APPENDIX B16:A

Appendix B16:A Model Setup

TAPM

The meteorological model, TAPM (The Air Pollution Model), was developed by the CSIRO and has been validated by the CSIRO, Katestone and others for many locations in Australia, southeast Asia and North America (see www.cmar.csiro.au/research/tapm for more details on the model and validation results from the CSIRO). TAPM has proven to be a useful model for simulating meteorology in locations where monitoring data is unavailable.

TAPM is a prognostic meteorological model that predicts the flows important to regional and local scale meteorology, such as sea breezes and terrain-induced flows from the larger-scale meteorology provided by the synoptic analyses. TAPM solves the fundamental fluid dynamics equations to predict meteorology at a mesoscale (20 kilometres to 200 kilometres) and at a local scale (down to a few hundred metres). TAPM includes parameterisations for cloud/rain micro-physical processes, urban/vegetation canopy and soil and radiative fluxes.

TAPM requires synoptic meteorological information for the region. This information is generated by a global model similar to the large-scale models used to forecast the weather. The data are supplied on a grid resolution of approximately 75 kilometres, and at elevations of 100 metres to 5 kilometres above the ground. TAPM uses this synoptic information, along with specific details of the location such as surrounding terrain, land-use, soil moisture content and soil type to simulate the meteorology of a region as well as at a specific location.

TAPM (version 4.0.5) was configured as follows:

- Synoptic data for 2009
- A domain consisting of 85 x 85 grid points, with an outer grid with 17.5 kilometre spacing between grid points, and nesting grids of 8.5 kilometre, 3 kilometre and 1 kilometre spacing
- Grid centred near the project site (latitude -26° 36', longitude 153° 5')
- Geoscience Australia 9-second digital elevation model terrain data
- 25 vertical grid levels
- Land-use for the innermost grid updated with Queensland Land Use data, based on the Australian Bureau of Agricultural and Resource Economics and Sciences, available at approximately 110m resolution and coastline delineation by comparison with aerial imagery
- TAPM default land-use for the outer three grids.

CALMET

CALMET is an advanced non-steady-state diagnostic three-dimensional meteorological model with micro-meteorological modules for overwater and overland boundary layers. The model is the meteorological pre-processor for the CALPUFF modelling system. CALMET is capable of reading hourly meteorological data from multiple sites within the modelling domain; it can also be initialised with the gridded three-dimensional prognostic output from other meteorological models such as TAPM. This can improve dispersion model output, particularly over complex terrain as the near surface meteorological conditions are calculated for each grid point.

CALMET (version 6.327) was used to simulate meteorological conditions in the study region. The CALMET simulation was initialised with the gridded TAPM three dimensional wind field data from the 1 kilometre (innermost) grid. CALMET treats the prognostic model output as the initial guess field for the CALMET diagnostic model wind fields. CALMET then adjusts the initial guess field for the kinematic effects of terrain, slope flows, blocking effects and 3-dimensional divergence minimisation. The geophysical data was supplied by Geosciences Australia.

Key features of CALMET used to generate the wind fields are as follows:

- Domain area of 80 by 80 grid points at 500 metre spacing
- Twelve vertical levels set at 20, 60, 100, 150, 200, 250, 350, 500, 800, 1600, 2600 and 4600 metres at each grid point.
- 365 days (1 January 2009 to 31 December 2009)
- Prognostic wind fields generated by TAPM for the 1 kilometre grid (innermost) used as MM5/3D.dat at surface and upper air for "initial guess" field
- All other options have been set to default.

CALPUFF

The CALPUFF dispersion model utilises the three-dimensional wind fields from CALMET to simulate the dispersion of air pollutants to predict ground-level concentrations across a gridded domain. CALPUFF is a non-steady-state Lagrangian Gaussian puff model containing parameterisations for complex terrain effects, overwater transport, coastal interaction effects, building downwash, wet and dry removal, and simple chemical transformation. CALPUFF employs the three-dimensional meteorological fields generated from the CALMET model by simulating the effects of time- and space-varying meteorological conditions on pollutant transport, transformation and removal. CALPUFF contains algorithms that can resolve near-source effects such as building downwash, transitional plume rise, partial plume penetration, sub-grid scale terrain interactions, as well as the long range effects of removal, transformation, vertical wind shear, overwater transport and coastal interactions. Emission sources can be characterised as arbitrarily-varying point, area, volume and lines or any combination of those sources within the modelling domain.

CALPUFF (version 6.42) was used to simulate the dispersion characteristics and emissions generated by the proposed activities. Hourly varying meteorological conditions were obtained from CALMET at 500 metre resolution.

Key features of CALPUFF used to simulate dispersion:

- Domain area of 61 by 61 grid points at 50 metre spacing
- 365 days (1 January 2011 to 31 December 2011)
- Partial plume path adjustment for terrain modelled
- Dispersion coefficients calculated internally from sigma v and sigma w using micrometeorological variables
- Minimum turbulence velocity of sigma-v over land set to 0.2 m/s
- Minimum wind speed allowed for non-calm conditions 0.2 m/s
- For dust modelling size fractions for TSP, PM_{10} and $PM_{2.5}$ were based on size fractions from the emission factor handbooks. The geometric mass mean diameters assumed in the modelling were 30 µm (TSP), 10 µm (PM_{10}) and 2.5 µm ($PM_{2.5}$). All pollutants were modelled with 0 µm geometric standard deviation.

All other options set to default.