

Issue No : 1
Issue Date : February 2012
Project No. : 1052

**AIR VENTILATION ASSESSMENT
FOR THE PROPOSED DEVELOPMENT
OF PUBLIC RENTAL HOUSING AT
SAN PO KONG**

EXPERT EVALUATION

Report Prepared by :
Allied Environmental Consultants Ltd.

COMMERCIAL-IN-CONFIDENCE

Issue No : 1
Issue Date : February 2012
Project No. : 1052

AIR VENTILATION ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF PUBLIC RENTAL HOUSING AT SAN PO KONG

EXPERT EVALUATION

Report Prepared by :
Allied Environmental Consultants Ltd.

COMMERCIAL-IN-CONFIDENCE

Author:

.....
Andy Lai
Bsc(Hons), HKIOA

**Checked &
Approved:**

.....
Timothy Sze
BEng(Hons), MEng BEAM Pro

This report has been prepared by Allied Environmental Consultants Limited with all reasonable skill, care and diligence within the terms of the Agreement with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.

We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies upon the report at their own risk.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1. INTRODUCTION	3
2. OBJECTIVE.....	3
3. SCOPE OF STUDY	3
4. SITE CHARACTERISTICS	4
4.0. SITE LOCATION AND SURROUNDING ENVIRONMENT.....	4
5. WIND AVAILABILITY	5
5.1. WIND DATA FROM HONG KONG OBSERVATORY.....	5
5.1.1. Wetland Park Weather Station.....	6
5.1.2. Wind Data from MM5.....	7
5.1.3. Findings of Wind Availability.....	8
6. EXPERT EVALUATION.....	8
6.1. EXISTING CONDITION	9
6.1.1. Non-Summer Condition.....	10
6.1.2. Summer Condition	11
6.2. PROPOSED DEVELOPMENT	13
6.2.1. Good Design Features.....	14
6.2.2. Problem and Focus Areas.....	15
6.3. RECOMMENDATION	16
7. FUTURE STUDY	17
7.1. METHODOLOGY FOR INITIAL STUDY	17
8. CONCLUSION.....	18

LISTS OF FIGURES

FIGURE 1	EXISTING PROJECT SITE LOCATION	5
FIGURE 2	LOCATIONS OF THE NEAREST HKO WEATHER STATIONS	6
FIGURE 3	KING’S PARK WIND ROSE (1981-2010)	7
FIGURE 4	WIND ROSE OF GRID (29,28), MM5	8
FIGURE 5	SITE ENVIRONMENT	10
FIGURE 6	EXISTING NON-SUMMER WIND ENVIRONMENT AT SUBJECT SITE (E WIND)	11
FIGURE 7	EXISTING SUMMER WIND ENVIRONMENT AT SUBJECT SITE (SW WIND)	12
FIGURE 8	LAYOUT PLAN FOR THE PROJECT	13
FIGURE 9	BUILDING ORIENTATION TO ENHANCE PREVAILING E WIND PENETRATION FROM THE SOUTH PART OF PROJECT SITE	14
FIGURE 10	BUILDING ORIENTATION TO ENHANCE PREVAILING SW WIND PENETRATION FROM THE SOUTH PART OF PROJECT SITE	15
FIGURE 11	POTENTIAL WIND SHELTERING BY PROJECT OF SUMMER E & SW AND NON-SUMMER E WIND PENETRATION	16
FIGURE 12	PREVAILING WIND IN THE LATEST DESIGN SCHEME	17

LISTS OF TABLES

TABLE 1	WIND AVAILABILITY DATA OF KING’S PARK, HKO 1981-2010	7
----------------	---	----------

EXECUTIVE SUMMARY

An AVA report is prepared on behalf of The Hong Kong Housing Authority (HKHA) to facilitate the amendment to the Outline Zoning Plan under section 16 for residential use by The Planning Department. This Expert Evaluation on Air Ventilation Assessment (AVA-EE) was conducted for the Project according to the *Technical Circular No. 1/06* and its *Annex A - Technical Guide for Air Ventilation Assessment for Development in Hong Kong* issued jointly by Housing, Planning and Lands Bureau and Environment, Transport and Work Bureau (referred to as the Technical Guide hereafter).

The Project is located at San Po Kong. The subject site is currently unoccupied while surrounding by high-rise residential, commercial and industrial buildings. The site topographies within site and around the site area are relatively flat.

The Public Rental Housing project with 6800 square meters gross site area will comprise of a 100mPD tall domestic-storey blocks with flat production of about 860, a supported hostel for mentally handicapped persons, retail shops and a sewage pumping station. This proposed development was evaluated in this EE-AVA.

A good design feature was incorporated into the initial scheme, which includes the proper building's orientation to capture the prevailing winds without substantial impediment from and to the surrounding developments..

However, a drawback for the initial scheme of the Project is also identified that the building block would still be possibly to contribute wind screening effect at the open area at ground level and the wind permeability into the site would be significantly affected in the southern side of the project building.

To ameliorate the potential effects, additional design measures are recommended to be adopted in the detailed design of the Project in order to minimize any potential adverse ventilation impact on the surrounding environment.

Create an openings on the 2nd and 3rd floor at the southern side of the building in order to allow prevailing wind from summer and non-summer period for penetration to the surrounding street level, hence a more comfortable pedestrian environment.

The above mentioned and recommended design measures has been incorporated into the latest design scheme for the Project. An AVA Initial Study using Computational Fluid Dynamic (CFD) Simulation is recommended to quantitatively assess the potential

ventilation impacts on the surrounding environments due to the Project based on the latest design scheme.

1. INTRODUCTION

Hong Kong Housing Authority (HKHA) proposes to develop the Development of Public Rental Housing at San Po Kong (the Project). The project site area is approximately 0.68 hectares. The development will comprise of a 100mPD high block with flat production of about 860, a supported hostel for mentally handicapped persons, retail shops and a sewage pumping station. The expected completion of the development is around _____.

Allied Environmental Consultants Limited (AEC) was commissioned by HKHA to carry out an Expert Evaluation on Air Ventilation Assessment (AVA-EE) to qualitatively evaluate the potential air ventilation impacts due to the Project. The AVA-EE was carried out according to the air ventilation assessment framework as set out in *Technical Circular No. 1/06* and its *Annex A - Technical Guide for Air Ventilation Assessment for Development in Hong Kong* issued jointly by Housing, Planning and Lands Bureau and Environment, Transport and Work Bureau (Technical Guide).

2. OBJECTIVE

The objective of the AVA-EE is to qualitatively review and evaluate the potential air ventilation impact on the pedestrian wind environment within and in the vicinity of the subject site due to the Project by comparing that to the existing conditions, i.e. without the Project.

3. SCOPE OF STUDY

The scope of study includes as follows:

- To identify any potentially affected areas due to the proposed building design including building heights, layout and deposition;
- To provide recommendations for alleviating the potential air ventilation impact identified;
- To identify any major wind corridors which should be preserved or reserved; and
- To advise whether any further detailed study is required for concerned areas and the scope of the detailed study required.

4. SITE CHARACTERISTICS

4.0. SITE LOCATION AND SURROUNDING ENVIRONMENT

The Project is adjacent to San Po Kong Industrial Area, as shown in *Figure 1*. The subject site is currently unoccupied. The site topographies within site and around the site area are relatively flat. The immediate surrounding environments as shown in *Figure 1* are analysed as follows:

- To the immediate north, the subject site is bounded by with sport recreational facility, Kai Tak East Playground including 4 outdoor basketball courts, an outdoor football pitch and an indoor sport centre with a building height of 15mPD
- At approximately 100m to east of the subject site, there are high-rise residential buildings, Rhythm Garden, of which the building heights ranging from 70mPD to 90mPD.
- At approximately 60m to the south of the subject site is a government building - Kai Tak Operational Base with a building height of 40mPD.
- To the immediate west, the subject site is bounded by high to low raised commercial and industrial buildings, such as Chiap King Industrial Building, AIA Finical Centre etc., of which the building heights range from 26mPD to 133mPD.

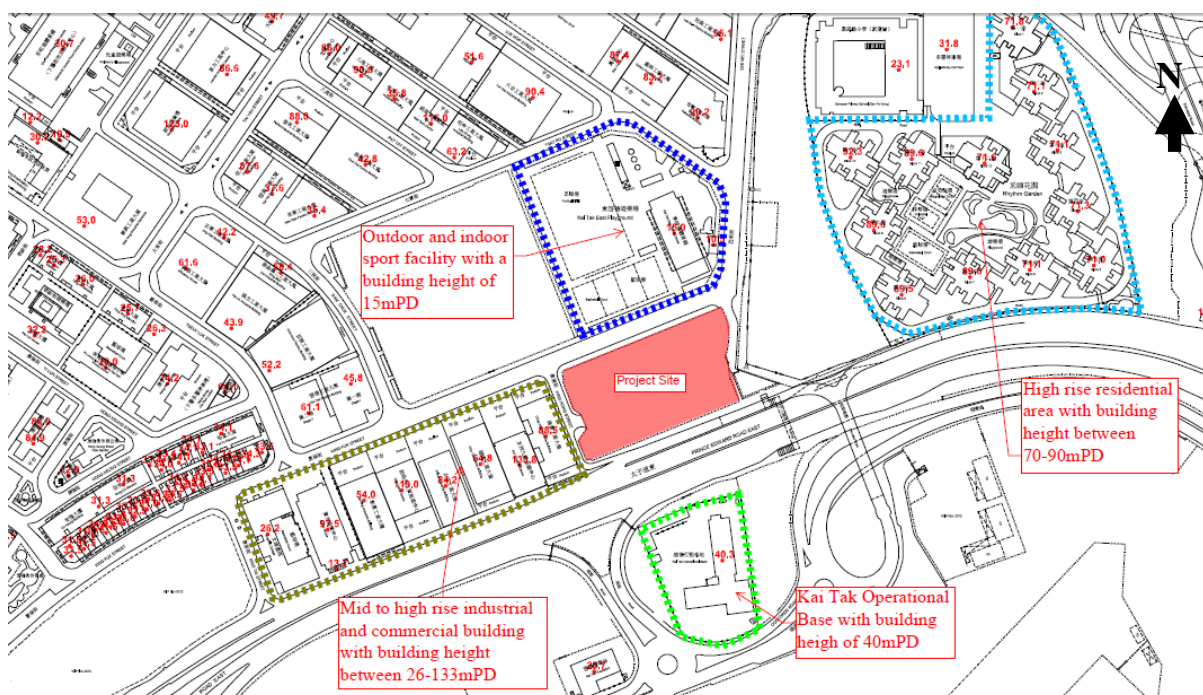


Figure 1 Existing Project Site Location

5. WIND AVAILABILITY

The wind data from Hong Kong Observatory (HKO) and Mesoscale Model (MM5) published by PlanD were adopted in this AVA-EE. The HKO wind data represents the lower level wind availability where the wind direction is influenced by local topography in the surrounding environment while the MM5 wind data represents the wind availability at boundary layer (i.e. 596mPD).

The occurrences of winds from different direction are referred to MM5 wind data while local wind conditions for different seasons (summer and non-summer periods) are referred to HKO wind data.

5.1. WIND DATA FROM HONG KONG OBSERVATORY

There is a HKO automatic weather station located in the vicinity of the subject site, Kai Tak (KT) which is approximately 3.7km on the south-east away from the subject site as shown in *Figure 2*. However, as there are not sufficient data available at the closest Kai Tak weather station, the wind data of King's Park (KP) weather station are obtained to identify wind availabilities during summer and non-summer periods as this seasonal information are not available in MM5 data.

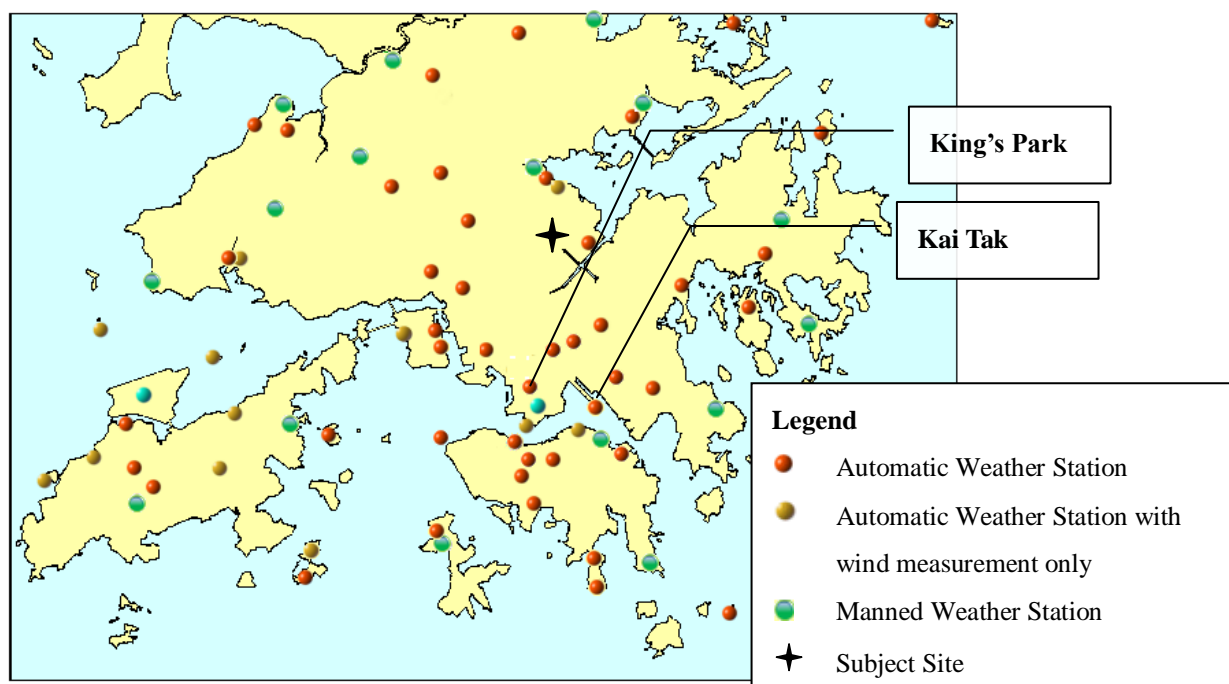


Figure 2 Locations of the Nearest HKO Weather Stations

5.1.1. Wetland Park Weather Station

The recorded annual mean wind speed measured at anemometer of KP automatic weather station was 3.1 m/s (11km/hr) from 1981-2010. Based on the King's Park wind rose from 1981-2010 as shown in **Figure 3**, it is found that east wind direction dominates the annual wind frequency. The monthly prevailing wind direction and wind speed of year 1981-2010 are listed in **Table 1**. It is found that wind mainly comes from east (E) and south-west (SW) direction in summer, while wind from east (E) dominates in non-summer period.

mean wind velocity is 5.73m/s. It is found that east (E) and east-northeast (ENE) winds dominate the annual wind frequency.

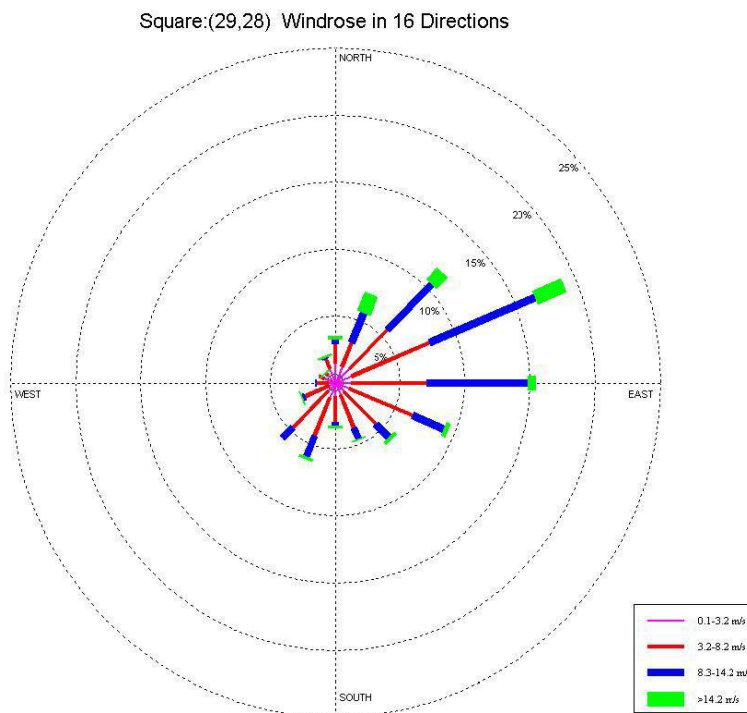


Figure 4 Wind Rose of Grid (29,28), MM5

Power law is used to convert the MM5 data at 596m above ground level to pedestrian level at 2m above ground level by taking consideration of the effect of topography/built-up area in the vicinity of the subject site on site wind availability.

5.1.3. Findings of Wind Availability

Based on the wind data from HKO and MM5, it is concluded that winds come from E are dominant annual wind directions. Wind from E and SW direction is the dominant during summer and wind from E for non-summer period.

6. EXPERT EVALUATION

This AVA-EE qualitatively evaluates the ventilation performance in the site environs with and without the Project. The study area of air ventilation assessment is approximately 200m from the subject site boundary of the subject site. The coverage is approximately 420m

diameter from the centre of the subject site. The conditions under prevailing wind, summer and non-summer time are considered. Building heights, street/road orientation and patterns, and open spaces have also been taken into account for evaluating the characteristics of wind environment.

6.1. EXISTING CONDITION

The subject site is currently unoccupied as shown in *Figure 5*. The existing conditions of subject site (i.e. without the Project) are summarized as the follows.

- Building Heights

The subject site is located in the southern end of San Po Kong industrial and commercial area, a plain of unoccupied plain on the elevation, which facilitates air movement. The existing land uses in the vicinity of the subject site includes residential, commercial, industrial and recreational areas. The building heights of the existing buildings located within the study area are shown in *Figure 5*

The height of majority of the existing commercial and industrial buildings located to the west and north of the subject site are ranged from 45mPD to 133mPD. These buildings would not cause significant impediments to the dominant E wind during non-summer and summer time but SW wind during summer period to penetrate to the street level.

High-rise residential buildings are located on the east side of the subject site. The building heights of these residential buildings range from 70 to 90mPD which cause certain amount of prevailing eastern wind to be obstructed from the east direction.

- Road/Street Pattern

Roads such as Prince Edward Road East and the open area next to Rhythm Garden to the east of the project site are considered as corridors within the study area for both summer and non-summer prevailing winds.

- Open Spaces

Open spaces and areas are located immediate to the east and north of the project site. The open spaces are currently unoccupied. These open spaces promote air circulation at pedestrian level and increase pedestrian comfort.

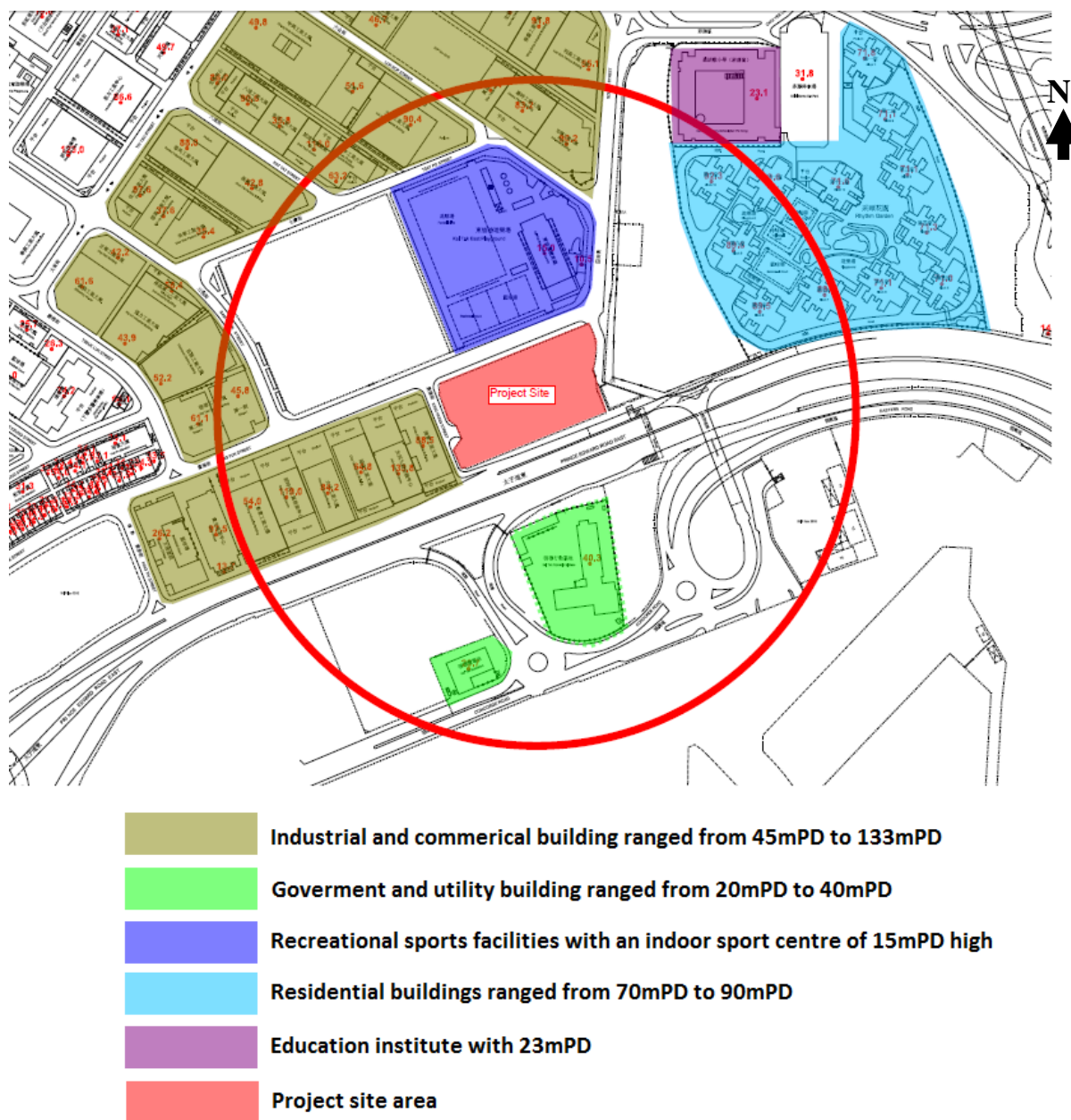


Figure 5 Site Environment

6.1.1. Non-Summer Condition

During the non-summer period, it is expected that the prevailing winds from E directions flow pass the subject site.

Although some high-rise industrial buildings are located to the east of the subject site as shown in **Figure 6**, the open area acts as a ventilation area to allow the prevailing winds

reaching to the subject site and the ventilation at pedestrian level is generally maintained.

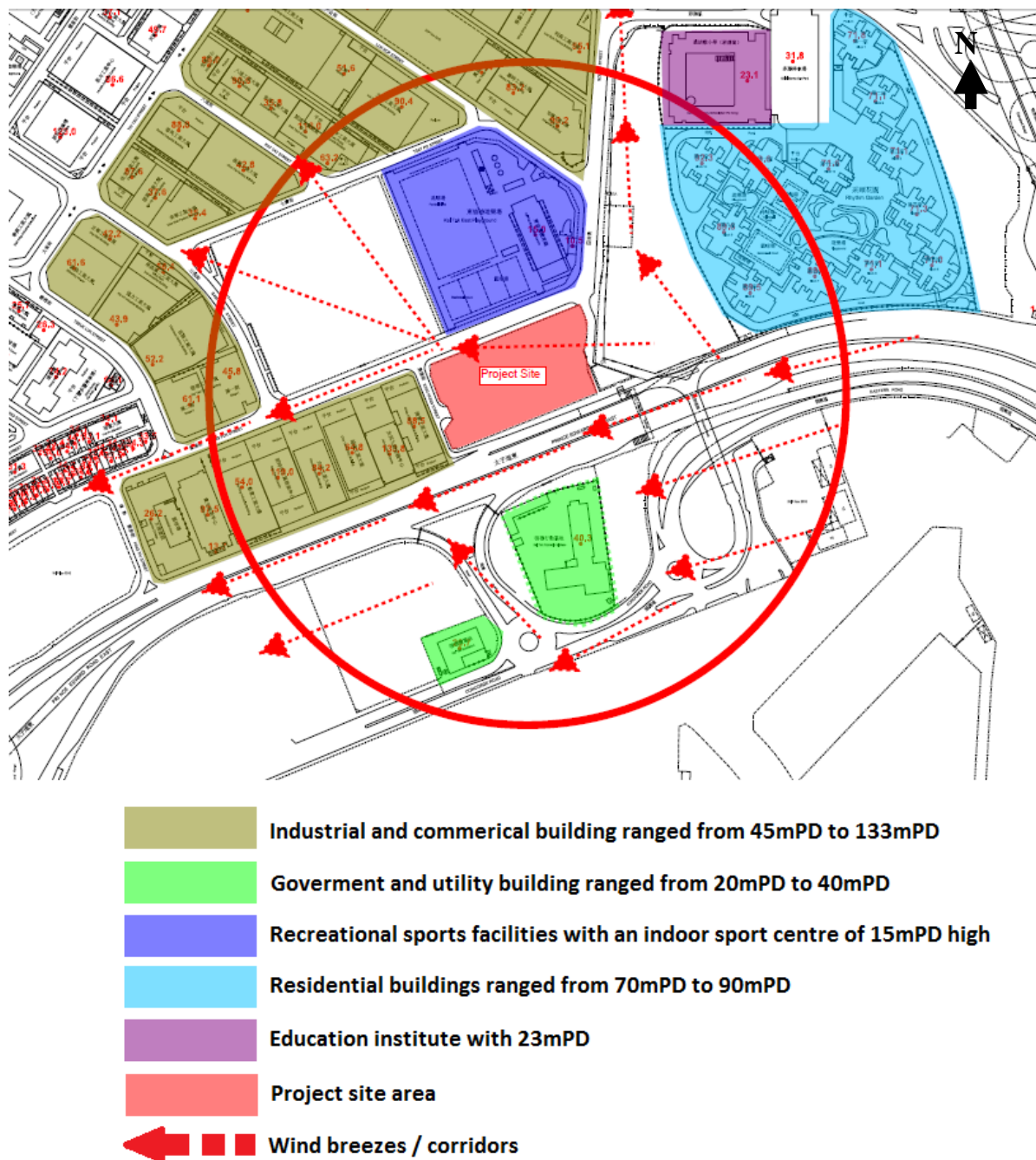


Figure 6 Existing Non-Summer Wind Environment at Subject Site (E Wind)

6.1.2. Summer Condition

During the summer period, it is expected that the prevailing winds from E and SW directions flow pass the subject site.

As shown on **Figure 7**, although there are high-rise commercial and industrial building located immediate west to the project site. There are relatively large areas of unoccupied land directly north and south of the project site which allows the prevailing SW wind to reach the subject site. The prevailing E wind condition is the same as during summer period.

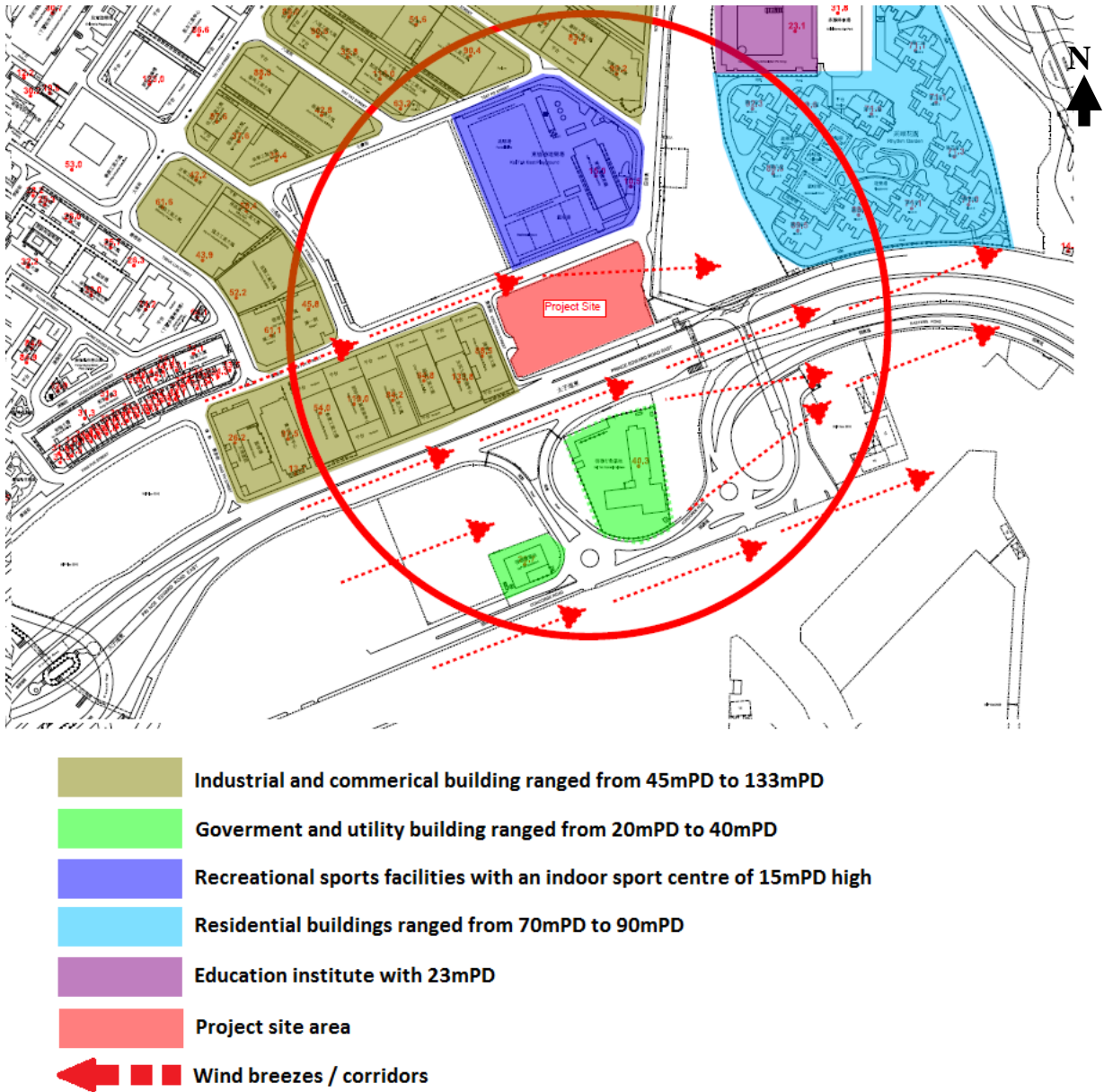


Figure 7 Existing Summer Wind Environment at Subject Site (SW Wind)

6.2. PROPOSED DEVELOPMENT

The project site area is approximately 6800 square meters. The development, as shown on *Figure 8*, will comprise of a 100mPD high block with flat production of about 860, a supported hostel for mentally handicapped persons, retail shops and a sewage pumping station. The composition of the latest scheme of the Project is summarized in the following table.



Figure 8 Layout Plan for the Project

	Proposed Development
Site Area	Around 6800 square meters
No of Residential Blocks	1
No of flats	Around 860 units
Building Height	100mPD
Other Facilities	A supported hostel for mental handicapped persons, retail shops and a sewage pumping station

6.2.1. Good Design Features

Before developing the latest design scheme, an initial design scheme as shown on **Figure 9** had been evaluated and design features of the initial scheme for improving air ventilation performance of the Project. Due to the location and the existing area development, the open area located in the southern side of the project allow most majorities of the prevailing east wind throughout the year and prevailing south-west wind during non-summer period to penetrate to the project site. Therefore the is oriented so that the shorter edges of the X-shape are facing the southern side; in result minimizing the impediment to the prevailing E and SW winds, domestic as shown on **Figure 9** and **Figure 10**

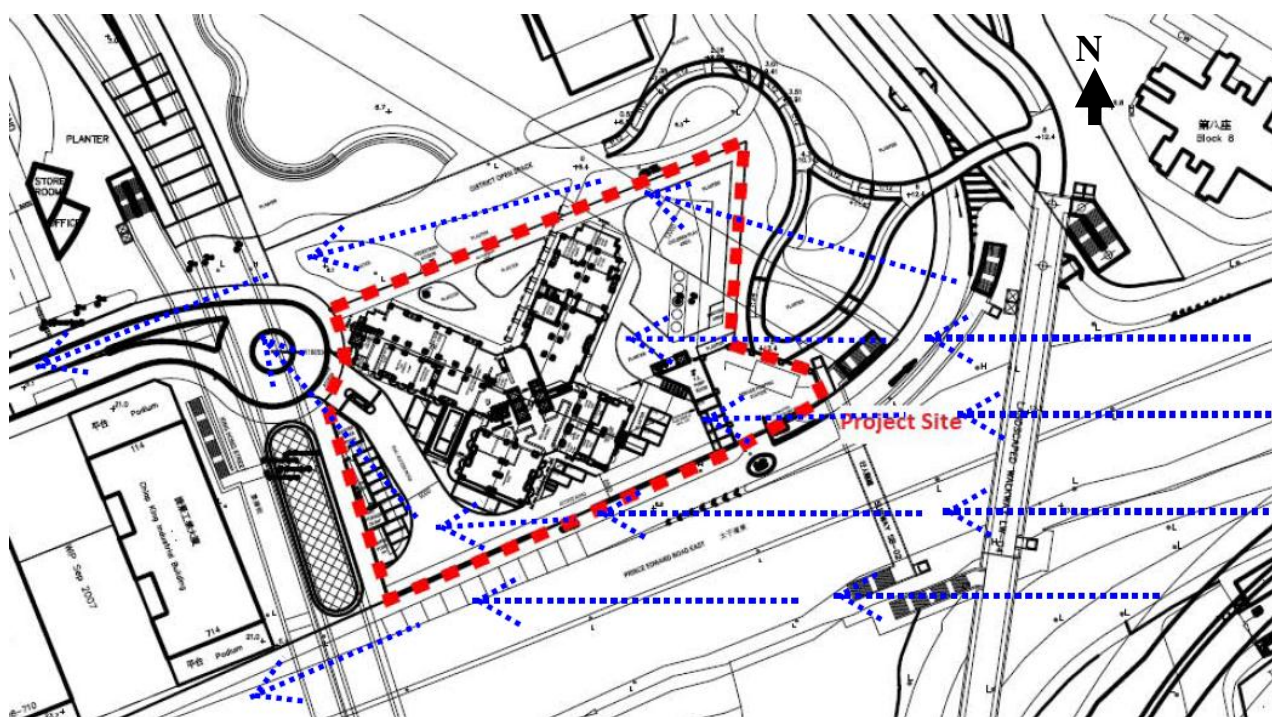


Figure 9 building orientation to enhance prevailing E wind penetration from the south part of project site

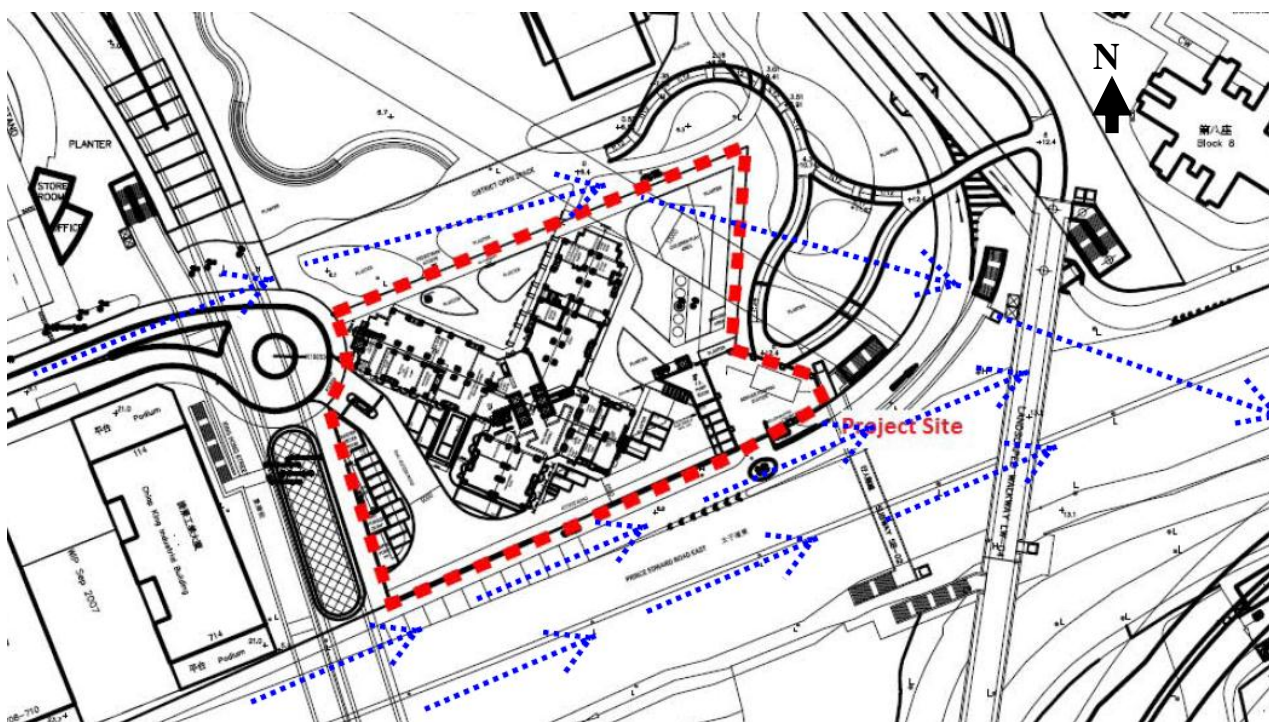


Figure 10 building orientation to enhance prevailing SW wind penetration from the south part of project site

6.2.2. Problem and Focus Areas

Nevertheless, a drawback is identified in the initial scheme during the AVA EE study.

- The building block would still be possible to contribute wind screening effect at the open area at ground level and the wind permeability into the site would be significantly affected. Similarly, the screening effect is more significant on the south part of the project building as the majority prevailing winds come from the southern part of the project area due to the open areas and existing area layout as shown on *Figure 11*.



Figure 11 Potential Wind Sheltering by Project of Summer E & SW and non-Summer E Wind Penetration

6.3. RECOMMENDATION

To enhance the air ventilation performance of the Project, recommendation can be adapt to the refined design scheme as shown in *Figure 12*.

An opening on the 2nd and 3rd could be adopt in the southern part of the subject building which allows wind penetration for prevailing east and south-west wind through the subject site to reduce the screening effect of the building.

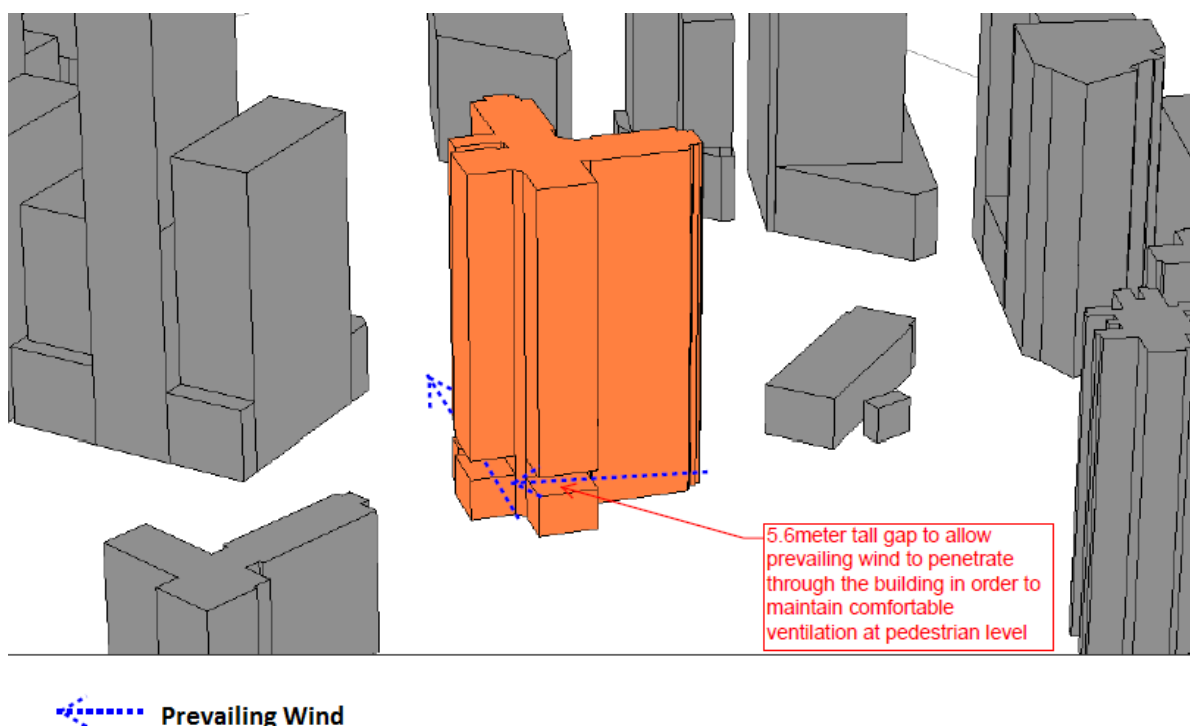


Figure 12 Prevailing wind in the latest Design Scheme

HKHA has incorporated the above recommendations into the latest design scheme to improve the air ventilation performance of the Project. It is recommended an AVA Initial Study to be conducted for the design scheme to quantitatively evaluate the air ventilation performance at the pedestrian level to evaluate the effectiveness of the recommended design measures.

7. FUTURE STUDY

As the Project would likely impose changes on the existing wind environment in the surrounding area, an AVA Initial Study will be conducted to quantitatively assess the potential air ventilation impacts due to the Project, identify any potential problematic areas and the mitigation measures required to ensure no adverse impact.

7.1. METHODOLOGY FOR INITIAL STUDY

According to the Technical Guide, both Computational Fluid Dynamics (CFD) and wind tunnel could be considered as the appropriate tools for AVA Initial Study. CFD is recommended as a cost-effective means for AVA Initial Study to evaluate the changes of the wind environment due to the Project.

The AVA Initial Study is to quantitatively evaluate potential air ventilation impacts of the

proposed development based on wind data obtained from MM5 by determining the Velocity Ratios (VR) at various concerned locations. The airflow distribution within the flow domain, being affected by the subject site-specific design and the nearby topography will be visualized under the prevailing wind conditions round the year.

8. CONCLUSION

This EE-AVA Study aims at providing qualitative evaluation of wind performance of the subject site under existing condition and proposed design option. The subject site is currently unoccupied while surrounding by high-rise residential, commercial and industrial buildings. Building heights and separations of these surrounding buildings have different degree of implications on air ventilation at pedestrian level within neighbourhood during summer and non-summer conditions.

The air ventilation performance of the initial scheme of the Project, which consists of one proposed public housing block, has been evaluated by comparing to the latest design scheme. Besides, the following good design feature in the Initial Scheme has been considered:

- Capturing the prevailing east and south-westerly winds without substantial impediment from and to the surrounding developments;

The following additional enhancement measures are recommended in the Expert Evaluation in order to improve the air ventilation performance of the latest Design Scheme:

- Create an opening on the 2nd floor and 3rd floor at the southern side of the building in order to allow prevailing wind from summer and non-summer period for penetration to the surrounding street level, hence a more comfortable pedestrian environment.

Lastly, an AVA Initial Study is recommended to quantitatively assess the potential air ventilation impacts on existing environment due to the Project based on the latest design scheme using Computational Fluid Dynamic (CFD) Simulation.