

Hong Kong Housing Authority
**Air Ventilation Assessment of
Proposed Public Housing
Development at J/O of Chai Wan
Road, Wing Ping Street, and San
Ha Street**

Expert Evaluation Report

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This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number --

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1 Introduction

1.1 Project Background

Ove Arup & Partners Hong Kong Ltd (Arup) was commissioned by the Hong Kong Housing Authority (HKHA) to carry out an Air Ventilation Assessment (AVA) – Expert Evaluation for the development at J/O of Chai Wan Road, Wing Ping Street, and San Ha Street (the Development).

1.2 Objective

The objective of this study is to evaluate the wind performance of the Development using the methodology of Air Ventilation Assessment, based on the “*Housing Planning and Lands Bureau – Technical Circular No. 1/06, Environment, Transport and Works Bureau – Technical Circular No. 1/06*” issued on 19th July 2006 (the Technical Circular) and “*Technical Guide for Air Ventilation Assessment for Development in Hong Kong – Annex A*” (the Technical Guide). This report presents the findings for the Expert Evaluation, which is to advise the implication of the proposed development on the pedestrian wind environment in a qualitative manner.

An Initial Study will be conducted in the next stage at detailed building design to help optimize the wind pertinence through the use of computation fluid dynamic (CFD) techniques.

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 development area and assessment of the wind performance under existing development situation and the proposed building design option in a qualitative way. The expert evaluation will cover the following tasks:

- Identify the wind condition
- Identify problem areas
- Identify good design features

2 Site Characteristics

The proposed Development is located within Chai Wan district, on a flat reclamation land. The Chai Wan Area is, exposed to the sea to the northeast and surrounded by Mount Collinson ($\approx 348\text{mPD}$) to the south, Mount Parker ($\approx 507\text{mPD}$) to the west and also Pottinger Peak ($\approx 312\text{mPD}$) to the southeast as shown in Figure 1.

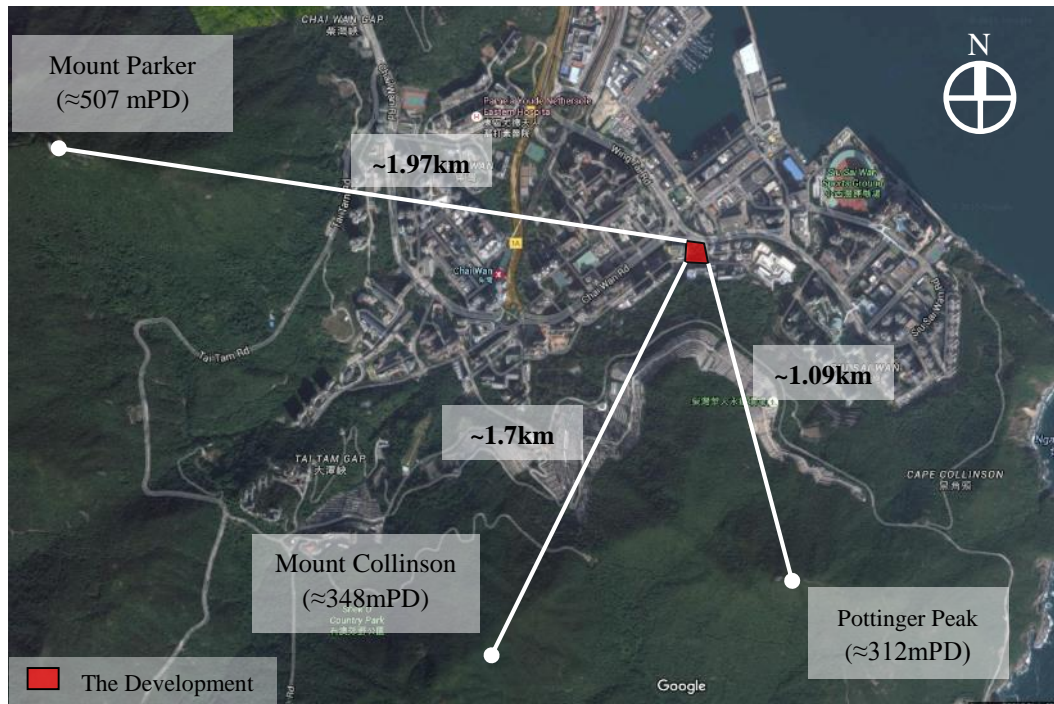


Figure 1 Topography of Chai Wan District (source: google map)

The Proposed Development is located adjacent to Chai Wan Road (Green line), Wing Ping Street (Black line) and San Ha Street (Orange Line). The location of the Development site is shown in Figure 2.

It is in close proximity to low rise school area (SKH Chai Wan St. Michael's Primary School and Caritas Chai Wan Marden Foundation Secondary School etc.) at its west and south. There are high rise residential estate (Chai Wan Estate and Lok Hin Terrace) at the southwest side. At its east side, there are mid to high rise residential buildings at Hong Ping Street. The industrial buildings cluster (Ex-bus depot of the China Motor Bus Company and Sunview Industrial building etc.) are located at the northeast side of the site.

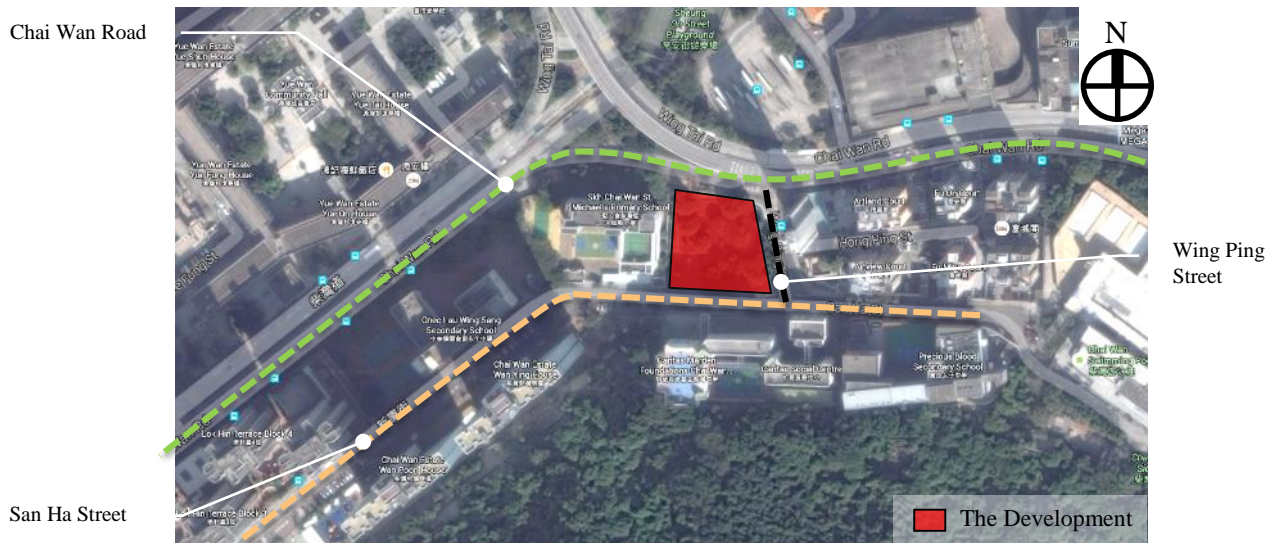


Figure 2 Location of surrounding major roads (source: google map)

- Chai Wan Fire Station (15.8mPD)
- ELCHK Faith Love Lutheran School (27.7mPD)
- Yue Wan Estate (62.5mPD)
- SKH Chai Wan St. Michael's Primary School & CNEC Lau Wing Sang Secondary School (29.1mPD - 33.5mPD)
- Lok Hin Terrace (98.8mPD)
- Chai Wan Estate (117.7mPD)
- Caritas Chai Wan Marden Foundation Secondary School & Precious Blood Secondary School (21.8mPD - 45.7mPD)



- Industrial Building cluster at Kwun Yip Street (49.0mPD-89.7mPD)
- Industrial Building cluster at On Yip Street (50.3mPD-51.6mPD)
- Sunview Industrial Building, Sino Favour Centre & Mega-iAdvantage (49.1mPD - 134.5mPD)
- Ex-bus depot of the China Motor Bus Company Limited (28.7mPD)
- Existing PTI
- Residential developments at Hong Ping Street (49.3mPD-90.1mPD)

Figure 3 Location of the Development and its surrounding developments (source: google map)

There will be a planned development at Wing Tai Road located northwest to the - Development and a planned development in a site zoned Comprehensive Development Area (CDA) on the ex-bus depot site situated to the north of the Development as shown in Figure 4. The development parameters of these planned developments are tabulated in Table 1.



Figure 4 Location of future developments (source: google map)

Table 1 Development parameters of planned developments

	Wing Tai Road	CDA site
Source	In-fill block at Yue Wan Estate	Approved planning application (no. A/H20/177) approved by the Town Planning Board on 23 August 2013
Number of blocks	1	3
Building height	Max. 110mPD	133.9 - 140mPD
Plot ratio	3.4 (Overall Yue Wan Estate)	5.98 (Domestic) 0.017 (Non-domestic)
Podium height	--	2-3 storeys
Podium coverage	Podium Free Design	Development above podium

3 Site Wind Availability

To investigate the wind performance of the Development site, 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. There are three sources of site wind data for this Development, including simulated RAMS, simulated MM5 data and the nearby Hong Kong Observatory (HKO) Station – North Point weather station.

3.1 RAMS Wind Data

As stipulated in the Technical Guide, the site wind availability would be presented by using appropriate mathematical models (e.g. RAMS simulation). Planning Department (PlanD) has set up a set of wind availability data of the Territory for AVA study, which could be downloaded at Planning Department Website¹.

The wind availability data at 200mPD of location grid (y:94, x:30) obtained from the RAMS simulation is utilised for the Expert Evaluation, as shown in Figure 5a and Figure 5b below.

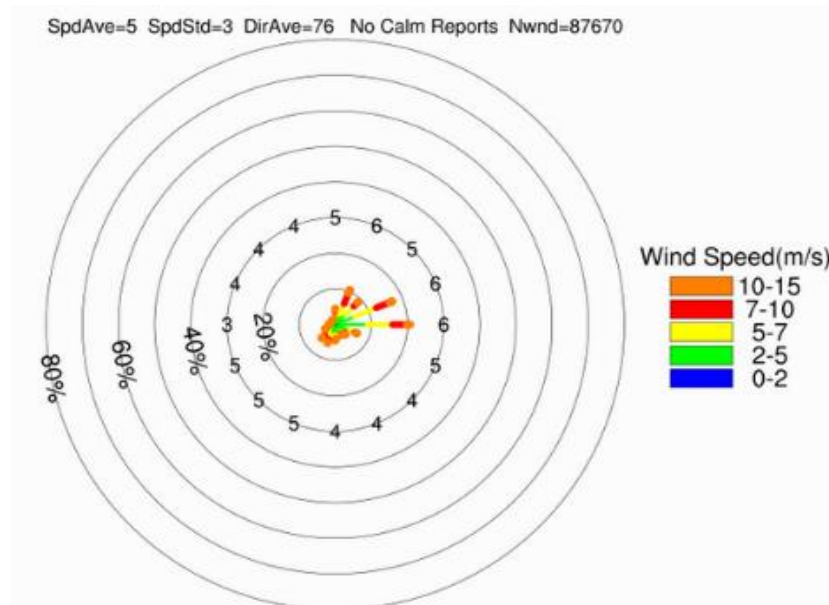


Figure 5a Annual Wind Rose at 200 mPD from RAMS data

¹ http://www.pland.gov.hk/pland_en/info_serv/site_wind/site_wind/index.html

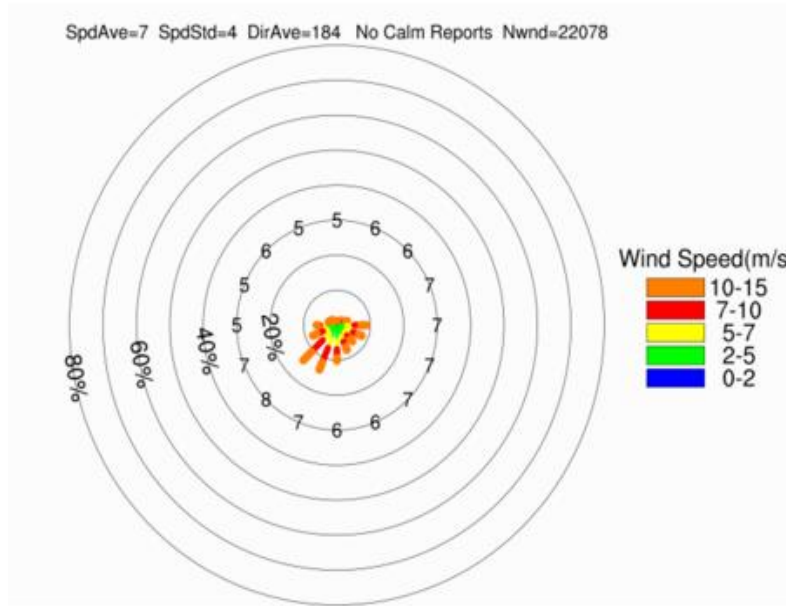


Figure 5b Summer Wind Rose at 200 mPD from RAMS data

Table 2 Prevailing wind frequency

Prevailing Wind	Annual			Summer		
	WIND DIRECTION	NNE	ENE	E	SSW	SW
WIND FREQUENCY	10.5%	17.0%	20.7%	13.2%	14.9%	11.4%

According to the RAMS wind data, NNE, ENE and E winds contribute to 10.5%, 17.0% and 20.7% of the annual wind frequency respectively while the SSW, SW and S winds contribute to 13.2%, 14.9% and 11.4% of the summer wind frequency respectively. Hence, NNE, ENE and E winds are identified as the annual prevailing wind direction and SSW, SW and S winds are identified as the summer prevailing wind direction.

3.2 MM5 Wind Data

The MM5 data quoted in the Term Consultancy for Air Ventilation Assessment Services report for the Chai Wan Area² is used as the second reference. With consideration of flow characteristics, MM5 data extraction location A (Red spot) would have closer flow pattern to the Development than location C (Green spot). Location A and the Development are located close to the same major breezeway. Wind Data from location A is selected for the study. The wind roses of the location A (shown in Figure 6) at 120m and 450m are extracted and illustrated in Figure 7.

With reference to the Expert Evaluation for the Chai Wan Area, the annual prevailing winds are NE, ENE and E, while the summer prevailing wind are E, SE and SW winds.

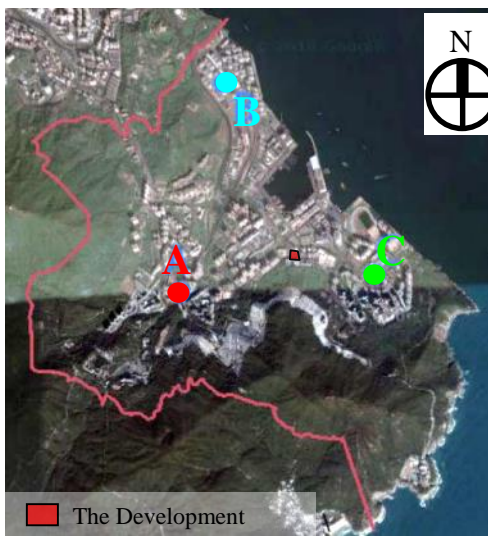


Figure 6 The three locations of MM5 extracted data

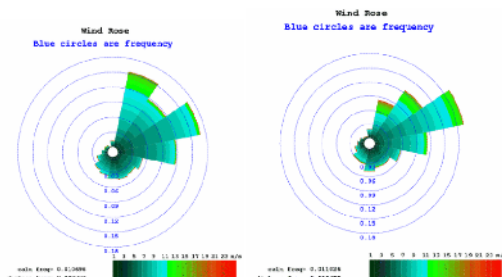


Figure 3.10 Wind roses (annual) at A (120m; 450m)

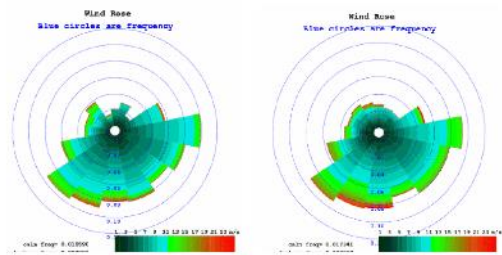


Figure 3.11 Wind roses (summer) at A (120m; 450m)

Figure 7 Annual and summer wind roses for Chai Wan Area

² Term Consultancy for Expert Evaluation and Advisory Services on Air Ventilation Assessment (PLNQ 35/2009)

3.3 Hong Kong Observatory

On the other hand, the prevailing wind direction measured at the closest weather station - North Point Weather Station from the Hong Kong Observatory³ is tabulated in Table 3 for each month. It can be seen from Table 3 that the E wind is the annual prevailing wind direction while the SW and E winds are the summer prevailing wind directions.

Table 3 Monthly Wind Direction Recorded at North Point Station (Source: HKO)

Month	Prevailing Wind Direction (°)	
January	90	
February	90	
March	90	
April	90	
May	260	
June	(Summer)	260
July		80
August		260
September	80	
October	90	
November	90	
December	90	
Annual	90	

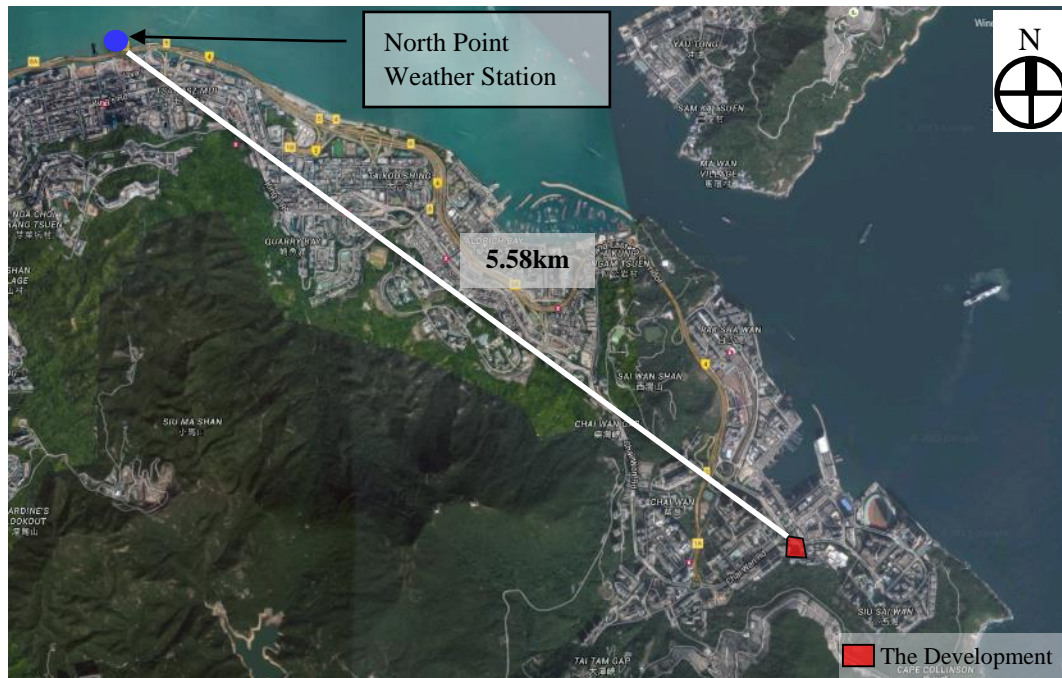


Figure 8 Location of North Point Weather Station

³ Summary of Meteorological and Tidal Observations in Hong Kong

3.4 Summary of the Site Wind Availability

These three sets of wind data have been studied. The wind data from North Point weather station is considered distant from the Development and this is not used in estimating the wind condition for this study. The RAMS and MM5 data indicated prevailing winds directions are tabulated in Table 4.

The tabulated data reflects similar annual prevailing wind directions which are NNE, NE, ENE and E, whereas the summer prevailing wind directions varies from E, SE, S, SSW and SW. The evaluation of site wind performance would consider both site wind availability data and site characteristics.

Table 4 Prevailing wind directions for the Study Area

Prevailing Wind Direction	RAMS	MM5 (Chai Wan Area)
Annual	NNE/ENE/E	NE/ENE/E
Summer	S/SSW/SW	E/SE/SW

4.1.1 Annual prevailing wind condition

North-Northeast (NNE), Northeast (NE), East-north-east (ENE) and East (E) directions are the annual prevailing wind directions.

In the topography characteristics described above, the NNE, NE and ENE prevailing winds from the sea and travel along the Fung Yip Street and then Chai Wan Road; and also Sun On Street and penetrate through the building separation between the planned CDA site and reach the Development and San Ha Street (the blue arrows in Figure 10).

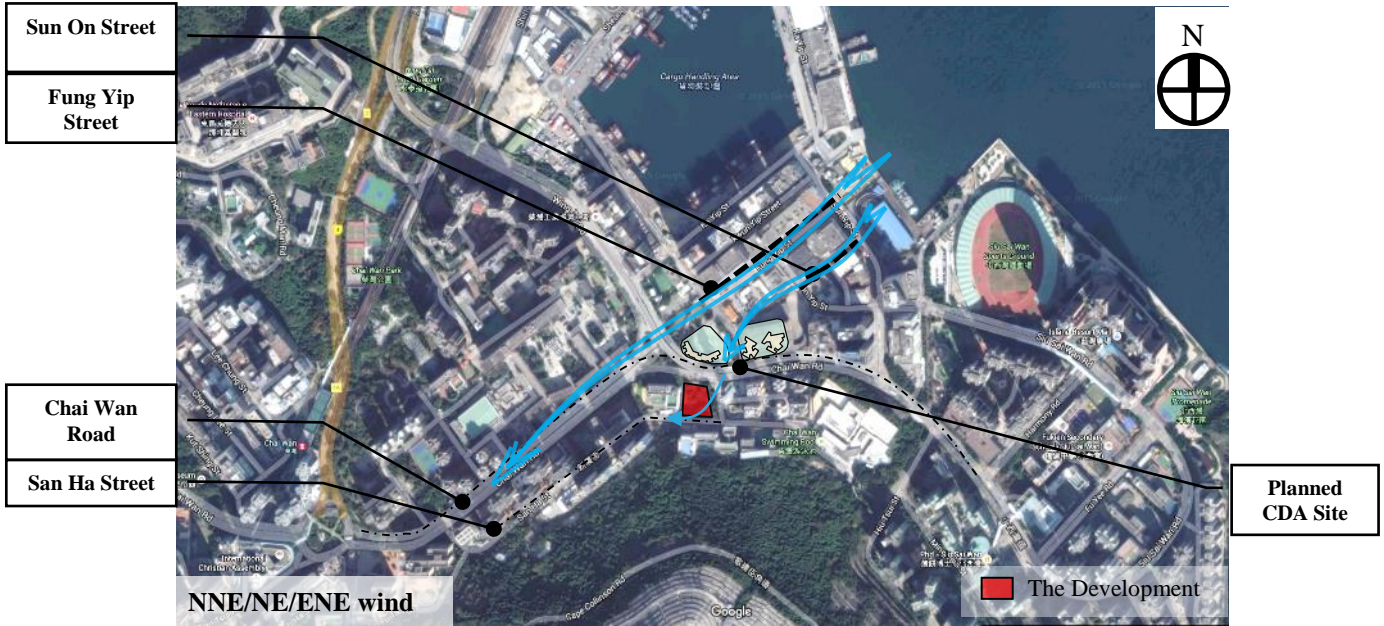


Figure 10 Wind environment of Chai Wan Area under annual condition (NNE, NE and ENE winds)

Under E wind direction, high-rise buildings situated at the upwind direction at the east, such as the Island Resort, Harmony Garden and residential building at Hong Ping Street may likely shield the approaching wind and deflect to Siu Sai Wan Road and Chai Wan Road via Siu Sai Wan Road Garden (the blue arrows in Figure 11). In addition, approaching wind would also penetrate over atop of the school districts and Chai Wan Swimming Pool and flow along San Ha Street and Chai Wan Road (the dark blue arrows in Figure 11).

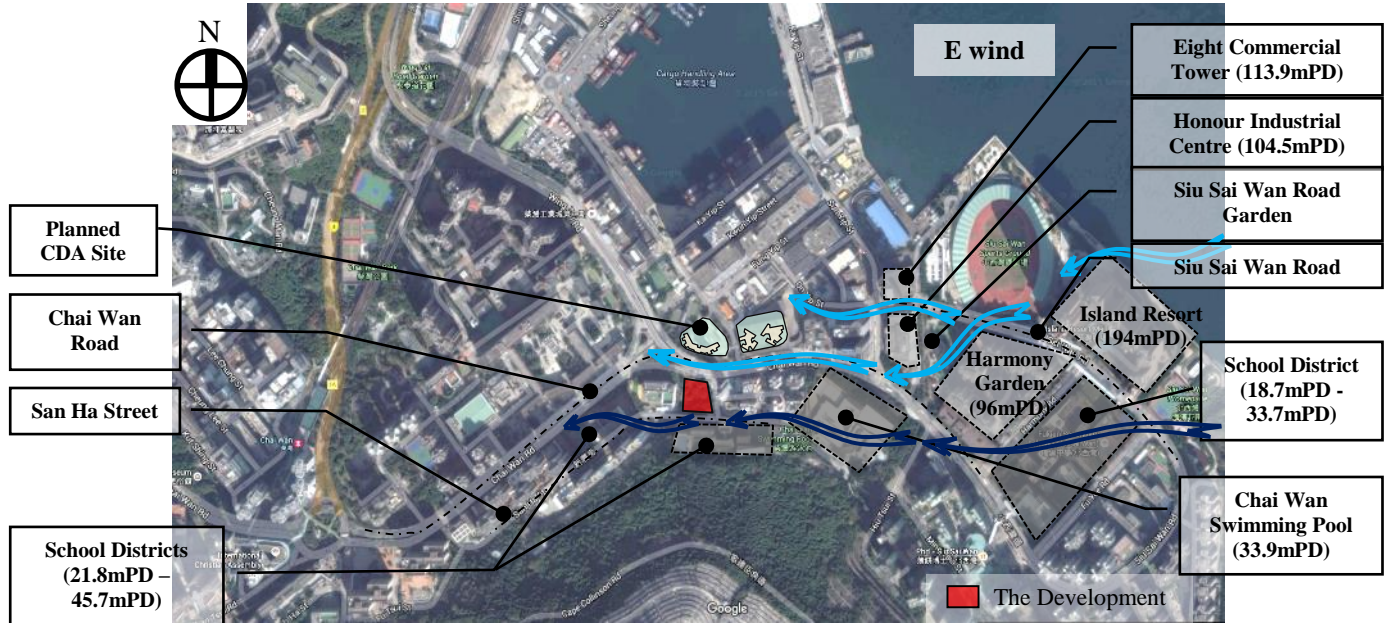


Figure 11 Wind environment of Chai Wan Area under annual condition (E wind)

4.1.2 Summer prevailing wind condition

East (E), Southeast (SE), South (S), South-Southwest (SSW) and Southwest (SW) directions are the summer prevailing wind directions. Under SSW and SW summer prevailing wind condition, Chai Wan Road serve as the major breezeway for inducing the SSW and SW prevailing wind passing through the Sheung On Playground and continue to travel along Fung Yip Street to allow wind penetration to the northeast of the Chai Wan Area. San Ha Street is the secondary breezeway to facilitate the penetration of the SSW and SW wind through Chai Wan Area. As the existing condition of the project site is open space, the summer prevailing wind along San Ha Street could further penetrate across the site and atop of the school sites to Chai Wan Road and Hong Ping Street. The E prevailing wind condition is as described in 4.1.1.

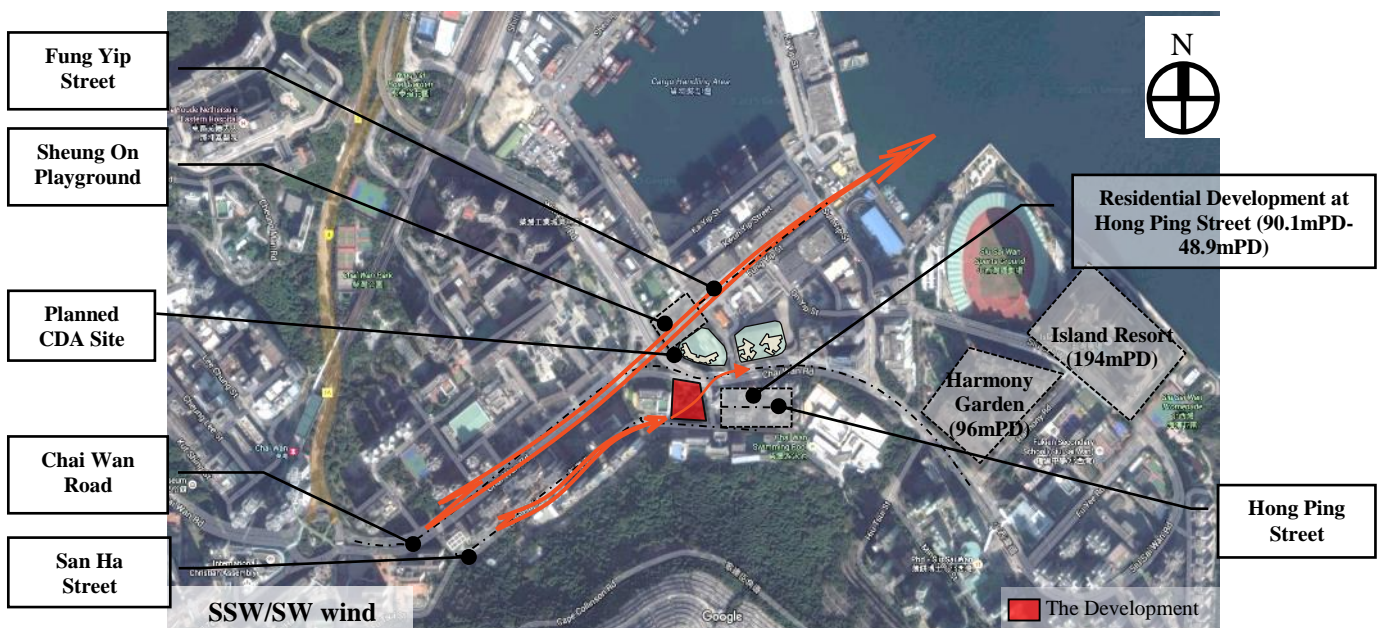


Figure 12 Wind environment of Chai Wan Area under summer condition (SSW and SW winds)

Under S wind condition, the Pottinger Peak (312mPD) is situated at the upwind direction that would alter the S approaching wind that majority of the incoming wind would likely penetrate into Chai Wan Area from southeast and southwest direction. Although minor south prevailing wind may skim over the Pottinger Peak and penetrate towards the Project Site, Caritas Chai Wan Marden Foundation Secondary School, Caritas Social Centre and Precious Blood Secondary School located at the downhill area of the Pottinger Peak would likely shield the approaching wind from Pottinger Peak. The wind being diverted by the high-rise residential cluster Lok Hin Terrace that travels along San Ha Street would become the dominant approaching wind towards the Project Site.

As the existing condition of the project site is open space, the summer prevailing wind along San Ha Street could further penetrate across the site to Chai Wan Road and Hong Ping Street.

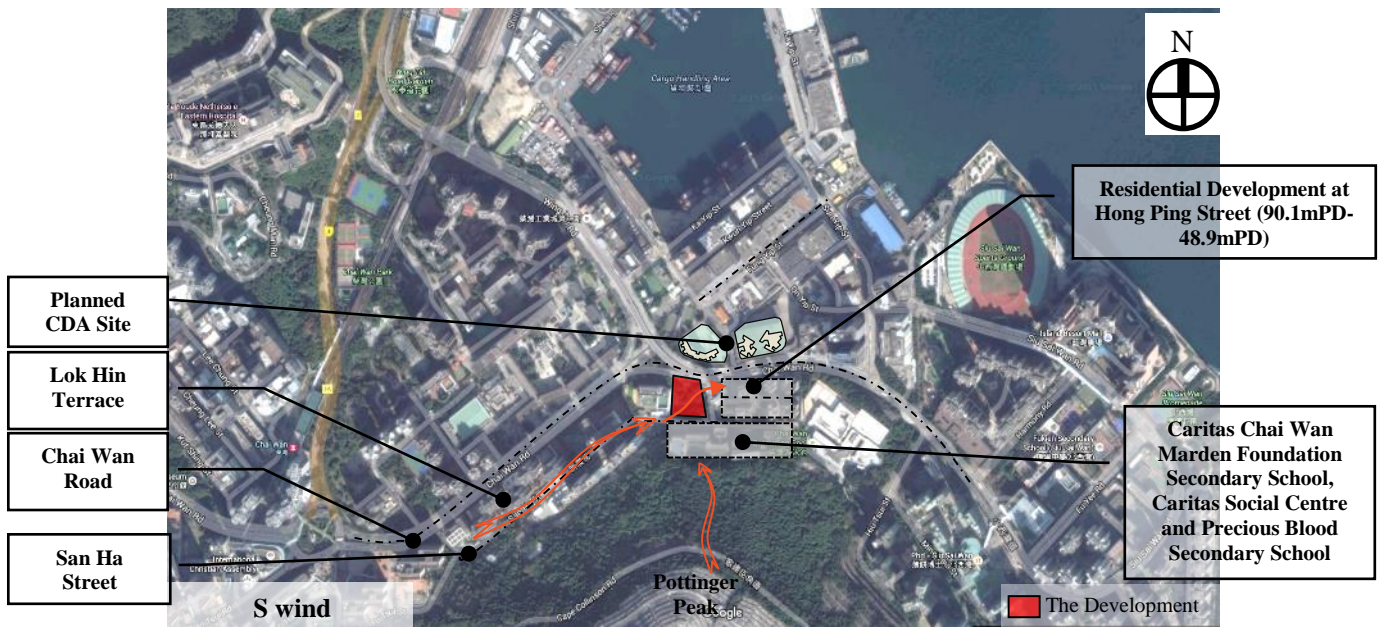


Figure 13 Wind environment of Chai Wan Area under summer condition (S wind)

Under SE wind direction, the relative openness to the south of Siu Sai Wan Estate allows the SE wind reaches Siu Sai Wan Estate through the building gaps (the purple arrow) and along Ming Tsui Street (the blue arrow). The approaching wind may likely penetrate into San Ha Street via the building separation between Chai Wan Swimming Pool and Schools and reach to the Development.

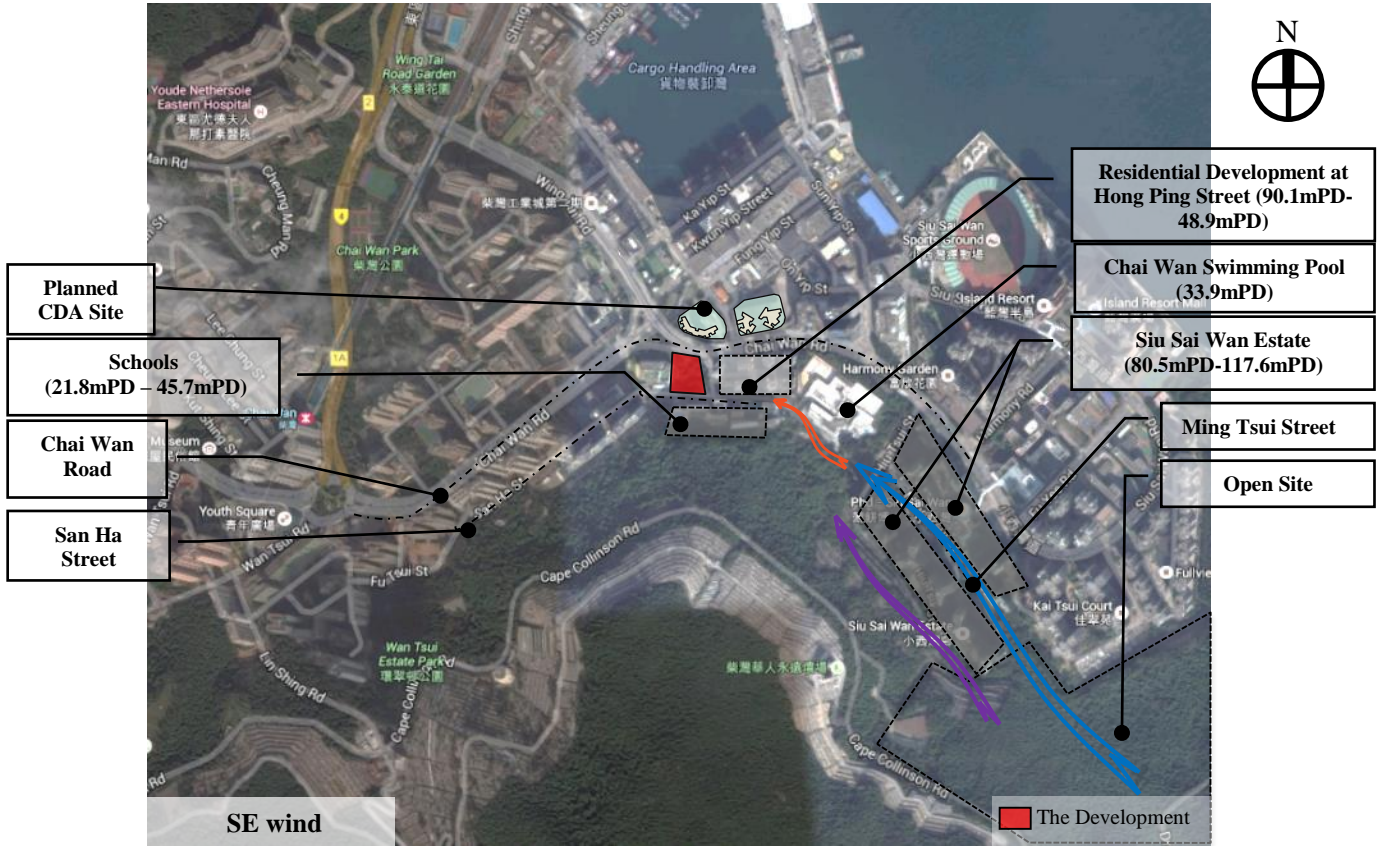


Figure 14 Wind environment of Chai Wan Area under summer condition (SE wind)

5 Preliminary Plan

The Development consists of a single residential block with 38 domestic storeys on a podium. The podium garden is provided at 11.3mPD with about 91% site boundary coverage. The tower block (from transfer plate or above) has a setback of about 7m from Site Boundary along Chai Wan Road and about 18m from the adjacent school block to its west. (Subject to future design)

Figure 15 and Figure 16 show the site layout plan and elevation of the Development.

Table 5 Indicative parameters of the Development

Gross Site Area	0.33 ha
Plot Ratio	10
Maximum Building Height	120mPD

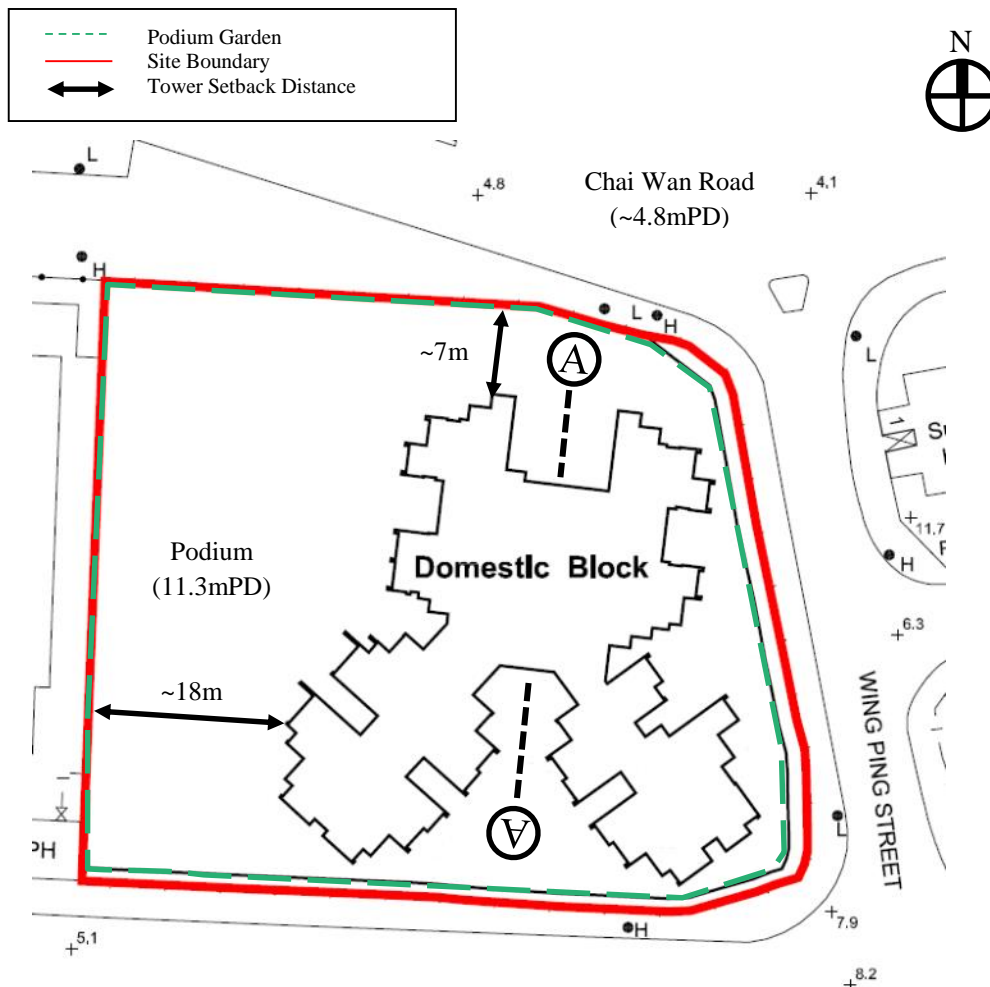


Figure 15 Site Layout Plan of the Development (Subject to future design)

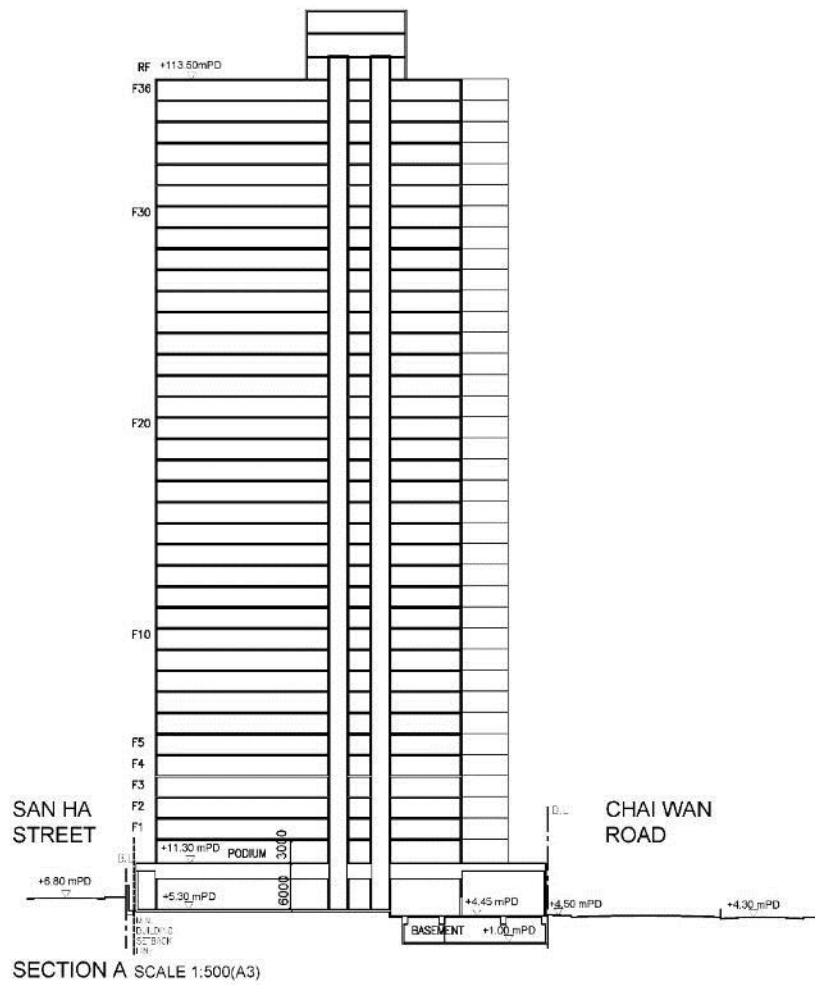


Figure 16 Elevation Plan of the Development

6 Ventilation Performance of the Proposed Development

This section explains how the annual and summer prevailing wind access to the Development and the ventilation impact to the surroundings by the Development.

6.1 Ventilation Performance under Annual Condition

Under E Wind

As the high rise and high density residential developments at Hong Ping Street is located at the east side of the development, the E prevailing wind flow mainly along Chai Wan Road and San Ha Street to reach the Development (the blue arrows in Figure 17). As the disposition of the tower block and podium of the Development is generally aligned with the adjacent buildings such as the residential development at Hong Ping Street and SKH Chai Wan St. Michael's Primary School, thus it is expected that the Proposed Development would not induce significant interruption to the major breezeway along Chai Wan Road. Hence, it is expected that the Development would not induce significant adverse impacts to the ventilation performance of major breezeway.

The Proposed Development is expected to induce wind shadow to the adjacent SKH Chai Wan St. Michael's Primary School, however, with provision of the tower setback of about 18m from the school site, the potential ventilation impact on the downstream school site could be reduced. The 18m separation between the school site and the tower of the proposed development would reduce the potential wake area on the school site. This would allow some incoming E wind to enter the school site at the downstream more easily.

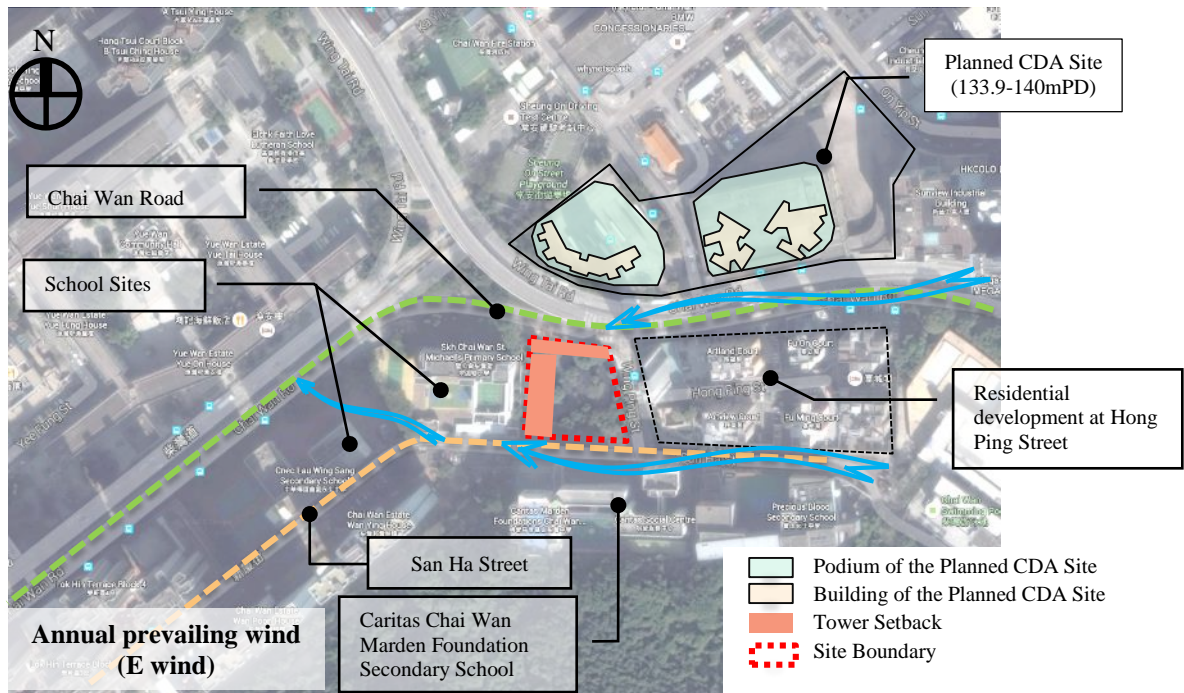


Figure 17 Wind environment under annual wind condition (E wind)

Under NNE, NE and ENE Wind

NNE, NE and ENE annual prevailing winds would likely flow through Sun On Street and Fung Yip Street from the waterfront. The air stream from Fung Yip Street would connect with Chai Wan Road for wind penetration (the purple arrows in Figure 18) while the air stream along Sun On Street would skim over the podium of the Planned CDA Site and reach to the Development. Hence, the approaching wind is diverted to reach the Development by NE direction.

With located at the immediate windward side of the Caritas Chai Wan Marden Foundation Secondary School, the high-rise domestic tower of the Development would potentially shield the approaching wind. The 18m separation between the school site and the tower of the proposed development allow some incoming NNE/NE/ENE winds to enter the school site at the downstream more easily and slightly alleviate the impact on the wind environment.

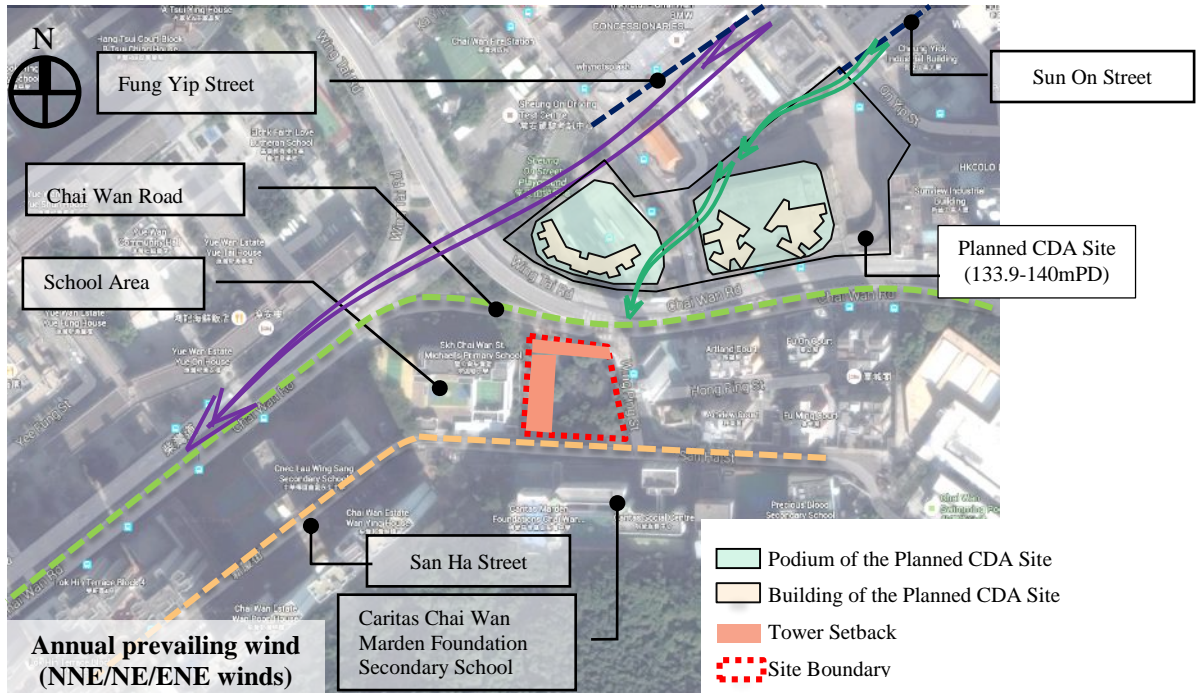


Figure 18 Wind environment under annual wind condition (NNE/NE/E winds)

6.2 Ventilation Performance under Summer Condition

Under summer condition, the prevailing winds are mainly coming from E, SE, S, SSW and SW wind directions, in which the E prevailing wind condition is described in Section 6.1.

Under S, SSW and SW winds

Under the S, SSW and SW winds, the prevailing wind would ventilate along Chai Wan Road. Since the Development is located away from of Chai Wan Road, the ventilation performance of the major breezeway would unlikely be interrupted by the Development.

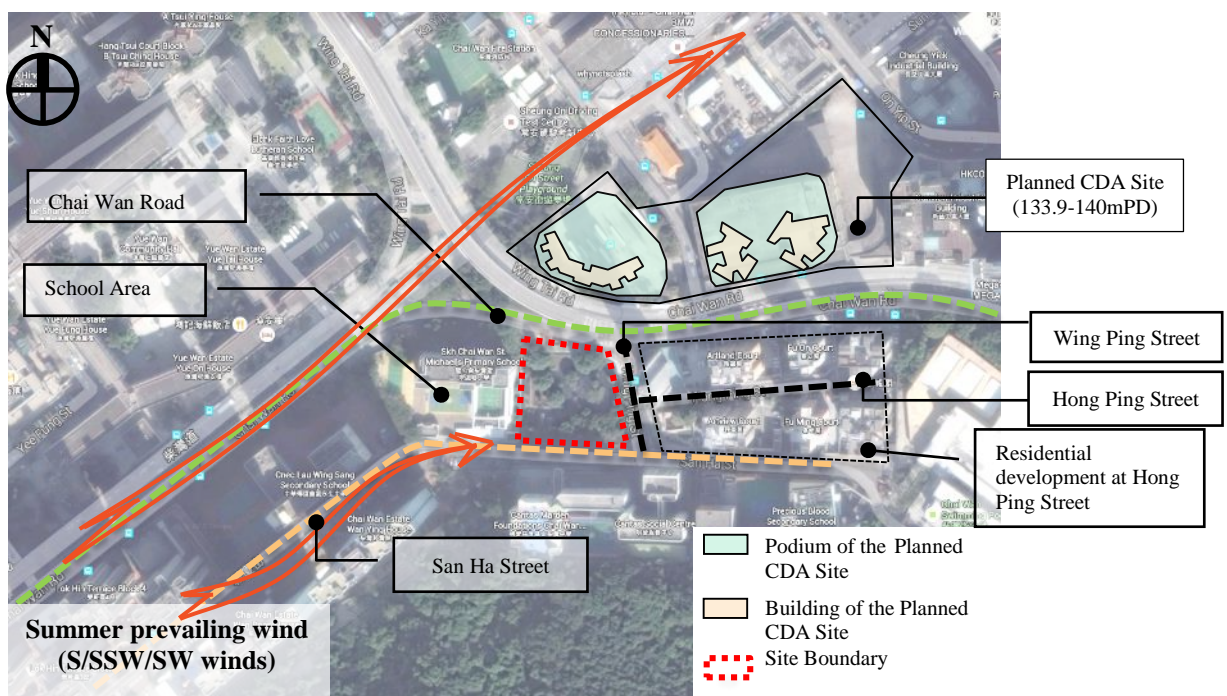


Figure 19 Wind environment under summer wind condition (SW/SSW Winds)

Besides, SW and SSW prevailing winds would reach the Development via the secondary wind path along San Ha Street. With the presence of the building block of the Development, it would be likely to cause localised ventilation impact on the leeward side, such as Wing Ping Street, Hong Ping Street, Chai Wan Road and Planned CDA Site in comparison to the existing situation.

The presence of the tower setback on podium top from the adjacent SKH Chai Wan St. Michael’s Primary School, may allow the prevailing wind ventilate through the Development as shown in Figure 20. Hence, the potential ventilation impact at the Chai Wan Road and Planned CDA Site is reduced under summer wind condition.

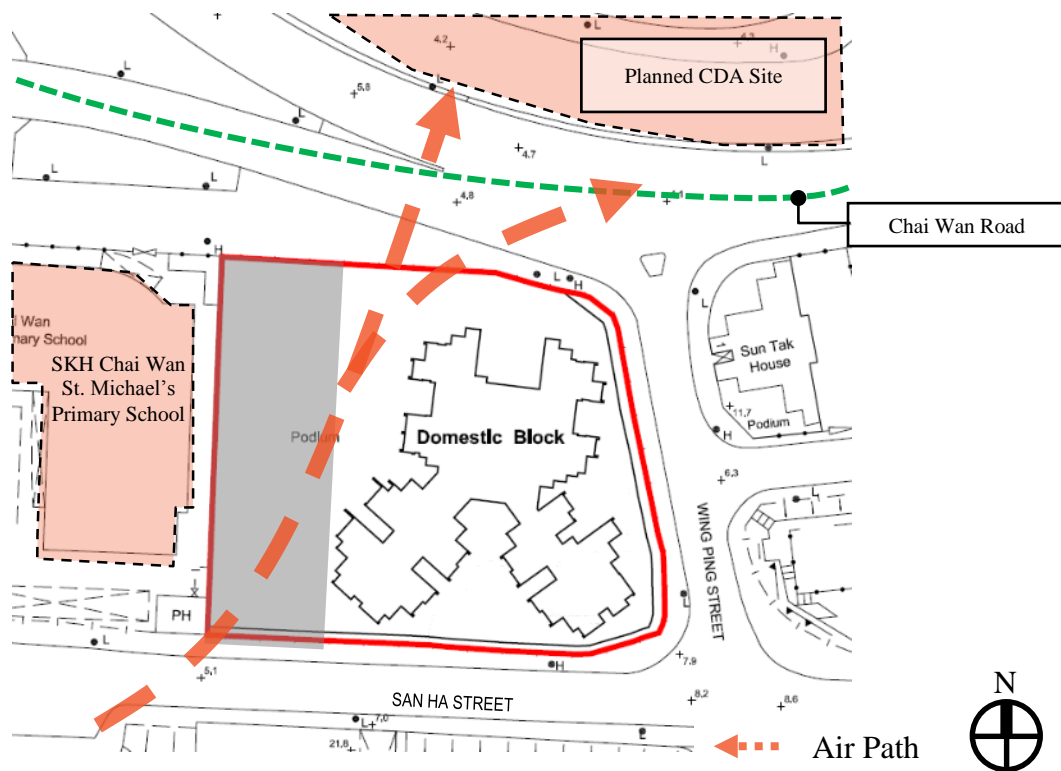


Figure 20 Summer wind condition (S/SSW/SW winds) of the Development

Under SE wind

Under the SE wind, the prevailing wind would ventilate along San Ha Street and reach to the Development. With the presence of domestic tower at the junction of Wing Ping Street and San Ha Street, the approaching wind would be diverted into two air streams, one ventilates along San Ha Street and the other one flow through Wing Ping Street as indicated in Figure 22. Hence, the high-rise domestic tower would potentially cast wind shadow towards the northwest part of its own site and the adjacent SKH Chai Wan St. Michael’s Primary School and a portion of Chai Wan Road. Since the school site is relatively low-rise, the SE incoming wind from San Ha Street would skim over the school area and carry on travelling along Chai Wan Road, minor ventilation impacts on the adjacent school site and Chai Wan Road are expected.

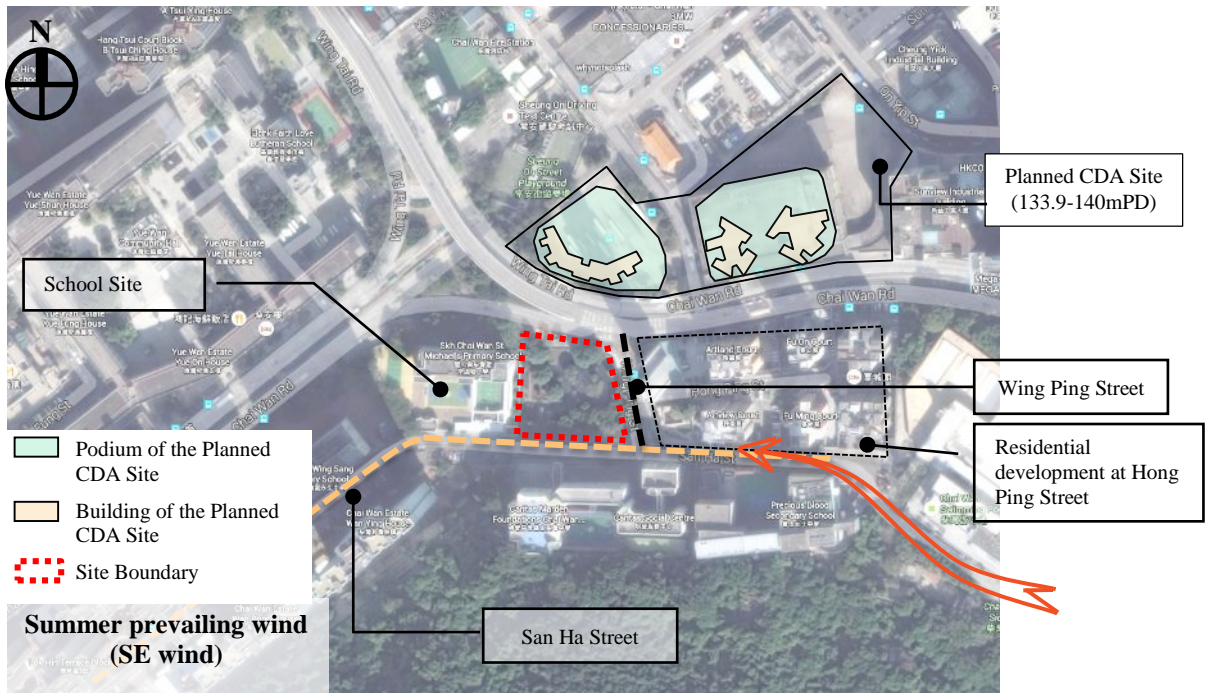


Figure 21 Wind environment under summer wind condition (SE Wind)

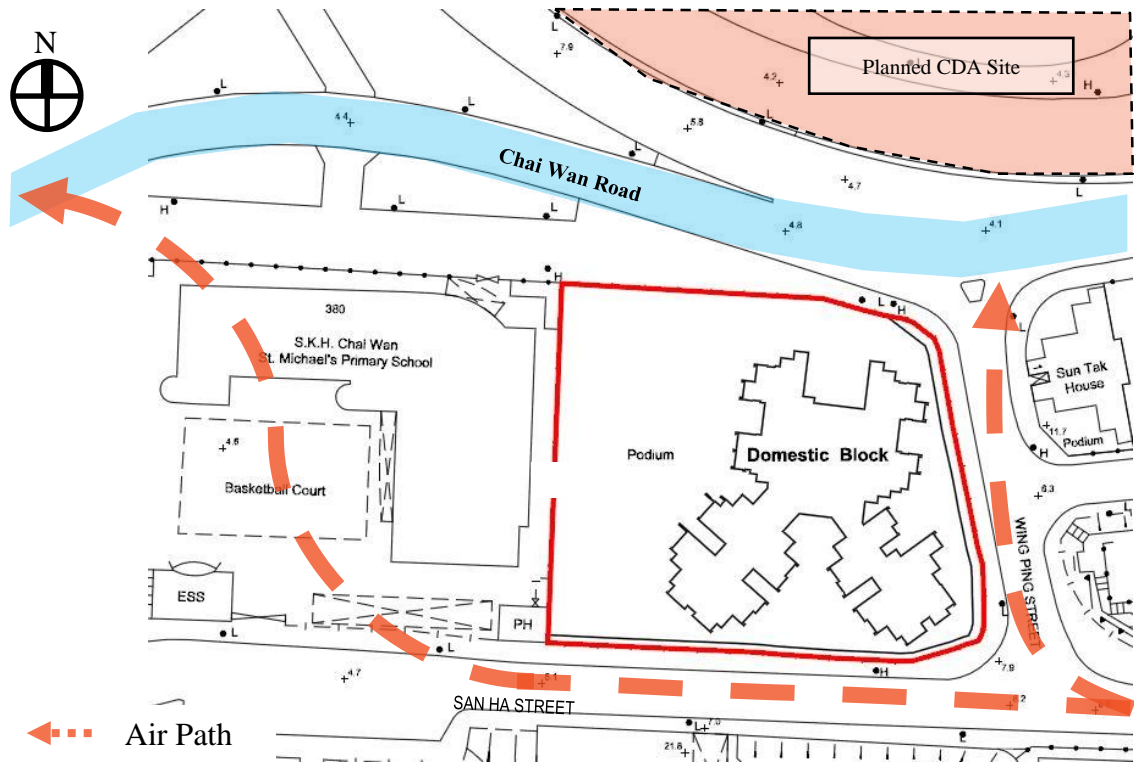


Figure 22 Summer wind condition (SE wind) of the Development

7 Recommendation

To further alleviate the wind performance of the Development and its surrounding areas and mitigate the localized ventilation impact on its downstream area, the following recommendation is suggested.

7.1 Empty bay at podium level

As discussed at Section 6.2, the presence of the Development would be likely to cause localised ventilation impact on Wing Ping Street and Hong Ping Street in comparison to the existing situation. Podium level empty bay (1 storey) of 10m in width could be considered at the southeast wing of the building block (Subject to detail design) to enhance summer wind permeability towards Wing Ping Street and Hong Ping Street at the leeward side.

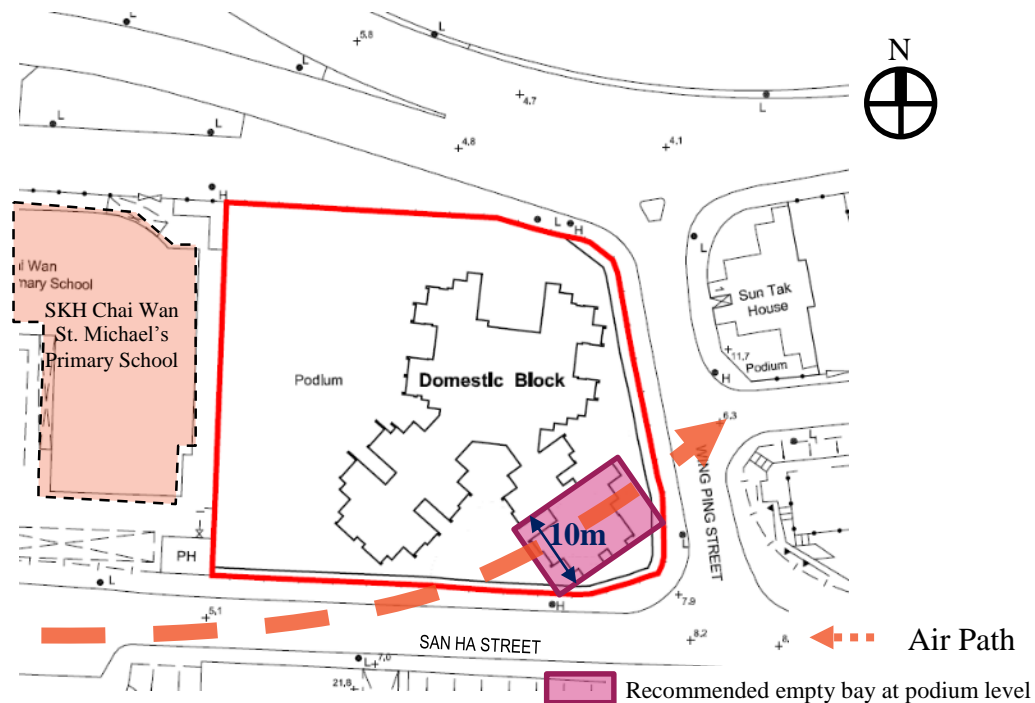


Figure 23 Recommended podium level empty bay for summer wind condition (Subject to future design)

8 Further Quantitative Study

In general, the Development may not significantly affect the ventilation performance of the major breezeway of Chai Wan Road under annual wind condition due to the tower setback from Chai Wan Road. However, localized ventilation impact would be induced at the school sites under annual condition and at Chai Wan Road and planned CDA site under summer condition. With provision of the below adopted and recommended mitigation measures listed below (Subject to detail design), the wind environment of leeward side is expected to be alleviated.

- 7m tower setback from Chai Wan Road
- 18m tower setback from adjacent school site
- Suggested 10m wide podium level empty bay

Since the ventilation impact of the Development would be subject to the detailed building design of the Development, it is recommended to proceed with the AVA Initial study to optimise the wind performance at the building design stage in accordance with the guideline given in “*HOUSING, PLANNING AND LANDS BUREAU TECHNICAL CIRCULAR NO. 1/06 ENVIRONMENT, TRANSPORT AND WORKS BUREAU TECHNICAL CIRCULAR NO. 1/06, Technical Guide for Air Ventilation Assessment for Developments in Hong Kong*”. The above recommended mitigation measures would be taken into account and assessed in the Initial Study.

9 Conclusion

Qualitative assessment of the wind environment of the Development at Chai Wan Road was conducted. The air ventilation impacts of the building design was studied.

According to the analysis, the annual prevailing wind comes from NNE, NE, ENE and E directions while the summer prevailing wind is from E, SE, S, SSW, and SW directions.

The Development consists of single building block that it is slightly setbacked from major breezeway of Chai Wan Road, so that the Development would not significantly affect the ventilation performance of the major breezeway of Chai Wan Road under the annual wind condition.

Besides, although localized ventilation impact would be induced at leeward side under summer and annual condition, tower setback is maintained with adjacent SKH Chai Wan St. Michael's Primary School to the west would allow wind penetration and reduce the ventilation impacts at the leeward side under summer and annual wind condition.

In addition, the Development could consider to further provide a 1 storey empty bay at podium level to improve the ventilation. It is also important to maintain the tower setback between building block and school building to facilitate wind penetration across the Development and hence minimize the localized ventilation impact.

While this Expert Evaluation provides qualitative analysis of wind performance of the Development, AVA Initial study is recommended to further optimize the wind performance at the building design stage.