Prepared for

Hong Kong Housing Authority

Prepared by

Ramboll Hong Kong Limited

PROPOSED RESIDENTIAL DEVELOPMENT AT SAN KWAI STREET, KWAI CHUNG

QUANTITATIVE AIR VENTILATION ASSESSMENT

Date	**22 August 2023**
Prepared by	**Echo Cao** **Environmental Consultant**
Signed	
Approved by	**Tony Cheng** **Senior Manager**
Signed	
Project Reference	**HD-EDSF3ED00**
Document No.	**R9120_v1.0.docx**

Ramboll Hong Kong Limited

21/F, BEA Harbour View Centre
56 Gloucester Road, Wan Chai, Hong Kong

Tel: (852) 3465 2888
Fax: (852) 3465 2899
Email: hkinfo@ramboll.com

Q:\Projects\HD-EDSF3ED00\04 San Kwai Street_Kwai Chung\04 Deliverables\05 AVA Report\R9120_v1.0.docx

CHAPTERS

TABLES

FIGURES

APPENDICES

1. INTRODUCTION

1.1 Background

1.1.1 The Subject Site at San Kwai Street is to be developed as Public Housing (PH). The Subject Site is located to the immediate west of San Kwai Street, to the south of Tai Lin Pai Road, and to the east of Kwai Chung Road. It is currently partly used as site offices. The zoning of the Subject Site was "Government, Institution or Community" (G/IC) and "Village" (V) under Kwai Chung Outline Zoning Plan No. S/KC/28 gazetted on 13 June 2014.

1.1.2 One Air Ventilation Assessment – Expert Evaluation was conducted in 2017 to support the rezoning of the Site from air ventilation point of view. It is now zoned as "Residential (Group A)" (R(A)2) under Kwai Chung Outline Zoning Plan No. S/KC/31 gazetted on 18 Nov 2022.

1.1.3 Ramboll Hong Kong Limited has been commissioned to undertake this AVA for the Proposed Development. This AVA contains a quantitative Computational Fluid Dynamics (CFD) assessment to evaluate the potential ventilation impact of the proposed development on the surrounding future pedestrian wind environment.

1.2 Subject Site and its Environs

1.2.1 The Subject Site is located at San Kwai Street, Kwai Chung. It is at low level with 6 mPD to 8 mPD from west to east. A steep slope is located to the immediate south of the Subject Site. A Public Housing Development, Hei Yiu House is situated on that slope.

1.2.2 **Figure 1** shows the location and environs of the Subject Site. The building height of the surrounding developments are indicated in **Figure 2**.

1.3 Baseline Scheme

1.3.1 The Baseline Scheme in this study is one of the design schemes in early design stage dated Mar 2018. The Baseline Scheme consists of one residential block with maximum building height at around 127 mPD on top of a podium with 12.5 mPD.

1.3.2 With reference to the approved AVA-EE report during the rezoning application, the following key mitigation measures have been identified in the OZP-compliant Scheme:

- At least 40m setback from the tower to Ha Kwai Chung Village
- At least 15m setback from the tower to the road kerb of Kwai Chung Road

1.4 Proposed Scheme

1.4.1 **Appendix 2** shows the layout of the proposed scheme for assessment purposes. The development consists of one domestic block with main roof height of 152 mPD. The domestic block consists of 42 domestic storeys and one refuge floor situated on a four-storey podium. Ancillary facilities including podium garden, social welfare facilities, car park, retail facilities and external recreational spaces are provided at the podium.

1.4.2 It is noted that all the key mitigation measures provided in section 1.3.2 have been maintained in the current Proposed Scheme.

1.4.3 When compared to the Baseline Scheme, the Building height is 25m higher in the Proposed Scheme and the tower setback to the northern edge is reduced from around 30m to around 20m. Since the differences in the Proposed Scheme do not impact the

identified mitigation measure listed in section 1.3.2, it is anticipated that the ventilation performance of the Proposed Scheme would not be significantly worse than the OZP-compliant Scheme.

1.4.4 Under the Proposed Scheme, higher building height is pursued so as to reduce the building footprint and enable provision of podium setback which could serve as air corridor. Higher building height also allows the creation of more permeability for wind penetration that aims to provided benefit locally.

1.4.5 While noting that building height of Proposed Scheme than that of the Baseline Scheme and may impose more blockage at higher level, it could also generate downwash wind, which would offset the high-level blockage impact in some extent, and could benefit the air ventilation of the area in-between the tower and in close vicinity.

2. SITE WIND AVAILABILITY

2.1 Site Wind Availability Data

2.1.1 According to the Planning Department's website, a meso-scale Regional Atmospheric Modeling System (RAMS) has been used to produce a simulated 10-year wind climate at the horizontal resolution of 0.5 km x 0.5 km covering the whole territory of Hong Kong. The simulated wind data represents the annual, winter and summer wind condition at various levels, i.e. 200 m, 300 m, and 500 m above terrain.

2.1.2 It is considered acceptable to use the simulated RAMS data for site wind availability. The use of RAMS data (grid: 071, 050) is preferred over measurement data at Waglan Island as it can reflect the effect of topography on wind availability.

2.1.3 The relevant annual windrose for the concerned district has been extracted from the Planning Department's website for site wind availability data. **Figure 4** shows the relevant windrose diagram (at 500 m) representing the frequency and wind speed distribution of the concerned district for both summer and annual conditions.

2.1.4 The windroses results illustrate the wind environment is affected by topography and buildings. **Table 2.1** below sets out a summary of the simulated site wind availability data including the probability of occurrence. In this quantitative AVA a CFD software has been used. According to the Technical Guide, simplification of wind data for the initial study has been adopted. The wind directions with highest probability of occurrence are selected for AVA purpose. A total of 11 wind directions has been selected (as highlighted in **Table 2.1**) with overall frequency of occurrence equivalent to 78.4 % and 81.0 % respectively of the time in a year (for both annual and summer conditions).

Table 2.1 Summary of RAMS Data and Wind Direction

Wind Direction	Probability for Annual Condition (%)	Probability for Summer Condition (%)
N	1.9	1.0
NNE	5.8	1.6
NE	10.3	2.1
ENE	12.3	2.8
E	16.9	7.4
ESE	11.2	9.0
SE	7.1	7.7
SSE	5.1	7.8
S	6.3	11.8
SSW	8.5	18.0
SW	5.5	13.2
WSW	2.7	6.1
W	2.4	5.0
WNW	1.4	2.9
NW	1.3	2.1
NNW	1.2	1.3

2.2 Topography and Building Morphology

Topography

2.2.1 The topography close to the Subject Site is generally flat to the west. The ground elevation increases gradually to about 100 mPD of Lai Yiu Estate towards east. Wonderland Villa at the high mountain is located about 500m to the southeast of the Subject Site with hilltop at about 230 mPD. Golden Hill with elevation up to 300 mPD is located at 1.3 km to the northeast of the Subject Site.

Building Morphology

2.2.2 There are mainly mid-rise to high-rise industrial buildings, i.e. Golden Dragon Industrial Centre Block 1 to 4 (about 90mPD), Goldfield Industrial Building (about 96mPD) located at the north to northeast of the Subject Site. Mid-rise Kwai Chung Depot and VTC Kwai Chung Complex (about 30mPD and 53mPD respectively) are located to the immediate east of the Subject Site. There are some low-rise village houses (about 30mPD) at the immediate southeast of the Subject Site. A proposed public housing (about 165mPD) at Lai Cho Road and high-rise residential buildings such as Fu Yiu House and Lok Yiu House (about 120mPD and 148mPD) are located at the south of the Subject Site. Besides, high-rise residential buildings, i.e. Kwai Tsui Estate (about 90mPD) and Kwan Fong Terrace (about 100mPD) are located at the west of the Subject Site. New Kwai Fong Garden Block A to E are located at the further west of the Subject Site. Kwai Ching House and Kwai Ming House (about 114mpD) are located at the northwest of the Subject Site. Kwai Oi House with about 70mPD is located at the further northwest of the Subject Site.

2.2.3 There are some open parks/playgrounds near the Subject Site. Central Kwai Chung Park is located at about 200m to the northeast to southeast of the Subject Site. This area is an open park that no wind obstruction at this area. Kwai Yi Road Playground is located at about 170m to the southwest of the Subject Site which is next to the Kwai Fong Terrace.

3. QUANTITATIVE ASSESSMENT METHODOLOGY

3.1 Atmospheric Conditions

3.1.1 Simulated wind profile curves are extracted from the Planning Department's website using RAMS site wind availability data and is directly adopted for this quantitative AVA. **Figure 5** shows the wind profile curves for grid X:071, Y:050.

3.1.2 Wind profile curves 0, 1 and 2 would be utilized for quantitative AVA according to the selected wind directions in **Table 2.1**.

3.1.3 For elevation from 0 to 10 m where wind profile information is not available, the wind speed is assumed based on fitted Log Law and measured wind speed value at 10 m from the RAMS site wind availability data for each wind profile curve.

3.1.4 The wind profile of 0 m to 10 m is interpolated and then combined with the wind profile curves on RAMS site wind availability data.

3.2 CFD Code and Major Parameters

3.2.1 A quantitative assessment based on requirement for Initial Study stipulated in the relevant Technical Guide has been conducted for the purpose of comparing the air ventilation performance between the Proposed and the Baseline Schemes.

3.2.2 The quantitative assessment is conducted by using a commercial CFD code, FLUENT. FLUENT model had been widely applied for various AVA research and studies worldwide. The accuracy level of the FLUENT model is well-accepted by the industry for AVA application.

3.2.3 Realizable K-epsilon turbulence providing better prediction of separation and vortexes has been adopted for air ventilation assessment as recommended in COST action C14.

3.2.4 Generally, the assessment area is determined by the height (H = 150m) of the highest building within the surrounding area. The domain covers the model area of over 300m. The surrounding area is determined by 2 times of the assessment area from the project site boundary. It is confirmed that all major noise barriers, elevated structures, and planned / committed / existing developments have been modelled in the simulation. **Figure 1** indicated the assessment area and surrounding area of the CFD model.

3.2.5 The domain dimension is about 4000m x 4000m and with an elevation of 1500m. More than 7,900,000 grid cells have been defined to simulate the air flow. Given the large domain adopted in this assessment and the physical limitation on the computational resources of the CFD model, the horizontal and vertical grid size employed in the CFD model in the vicinity of the Project Area is taken as a global minimum size of 2m and increase for the grid cells further away from the Project Area at a growth ratio of 1.3. The global maximum size of cells is 32m and smaller cell size up to 0.5m was used. Besides, four layers of prism cells (each layer of 0.5m thick) are employed above the terrain of Subject Site. The blockage ratio is less than 3%.

3.2.6 The windward boundary is defined as inflow with the wind profile defined. The leeward boundary is defined as outflow. The sky and lateral boundaries are defined as symmetric boundary condition.

3.2.7 **Appendix 3** shows the domain size and the CFD model in different views. **Figure 5** shows the wind profile curve adopted.

3.2.8 The advection terms of the momentum and viscous terms are resolved with the second order numerical schemes. The scaled residuals are converged to an order of magnitude of at least 1 x 10-4 as recommended in COST action C14.

3.3 Important Areas

3.3.1 The important surrounding areas that the public would often access have been identified as follows:

(1) Lai Yiu Estate
(2) Lai Yiu Street
(3) Lai Cho Road
(4) San Kwai Street
(5) Ha Kwai Chung Village
(6) Tang Uk Street
(7) Tai Lin Pai Road
(8) Kwai Chung Road
(9) Kwai Foo Road
(10) Kwai Chung Police Station
(11) Kwai Yi Road
(12) Kwai Fong Estate

3.4 Test Point Location

3.4.1 A total of 100 test points (including 30 numbers of perimeter test points defined along the boundary of the Subject Site, 70 numbers of overall test points) have been selected for quantitative air ventilation assessment. The overall test points generally representing important pedestrian areas are listed in Section 3.3. All test points are located at 2 m above ground level.

3.4.2 **Figures 6** shows the location of test points for quantitative air ventilation assessment.

4. KEY FINDINGS

4.1 Spatial Average Wind Velocity Ratios

4.1.1 The velocity ratio under a specific wind direction at a test point is calculated by dividing the simulated wind speed at the test point under this wind direction with the velocity at gradient height under the same wind direction. All test points are located at 2 m above ground level.

4.1.2 **Table 4.1** shows the Site spatial average velocity ratio (SVR), local spatial average velocity ratio (LVR) and average wind velocity ratio along surrounding air sensitive area during annual condition and summer condition (for the Baseline Scheme (BS) and Proposed Scheme (PS)).

4.1.3 The wind velocity ratios of individual test points are shown in **Figure 7a** and **Figure 8a** for annual condition of the Baseline Scheme and Proposed Scheme respectively, and **Figure 7b** and **Figure 8b** for summer condition of the Baseline Scheme and Proposed Scheme respectively. **Appendix 4** shows detailed simulation results of the Baseline Scheme and the Proposed Scheme respectively.

Table 4.1 Summary of Spatial Average Wind Velocity Ratios (VR) – Annual and Summer Condition

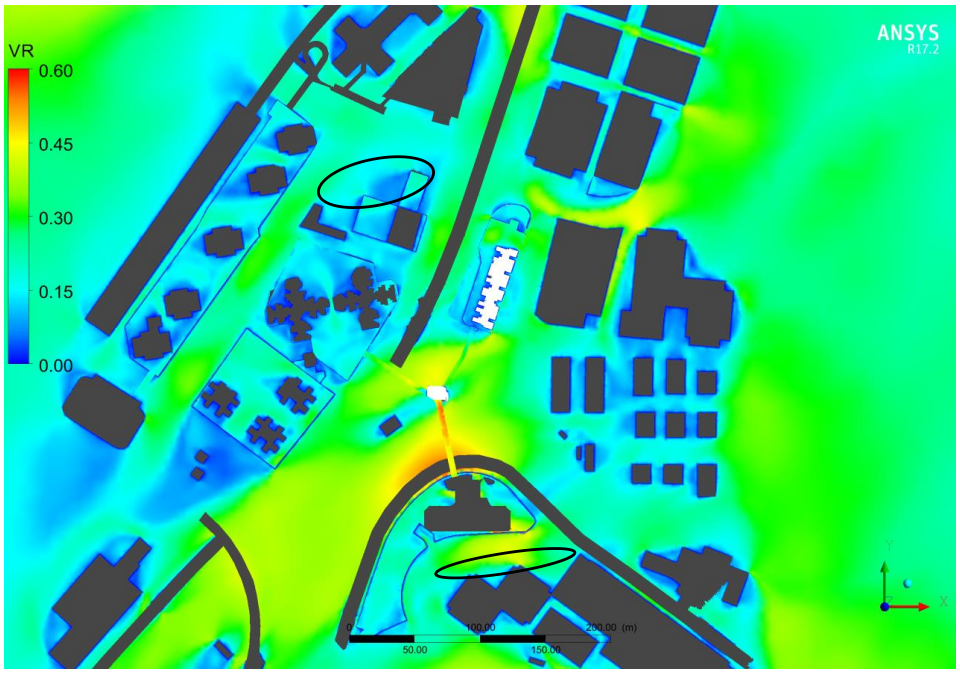
Location	Tests Point	Annual Condition		Summer Condition	
		BS	PS	BS	PS
SVR	P01-P30	0.26	**0.27**	0.25	**0.26**
LVR	P01-P30,T03-T04,T14-T17,T25-T31,T37-T42,T44-T45,T48-T50,T57-T64,T68-T105	0.24	0.24	0.24	0.24
Lai Yiu Estate	T03-T04,T17	**0.32**	0.29	**0.29**	0.27
Lai Yiu Road	T14-T16, T25-T26	**0.29**	0.28	**0.32**	0.31
Lai Cho Road	T25-T31	**0.36**	0.29	**0.40**	0.38
San Kwai Street	P15,P17,P19,T41,T57-T64	**0.19**	0.18	0.16	**0.18**
Ha Kwai Chung Village	T37-T40, T42,T44-T45	0.16	0.16	**0.18**	0.17
Tang Uk Street	T48-T50	0.12	**0.14**	**0.12**	0.11
Tai Lin Pai Road	T68-T74	0.18	**0.21**	0.17	0.17
Kwai Chung Road	P01,P03,P05,P07,P09,P11,T75-T87,T104-T105	0.27	**0.28**	0.26	0.26
Kwai Foo Road	T77,T88-T90,T100	**0.14**	0.13	0.14	0.14
Kwai Chung Police Station	T91-T92	**0.16**	0.13	0.16	0.16

Note: Highlighted in **red** where VR is higher in the Proposed Scheme

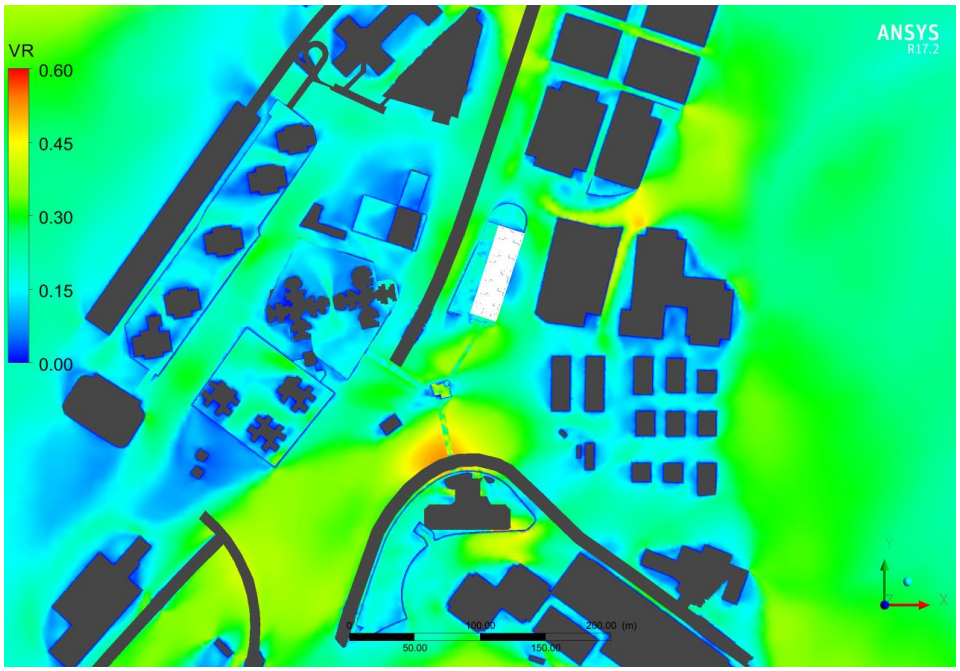
Highlighted in **blue** where VR is higher in the Baseline Scheme

4.2 Annual and Summer Weighted Average Contour

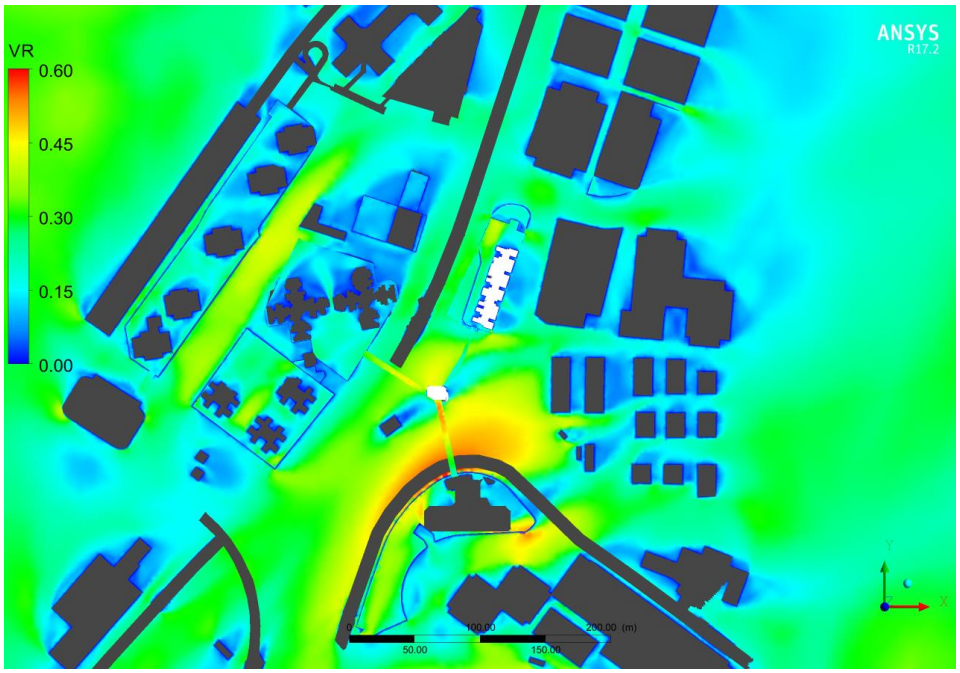
4.2.1 The annual and summer weighted average contour extracted below.



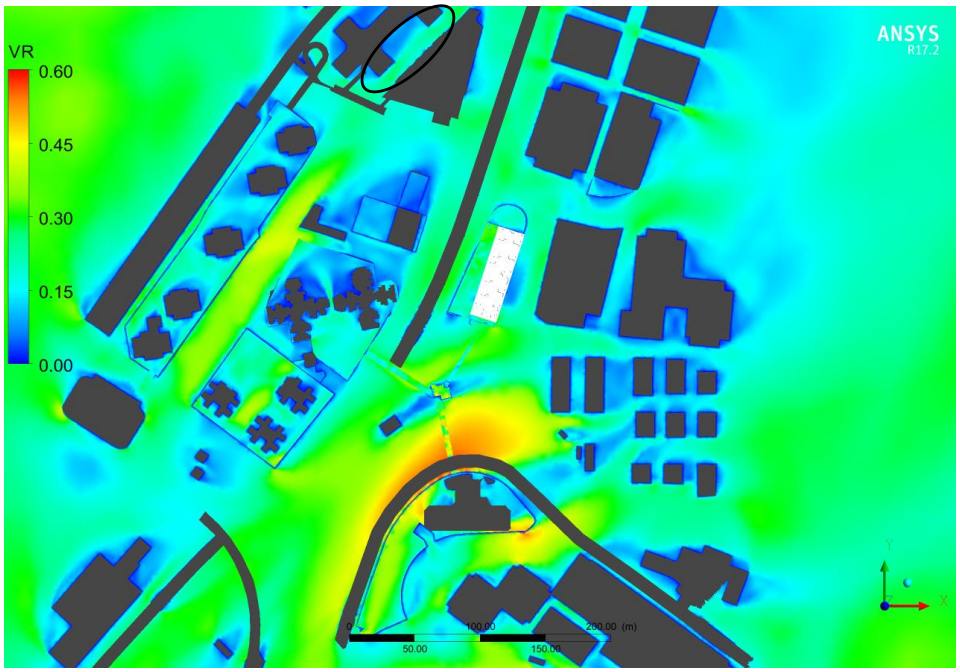
Annual Weighted Average Contour Plot for Baseline Scheme



Annual Weighted Average Contour Plot for Proposed Scheme



Summer Weighted Average Contour Plot for Baseline Scheme



Summer Weighted Average Contour Plot for Proposed Scheme

4.3 Discussion on Air Ventilation Performance

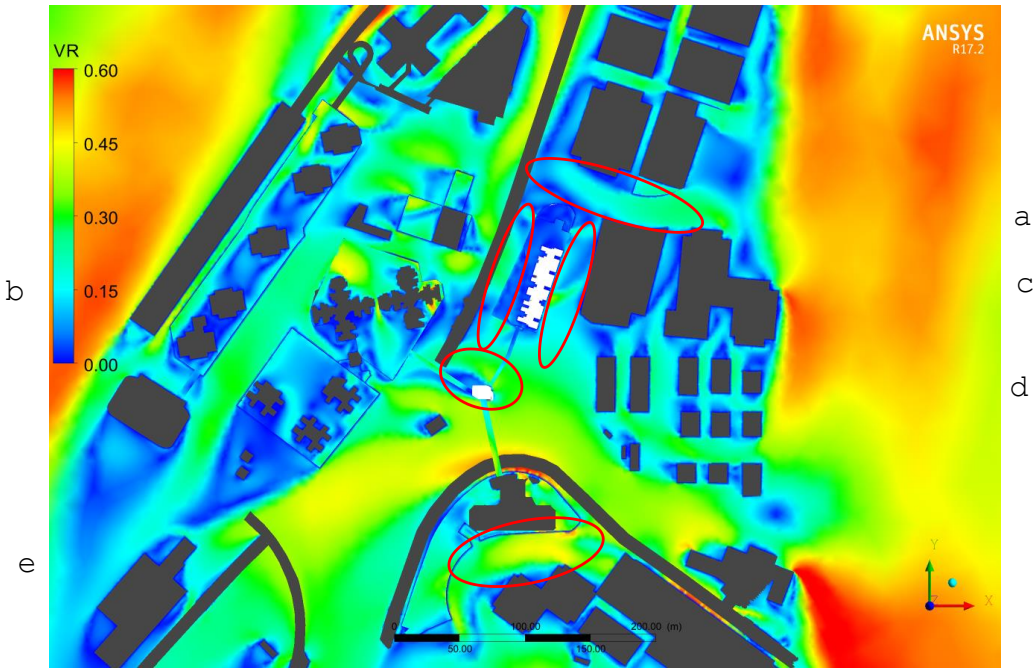
4.3.1 According to Table 4.1 and the weighted average contour above, it is noted that the SVR is slightly higher in the Proposed Scheme but the LVR is comparable between the two design schemes under both annual and summer condition. Based on the result, the proposed development would not induce a significant impact to the nearby area in air ventilation term under both annual and summer condition. This may be owing to the higher tower of the Proposed Scheme collecting the high-level wind and diverting them to the surrounding areas.

4.3.2 There are some variations in VR between two schemes. The VR of some areas is higher under the Proposed Scheme, including San Kwai Street (summer condition), Tang Uk Street (annual condition), Tai Lin Pai Road (annual condition) and Kwai Chung Road (annual condition).

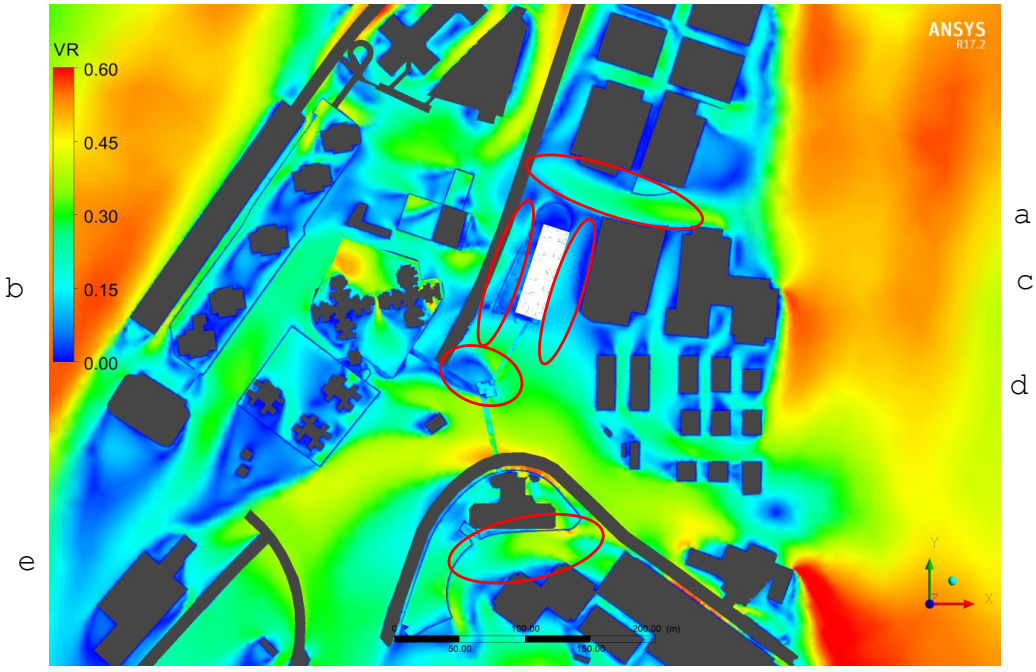
4.3.3 Under the summer condition, the areas with higher VR under the Baseline Scheme are Lai Yiu Estate (annual and summer condition), Lai Yiu Road (annual and summer condition), Lai Cho Road (annual and summer condition), San Kwai Street (annual condition), Tang Uk Street (summer condition), Kwai Foo Road (annual condition) and Kwai Chung Police Station (annual condition).

4.4 Directional Analysis

Wind performance under wind direction of NNE



Contour plot for Baseline Scheme



Contour plot for Proposed Scheme

4.4.1 Under NNE wind, the wind would mainly flow along Kwai Chung Road or from Central Kwai Chung Park and the area between Lai Cho Road and Ha Kwai Chung Village to reach the Subject Site.

a. The tower setback of the Proposed Scheme to the northern edge is reduced from around 30m to 20m when compared to the Baseline Scheme. The channelized effect improves the wind performance at Tai Lin Pai Road. Thus, the VR at this section of Tai Lin Pai Road is higher under the Proposed Scheme.

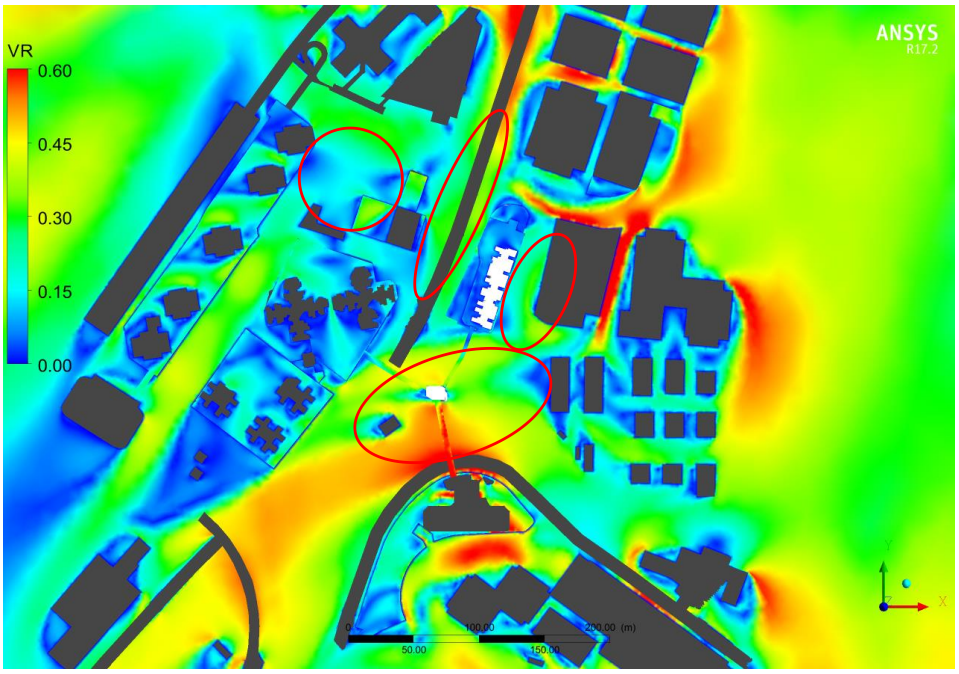
b. The driveway on the ground floor of the Baseline Scheme has larger permeability at west-east alignment, which could facilitate more upcoming wind along Kwai Chung Road to pass through the Subject Site. Therefore, the VR at Kwai Chung Road to the immediate west of the Subject Site is slightly higher under the Baseline Scheme.

c. As mentioned above, the higher permeability along west-east direction at the ground floor under the Baseline Scheme improves the wind performance at San Kwai Street.

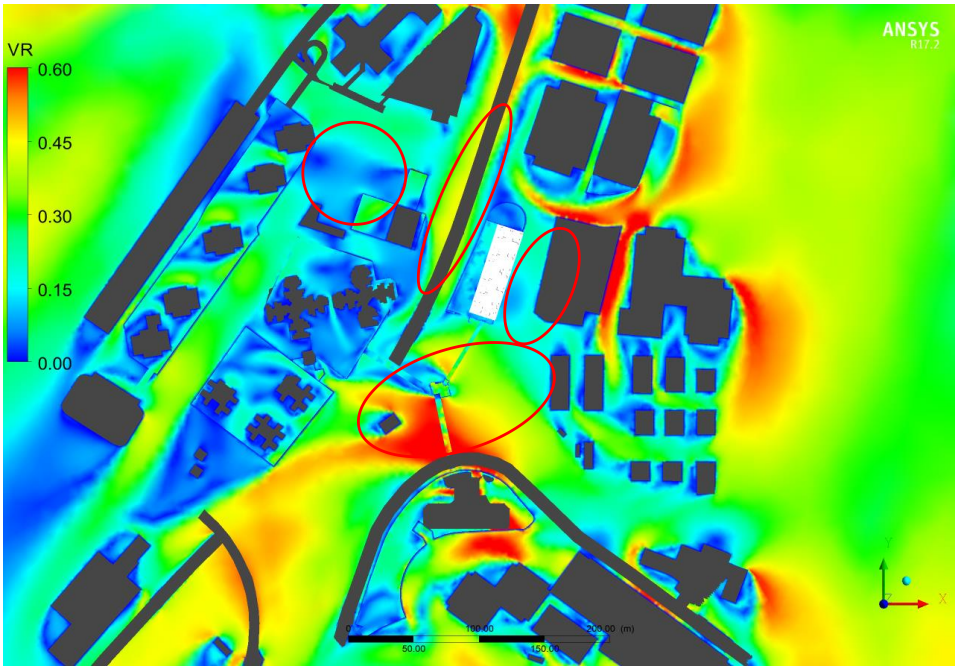
d. The minor different design of the elevated walkway and lift tower at the southern part of the site induces different wind flow pattern near the lift tower.

e. The higher building height of the tower under the Proposed Scheme and the different design of the lift tower/ elevated walkway has minor impact on the upcoming wind from the area between Ha Kwai Chung Village and Lai Cho Road. Slightly lower VR is observed at Lai Yiu Street.

Wind performance under wind direction of NE



Contour plot for Baseline Scheme



Contour plot for Proposed Scheme

4.4.2 Under NE wind, the wind would mainly flow along Kwai Chung Road or from Central Kwai Chung Park and the area between Lai Cho Road and Ha Kwai Chung Village to reach the Subject Site.

a. The increased height of the podium and tower as well as the decreased setback from the tower to the northern edge under the Proposed Scheme creates more downwash flow and benefits the wind performance at Kwai Chung Road.

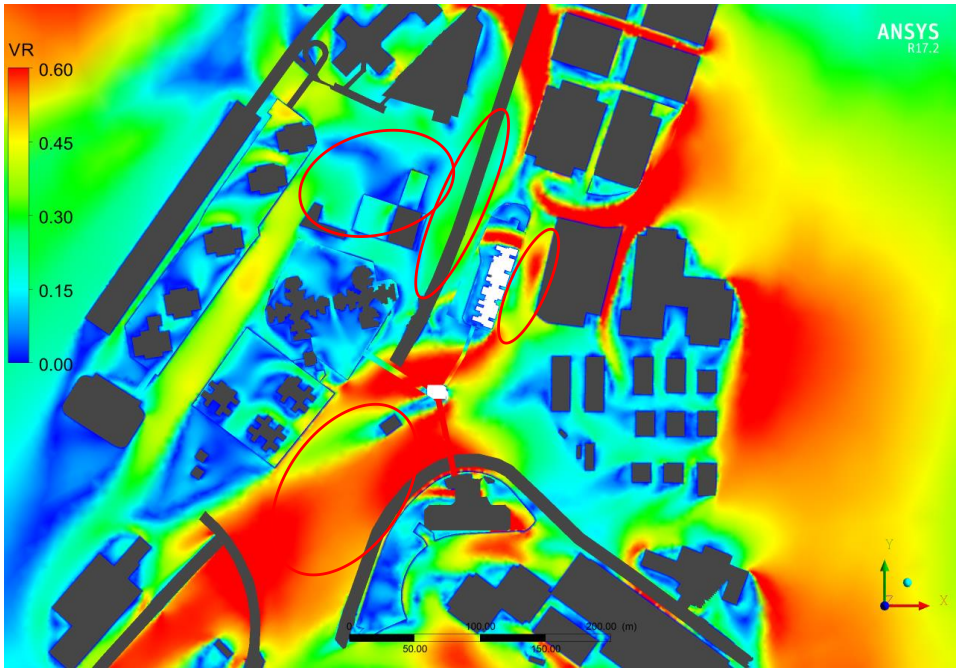
b. The minor different design of the elevated walkway and lift tower at the southern part of the site induces different wind flow pattern near the lift tower.

c. Part of the upcoming flow from the area between Lai Cho Road and Ha Kwai Chung Village flows towards north along San Kwai Street. Slightly less wind flows along San Kwai Street to north under the Proposed Scheme.

d. The higher building height of the tower and the decreased setback from tower to the northern edge has some blockage effect and impact on Kwai Chung Police Station at the downwind area.

Wind performance under wind direction of ENE

b



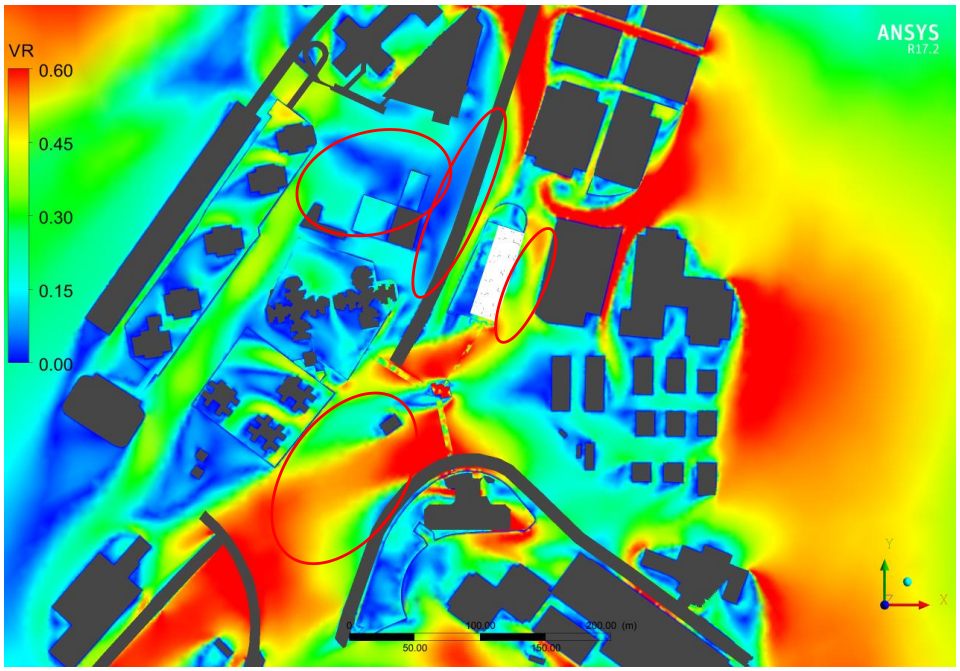
a

c

d

Contour plot for Baseline Scheme

b



a

c

d

Contour plot for Proposed Scheme

4.4.3 Under ENE wind, the wind would mainly flow along Kwai Chung Road and Tai Lin Pai Road or from Central Kwai Chung Park and the area between Lai Cho Road and Ha Kwai Chung Village to reach the Subject Site.

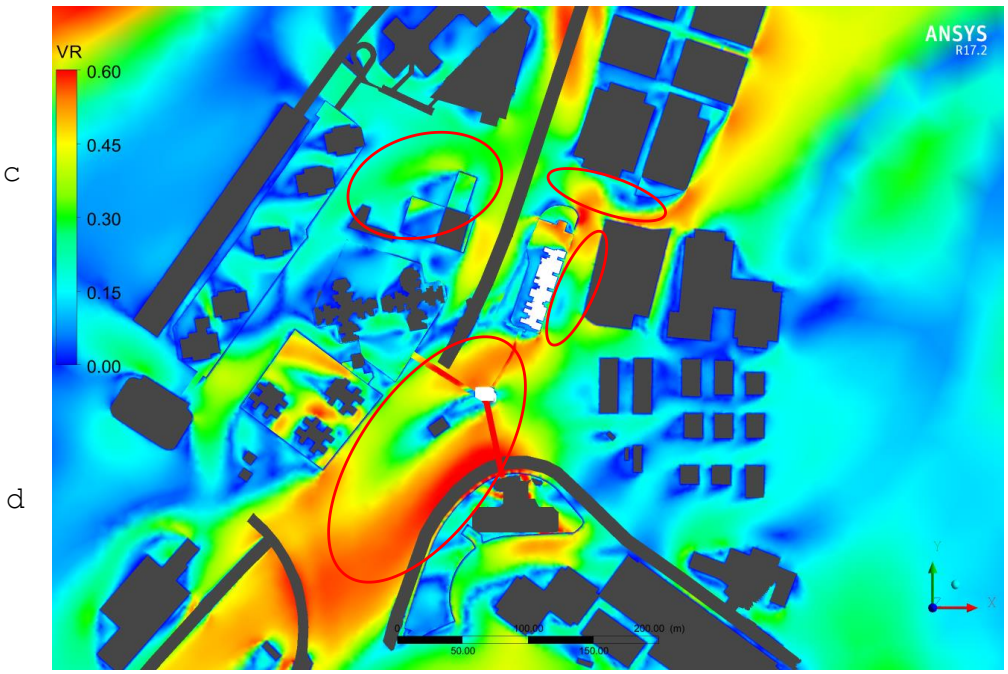
a. The larger setback from tower to the northern edge in the Baseline Scheme could facilitate more wind flowing towards west above the podium. In addition, the higher building height of the Proposed Scheme causes larger wake area. Thus, the VR of Kwai Chung Road is lower under the Proposed Scheme.

b. Similarly, the higher building height of the Proposed Scheme causes larger wake area at the downwind area, such as Kwai Chung Police Station.

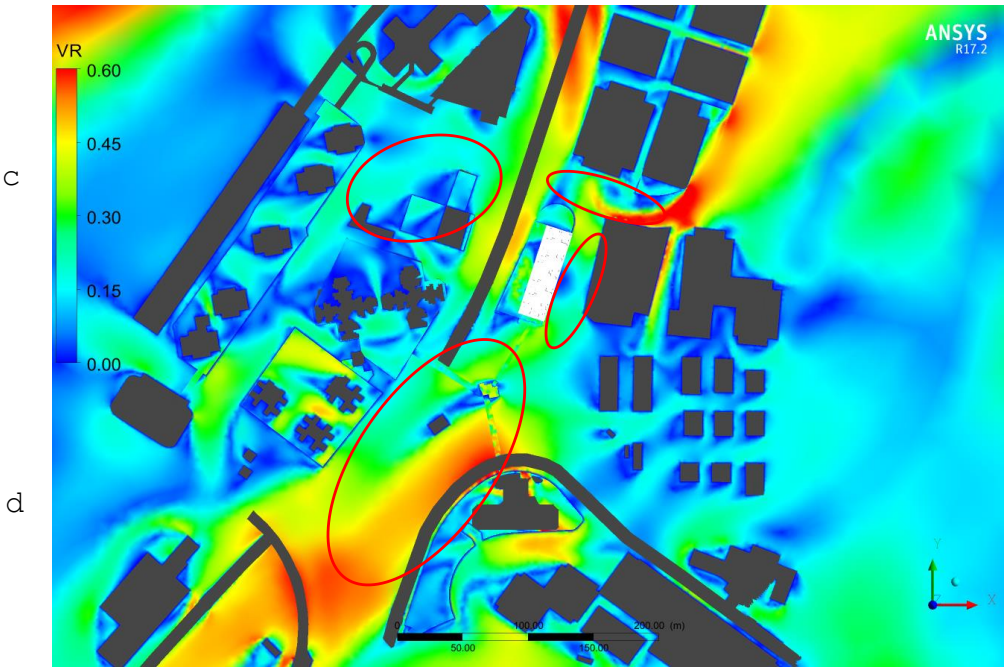
c. The difference of the podium and tower layout between the two schemes makes the different wind pattern at San Kwai Street to the immediate east of the Subject Site.

d. The minor different design of the elevated walkway and lift tower at the southern part of the site induces different wind flow pattern near the lift tower and its downwind area.

Wind performance under wind direction of E



Contour plot for Baseline Scheme



Contour plot for Proposed Scheme

4.4.4 Under E wind, , the wind would mainly flow along Kwai Chung Road to reach the Subject Site.

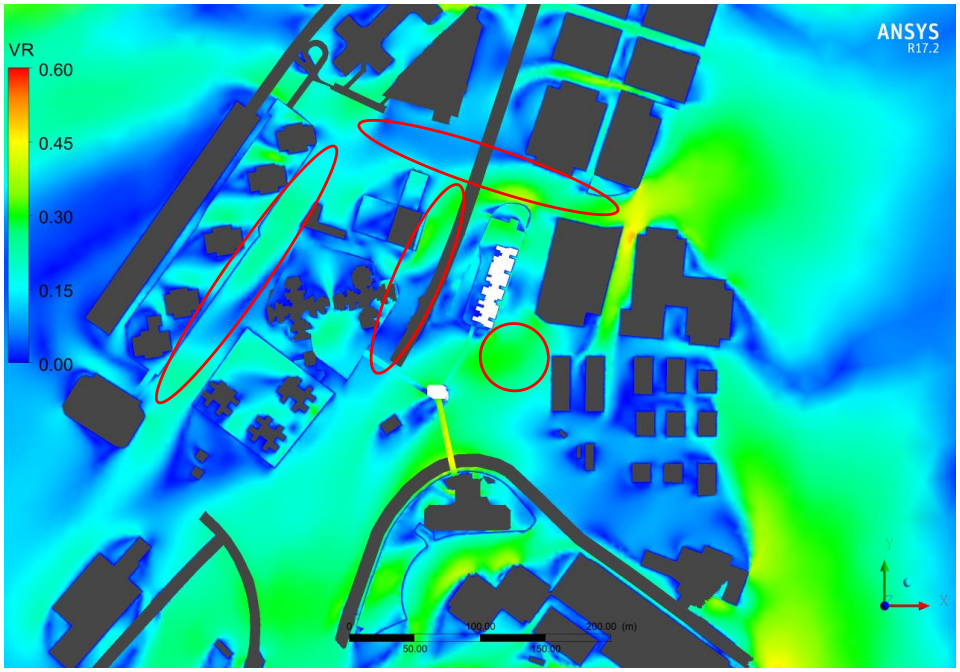
a. The tower setback of the Proposed Scheme to the northern edge is reduced from around 30m to 20m when compared to the Baseline Scheme. The channelized effect improves the wind performance at Tai Lin Pai Road. Thus, the VR at this section of Tai Lin Pai Road is higher under the Proposed Scheme.

b. The change in the position and footprint of the tower causes different wind pattern at Sun Kwai Street to the immediate east of the Subject Site under the downwash impact.

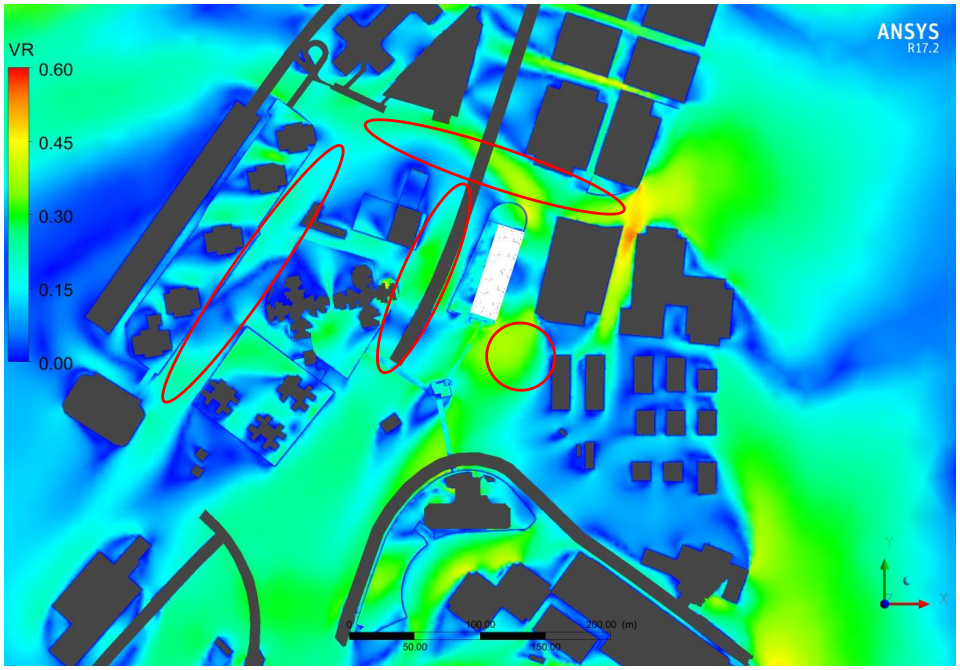
c. The higher building height of the Proposed Scheme causes larger wake area at the downwind area, such as Kwai Chung Police Station.

d. The minor different design of the elevated walkway and lift tower at the southern part of the site induces different wind flow pattern near the lift tower and its downwind area.

Wind performance under wind direction of ESE



Contour plot for Baseline Scheme



Contour plot for Proposed Scheme

4.4.5 Under ESE wind, the wind would mainly flow along Tai Lin Pai Road or skim over the low-rise buildings of Ha Kwai Chung Village to reach the Subject Site.

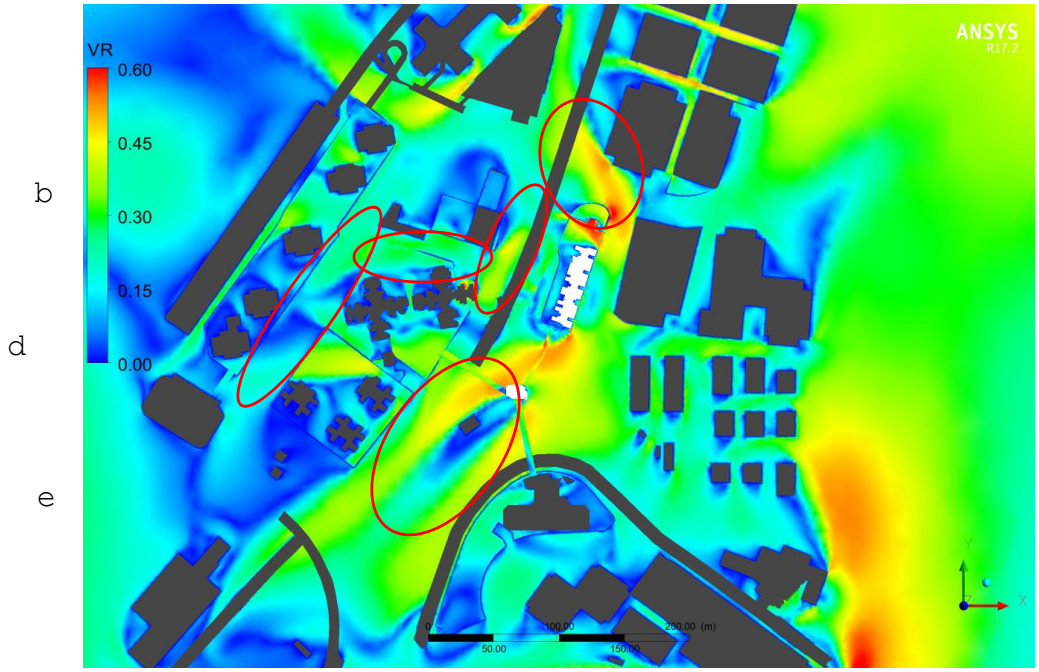
a. The higher building height of both the tower and podium under the Proposed Scheme induces stronger downwash wind. Part of the downwash wind towards north together with the upcoming wind along Tai Lin Pai Road, increases the wind performance along Tai Lin Pai Road.

b. Unlike the stronger downwash wind towards north along Tai Lin Pai Road under the Proposed Scheme, the podium of the Baseline Scheme diverts the wind from Tai Lin Pai Road to Kwai Chung Road towards south. This flow counters with the downwash wind from Bik Tsui House of Kwai Tsui Estate, thus the VR of this section along Kwai Chung Road is lower under the Baseline Scheme.

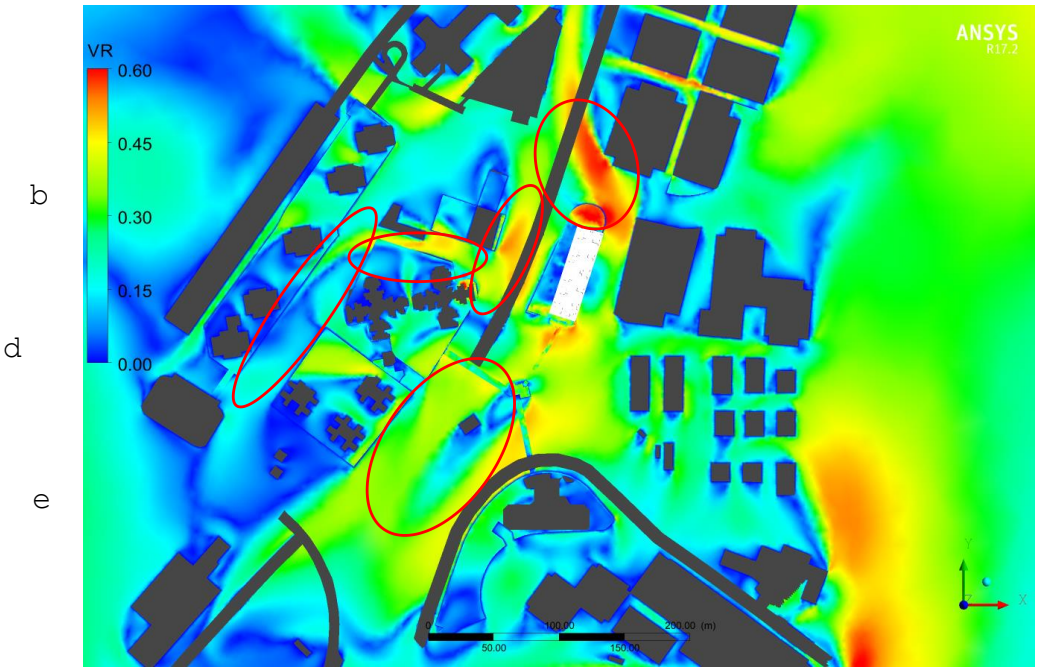
c. The higher building height of the Proposed Scheme generates larger wake area at the further downwind area, i.e. Kwai Yi Road.

d. Similarly, stronger downwash wind caused by higher tower under the Proposed Scheme improves the wind performance to the west of Ha Kwai Chung Village.

Wind performance under wind direction of SE



Contour plot for Baseline Scheme



Contour plot for Proposed Scheme

4.4.6 Under SE wind, the wind would mainly flow from San Kwai Street or skim over the low-rise buildings in Ha Kwai Chung Village to reach the Subject Site.

a. The increased height of both tower and podium as well as the decreased setback from the tower to the northern edge of the site boundary under the Proposed Scheme induce stronger downwash wind which enhances the wind performance at the area between the Subject Site and Wyler Centre Phase 1.

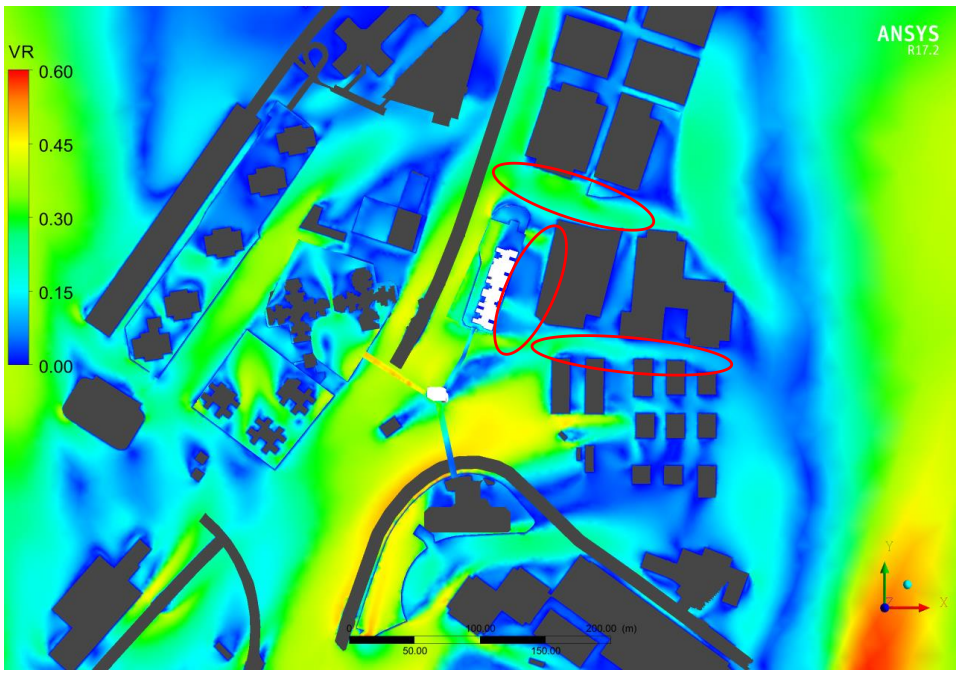
b. Unlike the stronger downwash wind towards northwest under the Proposed Scheme, the podium of the Baseline Scheme diverts the wind from Tai Lin Pai Road to Kwai Chung Road towards south. This flow counters with the downwash wind from Bik Tsui House of Kwai Tsui Estate, thus the VR of this section along Kwai Chung Road is lower under the Baseline Scheme.

c. This stronger wind is diverted to the lane between Kwai Chung Police Station and Kwai Tsui Estate. Therefore, it is observed that the VR of this lane is higher under the Proposed Scheme.

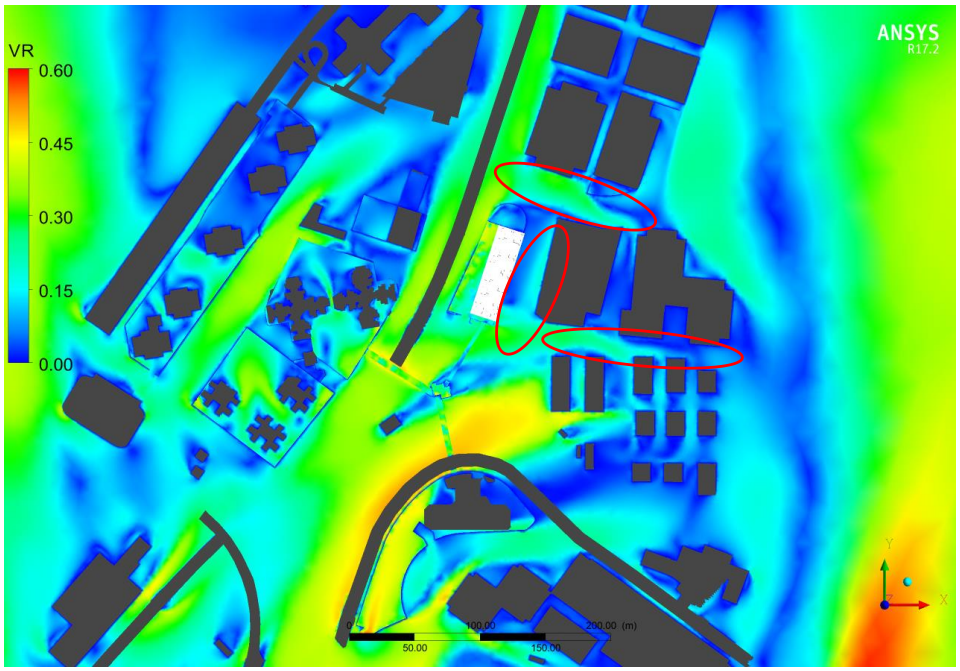
d. The abovementioned stronger wind along the lane between Kwai Chung Police Station and Kwai Tsui Estate continuously flows towards Kwai Yi Road and makes the wind pattern different from the Baseline Scheme.

e. Downwash wind generated from Kwai Tsui Estate and the Subject Site flows towards southwest around the area of elevated walkway and lift tower at the southern part of the site The minor design changes of the elevated walkway and lift tower induce different wind flow pattern near the lift tower and its downwind area.

Wind performance under wind direction of SSE



Contour plot for Baseline Scheme



Contour plot for Proposed Scheme

4.4.7 Under SSE wind, the wind would mainly flow from Kwai Chung Road or the slope to the west of Lai Cho Road and reach the Subject Site

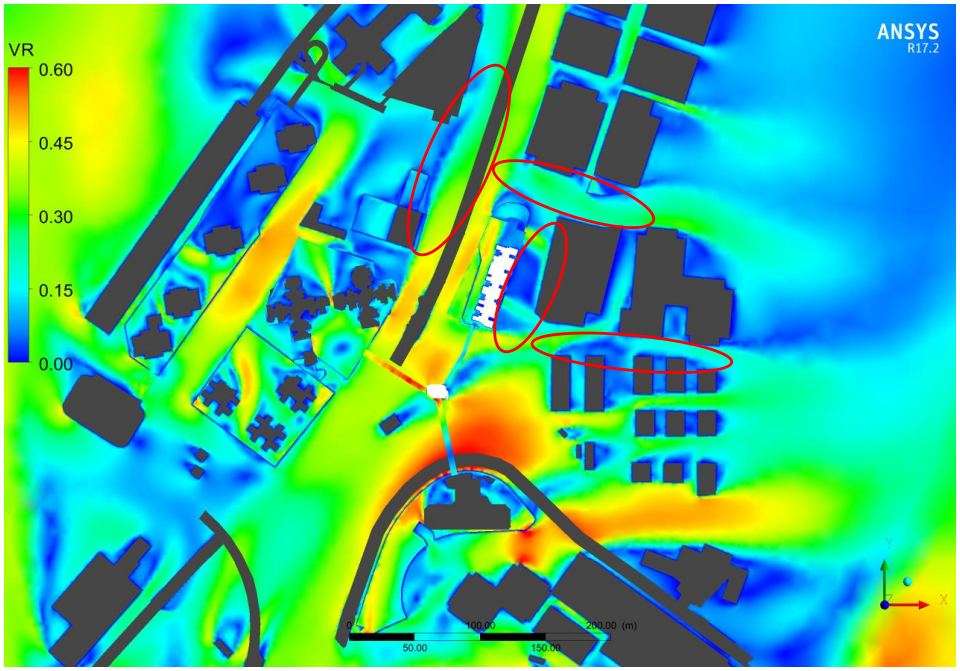
a. The driveway on the ground floor of the Baseline Scheme has larger permeability at west-east alignment, which could facilitate more upcoming wind along Kwai Chung Road to pass through the Subject Site. Thus, the wind pattern at the area to the east are different from the two schemes.

b. Compared to the Baseline Scheme, more wind flows from south to north along San Kwai Street, and then continuously flows towards Tai Lin Pai Road, makes the wind performance slightly worse at Tai Lin Pai Road.

c. The minor different design of the elevated walkway and lift tower at the southern part of the site induces different wind flow pattern near the lift tower and the further downwind area at San Kwai Street.

Wind performance under wind direction of S

d



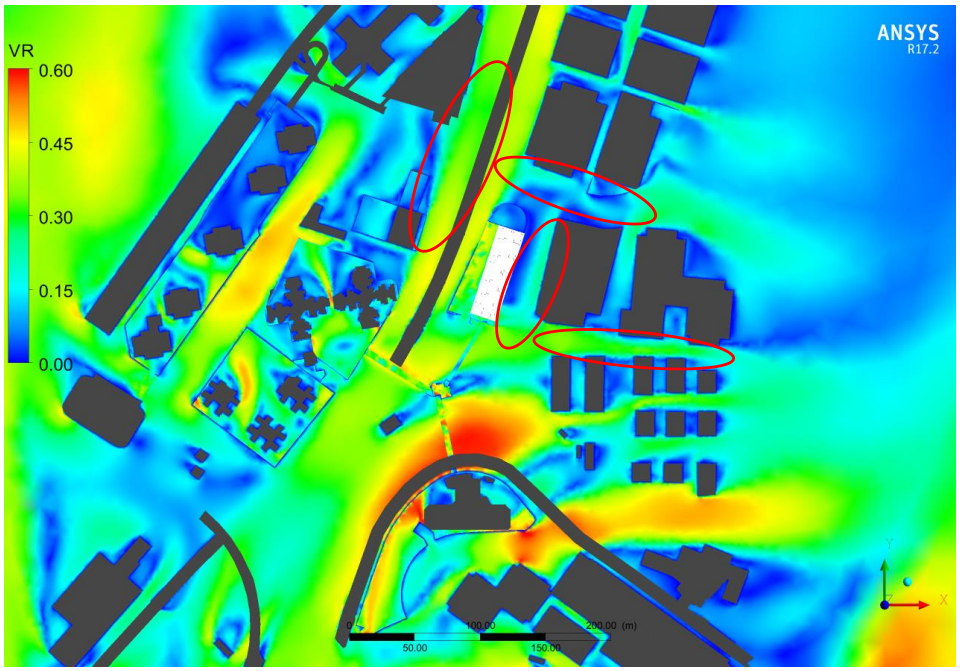
b

a

c

Contour plot for Baseline Scheme

d



b

a

c

Contour plot for Proposed Scheme

4.4.8 Under S wind, the wind would mainly flow from Kwai Chung Road or the slope to the west of Lai Cho Road and reach the Subject Site.

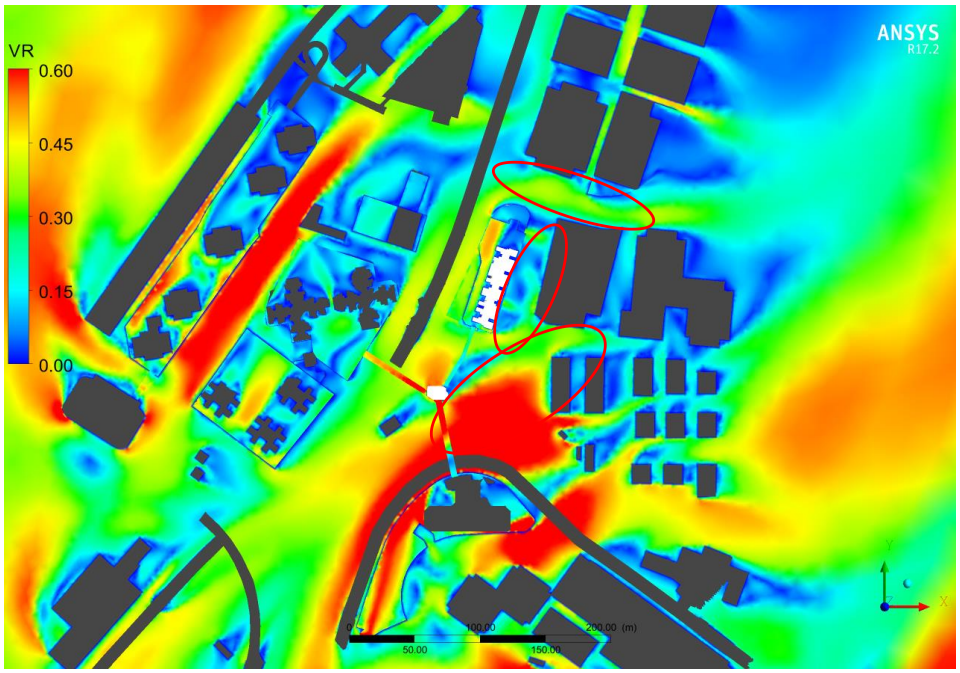
a. The driveway on the ground floor of the Baseline Scheme has larger permeability at west-east alignment, which could facilitate more upcoming wind along Kwai Chung Road to pass through the Subject Site. While under the Proposed Scheme, the wind flows from south to north along San Kwai Street. Thus, the wind pattern to the east of the Subject Site is different under the two schemes.

b. As mentioned above, more wind flows towards north at San Kwai Street. This flow counters with the wind along Tai Lin Pai Road, therefore the VR at Tai Lin Pai Road is lower under the Proposed Scheme.

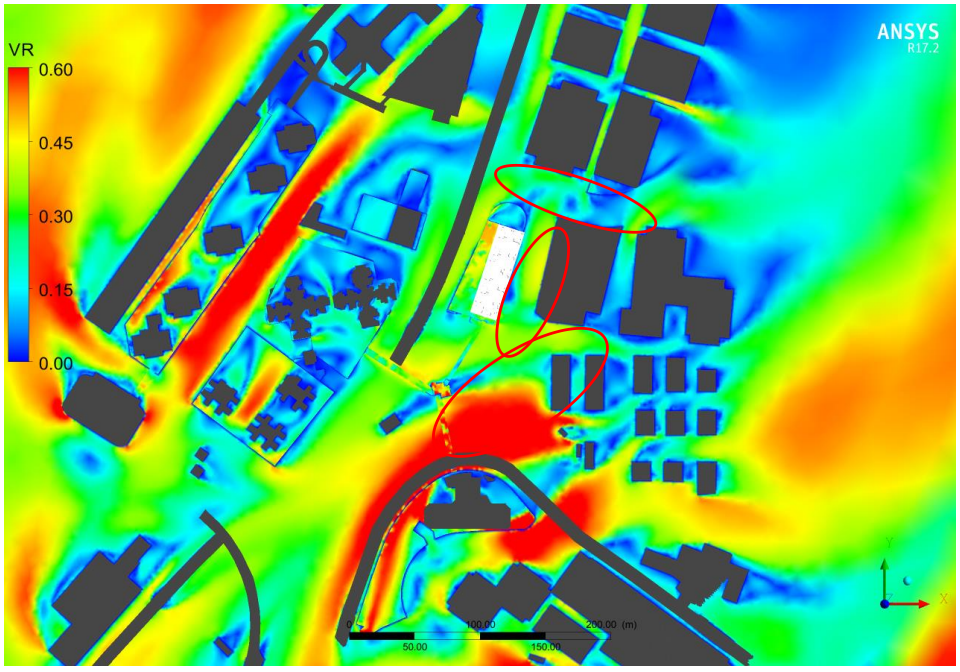
c. The minor different design of the elevated walkway and lift tower at the southern part of the site induces different wind flow pattern near the lift tower and the further downwind area at San Kwai Street.

d. The change in podium design such as ground floor layout or the height of podium make the different wind performance along Kwai Chung Road at downwind area under the two schemes.

Wind performance under wind direction of SSW



Contour plot for Baseline Scheme



Contour plot for Proposed Scheme

4.4.9 Under SSW wind, the wind would mainly flow from Kwai Chung Road to reach the Subject Site.

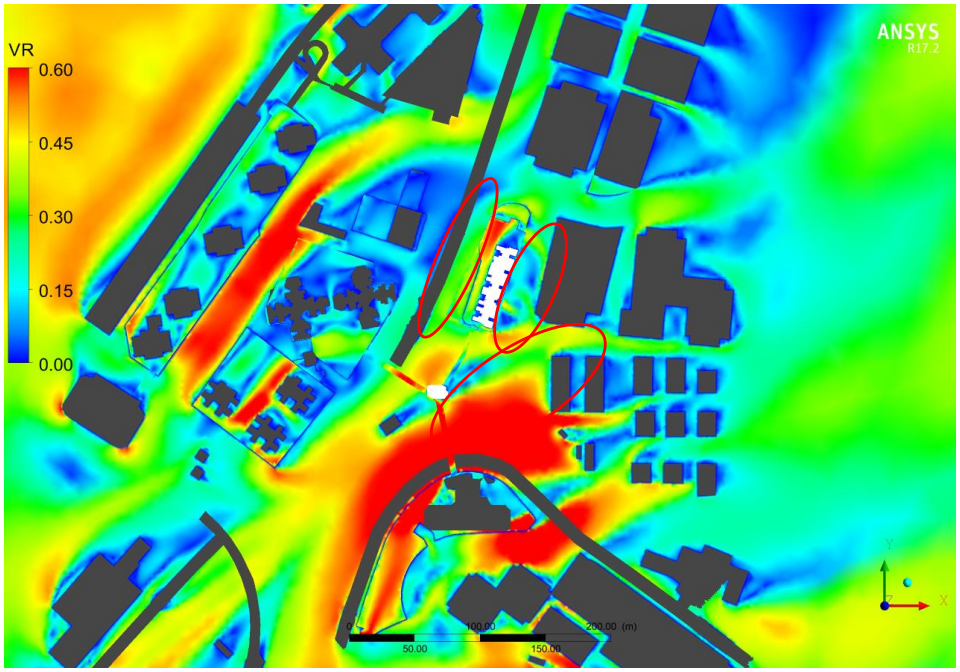
a. The driveway on the ground floor of the Baseline Scheme has larger permeability at west-east alignment, which could facilitate more upcoming wind along Kwai Chung Road to pass through the Subject Site. While under the Proposed Scheme, the wind flows from south to north along San Kwai Street. Thus, the wind pattern to the east of the Subject Site is different under the two schemes.

b. As mentioned above, more wind flows towards north at San Kwai Street. This flow counters with the wind along Tai Lin Pai Road, therefore the VR at Tai Lin Pai Road is lower under the Proposed Scheme.

c. The minor different design of the elevated walkway and lift tower at the southern part of the site induces different wind flow pattern near the lift tower and the further downwind area at San Kwai Street.

Wind performance under wind direction of SW

b

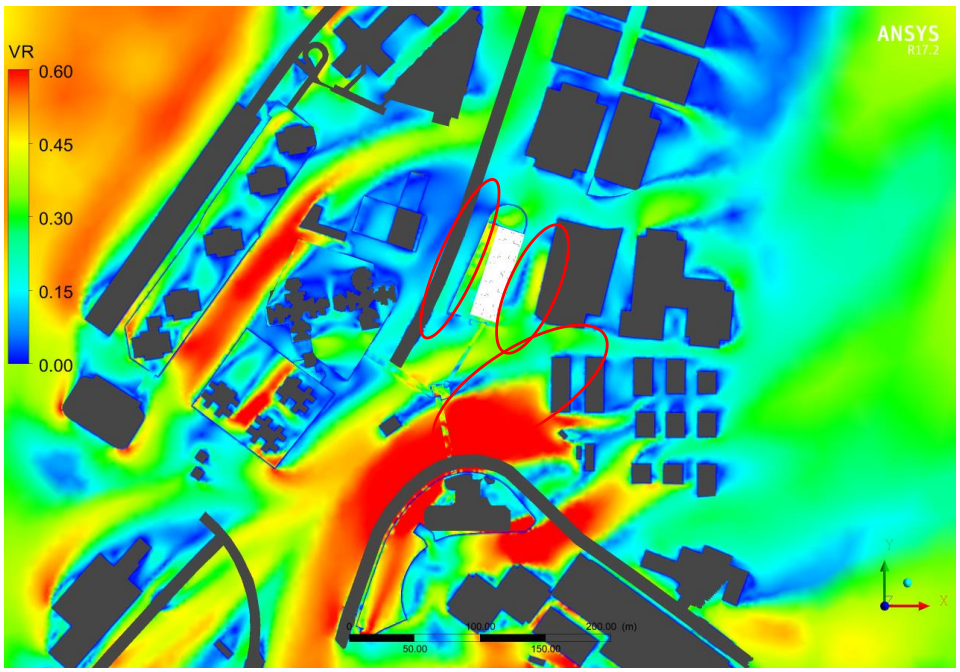


a

c

Contour plot for Baseline Scheme

b



a

c

Contour plot for Proposed Scheme

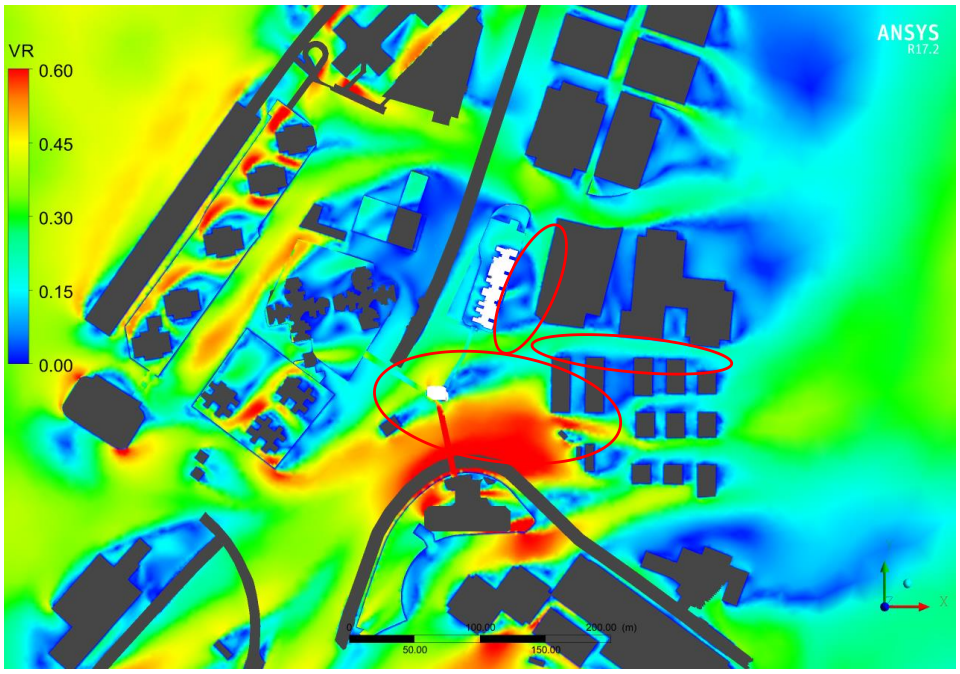
4.4.10 Under SW wind, the wind would mainly flow along Kwai Chung Road to reach the Subject Site.

a. The driveway on the ground floor of the Baseline Scheme has larger permeability at west-east alignment, which could facilitate more upcoming wind along Kwai Chung Road to pass through the Subject Site. While under the Proposed Scheme, the wind flows from south to north along San Kwai Street. Thus, the wind pattern to the east of the Subject Site is different under the two schemes.

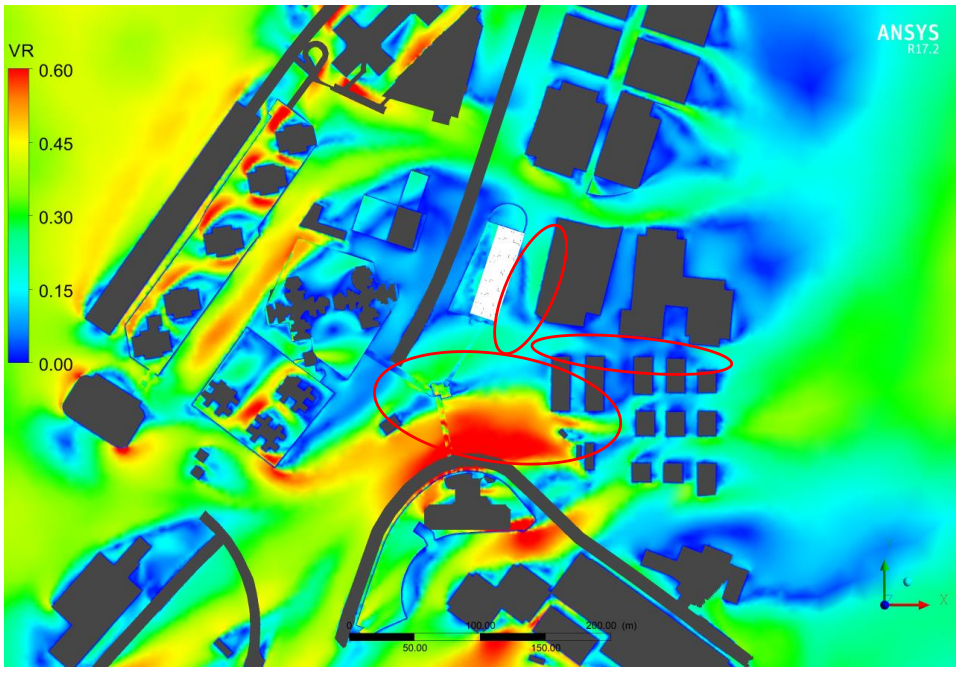
b. The buildings to the southwest of the Subject Site such as Kwai Tsui Estate are lower than both the Baseline Scheme and the Proposed Scheme. Higher building height of the Proposed Scheme may cause more downwash wind to counter with the flow along Kwai Chung Road. Thus, the VR at Kwai Chung Road is lower under the Proposed Scheme.

c. The minor different design of the elevated walkway and lift tower at the southern part of the site induces different wind flow pattern near the lift tower and the further downwind area at San Kwai Street.

Wind performance under wind direction of WSW



Contour plot for Baseline Scheme



Contour plot for Proposed Scheme

4.4.11 Under WSW wind, the wind would mainly flow along Kwai Chung Road to reach the Site.

a. The upcoming wind from Kwai Yi Road flows along Tai Lin Pai Road and towards San Kwai Street continuously. The driveway on the ground floor of the Baseline Scheme has larger permeability at west-east alignment, which could facilitate more upcoming wind along Kwai Chung Road to pass through the Subject Site. Thus, the wind pattern to the east of the Subject Site is different under the two schemes.

b. The minor different design of the elevated walkway and lift tower at the southern part of the site induces different wind flow pattern near the lift tower. Furthermore, the higher building height of the Proposed Scheme may cause more downwash wind at the southern part, which also alter the wind flow pattern nearby.

c. As mentioned above, the downwash flow at the southern part of the Subject Site has impact on further downwind area, San Kwai Street.

5. CONCLUSION

5.1.1 The proposed housing development located at Sun Kwai Street has been evaluated from an air ventilation perspective.

5.1.2 In order to minimize the potential impact due to the Proposed Development, the Proposed Scheme has provided the following main enhancement features:

- At least 40m setback from the tower to Ha Kwai Chung Village
- At least 15m setback from the tower to the road kerb of Kwai Chung Road
- About 20m setback from the tower to the northern edge of the Subject Site

5.1.3 According to Section 4.3, it is noted the SVR is slightly higher in the Proposed Scheme, but the LVR is comparable between the two design schemes under both annual and summer condition. Based on the result, the proposed development would not induce a significant impact to the nearby area in air ventilation term under both annual and summer condition. This may be owing to the higher tower of the Proposed Scheme collecting the high-level wind and diverting them to the surrounding areas.

5.1.4 There are some variations in VR between two schemes. The VR of some areas is higher under the Proposed Scheme, including San Kwai Street (summer condition), Tang Uk Street (annual condition), Tai Lin Pai Road (annual condition) and Kwai Chung Road (annual condition).

5.1.5 Under the summer condition, the areas with higher VR under the Baseline Scheme are Lai Yiu Estate (annual and summer condition), Lai Yiu Road (annual and summer condition), Lai Cho Road (annual and summer condition), San Kwai Street (annual condition), Tang Uk Street (summer condition), Kwai Foo Road (annual condition) and Kwai Chung Police Station (annual condition).

5.1.6 It is observed that the increase in building height would not induce significant impact to the surrounding areas in air ventilation term under both annual and summer condition. With the wind enhancement features discussed in Section 4.4, the Proposed Scheme could slightly enhance the wind flow in the Subject Site and nearby area.

Figures

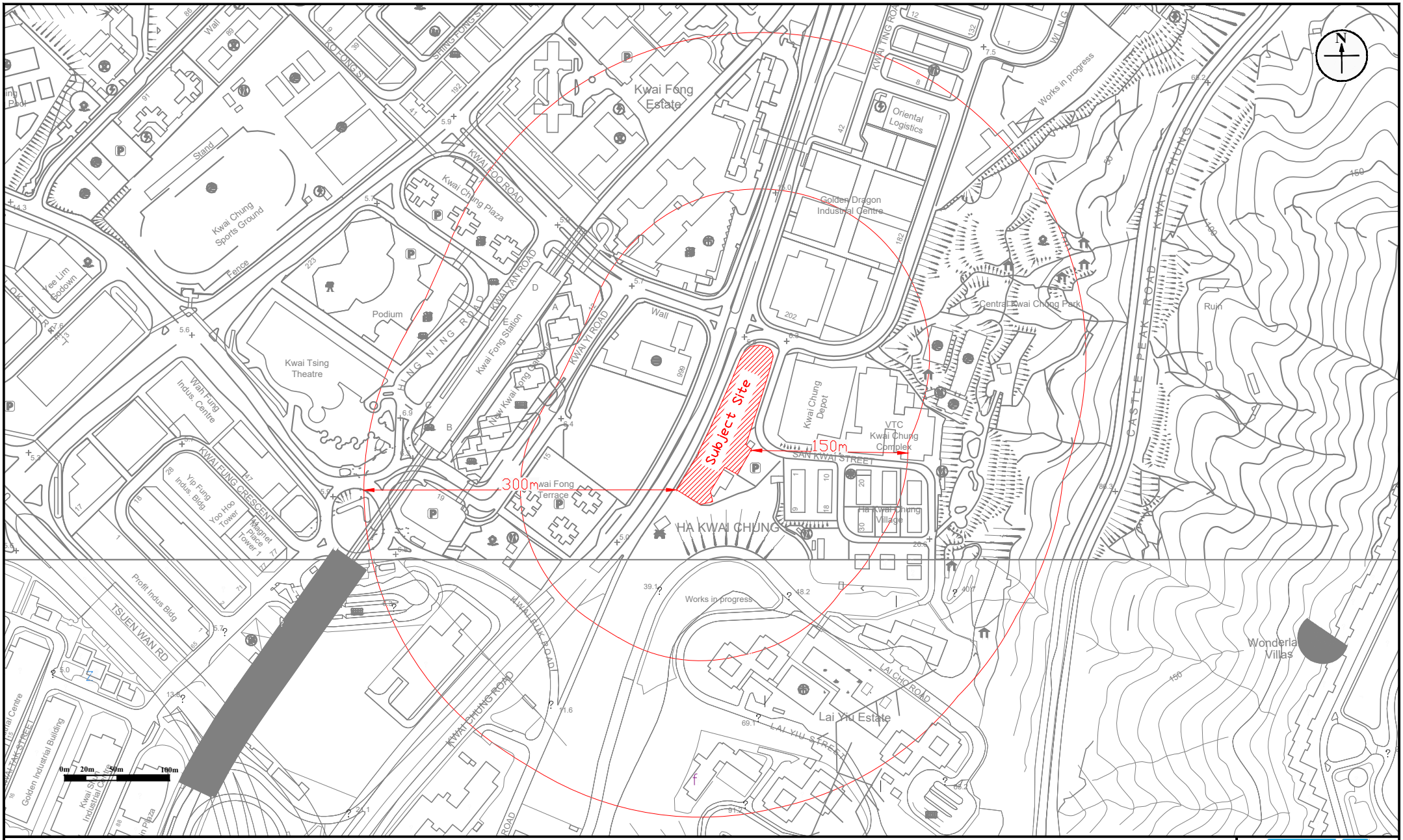


Figure: 1	RAMBOLL
Title: Location of Subject Site and Its Environs	Drawn by: EC Checked by: TC
Project: Public Housing Development at San Kwai Street	Rev.: 1.0 Date: Aug 2023

Q:\Projects\HD-EDSF3ED00\04 San Kwai Street_Kwai Chung\04 Deliverables\05 AVA Report\Fig\20230810_CFD\Figure 6_TP.dwg

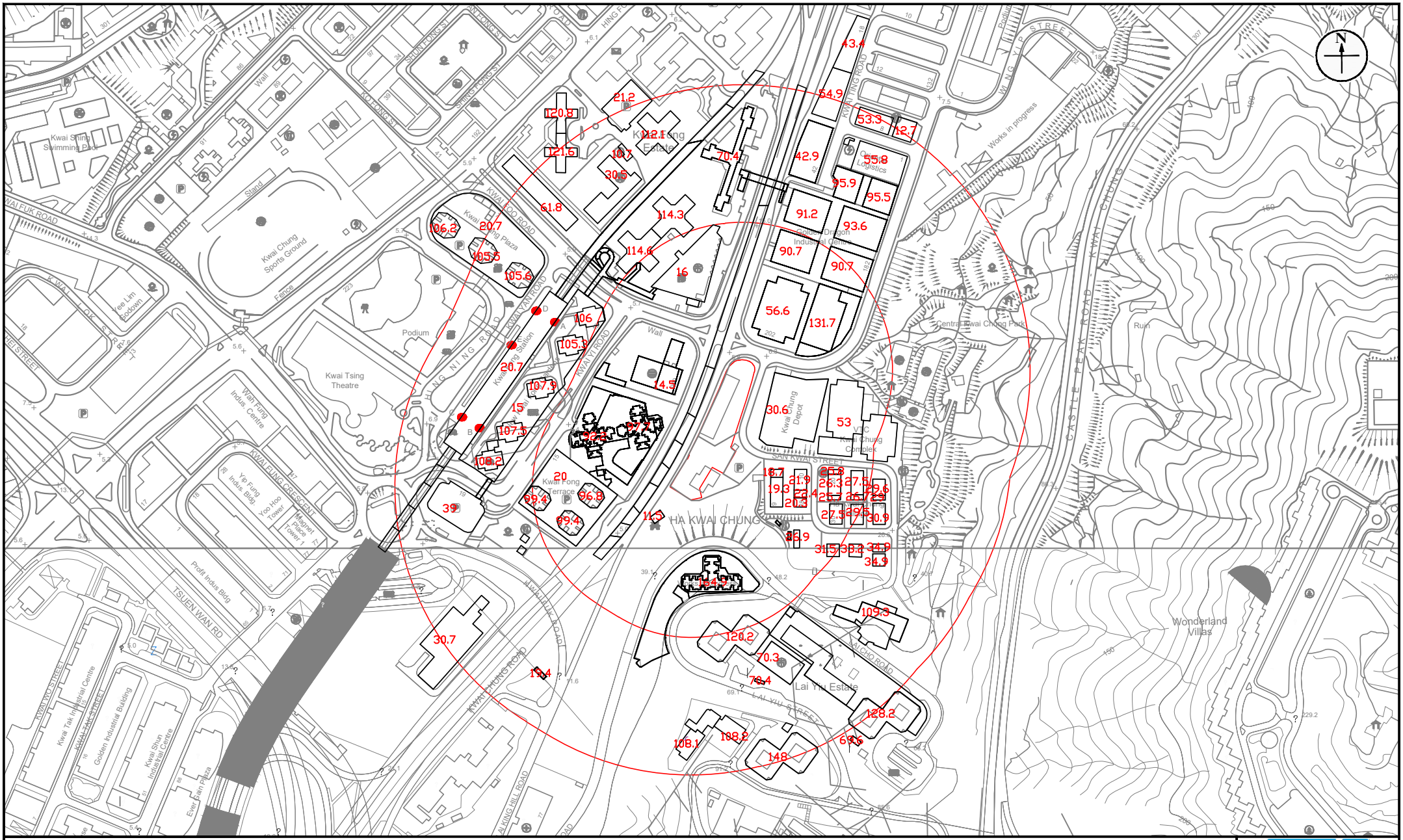


Figure: 2	RAMBOLL
Title: Building Height of Existing Development in the Immediate Vicinity of the Subject Site	Drawn by: EC Checked by: TC
Project: Proposed Residential Development at San Kwai Street	Rev.: 1.0 Date: Aug-23

Q:\Projects\HD-EDSF3ED00\04 San Kwai Street_Kwai Chung\05 Assessments\04 AVA\20220420\ss\surrounding_(0,0).dwg

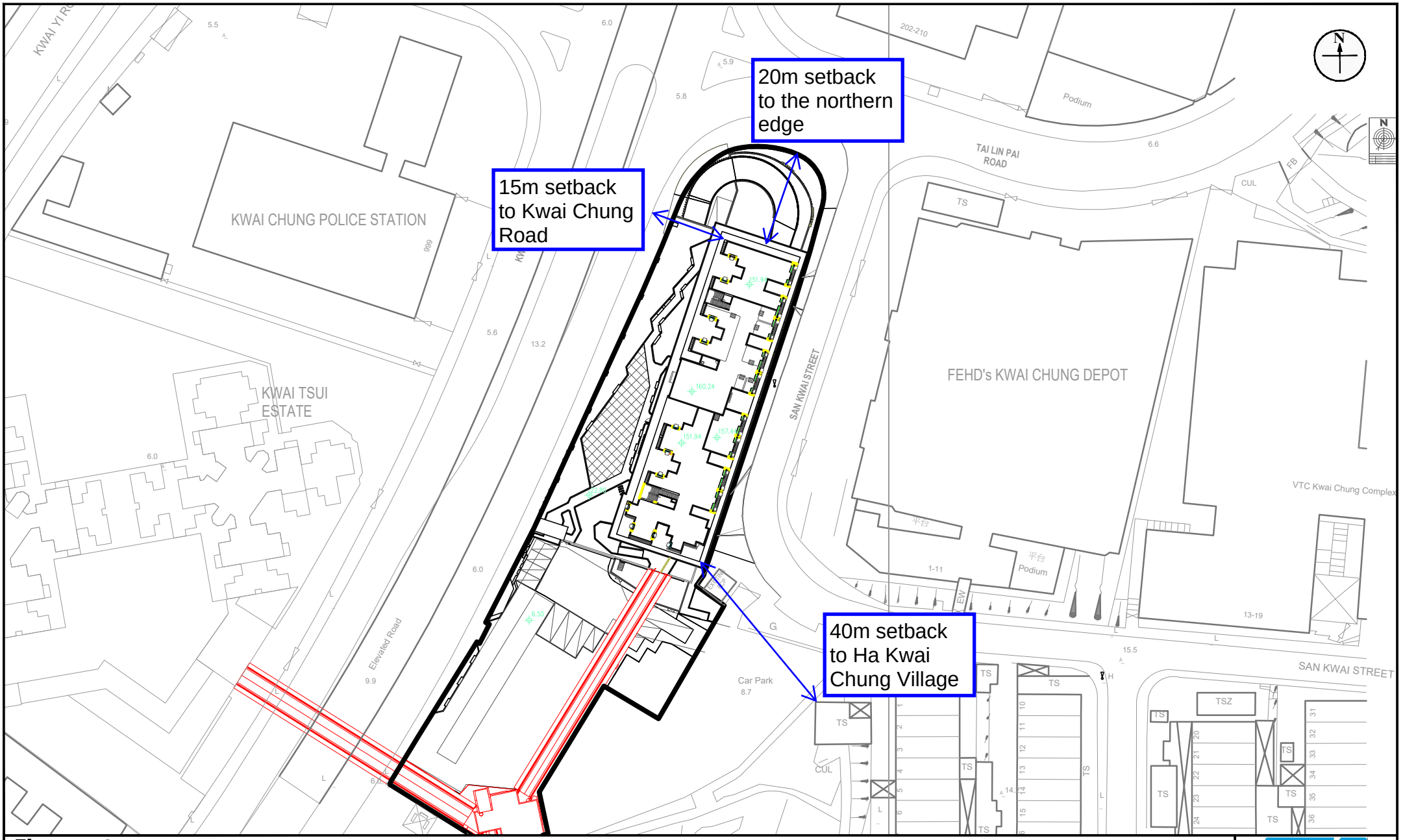


Figure: 3

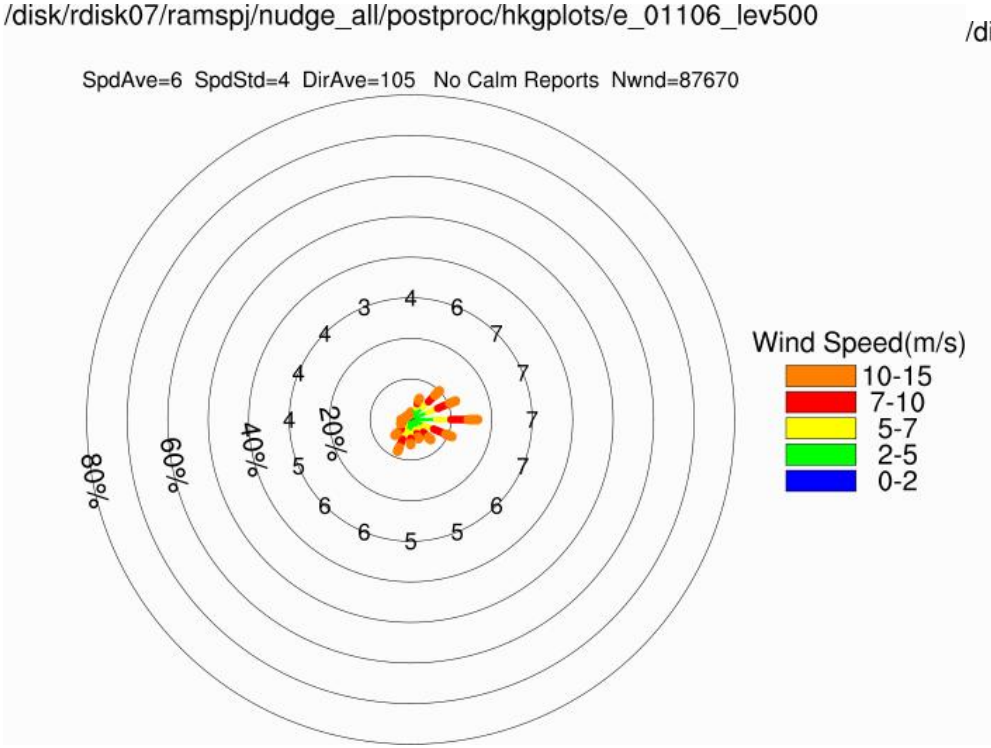
Title: Mitigation Measures Provided in the Proposed Scheme

Project: Proposed Residential Development at San Kwai Street

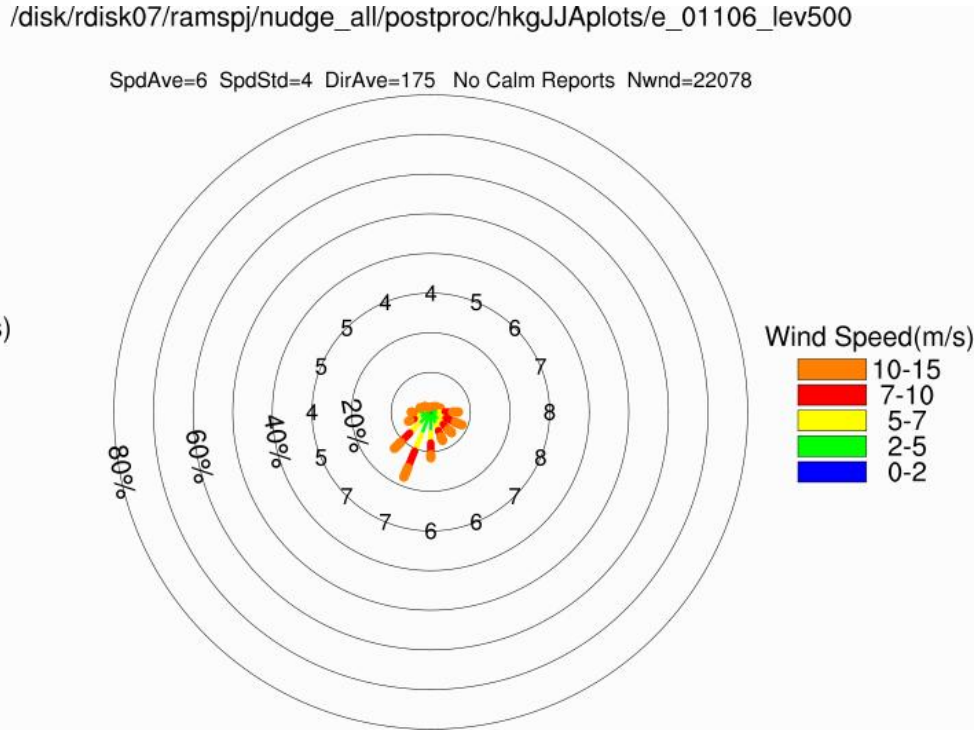
RAMBOLL

Drawn by:	EC
Checked by:	TC
Rev.:	1.0
Date:	Aug-23

Q:\Projects\HD-EDSF3ED00\04 San Kwai Street_Kwai Chung\04 Deliverables\05 AVA Report\Fig\20230810_CFD\Fig3.dwg



Annual Condition



Summer Condition

Figure:	**4**	RAMBOLL
Title:	**Windrose Diagram representing V∞ of the Area under Concern**	Drawn by: CL Checked by: SL
Project:	**Proposed Residential Development at San Kwai Street, Kwai Chung, N.T.**	Rev.: 1.0 Date: May 2018

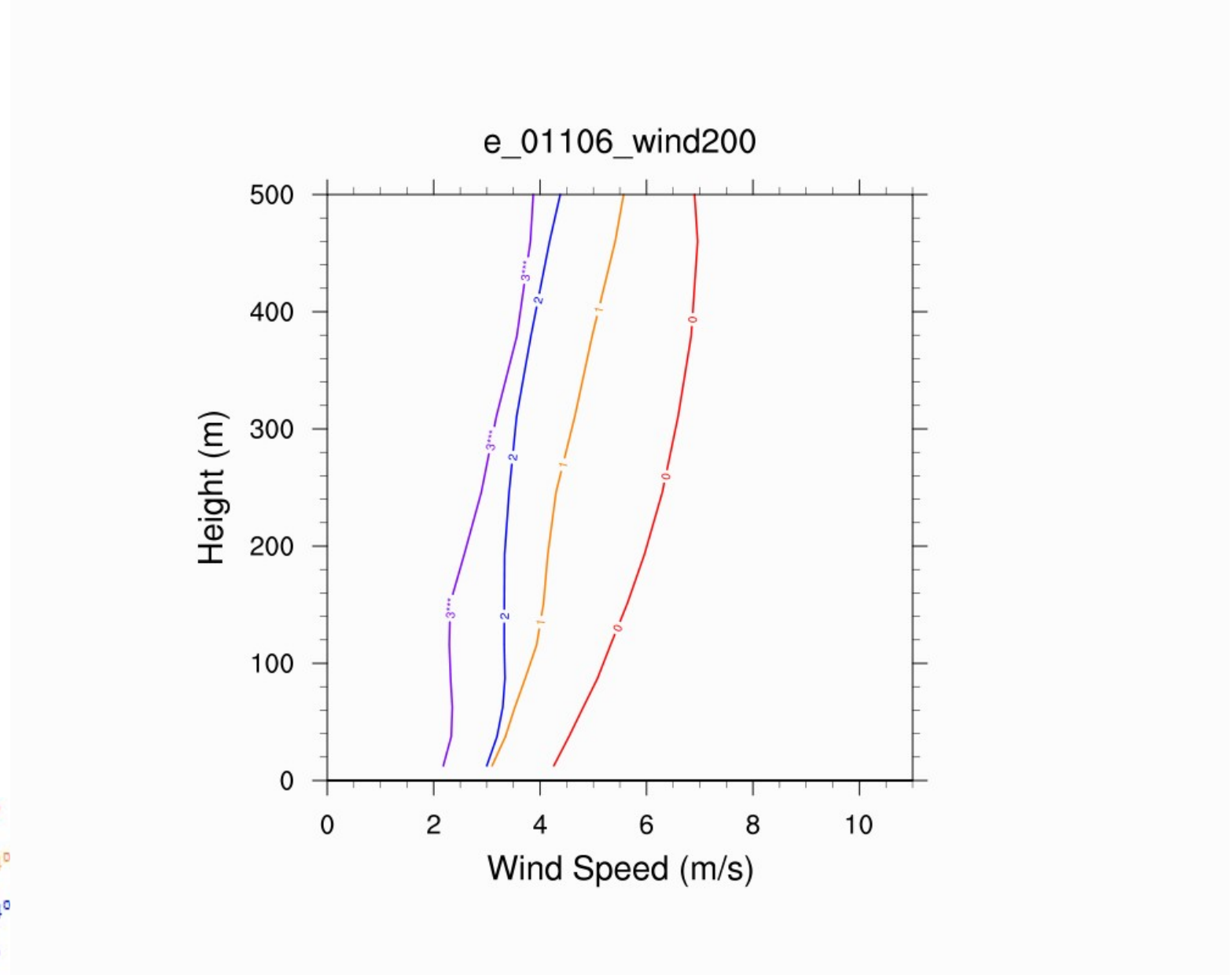


Figure: 5	RAMBOLL
Title: Wind Profile Curve for Grid X:071, Y:050	Drawn by: WT
	Checked by: EC
Project: Proposed Housing Development at San Kwai Street	Rev.: 1.0
	Date: Aug 2022

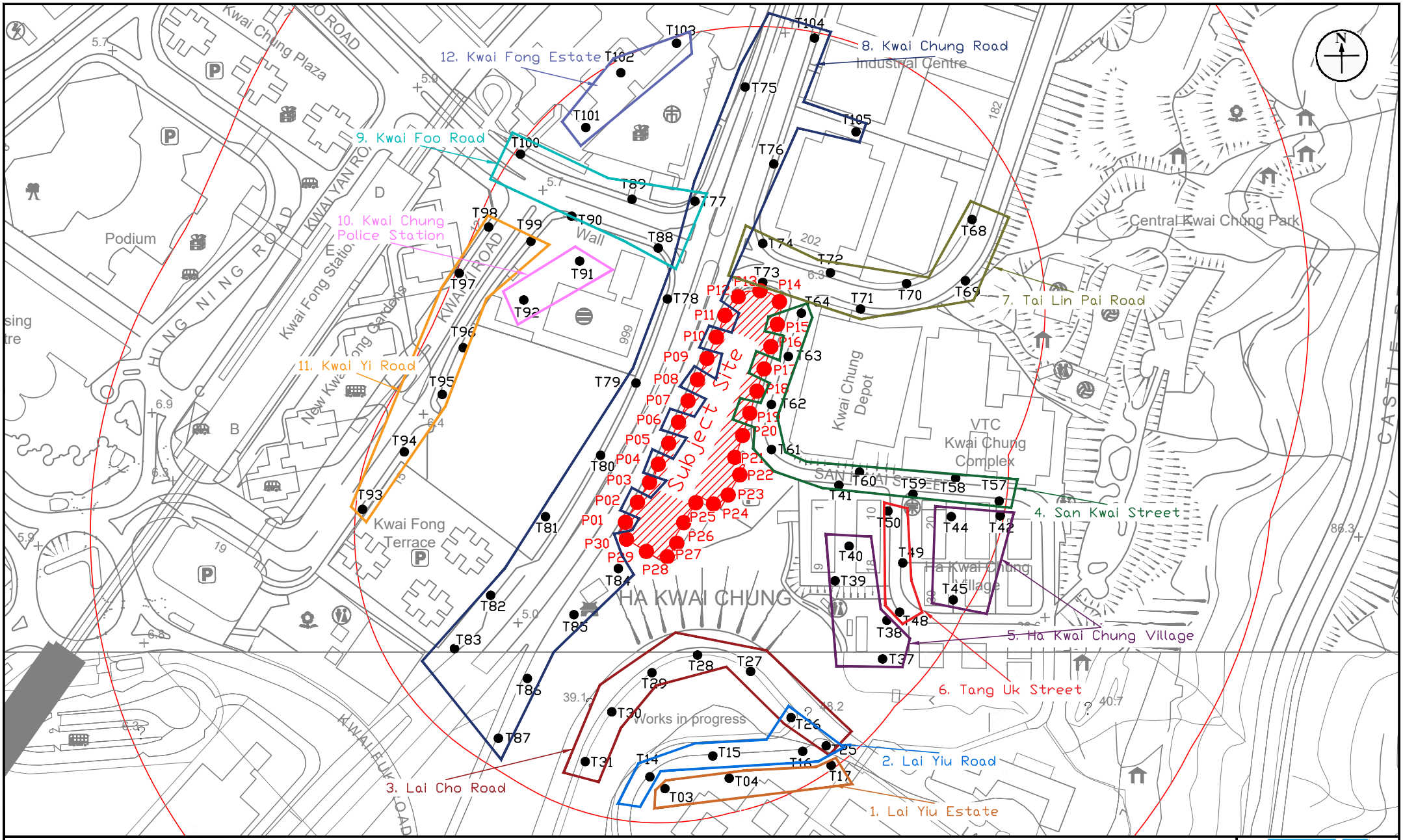


Figure: 6	RAMBOLL
Title: Test Points Selected for Quantitative Air Ventilation Assessment	Drawn by: EC Checked by: TC
Project: Public Housing DEvelopment at San Kwai Street	Rev.: 1.0 Date: Apr 2023

Q:\Projects\HD-EDSF3ED00\04 San Kwai Street_Kwai Chung\04 Deliverables\05 AVA Report\Fig\20230810_CFD\Figure 6_TP.dwg

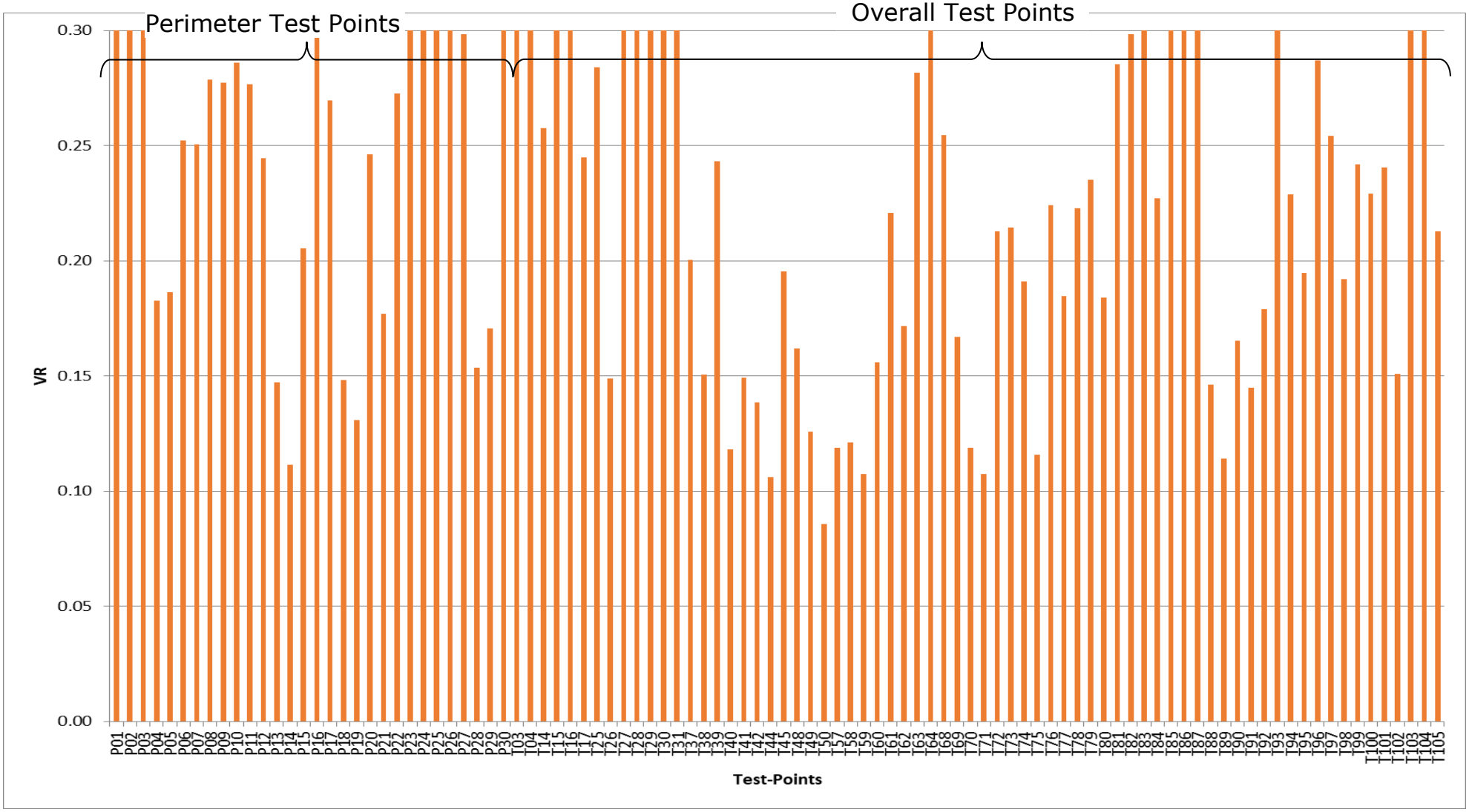


Figure: 7a	RAMBOLL
Title: Wind Velocity Ratios of Individual Test Points for Baseline Scheme (Annual)	Drawn by: EC Checked by: TC
Project: Proposed Housing Development at San Kwai Street	Rev.: 1.0 Date: Aug 2023

Q:\Projects\HD-EDSF3ED00\04 San Kwai Street_Kwai Chung\04 Deliverables\05 AVA Report\Fig\20230810_CFD\Figure 7a_BS-Annual.doc

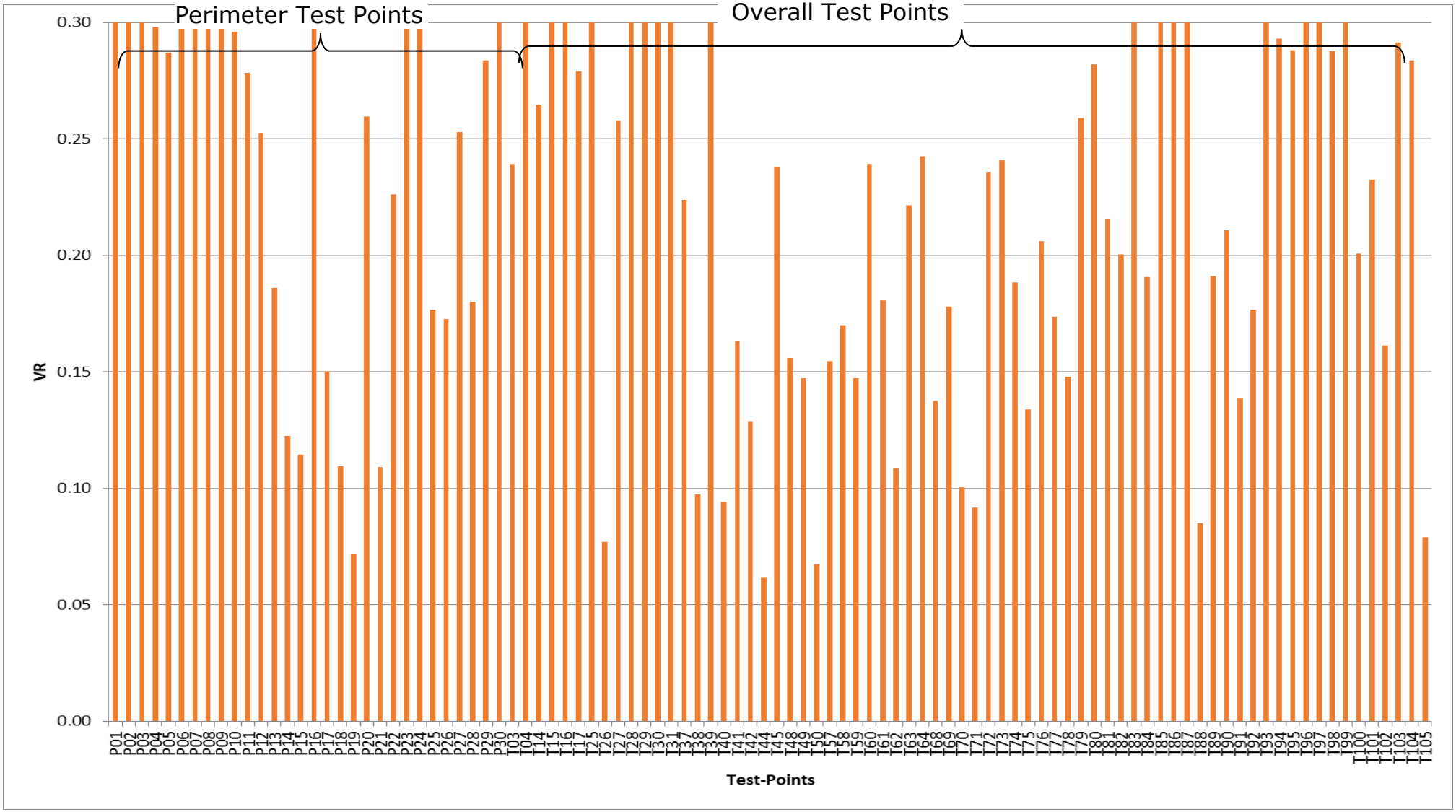


Figure: 7b	RAMBOLL
Title: Wind Velocity Ratios of Individual Test Points for Baseline Scheme (Summer)	Drawn by: WT Checked by: EC
Project: Public Housing Development at San Kwai Street	Rev.: 1.0 Date: Aug 2023

Q:\Projects\HD-EDSF3ED00\04 San Kwai Street_Kwai Chung\04 Deliverables\05 AVA Report\Fig\20230810_CFD\Figure 7b_BS-Summer.doc

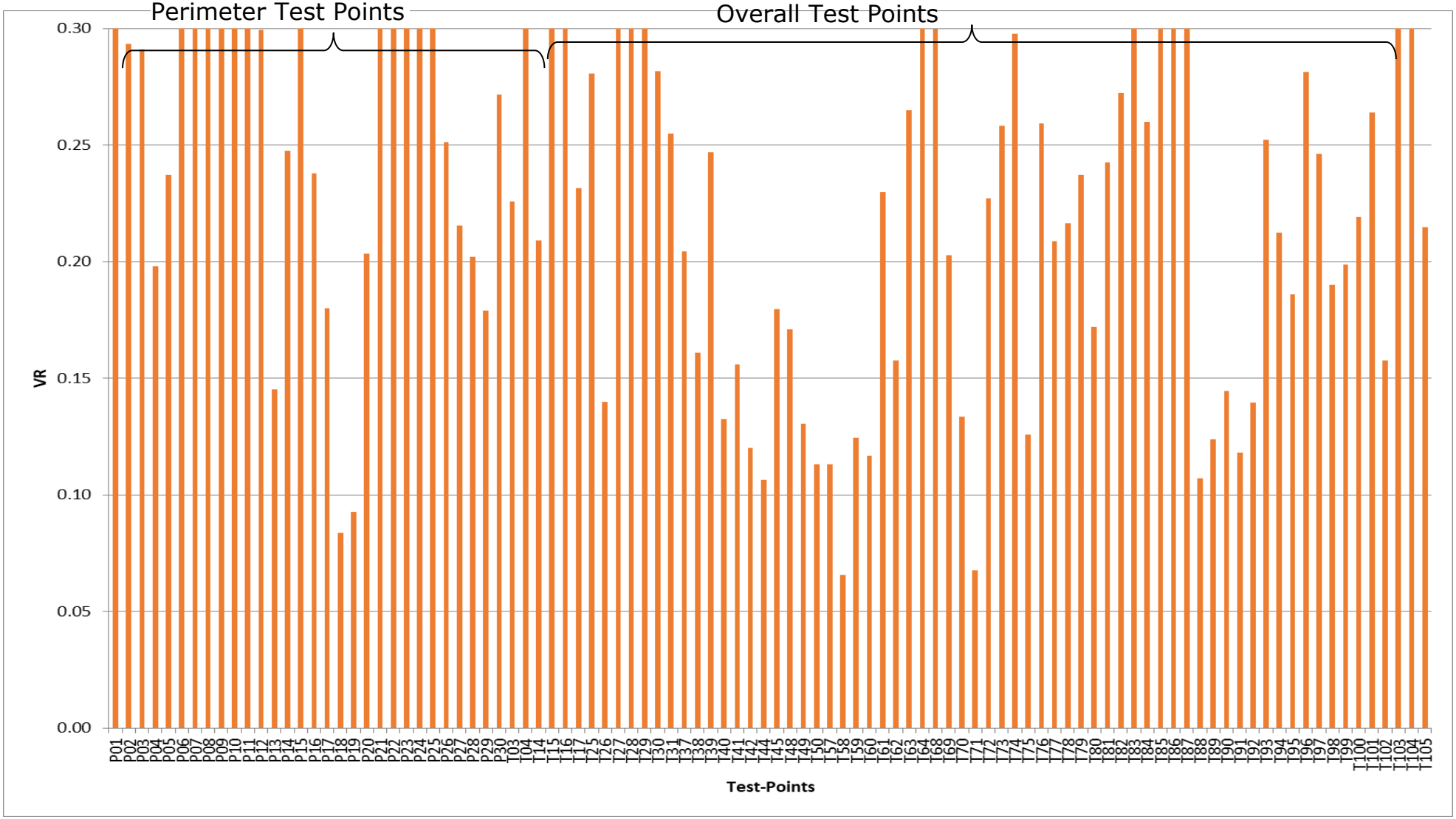


Figure: 8a	RAMBOLL
Title: Wind Velocity Ratios of Individual Test Points for Proposed Scheme (Annual)	Drawn by: WT Checked by: EC
Project: Proposed Housing Development at San Kwai Street	Rev.: 1.0 Date: Aug 2023

Q:\Projects\KTA83LYTEI00\04 Deliverables\02 AVA report\Figure_20221121\Figure 8a_PS-Annual.doc

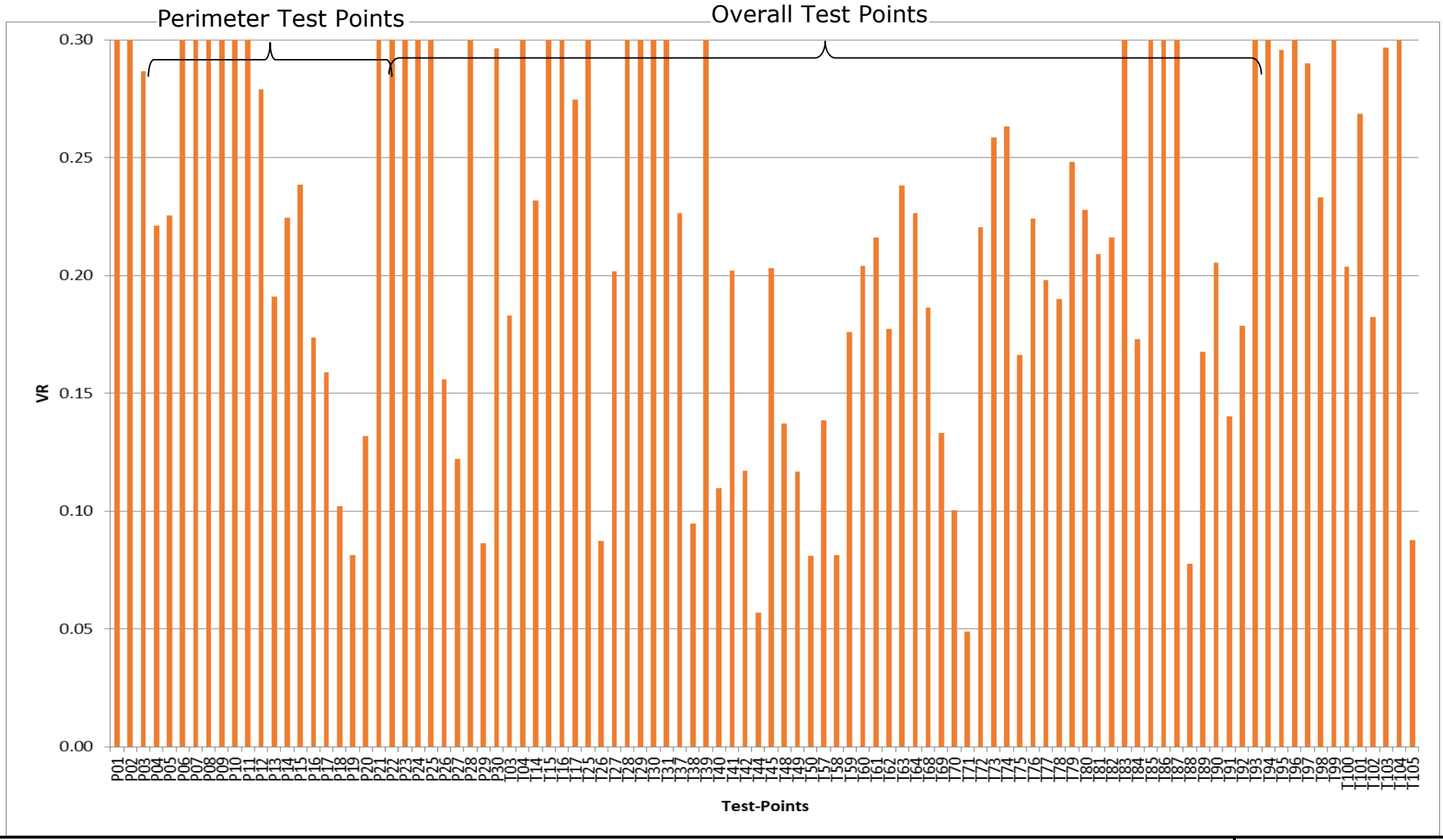
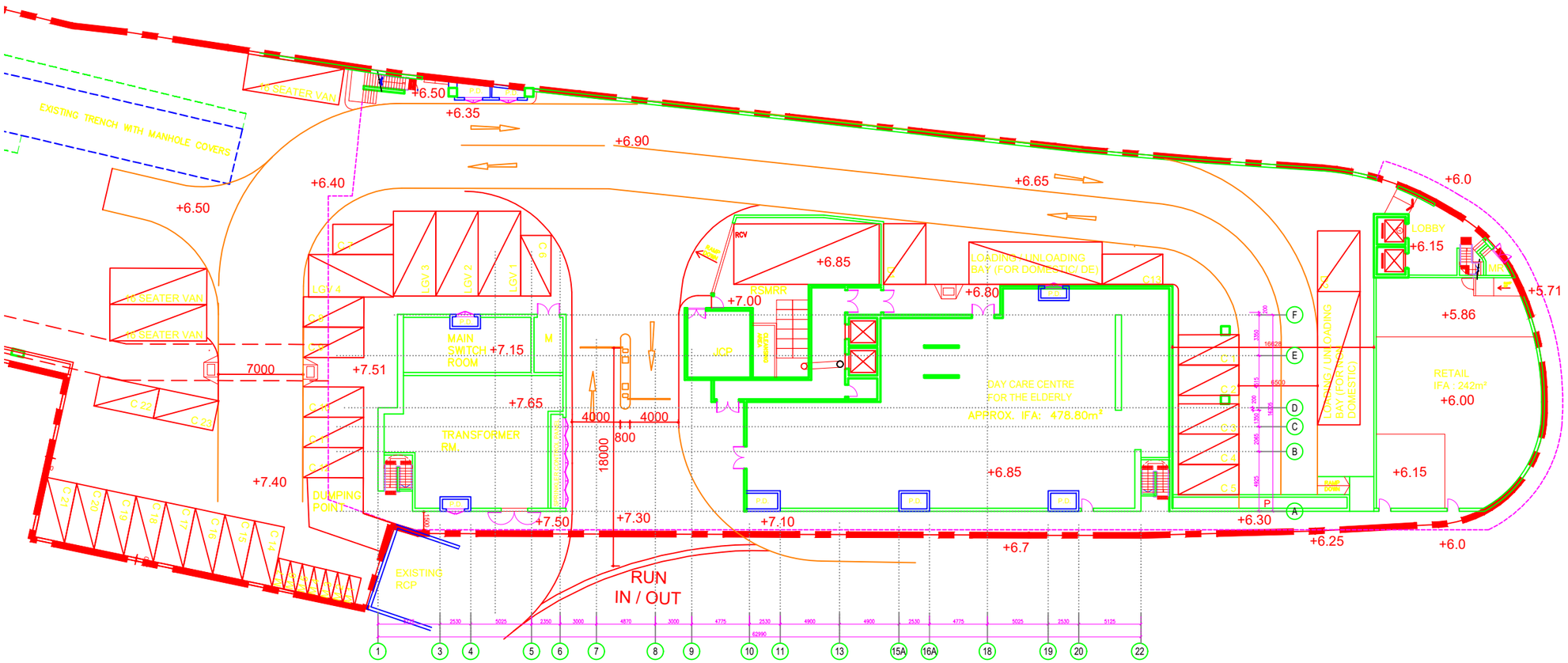


Figure: 8b	RAMBOLL
Title: Wind Velocity Ratios of Individual Test Points for Proposed Scheme (Summer)	Drawn by: WT Checked by: EC
Project: Proposed Housing Development at San Kwai Street	Rev.: 1.0 Date: Aug 2023

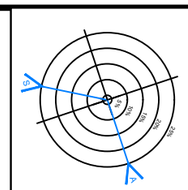
Q:\Projects\HD-EDSF3ED00\04 San Kwai Street_Kwai Chung\04 Deliverables\05 AVA Report\Fig\20230810_CFD\Figure 8b_PS-Summer.doc

Appendix 1

Master Layout Plan for the Baseline Scheme



GROUND FLOOR PLAN



Prevailing Wind		
A	Annual	2.44 m/s
S	Summer	2.58 m/s
W	Winter	2.21 m/s

NOTES

LEGEND:-

SITE BOUNDARY

DRAINAGE RESERVE AREA

REVISIONS

NO	DESCRIPTION AND DATE	INITIAL AND DESIGNATION DWN	CKD	AUTH
P01	GENERAL REVISION			

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED	PATRICK LUK CA/1		
CHECKED	TONY LEUNG SA/31		
	KELVIN WU A/3		
	PETER YEUNG STO(A)/9		
DRAWN	ROY TONG TO(A)/14		

PROJECT

PUBLIC RENTAL HOUSING DEVELOPMENT AT SAN KWAI STREET, KWAI CHUNG

DRAWING TITLE

GROUND FLOOR PLAN

SCALE 1:200 (A1); 1:400 (A3)

DRAWING NO.

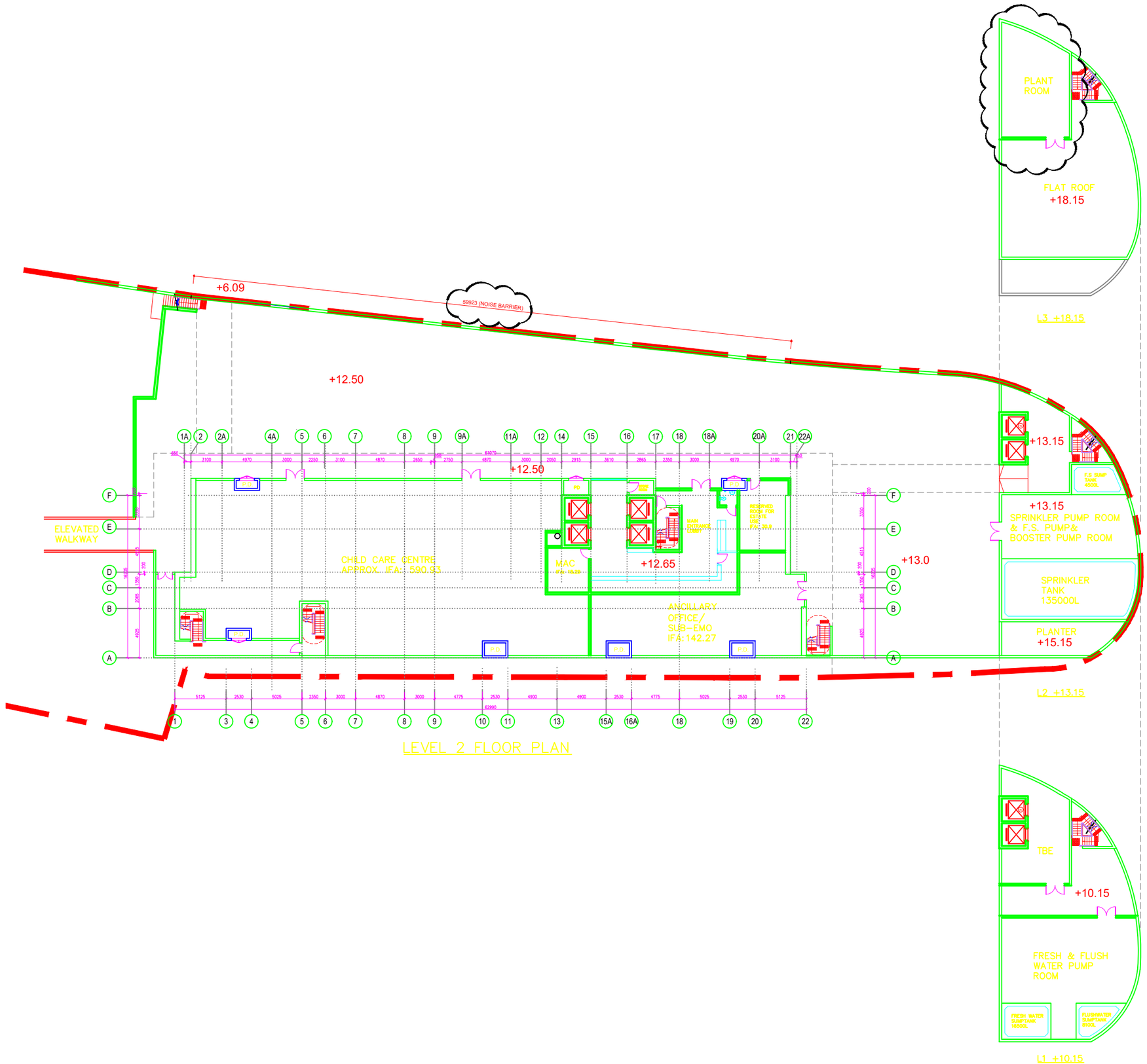
KS22/A/PDRC/LO-04/P01

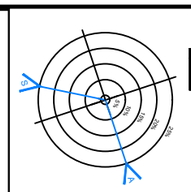
SOURCE

ICU NO.

AutoCAD 2000 A1 594 x 841

HOUSING DEPARTMENT





Prevailing Wind		
A	Annual	2.44 m/s
S	Summer	2.58 m/s
W	Winter	2.21 m/s

NOTES

LEGEND:-

SITE BOUNDARY

REVISIONS

NO	DESCRIPTION AND DATE	INITIAL AND DESIGNATION DWN	CKD	AUTH
P01	GENERAL REVISION			
P02	GENERAL REVISION			
P03	1. ADDED NOISE BARRIER 2. REVISED PLANT ROOM			

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED	PATRICK LUK CA/1		
CHECKED	TONY LEUNG SA/31		
	KELVIN WU A/3		
	PETER YEUNG STO(A)/9		
DRAWN	ROY TONG TO(A)/14		

PROJECT

PUBLIC RENTAL HOUSING DEVELOPMENT AT SAN KWAI STREET, KWAI CHUNG

DRAWING TITLE

PODIUM FLOOR PLAN (L2)

SCALE 1:200 (A1); 1:400 (A3)

DRAWING NO.

KS22/A/PDRC/LO-06/P03

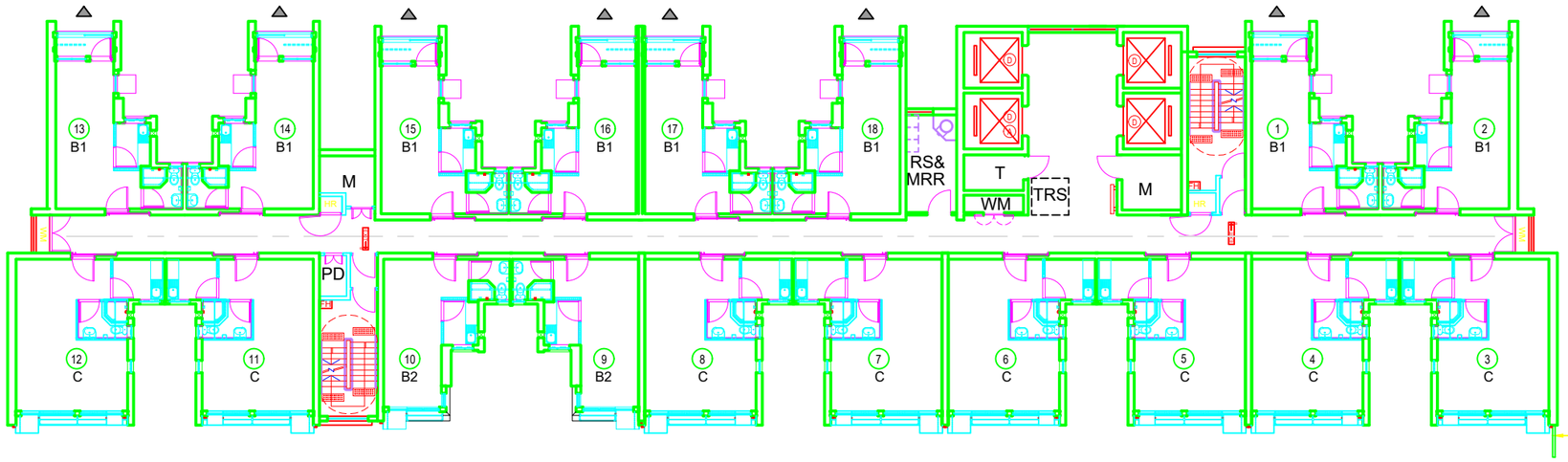
SOURCE

ICU NO.

AutoCAD 2000 A1 594 x 841

HOUSING DEPARTMENT

FLAT TYPE	B1	B2	C
NOS. OF FLAT/FL.	8	2	8
IFA OF FLAT/FL. (m^2)	23.72	21.46	30.31
FLAT MIX (%)	56		44



NOTES

LEGEND:-

△ ACOUSTIC BALCONY

REVISIONS	INITIAL AND DESIGNATION		
NO DESCRIPTION AND DATE	DWN	CKD	AUTH

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED			
CHECKED			
DRAWN			

PROJECT

PUBLIC RENTAL HOUSING DEVELOPMENT AT SAN KWAI STREET, KWAI CHUNG

DRAWING TITLE

TYPICAL FLOOR PLAN (F2-F39)

SCALE 1:250 (A1); 1:125 (A3)

DRAWING NO.

KS22/A/PDRC/LO-13/P03

SOURCE

ICU NO.

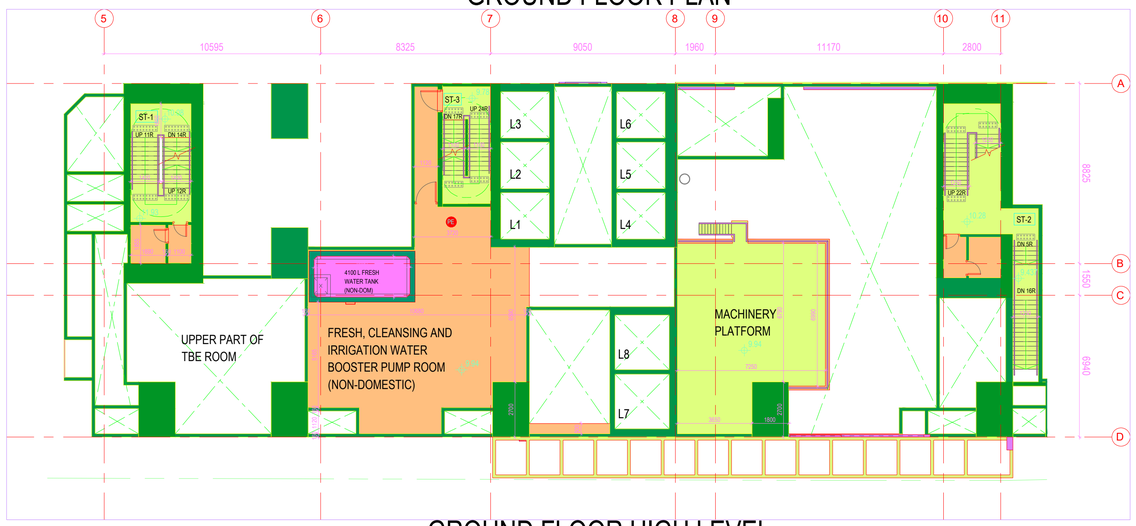
AutoCAD 2000 A1 594 x 841

HOUSING DEPARTMENT

Appendix 1

Master Layout Plan for the Proposed Scheme

GROUND FLOOR PLAN



GROUND FLOOR HIGH LEVEL

DISTANCE FROM FIRE SERVICE ACCESS POINT TO FIREMAN'S LIFT NO. L1	
ROUTE	DISTANCE (m)
A1	9.52
A2	5.77
A3	1.96
TOTAL (MAX ALLOWED 18m)	17.25

DISTANCE FROM FIRE SERVICE ACCESS POINT TO FIREMAN'S LIFT NO. 4	
ROUTE	DISTANCE (m)
A1	9.52
A2	5.77
A4	1.94
TOTAL (MAX ALLOWED 18m)	17.24

MAX. TRAVEL DISTANCE FROM KITCHEN* TO THE POINT OF DISCHARGE	
ROUTE	DISTANCE (m)
G1	6.97
G2	1.58
G3	13.77
TOTAL (MAX ALLOWED 30m)	22.32

ICU Ref. : HD(ICU) _____

Signature of Applicant (HD / PSP) :

ICU Approval Signature :

Signature for record Plan :

REVISIONS

NO	DESCRIPTION AND DATE	INITIAL AND DESIGNATION DWN	CKD	AUTH

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED	ELLEN K.S. NGAN CA/1	ORIGINAL SIGNED	JAN 2023
CHECKED	CAROL F. TY SA/31	ORIGINAL SIGNED	JAN 2023
	BEATRICE W.Y. CHOI A/26	ORIGINAL SIGNED	JAN 2023
	W.C.TANG STO(A)/58	ORIGINAL SIGNED	JAN 2023
DRAWN	T.Y. IP TO(A)/46	ORIGINAL SIGNED	JAN 2023

PROJECT

PUBLIC HOUSING DEVELOPMENT AT SAN KWAI STREET

DRAWING TITLE

GROUND FLOOR PLAN (SHEET 1 OF 2)

SCALE 1:150 (A1)

DRAWING NO.

KS22/ICU/A/GBP-13

SOURCE

ICU REF.

Revit 2018 A1 594 x 841

HOUSING DEPARTMENT

ICU Ref. : HD(ICU) _____

Signature of Applicant (HD / PSP) :

ICU Approval Signature :

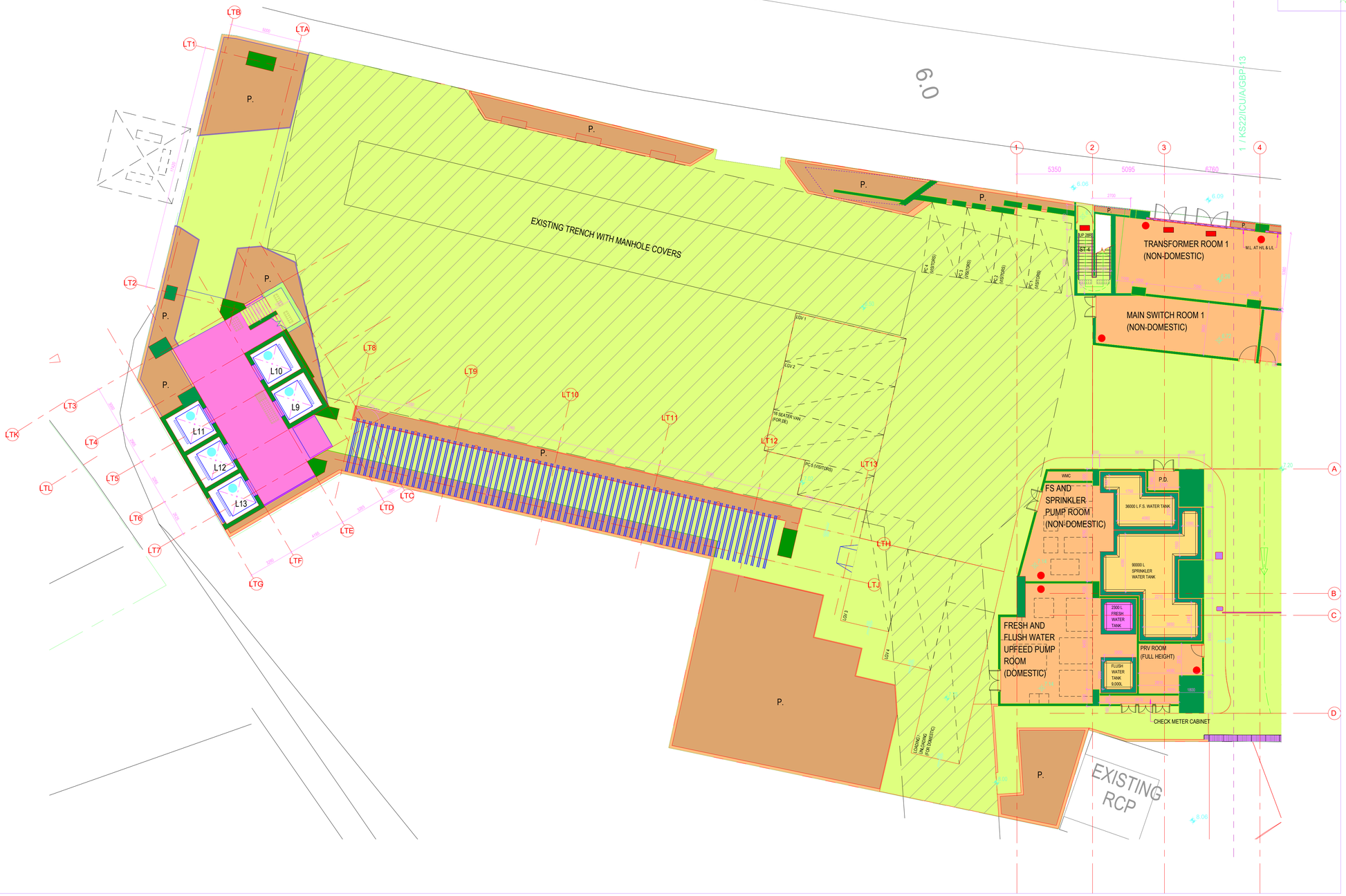
Signature for record Plan :

LEGEND:

SITE BOUNDARY

DRAINAGE RESERVE AREA

N



GROUND FLOOR PLAN

REVISIONS

NO	DESCRIPTION AND DATE	INITIAL AND DESIGNATION DWN	CKD	AUTH

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED	ELLEN K.S. NGAN CA/1	ORIGINAL SIGNED	JAN 2023
CHECKED	CAROL F. TY SA/31	ORIGINAL SIGNED	JAN 2023
	BEATRICE W.Y. CHOI A/26	ORIGINAL SIGNED	JAN 2023
	W.C.TANG STO(A)/58	ORIGINAL SIGNED	JAN 2023
DRAWN	T.Y. IP TO(A)/46	ORIGINAL SIGNED	JAN 2023

PROJECT

PUBLIC HOUSING DEVELOPMENT AT SAN KWAI STREET

DRAWING TITLE

GROUND FLOOR PLAN (SHEET 2 OF 2)

SCALE 1:150 (A1)

DRAWING NO.

KS22/ICU/A/GBP-14

SOURCE

ICU REF.

Revit 2018 A1 594 x 841

HOUSING DEPARTMENT

ICU Ref. : HD(ICU) _____

Signature of Applicant (HD / PSP) :

LEGEND:

SITE BOUNDARY

N

FIRST FLOOR PLAN

MAX. TRAVEL DISTANCE FROM CARPARK* TO THE POINT OF DISCHARGE	
ROUTE	DISTANCE (m)
C1	6.00
C2	17.04
C3	7.79
C4	1.38
C5	0.39
TOTAL (MAX ALLOWED 36m)	32.61

MAX. TRAVEL DISTANCE FROM CARPARK* TO THE POINT OF DISCHARGE	
ROUTE	DISTANCE (m)
C6	6.84
C7	7.70
C8	13.19
C9	4.00
C10	0.35
TOTAL (MAX ALLOWED 36m)	32.08

MAX. TRAVEL DISTANCE FROM CARPARK* TO THE POINT OF DISCHARGE	
ROUTE	DISTANCE (m)
C11	7.16
C12	12.10
C13	4.21
C14	5.67
C15	0.35
TOTAL (MAX ALLOWED 36m)	29.49

MAX. TRAVEL DISTANCE FROM CARPARK* TO THE POINT OF DISCHARGE	
ROUTE	DISTANCE (m)
C16	8.19
C17	10.35
C18	7.28
C19	9.30
C20	0.36
TOTAL (MAX ALLOWED 36m)	35.48

MAX. TRAVEL DISTANCE FROM CARPARK* TO THE POINT OF DISCHARGE	
ROUTE	DISTANCE (m)
S1	1.39
S1	0.63
S2	12.80
S3	15.64
S4	9.58
S5	3.15
TOTAL (MAX ALLOWED 48m)	43.20

ICU Approval Signature :

Signature for record Plan :

REVISIONS

NO	DESCRIPTION AND DATE	INITIAL AND DESIGNATION DWN	CKD	AUTH

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED	ELLEN K.S. NGAN CA/1	ORIGINAL SIGNED	JAN 2023
CHECKED	CAROL F. TY SA/31	ORIGINAL SIGNED	JAN 2023
	BEATRICE W.Y. CHOI A/26	ORIGINAL SIGNED	JAN 2023
	W.C.TANG STO(A)/58	ORIGINAL SIGNED	JAN 2023
DRAWN	T.Y. IP TO(A)/46	ORIGINAL SIGNED	JAN 2023

PROJECT

PUBLIC HOUSING DEVELOPMENT AT SAN KWAI STREET

DRAWING TITLE

FIRST FLOOR PLAN

SCALE 1:150 (A1)

DRAWING NO.

KS22/ICU/A/GBP-15

SOURCE

ICU REF.

Revit 2018 A1 594 x 841

HOUSING DEPARTMENT

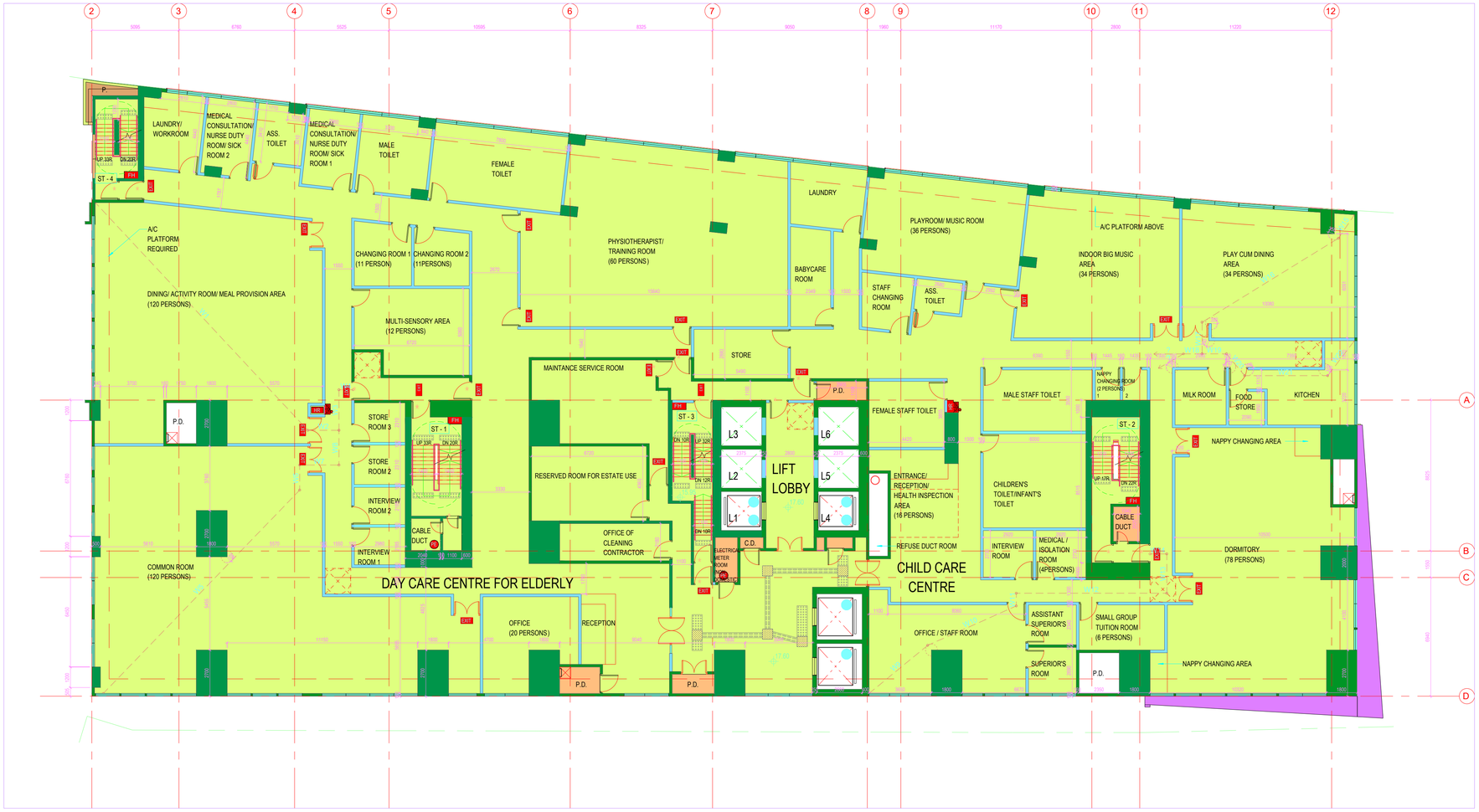
ICU Ref. : HD(ICU) _____

LEGEND:

SITE BOUNDARY

DRAINAGE RESERVE AREA

N



SECOND FLOOR PLAN

MAX. TRAVEL DISTANCE FROM DINING ROOM* TO THE POINT OF DISCHARGE	
ROUTE	DISTANCE (m)
W1	18.22
W2	1.83
W3	2.37
W4	0.83
TOTAL (MAX ALLOWED 30m)	23.23

MAX. TRAVEL DISTANCE FROM COMMON ROOM* TO THE POINT OF DISCHARGE	
ROUTE	DISTANCE (m)
W3	2.37
W4	0.83
W5	16.53
W6	1.46
W7	2.30
W8	2.04
TOTAL (MAX ALLOWED 30m)	25.52

MAX. TRAVEL DISTANCE FROM OFFICE/ STAFF ROOM* TO THE POINT OF DISCHARGE	
ROUTE	DISTANCE (m)
W9	4.43
W10	5.67
W11	0.74
W12	8.80
W13	2.30
W14	0.98
TOTAL (MAX ALLOWED 30m)	22.93

MAX. TRAVEL DISTANCE FROM KITCHEN* TO THE POINT OF DISCHARGE	
ROUTE	DISTANCE (m)
W18	1.09
W19	1.43
W20	1.66
W21	4.86
W22	2.59
TOTAL (MAX ALLOWED 12m)	11.63

MAX. TRAVEL DISTANCE FROM PLAY CUM DINING AREA* TO THE POINT OF DISCHARGE	
ROUTE	DISTANCE (m)
W15	1.67
W16	9.37
W17	1.85
W18	1.09
TOTAL (MAX ALLOWED 12m)	13.98

Signature of Applicant (HD / PSP) :

ICU Approval Signature :

Signature for record Plan :

REVISIONS

NO	DESCRIPTION AND DATE	INITIAL AND DESIGNATION DWN	CKD	AUTH

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED	ELLEN K.S. NGAN CA/1	ORIGINAL SIGNED	JAN 2023
CHECKED	CAROL F. TY SA/31	ORIGINAL SIGNED	JAN 2023
	BEATRICE W.Y. CHOI A/26	ORIGINAL SIGNED	JAN 2023
	W.C.TANG STO(A)/58	ORIGINAL SIGNED	JAN 2023
DRAWN	T.Y. IP TO(A)/46	ORIGINAL SIGNED	JAN 2023

PROJECT

PUBLIC HOUSING DEVELOPMENT AT SAN KWAI STREET

DRAWING TITLE

SECOND FLOOR PLAN

SCALE 1:150 (A1)

DRAWING NO.

KS22/ICU/A/GBP-16

SOURCE

ICU REF.

Revit 2018 A1 594 x 841

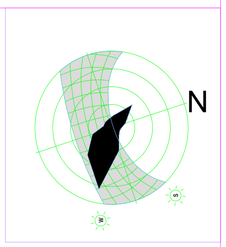
HOUSING DEPARTMENT

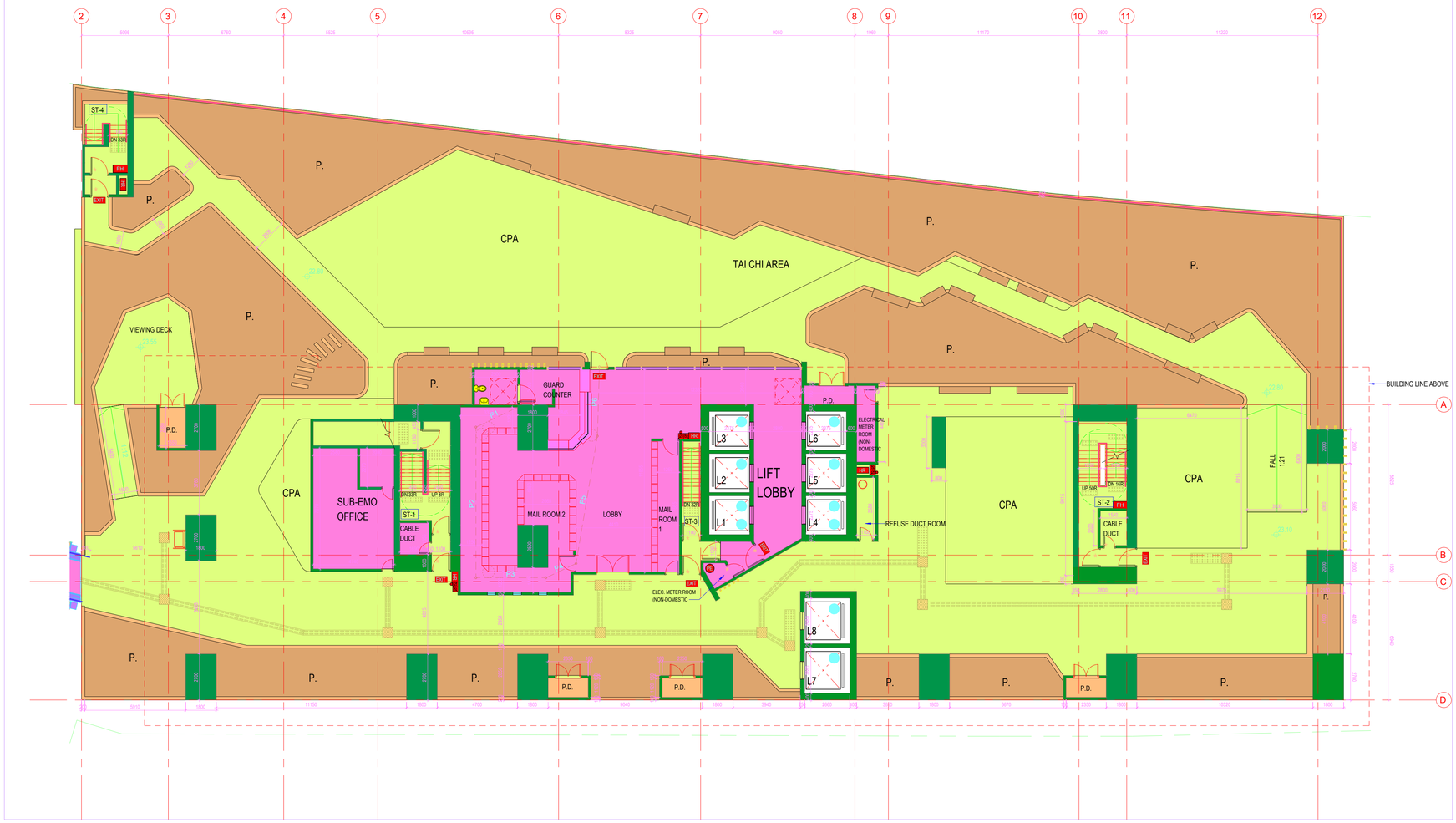
LEGEND:

SITE BOUNDARY

DRAINAGE RESERVE AREA

ICU Ref. : HD(ICU) _____





THIRD FLOOR PLAN

MAX. TRAVEL DISTANCE FROM MAIL ROOM 2* TO THE POINT OF DISCHARGE	
ROUTE	DISTANCE (m)
P1	2.69
P2	8.83
P3	4.10
P4	1.95
P5	7.56
P6	4.05
TOTAL (MAX ALLOWED 36m)	29.19

Signature of Applicant (HD / PSP) :

ICU Approval Signature :

Signature for record Plan :

REVISIONS

NO	DESCRIPTION AND DATE	INITIAL AND DESIGNATION DWN	CKD	AUTH

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED	ELLEN K.S. NGAN CA/1	ORIGINAL SIGNED	JAN 2023
CHECKED	CAROL F. TY SA/31	ORIGINAL SIGNED	JAN 2023
	BEATRICE W.Y. CHOI A/26	ORIGINAL SIGNED	JAN 2023
	W.C.TANG STO(A)/58	ORIGINAL SIGNED	JAN 2023
DRAWN	T.Y. IP TO(A)/46	ORIGINAL SIGNED	JAN 2023

PROJECT

PUBLIC HOUSING DEVELOPMENT AT SAN KWAI STREET

DRAWING TITLE

THIRD FLOOR PLAN

SCALE 1:150 (A1)

DRAWING NO.

KS22/ICU/A/GBP-17

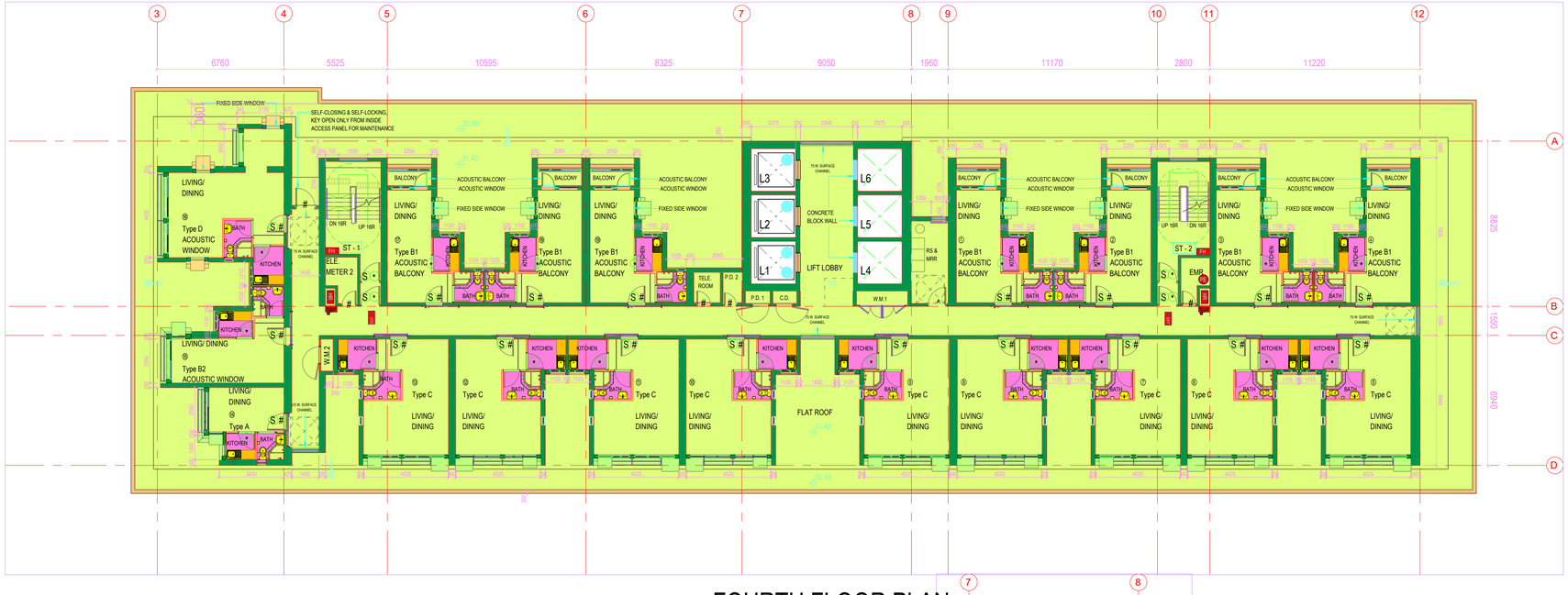
SOURCE

ICU REF.

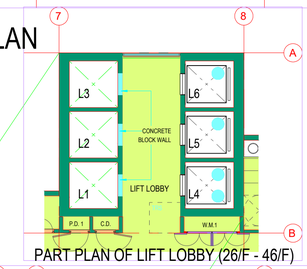
Revit 2018 A1 594 x 841

HOUSING DEPARTMENT

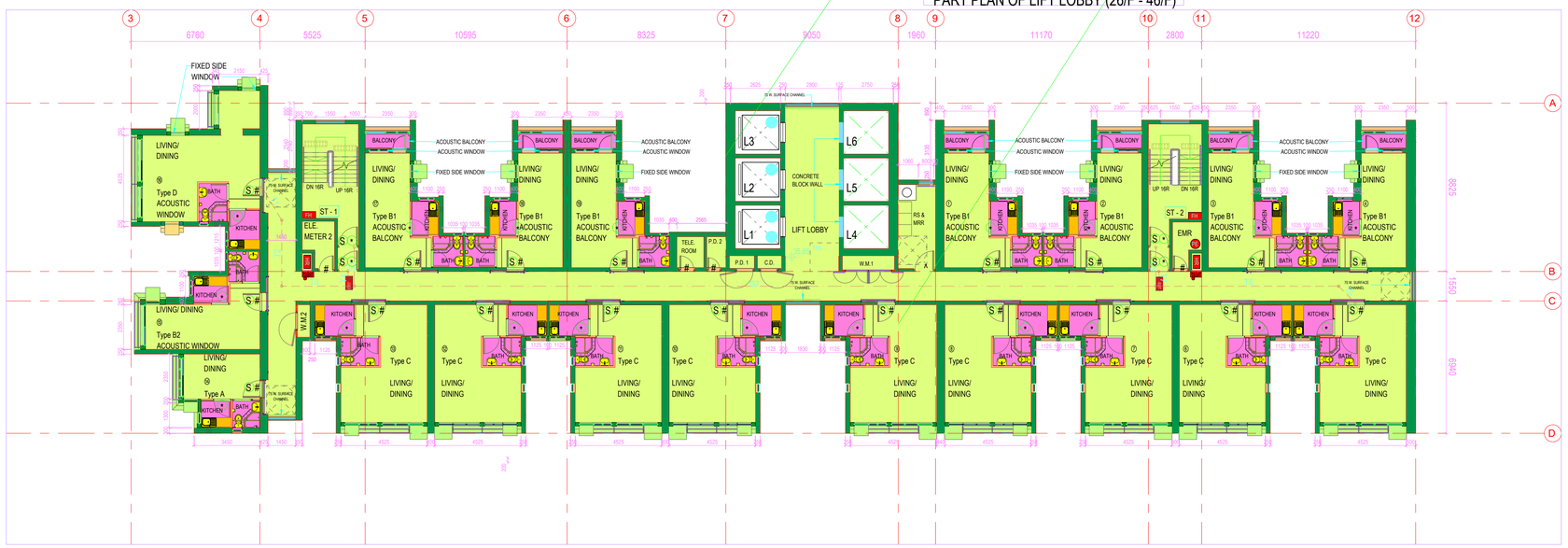
ICU Ref. : HD(ICU) _____



FOURTH FLOOR PLAN



PART PLAN OF LIFT LOBBY (26/F - 46/F)

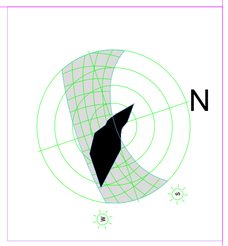


TYPICAL FLOOR PLAN (5/F - 46/F)

MAX. TRAVEL DISTANCE FROM FLAT 16" TO THE POINT OF DISCHARGE	
ROUTE	DISTANCE (m)
T1	2.02
T2	3.46
T3	3.48
T4	0.80
TOTAL (MAX ALLOWED 15m)	9.75

MAX. TRAVEL DISTANCE FROM FLAT 5" TO THE POINT OF DISCHARGE	
ROUTE	DISTANCE (m)
T5	1.23
T6	9.43
T7	0.78
TOTAL (MAX ALLOWED 15m)	11.43

STAIRCASE SEPARATION OF ST-01 TO ST-02	
ROUTE	DISTANCE (m)
S6	2.04
S7	42.06
S8	2.04
TOTAL (MAX ALLOWED 48m)	46.13



Signature of Applicant (HD / PSP) :

ICU Approval Signature :

Signature for record Plan :

REVISIONS

NO	DESCRIPTION AND DATE	INITIAL AND DESIGNATION DWN	CKD	AUTH

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED	ELLEN K.S. NGAN CA/1	ORIGINAL SIGNED	JAN 2023
CHECKED	CAROL F. TY SA/31	ORIGINAL SIGNED	JAN 2023
	BEATRICE W.Y. CHOI A/26	ORIGINAL SIGNED	JAN 2023
	W.C.TANG STO(A)/58	ORIGINAL SIGNED	JAN 2023
DRAWN	KATE H.Y. WONG TO(A)/25	ORIGINAL SIGNED	JAN 2023

PROJECT

PUBLIC HOUSING DEVELOPMENT AT SAN KWAI STREET

DRAWING TITLE

FOURTH PLAN & TYPICAL FLOOR PLAN

SCALE 1:150 (A1)

DRAWING NO.

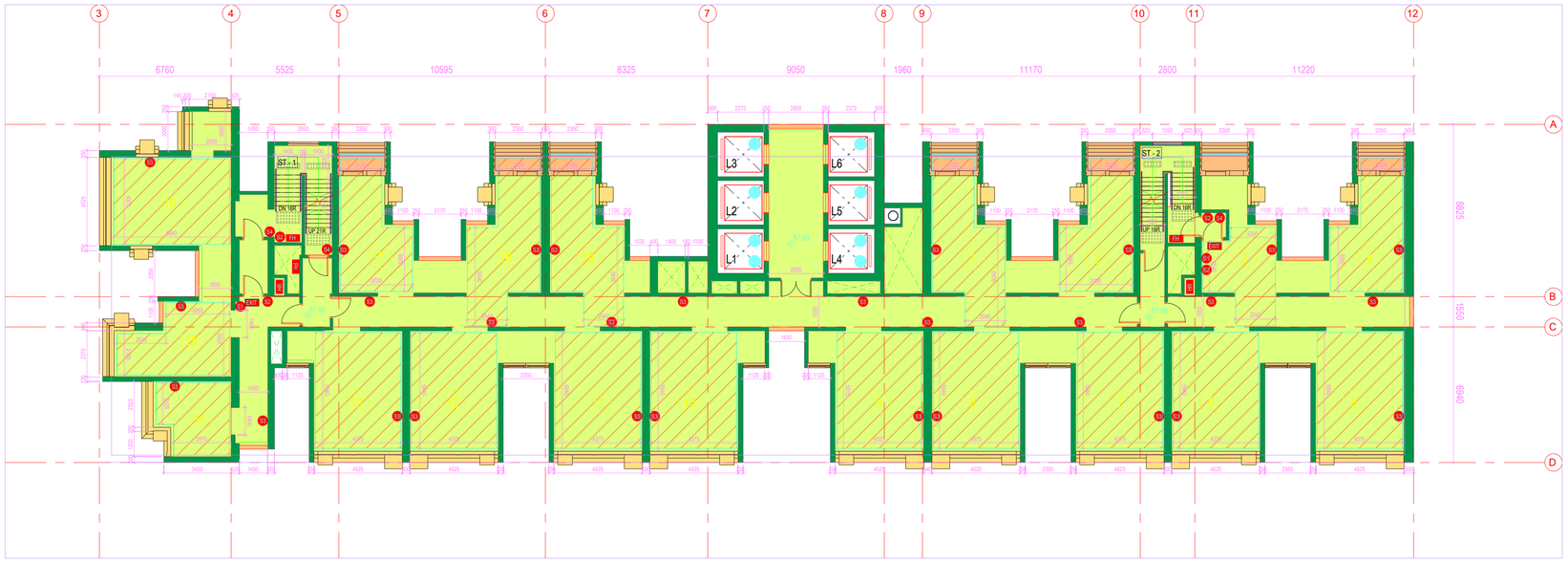
KS22/ICU/A/GBP-18

SOURCE

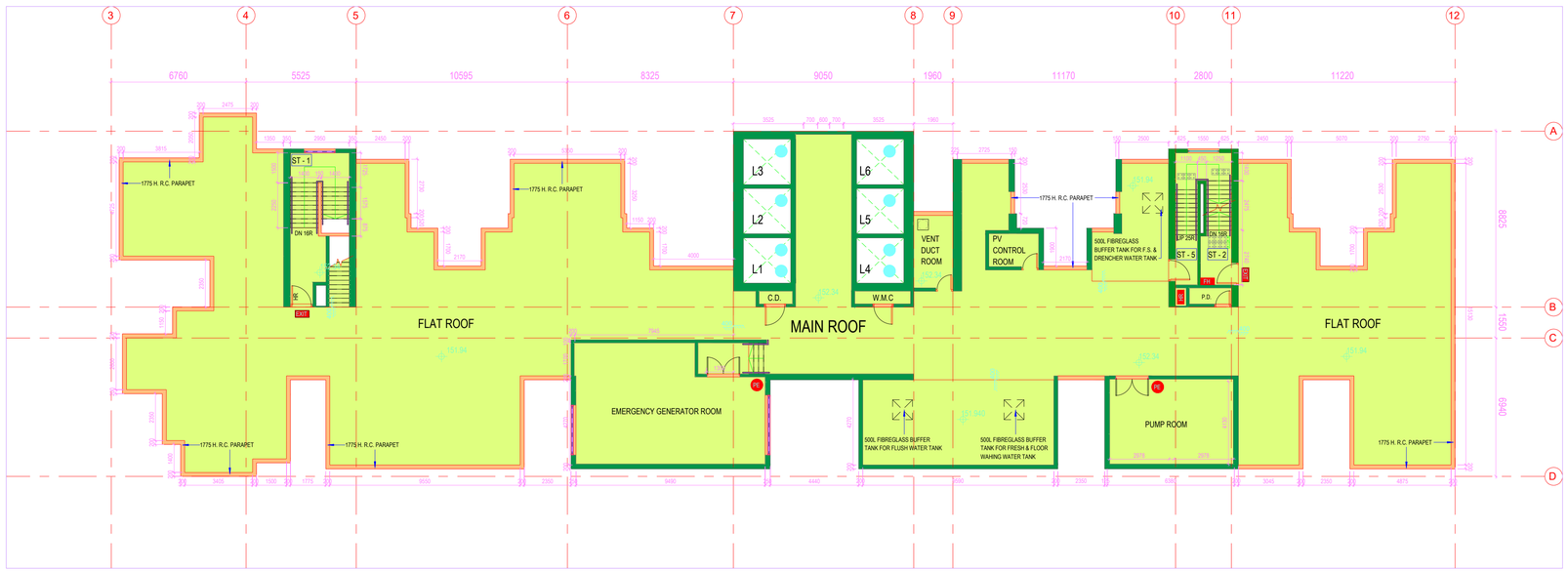
ICU REF.

Revit 2018 A1 594 x 841

HOUSING DEPARTMENT

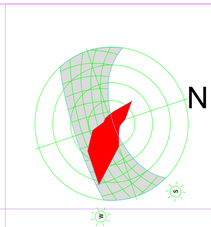


REFUGE FLOOR PLAN



MAIN ROOF FLOOR PLAN

ICU Ref. : HD(ICU) _____



LEGEND:

REFUGE AREA

S1

RUFUGE FLOOR 避火層
For Temporary Reset During Emergency Escape
緊急逃生時供暫時歇腳用
EXITS TO STREET LEVEL
在街道出口
staircase (No.)
( ) 號樓梯
staircase (No.)
( ) 號樓梯

S2

STAIRCASE (NO.)
( ) 號樓梯

S3

STAIRCASE (NO.)
( ) 號樓梯

S4

REFUGE FLOOR 避火層
For Temporary Reset During Emergency Escape
緊急逃生時供暫時歇腳用

NOTE: WORDS AND CHARACTERS IN BLOCK LETTERS NOT LESS THAN 50mm HIGH

THE MINIMUM DIMENSUIN OF REFUSE FLOOR AREA :
1350mm x 150% = 2025mm

REFUGE FLOOR AREA AT 24/F

PORTION	AREA (m²)
1	23.21
2	19.57
3	14.70
4	19.57
5	25.99
6	25.99
7	25.99
8	25.99
9	25.58
10	25.99
11	25.99
12	25.99
13	25.99
14	12.55
15	17.41
16	25.99
17	19.57
18	23.21
19	23.21
TOTAL :	432.47

TOTAL DOMESTIC G.F.A. FOR TYPICAL FLOOR (BEFORE EXEMPTION)

886.42 - 22.53 = 863.89

PROVIDED REFUGE FLOOR AREA (m²):

432.47 (PROVIDED) > 431.95 (REQUIRED)

Signature of Applicant (HD / PSP) :

ICU Approval Signature :

Signature for record Plan :

REVISIONS

NO	DESCRIPTION AND DATE	INITIAL AND DESIGNATION DWN	CKD	AUTH

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED	ELLEN K.S. NGAN CA/1	ORIGINAL SIGNED	JAN 2023
CHECKED	CAROL F. TY SA/31	ORIGINAL SIGNED	JAN 2023
	BEATRICE W.Y. CHOI A/26	ORIGINAL SIGNED	JAN 2023
	W.C.TANG STO(A)/58	ORIGINAL SIGNED	JAN 2023
DRAWN	KATE H.Y. WONG TO(A)/25	ORIGINAL SIGNED	JAN 2023

PROJECT

PUBLIC HOUSING DEVELOPMENT AT SAN KWAI STREET

DRAWING TITLE

REFUGE FLOOR PLAN & MAIN ROOF PLAN

SCALE 1:150 (A1)

DRAWING NO.

KS22/ICU/A/GBP-19

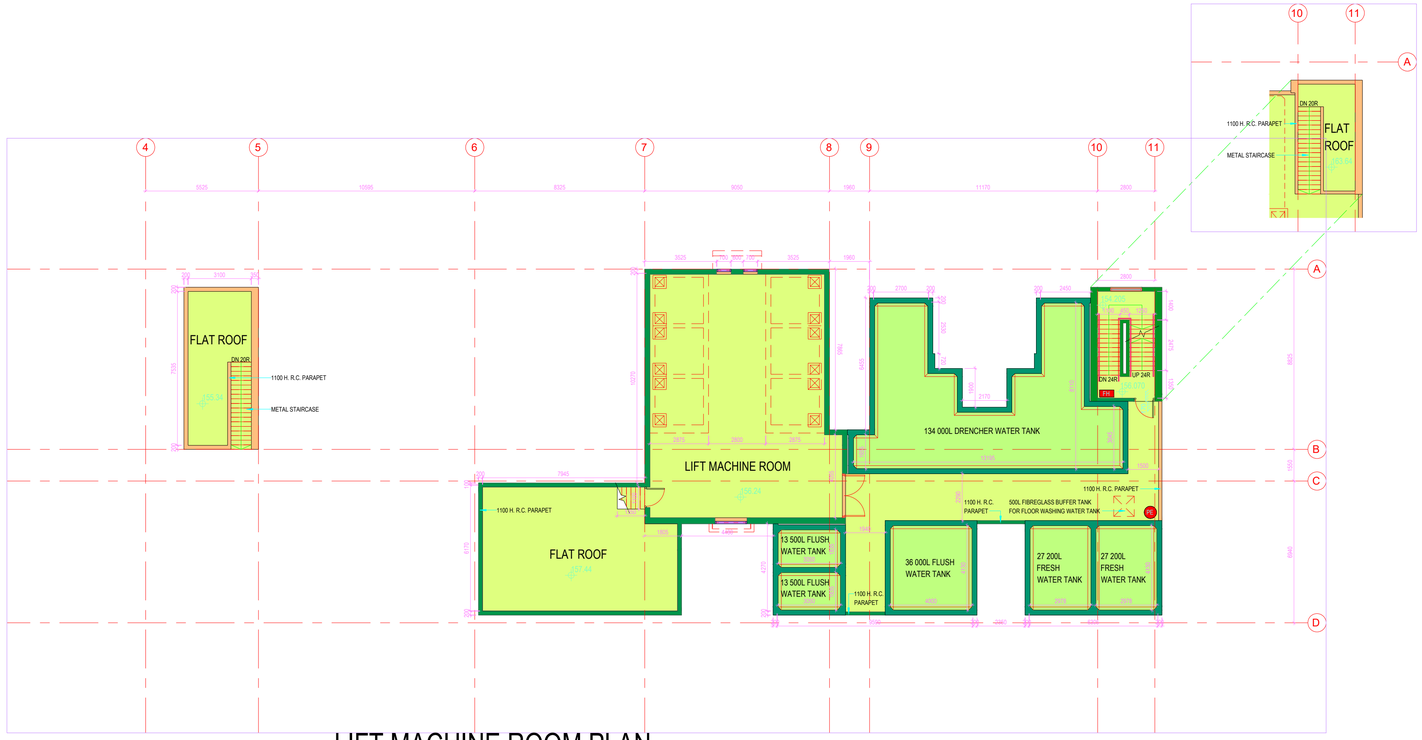
SOURCE

ICU REF.

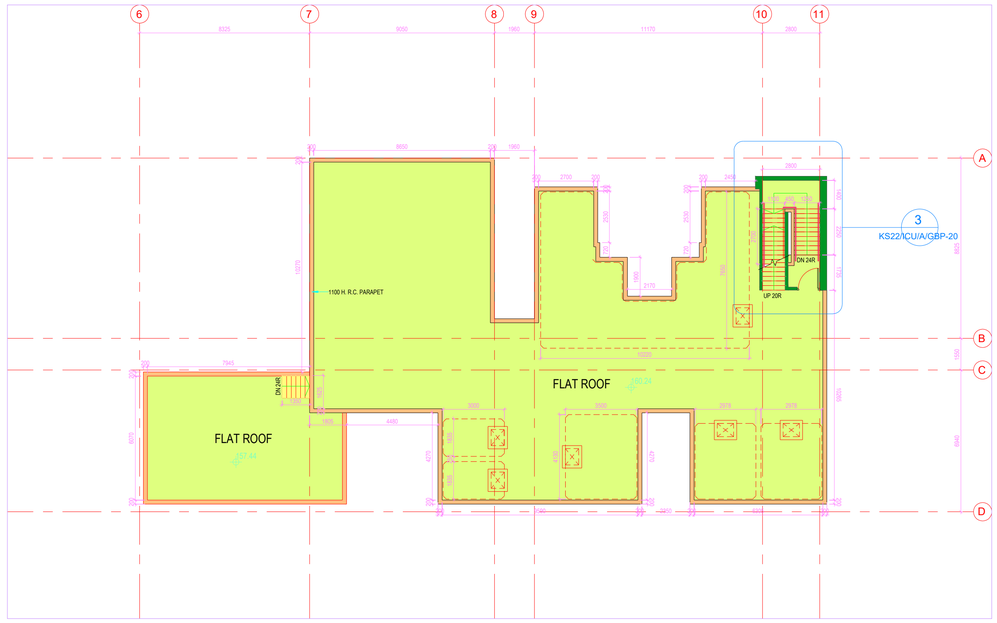
Revit 2018 A1 594 x 841

HOUSING DEPARTMENT

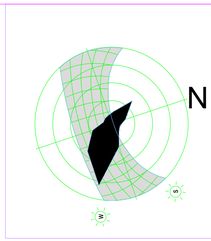
ICU Ref. : HD(ICU) _____



LIFT MACHINE ROOM PLAN



TOP ROOF PLAN



Signature of Applicant (HD / PSP) :

ICU Approval Signature :

Signature for record Plan :

REVISIONS

NO	DESCRIPTION AND DATE	INITIAL AND DESIGNATION DWN	CKD	AUTH

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED	ELLEN K.S. NGAN CA/1	ORIGINAL SIGNED	JAN 2023
CHECKED	CAROL F. TY SA/31	ORIGINAL SIGNED	JAN 2023
	BEATRICE W.Y. CHOI A/26	ORIGINAL SIGNED	JAN 2023
	W.C.TANG STO(A)/58	ORIGINAL SIGNED	JAN 2023
DRAWN	KATE H.Y. WONG TO(A)/25	ORIGINAL SIGNED	JAN 2023

PROJECT

PUBLIC HOUSING DEVELOPMENT AT SAN KWAI STREET

DRAWING TITLE

LMF PLAN & TOP ROOF PLAN

SCALE 1:150 (A1)

DRAWING NO.

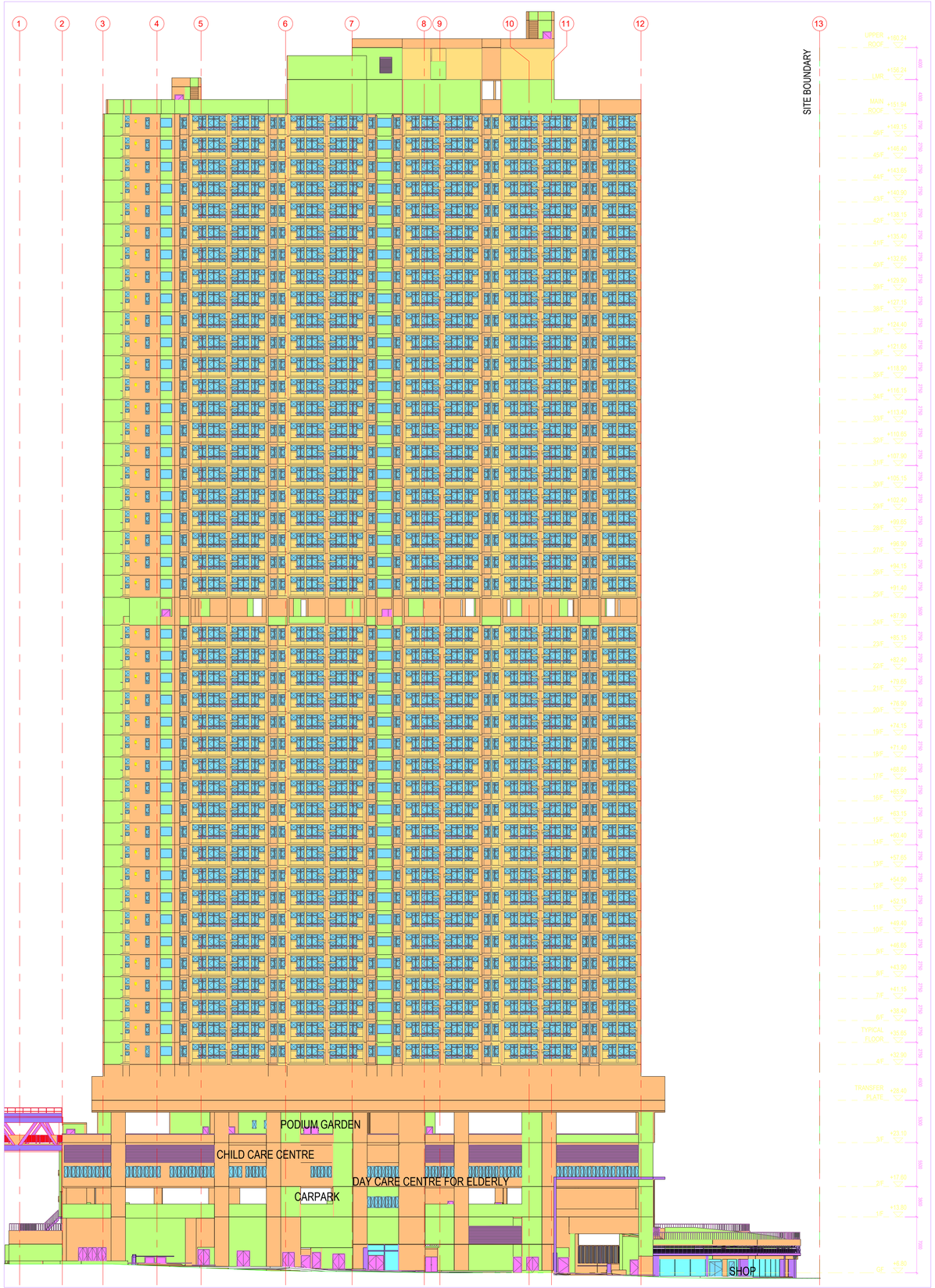
KS22/ICU/A/GBP-20

SOURCE

ICU REF.

Revit 2018 A1 594 x 841

HOUSING DEPARTMENT



ELEVATION 1

ICU Ref. : HD(ICU) _____

KEY PLAN

Signature of Applicant (HD / PSP) :

ICU Approval Signature :

Signature for record Plan :

REVISIONS		INITIAL AND DESIGNATION		
NO	DESCRIPTION AND DATE	DWN	CKD	AUTH

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED	ELLEN K.S. NGAN CA/1	ORIGINAL SIGNED	JAN 2023
CHECKED	CAROL F. TY SA/31	ORIGINAL SIGNED	JAN 2023
	BEATRICE W.Y. CHOI A/26	ORIGINAL SIGNED	JAN 2023
	W.C.TANG STO(A)/58	ORIGINAL SIGNED	JAN 2023
DRAWN	T.Y. IP TO(A)/46	ORIGINAL SIGNED	JAN 2023

PROJECT

PUBLIC HOUSING DEVELOPMENT AT SAN KWAI STREET

DRAWING TITLE

BLOCK ELEVATION - 1

SCALE 1:300 (A1)

DRAWING NO.

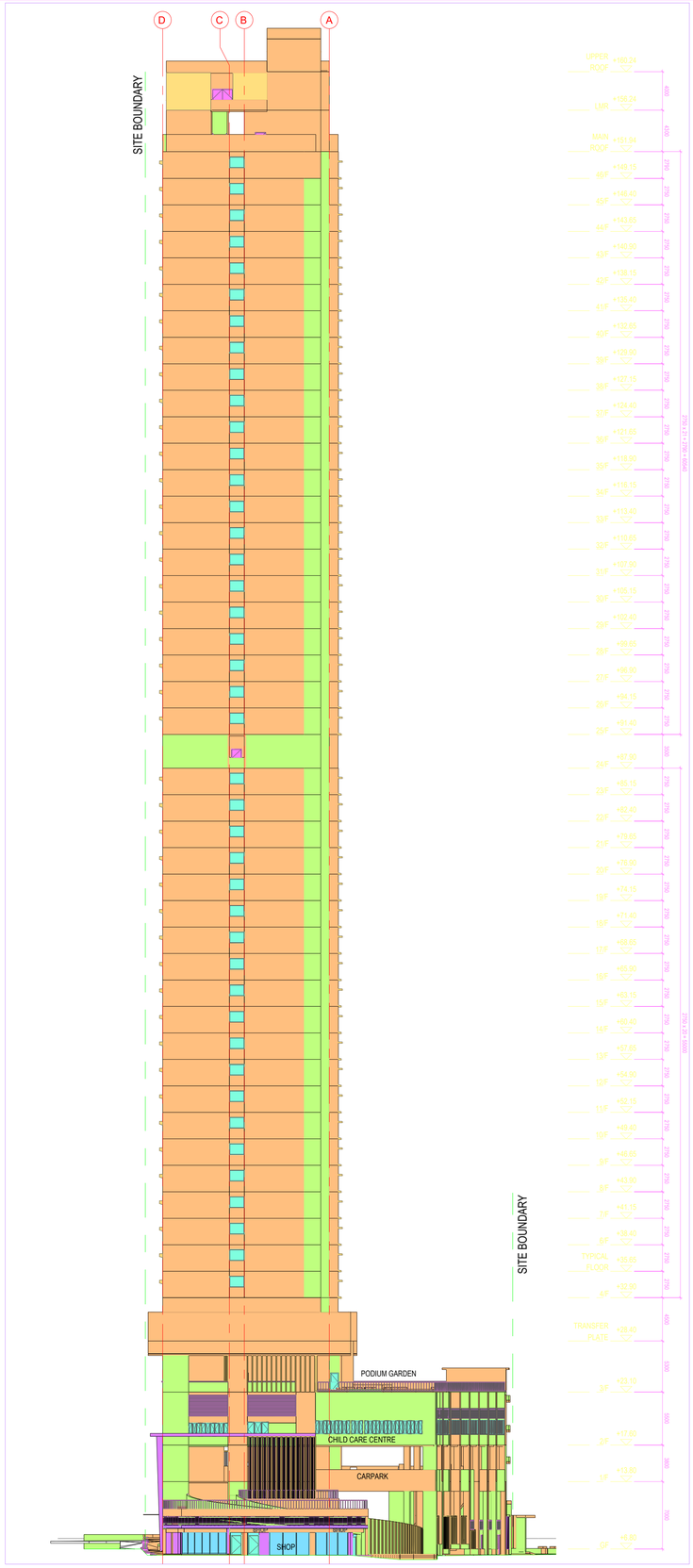
KS22/ICU/A/GBP-21

SOURCE

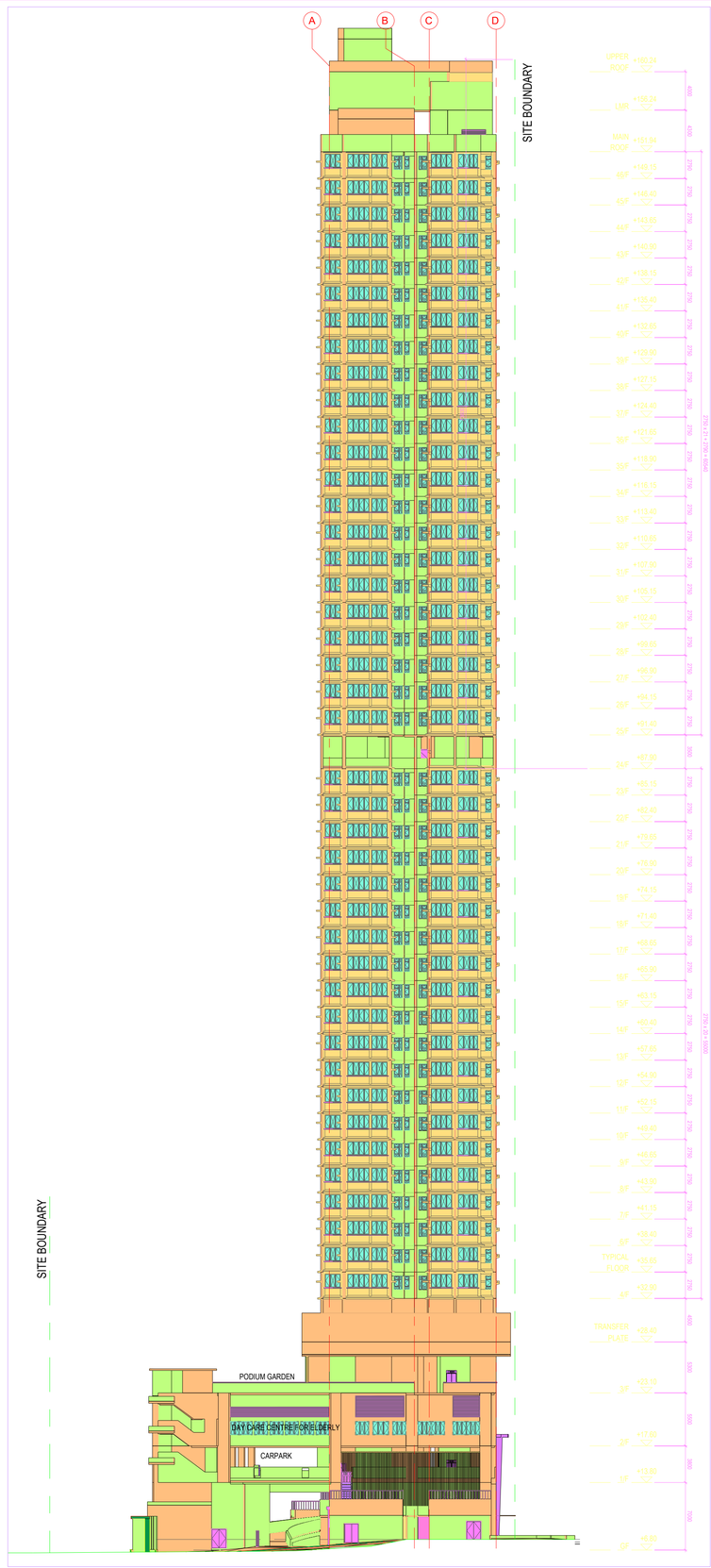
ICU REF.

Revit 2018 A1 594 x 841

HOUSING DEPARTMENT



ELEVATION 2



ELEVATION 3

ICU Ref. : HD(ICU) _____

KEY PLAN

Signature of Applicant (HD / PSP) :

ICU Approval Signature :

Signature for record Plan :

REVISIONS

NO	DESCRIPTION AND DATE	INITIAL AND DESIGNATION DWN	CKD	AUTH

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED	ELLEN K.S. NGAN CA/1	ORIGINAL SIGNED	JAN 2023
CHECKED	CAROL F. TY SA/31	ORIGINAL SIGNED	JAN 2023
	BEATRICE W.Y. CHOI A/26	ORIGINAL SIGNED	JAN 2023
	W.C.TANG STO(A)I/58	ORIGINAL SIGNED	JAN 2023
DRAWN	T.Y. IP TO(A)/46	ORIGINAL SIGNED	JAN 2023

PROJECT

PUBLIC HOUSING DEVELOPMENT AT SAN KWAI STREET

DRAWING TITLE

BLOCK ELEVATION - 2 & 3

SCALE 1:300 (A1)

DRAWING NO.

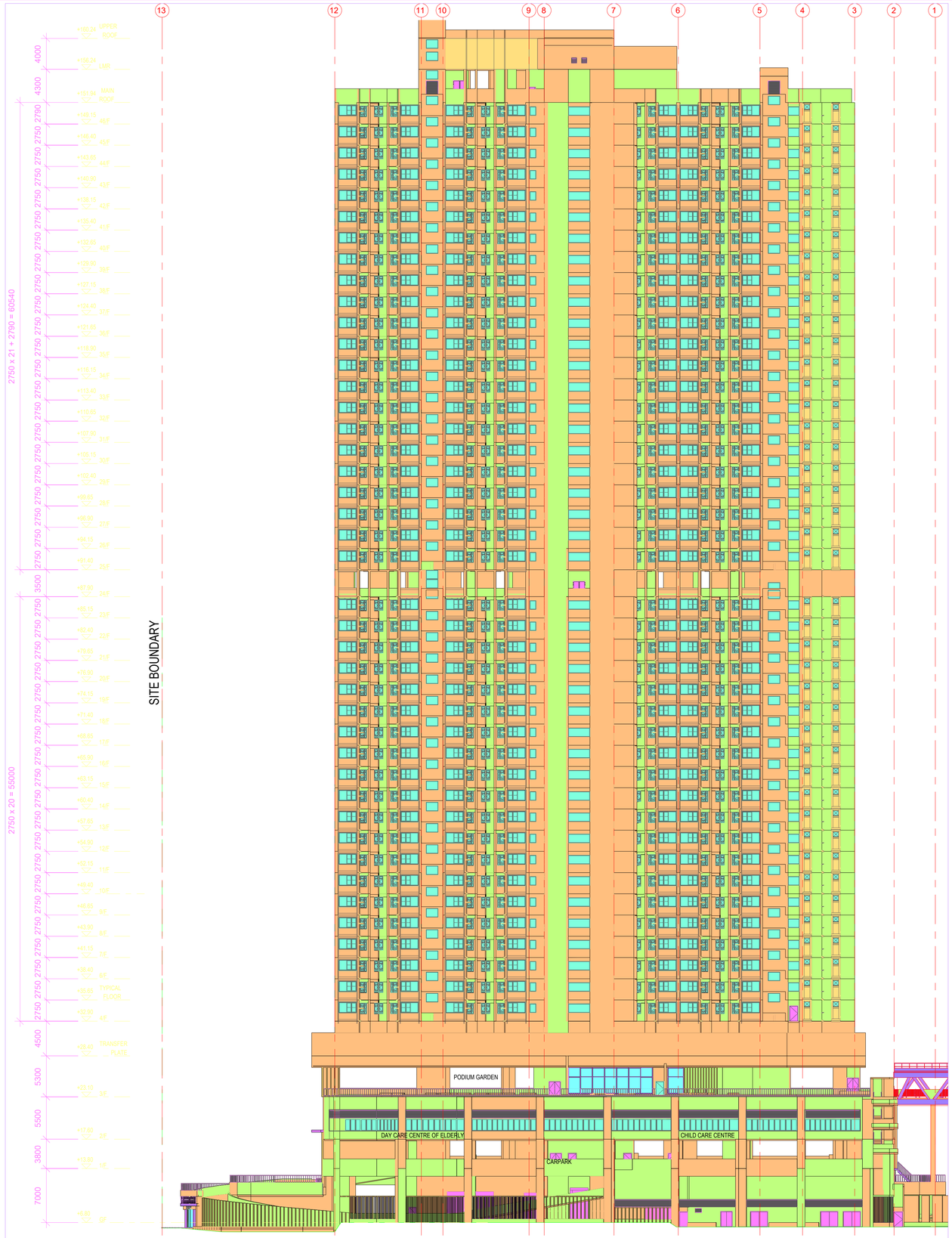
KS22/ICU/A/GBP-22

SOURCE

ICU REF.

Revit 2018 A1 594 x 841

HOUSING DEPARTMENT



ELEVATION 4

ICU Ref. : HD(ICU) _____

KEY PLAN

Signature of Applicant (HD / PSP) :

ICU Approval Signature :

Signature for record Plan :

REVISIONS

NO	DESCRIPTION AND DATE	INITIAL AND DESIGNATION DWN	CKD	AUTH

	NAME AND DESIGNATION	INITIAL	DATE
AUTHORISED	ELLEN K.S. NGAN CA/1	ORIGINAL SIGNED	JAN 2023
CHECKED	CAROL F. TY SA/31	ORIGINAL SIGNED	JAN 2023
	BEATRICE W.Y. CHOI A/26	ORIGINAL SIGNED	JAN 2023
	W.C.TANG STO(A)/58	ORIGINAL SIGNED	JAN 2023
DRAWN	T.Y. IP TO(A)/46	ORIGINAL SIGNED	JAN 2023

PROJECT

PUBLIC HOUSING DEVELOPMENT AT SAN KWAI STREET

DRAWING TITLE

BLOCK ELEVATION - 4

SCALE 1 : 300 1:300 (A1)

DRAWING NO.

KS22/ICU/A/GBP-23

SOURCE

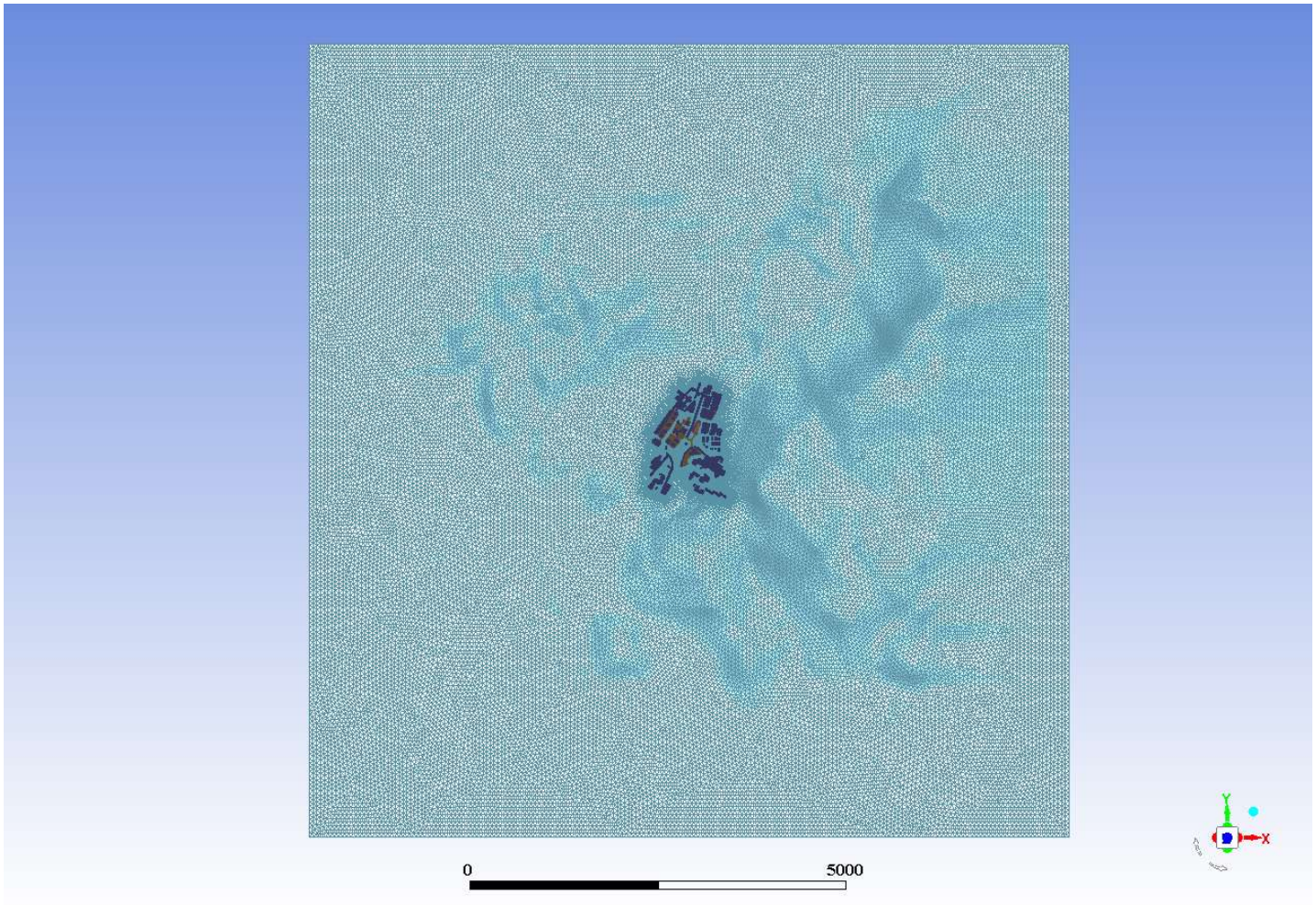
ICU REF.

Revit 2018 A1 594 x 841

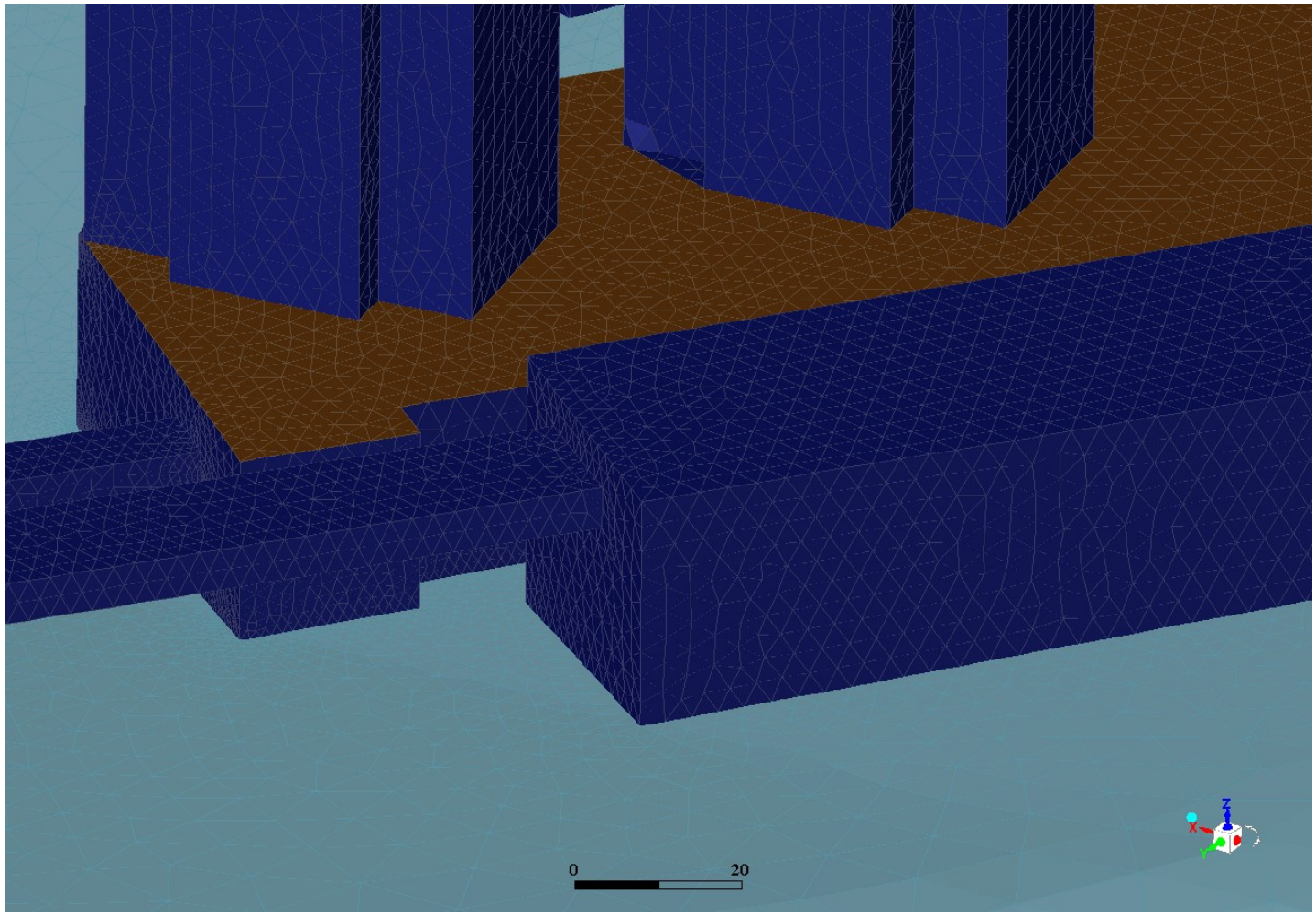
HOUSING DEPARTMENT

Appendix 3

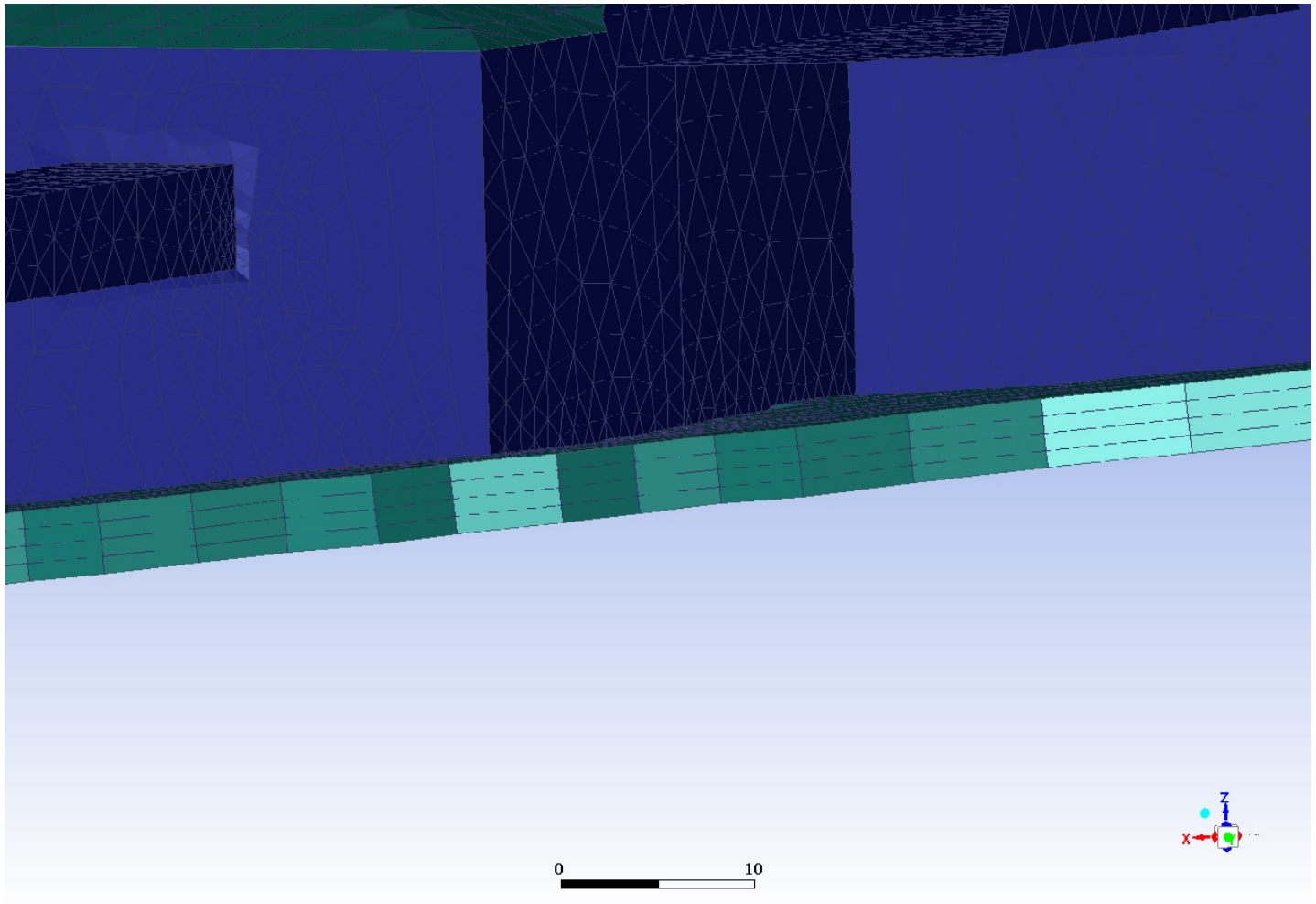
Captured Pictures of the CFD Model



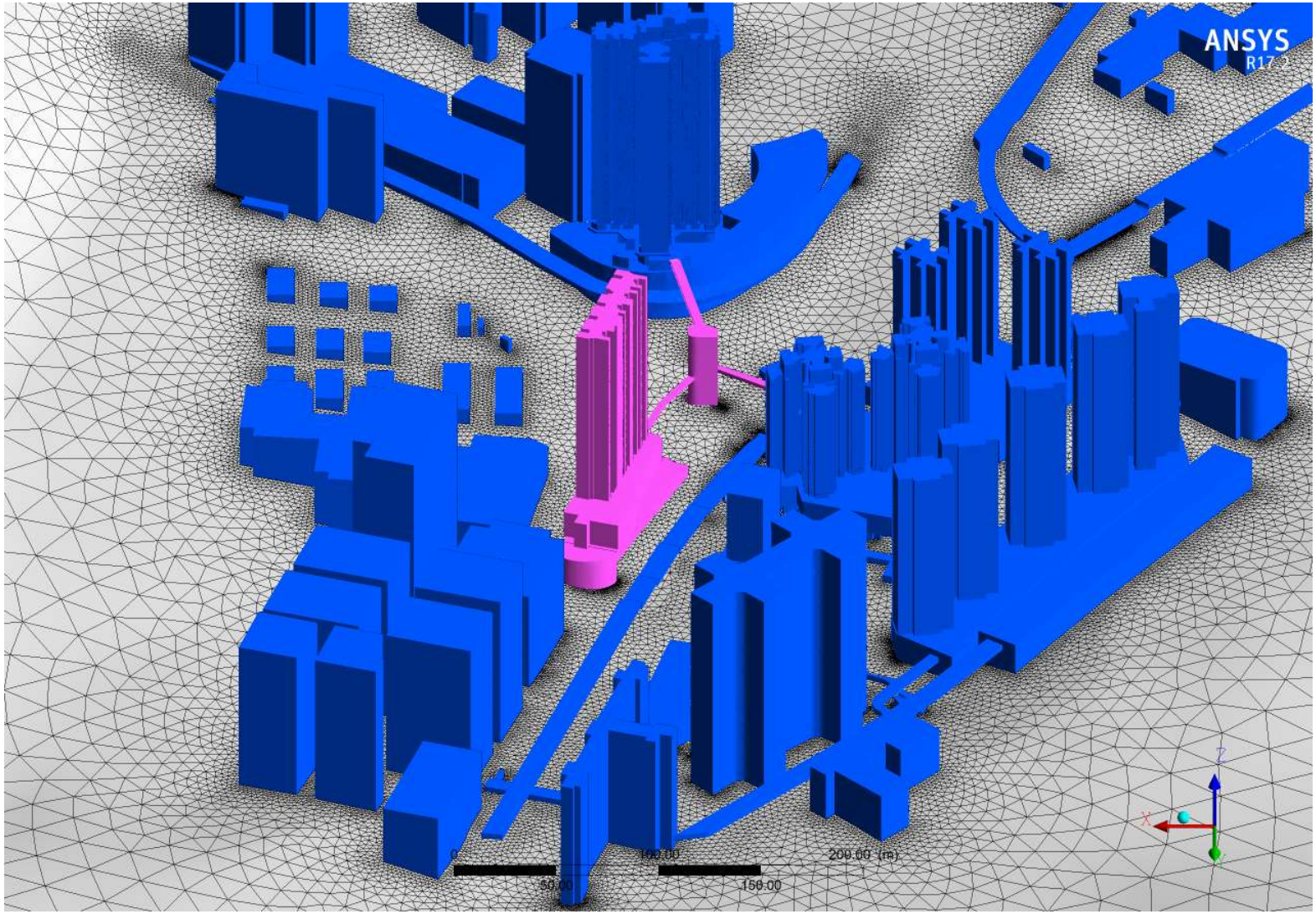
Domain



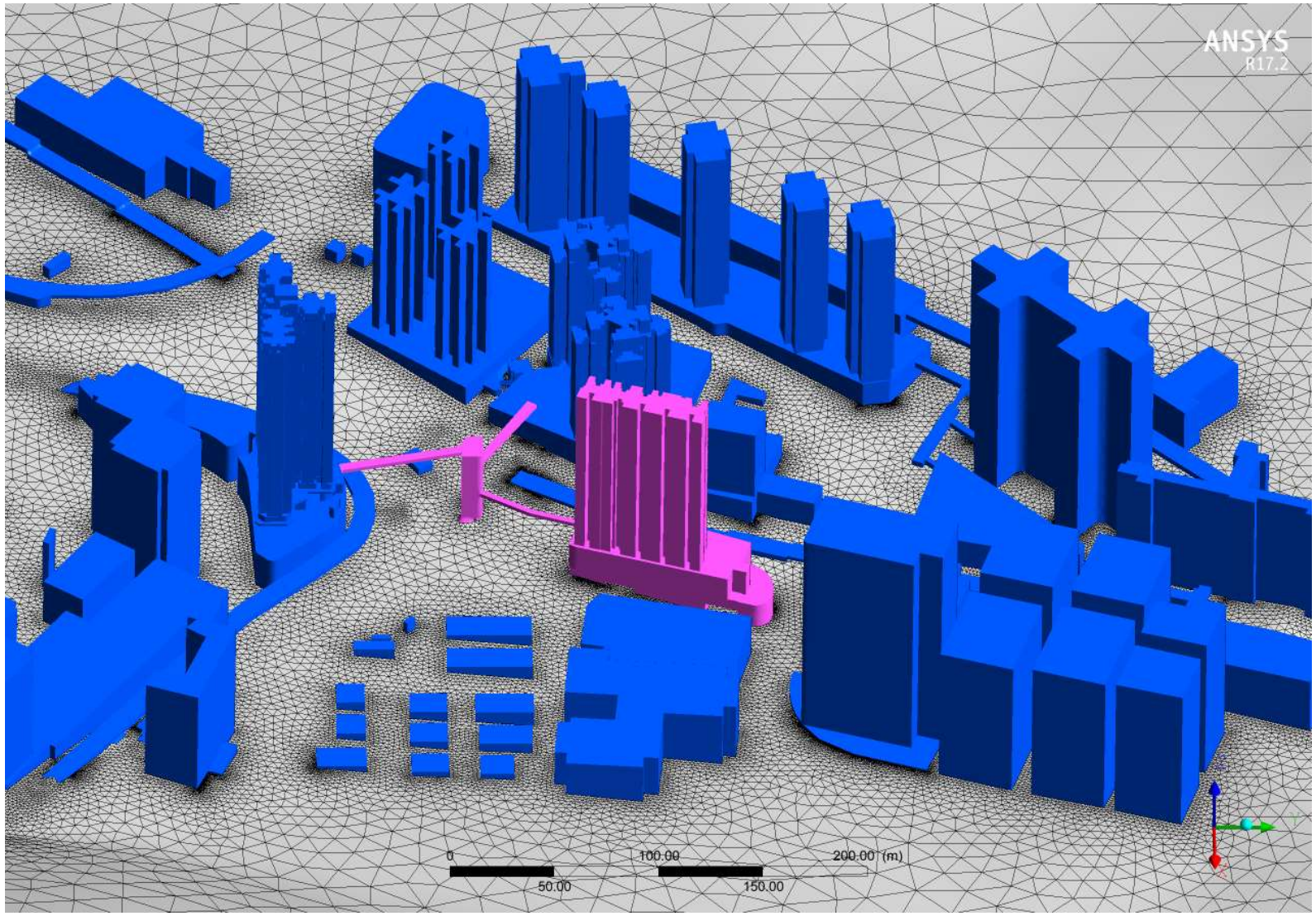
Surface Mesh



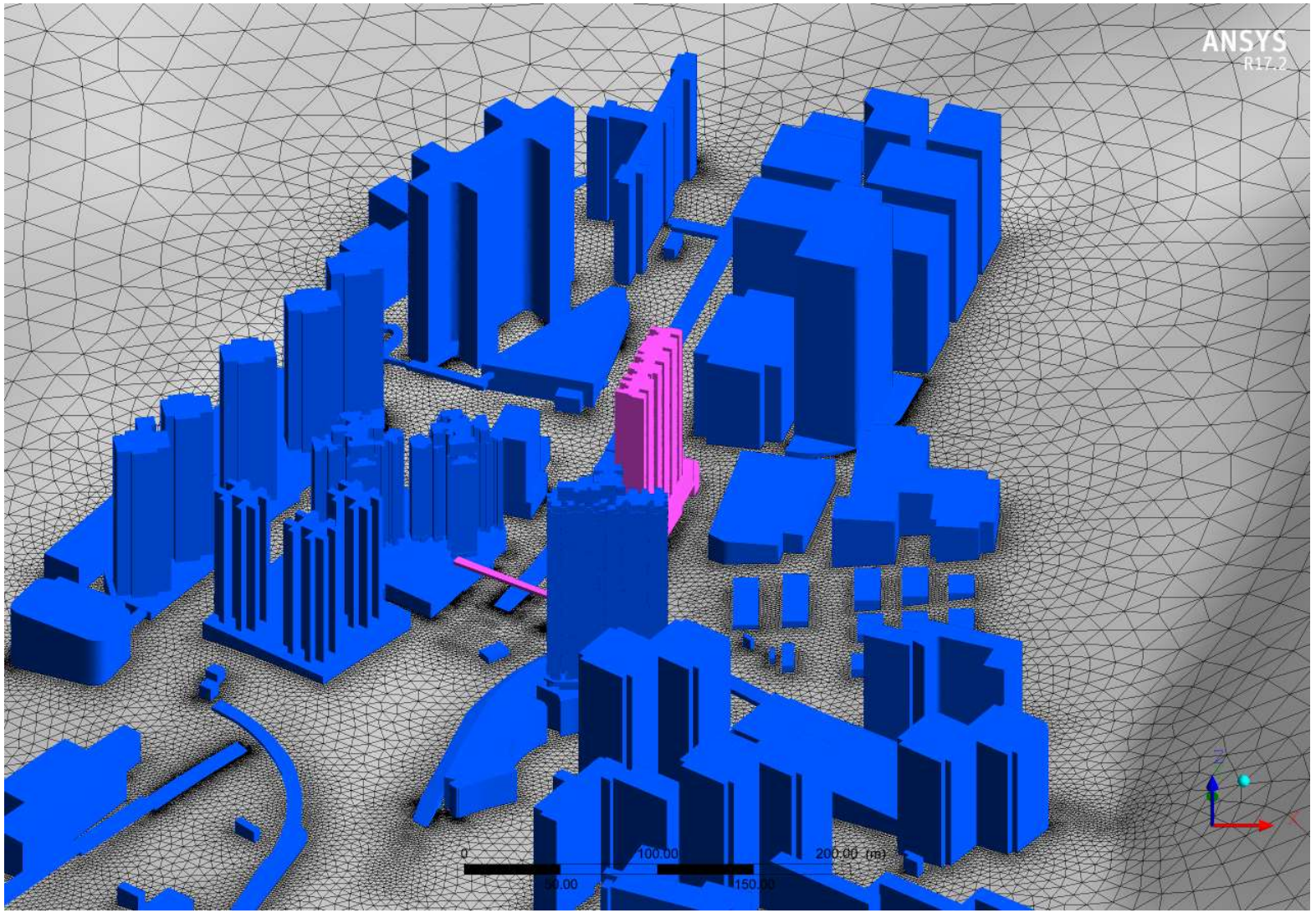
4 Layers of prismatic meshses at 0.5m thick



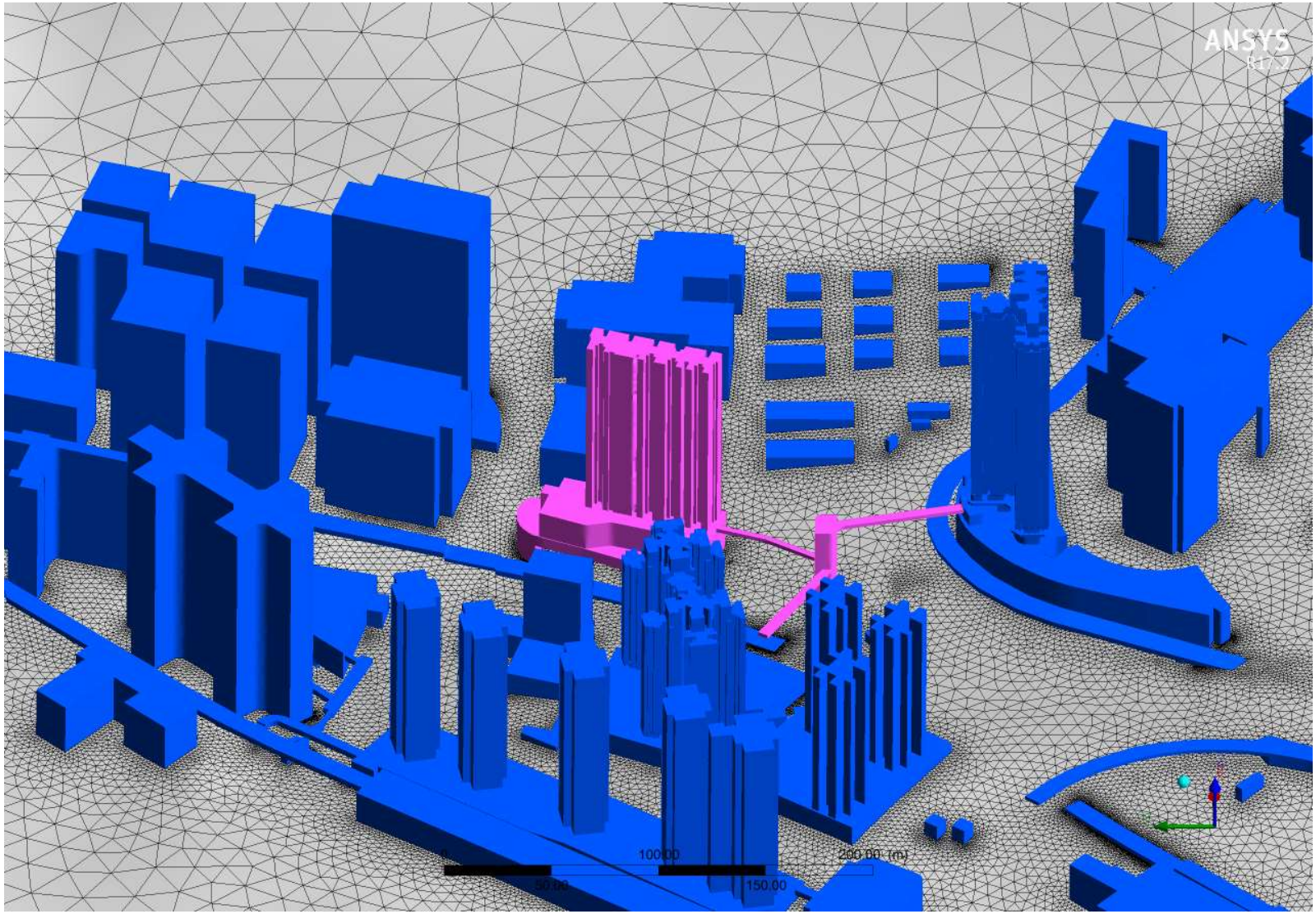
Baseline Scheme – N



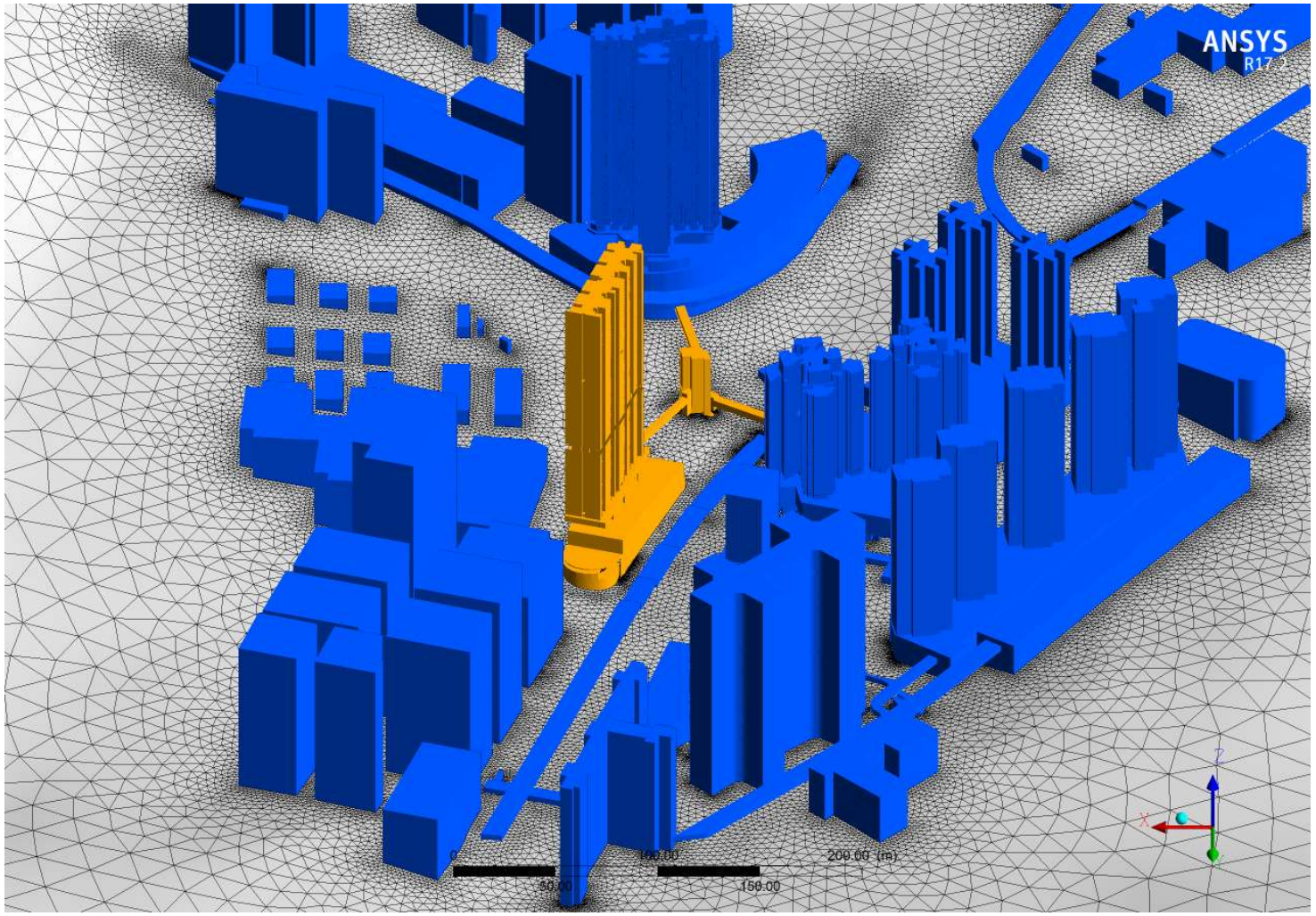
Baseline Scheme – E



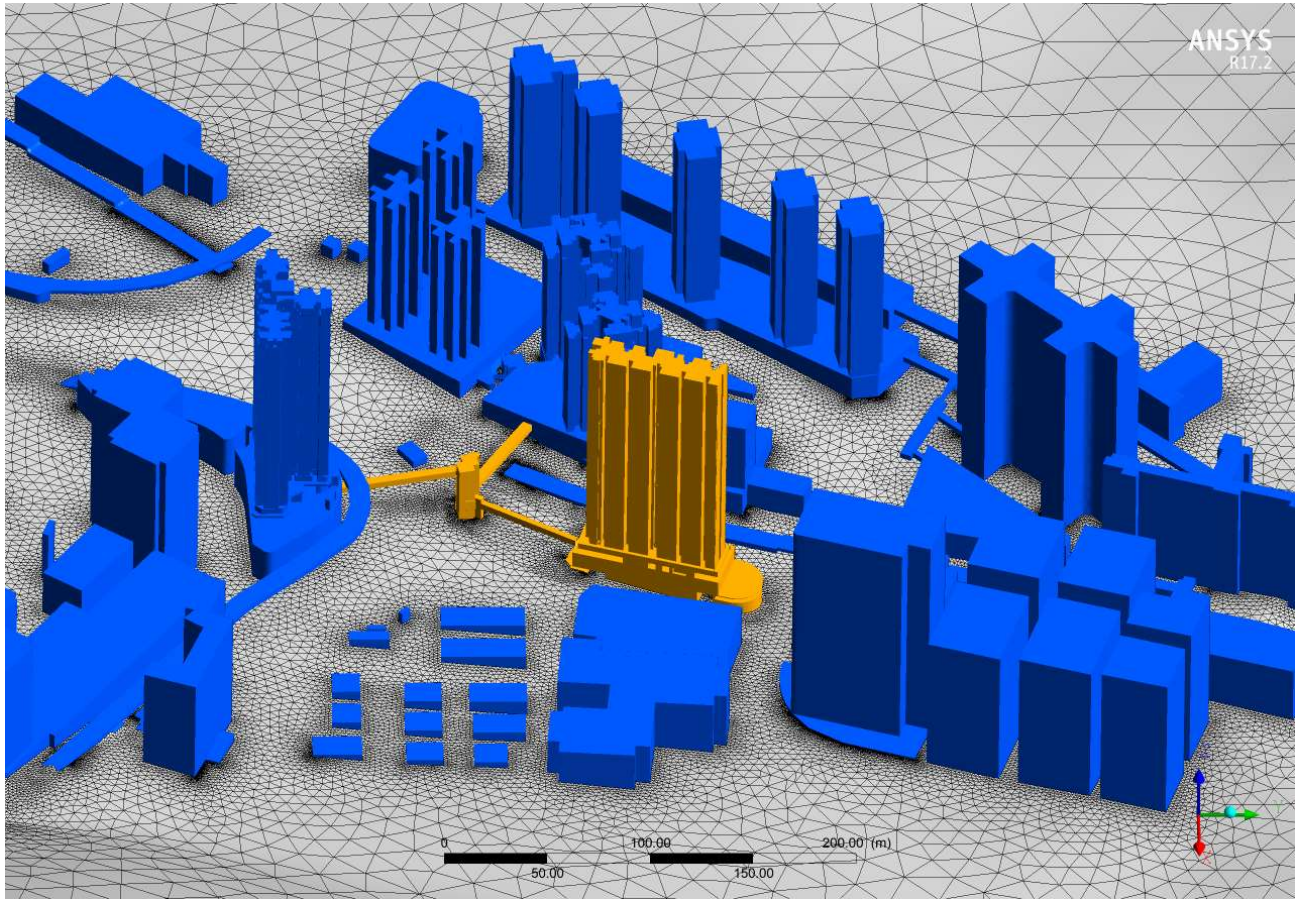
Baseline Scheme – S



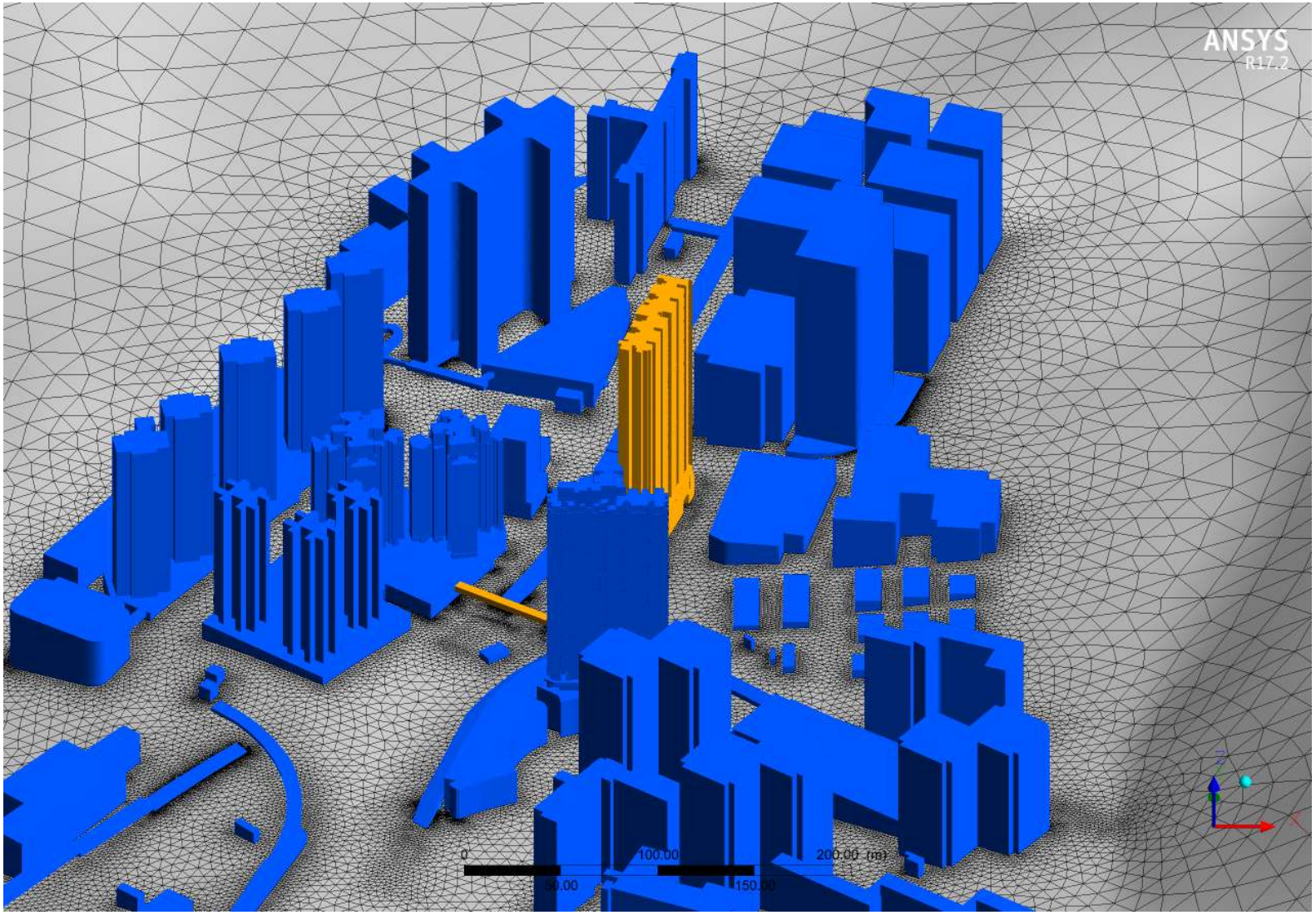
Baseline Scheme – W



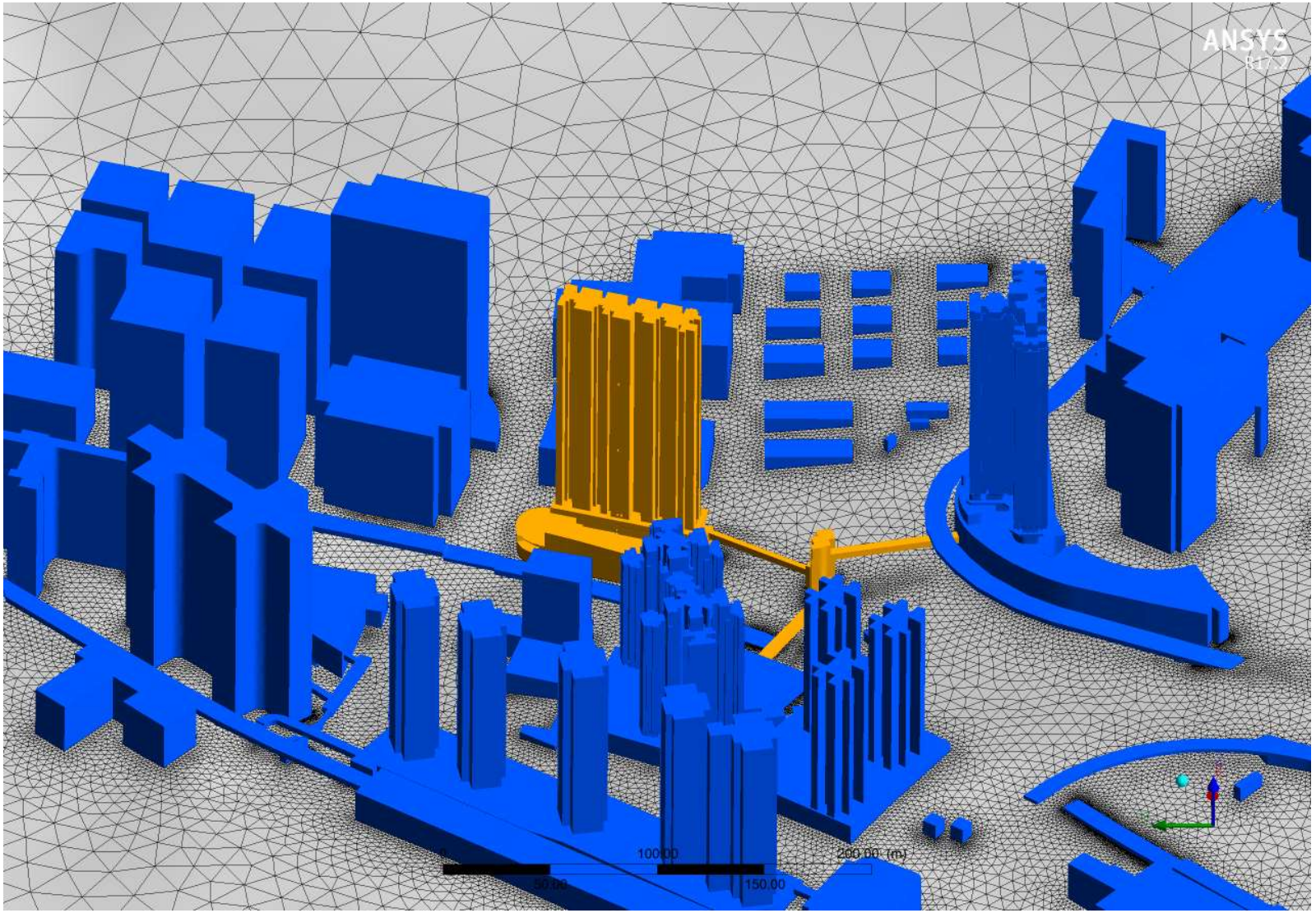
Proposed Scheme – N



Proposed Scheme – E



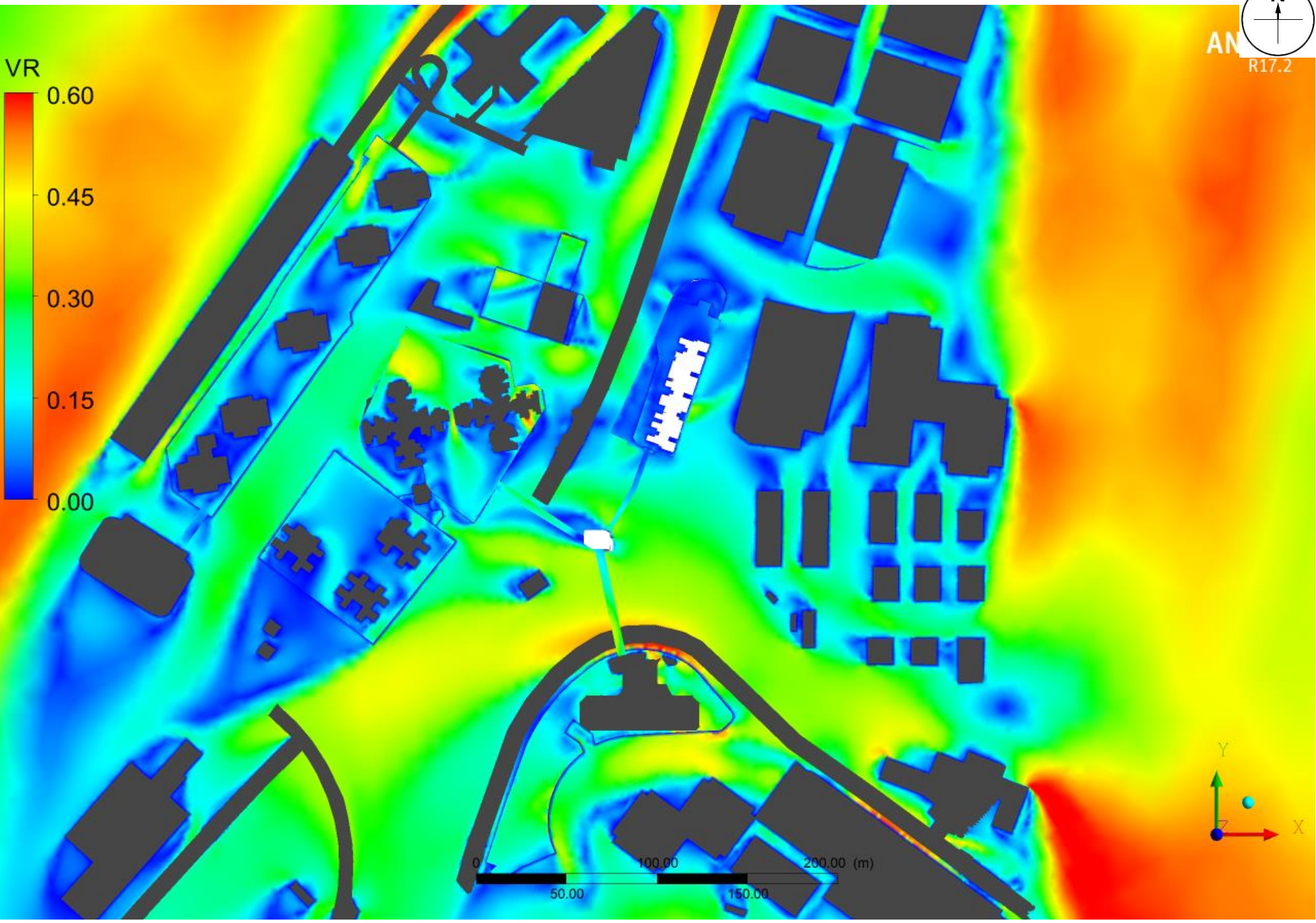
Proposed Scheme – S



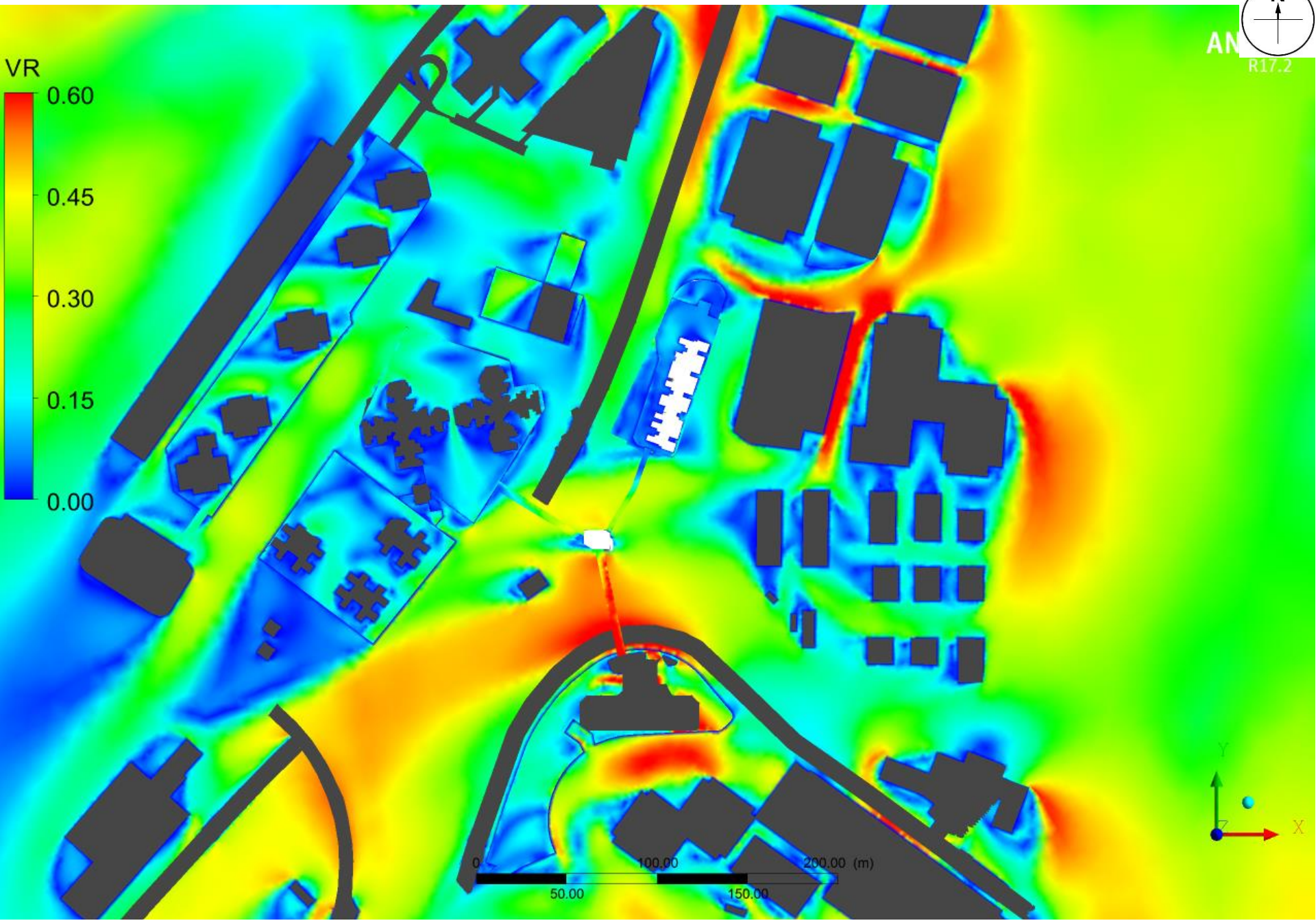
Proposed Scheme – W

Appendix 4

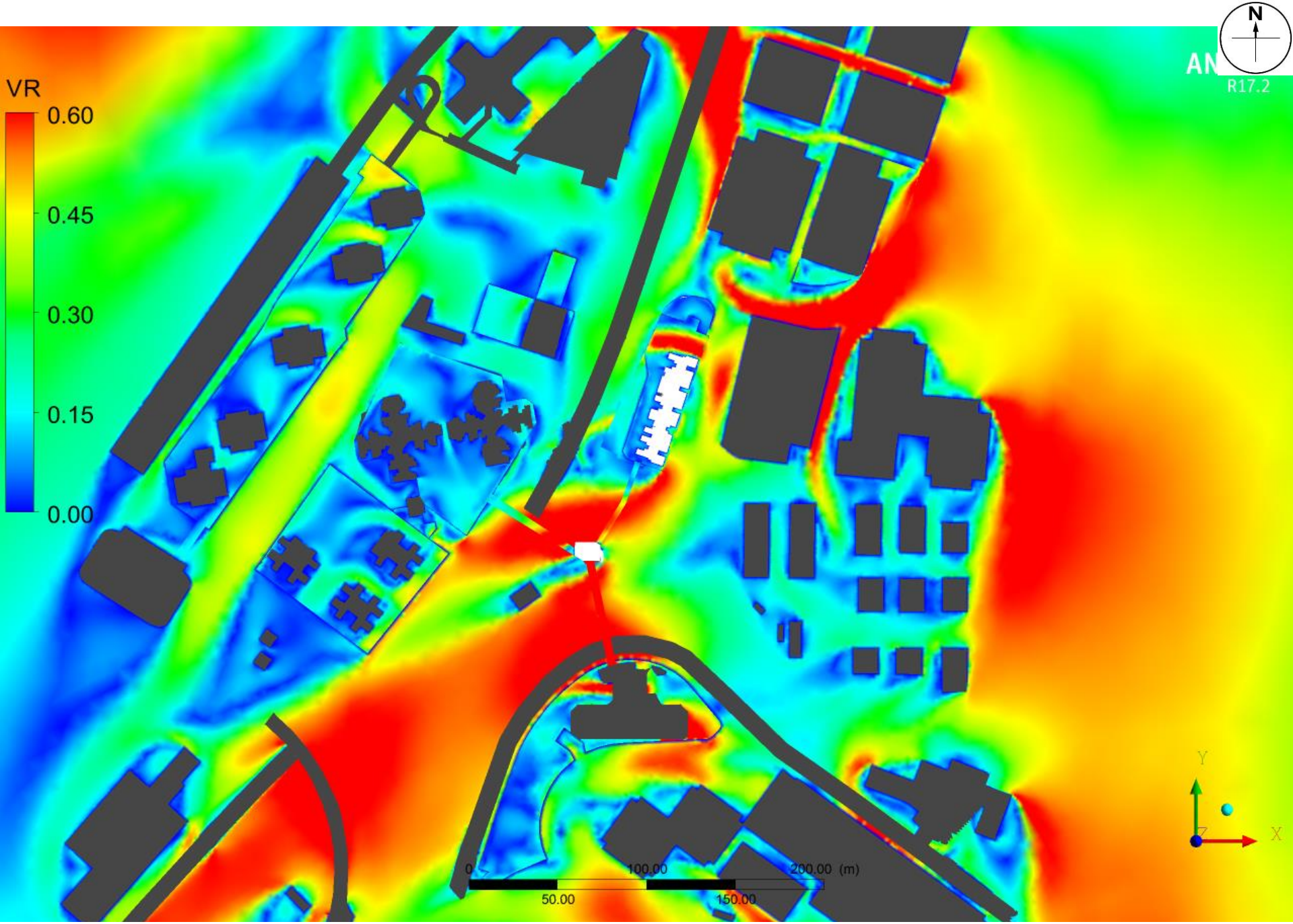
Contour and Vector Plot for CFD Simulation



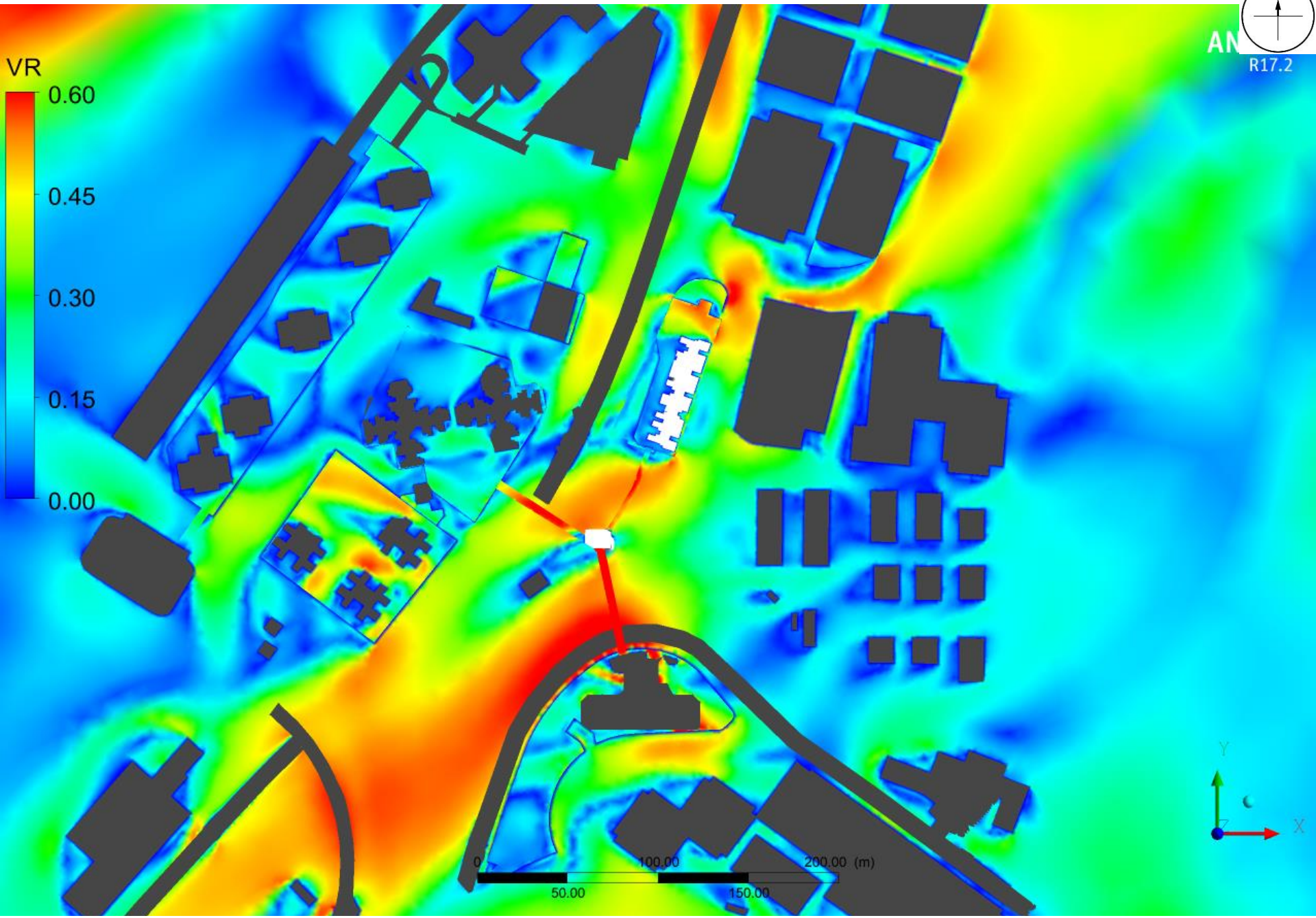
Baseline Scheme - Contour plot at pedestrian level under NNE Wind



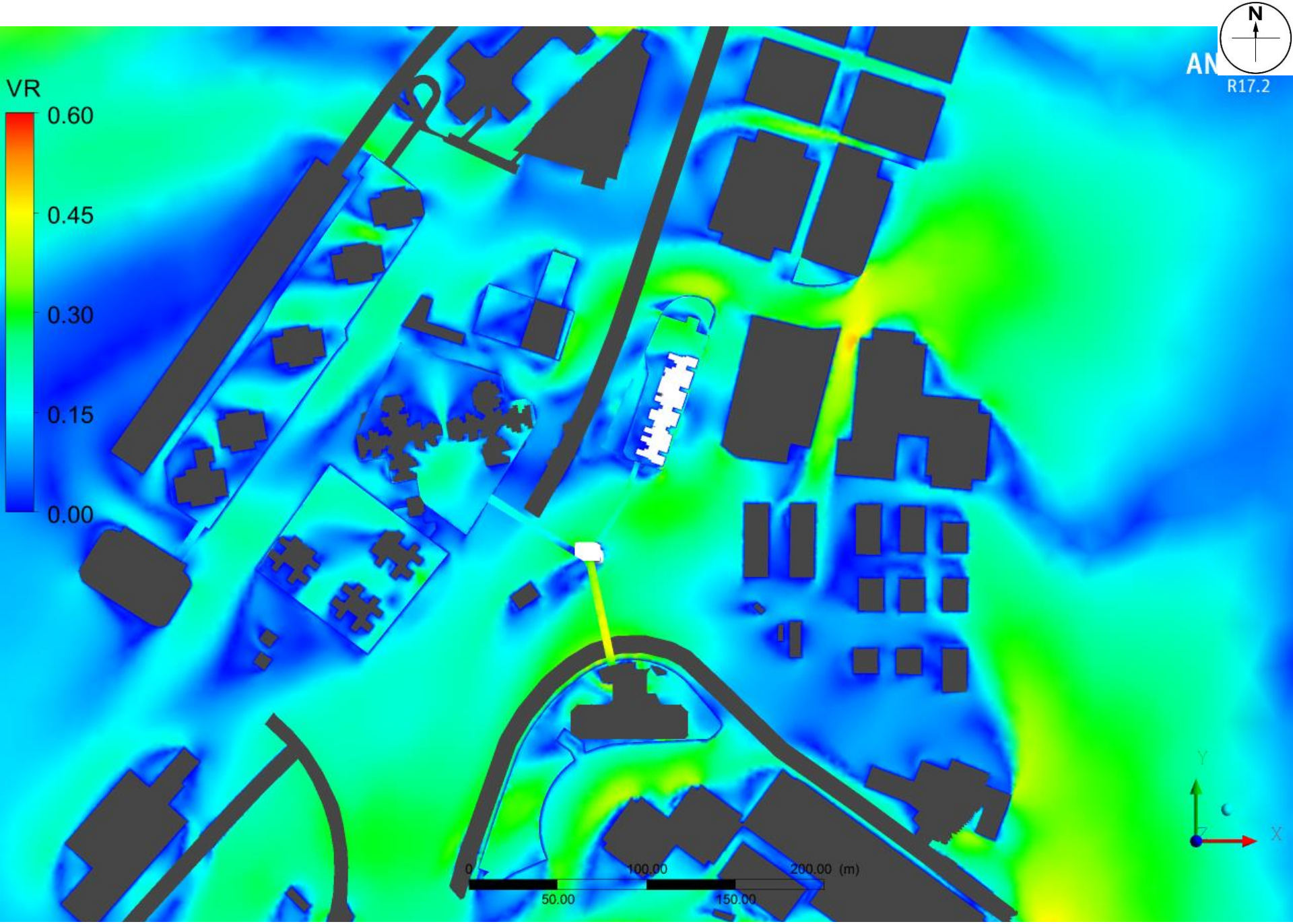
Baseline Scheme - Contour plot at pedestrian level under NE Wind



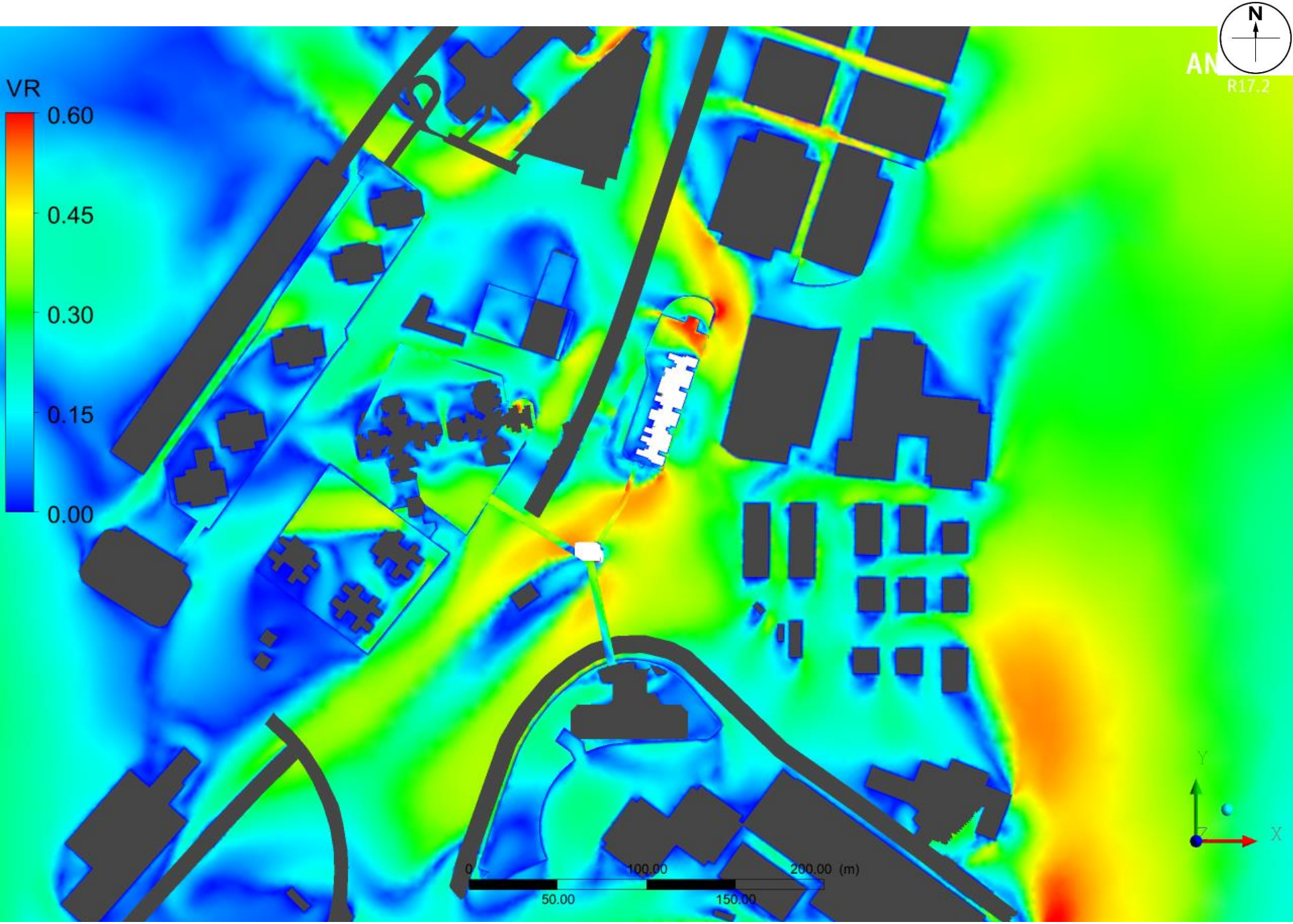
Baseline Scheme - Contour plot at pedestrian level under ENE Wind



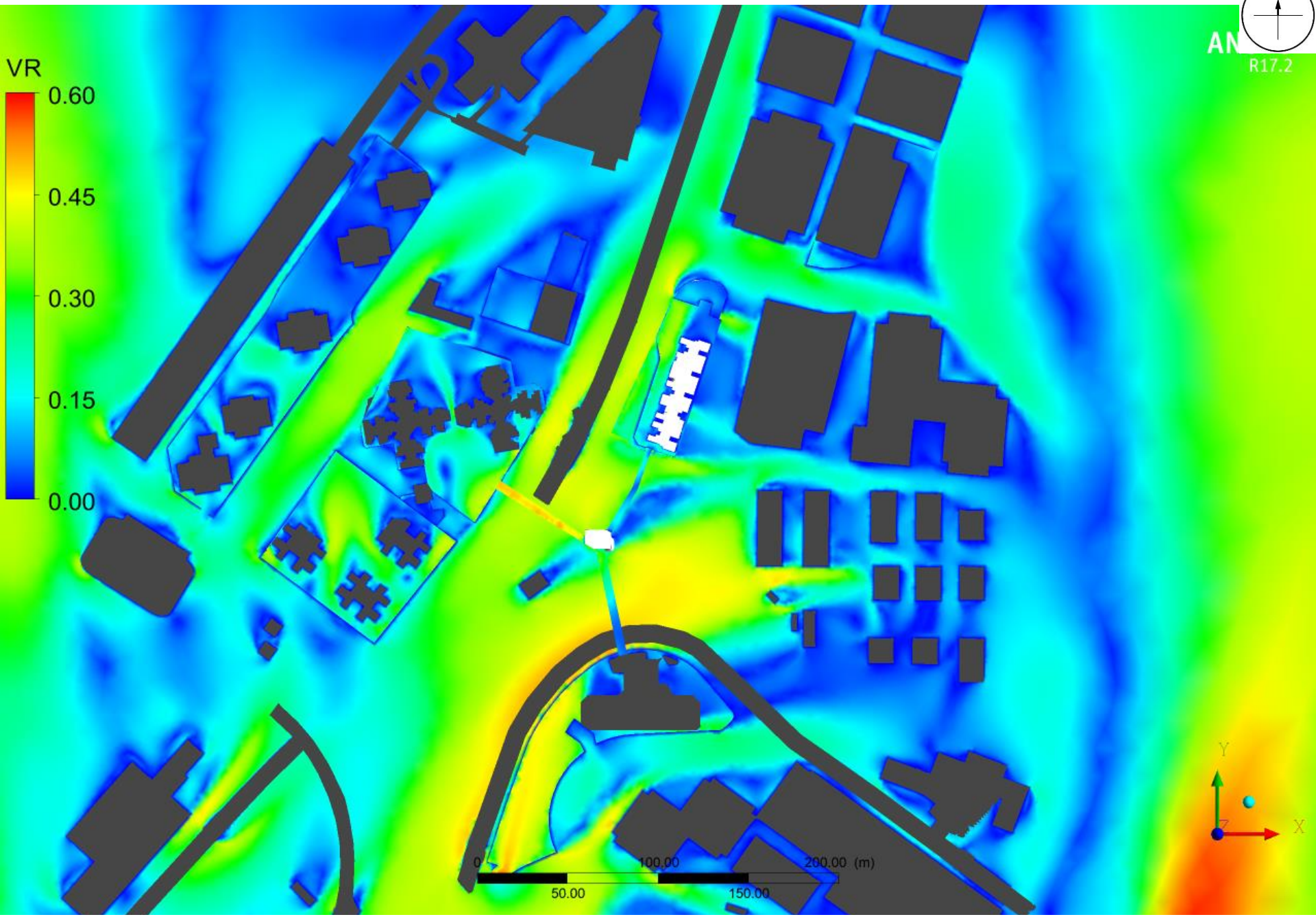
Baseline Scheme - Contour plot at pedestrian level under E Wind



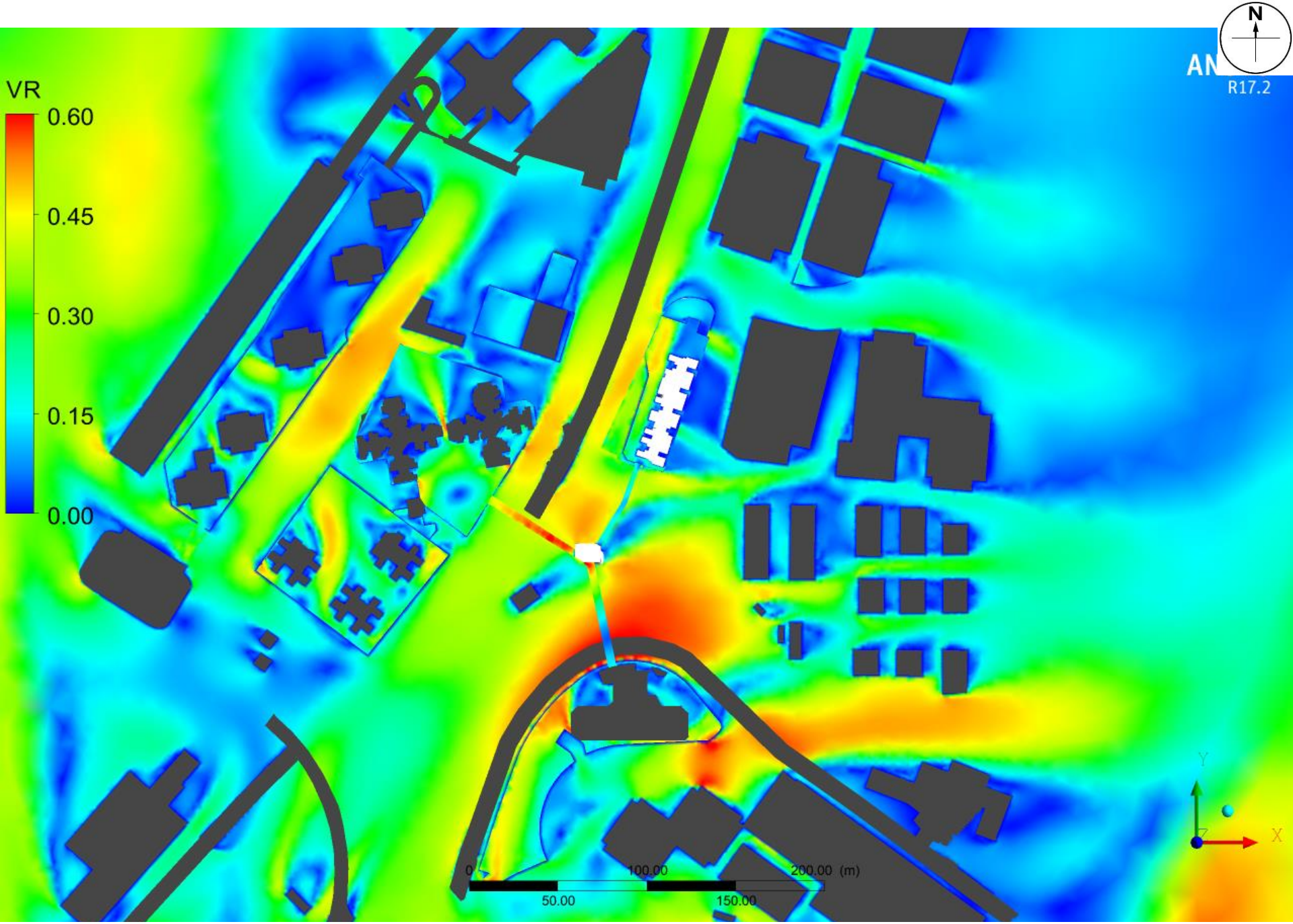
Baseline Scheme - Contour plot at pedestrian level under ESE Wind



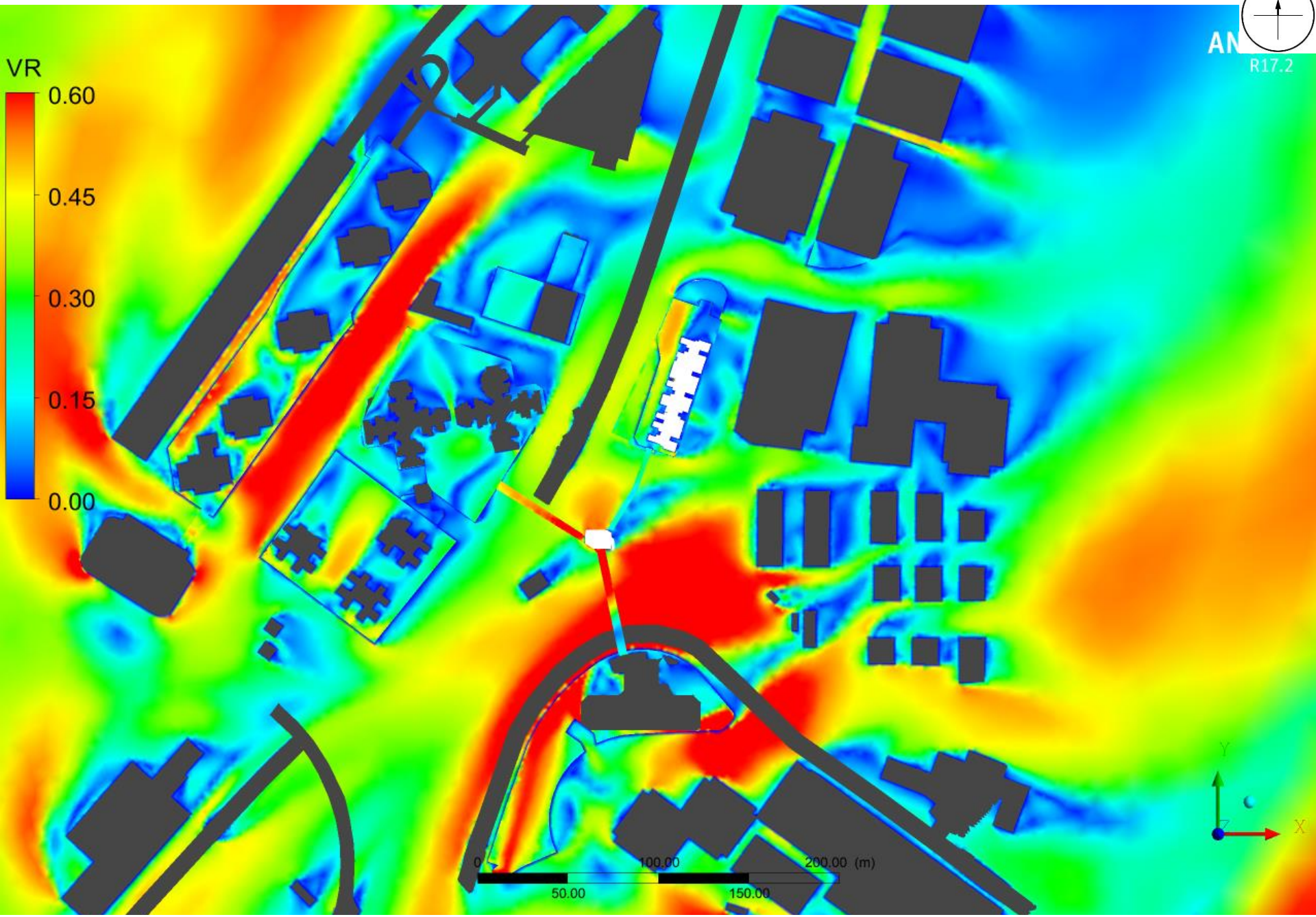
Baseline Scheme - Contour plot at pedestrian level under SE Wind



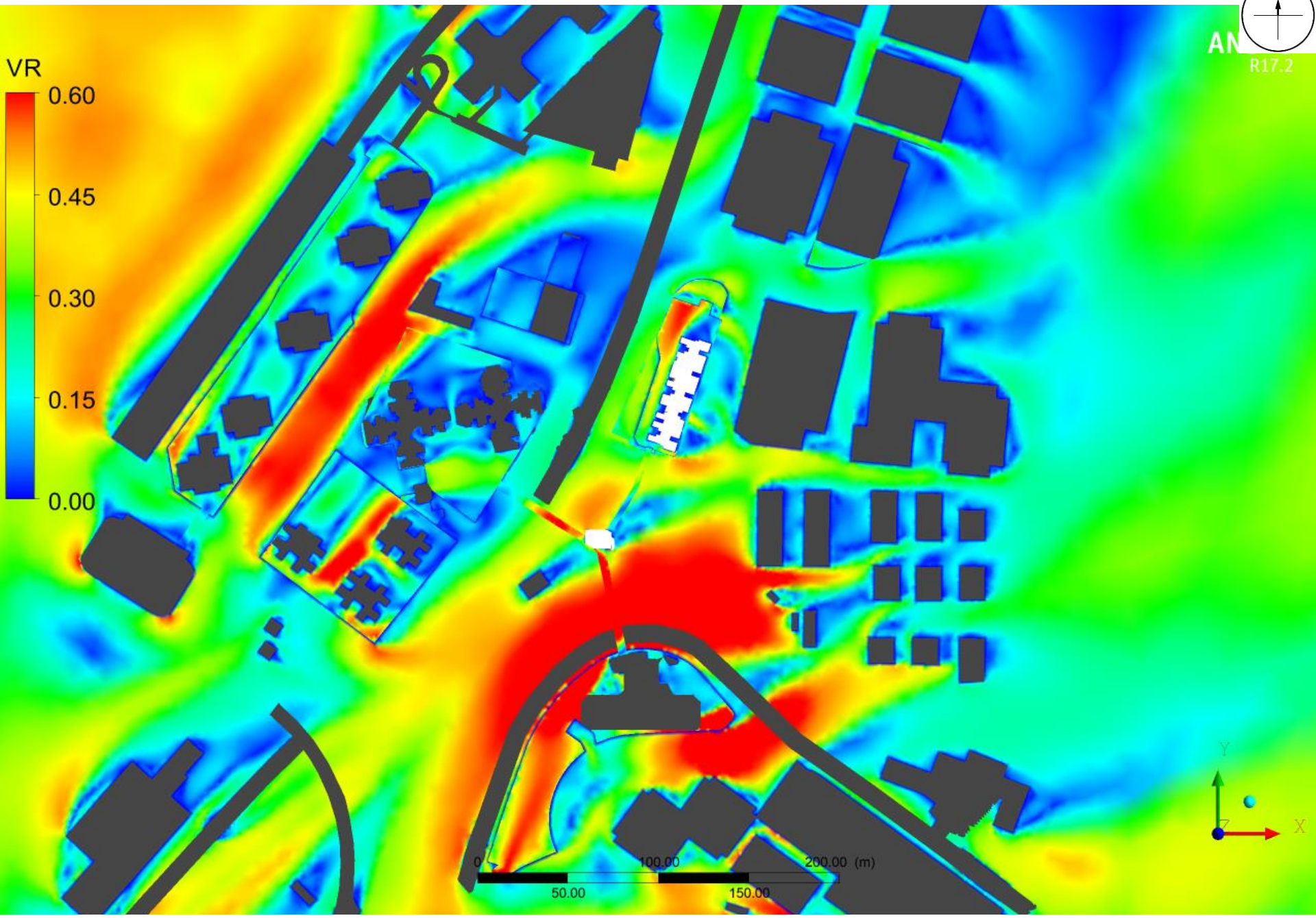
Baseline Scheme - Contour plot at pedestrian level under SSE Wind



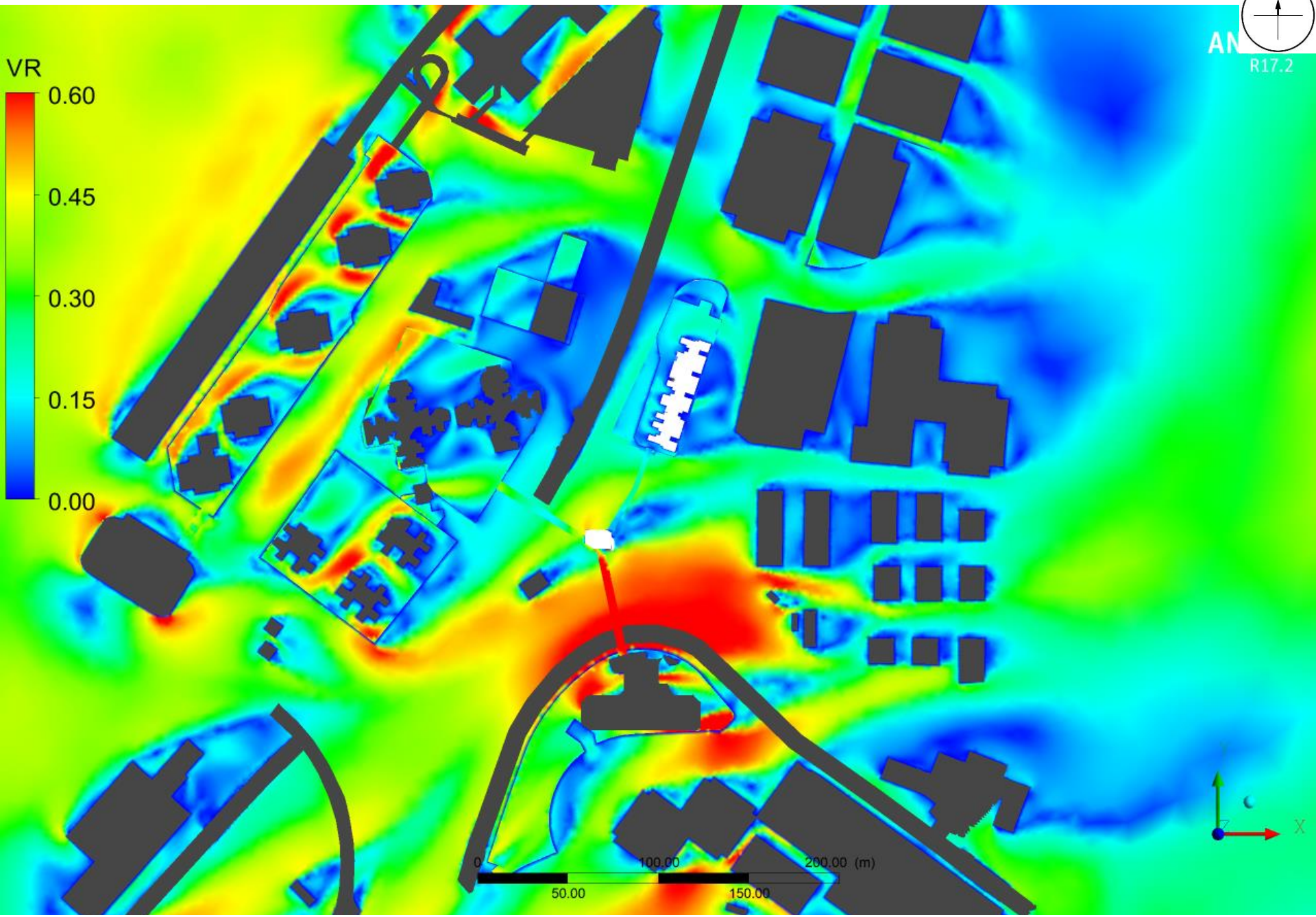
Baseline Scheme - Contour plot at pedestrian level under S Wind



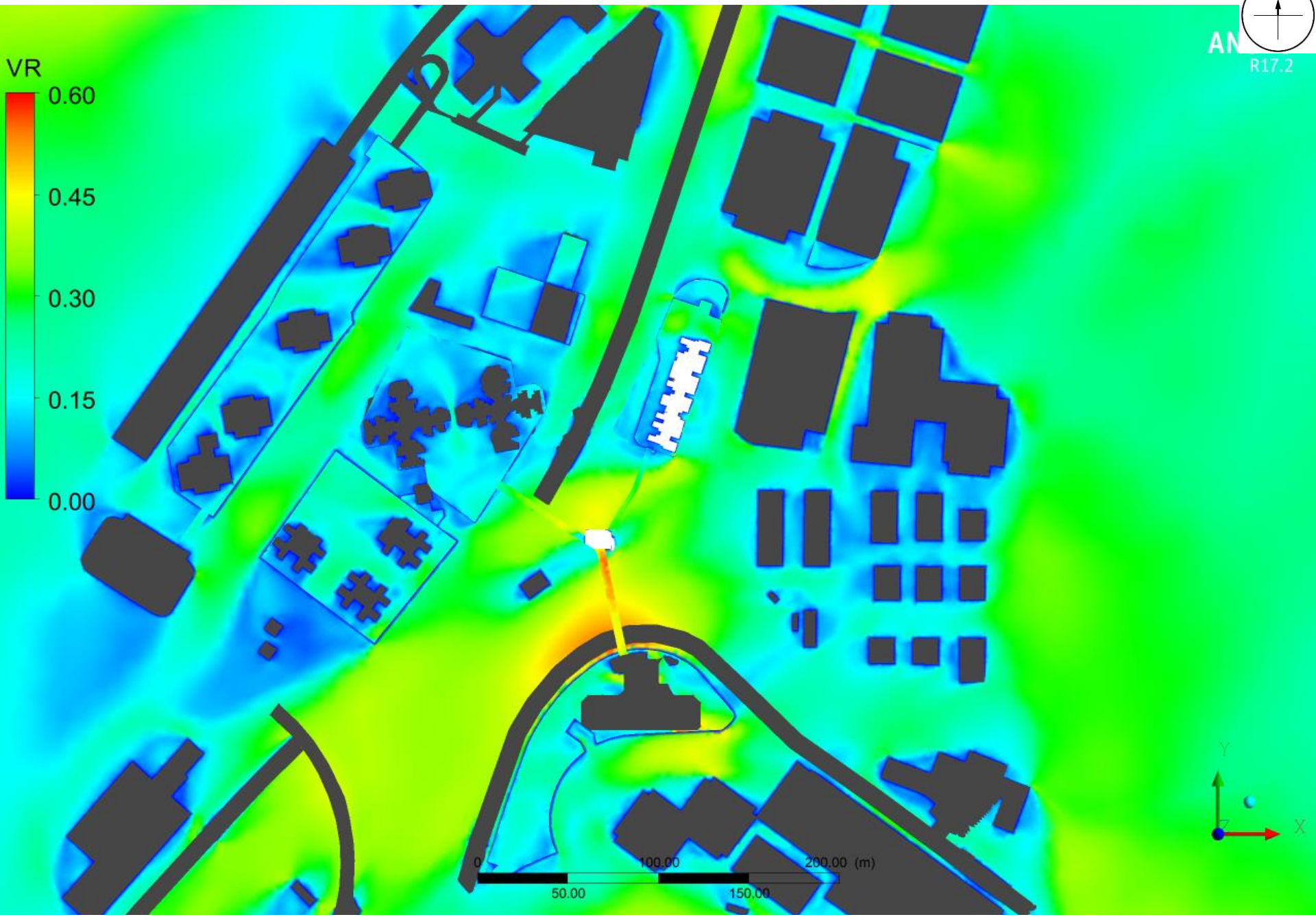
Baseline Scheme - Contour plot at pedestrian level under SSW Wind



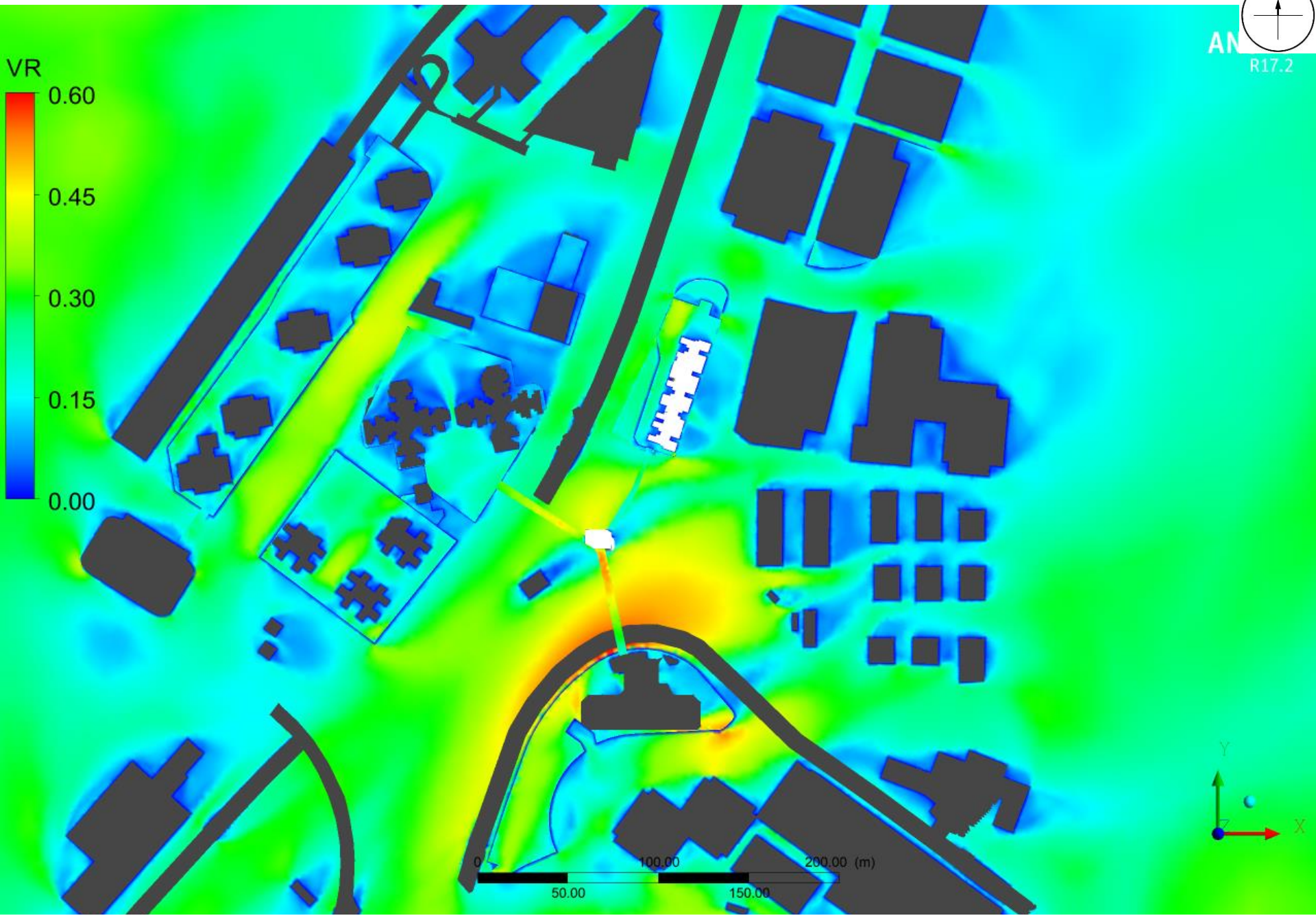
Baseline Scheme - Contour plot at pedestrian level under SW Wind



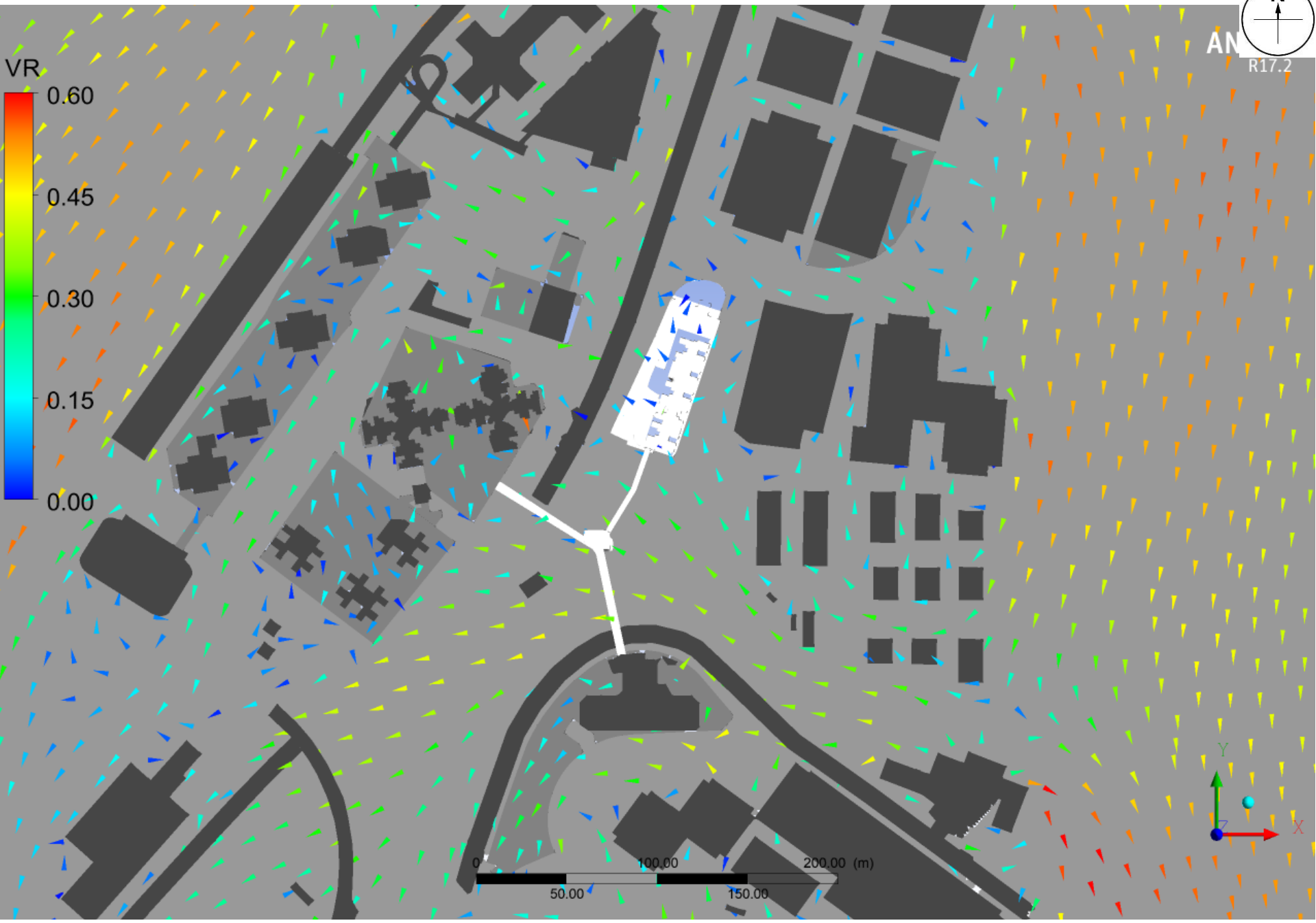
Baseline Scheme - Contour plot at pedestrian level under WSW Wind



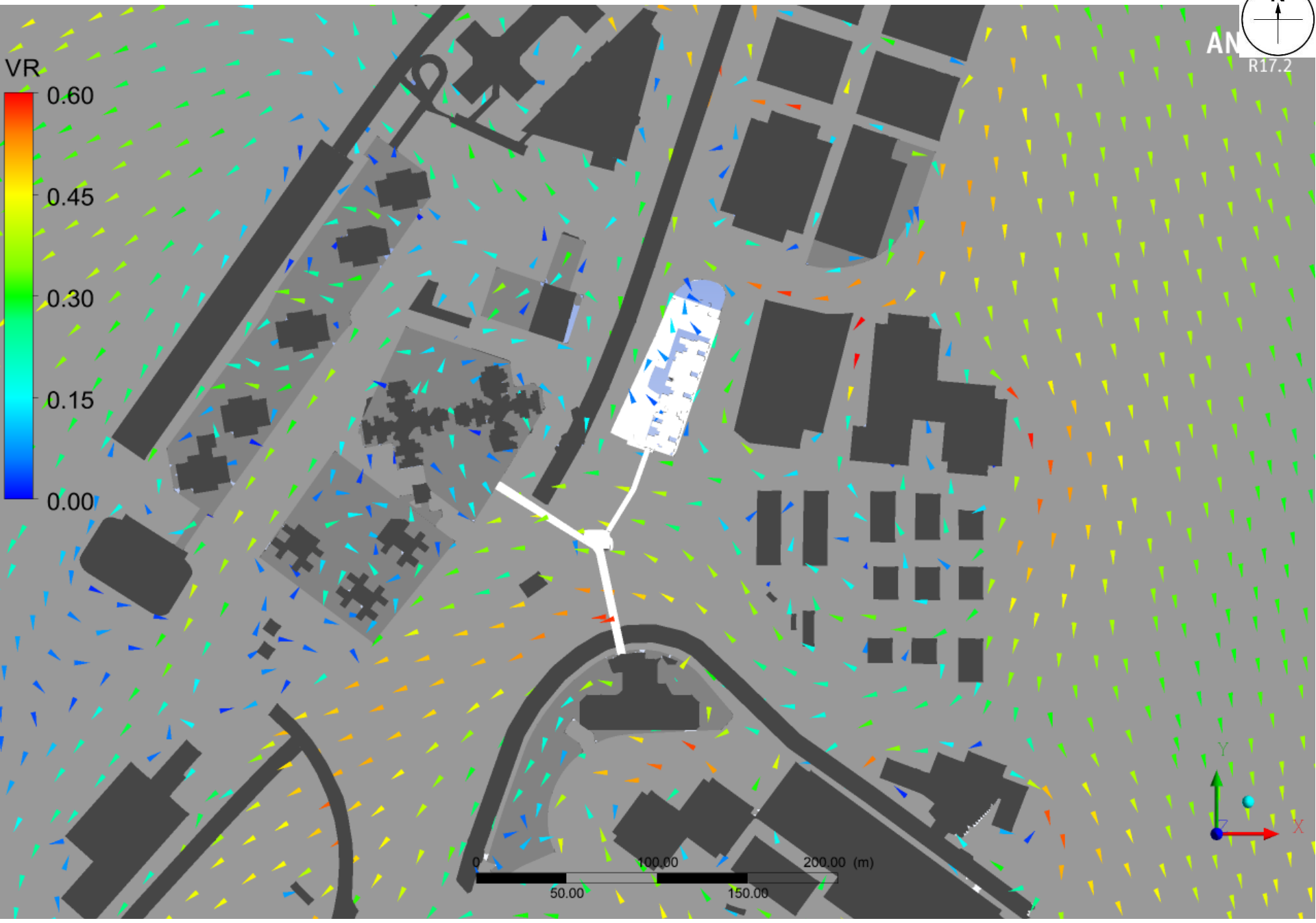
Baseline Scheme - Annual weighted wind speed colour at pedestrian level



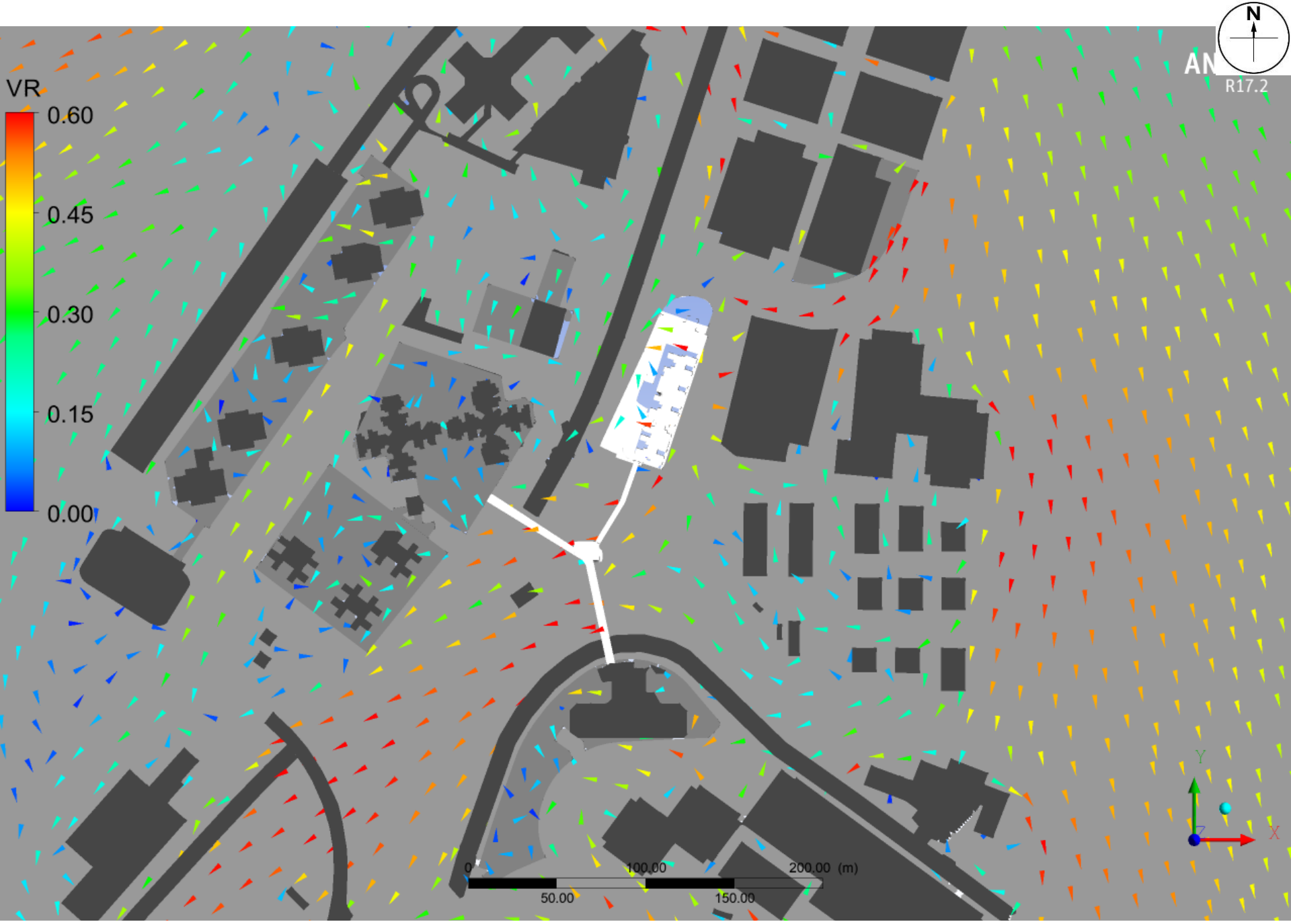
Baseline Scheme - Summer weighted wind speed colour at pedestrian level



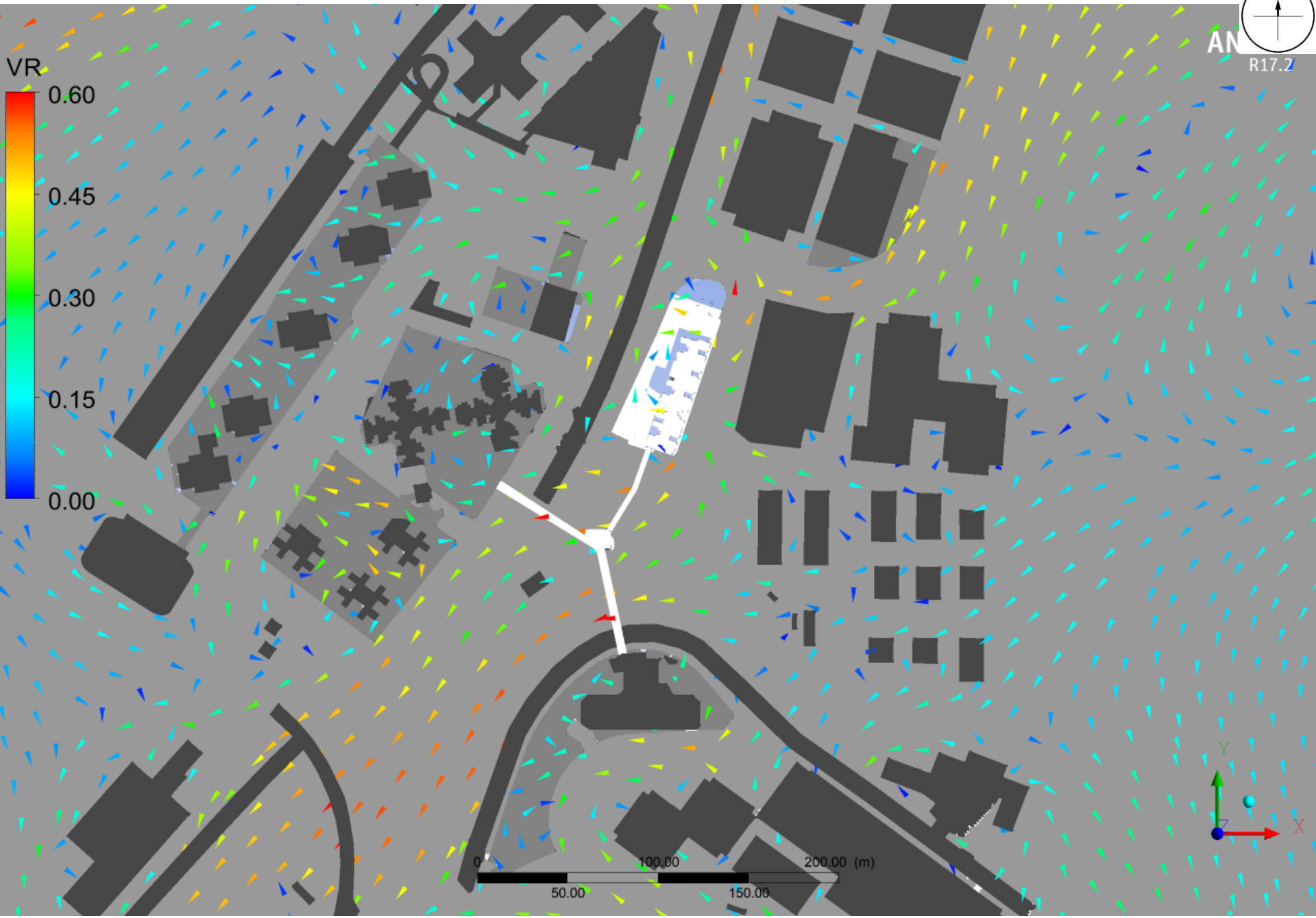
Baseline Scheme - Vector plot at pedestrian level under NNE Wind



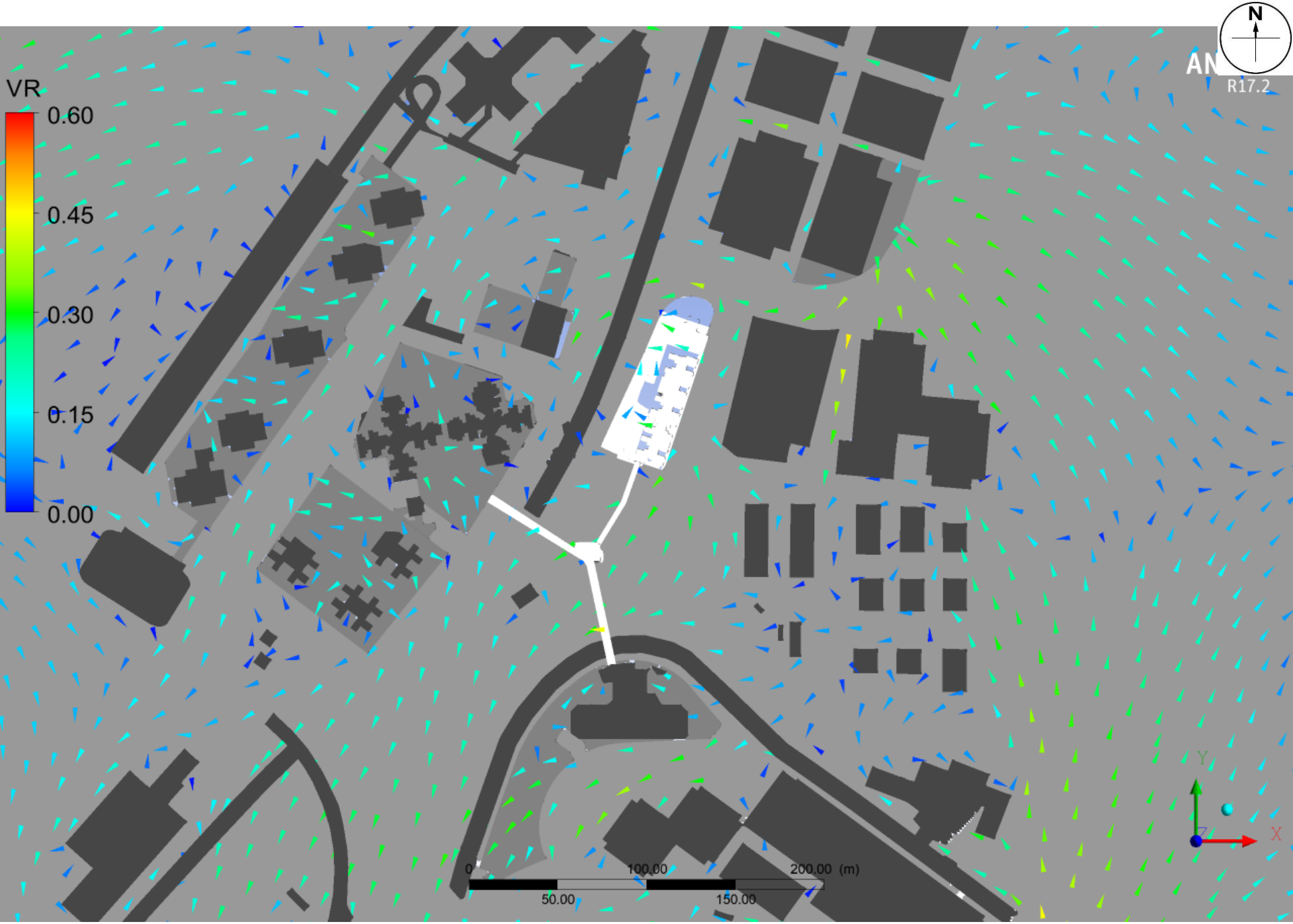
Baseline Scheme - Vector plot at pedestrian level under NE Wind



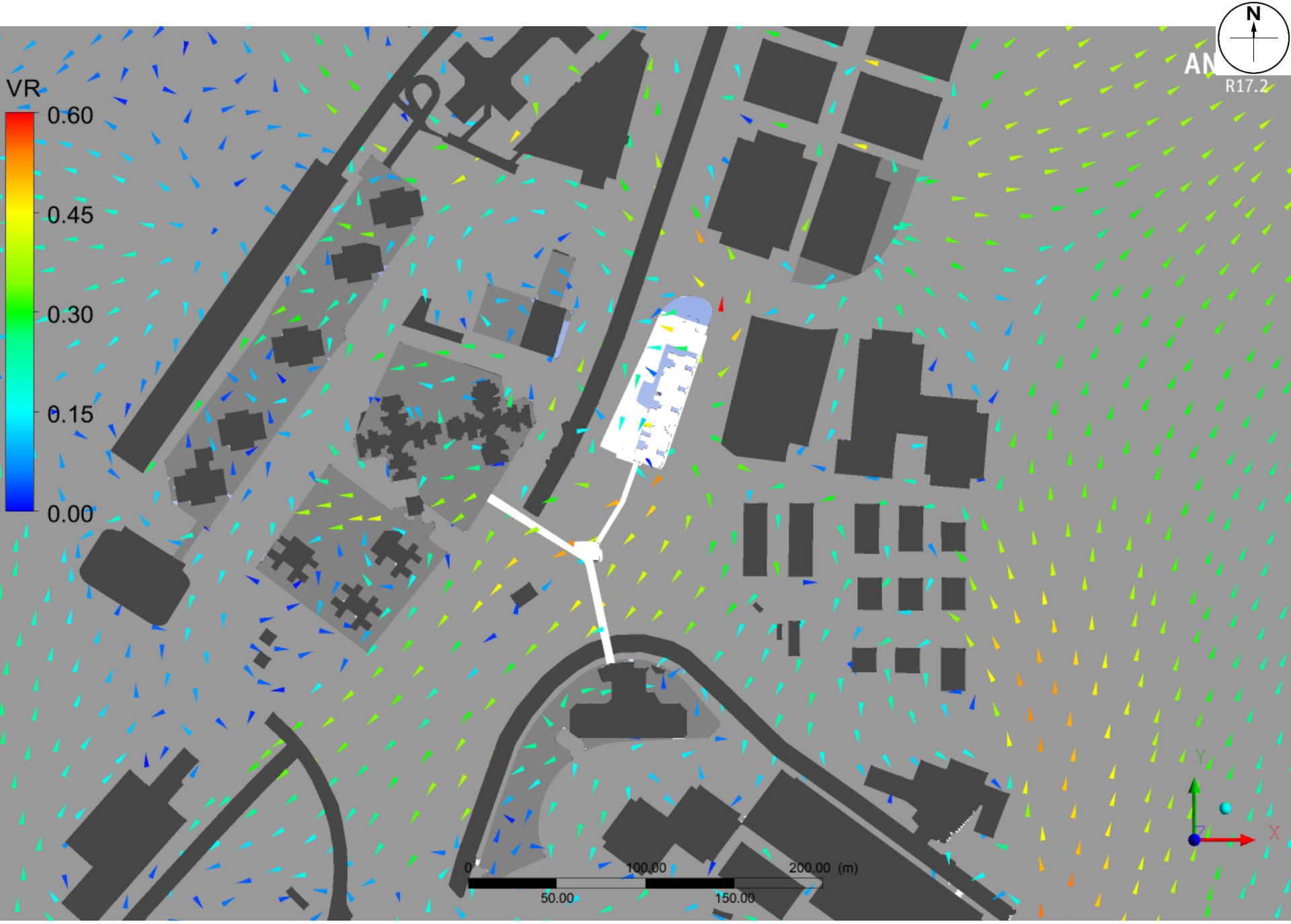
Baseline Scheme - Vector plot at pedestrian level under ENE Wind



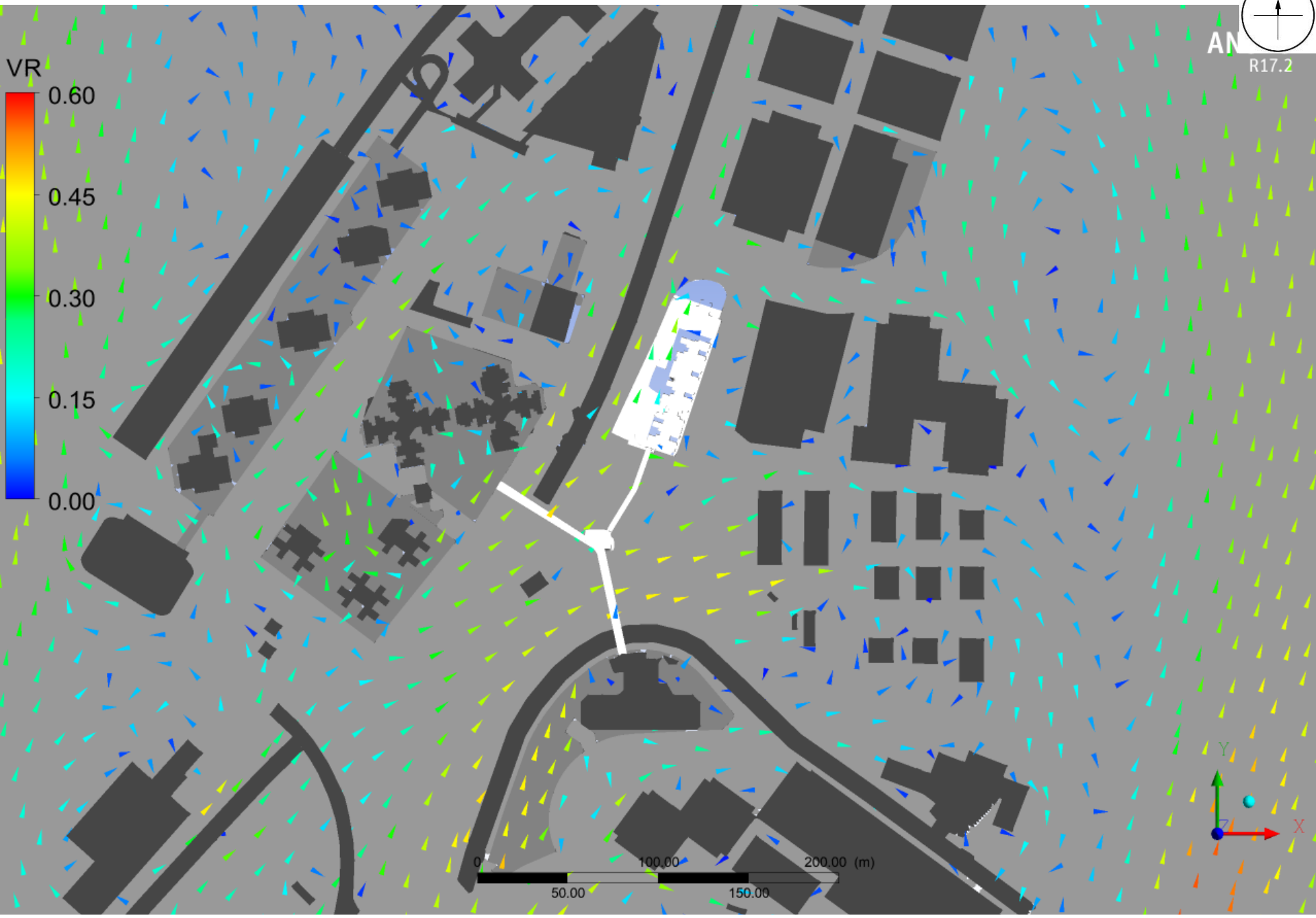
Baseline Scheme - Vector plot at pedestrian level under E Wind



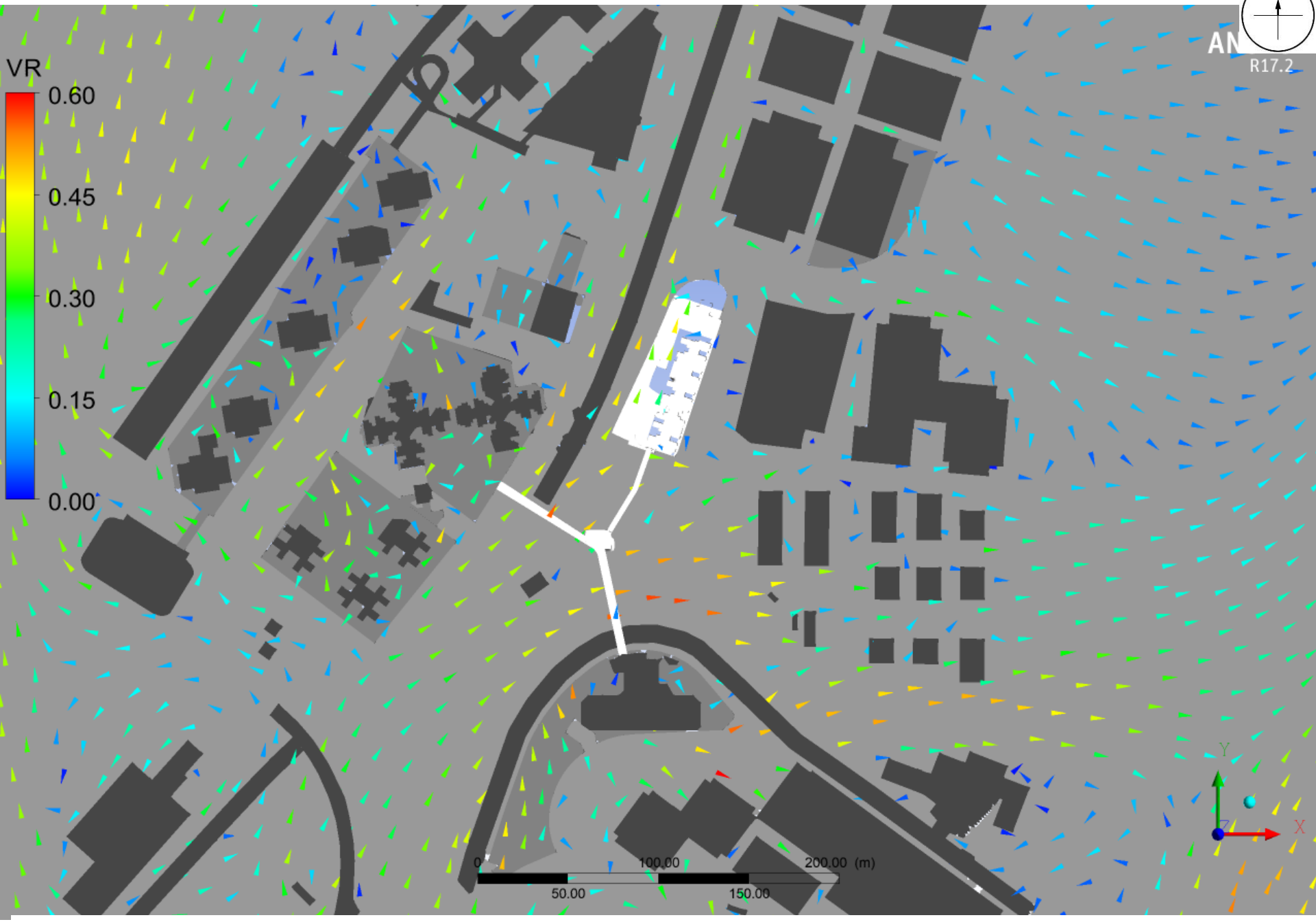
Baseline Scheme - Vector plot at pedestrian level under ESE Wind



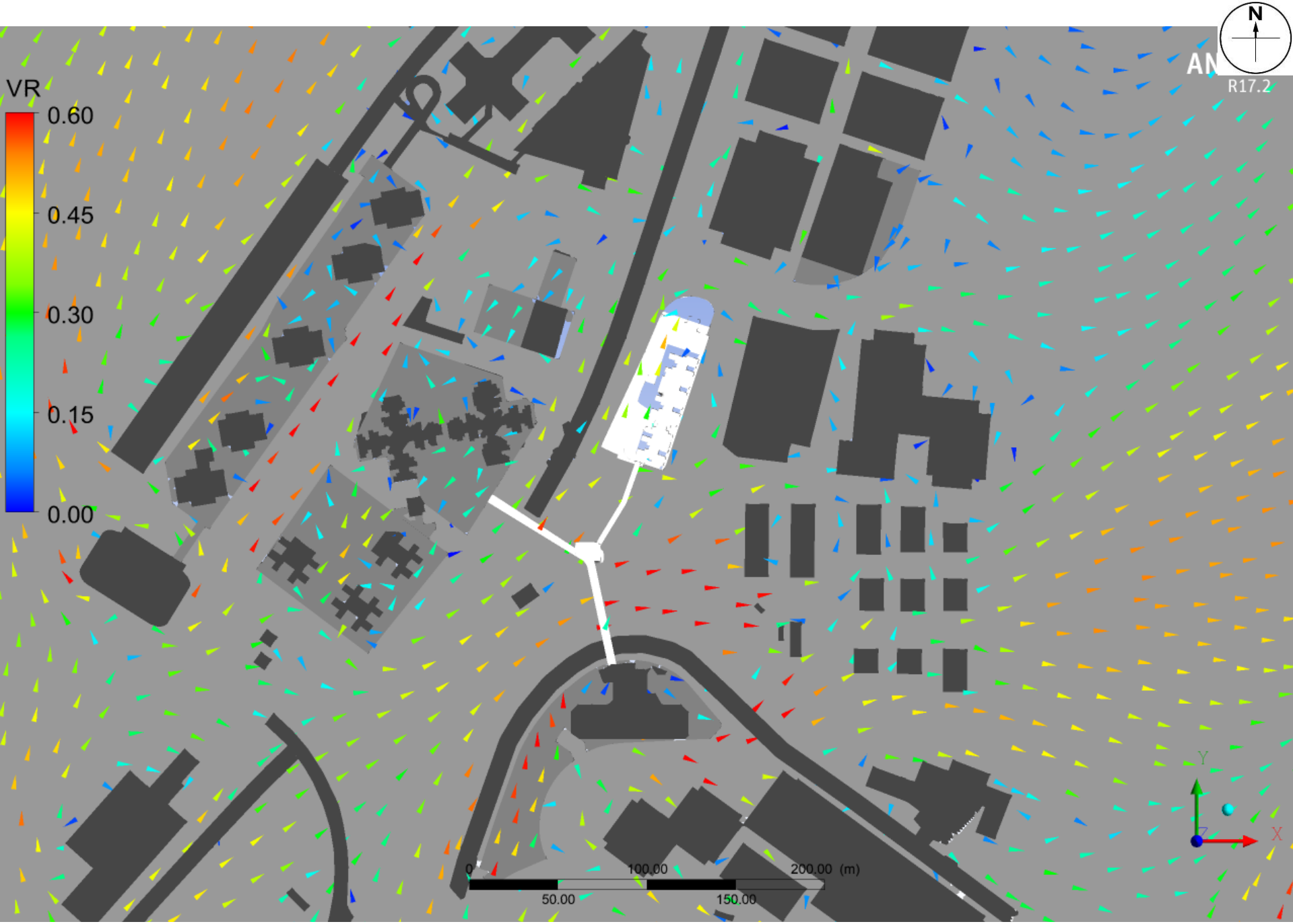
Baseline Scheme - Vector plot at pedestrian level under SE Wind



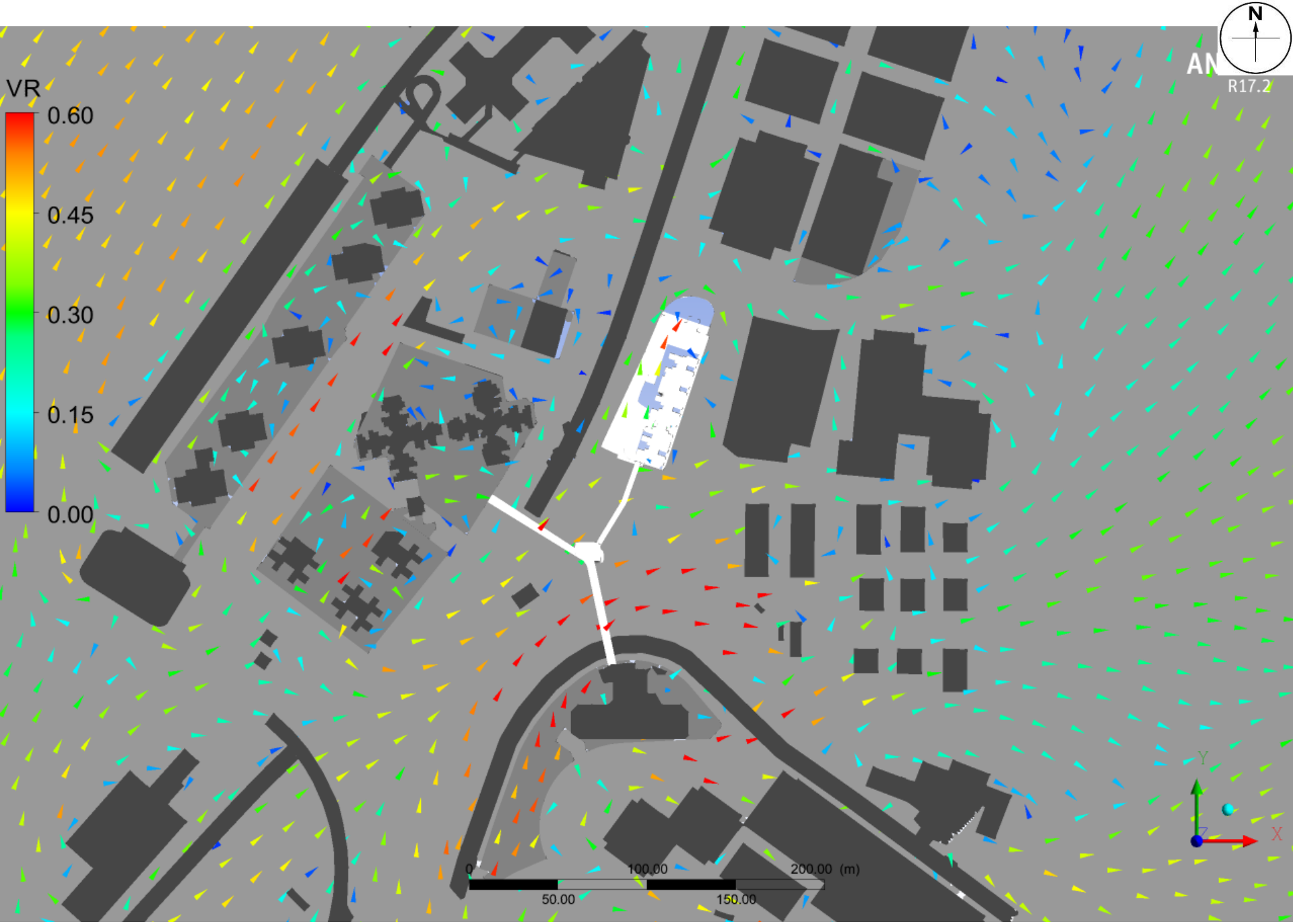
Baseline Scheme - Vector plot at pedestrian level under SSE Wind



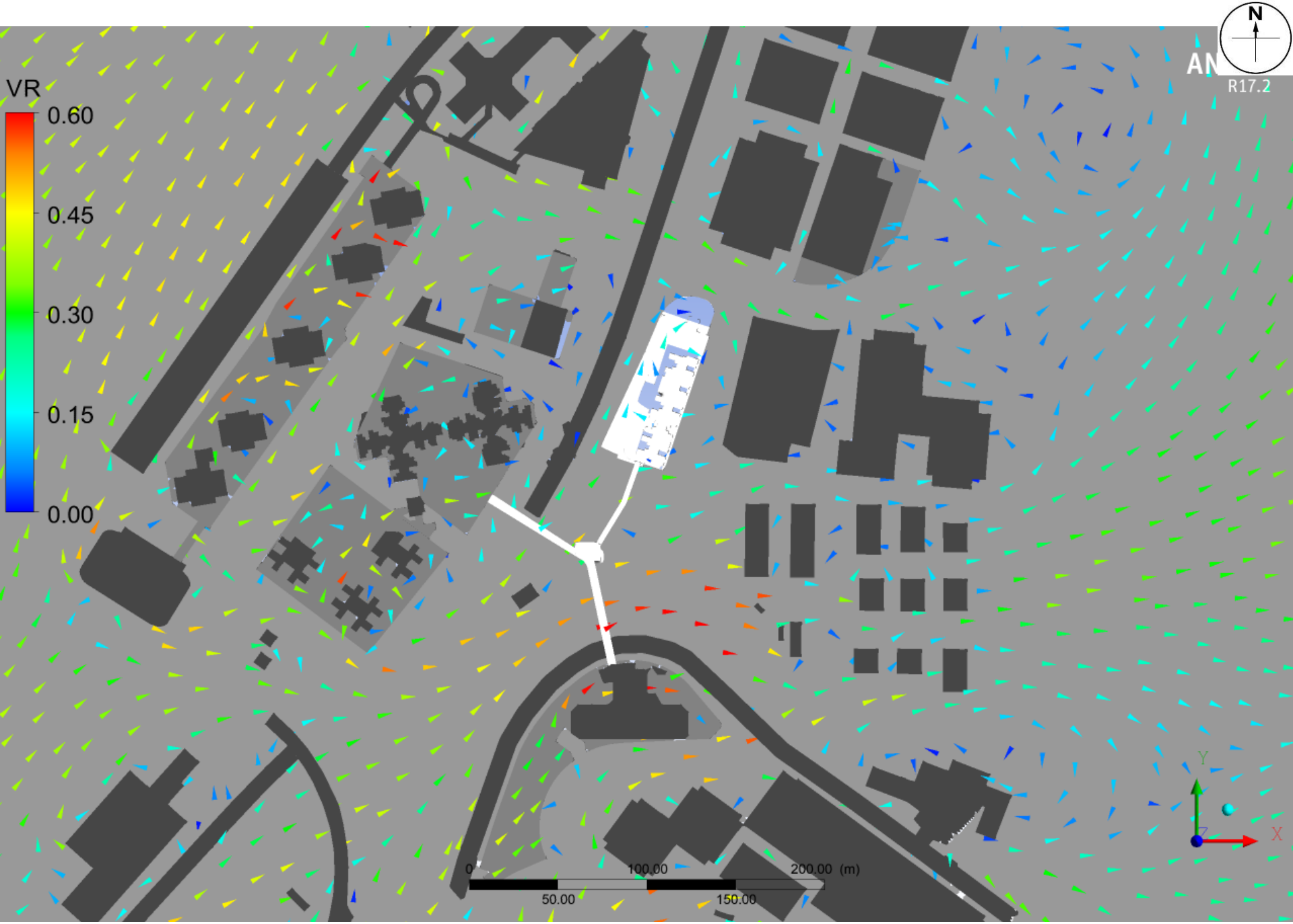
Baseline Scheme - Vector plot at pedestrian level under S Wind



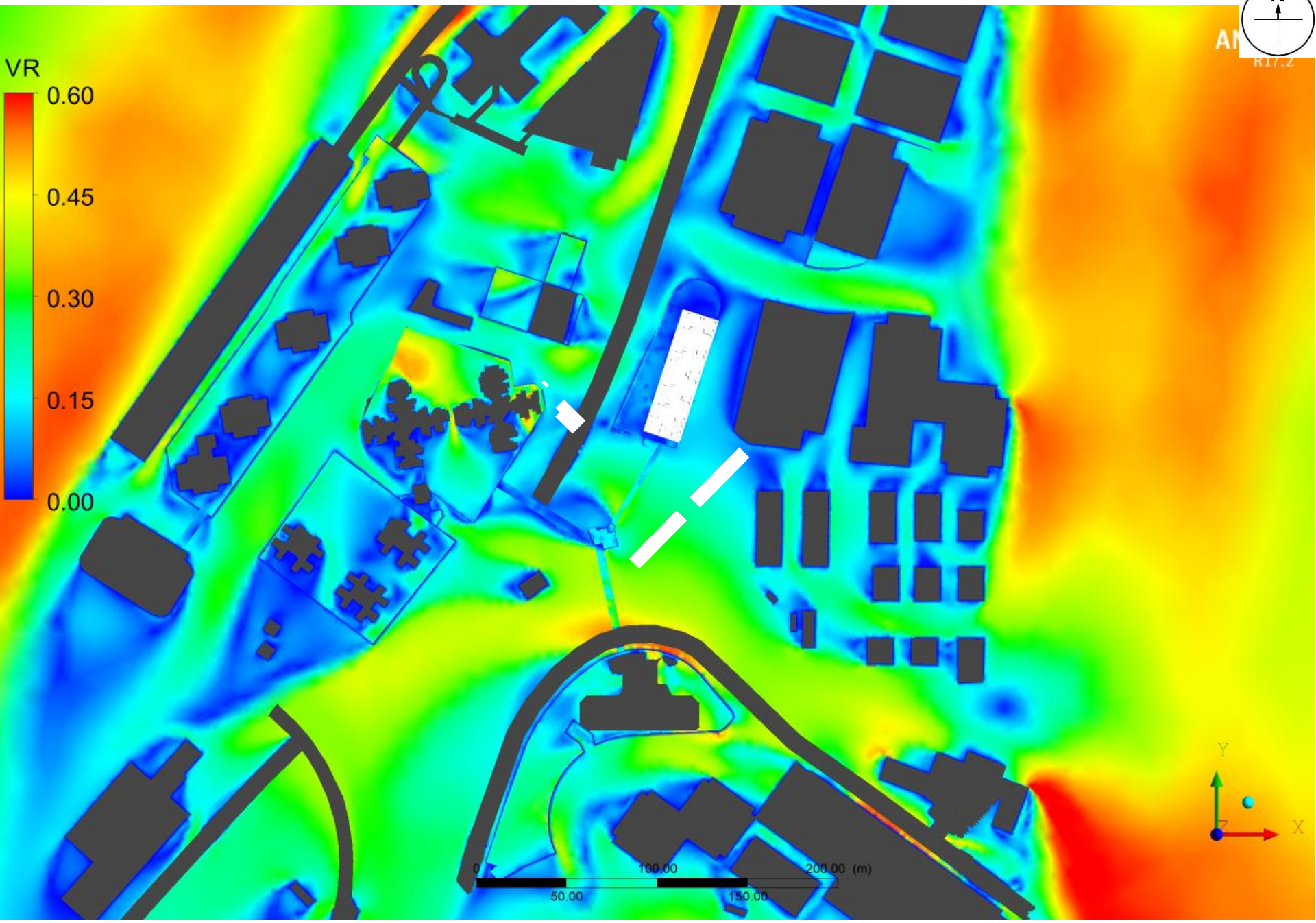
Baseline Scheme - Vector plot at pedestrian level under SSW Wind



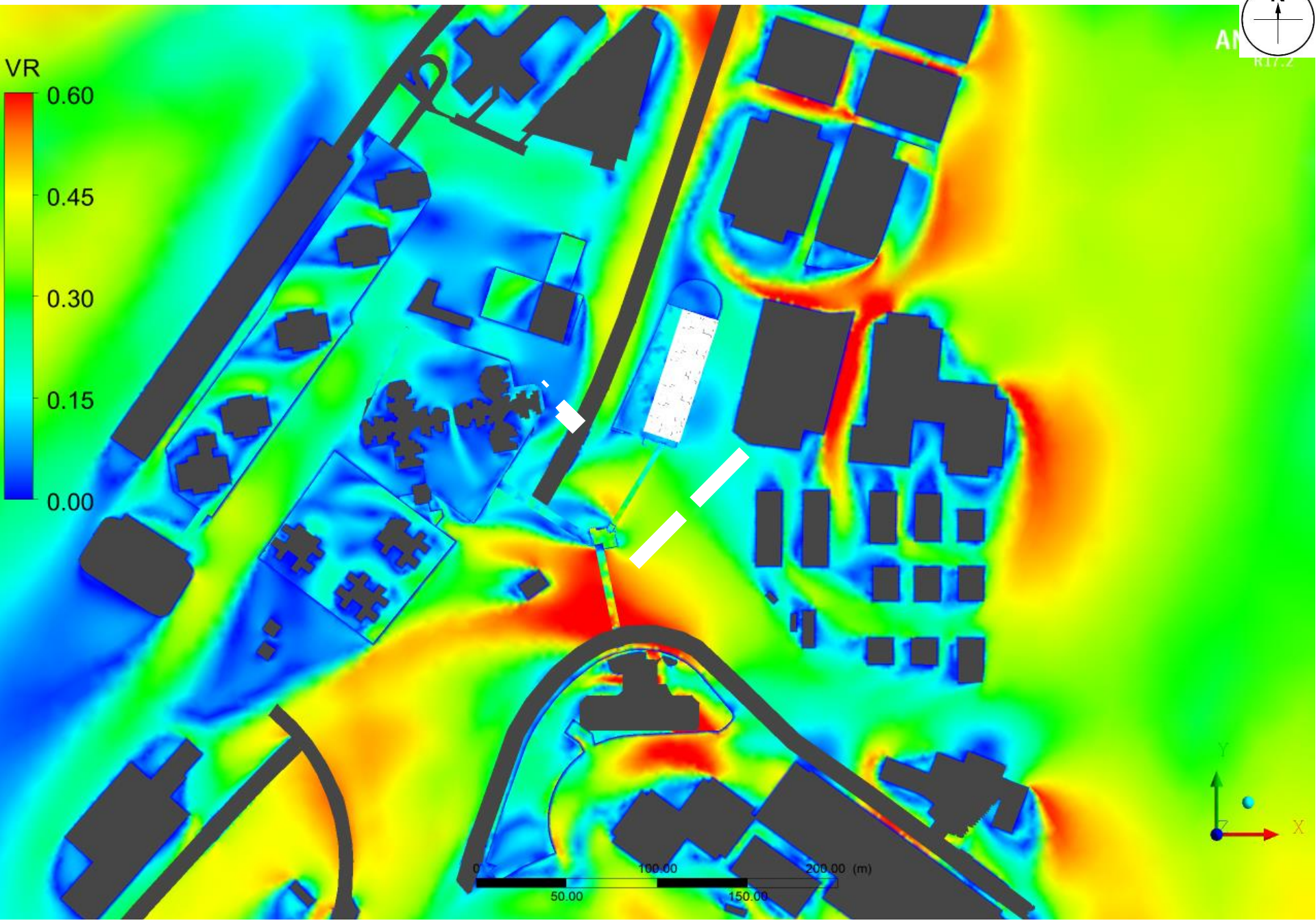
Baseline Scheme - Vector plot at pedestrian level under SW Wind



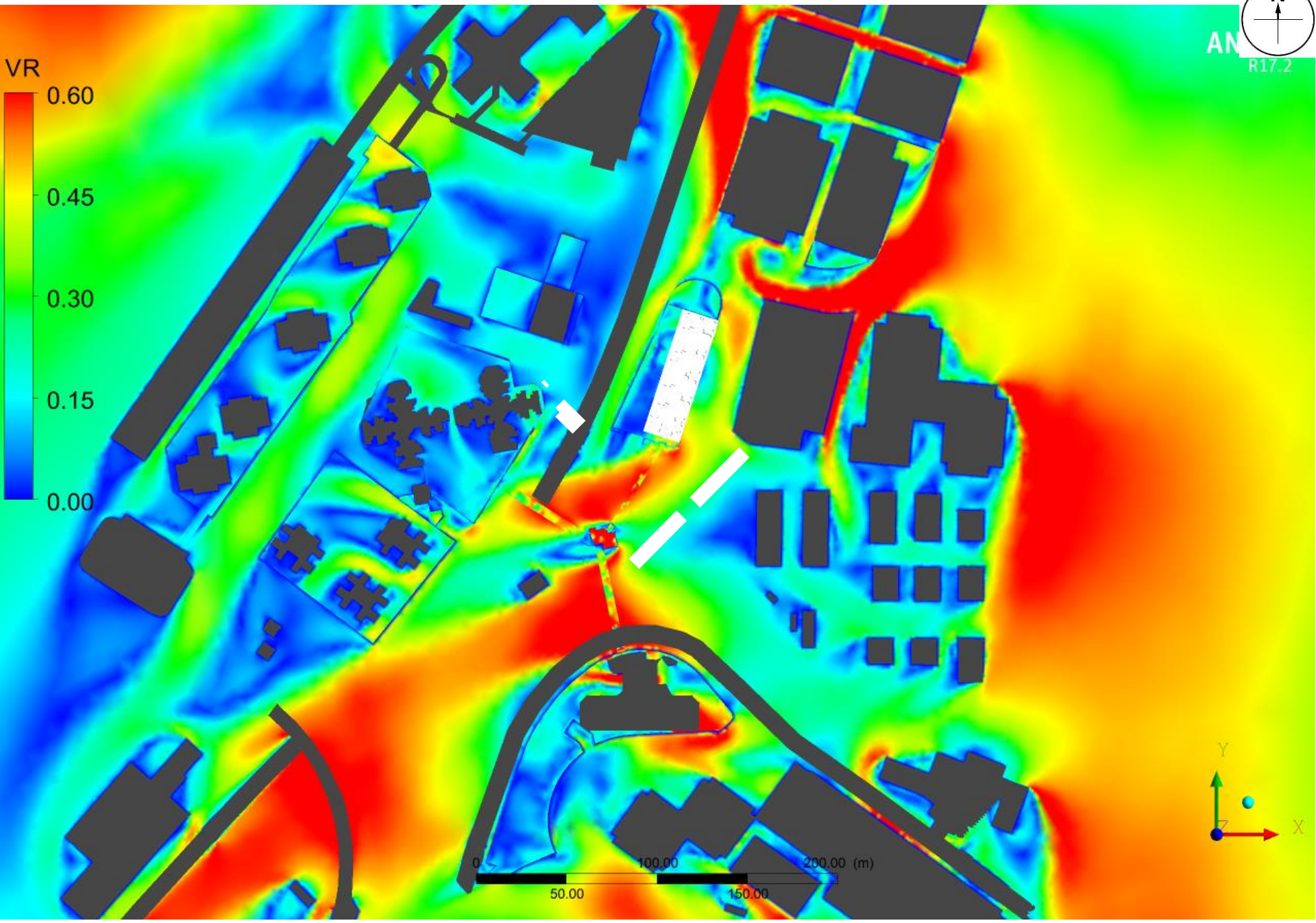
Baseline Scheme - Vector plot at pedestrian level under WSW Wind



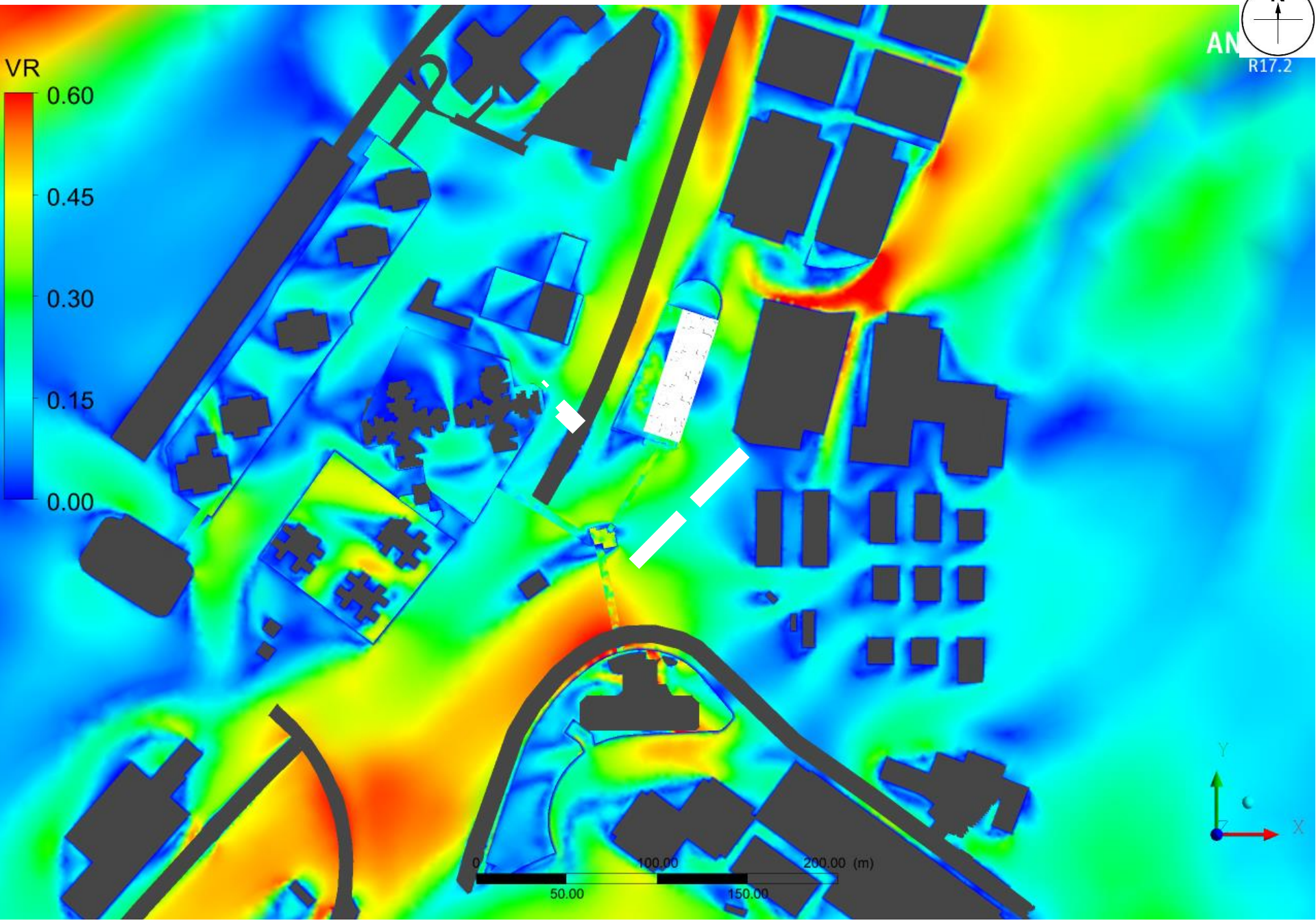
Proposed Scheme - Contour plot at pedestrian level under NNE Wind



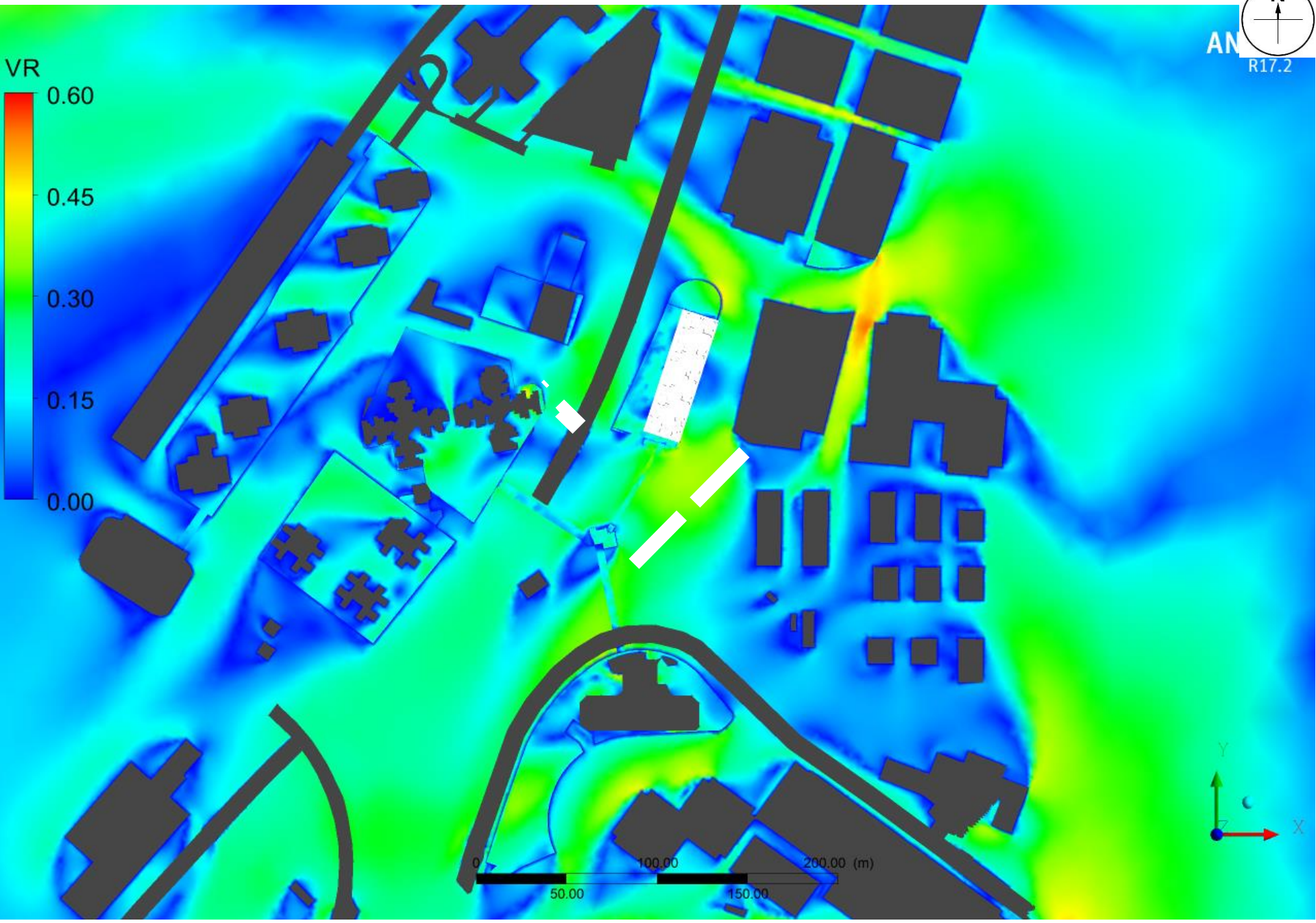
Proposed Scheme - Contour plot at pedestrian level under NE Wind



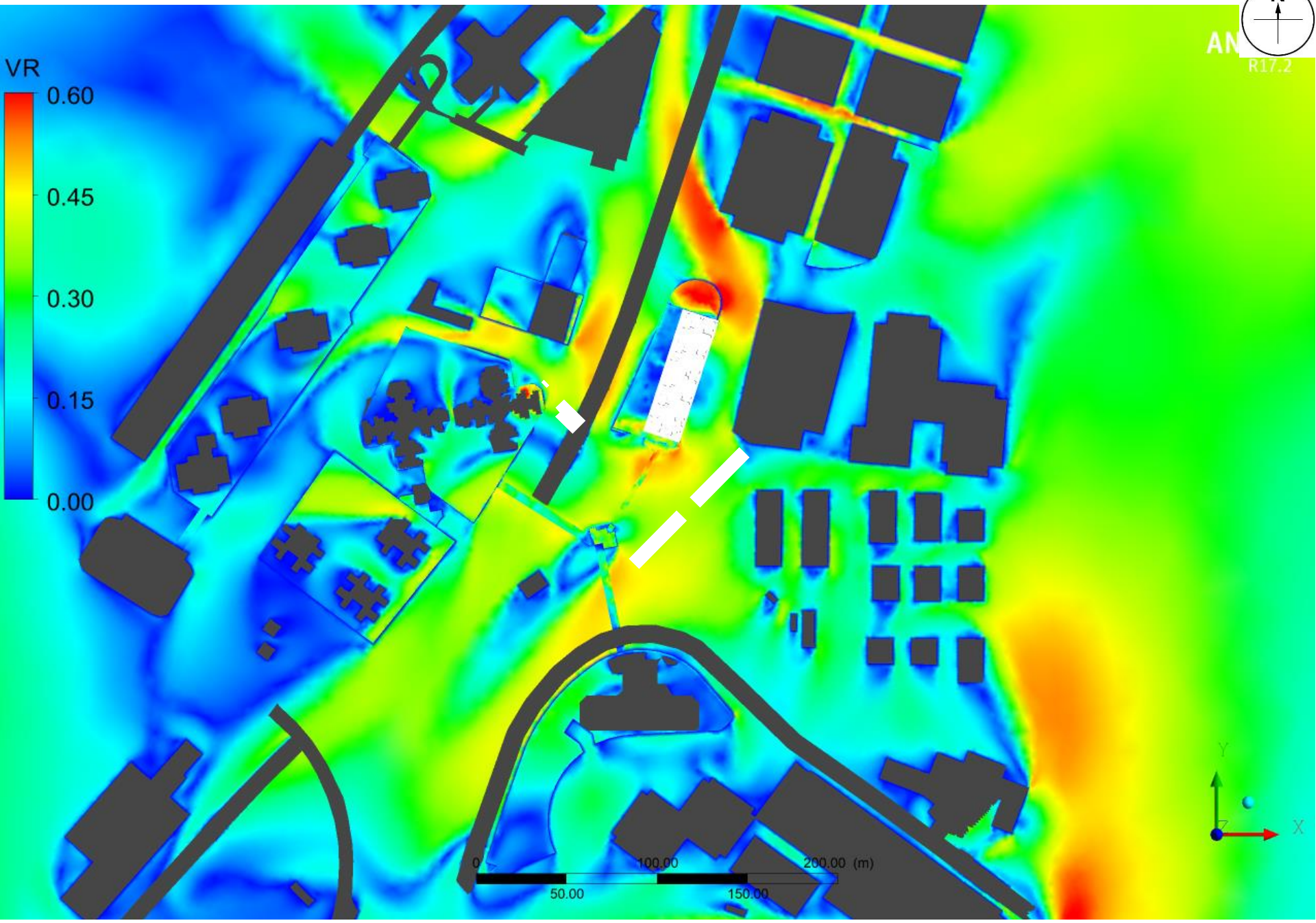
Proposed Scheme - Contour plot at pedestrian level under ENE Wind



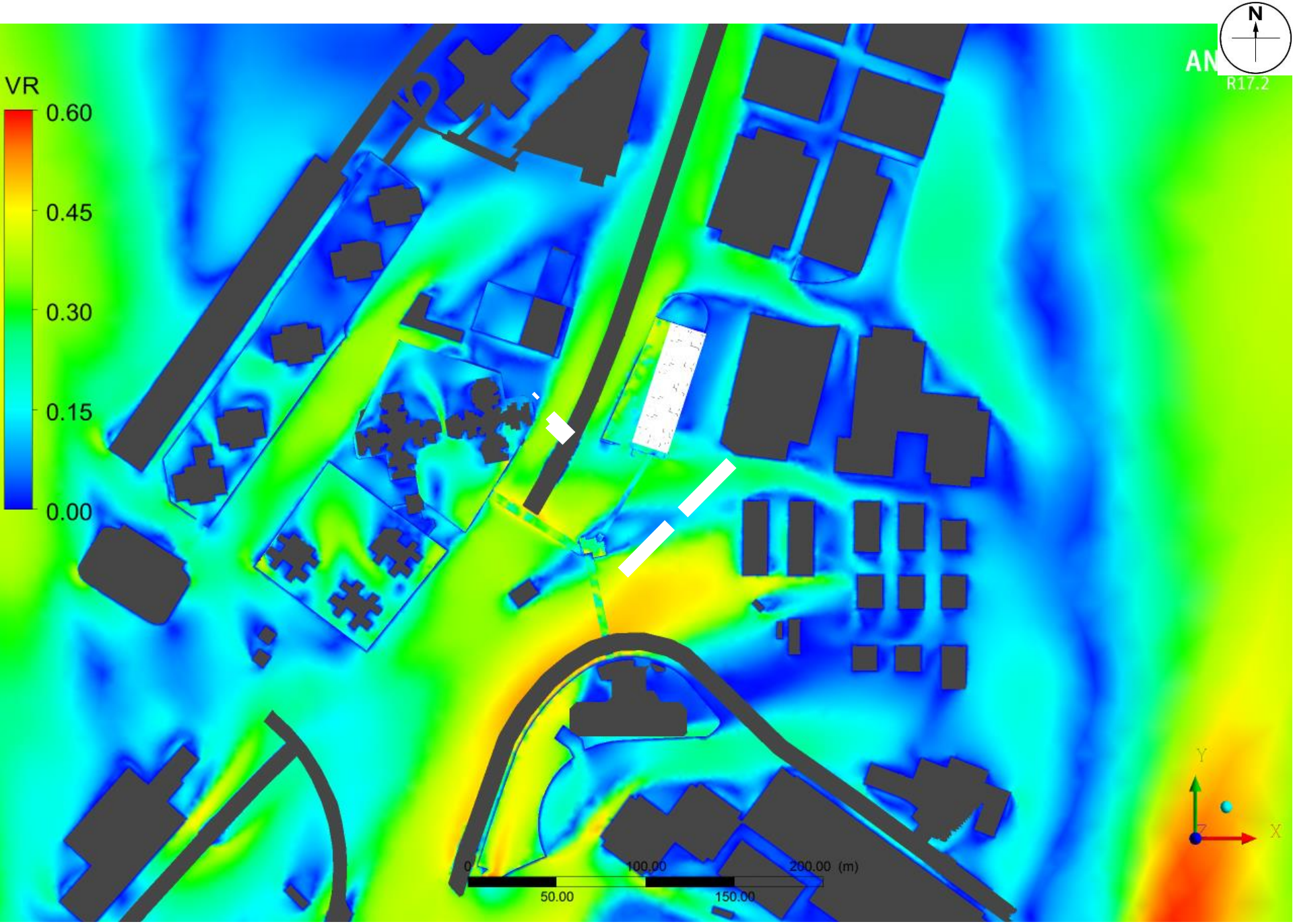
Proposed Scheme - Contour plot at pedestrian level under E Wind



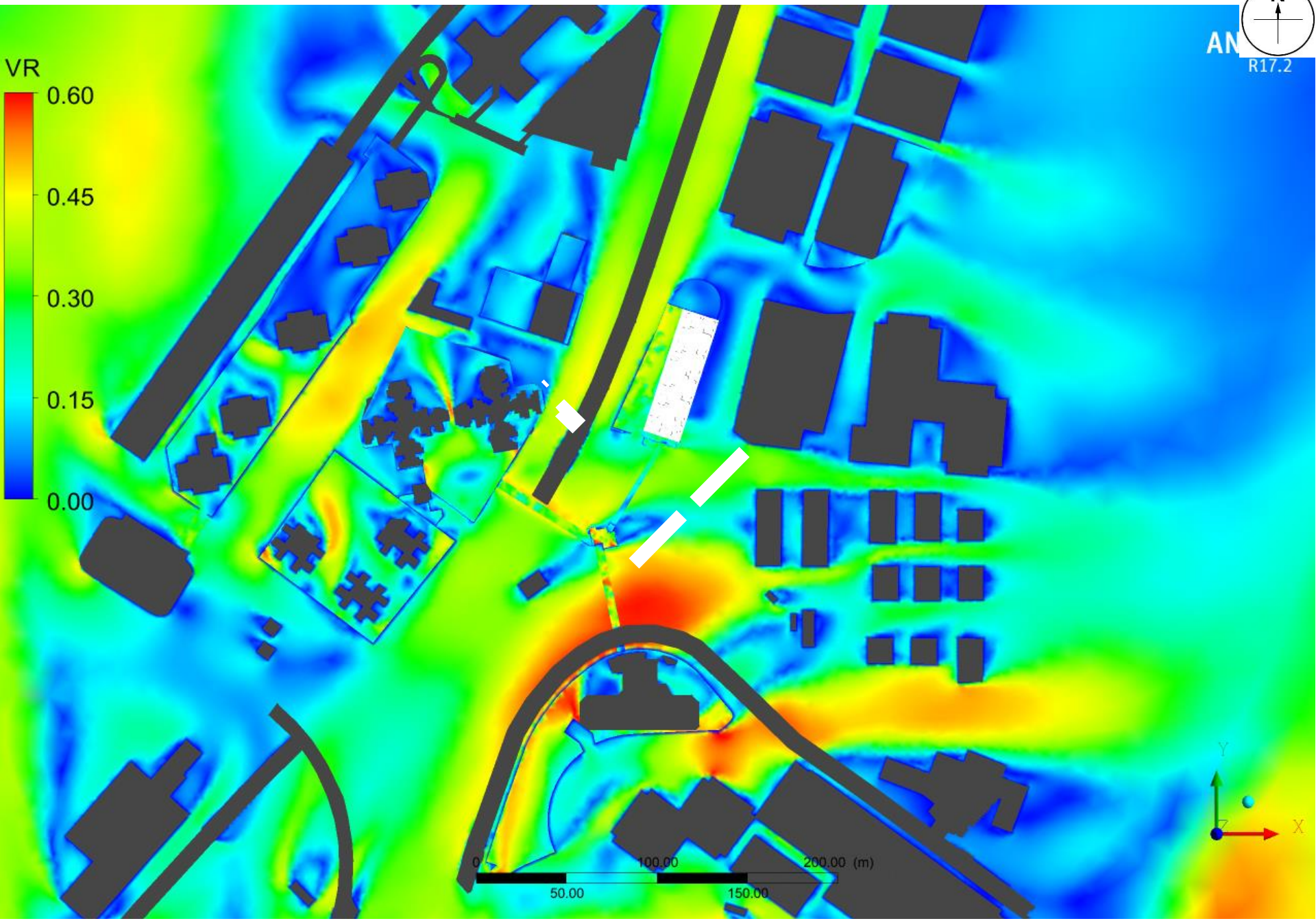
Proposed Scheme - Contour plot at pedestrian level under ESE Wind



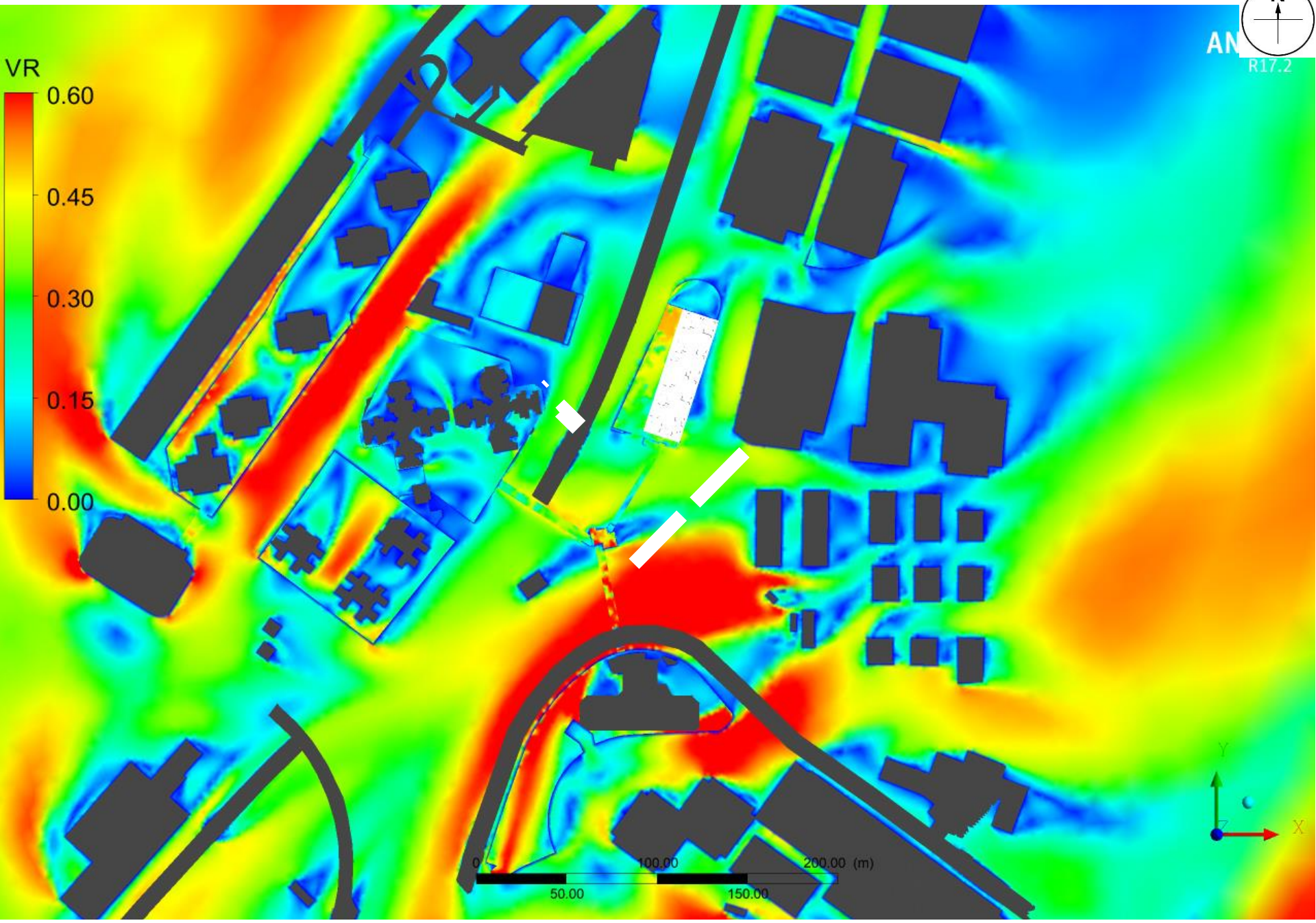
Proposed Scheme - Contour plot at pedestrian level under SE Wind



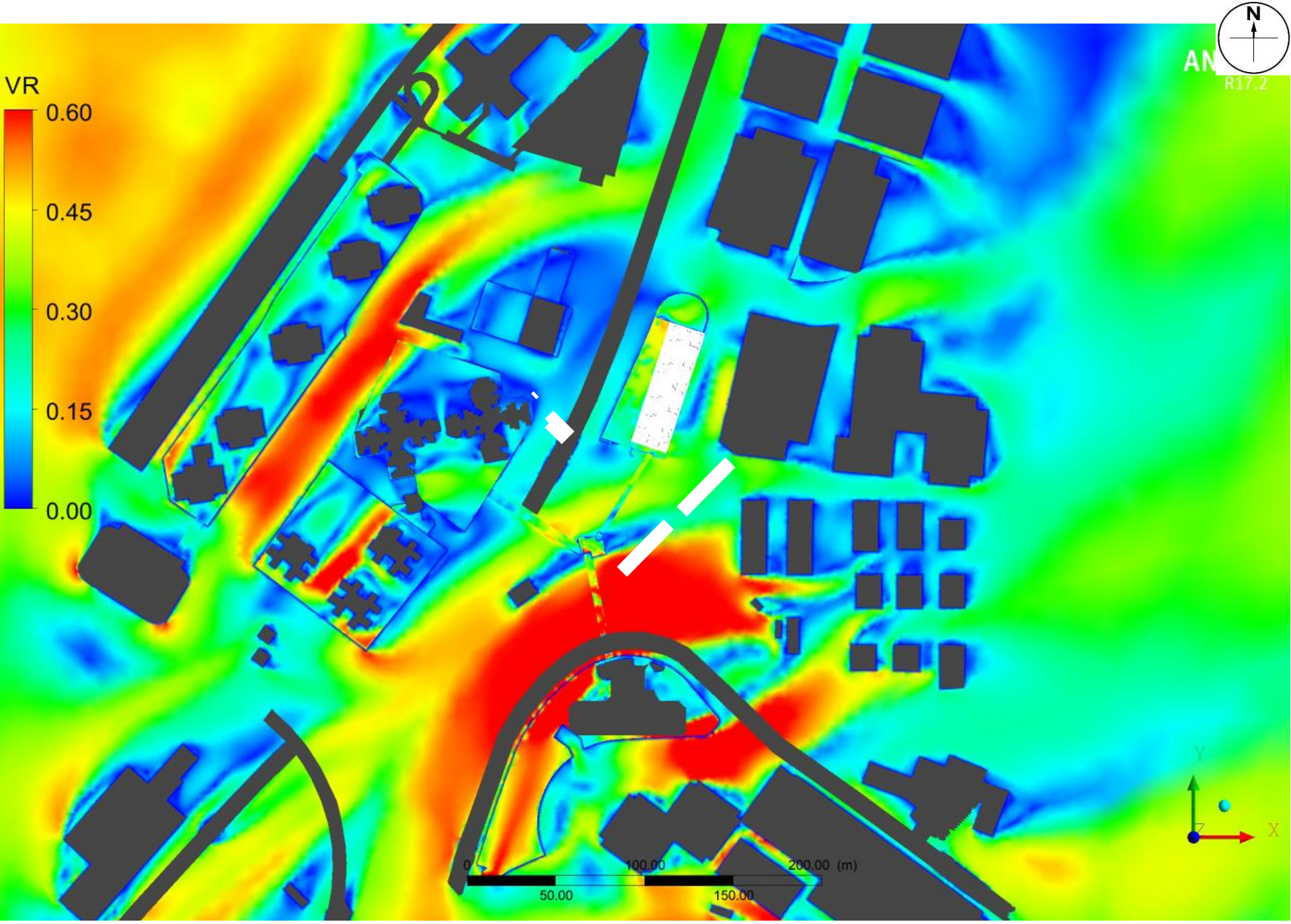
Proposed Scheme - Contour plot at pedestrian level under SSE Wind



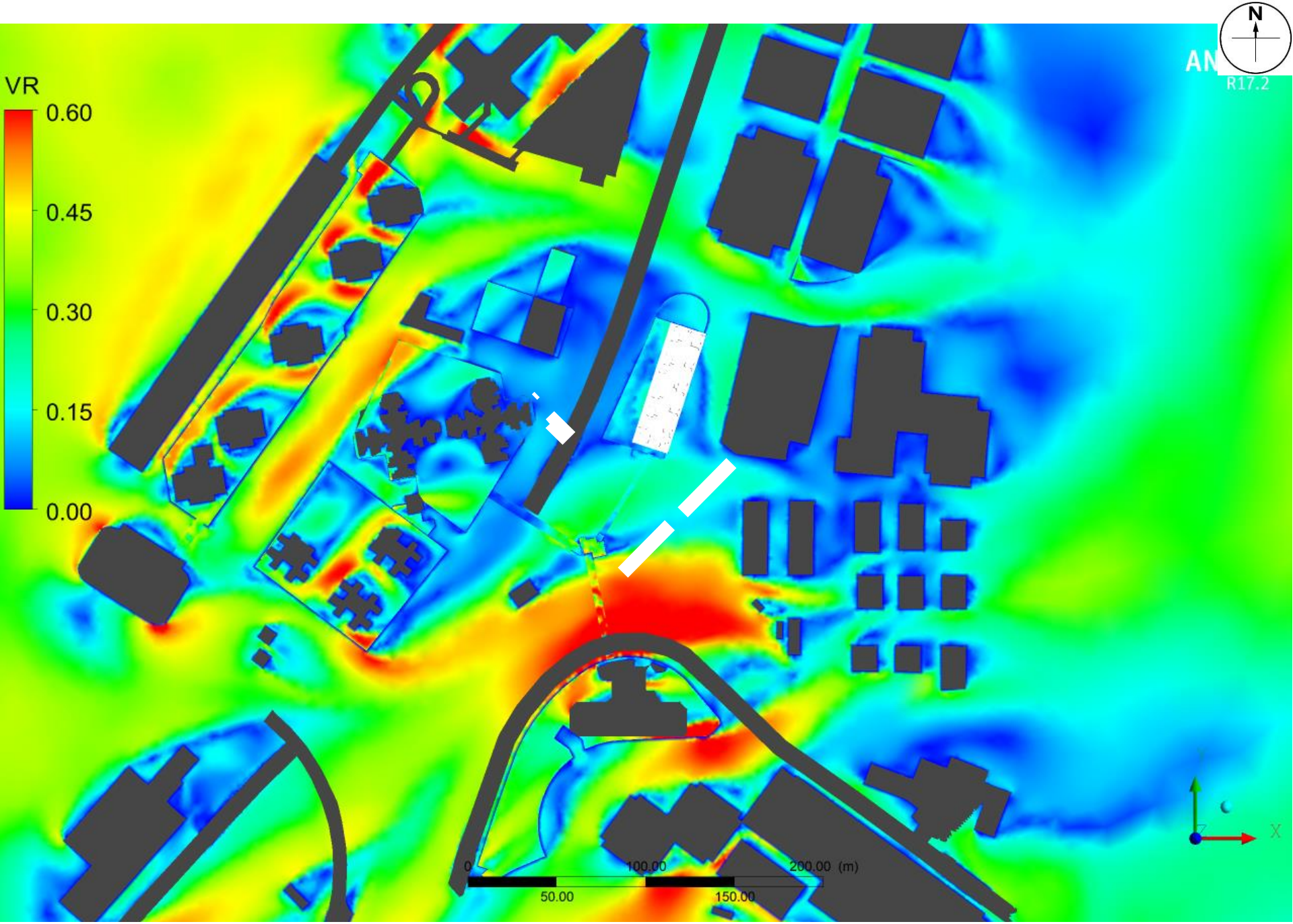
Proposed Scheme - Contour plot at pedestrian level under S Wind



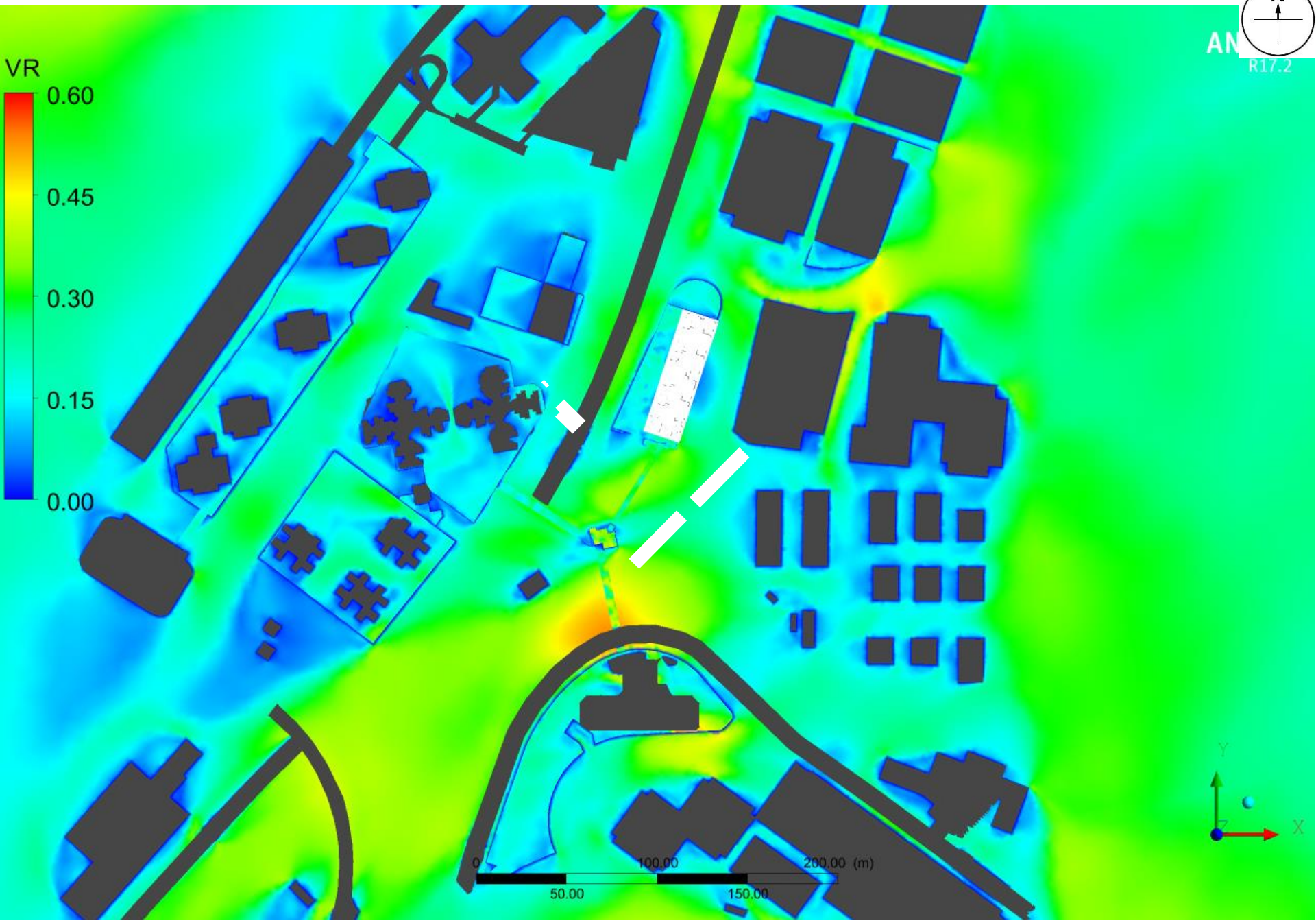
Proposed Scheme - Contour plot at pedestrian level under SSW Wind



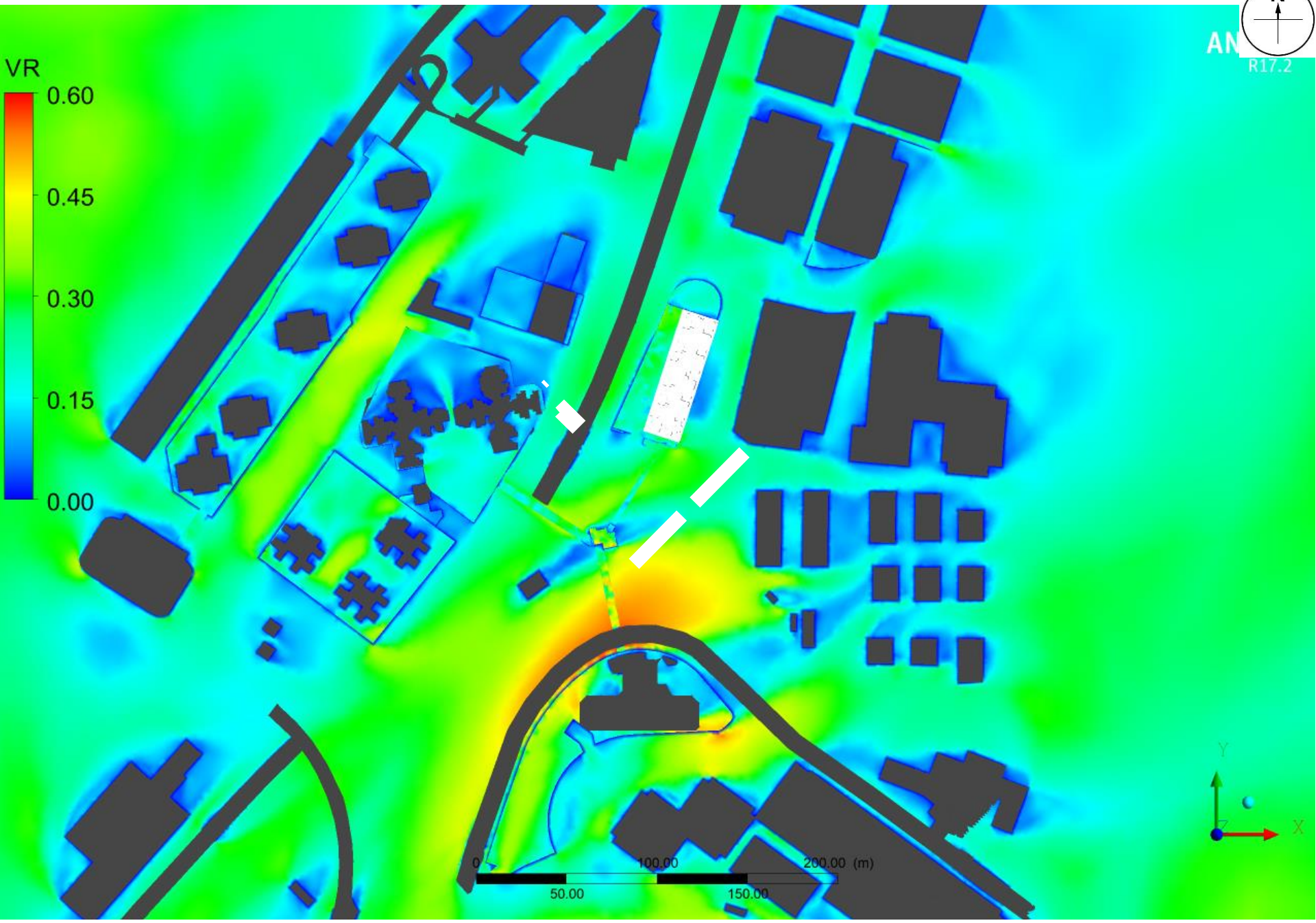
Proposed Scheme - Contour plot at pedestrian level under SW Wind



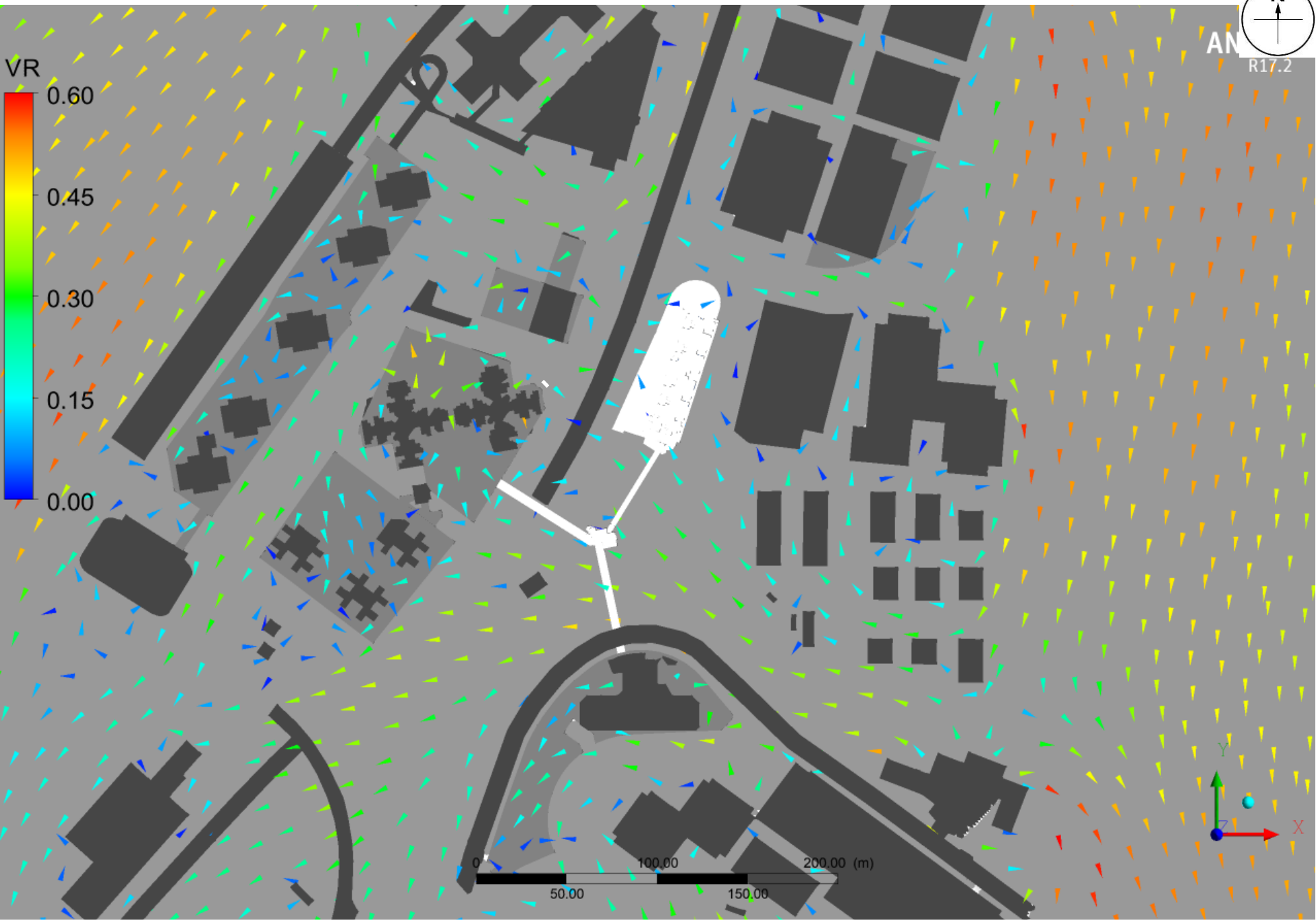
Proposed Scheme - Contour plot at pedestrian level under WSW Wind



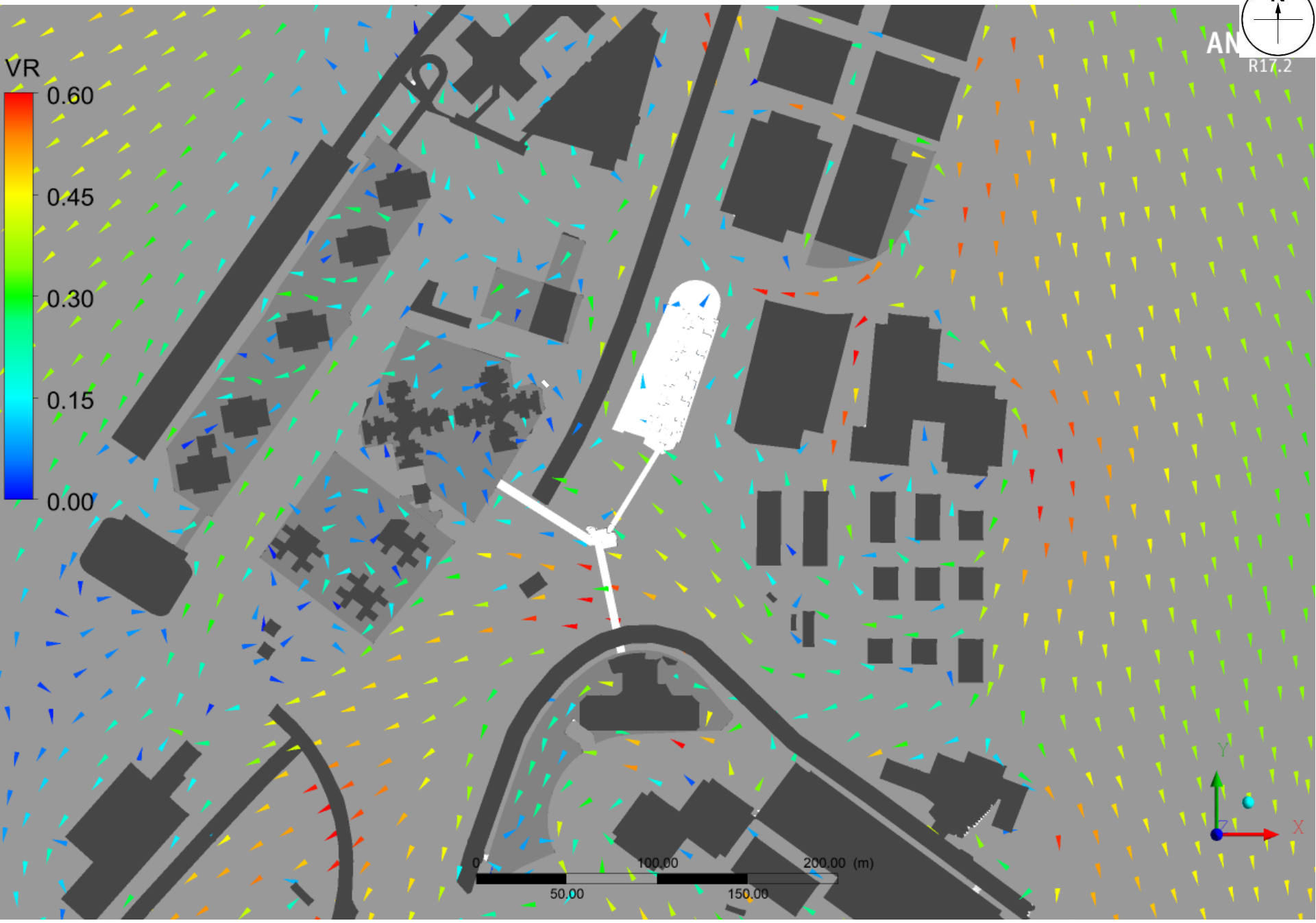
Proposed Scheme - Annual weighted wind speed colour at pedestrian level



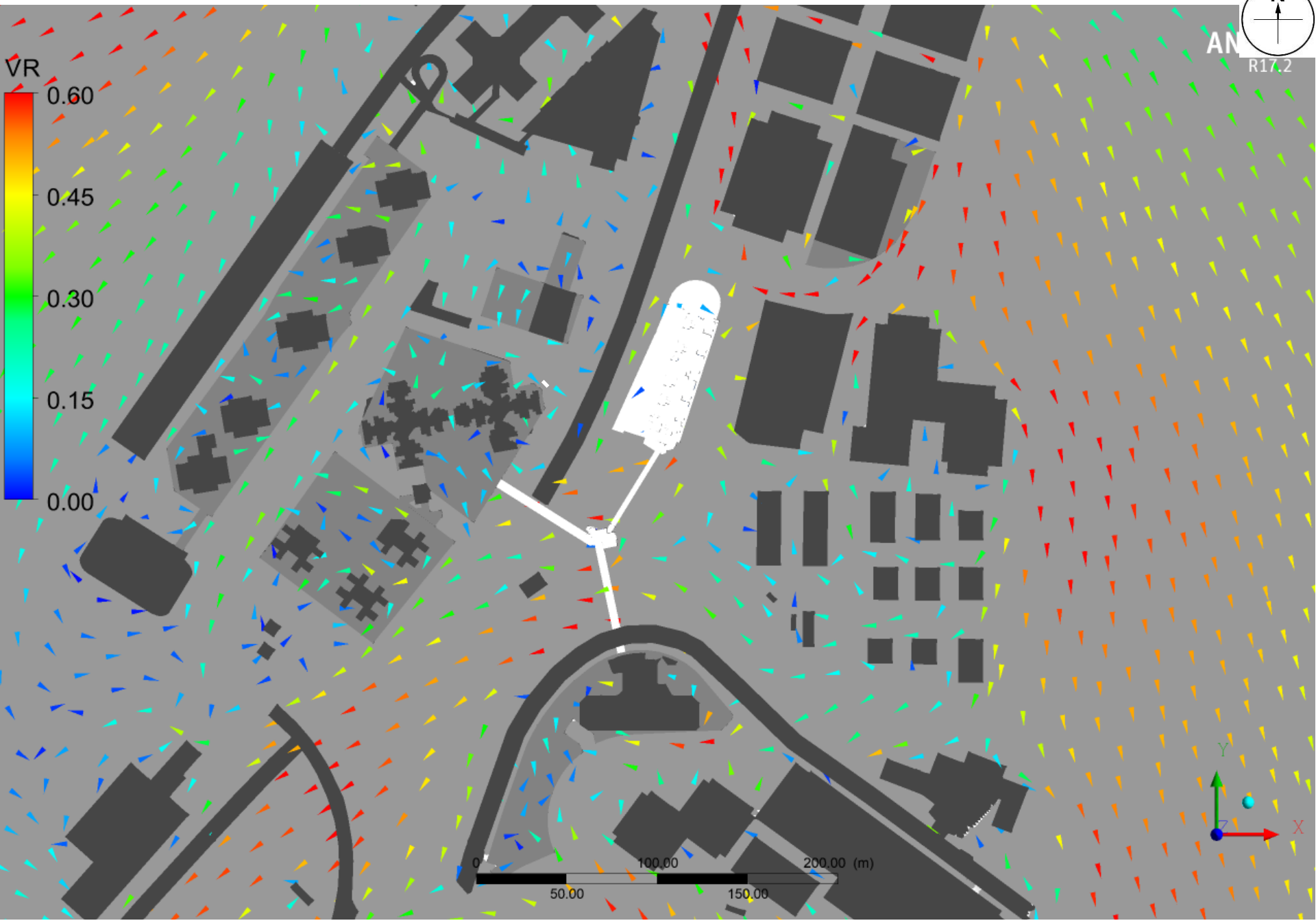
Proposed Scheme - Summer weighted wind speed colour at pedestrian level



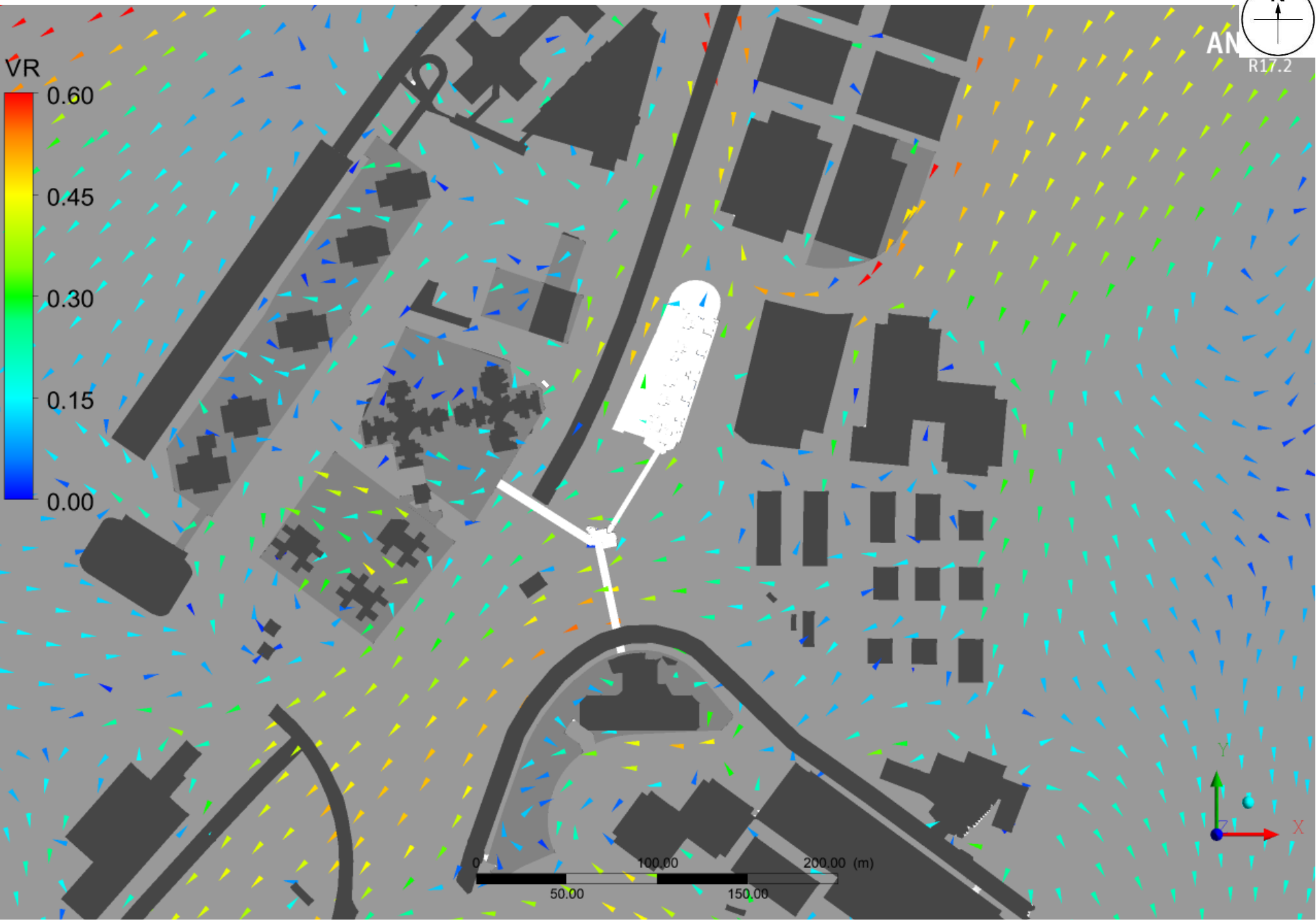
Proposed Scheme - Vector plot at pedestrian level under NNE Wind



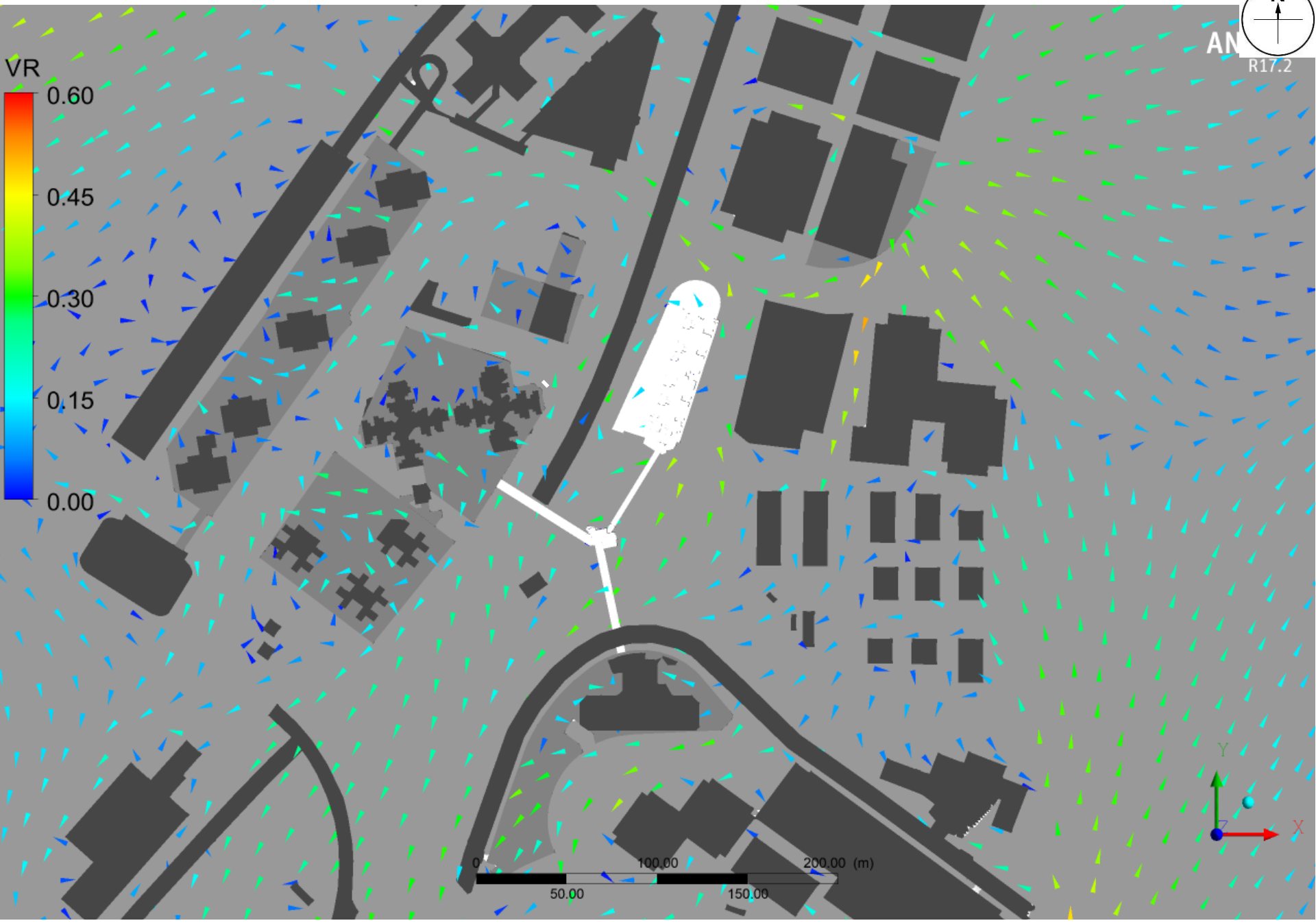
Proposed Scheme - Vector plot at pedestrian level under NE Wind



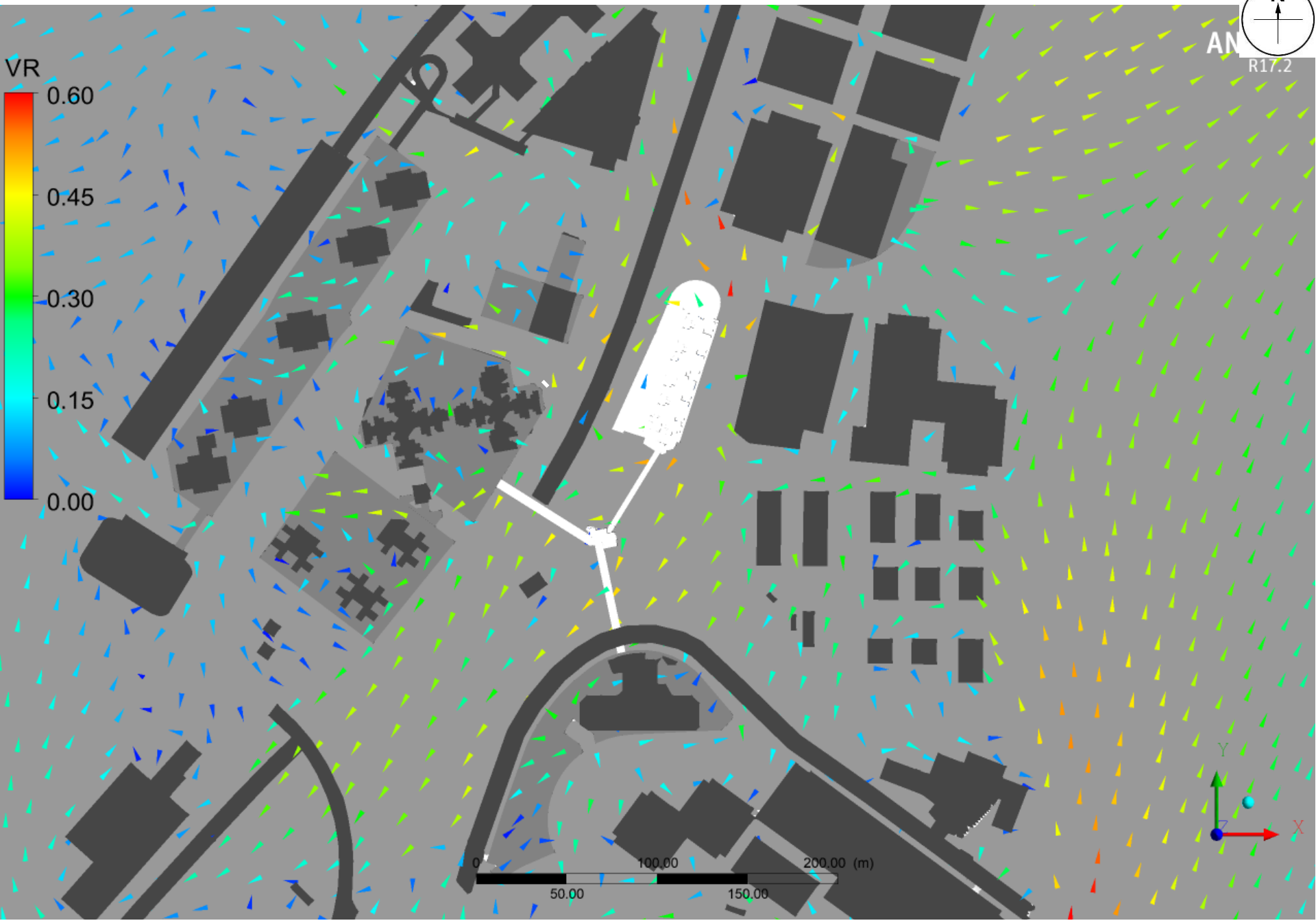
Proposed Scheme - Vector plot at pedestrian level under ENE Wind



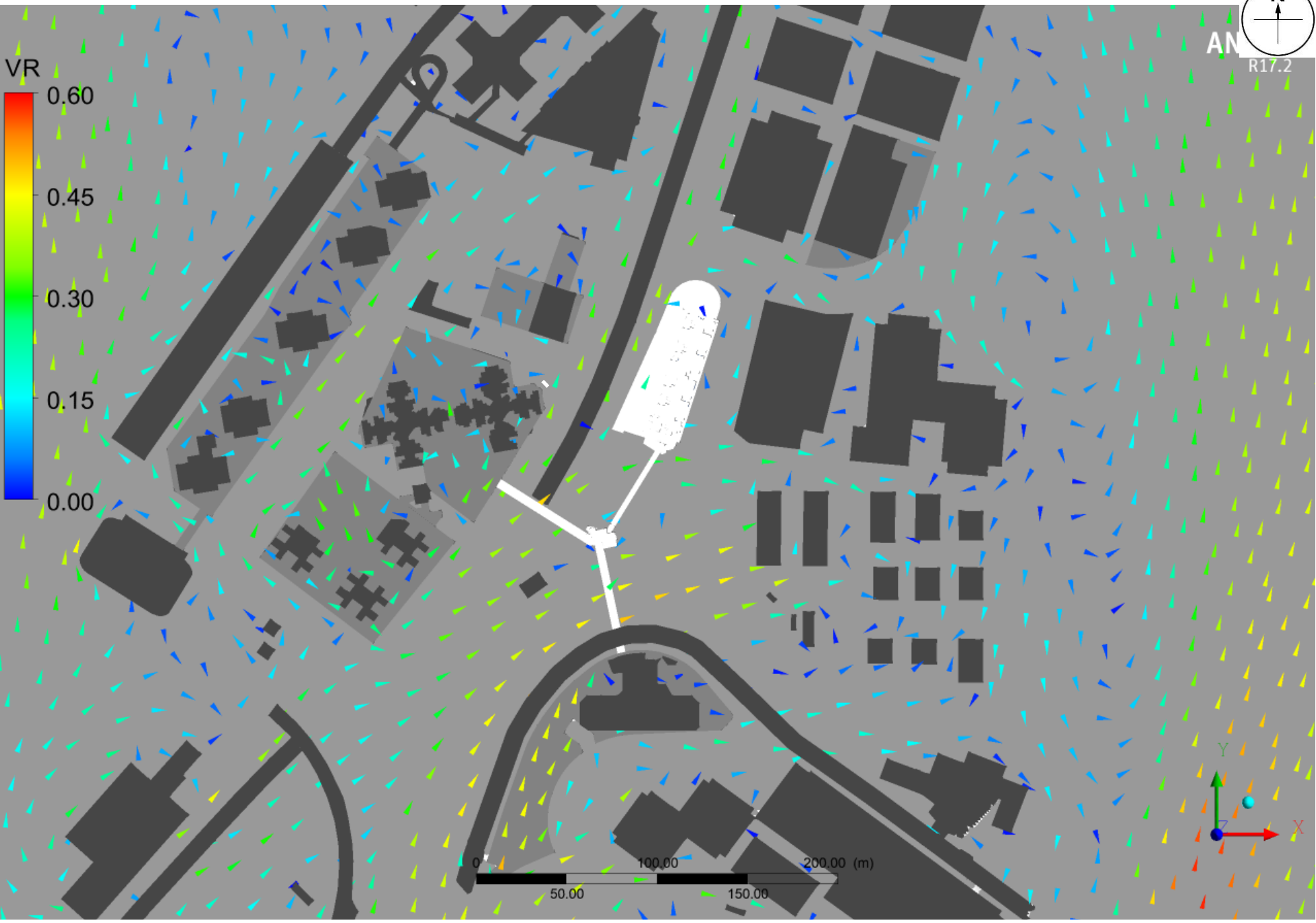
Proposed Scheme - Vector plot at pedestrian level under E Wind



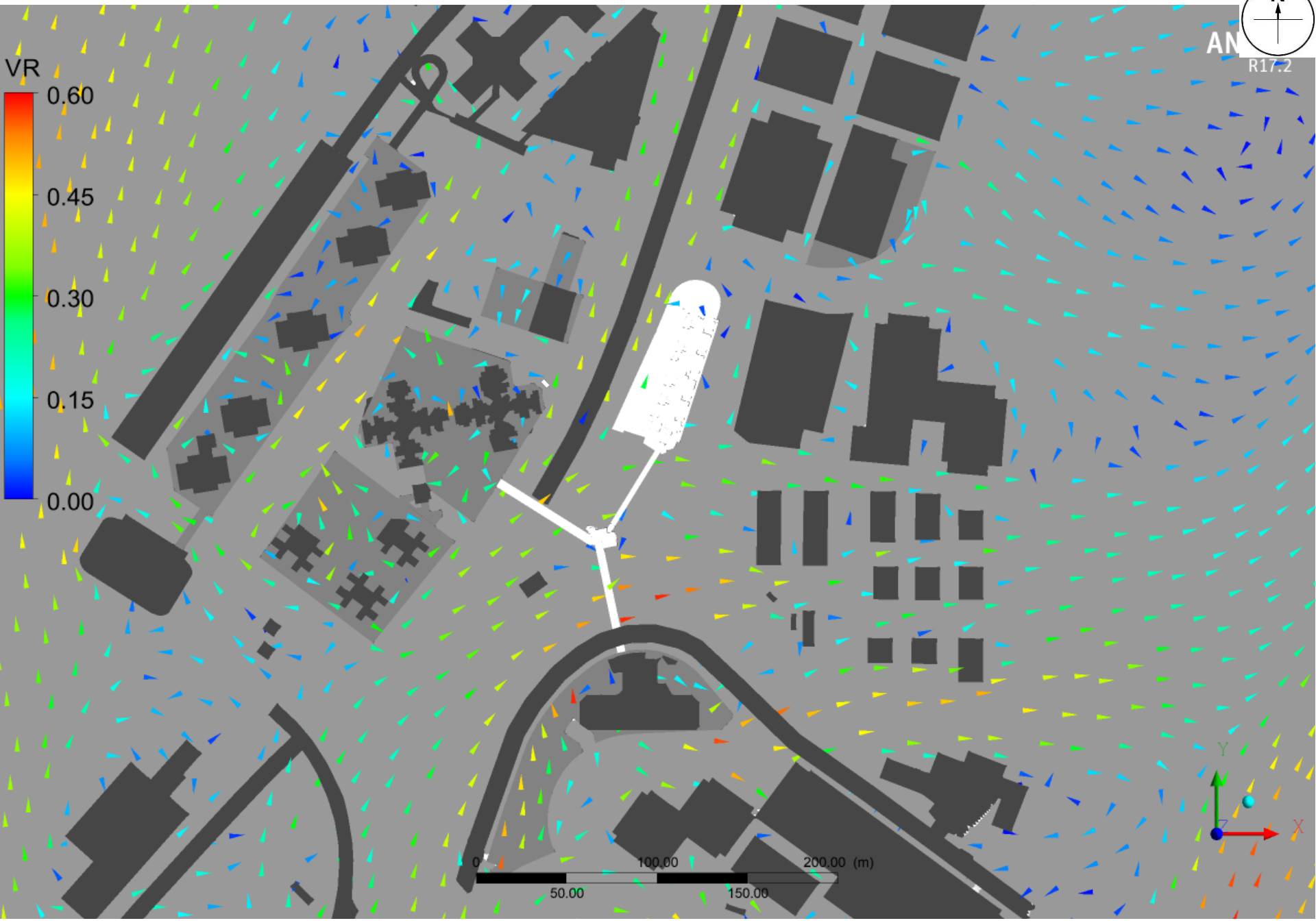
Proposed Scheme - Vector plot at pedestrian level under ESE Wind



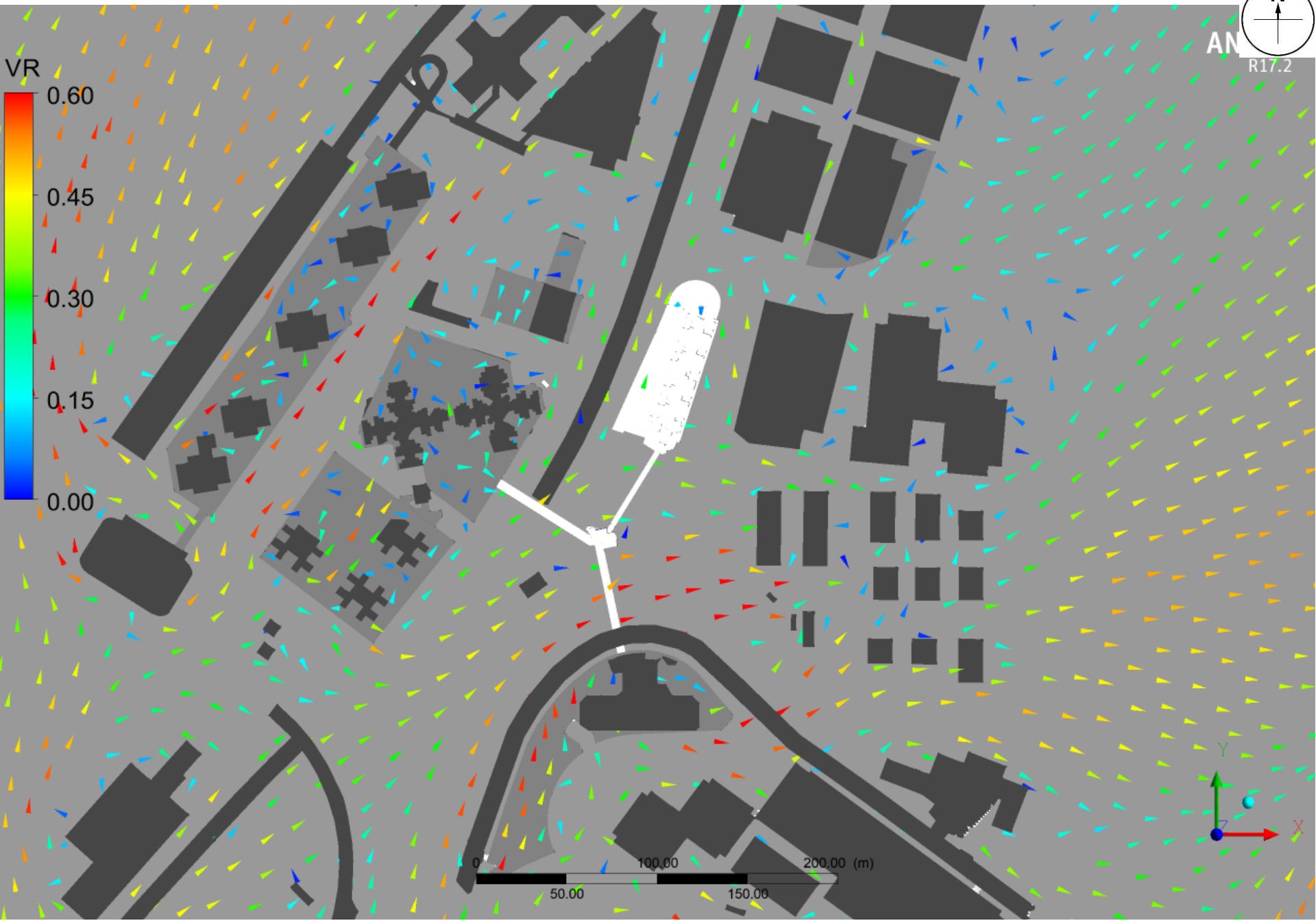
Proposed Scheme - Vector plot at pedestrian level under SE Wind



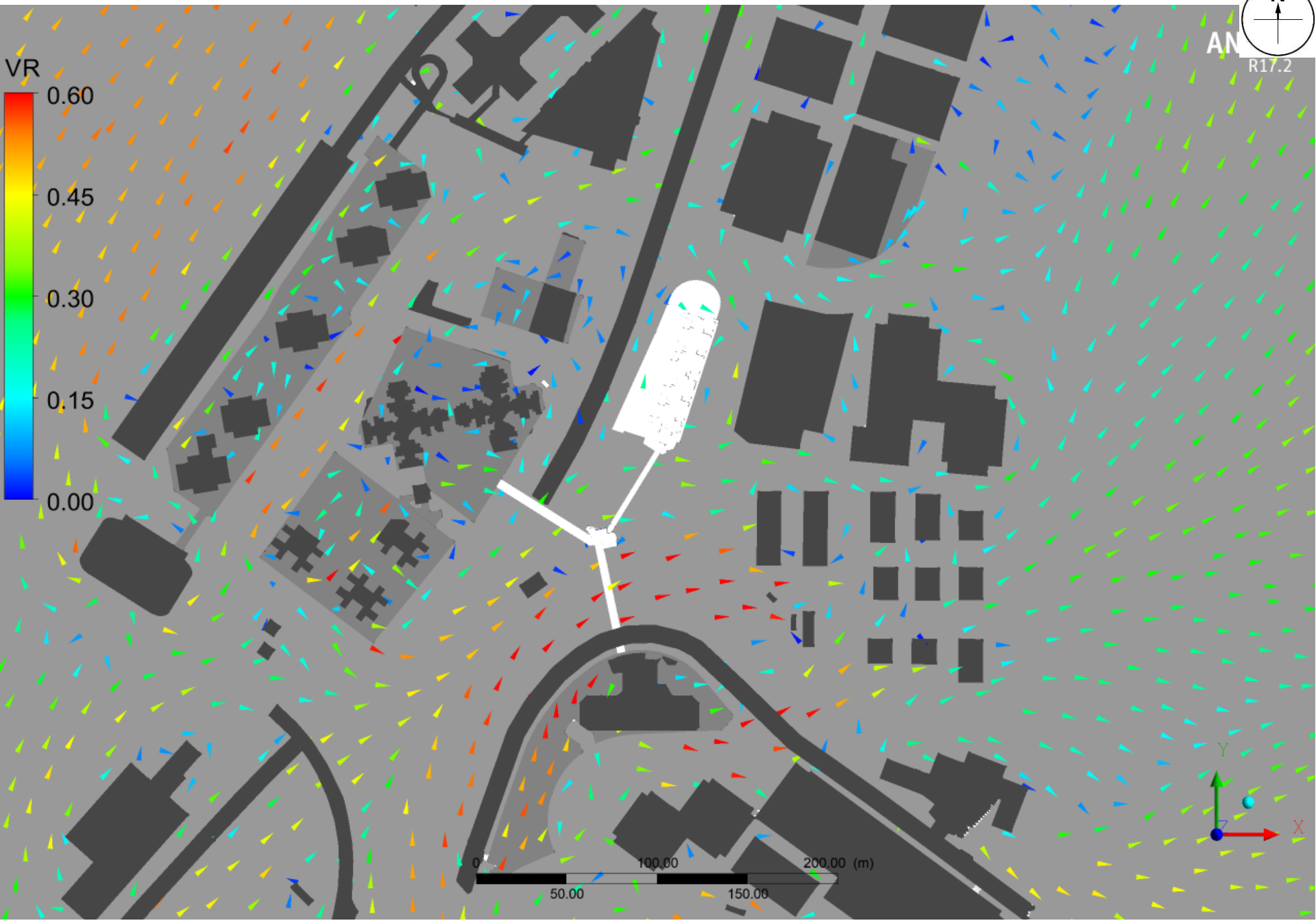
Proposed Scheme - Vector plot at pedestrian level under SSE Wind



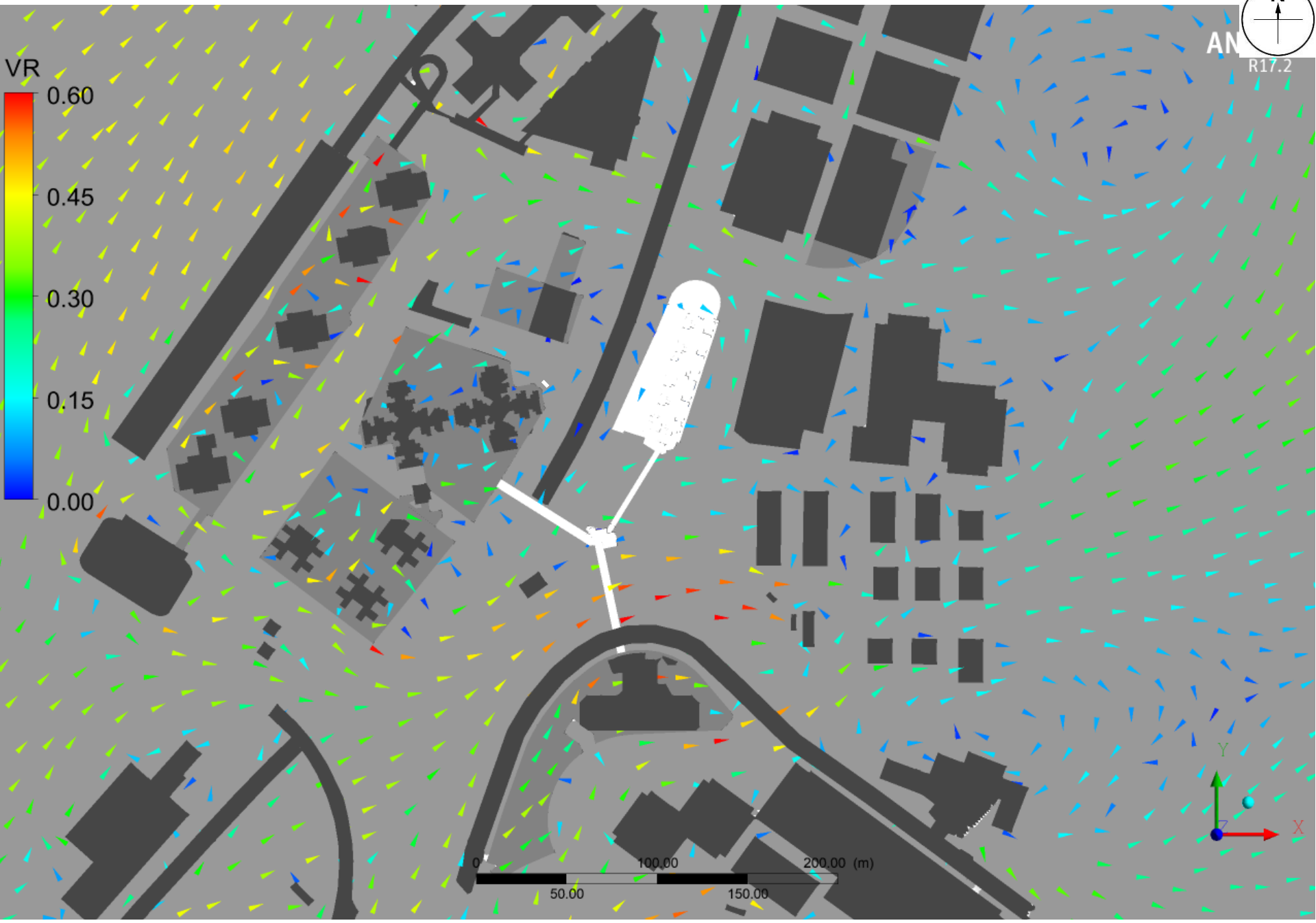
Proposed Scheme - Vector plot at pedestrian level under S Wind



Proposed Scheme - Vector plot at pedestrian level under SSW Wind



Proposed Scheme - Vector plot at pedestrian level under SW Wind



Proposed Scheme - Vector plot at pedestrian level under WSW Wind

Appendix 5

Detailed CFD Simulation Result for Selected Test Points

Detailed Wind Velocity Ratio under different Wind Directions

Test Point	Baseline Scheme												
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
P01	0.04	0.39	0.60	0.46	0.23	0.49	0.36	0.40	0.36	0.43	0.36	0.40	0.38
P02	0.22	0.43	0.55	0.45	0.18	0.41	0.41	0.46	0.40	0.44	0.32	0.40	0.39
P03	0.24	0.34	0.39	0.39	0.12	0.31	0.42	0.47	0.40	0.40	0.27	0.33	0.36
P04	0.10	0.14	0.02	0.25	0.06	0.20	0.38	0.43	0.35	0.33	0.23	0.18	0.30
P05	0.09	0.23	0.05	0.18	0.07	0.24	0.37	0.42	0.34	0.32	0.21	0.19	0.29
P06	0.08	0.28	0.38	0.26	0.01	0.16	0.39	0.46	0.37	0.34	0.20	0.25	0.30
P07	0.20	0.30	0.19	0.24	0.07	0.30	0.40	0.47	0.38	0.32	0.16	0.25	0.31
P08	0.27	0.29	0.25	0.29	0.14	0.22	0.41	0.48	0.38	0.32	0.17	0.28	0.32
P09	0.27	0.29	0.29	0.33	0.08	0.16	0.40	0.47	0.37	0.30	0.12	0.28	0.30
P10	0.19	0.30	0.33	0.33	0.08	0.25	0.38	0.45	0.36	0.27	0.09	0.29	0.30
P11	0.08	0.34	0.33	0.33	0.15	0.13	0.37	0.43	0.34	0.24	0.07	0.28	0.28
P12	0.16	0.36	0.27	0.17	0.17	0.13	0.38	0.43	0.33	0.19	0.03	0.24	0.25
P13	0.07	0.08	0.12	0.05	0.34	0.27	0.04	0.12	0.19	0.28	0.15	0.15	0.19
P14	0.01	0.06	0.03	0.21	0.16	0.22	0.06	0.01	0.07	0.18	0.14	0.11	0.12
P15	0.06	0.04	0.30	0.40	0.16	0.37	0.04	0.04	0.04	0.03	0.01	0.21	0.11
P16	0.04	0.21	0.46	0.54	0.27	0.47	0.23	0.29	0.21	0.38	0.22	0.35	0.31
P17	0.13	0.24	0.40	0.43	0.21	0.36	0.06	0.03	0.08	0.14	0.05	0.27	0.15
P18	0.16	0.21	0.07	0.26	0.10	0.20	0.05	0.01	0.08	0.17	0.04	0.15	0.11
P19	0.14	0.19	0.24	0.12	0.05	0.09	0.02	0.02	0.14	0.05	0.02	0.13	0.07
P20	0.30	0.13	0.37	0.23	0.16	0.25	0.21	0.26	0.29	0.43	0.05	0.25	0.26
P21	0.16	0.04	0.40	0.18	0.17	0.23	0.05	0.05	0.08	0.10	0.06	0.18	0.11
P22	0.15	0.13	0.48	0.33	0.23	0.34	0.10	0.11	0.23	0.32	0.15	0.27	0.23
P23	0.18	0.34	0.54	0.45	0.29	0.46	0.32	0.40	0.34	0.47	0.32	0.39	0.38
P24	0.19	0.38	0.59	0.50	0.29	0.50	0.26	0.36	0.29	0.43	0.31	0.41	0.36
P25	0.26	0.38	0.56	0.47	0.30	0.49	0.06	0.05	0.09	0.08	0.12	0.36	0.18
P26	0.30	0.35	0.49	0.40	0.27	0.43	0.03	0.08	0.13	0.09	0.09	0.33	0.17
P27	0.29	0.30	0.38	0.27	0.21	0.34	0.19	0.27	0.34	0.19	0.11	0.30	0.25
P28	0.11	0.17	0.19	0.13	0.08	0.13	0.16	0.21	0.24	0.21	0.19	0.15	0.18
P29	0.24	0.11	0.08	0.17	0.06	0.05	0.27	0.34	0.45	0.35	0.33	0.17	0.28
P30	0.24	0.20	0.64	0.44	0.26	0.50	0.31	0.35	0.31	0.38	0.36	0.38	0.36
Average SVR	**0.17**	**0.24**	**0.33**	**0.31**	**0.17**	**0.29**	**0.24**	**0.28**	**0.27**	**0.27**	**0.16**	**0.26**	**0.25**
T01							NA						
T02							NA						
T03	0.31	0.46	0.34	0.34	0.27	0.23	0.18	0.24	0.26	0.17	0.23	0.32	0.24
T04	0.40	0.52	0.51	0.47	0.22	0.19	0.20	0.32	0.45	0.52	0.39	0.40	0.36
T05							NA						
T06							NA						
T07							NA						
T08							NA						
T09							NA						
T10							NA						
T11							NA						
T12							NA						
T13							NA						
T14	0.22	0.34	0.25	0.27	0.15	0.18	0.17	0.27	0.36	0.35	0.19	0.26	0.26
T15	0.37	0.46	0.45	0.41	0.20	0.18	0.17	0.26	0.36	0.44	0.33	0.35	0.31
T16	0.39	0.30	0.48	0.41	0.25	0.08	0.26	0.57	0.84	0.83	0.60	0.41	0.55
T17	0.29	0.40	0.32	0.16	0.02	0.13	0.14	0.31	0.43	0.45	0.31	0.24	0.28
T18							NA						
T19							NA						
T20							NA						
T21							NA						
T22							NA						
T23							NA						
T24							NA						
T25	0.37	0.24	0.28	0.19	0.15	0.16	0.22	0.50	0.58	0.58	0.51	0.28	0.41
T26	0.33	0.24	0.20	0.12	0.06	0.16	0.03	0.07	0.07	0.04	0.10	0.15	0.08
T27	0.54	0.50	0.52	0.39	0.25	0.10	0.03	0.28	0.19	0.37	0.51	0.36	0.26
T28	0.46	0.49	0.55	0.52	0.28	0.23	0.35	0.50	0.61	0.63	0.59	0.46	0.49
T29	0.10	0.39	0.65	0.60	0.31	0.35	0.48	0.57	0.72	0.72	0.62	0.49	0.57
T30	0.08	0.30	0.59	0.52	0.27	0.33	0.45	0.51	0.63	0.66	0.54	0.43	0.52
T31	0.08	0.24	0.46	0.47	0.27	0.33	0.36	0.38	0.54	0.59	0.45	0.37	0.45
T32							NA						
T33							NA						
T34							NA						
T35							NA						
T36							NA						
T37	0.21	0.19	0.20	0.16	0.08	0.26	0.04	0.21	0.39	0.27	0.14	0.20	0.22
T38	0.23	0.30	0.18	0.08	0.08	0.22	0.04	0.12	0.07	0.06	0.19	0.15	0.10
T39	0.24	0.20	0.18	0.20	0.08	0.27	0.44	0.42	0.55	0.59	0.51	0.24	0.41
T40	0.21	0.06	0.18	0.10	0.06	0.22	0.07	0.10	0.08	0.07	0.09	0.12	0.09
T41	0.16	0.14	0.14	0.18	0.09	0.25	0.13	0.06	0.18	0.25	0.15	0.15	0.16
T42	0.18	0.15	0.13	0.16	0.06	0.16	0.07	0.11	0.18	0.13	0.12	0.14	0.13
T43							NA						
T44	0.18	0.19	0.17	0.08	0.00	0.08	0.02	0.05	0.11	0.06	0.05	0.11	0.06
T45	0.18	0.23	0.19	0.14	0.11	0.16	0.02	0.26	0.38	0.29	0.34	0.20	0.24
T46							NA						
T47							NA						
T48	0.26	0.27	0.17	0.10	0.09	0.19	0.13	0.29	0.06	0.11	0.43	0.16	0.16
T49	0.15	0.12	0.12	0.11	0.01	0.14	0.12	0.20	0.23	0.14	0.11	0.13	0.15
T50	0.19	0.07	0.05	0.05	0.15	0.15	0.04	0.05	0.05	0.04	0.05	0.09	0.07
T51							NA						
T52							NA						
T53							NA						
T54							NA						
T55							NA						
T56							NA						
T57	0.09	0.10	0.10	0.09	0.12	0.27	0.12	0.19	0.06	0.24	0.18	0.12	0.15
T58	0.10	0.10	0.11	0.05	0.11	0.29	0.08	0.18	0.16	0.26	0.18	0.12	0.17
T59	0.13	0.07	0.12	0.07	0.08	0.30	0.17	0.09	0.09	0.27	0.16	0.11	0.15
T60	0.07	0.14	0.16	0.18	0.02	0.09	0.17	0.26	0.32	0.42	0.23	0.16	0.24
T61	0.12	0.24	0.28	0.25	0.20	0.24	0.05	0.09	0.22	0.23	0.08	0.22	0.18
T62	0.13	0.23	0.28	0.20	0.08	0.18	0.03	0.04	0.13	0.14	0.05	0.17	0.11
T63	0.09	0.21	0.36	0.45	0.21	0.40	0.11	0.22	0.10	0.25	0.19	0.28	0.22
T64	0.10	0.53	0.72	0.42	0.25	0.40	0.16	0.17	0.19	0.24	0.24	0.39	0.24
T65							NA						
T66							NA						
T67							NA						
T68	0.08	0.05	0.53	0.42	0.22	0.24	0.03	0.10	0.06	0.08	0.11	0.25	0.14

T69	0.14	0.15	0.19	0.11	0.16	0.17	0.21	0.29	0.19	0.15	0.06	0.17	0.18
T70	0.19	0.18	0.14	0.07	0.12	0.18	0.02	0.08	0.05	0.19	0.12	0.12	0.10
T71	0.22	0.09	0.08	0.02	0.24	0.21	0.07	0.03	0.05	0.09	0.08	0.11	0.09
T72	0.07	0.21	0.33	0.18	0.19	0.13	0.28	0.21	0.31	0.30	0.13	0.21	0.24
T73	0.03	0.18	0.22	0.17	0.29	0.30	0.27	0.17	0.31	0.16	0.26	0.21	0.24
T74	0.10	0.16	0.29	0.16	0.05	0.46	0.24	0.28	0.11	0.10	0.27	0.19	0.19
T75	0.01	0.14	0.14	0.06	0.03	0.33	0.03	0.16	0.12	0.17	0.17	0.12	0.13
T76	0.12	0.11	0.56	0.20	0.11	0.04	0.23	0.30	0.25	0.24	0.17	0.22	0.21
T77	0.29	0.30	0.16	0.26	0.05	0.14	0.10	0.06	0.17	0.36	0.20	0.18	0.17
T78	0.28	0.31	0.19	0.28	0.18	0.12	0.15	0.21	0.17	0.05	0.01	0.22	0.15
T79	0.25	0.10	0.11	0.32	0.13	0.34	0.29	0.37	0.34	0.13	0.05	0.24	0.26
T80	0.05	0.11	0.14	0.18	0.06	0.15	0.42	0.46	0.41	0.21	0.12	0.18	0.28
T81	0.18	0.35	0.40	0.30	0.10	0.34	0.33	0.32	0.26	0.02	0.07	0.29	0.22
T82	0.27	0.37	0.46	0.34	0.12	0.29	0.26	0.28	0.18	0.10	0.08	0.30	0.20
T83	0.35	0.40	0.42	0.44	0.17	0.32	0.22	0.27	0.35	0.45	0.41	0.35	0.33
T84	0.36	0.45	0.30	0.17	0.06	0.08	0.20	0.20	0.25	0.23	0.27	0.23	0.19
T85	0.40	0.50	0.49	0.35	0.12	0.04	0.38	0.37	0.47	0.51	0.50	0.35	0.37
T86	0.40	0.49	0.50	0.45	0.19	0.18	0.37	0.34	0.45	0.50	0.41	0.39	0.38
T87	0.32	0.44	0.51	0.49	0.20	0.28	0.35	0.30	0.37	0.43	0.36	0.38	0.35
T88	0.18	0.20	0.11	0.22	0.13	0.06	0.04	0.09	0.08	0.03	0.08	0.15	0.09
T89	0.06	0.06	0.11	0.09	0.05	0.23	0.12	0.12	0.27	0.31	0.23	0.11	0.19
T90	0.26	0.21	0.08	0.25	0.12	0.12	0.20	0.04	0.20	0.45	0.27	0.17	0.21
T91	0.21	0.14	0.12	0.20	0.14	0.08	0.08	0.11	0.12	0.17	0.24	0.14	0.14
T92	0.09	0.14	0.26	0.21	0.19	0.15	0.17	0.16	0.11	0.25	0.23	0.18	0.18
T93	0.25	0.30	0.36	0.32	0.16	0.15	0.23	0.29	0.52	0.50	0.41	0.30	0.35
T94	0.16	0.19	0.22	0.25	0.11	0.24	0.23	0.34	0.36	0.37	0.31	0.23	0.29
T95	0.28	0.29	0.26	0.05	0.05	0.03	0.31	0.41	0.38	0.44	0.40	0.19	0.29
T96	0.21	0.28	0.31	0.16	0.16	0.29	0.38	0.50	0.58	0.61	0.52	0.29	0.44
T97	0.12	0.14	0.35	0.20	0.20	0.24	0.22	0.35	0.49	0.37	0.34	0.25	0.33
T98	0.09	0.06	0.20	0.11	0.14	0.25	0.17	0.36	0.48	0.32	0.15	0.19	0.29
T99	0.25	0.14	0.16	0.26	0.14	0.15	0.26	0.36	0.56	0.53	0.32	0.24	0.37
T100	0.06	0.27	0.37	0.21	0.21	0.33	0.14	0.26	0.04	0.24	0.36	0.23	0.20
T101	0.26	0.16	0.26	0.22	0.21	0.36	0.07	0.09	0.39	0.19	0.22	0.24	0.23
T102	0.17	0.06	0.22	0.10	0.15	0.26	0.06	0.18	0.14	0.12	0.38	0.15	0.16
T103	0.40	0.31	0.44	0.23	0.25	0.48	0.10	0.25	0.37	0.22	0.44	0.33	0.29
T104	0.24	0.43	0.40	0.47	0.19	0.12	0.23	0.40	0.26	0.31	0.28	0.34	0.28
T105	0.26	0.52	0.31	0.09	0.29	0.12	0.03	0.06	0.02	0.03	0.10	0.21	0.08
Average LVR	**0.20**	**0.25**	**0.30**	**0.26**	**0.15**	**0.24**	**0.20**	**0.25**	**0.28**	**0.29**	**0.23**	**0.24**	**0.24**

Detailed Wind Velocity Ratio under different Wind Directions

Test Point	Proposed Scheme												
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
P01	0.03	0.06	0.50	0.37	0.24	0.45	0.36	0.40	0.41	0.45	0.28	0.32	0.38
P02	0.04	0.09	0.55	0.27	0.14	0.29	0.40	0.46	0.46	0.40	0.22	0.29	0.36
P03	0.19	0.36	0.48	0.20	0.12	0.23	0.34	0.40	0.38	0.27	0.17	0.29	0.29
P04	0.20	0.20	0.21	0.17	0.08	0.20	0.27	0.33	0.29	0.18	0.10	0.20	0.22
P05	0.12	0.23	0.27	0.22	0.18	0.32	0.23	0.31	0.27	0.17	0.01	0.24	0.23
P06	0.11	0.32	0.30	0.29	0.29	0.43	0.30	0.41	0.36	0.22	0.07	0.31	0.31
P07	0.14	0.35	0.31	0.37	0.29	0.46	0.34	0.46	0.41	0.20	0.08	0.35	0.34
P08	0.20	0.33	0.32	0.43	0.23	0.43	0.35	0.46	0.42	0.18	0.07	0.36	0.33
P09	0.17	0.34	0.34	0.48	0.20	0.43	0.35	0.46	0.42	0.16	0.06	0.37	0.33
P10	0.17	0.32	0.37	0.50	0.16	0.39	0.36	0.47	0.43	0.14	0.04	0.36	0.32
P11	0.12	0.28	0.39	0.49	0.14	0.30	0.37	0.47	0.44	0.11	0.03	0.34	0.31
P12	0.06	0.23	0.32	0.45	0.11	0.23	0.37	0.46	0.42	0.04	0.03	0.30	0.28
P13	0.08	0.04	0.14	0.05	0.22	0.37	0.19	0.12	0.25	0.16	0.12	0.15	0.19
P14	0.05	0.21	0.22	0.26	0.41	0.58	0.02	0.05	0.09	0.34	0.19	0.25	0.22
P15	0.01	0.24	0.51	0.43	0.39	0.60	0.03	0.02	0.18	0.24	0.18	0.34	0.24
P16	0.09	0.20	0.34	0.30	0.23	0.36	0.05	0.02	0.18	0.18	0.14	0.24	0.17
P17	0.13	0.20	0.22	0.23	0.15	0.28	0.05	0.02	0.12	0.34	0.08	0.18	0.16
P18	0.15	0.15	0.11	0.03	0.05	0.12	0.04	0.02	0.08	0.30	0.13	0.08	0.10
P19	0.14	0.12	0.24	0.03	0.07	0.05	0.03	0.03	0.06	0.24	0.11	0.09	0.08
P20	0.14	0.08	0.41	0.21	0.24	0.26	0.06	0.06	0.11	0.11	0.07	0.20	0.13
P21	0.12	0.12	0.49	0.30	0.33	0.43	0.23	0.26	0.37	0.36	0.16	0.31	0.32
P22	0.13	0.20	0.47	0.30	0.36	0.45	0.31	0.34	0.40	0.39	0.22	0.34	0.36
P23	0.18	0.28	0.45	0.31	0.38	0.45	0.29	0.34	0.40	0.37	0.23	0.35	0.36
P24	0.20	0.31	0.49	0.33	0.36	0.46	0.29	0.34	0.40	0.40	0.24	0.37	0.36
P25	0.26	0.35	0.42	0.28	0.33	0.40	0.11	0.28	0.34	0.35	0.21	0.33	0.30
P26	0.28	0.36	0.32	0.22	0.27	0.34	0.15	0.09	0.08	0.10	0.14	0.25	0.16
P27	0.24	0.30	0.27	0.17	0.23	0.30	0.05	0.05	0.15	0.03	0.03	0.22	0.12
P28	0.27	0.48	0.05	0.08	0.07	0.10	0.28	0.34	0.44	0.47	0.37	0.20	0.30
P29	0.36	0.51	0.19	0.10	0.05	0.10	0.08	0.12	0.08	0.07	0.11	0.18	0.09
P30	0.29	0.30	0.17	0.25	0.27	0.41	0.29	0.29	0.28	0.33	0.25	0.27	0.30
Average SVR	**0.16**	**0.25**	**0.33**	**0.27**	**0.22**	**0.34**	**0.22**	**0.26**	**0.29**	**0.24**	**0.14**	**0.27**	**0.26**
T01							NA						
T02							NA						
T03	0.22	0.39	0.05	0.30	0.28	0.24	0.14	0.18	0.08	0.15	0.26	0.23	0.18
T04	0.36	0.56	0.54	0.47	0.25	0.19	0.17	0.35	0.44	0.49	0.41	0.42	0.36
T05							NA						
T06							NA						
T07							NA						
T08							NA						
T09							NA						
T10							NA						
T11							NA						
T12							NA						
T13							NA						
T14	0.17	0.26	0.12	0.26	0.14	0.20	0.18	0.23	0.27	0.30	0.18	0.21	0.23
T15	0.34	0.50	0.49	0.42	0.22	0.20	0.14	0.28	0.34	0.41	0.33	0.37	0.30
T16	0.39	0.36	0.53	0.37	0.28	0.11	0.24	0.57	0.77	0.77	0.62	0.42	0.52
T17	0.25	0.40	0.24	0.17	0.04	0.11	0.14	0.32	0.42	0.43	0.26	0.23	0.27
T18							NA						
T19							NA						
T20							NA						
T21							NA						
T22							NA						
T23							NA						
T24							NA						
T25	0.37	0.22	0.32	0.16	0.15	0.16	0.21	0.50	0.59	0.61	0.51	0.28	0.41
T26	0.34	0.24	0.18	0.05	0.05	0.24	0.03	0.13	0.05	0.10	0.08	0.14	0.09
T27	0.53	0.52	0.50	0.32	0.21	0.10	0.04	0.14	0.14	0.33	0.39	0.32	0.20
T28	0.40	0.40	0.49	0.44	0.26	0.23	0.36	0.45	0.62	0.61	0.58	0.41	0.47
T29	0.15	0.12	0.08	0.40	0.29	0.40	0.47	0.56	0.68	0.70	0.58	0.32	0.54
T30	0.12	0.16	0.07	0.29	0.25	0.36	0.46	0.52	0.61	0.66	0.51	0.28	0.49
T31	0.10	0.04	0.13	0.31	0.24	0.34	0.37	0.39	0.53	0.58	0.40	0.25	0.42
T32							NA						
T33							NA						
T34							NA						
T35							NA						
T36							NA						
T37	0.20	0.17	0.22	0.16	0.11	0.28	0.01	0.17	0.41	0.27	0.18	0.20	0.23
T38	0.21	0.32	0.21	0.09	0.06	0.26	0.02	0.12	0.08	0.09	0.04	0.16	0.09
T39	0.20	0.27	0.17	0.19	0.11	0.30	0.40	0.40	0.50	0.54	0.44	0.25	0.39
T40	0.20	0.16	0.14	0.08	0.11	0.24	0.08	0.07	0.12	0.10	0.09	0.13	0.11
T41	0.12	0.15	0.12	0.04	0.14	0.28	0.11	0.28	0.29	0.19	0.13	0.16	0.20
T42	0.12	0.13	0.14	0.11	0.07	0.15	0.06	0.13	0.11	0.14	0.14	0.12	0.12
T43							NA						
T44	0.17	0.24	0.16	0.07	0.04	0.11	0.05	0.05	0.04	0.07	0.07	0.11	0.06
T45	0.18	0.21	0.17	0.14	0.12	0.16	0.05	0.24	0.29	0.26	0.20	0.18	0.20
T46							NA						
T47							NA						
T48	0.24	0.29	0.20	0.12	0.07	0.23	0.07	0.20	0.11	0.11	0.25	0.17	0.14
T49	0.15	0.13	0.13	0.15	0.04	0.16	0.14	0.26	0.08	0.05	0.09	0.13	0.12
T50	0.21	0.12	0.06	0.09	0.19	0.20	0.03	0.03	0.05	0.06	0.05	0.11	0.08
T51							NA						
T52							NA						
T53							NA						
T54							NA						
T55							NA						
T56							NA						
T57	0.06	0.07	0.10	0.09	0.08	0.26	0.05	0.25	0.08	0.19	0.10	0.11	0.14
T58	0.05	0.07	0.05	0.02	0.05	0.18	0.01	0.14	0.05	0.13	0.06	0.07	0.08
T59	0.15	0.04	0.11	0.05	0.05	0.30	0.18	0.26	0.22	0.17	0.07	0.12	0.18
T60	0.08	0.05	0.12	0.06	0.03	0.12	0.21	0.28	0.31	0.29	0.06	0.12	0.20
T61	0.10	0.13	0.34	0.20	0.31	0.30	0.12	0.15	0.23	0.28	0.07	0.23	0.22
T62	0.09	0.12	0.24	0.10	0.10	0.18	0.10	0.12	0.33	0.20	0.08	0.16	0.18
T63	0.05	0.18	0.37	0.30	0.23	0.39	0.10	0.12	0.33	0.20	0.19	0.26	0.24
T64	0.15	0.44	0.54	0.39	0.25	0.41	0.04	0.12	0.26	0.20	0.17	0.35	0.23
T65							NA						
T66							NA						
T67							NA						
T68	0.09	0.11	0.53	0.48	0.28	0.28	0.10	0.17	0.12	0.13	0.03	0.30	0.19
T69	0.25	0.22	0.24	0.18	0.22	0.19	0.04	0.15	0.16	0.04	0.07	0.20	0.13
T70	0.13	0.18	0.18	0.11	0.17	0.13	0.07	0.08	0.05	0.13	0.10	0.13	0.10

T71	0.15	0.04	0.08	0.02	0.16	0.06	0.05	0.01	0.04	0.03	0.04	0.07	0.05
T72	0.09	0.07	0.45	0.29	0.21	0.04	0.28	0.15	0.30	0.22	0.20	0.23	0.22
T73	0.14	0.15	0.41	0.15	0.31	0.38	0.30	0.22	0.32	0.19	0.16	0.26	0.26
T74	0.11	0.17	0.44	0.32	0.24	0.51	0.26	0.30	0.23	0.11	0.27	0.30	0.26
T75	0.02	0.17	0.07	0.05	0.09	0.33	0.06	0.28	0.15	0.17	0.17	0.13	0.17
T76	0.14	0.23	0.54	0.28	0.05	0.07	0.23	0.33	0.32	0.21	0.18	0.26	0.22
T77	0.36	0.31	0.06	0.25	0.20	0.20	0.10	0.20	0.13	0.31	0.22	0.21	0.20
T78	0.23	0.32	0.02	0.28	0.11	0.31	0.19	0.30	0.23	0.03	0.05	0.22	0.19
T79	0.24	0.06	0.14	0.29	0.25	0.39	0.27	0.34	0.26	0.09	0.11	0.24	0.25
T80	0.13	0.18	0.09	0.19	0.09	0.09	0.37	0.38	0.30	0.16	0.11	0.17	0.23
T81	0.18	0.19	0.41	0.16	0.18	0.33	0.35	0.31	0.23	0.04	0.08	0.24	0.21
T82	0.22	0.33	0.36	0.26	0.14	0.35	0.26	0.27	0.24	0.12	0.09	0.27	0.22
T83	0.36	0.42	0.43	0.40	0.22	0.38	0.20	0.25	0.34	0.41	0.36	0.36	0.32
T84	0.33	0.50	0.42	0.22	0.10	0.09	0.17	0.18	0.18	0.20	0.23	0.26	0.17
T85	0.39	0.54	0.53	0.39	0.12	0.14	0.36	0.36	0.43	0.51	0.50	0.37	0.37
T86	0.32	0.37	0.52	0.45	0.22	0.22	0.36	0.34	0.43	0.52	0.41	0.38	0.38
T87	0.26	0.43	0.48	0.49	0.22	0.31	0.34	0.29	0.34	0.47	0.38	0.37	0.35
T88	0.23	0.19	0.05	0.12	0.06	0.10	0.03	0.06	0.09	0.07	0.13	0.11	0.08
T89	0.09	0.08	0.12	0.07	0.14	0.17	0.09	0.13	0.26	0.16	0.23	0.12	0.17
T90	0.28	0.15	0.06	0.13	0.16	0.15	0.19	0.07	0.21	0.38	0.31	0.14	0.21
T91	0.17	0.09	0.13	0.16	0.08	0.13	0.11	0.09	0.09	0.24	0.30	0.12	0.14
T92	0.10	0.12	0.22	0.17	0.07	0.09	0.19	0.16	0.14	0.33	0.26	0.14	0.18
T93	0.27	0.27	0.24	0.24	0.16	0.11	0.22	0.27	0.49	0.48	0.40	0.25	0.33
T94	0.16	0.15	0.05	0.28	0.19	0.22	0.25	0.36	0.33	0.37	0.33	0.21	0.30
T95	0.27	0.24	0.21	0.06	0.06	0.10	0.33	0.41	0.36	0.43	0.45	0.19	0.30
T96	0.24	0.21	0.25	0.15	0.19	0.45	0.38	0.48	0.55	0.61	0.53	0.28	0.45
T97	0.09	0.16	0.32	0.22	0.19	0.27	0.19	0.31	0.42	0.23	0.36	0.25	0.29
T98	0.04	0.04	0.20	0.15	0.14	0.29	0.15	0.33	0.42	0.02	0.23	0.19	0.23
T99	0.23	0.08	0.11	0.14	0.15	0.16	0.25	0.36	0.55	0.43	0.35	0.20	0.34
T100	0.22	0.24	0.31	0.15	0.26	0.29	0.15	0.26	0.04	0.26	0.36	0.22	0.20
T101	0.29	0.16	0.21	0.29	0.21	0.34	0.08	0.18	0.46	0.19	0.26	0.26	0.27
T102	0.17	0.08	0.22	0.13	0.08	0.22	0.07	0.16	0.25	0.16	0.39	0.16	0.18
T103	0.43	0.36	0.40	0.24	0.21	0.39	0.11	0.24	0.39	0.30	0.46	0.32	0.30
T104	0.20	0.36	0.53	0.47	0.18	0.13	0.27	0.43	0.36	0.32	0.27	0.36	0.32
T105	0.27	0.42	0.36	0.14	0.17	0.19	0.01	0.03	0.08	0.03	0.11	0.21	0.09
Average LVR	**0.19**	**0.23**	**0.28**	**0.23**	**0.18**	**0.26**	**0.19**	**0.25**	**0.28**	**0.26**	**0.21**	**0.24**	**0.24**