Nga Tsin Wai Road / Carpenter Road Development Scheme (KC-017)

Air Ventilation Assessment - Expert Evaluation

Issue | 30 June 2022

Job number --

Ove Arup & Partners Hong Kong Ltd
Level 5 Festival Walk
80 Tat Chee Avenue
Kowloon Tong
Kowloon
Hong Kong
www.arup.com

ARUP

Document Verification

ARUP

Job title		Nga Tsin Wai Road / Carpenter Road Development Scheme (KC-017)			**Job number** --
Document title		Air Ventilation Assessment - Expert Evaluation			**File reference**
Document ref					
Revision	**Date**	**Filename**			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
				Issue Document Verification with Document	✓

Contents

1 Introduction

Ove Arup & Partners Hong Kong Ltd (Arup) has been commissioned to conduct the Air Ventilation Assessment (AVA) – Expert Evaluation (EE) for the draft development scheme plan for the Nga Tsin Wai Road / Carpenter Road Development Scheme (KC-017), hereafter "the Scheme". This qualitative air ventilation assessment is carried out to support the draft development scheme plan (DSP) submission to the Town Planning Board under Section 25 of the Urban Renewal Authority Ordinance.

1.1 Site Information

Figure 1 shows the location of the Scheme. The Site is divided into three sites, the Main Site (i.e. Site C2 and A), Northern Site (Site B) and Eastern Site (Site C1). The Scheme are currently zoned as "Government, Institution or Community (G/IC)", "Residential (Group A) 2 (R(A)2)", "Open Space" and "Road" on the Approved Ma Tau Kok Outline Zoning Plan (OZP) No. S/K10/28[1] .

The Main Site and the Eastern Site of the Scheme are proposed to be rezoned as "R(A)", while the Northern Site of the Scheme proposed to be rezoned as "G/IC" in the draft DSP.

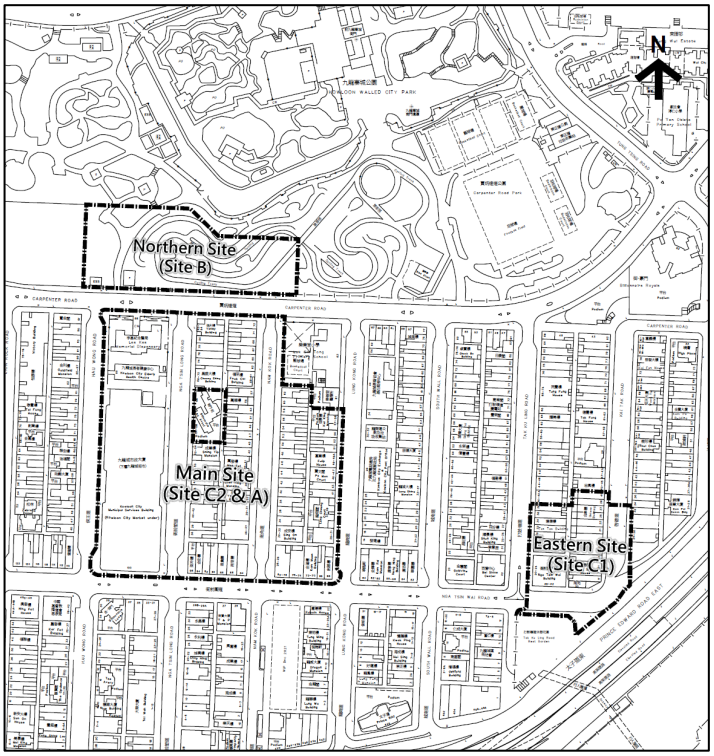


Figure 1 Site Plan

[1] https://www.legco.gov.hk/yr2022/english/brief/sk1028_20220325-e.pdf

1.2 Objective

The objective of the Study is to investigate the wind performance of the Proposed Development Scheme in the form of AVA – EE. The AVA-EE will be conducted in accordance with the "Technical Circular No. 1/06 – Air Ventilation Assessments" (*Technical Circular*) and its Annex A "Technical Guide for Air Ventilation Assessment for Developments in Hong Kong" (*Technical Guide*), which is jointly issued by Housing, Planning and Lands Bureau and Environmental, Transport and Works Bureau on 19th July 2006.

1.3 Study Tasks

The major task of this study is to carry out an expert evaluation on the characteristics of the site wind availability data of the Scheme area and assessment of the wind performance of the proposed development in a qualitative way. The expert evaluation will cover the following tasks:

- Identify the wind condition
- Evaluate wind performance of the Proposed Scheme
- Identify any problem areas and good design features that can mitigate problem areas.

2 Site Characteristics

Figure 1 presents the site boundary of the Scheme, Study Area and the surrounding environment. The Study Area broadly covers the Ngai Tsin Wai Road area in the Kowloon City District. The Scheme is predominantly a residential neighbourhood, which comprises of clusters of low-rise existing buildings with scattered high-rise redeveloped buildings. Table 1 summarizes the details of site characteristics including location, maximum building height, and corresponding index in Figure 2 and Figure 3.

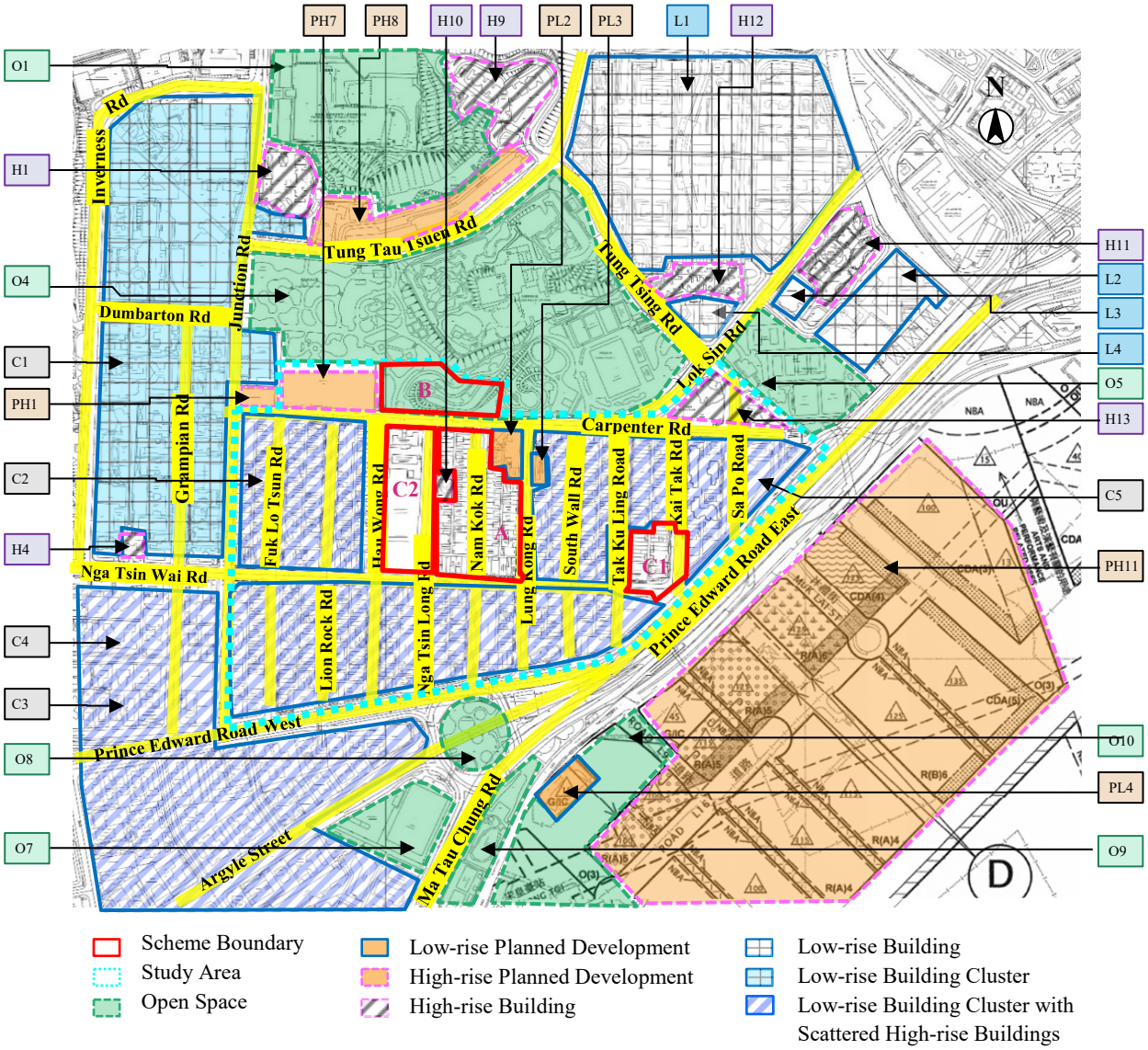


Figure 2 Overview of Study Area and Surrounding Area (Source: Lands Department)

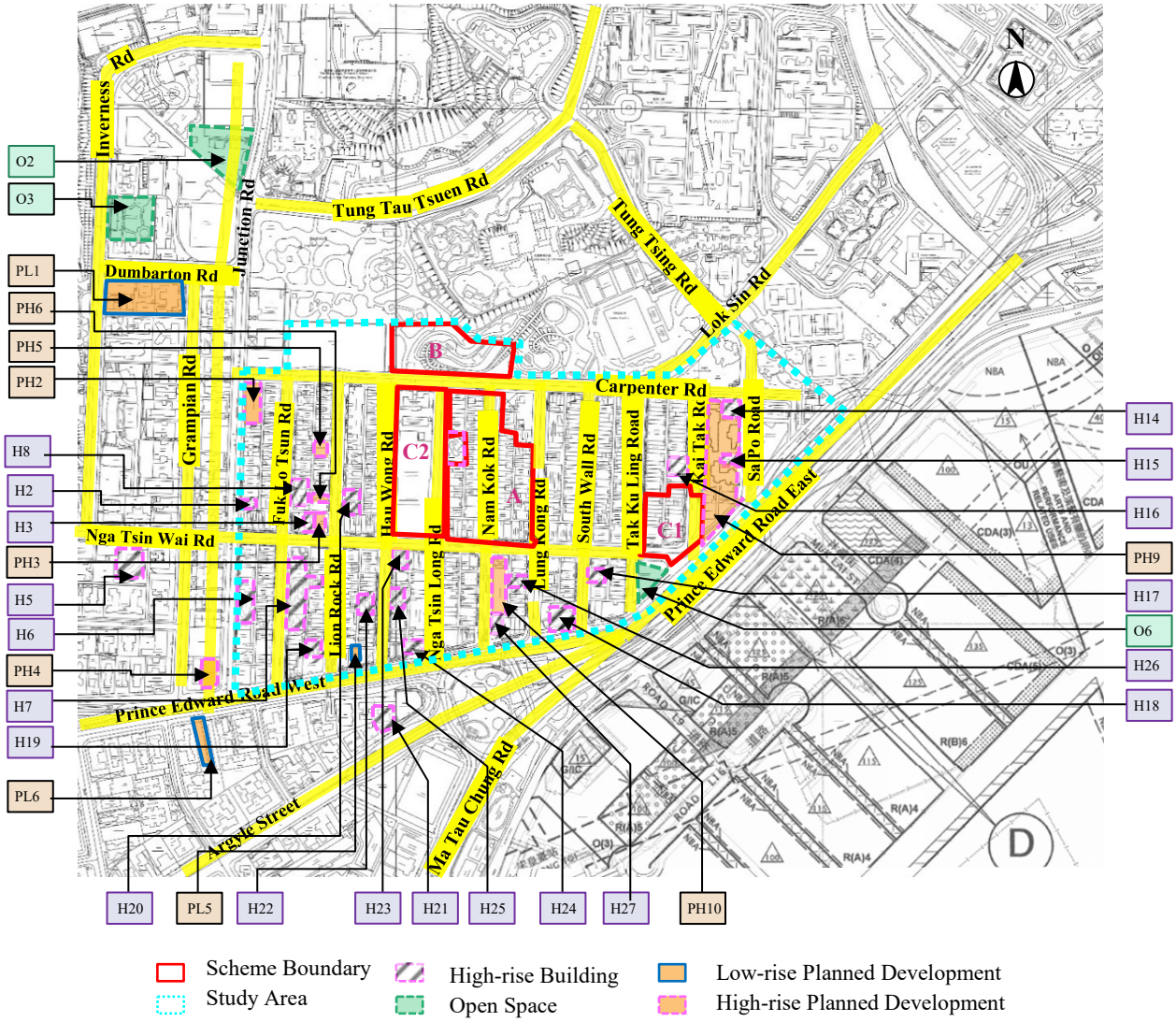


Figure 3 Scattered Open Space, Planned and High-Rise Building Details in Low-Rise Clusters (Source: Lands Department)

Table 1 Summary of Location of Surrounding Area of the Study Area.

	No.	Location	Maximum Building / Terrain Height (mPD)
Low-rise Building	L1	Tung Tau (I) Estate, Tung Tau (II) Estate	47
	L2	Lee Kau Yan Memorial School	31.2
	L3	Tung Tau Community Centre	26.1
	L4	Po Yan Oblate Primary School	26.1
High-rise Building	H1	Mei Yan House	138
	H4	Wellgan Villa	73.9
	H9	Mei Tak House	120
	H10	Billionnaire Avant	100.2
	H11	Tung Wui Estate	101-112
	H12	Wui Chi House (Tung Wui Estate)	99
	H13	Billionnaire Royale and Le Billionnaire	144.4-170
Planned Development	PL2	Proposed Lok Sin Tong Welfare Complex at 61 & 63 Lung Kong Road [2]	58.3
	PL3	40 Lung Kong Road [3]	44.21
	PL4	Planned Low-Rise GIC [4]	15
	PH1	NKIL 6561 [5]	100
	PH7	128 Carpenter Road [6]	100
	PH8	Redevelopment of Mei Tung Estate [7]	140
	PH11	Planned High-Rise Cluster [8] [9]	100-125
Open Space	O1	Pak Hok Shan	77
	O4	Carpenter Road Park and Kowloon Walled City Park	
	O5	Shek Ku Lung Road Playground	
	O7	Argyle Street Playground	
	O8	Olympic Garden	
	O9	Sung Wong Toi Playground	
	O10	Planned Open Space in Kai Tak Development	
C1		Low-Rise Building Cluster 1 (Low-rise building nature)	27.8-57.2
Open Space	O2	Stone Houses Family Garden	
	O3	Inverness Road Garden	

[2] https://www.info.gov.hk/tpb/en/papers/MPC/598-mpc_1-18.pdf
[3] https://www.info.gov.hk/tpb/tc/plan_application/Attachment/20201204/s12a_Y_K10_4_0_gist.pdf
[4] https://www1.ozp.tpb.gov.hk/plan/ozp_plan_notes/en/S_K22_7_e.pdf
[5] https://www1.ozp.tpb.gov.hk/plan/ozp_plan_notes/en/S_K10_27_e.pdf
[6] https://www.info.gov.hk/tpb/tc/plan_application/Attachment/20200515/s12a_Y_K10_3_0_gist.pdf
[7] https://www.info.gov.hk/tpb/en/whats_new/S_K8_22/R_S_K8_22_Attachments.pdf
[8] https://www1.ozp.tpb.gov.hk/plan/ozp_plan_notes/en/S_K22_7_e.pdf
[9] https://www.info.gov.hk/tpb//tc/plan_application/Attachment/20210223/s16_A_K22_30_0_gist.pdf

Planned Development	PL1	NKIL 1382 [10]	48
C2		Low-Rise Building Cluster 2 (Low-rise building nature with scattered high-rise buildings)	24.4-33.3
High-rise Buildings	H2	Luxe Metro	80.2
	H3	Kum On Hin	79.9
	H8	48 Fuk Lo Tsun Road (NKIL 3529 S.D.)	100.1
	H20	Zebrano and NKIL 5119	70.2-93.8
Planned Development	PL5	380 Prince Edward Road West, Kowloon [11]	50.1
	PH2	84-98 Junction Road [12]	100
	PH3	124-126 Nga Tsin Wai Road (NKIL 2725) [13]	80
	PH5	67-71 Lion Rock Road [14]	80
	PH6	NKIL 3778 [15]	80
C3		Low-Rise Building Cluster 3 (Low-rise building nature with scattered high-rise buildings)	27.5-45.6
High-rise Buildings	H5	The Bloomsville	115.6
	H21	Padek Palace	90.9
Planned Development	PL6	349 Prince Edward Road West, Kowloon [16]	39.1
	PH4	NKIL 1903 S.A. RP [17]	80
C4		Low-Rise Building Cluster 4 (Low-rise building nature with scattered high-rise buildings)	18.3-31.6
Open Space	O6	Tak Ku Ling Road Rest Garden	
High-rise Buildings	H6	Patina Wellness	99.9
	H7	Cambridge Heights, Genius Court, Oxford Heights and Cameron Mansion	67.5-106.4
	H17	10 South Wall Road (NKIL 5475 RP)	74.2
	H18	Prince Ritz	126.1
	H19	1 Lion Rock Road	73.8
	H22	The Opulence	89.1
	H23	Billionnaire Luxe	80.3
	H24	The Prince Place	87
	H25	The Avery	80.1
	H26	Urbana Lofts	93.8

[10] https://www2.ozp.tpb.gov.hk/gist/amend/en_tc/Y_K18_6_TC.pdf
[11] https://www2.ozp.tpb.gov.hk/gist/apply/en_tc/A_K10_249-1_TC.pdf
[12] Google Map / Site Visit
[13] https://www1.ozp.tpb.gov.hk/plan/ozp_plan_notes/en/S_K10_27_e.pdf
[14] https://www1.ozp.tpb.gov.hk/plan/ozp_plan_notes/en/S_K10_27_e.pdf
[15] https://www1.ozp.tpb.gov.hk/plan/ozp_plan_notes/en/S_K10_27_e.pdf
[16] https://www.info.gov.hk/tpb/tc/plan_application/Attachment/20190409/s16_A_K10_261_0_gist.pdf
[17] Google Map / Site Visit

	H27	420-422 Prince Edward Road East	80.2
Planned Development	PH10	4-24 Nam Kok Road [18]	100
C5		Low-Rise Building Cluster 5 (Low-rise building nature with scattered high-rise buildings)	14.8-38.1
High-rise Buildings	H14	High Place	*87.4*
	H15	Carlson Court	75.8
	H16	55 Kai Tak Road (NKIL 499 S.B. ss2)	91.7
Planned Development	PH9	KC-015 Kai Tak Road/ Sa Po Road [19]	120

To the north of Study Area, there are mainly large open spaces, including Carpenter Road Park and Kowloon Walled City Park (O4). At a further distance to the north direction, there is the Mei Tung Estate redevelopment (PH8) surrounded by high-rise residential buildings Mei Yan House (H1) and Mei Tak House (H9), and Pak Hok Shan (O1).

To the northeast, there are mainly low-rise buildings, including low-rise Tung Tau (I) Estate, Tung Tau (II) Estate (L1), Lee Kau Yan Memorial School (L2), Tung Tau Community Centre (L3), and Po Yan Oblate Primary School (L4), and high-rise building and open space situated within, such as Tung Wui Estate (H11 & H12) and Shek Ku Lung Road Playground (O5).

Kai Tak Development (PH11), an ongoing development comprising G/IC, CDA, OU, Commercial and Residential developments with building height ranging between 15mPD to 135mPD is situated to the east and southeast side of Study Area.

An extensive open space system is located at the south of Study Area, including Argyle Street Playground (O7), Olympic Garden (O8), Sung Wong Toi Playground (O9), and Planned Open Space in Kai Tak Development (O10) as well as a Planned Low-Rise GIC (PL4). To the southwest of the Study Area, high-density and Low-Rise Building Cluster 3 (C3) situated with few scattered high-rise buildings (H5, H21, and PH4) and planned low-rise 349 Prince Edward Road West, Kowloon (PL6). Meanwhile, a similar high-density and Low-Rise Building Cluster 4 (C4) with some high-rise buildings (H6, H7, H17-H19, H22-H26, and PH10) scattered within is located at the immediate south to the Scheme within Study Area.

A planned high-rise NKIL 6561 (PH1) is situated at the immediate northwest of Study Area. To the west and northwest, there is Low-Rise Building Cluster 1 (C1) with open spaces such as Stone Houses Family Garden (O2) and Inverness Road Garden (O3), and low-rise planned development at NKIL 1382 (PL1); as well as the high-rise Wellgan Villa (H4) in the area. Also, high-density and Low-Rise Building Cluster 2 (C2) with similar morphology as C4 is located at the west and northwest of the Study Area to the west of Site A, B and C2, which includes existing and proposed high-rise development, such as Luxe Metro (H2), Kum On Hin (H3),

[18] https://www1.ozp.tpb.gov.hk/plan/ozp_plan_notes/en/S_K10_27_e.pdf
[19] https://www1.ozp.tpb.gov.hk/plan/dev_plan_notes/tc/S_K10_URA1_2_c.pdf
https://www.info.gov.hk/tpb/en/papers/TPB/1202-tpb_10542.pdf

planned high-rise 84-98 Junction Road (PH2), 124-126 Nga Tsin Wai Road (NKIL 2725) (PH3), 67-71 Lion Rock Road (PH5), and NKIL 3778 (PH6).

The Low-Rise Building Cluster 5 (C5) indicates the area between Site A and Site C1, and the northeast of the Site C1, where scattered with high-rise residential buildings, including High Place (H14), Carlson Court (H15), and 55 Kai Tak Road (H16), planned high-rise buildings at KC-015 Kai Tak Road/ Sa Po Road (PH9). To the immediate northeast of Site A, there are planned low-rise Proposed Lok Sin Tong Welfare Complex at 61 & 63 Lung Kong Road (PL2) and 40 Lung Kong Road (PL3). Also, an existing high-rise Billionnaire Avant (H10) is located between Site A and C2 along Nga Tsin Long Road.

3 Site Wind Availability Data

To investigate the wind performance of the Scheme, the characteristic of the natural wind availability of the site is essential. Site wind availability data presented in the wind rose could be used to assess the wind characteristics in terms of the magnitude and frequency of approaching wind from different wind directions. According to the *AVA Technical Circular* [1] for Developments in Hong Kong, the site wind availability data will be referred to the simulated RAMS data from Planning Department.

Planning Department (PlanD) has set up a set of simulated meso-scale data of Regional Atmospheric Modelling System (RAMS) of the territory for AVA Study, which can be downloaded from Planning Department Website [1] . Among the wind data at three levels (200m, 300m and 500m), wind data at 200m would be suitable to represent the wind data with consideration of surrounding morphology. The location of the Scheme falls within the location grids (x: 083, y: 045), (x: 084, y: 045), (x: 083, y: 044) and (x: 084, y: 044) in the RAMS database [1], as indicated in Figure 4. The annual and summer wind roses at 200m are shown in Figure 5.

From these wind roses, the annual and summer prevailing wind directions are E/NNE/ENE and SW/E/SSW, respectively.

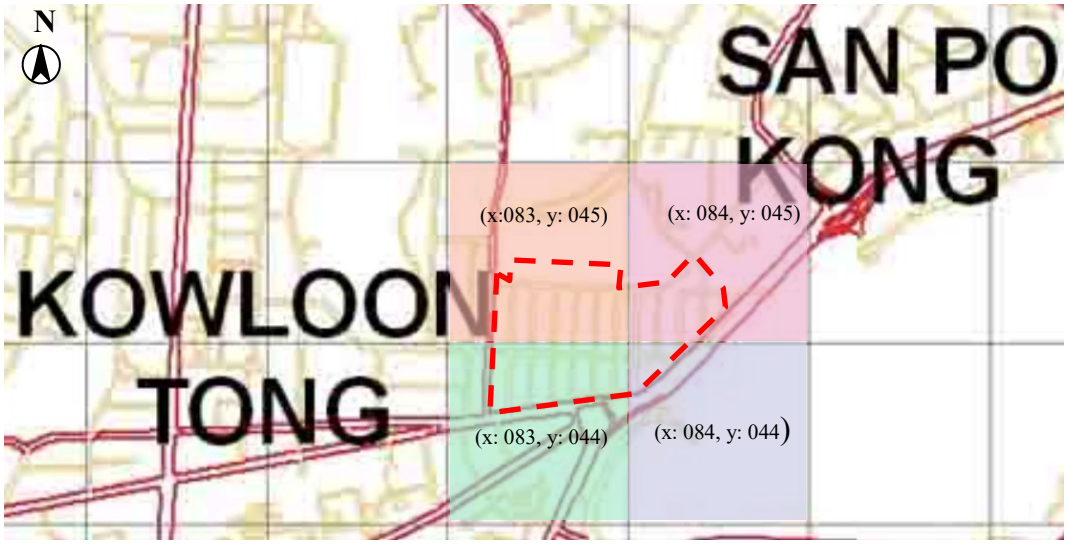


Figure 4 RAMS Grid and the Study Area Location

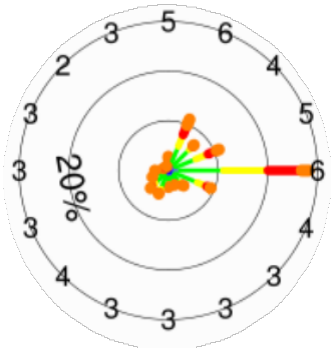
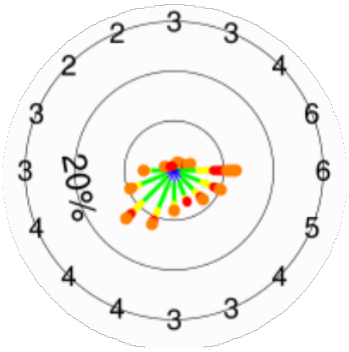
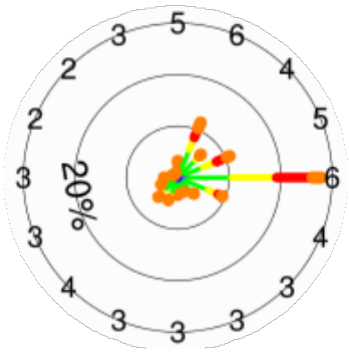
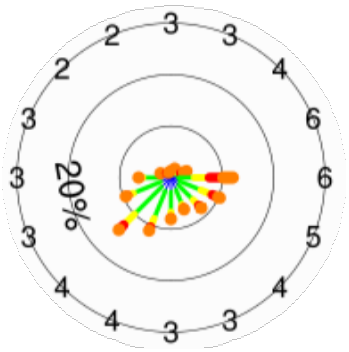
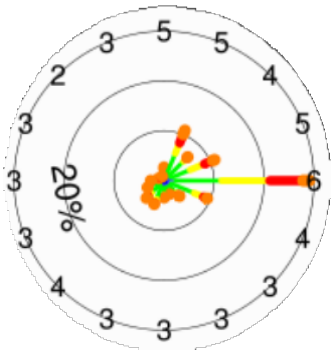
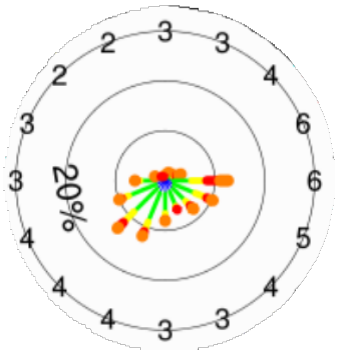
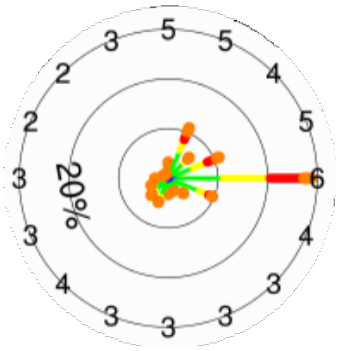
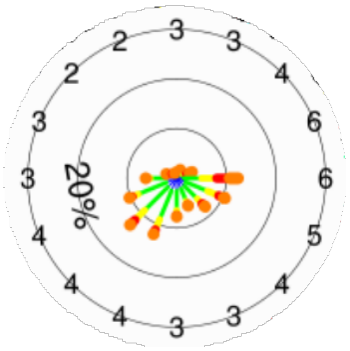
	Annual Wind Rose at 200m	Summer Wind Rose at 200m
Grid (x: 083, y: 045)		
Grid (x: 084, y: 045)		
Grid (x: 083, y: 044)		
Grid (x: 084, y: 044)		

Figure 5 Annual and Summer Wind Roses at 200m at Grids (x: 083, y: 045), (x: 084, y: 045), (x: 083, y: 044) and (x: 084, y: 044) [1]

4 Studied Scenarios

To evaluate the potential ventilation impact of the proposed changes of the Study Site, two schemes have been studied in this Air Ventilation Assessment – Expert Evaluation, namely, Baseline Scheme and Proposed Scheme.

4.1 Baseline Scheme

The Baseline Scenario is formulated based on the assumption that the land parcels within the identified scheme boundary are developed individually with all existing road and service lane remain (no road closure). The Baseline Scheme reflects possible redevelopment by market practitioners which are in various size of land parcels, and in compliance with the development restrictions as stipulated under the approved OZP and requirements under the Buildings Ordinance. The Baseline Scheme and the key development parameters of the Baseline Scheme are shown in Figure 6 and Table 2.

Apart from the planned development, all other buildings in the district are considered with existing condition.

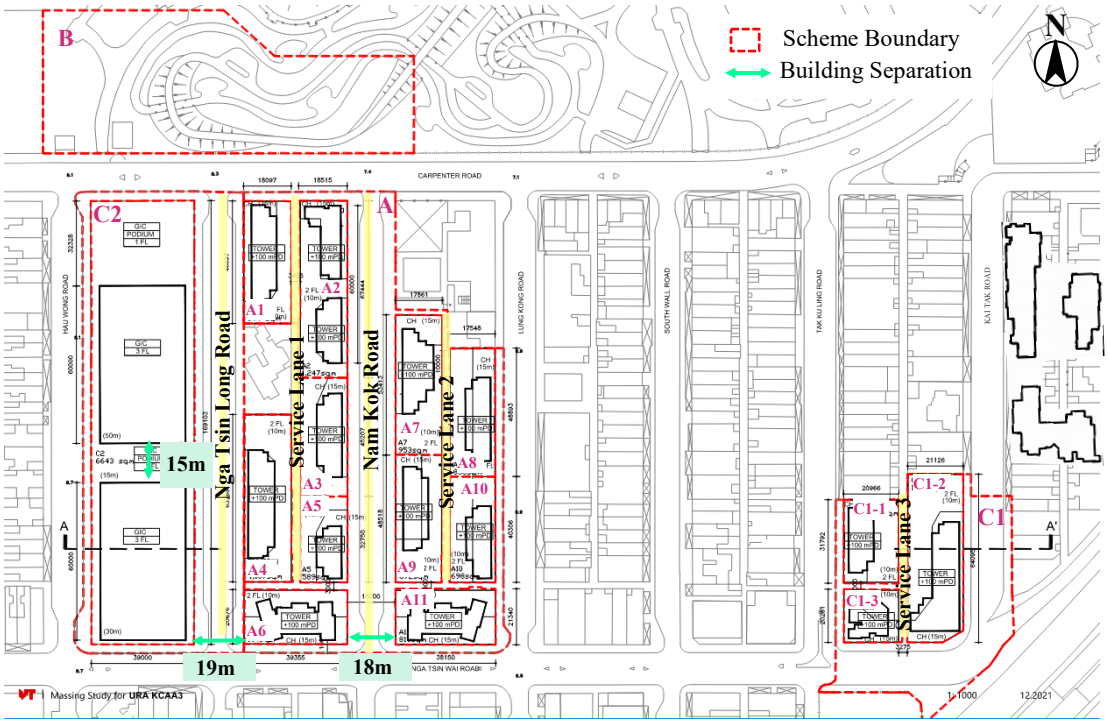


Figure 6 Layout Plan of Baseline Scheme

Table 2 Development Parameters of Baseline Scheme

Development Parameter	A	B	C1	C2
Net Site Area (sqm)	13,353	6,600	3,367	8,582
Plot Ratio	7.5 / 1.5 (or PR 7.5/ 0.9375 if it is a class A site)	/	7.5 / 1.5 (or PR 7.5/ 0.9375 if it is a class A site)	/
Maximum Building Height (mPD)	12 residential blocks of 100 mPD 11 two-storey podium and one-storey clubhouse	Existing Condition Open Space	3 residential blocks of 100 mPD 3 two-storey podium and one-storey clubhouse	2 GIC towers of 1 to 3 storeys (30-50 mPD) (in-situ redevelopment)

PR: Plot Ratio; GIC: Government, Institution and Community

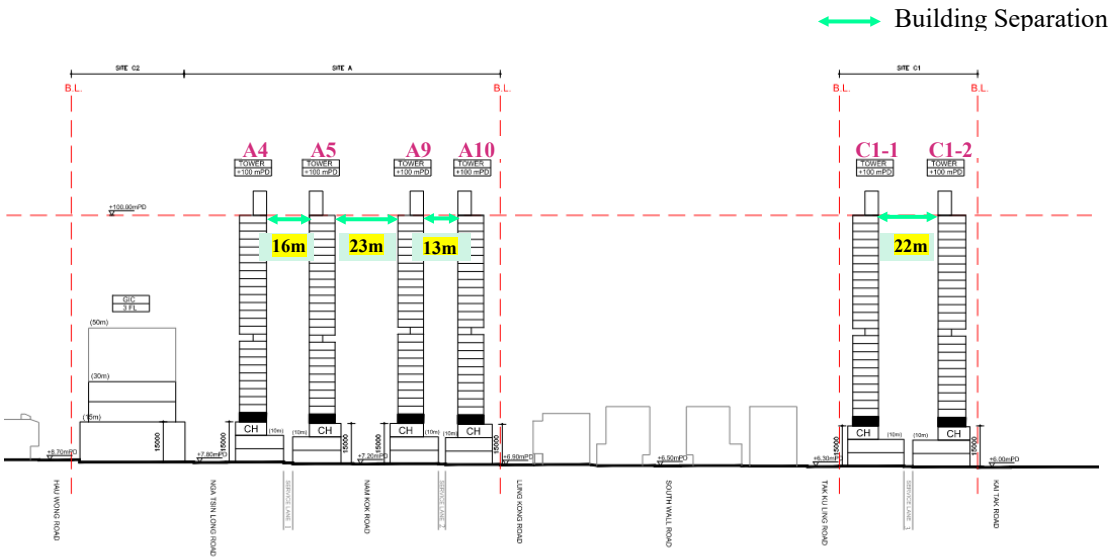


Figure 7 Section View of Baseline Scheme

4.2 Proposed Scheme

The Proposed Scheme and the key development parameters of the Proposed Scheme are shown in Table 3 and Figure 8. The Scheme has a net site area of about 25,302sq.m. for PR calculation in R(A) zone[20]. A new GIC complex of maximum 100mPD is proposed at the Northern Site (Site B). The Main Site (Site A and Site C2) are proposed for high-rise residential developments with a range of proposed building heights from 143mPD to 160mPD. The Eastern Site (Site C1) is proposed to develop a low-rise commercial complex of about 21mPD. The design is notional and subject to change at detailed design stage.

Nga Tsin Long Road and Nam Kok Road are proposed to be pedestrianized to enhance the walkability of the area. Diversion of Kai Tak Road/ Nga Tsin Wai Road is also proposed at the Eastern site (Site C1) to create a gateway square for public enjoyment.

Table 3 Development Parameters of Proposed Scheme

Development Parameter	**Main Site**	**Northern Site**	**Eastern Site**	**Main Site**
	A	**B**	**C1**	**C2**
Net Site Area (sq.m)	13,353	6,600	3,367	8,582
Gross Floor Area (sq.m) (Plot Ratio)	Dom: 106,824 (8.0) Non-Dom: 13,353 (1.0)	NA	Non-Dom: 2,000 (0.59)	Dom: 95,592 (11.1) Non-Dom: 9,949 (1.2)
Building Height (mPD)	Max. BHR: 160mPD Current Notional Design: 4 residential blocks ranging from +143mPD to +160mPD; Podia Design: 1 - 3 storeys of clubhouse/GIC/retail facilities.	Max. BHR: 100mPD Current Notional Design: +100mPD GIC Complex with stepped height profile	Max. BHR: 40mPD Current Notional Design: Commercial/retail low-rise block with about +21.1mPD	Max. BHR: 160mPD Current Notional Design: 3 residential blocks ranging from +143mPD to +160mPD; Podia Design: 1 - 3 storeys of clubhouse/GIC/retail facilities.

Dom: Domestic; Non-Dom: Non-Domestic; BHR: Building Height Restriction; GIC: Government, Institution and Community. Notional Design of Proposed Scheme for demonstration purpose and subject to change.

[20] The net site area has excluded the three new road sections in the Scheme (the two new private streets proposed at the Main Site (Site C2 &A) and the new diverted road at the Eastern Site (Site C1), and the surrounding pavement of the Scheme. Should there be later departmental comments for a smaller net site area, the technical assessments conducted based on the development potential from this net site area (i.e. 25,302sq.m.) would be considered as the worst-case scenario for the proposed development of the draft DSP.

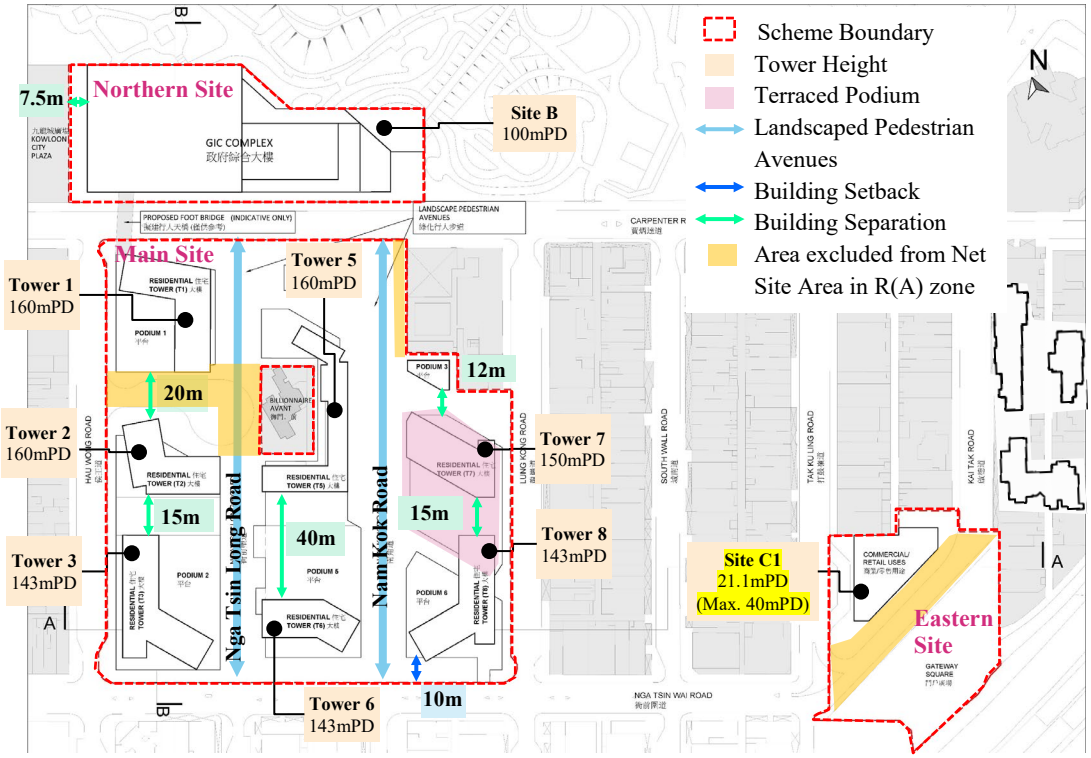


Figure 8 Notional Design of Proposed Scheme

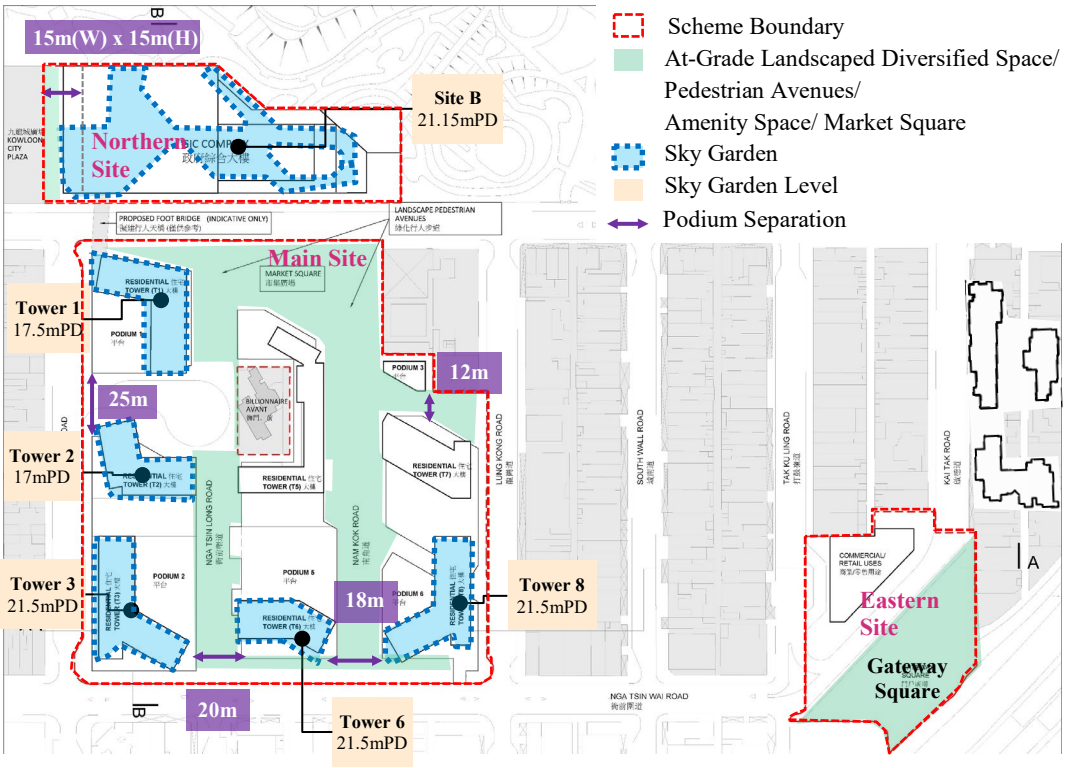


Figure 9 Landscaped Diversified Space of Proposed Scheme

Figure 10 Section A-A of Proposed Scheme

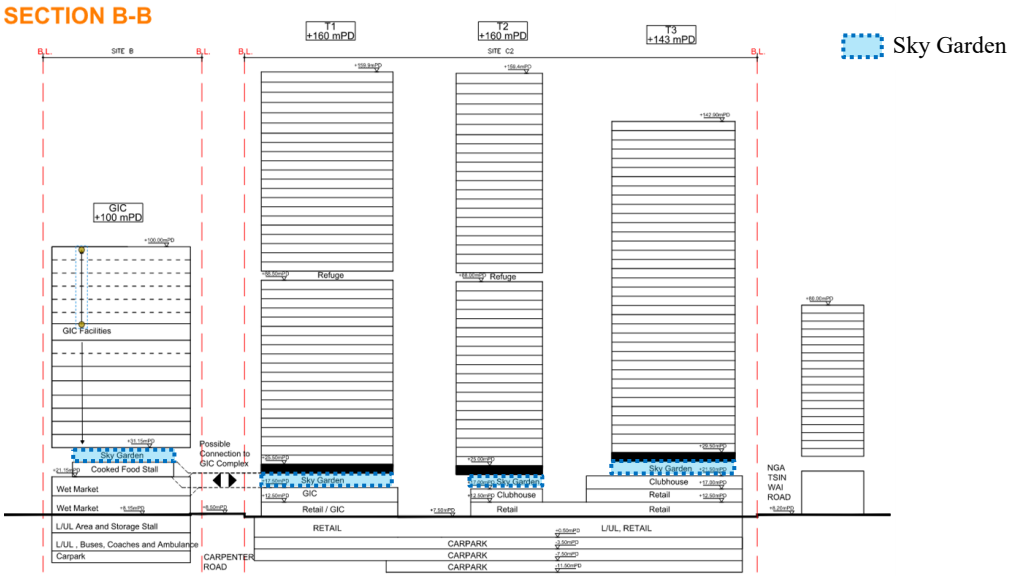


Figure 11 Section B-B of Proposed Scheme

Compared to Baseline Scheme, the following wind enhancement features have been adopted in the Proposed Scheme:

- Building Setback
- Building Separation
- Reduced Podium Coverage
- Provision of At-grade Landscaped Diversified Space (Landscaped Pedestrian Avenues, Market Square, Gateway Square, etc)
- Terraced Podium
- Stepped Building Height
- Sky Gardens, Landscaped terrace, Viewing Deck

5 Expert Evaluation of Directional Analysis

5.1 NNE Wind

NNE wind is one of the major prevailing wind directions under annual condition. With reference to AVA-Initial Study (AVA-IS) conducted for the planned high-rise buildings at KC-015 Kai Tak Road/ Sa Po Road, the NNE prevailing wind would penetrate through the low-rise developments including Tung Tau (I) Estate, Tung Tau (II) Estate, Lee Kau Yan Memorial School, Tung Tau Community Centre, and Po Yan Oblate Primary School before reaching the Study Area.

The existing high-rise buildings, such as Tung Wui Estate, Mei Yan House and Mei Tak House, as well as planned high-rise Mei Tung Estate redevelopment located at the upwind direction of the Study Area would partly shield the incoming NNE prevailing wind.

Nevertheless, the large open space Carpenter Road Park and Kowloon Walled City Park would act as a wind pocket to allow the wind coming from NNE to further distribute towards area to the south of Carpenter Road along north-south aligned roads. A majority of the incoming NNE wind would reach the Site A, B and C2 from Carpenter Road Park and Kowloon Walled City Park by travelling along the Hau Wong Road, Nga Tsin Long Road, and Nam Kok Road (**Magenta** arrows in Figure 12). However, the west portion of the Study Area would be shield by the planned 128 Carpenter Road. The wind availability in the west of the Study Area would be relatively limited.

The existing high-rise Billionnaire Royale and Le Billionnaire, 55 Kai Tak Road (NKIL 499 S.B. ss2) and planned high-rise buildings at KC-015 Kai Tak Road/ Sa Po Road would cast a wind shadow to Site C1 and block some incoming NNE wind from Tak Ku Ling Road and Kai Tak Road. Another stream of incoming wind would reach Site C1 from the scheme boundary through the planned split-level sunken plaza in the KC-015 Kai Tak Road/ Sa Po Road from Prince Edward Road East (**Blue** arrows in Figure 12).

As the building clusters within Study Area are generally aligned in the north-south direction, with the length and width being around 185m and 18 to 20m respectively, this will facilitate the NNE prevailing wind to penetrate towards the downwind directions.

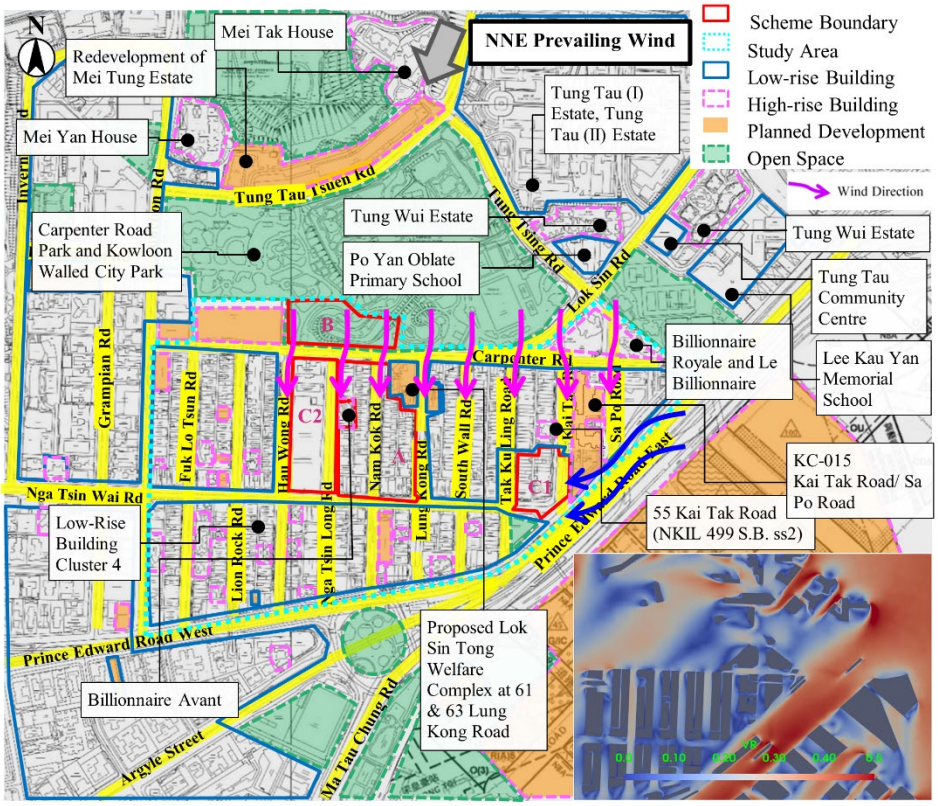


Figure 12 Wind Environment under NNE winds

5.1.1 Baseline Scheme (NNE Wind)

Since Site B would retain the existing open space condition under baseline scenario, the NNE prevailing wind would be able to reach a portion of Site A and C2 from the Carpenter Road Park and Kowloon Walled City Park (**Magenta** arrow in Figure 13). The NNE prevailing wind at high level would be able to skim over the Proposed Lok Sin Tong Welfare Complex at 61 & 63 Lung Kong Road to reach Site A, and then be downwashed by the high-rise buildings under Baseline Scenario to pedestrian level of Carpenter Road. Hence, the wind environment of Carpenter Road and Proposed Lok Sin Tong Welfare Complex at 61 & 63 Lung Kong Road would be enhanced (**Magenta** circle in Figure 13).

On the other hand, the first tier of buildings in Site A would cast a wind shadow to the leeward side, such as Billionnaire Avant in between Site A and Site C2. However, the wind captured by the first tier of buildings along Carpenter Road would be able to penetrate through the streets running in the north-south direction, i.e. Nga Tsin Long Road and Nam Kok Road (**Black** arrows in Figure 13). Localized enhancement would be expected at the north portion of Study Area.

The compact integrated podium structure in baseline scenario would impede the downwashed incoming NNE winds at low level. For the high-level NNE wind penetrated through the north-south aligned building separations within Site A, the two towers along Nga Tsin Wai Road (i.e. Site A6 and A11) would capture and downwash the incoming wind to low level, which would slightly enhance the wind environment onsite (**Green** circles in Figure 13).

Apart from the low-rise GIC portion in Site C2 would enable the NNE prevailing wind from Carpenter Road Park and Kowloon Walled City Park to skim over (**Brown** arrow in Figure 13), wind shadow would be induced by the high-rise buildings in Site A and reduce the wind availability at the south portion of Study Area, such as Low-Rise Building Cluster 4 to the south of Nga Tsin Wai Road.

A portion of incoming wind would reach to Site C1 skimming over the planned split-level sunken plaza at southern portion of the KC-015 Kai Tak Road/ Sa Po Road and Prince Edward Road East. The high-rise buildings in Site C1 would shield the incoming wind from reaching the leeward side along Nga Tsin Wai Road (**Blue** arrow and **Light Blue** circle highlighted in Figure 13). As the wind environment at Site C1 and its leeward side is dominant by wind shadow casted by the existing high-rise Billionnaire Royale and Le Billionnaire, 55 Kai Tak Road (NKIL 499 S.B. ss2) and KC-015 Kai Tak Road/ Sa Po Road to the north. Generally, relatively calm wind environment is expected.

5.1.2 Proposed Scheme (NNE Wind)

Similar to Baseline Scenario, the high-rise developments at the main site (Site A and C2) would be able to downwash the incoming high-level wind towards pedestrian level while wind shadow would be casted to the south of Nga Tsin Wai Road. Although the building height has been increased as compared with Baseline Case, the permeability under Proposed Scheme, such as provision of at grade amenity space, reduced podium coverage and building separation, has enhanced to allow air movement within the Study Area.

The stepping building height profile between Tower 7 at Site A and the planned redevelopment, Proposed Lok Sin Tong Welfare Complex at 61 & 63 Lung Kong Road, together with the 10m building setback provided between the two sites, would facilitate the incoming wind to be downwashed and further distributed at pedestrian level along Lung Kong Road and Nam Kok Road (**Green** circle and arrows in Figure 14).

The new GIC complex in Site B located at the north side of Carpenter Road would inevitably shield some of the incoming wind from Carpenter Road Park and Kowloon Walled City Park (**Magenta** arrow in Figure 14). However, the cascading profile of the GIC Complex allows a lower building height at its eastern part for more wind penetration towards the main site.

The stepping design of the new GIC building block including open-air viewing deck, sky garden, and landscaped terrace provided at the lower portion of the new GIC complex in Site B would increase the wind permeability to leeward sites by allowing some of the prevailing wind to skim over and reach to the downstream Sites A and C2 (**Purple** arrows in Figure 14).

In addition, the 15m(W) x 15m(H) podium separation from the planned 128 Carpenter Road (future Kowloon City Plaza) at the west of the new GIC complex in Site B improves the air permeability at low level. It would allow incoming NNE wind to penetrate through and reach the adjoining Carpenter Road. (**Red** arrow in Figure 14).

Besides, the stepping building height difference between high-rise residential towers in sites A & C2 and the new GIC complex in site B would enable high-level wind to skim over and facilitate a downwash effect at Carpenter Road. The building setback of Tower 5 would also allow the incoming NNE wind to be downwashed at the location further into the Study Area and improve the wind environment locally at Market Square and its leeward side along the 18m- to 20m-width pedestrian avenues (**Magenta** circles in Figure 14).

Under Proposed Scheme, Sites A and C2 incorporate reduced podium coverage designs to allow more amenity space at grade. The landscape pedestrian avenue and the at-grade landscaped diversified space provided at Nga Tsin Long Road would act as a wind entrance for more NNE wind, together with on-site air paths retained, to travel further into the hinterland of the Study Area, such as Low-Rise Building Cluster 4, along Hau Wong Road and Nga Tsin Long Road. (**Brown** arrows in Figure 14).

Site C1 would be approached by the incoming wind from planned split-level sunken plaza at KC-015 Kai Tak Road/ Sa Po Road and along the Prince Edward Road East. Comparing to the Baseline Scheme, the low-rise commercial podium in Site C1 with maximum building height of 40mPD would allow mid and high-level wind to flow atop it directly reaching the downstream portion of Low-Rise Building Cluster 4 and Low-Rise Building Cluster 5 (**Black** arrow in Figure 14). Apart from that, the building setback of commercial podium would also allow incoming wind to reach the downstream area along Nga Tsin Wai Road (**Blue** arrows in Figure 14).

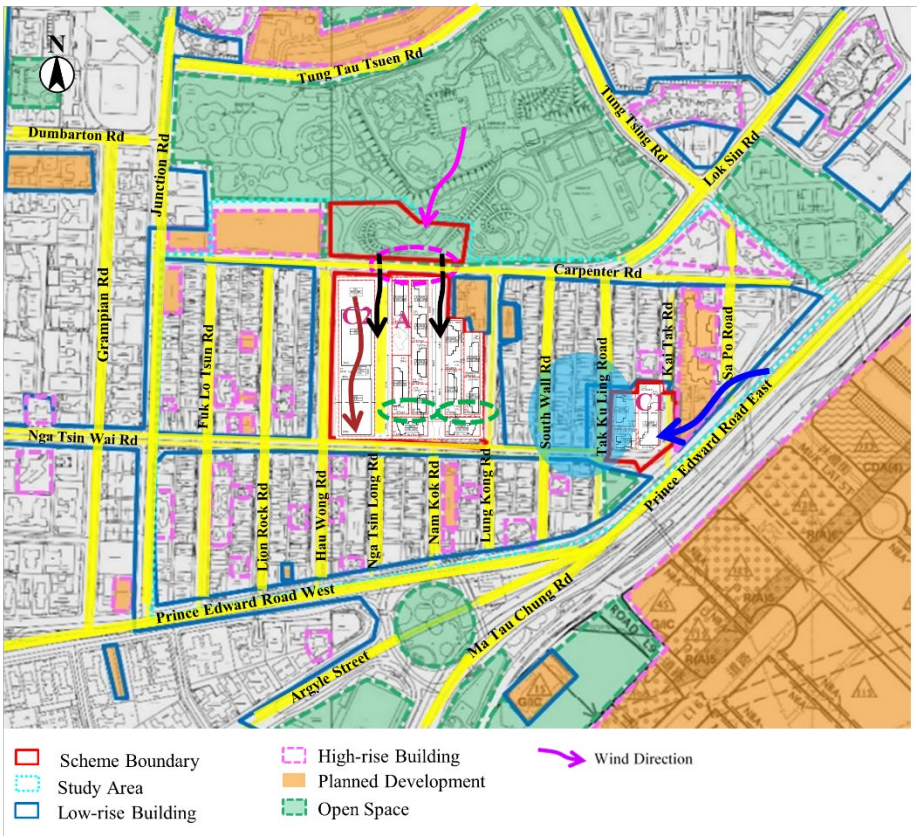


Figure 13 Wind Environment of Baseline Scheme under NNE winds

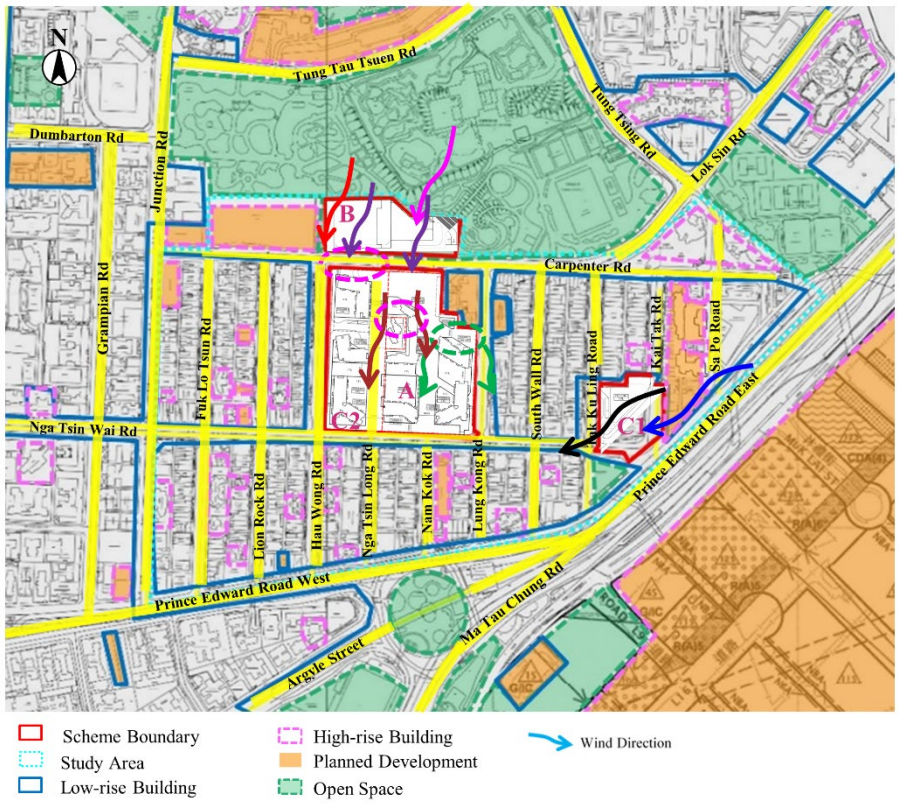


Figure 14 Wind Environment of Proposed Scheme under NNE winds

5.2 ENE/E Winds

ENE wind is one of the major annual prevailing wind directions and E wind is one of the major prevailing winds under both annual and summer conditions.

As indicated in AVA-Initial Study (AVA-IS) conducted for KC-015 Kai Tak Road/ Sa Po Road, the Site A, C1 and C2 are located downwind of the predominant annual and summer winds come from E / ENE directions, which shielded by the planned high-rise buildings at KC-015 Kai Tak Road/ Sa Po Road, existing high-rise residential buildings High Place and Carlson Court, and Low-Rise Building Cluster 5 in the east of Study Area. In addition, owing to the lack of building gaps or open spaces in east-west direction, the hinterland of Study Area would be relatively calm.

As for Site B, it is relatively open in the east. which is surrounded by large open space. The connection of open spaces, including Carpenter Road Park and Kowloon Walled City Park and Shek Ku Lung Road Playground, and local air paths, i.e. Lok Sin Road and Carpenter Road, allows incoming ENE/E wind to flow around the high rise Billionnaire Royale and Le Billionnaire and reach the new G/IC complex in Site B (**Red** arrows in Figure 15).

The existing low-rise Regal Oriental Hotel at the eastern edge of Study Area would shield a portion of the incoming wind at low and mid-level. But the incoming wind at high level would still be able to flow atop of the existing Regal Oriental Hotel and reach the planned KC-015 Kai Tak Road/ Sa Po Road. The planned KC-015 Kai Tak Road/ Sa Po Road is designed with a building separation of approximately 11m-wide at the middle of the project site and planned split-level sunken plaza would be provided at the southern portion of the site, which facilitate wind penetration into Study Area (**Blue** arrows in Figure 15).

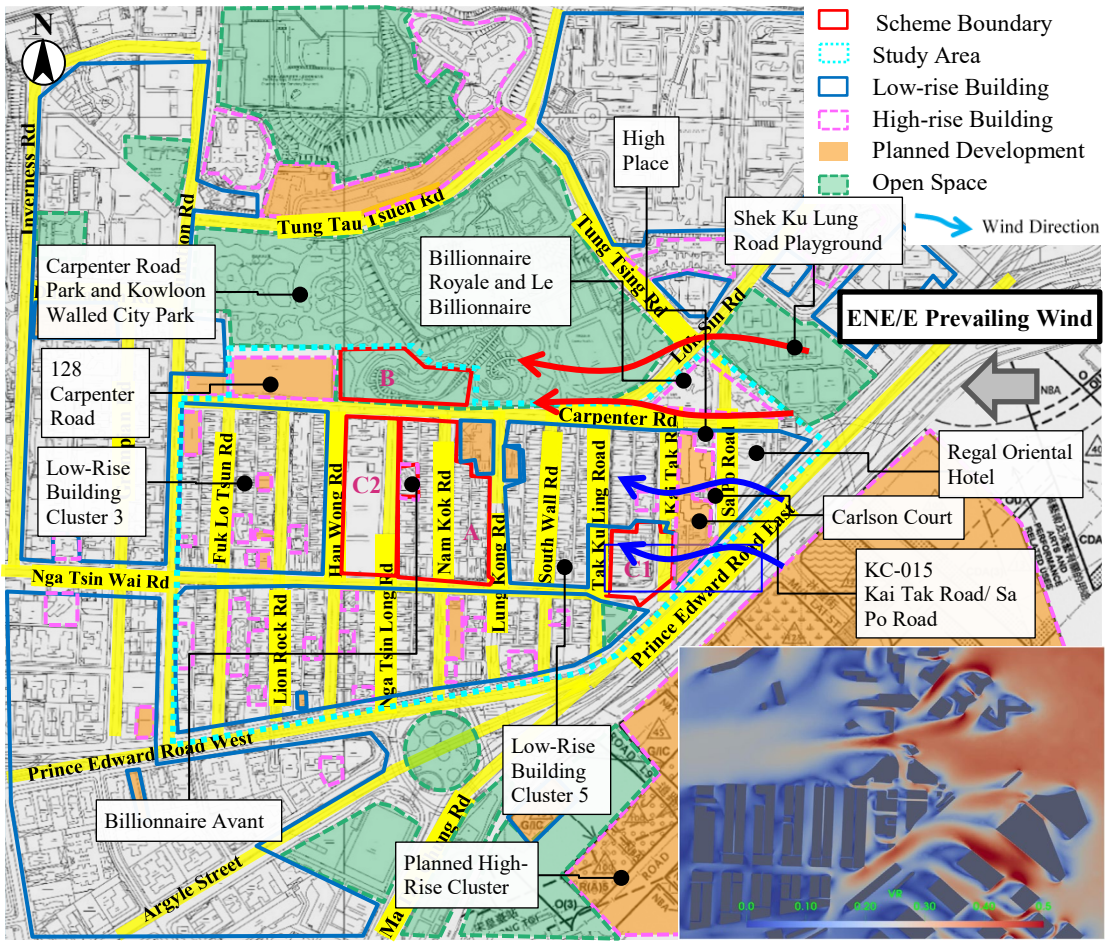


Figure 15 Wind Environment under ENE/E winds

5.2.1 Baseline Scheme (ENE/E Wind)

The prevailing ENE/E wind would reach Site C1 by passing through the planned split-level sunken plaza provided at the southern portion of the planned KC-015 Kai Tak Road/ Sa Po Road and Prince Edward Road West (**Blue** arrow in Figure 16). The OZP compliance high-rise building in Site C1 would shield the leeward developments in the Study Area. Downwash effects would then be induced by the large eastern façade of the high-rise building in Site C1 to divert wind to pedestrian level at Prince Edward Road West and the open space in southern part of the planned KC-015 Kai Tak Road/ Sa Po Road (**Blue** circle in Figure 16).

The wind environment in the leeward portion of Site C1 and the planned KC-015 Kai Tak Road/ Sa Po Road would be calmer due the wind shadow casted. The wind would recover slightly over the Low-Rise Building Cluster 5 between Tak Ku Ling Road and Lung Kong Road before reaching the high-rise development at Sites A and C2. Together with the wind penetrated through the building separation of the planned KC-015 Kai Tak Road/ Sa Po Road (**Green** arrow in Figure 16), the incoming wind would be downwashed to pedestrian level of Lung Kong Road to enhance the wind environment locally (**Magenta** circle in Figure 16).

However, the large podium coverage of Site A would hinder the wind penetration of the downwashed wind to travel through Site A. The wind environment of Site

C2 where is located at downstream of Site A is adversely affected. Meanwhile, the high-rise residential towers with similar building height and non-aligned building separations in East-West direction in Site A would cast a wind shadow over the leeward of Site A, including Site C2, Billionnaire Avant, and Low-Rise Building Cluster 3 with scattered high-rise buildings.

Since Site B would remain the existing condition in open space under the baseline scenario, the prevailing wind would skim over and be downwashed and diverted by the planned 128 Carpenter Road reaching Carpenter Road Park and Kowloon Walled City Park (**Red** arrows and **Black** circle in Figure 16).

5.2.2 Proposed Scheme (ENE/E Wind)

Similar to Baseline Scheme, the ENE/E wind would reach Site C1 through planned split-level sunken plaza provided by the planned KC-015 Kai Tak Road/ Sa Po Road and Prince Edward Road West. With the proposed low-rise commercial provided in Site C1 (**Blue** arrow in Figure 17) with maximum building height of 40mPD and building separation in the planned KC-015 Kai Tak Road/ Sa Po Road (**Green** arrow in Figure 17), wind entrance would be much enhanced to allow more mid and high level wind to skim over the Low-Rise Building Cluster 5 and reach Site A directly. The road diversion and the gateway square provided in Site C1, together with the Tak Ku Ling Road Rest Garden at the junction of Kai Tak Road and Nga Tsin Wai Road and the split-level sunken plaza provided by the planned KC-015 (i.e. enlarged scalable gateway), would create a widened wind entrance to facilitate the entry of annual ENE/ E winds into the Study Area (**Brown** arrows in Figure 17).

Downwash effect would be induced at Lung Kong Road towards pedestrian level due to the height difference between existing buildings and Tower 7 & 8 of the Proposed Scheme (**Black** circle in Figure 17). The building separation between Tower 7 & 8 would also allow the incoming wind to penetrate through to leeward area.

Apart from the stepping building height profile between the Proposed Scheme and the existing building, the step height profile among Site A, +160mPD for Tower 5 at west and +150mPD at east, also creates height variation to promote air movement. More incoming winds would be captured and downwashed at high level to ventilate the podium and pedestrian level (**Magenta** circle in Figure 17).

The east-west aligned 10-m building setbacks along Nga Tsin Wai Road and building separations from the Scheme boundary at Site A would enhance wind permeability. This would facilitate the incoming ENE/E winds to penetrate through Sites A and C2, and ventilate the district, Low-Rise Building Cluster 2, at the leeward side (**Black** arrows in Figure 17). Also, the sky garden, podium separation, and at-grade landscaped diversified space provided in Sites A and C2 also would promote air movements by enhancing wind permeability of the developments.

The new GIC complex in Site B would shield some wind at the eastern façade of the planned 128 Carpenter Road. However, a downwash effect would be induced by the complex to direct airflow to the pedestrian level by creating a stepping building height profile with the adjacent Carpenter Road and Carpenter Road Park

and Kowloon Walled City Park. This would help to capture the annual prevailing winds coming from the ENE/E direction to the pedestrian level (**Red** arrows and **Red** circle in Figure 17).

To the leeward of the GIC complex in site B, the sky garden design at 3/F would alleviate the shielding effect imposed by allowing the prevailing wind to ventilate the at low level. Also, owing to the building setback and the lower building height of the GIC complex compared to the planned 128 Carpenter Road, high-level prevailing winds would be captured and travel along Carpenter Road to ventilate the downwind surroundings.

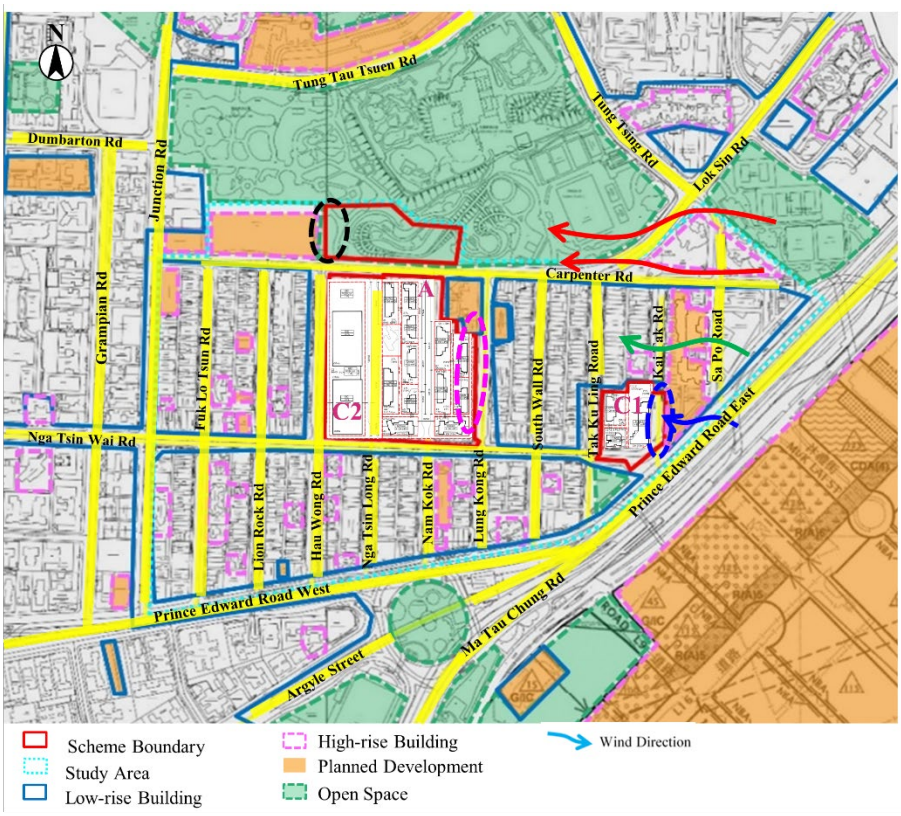


Figure 16 Wind Environment of Baseline Scheme under ENE/ E winds

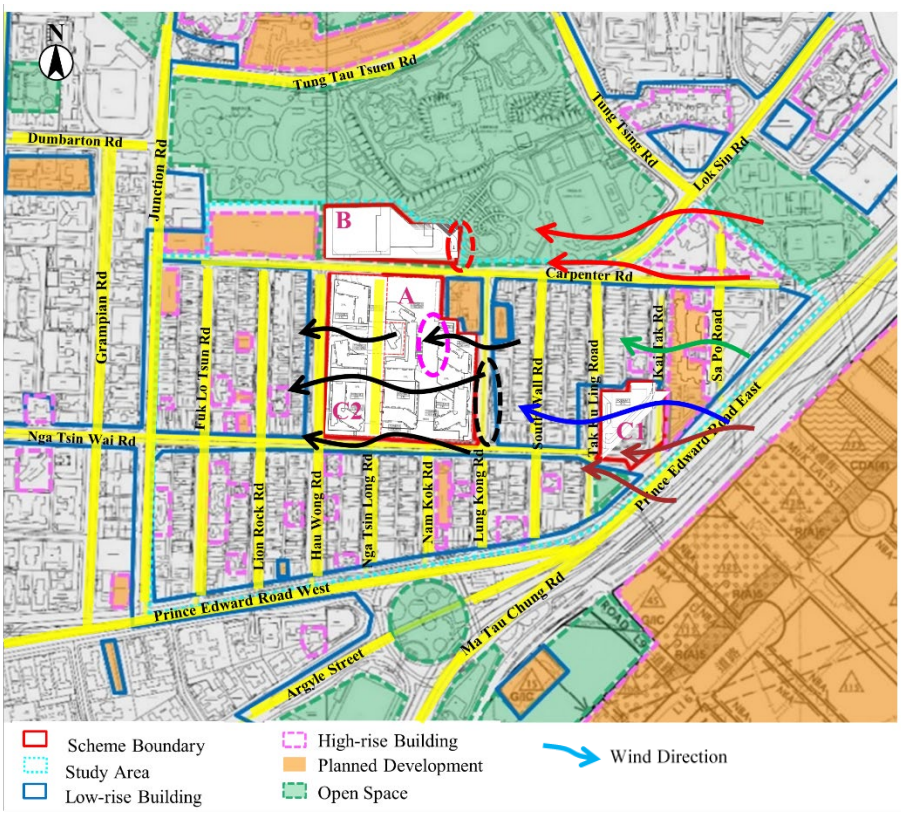


Figure 17 Wind Environment of Proposed Scheme under ENE/ E winds

5.3 SW/SSW Wind

SW and SSW wind directions are the major prevailing wind directions in summer. With reference to the previous AVA-IS of planned KC-015 Kai Tak Road/ Sa Po Road, the summer SSW/SW prevailing winds would travel along the north-south aligned roads, the wind performance in Study Area would be generally windier under summer wind condition.

As the area further to the south of Study Area is relatively open, open spaces including Argyle Street Playground, Olympic Garden, Sung Wong Toi Playground, and Planned Open Space in Kai Tak Development, it allows SW/SSW wind to penetrate through and reach the Study Area along Ma Tau Chung Road, Argyle Street, and Prince Edward Road West (**Purple** arrows in Figure 18).

Then, the incoming wind from Prince Edward Road West would flow along Hau Wong Road, Nga Tsin Long Road, Nam Kok Road and Lung Kong Road in Study Area to reach to Site A, B, and C2 (**Black** arrows in Figure 18).

The mid-to-high level incoming wind would skim over the Low-Rise Building Cluster 3 with generally low-rise building nature to reach the Study Area. Then, the incoming wind the penetrate through building gaps between the scattered high-rise buildings in the Low-Rise Building Cluster 4.

Meanwhile, another stream of the incoming wind from the Prince Edward Road West would travel along the road to the junction with Prince Edward Road East and enter the Site C1 from southwest boundary through Tak Ku Ling Road Rest Garden. (**Blue** arrow in Figure 18).

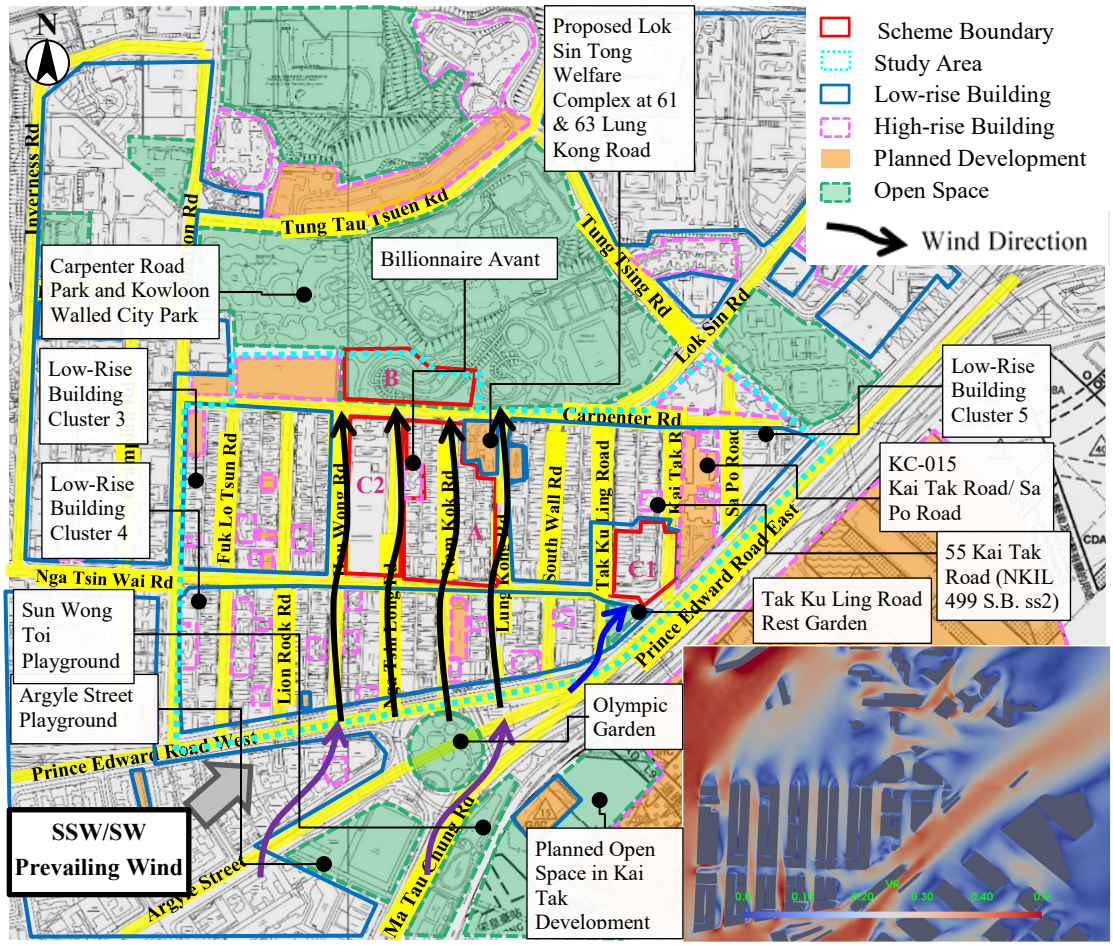


Figure 18 Wind Environment under SW/SSW winds

5.3.1 Baseline Scheme (SW/SSW Wind)

The high-rise development at Site A as well as the planned high-rise 128 Carpenter Road would downwash the incoming mid-to-high level SW/SSW wind to pedestrian level at Carpenter Road and Nga Tsin Wai Road, respectively (**Purple** arrows and **Purple** circles in Figure 19). The downwashed wind by the high-rise residential towers in Site A would be further delivered to the leeward side along Nga Tsin Long Road, Nam Kok Road, and Lung Kong Road.

The stepped building height difference between GIC towers in Site C2 and high-rise residential tower in Site A enables the SSW/SW prevailing wind to skim over GIC podium and be downwashed by the high-rise towers along the Nga Tsin Long Road enhancing the wind environment locally (**Magenta** circle in Figure 19). Owing to the packed podium coverage of the Scheme under Baseline Scheme in Site A, the wind enhancement effect would be localized. Wind shadow would be casted to the leeward area of Site A, Low-Rise Building Cluster 5, and the planned Proposed Lok Sin Tong Welfare Complex at 61 & 63 Lung Kong Road.

A portion of the summer SSW/SW wind would be direct to the Site B and planned low-rise Proposed Lok Sin Tong Welfare Complex at 61 & 63 Lung Kong Road along local air path, such as Hau Wong Road, Nga Tsin Long Road, and Nam Kok Road (**Black** arrows in Figure 19). Nevertheless, wind shadow effect would be

induced to Carpenter Road and Carpenter Road Park and Kowloon Walled City Park, including Site B, at leeward side of high-rise development in Site A resulting a relatively calmer wind condition.

Stepped building height profile with 20-m height difference between the GIC towers in Site C2 is adopted, downwash effect would be induced to divert mid-level wind to the podium (**Green** circle in Figure 19).

The high-rise towers in Site C1 would induce a downwash effect to enhance the wind environment at Tak Ku Ling Road Rest Garden and Nga Tsin Wai Road (**Blue** circle in Figure 19). The leeward area of the compact and integrated high-rise building and podium development in Site C1, such as the developments in Low-Rise Building Cluster 5 and high-rise 55 Kai Tak Road (NKIL 499 S.B. ss2), is hence relatively calm.

5.3.2 Proposed Scheme (SW/SSW Wind)

Similar to the Baseline scenario, the overall wind performance in Study Area is satisfactory under the dominant SSW/SW wind penetration along north-south aligned roads in summer (**Purple** arrows in Figure 20). The efficient block layout, building design and building separation under Proposed Scheme would further enhance overall air ventilation in Study Area.

Similarly, the high-rise development at Site A and C2 as well as the planned high-rise 128 Carpenter Road would induce downwash effect to divert high-level wind to pedestrian level of Carpenter Road and Nga Tsin Wai Road (**Purple** circles in Figure 20). Unlike Baseline Scheme, a portion of incoming wind would penetrate through building separations of high-rise residential towers further into the Scheme, and to the leeward side (**Brown** arrows in Figure 20).

Benefit from the stepped height profile and building separations in Sites A and C2, the second-tier high-rise residential towers, i.e. Tower 2 (+160mPD), Tower 5 (+160mPD) and Tower 7 (+150mPD), would able to capture the prevailing wind with some portions being penetrated through the building separations, and some portions of high-level wind being flown atop Tower 3, Tower 6, and Tower 8 (+143mPD). The captured wind would be further downwashed to podium level. With the terraced podium design of Tower 7 and tower abutting podium of Tower 2, the downwashed wind would be able to reach pedestrian level and enhance wind environment onsite (**Black** circle in Figure 20).

The reduced podium coverage creates at-grade large open-air landscaped diversified space within Sites A and C2, together with sky garden design and 10m podium setback along Nga Tsin Wai Road at Sites A and C2, would further enhance the wind permeability and facilitate wind penetration at the pedestrian level, especially for the summer prevailing winds coming from the SW quadrant.

However, the new GIC complex in Site B would hinder portion of the incoming wind from entering the Carpenter Road Park and Kowloon Walled City Park. Nevertheless, the building design of the GIC complex with cascading profile of lower building height on east part of the building, and 15m(W) x 15m(H) podium separation at grade at the west side of the GIC Complex would enhance the wind to

penetrate towards northern part of Carpenter Road Park. The elevated design at the podium portion, i.e. podium separation from the planned 128 Carpenter Road, sky garden at 3/F, and open-air viewing deck, and terraced podium at different levels of the GIC complex, would also alleviate the potential impact by allowing some wind penetration from Nga Tsin Long Road, Nam Kok Road, and the market square provided in Site A next to the Carpenter Road (**Green** arrows in Figure 20). Meanwhile, the prevailing wind at mid-level would be downwashed by the GIC complex and enhance wind availability to Carpenter Road (**Blue** circle in Figure 20).

The road diversion and the gateway square provided in Site C1, together with the Tak Ku Ling Road Rest Garden and the split-level sunken plaza at the planned KC-015 (i.e. enlarged scalable gateway) connects with Price Edward Road East and forms an air path aligned with SW/SSW prevailing wind direction (**Black** arrow in Figure 20). This facilitates more mid and high-level wind penetration across the Site C1 and ventilates the leeward area. Enhanced wind environment would be expected at planned KC-015 Kai Tak Road/ Sa Po Road as compared to Baseline Scenario.

Apart from that, the low-rise commercial podium in Site C1 enables prevailing wind to flow atop of it and reach the Low-Rise Building Cluster 5. Downwash effect would be induced by planned high-rise KC-015 Kai Tak Road/ Sa Po Road and existing high-rise 55 Kai Tak Road (NKIL 499 S.B. ss2). This would further enhance the wind environment at Kai Tak Road (**Black** circle in Figure 20).

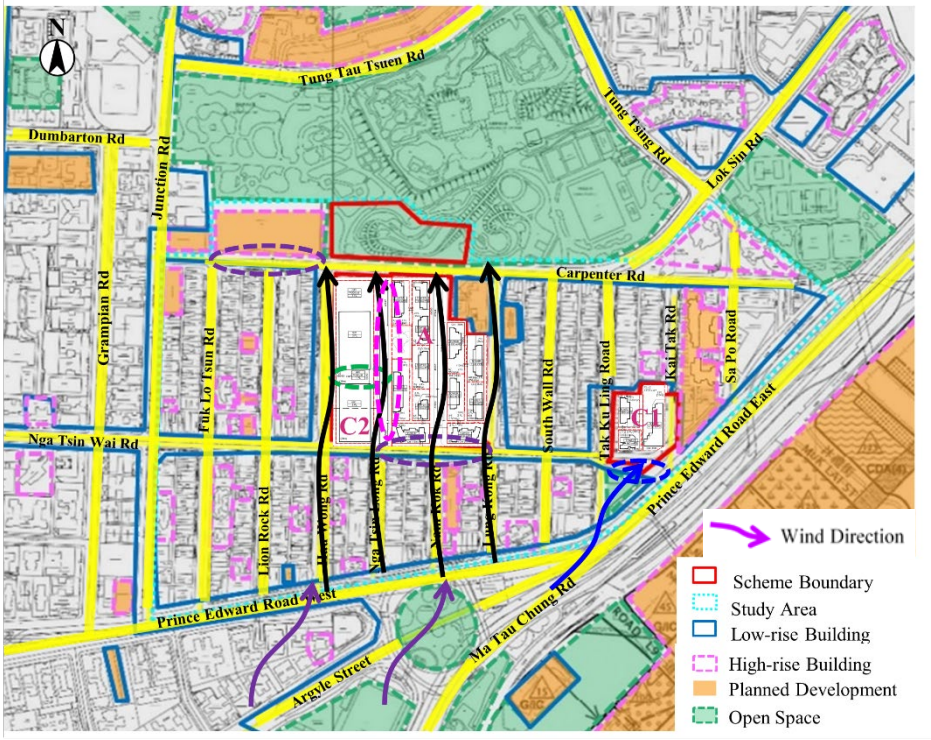


Figure 19 Wind Environment of Baseline Scheme under SW/SSW winds

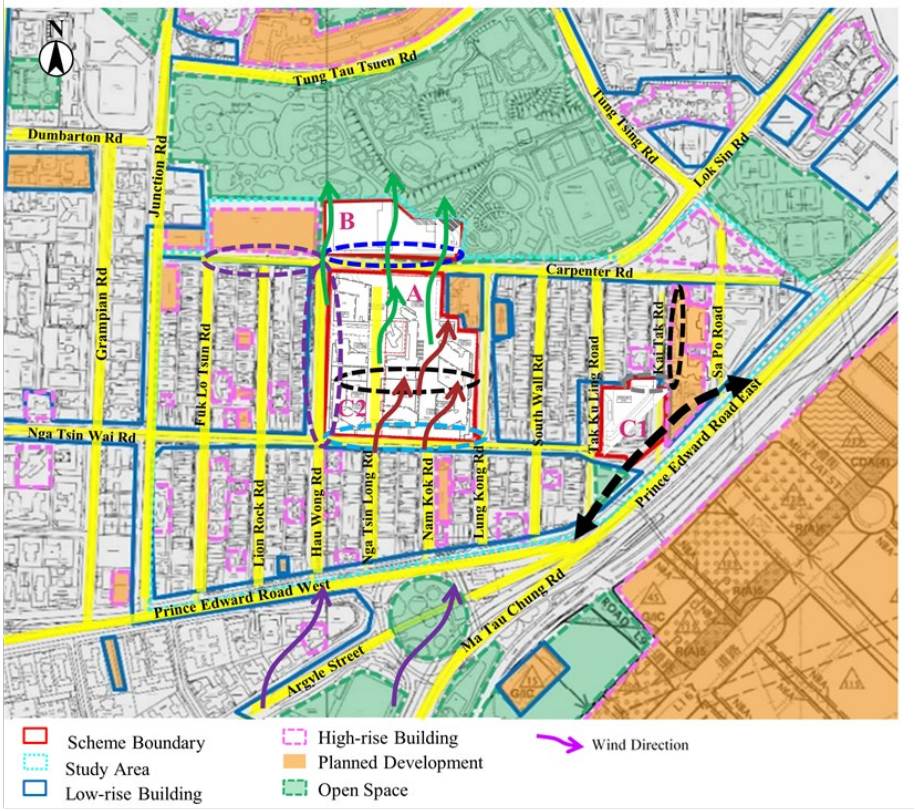


Figure 20 Wind Environment of Proposed Scheme under SW/SSW winds

6 Conclusion

Qualitative assessment of the wind environment of the Study Site was conducted. According to the wind availability data from PlanD, the annual prevailing wind comes from ENE, E and NNE directions while the summer prevailing wind is from E, SSW and SW directions.

6.1 Under annual wind condition (E/NNE/ENE Wind)

Under annual condition, the Scheme is mainly located downwind area of Low-Rise Building Cluster 5 with scattered high-rise buildings, such as KC-015 Kai Tak Road/ Sa Po Road and 55 Kai Tak Road (NKIL 499 S.B. ss2) under ENE/E wind condition; and the Scheme is surrounded by large open space Carpenter Road Park and Kowloon Walled City Park, where acts as a wind pocket to allow annual wind to reach the Scheme.

The overall annual wind condition under Proposed Scheme is similar with the Baseline Scheme. With wind enhancement features of Proposed Scheme, the adverse impacts to wind environment of downwind areas would be compensated.

Under Baseline Scenario, the compact high-rise building, large podium coverage and similar height profile of Sites A and Site C1 would result a relatively clam wind environment in downwind areas under ENE/E wind directions, while the incoming wind would be downwashed and penetrate through the streets running in the north-south direction under NNE wind direction.

Under Proposed Scenario, the creation of at-grade landscaped diversified space including two landscaped pedestrian avenues and market square, reduced podium coverage, east-west aligned building setbacks, stepped height profile and sky gardens in Site A and C2 would enhance wind permeability of the Scheme and divert more winds to leeward areas. Although the development in Site B would hinder a portion of prevailing winds, the downstream environment would be improved by the cascading building profile, the sky garden, open-air viewing deck, and landscaped terrace as well as the 15m(W) x 15m(H) podium separation at the western edge in Site B. Apart from that, the proposed Site C1 with lower building height (maximum BHR 40mPD) would allow more prevailing wind to skim over and the enlarged scalable gateway would act as wind entrance to ventilate affected leeward areas, comparing to the Baseline Scheme.

6.2 Under summer wind condition (SW/E/SSW Wind)

Under summer condition, the Study Site is located at leeward area of Low-Rise Building Cluster 4 and 5 with scattered high-rise buildings. As for the downwind area of Study Site, there are mainly Low-Rise Building Cluster 3, and a large open space Carpenter Road Park and Kowloon Walled City Park, where wind shadows would be casted.

The overall summer wind condition under Proposed Scheme is also similar with Baseline Scheme. With wind enhancement features of Proposed Scheme, the adverse impacts to wind environment of downwind areas would be compensated.

Under Baseline Scenario, the downwind environment is relatively clam owing to the compact high-rise building, large podium coverage and similar height profile of Sites A and Site C1. The prevailing wind from SSW/SW direction would reach to Site C2 through local air paths, while prevailing wind from ENE/E directions would be mostly hindered by high-rise buildings in Site A.

Under Proposed Scenario, the low-level wind would penetrate the at-grade landscaped diversified space, and sky gardens to the leeward areas onsite, such as the central part of the main site and the area in front of Billionnaire Avant, and further reach to Carpenter Road Park and Kowloon Walled City Park, and Low-Rise Building Cluster 3 with scattered high-rise buildings. The enlarged scalable gateway in Site C1 would create an air path connecting to Price Edward Road East would enhance the wind availability of its downstream areas, such as Low-Rise Building Cluster 5, and Site A and C2. In addition, the high-level wind would travel along the building separation among the north-south and east-west aligned towers in Sites A and C2 to the mentioned downstream areas.

6.3 Summary

In summary, it is expected that the Proposed Scheme would not lead to "insurmountable impact" in terms of air ventilation as compared with Baseline Scheme.

The building parameters under the Proposed Scheme is generally higher at the Northern Site (Site B) and the Main Site (Sites A and C2) than that of the Baseline Scheme. Nevertheless, higher permeability at both high and low levels provided under Proposed Scheme through tower alignment with north-south and west-east directions, building setback aligned with the prevailing wind directions, larger building and podium separation, reduced podium coverage, provision of at-grade landscaped diversified space, stepped building height, sky gardens, and terraced podium design, would facilitate more wind penetration through the site. Besides, for the Eastern Site (Site C1), a much lower building height and a creation of gateway square and road diversion at Proposed Scheme provides better condition for wind penetration and circulation than the Baseline Scheme.

As a whole, the Proposed Scheme would not lead to insurmountable impact in terms of air ventilation and the identified localized ventilation impact imposed by the Proposed Scheme at some locations would be alleviated through these wind enhancement features of the Proposed Scheme.

7 Reference

[1] Housing, Planning and Lands Bureau and Environment, Transport a& Works Bureau, Technical Circular No.1/06 Air Ventilation Assessment and its Annex A – Technical Guide for Air Ventilation Assessment for Developments in Hong Kong, dated 19th July 2006.

[2] Simulated RAMS wind data from Planning Department, available at: http://www.pland.gov.hk/pland_en/info_serv/site_wind/site_wind/index.html