Envirommental Statement

12 Air Quality

12 Air Quality

12.1 Introduction

This chapter provides the air quality assessment for the scheme. It includes:

- The assessment methodology, including definitions of 'significant' impact;
- An outline of the relevant legislation and policy;
- A description of baseline conditions;
- An assessment of impacts (with scheme versus without scheme);
- Recommendations for mitigation where impacts are potentially adverse and 'significant';
- The potential status of any 'residual' impacts that may remain after mitigation; and
- An assessment of uncertainty, cumulative impacts and transboundary impacts.

The issues considered have been identified in the Environmental Scoping Report (prepared by Halcrow Group Ltd) and subsequent Scoping Opinion received from the Government of Gibraltar (GoG), 2005 (see Appendix A); they are:

- The potential of emissions in to the air due to construction, causing nuisance (impacts that are local and temporary – for the duration of construction)
- The impacts of emissions from road traffic on local air quality once the scheme is in place (impacts that are local and potentially long-term once the scheme is fully open).

12.2 Assessment Methodology

12.2.1 Construction

'Nuisance dust' generally comprises inert mineral particles in the size range 1 to 75 microns.

Larger particles - generally those over 30 microns in diameter - emitted in to the air by construction operations at or very close to ground level will tend to settle close to the source.

Smaller particles may travel over greater distances before being deposited.

Experience from other large construction projects, including the Channel Tunnel Rail Link, has shown that complaints about dust are most likely within 100m of the site, during dry conditions, where there is inadequate dust suppression and there are one or more potentially sensitive receptors. For this assessment a potentially sensitive receptor has been defined as:

- One or more locations where the public may perceive the effect of emissions associated with the site as being a potential nuisance resulting in complaints and, ultimately, a Statutory Nuisance. Potentially sensitive receptors include: residential properties (including gardens), public open spaces (particularly those of conservation interest or perceived as having high amenity value); commercial/industrial premises, where activities may be disrupted as a consequence of the impact; and community facilities including schools and hospitals.

Generally, dust is only a cause of annoyance or a 'nuisance' when it forms a noticeable deposit on an exposed surface or disrupts a particular activity. Perception of dust as a problem is very subjective; the reaction of one individual can be substantially different to another, although it is likely that in a location that normally experiences low levels of deposition and soiling, perception may be greater. The likelihood of any impact having an adverse or 'significant' effect is therefore very hard to gauge with any certainty. This is reflected in the absence of legislated standards or widely accepted guidance thresholds to define a Statutory Nuisance due to dust. Relevant legislation dealing with Statutory Nuisance is given in Part II of the Public Health Ordnance 1950. Under the provisions of the Ordnance the Government of Gibraltar can identify a Statutory Nuisance and serve an Abatement Notice requiring abatement or cessation of one or more activities deemed to be causing the nuisance. In the absence of any standard, identification of a nuisance is dependant upon professional judgement of the local official as to whether or not Best Practicable Means (BPM) are being employed to control emissions. Where BPM is evident or can be clearly demonstrated then a particular activity cannot be deemed to be causing a Statutory Nuisance.

Whilst the impact of nuisance dust from construction may be measured by the increase in the rate of dust deposition or surface soiling over baseline levels (i.e. pre-construction levels), there is considerable uncertainty attached to the available methods of measurement, which are susceptible to other environmental influences. Measurements may also be confounded by other sources of dust in the local or wider area. Nuisance dust impacts during construction are likely to be temporary and episodic (most noticeable during dry windy periods) and are not likely to persist beyond the completion of construction.

For the purposes of this assessment a potentially significant adverse effect may occur where there are one or more potentially sensitive receptors within 100m of the site. In the case of construction dust it is possible to reduce the risk of a significant effect by applying appropriate mitigation and ensuring the use of BPM at all times. Means of ensuring BPM are considered further in Section 12.5.1.

Due to the long duration of the construction period, and the phased opening of the development, there will be periods where construction is in progress in some sites within the development while people are living in other parts. In the relevant years (2010 and 2015), construction traffic has been included within the "Do Something" scenario described in Section 12.2.2 below.

12.2.2 *Operation*

The impacts and effects of vehicle emissions on local air quality have been assessed using the methodology for Stage 2 local air quality assessment given in Volume 11, Section 3, Part 1 of the Design Manual for Roads and Bridges (DMRB)[1]. DMRB Volume 11 is published by the UK Highways Agency for use in assessing the environmental impacts of road schemes in England, and the air quality calculation method is widely used as a screening method for environmental assessments of schemes that will generate significant traffic increases. As a screening method, it is intended to provide pessimistic estimates of the effect of increasing traffic, in order to identify schemes where air quality will be a significant problem and detailed modelling may be required.

Estimates of pollutant levels have been derived for a base year 2005, and for future years. The future years considered are 2010, at which time construction will be fully under way but no part of the development will be occupied; 2015, when part of the development will be in use while later sites will be under construction; and 2020 which is the year after the whole development is complete. The year 2010 has been chosen since it is the year by which the EU Limit Value for Nitrogen Dioxide comes into force.

For these future years, estimates have been calculated for the "Do Something" option, i.e. the scenario in which the development is built, including the effects of construction traffic

[1] Volume 11, Section 3, Part 1 of the Department of Transport's *Design Manual for Roads and Bridges* as amended by Highways Agency advice note HA 207/07 in May 2007: www.highways.gov.uk

where relevant. The "Do Minimum" scenario has also been calculated, i.e. the situation if the development did not go ahead.

Local air pollutants associated with road traffic include carbon monoxide, benzene, 1,3-butadiene, nitrogen dioxide and PM_{10} (particulate matter of less than 10 microns diameter).

These pollutants are known from scientific research to have adverse effects on human health and are the pollutants assessed in the DMRB methodology.

Sulphur dioxide (SO_2) is a pollutant that is associated with large ships, but for which road traffic is not a significant source. Although SO_2 is mentioned in the scoping opinion as an issue to be considered, this refers to an earlier version of the development which was to include berthing facilities for cruise liners. Since this element of the development is no longer proposed, SO_2 has been omitted from the air quality assessment.

To quantify impacts of the development on levels of local air pollutants the DMRB spreadsheet model (version 1.03b, released in May 2007) has been used. The DMRB model is designed to provide relatively conservative estimates of pollutant levels adjacent to highways compared to more detailed models. Data input to the model include for each road section (or link): road type, the 2-way annual average daily traffic (AADT) flow, average speed and percentage of heavy duty vehicles (HDV = all vehicles over 3.5 tonnes). Also entered are annual average pollutant levels at a suitable background location (i.e. from a location where no one source is dominant). For the purposes of this assessment, Bleak House is taken to be reasonably representative of a background situation. This is the location of one of two automatic monitoring stations in Gibraltar; it is in the south, away from traffic.

The DMRB spreadsheet uses UK data for vehicle emissions; the data for light vehicles will differ between the UK and Gibraltar, with Gibraltar having a significantly higher proportion of motorbikes and scooters than the UK. Since emissions per vehicle kilometre are higher for cars than for motorbikes and scooters, the calculated values will be slightly higher than they would be if DMRB accounted for motorbikes separately.

For future year scenarios, traffic data and background pollutant levels are based on forecasts using appropriate adjustment factors. These factors allow for anticipated changes in the vehicle fleet, as more modern cars with modern emission-reduction technology gradually replace older, more polluting, vehicles. The factors were produced for the UK; for pollutants which are primarily emitted by road traffic they will also be appropriate for use in Gibraltar, as the same trend of modern vehicles being less polluting than older ones will apply.

Data on traffic generated by the development and routes used by construction traffic have been taken from the Transport Assessment (see Appendix H).

The assumption with regard to construction traffic, based on the latest available information, is that there would be about 260 trucks per working day, Monday to Friday, travelling in each direction to and from the airport road to the site, along Devil's Tower Road. The profile of truck movements will vary throughout the construction period but this is considered a 'worst case', suitable for this assessment. Initially these vehicles would enter the development site via the southern entrance, travelling along Catalan Bay Road. By 2015, when the seven sites forming the southern half of the development would be complete, approximately 50% of trucks would use the northern entrance, with the rest using the three more central entrances.

This assessment is based on calculations for three representative locations (receptors): one at the junction of Winston Churchill Avenue and Devil's Tower Road (Receptor 1), a second at the junction of Eastern Beach Road and Catalan Bay Road (Receptor 2) and the third at Catalan Bay village, on Sir Herbert Miles Road (Receptor 3). They are adjacent to the roads where additional traffic is predicted to arise due to the development. Receptor 2 is at a junction that will be redesigned if Eastside goes ahead; in the Do Something scenario, it is located beside the proposed roundabout.

The usual distance for estimating pollution levels is at 10 metres from the roadside but because many properties in Gibraltar lie right next to the road, in this case a kerbside location has been used. The results therefore would be slightly lower for properties away from the kerbside, and significantly lower for those at a significant distance from the kerbside.

The DMRB calculation methodology also provides a means to calculate total emissions of key pollutants across the road network. This is relevant for pollutants whose impact is on a regional or international basis, rather than primarily in the immediate vicinity of the road.

The calculation is applied to the roads for which traffic data with and without the development is available from the transport assessment (Appendix H of this Environmental Statement). This comprises Winston Churchill Avenue, the length of Devil's Tower Road / Catalan Bay Road / Sir Herbert Miles Road plus Eastern Beach Road and the main access road through the Eastside development. The pollutants assessed are total oxides of nitrogen, which is relevant to trans-boundary air pollution ("acid rain") and carbon dioxide, which is a greenhouse gas contributing to global warming. This assessment is reported in Section 12.8.

12.3 Baseline Conditions

12.3.1 *Legislation and Policy Context*

Gibraltar is an overseas territory of the UK where English law generally applies. Gibraltar as part of the European Union is bound by EU legislation regarding emissions to air and ambient air quality. The components of legislation relevant to this assessment are included in Gibraltar Government 'Ordnance' and 'Rules', which can be accessed via the website www.gibraltarlaws.gov.gi, in-particular:

- Public Health Ordnance 1950 (and subsequent amendments) - Part II covering Statutory Nuisance due to emissions to air (including dust) and the defence of Best Practicable Means; and
- Public Health (Air Quality Limit Values) Rules 2002 (and subsequent amendments) - mandatory EU Limit Values for ambient levels of Sulphur Dioxide, Nitrogen Dioxide, Oxides of Nitrogen, Ozone, PM_{10}, Lead, Benzene and Carbon Monoxide.

Table 12.1: Gibraltar ambient air quality standards

Pollutant	Limit Value	Measured as (averaging time)	To be achieved by
Carbon Monoxide (CO)	10mg/m³	Maximum Daily Running 8-hour Mean	01/01/2005
Benzene (C_6H_6)	5µg/m³	Annual Mean	01/01/2010
Lead (Pb)	0.5µg/m³	Annual Mean	01/01/2005
Sulphur Dioxide (SO_2)	350µg/m³ (not to be exceeded more than 24 times per year)	1-hour mean	01/01/2005
	125µg/m³ (not to be exceeded more than 3 times a year)	24-hour mean	01/01/2005
	* 20µg/m³	Annual Mean & Winter Mean (01/10 – 31/03)	19/07/2001
Nitrogen Dioxide (NO_2)	40µg/m³	Annual Mean	01/01/2010
	200µg/m³ (not to be exceeded more than 18 times a year)	1-hour mean	01/01/2010
Oxides of Nitrogen (NOx)	* 30µg/m³	Annual Mean (as NO_2)	19/07/2001
Ozone (O_3)	120µg/m³ (not to be exceeded more than 10 times a year or 25 times per calendar year averaged over 3 years)	Running 8-hour Mean	01/01/2010
PM_{10} particles <10microns diameter (gravimetric)	50µg/m³ (not to be exceeded more than 35 times per year)	24-hour Mean	01/01/2005
	40µg/m³	Annual Mean	01/01/2005
Notes: * Relevant to the protection of vegetation and ecosystems only (other standards relate only to human health)			

The Gibraltar Government is responsible for ensuring compliance with the Air Quality Limit Values Rules.

12.3.2 *Baseline Setting*

The proposed development site lies on the eastern side of Gibraltar protruding into the sea on reclaimed land. It extends from Eastern Beach Road in the north to the boundary of the settlement of Catalan Bay in the south (see Figure ES.2). Although the prevailing wind direction is from the East, i.e. towards the land, as shown in Figure 12.1 below at Bleak House, the wind strength is greater from the West, i.e. blowing towards the sea. The wind blows from the East (NE to SE) for about 45% of the time, the remainder of the time it blows mainly from the west SW to NNW (for about 40% of the time). The rainfall is highest in the winter months, November to March/April (see Table 12.2).

Figure 12.1: Indicative windrose

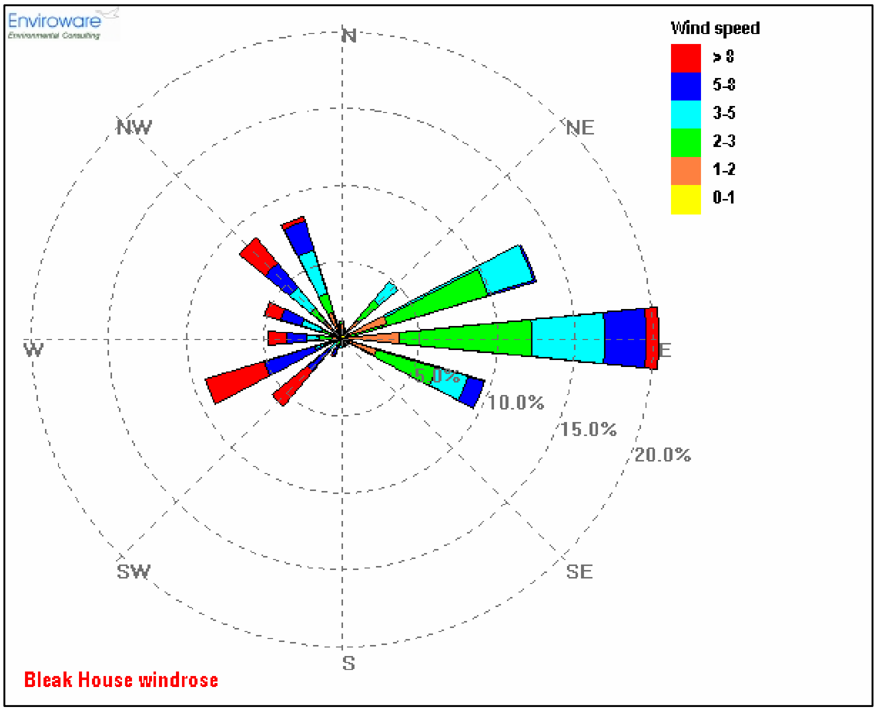

Table 12.2: Monthly rainfall (mm) from Met Office

Month	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan	136.0	61.4	17.6	71.0	55.3	27.7	482.2	212.0	75.2	70.4	111.2	107.4
Feb	tr	95.1	110.9	101.9	83.4	36.3	56.5	tr	160.4	39.8	0.0	47.6
Mar	89.8	117.9	42.0	203.6	1.6	20.6	130.3	3.7	53.6	77.1	20.4	1.2
Apr	132.3	63.6	49.3	99.6	58.3	27.5	122.9	24.1	21.6	32.6	144.6	79.0
May	10.1	3.4	3.0	57.8	22.6	9.7	80.1	38.9	27.0	10.0	43.0	21.0
Jun	2.3	3.6	146.6	1.2	2.1	26.8	5.1	5.2	4.2	tr	tr	0.8
Jul	0.2	tr	0.8	0.0	0.6	1.3	0.2	1.8	tr	1.2	0.0	tr
Aug	tr	2.5	tr	4.6	0.3	tr	0.8	1.0	tr	tr	tr	tr
Sep	4.9	55.6	15.1	21.6	18.1	8.8	25.0	30.2	30.4	26.8	8.8	39.4
Oct	76.4	195.3	141.7	158.3	49.4	0.6	58.2	70.0	0.8	147.0	85.7	72.4
Nov	54.9	66.2	11.1	142.5	62.1	96.8	160.7	230.0	2.4	42.8	90.0	55.4
Dec	292.3	145.2	112.2	6.8	3.9	357.3	651.8	181.9	64.4	35.2	287.2	306.0
TOTAL	799.2	809.8	650.3	868.9	357.7	613.4	1773.8	798.8	440	482.9	790.9	730.2

tr = trace (below measurable volume)

A number of potential receptors lie within 100 metres of the proposed work-site boundaries, most of which are not residential, or not occupied. The village of Catalan Bay is immediately to the south of the proposed development. The edge of the development will lie adjacent to the beginning of a line of pink two storey residential blocks (the 3 most northerly of the line) and a few one storey residential/commercial units (lying just north of the two storey residential blocks).

The line of two storey residential blocks continues for a further 10 blocks south alongside Sir Herbert Miles Road, all of which lie within 100 metres of the development site. In addition, to the south-east of this line of pink residential blocks lies a large 6 storey residential block adjacent to the beach at Catalan Bay.

At the southern edge of the Bay there is a large hotel overlooking the Bay and beach.

12.3.3 *Baseline Conditions*

Until 2005 there was no comprehensive long-term monitoring of ambient air quality in Gibraltar apart from at two locations where Black Smoke and Sulphur Dioxide were monitored between 2000 and 2003 (EA Ltd and DTI Garage). In 2005 the Environmental Agency established a formalised monitoring network (opened in February 2005) to enable the Gibraltar Government to discharge its duties for ensuring improvements in ambient air quality under the Public Health (Air Quality Limit Values) Rules 2002. The network was further expanded at the start of 2007. The monitoring network is currently maintained by NETCEN (part of AEA Technology); details can be found on the website: www.gibraltarairquality.gi.

The monitoring network comprises two automatic monitoring stations (AMS) measuring a number of key pollutants – one at the roadside on Rosia Road and one at a suburban location at Bleak House (see Table 12.3) – together with a number of non-automatic monitoring locations. The non-automatic sites include passive diffusion tubes for monitoring long-term levels of Nitrogen Dioxide and hydrocarbons, and gravimetric lead and PM_{10} samplers at the Rosia Road AMS. Although 2006 data are now available, 2005 figures are quoted because this is the base year used in the assessment.

Table 12.3 summarises 2005 ambient levels at AMS locations (including gravimetric PM_{10} monitoring data). Table 12.4 gives 2005 ambient levels of Nitrogen Dioxide as sampled at kerb- and road- side.

Table 12.3: 2005 Monitoring data for local air pollutants at AMS stations

Pollutant/Statistic	Rosia Road (roadside)	Bleak House (suburban) *	Unit/Statistic
Nitrogen Dioxide			
% capture	82%	84%	
Maximum 1-hour mean	206.00	155.00	µg/m³
Annual mean	41.73	23.09	µg/m³
Number >200µg/m³ (1-hour mean)	1.00	0.00	99.79th percentile
Oxides of Nitrogen			
% capture	82%	84%	
Maximum 1-hour mean	791.00	281.00	µg/m³ as NO_2
Annual mean	85.84	33.11	µg/m³ as NO_2
1,3-Butadiene (C_4H_6)			
% capture	79%	N/A	
Maximum 1-hour mean	4.84	N/A	µg/m³
Annual mean	0.29	N/A	µg/m³
Benzene			
% capture	88%	N/A	
Maximum 1-hour mean	66.33	N/A	µg/m³
Annual mean	2.30	N/A	µg/m³
Lead	No data	N/A	
Carbon Monoxide			
% capture	89%	N/A	
Maximum 1-hour mean	6.60	N/A	mg/m³
Annual mean	0.55	N/A	mg/m³
Sulphur Dioxide			
% capture	83%	N/A	
Maximum 15-minute mean	255	N/A	µg/m³
Maximum 1-hour mean	213	N/A	µg/m³
Maximum 24-hour mean	55	N/A	µg/m³
Annual mean		N/A	µg/m³
Number >266µg/m³ (15-minute mean)	0	N/A	99.90th percentile
Number >350µg/m³ (1-hour mean)	0	N/A	99.73th percentile
Number >125µg/m³ (24-hour mean)	0	N/A	99.18th percentile
PM_{10} (gravimetric)			
% capture	68%	N/A	
Maximum 1-hour mean	82	N/A	µg/m³
Annual mean	36.36	N/A	µg/m³
Number >50µg/m³ (24-hour mean)	13	N/A	90.41th and 90.08th percentiles

Notes
* (Bleak House AMS also measures ozone (which cannot be assessed using the DMRB methodology)

Table 12.4: 2005 Results for Nitrogen Dioxide diffusion tubes (µg/m³)

Start and End Date	South Barracks Road (K)	George Don House (K)	Prince Edwards Road (K)	Jum-per's (K)	Devil's Tower Road (K)	Glacis Road (K)	Red Sands Road (K)	Lime Kiln Road (K)	Rosia Road (R)	Water Gardens (R)	Queens-way (R)	Main Street (S)	Bleak House (S)	Harb-our Views (S)
02/02 - 02/03	55.4	38.5	40.5	66.4	50.2	51.1	49.0	41.7	43.2	41.3	34.3	31.4	28.8	32.7
02/03 - 29/03	55.8	36.3	38.7	64.9	42.9	45.9	50.7	40.2	38.8	40.6	33.8	31.5	26.8	31.6
29/03 - 26/04	61.1	48.5	40.7	58.8	52.4	55.7	39.0	40.0	37.6	50.1	34.0	35.9	26.4	39.2
26/04 - 24/05	56.0	43.1	35.2	56.5	49.6	55.2	41.2	39.3	41.2	48.9	37.9	33.6	29.4	36.6
24/05 - 20/06	65.8	21.7	34.6	68.1	37.6	32.4	42.6	35.9	36.6	26.6	24.7	22.9	18.1	23.4
21/06 - 18/07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19/07 - 15/08	59.2	40.4	40.4	63.7	44.9	48.5	42.9	40.5	37.2	42.8	36.1	-	25.7	35.7
16/08 - 12/09	56.5	42.8	47.0	67.0	50.5	59.6	44.3	46.1	43.3	53.0	43.7	42.5	33.2	40.0
13/09 - 10/10	77.6	30.0	42.3	84.6	46.5	46.6	52.4	43.0	42.1	38.0	32.7	32.0	21.8	31.1
11/10 - 07/11	56.5	38.9	39.8	57.6	46.8	51.2	40.0	36.1	46.1	47.1	40.5	40.2	31.0	33.5
08/11 - 05/12	53.5	45.0	51.7	60.2	56.6	64.9	47.8	44.8	51.2	48.2	42.1	41.8	35.4	38.3
06/12 - 02/01	55.7	33.9	37.1	58.4	39.5	46.1	50.7	34.4	40.1	39.6	32.2	31.6	28.3	28.4
Period mean	59.37	38.10	40.73	64.20	47.05	50.65	45.51	40.18	41.58	43.29	35.64	31.22	27.72	33.68

Notes:
K = within 1m of kerb
R = roadside 1 to 15m of kerb (usually 5m)
S = suburban location in residential area on outskirts of town

The data in Tables 12.3 and 12.4 suggest that in 2005 kerb- and road- side annual mean levels of Nitrogen Dioxide exceeded the Limit Value (40µg/m^3, Table 12.1) in most of the monitoring locations; only levels at suburban monitoring locations were below the Limit Value. Ambient levels of other local air pollutants that relate to public health appear to have been in compliance in all locations. Annual mean levels of Oxides of Nitrogen are indicated to be in excess of the Limit Value for the protection of vegetation and ecosystems (30µg/m^3, Table 12.1).

The Environmental Agency has compiled an inventory of annual emissions in to the air from the territory of Gibraltar (Box 12.1). The monitored ambient pollutant levels that are indicated in Tables 12.3 and 12.4 result from local emissions in combination/reaction with pollutants that are derived elsewhere and brought into the territory by atmospheric processes (i.e. trans-boundary pollution).

Box 12.1

Gibraltar Emission Estimates.

		NO_x	NMVOC	Carbon	CH4	N2O	HFC	PFC	SF6
		tonnes	tonnes	tonnes	tonnes	tonnes		tonnes C equiv.	
1	**Public Power Generation**	472	5	30720	2	1	0	0	0
2	**Inst, Comm.&Res. Combustion**	0	0	0	0	0	0	0	0
3	**Industrial Combustion**	93	1	22630					
4	**Production Processes**	0	0	0	0	0	0	0	0
5	**Extrac/Distrib. Fossil Fuel**	0	143	0	0	0	0	0	0
6	**Solvent and F-Gas Use**	0	372	0	0	0	0.8	0	0.05
7	**Road Transport**	208	415	8072	20	24	0	0	0
8	**Other Mobile Sources**								
	Shipping	55	6	762	1	1	0	0	0
	Aircraft	37	20	5999	2	1	0	0	0
	Other Off-Road	69	9	1183	0	2	0	0	0
9	**Waste Treatment and Disposal**	53	16	26					
10	**Agriculture**	0	0	0	0	0	0	0	0
11	**Nature**	0	0	0	0	0	0	0	0
	TOTAL	**987**	**987**	**69393**	**25**	**29**	**0.8**	**0**	**0.05**

The main source of local air pollutants including hydrocarbons, Oxides of Nitrogen (2nd to public power generation) and Nitrogen Dioxide is road traffic (Box 12.1); whilst not shown, road traffic will also be a substantial local source of PM_{10} (in exhaust emissions and from break and tyre wear, and road dust). The main sources of Sulphur Dioxide are likely to be industrial combustion, power generation and shipping; road traffic is not a substantial emitter of Sulphur Dioxide.

The main emitter of Greenhouse Gases (indicated in Box 12.1 as Carbon) is public power generation. Road and shipping sources currently rank as 3rd and 6th largest respectively out of the 14 categories/sub-categories.

12.4 *Predicted Impacts*

12.4.1 *Construction Phase*

Using the criteria set out in Section 12.2, the sensitive receptors that lie within 100 metres of the construction site are a number of buildings within Catalan Bay village.

The likelihood of dust nuisance is slight due to the distance (over 100 metres) of the majority of sensitive receptors from the site. In addition, there is relatively little wind from the north which would blow dust from the development towards the village.

The number of sensitive receptors that might be affected is of the order of 20 buildings. However, the close proximity of these buildings, some of them only the width of the road away from the southern edge of the development, means that there is some risk of dust affecting these properties during part of the construction period, if dust control measures are not in place.

In addition, due to the phased nature of the development, buildings constructed early in the programme will also potentially be exposed to construction dust from continuing construction activity on the remainder of the site.

The contribution of emissions from construction vehicles to effects on local air quality is shown in Tables 12.5 to 12.7 in Section 12.4.2. Increased emissions of oxides of nitrogen and particulates would be generated, but without causing any exceedence of standards for human health.

12.4.2 *Operation Phase*

The results of the calculation of traffic-related pollutant levels, using the DMRB methodology, demonstrate that with the scheme there would be no exceedances of the Limit Values for human health for Carbon Monoxide, Benzene, Nitrogen Dioxide and PM_{10} in the years that they are to be achieved by, or subsequently. Annual mean levels of Oxides of Nitrogen are predicted to exceed the Limit Value but this standard is for protection of vegetation and ecosystems (30µg/m^3). The results are in all cases lower in 2010, 2015 and 2020 than in the Base Year of 2005. This is due to the general trend that pollution levels decline over time as technology improves as emissions from vehicles are reduced. It should be noted that the 2005 Base Year results also all lie below the standards for human health.

The first two receptors are indicative of kerbside pollutant concentrations at the two junctions, to give an indication of the changes to be expected in concentrations. They do not represent actual sensitive receptors, there being no residential properties in these locations.

The third receptor is at a kerbside location on Sir Herbert Miles Road, and is indicative of kerbside locations in Catalan Bay village.

Tables 12.5 to 12.7 give the results for the three receptors compared to the air quality standards for Gibraltar. Receptor 1 is at the junction of Winston Churchill Avenue and Devil's Tower Road, Receptor 2 is at the junction of Eastern Beach Road and Catalan Bay Road and Receptor 3 is at Catalan Bay village, on Sir Herbert Miles Road.

In Tables 12.5 to 12.7 overleaf, "DM" refers to the Do Minimum scenario, which is the situation if the development did not go ahead. "DS" refers to the "Do Something" scenario, in which the effects of traffic generated by the development have been included, plus construction traffic in 2010 and 2015.

Table 12.5: Receptor 1 at kerbside – junction of Winston Churchill Avenue/Devil's Tower Road

	CO	Benzene	1,3-butadiene	NO_x	NO_2	PM_{10}	
	Annual mean mg/m³	Annual Mean μg/m³	Annual mean μg/m³	Annual mean μg/m³	Annual mean μg/m³	Annual mean μg/m³	Days >50μg/m³
2005 Base	0.54	1.52	0.44	83.23	34.49	29.20	24.7
2010 DM	0.34	1.14	0.26	63.98	29.46	26.61	16.6
2010 DS	0.34	1.14	0.31	76.40	31.91	27.69	19.7
2015 DM	0.28	1.04	0.22	47.43	24.95	23.87	9.9
2015 DS	0.36	1.13	0.31	61.91	28.13	25.48	13.6
2020 DM	0.28	1.05	0.22	41.63	23.43	23.39	8.9
2020 DS	0.38	1.21	0.30	47.98	24.93	24.67	11.6
Standard	10	5	N/A	30	40	40	35

Table 12.6: Receptor 2 at kerbside - junction of Eastern Beach Road/Catalan Bay Road

	CO	Benzene	1,3-butadiene	NO_x	NO_2	PM_{10}	
	Annual mean mg/m³	Annual Mean μg/m³	Annual mean μg/m³	Annual mean μg/m³	Annual mean μg/m³	Annual mean μg/m³	Days >50μg/m³
2005 Base	0.34	1.31	0.20	40.57	25.15	23.56	9.2
2010 DM	0.22	1.02	0.13	33.06	22.12	23.05	8.2
2010 DS	0.22	1.02	0.14	38.14	23.49	23.43	8.9
2015 DM	0.18	0.93	0.11	27.02	19.68	21.71	5.8
2015 DS	0.23	0.99	0.15	36.37	22.28	22.70	7.5
2020 DM	0.18	0.94	0.11	24.98	18.98	21.62	5.7
2020 DS	0.27	1.05	0.16	34.52	21.68	22.95	8.0
Standard	10	5	N/A	30	40	40	35

Table 12.7: Receptor 3 at kerbside - Sir Herbert Miles Road

	CO	Benzene	1,3-butadiene	NO_x	NO_2	PM_{10}	
	Annual mean mg/m³	Annual Mean µg/m³	Annual mean µg/m³	Annual mean µg/m³	Annual mean µg/m³	Annual mean µg/m³	Days >50µg/m³
2005 Base	0.32	1.29	0.18	36.62	24.09	23.10	8.3
2010 DM	0.21	1.01	0.12	30.40	21.37	22.76	7.6
2010 DS	0.22	1.01	0.13	36.16	22.97	23.20	8.5
2015 DM	0.17	0.92	0.10	25.16	19.12	21.52	5.5
2015 DS	0.21	0.96	0.12	29.04	20.27	22.06	6.4
2020 DM	0.17	0.93	0.10	23.40	18.50	21.46	5.4
2020 DS	0.20	0.97	0.12	26.76	19.51	21.93	6.2
Standard	10	5	N/A	30	40	40	35

Table 12.8: Measured Ambient Levels (AMS) in 2005

	CO	Benzene	1,3-butadiene	NO_x	NO_2	PM_{10}	
	Annual mean mg/m³	Annual Mean µg/m³	Annual mean µg/m³	Annual mean µg/m³	Annual mean µg/m³	Annual mean µg/m³	Days >50µg/m³
Rosia Road	0.55	2.3	0.29	85.84	41.73 (41.58)	36.36	13
Bleak House	N/A	N/A	N/A	33.11	23.09 (27.72)	N/A	N/A
Figures in brackets ( ) = NO_2 diffusion tubes							

The calculations show pollutant levels are predicted to be slightly higher with the development than without, due to the higher traffic flows, but show an overall reduction in all pollutants over time due to the effects of improvements in vehicle emissions. The pollutant levels for future years including the effects of the development are lower than the 2005 levels, because of this.

When the calculated levels are compared with the monitored data for Rosia Road (roadside location) and Bleak House (suburban location) in Table 12.8, the results are comparable although the monitored levels are slightly higher for Nitrogen Dioxide but given the uncertainty of the data (as discussed below) this is not unexpected. PM_{10} levels are relatively high at Rosia Road but still below the Limit Values; the calculations show these levels to decline over time, including the with scheme scenario, therefore no breaches of the objectives are anticipated.

The calculated nitrogen dioxide levels are lower than the results from the roadside diffusion tubes. The most likely explanation for this is that the monitored levels are influenced by other pollutant sources in addition to the roads which featured in the calculation, which did not affect the background levels measured at Bleak House. Possible sources include the airport and industrial sites along Devil's Tower Road.

12.5 Mitigation Measures

12.5.1 *Construction Phase*

As indicated in Section 12.2, emissions of nuisance dust can be mitigated. By ensuring that the use of BPM can be demonstrated at all times, the risk of causing a Statutory Nuisance can be minimised.

Typical measures to minimise dust emissions would include the following:

- Use of water to dampen down site roads during dry weather (use mobile bowsers or fixed sprays as appropriate).
- Minimise the quantities of construction aggregates stockpiled on site at any one time.
- Enforce speed limits on site, particularly during dry weather (a maximum of 15kph is typical).
- Cutting, grinding and masonry drilling operations not taking place without adequate dust arrestment (e.g. pavement saw with integral wet suppression system).
- Situating temporary stockpiles of waste and/or construction aggregates as far as practicable from sensitive off-site locations. Piles can be profiled to minimise loss of material through wind blow. Water sprays can be employed to dampen potentially dusty materials during dry weather.
- Clear away all spills of potentially dusty materials promptly and use appropriate means to minimise dust emissions.
- No plant or vehicles emitting black smoke (except during initial ignition) to be used on site.
- All waste and construction aggregates to be transported in covered wagons when on the public highway.
- Provision of facilities to prevent tracking out of mud onto the public highway.
- Provision of adequate pavement cleansing equipment. Regularly cleanse site access points to prevent accumulations of mud and other debris from site.

The construction method is not known in detail and may change during the long construction period. Therefore it cannot be stated at this stage which of these measures will be required.

Monitoring of 'nuisance dust' using instrumentation is not recommended as the available techniques only provide data after the fact and do not contribute to a pro-active site management regime. Instead, daily visual monitoring is recommended during dry or windy conditions. Visual monitoring should include recorded observations of weather (occurrence of wind and rain in-particular) and ground conditions (dry, damp or wet), site activities, dust suppression measures applied and effectiveness of measures (visible plumes of dust should not be crossing the site boundary into off-site areas). Control failures and remedial actions should also be recorded. All records should be filed on site.

12.5.2 *Operation Phase*

All potential air quality impacts of the development are due to road traffic generated by vehicles accessing and moving around the completed development. This assessment shows that the operation of the development will not result in significant air pollution impacts. Mitigation measures are therefore considered unnecessary for the operational phase.

12.6 Residual Impacts

12.6.1 *Construction Phase*

If BPM dust control measures are employed then no significant residual impacts are anticipated. Dust control measures and corrective actions should form part of the Construction Environmental Management Plan (CEMP), which is standard practice for most large contractors.

12.6.2 *Operation Phase*

No residual impacts are anticipated

12.7 Cumulative Effects

Traffic generated by the proposed 'Both Worlds' development is included in the "Do Minimum" scenario in the calculations, with the exception of the base year, 2005. It has been assumed that the Both Worlds development would be complete by 2010.

12.8 Transboundary Effects

Table 12.9 shows the results of a calculation of total emissions of oxides of nitrogen (in kilograms) and of carbon dioxide (in tonnes) from the modelled road network.

Table 12.9: Emissions of key transboundary pollutants from the modelled road network

	NO_x	**CO_2 (as carbon)**
	kg per year as NO_2	tonnes per year
2005 Base	8,871	588
2010 DM	6,606	586
2010 DS	8,941	670
2015 DM	4,437	486
2015 DS	7,646	900
2020 DM	3,669	395
2020 DS	6,545	862

The roads assessed are those most affected by the development. If all roads in Gibraltar were included in the calculation, the differences between emissions with and without the development would be larger numbers, but smaller proportions of the total.

The largest difference between the "Do Minimum" and "Do Something" in emissions for oxides of nitrogen is approximately 3.2 tonnes, in 2015, while the largest difference in emissions of carbon dioxide is 467 tonnes of carbon in 2020. These may be compared with the Environmental Agency's estimates of total emissions from all sources for the whole of Gibraltar; the increases are 0.3% for oxides of nitrogen and 0.7% for carbon dioxide.

Neither of these increases will have a significant effect on the environment of any other country. Although they are notable when compared to overall emissions from Gibraltar, the proportion of acid rain related pollutants in Spain which derive from Gibraltar is very small, and Gibraltar's contribution to worldwide carbon dioxide emissions is even smaller.

It should be noted that this assessment has not taken into account any changes in traffic flows within Spain which may arise. The development may lead to increases in traffic flows in the surrounding region, which will in turn lead to further emissions. However it may also be the case that some of the vehicle journeys, which for this assessment have been assumed to be new journeys, may actually be diversions of journeys which would otherwise have been made to other developments outside Gibraltar, in which case the increases in emissions could be over-estimates.

12.9 Uncertainty

Environmental impacts from dust due to construction are uncertain, as the exact construction techniques which will be used cannot be predicted so far in advance.

Consequently it is also uncertain exactly which mitigation measures will be required to ensure nuisance is not caused to the occupants of nearby properties.

The DMRB methodology used to calculate air quality effects due to traffic was designed for use in the UK. While the total emissions of pollutants from vehicles will be the same in any country where the composition of the vehicle fleet is similar, the effect of these emissions on pollutant levels near the road may differ due to differing meteorological conditions. This is especially the case for nitrogen dioxide, since the proportions of the different oxides of nitrogen in the atmosphere is influenced by sunlight. In addition, as noted in Section 12.2, no allowance has been made for Gibraltar having a higher proportion of motorbikes and scooters among light vehicles than the UK does.

Trans-boundary air pollution and local air quality effects due to emissions from traffic generated in Spain cannot be assessed as no forecasts are available for traffic generation outside the borders of Gibraltar.

12.10 Summary

12.10.1 *Construction*

The likelihood of dust nuisance is slight due to the distance of the majority of sensitive receptors from the site. Approximately 20 residential properties lie within 100 metres of the construction site. Furthermore, the wind blows either from the east or the west for much of the time and Catalan Bay is to the south, reducing the risk of dust being blown towards existing residential properties. To ensure potential dust nuisance is minimised, best practicable means (BPM) should be employed to control dust as part of the Construction Environmental Management Plan.

12.10.2 *Operation*

The assessment shows that in relation to traffic emissions the scheme would not cause any exceedances of the EU Limit Values for human health for carbon monoxide, benzene, nitrogen dioxide and PM_{10} in the years assessed. Pollution levels in 2010, 2015 and 2020 are predicted to be slightly higher with the development than without it, but lower than the levels in 2005 due to reductions in both background pollution and in vehicle emissions.

As the assessment shows no air pollution problem is anticipated with the development, there is no need for mitigation measures.