
Shade & Shadow Study for

The Inkwell

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Executive Summary

The purpose of this Shade/Shadow Study (Study) is to describe the existing sunlight exposure and shade/shadow conditions at the proposed Promenade Building (“project”) site and in the immediate vicinity, as well as analyzing the introduction of new sources of shade/shadow associated with the proposed project.

The proposed project is located in the City of Long Beach at the southeast corner of the E. Broadway and The Promenade. The new building would be a maximum 95 feet in height at Roof Stair Towers and 85 feet tall to top of roof parapet, and would be painted with an array of light colors (e.g., white, grey, black, metal panels, wood grain tiles, etc.). The perimeter of the site would include a variety of ornamental trees along the south elevation and east elevations along The Promenade North, and shrubs, as well as vertical lighting fixtures. Vehicular access would be provided via a driveway at the northwestern portion of the site along the Western alley. A total of 286 parking spaces would be provided on-site.

The proposed project would result in new shadows cast onto surrounding commercial buildings, The Promenade North, multi-family residential (high-rise, and mid-rise), adjacent historic building, and surface parking facilities, as well as onto adjacent roadways and sidewalks. As discussed in Section 4.1, Thresholds of Significance, *“For a project to generate a significant shadow impact, it must increase shadows cast upon shadow-sensitive uses. Shadow impacts are considered significant if shadow-sensitive uses would be shaded by proposed structures for more than 3 hours between late October and early April (including Winter Solstice), or for more than 4 hours between early April and late October (including Summer Solstice).”* (Long Beach Downtown Plan PEIR – 4.1 Evaluation of Shadow Effects)

1.0 PURPOSE OF STUDY

The purpose of this Shade/Shadow Study is to describe the existing sunlight exposure and shade/shadow conditions at the proposed Project site and in the immediate vicinity, as well as analyzing the introduction of new sources of shade/shadow associated with the proposed project. The information upon which this Study is based was compiled from site photographs, Google Earth 2018 satellite imagery, and shade/shadow diagrams prepared by Carrier Johnson + CULTURE in June 2018 for both the existing and proposed conditions.

Project Description

The project is a Mixed-Use Podium type construction of eight stories. Five stories Type III Residential with 189 units over two stories of Type 1 residential units, over one story Type I ground level parking and over three levels of subterranean parking.

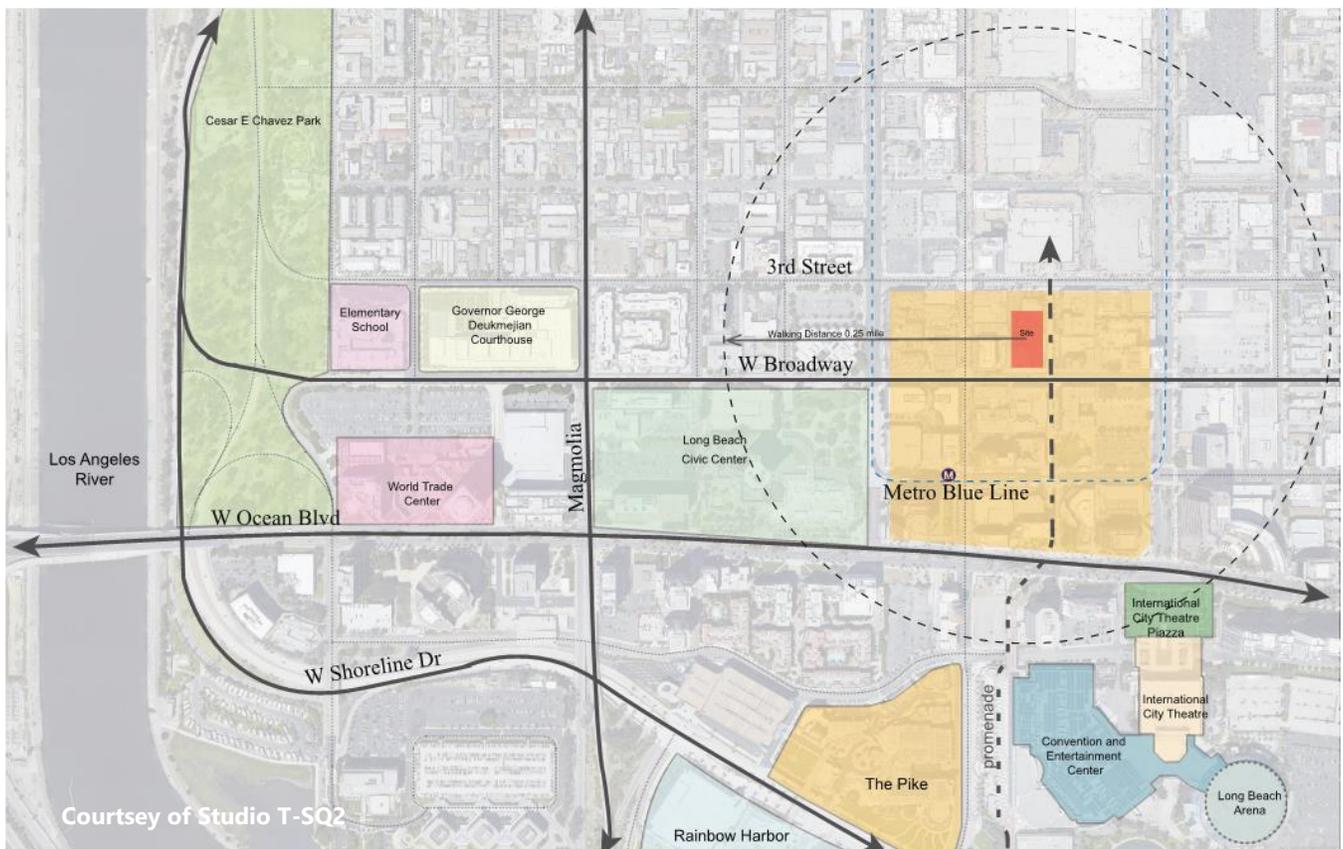
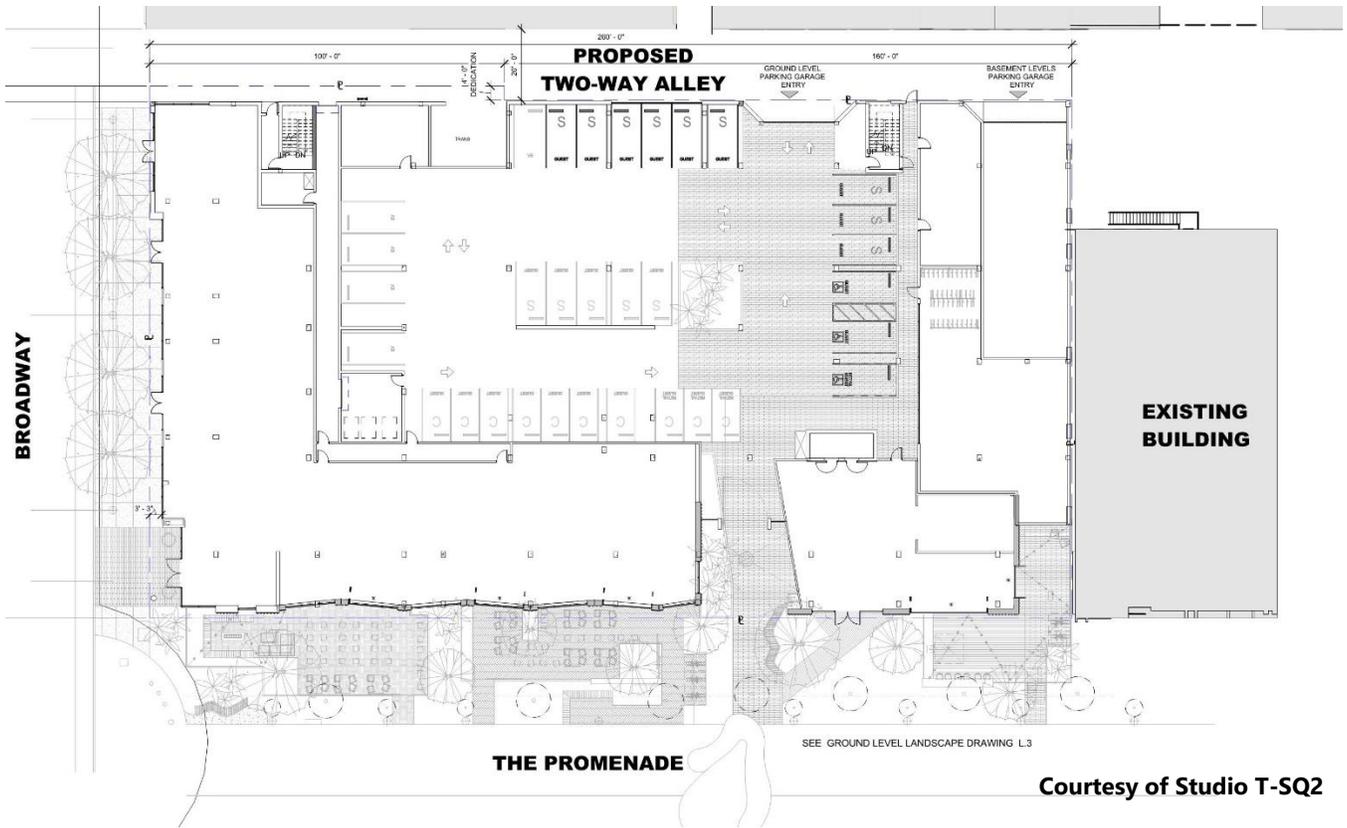


Figure 1 - Regional Vicinity Map



Figure 2 - Site Vicinity Map





Courtesy of Studio T-SQ2

Figure 3 - Conceptual Site Plan



2.0 METHODOLOGY

Shading refers to the effect of shadows cast upon adjacent areas by proposed structures.

Consequences of shadows upon land uses may be positive, including cooling effects during warm weather, or negative, such as the loss of natural light necessary for solar energy purposes or the loss of warming influences during cool weather. Shadow effects are dependent upon several factors, including the local topography, the height and bulk of the project's structural elements, sensitivity of adjacent land uses, season, and duration of shadow projection. Facilities and operations sensitive to the effects of shading include: routinely usable outdoor spaces associated with residential, recreational, or institutional (e.g., schools, convalescent homes) land uses; commercial uses such as pedestrian-oriented outdoor spaces or restaurants with outdoor eating areas; nurseries; and existing solar collectors. These uses are considered sensitive because sunlight is important to function, physical comfort, or commerce.

In order to identify the proposed project's potential shadow-related impacts, existing and project-generated morning, noon, afternoon, and evening shade patterns were compared for each of the four seasons. Specifically, four dates were used for analysis purposes:

- Winter and summer solstices (December 21 and June 21), when the sun is at its lowest and highest point, respectively, and
- Spring and fall equinoxes (March 21 and September 21), when day and night are of approximately equal length.

The longest shadows are cast during the winter months and the shortest shadows are cast during the summer months. The following discussion describes the summer/winter solstice and vernal/autumnal equinox phenomenon, local topography, and some general assumptions that affect shadow patterns in the project vicinity. Note that the analysis considers shadow effects associated with proposed building massing only; the shadow patterns associated with proposed landscaping are not addressed.

SUMMER AND WINTER SOLSTICE

"Solstice" is defined as either of the two points on the ecliptic that lie midway between the equinoxes (separated from them by an angular distance of 90°). At the solstices, the sun's apparent position on the celestial sphere reaches its greatest distance above or below the celestial equator, about 23.5° of the arc. At the time of summer solstice, approximately June 21, the sun is directly overhead at noon at the Tropic of Cancer. In the Northern Hemisphere, the longest day and shortest night of the year occur on this date, marking the beginning of summer. At winter solstice, approximately December 21, the sun is overhead at noon at the Tropic of Capricorn; this marks the beginning of winter in the Northern Hemisphere. Measuring shadow lengths for the winter and summer solstices represents the extreme shadow patterns that occur throughout the year. Shadows cast on the summer solstice are the shortest shadows during the year, becoming progressively longer until winter solstice when the shadows are the longest they are all year.

VERNAL AND AUTUMNAL EQUINOX

An equinox is the moment when the sun passes over the equator. The event occurs twice a year, approximately March 21 and September 21. The equinoxes are the two days each year when the middle of the sun is an equal amount of time above and below the horizon for every location on Earth. In the Northern Hemisphere, the March equinox is known as the vernal equinox and the September equinox is the autumnal

equinox. In the Southern Hemisphere, the names are reversed. In practice, at the equinox, the day is longer than the night.

The equinoxes can be interpreted as virtual points in the sky. As Earth moves around the sun, the apparent position of the sun relative to the other stars moves in a full circle over the period of a year. This circle is called the ecliptic, and is also the plane of Earth's orbit projected against the whole sky. Other bright planets like Venus, Mars, and Saturn also appear to move along the ecliptic, because their orbits are in a similar plane to Earth's. Another virtual circle in the sky is the celestial equator, or the projection of the plane of Earth's equator against the whole sky. Because Earth's axis of rotation is tilted relative to the plane of Earth's orbit around the sun, the celestial equator is inclined to the ecliptic by about 23.5°.

SHADE/SHADOW DIAGRAMS

The shade/shadow diagrams are composed of a series of three-dimensional rendered site plans. The site plans consist of the project massing models, as well as the surrounding context and geography. Upon receiving the electronic site plan files (AutoCAD) and project description, a 3D model is created to the correct heights to reflect building massing in Rhinoceros3D. The creation of the solar location is executed by correctly locating the project site based on survey coordinates within the Ladybug Environmental Analysis Tool. The 3D model is then merged with an ortho-rectified aerial photograph into Rhinoceros3D at the correct coordinates, creating a base for the model. The existing surrounding buildings are modeled to height and included with the project model. The model is then set to include the model location, times, and dates, and then the shadow conditions are rendered. The model illustrates the shadow effects of existing building and new buildings proposed as part of the project application. The orientation of the model was set to represent the orientation of the project site. Dates selected for each season were: summer/winter solstices and the vernal/autumnal equinoxes. For each of those days selected, the time periods were Sunrise, 12:00 p.m., and Sunset, with hourly increments between those times.

- Summer Solstice: 6AM – 8PM
- Winter Solstice: 7AM – 5PM
- Vernal and Autumnal Equinox: 7AM – 7PM

3.0 EXISTING CONDITIONS

The project site currently consists of a surface parking facility with parking lot lighting features.

The project is generally located within a developed area of Long Beach, surrounded by the following land uses:

- North

On the site immediately to the north of the project site is an existing two story commercial building with accompanying surface parking. Immediately across the street north of the project site is a two story parking garage structure, between the parking structure and the sidewalk exists a landscaped plaza that may be considered a shade sensitive use. Further to the northeast and north west are existing one and two story commercial buildings.

- East

Immediately east of the site is "The Promenade North" a pedestrian only walkable street that is a part of the public right-of-way and thus not considered in the sensitive uses areas although it facilitates several outdoor dining functions in the commercial space of the adjacent five story residential mixed-use building with a westward facing courtyard that may be considered a shade sensitive use, and an eight story mixed use residential and commercial building.

- South

South of the project site are several four to six story mixed-use residential and commercial buildings across the E. Broadway.

- West

Immediately west of the site is an eight story commercial building with an adjacent three story parking structure. Northwest of the site is a collection of one to three story commercial buildings.

Climate

The general region lies in the semi-permanent high-pressure zone of the eastern Pacific. As a result, the climate is mild, tempered by cool sea breezes. The climate consists of a semiarid environment with mild winters, warm summers, moderate temperatures and comfortable humidity. Precipitation is limited to a few winter storms. The usually mild climatological pattern is interrupted infrequently by periods of extremely hot weather, winter storms, or Santa Ana winds.

The average annual temperature varies little throughout the area (which encompasses the project site), averaging 75 degrees Fahrenheit (°F). However, with a less-pronounced oceanic influence, the eastern inland portions of the project's geographical area show greater variability in annual minimum and maximum temperatures. All portions of the area have had recorded temperatures over 100°F in recent years.

Although the project's geographical area has a semi-arid climate, the air near the surface is moist because of the presence of a shallow marine layer. Except for infrequent periods when dry, continental air is brought into the area by offshore winds, the ocean effect is dominant. Periods with heavy fog are frequent, and low stratus clouds, occasionally referred to as "high fog," are a characteristic climate feature. Annual average relative humidity is 70 percent at the coast and 57 percent in the eastern part of the area. Precipitation in the project area is typically 9 to 14 inches annually and is rarely in the form of snow or hail due to typically warm weather. The frequency and amount of rainfall is greater in the coastal areas of the project area.

Existing Shadow-Sensitive Uses

Per Long Beach Downtown Plan PEIR 4.1 Evaluation of Shadow Effects:

Facilities and operations sensitive to the effects of shading include solar collectors; nurseries; primarily outdoor-oriented commercial uses (e.g., certain restaurants); or routinely useable outdoor spaces associated with recreational, institutional (e.g., schools), or residential land uses. These uses are considered sensitive because sunlight is important to their function, physical comfort, and/or commerce.

The following existing uses within the project vicinity would be considered Shadow-sensitive:

- North of the site, across E. 3rd street is an existing public plaza fronting the public parking garage across that would be considered a shadow-sensitive use per Long Beach Downtown Plan PEIR 4.1
- East of the site the courtyard and outdoor seating of the associated restaurants in the building would be considered shadow-sensitive uses per Long Beach Downtown Plan PEIR 4.1

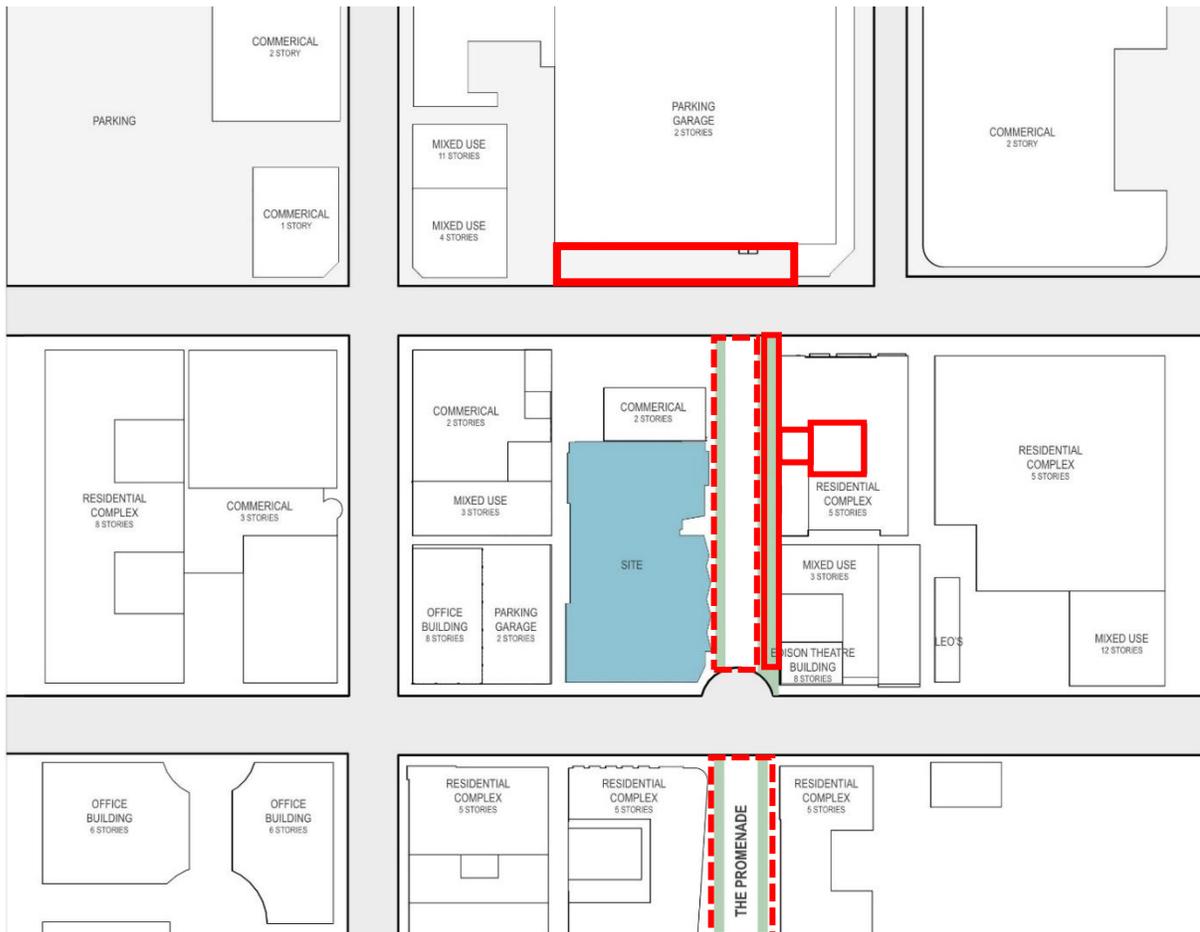


Figure 4 - Shadow Sensitive Uses (RED)

 Shadow Sensitive use per PEIR not impacted

 Public Right of Way

Proposed Shade/Shadow Conditions

The existing project site contains no built structures either temporary or permanent as such the existing project site casts no shade/shadow conditions on adjacent uses.

The proposed project would construct a new 200,000 sf, eight story mixed use building. Construction of this project would cast shadows on nearby residential and recreational uses. The following analysis describes the shadow conditions from the proposed project onto surrounding uses during the summer/winter solstices and the vernal/autumnal equinoxes.

Winter Solstice

On December 21, shadows are cast the longest they will be throughout the year by virtue of the low altitude of the sun in the daytime sky. From the morning (8AM) to evening (6PM) hour's shadows are cast northward across several adjacent land uses and across E. 3rd street and The Promenade – Right of Way. See FIGURE 5-8 PROPOSED SHADE & SHADOW PATTERNS. From sunrise through mid-afternoon shadows are cast westward over the top of existing one to three story commercial buildings and adjacent sidewalks and alleyway. From mid-afternoon through the evening shadows are cast Northeast across The Promenade-Right of Way and towards the adjacent five story residential mixed-use building. Total Area of shadow is approximately 9,455 sf of the 24,800 sf which encompasses the Promenade-Right of Way between E. Broadway and E. 3rd St.

Summer Solstice

On June 21, shadows are cast the shortest they will be throughout the year by virtue of the high altitude of the sun in the daytime sky. From the morning (6AM thru 11AM) shadows are cast predominantly westward and southwestward onto the adjacent eight story office building and adjacent parking structure not casting. SEE FIGURE 9-12 IMPACTED AREA. From noon through evening shadows are cast eastward across The Promenade-Right of Way, and towards the eight story mixed-use building southeast of the project site. Shadows cast from Noon to sunset exceed the four hour threshold for significant shadow per PEIR but do not impact any existing shadow-sensitive uses from early April to late October. Total Area of significant shadow is approximately 7,445 sf of the 24,800 sf which encompasses the Promenade-Right of Way between E. Broadway and E. 3rd St.

Vernal & Autumnal Equinox

On March 21, shadows are cast the approximately equally east and westward from the project. Through the morning hours shadows are cast directly westward towards the adjacent commercial and mixed use buildings. From Noon through the evening hours shadows are cast directly eastward across The Promenade N-Right of Way. and towards the adjacent residential mixed-use complex restaurant seating and courtyard space. Shadows cast into the neighboring courtyard do not exceed the three hour threshold for winter shade impact and are not considered impactful. Shadows cast to The Promenade-Right of Way exceed the 3 hour threshold for Late October to Early April but do not impact a shade sensitive use per PEIR. Total Area of significant shadow is approximately 5,925 sf of the 24,800 sf which encompasses the Promenade-Right of Way between E. Broadway and E. 3rd St.

On September 21, shadows are cast the approximately equally east and westward from the project. Through the morning hours shadows are cast directly westward towards the adjacent commercial and mixed use buildings. From Noon through the evening hours shadows are cast directly eastward across The Promenade N-Right of Way. and towards the adjacent residential mixed-use complex restaurant seating and courtyard space. Shadows cast into the neighboring courtyard do not exceed the three hour threshold for winter shade impact and are not considered impactful. Shadows cast to The Promenade-Right of Way exceed the 3 hour threshold for Late October to Early April but do not impact a shade sensitive use per PEIR. Total Area of significant shadow is approximately 11,215 sf of the 24,800 sf which encompasses the Promenade between E. Broadway and E. 3rd St.

4.0 SHADE/SHADOW ANALYSIS

Results of Shade/Shadow Analysis

Late October to Early April – *Shade for more than 3 hours*



Figure 5 - Winter Solstice Shadow Study (Worst case shadow day)

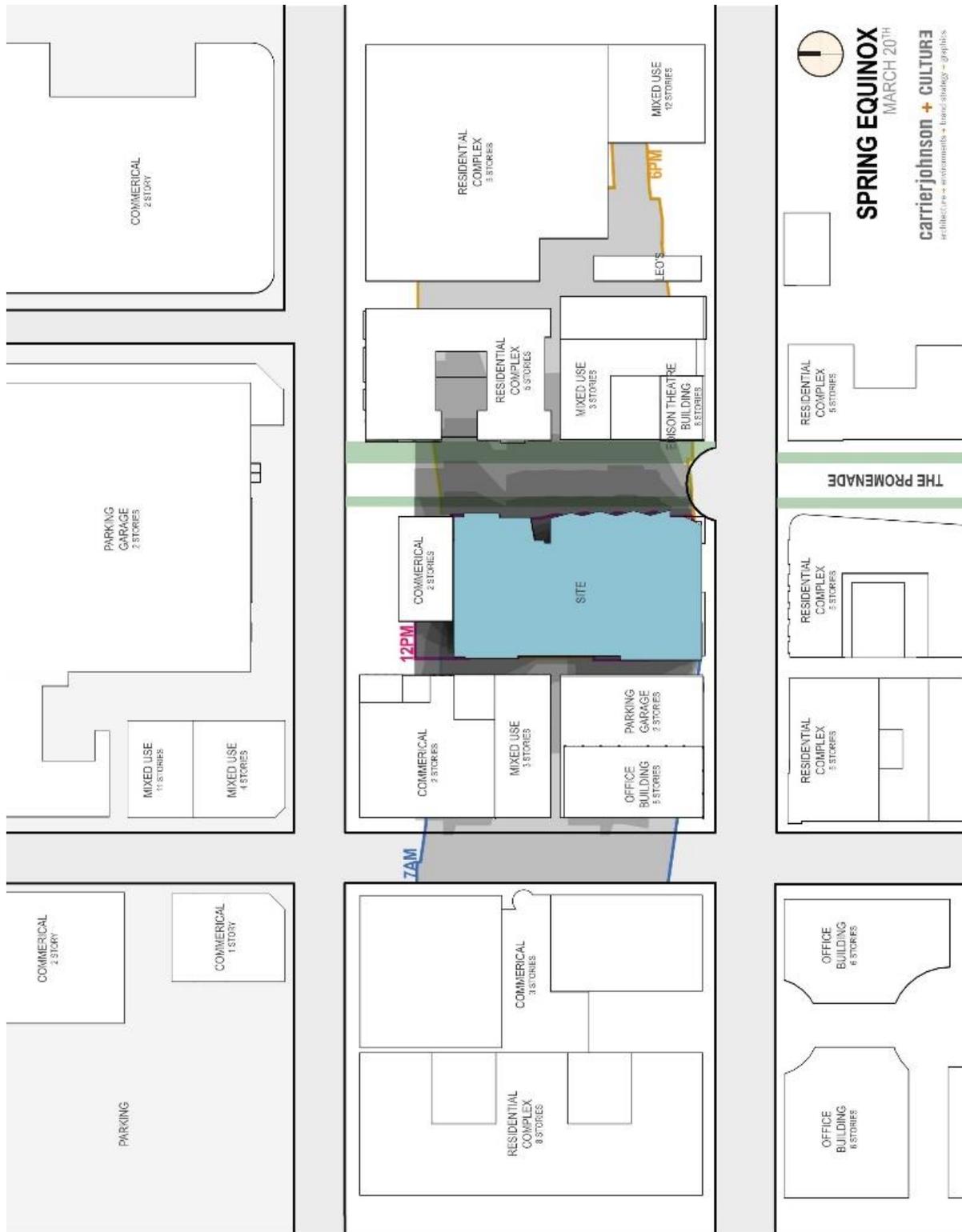


Figure 6 - Spring Equinox Shadow Study

Early April to Late October – *Shade for more than 4 hours*

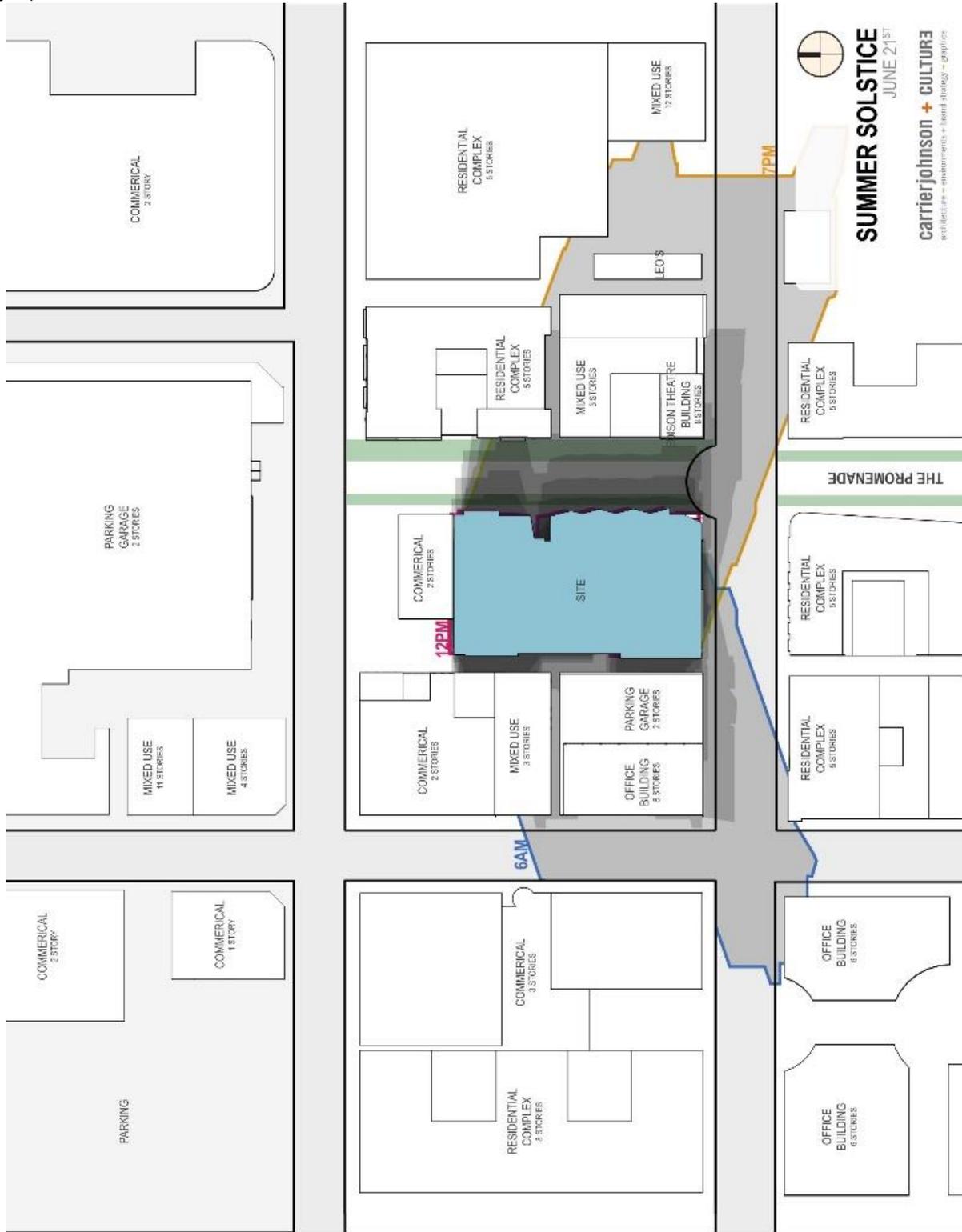
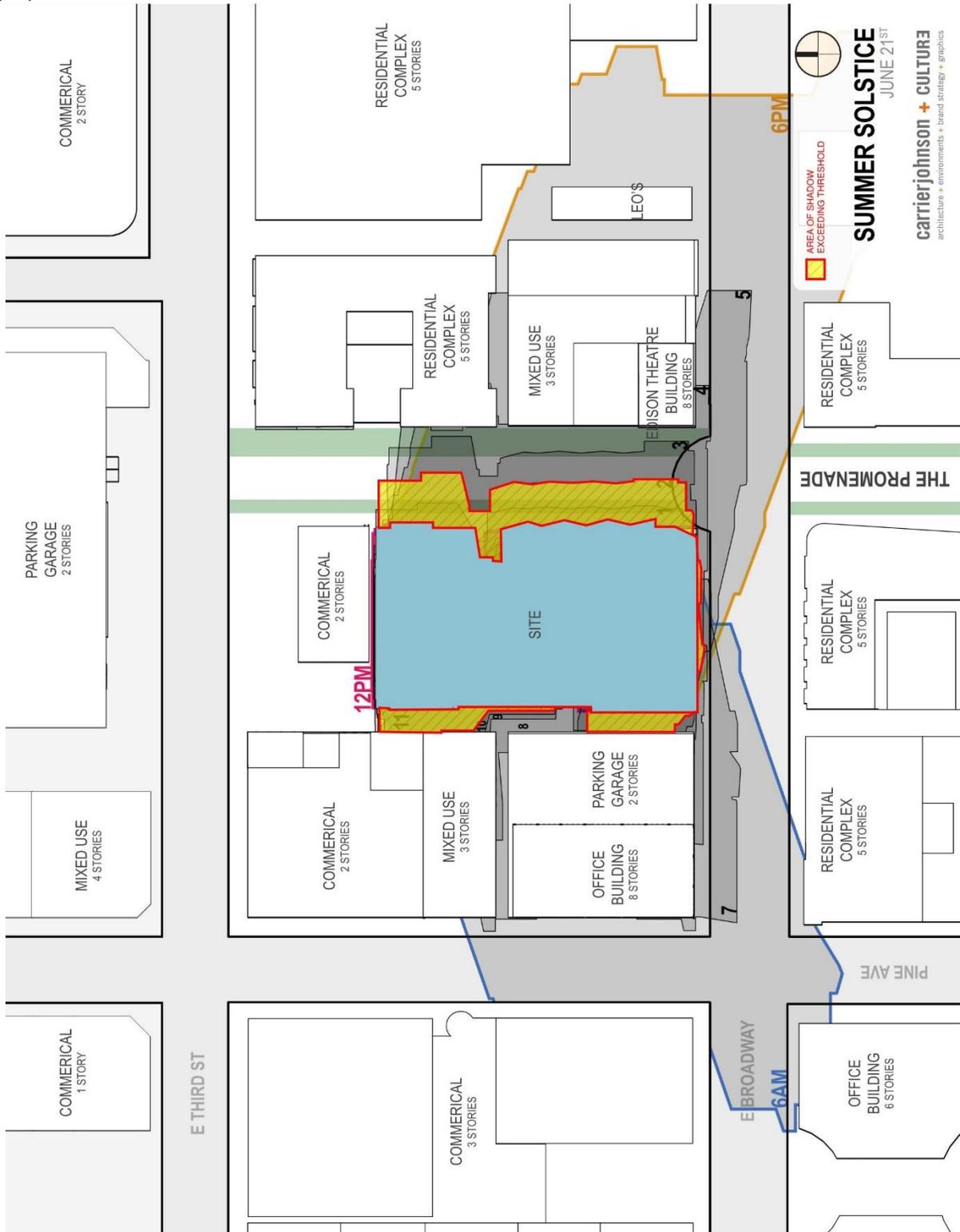


Figure 7 - Summer Solstice Shadow Study



Figure 10 - Spring Equinox Shadow Study

Early April to Late October – Shade for more than 4 hours



SUMMER SOLSTICE
JUNE 21ST
carrierjohnson + CULTURE
architecture + environments + brand strategy + graphics

Figure 11 - Summer Solstice Shadow Study

Impacts and Mitigation Measures

Areas Exceeding Shade Threshold

Late October to Early April – *Shade for more than 3 hours* – THROUGH WINTER MONTHS THE SHADOW IMPACT EXCEEDING THE 3 HOUR THRESHOLD LASTS FROM 10/15 THRU 3/31 TO VARYING DEGREES

Total Area of significant shadow is approximately 8,365 sf of the 24,800 sf within the Public Right of Way between E. Broadway and E. 3rd St.



Figure 13 - Shadow Exceeding Threshold - Winter Solstice

Total Area of significant shadow is approximately 11,215 sf of the 24,800 sf within the Public Right of Way between E. Broadway and E. 3rd St.

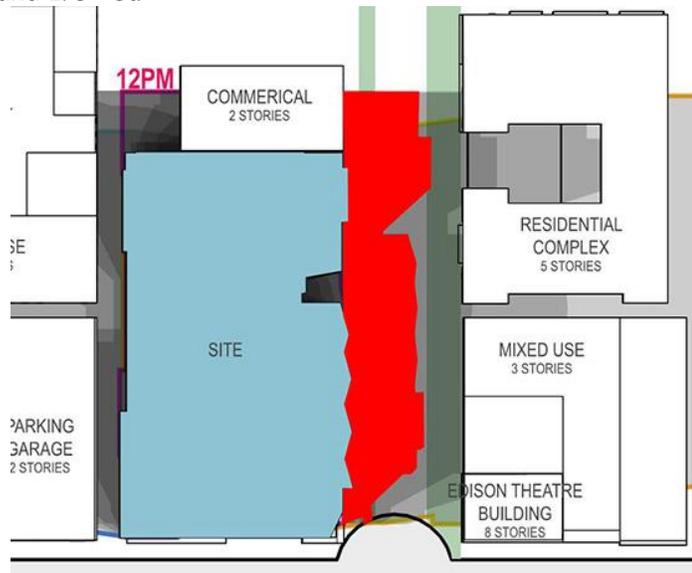


Figure 14 - Shadow Exceeding Threshold - Spring Equinox

■ Area Exceeding Threshold

Early April to Late October – *Shade for more than 4 hours* - THROUGH SUMMER MONTHS THE SHADOW IMPACT EXCEEDING THE 4 HOUR THRESHOLD LASTS FROM 3/31 THRU 10/15 TO VARYING DEGREES

Total Area of significant shadow is approximately 7,445 sf of the 24,800 sf within the Public Right of Way between E. Broadway and E. 3rd St.

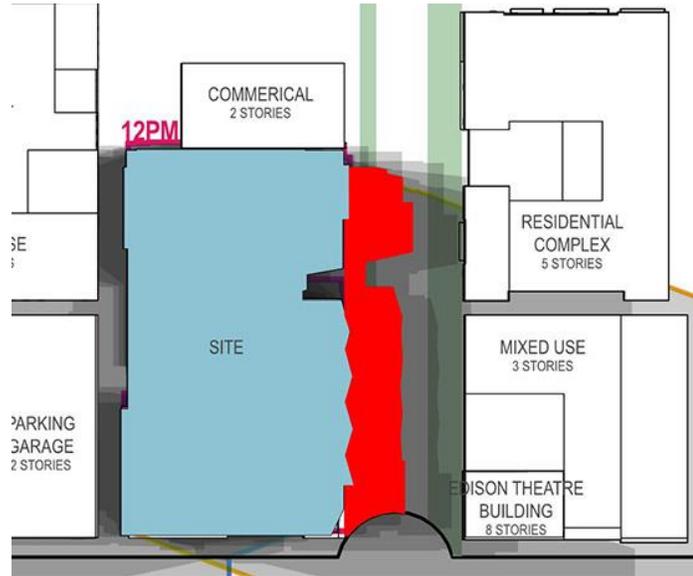


Figure 15 - Shadow Exceeding Threshold - Summer Solstice

Total Area of significant shadow is approximately 5,925 sf of the 24,800 sf within the Public Right of Way between E. Broadway and E. 3rd St



Figure 16 - Shadow Exceeding Threshold - Fall Equinox

■ Area Exceeding Threshold

Thresholds of Significance

Per Long Beach Downtown Plan PEIR 4.1:

Evaluation of Shadow Effects

Because of the high-rise development anticipated in the Downtown Plan, and without knowledge of exactly where all of these structures are likely to occur within the project boundary, shade and shadow impacts on existing and potential future sensitive receptor land uses are likely to occur. Therefore, the environmental analysis for the proposed project includes discussion of this issue. In determining shadow effects, the following factors are considered:

- Affected land use (i.e., is it a light-sensitive use whereby sunlight is essential to its use).
- Duration (i.e., how many hours per day might a use be shadowed).
- Time of day (i.e., is it in shadow at a time of day when sunlight is most important).
- Season (i.e., what time of year might a particular use be in shadow).
- Extent (i.e., what percentage of a particular use may be in shadow).
- Nature of the shadows (i.e., is the shadow more solid or more dappled).
- Pre-existing conditions (i.e., are there existing buildings, landscaping, or other features that currently shadow the use).

For a project to generate a significant shadow impact, it must increase shadows cast upon shadow-sensitive uses. Shadow impacts are considered significant if shadow-sensitive uses would be shaded by proposed structures for more than 3 hours between late October and early April (including Winter Solstice), or for more than 4 hours between early April and late October (including Summer Solstice). This significance criterion has been used in EIRs prepared for other projects in Downtown Long Beach in recent years and has become the standard by which shadow impacts are determined. Facilities and operations sensitive to the effects of shading include solar collectors; nurseries; primarily outdoor-oriented commercial uses (e.g., certain restaurants); or routinely useable outdoor spaces associated with recreational, institutional (e.g., schools), or residential land uses. These uses are considered sensitive because sunlight is important to their function, physical comfort, and/or commerce.

Analysis Summary

- Affected Land Use
 - The Promenade N is a part of the Public Right of Way network within downtown and as such is not considered to be a shade sensitive land use.
 - Restaurants within the vicinity; several adjacent restaurants have outdoor dining options while several do not, most of the established outdoor seating areas already provide shade canopies or structures or are shaded by the building housing the restaurant establishment already.
- Duration
 - Per previous diagrams and analysis the duration of shadow impact above the PEIR thresholds occur primarily from mid-February thru early mid to late September depending on the seasonal threshold.

- Time of Day
 - As the only significant adjacent shade sensitive land uses are immediately east of the project site the time of day of impact is primarily during mid-day thru 3pm AM.
- Season
 - Per previous documentation of shadow extent through Winter and Summer Solstice and Vernal/Autumnal Equinox it is indicated that shadow areas exceeding the time thresholds set forward in the PEIR occur predominantly throughout the year in both summer and winter months. As the majority of shadow is cast through the summer months when shade is a benefit given the projects climatic conditions we do not deem this to be impactful of adjacent uses.
- Extent
 - Per the previously documented analysis approximately 25% to 40% of the total square footage of the adjacent use exceeds the shadow threshold for impact although that adjacent use is a Public Right of Way, no existing shadow sensitive uses are in an area that exceed shadow impact threshold.
- Nature of Shadow
 - In all cases, the nature of the shadows is solid.
- Pre-existing conditions
 - Within the Public Right of Way the adjacent 5 story mixed-use building and 8 story commercial building cast shadow that exceed the threshold but do not impact existing shade sensitive uses within the vicinity of the proposed project.

Conclusion

Based on the Evaluation requirements in the Long Beach Downtown Plan PEIR the impacts of the shadows cast by the project are deemed to fall within the parameters of a “exceeding the allowable shadow threshold.” However, the impact of the shadows cast above the threshold is limited to 25% to 40% of the total square footage of The Promenade depending on the time of year and the threshold level considered during Fall-Winter months and Spring-Summer months. As previously identified while shadow sensitive uses front the Promenade to the East of the proposed project (existing outdoor restaurant seating) the shadows cast from the proposed project do not exceed the allowable threshold of these uses, additionally as The Promenade is considered a public right of way we do not deem the impact of shadow exceeding the allowable threshold within that area to create a significant impact to a shade sensitive use.

Furthermore per the Long Beach Downtown PEIR 4.1 Aesthetics:

Cumulative development of buildings of greater height and massing within Downtown would increase shadowing within the Downtown Plan. The shadow effects of individual buildings on light-sensitive uses would need to be addressed on a case-by-case basis since shading is dependent on building height, massing, and site location, as well as the existing conditions in the immediately surrounding uses, particularly to the north of a project site. However, the only mitigation available is to lower the height of proposed buildings, which would not be feasible in every instance and could require heights that would be below the height allowed by the proposed Plan. These shadowing impacts are expected to occur in the denser, taller, and most vibrant urban settings, which would be consistent with the goals of the Plan but cannot be mitigated at this PEIR level of analysis. Shade and shadow impacts from the proposed Project are expected to be significant and unavoidable, as discussed above for Mitigation Measure AES-3. Adding potential shade and shadow impacts from the cumulative projects, all of which include high-rise structures, will likely exacerbate this impact in locations near these cumulative project sites, particularly for areas north of the cumulative project sites. Therefore, the cumulative shade and shadow impacts are considered significant and unavoidable.

5.0 REFERENCES

Preparers

Carrier Johnson + CULTURE

Casey Mahon, AIA – Digital Process Manager/Simulation

Christopher Yanes – Designer

Vicki Piazza, RA, Leed AP BD+C – Associate Principal

Documents

1. Long Beach Downtown Plan PEIR
2. City of Long Beach Downtown Plan
3. Carrier Johnson + CULTURE – AutoCAD, Revit, SketchUP, Rhinoceros3D models

Web Sites

Googlemaps.com, 2018