Agreement No. C11081 Detailed Design for Re-provisioning of Ma Chai Hang Recreation Ground - Air Ventilation Assessment – Expert Evaluation Report for Section 16

Nov 2020

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1 Introduction

The objective of the Expert Evaluation of Air Ventilation Assessment (AVA-EE) is to review and evaluate the natural ventilation performance for the proposed re-provisioning of Ma Chai Hang Recreation Ground at Ma Chai Hang Road, Wong Tai Sin, Kowloon. The methodology and requirements as outlined in the Technical Guide for Air Ventilation Assessment for Development in Hong Kong (Technical Circular No. 1/06 and Annex A) issued by Housing, Planning and Lands Bureau and Environment, Transport and Work Bureau in 2006 will be followed. The location and coverage of the Development Site are shown in **Figure 1.1**.

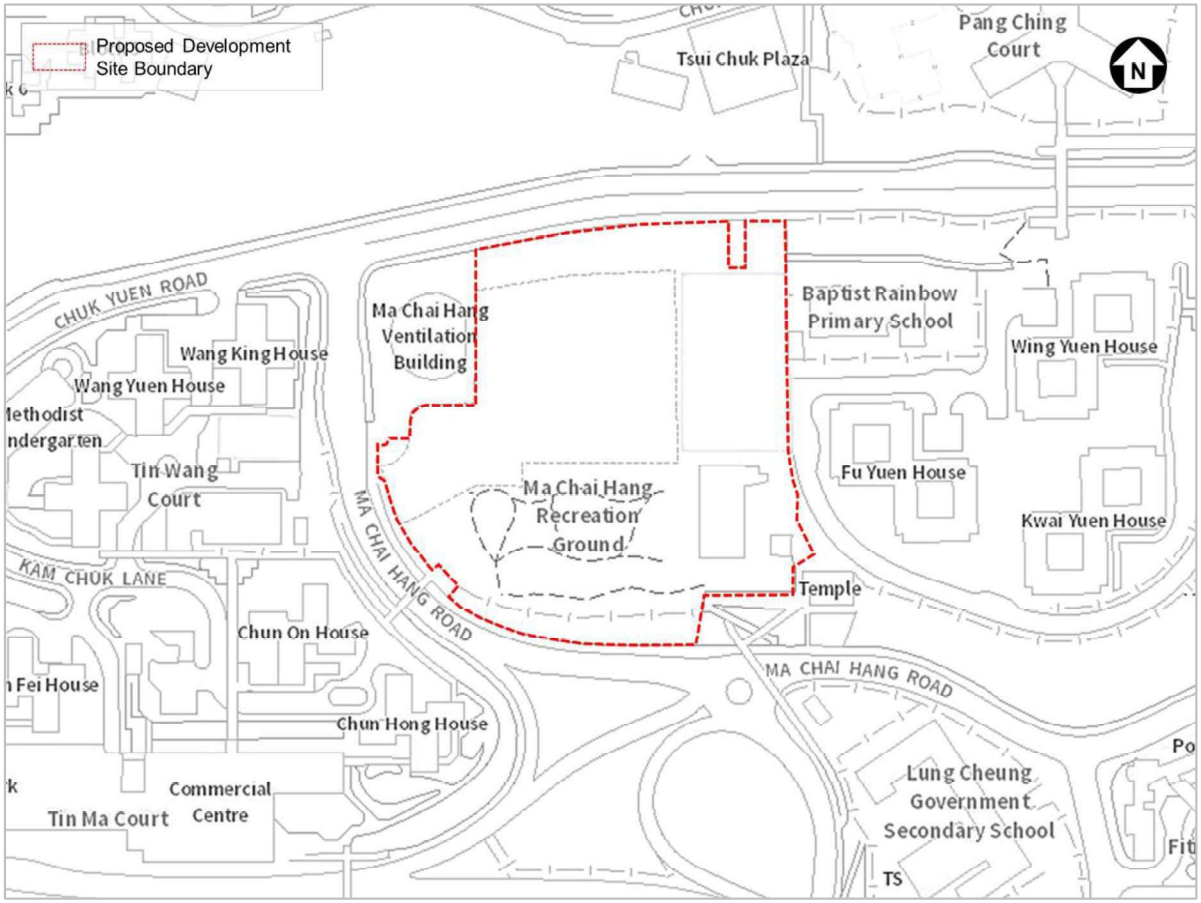


Figure 1.1 – Location of the Development Site

The Expert Evaluation is a qualitative assessment to evaluate the wind characteristics of the proposed Development Sites and its vicinity areas. The "Feasibility Study for the Establishment of Air Ventilation Assessment System" published by Hong Kong PlanD and Chinese University of Hong Kong in 2005 which indicated the qualitative guiding principles for the air

ventilation assessment will be referred to provide useful design reference for better air ventilation. The "Urban Design Guidelines" of Hong Kong Planning Standards and Guidelines Chapter 11 which provides the qualitative guidelines on air ventilation on both district and site level for better identifying the wind environment on pedestrian level as well as the "Sustainable Building Design Guidelines PNAP APP-152" by Building Department are also referred. Based on the existing wind data availability for the site, the following evaluation will be undertaken.

- Propose the guiding principles from air ventilation perspective under both annual and summer conditions;
- Identify major breezeway/air paths;
- Examine the merits and demerits of the proposed development layout;
- Identify the rough order of the magnitude of possible wind problem areas;
- Recommend in refine the development layout with incorporation of proposed mitigation measures;
- Recommend in consultation if further study should be staged into AVA Initial Study or Detailed Study.

The natural ventilation performance due to these changes is assessed under both of annual and summer prevailing wind directions. The likely prevailing wind patterns and directions at the pedestrian level of the assessment area and its surrounding environment will be assessed qualitatively. All adjacent existing and/or planned developments as well as the surrounding topographic characteristic will also be considered.

2 The Surrounding Environment

2.1 Surrounding Topography

As shown in **Figure 2.1**, the Development Site for the propose of re-provisioning of Ma Chai Hang Recreation Ground is situated at the south side of foothill of Lion Rock (~490mPD high) and the junction of Ma Chai Hang Road and Chuk Yuen Road, Kowloon. There are many developed urban areas with high-rise building blocks on a relatively flat land at the south, east and north sides of the Site, while some open areas and low-rise developments in the west.

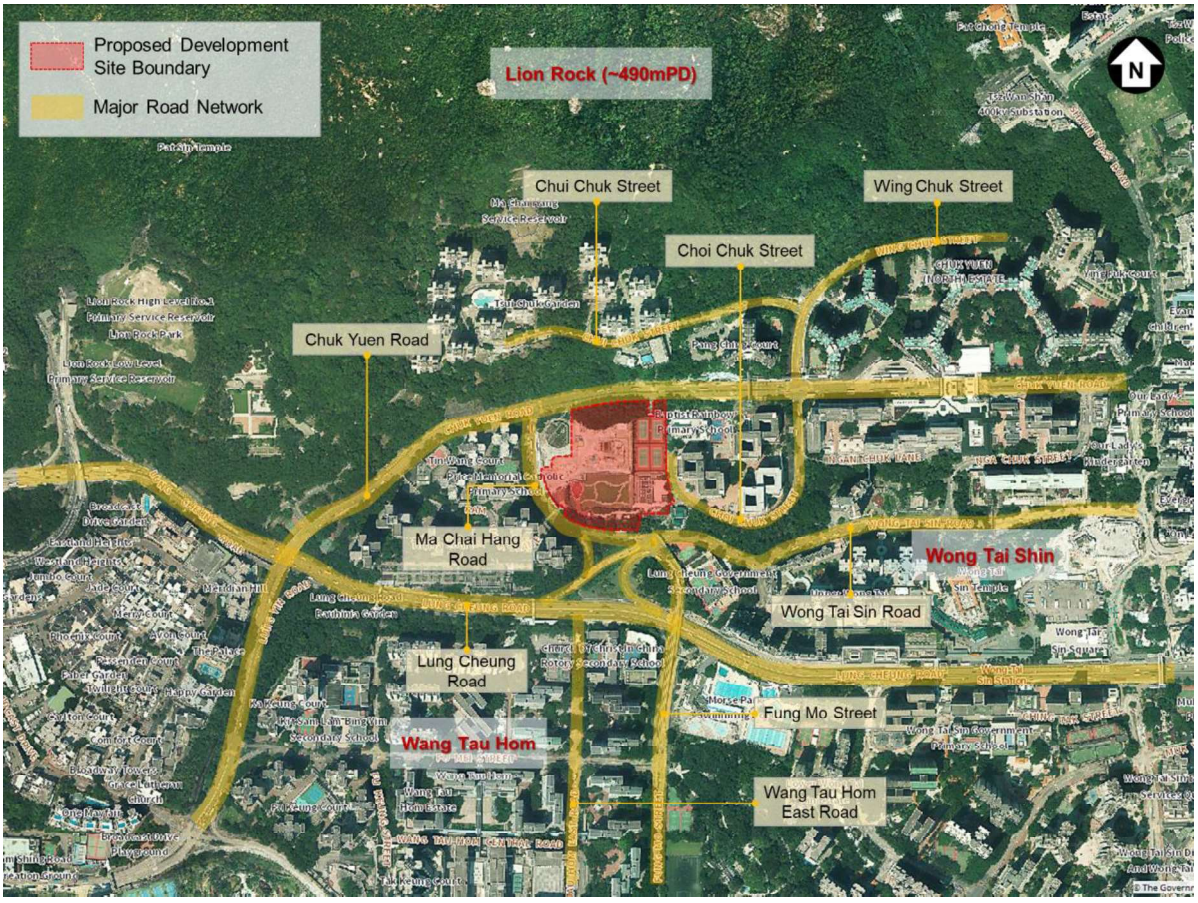


Figure 2.1 – Surrounding Topography of the Development Site

The digital elevation map around the Development Site area and its surroundings shows that there is an increase of the ground level from the south towards the north (see **Figure 2.2**). Referring to the road network in **Figure 2.1**, the ground rises gently northwards until Lung Cheung Road and then it goes steeper. The overall ground can be assumed reasonably flat with the west side being a little higher and the existing Site area is within the 40~60mPD level.

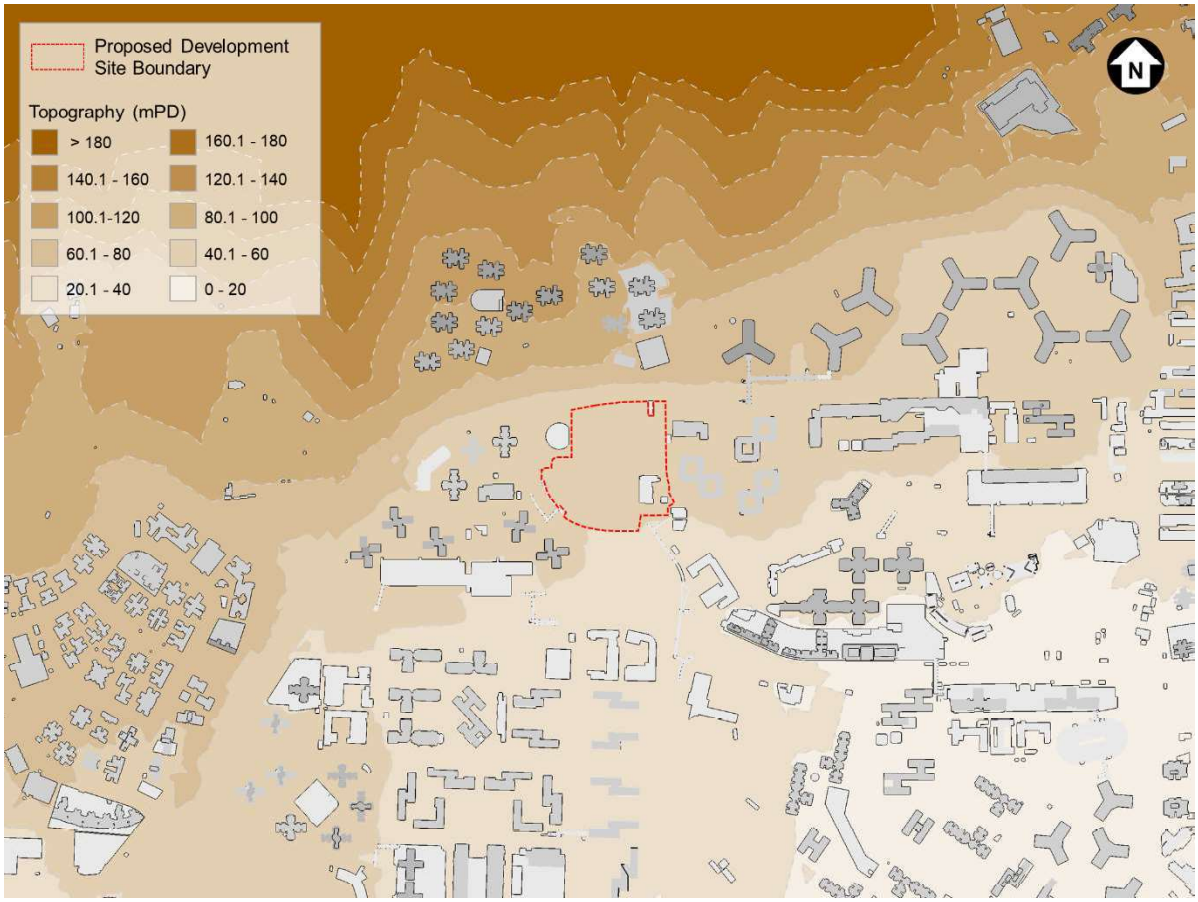


Figure 2.2 – Digital Elevation Map around the Development Site

2.2 Adjacent Features

In terms of topography, the Development Site is located on a relatively flat zone. Based on site inspection and preliminary desktop analysis and referring to **Figures 2.3** and **2.4**, the major surrounding building features include many low to high-rise residential buildings, Government, Institution and Community (G/IC) developments, elevation bridges and footbridges, etc. Moreover, several Non-Building Areas (NBAs), open spaces/areas and green belts in the vicinity of the Site are also observed.

With reference to the Statutory Planning Portal 2 of the Town Planning Board, the existing Site area (Ma Chai Hang Recreation Ground) and the Ma Chai Hang Ventilation Building could be regarded as open space areas. In its surrounding, several open spaces/areas could also be observed, i.e., Lion Rock Park, Lung Cheung Road Bauhinia Garden in west site, Morse Park in farther south side, etc. Moreover, two NBAs could be found close to the Lion Rock Park and Lung Cheung Road Bauhinia Garden.

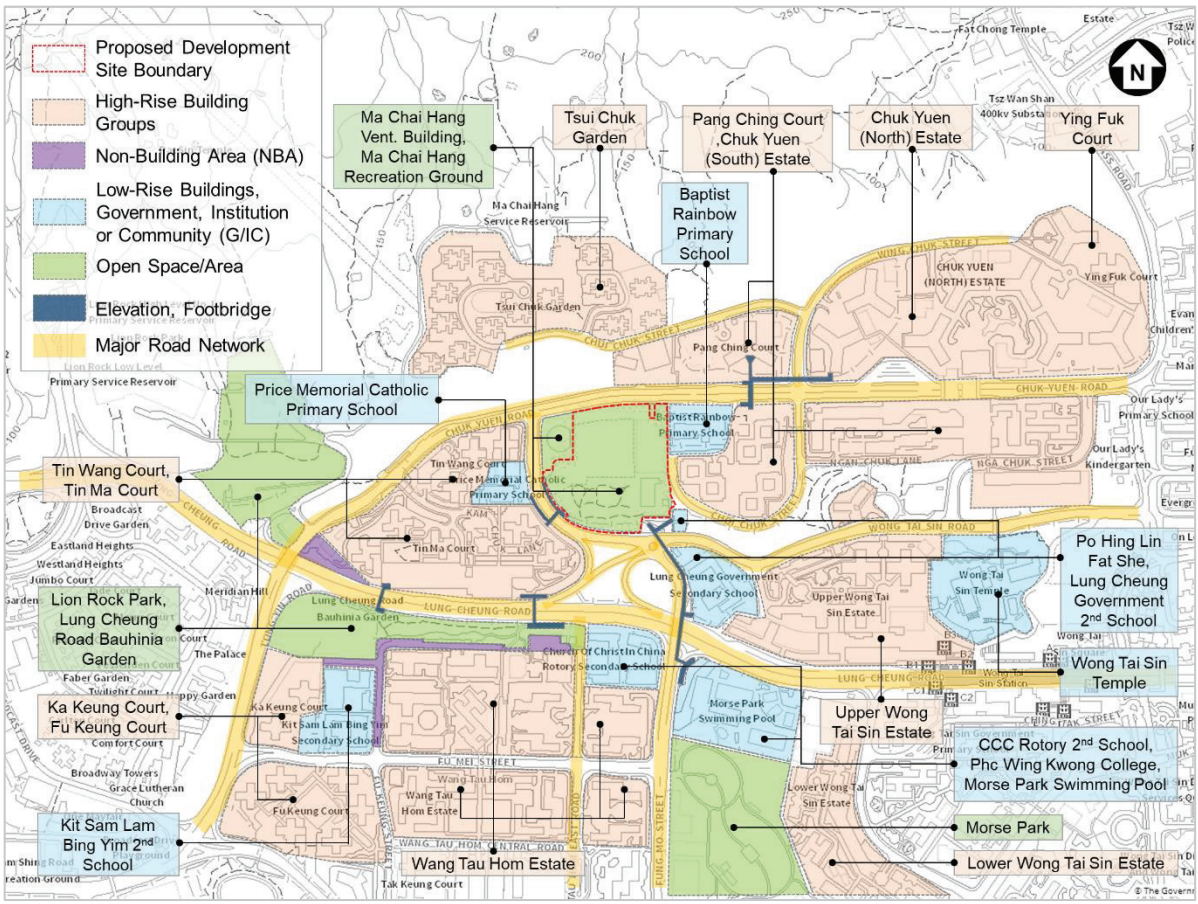


Figure 2.3 – Major Developments and Surroundings of the Development Site

There are several low-rise buildings and G/IC developments next to the Site and its vicinity, i.e., Price Memorial Catholic Primary School in the west; Kit Sam Lam Bing Yim Secondary School in the south-west, Po Hing Lin Fat She, Lung Cheung Government Secondary School, CCC Rotory Secondary School, Phc Wing Kwong College and Morse Park Swimming Pool in the south; Baptist Rainbow Primary School in the east and Wong Tai Sin Temple in the farther east side, etc.

Surrounding the Site, the high-rise residential buildings can be observed, such as Tsui Chuk Garden, Pang Ching Court, Chuk Yuen (north) Estate, Ying Fuk Court, Chuk Yuen (south) Estate and Upper Wong Tai Sin Estate, etc. from north to east. The high-rise residential buildings can be found in the south and west of the site as well, including Lower Wong Tai Sin Estate, Wang Tau Hom Estate, Ka Keung Court, Fu Keung Court, Tin Wang Court and Tin Ma Court, etc.

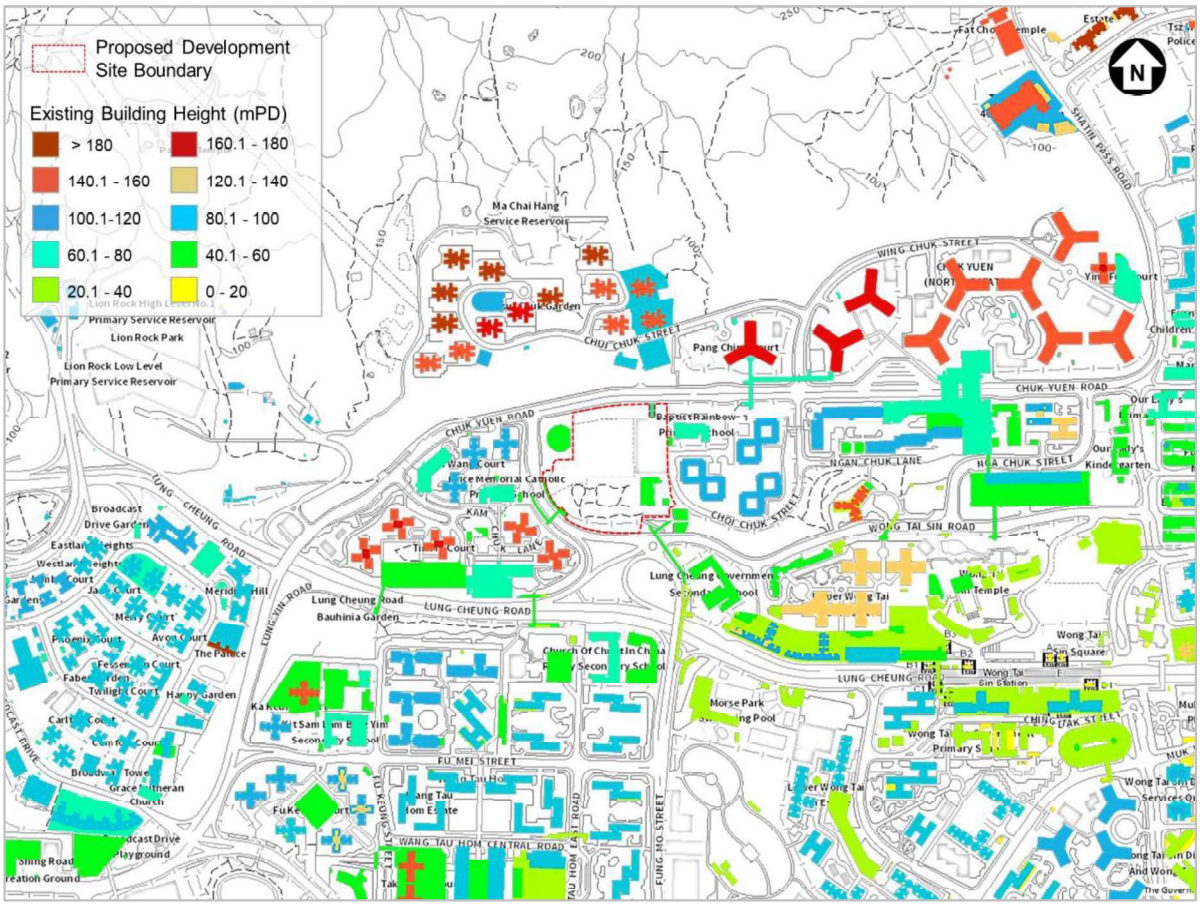


Figure 2.4 – Existing Building Height Plan around the Development Site

Moreover, as shown in **Figures 2.3** and **2.4**, several elevated bridges and footbridges are observed around the Site. The footbridges are generally located on the major road, i.e., the north side footbridge on the junction of Chuk Yuen Road and Wing Chuk Street to connect Pang Ching Court, Chuk Yuen (north) Estate and Chuk Yuen (south) Estate; the south-east side footbridge on the junction of Lung Cheung Road and Wong Tai Sin Road to connect Po Hing Lin Fat She, Lung Cheung Government Secondary School and Morse Park Swimming Pool; two south side foot bridges on the Lung Cheung Road to connect Tin Ma Court and Lung Cheung Road Bauhinia Garden; as well as the footbridge close to the south-west corner of the Site to take the connection role between the Site, Price Memorial Catholic Primary School and Tin Ma Court.

Referring to **Figure 2.1**, the major road networks namely Chuk Yuen Road, Ma Chai Hang Road, Lung Cheung Road, Wang Tau Hom East Road, Fung Mo Street, Wong Tai Sin Road, Choi Chuk Street, Chui Chuk Street and Wing Chuk Street are in the vicinity of the Site.

3 Site Wind Availability

3.1 Wind Environment

In the assessment of air ventilation at the pedestrian level inside an urban area, the long-term characteristics of the approaching wind would need to be known in advance. For instance, the occurrence, i.e. the frequency of a typical wind direction is the key parameter for the subsequent assessment. This information is also essential for the performance comparison for different building forms for a special site. To obtain the site wind availability in Ma Cha Hang, several widely accepted methods could be adopted, e.g., Hong Kong Observatory (HKO) direct measurement, reduced scale wind tunnel test and the mathematical models. In accordance with the AVA Technical Guide, all these methods are considered acceptable. The natural ventilation performance is assessed under annual and summer (June to August) prevailing wind directions. The non-typhoon wind roses for both annual and summer prevailing winds of a typical year should be adopted as the site wind availability for this study.

3.2 Wind Data from Hong Kong Observatory

Figure 3.1 shows several weather stations operated by HKO and could provide both monthly and annual data of wind roses. The location of the Development Site is also added for easy reference. Around the Site, the HKO Headquarters Weather Station in Tsim Sha Tsui is the nearest manned weather station (about 5km distance) from the Site in Ma Chai Hang. Therefore, the wind roses from this weather station would be considered for the subsequent assessment.

Based on the average annual wind rose at HKO Headquarters Weather Station from 1981 to 2010 in **Figure 3.2**, which are extracted from the HKO's website as below, it is observed that the winds from East (E) direction has the highest probabilities of occurrence, while the winds from East-North-East (ENE) and West (W) directions have over 10% frequency. As a result, the annual prevailing winds in Tsim Sha Tsui could be considered as the E, ENE and W winds.

https://www.hko.gov.hk/en/cis/region_climat/windrose.htm?&std=HKO

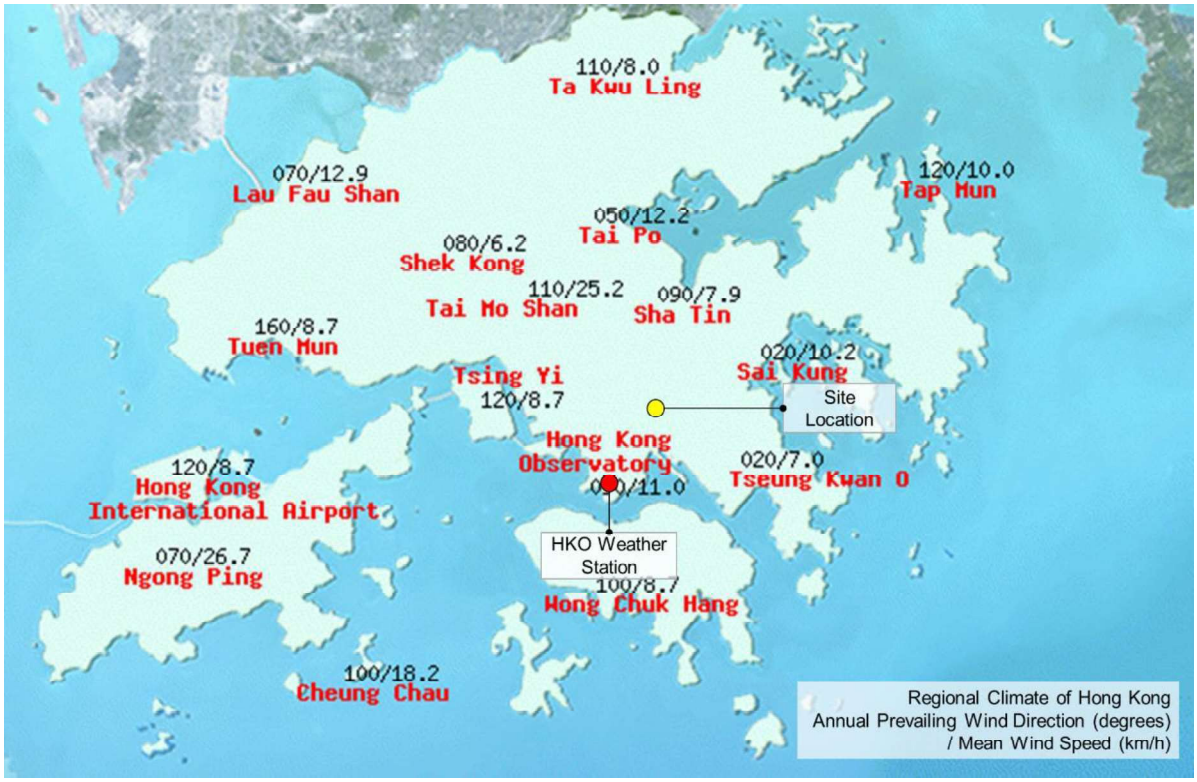


Figure 3.1 – Some of HKO Weather Stations and the Site Location.

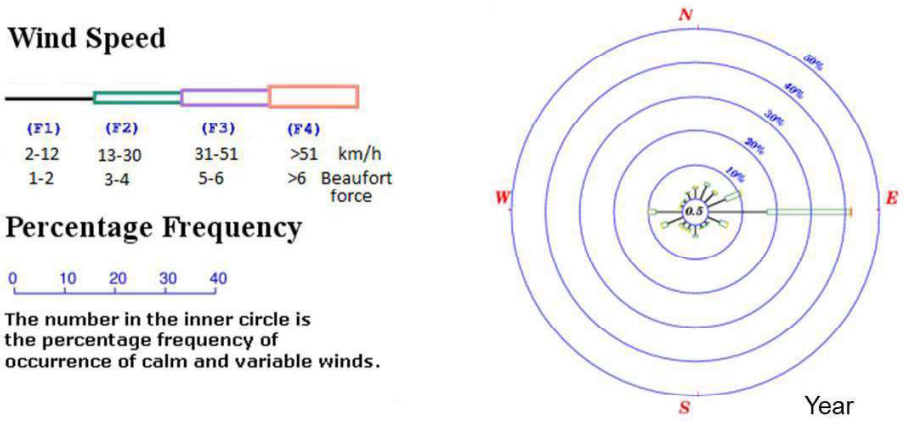


Figure 3.2 – Annual Wind Roses for Tsim Sha Tsui, 1981-2010

Wind data from June to August can reflect the wind environment during summers and are used to identify the prevailing summer wind directions. **Figure 3.3** shows the average monthly wind roses from 1981 to 2010 of the summer months at HKO Tsim Sha Tsui Station, the wind from E direction has percentage frequency occurrences of close to 30% in all the three summer months. The others dominant winds from South (S), West-South-West (WSW) and West (W) directions have obtained the percentage frequency occurrences of close to or over 10% in June

and July. It also has more than 10% frequency in W and WSW winds in July and August. Thus, the winds from E, S, WSW and W directions could be considered as the summer prevailing wind directions in Tsim Sha Tsui area.

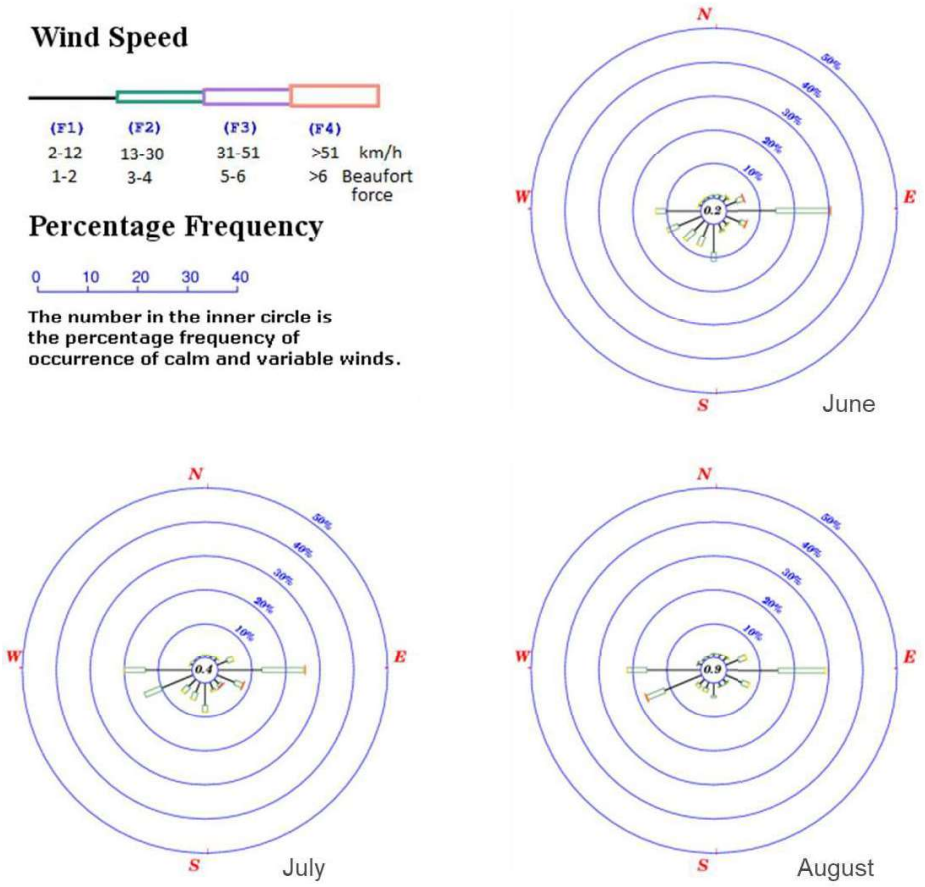


Figure 3.3 – Monthly Wind Roses in Summer for Tsim Sha Tsui, 1981-2010

As the data of wind roses is based on the HKO's measurements and the Development Site at Ma Chai Hang is about 5km away from the HKO weather station in Tsim Sha Tsui, the prevailing winds will be redirected and channelled by local surrounding environment and terrain features which locates slightly farther away from the Site. It means the more accuracy of wind data should be considered in the site wind evaluation.

3.3 Wind Data from Wind Tunnel Test

The Development Site is about 1km away from San Po Kong area. Therefore, the wind data get from the wind tunnel test for San Po Kong could be used for reference. The reduce scale wind tunnel test for the Experimental Site Wind Availability Study for San Po Kong area was conducted by the CLP Power Wind/Wave Tunnel Facility (WWTF) at The Hong Kong

University of Science and Technology in August 2009. The full report could be obtained from the website as below:

http://www.pland.gov.hk/pland_en/info_serv/site_wind/SanPoKong_site_wind.pdf

As shown in **Figure 3.4**, the wind roses corrected 200mPD level of San Po Kong is adopted in assessment as it gives a better representation on the topographical effect in proximity. Based on the wind data from the wind tunnel test and the annual wind roses, the North (N), North-East (NE) and East-South-East (ESE) winds has about 12%, 25% and 28% frequency occurrence, respectively. As a result, the N, NE and ESE winds could be identified as the annual prevailing wind directions in San Po Kong. Moreover, the ESE, S and WSW winds has about 22%, 10% and 25% frequency occurrence, respectively and these wind directions could be identified as the summer prevailing wind directions. Like the discussion in Seciton 3.2, these prevailing winds from San Po Kong to the current Development Site will also be redirected and channelled by its local surrounding environments.

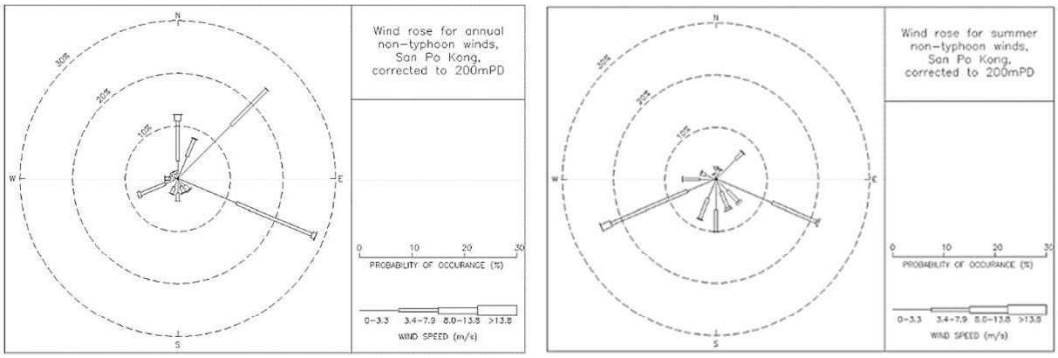


Figure 3.4 – Annual (left) and Summer (right) Wind Roses for San Po Kong

3.4 Wind Data from Previously AVA Expert Evaluation Report

The previously AVA-EE report of "Cat.A1-Term Consultancy of Expert Evaluation and Advisory Services on Air Ventilation Assessment (PLNQ 37/2007), Final Report Wang Tau Hom & Tung Tau Area 2010" (WTH&TTA AVA report 2010) by Chinese University of Hong Kong summarized several wind data of Wang Tau Hom and Tung Tau area via HKO measurements and MM5 simulations.

Referring to this "WTH&TTA AVA report 2010", the wind data at Kowloon Tsai station have been extracted for HKO as the nearest stations measuring wind. It's located between Lok Fu Park and Kowloon Tsai Park farther south-west side of the current Development Site. As shown

in **Figure 3.5**, the Kowloon Tsai's annual wind rose shows a prevailing wind direction of E, ESE and South-East (SE) with the consideration of over 10% frequency occurrence. While the summer prevailing wind directions are E, ESE, SE, S and WSW.

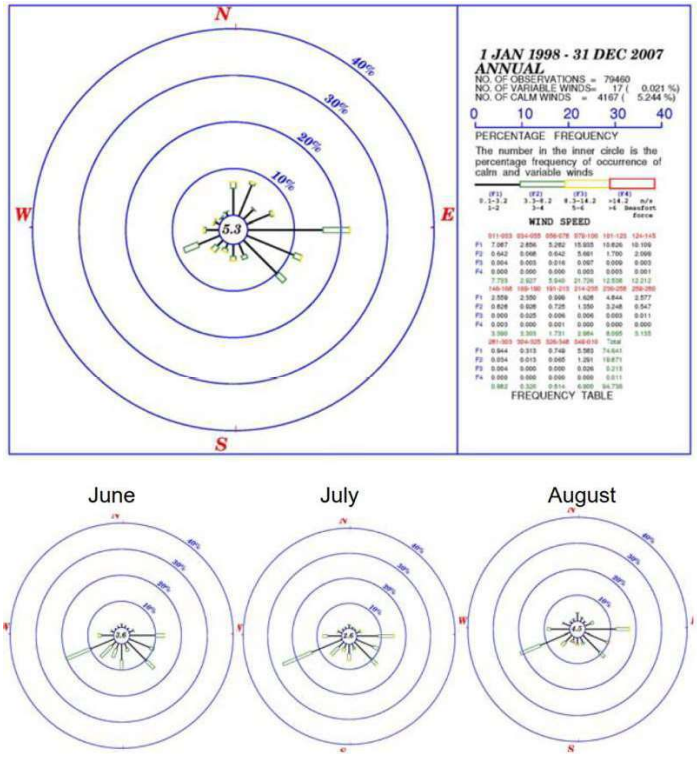


Figure 3.5 – Annual and Monthly (summer) Wind Roses for Tsim Sha Tsui, 1981-2010

Moreover, a set of wind data using MM5 simulations have also been provided in this report. Referring to this report, the wind data of locations A and B which in north-west and south-west side of the current Development Site, respectively are obtained for reference. In general, based on the MM5 wind roses, the annual prevailing wind directions are NE and E, while E, SE, SW and W winds are summer prevailing winds in location A. Also, in location B, the annul prevailing winds are NE, E and summer prevailing winds are E, SE and W. However, this MM5 data period only covered the whole year of 2004, the wind data in recently years may not be well reflected based on the MM5 simulation results.

3.5 Wind Data from Hong Kong PlanD

In recent years, a study on simulated site wind availability data for AVA in Hong Kong was conducted by City University of Hong Kong. It has been published online on Hong Kong Planning Department's website for public use since the middle of 2015. In the present study, the mesoscale model Regional Atmospheric Modelling System (RAMS) is used to simulate the

site wind data including wind rose and wind profile. As a result, the latest wind data and simulation method can be obtained. Based on the site wind availability data available on PlanD's website, the development site is located within grid (X:083 Y:048). **Figure 3.6** shows the location of the grid. The detailed site wind availability data of the development site could be found from the website as below.

https://www.pland.gov.hk/pland_en/info_serv/site_wind/site_wind/083048.html

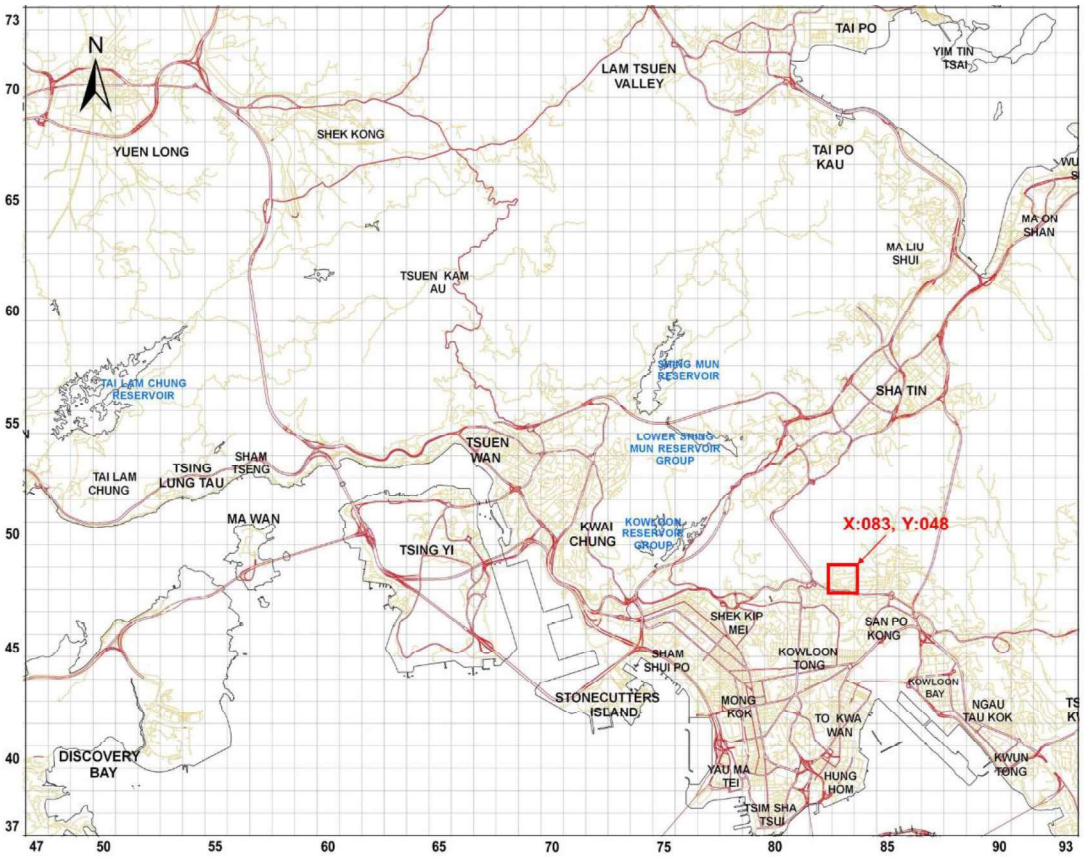


Figure 3.6 – Site Wind Availability Data Points for the Development Site

Figure 3.7 and **Tables 3.1** and **3.2** are the wind roses for annual and summer non-typhoon winds on the Development Site, corrected to 500, 300 and 200m height levels above ground, respectively. In the present study, the height level of 200m is adopted in determining the prevailing annual/summer winds. According to the wind rose plots below and the summary in **Table 3.1**, the E wind has more than 20% frequency of occurrence in annual wind data. Furthermore, the North-North-East (NNE), ENE and ESE winds have about 10% frequency of occurrence in annual wind data. In conclusion, the annual prevailing wind directions are NNE, ENE, E and ESE in the Development Site.

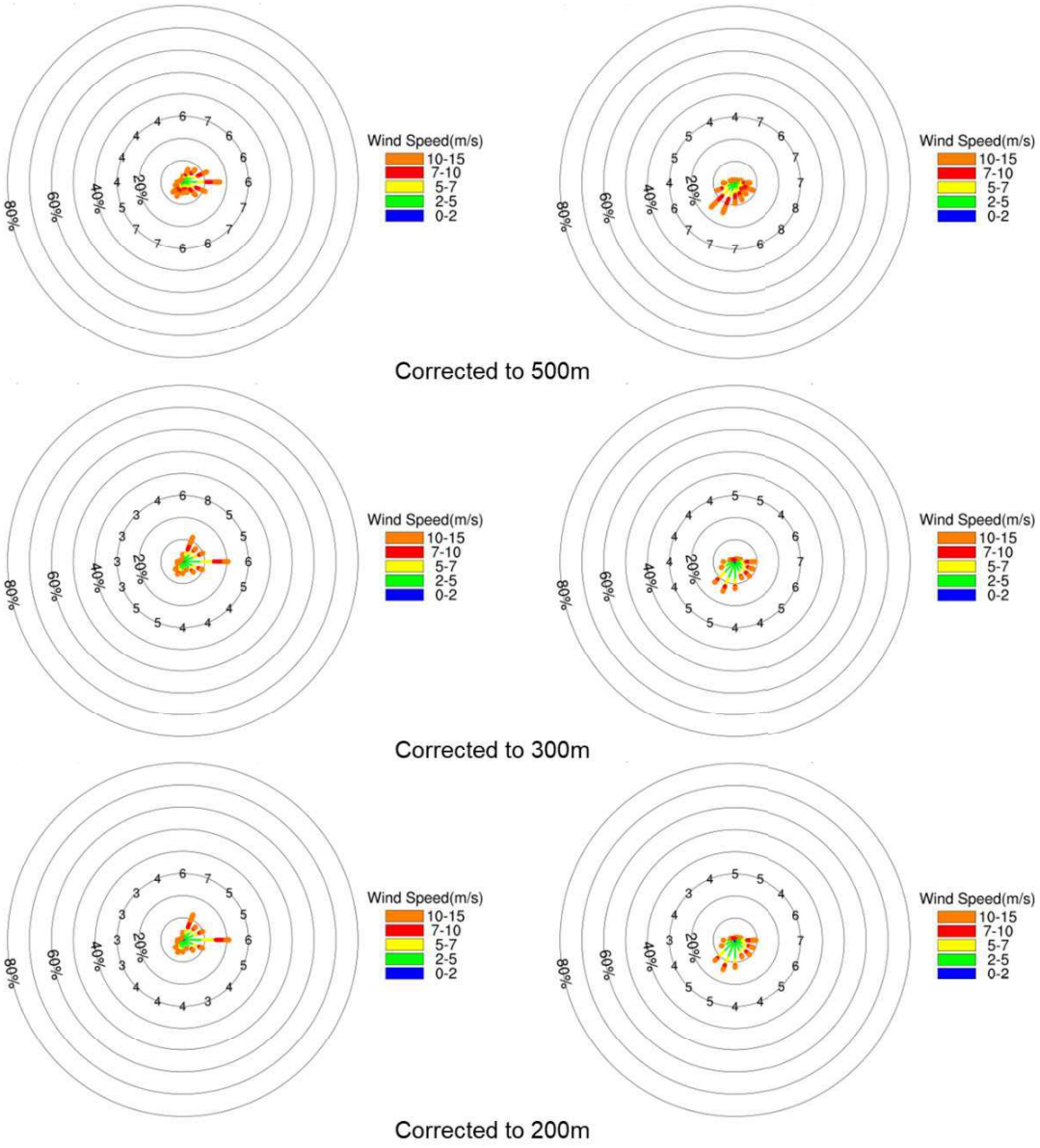


Figure 3.7 – Annual (left) and Summer (right) Wind Roses for Grid (X:083, Y:048)

Refer to **Figure 3.2** and **Table 3.2**, the summer prevailing winds are coming from S, South-South-West (SSW) and SW directions. In grid, both S, SSW and SW winds have over 10% frequency of occurrence. As a result, the S, SSW and SW could be considered as the summer prevailing wind directions.

Table 3.1 – Annual Percentage Occurrence of Directional Winds for Grid (X:083, Y:048)

Height	N	**NNE**	NE	**ENE**	**E**	**ESE**	SE	SSE
500m	0.027	**0.066**	0.081	**0.120**	**0.172**	**0.112**	0.083	0.051
300m	0.033	**0.121**	0.083	**0.100**	**0.208**	**0.097**	0.068	0.042
200m	0.034	**0.124**	0.082	**0.099**	**0.212**	**0.098**	0.066	0.043
Height	S	SSW	SW	WSW	W	WNW	NW	NNW
500m	0.050	0.070	0.065	0.037	0.027	0.013	0.012	0.013
300m	0.055	0.062	0.049	0.027	0.025	0.013	0.008	0.009
200m	0.054	0.061	0.048	0.027	0.024	0.012	0.007	0.009

Table 3.2 – Summer Percentage Occurrence of Directional Winds for Grid (X:083, Y:048)

Height	N	NNE	NE	ENE	E	ESE	SE	SSE
500m	0.012	0.014	0.018	0.032	0.072	0.091	0.074	0.083
300m	0.012	0.015	0.018	0.028	0.092	0.089	0.093	0.080
200m	0.012	0.015	0.018	0.029	0.096	0.091	0.093	0.082
Height	**S**	**SSW**	**SW**	WSW	W	WNW	NW	NNW
500m	**0.096**	**0.147**	**0.157**	0.089	0.054	0.025	0.019	0.015
300m	**0.122**	**0.145**	**0.132**	0.068	0.055	0.025	0.015	0.010
200m	**0.123**	**0.144**	**0.130**	0.068	0.054	0.023	0.014	0.010

3.6 Prevailing Wind Conditions

Table 3.3 shows the summary of annual and summer prevailing wind directions from different sets of site wind availability data. Based on discussion above, in the present study, the numerical wind data from the RAMS model will be considered for further evaluation on the wind environment on and around the Development Site.

As a result, the annual prevailing wind directions are considered as NNE, ENE, E and ESE directions in the Development Site; while the summer prevailing winds are under S, SSW and SW directions (see **Figure 3.8**). These prevailing wind directions are typical in Hong Kong and the building form of proposed housing development should make full use of these wind conditions.

Table 3.3 – Summary of Prevailing Wind Directions

Site Wind Data	Relative Position	Prevailing Winds	
		Annual	Summer
HKO measurement (Tsim Sha Tsui)	in farther SW side (~ 5km)	E, ENE, W	E, S, WSW, W
Wind Tunnel measurement (San Po Kong)	in farther SE side (~ 1km)	N, NE, ESE	ESE, S, WSW
HKO data from "WTH&TTA AVA report 2010" (Kowloon Tsai)	in farther SE side (~ 1km)	E, ESE, SE	E, ESE, SE, S, WSW
MM5 data from "WTH&TTA AVA report 2010" (location A)	in NW side (~500m)	NE, E	E, W, SE, SW
MM5 data from "WTH&TTA AVA report 2010" (location B)	in SW side (~500m)	NE, E	E, W, SE
RAMS numerical model (on the Site area)	on Site area	**NNE, ENE, E, ESE**	**S, SSW, SW**

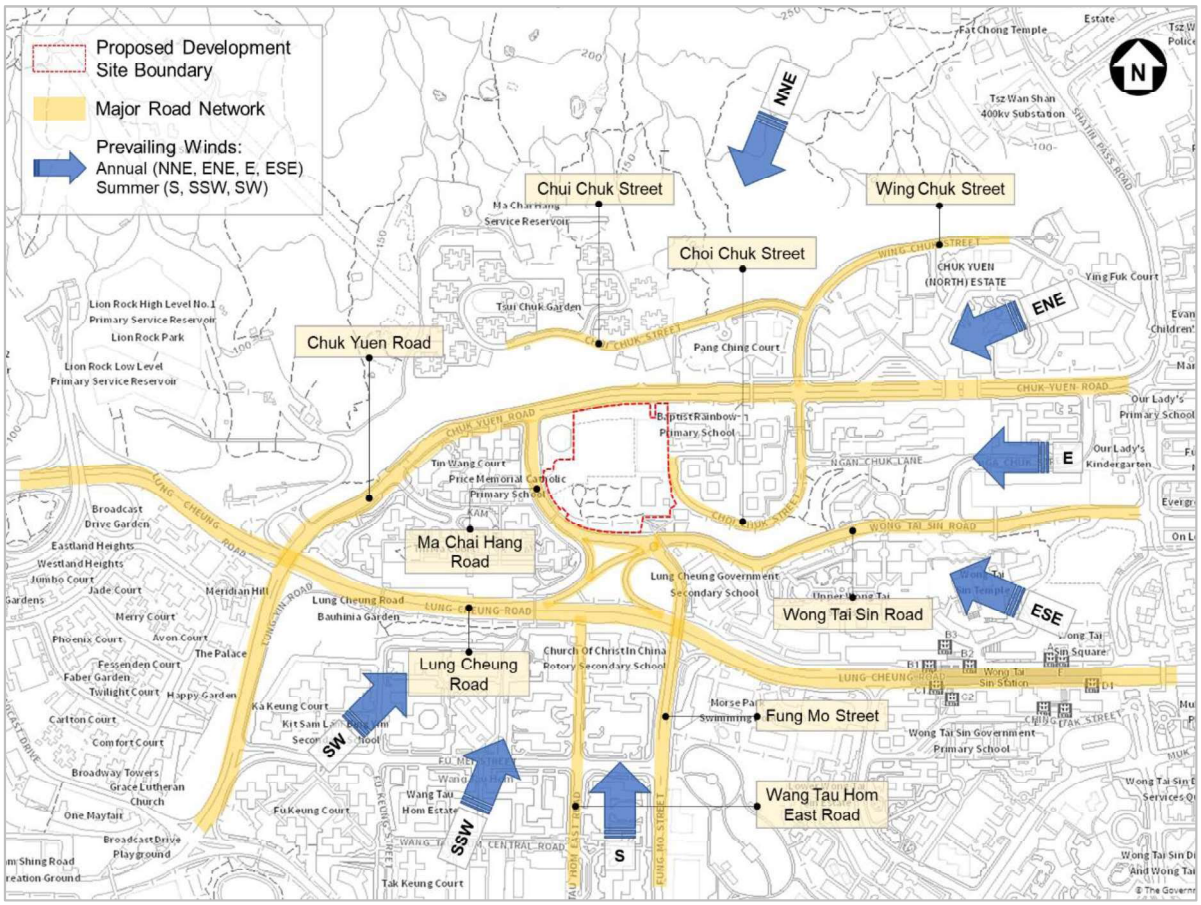


Figure 3.8 – Summary of Annual and Summer Prevailing Winds of the Development Site

4 Design Option for Proposed Building Plan

4.1 Initial Development Layout

Figure 4.1 and **Annex A** show the indicative Development Site layout plan for the re-provisioning of Ma Chai Hang Recreation Ground. The proposed re-provision comprised the construction of a 5-storey Sports Centre, 2-storey Annex Building, Football Field and at-grade Tennis Courts and Associated Facilities. Referring to **Table 4.1**, **Annexes B** and **C**, the 5-storey Sports Centre of +78.00mPD level high is in north-eastern corner of the Development Site, while a 2-storey Annex Building of +58.25mPD level high is in south-western corner of the Site. Moreover, there is a Football Field at the centre of the Site. Two at-grade Tennis Courts are on the west side of Football Field, while outdoor activities space with children recreation facilities and fitness equipment are on the south-eastern side of Football Field.

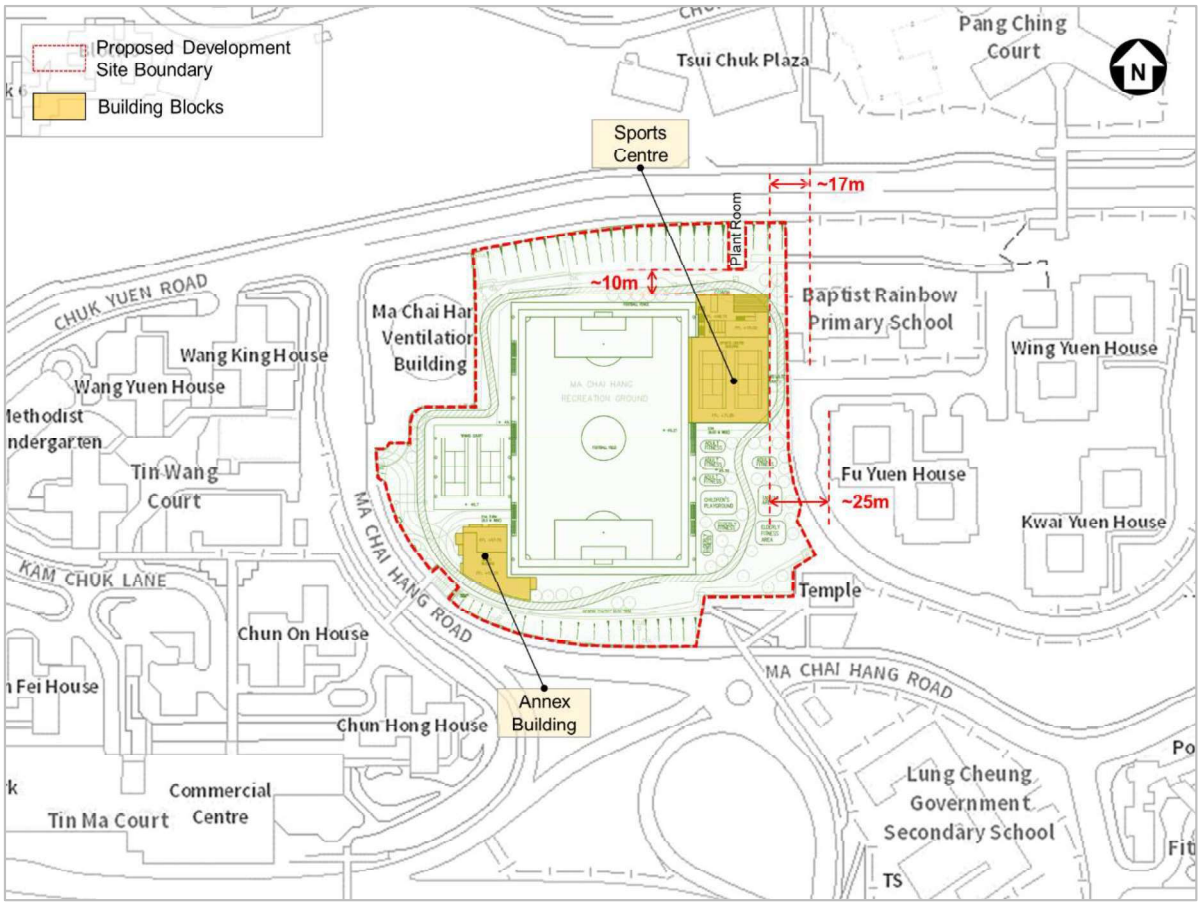


Figure 4.1 – Top View of the Development Site Layout Plan (Initial Development)

Table 4.1 – Summary of Proposed Development Parameters

Blocks	Storeys	Maximum Building Height
Sports Centre	5	+78.00mPD
Annex Building	2	+58.25mPD
Football Field	NA	+45.21mPD
Tennis Court	NA	+45.70mPD
Associated Facilities	NA	+45.39mPD

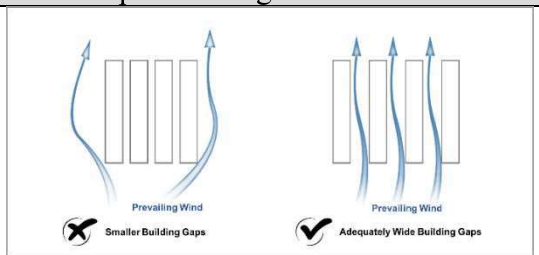
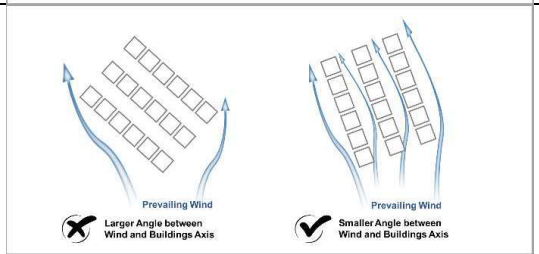
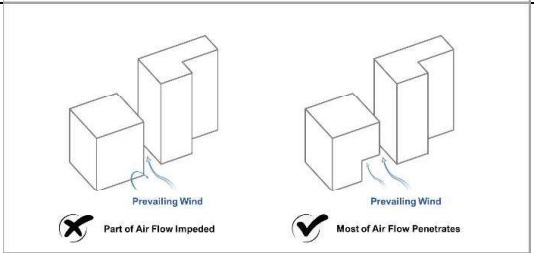
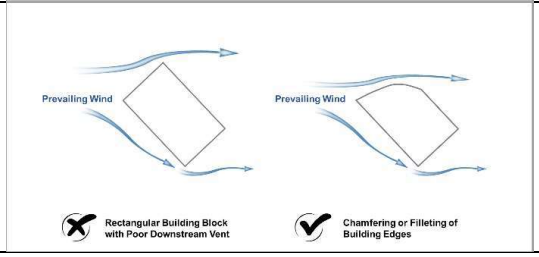
Referring to the description in Section 2, the major surrounding building features including a number of low to high-rise developments as well as open areas, green belts located in the vicinity of the Site. The increasing in development intensity as compared to the existing condition would inevitably lead to some effect on the surrounding pedestrian wind environment. The proposed development includes only two low-rise building blocks, it's envisaged that the adjacent existing development would not be significantly affected under annual prevailing NNE, ENE, E and ESE winds by the proposed sport centre since it is located at the leeward side. The location of the Baptist Rainbow Primary School would be at the leeward side of the proposed Sports Centre under summer prevailing S, SSW and SW winds. In order to minimize the air ventilation impact on the surround area, especially on the Baptist Rainbow primary school, the qualitative mitigation measures for the proposed building plan have been considered as follows and summarized in **Table 4.2**, which may help to alleviate the potential adverse impact of the proposed developments.

1) The building disposition can help to bring in prevailing wind to the site and its vicinity and the buildings separation with at least 15m wide is suggested. As shown in **Figures 4.1** and **4.2**, the disposition of the Sports Centre has been arranged about 17m away from the Baptist Rainbow Primary School to allow a clear wind corridor in N-S direction. Such building separations would allow wind penetration of the prevailing wind of S, SSW and NNE directions.
2) The development should be laid out and orientated to maximize air penetration by aligning the longer frontage in parallel to the wind direction. The angle between the axis of building blocks and the direction of prevailing wind is preferably within a small degree less than 30°. **Figure 4.2** shows that the longer frontage of the proposed Sports Centre is parallel to the prevailing S wind and with a small angle of about 22.5° between its long axis and the

prevailing winds of NNE and SSW directions. It could minimize blockage to winds under such wind directions.

3) The building setback at ground floor level with a proper clear headroom may enhance the incoming air permeability at pedestrian level. With reference to the Technical Guide for Air Ventilation Assessment in 2006, the air velocity at pedestrian level (2m above ground) is used to assess the wind effects on buildings and urban features. Therefore, the proper clear headroom may not less than 2m above ground level. For the current design option, there is a chamfered edge design for the Sports Centre in its north-east portion at ground floor level. The building separation between the Sports Centre and the plant room which outside of the Site boundary gradually increasing from about 12m wide to 18m wide (see **Figure 4.2**). Referring to **Figure 4.3**, the plant room is supported by several columns. At a similar mPD level to the ground of the Development Site, the plant room has a void over 3m wide and up to 11m high between the supporting columns and the clear headroom of the Sports Centre at ground level is over 5m high. As a result, like which discussed in mitigation measure item 1), the building separation between the Sports Centre and plant room will be 15m to 21m wide at the pedestrian level. The adequate width of the building separation would to enhance air permeability under prevailing ENE and E winds
4) Chamfering or filleting of building edges can make sure the passage of prevailing wind is not impeded by the proposed built form. As shown in **Figure 4.4**, a large filleting of building edge has been applied on the south-west elevation of the Annex Building. Hence the passage of the prevailing ESE wind will not be impeded by the proposed built form.

Table 4.2 – Schematic of Proposed Mitigation Measures

Item	Proposed Mitigation Measures	Key Feature
1)		A buildings separation with at least 15m wide is suggested [1-3].
2)		The smaller angle within 30° between the axis of building blocks and prevailing wind directions [1-3].
3)		Building setback at ground floor level with a clear headroom over 2m high to enhance air permeability at pedestrian level [1, 4].
4)		Chamfering or filleting of building edges to make sure the passage of prevailing wind is not impeded by the proposed built form.

Reference:

[1] “Feasibility Study for the Establishment of Air Ventilation Assessment System”, Planning Department of Hong Kong and Chinese University of Hong Kong, 2005.

[2] “Urban Design Guidelines” of Hong Kong Planning Standards and Guidelines Chapter 11, Planning Department of Hong Kong, 2015.

[3] “Sustainable Building Design Guidelines APP-152” of Practice Note for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers, Building Department of Hong Kong.

[4] “Technical Guide for Air Ventilation Assessment for Development in Hong Kong (Technical Circular No. 1/06 and Annex A)”, Housing, Planning and Lands Bureau and Environment, Transport and Work Bureau, 2006.

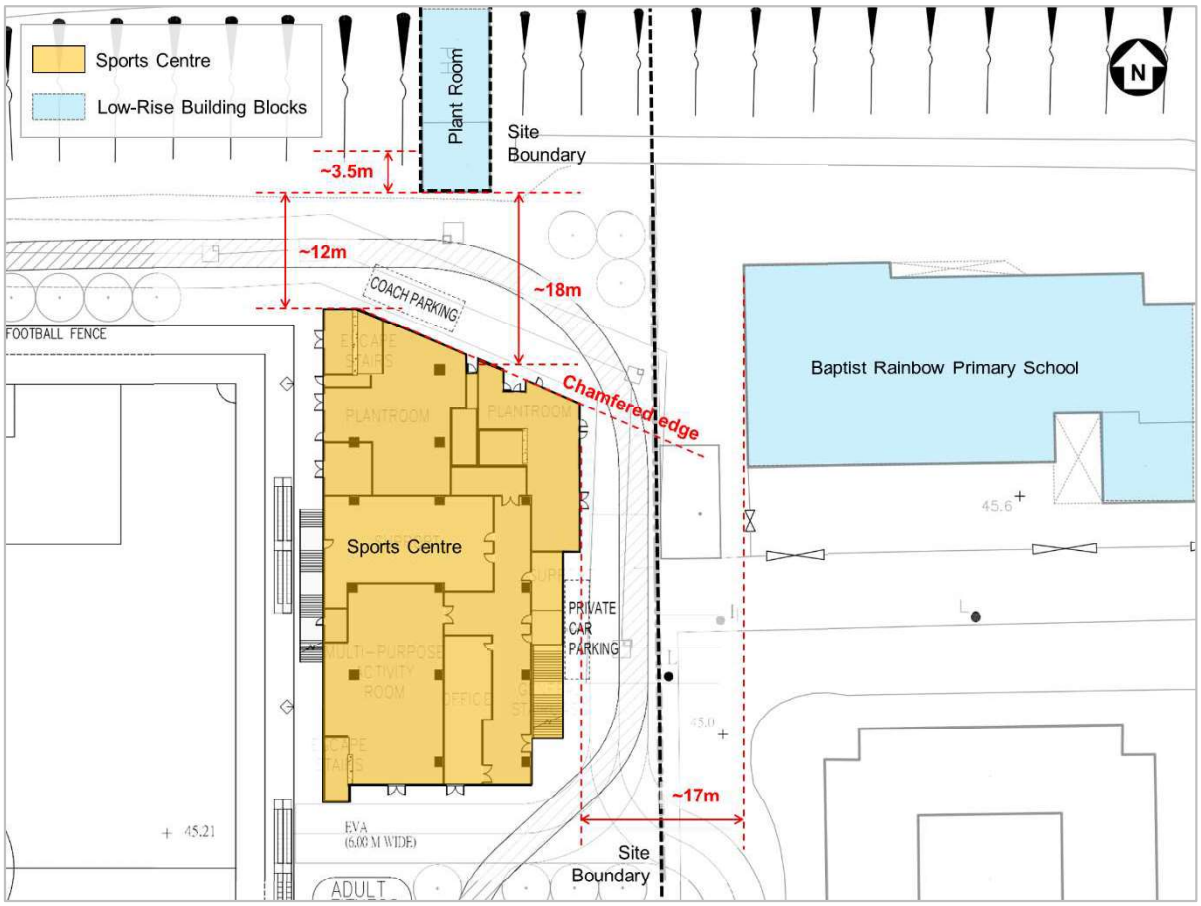


Figure 4.2 – Layout Plan for Sports Centre at Ground Floor Level

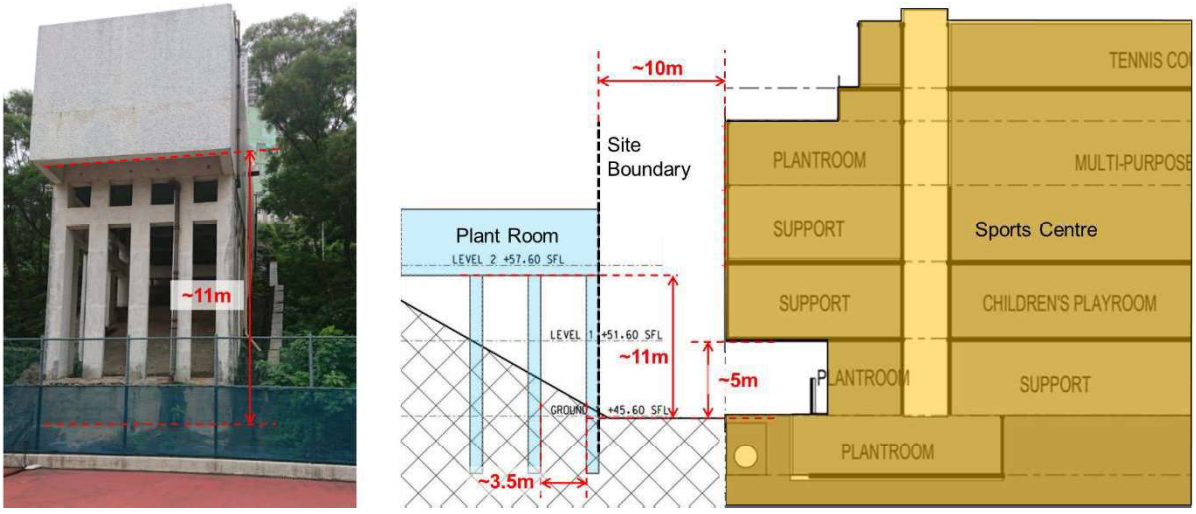


Figure 4.3 – Schematic Section View of the Plant Room and Sports Centre

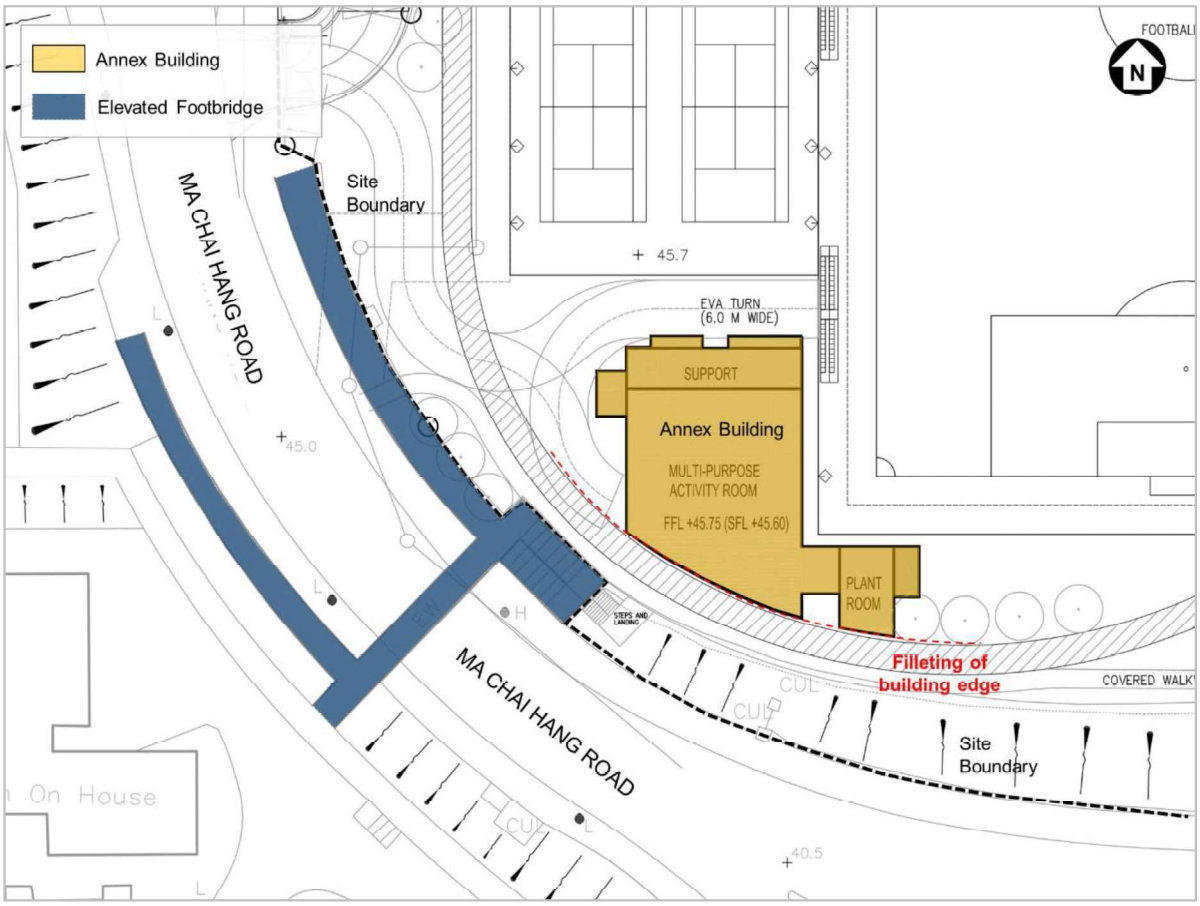


Figure 4.4 – Layout Plan for Annex Building at Ground Floor Level

5 Existing Wind Environment

Determining the prevailing wind directions is important in identification of wind corridors. As discussed in Section 3, the annual prevailing winds come from NNE, E, ENE and ESE directions, while the summer prevailing winds are mainly comprised of S, SSW and SW winds in the present assessment. With reference to the "WTH&TTA AVA report 2010", Lung Cheung Road is a main air path for east-west prevailing wind, while Fung Mo Street is the main north-south air path. Lung Cheung Road has an adequate width about 40 to 50m that the prevailing winds can flow through it in unobstructed way. Besides, Chuk Yuen Road, Ma Chai Hang Road, Wong Tai Sin Road and Choi Chuk Street are also the major roads in maintaining air ventilation around the Site region. Most of these roads and streets are linked with each other and with greeneries and open spaces to enter the Development Site area.

For the purpose of air ventilation assessment, the current Site area could be generally regarded as open space with only a 2-storey building structure inside the south-east portion. The subject Site is close to the south hillside of Lion Rock, its surrounding includes many low to high-rise buildings. As a result, the wind availability of the Site is largely affected by the surrounding topography and built environment.

5.1 Prevailing NNE Wind

Figure 5.1 shows the existing wind environment under prevailing NNE wind. Part of the upstream NNE wind flowing down the Lion Rock hillside will be blocked by the building blocks, i.e, Tsui Chuk Garden, Pang Ching Court and Chuk Yuen (North) Estate. While, there is a large building group separation between Tsui Chuk Garden and Pang Ching Court near the north-east of the Development Site. Therefore, the air permeability of the Development Site could be maintained and its impact on wind capturing potential of adjacent developments is not obvious. At pedestrian level, most of NNE wind could bypass the adjacent low to high-rise building blocks in the east (i.e., Baptist Rainbow Primary School, Chuk Yuen (South) Estate and Po Hing Lin Fat She, etc.) to the downstream area via the large open area of the existing Site easily. Moreover, a part of NNE wind could turn to the G/IC area in the west, i.e., Price Memorial Catholic Primary School due to the slightly blockage effect by the low-rise Ma Chai Hang Ventilation Building and the high-rise building blocks in Tin Wang Court and Tin Ma Court. In the downstream areas, there are open areas (i.e, Lung Cheung Road Bauhinia Garden, Morse Park), low-rise G/IC facilities (i.e., CCC Rotory 2nd School, Phc Wing Kwong College

and Morse Park Swimming Pool) and NBA in the northern and western sides of Wang Tau Hom Estate, which are useful for air path to coverage. The two major roads, Fung Mo Street and Wang Tau Hom East Road can also form major wind corridors to allow prevailing NNE to ventilate the further downstream areas.

A possible existing problematic area may be observed near the east and south-east side of the Site. When wind comes from prevailing NNE direction, at pedestrian level, a portion of winds would be blocked by the low-rise Baptist Rainbow Primary School and the high-rise building blocks in Chuk Yuen South Estate. These building blocks would induce wind blockage effect at the immediate leeward region, thus small wake zones would be created on this area and a relatively calm wind environment is expected at the pedestrian level.

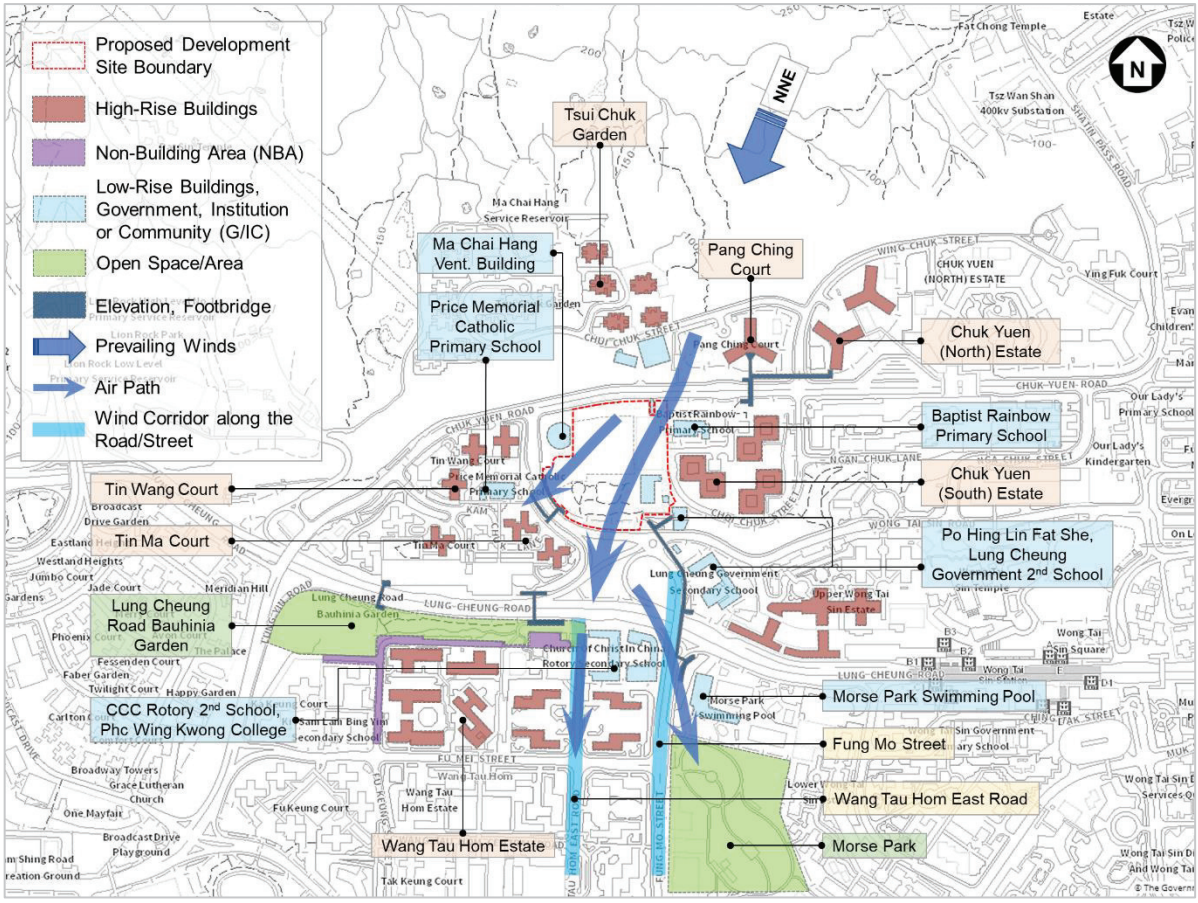


Figure 5.1 – Existing Wind Environment under Prevailing NNE Wind

5.2 Prevailing ENE, E and ESE Winds

Figure 5.2 shows the prevailing ENE, E and ESE winds passing through the Development Site. From north-east to south-east sides of the Site, it is covered by many high-rise building blocks,

e.g., Pang Ching Court, Chuk Yuen (North) Estate, Chuk Yuen (South) Estate, Upper Wong Tin Sin Estate, etc. These building blocks would induce wind blockage effect to the immediate leeward region. Thus, existing problematic areas could be observed in the low-rise Baptist Rainbow Primary School, Po Hing Lin Fat She and Lung Cheung Government Secondary School areas, as well as the east part of the Site, and relatively calm wind environment are expected at these areas.

The major potential east-west wind corridors, Chuk Yuen Road, part of Ma Chai Hang Road, Wong Tai Sin Road and Lung Cheung Road could be observed between these high-rise building groups. They would drive the incoming prevailing ENE, E and ESE winds to flow along the Development Sites. Typically, in the north side of the Site, the prevailing ENE and E winds along the Chuk Yuen Road may be separated by the Ma Chai Hang Ventilation Building. Therefore, part of the incoming winds could move downstream along the Chuk Yuen Road. While, at pedestrian level, the other part of winds could pass through the Site to its downstream area of Price Memorial Catholic Primary School. In the south side of the Site, the prevailing E and ESE winds along the Wong Tai Sin Road and Ma Chai Hang Road may be blocked by Po Hing Lin Fat She, Lung Cheung Government 2nd School and Tin Ma Count. As a result, part of incoming winds could pass through the south side of the Site to its downstream area in west side, i.e., Price Memorial Catholic Primary School. The other winds will be driven by the major air path along the Lung Cheung Road and move to its downstream areas. As Lung Cheung Road is long and has adequate width, together with the open area (Lung Cheung Road Bauhinia Garden) and NBAs nearby it, it could form a major wind corridor and the pedestrian level in its vicinity could then be well ventilated.

Near the west side of the Site, Tin Wang Court and Tim Ma Court are also high-rise building blocks, which would further reduce the amount of prevailing winds passing through and reach the downstream areas in the west. A weak environment performance is expected to observe on the pedestrian level behind these building blocks. Moreover, close to north-east of the Site, there is a footbridge on the junction of Chuk Yuen Road and Wing Chuk Street to connect Pang Ching Court, Chuk Yuen (north) Estate and Chuk Yuen (south) Estate with about 15m bridge height above Chuk Yuen Road. Thus, it may have less impact on ventilation at pedestrian level of its leeward area.

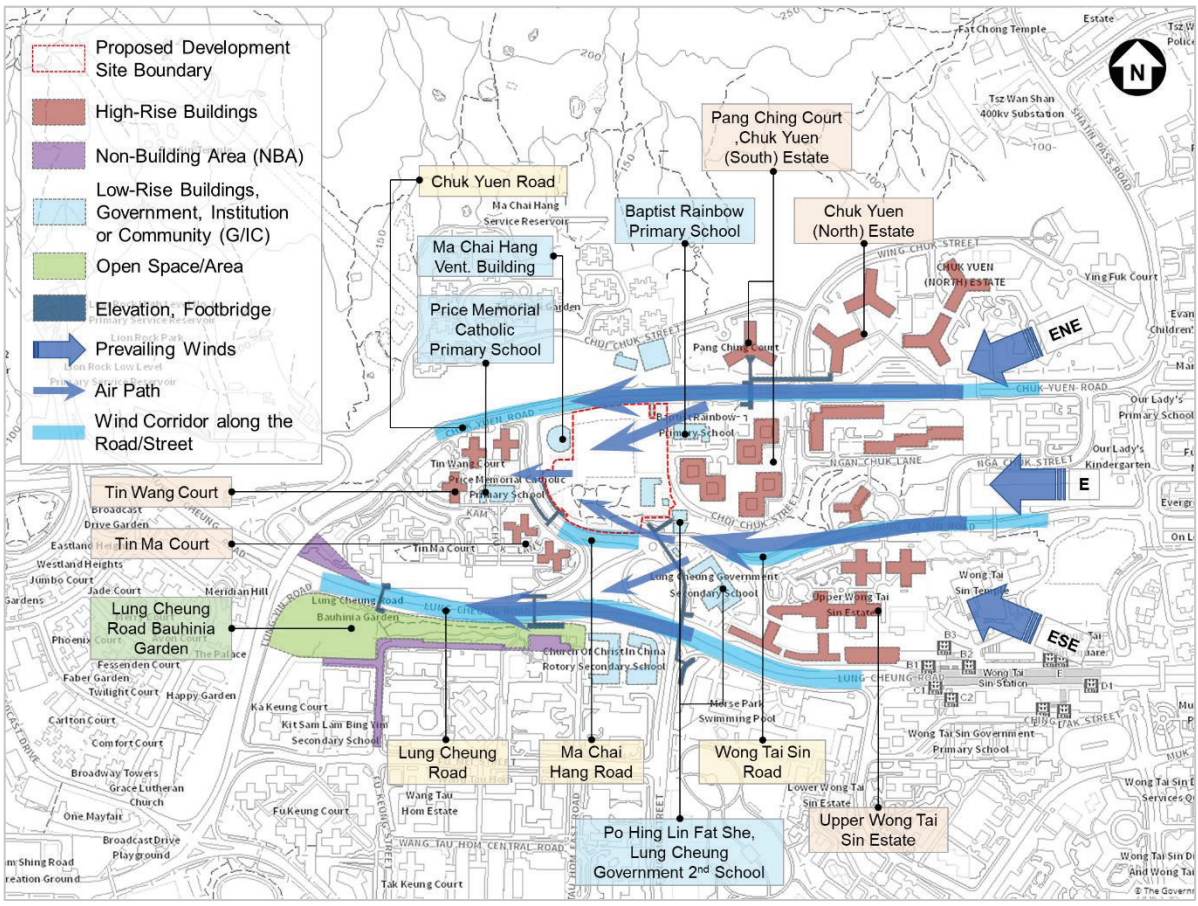


Figure 5.2 – Existing Wind Environment under Prevailing ENE, E and ESE Winds

5.3 Prevailing S, SSW and SW Winds

Figure 5.3 shows the upstream of prevailing S, SSW and SW winds coming through Wang Tau Hom Estate. The major roads in farther south side of the Development Site, i.e., Fung Mo Street and Wang Tau Hom East Road will take the rose of major wind corridors under these prevailing winds to drive incoming winds flowing to the Site. Moreover, a large open area, Morse Park is the east side of Fung Mo Street, inter-linked with the Morse Park Swimming Pool, could also be a natural wind corridor to allow sufficient air in the upstream zones to flow through the Site under prevailing S wind.

A cluster of building blocks in Wang Tau Hom Estate can be observed at farther south-west of the Site. High building volume density in these areas provide insufficient building gaps to allow prevailing winds to penetrate. However, the large open space, Lung Cheung Road Bauhinia Garden, NBA in north side of these building blocks may help incoming air to converge and thus part of incoming winds could reach the Site under SSW and SW winds.

At the immediate south-west of the Site, the Tin Ma Court with high-rise building blocks would further cause the adverse wind effect in Site area under prevailing SSW and SW winds since they would induce wind blockage effect at the immediate leeward region, thus a relatively calm wind environment is expected in south-west part of the Site.

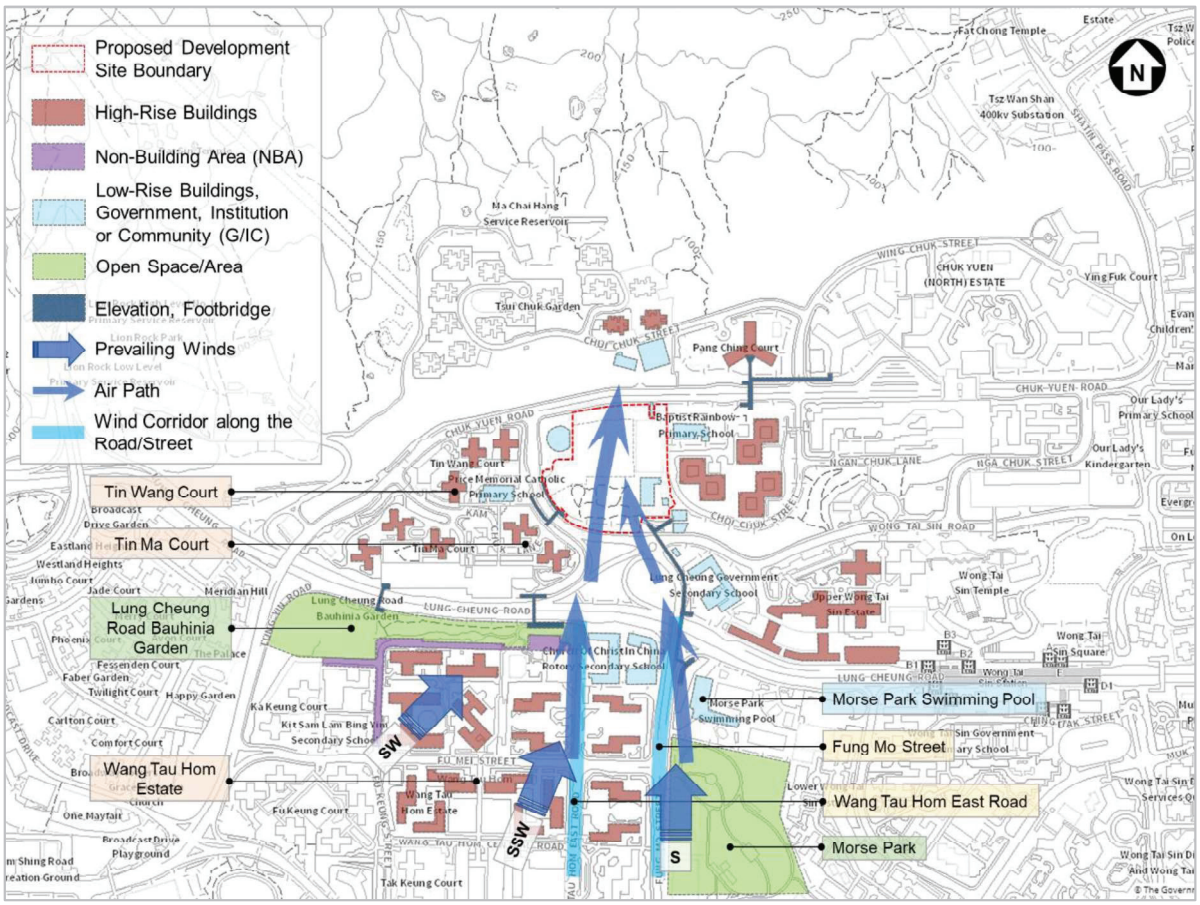


Figure 5.3 – Existing Wind Environment under Prevailing S, SSW and SW Winds

5.4 Summary

In general, the study area has a good ventilation network for air paths. The result of the evaluation on annual and summer prevailing winds and the surrounding topography revealed that the annual and summer prevailing winds could flow through the Development Site under the action of existing wind corridors. Although several possible existing problematic areas around the Site might attenuate ventilation performance, with some open areas, NBAs and wind corridors around to drive the prevailing winds flowing through the Development Site, the impact on wind captures of these possible affected problematic areas could be improved.

6 Ventilation Performance of Proposed Developments

This section outlines the discussion of natural ventilation at pedestrian level under prevailing wind directions. Referring to **Figures 4.1** to **4.4** and **Annexes A** to **C**, a 5-storey Sports Centre is of +78.00mPD high and a 2-storey Annex Building is of +58.25mPD high are designed in the development layout of the proposed option. It is expected that the new developments, especially the 5-storey Sports Centre would partially obstruct wind flow to downstream areas.

6.1 Prevailing NNE Wind

Figure 5.4 shows the annual prevailing wind from NNE direction passes through the Development Site. In general, no potential wind corridors along the road network around the Site could be observed under this wind direction. As compared to the existing condition, the proposed development would inevitably induce some adverse impacts on the surrounding pedestrian wind environment. Therefore, several proposed mitigation measures have been incorporated in the proposed development to alleviate the potential adverse impacts and maintain the ventilation performance around the Site.

It is envisaged that the 5-storey Sports Centre and Annex Building may block the incoming winds and create a weak wind performance in the immediate leeward region. Especially, the Sports Centre is close to Baptist Rainbow Primary School (about 74mPD high) in its east side. The incoming prevailing NNE wind may affect by the building separation between them. The Final Report "Feasibility Study for Establishment of Air Ventilation Assessment System" by Hong Kong PlanD in 2005 stated the building disposition can help to bring in prevailing wind to the site and its vicinity.

Referring to **Figures 4.1**, **4.2** and the proposed mitigation measures in **Table 4.2**, the gap between the Sports Centre and Baptist Rainbow Primary School is about 17m wide and the distance between the Sports Centre and Fu Yuen House is about 25m wide. These building separations could allow a clear wind corridor in N-S direction. Moreover, the Football Field could act an open area between Sports Centre and Annex Building, to allow sufficient air to penetrate the Development Site. Due to the adequately wide of the building gaps between these building blocks, it may maximize the air permeability of the Site and minimize its impact on wind capturing potential of adjacent developments. Moreover, as discussed in Section 4, the longer frontage of the proposed Sports Centre has a small angle of about 22.5° between its long

axis and the prevailing NNE wind direction to minimize blockage to wind under such wind directions. Such building separations would allow wind penetration of the prevailing NNE wind.

Due to the blockage effect of the proposed 2-storey Annex Building, a possible affected problematic area may be observed at the pedestrian level in its downstream area, i.e., part of Ma Chai Hang Road near the Site under prevailing NNE wind. Another possible affect problematic area with the Site may also be observed in the leeward area of the Sports Centre, i.e., part of Football Field and Associated Facilities in the same wind direction. Furthermore, as the proposed Sports Centre and Annex Building are both low-rise building blocks, which may have insignificant wind blockage effect to the further downstream area of the Site under NNE wind direction.

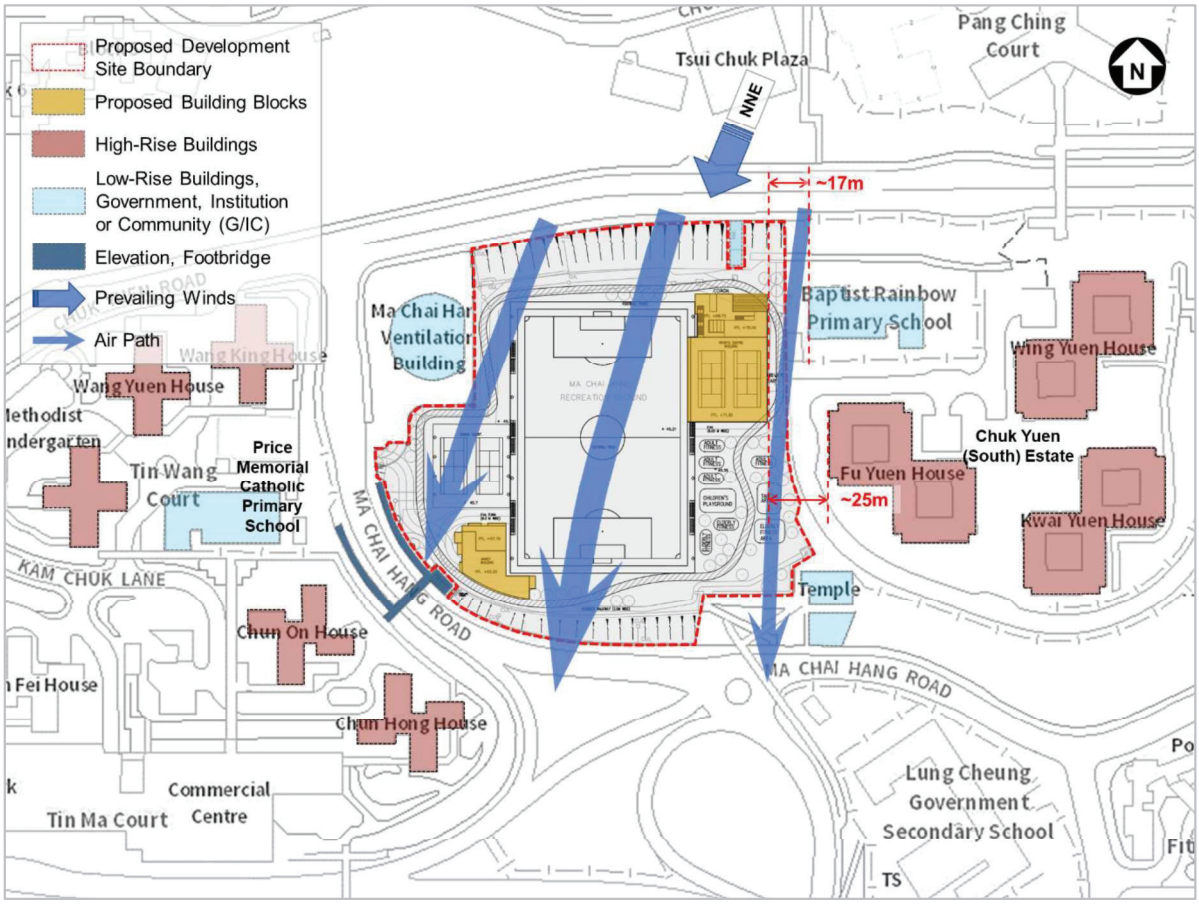


Figure 5.4 – Prevailing NNE Wind Passes the Development Site

6.2 Prevailing ENE, E and ESE Winds

Figure 5.5 shows the annual prevailing ENE, E and ESE winds passes through the

Development Site. Two major wind corridors along Chuk Yuen Road and Ma Chai Hang Road could be observed as the high-rise blocks in east side of the Site may block most of incoming winds to passing through. Thus, most of incoming winds will bypass the high-rise buildings, i.e., Chuk Yuen (South) Estate along these two major roads.

In comparison with the existing condition, the proposed 5-storey Sports Centre in the north-east corner of the Site may block the incoming prevailing ENE and E winds to passing through as only about10m wide building separation between it and the adjacent plant room (see **Figure 4.1**). Referring to the proposed mitigation measures in Section 4, however, at pedestrian level, there is a chamfered building setback with a clear headroom of about 5m high for the proposed Sports Centre. The building distance between the Sports Centre and the plant room from about will be 12m to 18m wide at pedestrian level (see **Figures 4.2** and **4.3**). Moreover, at least 3m wide column gap at the similar mPD level to the ground of the Site could be observed. Thus, the total building gap between the Sports Centre and plant room will be 15 to 21m wide at the pedestrian level (refer to the mitigation measures items 1 and 3 in **Table 4.2**). This adequate width of building gap and the void height may enhance air permeability to the north portion of the Site area under prevailing ENE and E winds. A possible affected problematic area could be observed at leeward side of the Sports Centre, i.e., the Football Field in the Site.

Under prevailing ESE wind, a part of incoming wind will bypass the Po Hing Lin Fat She in south-east to the Site directly at pedestrian level. The other part of ESE wind will move along Ma Chai Hang Road. The existing elevated footbridge (about 10m high above road level) in the south-east side may also slightly affect the incoming ESE wind to pass through. As shown in **Figure 4.4**, a filleting of building edges can make sure the passage of prevailing wind is not impeded by the proposed built form. For the proposed Annex Building, a large filleting of building edge has been applied on the south-west elevation. This mitigation measure could help to maintain the air permeability development site. As a result, the prevailing ESE wind along the Ma Chai Hang Road could pass through the south side of the Annex Building easily. The wind environment around the footbridge area may remain less change under such wind direction.

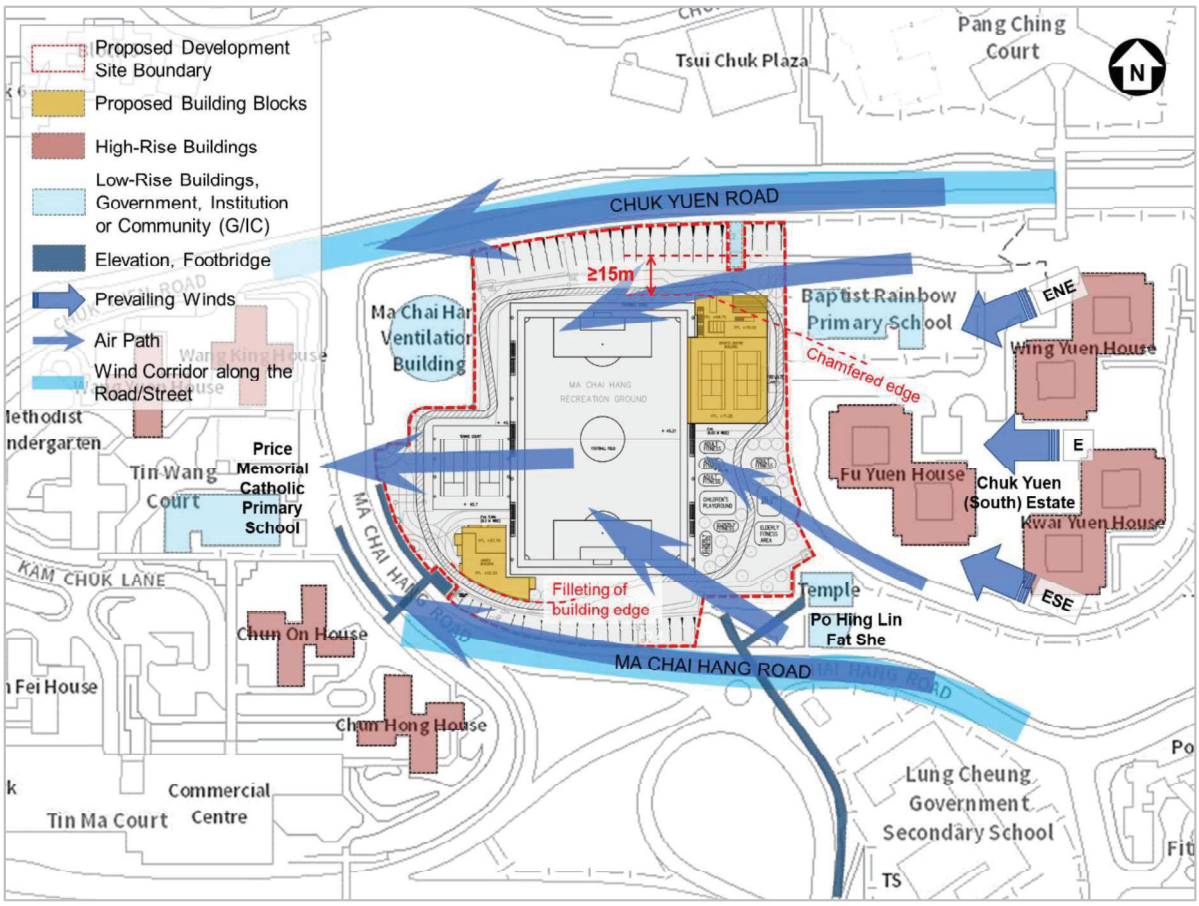


Figure 5.5 – Prevailing ENE, E and ESE Winds Pass the Development Site

6.3 Prevailing S, SSW and SW Winds

Figure 5.6 shows the local air paths on the Site under summer prevailing S, SSW and SW winds. In general, no potential wind corridors along the road network around the Development Site could be observed under these wind directions. Most of the prevailing winds could pass through the Site over the large open area of Football Field at the centre of the Site. Like which shown in **Figure 5.4**, the building separation of about 17m wide between the proposed Sports Centre and Baptist Rainbow Primary School may maximize the air permeability of the Site and minimize its impact on wind capturing potential of adjacent development. Moreover, the longer frontage of the Sports Centre is in parallel to the S wind direction and with a small angle less than less than 30° between its long axis and the SSW wind direction. Thus, this building deposition could minimize blockage to winds and the winds could pass through the gap and help to alleviate the potential adverse impact on wind environment in the wake under summer prevailing S and SSW wind directions. Due to the wind blockage effect, a possible affected problematic area may be observed at wake area of the Sport Centre under prevailing S and

SSW winds. Therefore, a relatively calm wind environment is expected between the Sports Centre and the plant room in the north side.

Moreover, the proposed Sports Centre has a similar building height (+78mPD) in comparison with the adjacent Baptist Rainbow Primary School (about +74mPD high), the incoming SW wind may partly prevented by the Sports Centre and results in a weaken of air ventilation at pedestrian level between these two building blocks. At the immediate south-west of the Site, the Tin Ma Court with high-rise building blocks would cause the adverse wind effect in Site area under prevailing SW wind since they would induce wind blockage effect at the leeward region, thus another relatively calm wind environment is expected in south-west part of the Site. It may further affect the strength of the SW wind at further downstream. With the consideration of the insufficient of the incoming SW wind, the possible affected problematic area between the Sports Centre and Baptist Rainbow Primary School may become less obvious in comparison with the existing wind environment.

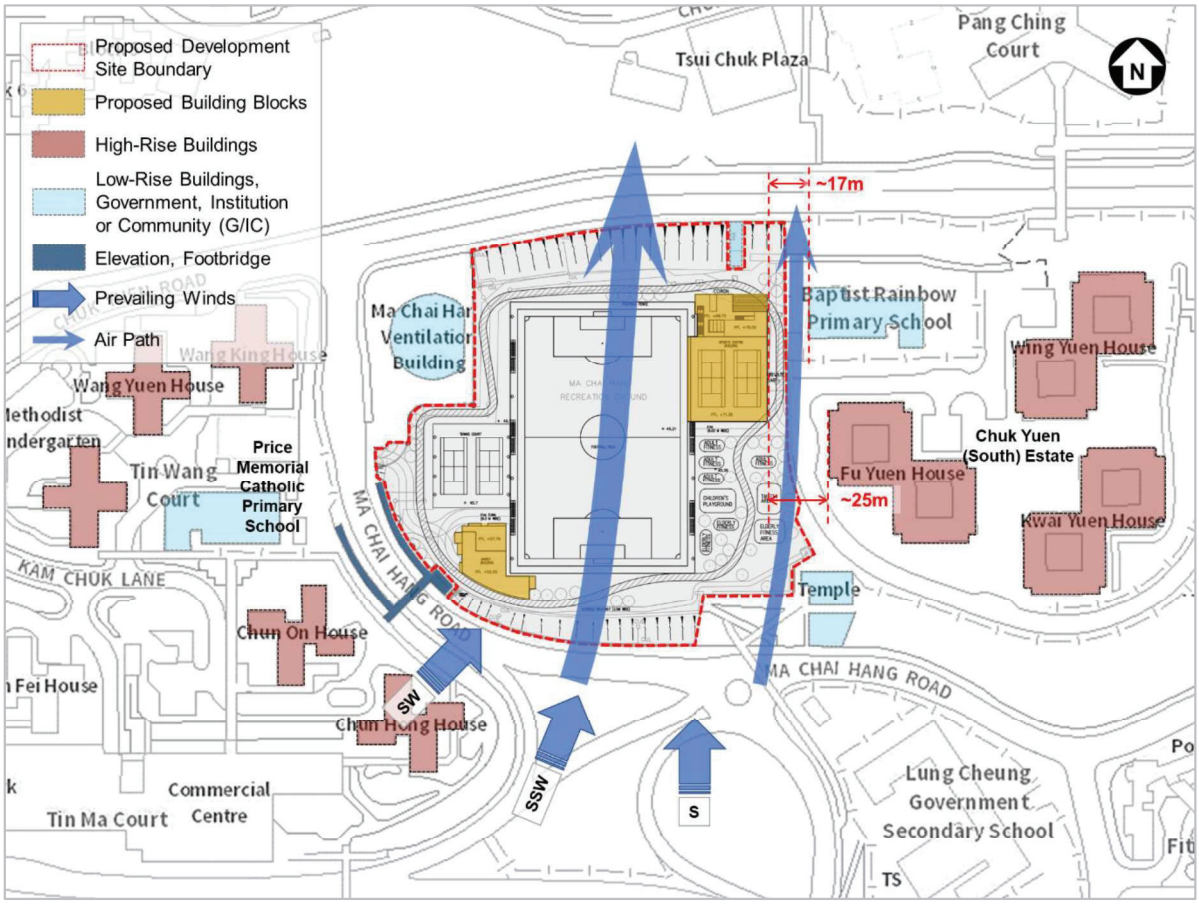


Figure 5.6 – Prevailing S, SSW and SW Winds Pass the Development Site

7 Conclusion and Recommendation

The Expert Evaluation based on the site wind characteristics and wind environment under the proposed development situation regarding qualitative assessment on air ventilation was conducted. The result of the evaluation provides an overview of likely impacts associated with the proposed development under both the annual prevailing NNE, ENE, E, ESE winds and summer prevailing S, SSW, SW winds as well as the surrounding topography and built environment.

As discussed above, the concerns mainly entail the prevailing winds and the impact that the proposed development might bring up upon to the neighbouring built-up areas. Since the Site is surrounded by different building heights as indicated, and the mitigation measures on air ventilation have been considered in the development design, the major ventilation corridors within the area remain unaffected. It is expected that the proposed development shall cause insignificant effect on the general air ventilation performance in the area.

In general, the proposed Development Site is bounded by Ma Chai Hang Road and Chuk Yuen Road. For the proposed design option, the prevailing winds are either along the major wind corridors in north-west direction along these two roads or pass through the Site easily via the large open area of the Football Field in Site. The proposed mitigation measures may help alleviate the potential adverse impact on ventilation.

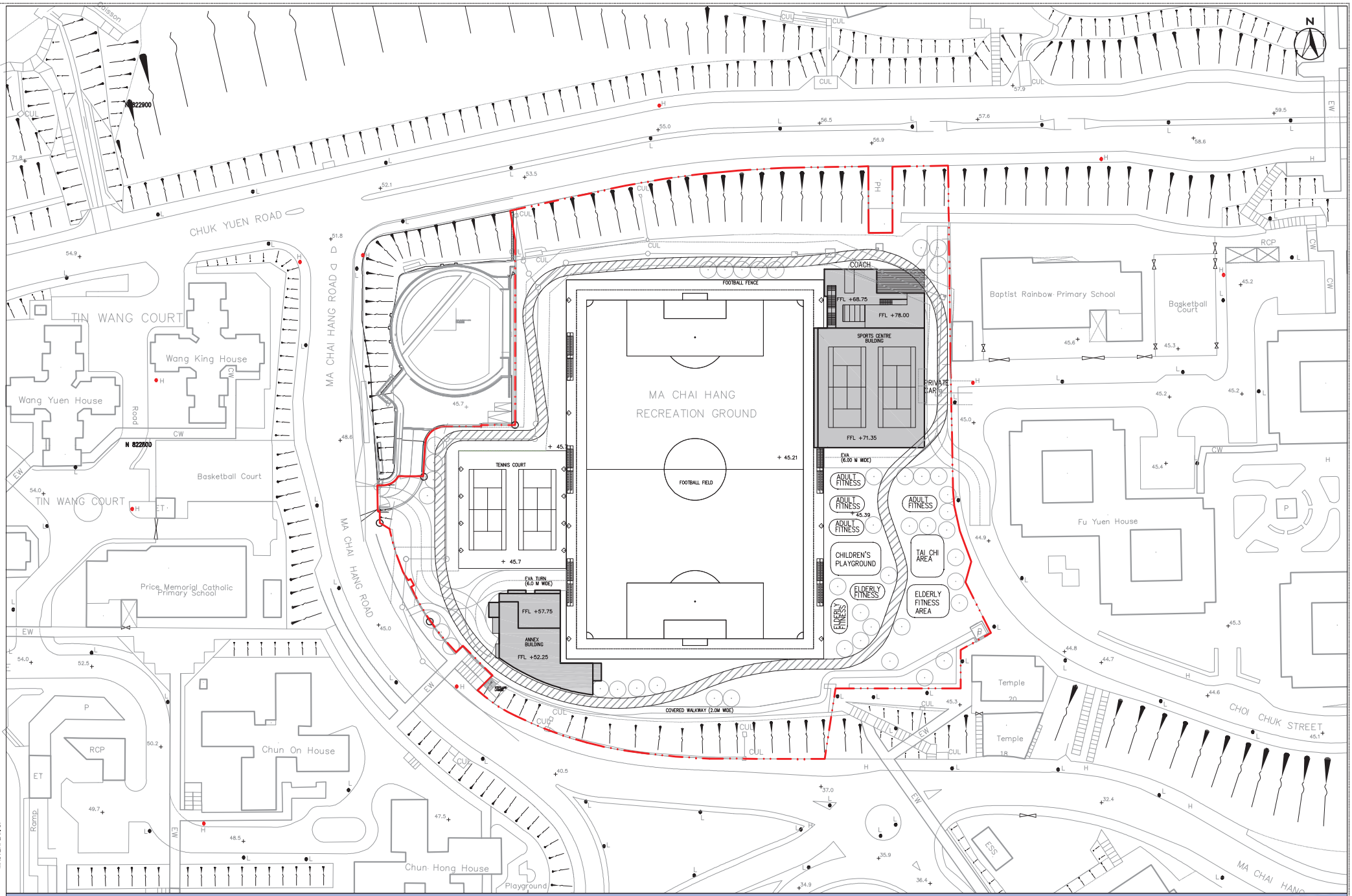
a) Under annual prevailing NE wind, the mitigation measures of a building separation of 17m wide between the Sports Centre and Baptist Rainbow Primary School, and together with a small angle about 22.5° between the longer frontage of the Sports Centre and NNE wind direction, may maximize the air permeability of the Site and minimize its impact on wind capturing potential of adjacent developments. At pedestrian level, a slightly weak of ventilation area on part of Ma Chai Hang Road could be observed at downstream of the Annex Building block the air to pass through.
b) Under annual prevailing ENE and E winds, the building setback at ground floor level of the Sports Centre may provide an adequate building gap (at least 15m wide) between the Sports Centre and its adjacent plant room in the north side. This mitigation measure may enhance air permeability to the north portion of the Site area. Moreover, the filleting of Annex

Building edge applied on its south-west elevation can make sure the incoming prevailing ESE wind is not impeded by the proposed built form.

c) Under summer prevailing S and SSW winds, like the wind environment under NNE wind direction, a good air ventilation at pedestrian level is expected at centre of the Site. Besides, the orientation of the Sports Centre is aligned the longer frontage in parallel and with a small angle to the S and SSW wind directions. It could minimize blockage to winds and maintain the air permeability to the downstream areas under such wind direction. Under summer prevailing SW wind, however, a possible affected problematic area may be observed in adjacent area of the Site, i.e., between the Sports Centre and Baptist Rainbow Primary School. As most of the incoming SW wind will be blocked by the high-rise building blocks inside the Tin Ma Court, the affected area may become less obvious in comparison with the existing wind environment.

In accordance with the AVA Technical Guide, the AVA Expert Evaluation provides a qualitative assessment to the design and/or design options and facilitates the identification of problems and issues. It is particularly useful for large sites and/or sites with specific and unique wind features, issues, concerns and problems. While, an AVA Initial Study will refine and substantiate the Expert Evaluation. It is to allow for scheme design optimization during detailed design stage and/or to prove that the future scheme would perform no worse than the current scheme in ventilation performance. To minimize any negative impacts and improve the existing wind environment, it is essential that the designers should consider the recommended good design features in detailed design of the development. The present AVA Expert Evaluation is sufficient for the planning application, there is no insurmountable impact on ventilation within and in vicinity of the Site due to the development and no further AVA Initial Study is recommended to be conducted.

Appendix A



MASTERPLAN GF
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RE-PROVISION OF MA CHAI HANG RECREATION GROUND

MASTERPLAN RF - SCALE 1:1000

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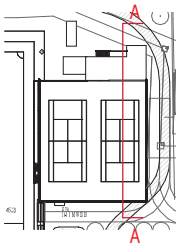
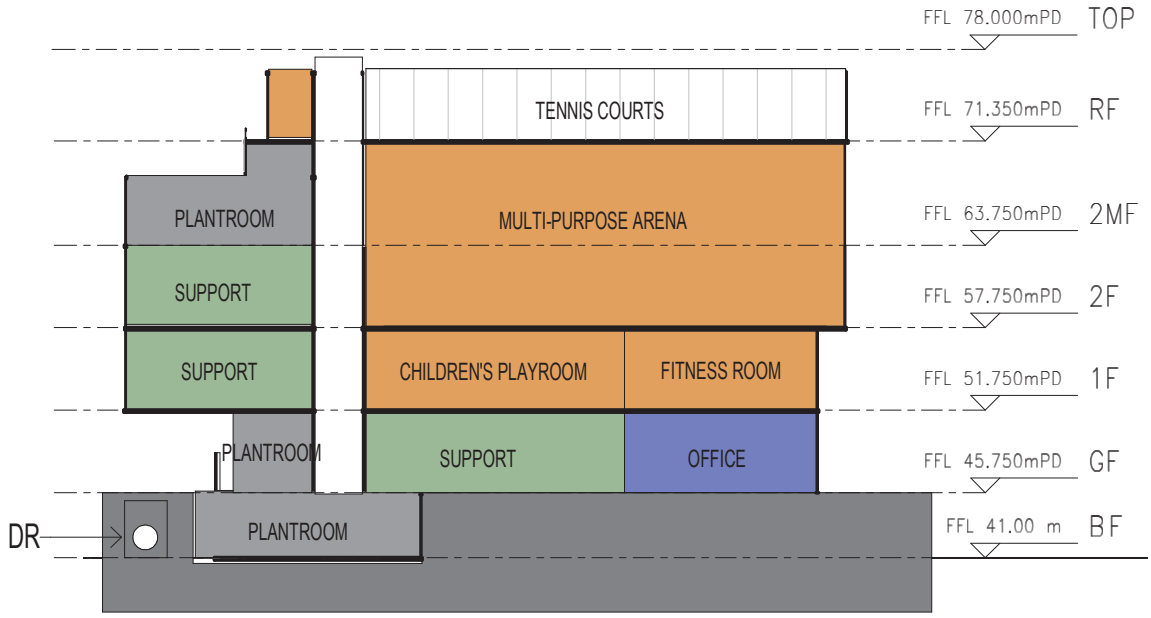
Appendix B



KEY PLAN



SPORTS CENTRE - SECTION A-A

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RE-PROVISION OF MA CHAI HANG RECREATION GROUND

SPORTS CENTRE SECTION A-A - SCALE 1:500

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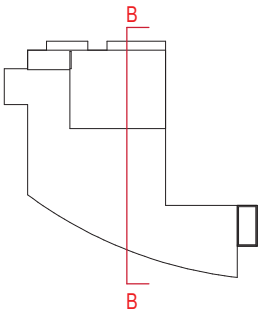
Appendix C



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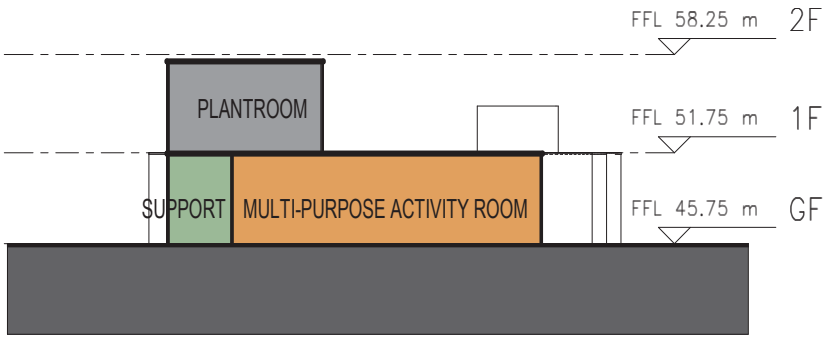

ANNEX BUILDING - SECTION B-B

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RE-PROVISION OF MA CHAI HANG RECREATION GROUND

ANNEX BUILDING - SEC B-B - SCALE 1:500

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