Annex C2

EIA Reports related to HZMB

Supplementary Information on Construction Air Quality in Tuen Mun

1. Introduction

1.1 The Tuen Mun Chek-Lap Kok Link (TM-CLKL) EIA Report was submitted under the Environmental Impact Assessment Ordinance on the 15 June 2009 and approved for public consultation by the DEP on the 14 August 2009. As part of the statutory consultation process, a presentation of the EIA report findings was made to the Environmental Impact Assessment Subcommittee of the Advisory Council on the Environment (EIASC) on the 21 September 2009.

1.2 A presentation on the construction and operational phase air quality impacts from the project was made. It was confirmed that during the operational phase, no exceedances of the Air Quality Objectives (AQOs) in the worst case assessment year of 2031 were predicted at any of the Air Sensitive Receivers (ASRs). In respect of the construction phase, no exceedances were predicted in North Lantau. In the Tuen Mun study area, exceedances were also not predicted except that exceedances of the annual Total Suspended Particulates (TSP) criteria of 80$\mu g/m^3$ were predicted at seven existing ASRs in the Pillar Point area during the construction stage.

1.3 It was noted that the existing background level (taken as a 5 year average from EPD's monitoring site in Yuen Long between 2003-2007) in the Pillar Point area is 103$\mu g/m^3$ and therefore already exceeds the annual criteria and that the maximum contribution from the TM-CLKL project has been reduced to less than 3 $\mu g/m^3$.

1.4 Notwithstanding, supplementary details on the air quality trends in the area, together with a review of whether further mitigation can be applied to the TM-CLKL project to reduce the TSP contributions further have been requested by the EIASC members.

1.5 After the EIASC meeting, members have requested the project proponent to provide supplementary information to facilitate Members' consideration of the EIA reports. This supplementary information is prepared to address the following two items:

- to consider further mitigation measures to reduce the exceedance of annual TSP level in Tuen Mun during the construction phase of the TM-CLKL and report on the findings; and

- to explain the effectiveness of watering as a mitigation measure to reduce TSP emissions in the construction phase.

2. Construction Phase Air Quality Assessment Methodology

2.1 The TM-CLKL will connect the proposed Tuen Mun Western By-pass (TMWB) and Lung Mun Road in the north with the proposed Hong Kong Boundary Crossing Facilities (HKBCF) east of the airport island and also to the North Lantau Highway and future Road P1 on Lantau Island. The land-based connection of the TM-CLKL from the TMWB will be on elevated viaduct and the marine connection from Pillar Point to the BCF will be by submarine tunnel to be constructed by tunnel boring machine (TBM).

2.2 At the northern landfall in Tuen Mun, adjacent to the River Trade Terminal at Pillar Point, the construction of TM-CLKL requires a reclamation of about 16.5 ha of land area to provide a land area for construction of the launching shaft for the tunnel boring machine (TBM) and ultimately, protection to the tunnel structure when constructed and associated tunnel operation roads and facilities. A further reclamation of about 19.1 ha will be required as an integrated part of the HKBCF reclamation for the tunnel to daylight at the south. A toll plaza at Tuen Mun Area 46 is proposed for the TM-CLKL and the connection with the proposed TMWB will be just north of the toll plaza area. The project details are provided in **Figure 3.1** of the EIA Report.

2.3 Potential construction air quality impacts in the Tuen Mun area would largely be from the northern reclamation and toll plaza works, related to the dust nuisance from exposed site areas, movement of vehicles along unpaved roads, material handling and wind erosion from the site. The potential impacts from the following concurrent projects have also been taken into account in order to present a worst case situation:

- Proposed Lantau Logistic Park (LLP) – 72ha (Phase1);
- HKBCF; and
- Tunnelling works for the TMWB.

2.4 The broad methodology for the construction dust assessment is to model the construction scenarios using the Fugitive Dust Model (FDM) based upon both heavy construction activities due to the proposed project works and wind erosion. Actual annual meteorological data for the year 2007 has been applied. Impacts from the project are predicted and mitigated, but in accordance with the EIAO-TM, the background levels are then added to the results to give the overall cumulative impacts.

2.5 In order to derive the background level for the Annual TSP assessment at Tuen Mun, reference was made to the last five years (2003-2007) of approved data from EPD's air quality monitoring station AQMS at Yuen Long. In other EIA

studies, the Tung Chung AQMS (Decommissioning of the Co-combustion Pilot Plant at Tap Shek Kok EIA) or an average between the Yuen Long and the Tsuen Wan AQMS (PAFF EIA) were taken as the reference in determining the background air quality. However, in order to take a conservative approach, the current EIA assessment has made reference to the highest background level at Yuen Long where it is affected by major roads, including Castle Peak Road. The Pillar Point area of the TM-CLKL project contains largely local roads and as such the overall background levels would be expected to be lower than that of Yuen Long. It should be noted that the subject works areas are of approximately equal distance from Yuen Long, Tsuen Wan and Tung Chung AQMS. If the average background annual TSP levels from these three AQMS are taken to represent the background level at Tuen Mun, according to the 2008 data, the background level would be about 75μgm^{-3} [(68+69+87)/3]. With such a background level, the AQO standard of 80μgm^{-3} should be complied with. Hence the adopted background of 103μgm^{-3} in the EIA report is rather conservative.

2.6 As noted above, the northern reclamation is required to house the launching shaft for the TBM and as such is required to be constructed early in the construction programme. Once the reclamation is complete, it is a potential source of dust and as such will be considered concurrent to all the other activities. The works areas for the toll plaza and viaducts in Tuen Mun, however, have been sub-divided into smaller areas, according to construction activities. The works areas for the toll plaza and viaducts in Tuen Mun are provided in **Figure 3.9c** of the EIA report.

2.7 In preparing the works schedule and programme in this area, efforts have been made to reduce the number of overlapping activities to minimise the cumulative dust generating activities and also the active works area. As such, restricting the works activities further is not considered viable within the current project programming.

3. Watering and Other Dust Suppression Measures

3.1 In addition to the careful scheduling of construction work activities as noted above, watering of the site areas and roads is considered the primary method for dust suppression from construction works sites and is a method that has been applied in most EIAs where dust mitigation is required. Examples of recently approved EIAs adopting the same principals include:

- Agreement No. CE 35/2006 (CE), Kai Tak Development Engineering Study cum Design and Construction of Advance Works – Investigation, Design and Construction, 2008 (watering 8 times per day to provide 87.5% reduction);
- Agreement No. NEX/1037, Tsim Sha Tsui Station Northern Subway, 2008 (watering 2 times per day to provide 50% reduction);
- Agreement No. CE 54/2001 (CE), Wan Chai Development Phase II Planning

and Engineering Review, EIA for Wan Chai Development Phase II and Central-Wan Chai Bypass, 2007 (watering 4 times per day to provide 75% reduction);

- Contract P235 Environmental Assessment Services for Permanent Aviation Fuel Facility, 2006 (watering 4 times per day to provide 75% reduction); and

- Agreement No. CE 87/2001 (CE) Further Development of Tseung Kwan O - Feasibility Study, 2005 (watering 4 times per day to provide 75% reduction).

3.2 Watering has long been recognised as one of the most effective dust suppression measures. The USEPA AP 42 "Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Source" fourth edition issued in September 1985 provides a guideline that an effective water programme (i.e., twice daily watering with complete coverage) would reduce dust emissions by 50% (section 11.2.4 refers). Often, in order to suppress the construction dust level to an acceptable standard, a higher percentage of reduction is required and the rule of "twice daily watering give 50% reduction" has been used as the basis to quantify the further increase in dust reduction with higher watering frequency.

3.3 Subsequent to publication of the 4th edition of AP42, further research on dust suppression efficiency was conducted. Cowherd *et al*., (1988) "Control of Open Fugitive Dust Sources, EPA-450/3-88-008, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1988" summarised the results of 14 tests conducted in four US states and concluded with an empirical model to estimate control efficiency of water. The work of Cowherd *et al* was adopted as one of the supporting reference in the updated edition of AP42 published in January 1995.

3.4 Cowherd *et al*. notes that the watering technique prevents the fine particulate material from leaving the works surface and becoming airborne due to disturbance of the surface (from mechanical equipment) or wind. The applied water acts to bind smaller particles to the coarser material with the results in reducing emissions.

3.5 The empirical model proposed by Cowherd *et al* for the efficiency of watering can be simplified as C = 100 - k (t), where *C* is the control efficiency (%), *k* is a constant for a fixed condition and *t* is the interval between watering (hour). This demonstrated that the control efficiency is directly proportional to the watering frequency.

3.6 As the project site is located at an area with a high background TSP level, up to 12 times watering per day is recommended to suppress the dust level to as low as practicable. The application of 12 times watering per day is considered to be onerous and at the limit of what would be considered practicable for a construction project of this size. Additional watering would be implemented in the localised areas close to ASRs where necessary.

3.7 In addition to watering, a range of house-keeping measures have also been detailed in Section 4.8.1.6 of the EIA Report, which, while not quantified, would serve to reduce dust levels further when implemented, as detailed below.

(i) The Contractor shall, to the satisfaction of the Engineer, install effective dust suppression measures and take such other measures as may be necessary to ensure that at the Site boundary and any nearby sensitive receivers, dust levels are kept to acceptable levels;

(ii) the Contractor shall not burn debris or other materials on the works areas;

(iii) in hot, dry or windy weather, the watering programme shall maintain all exposed road surfaces and dust sources wet;

(iv) where breaking of oversize rock/concrete is required, watering shall be implemented to control dust. Water spray shall be used during the handling of fill material at the site and at active cuts, excavation and fill sites where dust is likely to be created;

(v) open dropping heights for excavated materials shall be controlled to a maximum height of 2m to minimise the fugitive dust arising from unloading;

(vi) during transportation by truck, materials shall not be loaded to a level higher than the side and tail boards, and shall be dampened or covered before transport. Materials having the potential to create dust shall not be loaded to a level higher than the side and tail boards, and shall be covered by a clean tarpaulin. The tarpaulin shall be properly secured and shall extend at least 300mm over the edges of the side and tail boards;

(vii) no earth, mud, debris, dust and the like shall be deposited on public roads. Wheel washing facility shall be usable prior to any earthworks excavation activity on the site;

(viii) areas of exposed soil shall be minimised to areas in which works have been completed and shall be restored as soon as is practicable; and

(ix) all stockpiles of aggregate or spoil shall be enclosed or covered and water applied in dry or windy condition.

3.8 Also, dust control requirements in accordance with the Air Pollution Control (Construction Dust) Regulations would be strictly followed to avoid causing dust nuisance. Throughout the construction phase, dust monitoring and audit will be undertaken and an action plan has been defined in the EM&A Manual so that additional measures can be carried out whenever warranted.

4. Construction Phase Dust Modelling Results in Tuen Mun

4.1 The results presented in **Tables 4.10a** and **4.10b** of the EIA report present the maximum levels predicted at each ASRs with the background level of 103μg/m^3 added. However, it is considered useful to also consider the dust emissions predicted from the project only. Table 1 below presents the maximum dust emissions at each ASRs both with and without the background.

Table 1: Maximum Annual Average TSP concentrations (μg/m^3) at ASRs

Receiver Reference	Predicted Maximum Annual Average TSP Concentration (TM-CLKL and Cumulative Projects only) (Standard 80 μg/m^3)	Predicted Maximum Annual Average TSP Concentrations (With Background) (Standard 80 μg/m^3)
ASR1	2.2	105.2
ASR2	1.3	104.3
ASR3	0.6	103.6
ASR5	3.0	106.0
ASR6	2.6	105.6
ASR7	2.4	105.4
ASR10	0.8	103.8

4.2 It can be seen that the emissions from the TM-CLKL project at all ASRs range from only 0.6 to 3.0μg/m^3 (as compared to the criteria of 80μg/m^3). Given the size of the project, this is considered to be a practicable minimum.

4.3 It can also be seen from the Annual Average TSP Concentrations contour plot in **Figures 4.10f** and **4.11f** of the EIA Report that the higher of these concentrations are confined to the reclamation and toll plaza areas only and with only very small maximum dust emissions of 0.6-0.8μg/m^3 being predicted at the ASRs on the periphery of the works area (ASRs 10 and 3).

4.4 The sensitive receivers at Tuen Mun South residential area, including the closest development of Melody Garden some 700m plus from the site, are not ASRs in the EIA Report due to this distance from the works but do represent the closest residential area. Based upon the results at ASR10 at Butterfly Beach Park (which is much closer than the Tuen Mun South residential receivers) which show that ASR10 will be subject to project related dust elevations of only 0.8μg/m^3 maximum, it can be expected that the residential developments in Tuen Mun South would only receive a negligible increase in TSP from the project. Please refer to the revised contour plots in **Figures 1** and **2** attached. As such, overall it is concluded that the dust generated by the project is of very low concentrations and will be contained to within close proximity to the works.

5. Trends in Background Air Quality

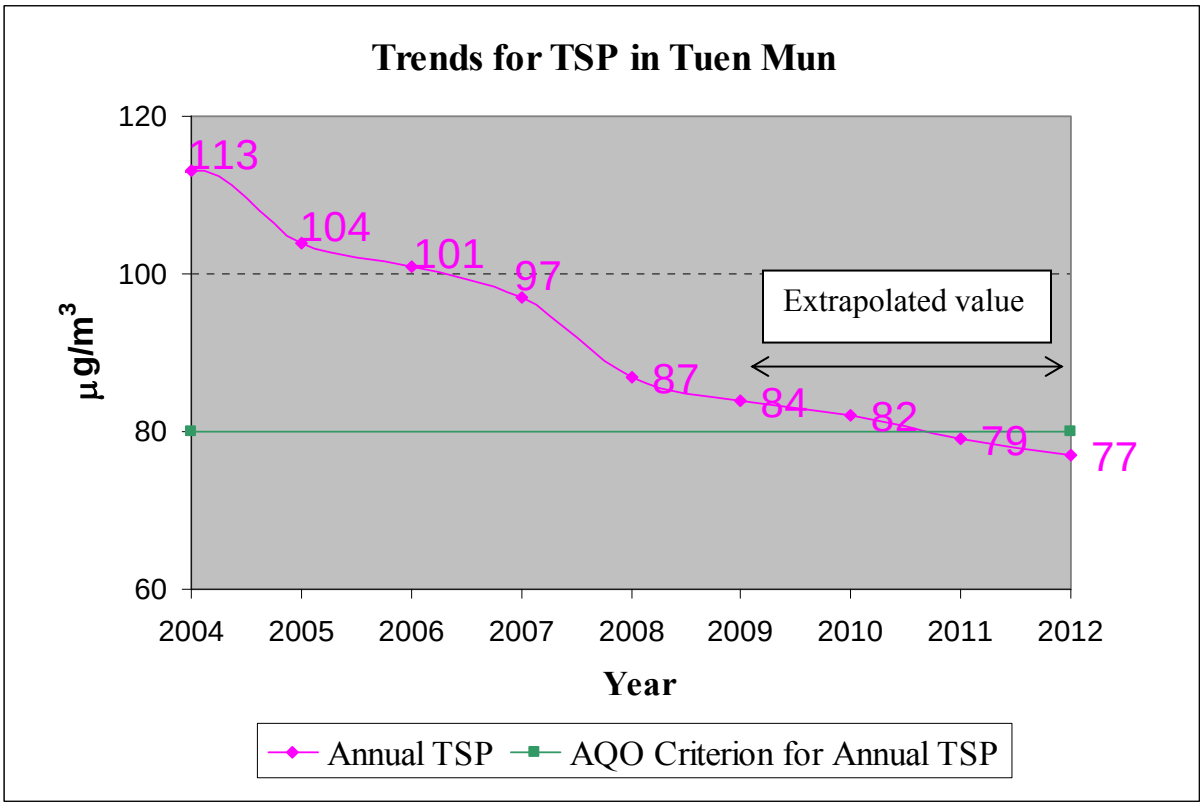
5.1 For the purposes of the EIA air quality assessment, the average of the last 5 years EPD TSP results was taken as the baseline. At the time of the EIA report for the TM-CLKL, only the data for the period 2003 to 2007 was available and approved.

Table 2 Annual Average TSP Results from EPD Monitoring Station in Yuen Long

Averaging Period	EPD Recorded Annual Average ($\mu g/m^3$)						Background Average ($\mu g/m^3$)
	2003	2004	2005	2006	2007	2008	
2003-2007	98	113	104	101	97	-	103
2004-2008	-	113	104	101	97	87	100
Percentage Decrease from Previous Year	-	-	8%	3%	4%	10%	

5.2 The major sources of TSP in Hong Kong are power stations, construction works sites, material stockpiles and muddy roads. The major sources of TSP in Tuen Mun side of the TM-CLKL project study area include power stations, fill banks and industrial plants at Area 38, PAFF and Ecopark Phase II construction sites and also the dust along Lung Mun Road. It is possible that some of the sources can be further controlled by third parties such as more agglomerators/desulphurisation facilities for power plants, install or upgrading of scrubbers system for industrial plants, additional covering/watering in the other construction sites and more cleansing of road surface. While the background TSP levels will also be influenced by more far field regional sources in the PRD, the above measures could help reduce the local annual TSP levels. However, as these measures are related to third parties projects, their implementation will not be controllable under the TM-CLKL project.

5.3 It can be seen from Table 2 above that the Annual TSP levels recorded by EPD's routine monitoring station in Yuen Long have been declining since 2004, and in 2008 the level was $87\mu g/m^3$ which is only marginally higher than the criteria of $80\mu g/m^3$. As such, if the 5 year annual average was calculated using the 2004-2008 data, it would be lower than the currently assumed and at $100\mu g/m^3$, as shown in Table 2 above. The decreases per year ranged from 3-10%. TSP levels for 2009 are not currently available from EPD, but taking a conservative reduction of only 3% per year, the TSP levels in 2009, and then further extrapolating to 2012 when the earthworks at the toll plaza and northern reclamation, has been carried out as can be seen in the chart below.



5.4 The projected background levels in 2012 would be expected to be about 77µg/m^3. At this stage, even if the TM-CLKL project contribution was added to the background (maximum 3.0µg/m^3), the current annual TSP AQO would be expected to be marginally met.

5.5 It should be noted that the Annual TSP criterion will not occur under the proposed new AQO currently released by Government for consultation.

5.6 As noted above, the source of the annual TSP exceedances are largely from the background sources which, while are decreasing over time, at present exceed the current AQO criterion of 80µg/m^3.

6. Further Mitigation Considerations

6.1 While the EIA assessment has considered a range of mitigation measures to reduce dust impacts to a minimum including works scheduling as far as possible, frequent watering and a series of other good housekeeping measures (section 4.8.1.6 of the EIA report) including all areas of exposed soil to be restored as soon as practicable. However, some further measures that may be considered are as follows:

(i) While the EIA Report, as noted above, has already recommended that the

areas of exposed soil shall be minimised to areas in which works have been completed ands shall be restored as soon as is practicable and that all stockpiles of aggregate or spoil shall be enclosed or covered and water applied in dry or windy condition, it is further suggested to strengthen this recommendation by requiring that temporary hydroseeding of exposed surfaces which are not proposed to be touched for a period of time be undertaken;

(ii) as noted above, while the current programming does not allow for further reduction of concurrent dusty construction activities, it is possible that the Contractor may develop an alternative construction programme and methods. As such, the Construction Contract will include a clause to require the Contractor to schedule works activities to minimise concurrent dusty activities;

(iii) looking into implementing further dust suppression or screening measures at the concerned ASRs; and

(iv) scheduling the works to avoid key dusty construction activities of other concurrent projects where possible.

6.2 The contribution from item (iv) would be marginal as noted above. The reductions associated with items (i), (ii) and (iii) cannot be quantified but these future measures will also contribute to reducing overall dust levels in the Pillar Point Area or at the concerned ASRs during the TM-CLKL project implementation.

6.3 As such, the levels recorded in the EIA Report would remain valid as worst case predictions of Annual TSP levels in Tuen Mun.

7. Conclusions

7.1 The TM-CLKL EIA assessment of TSP levels in Tuen Mun has been based upon a worst case scenario of concurrent project and works programme. In addition, all practicable mitigation measures have been recommended for dust suppression as far as possible. Notwithstanding the efforts to be paid in minimising TSP generated from the project, the annual average TSP background level already exceeds the Annual AQO criteria and therefore, the TM-CLKL has predicted exceedances of this standard. That said, it should be noted that for conservatism, a comparatively high background annual TSP level at Yuen Long AQMS has been made reference to.

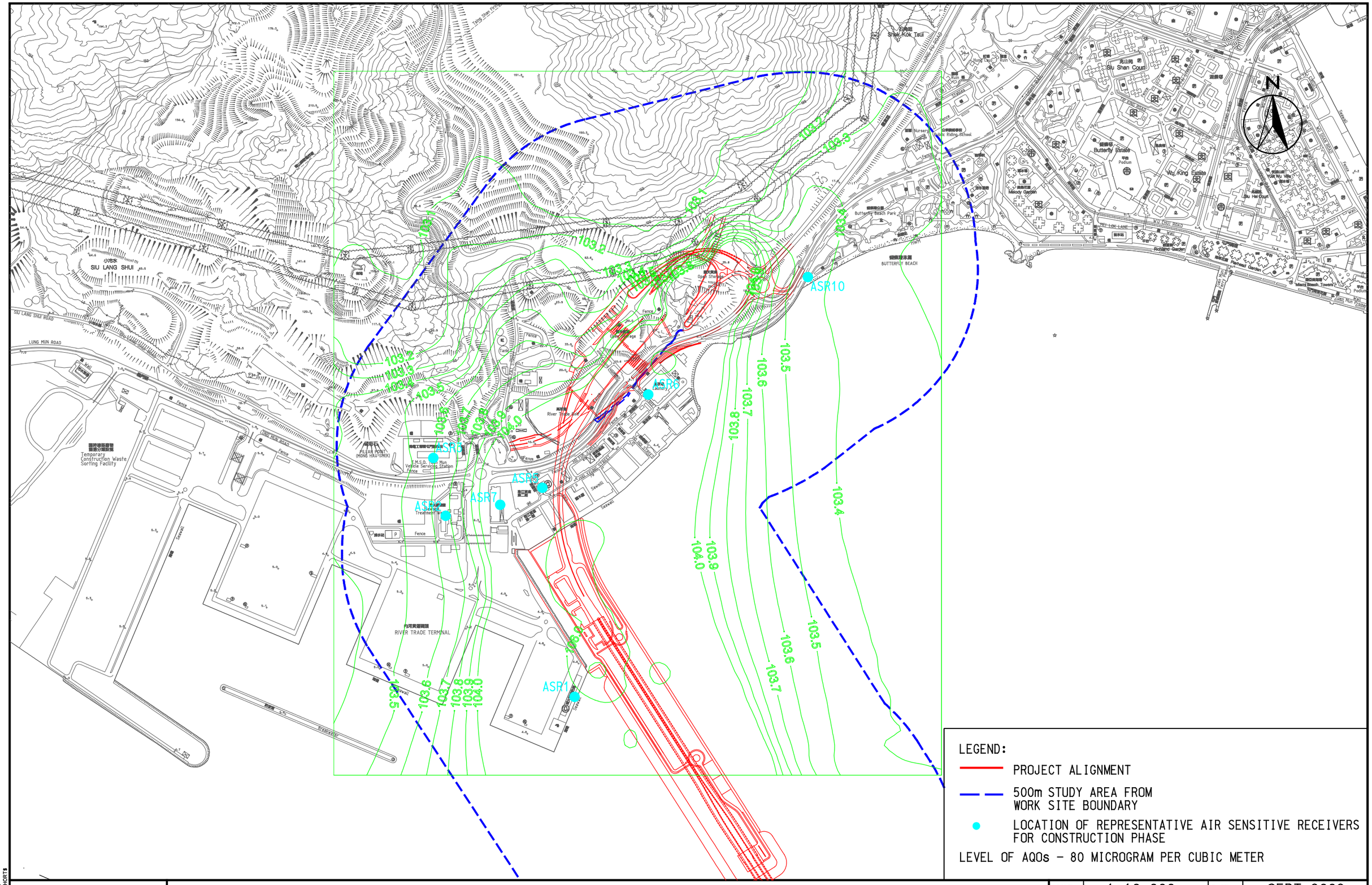
7.2 The magnitude of the residual impact is assessed in accordance with Section 4.4.3 of the TM-EIAO in **Table 3** below.

Table 3 Assessment of Residual Impacts from Annual Construction Dust

Criteria	Assessment
Effects on public health and health of biota or risk to life.	The dust generated during the construction works are unlikely to contain a significant proportion of fine particulates (less than 10 μm) which are deemed to the respirable and therefore have the potential to affect health if breathed in. In addition, about 99% of inhaled particulate matter is considered to be either exhaled or trapped in the upper areas of the respiratory system and expelled and as such, would be deemed to be more of a nuisance than a health risk.
Magnitude of the adverse environmental impacts.	The annual background levels in the area are already above the standard at 103 $\mu g/m^3$ although data from 2004 shows a definite downward trend of the annual average levels. The background level if calculated from the 2004-2008 data (2008 data was not available at the time of the EIA assessment) is 100 $\mu g/m^3$, some 3 $\mu g/m^3$ lower. The contribution of the project to dust levels in the area is relatively minor, being <3 $\mu g/m^3$ at all ASRs. The only other concurrent project being undertaken in the vicinity is the TMWB but significant dust emissions from the tunnel works are not expected and as such, the TM-CLKL will not contribute to cumulative impacts with other projects.
Geographic extent of the adverse environmental impacts.	The geographic extent of the adverse impacts from dust will not be large and will be limited to within about 200m from the TM-CLKL works area and project only dust levels at the closest residential development in Tuen Mun would be insignificant.
Duration and frequency of the adverse environmental impacts.	The construction-phase impacts of TM-CLKL construction will be of short to moderate duration (earthworks at northern reclamation and toll plaza are currently anticipated to be span for about 3.5 years) and, therefore, temporary and reversible.
Likely size of the community or the environment that may be affected by the adverse impacts.	As the impacts will be confined to a relatively small area, only a few commercial ASRs in the immediate vicinity will be temporarily affected.
Degree to which the adverse environmental impacts are reversible or irreversible.	Construction-phase impacts would be reversible.
Ecological context.	The ecological value of the area is low given that it is largely disturbed and developed already and occupied by non-residential facilities.
Degree of disruption to sites of cultural heritage.	Not applicable

Criteria	Assessment
International and regional importance.	The impacts are localised and not of international and regional importance.
Likelihood and degree of uncertainty of adverse environmental impacts.	The impacts predicted are based upon worst case assumptions and modelling parameters and as such, would not occur to the extent predicted on all occasions. However, the assessment has been made using approved mathematical modelling techniques and the degree of certainty on the results is high.

7.3 Based upon this assessment, the conclusion of the TM-CLKL EIA Report and this supplementary information is that the predicted residual impacts of the TM-CLKL project are insignificant and acceptable. In addition, it should be noted that, despite the worst case presented in the EIA Report, background TSP levels are declining and if they continue to decline at a modest rate of 3% per year, compliance of the Annual TSP level would occur in 2012 when the TM-CLKL works in Tuen Mun commence.



LEGEND:

- PROJECT ALIGNMENT
- 500m STUDY AREA FROM WORK SITE BOUNDARY
- LOCATION OF REPRESENTATIVE AIR SENSITIVE RECEIVERS FOR CONSTRUCTION PHASE

LEVEL OF AQOs – 80 MICROGRAM PER CUBIC METER

AECOM

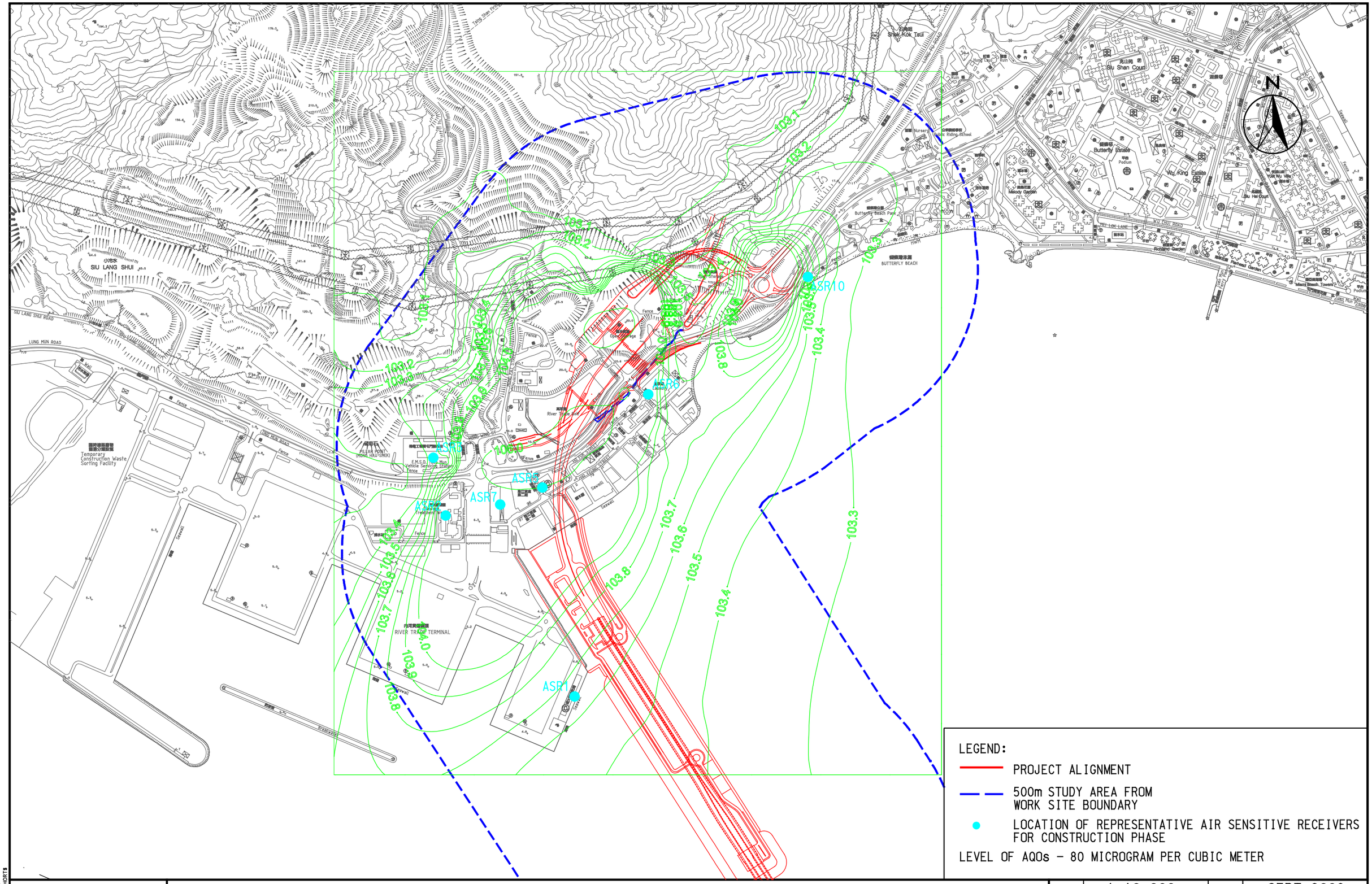
AGREEMENT NO. CE 52/2007(HY)
TUEN MUN – CHEK LAP KOK LINK – INVESTIGATION

ANNUAL AVERAGED TSP CONCENTRATION AT 1.5M ABOVE GROUND LEVEL AT TUEN MUN FOR SCENARIO 1

SCALE	1:10 000	DATE	SEPT.2009
CHECK		DRAWN	
JOB No.	60044963	**Annex C2-Figure 1**	

Plotting By: 9/23/2009
PLOT SCALE: #SCALESHORT#

K:\91124TMCLKL\Environmental\EIA REPORT\Figure 1_ACE.dgn



LEGEND:

- PROJECT ALIGNMENT
- 500m STUDY AREA FROM WORK SITE BOUNDARY
- LOCATION OF REPRESENTATIVE AIR SENSITIVE RECEIVERS FOR CONSTRUCTION PHASE

LEVEL OF AQOs – 80 MICROGRAM PER CUBIC METER

AECOM

AGREEMENT NO. CE 52/2007(HY)
TUEN MUN – CHEK LAP KOK LINK – INVESTIGATION

ANNUAL AVERAGED TSP CONCENTRATION AT 1.5M ABOVE GROUND LEVEL AT TUEN MUN FOR SCENARIO 2

SCALE	1:10 000	DATE	SEPT.2009
CHECK		DRAWN	
JOB No.	60044963	**Annex C2-Figure 2**	

Plotting By: 9/23/2009
PLOT SCALE: #SCALESHORT#

K:\91124TMCLKL\Environmental\EIA REPORT\Figure 2_ACE.dgn