WYONG SHIRE COUNCIL
ORDINARY MEETING

ENCLOSURES

Wednesday, 9 December, 2009

WYONG SHIRE COUNCIL

ENCLOSURES TO THE

ORDINARY MEETING

TO BE HELD IN THE COUNCIL CHAMBER,
WYONG CIVIC CENTRE, HELY STREET, WYONG
ON WEDNESDAY, 9 DECEMBER 2009 ,
COMMENCING AT 5:00:00 PM

INDEX

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Investigation of Odour Impacts Wyong South Sewage Treatment Plant

ODOUR ASSESSMENT

- Final Draft
- 30 November 2009

Investigation of Odour Impacts for Wyong South Sewage Treatment Plant

ODOUR ASSESSMENT

- Final Draft
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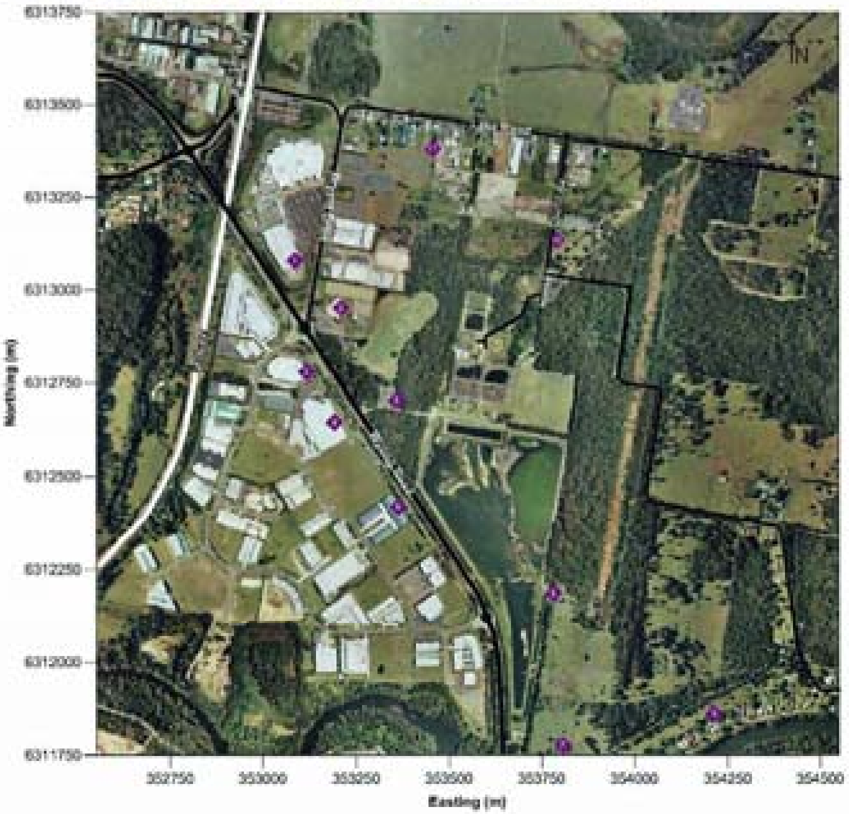
1. Introduction

1.1. General Introduction

Wyong Shire Council (WSC) operate and maintain six sewage treatment plants (STPs) within their local government area (LGA), one of which is Wyong South STP. The treatment plant is located off Wyong Road, approximately five kilometres (km) south of the main Wyong business district.

The Wyong South STP is located off Second Avenue at Tuggerah, NSW. The plant location including nearby sensitive receivers as indicated in purple can be seen in **Figure 1-1**. Land uses surrounding the study site include residential, commercial and industrial properties and open space including recreational areas and some vegetated areas. The nearest residents to the plant are located approximately 150 metres (m) west of the plant and 28 m to the east of the balance pond.

- Figure 1-1 Location of Wyong South Sewage Treatment Plant



Sinclair Knight Merz (SKM) has previously completed an odour assessment for Wyong South STP in July 2000. The study assessed the odour emissions from the treatment plant during five stages of plant upgrades.

Since the assessment undertaken in 2000 the plant configuration and operating conditions have changed to the extent that and additional assessment is required. Changes have included:

- Installation of a fourth aeration tank;
- Upgrade of the overload aerators in tank #3;
- A reduction in Biological Oxygen Demand (BOD) from both Masterfoods and Sanitarium waste water which have a combined equivalent population (EP) of 10,000;
- Increased load due to population growth;
- Operational changes including sludge retention time, sludge dewatering method and the injection of oxygen into rising mains.

1.2. Purpose of the Report

This report has been prepared by SKM for Wyong Shire Council. The purpose of the report is to assess the air quality impact of the STP under current operating conditions and to examine the effectiveness of possible odour control measures.

This report provides a quantitative odour assessment following the procedures outlined by the NSW Department of Environment and Climate Change and Water (DECCW) in their document titled *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (**DEC, 2005**).

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2. Consideration of Odour Controls

Council have identified a possible array of treatment plant modifications that could be undertaken to eliminate odours from treatment processes considered to be most odorous at the plant.

SKM has reviewed Council's information and concurs with the view that the inlet works, sludge lagoons and sludge handling procedures (eg. dewatering plant) have the potential to result in the most significant odours from the normal day to day operation of the plant.

On this basis, the following potential odour controls are considered appropriate at Wyong South STP to mitigate off-site odour impacts:

- Odour control at the inlet works;
- Odour control at the sludge dewatering building; and
- Removal of sludge lagoons and provision of additional sludge handling capacity.

2.1. Details and Cost for Odour Control Plant

Preliminary cost estimates for the possible array of odour controls are outlined in **Table 2-1**.

- Table 2-1 Estimate Odour Control Costs

Process	Cost Details
Inlet Works: The new inlet works includes: ▪ Grit removal system ▪ Screening ▪ Distribution chamber ▪ Odour scrubbing unit	**Estimated costs are:** ▪ Grit removal system – $1.5M for a vortex style grit separator ▪ Screening – $750K for new screens ▪ Distribution chamber and Civil works - $3M based on quotes for Mannering Park ▪ Odour control unit - $350K, based on activated carbon system and 10 m stack **Total Capital Cost = $5.6M** Additional Operating Costs,$20,000 p.a. for replacement of carbon and $2,000 p.a. for running the additional fans
Sludge Dewatering Building: Installation of ventilation system and odour control on building at approximately 12-15 air changes per hour. To include: ▪ a gas detector system ▪ Operate odour control system while dewatering unit is running, with failure of fan (low airflow) to electrically isolate building.	**Estimated costs are:** ▪ Estimated Capital Cost = $500 - $800K based on chemical scrubber or packaged biofilter and 10 m stack ▪ Estimated annual operating cost = $20,000 (electricity and chemicals) All costs are directly attributable to odour reduction.

The removal of sludge lagoons has a number of implications, including:

- A significant increase in the sludge production from the plant – anaerobic lagoons generally remove a significant amount of biomass;
- Significantly reduced carbon footprint from the STP due to the elimination of the uncontrolled emission of methane; and
- Decrease in operational flexibility due to the loss of a large storage buffer for sludge wasting.

In wasting mixed liquor directly from the Intermittent Decanting Aeration (IDEA) tanks it is assumed that Waste Activated Sludge (WAS) will be pumped to a buffer tank with 4 days retention. Assuming that the WAS concentration is as low as 3,000 mg/L it will be useful to allow for in-situ thickening by decanting supernatant from the buffer tank – this increases dewatering efficiency and reduces the required size of the tank. The buffer tank will need to be aerated in order to control odour. It is noted that Council estimates that a new Gravity Drainage Deck / belt Filter Press GDD/BFP is required to cope with the increase in net sludge production. An alternative might be to consider unattended operation of the existing presses. However, assuming that a new press is required the following equipment is proposed:

- 2 million litre (ML) concrete buffer tank;
- Diffused aeration system comprising duty/standby 15 kW PD blowers and about 250 9-inch membrane diffusers and associated pipework;
- A 5 kW submersible mixer;
- A GDD/BFP unit and associated equipment; and
- A dewatering & blower building (this does not appear to have been included in the Council estimate).

While the removal of the sludge lagoons is to facilitate a reduction odour, there will be additional odour sources introduced in the form of the 2 ML buffer tank as well as the additional sludge belt press. For the purpose of assessment it is assumed that the buffer tank would have dimensions of 22.5 m in diameter and a 5 m depth (estimated cost for this tank is $500 K). The additional belt press is assumed to be located adjacent to the existing sludge truck bay, with odour control by the enclosure of this area, as costed in **Table 2-1**.

2.2. Plant Layouts – Existing and Odour Control

The layout of the existing plant and for proposed odour control measures at Wyong South STP are shown in **Figure 2-1** to **Figure 2-4**.

- Figure 2-1 Existing Layout

- Figure 2-2 Proposed Layout for Control 1

Odour Assessment

- Figure 2-3 Proposed Layout for Control 2

- Figure 2-4 Proposed Layout for Control 3

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3. Air Quality Criteria

3.1. Overview

This section of the report outlines the relevant ambient air quality criteria applicable for the assessment of the Wyong South STP.

3.2. Odour Criteria

The DECCW regulates air quality in NSW, and has set odour criteria objectives for odour-producing activities such as STPs that are intended to minimise the adverse effects of odours on sensitive receptors. Under the *Protection of the Environment Operations Act 1997*, the Wyong South STP is not permitted to emit any offensive odour beyond the premises (buffer zone) boundary. An offensive odour is defined as one:

that, by reason of its strength, nature, duration, character, or quality, or the time at which it is emitted, or any other circumstances:

(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or

(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted.

Odour perception is very subjective and differs between individuals. The DECCW assessment criteria were designed to take into account the range of odour sensitivities within a community, and are based on population density as shown in **Table 3-1** (DEC, 2006).

- **Table 3-1 DECCW Odour Assessment Criteria**

Population of Affected Community	Odour assessment criteria # (complex mixture of odorous pollutants) (OU)	Hydrogen Sulphide# ($\mu g/m^3$)
Urban area (≥ 2000) and/or schools and hospitals	2.0	1.38
~500	3.0	2.07
~125	4.0	2.76
~30	5.0	3.45
~10	6.0	4.14
Single Residence (≤ 2)	7.0	4.83

nose-response averaging time, 99th percentile

The urban odour performance criterion of 2 odour units (OU) is typically used for odour impact assessments in residential areas. This level has been adopted for this assessment.

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A number of government agencies are responsible for assessing and managing odour for both scheduled and non-scheduled activities. These responsibilities are summarised below:

Odour assessment and management responsibilities	Responsible organisations
Land-use planning: Planning and development control. Considering existing land use and the likely impacts on these uses, if a change in the preferred land use is proposed in the area (including assessing the likelihood of conflict if rezoning or subdivisions are proposed in an area). Developing strategic approaches to ensure that new developments and redevelopment areas take into account odour from new and existing developments.	Department of Planning Local councils (Planning instruments include state environmental planning policies (SEPPs), regional environmental plans (REPs) and Local Environmental Plans (LEPs) that establish current and future land use especially where odour generating activities are concerned)
Best practice and odour control strategies: Development and review of best management practice guidelines for activities that emit odour. Development, implementation and review of general guidance about odour control strategies.	Department of Environment and Conservation (NSW) NSW Department of Primary Industries NSW Departement of Planning Local councils Industry
Assessment and approvals: Assessment and approval of proposals under relevant legislation to ensure activities are located, designed and operated in a manner that meets the requirements of the framework and best management practice. The assessment should consider the likelihood of the proposed activity resulting in land-use conflict, taking into consideration the compatibility of the proposed activity with the current land use in the area and the risk of change of land use in the short, medium and long term.	Proponents/operators NSW Department of Planning Local councils Department of Environment and Conservation (NSW)
Compliance, regulation and enforcement: Use of confirmed complaints to indicate that action may be required. The EPA regulates scheduled activities that emit 'offensive' odour. These activities are regulated under sections 124, 125, 126, 128 and 129 of the POEO Act. Non-scheduled activities that emit odour are local council's responsibility. These activities are regulated under sections 124, 125, 126 and 128 of the POEO Act and section 125 of the LG Act. Facilities with an approval under the EP&A Act which emit unacceptable levels of odour as a result of non-compliance with development consent conditions. These facilities would be regulated under s121B or s125 of the EP&A Act	Operators EPA Local councils NSW Department of Planning

In setting odour criteria the DECCW define a sensitive receptor as:

… a location where people are likely to work or reside; this may include a residential dwelling, school, hospital, office or public recreational area.

As relevant to potential impact on the Mariners Centre for Excellence proposed for development to the west and north of Wyong South STP it is clear people attending the complex in any capacity would be defined as sensitive receptors but there is no clear direction as to an appropriate criteria for this type of development. A conservative approach would be to set a criteria of 2 OU on the basis that at times, there will be more than 2000 people attending parts of the complex, eg. the "Tournament Field / Grand Stand" area to watch a soccer match, but this is perhaps too stringent on the basis of the frequency of use of the stadium, and the likelihood of adverse odour impacts occurring at times when the tournament field is in use. A 2 OU criteria is considered appropriate for the "Accommodation" area off Bryant Drive.

3.3. Hydrogen Sulphide (H_2S)

Hydrogen Sulphide (H_2S) is a colourless, poisonous gas with the characteristic odour of "rotten eggs" and is generated in wastewater by anaerobic bacteria, when the sewage is allowed to stand for a long period of time and becomes septic.

H_2S is considered to be very harmful by inhalation and prolonged or repeated exposure to the hydrogen sulphide component may lead to symptoms such as fatigue, headache, dizziness, hoarseness, cough and irritability.

The following health effects can be observed (ACHOS 2005):

- At concentrations of 0.13 parts per million (ppm) to 30 ppm, the odour is obvious and unpleasant;
- At 50 ppm, marked dryness and irritation of the nose and throat occurs. Prolonged exposure may cause a runny nose, cough, hoarseness, shortness of breath and pneumonia;
- At 100-150 ppm, there is a temporary loss of smell;
- At 200 to 250 ppm, H_2S causes severe irritation as well as symptoms such as headache, nausea, vomiting and dizziness. Prolonged exposure may cause lung damage (build-up of fluid in the lungs). Exposure for 4 to 8 hours can cause death;
- Concentrations of 300-500 ppm cause these same effects sooner and more severely. Death can occur in 1 to 4 hours;
- At 500 ppm, excitement, headache, dizziness, staggering, unconsciousness and respiratory failure occur in 5 minutes to 1 hour. Death can occur in 30 minutes to 1 hour; and
- Exposures above 500 ppm rapidly cause unconsciousness and death. Severe exposures which do not result in death may cause long-term symptoms such as memory loss, paralysis of facial muscles or nerve tissue damage.

According to the National Pollution Inventory (DEWHA 2009), Work Safe Australia suggest an allowable limit of 10 ppm , averaged over an eight hour work shift for workers, with exposure not to exceed 15 ppm.

4. Existing Environment

4.1. Overview

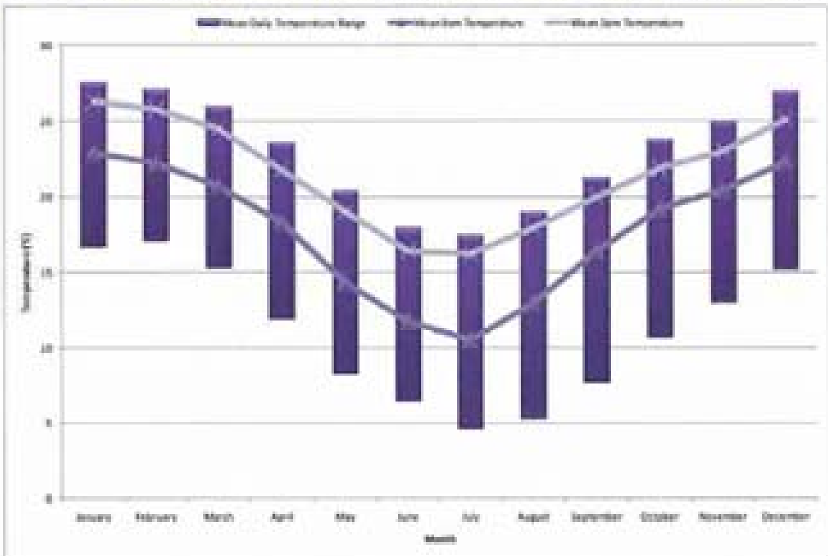
The following sub-sections provide a summary of the meteorological characteristics that influence atmospheric dispersion around the Wyong South STP study area. During the period of October 1992 to September 1993 a meteorological station was installed at Wyong South STP by Pavel Zib and Associates to characterise the meteorology of the area. One year of hourly records from the STP site have been used to summarise atmospheric influences on pollution transport in the study area. In addition, climatic data from the Bureau of Meteorology (BoM) at the Gosford automatic weather station (AWS), located at Narara Research Station and approximately 12km south west of the STP, have been reviewed to provide a more complete picture of the local environment.

4.2. Climate and Dispersion Meteorology

4.2.1. Temperature

Average monthly temperature records collected by the BoM between 1854 and 2009 at Narara Research Station (Station number 061087) are presented in **Figure 4-1**. The Gosford area experiences a relatively mild climate. Overall, the warmest month of the year is January which experiences a mean daily maximum temperature of 27.5°C, while July is the coolest month experiencing a mean daily minimum temperature of 4.6°C.

- **Figure 4-1 Average Monthly Temperature, Narara Research Station 1954-2009**



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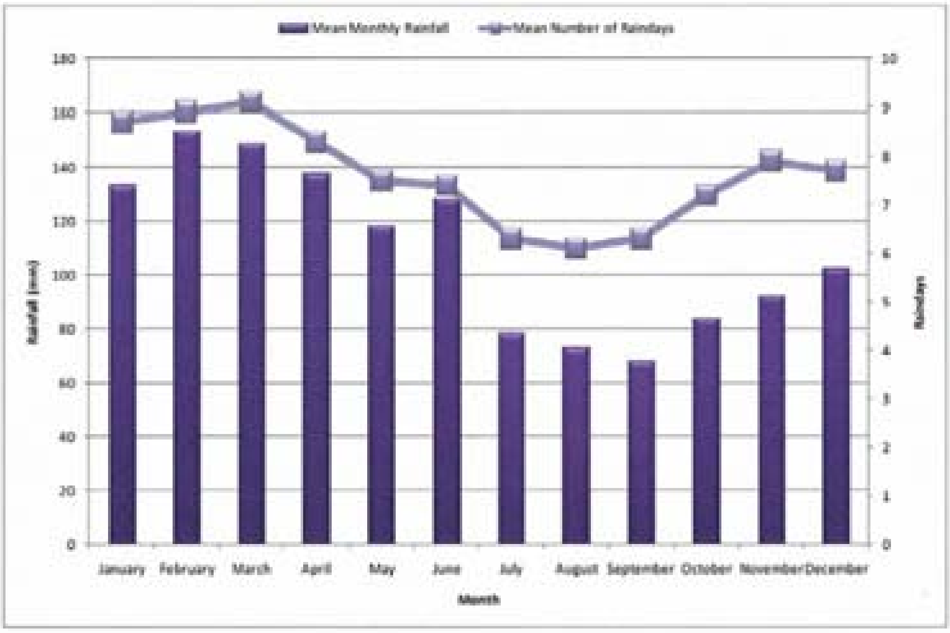
4.2.2. Rainfall

Rainfall data measured at the BoM climate station are presented in **Figure 4-2**. The average annual rainfall is 1317 mm. February has the highest rainfall on average, experiencing 153 mm of rain. September has the lowest rainfall averaging 68mm. The mean number of raindays annually is 91 days with the minimum number of raindays (6 days) occurring from July through to September and the maximum number of raindays (9 days) occurring in January, February and March.

- **Figure 4-2 Average Monthly Rainfall and Number of Raindays, Gosford 1916 to 2009**



4.2.3. Wind Speed and Wind Direction

Pavel Zib & Associates collected meteorological data at Wyong South STP for a period of one year (September 1992 to October 1993) to characterise the meteorology in the vicinity of the plant. The station collected hourly records of temperature, humidity, wind speed, wind direction and sigma-theta (a measure of the fluctuation of the horizontal wind direction). These hourly records have been obtained and prepared into a form suitable for the AUSPLUME dispersion model.

Wind-roses have been prepared from the 1992-93 wind data to illustrate the pattern of winds at the STP site. **Figure 4-3** shows the annual and seasonal wind-roses. On average, the annual wind speed measured at the STP site was 2.0 metres per second (m/s) and the predominant wind was from the southwest. During Spring and Summer an average wind speed of 2.2 m/s was experienced with the dominant wind direction coming from the south west during spring and from both the south west and south-southwest during summer. The wind speed is slightly lower during autumn and winter averaging 1.8 and 1.7m/s respectively. Similar to summer, the dominant wind direction in autumn is from both the southwest and south-south west. The dominant wind direction during the winter is from both the south west and the west-southwest.

4.2.4. Atmospheric Stability

To use the wind data to assess dispersion, it is necessary to also have available data on atmospheric stability. In dispersion modelling, atmospheric stability describes the rate at which a plume will disperse, represented by typically six classes; A to F (that is, unstable through to very stable conditions).

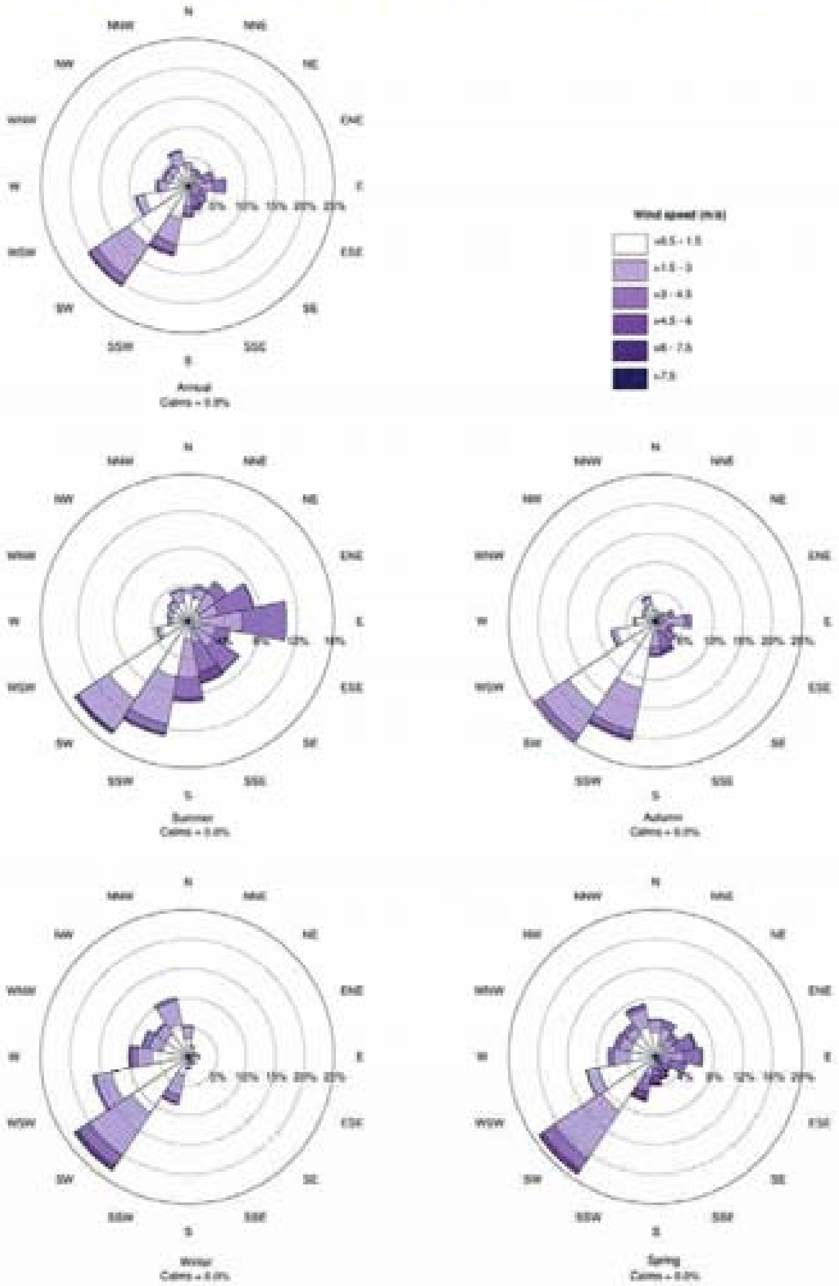
For the Wyong South STP site, a stability class was determined for each hour in the 1992-93 meteorological dataset using sigma-theta (a measure of the fluctuation of the horizontal wind direction) according to the method recommended by the US EPA (**US EPA, 1986**). **Table 4-1** shows the frequency of occurrence of the stability categories expected in the area.

- **Table 4-1 Frequency of occurrence of stability categories in the area**

Stability class	Frequency of occurrence (Wyong South STP 1992-03 data) (%)
A	14.0
B	8.5
C	13.5
D	18.1
E	15.3
F	30.5
Total	100

The most common stability class at the Wyong South site was determined to be F class. This suggests that the dispersion conditions are such that odour emissions disperse slowly for a significant proportion of the time.

- **Figure 4-3 Annual and Seasonal Windroses for Wyong South STP (1992-03)**



4.3. Existing Air Quality

The study area, in particular the area surrounding the treatment works, hosts very few sources of air pollution. There are no major industries in the general vicinity of the site. Odour from the treatment plant is the only potential source of significant odour in the area.

According to the *Wyong Shire Council State of Environment Report 2006 to 2007* WSC (WSC 2007) Wyong Shire Council received 18 odour complaints during the 2006-07 reporting period within the local government area. The majority of complaints were received when odours were generated by industrial and agricultural activities within close proximity to residential areas.

From the site inspection conducted on the 16th of November 2009 it could be seen that the existing inlet works at the site displayed a high level of H_2S corrosion. This corrosion was resulting in fugitive odour emissions from septic wastewater escaping from the inlet works. Existing sources of odour are further discussed in **Section 5.3**.

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5. Odour Assessment

5.1. Overview

This section of the report provides a quantitative assessment of odour impacts associated with the existing Wyong South STP and probable odour control measures. The assessment methodology and results of dispersion modelling are also provided in this section.

5.2. Dispersion Model

The DECCW guidelines (DEC 2005, DEC 2006) provide for a range of levels of assessment. The most accurate assessments are performed using site-specific input data, and are referred to as Level 2 assessments when they relate to air pollutants (DEC, 2005) or Level 3 assessments when related to odours (DEC, 2006). Site-specific assessments require reporting of the nose-response time (1 second) 99th percentile of dispersion model predictions. Model predictions were compared to the DECCW criterion for complex odours (2 OU).

AUSPLUME (version 6.0) model was used to predict odour concentrations within the vicinity of the Wyong South STP. AUSPLUME was developed by the Victorian EPA, and is an approved model for conducting site-specific odour impact assessments in NSW (DEC, 2006).

Inputs required by the AUPLUME model include:

- Emission source locations;
- Emission rates;
- Topographical data;
- Locations of sensitive receptors; and
- Meteorological conditions.

5.3. Odour Sources

5.3.1. Existing Odour Sources

The following is a list of the existing potential odour sources at the Wyong South STP:

- Inlet works;
- Aeration tanks (x4);
- Sludge lagoon (x3);
- WAS tank;
- Sludge dewatering building, which houses a belt filter press; and
- Truck bay for sludge outloading.

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Additionally, and as shown in **Figure 1-1**, there is a balance tank and large dewatering pond at the southern end of the plant. These are not typically seen as being significant odour sources at sewage treatment plants, and given their usual large size, attempts to include these sources within odour models can result in them being shown to be significant odour sources when site observations suggest that these sources contribute very little to off-site odour impacts. As such these sources are not included in the odour modelling for Wyong South STP.

5.3.2. Results of Odour Sampling and Calculated Emission Rates

Odour sampling at Wyong South STP was undertaken by Stephenson Environmental Management Australia (SEMA) on 16 November 2009.

In order identify the most appropriate time of day for odour sampling (i.e. time of maximum odour generation) continuous H_2S measurements were made at 4 locations on the plant in the week leading up to odour sampling.

Sampling locations were as follows:

- Inlet works;
- 2 x aeration tanks; and
- 1 x sludge lagoon.

The results of H_2S measurement are included in **Appendix A**. The results from the logged H_2S data showed that high levels of H_2S, in excess of 200 ppm exist in the non-ventilated and largely enclosed inlet works, with H_2S odour escaping through cracks in seals from corrosion of concrete along the perimeter of the inlet works. H_2S concentrations are consistently high at all times but seem to peak between 8 am and 12 noon each day. As such odour sampling was timed to coincide with this time of peak odour generation.

The SEMA odour sampling report is included in **Appendix B**.

Also included in **Appendix B** are the results of VOC testing taken from odour samples collected from a sludge lagoon, the sludge dewatering building and the dry weather pond. The results of testing for all VOCs are lower than DECC ambient air quality criteria, indicating VOC emissions from the plant are not considered an issue.

The odour emission data and total source areas assumed in the dispersion model for the existing plant and odour control scenarios are shown in **Table 5-1**, **Table 5-2** and **Table 5-3**.

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As the inlet works is enclosed but not ventilated, with odour escaping through cracks, it was modelled as a 1 m^2 source with odour sampled from within the enclosed freeboard of inlet works. Given the high H_2S levels it was considered too hazardous to lift the covers and sample odour via the traditional means with an isolation flux chamber.

In terms of modelling the control scenarios as described in **Section 2**, the following is assumed:

- ***Control Scenario1***: Enclosure of the inlet works with foul air treated at an odour control facility;
- ***Control Sceanrio2***: Enclosure of the inlet works and dewatering building with foul air treated at 2 x odour control facilities; and
- ***Control Scenario 3***: Enclosure of the inlet works and dewatering building with foul air treated at 2 x odour control facilities and replacement of the existing sludge lagoons with an aerated holding tank and standby dewatering unit.

Both odour control facilities have been modelled as stack sources.

It can be seen from **Table 5-2** and **Table 5-3** that the dominant sources of odour from the existing plant are from the aeration tanks and sludge lagoons.

Control scenarios 1 and 2 involve diverting emissions from the existing inlet work and dewatering building to separate odour control facilities. It was assumed that emissions from both odour control facilities are at the standard supplier guaranteed concentration of 500 OU. It is likely that the odour control facilities would result in a lower concentration 500 OU however for the purpose of this assessment the worst case scenario is assumed in which there would be no change in the emission rate from these sources.

For the purpose of comparing model results with odour assessment criteria, the emission rates in **Table 5-1**, **Table 5-2** and **Table 5-3** have been multiplied by peak to mean ratios. The peak-to-mean factors for the near-field have been applied for the purpose of this assessment. For area sources, these factors have numerical values of 2.5 for unstable and neutral atmospheric conditions and 2.3 for stable conditions. For volume and stack sources a peak-to-mean factor of 2.3 has been applied for all atmospheric conditions.

For the purposes of the modelling, odour emissions have been assumed to occur for 24 hours per day.

- **Table 5-1 Surface Odour Emission Rates for Area Sources**

Description	Area	Existing			Control 1			Control 2			Control 3		
		SOER	SOER (A,B,C,D)	SOER (E,F)	SOER	SOER (A,B,C,D)	SOER (E,F)	SOER	SOER (A,B,C,D)	SOER (E,F)	SOER	SOER (A,B,C,D)	SOER (E,F)
Inlet Works*	1	146.950	367.375	337.985	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aeration Tanks (Aerating Cycle)	2691	0.434	1.085	0.998	0.434	1.085	0.998	0.434	1.085	0.998	0.434	1.085	0.998
Aeration Tanks (Settling Phase)	2691	0.267	0.668	0.614	0.267	0.668	0.614	0.267	0.668	0.614	0.267	0.668	0.614
Sludge Lagoon No. 1	2000	0.285	0.713	0.656	0.285	0.713	0.656	0.285	0.713	0.656	NA	NA	NA
Sludge Lagoon No. 2	2408	0.724	1.810	1.665	0.724	1.810	1.665	0.724	1.810	1.665	NA	NA	NA
Sludge Lagoon No. 3	2193	0.285	0.713	0.656	0.285	0.713	0.656	0.285	0.713	0.656	NA	NA	NA
WAS Tank	133	0.306	0.765	0.704	0.306	0.765	0.704	0.306	0.765	0.704	0.306	0.765	0.704
Truck Loading Bay	50	0.157	0.393	0.361	0.157	0.393	0.361	NA	NA	NA	NA	NA	NA
Aerated Holding Tank#	397.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.431	1.078	0.992

SOER = Surface Odour Emission Rate (OU.m/s).

**SOER calculated using the average OU concentration of monitoring results conducted on the 16th November 2009 (refer to Appendix A) # Emission Rate based on the average SOER of the Sludge Lagoons*

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- **Table 5-2 Total Odour Emission Rates for Area Sources**

Description	Area	Existing			Control 1			Control 2			Control 3		
		TOER	TOER (A,B,C,D)	TOER (E,F)	TOER	TOER (A,B,C,D)	TOER (E,F)	TOER	TOER (A,B,C,D)	TOER (E,F)	TOER	TOER (A,B,C,D)	TOER (E,F)
Inlet Works*	1	147	367	338	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aeration Tanks (Aerating Cycle)	2691	1168	2920	2686	1168	2920	2686	1168	2920	2686	1168	2920	2686
Aeration Tanks (Settling Phase)	2691	718	1796	1653	718	1796	1653	718	1796	1653	718	1796	1653
Sludge Lagoon No. 1	2000	570	1425	1311	570	1425	1311	570	1425	1311	NA	NA	NA
Sludge Lagoon No. 2	2408	1743	4358	4009	1743	4358	4009	1743	4358	4009	NA	NA	NA
Sludge Lagoon No. 3	2193	625	1563	1438	625	1563	1438	625	1563	1438	NA	NA	NA
WAS Tank	133	41	102	94	41	102	94	41	102	94	41	102	94
Truck Loading Bay	50	8	20	18	8	20	18	NA	NA	NA	NA	NA	NA
Aerated Holding Tank	397.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	172	429	394

TOER = Total Odour Emission Rate (OU.m³/s),

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- **Table 5-3 Total Odour Emission Rates for Volume and Stack Sources**

Description	Area	Existing		Control 1		Control 2		Control 3	
		TOER	TOER (A,B,C,D,E,F)	TOER	TOER (A,B,C,D,E,F)	TOER	TOER (A,B,C,D,E,F)	TOER	TOER (A,B,C,D,E,F)
Dewatering Building*	27.5	0.157	0.393	0.157	0.393	NA	NA	NA	NA
Odour Control Facility 1	-	NA	NA	563	1294	563	1294	563	1294
Odour Control Facility 2	-	NA	NA	NA	NA	3748	8621	3748	8621

TOER = Total Odour Emission Rate (OU.m³/s).

** Calculated using the area of the belt filter press, and modelled as a volume source.*

5.4. Sensitive Receptors

The term sensitive receptor refers to all nearby receptors that may potentially be affected by odour emissions, both now and in the future. Land uses surrounding the study area include commercial properties extending from the north west to south west of the site including Coles Supermarket, Wyong RSL Club, Tuggerah Super Centre, and residential premises predominantly to the north and southeast.

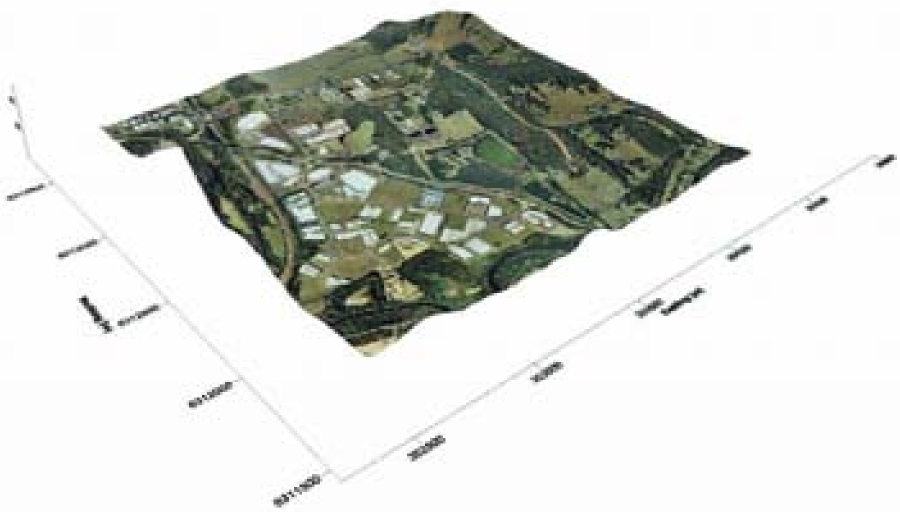
Also, a number of public recreational areas lie within the study area including Tuggerah Oval immediately to the east of the site and an additional oval to the west of the site behind Wyong RSL Club.

The location of sensitive receivers is shown in **Figure 1-1**.

5.5. Terrain

The proposed site is located amongst undulating terrain at elevations ranging between approximately 1 and 56 metres (refer to **Figure 5-1**). Ground-level odour emissions have been predicted over an area of 2 km by 2 km with gridded receptors located at located at 50 m spacings.

- **Figure 5-1 Terrain**



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5.6. Meteorological Data

One year of meteorological data from the Wyong South STP site was used in the dispersion modelling. The data were formatted for use in the AUSPLUME model and are described in Section 4.2.3 with wind roses provided in **Figure 4-3**. There were 8496 hours available which represented 97% of the year.

5.7. Results of Dispersion Modelling

The results of the odour modelling are shown for the existing STP and possible control measures in to **Figure 5-2** to **Figure 5-5.** In these figures, the purple contour represents the predicted 2 OU criterion level at the 99th percentile. This criteria is applicable to any high density land use development proposed in locations surrounding the plant.

The following points should be noted when reviewing the figures:

- Openings within the existing inlet works as a result of corrosion were considered to have a total surface area of 1m^2, thus the inlet works were modelled as a 1m^2 area source for the existing scenario;
- A worst case scenario is assumed for the control scenarios in which emissions from both odour control facilities are at the standard supplier guaranteed concentration of 500 OU;
- It is assumed for control scenarios 1, 2 and 3 that the inlet works would be fully sealed resulting in no fugitive emissions from this source; and
- It is assumed for control scenario 2 and 3 that 100% of emissions from the dewatering building and truck loading facility would be redirected to an odour control facility.

- **Figure 5-2 Existing Scenario**

- **Figure 5-3 Control Scenario 1**

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- **Figure 5-4 Control Scenario 2**

- **Figure 5-5 Control Scenario 3**

Results of the modelling indicate that the 2 OU criterion contour (nose-response times, 99th percentile) extends beyond the Wyong South STP site boundary for the existing plant, with the plume orientated towards the northeast.

For odour control scenario 1, which involves capturing and treating inlet works odours and ducting treated air to atmosphere via a stack, it can be seen that there is a slight increase in the odour concentration offsite when compared with the existing case, although this level of change is unlikely to be detectable. On the surface this appears to be at odds with the purpose of the odour control measure but in fact the existing inlet works is reasonably sealed with some isolated fugitive releases as assumed in the existing case modelling. The odour control measure is needed more to extract high level H_2S emissions which have severely corroded the existing inlet works rather than to reduce emissions.

For odour control scenario 2, which includes the treated inlet works and also treating a large volume of air from the sludge dewatering building and truck bay, it also shows and increase in odour compared to the existing case. Given the relatively low odour emissions measured in the sludge dewatering building on the day of testing (16 November 2009) it is questionable if this measure adds any value in terms of managing off-site odour impacts. Again, the predicted level of change is unlikely to be detectable.

For odour control scenario 3, the sludge lagoons have been removed, which are dominant odour source within the STP. This scenario shows a more significant reduction in odour concentration offsite, compare with the other odour control measures.

Table 5-4 shows the model predictions at the nearest sensitive receivers for the existing plant and possible odour control scenarios. It can be seen that there is a predicted increase in odour levels (at the 99th percentile) for Control 1 and Control 2 at all sensitive receivers and a predicted decrease for Control Scenario 3. Both existing and all control scenarios predict an odour concentration (at the 99th percentile) above the 2 OU criteria for sensitive receptor 5 to the west of the plant. .

- **Table 5-4 Predicted 99th Percentile Odour Levels due to Existing Plant and Proposed Control Measures**

Sensitive Receiver No	Predicted 99th percentile odour levels (OU) (DECCW Criteria of 2 OU)			
	Existing Plant	Control Scenario 1	Control Scenario 2	Control Scenario 3
1	0.76	0.79	0.90	0.61
2	1.36	1.38	1.48	0.91
3	1.21	1.23	1.37	0.94
4	1.49	1.51	1.64	1.28
5	**3.55**	**3.59**	**3.65**	**2.96**
6	1.75	1.78	1.83	1.45
7	0.60	0.62	0.76	0.60
8	1.25	1.29	1.47	1.18
9	0.53	0.56	0.68	0.52
10	**3.96**	**3.98**	**4.04**	**2.42**
11	0.85	0.86	0.92	0.55

As previously stated with respect to odour control scenario 2 it can be seen from the results of modelling that enclosure, ventilation and treatment of odours from the sludge dewatering building in addition to the inlet works (odour control scenario 1) has minimal benefit and would come at a high cost. As such an additional scenario (odour control scenario 4) has been developed which is the same as odour control scenario 3 but does not enclose the dewatering building or sludge loading truck bay. The results of this scenario are shown in **Figure 5-6**.

- Figure 5-6 Control Scenario 4

Odour control scenario 4 shows the lowest level of odour impacts and is considered to offer best value for odour reduction of the scenarios considered.

5.8. Additional Odour Control Opportunities

Further opportunities for reduction in odour impacts would most likely need to target the aeration tanks. While the odour concentration from the tanks are not particularly high (676 OU – aerating and 415 OU – settling), collectively they have a large surface area, and as such the potential for moderate odour impacts off-site.

Council has indicated that they are investigating the replacement of aeration units in two of the four aeration tanks. In this regard it was requested that SKM investigate whether there was any evidence of varying levels of odour generation from different types of aeration units eg. surface aerators vs diffused air aeration. The SKM review entailed:

- Discussion with SKM process engineers;
- Review of Sydney Water Corporation odour database; and
- Literature review.

No documented evidence of one process being more odorous than the other was found but there was a consensus that surface aerators which generate more aerosols than other forms of aeration could possibly generate more odours but this is not conclusive. The odour sample collection from aerating IDEA at Wyong South STP on 16 November 2009 was taken from an IDEA with surface aerators. As such it is not considered that any change in aeration process within the IDEAs could be relied upon for odour control.

Odour control from aeration tanks usually involves covering the tanks and ducting foul air to an odour control facility in a similar manner as is proposed for the inlet works. Given the large surface area of the four aeration tanks this form of odour control would be at significant cost.

5.9. Potential Impacts on the Mariners Centre for Excellence

The Central Coast Mariners have submitted a Development Application (DA) to Wyong Shire Council to develop a multi-use complex adjacent and to the west and north of Wyong South STP. An indicative layout of the main infrastructure is shown on odour modelling contour plots (refer to **Figure 5-2** to **Figure 5-6**).

5.9.1. Summary of Impacts in the Proposed Development Area

Results of odour modelling for the existing situation (refer to **Figure 5-2**) show impacts over various areas of the development range between 1 and 8 OU, with the highest impacts over the "Tournament Field / Grand Stand": 3 – 8 OU. Impacts of this order are considered to provide a moderate to high likelihood of future odour complaint in this area of the development, in particular the potential impact from the sludge lagoons both from normal operation of the lagoons and the potential impact from any maintenance or malfunction event which can result in higher odour generation than considered by the modelling assessment. In other areas of the development considered odour sensitive eg. the accommodation area off Bryant Drive impacts from the existing plant are predicted to be of the order of 1 – 2 OU and as such are not anticipated to cause adverse odour impacts in this area.

In terms of odour control scenarios, scenario 4 which removes the sludge lagoons, shows odour impacts in the "Tournament Field / Grand Stand" area to be reduced to 1 – 4 OU, with impacts less than 2 OU generally occurring in the grand stand area. As such the normal operation of the plant configured as modelled in odour control scenario 4 should not result in adverse odour impacts within the proposed development but as stated above the potential impact from any maintenance or malfunction event can result in higher odour generation than considered by the modelling assessment. Council would need to consider the range of potential operations that result in higher odours than those normally generated by the plant and the ability for these to be managed, so as not to coincide with events being held in the "Tournament Field / Grand Stand" area.

5.9.2. Odour Considerations by Council

Council in considering the proposed Mariners Centre for Excellence DA need to consider a range of factors relevant to potential odour impacts from the adjacent Wyong South STP.

DEC, 2006 provides the following points of consideration when developing odour mitigation and avoidance strategies:

1) Strategic approaches through appropriate land-use planning;
2) Appropriate site selection for new activities;
3) Managing odour at the source:
   - Best management practices (implementing odour-reducing operating procedures for new, modified or existing activities, especially for 'diffuse' sources);
   - Best available control technology (installing control equipment for new, modified or existing activities, especially for point sources);
4) Managing odour in the pathway;
5) Managing odour at the receptor;
6) Negotiated solutions between the operator of an existing activity and the affected individuals.

Points 1 and 2 are central to the decision currently before Council with respect to the Mariners Centre for Excellence DA. This assessment has shown the development may be feasible contingent on odour management at the plant (Point 3) being implemented. Point 4 – managing odour in the pathway is not considered appropriate given the close proximity of the treatment plant and the development area and Point 5 – managing odour at the receptor would not be feasible particularly in the "Tournament Field / Grand Stand" area where an open environment is needed. With respect to Point 6 – negotiated solutions, these would be recommended if Council were to approve the development and possible points for negotiation include:

- The scheduling of events at the Mariners Centre for Excellence and high odour generation maintenance operations at the treatment plant (eg. cleaning of aeration tanks) at different times (assuming this is possible and feasible); and
- Agreement and acknowledgement between Council and the developers (Mariners) that the proposed development is located next to a sewage treatment plant and may be subject to odours. This could be in the form of Section 149 certificates which form part of any development approval.

While the DEC Odour Policy (2006) suggests the use of Section 149 certificates as one means of reaching a negotiated position between parties in terms of managing future odour impacts, Council would need to carefully consider the value they have in this case, if the development were to be approved. Users of the proposed development eg. sporting participants and more specifically spectators/patrons are most likely to have an expectation that they will be not be subject to any adverse impact from nuisance odours, and people like spectators are difficult (or impossible) to include in "negotiated solutions".

6. Conclusion

This report provides an assessment of potential odour impacts associated with the existing the Wyong South Sewage Treatment Plant and to assess the effectiveness of three odour control options. Computer-based odour dispersion modelling with site measured odour data has used to assess impacts of proposed changes to the plant.

Meteorological data from the Wyong South STP meteorological station were combined with odour emissions for individual sources from the plant to predict off-site odour levels for the plant. Odour control options examined initially examined included:

- ***Control Scenario1:*** Enclosure of the inlet works with foul air treated at an odour control facility;
- ***Control Sceanrio2***: Enclosure of the inlet works and dewatering building with foul air treated at 2 x odour control facilities; and
- ***Control Scenario 3***: Enclosure of the inlet works and dewatering building with foul air treated at 2 x odour control facilities and replacement of the existing sludge lagoons with an aerated holding tank and standby dewatering unit.

Results of the modelling indicate that the 2 OU criterion contour extends beyond the Wyong South STP site boundary for the existing plant, with the plume orientated towards the northeast.

For odour control scenario 1, which involves capturing and treating inlet works odours and ducting treated air to atmosphere via a stack, a slight increase in the odour concentration off-site was predicted when compared with the existing case.

For odour control scenario 2, which included treatment of the inlet works and also treating a large volume of air from the sludge dewatering building and truck bay, the modelling showed an increase in odour compared to the existing case. Given the relatively low odour emissions measured in the sludge dewatering building on the day of testing it this measure was unlikely add value in terms of managing off-site odour impacts.

For odour control scenario 3, whereby the sludge lagoons were removed, the modelling showed a more significant reduction in odour concentration offsite, compared with the other control options.

An additional odour control scenario, being scenario 4 which is the same as scenario 3 but without enclosure, ventilation and odour control on the dewatering building and sludge outloading bay shows the lowest level of odour impacts and is considered to offer best value for odour reduction of the scenarios considered.

The Central Coast Mariners soccer team have submitted a Development Application (DA) to Wyong Shire Council to develop a multi-use complex adjacent and to the west and north of Wyong South STP.

Odour impacts from the existing sewage treatment plant are considered to provide a moderate to high likelihood of future odour complaint in the "Tournament Field / Grand Stand" area of the proposed development, in particular the potential impact from the sludge lagoons both from normal operation of the lagoons as well as impacts from any maintenance or malfunction event which can result in higher odour generation than considered by the modelling assessment. In other areas of the development considered odour sensitive eg. the accommodation area off Bryant Drive impacts from the existing plant are not anticipated to cause adverse odour impacts in this area.

In terms of odour control scenarios, scenario 4 odour impacts in the "Tournament Field / Grand Stand" area are generally less than 2 OU. As such the normal operation of the plant configured as modelled in odour control scenario 4 should not result in adverse odour impacts within the proposed development but as stated above the potential impact from any maintenance or malfunction event can result in higher levels of odour generation. Council would need to consider the range of potential operations that result in higher odours than those normally generated by the plant and the ability for these to be managed, so as not to coincide with events being held in the "Tournament Field / Grand Stand" area.

Council in considering the proposed Mariners Centre for Excellence DA need to consider a range of factors relevant to potential odour impacts from the adjacent Wyong South STP and in this regard DEC, 2006 provides a range of considerations when developing odour mitigation and avoidance strategies.

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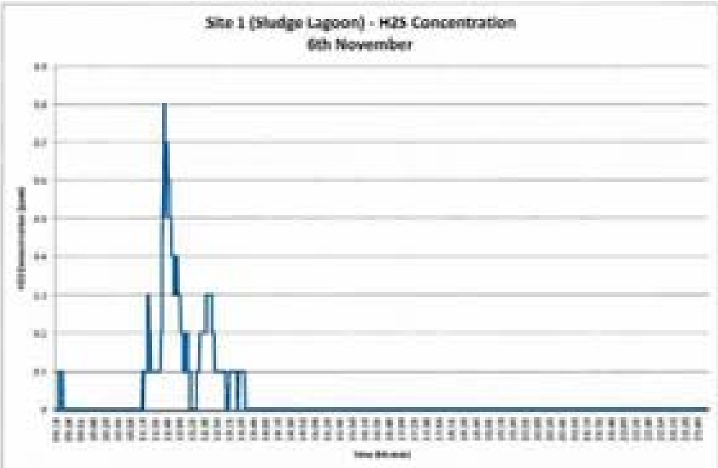
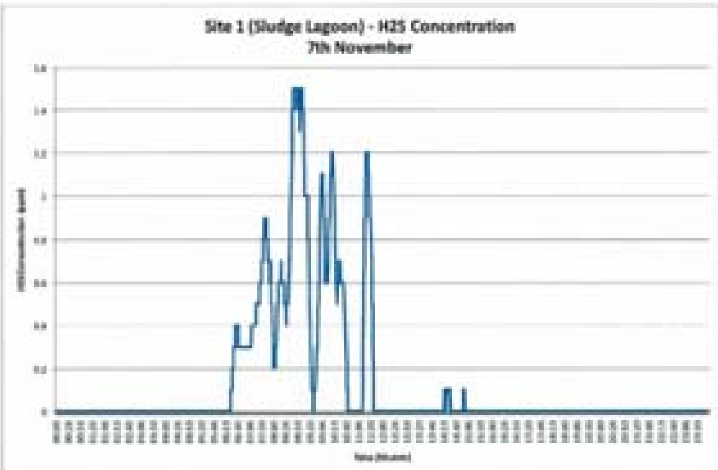
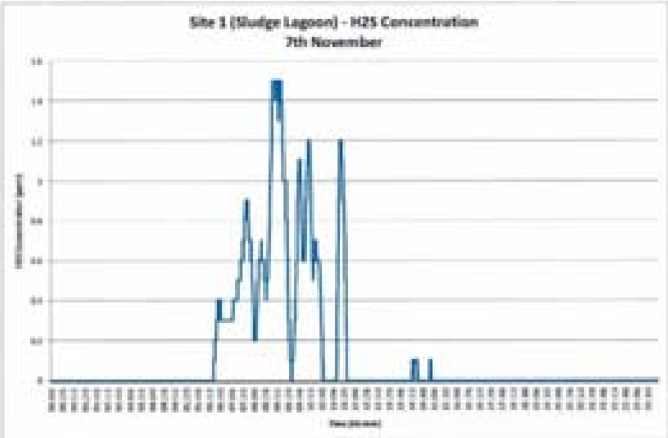
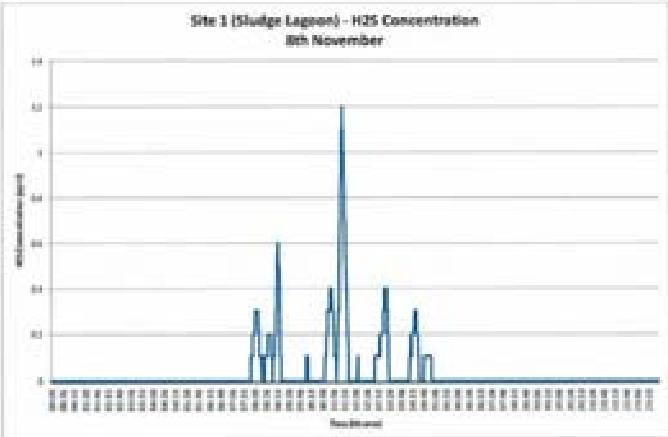
Appendix A Continuous H_2S Monitoring Results

A.1 Sludge Lagoon






Site 1 (Sludge Lagoon) - H2S Concentration
7th November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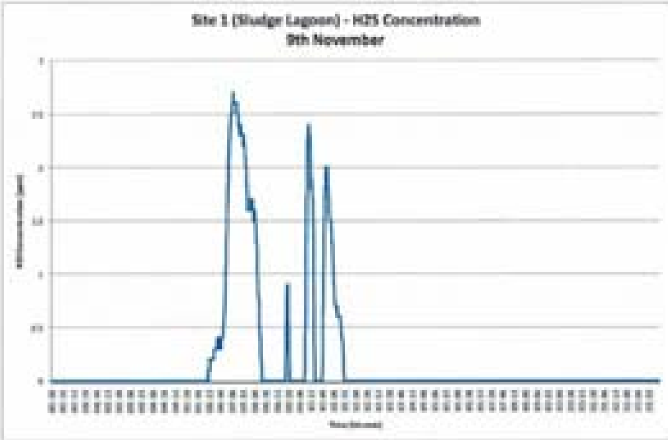
8th November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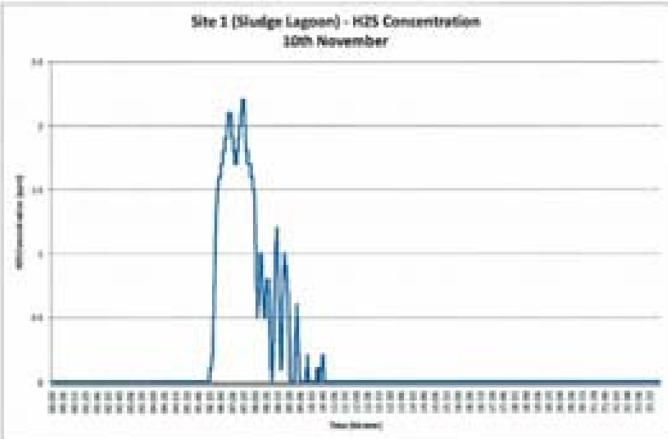
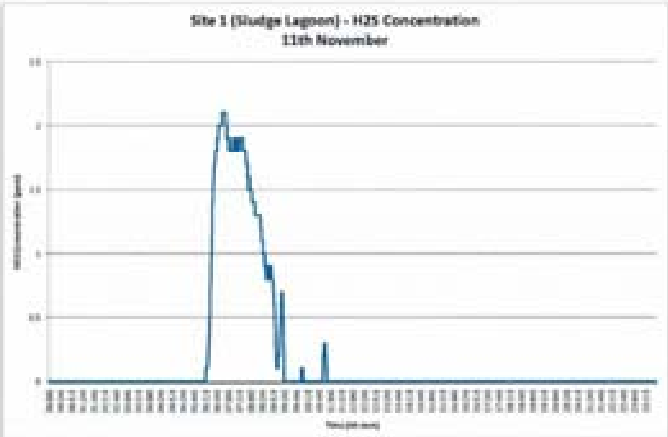
9th November


Site 1 (Sludge Lagoon) - H2S Concentration
10th November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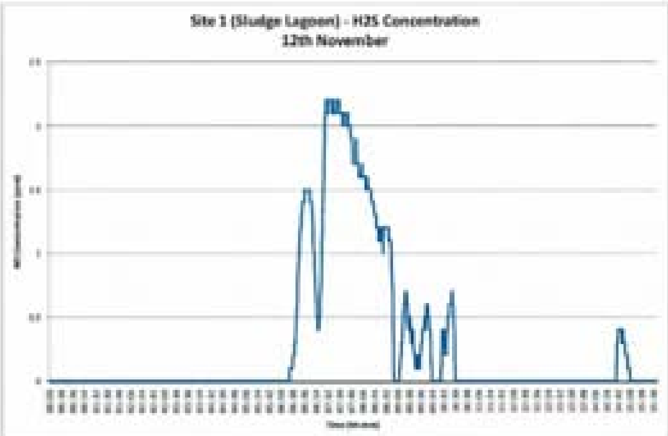
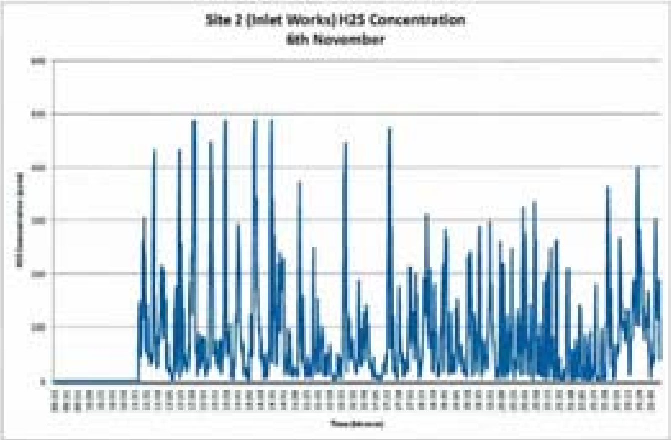
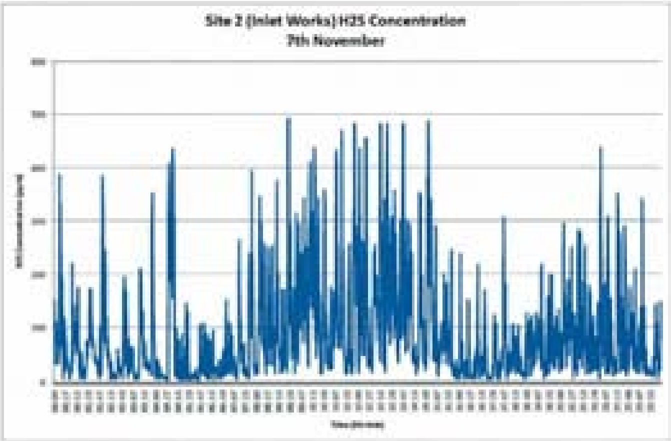
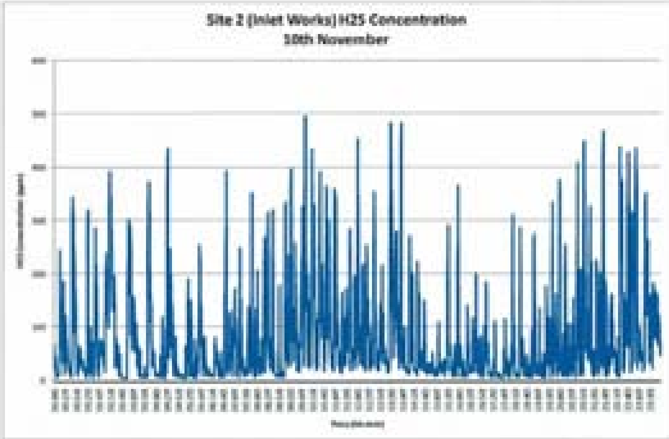
11th November

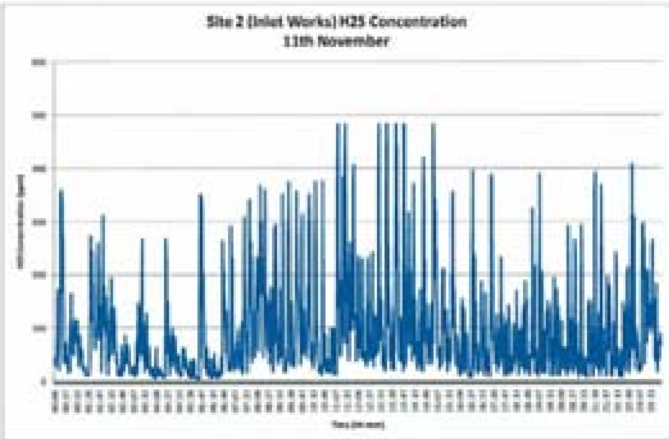

Site 1 (Sludge Lagoon) - H2S Concentration
12th November

A.2 Inlet Works






Site 2 (Inlet Works) H2S Concentration
10th November


Site 2 (Inlet Works) H2S Concentration
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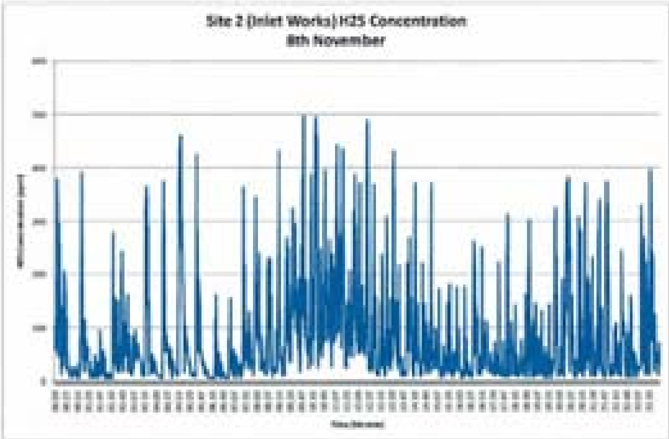
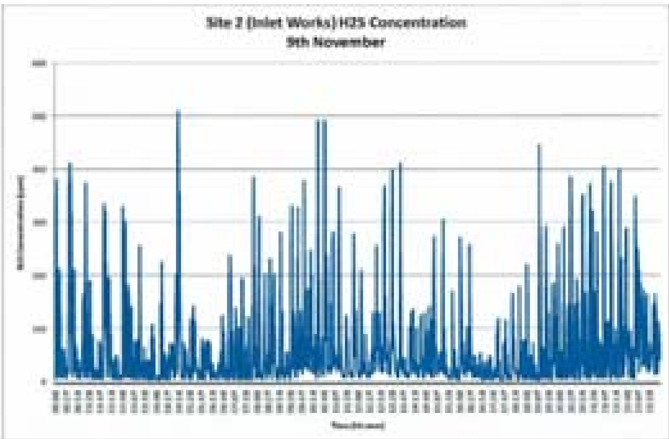
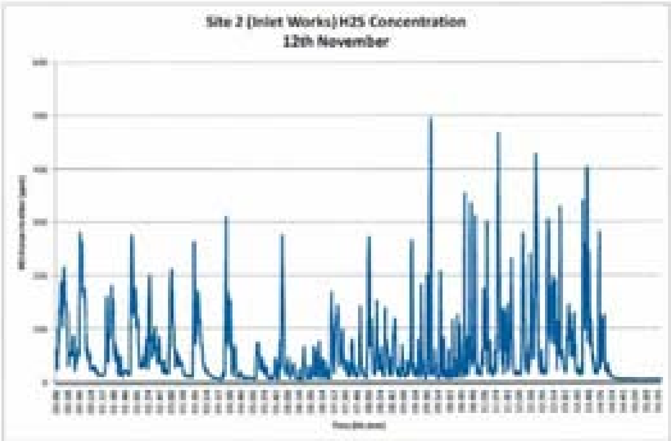
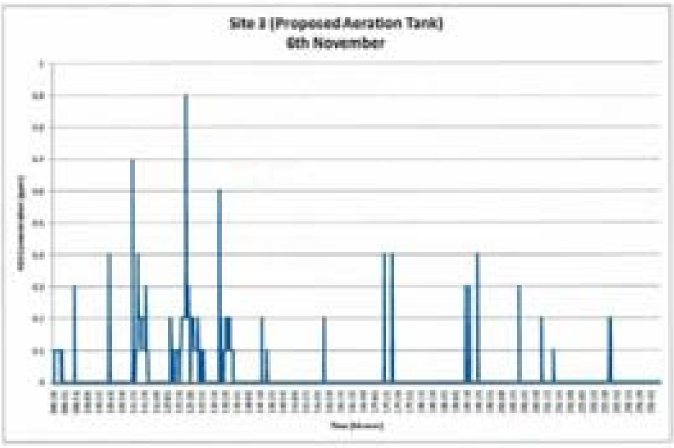

Site 2 (Inlet Works) H2S Concentration
8th November


Site 2 (Inlet Works) H2S Concentration
9th November


Site 2 (Inlet Works) H2S Concentration
12th November


Site 3 (Proposed Aeration Tank)
6th November