

VISUALISATION AS A TOOL TO GUIDE STREET TREE PLANTING FOR OPTIMAL BENEFIT GAIN

Dr Ana Macias

PhD Forestry Engineer, Arbocity, Spain

Co-author: Kieron J. Doick



1. Introduction

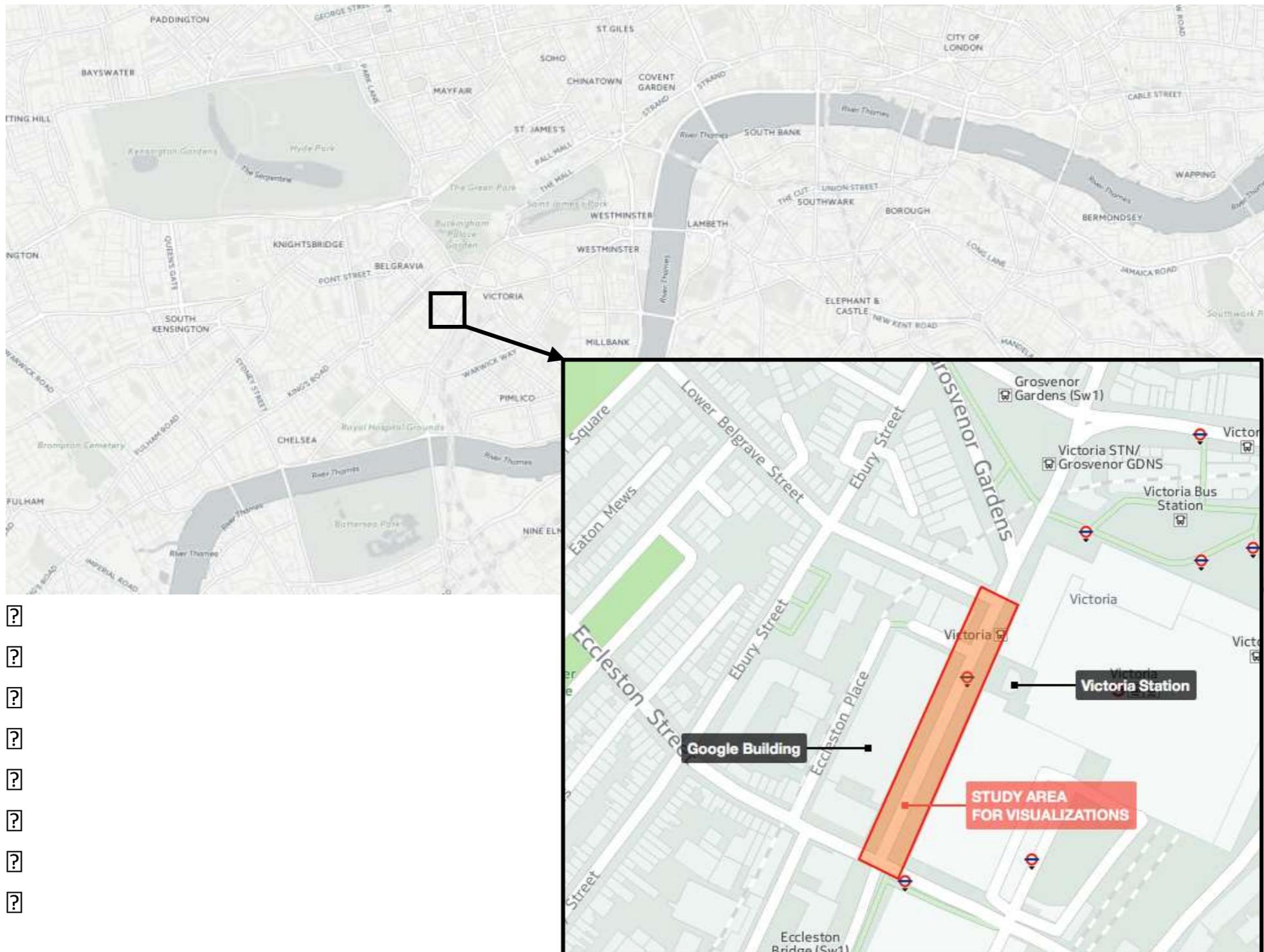
2. Methodology

3. Results

4. Implications and future work

- Climate change and urban heat island are warming our cities
- Trees can regulate urban climate in several ways: evapotranspiration, solar radiation reflection, **shade**
- Shade of urban trees is affected by built infrastructure: building height, street orientation and street width
- **Our model:**
 - studies interactions between street trees shading potential and the surrounding built architecture
 - uses visualisations to simulate different scenarios and calculate shaded surface
 - was tested by presenting examples of the case study visualisations to tree officers in London to assess the fitness-for-purpose of the model

- **Case study: Buckingham Palace Road**

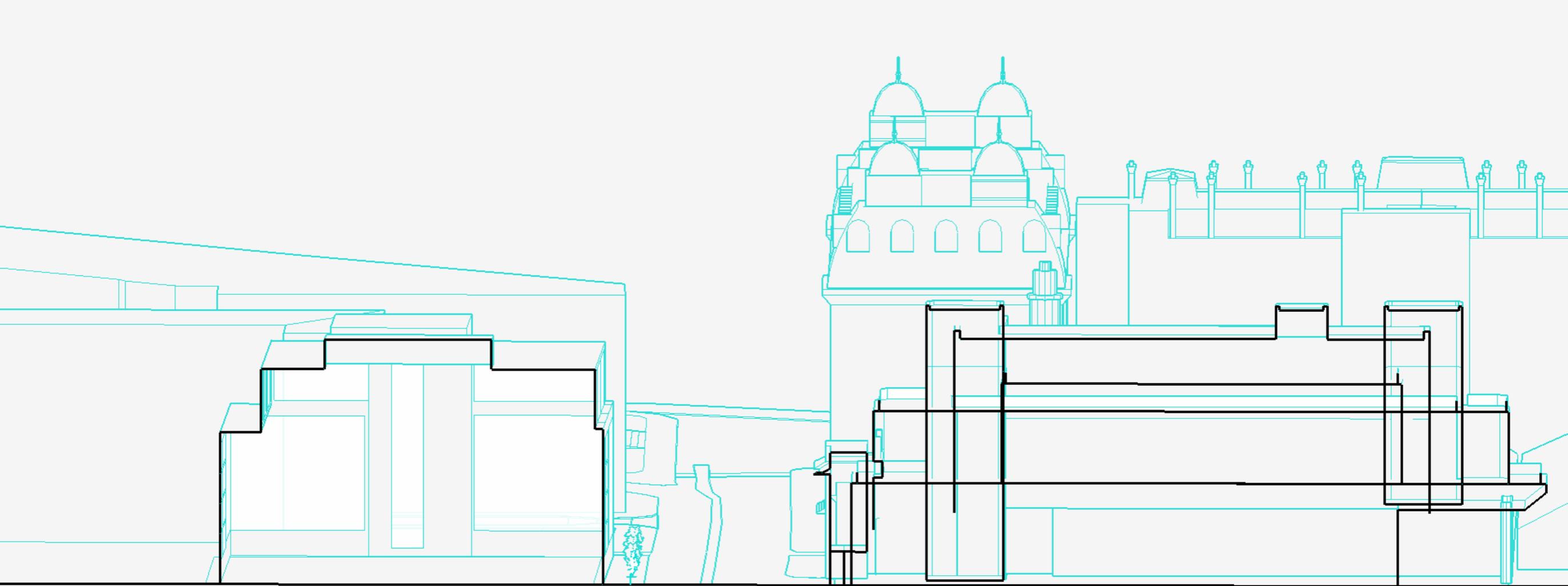


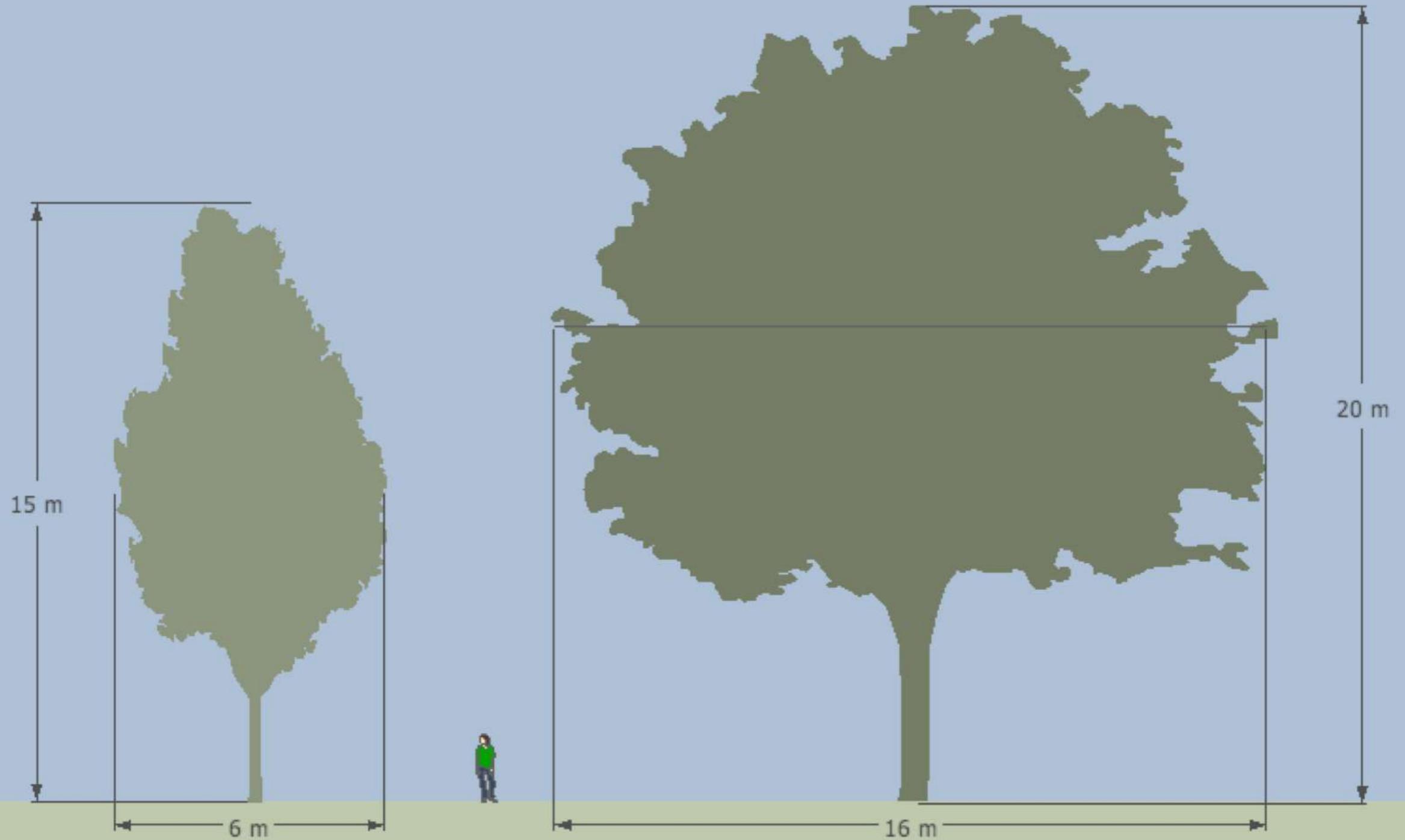
Street unit

- Defined as a section of street 50 m long with a determined width and buildings on both sides
- One street unit will be considered for this study
- Various scenarios populated by different trees varying in species, location and distance

Variables for case study

1. **Orientation: N-S**
2. **Street canyon ratio:**
 - Wide street
 - High buildings
3. **Tree**
 - Size:
 - Big trees, *Platanus x hybrida* (London plane)
 - Small trees, *Pyrus calleriana* (Callery pear)
 - Location: trees planted on the western side of the street only
 - Density: trees planted at low density
4. **Time**
 - Seasons: each scenario modelled for one day of each season:
 - Hours: each scenario modelled hourly from 4 am to 8 pm





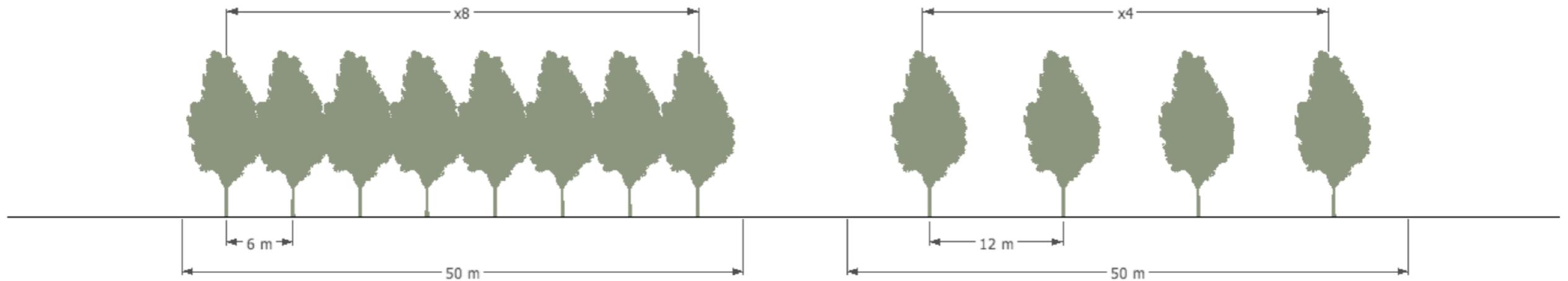
a

Platanus x hybrida



b

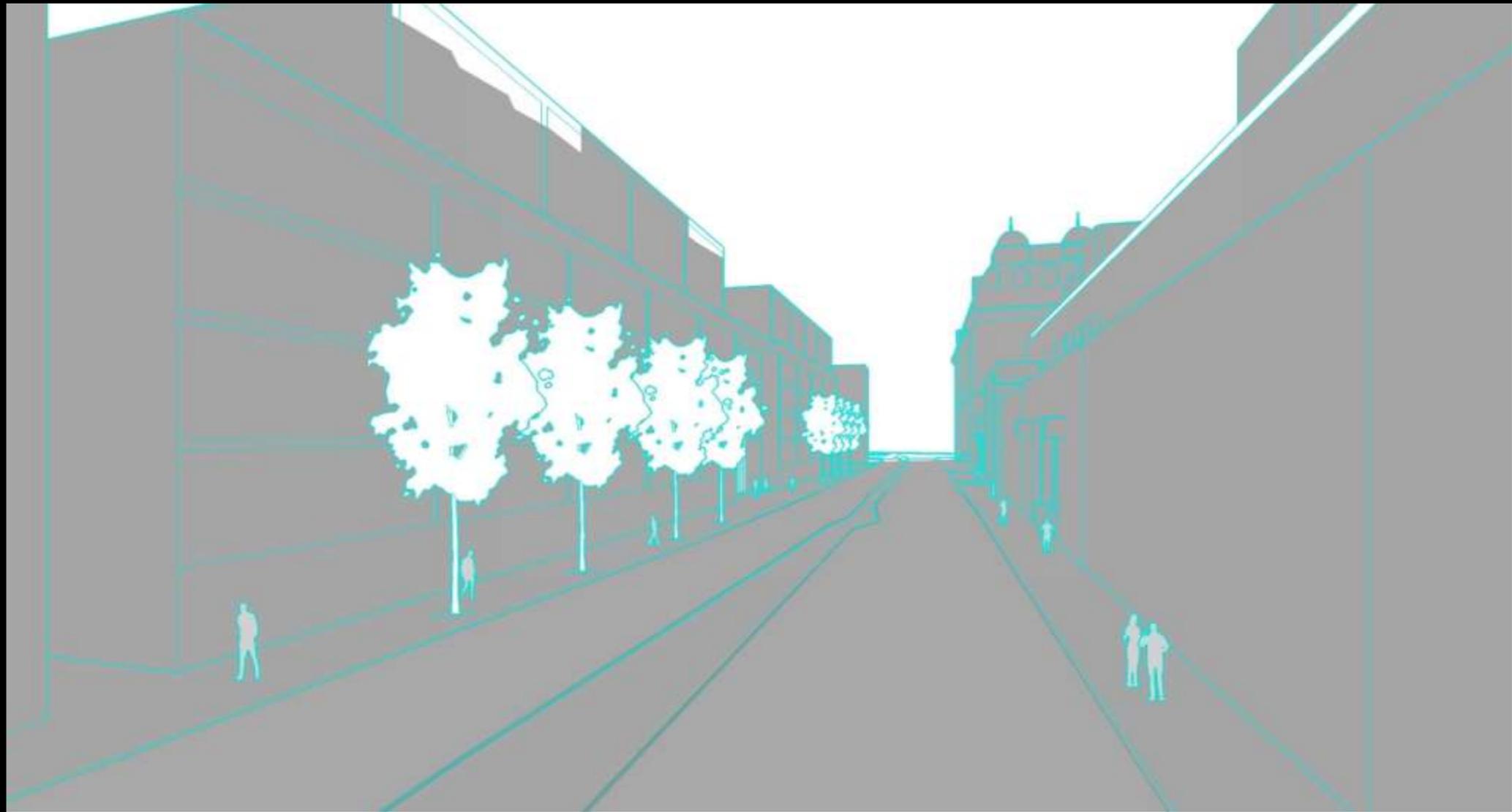
Pyrus calleriana





STREET VIEW - 5AM

NORTH-SOUTH STREET WITH TREES ON WEST SIDE POSITION



STREET VIEW - 7AM

NORTH-SOUTH STREET WITH TREES ON WEST SIDE POSITION



STREET VIEW - 9AM

NORTH-SOUTH STREET WITH TREES ON WEST SIDE POSITION



STREET VIEW - 11AM

NORTH-SOUTH STREET WITH TREES ON WEST SIDE POSITION



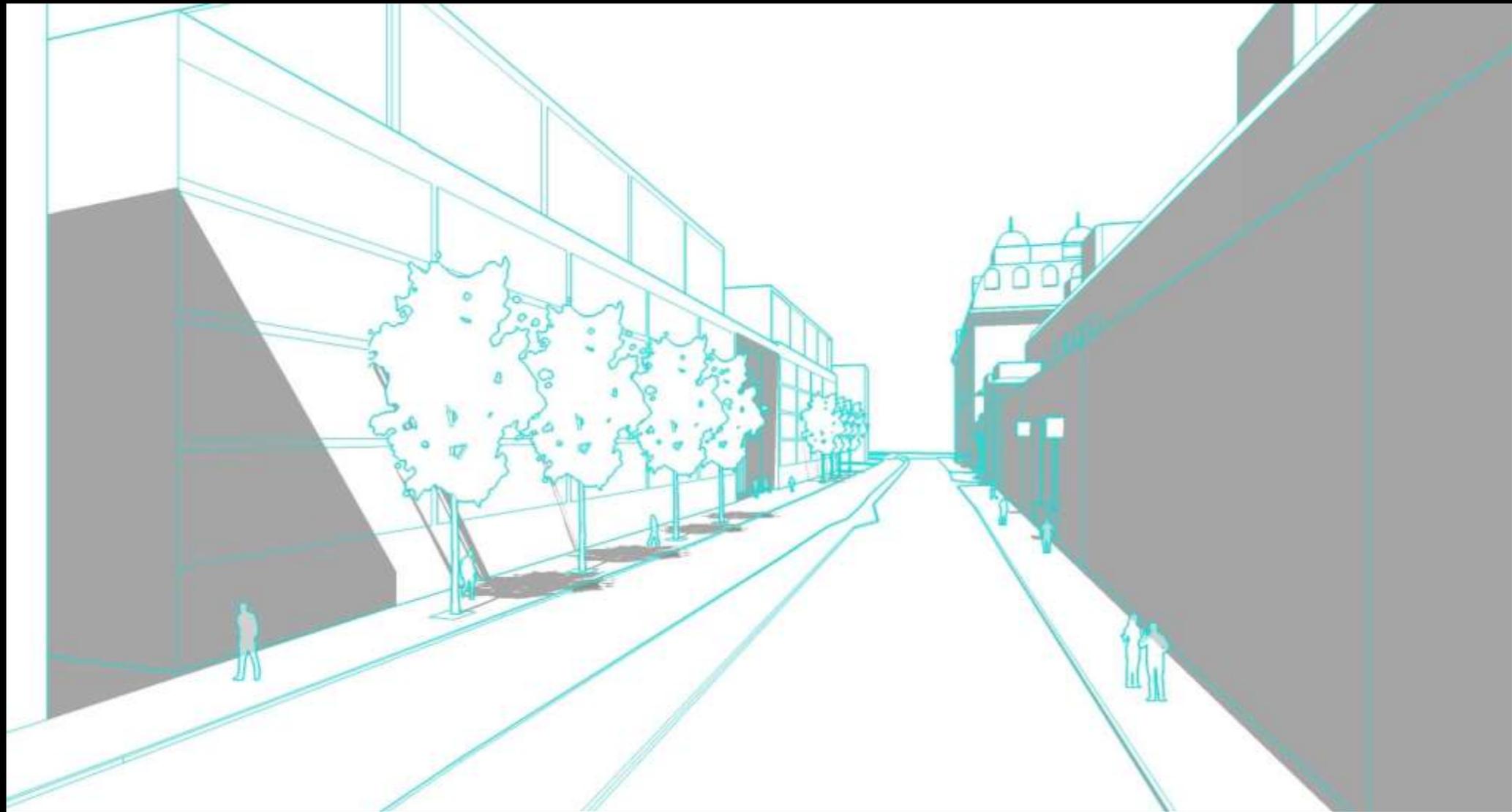
STREET VIEW - 12PM

NORTH-SOUTH STREET WITH TREES ON WEST SIDE POSITION



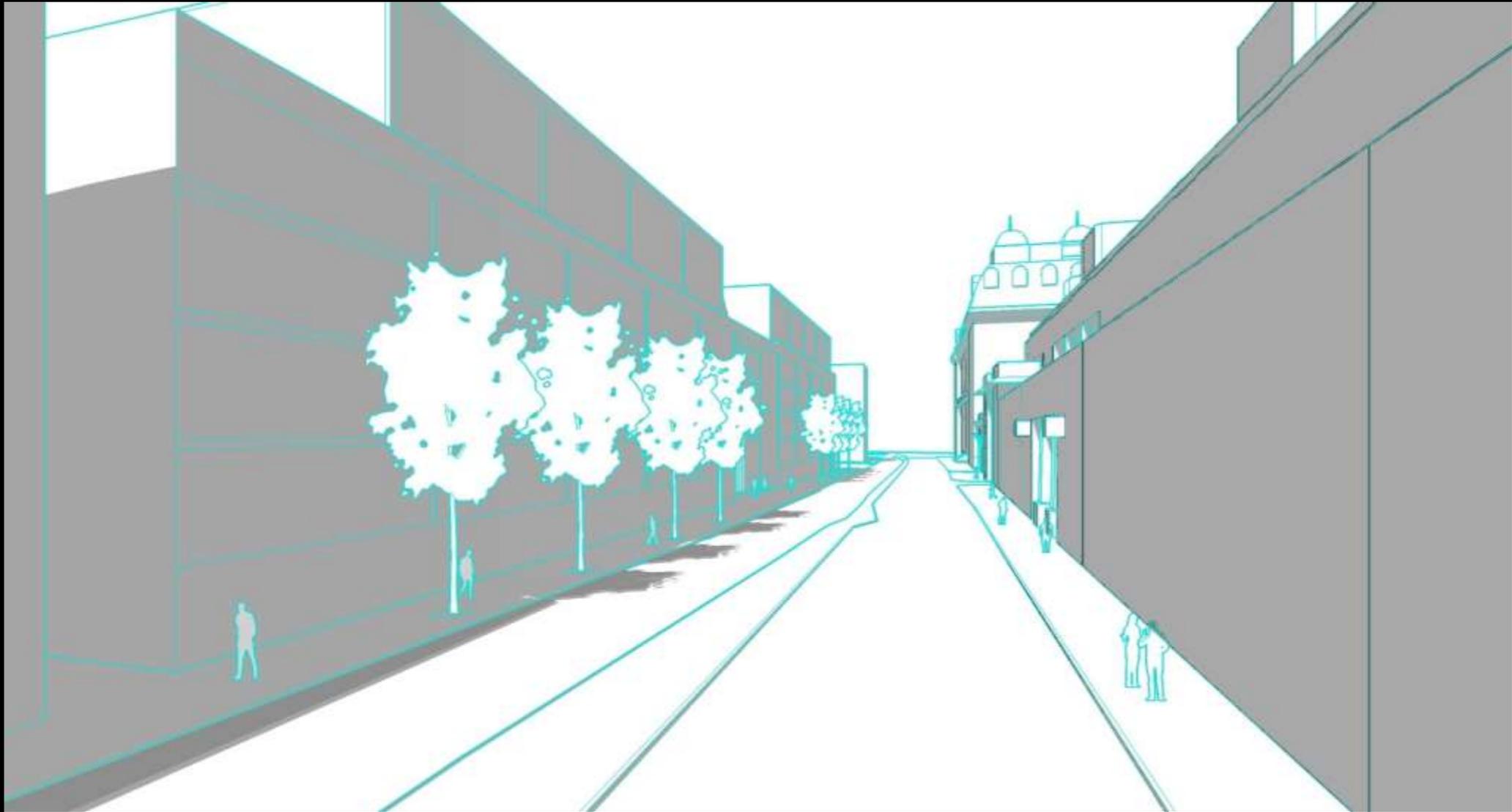
STREET VIEW - 1PM

NORTH-SOUTH STREET WITH TREES ON WEST SIDE POSITION



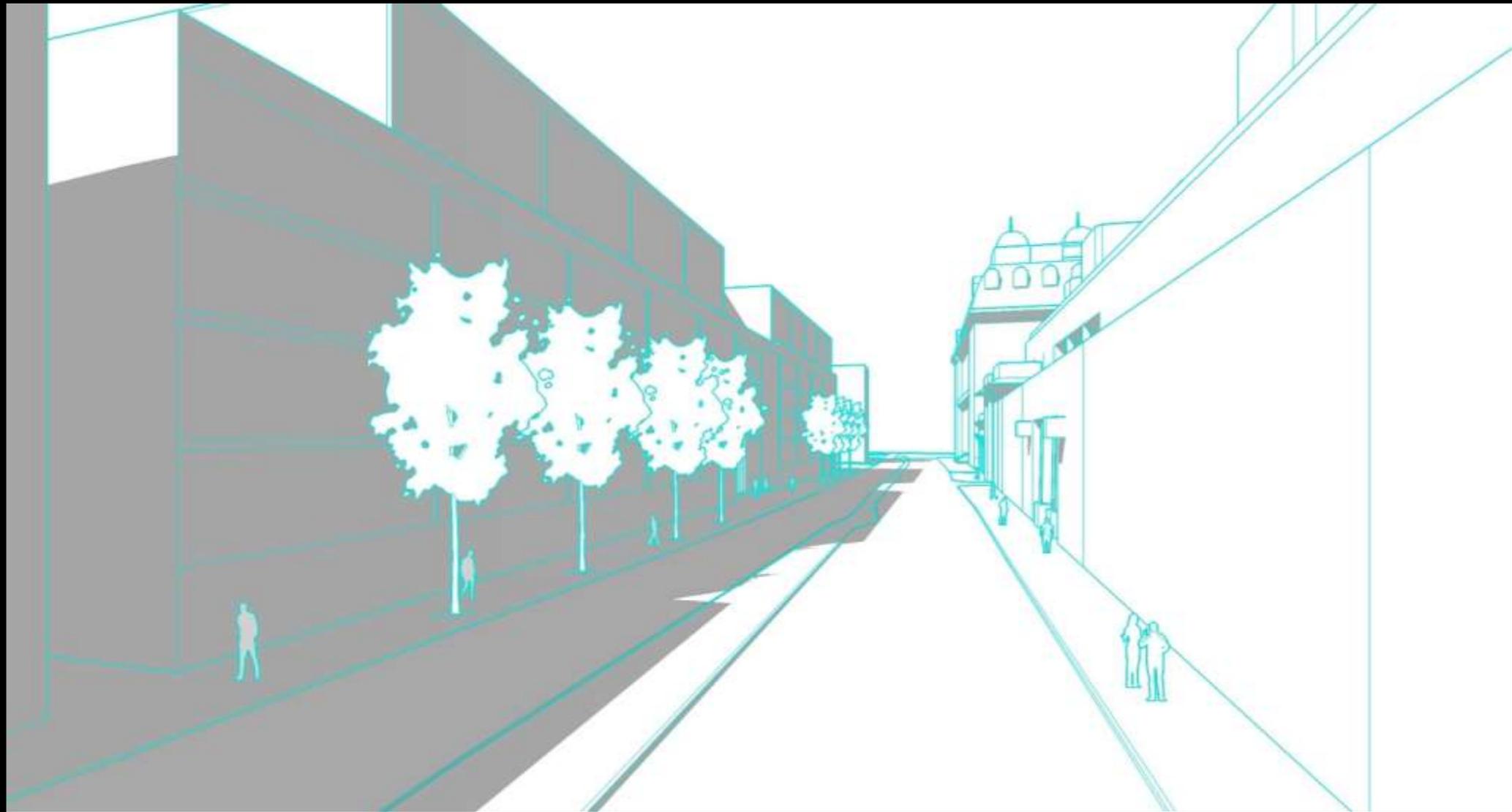
STREET VIEW - 2PM

NORTH-SOUTH STREET WITH TREES ON WEST SIDE POSITION



STREET VIEW - 3PM

NORTH-SOUTH STREET WITH TREES ON WEST SIDE POSITION



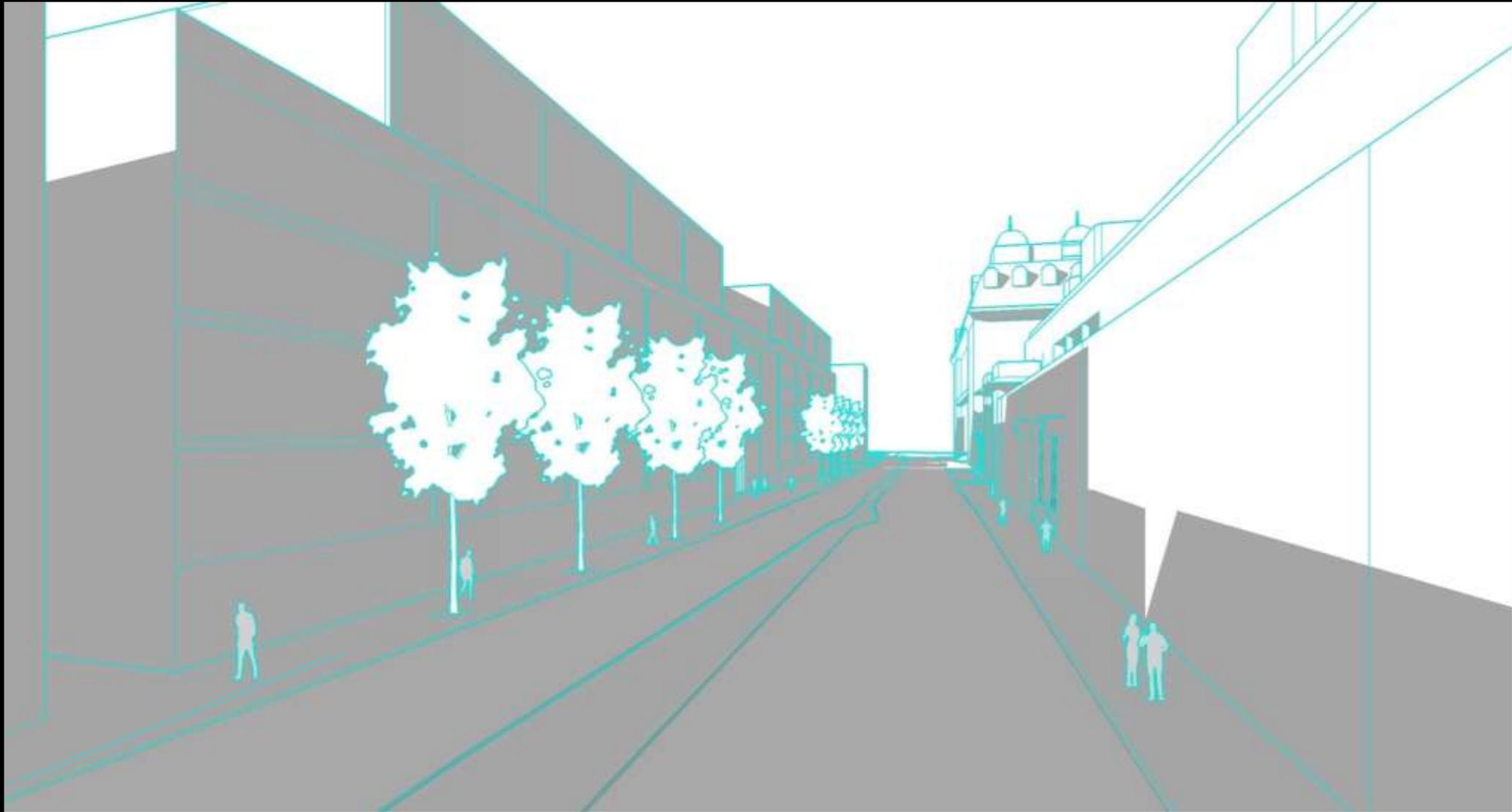
STREET VIEW - 4PM

NORTH-SOUTH STREET WITH TREES ON WEST SIDE POSITION



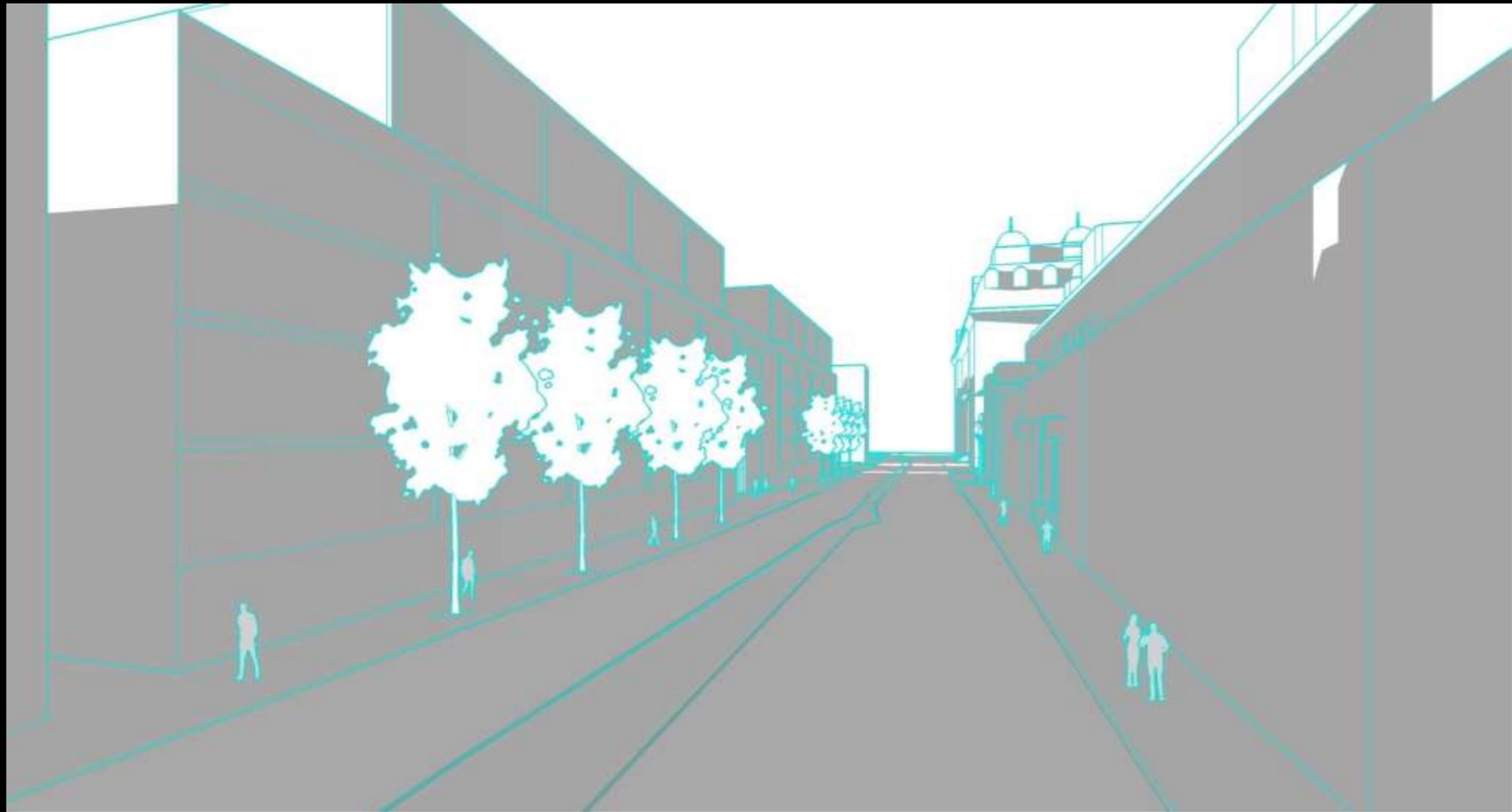
STREET VIEW - 5PM

NORTH-SOUTH STREET WITH TREES ON WEST SIDE POSITION



STREET VIEW - 7PM

NORTH-SOUTH STREET WITH TREES ON WEST SIDE POSITION



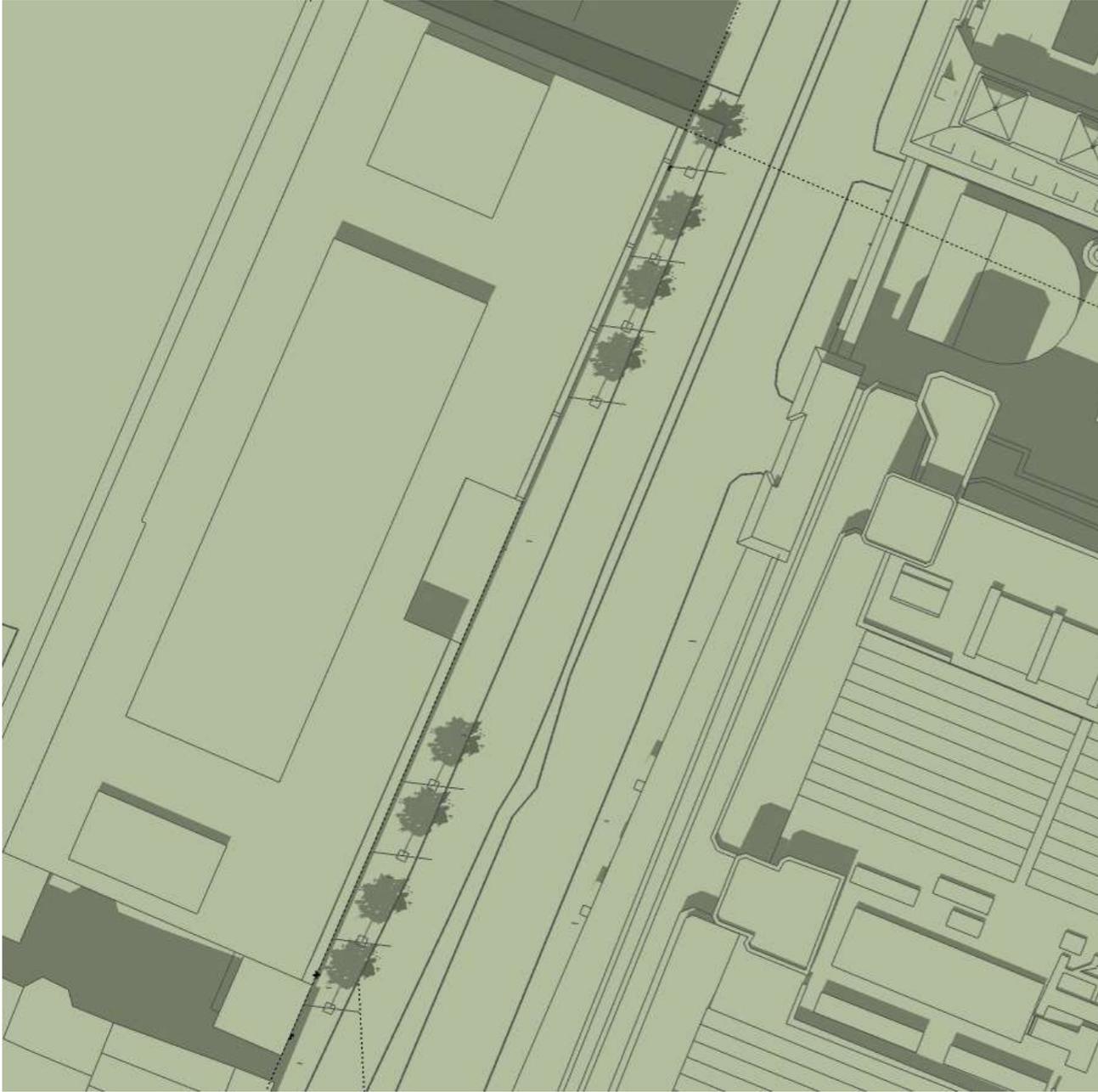


Image processing

- Gimp 2.8 (GNU Image Manipulation Program) image processing software to calculate the shaded area via pixel counting.
- 136 images were rendered and exported as 1920x964 pixel tiff files to retain maximum image quality

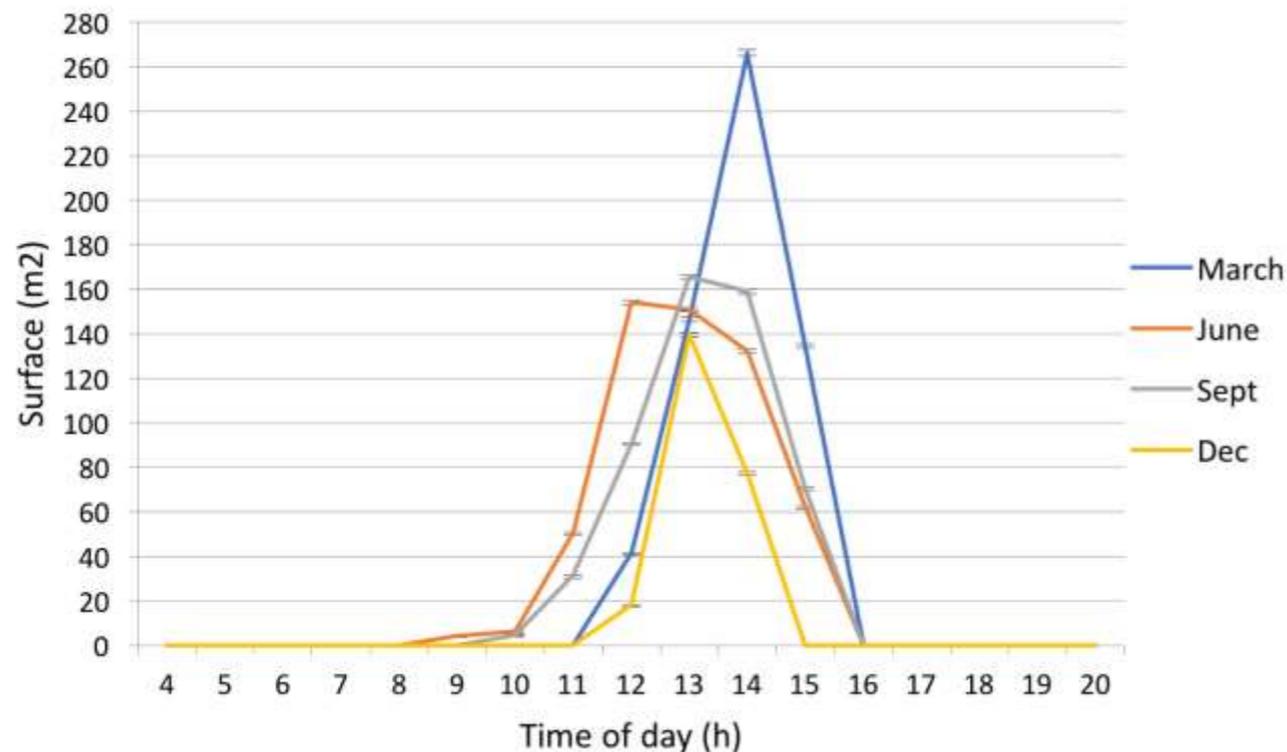
Interviews

- Visualisations presented during 16 one-to-one semi-structured interviews (lasting 30 to 60 minutes)
- Interviews with London Tree Officers from 13 of the 33 Boroughs.
- Photo elicitation
- Compiled into a visualisation presentation package
- 3 Images selected

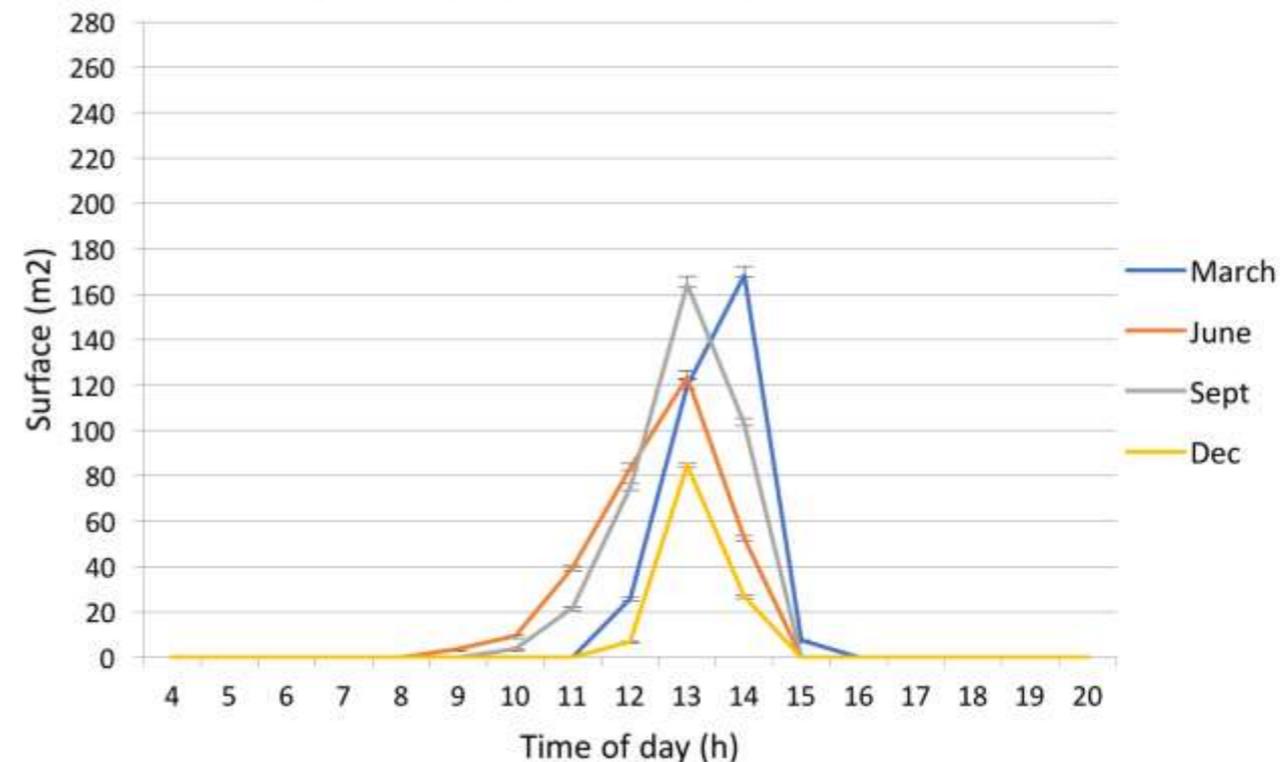
Image processing

- Number of hours street trees cast any shadow varies with the season:
 - 1st March: 4 hours
 - 1st June: 8 hours
 - 1st September : 6 hours
 - 1st December: 3 hours
- Shade surface in winter is smaller: only 1 street unit

Platanus x acerifolia total shade surface (m²)



Pyrus calleriana total shade surface (m²)



Interviews

- Overall evaluation was positive

Comments from interviewees	Positive	Neutral	Negative
Total	6	10	0
Total%	37	63	0

- Applications:
 - to deal with complaints about trees shading properties
 - for selecting new planting sites to maximize shade (limited by underground infrastructure)
 - scientific studies and data to support their decisions and increase their credibility in front of the politicians, insurance companies and the public
 - for species selection:
 - intensity and spread of shaded area for different sps.
 - shade tolerance for new planting sites
 - to evaluate the impact on hours of sun on existing trees from proposed construction of new buildings
- Main barrier: time
- One possible solution: integration with existing management software

- Set of rules to identify within a city those streets and those sides of the streets where tree planting could be prioritized in order to maximize their shading potential (that are easy to comprehend by non-experts on urban forestry)
- Especially useful for new developments
- Aid to guide the initial design, in cases where tree officers only involved in later stages
- The ability to simulate several alternative present and future scenarios → powerful tool to assist with planning and management decisions

LTOs said visualisations are
“*what they already do in [their] heads*”

Future scenarios to consider:

- Street canyon ratio: wide/narrow street + high/low buildings
- Street orientation: N-S + W-E + NW-SE/SW-NE
- Planting locations for trees: centre + 2 sides
 - north-south orientation, only one side (symmetrical)
 - west-east orientation, only north side
 - Centre, only for wide streets
- Tree planting density: high + low
- Tree size: big + small
- Shade reduction for deciduous trees in spring, winter and autumn
- Overlapping effect when contiguous "street units" included

Kieron Doick

Forestry Commission for funding the study

LTOA for helping distribute the study

London Tree Officers for their time and feedback

Thank you!

Questions Welcome