

Term Consultancies for Air Ventilation Assessment Services Under Agreement No. PLNQ 35/2009 Category A1 – Term Consultancy for Expert Evaluation and Advisory Services on Air Ventilation Assessment For an Instructed Project for <u>Kennedy Town & Mount Davis Area</u>

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Executive Summary

Study Area

The study area is the area covered by Kennedy Town & Mount Davis OZP on the northwest side of Hong Kong Island.



Study Area – Kennedy Town & Mount Davis OZP

Wind Availability

Northeasterly (including east wind) and southerly wind is prevailing annually whereas southerly, southwesterly and easterly wind is dominant in summer.

Existing Scenario

The study area has elevation ranging from less than 4mPD at waterfront to 269mPD at Mount Davis. The built area generally elevates at 4 to 80mPD. Within the study area of Kennedy Town and Mount Davis OZP, there exist a number of open spaces, mountain and slope areas, and low-rise G/IC areas including Belcher Bay Park, Cadogan Street Temporary Garden and the adjacent G/IC site, Kennedy Town Temporary Recreation Ground, Kennedy Town Playground, Forbes Street Temporary Playground, Ka Wai Man Road Garden, Mount Davis, other slopes and green belts, etc. As observed, other than Mount Davis and its immediate green belts and low-rise G/IC sites, open areas (which are good for wind penetration) are generally distributed along the waterfront, on the southwest to northwest sides of The Belcher's and HKU's residential halls, and aligned along Forbes Street.

The study area is of generally satisfactory air ventilation performance because there exists considerable coverage of greenery areas, open space (especially those along waterfront) and air paths (carriageways) connecting seafront which allow sea breeze, annual and summer prevailing wind penetration. Nevertheless, some problem areas have been identified within built area of Kennedy Town, foothill area and Pok Fu Lam Road west. They include: wind blockage due to cluster of building along waterfront between Queen's Road West and Des Voeux Road West that block northeasterly wind entry to Belcher's Street and other areas behind (including Queen's Road West); blockage of important southerly valley wind and sea breeze from northern side due to a committed development to the west of Smithfield Garden, and should be addressed in future planning of landuse. There is also air ventilation problem along Collinson Street due to blockage by future swimming pool complex at the waterfront but the impact is considered localized only and not particularly significant and therefore not further addressed in the study.

Initial Planned Scenario

The primary objectives of the imposition of BH restrictions in the initial planned scenario are to prevent out-of-context developments and further improve visual permeability and amenity in the Area. The initial planned scenario does not impose significant additional air ventilation impact. Generally, good design features including open space, greenery areas, streetscape and low- to midrise R(C)1 building clusters are maintained. Most identified existing air paths are maintained. Building height variation has been introduced. The air ventilation performance of most areas is considered satisfactory.

For the study area of Kennedy Town and Mount Davis OZP, the general recommendations are as follows:

- a) where there are already development restrictions (including site coverage, plot ratio and building height restrictions), they should be retained;
- b) existing open area and low-rise areas either in the form of open spaces, or GIC or OU sites such as Belcher Bay Park and Forbes Street Temporary Playground, provide useful air space within built area and are advantageous to air ventilation. These areas should be maintained to allow wind penetration in inland area;
- c) various height bands should be proposed taking the topography into consideration and allow wind from seaside and prevailing wind to penetrate to inland area easier;
- d) identified existing major air paths in the study area as mentioned under Section 3.3 above should not be obstructed; and
- e) future developments are encouraged to adopt suitable design measures to minimize any possible adverse air ventilation impacts. These include reduced and permeable podium, wider

gap between buildings, disposition, orientation and perforation of building towers to align with the prevailing winds, as appropriate.

According to the initial planned scenario, however, identified problems under existing scenario, including wind blockage due to a cluster of building along waterfront between Queen's Road West and Des Voeux Road West, and potential blockage of important southerly valley wind and sea breeze from northern side due to committed development to the west of Smithfield Garden, still exists.

Wind blockage due to Cluster of Buildings between Queen's Road West and Des Voeux Road West

Along the waterfront area, the committed development, Harbour One, is under construction and will block the remaining gap connecting to Belcher's Street later. The lack of an entry area for prevailing northeasterly wind flow in future would reduce wind availability along Belcher's Street. In addition, wind blockage at waterfront will generally reduce wind availability along Queen's Road West behind and further downwind area. Providing adequate gap between buildings can solve the problem. Moreover, the building gap should be positioned to allow further wind penetration to benefit more downwind areas.

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Initial Planned Scenario (BH Limit of R(A), R(B), R(C) and R(E) sites)

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Initial Planned Scenario (BH Limit of I, G/IC, OU sites)

Potential Blockage of Important Valley Wind and Sea Breeze due to Committed Development to the West of Smithfield Garden

Eventually when the committed development of HKU student hostel at Lung Wah Street is built, it will leave limited gap between it and existing Smithfield Garden development. It is difficult for major valley wind from southern side and sea breeze to penetrate further. Especially during summer time, wind availability and pedestrian comfort will be impacted at areas to the north of the committed development. Therefore, for future redevelopment of Smithfield Garden, the towers should not be sited close to this committed development in order to maintain building gap for wind penetration.

Recommendations

Built Area of Kennedy Town

In view of substantial blockage due to cluster of buildings including Yip Cheong, Kwan Yick Building Phase 1, Mei Sun Lau, HK Industrial Building and Harbour One along the northern waterfront, non-building area (NBA) or building gap above 15m (measured from the mean formation level) should be dedicated to allow northeasterly wind penetration to Belcher's Street and Rock Hill Street and further to the inland area. Two building gaps therefore are recommended. One is aligned with Belcher's Street and another is aligned with Woo Hop Street to allow further northeasterly wind penetration to inland areas of Kennedy Town.

Normally, the width of the building gap at the podium level area should be aligned with and at least of the same width of the identified air path behind (e.g. the width of Belcher's Street). Therefore, the two podium setback areas respectively aligned with Belcher's Street and Woo Hop Street should be of 15m and 10m wide. However, the ideal alignment of the building gap is in conflict with the committed development of Harbour One. Hence, for practical reason, the building gap aligned with Belcher's Street for northeasterly wind would to a large extent make use of the existing podia between buildings (including the committed building of Harbour One), and is in a curved alignment. Moreover, the minimum width of 10m is recommended in order to allow sufficient amount of wind penetrating to the inland Area via Belcher's Street

On the other hand, ideal alignment of another building gap will trespass Dragonfair Garden which would unlikely be developed in near future. Therefore, the podium setback area is shifted westward while the width of 10m (which is the same as Woo Hop Street) is designated to improve air ventilation.



Recommendations for Kennedy Town Built Area

Foothill Area and Pok Fu Lam Road West

Another building gap is suggested between Kwun Lung Lau and Smithfield Terrace and to extend southward to the east of the committed development of HKU student hostel at Lung Wah Street in order to form a continuous air path for better air ventilation (Figure 4.4).

This building gap at the podium level (measured 15m from mean formation level) is recommended to tally with the 15m-wide Smithfield Road for better air ventilation. However, in order not to impose undue constraints to adjacent developments and affect their likelihood for future redevelopment, the building gap is revised to 12m wide.



Recommendations for Foothill Area and Pok Fu Lam Road West

1.0 Introduction

1.1 Assignment

- 1.1.1 In order to provide better planning control on the building height upon development/redevelopment, the draft Kennedy Town & Mount Davis Outline Zoning Plan (OZP) No. S/H1/17 (the Plan) is being reviewed with a view to incorporating appropriate development restriction in the Plan for the various development zones of the OZP to guide future development/redevelopment. It is considered necessary to conduct an expert evaluation to assess the preliminary air ventilation impacts of the proposed development restrictions.
- 1.1.2 This expert evaluation report for Kennedy Town and Mount Davis Area was prepared based on materials provided by Planning Department in Nov and Dec 2010. Materials for Kennedy Town and Mount Davis Area provided to the Consultant include but not limited to the followings:
 - Wind Data
 - Aerial Photo and Site photos
 - Existing Building Height Profile (Number of Storeys/mPD)
 - Existing Spot Height under the Kennedy Town & Mount Davis OZP
 - Committed Development Sites with Podium and Building Heights
 - Draft Kennedy Town & Mount Davis OZP No. S/H1/17 and notes and explanatory statement
 - Existing Building Height Restrictions under the Kennedy Town & Mount Davis OZP
 - Proposed Building Height Restrictions under the Kennedy Town & Mount Davis OZP
 - Two options of Land Use Review of Kennedy Town & Mount Davis
 - Proposed height profiles for three HKU redevelopment sites along Pok Fu Lam Road
 - Expert Evaluation on Air Ventilation Assessment of Sai Ying Pun and Sheung Wan Area
 - Expert Evaluation on Air Ventilation Assessment of Mid-Levels West Area

1.2 Scope of Work

1.2.1 In this study, the Consultant is required to conduct a baseline analysis of the study area in Kennedy Town & Mount Davis and followed by an expert evaluation of the Initial Planned Scenario and Revised Scenario, if any.

1.3 Methodology

1.3.1 The methodology involves qualitative assessment to the existing situation with committed developments and the proposed scenario(s) to identify problems and issues. In this assessment, the good features and problem areas with respect to air ventilation performance have been identified. Mitigation direction and measures are proposed with respect to the proposed scenario. Recommendations will be made to particular sites for further quantitative air ventilation assessments. This study involves review of information provided by Planning Department as well as verification of situations through site inspection.

2.0 Wind Availability

2.1.1 The study area is the area covered by Kennedy Town & Mount Davis OZP on the northwest side of Hong Kong Island. **Figure 2.1** shows the study area.



Figure 2.1 Study Area – Kennedy Town & Mount Davis OZP

2.1.2 The wind availability analysis is based on both long term measurement data prepared by Hong Kong Observatory (HKO) and simulated wind availability data by Hong Kong University of Science and Technology (HKUST).

2.2 Measurement Data at Weather Station

2.2.1 Hong Kong Observatory (HKO)'s weather monitoring stations scattered in Hong Kong provide reliable data of wind environment. **Figure 2.2** shows the locations of the weather station in Hong Kong.



Figure 2.2 Hong Kong Weather Stations

- 2.2.2 The weather station nearest to the study area is at Green Island at about 500m to the northwest of the Kennedy Town area, and with ground elevation of 88mPD and measurement height at 107mPD (see **Figure 2.2**).
- 2.2.3 Summer and Annual Wind Rose result at Green Island is presented in **Figure 2.3** for reference. Wind Rose has been prepared based on long term monitoring data (10-year long).
- 2.2.4 According to Wind Rose result, southerly and southwesterly wind is found prevailing in summer (Jun to Aug). Northeasterly, easterly and southerly wind is prevailing annually.
- 2.2.5 The measurement data is affected by both topography and building landscape. Green Island is lack of building structure. The measurement height is at the highest point of the island (88mPD) and would unlikely be affected by topography and any structure on the island. The weather station is at high elevation, remote from the study area (500m apart) and surrounded by sea. There is limited blockage due to topography and building landscape except on the southeast side. The measurement data indicates that southeasterly wind is lacking, which may be attributed to the fact that the topography of Hong Kong Island substantially block southeasterly wind. It is envisaged that such blockage effect is even more significant for lower elevation of the study area.



Figure 2.3 Summer and Annual Wind Rose Result at Green Island Weather Station (Source: HKO)

2.3 Simulated Wind Availability Data

- 2.3.1 Hong Kong University of Science and Technology (HKUST) have simulated a set of wind data using MM5. The data period covers the whole year of 2004. The simulated data allows to project to different elevations. The simulated data at 450m is representative of wind data above urban canopy and generally least affected by topography and building morphology.
- 2.3.2 **Figure 2.4** shows the MM5 Wind Rose result at 120m (approximate urban canopy layer height) and 450m (approximate wind boundary layer height) representative of



the study area provided by the Institute of Environment of HKUST. **Figure 2.5** illustrates the concept of urban canopy and wind boundary layer.

Figure 2.4 Summer and Annual Wind Rose Result based on MM5 Simulation (Source: HKUST)



- 2.3.3 The summer Wind Rose result at 450m (leftmost one) indicates that southwesterly, southerly, southeasterly and easterly wind is prevailing in summer.
- 2.3.4 The annual Wind Rose result at both 120m and 450m shows that northeasterly wind (ENE wind in particular) is dominant annually.

2.4 Topography and Building Morphology of the Surroundings

- 2.4.1 **Figure 2.6** shows the aerial photo of the study area and the surroundings. The surrounding areas include Sai Ying Pun to the east, mid-level west to the southeast.
- 2.4.2 The study area has elevation ranging from less than 4mPD at waterfront to 269mPD at Mount Davis. The built area generally elevates at 4 to 80mPD (along Pok Fu Lam Road).
- 2.4.3 Hilly areas including High West and The Peak amount to around and over 500mPD to the southeast of the study area. Lung Fu Shan to the east amounts to around 260mPD. These hilly areas form significant blockage against southeasterly wind from reaching the study area. There is a trough of around 100mPD between Mount Davis and Lung Fu Shan/High West. This valley is regarded as the main entrance to allow southerly valley wind to the northern portion of the study area.
- 2.4.4 The northern waterfront and further inland area of Hong Kong Island is densely built and occupied by buildings. Existing buildings to the immediate east of the study area in Sai Ying Pun range from 40 to 120mPD. The waterfront area to the north of Connaught Road West is of low-rise and no significant wind blockage effect is envisaged. In further inland area on the northeastern side of this study area, easterly wind may flow along existing air paths such as Des Voeux Road West and Queen's Road West to enter the study area. Easterly wind availability will decrease due to topography descending from Sai Ying Pun to its western areas along Queen's Road West and building density & pattern.



Figure 2.6 Aerial Photo for the Study Area and Surroundings (Source: Google Map)

2.4.5 Wind from other prevailing wind directions is virtually unobstructed. Therefore, there is no problem envisaged for northerly wind and northeasterly wind breeze to reach the study area.

2.5 Summary of Wind Availability Data

Summer Wind Availability

2.5.1 The measurement data at HKO Green Island Weather Station indicates that southerly and southwesterly winds are prevailing. On the other hand, the simulated wind availability data representing the study area shows that southwesterly, east and southeasterly winds are important. Taking into account the topography and building landscape, it is anticipated that southerly valley wind, southwesterly wind and easterly wind along air paths are important, especially for the built area at the northern portion of the study area.

Annual Wind Availability

2.5.2 The measurement data at HKO Green Island Weather Station indicates that northeasterly and southerly winds are prevailing. On the other hand, the simulated wind availability data shows that northeasterly wind is dominant. Northeasterly (including east) wind is considered prevailing taking into consideration the topography and building landscape. Southerly valley wind is also considered important. **Table 1** summarizes important wind directions discussed above.

Tuste I Summing of Herming (find Directions						
Period	Green Island Weather	MM5 Simulation				
	Station	120m	450m			
Summer	S, SW		SW, S, E, SE			
Annual	NE, E, S	NE, E	NE			

Table 1 Summary of Prevailing Wind Directions

2.5.3 **Figure 2.7** summarizes important wind directions for the study area. Taking into account the topography, building landscape and existence of breezeway linking in the surrounding area, the wind availability is depicted. The figure indicates likely scenario of how important wind direction approaches the study area.



Figure 2.7 Summary of Important Wind Directions for the Study Area

3.0 Existing Condition of the Study Area

3.1 Location

3.1.1 The study area is on the northwest side of Hong Kong Island. The surrounding areas include Sai Ying Pun and Mid-levels West to the northeast, to the southeast. It includes Mount Davis on the west side which occupies over half of the study area and Kennedy Town on the east side (see **Figure 2.1**). It is bounded by Victoria Harbour to the north, Victoria Road along the western coastal area, Mount Davis Road to the southwest and south, Pok Fu Lam Road to the southeast, Hill Road to the east and Des Voeux Road West to the northeast.

3.2 Topography

3.2.1 The elevation of the study area ranges from about 4mPD at waterfront to 269mPD at the top of Mount Davis. Most built areas are of elevation from 4mPD (along northern waterfront) to 80mPD (near and along Pok Fu Lam Road and Mount Davis Road on the southeast to southwest sides) (see **Figure 2.6**).

3.3 Existing and Committed Building Developments and Wind Flow Regime

- 3.3.1 Within the study area, there exist a number of open spaces, mountain and slope areas, and low-rise G/IC areas including Belcher Bay Park, Cadogan Street Temporary Garden and the adjacent G/IC site, Kennedy Town Temporary Recreation Ground, Kennedy Town Playground, Forbes Street Temporary Playground, Ka Wai Man Road Garden, Mount Davis, other slopes and green belts, etc. (see **Figure 2.6** and **Figure 3.1**). As observed, other than Mount Davis and its immediate green belts and low-rise G/IC sites, other open areas (which are good for wind penetration) are generally distributed along the waterfront, on the southwest to northwest sides of The Belcher's and HKU's residential halls, and aligned along Forbes Street.
- 3.3.2 The major air spaces and air/wind paths in the study area are shown in **Figure 3.2**. The most important air path is the valley area which allows for southerly valley wind to reach the built area. Victoria Road, Pok Fu Lam Road, connected open space and low-rise area from playground along Forbes Street to R(C)1 sites to the northeast, etc. are of effective width (including slope and landscape area) of about 50m or longer mostly, and are considered major air paths. There are other air paths aligned along prevailing wind direction or allows wind breeze from seaside to enter into inland area and are considered important to maintain an environment of good air ventilation performance. For the purpose to facilitate discussion of the air ventilation performance according to the existing and committed developments, the study area is divided into 4 subareas (see **Figure 3.3**).

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Mountain/Slope, Open Spaces and Low-Rise G/IC Sites under Existing Scenario Figure 3.1

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- Built area of Kennedy Town (SA1); •
- Foothill Area and Pok Fu Lam Road West (SA2); •
- Area to the north of Mount Davis (SA3); and •
- Mount Davis and its Southern to Western Periphery (SA4). •

3.3.3 Appendix A shows photos of street view of the study area.



Figure 3.3

Division of Study Area

Built Area of Kennedy Town (SA1)

- 3.3.4 **Figure 3.4** shows the identified air path, good design feature and problem areas of this sub-area. This sub-area is fronting seashore to the north, bounded by Cadogan Street to the west, Hill Road to the east. The elevation of this sub-area is lower than the foothill area and Pok Fu Lam Road west to its immediate south.
- 3.3.5 Carriageways including Cadogan Street (Photo no.15), Davis Street (Photo no.16), Smithfield Road (Photo no. 19), North Street (Photo no. 23a, 23b) and Sands Street (Photo no. 25a, 25b) (both around 15m to 17m wide) are oriented in grid system connecting from waterfront to inland area. It enables sea breeze to penetrate into inland area easier. Southerly wind can also flow through the carriageways. The general air ventilation performance is therefore considered satisfactory.
- 3.3.6 The street width (building-to-building) of other carriageways oriented along other axis (e.g. Cathick Street (Photo no.17, 22a, 22b, 24a, 24b), Victoria Road (Photo no. 10, 11, 13, 14), Belcher's Street (Photo no.18a, 18b, 21a, 21b, 26a, 26b, 27a, 27b, 29, 31a, 31b, 35), Rock Hill Street (Photo no. 20) and Forbes Street) are around 15m to 19m. There carriageways are aligned along prevailing northeasterly, southerly and southwesterly wind directions and are considered important to act as air path for wind penetration as well.
- 3.3.7 There is a mix of old buildings (4 to 6 storeys) and newly constructed buildings up to 62 storeys. The highest buildings among this sub-area include those at The Belcher's (58 to 62 storeys) (Photo no. 34) along Belcher's Street, The Merton (49 to 57 storeys) (Photo no. 40) and Manhattan Heights (54 storeys) (Photo no. 40) along New Praya, Kennedy Town at the waterfront location.
- 3.3.8 Towers of the Belcher's (Photo no. 34, 37) are divided into two clusters. A gap of 30m wide is maintained between two building clusters and would enable northerly wind penetration from along Collinson Street (Photo no. 32) to Pok Fu Lam Road.
- 3.3.9 High-rise buildings such as The Merton and Manhattan Heights are situated along the waterfront which are in violation with the urban design guidelines under HKPSG. However, both developments are not located at potential air paths. The Merton leaves an open space of around 30m wide fronting seashore and immediate west to Davis Street to enable wind penetration, which is a good feature. However, Tower 3 of The Merton on the south side of Catchick Street is sited right behind the open space so that the effectiveness of the open space is significantly reduced.
- 3.3.10 There are two building clusters (between Davis Street (Photo no. 16) and Smithfield Road (Photo no. 19); between Sands Street (Photo no. 25a) and Holland Street) each with frontage of 120m and 125m and facing waterfront. It would result in larger wake area under sea breeze. The building height to street width (H/W) ratios for carriageways behind these two clusters are respectively 2:1 to 4:1 for Catchick Street and 4:1 to 6:1 for Belcher's Street. The impact due to linear building cluster

between Sands Street and Holland Street is relatively more significant due to higher H/W ratio. Therefore, it is necessary to improve air ventilation along Belcher's Street (e.g. by creating a potential air path for prevailing northeasterly wind penetration).

- 3.3.11 There are a number of committed developments in this sub-area such as the swimming pool complex within the G/IC(1) site at northeast of Sai Cheung Street and Harbour One development along Des Voeux Road West within "R(A)" zone at the waterfront, and other scattered developments in inland area. The highest one is elevated at around 178mPD intersected at Sands Street (Photo no. 25a, 25b, 40a) and Rock Hill Street (Photo no. 20).
- 3.3.12 A cluster of building consisting of St. Paul's College Primary School and Nam Wah Mansion and Hill View Garden on the eastern side of this sub-area is of not more than 56mPD high. It forms a linkage for NE prevailing wind to penetrate from along Hill Road to Pok Fu Lam Road.
- 3.3.13 A cluster of old tenement buildings is sited between Academic Terrace (32 to 33 storeys) and Ying Ga Garden (30 storeys). These tenement buildings are of 4 to 13 storeys high generally (with a few buildings up to 17 storeys) and are connected with the open area on northeast and southwest sides. Such linkage creates air path for important northeasterly wind penetration from along Pok Fu Lam Road to Forbes Street Temporary Playground (Photo no. 2, 3); and another potential air path from Belcher's Street to Forbes Street Temporary Playground as well.
- 3.3.14 One committed development is located at Hon Wah Middle School site for conversion of uses to the northwest of Academic Terrace at the identified NE-SW aligned air path. The building height remains the same as to the existing situation. No additional wind blockage impact is anticipated.
- 3.3.15 Smithfield Municipal Services Building may block some northeasterly wind flow from the NE-SW air path identified above to Forbes Street but the impact is alleviated due to the low-rise existing Kennedy Town Swimming Pool and open space of Forbes Street Temporary Playground.
- 3.3.16 The most prominent area is the cluster of buildings including Yip Cheong, Kwan Yick, Mei Sun Lau, HK Industrial Building and Harbour One (committed development under construction) between Des Voeux Road West and Queen's Road West (Photo no. 36a, 39a, 38) which forms an apparently continuous building structures fronting seashore. These buildings are of 17 to 29 storeys high and wind blockage effect is resulted. Northeasterly wind penetration to Belcher's Street and Rock Hill Street is blocked. Whether the potential air paths identified in this subarea can facilitate wind penetration depends on whether such wind blockage effect can be addressed.
- 3.3.17 Harbour One is located to the west end of Des Voeux Road West which is next to Hong Kong Industrial Building to the east. As this development is under construction, it implies that the problem situation identified before (i.e. blockage to northeasterly

wind entry to Belcher's Street) cannot be altered in near future until redevelopment of nearby development (Hong Kong Industrial Building, for example).

- 3.3.18 The committed development of swimming pool complex at G/IC site at northeast of the Belcher Bay Park has a maximum building height of 33mPD on the OZP. As Kennedy Town Praya (Photo no. 28, 30, 33) on the leeward side under northerly wind is over 16m wide, the building height to street width ratio after development will be 2:1. Such ratio is ideal in urban environment and no adverse air ventilation impact is anticipated. Due to insubstantial building height, air flow to downwind area through the building gap of The Belcher's would not be affected. However, the committed development may weaken air ventilation at pedestrian level along Collinson Street but not considered particularly significant (Photo no. 32).
- 3.3.19 Other committed developments are not located at existing and potential air paths. No significant air blockage impact is anticipated except that the building height to street width (H/W) ratio may increase after redevelopment. However, as there exist adequate number of air paths within the study area, the general air ventilation performance is still considered acceptable.





Foothill Area and Pok Fu Lam Road West (SA2)

3.3.20 **Figure 3.5** shows the identified major valley wind from the south, major air path allowing for northeasterly and southwesterly winds penetration (from playground along Forbes Street to R(C)1 sites and along Pok Fu Lam Road), and other air path, good design feature and problem areas of this sub-area. This sub-area is next to and on the southern side of Kennedy Town built area. It is bounded by Pok Fu Lam Road to the south; green belt, OU and G/IC sites to the west.



3.3.21 This sub-area consists of green belt (on the southern side mainly), G/IC, OU and residential uses. Three sites of HKU (Yam Pak Building, Ricci Hall & Flora Ho Sports Centre) are scattered along Pok Fu Lam Road within this sub-area. Residential developments of larger scale include Kwun Lung Lau, Smithfield Terrace, Smithfield Garden on the southwest side, University Heights and Academic Terrace on the northeast.

- 3.3.22 Pok Fu Lam Road allows important valley wind from southerly direction to flow along and distribute to other downwind areas. The identified air path from Pok Fu Lam Road/Belcher's Street to Forbes Street Temporary Playground would pass close to one of HKU sites (Ricci Hall).
- 3.3.23 Three HKU sites are being planned for redevelopment. As advised, the future buildings in these three sites will be developed to elevation comparable to neighboring buildings. Yam Pak Building occupies a small footprint and is not located at existing or potential air path alignment. It therefore bears no significance on air ventilation performance.



- 3.3.24 Ricci Hall site is to the south of The Belcher's and is near to the identified potential air path linking Belcher's Street to Forbes Street Temporary Playground. In addition, southerly valley wind can flow along Pok Fu Lam Road via this site to Belcher's Street. These air paths are close to the western side of Ricci Hall site. On the other hand, southerly valley wind along Pok Fu Lam Road may also pass via eastern portion of Ricci Hall site and through the building gap of The Belcher's to Belcher's Street. As eastern and western portion of Ricci Hall site bears some importance on air ventilation, substantial building structures should be avoided (see **Figure 3.6**).
- 3.3.25 For Flora Ho Sports Centre site, similar to the argument for Ricci Hall site, southerly valley wind along Pok Fu Lam Road will flow via both eastern and western portion of the site to downwind area. The wind flow via eastern portion of this HKU site along Pok Fu Lam Road is least obstructed under existing condition. The existing low-rise building at this site maintains a setback of 4m from eastern site boundary along Pok Fu Lam Road. As higher building upon redevelopment is envisaged, a minimum 5m wide setback from the lot boundary facing to Pok Fu Lam Road is recommended in order to maintain the air path along Pok Fu Lam Road (see **Figure 3.6**).
- 3.3.26 The southerly valley wind will flow via western portion of the Flora Ho Sports Centre site. Substantial building structures should be avoided among the western portion of this HKU site (see **Figure 3.6**).
- 3.3.27 A committed development of HKU student hostel (up to 156mPD) at Lung Wah Street is composed of 4 towers. It rests at the location of the north-south air path along Smithfield Road (Photo no. 1, 4). The existing developments such as Kwun Lung Lau, Smithfield Terrace, Mount Davis Ambulance Depot maintains building separation of around 20m wide for this identified air path except the portion between HKU Student Hostel at Lung Wah Street and Smithfield Garden. Both important valley wind from the south and sea breeze from northerly direction along Smithfield Road will be blocked and is considered a problem area.

Area to the north of Mount Davis (SA3)

- 3.3.28 **Figure 3.7** shows the identified major air path allowing southwesterly wind penetration, other air paths and good design feature of this sub-area. This sub-area is generally bounded by Cadogan Street to the east and green belt areas to the south. Its northern side is fronting to the sea. Victoria Road is at about 100m apart from the northern seafront. Most seafront areas are open. Therefore, the inner area can enjoy sea breeze without any blockage.
- 3.3.29 SW wind can flow along Victoria Road (Photo no. 10, 11, 13, 14),and low-rise developments along Sai Ning Street and Victoria Road. Victoria Road has an existing building to building width of around 70m wide at least and serves as a major air path. Sai Ning Street (Photo no. 12) is of the same orientation as Victoria Road. The general orientation of road carriageways is considered beneficial for air ventilation.
- 3.3.30 There is no committed development within this sub-area at present. As Victoria Road (effectively 70m wide) is connected to Belcher's Street, it is important to maintain it as the major air path so that southwesterly wind (occurs in summer) can benefit the pedestrian area along Belcher's Street as well. The O site and G/IC site on the northeast side, especially the eastern side close to Cadogan Street, should remain open or for low-rise building development to allow sea breeze to enter Victoria Road and Belcher's Street easier. Long and continuous buildings fronting seashore should be avoided. While there is no definite air path identified to be crucial so that no measure such as non-building area would be recommended, good design directions in the next sub-section (para. 3.4) should be observed and followed where practicable.



Mount Davis and its Southern to Western Periphery (SA4)

3.3.31 **Figure 3.8** shows the identified major southwesterly air path along carriageways with scattered development along it, and good design feature of this sub-area. This sub-area is mostly covered by green belt which would minimize extent of urban heat island effect. Built areas are along the southern to western periphery of Mount Davis. Prevailing northeasterly wind can flow along Victoria Road. Southwesterly wind in summer can flow along Mount Davis Road (Photo no.8, 9). The committed development (3 storeys) at 8 Mount Davis Road (around 126mPD) also bears no significance in terms of air ventilation performance. No significant air ventilation problem is anticipated.



Figure 3.8 Air Path and Good Design Feature of SA4

3.3.32 Overall speaking, the study area of Kennedy Town and Mount Davis OZP is of generally satisfactory air ventilation performance. There exists considerable

coverage of greenery areas, open space (especially those along waterfront), low-rise GIC and OU facilities along the waterfront, and air paths connecting seafront which allow important sea breeze, annual and summer prevailing wind penetration. Nevertheless, some problem areas have been identified within built area of Kennedy Town, foothill area and Pok Fu Lam Road west, which should be addressed.

3.4 General Direction for Air Ventilation Improvement

3.4.1 The usual air ventilation problem of urban area is due to building blockage. Urban canyon effect due to tall and compacted buildings prohibits wind flow to pedestrian area. There is a strong reliance on the building profile to provide necessary breezeway and air corridor for wind penetration. Existing carriageways usually serve such purpose. Therefore, there is a genuine need to preserve the existing street grid pattern and identified air path. It should aim to explore opportunities for improvement by widening particular carriageways or air path identified of importance (e.g. along prevailing wind). Carriageway of at least 15m to 20m is preferred to act as air path to allow wind penetration (see **Figure 3.9**). Moreover, through air path should be created where possible by removing existing/potential blockage.





Figure 3.9 Widening of Potentially Important Air Path by Building Setback

- 3.4.2 In addition, open area within the urban area can provide linkage to allow wind distribution and even serve as breezeway for wind entry. Open space with greening can help to reduce urban heat island effect. All open space already dedicated should be preserved as well.
- 3.4.3 H/W ratio is a measure of the urban canyon effect. A ratio of 2:1 is ideal while hard to achieve in urbanized area. A high H/W ratio would, however, render the situation difficult for wind to reach pedestrian level. Referring to Figure 3.10, there will be difficulty to remove air pollutants at street level under a H/W ratio of 3:1. The higher H/W ratio would result in weaker air flow then. Even downwash effect (see Figure 3.11), which urban area usually relies heavily on would become ineffective. The H/W ratio all along carriageways should be kept as low as practicably possible.


(Source: A. KOVAR-PANSKUS, P. LOUKA, J.-F. SINI, E. SAVORY, M. CZECH, A. ABDELQARI, P. G. MESTAYER and N. TOY, INFLUENCE OF GEOMETRY ON THE MEAN FLOWWITHIN URBAN STREET CANYONS – A COMPARISON OF WIND TUNNEL EXPERIMENTS AND NUMERICAL SIMULATIONS, Water, Air, and Soil Pollution: Focus 2: 365–380, 2002, Kluwer Academic Publishers)





Figure 3.11 Illustration of Building Downwash Effect (Source: HKPSG)

3.4.4 In order to improve air ventilation in urbanized area at which taller building can hardly be avoided, the more important direction should be to retain, enhance and/or create breezeway/air path through designation of open space, non-building area, setback of buildings, building gap, etc. (**Figure 3.12**).



Figure 3.12 Linkage of Roads, Open Spaces and Low-rise Buildings to Form Air Paths/Breezeways (Source: HKPSG)

3.4.5 As a general rule, buildings nearer to seashore should have shorter building height (BH) and with increasing height in inner region to promote air flow to inner area by means of downwash (see **Figure 3.11**). Especially, breezeway leading sea breeze to inner region is particularly important. Wind blockage must be avoided near the shore (see **Figure 3.13**).



Figure 3.13 Avoidance of Blockage at Waterfront

3.4.6 A stepping building height profile would allow wind from seaside or prevailing wind direction to penetrate to inland or further downwind region easier (**Figure 3.14**).



Prevailing Wind

- Figure 3.14 Good Building Height Profile
- 3.4.7 Building clusters with longer aspect perpendicular to prevailing wind direction should be avoided or significant wind blockage effect would be resulted. Breaking of continuous building structures should be considered (**Figure 3.15**).



Figure 3.15Avoidance of Long and Continuous Building Cluster perpendicular to Prevailing WindDirections

3.4.8 Development with less site coverage of podium buildings would also help improve air ventilation in adjacent areas (**Figure 3.16**).



Figure 3.16 Avoidance of Massive Podium Structure wherever possible

3.5 General Recommendation for the Study Area

- 3.5.1 For the study area of Kennedy Town and Mount Davis OZP, the general recommendations are as follows:
 - a) where there are already development restrictions (including site coverage, plot ratio and building height restrictions), they should be retained;
 - b) existing open area and low-rise areas either in the form of open spaces, or GIC or OU sites such as Belcher Bay Park and Forbes Street Temporary Playground, provide useful air space within built area and are advantageous to air ventilation. These areas should be maintained to allow wind penetration in inland area;
 - c) various height bands should be proposed taking the topography into consideration and allow wind from seaside and prevailing wind to penetrate to inland area easier;
 - d) identified existing major air paths in the study area as mentioned under Section 3.3 above should not be obstructed; and
 - e) future developments are encouraged to adopt suitable design measures to minimize any possible adverse air ventilation impacts. These include reduced and permeable podium, wider gap between buildings, disposition, orientation and perforation of building towers to align with the prevailing winds, as appropriate.

4.0 Evaluation of Initial Planned Scenario

4.1 Key Characteristics of Initial Planned Scenario

- 4.1.1 Figure 4.1 and Figure 4.2 shows the initial planned scenario. The primary objectives of the imposition of BH restrictions in the initial planned scenario are to prevent out-of-context developments and further improve visual permeability and amenity in the Area. According to the initial planned scenario (R(A), R(B), R(C) and R(E) sites), the waterfront site of the built area (on the northeast side of the study area) would have BH limit of 100mPD and gradually raised to 120mPD on the opposite side of Belcher's Street and to a maximum of around 160 to 170mPD at the foothill area. An exception is The Belcher's with BH limit of 220mPD with respect to the existing condition. For R(C)1 site between Academic Terrace and Ying Ga Garden, a BH limit of not more than 12 storeys is allowed to preserve the existing situation generally. For other undeveloped areas on the seaward side of Victoria Road, BH limit of 4 storeys are generally allowed.
- 4.1.2 Generally, good design features including open space, greenery areas, streetscape and low- to mid-rise R(C)1 building clusters are maintained. Most identified existing air paths are maintained. The air ventilation performance of most areas is considered satisfactory.
- 4.1.3 With respect to the initial planned scenario (I, G/IC and OU sites), there is generally a maximum of 8 storeys allowed within the built area for school sites on the northeast side of the study area. Some scattered sties, however, would allow higher BH limit including 2 HKU sites along Pok Fu Lam Road which allow BH limits of 135mPD and 140mPD. Another waterfront site currently occupied by China Merchants Godown allows for BH limit of 60mPD and 80 mPD. Most of these BH limits reflect the existing building height conditions.

Category A1 – Term Consultancy for Expert Evaluation and Advisory Services on Air Ventilation Assessment

For an Instructed Project for Kennedy Town & Mount Davis Area





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4.2 Evaluation of Air Ventilation Performance

Built Area of Kennedy Town (SA1)

- 4.2.1 As discussed before with respect to existing condition, the built area of Kennedy Town already has a major problem area regarding blockage of northeasterly wind entry to Belcher's Street and Queen's Road West due to compacted linear buildings, of Yip Cheong, Kwan Yick, Mei Sun Lau, HK Industrial Building and Harbour One. Other problem such as blockage due to long building cluster between Sands Street and Holland Street should be addressed by improving air ventilation along Belcher's Street behind. The committed development, Harbour One, is under construction and will block the remaining gap connecting to Belcher's Street later. The lack of an entry area for prevailing northeasterly wind flow in future would reduce wind availability along Belcher's Street and should be addressed. In addition, the wind blockage effect at waterfront will generally reduce wind availability along Queen's Road West behind and further downwind area. Providing adequate gap between buildings can solve the problem. Moreover, the building gap should be positioned to allow further wind penetration to benefit more downwind areas in Kennedy Town.
- 4.2.2 In the initial planned scenario, BH limit of 100mPD is allowed for waterfront site. It will increase the H/W ratio up to 6:1 to 8:1 and is theoretically more difficult for air flow over the building to reach street level. However, a number of existing grid-system carriageways connecting seafront to inland area within this sub-area can alleviate the problem. The overall impact becomes less significant than other inland urban built area in Hong Kong.
- 4.2.3 As discussed before under existing scenario, low- to mid-rise building clusters and open space is identified that can form a potential air path for northeasterly wind flow. The R(C)1 building cluster has a BH restriction of 12 storeys and is comparable to the existing situation. The existing NE-SW aligned air path identified in previous section can be conserved.

Pok Fu Lam Road West and Foothill Area (SA2)

4.2.4 As discussed before, the committed development (up to 156mPD) of HKU student hostel at Lung Wah Street is located to the east of Kennedy Town Service Reservoir Playground and will block the air path extended from along Smithfield. Eventually when such committed development is built, it will leave limited gap between the committed development and existing Smithfield Garden development. Important valley wind from south and sea breeze can be blocked. Especially during summer time, wind availability and pedestrian comfort will be impacted at areas to the north of this committed development. Therefore, for future redevelopment of Smithfield Garden, the towers should not be sited close to this committed development in order to maintain building gap for wind penetration.

Area to the north of Mount Davis (SA3)

- 4.2.5 The BH limit in this sub-area shown in **Figure 4.1 & 4.2** mainly reflects the low-rise developments and the existing condition.
- 4.2.6 The existing good design feature with open space, vast vegetation and low-rise GIC and OU structures should be preserved. They include: Victoria Road and immediate area which acts as a major air path for southwesterly wind flow; and open space (especially the area to the west of Cadogan Street) along waterfront which allows sea breeze from reaching Victoria Road and Belcher's Street.

Mount Davis and its Southern to Western Periphery (SA4)

- 4.2.7 The mountain area condition is not altered under initial planned scenario. Generally, BH limit of 1 to 2 storeys are allowed. Moreover, the area is generally zoned as GB. It is anticipated that only scattered building structures would be built. Therefore, it would not bear any significant adverse air ventilation impact or contribute to any significant heat island effect.
- 4.2.8 The periphery area consists of GB, G/IC, R(B), R(C) and OU sites, etc. The BH limit generally reflects the existing situation. For remaining undeveloped sites at the western coastal area, the BH limit is 4 storeys. The BH limit of both sites is not considered excessive as there is no important pedestrian area behind under sea breeze from southwest direction. No significant adverse air ventilation impact is envisaged.
- 4.2.9 Regarding the initial planned scenario within this region, the existing condition is generally respected. As the identified air paths remain unchanged, the proposed BH tallies with the existing situation and would not worsen the air ventilation performance.

4.3 Recommendations

- 4.3.1 General recommendations have been discussed under Section 3.5. According to the initial planned scenario, most existing open areas have been preserved. Various height bands are also introduced. More importantly, most existing identified air paths are preserved. For three HKU redevelopment sites, recommendations have been given to avoid adverse air ventilation impact. The air ventilation performance of the study area is generally satisfactory.
- 4.3.2 However, there remain some problem areas among Kennedy Town built area, foot hill area and Pok Fu Lam Road west. Specific recommendations are suggested below to alleviate adverse air ventilation.

Built Area of Kennedy Town (SA1)

- 4.3.3 **Figure 4.3** shows the recommendations for this sub-area and the details is described below.
- 4.3.4 In view of substantial blockage due to cluster of buildings including Yip Cheong, Kwan Yick Building Phase 1, Mei Sun Lau, HK Industrial Building and Harbour One along the northern waterfront, non-building area (NBA) or building gap above 15m (measured from the mean formation level) should be dedicated to allow northeasterly wind penetration to Belcher's Street and Rock Hill Street and further to the inland area. Two building gaps therefore are recommended. One is aligned with Belcher's Street and another is aligned with Woo Hop Street to allow further northeasterly wind penetration to inland areas of Kennedy Town.
- 4.3.5 Normally, the width of the building gap at the podium level area should be aligned with and at least of the same width of the identified air path behind (e.g. the width of Belcher's Street). Therefore, the two podium setback areas respectively aligned with Belcher's Street and Woo Hop Street should be of 15m wide and 10m wide. However, the ideal alignment of the building gap is in conflict with the committed development of Harbour One. Hence, for practical reason, the building gap aligned with Belcher's Street for northeasterly wind would to a large extent make use of the existing podia between buildings (including the committed building of Harbour One), and is in a curved alignment. Moreover, the minimum width of 10m is recommended in order to allow sufficient amount of wind penetrating to the inland Area via Belcher's Street.
- 4.3.6 On the other hand, ideal alignment of another building gap will trespass Dragonfair Garden which would unlikely be developed in near future. Therefore, the podium setback area is shifted westward while the width of 10m (which is the same as Woo Hop Street) is designated to improve air ventilation.
- 4.3.7 There is ventilation problem along Collinson Street due to blockage of wind flow from sea side by future swimming pool complex. However, the problem is considered localized only and not particularly significant. No further recommendation is made on this issue.



Figure 4.3 Recommended Scenario for SA1

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Foothill Area and Pok Fu Lam Road West (SA2)

- 4.3.8 Another building gap is suggested between Kwun Lung Lau and Smithfield Terrace and to extend southward to the east of the committed development of HKU student hostel at Lung Wah Street in order to form a continuous air path for better air ventilation (**Figure 4.4**).
- 4.3.9 This building gap at the podium level (measured 15m from mean formation level) is recommended to tally with the 15m-wide Smithfield Road for better air ventilation. However, in order not to impose undue constraints to the adjacent developments and affect their likelihood for future redevelopment, the building gap is revised to 12m wide.



Figure 4.4

Recommended Scenario for SA2

5.0 Conclusion and Further Recommendations

5.1 Conclusion

- 5.1.1 The initial planned scenario has been evaluated qualitatively taking into consideration of the site wind availability, topography, existing and committed building morphology and potential development sites and the information listed in para. 1.2.
- 5.1.2 The prevailing annual wind comes from the north-east, east and south; and the prevailing summer wind is mainly from the east, south, and south-west. Streets are in grid system and well aligned in the Area, and the Area comprises a number of open space, low-rise GIC and OU facilities along the waterfront area, slope areas with vegetations and some other open space and low-rise GIC facilities scattered throughout the area and along the Pok Fu Lam Road. Mount Davis and adjacent mountain of Lung Fu Shan at the east allow good penetration of wind in-between to the built area. The Area is of generally satisfactory air ventilation performance.
- 5.1.3 Recommendations with three building gaps mentioned under Section 4.3 have been made to improve the initial planned scenario from air ventilation standpoint. The recommended mitigations are considered practical and balance the development right with the benefits for better air ventilation for this study area.

5.2 Further Recommendations

- 5.2.1 Recommendations on redevelopment of 3 HKU sites are included in this context. Future redevelopment is encouraged to make reference to the recommendations and finetune the detailed design to avoid blockage to existing air paths.
- 5.2.2 No further study is suggested for the study area if the recommendations made in this report are incorporated in formulating the BH restrictions and to address the air ventilation issues earlier identified.

6.0 References

Hong Kong Planning Standards and Guidelines – Chapter 11 Urban Design Guidelines

Appendix A Photos of Street View of the Study Area





Location: Forbes Street

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Location: Smithfield Road

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Location No.: 6a

Location: Mount Davis Road

Project: Term Consultancies for Air Ventilation Assessment Services Under Agreement No. PLNQ 35/2009 Category A1 – Term Consultancy for Expert Evaluation and Advisory Services on Air Ventilation Assessment For an			
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Location No.: 7a

Location: Mount Davis Road

Project:	Term Consultancies for Air Ventilation Assessment Services Under Agreement No. PLNQ 35/2009 Category A1 – Term Consultancy for Expert Evaluation and Advisory Services on Air Ventilation Assessment For an Instructed Project for <u>Kennedy Town Area</u>	ENVIRON



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Location: Victoria Road

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Location: Victoria Road



Location No.: 11

Location: Victoria Road

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Location: Sai Ning Street



Location No.: 12

Location: Sai Ning Street

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Location: Cadogan Street



Location No.: 16

Location: Davis Street

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Location: Catchick Street



Location No.: 18a

Location: Belchers Street

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Location No.: 18b

Location: Belchers Street



Location No.: 19

Location: Smithfield Road

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Location No.: 22a

Location: Catchick Street

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Location No.: 23a

Location: North Street

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Location No.: 24b

Location: Catchick Street



Location No.: 25a

Location: Sands Street

Project:	Term Consultancies for Air Ventilation Assessment Services Under Agreement No. PLNQ 35/2009 Category A1 – Term Consultancy for Expert Evaluation and Advisory Services on Air Ventilation Assessment For an Instructed Project for <u>Kennedy Town Area</u>	ENVIRON



Location No.: 26a

Location: Belchers Street

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Location No.: 26b

Location: Belchers Street



Location No.: 27a

Location: Belchers Street

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Location: Praya Kennedy Town

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Location No.: 36

Location: Queen's Road West



Location No.: 37

Location: South Land

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Location No.: 39a

Location: Queen's Road West



Location No.: 39b

Location: Queen's Road West

Project:	Term Consultancies for Air Ventilation Assessment Services Under Agreement No. PLNQ 35/2009 Category A1 – Term Consultancy for Expert Evaluation and Advisory Services on Air Ventilation Assessment For an Instructed Project for <u>Kennedy Town Area</u>	ENVIRON



Location No.: 40

Location: Shing Sai Road



Project:	Term Consultancies for Air Ventilation Assessment Services Under Agreement No. PLNQ 35/2009 Category A1 – Term Consultancy for Expert Evaluation and Advisory Services on Air Ventilation Assessment For an Instructed Project for <u>Kennedy Town Area</u>	ENVIRON
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