BURGAN CAPE TERMINALS

AIR POLLUTION DISPERSION MODELLING ADDENDUM

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1 INTRODUCTION

An air quality impact assessment was conducted in 2014 by DDA Environmental Engineers (DDA) for the proposed Burgan Cape Terminals. That air quality impact assessment formed part of the Environmental Impact Assessment (EIA) for the project, which has been completed and environmental authorisation has been granted. Burgan is currently in the process of applying for an Atmospheric Emission Licence (AEL) for the project.

Since the original dispersion modelling study, the Vapour Recovery Unit (VRU) design information has become available and the actual expected emission quantities can now be determined. This has resulted in the need to update the air quality impacts and the dispersion modelling study. DDA was appointed by Environmental Resource Management to undertake this update.

The present addendum provides the updated emissions information and the assessment of the operational phase of the project.

2 *LEGISLATIVE REQUIREMENTS RELATING TO AEL*

2.1 *LISTED ACTIVITIES AND EMISSION LIMITS*

The Department of Environmental Affairs (DEA) has published a list of activities which result in atmospheric emissions and the associated minimum emission standards in Gazette No. 37054, 22 November 2013.

The Burgan Cape Terminals operations fall under Category 2.4 for the Storage and Handling of Petroleum Products. Under this category, the applicable tank types and appropriate fittings, so as to minimise emissions are stipulated. In addition, it is indicated that a vapour recovery (VRU)/destruction unit is required for all installations with a throughput greater than 50,000 m³ per annum of products with a vapour pressure greater than 14 kPa,. The emissions limits of these recovery units are specified in the listed activity Category 2.4, and are shown in Table 2.1 below.

Table 2.1. Emission Limits for Vapour Recovery Units (DEA, 2013)

Description:	Vapour Recovery Units		
Application:	All loading / offloading facilities with a throughput greater than 50,000 m³		
Substance or Mixture of Substances		Plant Status	mg/Nm³ under normal conditions of 273k and101.3 kPa
Common Name	Chemical symbol		
Total volatile organic compounds from vapour recovery / destruction units using thermal treatment.	N/A	New	150
		Existing	150
Total volatile organic compounds from vapour recovery / destruction units using non-thermal treatment.	N/A	New	40 000
		Existing	40 000

3 EMISSIONS INVENTORY

A detailed emissions inventory was compiled during the air quality study undertaken as part of the EIA. Fugitive emissions from the tanks, tank truck loading operations and the VRU were quantified. The VRU emissions were estimated based on the assumption of a vapour recovery efficiency of 99%. According to the final design, the VRU will achieve an emission of 35 g/m³ or less. The tanks' specifications and loading gantry operations remain the same as before. With the updated VRU emission of 35 g/m³, the updated emissions inventory is shown in *Table 3.2*.

For the speciation of the various compounds in the vapour emissions, the partial type profiles were used, based on the liquid and vapour weight percentage of the identified chemical components, in accordance with the AP-42 compilation of air pollutant. The estimated component fractions and their annual total emissions are shown in *Table 3.1* below.

Table 3.1. Annual Emissions Per Component

Component	Speciation (%)		Emission (kg/yr)				
	Petrol/Ethanol	AGO/BioFAME	Petrol	AGO	Ethanol	BioFAME	Total
Total VOCs	100%	100%	19,146	4,522	2,691	126	26,485
Hexane (-n)	0.55%	0.03%	105	1	15	0	121
Benzene	0.74%	0.14%	142	6	20	0	168
Isooctane	0.72%	-	138	-	19	-	157
Toluene	0.73%	1.63%	140	74	20	2	235
Ethylbenzene	0.06%	0.22%	11	10	2	0	23
Xylene (-m)	0.25%	4.11%	48	186	7	5	246
Isopropyl Benzene	0.01%	-	2	-	0	-	2
1,2,4-Trimethylbenzene	0.04%	3.27%	8	148	1	4	161
Cyclohexane	0.08%	-	15	-	2	-	17
Unidentified Components	96.80%	90.60%	18,533	4,097	2,605	114	25,349

Table 3.2. VOC Emissions per Fuel Type

Tank	Quantity	Nominal Capacity (m^3)	Product	Throughput	Emissions					Total Loss [a]	Loading Loss [b]	Total VOCs Concentration at VRU Stack [c]
					Tankage		Loadrack	VRU Stack [d]	Total			
				m^3/yr	kg/yr/tank	kg/yr	kg/yr	kg/yr	kg/yr	(w/w%)	(w/w%)	mg/Nm^3
Petrol - Internal Floating Roof Tank	3	9,000	Petrol	181,500	2,476	7,428	5,366	6,353	19,146	0.01%	0.009%	37,141
AGO (Small) - Vertical Fixed Roof Tank	3	9,000	AGO (diesel)	143,017	508	1,523	30	36	4,522	-	-	-
AGO (Large) - Vertical Fixed Roof Tank	4	13,000	AGO (diesel)	275,441	733	2,933						
Ethanol- Vertical Fixed Roof Tank	1	1,700	Ethanol	9,075	2,106	2,106	268	318	2,691	0.04%	0.008%	-
BioFAME- Vertical Fixed Roof Tank	1	1,700	BioFAME	12,554	106	106	18	1	126	-	-	-
EU Guideline (w/w%)							12,352			**0.01%**	**0.005%**	-
SA Emission Limit (mg/Nm3)										**-**	**-**	**40,000**

a. Total annual loss and loading loss was calculated for petrol and ethanol only. The densities utilised to calculate the yearly through put in kg/yr were 720 kg/m^3 and 789 kg/m^3 for petrol and ethanol respectively.

b. Loading losses were calculated by taking into consideration the losses at the loadrack and the VRU stack.

c. Total VOCs concentration at the VRU stack was calculated by taking into consideration petrol and ethanol emissions only. The product temperature was assumed to be the same as the average ambient temperature, which is 16.7 ^oC.

d. The VRU emissions were calculated by multiplying the concentration of 35 g/m^3 with the throughput for volatile fuel, i.e. petrol and ethanol. The emissions for AGO and BioFAME were based on the petrol emissions and their respective emission ratios at the loadrack.

4 AIR POLLUTION DISPERSION MODELLING

The resulting ground-level concentrations due to the updated emissions from the Burgan Cape Terminals were estimated with the use of a Gaussian dispersion model. The latest version of AERMOD View (Version 9.0) from Lakes Environmental was utilised. The basis of this model is the straight-line, steady-state Gaussian plume equation and is used for the simulation of emissions from stacks, isolated and multiple vents, liquid tanks, waste sites, storage piles, conveyor belts, etc.

There are two basic types of input needed to run the AERMOD model. Firstly, the emissions input set-up file and secondly the meteorological data file. The emissions input set-up file contains the selected modelling options, as well as source location and parameter data, receptor locations, meteorological data file specifications and output options. Five years of meteorological data (2006-2010) from the Department of Environmental Affairs and Development Planning was utilised in the dispersion modelling.

This set of data was generated by utilising a prognostic meso-scale model called WRF (Weather Research and Forecast Model). The WRF modelling resolution was 3 km. The modelled data with the centre point at -33.911720° (latitude) and 18.454020° (Longitude) was used.

The ambient concentrations of various VOCs were modelled based on the following:

- The emissions from the proposed terminal were modelled with area sources.
- The emissions from other sources, e.g. FFS Refiners fuel tank farm, Joint Bunker Services, vehicle exhaust, etc., were not included.
- The terminal emissions were assumed to be constant for all hours.
- Hydrocarbon spillage and abnormal event emissions were not taken into consideration.
- Five years of hourly meteorological data for the project area was utilised as input into the model.

4.1 DISPERSION RESULTS AND DISCUSSION

The maximum ambient concentrations of the VOCs over the 5 years of meteorological data were calculated and are presented as concentration isopleths in the figures below.

Figure 4.1 shows the maximum annual average benzene concentrations around the terminal. As can be seen, the maximum levels are well below the South African National Ambient Air Quality Standard of 5 $\mu g/m^3$.

These annual benzene concentrations were also used for the calculation of the carcinogenic risk, shown in *Figure 4.2*. A risk in excess of $1x10^{-4}$ is generally considered unacceptable and below $1x10^{-6}$ is considered negligible. It can be seen that the maximum risk is approximately $1x10^{-6}$, occurring within the immediate vicinity of the terminal. This indicates that the cancer risk in the study area due to the terminal's operations with the VRU mitigation in place is negligible.

In addition, the modelled annual concentrations of all the identified VOCs (shown in the emissions *Table 3.1*) were used for the calculation of the cumulative long-term health risk index. The cumulative long-term health risk index is the sum of the fractions of all the compounds' concentrations divided by their respective guidelines. The cumulative long-term health risk index contours can be found in *Figure 4.3*. It can be seen that the cumulative index did not exceed the value of 1 at any of the locations in the study area.

Figure 4.1 *Maximum Annual Benzene Ground Level Concentrations (Guideline: 5 µg/m3)*

Figure 4.2 Carcinogenic Health Risk (Guideline: 1x10-6)

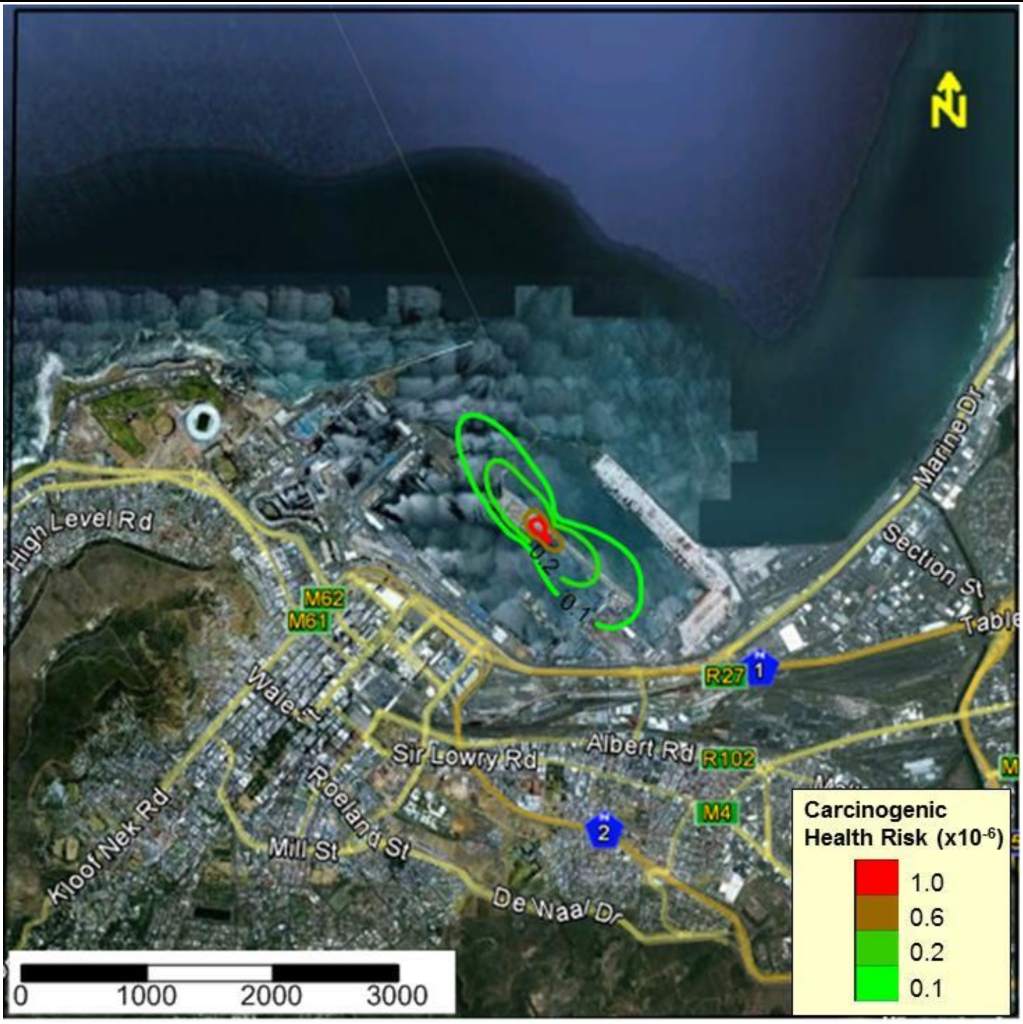
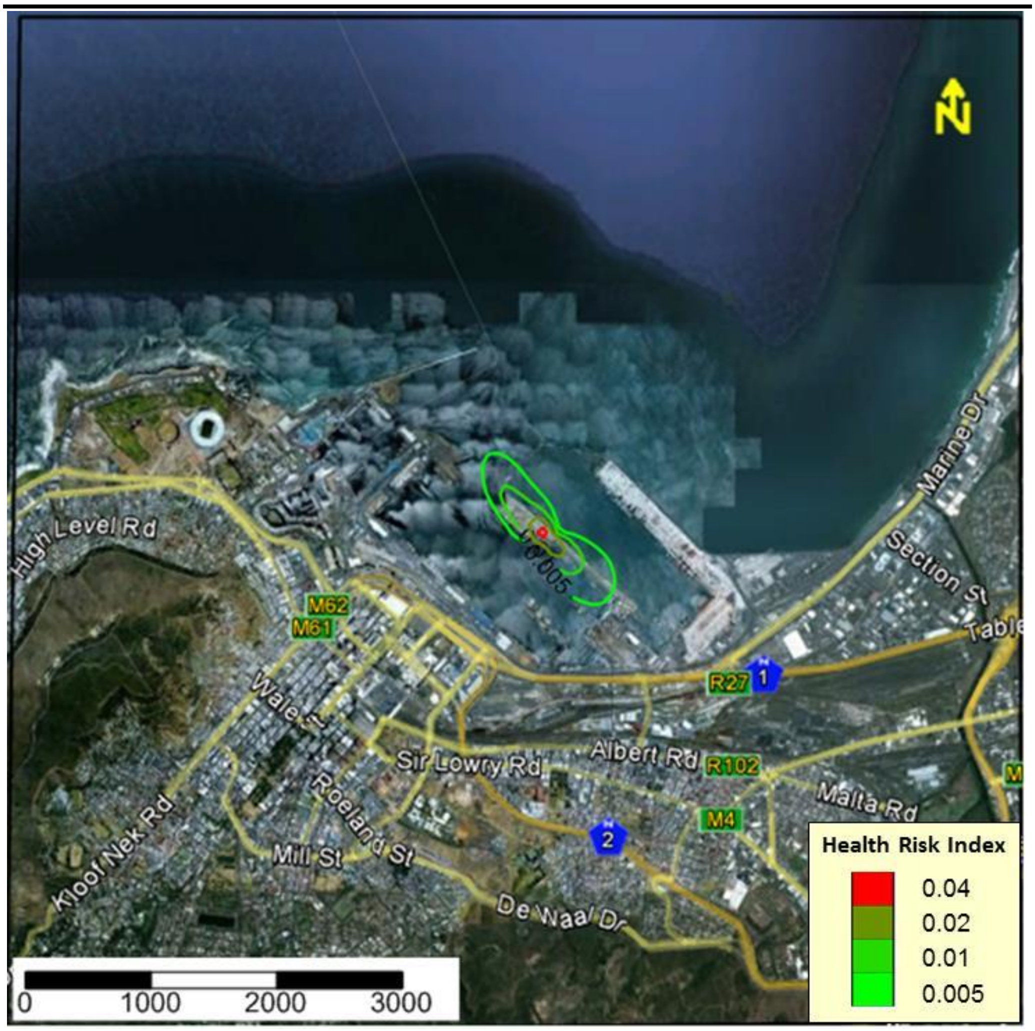


Figure 4.3 Long-term Health Risk Index (Guideline: 1)



5 IMPACT ASSESSMENT AND RECOMMENDATIONS

Based on the dispersion simulation of the fugitive emissions from the storage and loading operations of the terminal, it can be concluded that:

- The operation of the VRU is expected to have a significant mitigation effect on the emitted quantities from the terminal.
- The benzene concentrations around the terminal are within the South African annual ambient guideline.
- The carcinogenic risk and long-term human health risk arising from the terminal are considered negligible.

The general recommendations of the study are:

- With the completion of the project and after installation of the VRU, collection efficiency tests should be performed via measurements before and after the unit, in order to confirm the assumed efficiency values.

The updated impact table for the Burgan Cape Terminals is shown below. As can be seen, even though the updated VRU emissions were marginally higher than the ones utilised in the 2014 study, the resulting impacts remained predominantly the same.

Table 5-1. Updated Operational Impact

Nature: Operational activities would result in a **negative direct** impact on existing ambient air quality in the surrounding areas.
Sensitivity/Vulnerability/Irreplaceability of Resource/Receptor – Low
<u>Sensitivity</u>: The sensitivity around the port and the terminal is considered **low**.
Impact Magnitude – Small
• <u>Extent</u>: The extent of the impact is **local.**
• <u>Duration</u>: The expected impact will be **long-term.**
• <u>Scale</u>: The impact will **not** result in **notable changes** to the resource/ receptor.
• <u>Frequency</u>: The frequency of the impact will be **periodic.**
• <u>Likelihood</u>: The terminal operations will result in **possible** increase of the total VOC concentrations, in very close proximity to the terminal.
IMPACT SIGNIFICANCE (with standard MITIGATION) – NEGLIGIBLE.
Degree of Confidence: The degree of confidence is **high**.

6 REFERENCES

DEA, 2013. List of Activities which result in Atmospheric Emissions Which have or may have a Significant Detrimental Effect on the Environment, including Health, Social Conditions, Economic Conditions, Ecological Conditions or Cultural Heritage. Notice No. 893. 22 November 2013. Government Gazette No. 37054.

DDA, 2013. Air Pollution Dispersion Modelling for the Proposed Burgan Cape Town Harbour Terminal.