

Hong Kong Housing Authority
**Proposed Public Housing
Development at Tuen Mun Area
54 Sites 1 & 1A**
Air Ventilation Assessment – Expert
Evaluation

--

Issue 1 | 9 February 2021

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 --

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

ARUP

Contents

	Page
1 Introduction	1
1.1 Project Background	1
1.2 Study Objectives	1
2 Site Characteristics	2
2.1 Site Location and the Surrounding Area	2
3 Site Wind Availability	3
3.1 Site Wind Availability Data	3
4 Qualitative Evaluation – Existing Condition	6
4.1 E Wind	6
4.2 ESE Wind	7
4.3 S and SSW Wind	8
5 Ventilation Design for the Proposed Development	9
6 Qualitative Evaluation – the Proposed Development	11
6.1 E Wind	11
6.2 ESE Wind	12
6.3 S and SSW Wind	13
7 Air Ventilation Assessment – Initial Study	14
8 Conclusion	15

1 Introduction

1.1 Project Background

Ove Arup and Partners Hong Kong Ltd (Arup) was appointed by Hong Kong Housing Authority (HKHA) to carry out an Air Ventilation Assessment (AVA) for the Proposed Public Housing Development at Tuen Mun Area 54 Sites 1 & 1A (the Proposed Development).

The objective of this study is to evaluate the ventilation performance of the Proposed Development using the methodology of Air Ventilation Assessment, in accordance with “Technical Circular No. 1/06 – Air Ventilation Assessments” (the Technical Circular) and Annex A to the Technical Circular “Technical Guide for Air Ventilation Assessment for Developments in Hong Kong” (the Technical Guide) jointly issued by then Housing, Planning and Lands Bureau and Environmental, Transport and Works Bureau on 19th July 2006¹. This report presents the findings for Stage 1 of the AVA – Expert Evaluation.

1.2 Study Objectives

Expert Evaluation assesses the characteristics of wind availability of the site, and evaluates the air ventilation performance under the existing condition and with the Proposed Development in a qualitative way. The following tasks are conducted:

- Identification of site location and characteristics;
- Analysis of the wind condition;
- Evaluation of the wind flow characteristics under existing condition;
- Recommendation for the design scheme;
- Evaluation of the wind flow characteristics with the Proposed Development;
- Identify methodology for Stage 2 of the AVA – Initial Study.

¹ https://www.devb.gov.hk/filemanager/en/content_679/hplb-etwb-tc-01-06.pdf

2 Site Characteristics

2.1 Site Location and the Surrounding Area

The Development is located in Tuen Mun district (Area 54), at the foot of a mountain area between Castle Peak and Yuen Tau Shan to its west. It is surrounded by low-rise developments such as Po Wah Garden to the northeast, and Siu On Garden, Ming Wong Garden, Po Wah Garden Phase 3, and Pui Lin Garden to the southeast.

Slightly away from the Development, there are a number of high-rise building clusters at east, south, and southwest directions, such as TM54-Site2 Development under construction, planned TM54-Site4A(S) Development, planned TM54-Sites3&4(E) Development, indicative TM54-Sites3&4(W) Development, planned TM54-Site5 Development, and Po Tin Estate. These high-rise building clusters would induce certain impact to the prevailing wind flow.

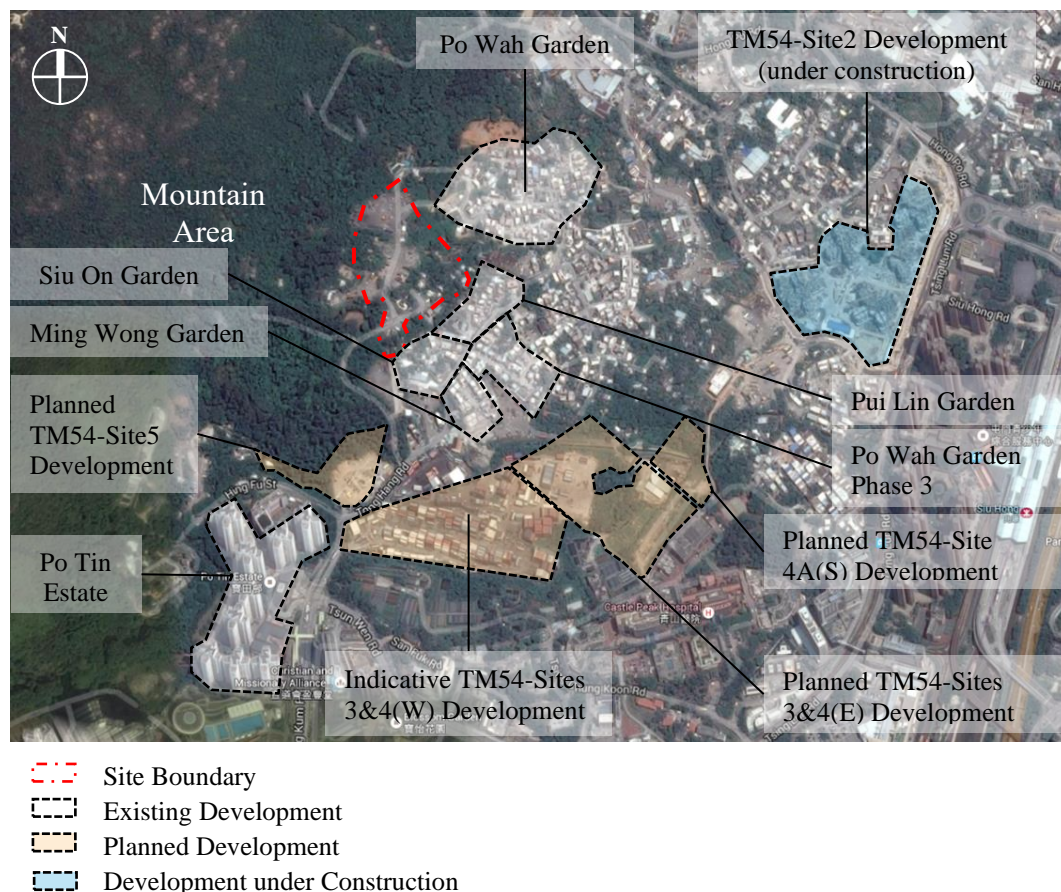


Figure 1 Site and the Surrounding Area of the Development

3 Site Wind Availability

3.1 Site Wind Availability Data

The site wind availability data for the study is obtained from Planning Department's website, which was simulated using the meso-scale numerical model Regional Atmospheric Modeling System (RAMS) [2]. The location of the Development falls within the location grid (x:038, y:063) in the RAMS database as indicated in Figure 2. The wind rose for annual condition is presented in Figure 3. The wind rose for summer condition is presented in Figure 4.

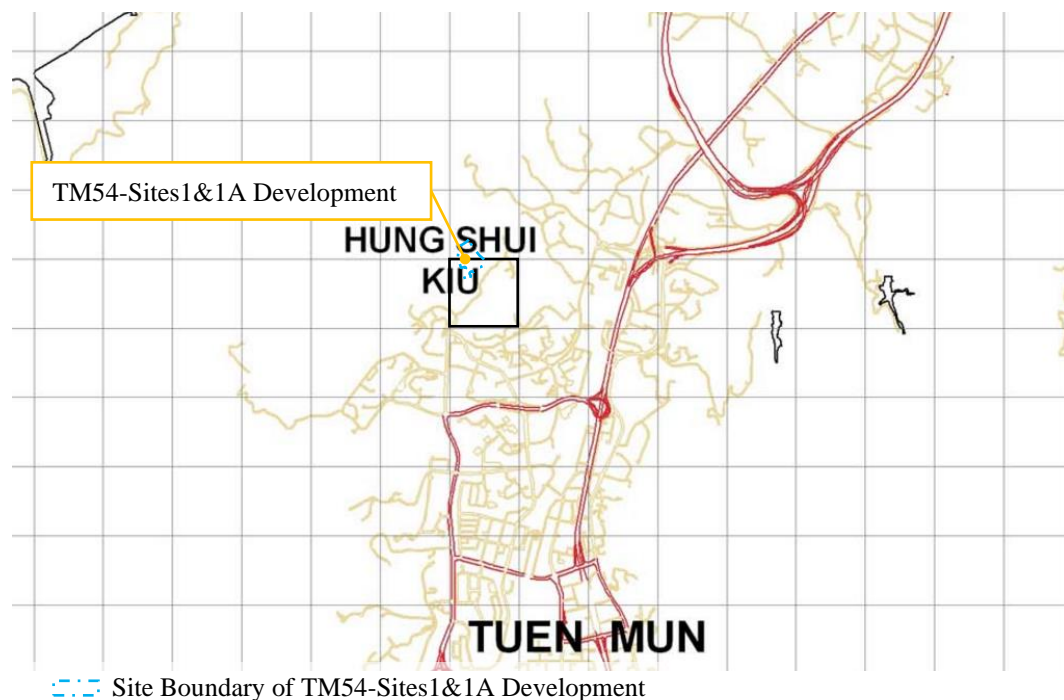


Figure 2 RAMS Grid and Location of the Developments

The wind rose for annual condition is presented in Figure 3, and the wind rose for summer condition is presented in Figure 4

As indicated by the wind roses, the annual prevailing wind directions are East (E) and East-southeast (ESE), and the summer prevailing wind directions are South (S) and South-southwest (SSW).

[2] http://www.pland.gov.hk/pland_en/p_study/comp_s/InceptionReport_webpage_11-12/final_report.pdf

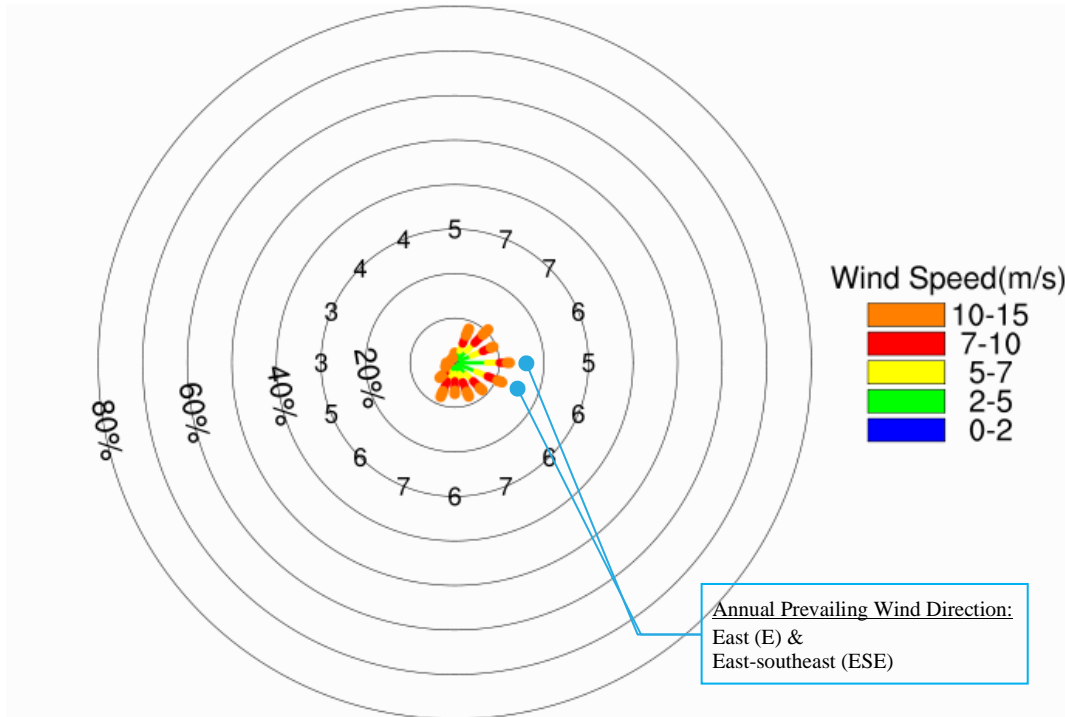


Figure 3 Wind Rose at 500mPD for Annual Condition (Grid x: 038, y: 063)

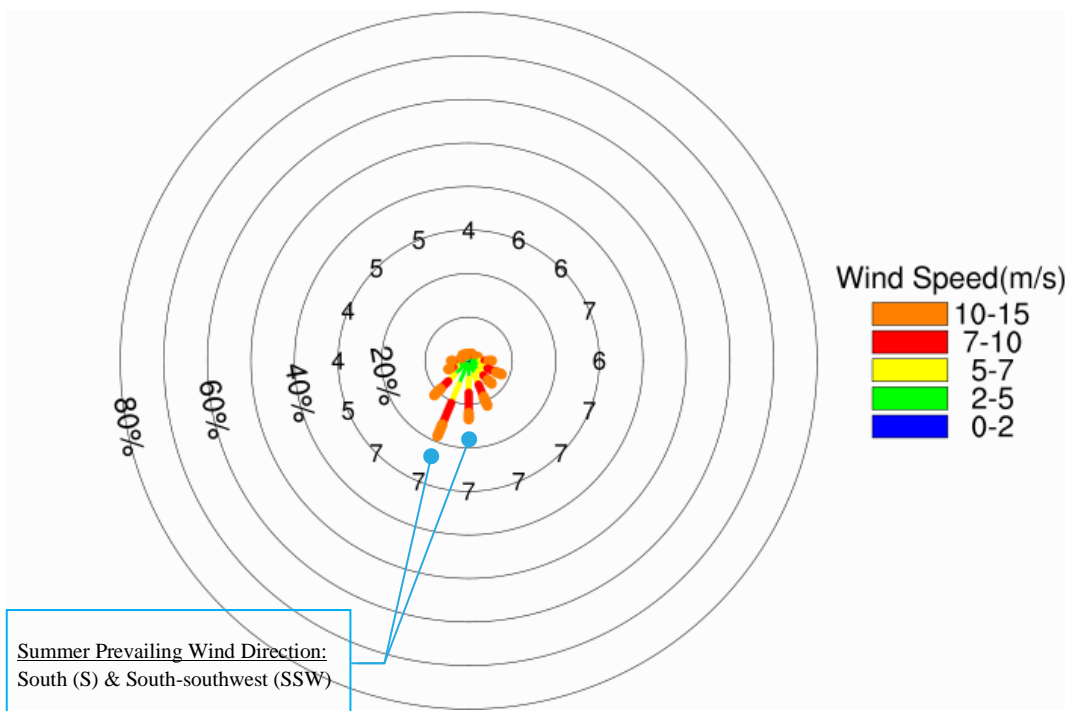


Figure 4 Wind Rose at 500mPD for Summer Condition (Grid x: 038, y: 063)

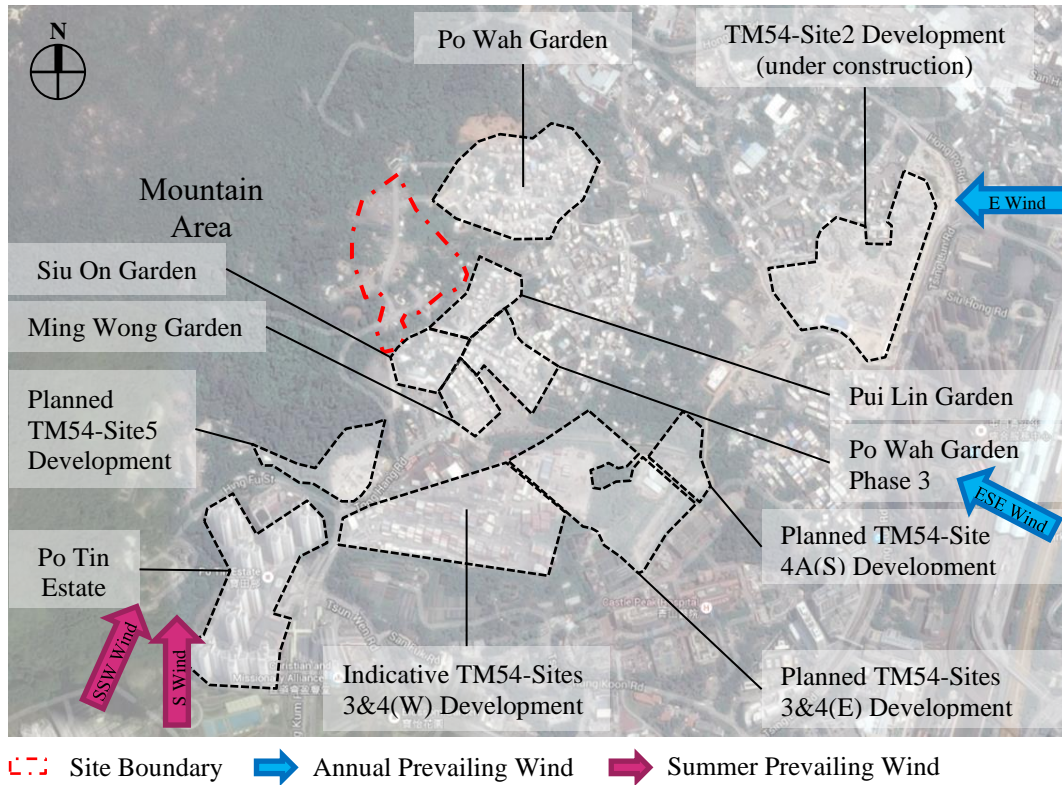


Figure 5 Prevailing Wind Directions at the Proposed Development

4 Qualitative Evaluation – Existing Condition

4.1 E Wind

E winds is a prevailing wind under annual condition.

The E wind would flow from the eastern quadrant and along the north of the TM54-Site2 Development, which would then stream atop the low-rise Po Wah Garden to reach the site (**Blue Arrow**). Under existing condition, the vacant site would allow wind to stream through and reach the downwind mountain area (**Blue Arrows**).

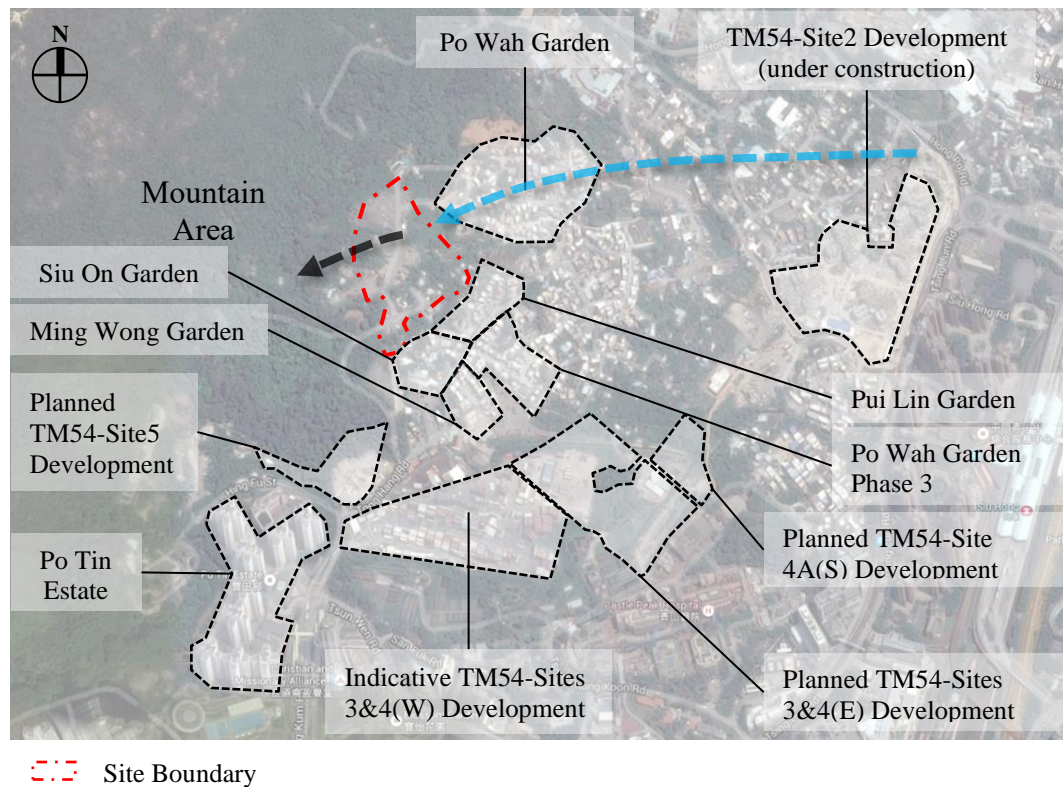


Figure 6 Wind Flow under Existing Condition under E Wind

4.2 ESE Wind

ESE wind is a prevailing wind under annual condition.

The ESE wind would arrive from the south-eastern quadrant, which would then flow atop the low-rise Siu On Garden, Pui Lin Garden and Ming Wong Garden to reach the site (**Blue Arrow**). The existing vacant site would allow wind to stream through and reach the downwind mountain area (**Blue Arrows**).

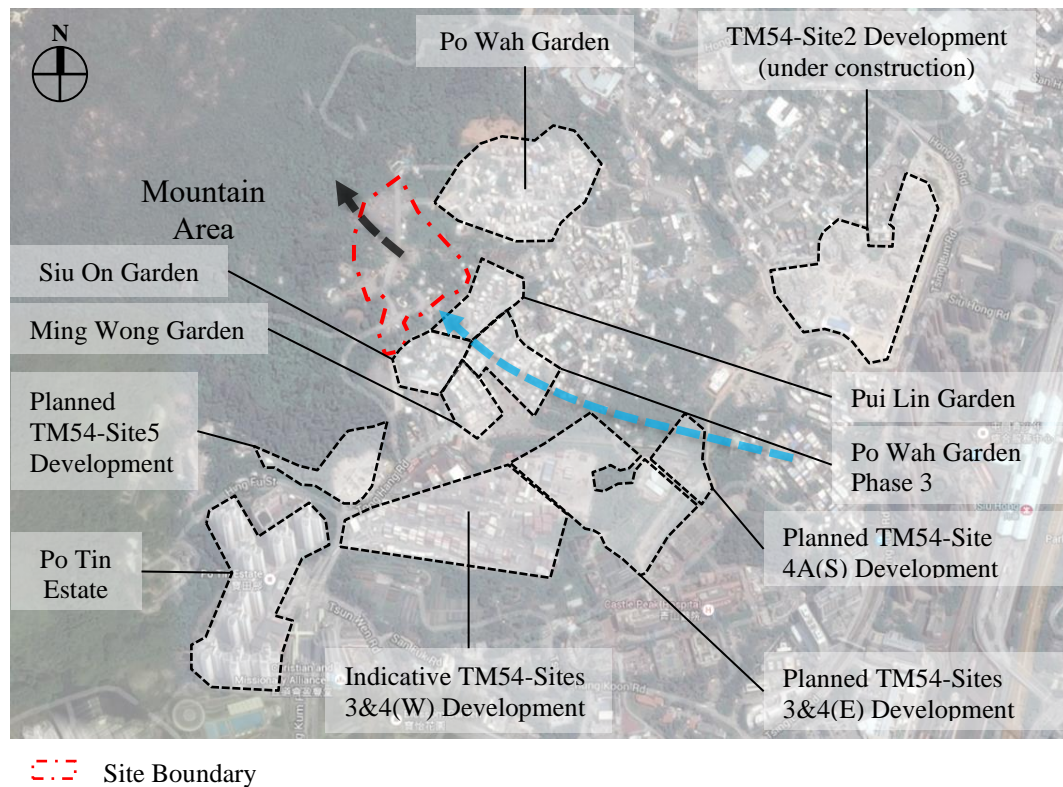


Figure 7 Wind Flow under Existing Condition under ESE Wind

4.3 S and SSW Wind

S and SSW wind are prevailing wind under summer condition.

S and SSW wind would arrive from the southern quadrant, which would then flow along the west of Po Tin Estate and the Planned TM54-Site5 Development to then reach the site (**Blue Arrow**). A portion of high-level S and SSW wind would also be able to flow atop Po Tin Estate and the Planned TM54-Site5 Development and reach the site (**Purple Arrow**). The existing vacant site would allow S and SSW wind to penetrate through and reach the developments at the downwind area, including the Po Wah Garden (**Black Arrows**).

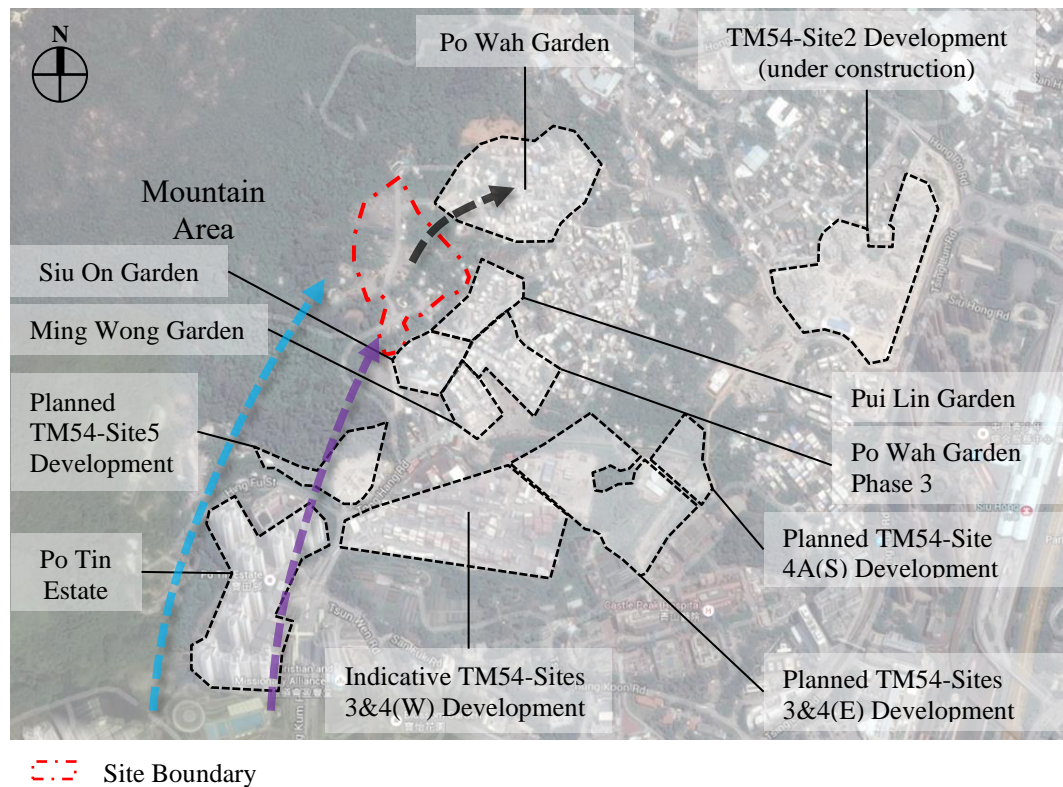


Figure 8 Wind Flow under Existing Condition under S and SSW Wind

5 Ventilation Design for the Proposed Development

Proposed Scheme is the intended development scheme, with minor relaxation of certain development restrictions. The key development parameters of Proposed Scheme are presented in Table 1.

Table 1 Development Parameters of Proposed Scheme

Development Parameter	Proposed Scheme
Plot Ratio (domestic portion)	6
Maximum Building Height	140mPD

The scheme consists of four domestic blocks with building height of 135mPD to 140mPD. There are podiums of 2 stories at Block 1 and Block 2. A semi-sunken carpark is located between Block 2 and Block 3. The site ground level is approximately 21.5mPD to 25.4mPD.

A minimum 20m wide NNE-SSW running NBA at +36mPD and above is provided under Proposed Scheme as indicated in Figure 9. Meanwhile, Block 4 has a setback of approximately 4m.

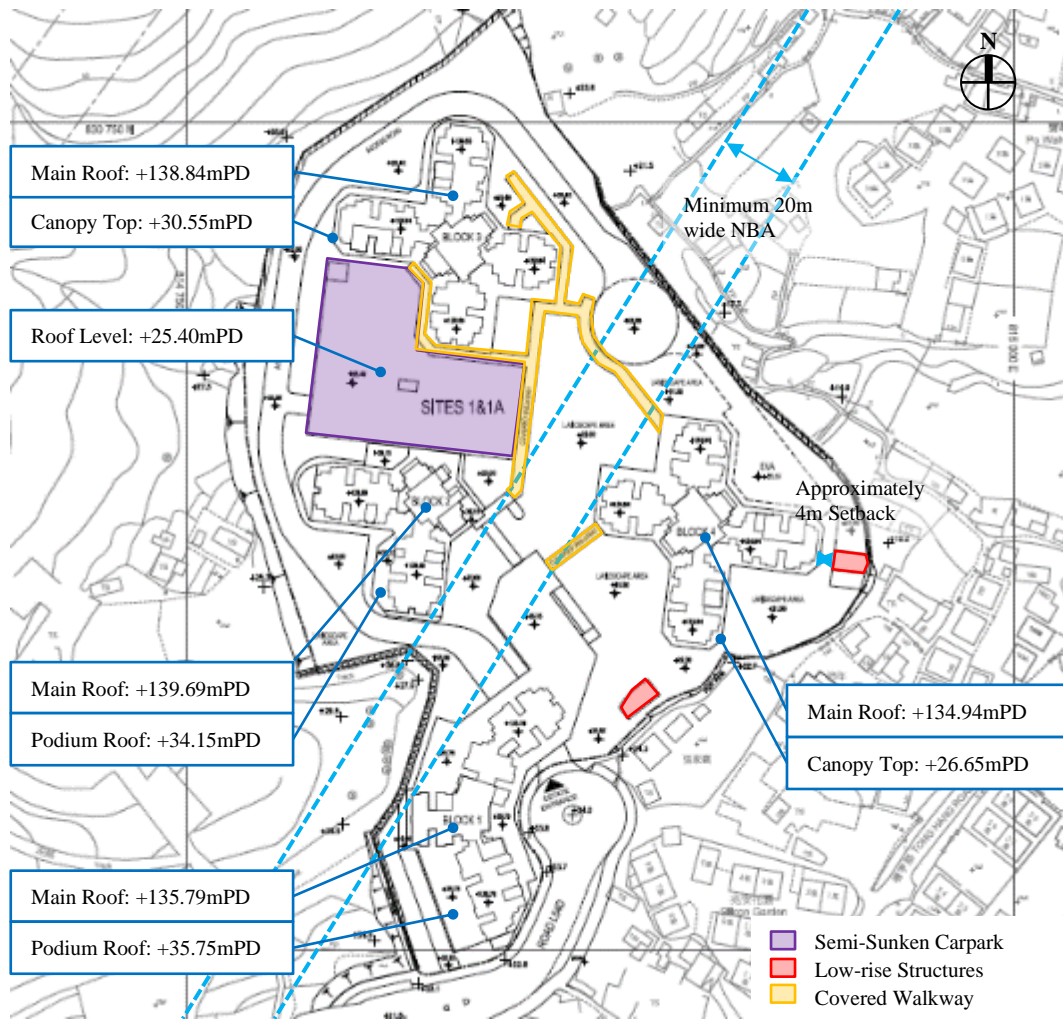


Figure 9 Proposed Scheme Master Layout Plan

6 Qualitative Evaluation – the Proposed Development

6.1 E Wind

The E wind would flow from the eastern quadrant and along the north of the TM54-Site2 Development, which would then stream atop the low-rise Po Wah Garden to reach the Proposed Development (**Blue Arrow**).

The eastern façade of Block 3 of the Proposed Development would be able to capture and downwash the E wind to pedestrian level and ventilate its immediate surroundings, including the Pui Lin Garden and the Po Wah Garden (**Blue Arrows**).

The NBA of at least 20m width would also enhance the permeability of the site by facilitating wind to penetrate the development to the southern site boundary (**Blue Arrows**).

The setback of Block 4 from the site boundary would also allow more wind to flow towards the south along the eastern site boundary, ventilating the downwind area such as Siu On Garden (**Green Arrow**).

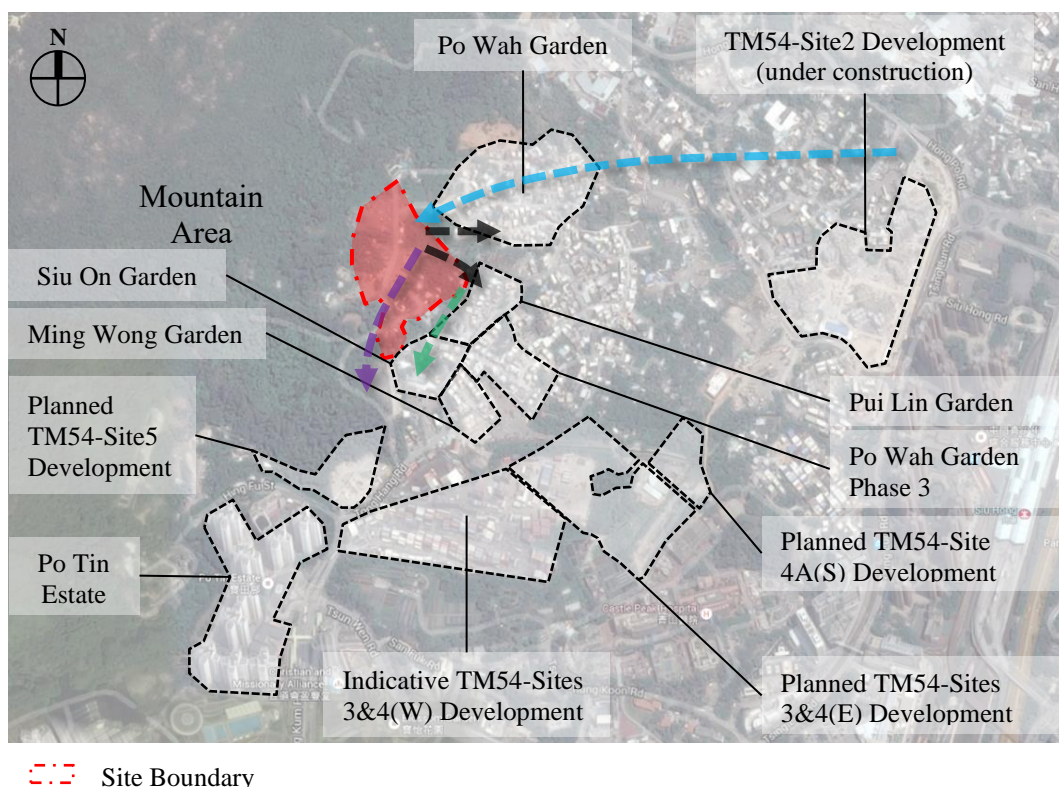


Figure 10 Wind Flow with the Proposed Development under E Wind

6.2 ESE Wind

The ESE wind would arrive from the south-eastern quadrant, which would then flow atop the low-rise Siu On Garden, Pui Lin Garden and Ming Wong Garden to reach the Proposed Development (**Blue Arrow**).

The eastern façades of Block 1 and Block 4 would be able to capture and downwash ESE wind to the pedestrian level and enhance the wind environment of the immediate surroundings, including Ming Wong Garden and Siu On Garden (**Black Arrows**).

ESE wind would flow towards the center of the Proposed Development through the building separation between Block 1 and 4, which would then be diverted by Block 3 to flow towards the western site boundary atop the semi-sunken carpark and along the NBA towards the northeastern site boundary. The wind environment at the western and northeastern site boundaries, and the immediate northeastern surrounding such as the Po Wah Garden would be enhanced (**Purple Arrows**).

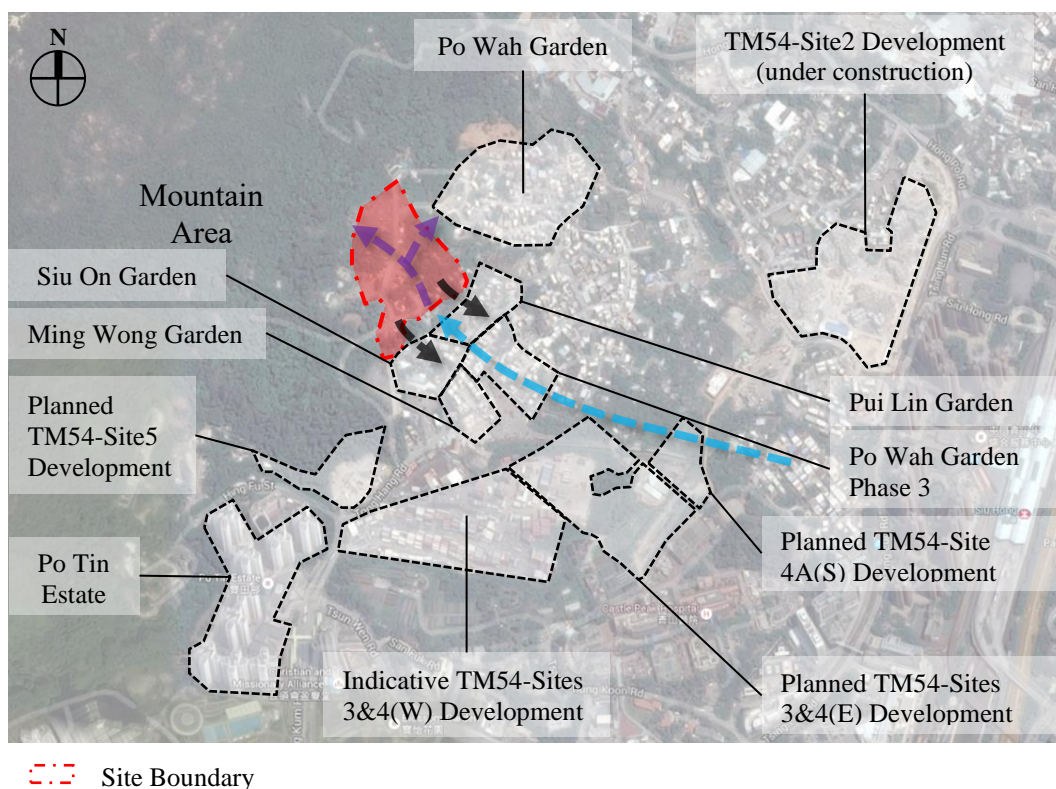


Figure 11 Wind Flow with the Proposed Development under ESE Wind

6.3 S and SSW Wind

S and SSW wind would arrive from the southern quadrant, which would then flow along the west of Po Tin Estate and the Planned TM54-Site5 Development to then reach the Proposed Development (**Blue Arrow**). A portion of high-level S and SSW wind would also be able to flow atop Po Tin Estate and the Planned TM54-Site5 Development and reach the Proposed Development (**Purple Arrow**).

The high-rise towers of the Proposed Development could create a wind shadow at the northeastern downwind region. However, the NBA would allow a portion of S and SSW wind to penetrate through the site and reach the northeastern site boundary to ventilate the adjacent surroundings, including the Po Wah Garden (**Black Arrow**), mitigating the effect of the wind shadow.

The southwestern façades of Block 1 and 2 would be able to capture and downwash the S and SSW wind to the pedestrian level and ventilate the southwestern site boundary (**Green Arrows**).

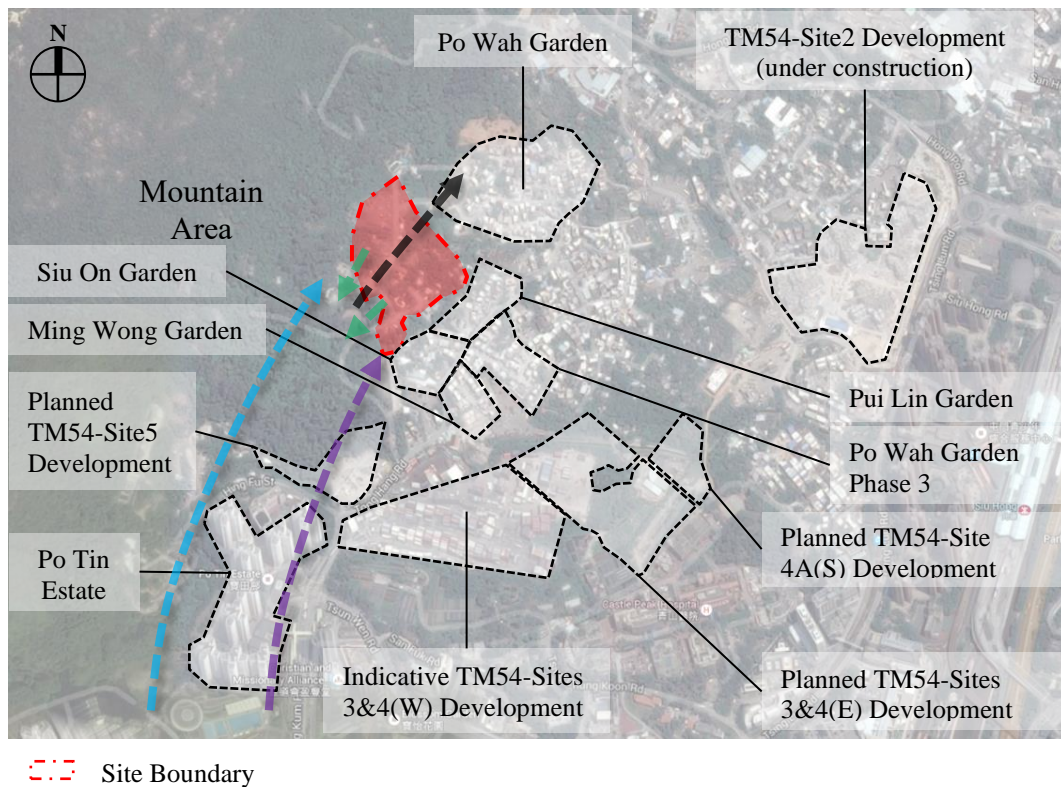


Figure 12 Wind Flow with the Proposed Development under S and SSW Wind

7 Air Ventilation Assessment – Initial Study

The AVA Expert Evaluation aims to assess the characteristics of wind availability of the site qualitatively and evaluate the air ventilation performance under the existing condition and with the Proposed Development.

To quantitatively investigate the wind flow pattern at and near the Proposed Development, and to assess the ventilation performance of the design scheme, an AVA Initial Study is being performed during the design stages, to inform and support design development.

According to the Technical Circular and the Technical Guide, Computational Fluid Dynamics (CFD) coupled with RAMS wind data is considered as the appropriate tool for AVA Initial Study. The simulation model contains information of the surrounding topography and buildings, as well as the Proposed Development itself. The air flow is simulated using CFD under the annual and summer wind conditions. General flow pattern and ventilation performance at the pedestrian level is reported.

8 Conclusion

Ove Arup and Partners Hong Kong Ltd (Arup) was appointed by Hong Kong Housing Authority (HKHA) to carry out an Air Ventilation Assessment (AVA) for the Proposed Public Housing Development at Tuen Mun Area 54 Sites 1 & 1A. An AVA Expert Evaluation is conducted as Stage 1 of the study and presented in this report.

RAMS wind data for the project site is obtained from Planning Department's website and analysed. According to the analysis, the annual prevailing wind directions are East (E) and East-southeast (ESE), and the summer prevailing wind directions are South (S) and South-southwest (SSW).

A local NBA of at least 20m and a 4m setback of Block 4 has been incorporated to enhance the permeability of the Proposed Development to minimise the potential ventilation impact on the Proposed Development and its surrounding areas, especially at the leeward side.

To further assess the air ventilation performance of the Proposed Development quantitatively, an AVA Initial Study using Computational Fluid Dynamics (CFD) technique is being performed during the design stages, to inform and support design development.