TERM CONSULTANCY FOR AIR VENTILATION ASSESSMENT SERVICES

Cat. A1– Term Consultancy for Expert Evaluation and Advisory Services on Air Ventilation Assessment (PLNQ 35/2009)

Final Report

Pak Shek Kok (East) Area

March 2013

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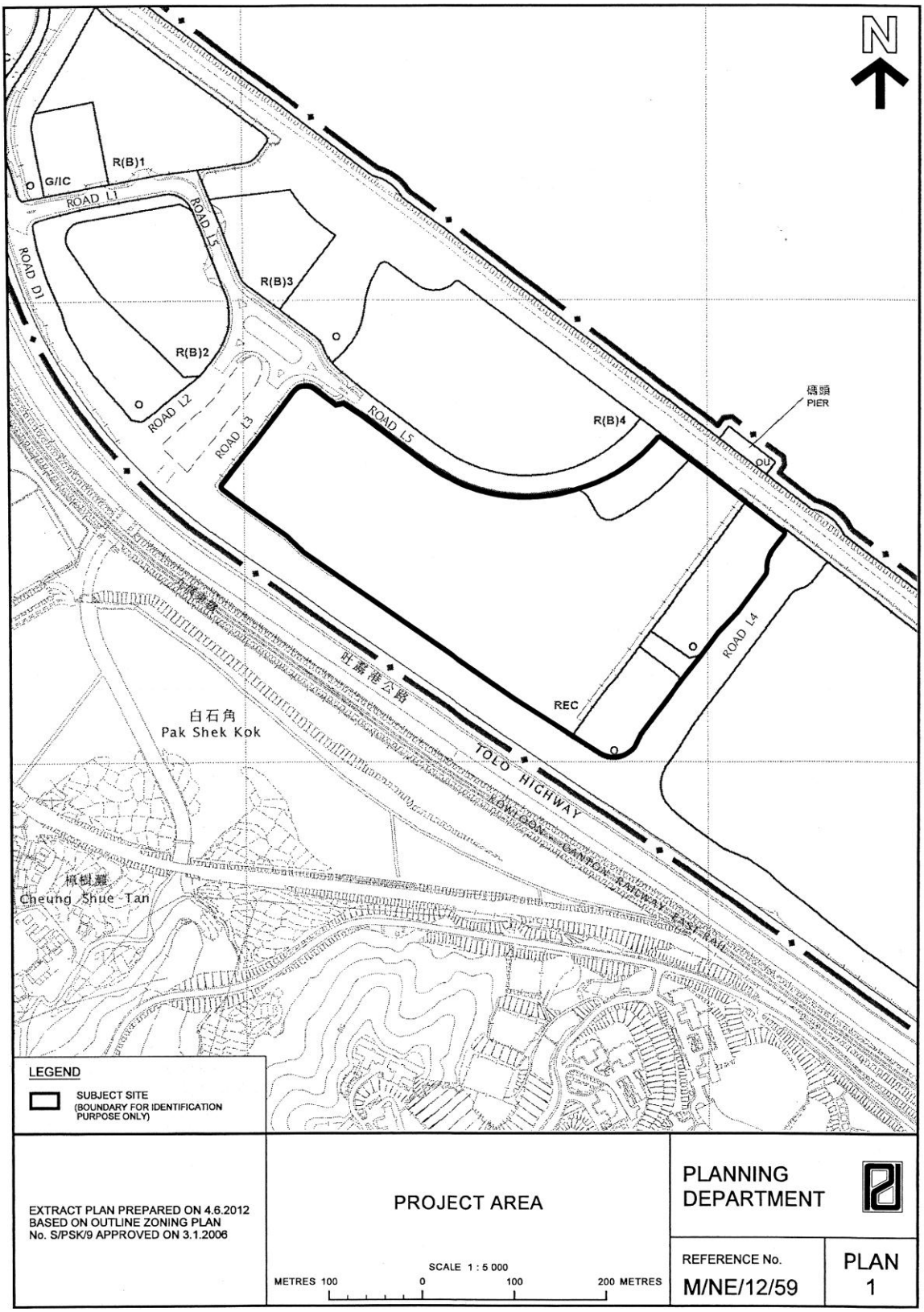
The Study Area



Expert Evaluation Report
of Pak Shek Kok (East) Area

Executive summary

0.1 Wind Availability

(a) The annual wind of the study area is mainly coming from the Northeast and East. The summer wind is mainly coming from the East and southerly quarters including Southwest, South and Southeast.

(b) Wind coming from the south and southwest will be weakened by the hills. When the prevailing wind comes from the Northeast and East over the water, the eastern part of the study area is unobstructed; while the western part 45m away from the committed development in R(B)4 site will also not be affected. When the prevailing wind comes from the Southeast, it is expected that the wind can enter the study area through the gaps, roads and open spaces of the Science Park.

0.2 Expert Evaluation and Recommendations of the Initial Planned Scenario

(a) On the whole, given the building height restriction of 55mPD and 47mPD, by carefully designing and positioning buildings on the site upon development, there should be no severe air ventilation issue.

0.3 Expert Evaluation and Recommendations of the Revised Planned Scenario

(a) A revised scenario that is very different from the Initial Planned Scenario is proposed by the Planning Department. On the whole, given the building height restriction of 52mPD at R(B)5 site and 40m at OU(SP) zone, by carefully designing and positioning buildings on site upon development, there should be no severe air ventilation issue.

(b) The NBA zone (25 - 40m wide) between the "R(B)5" and "OU(SP)" that functions as a buffer zone to maintain the street canyon ratio to 1.0 to 1.5 is useful to be maintained.

(c) Wall-like developments occupying the full frontage of the building site should be avoided. 25% to 33% building/urban permeability is preferred in future development in this study area. Bulky podium-type development occupying the full building site should be avoided. Ground coverage of no more than 65% is recommended.

0.4 Further Work

Further AVA study for the proposed OZP amendments is not necessary.

Expert Evaluation Report
of Pak Shek Kok (East) Area

1.0 The Assignment

1.1 The Pak Shek Kok (East) Outline Zoning Plan (OZP) No. S/PSK/9 is being reviewed with a view to rezoning the central part of Pak Shek Kok (East) area for residential development and other proposed developments, including the imposition of appropriate development restrictions to guide future development/redevelopment. It is therefore considered necessary to conduct an expert evaluation to assess the preliminary air ventilation impacts of the proposed development proposals and development restrictions.

1.2 This expert evaluation report is based on the materials given by Planning Department to the Consultant including:

Pak Shek Kok (East) Outline Zoning Plan
Proposed Building Height Restrictions (in mPD) for Pak Shek Kok (East) Outline Zoning Plan with
Existing Building Height of Pak Shek Kok in mPD
Committed Development in Pak Shek Kok

1.3 The consultant has studied the foregoing materials. During the preparation of the report, the consultant has visited the site and conducted working sessions with Planning Department.

2.0 Background

2.1 Planning Department's study: "Feasibility Study for Establishment of Air Ventilation Assessment System" has recommended that it is important to allow adequate air ventilation through the built environment for pedestrian comfort.

2.2 Given Hong Kong's high density urban development, the study opines that: "more air ventilation, the better" is the useful design guideline.

2.3 The Feasibility Study summarizes 10 qualitative guidelines for planners and designers. For the OZP level of consideration, breezeways/air paths, street grids and orientations, open spaces, non-building areas, waterfront sites, scales of podium, building heights, building dispositions, and greeneries are all important strategic considerations.

2.4 The Feasibility Study also suggests that Air Ventilation Assessment (AVA) be conducted in three stages: Expert Evaluation, Initial Studies, and Detailed Studies.

The suggestion has been adopted and incorporated into HPLB and ETWB Technical Circular no. 1/06. The key purposes of Expert Evaluation are to the following:

(a) Identify good design features.
(b) Identify obvious problem areas and propose some mitigation measures.
(c) Define "focuses" and methodologies of the Initial and/or Detailed studies.
(d) Determine if further study should be staged into Initial Study and Detailed Study, or Detailed Study alone.

2.5 To conduct the Expert Evaluation systematically and methodologically, it is necessary to undertake the following information analyses:

(a) Analyse relevant wind data as the input conditions to understand the wind environment of the Area.
(b) Analyse the topographical features of the Area, as well as the surrounding areas.
(c) Analyse the greenery/landscape characteristics of the Area, as well as the surrounding areas.
(d) Analyse the land use and built form of the Area, as well as the surrounding areas.

Based on the analyses:

(e) Estimate the characteristics of the input wind conditions of the Area.
(f) Identify the wind paths and wind flow characteristics of the Area through slopes, open spaces, streets, gaps and non building areas between buildings, and low rise buildings; also identify stagnant/problem areas, if any.
(g) Estimate the need of wind for pedestrian comfort.

Based on the analyses of the EXISTING urban conditions:

(h) Evaluate the strategic role of the Area in air ventilation term.
(i) Identify problematic areas which warrant attention.
(j) Identify existing "good features" that needs to be kept or strengthened.

Based on an understanding of the EXISTING urban conditions:

(k) Compare the prima facie impact, merits or demerits of the building height restrictions as proposed by Planning Department on Air Ventilation.
(l) Highlight problem areas, if any. Recommend improvements and mitigation measures if possible.
(m) Identify focus areas or issues that may need further studies. Recommend appropriate technical methodologies for the study if needed.

3.0 The Wind Environment

3.1 Hong Kong Observatory (HKO) stations provide useful and reliable data on the wind environment in Hong Kong (Figure 3.1). There are some 46 stations operated by HKO in Hong Kong. Together, these stations allow for a very good general understanding of the wind environment especially near ground level.

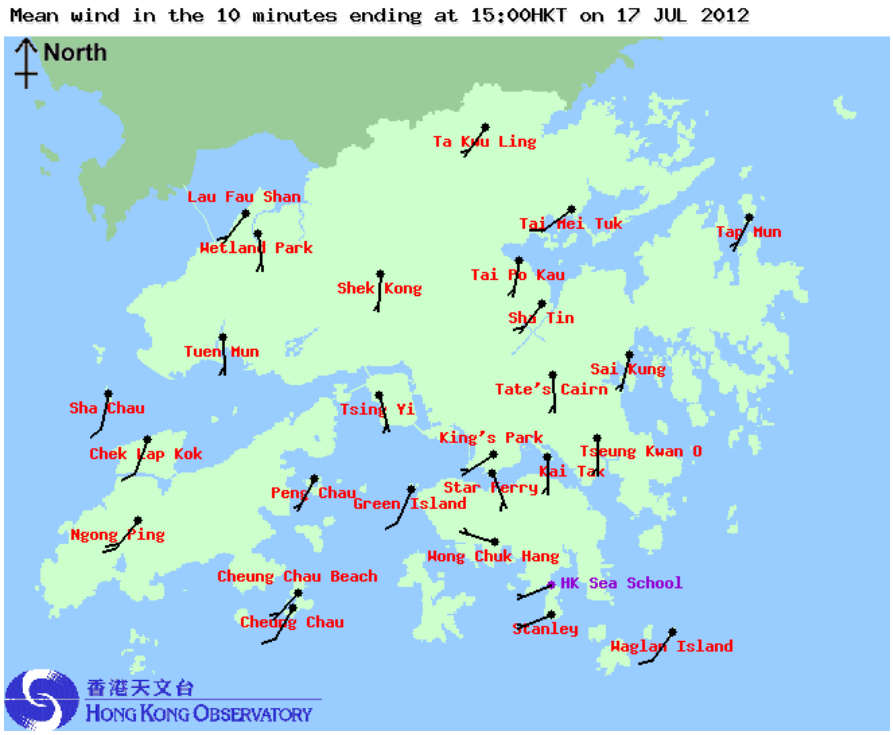


Figure 3.1 Some of the HKO stations in Hong Kong. This is a screen capture at 3pm on 17 July 2012 from the HKO website. The arrows show the wind directions and speeds of the time.

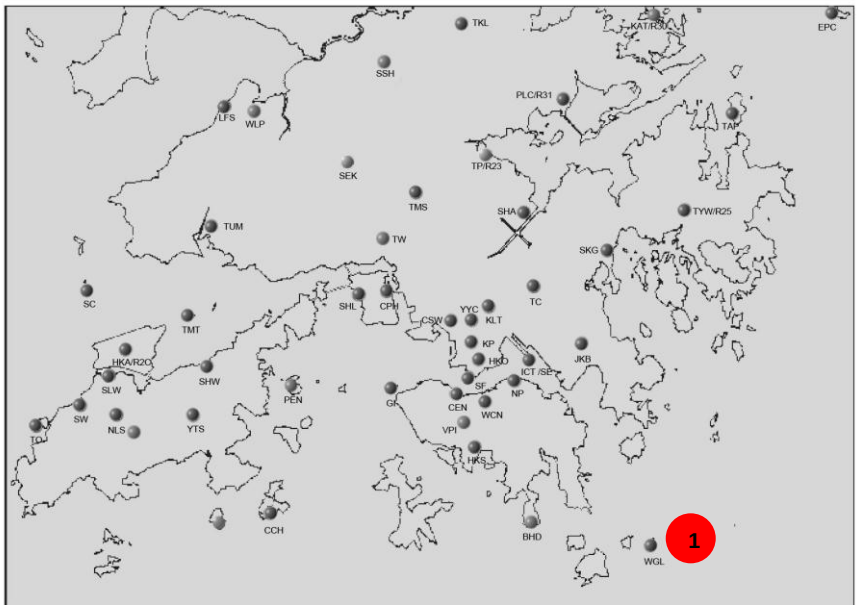


Figure 3.2 The HKO stations at 1: Waglan Island (WGL).

3.2 The HKO station at Waglan Island (WGL) is normally regarded by wind engineers as the reference station for wind related studies (Location 1 in Figure 3.2). The station has a very long measurement record, and is unaffected by Hong Kong's complex topography [unfortunately, it is known not to be able to capture the thermally induced local wind circulation like sea breezes too well]. Based on WGL wind data, studies are typically employed to estimate the site wind availability taking into account the topographical features around the site.

3.3 Based from the annual wind rose of WGL (Figure 3.3), it is apparent that the annual prevailing wind in Hong Kong is from the east. A major component of wind also comes from the northeast; and there is a minor, but nonetheless observable component from the southwest. WGL has weak to moderate wind (0.1m/s to 8.2 m/s) approximately 70% of the time.

3.4 For the study, seasonally or monthly wind environment should be understood (Figure 3.4 and 3.5). During winter, the prevailing wind comes from the northeast, whereas during summer, it comes from the southwest. As far as AVA is concerned, in Hong Kong, the summer wind is very important and beneficial for thermal comfort. Hence, based on WGL data, it is very important to plan our city, on the one hand, to capture the annual wind characteristics, and on the other hand, to maximize the penetration of the summer winds (mainly from the South-West) into the urban fabric.

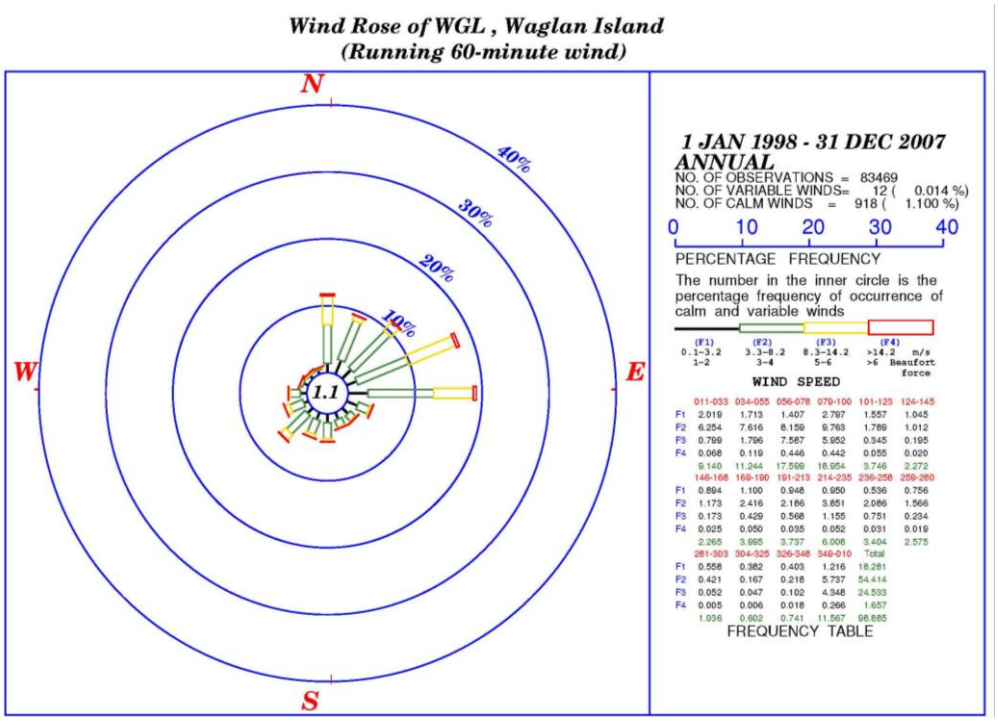


Figure 3.3 Wind rose of WGL 1998 to 2007[1] (annual).

[1] Wind data from 1998 to 2007 are the latest available 10-year data from HKO to the consultant.

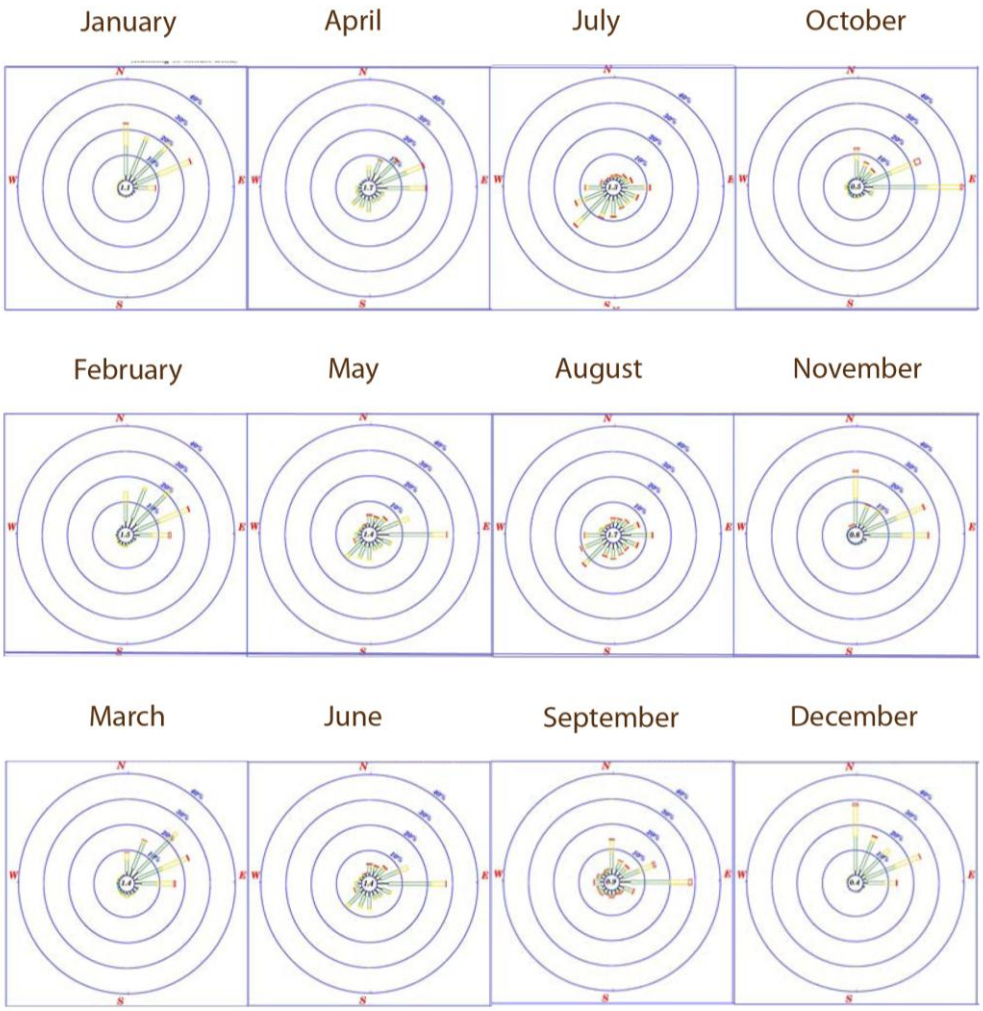


Figure 3.4 Monthly wind roses of WGL from 1998 to 2007.

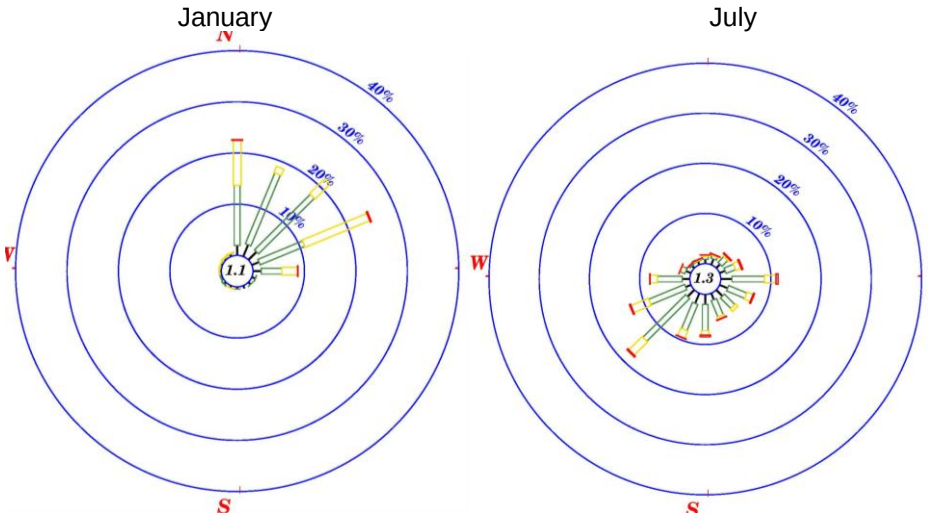


Figure 3.5 Wind roses of WGL from 1998 to 2007 (Jan and July).

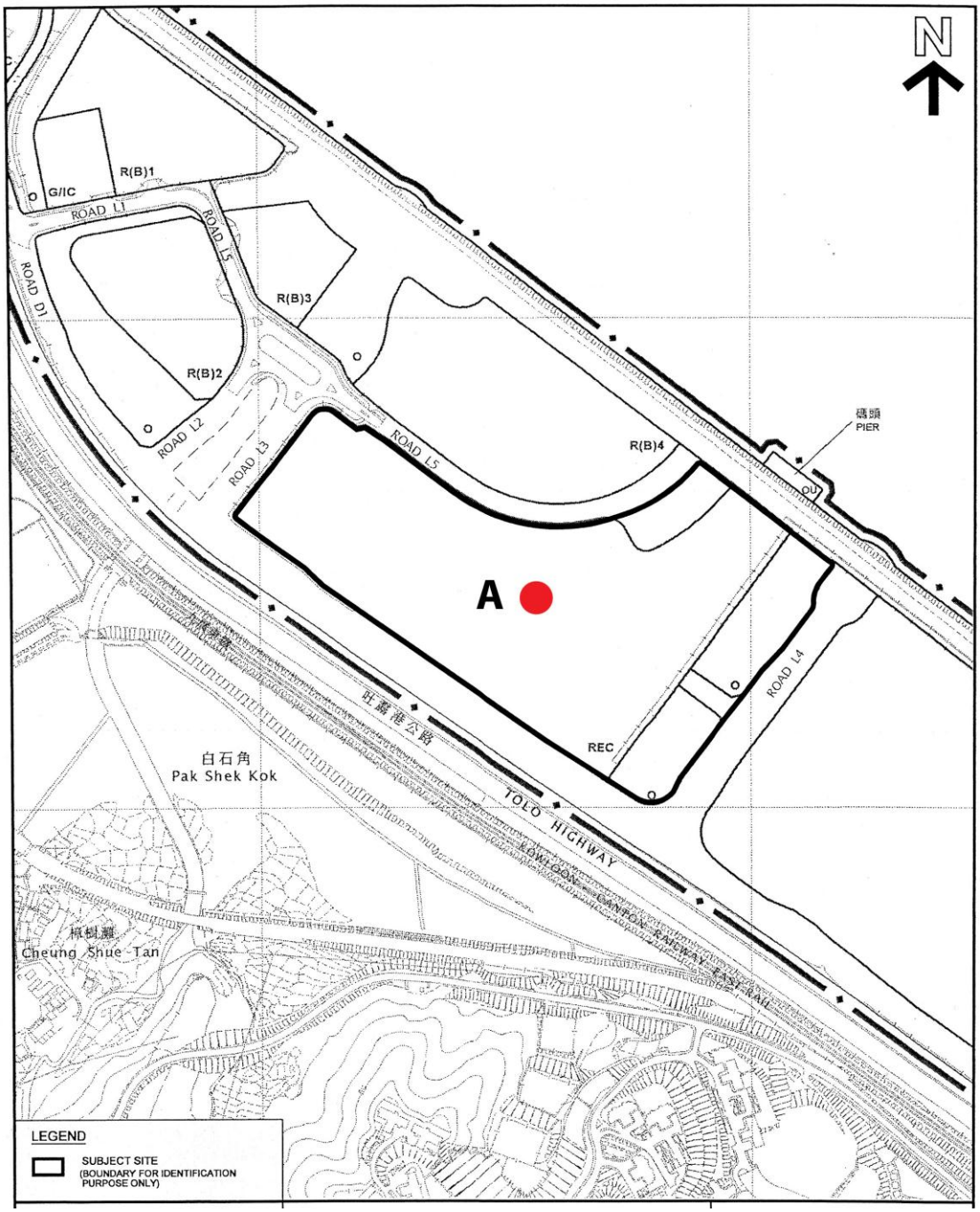


Figure 3.6 One location of MM5 extracted data (Point A).

3.5 Researchers at Hong Kong University of Science and Technology (HKUST), Prof Alexis Lau and Prof Jimmy Fung, have simulated a set of wind data using MM5. The data covered the entire year of 2004. Data from three locations within the study area were extracted at 60m, 120m and 450m above the ground (Figures 3.7 to 3.8). One location, according to the theories of MM5, was selected to representatively reflect the general wind pattern within the study area induced by topography.

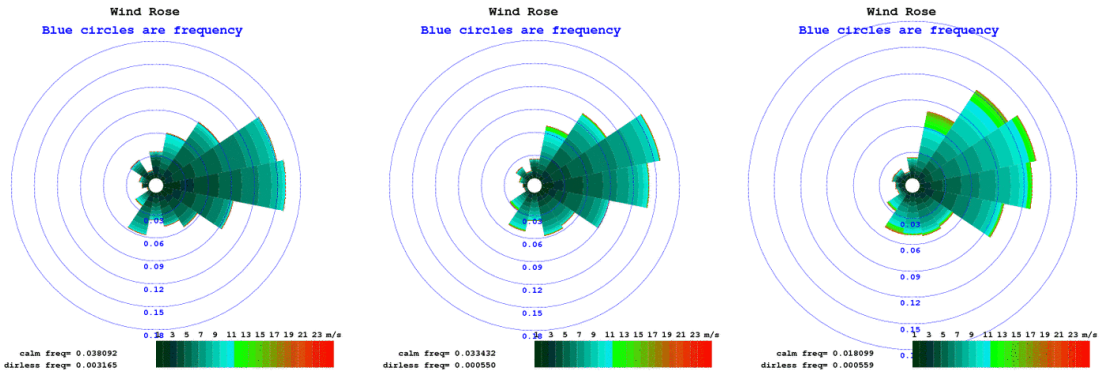


Figure 3.7 Wind roses (annual) at A (left: 60 m; middle: 120 m; right: 450 m).

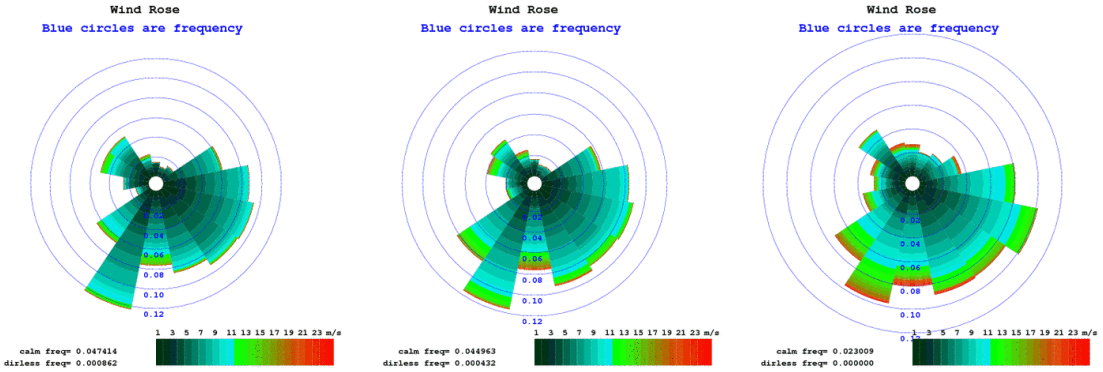
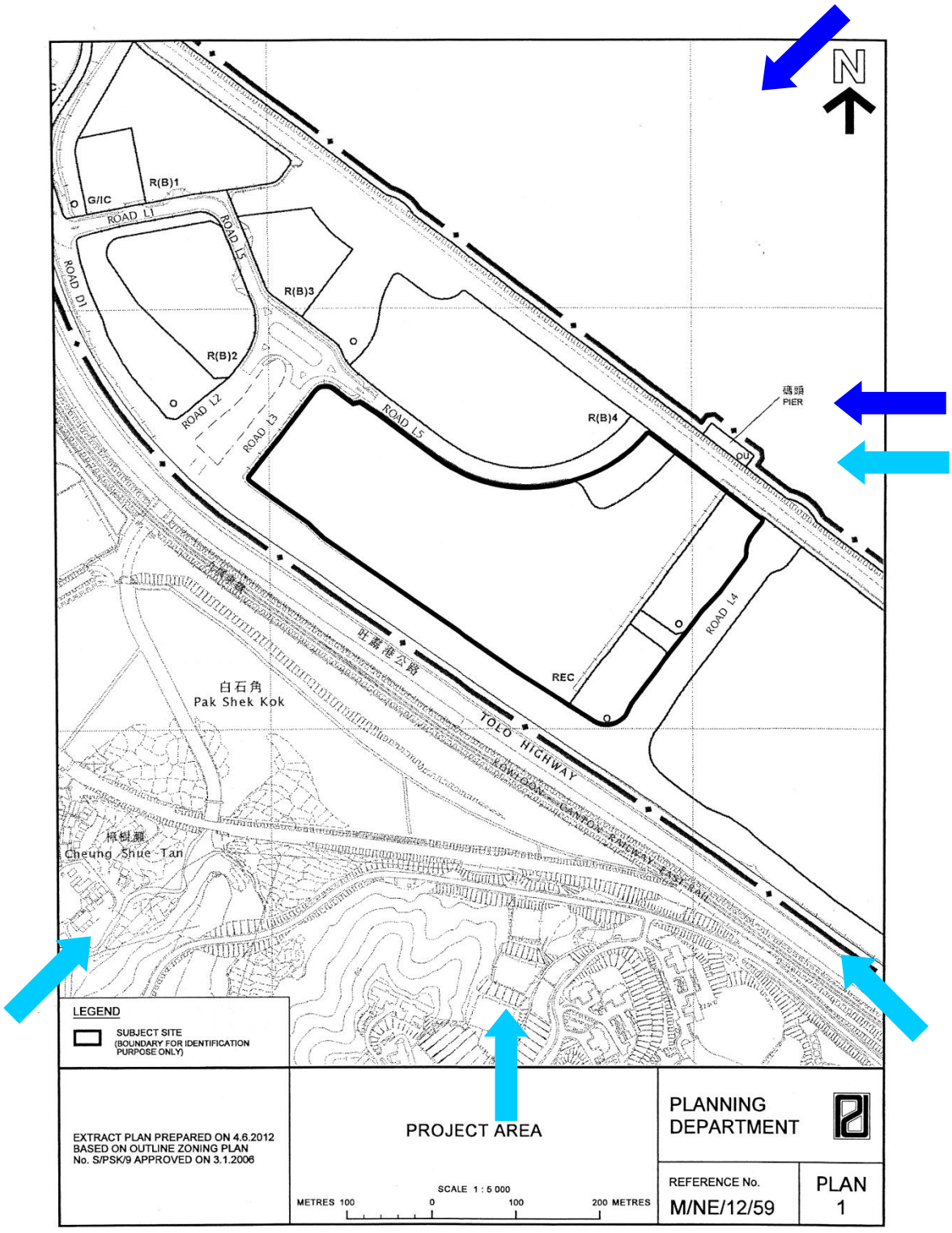


Figure 3.8 Wind roses (summer) at A (left: 60 m; middle: 120 m; right: 450 m).

3.7 In summary, based on the available wind data (Table 1), one may conclude that the annual wind of the study area is mainly from the Northeast and East. The summer wind is mainly coming from the East and southerly quarters including Southwest, South and Southeast (Figure 3.9).

Table 1 Summary of Prevailing Wind Directions

Period	MM5 Simulation		
	60 m	120 m	450 m
Annual	NE, E	NE, E	NE, E
Summer	E, SE, S, SW	E, SE, S, SW	E, SE, S, SW



Annual prevailing wind →

Summer prevailing wind →

Figure 3.16 A summary of the prevailing winds of the study area

4.0 Topography， Existing conditions and the Wind Environment

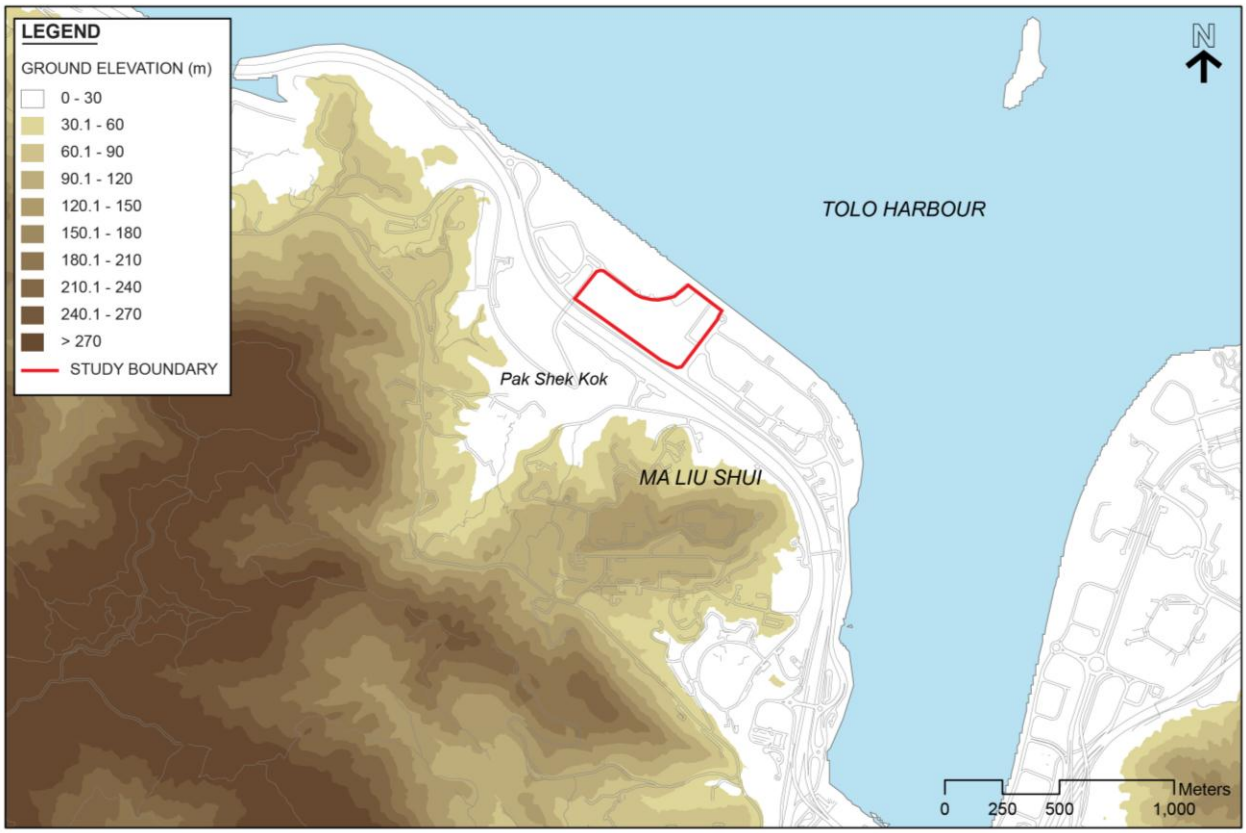


Figure 4.1 A digital elevation map of the study area

4.1 The Area is fronting the Tolo Harbour. It rises from the sea level to around 4.0 mPD, with hills lying south and west beyond the boundary (Figure 4.1).

4.2 The wind coming from the south and southwest will be weakened by the hills. When the prevailing wind comes from the Northeast and East over the water, the east part of the study area is unobstructed; while the west part will not be affected 45m away from the committed development in R(B)4 site[1]. When the prevailing wind comes from the Southeast, it is expected that the wind can enter the study area through the gaps, roads and open spaces in Science Park (Figure 4.2).

[1] Final Report of Term Consultancy for AVA Services - Expert Evaluation on Air Ventilation Assessment of Pak Shek Kok

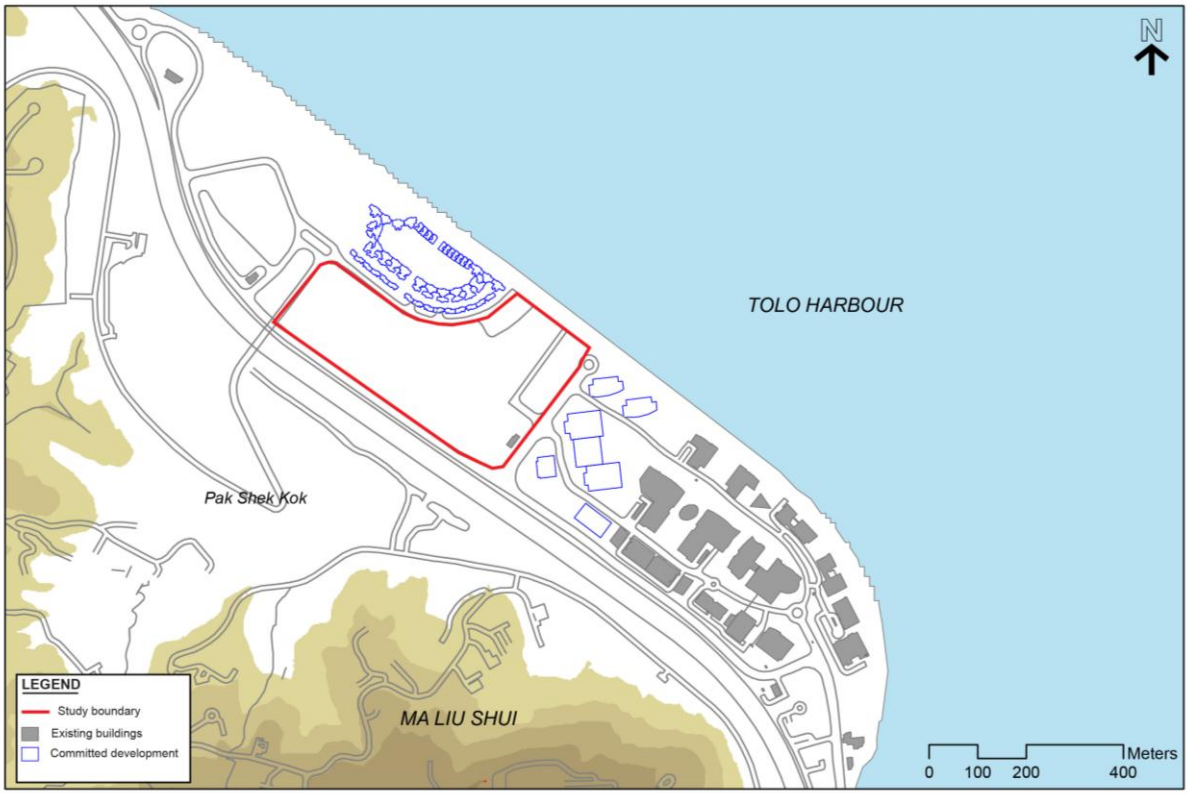
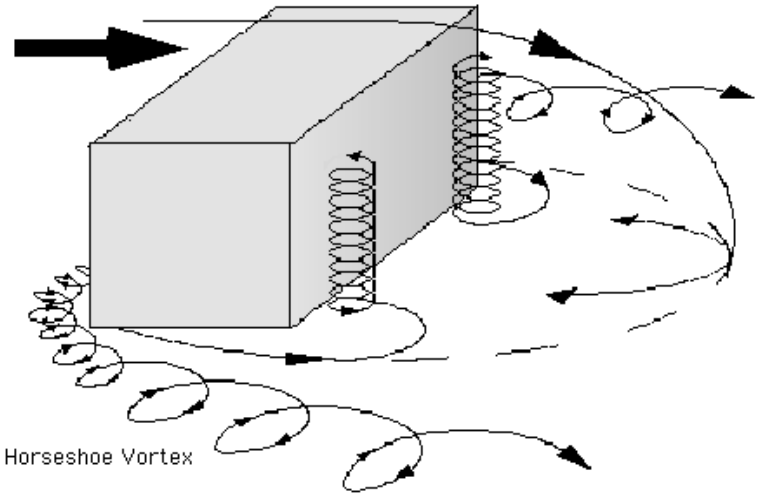


Figure 4.2 Existing conditions and committed development in Pak Shek Kok

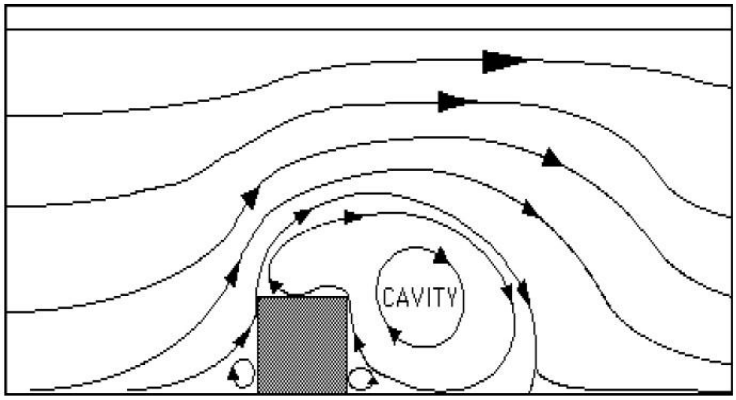
5.0 Assessment

5.01 The study area is currently vacant. The Initial Scenario includes a R(B)5 site with building height restriction of 55mPD, a site of Science Park with building height restriction of 47mPD and an O zone.

5.0.2 Based on the Technical Guide for Air Ventilation Assessment for Developments in Hong Kong jointly issued by the then Housing, Planning and Lands Bureau (HPLB) and Environment, Transport and Works Bureau (ETWB), the assessment area of a Project Area should be H from boundary of the Project Area, with H being the tallest building in the Project Area. It is understood that a building of height H can cause a wind wake area of approximately H from the building. The wake area is basically the “wind shadow” of the building with weaker and more turbulent winds



(a)



(b)

Figure 5.1 Building aerodynamics and Wind Wake

5.0.3 Without details or information of further developments in the Area, they are expected to be developed to their respective maximum plot ratio, maximum podium coverage and maximum height allowed. If buildings are built along the site boundary with maximum height (the worst case), the extent of the possible wake under prevailing wind directions can be estimated to be around 40m -50m (Figure 5.2 and 5.3).

5.0.4 Based on Figure 5.2, it can be concluded that the impact of the possible wind wakes to the surrounding due to the future development (the worst case) in R(B)5 site is insignificant. On the whole, adjacent residential zones are not affected by the possible wind wakes.

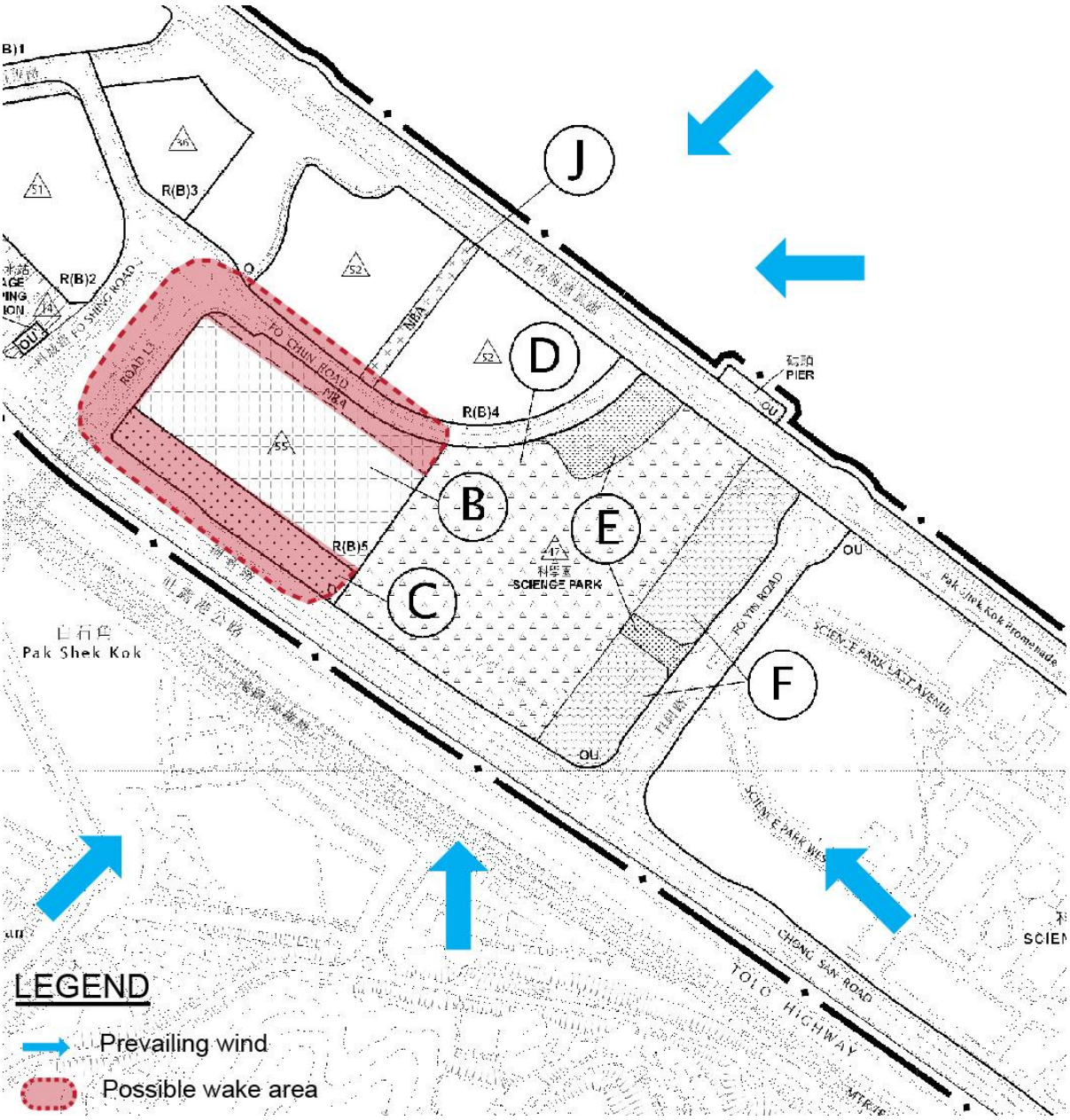


Figure 5.2 Possible wind wakes due to the R(B)5 zone under various wind directions. (Showing only wakes beyond the R(B)5 zone boundary)

5.0.4 Based on Figure 5.3, it can be concluded that the possible wind wakes due to the future development (the worst case) in Science Park site are likely to affect parts of R(B)4 site and R(B)5 site.

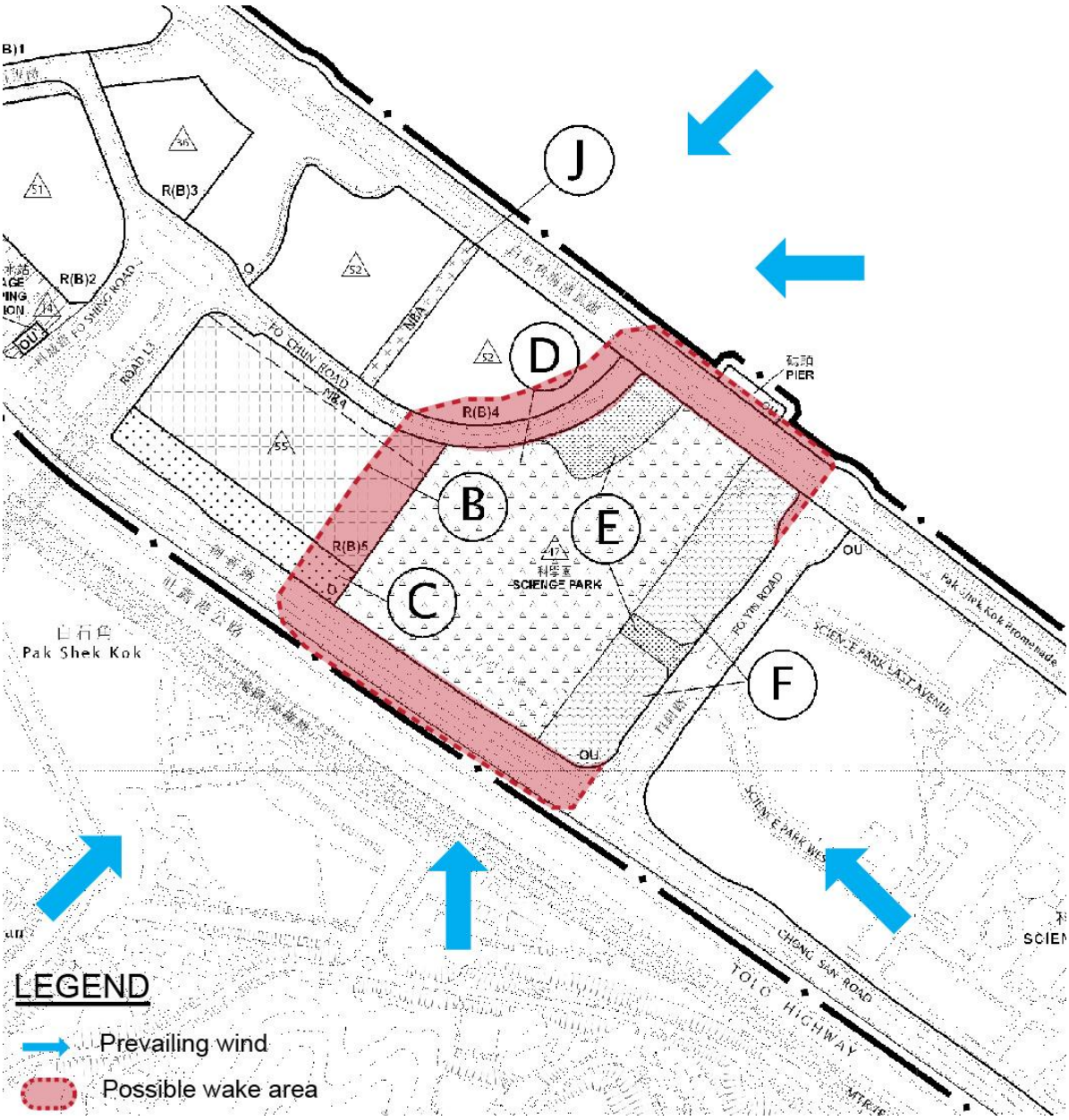


Figure 5.3 Possible wind wakes due to Science Park under various wind directions (Showing only wakes beyond the Science Park site boundary)

6.0 Expert Evaluation and Recommendations of the Initial Planned Scenario

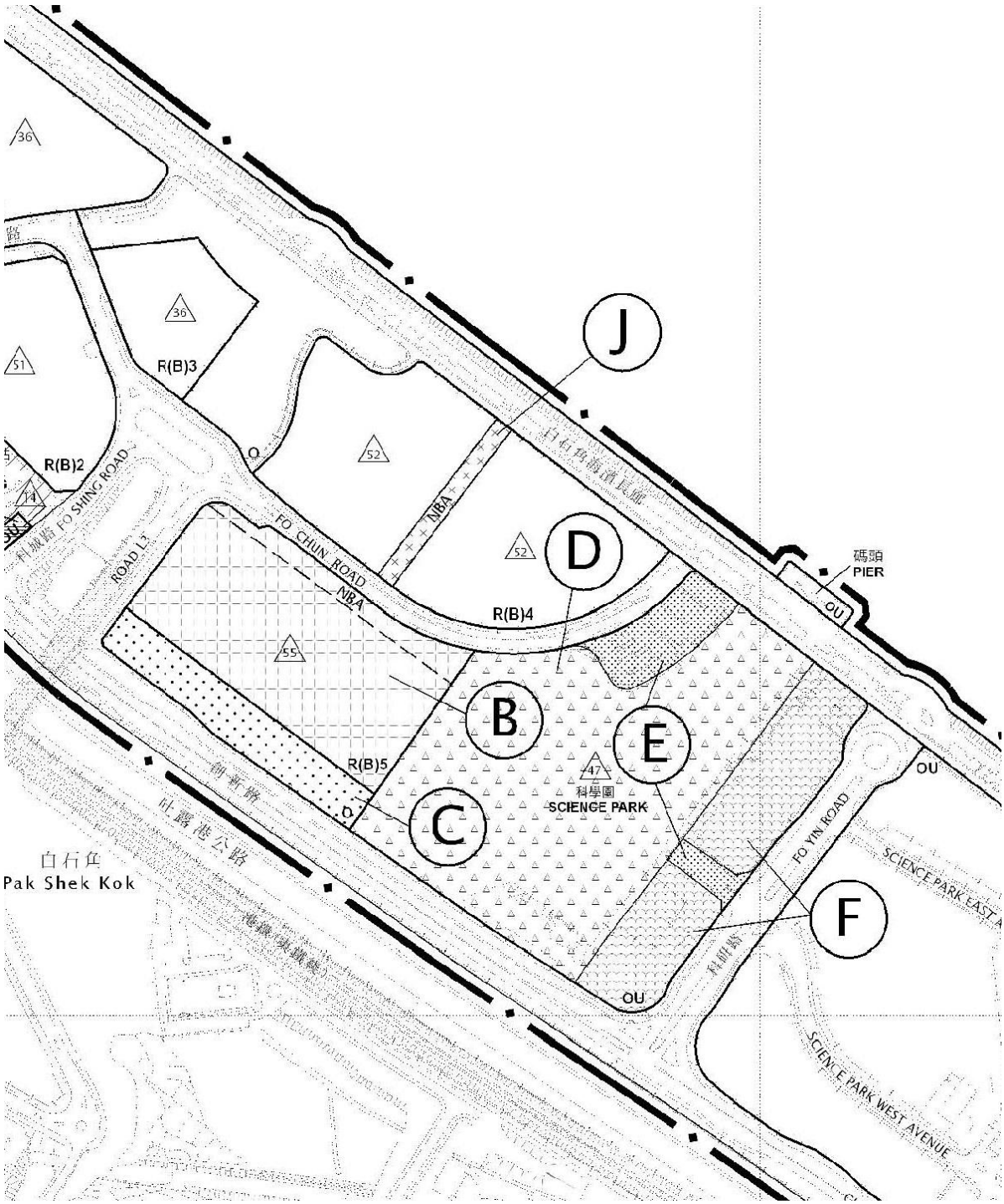


Figure 6.1 The Initial Planned Scenario of the study area (proposed building height restriction)

6.1 On the whole, given the building height restriction of 55mPD and 47mPD (Figure 6.1), by carefully designing and positioning buildings on site upon development, there should be no severe air ventilation issue.

6.2 The initial planned scenario proposes a NBA near Fo Chun Road (Figure 6.1). This NBA that function as a "buffer zone" between R(B)4 site and R(B)5 site is recommended to be maintained to mitigate the wind wake due to the buildings in R(B)4 site[1] and the possible wind wake due to the development in R(B)5 site (Figure 5.2).

6.3 Based on the assessment above, if development on the Science Park site is along the site boundary with maximum height (the worst case), the possible wind wakes are likely to affect parts of R(B)4 site and R(B)5 site. To mitigate the possible wind wake, it is recommended that a 40-50m wide "buffer zone" be incorporated between R(B)4 site, R(B)5 site and the Science Park site (Figure 6.2).

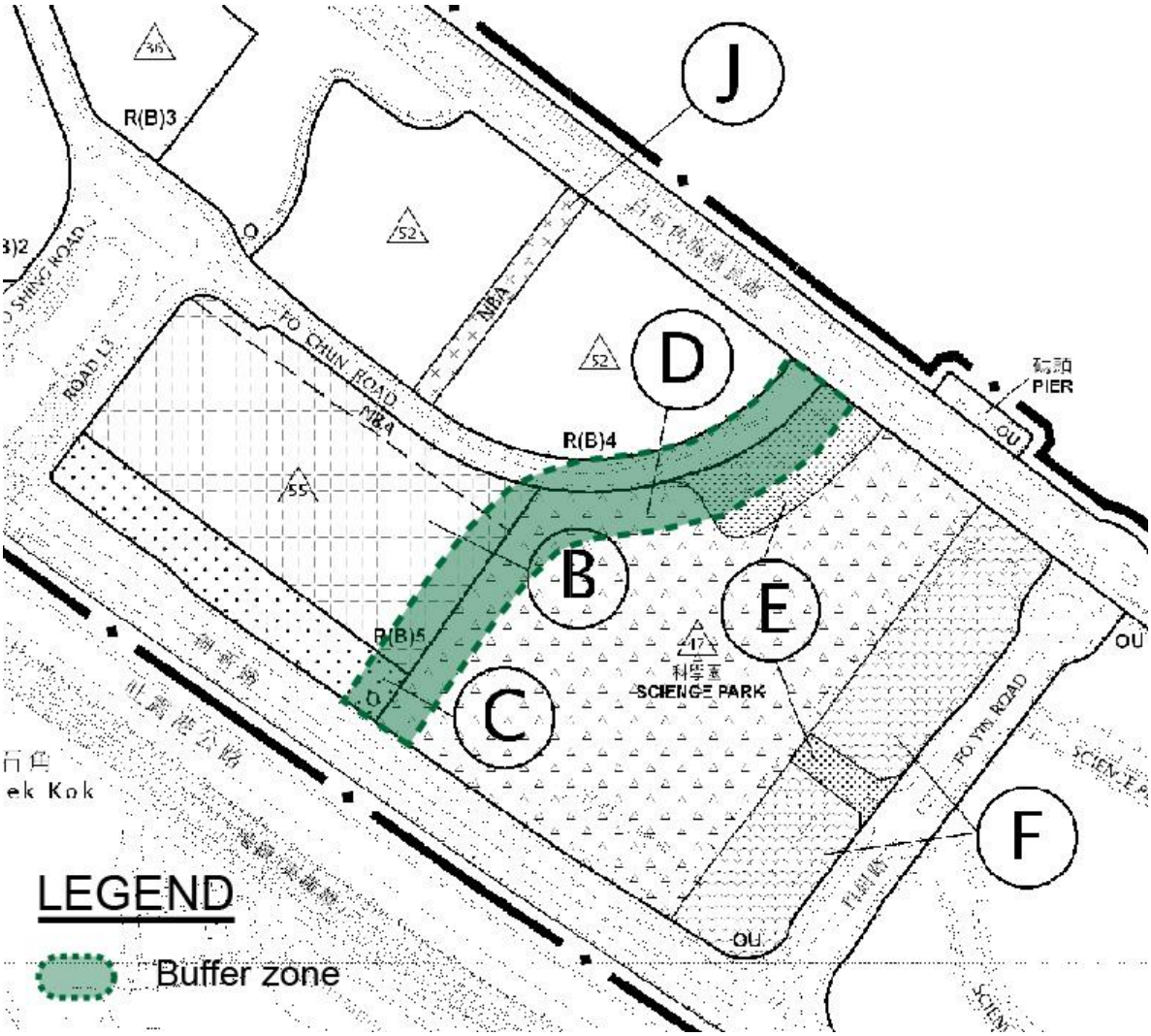


Figure 6. Recommended buffer zone.

[1] Final Report of Term Consultancy for AVA Services - Expert Evaluation on Air Ventilation Assessment of Pak Shek Kok.

7.0 Expert Evaluation and Recommendations of the Revised Planned Scenario

7.1 A revised scenario that is very different from the Initial Planned Scenario is proposed by the Planning Department.

7.2 The revised scenario is illustrated in Figures 7.1. The size of the "R(B)5" site is changed to 3.8 ha. Plot ratio of the site remains at 3.5 while the building height restriction is slightly reduced to 52mPD. The area for Hong Kong Science Park expansion "OU(SP)" zone will have a 40m building height restriction. The building height restriction is subject to further review in the future.

7.3 Referring to section 5 of this report, the possible wake areas due to the future development of the revised scenario have been assessed (Figure 7.2 and 7.3). On the whole, given the building height restriction of 52mPD at R(B)5 site and 40m at OU(SP) zone, by carefully designing and positioning buildings on site upon development (see 7.5 below), severe air ventilation issue is not anticipated.

7.4 The NBA (25 - 40m wide) between the "R(B)5" and "OU(SP)" that functions as a buffer zone to maintain the street canyon ratio to 1.0 to 1.5 is useful.

7.5 In general, when designing the "R(B)5" site and the Hong Kong Science Park expansion "OU(SP)" zone, building gaps and ground coverage reduction should be incorporated into the development of the study area. Wall-like developments occupying the full frontage of the building site should be avoided. 25% to 33%[1] building/urban permeability is preferred in future development in this study area. Bulky podium-type development occupying the full building site should be avoided. Ground coverage of no more than 65% is recommended[2].

[1] The Buildings Department's PNAP APP-152 on Sustainable Building Design Guidelines
[2] Urban Climatic Map and Standard for Wind Environment – Feasibility Study, Stakeholders Engagement Digest. December 2011. Planning Department, HKSAR.

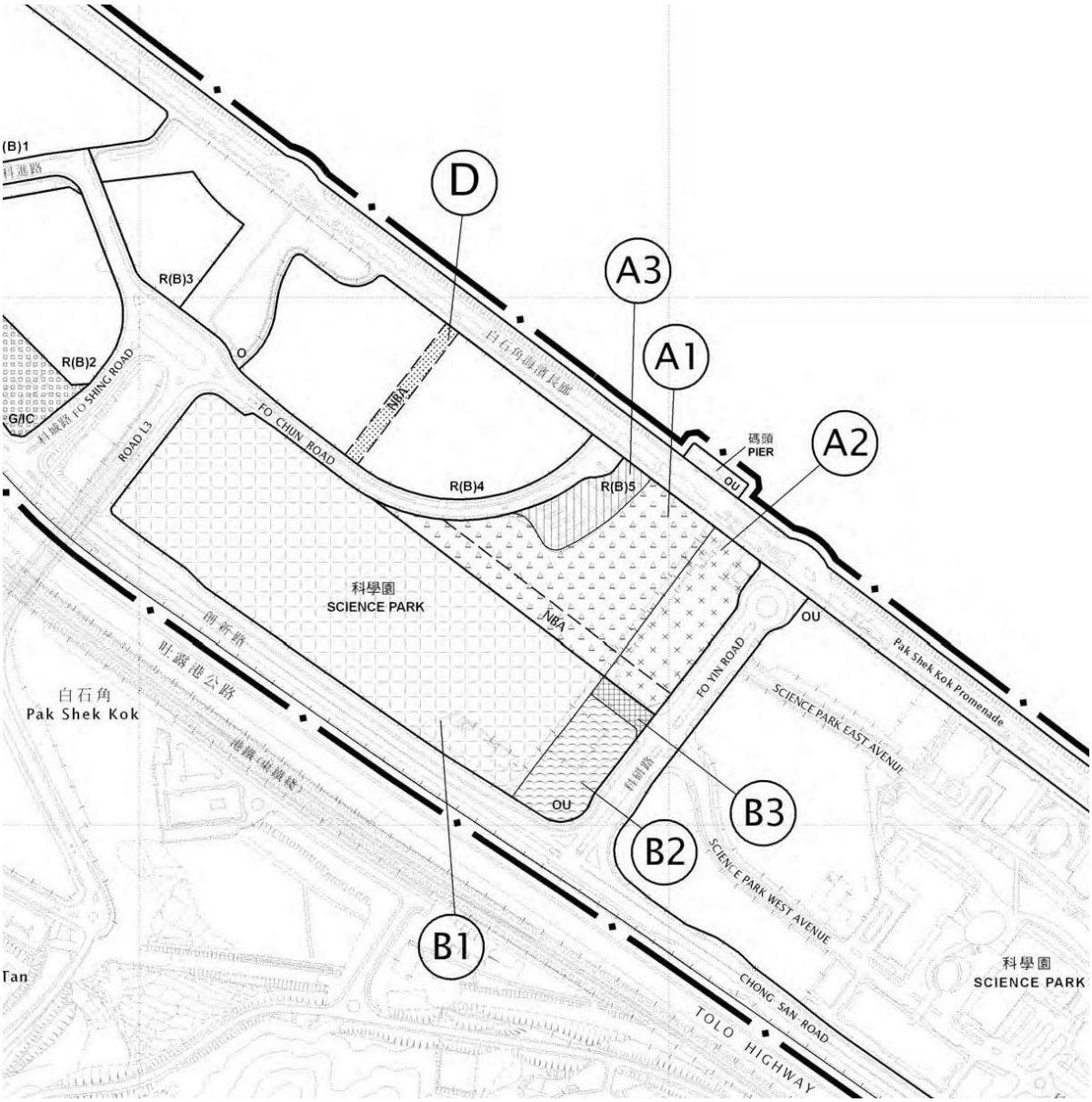


Figure 7.1 The Revised Planned Scenario of the study area

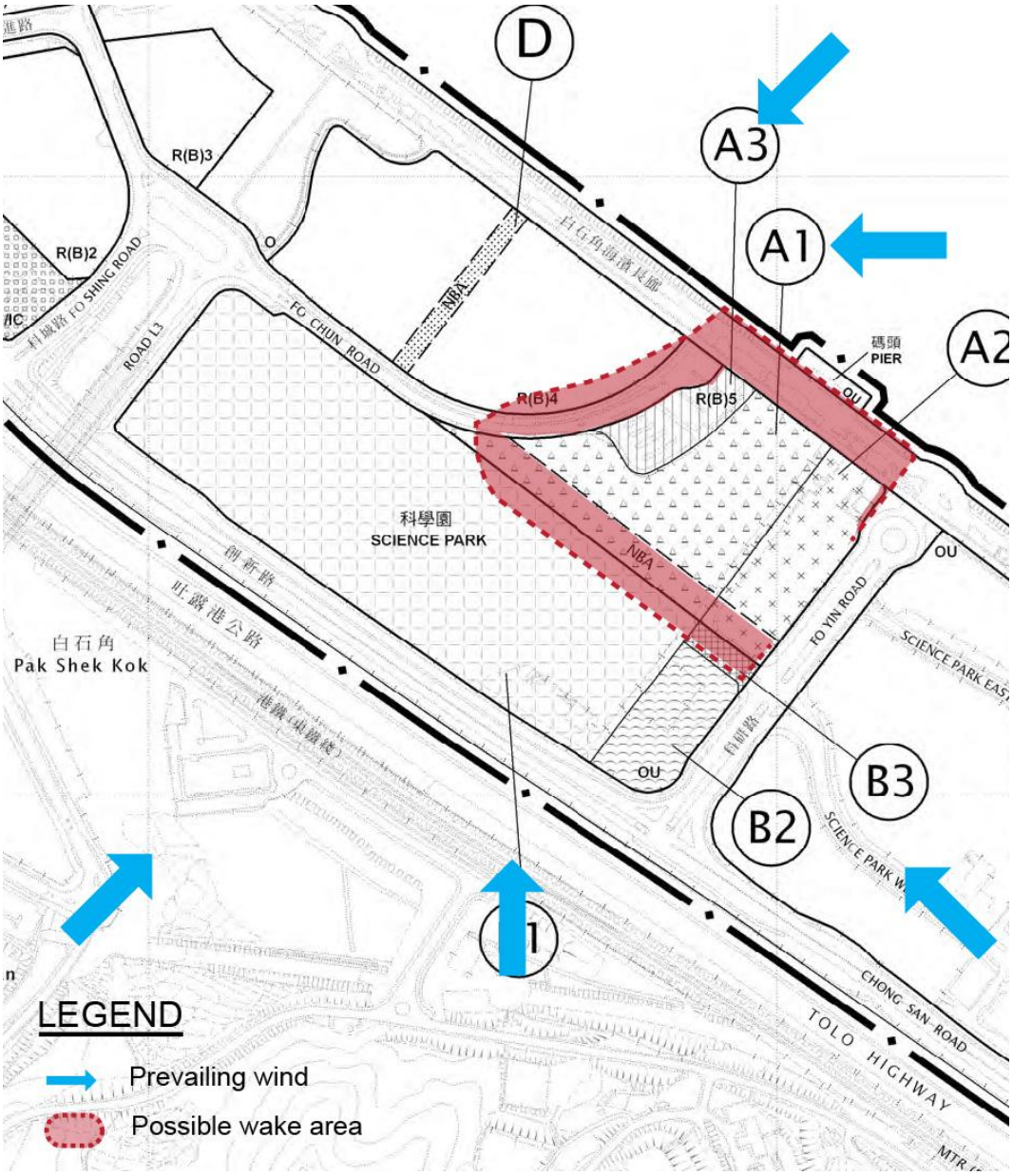


Figure 7.2 Possible wind wakes due to the R(B)5 zone under various wind directions. (Showing only wakes beyond the R(B)5 zone boundary)

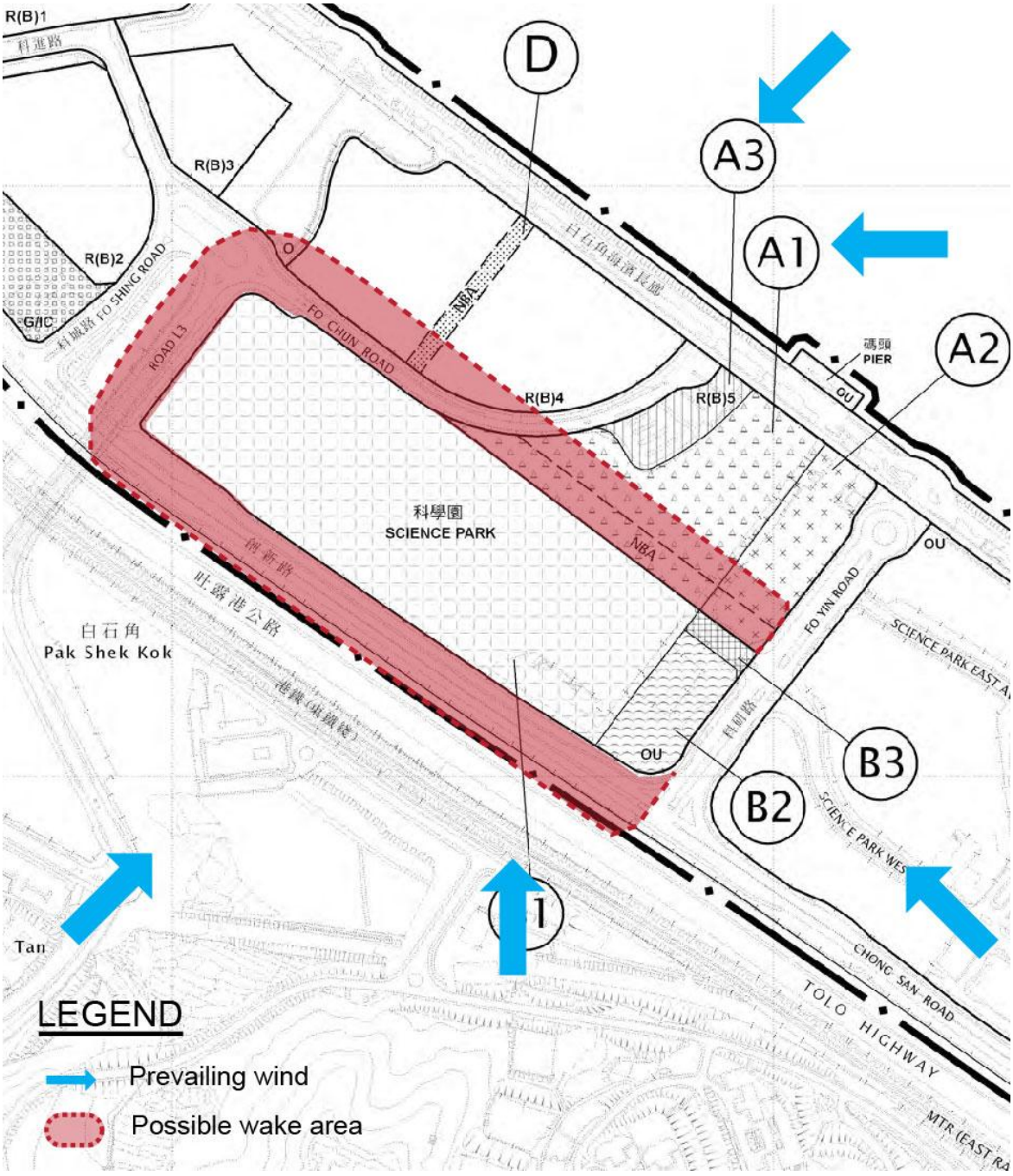
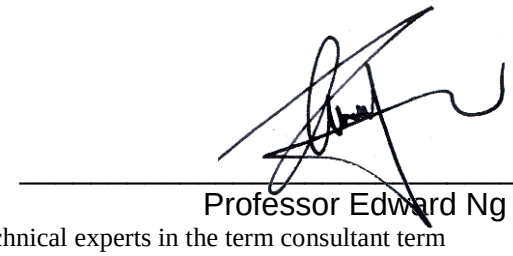


Figure 7.3 Possible wind wakes due to Science Park under various wind directions (Showing only wakes beyond the Science Park site boundary)

8.0 Further Work

Based on the expert assessment and subject to implementation of the proposed mitigation measures, the study area would have no major air ventilation issue at urban planning level. Further AVA study for the proposed OZP amendments is not necessary.



Date: 4 March 2013

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