Proposed Performance and Activity Venue at Moreton Terrace in Wan Chai Air Ventilation Assessment

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ENVIRON Hong Kong Limited

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ENVIRON

Prepared by:

Steve Lo
Environmental Consultant

Approved by:

Tony Cheng
Senior Manager

ENVIRON Hong Kong Limited
Room 2403, Jubilee Centre,
18 Fenwick Street, Wan Chai, Hong Kong
Tel: (852) 3465 2888
Fax: (852) 3465 2899
E-mail: info.hk@environcorp.com

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1.0 Introduction

The Project is to provide a performance and activity venue (PAV) for organizing a wide range of community building, cultural and leisure services activities for local residents (which account for approximately 160,000 persons) and visitors. This PAV will relieve the heavy usage of Leighton Hill Community Hall (LHCH) which is the only performance venue under Home Affairs Department (HAD) in the District.

The zoning of the subject site is currently zoned as "Open Space" under the Causeway Bay Outline Zoning Plan (S/H6/15), and is used for volleyball court. A S16 planning application is required for the proposed PAV. This Air Ventilation Assessment (AVA) study is to assess the potential impact after the construction of the proposed PAV.

ENVIRON Hong Kong Limited has been commissioned by the project proponent to conduct this AVA based on the development scheme provided by Home Affairs Department (HAD) (the project architect).

1.1 Objectives

In this study, it aims to assess the air ventilation impact at the pedestrian level in the vicinity of the subject site. The proposed development scheme will be compared with the baseline scheme, i.e. current landuse "Open Space" without the proposed development.

1.2 Subject Constraint

The subject site is about 0.075 ha; and is currently used for 2 volleyball courts. The landuse to the northeast of the subject site is football field. A busy bus terminus is located to the southeast of the subject site, and the Moreton Terrace Flyover is located to the west of the subject site with a foot path located in between. The Central Library (CL) is located to the north of the subject site with an existing vehicle access in between. **Figure 1** shows the location of the project site and its environs.

After reviewing the surrounding landuse and the development parameter of the proposed PAV, there are a number of site constraints in restricting the design of the proposed PAV. It is not feasible to provide additional mitigation measure for this proposed PAV. The followings are the various site constraints.

1.2.1 Area

The proposed performance and activity will accommodate:-

A) a hall and stage for about 300 persons (approx. 200sqm);

B) a multi-purpose function room for about 130 people with movable partitions with a store room (approx. 100sqm);

C) a community garden cum roof garden on the rooftop (approx. 400sqm); and

D) ancillary facilities including a stage meeting room, a stage control room, dressing rooms, a management office, a baby-care room, toilets, a booking office, store rooms, lifts, plant rooms, loading and unloading areas.

Due to the limited size of the site of about 0.075 ha, the main hall is smaller than a standard community hall (in accordance with the Hong Kong Planning Standards and Guidelines, a standard-designed community hall comprises of 450 person multi-purpose hall with associated facilities requires about 1,260 sq.m of GFA (32m x 39.5m)) and the size of the multipurpose function room has also been reduced (reduced from original scope of 140 sq.m to 100 sq.m). Home Affairs Department (HAD) is committed to provide a community garden cum roof garden on the rooftop to compensate the loss of open space (volleyball court).

1.2.2 Mass

To minimize the mass and height of the building, the required accommodations occupy majority of the floor plates. The required accommodations occupy three major floors: a multi-purpose function room on the ground floor, a hall on the first floor and second floor (double height space) and a community garden on the roof. The height of the building has taken into account the practical requirements, e.g. headroom, structure, building services. Plant rooms are located on ground floor for access and maintenance and spaces for services ducts and pipes have been reduced. Although there is not much open space available on ground floor, deck spaces are provided where possible on first floor and second floor to encourage cross ventilation across the building and adjacent site. However, it is believed that the provided open area shall not effectively benefit the pedestrian level.

It must be noted that the subject site is small and elongated; and various site constraints have posed limitations on the building design. There is no room for the proposed PAV to increase permeability at the ground floor. However, as the proposed PAV is 4 storeys only, the air ventilation at the Moreton Terrace Flyover downwind of the subject site is not significantly affected.

1.2.3 Vehicular Access

The subject site is located away from any roads. However, vehicles can access the subject site by the vehicular access via the car park area of the Hong Kong Central Library (HKCL), located at the northwestern side of the site for vehicular access during construction period, future operation and maintenance, and Emergency Vehicular Access (EVA) to the proposed development. Loading and unloading bay for the building is thus located at the northern corner adjacent to the EVA.

Possibility to use Moreton Bus Terminus (MTBT) for vehicular access for the building had been explored. It was found that MTBT was already fully occupied. It would cause disruption to public transport and jeopardize pedestrian safety should it be used as vehicular access.

1.2.4 Setback

The site is part of Government Land allocated to LCSD who yields up the site for HAD for this venue. The site boundary was assigned to the edges of the existing volleyball courts. The site is therefore constrained by the football fields to the northeast, and existing trees to the southwest. The site area of approximately 750sqm is quite tight to accommodate a GFA not more than 1,875 sqm. Despite of that, the southwest façade of the building has been set back to allow space for the existing trees. Further

setback of the building from the site boundary would make the required accommodations unfeasible and might result in increased building height.

1.3 Proposed Development

Based on the site constraints identified in section 1.2 above, the layout of the proposed PAV is developed. The proposed PAV is a 4 storey building with the roof level at 25.15 mPD. Electricity and mechanical plant rooms, management office and the loading bay for light goods vehicle are located at ground floor. A 100 m^2 multi-purpose function room is also located at ground floor. The hall and stage for about 300 persons is located at the 1st floor and 2nd floor. Garden and storage areas are located at roof level of the proposed PAV with the level at 19.40 mPD. The mPD level of the roof of the store room is 25.15 mPD.

The master layout plan of the proposed PAV is shown in **Figure 4**. Layout plans and section of the proposed PAV are attached in Appendix A.

2.0 Site Wind Availability

2.1 Site Wind Availability Data

According to the Experimental Site Wind Availability Study for Causeway Bay, Hong Kong (Wind Report for Causeway Bay), the frequencies of distribution of 16 wind directions annually, during summer and annual time were determined. **Figure 2** and **Table 1** showed the site wind availability data.

Table 1 Experimental Site Wind Availability Data for the Study Area (at 500m above ground)

	Percentage Occurrence (%) for Wind Speed Ranges:	
Wind Angle	**Annual**	**Summer**
0*	**12.5%**	**2.5%**
22.5*	**8.0%**	**2.0%**
45*	**8.5%**	**2.5%**
67.5*	**14.5%**	**4.5%**
90*	**24.0%**	**14.0%**
112.5*	**5.0%**	**8.0%**
135*	**3.5%**	**6.5%**
157.5*	**3.0%**	**6.5%**
180*	**4.0%**	**10.5%**
202.5*	**3.0%**	**8.5%**
225*	**5.0%**	**14.5%**
247.5*	**3.0%**	**9.5%**
270*	**2.5%**	**6.5%**
292.5	1.0%	2.0%
315	1.0%	1.0%
337.5	1.5%	1.0%
TOTAL	100%	100%
TOTAL Selected*	**93.8%**	**96.0%**

The wind direction and average wind speed selected for this assessment represents the condition at infinity height (~500m). Wind profile(s) for the site could be appropriated from the V∞ data with reference to coefficients appropriate to the site conditions from the information extracted from the Wind Study for Causeway Bay so that the near ground wind condition can be deduced. **Figure 1** indicated the measurement location of the reference experimental site wind data of easier reference.

According to the Wind Report for Causeway Bay, the dominant wind direction for annual is from east to north quarters; while that for summer is mainly from east to southwest (See **Figure 2**).

2.2 Topography and Building Morphology

Figure 10 shows the topography and building morphology of the area under concern.

Topography

The subject site is located behind the Hong Kong Central Library (CL) where it is relatively flat around the site. Open space is located to the northeast of the subject site, including the football field and Causeway Bay Sports Ground. Victoria Park is located further north of the subject site with Causeway Road and CL located in between.

The ground level of the immediate surrounding areas is around 5 mPD and ground elevation increase gradually to the south.

Building Morphology

Low rise buildings are located east and south to the subject site. High-rise buildings area located to west and south of the subject site. The major immediate existing development is the CL to the north of subject site. Underneath of the Moreton Terrace Flyover which is located immediate west of the subject site, there are four one storey GIC buildings. High rise buildings with the level up to 94mPD are located further west, including Park Avenue Tower, Grand View House, Sik King House, etc. Hotung Secondary School is located further southwest of the subject site and the school is located at platform with ground level at ~ 17 mPD. Highrise residential building Fontana Gardens is located immediate southeast of the school. Low rise residential buildings are located southeast to east of the subject site.

The building height in mPD number of storeys of the neighbouring buildings/developments is tabulated as follows and indicated in the **Figure 1**:

Table 2 Building Height of Existing Neighbouring Developments

Name of Building	Building Height (mPD)	Location from Subject site
Central Library	38	North
Park Avenue Tower	94	West
Grand View House	52	West
Sik King House	44	West
St. Mary's Church & School	12	Southwest
Hotung Secondary School	38	Southwest
Fontana Garden	84-97	South
Moreton Terrace Zone Substation	15	Southeast
Low-rise residential buildings south of Tung Lo Wan Road	20-35	Southeast

2.3 Summary of Site Wind Availability

According to the Expert Evaluation and Advisory Report for Causeway Bay Area (EE for Causeway Bay), the annual wind directions of the area include easterlies, north-easterlies and northerlies. As the

Victoria Park and Sports Ground, are located north of the district area, the district area enjoy the sea breeze from the north. From Table 1, the wind probability from the north direction is 12.5% and is considered to be the dominant wind direction for the area. The E (24.0%) and ENE (14.5%) wind are also dominant prevailing wind directions other than the north wind. With the present of the CL, the Moreton Terrace Flyover is the main air corridor of the district area. In addition, the level of Moreton Terrace Flyover is about 11mPD and street level of Moreton Terrace is about 5mPD. Since there is around 6m difference between the flyover and the street level, it is anticipated that the flyover will not have implication on the air movement. Since the Central Library is located to the north of subject site, wind come from the North is obstructed to downwind, especially to the Moreton Terrace Temporary Playground. However, the Central Library is aligned from northeast to southwest, therefore the prevailing northeast wind shall not affect the availability to downwind area.

During annual condition, wind from the northeast to east are the dominant wind directions. Causeway Bay Sports Ground and Moreton Terrace Temporary Playground provided air corridor to the southwest area during northeasterly wind. However, since there is development at higher platform located to the downwind area, the wind availability at that area will be reduced.

During summer condition, winds from southwest to east are the dominant wind directions. The St. Mary's Church southwest of the subject site will slightly reduce the wind speed from westerly direction. Since there is a school at a higher platform located southwest of the subject site, it is anticipated that the speed of the southwest wind will also be reduced at the subject site after passing through the school. Similarly, due to the presence of dense and compact low rise residential buildings to the southeast of the subject site, the wind speed from southeast direction will be reduced at the subject site after passing the low rise buildings. With the open space to the east, it is anticipated that there would be sufficient wind from easterly direction.

3.0 Discussion on Important Pedestrian Areas and Problem Area

3.1 Important Pedestrian Areas

The proposed building height (H) is about 19.85m above ground (main roof level is at 25.15 mPD with ground level at 5.3 mPD). Normally, assessment area shall be 1H (i.e. 25.15m) from the site boundary. However, the assessment area in the project is too small that cannot cover surrounding important pedestrian areas. An assessment area based on the highest building in the vicinity is modeled (i.e. around 120m).

Important pedestrian areas that the public would access more often are identified and include: Public Sports Ground and Football Field to the northeast, bus terminus to the southeast, footpath at ground level along the Moreton Terrace Flyover, Hotung Secondary School, and Tung Lo Wan Road Sitting Out area.

3.2 Problem Areas

In view of the flat topography and sufficient open space, the general wind availability in the immediate vicinity is considered good. However, as there are some tall buildings (e.g. Park Avenue Tower and immediate surrounding buildings) or bulky building (e.g. CL), it is anticipated that there would be some area, behind these buildings, with relative low wind speed when the wind direction is from the upstream of these buildings. For example, under the northern wind, the wind speed at the area between the CL and the subject site will be relatively low as the CL blocks the northeasterly wind. In view of the presence of dense low rise buildings at the southeast portion of the assessment area, the wind speed at the area around the bus terminus is likely to be relatively low. Under the wind from west to southwest direction, the high rise buildings (e.g. Park Avenue Tower) would block the wind in certain extent and the wind speed at the leeward area is likely to be reduced.

4.0 Expert Evaluation of Air Ventilation Performance of the Proposed Development

According to Figure 12 Existing Scenario showing Major Existing Breezeways of the EE for Causeway Bay (Appendix E), there are a number of major breezeway under annual condition identified in the area, and they are 1) the Moreton Terrace Flyover, the Tung Lo Wan Road and the Causeway Bay Sports Ground. During summer scenario, the Tung Lo Wan Road is the breezeway of the area. The major breezeway around the site is shown in Figure 8. The areas enjoy excellent breezes from the north due to the flat and open area of Victoria Park.

Annual Condition

According to the Expert Evaluation and Advisory Report for Causeway Bay Area (EE for Causeway Bay), the annual wind directions of the area include easterlies, north-easterlies and northerlies.

The subject site possibly encroaches into the identified major breezeways under both annual and summer condition. It is anticipated that the construction of the proposed PAV would not significantly reduce the air ventilation of the area which is named as the Northern Region in the EE for Causeway Bay. The proposed PAV would possibly block the wind passing through the main breezeways.

In addition, the subject site is located at the downwind area of north direction. The CL is a more bulky building in comparing with the proposed PAV which is only 4 storeys in height. Also, the subject site is away from the breezeway along the Sport Grounds. It is anticipated that the proposed PAV would not significantly affect the wind performance of the area under the north wind which is the major wind direction for the area. However, the proposed PAV would affect the wind flow along the open area between the Central Library and Moreton Terrace and create a larger wake area at Moreton Terrace Temporary Playground.

For the wind from northeast and east, it is expected that the wind speed at the subject site will be relatively high as there is no compact buildings at the upstream. The proposed PAV aligns from northwest to south east which is following the site boundary. Although the proposed PAV is 4 storeys only, the building is perpendicular to the wind direction. Therefore, it is anticipated that the wind speed at pedestrian level immediate behind the proposed PAV will be affected. However, it must be noted that there are a number of low rise building underneath of the Moreton Terrace Flyover which is leeward of the subject site under east and northeast wind direction. The wind flow shall be reduced in these area. On the other hand, these existing building is affecting the wind speed of the downwind area. Therefore, it is anticipated that the wind speed of the further downwind pedestrian area will not be significantly affected.

Summer Condition

During summer condition, winds from southwest to east are the dominant wind directions.

According to Figure 31 Wind Environment in the Northern Region (Appendix E), the subject site falls within one of the summer Breezeways from the southwest direction. As there is no building at the subject site currently, it is anticipated that the proposed PAV would affect the air ventilation of the localized area even it is only 4 storeys. Nevertheless, the proposed PAV is 4 storeys with roof level at 25.15 mPD while the building height of the nearby CL and the mid- to high-rise buildings are ~ 38

mPD and 15 to 94 mPD respectively. The proposed PAV is much lower than the nearby buildings. The high-rise buildings at upwind area are affecting the wind speed under existing condition. Also, there are low-rise 1-storey buildings underneath the Moreton Terrace Flyover; which is affecting the wind speed of the subject site and its surrounding area, especially to the eastern area of Moreton Terrace under summer prevailing wind, e.g. Moreton Terrace Temporary Playground.

For the wind from south direction, there are Hotung Secondary School, where is located at a higher platform, and high-rise buildings Fontana Gardens located at upwind area. These buildings will reduce the wind speed when the wind passes over them. Therefore, the wind speed at the subject site will be reduced. It must be noted that the bulky CL is located downwind of the subject site, the CL will block the south wind for the further leeward area at Causeway Bay Road and the Victoria Park. Therefore, it is anticipated that the proposed 4 storeys PAV would not significantly affect the air ventilation performance of the district area.

There are compact and dense low-rise buildings southeast of the subject site. These buildings would reduce the wind speed; and the wind speed at the subject site and surrounding area will be low under the wind direction from southeast. The proposed 4 storeys PAV is much lower than the surrounding buildings at downwind area. Therefore, it is anticipated that the proposed 4 storeys PAV would not significantly affect the air ventilation performance of the district area.

Overall Performance

The proposed PAV would possibly encroach into the any identified major breezeways under both annual and summer condition. The proposed PAV would not block the wind passing through the main breezeways. Also, the proposed PAV is 4 storeys which is much lower than the nearby buildings. Therefore, the air ventilation performance of the 7 area will not be affected after the construction of the proposed PAV.

However, the proposed PAV would affect the wind flow along the open area between the Central Library and Moreton Terrace and create a larger wake area at Moreton Terrace Temporary Playground. Furthermore, the proposed PAV is located at the existing air corridor along northeast to southwest from Causeway Bay Sports Ground and Moreton Terrace Temporary Playground.

However, there is no building at the subject site currently. It is anticipated that the air ventilation performance of the localized area immediate surrounding the subject site will be affected. A quantitative assessment is required to assess the potential impact.

5.0 Quantitative Assessment Methodology

5.1 CFD Code and Major Parameters

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.

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.

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	$\rho(\varepsilon/k)(C_{\varepsilon1}G - C_{\varepsilon2}\varepsilon) + \rho C_{\varepsilon3}G^2/k$

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

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

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

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.

The domain covers an area of over 240m (>2H where H=120m is the maximum height of the surrounding development) from the project site boundary. The domain dimension is about 2000m x 2000m and with an elevation of 1000m. 1-phase fluid is modeled at standard pressure. Nearly 2,850,000 grid cells are defined to simulate the air flow. Cartesian coordinate cell grid system is adopted with refinement within an area which is within about H 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 study area. The grid expansion ration is controlled to not more than 1.2.The grid size near the domain boundary on 4 sides and ceilings are >50m. It is defined in such a way that there will be at least 3 cells within major building gaps. For relevant streets/roads containing the test point, generally 8 to 10 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, the grid height of the layer near ground is about 0.5m and there will be 4 cells defined so that the result taken would be taken at the 3rd cell, instead of the cell adjacent to ground. Similarly, all test points would not be taken at the cell adjacent to wall/object.

Lateral clearance is around 700m (more than 5H) on each side. The vertical distance between the proposed development and the ceiling of the CFD domain amounts to more than 850m. Top and lateral boundary area defined as symmetric plane in the CFD. The distance between the proposed development and the inflow amounts to around 940m. The distance between the proposed development and the outflow amounts to around 940m. The height of the proposed development is around 45m tall above the ground. The percentage blockage is less than 3% with the surrounding public housing and private residential developments considered. The convergence criteria adopted in this study is 0.1%. In addition, spot values are checked to ensure that steady value can be obtained from simulation. The windward boundary is defined as inflow with the wind profile defined (as discussed below). The leeward boundary is defined as outflow. The sky and lateral boundaries are defined as neutral.

The commonly used hybrid-differencing numerical 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 to strike a balance between accuracy and computing efficiency with the low-convection region using higher order scheme).

5.2 Atmospheric Conditions

The wind profiles used in the Wind Study for Causeway Bay have been used in the modeling. The Wind Study for Causeway Bay determines the wind profile in terms of normalized wind speed at different elevations measured aboveground. Log Law has been used to approximate the wind profile of each wind direction for lowest elevations (4 to 100m aboveground) based on the wind profiles used in the Wind Study for Causeway Bay Model. **Appendix D** is a plot of normalized wind speed against heights under different wind directions. The corresponding logarithmic lines fitted to the plotted values are shown.

According to Log Law, $Uz = U^* \div \sigma \times \ln(Z \div Zo)$ where

Uz=wind speed at height z from ground;

σ=von Karman constant = 0.4

Zo=roughness length

U*=friction velocity

Z=height z from ground

The friction velocity is deduced by substituting Uz and Z using the reference velocity and height under each wind direction. The reference velocity refers to the average simulated V∞ value extracted from Experimental Site Wind Availability Study For Causeway Bay, Hong Kong. The reference height is 500m in this case. **Table 3** below showed the set of average simulated V∞, reference height and friction velocity.

Table 3 Friction Velocity adopted under Different Wind Direction

Wind Direction	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W
Zo (note)	0.001	0.008	0.05	0.15	0.25	0.4	0.001	0.7	0.05	0.01	0.015	0.001	0.005
U*	0.065	0.087	0.072	0.072	0.051	0.087	0.04	0.10	0.072	0.036	0.051	0.040	0.036

Note: roughness values depend on building density and topography outside the model area and are determined based on corresponding logarithmic lines fitted to the plotted values shown in **Appendix D**

Appendix C showed captured CFD models.

5.3 Test Point Location

Onsite survey was conducted to identify major pedestrian areas and features. Test points are selected and shown in **Figure 3**. Test points include perimeter test point defined along the boundary of the subject site, and overall test points from the subject site for the surrounding area. The boundary of the assessment area with 120m radius and surrounding area of this AVA study is also shown in **Figures 3**.

6.0 Key Findings

6.1 Spatial Average Wind Velocity Ratios

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 point located at 2m above the ground level.

Figure 3 shows the location of the test points within the assessment area. A total of 93 test points are selected including 30 number of perimeter test points, 77 number of overall test points. Demarcation of all focus areas is also shown on **Figure 3**.

Table 4 shows the site spatial avera ge velocity ratio (SVR), local spatial average velocity ratio (LVR) and average wind velocity ratio along surrounding air sensitive uses area during Annual Condition and Summer Condition respectively for the Proposed Scheme (PS) and Existing Scenario (EX).

The wind velocity ratios of individual test points are shown in **Figure 5** and **Figure 6** respectively for the proposed PAV and the existing scenario. All test points results are taken at 2m above pedestrian level. **Appendix B3** shows VR color plot at pedestrian level for downwind area. **Appendix C1 and C2** shows detailed simulation result of the proposed PAV and existing scenario respectively.

Table 4 Summary of Spatial Average Wind Velocity Ratios (VR) – Annual Condition

		Annual		Summer	
Spatial Average Wind Velocity Ratio (VR)	**Testpoint**	**PS**	**EX**	**PS**	**EX**
SVR (P1 to P30)	P01-P30	0.13	0.23	0.13	0.19
LVR (P1 to P30, T1 to T63)	P01-P30, T01-T79	0.18	0.21	0.17	0.19
All T Test Point	T01-T79	0.20	0.20	0.19	0.19
Football field	T05-T06	0.15	0.22	0.11	0.20
Causeway Bay Sports Ground	T01-T04	0.25	0.27	0.20	0.22
Tung Lo Wan Road (East)	T12-T19	0.17	0.17	0.17	0.16
Tung Lo Wan Road (West)	T45-T48,T64	0.18	0.18	0.21	0.20
Ho Tung Secondary School	T41,T43-T44,T65-T67	0.25	0.22	0.22	0.20
St. John Ambulance Brigade HK Island Area Headquarters	T36-T37,T42	0.24	0.23	0.23	0.22
Fontana Gardens	T37-T39	0.24	0.25	0.20	0.20
Moreton Terrace	T24,T26,T32-T35	0.19	0.19	0.16	0.17
Area under Moreton Terrace Flyover	T51-T54	0.20	0.23	0.14	0.15
Central Library	T25-T29	0.17	0.19	0.15	0.17
Shelter Street	T55-T57	0.17	0.17	0.19	0.15
Bus Terminus	T20-T23,T75-T77	0.14	0.14	0.17	0.16
Tennis Courts	T08-T11	0.18	0.20	0.14	0.16
Causeway Road	T30-T31	0.20	0.20	0.20	0.19
Local Road to the west	T58,T60-T62	0.22	0.21	0.23	0.22

Tung Lo Wan Road Sitting-out Area	T49-T50	0.25	0.27	0.24	0.25
CSA Hong Kong Training Centre	T07,T08,T78,T79	0.19	0.21	0.16	0.18
Playground of Ho Tung Secondary School	T43-T44,T65-T67	0.22	0.20	0.20	0.19
Tai Hand Road	T37,T68-T74	0.21	0.21	0.22	0.22

6.2 Discussions on Air Ventilation Performance

6.2.1 Overall Performance

There is no building at the subject site currently. After the construction of the proposed PAV, it is inevitable that the SVR of the subject site is much lower than that of the existing scenario under both Annual and Summer Condition. In view of having much lower average SVR value, the LVR value of the proposed PAV is also lower than that of the existing scenario. Similar to the SVR, the VR of the football field immediate northeast of the subject site is also smaller in the proposed PAV.

However, there is no significant difference of the average VR value at the further area. For example, the VR vaule at Causeway Bay Sports Grounds (T1 to T4) , Tung Lo Wan Road section west of Moreton Terrace (T44-T47, T63) and Moreton Terrace (T24, T26, T32-T34) is also similar for the proposed PAV and existing condition. Also, the average VR value of all T test point under annual condition is same in both existing scenario and proposed scheme. This can demonstrate that the proposed 4 storeys PAV would not have significant impact upon the air ventilation performance of the district area. The building height of the proposed PAV is lower than that of the surrounding buildings, such as CL and the high-rise buildings to the west of the subject site.

The Tung Lo Wan Road east is the main breezeway of the area during summer condition, the VR ratio of this breezeway (T12 – T19) is similar in both annual and summer condition. The proposed VR does not encroach into this main breezeway and no blocking of wind on it. The proposed PAV is sitting on the summer breezeway from southwest direction, and therefore would have some impacts on the air ventilation. The averaged VR ratio under summer condition is slightly lower at the proposed scheme.

6.2.2 Wind Direction Discussion

The following sections describe the air ventilation performance before and after the construction of the proposed PAV for each wind direction studied.

Wind performance under Wind Direction of N

According to the EE for Causeway Bay, the area is enjoying the northern wind from the sea breeze. The proposed PAV does not encroach into the main breezeway along Moreton Terrace Flyover as well as the Sport Grounds. The wind performance along the Moreton Terrace Flyover would not be significantly affected. The air ventilation at the Hotung School and sitting area is also not affected. In addition, there is a vortex created at the leeward area which benefit Moreton Terrace Temporary Playground and the bus terminus.

The proposed PAV is located behind the CL. The CL is a bulky development that the wind speed at some leeway area is low in the existing scenario. As the proposed PAV aligns from northwest to southeast, the wind speed at the football field is reduced after the construction of the PAV although it

has been affected by the CL. However, the proposed PAV would affect the wind flow along Moreton Terrace Flyover and create larger wake area at Moreton Terrace Temporary Playground and the bus terminus. The proposed PAV would obstruct the wind flow and reduce the effect of existing vortex, and therefore less wind reach the downwind area.

Wind performance under Wind Direction of NNE

Similar to the wind from north direction, the air ventilation at the main breezeways are not affected after the construction of the PAV. The air ventilation at the Hotung School, the siting area and the bus terminus is also not significantly affected.

As shown in the contour, the wind speed of the nearby football field is reduced after the construction of the PAV.

Wind performance under Wind Direction of NE

As shown in the contour for the existing scenario, the bulky CL is affecting the wind speed at the subject site. After the construction of the PAV, the air ventilation performance of the area near to the subject site is similar under both existing scenario and proposed scheme (as shown in the two contours). The air ventilation performance of the area at both existing scenario and proposed scheme is similar. However, it is observed that some wind flow generated at the windward area (i.e. Moreton Terrace Temporary Playground) of the PAV due to downwash effect and more wind flow at the eastern area of Moreton Terrace due to vortex generated at the leeward area of the subject site.

Wind performance under Wind Direction of ENE

The proposed PAV align from northeast to southwest, which is perpendicular to the ENE wind. As shown in the contour for existing scenario, ENE wind come from Causeway Bay Sport Ground pass though subject site and flow to downwind area (i.e. Moreton Terrace, Local Road to the west and Tung Lo Wan Road). However, the proposed PAV shall obstruct the prevailing wind flow to above mentioned area.

Wind performance under Wind Direction of E and ESE

The proposed PAV align from northwest to southeast, which is perpendicular to the easterly and ESE wind. Therefore, the wind speed of the area behind the PAV is reduced. It must be noted that the subject site is small and elongated; and a lot of site constraints on the design (section 1.2). There is no room for the proposed PAV to increase permeability at the ground floor. However, as the proposed PAV is 4 storeys only, the air ventilation at the Moreton Terrace Flyover downwind of the subject site is not significantly affected. However, the wind flow will be reduced under the flyover due the obstruction of the proposed PAV. On the other hand, it is observed that the wind availability is affected by the PAV at the Moreton Terrace Temporary Playground, since it obstruct the wind flow from the open area to the east to Moreton Terrace.

For the bus terminus, sitting area and the area further west, the wind speed is not high in view of the presence of the existing buildings such as Moreton Terrace Zone Substation.

Wind performance under Wind Direction of SE

The proposed PAV align from northwest to southeast, which is parallel to the easterly wind. Generally, According to the simulation result, it is believed that there will not be any implication on the air ventilation to surrounding area based on the design of the proposed development. However, the wind availability is slightly affected at the windward area, i.e. the bus terminus, since the PAV slightly reduce the air corridor along southeast at Moreton Terrace.

Wind performance under Wind Direction of SSE

The bulky CL and high-rise buildings as well as the compact and dense low-rise buildings are reducing the wind speed at the downwind area. As there is no room for the proposed PAV to increase the permeability at the ground floor, the air ventilation performance at the football field is reduced. However, the wind speed at the footpath immediate west of the subject site is increased after the construction of the proposed PAV, in view of the channelization effect.

Wind performance under Wind Direction of S

Similar to the wind from SSE, the existing buildings (e.g. CL and high-rise buildings) are affecting the air ventilation performance of the area. The construction of the PAV will affect the localized area; but it is 4 storeys tall that the air ventilation performance of further area is not affected. However, it is found that southern wind reduces at the football field due to the obstruction of the proposed PAV.

The air ventilation performance of the sitting area, bus terminus and school, which are located at the upwind area, is similar at both existing scenario and proposed scheme.

Wind performance under Wind Direction of SW

The existing buildings (e.g. CL and high-rise buildings) are affecting the air ventilation performance of the area and reducing the wind speed. As shown in the contours, the construction of the PAV will affect the localized leeway area; but it is 4 storeys tall that the air ventilation performance of further area is not affected. In addition, the PAV will direct the wind towards the Moreton Terrace Flyover due to the diversion of SW wind. The wind speed at the footpath west to the subject site is improved after the construction of the proposed PAV.

The air ventilation performance of the sitting area, bus terminus and school, which are located at the upwind area, is similar at both existing scenario and proposed scheme. However, since the proposed PAV is located on the breezeway at the football field, it is observed that SW wind will be obstructed by the proposed PAV and some wind diverted to the Moreton Terrace, thus less wind flow to the football field at the proposed scheme.

Wind performance under Wind Direction of SSW

As shown in the contour for existing scenario, SSW wind come from Tung Lo Wan Road pass though subject site and flow to downwind area (i.e. Moreton Terrace Temporary Playground and Causeway Bay Sport Ground). However, the proposed PAV shall obstruct the prevailing wind flow to above mentioned area, especially the Moreton Terrace Temporary Playground.

Wind performance under Wind Direction of WSW

Under this wind direction, the existing bulky buildings are affecting the air ventilation performance of the area. The wind speed is not high at the subject site and its surrounding area. The proposed 4 storeys PAV (~ 25.15 mPD) is located behind the high-rise buildings (~120 mPD); and is much lower than those high-rise building in front. The air ventilation performance of the area would not be affected after the construction of the proposed PAV.

Wind performance under Wind Direction of W

Similar to the wind from W, the existing bulky buildings are affecting the air ventilation performance of the area. The wind speed of the area is not high. After the construction of the proposed PAV, the air ventilation performance of the downwind area is slightly affected. However, as the proposed PAV does not encroach into the Moreton Terrace Flyover, the wind speed of this main breezeway is not affected.

6.2.3 Mitigation Measures

As mentioned in the section 1.2, there are a lot of site constraints in restricting the design of this 4 storeys building within a very small site. The ground floor of the proposed PAV has to accommodate the E&M rooms and other supporting facilities. The size of the multipurpose room at ground floor is reduced from the original requirement. Within this compact and small site, setback of the building from the site boundary is not feasible due to existing football field and large mature trees. In addition, there is no room for modifying the orientation of the building. The proposed PAV is constructed at a restricted and designated site.

In order to mitigate the impact of air ventilation at localized area, wind corridor and void area have been maximized in the proposed PAV. **Figure 7** shows the location of the wind corridor and void area within the PAV to mitigate the air ventilation impact.

There is no solid side wall at northeastern and northwestern side of the loading/unloading area of the proposed PAV. As mentioned in section 1.2.3, the subject site is located away from any road. The access of proposed PAV cannot be located at the southern portion as the traffic of the busy bus terminus cannot be disrupted. The proposed access is shared with the existing access of the CL. Therefore, the location of the loading /unloading area cannot be changed. In order to reduce the blocking effect, there is no solid wall at its two sides (northwestern and northeastern). It is anticipated that the wind can pass through the loading/unloading area.

The proposed PAV is a compact building and the ground floor is full of E&M rooms and function rooms. Therefore, there is no room for providing setback or wind corridor provided at ground floor. In order to increase permeability of the proposed PAV, there are a ~2m width void at 1st floor and a ~ 6m width void at 2nd floor. These void areas will allow the wind pass through the proposed PAV from east to west and vice versa. The air ventilation of the localized area can be improved. A streamline plot under E wind is provided in **Appendix B** for easier reference. It is believed that the void at 2nd floor shall not effectively benefit pedestrian level and only allow more wind flow at higher level.

7.0 Conclusion

The Proposed Scheme has been qualitatively and quantitatively evaluated with reference to the existing scenario which no building at the subject site.

The subject site is small and there are a lot of site constraints restricting the design of the proposed PAV and there is not feasible to provide additional mitigation measure for this proposed PAV. The air ventilation of the localized area surrounding the subject site is affected after the construction of the proposed PAV, especially the breezeway along northeast to southwest at the Causeway Bay Sport Ground and therefore he wind speed at the football field and other surrounding area is reduced. Mitigation measures have been proposed to minimize the potential localized impact.

As the proposed PAV is 4 storeys only, the air ventilation performance of the district area is not significantly affected.

Figures

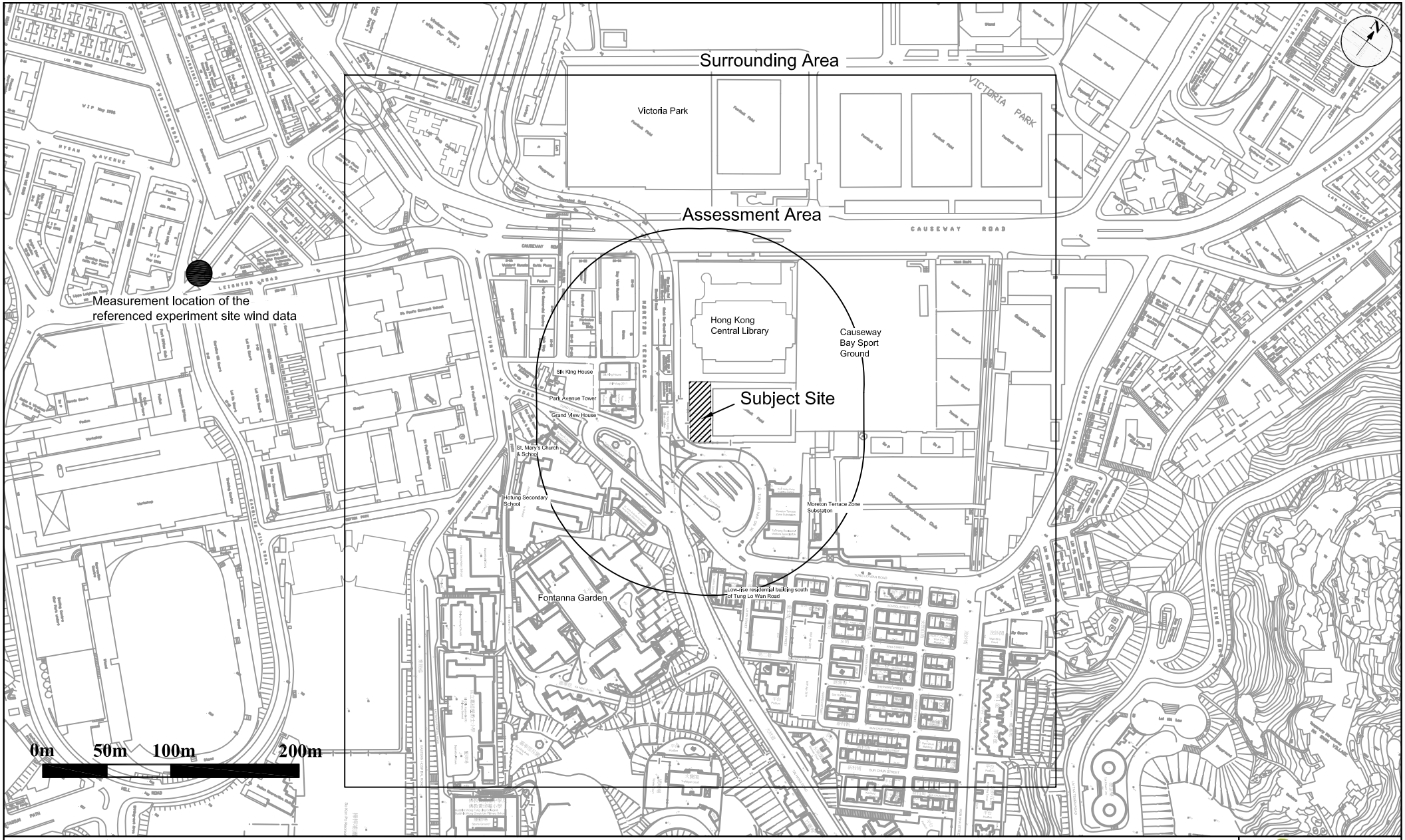
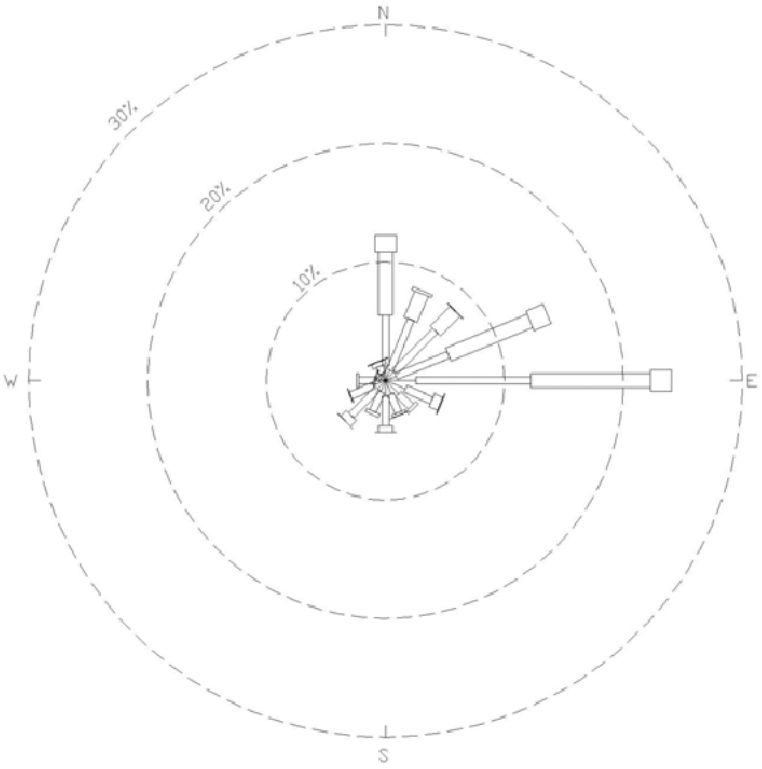
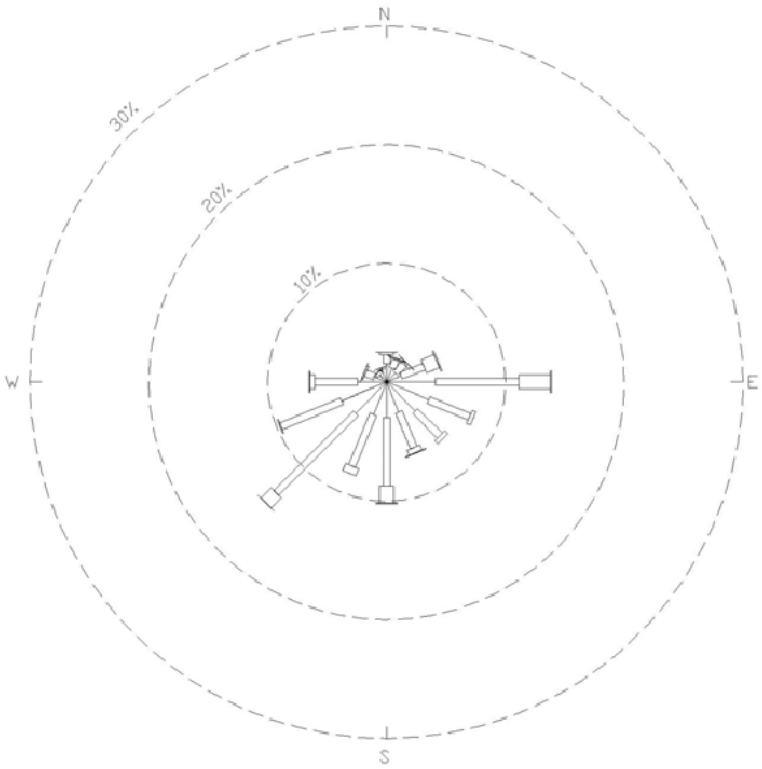


Figure: 1	ENVIRON
Title: Location of the Subject Site and its Environs	Drawn by: SLo Checked by: TC
Project: Proposed Performance and Activity Venue at Moreton Terrace in Wan Chai Air Ventilation Assessment	Rev.: 1.1 Date: Nov 2014



Wind Rose for Annual at 500m



Wind Rose for Summer at 500m

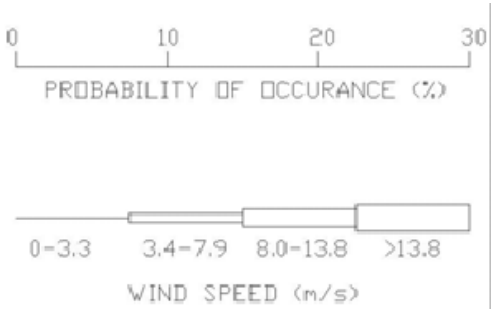


Figure:	**2**	ENVIRON
Title:	**Windrose Diagram representing V∞ of the Area under Concern**	Drawn by: SLo
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Project:	**Proposed Performance and Activity Venue at Moreton Terrace in Wan Chai** **Air Ventilation Assessment**	Rev.: 1.0
		Date: Jul 2014

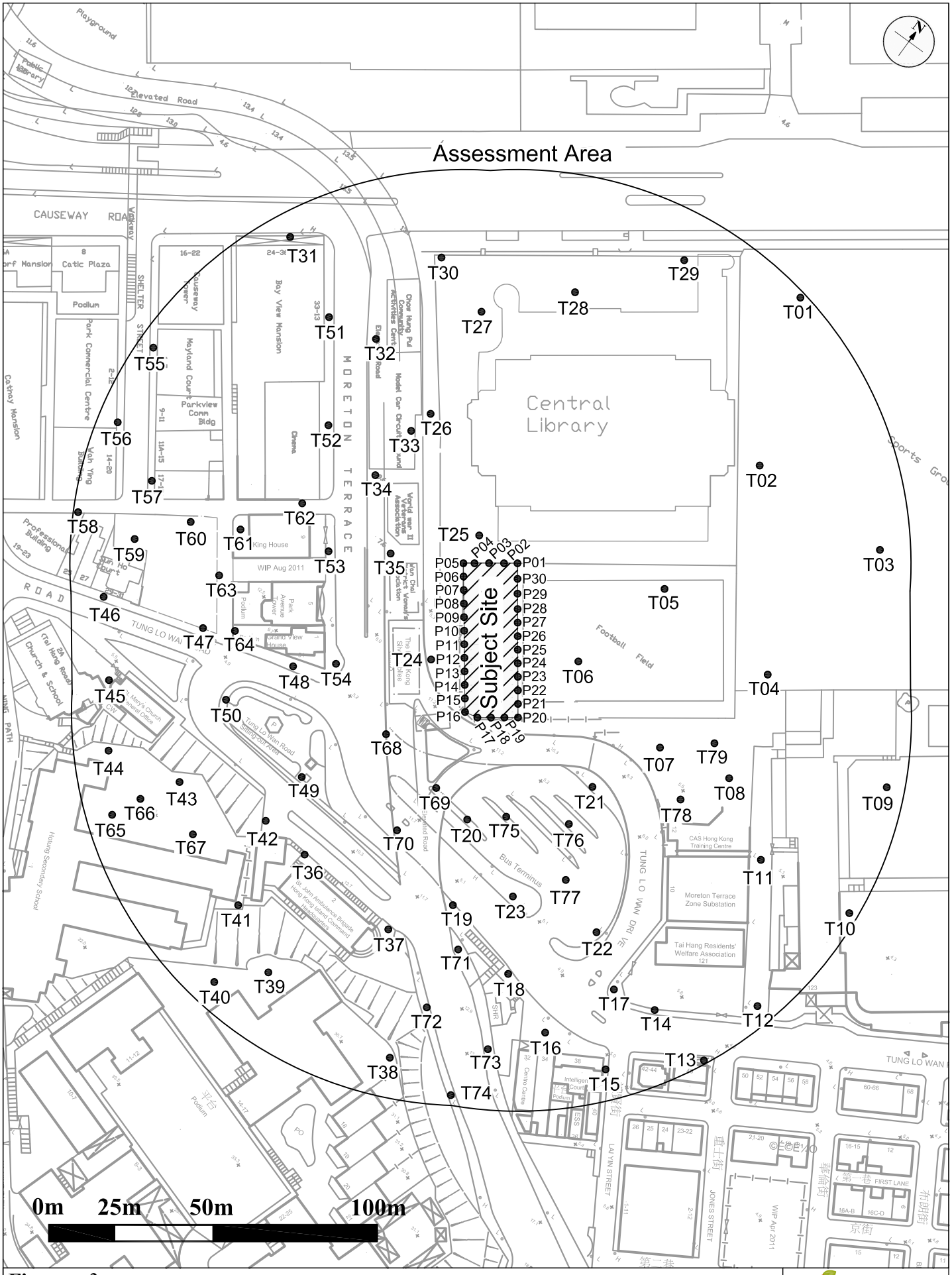

Figure: 3		ENVIRON
Title: Test Points Selected for Quantitative Air Ventilation Assessment		Drawn by: SLo
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Project: Proposed Performance and Activity Venue at Moreton Terrace in Wan Chai Air Ventilation Assessment		Rev.: 1.2
		Date: Nov 2014

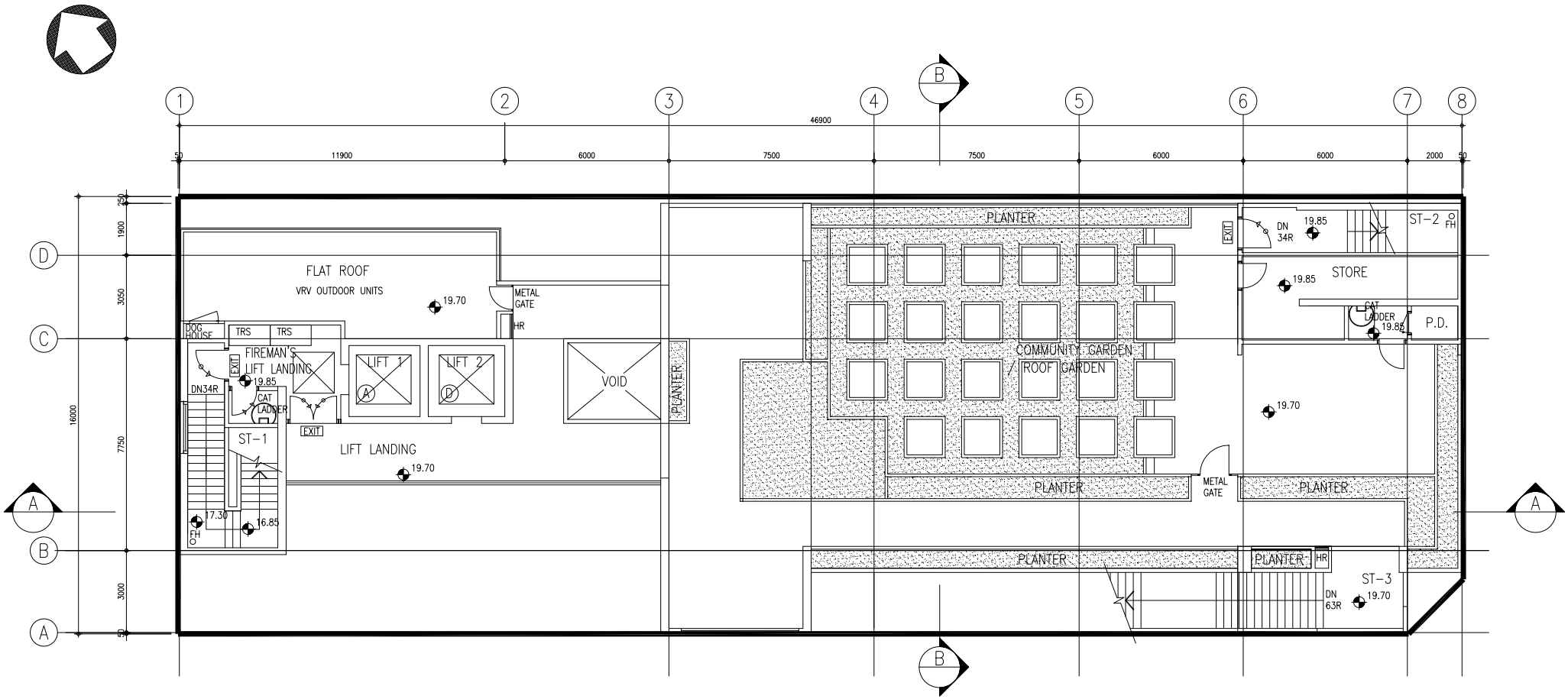

Figure: 4	ENVIRON
Title: Master Layout Plan	Drawn by: SL
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Project: Proposed Performance and Activity Venue at Moreton Terrace in Wan Chai Air Ventilation Assessment	Rev.: 1.0
	Date: Apr 2013

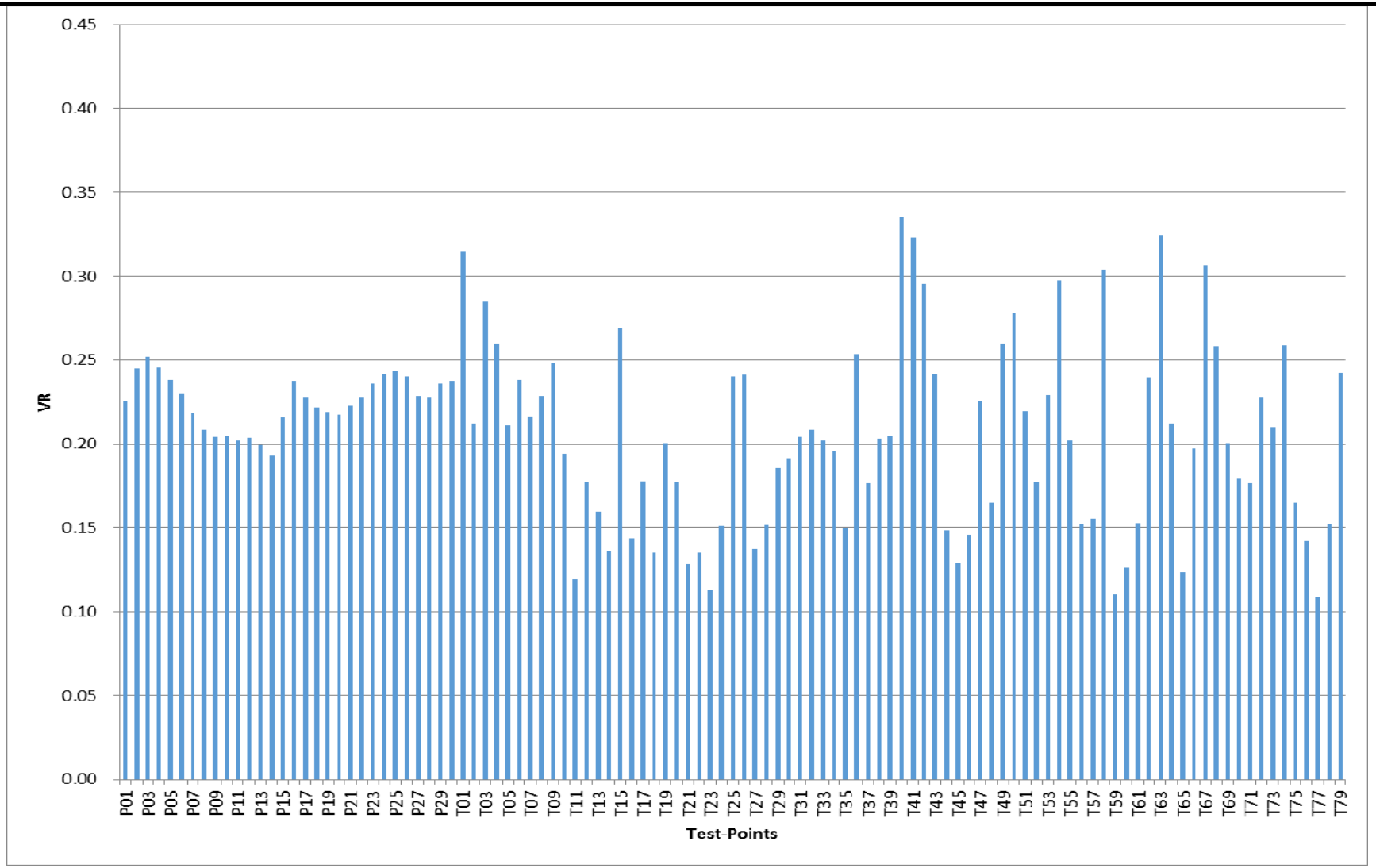

Figure: 5	ENVIRON
Title: Wind Velocity Ratios of Individual Test Points for Existing Scenario	Drawn by: Slo Checked by: TC
Project: Proposed Performance and Activity Venue at Moreton Terrace in Wan Chai **Air Ventilation Assessment**	Rev.: 1.1 Date: Nov 2014

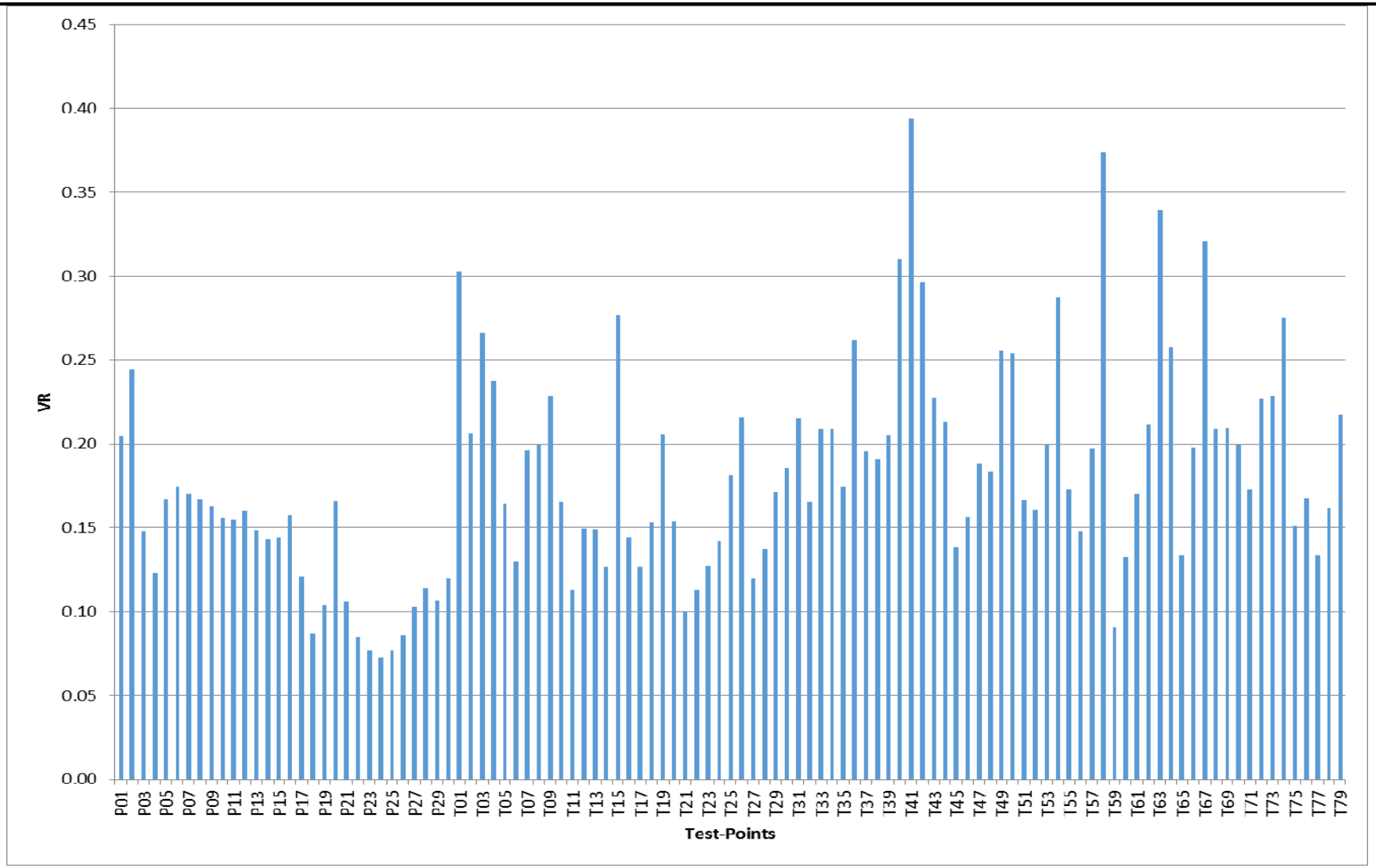

Figure: 6	ENVIRON
Title: Wind Velocity Ratios of Individual Test Points for Proposed Scheme	Drawn by: Slo
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Project: Proposed Performance and Activity Venue at Moreton Terrace in Wan Chai **Air Ventilation Assessment**	Rev.: 1.1
	Date: Nov 2014

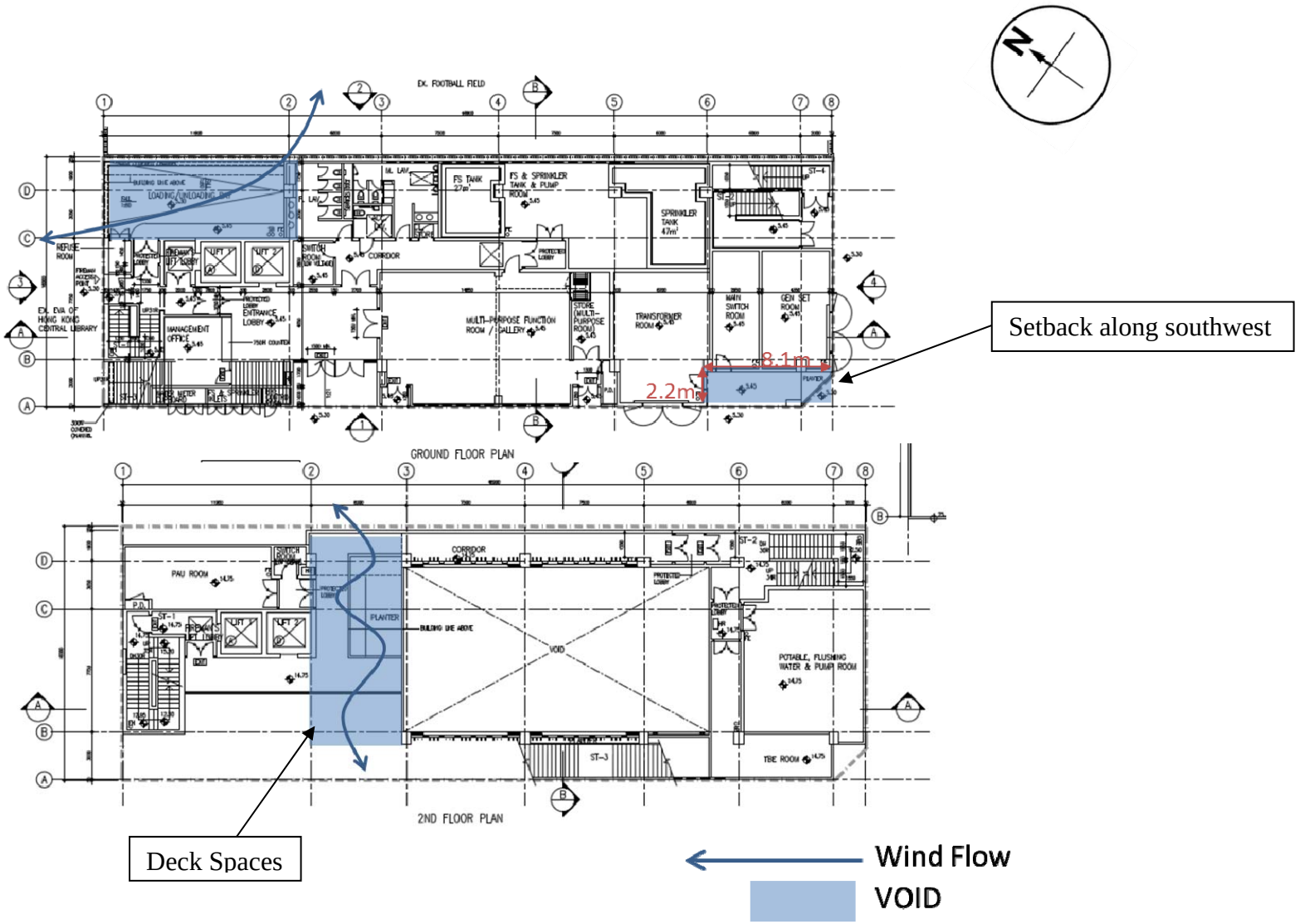

Figure: 7	ENVIRON
Title: Mitigation measures provided on the Proposed Scheme	Drawn by: Slo
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Project: Proposed Performance and Activity Venue at Moreton Terrace in Wan Chai Air Ventilation Assessment	Rev.: 1.1
	Date: Nov 2014

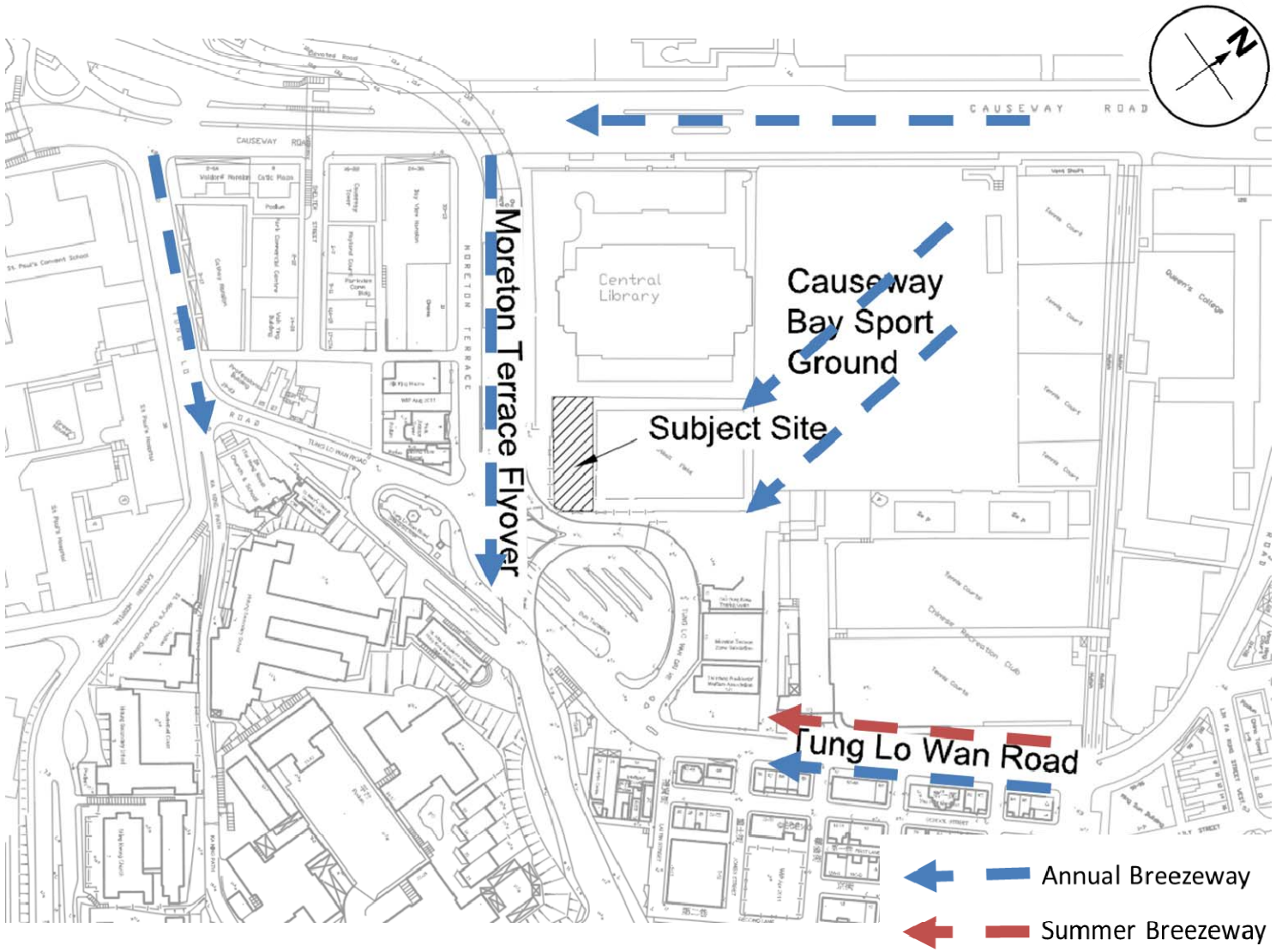

Figure: 8	ENVIRON
Title: Major Breezeway around the site	Drawn by: Slo
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Project: Proposed Performance and Activity Venue at Moreton Terrace in Wan Chai Air Ventilation Assessment	Rev.: 1.0
	Date: Nov 2014

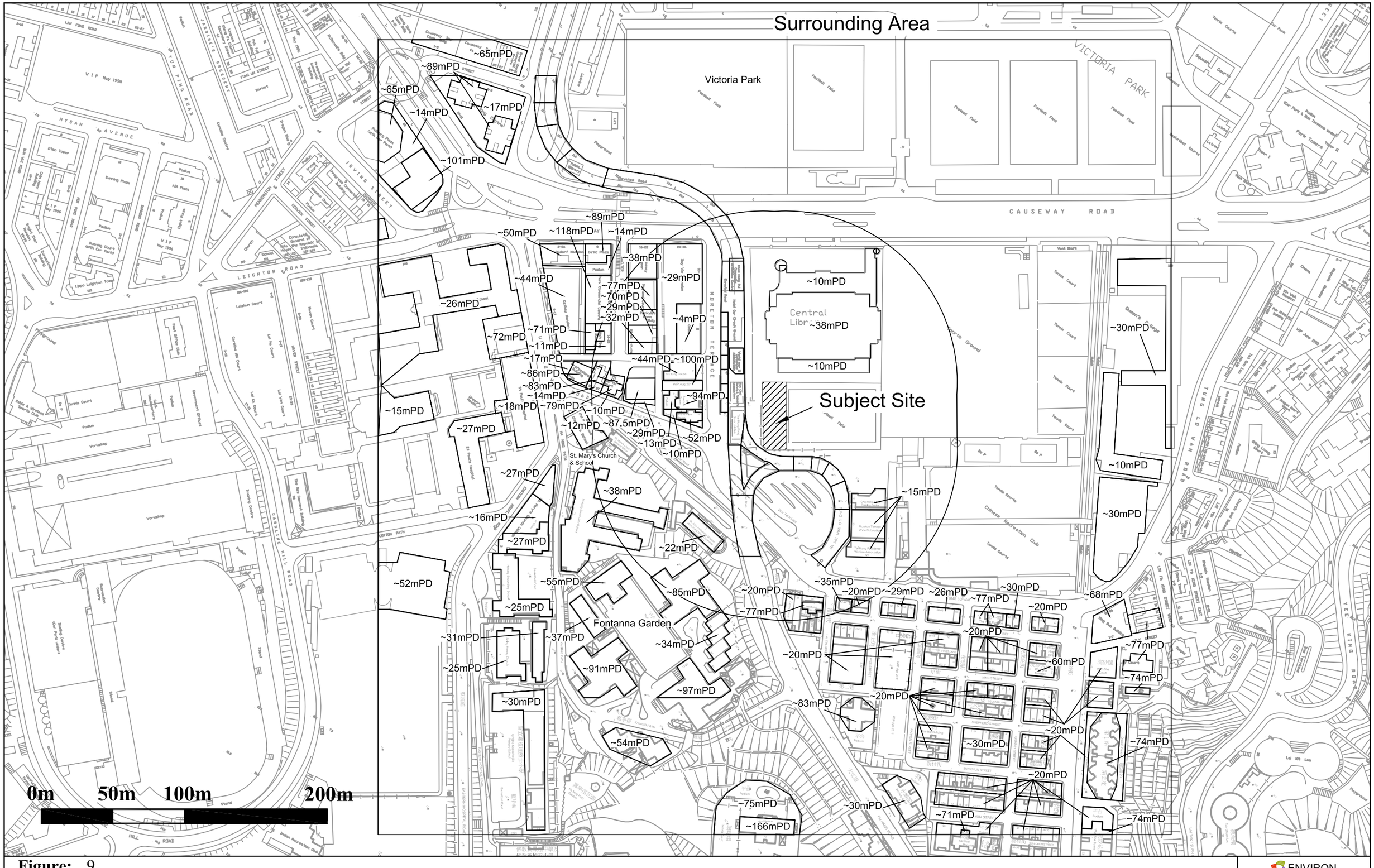

Figure: 9	ENVIRON
Title: Building Height of Surrounding Area	Drawn by: JL Checked by: CC
Project: Proposed Performance and Activity Venue at Moreton Terrace in Wan Chai Air Ventilation Assessment	Rev.: 1.0 Date: Nov 2014

Figure: 10	ENVIRON
Title: Topography of Area under Concern	Drawn by: SLo
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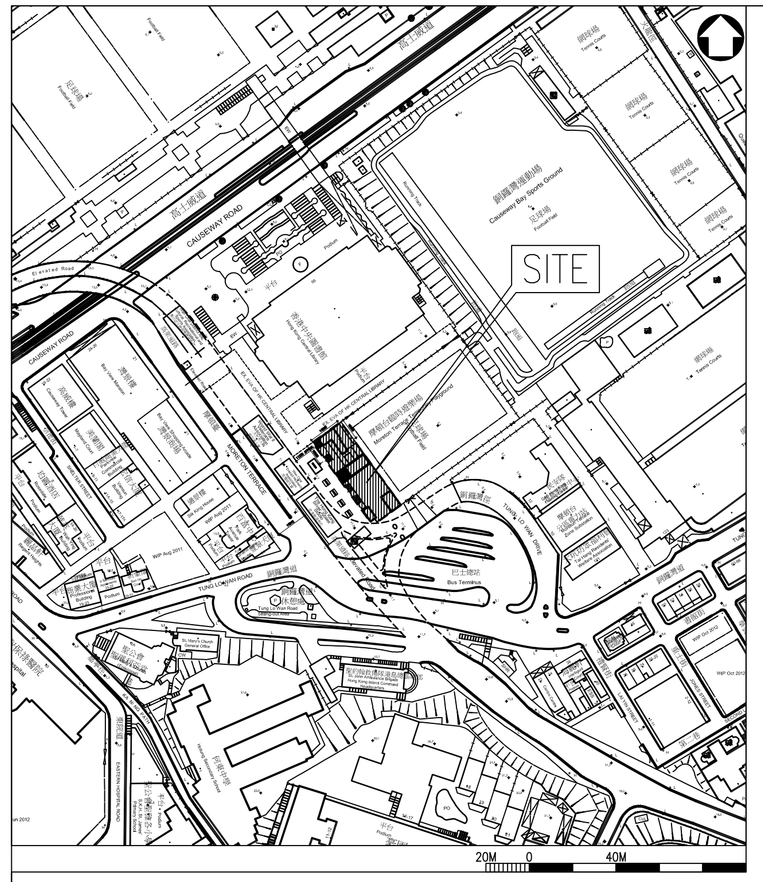
Project: Proposed Performance and Activity Venue at Moreton Terrace in Wan Chai	Rev.: 1.0
	Date: Oct 2014

Appendix A:
Plans and Sections of the Proposed Development Scheme



香港中央圖書館
Hong Kong Central Library

11.4
5.2
7000
(EX. EVA OF HK CENTRAL LIBRARY)
5.5
足球場
Football Field
平台
Podium
10000
EVA TO BE SERVED FOR THE PROPOSED BUILDING
14800
10000
11330 APPROX.
EX. PLANTER
EX. PLANTER
EX. PLANTER
EX. PLANTER
EX. PLANTER
5.3
5.3
11.2
7300
(EX. EVA OF HK CENTRAL LIBRARY)
7300
7300
World War II Veterans Association
二次世界大戰退役軍人會
11.3
Wan Chai District Women's Association
港灣婦女會
The Hong Kong Silver Jubilee Studio
香港銀禧樂苑
高架道路 Elevated Road
高架道路 Elevated Road
11.7
9.6
7.6
5.0
14942
摩頓臺 MORETON TERRACE
4.6
5.2
TUNG LO WAN ROAD
銅鑼灣道
5.2
5.5
12
6.8
8.3
銅鑼灣徑 TUNG LO WAN DRIVE
10.3
5.2
11.2
巴士總站
Bus Terminus

NOTES

1. THE BUILDING TO BE ACCOMMODATED NOT MORE THAN 500 PERSONS AND TO BE COMPLIED F.S. CODE 2011, CLAUSE B20.

LEGEND

SITE BOUNDARY
H STREET HYDRANT

no.	date	description	initial
REVISION			

	name	date
designed	J.W.H. TAM	04-2014
drawn	T.C. WONG	04-2014
checked	W.M. YIU	04-2014

approved
Chief Architect
Senior Architect
Project Architect
signed date

contract no.

file no.

project no.

contract
PERFORMANCE AND ACTIVITY VENUE AT MORETON TERRACE IN WAN CHAI

drawing title
BLOCK PLAN & EVA PLAN THOROUGHFARE CALCULATION

drawing no.
AB/8248/GP002

scale
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1 : 400 (A3)

office
ARCHITECTURAL BRANCH

ARCHITECTURAL SERVICES DEPARTMENT

CAD Ref. - ab8248gp002 sccu trial.dwg---1:1

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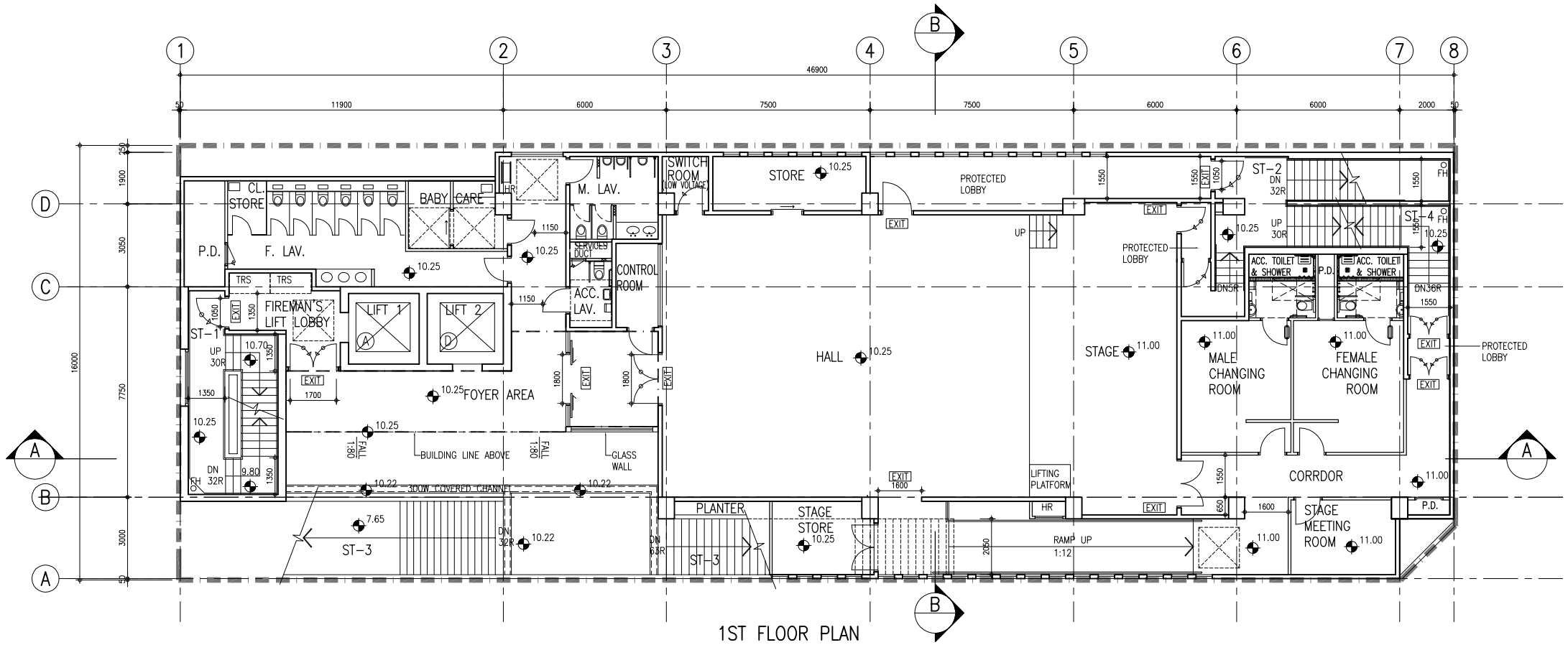
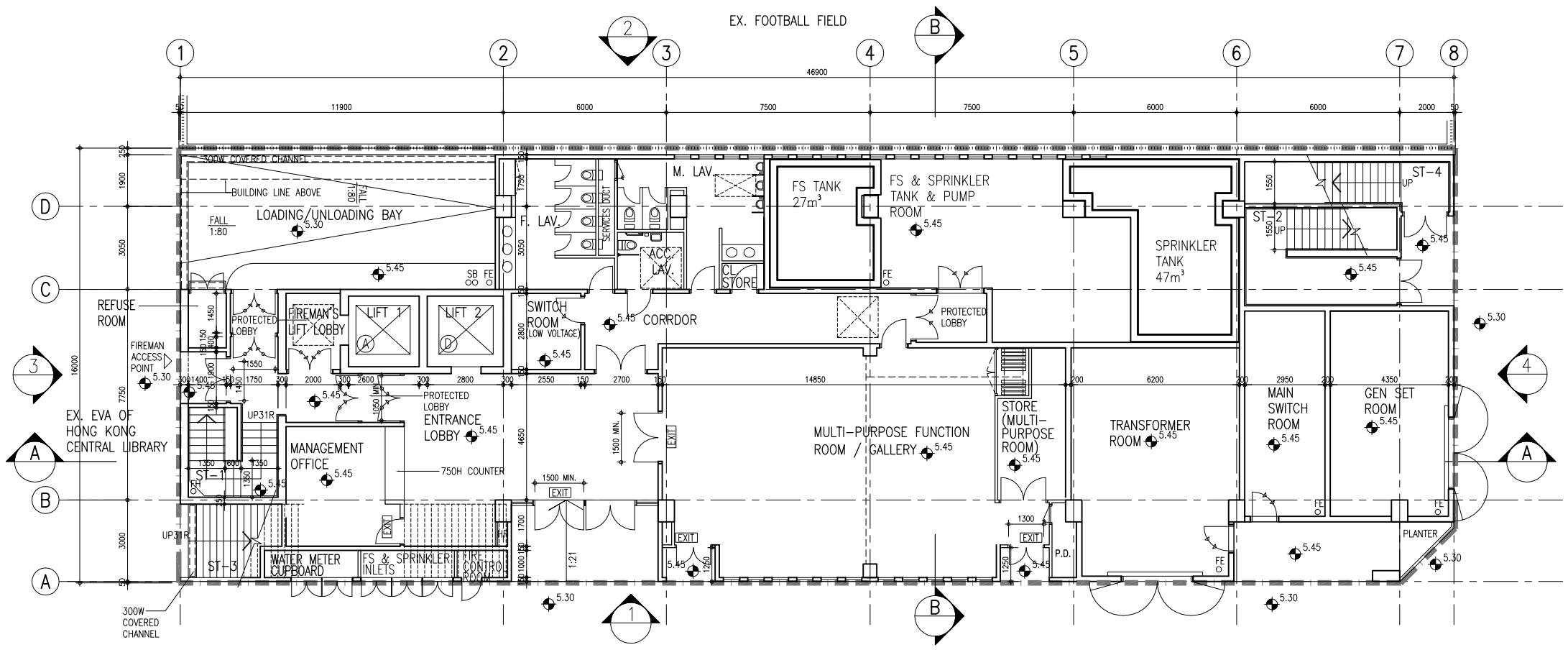


1ST FLOOR PLAN



GROUND FLOOR PLAN

EX. PLANTER | EX. PLANTER | EX. PLANTER | EX. PLANTER | EX. PLANTER

NOTES

no.	date	description	initial
REVISION			

	name	date
designed	J.W.H. TAM	04-2014
drawn	T.C. WONG	04-2014
checked	W.M. YIU	04-2014

approved

Chief Architect . . . . . signed . . . . . date

Senior Architect . . . . . signed . . . . . date

Project Architect . . . . . signed . . . . . date

contract no.

file no.

project no.

contract

PERFORMANCE AND ACTIVITY VENUE AT MORETON TERRACE IN WAN CHAI

drawing title

GROUND FLOOR PLAN & 1ST FLOOR PLAN

drawing no.

AB/8248/GP003

scale

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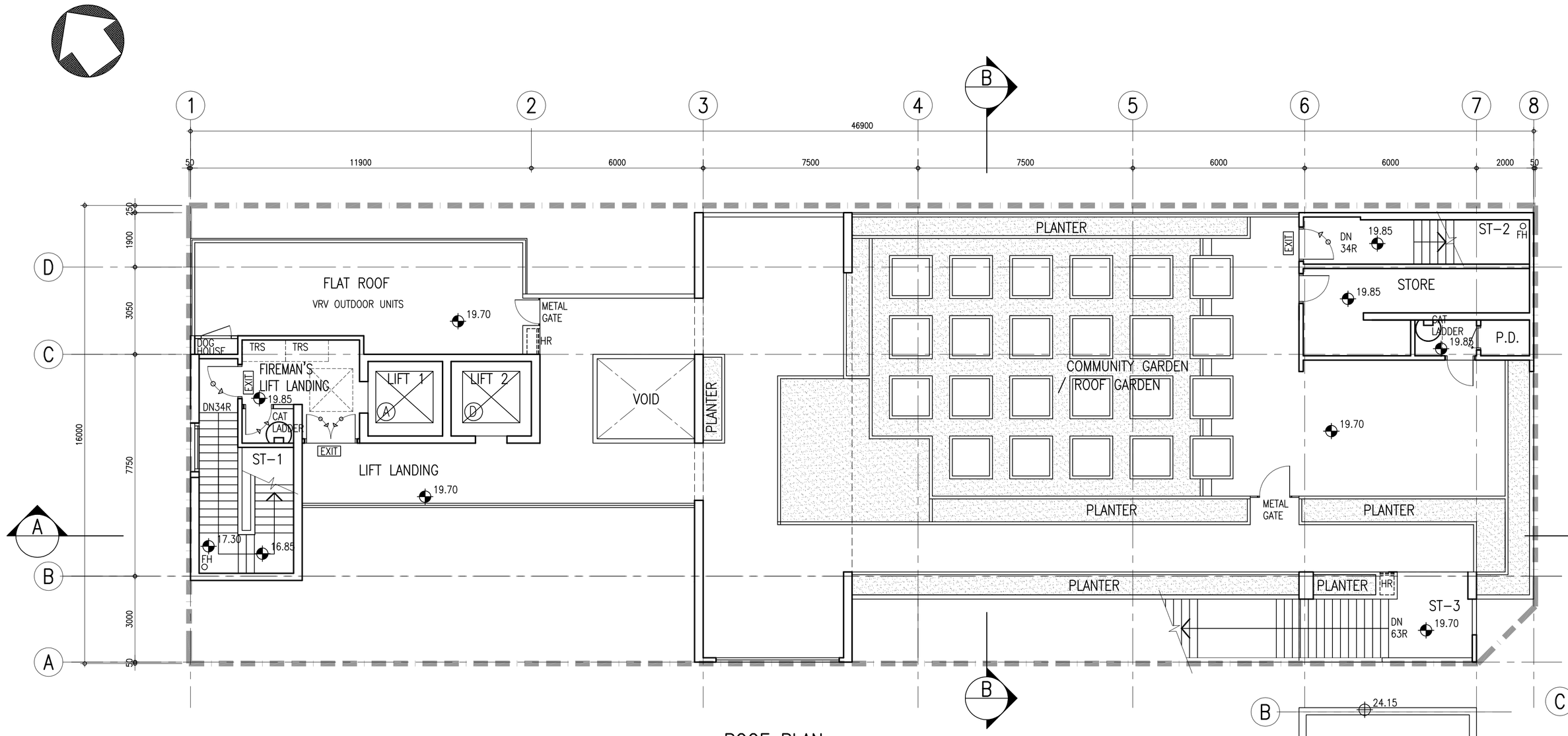
office

ARCHITECTURAL BRANCH

ARCHITECTURAL SERVICES DEPARTMENT



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no.	date	description	initial
REVISION			

	name	date
designed	J.W.H. TAM	04-2014
drawn	T.C. WONG	04-2014
checked	W.M. YIU	04-2014

approved

Chief Architect . . . . . .

Senior Architect . . . . . .

Project Architect . . . . . .

signed date

contract no.

file no.

project no.

contract

PERFORMANCE AND ACTIVITY VENUE AT MORETON TERRACE IN WAN CHAI

drawing title

2ND FLOOR PLAN & ROOF PLAN

drawing no.

AB/8248/GP004

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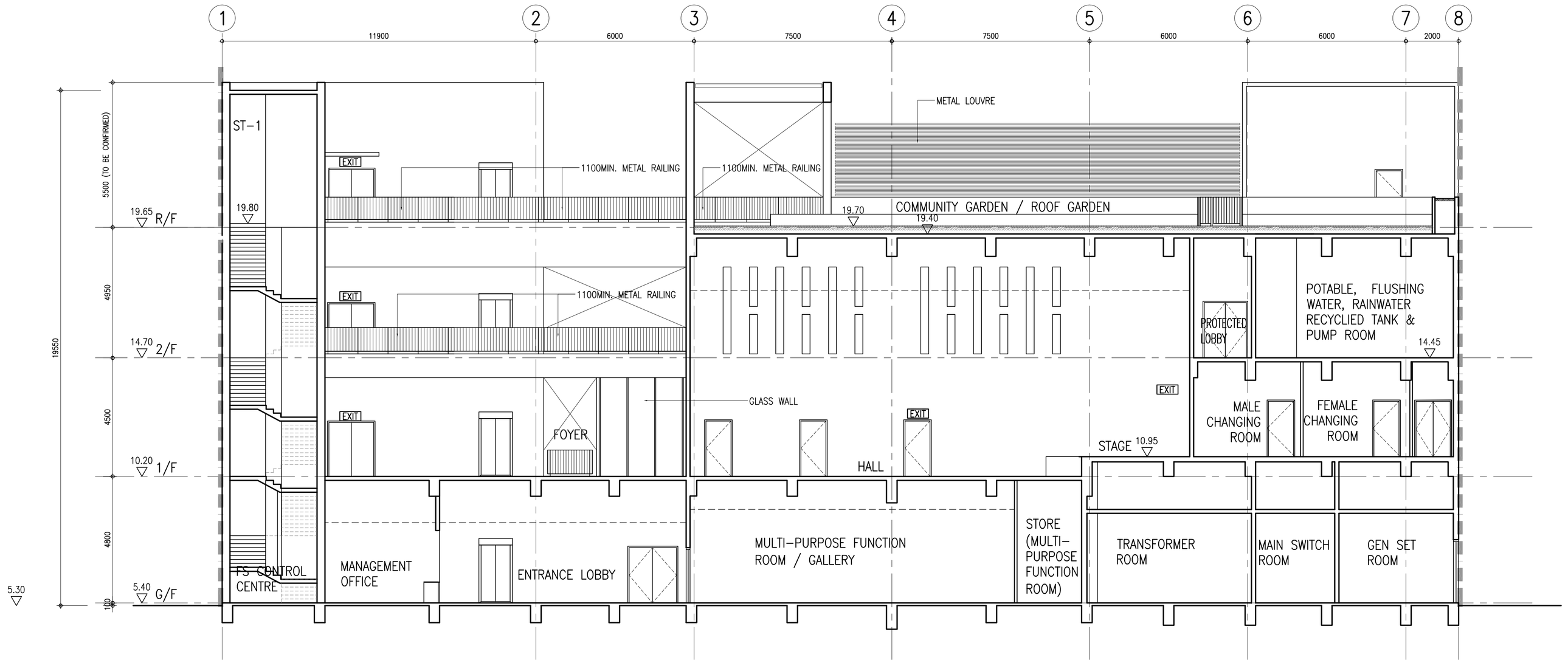
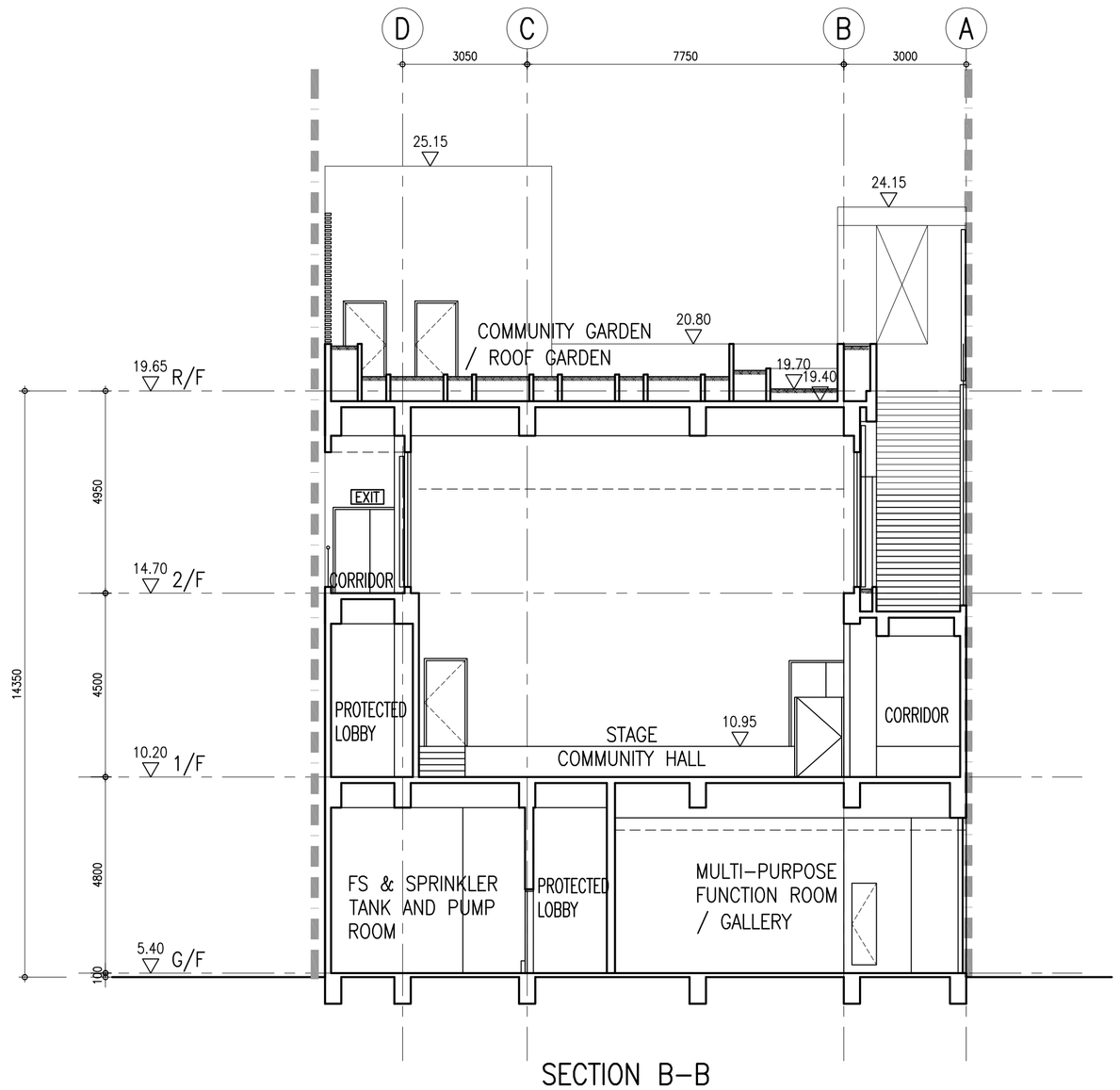
ARCHITECTURAL BRANCH

ARCHITECTURAL SERVICES DEPARTMENT



SECTION A–A



SECTION B–B

NOTES

no.	date	description	initial
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	name	date
designed	J.W.H. TAM	04–2014
drawn	T.C. WONG	04–2014
checked	W.M. YIU	04–2014

approved

Chief Architect . . . . . .

Senior Architect . . . . . .

Project Architect . . . . . .

signed date

contract no.

file no.

project no.

contract

PERFORMANCE AND ACTIVITY VENUE AT MORETON TERRACE IN WAN CHAI

drawing title

SECTION A–A & B–B

drawing no.

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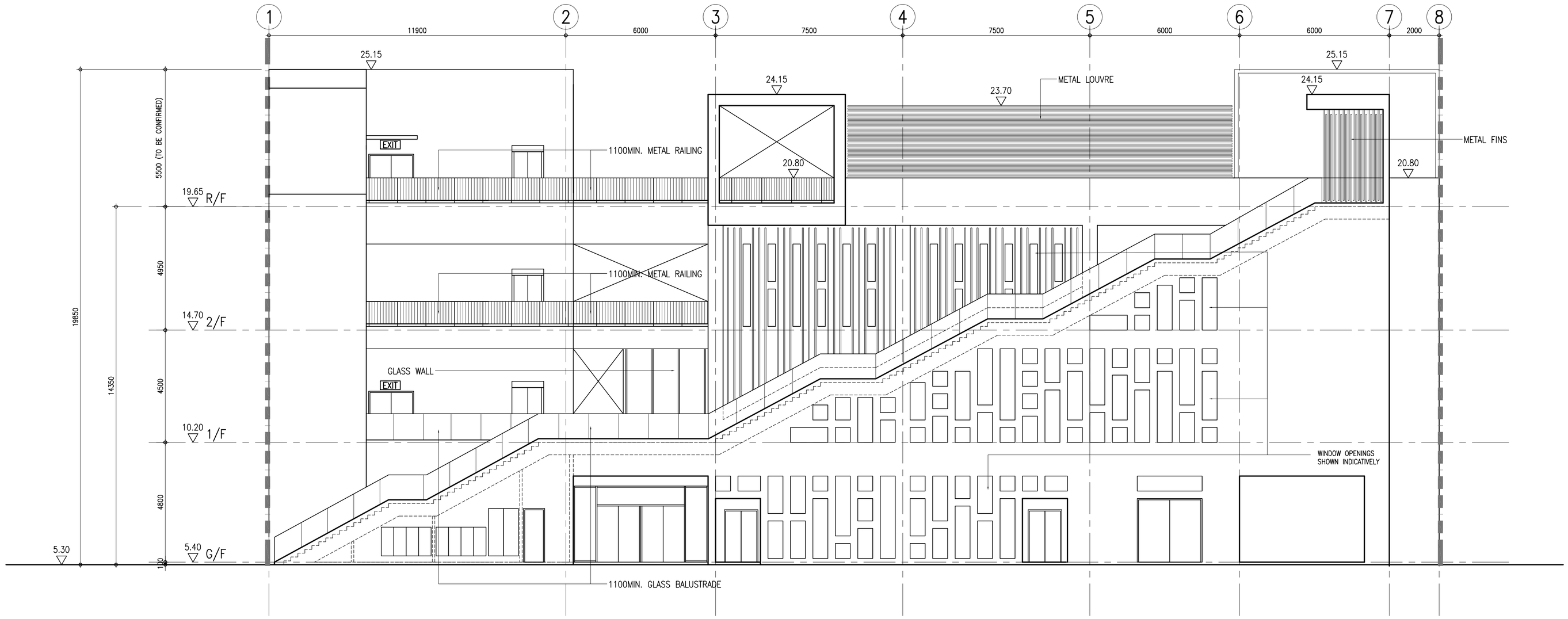
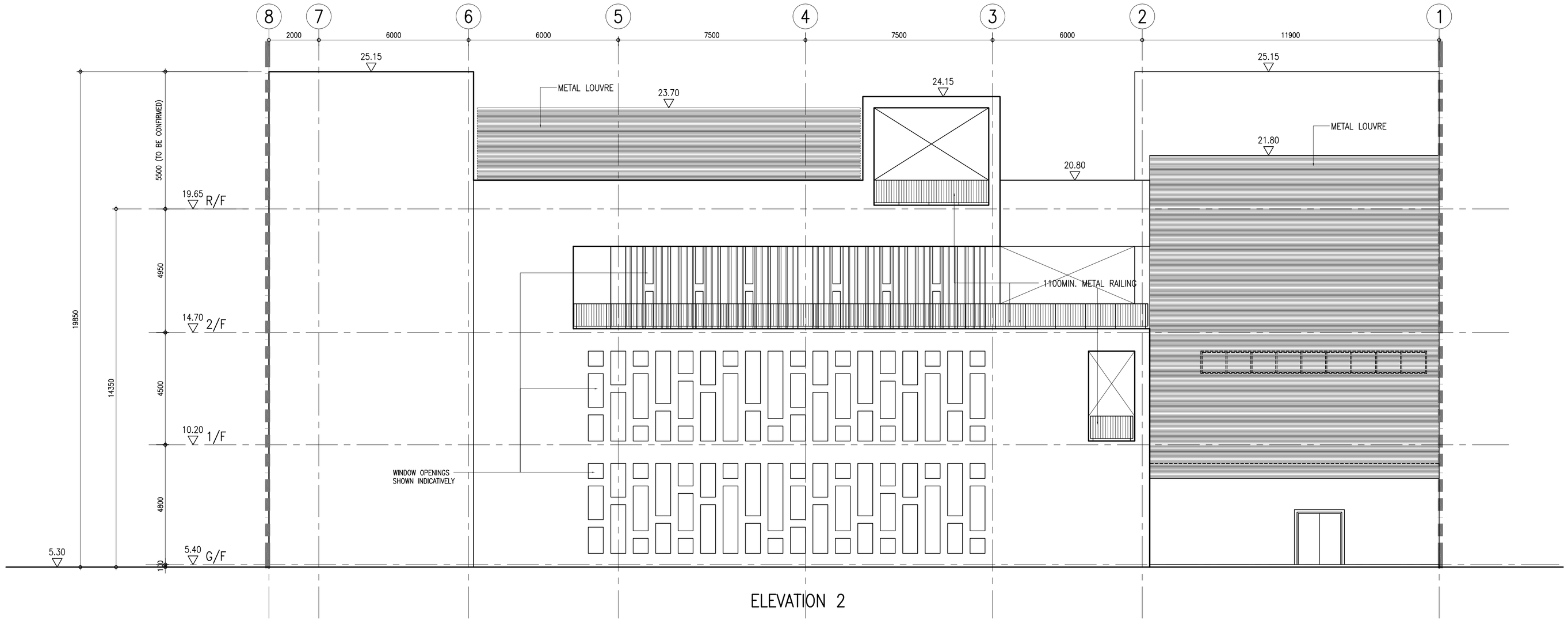
ARCHITECTURAL BRANCH

ARCHITECTURAL SERVICES DEPARTMENT



ELEVATION 1



ELEVATION 2

NOTES

no.	date	description	initial
REVISION			

	name	date
designed	J.W.H. TAM	04-2014
drawn	T.C. WONG	04-2014
checked	W.M. YIU	04-2014

approved

Chief Architect . . . . . .

Senior Architect . . . . . .

Project Architect . . . . . .

signed date

contract no.

file no.

project no.

contract

PERFORMANCE AND ACTIVITY VENUE AT MORETON TERRACE IN WAN CHAI

drawing title

ELEVATION 1 & 2

drawing no.

AB/8248/GP006

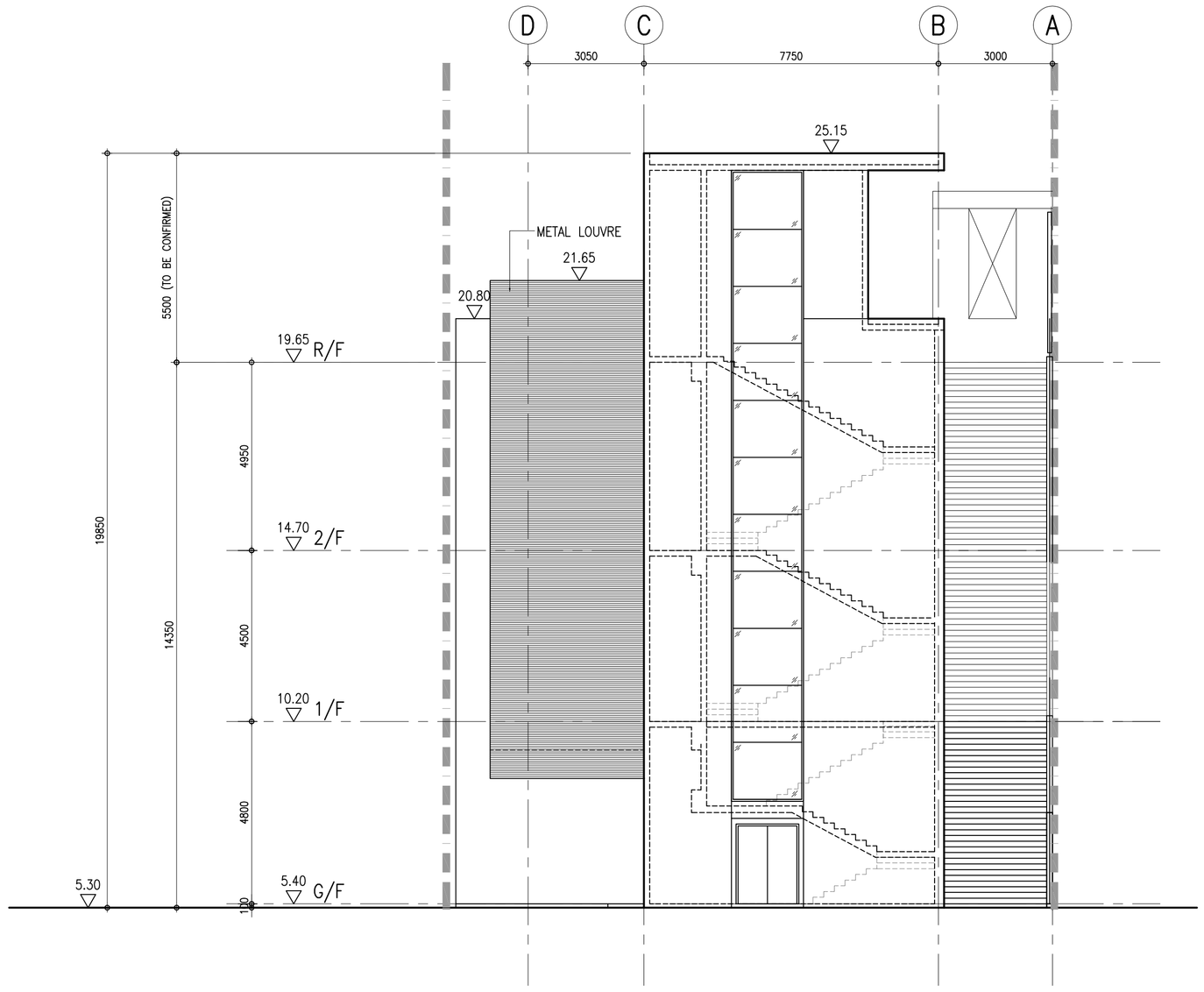
scale

1 : 100 (A1)
1 : 200 (A3)

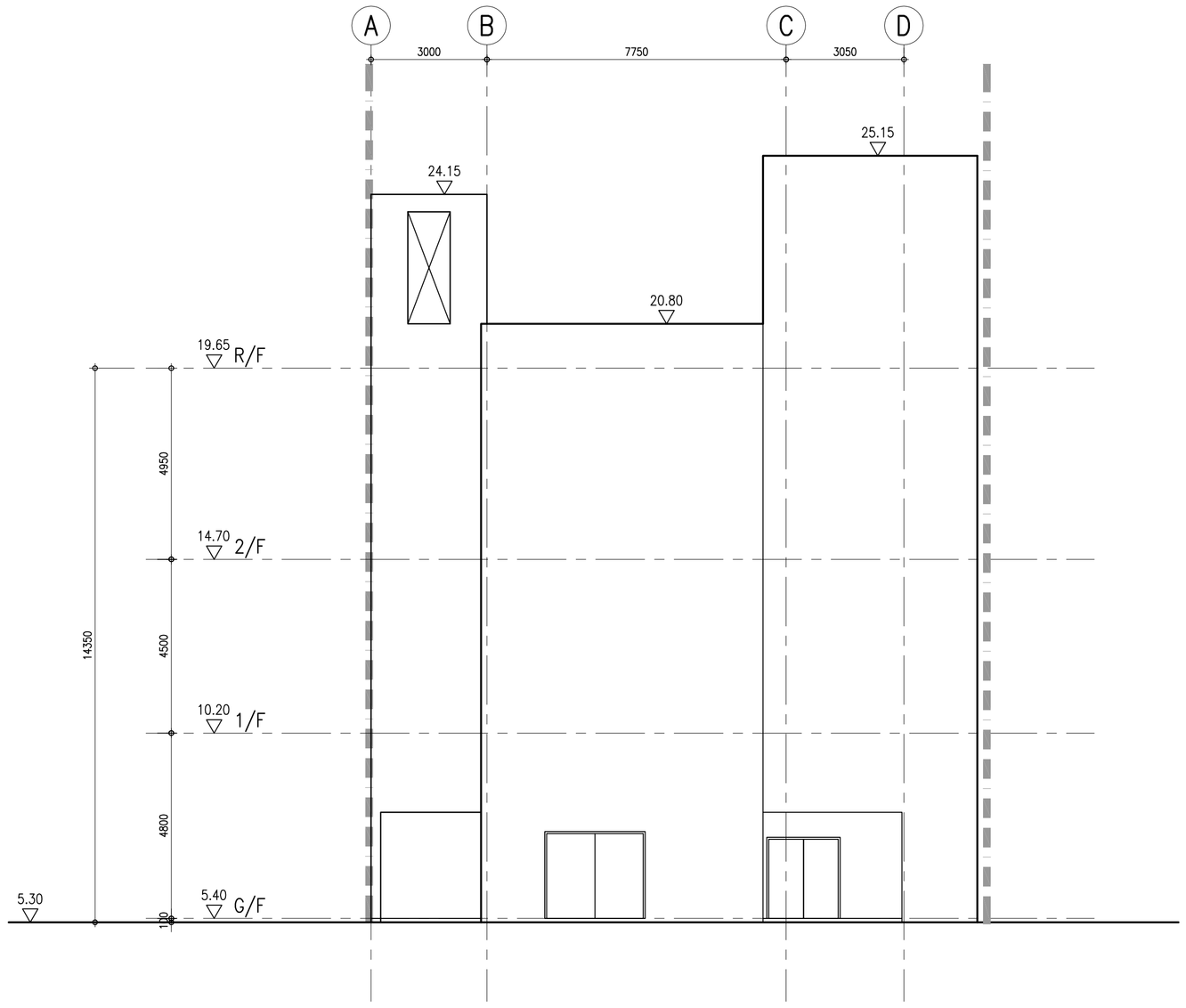
office

ARCHITECTURAL BRANCH

ARCHITECTURAL SERVICES DEPARTMENT



ELEVATION 3



ELEVATION 4

NOTES

no.	date	description	initial
REVISION			

	name	date
designed	J.W.H. TAM	04-2014
drawn	T.C. WONG	04-2014
checked	W.M. YIU	04-2014

approved

Chief Architect . . . . . .

Senior Architect . . . . . .

Project Architect . . . . . .
signed date

contract no.

file no.

project no.

contract

PERFORMANCE AND ACTIVITY VENUE AT MORETON TERRACE IN WAN CHAI

drawing title

ELEVATION 3 & 4

drawing no.

AB/8248/GP007

scale

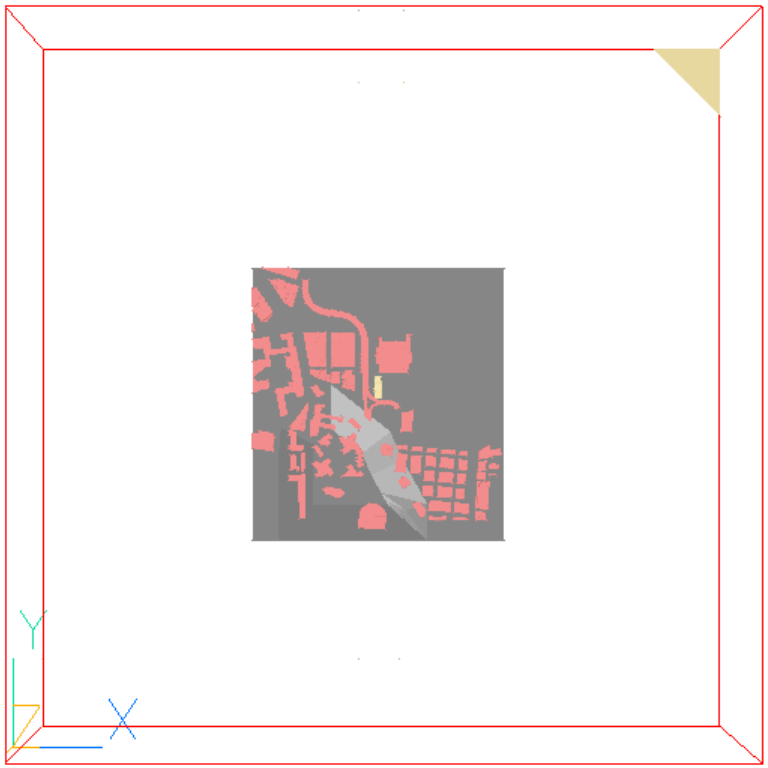
1 : 100 (A1)
1 : 200 (A3)

office

ARCHITECTURAL BRANCH

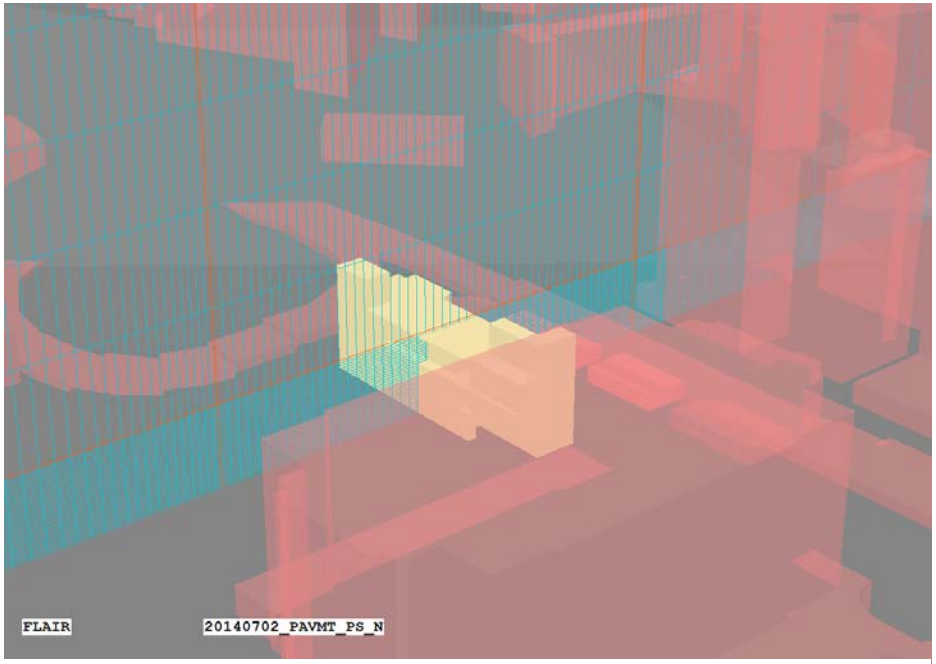
ARCHITECTURAL SERVICES DEPARTMENT

Appendix B:
Captured Pictures of the CFD Model

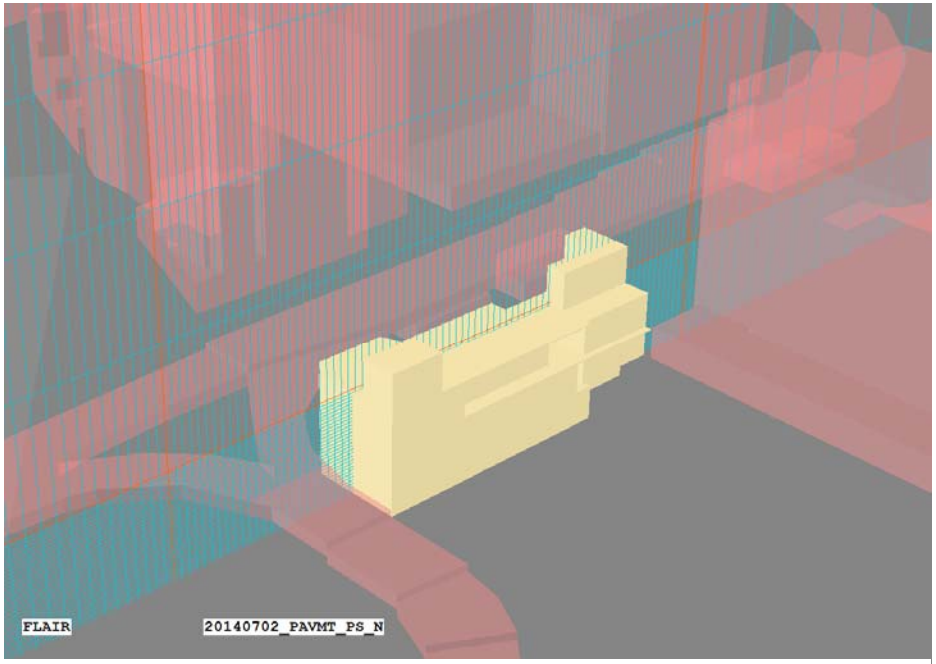


FLAIR 20140702_PAVMT_PS_N

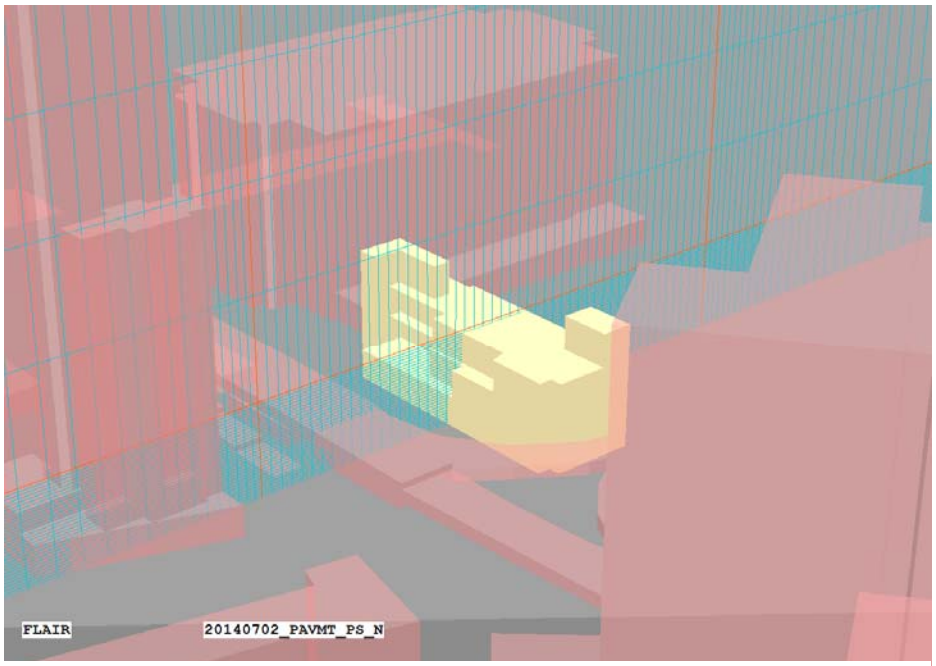
Domain



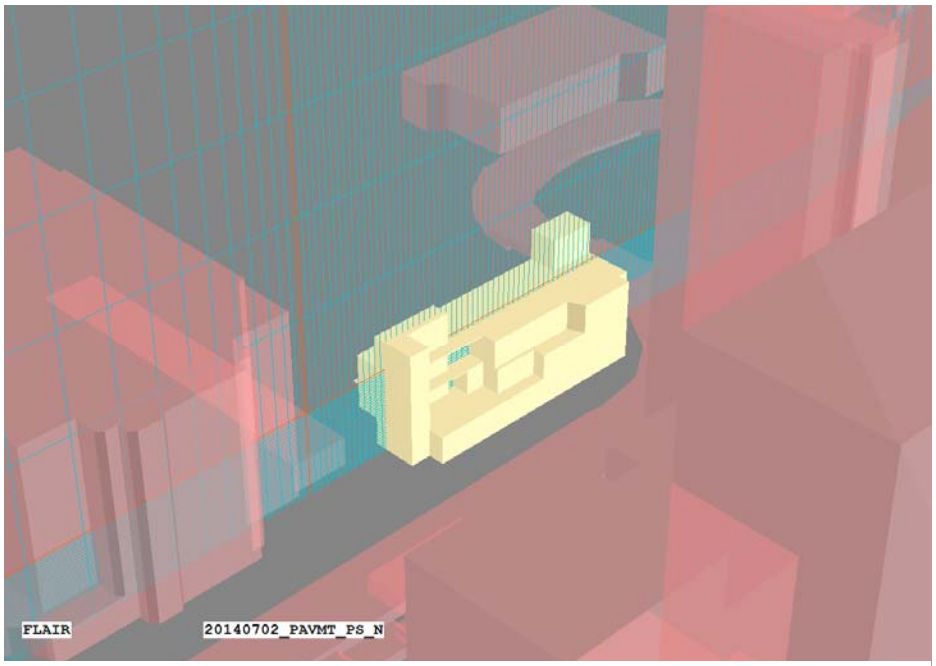
Proposed Scheme – N



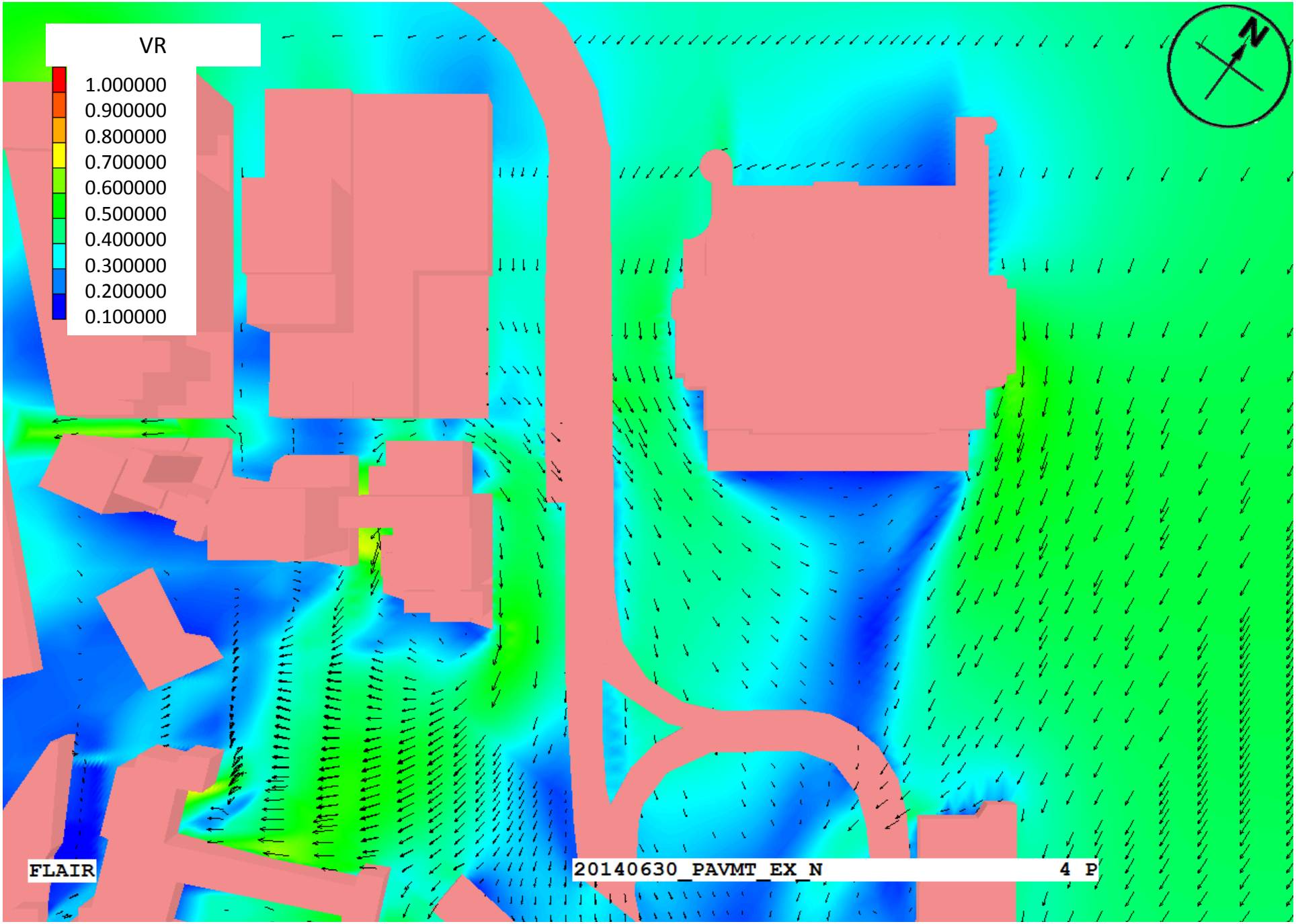
Proposed Scheme – E



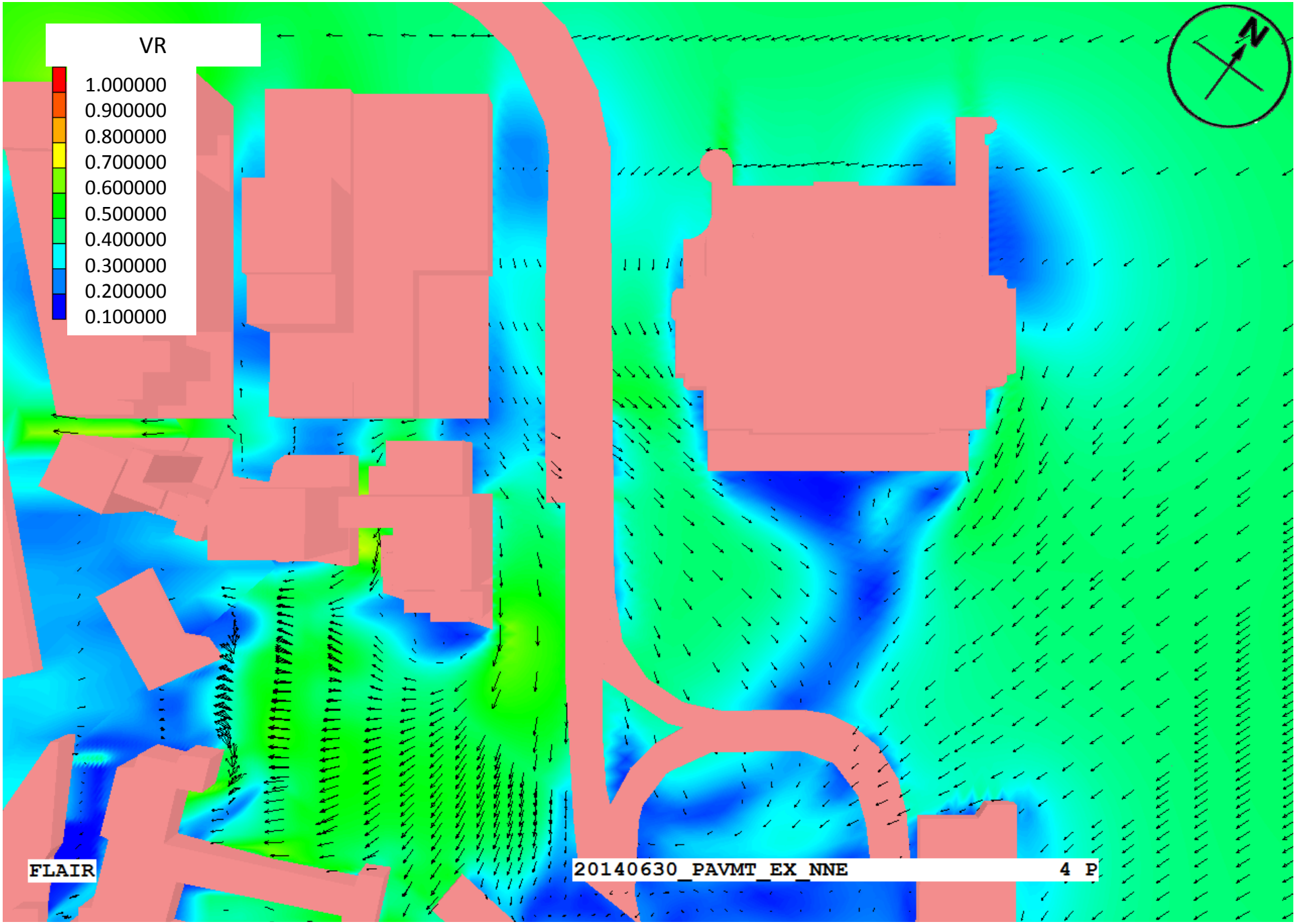
Proposed Scheme – S



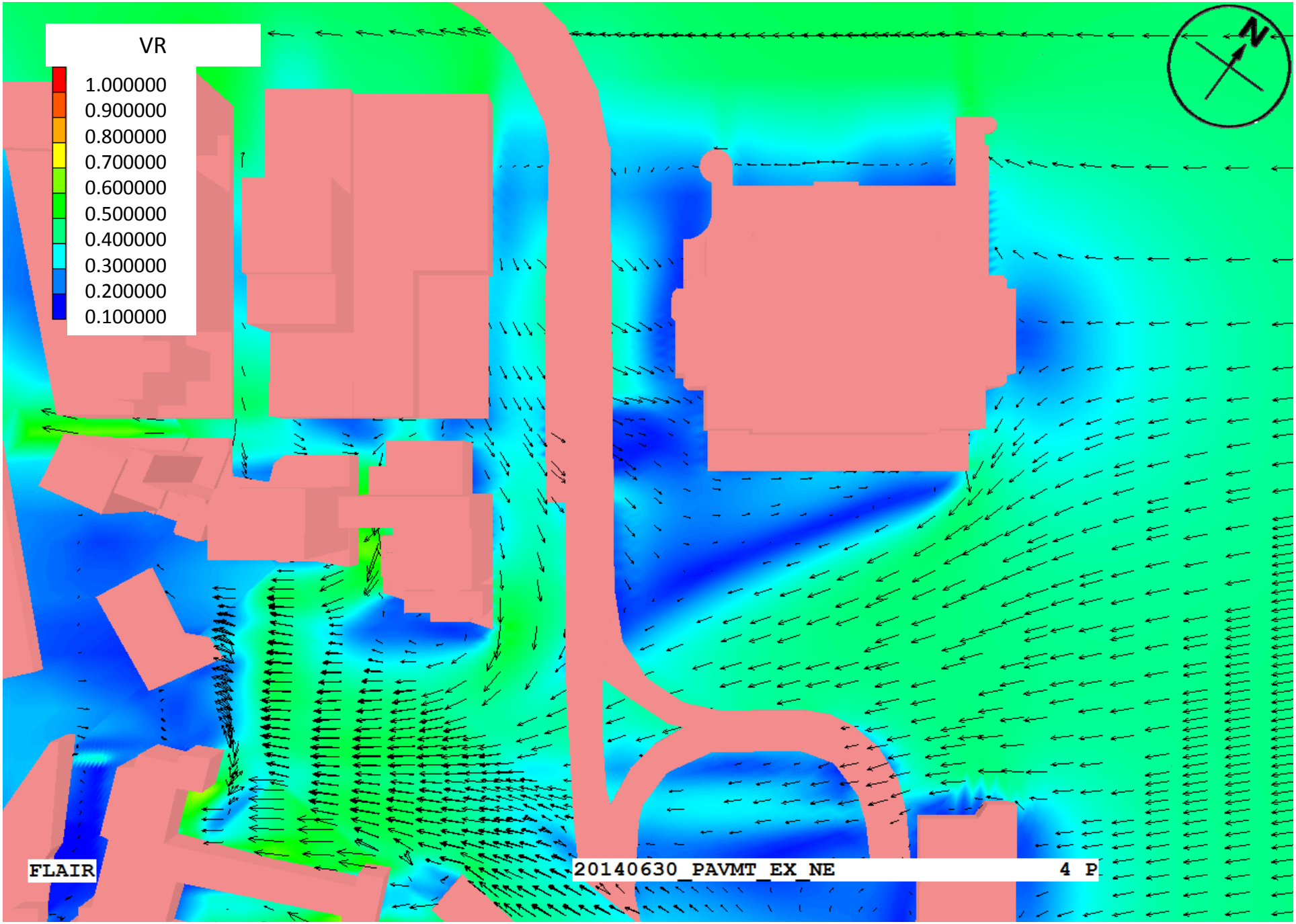
Proposed Scheme – W



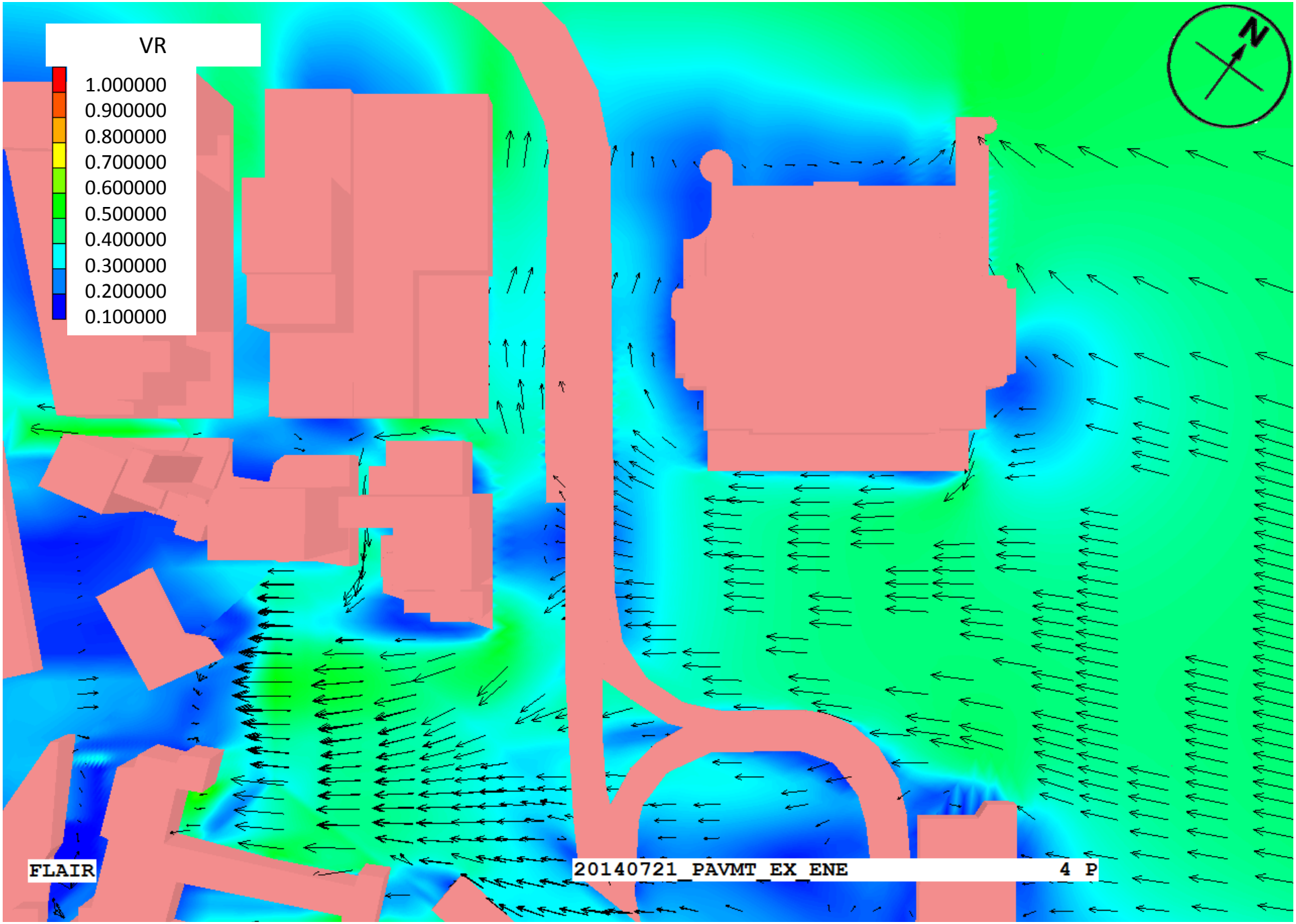
Existing Scenario– VR colour and vector plot at pedestrian level under N Wind



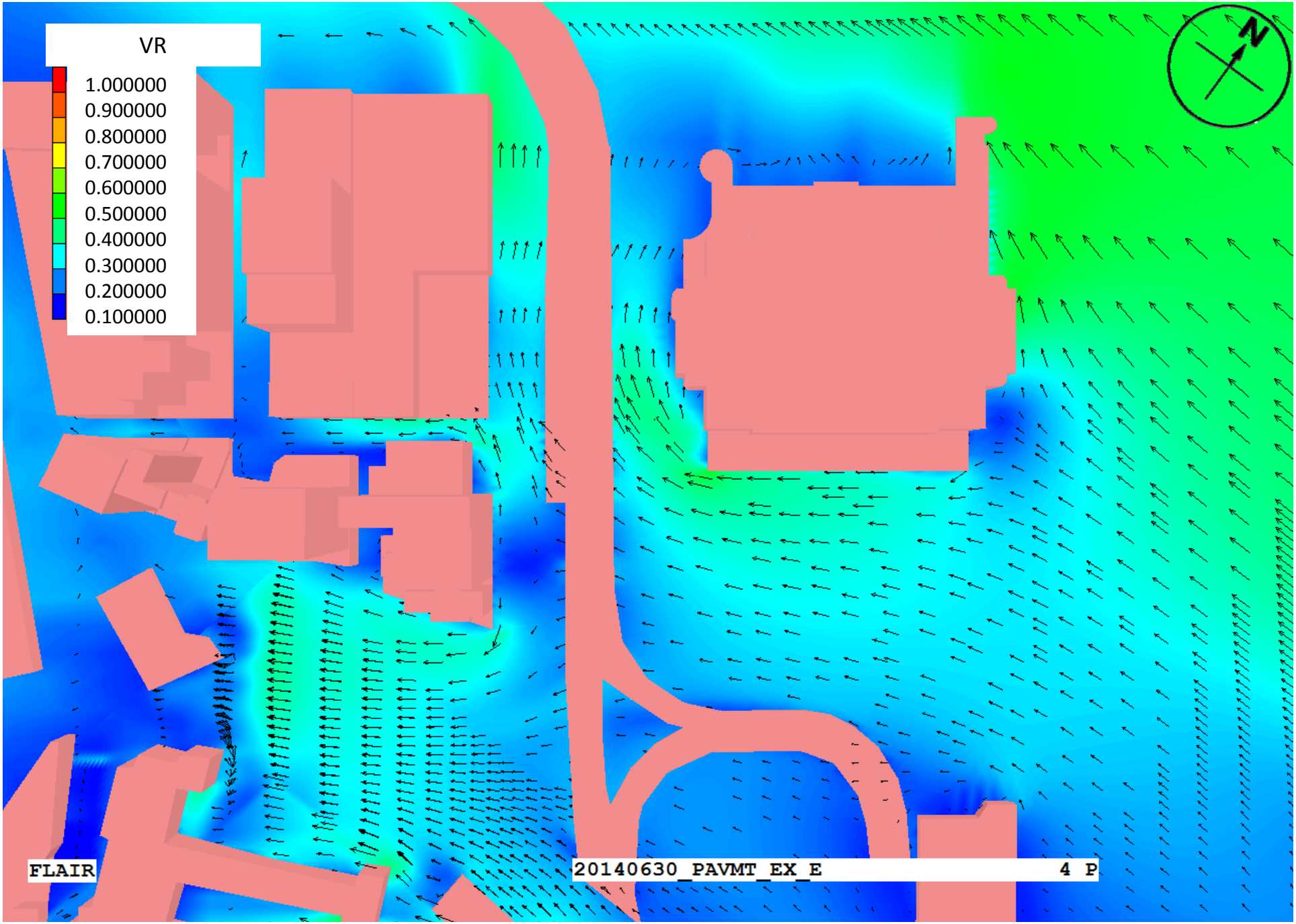
Existing Scenario– VR colour and vector plot at pedestrian level under NNE Wind



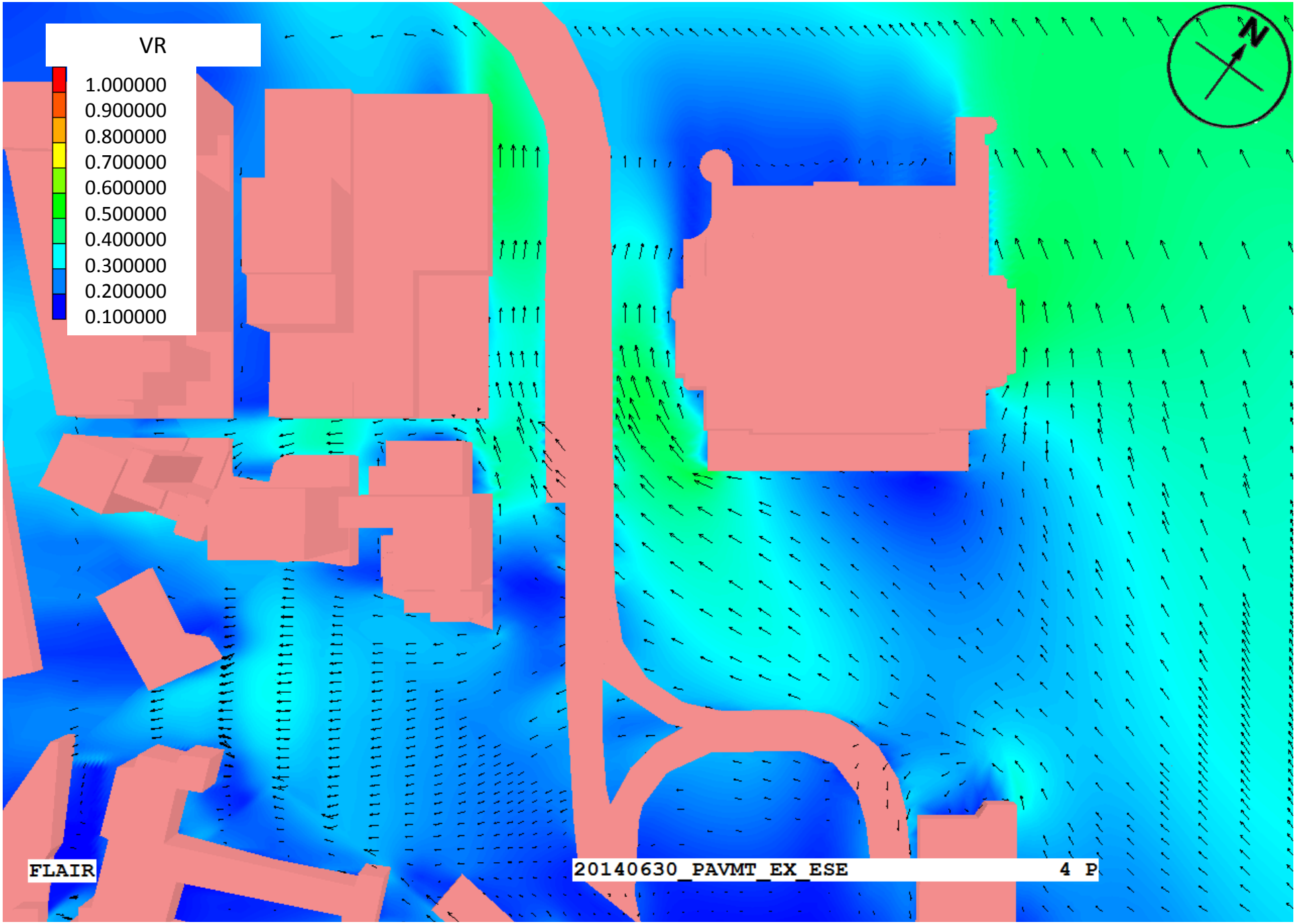
Existing Scenario– VR colour and vector plot at pedestrian level under NE Wind



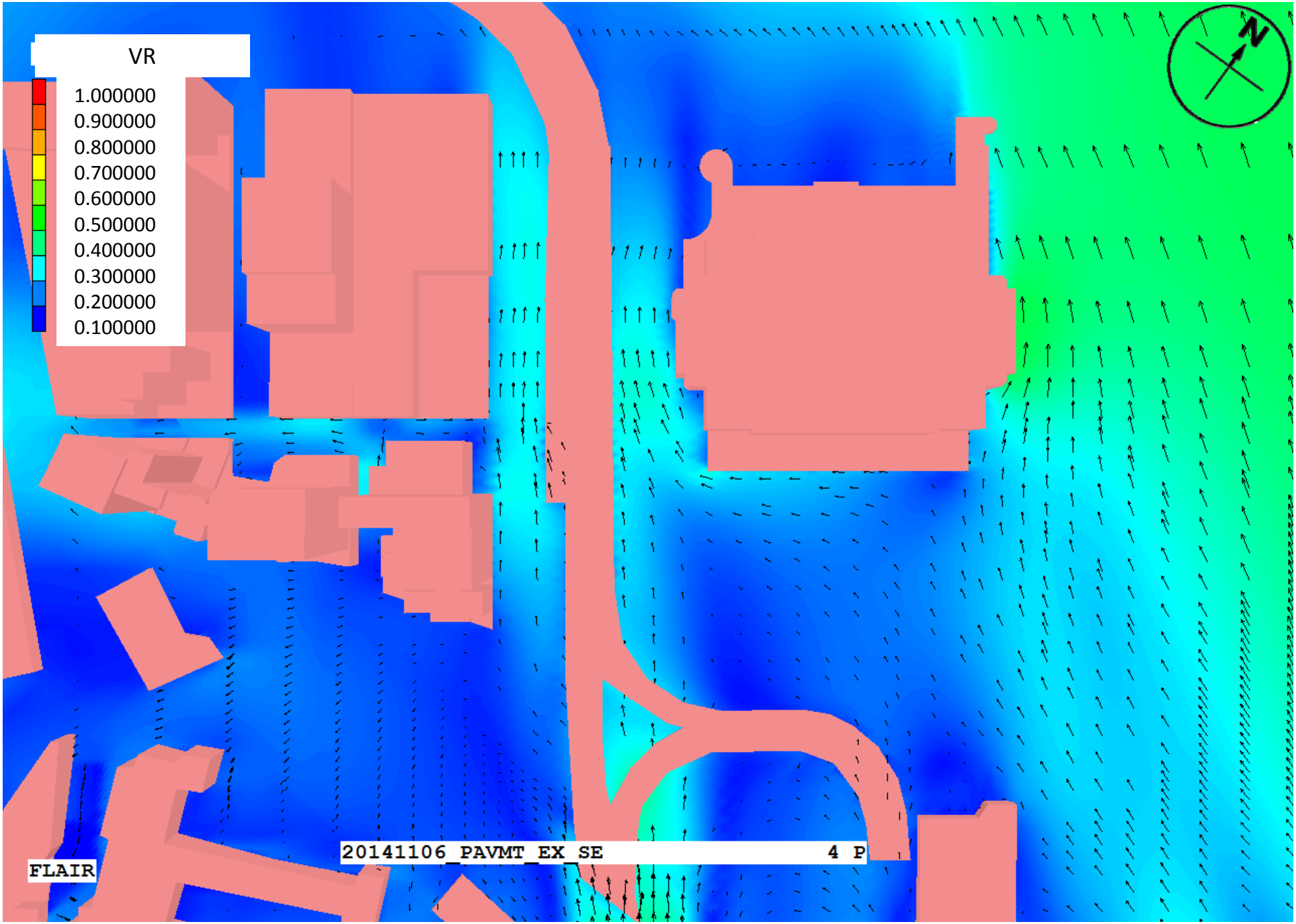
Existing Scenario– VR colour and vector plot at pedestrian level under ENE Wind



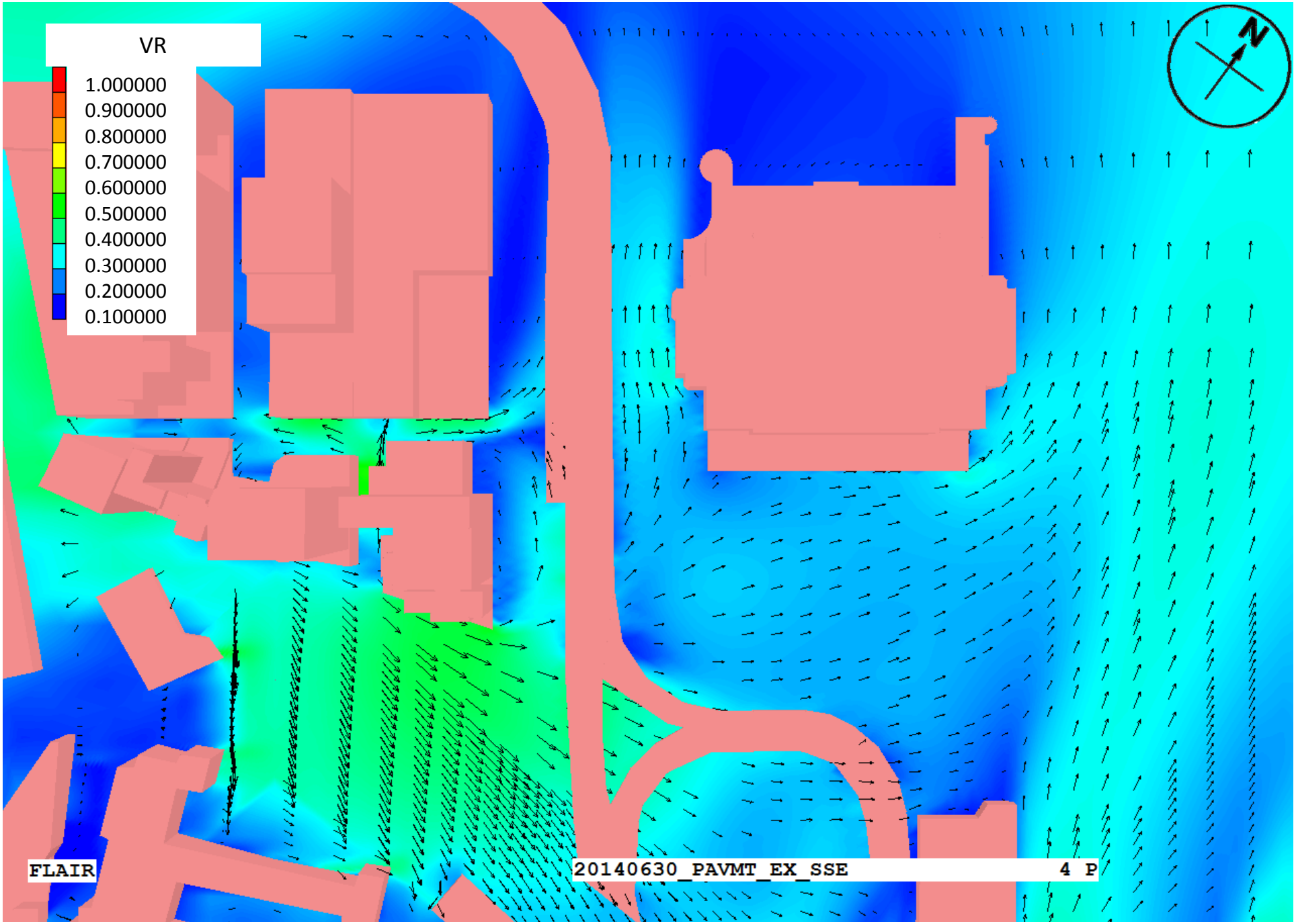
Existing Scenario– VR colour and vector plot at pedestrian level under E Wind



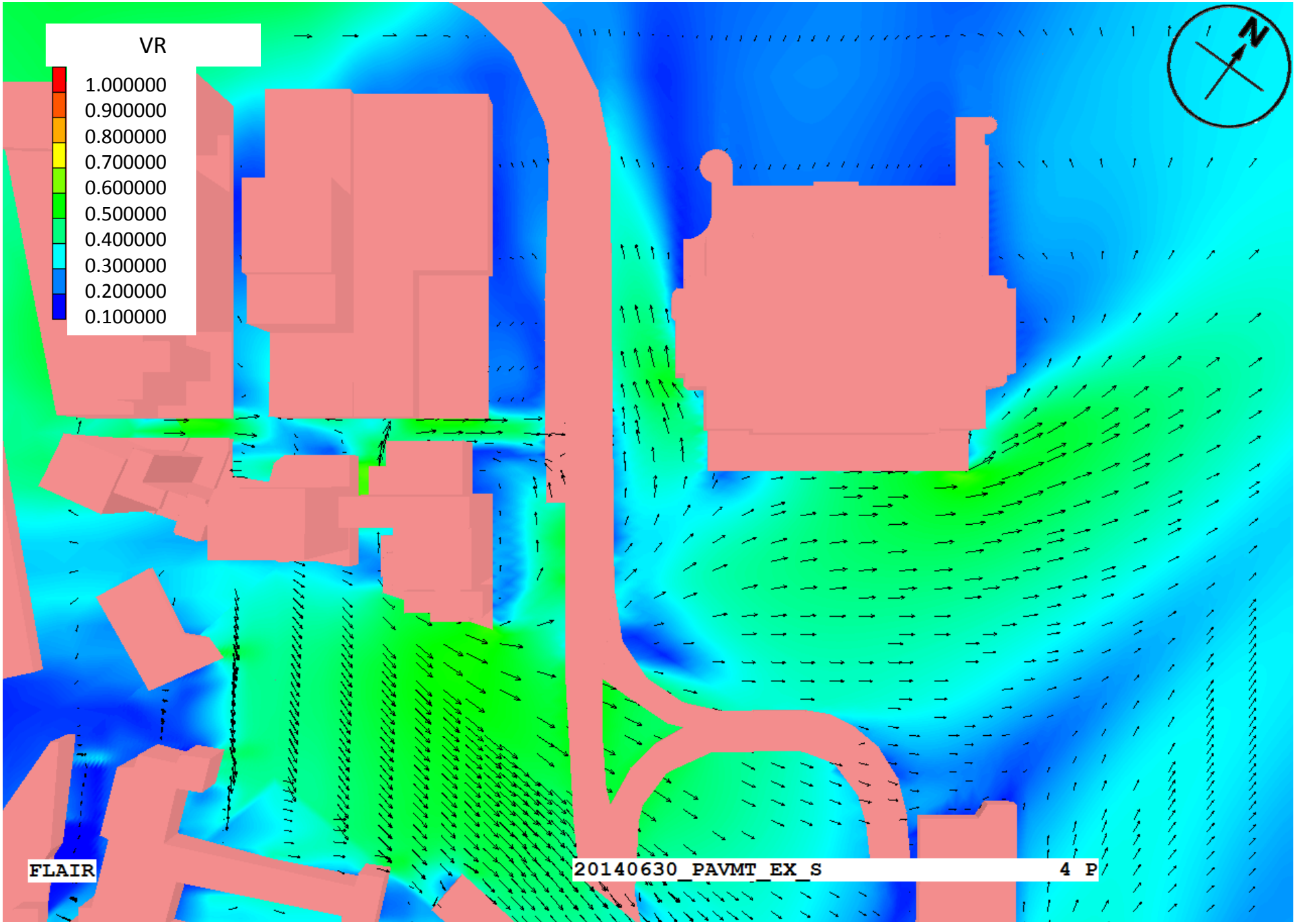
Existing Scenario– VR colour and vector plot at pedestrian level under ESE Wind



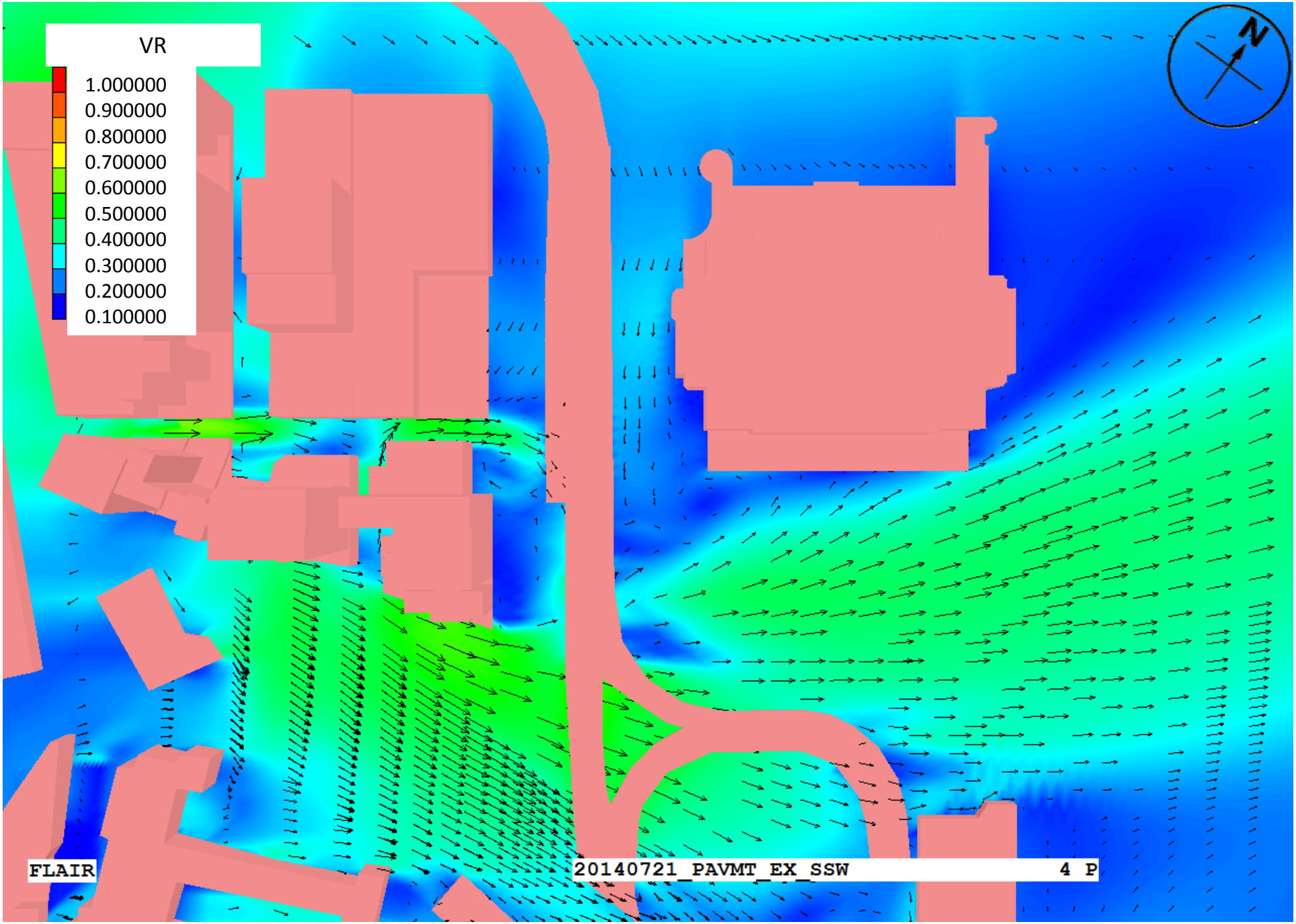
Existing Scenario– VR colour and vector plot at pedestrian level under SE Wind



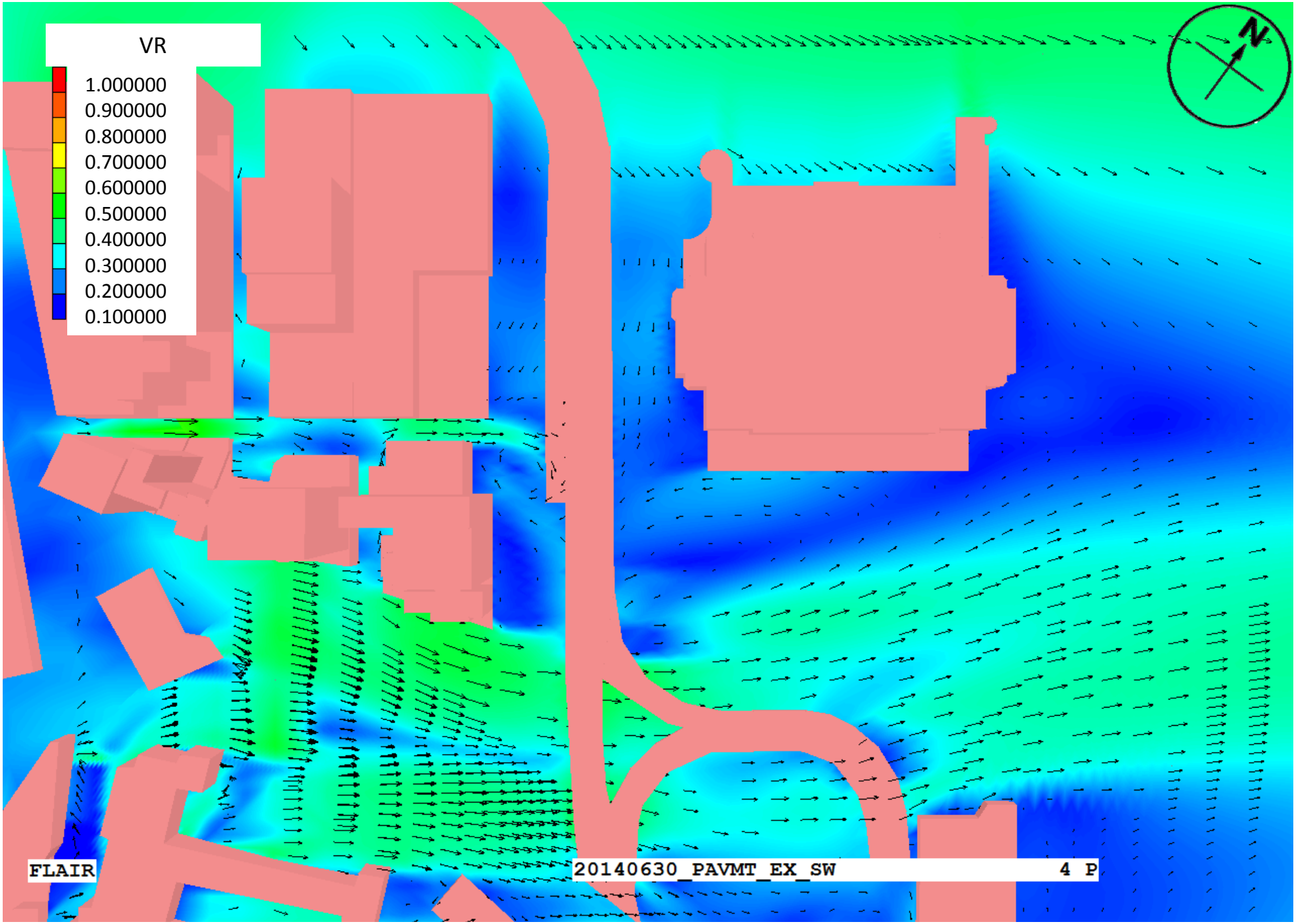
Existing Scenario– VR colour and vector plot at pedestrian level under SSE Wind



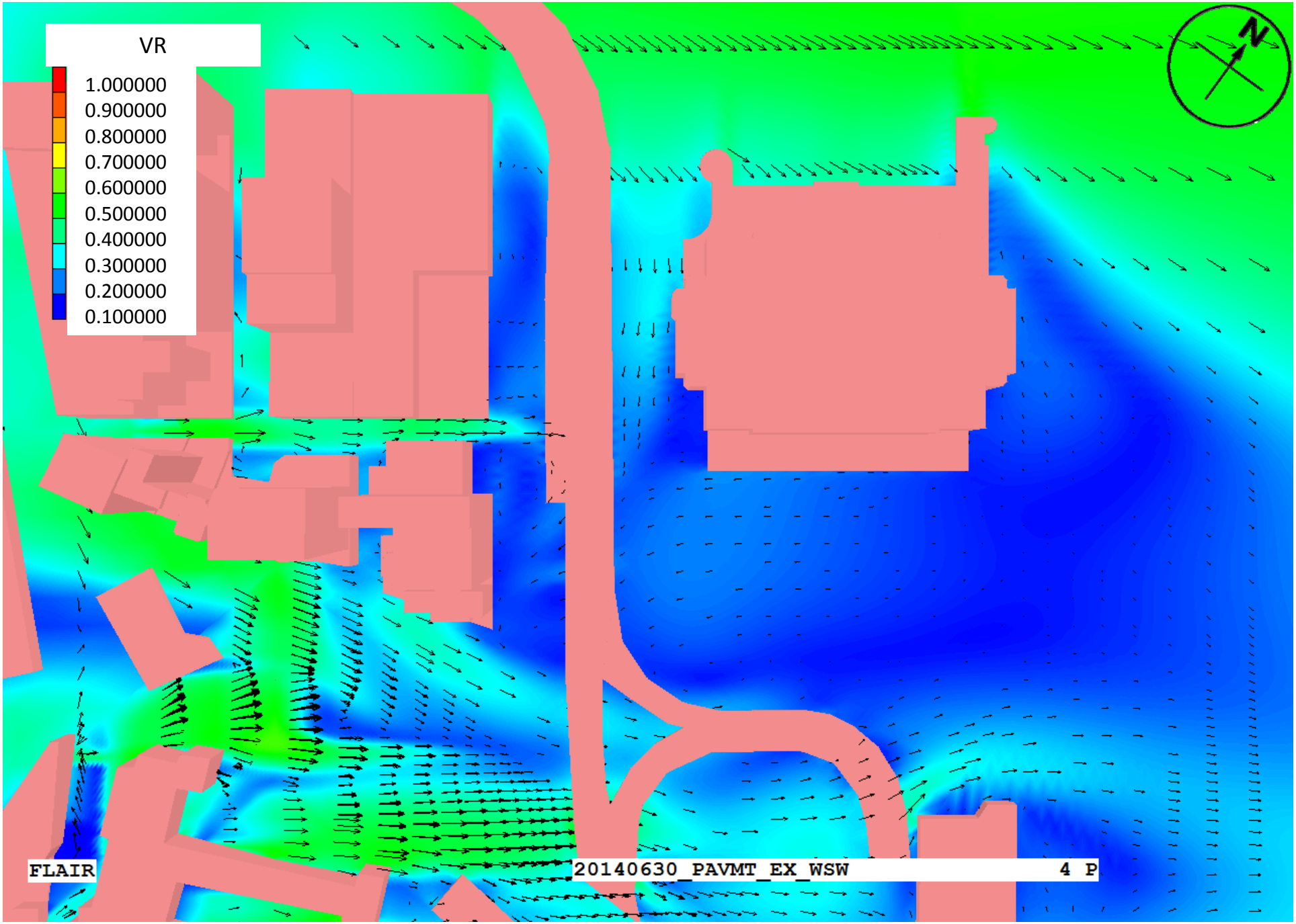
Existing Scenario– VR colour and vector plot at pedestrian level under S Wind



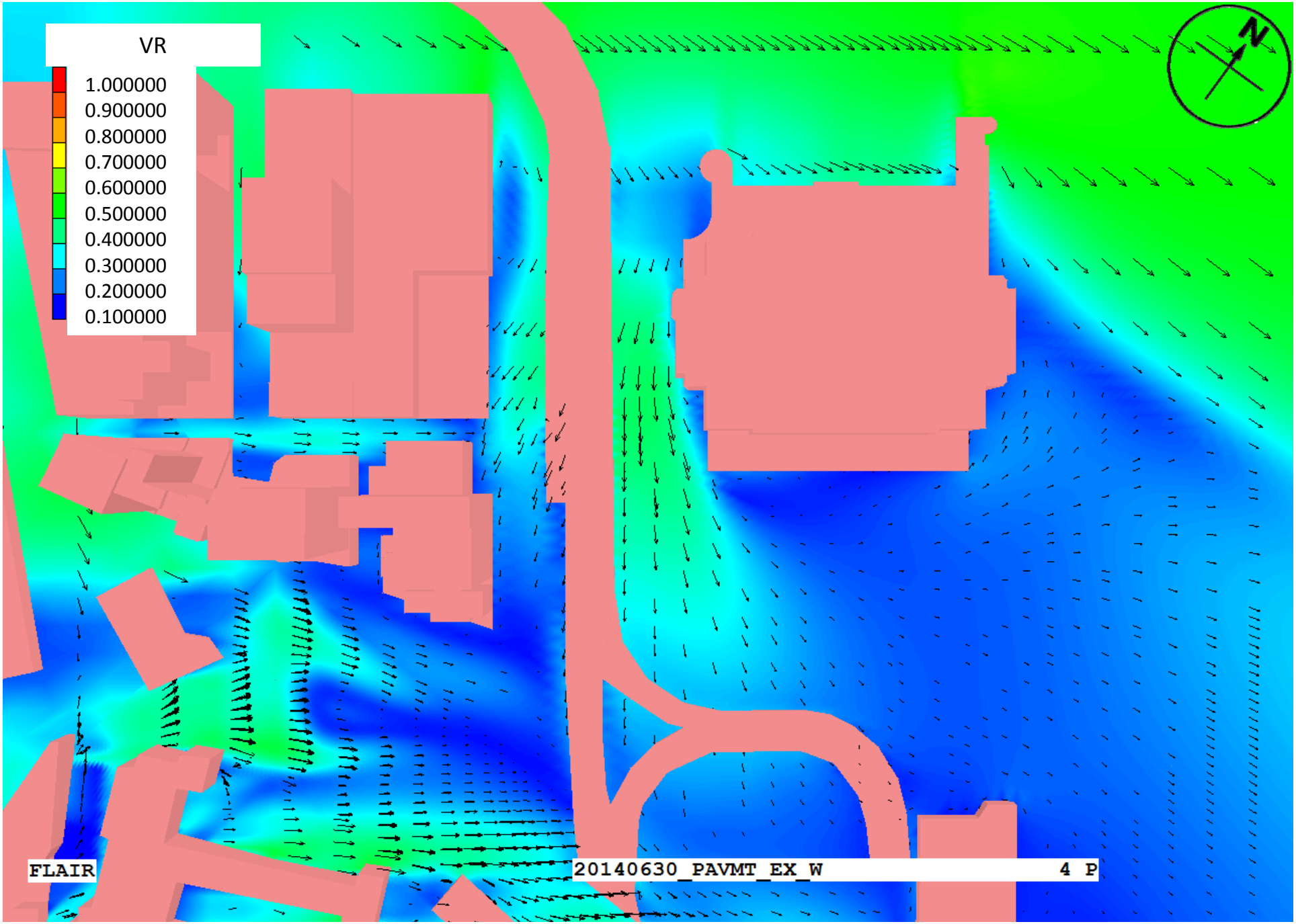
Existing Scenario– VR colour and vector plot at pedestrian level under SSW Wind



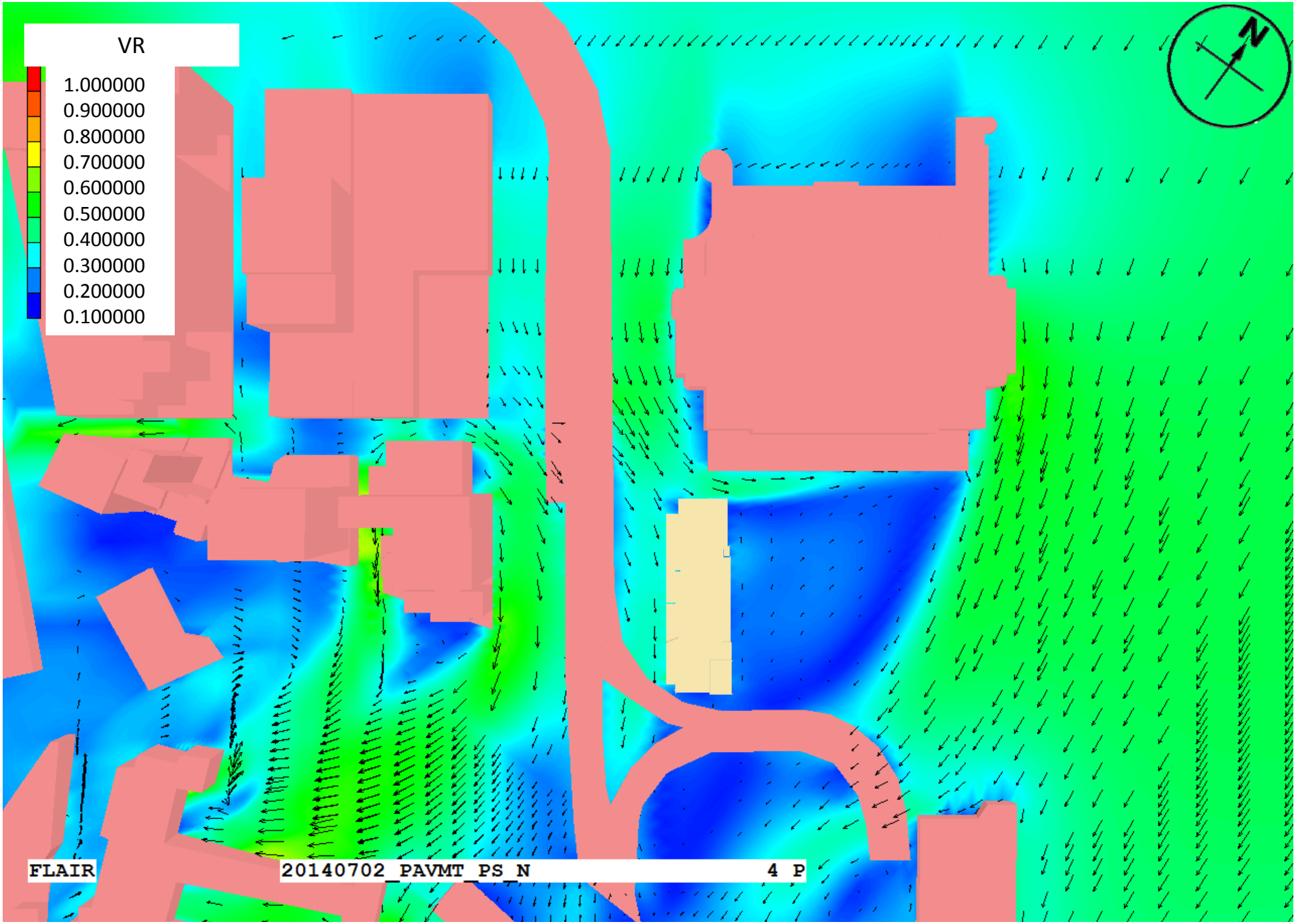
Existing Scenario– VR colour and vector plot at pedestrian level under SW Wind



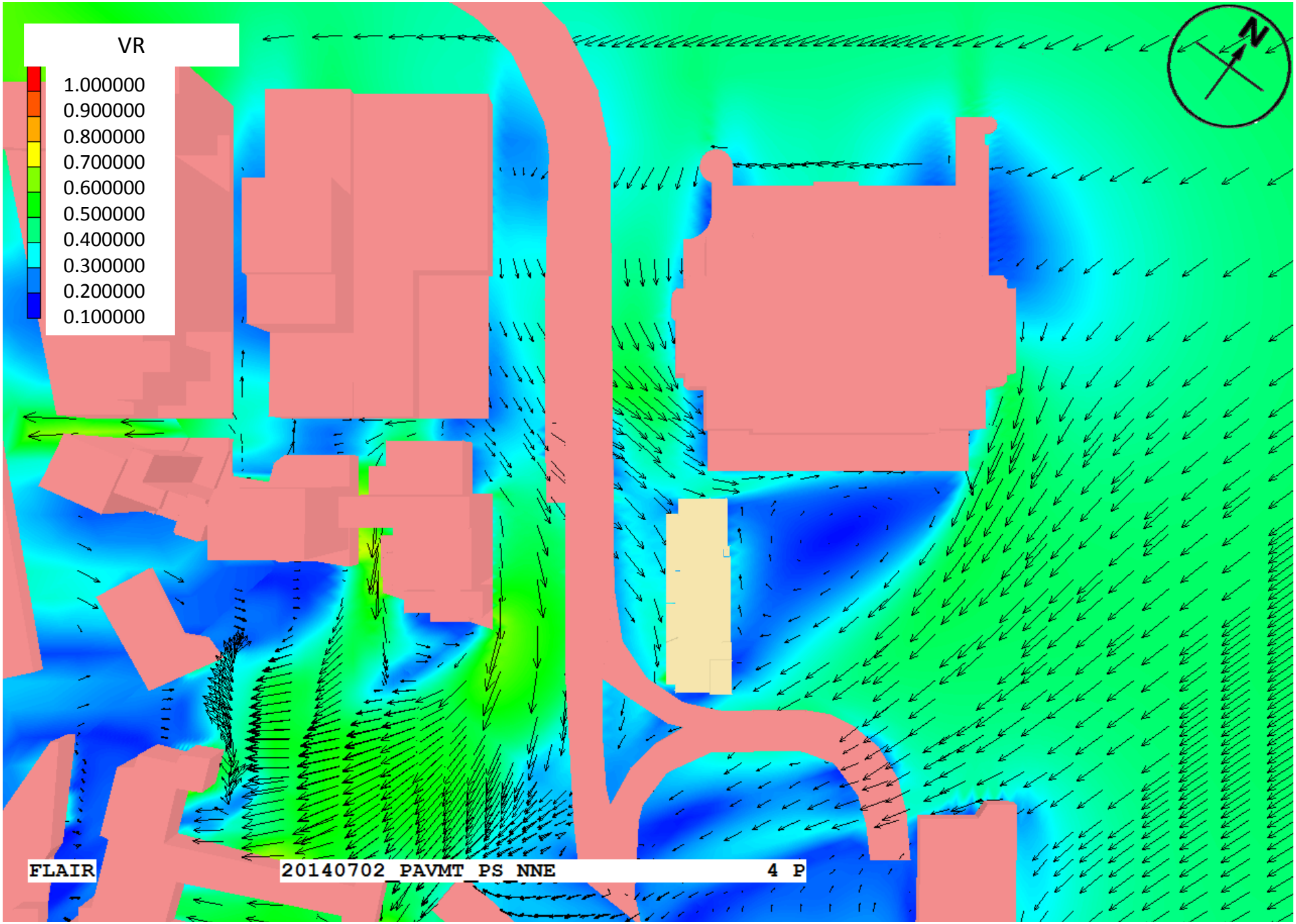
Existing Scenario– VR colour and vector plot at pedestrian level under WSW Wind



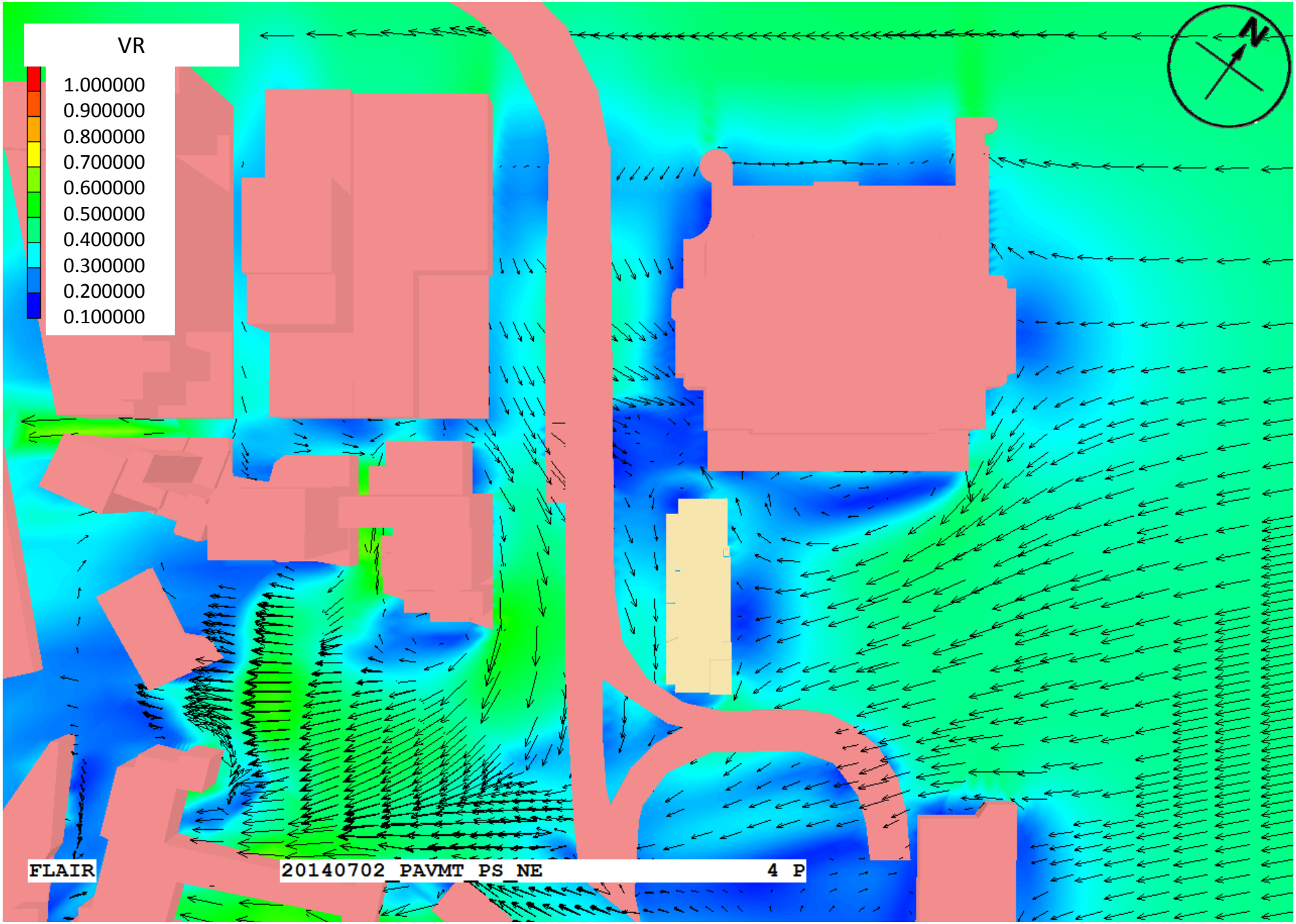
Existing Scenario– VR colour and vector plot at pedestrian level under W Wind



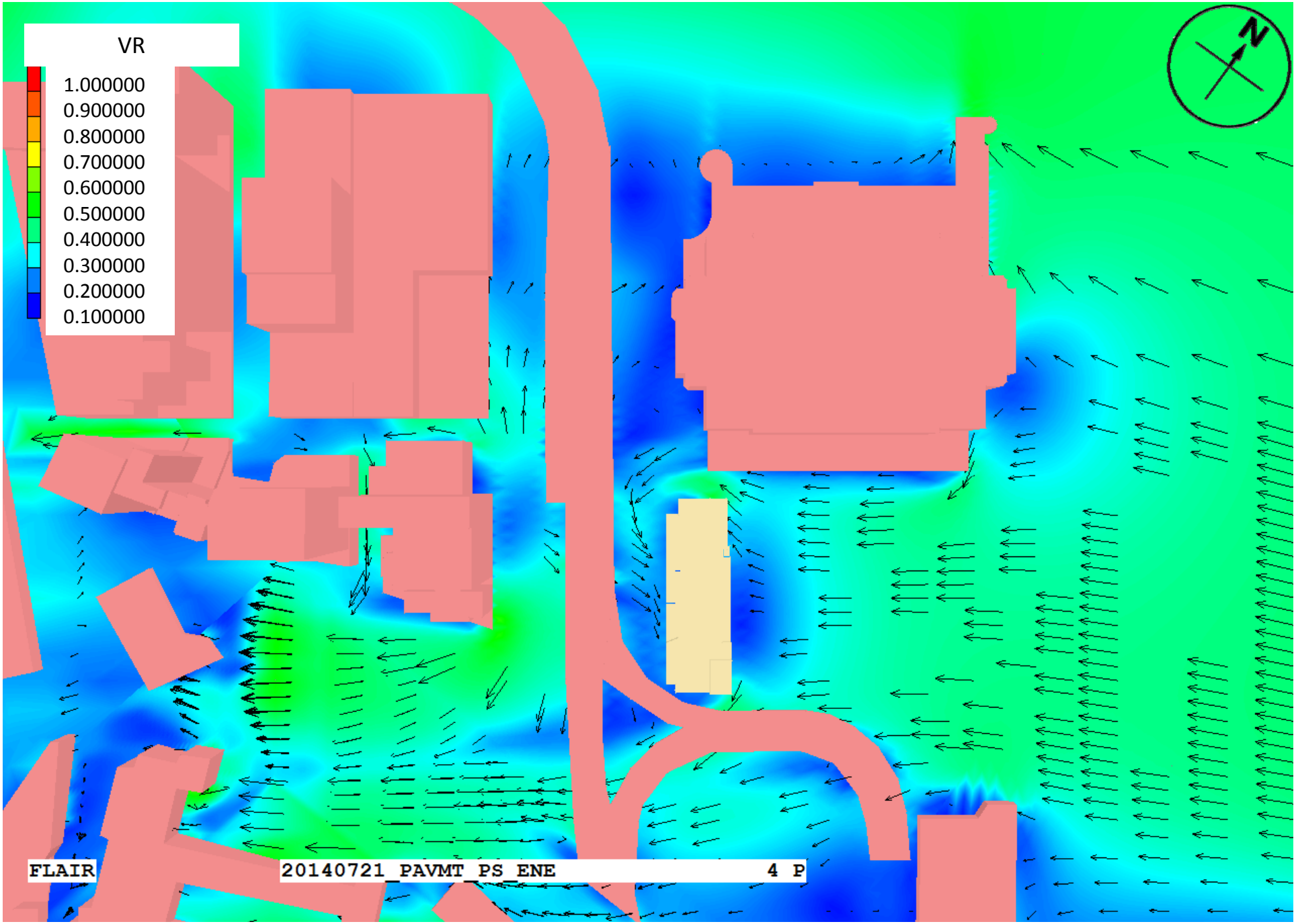
Proposed Scheme – VR colour and vector plot at pedestrian level under N Wind



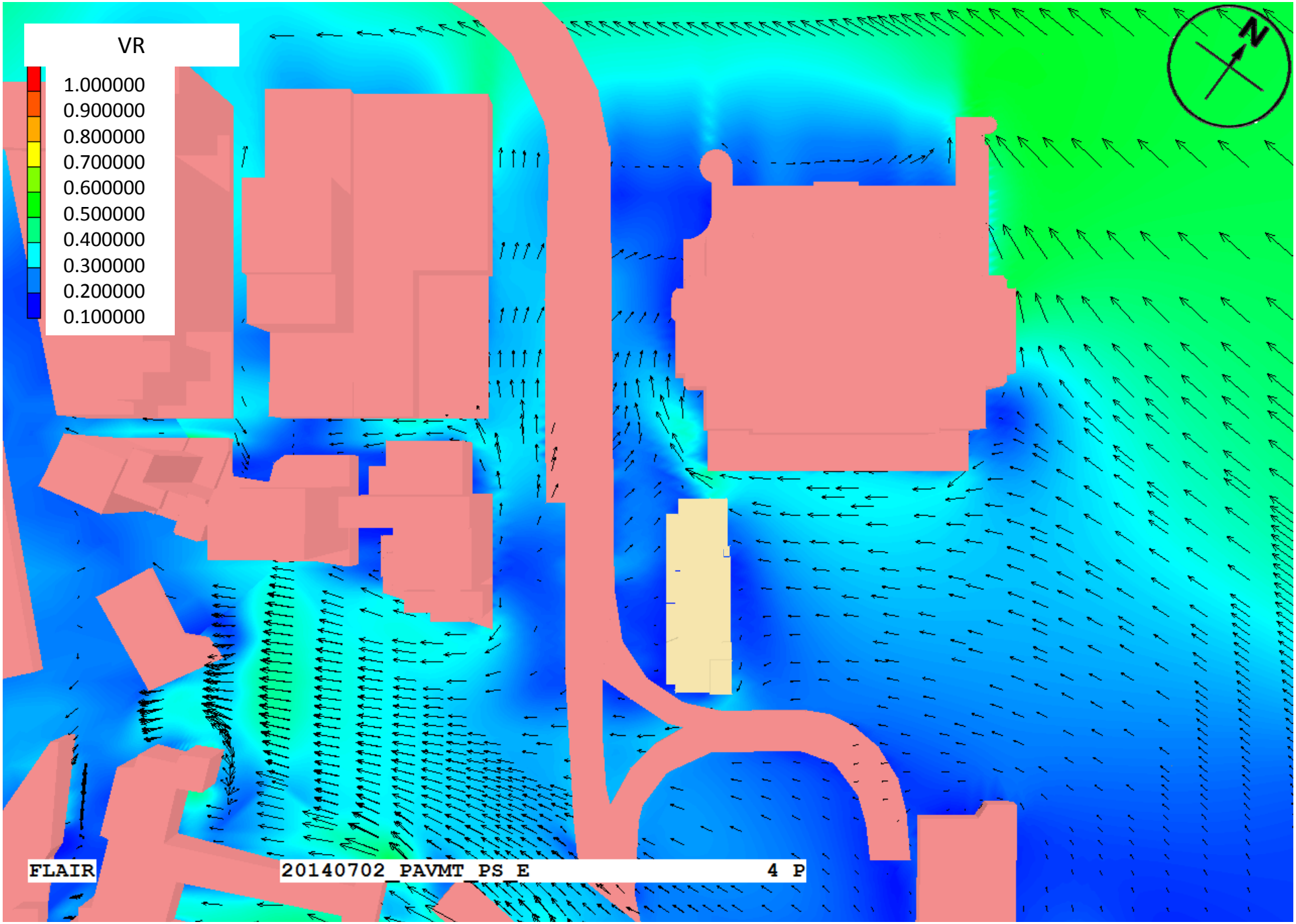
Proposed Scheme– VR colour and vector plot at pedestrian level under NNE Wind



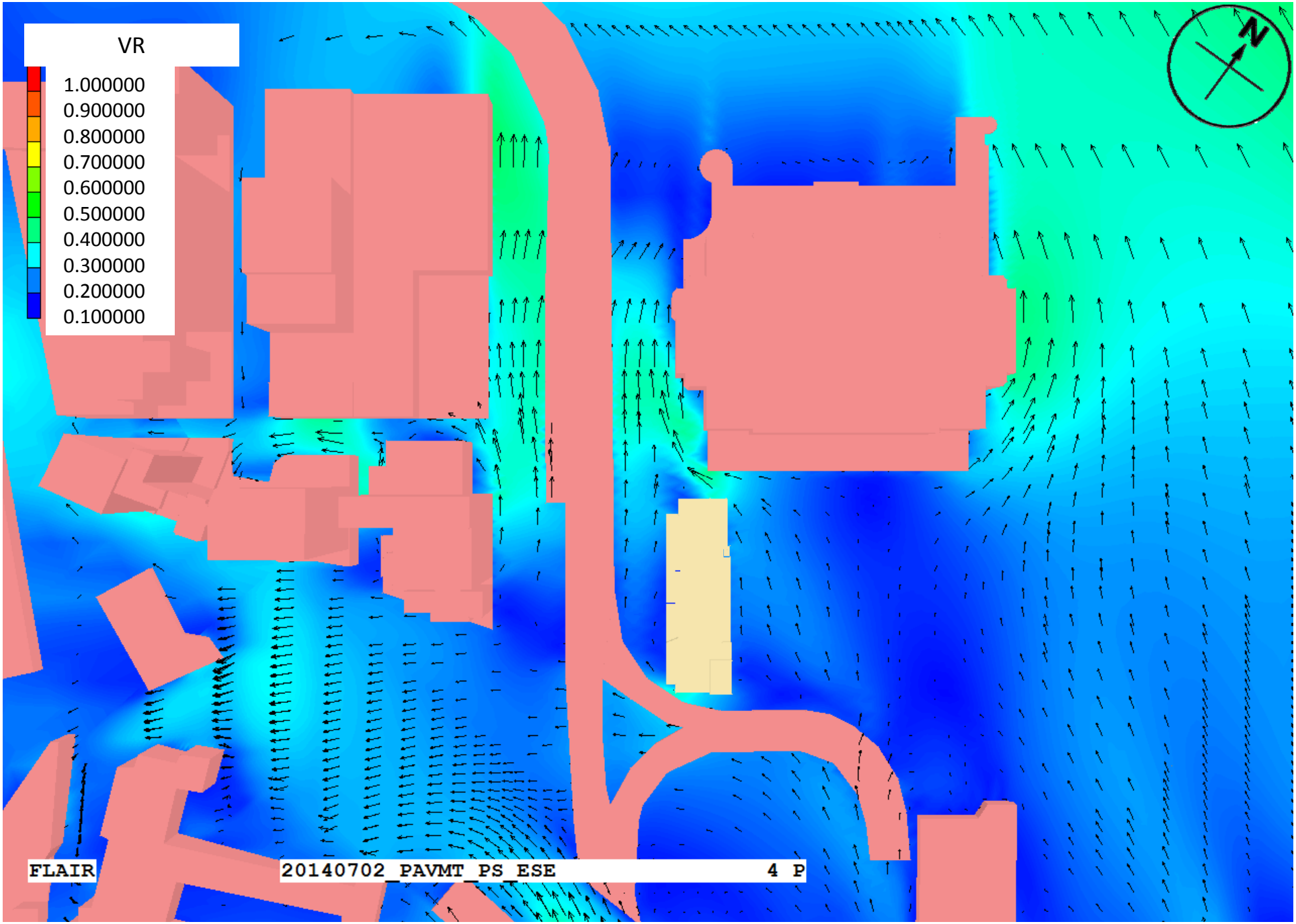
Proposed Scheme– VR colour and vector plot at pedestrian level under NE Wind



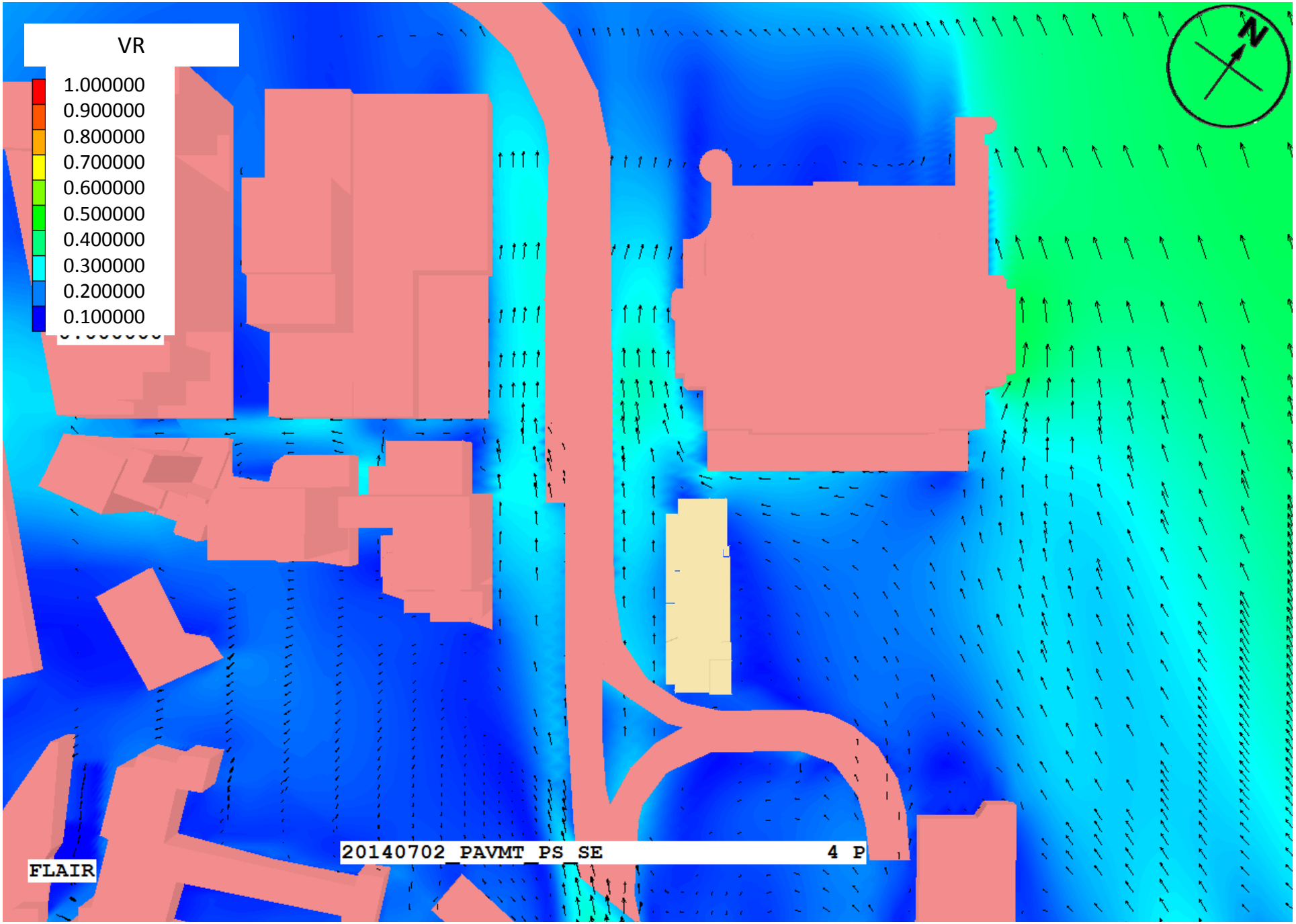
Proposed Scheme– VR colour and vector plot at pedestrian level under ENE Wind



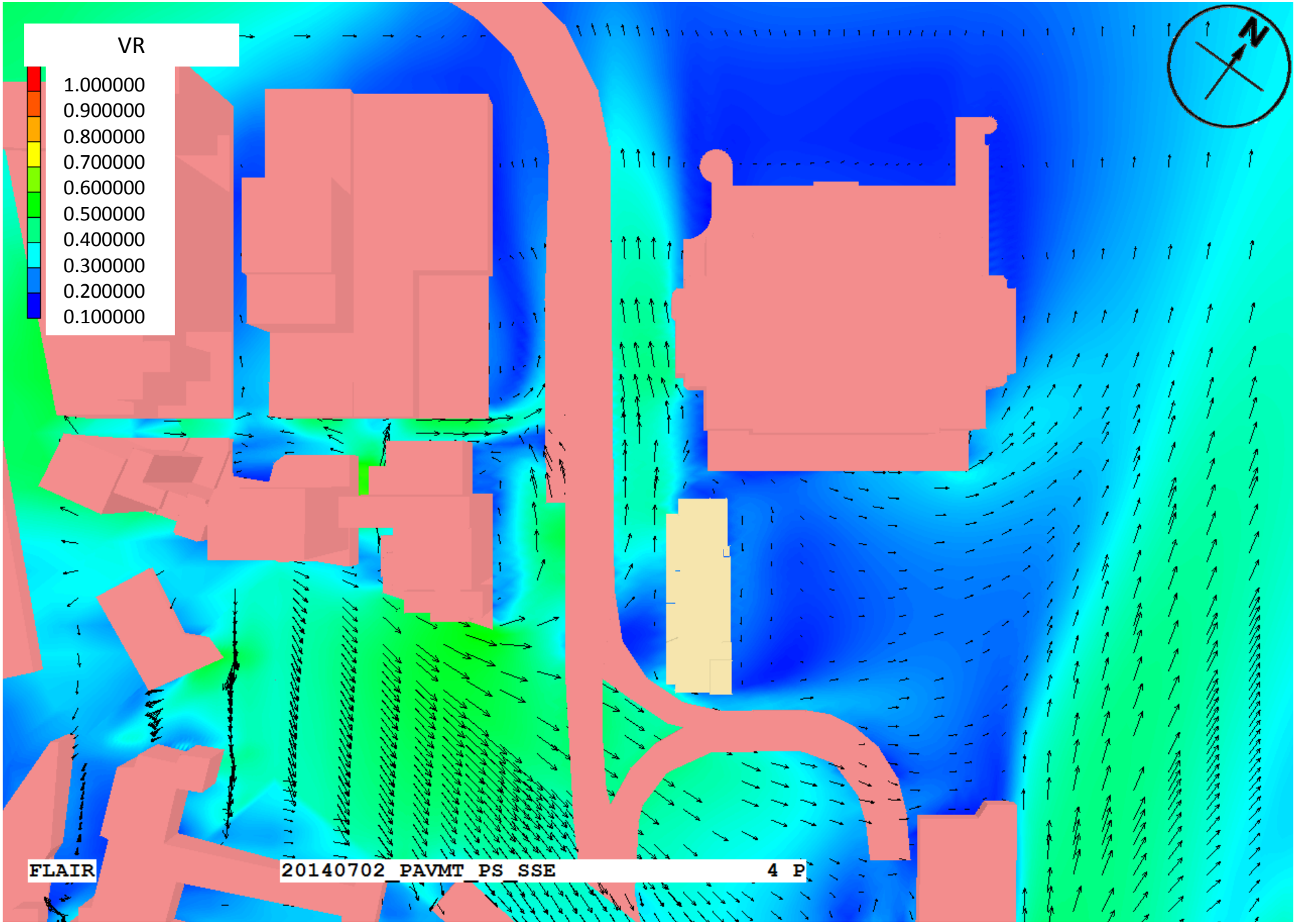
Proposed Scheme– VR colour and vector plot at pedestrian level under E Wind



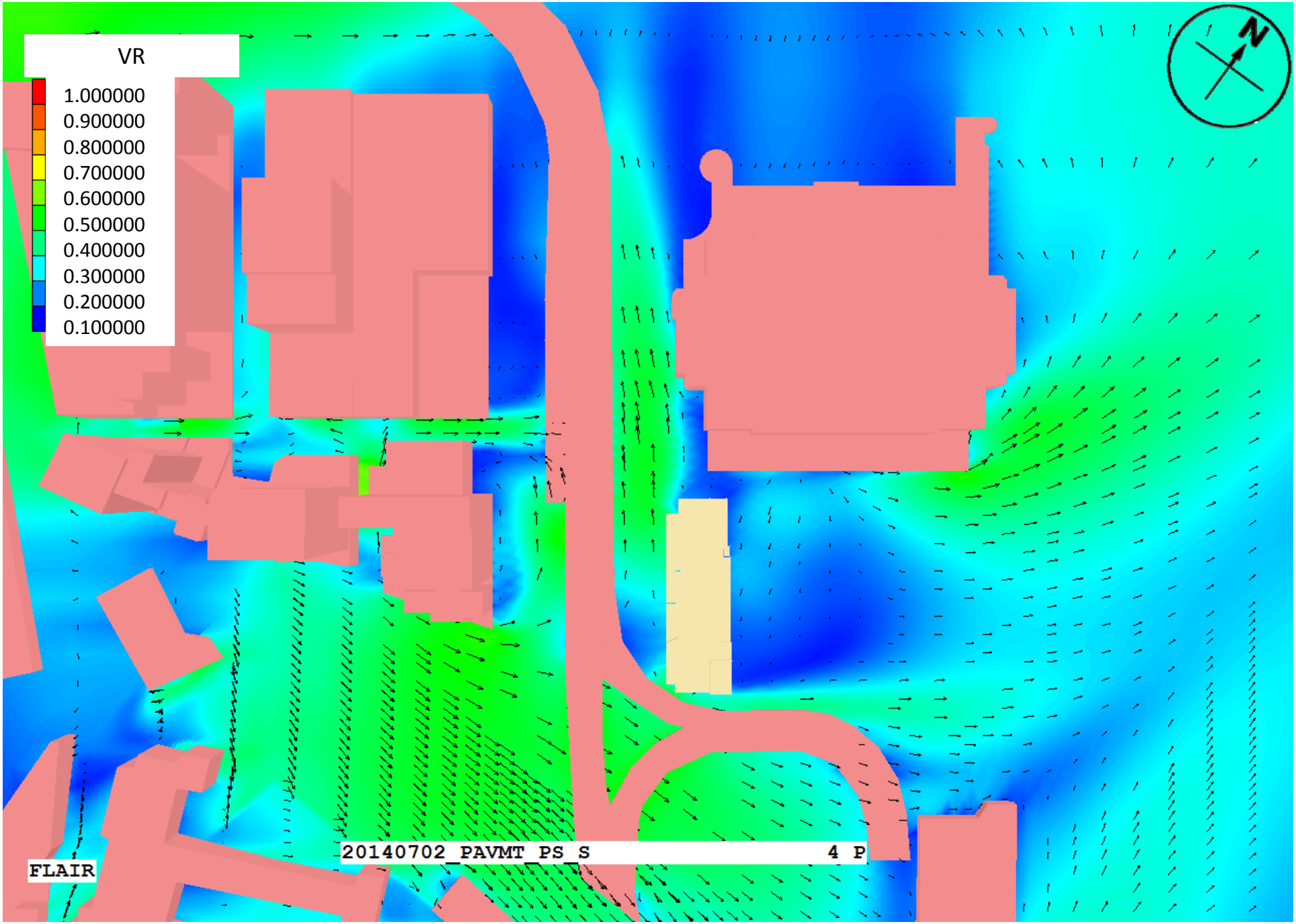
Proposed Scheme– VR colour and vector plot at pedestrian level under ESE Wind



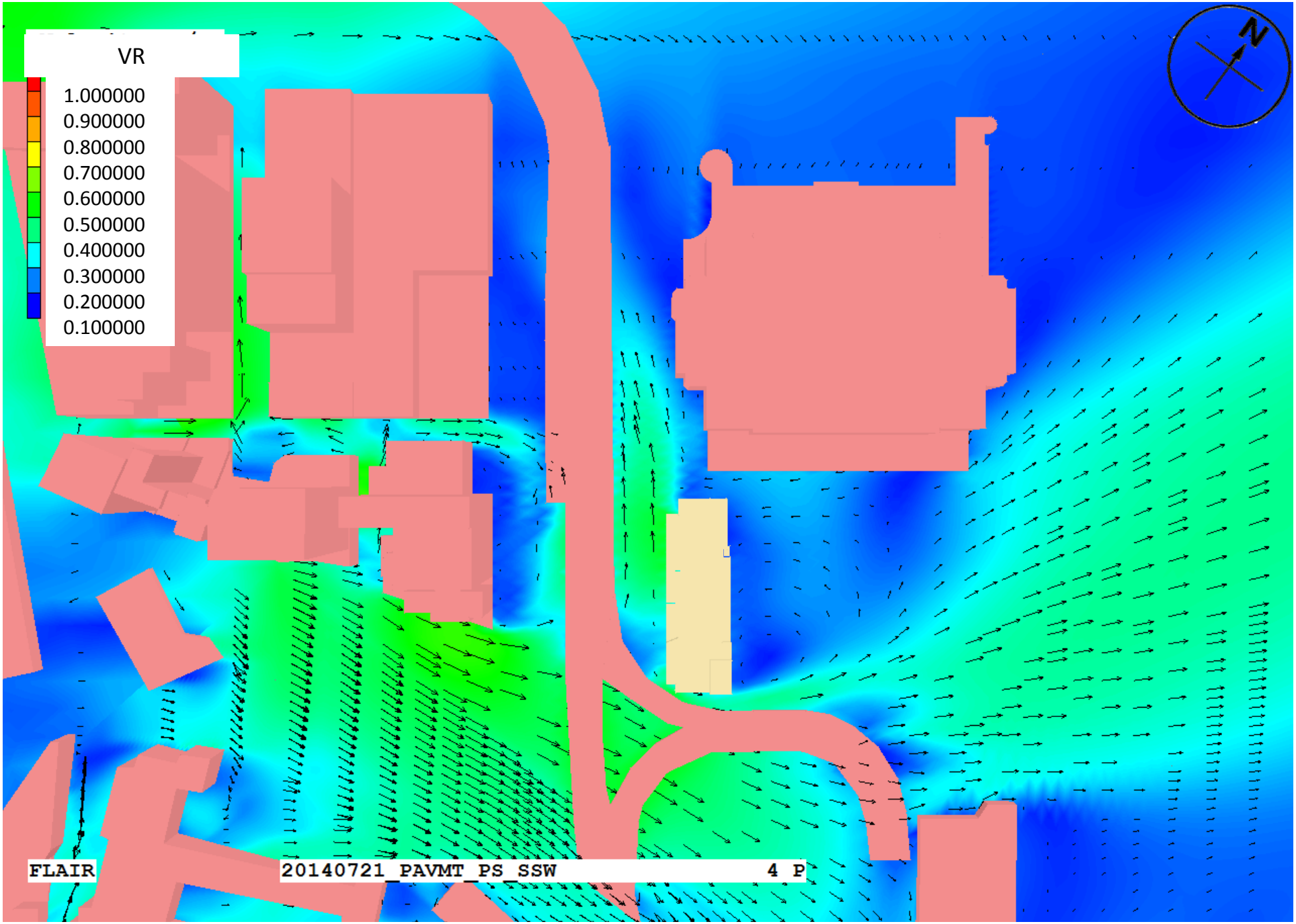
Proposed Scheme– VR colour and vector plot at pedestrian level under SE Wind



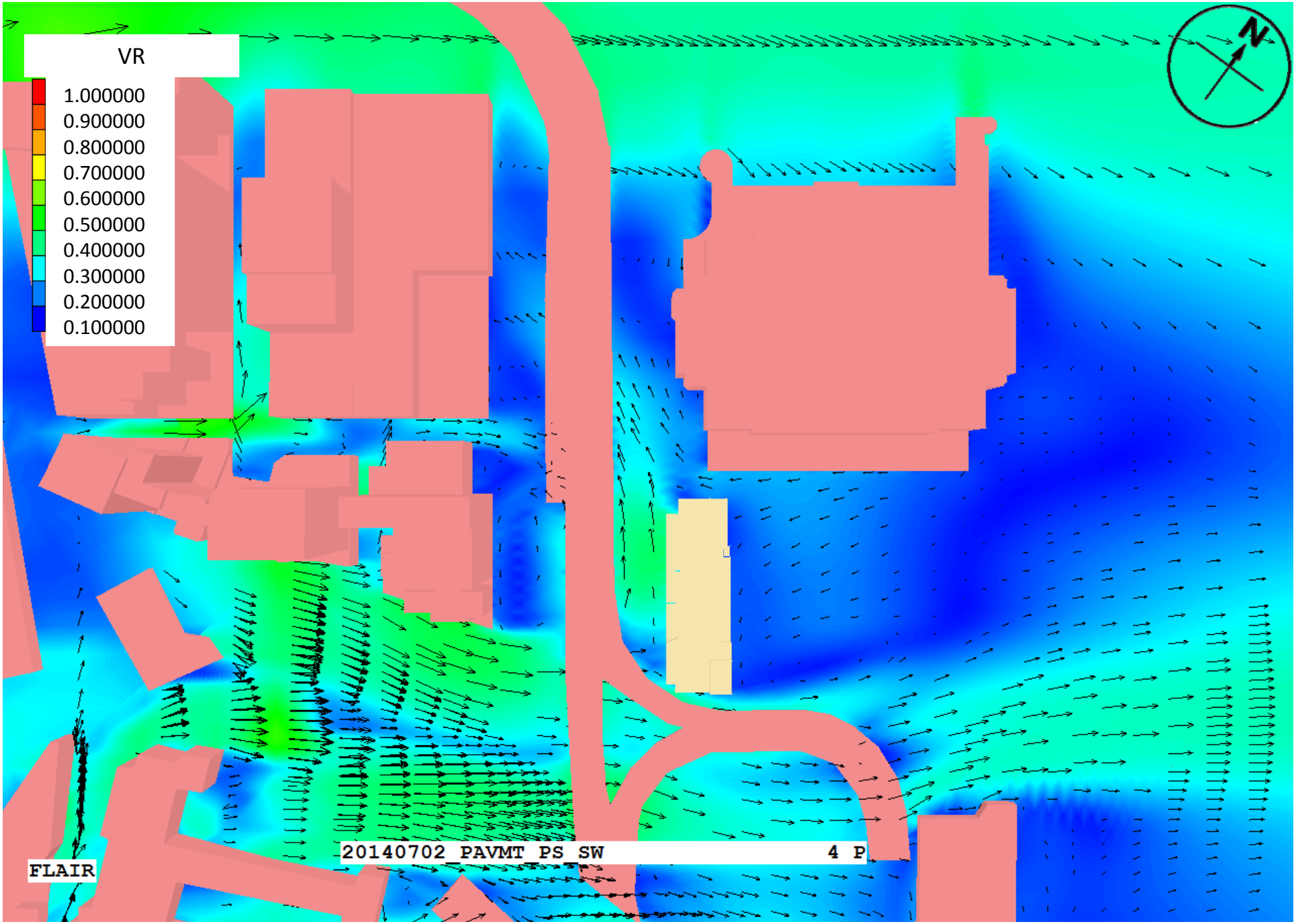
Proposed Scheme– VR colour and vector plot at pedestrian level under SSE Wind



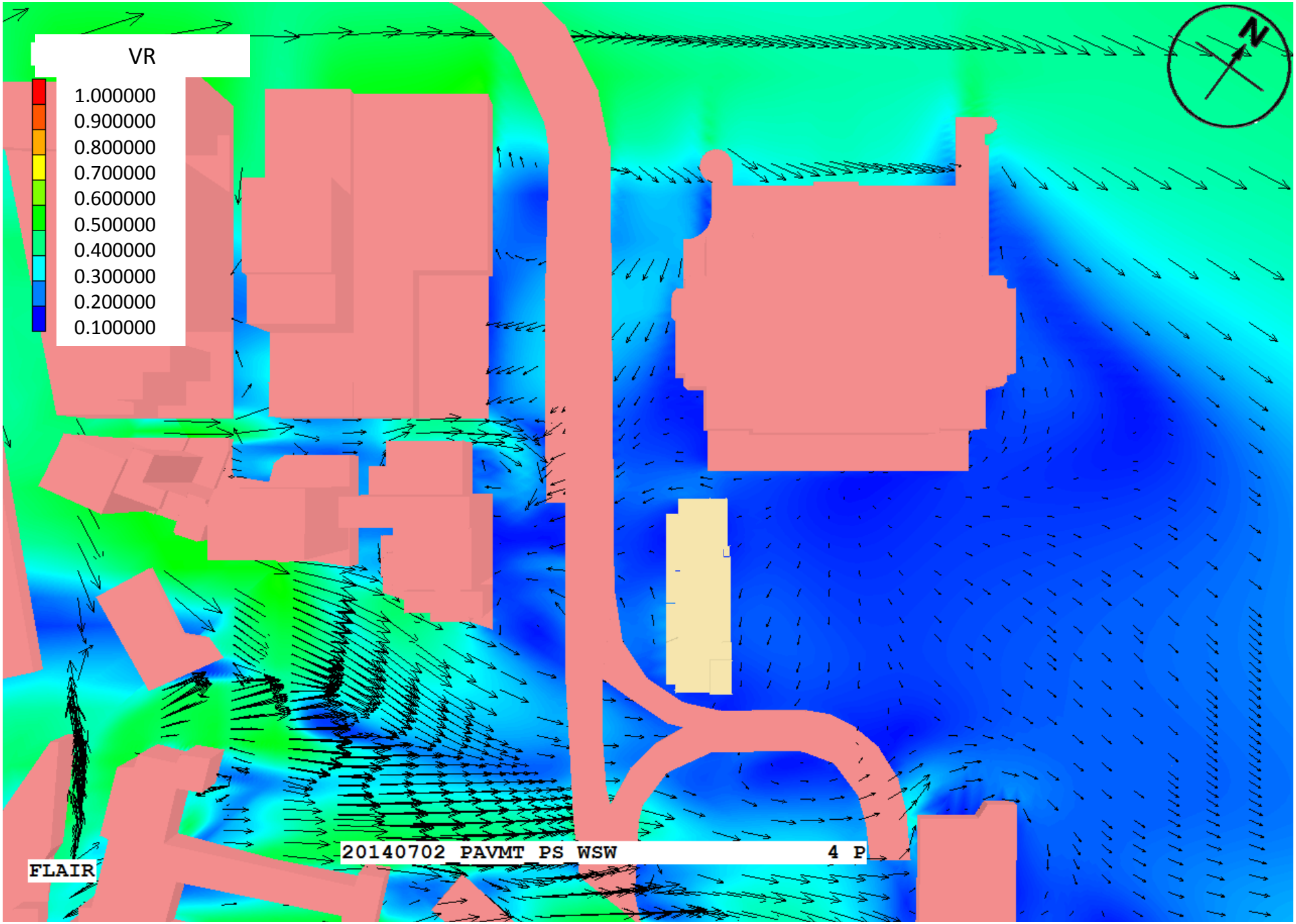
Proposed Scheme– VR colour and vector plot at pedestrian level under S Wind



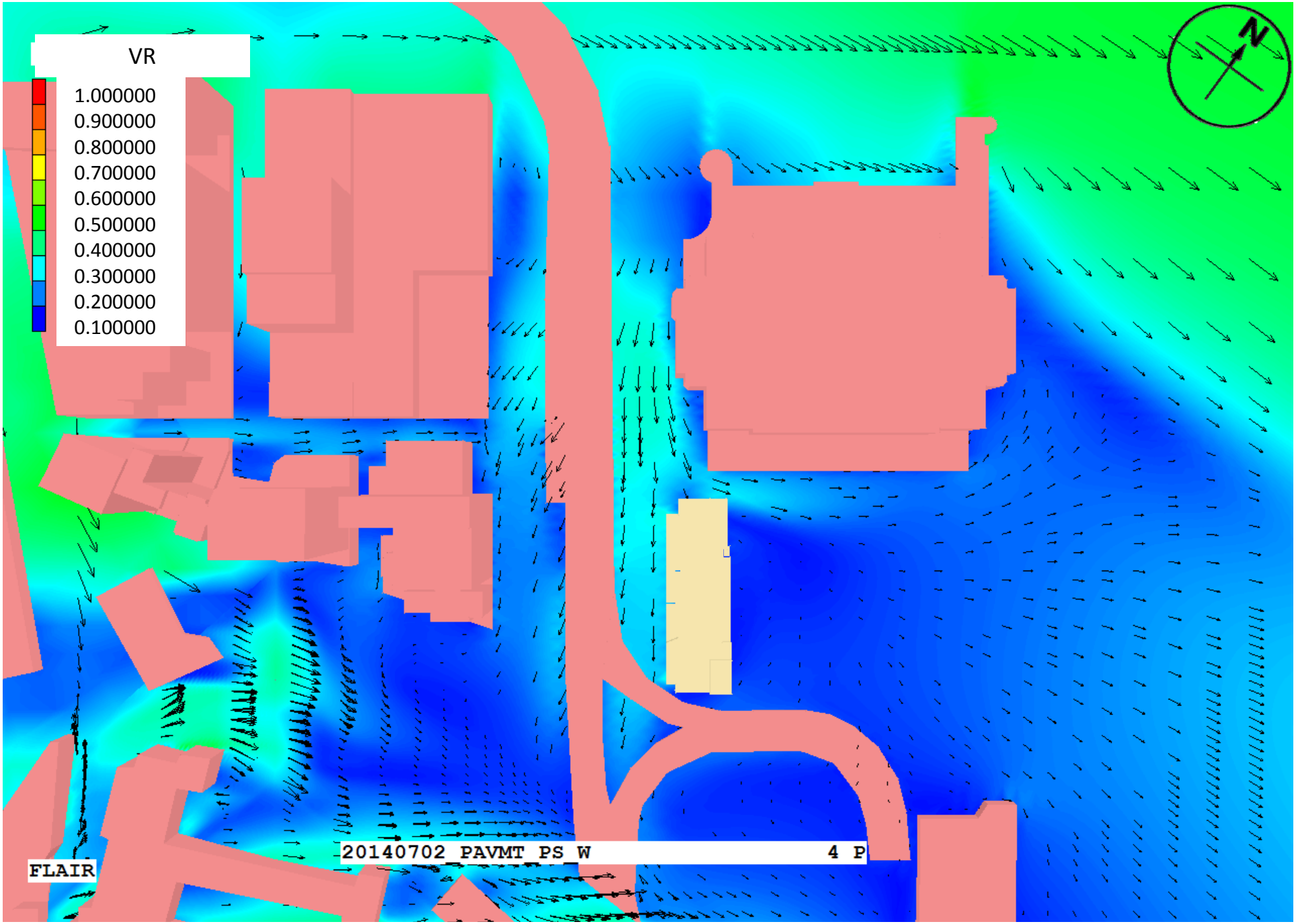
Proposed Scheme– VR colour and vector plot at pedestrian level under SSW Wind



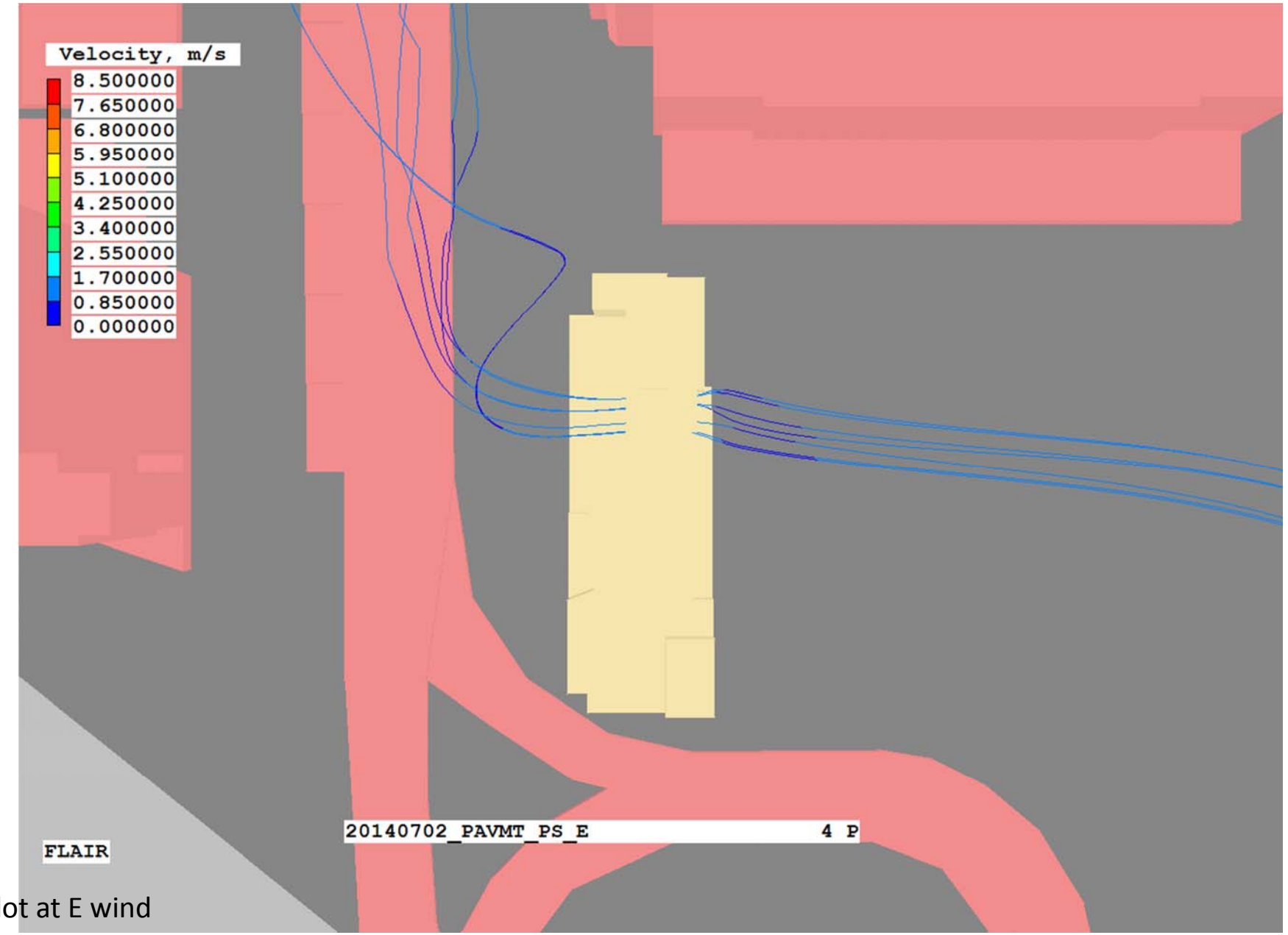
Proposed Scheme– VR colour and vector plot at pedestrian level under SW Wind



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



Proposed Scheme– VR colour and vector plot at pedestrian level under W Wind



Streamline Plot at E wind

Appendix C:
Detailed CFD Simulation Result for Selected Test Points

	Proposed Scheme (VR)														
Testpoint	**NNE**	**NE**	**E**	**ESE**	**SSE**	**N**	**S**	**SW**	**WSW**	**W**	**ENE**	**SSW**	**SE**	**Overall (Annual)**	**Overall (Summer)**
P01	0.21	0.20	0.21	0.21	0.09	0.29	0.04	0.11	0.06	0.21	0.30	0.11	0.14	0.20	0.14
P02	0.25	0.21	0.26	0.27	0.05	0.29	0.08	0.13	0.09	0.20	0.41	0.11	0.16	0.24	0.17
P03	0.28	0.07	0.10	0.10	0.07	0.28	0.11	0.09	0.10	0.14	0.20	0.08	0.07	0.15	0.11
P04	0.20	0.03	0.08	0.08	0.17	0.18	0.17	0.08	0.11	0.13	0.18	0.17	0.08	0.12	0.12
P05	0.18	0.08	0.09	0.14	0.28	0.22	0.33	0.21	0.10	0.18	0.20	0.33	0.15	0.17	0.19
P06	0.16	0.09	0.10	0.16	0.30	0.24	0.37	0.31	0.04	0.26	0.14	0.42	0.18	0.17	0.23
P07	0.20	0.12	0.08	0.13	0.25	0.26	0.35	0.34	0.02	0.22	0.12	0.41	0.16	0.17	0.21
P08	0.20	0.15	0.08	0.10	0.22	0.25	0.34	0.36	0.02	0.21	0.11	0.42	0.15	0.17	0.21
P09	0.21	0.18	0.06	0.07	0.18	0.25	0.31	0.35	0.04	0.20	0.12	0.40	0.13	0.16	0.20
P10	0.22	0.20	0.04	0.05	0.15	0.25	0.27	0.32	0.08	0.19	0.13	0.36	0.13	0.16	0.18
P11	0.25	0.21	0.04	0.04	0.12	0.26	0.23	0.29	0.11	0.19	0.13	0.31	0.13	0.15	0.17
P12	0.26	0.23	0.03	0.03	0.29	0.27	0.20	0.26	0.14	0.19	0.14	0.26	0.13	0.16	0.17
P13	0.27	0.23	0.03	0.04	0.09	0.27	0.17	0.21	0.14	0.18	0.14	0.21	0.14	0.15	0.14
P14	0.26	0.23	0.02	0.04	0.10	0.26	0.17	0.17	0.12	0.17	0.14	0.20	0.14	0.14	0.13
P15	0.25	0.23	0.02	0.05	0.16	0.25	0.26	0.14	0.11	0.17	0.12	0.27	0.15	0.14	0.15
P16	0.27	0.23	0.02	0.18	0.23	0.22	0.36	0.23	0.07	0.16	0.11	0.35	0.13	0.16	0.19
P17	0.16	0.11	0.04	0.25	0.19	0.13	0.32	0.25	0.05	0.07	0.07	0.33	0.05	0.12	0.17
P18	0.07	0.14	0.03	0.23	0.06	0.03	0.18	0.14	0.02	0.02	0.12	0.17	0.07	0.09	0.10
P19	0.09	0.18	0.08	0.19	0.06	0.04	0.16	0.06	0.04	0.03	0.16	0.13	0.09	0.10	0.10
P20	0.18	0.29	0.17	0.11	0.05	0.13	0.09	0.04	0.04	0.07	0.29	0.10	0.06	0.17	0.10
P21	0.06	0.18	0.11	0.06	0.07	0.11	0.05	0.06	0.05	0.04	0.17	0.08	0.05	0.11	0.08
P22	0.06	0.12	0.08	0.07	0.08	0.10	0.06	0.08	0.06	0.02	0.10	0.09	0.05	0.08	0.07
P23	0.11	0.07	0.07	0.09	0.09	0.10	0.07	0.08	0.07	0.02	0.06	0.10	0.05	0.08	0.07
P24	0.15	0.05	0.06	0.10	0.10	0.09	0.09	0.08	0.07	0.02	0.04	0.09	0.05	0.07	0.07
P25	0.17	0.06	0.05	0.11	0.10	0.09	0.12	0.08	0.07	0.02	0.05	0.09	0.05	0.08	0.08
P26	0.19	0.10	0.04	0.12	0.11	0.11	0.14	0.08	0.06	0.03	0.07	0.09	0.04	0.09	0.08
P27	0.21	0.16	0.03	0.12	0.11	0.14	0.16	0.08	0.05	0.04	0.12	0.09	0.04	0.10	0.09
P28	0.21	0.21	0.03	0.14	0.11	0.15	0.13	0.07	0.03	0.05	0.16	0.08	0.02	0.11	0.08
P29	0.14	0.19	0.08	0.13	0.08	0.10	0.09	0.04	0.03	0.05	0.17	0.04	0.04	0.11	0.07
P30	0.11	0.20	0.12	0.15	0.09	0.07	0.08	0.06	0.03	0.03	0.21	0.06	0.07	0.12	0.09
T01	0.25	0.28	0.40	0.30	0.10	0.28	0.23	0.23	0.26	0.35	0.35	0.05	0.33	0.30	0.26
T02	0.32	0.15	0.17	0.30	0.17	0.45	0.27	0.05	0.07	0.08	0.08	0.11	0.33	0.21	0.17
T03	0.34	0.29	0.27	0.15	0.28	0.38	0.26	0.05	0.05	0.08	0.29	0.30	0.26	0.27	0.20
T04	0.35	0.32	0.15	0.11	0.13	0.38	0.20	0.12	0.07	0.10	0.32	0.31	0.20	0.24	0.18
T05	0.10	0.30	0.20	0.04	0.13	0.03	0.23	0.06	0.04	0.08	0.32	0.07	0.10	0.16	0.12
T06	0.15	0.22	0.12	0.11	0.04	0.10	0.07	0.10	0.07	0.04	0.20	0.11	0.08	0.13	0.10
T07	0.31	0.29	0.09	0.02	0.12	0.31	0.25	0.21	0.01	0.06	0.29	0.24	0.08	0.20	0.15
T08	0.29	0.32	0.10	0.03	0.05	0.26	0.16	0.27	0.10	0.08	0.33	0.24	0.08	0.20	0.16
T09	0.34	0.31	0.09	0.11	0.29	0.37	0.23	0.23	0.08	0.14	0.32	0.18	0.19	0.23	0.19

	Proposed Scheme (VR)														
Testpoint	**NNE**	**NE**	**E**	**ESE**	**SSE**	**N**	**S**	**SW**	**WSW**	**W**	**ENE**	**SSW**	**SE**	**Overall (Annual)**	**Overall (Summer)**
T10	0.32	0.29	0.04	0.09	0.30	0.34	0.26	0.06	0.05	0.09	0.12	0.08	0.19	0.17	0.13
T11	0.19	0.09	0.04	0.03	0.29	0.29	0.18	0.06	0.06	0.06	0.09	0.05	0.07	0.11	0.09
T12	0.32	0.31	0.05	0.10	0.33	0.27	0.29	0.02	0.14	0.13	0.04	0.05	0.10	0.15	0.13
T13	0.24	0.23	0.10	0.16	0.27	0.23	0.22	0.03	0.14	0.27	0.07	0.07	0.09	0.15	0.14
T14	0.20	0.25	0.07	0.13	0.13	0.11	0.17	0.10	0.21	0.21	0.06	0.17	0.17	0.13	0.14
T15	0.31	0.23	0.35	0.06	0.34	0.44	0.25	0.29	0.06	0.23	0.12	0.24	0.37	0.28	0.25
T16	0.23	0.28	0.11	0.12	0.13	0.14	0.17	0.13	0.10	0.18	0.08	0.12	0.16	0.14	0.14
T17	0.15	0.19	0.09	0.07	0.30	0.16	0.08	0.08	0.21	0.20	0.08	0.13	0.21	0.13	0.14
T18	0.18	0.21	0.11	0.05	0.21	0.19	0.25	0.12	0.28	0.32	0.12	0.17	0.04	0.15	0.17
T19	0.20	0.22	0.17	0.12	0.15	0.08	0.27	0.31	0.38	0.36	0.25	0.18	0.38	0.21	0.25
T20	0.06	0.15	0.13	0.07	0.29	0.03	0.39	0.30	0.20	0.05	0.23	0.35	0.07	0.15	0.21
T21	0.06	0.10	0.06	0.13	0.20	0.07	0.23	0.15	0.04	0.03	0.14	0.21	0.06	0.10	0.12
T22	0.15	0.12	0.08	0.05	0.11	0.11	0.23	0.17	0.26	0.13	0.07	0.18	0.14	0.11	0.15
T23	0.06	0.08	0.11	0.03	0.22	0.17	0.30	0.17	0.23	0.11	0.12	0.22	0.06	0.13	0.16
T24	0.17	0.23	0.06	0.08	0.07	0.23	0.11	0.21	0.10	0.18	0.15	0.19	0.18	0.14	0.14
T25	0.23	0.08	0.22	0.24	0.16	0.27	0.19	0.13	0.07	0.19	0.12	0.14	0.17	0.18	0.16
T26	0.34	0.27	0.13	0.22	0.30	0.36	0.34	0.07	0.18	0.25	0.14	0.18	0.23	0.22	0.20
T27	0.24	0.12	0.05	0.03	0.07	0.29	0.03	0.17	0.16	0.07	0.08	0.09	0.06	0.12	0.10
T28	0.27	0.18	0.10	0.04	0.04	0.19	0.11	0.20	0.25	0.20	0.09	0.09	0.04	0.14	0.13
T29	0.20	0.22	0.19	0.11	0.03	0.12	0.08	0.22	0.23	0.25	0.21	0.08	0.11	0.17	0.16
T30	0.27	0.23	0.14	0.08	0.19	0.27	0.19	0.28	0.31	0.18	0.13	0.09	0.13	0.19	0.19
T31	0.28	0.34	0.22	0.11	0.05	0.12	0.11	0.32	0.45	0.32	0.22	0.15	0.05	0.22	0.22
T32	0.19	0.16	0.14	0.27	0.12	0.26	0.14	0.08	0.07	0.19	0.13	0.13	0.21	0.17	0.15
T33	0.33	0.29	0.15	0.18	0.21	0.30	0.25	0.15	0.18	0.25	0.15	0.18	0.15	0.21	0.19
T34	0.24	0.24	0.21	0.27	0.23	0.25	0.14	0.06	0.18	0.23	0.22	0.04	0.21	0.21	0.17
T35	0.30	0.21	0.15	0.11	0.17	0.20	0.19	0.12	0.11	0.06	0.19	0.15	0.08	0.17	0.14
T36	0.30	0.36	0.20	0.17	0.26	0.26	0.36	0.29	0.35	0.23	0.32	0.30	0.06	0.26	0.26
T37	0.08	0.21	0.21	0.27	0.22	0.19	0.26	0.24	0.32	0.29	0.13	0.19	0.17	0.20	0.23
T38	0.23	0.15	0.29	0.29	0.24	0.23	0.12	0.08	0.13	0.22	0.05	0.07	0.16	0.19	0.17
T39	0.41	0.32	0.07	0.04	0.05	0.34	0.05	0.26	0.30	0.25	0.26	0.11	0.09	0.20	0.16
T40	0.56	0.42	0.14	0.10	0.18	0.57	0.18	0.50	0.38	0.13	0.33	0.18	0.14	0.31	0.26
T41	0.56	0.61	0.38	0.10	0.19	0.48	0.24	0.29	0.43	0.35	0.46	0.23	0.07	0.39	0.30
T42	0.43	0.32	0.21	0.16	0.33	0.38	0.39	0.35	0.34	0.17	0.34	0.32	0.06	0.30	0.28
T43	0.38	0.29	0.16	0.13	0.26	0.38	0.31	0.25	0.17	0.04	0.18	0.17	0.08	0.23	0.20
T44	0.26	0.27	0.20	0.13	0.23	0.13	0.26	0.32	0.38	0.28	0.21	0.24	0.07	0.21	0.24
T45	0.10	0.14	0.07	0.09	0.30	0.16	0.27	0.29	0.30	0.16	0.09	0.31	0.06	0.14	0.20
T46	0.18	0.13	0.16	0.17	0.11	0.12	0.06	0.27	0.42	0.25	0.12	0.20	0.11	0.16	0.19
T47	0.20	0.29	0.14	0.08	0.21	0.20	0.22	0.30	0.24	0.09	0.20	0.29	0.05	0.19	0.20
T48	0.05	0.16	0.20	0.11	0.42	0.05	0.44	0.39	0.27	0.04	0.18	0.49	0.05	0.18	0.26

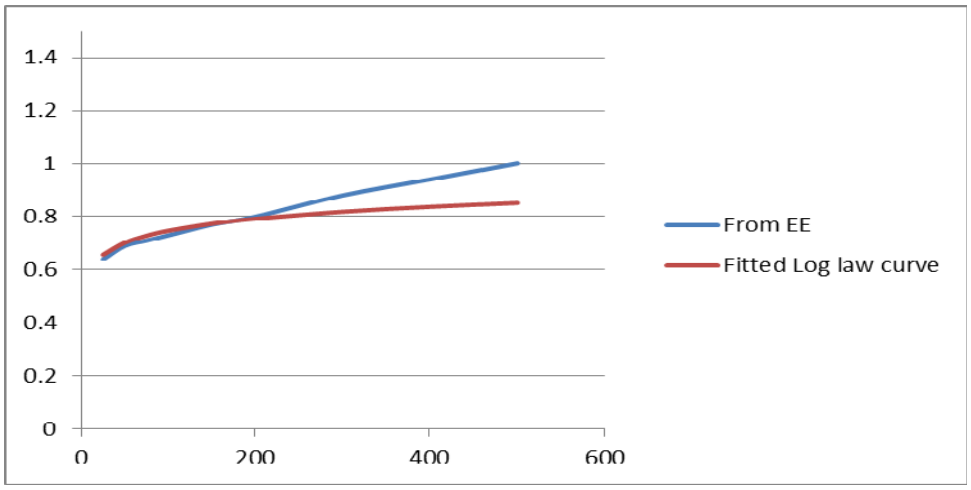
	Proposed Scheme (VR)														
Testpoint	**NNE**	**NE**	**E**	**ESE**	**SSE**	**N**	**S**	**SW**	**WSW**	**W**	**ENE**	**SSW**	**SE**	**Overall (Annual)**	**Overall (Summer)**
T49	0.42	0.30	0.19	0.13	0.37	0.35	0.42	0.29	0.11	0.04	0.23	0.35	0.04	0.26	0.24
T50	0.28	0.18	0.22	0.15	0.36	0.30	0.37	0.30	0.24	0.06	0.33	0.36	0.07	0.25	0.25
T51	0.17	0.14	0.19	0.33	0.03	0.26	0.03	0.09	0.13	0.11	0.13	0.07	0.20	0.17	0.13
T52	0.17	0.17	0.15	0.23	0.09	0.27	0.04	0.05	0.08	0.10	0.18	0.06	0.18	0.16	0.11
T53	0.27	0.23	0.20	0.27	0.09	0.32	0.13	0.02	0.12	0.12	0.18	0.05	0.21	0.20	0.14
T54	0.54	0.46	0.16	0.03	0.24	0.50	0.23	0.05	0.06	0.11	0.44	0.07	0.11	0.29	0.16
T55	0.11	0.16	0.19	0.11	0.09	0.18	0.19	0.20	0.27	0.29	0.17	0.28	0.09	0.17	0.19
T56	0.11	0.22	0.13	0.11	0.11	0.12	0.20	0.25	0.11	0.15	0.14	0.42	0.05	0.15	0.17
T57	0.24	0.23	0.18	0.07	0.18	0.22	0.25	0.26	0.21	0.04	0.21	0.36	0.04	0.20	0.19
T58	0.36	0.38	0.34	0.19	0.31	0.42	0.39	0.46	0.45	0.18	0.50	0.40	0.13	0.37	0.35
T59	0.14	0.10	0.05	0.10	0.08	0.13	0.13	0.10	0.17	0.07	0.08	0.09	0.05	0.09	0.10
T60	0.09	0.20	0.07	0.23	0.20	0.10	0.21	0.12	0.09	0.15	0.18	0.23	0.13	0.13	0.15
T61	0.23	0.23	0.04	0.18	0.26	0.23	0.28	0.19	0.12	0.08	0.23	0.25	0.13	0.17	0.17
T62	0.09	0.13	0.20	0.18	0.38	0.22	0.41	0.21	0.30	0.05	0.27	0.30	0.10	0.21	0.24
T63	0.65	0.55	0.02	0.25	0.48	0.66	0.53	0.33	0.11	0.04	0.35	0.48	0.19	0.34	0.29
T64	0.57	0.46	0.11	0.05	0.17	0.53	0.16	0.21	0.22	0.13	0.19	0.20	0.03	0.26	0.18
T65	0.15	0.13	0.10	0.05	0.24	0.19	0.25	0.18	0.15	0.10	0.11	0.18	0.05	0.13	0.15
T66	0.29	0.22	0.16	0.10	0.21	0.27	0.22	0.20	0.15	0.08	0.23	0.14	0.07	0.20	0.17
T67	0.44	0.42	0.25	0.12	0.21	0.49	0.27	0.30	0.37	0.22	0.37	0.27	0.04	0.32	0.26
T68	0.30	0.27	0.11	0.12	0.34	0.24	0.39	0.27	0.15	0.12	0.20	0.39	0.13	0.21	0.23
T69	0.14	0.19	0.16	0.11	0.33	0.19	0.44	0.31	0.14	0.11	0.26	0.42	0.19	0.21	0.25
T70	0.14	0.23	0.16	0.06	0.28	0.12	0.39	0.37	0.32	0.06	0.27	0.37	0.04	0.20	0.24
T71	0.12	0.22	0.11	0.18	0.22	0.15	0.28	0.23	0.29	0.41	0.18	0.21	0.07	0.17	0.21
T72	0.22	0.24	0.33	0.39	0.15	0.19	0.12	0.12	0.15	0.06	0.15	0.05	0.39	0.23	0.20
T73	0.28	0.19	0.29	0.34	0.25	0.31	0.18	0.13	0.19	0.15	0.07	0.07	0.40	0.23	0.21
T74	0.41	0.26	0.34	0.43	0.08	0.43	0.11	0.03	0.14	0.20	0.14	0.09	0.44	0.28	0.21
T75	0.06	0.18	0.13	0.08	0.27	0.03	0.37	0.26	0.12	0.04	0.25	0.33	0.05	0.15	0.19
T76	0.19	0.19	0.09	0.10	0.22	0.20	0.31	0.23	0.15	0.04	0.22	0.28	0.08	0.17	0.18
T77	0.09	0.06	0.11	0.07	0.17	0.25	0.30	0.18	0.25	0.07	0.08	0.26	0.07	0.13	0.16
T78	0.27	0.27	0.05	0.06	0.10	0.25	0.19	0.26	0.16	0.02	0.20	0.22	0.04	0.16	0.15
T79	0.33	0.32	0.11	0.02	0.09	0.33	0.26	0.24	0.06	0.08	0.33	0.28	0.09	0.22	0.17

	Existing Scenario (VR)														
Testpoint	**NNE**	**NE**	**E**	**ESE**	**SSE**	**N**	**S**	**SW**	**WSW**	**W**	**ENE**	**SSW**	**SE**	**Overall (Annual)**	**Overall (Summer)**
P01	0.19	0.13	0.31	0.27	0.13	0.26	0.19	0.14	0.11	0.06	0.28	0.06	0.16	0.23	0.18
P02	0.29	0.12	0.32	0.30	0.13	0.31	0.19	0.14	0.11	0.20	0.28	0.03	0.16	0.25	0.19
P03	0.33	0.11	0.31	0.32	0.14	0.34	0.21	0.14	0.11	0.29	0.27	0.05	0.15	0.25	0.20
P04	0.34	0.12	0.28	0.32	0.15	0.34	0.23	0.13	0.10	0.32	0.24	0.09	0.15	0.25	0.20
P05	0.33	0.13	0.26	0.31	0.16	0.34	0.23	0.13	0.09	0.32	0.23	0.10	0.15	0.24	0.20
P06	0.33	0.13	0.24	0.29	0.16	0.33	0.21	0.12	0.10	0.31	0.22	0.09	0.14	0.23	0.19
P07	0.33	0.12	0.22	0.27	0.16	0.31	0.21	0.09	0.10	0.30	0.22	0.10	0.13	0.22	0.18
P08	0.33	0.10	0.21	0.26	0.16	0.31	0.21	0.06	0.11	0.28	0.22	0.07	0.13	0.21	0.17
P09	0.33	0.07	0.19	0.25	0.16	0.30	0.22	0.03	0.11	0.27	0.22	0.17	0.13	0.20	0.17
P10	0.34	0.04	0.18	0.24	0.15	0.30	0.23	0.10	0.10	0.26	0.23	0.23	0.13	0.20	0.18
P11	0.34	0.05	0.17	0.22	0.15	0.30	0.21	0.10	0.10	0.24	0.23	0.27	0.13	0.20	0.18
P12	0.34	0.11	0.17	0.21	0.14	0.30	0.17	0.14	0.09	0.23	0.23	0.22	0.13	0.20	0.17
P13	0.34	0.18	0.16	0.20	0.13	0.30	0.13	0.10	0.08	0.22	0.23	0.12	0.13	0.20	0.15
P14	0.33	0.22	0.15	0.19	0.11	0.30	0.06	0.08	0.06	0.20	0.24	0.04	0.14	0.19	0.13
P15	0.32	0.24	0.15	0.17	0.12	0.29	0.14	0.32	0.04	0.18	0.25	0.26	0.15	0.22	0.19
P16	0.32	0.27	0.15	0.17	0.22	0.31	0.29	0.34	0.05	0.18	0.27	0.38	0.17	0.24	0.23
P17	0.30	0.27	0.15	0.17	0.21	0.28	0.28	0.32	0.06	0.17	0.27	0.35	0.14	0.23	0.22
P18	0.29	0.27	0.15	0.18	0.18	0.27	0.24	0.30	0.05	0.17	0.27	0.33	0.10	0.22	0.21
P19	0.28	0.28	0.16	0.19	0.17	0.26	0.23	0.29	0.05	0.17	0.28	0.31	0.05	0.22	0.20
P20	0.25	0.29	0.16	0.20	0.16	0.24	0.23	0.27	0.06	0.17	0.29	0.29	0.01	0.22	0.20
P21	0.28	0.29	0.18	0.21	0.16	0.25	0.22	0.27	0.03	0.19	0.30	0.25	0.02	0.22	0.19
P22	0.29	0.29	0.19	0.22	0.16	0.26	0.24	0.24	0.05	0.20	0.29	0.23	0.03	0.23	0.19
P23	0.31	0.28	0.19	0.23	0.17	0.27	0.26	0.25	0.07	0.21	0.29	0.29	0.03	0.24	0.21
P24	0.32	0.26	0.20	0.24	0.17	0.27	0.27	0.26	0.08	0.22	0.29	0.32	0.04	0.24	0.22
P25	0.33	0.23	0.21	0.25	0.18	0.28	0.29	0.23	0.09	0.22	0.29	0.35	0.05	0.24	0.22
P26	0.34	0.17	0.22	0.25	0.18	0.29	0.30	0.16	0.10	0.22	0.29	0.36	0.05	0.24	0.21
P27	0.34	0.05	0.23	0.25	0.18	0.30	0.30	0.06	0.11	0.23	0.29	0.31	0.06	0.23	0.20
P28	0.34	0.04	0.25	0.26	0.17	0.31	0.29	0.02	0.11	0.22	0.29	0.27	0.08	0.23	0.19
P29	0.33	0.09	0.26	0.26	0.17	0.31	0.27	0.06	0.11	0.21	0.29	0.22	0.09	0.24	0.19
P30	0.30	0.12	0.28	0.26	0.15	0.30	0.24	0.11	0.11	0.16	0.29	0.14	0.12	0.24	0.19
T01	0.26	0.29	0.41	0.35	0.17	0.28	0.17	0.24	0.35	0.43	0.35	0.07	0.33	0.32	0.28
T02	0.32	0.14	0.20	0.30	0.20	0.47	0.19	0.05	0.08	0.10	0.09	0.03	0.34	0.21	0.16
T03	0.34	0.29	0.29	0.26	0.25	0.39	0.29	0.12	0.04	0.11	0.30	0.33	0.27	0.28	0.23
T04	0.34	0.32	0.21	0.16	0.14	0.37	0.24	0.26	0.01	0.09	0.33	0.33	0.20	0.26	0.21
T05	0.16	0.27	0.24	0.07	0.17	0.13	0.38	0.10	0.05	0.07	0.34	0.31	0.10	0.21	0.18
T06	0.22	0.32	0.22	0.22	0.16	0.20	0.31	0.29	0.05	0.13	0.32	0.36	0.08	0.24	0.22
T07	0.27	0.31	0.15	0.14	0.15	0.26	0.19	0.22	0.11	0.08	0.31	0.24	0.07	0.22	0.18
T08	0.28	0.33	0.18	0.19	0.07	0.25	0.09	0.27	0.22	0.07	0.35	0.19	0.08	0.23	0.18
T09	0.34	0.32	0.16	0.20	0.18	0.37	0.22	0.18	0.16	0.11	0.33	0.15	0.19	0.25	0.19

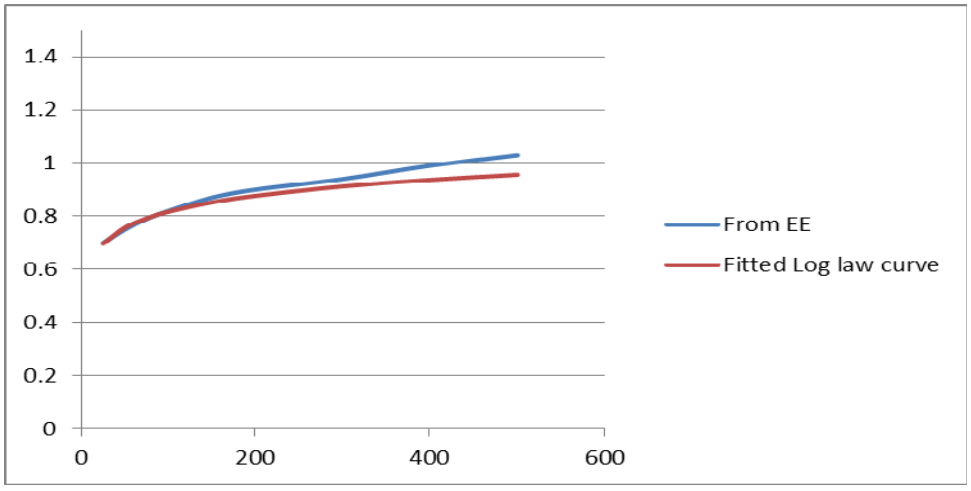
	Existing Scenario (VR)														
Testpoint	**NNE**	**NE**	**E**	**ESE**	**SSE**	**N**	**S**	**SW**	**WSW**	**W**	**ENE**	**SSW**	**SE**	**Overall (Annual)**	**Overall (Summer)**
T10	0.32	0.29	0.10	0.12	0.18	0.35	0.23	0.06	0.12	0.05	0.22	0.11	0.20	0.19	0.14
T11	0.20	0.08	0.05	0.14	0.22	0.29	0.18	0.06	0.07	0.03	0.09	0.06	0.07	0.12	0.10
T12	0.32	0.32	0.06	0.24	0.29	0.26	0.25	0.05	0.08	0.19	0.16	0.13	0.10	0.18	0.15
T13	0.24	0.25	0.14	0.13	0.28	0.21	0.19	0.10	0.08	0.24	0.09	0.09	0.09	0.16	0.15
T14	0.19	0.26	0.04	0.18	0.11	0.15	0.19	0.04	0.15	0.24	0.17	0.04	0.17	0.14	0.13
T15	0.32	0.25	0.30	0.24	0.34	0.49	0.28	0.27	0.10	0.19	0.04	0.22	0.37	0.27	0.25
T16	0.25	0.28	0.07	0.13	0.21	0.20	0.17	0.02	0.05	0.07	0.15	0.07	0.14	0.14	0.11
T17	0.15	0.20	0.19	0.17	0.18	0.17	0.05	0.22	0.13	0.24	0.16	0.25	0.22	0.18	0.18
T18	0.21	0.22	0.06	0.10	0.16	0.12	0.20	0.09	0.19	0.30	0.17	0.08	0.08	0.13	0.14
T19	0.17	0.26	0.15	0.05	0.09	0.13	0.25	0.21	0.32	0.37	0.28	0.16	0.39	0.20	0.22
T20	0.07	0.20	0.13	0.09	0.23	0.21	0.34	0.27	0.22	0.10	0.18	0.32	0.24	0.18	0.21
T21	0.15	0.10	0.09	0.08	0.17	0.13	0.24	0.21	0.14	0.10	0.13	0.23	0.08	0.13	0.15
T22	0.14	0.14	0.13	0.02	0.15	0.14	0.16	0.15	0.18	0.20	0.12	0.18	0.14	0.14	0.14
T23	0.07	0.14	0.11	0.02	0.18	0.08	0.25	0.09	0.18	0.14	0.14	0.14	0.05	0.11	0.13
T24	0.23	0.05	0.11	0.14	0.14	0.24	0.20	0.16	0.07	0.22	0.14	0.22	0.18	0.15	0.15
T25	0.30	0.07	0.32	0.36	0.14	0.32	0.27	0.04	0.05	0.30	0.21	0.07	0.21	0.24	0.19
T26	0.33	0.25	0.23	0.30	0.20	0.35	0.31	0.13	0.18	0.08	0.19	0.18	0.21	0.24	0.21
T27	0.26	0.08	0.11	0.06	0.10	0.30	0.04	0.16	0.22	0.13	0.07	0.13	0.04	0.14	0.12
T28	0.29	0.19	0.11	0.06	0.04	0.20	0.11	0.22	0.29	0.28	0.10	0.10	0.05	0.15	0.15
T29	0.21	0.23	0.20	0.13	0.04	0.12	0.08	0.23	0.32	0.33	0.22	0.10	0.12	0.19	0.18
T30	0.26	0.23	0.15	0.15	0.14	0.26	0.13	0.24	0.32	0.27	0.17	0.15	0.10	0.19	0.19
T31	0.32	0.36	0.17	0.13	0.05	0.15	0.11	0.23	0.32	0.37	0.23	0.16	0.05	0.20	0.19
T32	0.17	0.19	0.23	0.26	0.09	0.25	0.13	0.10	0.15	0.30	0.25	0.12	0.19	0.21	0.18
T33	0.33	0.29	0.14	0.17	0.18	0.30	0.23	0.14	0.15	0.33	0.14	0.17	0.14	0.20	0.18
T34	0.22	0.22	0.16	0.19	0.20	0.23	0.10	0.13	0.12	0.31	0.24	0.11	0.20	0.20	0.17
T35	0.30	0.23	0.13	0.15	0.12	0.20	0.15	0.04	0.11	0.06	0.10	0.09	0.08	0.15	0.11
T36	0.31	0.36	0.20	0.10	0.22	0.25	0.35	0.28	0.39	0.32	0.29	0.27	0.06	0.25	0.26
T37	0.10	0.22	0.19	0.10	0.16	0.21	0.23	0.18	0.26	0.26	0.14	0.15	0.14	0.18	0.19
T38	0.22	0.14	0.28	0.33	0.09	0.29	0.14	0.14	0.17	0.14	0.10	0.07	0.16	0.20	0.18
T39	0.36	0.30	0.12	0.08	0.10	0.30	0.09	0.16	0.31	0.28	0.25	0.09	0.09	0.20	0.16
T40	0.54	0.45	0.23	0.11	0.14	0.57	0.17	0.39	0.37	0.22	0.35	0.24	0.14	0.34	0.27
T41	0.42	0.52	0.32	0.16	0.09	0.34	0.22	0.23	0.31	0.28	0.40	0.21	0.08	0.32	0.25
T42	0.42	0.37	0.21	0.13	0.30	0.37	0.39	0.33	0.38	0.24	0.31	0.29	0.06	0.30	0.28
T43	0.40	0.26	0.17	0.14	0.26	0.40	0.30	0.24	0.15	0.09	0.24	0.18	0.08	0.24	0.20
T44	0.21	0.13	0.08	0.15	0.16	0.11	0.20	0.29	0.43	0.33	0.12	0.20	0.07	0.15	0.20
T45	0.10	0.20	0.09	0.06	0.28	0.09	0.29	0.26	0.24	0.13	0.05	0.30	0.06	0.13	0.18
T46	0.24	0.12	0.14	0.16	0.16	0.08	0.15	0.25	0.41	0.21	0.05	0.23	0.11	0.15	0.19
T47	0.39	0.36	0.16	0.09	0.21	0.27	0.19	0.27	0.15	0.04	0.26	0.27	0.05	0.23	0.19
T48	0.05	0.05	0.21	0.15	0.39	0.09	0.43	0.39	0.19	0.03	0.07	0.49	0.05	0.16	0.25

	Existing Scenario (VR)														
Testpoint	**NNE**	**NE**	**E**	**ESE**	**SSE**	**N**	**S**	**SW**	**WSW**	**W**	**ENE**	**SSW**	**SE**	**Overall (Annual)**	**Overall (Summer)**
T49	0.42	0.31	0.19	0.12	0.34	0.35	0.42	0.27	0.16	0.07	0.26	0.35	0.04	0.26	0.24
T50	0.36	0.24	0.24	0.17	0.35	0.29	0.39	0.32	0.15	0.18	0.35	0.38	0.07	0.28	0.27
T51	0.17	0.15	0.30	0.36	0.06	0.25	0.04	0.03	0.11	0.15	0.30	0.02	0.20	0.22	0.15
T52	0.17	0.18	0.17	0.23	0.02	0.26	0.09	0.10	0.05	0.14	0.23	0.13	0.18	0.18	0.13
T53	0.26	0.21	0.24	0.30	0.08	0.32	0.10	0.15	0.09	0.13	0.26	0.16	0.22	0.23	0.18
T54	0.55	0.43	0.23	0.13	0.16	0.50	0.20	0.04	0.06	0.02	0.41	0.04	0.10	0.30	0.16
T55	0.16	0.19	0.26	0.10	0.05	0.28	0.05	0.14	0.11	0.39	0.23	0.15	0.09	0.20	0.16
T56	0.11	0.23	0.14	0.08	0.09	0.15	0.16	0.21	0.22	0.14	0.16	0.21	0.05	0.15	0.16
T57	0.22	0.33	0.09	0.04	0.11	0.18	0.23	0.15	0.08	0.08	0.18	0.18	0.04	0.16	0.13
T58	0.45	0.40	0.14	0.18	0.16	0.44	0.40	0.47	0.44	0.22	0.30	0.48	0.13	0.30	0.32
T59	0.15	0.13	0.06	0.10	0.09	0.13	0.28	0.21	0.17	0.06	0.05	0.26	0.05	0.11	0.15
T60	0.11	0.23	0.07	0.27	0.23	0.09	0.08	0.07	0.23	0.23	0.14	0.08	0.13	0.13	0.14
T61	0.26	0.20	0.02	0.10	0.26	0.24	0.29	0.16	0.11	0.10	0.18	0.23	0.13	0.15	0.16
T62	0.08	0.11	0.25	0.23	0.33	0.20	0.45	0.31	0.33	0.06	0.32	0.41	0.10	0.24	0.28
T63	0.63	0.49	0.11	0.21	0.41	0.66	0.45	0.25	0.11	0.02	0.27	0.32	0.19	0.32	0.26
T64	0.27	0.38	0.14	0.07	0.19	0.36	0.19	0.19	0.17	0.05	0.21	0.21	0.03	0.21	0.16
T65	0.13	0.14	0.09	0.07	0.16	0.14	0.23	0.13	0.15	0.16	0.13	0.15	0.05	0.12	0.13
T66	0.26	0.27	0.15	0.11	0.21	0.27	0.21	0.19	0.19	0.09	0.23	0.13	0.07	0.20	0.17
T67	0.41	0.40	0.23	0.13	0.20	0.47	0.27	0.30	0.39	0.33	0.34	0.23	0.04	0.31	0.26
T68	0.40	0.30	0.17	0.17	0.33	0.23	0.43	0.34	0.20	0.15	0.29	0.45	0.11	0.26	0.27
T69	0.05	0.16	0.15	0.13	0.29	0.23	0.41	0.29	0.19	0.09	0.24	0.41	0.28	0.20	0.24
T70	0.18	0.21	0.15	0.09	0.24	0.09	0.37	0.37	0.41	0.14	0.15	0.36	0.04	0.18	0.24
T71	0.15	0.24	0.13	0.06	0.17	0.12	0.26	0.15	0.26	0.37	0.22	0.14	0.33	0.18	0.19
T72	0.21	0.24	0.30	0.32	0.19	0.19	0.19	0.12	0.08	0.12	0.20	0.11	0.39	0.23	0.20
T73	0.29	0.19	0.25	0.18	0.35	0.31	0.18	0.08	0.08	0.10	0.08	0.09	0.41	0.21	0.18
T74	0.42	0.20	0.29	0.41	0.35	0.41	0.23	0.13	0.15	0.15	0.04	0.09	0.44	0.26	0.23
T75	0.06	0.21	0.13	0.11	0.18	0.20	0.32	0.23	0.17	0.10	0.18	0.30	0.05	0.16	0.18
T76	0.22	0.17	0.10	0.07	0.17	0.09	0.26	0.24	0.21	0.08	0.13	0.26	0.07	0.14	0.17
T77	0.05	0.07	0.11	0.03	0.18	0.17	0.24	0.13	0.22	0.12	0.05	0.14	0.08	0.11	0.13
T78	0.25	0.25	0.07	0.16	0.12	0.24	0.14	0.26	0.26	0.05	0.09	0.19	0.03	0.15	0.16
T79	0.30	0.33	0.18	0.16	0.12	0.30	0.18	0.27	0.13	0.07	0.35	0.27	0.09	0.24	0.20

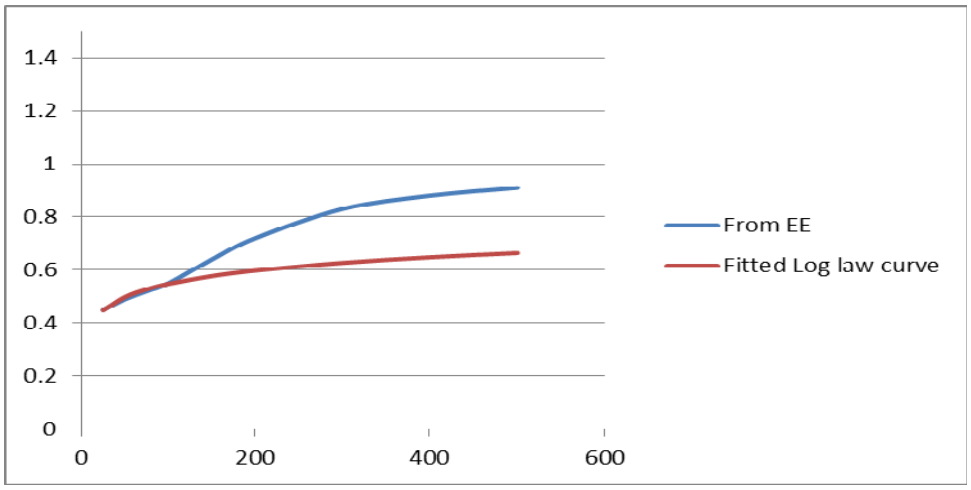
Appendix D:
Fitted Curve for Wind Profile Data



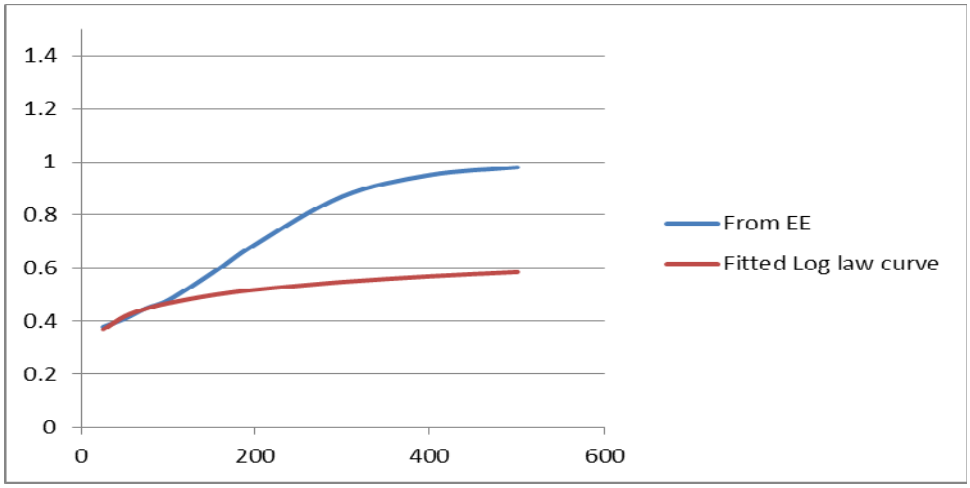
N Wind



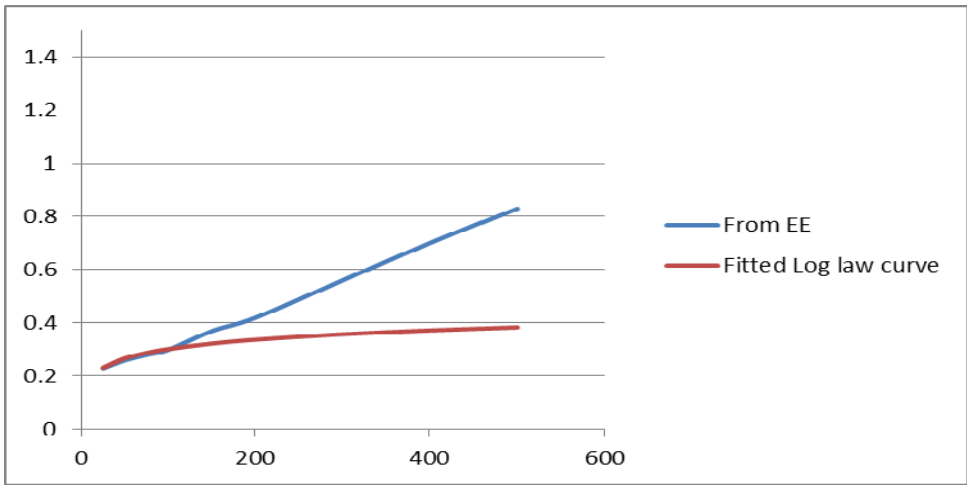
NNE Wind



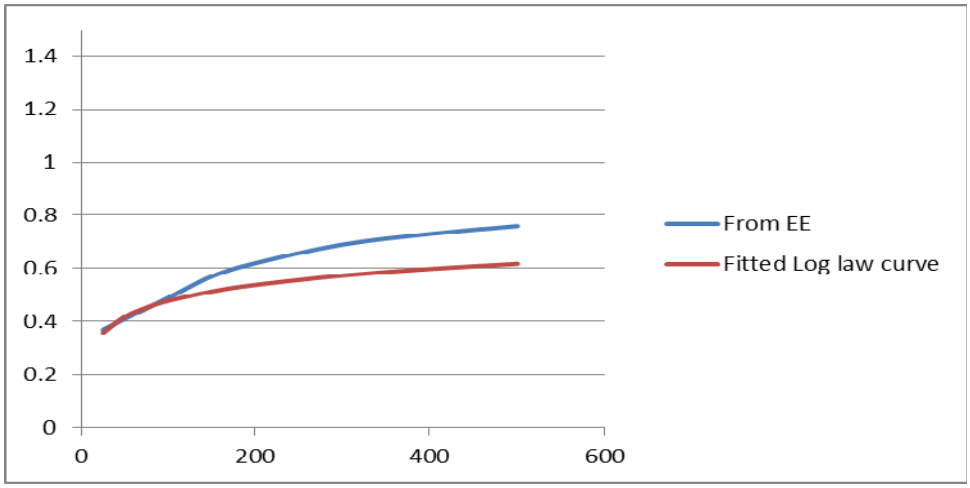
NE Wind



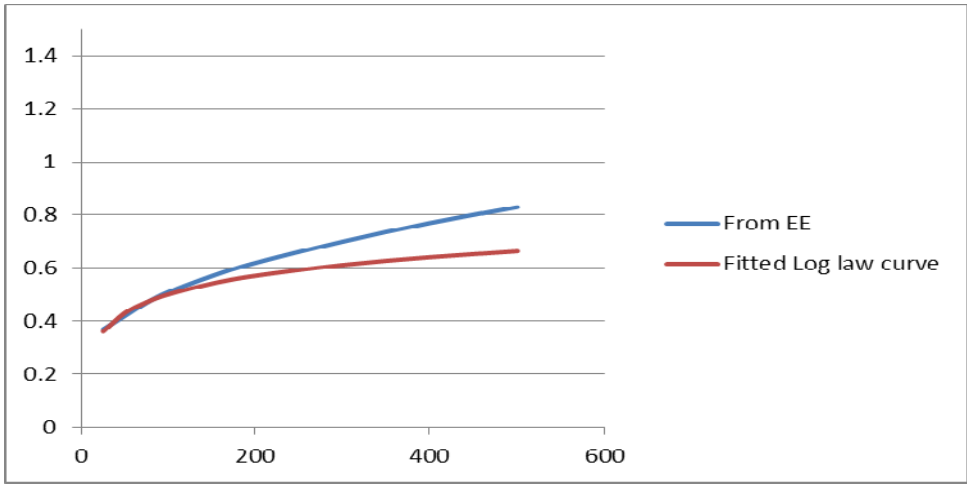
ENE Wind



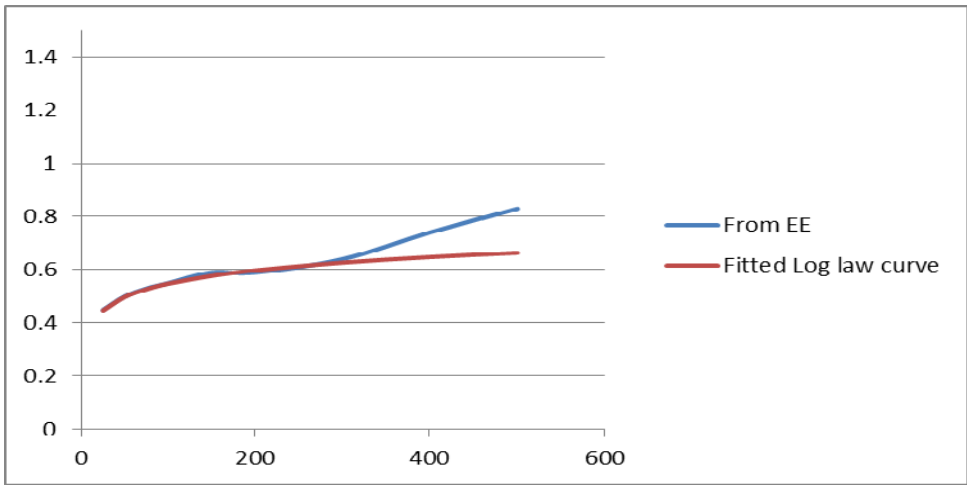
E Wind



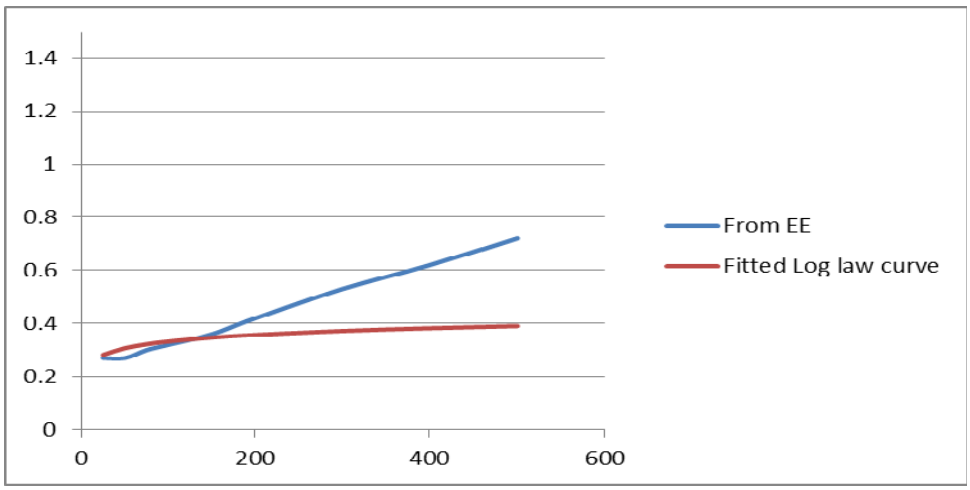
ESE Wind



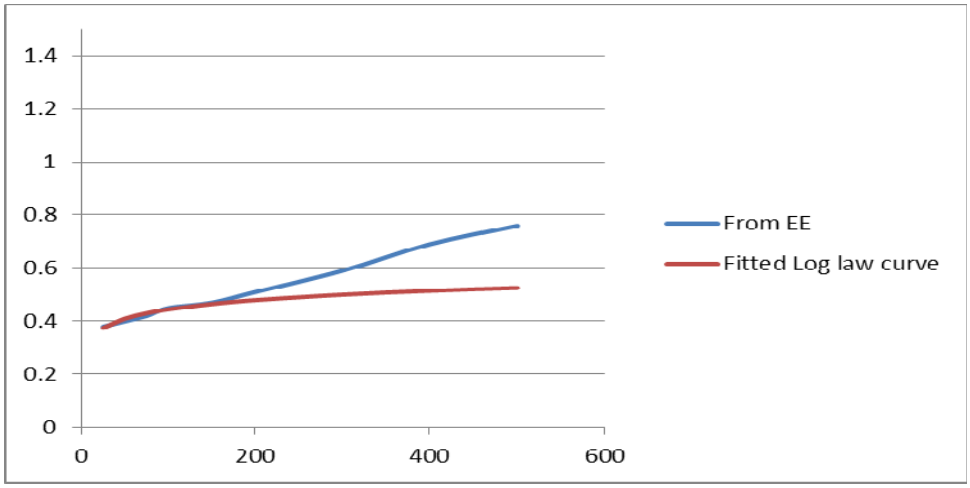
SSE Wind



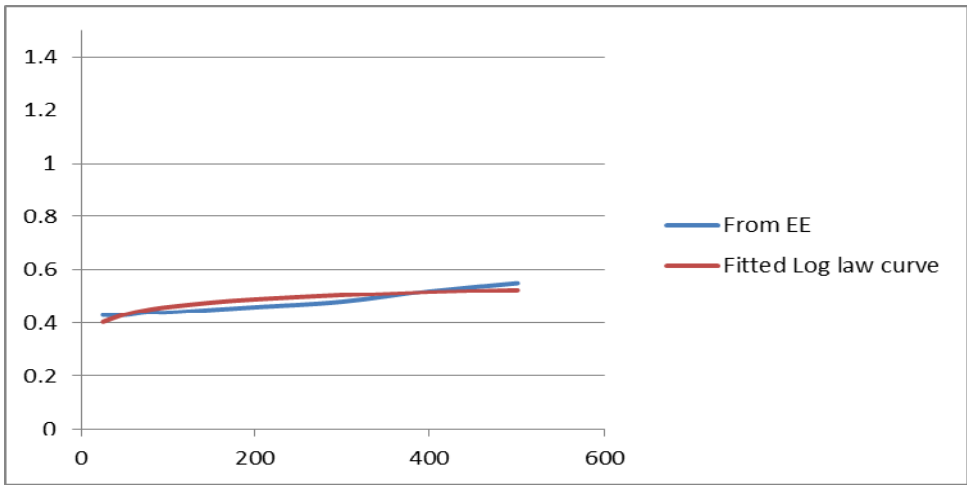
S Wind



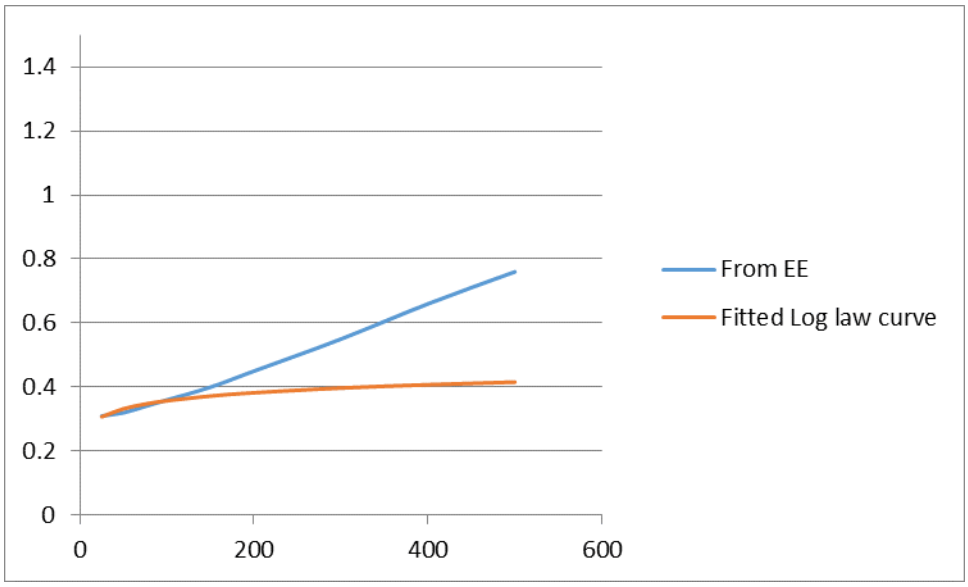
SSW Wind



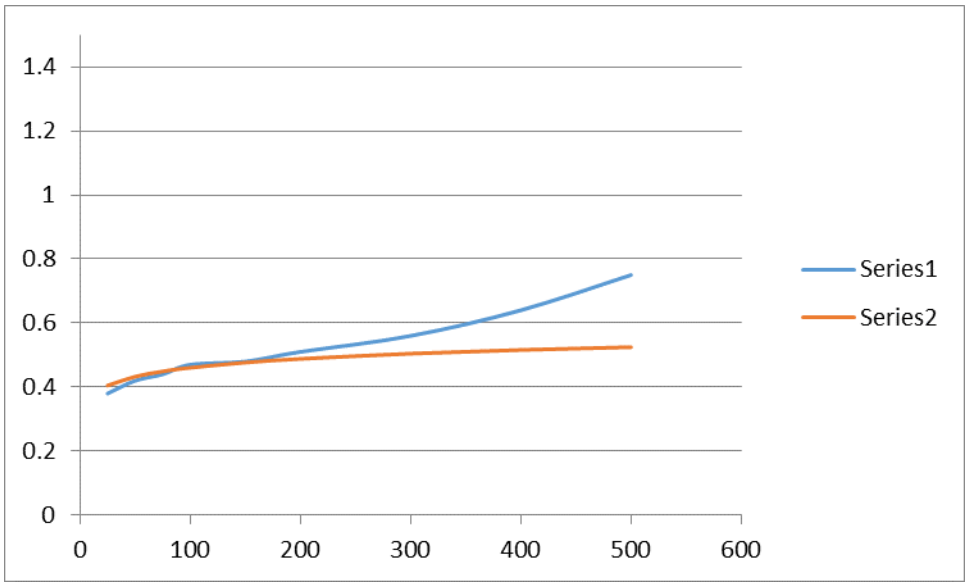
SW Wind



WSW Wind



W Wind



SE Wind

Appendix E:
Extract from Expert Evaluation and Advisory Report for Causeway Bay Area

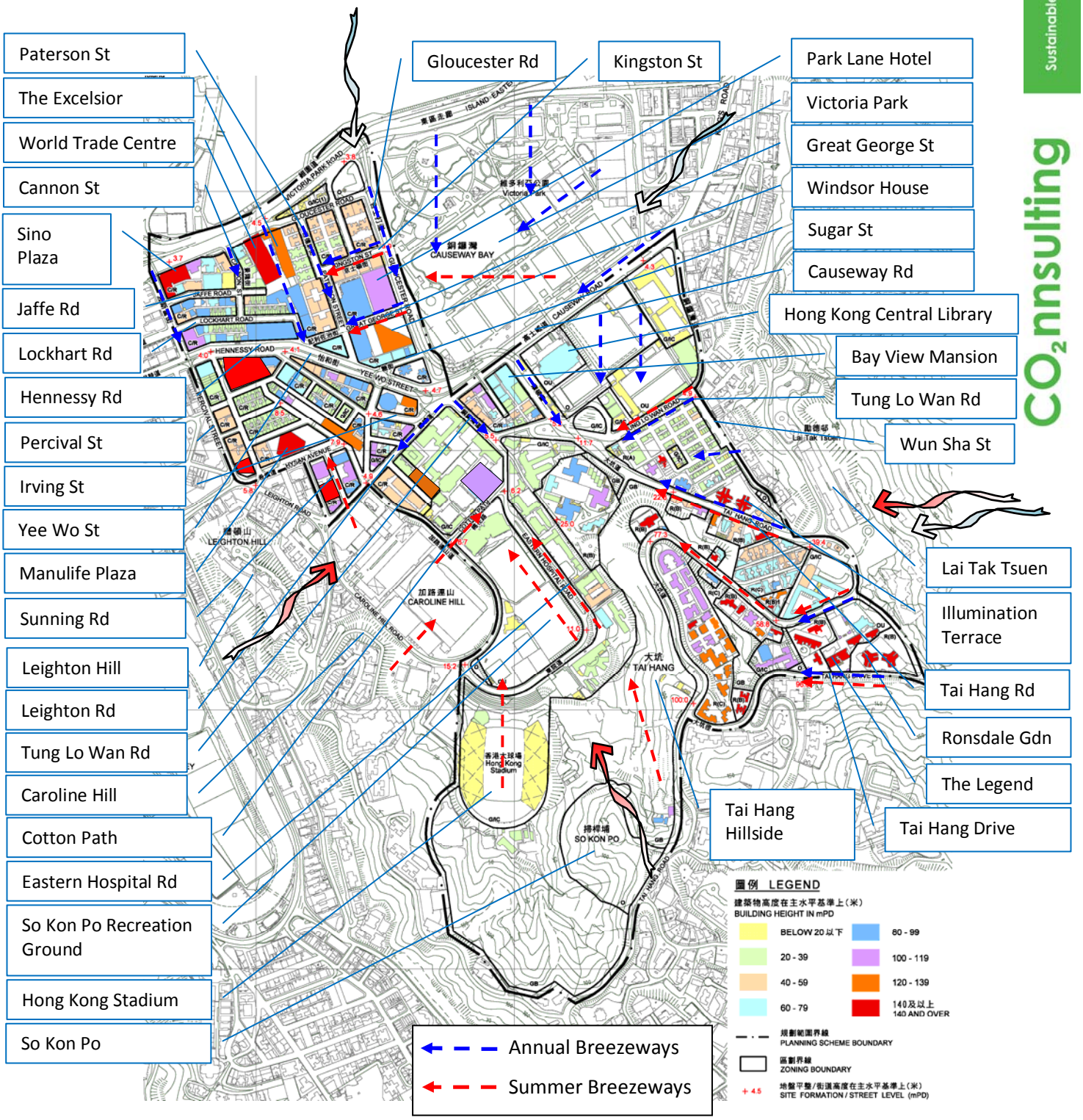


Figure 12 Existing Scenario showing Major Existing Breezeways

Reference: Expert Evaluation and Advisory Report for Causeway Bay Area (2010)

(6) The Northern Region

The proposed plan maintains the open space and G/IC developments which have a maximum building height of nine storeys. The air ventilation with the proposed plan in place will have no adverse impact on the northern area and those in the hinterland. See Figure 31.

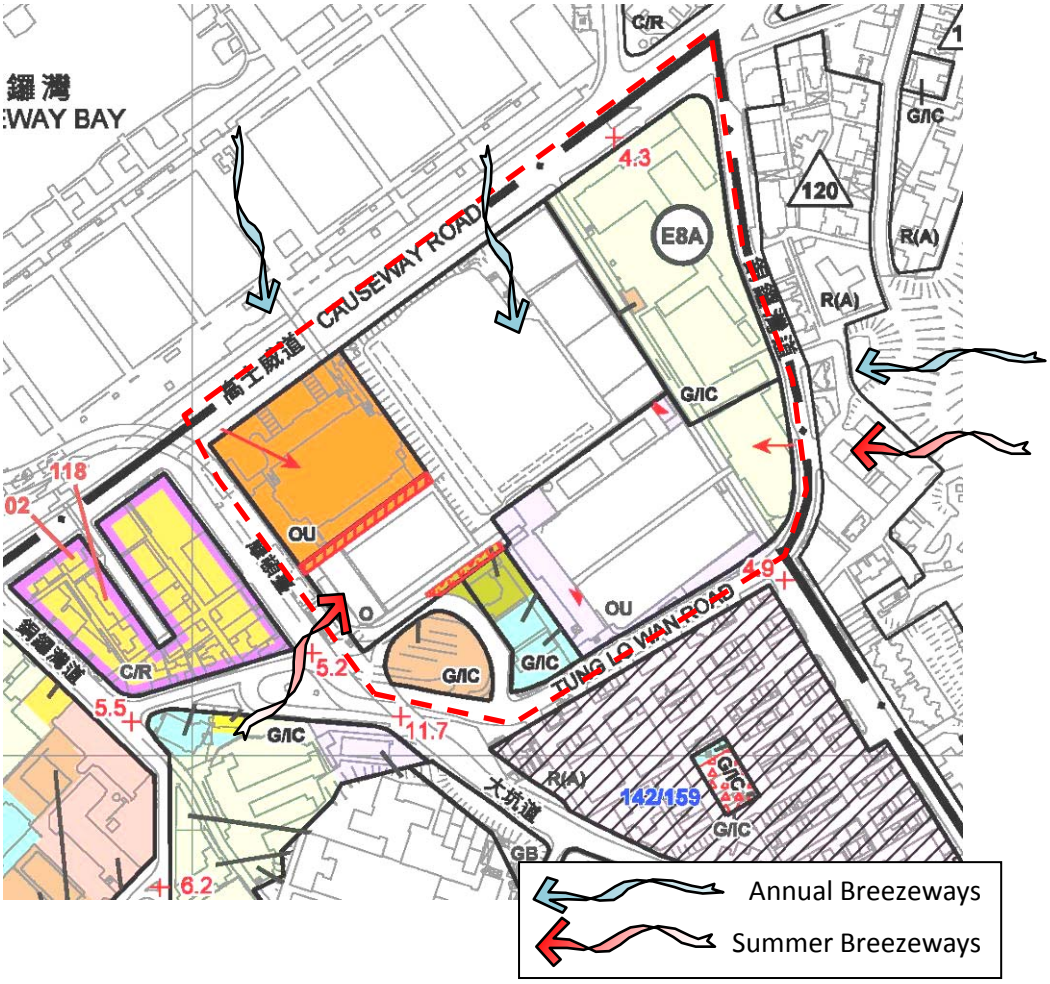


Figure 31 Wind Environment in the Northern Region

Reference: Expert Evaluation and Advisory Report for Causeway Bay Area (2010)