EAQ Consulting

# PROPOSED NEERABUP RESOURCE RECOVERY PRECINCT (NRRP) ODOUR IMPACT ASSESSMENT

**CITY OF WANNEROO**

# Proposed Neerabup Resource Recovery Precinct (NRRP) Odour Impact Assessment

## CITY OF WANNEROO

**Project Ref: EAQ-25025**

**February 2026**

EAQ Consulting

Environment | Air Quality

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| Report Revision(s) | | | | |
|---|---|---|---|---|
| **Version(s)** | **Description** | **Date** | **Author(s)** | **Reviewer(s)** |
| Draft_0.0 | Internal Review | 04.08.2025 | J. Hurley | DSB |
| Draft_1.0 | Draft Released to Client | 05.08.2025 | J. Hurley | Talis; City of Wanneroo |
| Final | | 25.08.2025 | | |

| Approved for Release | | |
|---|---|---|
| **Name** | **Position** | **File Reference** |
| John Hurley | Principal Air Quality Consultant | EAQ25025-NeerabupRRP+WksApp+OIA_Final |

**Signature**

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# 1 Background

Environmental & Air Quality Consulting Pty Ltd (EAQ) was engaged by Talis Consultants Pty Ltd (Talis) on behalf of the City of Wanneroo (the City) to undertake a Works Approval Odour Impact Assessment (OIA) of the City's proposed Neerabup Resource Recovery Precinct (NRRP) to be located at 570 Wattle Avenue, Neerabup Western Australia 6031 (the Site), with access from Trandos Road. The Site is to be located within the Neerabup Industrial Precinct.

The NRRP will be built in multiple stages, with Stage 1 being current. Stage 1 of the NRRP will comprise of a Waste Transfer Station (WTS), Materials Recovery Facility (MRF), and Community Recycling Centre (CRC), the details of which are:

- WTS (designed to 195,000tpa) – receivals of residual waste from the City's kerbside collection services, and potentially other local governments, for consolidation and bulk transport to recovery facilities in the southern Perth metropolitan area,
- MRF (Designed to 100,000tpa) - accept, sort and consolidate co-mingled recyclables from kerbside collections for downstream reprocessing, and
- CRC - to provide residents with a safe and accessible location to drop off household items for reuse, recycling or appropriate disposal.

For assessing malodour impacts from activities within the NRRP, the residual waste will comprise of kerbside collections, i.e., red-lid residential waste bins. These wastes are putrescible and therefore odorous.

Recycling waste from kerbside will pose no risk of malodour generation from the MRF within the NRRP.

Greenwastes will be placed in a bunker to the north of the CRC location and will comprise solely of residential drop-off waste streams. The greenwastes will be stockpiled in the bunker and collected fortnightly by contractor for external offsite processing. Raw greenwastes pose negligible risk for malodour impacts downwind of the NRRP.

## 1.1 Stage 1 Site Description Summary

Site entry for all commercial vehicles is via Trandos Road through the main site access across the weighbridge. Depending on which facilities the vehicles are servicing (i.e., WTS, MRF, CRC etc), they make their way to the respective facility after passing the weighbridge.

Community traffic enters the CRC site entrance and flows clockwise. Operational/service traffic for the CRC turns right after the weighbridge to service the drop off areas from the back of house service lanes.

Greenwastes will be short-term stockpiled in the bunker and collected fortnightly by contractor for external offsite processing.

### 1.1.1 Process Buildings' General Design

The WTS will comprise of:

- Fully enclosed, structurally sound building,
- Suitable access in and out of the building, with high-speed roller doors,
- Adequate ventilation for maintaining air quality,
- Waste delivery via kerbside collection vehicles and load out into haulage vehicles,
- 2 load out lanes:
  - 1 x reverse in lane with a compactor (WASTETECH S8000) and,
  - 1 x drive through lane without compaction.
- Mobile Equipment within WTS: 1x front end loader.

The MRF will comprise of:

- Two fully enclosed warehouse buildings:
  - 1 x building for material receival, processing and baling (the Receival and Processing Building), and
  - 1 x separate building directly to the north for the storage and dispatch of baled product (the Storage and Dispatch Building).
- Baled recyclables will be transported via forklift from the Receival and Processing Building to the Storage and Dispatch Building, and
- The exact Equipment within the MRF will be designed at a later stage but will consist of a conveyor system with various magnetic, optical, mechanical and manual sorting steps.

The CRC will comprise of:

- Main pieces of infrastructure:
  - Kiosk - A fully enclosed kiosk will be located at the CRC entrance to manage traffic, inspect materials, and accept payments. It will be connected to the Reuse Shop by a canopy over the entrance road,
  - Reuse Shop, Administration & Education Centre - The Reuse Shop will enable customers to drop off or purchase reusable items, with a forecourt for sorting and display. Adjoining this, the Education and Administration Centre will provide space for staff facilities, meetings, and community education on waste practices,
  - Household Hazardous Waste Shed (HHW Shed): The HHW Shed will safely accept and store hazardous materials in three modular enclosed areas with designated containment and spill management systems. It includes a hardstand and a canopy for customer drop-off, and
  - Multi-Tier Drop-off Facility: A 2,800m² raised hardstand with 16 sawtooth bays and 8 hook-lift bins will allow customers to reverse and deposit bulky waste like scrap metal, and residuals. The facility includes covered bays, laydown areas for items like tyres and mattresses, and optional weighbridges for accurate quantification.

## 1.2 NRRP Locality

The Neerabup Resource Recovery Precinct (NRRP) is to be located within the Neerabup industrial area. The site lies approximately 36 kilometres north of the Perth Central Business District (CBD), 10.5 kilometres (km) inland from the nearest coastline, and around 23 kms west of the Darling Scarp.

The site is situated at an elevation of approximately 46 metres (m) Australian Height Datum (AHD). Within a 5 km radius, the terrain is broadly flat to gently undulating and is classified as topographically simple for the purpose of atmospheric dispersion modelling. Surrounding land use includes a combination of industrial developments, vegetated reserves, and semi-rural allotments. To the north and northeast, landuse transitions into areas of natural bushland and agricultural market gardens. To the west and south, the precinct is bordered predominantly by industrial land uses and associated infrastructure corridors, with minimal residential encroachment.

To the south and west of the NRRP site, the terrain elevations increase by up to 40 metres before beginning a gradual decline in elevation. Residential areas are approximately 2 kms to the south, and over 6kms to the west, and thus due to residential areas' separation from the NRRP, topographic features are not expected to influence odour dispersion in the direction of residential areas.

Under steady-state atmospheric assumptions, wind speed and direction are considered constant across the dispersion pathway. Consequently, any odour plume generated from the NRRP is expected to disperse and dilute progressively as it travels downwind, thereby reducing odour concentrations at increasing distances from the source.

The NRRP is designed primarily as a short-term transfer and consolidation facility for municipal solid waste (i.e., residual waste). Incoming kerbside waste streams are received and held temporarily before being transported to external processing facilities. As such, there is limited potential for substantial on-site decomposition of waste. While residual waste may present a mild odour component due to typical bin storage durations of up to one week prior to collection, the operational model and management practices of the NRRP significantly reduce the likelihood of strong or persistent odour emissions being generated on-site.

The Locality of the NRRP is illustrated in Figure 1-1 to follow. Figure 1-2 presents the general layout design for the NRRP.

## 1.3 OIA Regulatory Guidance

The Works Approval application process is regulated by the Western Australia (WA) Department of Water and Environmental Regulation (DWER) under Part V of the *Environmental Protection Act 1986* (EP Act). The OIA will support the City's application for Environmental and Works Approvals to construct and operate the NRRP.

This OIA follows the most recent Government of WA DWER Guideline Odour Emissions June 2019 document where the Guideline provides assessment methods for delivering adequate odour data and information to the DWER for the assessment of applications under Part V of the EP Act; where, *"Part V*

*Division 3 of the EP Act provides the Department with mechanisms for regulating odour, by way of conditions on works approvals and licences applied to prescribed premises".*

The DWER employs a risk-based approach to its assessment of applications for instruments under Part V of the EP Act.

In determining the risk posed by odour, DWER considers:

- the location, proximity and sensitivity of receptors;
- the management of odour sources and activities;
- the intensity and offensiveness of the odour;
- potential odour impacts from other nearby sources;
- the topography and complexity of terrain;
- the size and / or complexity of the facility when compared with other Australian operations;
- any unusual configuration of odour sources or technology compared with other Australian operations;
- whether the proposal is located in a Strategic Industrial Area (SIA);
- the presence of multiple industry categories which may emit odours on the same site;
- current and cumulative impacts from odour; and
- pathways and impacts on sensitive receptors.

As per the WA DWER Guideline the screening distance between a "Category 61A - Solid waste facility (1,000 tonnes or more per year)", and/or a "Category 62 – Solid waste depot (500 tonnes or more per year)", and the nearest sensitive receptor is 500 metres and 200 metres respectively, where the Category 61A activity involves *"….solid waste produced on other premises is stored, reprocessed, treated, or discharged onto land", and the Category 62 activity involves "….waste is stored, or sorted, pending final disposal or re-use".*

- The NRRP will likely be a Category 62 Prescribed premise activity.

On this basis alone, the NRRP conforms with the recommended screening distance for odours given the nearest sensitive receptor (rural and/or urban) is approximately 960 metres to the north from the NRRP northern boundary (refer Figure 1-3).

Notwithstanding, this OIA provides a more detailed assessment to ensure all stakeholders are satisfied that the NRRP activities will pose no risk of malodour impacts at the nearest sensitive receptor. Also, the detailed OIA will provide the necessary insight into the levels of protection provided during the operations of the NRRP's WTS to mitigate near-field malodour impacts within the receiving environment.

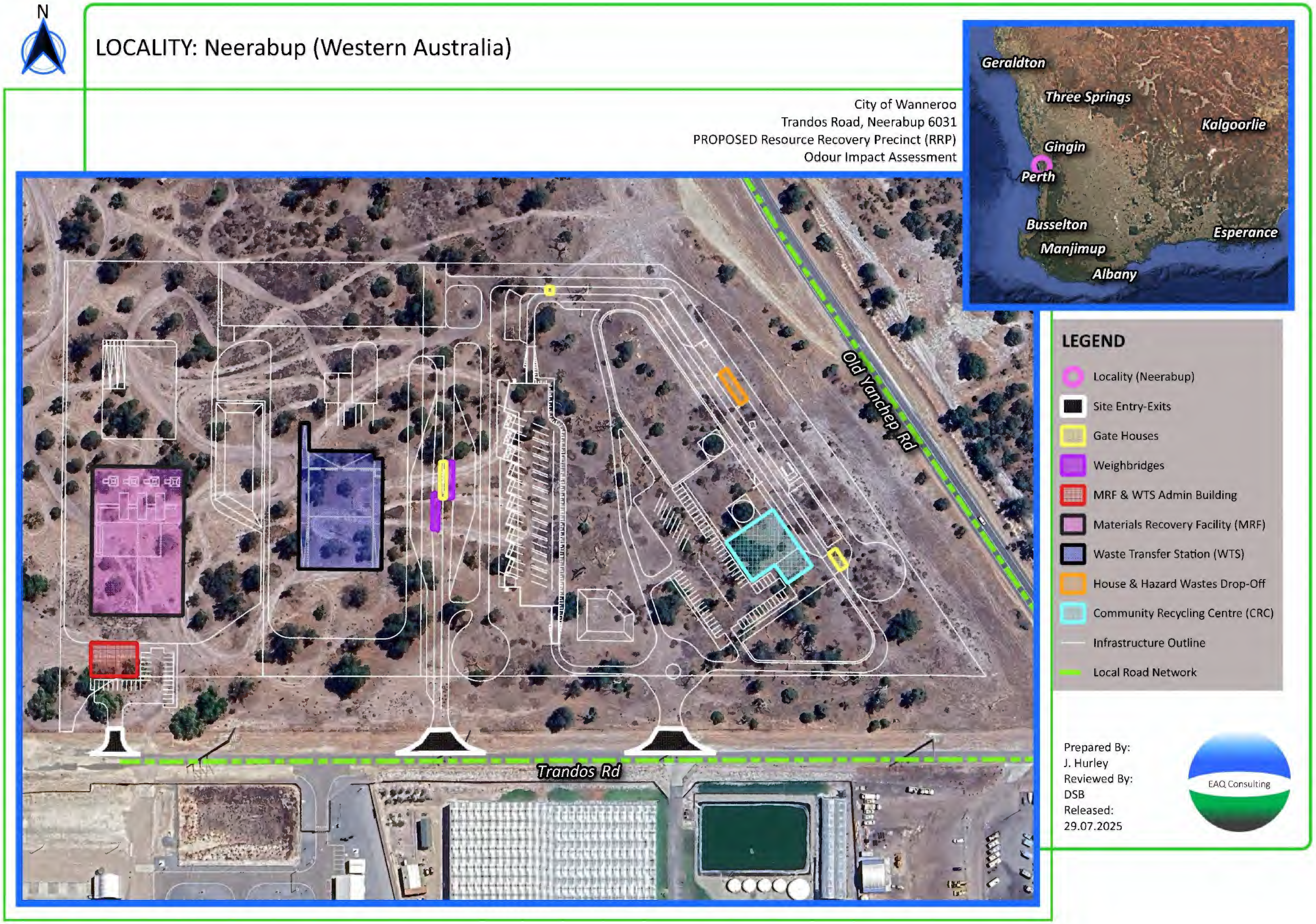



**Figure 1-1: Proposed NRRP & Locality**

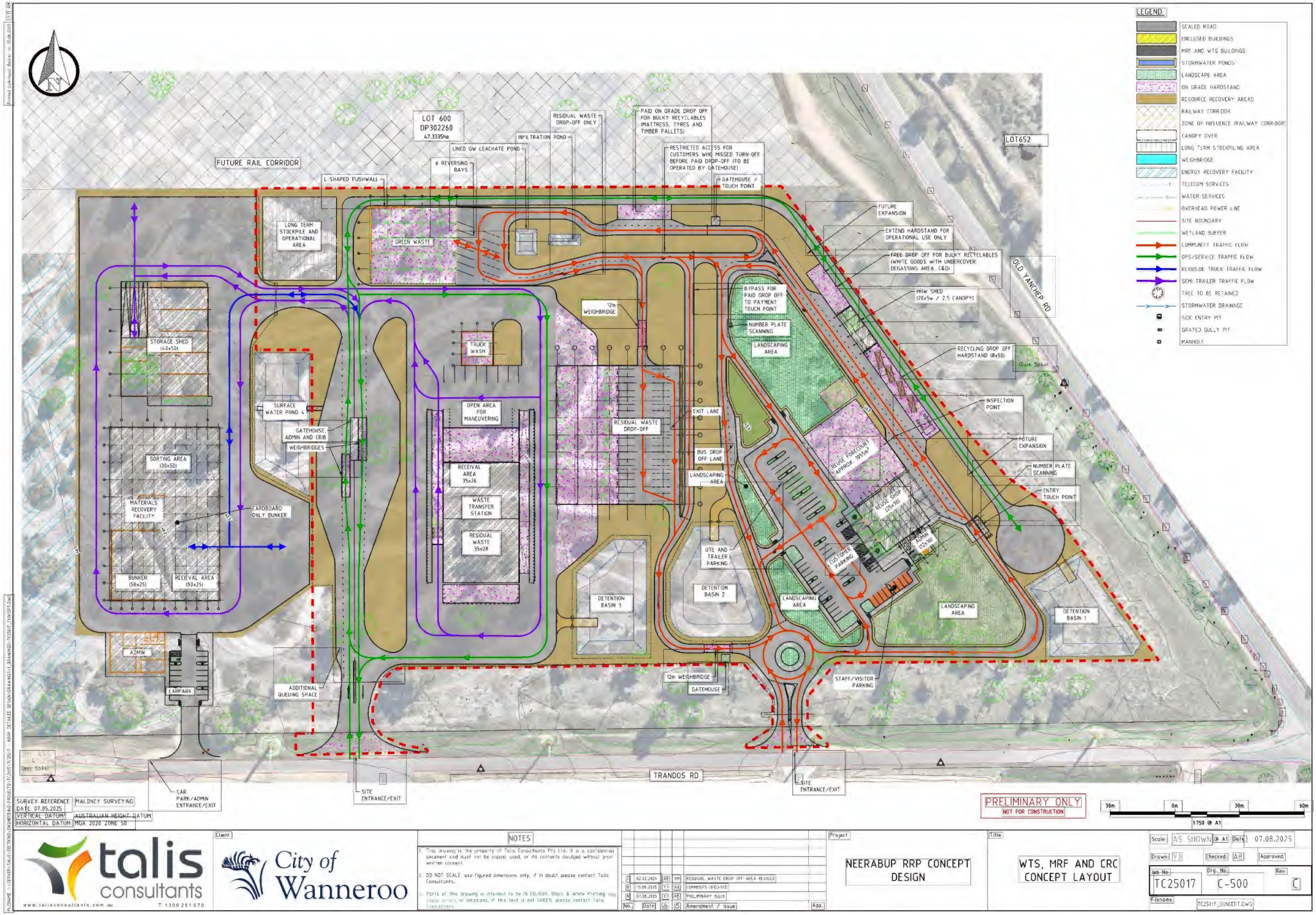



**Figure 1-2: Current General Arrangement Design of Proposed NRRP**

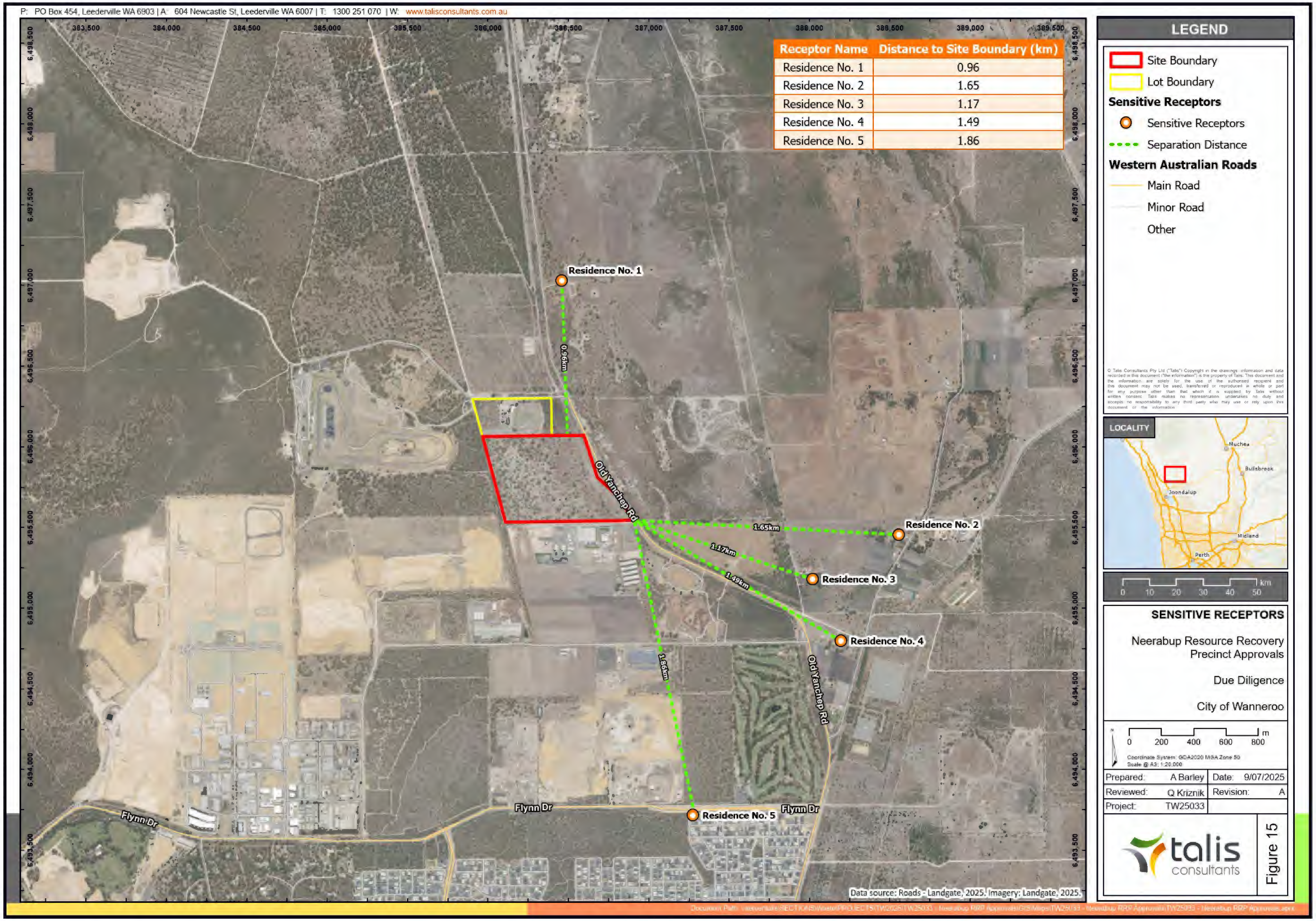



**Figure 1-3: Location of Nearest Sensitive Receptors surrounding the Proposed NRRP**

# 2 Detailed Odour Analysis

The proposed operational hours of the NRRP and its associated process areas are:

- WTS:
  - Monday to Friday: 6am to 6pm,
  - Saturday, 6am – 6pm (as required),
  - Sunday, closed, and
  - Public holidays 6am to 6pm (Excluding Christmas Day, Good Friday and New Years Day).
- CRC:
  - Monday to Sunday: 7:30am to 4pm and including public holidays (Excluding Christmas Day, Good Friday and New Years Day).
- MRF:
  - Monday to Sunday: 7am to 6pm and including public holidays excluding Christmas Day, Good Friday and New Years Day.

Daily truck movements are listed below.

**Table 2-1: Daily Truck and Waste Type Movements**

| Waste Stream | Kerbside Collection Drop-off | Daily Semi-Trailer Pick-ups (Bulk Haulage) |
|---|---|---|
| Residual Waste (WTS) | 145 | 32 |
| Recycling (MRF) | 98 | 38 |
| Greenwaste | approx.., 10.4 tonnes per day | 3 (146 tonnes/fortnight) |

Primary malodours from the NRRP activities will originate from the drop-off and loadout (i.e. transfer) of residual waste. Residual waste will include comingled inert and putrescible waste streams from kerbside collections, bulk retail and commercial waste streams, and some wastes from the public via the sawtooth drop-off public bays.

The odour characters within the NRRP will reflect those odours typically observed from residential bins. The odour of rubbish/garbage is the prominent odour descriptor which represents General Refuse. During seasonal variations the hotter months can cause higher odour strength emissions due to the advanced decomposition of the waste within residential bins and the council collection trucks. Contamination of green wastes within the residential bin collection can further exacerbate odour strength emissions. Other odours from within a NRRP are typically benign given those other co-mingled wastes are largely inert.

Incoming waste can be considered as 'fresh' and is held on the WTS floor for periodical timeframes between collection drop-offs, and the closure of the NRRP Site. The proposed management of the WTS aims to achieve nil putrescible waste retained on the WTS floor overnight and/or over weekends (i.e., clean floor policy). To achieve this waste is loaded via compaction 'tunnels' into waiting transport trucks for removal from the Site. The NRRP WTS odour emission sources and pathways-to-atmosphere will be:

- Bulk Waste Vehicle ingress/egress doorways (5)
- Waste Receivals and Daily Storage

  - WTS floor receiving residual, putrescible waste, and
  - WTS floor receive inert recyclables.
- Truck Loading/Loadout Bays (2)
- Sludge and Wash Leachate
  - Washdown of WTS as required resulting in minor volumes of leachates, and
  - Truck loading/loadout bay minor leachates from loading diverted into drain/sump.

All waste received on the WTS floor is mobilised into 'sectors' using a single Front-End-Loader (FEL) to ensure separation of residual waste and recyclables/inert wastes. Waiting waste removal transport trucks are loaded by the FEL within the designated loadout tunnel.

By contrast, the Materials Recovery Facility (MRF) handles only inert, recyclable, and non-putrescible waste streams. As such, the MRF is not considered a source of odour emissions and does not pose a risk of malodour impacts within the receiving environment.

The CRC is also a non-source of odour emissions and poses no risk of malodour impacts within the receiving environment.

## 2.1 EPOs & Benchmark Controls

The DWER Guideline "Better practice organics recycling" December 2022 is referred to given that greenwaste activities are proposed to be undertaken at the Site.

Under Section 51 (s.51) of the WA Environmental Protection Act (EP Act), *"operators of facilities must take all reasonable and practicable measures to prevent or minimise emissions. Under s.51 of the EP Act, it is an offence for occupiers of prescribed premises not to take these measures"*.

The Better practice organics recycling guideline:

- Sets environmental performance objectives (EPOs), which are the outcomes that must be achieved,
- Identifies benchmark controls as the standard for operators to demonstrate they have achieved the EPOs, and
- Allows for alternative controls to achieve the EPOs, consistent with a risk-based approach and to support effective and innovative site-specific solutions.

Subsequently, DWER will apply controls to meet the EPOs, whether benchmark or operator-proposed alternatives, as conditions within approvals granted under Pt V Division 3 of the EP Act. The EPOs most relevant to this OIA are listed below.

**Table 2-2: Environmental performance objectives**

| Aspect | Environmental performance objective |
|---|---|
| Emissions to land and water | Protect the environment by preventing and, where that is not possible, minimising emissions to land and water that may cause pollution or environmental harm. |
| Odour | Protect the environment by preventing and, where that is not possible, minimising odour emissions that may cause pollution or environmental harm. |

DWER provides "Benchmark controls" that serve to achieve the applicable EPOs, these are grouped into the following types:

- Planning: these controls refer to what operators are to prepare and act on to effectively implement infrastructure, equipment, process and management requirements,
- Infrastructure and equipment: these controls refer to design and installation specifications, and
- Operations: these controls refer to process and management requirements, including maintenance, monitoring and response measures.

DWER also supports operators implementing suitable alternative controls in place of the benchmark controls.

### 2.1.1 Feedstock

The Site's waste acceptance procedures for organics recycling comprise of residential greenwaste deliveries. The source for this organic product is from greenwaste materials that are dropped off to the bunkers near-to the CRC from domestic self-haul customers and is comprised of general landscaping materials (i.e., lawn clippings, leaves, plants, branches etc.), which are considered low risk feedstock sources as per Table 4 of the DWER Better practice composting guidelines.

In accordance with DWER's feedstock risk categories, Table 2-3 lists feedstock waste types, risk category and benchmark controls to achieve EPOs for *Emissions to land and water*, and *Odour*.

As part of the NRRP's operational and compliance systems, the site will refuse all wastes that don't meet the waste classifications required for the site and/or any contaminated wastes outside of the waste acceptance procedures and individual contaminant limitations as per the City of Wanneroo's current and proposed operational systems.

**Table 2-3: EPOs & Benchmark controls**

| Waste type | Standard feedstock | DWER Risk category | EPO | Benchmark controls |
|---|---|---|---|---|
| Greenwastes | Greenwaste (low contamination), natural fibrous organics, forestry residues. | Low | Emissions to land and water, Odour | Waste storage containment area/s, receivals and CRC location, short-term storage areas and hardstand bunkers, with bunkers graded to contain and divert leachates to sump for collection.<br>Clean, bulk/small and slightly decayed greenwastes from domestic deliveries.<br>Greenwastes are placed in the CRC area bunkers and then moved and stockpiled at a separate location within the NRRP.<br>Contaminated wastes are stockpiled and bailed (for e.g.) before removal via transport contractor/s. |

## 2.2 WTS Preliminary Design Concept Odour Emission Controls

The proposed WTS at the NRRP is designed to receive and transfer residual household waste (putrescible) and incoming bulk collection of residuals from retail and commercial streams.

Some comingled residual household wastes, coming from public deliveries, will be deposited in bins via the sawtooth drop-off public bays. These co-mingled residual waste (i.e., contaminated) will be transported to the WTS.

Greenwastes will be collected via the bunkers at the CRC and then moved to the long term storage area. No greenwastes will be deposited via the WTS.

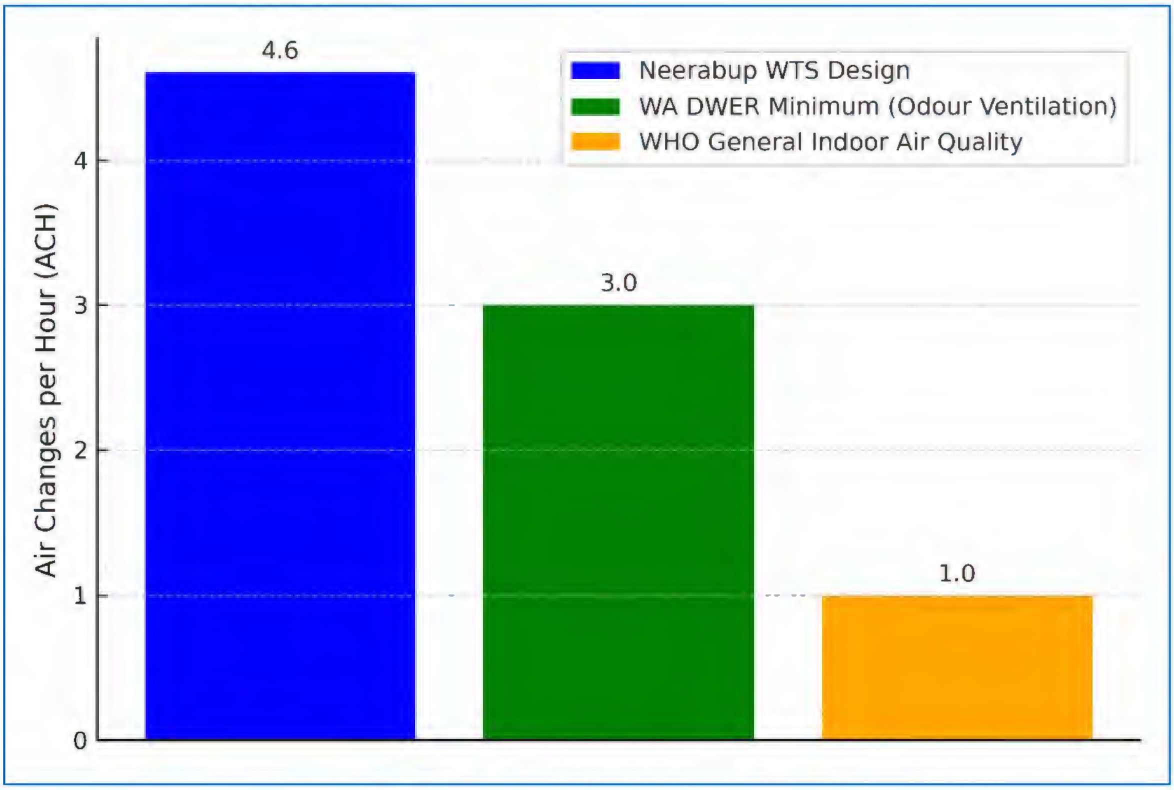
The WTS building design measures approximately 56 metres in length, 39.5 metres in width, and has a roof apex height of 17 metres. The eaves reach a height of 10.055 metres. To mitigate odour emissions and provide adequate internal worker comfort, the WTS will be equipped with a mechanical ventilation system designed to achieve typically four (4) air changes per hour. This is accomplished via a network of extraction fans discharging through a series of short stacks (6 of) positioned on the roof of the WTS building. Each stack will potentially be 3 metres above the roofline, have a diameter of 0.9 metres, and operate with an exhaust velocity of 10 metres per second.

This general design enables effective capture and upward dispersion of odorous air from within the WTS, particularly during the active periods of waste receival, stockpiling, and truck loading. The system operates to provide negative pressure inside the WTS to reduce fugitive odour emissions through doorways and openings.

The total estimated internal volume of the WTS building, based on the rectangular and roof-triangle cross sections, is approximately 29,934 cubic metres ($m^3$). To maintain odour control through adequate air exchange, the WTS is proposed to be fitted with 6 roof-mounted extraction stacks. Each stack, with a 0.9 m diameter and 10 m/s exit velocity, provides approximately 22,902 $m^3$ per hour of airflow. Together, the 6 stacks provide an estimated total exhaust capacity of 137,413 $m^3/h$.

Based on the estimated internal volume, this configuration achieves an air change rate of approximately 4.6 air changes per hour (ACH), exceeding the design target of 4 ACH and indicating a robust ventilation strategy.

As illustrated in the comparison figure below, the Neerabup WTS design exceeds both the DWER and WHO benchmarks, indicating a robust system capable of effectively managing indoor air quality and odour levels during waste handling operations.




https://www.wa.gov.au/government/publications/odour-emissions-guideline
https://www.who.int/publications/i/item/9789289041683

**Figure 2-1: Ventilation Rate (air-changes per hour) Benchmarking**

## 2.3 Operational Odour Analysis (OOA)

### 2.3.1 Proposed NRRP Activities

The NRRP will manage any potential for odour emissions based on the following key procedures:

- Waste received will be weighed and inspected and must comply with the waste categories set out in the City of Wanneroo's waste acceptance procedures to include diversion of wastes not meeting the acceptance criteria:
    - Waste type and volumes are monitored by onsite weighbridge operational staff and site operations personnel using waste classification guidelines.
- Discharge of wastes to the Environment are regulated and reported in accordance with the current DWER "Notification of waste discharges" under the EP Act 1986,
- CRC waste and recyclables are received in accordance with waste acceptance procedures,
- Greenwaste is received and deposited in designated areas within the CRC, and the greenwastes then moved to long-term stockpiling as required, to ensure the greenwaste bunkers are readily available daily,
- Incoming waste delivery trucks are covered and/or sealed as per contract arrangements,
- Wastes delivered to the WTS are done so as per designated waste classifications and in accordance with the receivals protocols for the WTS, where;

  - Contaminants are retained inside the WTS, compacted and/or bailed and loaded out for final removal to disposal facility offsite.
- Litter patrols conducted in accordance with the City of Wanneroo's management procedures of the NRRP,
- Unsecured loads resulting in lost waste from incoming/outgoing transport trucks are investigated immediately with cleanup crews deployed as required, contractor is advised of the contractual breach and put on notice, and
- All outgoing contaminated, non-recoverable wastes' transport trucks are covered and secured during transport.

The following Operational Odour Analysis (Table 2-4) summarises the proposed NRRP processes, sources of odour emissions, process controls, triggers and corrective actions and overall risk rating for odour impacts.

**Table 2-4: Operational Odour Analysis (OOA) of Proposed NRRP Operations & Odour Impact Potential**

| Odour Source | Dispersion Pathway | Process Description | Process Control | Triggers & Corrective Actions | Corrective Action Evaluation | Contingency Actions | Residual Odour Impact Potential | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Consequence | Likelihood | Impact Potential (onsite) | Impact Potential (nearest receiver) |
| Waste Deliveries to NRRP over weighbridge | Front Gate Ingress – Fugitive losses from transport vehicles. | Wastes delivered to the NRRP from City of Wanneroo kerbside collections, commercial collections, and segregated waste streams from domestic deliveries. Greenwastes to the CRC delivery bunkers from domestic waste streams. | Closed Waste Trucks and covered domestic loads. | Waste acceptance procedures and protocols – right of refusal. | Regular review of waste acceptance to NRRP. | Right of refusal to remove waste(s) from the NRRP prior to entry to designated waste receival area(s). | Minor | Possible | **Medium** *(localised odours at weighbridge)* | Low |
| Greenwaste Delivery to Community Recycling Centre (CRC) | Fugitive losses from deliveries. Odour losses as puffs and low-level fugitive, passive emissions from stockpiles. | Domestic trailers delivering greenwaste to the CRC greenwaste drop-off area. Moderate-High Strength Odours may be generated when the greenwastes are being long-term stockpiled where decomposition will occur within the stockpiles. | Negligible other than waste acceptance procedures and protocols. Limited Controls in place due to the nature of the activity, although greenwastes will be daily placed in the CRC greenwaste bunkers before being moved to the long-term stockpiling area. | Waste acceptance procedures and protocols – right of refusal. | Regular review of waste acceptance to NRRP. | Right of refusal to remove waste(s) from the NRRP prior to entry to designated waste receival area(s). Adequate separation distances between odour source and nearest receptor. | Moderate | Possible | **Medium** *(localised odours at CRC and long-term stockpiling area)* | Low |
| Waste Transfer Station (WTS) | The emission pathway to the nearest receptor is from stack odour emissions. There is negligible terrain influences nor complex meteorology. The nearest receptor is approximately 960 m to the north of the NRRP. | During transit the trucks are closed/covered, and the odour emission source is negligible given it is contained. | All waste trucks are covered. | Weighbridge staff and operational personnel accept waste according to licence conditions and waste classifications. | Non-conforming waste is refused site entry. | Not required. | Minor | Rare | Low | Low |
| | | RCVs unload putrescible wastes on the WTS floor. Initial displacement of an odour plume during deposition of the wastes. Wastes are stockpiled on the WTS floor to ensure separation from other non-putrescible wastes. The WTS is a volume source where odours are contained and extracted to provide negative pressure inside the WTS. | Air change rate of approximately 4.6 air changes per hour (ACH), exceeding the design target of 4 x ACH and indicating a robust ventilation strategy. | Wastes deemed highly odorous by operational personnel, such as Christmas food wastes, are cleared from the WTS floor ASAP into load-out truck. WTS floor washed down to remove leachates if/as required. | Removal of these odorous wastes directly into the load-out truck ensures the risk of fugitive malodour emissions from the WTS floor is minimised. | Covered load out truck, during standby, if the putrescible waste loads are highly odorous. | Moderate | Rare | **Medium** | Low |

| Odour Source | Dispersion Pathway | Process Description | Process Control | Triggers & Corrective Actions | Corrective Action Evaluation | Contingency Actions | Residual Odour Impact Potential | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Consequence | Likelihood | Impact Potential (onsite) | Impact Potential (nearest receiver) |
| Waste Transfer Station (WTS) | The emission pathway to the nearest receptor is from stack odour emissions. There is negligible terrain influences nor complex meteorology. The nearest receptor is approximately 960 m to the north of the NRRP. | Sludges & Wash Down Leachate. Ground level liquid wastes that undergo vapourisation, in particular within the hotter seasonal periods. | Liquid waste residues within the WTS will be managed in accordance with the City's leachate procedures and processes required to remove and contain liquid waste deposited on the WTS floor. | Visually noticed sludge and leachates. | Response protocols adhering to the City's procedures and processes. | Not required given the settling pit/tank volume and low volumes of liquid waste required to be pumped from the WTS floor during a response. | Minor | Rare | Low | Low |
| | | Outgoing Bulk Waste Trucks. 'Puffs' of odours during the loading of the bulk waste trucks within the loadout lane. Increased vehicle emissions and fumes from loader movements, bulk truck engine etc. | Air change rate of approximately 4.6 air changes per hour (ACH), exceeding the design target of 4 x ACH and indicating a robust ventilation strategy. | Time-clock controls in use to activate the 4 x extraction fans. | Ensure fans operational. | Cessation of loadout if fans off. Replacement impellers, motors and manual override of weather louvres as required. | Moderate | Rare | Medium | Low |
| Greenwastes | Fugitive losses from deliveries. Odour losses as puffs and fugitive, passive emissions from stockpiles. | Domestic trailers delivering greenwaste to the CRC greenwaste drop-off area. Moderate – High strength Odours may be generated when the greenwastes are being mulched / shredded and allowed to accumulate, at the long-term stockpiling area, where decomposition may occur. | Negligible other than waste acceptance procedures and protocols. Limited Controls in place due to the nature of the activity. Scheduling of greenwaste mulching / shredding (as required) to coincide with favourable wind conditions minimizing impacts on nearest sensitive receivers. Processing, shredding and stockpiling (as required) of greenwastes as quickly as practicable to minimize the volume of raw materials in the CRC greenwaste area. | Waste acceptance procedures and protocols – right of refusal. | Regular review of waste acceptance to NRRP. | Right of refusal to remove greenwastes from the NRRP prior to entry to designated receival area/s. Cessation of any mulching / shredding activity under those worst-case conditions where prevailing winds affect sensitive receivers on an ongoing basis. | Moderate | Possible | Medium | Low |

# 3 Local Meteorological Analysis

The nearest automatic weather stations surrounding the NRRP site is the Western Australia Department of Primary Industries and Regional Development (DPIRD) Wanneroo Station (WN), which is approximately 14 kms north, northwest from the NRRP.

Another DPIRD station is located at Pinjar (PNJR) which is closer to the NRRP site, however; the PNJR site has only been active since February 2025 and does not have long-term data yet available.

Further from the Wanneroo DPIRD station is the Pearce RAAF Base BoM AWS, which is approximately 23 kms away.

For this meteorological analysis, the Wanneroo DPIRD (WN) data has been reviewed, and a summary of the review found that:

- Morning hours in winter pose the greatest odour risk due to calm and stable conditions,
- Midday operations at the NRRP will benefit from convective mixing and stronger breezes that aid dispersion,
- Proper timing of any greenwaste shredding and loadout activities may help reduce any odours from greenwaste being observed beyond the NRRP boundaries,
- Residual waste and green waste handling activities at the NRRP are unlikely to result in offsite odour impacts when managed under proposed operational practices, and
- The NRRP layout, existing buffer distances to the nearest receptor and to those far-field residential receptors and ventilation for the WTS that will ensure stagnation of malodours inside the WTS is mitigated and therefore exhaust odours are diluted as much as practicable, are sufficient for maintaining compliance with odour standards.

### 3.1.1 Rainfall

In general terms rainfall often accompanies weather patterns with lower wind speeds (excluding storms) causing odours to disperse less effectively. However, rainfall causes wet deposition and can physically wash out odour particles thus reducing observations of airborne odours, humidity and temperature changes during rain can influence the volatility and spread of odorous compounds, and rainfall can cause odours to become more concentrated locally, especially when coupled with low winds and stable atmospheric conditions.

The 5 yearly analyses of rainfall for the location is illustrated in Figure 3-1 and shows that rainfall is low in summer as expected, and typically elevated in the other seasons with maximum rainfall in winter (again as expected). Year on year the rainfall trends are seasonally comparable. Winter exhibits the highest rainfalls, whilst since 2021, rainfall has declined in recent years for summer, autumn and spring.

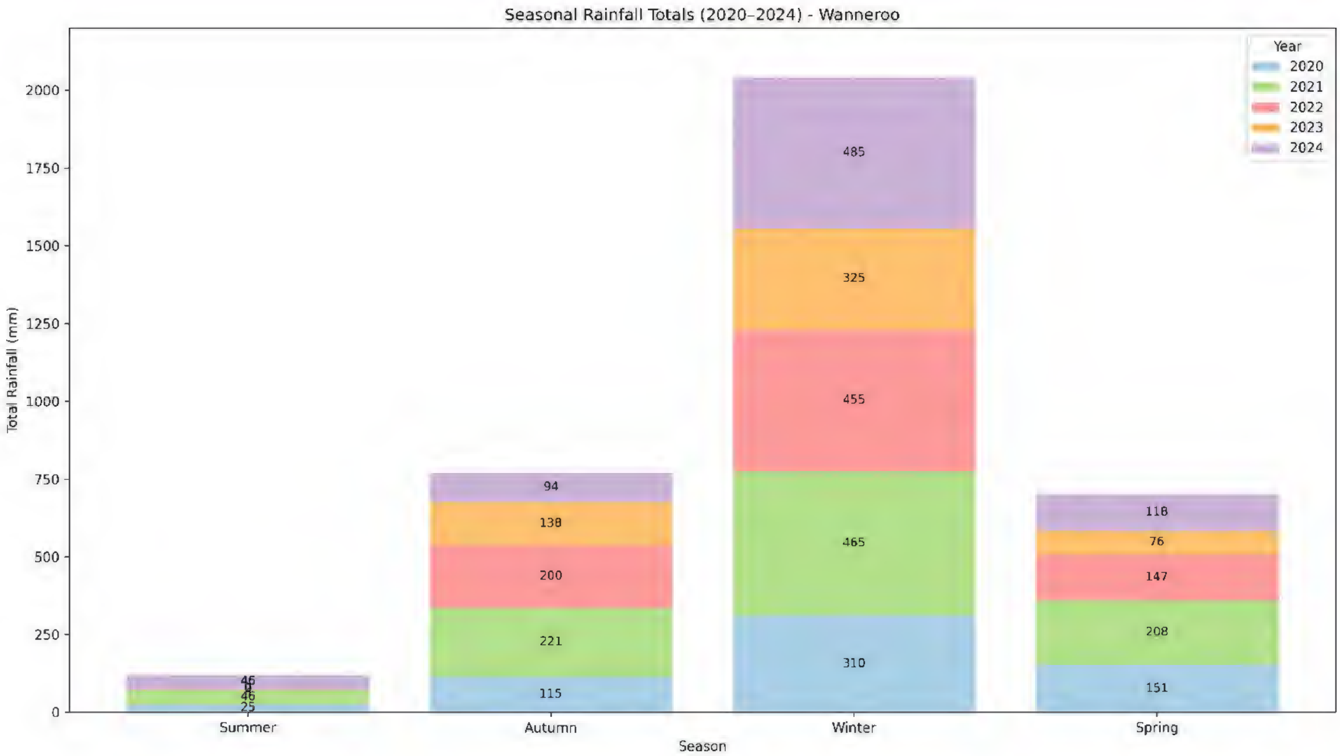



**Figure 3-1: Rainfall Characteristics for Wanneroo (2020-2024)**

### 3.1.2 Wind Characteristics

Figure 3-2 shows the annual windrose characteristics for the past 5 calendar years. It can be seen from the annual windroses that prevailing winds are characteristically from the south-southwest and east-southeast.

Figure 3-3 shows the distribution of wind direction trends for the location and further demonstrates that dominant winds prevail from the S-SW and E-SE.

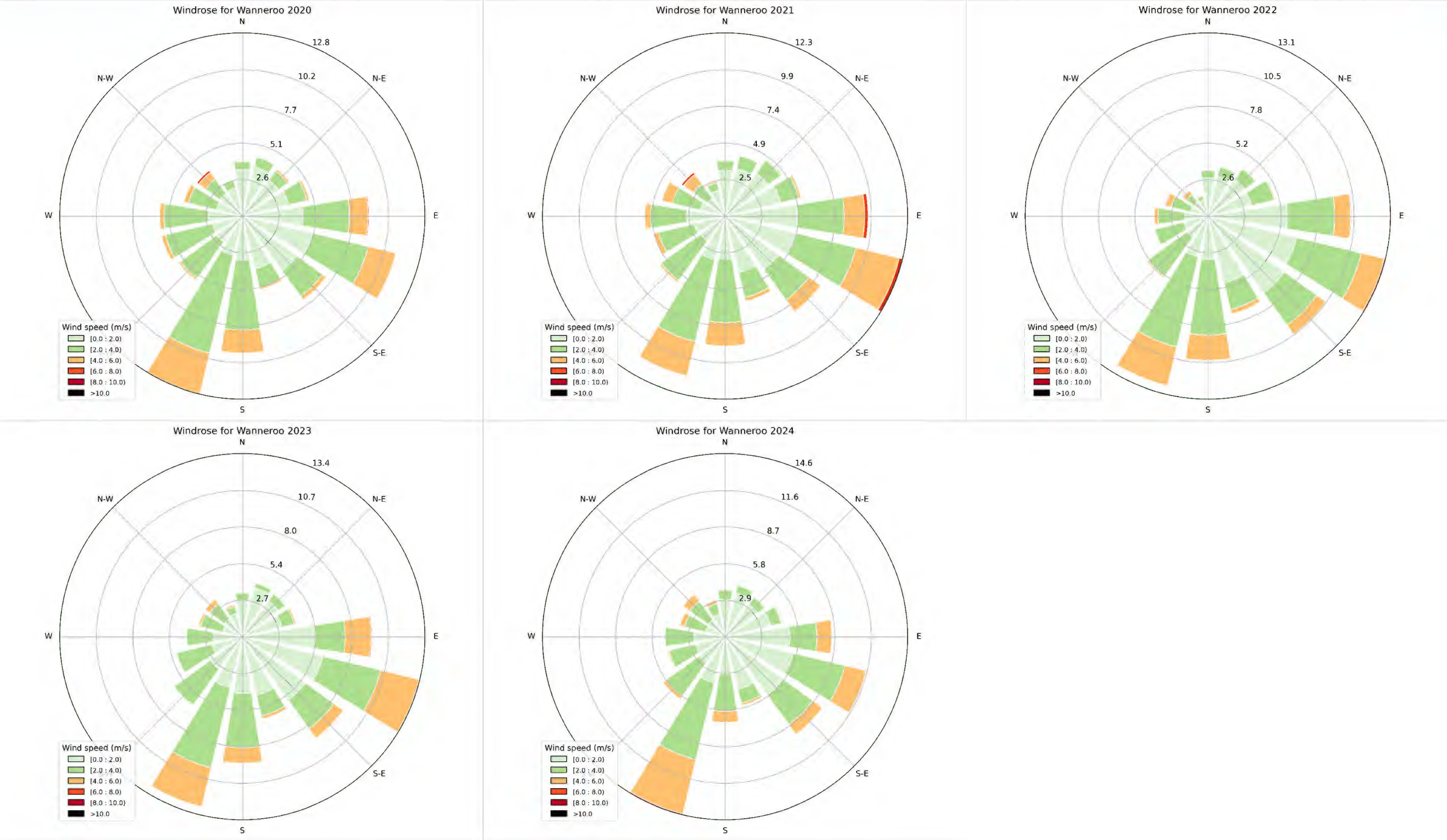



**Figure 3-2: Windrose Characteristics for the Calendar Years 2020-2024**

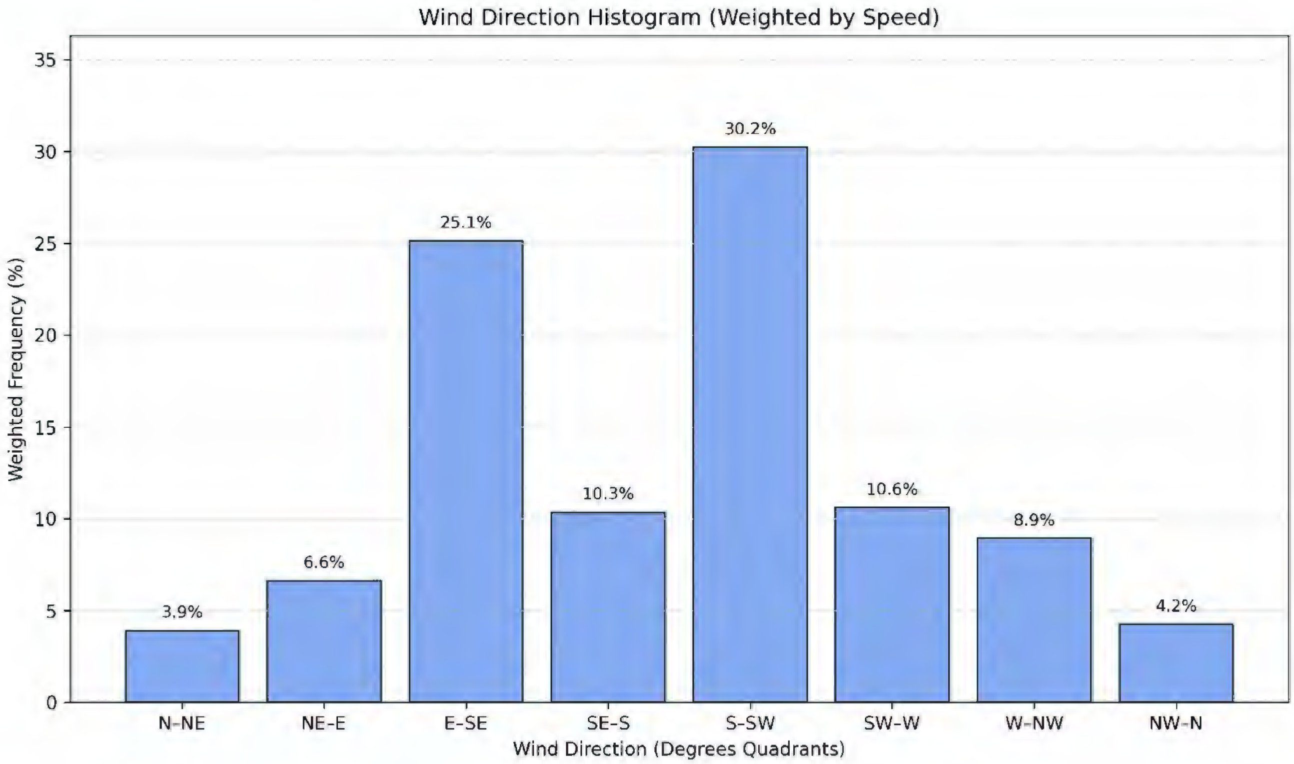



**Figure 3-3: Wind Direction Trends for the Calendar Years 2020-2024**

Further analysis of wind characteristics can be achieved by evaluating the U and V wind components, which are the horizontal vector components of wind speed to describe wind direction and magnitude mathematically, where;

- **U Component** = Zonal wind that represents east-west motion of wind, and:
  - Positive U = wind blowing from west to east (i.e., westerly winds), and
  - Negative U = wind blowing from east to west (easterly winds).
- **V Component** = Meridional wind that represents north-south motion of wind, and:
  - Positive V = wind blowing from south to north (i.e., southerly winds), and
  - Negative V = wind blowing from north to south (northerly winds).

The U Component illustrated in Figure 3-4, and the V Component illustrated in Figure 3-5 show the following key characteristics as discussed in Table 3-1.

**Table 3-1: U and V Wind Component Analysis**

| | |
|---|---|
| **U Component** | Sharp central peak at 0 m/s:<br>• Winds with little east–west component are most frequent,<br>• Likely indicates light winds or calm conditions are common, or<br>• Wind is primarily aligned north–south (V-dominant flow).<br>Asymmetry in distribution:<br>• The right side (positive U, westerlies) has a longer tail than the left,<br>• Suggests westerly winds (from the west, blowing east) are more frequent or stronger than easterly winds.<br>Year-to-year consistency:<br>• The shapes of the curves across all five years are very similar,<br>• Implies stable wind patterns over the 2020–2024 period at this site. |
| **U Component Summary** | 1. The site experiences a high frequency of light or calm wind conditions, especially with minimal east–west wind,<br>2. When winds are stronger, they are more likely to have a westerly component than easterly, and<br>3. Inter-annual variation in wind direction is low, supporting consistency in dispersion modelling assumptions across these years. |
| **V Component** | Sharp peak at V = 0:<br>• The dominant wind condition is low-magnitude V-component winds or winds aligned more east–west,<br>• Indicates a high occurrence of either calm conditions or wind dominated by the U component (zonal winds).<br>Positive V component is more frequent than negative:<br>• The curve is slightly skewed to the right (positive),<br>• Suggests that southerly-originating winds (blowing northward) are more frequent or sustained,<br>• This aligns with the typical Perth region climatology, where southerly sea breezes are common, especially in summer.<br>Interannual consistency:<br>• As with the U component, curves from 2020–2024 show strong overlap, indicating a stable meridional wind behaviour across years,<br>• Suitable for year-to-year comparison and modelling input validation. |
| **V Component Summary** | 1. Winds with a minimal north–south component are most frequent, meaning wind flows are often either calm or more east–west aligned,<br>2. When a north–south component is present, the southerly (positive V) component is more frequent and/or stronger than the northerly (negative V), and<br>3. Confirms the influence of regular south/southwest sea breezes, particularly during warmer months. |

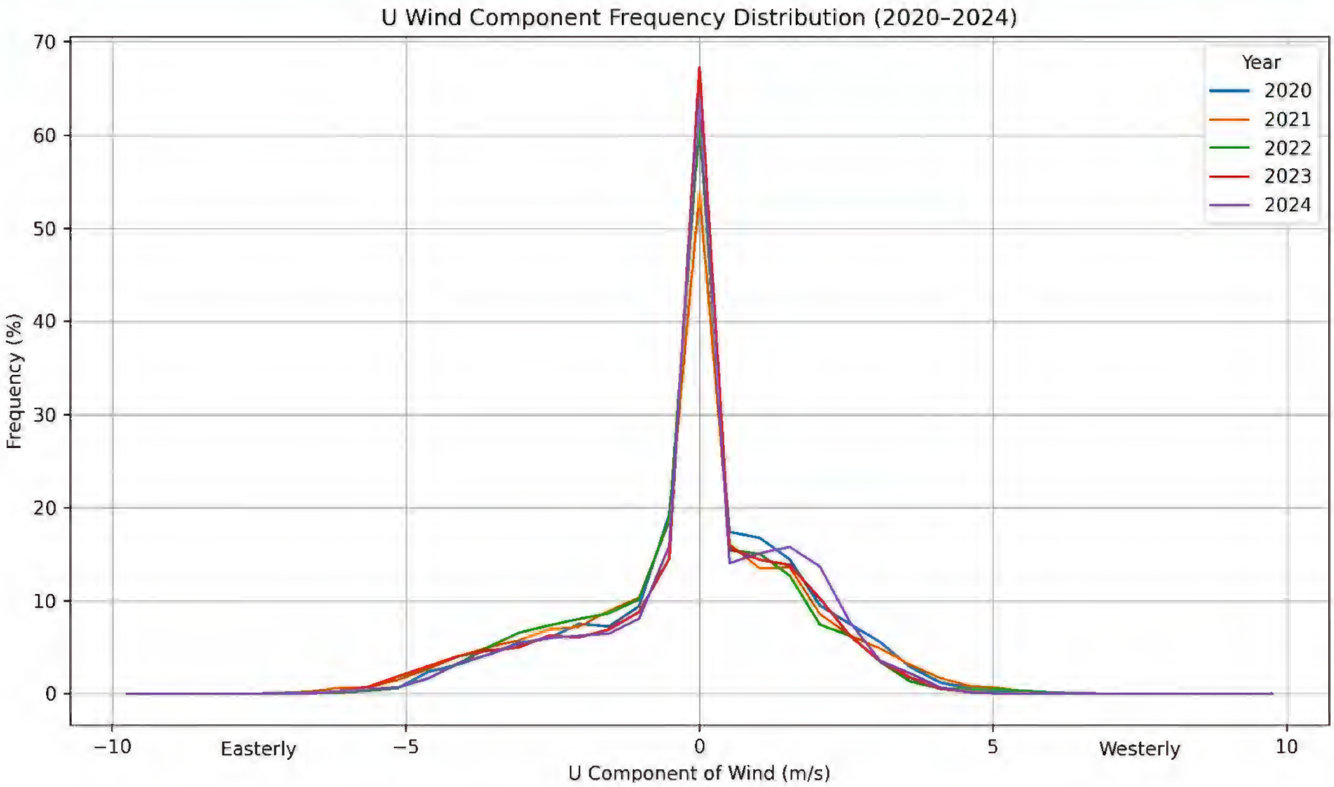



**Figure 3-4: U Component of Wind (East-West) 2020-2024**

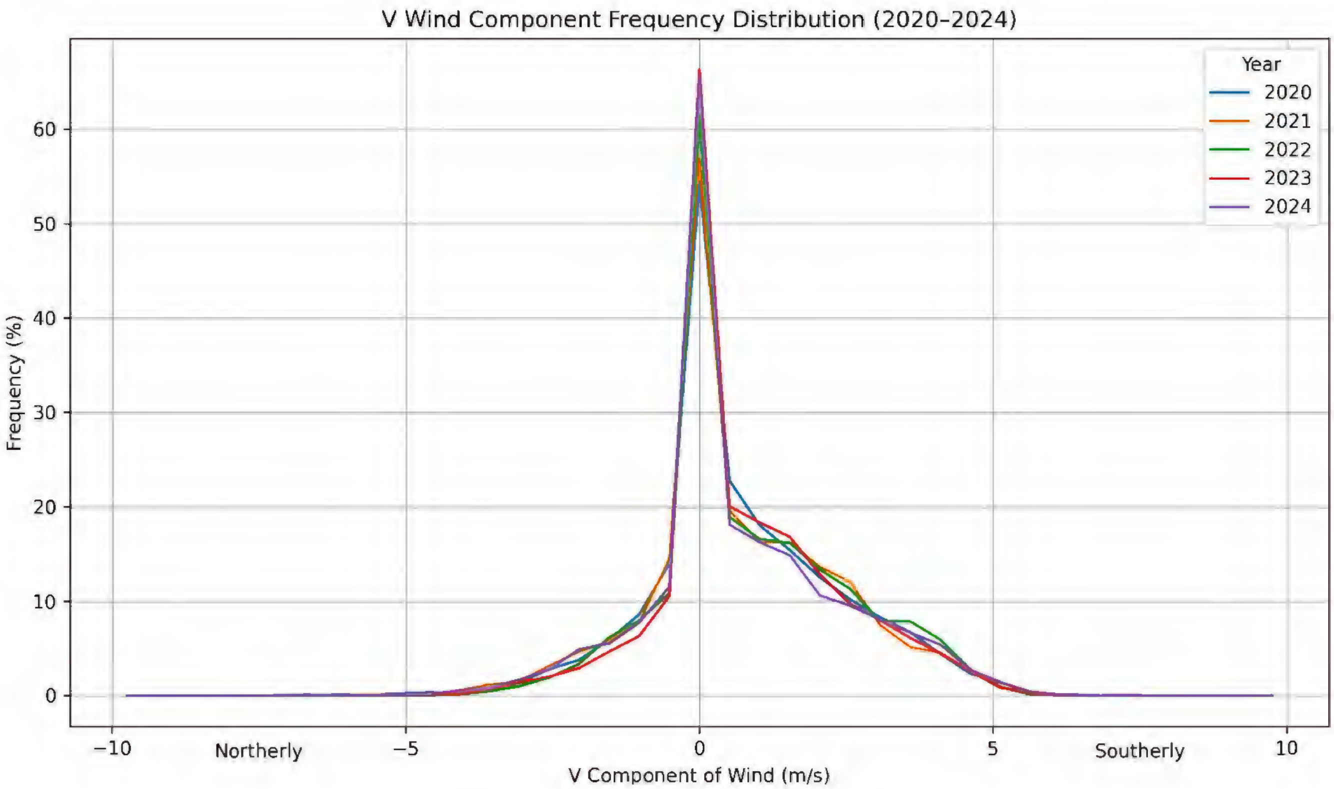



**Figure 3-5: V Component of Wind (North-South) 2020-2024**

Analysing the 5-year wind trends, the times of day have also been interrogated to determine wind trends during those operational times for the Site, which are 6am – 6pm, and are illustrated in Figure 3-6.

Winds during daytime are generally light to moderate, with most speeds between 1.5 m/s and 3.6 m/s. The dominant daytime wind directions are south to south-southwest (180°–210°) with approximately 1 in 5 observations over the 5 year data period. Easterly to ESE (90°–120°) winds are common in the mornings, and southwest and southeast quadrants are strong contributors to prevailing winds in the locality. Winds are strongest and most frequent from the S–SSW sector**,** characteristic of the Perth sea breeze system, typically developing from late morning to afternoon. Easterly winds are also common**,** likely in the early part of the day before sea breeze onset, and Wind speeds are generally suitable for odour dispersion but not excessively strong — often in the 2–3.5 m/s range.

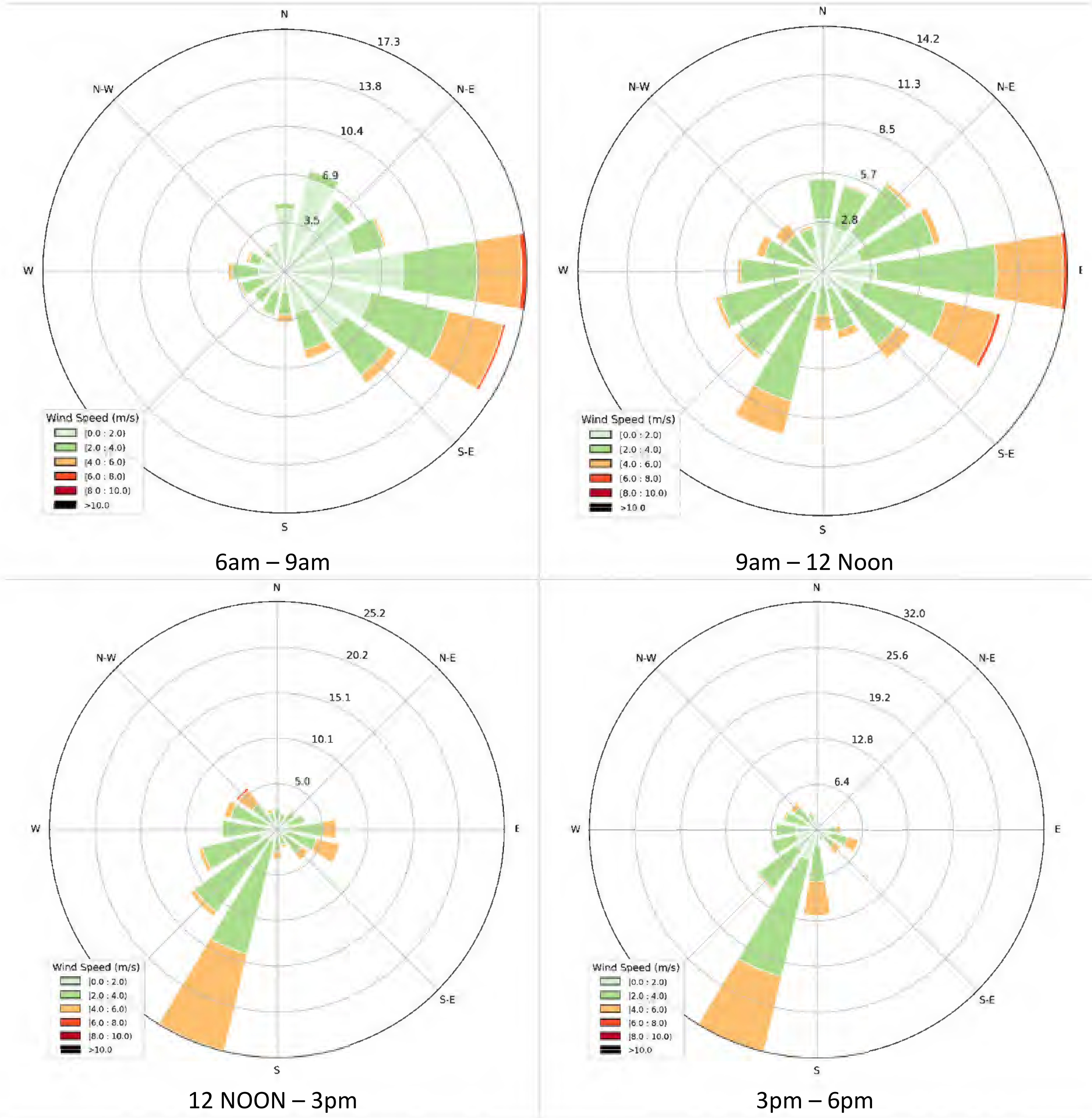



**Figure 3-6: Time of Day Windroses for Operational Hours of 6am – 6pm**

### 3.1.3 Atmospheric Stability

Stability classification is a measure of atmospheric stability determined from wind characteristics and other observations. Classes range from A (very unstable, sunny days) to F (very stable, light winds at night).

Unstable conditions (Stability Classes A to C) are associated with strong solar heating and surface turbulence, leading to enhanced vertical mixing of the atmosphere. This mixing causes rapid dispersion and dilution of airborne emissions, typically resulting in lower concentrations at ground level near the source, but it can also increase ground-level impacts further downwind due to vertical mixing bringing elevated high-strength odour plumes downward.

Class D (neutral stability) is typically associated with mechanical turbulence generated by moderate winds interacting with surface roughness and physical obstructions such as buildings and vegetation. These conditions often occur on overcast days or during transition periods (e.g., morning and evening) when solar heating is minimal, and atmospheric temperature gradients are weak.

During nighttime, in the absence of cloud cover and under light winds, the atmosphere tends to become stable, leading to Stability Classes E and F, where vertical mixing is suppressed and pollutants can accumulate near the earth’s surface.

Atmospheric stability classes were derived from DPIRD’s Wanneroo automatic weather station data using a modified Pasquill-Gifford scheme based on surface-level wind speed and solar radiation. During daytime, stability was classified using a radiation–wind speed matrix; at night, stability was inferred using wind speed thresholds in the absence of cloud cover data. This method, widely adopted for screening-level dispersion modelling, provides a reliable estimate of stability class under steady-state conditions and is suitable for applications where direct turbulence or vertical profiling data are unavailable.

The DPIRD automatic weather station at Wanneroo provides hourly measurements (among others) of:

- Wind speed and direction,
- Temperature,
- Solar radiation (daytime), and
- Relative humidity.

Since it does not provide direct turbulence measurements (e.g. standard deviation of vertical wind speed or Monin-Obukhov length), stability class estimation relies on proxy methods in lieu of further data development and analysis using prognostic models.

The most common method used is a variant of the Pasquill-Gifford-Turner (PGT) classification, adapted to surface-level observational data, and adopting the following assumptions described in Table 3-2.

**Table 3-2: Derived Atmospheric Stability Assumptions**

| | |
|---|---|
| **Assumption A:** Stability is primarily influenced by solar radiation and wind speed (daytime). | • During daylight hours, solar insolation drives thermal turbulence,<br>• Stability is then inferred using a matrix of solar radiation intensity vs. wind speed, for example:<br>o High radiation + low wind = very unstable (Class A),<br>o Moderate radiation + moderate wind = neutral (Class D), and<br>o Low radiation + high wind = stable (Class E/F). |
| **Assumption B:** At night, stability is governed by wind speed and cloud cover. | • After sunset (when solar radiation = 0 W/m²), the ground cools, and radiative cooling can cause stable stratification,<br>• In the absence of cloud cover data, wind speed thresholds are used as a proxy:<br>o Calm or low wind (≤2 m/s) → very stable (Class F),<br>o Moderate wind → stable (Class E), and<br>o High wind (>6 m/s) → neutral (Class D). |
| **Assumption C:** Solar radiation is a valid proxy for insolation class. | • DPIRD stations measure incoming solar radiation (W/m²), which is directly usable to classify daylight intensity as:<br>o Strong (>600 W/m²) → High insolation,<br>o Moderate (300–600 W/m²) → Medium, and<br>o Weak (<300 W/m²) → Low.<br>• This allows more accurate classification than earlier methods that only used time of day. |

Supporting these Assumptions are the following key points:

- The modified Pasquill-Gifford scheme is globally accepted for screening assessments and odour modelling when turbulence data is not available,
- DPIRD's solar radiation and wind speed sensors are high quality and maintained, and
- Stability class derived from local wind and radiation conditions at Wanneroo better reflects site-specific dispersion potential than generic climatological assumptions.

However, there are limitations, such as:

- The approach assumes homogeneous atmospheric conditions near the surface and does not account for elevated inversions or complex boundary layers,
- Cloudiness, which moderates radiative cooling, is not directly available and must be inferred or ignored in nighttime classification, and
- The method classifies hourly conditions as static, ignoring rapidly changing or transient atmospheric states (i.e., assumed steady-state).

### 3.1.3.1 Atmospheric Stability Findings

For the NRRP locality, the key stability characteristics during operational hours of 6am – 6pm are:

- 6am – 9am (Transition from Night to Day):
  - Dominated by Class A (Very Unstable), and Class B (Unstable) starting to emerge,
  - Rapid decrease in stable classes (E and F) as solar radiation increases,
  - Characterised by rapid warming and surface turbulence onset, and
  - Indicates strong convective mixing beginning early in the day.

- 10am – 3pm (Midday Period)
  - Dominated by Class C (Slightly Unstable) and Class B,
  - Class A still contributes notably between 10–12 PM,
  - Neutral (D) appears marginally,
  - This time period has the strongest thermal instability, caused by peak solar insolation, and
  - Ideal dispersion conditions where odour emissions are quickly diluted both vertically and horizontally.
- 4pm – 6pm (Late Afternoon)
  - Gradual reduction in unstable classes,
  - Class C and B decrease,
  - Class A becomes rare,
  - Class D (Neutral) and Class E (Slightly Stable) begin to reappear which signals transition toward evening cooling, reducing convective turbulence.

Overall, for the NRRP locality and daily operational hours there is predominance of unstable conditions (A, B, C) throughout daylight hours, the most frequent class is Class C (slightly unstable) between 11am and 3pm, stable classes (E and F) are largely absent during this period, and neutral (D) appears during transitions, especially around 6am and 5–6pm. As a result of the daytime stability characteristics, daytime odour emissions are likely to disperse well due to strong turbulence and mixing.

Figure 3-7 illustrates the hourly atmospheric stability trends for the 2020-2024 annual periods, whilst Figure 3-8 illustrates the proportional occurrences of stability trends for the 2020-2024 annual periods.

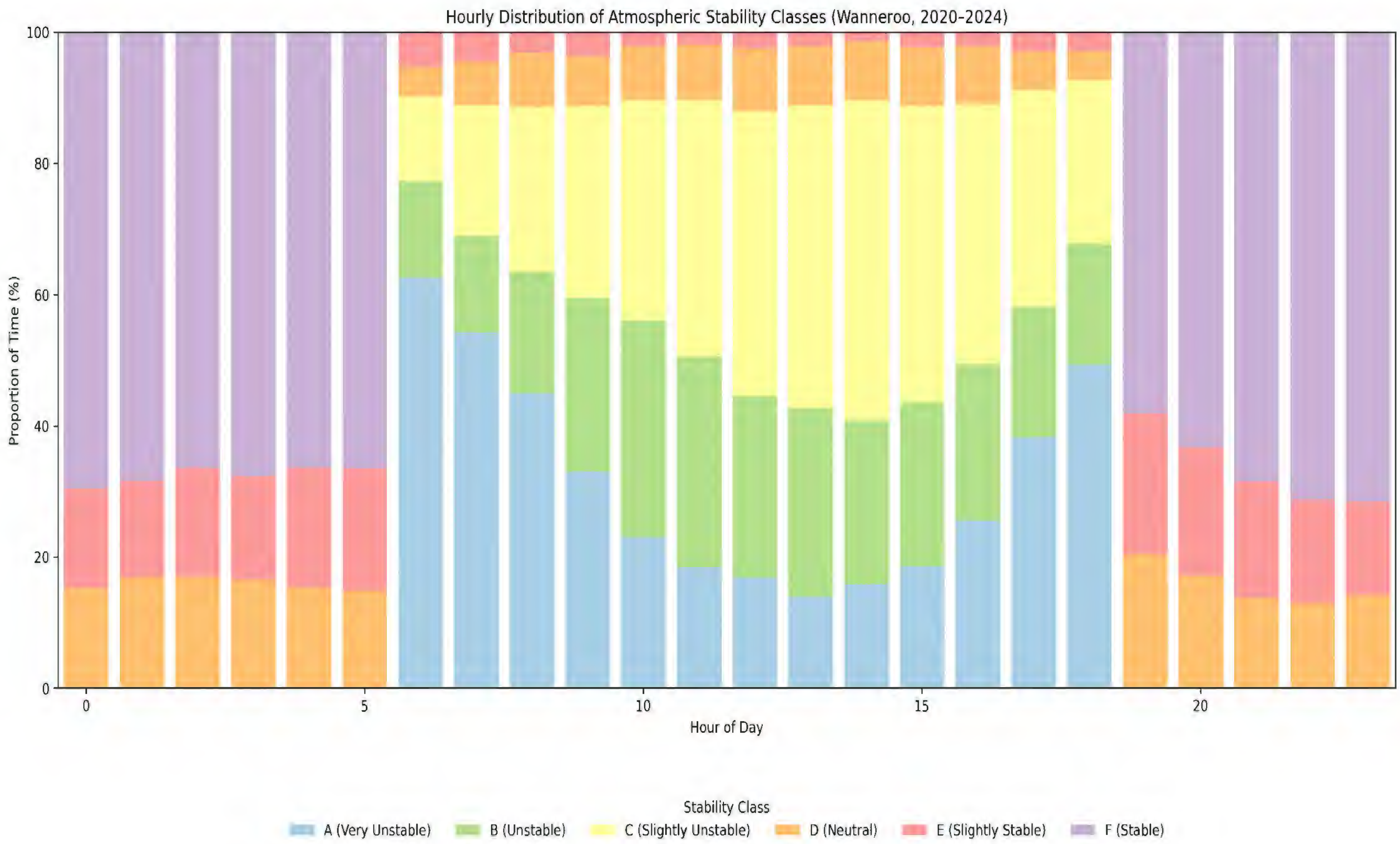



**Figure 3-7: Hourly Distribution of Atmospheric Stability for Wanneroo (2020-2024)**

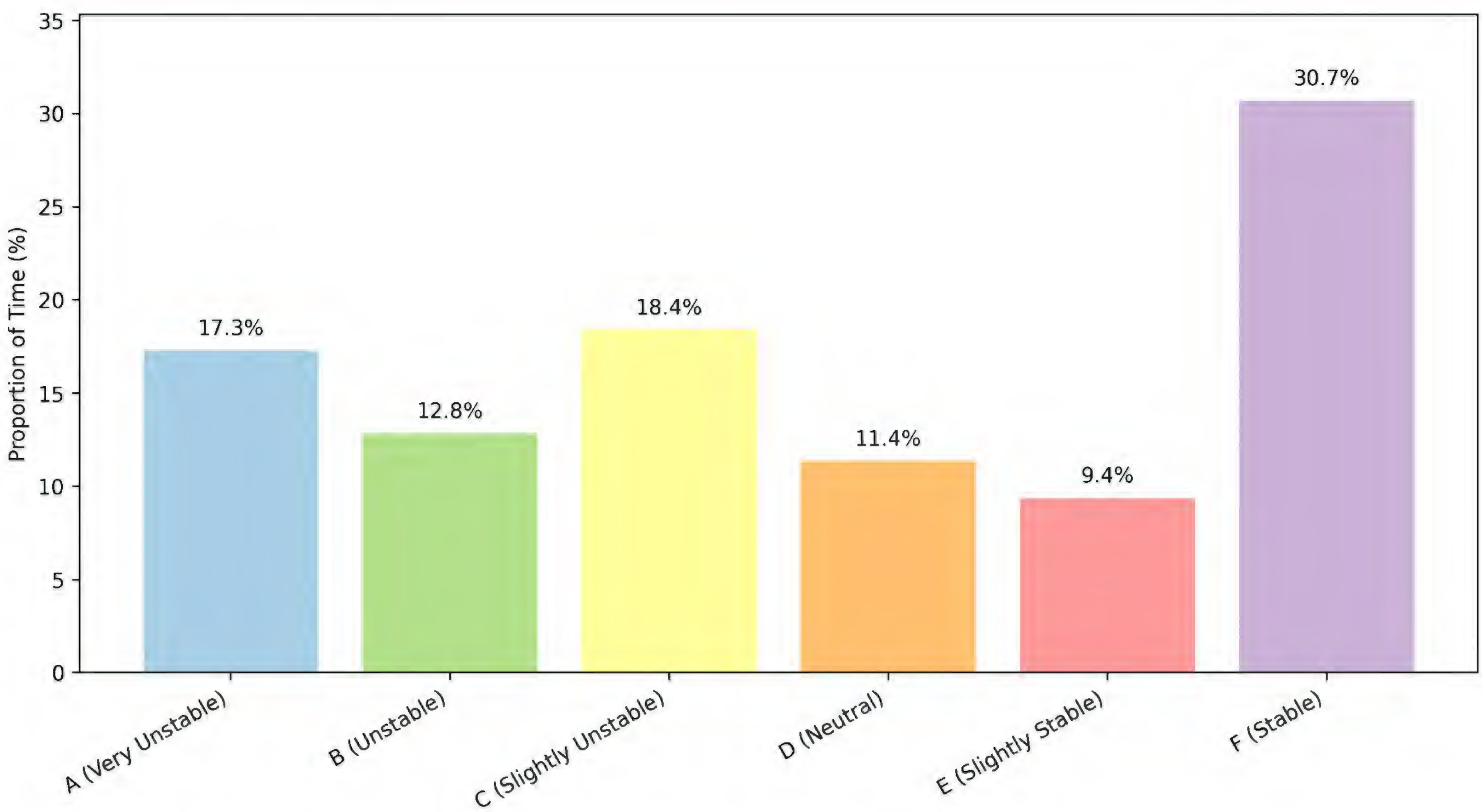



**Figure 3-8: Atmospheric Stability for Wanneroo (2020-2024)**

## 3.2 Summary of Odour Impact Potential based on Meteorology

The nearest non-residential sensitive receptor is located approximately 960 metres from the NRRP site boundary, while the closest residential sensitive receptor lies approximately 2 kilometres to the south. Given that northerly winds are negligible in this locality, separation distances to the nearest residential dwelling are considered more than sufficient to mitigate potential daytime odour impacts from site activities.

Daytime hours present a lower risk of malodour impacts due to typically stronger wind speeds and, importantly, the prevalence of convective atmospheric mixing. As the earth's surface warms during the day, rising air currents promote vertical dispersion, allowing odorous emissions to move upward and dilute more effectively within the atmosphere.

In the absence of strong convective mixing, mechanical turbulence plays a significant role in odour dispersion. This occurs when horizontal airflows interact with surface roughness elements such as vegetation, buildings, and terrain features, disrupting the structure of odour plumes and enhancing horizontal dilution near the surface.

Where the odour profile is characterised by moderate to low intensity emissions, and where the emissions do not contain high-risk malodorous compounds with low detection thresholds, such odours are more readily dispersed in the near field. This is due to the combined effect of mechanical dispersion (caused by airflow interacting with downwind obstructions) and convective uplift, both of which act to dilute and distribute the odour away from sensitive receptors.

Given the operational hours of 6am – 6pm, the favourable meteorological conditions that promote daytime dispersion of odours, the siting of the NRRP with respect to residential dwellings and prevailing winds, and the large separation distances between odour source and sensitive receptors, the likelihood of any malodour from activities at the NRRP having an amenity impact of the receiving environment is low.

# 4 Odour Emissions Evaluation - Modelling

## 4.1 Assessed Odour Emission Strengths

EAQ has been undertaking odour sampling and testing of residual (putrescible) waste facilities throughout Australia for 20+ years.

The most comparable site within Western Australia that has regular odour data capture is located south of the river in Canning Vale. For the past 5-years of testing (i.e., Jan 2020 – June 2025) the average strength of odours extracted from the Canning Vale WTS floor was approximately 1,200 ou/m$^3$, within a range of odour strengths from 390 – 5,400 OU.m$^3$. The average odour strength of 1,200 ou/m$^3$ approximately represents the 60$^{th}$ percentile of the dataset.

For conservatism, the 90$^{th}$ percentile odour strength of 2,200 ou/m$^3$ was assessed as the odour strength emission from the six (6) extraction fans with each extraction fan having the following characteristics:

- Height of 3 m above the roofline (i.e., at 20 m terminal exhaust),
- Diameter of 0.9 m,
- Exit velocity of 10 m/s, and
- Odour concentration of 2,200 OU.m$^3$, which;
    - Equates to an odour emission rate of 14,000 OU.m$^3$/s per stack.

## 4.2 Gaussian Screening Model

The odour screening model applied in this assessment is based on classical Gaussian plume dispersion theory and is intended to provide a conservative first-pass estimate of ground-level odour concentrations resulting from elevated point source emissions such as stacks or vents. The model uses established physics and empirical relationships to predict the dispersion of odorous compounds in the atmosphere under various meteorological conditions.

The core of the model is the Gaussian plume equation, which assumes a continuous, steady-state emission source and calculates ground-level concentrations as a function of downwind distance, emission rate, wind speed, effective stack height, and atmospheric turbulence. The model equation is:

**Equation 1:** $C(x) = (Q / (2\pi\sigma y\sigma zu)) * \exp(-(Heff^2 / (2\sigma z^2)))$

Where:

- C(x) is the odour concentration at a given downwind distance x (in OU.m$^3$),
- Q is the odour emission rate (OU.m3/s),
- σy and σz are the lateral and vertical dispersion coefficients (m), determined by atmospheric stability class,
- u is the wind speed at stack height (m/s), and
- Heff is the effective stack height (m), including buoyant plume rise.

Plume rise is estimated using a simplified buoyancy flux approach derived from Briggs' equations. The formula accounts for exit velocity, stack diameter, stack gas temperature, and ambient temperature to determine the vertical momentum of the emitted plume:

**Equation 2:** $\Delta h = 1.6 * (F / u^2)^\wedge(1/3)$, where $F = g * V * d^2 * (Ts - Ta) / Ta$

Here, g is gravitational acceleration (9.81 $m/s^2$), V is the stack exit velocity (m/s), d is the stack diameter (m), Ts is the stack temperature (K), and Ta is the ambient temperature (K). The effective height (Heff) is the stack height plus the calculated plume rise but limited to 1.5 times the building height or width to account for potential building downwash effects.

The dispersion coefficients σy and σz are empirically derived and vary according to atmospheric stability class (ranging from A: very unstable to F: very stable). These coefficients determine the extent of lateral and vertical plume spread and are defined as follows:

**Equation a:** $\sigma y(x) = ay * x * (1 + 0.0001x)^\wedge{-0.5}$
**Equation b:** $\sigma z(x) = az * x$

Where ay and az are stability-class-specific constants.

The model evaluates odour concentrations for multiple atmospheric stability scenarios, with particular focus on Classes D, E, and F, which are typical of neutral to stable daytime and evening conditions. The model also calculates average concentrations over selected stability classes to represent composite conditions.

Threshold distances are identified where predicted ground-level odour concentrations (GLCs) fall below defined odour thresholds (e.g. 1 $OU/m^3$ and 5 $OU/m^3$). These thresholds correspond to the typical human odour detection limit and the onset of potential odour nuisance, respectively. The model determines the distance downwind at which each threshold is first met.

Additionally, the model was used to generate circular odour contour plots, showing threshold exceedance radii around the emission source.

Key assumptions in the model include:

- Flat terrain and unobstructed wind flow,
- Constant meteorological conditions (wind speed and direction),
- No chemical transformation or deposition of the odorous compounds, and
- Receptors located at ground level.

The model is suited for preliminary or screening-level odour assessments and provides a practical means to compare alternative emission scenarios, stack configurations, or control strategies in terms of their potential off-site odour impacts.

The following figures present the outcomes of the Gaussian screening odour model assessment for the NRRP Waste Transfer Station (WTS), with Figure 4-1 showing that a GLC of 5 $OU.m^3$ is not observed downwind of the WTS.

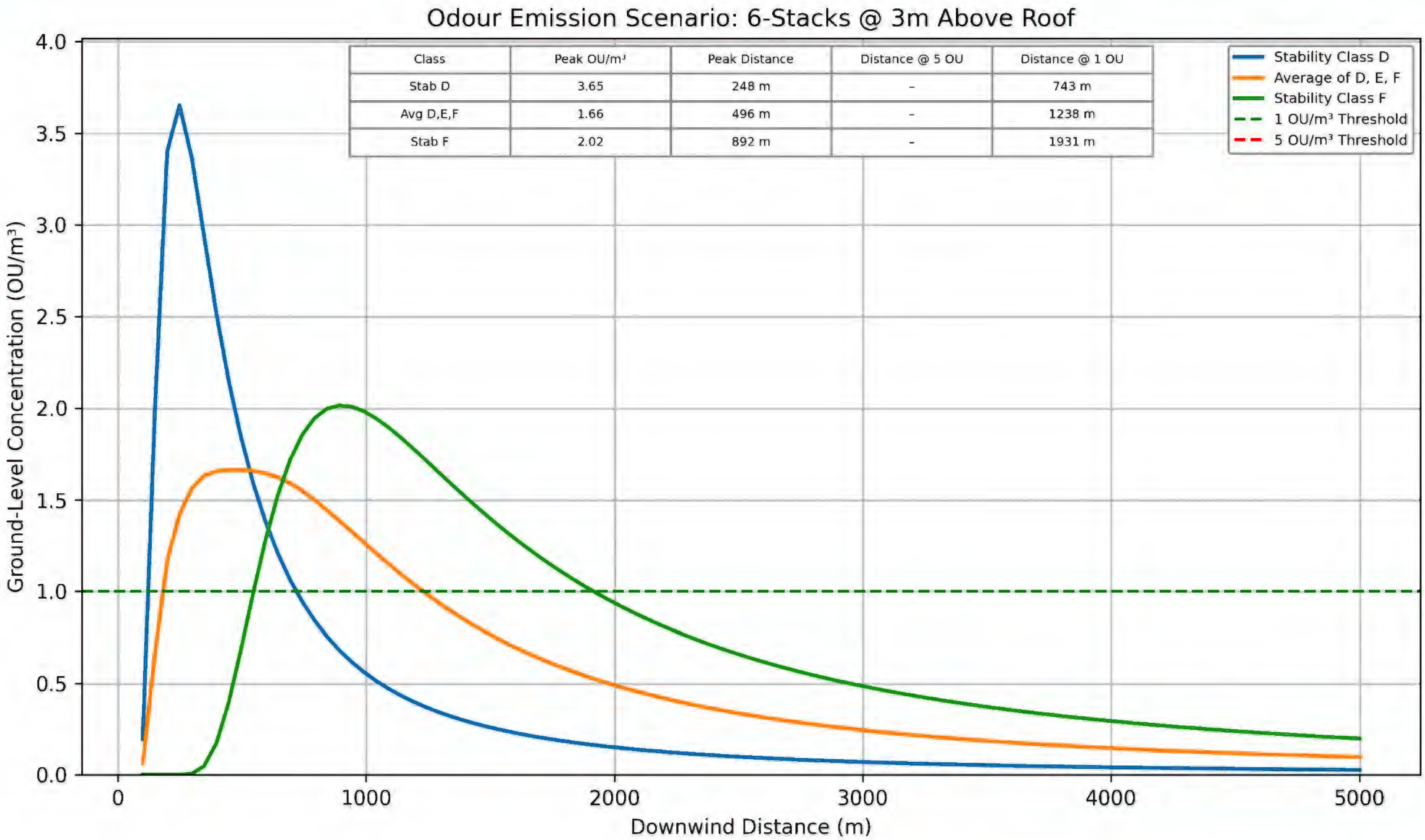



**Figure 4-1: Relationship of Ground Level Odour Concentration (GLC) versus Downwind Distance from WTS**

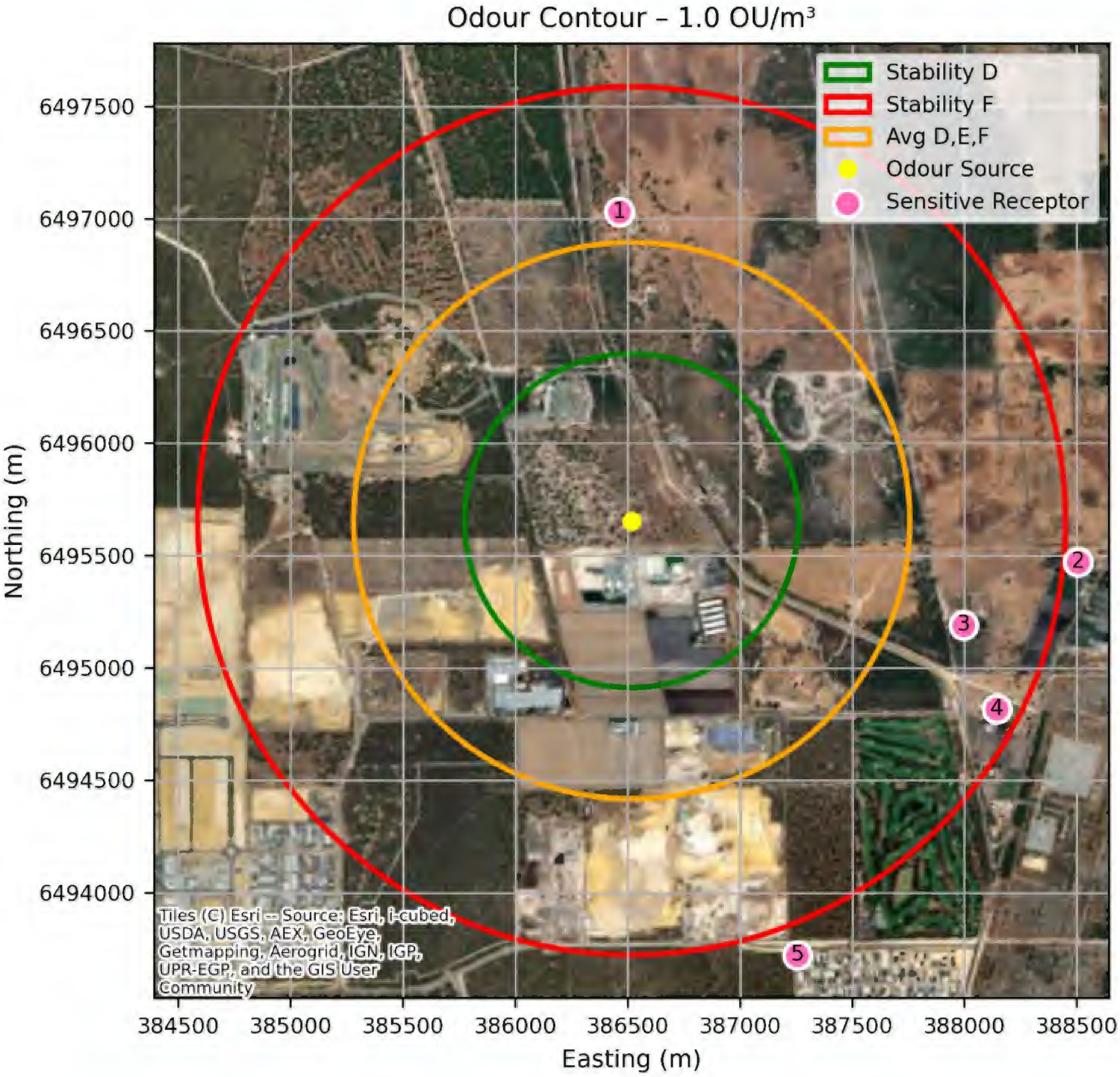



**Figure 4-2: Odour Screening 'Plot' of Averaged D, E and F, and Individual Stability's D & F - 1 OU.m³ GLC**

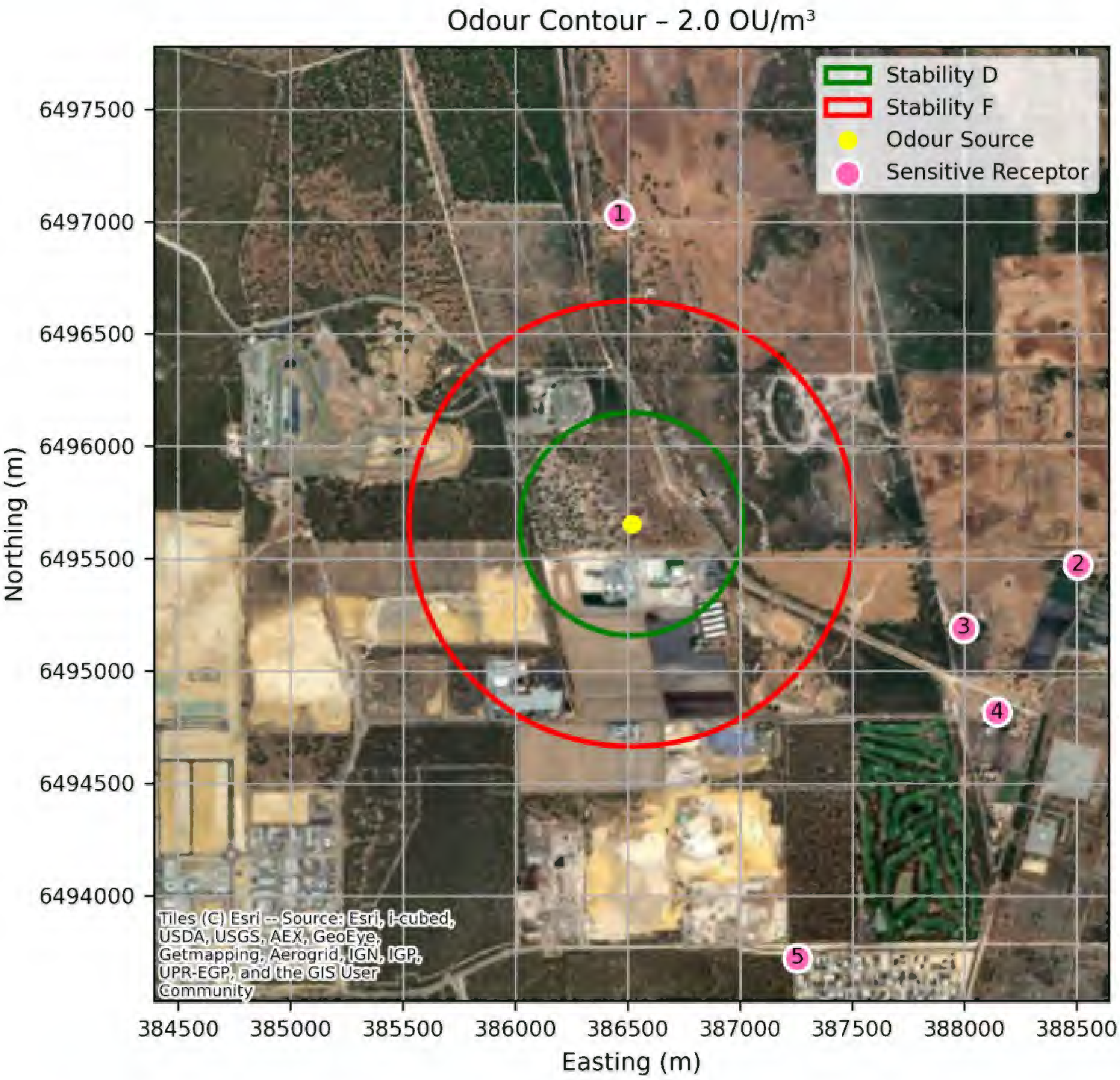



**Figure 4-3: Odour Screening 'Plot' of Individual Stability's D & F - 2 OU.m$^3$ GLC**

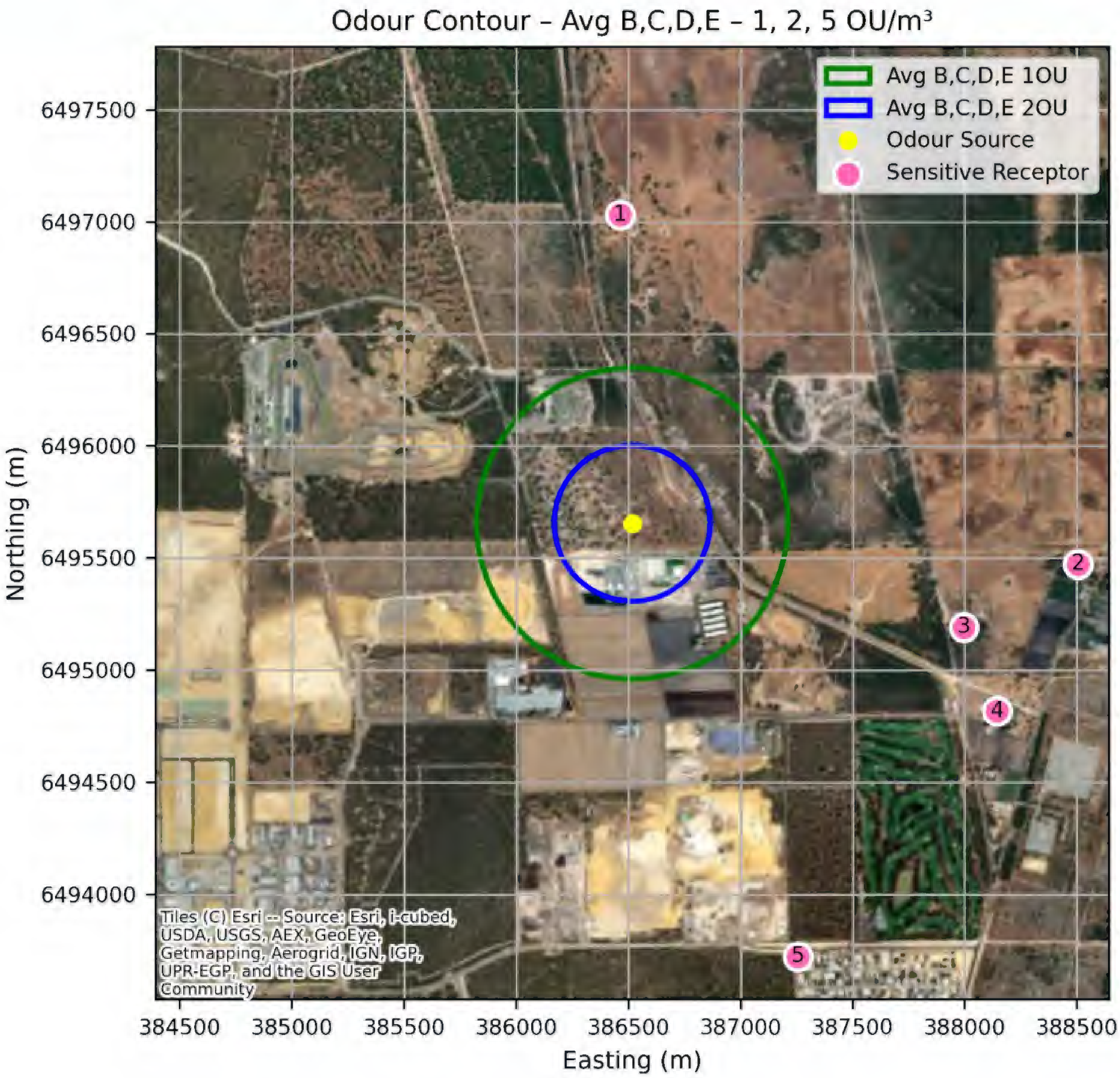



**Figure 4-4: Odour Screening 'Plot' of Daytime Averaged Stability's B, C D & E**

## 4.3 Summary of Screening Model Results

- The screening model shows that the incidence of ground level odours at a perceived observational strength of 5 OU.m$^3$ does not occur downwind of the WTS during operational hours (refer Figure 4-1),
- For Stability Class D (neutral) and average stability's of D, E and F, the model does not predict any odour observations at the nearest sensitive receptor at, or greater than, 1 OU.m$^3$ i.e., at odour threshold (refer Figure 4-2), and
- With daytime operational stability averages for classes B, C, D and E (excluding highly unstable class A), there is no prediction of odour observations at the nearest sensitive receptor (refer Figure 4-4).

# 5 Risk Evaluation

### 5.1.1 Neerabup Industrial Area

In consideration of the DWERs' Guidance Statement: Risk Assessments (2020), the proposed NRRP, assuming release of NRRP odours from 6 x roof exhaust stacks, under normal procedures, the *Consequence* of odour impacts at the nearest commercial and/or industrial receptor within the Neerabup Industrial Area is in the view of EAQ Moderate; where:

- Onsite impacts: mid level,
- Offsite impacts local scale: low level, and
- Offsite impacts wider scale: minimal.

And, the *Likelihood* of the risk occurring is **Unlikely**, where:

- The risk event will probably not occur in most circumstances.

Based on this assessment of the risk criteria under an exceptional event where uncontrolled odours are released to the environment; the future risk within the Neerabup Industrial Area is considered to be Medium.

On this basis the Risk Treatment would therefore be:

- Acceptability – *"Acceptable, generally subject to regulatory controls"*, and
- Treatment – *"Risk event is tolerable. We may apply some regulatory controls, including outcome-based conditions where practical and appropriate"*.

### 5.1.2 Nearest Residential Areas

Assuming release of NRRP odours from 6 x roof exhaust stacks, under normal procedures, the *Likelihood* of the risk occurring at the nearest residential (urban) receptor is **Rare**, where:

- The risk event may only occur in exceptional circumstances.

Based on this assessment of the risk criteria under an exceptional event where odours are released to the environment; the future risk is considered to be **Low** within the surrounding residential areas.

### 5.1.3 Risk Evaluation Conclusions

Given the large separation distances between the NRRP and the nearest residential receptor and further considering that odours from the NRRP will only be released during daytime hours, the risk of a malodour event at the nearest residential receptor that may result in an odour complaint is **Low**, and therefore the siting of the NRRP within the Neerabup Industrial Area is appropriate.

Some NRRP odours may be observed within the Industrial Area, however; these odours are unlikely to pose any nuisance to the observer given odours are only emitted during daytime hours where daytime dispersion of those odours is in general heightened resulting in low odour concentrations at ground level.

# 6 Summary Table for Detailed Analysis

| Detailed analysis tools | Tick if used | Comments |
|---|---|---|
| **Emission source** | | |
| Operational odour analysis (OOA) (priority tool) | ☒ | Table 2-4 |
| Odour source assessment (OSA) | ☐ | n/a |
| Pathway and receptor | | |
| Location review | ☒ | NRRP Locality |
| Meteorological Review | ☒ | Local Meteorological Analysis |
| Odour field assessment (OFA) | ☐ | n/a |
| Complaints data analysis | ☐ | n/a |
| Community surveys | ☐ | n/a |
| Comparative dispersion modelling | ☒ | Odour Emissions Evaluation - Modelling |
| Comparison with similar operations | ☒ | Assessed Odour Emission Strengths |