Air Ventilation Assessment
in support of the S12A planning application
for Proposed Youth Hostel
at 122A to 130 Hollywood Road, Sheung Wan

Prepared by:
Ramboll Environ Hong Kong Limited

Date:
May 2016

Reference Number:
R4955_V1.2b

RAMBOLL ENVIRON

Prepared by:

Calvin Chiu
Senior Manager

Approved by:

David Yeung
Managing Director

Ramboll Environ Hong Kong Limited
Room 2403, 24/F., Jubilee Centre
18 Fenwick Street, Wan Chai, Hong Kong
Tel: (852) 3465 2888
Fax: (852) 3465 2899
Email: hkinfo@environcorp.com

Contents

Figures

Appendices

1. Introduction

1.1 Background and Objectives

1.1.1 The Subject Site is located at No. 122A to 130 Hollywood Road, Sheung Wan. The applicant has proposed to re-develop the existing 6-storeys primary school into a 21-storeys youth hostel (including G/F, two storeys of M/F and 18 storeys of upper floor).

1.1.2 The Subject Site is currently zoned GIC and occupied by a primary school development and a temple (Man Mo Temple). According to the latest Sai Ying Pun and Sheung Wan outline zoning plan (OZP No. S/H3/29), it is permitted to develop a building of up to 8 storeys.

1.1.3 Ramboll Environ Hong Kong Ltd. (the Consultant) has been commissioned by the Applicant to conduct this Air Ventilation Assessment (AVA) in order to demonstrate that the Proposed Development will result in no worsened air ventilation performance generally when compared with the permitted use.

1.1.4 Architectural drawings of the proposed development including the Baseline Scheme (i.e. the permitted use) and Proposed Scheme (youth hostel) were provided by the project architect.

1.1.5 In this report, the air ventilation assessment (expert evaluation) for Sai Ying Pun & Sheung Wan Area (hereafter referred as EE-SYP&SW) prepared by Chinese University of Hong Kong in May 2010 and commissioned by Planning Department has been referenced in the discussion where appropriate.

1.2 Site Environs

1.2.1 The Subject Site is of rectangular shape (around 31m x 14m). The longer aspect of the site is facing east/west. It is bounded by Hollywood Road to the north (at about 25mPD immediate to the site), residential sites with building height restriction of 120mPD and 140mPD respectively to the east and south. The existing Man Mo Temple occupies western part of the Subject Site and will be retained. The surrounding area is sloping upward to the south with high gradient. Bridges Street to the further south is elevated at about 44mPD. Ping On Lane is a narrow alley between the existing school of the Subject Site and the neighbouring building to the east. A children's playground is situated on the opposite side of Hollywood Road. Ladder Street is to the west of Man Mo Temple. The Subject Site is situated in inland area with separation of about 500m from the Victoria Harbour waterfront to the north.

1.2.2 Some of the sites to the surrounding have already been developed with high-rise buildings including Tung Shing Terrace at Bridges Street, Como Como, Izi, CentreStage and Hollywood Terrace at Hollywood Road. Most low-rise buildings (4 to 6 storeys) can be found on the western side of the Subject Site along Hollywood Road, Square Street, etc.

1.2.3 **Figure 1** shows the location of the Subject Site and its surroundings.

1.3 Baseline Scheme

1.3.1 **Appendix A** shows the Baseline Scheme which is developed based on the permitted use under the current OZP. It consists of one tower of 8 storeys including G/F. The main roof is elevated at about 59mPD (building height is around 32.5m). Under the current OZP, the Subject Site is zoned "G/IC". As the area of the Subject Site is limited, it is reasonable to maximise the building coverage. Therefore, the Baseline Scheme would have the building occupied the entire site, analogous to many typical government office buildings.

1.4 Proposed Scheme

1.4.1 **Appendix B** shows the Proposed Scheme.

1.4.2 The Proposed Scheme consists of 1 single tower as the Baseline Scheme comprising 21 storeys including G/F, two storeys of M/F and 18 storeys of upper floor. At G/F, a Heritage Bazaar is incorporated in the permeable design (with maximum floor-to-floor height of 11m except for space with upper part occupied by E&M room) which is a covered open space area. A building setback of about 6m from the northern boundary is also incorporated at G/F. For 1/F and above, the building structure maintains about 3m setback from the northern boundary. The main roof of the building is elevated at about 96 mPD. The building height is around 70m.

2. Site Wind Availability

2.1 Site Wind Availability Data

2.1.1 The nearest Hong Kong Observatory Weather Station is in Central which is over 750m from the Subject Site. The surrounding topographical condition of this station and the Subject Site is significantly different. The weather data monitored at Central station may not be appropriate to represent wind availability of the Subject Site. **Figure 1** shows the location of the Central HKO Weather Station on plan.

2.1.2 In the EE-SYP&SW, simulated site wind availability data for Sai Ying Pun & Sheung Wan area at 4 locations were presented. Among these locations, location C is nearest to the Subject Site. According to EE-SYP&SW, annual prevailing wind is NE and E wind whereas summer prevailing wind is E and SW wind. **Figure 2a** indicates the dominance of each of the 16 wind directions and distribution of wind speed.

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

2.1.4 This evaluation is supposingly not a detailed study of the air ventilation performance. It is therefore considered acceptable to use the simulated RAMS data for Site Wind Availability initially as a starting point. The use of RAMS data is preferred over measurement data at Waglan Island as it can reflect the effect of topography to wind availability. It also provide more details such as the wind profile.

2.1.5 **Figure 2b** shows the grid number that corresponds to the location of the Subject Site and is directly extracted from the Planning Department website for site wind availability data (i.e. X: 075, Y: 034), and relevant windrose diagram at Grid X: 075, Y: 034 representing the frequency and wind speed distribution at infinity height of the district concerned for both annual and summer condition.

2.1.6 **Table 1** shows the summary of the simulated site wind availability data including probability of occurrence and average wind speed. In this quantitative air ventilation assessment, Computational Fluid Dynamics (CFD) tool will be employed. 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 assessment purpose. 11 wind directions were selected with overall frequency of occurrence equivalent to 91.0% and 86.0% respectively of the time in a year for both annual and summer condition.

Table 1 Summary of Simulated Site Wind Availability Data (V∞) and Wind Direction for the Application Area at 500m

	Percentage Occurrence (%)		
Wind Angle	**Annual**	**Summer**	**Designated Wind Profile Curve**
0	2.0%	1.1%	3
22.5	**5.0%***	**1.3%***	0
45	**8.5%***	**1.6%***	**0***
67.5	**14.5%***	**3.1%***	**0***
90	**22.3%***	**9.5%***	**0***
112.5	**10.0%***	**9.2%***	**1***
135	**6.5%***	**8.8%***	**1***
157.5	**4.2%***	**7.6%***	**1***
180	**4.2%***	**9.1%***	**1***
202.5	**5.7%***	**12.7%***	**2***
225	**5.9%***	**13.2%***	**2***
247.5	**4.2%***	**9.9%***	**2***
270	2.7%	5.5%	2
292.5	1.5%	3.0%	3
315	1.4%	2.5%	3
337.5	1.3%	1.7%	3
TOTAL Selected*	**91.0%**	**86.0%**	

* Selected wind direction and wind profile curve for quantitative AVA study

3. Topography and Building Landscape

3.1 Topography

3.1.1 **Figure 3** shows the surrounding area, the topography and building landscape. As discussed, the Subject Site is located at the district sloping upward to the south. The ground level of the district where the Subject Site resides is sloping upward from north to south. The surrounding area (measured about 2H from the Subject Site) covers areas to the north with lower elevation as well as area to the south which is elevated higher. The elevation ranges from about 3 to 4mPD along Jervois Street to about 75mPD at Caine Road. The Victoria Peak is separated by more than 1km to the southwest.

3.2 Building Landscape

3.2.1 Major roads in the surrounding include Hollywood Road, Bridges Road, Queen's Road Central, Jervois Street, Ladder Street, Wing Lee Street, Caine Road, Shing Wong Street, Staunton Street, Square Street, Upper Lascar Row, Lok Ku Toad, Ping On Lane, etc. Among these roads, Queen's Road Central, Hollywood Road, Caine Road, Bridges Road, Jervois Street and Lok Ku Road have road width (measured from building to building) of 10m to 15m. Ping On Lane is as narrow at about 2m only.

3.2.2 Buildings in the surrounding are generally compacted together with little or no gap in-between (especially those ageing building). There are some small-scale playgrounds and sitting out areas (see **Figure 3**) scattered including children's playground along Hollywood Road, Wing Lee Street Rest Garden, Kwong Hon Terrace Garden.

3.2.3 There are several high-rise developments in the immediate vicinity of the Subject Site such as Tung Shing Terrace to the south (maximum building height of ~138mpD), Ovolo to the north (maximum building height of ~97mpD), Izi Central to the northeast (maximum building height of ~110mpD), Hollywood Terrace to the northeast (maximum building height of ~134mpD), Como Como to the east (maximum building height of ~96mpD), CentreStage to the further east (maximum building height of ~162mpD) and Grandview Garden to the southeast (maximum building height of ~125mpD).

3.2.4 Most of the low-rise buildings (maximum building height between ~30 to ~50 mpD) can be found on the western side of the Subject Site along Hollywood Road, Square Street, etc.

4. Expert Evaluation

4.1 Introduction

4.1.1 The air ventilation performance of the Baseline and Proposed Scheme has been qualitatively evaluated in this study.

4.2 Wind Environment of the District, Major Feature and Problem Area

4.2.1 As discussed, wind from east and E and NE direction is prevailing annually whereas E and SW wind is dominant in summer as shown in **Figure 2 (a & b)**.

4.2.2 It is considered that the hill side to the south will reduce wind availability from southerly wind direction. Yet, southwesterly wind is still considered important in summer.

4.2.3 As mentioned in EE-SYP&SW, the district where the Subject Site resides is of high building coverage. Building clusters are generally impermeable.

4.2.4 For area in the vicinity of the Subject Site, there exists a playground at the junction of Hollywood Road and Ladder Street which is expected to provide function for wind distribution

4.2.5 The building coverage of the immediate Man Mo Temple onsite is low so that altogether it forms a rather large piece of open area and will benefit wind flow along Hollywood Road, Square Street and Ladder Street.

4.3 Good Design Direction for Site Level

4.3.1 According to the guidelines in Chapter 11 of HKPSG, the key principles to consider in order to improve air ventilation performance in site level include podium structure, building disposition, building permeability, building form, landscaping, projecting obstruction and cool materials.

4.3.2 *Podium Structure*. Compact integrated developments and podium structures with full or large ground coverage on extensive sites typically found in Hong Kong are particularly impeding air movement. The principle to improve air ventilation is to reduce coverage, provide setback, designate open area and improve building permeability.

4.3.3 *Building Disposition*. Adequate wide gaps should be provided between buildings. The axis of buildings should be in parallel to prevailing wind direction where possible. Staggering building to allow blocks behind to receive wind through gap and erecting towers abut the podium edge facing pedestrian area to enable most of the downwash are also preferred in general.

4.3.4 *Building Permeability*. The focus is to create building gap and highly permeable podium garden.

4.3.5 *Building Form*. Building form to amplify wind around it is preferable.

4.3.6 *Landscaping, Projecting Obstruction and Cool Materials.* Landscaping & use of cool materials would be encouraged whereas projecting obstruction would be avoided.

4.3.7 In addition, it is important to identify and preserve all important air corridors.

4.4 Evaluation of Merit/Demerit of Design Features of the Baseline Scheme and Proposed Scheme

Podium Structure

4.4.1 Both Baseline and Proposed schemes do not adopt any podium structure. However, the building structure will cover the entire site at the pedestrian level under the Baseline Scheme. On the other hand, the Proposed Scheme would provide building setback of about 6m from northern boundary and covered open area at G/F. Therefore, while both schemes do not involve any podium structure, the Proposed Scheme should outperform the Baseline Scheme when considering the lower portion of the design.

Building Height

4.4.2 The Proposed Scheme is up to about 96mPD whereas the Baseline Scheme is up to 59mPD only. The Proposed Scheme will result in more wind blockage at higher elevation.

Building Disposition and Building Form

4.4.3 As discussed, the Subject Site is limited in area so that there is not much choice for disposition of building. However, the design of the Proposed Scheme is such that about 3m setback from northern boundary is provided. It will help to facilitate more wind flow along Hollywood Road to the north. Therefore, the Proposed Scheme is considered better in terms of building form.

Building Permeability

4.4.4 The Baseline Scheme is a conventional design which is impermeable. The Proposed Scheme however adopts a design with the building coverage at G/F minimised. A covered open space is provided at G/F to facilitate wind penetration. The building permeability of the Proposed Scheme at G/F is considered better,

Landscaping, Projecting Obstruction and Cool Materials

4.4.5 Greening and use of cool materials can help to reduce heat island effect. With building setback and open space (including covered area) created, the Proposed Scheme would offer better opportunity to provide greenery.

4.5 Summary of Appraisal

4.5.1 The Baseline Scheme has lower building height when compared with the Proposed Scheme so that it would avoid wind blockage at higher elevation. On the other hand, the lower portion building design of the Proposed Scheme in terms of 6m setback from northern boundary and permeable design with least building structure would improve building permeability at G/F and facilitate wind flow along Hollywood Road to the north. The building of the Proposed Scheme maintains 3m setback from northern boundary which would facilitate wind flow along Hollywood Road at even higher elevation.

4.5.2 Both schemes have their merit and demerit. The improvement of building design at lower portion under the Proposed Scheme would likely result in better air ventilation performance near to the perimeter of the Subject Site. The lower building height of the Baseline Scheme may result in less building blockage at higher elevation and better air ventilation performance at locations further apart.

5. Quantitative Assessment Methodology

5.1 Atmospheric Conditions

5.1.1 Simulated wind profile curves are extracted from the Planning Department's website using RAMS site wind availability data and directly adopted for this quantitative AVA. **Figure 4** shows the wind profile curves for Grid X: 075, Y: 034.

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

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

5.1.4 The Log Law wind profile curves 0, 1 and 2 between 0m to 10m are shown in **Figure 5.**

5.1.5 From the Log Law curves, the wind profile of 0m to 10m is interpolated and then combined with the wind profile curves on RAMS site wind availability data. The wind profile assumption with respect to the selected wind directions for Initial Study is shown in **Figure 6**.

5.2 CFD Code and Major Parameters

5.2.1 A quantitative assessment based on requirement for Initial Study stipulated in the technical guide was conducted for the purpose to verify the air ventilation performance for the Proposed Scheme over the Baseline Scheme.

5.2.2 The quantitative assessment was conducted using a commercial CFD code, PHOENICS. PHOENICS employs structured grid with fine-grid embedding to fit small-scale flow features without the computational overhead of fully-unstructured grids. Turbulence models include various versions of K-epsilon model (such as RNG & Low Reynolds Number Model), LVEL, Kolmogorov-Wilcox two- equation k-f model and other models such as RSM and Sub-Grid-Scale LES model.

5.2.3 Modified version of K-epsilon turbulence models which give better prediction of separation and vortexes are adopted for air ventilation assessment. In this study, the Chen-Kim modified KE-EP turbulence model has been employed. The Chen-Kim model is a variant of K-ε based on comparison with experimental data. This model involves a modification which improves the dynamic response of the EP equation by introducing an additional time scale (KE/PK), where PK is the volumetric production rate of KE. The model maintains good agreement with experimental data on classical turbulent shear layers. Moreover, this is based on the KE-EP model which is appropriate for high-reynolds number problem such as external flow. These models are statistical turbulence models and are generally regarded as practical to model steady state condition. It uses different constants, and has an addition term in the ε equation. The effect of the changes is to reduce the turbulent viscosity in regions of high shear - e.g. in recirculation zones. Hence, it predicts a longer recirculation zone, in agreement with experimental evidence. The Chen-Kim model gives better prediction of separation and vortexes. It does not only keep the merits or Renormalization Group (RNG) model but also have nice results happening to jet stream fluid and feather fluid. The equation and parameters adopted in Chen-Kim turbulence model is shown below for reference:

Equation	Φ	Γ_Φ	S_Φ
Turbulent Kinetic Energy	k	ν_t/σ_k	$\rho(G-\varepsilon)$
Dissipation Rate	ε	ν_t/σ_ε	$\rho(\varepsilon/k)(C_{\varepsilon1}G - C_{\varepsilon2}\varepsilon) + \rho\, C_{\varepsilon3}G^2/k$

$$G = \nu_t\,(\partial_k U_i + \partial_i U_k)\,\partial_k U_i$$

$$\nu_t = C_\mu\, k^2 / \varepsilon$$

$\sigma_k = 0.75$, $\sigma_\varepsilon = 1.15$, $C_{\varepsilon1} = 1.15$, $C_{\varepsilon2} = 1.9$, $C_{\varepsilon3} = 0.25$, $C_\mu = 0.09$

5.2.4 It is understood that LES/DES generally requires careful application by the user, because compared to statistical turbulence modeling, the approach requires more accurate spatial resolution on finer meshes and small time steps, and as a consequence significant amounts of computer time. Typically, the time step should be in the range 1/200 to 1/50 of the large-eddy turnover time. Otherwise, there will be inadequate time resolution. Also, there is always the possibility of numerical damping of the fluctuations. LES and DES have the potential to produce more accurate solutions than statistical turbulence models, but misuse of these methods is fairly common due to inadequate temporal and spatial resolution. Considering the practicability issue, statistical turbulence model is considered a viable choice which can achieve generally acceptable level of accuracy.

5.2.5 The assessment area is determined by the height (H) of the tallest building on site (i.e. namely Arezzo with a building height of approximately 155m). Therefore, the assessment area shall be at least 1H (with H=160m) from the project site boundary.

5.2.6 The domain covers the model area of over 320m. The surrounding area is determined by 2 times the height of the highest building within the model area therefore is equivalent to at least 2H of the highest building (i.e. >2H where H=160m) from the project site boundary. It is confirmed that all major noise barriers, elevated structures, and planned / committed / existing developments in the model area have been modelled in the simulation

5.2.7 **Figure 3** shows the assessment area and surrounding area for the model simulation.

5.2.8 The domain dimension is about 2170m x 2150m and with an elevation of 1000m. Approximately 15,000,000 grid cells will be defined to simulate the air flow. Cartesian coordinate cell grid system is adopted with refinement within an area which is within about 1H from the Subject Site (and with denser grid near ground level). The grid size is generally smaller within the assessment area (<1m) and coarse outside and within the surrounding area. Grid expansion ratio is not more than 1.1. The grid size is larger near the domain boundary on 4 sides and ceilings are >30m. It is defined in such a way that there will be at least 3 cells within major building gaps. For major streets/roads containing the test point, generally 5 to 7 cells would be defined between walls/objects. The test point will be assigned in such a way that there will be at least 2 to 3 cells from the building façade or major obstacle. Within the level of 0 to 2m aboveground, there will be at least 3 cells defined (i.e. 3 cell layers along ground surface) so that the result taken would be taken at the 3rd or 4th cell, instead of the cell adjacent to ground. Similarly, all test points would not be taken at the cell adjacent to wall/object.

5.2.9 Lateral clearance is over 700m on each side. The vertical distance between the proposed development and the ceiling of the CFD domain amounts to more than 800m. The distance between the proposed development and the inflow/outflow amounts to more than 700m. It means that the domain boundary will be at least 5H away from the model as recommended in COST Action C14 (2004). The percentage blockage is less than 3%.

5.2.10 The commonly used hybrid-differencing scheme in PHOENICS is adopted. This scheme employs the 1st-order upwind-differencing scheme (UDS) in high-convection regions; and the 2nd-order central-differencing scheme (CDS) in low-convection regions automatically. It strikes a balance between accuracy and computing efficiency with the low-convection region (which is usually more difficult to predict) using higher order scheme.

5.2.11 The convergence factor is 0.1% (i.e. all simulation result reached the convergence level of 0.1% or lower). Some test spot values (with test point defined and scattered in assessment area, upwind, downwind and aside the development within the assessment area) are also checked to ensure that steady solution is arrived.

5.2.12 **Appendix C** shows the domain size and dimensions.

5.3 Test Point Location

5.3.1 A total of 154 test points are selected including 32 numbers of perimeter test point defined along the boundary of the Subject Site and 117 numbers of overall test point within the assessment area. The overall test point generally represents important pedestrian areas such as sitting out area and pedestrian walkway. All these test points are located at 2m above ground level. 5 special test points are defined among the Heirtage Bazaar onsite. **Figure 7** shows the tests points selected for quantitative air ventilation assessment.

6. Quantitative Assessment Result

6.1 Spatial Average Wind Velocity Ratio

6.1.1 The wind velocity ratio (VR) 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.

6.1.2 **Table 2** showed the site spatial average velocity ratio (SVR), local spatial average velocity ratio (LVR) and average VR of other focused areas.

6.1.3 The wind velocity ratios of individual test points are shown in **Figure 8** to **Figure 9** respectively for the Baseline Scheme and the Proposed Scheme for annual situation.

6.1.4 The wind velocity ratios of individual test points are shown in **Figure 10** to **Figure 11** respectively for the Baseline Scheme and the Proposed Scheme for summer situation.

6.1.5 **Appendix C** shows VR color plot at pedestrian level. **Appendix D** shows detailed VR result for tested wind directions.

Table 2 Summary of Spatial Average Wind Velocity Ratios (VR)

Spatial Average Wind Velocity Ratio (VR)	Baseline Scheme	Proposed Scheme
Annual Wind Situation		
SVR (P01-P32)	0.08	0.08
LVR (P01-P32,T01-T106)	0.07	0.07
Lok Ku Road (T01,T02,T07,T17,T24)	0.06	0.06
Queen's Road Central (T03,T08,T18,T25-T28, T34)	0.06	0.06
Jervois Street (T04, T05, T10,T11,T12, T19)	0.06	0.06
Cleverly Street (T04,T05,T09,T18)	0.06	0.06
Hillier Street (T12,T19,T20,T51,T114)	0.06	0.06
Ladder Street (T26,T33,T41,T56,T72,T83,T95,P1-P7)	0.07	0.06
Upper Lascar Row (T06, T16, T23, T32)	0.04	0.04
Children's Playground along Hollywood Road (T57-T58, T116)	0.06	0.07
Circular Pathway (T50-T51, T115)	0.06	0.06
Tung Street (T01,T02,T14, T15, T21,T29, T38, T43,T44)	0.04	0.04
Tai Ping Shan Street (T42,T44,T45,T54)	0.07	0.07
Square Street (T47,T54-T55,T109,T110)	0.05	0.05
Tank Lane (T46,T47,T70,T80,T107,T108)	0.05	0.06
Bridges Street (T71-T76)	0.07	0.07
Shing Wong Street (T35,T52,T76-T78,T88,T98,T105)	0.08	0.08
Staunton Street (T88-T90)	0.06	0.06
Chung Wo Lane (T90, T99,T117)	0.11	0.11
Caine Road (T100-T104, T106)	0.11	0.11
Wing Lee Street (T84-T87)	0.06	0.07
Sitting-out Area along Wing Lee Street (T84-T86, T96-T97)	0.07	0.07
HK Museum of Medical Sciences (T91-T94)	0.06	0.06

Kui In Fong (T54,T69,T79,T91)	0.07	0.07
Blake Garden (T53,T66-T68)	0.04	0.04
Hollywood Road (T13,T14, T21,T22,T30,T31,T39,T40,T48,T49,T56,T58,T59,T60-T65,P07-P15)	0.09	0.09
Gough Street (T35-T37)	0.11	0.11
Rozario Street (T81-T83)	0.05	0.05
Former Police Married Quarters (i.e. PMQ) (T65,T78,T111,T112)	0.06	0.06
Ping On Lane (P15-P21,T113)	**0.08**	**0.13**
Special Test Points within Subject Site (i.e. Heritage Bazaar) (S01-S05)	N/A	0.03
Summer Wind Situation		
SVR (P01-P32)	**0.06**	**0.07**
LVR (P01-P32,T01-T106)	0.06	0.06
Lok Ku Road (T01,T02,T07,T17,T24)	0.05	0.05
Queen's Road Central (T03,T08,T18,T25-T28, T34)	0.06	0.06
Jervois Street (T04, T05, T10,T11,T12, T19)	0.06	0.06
Cleverly Street (T04,T05,T09,T18)	0.06	0.06
Hillier Street (T12,T19,T20,T51,T114)	0.06	0.06
Ladder Street (T26,T33,T41,T56,T72,T83,T95,P1-P7)	0.06	0.06
Upper Lascar Row (T06, T16, T23, T32)	0.04	0.04
Children's Playground along Hollywood Road (T57-T58, T116)	**0.06**	**0.07**
Circular Pathway (T50-T51, T115)	0.04	0.04
Tung Street (T01,T02,T14, T15, T21,T29, T38, T43,T44)	0.04	0.04
Tai Ping Shan Street (T42,T44,T45,T54)	0.07	0.07
Square Street (T47,T54-T55,T109,T110)	0.05	0.05
Tank Lane (T46,T47,T70,T80,T107,T108)	**0.05**	**0.06**
Bridges Street (T71-T76)	0.06	0.06
Shing Wong Street (T35,T52,T76-T78,T88,T98,T105)	0.07	0.07
Staunton Street (T88-T90)	0.05	0.05
Chung Wo Lane (T90, T99,T117)	0.08	0.08
Caine Road (T100-T104, T106)	0.10	0.10
Wing Lee Street (T84-T87)	0.05	0.05
Sitting-out Area along Wing Lee Street (T84-T86, T96-T97)	0.05	0.05
HK Museum of Medical Sciences (T91-T94)	0.06	0.06
Kui In Fong (T54,T69,T79,T91)	0.06	0.06
Blake Garden (T53,T66-T68)	0.04	0.04
Hollywood Road (T13,T14, T21,T22,T30,T31,T39,T40,T48,T49,T56,T58,T59,T60-T65,P07-P15)	0.08	0.08
Gough Street (T35-T37)	0.09	0.09
Rozario Street (T81-T83)	0.04	0.04
Former Police Married Quarters (i.e. PMQ) (T65,T78,T111,T112)	0.06	0.06
Ping On Lane (P15-P21,T113)	**0.06**	**0.10**
Special Test Points within Subject Site (i.e. Heritage Bazaar) (S01-S05)	N/A	0.03

Note: bold value represents different VR

6.2 Discussion

6.2.1 According to the spatial average VR result for annual wind situation, it is noted that SVR and LVR of both schemes are the same. In addition, air ventilation performance of all focused areas is the same for both schemes except along Ladder Street, children's playground along Hollywood Road, Tank Lane, Wing Lee Street and Ping On Lane. For most of these focused areas except for Ladder Street, the air ventilation performance of the Proposed Scheme is better.

6.2.2 According to the spatial average VR result for summer wind situation, LVR of both schemes is the same and SVR of the Proposed Scheme is relatively higher. Air ventilation performance of all focused areas is the same for both schemes except at children's playground along Hollywood Road, Tank Lane and Ping On Lane. For all these focused areas, the air ventilation performance of the Proposed Scheme is better.

6.2.3 SVR and LVR are calculated based on a sufficient number of test points and are key indicators of the overall air ventilation performance. Based on the above, it can be concluded that the proposed scheme performs better for area immediate to the Subject Site under summer situation.

6.3 Directional Analysis

6.3.1 The surrounding area is densely covered with building structure. Generally, wind flow at pedestrian level would rely on carriageways and open space as air corridor/path. Under wind directions (NNE, SSE, S, WSW) where the carriageways are not aligned along these wind directions and cannot act as air corridor/path effectively, the wind availability of the surrounding area is generally low so that the air ventilation performance of both schemes would not make any significant difference.

6.3.2 In addition, it is notable that the difference in performance of both schemes is generally localised to area nearby the Subject Site. For area further apart, especially separated by other building structure, the performance is not sensitive to the design of the layout within the Subject Site.

6.3.3 As mentioned before, under NNE wind, most coming wind would be blocked and stop at around Queen's Road Central. With low wind availability among the surrounding area, there is no apparent difference of wind availability due to different schemes except that there is slight decrease of VR along Bridges Street and Hollywood Road near the Subject Site under the Proposed Scheme. In the absence of air corridor under NNE wind, downwashed wind plays a more important role. The high-rise nature of the Proposed Scheme may reduce wind availability of other existing high-rise tower at high level in the vicinity (e.g. Rich View Terrace). As a result, downwashed wind generated by Rich View Terrace may be reduced, resulting in a deterioration in wind performance at Bridges Street through Tank Street.

6.3.4 Under NE wind, there is slightly more wind flow under the Proposed Scheme along Hollywood Road in front of the Subject Site (possibly due to more building setback) but the difference is not significant. Possibly due to more building setback under the

Proposed Scheme, wind flow along Hollywood Road is least disturbed. In addition, higher wind availability at the north end of Ping On Lane immediate to the development under the Proposed Scheme is observed which is likely due to building downwash which divert more wind at higher elevation down to the pedestrian level due to high-rise nature of the Proposed Scheme. Added to this, more downwashed wind can enter Hollywood Road and flow along northwest to the site. Conversely, under the Baseline Scheme, less wind will flow northwest to the site along Hollywood Road but flow southward then to Ladder Street so that VR along Ladder Street under the Baseline Scheme is higher.

6.3.5 Under ENE wind, there is similar observation with higher wind flow along Hollywood Road (including road northwest to the site) under the Proposed Scheme which also benefits children's playground area. Similar to the situation under NE wind, more wind under the Baseline Scheme can go southward along Ladder Street. Higher wind availability at north end of Ping On Lane as under NE wind is observed. Building downwash effect under the Proposed Scheme may also bring more wind to other vicinity areas such as Bridges Street.

6.3.6 Under E wind, building downwash effect under the Proposed Scheme may also bring more wind to other vicinity areas such as Bridges Street.

6.3.7 Under E & ESE wind, the wind flow pattern along Hollywood Road of the Proposed Scheme is slightly different when compared with the Baseline Scheme. For the Baseline Scheme, some wind along Hollywood Road will flow southward along Ladder Street. For the Proposed Scheme, most wind will flow to further downwind area (e.g. Hollywood Road or playground area). This possibly may be due to longer building setback of the Proposed Scheme so that the flow along Hollywood Road is least disturbed on one hand, and there is air flow from Ping On Lane northward and merged with air flow along Hollywood Road on the other hand. As a result, wind will tend to flow along Hollywood Road still or slightly northward instead of going southward under the Proposed Scheme. Again, higher wind availability at north end of Ping On Lane is observed under E & ESE wind, which is also observed under NE wind.

6.3.8 Under SE wind, there is generally higher wind flow along Hollywood Road in front of the Subject Site and children's playground area (possibly due to more building setback) for the Proposed Scheme. Again, higher wind availability at north end of Ping On Lane is observed under SE wind, which is also observed under NE wind. Under the Proposed Scheme, downwash effect results in more wind flow through the gap between Grandview Garden and King's College Old Boys' Association Primary School and enter Wing Lee Street. Wind flow further benefits Rozario Street at the west end of Wing Lee Street.

6.3.9 Under SSE and S wind, wind availability is low, similar to the case under NNE wind.

6.3.10 It is also noted that slightly higher VR is evident to the north of Ping On Lane under the Proposed Scheme under SSE wind. It is possibly due to more building setback on the northern side for the Proposed Scheme which can reduce the bottleneck section (due to existence of building structure on two sides of Ping On Lane) as in the Baseline Scheme. Under S wind, wind flow along Ping On Lane is from north to south. Due to longer bottleneck section in the Baseline Scheme to speed up the flow, it appears that there is longer section of Ping On Lane with higher VR.

6.3.11 Under SSW and SW wind, wind comes from children's playground towards the Subject Site (possibly due to downwash from buildings such as Ovolo to the north of the children's playground). There is no noticeable difference between two schemes. Similar to the situation under SSE and S wind, slightly higher VR is evident to the north of Ping On Lane under the Proposed Scheme under SW wind, possibly due to reduced bottleneck section as well.

6.3.12 Under WSW wind, wind availability is low, similar to the cases under NNE, SSE and S wind.

6.3.13 As suggested by the VR result, wind availability of the assessment area is generally low. Under such condition, any difference in air ventilation performance due to two schemes will likely be narrowed down. As suggested from the result of contour plot, it can be observed that more wind flow along Hollywood Road and among children's playground along it can be observed, which is most likely due to building setback. On the other hand, the benefit of permeable G/F design cannot be realised from the simulation result, which may be due to impermeable nature of surrounding blocks. Lastly, the blockage impact due to higher building height of the Proposed Scheme cannot be observed. Rather, downwash effect leading to increased wind flow at Ping On Lane can be found.

6.4 Recommended Implementation of the Mitigation Measures

6.4.1 As discussed in Section 4.4, the Proposed Scheme would provide building setback of about 6m on G/F and tower setback of about 3m from the northern boundary. The Proposed Scheme also adopts a permeable G/F design consisting of covered open area as opposed to the Baseline Scheme which adopts an impermeable G/F design and with no setback.

6.4.2 These mitigation measures are essential in ensuring the Proposed Scheme will facilitate wind flow at the pedestrian level and effectively enhance wind availability to the surrounding area. Therefore, it is recommended that these requirements be incorporated as restrictions in the Statutory Notes of the OZP for the proposed "G/IC(2)" zone to ensure these mitigation measures be implemented.

7. Concluding Summary

7.1.1 To summarize, the location of the Subject Site does not have any connection to waterfront. The Proposed Scheme would result in increase in building height which would block wind flow at higher elevation. In spite of this, good design directions including 6m building setback and permeable design at G/F and general 3m building setback for the tower have been adopted in the Proposed Scheme.

7.1.2 According to the quantitative assessment result, SVR under annual situation and LVR under annual and summer situation of both schemes are the same. The SVR of the Proposed Scheme under summer situation is higher.

7.1.3 It suggests that the Proposed Scheme would not result in worse-off air ventilation impact.

FIGURES

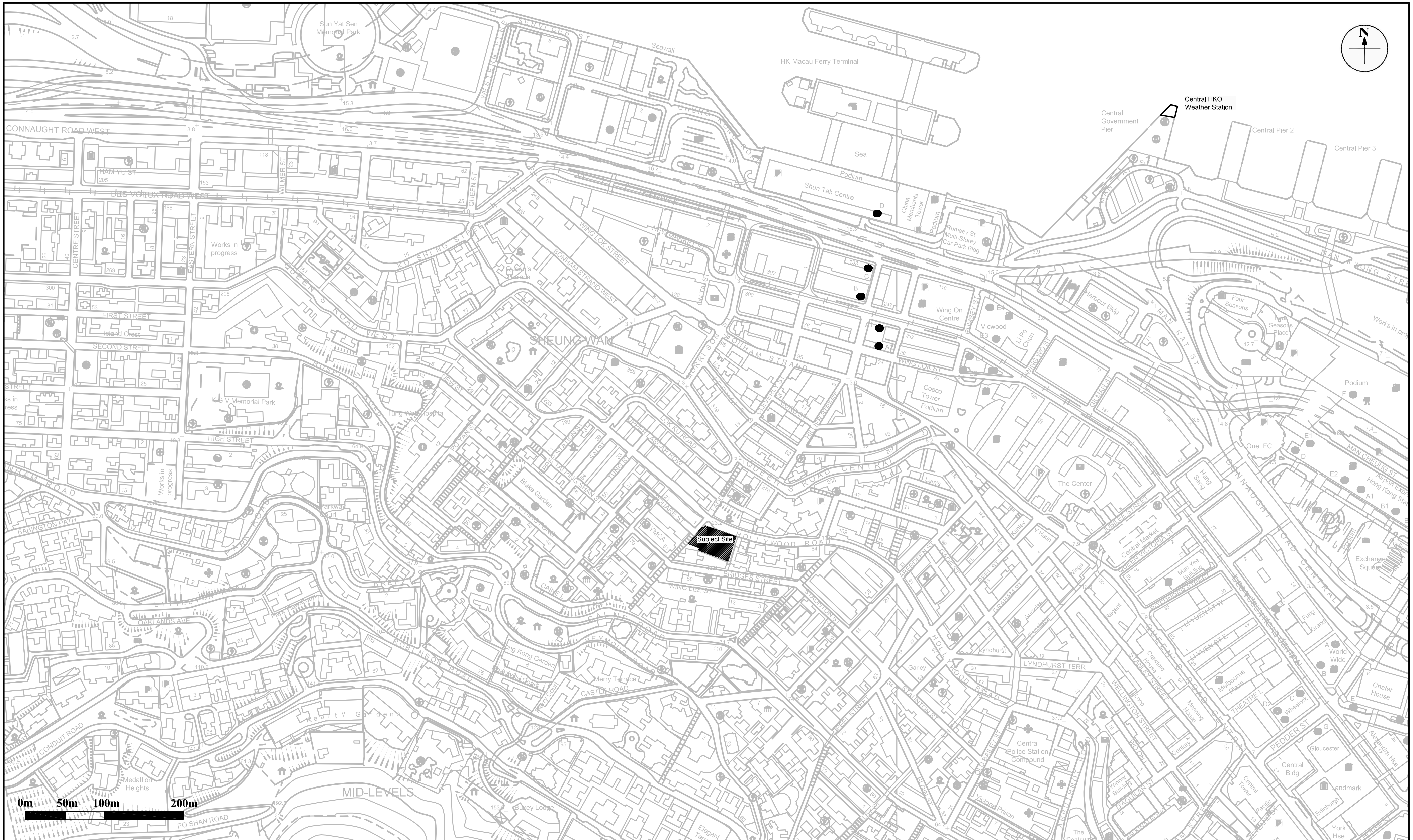


Figure: 1

Title: Location of the Subject Site and its Environs

Project: Air Ventilation Assessment in support of the S12A planning application for Proposed Youth Hostel At 122A to 130 Hollywood Road, Sheung Wan

RAMBOLL ENVIRON

Drawn by:	SL
Checked by:	CC
Rev.:	1.0
Date:	Mar 2016

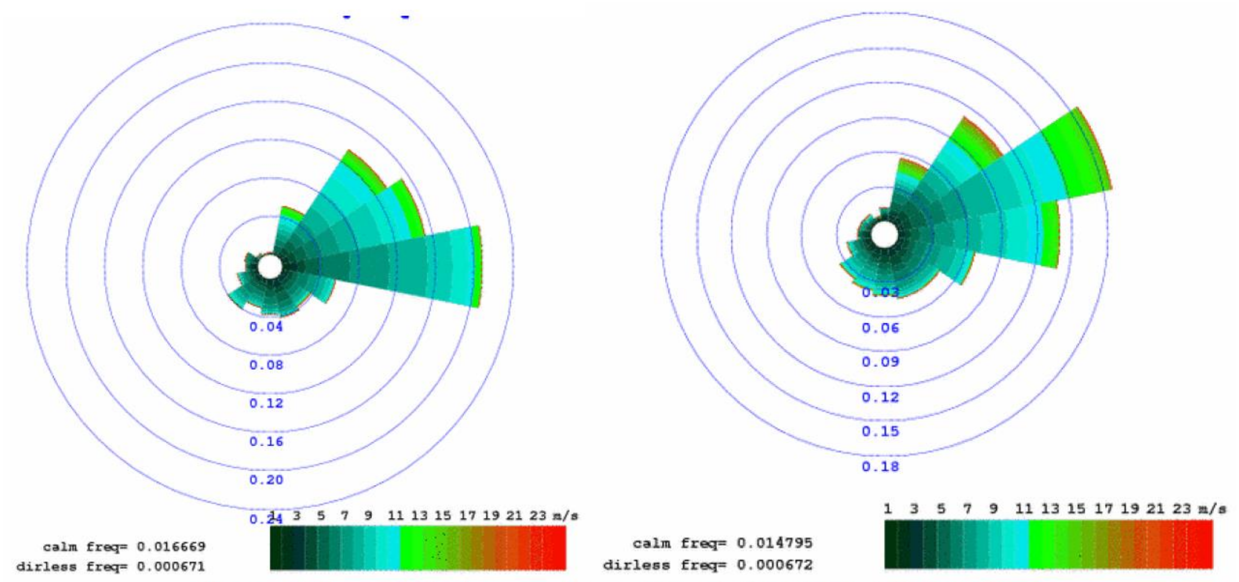


Figure 3.20 Wind roses (annual) at C (left:120m) (right:450m)

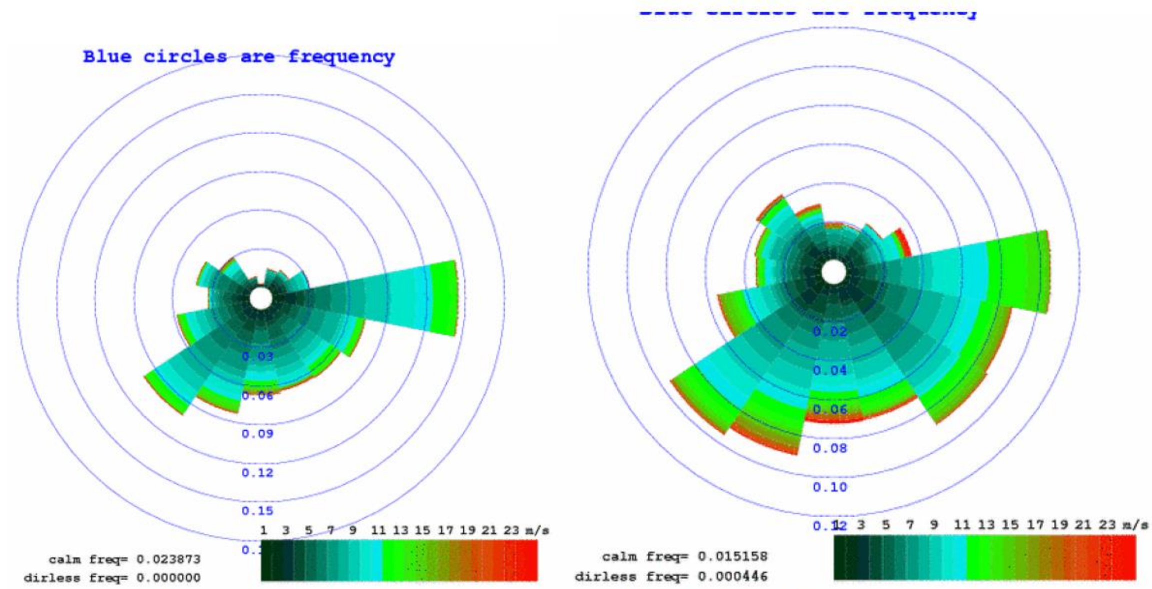
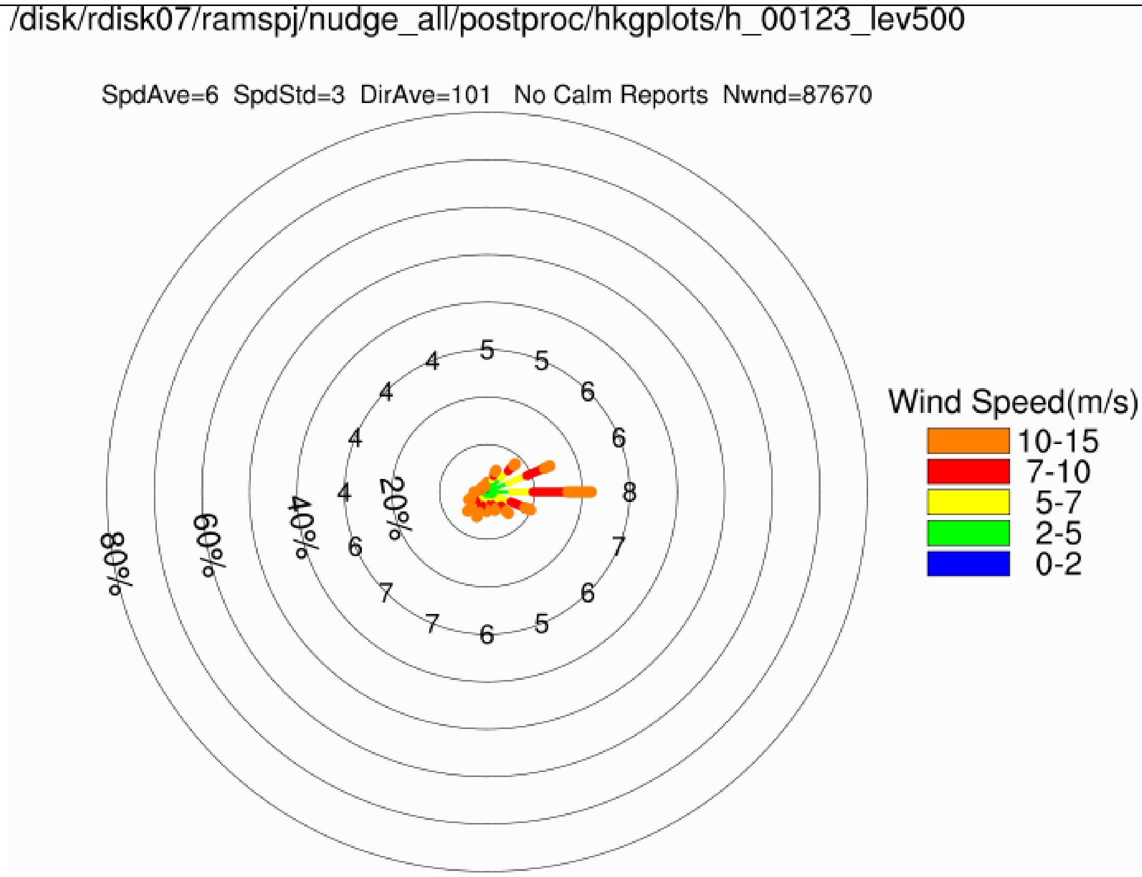


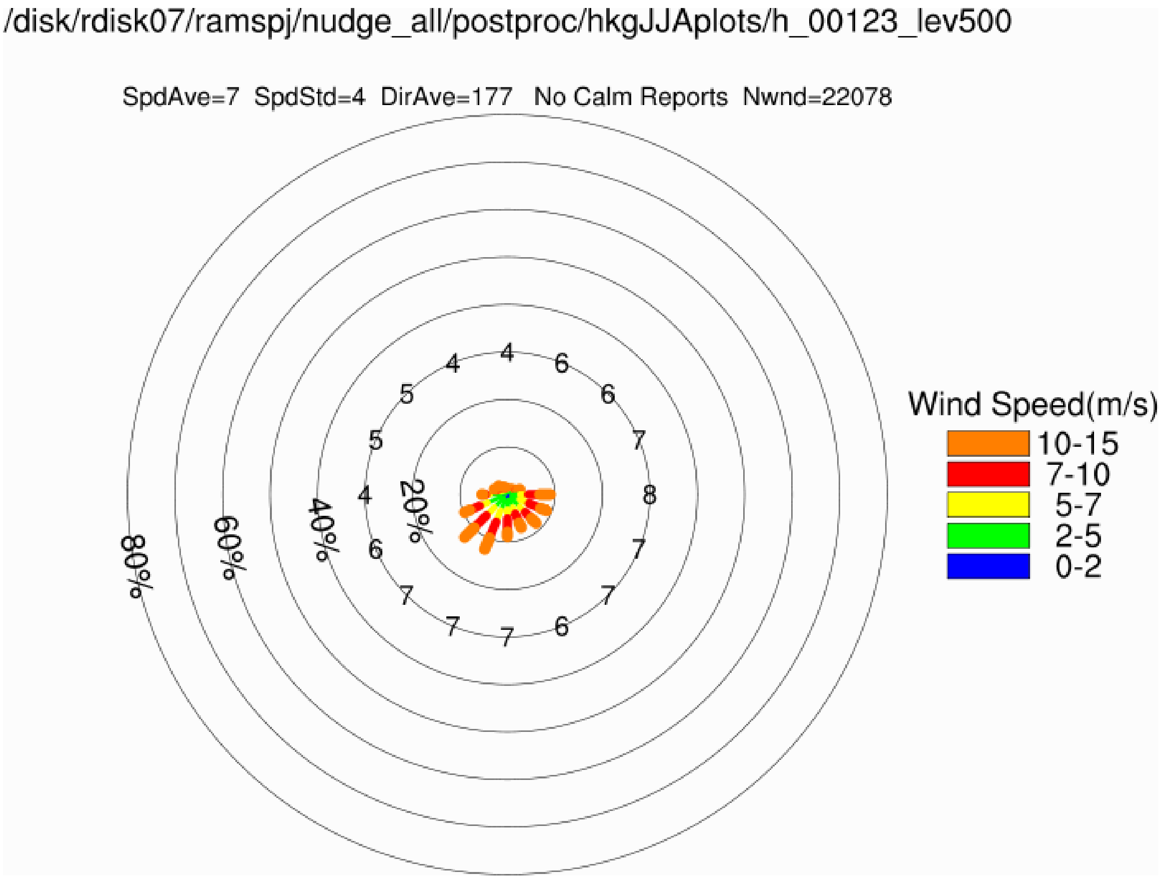
Figure 3.21 Wind roses (summer) at C (left:120m) (right:450m)

Extracted from EE-SYP&SW

Figure:	2a	RAMBOLL ENVIRON
Title:	Relevant Wind Rose Diagram extracted from EE-SYP&SW	Drawn by: SL
		Checked by: CC
Project:	Air Ventilation Assessment in support of the S12A planning application for Proposed Youth Hostel At 122A to 130 Hollywood Road, Sheung Wan	Rev.: 1.0
		Date: Feb 2016



Annual Wind Rose



Summer Wind Rose

Figure:	2b	RAMBOLL ENVIRON
Title:	Relevant Wind Rose Diagram extracted from RAMS	Drawn by: SL Checked by: CC
Project:	Air Ventilation Assessment in support of the S12A planning application for Proposed Youth Hostel At 122A to 130 Hollywood Road, Sheung Wan	Rev.: 1.1 Date: Jan 2016

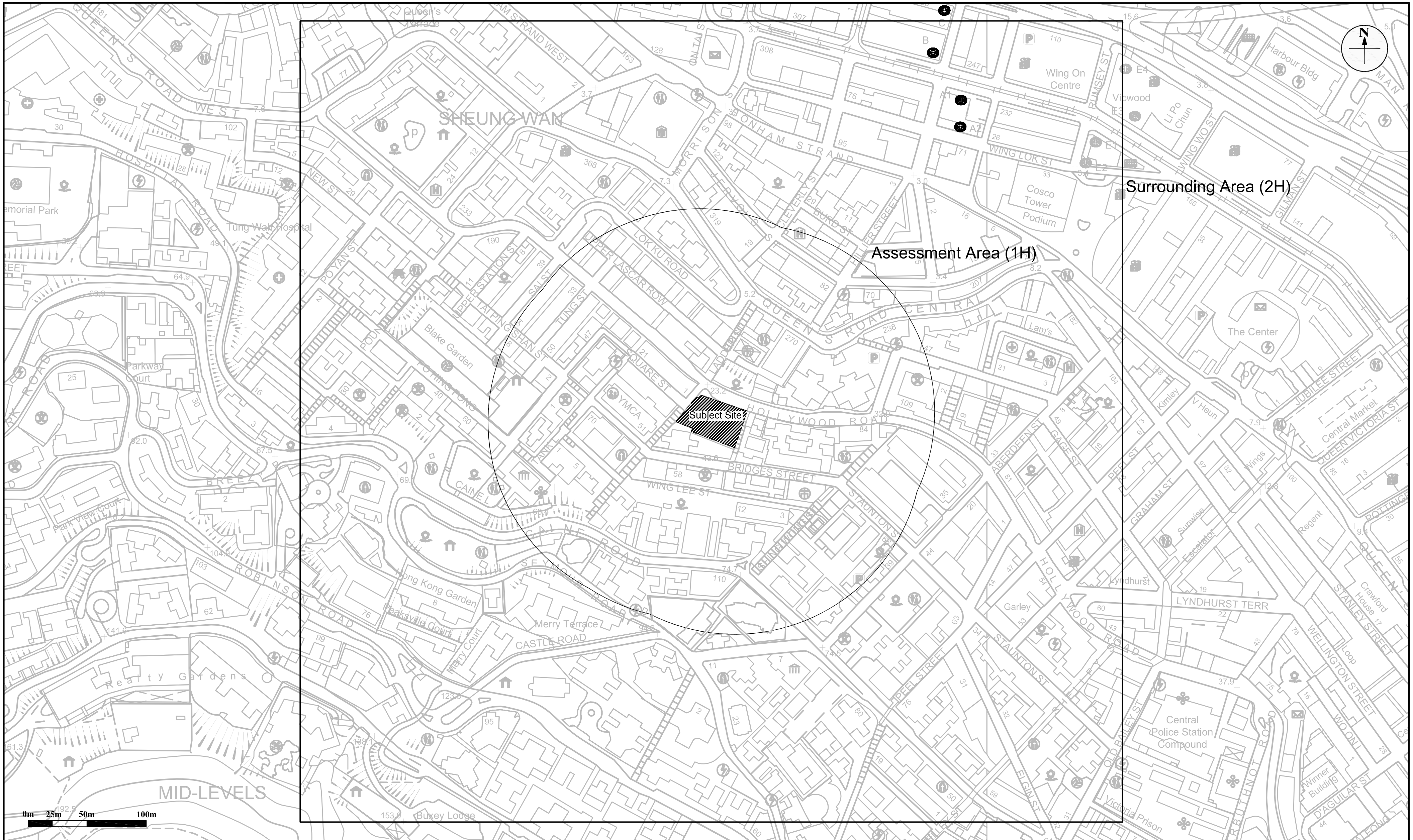


Figure: 3

Title: Assessment Area and Surrounding Area for CFD Simulation

Project: Air Ventilation Assessment in support of the S12A planning application for Proposed Youth Hostel At 122A to 130 Hollywood Road, Sheung Wan

RAMBOLL ENVIRON

Drawn by:	SL
Checked by:	CC
Rev.:	1.0
Date:	Mar 2016

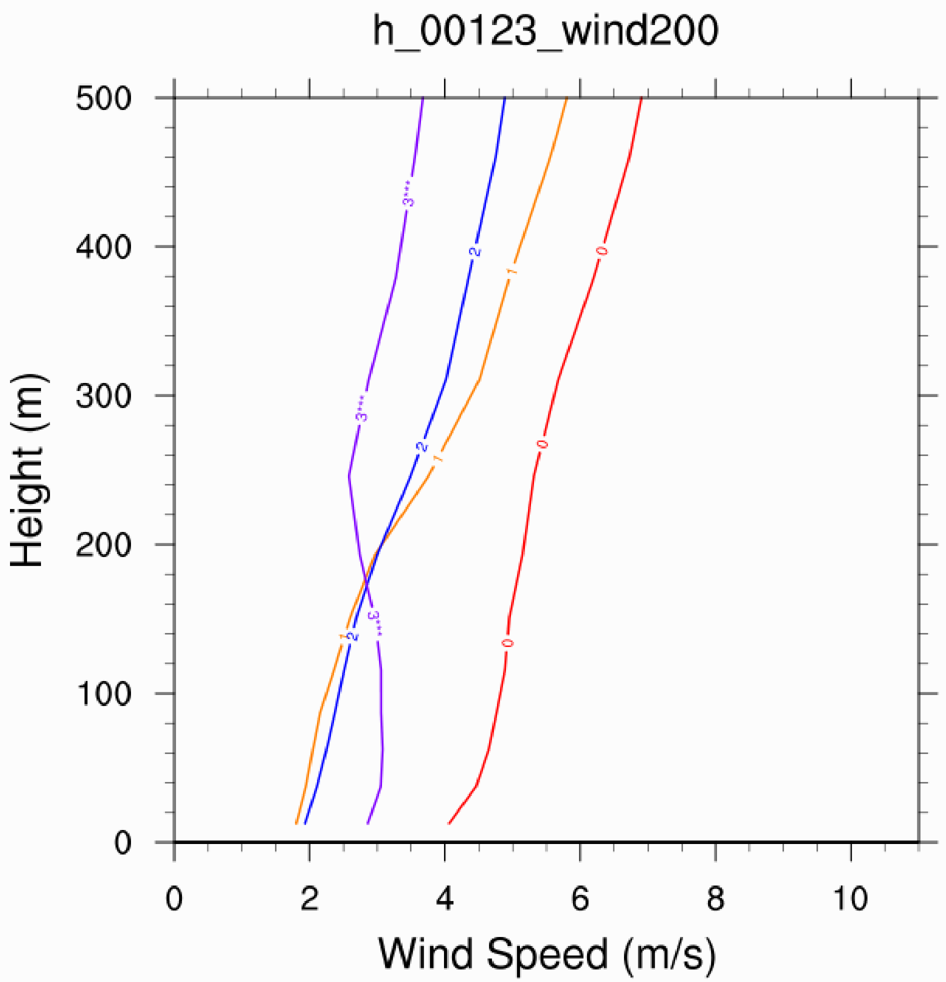


Figure:	4	RAMBOLL ENVIRON
Title:	Wind Profile Curve for Grid X:075, Y:034	Drawn by: SLo Checked by: CC
Project:	Air Ventilation Assessment in support of the S12A planning application for Proposed Youth Hostel At 122A to 130 Hollywood Road, Sheung Wan	Rev.: 1.0 Date: Jan 2016

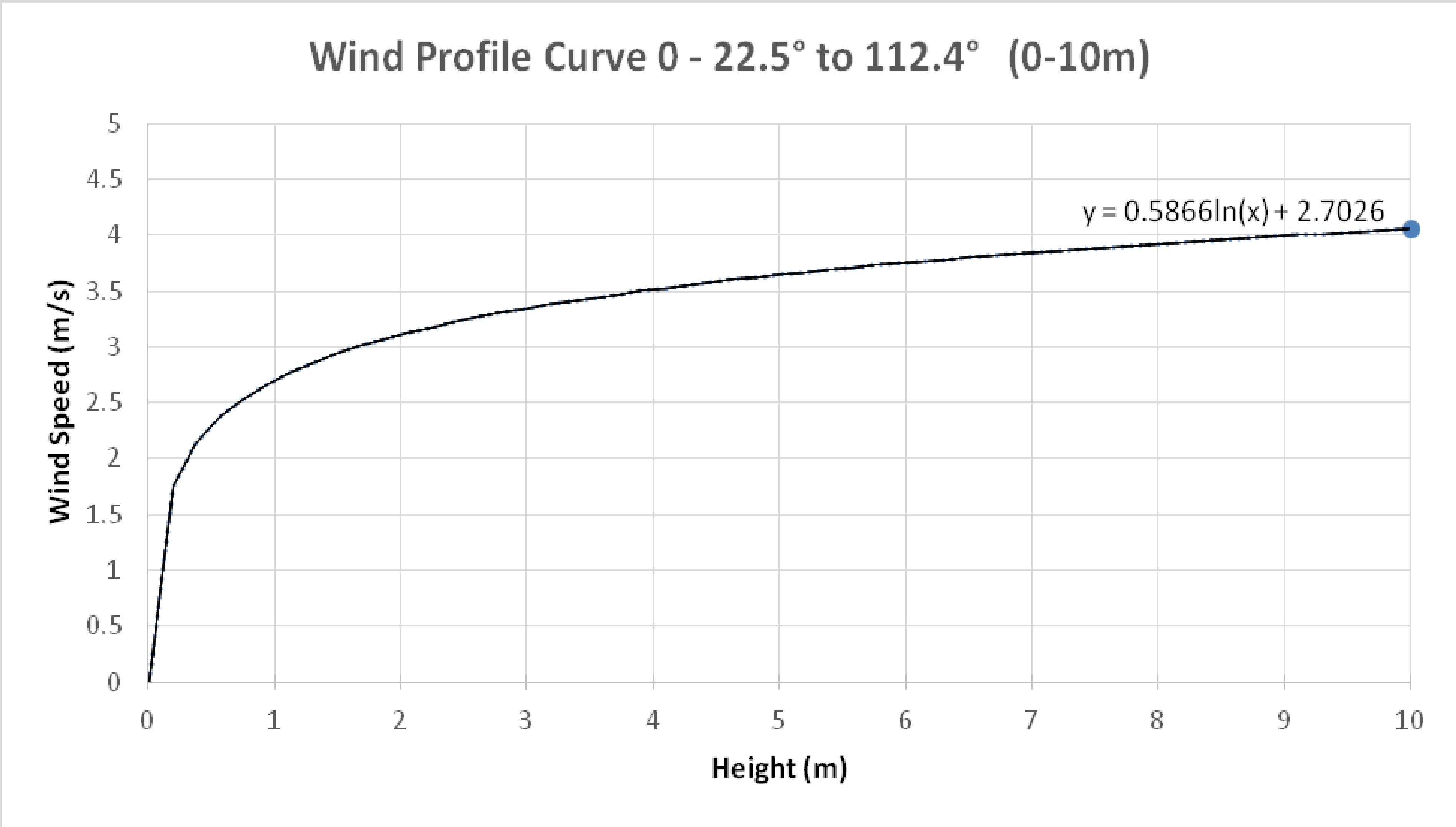


Figure:	5a	RAMBOLL ENVIRON
Title:	Log Law of Wind Profile Curve 0 at 0-10m	Drawn by: SLo Checked by: CC
Project:	Air Ventilation Assessment in support of the S12A planning application for Proposed Youth Hostel At 122A to 130 Hollywood Road, Sheung Wan	Rev.: 1.0 Date: Jan 2016

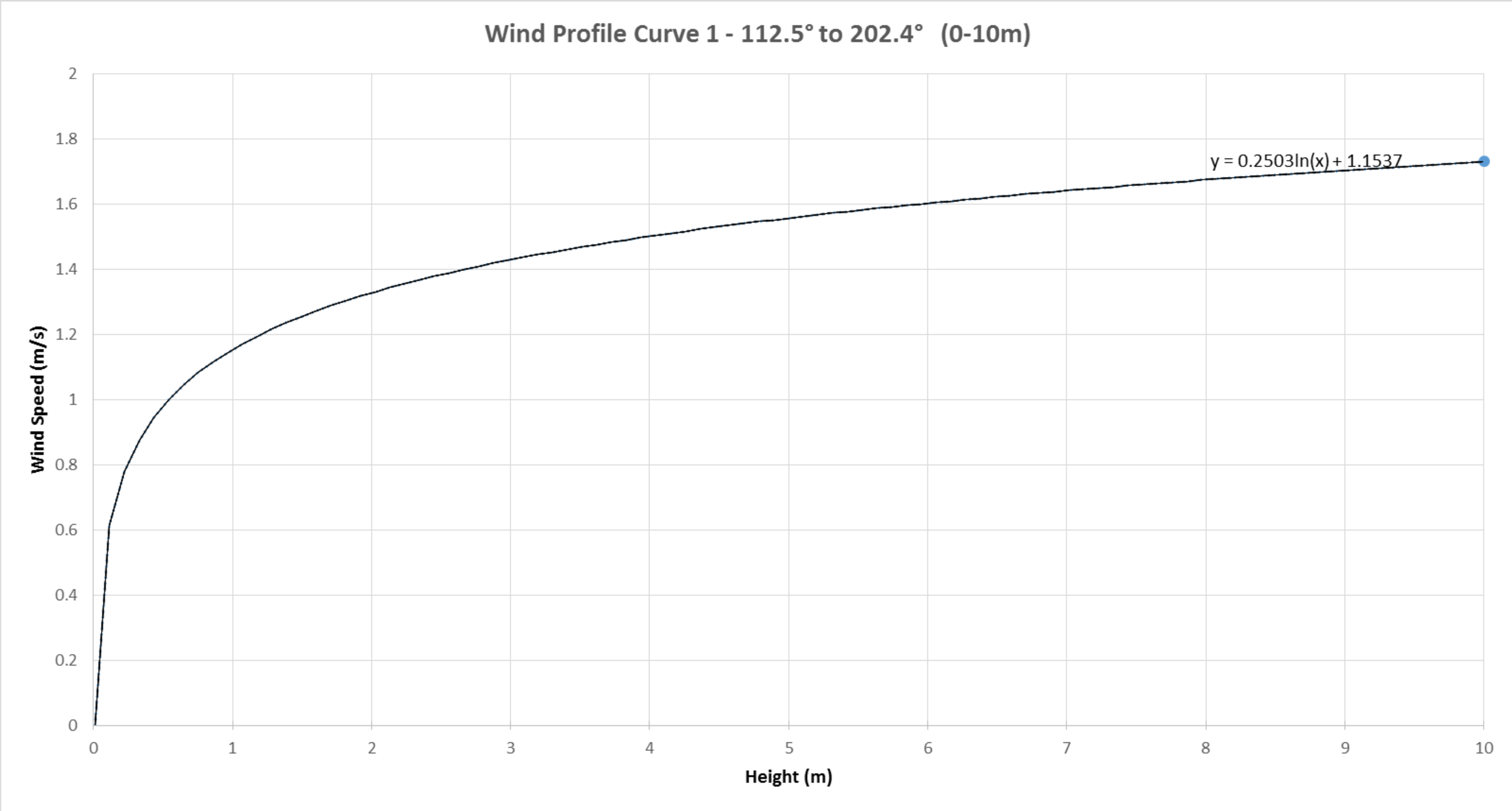


Figure:	5b	RAMBOLL ENVIRON	
Title:	Log Law of Wind Profile Curve 1 at 0-10m	Drawn by:	SLo
		Checked by:	CC
Project:	Air Ventilation Assessment in support of the S12A planning application for Proposed Youth Hostel At 122A to 130 Hollywood Road, Sheung Wan	Rev.:	1.0
		Date:	Jan 2016

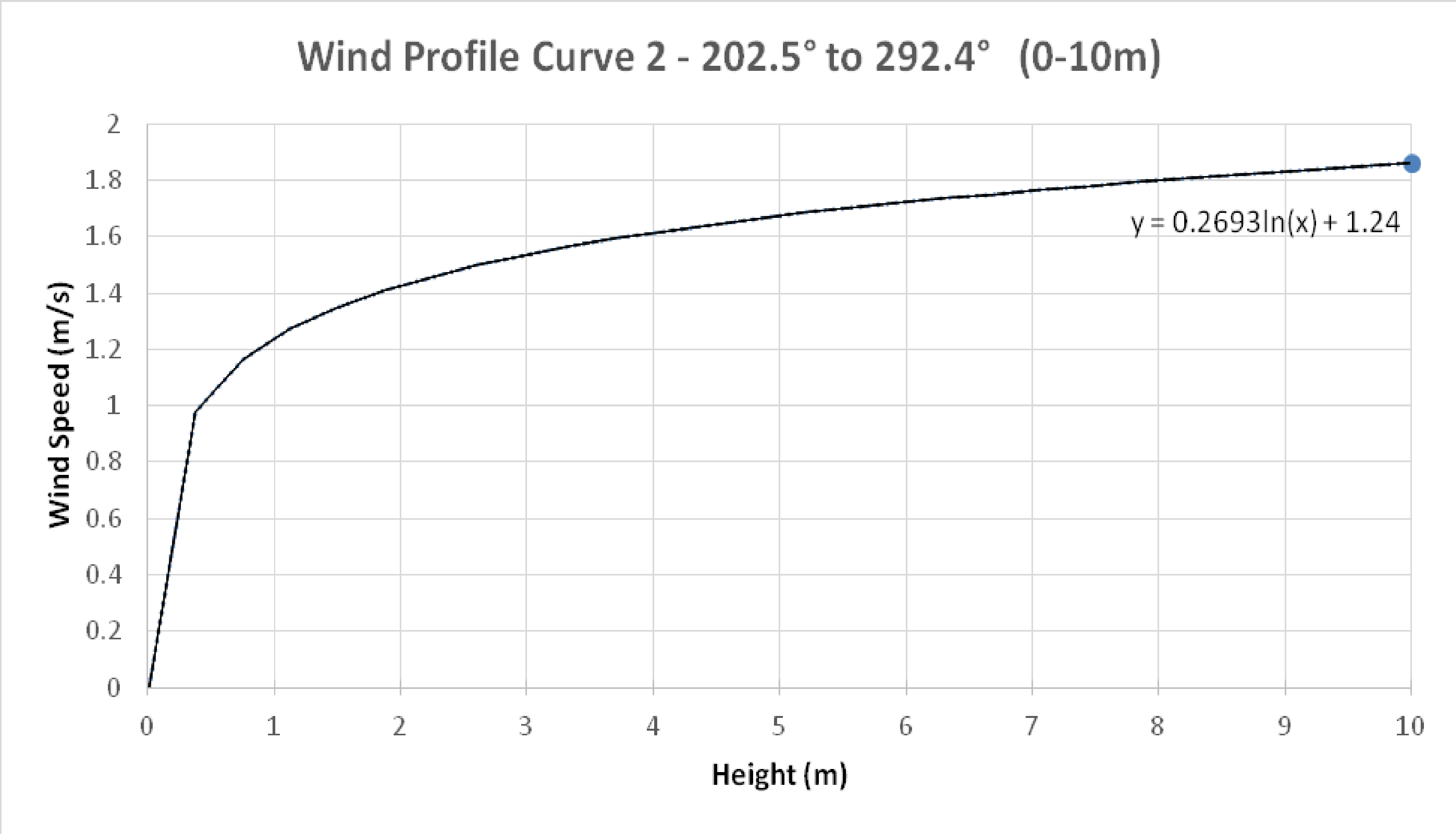


Figure:	5c	RAMBOLL ENVIRON	
Title:	Log Law of Wind Profile Curve 2 at 0-10m	Drawn by:	SLo
		Checked by:	CC
Project:	Air Ventilation Assessment in support of the S12A planning application for Proposed Youth Hostel At 122A to 130 Hollywood Road, Sheung Wan	Rev.:	1.0
		Date:	Jan 2016

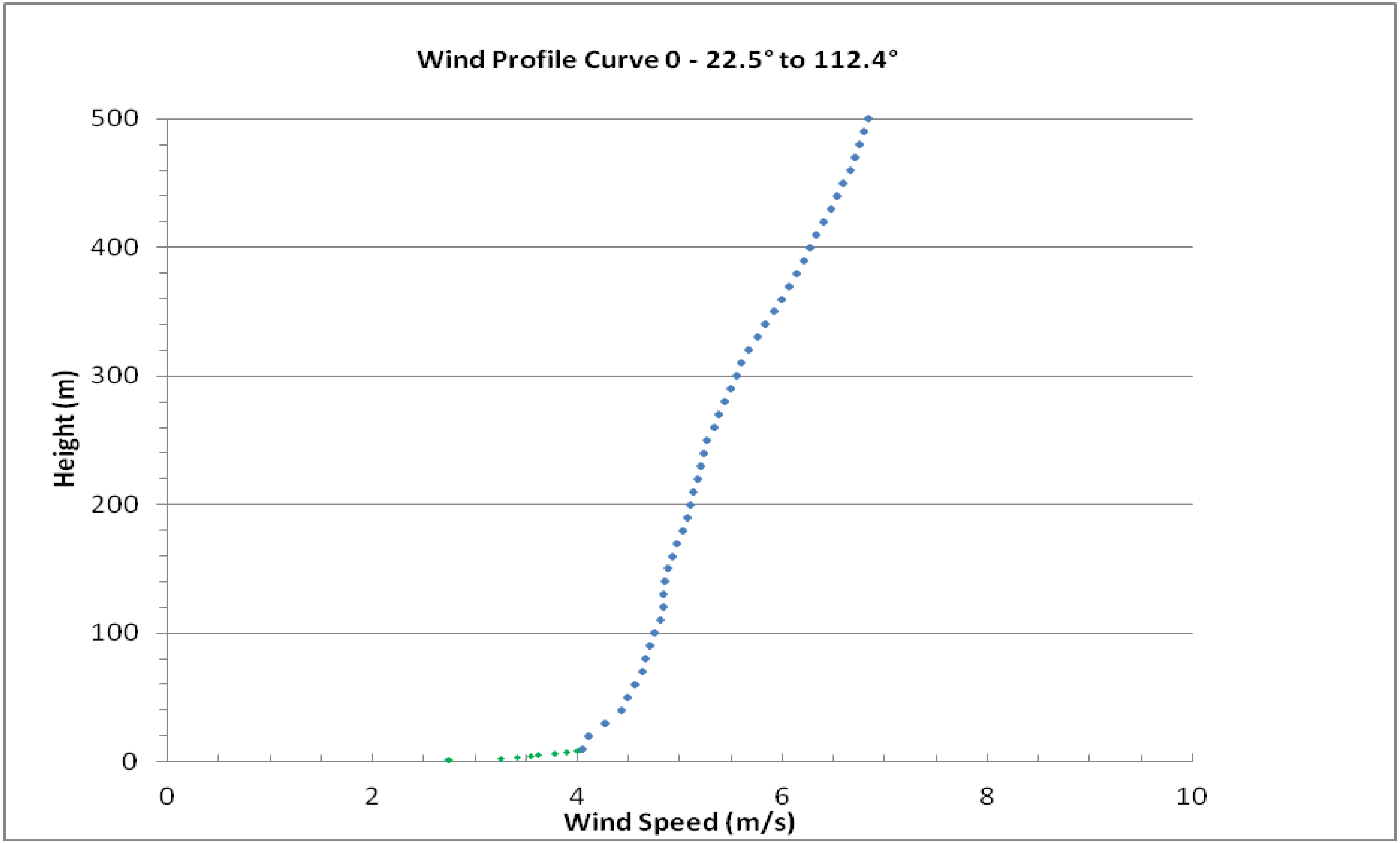


Figure:	6a	RAMBOLL ENVIRON
Title:	Plot of Wind Profile Curve 0 Adopted	Drawn by: SLo
		Checked by: CC
Project:	Air Ventilation Assessment in support of the S12A planning application for Proposed Youth Hostel At 122A to 130 Hollywood Road, Sheung Wan	Rev.: 1.0
		Date: Jan 2016

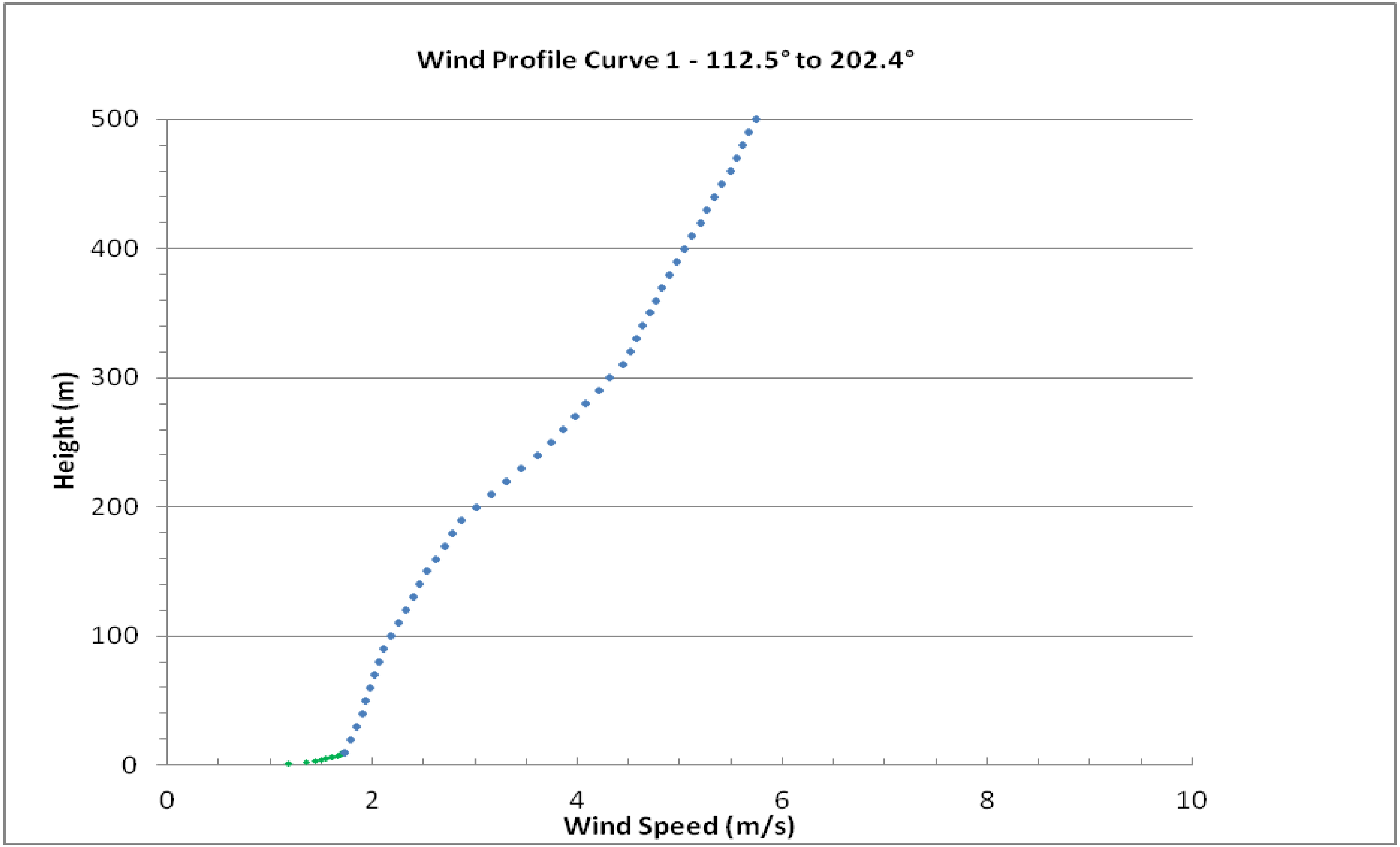


Figure:	6b	RAMBOLL ENVIRON
Title:	Plot of Wind Profile Curve 1 Adopted	Drawn by: SLo Checked by: CC
Project:	Air Ventilation Assessment in support of the S12A planning application for Proposed Youth Hostel At 122A to 130 Hollywood Road, Sheung Wan	Rev.: 1.0 Date: Jan 2016

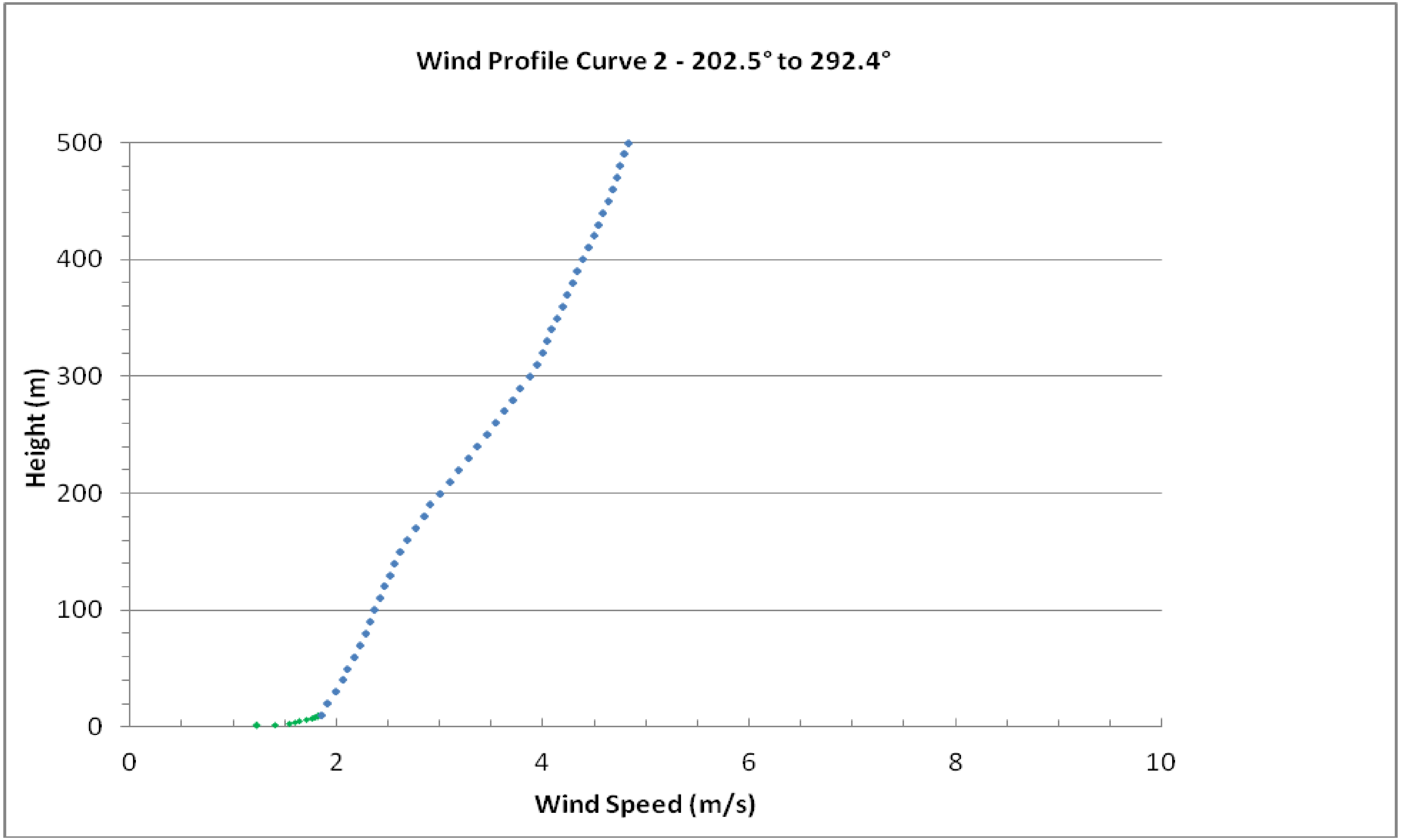


Figure:	6c	RAMBØLL ENVIRON	
Title:	Plot of Wind Profile Curve 2 Adopted	Drawn by:	SLo
		Checked by:	CC
Project:	Air Ventilation Assessment in support of the S12A planning application for Proposed Youth Hostel At 122A to 130 Hollywood Road, Sheung Wan	Rev.:	1.0
		Date:	Feb 2016

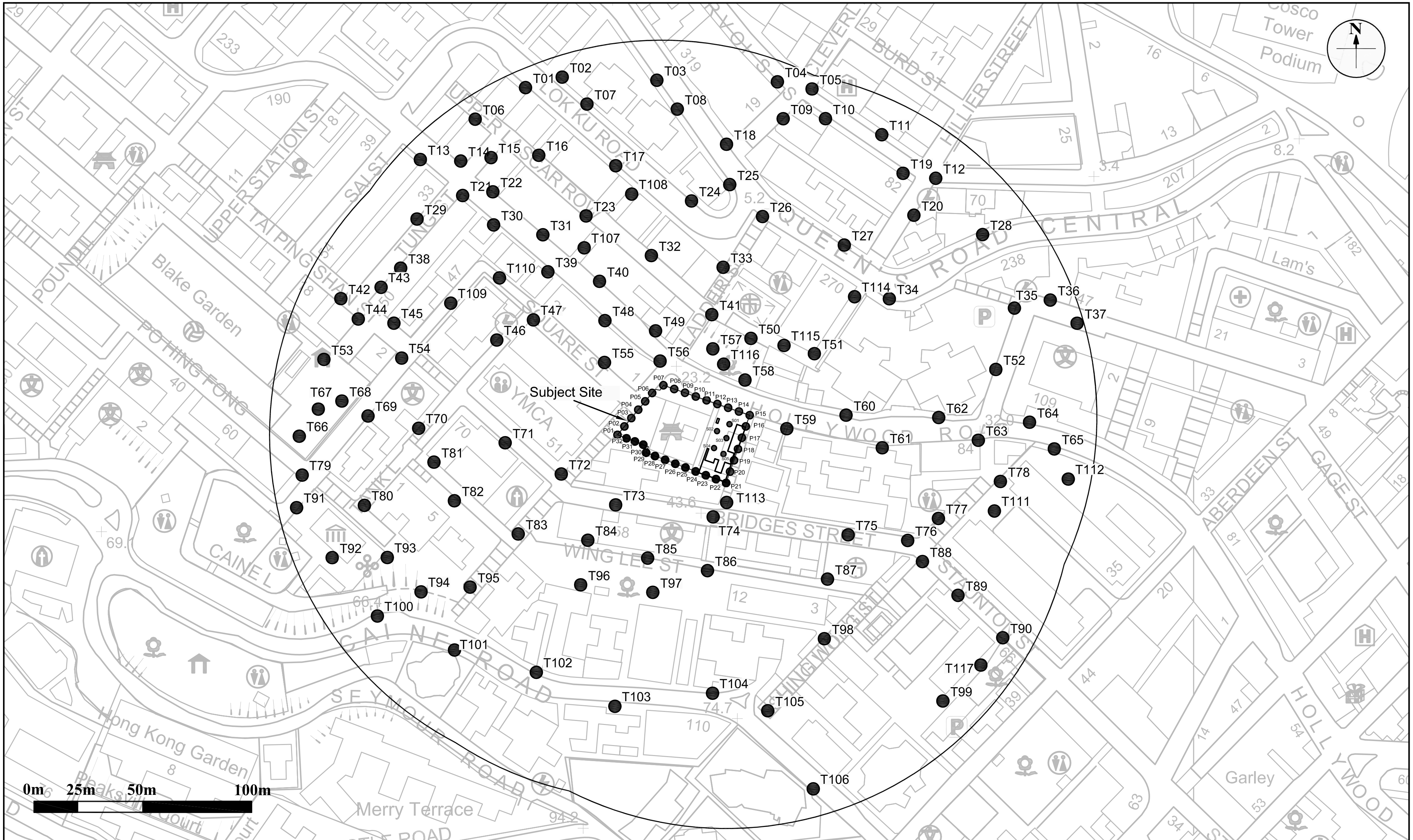


Figure:	7	RAMBOLL ENVIRON	
Title:	Perimeter and Overall Test Points selected for Initial Study	Drawn by:	SL
		Checked by:	CC
Project:	Air Ventilation Assessment in support of the S12A planning application for Proposed Youth Hostel At 122A to 130 Hollywood Road, Sheung Wan	Rev.:	1.0
		Date:	Jan 2016

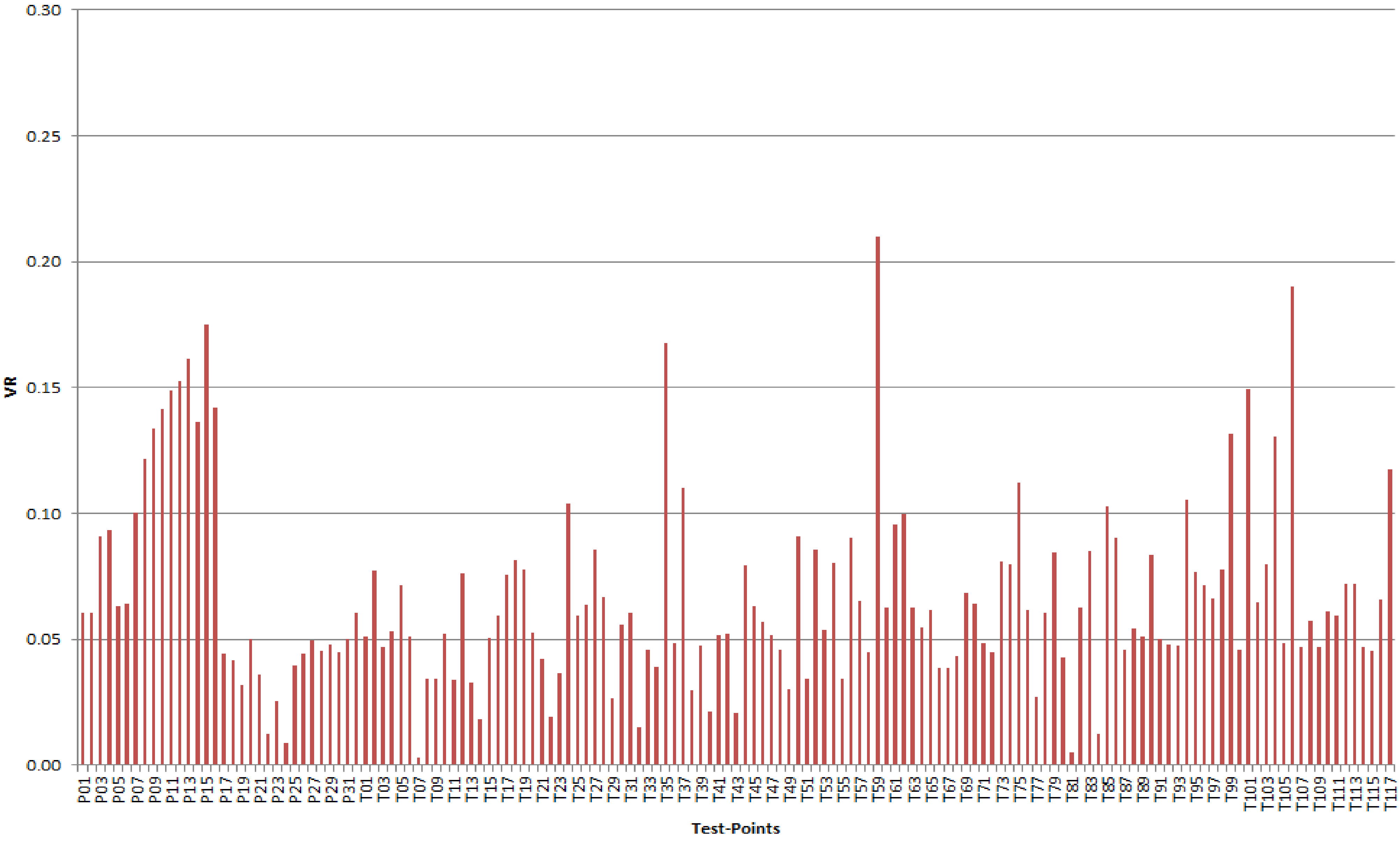


Figure:	8	RAMBOLL ENVIRON	
Title:	Wind Velocity Ratio of the Baseline Scheme (Annual)	Drawn by:	CC
		Checked by:	SL
Project:	Air Ventilation Assessment in support of the S12A planning application for Proposed Youth Hostel At 122A to 130 Hollywood Road, Sheung Wan	Rev.:	1.0
		Date:	Jan 2016

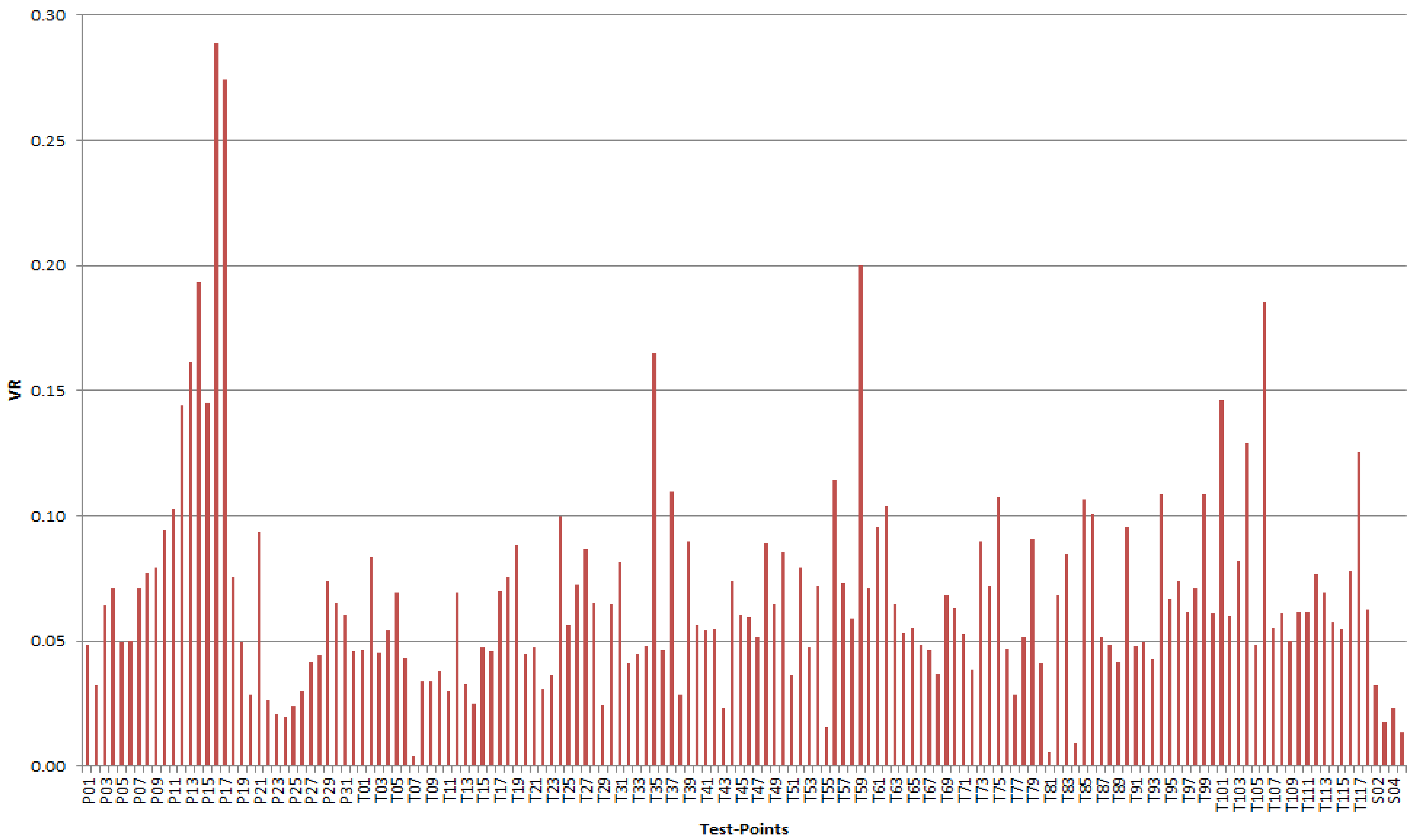


Figure:	9	RAMBOLL ENVIRON	
Title:	Wind Velocity Ratio of the Proposed Scheme (Annual)	Drawn by:	CC
		Checked by:	SL
Project:	Air Ventilation Assessment in support of the S12A planning application for Proposed Youth Hostel At 122A to 130 Hollywood Road, Sheung Wan	Rev.:	1.0
		Date:	Jan 2016

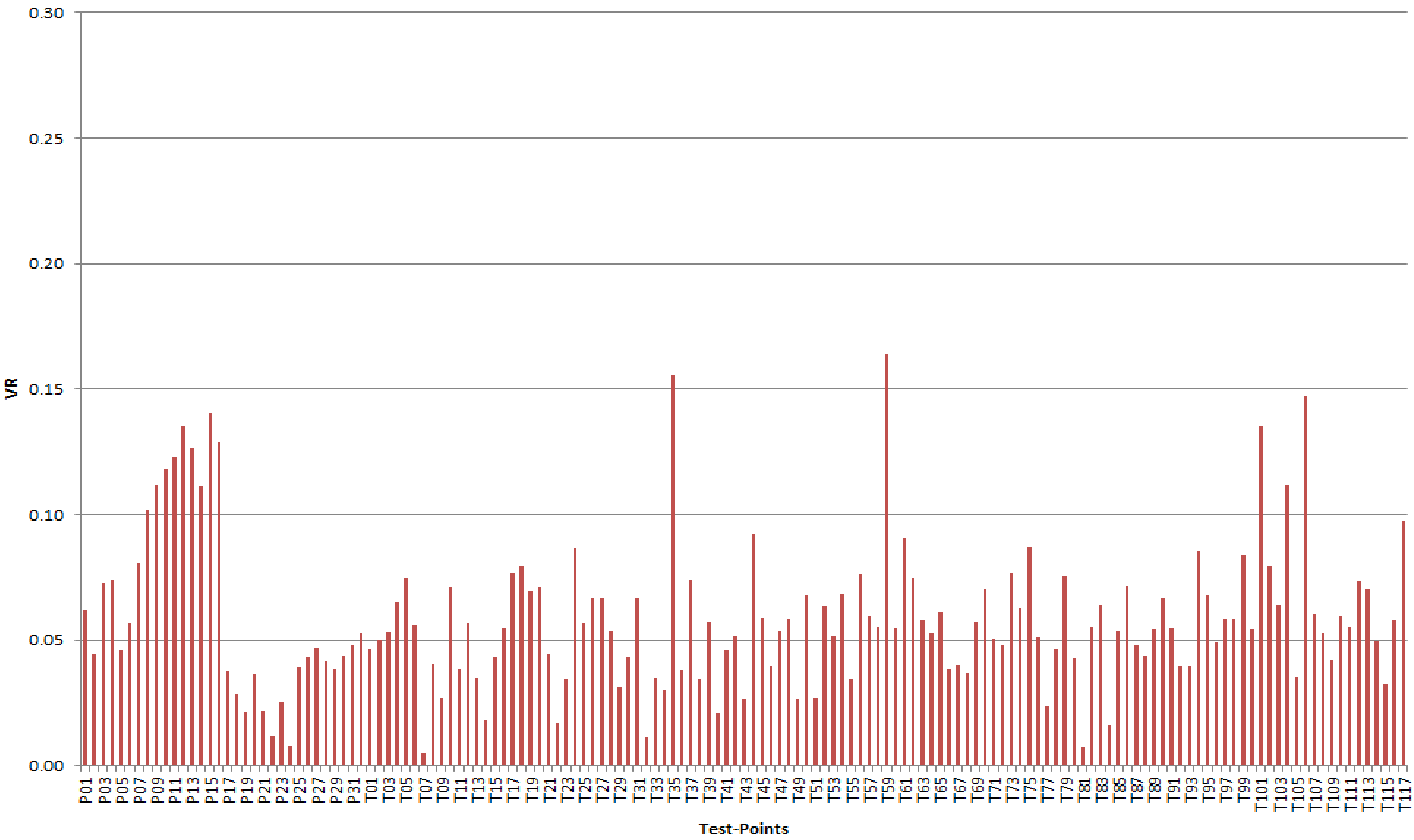


Figure:	10	RAMBOLL ENVIRON	
Title:	Wind Velocity Ratio of the Baseline Scheme (Summer)	Drawn by:	CC
		Checked by:	SL
Project:	Air Ventilation Assessment in support of the S12A planning application for Proposed Youth Hostel At 122A to 130 Hollywood Road, Sheung Wan	Rev.:	1.0
		Date:	Jan 2016

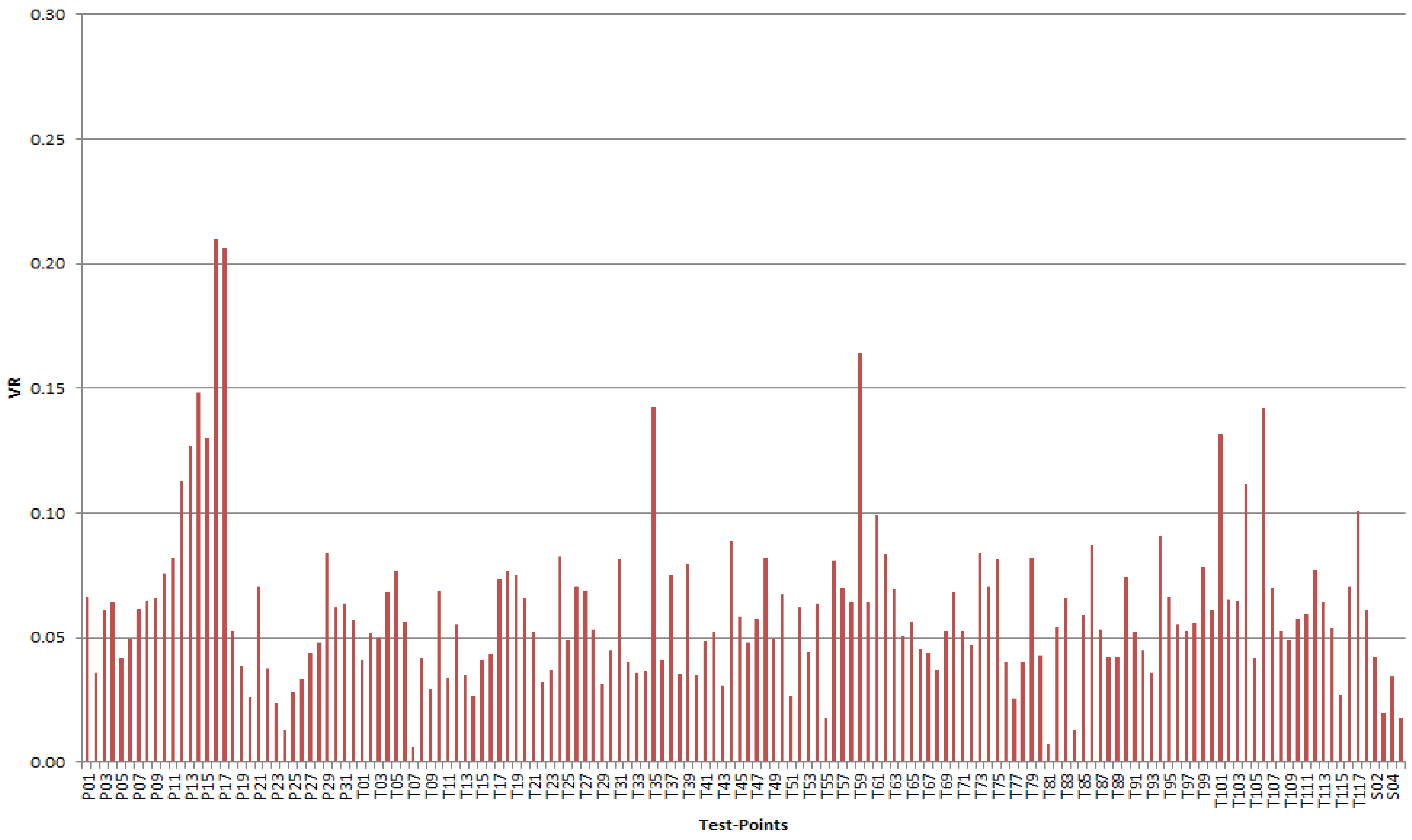
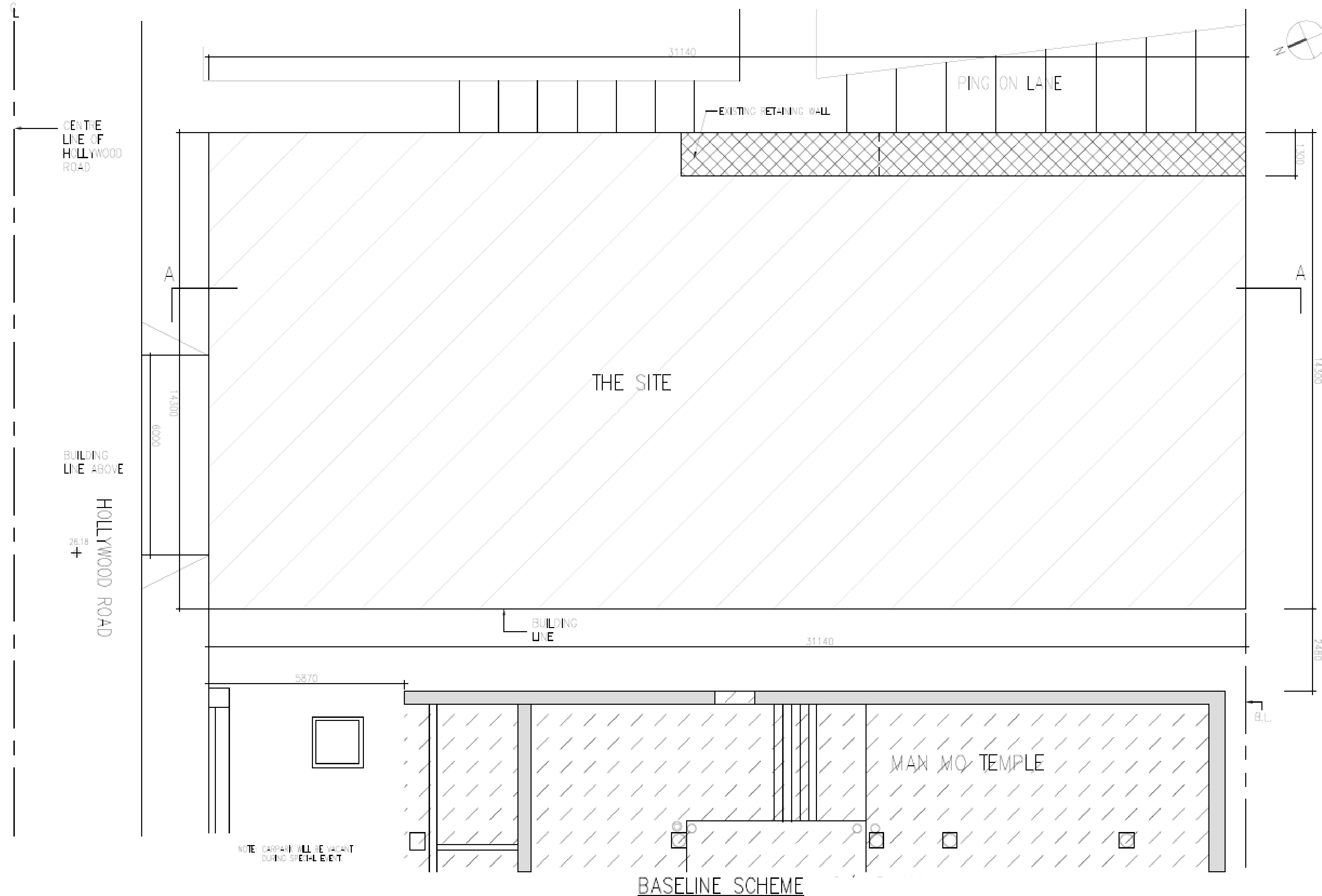


Figure:	11	RAMBOLL ENVIRON
Title:	Wind Velocity Ratio of the Proposed Scheme (Summer)	Drawn by: CC Checked by: SL
Project:	Air Ventilation Assessment in support of the S12A planning application for Proposed Youth Hostel At 122A to 130 Hollywood Road, Sheung Wan	Rev.: 1.0 Date: Jan 2016

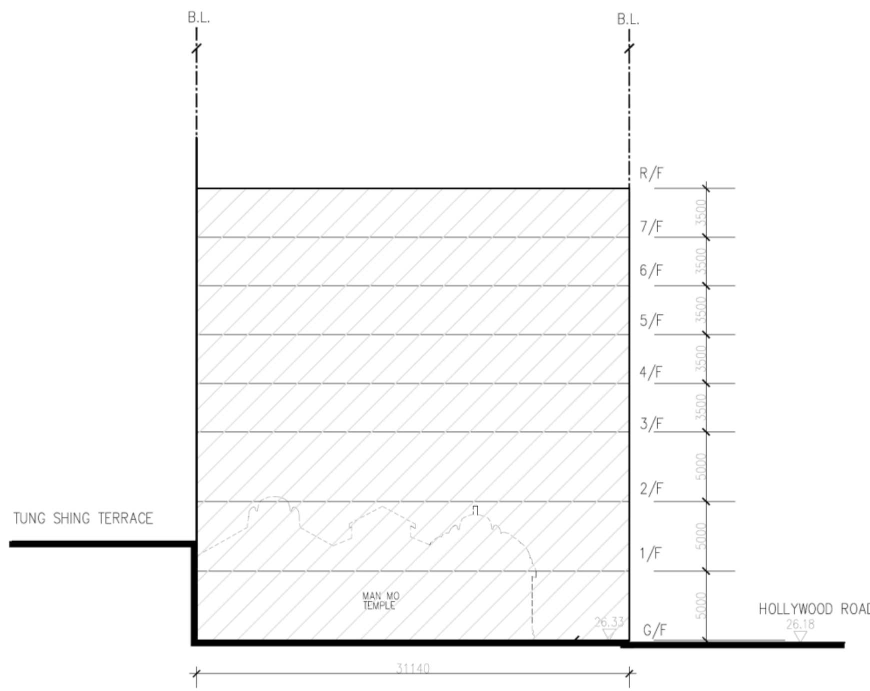
APPENDIX A:
BASELINE SCHEME



PROPOSED YOUTH HOSTEL AT 122A HOLLYWOOD ROAD, H.K. SCALE 1:100@A3

C Y S Associates (H K) Ltd.
Architects & Urban Designers.

SKA-130



BASELINE– SECTION A

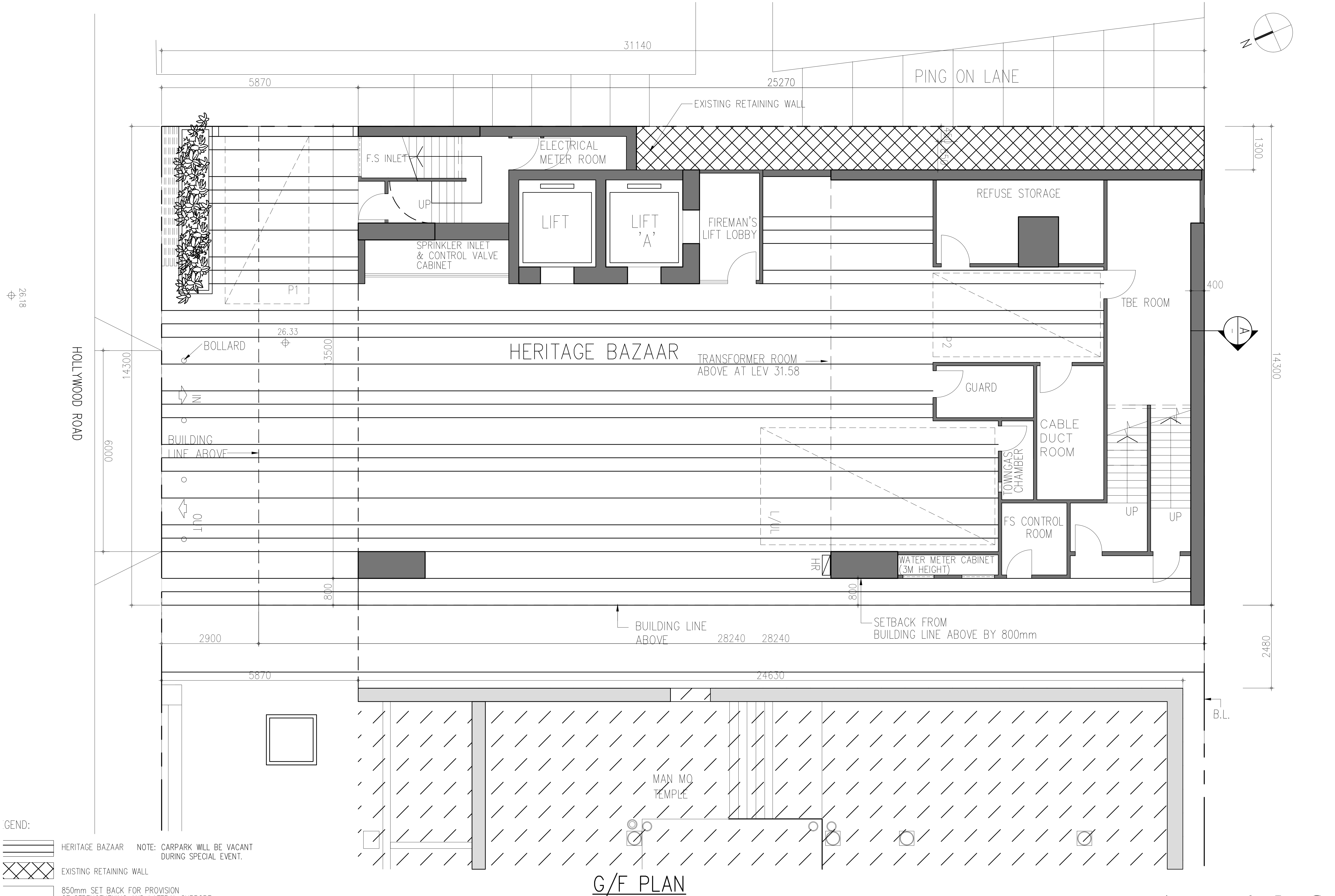
PROPOSED YOUTH HOSTEL AT 122A HOLLYWOOD ROAD, H.K.

SCALE 1:350@A3

C Y S Associates (H K) Ltd.
Architects & Urban Designers. CYS
36TH FLOOR • HONG KONG PLAZA • 186 CONNAUGHT ROAD WEST • HONG KONG
TEL: 2858 6693 • FAX: 2858 9083 2858 9366 • E-MAIL: cys@cysarch.com.hk

SKA-131

APPENDIX B:
PROPOSED SCHEME



GEND:

HERITAGE BAZAAR — NOTE: CARPARK WILL BE VACANT DURING SPECIAL EVENT.

EXISTING RETAINING WALL

850mm SET BACK FOR PROVISION OF STRENGTHENING AND LATERAL SUPPORT

G/F PLAN

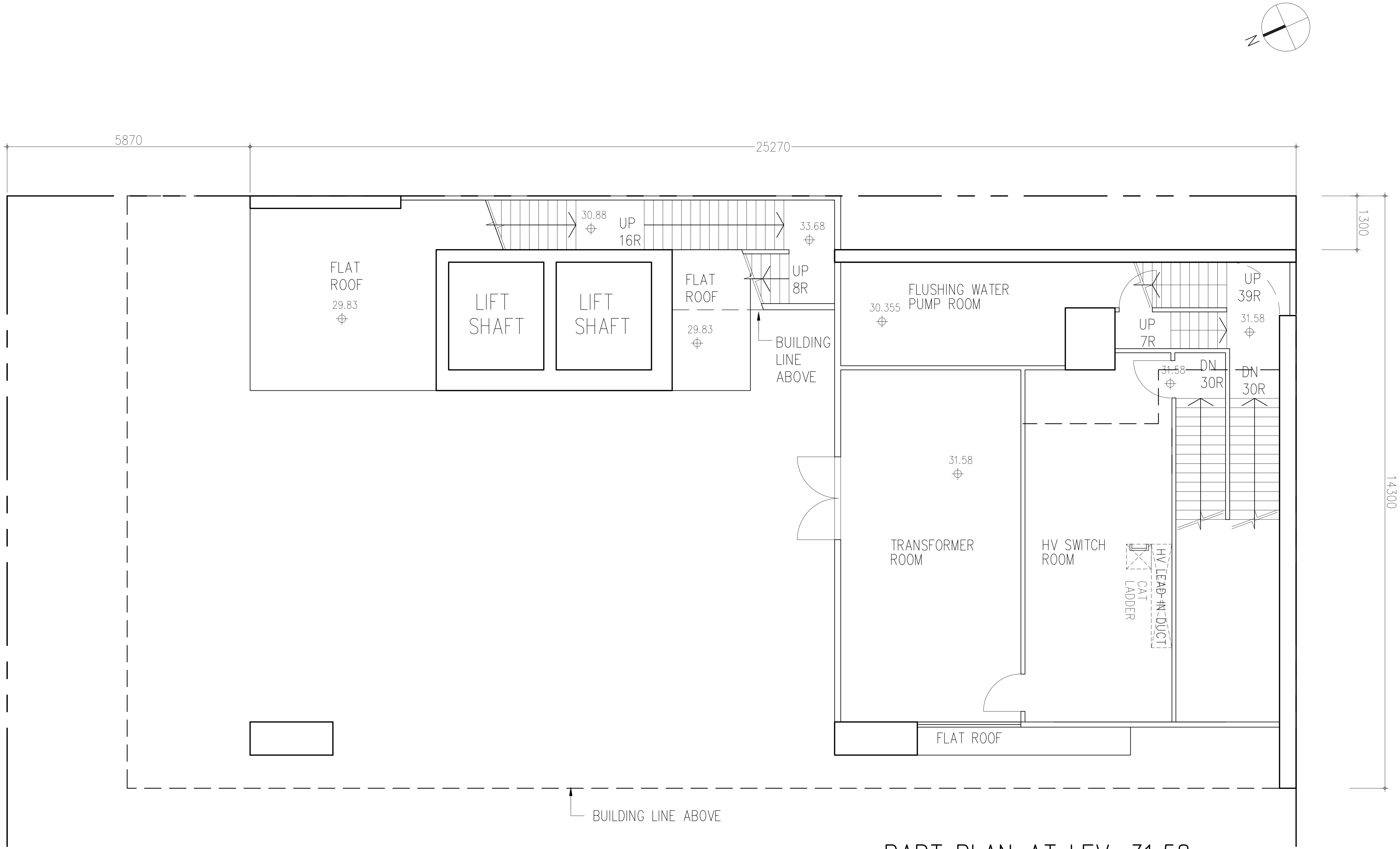
ROPOSED YOUTH HOSTEL AT 122A HOLLYWOOD ROAD, H.K.

SCALE 1:100@A3

C Y S Associates (H K) Ltd.
Architects & Urban Designers. CYS
36TH FLOOR • HONG KONG PLAZA • 186 CONNAUGHT ROAD WEST • HONG KONG
TEL: 2858 6603 • FAX: 2858 9083 2858 9366 • E-MAIL: cys@cysarch.com.hk

11-09-2015

SKA-112



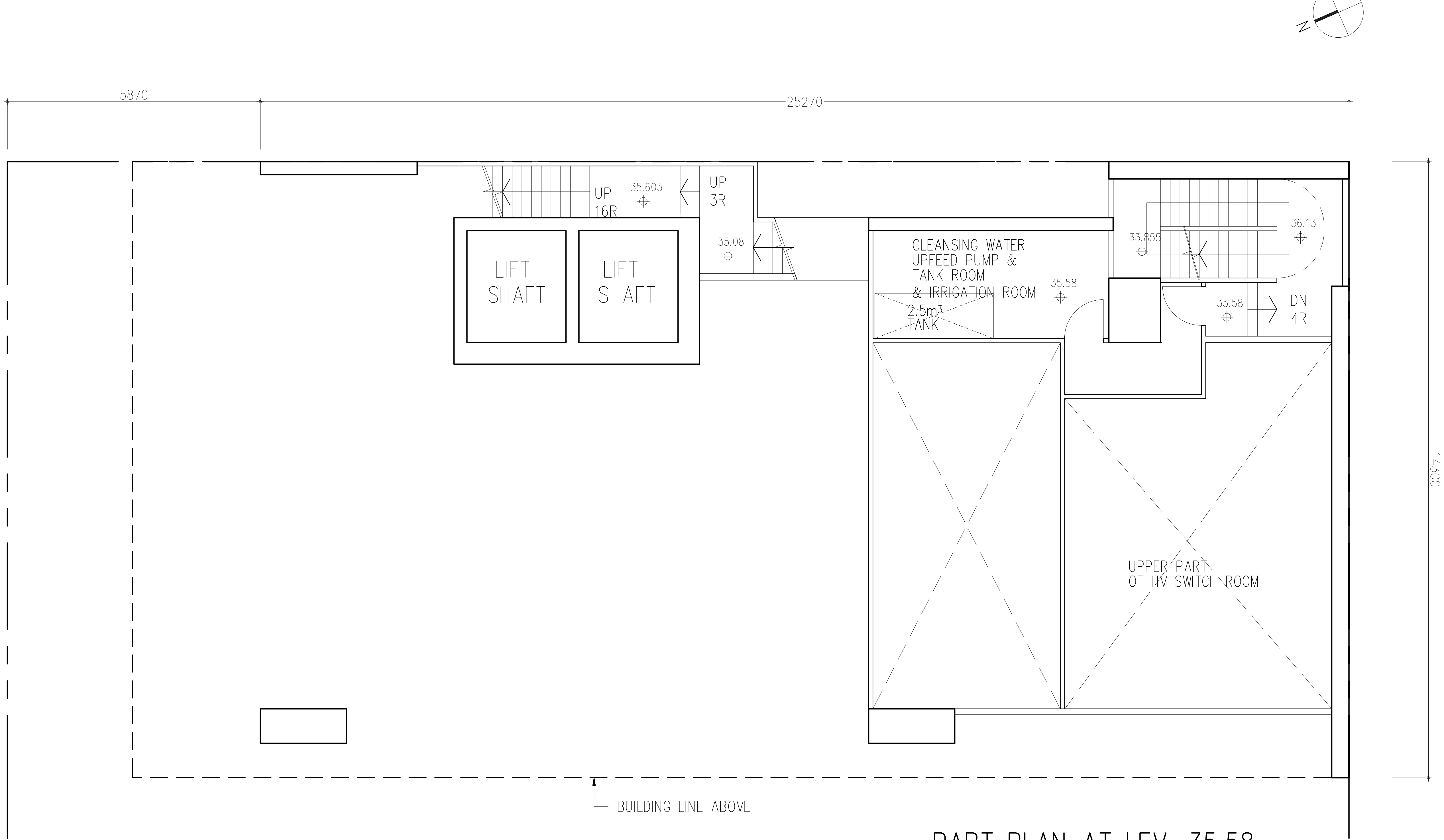
PART PLAN AT LEV. 31.58

PROPOSED YOUTH HOSTEL AT 122A HOLLYWOOD ROAD, H.K. SCALE 1:100@A3

C Y S Associates (H K) Ltd.
Architects & Urban Designers. CYS
36TH FLOOR • HONG KONG PLAZA • 186 CONNAUGHT ROAD WEST • HONG KONG
TEL: 2858 6693 • FAX: 2858 9083 2858 9366 • E-MAIL: cys@cysarch.com.hk

15-01-2016

SKA-123



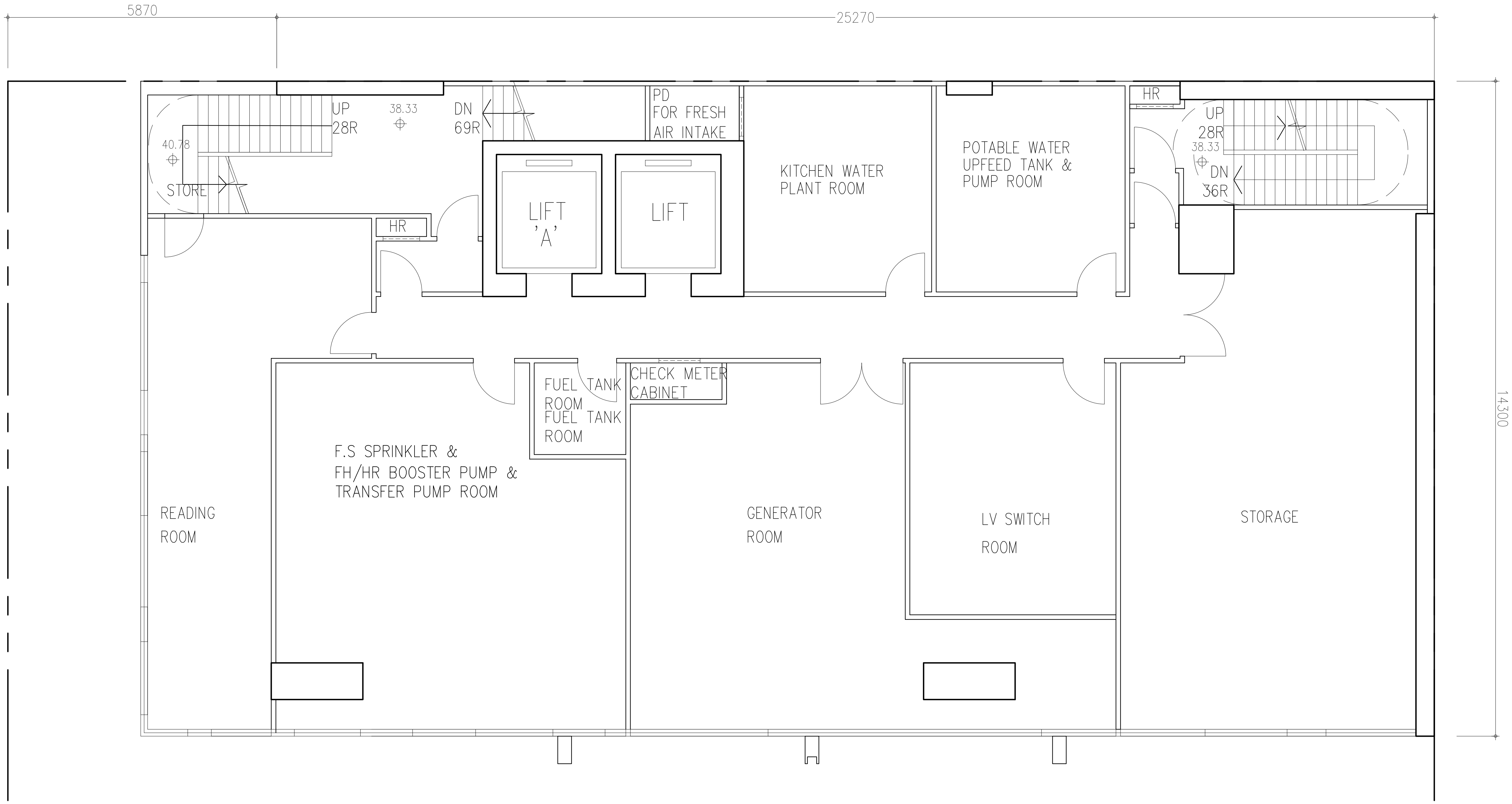
PART PLAN AT LEV. 35.58

PROPOSED YOUTH HOSTEL AT 122A HOLLYWOOD ROAD, H.K. SCALE 1:100@A3

C Y S Associates (H K) Ltd.
Architects & Urban Designers. CYS
36TH FLOOR • HONG KONG PLAZA • 186 CONNAUGHT ROAD WEST • HONG KONG
TEL: 2858 6693 • FAX: 2858 9083 2858 9366 • E-MAIL: cys@cysarch.com.hk

15-01-2016

SKA-124



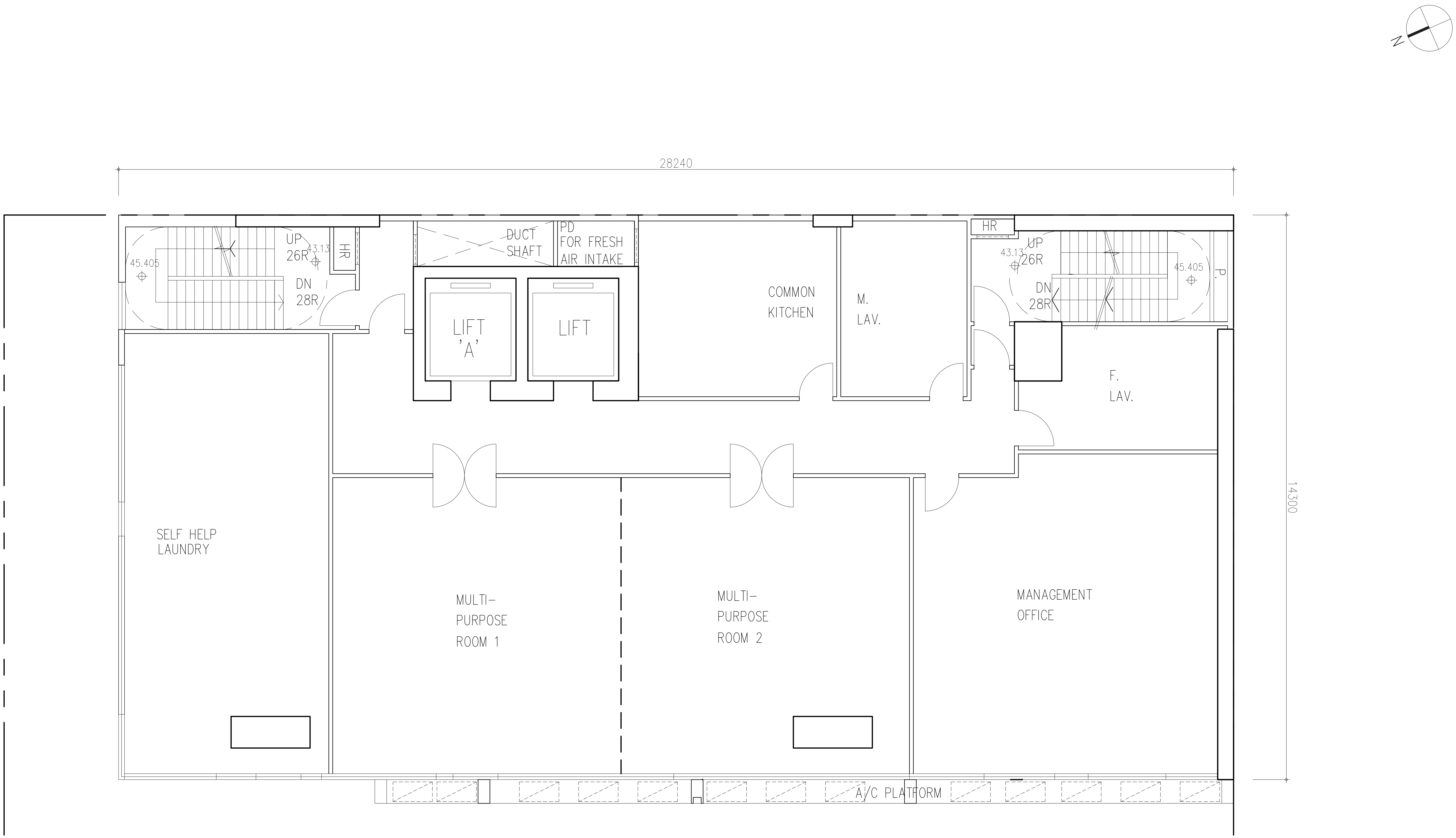
1/F PLAN

PROPOSED YOUTH HOSTEL AT 122A HOLLYWOOD ROAD, H.K. SCALE 1:100

C Y S Associates (H K) Ltd.
Architects & Urban Designers. CYS
36TH FLOOR • HONG KONG PLAZA • 186 CONNAUGHT ROAD WEST • HONG KONG
TEL: 2858 6693 • FAX: 2858 9083 2858 9366 • E-MAIL: cys@cysarch.com.hk

15-01-2016

SKA-125



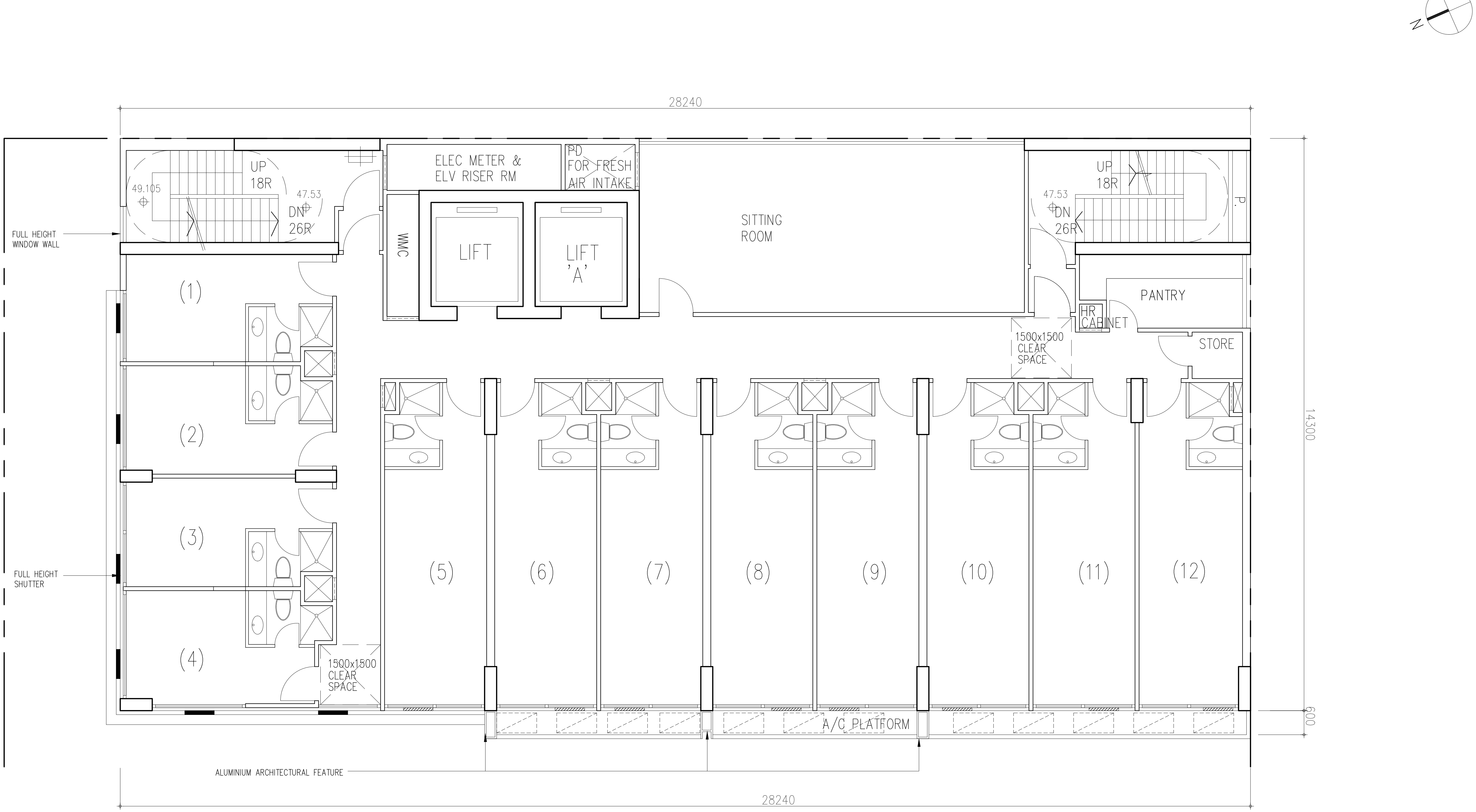
2/F PLAN

PROPOSED YOUTH HOSTEL AT 122A HOLLYWOOD ROAD, H.K. SCALE 1:100

C Y S Associates (H K) Ltd. CYS
Architects & Urban Designers.
36TH FLOOR • HONG KONG PLAZA • 186 CONNAUGHT ROAD WEST • HONG KONG
TEL: 2858 6693 • FAX: 2858 9083 2858 9366 • E-MAIL: cys@cysarch.com.hk

15-01-2016

SKA-126



HOSTEL FLOOR PLAN (3/F-12/F)
(LOW ZONE)

SINGLE ROOM : 4 NOS.
DOUBLE ROOM : 8 NOS.

TOTAL NUMBER OF FLATS IN LOW ZONE: 120 nos

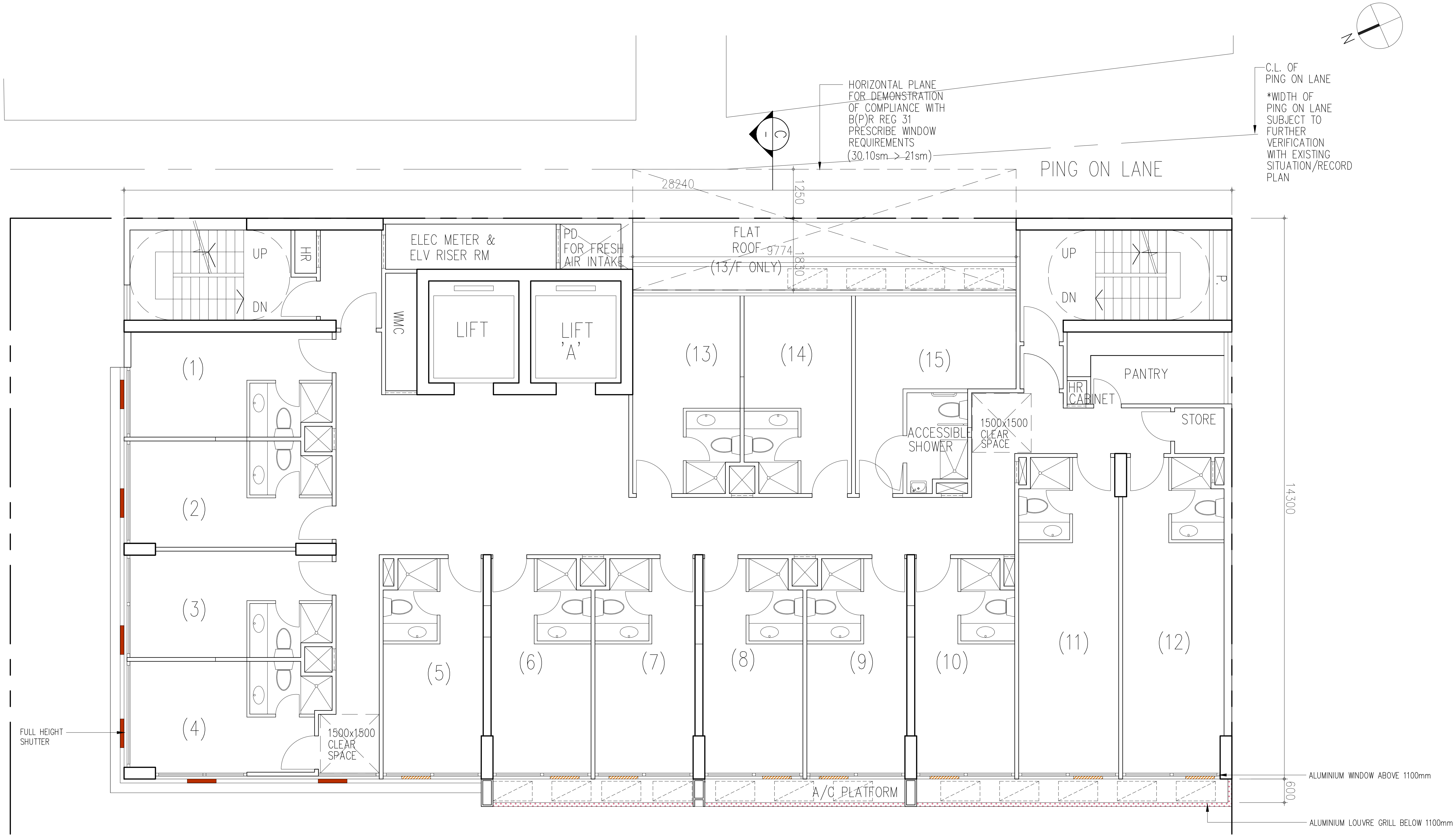
PROPOSED YOUTH HOSTEL AT 122A HOLLYWOOD ROAD, H.K.

SCALE 1:100

C Y S Associates (H K) Ltd.
Architects & Urban Designers. CYS
36TH FLOOR • HONG KONG PLAZA • 186 CONNAUGHT ROAD WEST • HONG KONG
TEL: 2858 6693 • FAX: 2858 9083 2858 9366 • E-MAIL: cys@cysarch.com.hk

15-01-2016

SKA-127



LEGEND:

- FULL HEIGHT ALUMINIUM SLIDING SHUTTER WITH WOOD-LIKE FINISH
- ALUMINIUM SLIDING SHUTTER WITH WOOD LIKE FINISH ON WINDOW SILL
- LOUVRE GRILL FIXED ON AC PLATFORM WITH ALUMINIUM WOOD-LIKE FINISH

HOSTEL FL PLAN (13/F – 18/F) (HIGH ZONE)

SINGLE ROOM : 13 NOS.
DOUBLE ROOM : 2 NOS.
TOTAL NUMBER OF FLATS IN HIGH ZONE: 90 nos

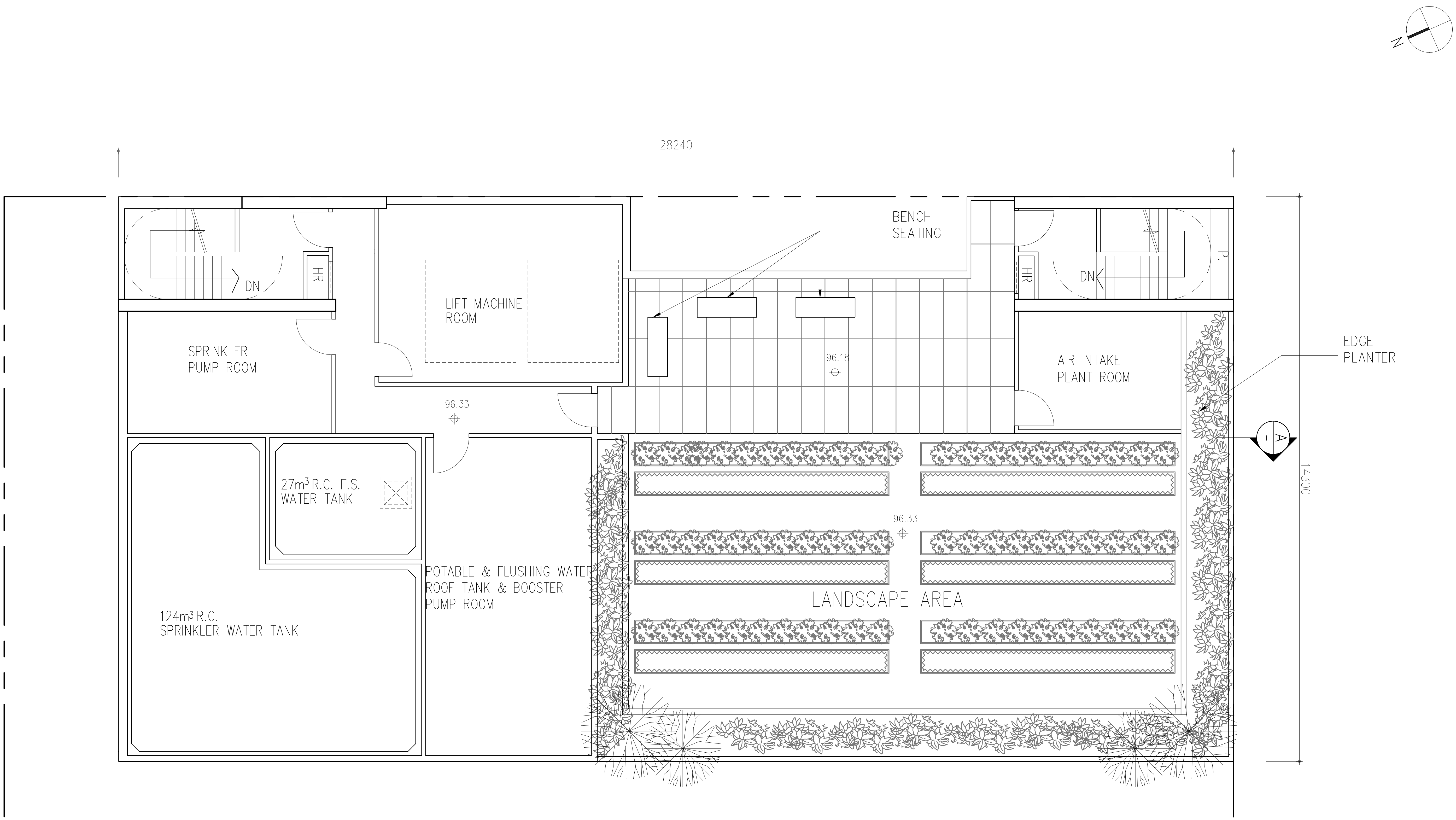
PROPOSED YOUTH HOSTEL AT 122A HOLLYWOOD ROAD, H.K.

SCALE 1:100

C Y S Associates (H K) Ltd.
Architects & Urban Designers.
36TH FLOOR • HONG KONG PLAZA • 186 CONNAUGHT ROAD WEST • HONG KONG
TEL: 2858 6693 • FAX: 2858 9063 2858 9366 • E-MAIL: cys@cysarch.com.hk

15-01-2016

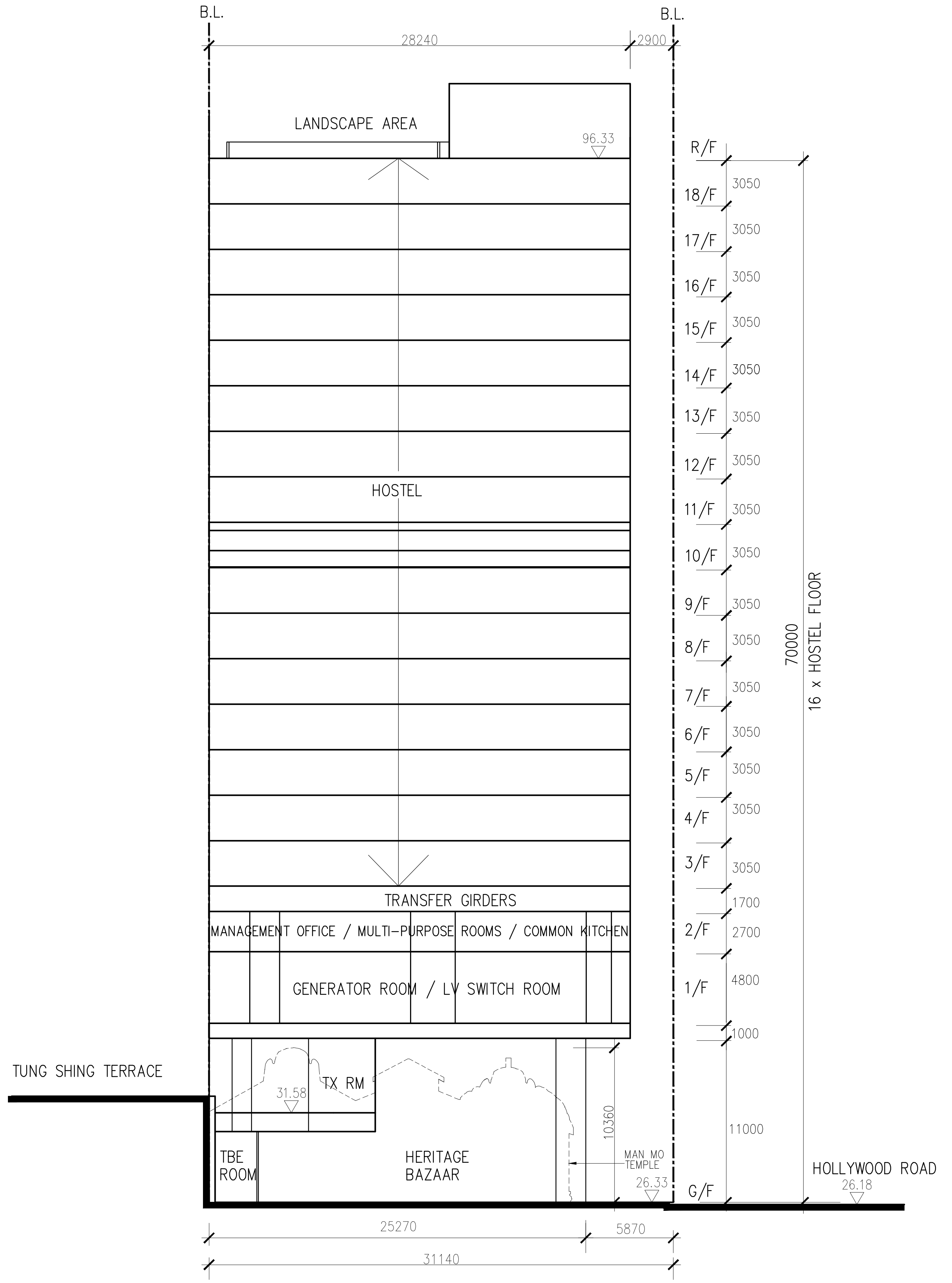
SKA-12



ROOF PLAN

PROPOSED YOUTH HOSTEL AT 122A HOLLYWOOD ROAD, H.K. SCALE 1:100

C Y S Associates (H K) Ltd.
Architects & Urban Designers. CYS
36TH FLOOR • HONG KONG PLAZA • 186 CONNAUGHT ROAD WEST • HONG KONG
TEL: 2858 6693 • FAX: 2858 9083 2858 9366 • E-MAIL: cys@cysarch.com.hk
15-01-2016
SKA-129



SECTION A

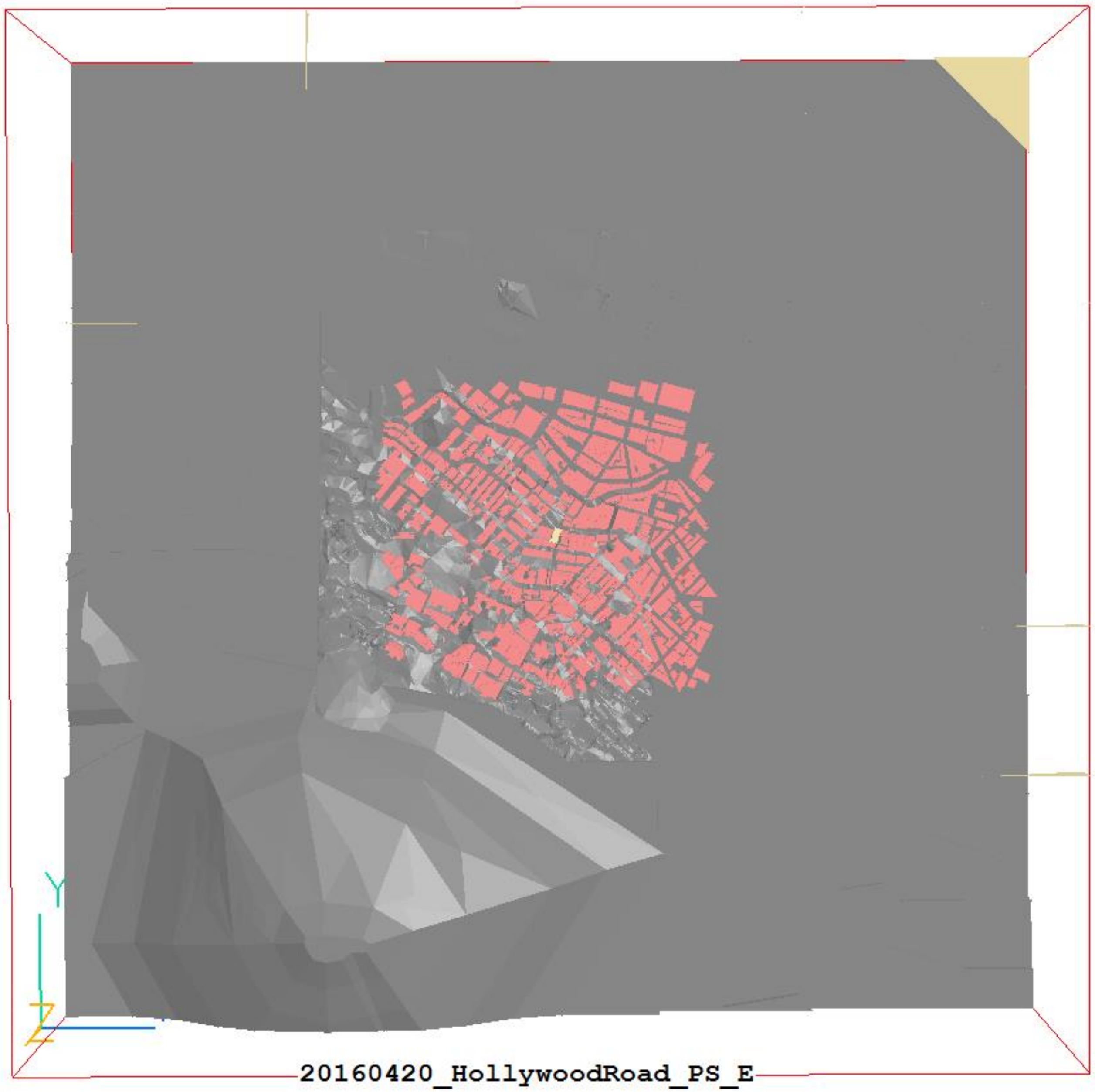
PROPOSED YOUTH HOSTEL AT 122A HOLLYWOOD ROAD, H.K.

SCALE 1:350@A3

C Y S Associates (H K) Ltd.
Architects & Urban Designers. CYS
36TH FLOOR • HONG KONG PLAZA • 186 CONNAUGHT ROAD WEST • HONG KONG
TEL: 2858 6693 • FAX: 2858 0083 2858 0366 • E-MAIL: cys@cysarch.com.hk

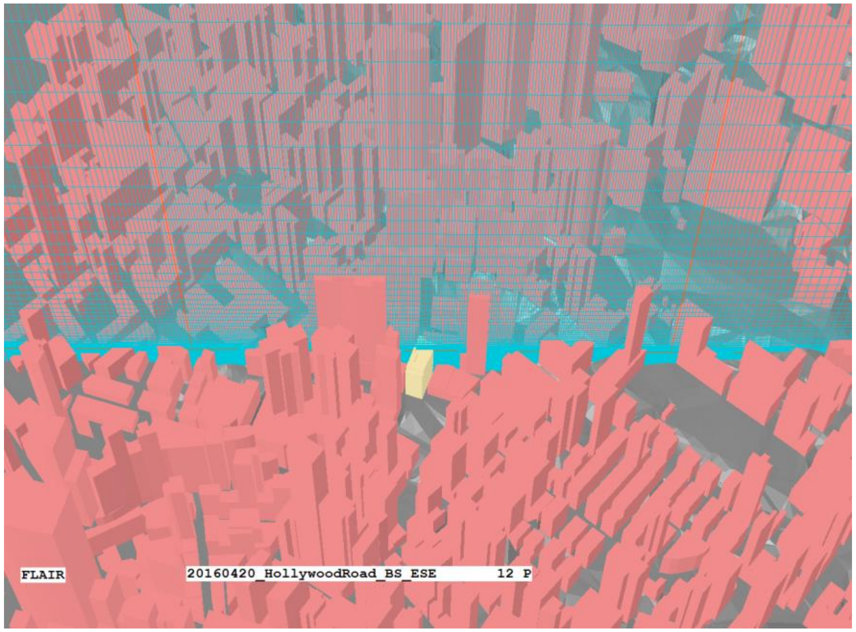
SKA-123b

APPENDIX C
CFD MODEL IN DIFFERENT VIEWS AND VECTOR/WIND VELOCITY RATIO CONTOUR PLOTS OF SIMULATION RESULTS

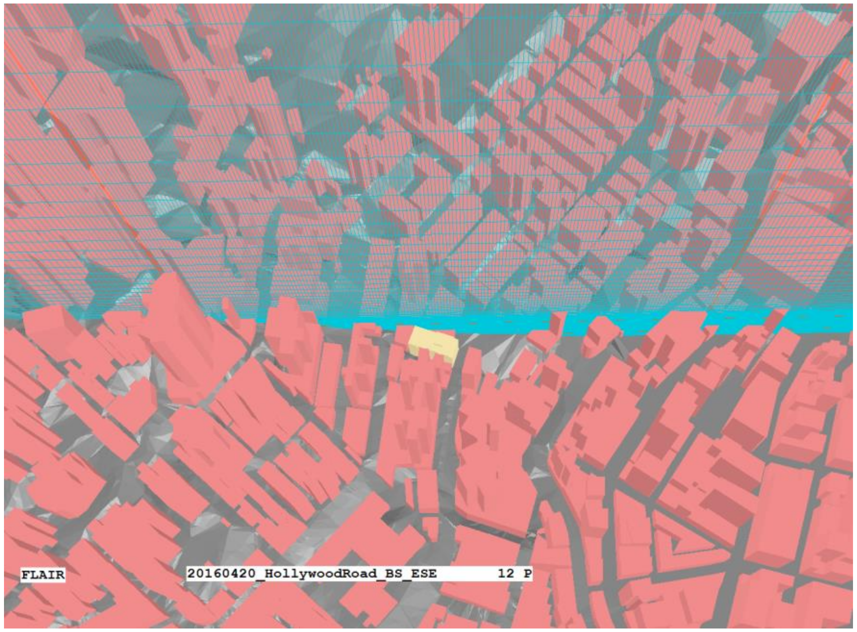


FLAIR

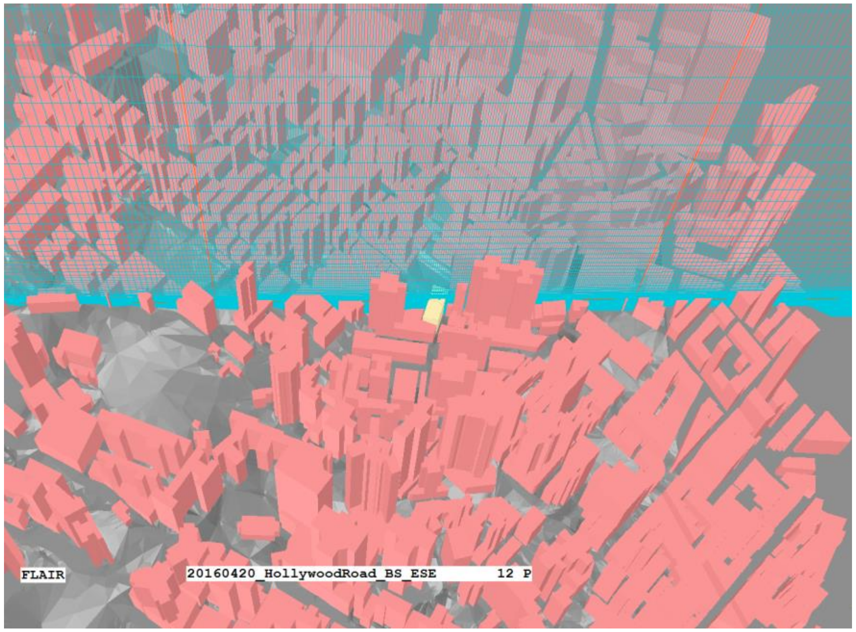
20160420_HollywoodRoad_PS_E



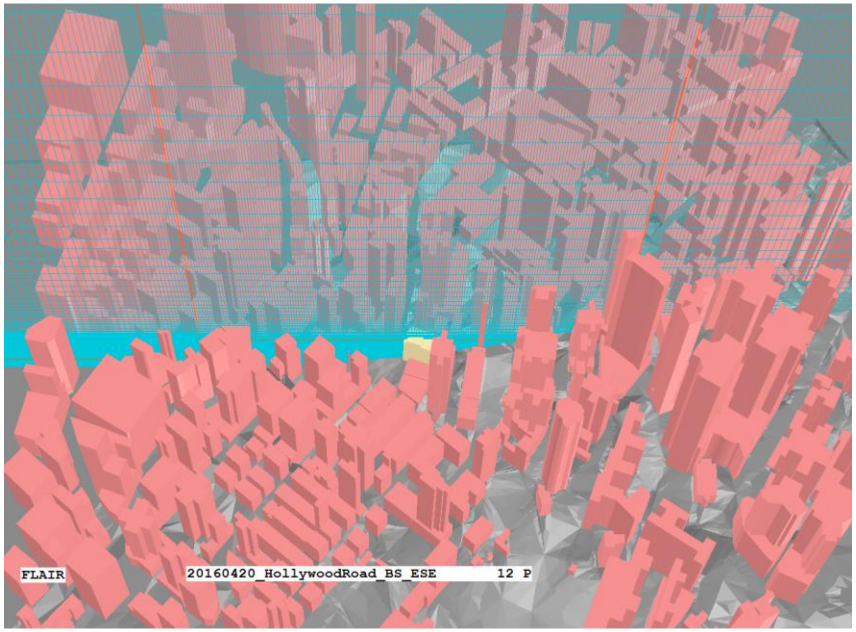
Baseline Scheme - N



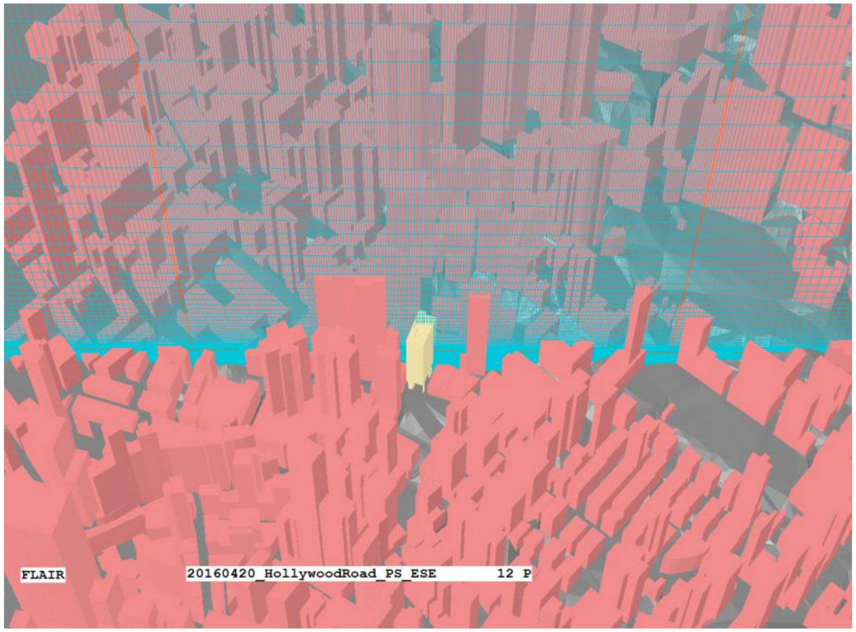
Baseline Scheme - E



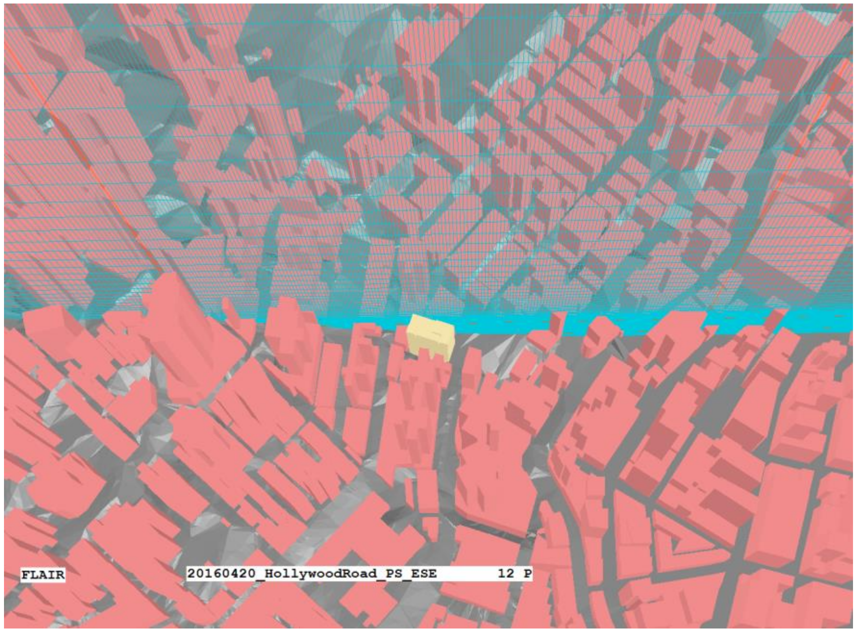
Baseline Scheme - S



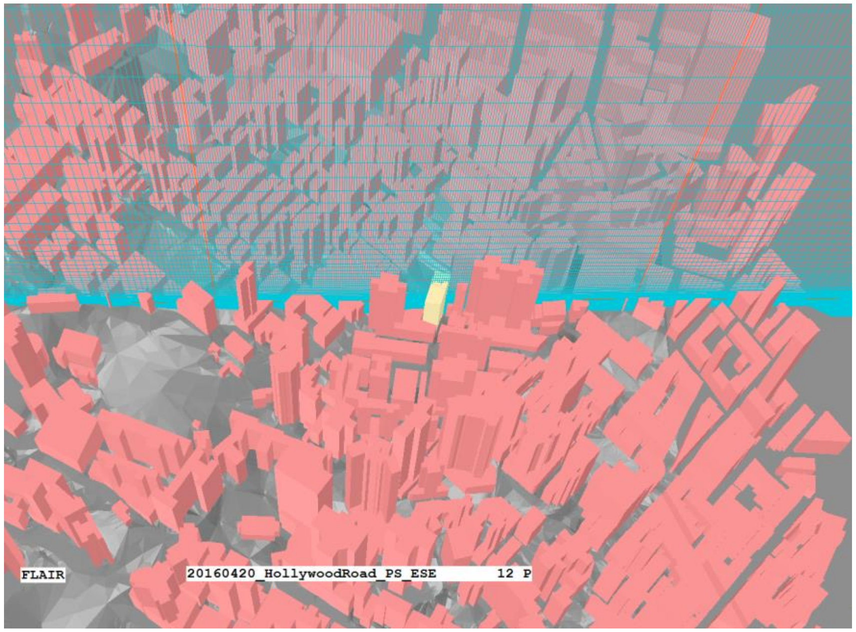
Baseline Scheme - W



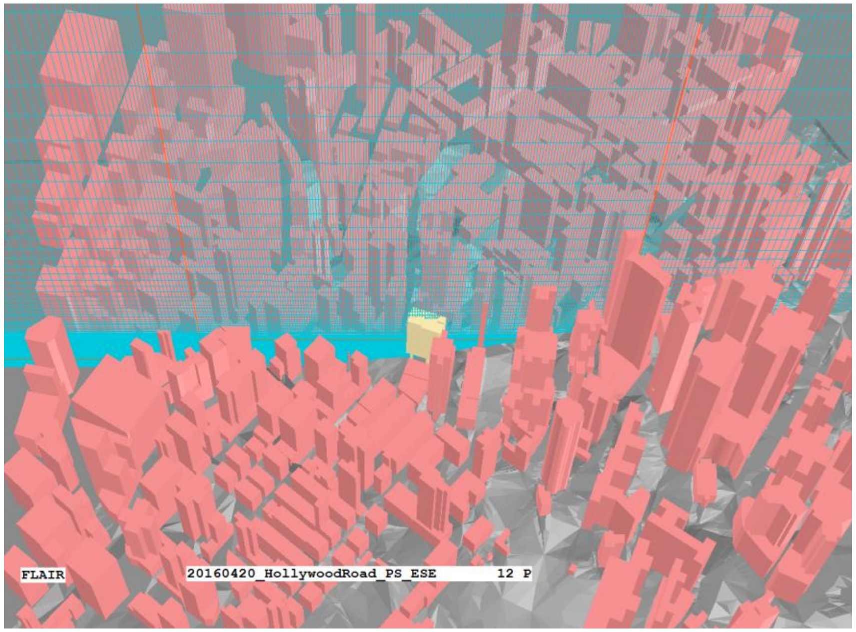
Proposed Scheme - N



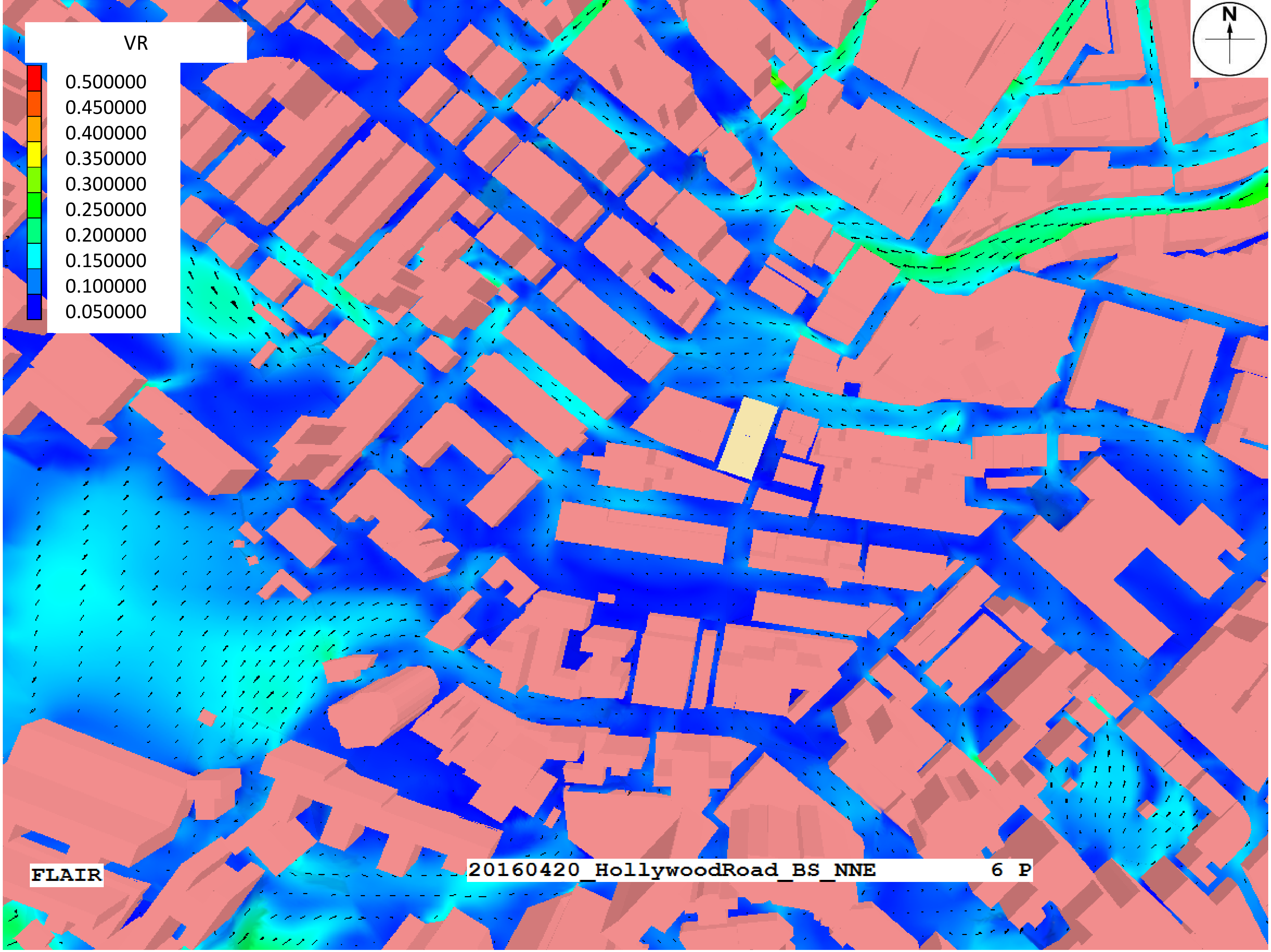
Proposed Scheme - E



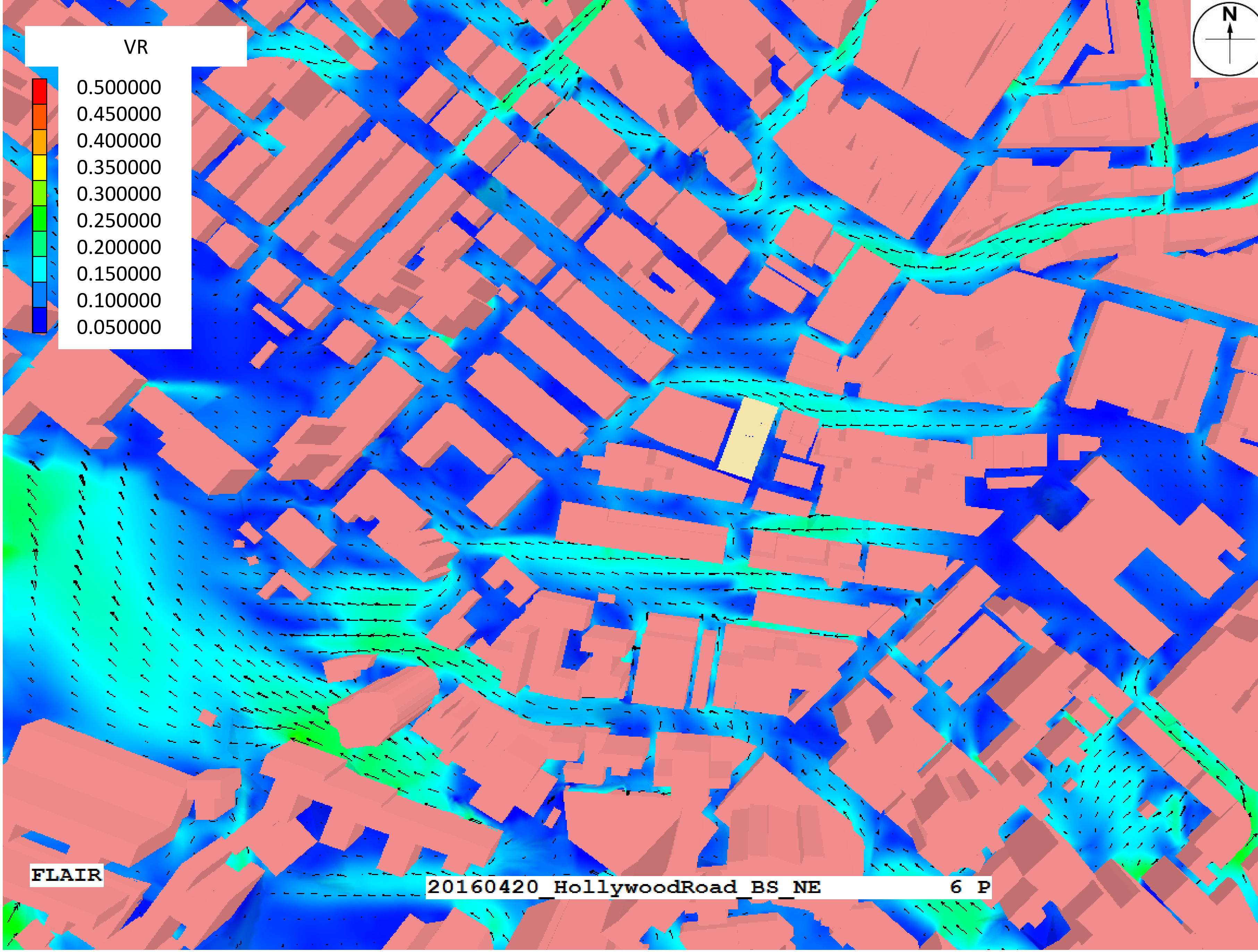
Proposed Scheme - S



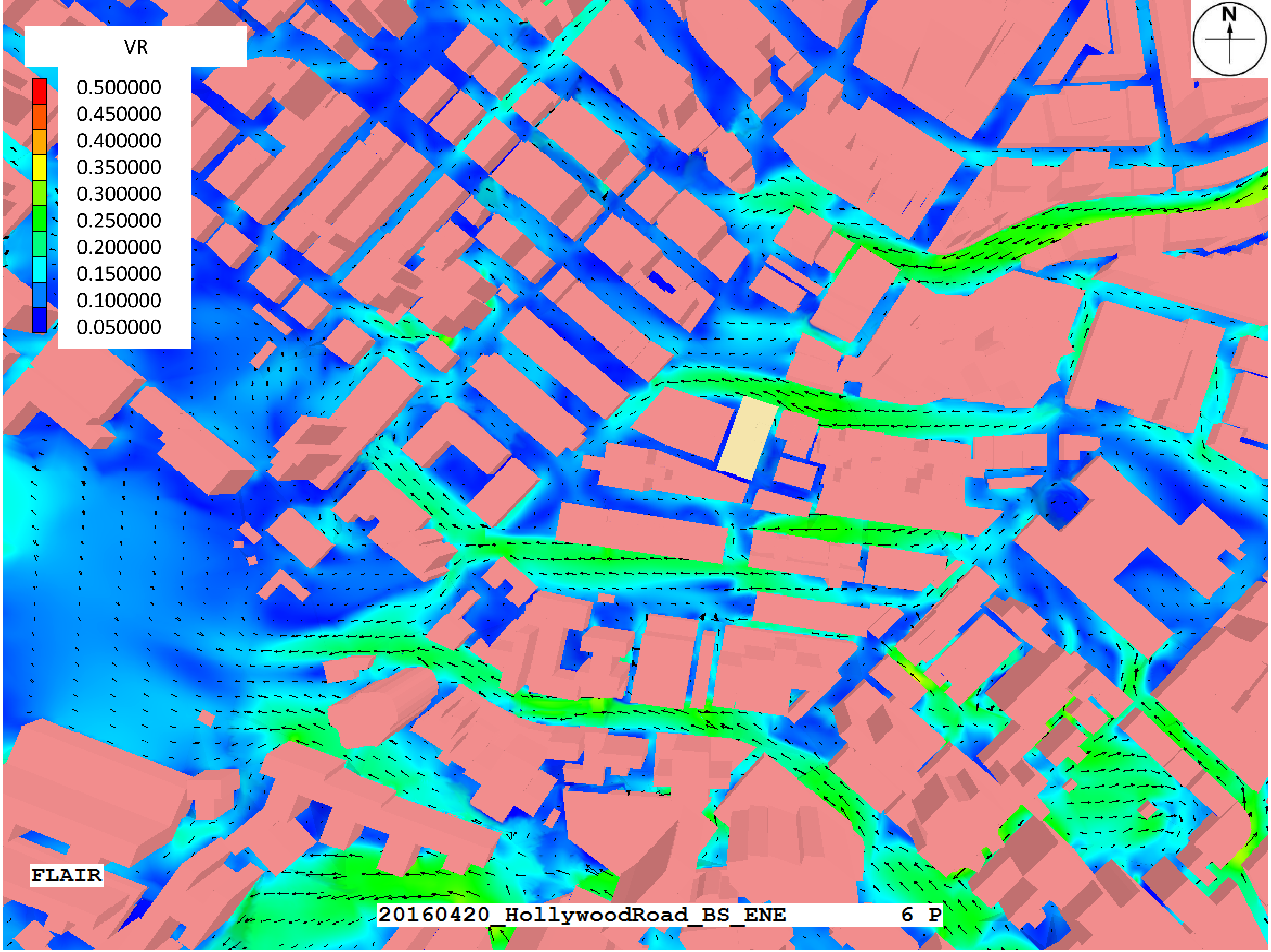
Proposed Scheme - W



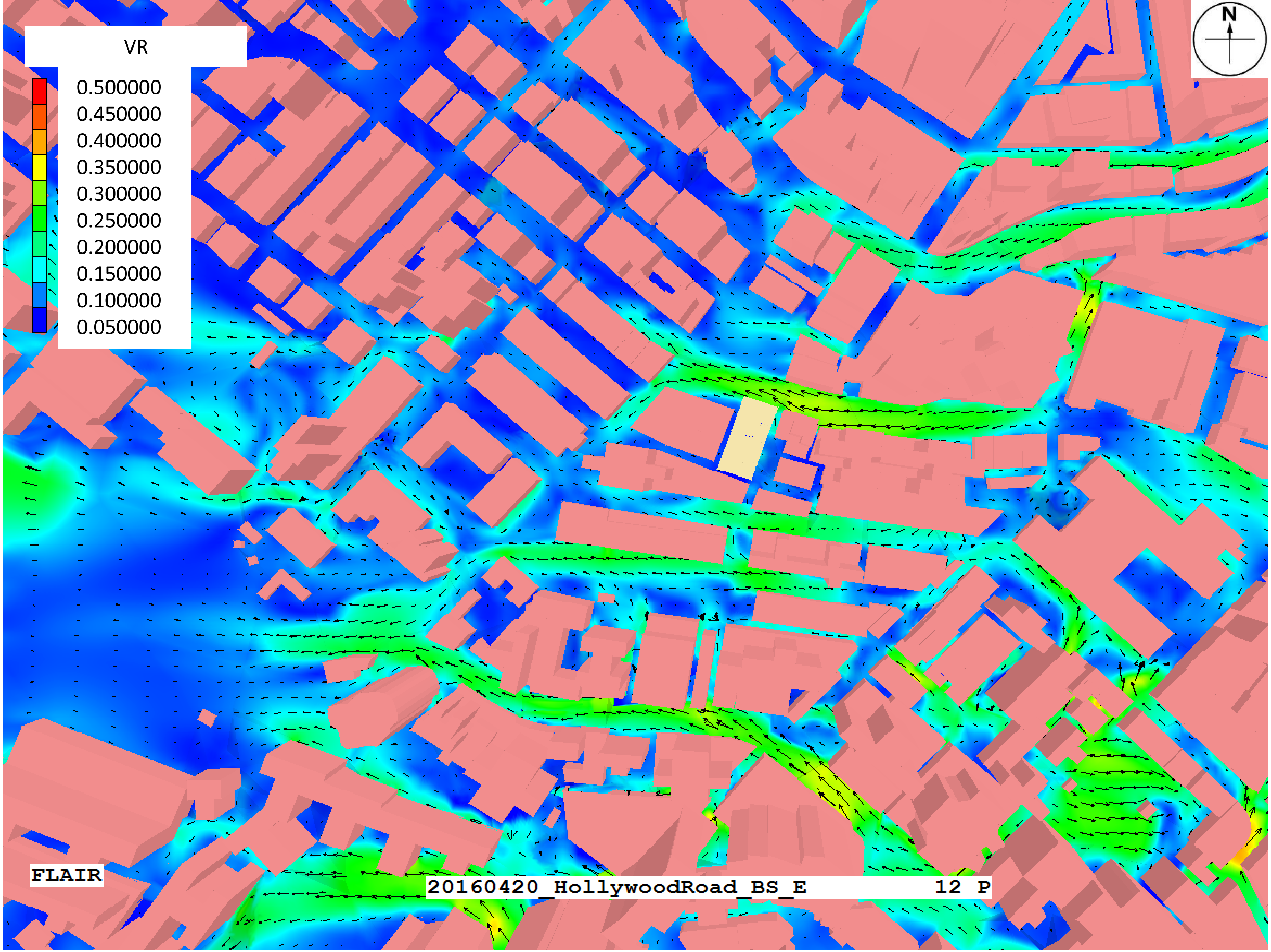
Baseline Scheme - Wind VR colour and vector plot at pedestrian level under NNE Wind



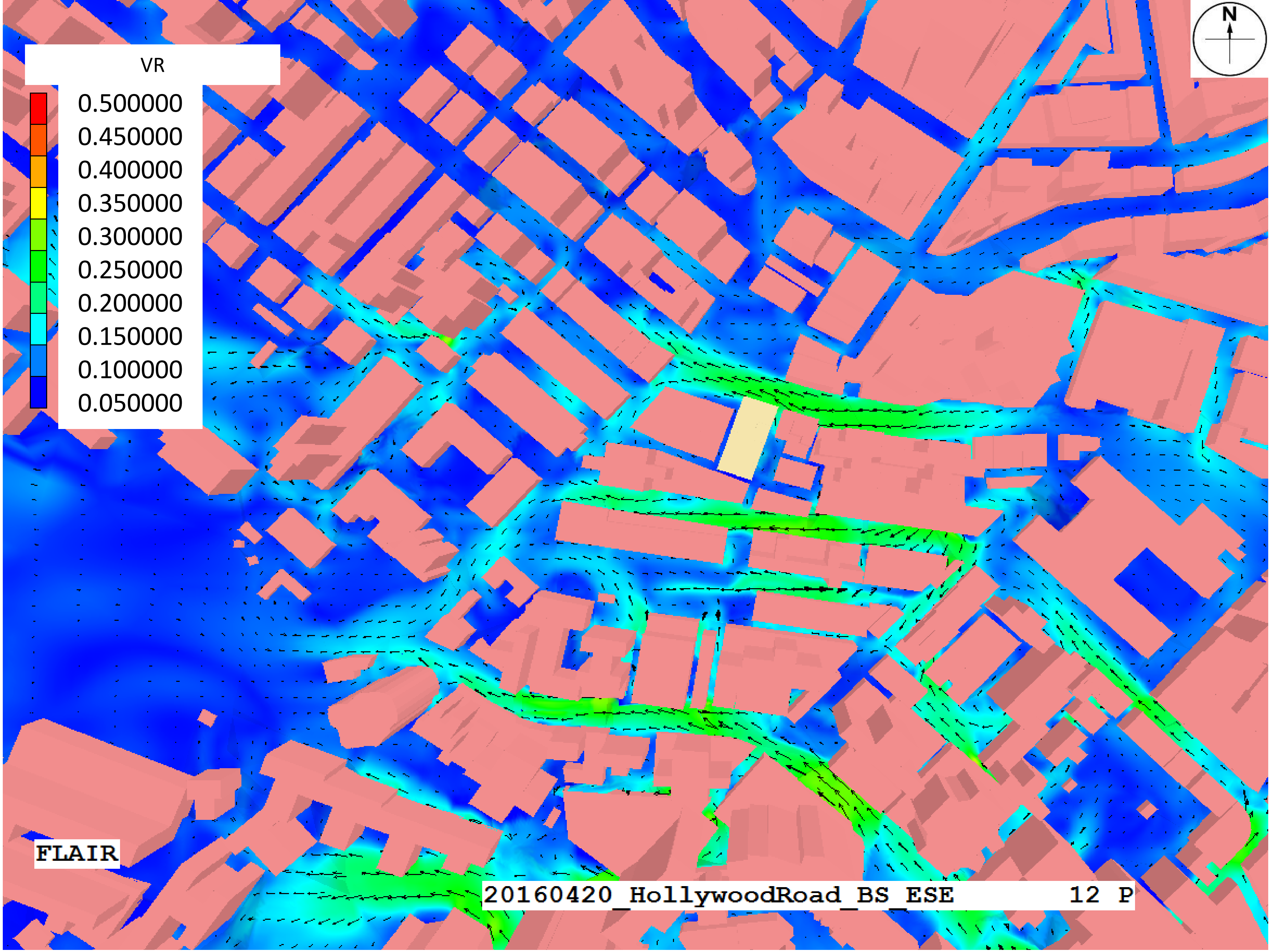
Baseline Scheme - Wind VR colour and vector plot at pedestrian level under NE Wind



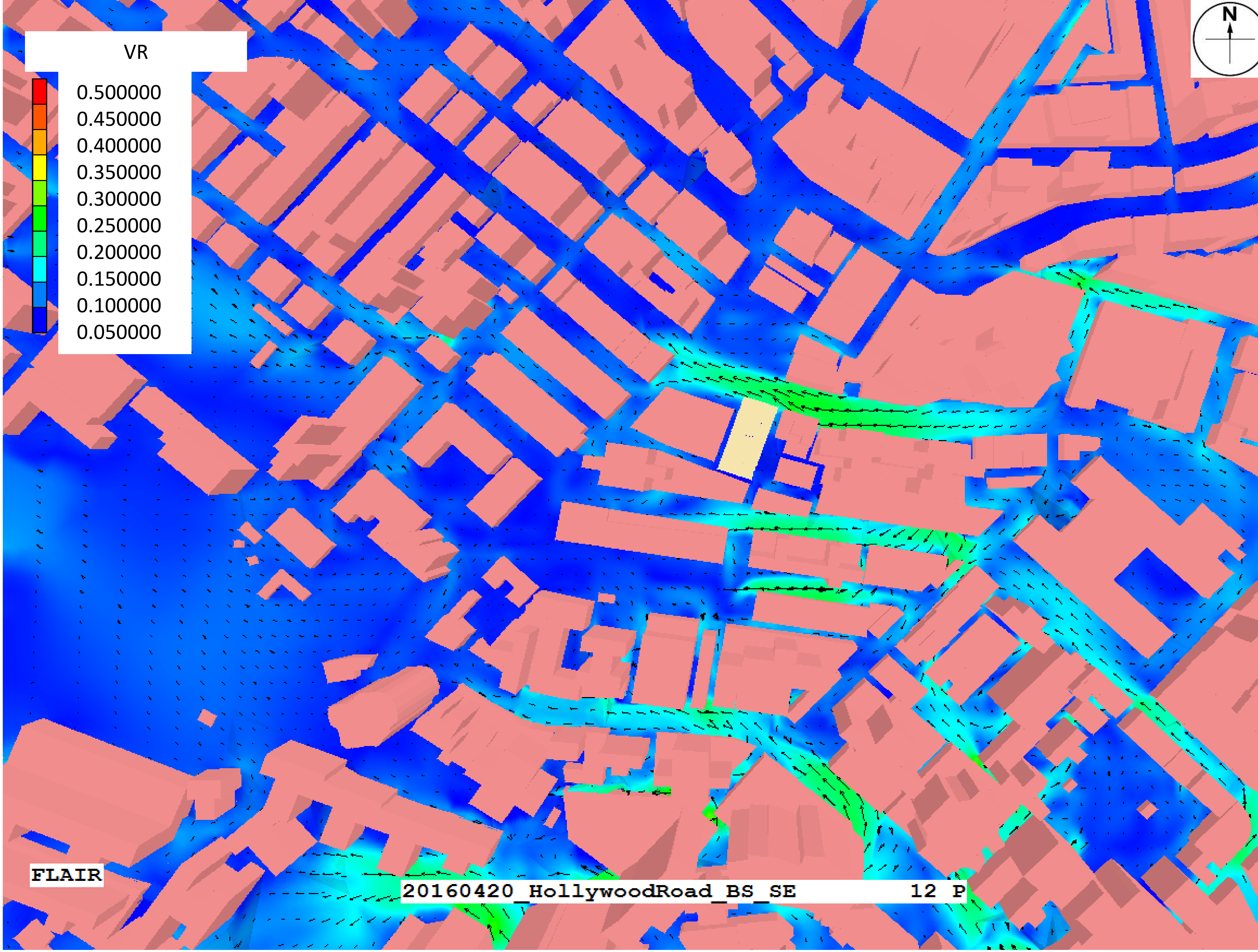
Baseline Scheme - Wind VR colour and vector plot at pedestrian level under ENE Wind



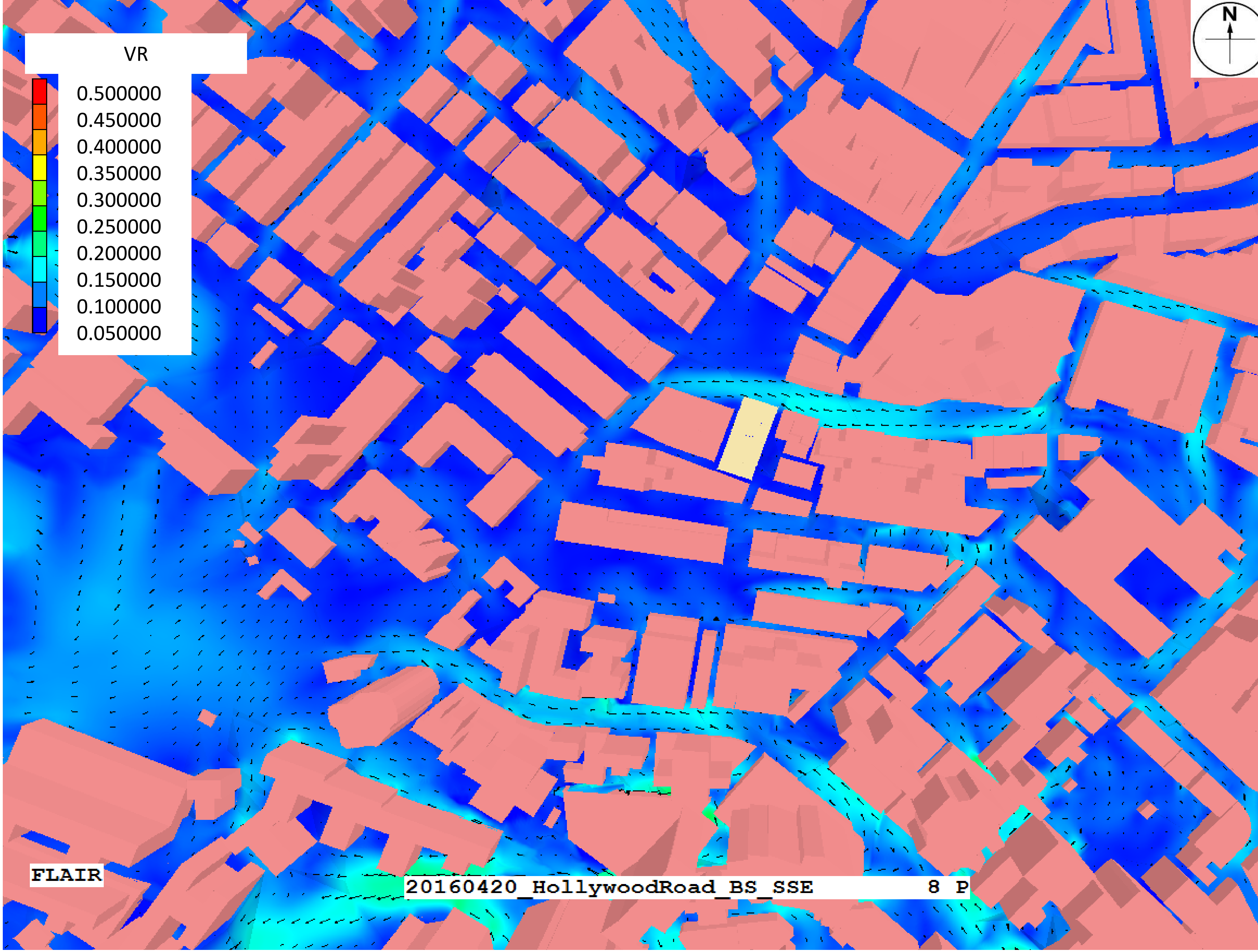
Baseline Scheme - Wind VR colour and vector plot at pedestrian level under E Wind



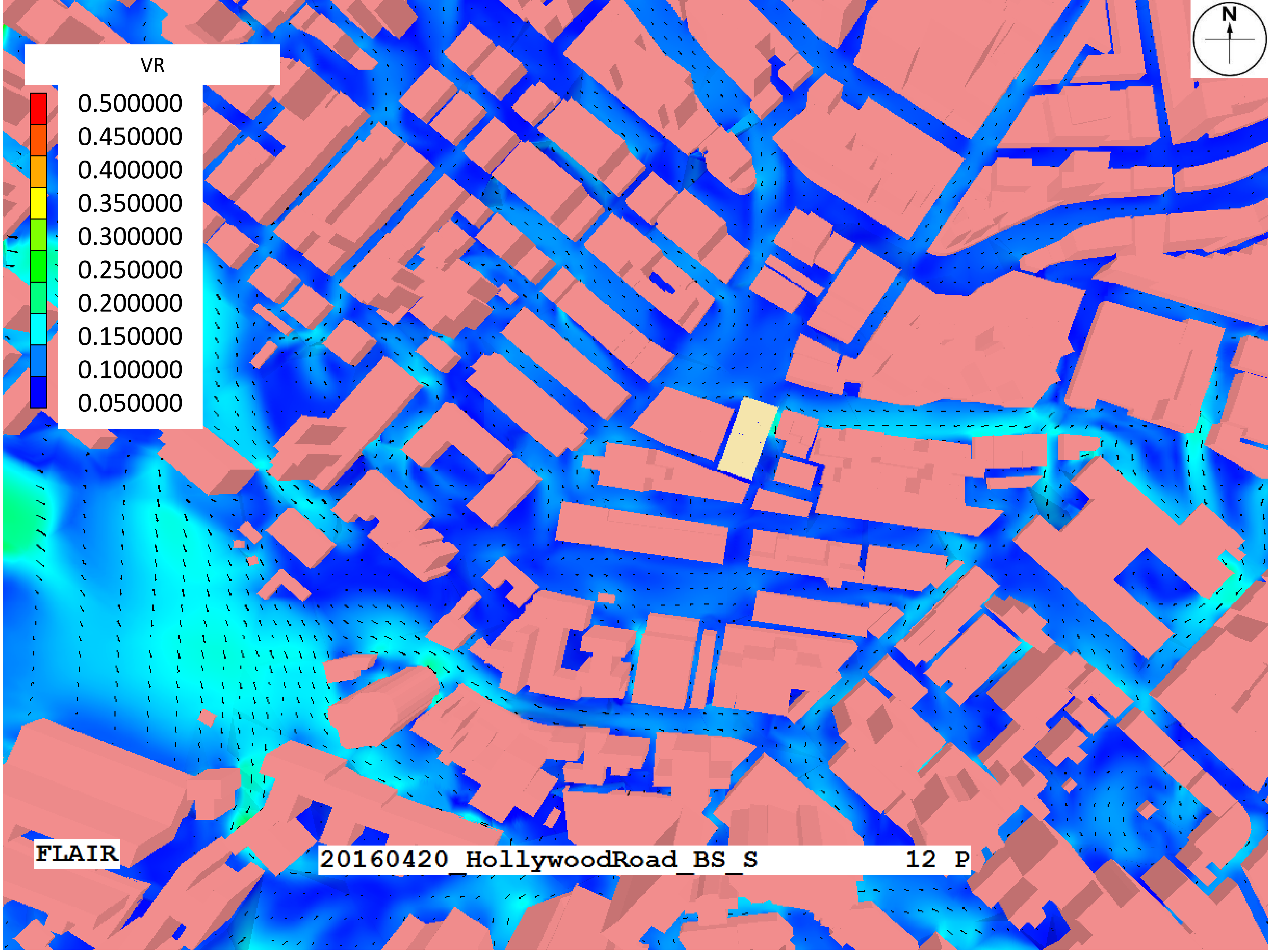
Baseline Scheme - Wind VR colour and vector plot at pedestrian level under ESE Wind



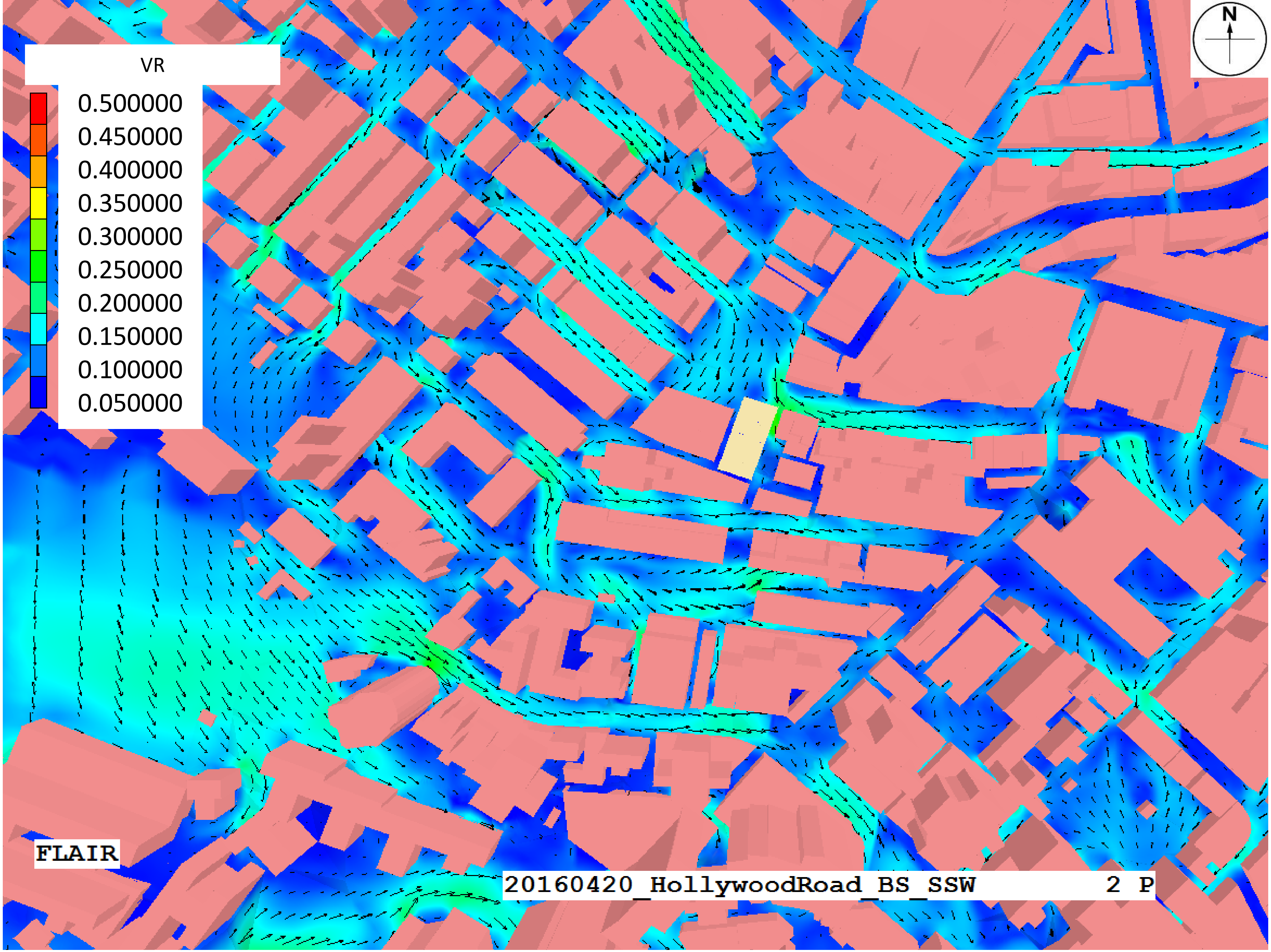
Baseline Scheme - Wind VR colour and vector plot at pedestrian level under SE Wind



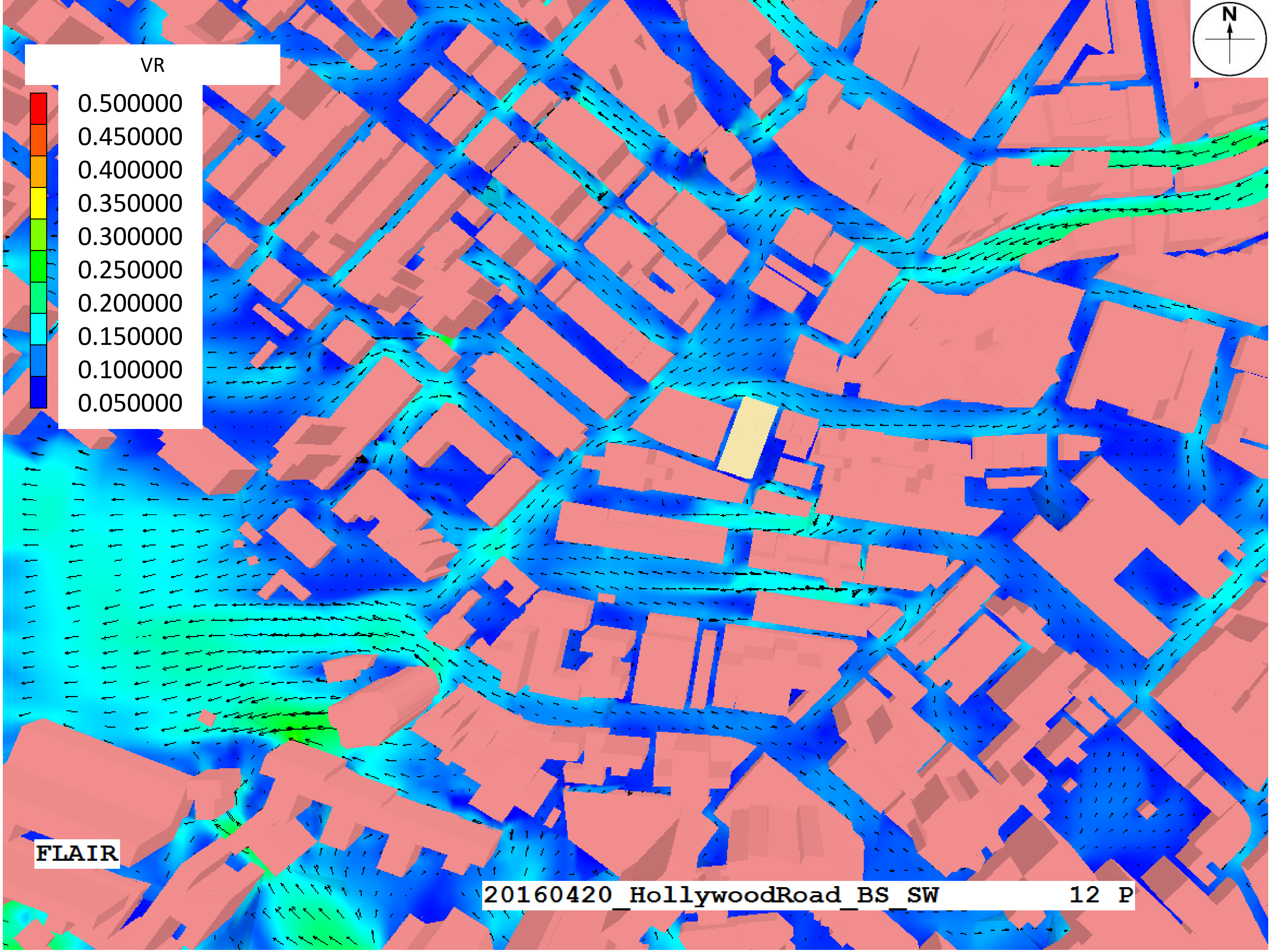
Baseline Scheme - Wind VR colour and vector plot at pedestrian level under SSE Wind



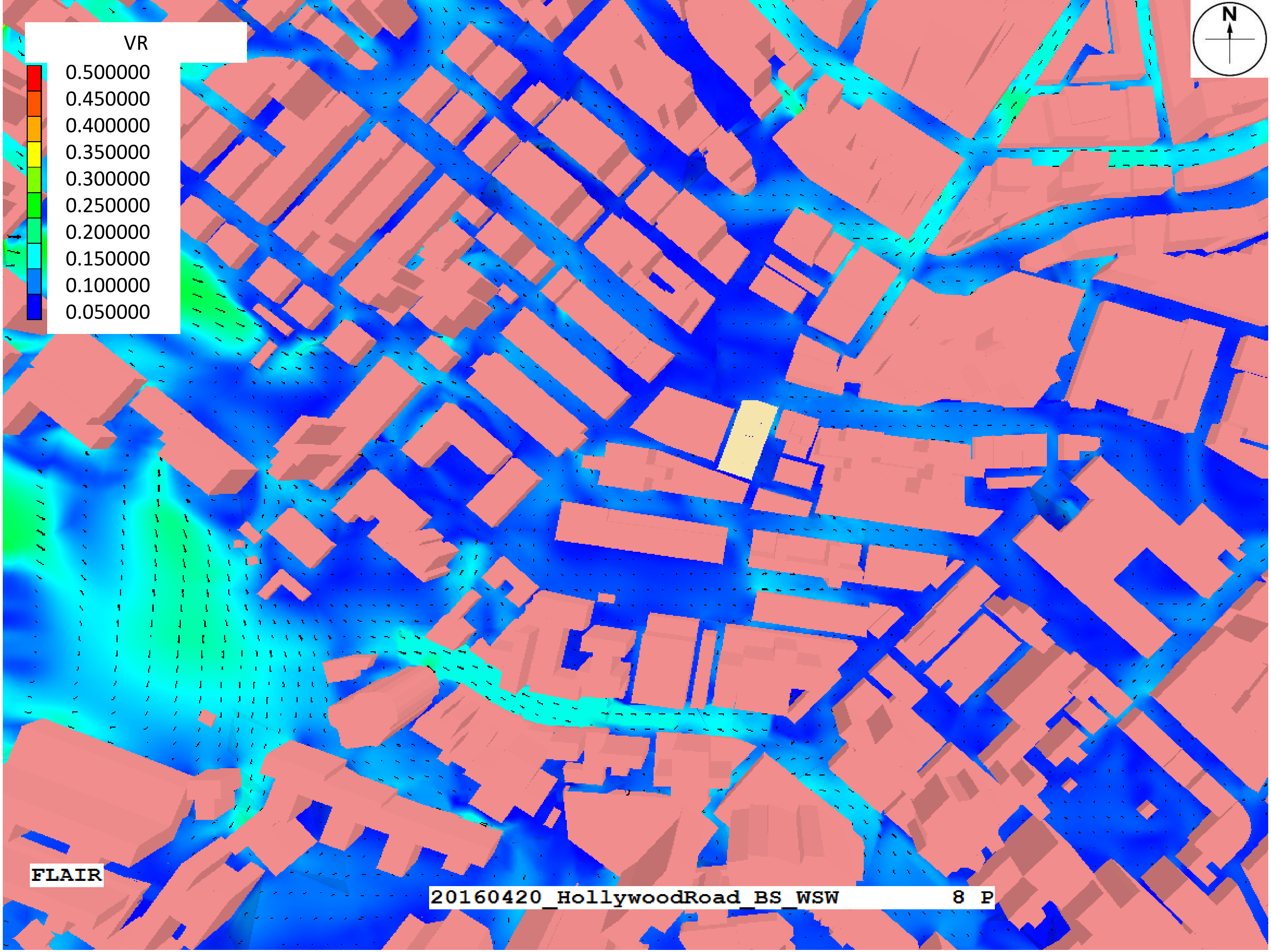
Baseline Scheme - Wind VR colour and vector plot at pedestrian level under S Wind



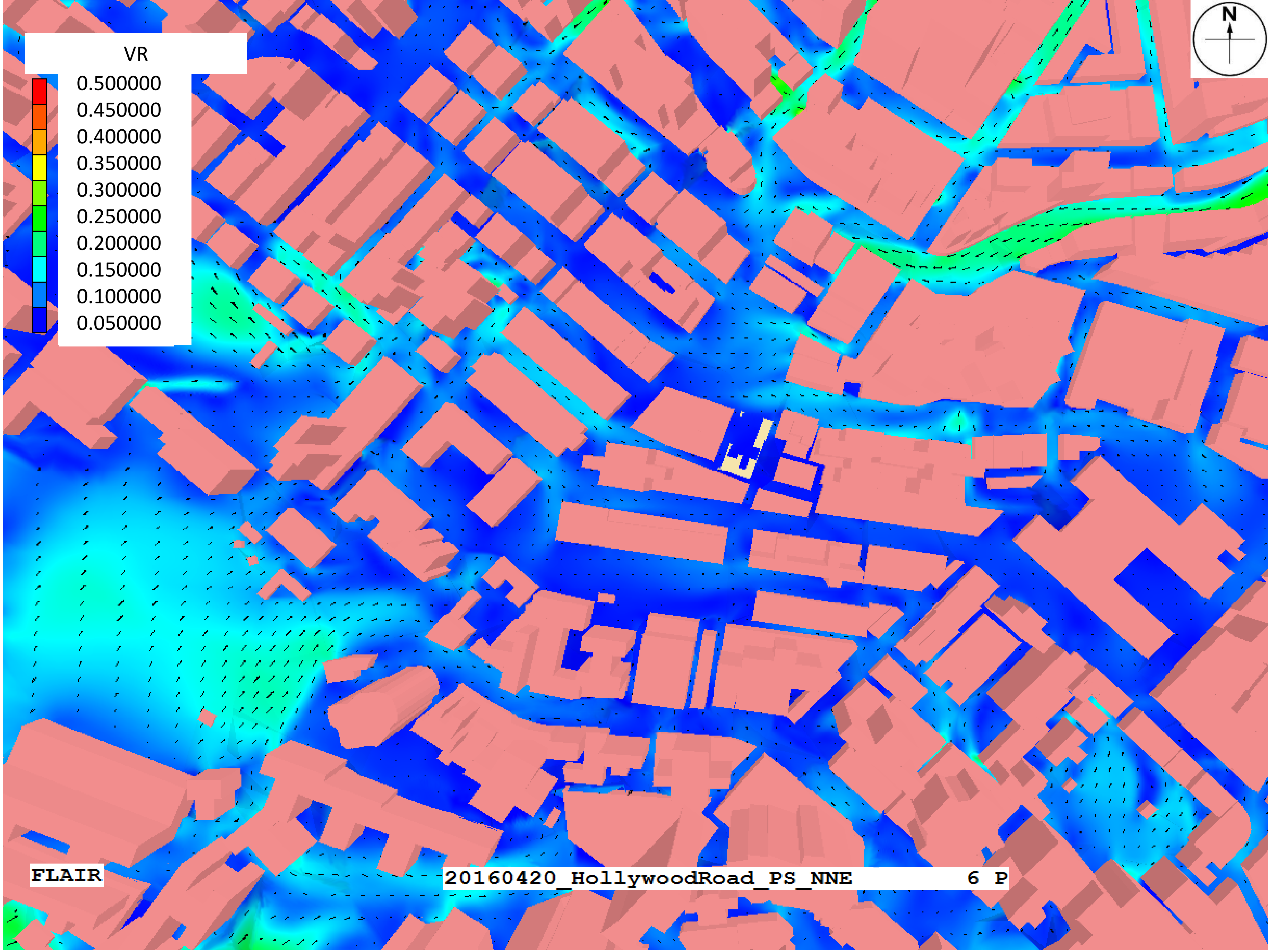
Baseline Scheme - Wind VR colour and vector plot at pedestrian level under SSW Wind



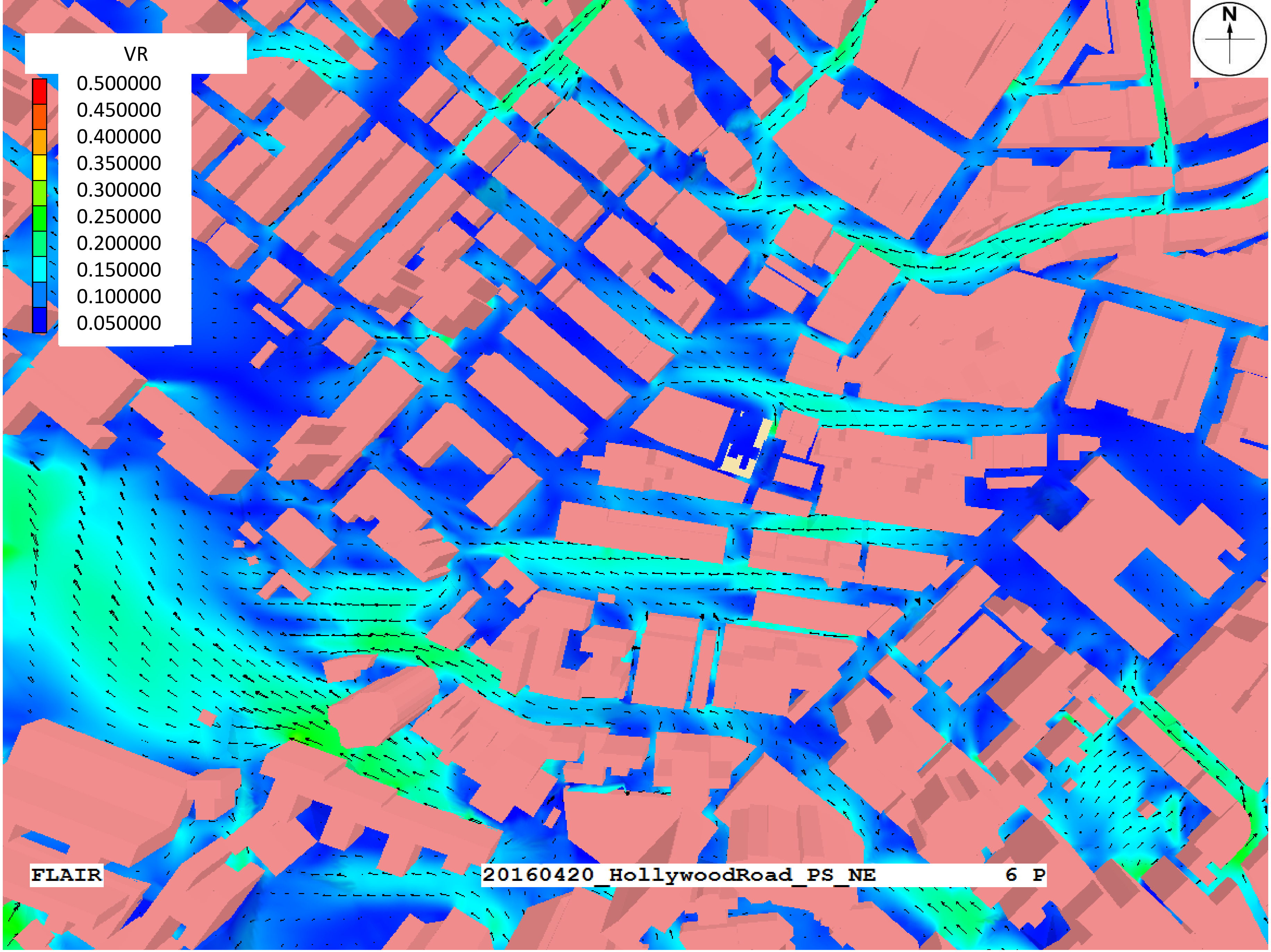
Baseline Scheme – Wind VR and vector plot at pedestrian level under SW Wind



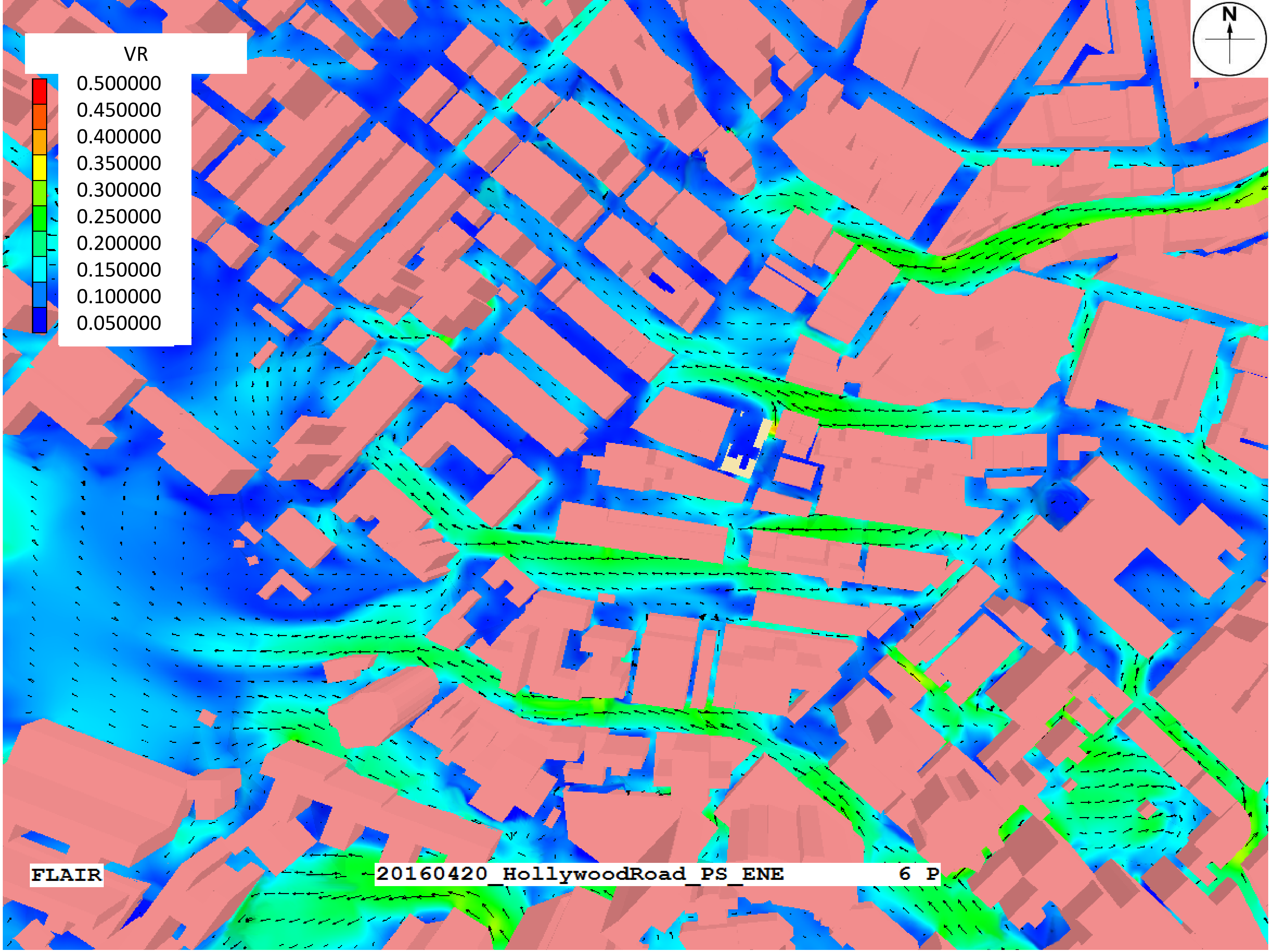
Baseline Scheme - Wind VR and vector plot at pedestrian level under WSW Wind



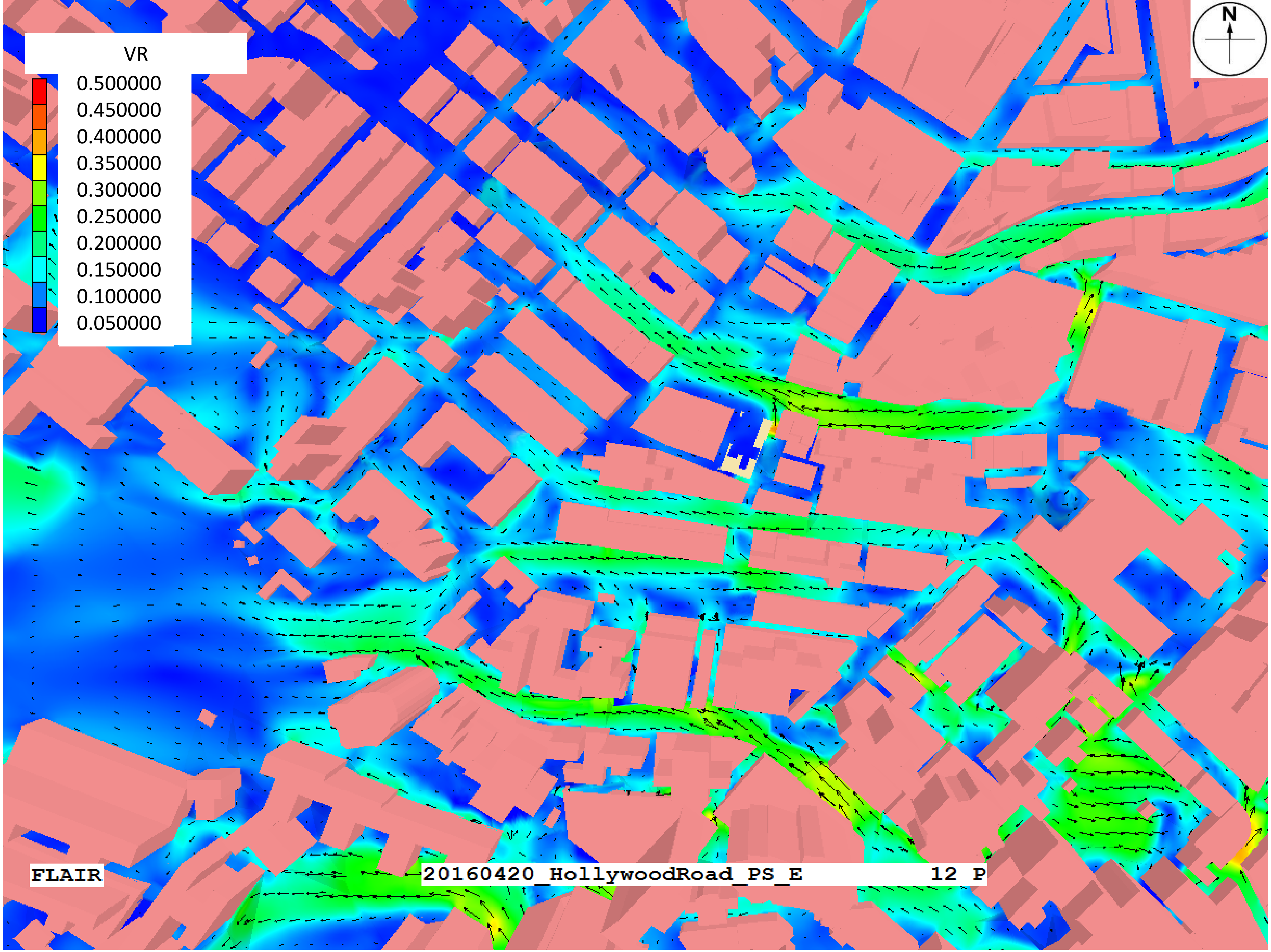
Proposed Scheme - Wind VR and vector plot at pedestrian level under NNE Wind



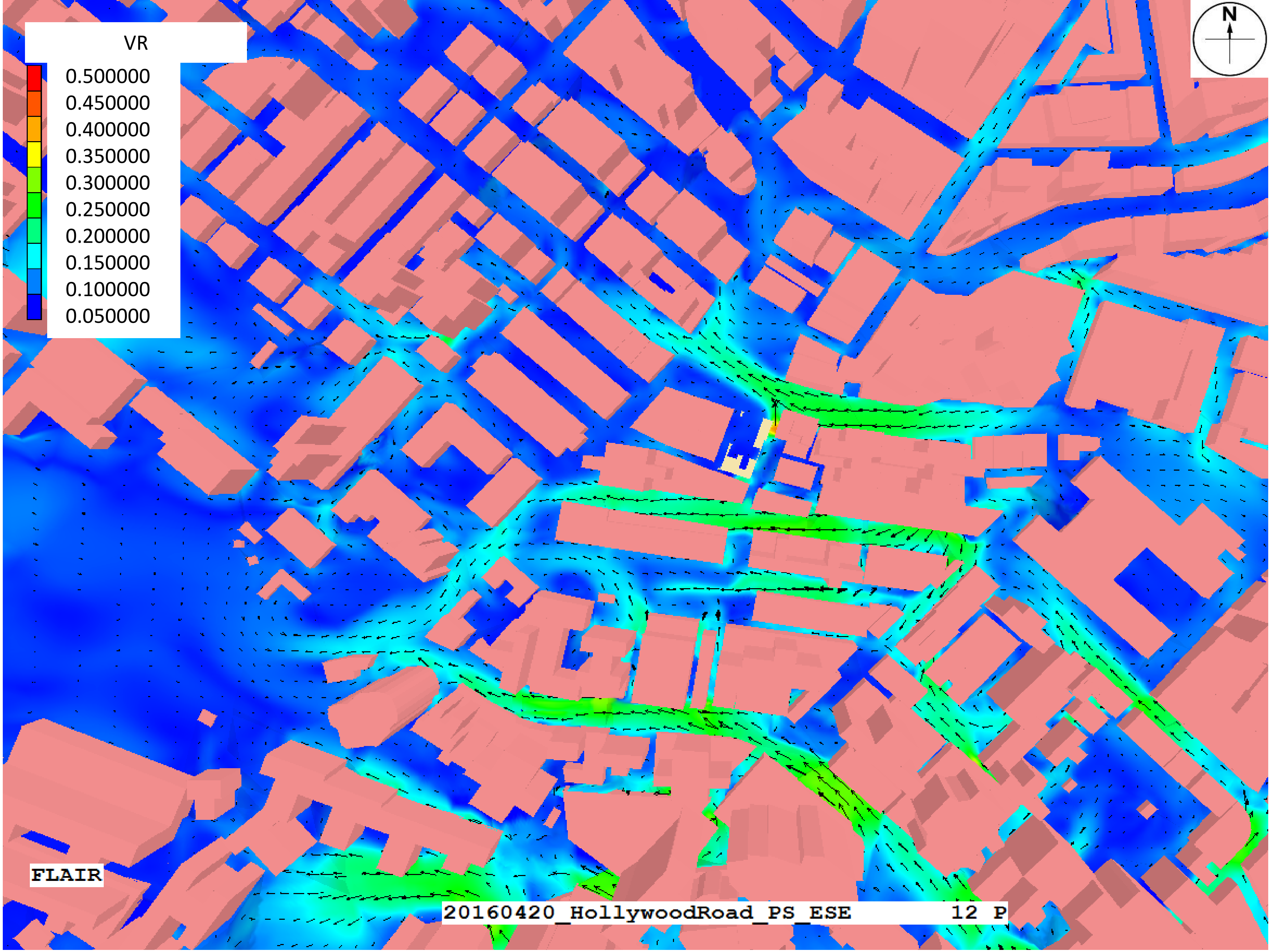
Proposed Scheme - Wind VR and vector plot at pedestrian level under NE Wind



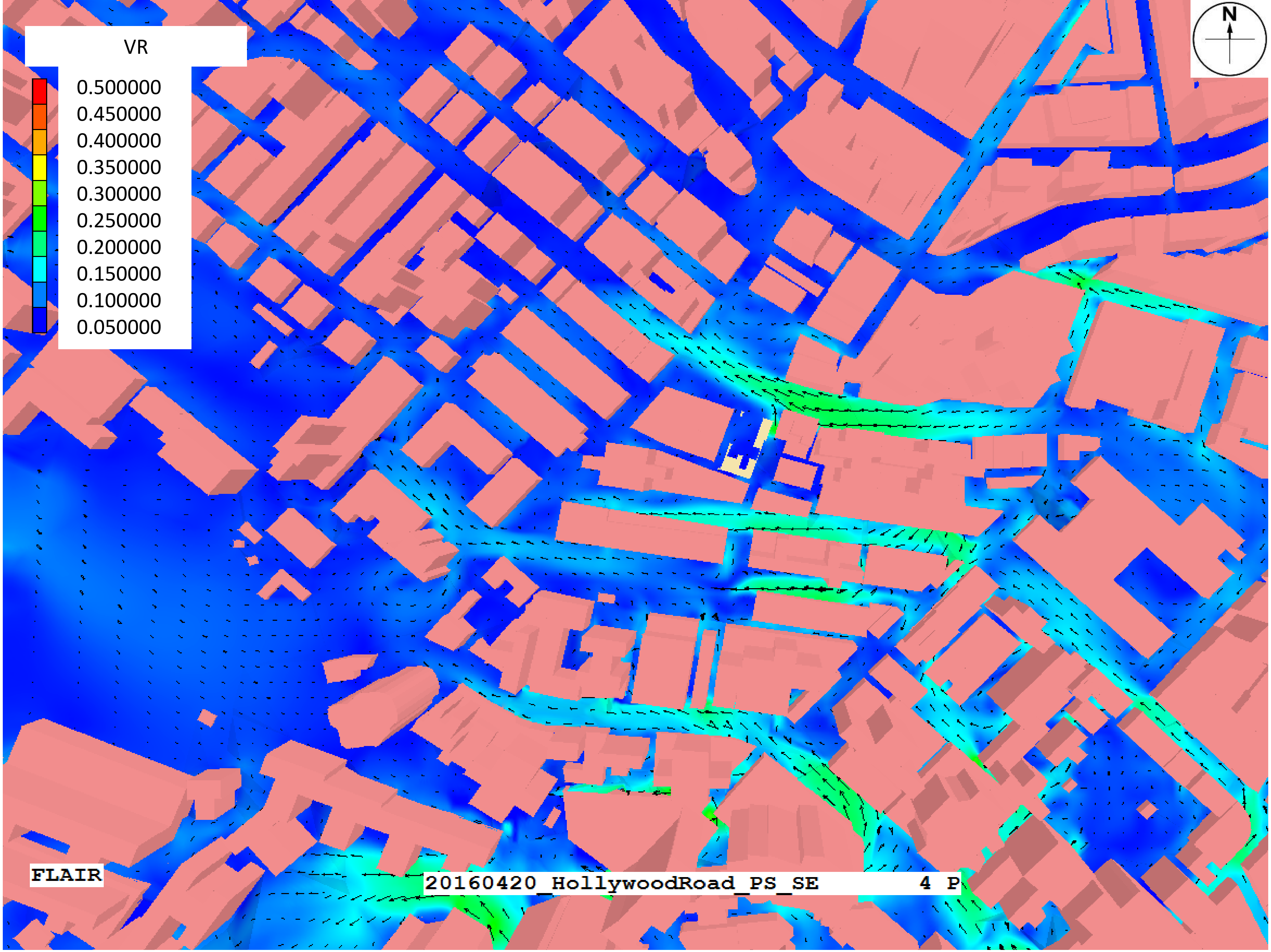
Proposed Scheme - Wind VR and vector plot at pedestrian level under ENE Wind



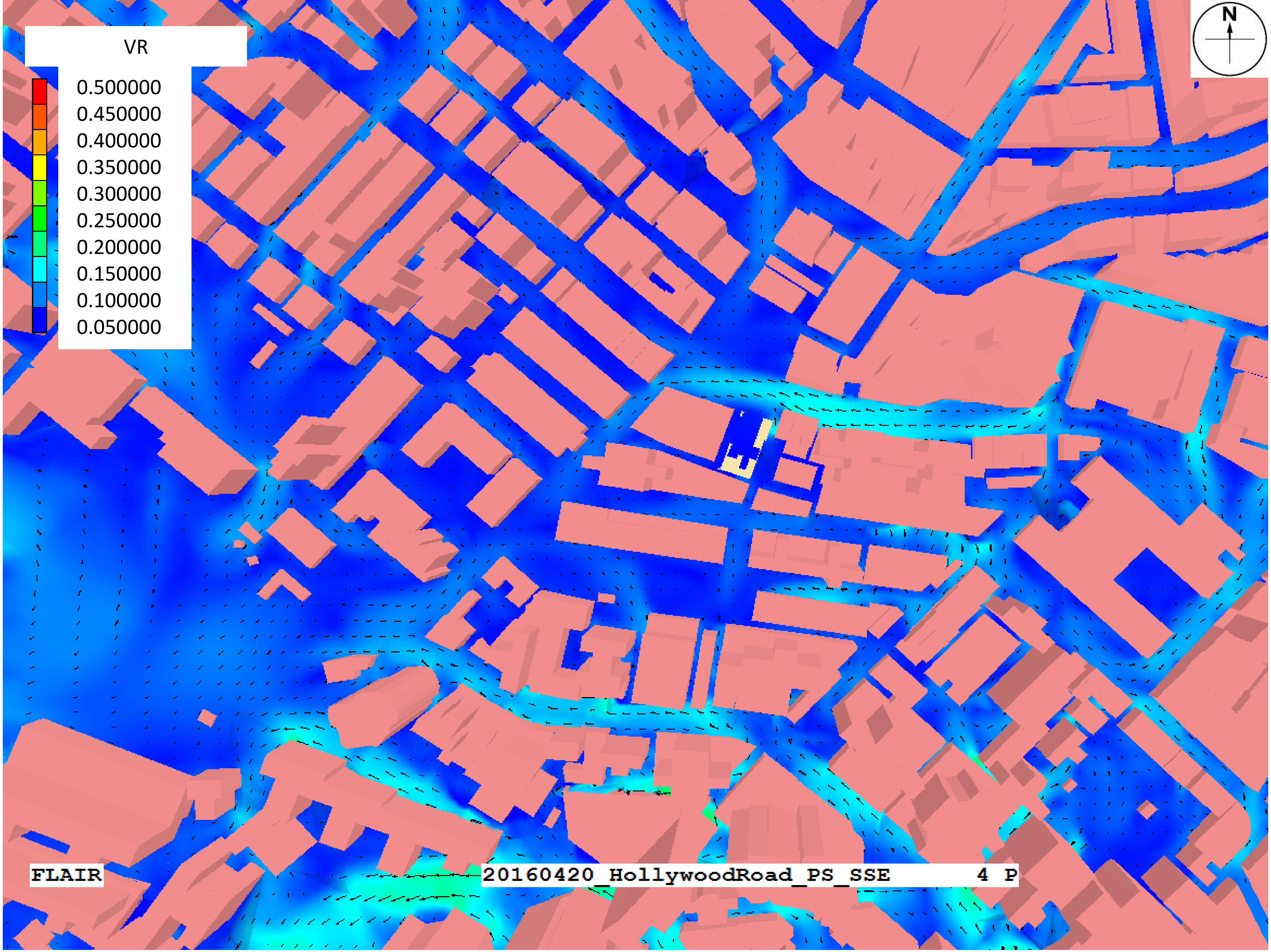
Proposed Scheme - Wind VR and vector plot at pedestrian level under E Wind



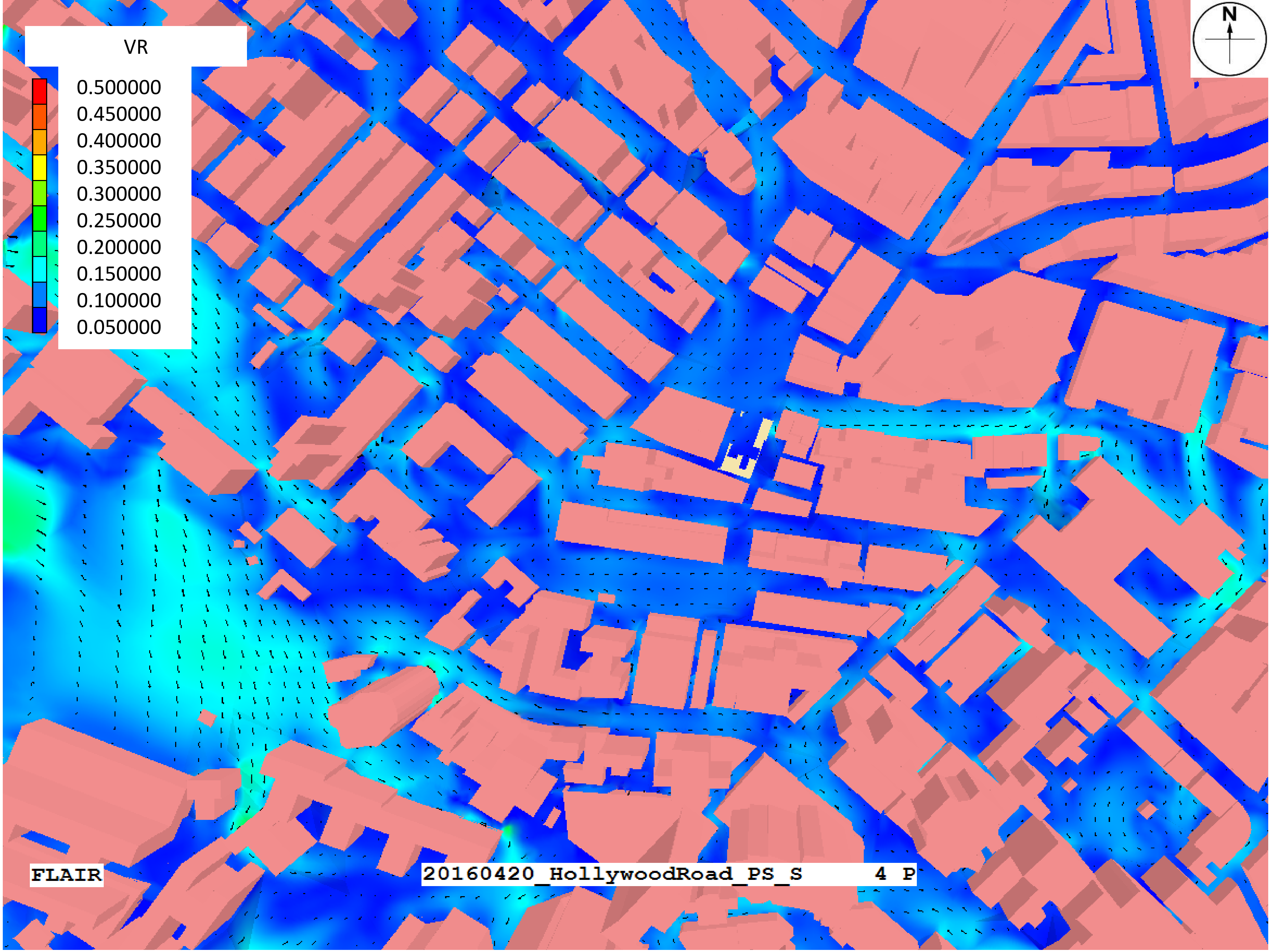
Proposed Scheme - Wind VR and vector plot at pedestrian level under ESE Wind



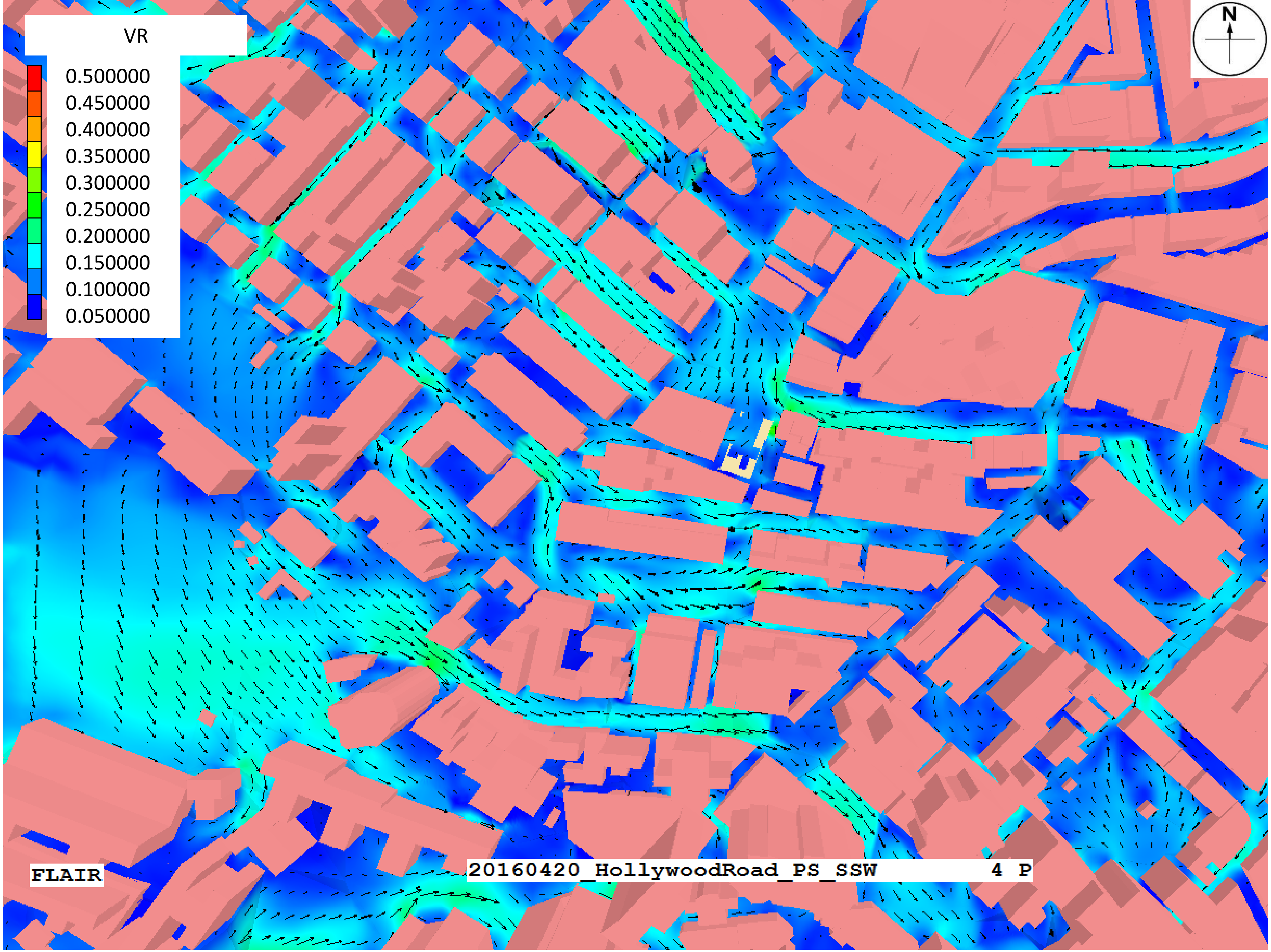
Proposed Scheme - Wind VR and vector plot at pedestrian level under SE Wind



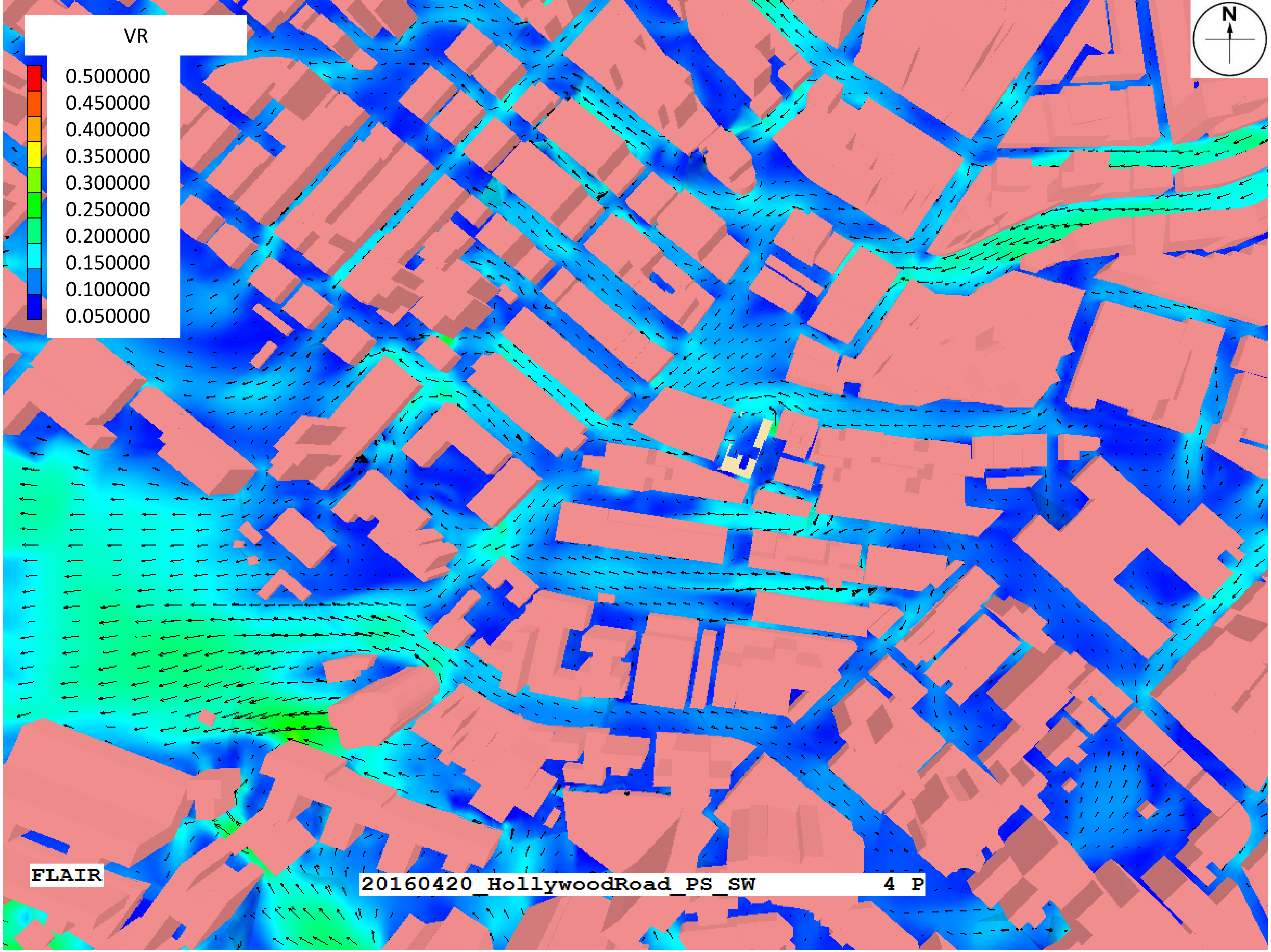
Proposed Scheme - Wind VR and vector plot at pedestrian level under SSE Wind



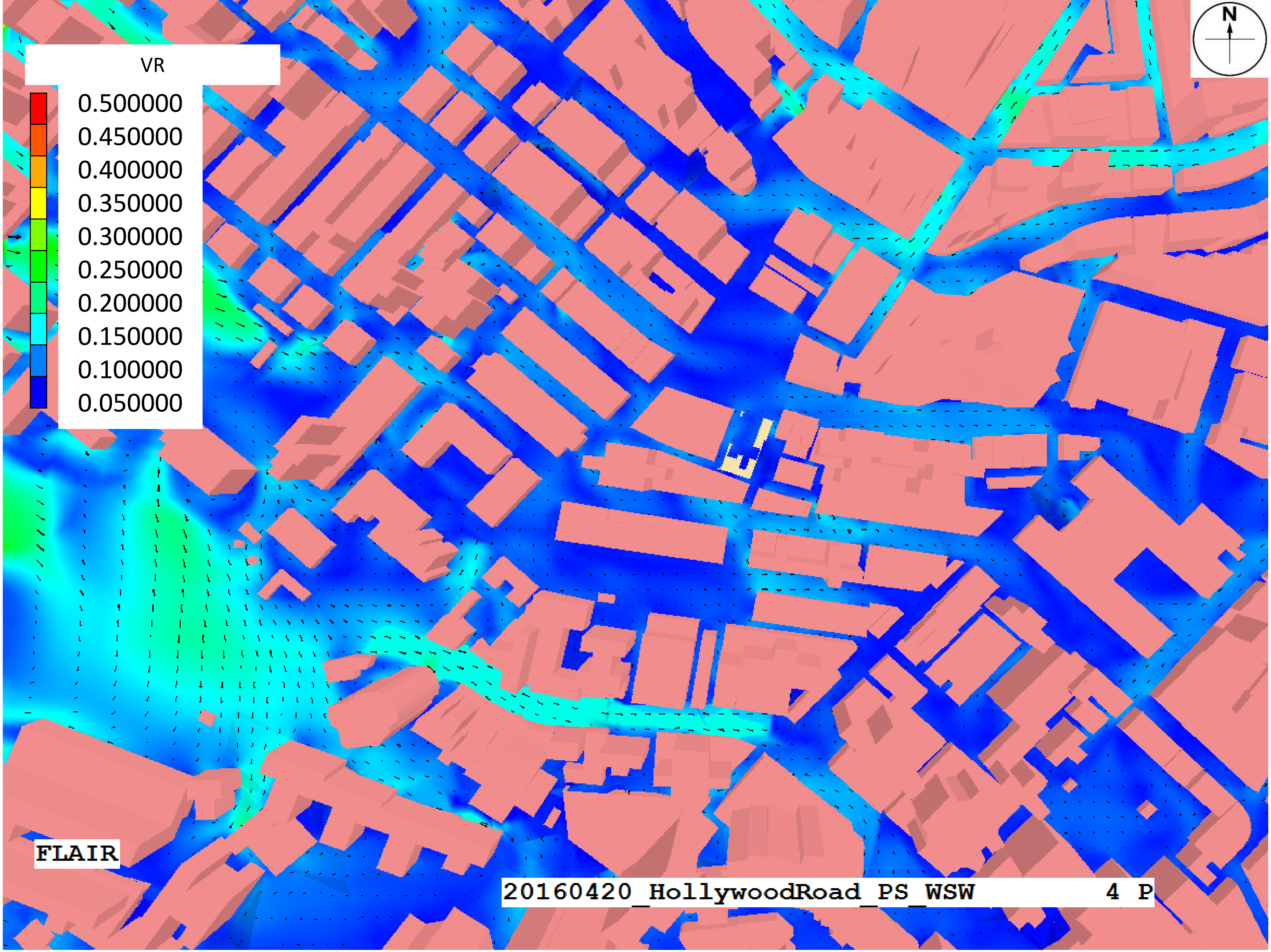
Proposed Scheme - Wind VR and vector plot at pedestrian level under S Wind



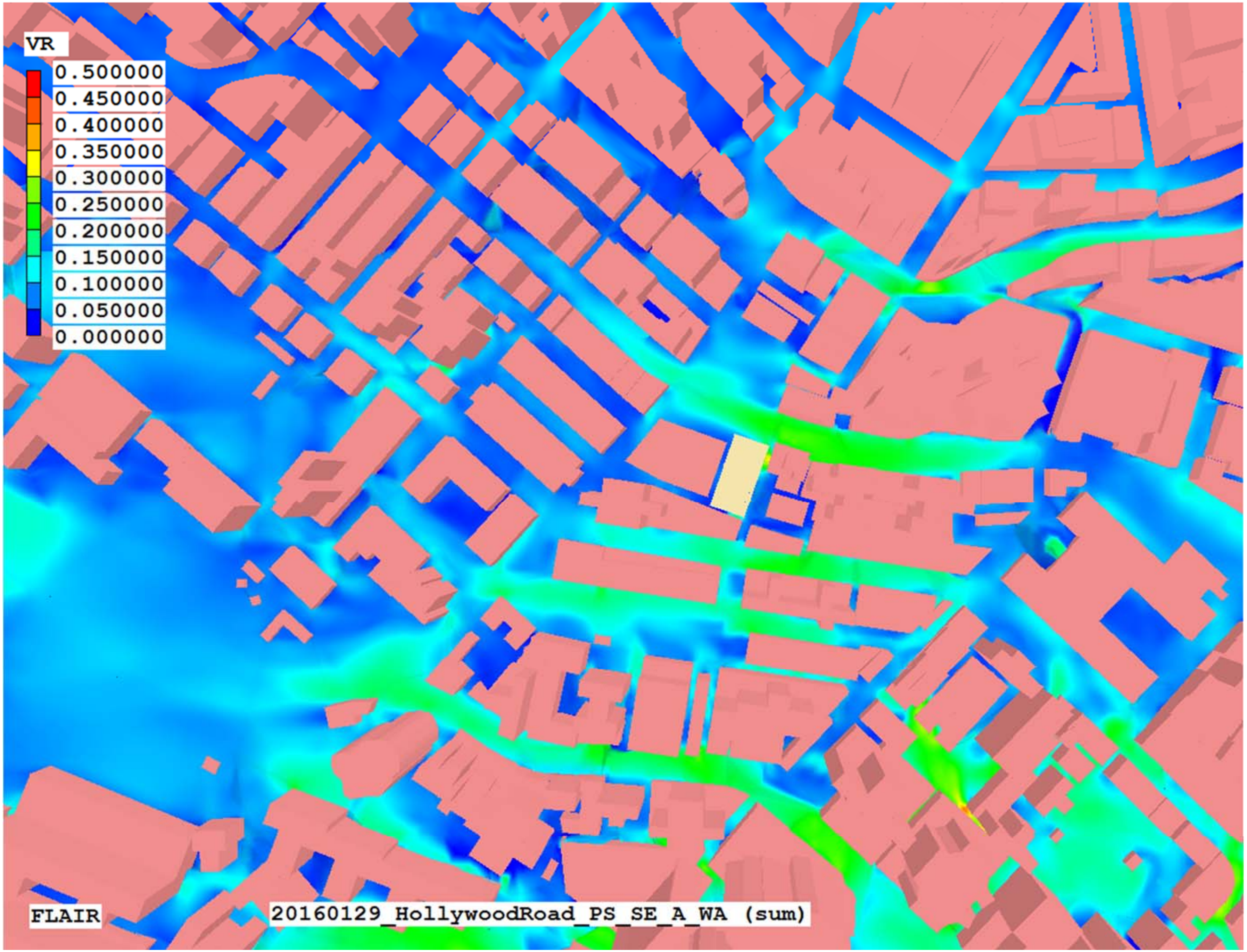
Proposed Scheme - Wind VR and vector plot at pedestrian level under SSW Wind



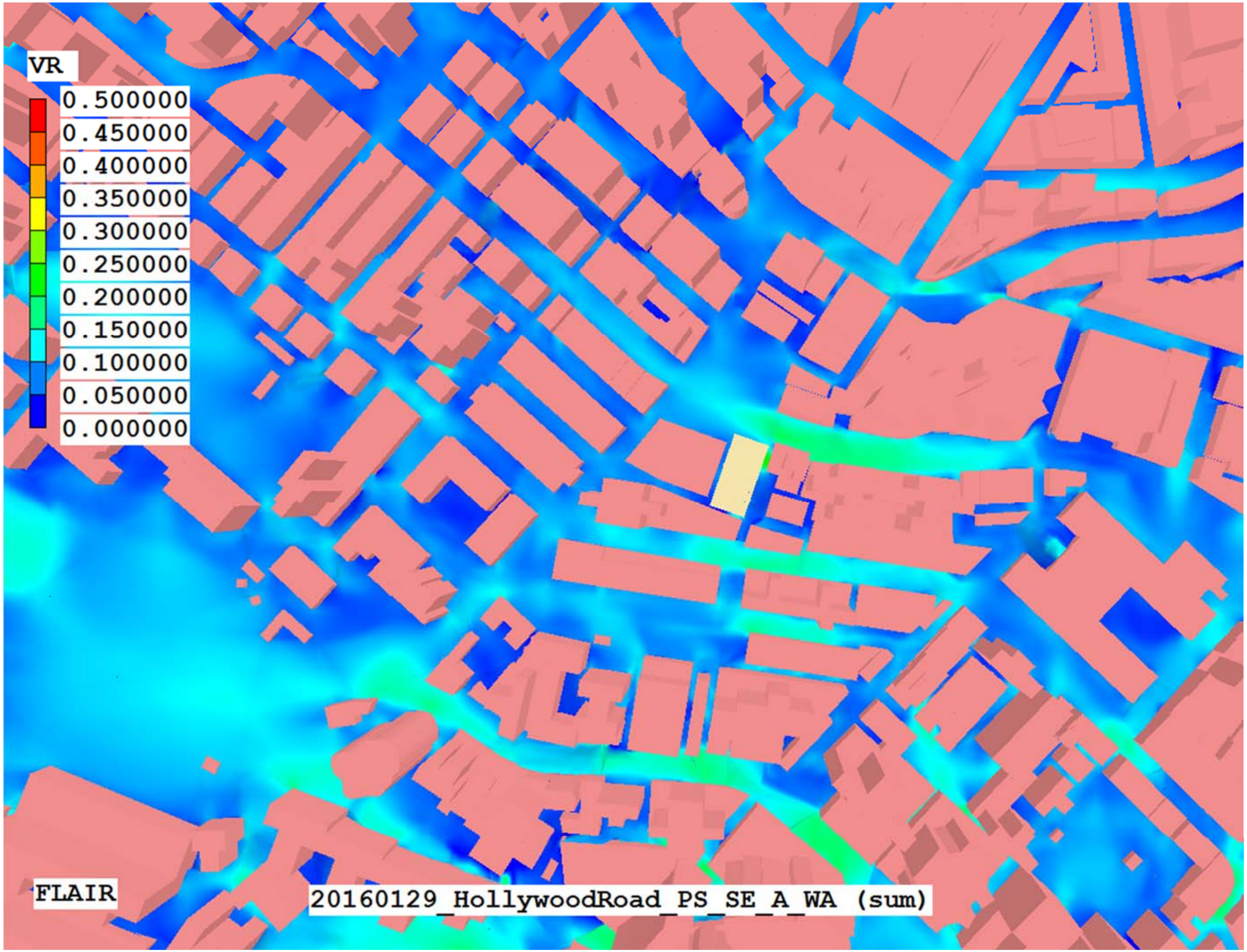
Proposed Scheme - Wind VR and vector plot at pedestrian level under SW Wind



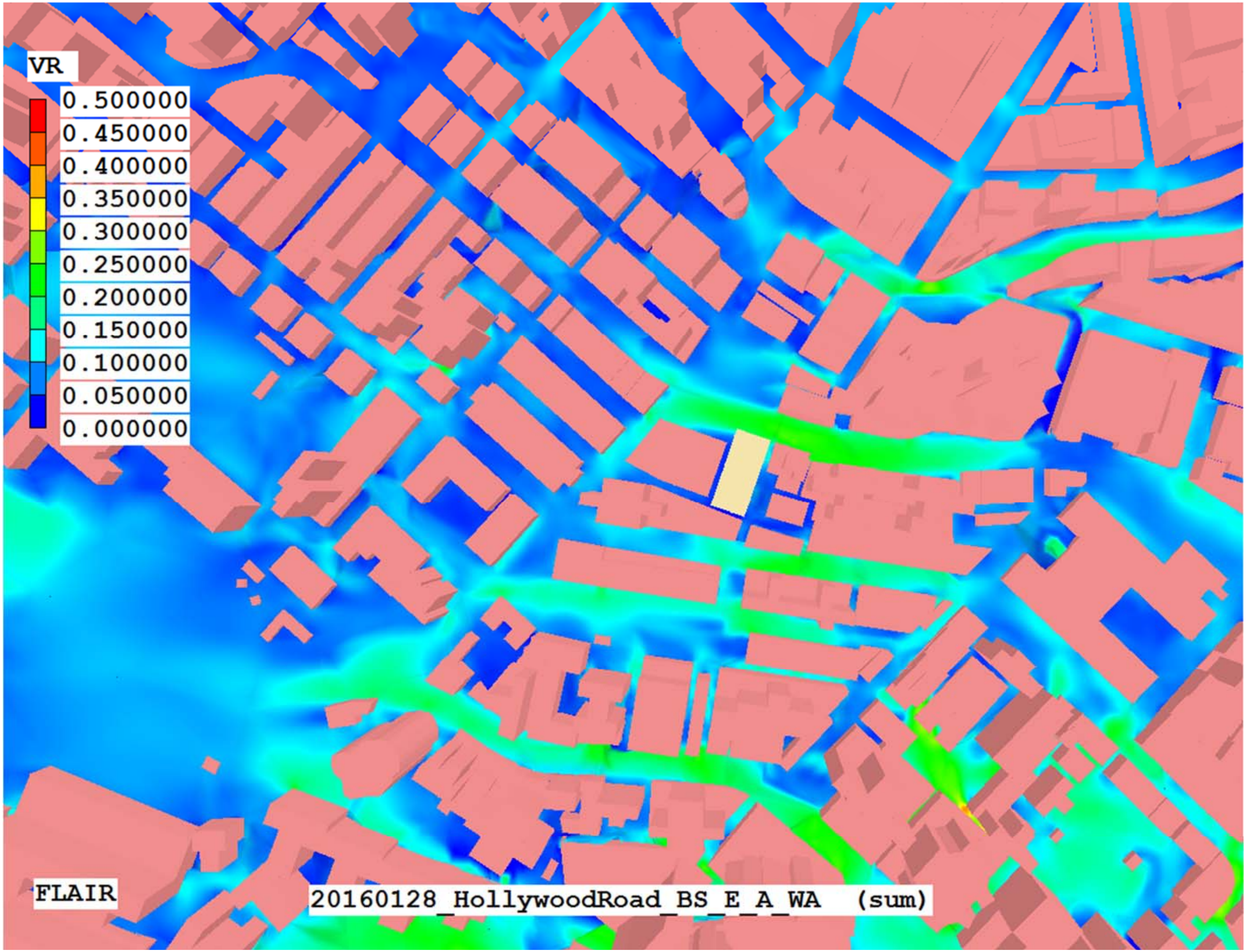
Proposed Scheme - Wind VR and vector plot at pedestrian level under WSW Wind



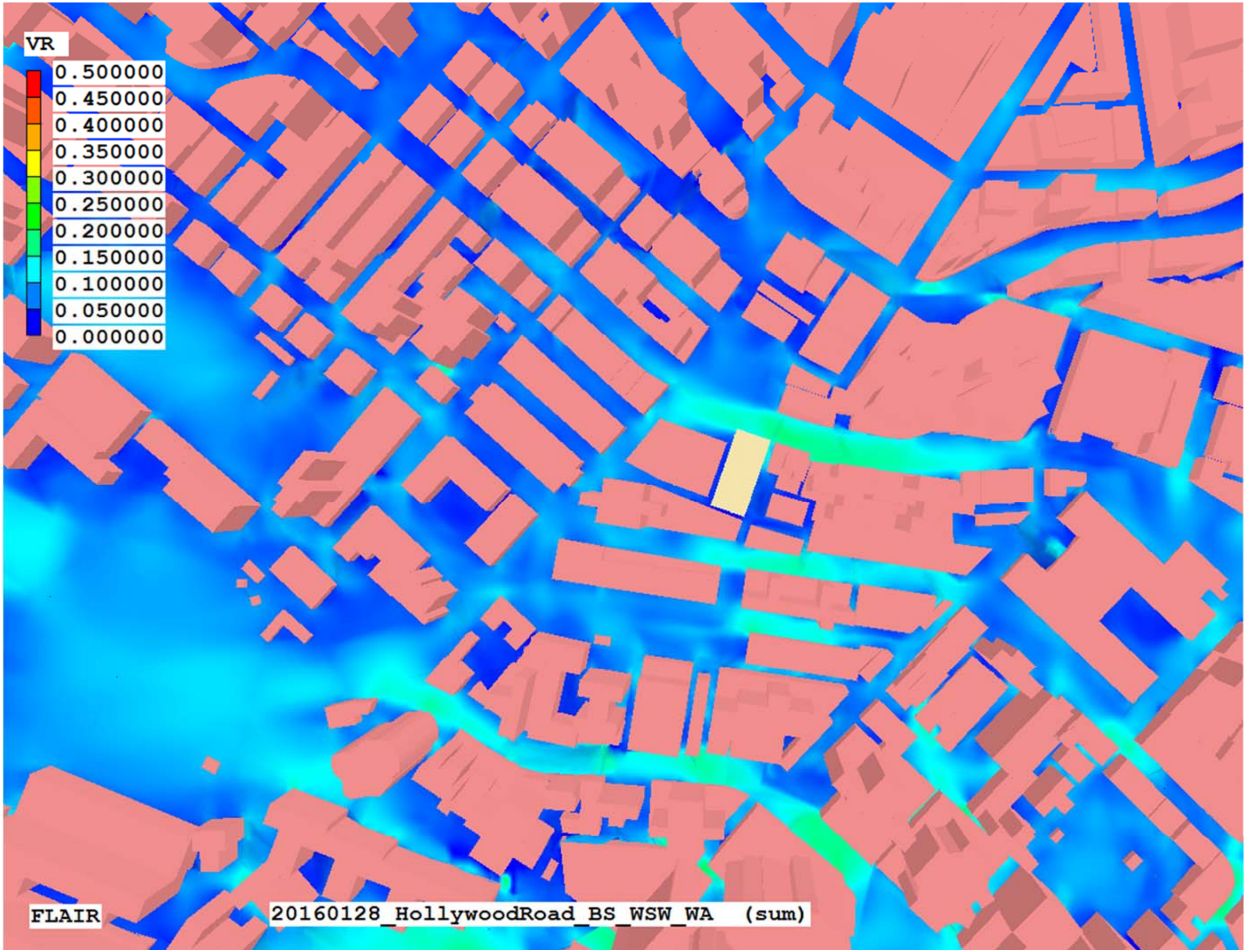
Proposed Scheme – Annual Weighted Average Contour



Proposed Scheme – Summer Weighted Average Contour



Baseline Scheme – Annual Weighted Average Contour



Baseline Scheme – Summer Weighted Average Contour

APPENDIX D:
DETAILED WIND VELOCITY RATIOS

	Baseline Scheme												
Test Point	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
P01	0.02	0.03	0.06	0.07	0.07	0.07	0.03	0.05	0.06	0.08	0.06	0.06	0.06
P02	0.00	0.04	0.09	0.09	0.09	0.05	0.04	0.03	0.04	0.01	0.01	0.06	0.04
P03	0.02	0.06	0.13	0.13	0.12	0.05	0.05	0.03	0.08	0.08	0.03	0.09	0.07
P04	0.03	0.06	0.14	0.13	0.11	0.04	0.06	0.03	0.08	0.09	0.02	0.09	0.07
P05	0.02	0.04	0.09	0.10	0.08	0.05	0.03	0.01	0.04	0.05	0.00	0.06	0.05
P06	0.03	0.06	0.09	0.07	0.07	0.05	0.04	0.05	0.07	0.07	0.01	0.06	0.06
P07	0.03	0.09	0.14	0.12	0.13	0.09	0.07	0.05	0.08	0.08	0.01	0.10	0.08
P08	0.03	0.11	0.16	0.15	0.16	0.13	0.09	0.06	0.11	0.10	0.01	0.12	0.10
P09	0.04	0.12	0.17	0.17	0.18	0.14	0.09	0.06	0.12	0.11	0.02	0.13	0.11
P10	0.05	0.13	0.20	0.16	0.20	0.16	0.11	0.06	0.11	0.11	0.02	0.14	0.12
P11	0.06	0.13	0.21	0.17	0.21	0.17	0.11	0.06	0.10	0.12	0.02	0.15	0.12
P12	0.06	0.13	0.20	0.16	0.23	0.17	0.09	0.08	0.13	0.16	0.04	0.15	0.14
P13	0.04	0.14	0.23	0.20	0.24	0.20	0.10	0.04	0.06	0.12	0.05	0.16	0.13
P14	0.02	0.12	0.19	0.16	0.21	0.15	0.06	0.02	0.12	0.09	0.06	0.14	0.11
P15	0.05	0.12	0.22	0.26	0.22	0.18	0.09	0.06	0.16	0.09	0.07	0.18	0.14
P16	0.00	0.09	0.16	0.21	0.17	0.10	0.01	0.14	0.21	0.09	0.08	0.14	0.13
P17	0.00	0.02	0.04	0.09	0.04	0.02	0.00	0.04	0.06	0.02	0.02	0.04	0.04
P18	0.00	0.05	0.05	0.07	0.05	0.03	0.01	0.02	0.02	0.01	0.01	0.04	0.03
P19	0.00	0.02	0.04	0.06	0.04	0.02	0.01	0.02	0.01	0.01	0.00	0.03	0.02
P20	0.02	0.05	0.10	0.04	0.10	0.01	0.01	0.03	0.03	0.04	0.01	0.05	0.04
P21	0.01	0.02	0.08	0.05	0.02	0.03	0.02	0.02	0.01	0.01	0.00	0.04	0.02
P22	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.03	0.01	0.01	0.01	0.01	0.01
P23	0.01	0.02	0.02	0.03	0.04	0.02	0.01	0.02	0.01	0.05	0.02	0.03	0.03
P24	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.01
P25	0.02	0.03	0.04	0.05	0.06	0.03	0.01	0.04	0.04	0.05	0.03	0.04	0.04
P26	0.02	0.04	0.05	0.05	0.07	0.04	0.02	0.04	0.05	0.05	0.04	0.04	0.04
P27	0.00	0.04	0.06	0.05	0.08	0.05	0.03	0.03	0.05	0.05	0.04	0.05	0.05
P28	0.01	0.04	0.05	0.05	0.06	0.05	0.03	0.02	0.04	0.05	0.03	0.05	0.04
P29	0.05	0.03	0.06	0.06	0.05	0.07	0.02	0.01	0.02	0.03	0.03	0.05	0.04
P30	0.06	0.03	0.04	0.04	0.08	0.07	0.01	0.03	0.05	0.03	0.04	0.04	0.04
P31	0.05	0.04	0.05	0.04	0.10	0.08	0.02	0.03	0.05	0.04	0.04	0.05	0.05
P32	0.04	0.04	0.08	0.06	0.11	0.08	0.02	0.04	0.03	0.05	0.04	0.06	0.05
T01	0.07	0.08	0.08	0.04	0.02	0.03	0.06	0.03	0.07	0.06	0.03	0.05	0.05
T02	0.09	0.11	0.14	0.09	0.06	0.00	0.01	0.00	0.01	0.13	0.03	0.08	0.05
T03	0.00	0.01	0.05	0.07	0.03	0.02	0.05	0.05	0.17	0.01	0.02	0.05	0.05
T04	0.10	0.08	0.04	0.03	0.03	0.01	0.03	0.05	0.11	0.10	0.13	0.05	0.07
T05	0.10	0.08	0.07	0.09	0.02	0.01	0.05	0.04	0.10	0.11	0.15	0.07	0.07
T06	0.04	0.12	0.08	0.01	0.02	0.04	0.06	0.05	0.08	0.08	0.07	0.05	0.06
T07	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01
T08	0.02	0.03	0.03	0.03	0.02	0.01	0.03	0.04	0.13	0.03	0.01	0.03	0.04
T09	0.08	0.07	0.02	0.04	0.01	0.00	0.02	0.02	0.03	0.04	0.03	0.03	0.03
T10	0.04	0.06	0.05	0.02	0.03	0.01	0.04	0.05	0.10	0.12	0.16	0.05	0.07
T11	0.07	0.03	0.02	0.03	0.04	0.02	0.05	0.02	0.10	0.02	0.03	0.03	0.04
T12	0.09	0.08	0.12	0.10	0.04	0.05	0.03	0.04	0.08	0.03	0.05	0.08	0.06
T13	0.02	0.03	0.02	0.03	0.05	0.04	0.02	0.05	0.02	0.03	0.05	0.03	0.04
T14	0.01	0.02	0.01	0.02	0.03	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02
T15	0.02	0.09	0.10	0.04	0.02	0.01	0.02	0.02	0.08	0.08	0.01	0.05	0.04
T16	0.05	0.09	0.09	0.05	0.03	0.02	0.02	0.02	0.10	0.08	0.05	0.06	0.05
T17	0.09	0.10	0.08	0.06	0.06	0.04	0.06	0.06	0.16	0.09	0.03	0.08	0.08

	Baseline Scheme												
Test Point	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
T18	0.11	0.11	0.09	0.08	0.05	0.02	0.04	0.06	0.17	0.13	0.02	0.08	0.08
T19	0.13	0.06	0.11	0.07	0.07	0.05	0.01	0.02	0.11	0.08	0.09	0.08	0.07
T20	0.07	0.03	0.03	0.05	0.02	0.05	0.06	0.05	0.08	0.11	0.14	0.05	0.07
T21	0.01	0.05	0.06	0.04	0.03	0.01	0.02	0.04	0.09	0.05	0.03	0.04	0.04
T22	0.01	0.03	0.02	0.03	0.01	0.01	0.00	0.00	0.04	0.01	0.02	0.02	0.02
T23	0.02	0.04	0.06	0.03	0.03	0.03	0.01	0.01	0.03	0.10	0.00	0.04	0.03
T24	0.12	0.17	0.11	0.12	0.07	0.05	0.07	0.10	0.10	0.08	0.07	0.10	0.09
T25	0.10	0.08	0.06	0.06	0.03	0.03	0.05	0.06	0.14	0.01	0.05	0.06	0.06
T26	0.05	0.05	0.10	0.05	0.03	0.03	0.05	0.04	0.09	0.10	0.10	0.06	0.07
T27	0.10	0.07	0.13	0.11	0.07	0.05	0.03	0.01	0.05	0.08	0.09	0.09	0.07
T28	0.08	0.07	0.12	0.08	0.02	0.00	0.02	0.03	0.04	0.08	0.10	0.07	0.05
T29	0.02	0.03	0.04	0.02	0.00	0.01	0.02	0.03	0.08	0.05	0.02	0.03	0.03
T30	0.05	0.06	0.08	0.07	0.07	0.02	0.01	0.03	0.03	0.06	0.03	0.06	0.04
T31	0.04	0.07	0.06	0.05	0.07	0.01	0.03	0.05	0.12	0.09	0.08	0.06	0.07
T32	0.00	0.01	0.01	0.04	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.02	0.01
T33	0.05	0.07	0.07	0.04	0.05	0.03	0.01	0.03	0.04	0.03	0.02	0.05	0.03
T34	0.03	0.03	0.06	0.06	0.02	0.01	0.00	0.02	0.02	0.04	0.05	0.04	0.03
T35	0.11	0.11	0.26	0.17	0.16	0.13	0.08	0.06	0.31	0.14	0.10	0.17	0.16
T36	0.02	0.00	0.04	0.09	0.08	0.07	0.03	0.01	0.03	0.01	0.02	0.05	0.04
T37	0.05	0.03	0.07	0.29	0.08	0.05	0.03	0.02	0.08	0.04	0.02	0.11	0.07
T38	0.04	0.04	0.05	0.01	0.00	0.00	0.03	0.03	0.09	0.07	0.01	0.03	0.03
T39	0.03	0.05	0.06	0.04	0.01	0.01	0.03	0.05	0.11	0.09	0.08	0.05	0.06
T40	0.00	0.03	0.01	0.03	0.01	0.00	0.02	0.02	0.04	0.02	0.02	0.02	0.02
T41	0.07	0.03	0.05	0.07	0.05	0.02	0.02	0.04	0.08	0.04	0.01	0.05	0.05
T42	0.15	0.07	0.08	0.01	0.03	0.01	0.02	0.02	0.08	0.09	0.09	0.05	0.05
T43	0.04	0.02	0.04	0.00	0.00	0.00	0.02	0.02	0.07	0.05	0.01	0.02	0.03
T44	0.12	0.05	0.06	0.07	0.09	0.06	0.03	0.11	0.21	0.05	0.10	0.08	0.09
T45	0.10	0.04	0.03	0.09	0.08	0.04	0.02	0.08	0.07	0.04	0.05	0.06	0.06
T46	0.09	0.05	0.09	0.06	0.08	0.03	0.00	0.04	0.02	0.01	0.06	0.06	0.04
T47	0.09	0.04	0.05	0.04	0.06	0.03	0.02	0.05	0.10	0.05	0.06	0.05	0.05
T48	0.04	0.04	0.03	0.05	0.01	0.02	0.03	0.05	0.12	0.09	0.06	0.05	0.06
T49	0.03	0.04	0.04	0.03	0.01	0.02	0.00	0.00	0.05	0.05	0.01	0.03	0.03
T50	0.09	0.05	0.10	0.16	0.05	0.09	0.05	0.04	0.06	0.05	0.03	0.09	0.07
T51	0.08	0.05	0.04	0.04	0.03	0.02	0.01	0.02	0.02	0.04	0.02	0.03	0.03
T52	0.04	0.09	0.07	0.14	0.11	0.10	0.09	0.02	0.03	0.03	0.01	0.09	0.06
T53	0.06	0.02	0.05	0.08	0.03	0.03	0.02	0.08	0.10	0.02	0.03	0.05	0.05
T54	0.07	0.04	0.12	0.10	0.09	0.04	0.01	0.04	0.11	0.09	0.02	0.08	0.07
T55	0.01	0.01	0.02	0.06	0.05	0.04	0.02	0.03	0.03	0.04	0.02	0.03	0.03
T56	0.04	0.08	0.07	0.14	0.12	0.09	0.03	0.02	0.09	0.08	0.04	0.09	0.08
T57	0.08	0.03	0.07	0.10	0.04	0.05	0.03	0.05	0.10	0.07	0.01	0.07	0.06
T58	0.07	0.02	0.04	0.04	0.02	0.03	0.02	0.04	0.16	0.05	0.04	0.05	0.06
T59	0.07	0.14	0.26	0.33	0.23	0.22	0.12	0.09	0.17	0.10	0.06	0.21	0.16
T60	0.06	0.03	0.06	0.09	0.07	0.06	0.05	0.04	0.05	0.05	0.04	0.06	0.05
T61	0.09	0.05	0.09	0.13	0.11	0.10	0.07	0.07	0.12	0.06	0.08	0.10	0.09
T62	0.05	0.13	0.11	0.16	0.07	0.07	0.09	0.05	0.05	0.07	0.03	0.10	0.07
T63	0.06	0.05	0.06	0.10	0.04	0.04	0.04	0.06	0.08	0.06	0.04	0.06	0.06
T64	0.06	0.01	0.12	0.03	0.05	0.05	0.07	0.07	0.04	0.05	0.04	0.05	0.05
T65	0.06	0.03	0.09	0.05	0.08	0.07	0.05	0.08	0.06	0.06	0.04	0.06	0.06
T66	0.04	0.02	0.04	0.05	0.05	0.01	0.03	0.02	0.07	0.03	0.04	0.04	0.04
T67	0.03	0.03	0.03	0.05	0.04	0.02	0.02	0.02	0.07	0.06	0.03	0.04	0.04
T68	0.07	0.04	0.06	0.05	0.03	0.02	0.01	0.04	0.05	0.04	0.03	0.04	0.04

	Baseline Scheme												
Test Point	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**Annual**	**Summer**
T69	0.09	0.06	0.11	0.06	0.08	0.04	0.00	0.01	0.08	0.08	0.04	0.07	0.06
T70	0.03	0.05	0.06	0.06	0.10	0.05	0.02	0.06	0.06	0.12	0.08	0.06	0.07
T71	0.05	0.03	0.03	0.07	0.04	0.05	0.02	0.00	0.11	0.08	0.01	0.05	0.05
T72	0.06	0.02	0.04	0.04	0.06	0.04	0.01	0.02	0.07	0.07	0.05	0.04	0.05
T73	0.08	0.04	0.06	0.12	0.12	0.04	0.01	0.06	0.12	0.05	0.08	0.08	0.08
T74	0.06	0.04	0.05	0.16	0.10	0.05	0.03	0.02	0.05	0.08	0.01	0.08	0.06
T75	0.01	0.12	0.20	0.12	0.14	0.11	0.06	0.04	0.07	0.05	0.08	0.11	0.09
T76	0.04	0.04	0.08	0.09	0.08	0.04	0.04	0.04	0.01	0.09	0.02	0.06	0.05
T77	0.03	0.00	0.06	0.02	0.02	0.02	0.02	0.02	0.04	0.02	0.02	0.03	0.02
T78	0.06	0.02	0.07	0.11	0.04	0.04	0.03	0.04	0.04	0.04	0.03	0.06	0.05
T79	0.02	0.07	0.08	0.15	0.06	0.02	0.06	0.08	0.08	0.06	0.09	0.08	0.08
T80	0.04	0.02	0.04	0.06	0.06	0.03	0.01	0.03	0.05	0.04	0.07	0.04	0.04
T81	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.02	0.00	0.01	0.01	0.01
T82	0.04	0.05	0.09	0.08	0.04	0.02	0.04	0.04	0.10	0.05	0.04	0.06	0.06
T83	0.04	0.06	0.12	0.14	0.06	0.03	0.02	0.03	0.07	0.10	0.02	0.09	0.06
T84	0.01	0.01	0.02	0.00	0.01	0.00	0.00	0.01	0.03	0.03	0.02	0.01	0.02
T85	0.04	0.14	0.20	0.18	0.01	0.03	0.03	0.03	0.04	0.05	0.01	0.10	0.05
T86	0.03	0.10	0.15	0.10	0.07	0.09	0.02	0.03	0.09	0.10	0.02	0.09	0.07
T87	0.05	0.04	0.04	0.04	0.06	0.05	0.04	0.04	0.05	0.09	0.01	0.05	0.05
T88	0.05	0.02	0.07	0.07	0.07	0.08	0.04	0.03	0.03	0.02	0.02	0.05	0.04
T89	0.05	0.02	0.03	0.07	0.05	0.09	0.07	0.04	0.06	0.04	0.03	0.05	0.05
T90	0.04	0.03	0.12	0.12	0.09	0.11	0.03	0.05	0.06	0.05	0.02	0.08	0.07
T91	0.06	0.01	0.04	0.07	0.04	0.03	0.07	0.02	0.06	0.07	0.08	0.05	0.05
T92	0.04	0.01	0.07	0.08	0.05	0.02	0.02	0.01	0.08	0.02	0.02	0.05	0.04
T93	0.03	0.05	0.05	0.07	0.03	0.02	0.01	0.02	0.07	0.03	0.04	0.05	0.04
T94	0.03	0.16	0.11	0.17	0.07	0.04	0.02	0.04	0.12	0.11	0.05	0.11	0.09
T95	0.03	0.07	0.13	0.07	0.09	0.05	0.04	0.02	0.08	0.07	0.09	0.08	0.07
T96	0.01	0.08	0.14	0.11	0.03	0.01	0.00	0.04	0.06	0.06	0.03	0.07	0.05
T97	0.00	0.08	0.09	0.08	0.08	0.03	0.01	0.06	0.11	0.05	0.02	0.07	0.06
T98	0.04	0.06	0.07	0.16	0.05	0.03	0.02	0.05	0.07	0.05	0.02	0.08	0.06
T99	0.02	0.02	0.12	0.33	0.13	0.08	0.03	0.01	0.05	0.04	0.03	0.13	0.08
T100	0.07	0.05	0.01	0.06	0.01	0.02	0.01	0.03	0.12	0.10	0.03	0.05	0.05
T101	0.09	0.16	0.21	0.18	0.12	0.01	0.08	0.13	0.24	0.15	0.10	0.15	0.14
T102	0.00	0.05	0.03	0.07	0.10	0.04	0.05	0.04	0.16	0.10	0.07	0.06	0.08
T103	0.01	0.04	0.12	0.11	0.11	0.07	0.05	0.04	0.05	0.05	0.04	0.08	0.06
T104	0.02	0.10	0.19	0.16	0.17	0.14	0.09	0.06	0.13	0.05	0.11	0.13	0.11
T105	0.01	0.02	0.06	0.09	0.03	0.04	0.02	0.03	0.03	0.02	0.03	0.05	0.04
T106	0.08	0.11	0.23	0.30	0.25	0.19	0.11	0.05	0.13	0.07	0.10	0.19	0.15
T107	0.03	0.01	0.03	0.05	0.06	0.04	0.03	0.07	0.14	0.06	0.02	0.05	0.06
T108	0.05	0.12	0.07	0.02	0.09	0.10	0.02	0.01	0.11	0.02	0.03	0.06	0.05
T109	0.10	0.03	0.04	0.05	0.07	0.03	0.03	0.04	0.06	0.01	0.05	0.05	0.04
T110	0.03	0.05	0.07	0.06	0.09	0.05	0.02	0.05	0.07	0.08	0.04	0.06	0.06
T111	0.05	0.01	0.10	0.06	0.05	0.08	0.05	0.08	0.03	0.05	0.05	0.06	0.06
T112	0.03	0.04	0.04	0.11	0.08	0.06	0.05	0.09	0.13	0.04	0.04	0.07	0.07
T113	0.06	0.03	0.08	0.08	0.10	0.07	0.04	0.03	0.06	0.14	0.02	0.07	0.07
T114	0.06	0.04	0.06	0.03	0.05	0.06	0.03	0.05	0.02	0.08	0.07	0.05	0.05
T115	0.06	0.04	0.03	0.09	0.01	0.08	0.04	0.01	0.01	0.03	0.02	0.05	0.03
T116	0.07	0.06	0.08	0.08	0.08	0.04	0.02	0.03	0.11	0.06	0.01	0.07	0.06
T117	0.04	0.05	0.09	0.24	0.10	0.08	0.02	0.09	0.13	0.07	0.04	0.12	0.10

	Proposed Scheme												
Test Point	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**Annual**	**Summer**
P01	0.03	0.04	0.03	0.03	0.07	0.05	0.03	0.06	0.11	0.09	0.08	0.05	0.07
P02	0.01	0.02	0.05	0.03	0.02	0.01	0.04	0.03	0.05	0.05	0.04	0.03	0.04
P03	0.01	0.04	0.11	0.07	0.04	0.03	0.06	0.05	0.05	0.09	0.08	0.06	0.06
P04	0.00	0.06	0.12	0.09	0.04	0.02	0.06	0.04	0.11	0.05	0.07	0.07	0.06
P05	0.02	0.05	0.08	0.06	0.05	0.02	0.04	0.01	0.05	0.06	0.04	0.05	0.04
P06	0.02	0.05	0.06	0.05	0.04	0.06	0.02	0.05	0.06	0.06	0.04	0.05	0.05
P07	0.02	0.08	0.14	0.07	0.01	0.06	0.07	0.05	0.09	0.09	0.02	0.07	0.06
P08	0.03	0.09	0.16	0.07	0.03	0.07	0.07	0.05	0.09	0.08	0.01	0.08	0.06
P09	0.04	0.09	0.17	0.07	0.03	0.08	0.07	0.05	0.09	0.08	0.02	0.08	0.07
P10	0.04	0.10	0.19	0.09	0.06	0.10	0.07	0.05	0.09	0.08	0.02	0.09	0.08
P11	0.05	0.10	0.19	0.10	0.09	0.11	0.07	0.05	0.08	0.09	0.02	0.10	0.08
P12	0.04	0.12	0.23	0.17	0.21	0.14	0.07	0.05	0.08	0.11	0.06	0.14	0.11
P13	0.04	0.12	0.24	0.21	0.21	0.17	0.08	0.05	0.11	0.11	0.06	0.16	0.13
P14	0.02	0.12	0.26	0.29	0.29	0.16	0.08	0.04	0.13	0.11	0.09	0.19	0.15
P15	0.05	0.09	0.18	0.19	0.19	0.15	0.08	0.04	0.18	0.11	0.09	0.15	0.13
P16	0.05	0.20	0.41	0.45	0.37	0.24	0.13	0.07	0.12	0.23	0.05	0.29	0.21
P17	0.05	0.19	0.38	0.42	0.35	0.22	0.12	0.07	0.18	0.20	0.05	0.27	0.21
P18	0.02	0.07	0.11	0.11	0.13	0.06	0.03	0.01	0.01	0.06	0.01	0.08	0.05
P19	0.01	0.04	0.06	0.07	0.08	0.03	0.02	0.02	0.03	0.03	0.02	0.05	0.04
P20	0.04	0.02	0.03	0.04	0.03	0.03	0.01	0.03	0.04	0.02	0.02	0.03	0.03
P21	0.02	0.03	0.07	0.21	0.10	0.04	0.03	0.04	0.08	0.06	0.01	0.09	0.07
P22	0.01	0.01	0.02	0.02	0.04	0.03	0.01	0.04	0.06	0.05	0.03	0.03	0.04
P23	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.03	0.04	0.04	0.02	0.02
P24	0.01	0.01	0.05	0.02	0.02	0.01	0.00	0.01	0.00	0.01	0.02	0.02	0.01
P25	0.00	0.03	0.03	0.02	0.01	0.01	0.02	0.01	0.01	0.05	0.08	0.02	0.03
P26	0.00	0.03	0.04	0.03	0.00	0.02	0.02	0.01	0.02	0.06	0.08	0.03	0.03
P27	0.01	0.03	0.07	0.04	0.02	0.03	0.02	0.00	0.05	0.06	0.09	0.04	0.04
P28	0.01	0.03	0.07	0.04	0.03	0.02	0.02	0.02	0.05	0.10	0.08	0.04	0.05
P29	0.04	0.05	0.10	0.06	0.08	0.03	0.03	0.05	0.11	0.16	0.10	0.07	0.08
P30	0.05	0.04	0.10	0.06	0.08	0.02	0.03	0.04	0.06	0.10	0.06	0.07	0.06
P31	0.06	0.02	0.08	0.06	0.08	0.03	0.03	0.05	0.08	0.10	0.05	0.06	0.06
P32	0.07	0.02	0.04	0.03	0.07	0.03	0.02	0.06	0.09	0.10	0.04	0.05	0.06
T01	0.07	0.08	0.07	0.03	0.01	0.03	0.03	0.03	0.08	0.07	0.02	0.05	0.04
T02	0.12	0.15	0.15	0.09	0.06	0.00	0.00	0.00	0.00	0.13	0.04	0.08	0.05
T03	0.01	0.03	0.04	0.06	0.03	0.02	0.03	0.05	0.16	0.02	0.01	0.05	0.05
T04	0.10	0.10	0.03	0.03	0.03	0.02	0.02	0.06	0.11	0.11	0.13	0.05	0.07
T05	0.09	0.08	0.04	0.09	0.02	0.02	0.04	0.05	0.09	0.12	0.15	0.07	0.08
T06	0.05	0.09	0.04	0.01	0.01	0.04	0.06	0.05	0.09	0.10	0.07	0.04	0.06
T07	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.00	0.00	0.00	0.01
T08	0.02	0.03	0.03	0.03	0.02	0.01	0.03	0.04	0.13	0.04	0.01	0.03	0.04
T09	0.05	0.07	0.03	0.03	0.01	0.01	0.01	0.02	0.03	0.05	0.03	0.03	0.03
T10	0.04	0.02	0.01	0.01	0.03	0.02	0.04	0.06	0.09	0.13	0.16	0.04	0.07
T11	0.07	0.01	0.03	0.02	0.04	0.01	0.03	0.02	0.09	0.02	0.03	0.03	0.03
T12	0.11	0.06	0.09	0.09	0.04	0.05	0.03	0.04	0.07	0.05	0.05	0.07	0.06
T13	0.04	0.03	0.03	0.03	0.04	0.03	0.02	0.04	0.02	0.04	0.05	0.03	0.04
T14	0.02	0.03	0.03	0.02	0.03	0.02	0.02	0.01	0.04	0.04	0.02	0.03	0.03
T15	0.01	0.09	0.09	0.04	0.02	0.01	0.00	0.02	0.08	0.08	0.02	0.05	0.04
T16	0.05	0.07	0.06	0.04	0.03	0.01	0.02	0.03	0.07	0.07	0.05	0.05	0.04
T17	0.10	0.10	0.08	0.05	0.05	0.04	0.03	0.06	0.16	0.10	0.04	0.07	0.07

	Proposed Scheme												
Test Point	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	Annual	Summer
T18	0.09	0.11	0.10	0.06	0.04	0.02	0.02	0.07	0.17	0.14	0.01	0.08	0.08
T19	0.14	0.06	0.12	0.11	0.07	0.04	0.05	0.01	0.10	0.09	0.09	0.09	0.08
T20	0.06	0.02	0.03	0.02	0.03	0.05	0.04	0.05	0.08	0.11	0.13	0.04	0.07
T21	0.03	0.05	0.05	0.04	0.04	0.03	0.03	0.05	0.10	0.06	0.05	0.05	0.05
T22	0.03	0.01	0.03	0.04	0.03	0.01	0.02	0.02	0.04	0.06	0.02	0.03	0.03
T23	0.03	0.03	0.05	0.03	0.03	0.04	0.02	0.00	0.02	0.11	0.01	0.04	0.04
T24	0.12	0.16	0.13	0.09	0.08	0.06	0.08	0.10	0.09	0.08	0.05	0.10	0.08
T25	0.11	0.09	0.07	0.04	0.03	0.03	0.05	0.06	0.09	0.02	0.05	0.06	0.05
T26	0.07	0.04	0.11	0.08	0.04	0.03	0.04	0.04	0.09	0.11	0.09	0.07	0.07
T27	0.11	0.07	0.13	0.11	0.07	0.05	0.04	0.02	0.05	0.09	0.09	0.09	0.07
T28	0.12	0.07	0.12	0.06	0.02	0.00	0.03	0.03	0.03	0.09	0.10	0.07	0.05
T29	0.01	0.03	0.04	0.01	0.01	0.00	0.02	0.03	0.08	0.06	0.01	0.02	0.03
T30	0.04	0.06	0.07	0.12	0.06	0.04	0.01	0.02	0.01	0.06	0.02	0.06	0.04
T31	0.04	0.07	0.08	0.11	0.06	0.04	0.04	0.06	0.12	0.11	0.09	0.08	0.08
T32	0.03	0.03	0.05	0.05	0.04	0.03	0.03	0.03	0.04	0.05	0.04	0.04	0.04
T33	0.07	0.04	0.07	0.06	0.01	0.03	0.02	0.03	0.07	0.03	0.01	0.04	0.04
T34	0.11	0.08	0.03	0.07	0.02	0.01	0.01	0.02	0.02	0.07	0.05	0.05	0.04
T35	0.13	0.12	0.26	0.17	0.18	0.14	0.08	0.06	0.21	0.13	0.10	0.16	0.14
T36	0.01	0.00	0.03	0.08	0.08	0.07	0.01	0.01	0.03	0.03	0.03	0.05	0.04
T37	0.04	0.02	0.07	0.29	0.08	0.05	0.02	0.01	0.08	0.04	0.03	0.11	0.08
T38	0.04	0.04	0.04	0.01	0.01	0.00	0.03	0.03	0.08	0.07	0.02	0.03	0.04
T39	0.03	0.06	0.08	0.18	0.03	0.02	0.03	0.05	0.11	0.10	0.09	0.09	0.08
T40	0.01	0.05	0.02	0.17	0.02	0.00	0.00	0.00	0.04	0.04	0.00	0.06	0.04
T41	0.06	0.04	0.06	0.07	0.06	0.05	0.02	0.04	0.08	0.05	0.00	0.05	0.05
T42	0.16	0.04	0.10	0.02	0.05	0.02	0.03	0.02	0.07	0.08	0.09	0.05	0.05
T43	0.04	0.03	0.03	0.01	0.00	0.00	0.03	0.02	0.06	0.05	0.04	0.02	0.03
T44	0.10	0.04	0.06	0.06	0.07	0.03	0.08	0.11	0.18	0.08	0.07	0.07	0.09
T45	0.11	0.02	0.05	0.07	0.11	0.02	0.03	0.08	0.07	0.04	0.05	0.06	0.06
T46	0.09	0.05	0.09	0.06	0.07	0.04	0.01	0.04	0.02	0.07	0.06	0.06	0.05
T47	0.09	0.04	0.05	0.04	0.03	0.05	0.02	0.05	0.09	0.08	0.06	0.05	0.06
T48	0.04	0.05	0.11	0.13	0.09	0.05	0.00	0.05	0.12	0.10	0.08	0.09	0.08
T49	0.04	0.06	0.06	0.11	0.06	0.04	0.02	0.02	0.04	0.06	0.02	0.06	0.05
T50	0.10	0.06	0.09	0.14	0.04	0.10	0.03	0.03	0.06	0.08	0.03	0.09	0.07
T51	0.03	0.04	0.04	0.07	0.03	0.02	0.01	0.02	0.01	0.04	0.01	0.04	0.03
T52	0.05	0.08	0.04	0.13	0.11	0.10	0.09	0.03	0.02	0.04	0.00	0.08	0.06
T53	0.05	0.02	0.06	0.07	0.04	0.01	0.01	0.08	0.10	0.02	0.01	0.05	0.04
T54	0.06	0.06	0.10	0.09	0.06	0.04	0.04	0.03	0.10	0.09	0.02	0.07	0.06
T55	0.01	0.01	0.02	0.01	0.02	0.01	0.00	0.00	0.02	0.04	0.02	0.02	0.02
T56	0.04	0.08	0.16	0.19	0.11	0.11	0.04	0.03	0.08	0.06	0.03	0.11	0.08
T57	0.06	0.04	0.07	0.09	0.14	0.04	0.02	0.05	0.10	0.09	0.02	0.07	0.07
T58	0.09	0.02	0.03	0.09	0.04	0.03	0.01	0.04	0.17	0.06	0.04	0.06	0.06
T59	0.05	0.09	0.26	0.31	0.22	0.21	0.13	0.09	0.16	0.13	0.07	0.20	0.16
T60	0.06	0.06	0.07	0.09	0.07	0.07	0.06	0.04	0.06	0.06	0.05	0.07	0.06
T61	0.05	0.05	0.09	0.12	0.11	0.09	0.08	0.07	0.13	0.10	0.10	0.10	0.10
T62	0.05	0.12	0.11	0.17	0.07	0.07	0.10	0.06	0.06	0.09	0.05	0.10	0.08
T63	0.05	0.06	0.05	0.09	0.04	0.04	0.05	0.06	0.10	0.09	0.09	0.06	0.07
T64	0.07	0.02	0.11	0.03	0.05	0.05	0.07	0.08	0.04	0.04	0.04	0.05	0.05
T65	0.06	0.01	0.09	0.04	0.07	0.06	0.05	0.08	0.07	0.04	0.04	0.06	0.06
T66	0.07	0.03	0.07	0.06	0.01	0.02	0.03	0.04	0.07	0.06	0.04	0.05	0.05
T67	0.07	0.02	0.05	0.07	0.02	0.01	0.01	0.02	0.08	0.08	0.03	0.05	0.04
T68	0.10	0.03	0.03	0.03	0.04	0.02	0.01	0.05	0.05	0.05	0.03	0.04	0.04

	Proposed Scheme												
Test Point	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**Annual**	**Summer**
T69	0.12	0.06	0.09	0.09	0.08	0.00	0.01	0.01	0.06	0.09	0.04	0.07	0.05
T70	0.01	0.06	0.08	0.05	0.07	0.05	0.02	0.06	0.06	0.13	0.08	0.06	0.07
T71	0.05	0.04	0.01	0.09	0.05	0.03	0.05	0.02	0.09	0.08	0.01	0.05	0.05
T72	0.01	0.01	0.05	0.04	0.02	0.00	0.02	0.01	0.13	0.07	0.05	0.04	0.05
T73	0.06	0.06	0.02	0.16	0.13	0.07	0.03	0.06	0.12	0.06	0.05	0.09	0.08
T74	0.07	0.03	0.04	0.11	0.11	0.06	0.03	0.03	0.10	0.07	0.04	0.07	0.07
T75	0.04	0.12	0.20	0.11	0.14	0.10	0.05	0.05	0.07	0.04	0.07	0.11	0.08
T76	0.04	0.05	0.07	0.06	0.02	0.02	0.02	0.03	0.04	0.07	0.04	0.05	0.04
T77	0.02	0.03	0.06	0.02	0.02	0.02	0.02	0.02	0.05	0.02	0.01	0.03	0.03
T78	0.06	0.02	0.03	0.11	0.03	0.04	0.03	0.04	0.03	0.03	0.02	0.05	0.04
T79	0.02	0.06	0.08	0.16	0.08	0.01	0.07	0.08	0.08	0.08	0.09	0.09	0.08
T80	0.05	0.03	0.02	0.06	0.05	0.01	0.02	0.04	0.05	0.04	0.07	0.04	0.04
T81	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.02	0.00	0.01	0.01	0.01
T82	0.04	0.03	0.15	0.08	0.01	0.08	0.01	0.04	0.10	0.04	0.03	0.07	0.05
T83	0.05	0.08	0.10	0.14	0.06	0.04	0.03	0.04	0.06	0.11	0.02	0.08	0.07
T84	0.02	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.03	0.02	0.00	0.01	0.01
T85	0.06	0.13	0.20	0.18	0.05	0.02	0.03	0.02	0.05	0.05	0.01	0.11	0.06
T86	0.05	0.10	0.14	0.11	0.12	0.09	0.04	0.03	0.13	0.08	0.05	0.10	0.09
T87	0.03	0.03	0.04	0.07	0.06	0.05	0.05	0.04	0.07	0.08	0.00	0.05	0.05
T88	0.00	0.01	0.07	0.07	0.04	0.07	0.05	0.03	0.05	0.02	0.02	0.05	0.04
T89	0.04	0.02	0.03	0.06	0.02	0.09	0.06	0.04	0.04	0.04	0.01	0.04	0.04
T90	0.04	0.04	0.15	0.14	0.09	0.12	0.03	0.06	0.07	0.05	0.02	0.10	0.07
T91	0.06	0.03	0.03	0.06	0.03	0.04	0.08	0.01	0.04	0.06	0.10	0.05	0.05
T92	0.05	0.02	0.06	0.07	0.05	0.02	0.02	0.01	0.08	0.03	0.06	0.05	0.04
T93	0.05	0.05	0.05	0.06	0.04	0.03	0.02	0.02	0.07	0.01	0.04	0.04	0.04
T94	0.06	0.16	0.12	0.15	0.06	0.06	0.06	0.04	0.12	0.11	0.07	0.11	0.09
T95	0.04	0.05	0.07	0.07	0.10	0.05	0.06	0.01	0.08	0.06	0.10	0.07	0.07
T96	0.02	0.08	0.14	0.10	0.04	0.04	0.01	0.07	0.06	0.07	0.03	0.07	0.06
T97	0.03	0.08	0.09	0.07	0.05	0.04	0.00	0.05	0.10	0.06	0.01	0.06	0.05
T98	0.05	0.06	0.09	0.12	0.05	0.03	0.02	0.05	0.08	0.05	0.02	0.07	0.06
T99	0.04	0.05	0.15	0.17	0.16	0.13	0.03	0.02	0.05	0.04	0.03	0.11	0.08
T100	0.06	0.02	0.05	0.11	0.01	0.02	0.01	0.02	0.12	0.09	0.06	0.06	0.06
T101	0.08	0.18	0.20	0.17	0.11	0.03	0.08	0.11	0.21	0.15	0.11	0.15	0.13
T102	0.01	0.05	0.04	0.06	0.14	0.05	0.05	0.04	0.06	0.06	0.08	0.06	0.07
T103	0.01	0.06	0.12	0.11	0.10	0.07	0.06	0.03	0.05	0.05	0.05	0.08	0.06
T104	0.02	0.09	0.19	0.15	0.17	0.14	0.06	0.06	0.14	0.05	0.11	0.13	0.11
T105	0.01	0.03	0.04	0.09	0.03	0.05	0.03	0.02	0.06	0.03	0.03	0.05	0.04
T106	0.07	0.11	0.23	0.29	0.25	0.19	0.10	0.04	0.13	0.07	0.08	0.19	0.14
T107	0.03	0.01	0.03	0.07	0.03	0.12	0.03	0.07	0.14	0.07	0.03	0.06	0.07
T108	0.04	0.10	0.08	0.06	0.01	0.10	0.03	0.03	0.10	0.03	0.03	0.06	0.05
T109	0.10	0.02	0.04	0.06	0.06	0.03	0.05	0.05	0.07	0.02	0.06	0.05	0.05
T110	0.02	0.06	0.07	0.07	0.07	0.08	0.02	0.04	0.06	0.07	0.03	0.06	0.06
T111	0.03	0.03	0.10	0.06	0.05	0.08	0.04	0.08	0.05	0.06	0.04	0.06	0.06
T112	0.03	0.03	0.07	0.12	0.07	0.07	0.06	0.09	0.13	0.06	0.03	0.08	0.08
T113	0.03	0.03	0.07	0.10	0.08	0.12	0.05	0.04	0.02	0.09	0.04	0.07	0.06
T114	0.05	0.05	0.05	0.07	0.05	0.07	0.02	0.03	0.03	0.08	0.07	0.06	0.05
T115	0.09	0.04	0.10	0.09	0.02	0.03	0.02	0.00	0.01	0.01	0.01	0.05	0.03
T116	0.05	0.08	0.08	0.08	0.14	0.07	0.02	0.03	0.10	0.08	0.01	0.08	0.07
T117	0.05	0.06	0.11	0.25	0.10	0.15	0.05	0.07	0.10	0.07	0.03	0.13	0.10
S01	0.01	0.06	0.10	0.05	0.08	0.05	0.02	0.04	0.07	0.10	0.04	0.06	0.06
S02	0.02	0.01	0.02	0.04	0.03	0.04	0.01	0.03	0.05	0.08	0.06	0.03	0.04
S03	0.02	0.01	0.02	0.01	0.01	0.04	0.01	0.01	0.03	0.02	0.02	0.02	0.02
S04	0.02	0.01	0.02	0.02	0.01	0.02	0.01	0.02	0.07	0.06	0.05	0.02	0.03
S05	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.01	0.02	0.01	0.02