5 AIR QUALITY

5.1 Introduction

The IEIA described that the casting of concrete armours is likely to be the only source of dust during the construction of the breakwater. This was not expected to result in unacceptable air quality impacts. The IEIA further stated that no unacceptable air quality impact was anticipated from the operations of the DGA.

Air emissions during the construction and operation of the proposed DGA are not regarded as key issues and are not assessed in this study.

In a meeting with a group of fishermen from Ma Wan on 15 December 1997, concern with odour emissions from the vessels was raised. Some fishermen mentioned that when they were near the existing TWDGA, they encountered odour emitted from vessels anchored there, especially when the tanks of these vessels were being cleaned. They were concerned that Ma Wan residents could be affected by odour emitted from vessels in the proposed DGA.

The vapour of petroleum products including diesel, kerosene and bunker fuel carried by vessels anchored in the DGA is odorous. Besides escaping from the storage tanks when they are cleaned, odour can also be expelled from the breathing vents of the storage tanks. This breathing loss is due to vapour expansion from diurnal temperature and barometric pressure changes.

Odour emissions from vessels in the proposed DGA is a key issue and is assessed in this study. The objective of the odour assessment is to determine potential odour impacts of the proposed DGA on nearby sensitive receivers.

5.2 Environmental Legislation and Standards

Using computer dispersion modelling for odour assessment, EPD has adopted a guideline level of 5 odour units (OU), averaged over 5 seconds, at odour sensitive receivers. For compliance odour monitoring at existing facilities, EPD has recommended an odour nuisance criterion of 2 OU at the site boundary.

5.3 Assessment Methodology and Criteria

To assess future conditions during operation, computer dispersion modelling was undertaken to determine the odour impacts in the vicinity of the proposed DGA based on the odour levels measured at the existing TWDGA.

In anticipation of addressing the fishermen's concern adequately during District Board consultation, the Consultants recommended that odour monitoring be carried out at the existing TWDGA.

The assessment methodology thus combines odour monitoring with computer dispersion modelling.

Assessment Criteria

For the purpose of this assessment, the guideline level of 5 odour units (OU) averaged over 5 seconds at odour sensitive receivers adopted by EPD was compared with the computer odour modelling results to assess the degree of potential odour impacts due to the operation of the proposed DGA site.

applied. To further convert the 3-minute averages to 5-second averages, a multiplying factor of 10 was applied for those hours with atmospheric stability classes A to D, and a factor of 5 for those hours with stability classes E to F. This is in accordance with *Odour Control - A Concise Guide, Warren Spring Laboratory.*

The rationale for choosing the rural mode dispersion option is because it takes due account of the topographical nature of the vicinity of the proposed DGA. Graduated plume rise, stack tip downwash and calm data processing were assumed in the model runs.

To ascertain the worst-case condition, 540 predefined separate meteorological conditions were used in the dispersion modelling. The resolution on the wind direction was set to 10-degree increments. The models were tested with Pasquill stability classes B and D (for day-time hours), class F (for night-time hours), and 5 wind speed conditions of $1ms^{-1}$, $2ms^{-1}$, $4ms^{-1}$, $6ms^{-1}$ and $8ms^{-1}$. At each receiver location the 5-second average odour concentrations were predicted for each of the predefined meteorological condition. The maximum 5-second average odour concentration among the 540 meteorological conditions was calculated at each sensitive receiver and compared with the guideline level of 5 odour units.

The model output was presented in form of contours of odour levels from the future odour source at the proposed DGA, as well as maximum 5-second average odour levels at the sensitive receivers. The assessment height was 1.5 m above sea level.

5.4 Baseline Conditions

There is currently no major odour generating activities or petroleum-based odour sources identified in the vicinity of the proposed DGA site. It is not anticipated that there will be any changes to the current situation except the operation of the proposed DGA site. The current and future (without the proposed DGA) background odour level in the vicinity of the site is therefore considered to be minimal.

5.5 Sensitive Receivers

Sensitive receivers include existing residents of Ma Wan Town and nearby villages, as well as the committed future development for residential use to the north-eastern side of Ma Wan.

The predicted odour impacts from the proposed DGA are presented in the form of odour contours which cover all the sensitive receivers in the vicinity of the proposed DGA.

5.6 Prediction and Evaluation of Operational Phase Odour Impacts

The predicted worst-case 5-second average odour levels in the form of contours are shown in **Figure 5.1**. The maximum distance of the 5 OU odour level contour would be around 500 m from the boundary of the proposed DGA.

Since the air sensitive receivers in the vicinity of the proposed DGA are located more than 550m from the boundary of the proposed DGA, it is not expected that there would be any exceedance of the odour limit of 5 OU (5-second average) at the odour sensitive receivers.

Odour Monitoring

Odour sampling and analysis was carried out within the existing TWDGA. The purpose is to determine the odour levels within the DGA. Five representative odour samples were collected from a number of odourous positions close to the vessels moored in the existing TWDGA. (The sampling was carried out down wind of the source). These samples were collected with an odour sampling system, which consists of a battery-operated air pump, a sampling vessel, and nalophane NA^{TA} odour bags.

Odour samples collected were analyzed in an odour laboratory. Odour concentrations in these samples were determined by a Forced-choice Dynamic Olfactometer in accordance with the Dutch National Standard (NVN 2820). Eight panel members previously selected through screening tests using a 50 ppm of certified n-butanol gas as a standard gas participated in the odour test.

The unit of measurement is odour unit per cubic meter (OUm^{-3}). For each sample, the dilution factor required to reach the detection threshold of 1 OUm^{-3} was determined. Odour concentrations were then expressed in terms of multiples of the detection threshold.

Emission Calculations

In order to provide a practical emission rate for the modelling, the emission rate was estimated from the odour levels measured at the existing TWDGA. The highest odour level recorded was taken as the odour level at the boundary of the vessel. The odour emission strength of the vessel was back-estimated from the assumed odour level at the boundary of the vessel based on the following assumptions:

- area source of 3 x 3 m^2 on the vessel;
- emission height of 1.5 m above sea level; and
- Pasquill stability class B and wind speed of 1ms^{-1} (the meteorological conditions during the odour sampling).

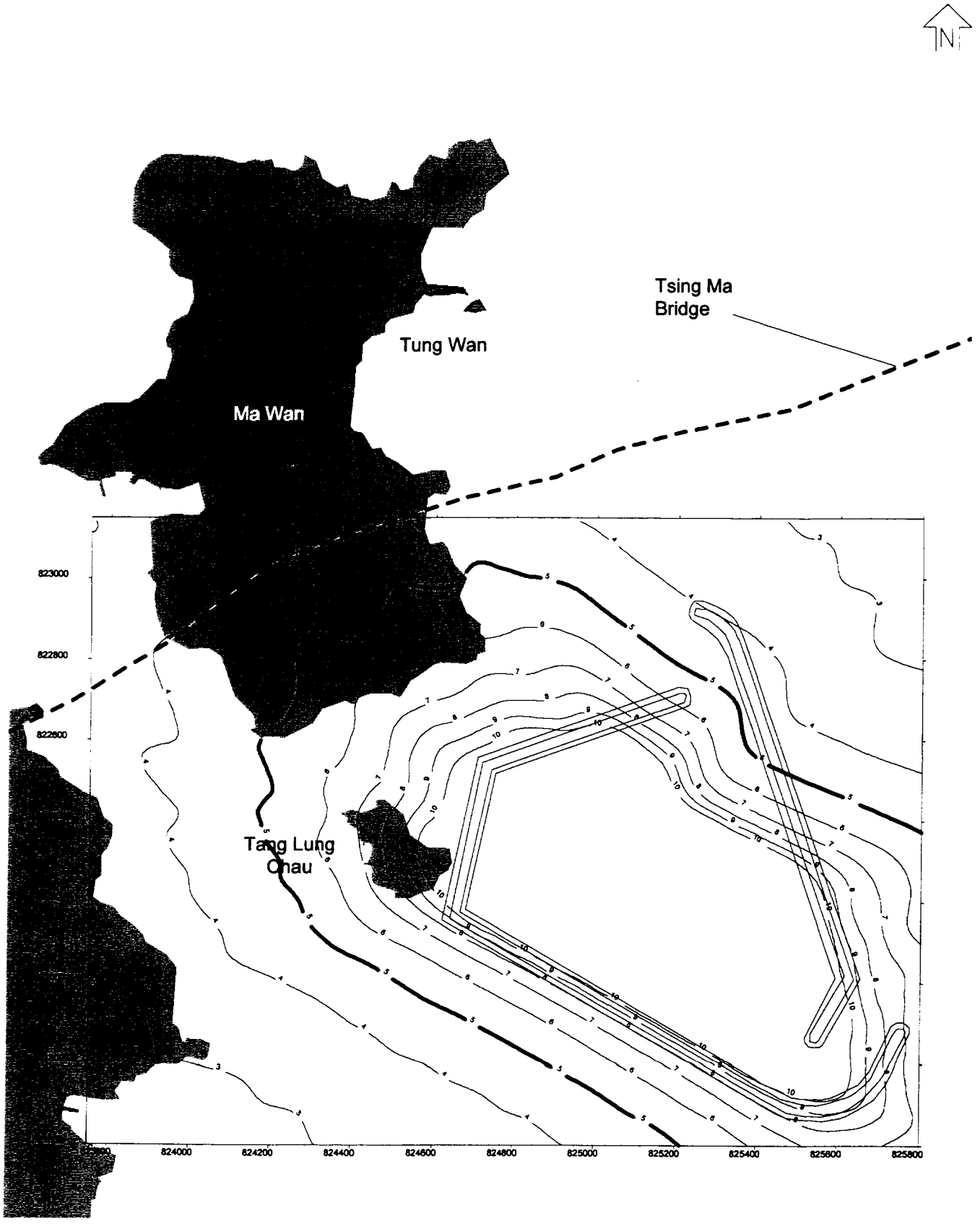
As the DGA can accommodate 72 vessels, the odour emission rate was averaged over the area of DGA of 72 odour emission sources.

Computer Dispersion Modelling

The USEPA ISCST3 Model was used to model odour dispersion. Since odour nuisance perceived can be caused by very brief exposures (down to 1 to 2 seconds), the 5-second average concentration rather than the hourly average concentration was calculated. This was achieved by converting 15-minute average concentrations to 3-minute average concentrations and then to 5-second averages.

The rural mode dispersion option of the ISCST3 Model was used to predict 15-minute average odour concentrations at selected sensitive receivers. According to the *Workbook of Atmospheric Dispersion Estimates, D. Bruce Turner*, the Pasquil-Gifford parameters, σ_y and σ_z, for rural mode dispersion may be estimated for a short averaging time period (say 15 minutes) and yet are equivalent to computer dispersion models set up to estimate conservative 1-hour average concentrations. The 1-hour average odour concentrations predicted from the ISCST3 model were taken as the 15-minute average odour concentrations in this assessment. It should be note that this assumption was taken only for the purpose of this odour assessment and may not be applicable for the modelling of other air pollutants.

To convert the 15-minute averages (which are assumed to be equivalent to the 1-hour averages) to 3-minute averages, the power-law relationship was applied for different stability classes. For stability classes A to F, multiplying factors of 2.236, 2.236, 1.709, 1.380, 1.308 and 1.308 respectively were



PREDICTED MAXIMUM 5-SECOND AVERAGE
ODOUR LEVEL CONTOUR PLOT

FIGURE 5.1

SCALE 1 : 16000

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5.7 Conclusions

Air quality dispersion modelling was undertaken to determine the odour impacts in the vicinity of the proposed DGA. Odour emissions from the vessels are considered. The modelling results indicated that there would be no exceedance of the 5-second average odour limit at the identified air sensitive receivers. Therefore air pollution mitigation measures are not required.