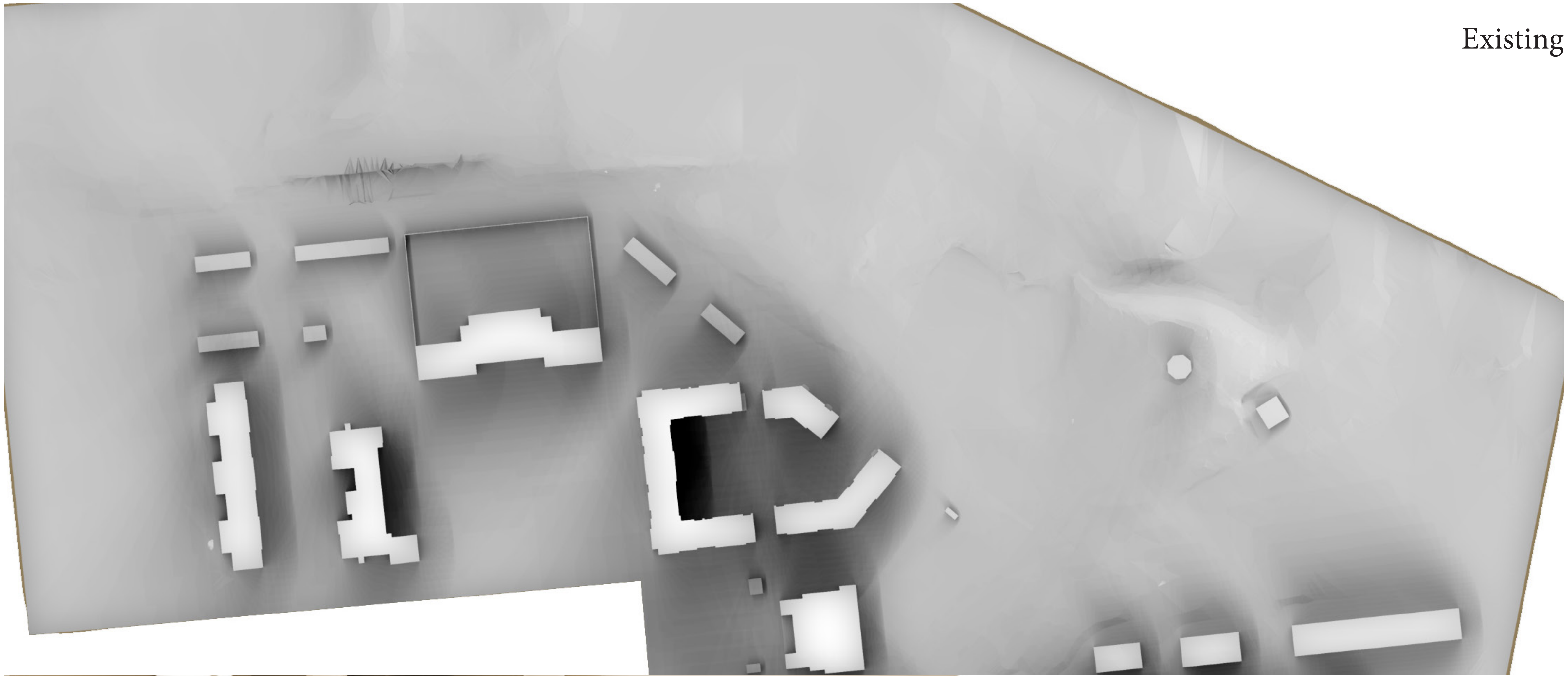
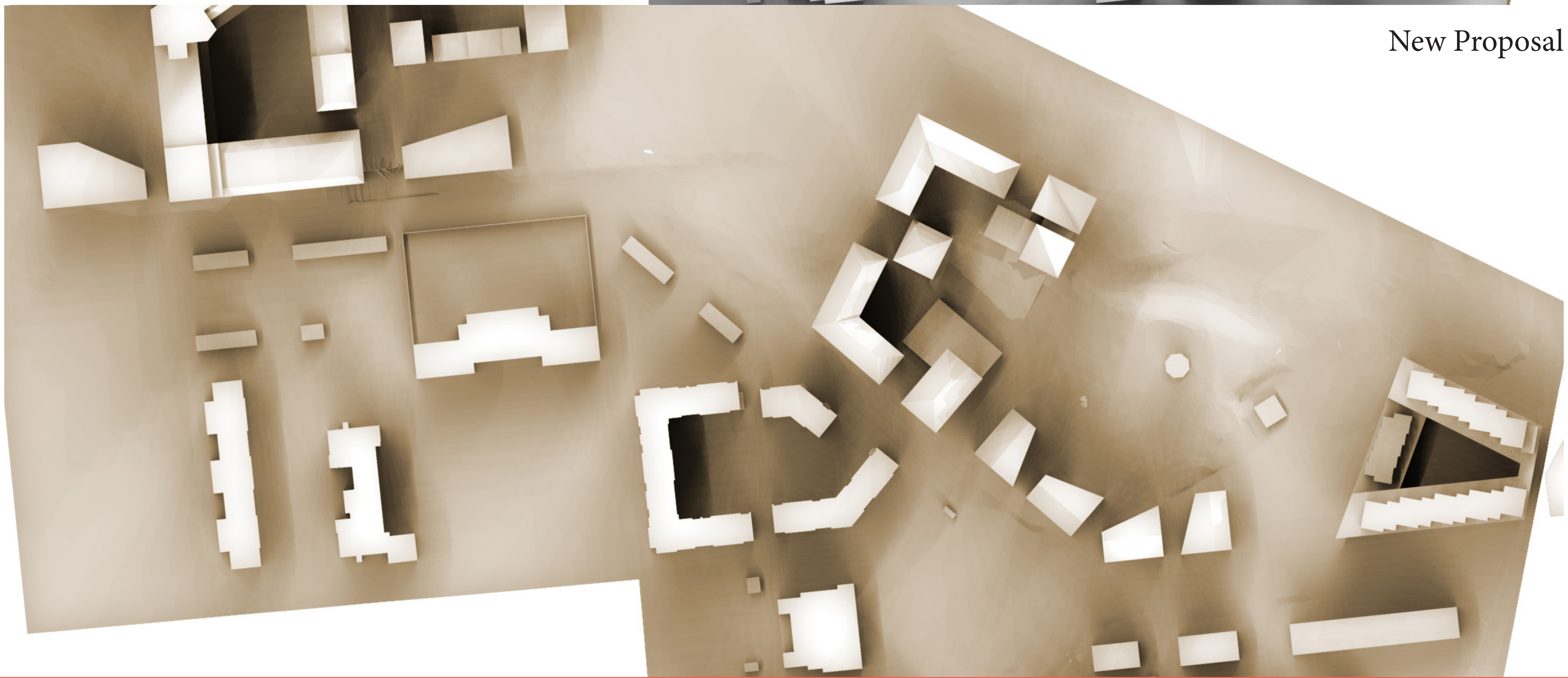
Ulleråker project

Daylight and Sun Study

2018-03-20





Shadow Range Analysis from sunrise to sunset on 21st of June for existing condition and new proposal.

Quality:

- Continuous spectral power distribution and excellent colour rendering
- Variation (CCT and intensity) through the day and seasons
- High light levels available, ...

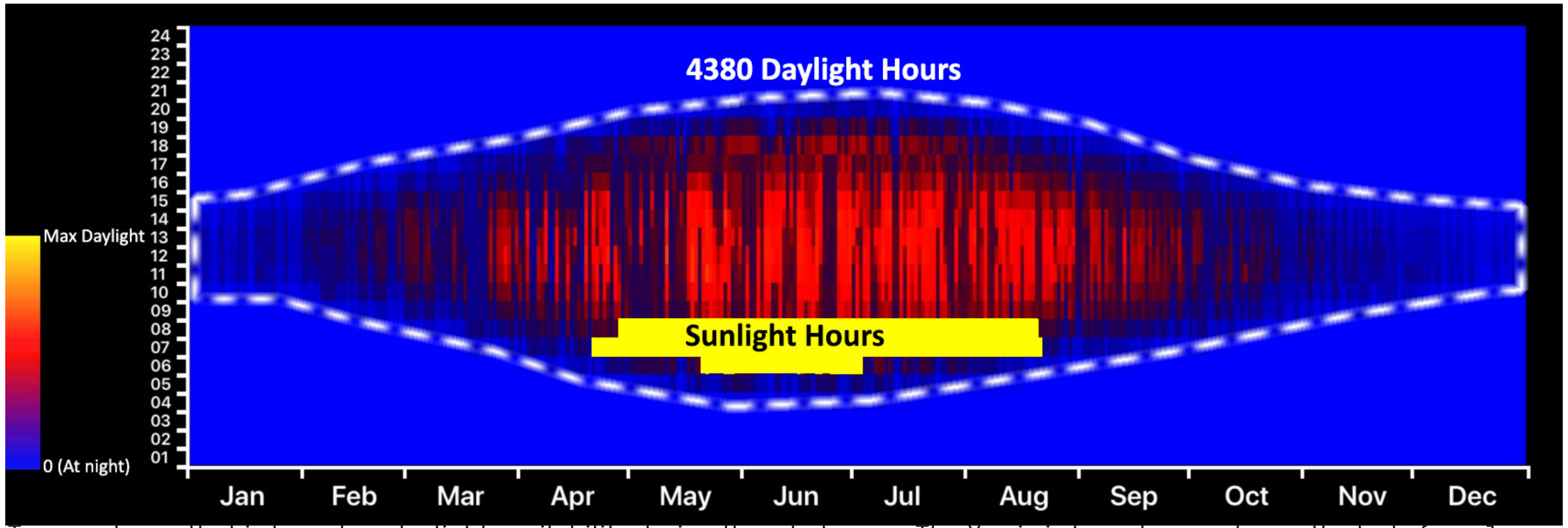
Health:

- Circadian regulation, adjusting our body clock
- Human wellbeing, increased alertness, productivity and visual performance
- Importance of view and contact with outside world
    - Knowledge of weather and time of day
    - Relief from feelings of monotony or boredom
    - A change of visual focus
    - Satisfaction (home/job) and decreased intention to quit, ...

Energy:

- Daylight is a free source of energy
- Daylight is wireless
- Well-planned daylighting can significantly reduce energy consumption in electric lighting in a building, ...

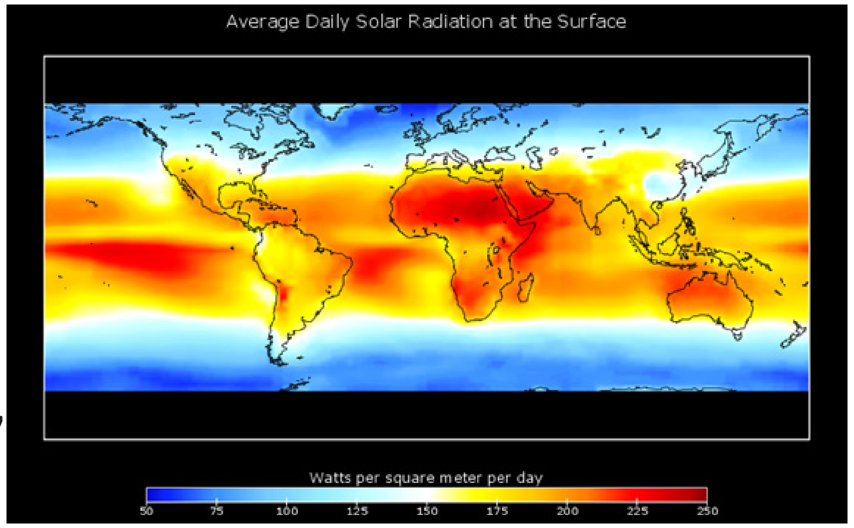
Here in this project, we did 3 types of daylight analyses. Each was done for a specific need. In the following we discuss them shortly. The first is **Sunlight Hours** analysis. Here we did 2 types of sunlight Hours analysis. The first type (see the pages 4-7) is based on considering the whole year sunny and check how many hours in a year (in comparison with 4380 daytime hours in a normal year) each point in the space can face direct sunlight. We did this analysis when we want to define where is the appropriate places for streets, parking lots, bicycle path, etc.



Temporal map that is based on daylight availability during the whole year. The X axis is based on each month starts from January until December. However Y axis is a 24 daily hours from midnight to midnight. The above image is a map for Stockholm. The yellowish part shows which part of year (from 4380 daylight hours) the selected point in the space can face direct sunlight

However the other type (see the pages 8-11) that we used here is doing Sunlight Hours study only for the time of a year that we feel comfortable temperature when we are outside. Such analysis based on UTCI calculation formula and it is based on the weather data from Arlanda airport weather station. Such weather data represents the prevailing conditions of the place and is created based on on-site measurement over a period of years. This analysis can help us to find where is the best place to sit, play or walk during those time of year that we enjoy to be outside.

The third and last analysis (see the pages 12-15) that we did here is the **Solar Radiation** analysis that is based on how much solar radiation is falling on a surface. The same as UTCI based Sunlight Hours study, this analysis is also based on weather data that is extracted from Arlanda station. Here in this project, we used this type of analysis to define the suitable green areas. Therefore, we used the whole year Solar Radiation to check where is the best place to grow trees, bushes or vegetables.

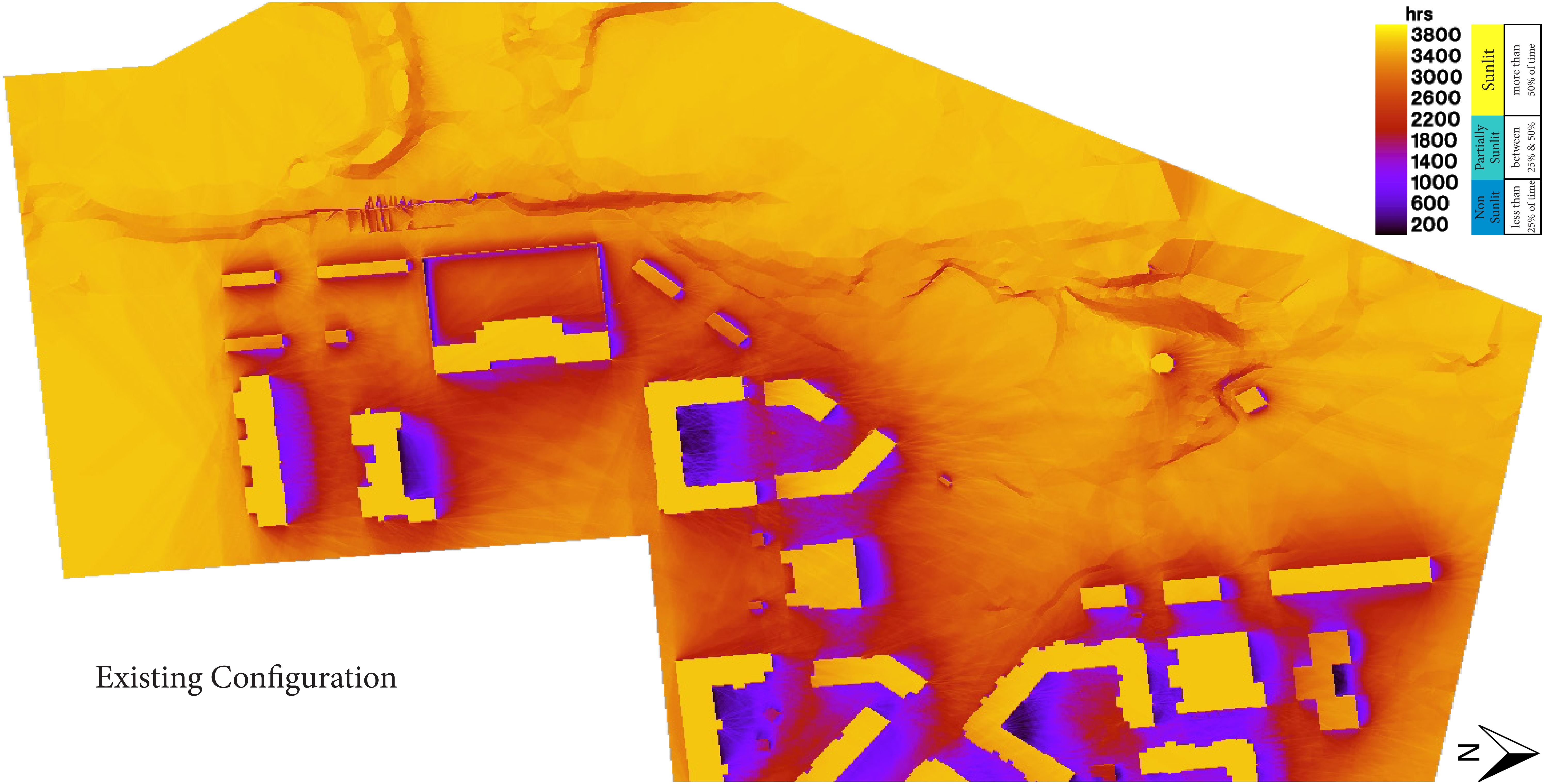


Annual Sunlight Hours

SWECO

This kind of analysis calculates total sunlight hours (considering the whole year sunny) that each interested point is supposed to get during a specific or in a yearly period (in comparison with 4380 daytime hours in a normal year).

This type of analysis gives us information to find out where the most problematic areas regarding glare or excess heat are, while it also shows where is potentially good for placing a children play ground, pedestrian walkways, or parking lots.



Existing Configuration

Annual Sunlight Hours

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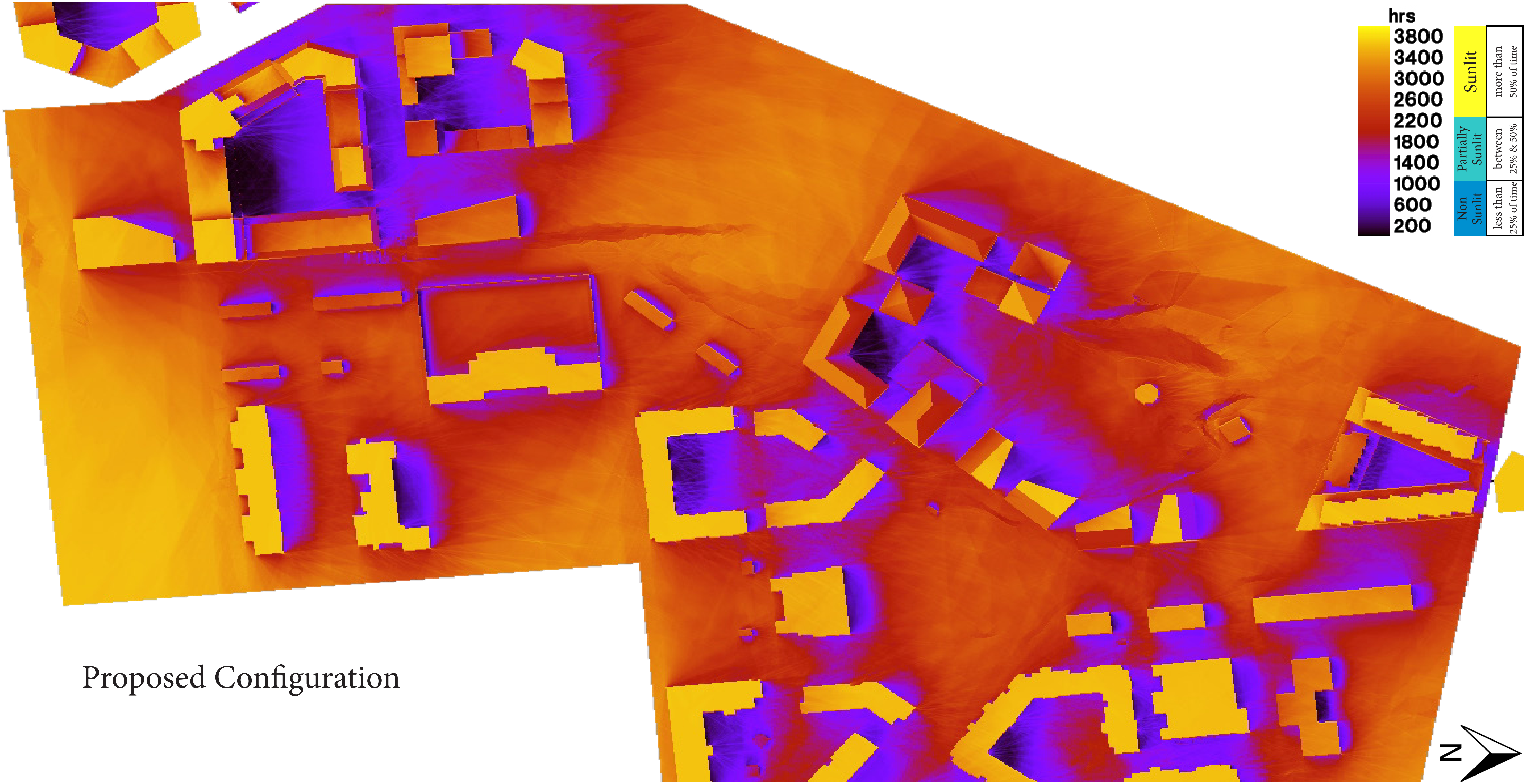

Proposed Configuration

Annual Sunlight Hours

SWECO

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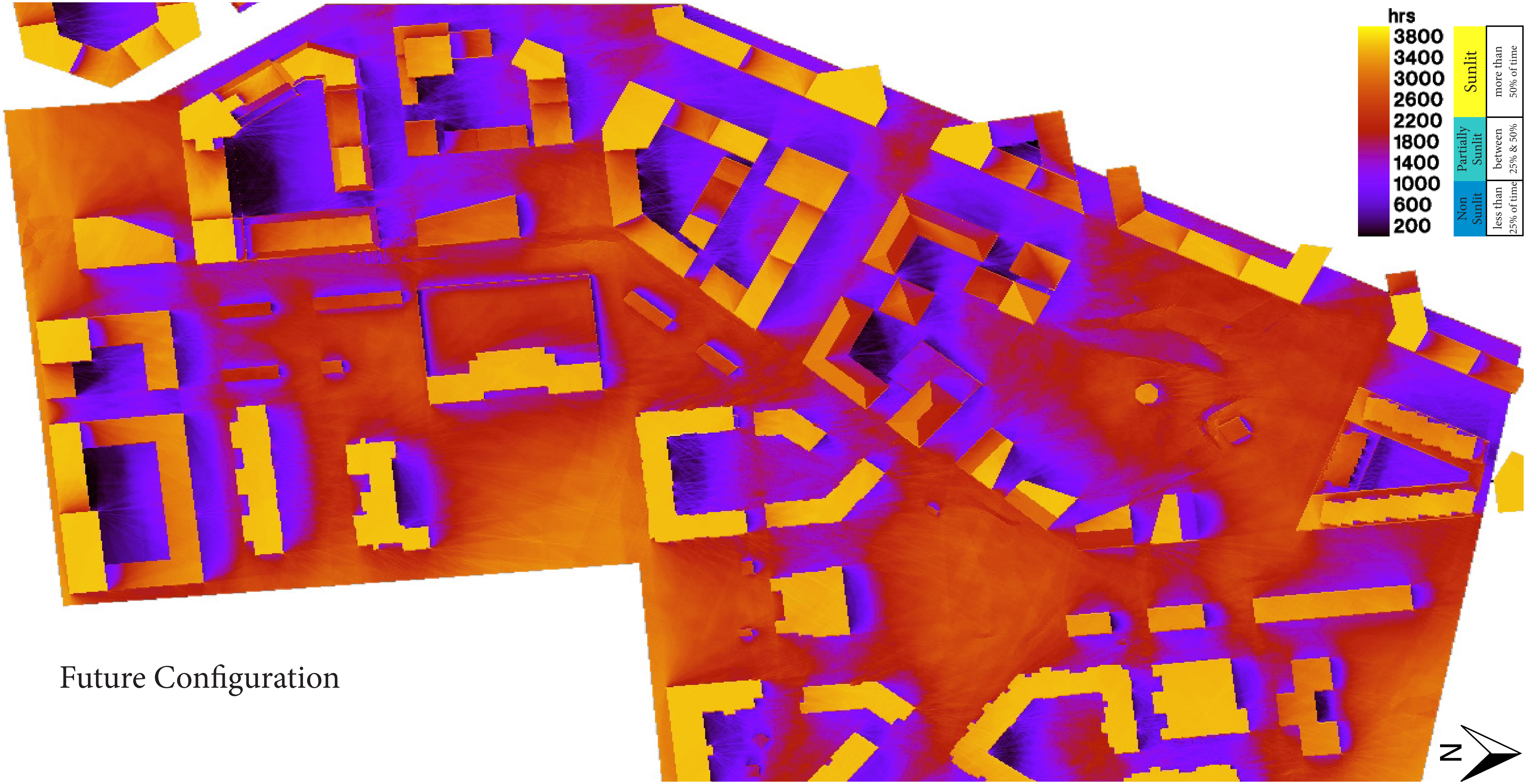
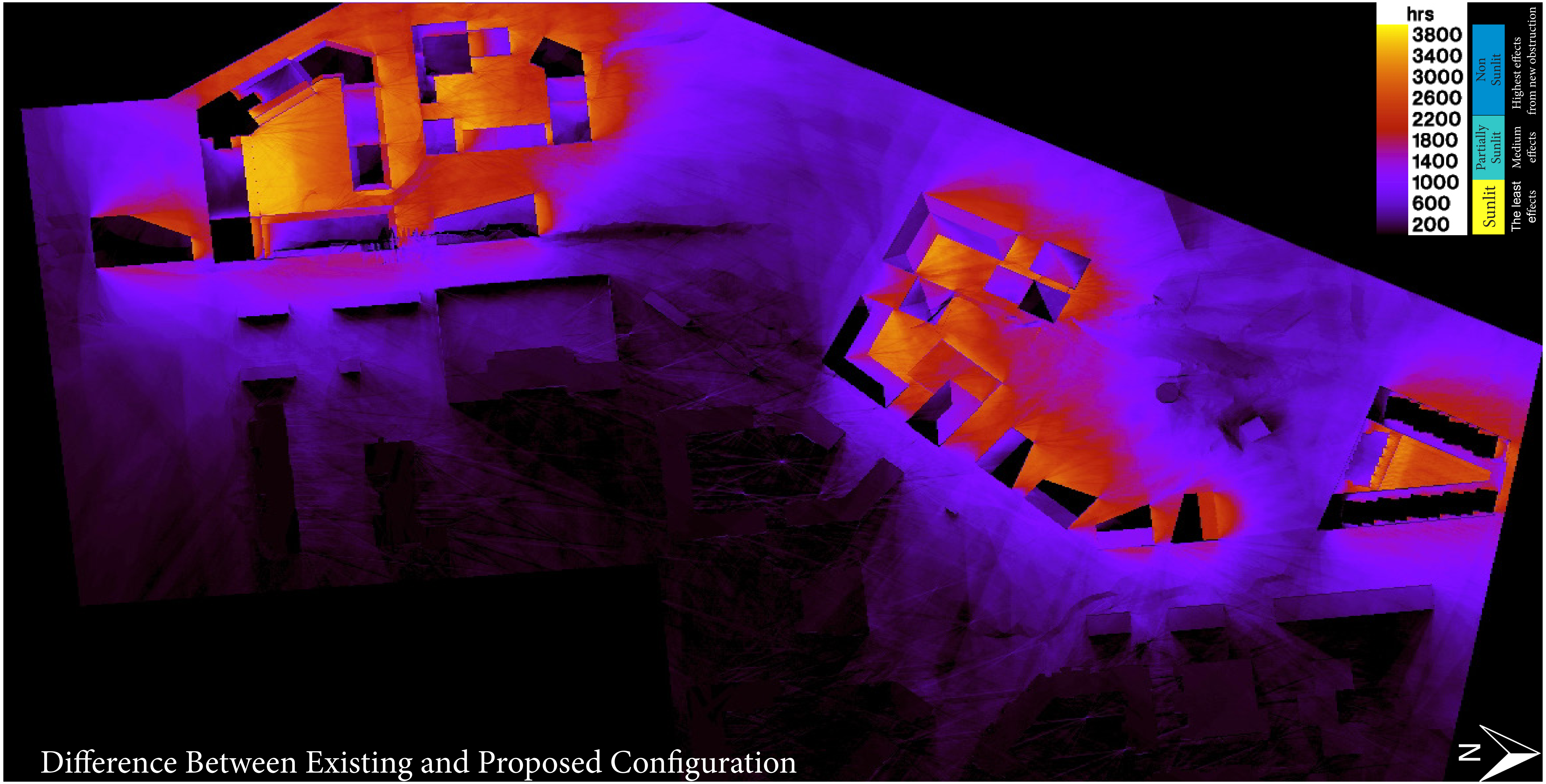


Future Configuration

Annual Sunlight Hours

This kind of analysis calculates total sunlight hours (considering the whole year sunny) that each interested point is supposed to get during a specific or in a yearly period (in comparison with 4380 daytime hours in a normal year).

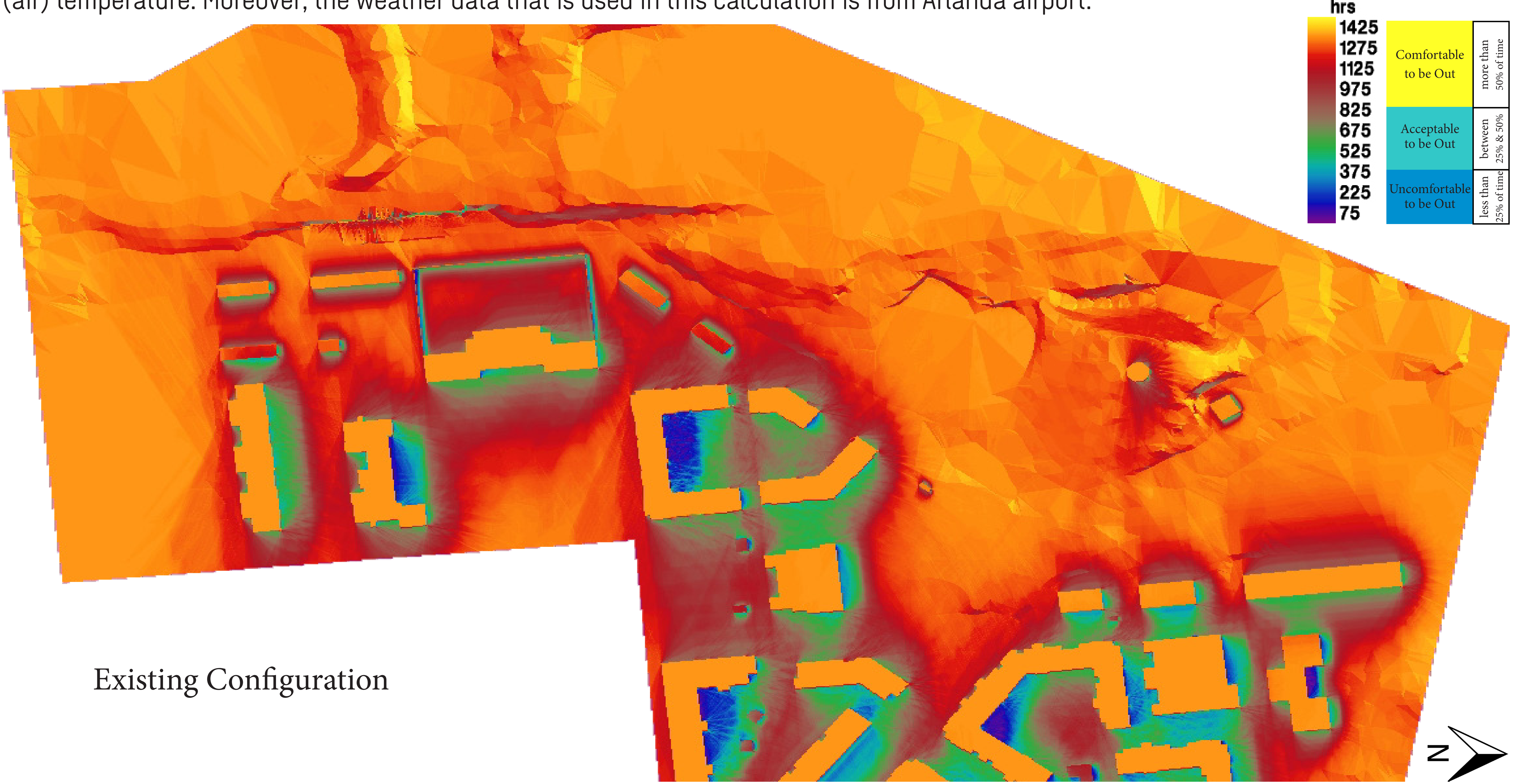
In this page, what we see is the Annual Sunlight Hours subtraction of the new proposal from the exiting condition. So, the higher value (toward yellowish color) in this map means that that part of space recevies much less sunlight hours when the new buildings are added.



Difference Between Existing and Proposed Configuration

UTCI based Annual Sunlight Hours

UTCI (Universal Thermal Climate Index) is the temperature that weather forecast media used when they say that the temperature "feels like" something higher or lower than the actual outside dry bulb temperature. Here, in the below image, what is done is based on firstly finding the comfortable outside temperature for the whole year and then doing the sunlight hours study for all those hours that people enjoy to be outside. To be able to do this calculation for the whole year we assume that the mean radiant temperature is equal to dry bulb (air) temperature. Moreover, the weather data that is used in this calculation is from Arlanda airport.



Existing Configuration

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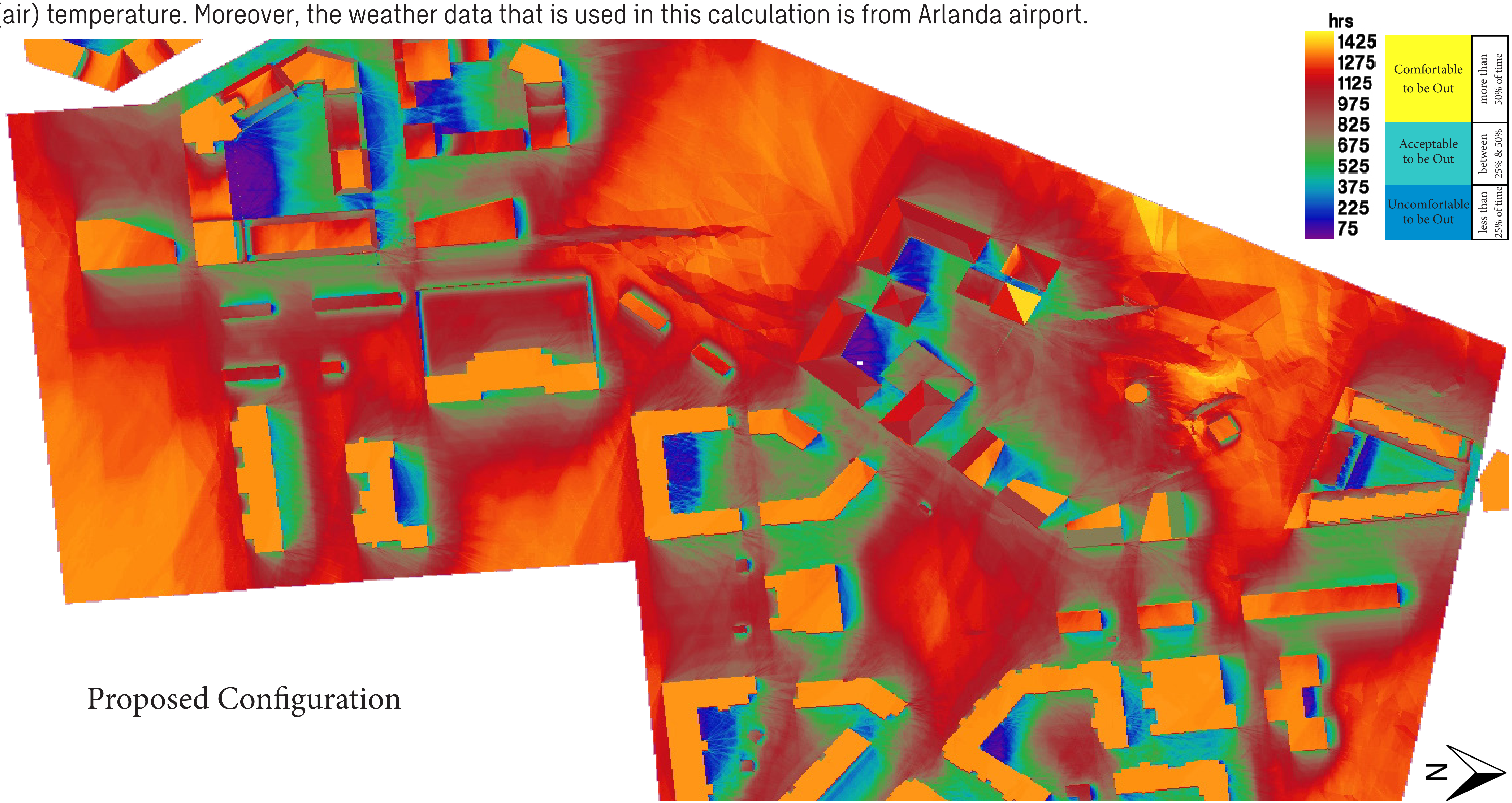

Proposed Configuration

UTCI based Annual Sunlight Hours

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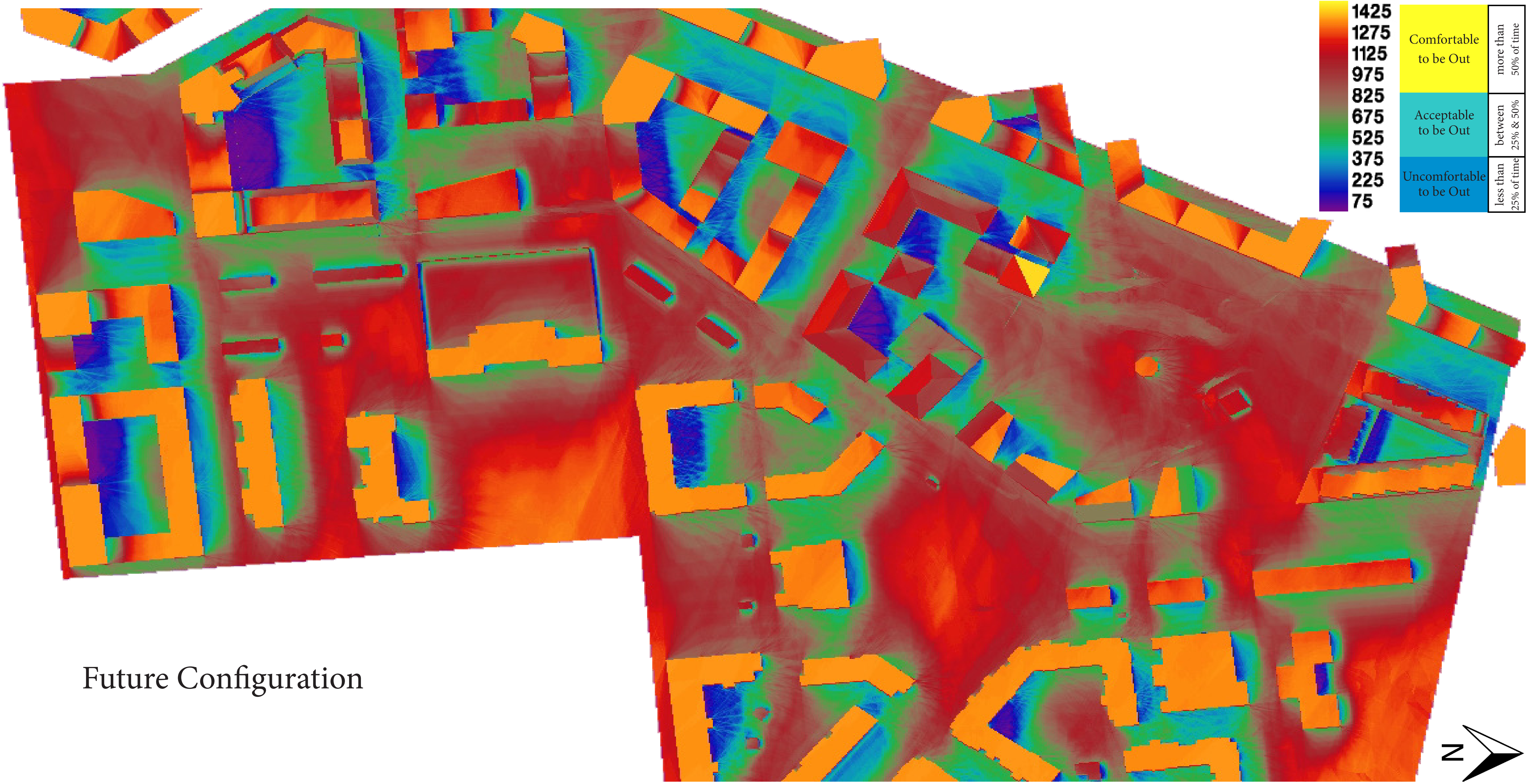
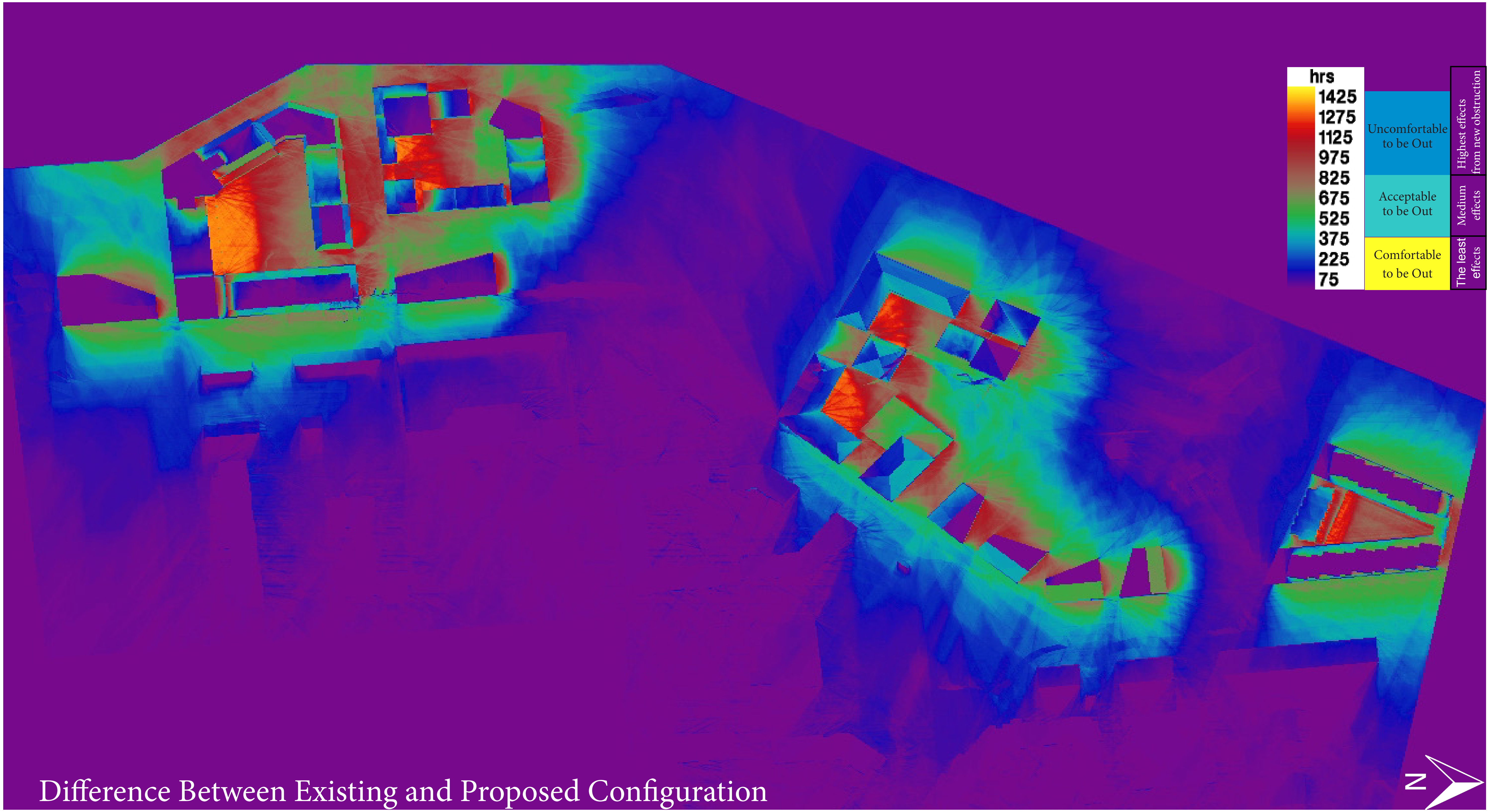


Future Configuration

UTCI based Annual Sunlight Hours

Here, in the below image, what we see is the UTCI based Sunlight Hours subtraction of the new proposal from the exiting condition. So, the higher value (toward yellowish color) in this map means that that part of space much more looses its potential to be reagrded as a good place to sit or walk (when outside temperature is in a comfortable range) in outside when the new buildings are added.

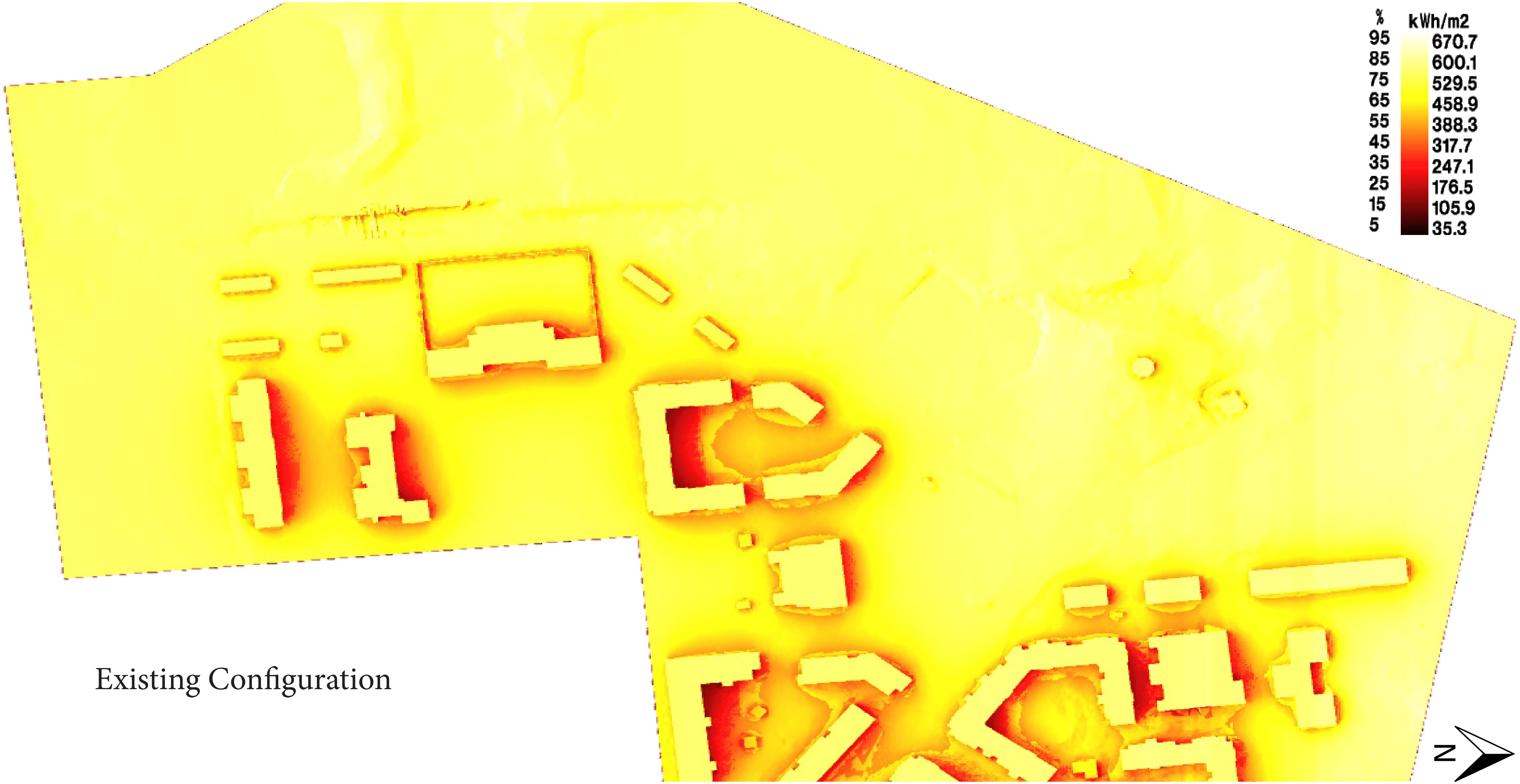


Difference Between Existing and Proposed Configuration

Annual Solar Radiation (Insolation Analysis)

The insolation analysis is a way to calculate Incident Solar Radiation falling on a surface. Its calculation is based on a standard weather data file representing the prevailing conditions of the place and is created based on on-site measurement over a period of years.

At an urban scale, it shows where it is best to locate photovoltaic panels, solar collectors or the potentially good locations for plants, vegetation and trees to receive the right amount of light that is needed for them to grow.



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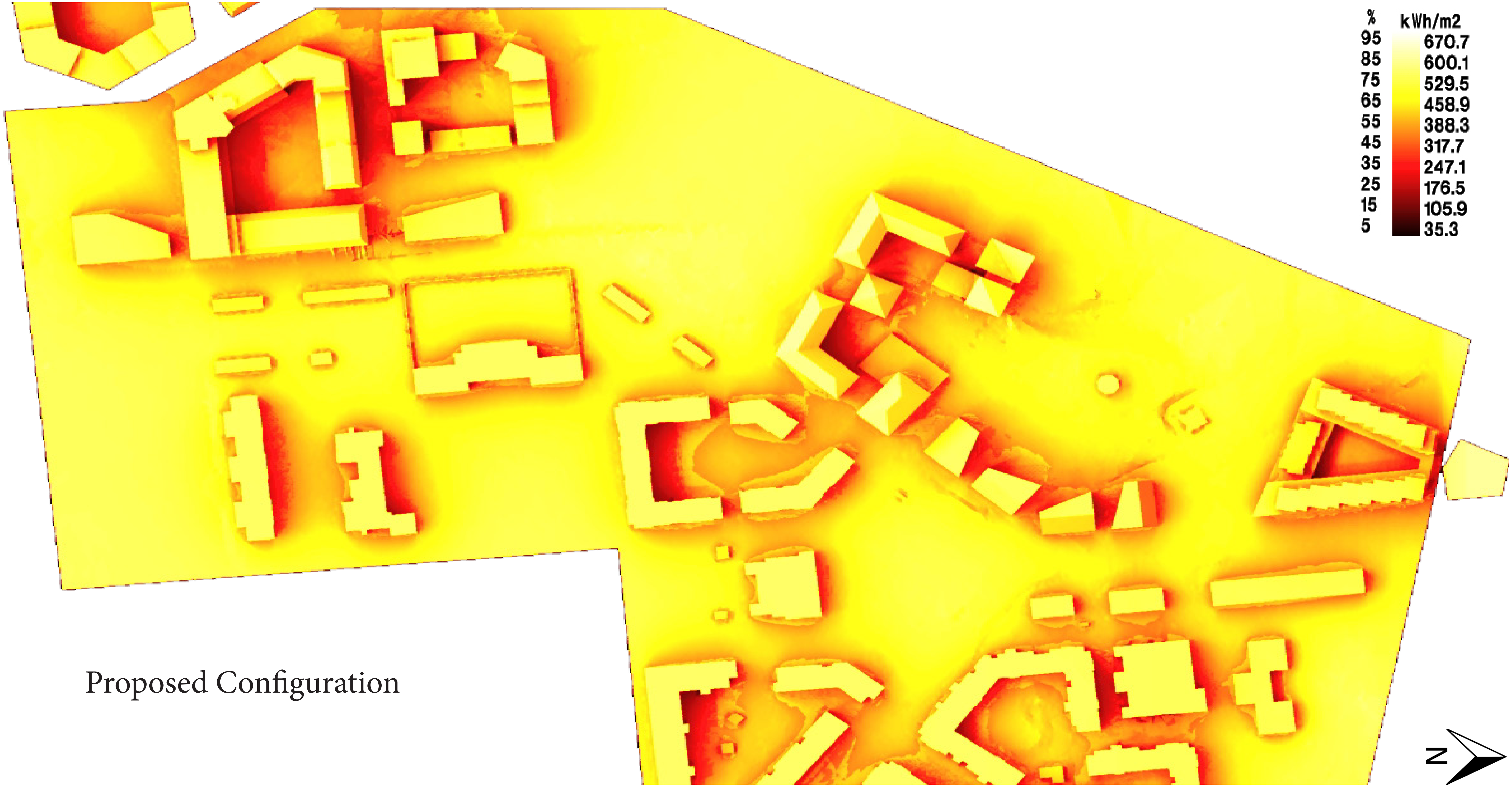

Proposed Configuration

Annual Solar Radiation (Insolation Analysis)

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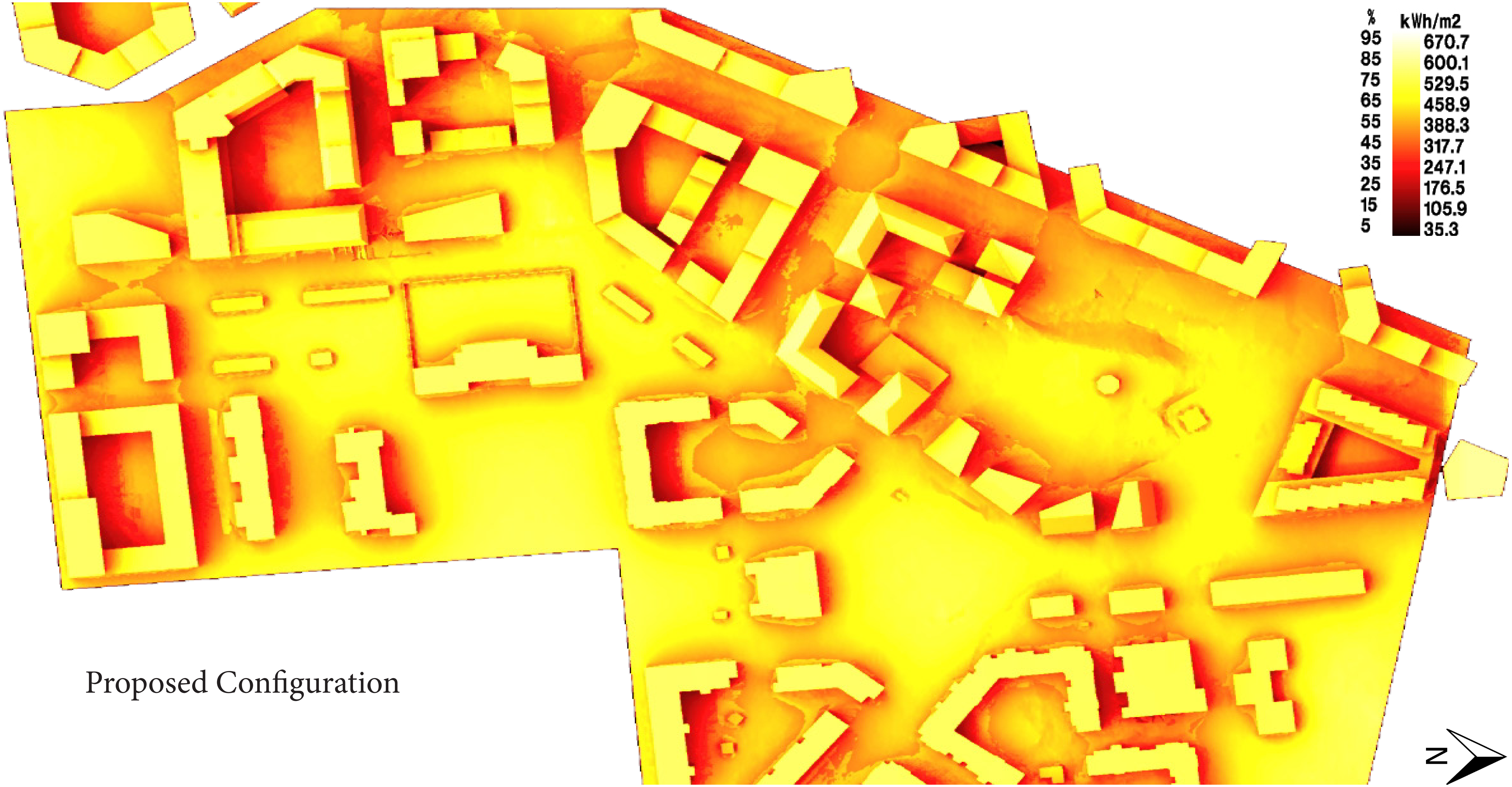

Proposed Configuration

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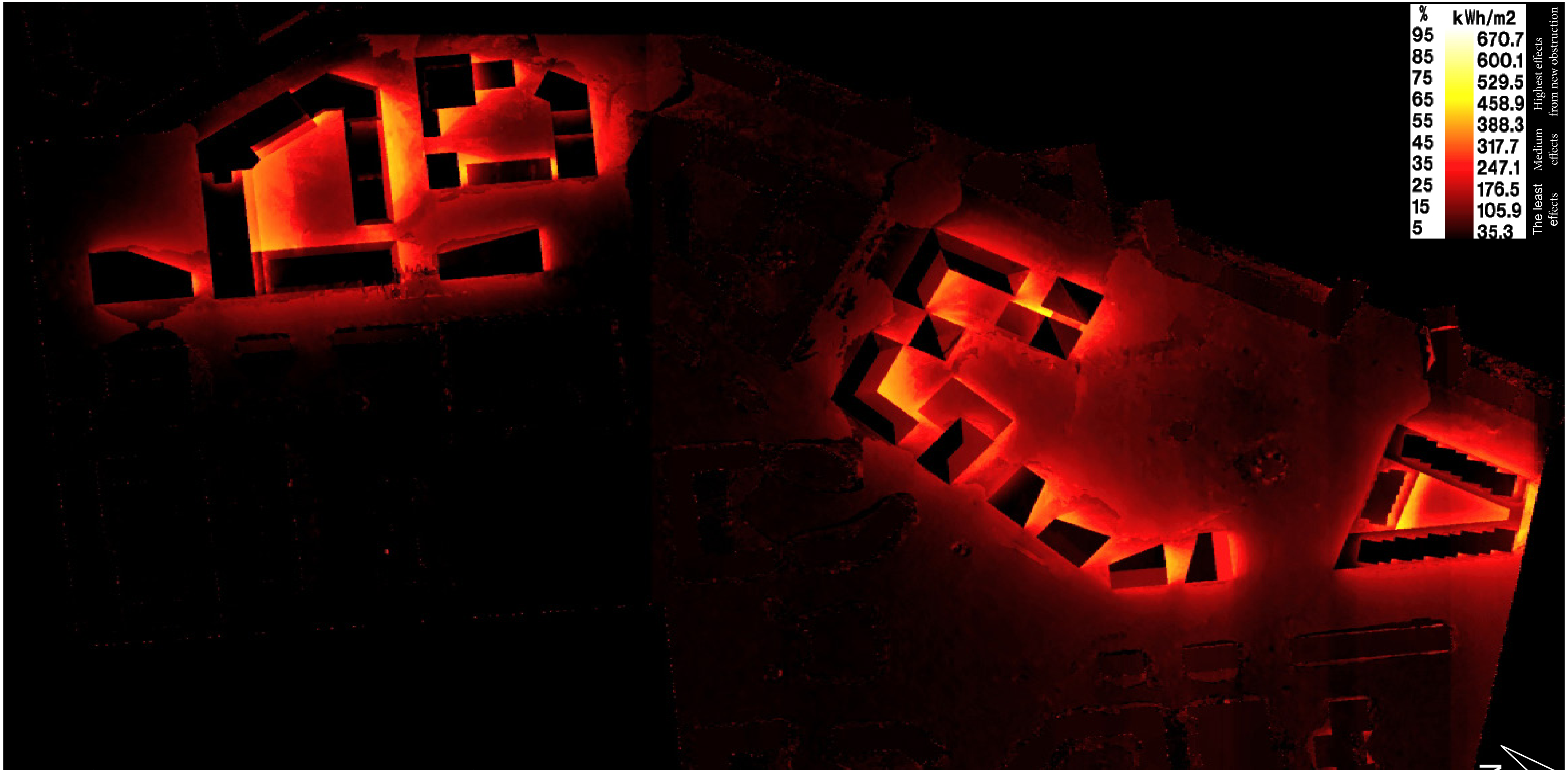


Difference Between Existing and Proposed Configuration

Categorizing the spaces with different functions

By doing the aforesaid analysis (Annual Sunlight Hours, UTCI based Annual Sunlight Hours and Annual Solar Radiation analysis) and considering the following definitions, we categorize the outdoor areas as six different types of function that are illustrate in pages 17 and 22:

- To define the best places for pedestrian paths ("**Pedestrian Path**"), we choose those areas with more than 50% of all the sunlight hours show them with reddish color.
- To define a good place to sit ("**Sitting Places**"), we choose areas with more than 50% of all yearly hours that are categorized as "No Thermal Stress" (it means those hours that have comfortable temperature feeling in outside) in the UTCI scale. Such areas illustrated by yellowish color.
- Regarding the difference between pedestrian paths and sitting places, as any places that are categorized as a appropriate place to sit will be good to walk too, we make another category that is defined as "**Sitting Places or Pedestrian Path**" by intersecting the area between "**Pedestrian Path**" and "**Sitting Places**" that represent by orange color.
- To define a good place for "**Green Areas**", we choose areas with more than 400 kWh/m^2 per year and show it by greenish color. How ever we define another areas with a minimum yearly radiation access of 300 kWh/m^2 and name it "**Possible to be as Green Area**" and illustrate it by dark greenish color.
- Since most of the time, the area that are suitable to sit is an area that is good to grow trees and plants, we make a union between "**Sitting Places**" and "**Green Area**" and name it as "**Sitting Places or Green Area**" . It is represented by light green color.
- All the areas that are not belonged to any of the above categories are classified as a place that are "**Mostly in shadows**" all year round. They presented by **bluish** color. Functions like streets or parking lots are suit well in these areas.

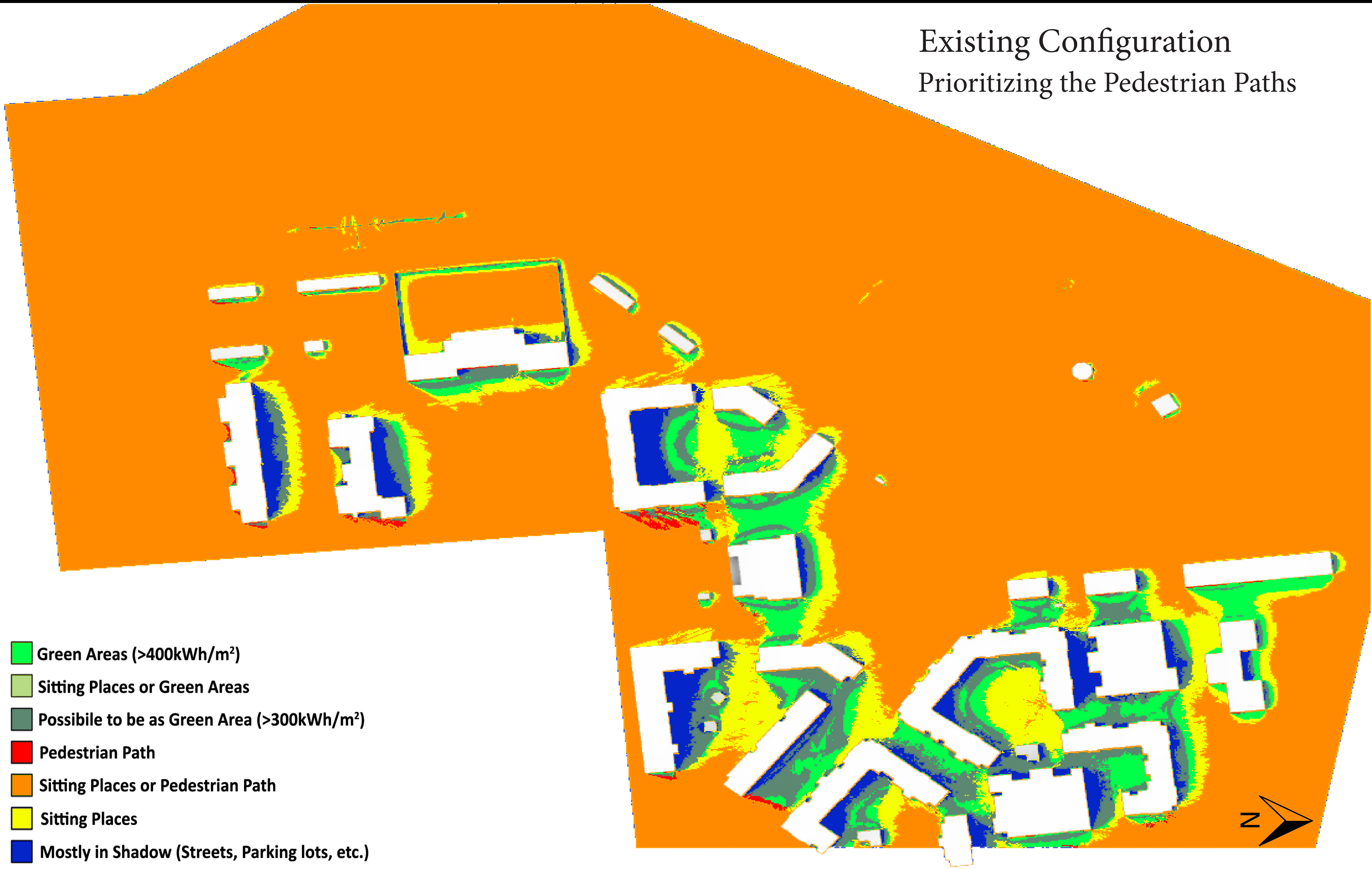
Since the areas that are suitable for sitting or pedestrian paths and places that are good to be define as green areas share a considera-ble proportion, we made two pages that one is based on an illustration that green areas are prioritized the other is where the pedestrian paths are prioritized.

Here it is also worth to say that to have a better conclusion about the function of each area in the space, we need to include other fac-tors such as wind comfort analysis too.

Categorizing the spaces with different functions

Existing Configuration

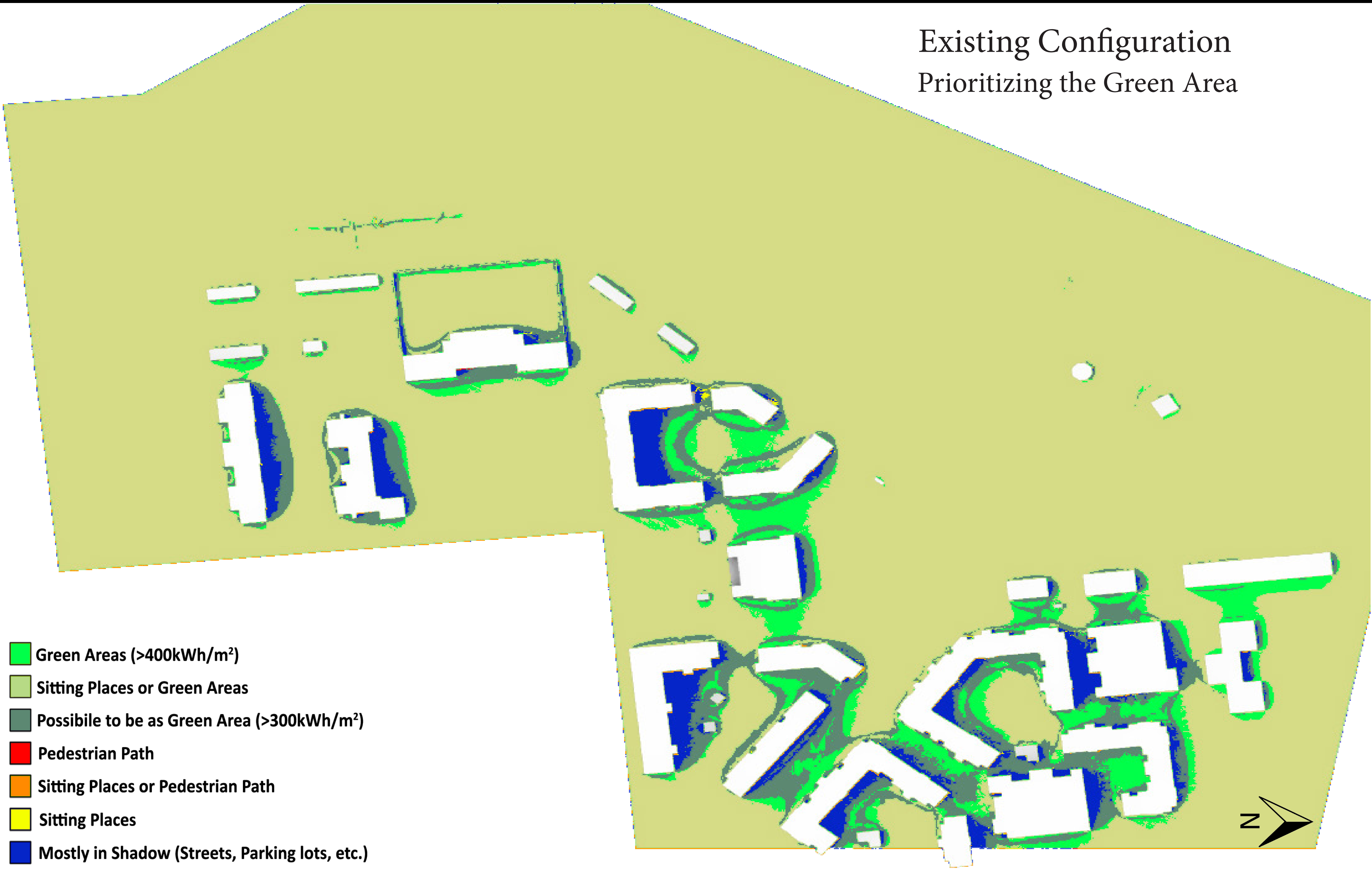
Prioritizing the Pedestrian Paths



SWECO

Existing Configuration

Prioritizing the Green Area

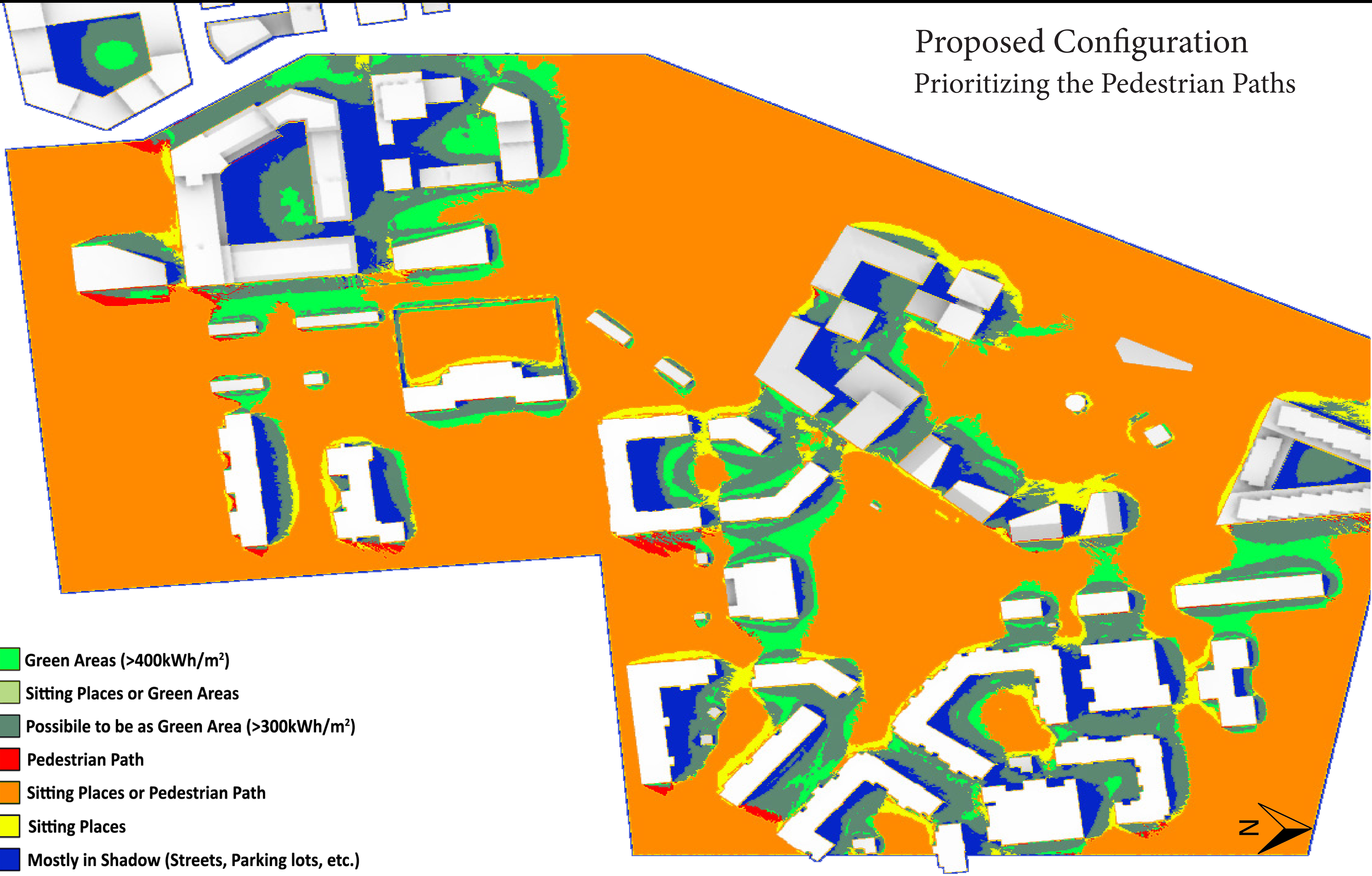


- Green Areas (>400kWh/m²)
- Sitting Places or Green Areas
- Possibile to be as Green Area (>300kWh/m²)
- Pedestrian Path
- Sitting Places or Pedestrian Path
- Sitting Places
- Mostly in Shadow (Streets, Parking lots, etc.)

Categorizing the spaces with different functions

Proposed Configuration

Prioritizing the Pedestrian Paths



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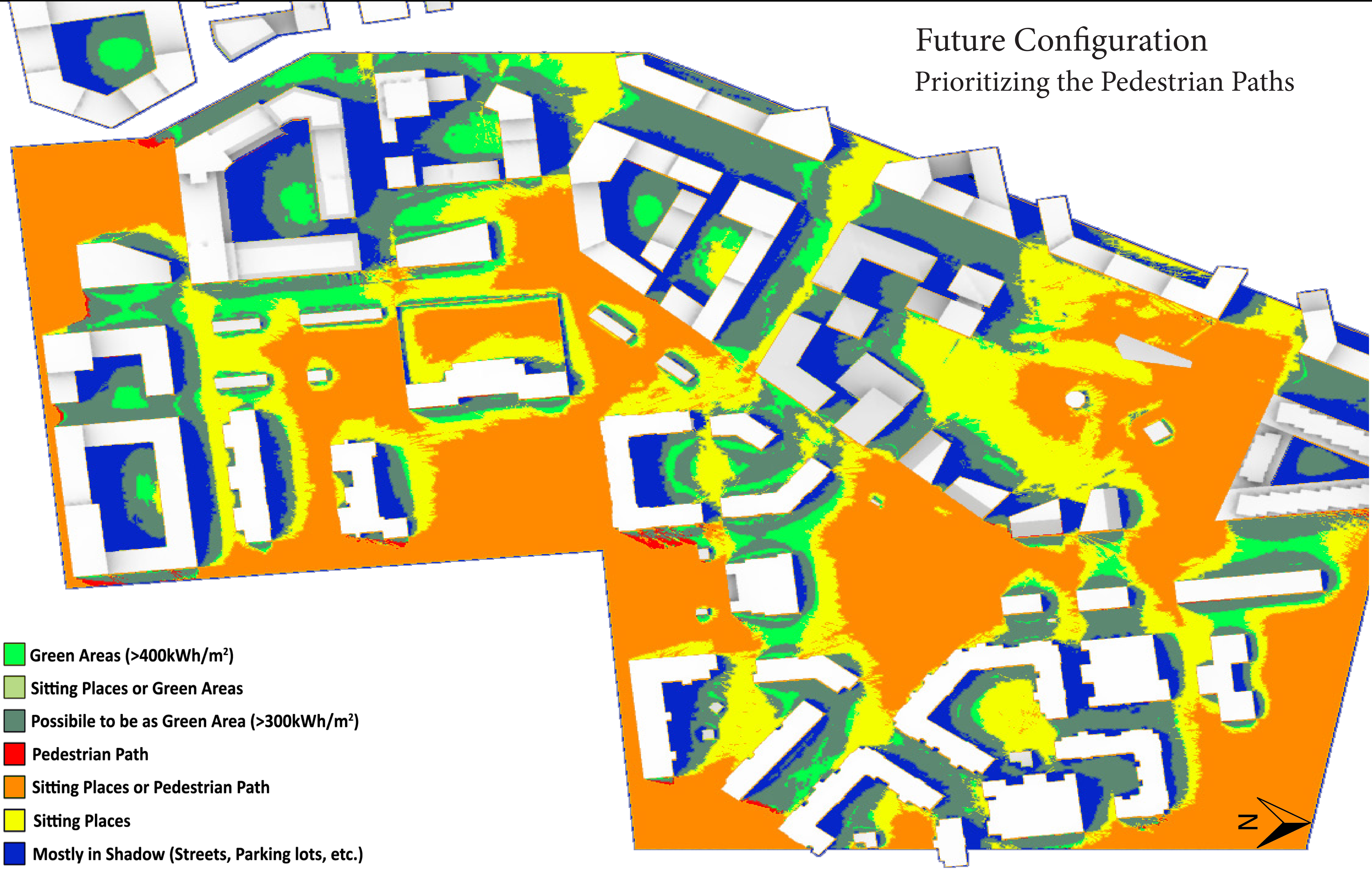
Categorizing the spaces with different functions

Categorizing the spaces with different functions

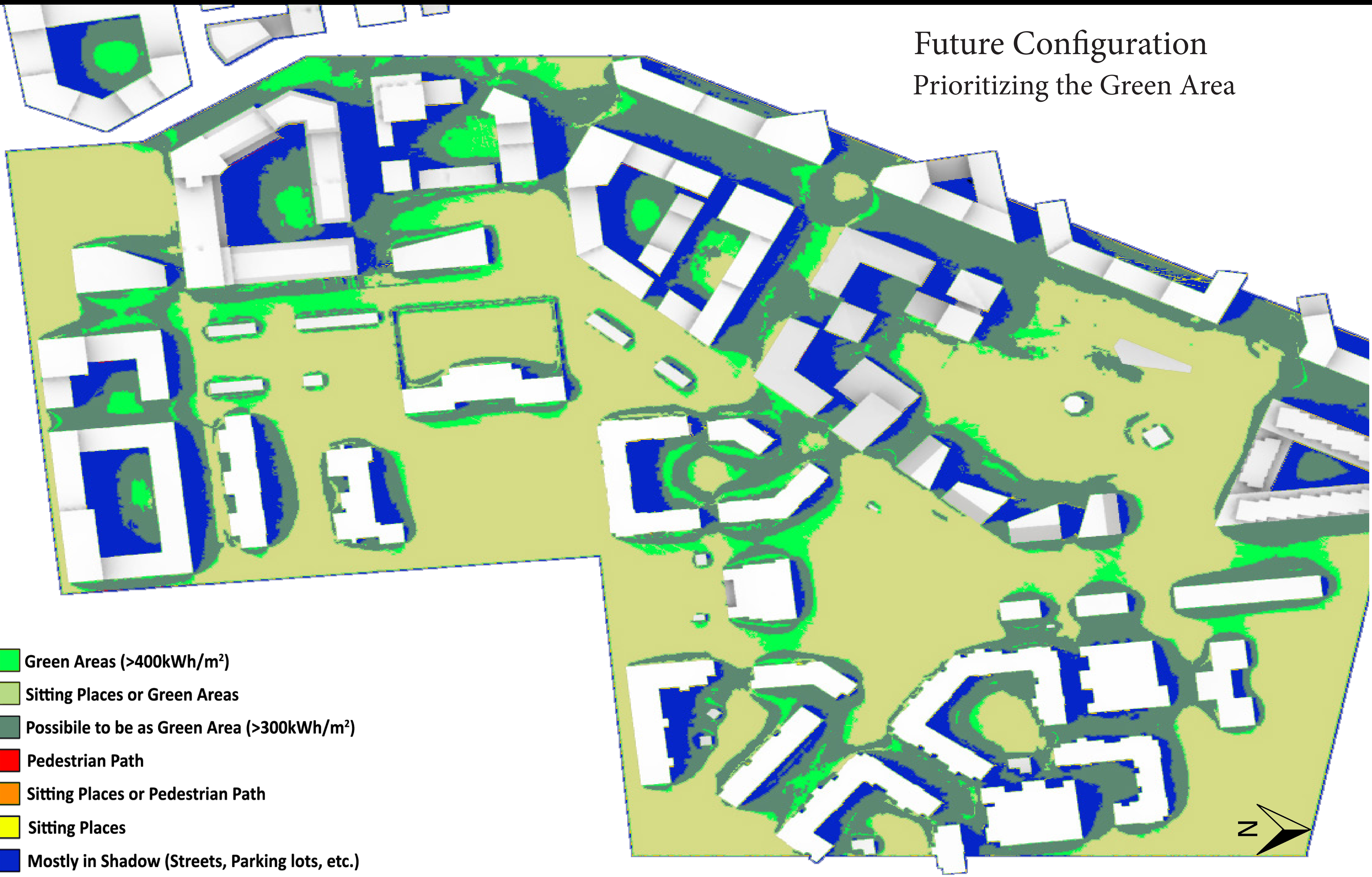


Categorizing the spaces with different functions

SWECO

Future Configuration

Prioritizing the Green Area



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