

WIPS Management Pty Ltd



AIR EMISSIONS ASSESSMENT

- Air Quality Assessment
- Final Report
- 11 December 2007



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1. Introduction

1.1 General Introduction

This report provides an assessment of air quality and greenhouse gas impacts associated with air emissions from the operation of the WIPS Management facility, which is proposed to manufacture wall panels at a plant located in the Hunter Economic Zone (HEZ), south of Kurri Kurri, NSW (refer to **Figure 1-1**)

Major industrial development within the HEZ must incorporate the principles of ecologically sustainable development, including the protection and conservation of ecosystems (CCC, 2006). The *HEZ Air Quality Management Strategy* (SKM 2002) provided a framework for the HEZ to develop in a manner that ensures the sustainable protection of air quality in the area on both a local and regional basis. The *HEZ Air Quality Management Strategy* (SKM 2007) described existing concentrations of major urban air pollutants in ambient air and identified the meteorological factors likely to affect the dispersion of air pollutants. The study identified background concentration levels for the gaseous air pollutants, oxides of nitrogen (NO_X) and ozone (O₃), and atmospheric particulate matter (smaller that 10 micrometres diameter, PM₁₀).

The development proposes to produce wall panels for commercial and domestic applications using polyisocyanate (PIR) foam technology. PIR foam is a cellular, thermoset plastic formed when two organic liquids are combined with other chemicals. The result is a stable, rigid foam that has high thermal insulating qualities and has been used successfully as foundation, wall and roof insulation (http://www.dyplastproducts.com/polyisocyanurate_foam.htm).

The wall panel manufacturing process has the potential to emit vapours and particles to the air, as discussed in this report.

1.2 Project Objectives

The objectives of this project address the following:

- Air Quality Issues;
- Air Quality and Dispersion Modelling;
- Air Quality Assessment; and
- Greenhouse Gas Assessment.

The WIPS Management Facility will be located within Precinct 1 of the HEZ, approximity consisting of 100 ha of developable land which is expected to be divided into 49 development blocks. ranging in size from less than 1 ha to 8 ha. Refer to **Figure 1-2** for a site plan for the WIPS Management development.



• Figure 1-1 Hunter Economic Zone (HEZ) Site and Surrounding Area.

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• Figure 1-2 WIPS Management Plant Layout



2. Air Quality Issues

2.1 The Manufacturing Process

The PIR foam technology involves the blending of liquid hydrocarbons, in the presence of other chemicals such as a blowing agent that creates the closed cell structure, a catalyst, flame retardants and other agents. The cell structure and the rigid foam panel, typical of PIR foam technology is illustrated in **Figure 2-1**.

Figure 2-1 Polyisocyanurate (PIR) cell structure and wall panel



http://www.brufma.co.uk/PURPIR/index.htm?purpir_home.htm~main, accessed 01/06/2006 12:48

The PIR foam panel is derived from 4 main components:-

- 1) MDI (Methylene Diphenyl di-Isocyanate, $C_{15}H_{10}N_2O_2$)
- 2) Polyol (a generic name for low molecular weight, water-soluble polymers/hydrocarbons)
- Pentane (hydrocarbon C₅H₁₂), a volatile hydrocarbon, liquid at room temperature. In recent years, the manufacturers of rigid insulation panels have used pentane to replace substances that deplete the ozone layer. Pentane has the added environmental benefit of either zero or low global warming potential

 (http://en.wikipedia.org/wiki/Pentane),.http://www.alumashield.com/GS/press_kit/pentane_paper_rev1.pdf
 .
- 4) Catalysts (amines and organic acids) assist the reaction in which molecules rearrange and join.

The PIR foam product is laid down by an exothermic reaction that occurs between the MDI and Polyol. As the mixture heats up, the pentane evaporates and results in expansion of the mix,

creating a cell structure (that is, pentane acts as a blowing agent). During the initial setting of the foam, up to 5% of the pentane volume is released, hence the need for an air extraction system (refer to **Section 2.3**).

Table 2-1 identifies the substances and quantities proposed to be used in the process. Thequantities are within the threshold set by SEPP 33: Hazardous and Offensive Development (DUAP1997).

| Substance | Total Storage (kg) | No. of Tanks | Quantity per Tank (L) | Distance to Boundary |
|--|-----------------------|--------------|--------------------------|-------------------------|
| MDI (Methylene Diphenyl di-Isocyanate) | 150,000 | 3 | 50,000 | 20 m |
| Polyol (water soluble polymer hydrocarbon) | 150,000 | 3 | 50,000 | 20 m |
| Pentane (blowing agent) | 110,000 | 2 | 55,000 | 20 m |
| Catalyst (1) | 5,000 | 5 | 1,000 | 20 m |
| Catalyst (2) | 5,000 | 5 | 1,000 | 20 m |

Table 2-1 – Chemical Storage Details

2.2 Substances with the Potential to Release Air Emissions

The manufacturing process involves stages with the potential to emit vapours and particles, depending on the nature of the process. **Figure 2-2** illustrates the steps in the manufacturing process (described in further detail in **Appendix C**).

Primarily, the blending of chemicals produces the rigid foam of polyisocyanate (PIR) (**Figure 2-2**, steps **12** and **13**). The walls are produced in two halves which are glued or sandwiched together to from 100mm walls (two 50mm panels) and 200mm walls (two 100mm panels). Maximum cut panel lengths are 7.0 metres and maximum panel height is 2.7 metres (**Figure 2-2**, step **28**). All walls are pre finished with an acoustic barrier coating and a fire retarding coating (**Figure 2-2**, steps **14** and **17**). Windows and doors are fitted during the manufacturing process (**Figure 2-2**, step **55**).

When the rigid foam is cut or ground, dust is produced and removed, since the dust can yield an ignitable mixture in the air. The dust collection system extracts dust at the site of the cutting tool and via an extraction hood. All dust (greater than 97%) is collected and stored in the dust silo and recycled into the manufacturing process (WIPS Management Australia, 2006a).

Figure 2-2 illustrates the stages in the manufacturing processes and the sites with potential for air emissions. These sources generally relate to areas where vapours may be emitted from the chemical components or from cutting and abrading of the rigid panels.





Figure 2-2 Wall Panel Manufacturing Process

Key (areas with potential for air emissions)

| 12 Metering and foam laydown | 13 Wide double belt laminator | 14 Acoustic barrier coating |
|---------------------------------|------------------------------------|--|
| | | |
| 16 Acoustic Barrier curing oven | 17 Fire barrier coater | 18 Fire barrier curing oven |
| | | j |
| 19 Cut off saw | 28 CNC horizontal machining centre | 29 Post machining dust extraction |
| | | 27 T OST HIDSHINING COST ONLI CONTROLOGI |
| 30 Dust collection silo | 32 Dust recycling press | 34 Off cut bandsaw and dust extractor |
| So Dust concention sho | 32 Dust recycling press | |
| 40 Dust extraction hood | 41 Hot melt adhesive coater | 43 Rotary laminator |
| To Bust on addition nood | | To rectary laminator |
| 47 Render coater | 50 Paint coater | 48 Render coater curing oven |
| | | To Render could carring over |
| 51 Paint coater curing oven | | |
| or rain coater caring over | | |

Note: Emission sources as identified by J Court, for Cessnock City Council, following review of progress of the Statement of Environmental Effects, meeting minutes by JL Design, 04/07/06)

Table 2-2 provides further detail on the substances used in the manufacturing process with the potential for air emissions. The product application rates (kg/hr) are based on the estimated production volumes and average annual operating hours of the proposed plant (WIPS Management Australia, 2006b).

| Process | Substances/ products used in manufacturing process | | | | | | | |
|-----------------------|--|--|-------------|--|---|--|---|--|
| Number of Products | Common Name | Chemical Components | CAS Number | Component (Content W/W, max, from MSDS) | MSDS reference (or equivalent provided by Walltech) | % Ingredient Application rate | Product Total Application rate (kg/hr) (Walltech) | Impact Assessment Criteria, References: Approved Methods (NSW DEC, 2005), Exposure Standards (NOHSC, 1995) |
| Laydown | | | | | | | | |
| 1 | MDI | Ingredients | | | | | 1,620 | |
| | | methylene diphenyl isocyanate (diphenylmethane diisocyanate) | 101-68-8 | | DNCREL (2000) | 100% | | NSW DEC (2005, principal toxic, p30) |
| 2 | (polyol) Elastopor H1129/5/0 polyol | Ingredients | | | Elastogran (2004) | | 810 | |
| | component | methlbis(2-dimethylaminoethly)amine | 3030-47-5 | 2% | Elastogran (2004) | 2% | | |
| | component | triethly phosphate | 78-40-0 | 10% | (Elastogran 2004) | 10% | | |
| 3 | Pentane | n-pentane | | | Elastogan (1997) | | 270 | NSW DEC (2005, individual toxic, p32) |
| 4 | Catalyst | | | |) | | 56 | |
| | | | | | | | | |
| 4(i) | Catalyst KX 491 | Ingredients | | | | | 19.6 | 6 (35% total catalyst consumption) |
| | | N,N,N',N'-tetramethyl-2, 2'-oxybis(ethylamine) | 3033-62-3 | 3%-10% | BASFANZ (2005) | 10% | | ethylamine in NOHSC (1995, p95) |
| | | N,N',N"-tris(dimethylamino-popyl)-hexahydrotrainzine | 15875-13-5 | 5%-10% | BASFANZ (2005) | 10% | | |
| | | 2-(2-(dimethylamino)ethoxy)ethanol | 1704-62-7 | 5%-10% | BASFANZ (2005) | 10% | | |
| | | Iriethylamine | 121-44-8 | 1%-2% | BASFANZ (2005) | 2% | | NOHSC (1995, p112) |
| | | polypropylene glycol | 25322-69-4 | >25% | BASFANZ (2005) | 25% | | NSW DEC (2005, individual toxic, p32) |
| 4(ii) | Catalyst KX 958 | Ingredients | | | | | 36.4 | 4 (65% total catalyst consumption) |
| | | Diethylene glycol | 111-46-6 | >25% | Elastogran (2006b) | 40% | | |
| | | Potassium 2-ethylhexanoate | 3164-85-0 | >25% | Elastogran (2006b) | 40% | | |
| | Catalyst KX 958 | ethyleneglycol | 107-21-1 | 5%-10% | Elastogran (2006b) | 10% | | NSW DEC (2005, individual toxic, p32) |
| Adhesive Coater | Pur-Fect 789A | Ingredients | | | NS&C (2004) | | 97 | |
| | | Urethane reactive hot melt | | 98% | NS&C (2004) | 98% | | Not in references, not assessed |
| | | Diphenyl methane-4, 4-diisocyanate | 101-68-8 | 1%-5% | NS&C (2004) | 5% | | NOHSC (1995 p98, modelled as MDI) |
| Acoustic Barrier | Acoustiflex | Ingredients | | | | | 1,166 | |
| 1 | | DOP | | | | 15% | | |
| 2 | | PVC | | | | 10% | | |
| 3 | | CaCa | | | | 75% | | |
| 4 | | carbon black | 1333-86-4 | | | 1% | | NSW DEC (2005, individual toxic, p31) |
| Fire Barrier | Sodium silicate | Ingredients | | | | | 2,916 | |
| | | Sodium silicate hydrate | 1344-09-8 | > 80% | PQA (2005) | 80% | | |
| | | Hydrated water loss | 7732-18-20 | < 20% | PQA (2005) | 20% | | |
| Render Coater | | Ingredients | | | | | 3,888 | |
| | | Polymer & additives | unspecified | < 10% | Rockcote (2005) | 10% | | |
| | | Inert aggregates | unspecified | 20%-70% | Rockcote (2005) | 70% | | |
| | | cement | unspecified | 20%-50% | Rockcote (2005) | 50% | | |
| Acrylic Sealer | | Ingredients | | | | | 146 | |
| | | Inert pigments | unspecified | 30%-40% | Rockcote (2003) | 40% | | |
| | | Polymer dispersion | unspecified | 35%-45% | Rockcote (2003) | 45% | | |
| | | Additives | unspecified | < 10% | Rockcote (2003) | 10% | | |

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2.3 Air Extraction System

The air extraction system generally consists of a ducting and extraction fan to remove vapours from approximately the area where the foam is laid down on the processing line (**Figure 2-2**, steps **12** to **18**). The main objective of the extraction system is to remove and prevent the build-up of flammable vapours within the foaming gantry room. There are approximately a dozen pick-up points located at strategic points around the room. The system also incorporates a gas monitoring system to ensure that gas vapours do not go above 20% of the Lower Explosive Limit. During normal production the gas meters would be expected to read 0%.

As noted above in **Section 2.2**, the dust extraction system collects particles generated by cutting and abrading of the panels. Dust particles are recycled into the manufacturing process (also refer to **Figure 2-2**, **6**, **29**, **31**, **32**, **34** and **40**).

The following sub-section of the report discusses air emissions from substances used in the manufacturing process.

2.4 Air Emissions from MDI (Methylene Diphenyl Isocyanate)

MDI vapours irritate the mucous membranes of the nose, throat and lungs. Protective gloves and goggles are recommended during all handling of MDI (Elastogran, 2003). Vapours from the MDI used in the production process of the proposed development will be removed via the air extraction system (refer to **Section 2.3**).

Estimates of vapour emission rates for MDI used in the modelling process are discussed in **Section 4.4.3** and **Table 4-6**.

2.5 Air Emissions from Polyol Components including Catalysts

The handling of polyol components also requires the effective ventilation and the wearing of protective gloves and goggles (Elastogran, 2004). Vapours from the polyol components used in the production process of the proposed development will be removed via the air extraction system (refer to **Section 2.3**).

Estimates of vapour emission rates for polyol and catalysts used in the modelling process are discussed in **Section 4.4**.

2.6 Air Emissions from Pentane

Pentane has a low toxicity and a high vapour pressure, and consequently exposure levels may be reached quickly in unfavourable conditions. Therefore an effective ventilation system is required. This particularly applies at floor level because the vapours are heavier than air. Pentane has good solvent properties and can easily penetrate the skin. Thus, goggles and protective clothing is required when handling.

Pentane will be delivered to the site in a Standard ISO Container by an approved dangerous good carrier, such as Chemtrans (refer to **Figure 2-3**).

Figure 2-3 Standard ISO Container for Delivering Pentane to the WIPS Management Site



An estimate of the vapour emission rate for pentane used in the modelling process is discussed in **Section 4.4.3**.

2.6.1 Vapour Recovery Process for Pentane

The vapour recovery or balancing is simply a vent line and valves that connect the top of the storage tank to the top of the ISO Container during transfer. This allows the vapour to balance between both tanks during transfer and hence no vapours are emitted to atmosphere as the net transfer of volume is nil.



3. Air Quality and Dispersion Meteorology

3.1 Overview

This section of the report describes the air quality and meteorological conditions in the area surrounding the HEZ.

The air quality data is sourced from the NSW Department of Environment and Climate Change's (DECC) ambient air quality monitoring site at Beresfield, approximately 25 km east of the HEZ.

Donaldson Mine operates numerous air quality sampling sites in the Black Hill –Beresfield and reports six month summary data. Since 2000, the reports attributed high concentrations of particle matter to high incidences of bushfires, road works, heavy duty vehicles, dust storms and bird droppings (Donaldson 2001, 2002, 2003). Consequently, data in the Donaldson reports were considered inappropriate for characterising air quality in the local area of the HEZ.

The establishment of background air quality levels in the area will enable a comparison the predetermined air quality criteria (refer to Section 3) to be made and air quality margins to be determined.

The meteorological data described in this section is taken from the HEZ site.

3.2 Local Dispersion Meteorology

The impact that air emissions from the HEZ may have on the surrounding area is dependent on the climate and dispersion meteorology.

Latitude, topography, elevation and proximity to the ocean strongly influence the climatology and dispersion meteorology of the area. In general, the climate is mild with warm summers and cool winters. Local diurnal variations in drainage flows also strongly affect climate throughout the year. The rainfall exhibits a distinct seasonal pattern with most rain falling during the summer months.

The Australian Bureau of Meteorology operates a meteorological station at Cessnock (Nulkaba), approximately 8 km north west of the HEZ. The temperature, humidity, rainfall and wind data presented in the following sections were obtained from the Nulkaba station. This data have been recorded by the Bureau of Meteorology for over a period of 20 years. The Nulkaba station is considered to experience similar climatic conditions to the HEZ.

3.2.1 Temperature

As shown in **Figure 3-1**, the area experiences a relatively mild climate with the 9:00 am mean temperatures ranging between 23°C in January to 9.8°C in July. The 3:00 pm mean temperature range is between 28.4°C in January and 16.4°C in July. Overall, the warmest month of the year is

January which experiences a mean daily maximum temperature of 29.9°C, while July is the coolest month experiencing a mean daily maximum temperature of 17.5°C.



Figure 3-1 Mean Monthly Temperature Range, Cessnock (Nulkaba)

3.2.2 Rainfall

The rainfall data presented in **Figure 3-2** shows January, February and March as the wettest months of the year, receiving mean monthly rainfall of 99 mm, 95 mm and 84 mm, respectively. The driest months are July and August, receiving average rainfall of 31 mm and 40 mm, respectively. The mean annual rainfall of 760 mm occurs over an average of 108 rain days throughout the year.



Figure 3-2 Mean Monthly Rainfall and Evaporation, Cessnock (Nulkaba)

The mean monthly evaporation rates (**Figure 3-2**) show a strong seasonal pattern, being greatest during the warmer months and least during the cooler months. Mean monthly evaporation rates range from approximately 51 mm/month in June to 183 mm/month in December. Evaporation typically exceeds rainfall in all months except June, when they are approximately equal.

3.2.3 Relative Humidity

The 9:00 am relative humidity readings recorded at the Nulkaba Station, shown in **Figure 3-3**, are lowest during the warmer months and highest during the cooler months. The relative humidity readings for 9:00 am range between 58% in October to 81% in May. The 3:00 pm relative humidity readings are significantly lower than the 9:00 am readings, exhibiting a range between 42% in August to 56% in May.



3.2.4 Wind Speed and Direction

The general wind flow patterns for the HEZ have been described using surface wind roses and wind frequency data based on 1-hourly data for 2004 obtained from the HEZ meteorological site (as shown on **Figure 1-1**, refer to **Appendix B** for HEZ wind roses). The topographical features within the HEZ, especially the ridgeline running south from Mount Tomalpin, most likely influence the wind flows at the site.

Analysis of surface wind observations during 2004 illustrates the seasonal pattern of winds at the HEZ meteorological site. **Figure A-6-1** shows the seasonal wind roses. The labels on the petals of the wind rose indicate the frequency of winds recorded as blowing from that direction at the HEZ site. During summer, the HEZ site experienced a dominance of winds from the southeast. These



winds turned, flowing from the south-west and north west during autumn. North westerly winds dominated and strengthened during winter.

During the morning hours of autumn light winds from a southerly direction dominate. These light southerly winds turn to stronger north westerly winds towards the end of autumn and continue throughout winter and the beginning of spring. During late spring these north westerly winds are less dominant, with a higher frequency of lighter winds from the southern sector.

3.2.5 Drainage Flows and Temperature Inversions

Night time cold air drainage flows are described by the surface wind roses using 1-hourly data for 2004, obtained from the HEZ meteorological site (refer to **Figure A-6-2**). These wind roses show night time drainage generally flows from the south in summer and west-north-west to south-south-west in winter.

The Hunter Valley Meteorological Study (HVMS, MUSES 1982) presented the most detailed description of atmospheric drainage flows and temperature inversions in the Hunter Valley. The study reported that cold air drainage flows occur frequently during the evenings and night time hours, particularly within the cooler months. Northwest to southeast flows are dominant within the Hunter Valley region. The main north westerly drainage flows down the Hunter Valley are light flows, ranging between 1.5 and 1.9 m/s.

The Kurri Kurri area, located immediately to the north of the HEZ, was found to experience a subregional drainage flow within the main drainage flow, from the south southeast to south southwest directions, with a slightly lower wind speed that the regional northwest to southeast flow (MUSES 1982). The significant topography of Mt Tomalpin, located to the south of Kurri Kurri in the HEZ, most likely is responsible for the drainage flows identified from the HEZ data (refer to **Figure A-6-2**) and the earlier report (MUSES 1982)

The HEZ Air Quality Management Strategy (HAQMS, SKM 2002) reported that afternoon wind patterns in Cessnock during summer and autumn are predominantly from a south easterly direction. By May, the direction of these winds changes to north easterly, which continues to prevail throughout the winter months until October. Winds are stronger during the afternoon than the morning throughout all months of the year.

The *HVMS* (MUSES 1982) also determined that nocturnal radiation inversions within the Hunter Valley are common occurring on most nights with clear skies and calm or low wind speed conditions



These findings may be of critical importance to development within the HEZ as many industries will be locating to the south of the residential areas of Kurri Kurri and Weston, placing them immediately up wind of these areas during drainage flow conditions.

3.2.6 Mixed Layer Height

The mixed layer height is the depth of the atmosphere through which surface based air emissions will disperse. In general, the mixed layer height will increase during the day as the sun causes convection to deepen the turbulent layer near the ground. The depth of the mixed layer is also influenced by wind, generally increasing as wind speeds increase, due to the generation turbulence induced by flow over the rough ground.

Thus mixed layer depth is heavily influenced by wind speeds and surface roughness, and is an important consideration for determining the dispersion of ground based pollutants such as odour into the atmosphere.

3.2.7 Atmospheric Stability Class

Atmospheric stability class is used to categorise the rate at which a plume will disperse. The Pasquill-Gifford stability class assignment scheme uses six stability classes from A through to F. Class A refers to unstable conditions where pollutants spread rapidly throughout the mixed layer and class F refers to stable conditions where plume spread is slow. Atmospheric stability class is also an important consideration for odour dispersion.

3.3 Existing Ambient Air Quality

The *HAQMS* (SKM 2002) identified the air pollutants of interest in the HEZ to be particulate matter smaller that 10 micrograms diameter (PM_{10}), oxides of nitrogen (NO_X) and ozone (O_3). The following sections discuss the trends is ambient concentrations of these air pollutants, with reference to data sources from the air quality monitoring site operated by the DECC at Beresfield.

3.3.1 Particulate Matter Smaller Than 10 Micrometres (PM₁₀)

Figure 3-4 and **Figure 3-5** show the trends in the PM_{10} concentrations at Beresfield, measured by a continuous monitor, the Tapered Element Oscillating Microbalance (TEOM). The data are generally below the DECC criteria for the 24-hour average and the annual average, except for months during spring and summer that are most likely affected by bushfire smoke (PHAA 2001, NSWRFS 2003). In excluding these peaks, average PM_{10} concentrations show a slightly downward trend over the period. It is noted that the results from the Beresfield AQM site would most likely be elevated by traffic on the New England Highway and by heavily laden coal trains on the Main Northern Railway, which passes close to Francis Greenway High, the site of the monitoring station. **Figure 3-5** shows that a background PM_{10} concentration of 19 µg/m³ represents a reasonable assumption for the HEZ.



Figure 3-4 Beresfield PM₁₀ Concentrations, Monthly Maximum 24-hour Average, January 2002 to June 2005, measured by TEOM



Figure 3-5 Beresfield PM₁₀ Concentrations, Average of All Hours in Month, January 2000 to June 2005, measured by TEOM



3.3.2 Nitrogen Dioxide (NO₂)

 NO_2 concentrations recorded at Beresfield during January 2000 to June 2005 were very low compared to DECC air quality criteria. The monthly maximum 1-hour average NO_2 concentrations

were less than 6 pphm, that is, less than 50% of the DECC criterion of 12 pphm (refer to **Figure 3-6**). Similarly, the hourly NO₂ concentrations, averaged for all months, also were less than 50% of the DECC criterion of 3 pphm (refer to **Figure 3-7**). **Figure 3-7** shows that a background NO₂ concentration of 0.9 pphm represents a reasonable assumption for the HEZ. Analysis of average hourly NO_X concentrations suggested an appropriate background NO_X concentration of 19 pphm (DECC, 2000, 2001, 2002, 2003, 2004).

Figure 3-6 Beresfield NO₂ Concentrations, Monthly Maximum 1- Hour Average, January 2000 to June 2005



Figure 3-7 Beresfield NO₂ Concentrations, Average of All Hours in Month, January 2000 to June 2005



3.3.3 Ozone (O₃)

 O_3 concentrations at Beresfield during January 2002 to June 2005 were less than the DECC criterion of 10 pphm for the maximum 1-hour average concentration, with one allowable exceedence (DECC 2005) (refer to **Figure 3-8**). As noted above, the results from the Beresfield AQM site would most likely be elevated by traffic on the New England Highway, in comparison with the HEZ. The hourly O_3 concentrations, averaged for all months, are shown in **Figure 3-9**.

■ Figure 3-8 Beresfield O₃ Concentrations, Monthly Maximum 1- Hour Average, January 2000 to June 2005



■ Figure 3-9 Beresfield O₃ Concentrations, Average of All Hours in Month, January 2000 to June 2005



3.3.4 Summary Background Concentrations

Background concentrations of PM_{10} , NO_2 , NO_X and O_3 were determined from averages of ambient air quality data, as described above, and summarised in **Table 3-2**.

Table 3-1 Background Pollutant Concentrations

| From Statistics: | Background estimate from ambient air quality data | Background concentration used for air dispersion modelling |
|--|---|---|
| PM ₁₀ (average of all hours in months January 2000 - June 2004) | 19 μg/m ³ | 20 μg/m ³ , value used for air dispersion modelling |
| NO ₂ (average of all hours in months January 2000 - June 2004) | 0.9 pphm | Considered to be an overestimate for HEZ. Recommended value used for air |
| NO _X (average of all hours in months January 2000 - June 2004) | 19 pphm | dispersion modelling NO _X = 0.1pphm (M Cope, CSIRO, personal communication, 15/06/06) |
| O_3 (average of all hours in months January 2000 - June 2004) | 1.6 pphm | Recommended value used for air dispersion modelling $O_3 = 2$ pphm (M Cope, CSIRO, personal communication, 15/06/06) |

Note: $\mu g/m^3 =$ micrograms per cubic metre, pphm = parts per hundred million

3.3.5 Air Toxics

No continuous background monitoring of air toxics is available for the local area of the HEZ. During 1996-2000, DECC monitored air toxics in the NSW Greater Metropolitan Region, including three sites in the Hunter, namely Beresfield, Wallsend and Newcastle, located approximately 25 km E, 25 km ESE and 30 km ESE from the HEZ site. Results indicated very low levels in the Hunter, with the three sites scoring a ranking of 4, where rank 1 represented the highest range of monitored levels and rank 4 represented the lowest range (**Table 3-2**) (DECC 2005). These results suggest that existing levels near the HEZ site are expected to be very low.

| Table 3-2 – Annual Av | verage Ground Lev | el Concentrations of Air | Toxics 1996-2000 |
|-----------------------|-------------------|--------------------------|------------------|
| | | | |

| Site | Benzene (ppb) | Toluene (ppb) | Xylene (ppb) |
|------------|---------------|---------------|--------------|
| Beresfield | 0.4 | 0.6 | 1.4 |
| Wallsend | 0.8 | 0.9 | 4.0 |
| Newcastle | 0.6 | 1.1 | 4.0 |



4. Air Quality Assessment

4.1 Overview

This section of the report outlines the ambient air quality criteria applied to the project and the methods and results of modelling which has been applied for assessment purposes.

4.2 Air Emission Standard

For scheduled premises, the *Protection of the Environment Operations (Clean Air) Regulation* 2002 (DECC 2002) sets out the emission standards for volatile organic compounds (VOCs) and principal toxic air pollutants associated with vapour recover units, as in **Table 4-1**.

| Air Impurity | Plant | Standard of Concentration | | |
|--|---|---------------------------|---------------------------|--|
| Volatile organic compounds (VOCs), as n-propane equivalent | Any vapour recovery | Group 1, 2, 3, 4 or 5 | - | |
| | unit treating air impurities that originate from material containing any principal toxic air pollutant* | Group 6 | 20 mg/m ³ VOCs | |
| | Any vapour recovery unit treating air impurities that originate from material not containing any principal toxic air pollutant | Group 1, 2, 3, 4 or 5 | - | |
| | | Group 6 | 40 mg/m ³ VOCs | |

Table 4-1 – Standards of Concentration for Scheduled Premises: vapour recovery units (DECC 2002).

Note 1: Subject to this Division of *Protection of the Environment Operations (Clean Air) Regulation 2002* (DECC 2002), an activity carried out, or plant operated, on scheduled premises belongs to Group 6 if it commenced to be carried on, or to operate, on or after 1 September 2005, as a result of an environment protection licence granted under the Protection of the Environment Operations Act 1997 pursuant to an application made on or after 1 September 2005.

Principal toxic air pollutants are defined on the basis that they are carcinogenic, mutagenic, teratogenic, highly toxic or highly persistent in the environment (DECC 2005). Pentane is a VOC and the calculated emission concentration is approximately 375 mg/m³, which is above the standard concentration in **Table 4-1**. However, while pentane is an individual toxic air pollutant, it is not a principal toxic air pollutant. Thus, the criteria in **Table 4-1** do not apply to the proposed WIPS Management plant.

4.3 Ambient Air Quality Criteria

The principal urban air pollutants relevant to this report are shown in **Table 4-2** (DECC 2005) and **Table 4-3** (DECC 2006, NOHSC 1995).



Table 4-2 – DECC Ambient Air Quality Impact Assessment Criteria

| Pollutant | Averaging Period | Concentration | Units | Source |
|----------------------|------------------|---------------|-------------------|-----------|
| Ozone O ₃ | 1 hour | 10 | pphm | NEPC 1998 |
| NO ₂ | 1 hour | 12 | pphm | NEPC 1998 |
| | Annual | 3 | pphm | NEPC 1998 |
| PM ₁₀ | 24 hours | 50 | pphm | NEPC 1998 |
| | annual | 30 | μg/m ³ | EPA 1998 |

Note: pphm = parts per hundred million, $\mu g/m^3$ = micrograms per cubic metre, mg/m³ = milligrams per cubic metre

Table 4-3 –Impact Assessment Criteria for Individual Toxic Air Pollutants

| Product Common Name | Chemical components | Impact Assessment Criteria | Source |
|---------------------------|-------------------------------|----------------------------------|------------------------------------|
| MDI | methylene diphenyl isocyanate | 0.00004 | DECC (2005, principal toxic, p30) |
| Pentane | n-pentane | 33 | DECC (2005, individual toxic, p32) |
| Catalyst | ethylamine | 0.3 | NOHSC (1995, p95)* |
| | triethylamine | 0.2 | NOHSC (1995, p112)* |
| | polypropylene glycol | 6.6 | DECC (2005, individual toxic, p32) |
| | Ethyleneglycol | 1.0 | DECC (2005, individual toxic, p32) |
| | | | |

* Impact assessment criteria derived from exposure standard, time- weighted average, 8 hour day, 5 day week

4.4 Modelling Methodology

The *HEZ Air Emissions Assessment – Allocating Margins* Study (SKM 2005) applied The Air Pollution Model (TAPM) (CSIRO, Hurley 2003) to investigate the capacity of the HEZ to comply with ambient air quality criteria. This report also uses TAPM to assess the air impacts of the proposed WIPS Management plant, to ensure a consistent approach to air emissions assessment for the HEZ.

4.4.1 Description of The Air Pollution Model (TAPM)

The Air Pollution Model (TAPM) developed by the CSIRO (Hurley 1999, 2005) predicts local meteorological and air pollution concentration components.

The meteorological component predicts winds, temperature, pressure, water vapour, cloud/rain water and turbulence. The model is driven by six-hourly synoptic scale data for wind, temperature, rainfall and specific humidity from the Bureau of Meteorology Limited Area Prediction System (LAPS) model. TAPM also has a data assimilation capacity, which uses observed wind speed and wind direction data to nudge the predicted concentrations towards the observations. That is, data assimilation allows the predicted values to compare more closely with meteorological observations from the local area.



The air pollution component of TAPM predicts concentrations of the air pollutants using either a photochemistry mode that accounts for interaction of urban air to produce PM_{10} , NO_2 , NO_X , SO_2 and O_3 , or a tracer mode that is suited to the modelling of as individual pollutants such as pentane emissions. The building wake component allows plume rise and dispersion to include wake effects on meteorology and turbulence.

4.4.2 Model Configuration

TAPM v.3.0.7 was run for the period 1/1/2004 to 31/12/2004 and configured with four nested grids of 25 x 25 x 25 points with grid spacing of 30,000, 10,000, 3,000 and 1,000 metres for meteorology. The grids were centred at latitude and longitude -32°50"30', 115°24" corresponding to map grid reference Easting 350,000m, Northing 6,365,000m, using map projection MGA Zone 56 (GDA 94). Default model options were used for soil parameters and the main land use type around the HEZ. The terrain data used was obtained from Geoscience Australia (SI56) at ninesecond grid spacing (approximately 0.3 km).

Modelling was conducted using meteorology produced by TAPM, as well as with assimilation of wind data. Observations of wind speed and wind direction used in this modelling were taken from the from the HEZ meteorological station (as shown on **Figure 1-1**).

Initially, TAPM was configured to model pentane emissions in Tracer Mode, applying the pentane emissions release parameters shown in **Table 4-4**). No background pollutant concentrations were included.

In addition, TAPM was configured to run in photochemistry mode, using the following background concentrations (refer to **Table 3-1**):

- $PM_{10} \ 20 \ \mu g/m^3$
- $NO_X 0.1 pphm$
- O₃ 2 pphm
- Rsmog 0.05 pphm

Data for the building wake component as follows:

- Height of building -12 m
- North West Corner Easting (m) 354,826 Northing (m) 6,6365,437
- North East Corner Easting (m) 355,021 Northing (m) 6,365,391
- South East corner Easting (m) 354,974 Northing (m) 6,365,167

4.4.3 Air Emission Release Parameters Used in the Modelling Assessment

For the purpose of modelling, it was assumed that the proposed plant was ventilated by an exhaust stack or flue, located along the northern wall of the plant and extending 2 metres past the roof line (refer to **Figure 1-3** section line 06-03).

Table 4-4 sets out the parameters for modelling the release of air emissions from pentane and MDI.

| Parameter | Characteristics |
|--|---|
| Height of exit point above ground | 14 metres (m) |
| Flue internal radius | 0.5 m |
| Exit velocity of emission | 9 metres per second (m/s) |
| Emission exit temperature | 300 Kelvin (K, close to ambient) |
| Emission of MDI | 0.00001 (g/s) (also refer to Table 4-5 and Table 4-6) |
| Emission rate of pentane | 3.75 grams per second (g/s), refer to Section 4.4.3 and Table 4-3 |
| Emission rate of other chemical components | (Refer to Table 4-5) |

Table 4-4 Parameters for Modelling Air Emissions Release

The emission rates of vapours released from the chemical components used in the manufacturing process were derived from a number of sources. **Table 4-5** lists the emission rates used in the modelling of air impacts in this report.

The emission rate of pentane, 3.75 g/s, was based on the assumption that pentane released vapours at a rate of 5% of hourly consumption (270 kg/hr, WIPS Management Australia, 2006c). This value was selected based on advice, first, that the maximum emission rate of pentane during production is 5% of the used pentane, and second, that in most of the plant the emission rate will be much lower.

The emission rate for MDI was calculated with reference to a case study of a polyurethane wall panel manufacturing plant in German, provided by *Elastogran*, (Volker.nuthmann@elastogran.de). The case study reported quantities of raw material consumption for main ingredients, the ventilation rate of the plant exhaust system and the measured concentration of MDI. This example was used in conjunction with the materials consumption rates proposed for the WIPS Management development and an emission rate for MDI was derived using the method presented in which described in **Table 4-6**.

Material safety data sheets provided information on the percentage composition of chemical ingredients in the component products (refer to **Table 4-5**). This information was used in conjunction with material consumptions rates to estimate emission rates for the individual ingredients. In the case of some ingredients, for this assessment, it was assumed that 100% of the

product would be vapourised. For these ingredients, the emission was assumed to be equal to the application rate of the chemical (refer to **Table 4-6**).

 Table 4-5 Calculated vapour emission rates for chemical substances used in the manufacturing process

| Product Common Name | Chemical components | Product Application Rate (kg/hr | Ingredient Application Rate (%) | Ingredient Application Rate (g/s) | Estimated Vapour Emission Rate (g/s) |
|---------------------------|-------------------------------------|---------------------------------------|---------------------------------------|---|---|
| MDI | methylene diphenyl isocyanate | 1,620 | 100% | 450 | 0.00001 ^a |
| Pentane | n-pentane | 270 | 100% | 75 | 3.75 ^b |
| Catalyst | Catalyst KX491 [°] | 19.6 | | | |
| | ethylamine | | 10% | 0.54 | 0.54 ^d |
| | triethylamine | | 2% | 0.11 | 0.11 |
| | polypropylene glycol | | 25% | 1.36 | 1.36 |
| | Catalyst KX 948 | 36.4 ^e | | | |
| | Ethyleneglycol | | 10% | 1.01 | 1.01 |

^a Refer to **Section 4.4.3** and **Table 4-6**; ^b 5% vaporised; ^c 35% of total catalyst, 56 kg (WIPS Management Australia, 2006c); ^d Assume emission rate = 100% of consumption rate; ^e 65% of total catalyst

Table 4-6 Method for Estimating Air Emission Rate for Modelling MDI

| Work: To calculate emission rate for MDI (based on application rate 450g/s) | | | | | | |
|---|--|----------------------------|-------------------|--|--|--|
| Given | Concentration rate (mg/m3) x Ventilation Rate (m3/h) = Vapour Emission Rate (mg/h) | | | | | |
| | | | | | | |
| From Germa | an Example | | | | | |
| | Consumption rate (MDI) = | 558 | kg/h | | | |
| | = | 155 | g/s | | | |
| | | | | | | |
| | Concentration rate (MDI) = 0.002 mg/m ³ | | | | | |
| | Ventilation rate = | 6300 | m³/h | | | |
| | | | | | | |
| then | | | | | | |
| | Vapour Emission Rate (MDI) = | 12.6 | mg/h | | | |
| | = | 0.000035 | g/s | | | |
| | | | | | | |
| By Unitary N | lethod | | | | | |
| | Consumption rate (MDI) (g/s) | Vapour Emission Rate (g/s) | Comment | | | |
| lf | 155 | 0.0000035 | German example | | | |
| then | 1 | 0.000000226 | Unitary method | | | |
| and | 450.0 | 0.00001 | For modelling MDI | | | |



4.5 Air Dispersion Modelling Results

This section of the report discusses the modelled results for MDI, pentane and other substances used in the manufacturing process, as well as PM_{10} , NO_2 and O_3 .

MDI and pentane were modelled using TAPM in tracer mode. Results are presented in **Figure 4-1** and **Figure 4-2**. These results were used to derive the impacts of other substances used in the manufacturing process. These results are summarised in **Table 4-7**.

In addition, pentane was modelled as a volatile organic compound (VOC), using TAPM in photochemistry mode. Atmospheric photochemistry typically involves interactions between VOCs, such as pentane, and the major urban air pollutants PM_{10} , NO_X/NO_2 and O_3 . Results indicated that impacts were low, due to the relatively very small amount of pentane emitted (3.75 g/s). The impacts are discussed below (refer to **Section 4.5.3**), however, concentration plots for PM_{10} , NO_2 and O_3 are not included.

4.5.1 Modelled MDI Dispersion

TAPM predicted very low concentrations of MDI across the study area (refer to Figure 4-1).

The maximum 1-hour MDI concentration predicted for the HEZ is $2.22 \times 10^{-7} \text{ mg/m}^3$, which is less than 1 % compared of the DECC criterion of $4.0 \times 10^{-5} \text{ mg/m}^3$.

Figure 4-1 shows the predicted maximum 1-hour MDI concentrations, with contours indicating very low levels, less than $1.0 \times 10^{-7} \text{ mg/m}^3$, in the nearby residential area of Pelaw Main.





Figure 4-1 Modelled Maximum Hourly MDI Concentrations (mg/m³)



4.5.2 Modelled Pentane Dispersion

The maximum hourly pentane concentration of 0.569 mg/m^3 predicted for the HEZ is very low, less than 2 % of the DECC criterion of 33 mg/m^3 .

Figure 4-2 shows the predicted maximum 1-hour pentane concentrations, with contours indicating pentane concentration levels of approximately of 0.050 mg/m³ in the nearby residential area of Pelaw Main.



Figure 4-2 Modelled Maximum Hourly Pentane Concentrations (mg/m³)



4.5.3 Modelled Impact of Pentane on Atmospheric Photochemistry

As noted above, pentane was modelled as a volatile organic compound (VOC), using TAPM in photochemistry mode, to assess the impact of pentane emissions on concentrations of the urban air pollutants PM_{10} , NO_X/NO_2 and O_3 .

Modelling of pentane emissions had a minimal impact on PM_{10} formation from the proposed development. TAPM predicted that pentane emissions would add an additional 0.3 µg/m³ to the annual average PM_{10} concentration across the study area and up to 2.0 µg/m³ to the maximum 24-hour concentration. The predicted 24-hour maximum PM_{10} concentrations ranged from 20.4 to 22.0 µg/m³ across the study area. The predicted PM_{10} concentrations are low compared to the DECC criteria of 50 µg/m³ for the 24 hour average concentration.

Similarly, predicted NO₂ concentrations indicate a minimal impact of pentane emissions from the proposed plant. The predicted annual average NO₂ concentration ranged from 0.08 to 0.10 pphm. The maximum 1-hour NO₂concentration was predicted to range from 0.09 to 0.10 pphm. Modelled NO₂ concentrations are predicted to be low compared to the DECC criteria of 3 pphm for the annual average and 12 pphm for the 1-hour maximum concentration.

Predicted O_3 concentrations indicated a minimal impact of pentane emissions from the plant and are low compared with the DECC criteria of 10 pphm for the maximum 1-hour average concentration. The maximum 1-hour O_3 concentration was predicted to range from 3.25 to 3.97 pphm. The predicted annual average O_3 concentration ranged from 2.03 to 2.11 pphm.

4.5.4 Dispersion of Other Toxic Substances in the Manufacturing Process

The impacts of other toxic substances used in the manufacturing process were derived by scaling the results from the modelling of pentane. The analysis indicated that the projected air impacts of toxic substances used in the manufacturing process are within the impact assessment criteria (refer to **Table 4-7**).

It is noted that the modelling assessment applied to these substances is very conservative, in that it assumes that 100% of the substance used in the process is emitted whereas, in reality, emissions would be negligible or non-existent.

Table 4-7 Projected Air Impacts of Other Components in the Manufacturing Process

| Process | Substances / produ | cts used in manufacturing process | | | | | | |
|-----------------------|--------------------|---|--|--|---|---|---|--|
| Number of Products | Common Name | Chemical Components | Assume emission rate = 100% consumption rate (g/s) | Calculated vapour emission rate (g/s) | Modelled maximum concentration (mg/m3) | Projected maximum concentration (mg/m ³) | Impact Assessment Criteria (1hour averaging period, mg/m ³) | Comparison with Impact assessment criteria (mg/m3) |
| Laydown | MDI | La sura d'a sta | | | | | | |
| | MDI | Ingredients | | | | | | |
| | | methylene diphenyl isocyanate (diphenylmethane diisocyanate) | | | 0.000000222 | | 0.00004 | Within criteria |
| | Pentane | n-pentane | | 3.75 | 0.569 | | 33 | Within criteria |
| | Catalyst | | | | | | | |
| | Catalvet KX 401 | Ingradianta | | | | | | |
| | | N,N,N',N'-tetramethyl-2, 2'- oxybis(ethylamine) Triethylamine polypropylene glycol | 0.54 0.11 1.36 | | | 0.082 0.017 0.206 | 0.3 0.2 6.6 | Within criteria Within criteria Within criteria |
| | Catalyst KX 958 | Ingredients | | | | | | |
| | Catalyst KX 958 | ethyleneglycol | 1.01 | | | 0.153 | 1.0 | Within criteria |
| Adhesive Coater | Pur-Fect 789A | Ingredients | | | | | | |
| | | Diphenyl methane-4, 4-diisocyanate | included in MDI | | | | 0.00037 | Within criteria |
| | | | | | | | | |



4.6 Consideration of Cumulative Impacts

The following sections outline a consideration of cumulative impacts on ambient air quality. The cumulative impact of NO_x , PM_{10} , MDI and Pentane are considered.

4.6.1 NO_x and PM₁₀ Emissions

SKM (2006) undertook a dispersion modelling exercise to quantify emission margins that could result from the development of the HEZ. As part of the allocating margins exercise, dispersion modelling of NO_x/NO_2 and PM_{10} were undertaken with consideration of present background pollution levels, including O_3 . Results from SKM (2006) show an allowable margin of 20 ppb and $10 \ \mu g/m^3$ for annual average NO_2 and PM_{10} respectively. The results of SKM (2006) modelling also indicate that facilities, including WIPS Management, could emit up to a total of 250 g/s NO_2 and 63 g/s PM_{10} in conjunction with defined background pollution whilst still maintaining ambient air quality to within the allowable margins.

It is noted that the WIPS Management facility will have no direct emission of NO_x and as such will have a negligible impact on emission margins that can be allocated to the other industries developing in the HEZ. That is, there is no cumulative impact of NO_x emissions impacting on air quality other than a minor potential increase in NO_2 (less than 0.1 pphm as a 1-hour maximum impact) resulting from secondary reactions of VOC (pentane) emissions.

With respect to PM_{10} , there will be negligible emissions of particulates, with sophisticated pollution controls being applied to all foam cutting operations which is the only potential source of PM_{10} . As such, no erosion of the estimated PM_{10} margin allowable in the HEZ will result from the WIPS Management development.

4.6.2 MDI and Pentane Emissions

In the general industrial context, MDI and Pentane emissions are considered uncommon, with very few industry types using such substances. On this basis, it is considered unlikely that a significant cumulative impact will result from emissions of MDI or Pentane from the WIPS Management site. A search of the National Pollutant Inventory, for the year 2005/2006, shows that no stationary industrial sources reported emitting MDI emissions in the Greater Metropolitan Sydney region. The NPI shows only four industrial facilities reporting emissions of MDI within Australia as a whole. Pentane is not listed as a separate NPI reporting substance; however it would be reported under the generic classification of total volatile organic compounds, along with many other substances. On the basis of the narrow selection of industry types that utilise MDI and Pentane, coupled with the very few facilities that report MDI emissions within Australia, it is unlikely the future development of the HEZ will yield many more facilities that emit either substance.



Significant cumulative impacts caused by emissions of MDI or Pentane within the HEZ are unlikely. However, should another facility with the potential to emit either MDI or Pentane propose development within the HEZ, a cumulative impact assessment should be undertaken, taking into account WIPS Management emissions.



5. WIPS Management Greenhouse Gas Assessment

5.1 Overview

This section of the study provides an assessment of greenhouse gas (GHG) emissions from the proposed WIPS Management operation. Specifically this section includes the following:

- A summary of greenhouse gases and climate impacts;
- International, National and State and Territory responses to Greenhouse;
- A brief description of how the proposed plant operates and it's energy requirements; and
- Greenhouse Gas emissions associated with the proposed plant.

5.2 Greenhouse Gas Issues

This section of the report sets out issues associated greenhouse gases and climate change. Also detailed are national and international responses to greenhouse gas management.

5.2.1 Climate Change

The greenhouse effect is a natural phenomenon that makes the Earth 33°C warmer than it would otherwise be, and occurs due to gases found in the atmosphere known as greenhouse gases (GHG). Since the start of the Industrial Revolution (c1750-1800) the emission of greenhouse gases has risen substantially due to increased industrial and agricultural production, and the use of fossil fuels. The resulting enhancement to GHG levels has led to increased global temperatures and changes in precipitation patterns.

It is reported that the global rate of increase in the atmosphere of CO_2 concentrations over the last 200 years far exceeds the rate of the previous 20,000 years. Although Australia contributes just 1% of the global GHG emissions, our per capita emissions are amongst the highest in the world (AGO, 1998). Overall total net greenhouse gas emissions in Australia increased 6.3% between 1990 and 2000. Between 1999 and 2000 alone emissions increased by 2.1%. Most of the increases have come from energy generation, agriculture and motor vehicles.

5.2.2 Important Greenhouse Gasses

Major GHGs produced or influenced by human activities include the following. A brief discussion on each of these gases is presented below:

- Carbon dioxide (CO₂);
- Methane (CH₄);
- Nitrous oxide (N₂O);



- Synthetic halocarbons;
- Sulfur hexafluoride (SF₆); and
- Other important gases.

Carbon Dioxide

Carbon dioxide is the main anthropogenic gas contributing to climate change and concentrations of this gas in the atmosphere have increased by 30% during the past 200 years (CSIRO, 2000). The major anthropogenic sources of CO_2 emissions are fossil fuel combustion and land clearing for agriculture.

Methane

Atmospheric methane concentrations have increased by 150% during the past 200 years (CSIRO, 2000) and although there is less methane in the atmosphere than CO_2 , it is a significantly stronger greenhouse gas. The major anthropogenic sources of methane are cattle, rice growing and leakages during natural gas production, distribution and use. Presently, natural processes remove methane from the atmosphere at almost the same rate as it is being added to it. However, over the next 100 years, methane concentrations are likely to rise.

Nitrous Oxide

Atmospheric nitrous oxide concentrations have increased by 15% during the past 200 years and it can persist in the atmosphere for up to 100 years. Major sources of nitrous oxide include industrial processes, fertiliser use and other agricultural activities, including land clearing.

Halocarbons and Sulphur Hexafluoride

Hydrofluorocarbons (HFC) are chlorofluorocarbons (CFC) with the chlorine atom removed, and were introduced to replace CFCs in the refrigerant industry since they do not deplete ozone. However, HFCs can be over 11,000 times stronger greenhouse gases than CO₂.

HFCs, PFCs (perfluorocarbons, another CFC substitute) and sulfur hexafluoride (a gas used for electrical insulation) are powerful greenhouse gases. Technologies exist to reduce emissions of these gases to near zero over the next few decades. Thus, they represent probably the most significant, immediate opportunity to slow down the current growth of greenhouse gases in the atmosphere.

Other Important Gasses

The hydroxyl radical (OH) is a highly reactive agent that helps cleanse the atmosphere of pollutants such as methane. OH will also react with carbon monoxide which, although not a GHG, reduces the amount of OH in the atmosphere, thereby increasing the length of time Greenhouse Gases such

as methane stay in the atmosphere. Carbon monoxide, hydrocarbons and oxides of nitrogen can react to form ozone, another GHG. In contrast to ozone depletion in the stratosphere, ozone in the troposphere acts as an effective GHG.

5.2.3 Global Warming Potential

Global warming potentials (GWPs) are used to compare the abilities of different greenhouse gases to trap heat in the atmosphere. GWPs are based on the radiative efficiency (heat-absorbing ability) of each gas relative to that of carbon dioxide (CO_2), as well as the decay rate of each gas (the amount removed from the atmosphere over a given number of years) relative to that of CO_2 . The GWP provides a construct for converting emissions of various gases into a common measure, which allows climate analysts to aggregate the radiative impacts of various greenhouse gases into a uniform measure denominated in carbon or carbon dioxide equivalents.

The generally accepted authority on GWPs is the Intergovernmental Panel on Climate Change (IPCC). In 2007, the IPCC updated its estimates of GWPs for key greenhouse gases. **Table 5-1** compares the GWPs published in 1996 in the IPCC's Second Assessment Report with those published in 2001 in the IPCC's Third Assessment Report (TAR) and 2007 in the Fourth Assessment Report (AR4).

| Greenhouse Gas | 1996 IPCC GWP | 2001 IPCC GWP | 2007 IPCC GWP |
|--|---------------|---------------|---------------|
| Carbon Dioxide | 1 | 1 | 1 |
| Methane | 21 | 23 | 25 |
| Nitrous Oxide | 310 | 296 | 298 |
| HFC-23 | 11,700 | 12,000 | 14,800 |
| HFC-125 | 2,800 | 3,400 | 3,500 |
| HFC-134a | 1,300 | 1,300 | 1,430 |
| HFC-143a | 3,800 | 4,300 | 4,470 |
| HFC-152a | 140 | 120 | 124 |
| HFC-227ea | 2,900 | 3,500 | 3,220 |
| HFC-236fa | 6,300 | 9,400 | 9,810 |
| Perfluoromethane (CF ₄) | 6,500 | 5,700 | 7,390 |
| Perfluoroethane (C ₂ F ₆) | 9,200 | 11,900 | 12,200 |
| Sulphur Hexafluoride (SF ₆) | 23,900 | 22,200 | 28,800 |

Table 5-1 Comparison of 100-Year GWP Estimates from the IPCC's Second (1996), Third (2001) and Fourth (2007) Assessment Reports

In assessing the greenhouse impact from a collection of different gases it is typical to report the collective impact as carbon dioxide equivalents (CO₂-e).



 $^{\circ}CO_2$ -e' is a metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). For example, the GWP for methane is 23 and for nitrous oxide 296. This means that emissions of 1 tonne of methane and nitrous oxide respectively is equivalent to emissions of 23 and 296 tonnes of carbon dioxide in terms of GWP.

5.3 Greenhouse Gas Response and Management

This section of the report sets out both international and national response to greenhouse gas management.

5.3.1 International Response – Kyoto Protocol

The international response to climate change has involved the development of an international treaty designed to limit the emissions of GHG and ozone depleting substances: the *Kyoto Protocol to the Framework Convention on Climate*.

The Kyoto Protocol establishes provisions to limit emissions of specified Greenhouse Gases (GHGs) (UNEP, 1997). Australia took an active part in negotiating the *Kyoto Protocol* and subsequently signed it in 1998 (Commonwealth of Australia 1998). Most signatories to the *Kyoto Protocol* would be required to reduce GHG emissions by at least five per cent below 1990 levels by 2008–2012 (DEC, 2003).

It should be noted that Australia ratified the Kyoto Protocol in December 2007, however the completion of legalities associated with ratifying the agreement are not expected to occur until mid-way through 2008.

The Kyoto Protocol sets a framework for the control of the emission of six greenhouse gases (GHGs). These are:

- Carbon dioxide (CO₂);
- Methane (CH₄);
- Nitrous oxide (N₂O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Sulphur hexafluoride.

5.3.2 National Response

National Greenhouse Strategy

The *National Greenhouse Strategy* was developed to provide the strategic framework for an effective greenhouse response and for meeting current and future international commitments



(Commonwealth of Australia 1998). The Strategy was endorsed by the Commonwealth and all State and Territory governments in 1998. The three goals of the *National Greenhouse Strategy* are:

- 1) to limit net GHG emissions, in particular to meet our international commitments;
- 2) to foster knowledge and understanding of greenhouse issues and
- 3) to lay the foundations for adaptation to climate change.

Australia has developed methodologies consistent with the Intergovernmental Panel on Climate Change (IPCC) guidelines for preparing and reporting the National Greenhouse Gas Inventory (NGGIC, 1996).

The Australian Greenhouse Office

The Australian Greenhouse Office, part of the Department of the Environment and Heritage, delivers the majority of programs under the Australian Government's \$1.8 billion climate change strategy.

The Government's climate change strategy is centred on five key areas including emissions management, international engagement, strategic policy support, impacts and adaptation, and science and measurement. Major initiatives include:

- boosting renewable energy actions and pursuing greater energy efficiency;
- investing significant resources into greenhouse research and monitoring Australia's progress towards its Kyoto target through the National Greenhouse Gas Inventory;
- studying the landscape of Australia through the National Carbon Accounting System;
- encouraging the development and commercialisation of low emissions technologies; and
- encouraging industry, business and the community to use less greenhouse intensive transport
- fostering sustainable land management practices.

The Australian Government is building partnerships with industry through the <u>Greenhouse</u> Challenge program, which provides a framework for undertaking and reporting on actions to abate emissions. The Greenhouse Friendly initiative and <u>Greenhouse</u> Gas Abatement program encourage industry action to abate greenhouse emissions from range of sectors.

In addition, the Government encourages households, communities and local councils to take action to reduce greenhouse gas emissions through its Local Greenhouse Action initiative which includes the International Cities for Climate Protection program. Action is also being pursued with the energy industry through the establishment of efficiency standards.

5.3.3 NSW State Response

In 2005 the NSW Government announced the NSW Government Greenhouse Plan following the release of a Discussion Paper on a New South Wales Greenhouse Strategy in 2004 for community consultation¹. Key principles and goals of the Plan include:

- Raising awareness of climate issues within the broader community;
- Recognising that climate change is a global, long term and complex issue with no easy solution;
- Promoting understanding of the likely impacts on NSW, and identify strategies for adaptation to the environmental, social and economic impacts of climate change;
- Limiting the growth of greenhouse gas emissions and reduce these emissions in NSW. The Plan outlines targets, strategies and actions to achieve significant emission reductions;
- Promoting climate change partnerships through co-operative approaches by Government, individuals, industry, business and community groups;
- Reducing business uncertainties by establishing carbon constraints in order to promote new investment and innovation;
- Identifying key strategic areas for cooperative work with other Australian jurisdictions
 including the development and establishment of a Kyoto compliant national emissions trading
 scheme; and
- Assisting in implementing these key strategic initiatives, the Government has established a special Greenhouse Innovation Fund with a total of \$24 million in funding over a four year period.

Specific initiatives have also been developed for the following sectors:

- Energy generation and energy efficiency;
- Buildings;
- Transport;
- Waste;
- Industrial processes and fugitive emissions;
- Agriculture, natural resources and land management; and
- Government leadership and Government Energy Management Policy.

The Plan will be oversighted by the NSW Greenhouse Office and a Chief Executive Officers Group chaired by the Director General, The Cabinet Office, with annual progress reports published.

¹ http://www.greenhouse.nsw.gov.au/climate_change_in_nsw/greenhouse_plan



In June 2005 the NSW Government became the first Australian jurisdiction to commit to long term reduction targets of a 60% cut in greenhouse emissions by 2050, and a return to year 2000 greenhouse emission levels in NSW by 2025. The NSW Government also supports a national target of 60% reduction in carbon dioxide equivalent emissions by 2050.

5.3.4 Local Government Response - Cessnock Council

Cessnock City Council (CCC) is undertaking a range of initiatives to help reduce GHG emissions in within the local government area. CCC is a participant of the international Cities for Climate (CCP) Protection program, which it has proscribed to since 2002. As part of its participation in the program, CCC is developing a Local Greenhouse Action Plan, which is aimed a reducing GHG emissions through energy efficiency as well as exploring opportunities for the employment of alternate fuels and the purchase of green energy.

In addition to participating in the CCP program, CCC is pursuing additional programs to achieve a reduction in GHG emissions. These programs include:

- The Refit Program, in partnership with Energy Australia and Hunter Water, which provides low cost kits for reducing household energy and water usage, and;
- Submittion of BASIX Certificates with a development application, aimed at ensuring building/dwelling designs are energy efficient.

5.4 WIPS Management Operation Greenhouse Gas Assessment

GHG emissions are likely to result from the WIPS Management operation via the consumption of grid supplied electricity. The following sections provide an assessment of GHG emissions resultant from WIPS management consumption of NSW grid electricity.

5.4.1 Greenhouse Gas Emission Factors

The Australian Greenhouse Office have prepared a document called *AGO Factors and Methods Workbook, December 2006 – For use in Australian Greenhouse Emissions Reporting* (AGO, 2006) which provides a single source of current greenhouse gas emission factors for Australian organisations to estimate their emissions and abatement.

This workbook provides three types of assessment categories -

- Scope 1 covers direct (or point source) emissions per unit of activity at the point of emission release (i.e. fuel use, energy use, manufacturing process activity, mining activity, on-site waste disposal, etc.).
- Scope 2 covers indirect emissions from the combustion of purchased electricity, steam or heat produced by another organisation. Scope 2 emissions are physically produced by the burning of fuels (coal, natural gas, etc.) at the power station or facility. Following The



GHG Protocol, scope 2 emissions are allocated to the organisation that owns or controls the plant or equipment where the electricity is consumed. The electricity consumer reports only the emissions from the electricity they use under scope 2, and reports the emissions associated with transmission and distribution (T&D) losses under scope 3.

- 3) Scope 3 includes all other indirect emissions that are a consequence of an organisations activities but are not from sources owned or controlled by the organisation. Scope 3 emission factors should be used for organisations that:
- burn fossil fuels: to estimate their indirect emissions attributable to the extraction, production and transport of those fuels; or
- consume purchased electricity: to estimate their indirect emissions from the extraction, production and transport of fuel burned at generation and the indirect emissions attributable to the electricity lost in delivery in the T&D network.

For example scope 3 emissions can include:

- Disposal of waste generated (e.g. if the waste is transported outside the organisation and disposed of);
- Use of products manufactured and sold;
- Disposal (end of life) of products sold;
- Employee business travel (in vehicles or aircraft not owned or owned by the reporting organisation);
- Employees commuting to and from work;
- Extraction, production and transport of purchased fuels consumed;
- Extraction, production and transport of other purchased materials or goods;
- Purchase of electricity that is sold to an end user (reported by electricity retailer);
- Generation of electricity that is consumed in a T&D system (reported by end user);
- Out-sourced activities; and
- Transportation of products, materials and waste.

Emissions from the WIPS Management plant are considered to fall under Scope 2 and Scope 3, as such providing a full fuel cycle emission factor. A full fuel cycle emission factor gives the quantity of emissions released per unit of energy for the entire fuel production and consumption chain.

For the consumption of purchased electricity, the full fuel cycle emission factor is the sum of the 'scope 2' indirect emission factor for emissions from fuel combustion at the power station and the specific 'scope 3' emission factor for emissions from the extraction, production and transport of



that fuel and for emissions associated with the electricity lost in transmission and distribution (AGO, 2006).

5.4.2 WIPS Management Operation Greenhouse Gas Emissions

The WIPS Management plant will use only electricity from the existing NSW grid and will not directly combust fuels such as natural gas on-site. In this case emission factors used are those for the consumption of purchased electricity. The factors estimate emissions of CO_2 , CH_4 and N_2O expressed together as carbon dioxide equivalent (CO_2 -e). The greenhouse gas emissions in tonnes of CO_2 -e attributable to the quantity of electricity used may be calculated with the following equation:

GHG emissions (t CO_2 -e) = Q x EF /1000

Where: Q (activity) is the electricity consumed by the plant (kWh or GJ); EF is the relevant emission factor, and division by 1000 converts from kg to tonnes (AGO, 2006).

The emission factor for scope 2 covers emissions from fuel combustion at power stations associated with the consumption of purchased electricity. The emission factor for scope 3 covers both the emissions from the extraction, production and transport of fuels used in the production of the purchased electricity (i.e. fugitive emissions and stationary and mobile fuel combustion emissions) and also the emissions associated with the electricity lost in transmission and distribution on the way to the consumer (from both fuel combustion and fuel extraction).

Indirect greenhouse emissions from the consumption of electricity are calculated in **Table 5-2** from 2006 NSW grid average emissions factors. The emission factor includes CO_2 , CH_4 and N_2O direct emissions from power generation as well as indirect combustion and fugitive emission from transmission losses etc.

| Variable | Value | Units |
|--------------------------------------|---------|--------------|
| 2006 full fuel cycle emission factor | 1.068 | kg CO2-e/kWh |
| Annual energy consumption | 7373513 | kWh/year |
| Total CO2-e | 7875 | t/year |

Table 5-2 WIPS Management Plant GHG Emissions

The above emission calculation is based on an estimated facility electricity consumption, where the facility operates 7 days per week and 24 hours per day. The assessment assumes facility operations of up to 90% of the time on an annual basis. From a realistic standpoint, it is possible that the WIPS Management plant could experience 'downtime' for up to 10% of the time on annual basis, this may result from scheduled servicing, breakdowns and other non operational periods.



5.4.3 Percentage of National Greenhouse Gas Emissions

From Australia's National Greenhouse Gas Inventory Report (AGO, 2005), the energy usage of the proposed plant can be compared with total national Greenhouse Gas emissions.

Net Greenhouse Gas emissions are reported by AGO (2005) as 559 Mt CO2-e in 2005, an increase of 11 % from 1990 levels. A breakdown of Greenhouse Gas emissions across various sectors is presented in **Table 5-3**.

Table 5-3 Australian Net Greenhouse Gas Emissions by Sector (Kyoto accounting), 2005 (Source: National Greenhouse Gas Inventory Report (2007))

| Sector and Subsector | Emissions (Mt) | | | | |
|---|-----------------|-----------------|------------------|-------------------|--|
| | CO ₂ | CH ₄ | N ₂ O | CO _{2-e} | |
| All energy (combustion + fugitive) | 361.1 | 1.3 | 0.01 | 391 | |
| Stationary energy | 277.2 | 0.1 | 0.003 | 279.4 | |
| Transport | 78.3 | 0.03 | 0.005 | 80.4 | |
| Fugitive emissions from fuel | 5.6 | 1.2 | 0.0001 | 31.2 | |
| Industrial processes | 23 | 0.003 | 0.0001 | 29.5(b) | |
| Agriculture | NA | 3.2 | 0.07 | 87.9 | |
| Land use, land use change and forestry | 31.4 | 0.1 | 0.002 | 33.7 | |
| Waste | 0.03 | 0.8 | 0.002 | 17 | |
| Total | 416 | 5 | 0.1 | 559 | |

(a) Emissions are included in Industrial Processes for reasons of confidentiality

(b) HFCs, PFCs and SF6 are not separately reported here but are included in the CO2-e total

As calculated, the WIPS Management plant with net annual GHG emission of the order of 7875 tonnes / year (CO_2 .e) equates to approximately 0.001 % of the total 559 Mt CO_2 .e per year net national emissions in the year 2005.



6. Conclusions

6.1 Air Quality Impacts

The emissions from the proposed development were determined based on technical data provided for the plant, taking into consideration estimates of background levels of PM_{10} , NO_2 and O_3 determined for the HEZ.

The air dispersion of emissions was determined using the Air Pollution Model (TAPM v3.0.7, Hurley 2005). The TAPM results were based on technical data for the plant, the location of the proposed plant and surrounding terrain. Meteorological data for 2004 was generated by TAPM, including data assimilation to nudge meteorological predictions towards observations from the HEZ meteorological site.

The primary results of this study in relation to the DECC guidelines are:

- Maximum 1-hour MDI concentration 2.2 x 10⁻⁷ mg/m³ predicted for the HEZ is very low, less than 1 % compared to the DECC criterion of 4 x 10⁻⁵ mg/m³
- Maximum 1-hour pentane concentrations are less than 0.6 mg/m³ across the HEZ and surrounding area, that is less than 2% compared to the DECC criterion of 33 mg/m³ (refer to Figure 4-2).
- The photochemical impacts of pentane emissions on concentrations of PM_{10} , NO_X/NO_2 and O_3 were insignificant, due to the relatively very small amount of pentane emitted (3.75 g/s).
- Other chemical substances emitted to the atmosphere during the manufacturing process were predicted to be within the criteria set for individual toxic air pollutants.

In conclusion, the air quality impacts associated with pentane emissions from the proposed WIPS Management plant are predicted to result in no adverse air quality impact in the HEZ and surrounding area.

Nevertheless, it is recommended that the cumulative impact of the emissions from the plant be considered by subsequent industries locating within the HEZ to ensure future air quality within surrounding sensitive receiver area is preserved.

6.2 Greenhouse Gas Impacts

The proposed polyisocyanate foam panel manufacturing facility would operate continuously throughout the year, sourcing its electrical power from the existing grid supply.



This study provided a summary of greenhouse gases and associated climate change, and potential emissions of greenhouse gases from the proposed facility. The greenhouse impact of the plant, from energy use in the manufacturing process, was reported as carbon dioxide equivalent (CO₂-e), which is used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP).

Emissions were based on the expected annual electricity consumption at the WIPS Management facility. It is estimated that the facility will emit 7875 t/year (CO_2 -e) of GHG. The total facility emissions are interpreted in the context of total national GHG emissions. In this context, the WIPS Management facility is predicted to equate to 0.001 % of total national GHG emissions (CO_2 -e).



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Appendix A Wind Roses

Figure A-1 HEZ Seasonal Wind Roses 2004 Observations





Figure A-2 HEZ Night time Seasonal Wind Roses 2004 Observations





Figure A-3 HEZ Seasonal Wind Roses 2004 TAPM





Figure A-4 HEZ Night time Seasonal Wind Roses 2004 TAPM





Appendix B The WIPS Management Manufacturing Process

Prepared by WIPS Management Australia Pty Ltd

July 2006

The WIPS Management Continuous Manufacturing Process produces wall sandwich panels for commercial and domestic applications at a width up to 2.7 metres and at a production line speed of six metres per minute.

Primarily we mix chemicals to produce polyisocyanate rigid foam of 40kg/m3 density.

Finished walls are produced in thicknesses of 100mm and 200 mm. Maximum cut panel lengths are 7.0 metres and maximum panel height is 2.7 metres. All walls are pre finished on the outside only requiring painting on site including rendered surfaces for outside walls. All services required within the walls have been prepared for site installation or have been pre installed during the manufacturing process. Windows and doors are fitted during the manufacturing process.

The process sees all walls produced in two halves. 100mm walls produced as two 50mm panels and 200mm walls produced as two 100mm panels. This approach allows the centre of the walls to be machined to the specification produced by the 3D modelling software during the design phase. Once all components have been inserted, the walls are glued together ready for delivery to site.

The process is as follows:

<u>1. Pentane Delivery & Storage</u>

The pentane is delivered in 20,000 litre iso-containers. The liquid is pumped into 55,000 litre underground storage tanks. From the storage tanks, the pentane is piped to the metering unit for production.

2. Polyol Delivery & Storage

The Polyol is delivered in 20,000 litre iso-containers. The liquid is pumped into 50,000 litre above ground storage tanks. From the storage tanks, the Polyol is piped to the metering unit for production.

3. Isocyanate Delivery & Storage

The Isocyanate is delivered in 20,000 litre iso-containers. The liquid is pumped into 50,000 litre above ground storage tanks. From the storage tanks, the isocyanate is piped to the metering unit for production.

4. Catalyst Delivery & Storage

The Catalysts are supplied in 1000 litre IBC and stored in a dangerous goods store. IBC's are loaded into a rack and gravity feed into the metering unit for production.

5. Flexible Facings Delivery & Storage

The flexible facings arrive in coils on pallets and measure 2.7 metres long and 1.5 metre diameter. They are unloaded by forklift and stored adjacent to the chemical store. They are transferred by forklift to the uncoilers for production where a shaft is inserted into the core and then lifted into place by overhead crane.

6. Recycled Panel In feed



The panels coming back from the secondary process for recycling are 635mm wide x 48mm thick in random lengths. They are laid onto the panel in feed conveyor four strips wide, i.e. 4 x 635mm. A 2.7 metre wide power driven conveyor belt moves the random length panels towards the uncoiling flexible facings.

7. Lower Uncoilers & Pinch Rollers

The Uncoiler unrolls the flexible facings. It is pulled through by power driven pinch rollers and feed into the double belt laminator through a series of guides

8. Hot Melt Adhesive Coater & Melter with Transfer Manifold

The hot melt polyurethane adhesive arrives as a solid in 200 litre straight sided steel drums with foil liners. The drums are placed in a drum melter and the melted adhesive is transferred into a manifold which loads the hot melt roll coater. The coater applies the adhesive over the full 2.7 metre width of the lower paper coil and the recycled board is introduced to the adhesive face. The drums are recycled with zero waste generated.

9. Rotary Laminator

The 2.7 metres wide rotary laminator presses together the adhesive and the recycled board to ensure transfer of adhesive is achieved. The adhesive is cured within 30 seconds.

10. Upper Uncoiler & Pinch Rollers

The upper uncoiler sits on top of the double belt laminator. Flexible facings have a shaft inserted into the core and are then lifted by overhead crane onto the uncoiler. The coils are feed into the double belt conveyor by power driven pinch rollers.

11. Pre Heating Stations

The upper and lower flexible facings pass through pre heating stations to heat the facing to the desired temperature for maximum bond to the foam.

12. Metering & Foam Lay down

The metering machine mixes the chemicals through mass flow meters with closed loop controls. The mixed chemicals are transferred into a mixing head which is mounted on a traversing gantry. The materials are laid down onto the lower flexible facing. Monitoring equipment measures levels of gases produced during the process with full extraction systems in place.

13. Wide Double Belt Laminator

The double belt laminator is a continuously moving 20 metre long mould. Panels are produced in widths up to 2.8 metres and in thicknesses of 50mm and 100mm. The production speed is 6.0 metres per minute. Once the parameters are set, the top and bottom facings are feed into the machine and the laid down foam expands to a density of 40kg per m3 to produce a solid sandwich panel.

14. Acoustic Barrier Coater

On leaving the double belt laminator, the 2.7 metre wide formed continuous panel is knife coated with a liquid acoustic material to a thickness of 2.0mm. The material is pre mixed off line and pumped onto the panel surface, where the knife blade evenly distributes the material to the set thickness. Heating is introduced to cure the material.

15. Laminate Uncoiler

A flexible facing is rolled onto the wet acoustic material and pressed with a rotary laminator.

16. Curing Oven

The panel passes through an oven which cures the coating ready for handling.

17. Fire Barrier Coater

A 2.7 metre wide roll coater applies a layer of fire coat liquid over the foil facing to a thickness of 3mm, bringing the total acoustic and fire coating thickness to 5.0 mm.

18. Curing Oven

The panel passes through an oven which cures the coating ready for handling.

19. Cut Off Saw

The computer controlled saw cuts the panel to the desired length on the fly without stopping the continuous process. Dust is extracted to the dust silo. The saw is within a sound proof room.

20.Transfer Station

Cut panels are accelerated ahead of production to the loading bay of the cooling station. A visual check of the panel is conducted and if rejected, the panel is transferred to the reject bay.

21. Panel Reject Bay

Panels that enter the reject bay are stacked onto a pallet and at the end of the production run granulated and recycled into flooring boards.

22. Cooling Station

The cooling station picks the panels up from the transfer station with a series of fingers. It progresses in to a vertical position and is held in total for two hours. The panels index across as more panels are picked up.

23. Exit Transfer Station

The panels are laid down on the transfer station after the two hour cooling and transported on powered rollers to the stacking unit.

24. Stacking Unit

The stacking unit is an overhead vacuum stacker. It picks up the panel and places it either in the secondary process lines or stacks the panels for delivery on pallets.

25. Panel Buffer Storage or Delivery

The buffer area allows panels to be stacked if down stream processes bottle neck. The stacked panels can be introduced back into the production process at any time. Finished panels are loaded flat pack onto pallets and loaded by forklift onto trucks for delivery

26. Transfer Station

The transfer station moves the panels to one of two secondary process lines with power driven rollers.

27. CNC Loading Bay

The panels sit in the loading bay ready for transfer onto the CNC centre. They are transferred with powered belt drives.



28. CNC Horizontal Machining Centre

The CNC has a working area of 7.5 metres x 2.8 metres. It machines the panel to the specification downloaded from the design software. Dust is extracted at the tool with a high volume cyclone extraction system. Panel off cuts and cut outs are cut into 635mm wide strips for recycling. The panels are driven on and off the CNC by belt drives. Vacuum is applied to hold the panels in place during machining. As the panels exit the CNC, the off cuts drop onto a side transfer conveyor for recycling. The machined panels continue on to the steel framing bay.

29. Dust Extraction & Dust Hood

All dust from the machining process is extracted in a two part process. 95% of the dust is extracted at the machining head. The balance is extracted via a 2.8 metre wide extraction hood which the panels pass under as they move off the CNC.

30. Panel Granulator

Off cuts that are smaller than 635mm in one direction are feed into a granulator and the dust sent to the dust silo.

31. Dust Collection Silo

The dust silo is located next to the recycling press. It has capacity to hold the volumes of dust created during a shift.

32. Dust Recycling Press

The dust recycling mixes isocyanate with the dust and presses it into a flooring sheet 2.5 metres x 1.2 metres x 22mm thick. It has been sized to consume dust at the rate produced by the manufacturing process.

33. Off Cut Side Transfer

The side transfer conveyor takes the off cut panels from the CNC under the floor across to a transfer trolley.

34. Off Cut Horizontal Bandsaw & Dust Extractor

As the panels are taken off the conveyor, they pass through a 700mm wide horizontal bandsaw which slices all panels back to 48mm in thickness. Dust is extracted to the dust silo. The skin off cuts are collected for transport to a paper recycling

35. Off Cut Transfer Cart

The trimmed off cuts are stacked onto the transfer cart and towed to the panel in feed for recycling.

36. Steel Frame Placement

Plates, Top Hats, Studs, Lintels and Bracing Units are pre assembled and cut to length in the component store. They are transferred in bins to the framing bay where they are inserted into the machined panel manually. Bottom plates to stud connections are completed by crimping. Top plates and top hats are fixed by screw connection.

37.Component, Plywood blocking, Cavity Slider & Ducted Skirting Placement

All components are pre assembled in the component store. They are transported in bins to the component bay where they are installed manually. All components and blocking are glue fixed with hot melt glue guns. Cavity sliders and ducted skirting are screw fixed to the framing members.



38.Quality Control & Labelling Station

A visual quality control inspection is undertaken prior to joining the two panels together. Panels are checked for dimension and an identification sticker fixed. The inspector signs off on the check.

39.Panel Side Transfer

The panel moves sideways to allow in the inline process to be completed.

40.Dust Extraction Hood

After inspection, the panels pass under a second 2.7 metre wide dust extraction hood to ensure a dust free surface for the adhesive process to follow.

41. Hot Melt Adhesive Coater & Melter with Transfer Manifold

Adhesive is applied to the non framed half of the wall only.

42. Panel Rotator

The glued panel is inverted in the panel rotator and the adjoining panel is aligned below and the two halves joined together.

43. Rotary Laminator

The two panel halves then pass through the rotary laminator to ensure transfer of the adhesive. The adhesive cures within two minutes of coming together.

44. Reveal & Sill Fabrication

100mm, 200mm and 300mm wide reveals are prefabricated as a continuous supply to two docking saws that cut to the required lengths. The reveals are made up from 20mm thick foam with two finishing PVC moulds glued on each side. Render coat is applied to provide a finish surface to one face. The profiled sills are supplied pre finished and similarly cut to length.

45. Reveal & Sill Fitting and Waterproofing Station

The openings of doors and windows are coated with a waterproof membrane which acts as an adhesive which is used to fix the sills and reveals. The 300mm reveals are supplied loose pack and installed on site as the infill between floors on two storey construction.

46. Bead Fitting Station

Female PVC render beads are glued to all edges of external walls to provide a finishing edge for the render coating. It also provides the connection point for the male connectors on site. They are supplied in full lengths with joins at corners only. Beads are cut with hand tools after they are glued using the wall as the measuring guide.

47. Render Coater

Polymer modified render is applied with a 2.7 metre wide roll coater to a thickness of 4mm. The dry powder render is stored in a silo and pumped to a mixer and mixed with water. The wet render is then feed into the roll coater for application.

48. Curing Oven

The curing oven is heated with infrared heaters and circulated warm air which cures the render. The oven is 7.5 metres long x 2.7 metres wide.

49.Quality Control Inspection

The render coat is inspected for quality of finish.

50.Paint Coater

An acrylic sealer is applied with a paint roll coater of 2.7 metre width. Paint is supplied in 200 litre drums.

51.Curing Oven

The curing oven dries the paint. The oven measures 7.5 metres x 2.7 metres.

52. Quality Control Inspection Station

A final quality control inspection is carried out to ensure the panel meets all standards set. Once certified, the panel is ready for dispatch.

53. Tilt Table

The panel is driven onto the tilt table by belt drives. Once on the table, the panel is tilted upwards to an angle of 85 degrees. The table can tilt to either the left or right.

54. Overhead Magnetic Lifting Crane

A magnetic coupler attached to the overhead crane is coupled to the steel top plate of the wall and lifted into the delivery cassette.

55. Window & Door Frame Installation

Windows and door frames are transferred from the component store and inserted manually into the wall openings and screw fixed to the steel studs at the sides of openings.

55. Delivery Cassette Loading Bay

External walls are loaded with the external surface facing in. Two delivery cassettes are presented on a mobile trolley that hold the cassettes at an 85degree angle to ensure the panels don't fall out once inserted into the cassette.

56. Delivery Cassette Storage Bays

The two cassettes loaded onto the trolleys are towed with an electric cart to the storage bays until ready for transport. Side tarps are fitted to provide wind protection during delivery and display the WIPS Management Name and contact details.

57. Truck Loading & Cassette Return Bays

The delivery truck drives into the loading bay area. The electric cart tows the trolley with the cassettes from the storage bay to the loading bay where an overhead crane lifts the cassettes onto the truck. The cassettes have been designed to lock onto the truck body in a way similar to that of shipping containers. The truck is then ready to drive out of the loading bay.

Trucks returning with empty delivery cassettes are unloaded with the overhead crane and the cassettes are placed on a trolley and returned to the storage area ready for the next job.



