Shoalhaven Starches Pty Ltd

Shoalhaven Starches expansion project - Modification 11 and Modification 12 (Project Approval MP_06_0228)

Revised odour and air quality assessment

May 2017

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1. Introduction

GHD was engaged by Shoalhaven Starches Pty Ltd (Manildra) to conduct an air quality and odour impact assessment for a proposed modification to the approved Shoalhaven Starches Expansion Project (SSEP). The existing Shoalhaven Starches factory is located at Bolong Road in Bomaderry, New South Wales.

Flour and grains are processed at the factory to produce ethanol, starch, gluten, glucose and distiller's dried grain (DDG). Shoalhaven Starches is the holder of Environment Protection Licence number 883 issued for the plant by the NSW EPA.

The Shoalhaven Starches Bomaderry plant currently produces around 225 million litres (ML) of ethanol per year. On 28 January 2009 the (then) Minister for Planning issued Project Approval MP 06_0228 for the Shoalhaven Starches Expansion Project. The Project Approval for the SSEP enabled Shoalhaven Starches, subject to certain conditions, to increase ethanol production in a staged manner at its Bomaderry Plant from the previous approved level of 126 million litres per year to 300 million litres per year. Following the Minister's determination Shoalhaven Starches have been implementing and commissioning works in accordance with this approval. Work on the change in operations has been completed, coupled to quarterly testing (independent audits) of emissions from licensed discharge points (a condition of the Licence), with the purpose to validate the predicted impacts against the original predictions in 2008 for the ethanol expansion.

The increase in ethanol production associated with the SSEP Project Approval was made in response to the NSW Government's ethanol mandate which increased the mandated ethanol content by volume in petrol in NSW from 2% to 6% in October 2011. The SSEP sought to increase ethanol production capacity at the Shoalhaven Starches site to meet the expected increase in demand for ethanol arising from this site. The increase in ethanol production required upgrades to the Stillage Recovery Plant including six additional Dried Distillers Grains Syrup (DDGS) dryers.

Demand for ethanol however has not met that which was anticipated following the introduction of the NSW Governments ethanol mandate. Under these circumstances, it is now proposed to reduce the number of approved DDGS Dryers from six to four (Mod 11). The reduction in Dryer footprint on the site will release land for other development purposes. In addition to the proposed reduction in number of DDGS dryers from six to four, the modification process (Mod 11) also includes the following:

- A minor modification to footprint of the four DDG dryers
- Relocation of the cooling towers in the DDG Plant
- A Mill Feed Silo and structure to feed DDG dryers
- Expanded use of the existing coal and woodchip storage area within the SS Environmental farm
- The addition of two biofilters to cope with the increased number of DDG Dryers
- A forklift maintenance building adjacent to the relocated DDG dryers, along with a container preparation area adjacent to the relocated DDG Dryers

The assessment has also been updated to include additional changes associated with modification application MP06_0028 for the proposed modification to Beverage Grade Ethanol Distillery Plant (Mod 12). Shoalhaven Starches intend to undertake modifications to the existing Ethanol Distillery Plant at their Bomaderry plant to:

– increase the proportion of ‘beverage” grade ethanol that is able to be produced on the site. This modification will enable increased flexibility in terms of the range of types of ethanol produced at the site (i.e. between fuel, industrial and beverage grade ethanol) to meet market demands; and
– to modify the type and location of the Water Balance Recovery Evaporator that has been previously approved under MOD 2 adjacent to the Ethanol Plant

A review of the MP06_0028 Proposed Beverage Grade Ethanol Modification found that the only additional source of odour is the washing column D500 vent which is located on the vacuum column.

These changes, in turn, require an application to EPA accompanied by a report assessing the change (if any) to the predicted off-site impacts. In order to meet EPA NSW requirements outlined in an email from Stefan Press on 4 March 2016; and in an email from Deana Burn (Department of Planning and Environment) on 12 January 2016, this report provides:

- A comparative analysis of the odour results/modelling resulting from the proposed modifications, compared with the odour impacts predicted in the original Air Quality Assessment for the Shoalhaven Starches Expansion Project.
- A comparison of odour results/modelling from the proposed modifications, with the odour results/modelling obtained from the most recent independent odour audits for the premises.
- Where necessary, details of all reasonable and feasible measures to mitigate odour impacts to a level of impact no greater than predicted in the original EA.
- An air quality assessment to demonstrate that the two new biofilters (to treat the DDG driers) will be sufficiently sized to adequately treat the volume and strength of odorous airstreams associated with the modified DDG dryers.

Additional correspondence was provided from the EPA in a letter to Department of Planning and Environment dated 16 February 2017 based on EPA’s review of the May 2016 version of this report. This current version has been updated to address these comments Table 1 details the specific issues raised by the EPA and how these matters have been addressed in the body of this revised report.

Table 1 Response to EPA issues 2017

EPA issue	Response
Odour dispersion modelling was undertaken using average odour emissions data, not the peak	Odour dispersion modelling has been updated using the peak odour emission rates from the odour monitoring conducted by SEMA between May 2016 and February 2017 (four quarters) for EPA ID sources and scaled to a 300 ML per year production. Refer Section 6.1.2 of this report.
Odour dispersion modelling is undertaken using monitoring data (based on 219 ML plant capacity), not the approved 300 ML ethanol plant capacity	Odour dispersion modelling has been undertaken for the approved 300 ML plant capacity. Odour emissions for relevant sources have been scaled appropriately and shown in Table 6.
Emissions in 2016 are estimated to be approximately 10% less than those in 2008, however,	The revised assessment found that emissions are estimated to be approximately 12% less than those in 2008, and odour impacts are predicted to remain similar at receptors. While there has been overall reductions

odour impacts at receptors are predicted to increase	there has been increases in odour emissions from Gluten dryer 3 and 4, which together make up 32% of the Scenario 1 total. These two sources are modelled as horizontal discharges with a velocity of 0.1 m/s, which contributes to poor odour dispersion. Refer Section 6.2
Unclear as to why receptor heights were changed	Receptor heights in this revised assessment are the same as the original 2008 assessment. This is discussed in Section 7.1
Errors in the emissions for No. 3 starch dryer and No. 5 starch dryer should be revised and remodelled	The emissions inventory and dispersion model have been updated to fix this error. Refer to the updated emissions inventory in Table 6.
Difficult to compare emission inventories between GHD (2008) and GHD (2016)	A clear comparison of the emission inventories between GHD (2008) and the inventory in this assessment is provided in Table 6. This also includes comments to explain why there are differences.
Odour impacts should be reported in integers, not as decimals	Odour impacts are reported as integers in Table 7.
No additional controls are proposed to mitigate the increased odour impacts	An odour mitigation scenario has been assessed in Section 6.3 to reduce odour impacts from the site.

The revised odour assessment provided in this report is a Level 2 assessment as defined in the DEC Modelling Guideline[1] (ie "refined dispersion modelling technique using site-specific input data"). The Technical framework is used by the Department of Planning and Environment and NSW EPA to assess proposals and set licence and consent conditions, under the *Environment Planning and Assessment Act 1979*, the *Protection of the Environment Act 1997,* and the *Local Government Act 1993*.

It should be noted that some new odour sources in the proposed Packing plant and the Flour Mill areas have been characterised by others[2] (in terms of source dimensions and odour emission rate) and these have been adopted by GHD in this modelling).

The revised air quality and odour assessment is based on previous site visits, measured and estimated odour emission rates at the site, emission rate databases, an examination of local meteorology, and the outputs of odour dispersion modelling using CALMET/CALPUFF models.

The assessment has been conducted with reference to:

- Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales (EPA, 2016)
- Assessment and Management of Odour from Stationary Sources in New South Wales (Department of Environment and Conservation, 2006).

1 DEC 2005 "Approved Methods for the Modelling and Assessment of Air Pollutants in New South wales", 26 August 2005.
2 Stephenson Environmental Management Australia (SEMA)

1.1 Scope

The scope of work adopted to conduct the assessment is listed below.

1. Check the previous odour emission inventory to confirm if more recent emission rate measurements have been conducted at any identified source.
2. Check any source measurements of Total Suspended Particulates (TSP) available from significant dust sources. Assess whether the current TSP inventory is adequate to represent plant emissions of TSP.
3. Alter the coordinates of sources to be moved arising from the proposed modification and create new sources (coordinates, emission rates) for the two additional bio-filters. Set the emission rate of sources to be removed to zero.
4. Check the performance of the existing biofilters as a guide for the efficiency of the proposed additional biofilters
5. Check the proposed changes arising from the proposed plant modification to identify where the built form array of the plant will change and make the required changes in BPIP (a program that assesses the influence of building wakes on air dispersion of nearby sources).
6. Conduct the simulations of off-site impact from plant emissions of odour and TSP.
7. Report the results for presentation to the NSW Department of Planning and Environment.

1.2 Limitations

This report: has been prepared by GHD for Shoalhaven Starches Pty Ltd and may only be used and relied on by Shoalhaven Starches Pty Ltd for the purpose agreed between GHD and the Shoalhaven Starches Pty Ltd as set out in section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Shoalhaven Starches Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

GHD has not been involved in the preparation of the planning submission and has had no contribution to, or review of the submission. GHD shall not be liable to any person for any error in, omission from, or false or misleading statement in, any other part of the submission.

The opinions, conclusions and any recommendations in this report are based on explicit assumptions made by GHD, described in section 1.3 and throughout the body of this document, and limitations of the modelling software CALPUFF. GHD disclaims liability arising from any of the assumptions being incorrect. GHD has prepared this report on the basis of information provided by Shoalhaven Starches Pty Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.3 Assumptions

The major assumptions used in this assessment are as follows:

- Stack emission testing reports from the past year are accurate and representative of normal operations, and do not vary significantly.
- The odour dispersion modelling using the NSW EPA and US EPA approved regulatory Gaussian puff dispersion model CALPUFF V 5, which was considered appropriate for the location. Limitations with the predicted odour are inherent within the model and in its ability to handle multiple buildings and stacks in a complex setup, with wake effects included. As such, the layout of the plant was simplified in order for the model to handle the setup.
- Odour emissions from the major sources of odour were modelled as both variable emission and fixed point, volume and area sources in CALPUFF with appropriate dispersion characteristics.
- The site representative meteorological data was obtained from previous assessments of the plant, which have been approved by EPA NSW in the past and evaluated against the most recent observations from Nowra in Section 6.
- Small silos in the Packing Plant are conservatively assumed to be filled 24 hours a day.
- Odour sources with horizontal releases have conservatively been modelled with vertical velocities of 0.1 m/s.
- The VOC concentration in the biofilter exhaust is not high enough to induce density flows of the exhaust plume in ambient air.
- The emissions inventory, and therefore the dispersion modelling results, is largely based on estimates and on data measured on site by Stephenson Environmental Management Australia (SEMA). Actual measurements are dependent on site conditions at the time of measurement and these conditions may change. GHD does not accept any responsibility for updating the measurements or estimates made by SEMA.

1.4 Report structure

This report:

- Describes the operations of the plant
- Describes the site-representative meteorological data
- Describes the proposed modifications
- Characterises odour sources at the plant, accounting for the required changes to the original model setup in 2008
- Presents the results of odour dispersion modelling for the existing and proposed scenarios using CALPUFF
- Presents a summary of the results and draws conclusions as to the off-site impacts (both odour and dust)
- Outlines the limitations of the analyses and conclusions presented.

2. Site location and context

2.1 Site description

Figure 1 shows the location and layout of the Shoalhaven Starches plant in Bomaderry, New South Wales. It is located between the Shoalhaven River and township of Bomaderry. The plant comprises a factory, a proposed (but not yet constructed) packing plant and environmental farm. The packing plant lies immediately to the north of the factory, while the environmental farm is situated approximately 400 m to the east.

Nearby Rural Residences

The site is proximate to a number of sensitive receptors. The township of Bomaderry lies to the northwest of the factory and west of the packing plant. Nowra is situated south of the plant. The nearest receptors to the factory, packing plant and environmental farm are identified in Figure 2, with the approximate distances and orientation of each residence from the plant listed in Table 2. These receptors were selected to be consistent with previous odour assessments of the plant. These residences qualify as sensitive receptors, as defined in the DEC odour assessment guideline as “a location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area” (Department of Environment and Conservation, 2006).

Table 2 Location of identified sensitive receptors

Receptor	Range, m	To nearest odour source	Direction	Easting (m)	Northing (m)
R1	150	Packing Plant	W	281,430	6140,610
R2	1300	Factory	SW	280,400	6139,650
R3	700	Factory	S	281,510	6139,310
R4	1300	Factory	SE	283,000	6139,450

1:5,000

0 50 100 150

Metres (at A4)

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid Of Australia, Zone 56

N

LEGEND

Shoalhaven Starches Factory

Packing plant (proposed)

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Manildra Group Pty Ltd
Shoalhaven Starches

Job Number | 3133842
Revision | A
Date | 22/3/2016

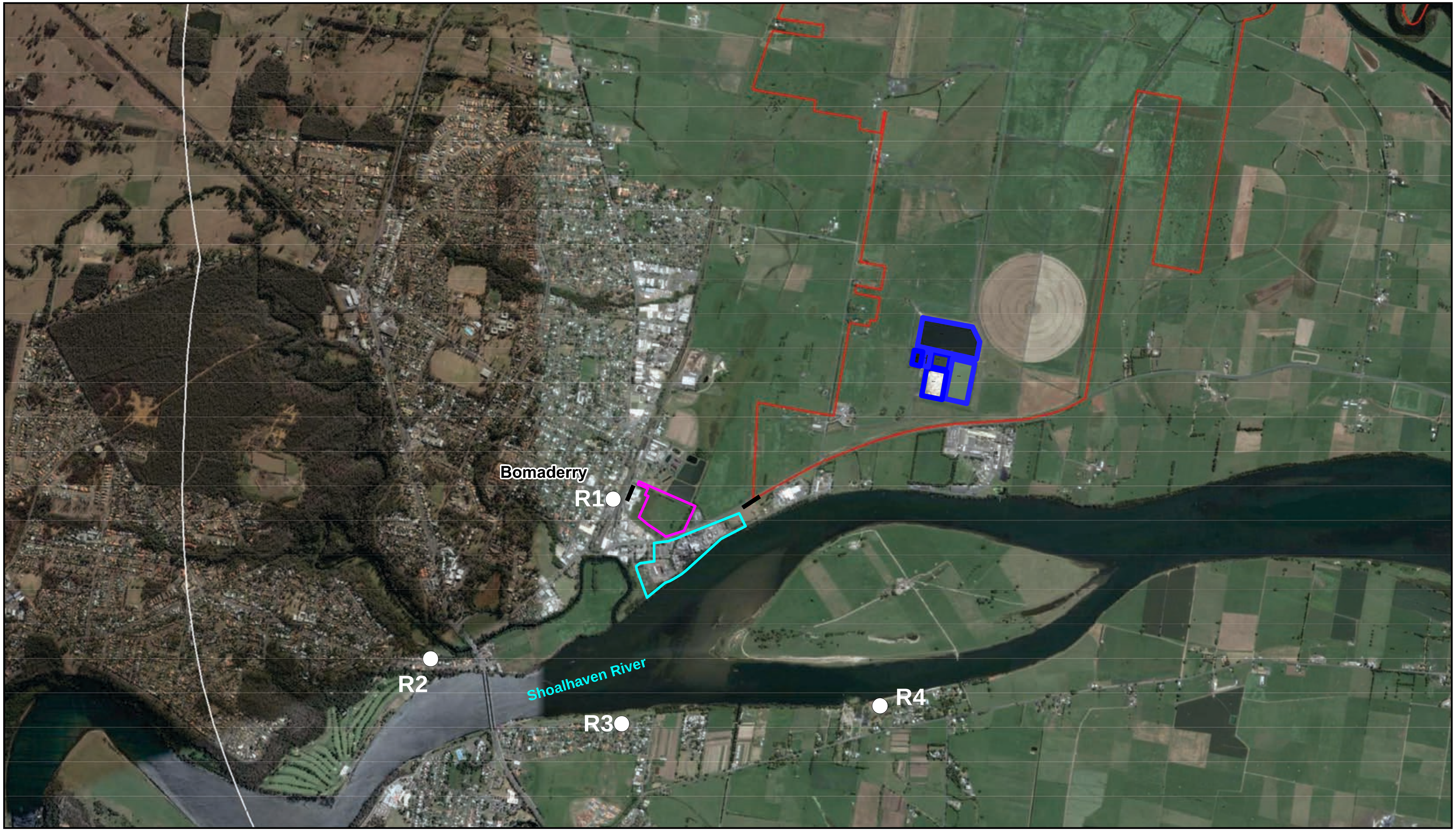
Site location

Figure 1

G:\31\33842\GIS\Maps\Working

8/180 Lonsdale St Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com.au **W** www.ghd.com.au

Source: NearMap; Created by: B McKay



1:30,000

0 300 600 900

Metres (at A4)

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid Of Australia, Zone 56

N

LEGEND

- Shoalhaven Starches Factory
- Packing plant (proposed)
- Environmental Farm
- Sensitive receptors
- Effluent storage dams

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Manildra Group Pty Ltd
Shoalhaven Starches

Job Number 3133842
Revision A
Date 22/3/2016

Site context

Figure 2

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8/180 Lonsdale St Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com.au **W** www.ghd.com.au

Source: NearMap; Created by: B McKay

3. Operation description

3.1 General overview

Wheat flour and grains (wheat) are processed at the Shoalhaven Starches factory to produce ethanol, starch, gluten and glucose. Solid wastes are treated to produce distiller's dried grain (DDG), with liquid wastes being transferred to the environmental farm waste water treatment plant. Excess treated waste water is irrigated onto pasture. The main processing and materials treatment areas at Shoalhaven Starches comprise the:

- Flour mill
- Starch plant
- Glucose plant
- Ethanol and distillation plants
- DDG plant
- Packing plant
- Pellet Plant
- Environmental farm

A brief description of the production process associated (including emission control) with each plant is given below. Figure 3 shows the layout of the plant in terms of its operational areas, along with the major odour sources of the plant, accounting for around 80% of total odour emissions (excluding the environmental farm).

3.2 Flour mill

Shoalhaven Starches commenced full operations at the flour mill in June 2011. The flour mill was originally approved by NSW Department of Planning and Environment in 2007 and was consolidated into the ethanol expansion project approval in 2008.

Proposed modifications to the flour mill were approved in March 2016, which enabled an increase in the total flour production capacity on the site from the previously approved limit of 265,000 tonnes per annum to 400,000 tonnes per annum. The overall amount of flour used in the production process at the Bomaderry site will however remain within the previously approved 20,000 tonnes per week limit.

The flour is used in the plant to produce starch, gluten, glucose and ethanol. All remaining mill feed and pollard (flour sieving rejects) is processed through the DDG dryers for sale as stock feed. Flours from the various grinding operations are collected and blended together before passing through final treatment and weighing operations to bulk storage bins. Flour is taken from these bins for use in existing site production processes.

All air extracted from the mill is passed through Buhler Airjet bag houses prior to being discharged to the atmosphere vertically via four individual stacks. Approval has previously been obtained for the installation of additional plant to increase production, along with two additional exhausts from the roof of the building.

Flour mill stack testing was last conducted in September 2011 by SEMA, for both TSP, PM_{10} and odour.

3.3 Starch plant

Within the starch plant, flour is processed to separate the starch from gluten (the protein component of flour). The starch is graded, dried and packed for shipment. Different grades of starch are manufactured for food and paper making applications. Starch that is not used for these applications is used as a raw material for the ethanol plant. Gluten is dried and sold for use in the food industry.

Aqueous (water-based) wastes are reused within the plant or are transferred to the environmental farm waste water treatment plant.

Starch Dryer No.5 has been constructed and is undergoing commissioning (see Figure 3). No change to the production volume is predicted.

3.4 Glucose plant

The glucose plant (contained within the starch plant area) houses two lines; the 'confectioners' glucose line and the 'brewers' glucose line. Confectioner's glucose is distinguished by having been demineralised to remove latent odours and flavours that might be carried through to the final product by the glucose.

Both processes use starch as the raw material. The starch is broken down to its constituent glucose molecules using enzymatic and hydrolytic processes. Water is removed from the resulting solutions using evaporation to produce glucose and brewer's solutions of desired concentration. The glucose product is shipped to customers in bulk containers.

The glucose manufacturing process generates aqueous wastes, mostly condensate from the evaporators, which is reused during regeneration of the ion exchangers.

3.5 Ethanol and distillation plants

Waste starch from the starch plant is transferred to the ethanol plant and fermented to produce ethanol. Starch (described in section 3.3), which is in suspension, is heated in jet cookers before being fermented.

Fermentation is carried out in fermentation vessels using the treated substrate to which an ethanol-producing yeast inoculum has been added. The yeast inoculum is generated using yeast propagator vessels, these being seeded using commercial strains of yeast.

Wastes from the fermenters are transferred to the DDG plant (refer to section 3.2) for processing. Fermentation liquor from the ethanol plant is transferred to the distillation plant where water and other impurities are removed to produce various grades of ethanol.

3.6 DDG plant

Wastes from the ethanol and distillation plant are dewatered in decanter centrifuges and dried in steam dryers to produce granular DDG. Light phase from the DDG decanters is evaporated to recover soluble protein (syrup) and produce clear condensate (liquid line). The syrup is added to the dryer feed for recovery of the solids (solids line). DDG granular product is transferred to the DDG Pellet Plant for pelletising; the DDG pellets are stored in silos. Some of the granular DDG product is stored in a storage shed until it is loaded into trucks in the DDG load-out area.

Exhaust gases from the existing DDG dryers (three) are transferred to the boiler air intake in order to destroy odorous components of the gases by combustion.

3.7 Steam production

Steam is generated at Shoalhaven Starches by four gas fired boilers (numbers 1, 3, 4 and 7), one wood fired boiler (number 2) and two coal fired boilers (numbers 5 and 6) boilers. The combustion gases from these boilers are discharged via stacks, with boilers 5 and 6 having a combined stack. Exhaust from boiler 4 is treated in a cyclone and those from boilers 5 and 6 are treated in a bag house prior to discharge to atmosphere.

3.8 Environmental farm

A number of wastewater streams are produced at the factory. These consist of five clear condensate streams (distillation plant condensate, evaporator condensate, DDG condensate, a small flow from the carbon dioxide plant and boiler blowdown) and a combined 'dirty' stream from the factory processes. The 'dirty' wastewater streams are combined in the farm tank (located at the factory) and pumped to the waste water treatment plant. Treated water is pumped back to the factory for re-use, while excess treated water is stored in dams for irrigation on the farm.

3.9 Packing plant (proposed)

It is proposed that dried gluten/starch will be pneumatically transferred from the existing site to the proposed new packing plant via underground pipes. This dried material is proposed to be stored in silos.

At present, the approved packing plant has not been constructed at the Shoalhaven Starches sites. The proposed packing plant was assessed by SEMA in 2015 (Stephenson Environmental Management Australia, 2015).

The packing plant will consist of seven silos that will store either gluten or starch product. The medium and large silos are to be filled 24 hours a day, seven days a week, while the small silos can be filled at any time of the day for eight hours.

3.10 Other activities

3.10.1 Product load-out areas

Starch, glucose and ethanol products are loaded into road tankers from bulk storage silos and tanks. Load out of starch and glucose does not have the potential to generate odours, as these products have a low inherent odour characteristic.

Given the flammable nature of ethanol, the load out process is strictly controlled for occupational health and safety purposes. These controls have the secondary effects of minimising the potential for vapour generation and spillage.

3.10.2 Cooling towers

Cooling towers operate as part of the cooling water circuit for the ethanol glucose and DDG plants. The recirculated cooling water has the potential to absorb odours and to disperse the odours to atmosphere during the evaporative cooling (aeration) process within the cooling towers. In addition, contamination of the cooling water by-product, process intermediates or wastes can introduce odorous materials direct to the cooling water, which can greatly increase its odour generating potential. The aeration process readily strips the more volatile (and potentially odorous) compounds from the water, providing a high-volume potential source of odour that is released direct to atmosphere.

3.10.3 Biofilters

Exhaust air from odorous sources at the DDG plant is captured and ducted to two existing soilbed biofilters, each having a surface area of 110 m^2, located at the southwest corner of the factory (on the southern margin of the container storage area – placed to the left lower margin in Figure 3). The biofilters comprise a bed of organic bark and compost material (the matrix), with distribution of the odorous airstream through the floor of the biofilter via a manifold. Biological oxidation of odorous compounds takes place as the foul air percolates upward through the matrix. The oxidation is achieved by a population of microorganisms in the bed.

While the efficiency of biofilters destroying odorous components of the waste air varies according to a range of factors including soil moisture, composition and temperature, it is very high. Any odour in the exhaust air from the biofilter is due to the inherent odour of the matrix materials and typically has an 'earthy' characteristic. The odour level of the matrix is typically in the range of 250 to 500 OU, and it is this 'background' level that limits the efficiency of a soilbed biofilter.

The two biofilters at the site operate in parallel and are sized so that one biofilter can be taken offline during periodic replacement of the matrix of the sister filter.

As such, a soilbed biofilter operating as designed, with no malfunctions, will not vary significantly in its odour emissions; it will emit at the matrix background level independent of fluctuations in the input odour loading.

3.11 Proposed modifications

Manildra propose to change the configuration of the DDG Plant to the southwest of the factory site. These changes are shown in Figure 4 and consist of a staging process, and thus impacts have been assessed separately.

Proposed modifications to the ethanol distillery (Mod 12) are shown in Figure 5 and includes:

- Relocation of previously approved Evaporator;
- Beverage grade ethanol plant. Existing structures (two water tanks, diesel above ground tanks, a brick pump house, and redundant former plant) will be demolished as part of these works;
- Installation of three above ground tanks. Two 400 kL tanks (tanks 1 and 2) will be installed in the ethanol recovery area. An existing tank will be removed to make room for one of these tanks. A 1,000 kL tank (tank 8) will be installed in the ethanol storage area;
- Cooling towers;
- New gantry pipe connecting the ethanol plant, tanks and cooling towers;
- Electrical substation;
- Emergency ISO tank container storage area, including extension of an access road (as shown in red) from the former Dairy Farmers complex;
- An internal access road to and from the ISO tank container storage; and
- Two railway sidings will be extended along the south-eastern side of a former Dairy Farmers site to accommodate an extension of the railway siding, existing water treatment tanks, pump house and piping will be removed, and existing water treatment ponds will be filled in.
- Proposed car parking area near the existing BOC gas facility.

The main changes affecting odour impacts and dust consist of:

- **Scenario 1**
  - Installation of DDG dryer 4 to the new building to the north of the proposed container storage area, with air leakage to be collected and ducted to the existing biofilters
  - The installation of three DDG dryers to be ducted to two new biofilters
  - The relocation of the approved cooling towers
  - washing column D500 which is located on the vacuum column (proposed beverage grade ethanol plant)

Further discussion of this scenario is presented in section 6.1.2.

1:2,500

0 25 50 75

Metres (at A4)

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid Of Australia, Zone 56

N

LEGEND

- Shoalhaven Starches Factory
- Packing plant (proposed)
- DDG Plant
- Flour Mill
- Boiler house
- Starch plant
- Ethanol recovery and storage area
- Fermenters
- Odour sources

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Shoalhaven Starches

Site layout and major sources

Job Number	3133842
Revision	A
Date	22/3/2016

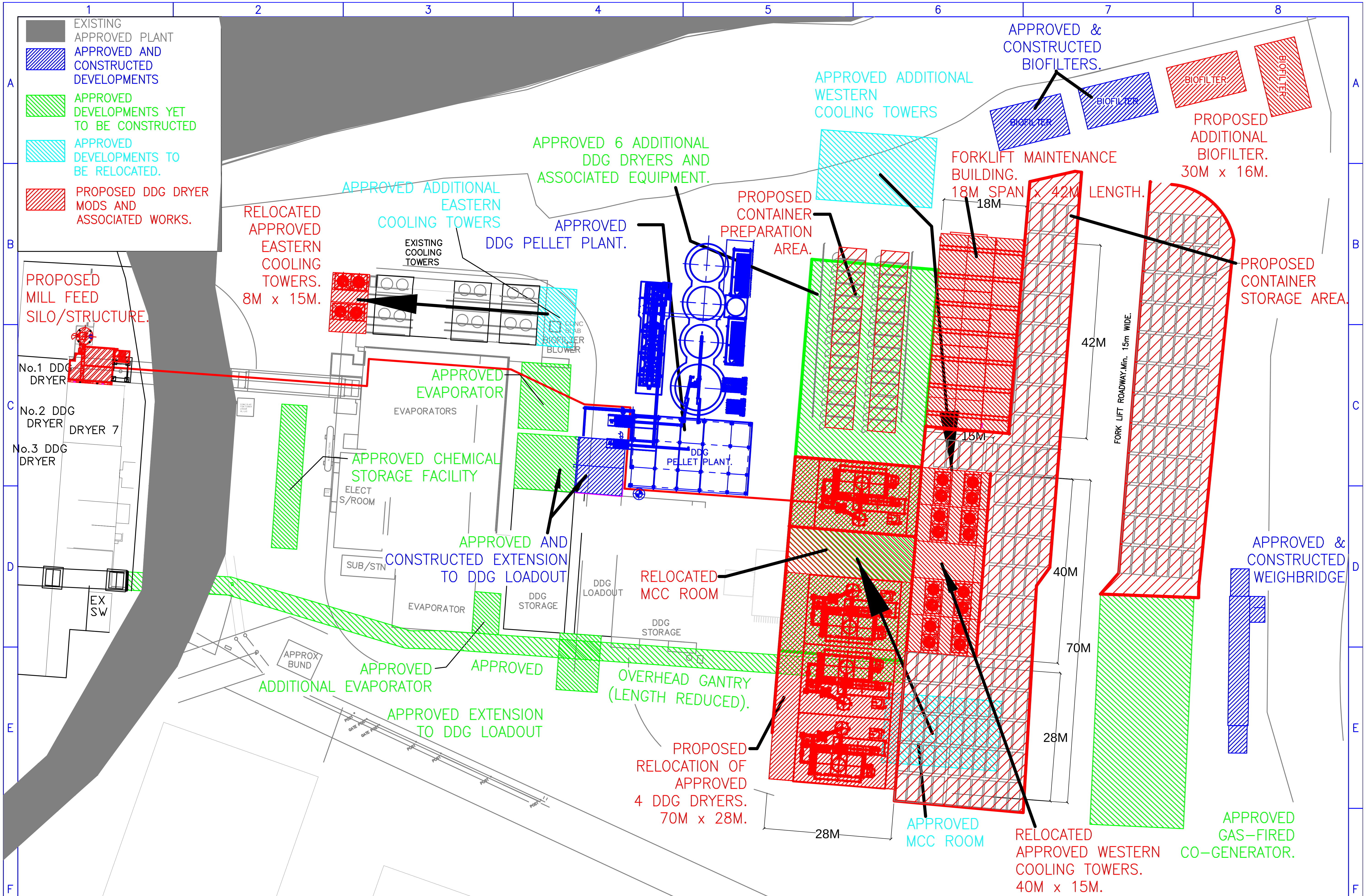
Figure 3

G:\31\33842\GIS\Maps\Working

8/180 Lonsdale St Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com.au W www.ghd.com.au

Source: NearMap; Created by: B McKay

Figure 4 Proposed changes to DDG plant



ISS	DATE	ZONE	CHANGE AMMENDMENTS	BY	CKD
J	8-4-16	B5	Wording changed.	P.C.	C/ Stod.
I	30-3-16	ALL	proposals finalised.	P.C.	G.M.
I	15-9-15	ALL	proposal	P.C.	G.M.

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Commitment to Excellence

DRAWN	P.J.C.
TRACED	----
CHECKED	
APPROVED	
DRG PRACTICE AS1100	

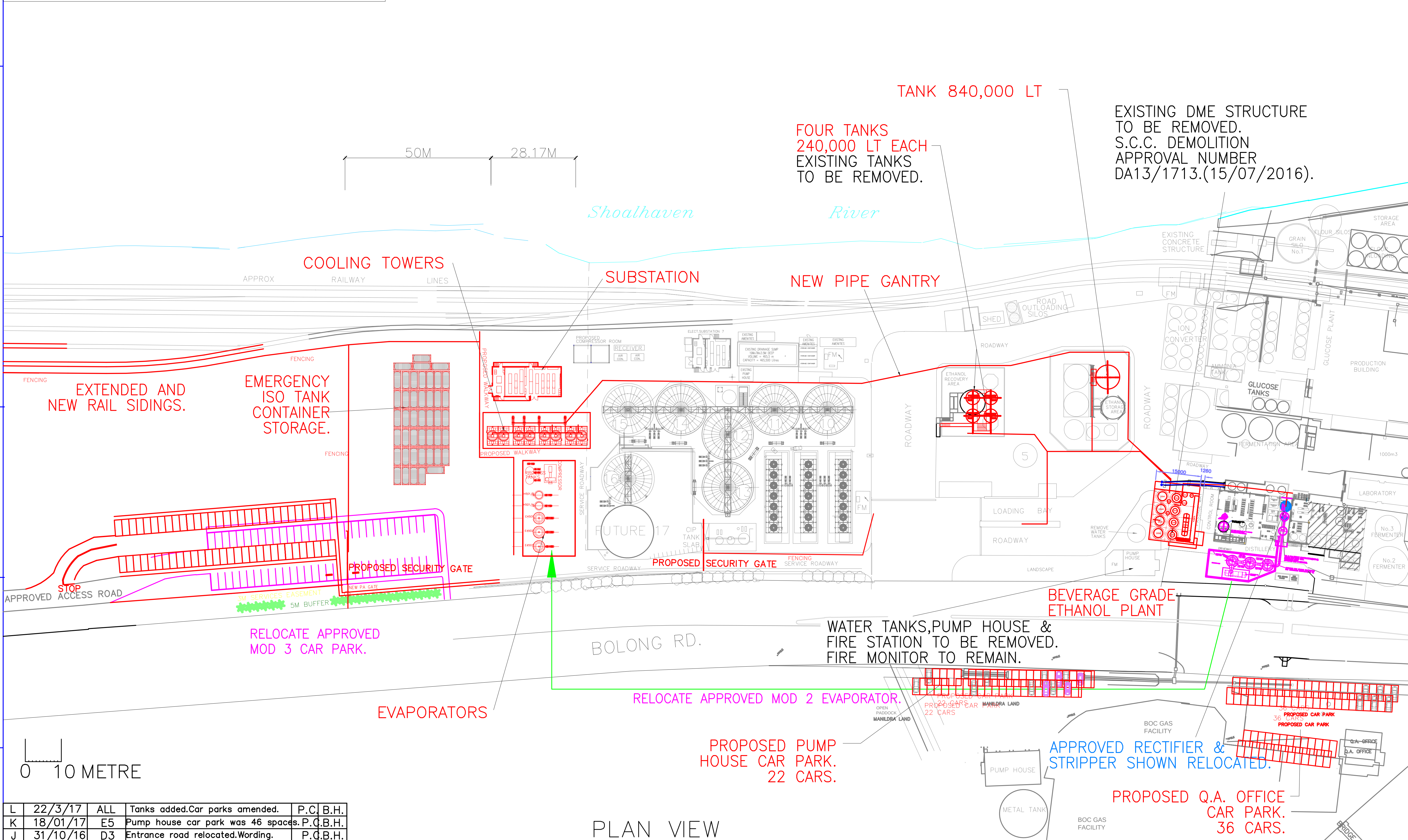
TOLERANCES LINEAR ±.2 ANGULAR ±.5
FINISH NA
MATERIAL NA

MANILDRA GROUP.NOWRA.
TITLE DDG DRYING. LAYOUT OF DDG DRYER MODS.

SIZE A3 | SCALES 1:750 | SHT
ISSUE 5765A
DRG № MN261-001-J

Figure 5 Proposed changes to beverage grade ethanol plans

EXISTING — BLACK.
PROPOSED MODIFICATION WORKS—RED
RELOCATED APPROVAL — BLUE
ORIGINAL MOD 2 APPROVAL—MAGENTA



PLAN VIEW

L	22/3/17	ALL	Tanks added.Car parks amended.	P.C	B.H.
K	18/01/17	E5	Pump house car park was 46 spaces.	P.C	B.H.
J	31/10/16	D3	Entrance road relocated.Wording.	P.C	B.H.
H	26/10/16	ALL	Tanks capacity adjusted.	P.C	B.H.
G	26/10/16	ALL	Syrups tank removed.	P.C	B.H.
E	15/9/16	ALL	Car parks relocated.	P.C	B.H.
D	30/8/16	A L L	Pipe runs revised.Approved Manildra.	P.C.	K.L.
ISS	DATE	ZONE	CHANGE AMENDMENTS	BY	CKD

Commitment to Excellence

MANILDRA GROUP
100% AUSTRALIAN

GEM OF THE WEST

DRAWN P.J.C.
TRACED ----
CHECKED
APPROVED
DRG PRACTICE AS1100

TITLE
MODIFICATION TO SHOALHAVEN STARCHES EXPANSION PROJECT.
PROPOSED BEVERAGE GRADE ETHANOL PLANT. PLAN VIEW.

SIZE A3 | SCALES 1:1200 | SHT
MR-5927
DRG No MN285-002L

4. Criteria for assessment

4.1 Odour

Odour Concentration

Odour 'strength' or concentration is measured in odour units (OU), where 1 OU represents the concentration of a sample that can just be detected by 50% of people in a controlled situation where there is no background ‘ambient ‘ odour.

Measurement of Odour

The most common method of measuring odour concentration is Dynamic Olfactometry using the ‘forced choice’ method. Dynamic olfactometry simply dilutes the odour sample in known ratios with odour free air. At each dilution, the diluted odour and a zero odour is presented in turn to six panellists via two ‘sniffing’ ports. Further, the selection of the port with the diluted odour sample is randomly reassigned at each presentation. Each panellist is required (forced) to nominate the port (left or right) from which the diluted odour emanates. Each panellist’s response (i.e. 'guess', 'likely' or 'certain') is recorded. The sequence of presentations generally follows a decreasing dilution ratio, and when half of the panellists have correctly returned a ‘certain’ response, that dilution ratio is numerically equal to the concentration of the original, undiluted odour sample. Hence, for example, if the dilution needed to get the 50% response was 250:1, then by definition the original sample had an odour concentration of 250 OU.

EPA Criterion for Odour

EPA has defined an odour criterion and the Odour Guideline specifies how it should be applied in dispersion modelling to assess the likelihood of nuisance impact arising from the emission of odour.

Odour impact is a subjective experience and has been found to depend on many factors, the most important of which are:

- The **F**requency of the exposure
- The **I**ntensity of the odour
- The **D**uration of the odour episodes
- The **O**ffensiveness of the odour
- The **L**ocation of the source

These factors are often referred to as the FIDOL factors.

DEC defined the odour criterion to take account of two of these factors (**F** is set at 99 percentile, **I** is set at from 2 to 7 OU). The choice of criterion odour level has also been made to be dependent on the population of the affected area, and to some extent it could be said that population is a surrogate for location – so that the **L** factor has also been considered. The relationship between the criterion odour level **C** to affected population **P** is given below.

$$C = [\log P - 4.5] \div -0.6 \qquad \text{Equation 1}$$

Table 3 lists the values of C for various values of affected populations as obtained using equation 1.

Table 3 Odour criterion for the assessment of odour

Population of affected community	Odour performance criteria (nose response odour certainty units at 99th percentile)
Single Residence (≤ ~2)	7
~ 10	6
~ 30	5
~ 125	4
~ 150	3
Urban (~2,000)	2

The NSW Approved Methods specifies a criterion of two odour units at the 99th percentile over a short term averaging nose-response time of one second for a complex mixture of odorous air pollutants in an urban area (population greater than 2000 or with schools and hospitals). The criterion is applied at the location of the nearest sensitive receptor or likely future location of sensitive receptor.

5 OU is commonly taken as a conservative measure of the odour level which can be distinguished against the ambient background level of odour, and which if offensive, could result in complaint.

1 OU generally cannot be detected in a non-laboratory situation (i.e. where the ambient background odour levels reduce the detectability of a given odorant).

As the CALPUFF dispersion model (utilised in this assessment), when operating in micrometeorological mode can only predict concentrations over an averaging period of one hour, a ratio between the one second peak concentration and 60 minute average concentration has been applied to the source odour emission rates. In this manner, the predicted one hour odour levels predicted in CALPUFF represent the corresponding one second short-term levels required to be compared to the DEC criterion. The ratio is known as the peak to mean ratio (PM60). PM60 is a function of source type, stability category and range (i.e. near or far-field), and values are tabulated in the modelling Guideline[3]. This is reproduced below.

Table 6.1: Factors for estimating peak concentrations in flat terrain (Katestone Scientific 1995 and 1998)

Source type	Pasquill–Gifford stability class	Near-field P/M60*	Far-field P/M60*
Area	A, B, C, D	2.5	2.3
	E, F	2.3	1.9
Line	A–F	6	6
Surface wake-free point	A, B, C	12	4
	D, E, F	25	7
Tall wake-free point	A, B, C	17	3
	D, E, F	35	6
Wake-affected point	A–F	2.3	2.3
Volume	A–F	2.3	2.3

* Ratio of peak 1-second average concentrations to mean 1-hour average concentrations

Figure 6 Extract from NSW Approved Methods

3 Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DEC, 2005).

4.2 Dust

Dust impacts can be assessed against several criteria, namely:

- Total suspended particles (TSP)
- Deposited dust
- Fine particulate matter less than 10 micron equivalent aerodynamic diameter PM_{10}

Table 4 below summarises the criteria for pollutants relevant to the operation of the plant from the Approved Methods for the Modelling and Assessment of Air Pollutants (EPA, 2016).

Table 4 Air quality impact assessment criteria - other pollutants

Pollutant	Averaging period	Criterion -
Particulate Matter PM_{10}	24 hours	50 µg/m^3
	Annual	30 µg/m^3
TSP	Annual	90 µg/m^3
Deposited Dust	Annual	4 g/m^2/month

5. Meteorological data

A 12-month dataset was constructed using the 3D prognostic modelling package, TAPM and the diagnostic 3D meteorological model, CALMET for the period from January to December 2004. This 12 month period was chosen to be consistent with previous modelling undertaken for the 2008 Air Quality Assessment, approved at the time by EPA and to allow to a direct comparison to previous modelling. Further detail is provided in Appendix A in regards to the selection and construction of the meteorological dataset used in the modelling.

The CALMET modelling can be summarised as follows:

- Prognostic models TAPM and CALMET were used for initial wind field 'guesses'
- Observations from both the environmental farm Automatic Weather Station (AWS) and Nowra AWS were used to optimise and check the prognostic model simulations
- Wind speeds and direction observations from the environmental farm AWS were assimilated into the prognostic model to make the data site-specific

The result of assimilating this data into the CALMET simulations makes the data site-specific (required for a Level 2 assessment), and inter-annual variability is not required to be accounted for, with the conditions of the Approved Methods met for using "*atleast one-year of site-specific meteorological data*".

An annual wind rose generated using CALMET is provided in Figure 7 to show the wind field at the factory. The following trends are evident from Figure 7:

- Annual average wind speed of 3.2 m/s
- Winds are most prevalent from the west and west northwest, accounting for around one third of all winds
- Winds are least prevalent along the north-south axis
- Light winds (shown in grey) are more prevalent from the northwest
- Drainage flows occurring during stable conditions at night time are dominated by the following distinct features (in order of scale):
  - Shoalhaven River running west to east through the site
  - Browns Mountains to the northwest of the site
  - Yalwal State Forest mountain range to the west.

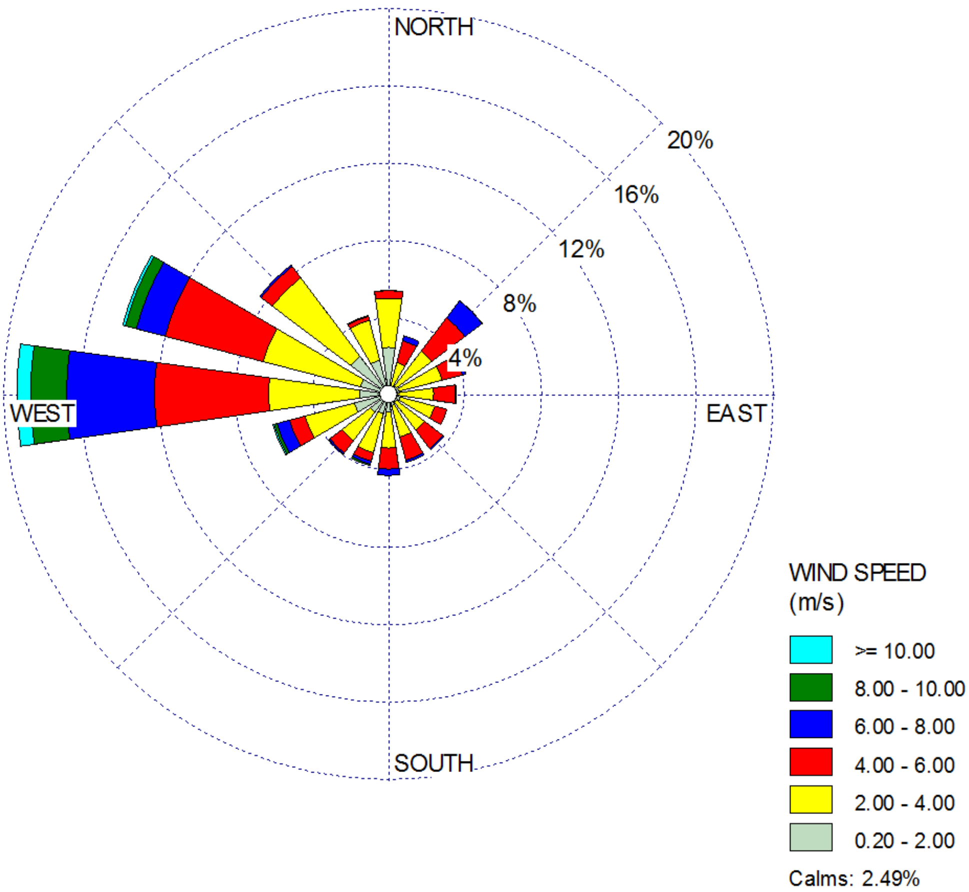


Figure 7 CALMET wind rose for the factory

6. Emission inventory

6.1 Odour

6.1.1 Source identification

Odour emanating from Shoalhaven Starches is comprised of a complex mixture of primarily odorous volatile organic compounds (VOCs). VOC speciation data from a range of principal odour sources indicates that the individual VOCs within the mixture tend to be classified under odour-based air quality criteria rather than toxicity-based[4] criteria. Therefore, the identified sources of odour are modelled collectively as odour.

Consistent with the 2008 Air Quality Assessment (GHD, 2008), the following sources contribute to the majority of the odour impacts from the Shoalhaven Starches sites, in order of significance:

- Environmental farm (effluent treatment and storage system)
- DDG Plant (including Pellet Plant exhaust stack and biofilters)
- Starch Plant (Gluten and Starch Dryers)
- Ethanol Plant (yeast propagators and retention tank)

A number of other minor odour sources contribute to the remainder of the plant's odour impact. These are detailed in Appendix B.

6.1.2 Proposed modifications

The proposed modifications, as described in section 3.11, are summarised below.

Approved and existing (baseline) operations

The approved and existing operations consists of all odour sources at the Shoalhaven Starches plant, including EPA monitored sources and all minor sources, conservatively scaled for a 300 ML per year production. It also includes approved operations that are sources of odour, both recently constructed. This consists of:

- Silos at the proposed packing plant. The Air Quality Impact Assessment: Modifications to Packing Plant conducted by SEMA (Stephenson Environmental Management Australia, 2015), calculated a maximum modelled odour concentration of 0.7 OU from a combined OER of the silo vents of 1,882 OUm^3/s.
- Recent upgrades to the existing flour mill. The Air Quality Impact Assessment: Modifications to Existing Flour Mill conducted by SEMA (Stephenson Environmental Management Australia, 2015) calculated a maximum modelled odour concentration of 0.3 OU from a combined OER of the mill baghouses of 471 OUm^3/s.
- Starch Dryer 5, recently constructed in the factory building on Bolong Road near the Maintenance Workshop. The Air Quality Impact Assessment: Dryer 5 Relocation conducted by SEMA (Stephenson Environmental Management Australia, 2015) calculated a maximum modelled odour concentration of 0.54 OU from an increase in OER of 6,800 OU/m^3/s associated with Dryer 5.
- Proposed new Flour Mill B. The Air Quality Impact Assessment: Proposed Flour Mill B conducted by SEMA (Stephenson Environmental Management Australia, October 2016)

[4] Based on VOC speciation data for selected sources in the DDG plant: DDG dryers, palmer cooler and condensate tanks.

calculated a maximum modelled odour concentration of 0.7 OU from a OER of 5637 OU/^{m3}/s.

The following assumptions and additions apply to the audit modelling:

- Peak odour emission rates were taken from the odour monitoring conducted by SEMA between May 2016 and February 2017 (four quarters) for EPA ID sources and scaled to a 300 ML per year production. The quarter with the maximum measured total OER was selected for use in the assessment and is consistent with guidance in the Approved Methods and the recommendation from EPA (16 February 2017) that peak emissions should be assessed. The peak period was found to be quarter 3 2016. A summary of these is presented in Appendix C.
- Specific odour emission rates from the effluent storage dams were based on most recent testing (May 2016) in conjunction with historical results
- Odour emission rates were assumed to be unchanged for sources originally measured in 2008 that have not been measured since

New sources:

- Pellet plant exhaust stack, taking odorous air from the pellet coolers, drag chains, container loading/aspiration channel, DDG cyclones and DDG silos
- No. 5 starch dryer
- Seven silos for the new packing plant
- Pellet plant fugitives, consisting of the wheat silos, barley intake fan, barley silo fan, barley grinding fan and bulk bag aspiration fan (non-DDG odour sources)

The installation of one new DDG dryer (DDG dryer 4) and Mill Feed silo, along with the relocation of the eastern cooling towers and the addition of the building to house the dryers (included in the model to update building wake effects).

The installation of an additional three dryers as well as DDG dryer 4, all to be ducted and captured via the two new biofilters. This incorporates the additional sources:

- Western cooling towers adjacent to the new DDG dryer building, assumed to have the same odour emissions and source characteristics as from the existing cooling towers
- Two new biofilters, adjacent to the existing biofilters
- washing column D500 which is located on the vacuum column

At present, two biofilters operate on a combined design air flow of 15,000 m^3/h, with the flow split between two biofilters, each with a surface area of 110 m^2. The biofilters receive air from a combination of odorous sources in the existing DDG plant, including feed dump, condensate, finish feed, finisher pump tank, dryer feed tank, feed holding tank and CIP (fresh caustic).

Air leakage from DDG Dryer 4 is to be captured and ducted to the existing biofilter. The air leakage is estimated to be 1500 kg/h at 54ºC. At a density of air, this equates to 0.38 m^3/s of additional exhaust air to feed to the biofilters. Each biofilter is designed for an air intake/treatment of 15,000 m^3/h (4.17 m^3/s).

A summary of the existing biofilter operations is provided below in Table 5. As stated in the (The Odour Unit, 2010).

“the odour destruction performance of the biofilter is not dependent to any significant extent on inlet odour concentrations less than 50,000 odour units”.

If this odour concentration is exceeded, the surface loading requires an update in the design to cope with the additional odour.

Table 5 Summary of biofilter operations

Parameter	Unit/measure	Parameter
Exhaust air flow rate ducted to biofilter (2016/2017)	Flow rate	2.6 to 3.1 m^3/s
Current total odour emission rate ducted to biofilter (2016/2017)	Odour concentration	7,600 to 9,800 OU
Biofilter A	area	110 m^2 (55% split)
	Air flow split	55 %
Biofilter B	area	110 m^2
	Air flow split	45 %
Max capacity for one biofilter	Flow rate	15,000 m^3/hour
		4.17 m^3/s
Bed depth	Length	1.8 m
Contact time	Time	48 s
Spare capacity (at maximum observed flow rate 2016/17)	Flow rate	3.3 m^3/s
Additional exhaust air from DDG dryer 4 (proposed)	Flow rate	0.38 m^3/s
Additional exhaust air likely from DDG dryers 5 to 7 (proposed)	Flow rate	Up to 5.0 m^3/s

The biofilter design for a bed depth of 1.8 m gives a contact time of 48 seconds – this is considered more than adequate to allow either biofilter to accept double the load while its' sister biofilter is off-line for replacement of the bed matrix.

With the two existing biofilters operating at around 50% of capacity, an additional 0.38 m^3/s of exhaust air could be absorbed by the two existing biofilters, resulting in no changes required to connect DDG dryer 4 to the system for Scenario 1.

The addition of DDG dryers 5 to 7 is expected to also involve the addition of numerous decanters and other potential odour sources which are yet to be fully defined. As a result, for this scenario it is assumed that the new system would be equivalent to the existing system for the DDG building and will require an additional two biofilters (with flow splitting) on site.

The flow rate of the new washing column vent will be 70 kg/h of air saturated in water (0.07 m^3/h assuming a density of 1000 kg per m^3) (Technip Technical specification X500 – Vacuum package). This equates to 0.001166 m^3/min of air flow which would have a similar odour character and level to the measured D6 vent. The corresponding OER based on this flowrate is 23.3 ou.m^3/min (~0.4 ou.m^3/s)

6.1.3 Source summary

Existing and Approved (Baseline) scenario

Modelling for the approved baseline scenario comprised the following sources:

- 49 point sources (each assumed at constant OER) throughout the factory area
- Three point sources with variable emissions within the factory area
- 11 area sources (consisting of two biofilters and the effluent treatment ponds)
- Five volume sources within the factory area

Scenario 1

Addition of DDG Dryer 4 and the buildings has the following additional two sources:

- Cooling towers located on the western side of the proposed DDG building, adding an additional 172 OUm^3/s, based on measurements from the existing on-site cooling towers to total existing OER from the plant.
- Mill feed silo, located to the south of the existing DDG building, adding an additional 173 OUm^3/s, based on measurements from the existing Gluten 1 B silo to total existing OER from the plant.

Addition of DDG dryers 5 to 7 has the following additional sources:

- Two biofilters, located adjacent to the existing biofilters in the southwest corner of the plant, adding an additional 0.85% to total existing OER from the plant (based on doubling the current OER from the two existing biofilters).

Upgrades for modifications to the proposed beverage grade ethanol distillery plant (MP06_0028) has the following additional source:

- washing column D500 which is located on the vacuum column

These sources are detailed in Appendix B.

6.2 Comparison of site total odour emissions for nominated Scenarios

A comparison of the sources that were modelled in the 2009 approval of the ethanol expansion project (GHD, 2008) and those that have been modelled as part of the MOD11 proposal (GHD May 2016) and MOD12 have been included below in Table 6. It can be seen that odour levels between 2008 and this assessment decrease by approximately 12%. Source release parameters are shown in more detail in Appendix B.

Although total emissions are lower now than in 2008, predicted impacts as shown in Section 7 (Table 7) of this report are not predicted to change at all when predicted odour units are reported as integers as requested by EPA. This is largely due to increases in odour emissions from Gluten dryer 3 and 4, which together make up 32% of the Scenario 1 total. These two sources are modelled as horizontal discharges with a velocity of 0.1 m/s which contributes to poor odour dispersion. This is discussed in more detail in Section 6.3.

The 12% decrease also the result of measured odours versus 2008 predictions and removal of various odour sources as shown in Table 6.

Table 6 Comparison of odour emissions from 2008 emissions to current proposal

Source	Model Reference	2008 EA MOER ou.m3/s before control	2008 EA MOER ou.m3/s stage 1 controls	Current 2017 MOER ou.m3/s (Mod 11 and Mod 12)	Comments
Boilerhouse					
Boiler no 2 - wood waste	BOILER2	13104	13104		Odours emanating from the combustion of coal were not included in 2008 modelling (EA 2008 p.34)
Boiler no 4	BOILER4	22889	22889	3171	Conversion from coal-fired to gas-fired boiler has reduced boiler air flow rates.
boiler 5 & 6	BOILER5	72440	72440	38463	Original modelling assumed DDG odour destruction efficiency of zero % through boilers (EA 2008 p.34)
			Sub-total MOER	**41634**	
			% of Total MOER	**15%**	
DDG Plant					
Feed dump tank	DDG20	8917	1338		ducted to biofilter
Condensate tank	DDG23	25711	3857		ducted to biofilter
Vent condenser	DDG24	3500	525		ducted to biofilter
Condenser drain	DDG25	3167	3167	31	Now labelled VCD. Condensate collected via ground level drain and then conveyed via pipe to waste water treatment plant @ farm
Finish feed tank	DDG26	18333	2750		ducted to biofilter
Finisher pump tank	DDG28	1433	215		ducted to biofilter
Dryer feed tank	DDG30	1433	215		ducted to biofilter
DDG Syrup Feed holding tank	DDG31	1317	198		ducted to biofilter
CIP tank	DDG32	417	63		ducted to biofilter
DDG tent storage area	DDG36	12862	1929	1929	Assumed control was pelletised DDG would reduce odour emissions.

Product storage sheds	DDG34	6820	1023	1023	Assumed control was pelletised DDG would reduce odour emissions.
Grounds	DDG37	203	0		Assumed control was that pellet plant would prevent any spillage of DDG product in the forecourts areas of DDG storage areas and so reduce odour to zero
DDG dryer building	DDG39	70504	7050		Odour sources ducted to boilers
palmer cooler	DDG16	17666	2650		Ducted to boilers
DDG heat exchanger	DDG45	2333	0		Ducted to boilers
Decanter 3&4	DDG5	1700	1700		Ducted to boilers
Decanter 1&2	DDG2	260	260		Ducted to boilers
Decanter feedtank	DDG1	217	108		Ducted to boilers
feed dryer baghouses	DDG18	867	130		Ducted to biofilter
light phase tank	DDG19	450	450	20	Ducted to boilers
cooling towers	DDG46	68333	6833	172	Odour testing undertaken has confirmed low results. Also possible condensate used in cooling towers when original testing in 2008 done - this practice no longer occurs
DDG Loadout Shed Awning	DDG35			923	Not in EA 2008 modelling inventory
DDG evap condensate tanks		36000	5400		Not installed (part of proposed 6 DDG dryers) Proposed to be ducted to biofilter.
DDG transfer cyclones (6)		9083	1362		Existing cyclones go to boilers 5 & 6. Proposed cyclones to go through to existing and new biofilters
DDG dryers (6)		6321	948		Existing DDG dryer (3) go to boilers 5 & 6; proposed new DDG Dryers (4) to go through to existing and new biofilters
Decanters (10)		8417	1263		Existing decanters go to Boilers. Proposed new decanters to go through to existing and new biofilters
pelletiser baghouse (2)		34378	5157		Transfered to the pelletiser exhaust stack - PPES
DDG general ventilation		722	108		Includes proposed DDG evap. condensate tanks and minor point sources associated with Pelletizer plant transfer points (EA 2008 p.32)
pellet exhaust stack	PPES			38240	Installed via MOD 5
Pellet silo	S12	350	350	350	
stillage surge tank	SST			149	

pellet plant fugitives (non-DDG sources)	PPF			5771	Installed MOD 5
Additional Cooling towers	CTP			172	Proposed MOD11
			Sub-total MOER	**48780**	
			% of Total MOER	**18%**	
Ethanol Plant					
Grain silo baghouse	E1	183	183		De-commissioned
ethanol cooling towers	E23	65833	0		Located in an area away from odour sources. Used fresh water. Odour considered negligible (EA 2008 p.12)
Yeast Propagators -tanks 4 and 5	E15Y4	14167	14167	820	Now YP45. Reduction due to removal of ammonia addition. 2 Tanks operate in batch sequence.
Yeast Propagators -tanks 4 and 5	E15Y5	14167	14167		Now YP45. Reduction due to removal of ammonia addition.
Grain retention tank	E8	6500	3250	3250	Now labelled GRT.
propagator tanks 1,2,3	E14	5500	5500		Configuration of propagator tanks changed - odour now accounted for via tanks YP45
Ethanol recovery scrubber	ERESC			3132	
Fermenters 10-16	FERM	1237	1237	2668	Previously sum of FERM10 (518) and FERM11(719) in 2008
jet cooker 1 retention tank	E13	1067	1067	1067	
jet cooker 2/4 grain retention	E7	1133	1133	567	
Feed to distillery	E22	167	83	83	
			Sub-total MOER	**11587**	
			% of Total MOER	**4.2%**	
Distillery					

Incondensable gases vent	D6	400	400	558	
Molec. sieve vacuum drum	D2	1350	1350	1350	
DME vent	D12	107	107		De-commissioned
Column Washing Vent	CWV			23	Proposed MOD 12
			Sub-total MOER	**1931**	
			% of Total MOER	**0.7%**	
Starch and Glucose					
cyclone and FF ID4	A4	1654	1654	679	Existing Flour Mill
cyclone and FF ID5	A5	617	617	96	Existing Flour Mill
cyclone and FF ID6	A6	1477	1477	449	Existing Flour Mill
cyclone and FF ID7	A7	551	551	932	Existing Flour Mill
Drum vac receiver	C4	3500	3500	1400	Only 1 drum in operation now, previously 3 in 2008
Dry gluten roof bin	S07	4500	4500	4500	
Enzyme tanks	B7	4083	2042	2042	
flash vessel jet cooker	C1			970	
flour bin aspirator	S13A	500	500	500	Combined S13 source in 2008 @ 1000 OER (refer to EA 2008 p.30)
flourbin aspirator	S13B	500	500	500	
flourbin motor drive	S06	283	283	283	
flour mill aspiration (Mod 8)	FMP1			266	MOD 8
flour mill aspiration (Mod 8)	FMP2			205	MOD 8
high protein dust collector	S08	600	600	600	
ion exchange effluent tank	C18	250	250	250	

no 1 gluten dryer baghouse	S02	13182	9866	5925	
no 1 starch dryer	S01	6315	4736	5193	
no 2 gluten/starch dryer	S04	5511	4133	2354	Result based on gluten drying
no 3 gluten dryer baghouse	S03	19501	14625	58917	High result to be investigated; flow rates highly variable; investigate alternate sampling point
no 3 starch dryer	S18	6436	4827	1663	
no 4 gluten dryer baghouse	S05	13331	9998	31222	High result to be investigated
no 4 starch dryer	S19	7151	5363	1824	
no 5 ring dryer gluten/starch	SDR5	12881	9661	4817	Result based on current gluten drying
no 5 starch dryer	SD5	6794	5096	6800	New starch dryer MOD7
no 6 gluten dryer	GD6			12568	
no 7 gluten dryer	GD7			9553	
spray dryer	S20	983	738	738	
starch kestner dryer	DDG40	3000	0		Dryer De-commissioned
starch factory rejects	E10	183	183	183	
Farm tank	F18	7667	3834	3834	
pellet mill silo	PMFS			173	Not constructed MOD10.
Flour Mill B Exhaust (10 points)				5637	Not constructed MOD10
			Sub-total MOER	**165,073**	
			% of Total MOER	**59%**	
Packing Plant MOD 9					
starch silo 1	PPL1			86	Not constructed
starch silo 2	PPL2			86	Not constructed

gluten silo 1	PPM1			173	Not constructed
gluten silo 2	PPM2			173	Not constructed
gluten silo 3	PPM3			173	Not constructed
small gluten silo	PPS1			92	Not constructed
small starch silo	PPS2			35	Not constructed
			Sub-total MOER	**818**	
			% of Total MOER	**0.3%**	
Area sources: Env farm after WWTP					
Biofilter A	BIO1			440	
Biofilter B	BIO2			330	
Biofilter C	BIO3			1089	proposed MOD 11
Biofilter D	BIO4			1280	proposed MOD 11
storage dam 1	PO1		3600	148	
storage dam 2	PO2			1656	
storage dam 3	PO3			192	
storage dam 5	PO5			515	
storage dam 6	PO6			1775	
SO basin	SOBAS		23400	830	
MBR	MBR		500	62	
			Sub-total MOER	**8317**	
			% of Total MOER	**3%**	
Total (2008)			**317,159**		
Total (Mod 11 and Mod 12)				**278,140**	
Decrease from 2008				**12 %**	

6.3 Odour mitigation

In order to reduce the potential for odour impacts from the site to meet the odour criterion, a review of significant odour sources was undertaken and how they are released into the atmosphere. The review found that Gluten dryer 3 and 4 which together make up 32% of the site total are horizontal discharges. These were modelled with a velocity of 0.1 m/s, meaning that odour is not being adequately dispersed resulting in elevated ground level odour impacts under certain meteorological conditions. An odour mitigation scenario was designed after consultation with engineers from Shoalhaven Starches.

The following stack discharge scenario has been assessed:

- Gluten Dryer No.3, average airflow velocity of 10.975 m/s, at 65 degrees duct, vertical airflow 9.95 m/s
- Gluten Dryer No.4, average airflow 16.575 m/s, at 45 degrees duct, vertical airflow 11.72 m/s.

Angling the ducts from horizontal towards vertical, enable emissions to be dispersed up into the atmosphere at their calculated velocity. This will assist dispersion of odours and potentially reduce ground level odour impacts.

Results of the odour mitigation assessment are discussed in Section 7.3.

6.4 Dust emissions

6.4.1 Source identification

The main sources of dust, consisting of TSP, PM_{10} and $PM_{2.5}$, are listed below:

- Gluten and starch dryers
- Boilers:
  - Boiler 1 – Gas fired
  - Boiler 2 – Wood fired
  - Boiler 3 – Gas fired
  - Boiler 4 – Gas fired (converted from coal)
  - Boiler 5/6 – Coal fired
  - Boiler 7 – Gas fired
- Flour Mill baghouses
- DDG Pellet Plant exhaust stack
- Product silos
- Coal and woodchip stockpiles

No dust emissions are expected to arise from a normal-functioning biofilter, which acts as an impassable filtration device due to the density of its matrix. As a consequence, all new emissions from the proposed DDG dryer 4 (and subsequent DDG dryers 5 to 7) are expected to be captured in the biofilters. No net increase in particulate emissions from the plant as a result of the proposed modifications is therefore predicted. The addition of the cooling towers and mill feed silo are also expected to add negligible particulate emissions to the current footprint of the plant.

The relocation of the coal and wood chip storage area is expected to improve predicted dust impacts caused by wind erosion of unstable/uncovered surfaces. At present, the coal stockpiles cover an area of approximately 550 m^2. The relocation of the storage area to the environmental farm north of Bolong Road will increase the distance to sensitive receptors R1 to R4, along with the town of Bomaderry. With appropriate dust controls, including currently used practices of watering and suitable design dimensions, it is predicted that this would result in lower levels of dust due to wind erosion encountered at nearby sensitive receptors.

The proposed beverage grade ethanol modification has no significant sources of operational dust emissions. The proposed modifications listed in Section 3.11 include relocation of equipment, new tanks, a pipe, substation, cooling towers and a paved access road. The existing rail siding, which is being extended, is not a significant source of dust.

As dust impacts are only predicted to improve as a result of the proposed modifications, no modelling was undertaken. Shoalhaven Starches have existing dust controls in place to manage dust emissions at the site and impacts from the proposal are not expected at nearby sensitive receptors.

7. Dispersion modelling

The odour dispersion modelling was conducted using the US EPA regulatory Gaussian puff model CALPUFF Version 5.8. This model is also a recognised regulatory model in NSW. Where the modelling of odour dispersion is in complex terrain (as is the case at the Shoalhaven site), CALPUFF is recommended for use under NSW Guidelines. CALPUFF is especially suited for modelling light to calm wind conditions.

7.1 Model configuration and parameter selection

The following settings were used in the simulations:

- Model: CALPUFF Version 5.8
- The receptor grid was 25 km x 25 km, with a 200 m grid resolution
- The nearest receptors from the townships of Bomaderry (to the west) and Nowra (to the south) were used as sensitive receptors, along with a few isolated residences around the factory and environmental farm
- Ground level receptor heights have been modelled using the same terrain data as the original 2008 GHD assessment. This terrain data was used in the CALMET 2004 model which is used for CALPUFF modelling. In the June 2016 GHD Odour Audit, receptor heights were changed to represent latest available terrain data which is of higher resolution than the 2008 terrain data. This was identified as an error as the terrain in the corresponding CALMET model and CALPUFF model were not also updated. Receptor heights have therefore been reverted back to the original heights used in the 2008 model.
- Emissions were scaled based on a nose-response time for odour of one minute, applying a peak-to-mean ratio to the one hour average concentration of 2.3 for wake affected point sources and volume sources, and variable scaling for non-wake affected sources and area sources
- Meteorology was taken from the CALMET 2004 synthesised dataset, approved for use in previous studies.

7.2 Building wake effects

Building wake effects were modelled to the extent practicable. A summary of building heights input in to the model is provided below, with area sources shown in red and building footprints shown in grey. For proposed Scenario 1, additional buildings and structures were added to the southwest area of the factory.

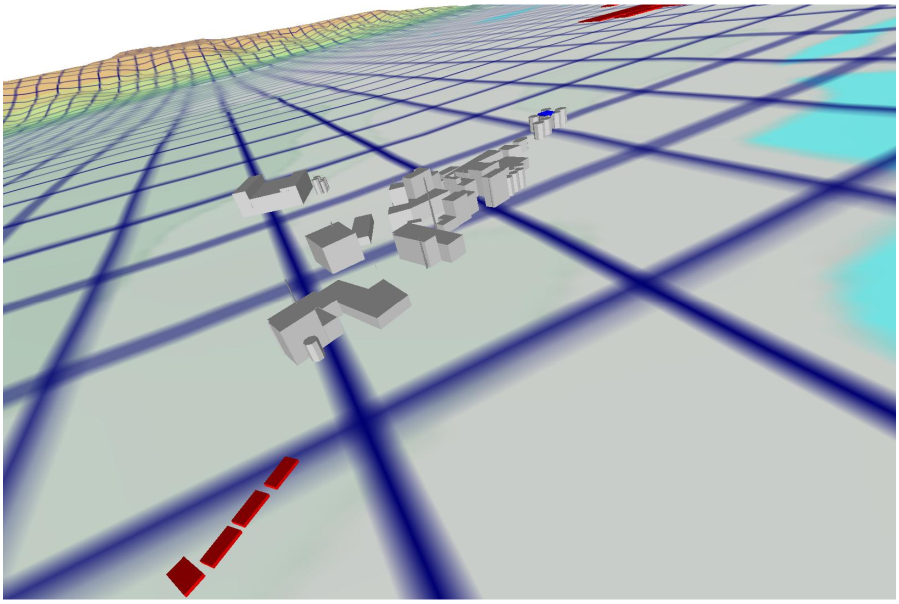


Figure 8 Model setup for building wake effects – Existing and approved scenario (source: Lakes CALPUFF View, CALPUFF 3D 7.5.0)

7.3 Odour assessment

Table 7 shows the predicted odour levels for the existing situation and Scenario 1. Results of the mitigation scenario (change in the angle of the Gluten dryer 3 and 4 ducts) are also presented.

Figure 9 shows the predicted 99th percentile odour impacts (one minute nose-response time) for the existing and approved operations at the plant and environmental farm when compared to the incremental impact from the additional odour sources modelled in Scenario 1.

Figure 10 shows the predicted 99th percentile odour impacts (one minute nose-response time) for the existing and approved operations when compared to the incremental impact from the additional odour sources modelled in scenario 1 with mitigation.

Results show that the impact assessment odour criteria are achieved at R1 and R2 for both the existing scenario and Scenario 1, however exceeded at R3 and R4.

Results show that with the odour mitigation scenario, predicted odour levels achieve the impact assessment odour criteria at all receptors.

Table 7 Predicted peak (99th percentile, short term averaged) odour impact at nearby receptors

Receptor	Range, m	To nearest odour source	Direction	Odour criterion	Odour impact, OU, 99th percentile, nose-response time		
					Existing (Baseline) Scenario	*Scenario 1*	*Scenario 1 (Mitigated)*
R1 Bomaderry	150	Packing Plant	W	6	5	5	3
R2 North Nowra	1300	Factory	SW	3	3	3	2
R3 Nowra	700	Factory	S	5	**6**	**6**	4
R4 Terara	1300	Factory	SE	5	**6**	**6**	4

Paper Size A3

0 250 500 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Legend

- Packing plant (proposed)
- Shoalhaven Starches Factory
- Environmental farm boundary
- Identified sensitive receptors
- Odour unit contour (existing)
- Odour unit contour (no mitigation)

Manildra Group Pty Ltd
Shoalhaven Starches

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Date	22 May 2017

Odour impacts
Existing vs 'Mod 11 and Mod 12' (No mitigation)

Figure 9

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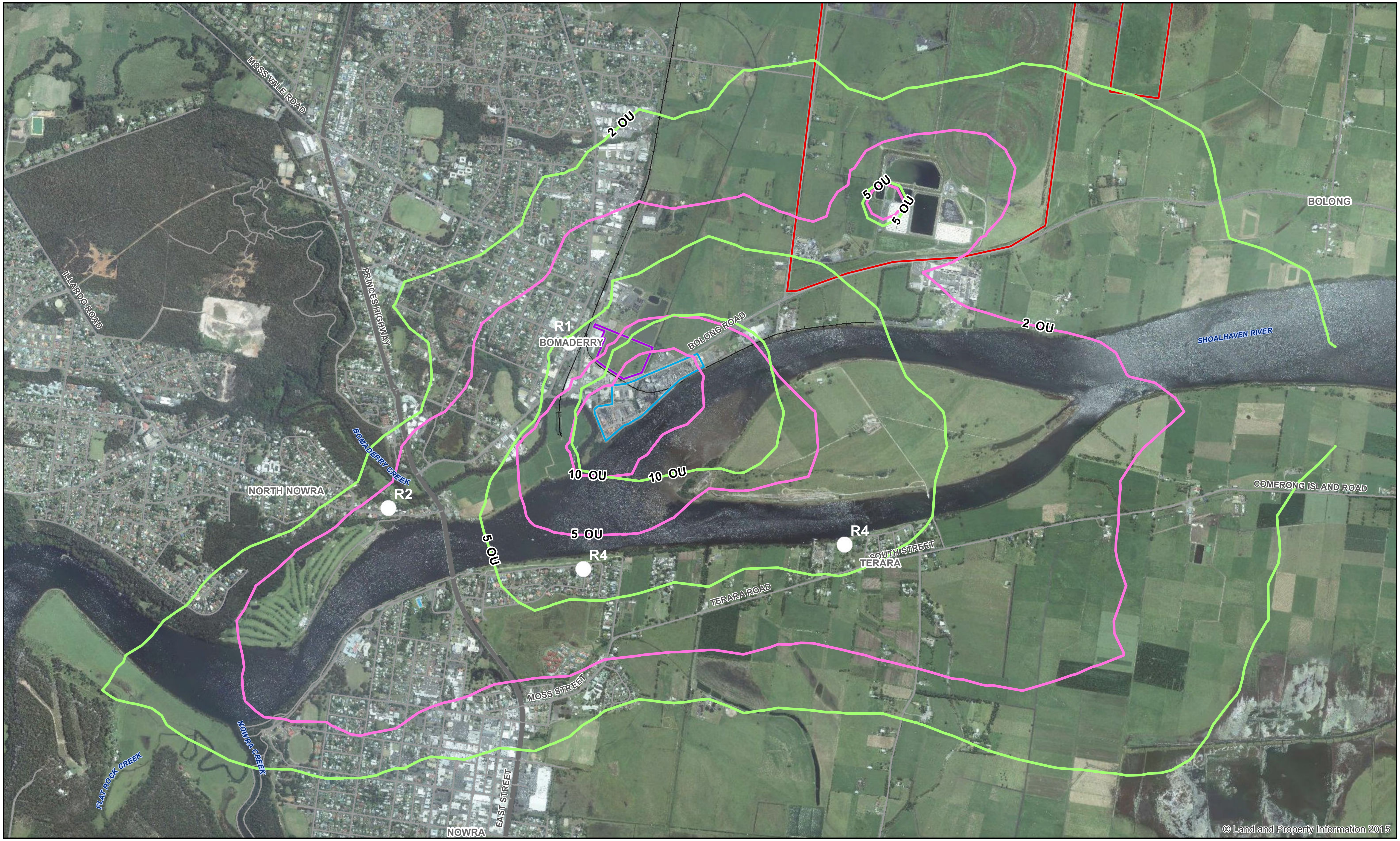
Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data source: LPI, topographic base data, 2012. Created by:apmiller



Paper Size A3

0 250 500 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Legend

- Packing plant (proposed)
- Shoalhaven Starches Factory
- Environmental farm boundary
- Identified sensitive receptors
- Odour unit contour (existing)
- Odour unit contour (mitigation)

GHD

Manildra Group Pty Ltd
Shoalhaven Starches

Job Number	21-26310
Revision	A
Date	22 May 2017

Odour impacts
Existing vs 'Mod 11 and Mod 12' (With mitigation)

Figure 10

G:\21\26310\GIS\Maps\Deliverables\31_33842_Z001_NoMitigation.mxd

Data source: LPI, topographic base data, 2012. Created by:apmiller

8. Conclusions and implications

GHD was engaged by Manildra to conduct an air quality and odour impact assessment for a proposed modification to the approved SSEP.

The addition of the proposed sources of the DDG dryers requires the duplication of the two existing biofilters, taking the total number of on-site biofilters to four, in order to meet treatment requirements.

A marginal increase was observed in predicted odour impacts as a result of the addition of two biofilters, relocated cooling towers, the Mill feed silo and column washing vent when compared with existing operations plus those operations already approved. It is considered highly unlikely that this increase in odour would be detected at sensitive receptors.

As a result, it is predicted that no discernible increase in perceived odour impacts would be evident as a result of the proposed modifications to the plant. Odour modelling included the maximum measured quarter in regards to total odour levels from quarterly monitoring conducted at the EPA Licence points and is considered conservative.

Additionally, odour impacts were compared with previous odour assessments of the plant, with the following features observed from odour measurements and modelling results:

- An overall decrease in total odour emissions from the plant by around 12 % to the original ethanol expansion assessment in 2008.
- Odour impacts from Scenario 1 are similar to those predicted in 2008; with the exception of a slight extension of impacts to the south and south west, as a result of small changes to the layout of the plant and increases in emissions from Gluten Dryer Baghouse 3 and 4.
- An odour mitigations scenario has been undertaken which changes the angle that the Gluten Dryer Baghouse 3 and 4 duct release emissions. The mitigation scenario directs emissions towards vertical rather than horizontal and have been modelled with an increase stack exit velocity. This significantly increases dispersion and reduces predicted ground level odour impacts. Predicted odour levels with this mitigation scenario in place comply with the impact assessment criteria at all sensitive receptors, as shown in Table 7.

9. References

Department of Environment and Conservation. (2006). *Technical Framework: Assessment and management of odour from stationary sources in NSW.* Sydney: NSW government.

EPA. (2016). *Approved Methods for the Modelling and Assessment of Air Poluutants in New South Wales.* Sydney: NSW Government.

GHD. (2008). *Shoalhaven Starches- Report of Ethanol Upgrade Air Quality Assessment.* Melbourne: GHD.

Stephenson Environmental Management Australia. (2015). *Modifications to Existing Flour Mill.* Newington: Stephenson Environmental.

Stephenson Environmental Management Australia. (2015). *Modifications to Packing Plant.* Newington NSW: Stephenson Environmental Management Australia.

The Odour Unit. (2010). *Ethanol Upgrade: DDG Biofilter Commissioning & Operating Manual .* Eveleigh, NSW: The Odour Unit.

Appendices

Appendix A – Meteorological analysis

The following section is taken from the Shoalhaven Starches Report on Ethanol Upgrade: Air Quality Assessment (GHD, 2008), and describes the meteorology of the area and how the dataset was compiled.

A1 Meteorology

The three-dimensional meteorological data for a CALPUFF model simulation are provided by CALMET[5], its meteorological pre-processor. CALMET requires meteorological input from surface weather station networks and upper air stations.

The following sub-sections describe the available meteorological data, how the data was applied and the features of the dispersion meteorological data used to run CALPUFF.

A1.1 Data Available

Wind data were collected at three locations within the Shoalhaven Starches facility. Of these three stations, only one station, the automated weather station (AWS) located near the storage ponds at the environmental farm (hereafter referred to as Farm AWS), is compliant with the Australian Standard for the measurement of horizontal wind for air quality applications (AS 2923:1987). The other two stations, in particular the weather station located at the factory, are compromised by building and equipment infrastructure. Wind data have been collected at the Farm AWS since 2003, with the most complete data set collected in 2004.

The nearest source of additional surface meteorological data was the Bureau of Meteorology (BoM) Nowra AWS located approximately 12 km to the west at the Royal Australian Navy base at Nowra (HMAS ALBATROSS). This data source was considered to be too far from the subject area to be site-representative.

The nearest source of upper air meteorological data was also the HMAS ALBATROSS site, which does irregular upper air soundings based on operational requirements. However, the time gap between these vertical atmospheric soundings is too large to be suitable for use as model input.

A1.2 Data Application

To take full advantage of the CALPUFF features, described in Section 7.1, and make use of the available meteorological data described above, a combined prognostic/diagnostic meteorological modelling approach was used to synthesise the three-dimensional meteorological data input required by CALPUFF.

The regional-scale prognostic meteorological model, TAPM[6], was used to simulate the meteorology over the subject site with consideration to the DECC *Approved Methods*. TAPM is an approved model for specialist applications and its use, as part of this assessment, is described in the next section.

The observations from the Farm AWS and Nowra AWS were first used for optimising and checking the performance of the prognostic model simulation.

Wind speed and wind direction data from the Farm AWS were then assimilated into the prognostic model.

The subsequent TAPM output (with assimilated Farm AWS data) was then passed to meteorological pre-processor model CALMET (version 5.5).

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5 Scire J.S., E.M. Insley, R.J. Yamartino, and M.E. Fernau, 1995: A User's Guide for the CALMET Meteorological Model. Report prepared for the USDA Forest Service by EARTH TECH, Concord, MA. See: http://www.src.com/calpuff/calpuff1.htm

6 Hurley, P. The Air Pollution Model (TAPM) version 3. CSIRO Atmospheric Research Paper No. 31, 2005

A2 Prognostic Meteorological Modelling

TAPM (version 3.0.7) was developed at CSIRO Division of Atmospheric Research as a PC-based prognostic modelling system that can predict regional scale three-dimensional meteorology. TAPM accesses databases of synoptic weather analyses from the Bureau of Meteorology. The model then provides the link between the synoptic large-scale flows and local climatology, which includes characterising such factors as local land use and topography, and their influence on atmospheric stability and mixing height.

TAPM was initially configured with a nested model grid coverage designed to capture:

- Broad scale synoptic flows
- Regional to local scale wind channelling
- The influence of local land use

The nested grids were then configured with surface characteristics, such as terrain elevation, surface type (land use and vegetation type), soil type and deep soil moisture content.

Specific model settings were:

- Four nested grids at 1 000 m, 3 000 m, 10 000 m and 25 000 m resolution, with 55 x 55 grid points. The grid was set to ensure the locations of the Farm AWS and Nowra AWS were within the inner nested grid
- Surface vegetation and precipitation processes were included, whereas, non-hydrostatic processes were not included

Following an initial model run, the model output from the grid point nearest to the Farm AWS was compared with data recorded at that station. Specifically, the predicted hourly ambient temperatures and the annual wind rose (wind speed and direction distributions) were compared with corresponding recordings. Model output from the model grid point nearest to the Nowra AWS was also compared with an annual wind rose derived from data recorded at that station.

Figure A1 shows the scatter plot of observed and predicted ambient temperature at the Farm AWS. The determined optimal model configuration produced a correlation coefficient of 0.88 for predicted temperature. The strong correlation between predicted and recorded temperature indicates that the model is accurately calculating the surface energy balance, which, in turn, adds confidence to the hourly varying predictions made for atmospheric stability and the height of the mixed layer.

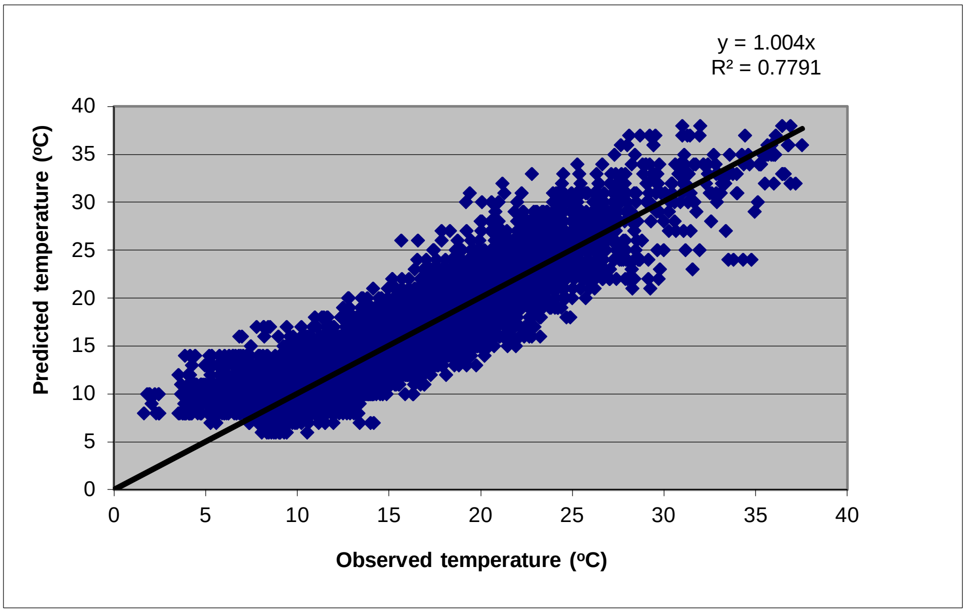

Figure A1 Scatter Plot of Observed and Predicted Ambient Temperature

A2.1 Wind Distribution

Figure A2 shows the predicted (a) and observed (b) wind roses for the location of the Nowra AWS. The directional distribution of winds predicted by TAPM shows reasonable agreement with the recorded observations and with the wind patterns expected for this region.

Figure A3 shows the predicted (a) and observed (b) wind roses for the location of the Farm AWS after the initial TAPM simulation. The directional distribution of winds predicted by TAPM shows reasonable agreement with the recorded wind patterns expected for this region.

The wind speed and direction observations from the Farm AWS were assimilated into the prognostic model simulation to improve the ability of the model to capture the effects of local wind channelling and low wind speed conditions. The improvement to wind direction distributions in the model output is clearly evident in Figure A3(c). The marked improvement in the capture of low wind events is examined below.

It is understood that TAPM performs reasonably well at simulating low wind speeds when the atmosphere is unstable but is known to perform relatively poorly during stable atmospheric conditions[7]. This is a critical factor in this assessment given that odour emissions occur 24-hours per day, resulting in predictions of maximum odour impact dominating during these conditions.

Figure A4 shows a histogram of wind speed distribution for observations at the Farm AWS, predictions from TAPM and predictions from TAPM after wind speed and direction data from the Farm AWS were assimilated into TAPM. It is clear from this figure that TAPM did reasonably well at originally predicting moderate to high wind speeds but did relatively poorly predicting low wind speeds. However, Figure A4 also shows that the representation of low winds in the TAPM output was significantly improved once the Farm AWS data were assimilated into the model.

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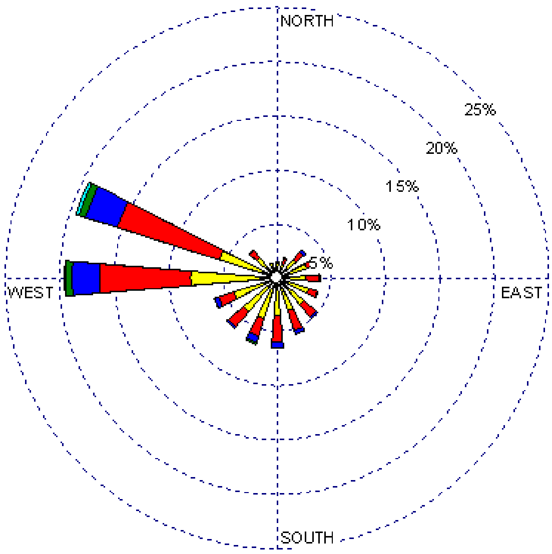
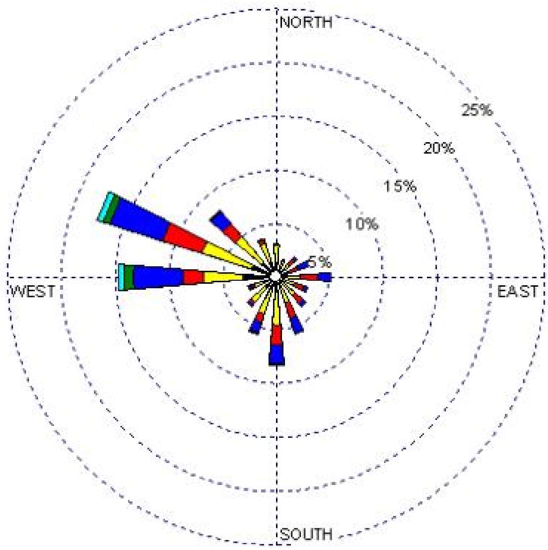
7 Luhar, A., Hurley, P. and Rayner, K. Improving Land Surface Processes in TAPM. Part 2: Low Wind Stable Conditions. 14th IUAPPA World Congress 2007

TAPM output at Nowra AWS grid point	Recorded at Nowra AWS
	

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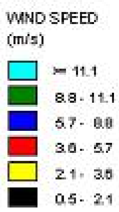

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Figure A2 Nowra AWS - Annual Wind Roses (Year 2004)

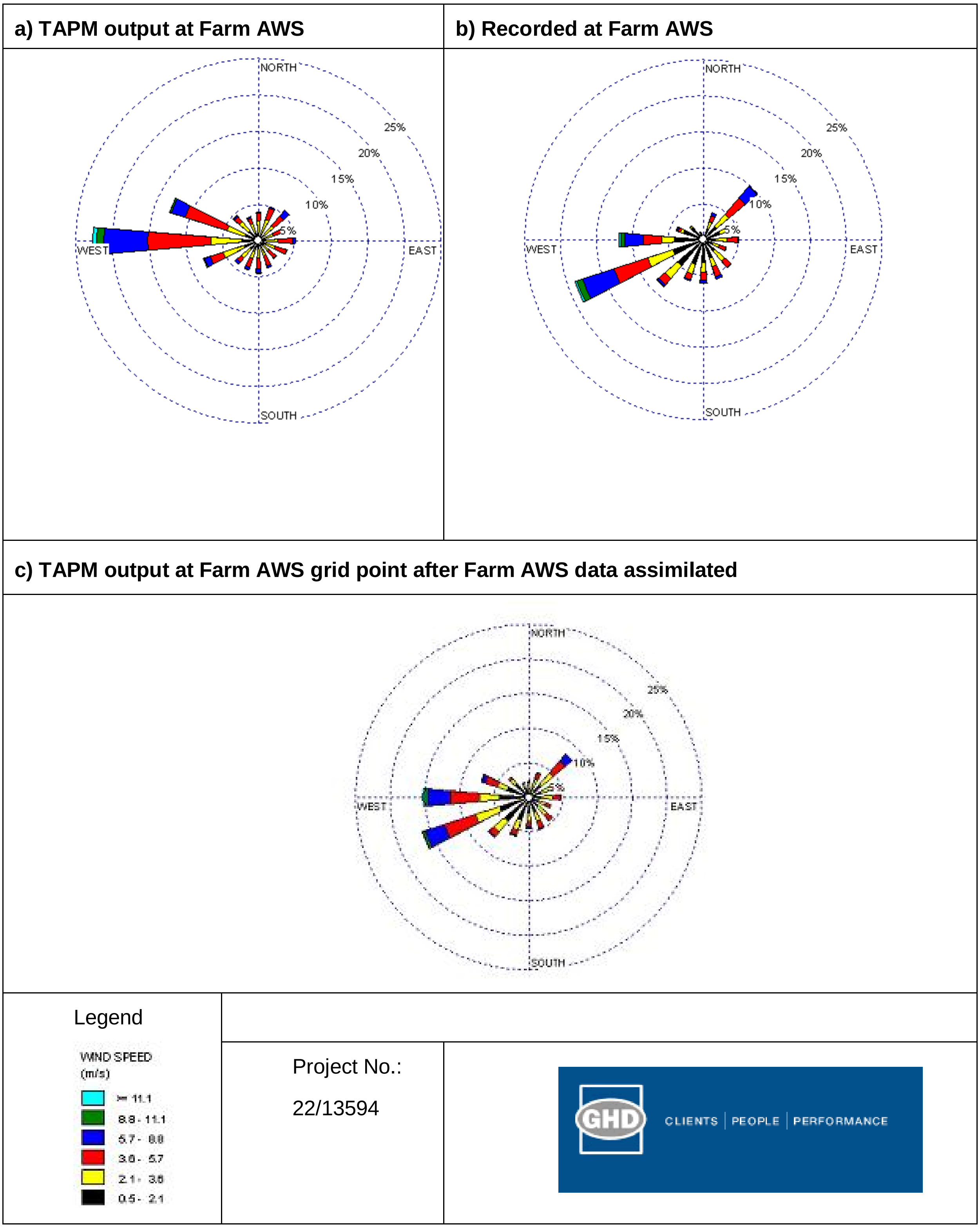

Figure A3 Farm AWS - Annual Wind Roses (year 2004)

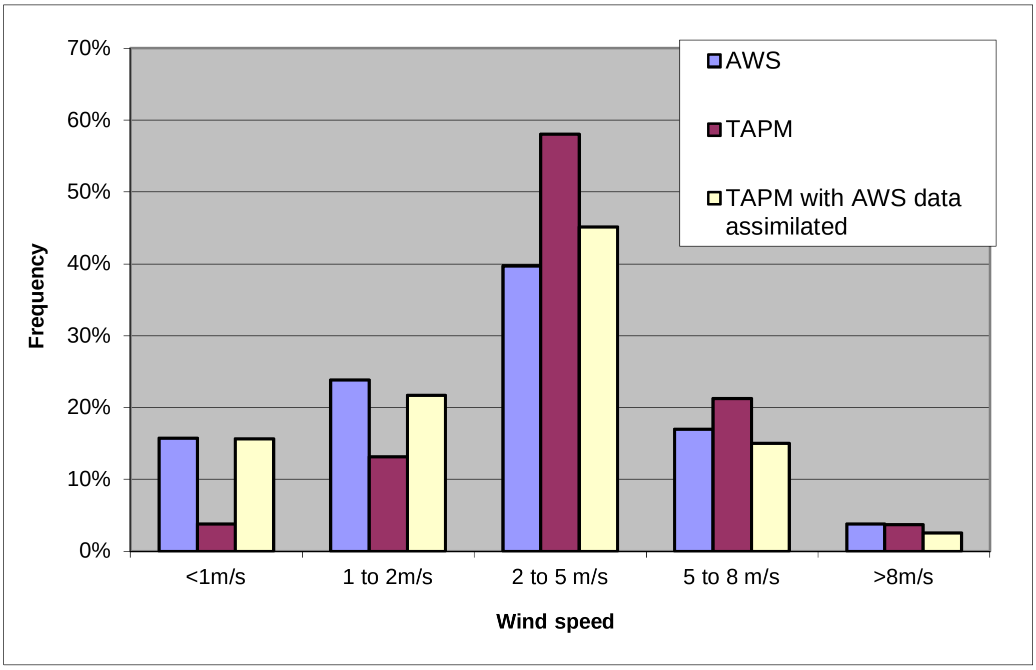

Figure A4 Wind Speed Distribution – TAPM and Farm AWS

To further investigate the effect of data assimilation on model output, a sensitivity analysis was conducted to compare the subsequent CALPUFF model predictions using meteorological input derived with and without the assimilation of observed wind speed and wind direction data from the Farm AWS into TAPM. Good agreement was found in the general pattern of dispersion (i.e. similar directions of poor dispersion), however, the highest ground level odour concentrations were predicted when the assimilated meteorological data file was used, which was expected given the higher frequency of light winds.

A3 Diagnostic Meteorological Model - CALMET

The TAPM output (with assimilated data) was then passed to model CALMET (version 5.5)[8], which is the 3D meteorological diagnostic model pre-processor to the CALPUFF 3D puff based dispersion model.

Hourly varying 3D meteorological data, at a 1000 m resolution, were extracted from the TAPM inner nested grid and passed to CALMET in their entirety as initial guess fields. Surface meteorological parameters and vertical profile data were also extracted from TAPM at a grid point near the factory, and used as if they were observations in the diagnostic model (i.e. pseudo-data).

CALMET was configured with a 15 km by 15 km grid at 200 m resolution and with local scale surface characteristics, such as terrain elevation and land use (e.g. forest or sparse growth, water or residential). The land use and terrain elevation information was derived from US Geological Survey and AusLig data, respectively, with adjustments based upon inspection of aerial photographs, topographical and land uses maps, and a site inspection.

CALMET was used to produce hourly site-representative winds and micrometeorological information, which was used with the CALPUFF 3D puff-based dispersion model to assess the impacts of the air pollutants on the surrounding land uses.

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8 Scire J.S., E.M. Insley, R.J. Yamartino, and M.E. Fernau, 1995: A User's Guide for the CALMET Meteorological Model. Report prepared for the USDA Forest Service by EARTH TECH, Concord, MA. See: http://www.src.com/calpuff/calpuff1.htm

A3.1 Site-specific meteorology

Figure A5 shows a wind rose that illustrates the distribution of wind speed and direction at the location of the Factory. On an annual basis the prevailing winds are from the west with winds also from the west-north-west, north-west, west-south-west and north-east. The mean wind speed is 3.2 m/s, with higher speed winds associated with westerly winds with speeds up to 11 m/s; such speeds are not reached from other directions. The highest frequency of light winds occurs from the south-west, west and north.

Figure A6 provides a seasonal breakdown of the predicted wind distribution at the Factory, this figure reveals a north-easterly predominance during summer (sea-breeze) and a westerly predominance during the other seasons, in particular during winter.

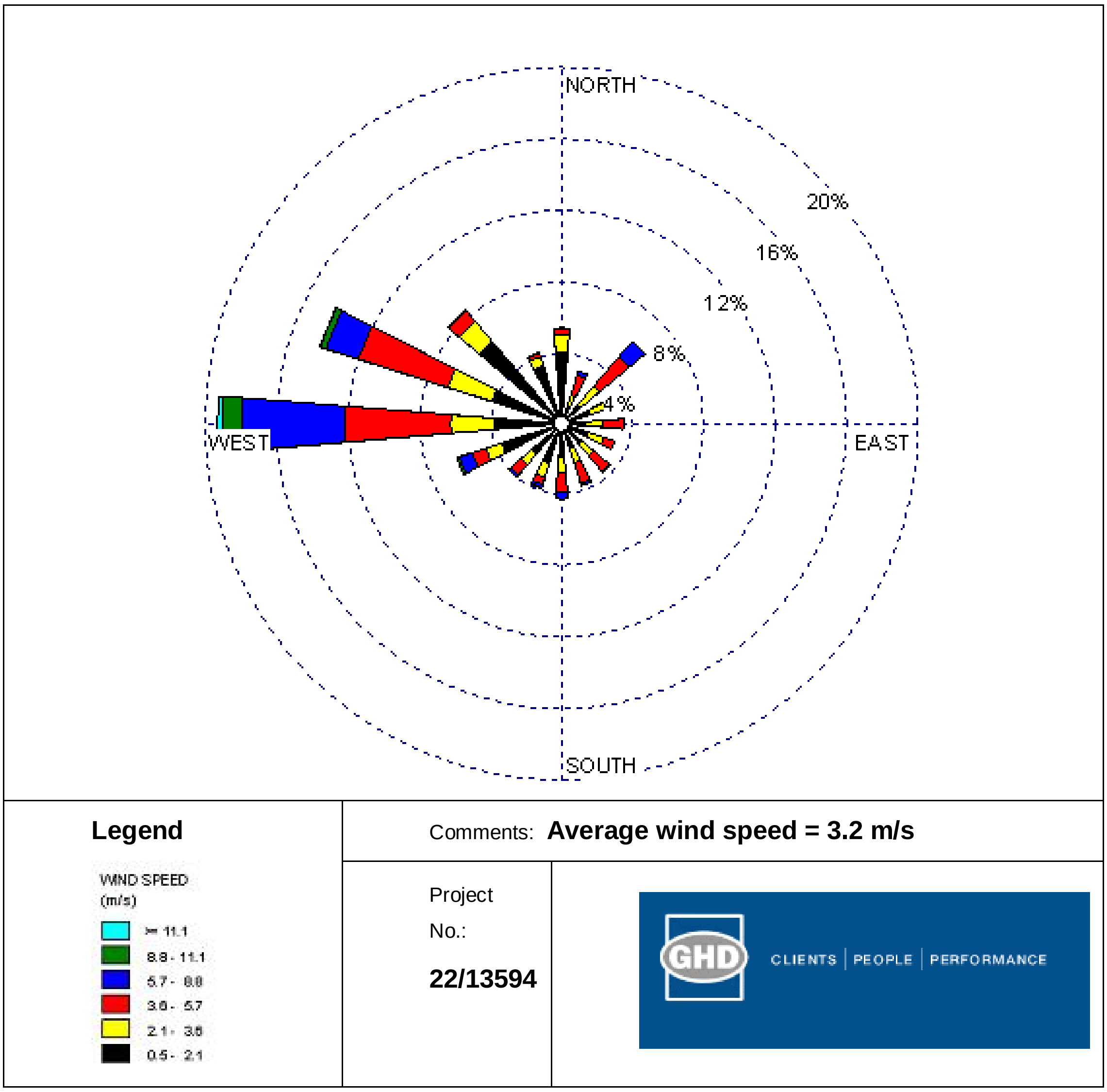
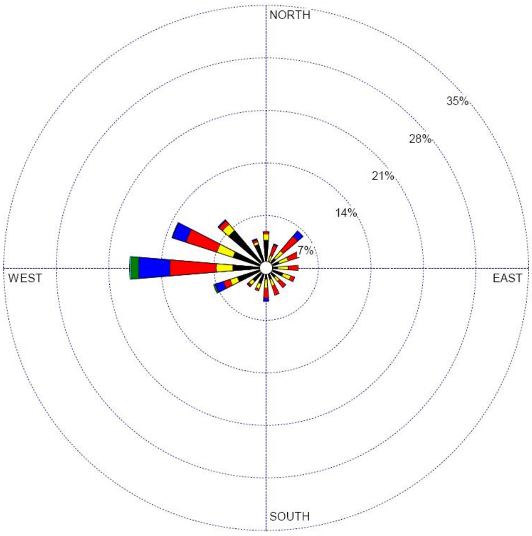
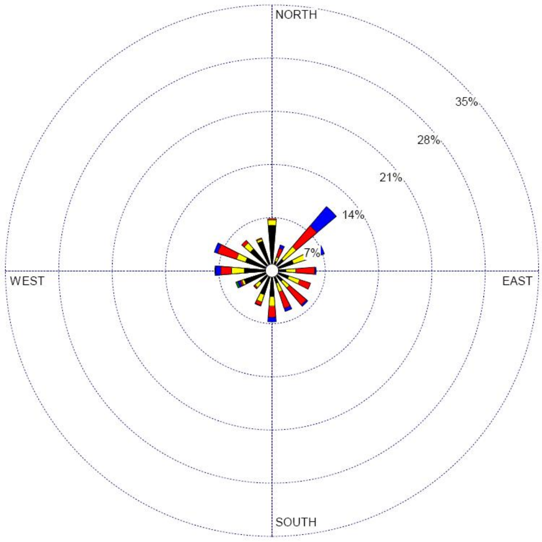
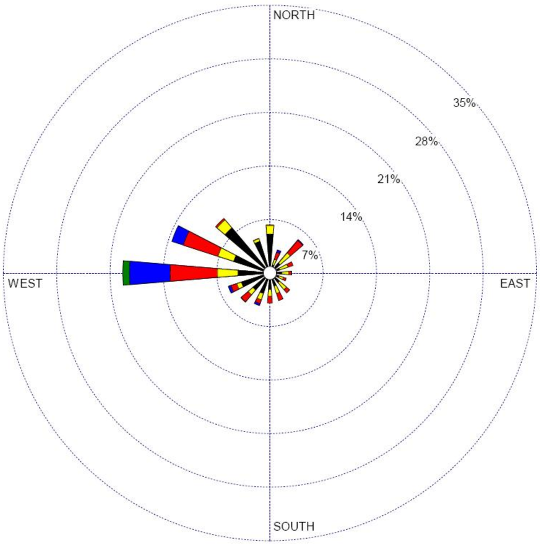
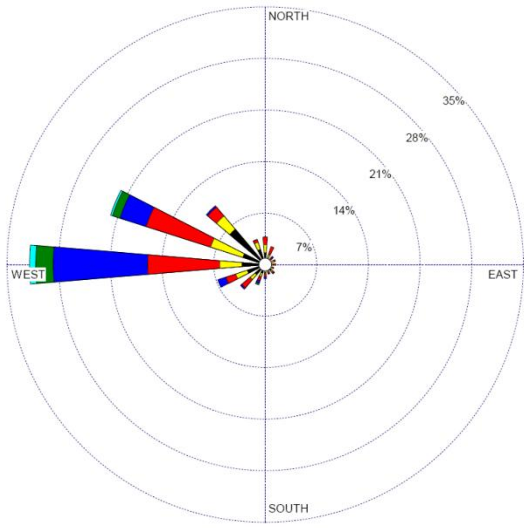


Figure A5 Factory Annual Wind Rose - Year 2004

Spring (average wind speed = 3.1 m/s)	Summer (average wind speed = 2.8 m/s)
	
Autumn (average wind speed = 2.8 m/s)	**Winter (average wind speed = 4.1 m/s)**
	

Legend

WIND SPEED (m/s)

- >= 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

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Figure A6 Factory Seasonal Wind Roses - Year 2004

A categorised measure of atmospheric stability is also output from the model. These can be broadly defined as listed in Table A1.

Table A1 Atmospheric Stability Classes and Distribution

Stability Class	Description	Frequency of Occurrence [1]
A	Extremely unstable atmospheric conditions, occurring near the middle of day, with very light winds, no significant cloud.	2%
B	Moderately unstable atmospheric conditions occurring during mid-morning/mid-afternoon with light winds or very light winds with significant cloud.	14%
C	Slightly unstable atmospheric conditions occurring during early morning/late afternoon with moderate winds or lighter winds with significant cloud.	17%
D	Neutral atmospheric conditions. Occur during the day or night with stronger winds. Or during periods of total cloud cover, or during twilight (transition) period.	22%
E	Slightly stable atmospheric conditions occurring during the night-time with some cloud and/or light-moderate winds.	12%
F	Moderately stable atmospheric conditions occurring during the night-time with no significant cloud and light winds.	32%

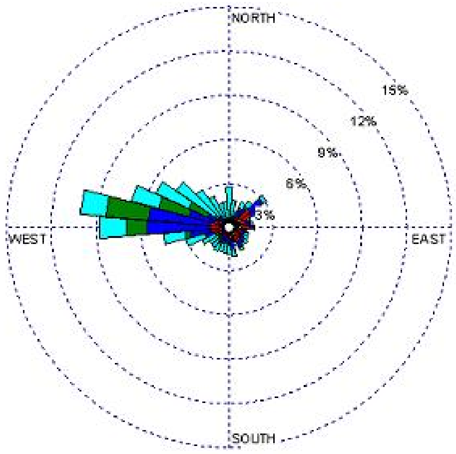
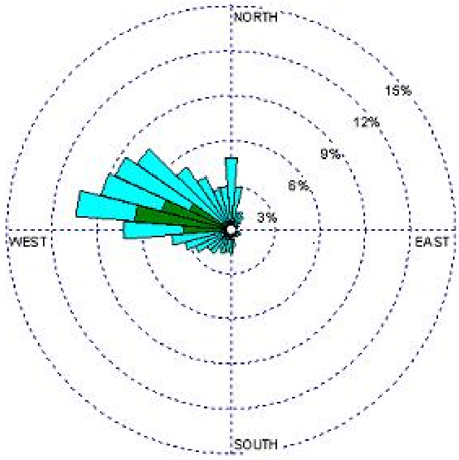
1. Stability data in this table extracted from Factory meteorological data

Potential off-site odour impact would tend to be maximised when winds are light and the atmosphere is stable, conditions that typically occur during the early evening and night-time. Table A1 shows that these conditions occurred for approximately 44% of the time.

The occurrence of stable air flows is of significance as these generally provide the conditions for worst case dispersion of emissions to air from ground based (or near-ground based) sources, and hence potentially the highest impact to odour amenity. This is due to the limited mixing in the vertical plane of these light wind airflows, and hence less dilution of the emissions from the majority of odour sources, which are either at ground level or wake affected short stacks. Therefore, the distribution of light wind stable flows can define the directions of “poor odour dispersion” from the factory and environmental farm.

Vertical mixing of airflows can be brought about by two mechanisms. The first is mechanical mixing caused by the shear stresses as air moves over rough terrain. The second is via thermal convective mixing, which has the potential to occur significantly only during daytime. The occurrence of unstable and strong-wind neutral air flows generally provide the conditions for the highest ground level concentrations due to emissions to air from elevated stack sources, such as the coal-fired boiler exhaust stacks found at the factory.

A rose that illustrates the directional distribution of the predicted atmospheric stability is shown in Figure A7. During these stable periods, the regional scale cool air drainage flows down the river valley from the west to dominate the transport and dispersion of emissions to air from the factory and environmental farm. To a lesser extent, local slope drainage flows from the elevated terrain located to the north, west-north-west and west-south-west of the site would also generate these conditions for poor dispersion.

<table>
<tr><th>All stability classes</th><th colspan="2">E & F Stability classes
(stable conditions only)</th></tr>
<tr><td>
</td><td colspan="2">
</td></tr>
<tr><td rowspan="2">Legend

Stability Class

F
E
D
C
B
A</td><td colspan="2">Comments: Location of Factory</td></tr>
<tr><td>Project No.:

22/13594</td><td>GHD CLIENTS | PEOPLE | PERFORMANCE</td></tr>
</table>

Figure A7 Factory Annual Stability Rose - Year 2008

Appendix B - Complete odour emission inventory

The following Table details all sources modelled for both the existing and proposed modifications

Source	EPA ID	ID	Source type	Height m	Diameter m	Exit velocity m/s	Exit temperature K	OER after control OUm^3/s	Peak to mean adjusted total OER OUm^3/s
Boiler No. 4	42	BOILR4	tall wake free	39	1.1	1.7	417.2	3171.8	var
Combined Boiler Stack for No. 5 & 6 Boilers. Coal combustion odour	35	BOILR5	tall wake free	54	2.05	13.5	411.2	38468.3	var
additional cooling towers to the west (proposed)		CTP	wake affected	10	4.5	6	295	172.0	395.6
Cooling towers		DDG46	wake affected	10	4.5	6	295	172.0	395.6
Light phase recovery tank		DDG19	wake affected	11	0.1	3.3	362	20.0	46.0
Pellet Mill Silo (proposed)		PMFS	wake affected	23				173.0	397.9
Pellet Plant exhaust stack	46	PPES	tall wake free	49.2	1.5	14.1471061	318.2	38240.0	var
Pellet silo (mill feed silo)		S12	wake affected	2	0.3	0.1	304	350.0	805.0
Stillage surge tank		SST	wake affected	2	0.2	3.3	360	149.0	342.7
Vent condensor drain		VCD	wake affected	24.1	0.3	0.3	300	31.0	71.3

Source	EPA ID	ID	Source type	Height m	Diameter m	Exit velocity m/s	Exit temperature K	OER after control OUm^3/s	Peak to mean adjusted total OER OUm^3/s
Ethanol Recovery Scrubber Discharge	16	ERESC	variable, wake affected	28	0.3	7.1	299.5	2467.6	5675.5
Fermenters (10-16)	44	FERM	tall wake free	21	0.28	5.1	305.8	2667.5	6135.3
Yeast propagators - tanks 4 & 5		YP45	wake affected	17	0.4	3.2	302	820.0	1886.0
cyclone and fabric filter		A4	wake affected	33	1.6	6	313	679.0	1561.7
cyclone and fabric filter		A5	wake affected	33	1.6	6	313	96.0	220.8
cyclone and fabric filter		A6	wake affected	33	1.6	6	311	449.0	1032.7
cyclone and fabric filter		A7	wake affected	33	0.8	9	297	932.0	2143.6
Drum vacuum receiver		C4	wake affected	21	0.2	20	314	1400.0	3220.0
Dry gluten roof bin		S07	wake affected	25	0.7	0.1	328	4500.0	10350.0
Enzyme Tanks		B7	wake affected	6	0.5	0.3	327	2042.0	4696.6
Feed transfer to distillery		E22	wake affected	15	0.3	0.1	300	83.0	190.9
Flash Vessel Jet Cooker		C1	wake affected	21	0.1	0.1	350	970.0	2231.0
Flour bin aspirator		S13A	wake affected	2.5	0.4	0.1	306	500.0	1150.0
Flour bin aspirator		S13B	wake affected	2.5	0.4	0.1	306	500.0	1150.0

Source	EPA ID	ID	Source type	Height m	Diameter m	Exit velocity m/s	Exit temperature K	OER after control OUm^3/s	Peak to mean adjusted total OER OUm^3/s
Flour bin motor drive		S06	wake affected	24	0.3	0.1	307	283.0	650.9
Flour mill stack propsed and approved 1		FMP2	wake affected	31.8	0.68	4.4	320	266.0	611.8
Flour mill stack propsed and approved 2		FMP1	wake affected	33.4	0.9	4.2	300	205.0	471.5
Retention - tank 2 (now located in adjacent tank)		GRT	wake affected	21	0.25	0.1	293	3250.0	7475.0
High protein dust collector		S08	wake affected	24.5	0.4	0.1	316	600.0	1380.0
Incondensible gases vent		D6	wake affected	13	0.2	0.6	309	558.0	1283.4
Ion exchange effluent tank		C18	wake affected	2.5	0.32	0.1	307	250.0	575.0
Jet cooker 1 - retention tank		E13	wake affected	10	0.2	0.1	362	1067.0	2454.1
Jet cooker 2 & 4 - Retention		E7	wake affected	9	0.1	2.2	373	567.0	1304.1
Molecular Sieve - Vacuum drum		D2	wake affected	10	0.1	13	337	1350.0	3105.0
No. 1 Gluten Dryer baghouse	8	S02	wake affected point	25.5	3.2	0.1	344.7	5925.0	13627.5

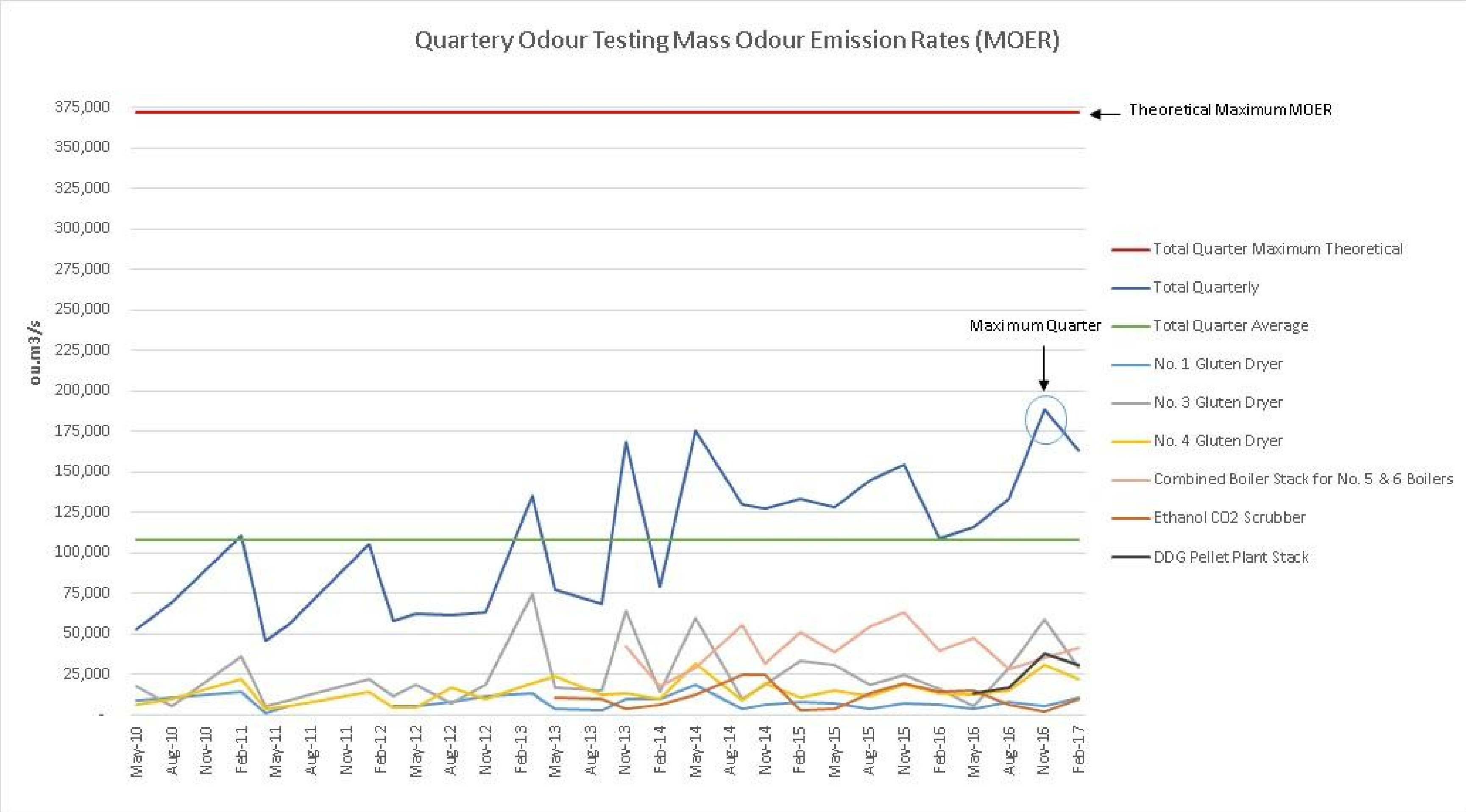
Source	EPA ID	ID	Source type	Height m	Diameter m	Exit velocity m/s	Exit temperature K	OER after control OUm^3/s	Peak to mean adjusted total OER OUm^3/s
No. 1 Starch Dryer	12	S01	wake affected	26	1.3	9.3	314.2	5193.3	11944.7
No. 2 Gluten Dryer baghouse (aka. No 2 Starch Dryer)	9	S04	wake affected	27	3.2	0.1	333.2	2353.7	5413.4
No. 3 Gluten Dryer baghouse	10	S03	wake affected	21	2.5	0.1 (9.95 mitigation)	348.2	58916.7	135508.3
No. 3 Starch Dryer	13	S18	wake affected	20	1.2	21.8	317.2	1663.2	3825.4
No. 4 Gluten Dryer baghouse	11	S05	wake affected	30	2.7	0.1 (11.72 mitigation)	349.2	31221.7	71809.8
No. 4 Starch Dryer	14	S19	wake affected	20	1.2	21.8	315.7	1824.0	4195.2
No. 5 Ring Dryer Starch		SDR5	wake affected	25	1.2	0.1	320	4817.0	11079.1
No. 5 Starch Dryer		SD5	wake affected	33.5	2.35	14.96	329.2	6800.0	15640.0
No. 6 Gluten Dryer		GD6	wake affected	35	1.7	22.4	346.2	12568.0	28906.4
No. 7 Gluten Dryer		GD7	wake affected	29	1.7	18.9	341.2	9553.0	21971.9
Spray dryer		S20	wake affected	19	1.4	0.1	335	738.0	1697.4
Starch factory rejects collection tank		E10	wake affected	8	0.1	0.1	308	183.0	420.9

Source	EPA ID	ID	Source type	Height m	Diameter m	Exit velocity m/s	Exit temperature K	OER after control OUm^3/s	Peak to mean adjusted total OER OUm^3/s
Large Starch Silo 1		PPL1	wake affected	26.5	0.16	6.8	323.2	86.4	198.8
Large Starch Silo 2		PPL2	wake affected	26.5	0.16	6.8	323.2	86.4	198.8
Medium Gluten Silo 1		PPM1	wake affected	20.7	0.16	6.8	323.2	173.0	397.9
Medium Gluten Silo 2		PPM2	wake affected	20.7	0.16	6.8	323.2	173.0	397.9
Medium Gluten Silo 3		PPM3	wake affected	20.7	0.16	6.8	323.2	173.0	397.9
Small Gluten Silo		PPS1	wake affected	34.3	0.2	18.6	323.2	91.6	210.6
Small Starch Silo		PPS2	wake affected	34.3	0.2	18.6	323.2	35.0	80.5
Biofilter A	40	BIO1	area					440.0	var
Biofilter B	41	BIO2	area					330.0	var
Biofilter C		BIO3	area					1089.0	
Biofilter D		BIO4	area					1280.0	
Effluent storage dam 1	19	PO1	area					147.5	var
Effluent storage dam 2	20	PO2	area					1656.4	var
Effluent storage dam 3	21	PO3	area					191.7	var
Effluent storage dam 5	23	PO5	area					515.2	var

Source	EPA ID	ID	Source type	Height m	Diameter m	Exit velocity m/s	Exit temperature K	OER after control OUm^3/s	Peak to mean adjusted total OER OUm^3/s
Effluent storage dam 6	24	PO6	area					1775.3	var
Sulphur Oxidisation Basin	25	SOBAS	area					829.8	var
Membrane bio-reactor		MBR	wake affected					62.4	
DDG load out shed - awning		DDG35	volume					923.0	2122.9
DDG product storage sheds		DDG34	volume					1023.0	2352.9
DDG tent storage area		DDG36	volume					1929.0	4436.7
Pellet plant fugitives (discharged direct to atmosphere)		PPF	wake affected					5771.0	13273.3
Farm tank		F18	volume					3834.0	8818.2
Column washing vent		CWV	point					23.3	53.6
Flour Mill B (proposed, pending approval)		FMBA	point	39.5	0.65	10.1	322	560.0	1288.0
Flour Mill B (proposed, pending approval)		FMBB	point	39.5	1	9.55	322	1260.0	2898.0

Source	EPA ID	ID	Source type	Height m	Diameter m	Exit velocity m/s	Exit temperature K	OER after control OUm^3/s	Peak to mean adjusted total OER OUm^3/s
Flour Mill B (proposed, pending approval)		FMBC	point	39.5	1	9.55	322	1260.0	2898.0
Flour Mill B (proposed, pending approval)		FMBD	point	39.5	0.65	10.1	300	257.0	591.1
Flour Mill B (proposed, pending approval)		FMBE	point	39.5	1.1	8.77	300	642.0	1476.6
Flour Mill B (proposed, pending approval)		FMBF	point	39.5	1.1	8.77	300	642.0	1476.6
Flour Mill B (proposed, pending approval)		FMBG	point	39.5	0.5	10.2	293	200.0	460.0
Flour Mill B (proposed, pending approval)		FMBH	point	39.5	0.65	9.04	293	300.0	690.0
Flour Mill B (proposed, pending approval)		FMBI	point	39.5	0.65	9.04	293	300.0	690.0
Flour Mill B (proposed, pending approval)		FMBM	point	24	0.65	6.53	294	217.0	499.1

Appendix C – Summary of quarterly EPA Licence Point odour emissions



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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
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