

APPENDIX 5A

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**Details of Construction  
and Operational Phases  
Air Emissions  
Calculations**

<b>Appendix 5A1: Unmitigated Construction Phase Dust Emission Factors</b>		
<b><u>Daytime Dust Emissions from SWC Works Areas</u></b>		
<b>1 Truck unloading</b>		
2-way truck flow (veh/day)	180	estimated
Truck volume (Mg)	10	calculated
Total material handling (Mg/day)	900	assumed
Operating hour per day	10	calculated based on AP-42 Table 11.9-4
TSP emission rate (kg/hr)	9.00E-02	
<b>2 Bulldozing</b>		
		mean value from AP-42 Table 11.9-3 for bulldozer
Moisture content (%)	7.9	mean value from AP-42 Table 11.9-3 for bulldozer
Silt content (%)	6.9	calculated based on AP-42 Table 11.9-2
TSP emission rate (kg/hr)	1.80E+00	
<b>3 Truck loading</b>		
2-way truck flow (veh/day)	180	assume 50% of construction traffic go to northern works areas
Truck volume (Mg)	10	estimated
Total material handling (Mg/day)	900	calculated
Operating hour per day	10	assumed
TSP emission rate (kg/hr)	1.62E+00	calculated based on AP-42 Table 11.9-4
<b>4 Vehicle traffic on unpaved roads</b>		
Silt content (%)	4.3	mean value from AP-42 Table 11.9-3 for haul truck
Moisture content (%)	2.4	mean value from AP-42 Table 11.9-3 for haul truck
Average weight of vehicle (Mg)	24	estimated
2-way truck flow (veh/day)	180	assume 50% of construction traffic go to northern works areas
Average one-way travel distance within site (km)	0.1	estimated
Operating hour per day	10	assumed
TSP emission rate (kg/hr)	2.45E+00	calculated based on AP-42 Section 13.2.2
<b>5 Site erosion</b>		
TSP emission rate (Mg/hectare/yr)	0.85	AP-42 Table 11.9-4
Total site area (sq.m)	48763	estimated
TSP emission rate (kg/hr)	4.73E-01	calculated
<b>Total daytime TSP emissions from SWC works areas (unmitigated)</b>		
	<b>6.43</b>	<b>kg/hr</b>
	or	3.66E-05 g/sq.m/s
<b><u>Daytime Dust Emissions from Deep Bay Link Works Area</u></b>		
<b>1 Truck unloading</b>		
2-way truck flow (veh/hr)	18	estimated
Truck volume (Mg)	10	calculated
Total material handling (Mg/hr)	90	assumed
TSP emission rate (kg/hr)	9.00E-02	calculated based on AP-42 Table 11.9-4
<b>2 Bulldozing</b>		
Moisture content (%)	7.9	mean value from AP-42 Table 11.9-3 for bulldozer
Silt content (%)	6.9	mean value from AP-42 Table 11.9-3 for bulldozer
TSP emission rate (kg/hr)	1.80E+00	calculated based on AP-42 Table 11.9-2
<b>3 Truck loading</b>		
2-way truck flow (veh/hr)	18	estimated

	Truck volume (Mg)	10	estimated
	Total material handling (Mg/hr)	90	calculated
	TSP emission rate (kg/hr)	1.62E+00	calculated based on AP-42 Table 11.9-4
	<b>4 Vehicle traffic on unpaved roads</b>		
	Silt content (%)	4.3	mean value from AP-42 Table 11.9-3 for haul truck
	Moisture content (%)	2.4	mean value from AP-42 Table 11.9-3 for haul truck
	Average weight of vehicle (Mg)	24	estimated
	2-way truck flow (veh/hr)	18	estimated
	Average one-way travel distance within site (km)	0.25	estimated
	TSP emission rate (kg/hr)	6.13E+00	calculated based on AP-42 Section 13.2.2
	<b>5 Site erosion</b>		
	TSP emission rate (Mg/hectare/yr)	0.85	AP-42 Table 11.9-4
	Total site area (sq.m)	86115	estimated
	TSP emission rate (kg/hr)	8.36E-01	calculated
	<b>Total daytime TSP emissions from Deep Bay Link works area (unmitigated)</b>	<b>10.47</b>	<b>kg/hr</b>
	or	3.38E-05	g/sq.m/s
	<b><u>Daytime Dust Emissions from Access Roads</u></b>		
	<b>1</b> Base emission factor for TSP	24	AP-42 Table 13.2-1.1, TSP
	Road surface silt loading (g/sq.m)	0.015	AP-42 Section 13.2.1.3, limited access roadways
	Average weight of vehicle (tonne)	24	estimated
	TSP emission rate (g/vehicle km travelled)	22.58	AP-42 Section 13.2.1, eqn (1)
	2-way truck flow (veh/day)	360	from traffic forecast
	Average length of access road (km)	2.47	measured
	Operating hour per day	10	assumed
	TSP emission rate (kg/hr)	2.01E+00	
	<b>Total daytime TSP emission from Access Roads</b>	<b>2.01</b>	<b>kg/hr</b>
	or	2.26E-01	g/km/s
	<b><u>Nighttime Dust Emissions</u></b>		
	<b>1 Site erosion</b>		
	TSP emission rate (Mg/hectare/yr)	0.85	AP-42 Table 11.9-4
	Total site area (sq.m)	152380	estimated
	TSP emission rate (kg/hr)	1.48E+00	
	<b>Total nighttime TSP emissions</b>	<b>1.48</b>	<b>kg/hr</b>
	or	2.70E-06	g/sq.m/s

<b>Appendix 5A2: Mitigated Construction Phase Dust Emission Factors</b>		
<b>Daytime Dust Emissions from SWC Works Areas</b>		
<b>1 Truck unloading</b>		
2-way truck flow (veh/day)	180	estimated
Truck volume (Mg)	10	calculated
Total material handling (Mg/day)	900	assumed
Operating hour per day	10	calculated based on AP-42 Table 11.9-4
Dust mitigation efficiency (%)	50	For twice daily watering with complete coverage, AP-42 4th edition S11.2.4.4
TSP emission rate (kg/hr)	4.50E-02	
<b>2 Bulldozing</b>		mean value from AP-42 Table 11.9-3 for bulldozer
Moisture content (%)	7.9	mean value from AP-42 Table 11.9-3 for bulldozer
Silt content (%)	6.9	calculated based on AP-42 Table 11.9-2
Dust mitigation efficiency (%)	50	For twice daily watering with complete coverage, AP-42 4th edition S11.2.4.4
TSP emission rate (kg/hr)	8.99E-01	
<b>3 Truck loading</b>		
2-way truck flow (veh/day)	180	assume 50% of construction traffic go to northern works areas
Truck volume (Mg)	10	estimated
Total material handling (Mg/day)	900	calculated
Operating hour per day	10	assumed
Dust mitigation efficiency (%)	50	For twice daily watering with complete coverage, AP-42 4th edition S11.2.4.4
TSP emission rate (kg/hr)	8.10E-01	calculated based on AP-42 Table 11.9-4
<b>4 Vehicle traffic on unpaved roads</b>		
Silt content (%)	4.3	mean value from AP-42 Table 11.9-3 for haul truck
Moisture content (%)	2.4	mean value from AP-42 Table 11.9-3 for haul truck
Average weight of vehicle (Mg)	24	estimated
2-way truck flow (veh/day)	180	assume 50% of construction traffic go to northern works areas
Average one-way travel distance within site (km)	0.1	estimated
Operating hour per day	10	assumed
Dust mitigation efficiency (%)	50	For twice daily watering with complete coverage, AP-42 4th edition S11.2.4.4
Dust reduction due to speed control (%)	59	Speed limit reduce to 10km/hr, reduction according to Section 13.2.2.2
TSP emission rate (kg/hr)	5.07E-01	calculated based on AP-42 Section 13.2.2
<b>5 Site erosion</b>		
TSP emission rate (Mg/hectare/yr)	0.85	AP-42 Table 11.9-4
Total site area (sq.m)	48763	estimated
Dust mitigation efficiency (%)	50	For twice daily watering with complete coverage, AP-42 4th edition S11.2.4.4
TSP emission rate (kg/hr)	2.37E-01	calculated
<b>Total daytime TSP emissions from SWC works areas (mitigated)</b>	<b>2.50</b>	<b>kg/hr</b>
	or	1.42E-05
		g/sq.m/s
<b>Daytime Dust Emissions from Deep Bay Link Works Area</b>		
<b>1 Truck unloading</b>		

	2-way truck flow (veh/hr)	18	estimated
	Truck volume (Mg)	10	calculated
	Total material handling (Mg/hr)	90	assumed
	Dust mitigation efficiency (%)	50	For twice daily watering with complete coverage, AP-42 4th edition S11.2.4.4
	TSP emission rate (kg/hr)	4.50E-02	calculated based on AP-42 Table 11.9-4
	<b>2 Bulldozing</b>		
	Moisture content (%)	7.9	mean value from AP-42 Table 11.9-3 for bulldozer
	Silt content (%)	6.9	mean value from AP-42 Table 11.9-3 for bulldozer
	Dust mitigation efficiency (%)	50	For twice daily watering with complete coverage, AP-42 4th edition S11.2.4.4
	TSP emission rate (kg/hr)	8.99E-01	calculated based on AP-42 Table 11.9-2
	<b>3 Truck loading</b>		
	2-way truck flow (veh/hr)	18	estimated
	Truck volume (Mg)	10	estimated
	Total material handling (Mg/hr)	90	calculated
	Dust mitigation efficiency (%)	50	For twice daily watering with complete coverage, AP-42 4th edition S11.2.4.4
	TSP emission rate (kg/hr)	8.10E-01	calculated based on AP-42 Table 11.9-4
	<b>4 Vehicle traffic on unpaved roads</b>		
	Silt content (%)	4.3	mean value from AP-42 Table 11.9-3 for haul truck
	Moisture content (%)	2.4	mean value from AP-42 Table 11.9-3 for haul truck
	Average weight of vehicle (Mg)	24	estimated
	2-way truck flow (veh/hr)	18	estimated
	Average one-way travel distance within site (km)	0.25	estimated
	Dust mitigation efficiency (%)	50	For twice daily watering with complete coverage, AP-42 4th edition S11.2.4.4
	Dust reduction due to speed control (%)	59	Speed limit reduce to 10km/hr, reduction according to Section 13.2.2.2
	TSP emission rate (kg/hr)	1.27E+00	calculated based on AP-42 Section 13.2.2
	<b>5 Site erosion</b>		
	TSP emission rate (Mg/hectare/yr)	0.85	AP-42 Table 11.9-4
	Total site area (sq.m)	86115	estimated
	Dust mitigation efficiency (%)	50	For twice daily watering with complete coverage, AP-42 4th edition S11.2.4.4
	TSP emission rate (kg/hr)	4.18E-01	calculated
	<b>Total daytime TSP emissions from Deep Bay Link works area (mitigated)</b>	<b>3.44</b>	<b>kg/hr</b>
	or	1.11E-05	g/sq.m/s
	<b><u>Daytime Dust Emissions from Access Roads</u></b>		
	<b>1</b> Base emission factor for TSP	24	AP-42 Table 13.2-1.1, TSP
	Road surface slit loading (g/sq.m)	0.015	AP-42 Section 13.2.1.3, limited access roadways
	Average weight of vehicle (tonne)	24	estimated
	TSP emission rate (g/vehicle km travelled)	22.58	AP-42 Section 13.2.1, eqn (1)
	2-way truck flow (veh/day)	360	from traffic forecast
	Average length of access road (km)	2.47	measured
	Operating hour per day	10	assumed
	TSP emission rate (kg/hr)	2.01E+00	
	<b>Total daytime TSP emission from Access Roads</b>	<b>2.01</b>	<b>kg/hr</b>
	or	2.26E-01	g/km/s
	<b><u>Nighttime Dust Emissions</u></b>		

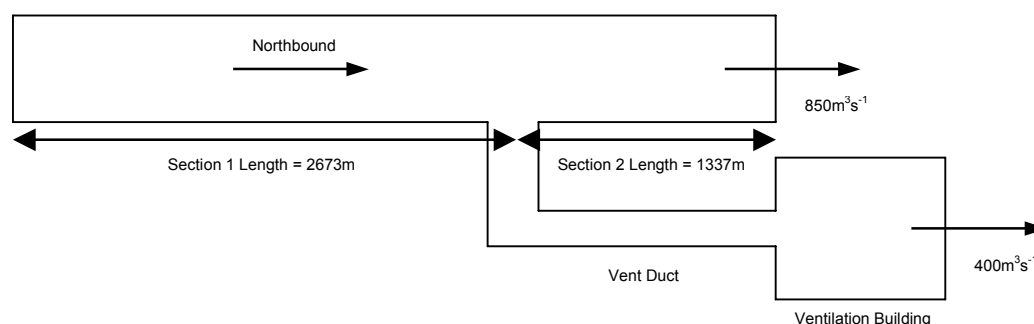
<b>1</b>	<b>Site erosion</b>		
	TSP emission rate (Mg/hectare/yr)	0.85	AP-42 Table 11.9-4
	Total site area (sq.m)	152380	estimated
	TSP emission rate (kg/hr)	1.48E+00	
	<b>Total nighttime TSP emissions</b>	<b>1.48</b>	<b>kg/hr</b>
		or	2.70E-06
			g/sq.m/s

### Appendix 5A3

### Detailed Calculation of Traffic Emissions from Route 10 Northern Portal, Ventilation Building, and Toll Plaza

#### *Tunnel Portal and Ventilation Buildings*

	NOx	RSP	CO	SO <sub>2</sub>	Reference
Total length of tunnel (m)	4010	4010	4010	4010	Route 10 EIA Final Assessment Report (Sep 2001)
Length of tunnel in section 1 (m)	2673	2673	2673	2673	Route 10 EIA Final Assessment Report (Sep 2001)
Length of tunnel in section 2 (m)	1337	1337	1337	1337	Route 10 EIA Final Assessment Report (Sep 2001)
Peak hourly traffic flow (northbound) (veh/hr)	4300	4300	4300	4300	DBL EIA Report Table 2.9
Total emissions (g/km/hr)	5977	751	11468	624	DBL EIA Report Table 2.9 to 2.13
Average emission rate (g/km/veh)	1.3900	0.1747	2.6670	0.1451	calculated
Total emission rates in section 1 (g/s)	4.4379	0.5576	8.5150	0.4633	calculated
Flowrate at vent building (m <sup>3</sup> /s)	400	400	400	400	Route 10 EIA Final Assessment Report (Sep 2001)
Flowrate at tunnel portal (m <sup>3</sup> /s)	850	850	850	850	Route 10 EIA Final Assessment Report (Sep 2001)
Emission rate through vent building (g/s)	1.4201	0.1784	2.7248	0.1483	calculated
Remaining emission rate in section 1 (g/s)	3.0178	0.3792	5.7902	0.3151	calculated
Total emission rate in section 2 (g/s)	2.2198	0.2789	4.2591	0.2317	calculated
Total emission rates through tunnel portal (g/s)	5.2376	0.6581	10.0493	0.5468	calculated
Coverision of NOx to NO <sub>2</sub> (%)	20	N/A	N/A	N/A	calculated
Emission rates of NO <sub>2</sub> through vent (g/s)	0.2840	N/A	N/A	N/A	calculated
Emission rates of NO <sub>2</sub> through portal (g/s)	1.0475	N/A	N/A	N/A	calculated



#### *Toll Plaza*

With reference to Table 2.9 of the DBL EIA Report, for the northbound Route 10 traffic, the traffic composition is 62% car + 38% GV (out of which is 44% LGV + 56% HGV as stated in Table 2.8 of the DBL EIA Report), that is

Traffic composition = 62% car + 16.72% LGV + 21.28% HGV

Taking the idling NO<sub>x</sub> emission factors of 0.2, 0.5 and 2.0 g/min/vehicle for car, LGV and HGV respectively,

Composite idling NO<sub>x</sub> emission from Route 10 northbound traffic  
= 62% x 0.2 + 16.72% x 0.5 + 21.28% x 2.0 = 0.6332 g/min/veh

Assuming the toll plaza queuing area of 30m by 50m with a capacity of about 80 vehicles,

Total NO<sub>x</sub> emission from the queuing area =  $0.6332 \times 80 / 60 = 0.8443$  g/s  
Therefore 20% of NO<sub>x</sub> emission = 0.1689 g/s or 1.13E-04 g/sq.m/s

Similarly for the Route 10 southbound traffic, the traffic composition is 46% car + 54% GV (out of which is 44% LGV + 56%HG V as stated in Table 2.8 of the DBL EIA Report), that is

Traffic composition = 46% car + 23.76% LGV + 30.24% HG V

Taking the idling NO<sub>x</sub> emission factors of 0.2, 0.5 and 2.0 g/min/vehicle for car, LGV and HG V respectively,

Composite idling NO<sub>x</sub> emission from Route 10 northbound traffic  
=  $46\% \times 0.2 + 23.76\% \times 0.5 + 30.24\% \times 2.0 = 0.8156$  g/min/veh

Assuming the toll plaza queuing area of 30m by 50m with a capacity of about 80 vehicles,

Total NO<sub>x</sub> emission from the queuing area =  $0.8156 \times 80 / 60 = 1.0875$  g/s  
Therefore 20% of NO<sub>x</sub> emission = 0.2175 g/s or 1.45E-04 g/sq.m/s

For RSP, CO, and SO<sub>2</sub>, the emission rates for the above sources are estimated based on NO<sub>x</sub> emission rates estimated above and their ratio with the NO<sub>x</sub> emissions for the Route 10 open road emissions presented in Table 2.10 to 2.13 of the DBL EIA Report.