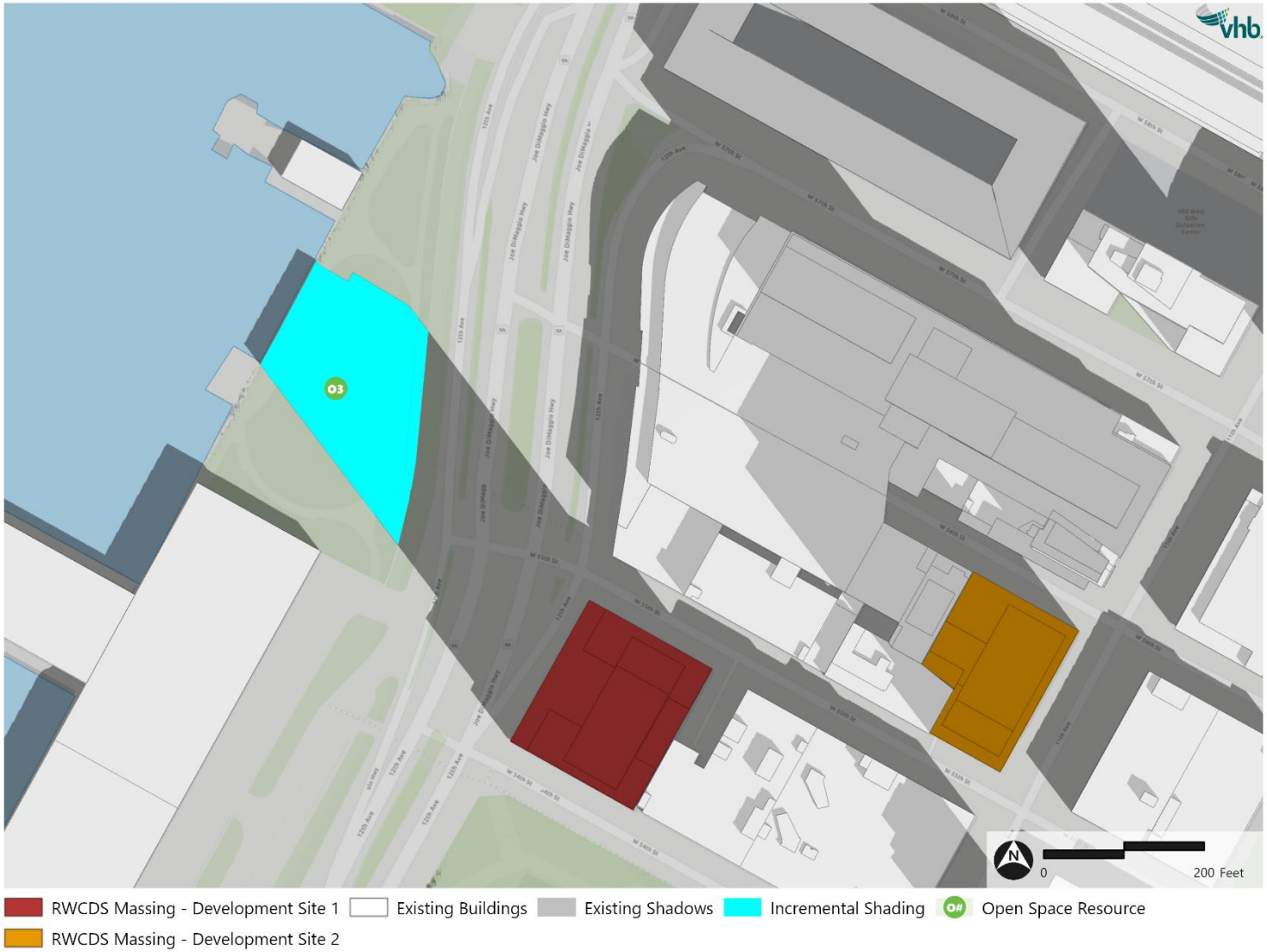


Figure 6-31 May 6/August 6 – 8:00 AM



Figure 6-32 May 6/August 6 – 9:00 AM

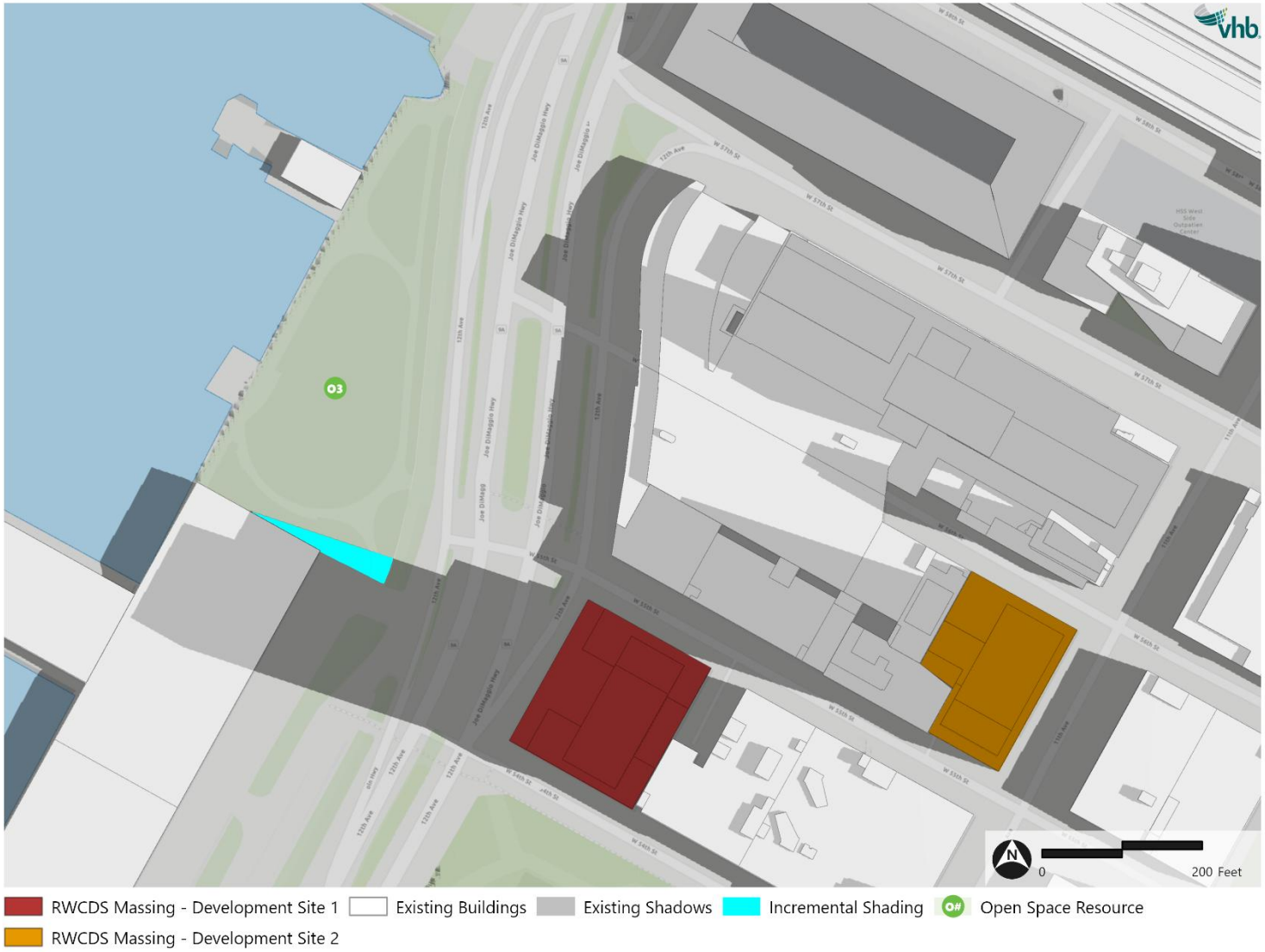
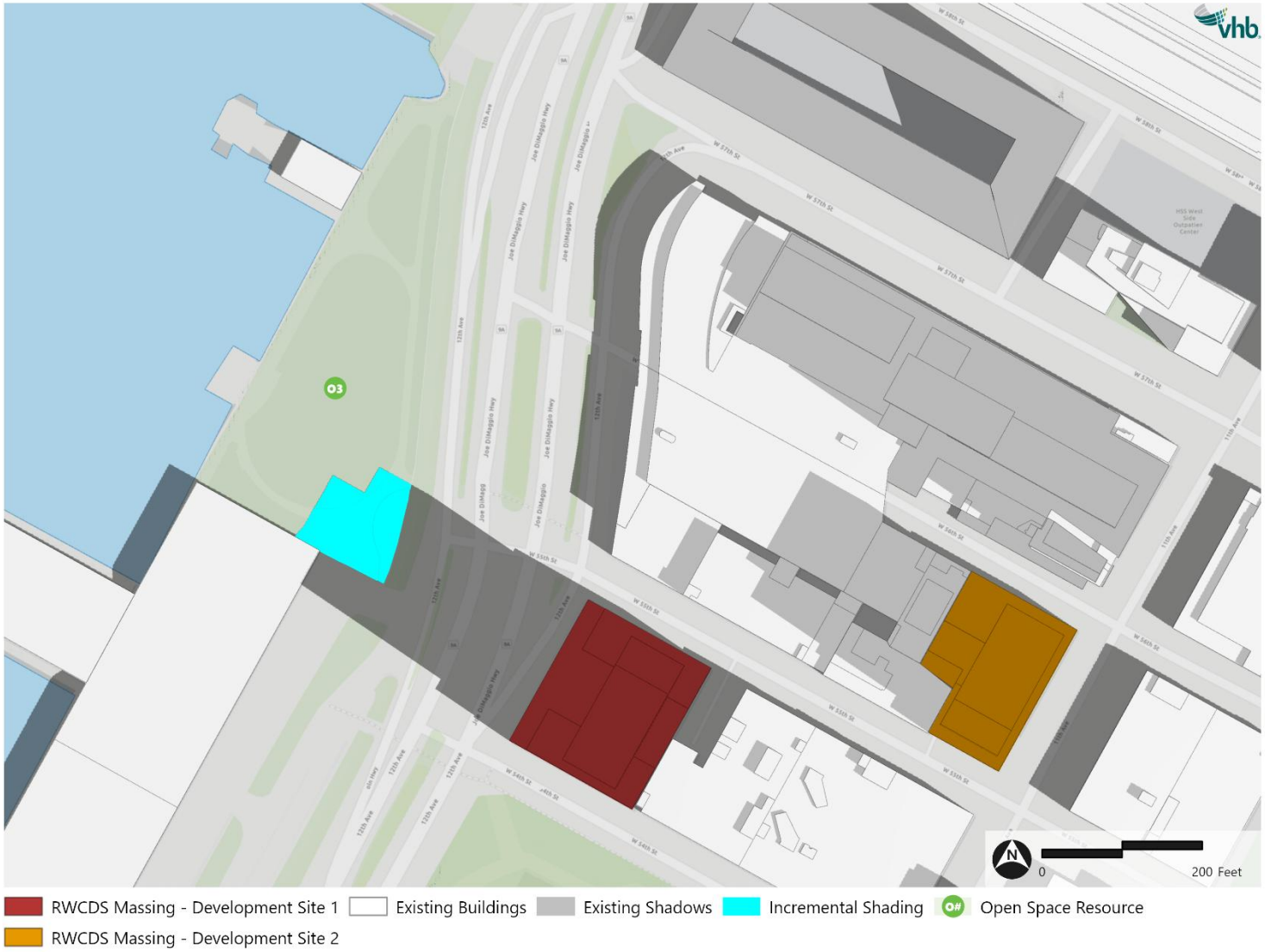


Figure 6-33 May 6/August 6 – 10:00 AM



O4 – Pier 97 at Hudson River Park

Figure 6-34 December 21 – 9:15 AM

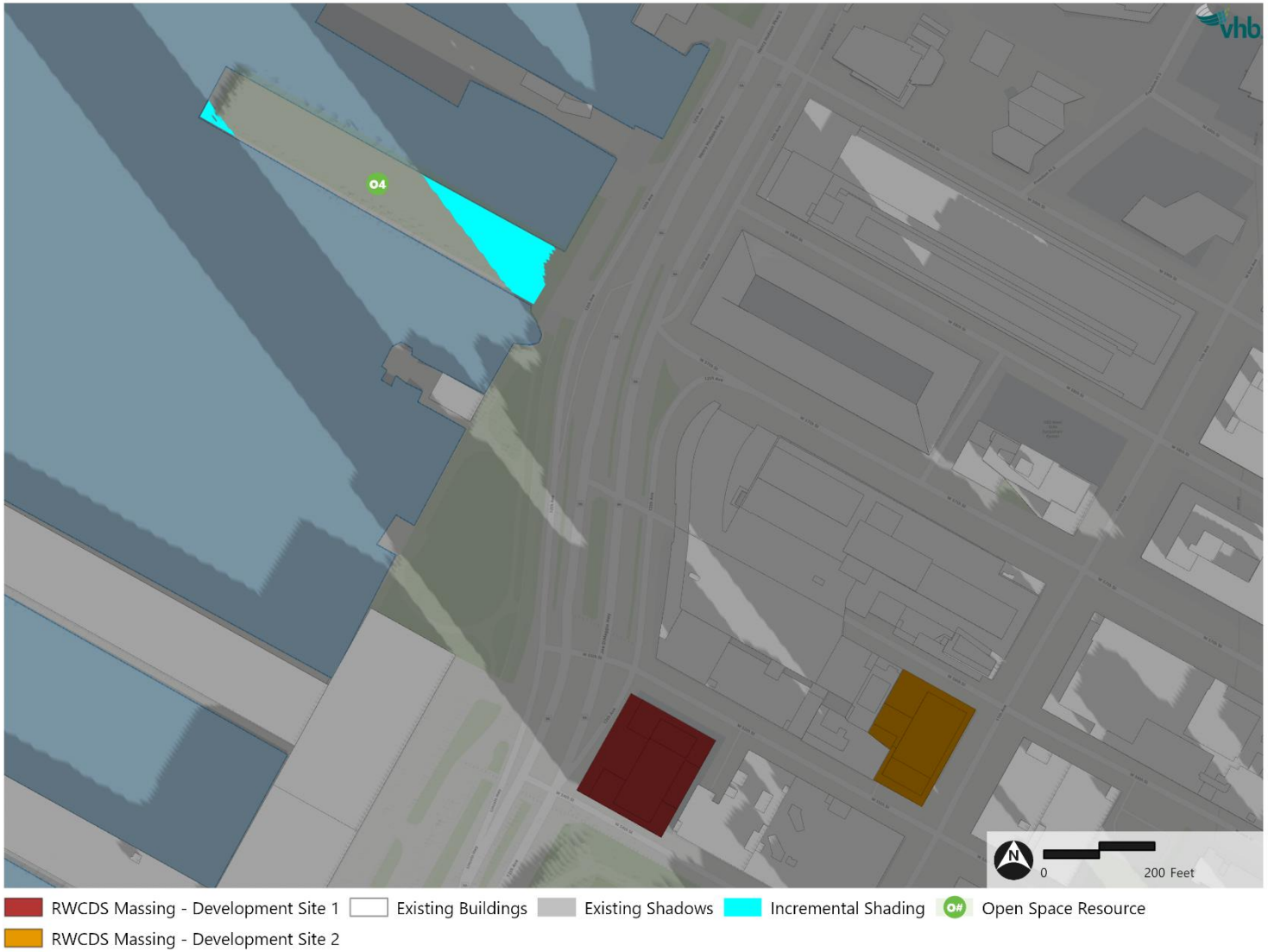
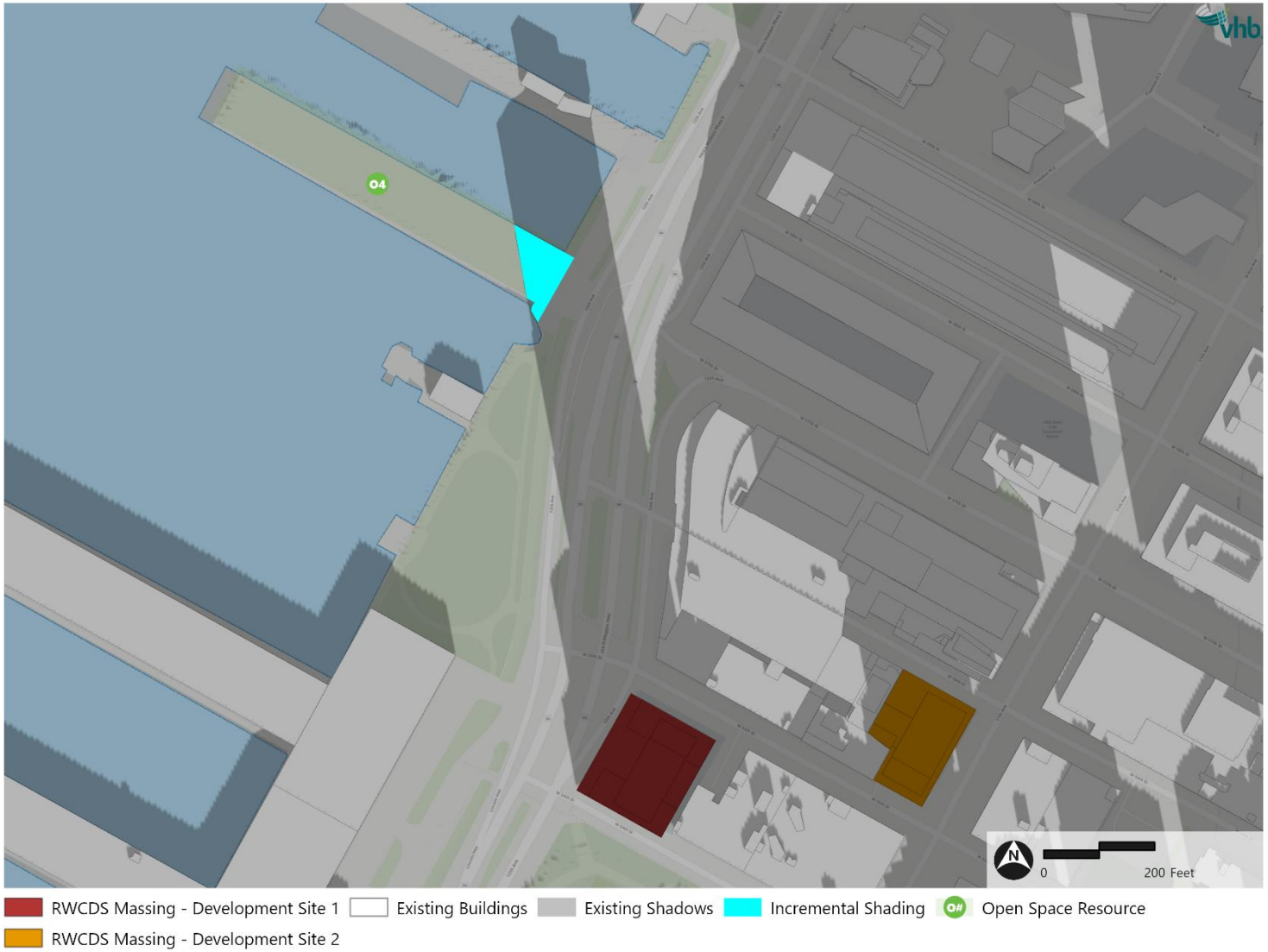


Figure 6-35 December 21 – 10:15 AM



Figure 6-36 December 21 – 11:15 AM



N1 – Hudson River

Figure 6-37 December 21 – 9:00 AM



Figure 6-38 December 21 – 10:00 AM

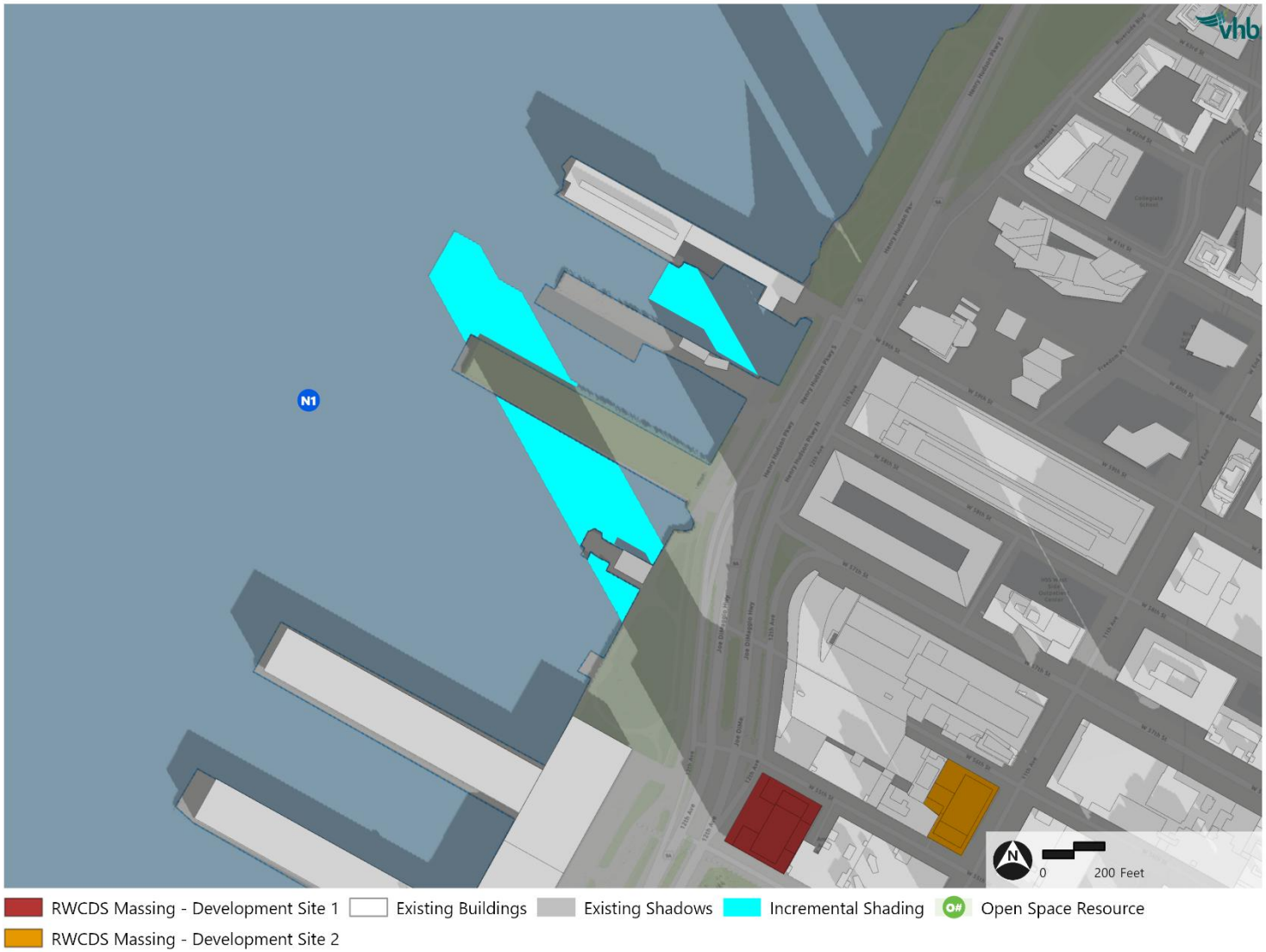


Figure 6-39 December 21 – 11:00 AM

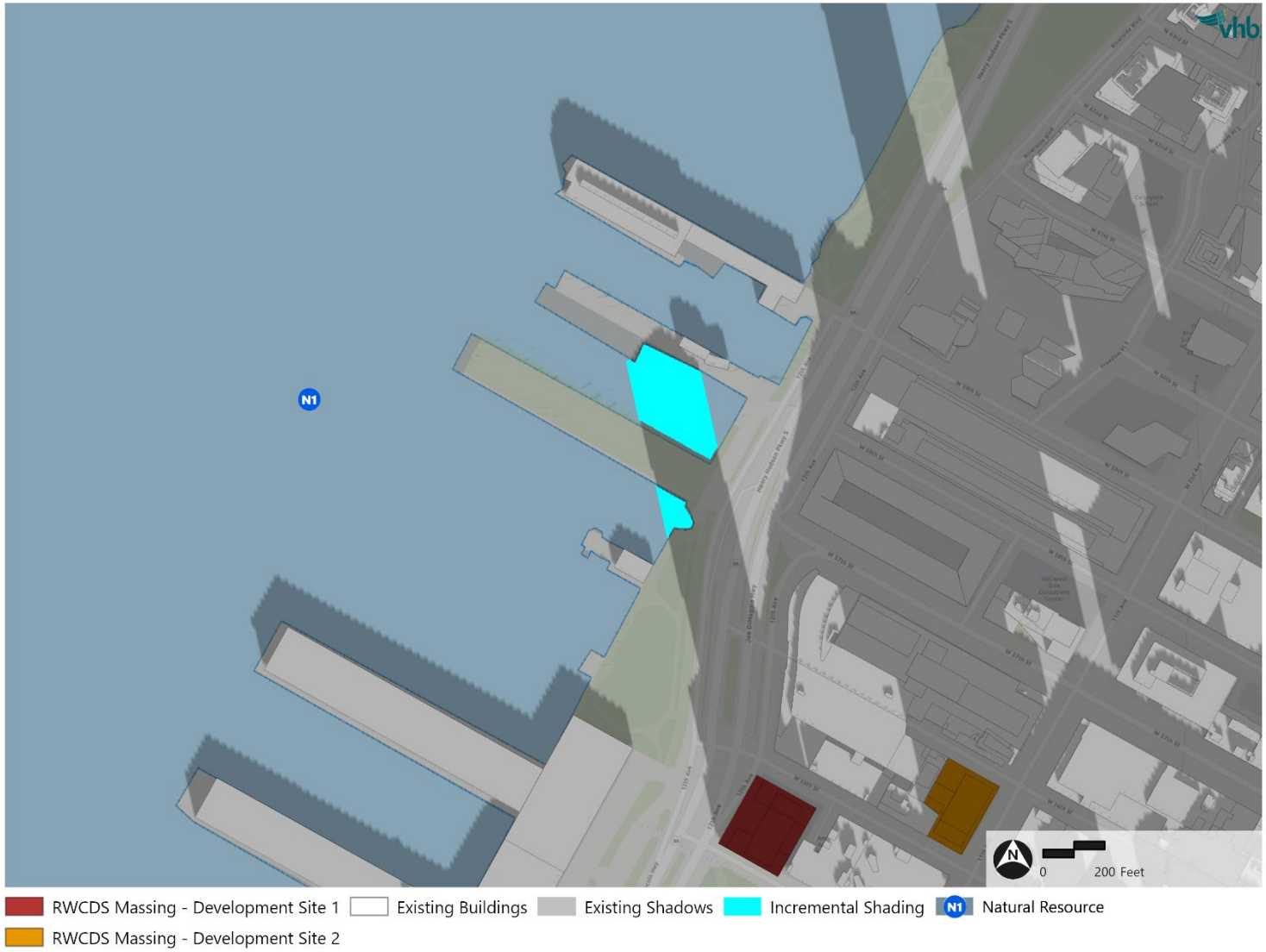


Figure 6-40 December 21 – 12:00 PM

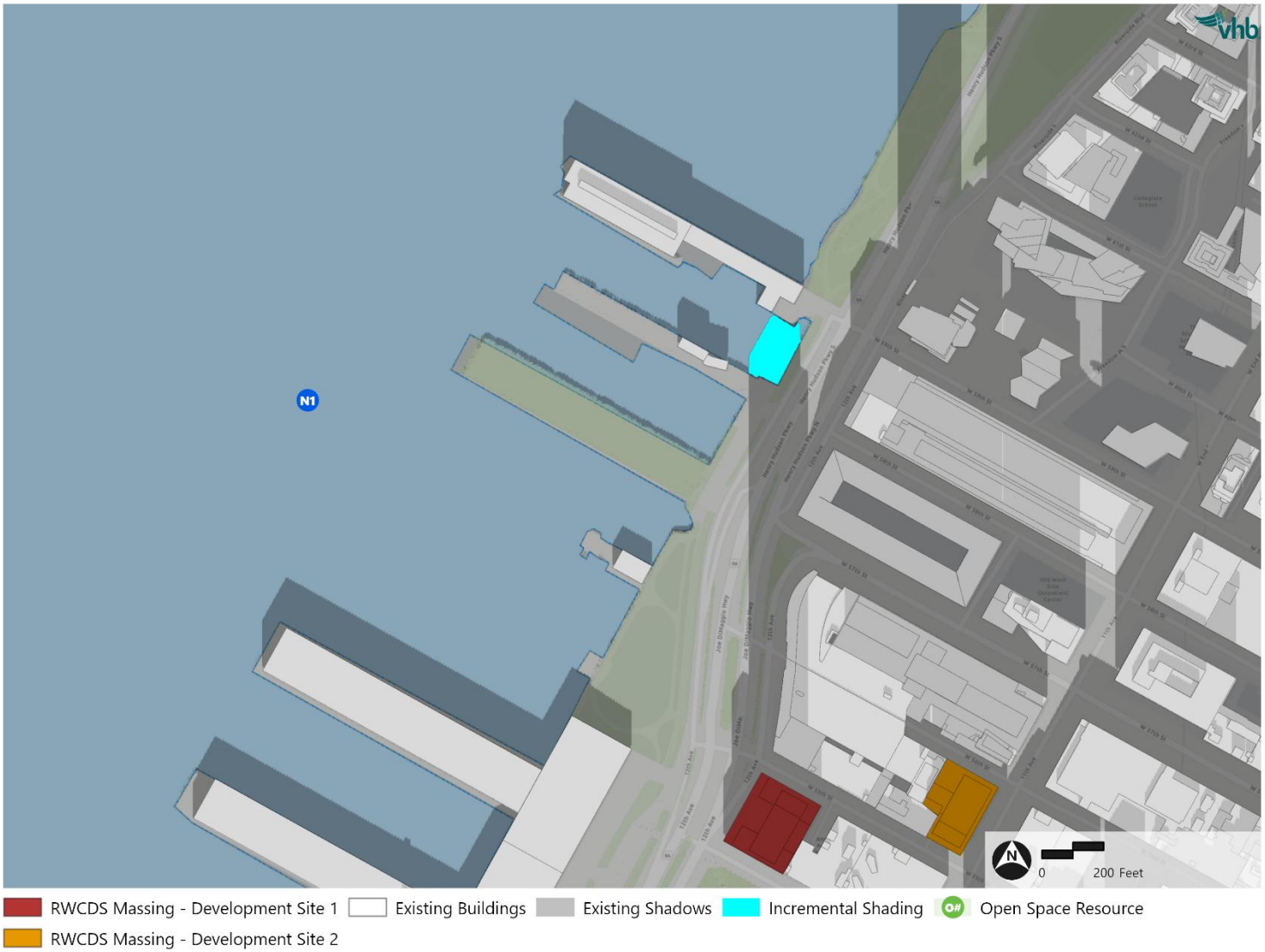


Figure 6-41 March 21/September 21 – 8:00 AM

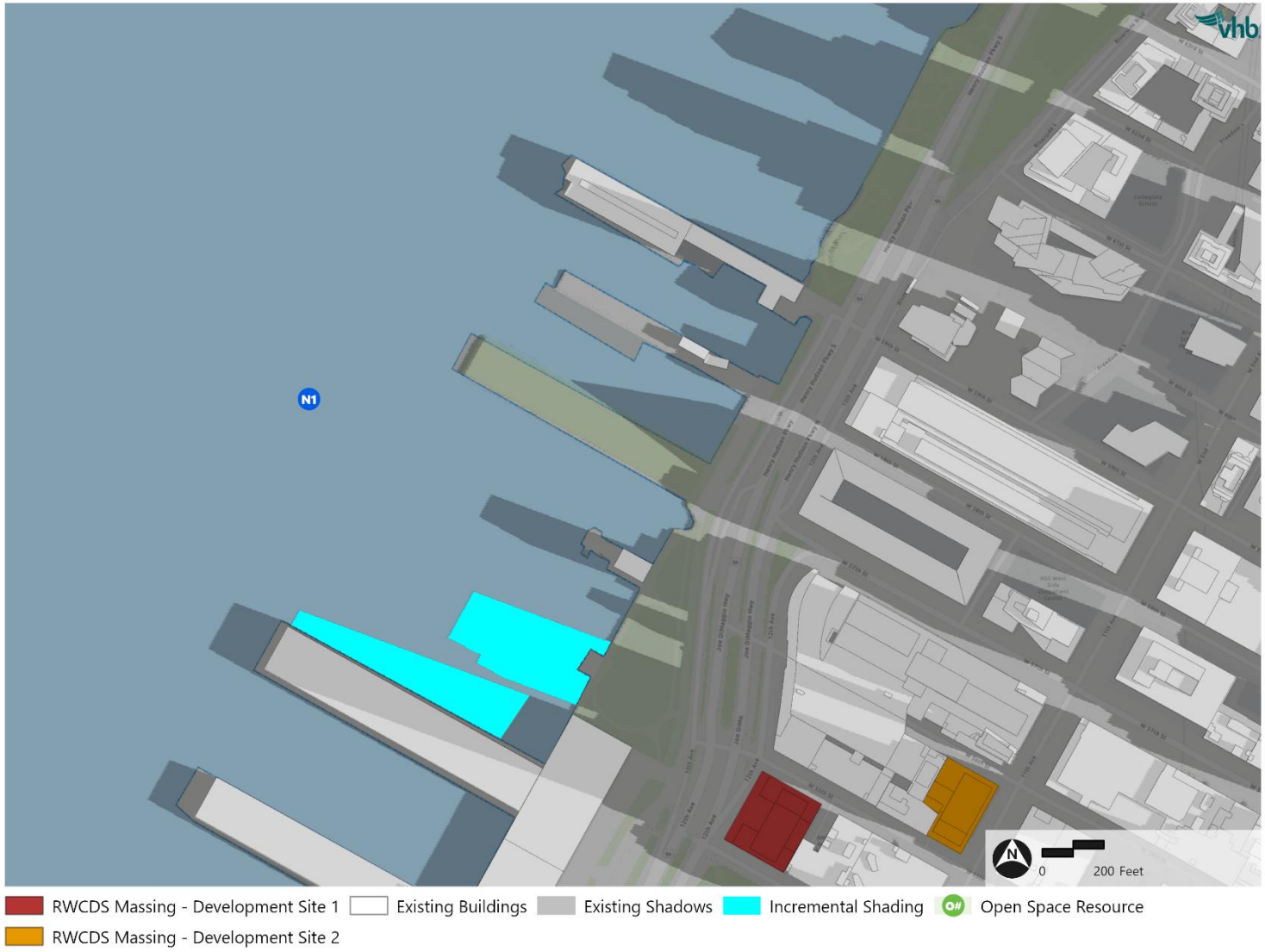


Figure 6-42 March 21/September 21 – 9:00 AM

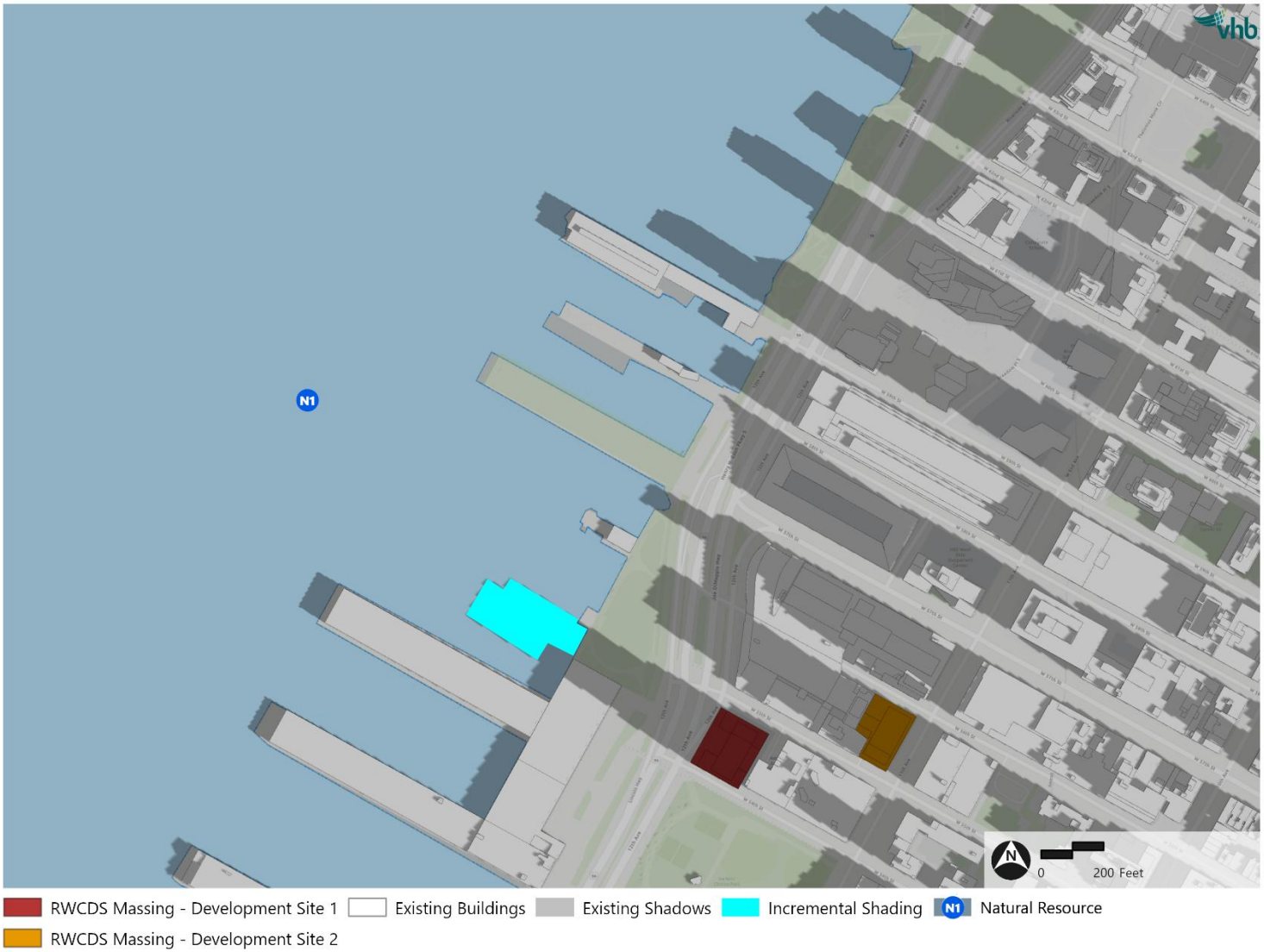


Figure 6-43 March 21/September 21 – 10:00 AM

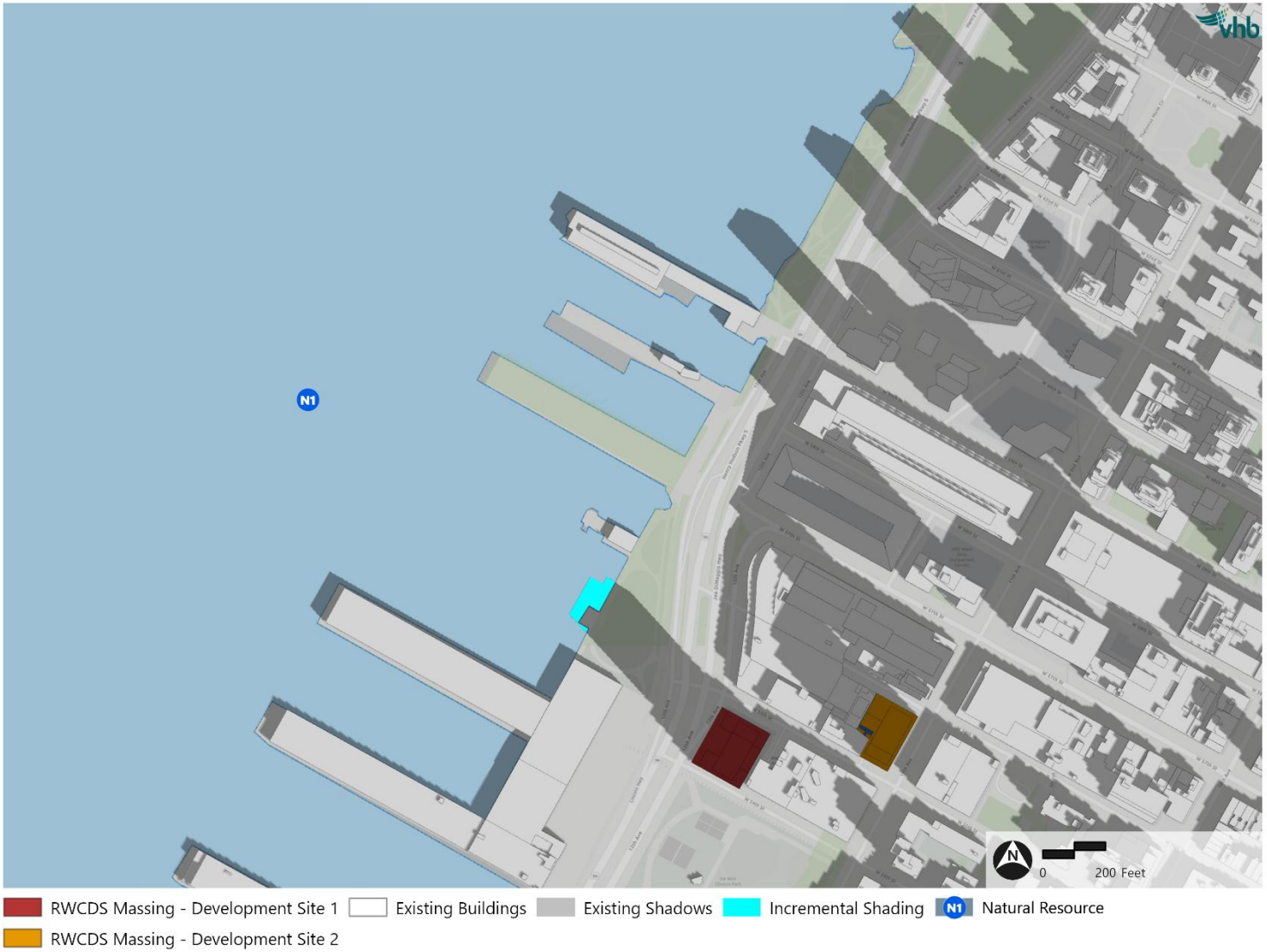


Figure 6-44 May 6/August 6 – 7:00 AM

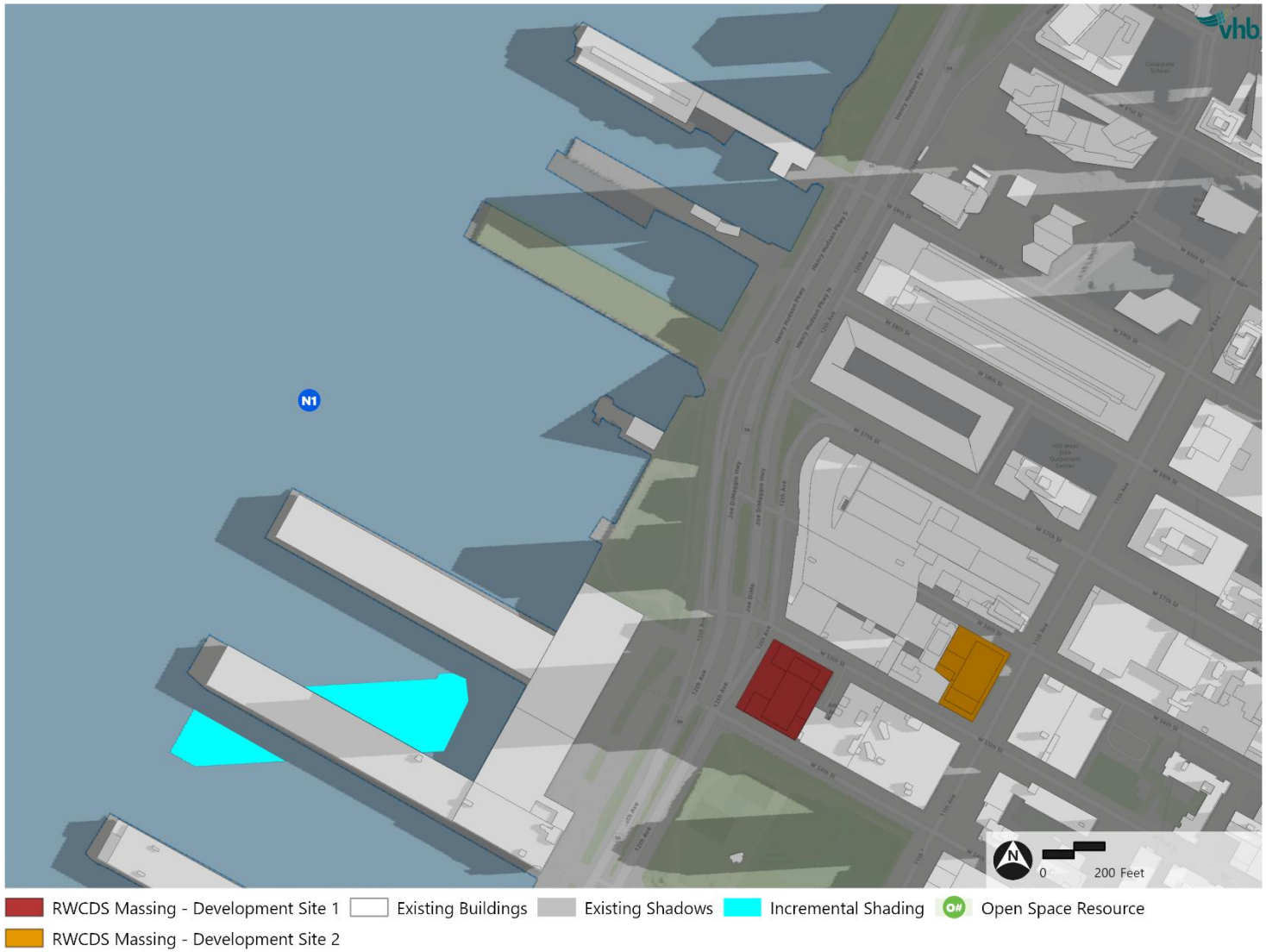


Figure 6-45 May 6/August 6 – 8:00 AM

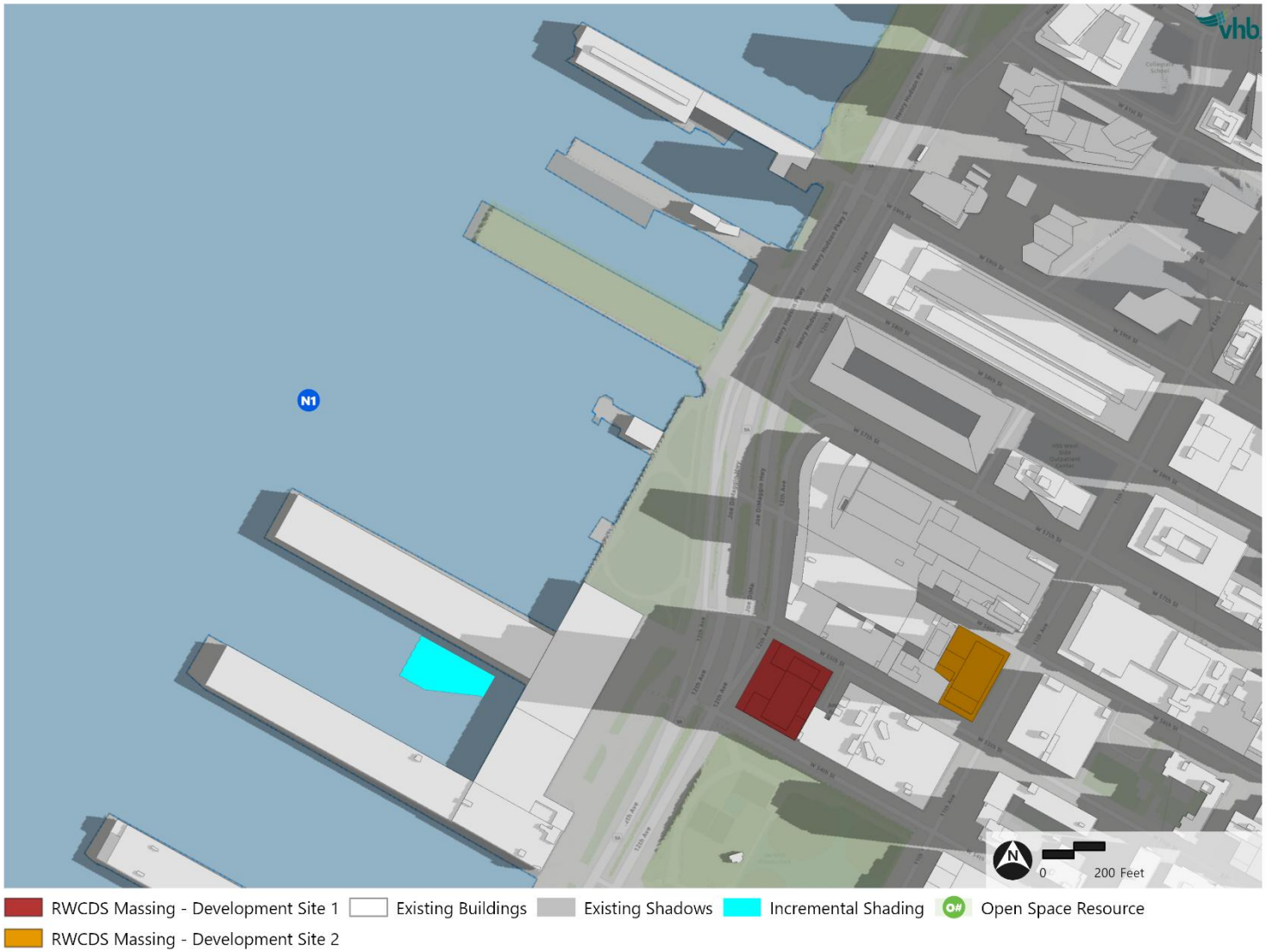


Figure 6-46 June 21 – 6:30 AM

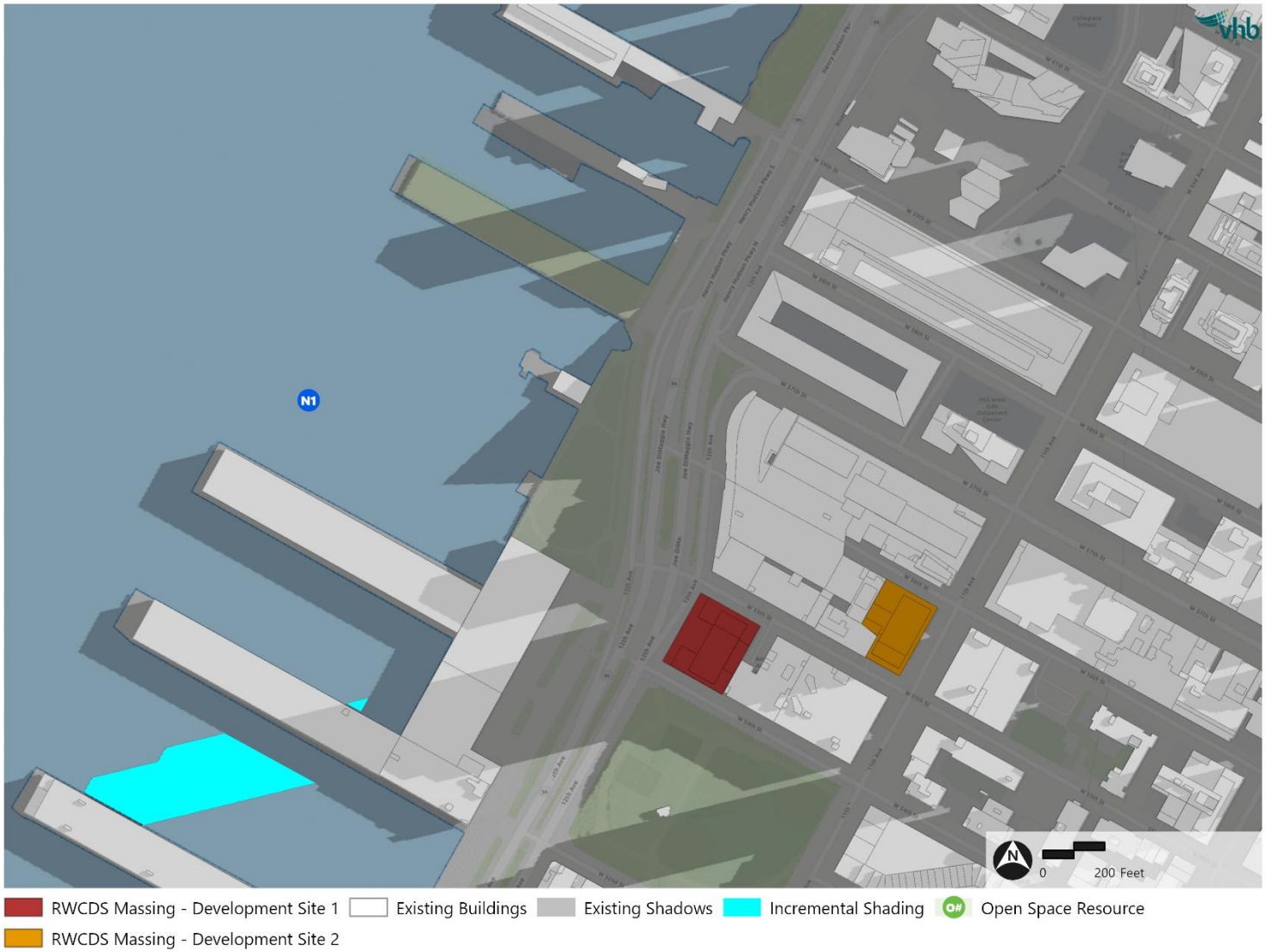


Figure 6-47 June 21 – 7:30 AM

