# Chapter 7: Shadows

## A. INTRODUCTION

As described in Chapter 1, "Project Description," the proposed project includes buildings that could rise to a maximum height of 400 feet in two locations. This chapter assesses whether the proposed project would result in new shadows that would adversely impact any nearby sun-sensitive resources, including publicly accessible open spaces, historic resources with sunlight-dependent architectural features, or important natural features.

### PRINCIPAL CONCLUSIONS

The analysis concluded that the proposed project's development on Site A would result in more than three-and-a-half hours of new midday shadows on portions of Grand Ferry Park throughout the year. During the fall, winter, and early spring the utility of the park will be significantly impacted due to increased shadows on sun-sensitive features used by park visitors (e.g., benches, picnic tables, etc.) and the park's vegetation would also be adversely affected. The significant adverse impact would occur upon full construction of Site A, which is projected to be completed in 2020. During the primary growing season (April through October), all areas of the park would continue to get several hours of sun in the morning, and most areas of the park would get sun later in the afternoon as well. However, several hours of new midday shadow would be cast on the park. In December, under the future without the proposed project condition (the "No Action" condition), sunlight is already limited throughout the day, and the proposed project would remove all or most of the remaining sunlight for about two hours around midday. Portions of the park would continue to receive direct sunlight throughout the day during the spring, summer, and fall. However, the several hours of incremental midday shadow would cause a significant adverse impact to the users of this open space during the fall, winter, and early spring, and would likely also adversely impact the park's vegetation. Most trees and many plants require a minimum of between four to six hours of sunlight to maintain healthy growth during normal conditions. The long duration of increased shadow during the spring, as well as the increased shadows during the remainder of the year, have the potential to reduce the amount of sunlight to a level below that needed for plant and tree survival.

However, the proposed project would create approximately four acres of new public open space, including a connection to Grand Ferry Park. This new project-created open space would provide an esplanade with benches and plantings along the water's edge, a lawn in front of the renovated Refinery, and several active recreation areas, including playgrounds and an active play lawn with a water feature that could function as an ice rink in winter. During the spring, summer, and fall seasons, the new project-created open space would provide sunlit areas during times when Grand Ferry Park is experiencing areas of incremental shadow.

No other significant adverse shadow impacts would occur as a result of the proposed project.

## B. DAILY AND SEASONAL VARIATIONS IN SHADOWS

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

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

## C. METHODOLOGY

The first step in the assessment of a project's shadow impacts is to determine whether project shadows would be long enough to reach any sunlight-sensitive open spaces, natural features, or architectural resources at any time of year. If this preliminary or screening analysis indicates they might, then a detailed shadow analysis is necessary. The detailed analysis compares the extent and duration of project-generated incremental shadows on any sun-sensitive uses and vegetation of open spaces, or sunlight-sensitive features of architectural resources, and assesses the effects of new shadows on such resources. The detailed analysis compares project shadows to a baseline condition representing the future Build year without the proposed project. The baseline model used for comparison includes structures on the project site that could be built as-of-right under the existing M-3 zoning. The project-generated incremental shadow refers to the additional shadow that would be cast by the proposed project compared to the buildings that would be constructed on the site in the No Action condition.

Following the guidelines of the *CEQR Technical Manual*, this analysis considers shadows on four representative days of the year: March 21 (equivalent to September 21, the equinoxes); June 21, the summer solstice; May 6 (equivalent to August 6, the midpoints between the equinoxes and summer solstice); and December 21, the winter solstice.

The CEQR methodology does not consider shadows and incremental increases in shadows within 1½ hours of sunrise or sunset to be significant. Therefore, the analysis period on each of the four representative days is between 1½ hours after sunrise and 1½ hours before sunset. Additionally, CEQR does not consider shadows on city streets, sidewalks, and other buildings to be significant.

In the assessment of shadow impacts on sun-sensitive resources, the *CEQR Technical Manual* focuses on uses and users of the open space, landscaping and vegetation, and, in the case of architectural resources, features or details that are both sunlight-dependent and make such resources significant. According to the *CEQR Technical Manual*, a significant shadow impact

may occur when there is substantial reduction in sunlight to a sun-sensitive use or feature, threatening the survival of vegetation or significantly reducing the usability of the open space, or in the case of an architectural feature, obscuring the elements or details that make that resource significant. The determination of impact significance is based on an assessment of how a project's incremental shadows specifically would affect sun-sensitive features of individual resources.

As discussed in Chapter 1, "Project Description," the proposed project would create approximately four acres of public open space on the waterfront parcel of the project site, including a waterfront esplanade connecting to Grand Ferry Park at its northern edge and South 5th Street at its southern edge, with small play and gathering areas in between. The new space would also contain a nearly one-acre grassy lawn area between the Refinery and the water's edge, and upland connections across the project site. According to *CEQR* methodology, shadows cast on open spaces that are part of a proposed project are not considered impacts of an action because without the action, the open space would not exist. However, a qualitative assessment of shadows on this proposed open space is included in this analysis.

In modeling the shadows of the proposed project, the analysis conservatively utilized the maximum zoning envelopes within which development could occur rather than the illustrative buildings shown in Chapter 1, "Project Description." These building envelopes are shown in Figure 7-1,[1] taken together, these envelopes represent more bulk than would be permitted under the proposed project. Absent the proposed project, the project site will be developed with uses permitted under the existing M3-1 zoning, including a storage facility, a building materials storage yard, a distribution facility, and a catering hall/restaurant (see Figure 7-2). No new public open space will be created along the waterfront. Shadows cast by the structures in the No Action condition are considered to be part of the baseline shadow, and any additional shadow that would be cast by the proposed project would be considered new or incremental shadow.

For the detailed analysis, shadows were modeled using the solar rendering capabilities of MicroStation V8 software. A three-dimensional model of existing buildings and topography around the project site was developed by AKRF using building footprint and topographical data from the New York City Department of Information Technology and Telecommunication, USGS, and the Sanborn Map Company. Three-dimensional models of the proposed maximum building envelopes and the as-of-right structures were provided by the project sponsor and were integrated into the existing conditions model by AKRF. Other known development projects in the study area were added to the existing conditions model, as accurately as available information allowed, to correctly model the future baseline conditions.

## D. SCREENING ANALYSIS

A screening analysis was performed to determine which open spaces, sunlight-sensitive historic resources, or important natural features could be affected by project shadows at any time of year. To identify resources of concern, the maximum shadow length was calculated for the proposed zoning envelopes on the four analysis days, taking into account time of day as well as season. For example, on the December 21 analysis day a building has a maximum shadow length factor equal to 4.3 times its height at the beginning and end of the analysis period when shadows are cast to the northwest and northeast, respectively. Toward midday, as the sun rises in the sky, the

[1] All Shadows figures appear at the end of this chapter.

shadow length factor is reduced to 2.07 times the height of the building. Shadow length factors for the other analysis days throughout the calendar year are shorter than they are in December. However, the daylight hours are longer during the rest of the year, resulting in longer analysis periods and shadows that fall further to the southwest and southeast at the beginning and end of the day. During the December analysis day, shadows are cast up to 43 degrees east and west of true north, but in June, shadows are cast up to 108 degrees east and west. Open spaces in the southern portion of the area that could be reached by project shadow in June would not be affected in December.

Using the heights and forms of the proposed zoning envelopes, the full extent of the area that could be reached by project shadow was calculated for each of the analysis days and delineated on a street map. In coordination with the open space and historic resource analyses presented in other chapters of this EIS, open spaces and historic resources were also shown on the map. All sun-sensitive resources that fell fully or partially within the perimeter representing the maximum shadow length from the proposed maximum building envelopes were included in the more detailed analysis below.

## RESOURCES OF CONCERN

Four sun-sensitive resources were included in the detailed shadow analysis.

The project site is located along the eastern shore of the **East River**, a tidal strait that connects New York Harbor with the western end of Long Island Sound. The river's hydrodynamic and estuarine character, coupled with the numerous municipal and industrial discharges that have occurred in the river over many years, make it a physically harsh environment. For this reason, many of the species using the area must be tolerant of highly variable conditions.

The open space nearest the project site is the adjacent **Grand Ferry Park**, a 1.8-acre passive open space located along the East River waterfront at Grand Street. This well-used park was recently renovated by the New York City Department of Parks and Recreation (DPR) and features a waterfront walkway, lawn area, and seating, as well as areas that have been designed to function as wetlands with native plantings and a swale providing drainage from Grand Street to the East River.

A block-and-a-half east of the project site, along Wythe Avenue between Grand and South 1st Streets, is the **William Sheridan Playground** adjacent to Public School (PS) 84. This 0.79-acre playground features nautical-themed play equipment, chess and checker tables, swings, and benches.

The analysis concluded that the fourth resource, **Berry Playground**, which is located along South 3rd Street between Berry Street and Bedford Avenue, would not experience incremental shadow at any time of year, and consequently this resource will not be discussed further.

The Rectory for Saints Peter and Paul Roman Catholic Church is the only historic resource within the study area. The Rectory, located on the west side of Berry Street between South 2nd and 3rd Streets, does not feature sunlight-sensitive windows on its rear (west) or south facades, which, given the building's orientation, are the only facades that could receive project-generated shadow (see Figure 7-1). Therefore, there would be no potential for significant adverse shadow impacts on this historic resource and no further analysis is necessary.

## E. DETAILED ANALYSIS AND ASSESSMENT

The detailed analysis compared shadows in the future with the proposed project to shadows in the No Action condition on each of the four analysis days. Table 7-1 shows the duration of incremental shadows on the sun-sensitive resources on each of the four analysis days. The extent, duration, and effects of these incremental shadows are discussed below for each resource. Figures 7-3 through 7-12 depict the extent of incremental shadows on the resources at certain times of each analysis day referenced in the text discussion. A qualitative discussion of shadows on the project's proposed open space is also included.

**Table 7-1**
**Incremental Shadow Durations**

| Resource | March 21<br>8:36 AM-5:29 PM<br>EDT | May 6<br>7:27 AM-6:18 PM<br>EDT | June 21<br>6:57 AM-7:01 PM<br>EDT | December 21<br>8:51 AM-2:53 PM EST |
|---|---|---|---|---|
| **NATURAL RESOURCES** | | | | |
| East River | 8:36 AM–1:00 PM<br>Total: 4h 24m | 7:27 AM–12:30 PM<br>Total: 5h 3m | 6:57 AM–12:15 PM<br>Total: 5h 18m | 8:51 AM–12:45 PM<br>Total: 3h 54m |
| **OPEN SPACES** | | | | |
| Grand Ferry Park | 9:45 AM–4:00 PM<br>Total: 6h 40m[1] | 10:45 AM–3:00 PM<br>Total: 4h 15m[2] | 11:30 AM–3:15 PM<br>Total: 3h 45m[3] | 8:51 AM–1:30 PM<br>Total: 4h 39m[4] |
| PS 84 William Sheridan Playground | 5:25 PM–5:29 PM<br>Total: 4m | 5:30 PM–6:15 PM<br>Total: 45m | 6:30 PM–7:01 PM<br>Total: 31m | — |

**Notes:**
EST=Eastern Standard Time
EDT=Eastern Daylight Time
March 21 is the equivalent of September 21; May 6 is the equivalent of August 6.
[1] From 1:00 PM to 5:29 PM there would be less shadow in certain areas compared to the No Action condition.
[2] From 12:45 PM to 6:15 PM there would be less shadow in certain areas compared to the No Action condition.
[3] From 12:45 PM to 5:45 PM there would be less shadow in certain areas compared to the No Action condition.
[4] From 1:00 PM to 2:53 PM there would be less shadow in certain areas compared to the No Action condition.

As described in the Notes section of Table 7-1, during the afternoons throughout the year some areas of Grand Ferry Park would experience more sunlight in the future with the proposed project, compared to the baseline condition.

### GRAND FERRY PARK

As shown on Figure 1-4 in Chapter 1, "Project Description," Grand Ferry Park is located just north of the project site, adjacent to the portion of the waterfront parcel referred to as Site A. After the full build-out of the proposed project in 2020, portions of Grand Ferry Park would experience incremental shadow cast by the proposed building at Site A from late morning to mid-afternoon throughout the year. In the middle and late afternoons, an area on the west side of the park would experience more sunlight with the proposed project, because the buildings under the proposed project would not extend as far west toward the waterfront as those in the No Action condition.

On the March 21/September 21 analysis day, Grand Ferry Park would continue to be fully or mostly in sun until late morning. Incremental shadow from Site A would enter the southwestern corner of the park at 9:45 AM. By 11:00 AM most of the southern half of the park would be in

Site A's shadow (see Figure 7-1). From 11:00 AM to 2:00 PM a substantial area of the park would continue to be shaded by Site A (see Figure 7-2). From 2:00 PM to 3:00 PM there would be roughly equal areas of incremental shadow and incremental sunlight (see Figure 7-3; the incremental sunlight that would occur because the footprint of the building on Site A would be smaller than that of the building at this location in the No Action condition). From 3:00 PM until the end of the analysis day at 5:29 PM there would be more sunlight on the park with the proposed project compared with the No Action condition (see Figure 7-4).

On the May 6/August 6 analysis day, shadows are shorter than in March and September. The shadow from the building on Site A would only reach across the southern half of the park at its greatest extent, and the northern half of the park would be in sun for the entire day. The shadow from the building at this location in the No Action condition would also be shorter, and would never reach beyond the southern edges of the park.

Consequently, on the May 6/August 6 analysis day, Site A's incremental shadow would affect the southern half of the park. Incremental shadow would enter the south side of the park at 10:45 AM, and spread eastward. Between 12:00 PM and 1:00 PM the incremental shadow would cover approximately a third of the park (see Figure 7-5). After 1:30 PM the incremental shadow would be smaller and limited to the eastern side of the park (see Figure 7-6), and at 3:00 PM it would exit the park completely. From 2:00 PM until the end of the analysis day there would be more shadow without the proposed action than with it, though the shadow from the buildings in the No Action condition would be limited to a small area on the southern edge of the park during this period (see Figure 7-7).

On June 21 shadows are the shortest, and the park would be mostly in sun throughout the day. Shadow from the building on Site A would not enter the southern part of the park until 11:30 AM, and would be limited to the southern area through the midday (see Figure 7-8 12:45 PM). After 2:30 PM the incremental shadow would be very small and limited to the southeastern corner of the park (see Figure 7-9), and it would exit completely at 3:15 PM.

On December 21 shadows are longest. Existing shadows, including shadow from buildings in the No Action condition, keep most of the park in shade for the entire day; an area on the north side remains sunny during the morning and midday under the No Action condition, and the west side gets sun near the end of the analysis day.

Between the start of the December 21 analysis day and 10:00 AM, the proposed project would add small areas of new shadow to the northern side of the park. After 10:00 AM, however, larger areas would be shaded by the project, removing most of the remaining sun (see Figure 7-10). Between 11:30 AM and 12:30 PM baseline shadow would cover much of the park, and the small area of remaining sunlight would be removed by incremental shadow (see Figure 7-11). From about 1:00 PM until the end of the analysis day at 2:53 PM, as the shadows continue moving eastward, there would be more sun on the west side of the park with the proposed project, as compared to the No Action condition (see Figure 7-12).

More detailed shadows diagrams of Grand Ferry Park, showing the location of sun-sensitive features such as seating areas and vegetated areas, are provided for the March 21/September 21 and December 21 analysis days in Figures 7-13 to 7-19.

Grand Ferry Park was recently reconstructed by DPR. As described in Chapter 6, "Open Space," the park is well-used and features a waterfront walkway and a number of sunlight-sensitive elements such as a lawn area and seating, trees, and areas that have been designed to function as wetlands, with native plantings and a swale providing drainage from Grand Street to the East

River. During the primary growing season (April through October), all areas of the park would continue to get several hours of sun in the morning, and most areas of the park would get sun later in the afternoon as well. However, several hours of new midday shadow would be cast on the central portion of the park, and about two hours of new shadow would fall on the northern section of the park. In December, under the No Action condition, sunlight is already limited throughout the day and the proposed project would remove all or most remaining sunlight, which would be mostly in the northern section of the park, for about two hours around midday. The central section of the park contains primarily an area of landscaped turf and plantings, paved walkways, and the riprap along the shore. The northern section of the park contains landscaped areas of plantings, a paved area with seating and tables and trees, and the riprap along the shore.

Portions of the park would continue to receive direct sunlight throughout the day during the spring, summer, and fall. However, the several hours of incremental midday shadow would cause a significant adverse impact to the users of this open space during the fall, winter, and early spring, and would likely also adversely impact the park's vegetation. Most trees and many plants require a minimum of between four to six hours of sunlight to maintain healthy growth during normal conditions. The long duration of increased shadow during the spring, as well as the increased shadows during the remainder of the year, have the potential to reduce the amount of sunlight to a level below that needed for plant and tree survival.

**EAST RIVER**

The project site is located on the eastern shore of the East River. The proposed project would result in incremental shadows on portions of the East River during the morning hours throughout the year.

Early on the March 21/September 21 analysis day, the proposed project would cast long shadows westward across adjacent areas of the river. These shadows would move eastward over the course of the morning, shrinking in extent as the sun rises higher (see Figure 7-3 depicting 11:00 AM). The incremental shadows would continue moving eastward and would exit the river at 1:00 PM (see Figure 7-4 depicting 12:45 PM).

On May 6/August 6, the analysis day is longer and shadows are shorter than in March and September. Long incremental shadows would fall to the southwest on the East River early in the morning. The shadows would move to the northeast over the course of the morning, and the last incremental shadow would move off the river at 12:30 PM (see Figure 7-7).

On the June 21 analysis day, shadows are shortest. Incremental shadows would fall to the southwest onto the river at the start of the day, and would shrink and move east through the morning. These shadows would be off the river before 12:30 PM (see Figure 7-10 depicting 12:45 PM).

On December 21, the shortest day of the year, shadows are longest. The sun's angle is such that very long incremental shadows cast by all the sites would fall to the northwest of the project site at the start of the day. These shadows would move quickly eastward and by noon would fall due north. The incremental shadows would move off the river at 12:45 PM.

The current flows swiftly in the East River and would move phytoplankton and other natural elements quickly through the shaded areas. Therefore, project-generated shadows would not be expected to affect primary productivity. At least one small section of the river next to the shore would receive more than four hours of incremental shadow in some seasons, but most areas of the river would receive shorter durations as the shadows move eastward during the morning. The

areas that receive the longest durations of new shadow on summer mornings would continue to receive more than five hours of direct sunlight in the afternoon, because there are no intervening structures to the west. Incremental shadows would therefore not be likely to significantly affect aquatic resources (plankton or fish) in these areas of the East River. Consequently, project-generated shadows would not cause significant adverse impacts on the East River.

### PS 84 WILLIAM SHERIDAN PLAYGROUND

The William Sheridan Playground is located two blocks east of the project site, far enough away that it would only experience incremental shadow at the very end of the analysis day in the spring, summer, and fall. On the March 21/September 21 analysis day a small area of incremental shadow would fall on the northwest corner of the basketball court, in the northwest section of the playground, for the final four minutes of the day. On May 6 and August 6, much of the playground is in existing shade in the late afternoon, and between 5:30 PM and 6:00 PM a small area of incremental shadow would fall in the southeast area of the space where a large, paved, featureless play area is located. Additionally, from about 5:50 PM to 6:15 PM incremental shadow would fall on areas of the basketball court and the play structures in the northeast part of the space. On June 21 incremental shadow would spread from the northwest corner of the space at 6:30 PM across the whole northern portion of the space by 7:01 PM, the end of the analysis day. No incremental shadow would reach the playground in the winter.

The limited extent and duration of new shadow—between 30 and 45 minutes in the late afternoons of the late spring and summer, and 4 minutes in the early spring and the fall--would not cause a significant adverse impact to the users of the space or the few trees that dot this fully paved playground.

### PROPOSED OPEN SPACE

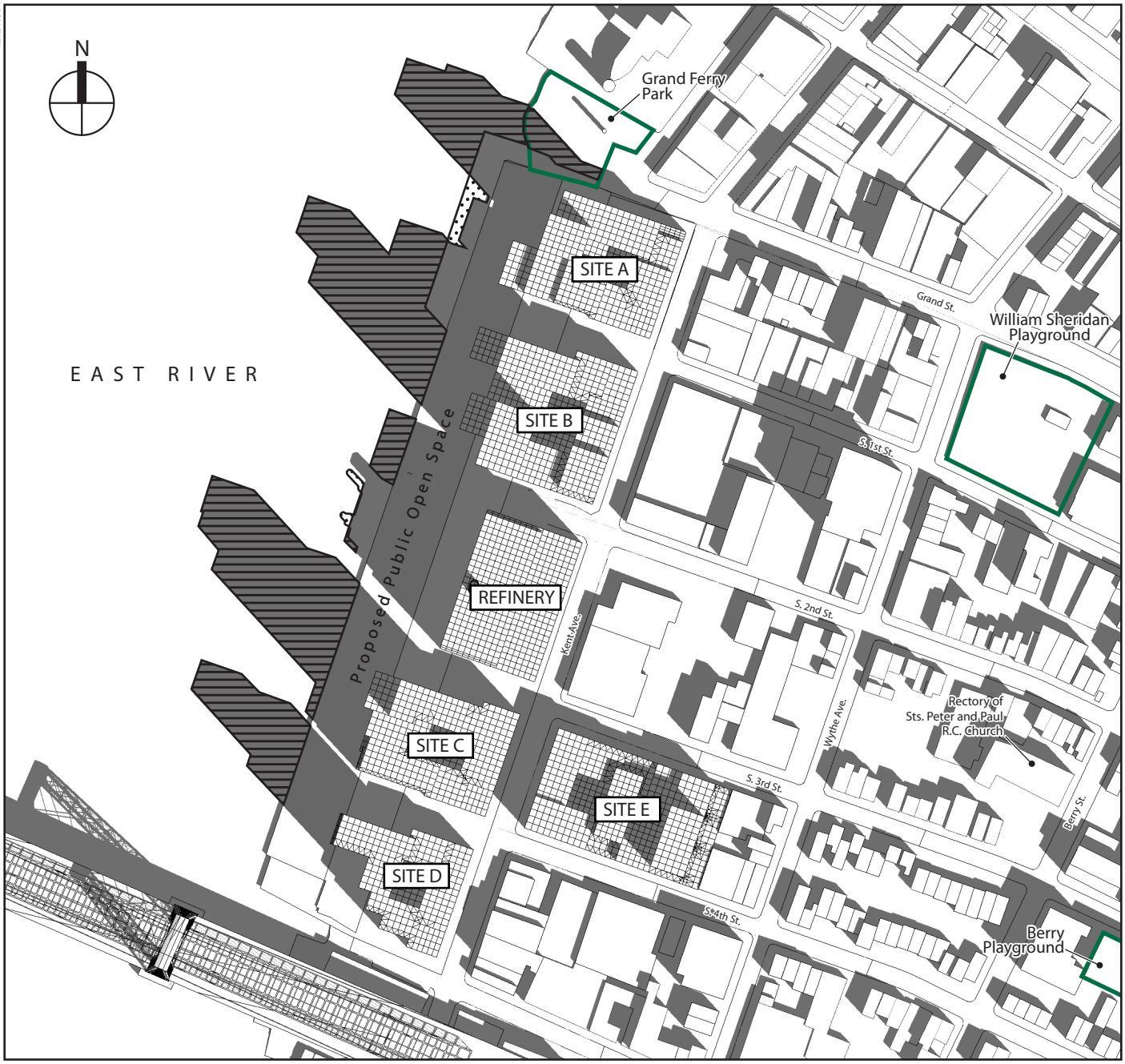
The waterfront open space that would be created with the proposed project stretches along the entire north-south length of the project site, between the proposed buildings and the shoreline. It would be connected to Grand Ferry Park and South 5th Street, forming a continuous public open space. Due to its position just west of the proposed buildings it would receive substantial areas of shadow from the project during the morning hours, and little or no shadow throughout the afternoon. During the middle of the day some areas would be shaded while others would be in sun, which could compensate somewhat for the incremental shadow occurring at this time on Grand Ferry Park.

As described in Chapter 1, “Project Description,” and Chapter 6, “Open Space,” the proposed open space would connect to Grand Ferry Park. The proposed open space would extend public access to the waterfront from Grand Ferry Park five blocks south to South 5th Street and would provide an esplanade with benches along the water’s edge, a lawn in front of the renovated Refinery, and several active recreation areas, including playgrounds and an active play lawn with a water feature that could function as an ice rink in winter. Trees and plantings would be located along the esplanade in planters at grade. Throughout the project site, the open space is designed to connect the neighborhood to the esplanade and to provide open views of the Manhattan skyline, the harbor, and three landmarked bridges.

During all seasons, the project-created open space would provide new sunlit areas during times when Grand Ferry Park is experiencing areas of incremental shadow. On the March 21/September 21 analysis day, there would be several areas of sun along the proposed open space beginning just after noon, when Grand Ferry Park would be most affected by project

shadow (see Figure 7-14). By 2:30 PM most of the proposed open space would be in sun, while a portion of Grand Ferry Park would still be experiencing some incremental shadow (see Figure 7-15). On the May/August and June analysis days, large areas of sun would be found along the proposed open space at the times when Grand Ferry Park would experience the most incremental shadow for those seasons (see Figures 7-5 and 7-8). ✷

12.21.09




Shadow

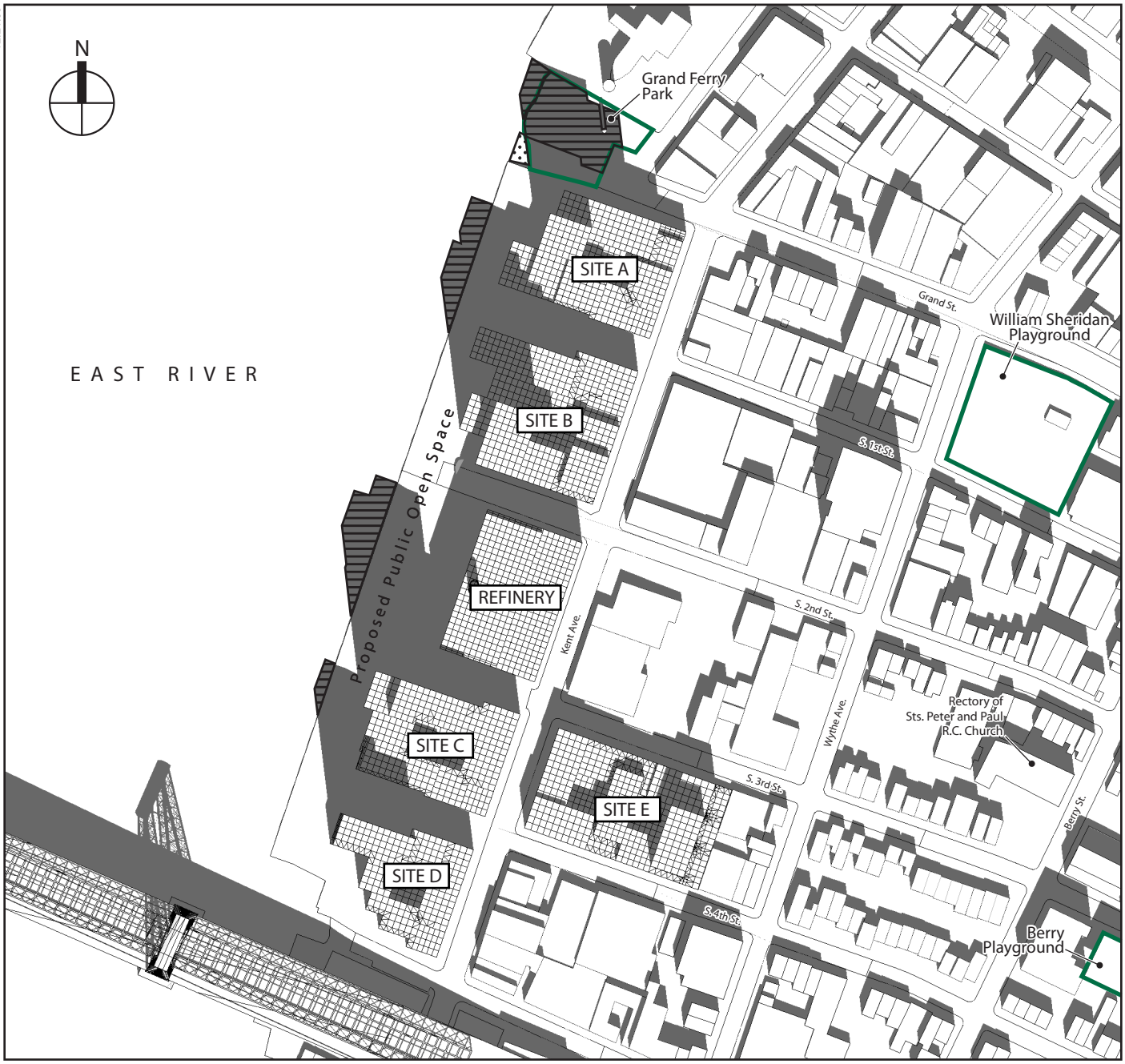
Publicly-Accessible Open Space

Proposed Zoning Envelope

Incremental Shadow on Sun-Sensitive Resources

Incremental Sunlight on Sun-Sensitive Resources

Shadows
March 21 / Sept. 21 - 11:00 AM EDT
Figure 7-1




0 200 500 FEET

SCALE

Shadow

Publicly-Accessible Open Space

Proposed Zoning Envelope

Incremental Shadow on Sun-Sensitive Resources

Incremental Sunlight on Sun-Sensitive Resources

# Shadows
## March 21 / Sept. 21 - 12:45 PM EDT
Figure 7-2




Shadows
March 21 / Sept. 21 - 2:30 PM EDT
Figure 7-3

12.21.09




Shadows
March 21 / Sept. 21 - 4:30 PM EDT
Figure 7-4




Shadows
May 6 / August 6 - 12:30 PM EDT
Figure 7-5




# Shadows
## May 6 / August 6 - 2:15 PM EDT
Figure 7-6

12.21.09




0 200 500 FEET

SCALE

Shadow

Publicly-Accessible Open Space

Proposed Zoning Envelope

Incremental Sunlight on Sun-Sensitive Resources

Shadows
May 6 / August 6 - 4:15 PM EDT
Figure 7-7




Shadows
June 21 - 12:45 PM EDT
Figure 7-8

12.21.09




0 200 500 FEET

SCALE

Shadow

Publicly-Accessible Open Space

Proposed Zoning Envelope

Incremental Shadow on Sun-Sensitive Resources

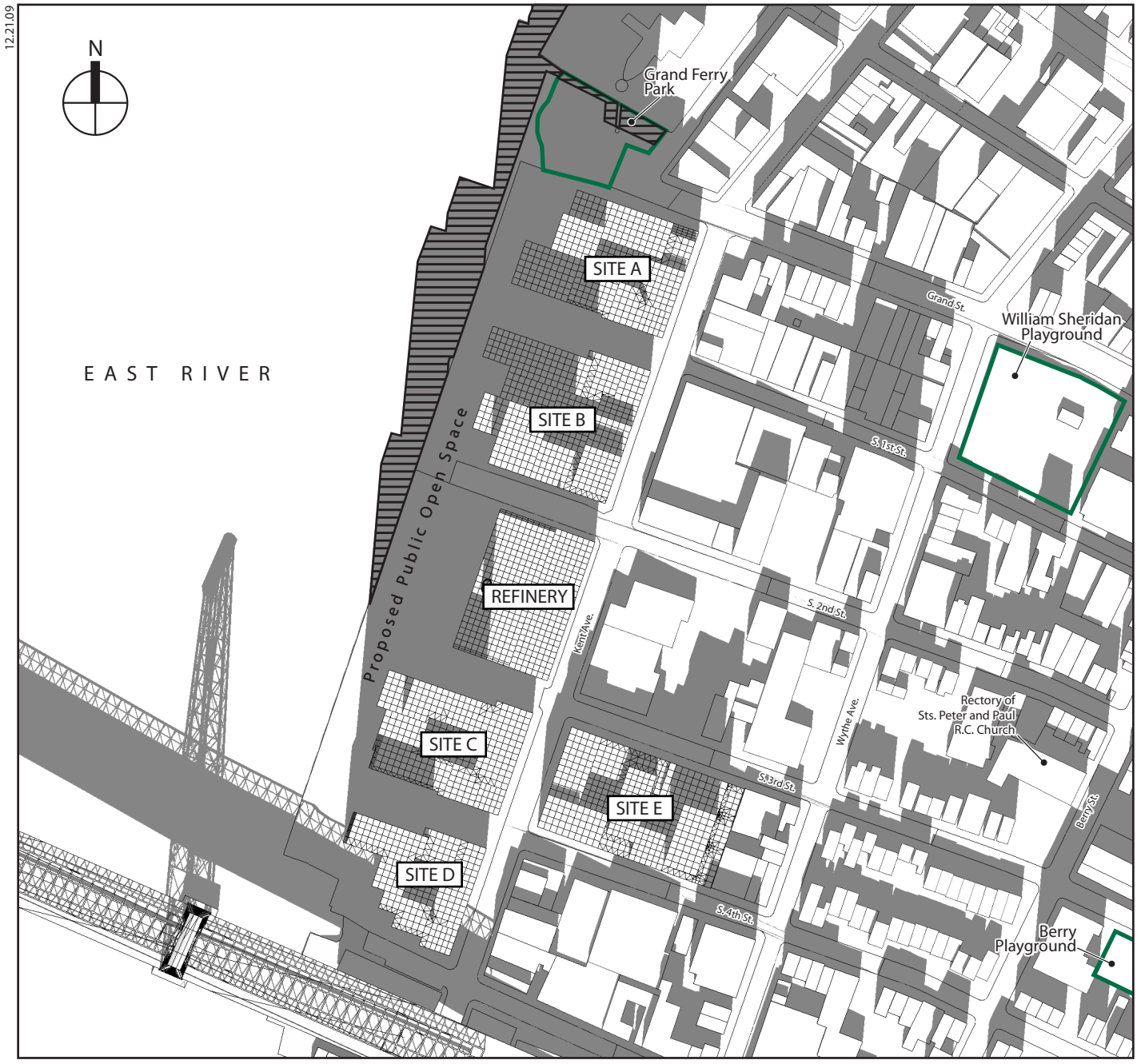
Incremental Sunlight on Sun-Sensitive Resources

# Shadows
## June 21 - 2:45 PM EDT
Figure 7-9

12.21.09



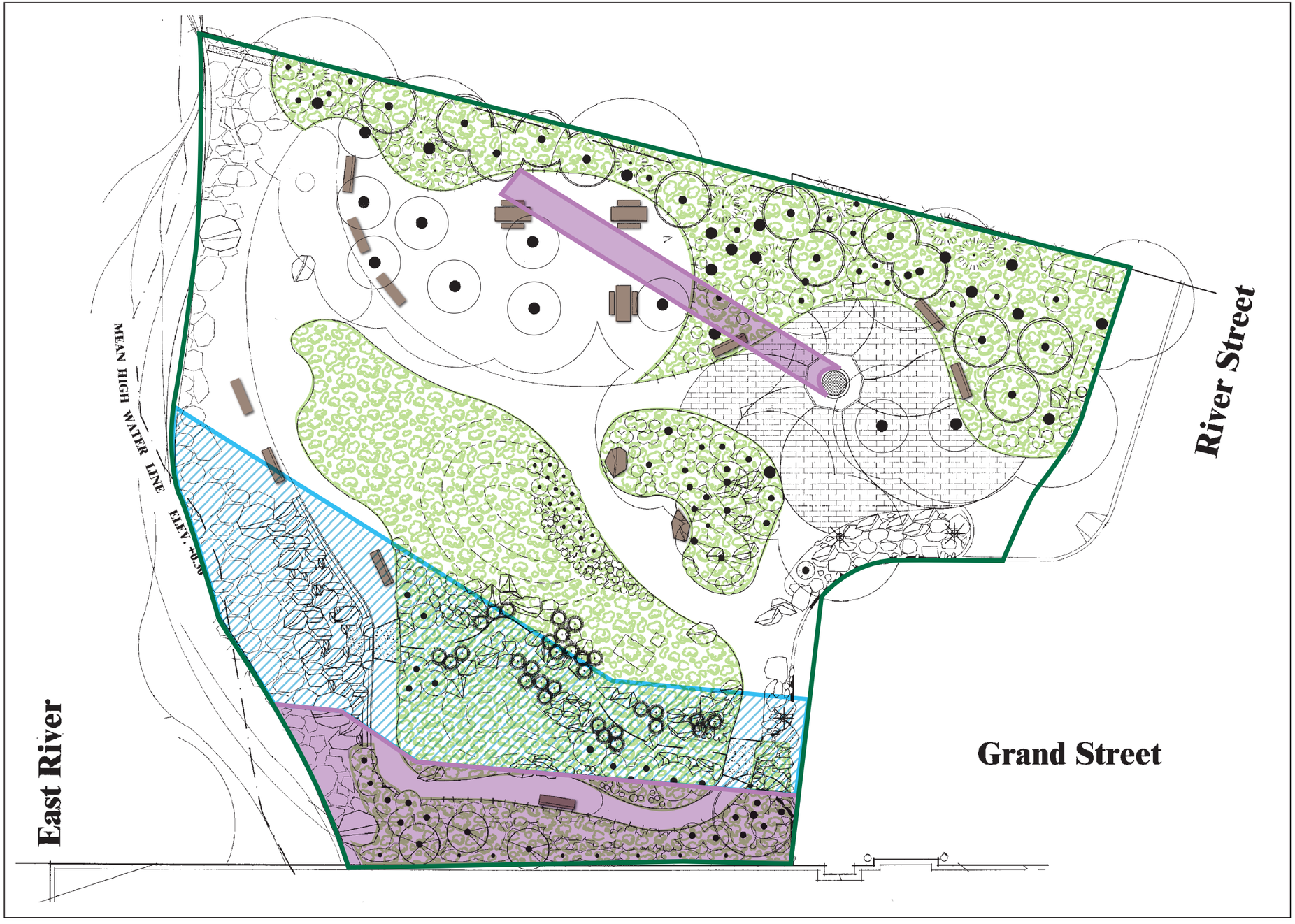

Shadows
December 21 - 10:15 AM EST
Figure 7-10




Shadows
December 21 - 12:15 PM EST
Figure 7-11

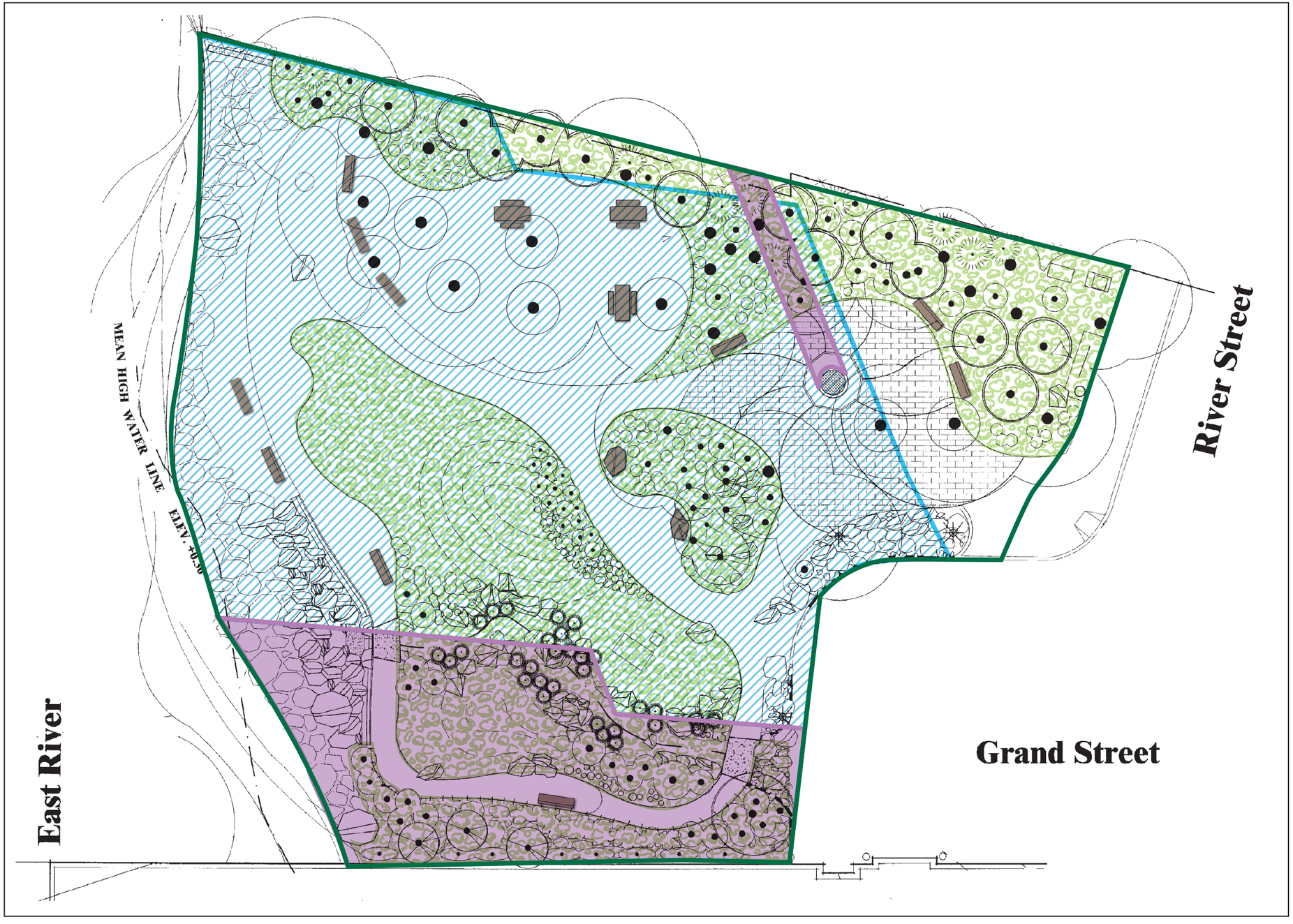



Shadows
December 21 - 2:15 PM EST
Figure 7-12

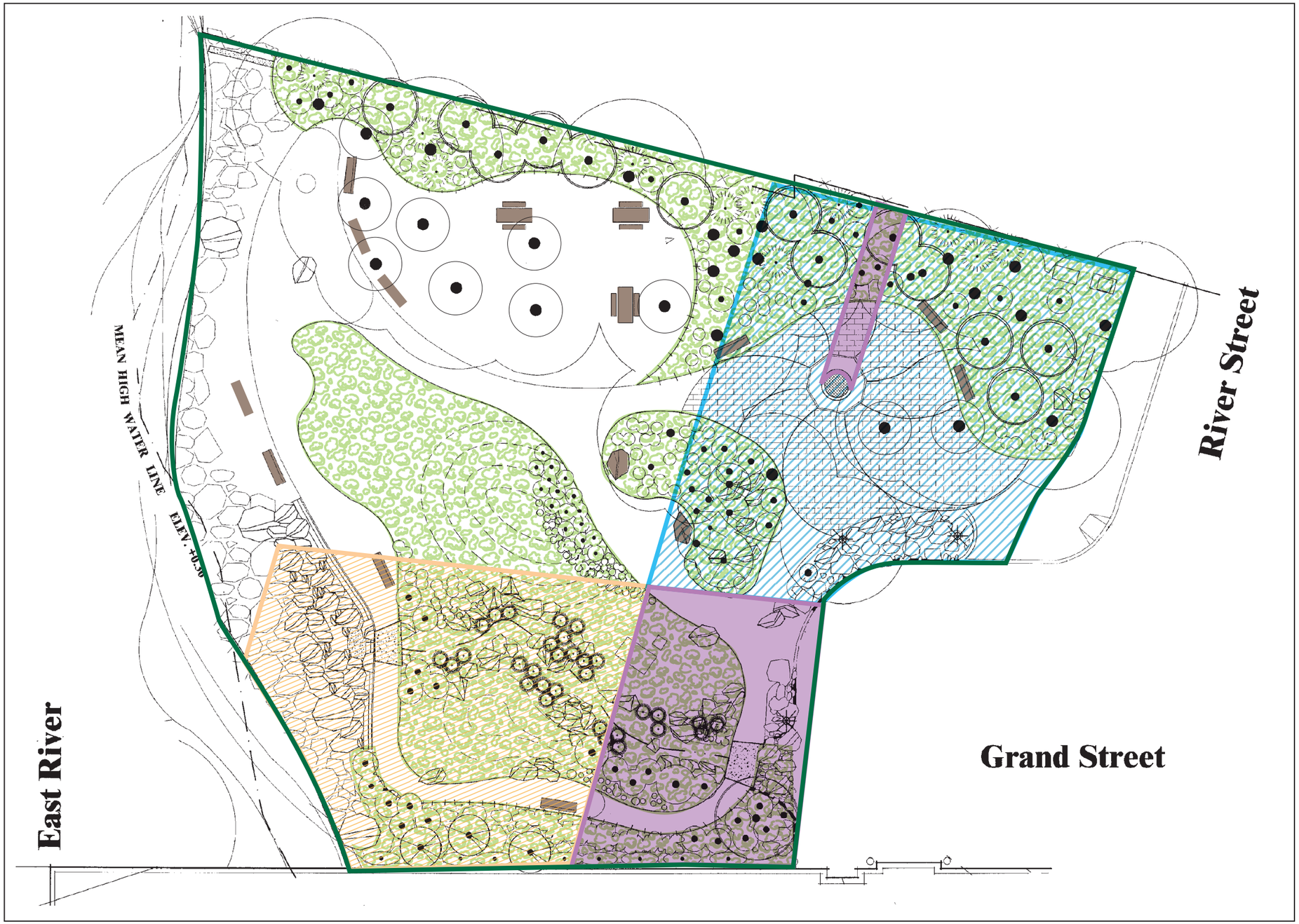



Shadows on Grand Ferry Park
March 21 / Sept. 21 - 11:00 AM EDT
**Figure 7-13**

12.29.09

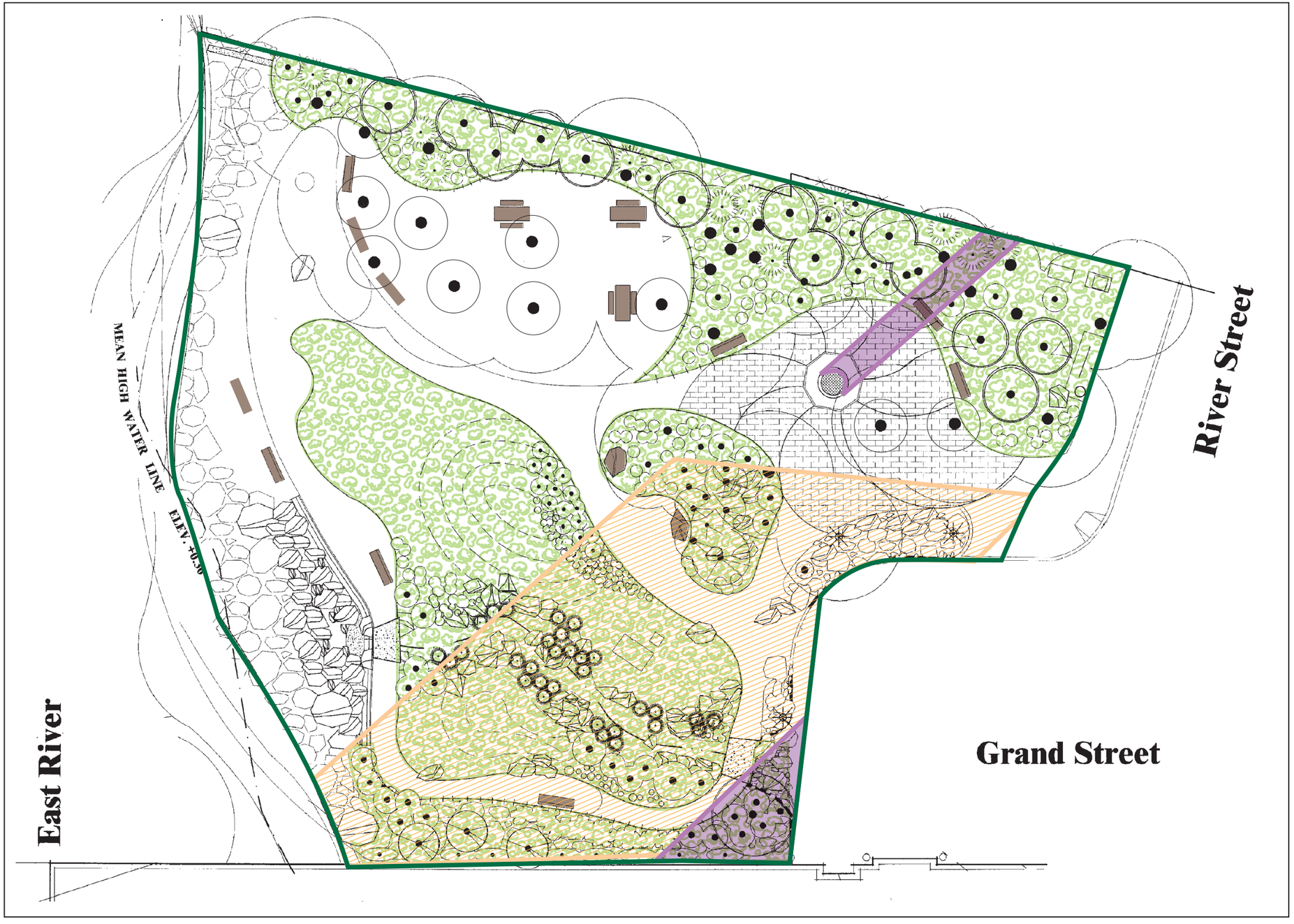



Shadows on Grand Ferry Park
March 21 / Sept. 21 - 12:45 PM EDT
**Figure 7-14**

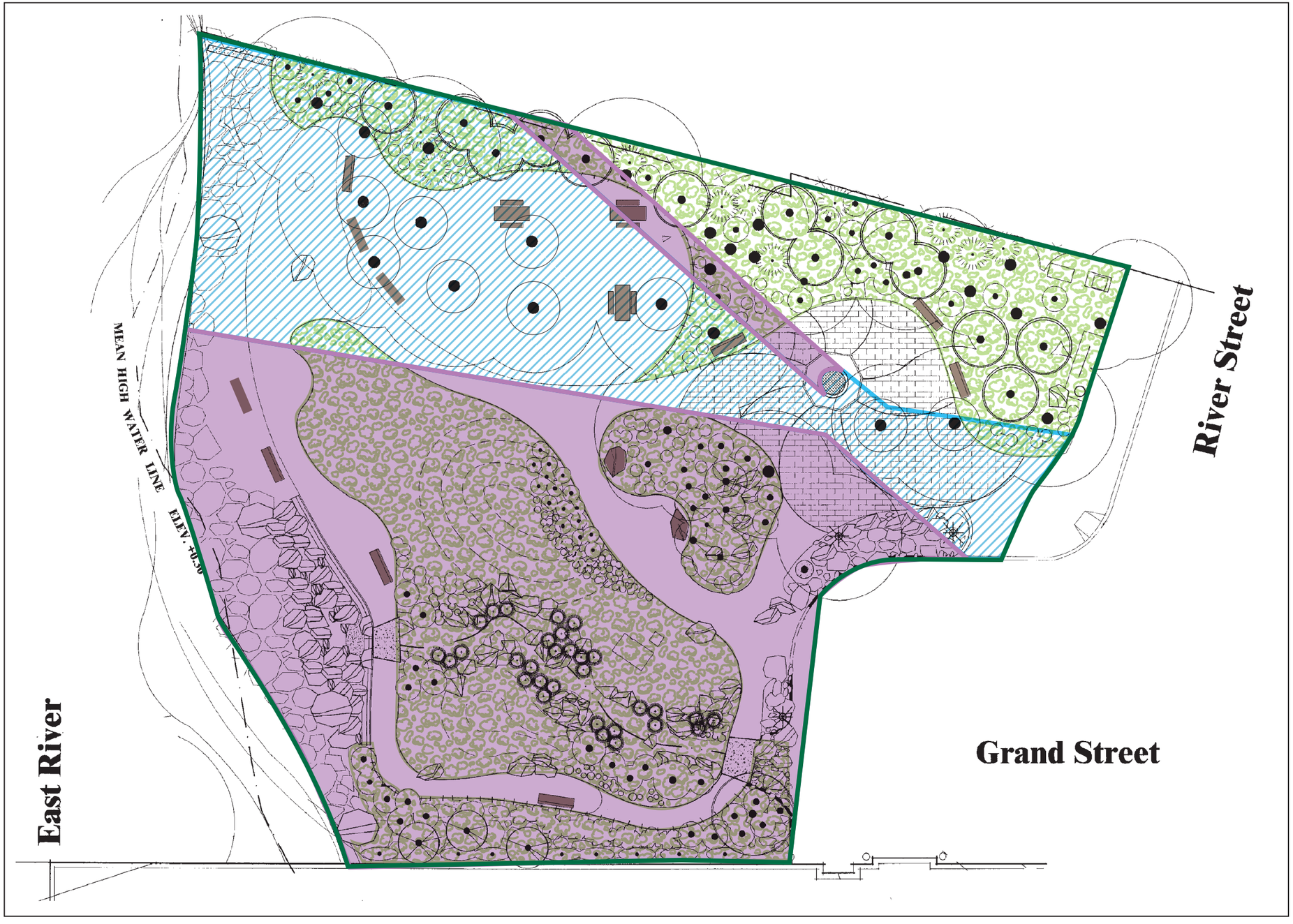



Shadows on Grand Ferry Park
March 21 / Sept. 21 - 2:30 PM EDT
**Figure 7-15**

12.29.09

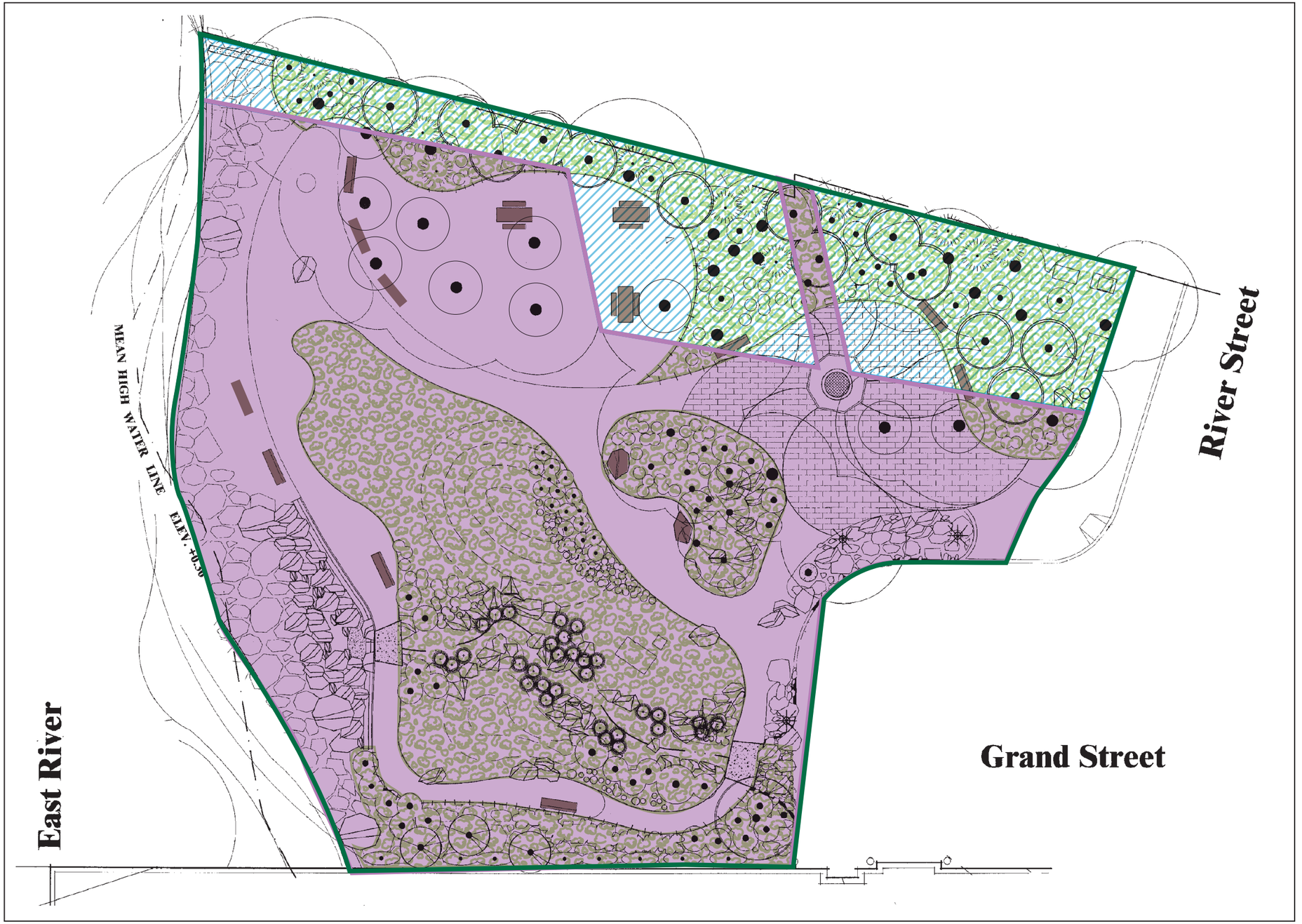



Shadows on Grand Ferry Park
March 21 / Sept. 21 - 4:30 PM EDT
**Figure 7-16**

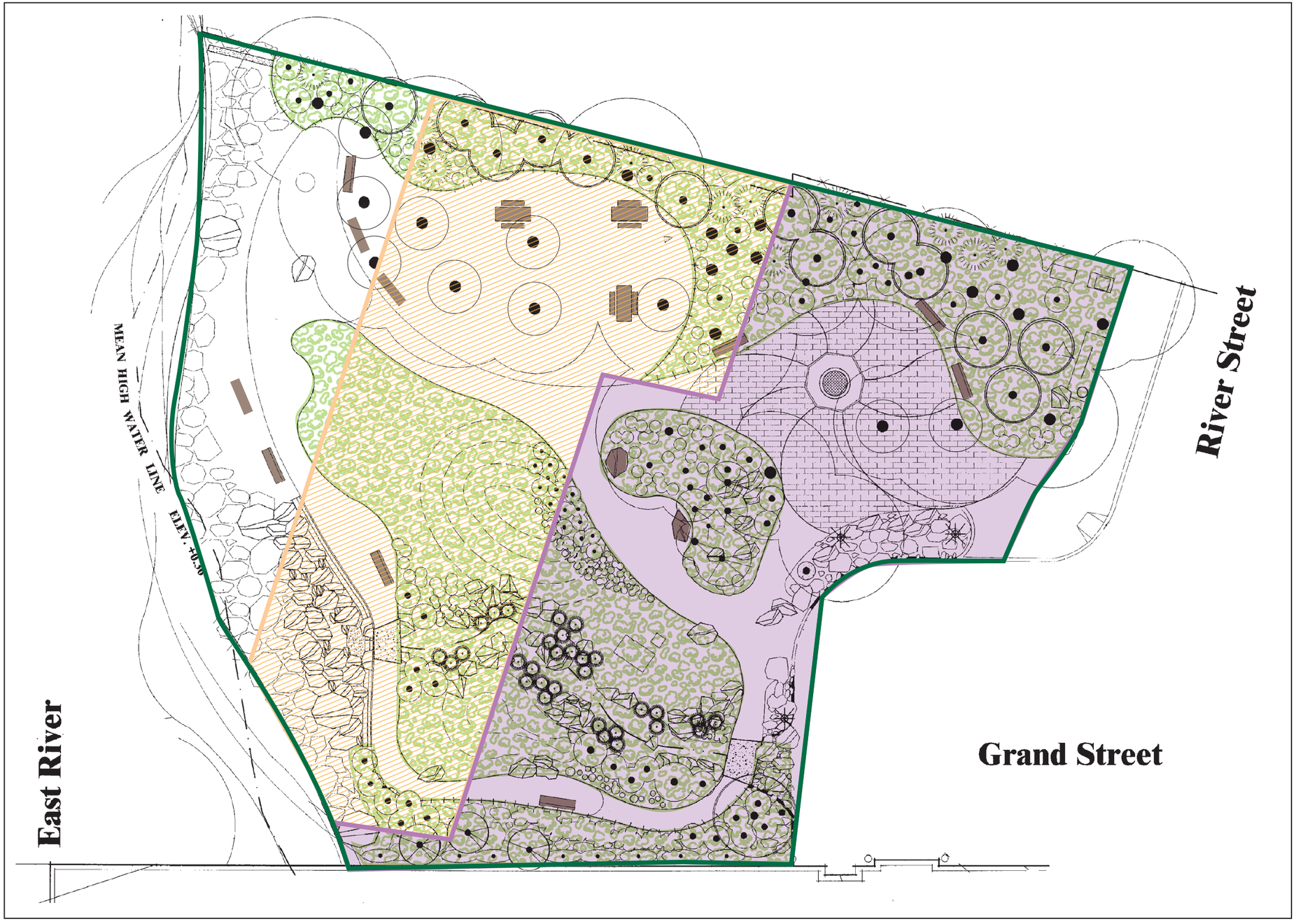



Shadows on Grand Ferry Park
December 21 - 10:15 AM EST
**Figure 7-17**

12.29.09




Shadows on Grand Ferry Park
December 21 - 12:15 PM EST
**Figure 7-18**




Shadows on Grand Ferry Park
December 21 - 2:15 PM EST
**Figure 7-19**