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Merimbula Sewage Treatment Plant Upgrade and Ocean Outfall

Appendix N

Air Quality Impact Assessment

Appendix N

Air Quality Impact Assessment

Client: Bega Valley Shire Council

ABN: 26 987 935 332

Prepared by

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May 2021

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Table of Contents

Figures

Tables

Executive Summary

Bega Valley Shire Council (BVSC) is proposing an upgrade to the Merimbula Sewage Treatment Plant (STP) including a new ocean outfall in Merimbula Bay (the Project). The Project would be located between Merimbula and Pambula on Arthur Kaine Drive, within the Bega Valley Shire local government area (LGA). The Merimbula STP is bounded by the Pambula Merimbula Golf Club (PMGC) to the south, Merimbula Lake to the west, Merimbula Airport to the north and Arthur Kaine Drive to the east. The Merimbula STP is accessed via Arthur Kaine Drive, which links to Princes Highway to the west and providing direct access to Merimbula Airport in the north.

The Project would involve an upgrade of sewage treatment at the Merimbula STP and replacement of the existing beach face outfall and dunal exfiltration ponds with an ocean outfall in Merimbula Bay. Specifically, the Project would involve:

- upgrade of the STP to improve the quality of treated wastewater (including for beneficial re-use);
- decommissioning of the beach-face outfall, as well as an STP effluent pond;
- discontinuing the use of the dunal exfiltration ponds;
- installation of a secondary disposal mechanism - an ocean outfall pipeline about 3.5 km in length to convey treated wastewater to a submerged diffuser;
- installation of upgraded pumps; and
- continuation of the beneficial re-use irrigation scheme at the PMGC grounds and the Oaklands agricultural area, with treated wastewater of improved quality.

The Project area comprises the existing Merimbula STP site and ocean outfall alignment, as well as areas required for construction, including laydown areas within the adjacent PMGC grounds and on Merimbula Beach (with access via Pambula Beach).

The Project is aimed at reducing the environmental and health impacts of current operations, by providing a higher level of treatment and a superior mode of discharge/ dispersion of the treated wastewater via an ocean outfall in Merimbula Bay. The upgraded STP would be operated with the additional treatment processes which would improve the quality of the treated wastewater.

This Air Quality Impact Assessment is one of a number of technical documents that forms part of the Environmental Impact Statement (EIS) for the Project. This assessment addresses the relevant Secretary's Environmental Assessment Requirements (SEARs), aiming to identify potential impacts of the Project and to outline performance outcomes and mitigation and management measures relating to air quality transport during detailed design, construction and operation of the Project.

A qualitative assessment of odour impacts during construction identified the potential for intermittent odour impacts to occur from the decommissioning of the effluent storage pond (at the STP site) and beach-face outfall pipeline. There is also the potential for odour impacts during directional drilling, which may encounter acid sulphate soils. However with the directional drilling method proposed (including capture of the drilling spoil and drilling fluids) and adequate management measures during the drilling process, odour impacts from any acid sulphate soils encountered are expected to be minor. The assessment found that while there is potential for some minor odour impacts to occur from these activities, the removal of the effluent storage pond, cessation of use of the dunal exfiltration ponds and the replacement of the beach-face outfall with an ocean outfall would result in an overall reduction of odour concentrations from the STP once operational.

A qualitative assessment of potential dust impacts associated with construction of the Project was undertaken against the UK Institute of Air Quality Management's (IAQM) 2014 *Guidance on the assessment of dust from demolition and construction*. The unmitigated risk rating for construction of the Project was found to be negligible to medium, and as such appropriate mitigation measures have been recommended. These would be included in an Construction Air Quality Management Plan (CAQMP) developed for the Project, to minimise and manage potential dust impacts on nearby sensitive receptors.

A quantitative assessment of odour impacts was undertaken for the operation of the upgraded Merimbula STP. The 'CALPUFF dispersion model' was used to undertake a Level 2 Assessment in Accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA, 2017).

Four modelling scenarios were considered when assessing the existing and proposed impacts from the STP. Two scenarios were modelled for the existing STP configuration, and two scenarios modelled for the upgraded configuration. The first emission scenario, based on maximum emission rates, was representative of upset conditions but was found to be overly conservative and not representative of existing plant conditions based on the history of odour complaint records in the surrounding area (i.e. no odour complaints on record). Given the lack of representativeness of the worst-case data, a second emission scenario was adopted which used "realistic worst case" emissions to assess the potential odour impacts from the upgraded STP. Based on the realistic worst case scenario modelling results, there were no predicted exceedances of the criterion (i.e. 99^{th} percentile 4 odour units (OU)) for existing or proposed operations from the Merimbula STP. Predicted offsite odour concentrations are expected to decrease as a result of the STP upgrade due to the removal of existing large area sources; namely the effluent storage pond and exfiltration ponds. Given the compliance with the odour criterion, no adverse impacts in relation to ground level odour concentrations are anticipated from the Project.

Treated wastewater from the upgraded STP would be treated to a higher standard under the Project; with treated wastewater discharged via a new ocean outfall away from the beach. Changes to the quality of the treated wastewater and the remote location of the discharge point at the outfall pipeline diffuser would result in lower odour concentrations within the vicinity of the existing beach-face outfall and improve the amenity of the beach with regards to odour.

A qualitative assessment of potential cumulative impacts was also conducted to identify cumulative air quality impacts during construction and operation of the Project. While no cumulative impacts relating to odour were identified, the Merimbula Airport Aviation Precinct when constructed in 2021, would result in additional combustion emissions from aircraft; vehicles and associated mobile equipment. As combustion emissions from the upgraded Merimbula STP during operation are likely to be like existing operations, cumulative impacts with operation of the Merimbula Airport General Aviation Precinct are likely to be negligible.

In summary, provided appropriate mitigation measures for dust and odour are implemented for the construction period of the Project, no significant air quality impacts are anticipated from the Project. The operation of the Project is predicted to result in a reduction of odour concentrations through increased levels of treatment of the wastewater; reduction of sources of odour emissions and replacement of the beach-face outfall to an ocean outfall.

1.0 Introduction

Bega Valley Shire Council (BVSC) is proposing an upgrade to the Merimbula Sewage Treatment Plant (STP) including a new ocean outfall in Merimbula Bay (the Project). The Project would be located between Merimbula and Pambula, within the Bega Valley Shire local government area (LGA). The Project area includes both the operational footprint and the construction footprint, and is shown in **Figure 2-1**.

This Air Quality Impact Assessment report has been prepared to assess the potential air quality impacts during construction and operation of the Project.

1.1 Project overview

The Project would involve an upgrade of sewage treatment processes at the Merimbula STP, decommissioning of an existing effluent storage pond, and replacement of the existing beach-face outfall and dunal exfiltration ponds with an ocean outfall pipeline in Merimbula Bay.

When operational, the Project would involve continuation of the beneficial re-use irrigation scheme at the Pambula Merimbula Golf Club (PMGC) grounds and the nearby Oaklands agricultural area, with improved treated wastewater quality from the upgraded STP.

The Project would reduce the environmental and health impacts of the current operations, by providing a higher level of treatment and a superior mode of discharge/dispersion of the treated wastewater via the ocean outfall offshore in Merimbula Bay.

The Project is described in further detail in **Section 2.0**, and an overview of the Project area is provided in **Figure 2-1**. A full Project description is provided in the EIS (refer **Chapter 2 Project description**).

1.2 Purpose of this technical report

The aim of this technical report is to address the relevant Secretary's Environmental Assessment Requirements (SEARs) for the project provided by the NSW Department of Planning Industry and Environment (DPIE) (Application number SS1 7614). The SEARs specifically relating to air quality, which have been addressed in this report, are provided in **Section 1.2.1**.

1.2.1 Secretary's Environmental Assessment Requirements

Table 1-1 sets out the SEARs relevant to this air quality impact assessment, and identifies where the individual requirements have been addressed in this report.

Table 1-1 Secretary's Environmental Assessment Requirements – Air quality

Secretary's Environmental Assessment Requirements	Where addressed in report
13. Air quality	
1. The Proponent must undertake an air quality impact assessment (AQIA) for construction and operation of the Project in accordance with the current guidelines.	**Section 5.0**, and **Section 6.0**
2. The Proponent must ensure the AQIA demonstrates the ability to comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations Act 1997* and the *Protection of the Environment Operations (Clean Air) Regulation (2010).*	**Section 3.0**, **Section 5.0** and **Section 6.0**

1.2.2 Structure of this report

The report has been structured in the following sections:

- **Section 1.0** – introduces the Project; scope of this technical report and the relevant SEARs.
- **Section 2.0** – provides a Project description, including the existing and proposed operation, and identifies potential sources of air pollutants.
- **Section 3.0** – provides a description of the assessment methodology used to assess construction and operational impacts, including the study area and relevant air quality criteria.
- **Section 4.0** – provides a description of the existing environment, including local meteorology, climatic conditions, air quality and topography.
- **Section 5.0** – provides a construction air quality impact assessment of the Project.
- **Section 6.0** – provides an operational air quality impact assessment of the Project.
- **Section 7.0** – provides an assessment of cumulative impacts of the Project and other identified future developments within the study area.
- **Section 8.0** – provides recommended air quality mitigation and management measures for the Project.
- **Section 9.0** – provides a summary and conclusion of the report.

2.0 Project description

This chapter outlines the existing operations at the Merimbula STP and provides a summary of the Project description. A full Project description is provided in **Chapter 2 Project description** of the EIS.

The Project would be located between Merimbula and Pambula on Arthur Kaine Drive, within the Bega Valley LGA approximately 3.5 kilometres (km) south of the Merimbula town centre and 2.5 km north of Pambula village, as shown on **Figure 2-1**. The Merimbula STP is bounded by the PMGC to the south, Merimbula Lake to the west, Merimbula Airport to the north and Arthur Kaine Drive to the east. The Merimbula STP is accessed via Arthur Kaine Drive, which links to Princes Highway to the west and provides direct access to Merimbula Airport in the north.

2.1 Existing operations

The existing operations at the Merimbula STP consist of:

- sewage treatment at the Merimbula STP; and
- disposal of treated wastewater via:
  - a beach-face outfall;
  - dunal exfiltration ponds; and
  - a beneficial re-use scheme at the adjacent PMGC grounds, and at Oaklands agricultural area.

The STP is an intermittently decanted extended aeration (IDEA) activated sludge plant designed to serve an equivalent population of 15,500. The STP has a capacity to accommodate an average dry weather flow of up to 3.72 megalitres per day (ML/day) and a peak wet weather flow of seven times the average dry weather flow, or 26 ML/day. It handles an average of 790 megalitres (ML) of treated wastewater per year .

The current strategy for managing treated wastewater from the Merimbula STP comprises a combination of:

- beneficial re-use (the preferred disposal option): use of treated wastewater to irrigate the adjacent PMGC grounds and 'Oaklands' agricultural area (approximately 25% of annual treated wastewater), located on the Pambula River flats at South Pambula; and
- disposal: discharge of excess treated wastewater to the environment, via dunal exfiltration ponds located within the sand dunes east of the STP between the ocean and Merimbula Lake (approximately 25% of annual treated wastewater), or via the existing beach-face outfall east of the STP at Merimbula Beach (approximately 50% of annual treated wastewater).

2.2 The Project

The Project would involve:

- upgrade of the STP to improve the quality of treated wastewater (including for beneficial re-use);
- decommissioning of the beach-face outfall, as well as an STP effluent storage pond;
- discontinuing the use of the dunal exfiltration ponds;
- installation of a secondary disposal mechanism - an ocean outfall pipeline about 3.5 km in length to convey treated wastewater to a submerged diffuser;
- installation of upgraded pumps; and
- continuation of the beneficial re-use irrigation scheme at the PMGC grounds and nearby Oaklands agricultural area with treated wastewater of improved quality.

Upgrades to the STP and the ocean outfall would reduce the environmental and health risks and impacts of the current operations, by providing a higher level of treatment and a superior mode of discharge/ dispersion of the treated wastewater via an ocean outfall offshore in Merimbula Bay.

A summary of the proposed Project elements is provided in **Table 2-1**.

The Project area comprises the existing Merimbula STP site and the proposed outfall pipeline alignment. The Project construction areas would include areas within the Merimbula STP, temporary laydown areas on the adjacent PMGC grounds and on Merimbula Beach (with associated access from Pambula), as shown in **Figure 2-1**.

The EIS is based on a concept design for the Project. It is noted that during subsequent design stages, and subsequent to a design and construction contractor(s) being engaged, details of the Project may change or be refined (e.g. specific locations of some elements or infrastructure within the existing STP site; materials to be used in plant construction and technology).

Table 2-1 Project elements

Project element	Summary
STP upgrade	The STP upgrade would involve additional treatment processes incorporated into the existing STP site, including two stage poly aluminium chloride (PAC) dosing, ultraviolet (UV) disinfection, chlorine dosing and tertiary filtration (if required). The indicative physical layout of the proposed STP upgrade is shown in **Figure 2-2**. The new treatment processes would be incorporated into the following existing STP phases (refer **Chapter 2 Project description** for further information): *Phase two: secondary treatment* Addition of: • two stage PAC dosing for phosphorous removal. *Phase three: disinfection* A change to the existing disinfection (chlorine dosing) treatment, involving: • addition of ultraviolet (UV) treatment; • chlorine dosing would continue to be applied to treated wastewater, however wastewater would be divided into two separate streams: - wastewater to be beneficially re-used would be dosed with chlorine; and - wastewater to be discharged via the ocean outfall would no longer be subject to chlorine dosing. • the chlorine dosing proposed would involve installation of a new chlorine dosing unit (including two 920 kg drum storage of chlorine, and a new pump system). The chlorine dosing unit would be stored at a dedicated storage facility within the STP (either the existing chlorine storage shed would be upgraded to house the increased volume of chlorine required for the Project, or a new shed would be built on or near to the site of the existing shed); and • tertiary filtration could also be installed (if required).

Project element	Summary

	The Project would also require the following within the existing STP site:
	• a new storage tank and new chlorine contact tank;
	• installation of up to four additional pump stations:
	  - ocean outfall pump station – to pump treated wastewater through the outfall pipeline;
	  - storage tank pump station – to pump treated wastewater to the new storage tank;
	  - chemical sludge pump station (if tertiary filters required) – to pump sludge and treated wastewater; and
	  - pump station – to pump from wet weather overflow back into the STP treatment train.
	• installation of ancillary infrastructure (including new sheds/structures to house new treatment processes, above-ground storage tanks, pipes, pits, power supply and additional low voltage (LV) connection (including transformer, cabling and distribution board), control kiosks, a retaining wall and internal access roads); and
	• relocation and upgrade of utilities to accommodate the additional features proposed.

Existing STP effluent storage pond	The existing 17 ML effluent storage pond within the STP site would be decommissioned, including dewatering and sediment/sludge removal.

New ocean outfall pipeline and effluent diffuser, and associated pump station	*<u>Phase four: Disposal and beneficial re-use</u>*
	New additions would involve:
	• installation of a 3.5 km outfall pipeline – the pipeline would travel from the STP in an east-south-easterly direction to a location approximately 2.7 km offshore in Merimbula Bay;
	• the pipeline would involve two construction methods for different sections of the pipeline as follows:
	  - 'Section one' – STP to a location beyond surf zone: underground trenchless drilling method (refer **Figure 2-3**); and
	  - 'Section two' – Location beyond surf zone to offshore pipeline termination point: laying of pipeline on sea floor and covering with rock or concrete mattresses (refer **Figure 2-4**).
	• Section one of the pipeline (the onshore component) would be about 0.8 km and below ground. installation of the underground section would be via a trenchless method (e.g. horizontal direction drilling or direct drive tunnelling), followed by pipeline insertion via pulling or pushing;
	• Section two (the above ground section of the pipeline) would be installed via direct placement on the sea floor in 600 m to 800 m pipe lengths. This would also involve progressive protection and stabilisation works for the pipeline (e.g. potentially using concrete or rock mattresses) held together with ropes/ slings/ cables;
	• the terrestrial component of the outfall pipeline would be laid between about -9.3 m and -19.5 m AHD, with greater depth largely depending on the nature of the overlying sand dunes;
	• a multi-port pipeline diffuser would be located at the end of the pipeline at a depth of approximately 30 m; the diffuser would be approximately 80 m in length;
	• the pipeline would have an outer diameter of up to 450 mm (366 mm internal diameter) and consist of pipeline lengths welded together;
	• a transition riser may be required to connect the underground pipeline with the above ground section of pipeline on the sea floor (if required, the riser would be located beyond the surf zone); and
	• the pipeline would contain valves along its length for mitigating against air entrapment.

Project element	Summary
Existing exfiltration ponds	The existing exfiltration ponds within the adjacent sand dunes (east of the STP site) would cease to be used under the Project.
Existing beach-face outfall	The existing public beach-face outfall pipeline would be decommissioned. The exposed end of the outfall pipeline would be removed, and the remainder of the pipeline would remain in-situ (i.e. would remain buried underground).
Water use	The STP would continue to use potable town water for kitchen and amenities on site. Apart from these water inputs, the Project would not require any other ongoing water source during operation.
Construction	
Construction footprint	The construction footprint includes temporary compound and laydown areas as shown in **Figure 2-5**. The location of laydown areas would be confirmed during detailed design and would depend on the method and location/s proposed to be used for directional drilling by the construction contractor. Temporary construction laydown areas would be located: • within the STP site; • within a portion of the adjacent PMGC grounds; and • on Merimbula Beach (if required, for pipe stringing and potentially an intermediate drill rig site for directional drilling). A total of approximately 2,800 square metres (m2) (or 0.28 hectares) of vegetation removal / trimming would be required in the following locations: • approximately 217 m2 at the Pambula Beach access track; and • approximately 2,464 m^2 of regrowth scrub within the existing STP site and for construction access from the construction laydown area within the PMGC grounds; and • approximately 47 m^2 at the existing beach face outfall pipeline (to be decommissioned).
Construction timing, hours and workforce	Pending Project approval, it is proposed to commence construction in 2022, with construction anticipated to be undertaken over a period of 24 months. Construction would be staged and there would be times when some construction stages overlap. Works would typically be limited to standard daytime hours, which include: • 7:00 am to 6:00 pm Monday to Friday; • 8:00 am to 1:00 pm Saturday; and • no work on Sundays, public holidays. Certain works may need to occur outside standard construction hours for the safety of workers, in accordance with transport licence requirements, or for constructability reasons. Activities to be carried out during out of hours periods may include oversized load deliveries and pipeline pulling as part of the directional drilling (which would need to be undertaken continuously until completed, which may take up to 48 hours). Construction works in Merimbula Bay could occur seven days a week to maximise works during favourable offshore weather conditions. Approval from BVSC would be required for any out of hours work and the affected community would be notified. Construction of the Project would require a workforce of around 20 workers, with peak construction periods requiring up to 30 workers.
Traffic, construction vehicle types and workforce	Construction traffic would indicatively comprise: • 5 to 10 heavy vehicles per day (e.g. truck and dogs); and • 10 to 20 light vehicles per day. Vehicles transporting machinery or oversized materials such as

<table>
<tr><th>Project element</th><th>Summary</th></tr>
<tr><td></td><td>
prefabricated units may be required from time to time, and oversized vehicles would require escort to and from site. The largest truck expected as part of construction is the directional drilling rig truck (the exact size would be confirmed by the construction contractor).
The construction phase of the Project would require construction vehicles to transport materials and equipment along the existing road network to the construction compound/laydown areas at the Merimbula STP and PMGC grounds and, if required, at the Merimbula Beach laydown area via Pambula Beach.
In facilitating these construction activities, various plant and equipment would be required, including:

small, medium and large excavators (3 tonne to 25 tonne) (tracked and wheeled);
compaction plant (e.g. roller/s, plate compactor);
grader;
bulldozer;
directional drilling rig truck and associated infrastructure (i.e. drilling fluid recovery and recovery unit);
pumps for dewatering (if required);
vacuum truck;
bobcat;
concrete trucks and pumps;
mobile cranes (e.g. franna crane, scissor lift, forklift);
semi-trailers and tipper truck;
telehandlers;
micro-piling rig (on barge);
water carts;
hand tools and welding equipment;
barges (e.g. 55 m and 73 m barges, jack-up barge) and tugs;
small, self-propelled vessel;
demolition saw, jackhammer, grinder;
generator/s, lighting tower;
forklift;
light vehicles and light trucks; and
heavy vehicles.

The size of vehicles used for haulage would be consistent with the access route constraints, safety and any worksite constraints. Some construction activities (such as the delivery of precast sections) may require truck and trailer combinations or semi-trailers.
</td></tr>
</table>

Project element	Summary
Access	Construction vehicles would access/egress the STP site via the following accesses: • Arthur Kane Drive, via either the northern end of the STP site, and/or the existing main STP entrance. Construction of the outfall pipeline would also utilise the following accesses: • Coraki Drive, Pambula (construction vehicles would enter the temporary beach access track from the end of Coraki Drive, before traversing the beach access track to the laydown area on Merimbula Beach); and • Port of Eden, Twofold Bay (barge/s would transport materials and equipment northward to the location of the proposed outfall pipeline alignment). Construction site accesses at Arthur Kaine Drive and Pambula Beach are shown in **Figure 2-5**. Construction materials and equipment could also be delivered to the Port of Eden using shipping containers, with construction vehicles expected to haul these containers to the construction sites via the Princes Highway.

2.3 Operational stage

The Project would be operated with the additional treatment processes which would improve the quality of the treated wastewater. Levels of total phosphorus, total suspended solids, biological oxygen demand, virus, bacteria and other pathogens would be managed to be within discharge limits. Treated wastewater would be tested for quality prior to discharge via the ocean outfall pipeline or via beneficial re-use offsite (to existing land application areas at the Oaklands agricultural area or the adjacent PMGC grounds). Maintenance activities for the STP and ocean outfall would also be undertaken and would continue until the STP is decommissioned or further upgraded in the future.

FIGURE 2-1: PROJECT AREA

Legend

- Project area
- Project area (temporary construction area)

N
0 500 1,000 m

AECOM

Source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

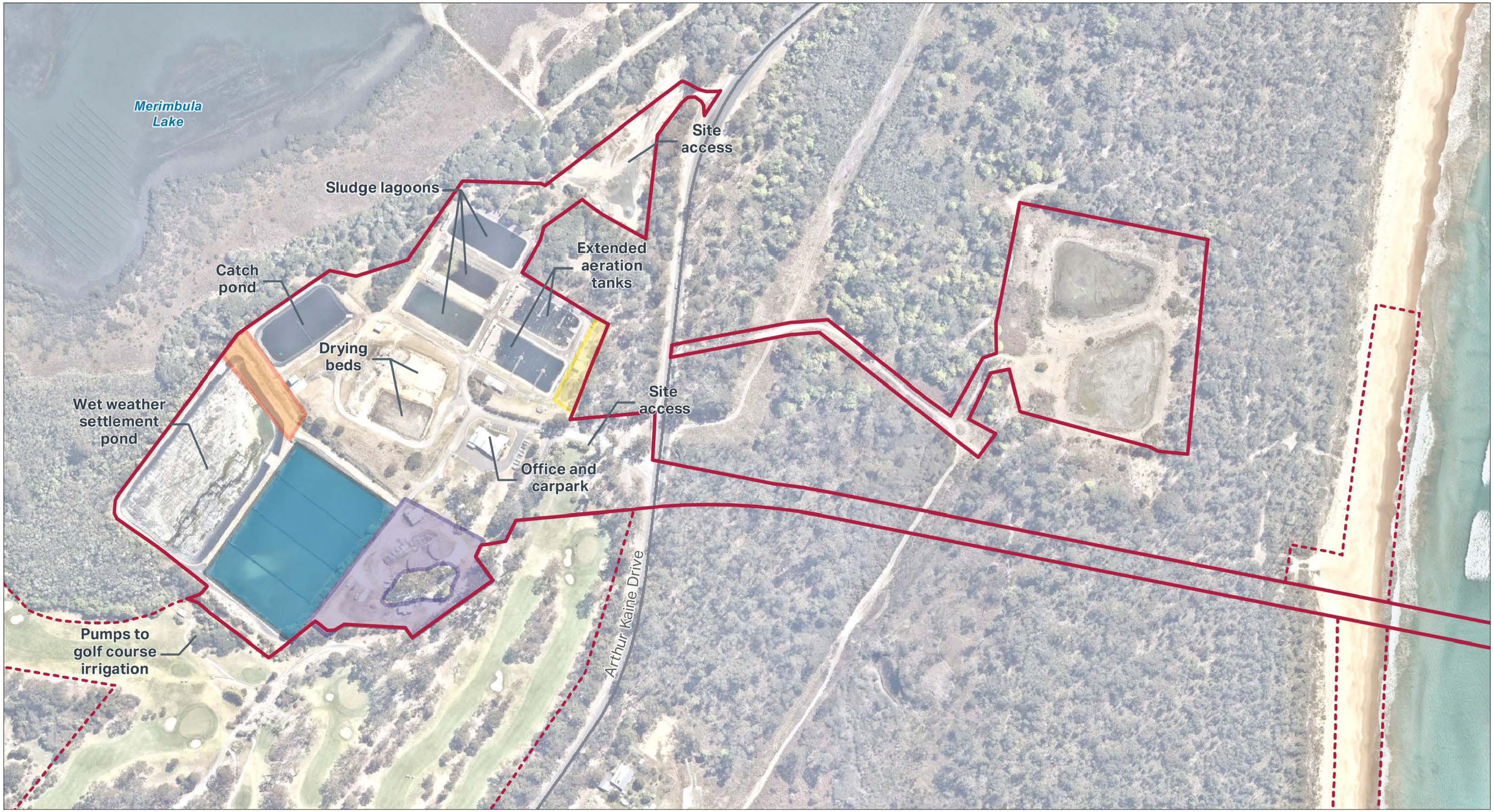

FIGURE 2-2: PROPOSED STP LAYOUT (INDICATIVE)

N 0 50 100 m

Legend

- Project area
- Project area (temporary construction area)

Proposed Project Upgrades

- PAC dosing, UV disinfection, tertiary treatment
- Pump stations, storage, chlorine disinfection
- PAC dosing (second unit)
- Effluent storage pond to be decommissioned

Source: Nearmap, 2019

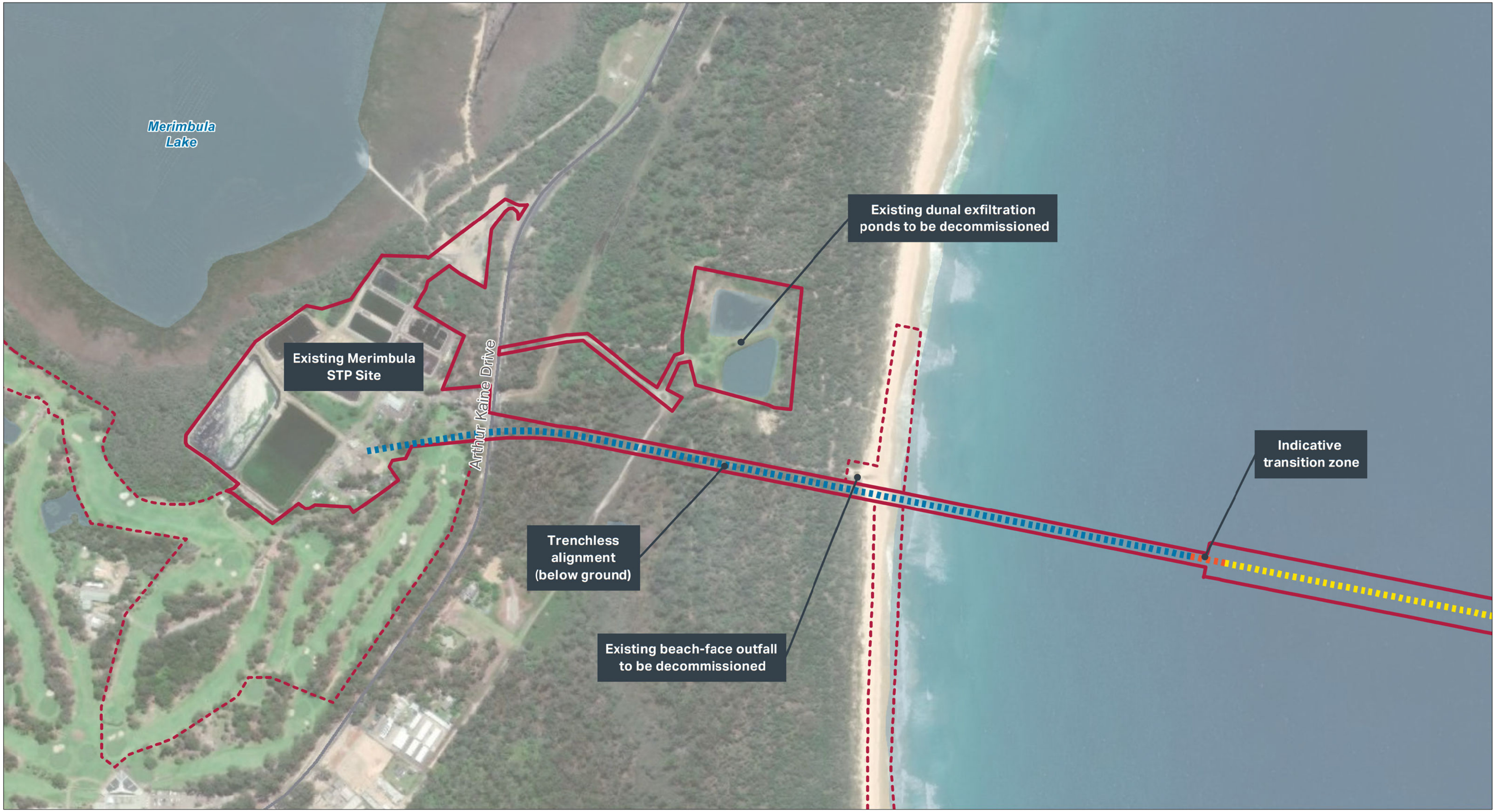

FIGURE 2-3: OCEAN OUTFALL PIPELINE - SECTION 1 (BELOW GROUND)

N

0 100 200 m

AECOM

Source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Project area
- Project area (temporary construction area)
- Outfall pipeline – Section 1 (below ground)
- Transition Zone
- Outfall pipeline – Section 2 (above seafloor)

FIGURE 2-4 : OCEAN OUTFALL PIPELINE – SECTION 2 (ABOVE SEAFLOOR)

N
0 200 400 m

Legend

- Project area
- Project area (temporary construction area)
- Outfall pipeline – Section 1 (below ground)
- Transition Zone
- Outfall pipeline – Section 2 (above seafloor)
- Diffuser (above seafloor)

Source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

FIGURE 2-5: CONSTRUCTION COMPOUND/LAYDOWN AREAS

Legend

- Project area
- Temporary project area for construction
- Construction access
- Construction compound/laydown area
- Construction laydown area and potential intermediate drilling site
- Construction laydown area at Pambula-Merimbula Golf Club grounds

Source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

2.4 Potential sources of air emissions

The potential sources of air emissions during construction and operation of the Project are discussed below.

2.4.1 Emission sources during construction

Odour emissions

There is the potential for a change in the overall site odour profile due to the decommissioning of the 17 Mega Litre (ML) effluent storage pond at the STP site, decommissioning of the beach-face outfall, and cessation of use of the dunal exfiltration ponds. The cessation of the use of these features would all be expected to decrease the odour emitted from the site.

There is potential for odour emissions associated with the disturbance of potential acid sulphate soils during earthworks. This is considered unlikely however if potential acid sulfate soils are managed in accordance with protocols, which include recycling of the drilling slurry/fluids and having waste spoil material from the directional drilling operation taken offsite. Note that management of acid sulfate soils (ASS) is described further in the EIS in **Chapter 13 Landform, geology and soils**.

Temporary odour emissions associated with construction have been assessed qualitatively in **Section 5.1**.

Dust emissions

Potential sources of dust emissions during construction would include dust generated from earthworks and material handling activities; decommissioning of existing infrastructure; wheel-generated dust from unpaved roads and exposed areas, and from stockpiles. The methodology used to assess potential dust impacts from construction activities is provided in **Section 3.5** and an assessment of the potential dust impacts is provided in **Section 5.2**.

Vehicle emissions

The source of non-construction vehicle emissions during the Project construction phase are due to the combustion of diesel fuel by heavy vehicles, mobile construction equipment and stationary equipment such as diesel generators. Emissions are expected to depend on the nature of the emissions source i.e. size of the equipment, usage rates, duration of operation, etc. Pollutants emitted by construction vehicles include carbon monoxide (CO), particulate matter (PM_{10} and $PM_{2.5}$), nitrous oxides (NO_x), sulphur dioxide (SO_2), volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons (PAHs).

The methodology used to assess potential air quality impacts from construction vehicles is provided in **Section 3.6**, and a qualitative assessment of potential air quality impacts from combustion emissions is provided in **Section 5.3**.

2.4.2 Emission sources during operation

Odour emissions

Sewage treatment plant

Sources of odour that have been identified at the existing STP include:

- inlet works and associated odour control unit;
- intermittently decanted extended aeration (IDEA) tanks (2);
- catch pond;
- wet weather overflow pond;
- sludge drying bed (2);
- sludge lagoon (3);
- effluent storage pond; and
- exfiltration pond (2).

Other sources of odour emissions from the existing STP include the chorine contact pump and pumping stations. These operations however are considered to only represent insignificant sources of odour emissions from the STP site, and as such are not considered further in this assessment.

Changes in odour sources as a result of the Project that would influence odour emissions from the site are described in detail in the EIS in **Chapter 2 Project description**, and would include:

- the decommissioning of the STP effluent storage pond and installation of an enclosed 2.3 ML storage tank;
- installation of an enclosed above-ground chlorine contact tank;
- ceasing use of the two dunal exfiltration ponds;
- removal of the existing beach-face outfall.

Other sources of odour from the proposed STP configuration would include ultraviolet (UV) treatment and the potential use of tertiary filtration units which would be enclosed. Given the high level of treatment of effluent entering these systems, these are considered very minor sources of odour. Similarly, additional storage tank and tertiary filtration pumping stations would not be a major contributor of odour emissions from the site. As such these have not been considered further.

A quantitative assessment of potential odour emissions from operation of the plant is provided in **Section 6.0**, with the methodology for the assessment documented in **Section 3.7**.

Ocean outfall pipeline

Following the upgrade to the STP, treated wastewater from the Merimbula STP would be treated to a higher standard; with treated wastewater discharged via a new offshore ocean outfall, located away from the beach. The dunal exfiltration ponds would also cease to be used. Changes to the treated wastewater quality, the relocation of the discharge point offshore and cessation of use of the dunal exfiltration ponds would result in a net reduction in odour emissions from the STP infrastructure.

The assessment did not address existing impacts from the beach-face outfall given the absence of available site specific emissions data. However as the removal of this onshore discharge point removes the potential source of odour, its’ removal is expected to result in a reduction of odour emissions at this location. As discussed above, an assessment of ceasing the use of the dunal exfiltration ponds has been included as part of the quantitative assessment of the existing and proposed STP operations.

Dust emissions

No significant changes to dust emissions between the current operation of the STP and proposed operations under the Project are anticipated, and as such no further assessment of operational dust impacts has been undertaken.

Vehicle emissions

Combustion emissions from vehicles traversing the STP site would include CO, PM_{10} and $PM_{2.5}$, NO_x, SO_2, VOCs and PAHs. No significant change to vehicle numbers between the current operation of the STP and proposed operations is expected after the upgrade. On this basis, no further assessment of the potential impacts during operation has been undertaken.

3.0 Methodology

The following assessment methodology has been separated into two distinct sections as follows:

- qualitative construction impact assessment (**Section 3.4**, **Section 3.5** and **Section 3.6**); and
- quantitative operational impact assessment (**Section 3.7**).

3.1 Relevant guidelines and legislation

Legislation relating to projects contributing to air quality in NSW can be broadly divided into either federal or state-based legislation and consists of several distinct pieces of legislation that need to be considered. As an overview, the legislation applicable to air quality in NSW has been summarised in **Figure 3-1**.

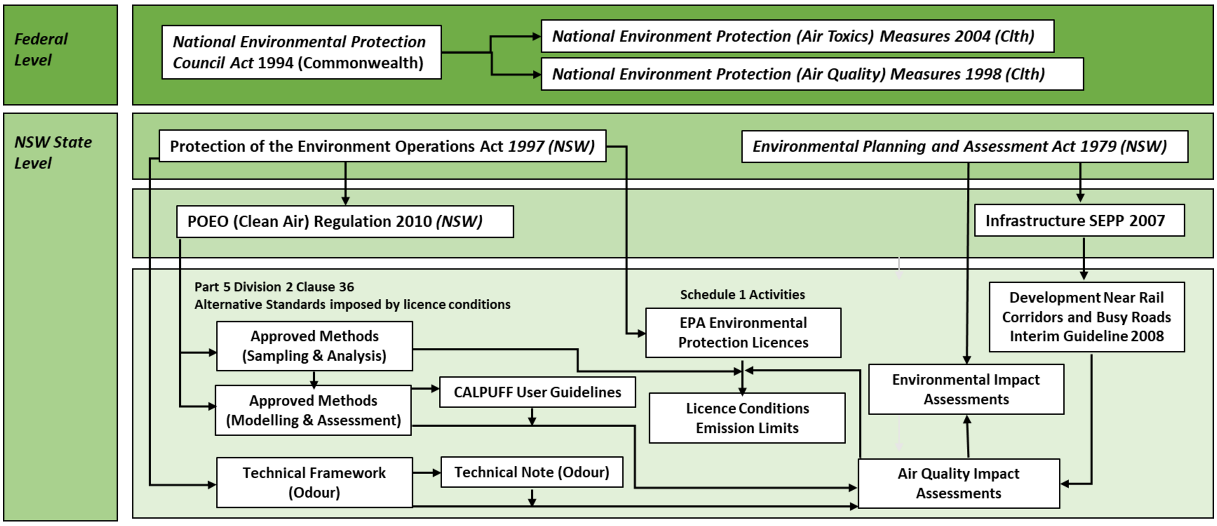

Figure 3-1 NSW Air Quality Regulatory Framework

Figure Notes: Infrastructure SEPP: *State Environmental Planning Policy (infrastructure) 2007*

The SEARs in **Section 1.2.1** require that that the AQIA for construction and operation of the Project in accordance with the current guidelines. The relevant guidelines are as follows:

- the *NSW Technical Framework and Technical Notes* (The Odour Policy) under the *Protection of the Environment Operations Act 1997* (NSW) (POEO Act); and
- the *NSW Approved Methods for Modelling and Assessment and CALPUFF User Guidelines* under Part 5 Division 2 Clause 35 of *the Protection of the Environment Operations (Clean Air) Regulation 2010* (NSW).

NSW EPA Odour Assessment Criteria under the Approved Methods is further discussed in **Section 3.3.**

This technical report has therefore assessed the potential air quality impacts in accordance with the specific methodologies described below:

- dust impacts associated with construction of the Project were qualitatively assessed using the methodologies outlined in the UK Institute of Air Quality Management's *Guidance on the assessment of dust from demolition and construction* (IAQM, 2014); and

- a quantitative assessment of the potential odour impacts associated with operation of the upgraded STP was undertaken. A Level 2 odour impact assessment examining potential ground level odour impacts was undertaken using the dispersion model 'CALPUFF' in accordance with the following guidelines:
  - *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA, 2017);
  - *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into Approved Methods for Modelling and Assessments of Air Pollutants in NSW, Australia* (TRC, 2011);
  - *Technical Framework, Assessment and Management of Odour from Stationary Sources in NSW* (DEC, 2006); and
  - *Technical Notes, Assessment and Management of Odour from Stationary Sources in NSW* (DEC, 2006).

3.2 Study area

The Merimbula STP is located off Arthur Kaine Drive, Merimbula within the Bega Valley Shire Local Government Area (LGA). The STP is bound by the Merimbula Airport to the north and PMGC to the east, south and west. The STP and the associated upgrade construction envelope is situated approximately 2.5 km south of the Merimbula Township and 1.5 km northeast of Pambula Village as shown in **Figure 2-1**.

Construction dust impacts were considered within 350 m of the Project Area boundary and within 50 m of the Project heavy vehicle entry point for the site in accordance with the UK Institute of Air Quality Management's *Guidance on the assessment of dust from demolition and construction* (IAQM, 2014). The construction footprint is shown in purple in To assess the operational (odour) impacts from the Project the study area has been defined by a 6 km by 6 km area centred on the STP and is shown in blue in **Figure 3-2**.

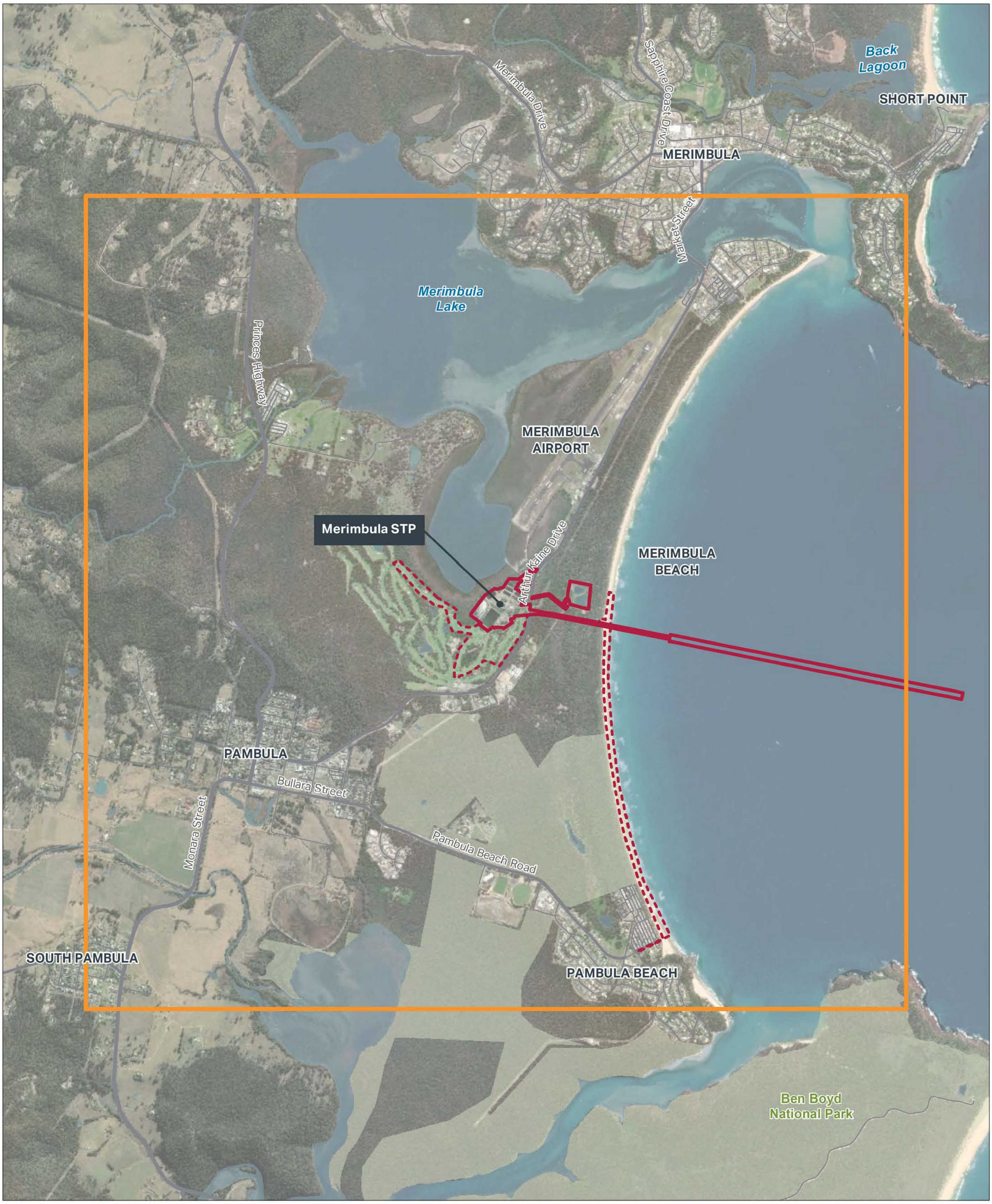

FIGURE 3-2: STUDY AREA

AECOM

Legend

- Project area
- Project area (temporary construction area)
- Study Area

Source: Department of Customer Service, 2020; Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

3.3 NSW EPA odour assessment criteria

The perception of odour is based on an individual's response to chemical exposure. The odour threshold is the theoretical minimum concentration of a chemical that produces an olfactory response, which, in practice, is used to indicate whether an odour is detectable. The odour threshold defines 1 odour unit (1 OU) for each chemical. The threshold relates to odour detection and does not consider the recognition of an odours character.

The EPA's impact assessment criteria for complex mixtures of odours (EPA, 2017) were designed to consider the ranges of individual sensitivity to odours based on a statistical evaluation of the size of the surrounding population. As population density increases, the proportion of sensitive individuals is also likely to increase; as such, areas with larger populations require more stringent criteria. The criteria are shown in **Table 3-1**.

Table 3-1 EPA impact assessment criteria – complex odours

Population	Criteria (Odour Units)*
Urban (≥ ~2000) and/or schools and hospitals	2
~ 500	3
~ 125	4
~ 30	5
~ 10	6
Single residence (≤ ~2)	7
*99th percentile nose response time	

The Merimbula STP is located adjacent to a golf course to the southwest, and an airport to the north. There are some residential and commercial properties located on Arthur Kaine Drive and their proximity to the Project area is discussed further in **Section 4.5**. The remaining adjoining land is undeveloped and is comprised of native vegetation such as mangroves and saltmarsh. Population surrounding the site is relatively low with a population density for Merimbula (as of 2019) of 0.98 persons per hectare (ha), which equates to 98 people per square kilometre (km^2).

Section 3.1 of the NSW EPA Odour Technical Notes lists an equation to allow the calculation of an odour criterion based on population density. Equation 3.1 from the Odour Technical Notes outlining the equation for determination of odour criterion is shown below:

$$Odour\ assessment\ criterion\ (OU) = (log_{10}\,(population) - 4.5)/-0.6$$

Based on this equation, the appropriate odour criterion for Merimbula would be 4.2 OU, which was calculated using a population density of 98 people per km^2. The population density surrounding the Merimbula STP however is expected to be lower than the Merimbula township (based on a review of nearby sensitive receptors as discussed in **Section 4.5**). Given the information discussed outlined above, the location of sensitive receptors to the STP and the land use around the STP, an odour criterion of 4OU has been adopted for this assessment.

3.4 Construction odour assessment methodology

3.4.1 Odour impact assessment

A qualitative assessment of odour impacts from construction works associated with the STP upgrade and new ocean outfall are provided in **Section 5.1**. Potential sources of odour that were assessed included both the decommissioning of existing wastewater infrastructure and the potential disturbance of acid sulphate soils (ASS).

3.5 Construction dust assessment methodology

Potential impacts from dust generation during construction have been assessed using the UK Institute of Air Quality Management's *Guidance on the assessment of dust from demolition and construction*

(IAQM, 2014). This document provides a qualitative risk assessment process for the potential unmitigated impact of dust generated from demolition, earthmoving and construction activities.

It is noted that the IAQM methodology assesses the risk of impacts associated with demolition and construction without the application of any mitigation measures. The assessment provides a classification of the risk of dust impacts which then allows the identification of appropriate mitigation measures commensurate with the level of risk.

The IAQM guidance process is a ***four-step*** risk-based assessment of dust emissions associated with demolition, land clearing and earth moving, and construction activities. The IAQM assessment process is described below.

3.5.1 Step 1 – Screening assessment

An assessment will normally be required where there is:

- a "human receptor" within:
  - 350 m from the boundary of a site; or
  - 50 m from the route used by construction vehicles on public roads up to 500 m from a site entrance.
- a "ecological receptor" within:
  - 50 m from the boundary of a site; or
  - 50 m from the route used by construction vehicles on public roads up to 500 m from a site entrance.

3.5.2 Step 2 – Dust risk assessment

Step 2 in the IAQM methodology is a risk assessment tool designed to appraise the potential for dust impacts due to unmitigated dust emissions from a construction project. The key components of the risk assessment are defining the dust emission magnitudes (Step 2A) and the surrounding area sensitivity (Step 2B), which are combined in a risk matrix (Step 2C), to determine an overall unmitigated risk of dust impacts.

3.5.3 Step 2A – Dust emission magnitude

Dust emission magnitudes are estimated according to the scale of works being undertaken and are classified as either Small, Medium or Large. The IAQM guidance provides examples of demolition, earthworks, construction and track-out to aid classification, which have been reproduced in **Table 3-2** below.

Table 3-2 Examples of Small, Medium and Large demolition and construction activities

Activity		Small	Medium	Large
Demolition	Total building volume (cubic metres (m^3))	<20,000	20,000–50,000	>50,000
Earthworks	Total site area (square metres (m^2))	<2,500	2,500–10,000	>10,000
	Number of heavy earth moving vehicles active at one time	<5	5-10	>10
	Total material moved (tonnes)	<20,000	20,000–100,000	>100,000
Construction	Total building volume (m^3)	<25,000	25,000–100,000	>100,000
Track-out	Number of heavy vehicle movements per day	<10	10-50	>50

3.5.4 Step 2B – Sensitivity of surrounding area

The "sensitivity" component of the risk assessment is determined by defining the surrounding area's sensitivity to dust soiling, human health effects and ecological impacts. This is described further below.

Sensitivity of the area to dust soiling and human health effects

The IAQM methodology classifies the sensitivity of an area to dust soiling and human health impacts due to particulate matter effects as high, medium, or low. The classification is determined by a matrix for both dust soiling and human health impacts (refer **Table 3-3** and **Table 3-4** respectively). Factors used in the matrix tables to determine the sensitivity of an area are as follows:

- receptor sensitivity (for individual receptors in the area):
  - high sensitivity: locations where members of the public are likely to be exposed for eight hours or more in a day. (e.g. private residences, hospitals, schools, or aged care homes);
  - medium sensitivity: places of work where exposure is likely to be eight hours or more in a day;
  - low sensitivity: locations where exposure is transient, around one or two hours maximum. (e.g. parks, footpaths, shopping streets, playing fields);
- number of receptors of each sensitivity type in the area;
- distance from source; and
- annual mean PM_{10} concentration (only applicable to the human health impact matrix).

Table 3-3 Surrounding area sensitivity to dust soiling effects on people and property

Receptor sensitivity	Number of receptors	Distance from the source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

The IAQM guidance provides human health sensitivities for a range of annual average PM_{10} concentrations (i.e. >32, 28-32, 24-28 and <24 micrograms per cubic metre (μg/m³)). It is noted in the IAQM guidance that the human health sensitivities are tied to criteria from different jurisdictions (UK and Scotland). The annual average PM_{10} criteria for Australia differ from that used in the UK and Scotland, and as such concentrations corresponding to the risk categories need to be modified to match Australian conditions. The NSW EPA annual average criterion for PM_{10} based is 25 μg /m³ and therefore the scaled criteria for NSW is:

- >25 μg/m³;
- 22-25 μg/m³;
- 19-22 μg/m³; and
- <19 μg/m³.

A comprehensive record of PM_{10} concentrations within the recent past was not available; however based on the location of the study area within a regional coastal area with low levels of development, low PM_{10} background concentrations would be expected. Based on a 24 hours data source from a monitoring station in Merimbula in March 2020 installed to monitor particulates during the 2019-2020 bushfire season, particulate concentrations are around 19 μg/m³ (refer **Section 4.3.1**). Due to absences in available local monitoring data background PM_{10} concentrations in the region surrounding the Project have therefore been assumed to lie within the 19-22 μg/m³ concentration range.

Table 3-4 provides the IAQM guidance sensitivity levels for human health impacts for the ranges outlined above for the annual average PM_{10} concentrations and highlights the relevant range for Merimbula, NSW.

Table 3-4 Surrounding area sensitivity to human health impacts for annual average PM_{10} concentrations

Receptor sensitivity	Annual average PM_{10} concentration	Number of receptors	Distance from the source (m)				
			<20	<50	<100	<200	<350
High	>25 µg/m³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	22-25 µg/m³	>100	High	High	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	19-22 µg/m³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<19 µg/m³	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>25 µg/m³	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	22-25 µg/m³	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	19-22 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<19 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	≥1	Low	Low	Low	Low	Low

Sensitivity of area to ecological impacts

Ecological impacts from construction activities may occur due to deposition of dust on areas of ecological value. The sensitivity of ecological receptors can be defined by the following:

- High sensitivity ecological receptors:
  - locations with international or national designation and the designation features may be affected by dust soiling; and
  - locations where there is a community of particularly dust sensitive species.
- Medium sensitivity ecological receptors:
  - locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; and
  - locations within a national designation where the features may be affected by dust deposition.
- Low sensitivity ecological receptors:
  - locations with a local designation where the features may be affected by dust deposition.

The sensitivity of an ecological area to impacts is assessed using the criteria listed in **Table 3-5**.

Table 3-5 Surrounding area sensitivity to ecological impacts

Receptor sensitivity	Distance from source (m)	
	<20	20–50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

It should be noted that this is not a quantitative ecological assessment and risks discussed in this context need to be understood in terms of the IAQM guidance. For a particular group of ecological receptors, a risk rating indicates the risk that that an ecologically sensitive area may experience unmitigated dust concentrations, with the associated potential ecological impacts, as outlined above.

3.5.5 Step 2C – Unmitigated risks of impacts

The dust emission magnitudes determined in Step 2A (**Section 3.5.3**) are combined with the sensitivities determined in Step 2B (**Section 3.5.4**) to determine the risk of impacts with no mitigation applied. **Table 3-6**, reproduced from the IAQM guidance, provides the risk of dust impacts from demolition, earthworks, construction and track-out for each scale of activity.

Table 3-6 Risk of dust emissions

Activity	Surrounding area sensitivity	Dust emission magnitude		
		Large	Medium	Small
Demolition	High	High	Medium	Medium
	Medium	High	Medium	Low
	Low	Medium	Low	Negligible
Earthworks	High	High	Medium	Low
	Medium	Medium	Medium	Low
	Low	Low	Low	Negligible
Construction	High	High	Medium	Low
	Medium	Medium	Medium	Low
	Low	Low	Low	Negligible
Track-out	High	High	Medium	Low
	Medium	Medium	Low	Negligible
	Low	Low	Low	Negligible

3.5.6 Step 3 – Management strategies

The outcome of Step 2C is used to determine the level of management that is required to ensure that dust impacts on surrounding sensitive receptors are maintained at an acceptable level. A high or medium-level risk rating means that suitable management measures must be implemented during the project.

3.5.7 Step 4 – Reassessment

The final step of the IAQM methodology is to determine whether there are significant residual impacts, post mitigation, arising from a Project. The guidance states:

For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be "not significant".

Based on this expectation, as well as experience in Australia, it can be demonstrated that construction activities with targeted mitigation measures can achieve high degrees of dust mitigation which significantly minimise dust impacts to a negligible level.

3.6 Construction vehicle emissions

A qualitative assessment of vehicle emissions from construction works due to the combustion of diesel fuels by heavy vehicles and mobile construction equipment associated with the Project are provided in **Section 5.3**. Assessment of dust impacts associated with track-out has also been assessed in accordance with the IAQM methodology described above.

3.7 Operation assessment methodology

3.7.1 Overview

The air dispersion modelling conducted for this assessment was undertaken using the CALPUFF modelling suite with prognostic meteorological data derived from The Air Pollution Model (TAPM). The data available for this Project and a discussion of the methodologies required to implement CALPUFF are discussed in the following sections.

The flow diagram outlined in **Figure 3-3** shows the general data flow for the different programs used and the input data required for the dispersion model.

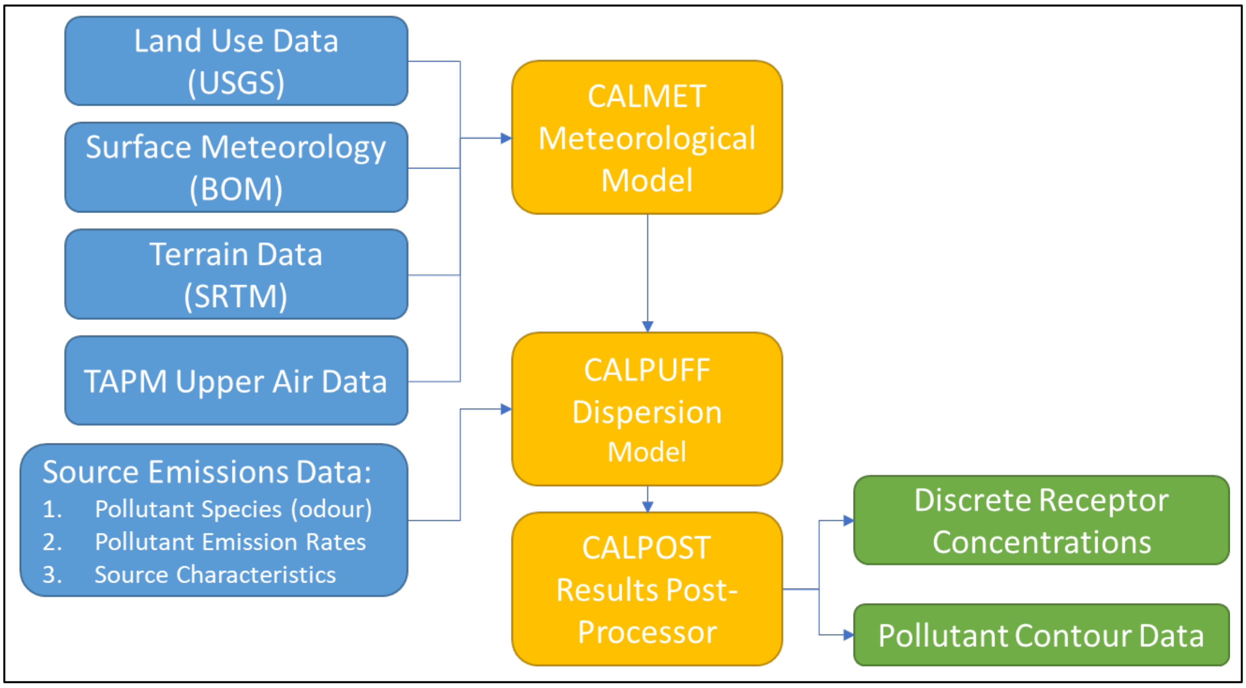

Figure 3-3 Site model program and input flow chart

3.7.2 Modelled scenarios

Two scenarios have been modelled to assess the potential odour impacts from the Merimbula STP. The two scenarios were based around the predicted odour emissions from the existing plant configuration, and the predicted odour emissions from the proposed plant configuration (the Project). For each scenario, two emission rate scenarios (maximum emission rates and realistic worst case) were modelled, which are described further in **Section 3.7.6**.

A description of each modelled scenario is presented in **Table 3-7**.

Table 3-7 Modelled scenarios

Scenario ID	Scenario name	Description
Scenario 1a	**Existing Operations** (Maximum Emission Rates) (MER)	• operation of existing STP operations • odour emission rates based on maximum emission rates and provides a very conservative estimate of operations; which is likely to be representative of upset conditions.
Scenario 1b	**Existing Operations** (Realistic Worst Case) (RWC)	• operation of existing STP operations • odour emission rates based on 75th percentile emission rates and represents an outcome that can be reasonably projected to occur based on day to day operations.
Scenario 2a	**Proposed Operations** (Maximum Emission Rates) (MER)	• operation of proposed STP operations including: - removal of effluent storage pond and exfiltration pond emissions; and - inclusion of storage tank and chlorine contact tank emissions. • odour emission rates based on maximum emission rates and provides a very conservative estimate of operations; which is likely to be representative of upset conditions.
Scenario 2b	**Proposed Operations** (Realistic Worst Case) (RWC)	• operation of proposed STP operations including: - removal of effluent storage pond and exfiltration pond emissions; and - inclusion of storage tank and chlorine contact tank emissions. • odour emission rates based on 75th percentile emission rates and represents an outcome that can be reasonably projected to occur based on day to day operations.

3.7.3 Key model input parameters

A summary of the data and parameters used as inputs to TAPM, CALMET and CALPUFF are shown in **Table 3-8**. The CALMET and CALPUFF settings have been chosen in accordance with the following documents:

- *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (Barclay & Scire 2011); and
- *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA 2017).

Table 3-8 Summary of model input parameters

Parameter	Input
TAPM	
Horizontal resolution	41 x 41 grid points; outer grid spacing 30,000 m x 30,000 m with an inner grid spacing of 1,000 m.
Grid centre coordinates (mX, mY)	757600, 5910466
Vertical levels	25
Land use data	Default TAPM database
Simulation length	31 December 2016 to 1 January 2018
CALMET (v6.42)	
Meteorological grid domain	10 km x 10 km
Meteorological grid resolution	100 metre resolution (100 x 100 grid cells)
Reference grid coordinate (centre)	757900 E, 5910300 S
Cell face heights in vertical grid	0, 20, 40, 80, 160, 320, 640, 1200, 2000,3000 and 4000m
Simulation length	1 year (2017)
Surface meteorological stations	Merimbula Airport (BoM) 2017
Upper air meteorological station	Pseudo Upper Air stations (4) generated from TAPM prognostic data.
Terrain and land use data	Terrain elevations were extracted from the NASA Shuttle Radar Topography Mission Version 3 data set (SRTM1 30 metre resolution). Land use data taken from GLCC Australia Pacific (~1 km resolution)
TERRAD (Terrain radius of influence)	10 km
RMAX1 (Radius of influence of meteorological stations: surface)	5 km
RMAX2 (Radius of influence of meteorological stations: aloft)	10 km
R1 (Observation weighting: surface)	5.0 km
R2 (Observation weighting: aloft)	10.0 km
IEXTRP (Vertical extrapolation of surface wind observation)	- 4 (extrapolate using similarity theory, exclude upper air observations from layer 1)
BIAS (NZ) (Layer dependent weighting factor for initial guess field)	-1.0,- 0.7, -0.5, -0.2, 0.0, 0.0,0.0, 0.0, 0.0, 0.0
CALPUFF (v7.2.1)	
Computational grid	10 km x 10 km approximately centred on the site
Sampling grid	6 km x 6 km Sampling grid approximately centred on the site. Grid spacing 100 m
Nested grid	1 km x 1 km nested grid approximately centred on the site. Grid spacing 50m
Receptors	Discrete Receptors: 16 modelled as sensitive receptors
Dispersion option	Dispersion coefficient. Use turbulence computed from micrometeorology
Meteorological modelling period	1 January 2017 to 31 December 2017

The CALMET settings have been selected in accordance with Barclay & Scire (2011). A review of the prepared CALMET meteorological data using the above settings, as provided in **Annexure A**, shows a strong correlation between measured surface patterns and predicted data. It is therefore concluded that the meteorological data used in the assessment is fit for purpose.

3.7.4 Dispersion meteorology input to model

The meteorological data is used by the CALPUFF model in different ways to estimate the dispersion of air pollutants:

- ambient temperature is used to incorporate thermal buoyancy effects when calculating the rise and dispersion of pollutant plumes;
- wind direction determines the direction in which pollutants will be carried;
- wind speed influences the dilution and entrainment of the plume into the air continuum;
- atmospheric stability class is a measure of atmospheric turbulence and the dispersive properties of the atmosphere. Most dispersion models utilise six stability classes, ranging from A (very unstable) to F (stable/very stable); and
- vertical mixing height is the height at which vertical mixing occurs in the atmosphere.

The CALMET meteorological model has been used to generate meteorological data for the Merimbula STP site for the year 2017. Prognostic meteorological data were generated using TAPM across a 40 km x 40 km grid with a 1 km grid spacing centred close to the Merimbula Project area. TAPM data was used to generate pseudo-upper air station data which were then used along with surface observation station data from the Bureau of Meteorology monitoring station data at Merimbula Airport (Station ID 069147), as input into the CALMET meteorological module to compute the wind fields required by CALPUFF. The meteorological modelling domain for CALMET covered an area of 10km by 10 km centred on the Merimbula STP.

Further analysis of CALMET data at Merimbula STP is provided in **Annexure A** including wind roses for time of day. As outlined in **Annexure A**, the CALMET 2017 meteorological data set for Merimbula STP shows good correlation with the 2017 meteorological data for the BoM Merimbula AWS data and is considered appropriate for use in CALPUFF. More detailed information comparing the CALMET 2017 meteorological data with data collected from BoM observational data at Merimbula Airport is also provided in **Annexure A**.

3.7.5 Terrain input to model

Digital terrain data used to generate the upper air prognostic meteorological data were obtained from the TAPM 9 second DEM database covering an area of 30 km by 30 km on a 1 km grid, roughly centred on the STP site.

For the CALMET model, a geophysical processor was used to convert land use and terrain data from the Lakes Environmental WebGIS, which utilises SRTM1 data for terrain at approximately a 30 m resolution and GLCC Australia Pacific at a 1 km resolution across the meteorological domain.

3.7.6 Emissions rates estimation

Odour emissions were estimated using a comprehensive odour sampling and monitoring database for the Sydney Water wastewater network; which covers the Sydney, the Illawarra and Blue Mountain regions. Similar odour sources to those identified in **Section 2.4.2** were identified within the database to estimate the Specify Odour Emission Rates (SOER) and/or total odour emission rates (TOER) required for each source. Other source parameters including area and tank dimensions were determined from site plans and satellite imagery.

The odour database used to obtain emission rates includes a wide variety of STPs including both large and small operations as well as data points from individual sources in various states of repair. To provide a more realistic assessment of odour impacts from the existing and proposed plant, two sets of emissions data have been considered. These two data sets include the following:

- **Maximum Emission Rates from the data base for each source**: this option included data that was more likely representative of upset conditions given the analysis of the data i.e. small number of outlier data points suggesting unusual operating conditions. This was observed to be the case for larger contributing odour sources such as sludge lagoons and aeration tanks.
- **75th Percentile Emission Rates from the data base for each source**: This option provides a more realistic estimate of day to day operations from the Merimbula STP while still maintaining a level of conservatism. This was achieved by selecting a percentile which omitted the small number of data outliers in each data set while still including elevated conditions more likely representative of normal operational odour ranges.

As discussed in **Section 4.3.2**, no odour complaints relating to the operation of the existing STP were received by BVSC, indicating that the existing operations at the STP are generally performing well with regards to odour emissions.

Source parameters and emission rates for area sources are presented in **Table 3-9**. All sources have been modelled as nearfield area sources with a peak-to-mean ratio of 2.5 for Pasquil-Gifford (PG) stability classes A, B, C and D and a peak-to-mean ratio of 2.3 for stability classes E and F in accordance with the NSW EPA 2017 *Approved Methods*.

Emission rates for similar emission sources within the odour data base have been assigned where possible. Catch pond emission rates were assumed to have a similar odour emission rate to the STP maturation pond, and the exfiltration ponds emission rates were assumed to be similar to odour emission rates from the wet weather overflow pond. All foul air from the inlet works was assumed to be treated by the odour control unit; with all odour emissions coming from the deodorising bed adjacent to the inlet works. Emissions from the effluent storage pond and exfiltration ponds were modelled for the existing scenario only, as these sources would no longer be active under the proposed scenario.

Source parameters and emission rates for the two proposed volume sources are presented in **Table 3-10.** Both the proposed storage tank and chlorine contact tank are assumed to enclosed. For the purpose of this assessment it is assumed the storage and chorine contact tanks have a capture rate of 99 percent.

Both sources in **Table 3-10** have been modelled as nearfield volume sources with a peak-to-mean ratio of 2.3 for all Pasquil-Gifford (PG) stability classes in accordance with the NSW EPA 2017 *Approved Methods*.

Modelled area and volume source locations and coordinates are provided in **Annexure B**. Percentage source contributions for each modelled scenario are also provided in **Annexure B**.

Table 3-9 Maximum and 75th Percentile specific odour emission rates and source parameters for area sources

Source ID	Source description	Area (m)	Base elevation (MSL)	Initial sigma Z	Maximum SOER (OU/m²)			75%ile SOER (OU/m²)		
					Raw SOER	Peak-to-Mean SOER		Raw SOER	Peak-to-Mean SOER	
						ABCD	EF		ABCD	EF
DB	Deodorising bed	112	96	1.0	0.181	0.452	0.416	0.171	0.427	0.393
IDEA1	IDEA tank 1	1943	1820	1.0	1.188	2.971	2.733	0.397	0.993	0.913
IDEA2	IDEA tank 2	1769	1769	1.0	1.188	2.971	2.733	0.397	0.993	0.913
CP	Catch pond	2144	2144	1.0	0.202	0.506	0.465	0.185	0.463	0.426
WWOP	Wet weather overflow pond	9244	9244	1.0	0.040	0.099	0.091	0.031	0.077	0.071
DB1	Drying bed 1	1176	1176	1.0	0.170	0.425	0.391	0.118	0.295	0.271
DB2	Drying bed 2	1066	1066	1.0	0.170	0.425	0.391	0.118	0.295	0.271
SL1	Sludge lagoon 1	1728	1638	1.0	1.727	4.317	3.972	0.551	1.378	1.268
SL2	Sludge lagoon 2	1728	1638	1.0	1.727	4.317	3.972	0.551	1.378	1.268
SL3	Sludge lagoon 3	1728	1638	1.0	1.727	4.317	3.972	0.551	1.378	1.268
MP	Effluent storage pond	10956	10824	1.0	0.202	0.506	0.465	0.185	0.463	0.426
EFP1	Exfiltration pond 1	3935	3935	1.0	0.040	0.099	0.091	0.031	0.077	0.071
EFP2	Exfiltration pond 2	3537	3537	1.0	0.040	0.099	0.091	0.031	0.077	0.071

Table 3-10 Maximum and 75th Percentile Total Odour Emission Rates and Source Parameters for Volume Sources

Source ID	Source description	Tank diameter (m)	Tank height (m)	Base elevation (m)	Initial sigma Z	Initial sigma Y	Capture rate (%)	Maximum TOER (OU)		75%ile TOER (OU)	
								Raw TOER	Peak-to Mean TOER	Raw TOER	Peak-to Mean TOER
ST	Storage tank	18	10	9.54	2.3	2.2	99	5.26	12	4.81	11
CT	Chlorine treatment	15	6.5	5.55	1.5	1.3	99	5.70	13	5.05	12

3.7.7 Limitations of model

The atmosphere is a complex, physical system, and the movement of air in a given location is dependent on a number of different variables, including temperature, topography and land use, as well as larger-scale synoptic processes. Dispersion modelling is a method of simulating the movement of air pollutants in the atmosphere using mathematical equations. The model equations necessarily involve some level of simplification of these very complex processes based on our understanding of the processes involved and their interactions, available input data, and processing time and data storage limitations.

These simplifications come at the expense of accuracy, which particularly affects model predictions during certain meteorological conditions and source emission types. For example, the prediction of pollutant dispersion under low wind speed conditions (typically defined as those wind speeds less than 1 m/s) or for low-level, non-buoyant sources, is problematic for most dispersion models. To accommodate these known deficiencies, the model outputs tend to provide conservative estimates of pollutant concentrations at particular locations.

While the models contain a large number of variables that can be modified to increase the accuracy of the predictions under any given circumstances, the constraints of model use in a commercial setting, as well as the lack of data against which to compare the results in most instances, typically precludes extensive testing of the impacts of modification of these variables. With this in mind, model developers typically specify a range of default values for model variables that are applicable under most modelling circumstances. These default values are recommended for use unless there is sufficient evidence to support their modification.

As a result, the findings of dispersion modelling provide an indication of the likely level of pollutants within the modelling domain. While the models, when used appropriately and with high quality input data, can provide very good indications of the scale of pollutant concentrations and the likely locations of the maximum concentrations occurring, their outputs should not be considered to be representative of exact pollutant concentrations at any given location or point in time. As stated above, however, the model predictions are typically conservative, and tend to over predict maximum pollutant concentrations at receiver locations.

This assessment was undertaken with the data available at the time of the assessment. Should changes to the Project be made, further assessment may be required to determine if the findings of this assessment are still applicable.

4.0 Existing environment

4.1 Meteorology

Meteorology in the area surrounding the site is affected by several factors such as terrain and land use. Wind speed and direction are affected by topography and land use at the local scale (typically on a scale of a few meters to 150 km), while synoptic scale winds affect wind speed and direction on a much larger scale (commonly at distances of over 500 km to1,000 km). Wind speed and direction are important variables in assessing potential air quality impacts, as they dictate the direction and distance air pollutant plumes travel.

The Bureau of Meteorology (BoM) operates a broad meteorological monitoring network throughout Australia. The nearest meteorological station to the site is the Merimbula Airport Automatic Weather Station (AWS) (Station ID 069147) located approximately 1.1 km north northeast of the STP. Given the proximity of the station to the STP and surrounding flat terrain; meteorological data from the Merimbula Airport AWS is considered representative of meteorological conditions within the Project area.

Annual and seasonal wind roses for the Merimbula area are presented in **Figure 4-1**. The wind roses show that on an annual basis the dominant wind direction is from the southwest; occurring for approximately 11.4 per cent of the time. The annual average wind speed was found to be 2.6 m per second. Calm wind conditions (which are defined as conditions with wind speeds <0.5 m/s) were found to occur almost 20 percent of the time in 2017. Calm conditions are relevant in this situation as they generally result in poorer dispersion of air pollutants and generally result in nearfield odour impacts.

Seasonally in 2017, the highest average wind speeds were observed during spring months (3.0 m/s) and the lowest average wind speeds occurred in autumn (2.3 m/s). During autumn, the dominant wind direction, is from the southwest with the wind rose shape similar to the annual wind rose. In spring and summer, northeast winds were more common and during winter months a higher proportion of westerly and north westerly winds were observed. A high frequency of calm conditions occur throughout the year with Autumn having the highest proportion of calms occurring over 26 percent of the time.

Data from BoM AWS at Merimbula Airport for 2017 has been used in the meteorological model CALMET as described in **Section 3.7**.

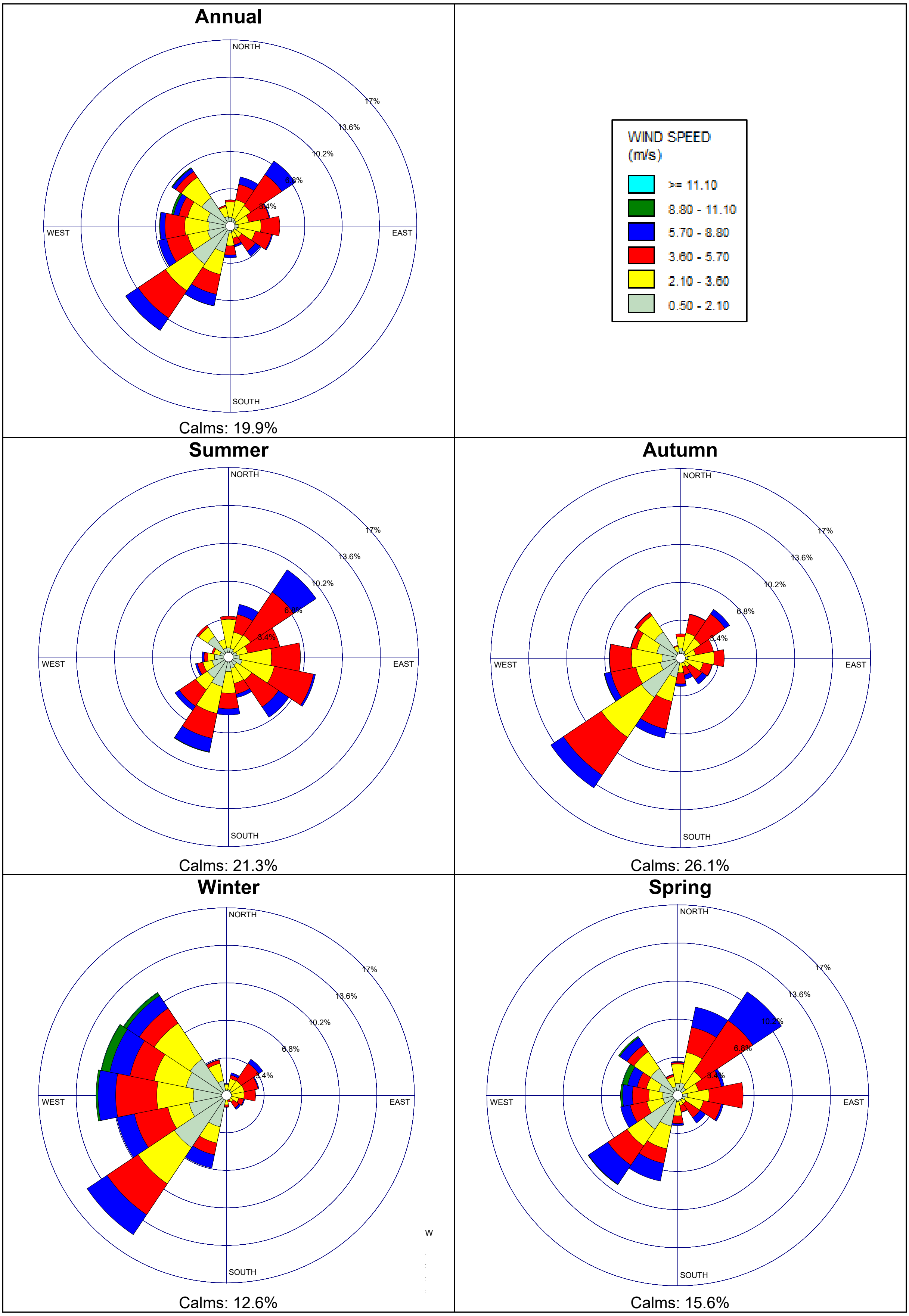

Figure 4-1 Annual and seasonal wind roses CALMET 2017 data at Merimbula

4.2 Climate

The BoM meteorological station at Merimbula Airport records climate data for a range of meteorological parameters for the local area including, temperature, humidity, rainfall, wind speed and wind direction. A summary of the long-term data recorded at this station between 1998 and 2019 is shown in **Table 4-1**. The data provides an indication of the regional climatic conditions throughout the year at Merimbula.

Table 4-1 Climate summary, BOM Monitoring Station at Merimbula Airport AWS, 1998 to 2019

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean maximum temperature (Degrees Celsius (°C))	24.9	24.8	23.7	21.7	19.2	16.9	16.6	17.4	19.4	20.7	21.7	23.3
Mean minimum temperature (°C)	15.5	15.2	13.7	11.0	7.6	5.7	4.1	4.7	6.8	9.0	11.8	13.8
Mean rainfall (millimetres (mm))	61.9	84.1	77.7	64.0	49.2	76.6	45.1	45.1	43.9	53.5	82.0	62.4
Decile 5 (median) rainfall (mm)	44.6	60.0	47.9	46.8	31.2	49.0	27.0	32.0	21.2	52.0	73.8	49.7
Mean number of days of rain ≥ 1 mm	6.7	6.0	6.1	5.5	4.0	5.9	4.0	4.7	5.8	7.2	7.9	6.9
Mean 9am temperature (°C)	20.4	19.9	17.9	17.1	13.6	10.7	10.1	11.7	14.8	16.5	17.6	19.3
Mean 9am relative humidity (%)	70	73	76	70	74	78	76	69	63	62	68	65
Mean 9am wind speed (km/h)	10.0	8.1	6.7	7.8	7.6	7.8	7.8	8.6	9.7	11.2	11.1	11.6
Mean 3pm temperature (°C)	22.8	22.9	22.0	19.9	17.4	15.4	14.9	15.7	17.2	17.9	19.4	21.2
Mean 3pm relative humidity (%)	65	64	62	61	60	60	58	55	58	61	65	63
Mean 3pm wind speed (km/h)	20.1	19.1	17.6	15.1	13.6	12.4	13.6	16.1	18.3	18.9	19.4	19.6

As shown in **Table 4-1**, the warmest temperatures occur during the summer months, with the highest average maximum temperature (24.9°C) occurring in January. July is the coldest month, with a recorded average minimum temperature of 4.1°C. February is the wettest month, with an average rainfall of 84 millimetres, while September is the driest month with an average rainfall of 44 millimetres. Humidity follows a diurnal cycle, with higher humidity in the morning compared to the afternoon. Wind speeds are higher in the afternoon compared to the morning, with the highest average wind speeds occurring in January (20.1 km/h).

Meteorological data for Merimbula Airport AWS along with prognostic data has been used to define the meteorology for the assessment. **Section 3.7.4** outlines the data used for the development of the dispersion modelling meteorological data set.

4.3 Existing air quality

4.3.1 Air pollutants

The NSW Environment, Energy and Science (EES) Group, under the Department of Planning Industry and Environment operates a broad air quality monitoring network throughout NSW. There are no EES air quality monitoring stations within the Bega Valley Shire local government area (LGA). Despite the lack of an EES monitoring station, BVSC is required to prepare a comprehensive State of Environment Report (SoER) every four years which assesses the progress towards achieving the community's environmental objectives. The most recent report covers the period between July 2012 and June 2016 and provides a discussion on regional air quality.

The Bega Valley Shire SoER (Bega Valley Shire Council, 2016) states that regional air quality within the Bega Valley Shire LGA is generally good. The region has very little heavy industries and the primary source of air emissions is generally from wood smoke from wood heaters during the winter months and vegetation burning. Sources of vegetation burning are from both private land holders as well as back burning activities from the Rural Fire Service and National Parks and Wildlife Service. The main sources of air pollutants from wood smoke are particulates, carbon monoxide, nitrogen oxides and volatile organic compounds (VOCs).

Despite no long-term monitoring data available in Merimbula from EES, emergency monitoring of PM_{10} and $PM_{2.5}$ concentrations occurred during the bushfires in Merimbula in late 2019 and early 2020. The monitoring station was still operational in March 2020 after the fires had been extinguished. A snapshot of particulate concentrations at Merimbula has been examined for 1 March 2020, which represented a time period after the bushfires (which would have resulted in an unrealistically elevated background concentrations) and prior to public lockdown restrictions associated with the COVID-19 pandemic (which occurred in late March 2020), and are also likely to have resulted in below average ambient particulate concentrations due to a reduction in activities such as vehicle movements and associated emissions.

On 1 March 2020 the 24-hour average concentration for $PM_{2.5}$ and PM_{10} was found to be 4.3 and 19.8 $\mu g/m^3$ respectively. This is below the 24 hour maximum and annual average criteria for $PM_{2.5}$ and PM_{10} (DPIE, 2020). While 24 hours of data does not account for natural and seasonal variability generally observed within a 12-month dataset, these concentrations are likely to be fairly typical of annual average concentrations observed within a rural coastal area with limited sources or air pollution within the regional airshed.

4.3.2 Odour

Odour impact assessments differ from other air pollutants in that odour concentrations at sensitive receptors are rarely cumulative. Different odour sources typically have different odour characteristics which can mask or add to the odours from a source. As such, odour impacts from a source of interest (i.e. the Project in this case) are usually considered in isolation.

The land use surrounding the STP contains both mangrove and salt marsh communities which due to sediments beneath the mangrove canopies can release a sulphidic odour when sediments are disturbed (due to the high level of organic content within the sediments).

Odour concentrations from the existing STP are discussed in **Section 6.0**. BVSC has advised there have been no odour complaints logged with BVSC relating to the operation of the existing STP.

4.4 Terrain

Figure 4-2 shows a representation of the local terrain of the Project area and surrounds. Terrain data were captured from NASA's Shuttle Radar Topography Mission (SRTM), which produces terrain information for the entire globe. For Australia, terrain data are available at approximately 30 m resolution (1-arc second). SRTM terrain data in **Figure 4-2** shows terrain height varies within the study area between 247 m and 0 m above Mean Sea Level (MSL). The Merimbula STP site lies in a low-lying area just off the coastline to the east approximately 1 to 10 m above sea level, with higher elevations to the west.

Given the nature of the terrain around the STP, topography is not expected to heavily influence the dispersion patterns.

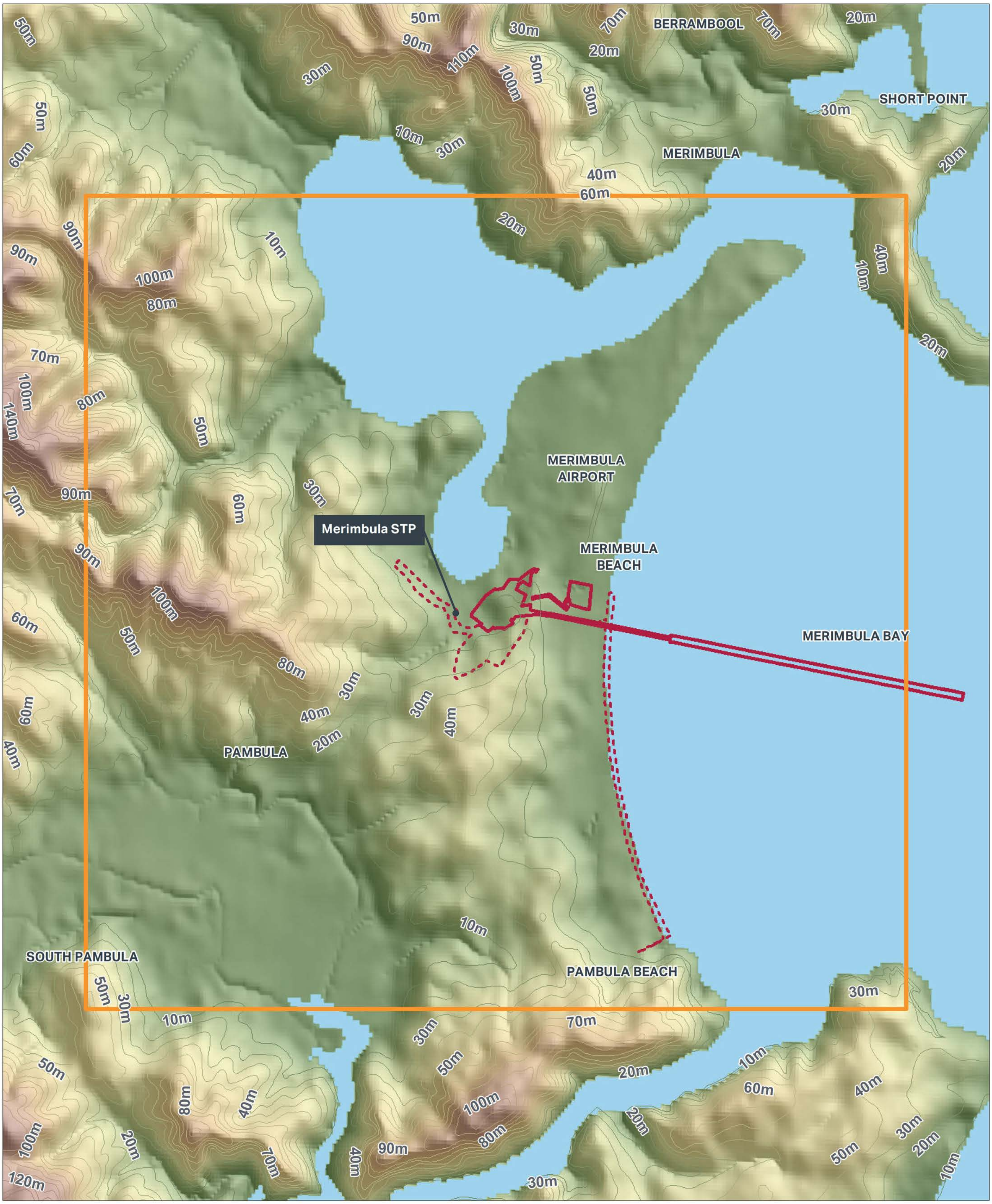

FIGURE 4-2: TERRAIN SURROUNDING THE PROJECT AREA

Legend

- Project area
- Project area (temporary construction area)
- Study Area

Terrain (SRTM)
High
Low

Source: Department of Customer Service, 2020;

4.5 Land use and sensitive receptors

4.5.1 Existing land use and sensitive receptors

The Merimbula STP in located off Arthur Kaine Drive and is bound by the Merimbula Airport to the north and PMGC grounds to the east, south and west. The plant is situated approximately 2.5 km south of the Merimbula Township and 1.5 km north east of Pambula Village.

There are several residential and commercial properties located to the southeast of the STP on Arthur Kaine Drive, including a restaurant and motor inn. The remaining land use between properties on Arthur Kaine Drive and Merimbula and Jiguma Beaches is characterised as predominantly natural vegetation and includes endangered Bangalay Sand Forest; a community of over 50 endemic species including Eucalypt, Banksia, Dianella and Dichondra.

Areas proposed to be used during construction of the Project also include a large strip of land extending from Pambula Beach to Merimbula Beach. With the exception of residential and commercial properties situated in Pambula, the land use adjacent to the western boundary of the Project area is primarily native vegetation.

A total of 16 discrete receptors have been included in the model as discussed in **Section 0** and are considered representative of nearby sensitive receptor locations. Sensitive receptors are shown in **Figure 4-3**.

FIGURE 4-3: LOCATION OF MODELLED DISCRETE RECEPTORS

N 0 200 400 m

AECOM

Legend

- Project area
- Project area (temporary construction area)
- Modelled discrete receptors

In addition to the discrete receptors shown above in **Figure 4-3**, gridded receptors at 50 m intervals have been used to enable the prediction of ground level odour concentrations over a 6 km by 6 km area centred on the STP**.** The location of the sampling grid is shown in **Figure 4-4**.

FIGURE 4-4: SAMPLING GRID LOCATION

AECOM

Legend

- Project area
- Project area (temporary construction area)
- Study Area
- Gridded Receptors

Source: Department of Customer Service, 2020; Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

4.5.2 Future surrounding development

Merimbula Airport is located immediately to the north of Merimbula STP. The *Merimbula Airport Masterplan 2033 For Bega Valley Shire Council* (Rehbein Airport Consulting, 2013) was prepared to establish the Framework for the future planning and development of Merimbula Airport. The Masterplan is currently under review by BVSC and is expected to include a consultative phase once changes to the exiting adopted masterplan have been made.

While the Masterplan is currently being revised the existing document has been used in this assessment as an indicative guide to the location of potential future sensitive receptors. The Merimbula Airport Masterplan outlines future projects (Stage 2) to occur between 2023 and 2033; which include development of a new passenger terminal precinct to the south of the existing terminal and a new commercial precinct. The current proposed location of the new commercial development precinct would be adjacent to the north eastern boundary of the STP as shown in **Figure 4-5**. Future commercial receptors within the commercial development and passenger precinct may be considered as sensitive receptors. As development plans for future airport precincts are currently at a preliminary stage, no discrete sensitive receptors have been added to the model at this location; however potential cumulative odour impacts based on the precincts outlined in **Figure 4-5** are discussed in **Section 7.0**. based on the 99th percentile odour concentration contour plots (estimated from gridded receptors).

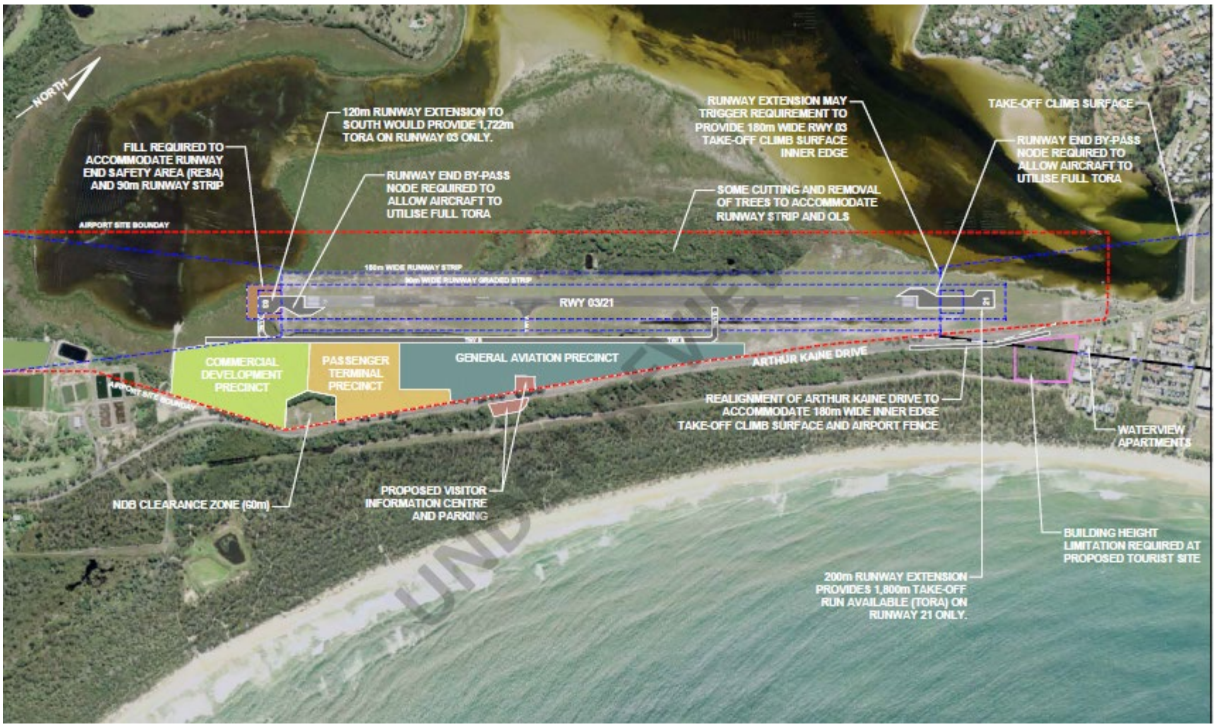

Figure 4-5 Existing Merimbula Airport Masterplan (Rehbein, 2014)

5.0 Construction impact assessment

5.1 Odour impacts

Potential odour impacts from the site during construction would be temporary in nature. Potential sources of odour would include both the decommissioning of existing wastewater infrastructure and the potential disturbance of ASS.

Construction of the Project is expected to take up to 24 months. During this time intermittent odour impacts may occur due to construction work, including the decommissioning of the 17 megalitre (ML) effluent storage pond and beach-face outfall pipeline, and cessation of use of the exfiltration ponds. While there is the potential for some minor odour impacts to occur, the removal of the effluent storage pond, cessation of use of the dunal exfiltration ponds and the replacement of the beach-face outfall with an ocean outfall would result in an overall reduction of odour concentrations from the STP once operational (as discussed in **Section 6.0**).

There is also the potential for odour impacts during excavation works which may encounter ASS, which naturally occur in soils and sediments that contain iron sulphides. When exposed to air the iron sulphides in the soil react with oxygen and water to produce a variety of iron compounds and sulphuric acid; which are generally odorous. The majority of the study area does not contain mapped ASS; however as identified in **Chapter 13 Landform Geology and Soils** of the EIS(AECOM, 2020) and shown in **Figure 5-1**, there is the potential to encounter ASS soils during directional drilling of the proposed ocean outfall pipeline. No ground disturbing works are currently proposed at the PMGC laydown area or at the location of the exfiltration ponds.

FIGURE 5-1: ACID SULFATE SOIL CLASS MAPPED IN THE PROJECT AREA AND SURROUNDS

Legend

- Project area
- Project area (temporary construction area)

Acid Sulfate Soils Class

- Class 1
- Class 2
- Class 3
- Class 4

Source: Department of Customer Service, 2020; Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

Good management of potential ASS would not only prevent the generation of sulphuric acid, but also result in a reduction of any odour emissions that may be generated. Potential impacts and management measures for ASS are discussed in greater detail in **Chapter 13 Landform Geology and Soils** of the EIS. General air quality management measures are also discussed in **Section 8.0** of this report. The management measures provide that the directional drilling method captures drilling spoil/fluid, recycles it in the drilling process where possible and otherwise removes the spoil/fluid from site and disposes of it at a licensed facility. Therefore, potential odour impacts from any ASS encountered during directional drilling are expected to be localised and minor.

5.2 Dust impacts

As mentioned above construction of the proposed STP upgrade and ocean outfall is anticipated to take up to 24 months. Potential dust impacts during the construction period have been determined based on the IAQM construction dust assessment guidance documentation discussed in **Section 3.5** and the expected scale of the construction activities outlined in the EIS in **Chapter 2 Project description.**

The magnitude of the unmitigated emissions from the construction footprint activities are rated as small for both demolition and track out works, as no demolition works are proposed as part of the Project, and there would be a limited heavy vehicle construction vehicle fleet. The magnitude of the unmitigated emissions from both earthworks and construction were rated medium due to the expected extent of construction activities detailed in in the EIS in **Chapter 2 Project description**.

The sensitivities for the different construction activities are provided in **Table 5-1**. As described in **Section 4.5**, the Merimbula STP is bound by the Merimbula Airport to the north and PMGC grounds to the east, south and west. There are several residential and commercial properties located to the southeast of the STP on Arthur Kaine Drive which included a restaurant and motor inn. The nearest sensitive receptor to the Project area is located approximately 220 m to the southeast. Given that the predominant land use surrounding the remaining Project area is predominantly natural vegetation, the sensitivity of the area for dust soiling was rated as low.

Based on the location of the study area within a regional coastal area with low levels of development; low PM_{10} background concentrations would be expected. The monitoring station in Merimbula installed in March 2020 to monitor particulates during the 2019-2020 bushfire season indicates particulate concentrations are around 19 $\mu g/m^3$ (see **Section 4.3.1**). Due to absences of available local monitoring data background PM_{10} concentrations in the region surrounding the Project have been assumed to lie within the 19-22 $\mu g/m^3$ concentration range; therefore the sensitivity to human health effects for annual average PM_{10} was rated low.

The study area and immediate surrounds are characterised by extensive areas of remnant native vegetation, with patches of urban and semi-rural development. These areas contain three threatened ecological communities in various states of condition (Ecological Australia, 2020). Given the proximity to endangered ecological communities and that the sensitivity of the ecological community is uncertain, the ecological sensitivity of the area has been rated as medium.

The potential risks for the overall construction footprint were found to be "low" to "negligible" for construction activities in relation to potential impacts relating to dust soiling and human health. The potential unmitigated ecological risks from the Project were found to range from "negligible" to "moderate".

Table 5-1 Summary of risk assessment for construction footprint

Activity	Step 2A: Potential for dust emissions	Step 2B: Sensitivity of area			Step 2C: Risk of dust impacts		
		Dust soiling	Human health	Ecological	Dust soiling	Human health	Ecological
Demolition	Small	Low	Low	Medium	Negligible	Negligible	Low
Earthworks	Medium	Low	Low	Medium	Low	Low	Medium
Construction	Medium	Low	Low	Medium	Low	Low	Medium
Track-out	Small	Low	Low	Medium	Negligible	Negligible	Negligible

The unmitigated risk rating for construction of the Project ranges from “negligible” to “medium”. Given these ratings, mitigation measures are recommended to be included in the Construction Air Quality Management Plan (CAQMP) for the Project to minimise potential dust impacts to nearby sensitive receptors. The recommended mitigation and management measures are provided in **Section 8.1**.

5.3 Vehicle emissions

The source of vehicle emissions during the Project construction phase would be from the combustion of diesel fuel by heavy vehicles, mobile construction equipment and emissions from stationary equipment such as diesel generators. Emissions are expected to depend on the nature of the emissions source i.e. size of the equipment, usage rates, duration of operation etc. Pollutants emitted by construction vehicles CO), particulate matter (PM_{10} and $PM_{2.5}$), NO_2, SO_2, VOCs, and PAHs.

Construction traffic would include approximately 5 to 10 heavy vehicles and 10 to 20 light vehicles per day. Construction vehicles are expected to access the Project area via Arthur Kane Drive to the STP and via Coraki Drive, Pambula for the construction of the outfall pipeline. Barges (and smaller vessels) from Port of Eden, Twofold Bay would also be utilised to transport materials and equipment northward to the Project area, and work along the offshore component of the outfall pipeline alignment.

With regards to sensitive receptors there are several residential and commercial properties disbursed between natural vegetation located to the southeast of the STP on Arthur Kaine Drive which includes a restaurant and motor inn. The remaining construction area, including the large strip of area extending from Pambula Beach to Merimbula Beach, is primarily native vegetation with the exception of residential and commercial properties situated in Pambula west of the Project area.

Given the typically transitory nature of construction site mobile equipment, low vehicle numbers, limited sensitive receptors in the receiving environment and the commonly applied mitigation measures expected to be incorporated into the operation of the equipment, adverse air quality impacts from the operation of construction equipment are not expected.

6.0 Operational impact assessment

Predicted ground level 99th percentile odour concentrations at sensitive receptors are provided in **Table 6-1** for all modelled scenarios described in **Section 3.7.2** using estimated odour emission rates documented in **Section 3.7.6**. Contour plots showing predicted existing and proposed 99th percentile odour concentrations are provided in **Figure 6-1** and **Figure 6-2** for maximum emission rate (MER) and realistic worst case (RWC) emission scenarios respectively.

The MER scenarios (Scenario 1a and Scenario 2a) in **Table 6-1** provide a highly conservative estimate of existing and proposed operations from the Merimbula STP and are more likely representative of upset conditions. Results of the modelling show that for the MER scenarios there is an exceedance of the 99th percentile 4OU odour criterion for both proposed and existing operations at some sensitive receptors. Specifically, the exceedances included the PMGC, the Merimbula Airport Air Navigation Facility and some commercial and residential receptors on Arthur Kaine Drive near the STP as seen in **Figure 6-1**. As no odour complaints (see **Section 4.3.2**) relating to the operation of the existing STP have been made to BVSC, it is likely that the existing performance of the STP is generally adequate with regard to odour emissions. As such predicted exceedances of ground level odour concentrations are not likely to be representative of typical operations from the plant as it is not reflective of the complaints record. A significant number of existing odour complaints would be expected based on the predicted ground level odour concentrations estimated for Scenario 1a. Further details on source contributions from the MER scenarios are provided in **Annexure B**.

Given the unrealistically high predictions from the MER scenarios, the RWC scenarios (Scenario 1b and Scenario 2b) which utilise 75th percentile emission rates as discussed in **Section 3.7.6** are considered to provide a more realistic estimate of day to day operations from the Merimbula STP while still maintaining a level of conservatism. **Table 6-1** and **Figure 6-2** show that the 99th percentile odour concentrations at all sensitive receptors are below the 4 OU criteria for both the existing and proposed operations and the 4 OU contour footprint is significantly smaller than for the RWC scenarios. When comparing the existing and proposed RWC scenarios, the Project is predicted to reduce ground level odour concentrations at all sensitive receptors. The PMGC and some nearby commercial and residential receptors along Arthur Kaine Drive are predicted to experience a reduction in 99th percentile odour concentrations by over 20% (1 OU or more). The reduction in odour concentration is likely attributed to the reduction in existing large area sources, namely the effluent storage pond and use of the exfiltration ponds.

The highest predicted 99th percentile odour concentrations for Scenario 2b were expected to occur at Receptor 6 (situated along Arthur Kaine Drive), and at the Merimbula Airport Air Navigation Facility with an estimated Odour Concertation of 2.2 OU, which is well below the 4 OU criterion. The estimated odour concertation at the PMGC adjacent to the STP was 1.5 OU. **Figure 6-2** also shows a reduction in predicted odour concentrations across the PMGC grounds when compared to the existing Scenario 1b (with the exception of the very north-eastern tip of the PMGC grounds which is under the 4 OU criterion contour). For Scenario 2b, proposed operations are also shown to reduce potential odour concentrations to the north of the STP, with predicted 99th percentile odour concentrations at the Airport of less than 3 OU.

In summary, based on the review of predicted ground level odour concentrations for the existing STP and in consideration of there being no history of odour complaints due to the STP, the RWC modelled scenarios are considered to provide a more realistic estimate of day to day operations from the Merimbula STP, while still a maintaining a level of conservatism. Based on RWC modelled scenarios there were no predicted exceedances of existing or proposed operations from the Merimbula STP. In any case, predicted odour offsite odour concentrations are expected to decrease with the Project due to the removal of existing large area odour sources; namely the effluent storage pond and exfiltration ponds. As such no significant adverse impacts are anticipated in relation to ground level odour concentrations from the Project.

Table 6-1 Predicted 99th Percentile odour concentrations

Sensitive receptor ID	Predicted 99th Percentile odour concentration (OU)				Estimated odour concentration reduction	
	Existing		Proposed			
	MER (Scenario 1a)	RWC (Scenario 1b)	MER (Scenario 2a)	RWC (Scenario 2b)	MER	RWC
R1	**4.9**	2.5	3.8	1.5	22%	41%
R2	2.4	1.3	1.8	0.7	25%	45%
R3	3.5	1.7	2.7	1.0	22%	41%
R4	**4.7**	2.2	3.7	1.4	20%	38%
R5	**6.2**	2.9	**5.1**	1.9	18%	35%
R6	**7.1**	3.2	**6.0**	2.2	16%	32%
R7	2.4	1.2	1.8	0.7	24%	43%
R8	2.1	1.1	1.5	0.6	25%	45%
R9	1.8	0.9	1.3	0.5	26%	46%
R10	1.6	0.9	1.2	0.5	27%	46%
R11	**6.8**	2.7	**6.2**	2.2	8%	18%
R12	3.6	1.5	3.3	1.2	9%	20%
R13	2.4	1.0	2.2	0.8	10%	22%
R14	3.2	1.3	2.9	1.0	10%	20%
R15	1.3	0.7	1.0	0.4	26%	45%
R16	0.6	0.3	0.5	0.2	24%	44%
NSW EPA Criterion (OU)	**4.0**	**4.0**	**4.0**	**4.0**		

Figure 6-1 Predicted 99th Percentile odour concentration contours for maximum emission rate scenarios

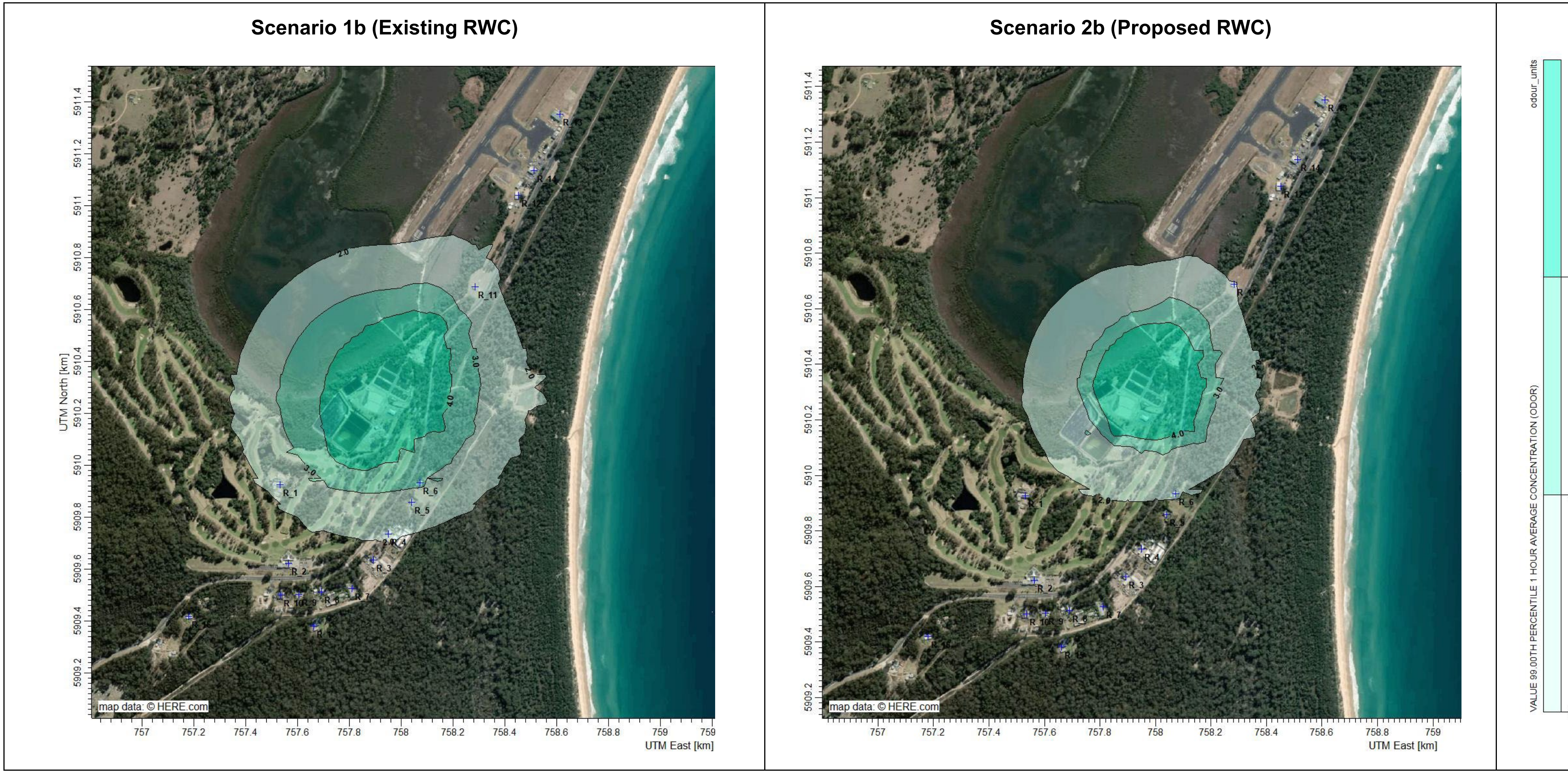

Figure 6-2 Predicted 99th Percentile odour concentration contours realistic worst-case emission scenarios

7.0 Cumulative impacts

A search of proposed developments on the DPIE and BVSC websites was conducted as part of the cumulative impact assessment undertaken for the EIS (refer **Chapter 27 Cumulative impacts**), to identify the potential for any cumulative air quality impacts to occur during construction and operation of the Project. Several projects were identified in the surrounding area, however these are not expected to contribute to cumulative impacts with the Project, either due to their location, size or timing. No potential for cumulative impacts relating to odour impacts were identified. Other proposed developments identified within the Merimbula region which have the potential to generate dust during construction include the Lake Street Shared Path (by BVSC), and Merimbula Airport Activation Precinct and Merimbula Runway Extension, which are expected to be completed prior to construction commencing for the Project. Cumulative dust impacts during construction are therefore not anticipated.

The Merimbula Airport General Aviation Precinct Project forms part of the 2014 Merimbula Airport Master Plan and is the first of three commercial development precincts. The Project area is located on the northern and western sides of the Merimbula Aircraft Maintenance section, to the north of the Merimbula Airport Passenger Terminal. The location of the General Aviation Precinct is shown in **Figure 4-5** and is within 700 m of the Merimbula STP. The first stage involves the construction of taxiways, roadways, services and building platforms for the commercial and general aviation precinct. Once complete, business and light aircraft owners will be able to lease land to park aircraft, and construct hangars and buildings for aviation-based businesses. Construction of the Project is scheduled to be completed in the first half of 2021. Operational impacts associated with the Merimbula Airport General Aviation Precinct would largely be combustion emissions from aircraft, vehicles and associated mobile equipment. As combustion emissions from the upgraded Merimbula STP during operation are likely to be like existing operations, the Project is not expected to contribute towards significant cumulative impacts in conjunction with the operation of the Merimbula Airport General Aviation Precinct.

8.0 Mitigation and management measures

8.1 Overview

This chapter describes the performance outcomes for the Project in relation to air quality, and describes the mitigation and management measures recommended to address the identified air quality impacts during construction and operation of the Project. The mitigation and management measures described would be included in a Construction Environmental Management Plan (CEMP) for the Project, and implemented during operation as relevant.

8.2 Performance outcomes

Emissions of air pollutants from construction activities can be mitigated using a range of physical or operational measures designed to minimise both the generation and transport of pollutants away from source of the emissions. In terms of dust emissions from the construction activities, the objective of any mitigation or management measure is to ensure the constructions activities meet a range of air quality performance outcomes. If the outcomes are met, it is expected that the site would achieve an acceptable level of dust generation for the construction activities and minimise adverse impacts on surrounding receptors (receptors refer to residential premises, hospitals, schools etc). The air quality performance outcomes for the construction phase of the Project are as follows:

- visible dust is managed during construction to minimise the release beyond the Project area boundaries;
- no unnecessary vehicle combustion emissions;
- no soil track-out onto public roads;
- no complaints from receptors in relation to dust emissions; and
- no odour complaints from receptors during construction works; and
- temporary impacts of odour are appropriately mitigated and managed.

The Project would be designed, constructed and operated with the aim of achieving these performance outcomes.

8.3 Mitigation and management measures

The performance outcomes described above would be addressed through the mitigation and management measures described in **Table 8-1**. Note that this list of measures represents a minimum requirement for the Project and additional measures may be required to further reduce potential dust and odour emissions. As predicted odour concentrations are expected to comply with the NSW EPA ground level criterion (refer to **Table 6-1**), and therefore no mitigation measures are proposed.

Note that the directional drilling method and management measures described in the EIS in **Chapter 13 Landform, geology and soils** are expected to address potential odour impacts from any acid sulfate soils encountered during directional drilling.

Table 8-1 Mitigation and management measures

ID	Mitigation and management measure	Applicable location
Construction		
AQ1	Daily construction activities should be planned to consider the expected weather conditions for each workday. Undertake regular dust observations of active excavation, earthmoving works or stockpiling areas, with the aim is to ensure visible dust is not moving off-site and that any areas needing additional measures are identified early. Compile records of observations to enable the demonstration that dust is being managed in an ongoing manner. Records should include (as a minimum) the following: • observation date and time; • area being inspected; • level of dust being generated; • meteorological conditions when observation occurred; and • mitigation/management measures undertaken.	Project area (construction areas)
AQ2	Minimise exposed surfaces, such as stockpiles and cleared areas, including partial covering of stockpiles with materials such as dust mesh where practicable.	Project area (construction areas)
AQ3	Water exposed soil surfaces using water trucks or sprinklers during demolition and construction.	Project area (construction areas)
AQ4	Establish defined site entry and exit points to minimise tracking of soil on surrounding roads. Use wheel washes or shaker grids where the risk of off-site track-out of soil is identified.	Entry and exit points to Project area
AQ5	Cover heavy vehicles entering and leaving the Project area to prevent material escaping during transport.	Project area (construction areas)
AQ6	Keep vehicles and construction equipment operating on site well maintained and turned off when not operating (minimise idling on the site).	Project area (construction areas)
AQ7	Minimise the handling of spoil when excavating and loading of vehicles.	Project area (construction areas)
AQ8	Prior to commencement of construction works for the Project, deliver information flyers to the surrounding community; noting there may be some potential temporary odour impacts arising from the Project (e.g. when excavating spoil/sludge from site from the decommissioning of the existing effluent storage pond). Provide contact information directing the community to the operator-run complaints management system.	Notifications to surrounding community as relevant

9.0 Conclusion

The aim of this technical report was to assess the potential air quality impacts associated with the proposed Merimbula STP Upgrade and Ocean Outfall (the Project).

A qualitative assessment of odour impacts during construction identified the potential for temporary intermittent odour impacts to occur due to both construction work, including the decommissioning of the effluent storage pond, and the beach-face outfall pipeline. There is also the potential for odour impacts to occur during directional drilling for the outfall pipeline, which may encounter acid sulphate soils. However with the drilling method proposed and adequate management measures, odour impacts from any acid sulphate soils encountered are expected to be minor. The assessment found that while there is potential for some minor odour impacts to occur during construction, the removal of the effluent storage pond, cessation of use of the dunal exfiltration ponds and the replacement of the beach-face outfall with an ocean outfall would result in an overall reduction of odour concentrations from the STP once operational.

A qualitative assessment of potential dust impacts associated with construction was undertaken in accordance with the UK Institute of Air Quality Management (IAQM), 2014 *Guidance on the assessment of dust from demolition and construction* for the Project. The unmitigated risk rating for construction of the Project was found to be “negligible” to “medium” and as such appropriate mitigation measures would need to be included in the CEMP to manage potential dust impacts on nearby sensitive receptors.

A quantitative assessment of odour impacts was undertaken for the operation of the upgraded Merimbula STP. The CALPUFF Dispersion model was used to undertake a Level 2 Assessment in Accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA 2017).

Four modelling scenarios were considered when assessing the existing and proposed impacts from the STP. Two scenarios were modelled for the existing STP configuration and two scenarios modelled for the upgraded configuration. The first emission scenario; based on maximum emission rates; was representative of upset conditions but was found to be overly conservative and not representative of existing plant conditions based on the history of odour complaint records in the surrounding area i.e. no odour complaints on record. Given the lack of representativeness of the worst-case data, a second emission scenario was adopted which used more “realistic worst-case” emissions to assess the potential odour impacts from the upgraded STP. Based on the “realistic worst-case” scenario modelling results, there were no predicted exceedances of the 99^{th} percentile 4 OU criterion for existing or proposed operations from the Merimbula STP. Predicted offsite odour concentrations are expected to decrease as a result of the STP upgrade due to the removal of existing large area sources; namely the effluent storage pond and exfiltration ponds. Given the compliance with the odour criterion, no adverse impacts in relation to ground level odour concentrations are anticipated from the Project.

Effluent from the proposed Merimbula upgrade would be treated to a higher standard with effluent discharged through a new ocean outfall approximately 2.4 km offshore in Merimbula Bay. Changes to the quality and discharge point of treated wastewater would result in lower odour concentrations within the vicinity of the existing beach-face outfall and improve the amenity of the beach with regards to odour.

A qualitative assessment of potential cumulative impacts was also conducted to identify any cumulative air quality impacts that may be possible during construction and operation of the Project. While no cumulative impacts relating to odour were identified, the Merimbula Airport Aviation Precinct (when constructed) would result in additional combustion emissions from aircraft, vehicles and associated mobile equipment. Although, as combustion emissions from the upgraded Merimbula STP during operation are likely to be like existing operations, the Project is not expected to contribute to significant cumulative impacts with the Merimbula Airport General Aviation Precinct.

In summary, provided appropriate mitigation and management measures for dust and odour are implemented for the construction period of the Project, no significant air quality impacts are anticipated from the Project. The operation of the Project is predicted to result in an overall reduction in odour concentrations through increased levels of treatment and improved quality of treated wastewater, reduction in the number of odour sources and through the replacement of the beach-face outfall with an ocean outfall.

10.0 References

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11.0 Abbreviations

Term	Description
AQIA	Air Quality Impact Assessment
ASS	Acid sulphate soils
AWS	Automatic weather station
BIAS (NZ)	CALMET critical parameter. Layer dependent weighting factor for initial guess field.
CEMP	Construction Environmental Management Plan
BoM	Bureau of Meteorology
CO	Carbon monoxide
DPIE	Department of Planning, Industry and Environment
EES	Environment, Energy and Science
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
IAQM	Institute of Air Quality Management
IDEA	Intermittently decanted extended aeration
IEXTRP	CALMET critical parameter. Vertical extrapolation of surface wind observation
MER	Maximum Emission Rate
LGA	Local Government Area
ML	Megalitres
NO_2	Nitrogen dioxide
NOx	Oxides of nitrogen
OU	Odour Units
PAHs	Polycyclic aromatic hydrocarbons
PG	Pasquil-Gifford (PG) stability classes
$PM_{2.5}$	Particulate matter equal to or less than 2.5 microns in diameter
PM_{10}	Particulate matter equal to or less than 10 microns in diameter
RMAX1	CALMET critical parameter. Radius of influence of meteorological stations: surface
RMAX2	CALMET critical parameter. Radius of influence of meteorological stations: aloft
RWC	Realistic Worst Case
R1	CALMET critical parameter. Observation weighting: surface
R2	CALMET critical parameter. Observation weighting: aloft
SEARs	Secretaries Environmental Assessment Requirements
SO_2	Sulphur dioxide
SOER	Specific Odour Emission Rate
SoER	State of Environment Report
SRTM	Shuttle Radar Topography Mission

Term	Description
STP	Sewage Treatment Plant
TAPM	The Air Pollution Model
TERRAD	CALMET critical parameter. Terrain radius of influence
TOER	Total odour emission rate
VOCs	volatile organic compounds

Appendix A

Meteorological Data Analysis

CALMET Analyses

This section presents a summary of CALMET model predictions at the Merimbula STP site, with reference against observations recorded at the Bureau of Meteorology Merimbula Airport Automatic Weather Station (AWS) (Station ID 069147) located approximately 1.1 km north-northeast of the Merimbula STP.

Winds

Wind predictions were extracted from CALMET at the Merimbula STP site for reference against the BoM Merimbula Airport AWS. The following tables present a comparison between the data sets.

Wind speed statistics for 2017 are presented in **Table A1.** Given the proximity of the AWS; situated at Merimbula Airport; adjacent to the STP site and relatively flat terrain, good correlation between the two data sets with regards to both wind speeds and the occurrence of calms is evident based on the data presented in **Table A-1**.

CALMET wind roses for 2017 and the Merimbula STP; have also been compared to annual wind roses for the 2017 BoM data at Merimbula Airport AWS in **Figure A1**; further demonstrating the good correlation between the two data sets. Both wind roses show a high proportion of south-westerly winds and calm conditions occurring approximately 20 percent of the time.

Table A-1 CALMET Merimbula STP and BoM Merimbula Airport wind statistics comparison 2017

Wind parameter	CALMET Merimbula STP	BoM Merimbula Airport
Minimum (m/s)	0.0	0.0
Average (m/s)	2.6	2.6
Maximum (m/s)	11.9	11.9
Calms (%) (<0.5 m/s)	19.9	19.9

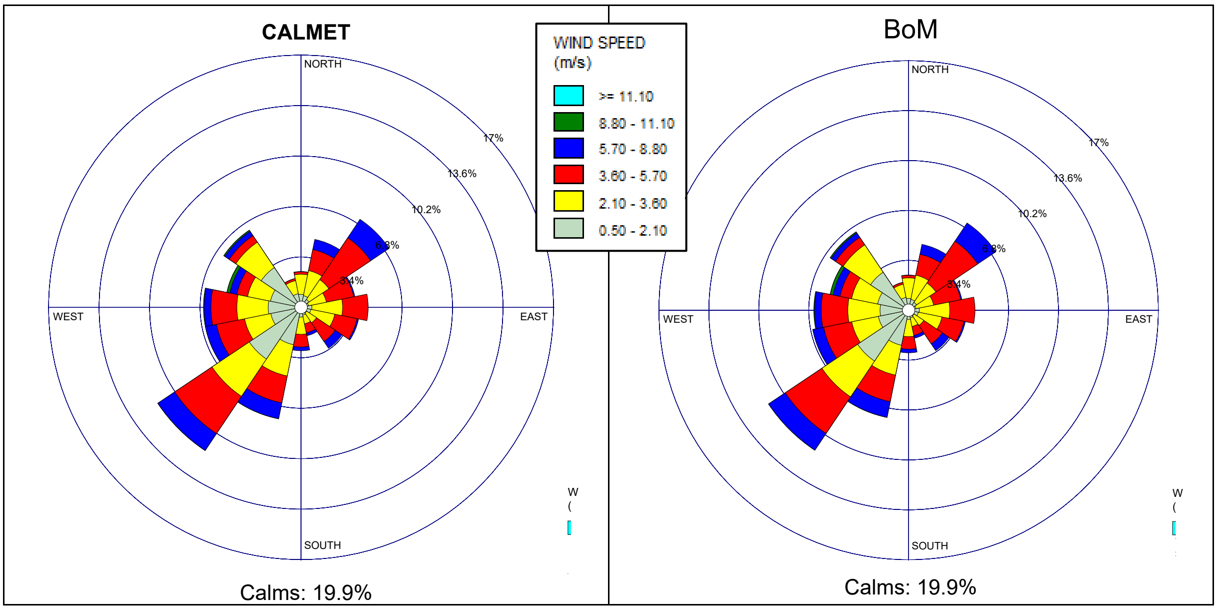
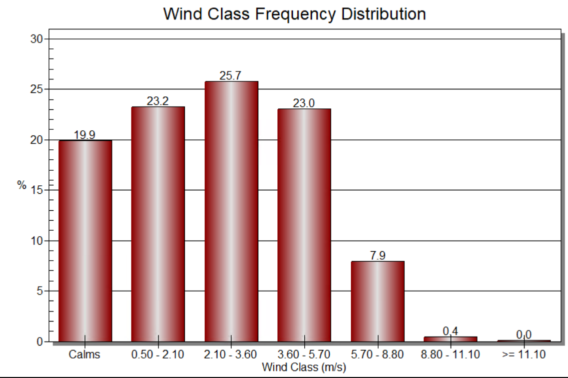
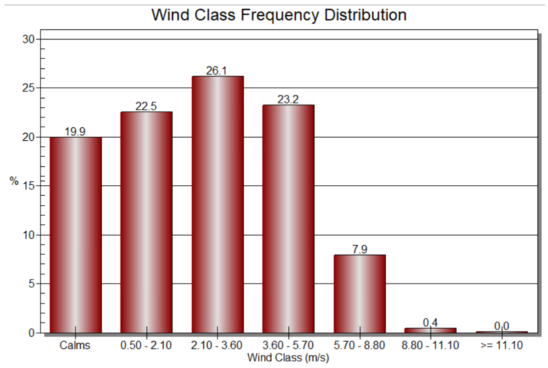


Figure A-1 Annual wind rose comparison CALMET Merimbula 2017 to BoM Merimbula Airport AWS

The wind speed frequencies presented in **Table A-2** show a strong correlation between the predicted CALMET and observed BoM Merimbula Airport AWS datasets, with the winds being predominantly light to moderate in nature, with a high frequent of calms. The CALMET Merimbula STP data shows the same percentage of calms and a similar percentage of light winds and lower moderate winds compared to the BoM data.

Table A-2 Wind speed frequency distributions comparison

Wind class frequency (%)	
	
CALMET (Merimbula STP) 2017	BoM Merimbula Airport AWS 2017

The majority of odour impacts generally occur during the early evening and early hours of the morning; when calm conditions that limit air dispersion. A comparison of wind roses for time of day; broken down into 6 hourly intervals for the CALMET Merimbula data has been presented in **Figure A-2**. While calm conditions commonly occur at Merimbula; calm events were shown to occur more commonly between the hours of 6:00 pm to 6:00 am occurring approximately a third of the time. During this period; south westerly winds are most prevalent. During the day the occurrence of calms were found to be lower; and north-easterly winds were more common.

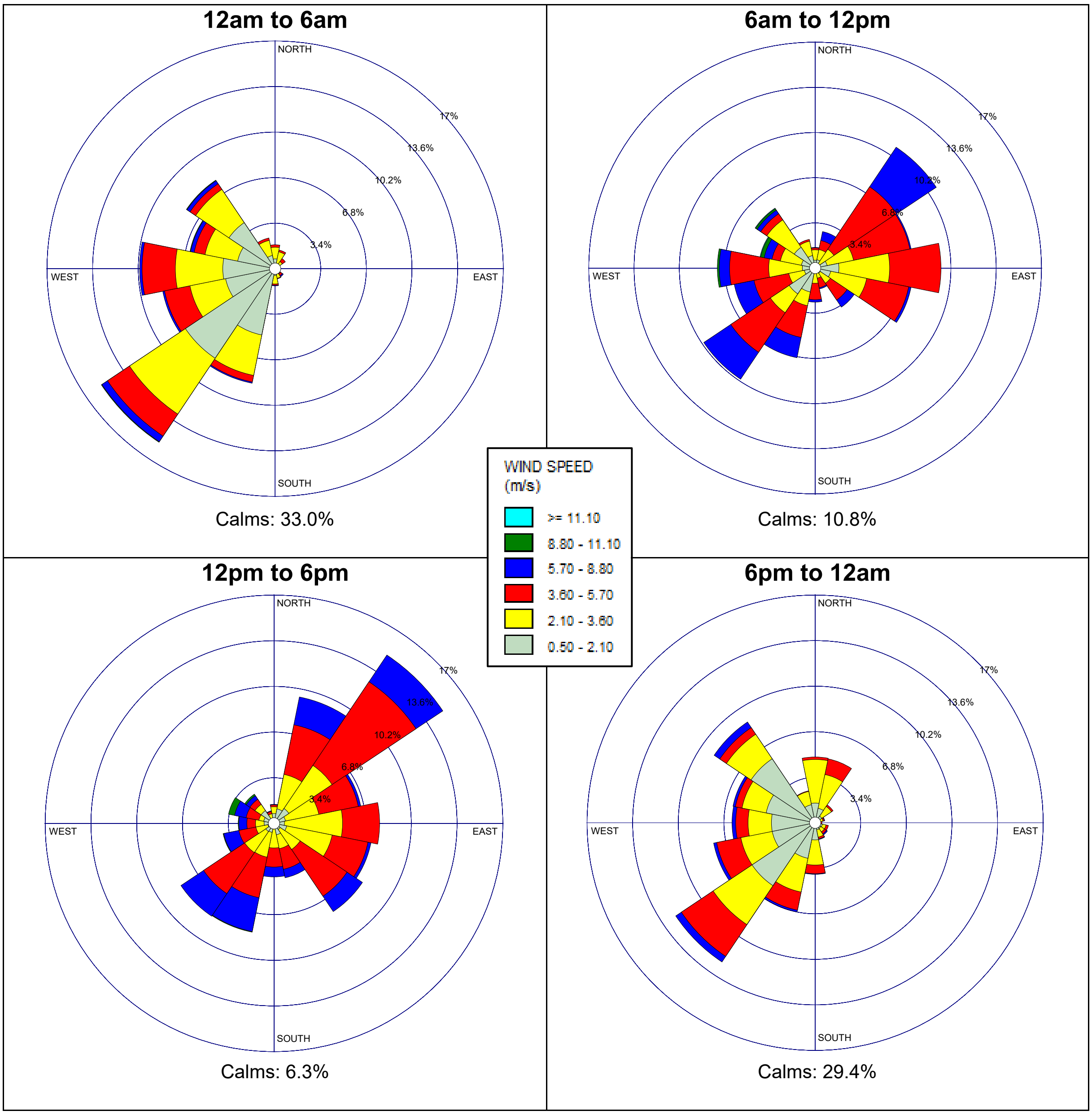


Figure A-2 CALMET Merimbula Wind Roses for Time of Day 2017

A selected hourly wind field predicted by CALMET for 2017 surrounding the site for the dominant wind direction (southwest) is shown in **Figure A-3**. The wind condition for the wind field below includes winds of 2.5 m/s at a direction of 244 degrees and stability class F. The data set shows the terrain influences on windspeed and wind direction observed inland and along the coastline; particularly at higher elevations before south westerlies move offshore.

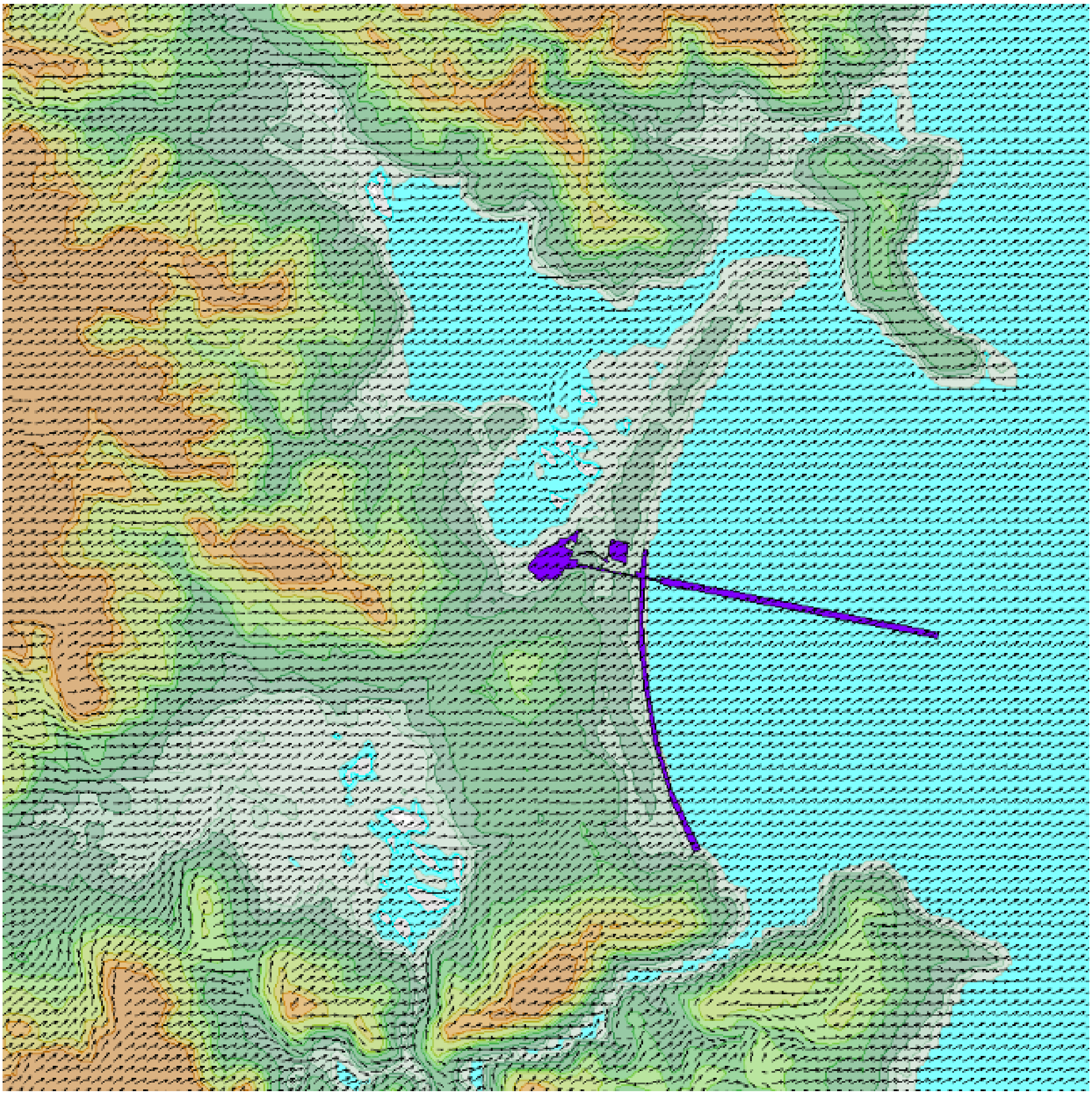


Figure A-3 CALMET 2017 Wind Field 10 pm 02 June 2017

Temperature

Temperature data is estimated within the CALMET program for each hour of the meteorological data set. A comparison of the temperature vs. hour of day for CALMET Merimbula is presented in **Figure A-4** The results are consistent with expected patterns for the NSW South Coast region.

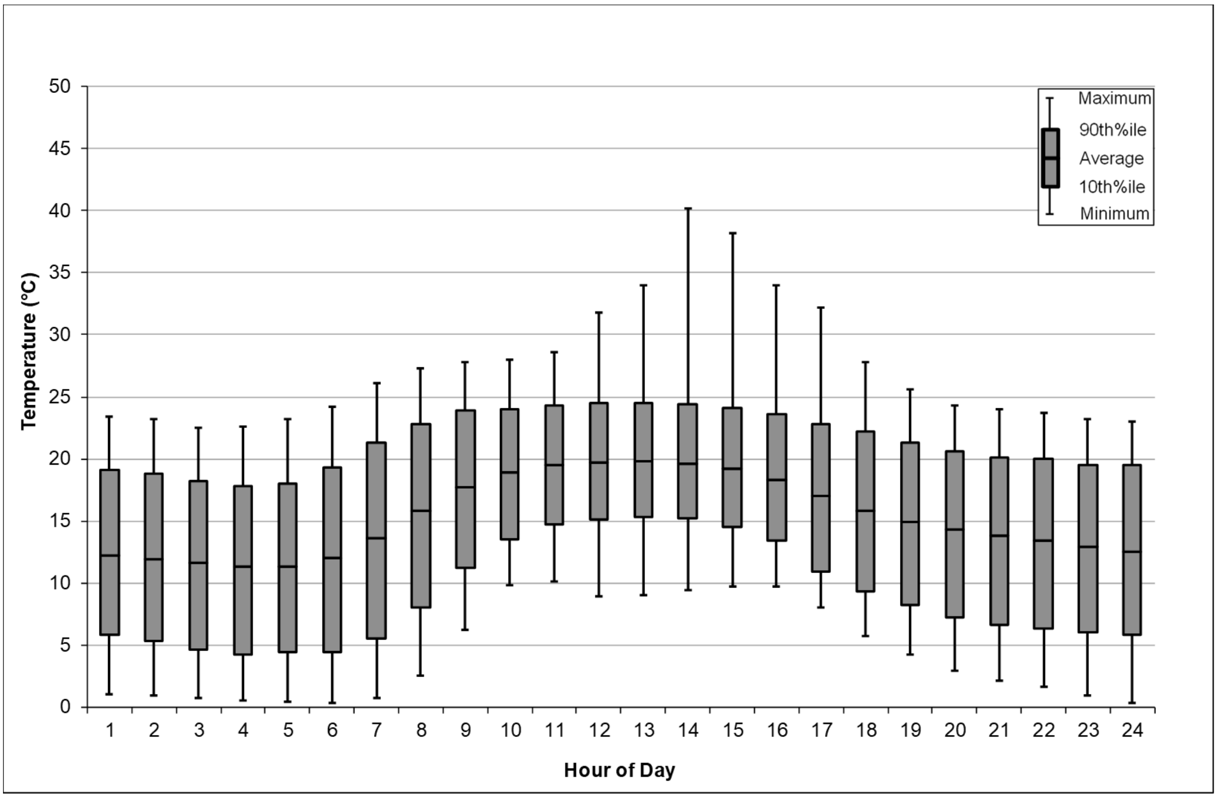


Figure A-4 Box and Whisker plot of temperature data for CALMET Merimbula STP 2017

Mixing height

Mixing height is estimated within CALMET for stable and convective conditions (respectively), with a minimum mixing height of 50 m. **Figure A-5** presents mixing height statistics by hour of day across the meteorological dataset, as generated by CALMET at the Merimbula Project location. These results are consistent with general atmospheric processes that show increased vertical mixing with the progression of the day, as well as lower mixing heights during night time. In addition, peak mixing heights are consistent with typical ranges.

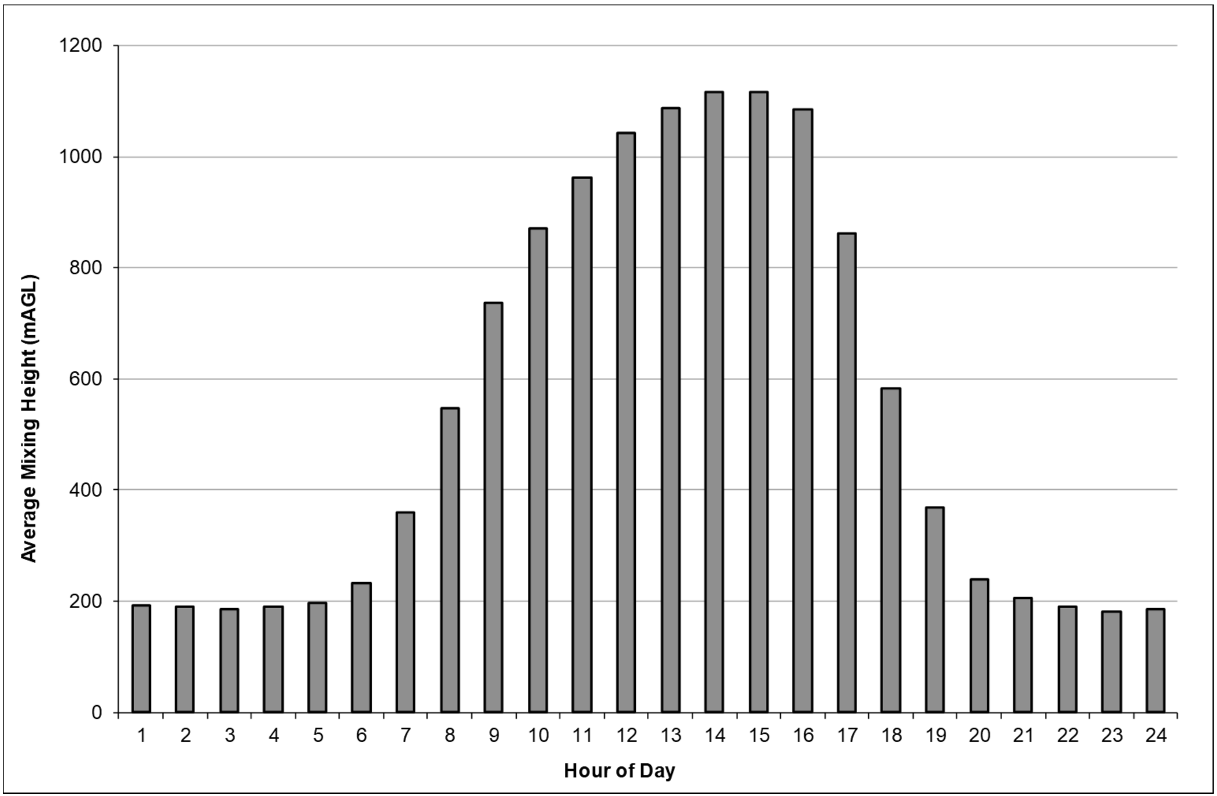


Figure A-5 Mixing height statistics by hour of day for CALMET Merimbula 2017

Atmospheric stability

Stability class is used as an indicator of atmospheric turbulence for use in meteorological models. The class of atmospheric stability generally used in these types of assessments is based on the Pasquill-Gifford-Turner (PG) scheme where six categories are used (A to F) which represent atmospheric stability from extremely unstable to moderately stable conditions respectively. The stability class of the atmosphere is based on three main characteristics, these being:

- static stability (vertical temperature profile/structure);
- convective turbulence (caused by radiative heating of the ground); and
- mechanical turbulence (caused by surface roughness).

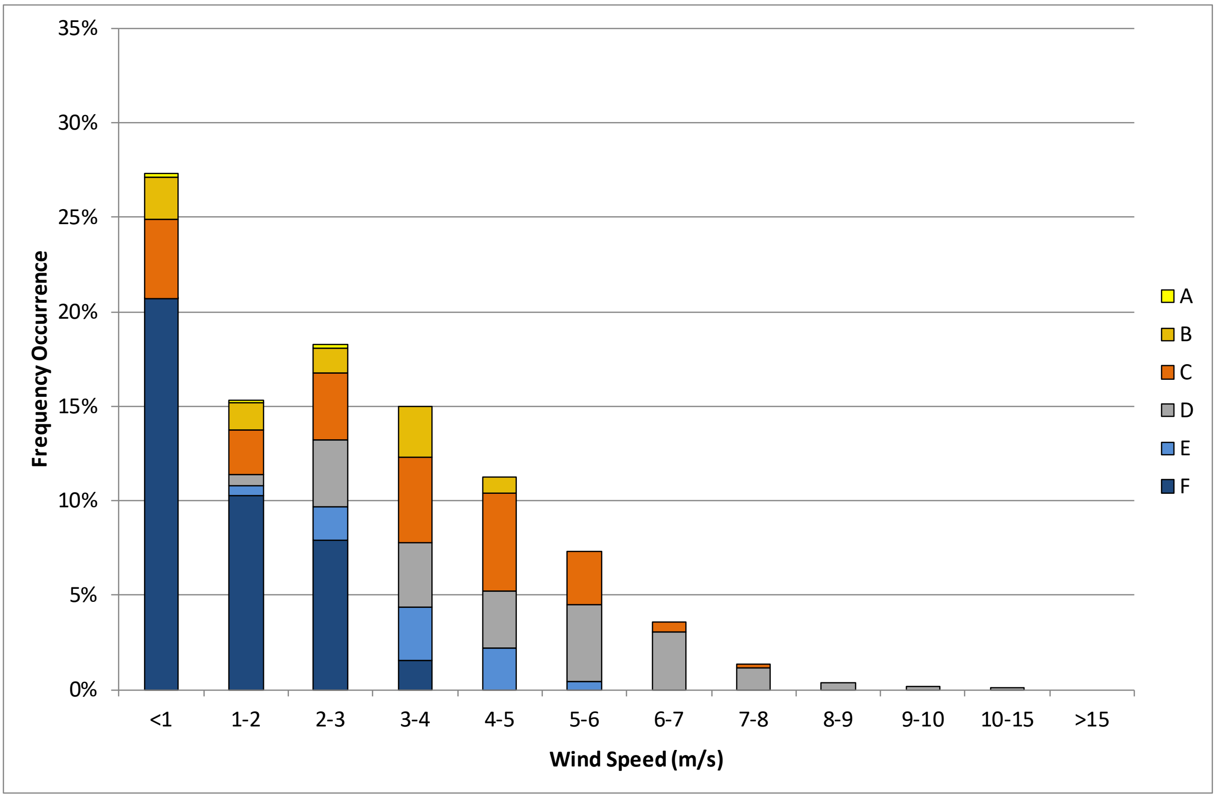
Whilst CALPUFF centrally uses Monin-Obukhov (MO) similarity theory to characterise the stability of the surface layer, conversions are made within the model to calculate the PG class based on Golders method (Golder 1972[2]) as a function of both MO length and surface roughness height. The PG Stability class frequencies for the CALMET data are provided in **Table A-2**.

[2] Golder, D. 1972, "Relations among stability parameters in the surface layer", Boundary Layer Meteorology, 3, 47-58

Table A-2 Stability class frequency for CALMET Merimbula 2017

Stability class	Frequency
	CALMET Merimbula STP
A (Extremely Unstable)	0%
B (Moderately Unstable)	9%
C (Slightly Unstable)	23%
D (Neutral)	20%
E (Slightly Stable)	8%
F (Moderately Stable)	40%

Figure A-6 and **Table A-3** present an analysis of stability class frequency against wind speed at CALMET Merimbula and confirm a typical distribution.



FigureA-6 Stability class frequency by wind speed CALMET Merimbula 2017

Table A-3 **Stability class frequency by wind speed CALMET Merimbula 017**

Stability class	Frequency by wind speed (m/s)											
	<1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-15	>15	All
A	16	8	16	0	0	0	0	0	0	0	0	0	40
B	198	130	114	234	75	0	0	0	0	0	0	0	751
C	365	205	309	393	453	247	45	20	0	0	0	0	2037
D	2	54	312	301	269	355	266	100	34	16	6	0	1715
E	0	42	156	249	190	39	0	0	0	0	0	0	676
F	1813	901	692	133	0	0	0	0	0	0	0	0	3539
TOTAL	**2394**	**1340**	**1599**	**1310**	**987**	**641**	**311**	**120**	**34**	**16**	**6**	**0**	**8758**

Figure A-7 presents an analysis of stability class at CALMET Merimbula by hour of the day and confirms a typical distribution.

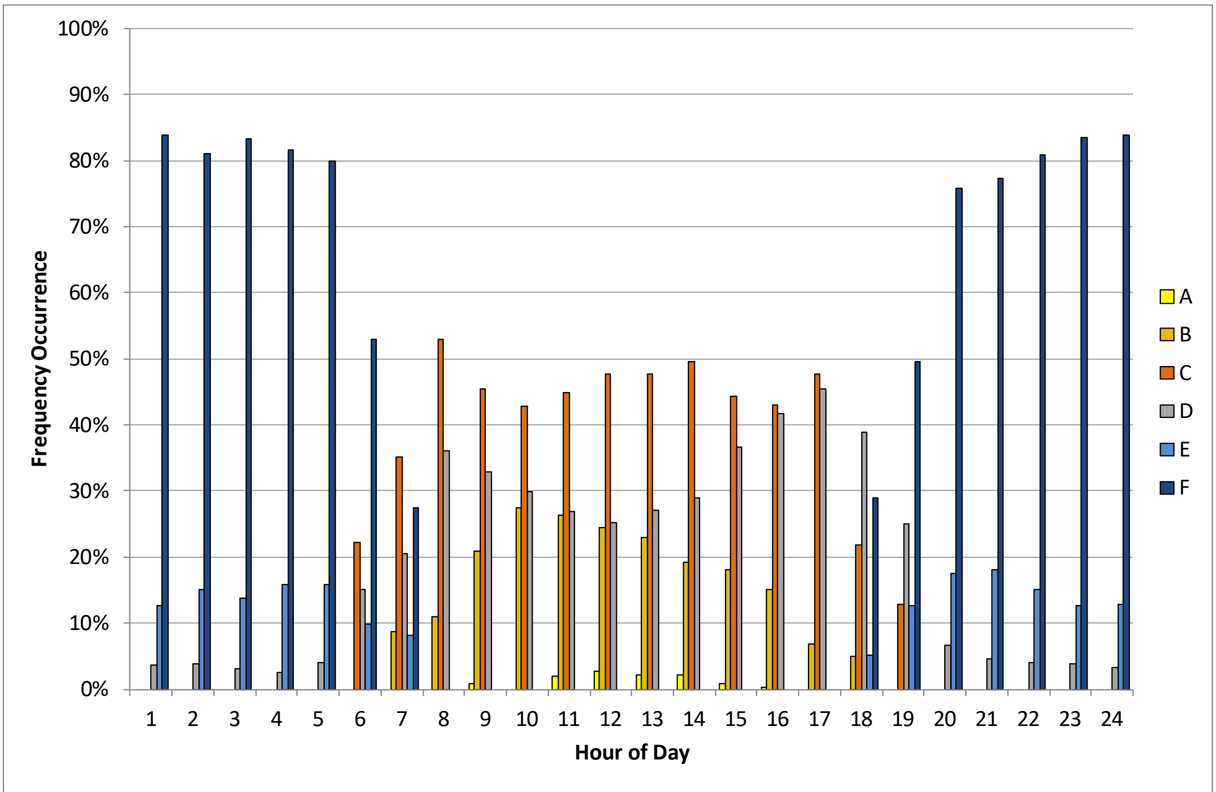


Figure A-7Stability class by hour of day CALMET Merimbula 2017

Conclusion

A 12 month meteorological dataset has been prepared for the Merimbula STP site using a combination of local observations and prognostic modelling. Data has been evaluated using hourly observation data. The findings of the data analysis show that the CALMET model is performing well. The predicted meteorology is considered to be fit for purpose and acceptable for use in modelling of emissions from the Merimbula STP site.

Appendix B

Source Locations and Emission Rate Contributions

Source Locations

Coordinates for the location of modelled sources of odour are included in **Table B-1**. The location of sources is also presented in **Figure B-1**.

Table B-1 Location of all modelled sources.

Source type	Model ID	Source description	MGA 55 Coordinate (m)	
			X	Y
Area	IDEA1	Existing Intermittently Decanted Extended Aeration (IDEA) Tank 1	757954.8	5910280
	IDEA2	Existing IDEA Tank 2	758038.4	5910307
	CP	Existing Catch Pond	757827.4	5910337
	WWOP	Existing Wet Weather Overflow Pond	757754	5910275
	MP	Existing Effluent Storage Pond	757809.9	5910205
	DB1	Existing Drying Bed 1	757903.8	5910207
	DB2	Existing Drying Bed 2	757927.5	5910267
	SL1	Existing Sludge Lagoon 1	757958.9	5910309
	SL2	Existing Sludge Lagoon 2	757976.4	5910340
	SL3	Existing Sludge Lagoon 3	757994.6	5910371
	EFP1	Exfiltration Pond 1	758442	5910230
	EFP2	Exfiltration Pond 2	758434	5910370
	DB	Deodorising Bed - Inlet Works Odour Control	758026.7	5910241
Volume	CT	Chlorine Contact Tank	757853.2	5910071
	ST	2.3 ML Storage Tank	757905.8	5910107

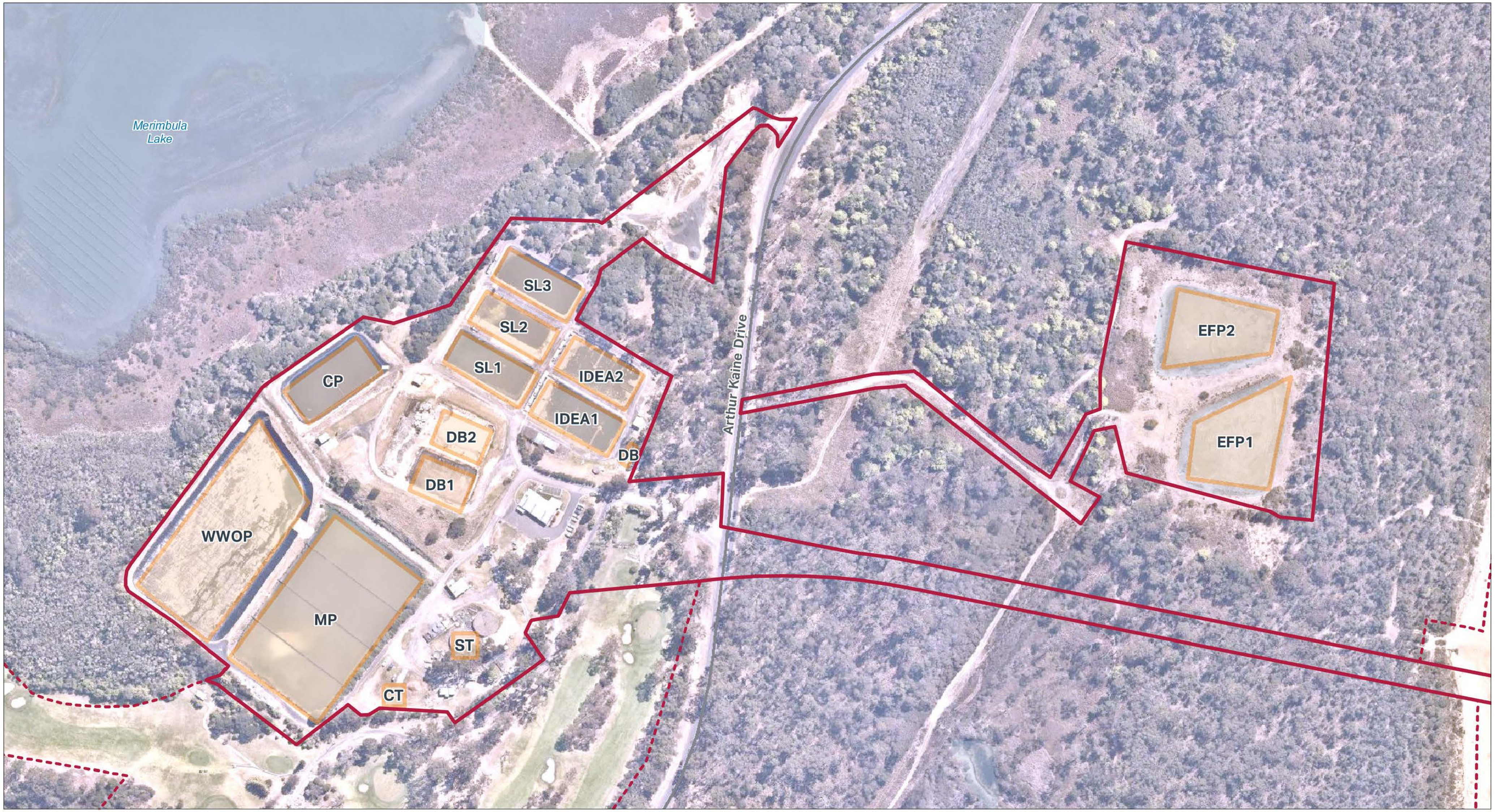


FIGURE B-1: MODELLED AREA AND VOLUME SOURCE LOCATIONS

0 50 100 m

AECOM

Legend

Project area

Project area (temporary construction area)

Volume Source Locations

Source: Nearmap, 2020

Source Contributions

Source contributions for Total Odour Emission Rates (TOER), exclusive of peak-to-mean factors for each modelled scenario are provided in **Table B-2**. The following key points can be derived from **Table B-2**:

- Total emission rates from the Proposed Scenarios (2a and 2b) are notably lower than existing operations; which is largely attributed to the removal of the effluent storage pond a large area source, and to a lesser extent the dunal exfiltration ponds.
- Total emission rates for the maximum emission rate (MER) scenarios (1a and 2a) are more than double the emission rate totals for the realistic worst case (RWC) scenarios (1b and 2b) based on 75th percentile emissions data from the odour database. This is largely attributed to very high odour emission rates from the IDEAs and Sludge Lagoons in the MER Scenarios; which are likely based on upset conditions.

Table B-2 Source contributions for all modelled scenarios

Model ID	Scenario 1a		Scenario 1b		Scenario 2a		Scenario 2b	
	TOER (OU)	Source Contribution	TOER (OU)	Source Contribution	TOER (OU)	Source Contribution	TOER (OU)	Source Contribution
DB	17	0.1%	16	0.2%	17	0.1%	16	0.3%
IDEA1	2163	13.2%	723	9.9%	2163	15.5%	723	14.1%
IDEA2	2102	12.8%	702	9.6%	2102	15.1%	702	13.7%
CP	434	2.6%	397	5.4%	434	3.1%	397	7.8%
WWOP	366	2.2%	286	3.9%	366	2.6%	286	5.6%
DB1	200	1.2%	139	1.9%	200	1.4%	139	2.7%
DB2	181	1.1%	126	1.7%	181	1.3%	126	2.5%
SL1	2829	17.2%	903	12.3%	2829	20.3%	903	17.6%
SL2	2829	17.2%	903	12.3%	2829	20.3%	903	17.6%
SL3	2829	17.2%	903	12.3%	2829	20.3%	903	17.6%
MP	2190	13.3%	2003	27.4%	0	0.0%	0	0.0%
EFP1	156	0.9%	122	1.7%	0	0.0%	0	0.0%
EFP2	140	0.9%	110	1.5%	0	0.0%	0	0.0%
ST	0	0.0%	0	0.0%	5.26	>0.1%	12.10	0.2%
CT	0	0.0%	0	0.0%	4.37	>0.1%	10.04	0.2%
Totals	**16418**	**100%**	**7316**	**100%**	**13960**	**100%**	**5120**	**100%**