



Union (T2), Water Street, Manchester

Updated Appendix 11.1: Wind Microclimate (Rev 1)

06 May 2020

Appendix 11.1

Wind Microclimate

Wind Tunnel

The wind tunnel tests were carried out in RWDI Anemos Ltd.'s boundary layer wind tunnel facility, in Milton Keynes. This tunnel has an open working section with an effective width of 3.0 m.

An atmospheric boundary layer, representative of the conditions at the Site, was simulated using a turbulence grid and an arrangement of roughness elements distributed over the floor of the wind tunnel.

The boundary layer simulation was calibrated against the variation in mean wind speed and the intensity and scale of the turbulence with height above ground level appropriate to the Site, based on profiles derived using the widely accepted Deaves and Harris log law wind model and a detailed terrain analysis for the area surrounding the Site. This method yields a good approximation of the mean flow and turbulence characteristics and fully meets the requirements of clause NA2.2 'Guidance on design assisted by testing and measurements' from the UK National Annex to BS EN 1991-1-4:2005.

Figure A11.1 presents the variation of mean wind speed, longitudinal turbulence intensity and gust wind speed used in the tests. The wind speed profiles are normalised by the mean wind speed at a reference height of 114 m (the approximate maximum height of the Proposed Development above the local ground level).

Instrumentation

Measurements of pedestrian level wind speeds were made using instruments known as Irwin probes. These are standard devices for such measurements. The probes consist of a small tube with a pit at its base. The pressure difference between the top of the tube and the pit is calibrated against wind speed. The top of the tube is set at an equivalent full-scale height of 1.5 m to measure wind speeds at pedestrian height. The sampling rate, combined with the wind tunnel running speed and the linear scale of the model, were appropriate to the model scale simulation used.

People subjected to fluctuating or gusty wind conditions will react to either the mean wind strength or to the maximum gust that occurs. For this reason, both the mean and maximum gust speeds were determined for each measurement location. The gust speed was then converted to a gust-equivalent-mean value based on a factor of $1 / 1.85$.

Measurements were made for a full range of wind directions in 22.5° increments. The wind tunnel measurements were recorded as non-dimensional wind speed ratios relative to the wind tunnel reference wind speed.

Wind Tunnel Model

The wind tunnel model of the Proposed Development and existing / future surrounding area was constructed by RWDI, based on a 3D model, plans and elevations provided by the design team in March 2020. Existing surrounding building were based on survey information provided for previous tests and new or future buildings were based on planning application information sourced from the local authority planning portals. The linear scale of the model is 1:300. The model was constructed on a circular baseboard of diameter 2.4 m, centred on the approximate centre of the St John's masterplan.

Proposed semi-mature trees and existing surrounding trees were modelled in winter, or bare, format.

Figure A11.2a illustrates the models for existing / baseline Site conditions, the Proposed Development in the context of existing / baseline surrounding conditions and the Proposed Development with consented / committed future surrounding developments. Figure A11.2b shows close-up images of the landscaping modelled and a landscaping plan.

Figure A11.2c presents images and a plan of the additional mitigation measures developed for the more likely interim scenario upon completion of the Proposed Development, with the proposed Union T1 in place of the consented St John's T1.

Wind Climate Statistics

The wind climate, based on statistics from Manchester Airport for the period 2001 to 2015 transposed to apply to the Site, is summarised in Figure A11.3 in terms of the seasonal wind speed and direction probability distributions at a reference height of 114 m, corresponding to the approximate maximum height of the Proposed Development above the local ground level.

The factors applied to correct the statistics from 10 m height in open-country terrain at sea level to reference height at the Site are also presented.

Pedestrian Level Wind Environment Results

The measured wind speed ratios from the wind tunnel tests are combined with the wind statistics applicable to the Site to assess the pedestrian level wind environment based on the Lawson criteria for pedestrian comfort and safety. The resulting annual and seasonal ratings for each measurement location are summarised in Figures A11.4 for the following scenarios:

- Existing (Baseline) Site conditions;
- Proposed Development (inc. landscaping) with existing (baseline) surrounds;
- Proposed Development with additional mitigation and interim surrounds comprising the proposed Union T1 and existing (baseline) surrounds elsewhere; and
- Proposed Development (inc. landscaping) with consented /committed future surrounds.

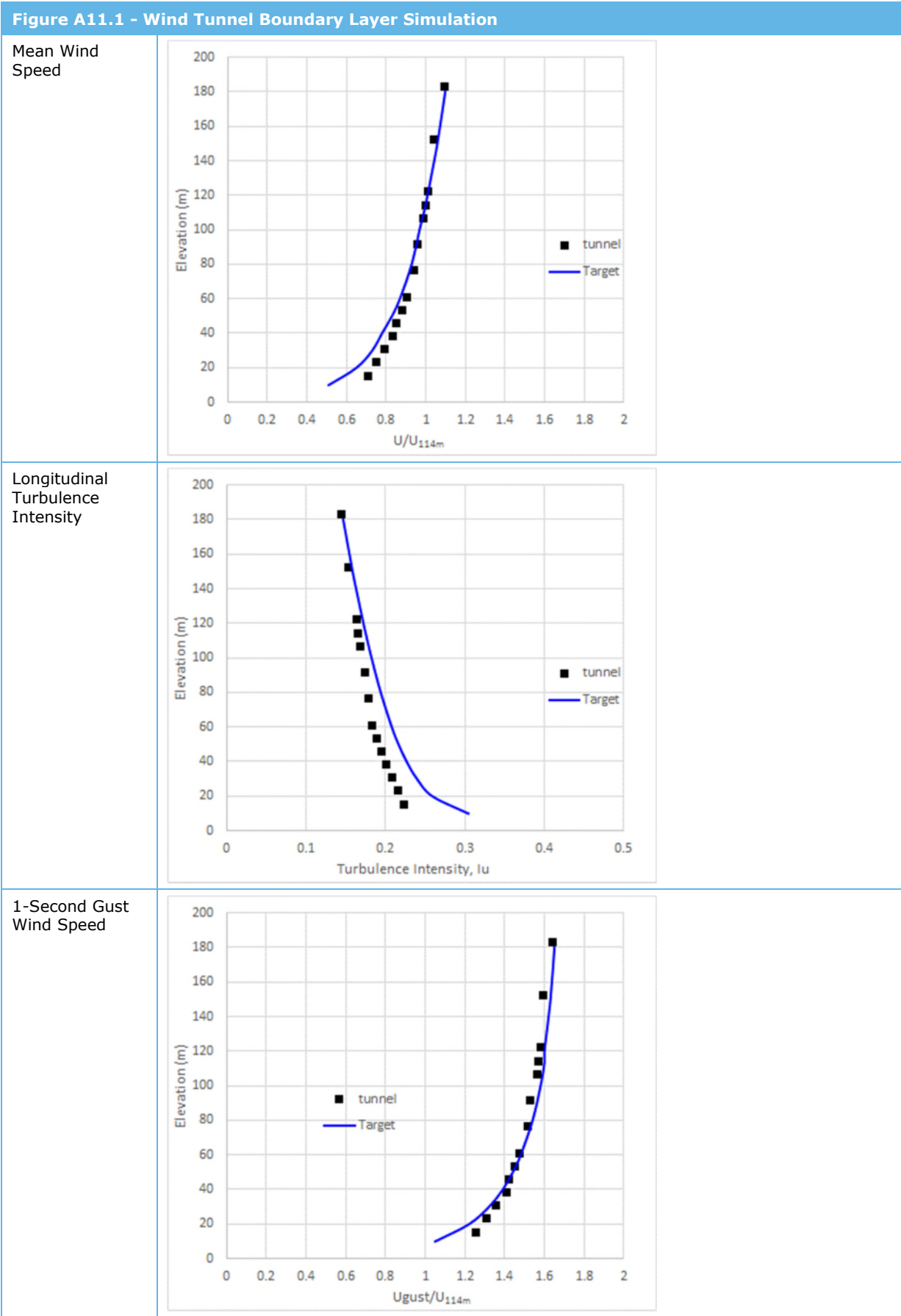


Figure A11.2a - Wind Tunnel Model

Existing Site Conditions



Close up of Proposed Development



Close up of Proposed Development



Proposed Development with Existing Surrounds



Proposed Development with Future Surrounds



Wind Tunnel Set-up



Figure A11.2b - Wind Tunnel Model, Close ups of Proposed Landscaping and Designed-In Mitigation (with Future Surrounds)

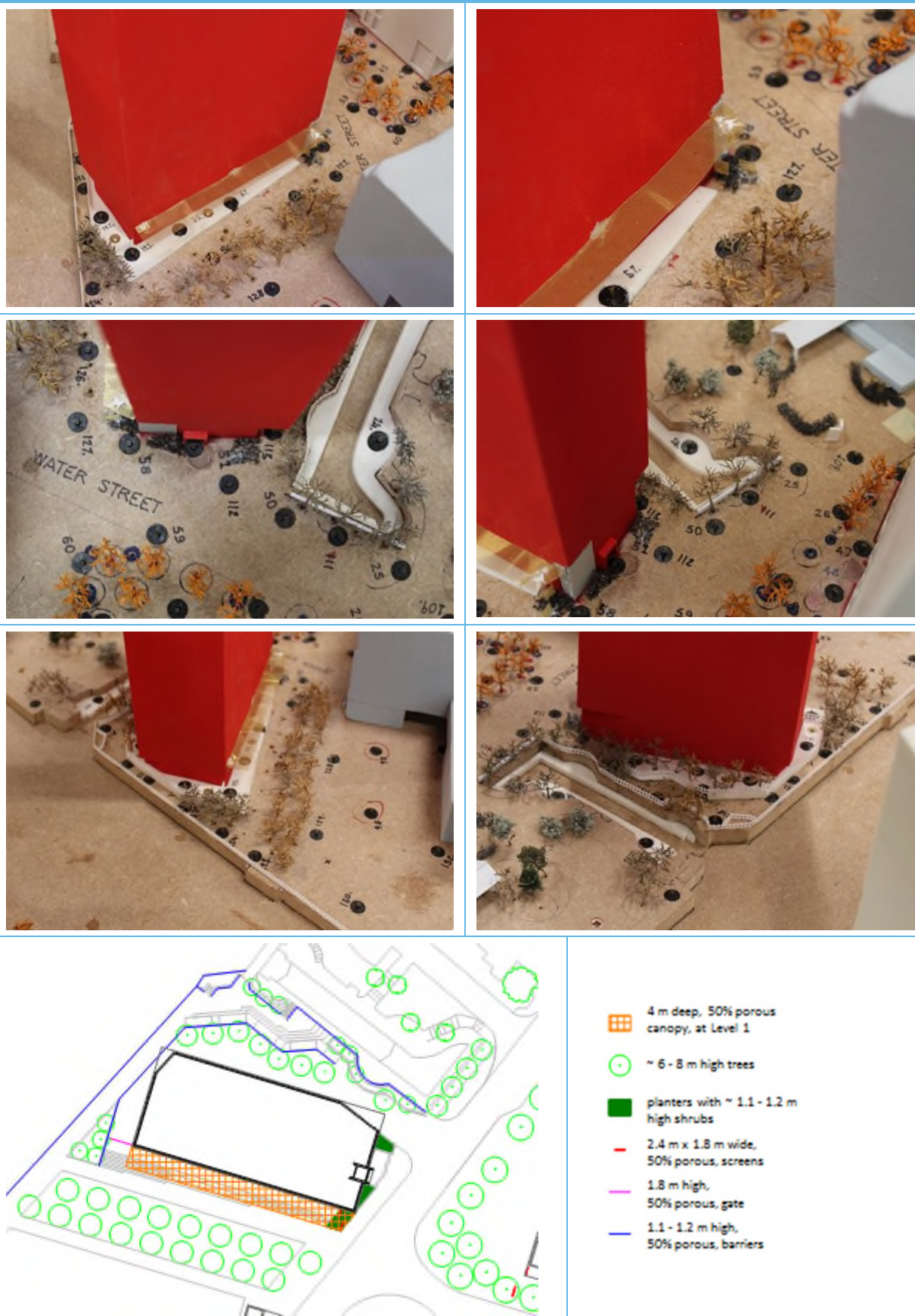


Figure A11.2c - Wind Tunnel Model, Close ups of Additional Mitigation with Interim Surrounds



Figure A11.3a - Wind Speed Correction Factors
Open Country at Sea-Level to Ref. Height (114 m) at Site

Direction	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°
Factor	1.34	1.32	1.31	1.30	1.30	1.31	1.31	1.32
Direction	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
Factor	1.32	1.31	1.33	1.34	1.34	1.34	1.34	1.34

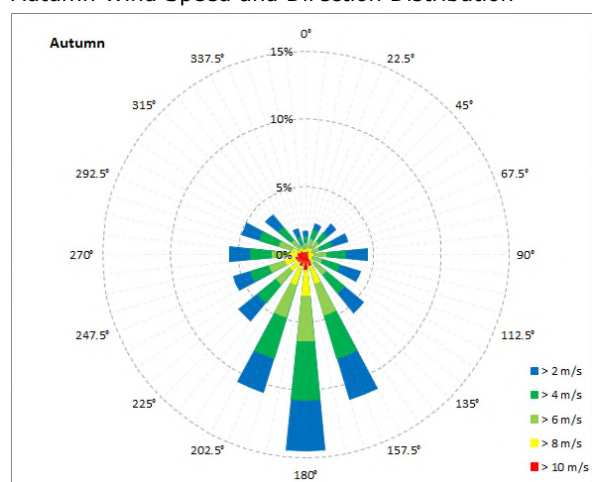
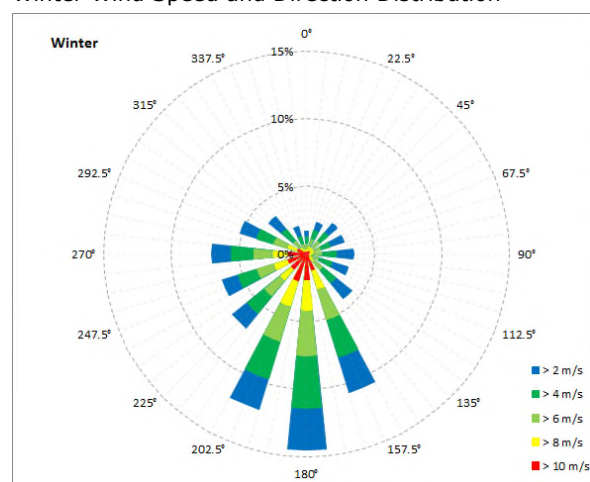
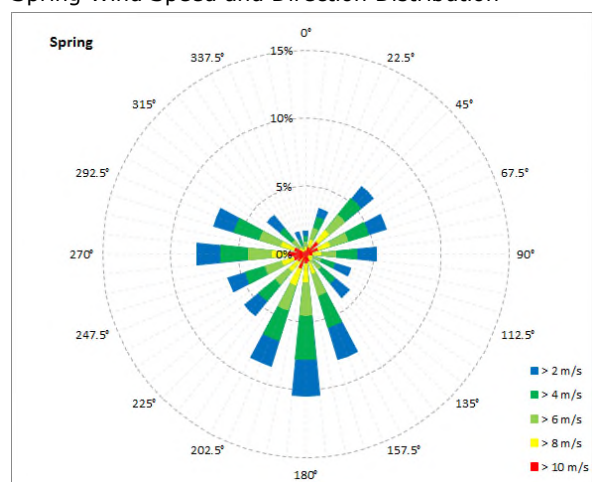
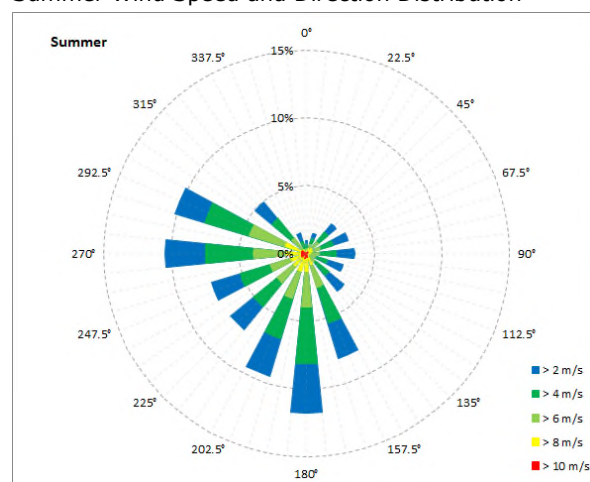
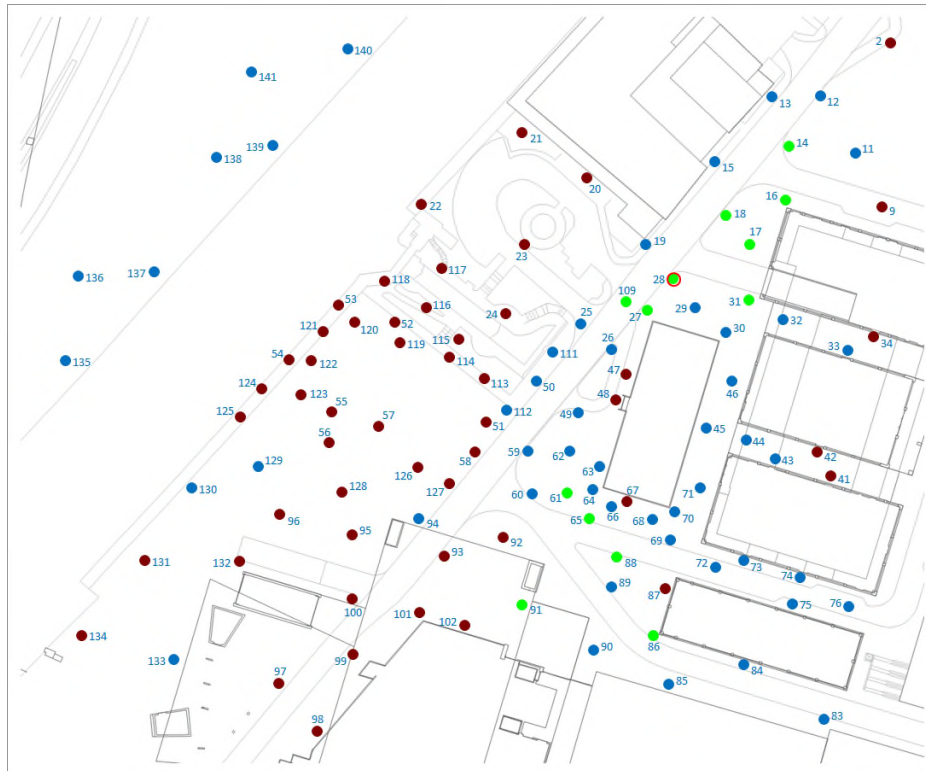
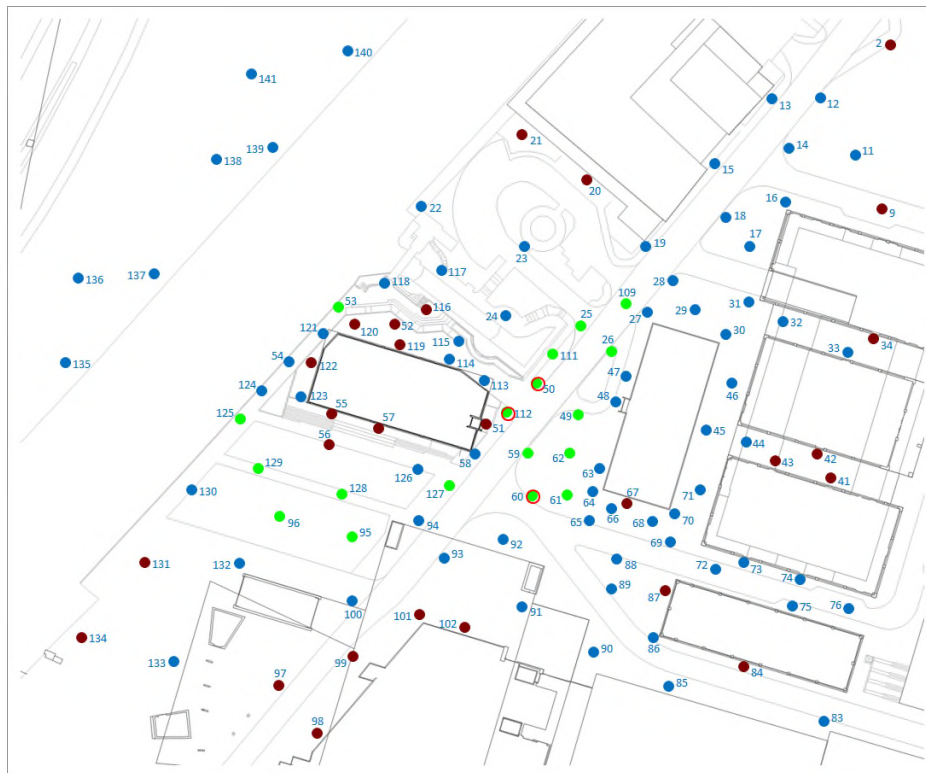
Figure A11.3b - Wind Climate at Site (at Ref. Height of 114 m)
Autumn Wind Speed and Direction Distribution

Winter Wind Speed and Direction Distribution

Spring Wind Speed and Direction Distribution

Summer Wind Speed and Direction Distribution


Figure A11.4a - Pedestrian Level Wind Environment – Annual Comfort and Safety Ratings

Existing
Site
Conditions



Proposed
Development
with
Existing
Surrounds

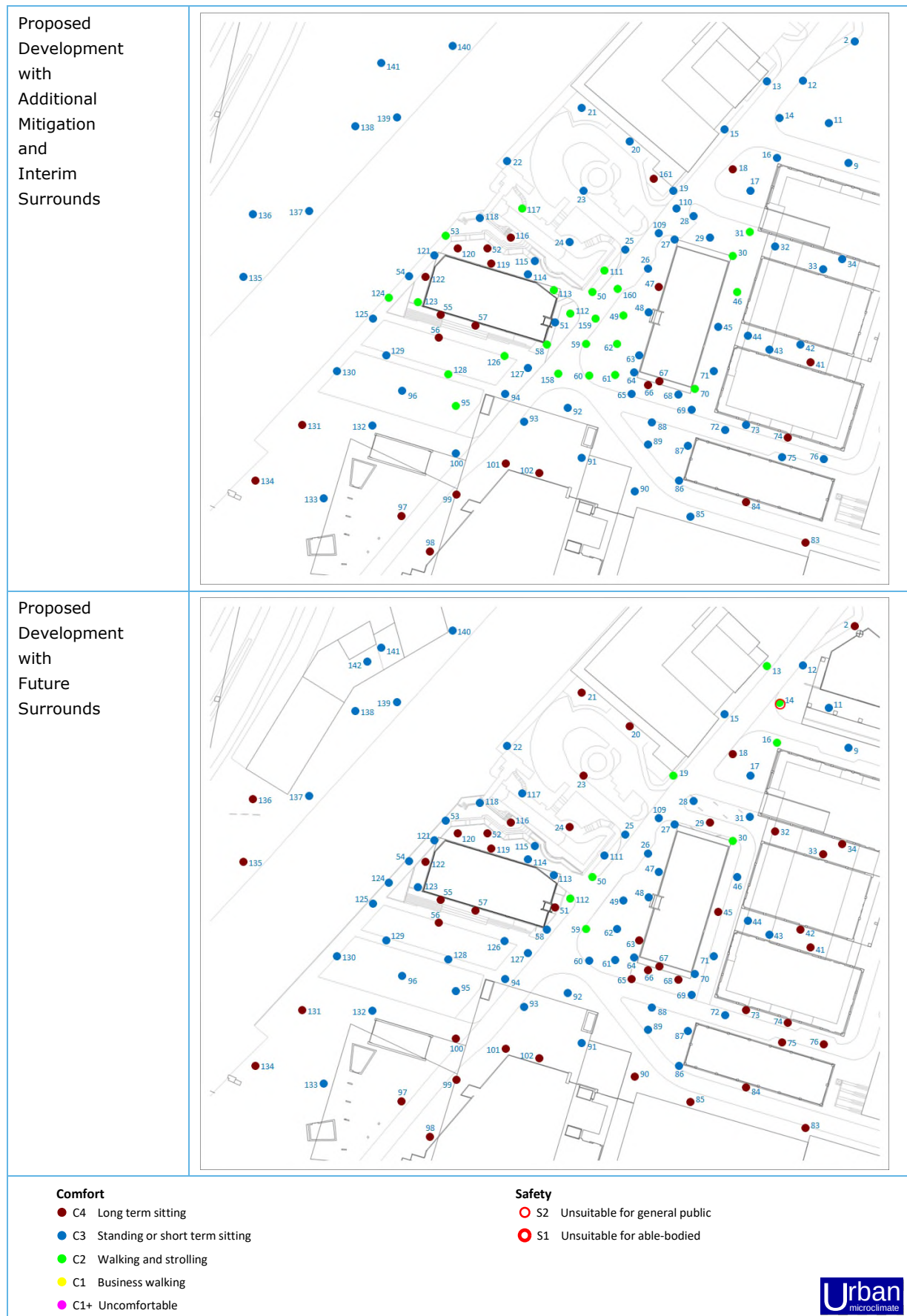


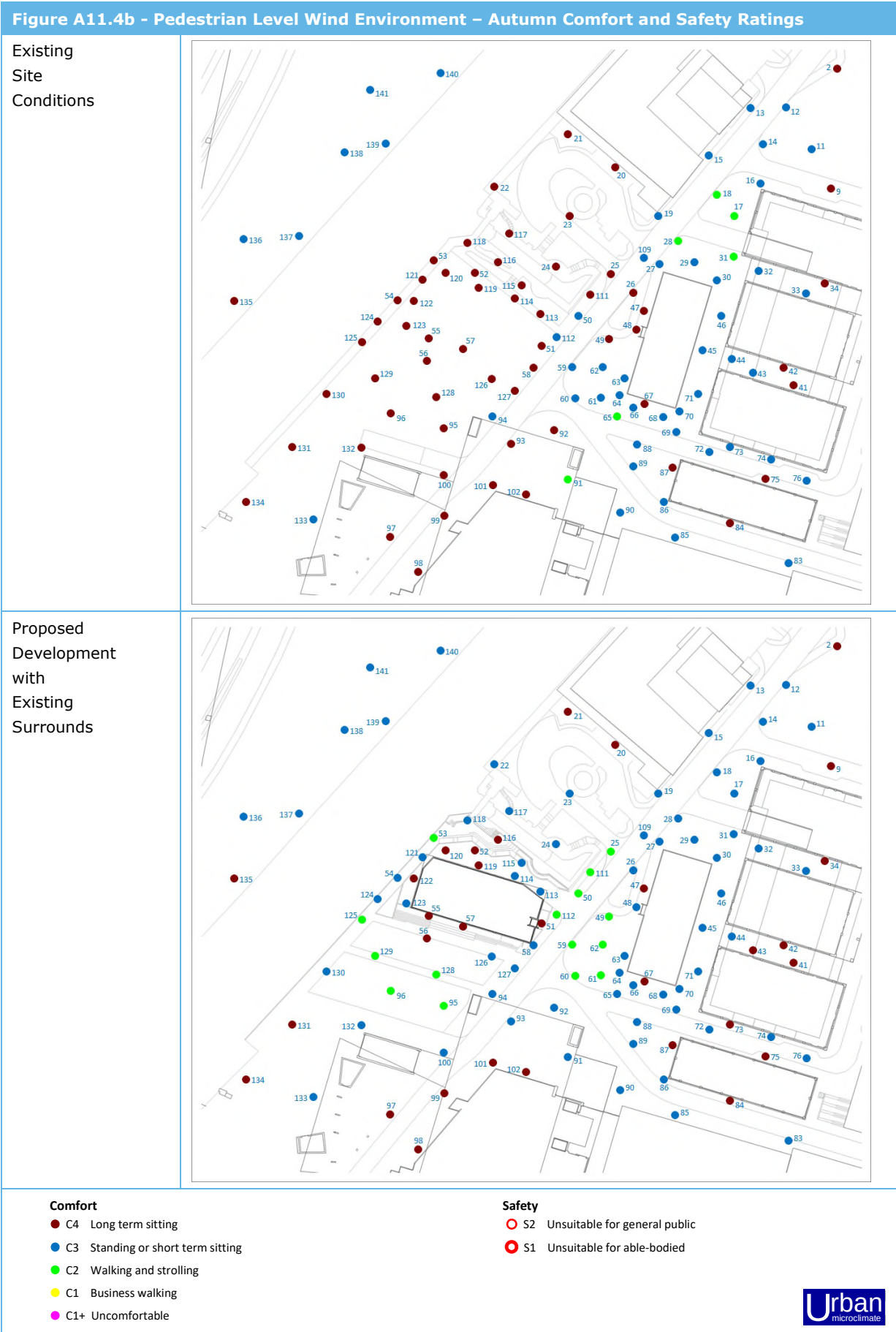
Comfort

- C4 Long term sitting
- C3 Standing or short term sitting
- C2 Walking and strolling
- C1 Business walking
- C1+ Uncomfortable

Safety

- S2 Unsuitable for general public
- S1 Unsuitable for able-bodied





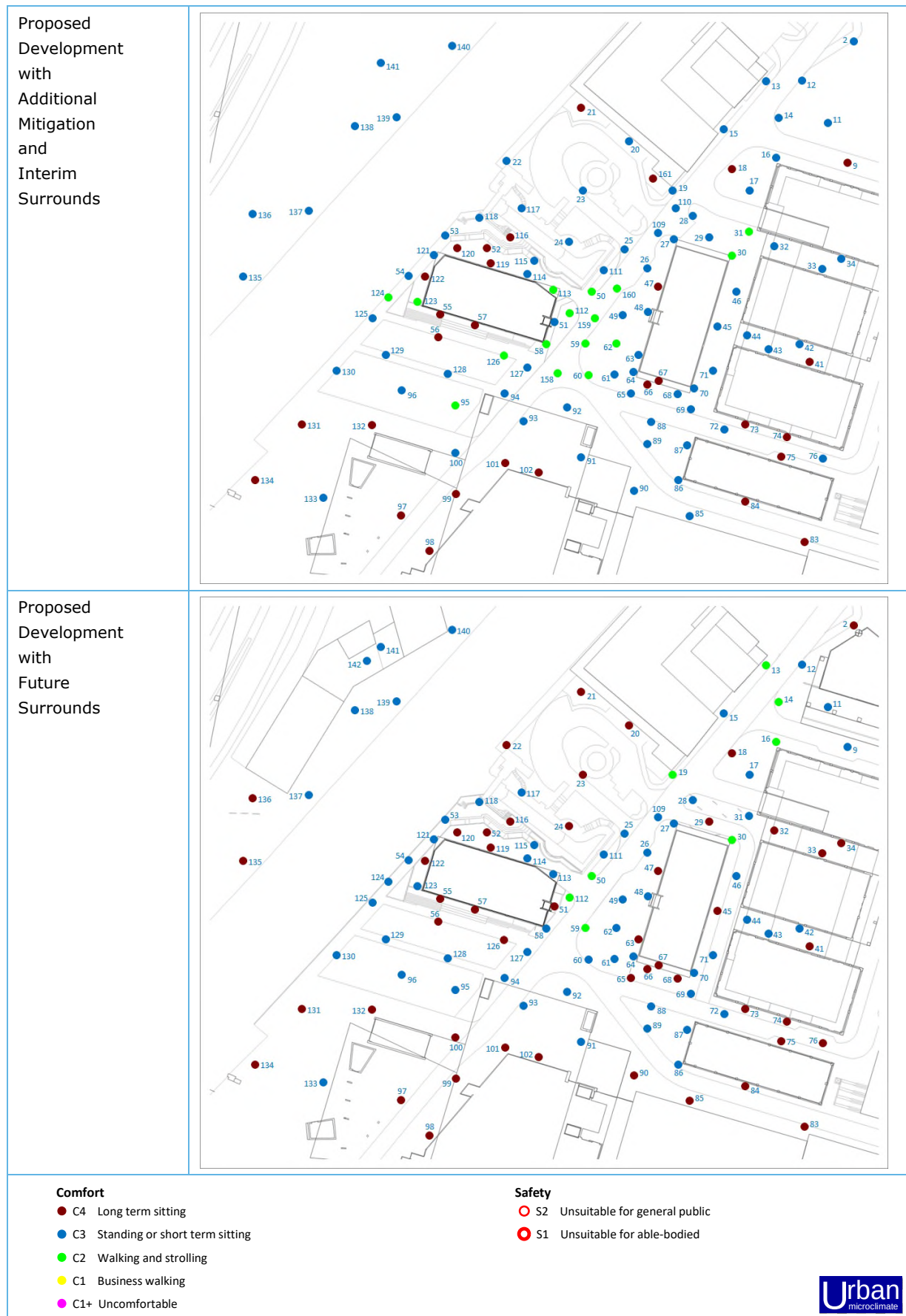
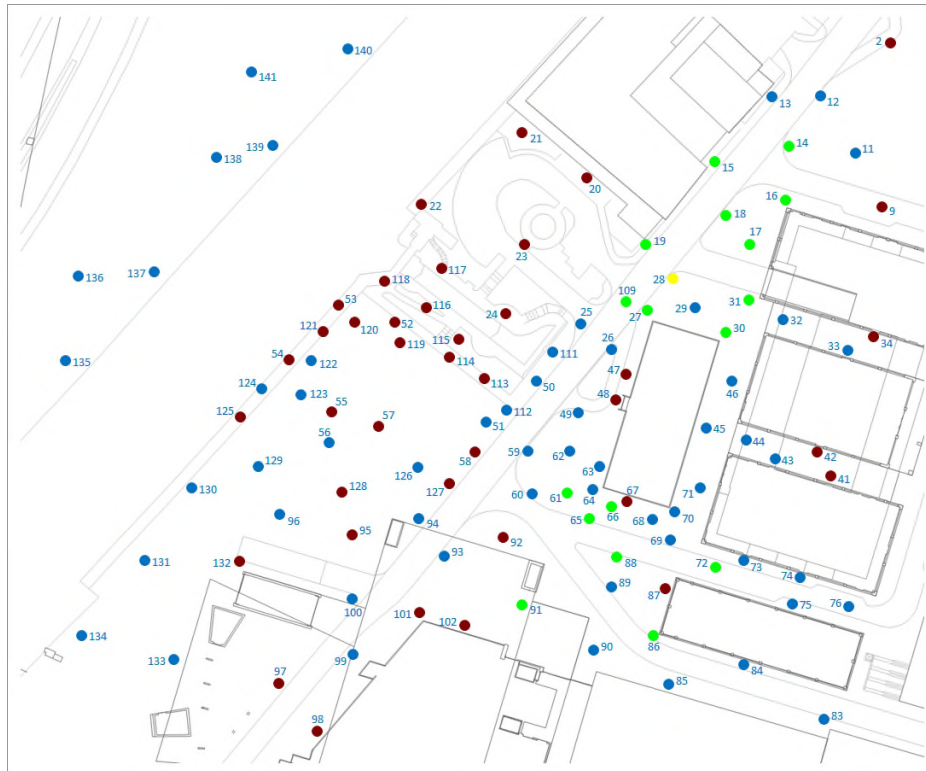
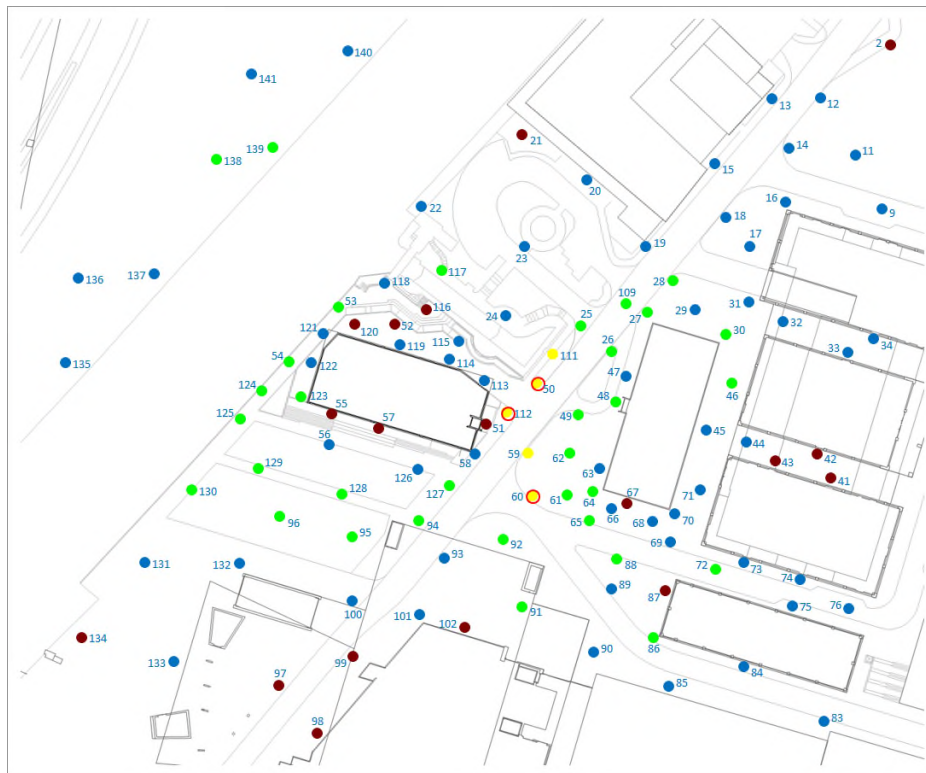


Figure A11.4c - Pedestrian Level Wind Environment – Winter Comfort and Safety Ratings

Existing
Site
Conditions



Proposed
Development
with
Existing
Surrounds



Comfort

- C4 Long term sitting
- C3 Standing or short term sitting
- C2 Walking and strolling
- C1 Business walking
- C1+ Uncomfortable

Safety

- S2 Unsuitable for general public
- S1 Unsuitable for able-bodied

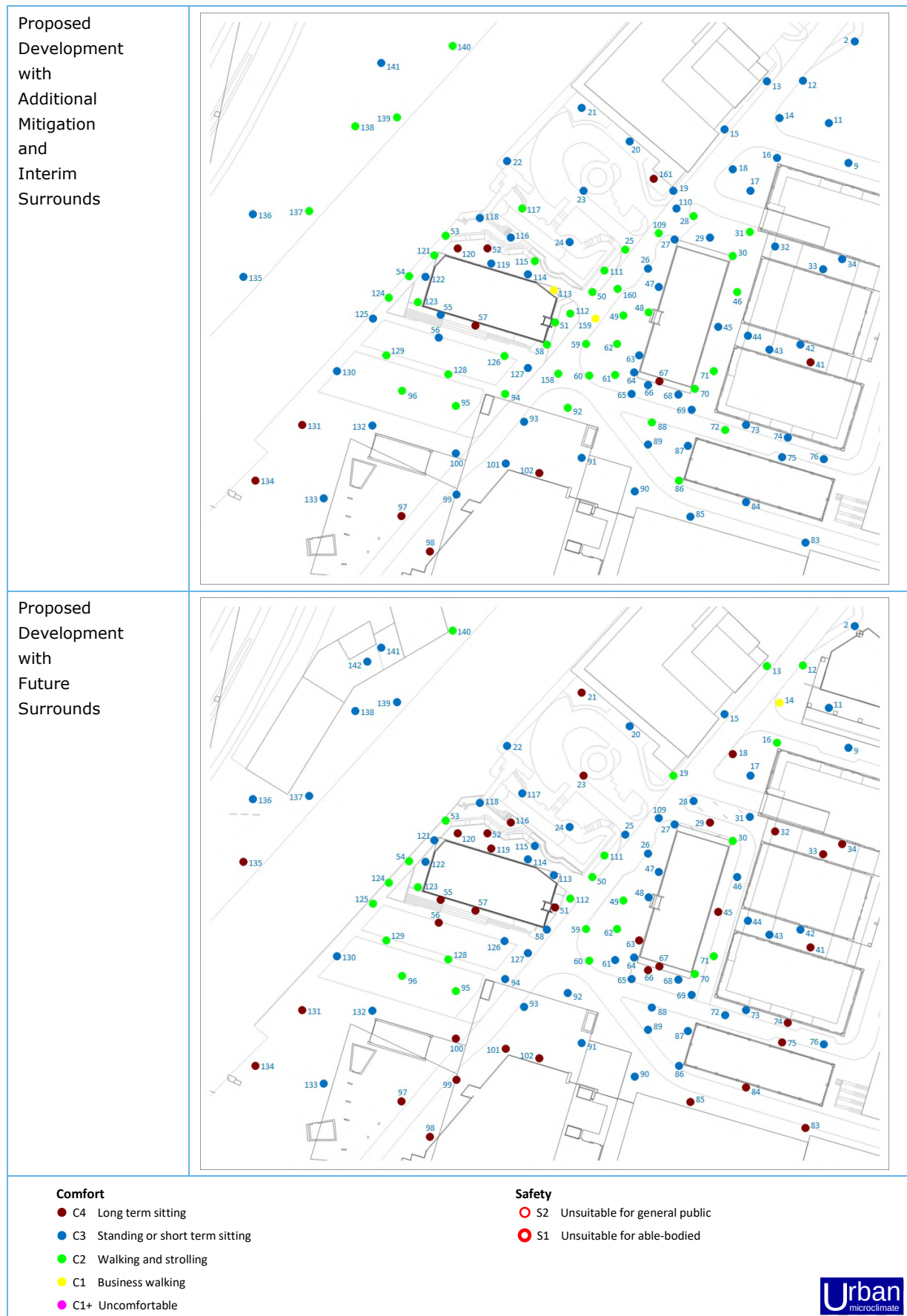
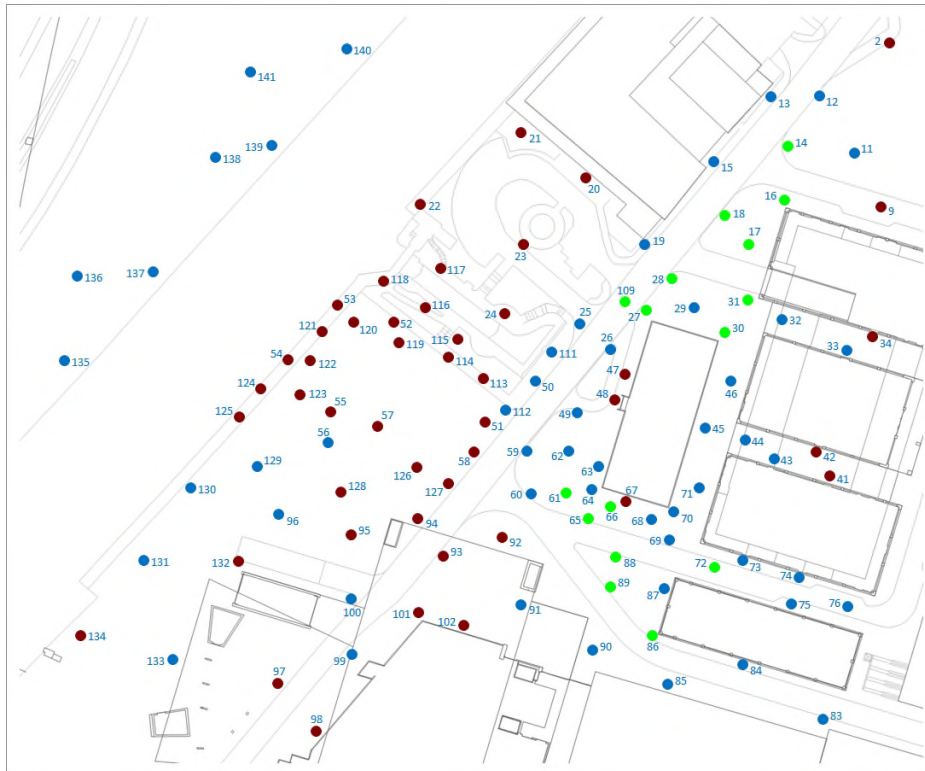
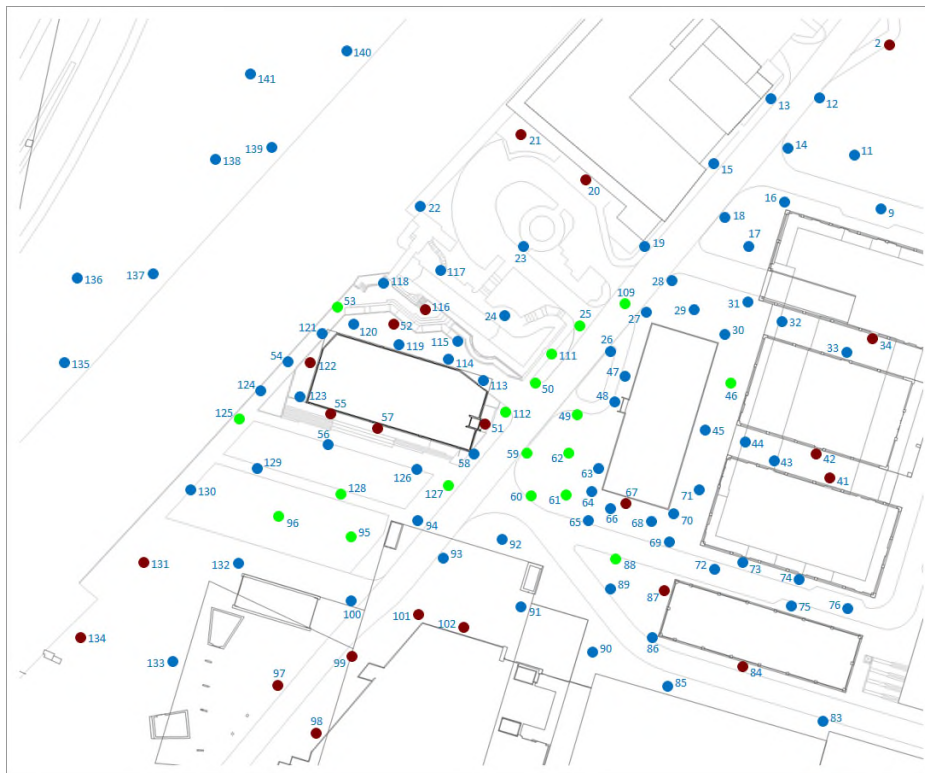


Figure A11.4d - Pedestrian Level Wind Environment – Spring Comfort and Safety Ratings

Existing
Site
Conditions



Proposed
Development
with
Existing
Surrounds

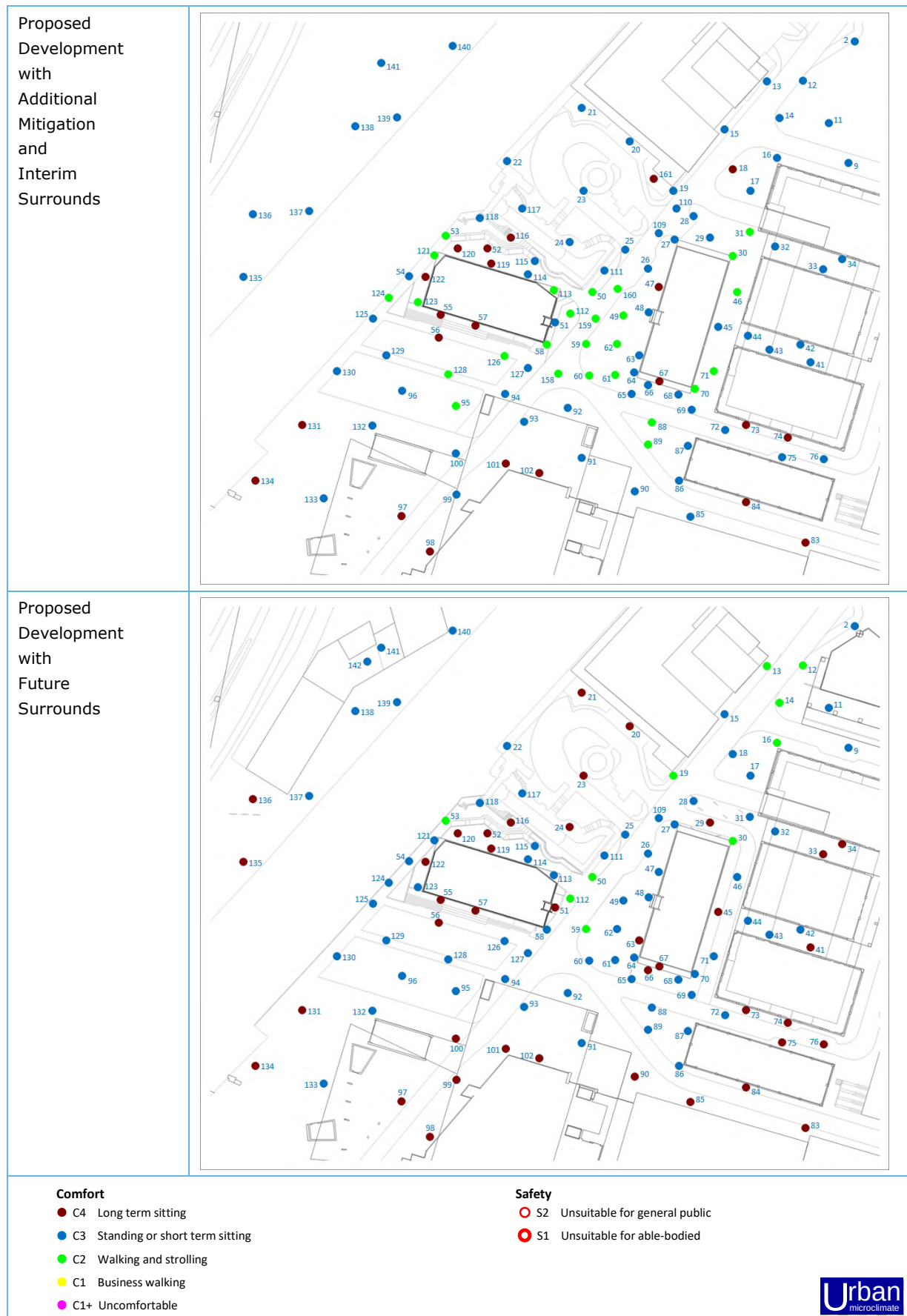


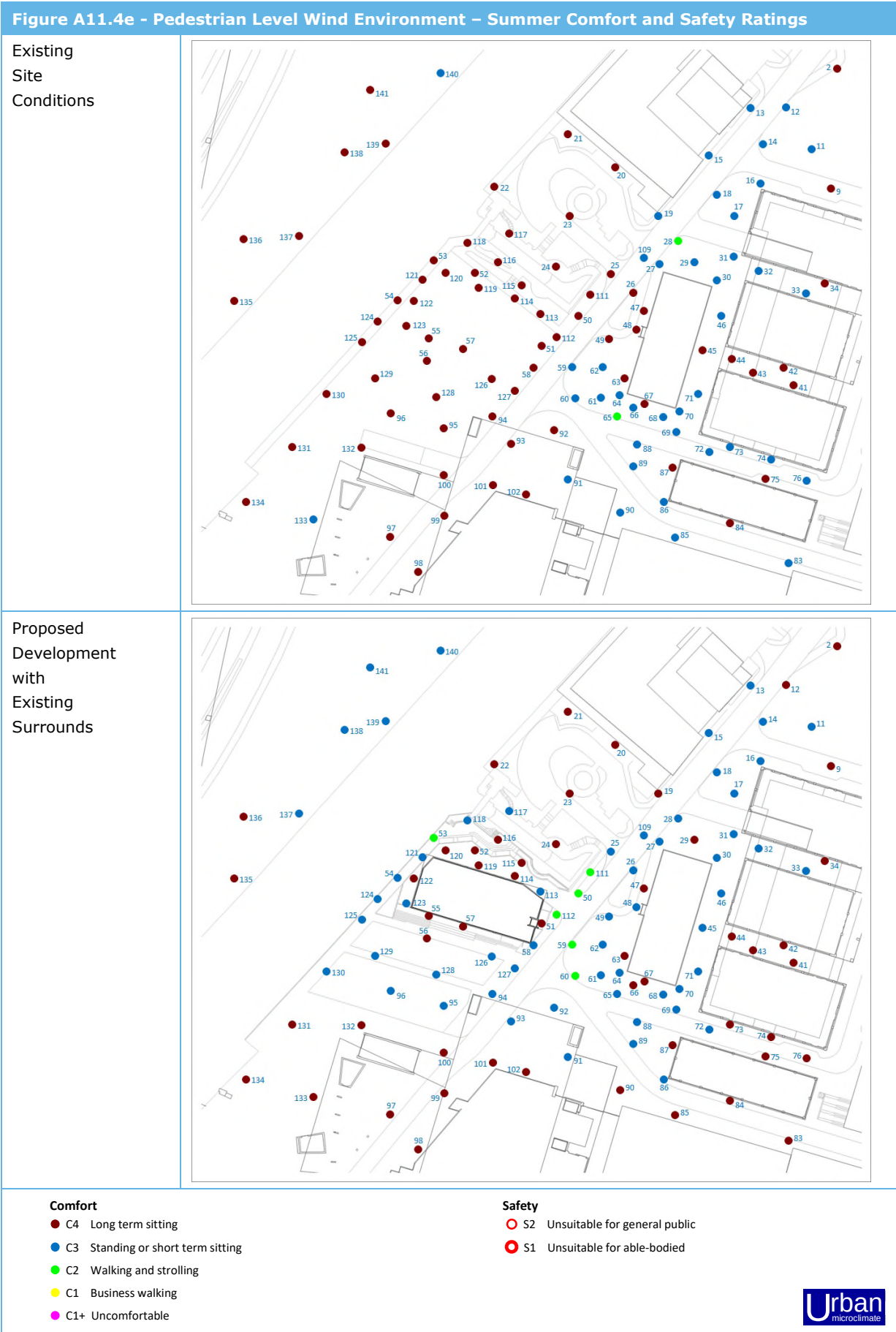
Comfort

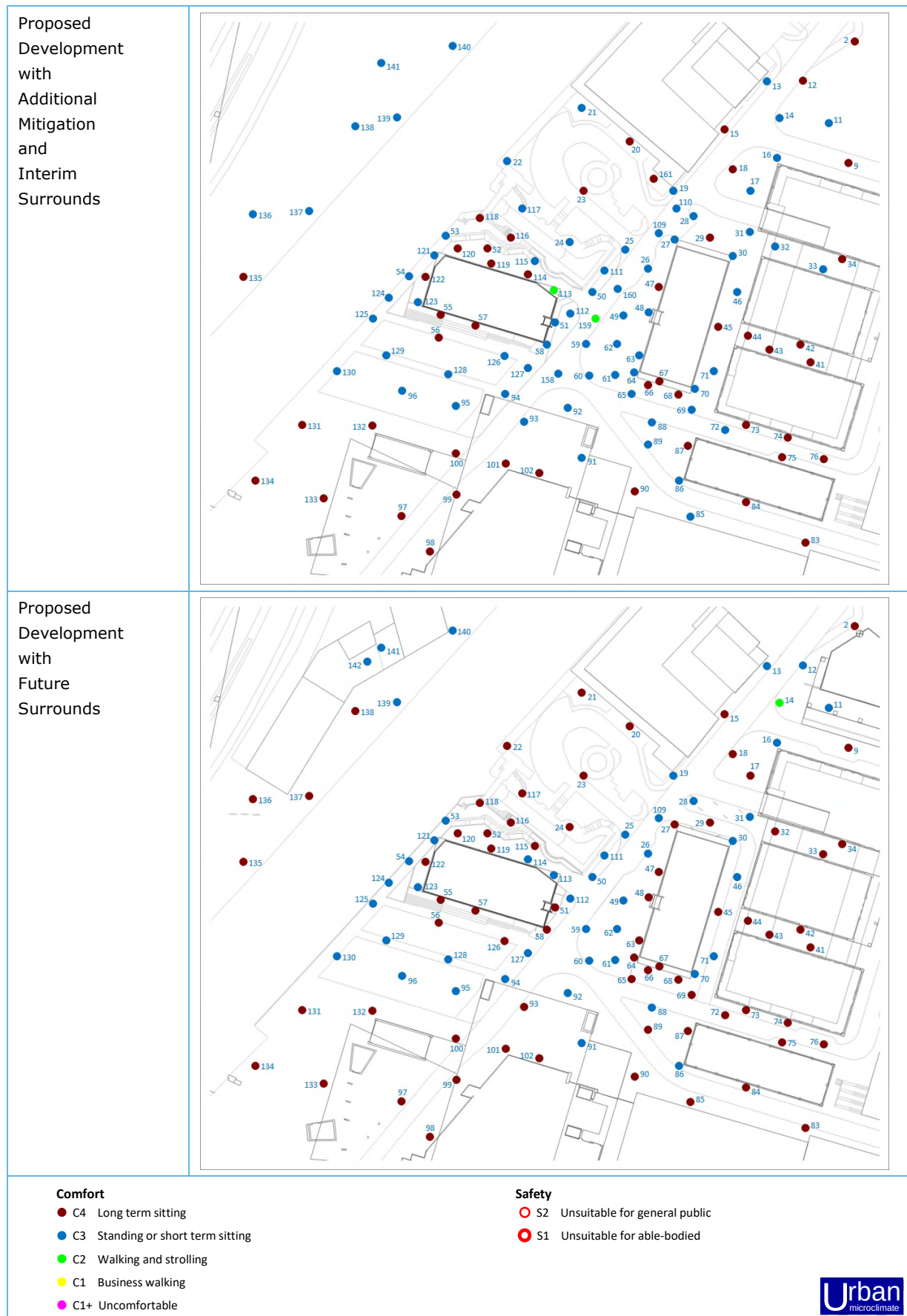
- C4 Long term sitting
- C3 Standing or short term sitting
- C2 Walking and strolling
- C1 Business walking
- C1+ Uncomfortable

Safety

- S2 Unsuitable for general public
- S1 Unsuitable for able-bodied









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