6. AIR QUALITY IMPACT ASSESSMENT

6.1 Introduction

This section presents the potential air quality impacts on ASRs during the construction phase and operational phase of the road networks near the West Rail Yuen Long, Tin Shui Wai and Tuen Mun Centre stations. Dust impact upon the ASR is the major issue during the construction phase, while vehicle emissions are the major source of pollutants during the operation phase. Mitigation measures will be recommended, where necessary, to reduce the identified impacts on the ASRs to acceptable levels.

6.2 Construction Phase

6.2.1 Potential Sources of Impacts

Dust nuisance is the major potential impact during the construction phase of the roadworks. The major construction works of the Project in Yuen Long, Tin Shui Wai and Tuen Mun Centre are outlined below:

- the improvement of the new distributor roads A1, L1, L2, L3, 6/L3, PTI access and Castle Peak Road;
- the improvement of the junction on Tin Fuk Road and Ping Ha Road; and the widening of Tin Fuk Road, Ping Ha Road and Tin Yiu Road; and
- the improvement of the junctions at Pui To Road and Tuen Mun Heung Sze Wu Road, Yan Ching Street and Tuen Mun Heung Sze Wui Road, Kin Fung Circuit and Tsun Wen Road and Tsun Wen Road and Pui To Road; and widening of Kin Fung Circuit, Pui To Road, Ho Pong Street, Tuen Mun Heung Sze Wui Road and Yan Ching Street.

General road work activities such as materials handling, top soil removal, site clearance and wind erosion are the main dust generating sources. As the worksites will be small and restricted by existing highway boundaries, excavated fill materials will be transported off-site and therefore, stockpiling is not expected. Also, the existing road networks will be used as the route for transportation, and haulage within the small worksite is not expected.

SO_2 and NO_2 will be emitted from the diesel-powered mechanical equipment used on-site. However, the number of such plant required on-site will be limited and gaseous emissions will be minor. It is therefore not expected to cause an exceedance of the AQO for these pollutants due to the limited construction plant on site.

Due to the small scale of the sites, the volume of excavated material and the rate of excavation are anticipated to be low. It is therefore, expected that the dust impact due to the improvement work is low. However, in order to ensure the environmental performance of construction works, environmental control and mitigation measures are

recommended and checked by environmental monitoring and audit to ensure that the dust criteria will be satisfied. The mitigation measures are described in *Section 6.2.2.*

6.2.2 Mitigation Measures During Construction Phase

Under the *Air Pollution (Construction Dust) Regulation*, the following requirements should be followed and incorporated in the contract specification to limit the dust emission from the site:

- the heights from which materials are dropped should be controlled to a minimum practical height to control fugitive dust arising from unloading;
- materials should not be loaded to a level higher than the side and tail boards, and should be dampened or covered before transport;
- water sprays should be applied to maintain the worksite wet;
- all dusty materials should be sprayed with water prior to any loading, unloading or transfer operation so as to maintain the dusty materials wet;
- the load carried by the vehicle should be covered by clean impervious sheeting to ensure that the dusty materials do not escape from the vehicle; and
- the excavation working area should be sprayed with water after the operation so as to maintain the entire surface wet.

6.2.3 Residual Impacts

With the implementation of the above suggested mitigation measures, the dust emissions from the site should be minimised and residual adverse impacts on the nearby sensitive receivers are not expected. To scrutinise the effectiveness of the recommended dust control measures, environmental monitoring is recommended to ensure that dust levels during the construction are controlled to within the specified dust criteria. The locations and requirements of dust monitoring are identified in *Section 11.*

6.2.4 Cumulative Impacts

Although the exact programming of the construction works has still to be finalised, it is currently envisaged that the construction period for each of the EPIW will be approximately one year. The EPIW construction works are expected to be undertaken either partially in advance of, or in parallel with the construction for the West Rail station works. The potential for cumulative dust impact therefore exists, and this is discussed below.

Yuen Long

The *West Rail EIA Report* concluded that the major dust source during the construction of Yuen Long station would be from the concrete batching plants sited at Nam Pin Wai and Tung Tau Tsuen. It is proposed that the batching plant will be located to the west of Nam Pin Wai (the worst affected ASR identified in the West Rail EIA Report); whilst the

site of the EPIW works is located to the east of Nam Pin Wai. As a consequence, Nam Pin Wai is predicted to experience dust impact from the batching plant under the influence of a westerly wind, however, Nam Pin Wai would only potentially receive dust impacts from the EPIW site under the influence of an easterly wind. It is therefore considered unlikely that cumulative dust impacts will be experienced at Nam Pin Wai from the West Rail station construction works and EPIW works.

Tin Shui Wai

According to the *West Rail EIA Report*, the dust impact at the identified ASRs from the station construction works is low and lower than the dust criteria by 14%. As the scale of the EPIW is small, cumulative dust impact will be low and within the dust criteria.

Tuen Mun Centre

Similar to the construction of Yuen Long Station, the major dust source associated with the construction of the West Rail Station is predicted to be the concrete batching plant located to the west of the Lui Ming Choi Secondary School (the worst affected ASR). A high dust impact was identified at this receiver position in the West Rail EIA Report. However, the high dust emissions were assumed in the West Rail EIA Study as a worst case scenario. In actuality, the emissions from the concrete batching plant will be controlled through the implementation of the measures defined within the Best Practicable Means Requirement for Cement Works (Concrete Batching Plant). Emission from the batching plant may therefore be reduced to 15% of the total emission from the site, i.e., the potential dust contribution from the batching plant is likely to be reduce to 15% of that stated in the West Rail EIA Report. In addition, as the scale of the EPIW works is small and the dust impacts will be low, any potential cumulative dust impacts are predicted to be within the required dust criteria..

6.3 Operational Phase

6.3.1 Potential Sources of Impact

With the operation of West Rail Yuen Long, Tin Shui Wai and Tuen Mun Centre Stations, and the associated supporting facilities such as public transport interchanges, traffic flows within the study areas will be increased. The increased traffic volumes will give rise to air quality impacts at adjacent sensitive developments. Vehicular exhaust will be the major source of impacts, and pollutants like NO_2, CO and RSP have been identified as the major components of vehicle exhaust for the assessment.

6.3.2 Assessment Methodology

Nitrogen dioxide (NO_2), carbon monoxide (CO) and respirable suspended particulates (RSP) are considered as the major pollutants associated with the vehicular exhaust emission. The emission factors for each of these pollutants are based on *EURO III* criteria. Cumulative air quality impact taking account of air emissions from traffic on

existing road networks, new distributor roads and the widened road networks will be assessed. Castle Peak Road - Yuen Long, Ping Ha Road and Tuen Mun Heung Sze Wui Road, being the major road of Yuen Long, Tin Shui Wai and Tuen Mun area, is the major pollutant source of the areas. The total traffic flow of Castle Peak Road, Ping Ha Road and Tuen Mun Heung Sze Wui Road including the traffic breakdowns and vehicle exhaust emission rates for the year 2003, 2011 and 2018 have been forecasted and presented in *Tables 6.3 a, 6.3 b* and *6.3 c* respectively. The details of the traffic breakdown and the emission calculations for each link are presented in *Annex H.*

Table 6.3a NO_x Emission Rate from Castle Peak Road - Yuen Long

	Year 2003	Year 2011	Year 2018
Total Traffic Flow (veh/hr)	3,492	4,173	5,053
% Traffic Breakdown of P-c/p[(i)]	25	25	25
% Traffic Breakdown of Taxi	20	20	20
% Traffic Breakdown of PuLB[(i)]	11.5	11.5	11.5
% Traffic Breakdown of LGV[(i)]	18	17.5	17.5
% Traffic Breakdown of HGV[(i)]	15	15	15
% Traffic Breakdown of PuBus[(i)]	10.5	11	11
Fleet Emission Rate of NO_x of P/c-p (g/km)[(ii)]	0.90	0.71	0.71[(iii)]
Fleet Emission Rate of NO_x of Taxi (g/km)[(ii)]	1.27	0.73	0.73[(iii)]
Fleet Emission Rate of NO_x of PuLB (g/km)[(ii)]	1.91	1.54	1.54[(iii)]
Fleet Emission Rate of NO_x of LGV (g/km)[(ii)]	1.53	1.23	1.23[(iii)]
Fleet Emission Rate of NO_x of HGV (g/km)[(ii)]	6.21	3.84	3.84[(iii)]
Fleet Emission Rate of NO_x of PuBus (g/km)[(ii)]	10.53	6.43	6.43[(iii)]
NO_x Emission Rate of the fleet (g/km-hr)	10,594	5,334	10,046

Note:

(i) P-c/p : Petrol Private Car; PuLB : Public Light Bus; LGV : Light Goods Vehicles; HGV : Heavy Goods Vehicles; PuBus : Public Bus

(ii) Fleet Emission Rate based on EURO III criteria

(iii) 2018 NO_x emission rates are not available and 2011 emission rate is used.

Table 6.3b NO_x Emission from Ping Ha Road of Tin Shui Wai

	Year 2003	Year 2011	Year 2018
Total Traffic Flow (veh/hr)	864	1,588	1,826
% Traffic Breakdown of P-c/p[(i)]	25	25	70
% Traffic Breakdown of Taxi	20	19.5	-
% Traffic Breakdown of PrBus[(i)]	8	8	-
% Traffic Breakdown of LGV[(i)]	15	16	-

	Year 2003	Year 2011	Year 2018
% Traffic Breakdown of HGV[(i)]	24	24.5	30
% Traffic Breakdown of PuBus[(i)]	8	7	-
Fleet Emission Rate of NO_x of P/c-p (g/km)[(ii)]	0.90	0.71	0.71[(iii)]
Fleet Emission Rate of NO_x of Taxi (g/km)[(ii)]	1.27	0.73	-
Fleet Emission Rate of NO_x of PrBus (g/km)[(ii)]	9.08	5.54	-
Fleet Emission Rate of NO_x of LGV (g/km)[(ii)]	1.53	1.23	-
Fleet Emission Rate of NO_x of HGV (g/km)[(ii)]	6.21	3.84	3.84[(iii)]
Fleet Emission Rate of NO_x of PuBus (g/km)[(ii)]	10.53	6.43	-
NO_x Emission Rate of the fleet (g/km-hr)	3,248	3,771	3,104

Note:

(i) P-c/p : Petrol Private Car; PrBus : Public Light Bus; LGV : Light Goods Vehicles; HGV : Heavy Goods Vehicles; PuBus : Public Bus

(ii) Fleet Emission Rate based on EURO III criteria

(iii) 2018 NO_x emission rates are not available and 2011 emission rate is used.

Table 6.3c NO_x Emission from Tuen Mun Heung Sze Wui Road at Year 2018

	Year 2003	Year 2011	Year 2018
Total Traffic Flow (veh/hr)	2,000	2,460	3,280
% Traffic Breakdown of P-c/p[(i)]	35	33	32
% Traffic Breakdown of Taxi	34	34	34
% Traffic Breakdown of PrBus[(i)]	2	20	10.5
% Traffic Breakdown of HGV[(i)]	19	10	19.5
% Traffic Breakdown of PuBus[(i)]	10	3	4
Fleet Emission Rate of NO_x of P/c-p (g/km)[(ii)]	0.90	0.71	0.71[(iii)]
Fleet Emission Rate of NO_x of Taxi (g/km)[(ii)]	1.27	0.73	0.73[(iii)]
Fleet Emission Rate of NO_x of PrBus (g/km)[(ii)]	9.08	5.54	5.54[(iii)]
Fleet Emission Rate of NO_x of HGV (g/km)[(ii)]	6.21	3.84	3.84[(iii)]
Fleet Emission Rate of NO_x of PuBus (g/km)[(ii)]	10.53	6.43	6.43[(iii)]
NO_x Emission Rate of the fleet (g/km-hr)	6,350	5,318	8,946

Note:

(i) P-c/p : Petrol Private Car; PrBus : Public Light Bus; HGV : Heavy Goods Vehicles; PuBus : Public Bus

(ii) Fleet Emission Rate based on EURO III criteria

(iii) 2018 NO_x emission rates are not available and 2011 emission rate is used

A comparison of total emission rate of the fleet for the critical pollutant, NO_x, from the Castle Peak Road, Ping Ha Road and Tuen Mun Heung Sze Wui Road for the year 2003,

2011 and 2018 has been carried out. It was suggested that the NO_x emissions will be larger for Castle Peak Road in year 2003 and for Ping Ha Road in year 2011 and Tuen Mun Heung Sze Wui Road in year 2018. For Yuen Long area, traffic data for year 2003 were, therefore, employed for the assessment of worst case impact while traffic data for year 2018 were employed to Tuen Mun area for the assessments. For Tin Shui Wai area, traffic data for year 2011 were employed for the assessment.

The air dispersion model, *CALINE4*, approved by the EPD was used to predict the pollutant levels of NO_2, CO and RSP.

Peak hour traffic will occur during the daytime period, resulting in the worst case meteorological conditions; as specified in the 1998 *EPD's Draft Guidelines for Local-scale Air Quality Assessment Using Models*, these conditions will be used for the dispersion model which include:

- wind speed 1 ms^{-1};
- wind direction worst case for each receivers;
- stability class D;
- mixing height 500 m;
- standard deviation of wind direction 18 degrees; and
- temperature 298K

The NO_x gas was assumed to be inert and levels of conversion to NO_2 were taken as 20% of total NO_x emission.

The cumulative air quality impacts at ASRs in association with the proposed improvement of road networks, together with the background air quality were assessed against the AQOs.

6.3.3 Prediction and Evaluation of Impacts

The hourly concentrations of pollutants from vehicular emissions at ground level and 10m above ground were predicted; and the results are presented in *Tables 6.3d-f* for Yuen Long, Tin Shui Wai and Tuen Mun Centre.

Table 6.3d Yuen Long EPIW - Predicted Hourly Concentration of Pollutants (μgm^{-3})

ASRs	Predicted Hourly Concentration [i](μgm^{-3})					
	At Ground Level			At 10 m Above Ground		
	NO_2	CO	RSP	NO_2	CO	RSP
A1	144	1180	78	122	950	73
A2	178	1410	87	152	1180	80
A3	103	835	67	92	835	65
A4	118	950	70	95	835	65

ASRs	Predicted Hourly Concentration [i](μgm^{-3})					
	At Ground Level			At 10 m Above Ground		
	NO_2	CO	RSP	NO_2	CO	RSP
A5	99	835	67	92	835	64
A6	114	950	70	92	835	64
A7	95	835	65	84	720	63
A8	152	1180	80	103	835	67
A9	174	1295	86	122	950	72
A10	171	1295	85	144	1180	78
A11	171	1295	87	148	1180	79
A12	156	1180	81	133	1065	75
A13[ii]	-	-	-	88	835	63
Criteria	300	30,000	180 [iii]	300	30,000	180 [iii]

Notes:

(i) Background included in the above prediction

(ii) Since the ground level of A13 is the LRT Station, therefore, the assessments are only predicted at 10 m above ground

(iii) Since no hourly RSP level stipulated in the AQO, daily RSP criteria is used.

The results of evaluation indicate that all the predicted hourly concentration of pollutants for Yuen Long EPIW are within the AQO criteria. The predicted hourly concentration of NO_2, CO and RSP at ground level are in the range of 95 - 178 μgm^{-3}, 835 - 1,410 μgm^{-3} and 65 - 87 μgm^{-3} respectively. While the predicted hourly concentration of NO_2, CO and RSP at receiver height of 10 m above ground range from 84 - 152 μgm^{-3}, 720 - 1180 μgm^{-3} and 63 - 80 μgm^{-3} respectively. The highest concentrations of the critical pollutant, NO_2, at the worst level, i.e., ground level was predicted at A2 (Far East Consortium Yuen Long Building).

The isopleth of NO_2 of the Yuen Long area at ground level is shown in *Figure 6.3a*. It confirms that the AQO criteria of the area will be satisfied during the operational phase of the Project in Yuen Long. No mitigation measures are necessary for this road scheme.

Noise barriers of 3m height have been recommended near Nam Pin Wai (referred *to Section 5.3.4.1*). With the barrier in place, pollutants will be dispersed over the barrier and pollutant levels at ASRs close to the EPIW works, such as those at Nam Pin Wai, would be slightly increased. However, maximum NO_2 level is predicted to be well within the AQO (59% of AQO). Consequently, adverse air quality impacts are not expected as a result of the presence of the noise barriers.

Table 6.3e Tin Shui Wai EPIW - Predicted Hourly Concentration of Pollutants (μgm^{-3})

ASRs	Predicted Hourly Concentration [(i)] (μgm^{-3})					
	At Ground Level			At 10 m Above Ground		
	NO_2	CO	RSP	NO_2	CO	RSP
A14	92	950	62	80	835	60
A15	77	835	59	73	720	58
A16	69	720	58	65	720	56
A17	69	720	58	65	720	56
A18	77	720	58	69	720	57
A19	84	835	60	80	835	59
A20	88	950	63	80	950	61
A21	69	720	57	65	720	56
A22	99	950	64	88	835	61
Criteria	300	30,000	180 [(ii)]	300	30,000	180 [(ii)]

Notes:

(i) Background included in the above prediction

(ii) Since no hourly RSP level stipulated in the AQO, daily RSP criteria is used.

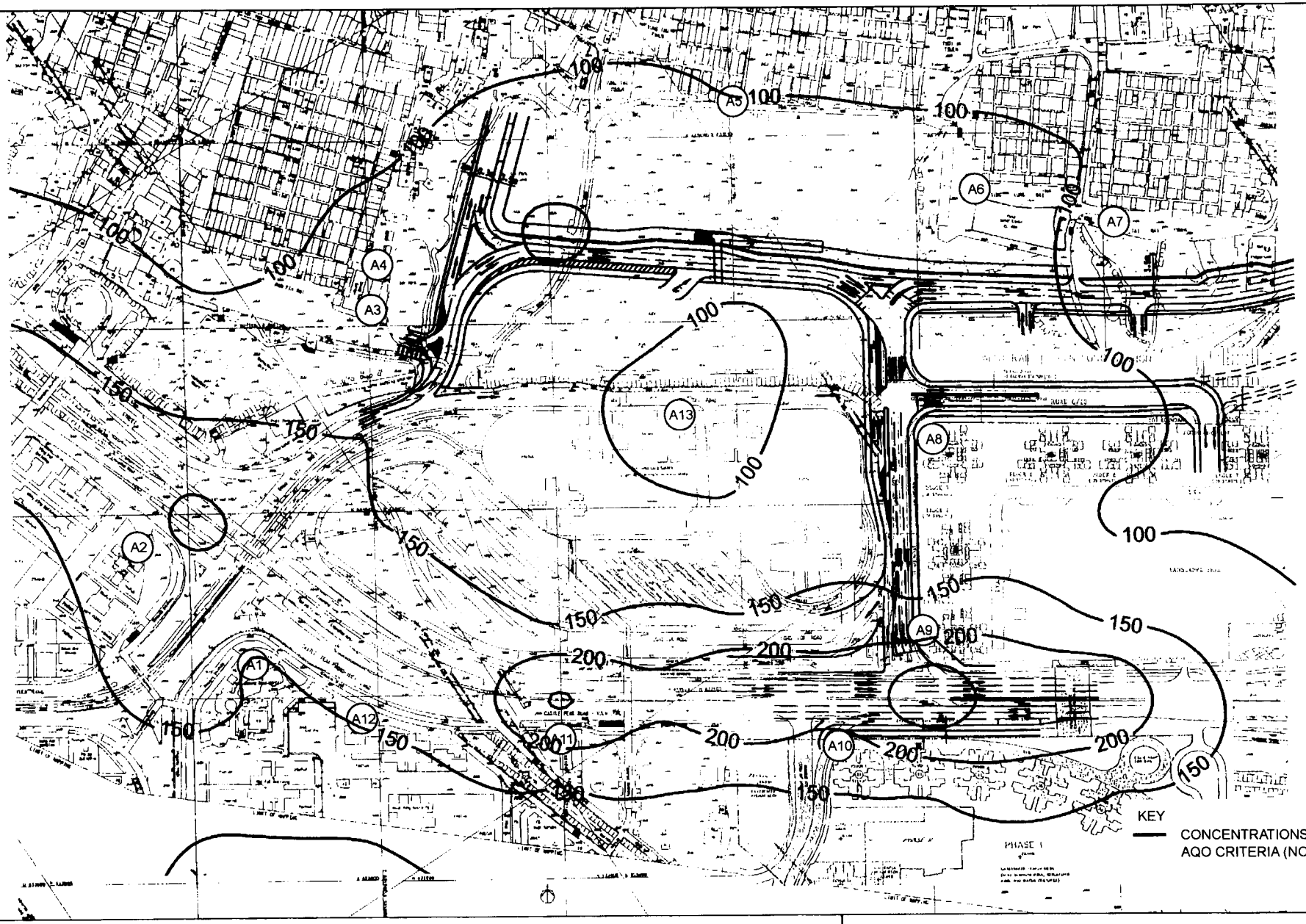
The results of the evaluation indicate that all the predicted hourly concentrations of pollutants for Tin Shui Wai EPIW are within the AQO criteria. The predicted hourly concentration of NO_2, CO and RSP at ground level are in the range of 65 - 99 μgm^{-3}, 720 - 950 μgm^{-3} and 56 - 64 μgm^{-3} respectively. While the predicted hourly concentration of NO_2, CO and RSP at a receiver height of 10 m above ground range from 62 - 88 μgm^{-3}, 720 - 835 μgm^{-3} and 56 - 61 μgm^{-3} respectively. The highest concentrations of the critical pollutant, NO_2, at the worst affected height, ground level, was predicted at A22.

The isopleth of NO_2 for the Tin Shui Wai area at ground level is shown in *Figure 6.3b*. It confirms that the AQO criteria of the area will be satisfied during the operational phase. No mitigation measures are necessary for this road scheme.

Noise barriers of 5 m and 7 m high at Ping Ha Road and 4.5 m high barrier at Tin Yiu Estate have been recommended to mitigate traffic noise. As discuss above, the presence of the barriers is likely to result in slightly increased levels of pollutants. However, at this location, the maximum NO_2 level is predicted to be 31% of AQO. Adverse air quality impacts are not therefore predicted.

Table 6.3f Tuen Mun Centre EPIW - Predicted Hourly Concentration of Pollutants (μgm^{-3})

ASRs	Predicted Hourly Concentration [(i)] (μgm^{-3})					
	At Ground Level			At 10 m Above Ground		
	NO_2	CO	RSP	NO_2	CO	RSP



ISOPLETHS OF NO2 AT THE WORST AFFECTED LEVEL (GROUND LEVEL) FOR YUEN LONG

FIGURE 6.3a

Contract/C1800r28

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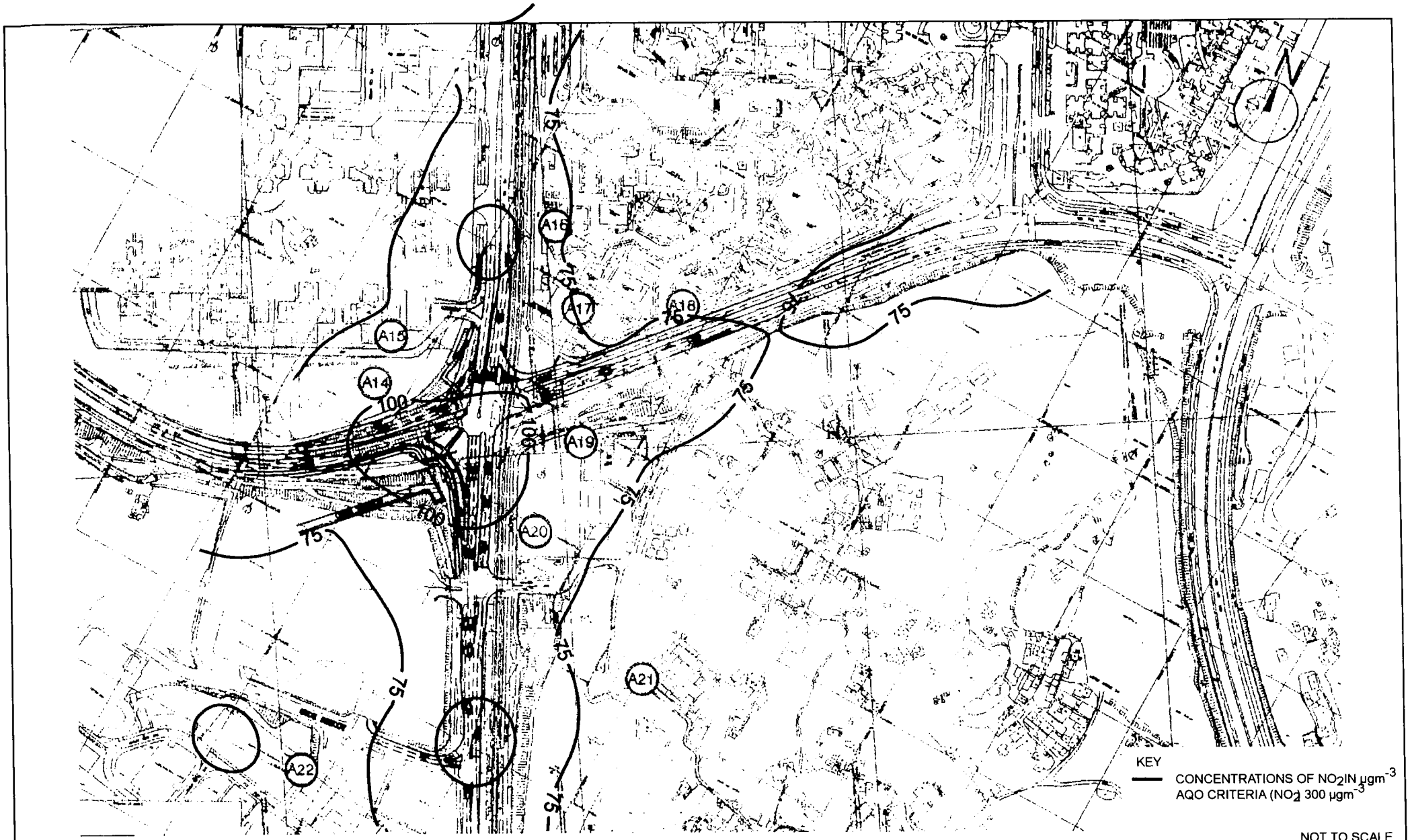
KOWLOON - CANTON RAILWAY CORPORATION

WEST RAIL: DD-901 ENVIRONMENTAL SUPPORT SERVICES



ISOPLETHS OF NO2 AT WORST AFFECTED LEVEL (GROUND LEVEL) FOR TIN SHUI WAI

FIGURE 6.3b

C1800r29

ERM

KOWLOON - CANTON RAILWAY CORPORATION

WEST RAIL: DD-901 ENVIRONMENTAL SUPPORT SERVICES

ASRs	Predicted Hourly Concentration [i](μgm^{-3})					
	At Ground Level			At 10 m Above Ground		
	NO_2	CO	RSP	NO_2	CO	RSP
A23	99	950	64	65	720	56
A24	88	835	62	62	720	56
A25	110	1065	65	62	720	56
A26	110	1065	65	62	720	56
A27	80	835	60	62	720	56
A28	84	835	60	62	720	56
A29	103	1065	64	65	720	56
A30	99	1065	64	65	720	56
A31	99	950	63	84	835	60
A32	141	1295	71	92	950	61
A33	125	1180	68	99	950	62
A34	99	950	63	84	835	60
A35	110	1065	65	84	835	59
A36	73	720	58	69	720	57
A37	69	720	57	69	720	57
A38	65	720	57	65	720	56
Criteria	300	30,000	180 [ii]	300	30,000	180 [ii]

Notes:

(i) Background included in the above prediction

(ii) Since no hourly RSP level stipulated in the AQO, daily RSP criteria is used.

The results of evaluation indicate that all the predicted hourly concentration of pollutants for Tuen Mun Centre EPIW are within the AQO criteria. The predicted hourly concentration of NO_2, CO and RSP at ground level are in the range of 65 - 141 μgm^{-3}, 720 - 1,295 μgm^{-3} and 57 - 71 μgm^{-3} respectively. While the predicted hourly concentration of NO_2, CO and RSP at receiver height of 10 m above ground range from 62 - 99 μgm^{-3}, 720 - 950 μgm^{-3} and 56 - 62 μgm^{-3} respectively. The highest concentration of the critical pollutant, NO_2 at the worst level, i.e., ground level, was predicted at A32 (Kam Wah Garden Block 1).

The isopleth of NO_2 for Tuen Mun Centre at ground level is shown in *Figure 6.3c*. It confirms that the AQO criteria of the area will be satisfied during the operational phase of the Project. No mitigation measures are required for this road scheme.

6.3.4 Residual Impacts

No mitigation measures are required for these road schemes to meet the AQO criteria, and therefore, there is no requirement to assess the residual impacts (after the implementation

of mitigation). As the operation of the EPIWs will comply with the AQO criteria, there will be no adverse air quality impacts to the local community.

6.3.5 Cumulative Effects

The cumulative effects of the operation of the proposed EPIWs and the air emissions from traffic on existing road networks, new distributor roads and the widened road networks have been assessed. However, the cumulative effects from the operation of West Rail have not been considered due to the minimal air pollutants emitted from the electric trains operating on this system.

6.4 Conclusion

6.4.1 Construction Phase

Dust nuisance would be the major air pollutants during construction phase. The major dust generating activities have been identified to be material handling, top soil removal and wind erosion. It was envisaged that the volume of material to be handled on site and the excavation rate for road construction would be low. Adverse dust impact on the nearby ASRs was not expected. However, mitigation measures have been recommended, as outlined in *Table 6.4a* below, to ensure there is no exceedance of the dust criteria, and consequently no adverse air quality impacts on the health of the local community.

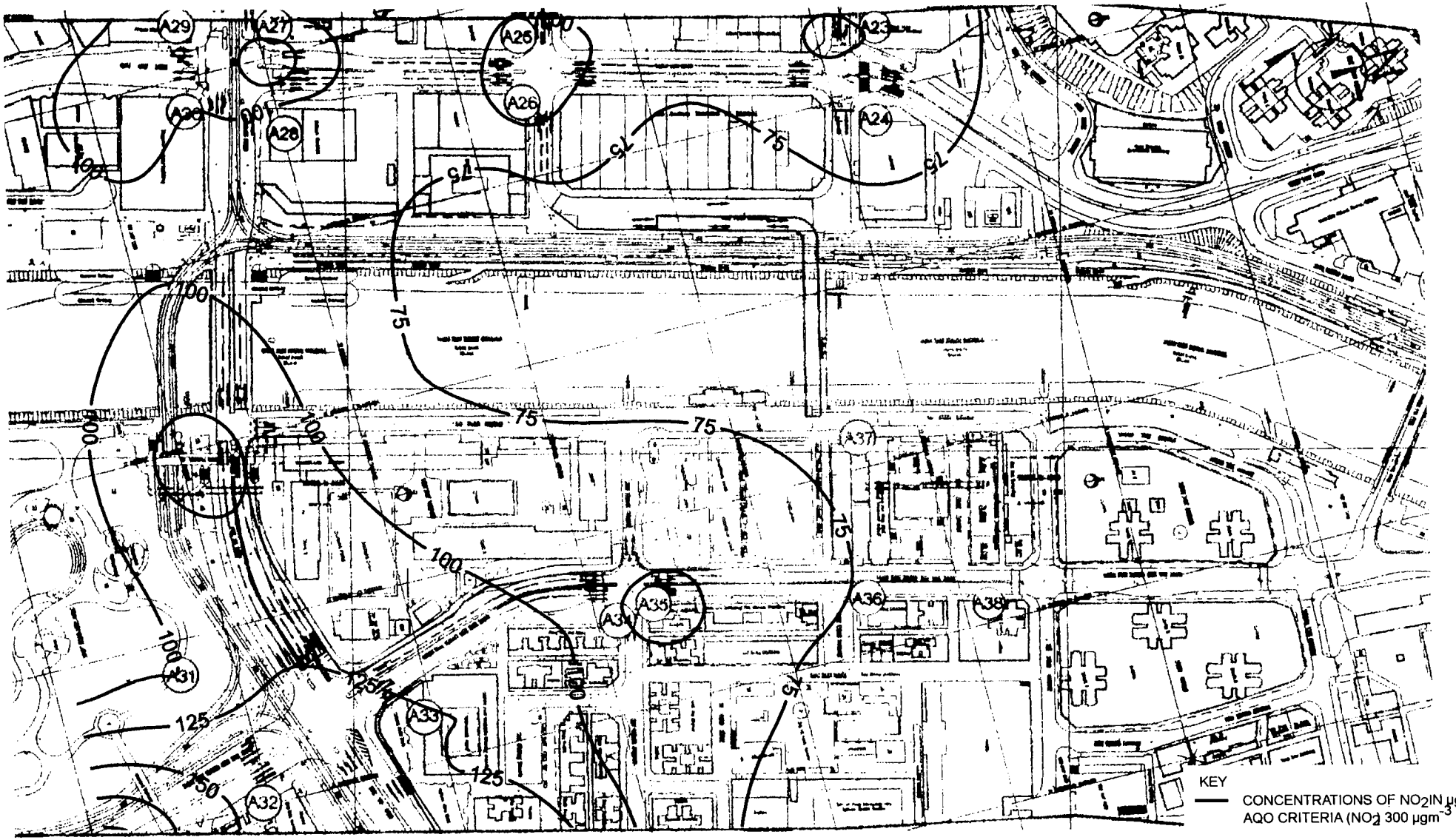
Cumulative dust impact is expected due to the same phasing of the EIPW and the station works. However, due to the small scale of EPIW and the different influence of the wind to the worst affected ASRs, no cumulative impact is expected.

6.4.2 Operational Phase

The assessment indicated that the air quality levels at the identified ASRs would be within the AQO criteria under the worst case scenario. Consequently, there should be no adverse air quality impacts on the health of the local community. No mitigation measures are necessary.

Table 6.4a - Summary of Recommended Mitigation Measures During Construction and Operation of the Project

Phase	Recommended Mitigation Measures
Construction Phase	Requirements stated in the *Air Pollution (Construction Dust) Regulation* should be followed and incorporated in the contract specification to limit the dust emission from work sites. These include: • the heights from which materials are dropped should be controlled to a minimum practical height to control fugitive dust arising from unloading; • materials should not be loaded to a level higher than the side and tail boards, and should be dampened or covered before transport; • water sprays should be applied to maintain the worksite wet; • all dusty materials should be sprayed with water prior to any loading, unloading or transfer operation so as to maintain the dusty materials wet;



NOT TO SCALE

ISOPLETHS OF NO2 AT WORST AFFECTED LEVEL (GROUND LEVEL) FOR TUEN MUN CENTRE

FIGURE 6.3c

C1800r30

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WEST RAIL: DD-901 ENVIRONMENTAL SUPPORT SERVICES

Phase	Recommended Mitigation Measures
	• the load carried by the vehicle should be covered by clean impervious sheeting to ensure that the dusty materials do not leak from the vehicle; and • the excavation working area should be sprayed with water after the operation so as to maintain the entire surface wet.
Operation Phase	None required.