3. Air Quality Impact Assessment

3.1 Introduction

This section presents the assessment of potential air quality impacts associated with the construction and operational phases of the proposed Organic Waste Treatment Facility – Phase 2 (OWTF 2). Dust generated from construction activities is the primary concern during the construction phase. During the operation phase the major sources of air pollution include, but are not limited to: emissions from burning generated biogas in a combined heat and power (CHP) plant; emissions from an odour treatment unit, which is used to treat odorous emissions, and; emissions from flaring, under equipment outages.

Representative Air Sensitive Receivers (ASRs) within 500 m of the subject site have been identified and the worst case impacts on these receivers will be assessed. Suitable mitigation measures, where necessary, have been recommended to protect the nearby sensitive receivers and to achieve the legislative criteria and guidelines.

3.2 Environmental Legislation, Standards and Guidelines

The criteria and guidelines for evaluating air quality impacts are laid out in Annexes 4 and 12 of the *Technical Memorandum on Environmental Impact Assessment Ordinance* (EIAO-TM), respectively.

The principal legislation for the management of air quality is the *Air Pollution Control Ordinance (APCO) (Cap 311)*. The APCO specifies Air Quality Objectives (AQOs) which stipulate the statutory limits of air pollutants and the maximum allowable numbers of exceedence over specific periods. The AQOs are shown in **Table 3.1**.

Table 3.1: Hong Kong Air Quality Objectives

Pollutant	Averaging Time	AQO concentration (µg/m³)	Allowable exceedences
Sulfur Dioxide (SO_2)	1 hour	800	3
	24 hour	350	1
	Annual	80	0
Total Suspended Particulates (TSP)	1 hour(1)	500	3
	24 hour	260	1
	Annual	80	0
Respirable Suspended Particulates (PM_{10})	24 hour	180	1
	Annual	55	0
Nitrogen Dioxide (NO_2)	1 hour	300	3
	24 hour	150	1
	Annual	80	0
Carbon Monoxide (CO)	1 hour	30,000	3
	8 hour	10,000	1
Ozone (O_3)	1 hour	240	3
Lead	3 month	1.5	0

Note (1) EIAO-TM, not an AQO

In January 2012, EPD announced the proposed new AQOs. With passage of the Air Pollution Control (Amendment) Ordinance 2013 by the Legislative Council on 10 July 2013, the new AQOs as listed in **Table 3.2** are due to take effect on 1 January 2014.

Table 3.2: Proposed New Hong Kong Air Quality Objectives (as announced 17 January 2012)

Pollutant	Averaging Time	AQO concentration (µg/m³)	Allowable exceedances
Sulfur Dioxide (SO_2)	10 minute	500	3
	24 hour	125	3
Respirable Suspended Particulates (PM_{10})	24 hour	100	9
	Annual	50	0
Fine Suspended Particles ($PM_{2.5}$)	24 hour	75	9
	Annual	35	0
Nitrogen Dioxide (NO_2)	1 hour	200	18
	Annual	40	0
Carbon Monoxide (CO)	1 hour	30,000	0
	8 hour	10,000	0
Ozone (O_3)	8 hour	160	9
Lead	Annual	0.5	0
Total Suspended Particulates (TSP)	1 hour(1)	500	-

Note (1) EIAO-TM, not an AQO

There is the potential for emissions that are not covered by the EPD's AQOs. These emissions may arise if the biogas generated is consumed onsite in the CHP or during emergency use of the flare. The air quality standards for various other potential pollutants are proposed by making reference to overseas standards, as detailed in **Table 3.3**.

Table 3.3: Proposed Air Quality Standards for Other Potential Emissions

Pollutant	Averaging Time	Air Quality Standards (µg/m³)	Reference
Hydrogen Chloride	1 hour	2,100	Cal/EPA Acute reference level from Office of Environmental Health Hazards Assessment, California http://www.oehha.ca.gov/air/acute_rels/allAcRELs.html
	Annual	20	Integrated Risk Information System, USEPA
Hydrogen Fluoride	1 hour	240	Cal/EPA Acute REL http://www.oehha.ca.gov/air/acute_rels/allAcRELs.html
	Annual	14	California, OEHHA (2005) http://www.oehha.ca.gov/air/chronic_rels/allAcRELs.html
Volatile Organic Compounds (Methane)	1 hour	600,000	TEEL-0 (the threshold concentration below which most people will experience no adverse health effects) from Office of Health, Safety and Security, US Department of Energy http://www.hss.energy.gov/HealthSafety/WSHP/chem_safety/teel.html

3.3 Assessment Area and Sensitive Receivers

The existing and planned representative Air Sensitive Receivers (ASRs) that could be affected by the Project within 500 m from its site boundary have been identified and are summarised in **Table 3.4**. The locations of ASRs and the boundary of 500 m study area are shown in **Figure 3.1**. It should be noted that one of the ASRs required to be assessed in the Study Brief, namely the Police Border District Headquarters, is outside the 500 m boundary from the Project site.

Table 3.4: Representative ASRs Identified for Assessment

ASR	Description	Existing/ Proposed	Type of Use	Height above ground (m)	Horizontal distance from study area boundary (m)	Construction Phase	Operation Phase
A1	Temple	Existing	Temple	1.5 5 10	163	✓	✓
A2	Village House No. 308, Sha Ling	Existing	Residential	1.5 5 10	36	✓	✓
A3	San Uk Ling Holding Centre	Existing	Office	1.5 5 10	204	✓	✓
A4	Village House No. 257, Sha Ling	Existing	Residential	1.5 5 10	214	✓	✓
A5	Village House, Sha Ling	Existing	Residential	1.5 5 10	26	✓	✓
A6	Village House, Sha Ling	Existing	Residential	1.5 5 10	17	✓	✓
A7	Village House, Sha Ling	Existing	Residential	1.5 5 10	166	✓	✓
A8	Police Dog Unit and Force Search Unit Training School	Existing	Office	1.5 5 10	374	✓	✓
A9	Hong Kong Police Force Border District Headquarters	Existing	Office	1.5 5 10	600	✓	✓
A10	Rifle range	Existing	Office	1.5 5 10	289	✓	✓
A11	House 1,Proposed Kong Nga Po Residential Development	Proposed	Residential	1.5 5 10 15	368	✗	✓
A12	House 2,Proposed Kong Nga Po	Proposed	Residential	1.5 5	330	✗	✓

ASR	Description	Existing/ Proposed	Type of Use	Height above ground (m)	Horizontal distance from study area boundary (m)	Construction Phase	Operation Phase
	Residential Development			10			
				15			
A13	House 3,Proposed Kong Nga Po Residential Development	Proposed	Residential	1.5	334	✗	✓
				5			
				10			
				15			
A14	Assumed Village House 1, Proposed Hung Lung Hang Residential	Proposed	Residential	1.5	484	✗	✓
				5			
				10			
				15			
A15	Assumed warehouse 1, Proposed Man Kam To Development Corridor	Proposed	Office	7	269	✗	✓
				9.8			
				12.6			
A16	Assumed warehouse 2, Proposed Man Kam To Development Corridor	Proposed	Office	7	189	✗	✓
				9.8			
				12.6			
A17	Assumed warehouse 3, Proposed Man Kam To Development Corridor	Proposed	Office	7	193	✗	✓
				9.8			
				12.6			
A18	Village House No. 62, Sha Ling	Existing	Residential	1.5	440	✓	✓
				5			
				10			
A19	Village House, Sha Ling	Existing	Residential	1.5	385	✓	✓
				5			
				10			

3.4 Description of the Existing Environment/ Background Air Quality

The latest 5-year-average (2007 – 2011) ambient concentrations of pollutants measured at the closest EPD monitoring station to the proposed Project site, i.e., EPD's Tai Po monitoring station, are noted for reference in **Table 3.5.**

Table 3.5: 5-year Annual Average Concentration at Tai Po Air Quality Monitoring Station (Year 2007-2011)

Pollutant	5-year Average Concentration ($\mu g/m^3$)	Current Annual AQO ($\mu g/m^3$)
Sulfur Dioxide (SO_2)	12	80
Nitrogen Dioxide (NO_2)	48	80
Total Suspended Particulates (TSP)	68	80
Respirable Suspended Particulates (PM_{10})	48	55

It can be seen that the 5-year average air pollutant levels are in compliance with the current annual AQOs. Nevertheless, with the Government's on-going and planned programmes to tackle various air pollution issues in Hong Kong, it is anticipated that the future background air quality would be improving. To predict the future background air pollutant concentration, the Pollutants in the Atmosphere and the Transport over Hong Kong (PATH) model, has been used.

The PATH model was updated in December 2012. This version is considered to be appropriate to use, as there have been no updates since the model release.

3.5 Emissions Inventory

3.5.1 Introduction

OWTF 2 is expected to receive and process up to 300 tonnes of source-separated organic waste for treatment each day. It is proposed that the OWTF 2 will produce biogas as a source of renewable energy and a compost / soil conditioner for use in landscaping, agriculture or horticulture. The biogas can be used as an energy source in its own right or be used to generate heat and electricity for OWTF 2 with surplus exported to the power grid.

The construction of the Project will involve demolition and removal of the existing above ground structures of the Sha Ling Livestock Waste Composting Plant (SLCP), and the construction of an building and supporting infrastructure and civil engineering works. The main building will house technical, administration, and control areas, an environmental education centre, and pre-treatment and processing facilities, including reception bunker, conveyors, pulpers, grit separation and storage tanks. Process structures will include hygienisation units, digesters, composting system, wastewater and air treatment plants; and facilities for biogas storage, processing, utilisation and transmission etc. It is anticipated that the proposed construction work of OWTF 2 site will be fully completed and commissioned in 2017.

3.5.2 Construction Phase

3.5.2.1 Project Emissions

During construction, the major activities that would generate construction dust emissions include the following:

- Site clearance;
- Demolition and removal of the existing above ground structures;
- Excavation activities;
- Foundation works;
- Movement of mobile plant and vehicles on haul roads;
- Storage of potentially dusty construction materials;
- Installation of process equipment and storage tanks; and,
- Construction of superstructure.

The number of working days per month and number of working hours per day of the Project are anticipated to be 26 days and 12 hours, respectively, and no construction work is anticipated to be carried out on Sundays. Therefore, these assumptions would be adopted in the model calculation.

Prediction of dust emissions has been based on emissions factors from the *Compilation of Air Pollution Emission Factors (AP-42), 5th Edition* published by the US Environmental Protection Agency (USEPA). Based on, *Section 13.2.3.3 of AP-42*, the emission factor for a typical heavy construction activity is 2.69 megagrams (Mg)/hectare/month of activities. Based on *Table 11.9-4 of AP-42*, the emission factor of wind erosion is 0.85 megagrams (Mg)/hectare/year. Areas of heavy construction are to have mitigation measures applied, namely watering, to reduce dust emissions.

Dust emissions during construction can be suppressed by regular water spraying on site. In general, water spraying twice a day could reduce dust emission from active construction area by 50%. However, for the Project, more frequent water spraying is proposed. Watering eight times per day, or once every 1.5 hours, is suggested at all active works areas in order to achieve a higher dust suppression efficiency of 87.5%. Active construction activities include construction of roads, drilling, ground excavation, cut and fill operations (i.e. earth moving), etc.

Emission factors for stockpiles are calculated according to *Section 13.2.4.3 of AP-42*, and the associated factor of wind erosion is based on *Table 11.9-4 of AP-42*. It should be noted that, the stockpiles are anticipated to be 80% covered with impervious sheeting to reduce windblown dust. The key dust emission factors are summarised in **Table 3.6**.

Full calculations of the construction dust emissions can be found in **Appendix 3.1**.

Table 3.6: Key Dust Emission Factors to be adopted in the Assessment

Activities	Value	Unit	Reference
Heavy construction activities including all above ground and open construction works, excavation and slope cutting works	2.69 2.39494E-04 2.99368E-05	Mg/hectare/month g/m²/s (unmitigated) g/m²/s (mitigated)	Section 13.2.3.3 AP-42, 5th Edition
Wind erosion from heavy construction	0.85 2.69533E-06	Mg/hectare/year g/m²/s	Table 11.9-4 AP-42, 5th Edition
Stockpiles – disturbed	5.97336E-07 1.19467E-07	g/m²/s (unmitigated) g/m²/s (mitigated)	Section 13.2.4.3 AP-42, 5th Edition $E=k*0.0016*[(U/2.2)^{1.3}/(M/2)^{1.4}]$
Stockpiles – wind erosion	0.85 2.69533E-06 5.39066E-07	Mg/hectare/year g/m²/s (unmitigated) g/m²/s (mitigated)	Table 11.9-4 AP-42, 5th Edition

3.5.2.2 Cumulative Impacts

Construction of the OWTF 2 is expected to commence in the first quarter of 2015. Based on current available information, the proposed/committed projects that may have cumulative effects during the construction phase of the Project include:

- Cement Mixer Plant (no construction details);
- Proposed Man Kam To Development Corridor (no construction details);
- Columbarium, Crematorium and related facilities at Sandy Ridge Cemetery as recommended under the “Land Use Planning for the Closed Area Feasibility Study” (construction period 2019 – 2022)
- Proposed comprehensive development on Kong Nga Po Road (no construction details);
- Proposed residential development in Hung Lung Hang (no construction details); and

- If biogas export to the gas grid is considered, construction of a 200mm diameter biogas pipeline.

Where construction programmes are known, cumulative assessment has been conducted. However, projects identified are generally in early development (recommended or feasibility) and there is currently no information regarding the construction program or emissions that the construction of these projects may produce. Sandy Ridge development has a construction timetable, however the coincurrent effects are not anticipated due to the differing construction period to OWTF 2. The projects listed are therefore not assessed in this EIA and would need to be included in studies conducted by the project proponent.

OWTF 2 will include construction of a rising main to transfer sewage flows to the existing Sha Ling pumping station, minor modification of the access road to accommodate swept path of RCVs accessing the site, and may include construction of a gas pipeline connection running from the site along the Kong Nga Po road to the existing NENT Landfill / Tai Po Synthetic Natural Gas (SNG) pipeline. Air quality impacts will be confined to the construction phase when trenching works and minor road modifications may be carried out. As the works are of short duration and subject to standard construction dust mitigation measures, any potential construction dust is expected to be mitigated to an acceptable level of impact.

3.5.3 Operation Phase

3.5.3.1 Project Emissions

During the operation phase, there would be air quality impacts on the ASRs due to:

- Emissions from odour treatment unit;
- Exhausts from CHP;
- Emissions from flaring; and,
- Existing and proposed open roads outside the OWTF 2 area but within the 500 m study area.

To estimate the emissions from the odour treatment unit, CHP and flaring of OWTF 2, reference has been made to the emissions data from the OWTF Phase I (OWTF 1) because both OWTF 1 and OWTF 2 share similar process designs as compared in **Table 3.7** and discussed below.

The comparison shows that a similar process capacity, of 200-300 t/d would be used. The same digestion method is proposed and feedstocks are both likely to mainly consist of food waste. The total capacity of the OWTF 1 and OWTF 2 digestion tanks are similar at around 13,000m^3 and 16,000m3 respectively. Although the retention time in the digesters varies, the biogas produced is expected to be similar due to the same digestion process and similar feedstocks.

The energy generation for both OWTF 1 and OWTF 2 are proposed to be Combined Heat and Power (CHP). Both are to have a gas treatment system, prior to use in the CHP, to reduce hydrogen sulfide content. Due to the similar gas produced in the digestion stage, the emissions from the CHP are expected to also be similar.

Both Phases propose an aerobic tunnel system for composting the dewatered digestate from the digestion tanks. Processing time in the composting plant of the different Phases is two to three weeks. Due to the nature of the feedstocks, the resulting compost and associated emissions from this process are expected to be similar.

As the biogas produced is expected to be of a similar nature, the emissions from flares are also expected to produce comparable concentrations of assessed contaminants.

From the comparison of OWTF 1 and OWTF 2 it can be seen that the processes and associated products and emissions would be expected to be of similar nature. Therefore it is reasonable to make reference to the emission information from OWTF 1 where it is not available for OWTF 2. Where emission data is available for both OWTF 1 and OWTF 2, the maximum of either value is adopted in order to be conservative. Details of the emission information used for this assessment are discussed in the following sections.

Table 3.7: Process comparison between OWTF 1 and OWTF 2

Process	OWTF 1	Reference[1]	OWTF 2	Reference[2]
Waste received	200 t/d	s1.4	300 t/d	s3.4.2
Digestion				
• Digestion type	Wet anaerobic digestion	s2.27	Wet anaerobic digestion	s3.1
• Digester size	Five x 2,660 m^3	s2.30	Total 16,000 m^3	s3.4.2
• Retention time	40 days	s3.18	24 days (dependent on biogas yield, waste composition, final digestion method, footprint)	s3.4.2
Energy Generation				
• Generation type	Combined Heat and Power (CHP)	s2.31	Combined Heat and Power (CHP) OR Boiler	s3.2.3
• Capacity	N/A			
• Digester gas pre-treatment to generation	Gas cleaning unit for removal of hydrogen sulfide (H_2S	s3.19	Gas cleaning unit for removal of hydrogen sulfide (H_2S)	s3.2.3
Composting				
• Process	Aerobic Tunnel composting	s3.22 s2.30	Aerobic Tunnel composting	s3.5 s3.5
• Capacity (final compost)	5,500 t/year		15,300 t/year	Table 3.1
• Retention time (composting)	about 2 weeks	s3.22	7 days	Table 3.1
• Retention time (curing)			14 days	Table 3.1
Gas Treatment				
• Energy generation exhaust treatment	Desulfurisation (absorption) - H_2S to <250 mg/m^3 - Condensate removal	s2.31	*Thermal process* - Carbon monoxide (CO), Total hydrocarbons (THC), formaldehyde and methane (CH_4) removal AND *Catalyst Treatment* - 80 – 90% H_2S reduction - 50 – 100 mg/Nm^3 Nitrogen oxides (NO_x)	s3.6.2
• Odour treatment	Scrubber and biofilter	s2.32	*Biofilter and Active Carbon*	s3.6.2

Process	OWTF 1	Reference[1]	OWTF 2	Reference[2]
unit			*Filter* - 0.25 ppm H_2S - 0.25 ppm Ammonia - 0.25 ppm Mercaptans OR *UV-C and Ozone Technology (recommended)* - 90 – 98% odour unit reduction	
Flare				
• Usage	Emergency use in the event of energy generation failure	s2.31	Emergency use in the event of energy generation failure	s3.4.2

AECOM, December 2009. *Organic Waste Treatment Facilities Phase 1 – Feasibility Study. Environmental Impact Report.* Hong Kong

2 Mott MacDonald, June 2012. *Development of Organic Waste Treatment Facilities Phase 2 – Feasibility Study Preliminary Design of OWTF.* Hong Kong

3.5.3.2 Emissions from CHP

The preliminary design incorporates a combination of thermal and catalytic treatment processes to remove pollutants from the exhaust gasses from the gas cleaning unit and CHP. Following thermal and catalytic treatment, the exhaust will be vented via the flue stack. The design emission rates for the CHP are shown in **Table 3.8**. Emissions that may need to be considered are listed as follows:

- Dust
- Carbon Monoxide (CO)
- Nitrogen Oxides (NO_x)
- Sulfur Dioxide (SO_2)
- Volatile Organic Compounds (VOCs)
- Hydrogen Chloride (HCl)
- Hydrogen Fluoride (HF)

Table 3.8: Operational Emissions comparison between OWTF 1 CHP and OWTF 2 CHP

Equipment	Parameter	Units	OWTF 1	OWTF 2	Value used for OWTF 2 assessment	Notes
Energy Generation						
	Flowrate	Nm^3	2,500	2,500	2,500	Flowrate is a maximum
	Temperature	°C	460	not available	460	
	RSP	mg/Nm^3	15	not available	15	
	CO	mg/Nm^3	650	1,100 200 300	300(1)	OWTF 2 - no gas cleaning OWTF 2 - with catalytic treatment OWTF 2 - with thermal
	NO_x	mg/Nm^3	300	500 500 100	500(1)	OWTF 2 - no gas cleaning OWTF 2 - with catalytic treatment OWTF 2 - with thermal
	SO_2	mg/Nm^3	50	15	15	

Equipment	Parameter	Units	OWTF 1	OWTF 2	Value used for OWTF 2 assessment	Notes
	VOC	mg/Nm^3	150	not available	150	
	HCl	mg/Nm^3	10	not available	10	
	HF	mg/Nm^3	1	not available	1	

(1) Worst-case of two post gas-treatment technologies

3.5.3.3 Emissions from odour treatment unit

The proposed odour treatment system for the OWTF 2 involves all stages taking place within enclosed facilities or process treatment housings which are under negative pressure. The air from the reception, preparation and pre-treatment areas, the mixing tank, and the composting plant will be ventilated using a fan and duct system. The ventilated air will be treated to remove odours and dust prior to venting through the flue stack.

The proposed odour treatment system is a two stage process involving either a biofilter, or ultraviolet light (UV-C) together with ozone treatment as the first stage, and an activated carbon filter as the second stage. It is recommended to install the UV-C and ozone treatment system with second stage active carbon filters as this has lower footprint and maintenance requirements than the option of using a biofilter. The design emission rates of the odour treatment unit are shown in **Table 3.9**.

Table 3.9: Operational Emissions comparison between OWTF 1 and OWTF 2 odour treatment units

Equipment	Parameter	Units	OWTF 1	OWTF 2	Value used for OWTF 2 assessment	Notes
Odour treatment unit						
	Flowrate	Nm^3/h	not available	195,000	195,000	Flowrate is a maximum
	Temperature	°C	35	50	35	Maximum temperature from odour treatment unit. Lower value used as this give worse thermal dispersion
	VOCs (include NMVOC)	mg/Nm^3	680	not available	680	
	RSP	mg/Nm^3	6	not available	6	
				500	50	OWTF 2 includes NH_3 and H_2S and is based on no gas cleaning
	Odour	OU/Nm^3	300	50		OWTF 2 includes NH_3 and H_2S and is based on UV-C and Ozone technology
	Dust	mg/Nm^3	not available	<10	10	

3.5.3.4 Emissions from flaring

In the event of a system outage with the CHP, the biogas would need to be flared to protect the system from over-pressure. The gas flare system will be capable of accommodating all of the gas produced at the facility, in case of an emergency. The design emission rates for the flare are shown in **Table 3.10**.

Emissions that may need to be considered are listed as follows:

- Dust
- Carbon Monoxide (CO)
- Nitrogen Oxides (NO_x)
- Sulfur Dioxide (SO_2)
- Volatile Organic Compounds (VOCs)
- Hydrogen Chloride (HCl)
- Hydrogen Fluoride (HF)

Table 3.10: Operational Emissions comparison between OWTF 1 flare and OWTF 2 flare

Equipment	Parameter	Units	OWTF 1	OWTF 2	Used in OWTF 2 assessment	Notes
Flare						
	Flowrate	Nm^3/h	not available	1,500	1,500	Flowrate is a maximum
	Temperature	°C	900	not available	900	
	RSP	mg/Nm^3	5	not available	5	
	CO	mg/Nm^3	100	not available	100	
	NO_x	mg/Nm^3	200	not available	200	
	SO_2	mg/Nm^3	50	not available	50	
	VOC	mg/Nm^3	21	not available	21	
	HCl	mg/Nm^3	10	not available	10	
	HF	mg/Nm^3	1	not available	1	

3.5.3.5 Emissions from open roads

From **Figure 3.1**, the two major roads, namely the Man Kam To Road and Kong Nga Po Road, that would contribute to road traffic emissions within 500 m of the Project site have been identified. Based on the observed traffic data in 2012 as given in the Traffic Impact Assessment (TIA), the AM and PM peak-hour traffic flows of the existing Kong Nga Po Road and Man Kam To Road, expressed in passenger car units per hour (pcu/h), are summarised in **Table 3.11**. The TIA has been submitted to Transport Department (TD) who has approved the projected traffic flows for use in the EIA[1].

Additional traffic is expected to occur south of the Kong Nga Po / Man Kam To Road intersection. The portion of Man Kam To Road that lays within the study area is to the north of this junction, and so, no additional traffic due to the OWTF 2 is expected at this portion.

During the operation phase of the OWTF 2, the TIA shows that extra traffic flows will be generated mainly at Kong Nga Po Road and the associated AM and PM peak-hour flows will be increased by 31 pcu/h and 30 pcu/h respectively. The vehicles travel approximately 590 m of Kong Nga Po Road, within the assessment area to reach the OWTF 2 site. As shown in **Table 3.11** the extra traffic flows due to operation of the OWTF 2 would be minor (less than 2.2% of the observed total peak-hour traffic flow of the two major roads).

[1] TD letter to MM ref: NR 157/161-FSSDD89 dated 25 July 2013.

Table 3.11: Traffic Flows of Man Kam To Road and Kong Nga Po Road

Major Road	AM Peak Traffic Flow (pcu/h)	PM Peak Traffic Flow (pcu/h)
Man Kam To Rd – 2012 observed traffic flow	1521 (i.e.866+655 for 2-way traffic)	1199 (i.e.679+520 for 2-way traffic)
Kong Nga Po Rd – 2012 observed traffic flow	210 (i.e. 68+142 for 2-way traffic)	209 (i.e. 65+144 for 2-way traffic)
Kong Nga Po Rd - estimated increase in traffic flow due to operation of OWTF 2	31 (i.e. 15+16 for 2-way traffic)	30 (i.e., 15+15 for two-way traffic)

The OWTF2 reference design assumes that there will be an average of 60 deliveries of source separated organic waste to the facility at Sha Ling each day in dedicated Collection Vehicles[2]. It is further assumed that OWTF 2 will be open to accept organic waste every day, 7 days a week between the hours of 7 am to 9 pm (14 hours) and that there would be a peak period for unloading in the morning and evening.

The projected maximum number of RCV arriving at OWTF during morning and evening peaks would be up to 6 vehicles per hour. Waste deliveries may comprise either conventional Refuse Collection Vehicles (RCV) or vehicles transporting purpose built containers that enclose the loose or bagged organic waste. The containment unit for organic waste during transportation (RCV or container) must be designed to prevent ingress of rainwater (reducing leachate generation) and leakage of leachate. The containment unit must be robust and made of a corrosion resistant material (stainless steel or high density / hard wearing plastic are preferred). These containment units will be sealable to ensure a water and air tight seal that prevents ingress of water or any escape of odour. Following discharge at the OWTF2 the waste transfer vehicles will pass through a cleaning process before leaving to remove potential for odour impact on the public highway.

It is anticipated that waste collection operators using OWTF2 will employ industry good practice in terms of operation and maintenance of vehicles engaged in the transport of organic waste[3]. Moreover, guidelines and good operating practices will be formulated to avoid odour nuisance arising from the operation of the facility and the transportation of organic waste. In view of this, odour emission from the waste collection vehicles during transportation of organic waste is therefore not anticipated..

3.5.4 Operation Phase – Identification of Key Air Pollutants of Concern

As presented in **Section 3.2**, under the APCO, AQOs are stipulated for seven criteria air pollutants, namely, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), total suspended particulates (TSP), respirable suspended particulates (RSP), carbon monoxide (CO), ozone and lead. Each of the seven criteria pollutants has been reviewed for relevance as major air pollution sources of the Project as follows.

Nitrogen Dioxide (NO_2)

According to the "*2011 Hong Kong Emission Inventory Report*" published by EPD in March 2013, navigation and road transport are the top two major sources of nitrogen oxides (NO_x) generated in Hong

[2] The Traffic Impact Assessment for the OWTF 2 assumes an average of 60 Refuse Collection Vehicles (RCV) each day with a conservative allowance for 10 RCV each day in line with the approach adopted for OWTF1

[3] Industry good practice includes correctly operated and maintained Refuse Collection Vehicles (RCV) with appropriately sized leachate reservoirs and with collection chamber sealed during transport phase or dedicated sealable containers used for transport between collection point and OWTF2

Kong, constituting respectively about 33% and 29% of the total NO_x emission in 2011. NO_x is transformed to NO_2 in the presence of O_3 under sunlight. As summarised in **Table 3.5**, the latest 5-year average of the annual NO_2 concentration is about 60% of the corresponding AQO. Therefore, NO_2 has been identified as a key air pollutant of the emissions from both road traffic and OWTF 2 emissions, and has been assessed against the relevant AQOs for this Project.

Respirable Suspended Particulates (RSP)

According to the latest statistics of *"2011 Hong Kong Emission Inventory Report"*, navigation and road transport are the top two major sources of RSP in Hong Kong, accounting for respectively about 37% and 19% of the total RSP emissions in 2011. As summarised in **Table 3.5**, the latest 5-year average of the annual RSP concentration in the urban area is about 87% of the corresponding AQO. Therefore, RSP has been identified as a key air pollutant of the emissions from both road traffic and OWTF 2 emissions, and has been assessed against the relevant AQOs for this Project.

Sulfur Dioxide (SO_2)

According to the latest statistics of *"2011 Hong Kong Emission Inventory Report"*, 54% of total SO_2 emission in Hong Kong is attributed to navigation while less than 1% of the total emission is due to road transport. The introduction of ultra low sulfur diesel for vehicle fleet in 2000 has also helped to reduce the SO_2 emission from road transport in Hong Kong. As summarised in **Table 3.5**, the latest 5-year average of the annual SO_2 concentration in the urban area is about 15% of the corresponding AQO. While the 5-year average SO_2 level appears to be well below the relevant AQO with a large margin, the OWTF 2 is expected to produce SO_2 emissions. Therefore, SO_2 has been identified as a key air pollutant of the emissions and has been assessed against the relevant AQOs for this Project.

Ozone

According to the *"Air Quality in Hong Kong 2011"* published by EPD[4], ozone is a major constituent of photochemical smog. It is not a pollutant directly emitted from man-made sources but formed by photochemical reactions of primary pollutants such as NO_x and volatile organic compounds (VOCs) under sunlight. As it takes several hours for these photochemical reactions to take place, ozone recorded in one place could be attributed to VOC and NOx emissions from places distant from the assessment site. Hence, ozone is a regional air pollution problem. Therefore, unlike such air pollutants as $NO_{x,}$,RSP and SO_2, ozone is not a pollutant directly attributable to emissions from nearby process or road traffic. As a result, ozone is not identified as a key air pollutant for air quality impact assessment for this Project, though it is one of the criteria pollutants under the AQO.

Carbon Monoxide (CO)

According to the latest statistics of *"2011 Hong Kong Emission Inventory Report"*, road transport and navigation are the top two major sources of CO emissions in Hong Kong, contributing respectively to about 67% and 18% of the total CO emission in 2011. However, based on the *"Air Quality in Hong Kong 2012 Preliminary Report"* published by EPD[5], the highest 1-hour CO level and the highest 8-hour CO concentration in Yuen Long are respectively 2,200 $\mu g/m^3$ and 1,945 $\mu g/m^3$, which are only 7% and 19% of the corresponding AQO respectively. While the CO levels appears to be well below the relevant AQO with

[4] http://www.epd-asg.gov.hk/english/report/files/AQR2011e_final.pdf

[5] http://www.epd-asg.gov.hk/english/report/files/AQR2012_prelim_en.pdf

a large margin, the OWTF 2 is expected to produce CO emissions. Therefore, CO has been identified as a key air pollutant of the emissions and has been assessed against the relevant AQOs for this Project.

Lead

Since leaded petrol was banned in Hong Kong on 1 April 1999, it is no longer considered as a primary source in Hong Kong. According to the *"Air Quality in Hong Kong 2011"* published by EPD, the ambient lead concentrations continued to linger at very low levels during 2011 as in previous years, and the overall 3-month averages, ranging from 0.02 µg/m^3 (in Kwun Tong and Tung Chung) to 0.104 µg/m^3 (in Yuen Long), were well below the AQO limit of 1.5 µg/m^3. Therefore, it is not considered as a key air pollutant for the operation phase air quality impact assessment.

Identified Key Air Pollutants

Based on the above review results and information on pollutants emitted from the OWTF 2 (**Section 3.5.3**) and concurrent sources, the following key air pollutants are considered relevant to the project and have been assessed:

- Dust
- Carbon Monoxide (CO)
- Nitrogen Dioxide (NO_2)
- Sulfur Dioxide (SO_2)
- Volatile Organic Compounds (VOCs)
- Hydrogen Chloride (HCl)
- Hydrogen Fluoride (HF)
- Respirable Suspended Particulates (RSP/PM_{10})
- Fine Suspended Particulates (FSP/$PM_{2.5}$)
- Odour

3.6 Assessment Methodology

3.6.1 Construction Phase

3.6.1.1 Introduction

To assess construction phase impacts through air quality modelling, use of the air quality model Fugitive Dust Model (FDM) was required. In accordance with the EPD's *Guidelines on Choice of Models and Model Parameters*, FDM was used to predict the air pollutant concentrations due to open dust source impacts, which are shown in **Figure 3.2**. Details of the emission rates from the activities are given in **Appendix 3.1.**

3.6.1.2 Model Description - FDM

FDM is a computerised air quality model specifically designed for computing the concentration and deposition impacts from fugitive dust sources. The model is generally based on the well-known Gaussian Plume formulation for computing concentrations, but the model has been specifically adapted to incorporate an improved gradient transfer deposition algorithm[6]. FDM is one of the air quality models listed as commonly used for EIA studies by EPD in *Guidelines on Choice of Models and Model Parameters.*

It should be noted that FDM and all Gaussian based dispersion models have limited ability to predict dispersion in the following situations:[7]

Causality effects

Gaussian plume models assume pollutant material is transported in a straight line instantly (like a beam of light) to receptors that may be several hours or more in transport time away from the source. The model takes no account for the fact that the wind may only be blowing at 1 m/s and will have only travelled 3.6 km in the first hour. This means that Gaussian models cannot account for causality effects, where the plume may meander across the terrain as the wind speed or direction changes.

This effect is not considered to be significant for the OWTF 2 site as the site is small.

Low wind speeds

Gaussian-plume models 'break down' during low wind speed or calm conditions due to the inverse speed dependence of the steady state plume equation. These models usually set a minimum wind speed of 0.5 m/s or 1.0 m/s and ignore or overwrite data below this limit.

Straight-line trajectories

Gaussian models will typically overestimate terrain impingement effects during stable conditions because they do not account for turning or rising wind caused by the terrain itself.

This may result in conservative results for elevated ASRs.

Spatially uniform meteorological conditions

Gaussian models assume that the atmosphere is uniform across the entire modelling domain, and that transport and dispersion conditions exist unchanged long enough for the material to reach the receptor even if this is several kilometres away. In the atmosphere, truly uniform conditions rarely occur.

Although the site is small, variation in the meteorological conditions is expected due to the local terrain. However, as a full year is modelled, most conditions are expected to be modelled and therefore the results are considered reasonable.

No memory of previous hour's emissions

In calculating each hour's ground-level concentrations, Gaussian models have no memory of the contaminants released during the previous hours. This limitation is especially important for the proper simulation of morning inversion break-up, fumigation and diurnal recycling of pollutants.

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[6] Winges, 1991. *User's Guide for the Fugitive Dust Model (FDM) (Revised) User's Instructions.* Seattle, USEPA.

[7] *Good Practice Guide for Atmospheric Dispersion Modelling.* Ministry for the Environment, New Zealand (June 2004)

3.6.1.3 Assumptions and Inputs – FDM

Hourly meteorological data for a full year as extracted from the PATH model released by EPD in December 2012 (meteorological data year 2010, grid 25, 44) has been adopted for use in FDM and is considered to be the most up to date data available, and representative of the site wind data at OWTF 2.

Prediction of dust emissions is based on emissions factors from the *Compilation of Air Pollution Emission Factors (AP-42), 5th Edition* published by the US Environmental Protection Agency (USEPA). The locations of assumed dust sources are given in **Figure 3.1**. The key dust emission factors adopted in FDM are summarised in **Table 3.6**.

With addition of the TSP background level of 67 µg/m^3, which is the 5-year average TSP levels recorded in EPD's Tai Po Air Quality Monitoring Station (see **Table 3.5**), the hourly, daily and annual TSP concentrations at the identified ASRs have been predicted and compared with the current hourly, daily and annual average TSP criteria of 500 µg/m^3, 260 µg/m^3 and 80 µg/m^3 respectively.

3.6.1.4 Methodology – FDM

Construction on the OWTF 2 site is expected to be completed over approximately 21 months (with 6 months testing and commissioning). However the FDM assessment has been completed assuming a construction period of nine months as a conservative approach. The emissions are applied for one full year to capture seasonal conditions.

For hourly and daily TSP, a tiered modelling approach may be adopted. Tier 1 assumes 100% active area for a given year is emitting TSP. This Tier 1 scenario (i.e. assuming 100% active area for the OWTF 2) is hypothetical and for screening purposes to identify which ASRs may be subject to TSP concentrations above the relevant standards. For the purpose of the Tier 1 screening, the dust mitigation measures, including frequent water spraying, as detailed in **Section 3.8.1.1**, are taken into account when estimating the dust emission rates from the construction activities. Details of the Tier 1 dust sources including their coordinates, dimensions and estimated emission rates are detailed in **Appendix 3.2**. Locations of the assumed dust sources for Tier 1 assessment are shown in **Figure 3.2**. The Tier 1 hourly and daily TSP levels at all the ASRs are then predicted for both scenarios of with the dust mitigation measures in place.

The ASRs identified with hourly or daily TSP non-compliance under Tier 1 screening, where mitigation measures are in place, are selected for the subsequent Tier 2 assessment.

For Tier 2 it is assumed that the percentage active area would be located closest to the ASR being assessed. The Tier 2 hourly or daily TSP levels at each of these ASRs are then predicted with the dust mitigation measures in place.

For the assessment of annual TSP concentrations, the active work area over the entire year would be less than that for a typical working hour or a typical working day. The annual TSP assessment is based on the percentage active area. The annual TSP levels are predicted at all the ASRs for both scenarios of with and without the dust mitigation measures in place.

3.6.2 Operation Phase

3.6.2.1 Introduction

To assess the operational air quality, a variety of models are required. In accordance with EPD's *Guidelines on Choice of Models and Model Parameters,* the following air dispersion models have been employed to predict the cumulative pollutant concentration levels at the identified ASRs:

- EMFAC-HKv2.5.1 (I and M) model has been used to determine the fleet average emission factors for NO_x and RSP, for all the planned and existing roads within the 500m assessment area.

- CALINE4 has been used to predict the air pollutant concentrations due to vehicular emissions from all open road links within the 500m assessment area, which are shown in **Figure 3.3b**.

- ISCST3 has been used to predict the air pollutant concentrations due to stack sources at the OWTF 2

3.6.2.2 Model Description – EMFAC-HKv2.5.1

EMFAC-HKv2.5.1 is an emissions inventory model that calculates emissions inventories for motor vehicles operating on roads in Hong Kong. The model is used for estimating vehicular tailpipe emissions including RSP and NO_x. The model can take into account both vehicle technologies and driving conditions. The model follows that of the California Air Resources Boards' EMFAC model but with modifications to cater for local factors, including the substantial reduction of the smoky vehicle problem in recent years.

3.6.2.3 Assumptions and Inputs – EMFAC-HK

For all the planned and existing roads within the 500 m assessment area the EMFAC-HKv2.5.1 model (I and M) has been used to determine the fleet average emission factors.

EMFAC-HKv2.5.1 is considered appropriate to be used for the impact evaluation of this Project as it is the most up-to-date version of the model available.

The Burden mode, used for calculating area-specific emission factors, has been selected in the model. Under this mode, the total emissions of pollutants such as FSP, RSP and NO_x were computed for each type of vehicle class based on temperature, relative humidity, speed corrected emission factors and vehicle activity. Hourly output was selected. The assumptions and input parameters on modelling of vehicle emission factors are presented in the following sections. The traffic data used for the assessment includes the hourly traffic flows of 16 vehicle classes at various road links.

Traffic data from the TIA for observed traffic flow in 2012 and maximum projected traffic flow generated by the OWTF 2 is provided below.

<u>Vehicle Emission Standards</u>

The emission standards, according to the latest implementation programme (as of November 2012) have been adopted in EMFAC-HKv2.5.1 model for vehicles registered in Hong Kong. In this model, the latest European Union (EU) emission standard, Euro VI, for all vehicle classes can be applied, with the exception of motorcycles which do not have applicable new EU emission standards.

Road Grouping

The road links for assessment have been grouped into two types. The road types are characterised by interrupted flow. Emission factors for the following two road types have been calculated:

- Road Type A – Kong Nga Po Road (Design speed limit: 50kph);
- Road Type B – Man Kam To Road (Design speed limit: 50kph);

Vehicle Classes

Vehicles operating on open roads have been categorised into 16 vehicle classes according to the *Guideline on Modelling Vehicle Emission – Appendix I* for EMFAC-HKv2.5.1, and is presented in **Table 3.12**.

Table 3.12: Vehicle Classification in the EMFAC-HK Model

Index	Description	Notation in EMFAC-HK Model	Fuel Type	Gross Vehicle Weight
1	Private Cars (PC)	PC	ALL	ALL
3	Taxi	taxi	ALL	ALL
4	Light Goods Vehicles (<=2.5t)	LGV3	ALL	<=2.5ton
5	Light Goods Vehicles (2.5-3.5t)	LGV4	ALL	>2.5-3.5ton
6	Light Goods Vehicles (3.5-5.5t)	LGV6	ALL	>3.5ton
7	Medium & Heavy Goods Vehicles (5.5-15t)	HGV7	ALL	>5.5ton-15ton
8	Medium & Heavy Goods Vehicles (>=15t)	HGV8	ALL	>15ton
11	Public Light Buses	PLB	ALL	ALL
12	Private Light Buses (<=3.5t)	PV4	ALL	<=3.5ton
13	Private Light Buses (>3.5t)	PV5	ALL	>3.5ton
14	Non-franchised Buses (<6.4t)	NFB6	ALL	<=6.4ton
15	Non-franchised Buses (6.4-15t)	NFB7	ALL	>6.4ton – 15ton
16	Non-franchised Buses (>15t)	NFB8	ALL	<=15ton
17	Single Deck Franchised Buses	FBSD	ALL	ALL
18	Double Deck Franchised Buses	FBDD	ALL	ALL
19	Motor Cycles	MC	ALL	ALL

Data was provided from the traffic consultants for current traffic flow based on measured traffic data in 2012. Twelve vehicle classes, namely: Motorcycle (MC); Private Car (PC); Taxi (TAXI); Light Goods Vehicle (LGV); Medium Goods Vehicle (MGV); Heavy Goods Vehicle (HGV); Container (CONT); Green Mini Bus (GMB); Public Light Bus (PLB); Light Bus (L BUS); Bus (BUS), and; Coach (NFB) as provided, were regrouped to the 16 vehicles classes as described in **Table 3.12**. Based on the vehicle population as predicted by EMFAC-HKv2.5.1 in the year 2017, the proposed vehicle composition used for splitting the 12 vehicle classes into the 16 vehicle classes as required by EMFAC-HKv2.5.1 is shown in **Table 3.13** and **Appendix 3.4**.

Table 3.13: Breakdown percentage of splitting 12 vehicle classes into EMFAC-HKv2.5.1 defined vehicle classes

EMFAC vehicle class	Fuel Type	MC	PC	TAXI	LGV	MGV	HGV	CONT	GMB	PLB	L BUS	BUS	NFB
PC	Petrol	0	0.996	0	0	0	0	0	0	0	0	0	0
	Diesel	0	0.004	0	0	0	0	0	0	0	0	0	0
	LPG	0	0.000	0	0	0	0	0	0	0	0	0	0
Taxi	Petrol	0	0	0.000	0	0	0	0	0	0	0	0	0
	Diesel	0	0	0.000	0	0	0	0	0	0	0	0	0
	LPG	0	0	1.000	0	0	0	0	0	0	0	0	0
LGV3	Petrol	0	0	0	0.002	0	0	0	0	0	0	0	0
	Diesel	0	0	0	0.014	0	0	0	0	0	0	0	0
	LPG	0	0	0	0.000	0	0	0	0	0	0	0	0
LGV4	Petrol	0	0	0	0.014	0	0	0	0	0	0	0	0
	Diesel	0	0	0	0.603	0	0	0	0	0	0	0	0
	LPG	0	0	0	0.000	0	0	0	0	0	0	0	0
LGV6	Petrol	0	0	0	0.000	0	0	0	0	0	0	0	0
	Diesel	0	0	0	0.366	0	0	0	0	0	0	0	0
	LPG	0	0	0	0.000	0	0	0	0	0	0	0	0
HGV7	Petrol	0	0	0	0	0.000	0.000	0	0	0	0	0	0
	Diesel	0	0	0	0	1.000	0.261	0	0	0	0	0	0
	LPG	0	0	0	0	0.000	0.000	0	0	0	0	0	0
HGV8	Petrol	0	0	0	0	0	0.000	0.000	0	0	0	0	0
	Diesel	0	0	0	0	0	0.739	1.000	0	0	0	0	0
	LPG	0	0	0	0	0	0.000	0.000	0	0	0	0	0
PLB	Petrol	0	0	0	0	0	0	0	0.000	0.000	0	0	0
	Diesel	0	0	0	0	0	0	0	0.217	0.217	0	0	0
	LPG	0	0	0	0	0	0	0	0.783	0.783	0	0	0
PV4	Petrol	0	0	0	0	0	0	0	0	0	0.489	0	0
	Diesel	0	0	0	0	0	0	0	0	0	0.057	0	0
	LPG	0	0	0	0	0	0	0	0	0	0.000	0	0
PV5	Petrol	0	0	0	0	0	0	0	0	0	0.002	0	0
	Diesel	0	0	0	0	0	0	0	0	0	0.207	0	0
	LPG	0	0	0	0	0	0	0	0	0	0.245	0	0
NFB6	Petrol	0	0	0	0	0	0	0	0	0	0	0	0.000
	Diesel	0	0	0	0	0	0	0	0	0	0	0	0.409
	LPG	0	0	0	0	0	0	0	0	0	0	0	0.000
NFB7	Petrol	0	0	0	0	0	0	0	0	0	0	0	0.000
	Diesel	0	0	0	0	0	0	0	0	0	0	0	0.293
	LPG	0	0	0	0	0	0	0	0	0	0	0	0.000
NFB8	Petrol	0	0	0	0	0	0	0	0	0	0	0	0.000
	Diesel	0	0	0	0	0	0	0	0	0	0	0	0.298
	LPG	0	0	0	0	0	0	0	0	0	0	0	0.000
FBSD	Petrol	0	0	0	0	0	0	0	0	0	0	0.000	0
	Diesel	0	0	0	0	0	0	0	0	0	0	0.066	0
	LPG	0	0	0	0	0	0	0	0	0	0	0.000	0
FBDD	Petrol	0	0	0	0	0	0	0	0	0	0	0.000	0
	Diesel	0	0	0	0	0	0	0	0	0	0	0.934	0

EMFAC vehicle class	Fuel Type	MC	PC	TAXI	LGV	MGV	HGV	CONT	GMB	PLB	L BUS	BUS	NFB
	LPG	0	0	0	0	0	0	0	0	0	0	0.000	0
MC	Petrol	1.000	0	0	0	0	0	0	0	0	0	0	0
	Diesel	0.000	0	0	0	0	0	0	0	0	0	0	0
	LPG	0.000	0	0	0	0	0	0	0	0	0	0	0
Total		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Exhaust / Evaporation Technology Fraction

Vehicle classes are grouped with different exhaust technology indexes and technology fractions. Each technology group represent a distinct emission control technologies. The EMFAC-HKv2.5.1 model has a set of default exhaust technology fractions which best represents the scheduled implementation of new vehicle emission standards as of November 2012. The Clean Air Plan for Hong Kong was released by Environment Bureau in March 2013, with information about the latest vehicle emission controls to be implemented, however no detailed timeframes or emission inventories are available, therefore the default exhaust technology fractions for November 2012 are considered to be applicable in this assessment.

Vehicle Population

According to the *Guideline on Modelling Vehicle Emissions,* the vehicle population forecast function in EMFAC-HKv2.5.1 used 2010 as the base year.

Natural replacement of vehicles and a set of annual growth rates and survival rates for different vehicles are assumed for 2011 to 2040. In particular, vehicles including private cars, motorcycles, and goods vehicles are assumed to grow by a varying percentage (from 0% - 2.5% annual) during the period whereas the number of franchised buses, public light buses and taxis are assumed to have no growth.

The default populations from the November 2012 population information have been adopted for the model. The vehicle age distributions for 2017, based on base year 2010, are presented in **Appendix 3.5** for reference. The use of electric vehicles (EVs), which do not have tailpipe emissions, has been promoted by the government in the recent years. By April 2012, there were more than 310 EVs in Hong Kong. The introduction of EVs will have an impact on the future vehicle fleet composition, although the effect is still unknown. Impacts will vary with policy in the future and the successful application of EVs as an alternative to the traditional vehicles. As a conservative approach, this assessment does not take into account the presence of EVs and any programme on the promotion of EVs.

Accrual Rate

Default values and compositions have been adopted with reference to the EMFAC-HKv2.5.1 Guideline.

Vehicle Kilometres Travelled (VKT)

For each vehicle class, the Vehicle Kilometres Travelled (VKT) of both AM and PM peak hours is calculated by multiplying the hourly number of vehicles with the length of the corresponding road link (in kilometres). The AM and PM peak traffic pattern for the observed data in 2012 was given by the traffic consultant.

The 2012 traffic pattern and Annual Traffic Census data was used to project the AM and PM peak flows for operation year 2017. Traffic information for Kong Nga Po Road was measured in the Annual Traffic Census in years 2004, 2005, 2009 and 2010. Based on this information an average growth of 1.8% per year was calculated. The growth factor of 1.8% was applied to the observed 2012 data to estimate the AM and PM total traffic count for 2017.

Individual growth factors were applied to the various vehicle classes based on the measured traffic population in the Annual Traffic Census for 2002 to 2011. Motorcycles and Private Vehicles were expected to grow by 2.5%pa, Taxis, Franchised Buses, Public Light Buses and Goods Vehicles were expected to grow by 0%pa and Non-franchised Buses were expected to grow by 0.4%pa. Full calculation details can be found in **Appendix 3.6**.

Additional traffic is expected to occur south of the Kong Nga Po / Man Kam To Road intersection due to the OWTF 2 project. The portion of Man Kam To Road that lies within the study area is to the north of this junction; therefore, no additional traffic due to the OWTF 2 is expected at this portion.

During operation phase of the OWTF 2, it is anticipated that extra traffic flows will be generated mainly at the Kong Nga Po Road and the associated AM and PM peak-hour flows will be increased by 31 pcu/h and 30 pcu/h respectively. The vehicles travel approximately 590 m of Kong Nga Po Road, within the assessment area to reach the OWTF 2 site. All additional traffic flows are assumed to be heavy goods vehicles (HGV). A conservative conversion factor of 2 pcu/veh has been applied to determine the additional HGV emissions generated by OWTF 2 (where 2 pcu/veh for Medium Goods Vehicles, 2.5 pcu/veh for Heavy Goods Vehicles), giving additional traffic volumes of 15 veh/hr and 16 veh/hr for AM and PM peak-hour flows respectively. Total traffic flowrates for 2017 including vehicle class are in **Appendix 3.7**. The sections of Kong Nga Po Road and Man Kam To Road within the project boundary are 1428 m and 998 m respectively.

Daily Trips

The daily trips were used to estimate the cold start emissions of the petrol and LPG vehicles only, as is prescribed by the EMFAC-HKv2.5.1 model. Therefore, trips for vehicles other than petrol or LPG type vehicles would be assumed to be zero. Trips are estimated as follows.

The number of trips in the assessment area, $\text{Trip}_{\text{within assessment area}}$, has been estimated as:

$$\text{Trip}_{\text{within assessment area}} = (\text{Trip}_{\text{within HK}}/\text{VKT}_{\text{within HK}}) \times \text{VKT}_{\text{within assessment area}}$$

$\text{Trip}_{\text{within HK}}$ is the default data of EMFAC-HKv2.5.1 model. $\text{VKT}_{\text{within HK}}$ is the VKT of local roads in Hong Kong, which is estimated based on the default VKT data of EMFAC-HKv2.5.1 model and the relevant data as published in the *Annual Traffic Census 2011* by TD. Details of the trip estimation are as shown in **Appendix 3.8**. According to the Mobile Source Group of EPD, the default VKT and trips in the model are based on EPD's estimated data for Hong Kong. $\text{VKT}_{\text{within assessment area}}$ is calculated as mentioned above. The trips for AM and PM peak for both Kong Nga Po Road and Man Kam To Road are provided in **Appendix 3.9**.

While the number of trips is dependent on vehicle population, project-specific vehicle population data is not available for the assessment area. However, project-specific VKT has been estimated based on the traffic forecast in the assessment area. Moreover, it can be argued that VKT is related to vehicle population in such a way that a higher vehicle population would generally result in a higher VKT. As a result, the number of trips in the assessment area has been estimated on the basis of the project-specific VKT and the assumption that the number of trips per VKT in the assessment area would be similar to the number of trips per VKT in Hong Kong. This approach for estimating the number of trips is a commonly used and accepted method and is based on reasonable assumptions and the best available data.

Hourly Temperature and Relative Humidity Profile

Annual and monthly hourly average ambient temperature and relative humidity obtained from the meteorological data as extracted from the 2010 HKO's King's Park meteorology station (with at least 90% valid data) have been adopted. The 24-hour variations of the annual averages of temperature and relative humidity are presented graphically in **Appendix 3.10**.

Speed Fractions

Speed fraction data was not available for the observed data from the 2012 traffic survey carried out as part of the TIA. The speed limit for both Kong Nga Po Road and Man Kam To Road is 50 km/h. The TIA shows the intersection at Kong Nga Po and Man Kam To Road is predicted to still have operating capacity in 2022. From this it is assumed that there is no congestion on the roads and therefore traffic is able to travel at the road design speed of 50 km/h.

Predicted Emission Factors by EMFAC-HKv2.5.1 model

As limited data is available for this assessment, emission rates were modelled for year 2017 only. In modelling with EMFAC-HKv2.5.1, the emissions for each vehicle class at the AM and PM peak hours are then divided by the corresponding VKT to obtain emission factors in grams/vehicle-kilometre (g/veh-km). The calculations of emission factors are shown in **Appendix 3.11**. Despite only running for a single year it is considered that the worst-case emission values are used for the calculation. This is because despite the increased traffic volume, the total emissions are expected to decrease as a result of the retirement of older and more polluting vehicles in the fleet, which would be replaced with newer vehicles with lower emissions, this pattern is commonly shown (refer to EIA 210/2013 *Table 3.8*, EIA 209/2013 *Table 5.12*, EIA 208/2013 *Table 4.28*). Therefore, the emission factors for the prediction of air quality impacts due to vehicular emissions in 2017 are considered to be conservative.

3.6.2.4 Model Description – ISCST3

In accordance with *EPD's Guidelines on Choice of Models and Model* Parameters, the Industrial Source Complex – Short Term version 3 (ISCST3) model was used to quantitatively assess the air quality impact due to the following key emission sources:

- Stack exhaust for CHP (Point source);
- Flare exhaust (Point Source);
- Exhaust from odour treatment unit (Point source).

ISCST3 is a steady state Gaussian plume model which can be used to assess pollutant concentrations from sources associated with an industrial source complex. ISCST3 and all Gaussian based dispersion models have limited ability to predict dispersion in the situations as described previously in **Section 3.6.1.2**.

3.6.2.5 Assumptions and Inputs – ISCST3

The operational sources for ISCST3 modelling (shown in **Figure 3.3a** and **3.3b**) include:

Stack exhaust for CHP

To allow for the greatest flexibility in the design and tender stage and to predict the reasonable worst case, the maximum concentrations from both OWTF 1 and OWTF 2 have been chosen. Modelled emissions are in **Table 3.8**.

Exhaust from odour treatment unit

To allow for the greatest flexibility in the design and tender stage and to predict the reasonable worst case, the maximum concentrations from both OWTF 1 and OWTF 2 have been chosen. Modelled emissions are shown in **Table 3.9**.

Flare exhausts

No emissions information for OWTF 2 was available for the flare at the time of assessment; it is therefore assumed that the emissions would be the same as those in OWTF 1. These values are considered to be reasonable as the processes and feedstocks are similar. Modelled emissions are shown in **Table** 3.10.

Background concentrations and meteorological data

PATH background concentrations of the relevant pollutants (NO_2, RSP, SO_2) for year 2020 and TSP background level of 67 µg/m^3, which is the 5-year average TSP levels recorded in EPD's Tai Po Air Quality Monitoring Station (see **Table 3.5**) have been added to the modelled values. The hourly, daily and annual pollutant concentrations at the identified ASRs have been predicted and compared with the hourly, daily and annual average AQOs.

Hourly meteorological data for a full year extracted from the most up-to-date PATH model released by EPD in December 2012 (meteorological data year 2010, grid 25, 44) has been adopted for ISCST3 as it is considered to be the most current data available and representative of the site wind data at the OWTF 2.

3.6.2.6 Other Chimney Emissions

According the information provided by EPD (**Appendix 3.14**), there is no existing/planned chimney emission (e.g., chimney for the Specified Process or chimney application under the Air Pollution Control Ordinance) within the 500 m study area of the Project site. Therefore, no other point sources would be included in the ISCST3 modelling.

3.6.2.7 Model Description - PATH

The PATH model is a numerical air quality modelling system developed specifically for use in Hong Kong. The model comprises of three models: an emission model; a prognostic meteorological model; and a Eulerian transport and chemistry model. These models are interfaced together and set up on a series of nested domains to account for influences outside of Hong Kong and are used to predict regional wide background pollution concentrations.

3.6.2.8 Assumptions and Inputs – PATH

An updated version of PATH was released by the EPD for general use in December 2012. As there is no inventory update since the release of the latest PATH, for the submission of this report, use of the 2012 PATH model in its current state is considered appropriate.

3.6.2.9 Other Assumptions

NO_x to NO_2 Conversion

The Ozone Limiting Method (OLM) as described in *EPD's Guidelines on Choice of Models and Model Parameters* has been adopted to estimate the conversion of NO_x to NO_2 from vehicular emissions and for NO_x emissions on site from burning of biogas. A conversion factor of 0.1 of NO_x to NO_2 for biogas burning has been adopted as was used in OWTF 1 assessment. The ozone concentrations are based on the future hourly background ozone concentrations for year 2020, which were extracted from grid (25, 44) of the most up to date PATH. The total NO_2 is therefore estimated as follows:

$[NO_2]_{total}$ = 0.10 x $[NO_x]_{ISC}$ + minimum of {0.90 x $[NO_x]_{ISC}$ or (46/48) x $[O_3]_{PATH}$} + 0.075 x $[NO_x]_{vehicle}$ + minimum of {0.925 x $[NO_x]_{vehicle}$ or (46/48) x $[O_3]_{PATH}$}+ $[NO_2]_{PATH}$

where

- $[NO_2]_{total}$ is the total hourly NO_2 concentration;
- $[NO_x]_{ISC}$ is the hourly NO_x concentration as predicted by ISCST3;
- $[NO_x]_{vehicle}$ the hourly NO_x concentration as predicted by Caline4;
- $[NO_2]_{PATH}$ is the hourly NO_2 concentrations as extracted from the aforementioned grid of the PATH model.

Similarly, the other total hourly concentrations are also calculated by adding together the hourly results predicted by ISCST3 and PATH concentration.

With the total hourly concentration estimated, the daily results are obtained by taking the arithmetic mean of the 24 hourly results. Similarly, the annual concentrations are calculated as the arithmetic mean of the whole year of hourly results.

RSP to FSP Conversion

The conversion of RSP to FSP has been described in *EPD's Guidelines on the Estimation of PM2.5 for Air Quality Assessment in Hong Kong.* Background FSP emissions were estimated by applying a multiplication factor of 0.75 to the background RSP from PATH. The nearfield emissions of FSP were estimated by running the EMFACv2.5.1 model for FSP. The ratio of FSP:RSP was found to be 0.92:1. This information was used as a conversion factor to calculate the FSP concentrations from vehicular emissions. Calculations are shown in **Appendix 3.11**. No information was available for the FSP:RSP ratio for the OWTF equipment, including emissions from flaring and from the CHP. A conservative assumption of 100% of RSP from flaring or the CHP unit is used for FSP emissions for these units.

Odour Conversion

In *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, Department of Environment and Conservation (NSW)* peak-to-mean ratios are used to convert mean 1-hour averages to peak 1-second averages. The value for wake-affected point sources of 2.3 (for all stability classes) has been used to predict 5-second average concentrations. It should be noted the peak-to-mean ratios are for flat terrain and may over or under predict the values at the ASRs.

3.6.2.10 Cumulative Impacts

Operation of the Project is expected to commence in 2017. Based on current available information, the proposed/committed projects that are anticipated to have cumulative effects during the operation phase of the Project include:

- Cement Plant and the proposed Man Kam To Development Corridor; and
- Columbarium, Crematorium and related facilities at Sandy Ridge Cemetery recommended in the "Land Use Planning for the Closed Area Feasibility Study"..

Projects identified are in early development (recommended or feasibility) and there is currently no information regarding the development program or emissions these projects may produce. Therefore, they are not assessed in this EIA and would need to be included in studies conducted by the project proponent.. There are no planned/existing chimneys within the study area.

3.7 Prediction and Evaluation of Environmental Impact

3.7.1 Construction Phase

The Tier 1 screening results for mitigated scenarios including the background contribution are summarised in **Table 3.14**. The full results can be found in **Appendix 3.12**. There are no ASRs that exceed the hourly TSP criterion, the daily or annual TSP AQOs for the Tier 1 mitigated scenario. Therefore it is not necessary to model the Tier 2 scenario. The contours for hourly, daily and annual unmitigated and mitigated concentrations are shown in **Figures 3.4a** to **3.4f**.

Table 3.14: Construction modelling results summary (Tier 1 mitigated scenario)

Pollutant	Averaging Period	Current Criteria (µg/m^3)	Maximum concentration range for all ASR (µg/m^3)
Total Suspended Particulate (TSP)	1 hour	500	86 to 421
	24 hour	260	70 to 128
	Annual	80	68 to 79

3.7.2 Operation Phase

The operational phase assumes digester heights of 25 m, stack height of 30 m and flare height of 20 m. The rest of the major buildings and facilities are between 11 to 19 m. The emissions modelled are for mitigated values as shown in **Table 3.8** and **Table 3.9**.

The pollutants assessed were:

- Nitrogen dioxide (NO_2);
- Respirable Suspended Particulate (RSP/PM_{10});
- Fine Suspended Particulate (FSP/$PM_{2.5}$);
- Total Suspended Particulate (TSP/Dust);
- Carbon Monoxide (CO);
- Sulfur Dioxide (SO_2);
- Odour;
- Volatile Organic Compounds (VOC);
- Hydrogen Chloride (HCl), and;
- Hydrogen Fluoride (HF).

Table 3.15 summarises the cumulative operational modelling results against the AQO as of January 2013. Full results can be found in **Appendix 3.13**. Shaded cells indicate the modelled value is above the existing AQO and the allowable exceedances, that is, the modelled value is non-compliant. The contours of the operational scenarios are shown in **Figure 3.6** to **Figure 3.41**. The modelling results show that the predicted maximum concentrations of various air pollutants at all ASRs are compliant with the current AQOs.

Table 3.15: Cumulative operation modelling results summary (Mitigated)

Pollutant	Averaging Period	Current AQO (µg/m^3)	Maximum concentration range for all ASR (µg/m^3)
Nitrogen dioxide (NO_2)	1 hour	300	155.0 to 187.3
	24 hour	150	78.4 to 92.3
	Annual	80	20.5 to 29.1
Respirable Suspended Particulate (RSP/PM_{10})	24 hour	180	121.0 to 126.9
	Annual	55	43.0 to 43.6
Total Suspended Particulate (TSP/Dust)	1 hour	500 (1)	68.0 to 206.3
	24 hour	260	68.0 to 89.0
	Annual	80	68.0 to 68.9
Carbon Monoxide (CO)	1 hour	30,000	2278.1 to 2280.4
	8 hour	10,000	1458.7 to 1461.3
Sulfur Dioxide (SO_2)	1 hour	800	65.9 to 66.7
	24 hour	350	27.1 to 27.9
	Annual	80	6.5 to 6.6
Odour	5 second	5 (2)	0.00 to 1.59
Volatile Organic Compounds (VOC)	1 hour	60000 (3)	2.5 to 9423.2
Hydrogen Chloride (HCl)	1 hour	2100 (3)	0.3 to 5.8
	Annual	20 (3)	0.001 to 0.031
Hydrogen Fluoride (HF)	1 hour	240 (3)	0.00 to 0.58
	Annual	14 (3)	0.0001 to 0.0031

1. TM-EIAO
2. Unit is OU/m^3
3. Refer to **Table 3.3**

Table 3.16 summarises the cumulative operational modelling results against the AQO as of January 2014. Full results can be found in **Appendix 3.13**. Shaded cells indicate the modelled value is above the new AQO and the allowable exceedances, that is, the modelled value is non-compliant. The modelling results show that the predicted maximum concentrations of various air pollutants at all ASRs are compliant with the new AQOs.

Table 3.16: Cumulative operation modelling results summary (Mitigated)

Pollutant	Averaging Period	New AQO (µg/m^3)	Maximum concentration range for all ASR (µg/m^3)
Nitrogen dioxide (NO_2)	1 hour	200	155.0 to 187.3
	Annual	40	20.5 to 29.1
Respirable Suspended Particulate (RSP/PM_{10})	24 hour	100	121.0 to 126.9(4)
	Annual	50	43.0 to 43.6
Fine Suspended Particulate (FSP/$PM_{2.5}$)	24 hour	75	90.7 to 96.6(4)
	Annual	35	32.3 to 32.8
Total Suspended Particulate (TSP/Dust)	1 hour	500(1)	68.0 to 206.3
Carbon Monoxide (CO)	1 hour	30,000	2278.1 to 2280.4
	8 hour	10,000	1458.7 to 1461.3
Sulfur Dioxide (SO_2)	10 minute	500	161.5 to 163.3
	24 hour	125	27.1 to 27.9
Odour	5 second	5(2)	0.00 to 1.59
Volatile Organic Compounds (VOC)	1 hour	60000(3)	2.5 to 9423.2
Hydrogen Chloride (HCl)	1 hour	2100(3)	0.3 to 5.8
	Annual	20(3)	0.001 to 0.031
Hydrogen Fluoride (HF)	1 hour	240(3)	0.00 to 0.58
	Annual	14(3)	0.0001 to 0.0031

1. TM-EIAO
2. Unit is OU/m^3
3. Refer to Table 3.3
4. Maximum predicted exceedance for all ASR is 2 per year. Maximum allowable exceedances per year is 9. Therefore, 24 hour average RSP and FSP are compliant

3.8 Mitigation of Adverse Environmental Impact

3.8.1 Construction Phase

3.8.1.1 General Dust Control Measures

To achieve compliance with the TSP criteria during the construction phase, good practices for dust control should be implemented to reduce dust impacts. The dust control measures are detailed as follows:

Dust emissions could be suppressed by regular water spraying on site. In general, water spraying twice a day could reduce dust emission from active construction area by 50%. However, for OWTF 2 more frequent water spraying is proposed. Watering eight times per day, or once every 1.5 hours, is suggested at all active works areas in order to achieve a higher dust suppression efficiency of 87.5%. The calculation for dust suppression by watering is in **Appendix 3.3**. Construction activities include construction of roads, drilling, ground excavation, cut and fill operations (i.e. earth moving), etc. In addition, all the stockpiles should be at least 80% covered with impervious sheeting to reduce windblown dust.

3.8.1.2 Best Practices for Dust Control

In addition to implementing the recommended dust control measures mentioned above, it is recommended that the relevant best practices for dust control as stipulated in the *Air Pollution Control (Construction Dust) Regulation* should also be adopted to further reduce the construction dust impacts of the Project. These best practices include:

Good Site Management

- Good site management is important to help reducing potential air quality impact down to an acceptable level. As a general guide, the Contractor should maintain a high standard of housekeeping to prevent emissions of fugitive dust. Loading, unloading, handling and storage of raw materials, wastes or by-products should be carried out in a manner so as to minimise the release of visible dust emission. Any piles of materials accumulated on or around the work areas should be cleaned up regularly. Cleaning, repair and maintenance of all plant facilities within the work areas should be carried out in a manner minimising generation of fugitive dust emissions. The material should be handled properly to prevent fugitive dust emission before cleaning.

Disturbed Parts of the Roads

- Each and every main temporary access should be paved with concrete, bituminous hardcore materials or metal plates and kept clear of dusty materials; or
- Unpaved parts of the road should be sprayed with water or a dust suppression chemical so as to keep the entire road surface wet.

Exposed Earth

- Exposed earth should be properly treated by compaction, hydroseeding, vegetation planting or seating with latex, vinyl, bitumen within six months after the last construction activity on the site or part of the site where the exposed earth lies.

Loading, Unloading or Transfer of Dusty Materials

- All dusty materials should be sprayed with water immediately prior to any loading or transfer operation so as to keep the dusty material wet.

Debris Handling

- Any debris should be covered entirely by impervious sheeting or stored in a debris collection area sheltered on the top and the three sides.
- Before debris is dumped into a chute, water should be sprayed so that it remains wet when it is dumped.

Transport of Dusty Materials

- Vehicle used for transporting dusty materials/spoil should be covered with tarpaulin or similar material. The cover should extend over the edges of the sides and tailboards.

Wheel washing

- Vehicle wheel washing facilities should be provided at each construction site exit. Immediately before leaving the construction site, every vehicle should be washed to remove any dusty materials from its body and wheels.

Use of vehicles

- The speed of the trucks within the site should be controlled to about 10km/hour in order to reduce adverse dust impacts and secure the safe movement around the site.
- Immediately before leaving the construction site, every vehicle should be washed to remove any dusty materials from its body and wheels.
- Where a vehicle leaving the construction site is carrying a load of dusty materials, the load should be covered entirely by clean impervious sheeting to ensure that the dusty materials do not leak from the vehicle.

Site hoarding

- Where a site boundary adjoins a road, street, service lane or other area accessible to the public, hoarding of not less than 2.4m high from ground level should be provided along the entire length of that portion of the site boundary except for a site entrance or exit.

3.8.2 Operation Phase

The modelling results are based on mitigated emissions from the various equipment and all ASRs have been found to be within the relevant existing AQO criteria for all assessed air quality pollutants. The mitigation measures suggested for the operation phase are to include gas cleaning equipment and stack on the CHP and odour treatment unit.

The preliminary design suggests the use of a two stage process involving either a biofilter or Ultraviolet Light (UV-C) together with ozone treatment as the first stage, and an activated carbon filter as the second stage for the odour treatment unit. It is recommended to install the UV-C and ozone treatment system with second stage active carbon filters as this has a lower footprint requirement than the biofilter option. Based on the untreated odour emission strength on 500 ou/m^3 and flowrate of 195,000 m^3/hr, a minimum odour removal efficiency of 90% is recommended to give a maximum outlet emission concentration of 50 ou/m^3. However, the actual unit installed depends on the final design by the contractor in the design phase.

For the CHP, the preliminary design incorporates a combination of thermal and catalytic treatment processes to remove pollutants from the exhaust gasses from the CHP.

Both the odour treatment unit and the CHP emissions are suggested to be directed to a flue to aid the dispersion and minimise effects on ASRs.

RCV's travelling to and from the OWTF2 site must be clean and the waste transfer compartment sealed during transport to avoid odour impacts. Deliveries will be scheduled to minimise / avoid queuing of vehicles[8]. In parallel, OWTF2 operator will not wish to accumulate waste materials at the site and will facilitate prompt processing.

Waste deliveries may comprise either conventional Refuse Collection Vehicles (RCV) or vehicles transporting purpose built containers that enclose the loose or bagged organic waste. The containment unit (RCV or container) must be designed to prevent ingress of rainwater (reducing leachate generation) and leakage of leachate. The container unit must be robust and made of a corrosion resistant material (stainless steel or high density / hard wearing plastic are preferred). These container units will be sealable to ensure a water and air tight seal that prevents ingress of water or any escape of odour. Following discharge at the OWTF2 the waste transfer vehicles will pass through a cleaning process before leaving the facility to remove potential for odour impact on the public highway. In view of this, odour emission from the waste collection vehicles during transportation of organic waste is therefore not anticipated.

3.9 Evaluation of Residual Impact

3.9.1 Construction Phase

With proper implementation of the recommended mitigation measures, no ASRs are predicted to exceed the hourly, daily or annual TSP criteria, hence there are no residual effects anticipated during the construction phase.

3.9.2 Operation Phase

The project is expected to be in compliance with the current and new AQO limits and other relevant criteria for all pollutants assessed.

Although the project is expected to be in compliance of the current and new AQO and other relevant criteria, it is still recommended to apply the mitigation measures, to minimise the potential effect on ASRs.

3.10 Environmental Monitoring and Audit

3.10.1 Construction Phase

As no ASRs are predicted to exceed the relevant criteria with implementation of the recommended mitigation measures, regular dust monitoring is not considered necessary during the construction phase of the Project. However, regular site audits are suggested to ensure the dust control measures are properly implemented. Details of the environmental monitoring and audit (EM&A) programme will be presented in the stand-alone EM&A Manual.

[8] It is not in waste collection operators commercial interests to have vehicles queuing to discharge loads at OWTF2 as this is non-productive time, Operators will arrange their schedules to minimise queue times at OWTF2.

3.10.2 Operation Phase

Should the recommended mitigation measures be implemented for the operational phase, no ASRs are predicted to exceed the relevant criteria under the current and new AQOs. Odour patrol at the project site boundary is proposed to monitor any odour impact arising from the operation of the OWTF. Regular audits are also suggested to ensure proper operation and maintenance of the recommended pollution control equipment. Details of the environmental monitoring and audit (EM&A) programme are contained in the stand-alone EM&A Manual.

3.11 Conclusion

3.11.1 Construction Phase

With the implementation of the recommended mitigation measures as well as the relevant control requirements as stipulated in the *Air Pollution Control (Construction Dust) Regulation*, it has been assessed that there would be no exceedance of the hourly, daily or annual TSP criteria at any of the ASRs.

3.11.2 Operation Phase

During the operation phase, all the assessed ASRs would be in compliance with the relevant current and new AQOs and other relevant criteria for all emissions modelled in this EIA. It is recommended that emission control equipment should be installed to reduce any potential effects on the local residents and sensitive receivers.

The recommended mitigation measures include gas cleaning equipment and stack for the CHP and odour treatment unit. This odour treatment assessment is based on the application of a UV-C and ozone treatment system with second stage active carbon filters recommended in the preliminary design. For the CHP, the preliminary design incorporates a combination of thermal and catalytic treatment processes to remove pollutants from the exhaust gasses from the CHP. Both the odour treatment unit and the CHP emissions are suggested to be directed to a flue to aid the dispersion and minimise effects on ASRs.