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ABC site: Impact of possible development on daylight

REVISED DRAFT

Prepared for:
Community Board 7
Manhattan

George M. Janes, AICP
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Today

What is daylight?

How does daylight differ from shadows?

How does building form impact daylight?

- The case of the ABC site

What is daylight?

Light from direct sun

- *Most daylight is light from direct sun because direct sun is very powerful*

Light from direct sky

- *Light from the sky provides a significant amount of light, especially to areas that are already in shadow*

Reflected light from sun and sky

- *Buildings reflect light in certain directions and amounts*

Daylight is not shadows, but daylight is influenced by shadows

Daylight and solar energy are directly correlated and are used interchangeably herein

In NYC, we routinely study shadows but not daylight

Even though NYC zoning is inspired and shaped by regulations designed to improve daylighting:

- 25% towers / “wedding cake” buildings
- 40% towers
- Rear yard setback
- Sky exposure planes
- Initial setback distances
- Wide-street/narrow-street height differentials
- Daylight Compensation & Daylight Evaluation in Midtown

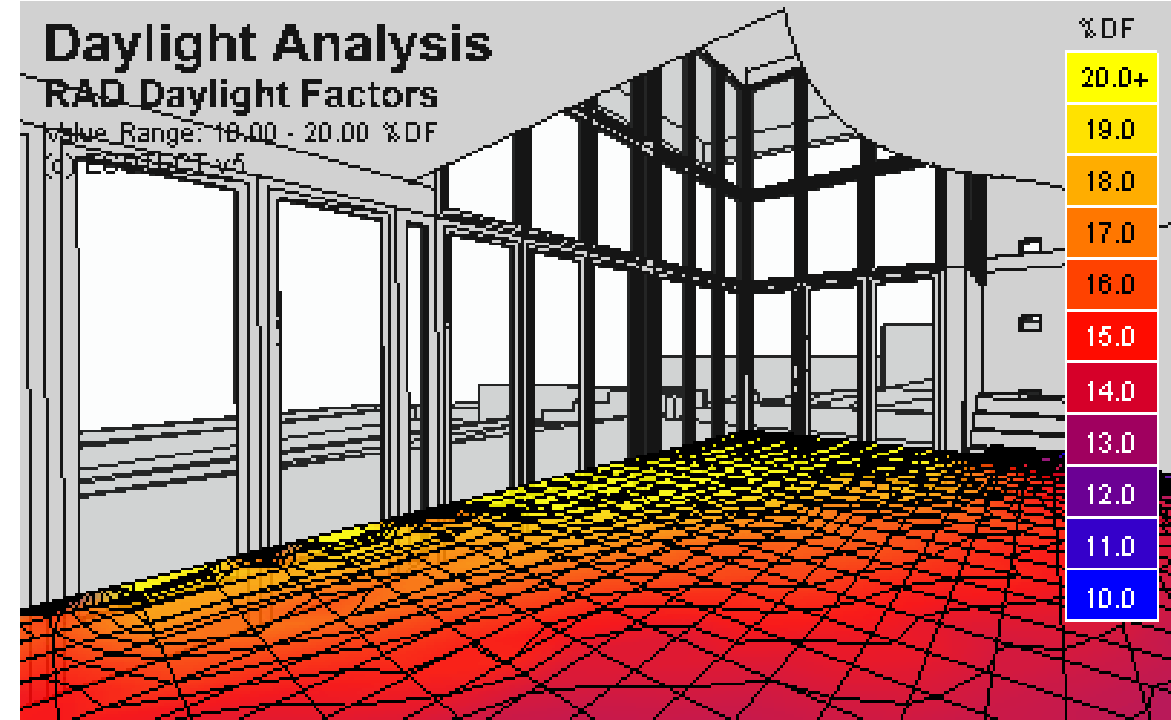
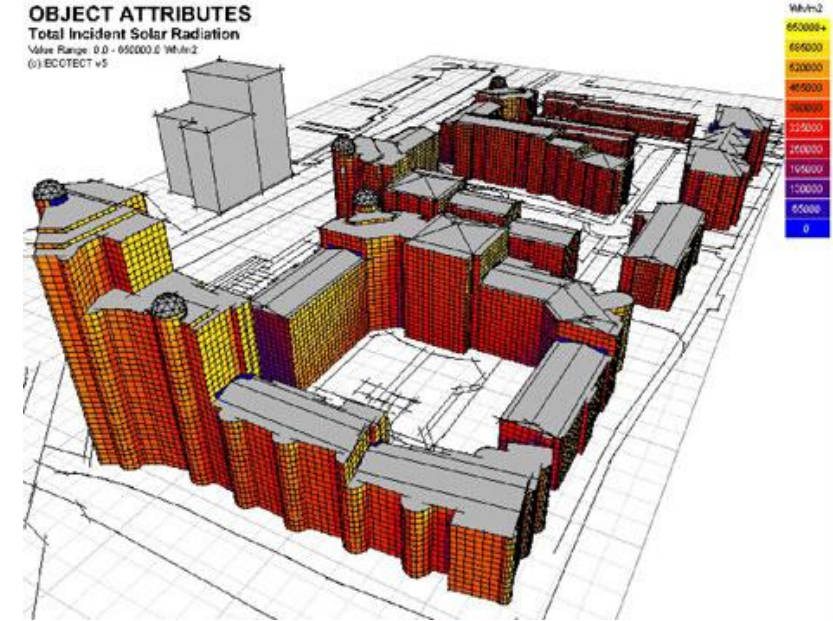
All are zoning mechanisms that allow more daylight to reach the ground



But shadows are easier to measure than daylight

Until 2014, it was difficult to do daylighting analysis:

- The 3D model of NYC was not available until 2014
- Daylighting models are now built into ArcGIS and some CAD tools, and are much easier to use
- Daylighting tools are now used routinely by practitioners



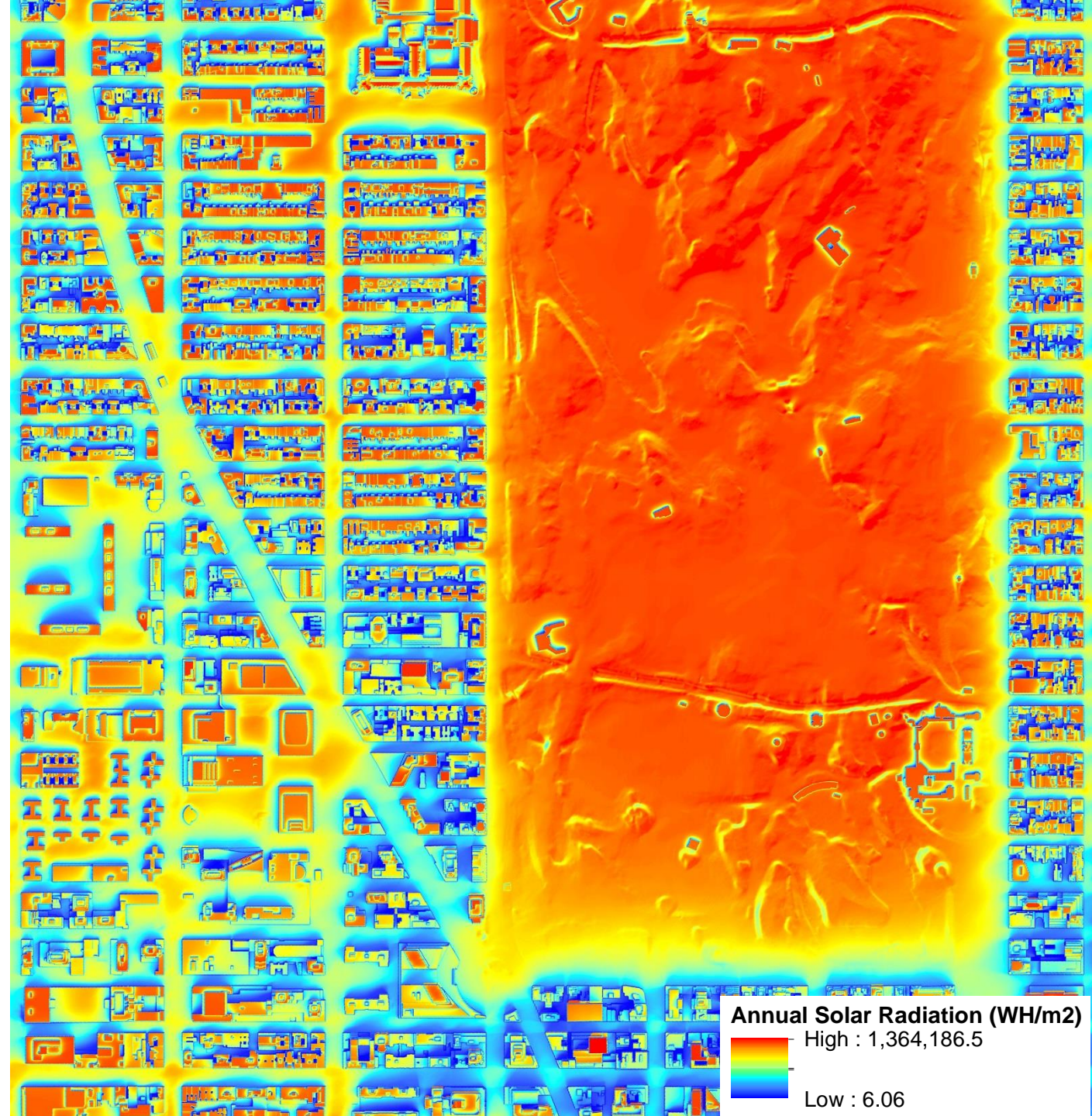
But shadows are easier to measure than daylight

- A shadow is the absence of direct sun: if an area is already in shadow, it cannot be shadowed more, even though new development darken an area by blocking sky
- EIS shadow analysis focuses only on new shadows, and only on “shadow sensitive resources”
- In environmental reviews, we don’t care about shadows on streets or sidewalks, private outdoor spaces, or windows
- Yet impacts on daylight is the very reason we have the bulk regulations that we do

Research question: **How do different bulk regulations perform on daylighting in high density districts?**

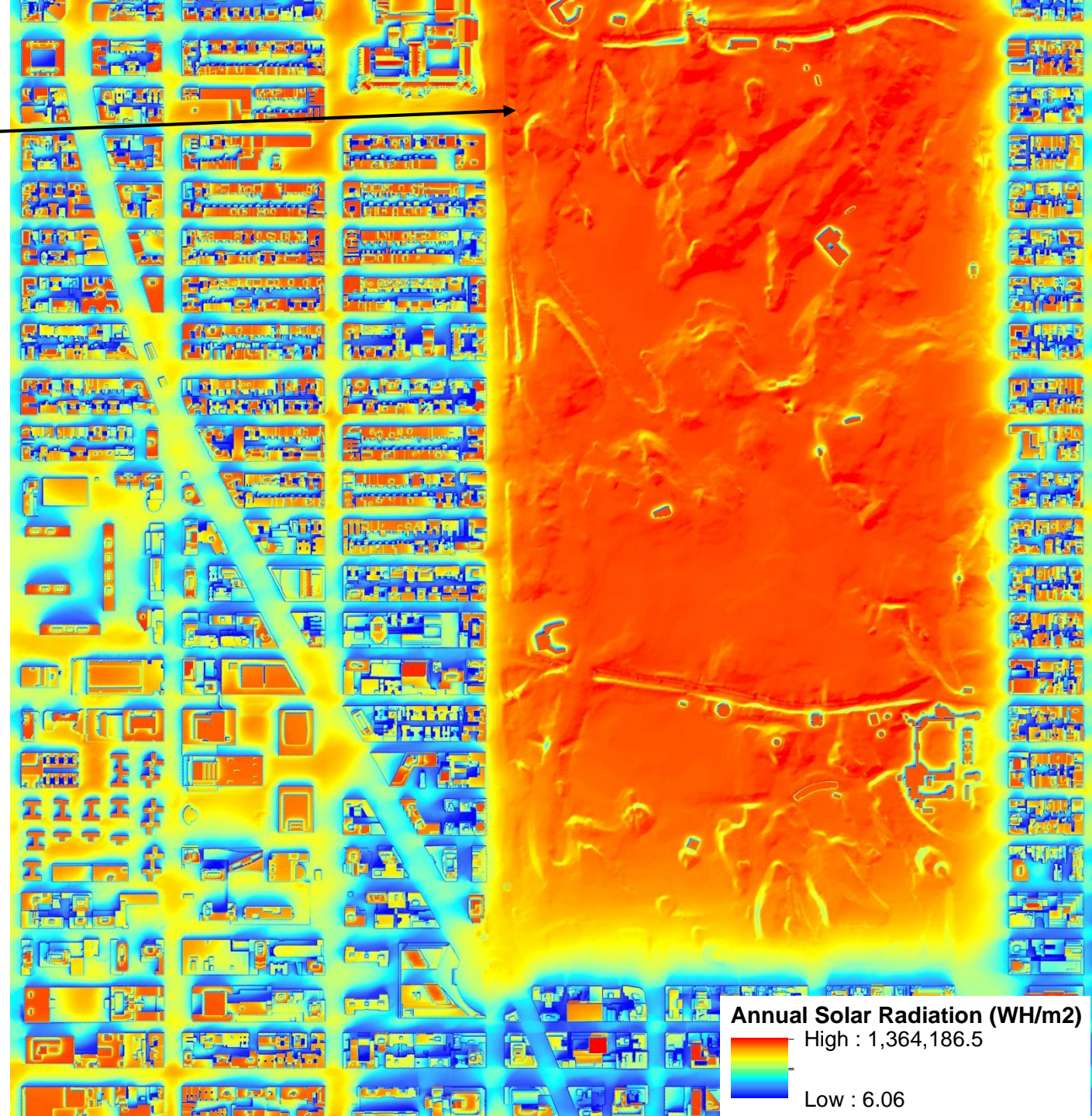
Specifically, how does Standard Tower compare to Tower-on-Base when measured by daylighting?

So let's start by talking about light and energy



Red/orange areas get a lot of daylight

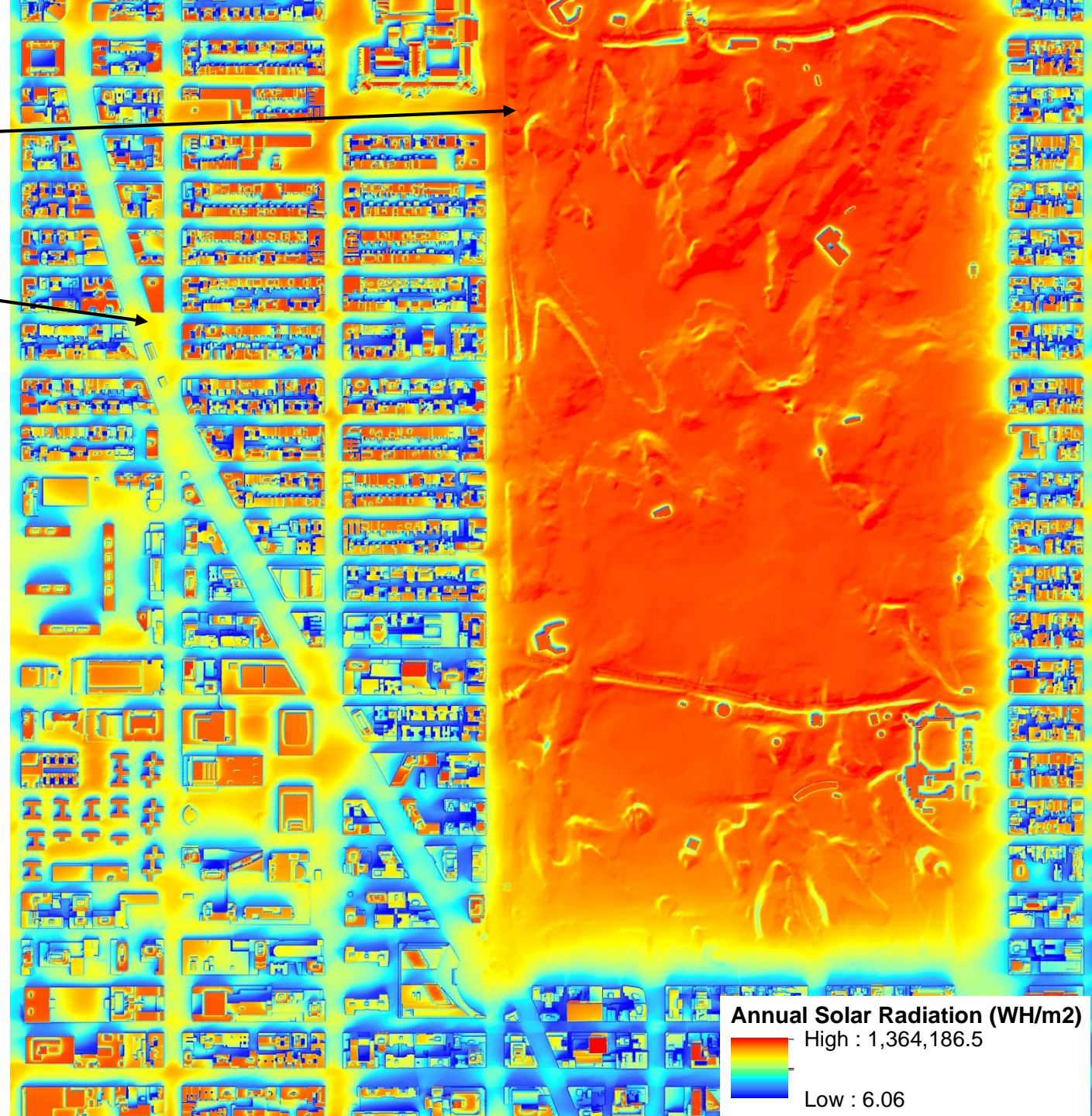
Large parks



Red/orange areas get a lot of daylight

Large parks

Wide avenues

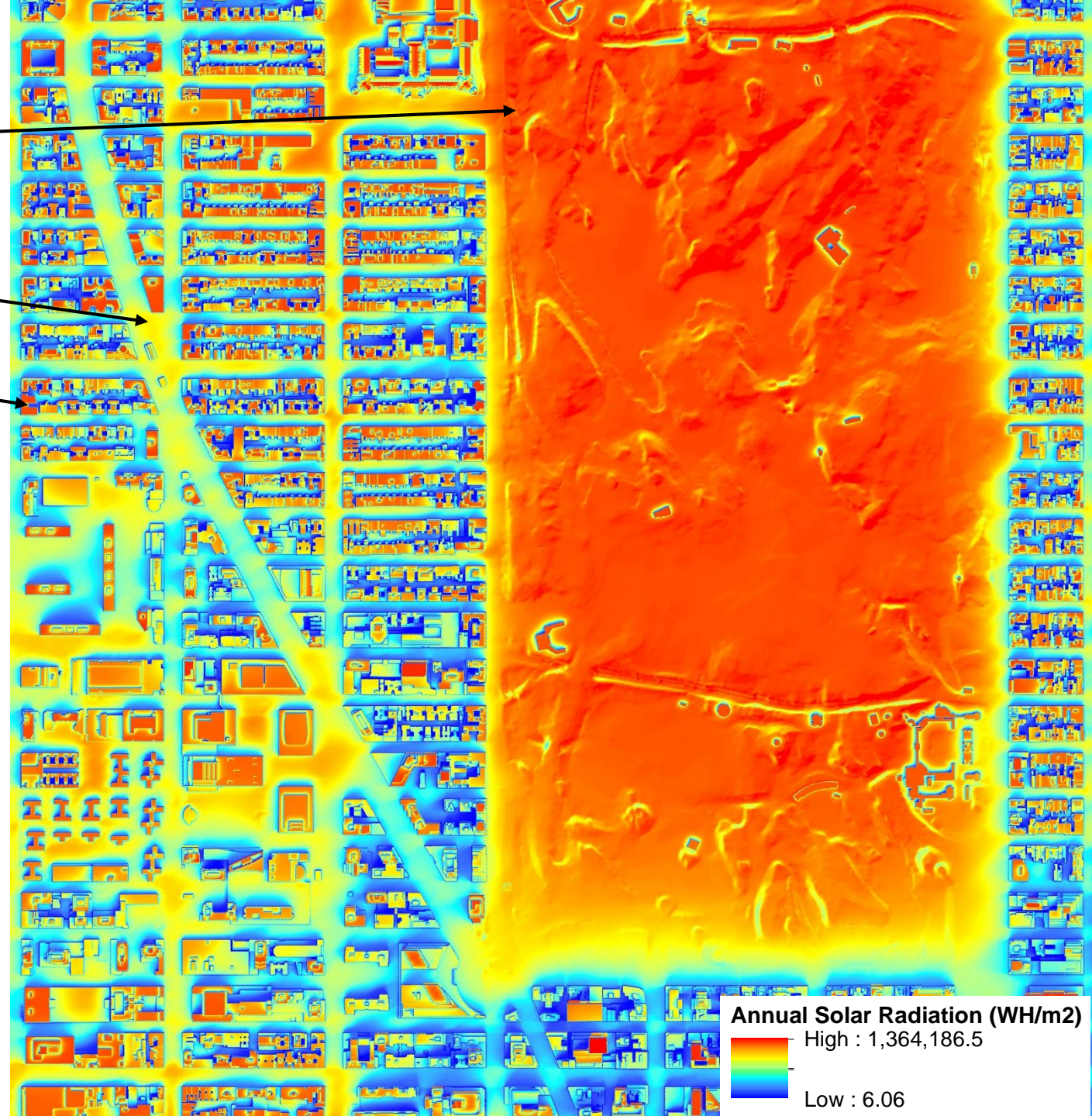


Red/orange areas get a lot of daylight

Large parks

Wide avenues

Rooftops



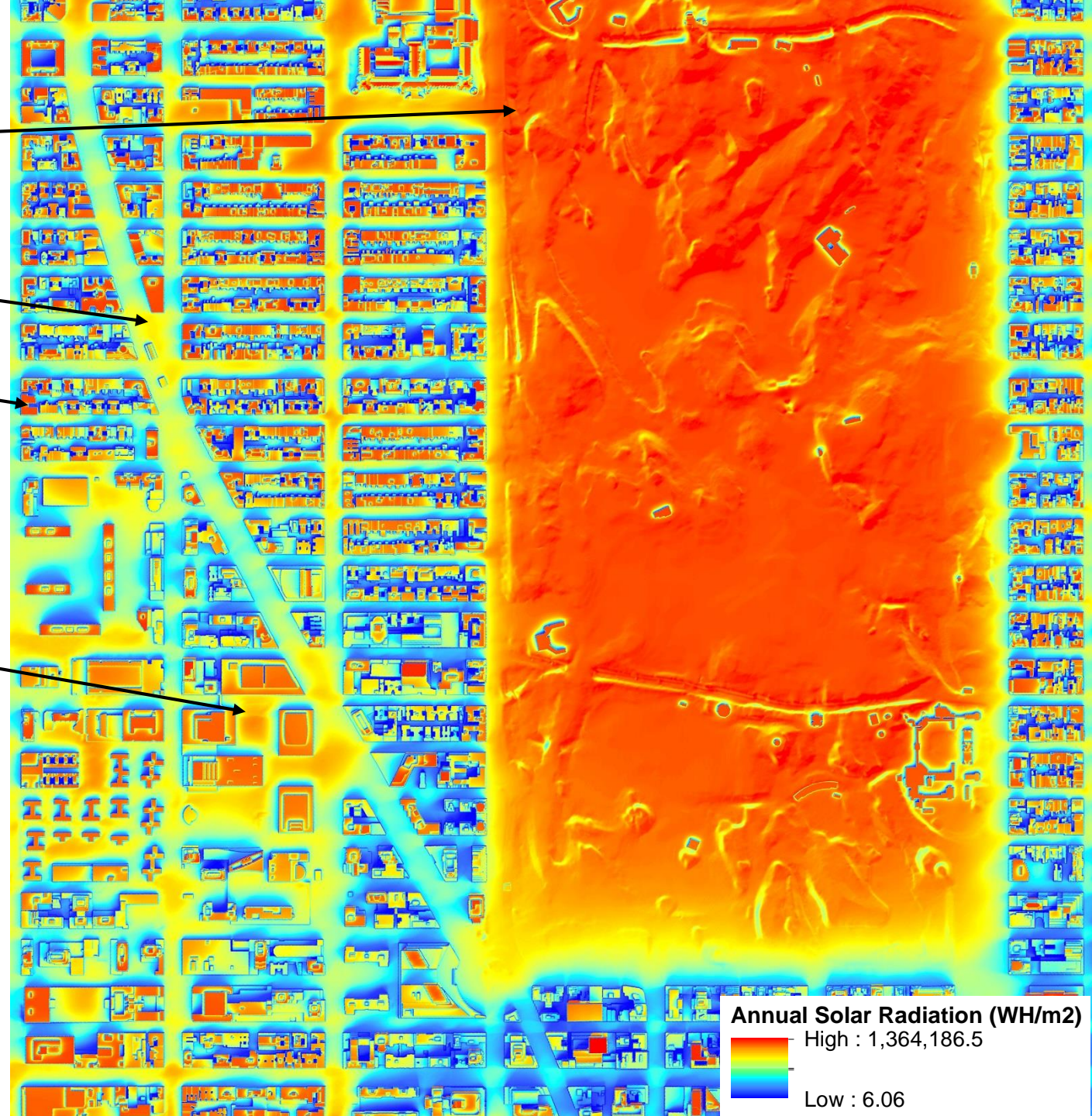
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Large parks

Wide avenues

Rooftops

Lincoln Center



Red/orange areas get a lot of daylight

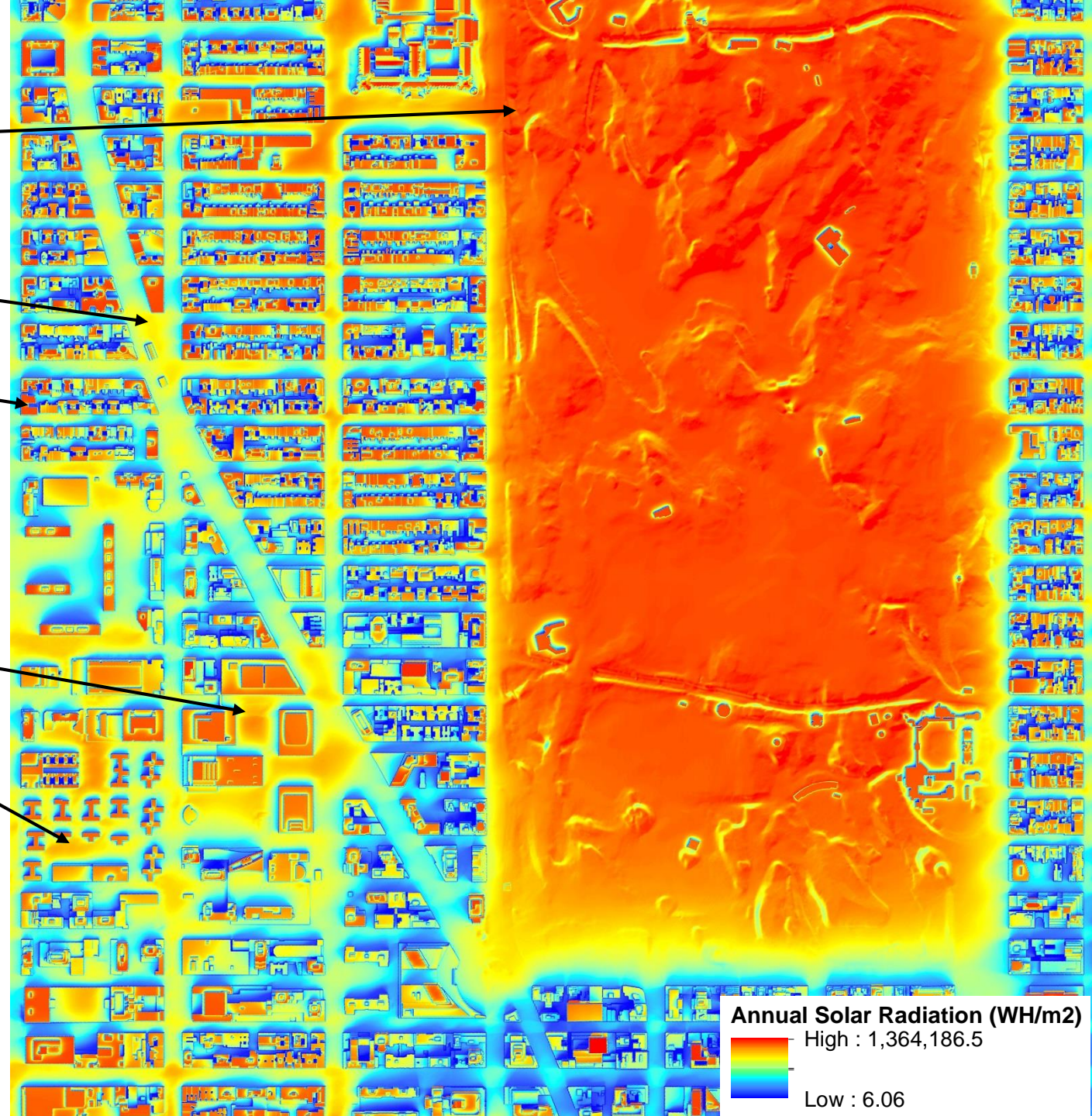
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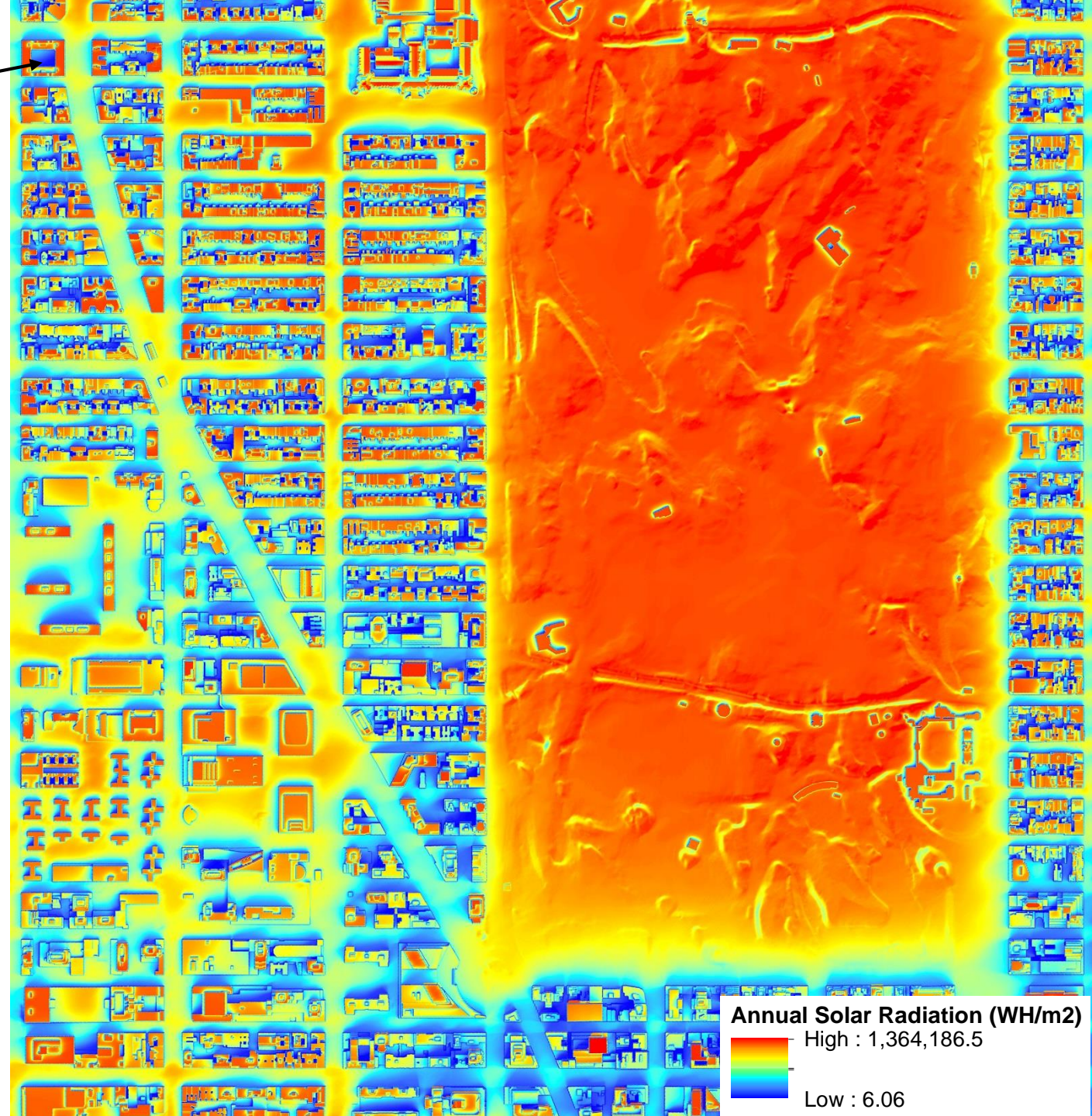
Lincoln Center

Tower in the park housing



Blue areas don't get much daylight

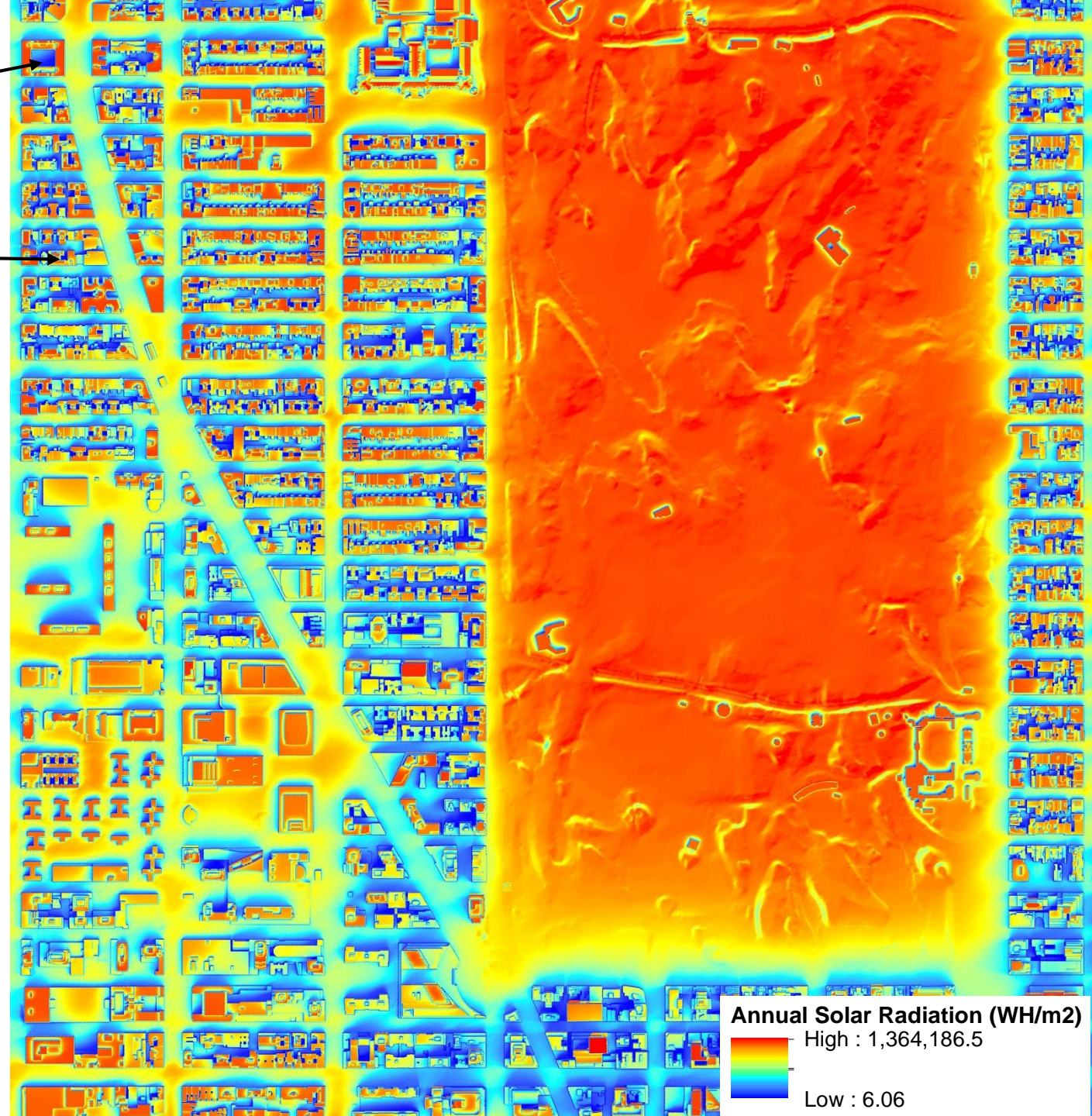
Inner courts



Blue areas don't get much daylight

Inner courts

Light wells

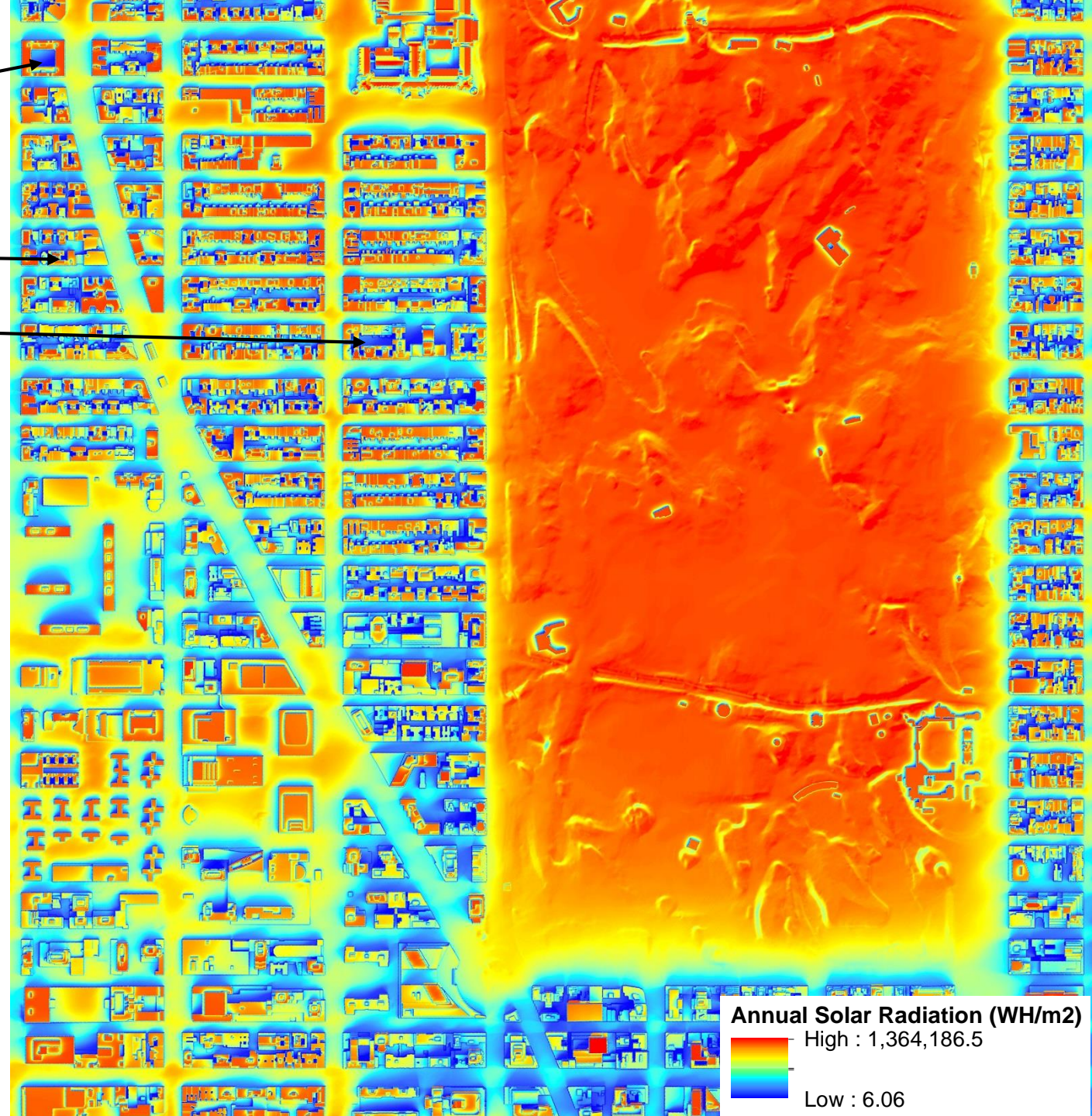


Blue areas don't get much daylight

Inner courts

Light wells

Rear yards



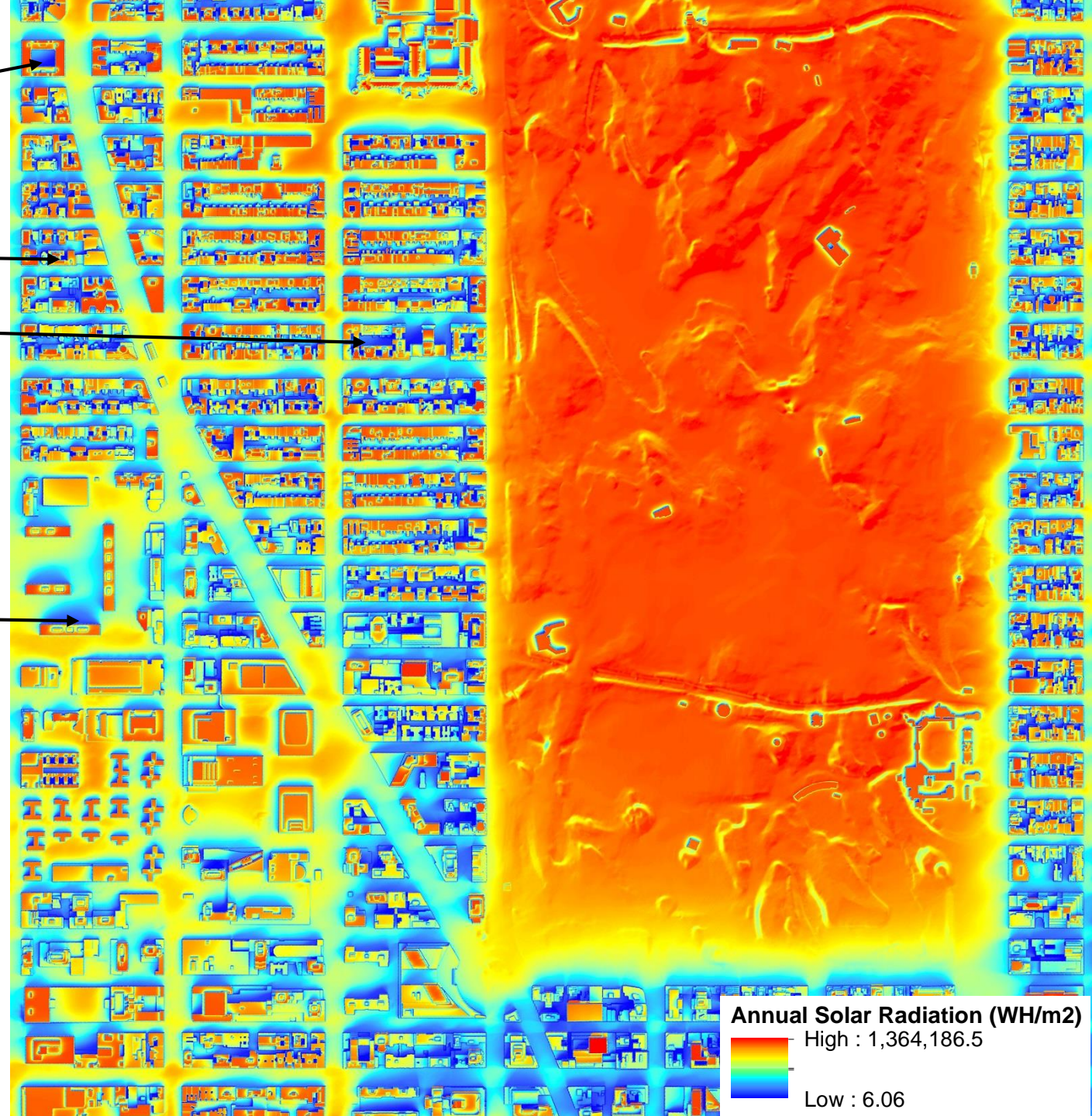
Blue areas don't get much daylight

Inner courts

Light wells

Rear yards

Land facing the north side of a tall building



Blue areas don't get much daylight

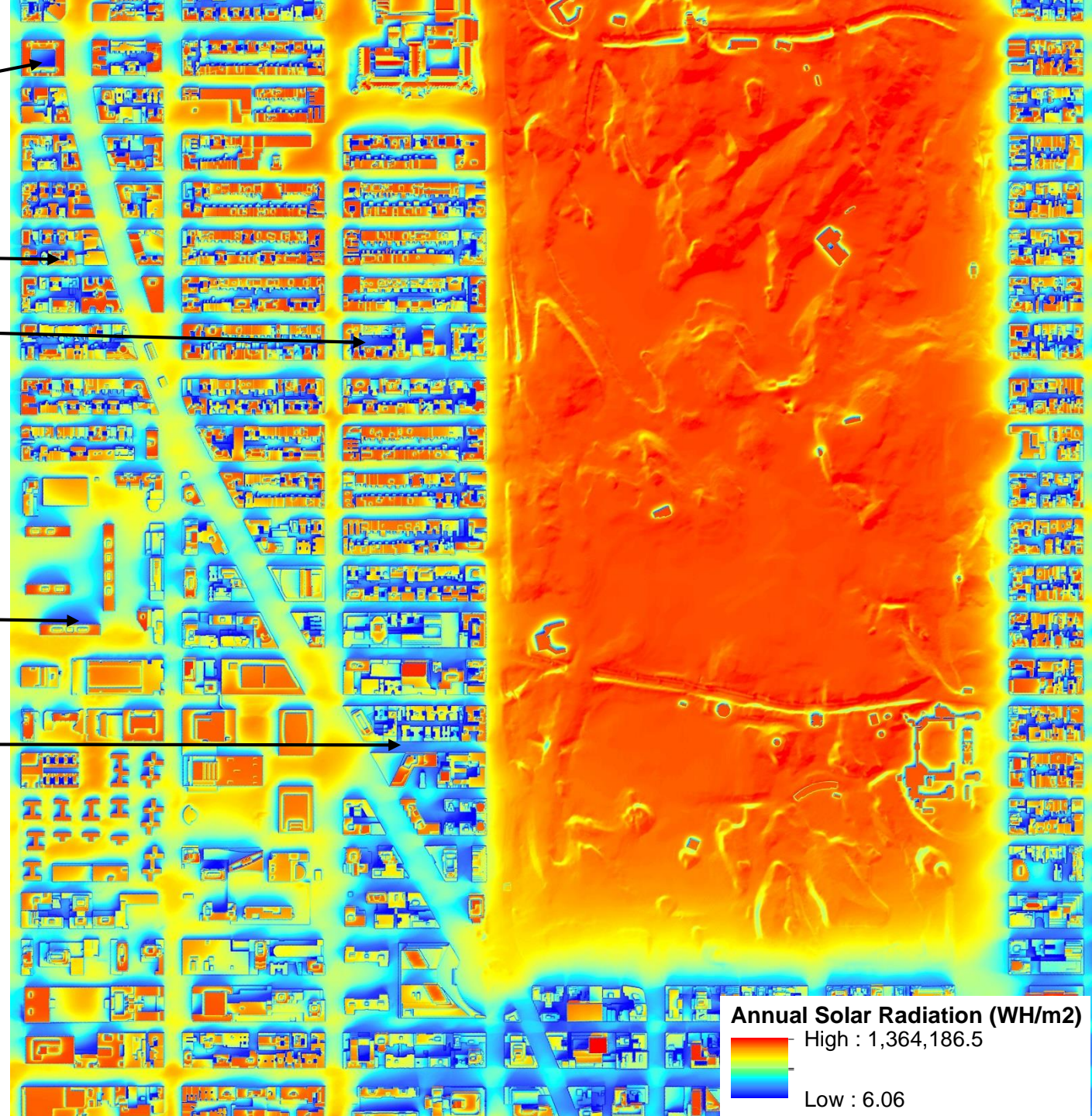
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Light wells

Rear yards

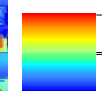
Land facing the north side of a tall building

Narrow streets



Annual Solar Radiation (WH/m2)

High : 1,364,186.5



Low : 6.06

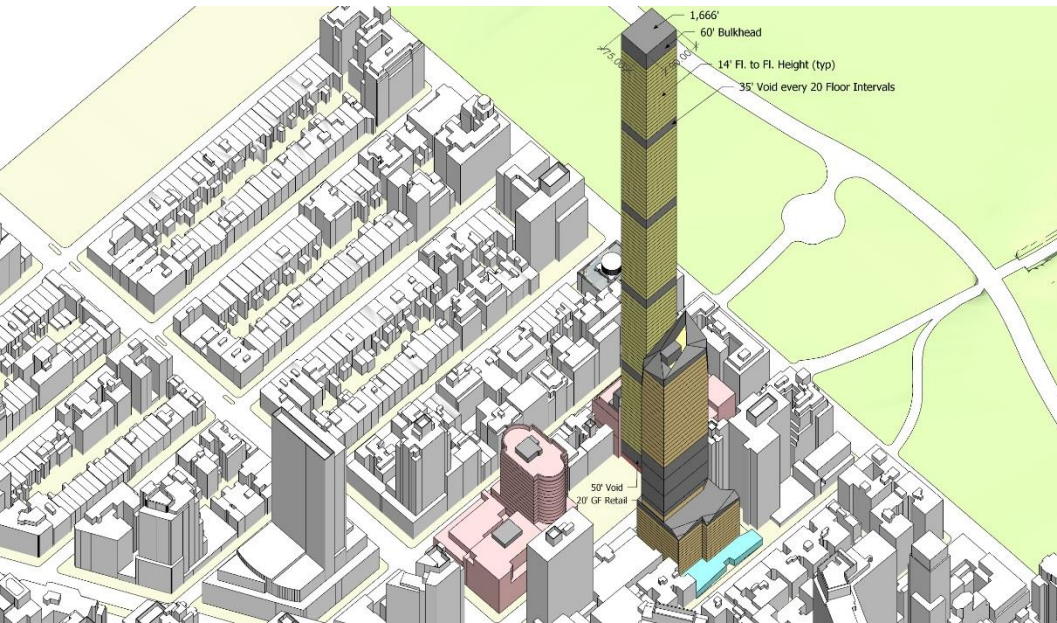
We study four scenarios for hypothetical development on the ABC site



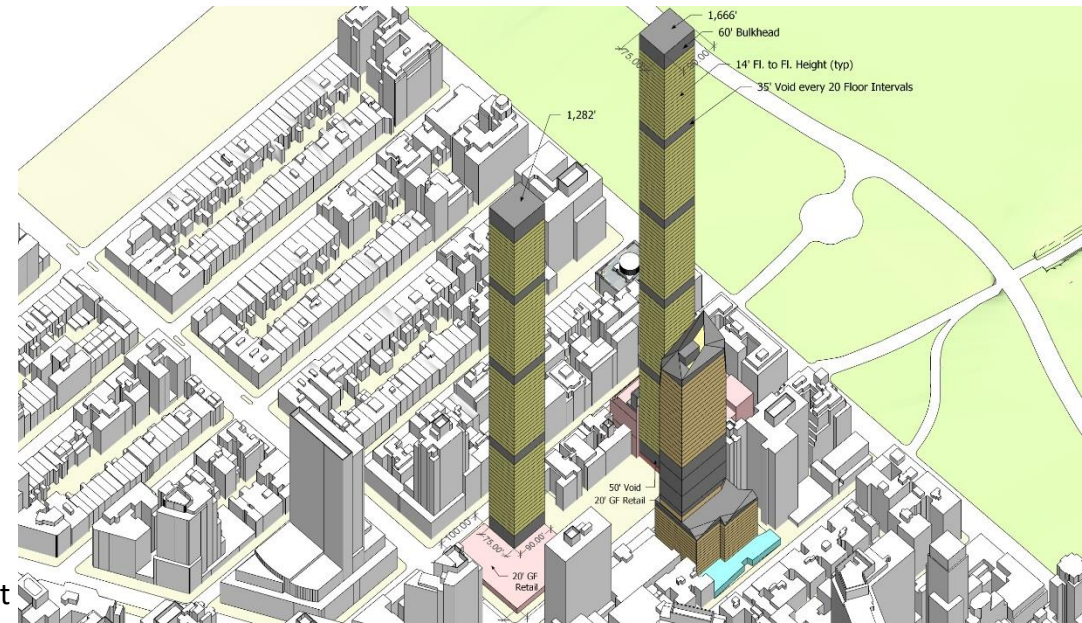
"Existing"
conditions on
ABC block



Tower-on-base
with Special
Lincoln Square
District
regulations

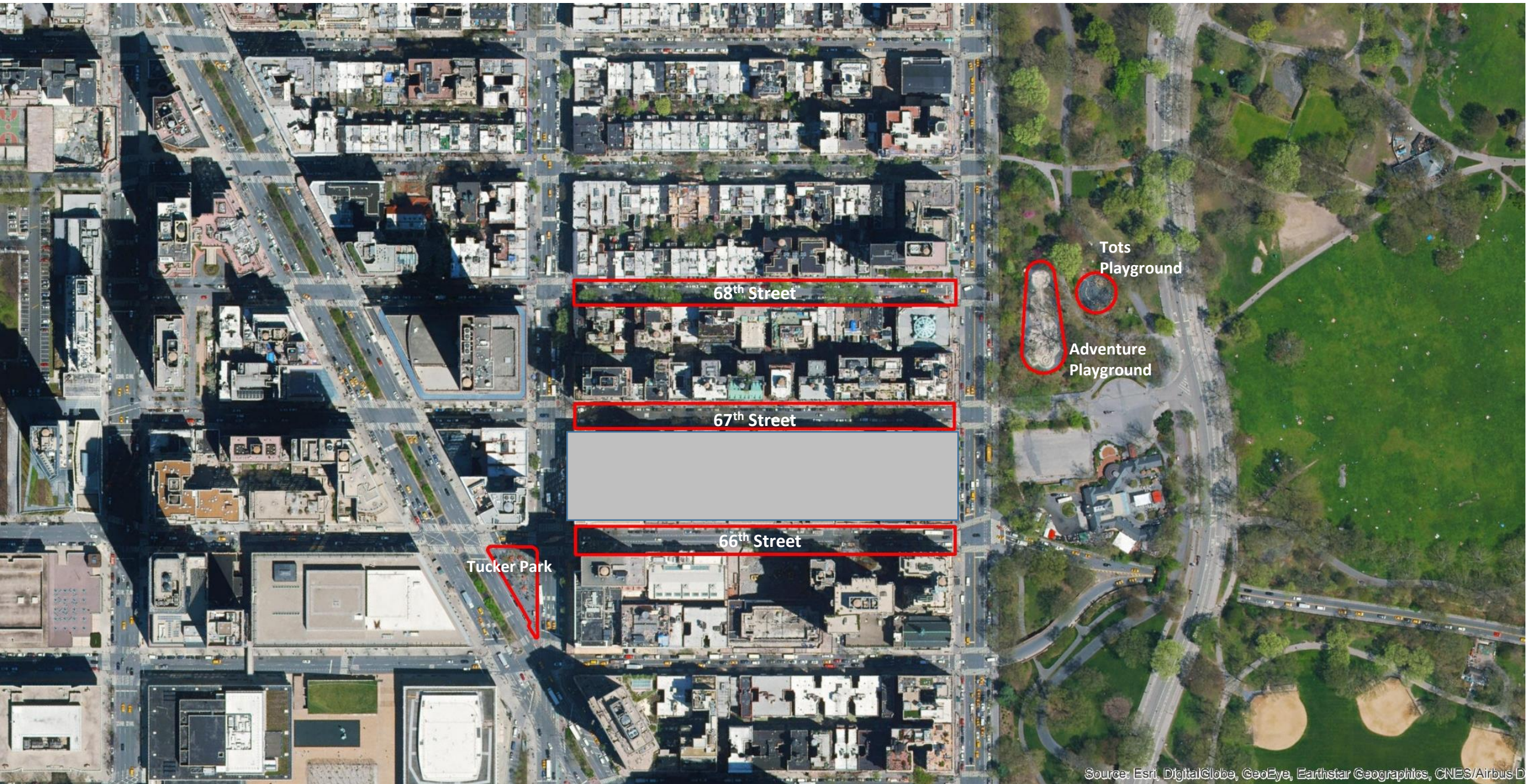


Development
with existing
zoning, phase 1



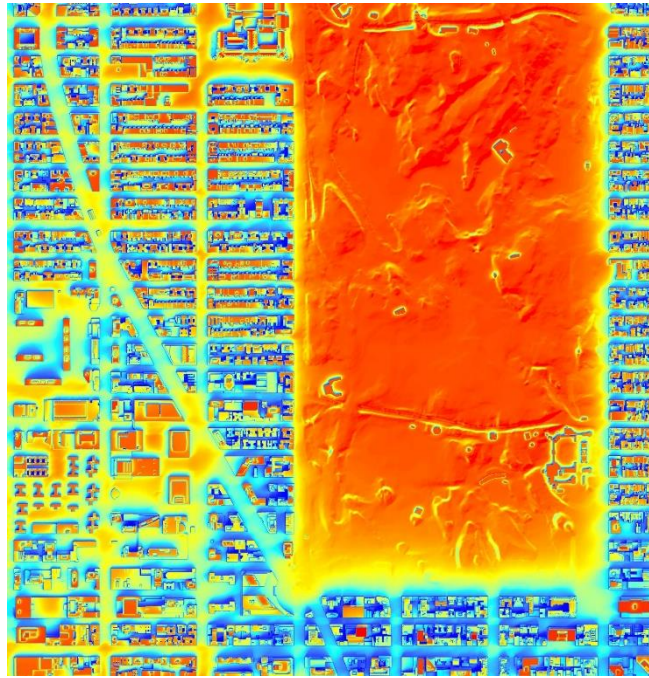
Development
with existing
zoning, built-out

In addition to a large study area, the following areas individually studied

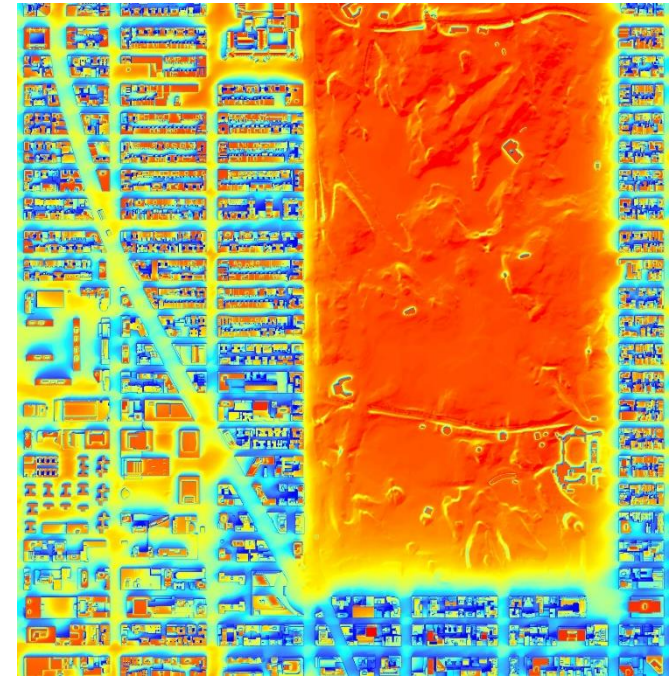


We ran the four analyses and compared the results

“Existing”
conditions on
ABC block



Tower-on-base
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Lincoln Square
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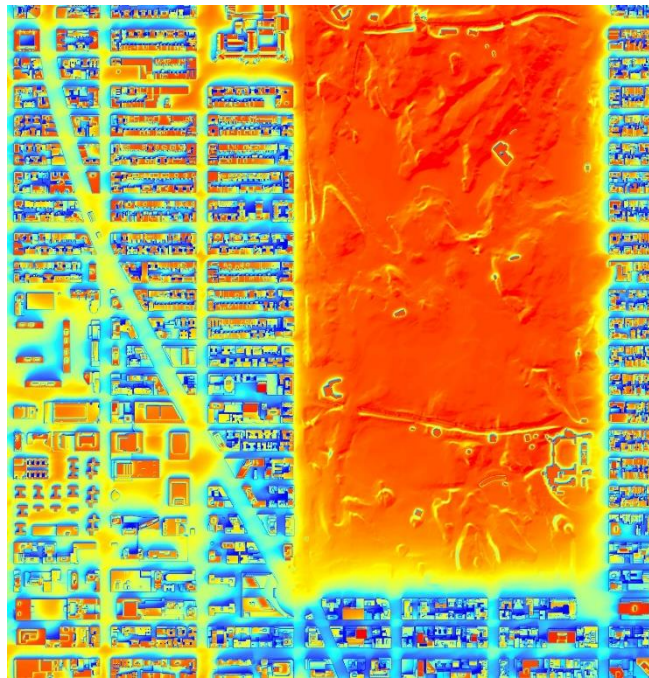
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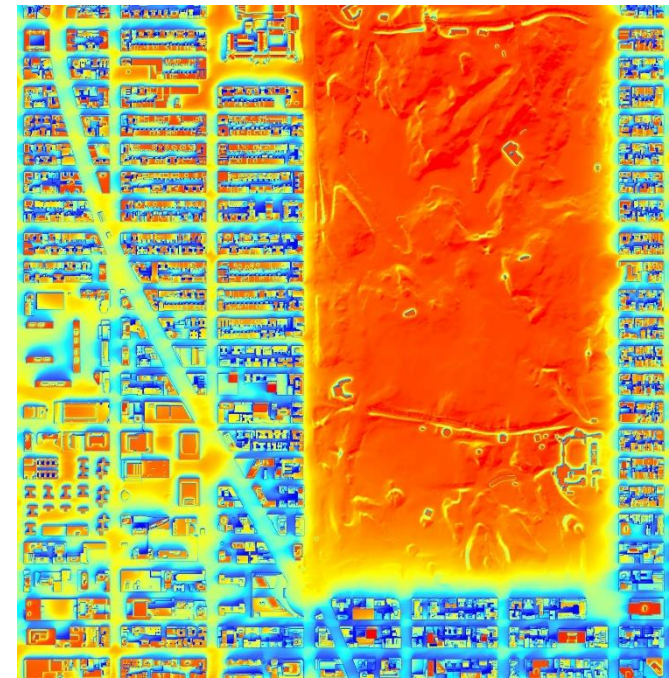
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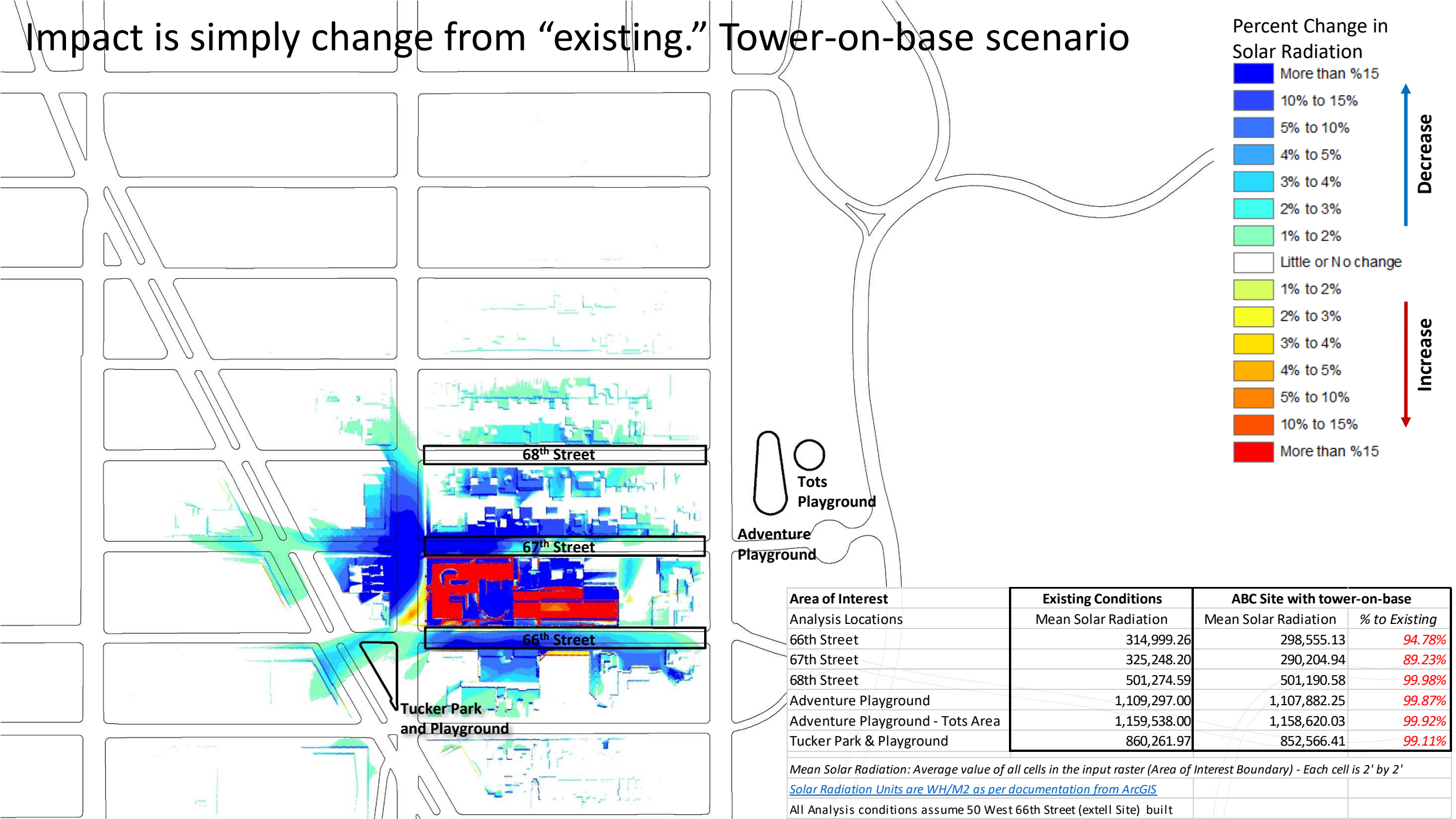
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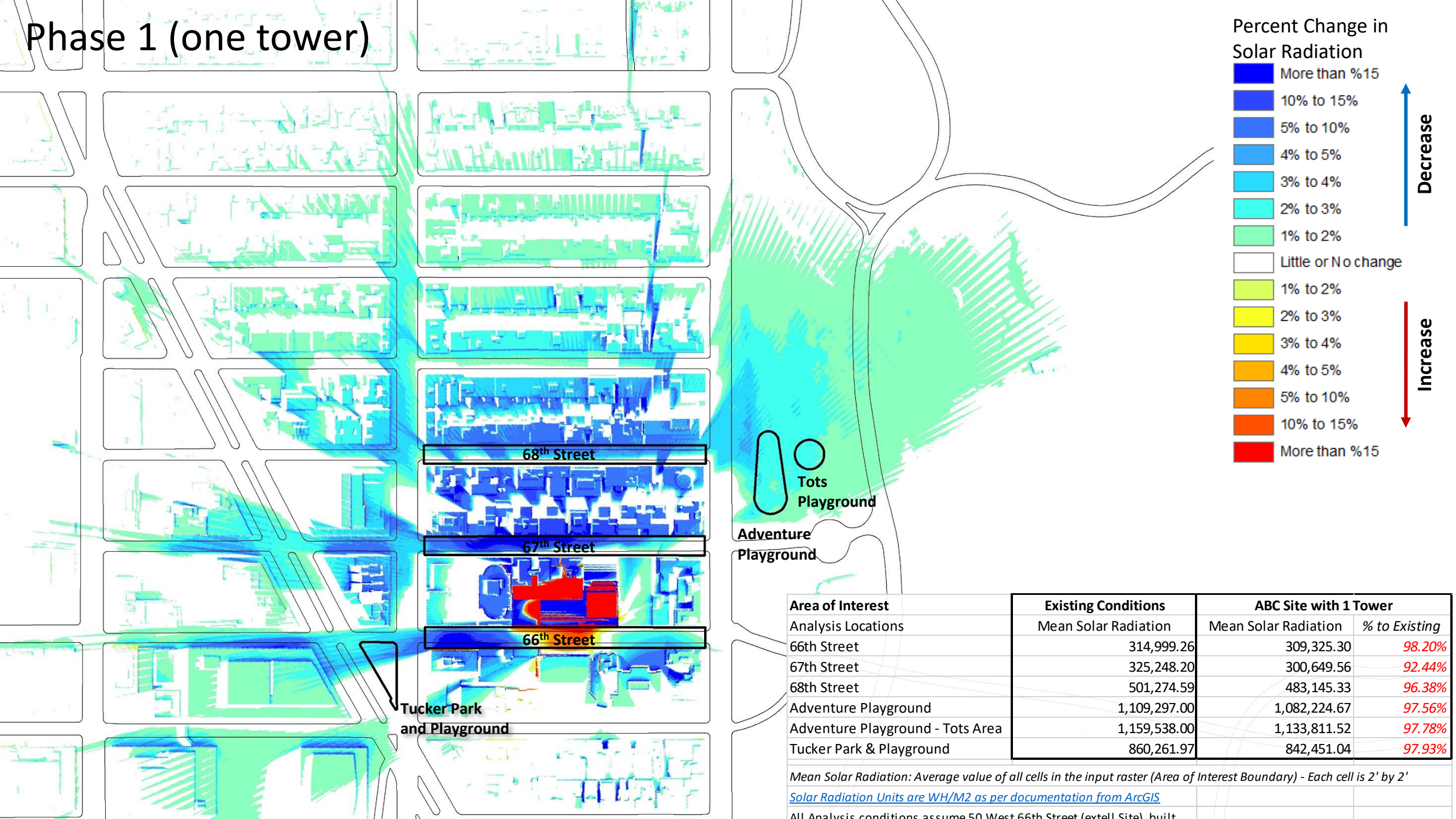
Development
with existing
zoning, built-
out



Impact is simply change from “existing.” Tower-on-base scenario



Phase 1 (one tower)



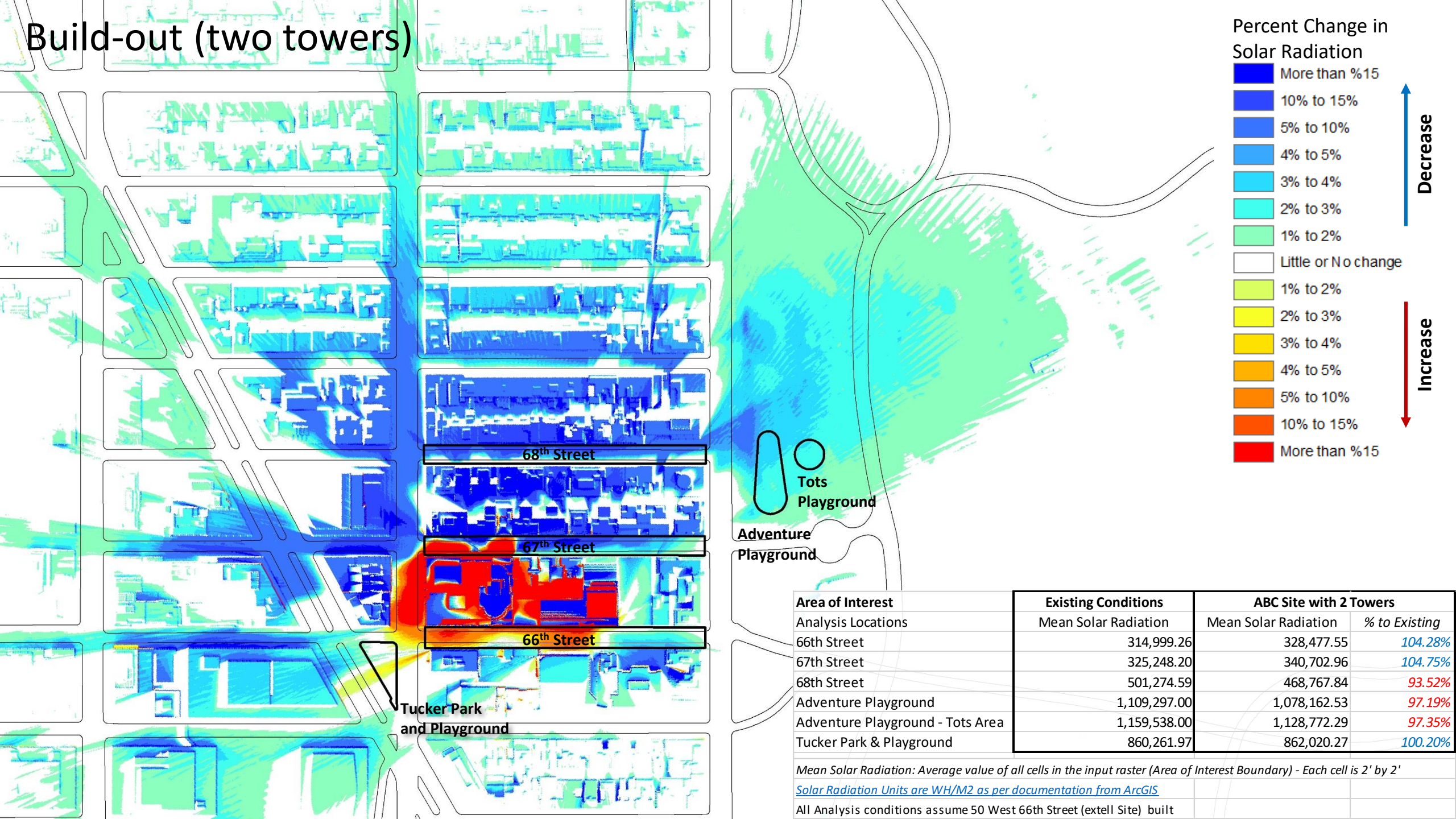
Area of Interest	Existing Conditions	ABC Site with 1 Tower	
	Mean Solar Radiation	Mean Solar Radiation	% to Existing
Analysis Locations			
66th Street	314,999.26	309,325.30	98.20%
67th Street	325,248.20	300,649.56	92.44%
68th Street	501,274.59	483,145.33	96.38%
Adventure Playground	1,109,297.00	1,082,224.67	97.56%
Adventure Playground - Tots Area	1,159,538.00	1,133,811.52	97.78%
Tucker Park & Playground	860,261.97	842,451.04	97.93%

Mean Solar Radiation: Average value of all cells in the input raster (Area of Interest Boundary) - Each cell is 2' by 2'

[Solar Radiation Units are WH/M2 as per documentation from ArcGIS](#)

All Analysis conditions assume 50 West 66th Street (extell Site), built

Build-out (two towers)



Area of Interest

Analysis Locations

66th Street
67th Street
68th Street
Adventure Playground
Adventure Playground - Tots Area
Tucker Park & Playground

Existing Conditions

Mean Solar Radiation

314,999.26
325,248.20
501,274.59
1,109,297.00
1,159,538.00
860,261.97

ABC Site with 2 Towers

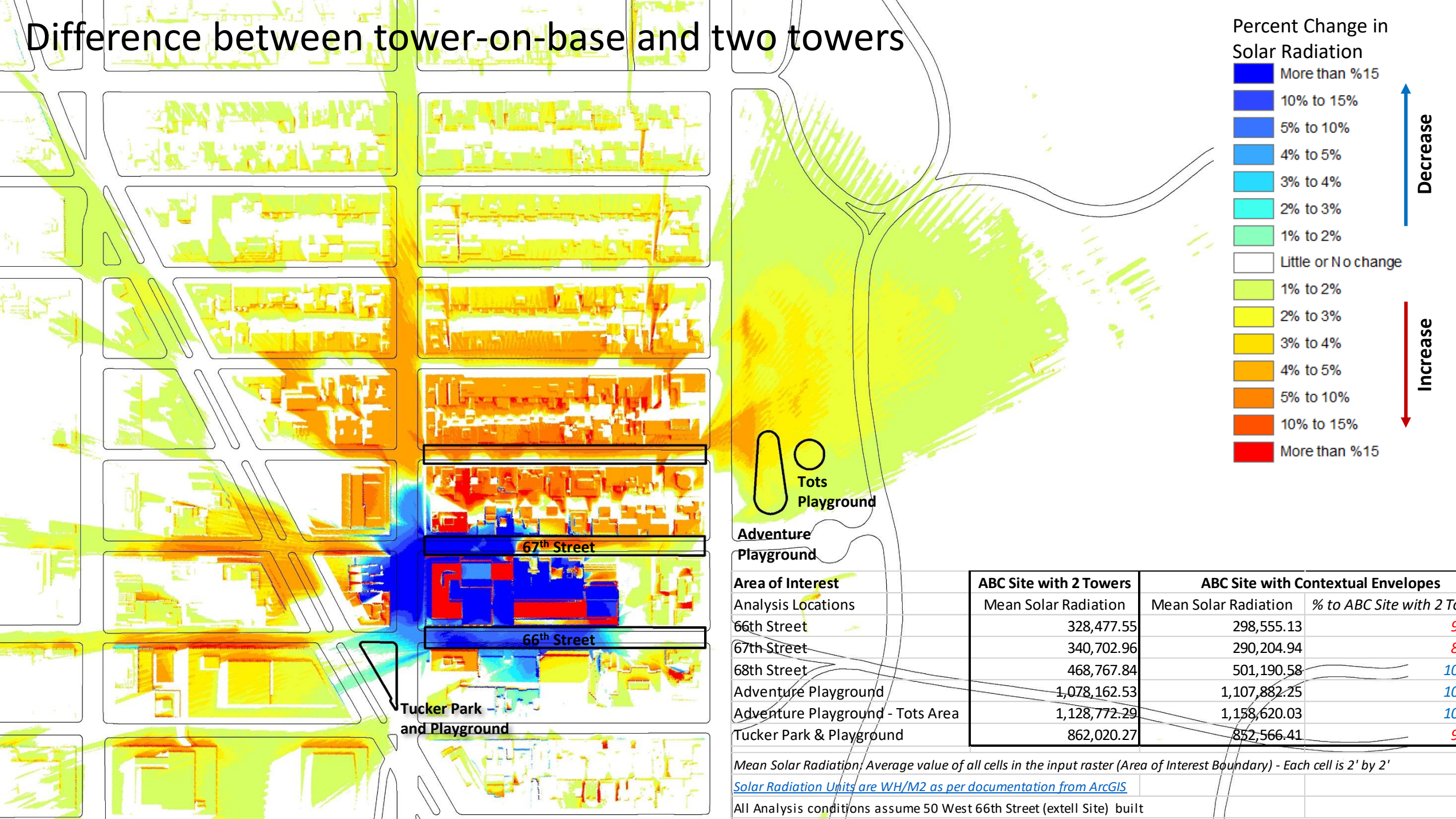
Mean Solar Radiation	% to Existing
328,477.55	104.28%
340,702.96	104.75%
468,767.84	93.52%
1,078,162.53	97.19%
1,128,772.29	97.35%
862,020.27	100.20%

Mean Solar Radiation: Average value of all cells in the input raster (Area of Interest Boundary) - Each cell is 2' by 2'

Solar Radiation Units are WH/M2 as per documentation from ArcGIS

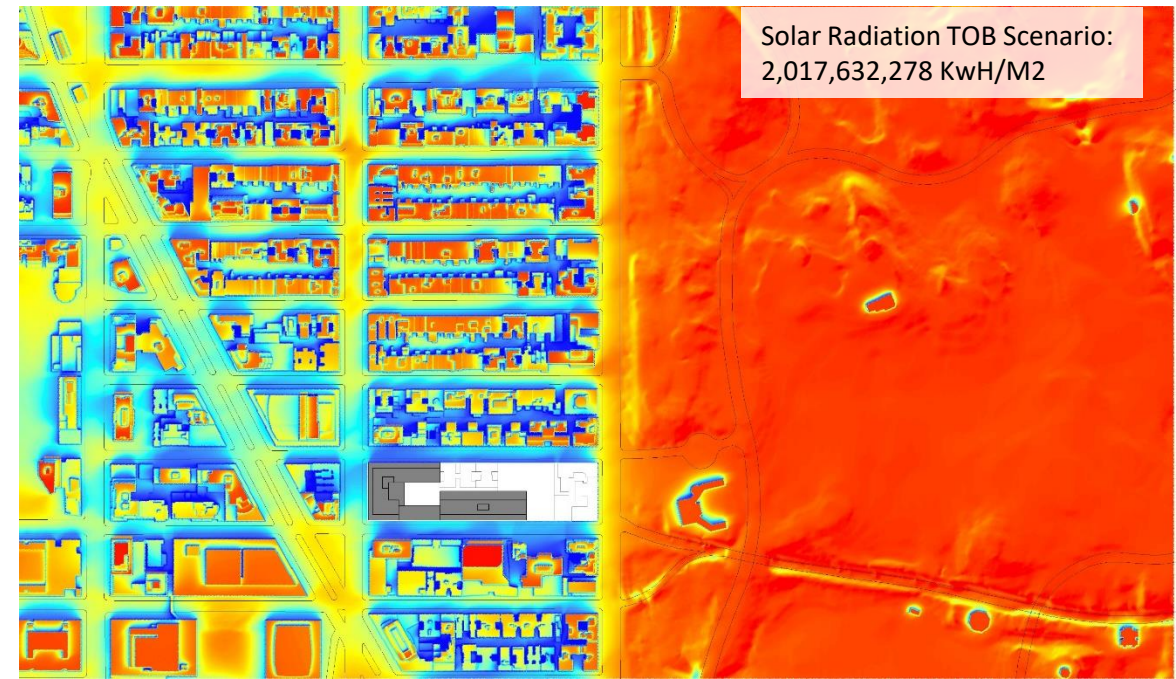
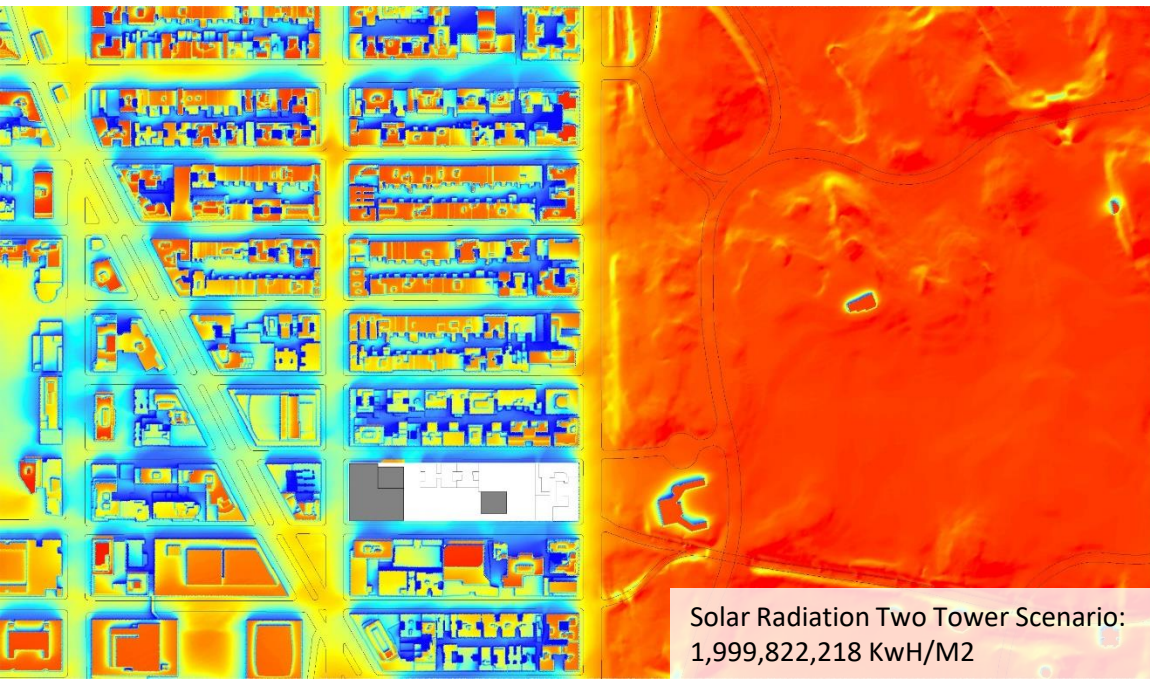
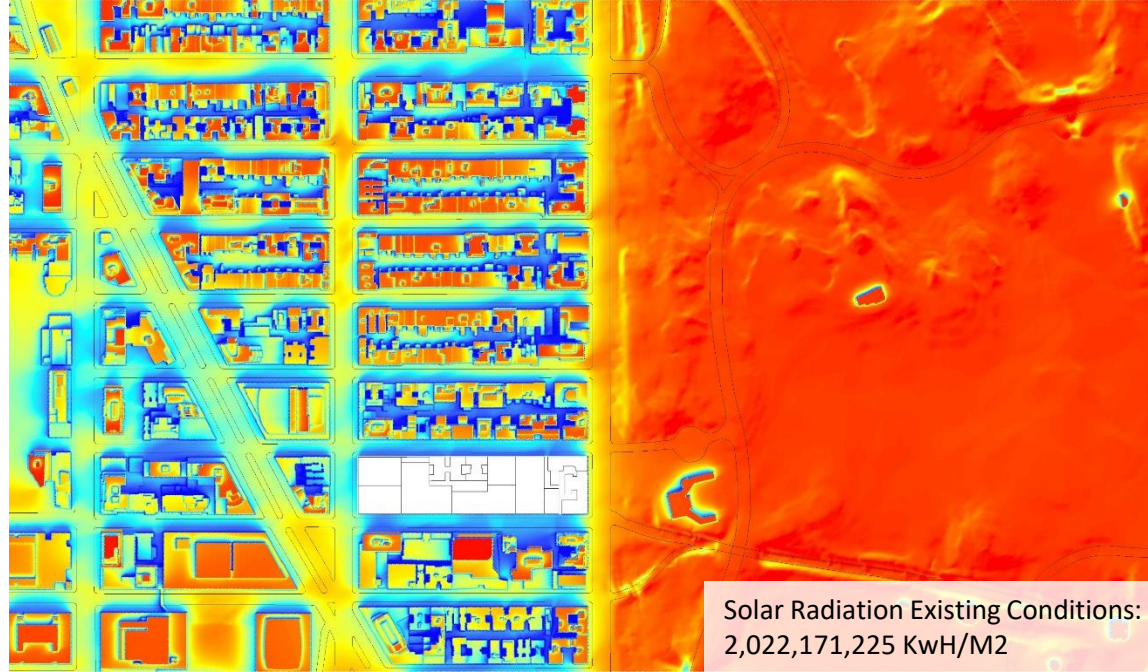
All Analysis conditions assume 50 West 66th Street (extell Site) built

Difference between tower-on-base and two towers



Some places lose, others gain, what is the net effect?

Measure light inside the ABC block and outside the ABC block



Solar energy & light that would otherwise hit the ground is taken by the towers. Total daylight is constant, so losses here mean gains there: **Ignoring reflectivity, daylight is zero sum**

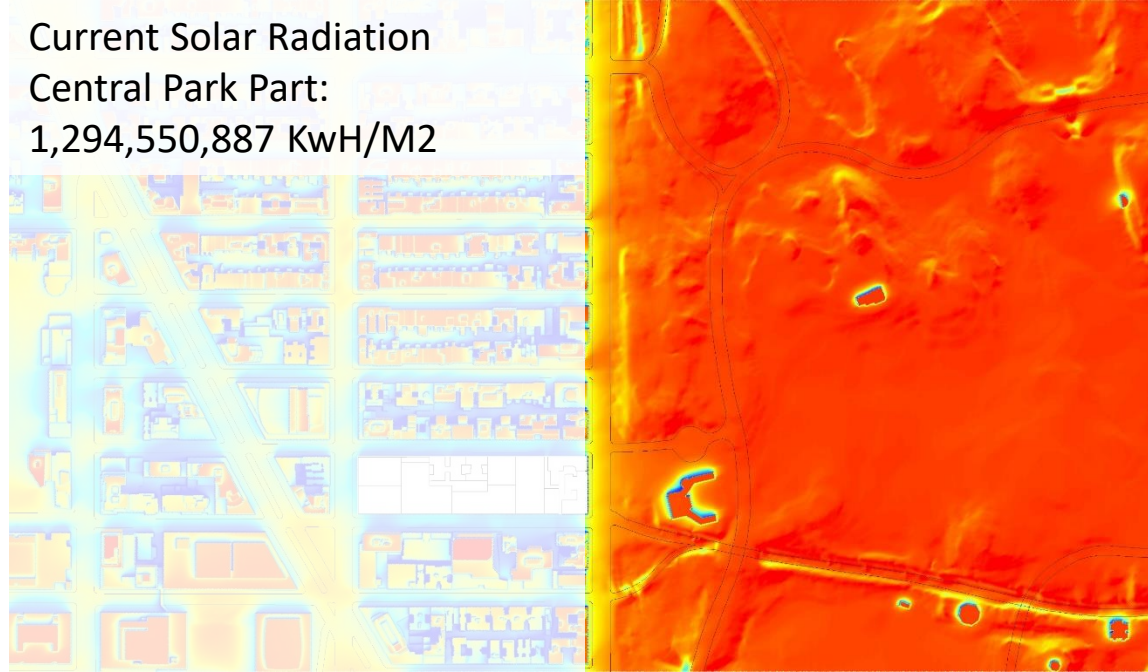
- Inside the ABC block, light and energy goes up substantially
- Outside the ABC block, the two tower scenario reduces light and energy received by 22,349,007 Kwh/M²
- The tower-on-base scenario reduces energy and light outside the ABC block by just 4,538,947 Kwh/M²
- In other words, **the supertalls take 5 times as much light from the neighborhood than the tower-on-base**

But what does that mean? Percent loss isn't very large

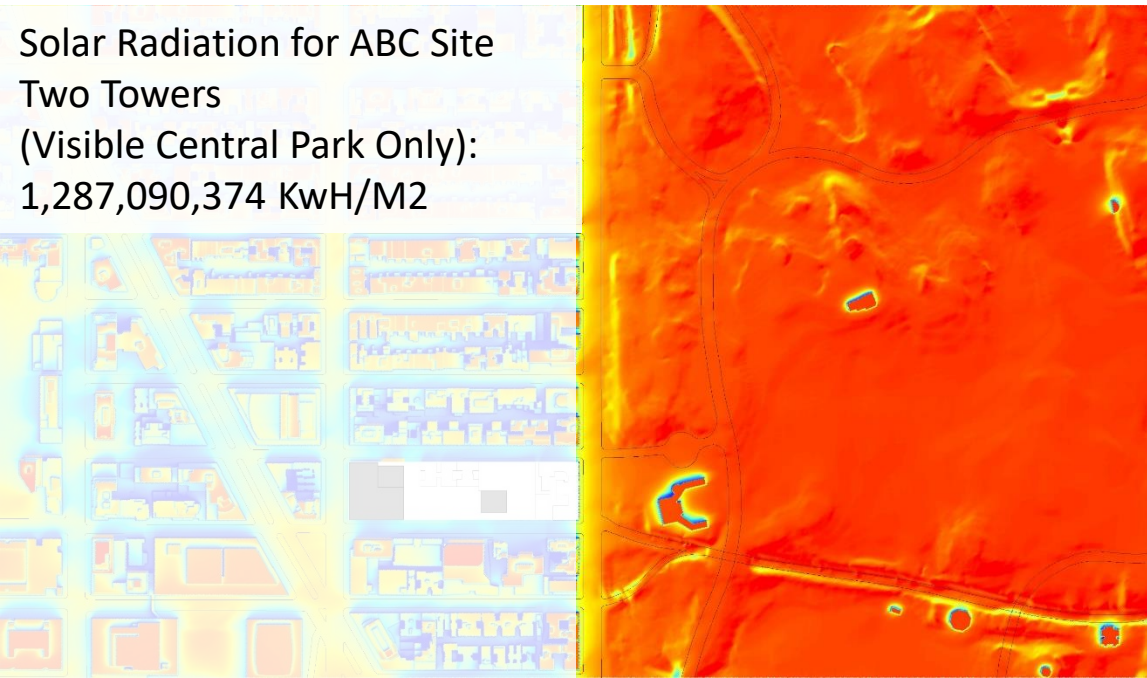
- About 17,810,060 Kwh/M2 more energy is lost to the neighborhood with two supertall towers
- The area studied is 859,980 square meters, which means that each square meter loses on average 20.7 kilowatts hours of energy over the course of a year. That doesn't seem like much, but . . .
- ConEd retail electrical rates average about \$0.21 per kilowatt hour
- There are 859,980 square meters impacted
- That means **the value of the energy taken by the towers is \$3,738,333** over a year. That's over \$10,000 worth of energy every day

**If we do the same
calculations on the
Central Park portion
of the study area . . .**

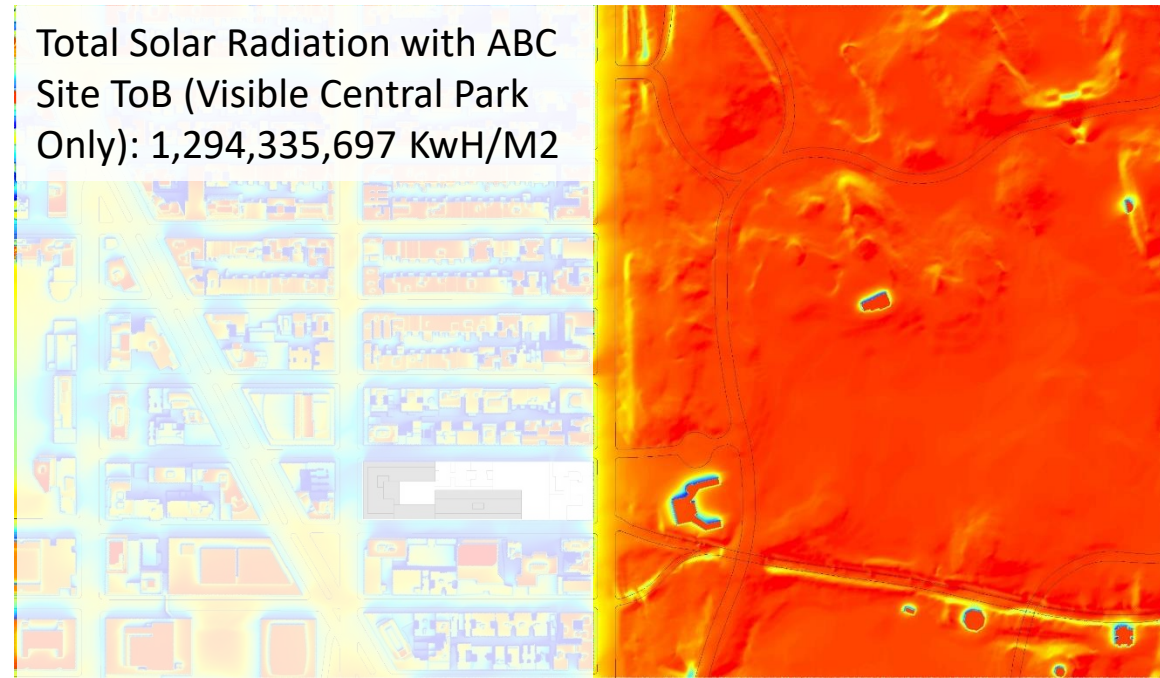
Current Solar Radiation
Central Park Part:
1,294,550,887 Kwh/M2



Solar Radiation for ABC Site
Two Towers
(Visible Central Park Only):
1,287,090,374 Kwh/M2



Total Solar Radiation with ABC
Site ToB (Visible Central Park
Only): 1,294,335,697 Kwh/M2



We see Central Park losing less energy in absolute terms, but the difference between the forms is substantial

- The two tower scenario takes 7,460,513 Kwh/M2 from the Park compared to just 215,190 Kwh/M2 for the tower-on-base (TOB) scenario
- The two tower scenario takes **35 times** more light and energy from the Park than the TOB scenario and the difference is 7,245,323 Kwh/M2
- The Park portion of the study area is 419,640 square meters, which means that each square meter of park loses, on average, 17.3 kilowatts hours of energy over the course of a year.
- The **value of the energy taken by the towers that would otherwise go to the Park is \$1,524,552** over a year

Findings

- The mantra that towers are good for light is common, but it is also not entirely accurate: Towers are better for light nearby, but negatively impact daylight over a large area
- Height really does matter to daylight. The TOB scenario show large buildings (over 300 feet tall), but there are still big differences compared to the supertalls
- Building form really does matter: Tower-in-the-park developments perform very well
- When measuring amount of light, orientation matters: Most daylight comes from direct sun and the largest impacts are to the north
- Even though they are to the west, the two tower scenario measurably impacts Central Park. The supertalls on 57th Street will be / are having a much larger impact



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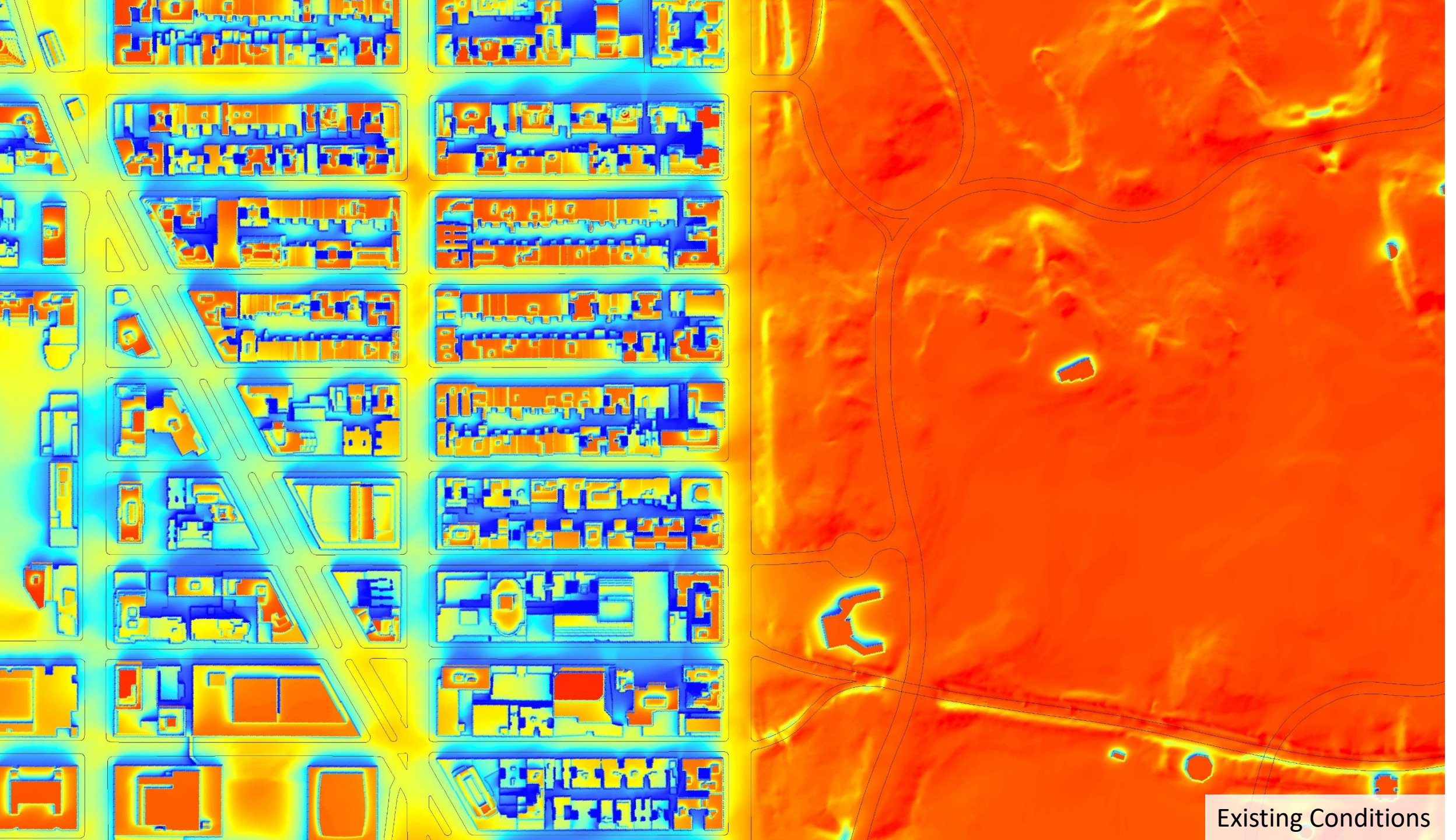
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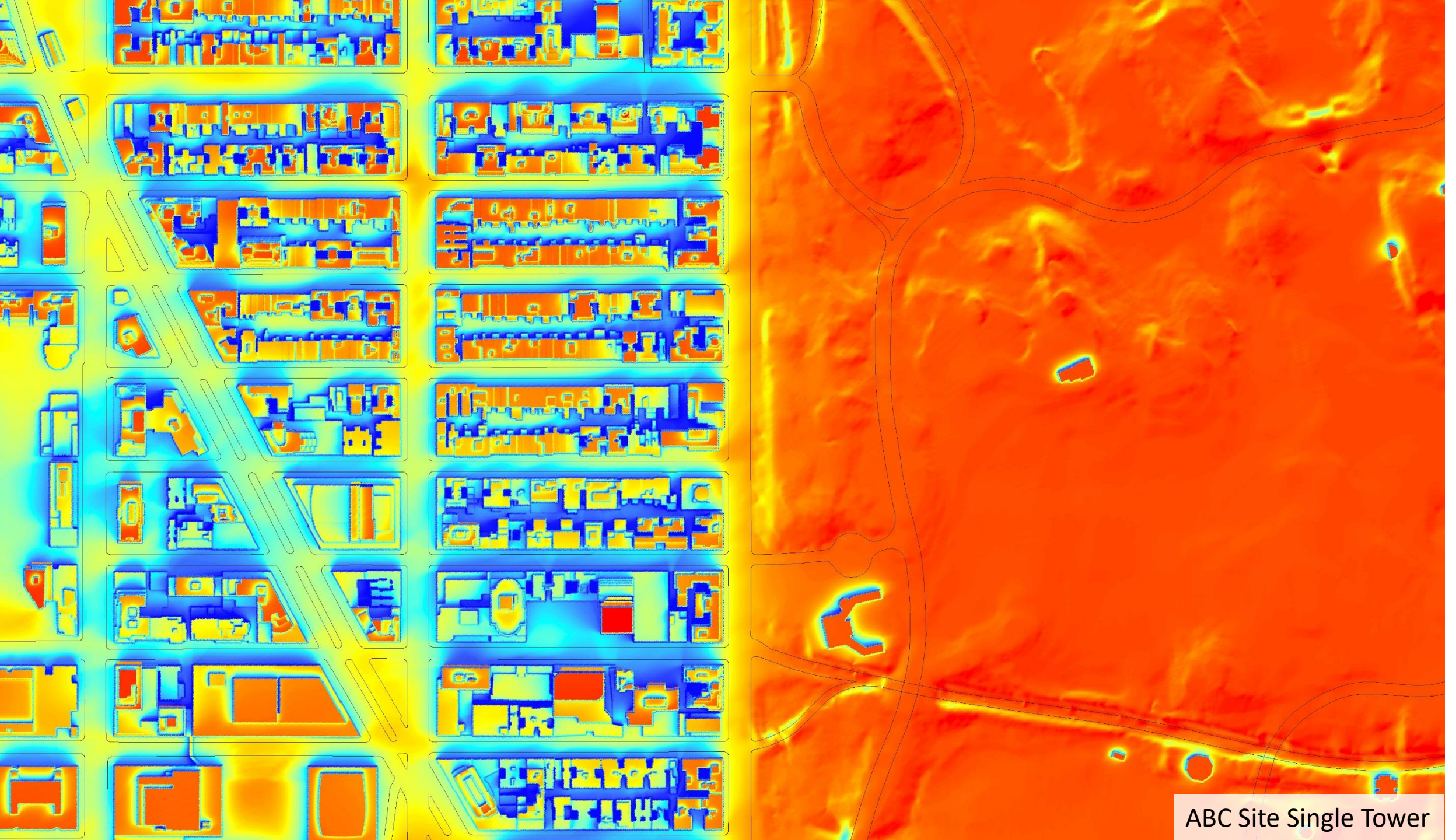
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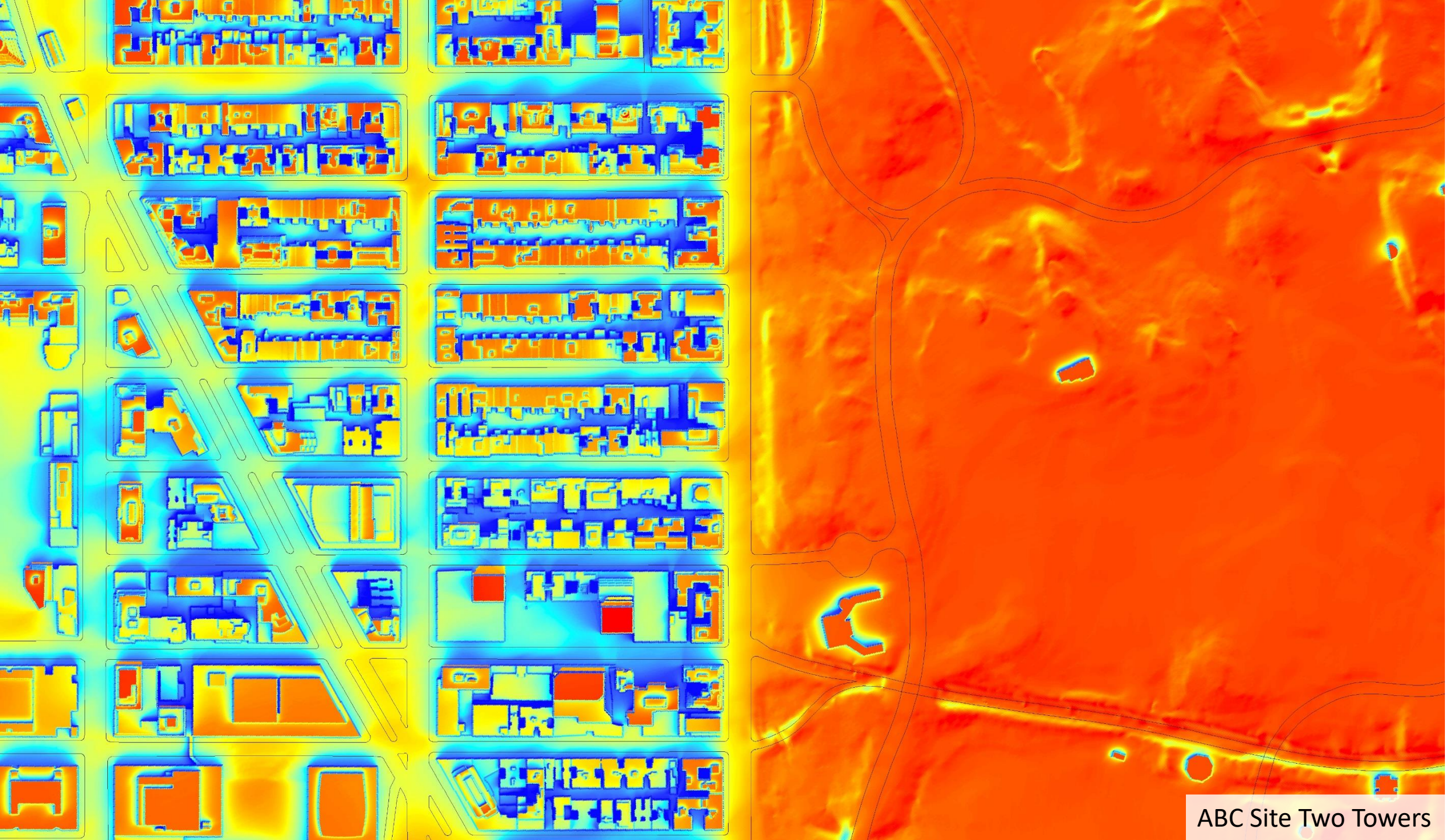
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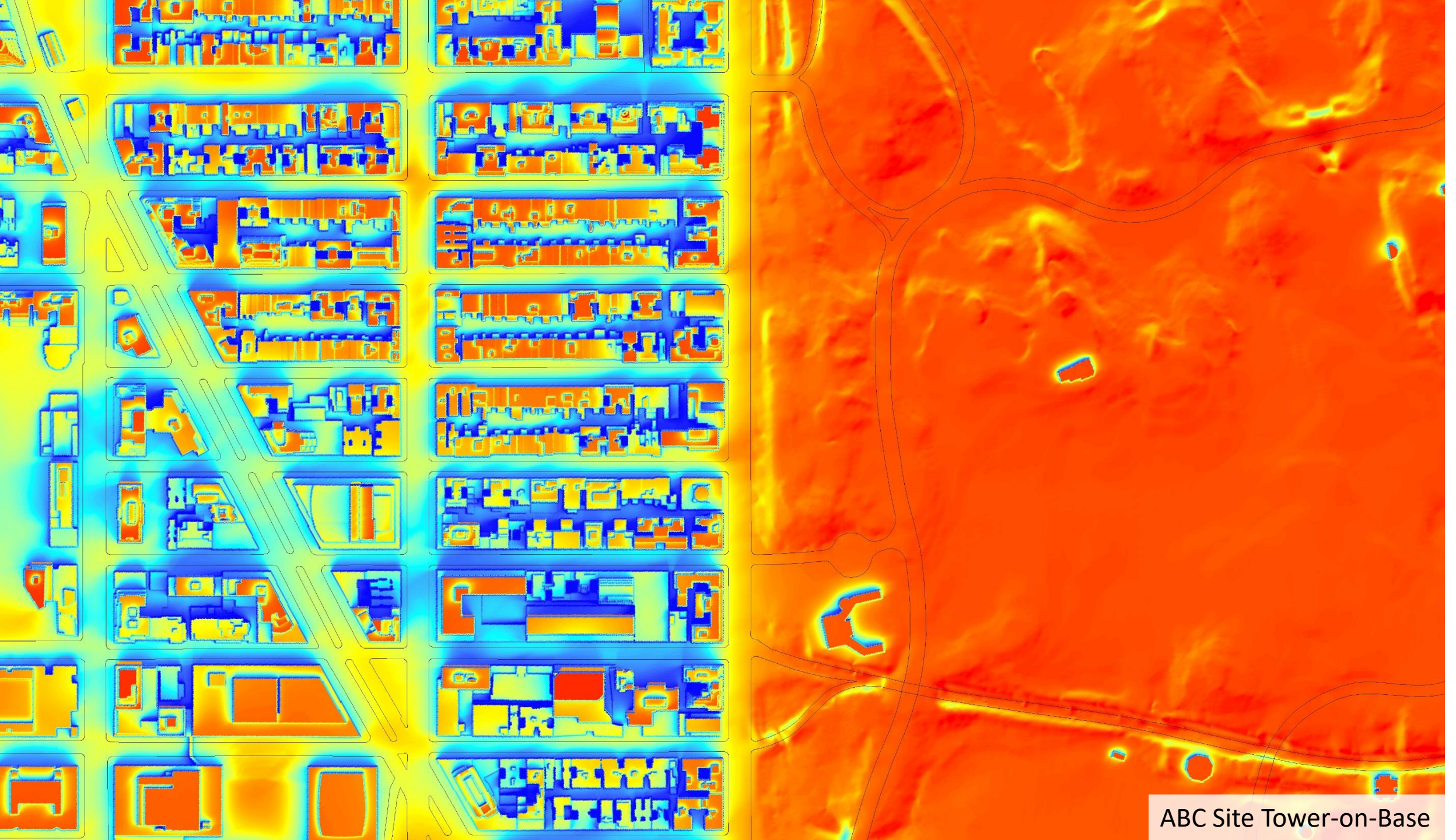
Existing Conditions



ABC Site Single Tower



ABC Site Two Towers



ABC Site Tower-on-Base