Appendix A

Meteorological Review

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The following appendix discusses the meteorological data used for the St Marys Waste Management Facility expansion project dispersion modelling, in terms of wind speed, stability class and mixing height.

Wind Speed

A comparison of the annual wind roses from the EPA monitoring station at St Marys (EPA 2013a) and the CALMET data is shown in **Figure 6**. The St Marys data indicate that the dominant wind direction for 2011 was from the south, which correlates well with the metrological data generated by CALMET.

| EPA (2011) | CALMET (2011) |
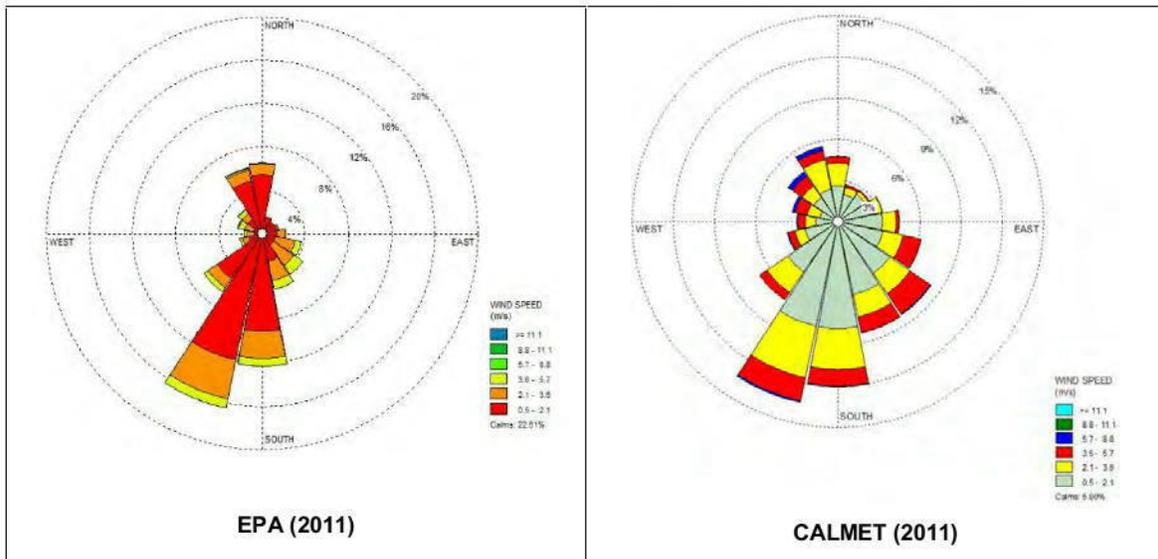
Figure 6   Comparison of 2011 wind roses from the St Marys EPA Monitoring Station and 2011 CALMET Data for St Marys Facility

The frequency distribution of hourly averaged wind speed values from the CALMET data generated for the assessment is shown below in **Figure 7**. The average annual wind speed was predicted to be 2.0m/s. As shown, low wind speeds within the area (less than 2 m/s) occur 61percent of the time and medium to strong winds (> 4 m/s) occurring approximately 10 percent of the time.
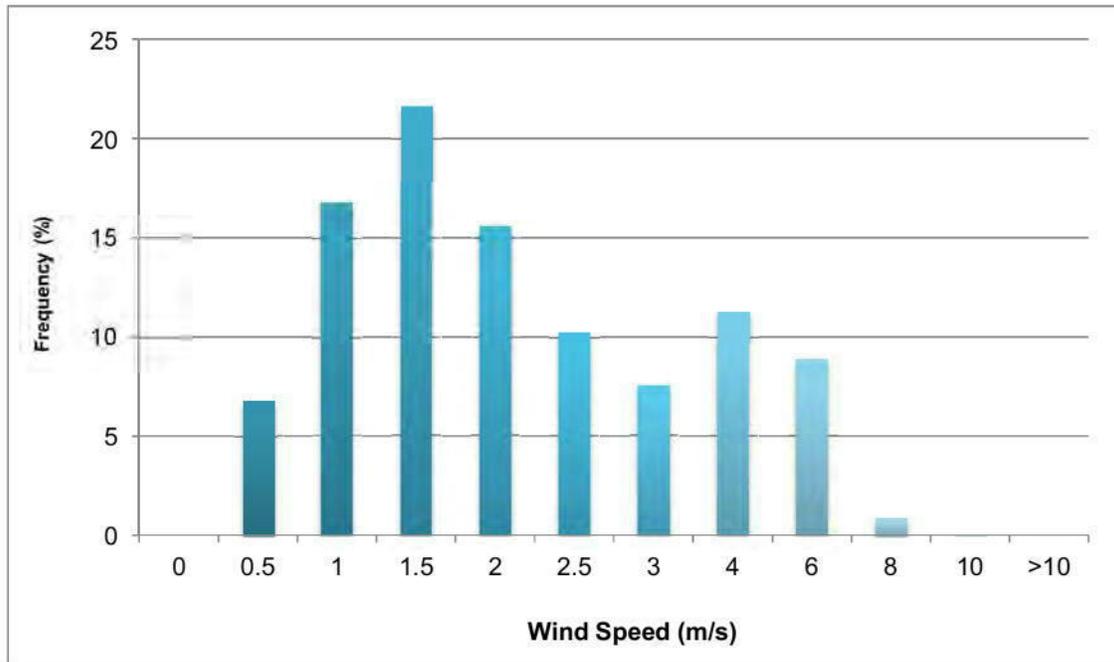
Figure 7   Frequency Distribution of Wind Speed; St Marys Facility CALMET Data, 2011

Figure 8 shows the distribution of wind speeds by hour of day. As shown, wind speeds generally average around 1.5m/s during the night time. During the day wind speeds are still light though generally higher than night time wind speeds with peak wind speeds tending to occur between 3pm and 5 pm.
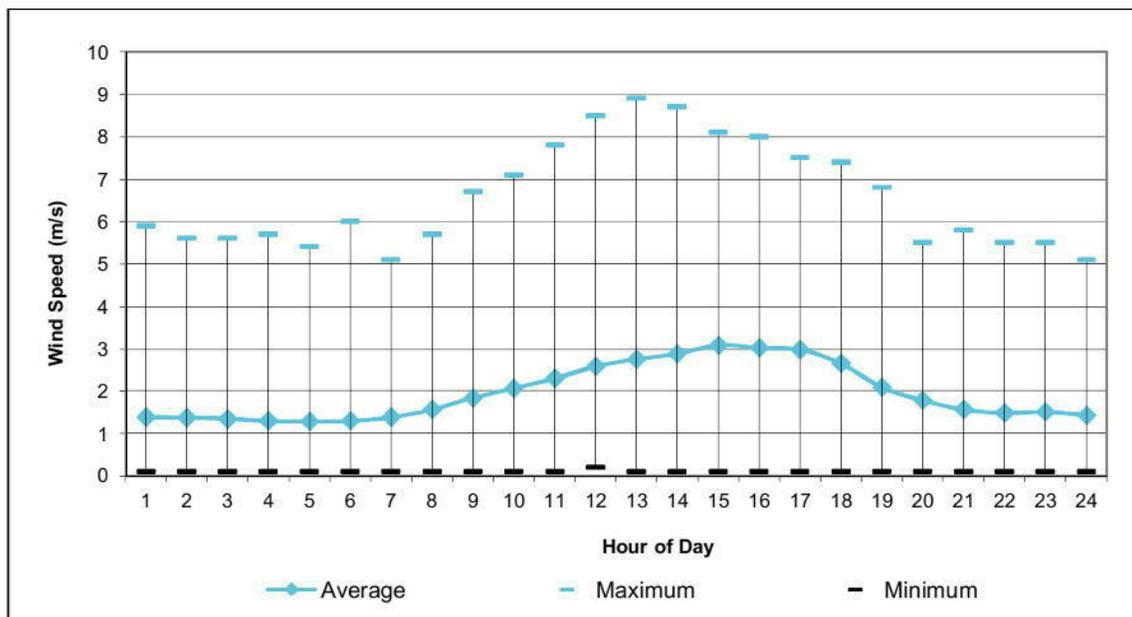

Figure 8   Wind Speed by Hour of Day; St Marys Facility CALMET Data, 2011

Stability Class

An important aspect of plume dispersion is the atmospheric turbulence level in the region of the plume, near the ground in this case. Turbulence acts to increase the cross-sectional area of the plume due to random motions, thus diluting or diffusing a plume. For traditional dispersion modelling using Gaussian plume models, categories of atmospheric stability are used in conjunction with other meteorological data to describe atmospheric conditions and thus dispersion.

The most well-known stability classification is the Pasquill-Gifford scheme, which denotes stability classes from A to F. Class A is described as highly unstable and occurs in association with strong surface heating and light winds, leading to intense convective turbulence and much enhanced plume dilution. At the other extreme, class F denotes very stable conditions associated with strong temperature inversions and light winds, which commonly occur under clear skies at night and in the early morning. Under these conditions plumes can remain relatively undiluted for considerable distances downwind. Intermediate stability classes grade from moderately unstable (B), through neutral (D) to slightly stable (E). Whilst classes A and F are strongly associated with clear skies, class D is linked to windy and/or cloudy weather, and short periods around sunset and sunrise when surface heating or cooling is small.

As a general rule, unstable (or convective) conditions dominate during the daytime and stable flows are dominant at night. This diurnal pattern is most pronounced when there is relatively little cloud cover and light to moderate winds. The frequency distribution of estimated stability classes in the meteorological file is shown in **Figure 9.** The data show a total of forty-eight percent of hours with either E or F class. This is consistent with the expected occurrence of stable conditions at inland locations that experience a high proportion of calm wind conditions. Stable and calm conditions decrease the dispersion of pollutants in the atmosphere and can lead to increased ground level concentrations close to an emission source.
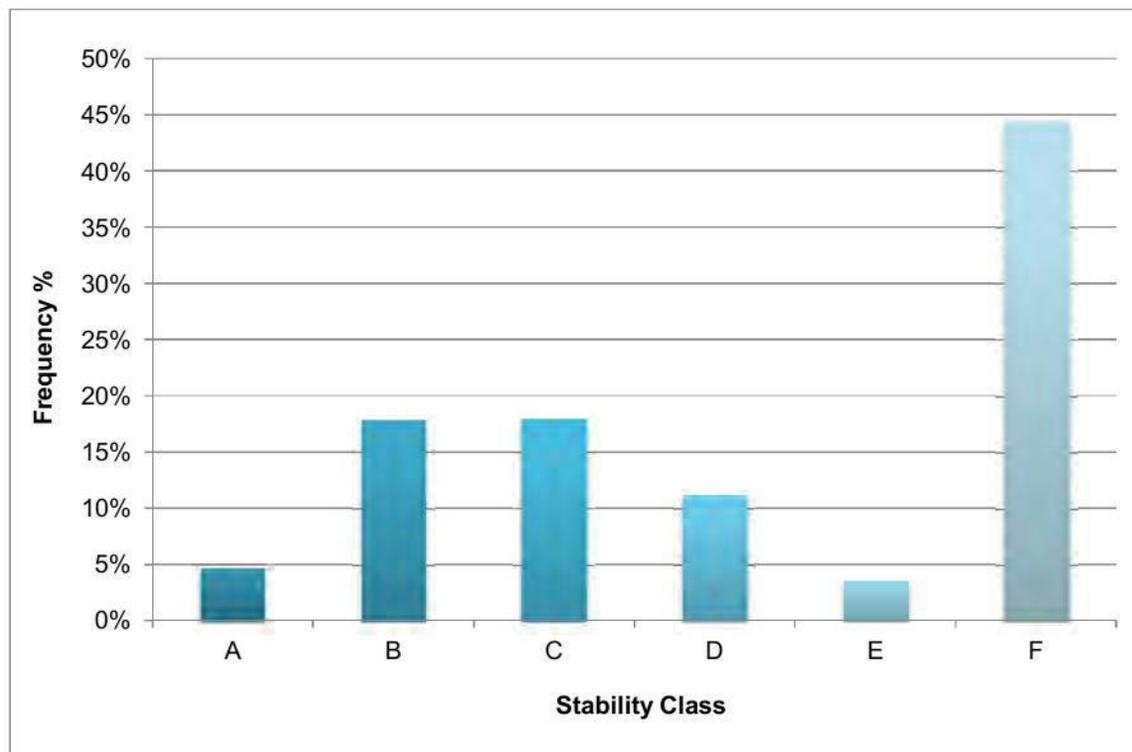

Figure 9   **Frequency Distribution of Stability Class; St Marys Facility CALMET Data, 2011**

Mixing Height

Mixing height is the depth of the atmospheric surface layer beneath an elevated temperature inversion. It is an important parameter within air pollution meteorology. Vertical diffusion or mixing of a plume is generally considered to be limited by the mixing height, as the air above this layer tends to be stable, with restricted vertical motions.

CALMET was used to calculate mixing heights in the assessment. The diurnal variation of mixing height is summarised in **Figure 10** Mixing heights are lower during the night and early morning hours (< 200 m), increasing after sunrise to a maximum of 2900 metres by late-afternoon. This pattern of a marked diurnal cycle is consistent with the development's inland location.
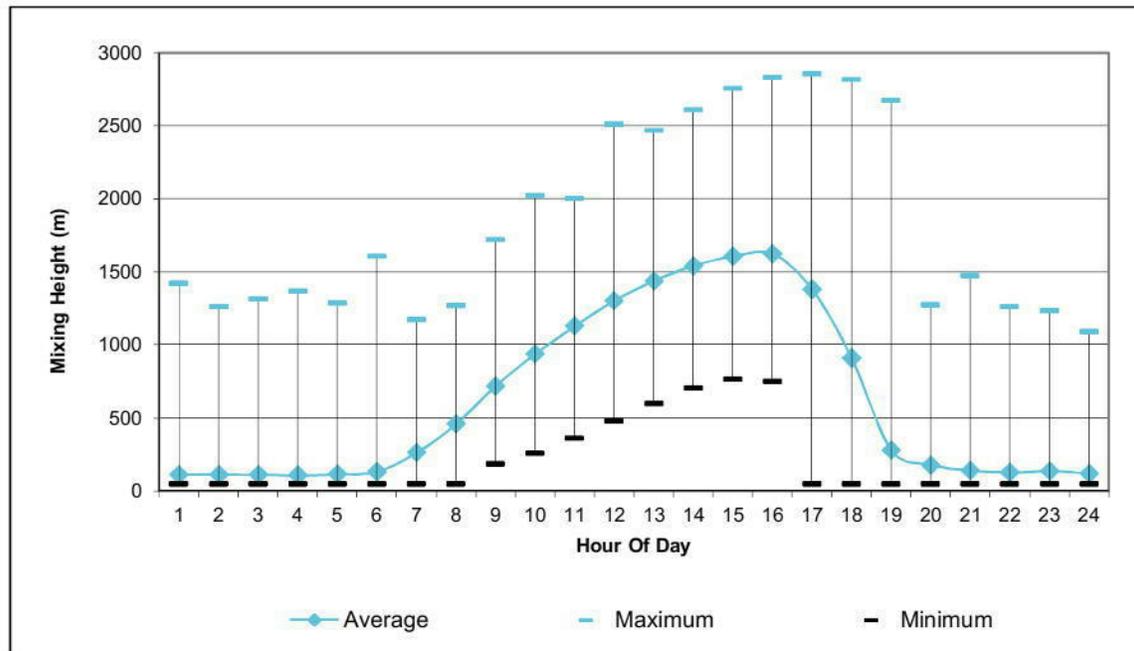

Figure 10   Hourly Mixing Height; St Marys Facility CALMET Data, 2011