



Kalgoorlie-Boulder Odour Impact Investigation

Odour Sources Identification

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Odour Impact Assessment

Scope of Work Odour Sources Identification

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1. Introduction

1.1 Background

The community in the southern suburbs of Kalgoorlie-Boulder has experienced persistent odour issues over the past 24 months. During this time, the City of Kalgoorlie-Boulder (the City) received 101 odour complaints, while the Department of Water and Environmental Regulation (DWER) recorded 75 complaints.

Although residents have frequently pointed out the South Boulder Wastewater Treatment Plant (SBWWTP) as the alleged source of the odours affecting them, other possible emitters in the area can be contributing to the problem. In response, the City has mapped complaint locations and conducted multiple odour assessments to identify the source(s) to find a long-term solution to this on-going issue.

The City has also engaged with the DWER and the Department of Health (DoH). However, investigations by the City and data from DWER and DoH have not conclusively identified the specific sources of the odours.

Recognising the need for specialised scientific support, the City decided to seek expert assistance in odour assessment to improve the likelihood of identifying the source(s).

1.2 Scope of work

In September 2024, the City engaged OPAM Consulting to deliver specialist odour consultant services and conduct a thorough investigation into the odour issues affecting residents in the southern suburbs of Kalgoorlie-Boulder. The outlined scope of work included five distinct phases, designed to gather comprehensive information to identify the source(s) or, at a minimum, some of the primary contributors to the odour impacting the community:

- **Phase 1:** Review of the information collected by the City and possibly DWER over the past 24 months, including the content, number, and locations of odour complaints, analysis of potential correlations with wind conditions, and identification of potential sources based on types of activity and complaint analysis;
- **Phase 2:** Conduct odour field surveys (odour patrols) upwind and downwind of suspected sources under varying wind conditions to detect the presence of odours potentially linked to community complaints;
- **Phase 3:** Visit sites that may be contributing to odour emissions to assess their operations and management practices, identify potential causes of the emissions, and possibly suggest basic mitigation measures;
- **Phase 4:** Facilitate community engagement through a volunteer group who will notify OPAM Consulting director when they experience odours during his time in Kalgoorlie-Boulder.

- **Phase 5:** Compile a comprehensive report detailing all data and information collected throughout the investigation, including analysis, interpretations, and conclusions.

2. Initial deskwork review

The investigation included research into potential odour emitters in the area and possible local sources situated closer to the locations of the residents' odour reports. This work utilised information from the Part V licence and decision documents provided by the DWER, as well as data obtained from certain companies.

For the review of the odour reports, OPAM Consulting had less than three weeks to complete this task before traveling to Kalgoorlie-Boulder. During this time, most of the 2024 odour reports submitted to both the City and DWER were reviewed using the information contained in the complaint records provided.

Three key pieces of information considered when evaluating odour reports are:

- the location of the community member exposed to the odour;
- the time or period during which the odour was recognised;
- the wind conditions during the time leading up to when the odour was noticed and possibly the period during which the odour remained present for the community member.

For the location, while some records included a full address, others provided the street name only.

Establishing the exact time or period of the odour event was often challenging. For most of the records, only the time of the lodgement was reported rather than the odour event's time or period. Community members who used DWER's online form and completed all required fields provided more reliable data, including the time or start of the odour event period.

For the wind conditions, the Bureau of Meteorology (BoM) information providing the average wind at 9am and 3pm per day is irrelevant for odour report review. The only available source for historic wind conditions in the area was the Kalgoorlie-Boulder airport weather station, accessed via the site Weather Underground:

[Weather Underground - Kalgoorlie-Boulder Airport.](#)

Ideally, a 5- to 10-minute averaging period is preferred for assessing potential back trajectories from the affected location to a probable odour source. However, in this case, only 30-minute averages were available, which limited the precision of the analysis.

From the few odour reports containing at least these three key components, the review has shown a large proportion of odour reports under southerly (S), and south-easterly (SE) wind conditions. Few odour reports were lodged under south-westerly (SW) wind

conditions and easterly (E) winds. Few rarer reports occurred under northerly (N) wind conditions.

The review of the characteristics of the potential emitters (type of sources and emissions, frequency of emissions and their locations) correlated to the review of the odour reports allowed OPAM Consulting to identify the main potential emitters that could have a role in odour impacts in the southern suburbs of Kalgoorlie-Boulder.

The main potential sources of odour in the vicinity of the southern suburbs of Kalgoorlie-Boulder are identified in **Figure 1**.

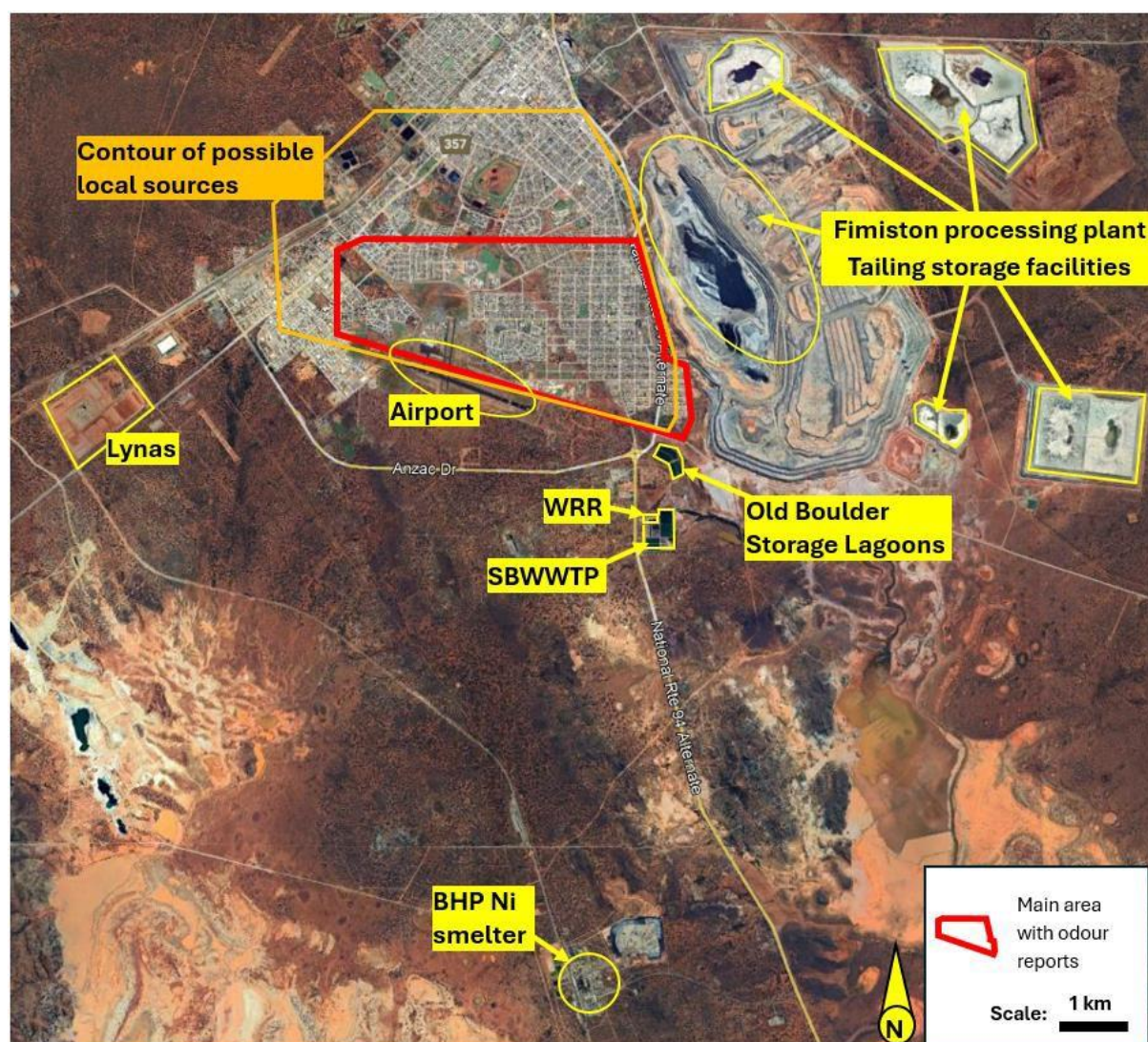


Figure 1: Main potential odour emitters and main area with odour reports

Large industrial activities such as Western Resource Recovery Pty Ltd (WRR), the South Boulder Wastewater Treatment Plant (SBWWTP) and storage lagoons, Lynas, Fimiston (including the tailing ponds), the airport or the BHP Nickel Smelter would be considered as far sources.

The large orange contour around the southern suburbs of Kalgoorlie-Boulder encompasses potential local source of odour including activities within the industrial

areas (southwest and northeast of this area), some residential gold extraction processing sites but also park watering operations.

These sites were among the sources assessed during the odour patrols conducted by OPAM Consulting during its initial five-day visit to Kalgoorlie-Boulder from 20 to 25 October 2024. Concurrent activities, including community engagement and site visits, were also carried out during this period to enhance the likelihood of identifying the source(s) potentially responsible for the reported odours.

3. Community Engagement

OPAM Consulting believed that holding an informational meeting would be beneficial for both the community and the City. During this session, OPAM Consulting outlined the purpose of their visit and detailed the preliminary work conducted to identify potential odour sources. It was explained that these sources would be evaluated through odour surveys carried out over the following days under various wind conditions to confirm any odour impacts originating from them. Some of these sites would also be visited to review their operations and potential sources of odour emissions.

OPAM Consulting then explained that community volunteers were needed to participate in the upcoming three-day investigation program. Their role would be to quickly notify OPAM Consulting whenever they detected an odour, particularly those that would typically prompt them to submit an odour report.

Clear and specific conditions were established for community members enrolling in the program, outlining their role and that of OPAM Consulting. These included:

- Volunteers would remain anonymous in any reports issued as part of this program.
- The right to ask questions or withdraw from the group at any time;
- An expectation that volunteers would provide honest and prompt information to OPAM Consulting;
- Assurance that OPAM Consulting would make every effort to visit reported odour locations promptly;
- Acknowledgement that OPAM Consulting might not always be able to attend due to rest requirements or ongoing investigations;
- OPAM Consulting would not respond directly to text messages received;
- Short discussions could be held on-site if necessary;
- Any abusive or repetitive messages or calls would result in the sender being blocked.

Volunteers reported odour impacts via text messages between 7:00pm on Monday 21 October to 6am Friday 25 October 2024. A total of 22 text messages were received by OPAM Consulting during this period from 11 active different volunteers.

OPAM Consulting extend its gratitude to the volunteers for their active participation in reporting odours as they identified them. Their timely and consistent support was instrumental in enabling OPAM Consulting to achieve the objectives of this project within the limited timeframe.

Table 1 details the text messages received from each volunteer during the program. It includes the street of residence for each volunteer, the date and time of each message, and a brief summary of the information shared in the message.

Table 1: Text messages per volunteer

Residence location	Date – time - information
Clancy Street, Boulder	22/10 – 01.54: 1 st experienced at 1.00, stronger now 23/04 – 00.04: 1 st experienced at 23.30, stronger now 24/04 – 19.07: <u>driving at the level of SBWWTP</u>
Jordan St Broadwood	21/10 – 18.34: arrived home – still here 23/10 – 9.45: SE wind and <u>no odour</u> 23/10 – 21.37: odour
Longmore Parade, Broadwood	21/10 – 21.38: odour is coming and going, since 19.30 23/10 – 21.05: since 20.50
Crowley Gardens, Somerville	23/10 – 18.43: since 18.30 rotten egg, burning chemical
Forrest Street boulder	22/10 – 6.07 23/10 – 7.54: <u>near BP shop</u> 23/10 – 14.05: <u>near BP station</u> . Since 8am and still present
Hopkins Street boulder	21/10 – 23.48: odour now 22/10 – 22.37: since 22.30
West End King St	22/10 – 6.29: stink is bad
Clancy St Boulder	22/10 – 6.16: sewage smell
Piccadilly St, Somerville	22/10 – 3.03: light odour
Smythe Drive, Broadwood	21/10 – 18.33: slight chemical 22/10 – 4.34: sewage smell since 2.00 23/10 – 21.02: strong chemical since 20.50 (araldite glue and burning plastic) 23/10 – 21.20: mix of chemicals, sewage, dirty drain, burning plastic
Pirie Street, South Boulder	22/10 – 23.26

Figure 2 illustrates the average locations where volunteers reported odour impacts, along with the average wind direction before and at the time of the report. Wind data was sourced from the Kalgoorlie-Boulder Airport station via the following website: [Weather Underground - Kalgoorlie-Boulder Airport](https://www.weatherunderground.com.au/en/station/3081416).

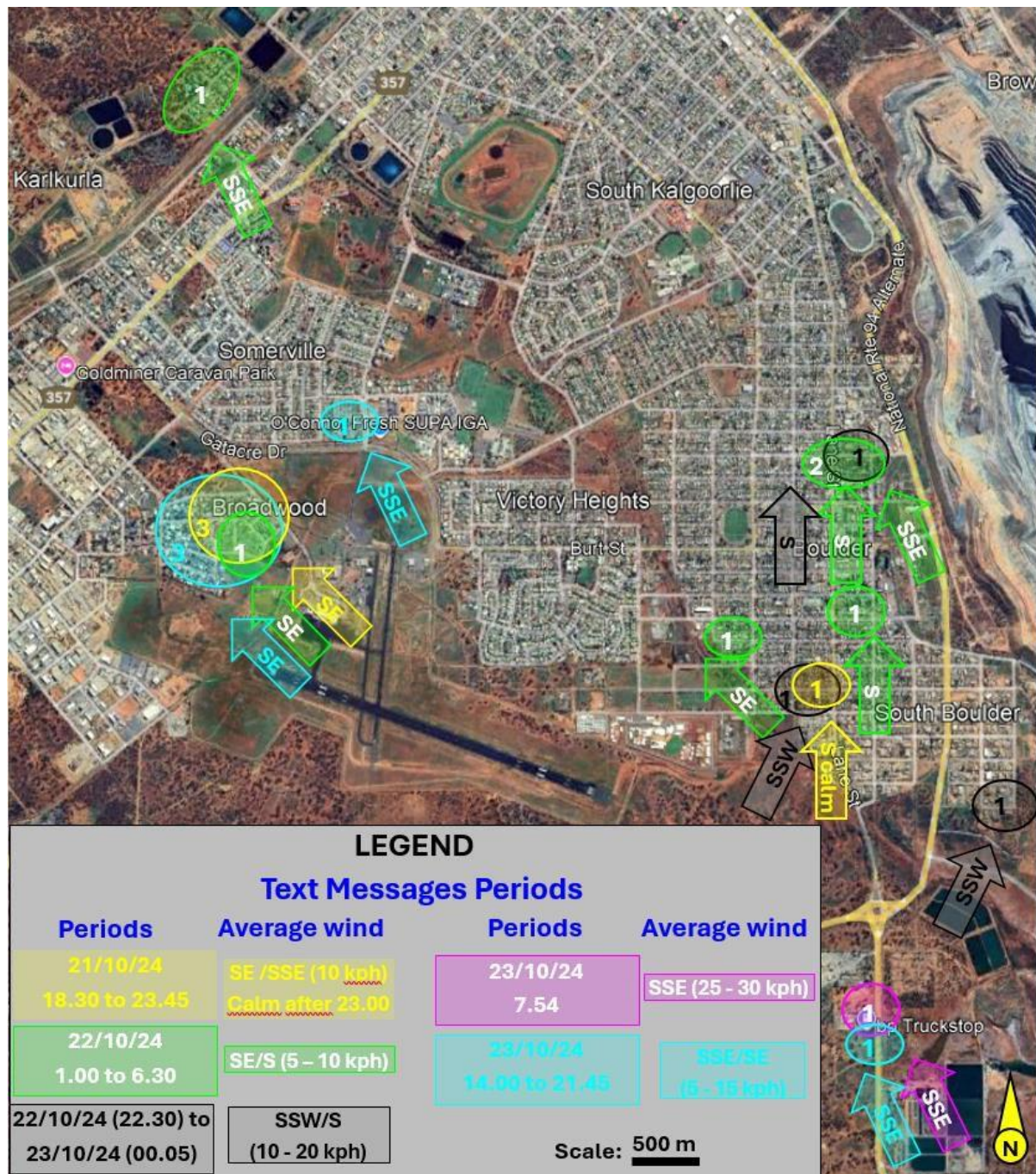


Figure 2: Areas impacted by odour (volunteers text messages)

It can be noted that all reported odour impacts occurred under SSW/SE winds ranging from 5 to 20 kph. It does mean that some of the sources responsible for the odour impacts are south of these locations. These sources can be far or local sources.

Odour patrols (OPs) were conducted in response to some of these messages or were already underway at the time the messages were received (refer to Section 5.3).

4. Possible odour emitters and sites visits

4.1 South Boulder WWTP (SBWWTP)

The South Boulder Wastewater Treatment Plant (SBWWTP) processes sewage from Kalgoorlie-Boulder through a reticulated sewerage system. Additionally, it receives a limited quantity of condensates from the adjacent WRR facility, operated by Veolia.

Since 2019, the SBWWTP has also accepted Controlled Waste categories K130 (sewage waste from reticulated systems) and K210 (septage waste) via road transport. The sewage waste received through the reticulated sewerage system was treated on-site using an Intermittent Decant Extended Aeration (IDEA) activated sludge plant. It comprised an Aerobic Anoxic Tank (AAT) followed by two Intermittent Aeration Tanks (IAT) and finally a Balance Tank.

Figure 3 illustrates the layout of the SBWWTP prior to 2020.

During normal operations, most of the water treated through the IDEA was discharged to the Old Boulder storage lagoons, located north of the SBWWTP, through point 7 in **Figure 3**. Intermittently, this treated water was discharged into Lagoon 1, then Lagoon 2, and finally Lagoon 3. From Lagoon 3, the treated effluent was directed either to the Old Boulder storage lagoons or the environment, specifically Hannan's Lake.

Desludging operations commenced in early 2020, starting with Lagoon 1, followed by Lagoon 2 in mid-2020. Construction of Lagoons 1A and 1B began in late 2021, and Lagoon 3 underwent desludging during the summer of 2021–2022.

By April 2022, Lagoon 1B was filled with wastewater, and Lagoon 2 received a new liner by June 2022. In July 2022, Lagoons 1A, 1B, and 2 were filled with wastewater, while Lagoon 3 was refilled with water by August 2022.

With the commissioning of the new lagoons, the gradual decommissioning of the IDEA system began. Between July and December 2022, raw wastewater was directed to Lagoons 1A and 1B for six hours per day. The proportion sent to the Lagoons increased up to April 2023 when the total wastewater throughput was directed to Lagoons 1A and 1B, allowing for the decommissioning of the IDEA system.



Figure 3: SBWWTP prior to 2020

The new facility transitioned from a mechanical treatment to a pond treatment system with a daily throughput of about 6 ML/day.

Figure 4 presents a view of the current facility with the IDEA decommissioned and the full throughput treated through the pond system.



Figure 4: Current configuration of the SBWWTP

The bacterial population in facultative Lagoons 1A and 1B needed time to grow to a critical level capable of handling the increased organic load introduced with the new lagoon system. However, bacterial growth was slower due to the cooler winter conditions when the system commenced operation, which were not conducive to optimal biological activity.

Additionally, the facility lacks preliminary or pre-treatment systems for incoming effluent, meaning the entire load of solid material is carried directly into Lagoons 1A and 1B. This results in a high oxygen demand without any mechanical aeration to support decomposition.

During OPAM Consulting's site visit on 21 October 2024, it was observed that approximately one-sixth to one-eighth of the surface area of Lagoon 1A and Lagoon 1B was covered with partially crusted solid material (see photos in **Attachment 1** of this report). This solid layer was notably odorous when downwind and is likely a significant contributor to the overall odour emissions from the site.

Solid material accumulates primarily at the bottom of the ponds under anaerobic conditions. Over the past 18 to 24 months, accumulated solids in Lagoons 1A and 1B have likely formed a thick layer at the bottom of the lagoons, particularly at their western ends near the inlets. This layer is subjected to anaerobic conditions, which can result in the production of biogas containing odorous compounds.

During this period, as the volume of raw wastewater directed to the IDEA system decreased and the volume sent to the passive lagoon system increased, the SBWWTP significantly ramped up its acceptance of K210 (septic waste). Although K210 represented only about 1% of the monthly throughput at its peak (refer to **Figure 5**), it had an unfavourable impact on treatment processes, particularly by lowering pH levels and reducing available oxygen. In July 2024, the facility drastically reduced its intake of K210, with most of this waste now being redirected to another treatment facility in Coolgardie.

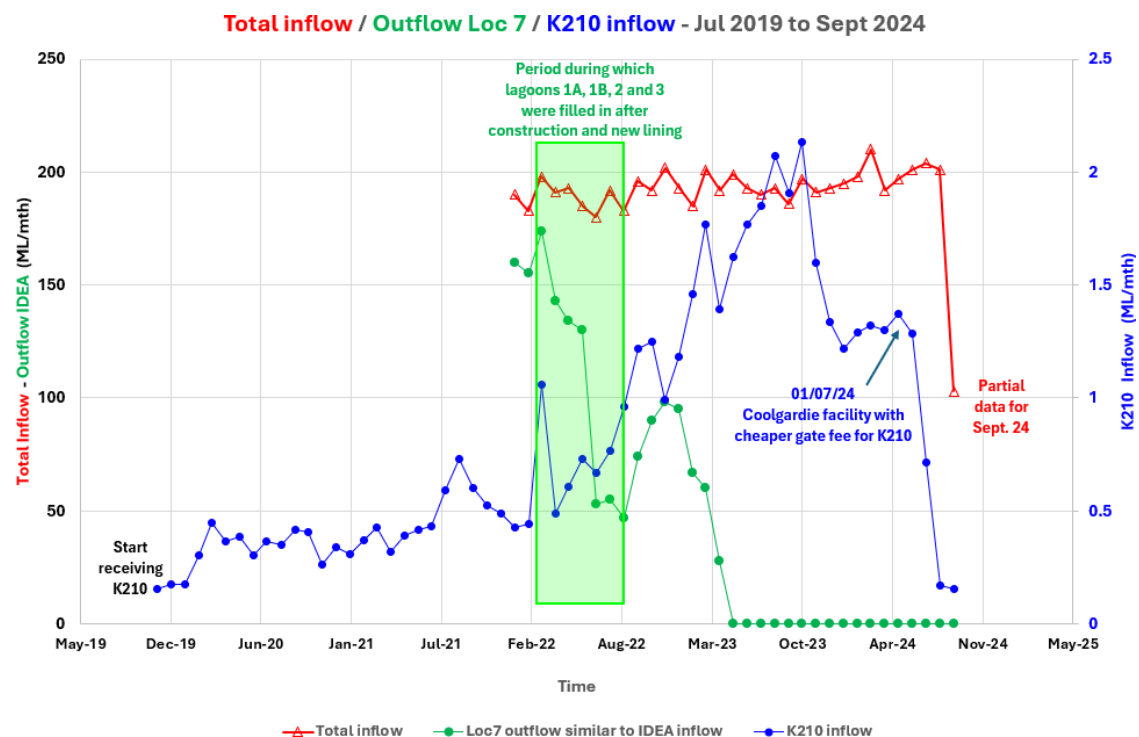


Figure 5:SBWWTP and IDEA wastewater throughput - K210 intake

pH and oxygen levels are critical factors influencing water treatment processes and the formation of odorous compounds.

Oxygen saturation in water decreases as temperature rises. In facultative ponds, algae contribute oxygen during warm and sunny daytime conditions through photosynthesis, causing pH and oxygen levels to rise. However, during periods of low light or nighttime, when photosynthesis is limited, oxygen and pH levels can drop significantly.

Measuring dissolved oxygen in water accurately can be challenging. Instead, the oxidation-reduction potential (ORP) offers a more reliable indicator of the water's oxidative or reductive capacity, especially concerning the presence of oxygen (O_2). A positive ORP value reflects an oxidative environment, while a negative ORP value indicates a reductive environment.

Figure 6 provides a graphical representation of the biological and chemical activities occurring in wastewater across various ORP levels.

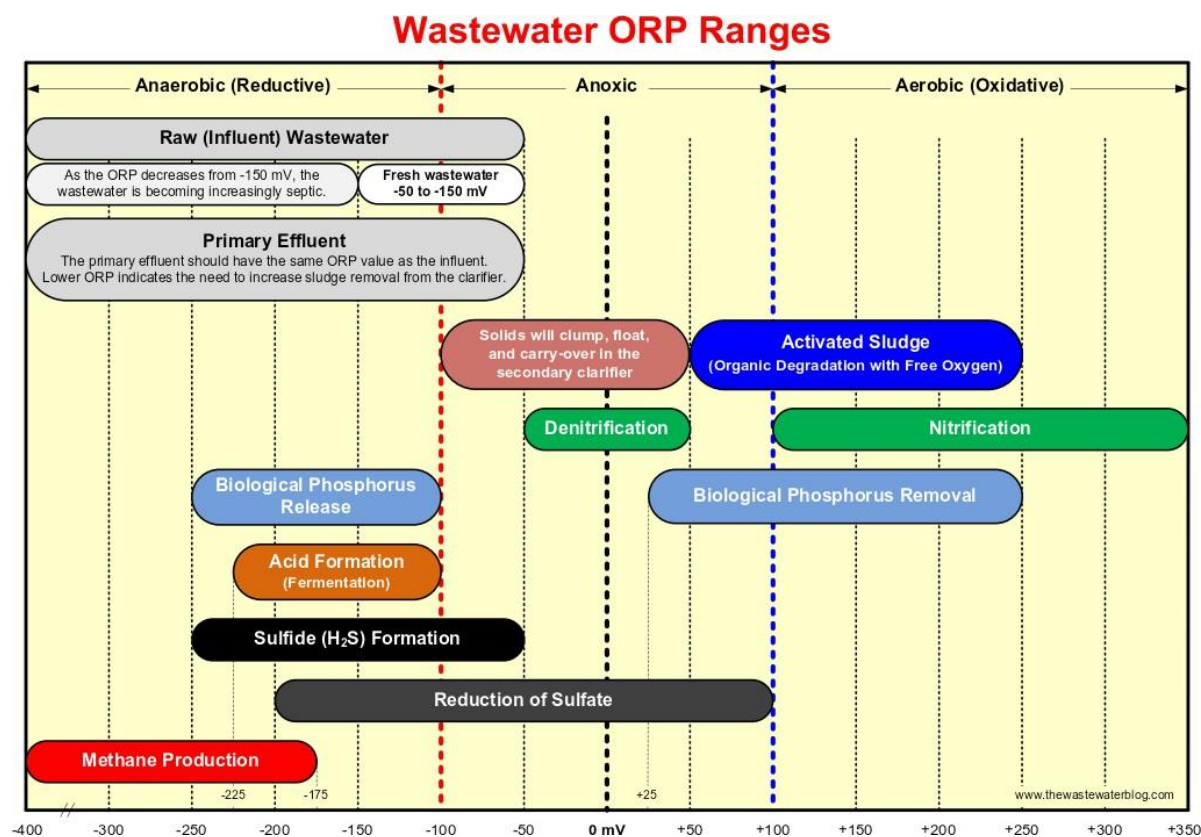


Figure 6: Biological and chemical activities at different ORP levels

pH is a key factor in odour control as it affects the dissociation of hydrogen sulphide (H_2S), a compound known for its characteristic "rotten egg" smell. Sulphide ions exist in three forms: H_2S , HS^- , and S^{2-} , but only H_2S is odorous.

Figure 7 depicts the relationship between water pH levels and the percentage of H_2S present at the liquid-gas interface, emphasising how pH influences the formation of this odorous compound.

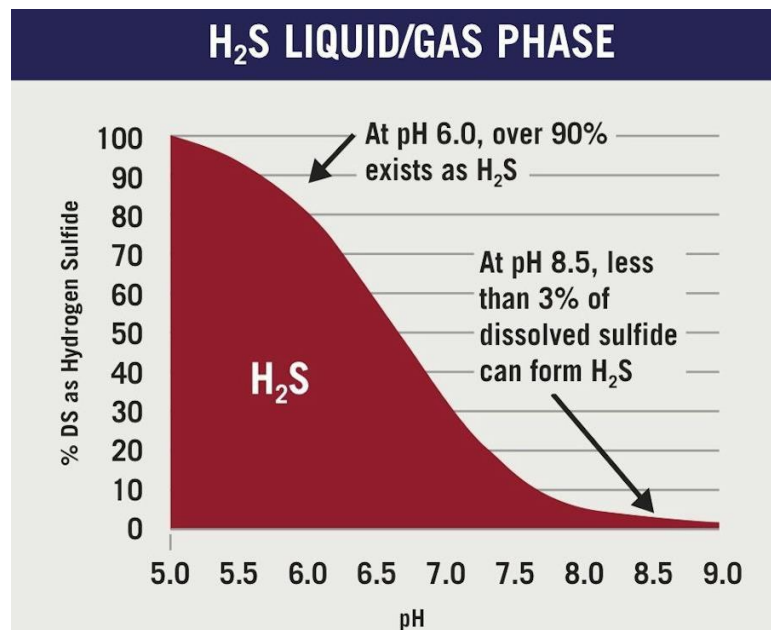


Figure 7: Levels of H_2S for different pH levels

Table 2 presents the average of various water quality parameters at two locations: Point 7 (outlet of the IDEA system) during the period from July 2022 to March 2023, prior to the decommissioning of the IDEA system, and Point 8 (outlet of Lagoon 3) for the pond system exclusively, from April 2023 to June 2024. The data was sourced from the Annual Environmental Reports provided by the City to OPAM Consulting.

Table 2: Outlet water parameter (IDEA vs Pond system)

Parameter	Units	Loc. 7 (IDEA) (Jul 22 to Mar. 23)	Loc 8 (pond system) (Apr. 23 – Jun. 24)
Faecal Coliforms	CFU/100mL	89,667	281,133
BOD ₅	mg/L	18	66
COD	mg/L	38	232
Total Nitrogen	mg/L	12.3	54
Ammonium Nitrogen	mg/L	4.32	38
Nitrite	mg/L	0.16	0.01
Nitrate		5.39	0.01

Table 2 highlights significant differences in water quality between Point 7 (IDEA system outlet) and Point 8 (pond system outlet). The absence of nitrite and nitrate at Point 8 indicates a lack of nitrification of reduced nitrogen compounds, primarily ammonia, in the pond system. At pH levels above 7.5–8, ammonia emissions from the lagoons can be expected.

Figure 8, provided by the City, shows the pH levels of the lagoons since the pond system was implemented. The average pH for Lagoons 1A and 1B ranged between 6.8 and 7.7, suggesting a potential risk of significant H_2S emissions during this period (up to August 2024). It is important to note that monitoring was conducted during daytime, which does not account for worst-case scenarios, such as lower pH and oxygen levels typically occurring at night time, early morning, or early evening.

Additionally, no monitoring of oxygen or ORP levels was conducted at the SBWWTP, leaving a gap in understanding the oxidative or reductive conditions within the lagoons.

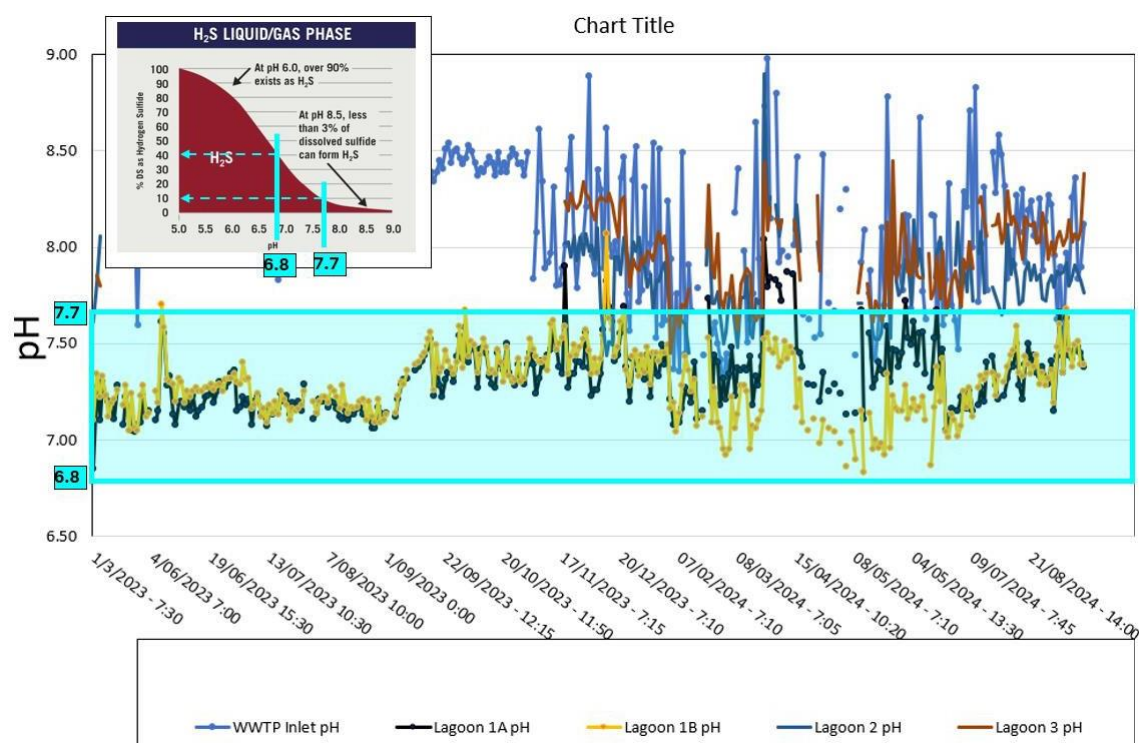


Figure 8: pH in the lagoons since the pond system operation

On 21 October 2024, OPAM Consulting conducted a site visit to monitor water quality using a handheld portable YSI water meter. The points assessed during the monitoring are detailed in **Attachment 1** of this report. Measurements were taken between 13:30 and 15:30.

Monitoring was performed using the following methods:

- **In-flow:** Directly inserting the probe into the well (represented as "in flow" in **Figure 9**).
- **Sampler well:** Inserting the probe into a sampler with a sample collected from the well (labelled "sampler well" in **Figure 9**).
- **Sampler lagoon:** Inserting the probe into a sampler with a sample collected from the lagoon (labelled "sampler lagoon" in **Figure 9**).

- **Lagoon:** Directly immersing the probe into the lagoon (labelled "lagoon" in Figure 9).

It shows up to 0.4 unit of pH difference for the various methodologies used to sample and collect the pH with the probe at a same location.

Figure 9 present the pH and ORP values for the various locations. No appropriate sampling was possible at the inlet of the SBWWTP.

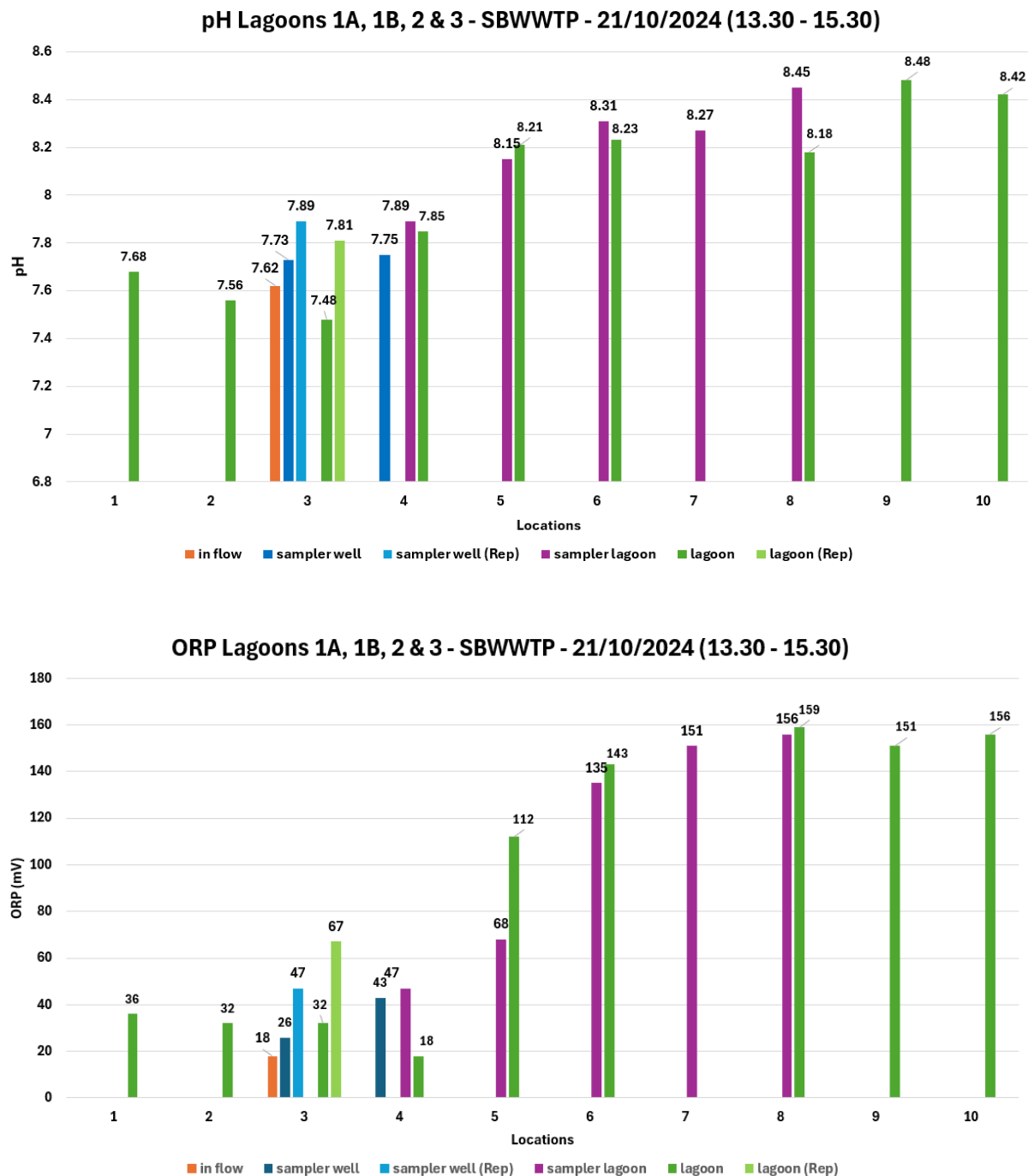


Figure 9: pH and ORP levels in the different lagoons (early afternoon)

Figure 10 presents the risk associated with H_2S emissions (vs pH levels) and biological and chemical activities for the different ORP for each lagoon.

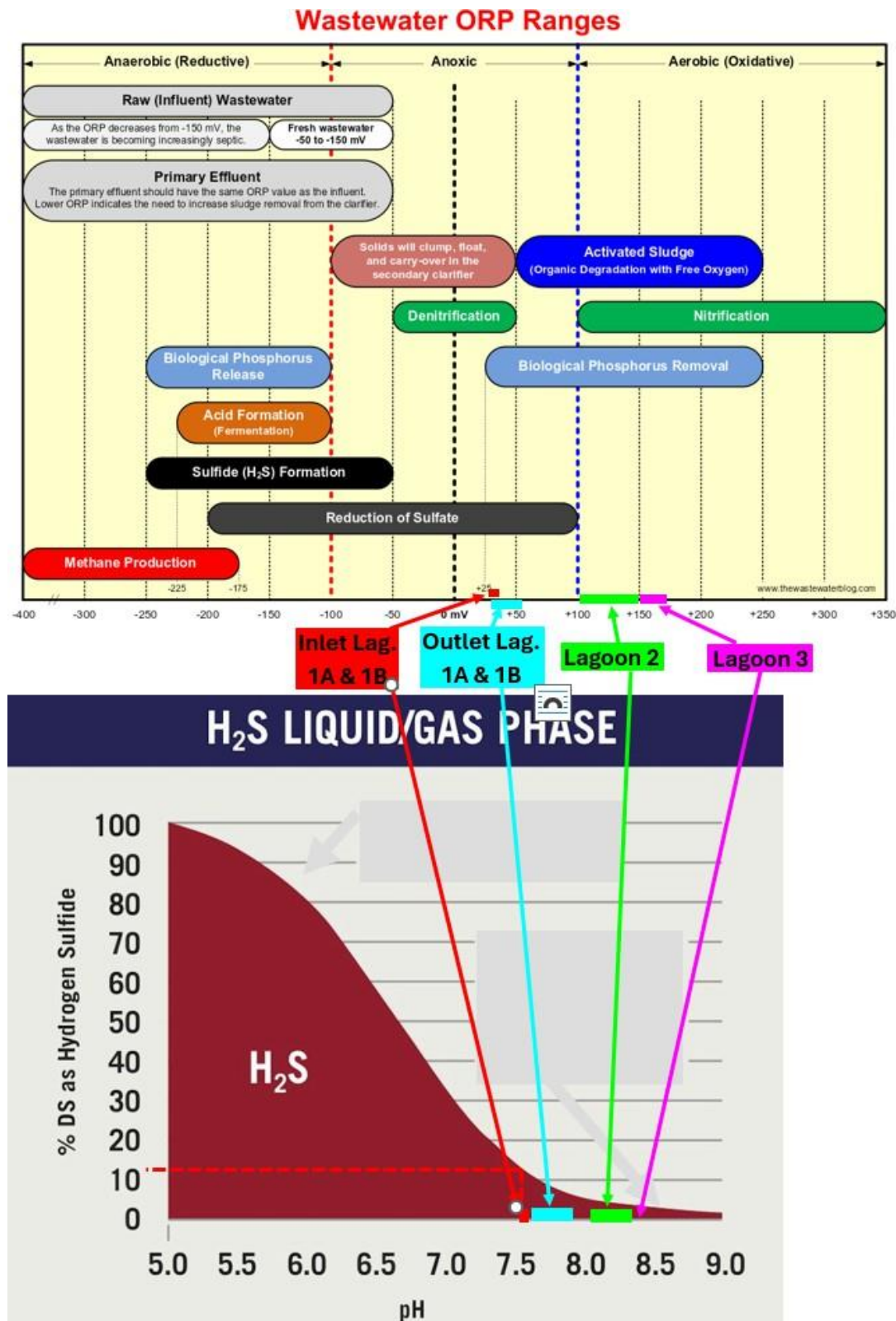


Figure 10: Zones of pH and ORP for the lagoons

The pH levels at the SBWWTP inlet are expected to be comparable to or slightly lower than those measured.

At Location 5 (the inlet of Lagoon 2), pH levels increased from 7.5–7.9 at the outlets of Lagoons 1A and 1B to 8.1–8.2, while the ORP (oxidation-reduction potential) rose from 30–60 mV to 80–100 mV. This demonstrates that even the limited turbulence in the underground drain—spanning 250–300 meters and exposed to the atmosphere at three wells—significantly improves these parameters and enhances water quality.

These variations can be compared to the changes observed between the inlet and outlet of Lagoons 1A and 1B, which, despite having a much longer hydraulic retention time, experience minimal aeration due to the limited surface exposure of the water column.

Additionally, during nighttime, early morning, and evening, pH and ORP levels are likely lower than those measured in the early afternoon. This suggests an elevated risk of H₂S emissions during these times.

CONCLUSION

Until March 2023, all wastewater received at the SBWWTP was treated using the mechanically aerated IDEA system. Following a transitional period between July 2022 and March 2023, the IDEA system was decommissioned. Since April 2023, the facility has relied solely on a pond system for wastewater treatment, without any preliminary treatment or mechanical aeration.

Based on water quality data provided by the City, the performance of the pond system is lower than the water treated through the IDEA system. The combination of absence of mechanical aeration, low winter temperatures during the transition period, and the additional intake of significant volumes of K210 liquid waste, likely contributed to low pH levels and potentially low ORP levels (though not measured). These factors likely played a significant role in facilitating odour emissions.

From March to August 2023 and March to June 2024, the combination of low pH and presumed low ORP (indicating reduced oxygen levels in the lagoons) created conditions conducive to H₂S emissions, particularly during the evening, nighttime, and early morning hours.

An assessment of pH and ORP across all lagoons was conducted by OPAM Consulting on 20 October 2024. Although the pH values measured during this assessment were higher than the figures shown in **Figure 8**, the combination of these values with the observed low but positive ORP levels suggests that H₂S emissions may still be occurring, albeit at a reduced rate compared to the initial 12 months of operation.

The significant reduction in K210 liquid waste intake since July 2024 is expected to improve the treatment performance of the pond system further.

RECOMMENDATIONS

The assessment conducted by OPAM Consulting provides a general snapshot of lagoon conditions. However, repeated assessments are necessary to capture longer-term trends in lagoon treatment performance. According to the site technician interviewed on 21 October 2024, pH measurements have been conducted every two days, though not consistently at the same times. This inconsistency is problematic, as pH and ORP can vary significantly throughout the day.

To improve monitoring, it is recommended to conduct measurements once or better, twice daily (early morning and early afternoon), at fixed time at the inlet and outlet of Lagoons 1A, 1B, and 2, as well as at the outlet of Lagoon 3. The monitoring should include at least pH and ORP. Establishing a reproducible methodology would enhance the reliability of the results. This approach would allow trend analysis to identify variations by time of day, month, or season, and help in identifying risk of odour emissions with the support of experienced professional in wastewater treatment.

Recognising that Kalgoorlie is a remote area where operating and maintaining heavy mechanical systems can be challenging, it is recommended to secure daily technical support from experienced wastewater treatment professionals.

Additionally, as a minimum, the facility should consider designing a preliminary treatment system to separate solids, sand, and grease from the inflow before directing it to Lagoons 1A and 1B.

Lastly, in the absence of preliminary treatment and solid separation and after 20 months of operations, bathymetric surveys of Lagoons 1A and 1B should be undertaken. These surveys would help determine sludge levels and assess the risk of anaerobic layer formation, which could contribute to odour issues.

FUTURE PLANS FOR THE SBWWTP

OPAM Consulting was informed of upcoming developments at the SBWWTP, which include:

- **Construction of a Preliminary Inlet work:** A screening system will be installed at the inlet of the SBWWTP to filter the effluent.
- **Implementation of a new IDEA System:** This system will consist of two identical parallel trains, each comprising an Aerobic Anoxic Tank (AAT), two Intermittent Aeration Tanks (IAT), and a Balance Tank.

The timeline for the operation of this new system remains unclear. Although not yet confirmed, the plan is to treat 30% of the incoming effluent through the new IDEA trains and 70% through the pond system.

4.2 Western Resource Recovery Pty Ltd (WRR)

Figure 11 presents the main operations at the site.

Some Intermediate Bulk Containers (IBCs) containing fertilisers, pesticides, coolants, and greases are stored within a bunded area at the centre of the premises. These materials are stabilized by mixing them with sand, compost, and hydrated lime to adjust the pH. The resulting mixture is then stored in the northeastern corner of the facility.

The site includes three underground tanks with lids for grease trap waste. The grease trap waste is stored in these tanks before being loaded into tankers and transported for treatment in Welshpool, east of Perth.

The facility also accepts emulsified (oily) water, which is unloaded from tankers into the waste receival bay near the entrance. Water, oil and sludge are separated by gravity, and the oil, forming the top layer, is collected into sealed tanks. This oil, containing less than 10% water and with a specific gravity, is then transported by recycling companies. The sludge is stabilised. The aqueous effluent, containing residual oil from the waste receival bay, is pumped into tankers and transferred to one of four ponds for evaporation.

During a site visit on 21 October 2024, OPAM Consulting conducted pH monitoring. The equipment used was not optimal for measurements near the edge due to a thick oil layer observed on the water's surface. This oil layer likely limits the water's exposure to the atmosphere, significantly reducing the evaporation rate.

Table 3 presents the values of pH measured in each pond.

Table 3: Measured pH in WRR ponds

	Pond 1	Pond 2	Pond 3	Pond 4
pH	8.3	8.4	7.9	8.6

OPAM Consulting was informed that WRR manages the pH of wastewater ponds within the range of 6 to 8 to maintain effective treatment processes, as:

- A pH below 6 can increase the solubility of heavy metals, potentially compromising the integrity of pond liners.
- A pH above 8 can make certain pollutants more challenging to remove and may result in scaling or damage to infrastructure.

Additionally, the thick oily layer on the water surface likely reduces evaporation rates and may hinder the removal of some pollutants at higher pH levels. Chemicals are applied to the ponds to regulate and maintain the pH within the desired range.



Figure 11: WRR layout and main operations

CONCLUSION

Oily water makes up a significant portion of the liquid waste received at WRR. While gravity separation over a large surface area is straightforward to operate and energy-efficient, it is a slow process with limited effectiveness.

The four ponds cover a combined surface area of 5,200 m², with oil exposed to the atmosphere. This results in high concentrations of odorous hydrocarbons being released into the air, making it a major source of odour in the area.

RECOMMENDATIONS

Dissolved Air Flotation (DAF), with or without the use of polyelectrolytes and coagulants to capture oil droplets and suspended particles in floc, could be a viable separation technique for this facility. It is a cost-effective, low-maintenance system with a much smaller footprint. Implementing DAF would minimise the risk associated with large surface areas exposed to the atmosphere and significantly reduce the volume of odorous air emitted from the ponds and transported offsite.

Another engineered option, such as stripping, could also be considered, though it may not be justified for this site.

4.3 Lynas

A concentrate from the Mt Weld mine is neutralised and filtered at a new facility located southwest of Kalgoorlie along the Great Eastern Highway. This facility was under construction and commissioning from 2022 - 2024. Lynas produced their first batch in June 2024, followed by low volumes of production in July-September 2024. At present, the site is not in full production.

A site visit was held on Thursday 24 October 2024.

The facility is equipped with two Venturi scrubbers and two wet electrostatic precipitators to manage kiln exhaust emissions.

Lynas has a contract with the City to reuse a significant portion of treated water from the SBWWTP. This water is stored in a 20ML open tank onsite and used in the process in a close loop. A small fraction is also used to create a lime slurry, which is then utilised in the air treatment system for stack emissions.

The site also features large evaporation dams covering 285,000 m² for storing and evaporating process water. With limited production during the commissioning phase, these ponds were most of them empty or with low water levels as observed during the site visit.

Given that odour impacts have been reported for the past 18–24 months, it is unlikely that this facility has been a source of odours affecting the community.

4.4 Fimiston

No site visit could not be arranged but a video meeting was organised during the presence of OPAM Consulting in Kalgoorlie-Boulder.

The Fimiston Processing Plant currently operates two parallel circuits to process refractory sulphide ore from the Fimiston Open Pit and ore from the Mt Charlotte Underground Mine.

The plant includes:

- Two crushing circuits supplying coarse ore to a mill feed stockpile.
- Two milling circuits:
 - Fimiston Circuit: A semi-autogenous grinding (SAG) mill, a pebble crushing circuit, two secondary ball mills, and four Knelson concentrators.
 - Mt Charlotte Circuit: A single SAG mill and ball mill with one Knelson concentrator.
- A flotation circuit and three carbon-in-leach (CIL) circuits for processing milled ore.
- A filtration and ultra-fine grinding (UFG) via a CIL circuit for processing flotation concentrates.
- A gold recovery circuit comprising an Acacia reactor, elution, electrowinning, smelting, and gold bullion production.
- Tailings storage facilities (TSFs).

The site also features:

- A kiln off-gas cleaning circuit with a stack height of 20.6 m.
- A gold room furnace with a stack height of 15.3 m.

The stacks are not tall stacks. During the limited timeframe of OPAM Consulting's presence in Kalgoorlie-Boulder, it was not possible to determine whether the effective height of the emissions plume reaches the same level as, or exceeds, the height of the Super Pit perimeter. This factor is critical in assessing the potential for the plume to travel above the pit and impact Boulder or South Boulder under NE, E, or SW winds. Further assessments are recommended to evaluate this possibility.

If such emissions occur, resulting, on some occasions in odour impacts within residential areas, the likely characteristic of the emissions would be related to combustion and possibly sulphur dioxide (SO₂). Although odour character provided by community member are very personal, the character of SO₂ odour did not seem to be part of the general descriptions provided by the residents who reported odours. In addition, these emissions and impacts would have been present in this areas for several years while the odour reports have started about 18-24 months.

Information was requested about potential reduced sulphur compounds adsorbed on rock surfaces after blasting, particularly on the western side of the Super Pit near Kalgoorlie. However, no detailed response was available at the time of drafting this report.

The large TSFs were assessed during odour patrols (refer to Section 5), and no odours were detected downwind of these operations at various distances and under differing wind conditions during OPAM Consulting's presence to Kalgoorlie-Boulder in late October 2024.

This source, if confirmed, is unlikely this be a primary source of the odours reported by the community. Finally, many odour reports have been logged under southerly winds, ruling out this site as a potential source for most impacts reported in South Boulder, Victory Heights, Somerville, or Broadwood.

4.5 BHP Nickel Smelter

A site visit could not be organised during OPAM Consulting's time in Kalgoorlie-Boulder. There is limited information regarding potential odour emissions from this facility. For odours from this site to impact the southern suburbs of Kalgoorlie-Boulder, emissions would need to originate from the main stacks of the processing plant.

Based on the smelter operations and the plant's various stacks, the primary odorous compound likely to be emitted is sulphur dioxide (SO₂). Although odour character provided by community member are very personal, the character of SO₂ odour did not seem to be part of the general descriptions provided by the residents who reported odours.

Additionally, this facility has been operating for many years. Should this facility is an odour source, these emissions and impacts, if any, would have been present in this areas for several years while the odour reports have started about 18-24 months ago. This source, if confirmed, is unlikely this be a primary source of the odours reported by the community.

4.6 Kalgoorlie-Boulder airport

No site visit was organised for this potential odour source.

The primary odours from the airport are exhaust fumes from large planes on the tarmac during taxiing while passengers are boarding or disembarking.

Burnt hydrocarbons and exhaust fumes are emitted from the aircraft tail while idling on the tarmac. It can be sometimes described by community members as a chemical odour due to the nature of the jet fuel (refined kerosene). These planes can remain stationary on the tarmac for extended periods. Given the open surroundings and flat terrain around the airport, these odours can travel with minimal dilution to nearby sensitive receptors (see Section 5)..

4.7 Local sources

The primary local sources within or near the main odour report area include industrial zones (West Kalgoorlie and the southern area of South Boulder), parks (irrigation activities), and dams. Although local residential gold extraction processing sites have

been reported to OPAM Consulting, it was not possible during the short period of time of OPAM Consulting presence in Kalgoorlie-Boulder to assess these sources.

Figure 12 identifies the locations of these potential sources.

Within the limited timeframe available to OPAM Consulting, only the industrial area in South Boulder was inspected. Due to time constraints and wind conditions, the West Kalgoorlie industrial area was not patrolled. The decision to focus on the South Boulder industrial area was based on the prevailing winds reported or identified on odour report days, which were primarily from the south and southeast.

Dams were also investigated; however, several were assessed under suboptimal wind conditions (refer to Section 5).

Regarding parks, the City provided a list of those irrigated with recycled water from the SBWWTP. **Table 4** outlines the parks that were investigated and those that were not due to time limitations. All odour patrols were conducted after 22:00 (refer to Section 5).

Table 4: Parks within or close to the odour reporting area

Investigated parks	Parks not investigated
• Rasmussen Park • Centennial Park • Admin (City offices) • Hefron Park • Mosconi Park • Wingate Park	• Ramus Park • Dwyer Park • Rotary Park

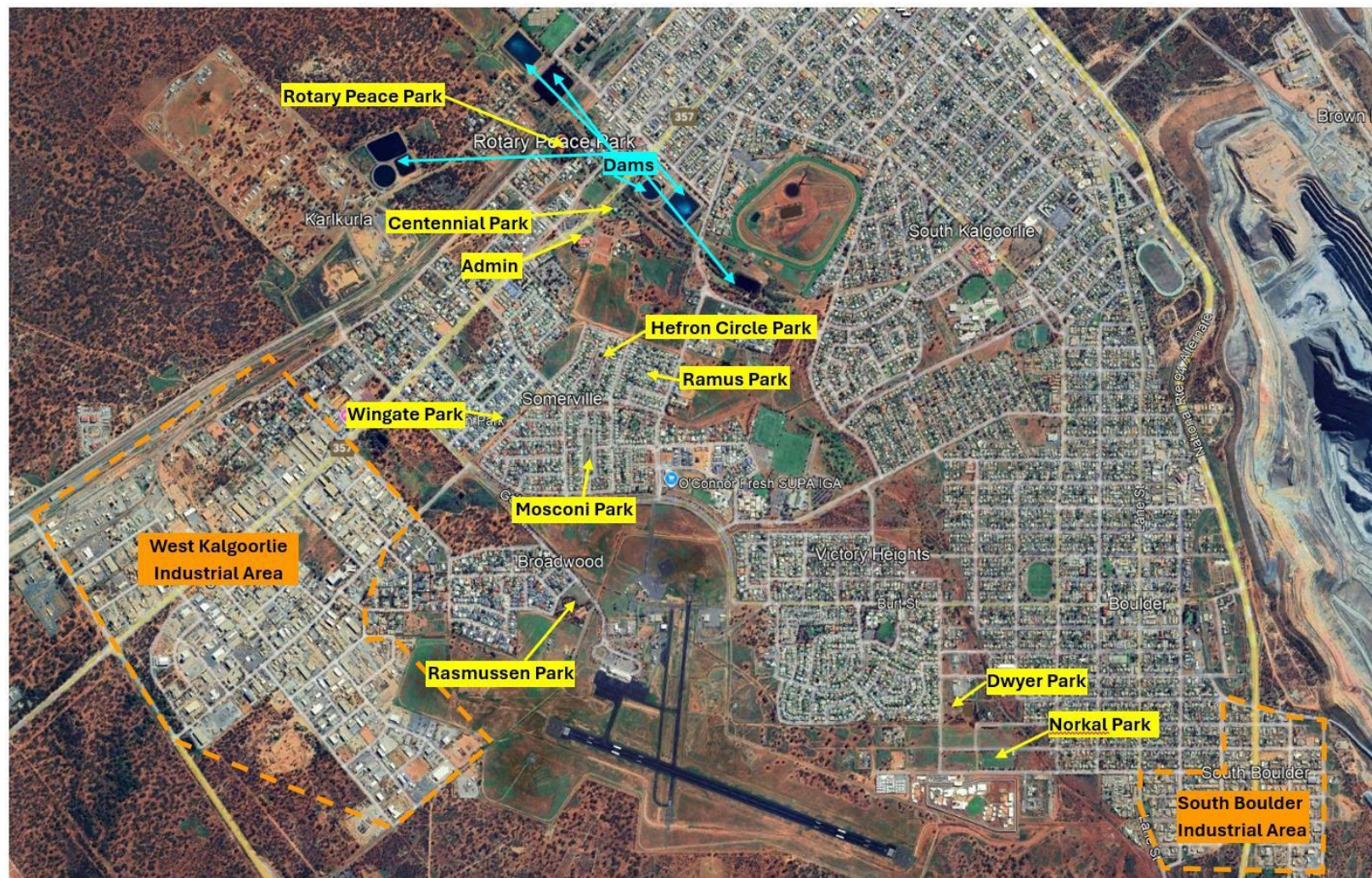


Figure 12: Local sources locations

5. Odour Patrols (OPs)

5.1 Methodology

The odour surveys were conducted following a modified method based on the EN 16841 Part 2:2016 standard (**EN, 2016**). This standard is widely applied in Australia and New Zealand for assessing odour plume impacts .

The primary objective of the odour surveys in Kalgoorlie-Boulder was to identify the presence of odours, determine their extent, and establish the distance at which odours could be recognised under specific meteorological and operational conditions.

An odour assessment approach, which relies on observational and empirical data, provides greater value than theoretical modelling for this project. This aligns with DWER recommendations for odour impact assessments (**DWER, 2019**).

All odour patrols (OPs) were conducted by OPAM Consulting's Director, who has been certified to meet the requirements of the ANZ 4323.3:2001 standard (**AS 4323**). These assessments employed the dynamic plume method for odour evaluation.

The dynamic plume method involves conducting short surveys over multiple periods under varying meteorological conditions. The odour panellist identifies the presence or absence of odour at locations downwind of a source. For each measurement, the panellist remains at a specific point for 1 to 3–4 minutes, depending on the project's purpose, the type of odour source, and prevailing wind conditions. The panellist then moves to another location along a predetermined path that intersects the odour plume's potential trajectory.

Before assessments, OPAM Consulting conducts reconnaissance to confirm the accessibility of measurement points and ensure the safety of the odour panellist while stationed at these points. All measurements were performed in public areas.

Typically, each measurement session lasts 1–2 hours and includes several individual assessments. However, for this project, sessions were occasionally extended to maximise the survey period in Kalgoorlie-Boulder, relying on input from the local community to pinpoint specific locations affected by odours.

The Director of OPAM Consulting has extensive experience in applying and refining the dynamic plume method, having used it numerous times while working for DWER and as a contractor for organisations like DWER and SA EPA. The results from this method have been reliably used as evidence in tribunal and court cases, including prosecutions. Its effectiveness lies in providing accurate field observations and detailed information about the intensity and characteristics of identified odours.

This methodology also offers flexibility, allowing for rapid adjustments to the assessment path in response to changes in wind direction or real-time reports from the community via text messages about odour impacts in specific locations.

When conducting OPs, OPAM Consulting closely monitors weather forecasts to predict wind patterns over the next 2–3 days, ensuring patrols are conducted

downwind of potential odour sources. Early morning and late afternoon OPs are prioritised due to the likelihood of more conducive atmospheric conditions, such as stability and thermal inversions.

For this project, while some OPs were planned based on specific wind conditions, many were also informed by real-time text messages from the community. If an odour was detected, the following details were recorded:

- Odour intensity: A measure of the odour's strength.
- Odour characteristic: A description of what the odour smells like.

In addition to conducting olfactory assessments, OPAM Consulting utilised a Jerome analyser, capable of detecting hydrogen sulphide (H₂S) concentrations as low as 3 parts per billion (ppb). H₂S serves as an expected indicator of emissions originating from the SBWWTP.

5.2 Presentation of the results

For each measurement session (each OP), odour maps are presented that depict the findings in the field.

A. Odour intensity

Odour intensity reflects how strongly an odour is recognised.

OPAM Consulting does not use the German Odour Intensity Scale from VDI 3940 Part 3:2010, as it has been a source of confusion for years among odour specialists and regulators. Instead, with the endorsement of the DWER Air Quality Branch specialists, OPAM Consulting adopts the odour intensity scale outlined by the Victorian EPA (VEPA, 2022). This scale is detailed in **Table 5**.

Table 5: Odour intensity scale.

Obvious	Odour is easy to recognise and always noticeable without any effort or focus on it. Odour can be described and may be attributed to a source.
Subtle	Odour is recognised, can be described, and may be attributed to a source. However, you may need to focus by standing still, inhaling into the wind, and concentrating to recognise it.
0	• No odour • Odour is below the recognition threshold in the field.

B. Odour characters

A colour-coded used in the odour maps to represent the odour characteristics and sources identified during these OPs is presented in **Table 6**.

During an assessment, where no odour was recognised or an odour was detected but could not be recognised and described with certainty, it is rated as "No odour" and a represented as white colour-code.

Table 6: Colour code for odours recognised during these OPs

Source	Odour character	Colour	
		Subtle	Obvious
SBWWTP	putrid, rotten egg, pungent		
Park Irrigation	stale water		
WRR	Hydrocarbon (HC), petrochemical		
Airport	Burnt hydrocarbon, exhaust fumes		
Industries	SO ₂ , irritant, metallic		
No odour	-		

C. Meteorological information

Data is presented for the whole measurement session of a specific day.

Wind cones or large arrows are presented on the odour maps. When a source is identified, the wind cone starts at this source and represents the sector of the wind directions during the whole duration of the measurement session downwind this source.

When no specific source is identified or several sources may be investigated, arrows indicate the approximate wind direction(s) for a period.

Wind data used for the odour map has been extracted from the:

- Site Weather Underground ([Weather Underground - Kalgoorlie-Boulder Airport](#));
- Field notes of the field operator who frequently assessed the wind direction with a light string and the wind speed with a handheld anemometer.

A graph presenting wind direction and speed is extracted from the site Weather Underground for the period of the OP and presented in the following sections.

D. Odour observations

For each OP, a section describes the odours that were recognised offsite including their characteristics, the time when and the location at which it was recognised. Finally, additional information about some specific context or conditions are provided if available.

E. Odour map

Each odour map represents the results of one OP and includes:

- A map of the area investigated with identification of the measurement locations;

- A legend including:
 - The scale;
 - The wind cone and the range of average wind speed ;
 - The north direction;
 - Some colour-coded dots (**Table 5**) for the characters and intensity scale of the recognised odour (dynamic method).

5.3 OP #1 – Mond. 21 Oct. to Tue. 22 Oct. 2024

Wind data for OP #1 is presented in **Figure 13**.

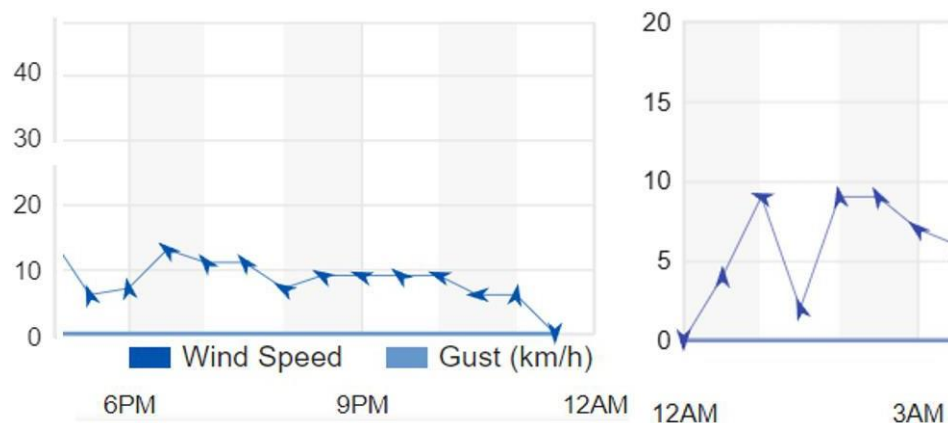


Figure 13: Wind data for OP #1

On Monday evening, starting after 7:00 pm, a light ESE/SE breeze was observed in the area before transitioning to still conditions between 11:00 pm and midnight. After 12:30 am, a light ESE/SSE breeze resumed and continued until the end of the odour patrol (OP).

Three odour maps were generated for OP #1, each corresponding to a specific time period:

- Map 1: 19.22 to 21.43, shown in **Figure 14**.
- Map 2: 22.04 to 22.25, shown in **Figure 15**.
- Map 3: 22.40 to 02.22, shown in **Figure 16**.

5.3.1 ODOUR MAP 1 (19.22 – 21.43)

Odour map 1 is presented in **Figure 14**.

Two text messages were received at 18.33 and 18.34 from Smythe Drive and Jordan Street, respectively. OPAM Consulting proceeded to the area and identified a hydrocarbon (HC), burnt exhaust odour at the corner of Toia Street and Smythe Drive at 19.22. The odour persisted for approximately three minutes at a noticeable level.

At 19.29, the same odour, with the same intensity, was also recognised at the corner of Greenhill Road and Redfern Road. During this time, a small propeller aircraft and a larger Qantas aircraft were observed taxiing on the tarmac.

To assess whether the odour extended upwind, OPAM Consulting drove along Anzac Drive from 19.38 to 19.42 over a 500-metre stretch, upwind of the airport. No odour was detected in this area. The Qantas aircraft subsequently took off at 19.43. OPAM Consulting returned to the corner of Toia Street and Smythe Drive at 19.54, but no odour was recognised at that time.

Given the light southeast wind, it is highly likely that the odour reported by the two community members was related to exhaust fumes from the Qantas plane while it was taxiing on the tarmac.

Later, at 21.38, another text message was received from Longmore Parade, Broadwood. Upon patrolling the area at 21.43, a faint hydrocarbon odour was detected. However, this odour was slightly different from the burnt exhaust odour identified earlier in the evening. Its source was unclear. Although the odour bore similarities to those occasionally associated with the WRR facility, it was not possible to attribute it definitively at this time.

The resident's text message noted that the odour had been present since 19.30. Another possibility is that the earlier odour (recognised between 19.20 and 19.40) may have entered and lingered within the resident's house since that time.

The odour from WRR was recognised on Anzac Drive (1,800m) at 20.08 and 20.15 at a subtle level. It was later recognised at an obvious level along Goldfields Highway, between the entrances of the BP petrol station and WRR, at 20.34.

The SBWWTP sewage odour was recognised twice NW of the facility along Goldfields Highway, once at a subtle level (20.38) and once at obvious level (20.43).

No odours from WRR or SBWWTP were detected along Anzac Drive after these times.

OPAM Consulting then proceeded to the Lynas facility on Great Eastern Highway. A small plume was observed being emitted from the tall stack, but no plume and no odour was noticeable at ground level. It is known that the Lynas stack emits water vapour (steam)

5.3.2 ODOUR MAP 2 (22.04 – 22.25)

Odour map 2 is presented in **Figure 15**.

OPAM Consulting then drove north along Goldfields Highway, west of the Super Pit, and at 22:04 recognised an acrid, burnt match-type odour. Based on the established ESE wind direction, this odour likely originated from the Fimiston stacks located east of the Super Pit (refer to **Figure 15**).

The same odour was not detected further downwind of the Fimiston stacks, including at the following locations and times:

- Corner of Federal Road and Short Street (22.05),
- Corner of Federal Road and Harvey Street (22.06), and
- Corner of Federal Road and Tupper Street (22.07).

Boorara Road (22.08 to 22.12) and Black Street North (22.12 to 22.25) were also patrolled, downwind of the northern tailings pond. No odour was detected in these areas.

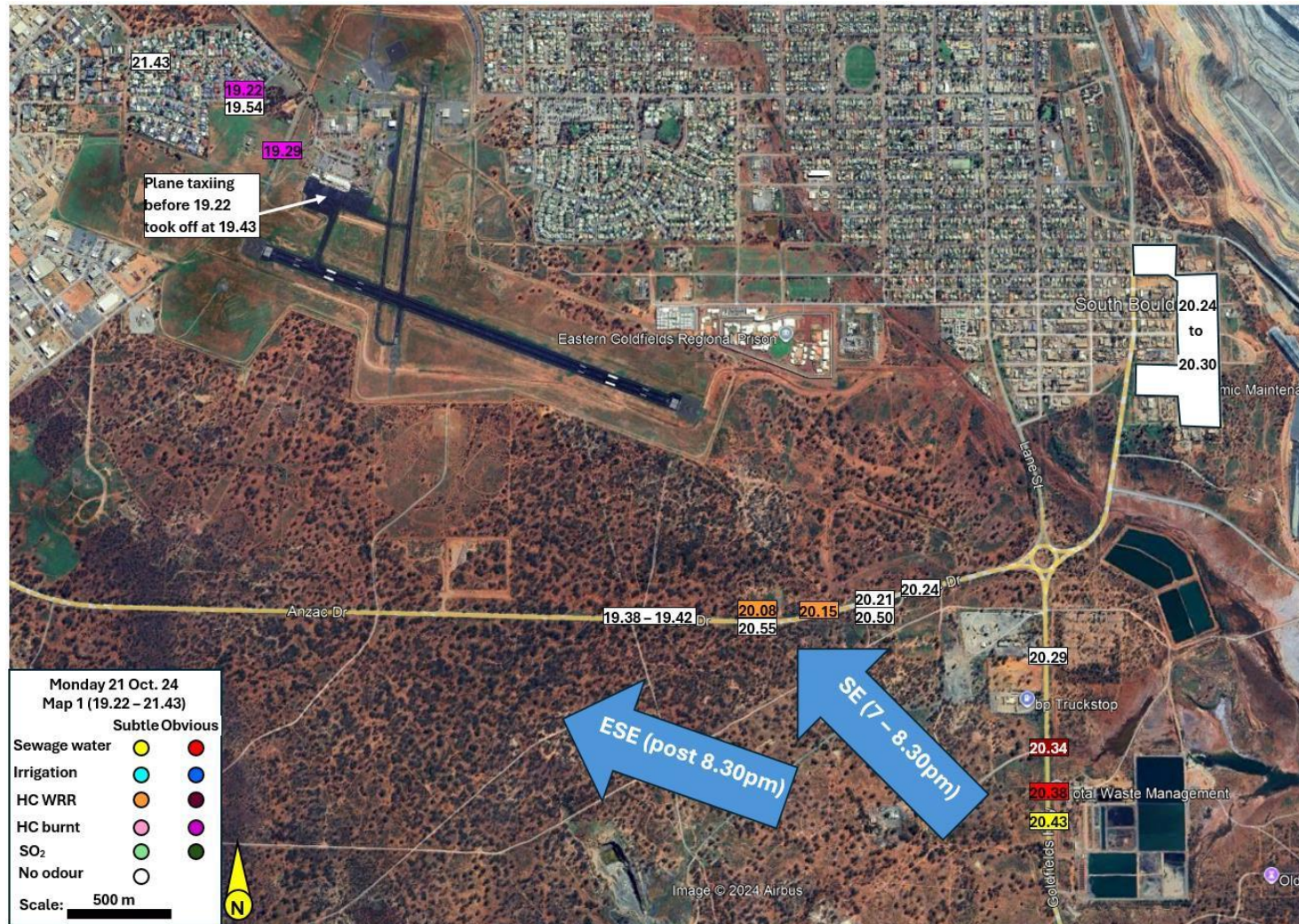


Figure 14: Odour Map 1 (OP #1)



Figure 15: Odour Map 2 (OP #1)

5.3.3 ODOUR MAP 3 (22.40 – 02.23)

Odour map 3 is presented in **Figure 16**.

OPAM Consulting arrived at Mosconi Park at 22.40, where irrigation was in progress. A faint stale water odour was recognised downwind of the sprinklers. A water sample was taken by partially filling a bottle from a sprinkler, and subsequent testing of the headspace confirmed the subtle stale odour. A second patrol around the park, conducted close to and downwind of the sprinklers at 00.24, showed that the odour intensity and character remained the same near the sprinklers and diminished significantly at a distance of 50 metres.

At 23.00, irrigation was also in operation at Wingate Park, located at the corner of Wingate Street and McCarthy Street. Here, the odour was more pronounced, with a higher intensity compared to Mosconi Park. The odour at Wingate Park was also more unpleasant. Water used for irrigation at this park would likely trigger odour reports from the residents. A follow-up investigation at 00.27 revealed similar odour characteristics and intensity.

While irrigation water at Wingate Park is likely to trigger odour reports, the extent of the impact could not be determined due to the calm wind conditions, which prevented assessment of the odour plume's reach.

At 23.48, a text message reported an odour at Hopkins Street, Boulder. On the way to Hopkins St, a putrid stale water odour was recognised on Burt Street at 23.50. However, due to the lack of wind, it was not possible to pinpoint the source or trace the plume.

Hopkins Street and the surrounding streets were patrolled from 23.52 to 00.07, but no odour was recognised during this time.

An inspection of Norkal Park on Vivian Street was conducted as irrigation was scheduled to commence at 23.45. However, no irrigation activity was observed.

At 00.30, while driving along Keegan Street, a plume of putrid sewage odour was encountered, leading to the identification of ongoing irrigation in Dwyer Park at the corner of Keegan Street and Parry Way. The odour from the water used for irrigation at this park would likely trigger odour reports from residents in the area, including those between Cavalier Court and Keegan Street, as well as along Parry Way.

At 01.54, a text message from Clancy Street, Boulder, reported an odour present since 01.00, which was said to be intensifying. The resident noted the odour was inside the house, despite no windows or doors being opened.

At 02.00, OPAM Consulting patrolled the area around Clancy Street until 02.23. Irrigation was observed at Loopline Park; however, it did not appear to involve recycled water. No odour was detected at the park or in the surrounding area during this patrol.

It is worth noting that wind conditions between 00.30 and 01.00 were predominantly easterly, suggesting that the odour could have originated from the west of Clancy Street, potentially from the Super Pit or Fimiston operations. However, with the odour possibly intermittent and with the limited timeframe of OPAM Consulting's presence in Kalgoorlie-Boulder, a more comprehensive investigation into potential sources was not possible.

OUTCOME 1

Aircraft idling on the tarmac while taxiing can produce odours that may impact Broadwood under SE winds and could be responsible for some of the reported odour incidents. The odour was recognised at distances between 300 m and 800 m.

OUTCOME 2

The odour from WRR has the potential to travel nearly 2,000 metres, which could reach the southern edge of South Boulder under similar wind speeds and atmospheric conditions under a S wind.

OUTCOME 3

The low level of odour from the recycled water used at Mosconi Park may not be a nuisance for surrounding residents. However, the level and character of the odour at Wingate Park and Dwyer Park would likely trigger odour reports.



Figure 16: Odour map 3 (OP #1)

5.4 OP #2 – Tuesday 22 October 2024

Wind data for OP #2 is presented in **Figure 17**.

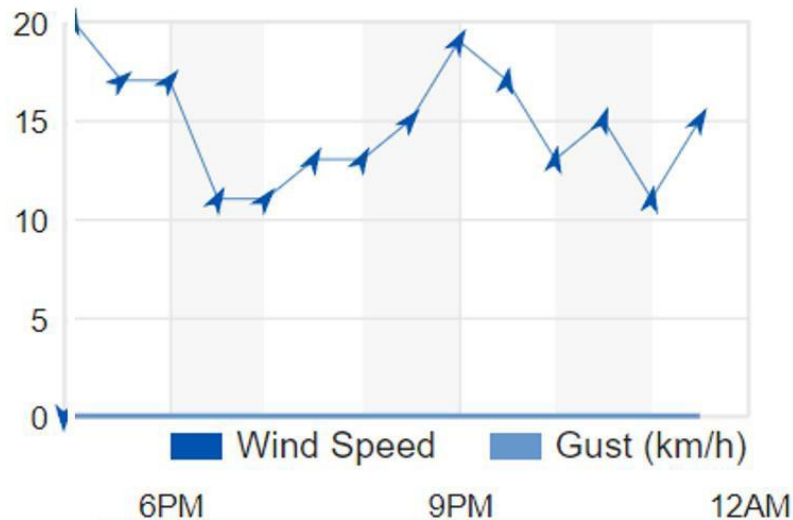


Figure 17: Wind data for OP #2

The wind was from WSW to NW most of the day before shifting to SW/SSW by end of the afternoon and up to 21.00 before trending around S/SSW after 21.00.

The speed remained within the range 10-20 kph

Two odour maps were generated for OP #2, each corresponding to a specific time period:

- Map 1: 18.00 to 19.40, shown in **Figure 18**.
- Map 2: 20.22 to 20.47, shown in **Figure 19**.
- Map 3: 22.30 to 00.20, shown in **Figure 20**.

5.4.1 ODOUR MAP 1 (22.40 – 02.23)

Odour map 1 is presented in **Figure 18**.

At 18.00, a pungent/putrid odour was detected at Point B1. B1 is located approximately 1,300 m from WRR ponds and about 1,500m from the SBWWTP lagoons 1A & 1B. The odour was subtle and could not be definitively attributed to a specific source. A bi-coloured marker has been used to represent this uncertainty.

At 18.28, the same odour was detected at Point B2 at subtle level. Point B2 is situated 1,900m from WRR ponds and the SBWWTP lagoons 1A & 1B. Attribution to a specific source was not possible, and a similar bi-coloured marker was applied.

At 18.37, the odour was recognised at Point B3 at subtle level. B3 is located about 1,300m from WRR ponds and approximately 1,400m from the SBWWTP lagoons 1A & 1B. A reading of 4ppb of H₂S by the Jerome equipment occurred at this point also. This suggests that part of the detected odour originated from the SBWWTP.



Figure 18: Odour map 1 OP #2

At 18.43, no odour was detected at Point B4, likely due to being outside the odour plume.

At 18.50, the odour was present at Point B5, with a H₂S reading of 3.8 ppb, again indicating that the SBWWTP contributed to the detected odour.

For points B6 to B9, patrolled between 18.54 and 19.40 in the NNE/NE sectors of both WRR and the SBWWTP, no odour was recognised.

Then OPAM Consulting drove to the BHP smelter and there wasn't any plume from the stack.

OPAM Consulting then drove to Lynas and could not detect any specific odour neither on the Great Eastern Highway nor along Johns Rd. There was no stack emissions or visible ground level emissions. This is not presented in odour map 1 (refer to **Figure 18**).

5.4.2 ODOUR MAP 2 (20.22 – 20.47)

Odour map 2 is presented in **Figure 19**.

OPAM Consulting endeavoured to identify all ponds, reservoirs, or dams within residential areas, as many are likely to store recycled water, which has been recognised as a potential odour source during park irrigation.

Assessments were conducted directly downwind and near the edge of the reservoirs wherever possible, except for the three dams located at the end of Piccadilly Street, at Points B10 and B11 (refer to Odour Map 2 – **Figure 19**).

No odour was detected downwind of any reservoirs assessed. However, assessments at Points B10 and B11 were inconclusive as these locations were not directly downwind at the time of inspection.

5.4.3 ODOUR MAP 3 (22.30 – 00.20)

Odour map 3 is presented in **Figure 20**.

At 22.30, OPAM Consulting conducted an assessment downwind of the sprinklers operating at the City Council building. The odour level was very low and unlikely to trigger any odour complaints.

At 22.37, a text message was received reporting an odour on Hopkins Street, Boulder. OPAM Consulting conducted an odour patrol at the address and its vicinity around 22.45. No odour was detected during this patrol.

To investigate potential local sources, the industrial area bordered by Dwyer Street (north), Waverley Street (east), Goldfields Highway (west), and Pirie Street (south) was patrolled between 22.47 and 22.57. No odour was detected, and no site or activity was identified as a potential source of odour emissions.

At 23.00, no odour was noted near the BP petrol station under a southerly wind.



Figure 19: Odour map 2 (OP #2)

At 23.05, irrigation was in progress at Rasmussen Park. The water from the sprinklers emitted a subtle stale odour. By 23.20 at Hefron Park, the same odour with the same subtle intensity was observed. Samples of water from each park were collected in bottles, and the headspace of each was assessed the following morning, Wednesday 23 October 2024, with no prior odour exposure. The subtle stale odour was confirmed in both samples.

At 23.26, a text message reported an odour on Pirie Street. OPAM Consulting arrived at Pirie Street and patrolled the area, including Leviathan Street and Shannon Street, around 23.33, but no odour was detected under S to SSW winds.

At 00.04, another text message reported an odour at Clancy Street, Boulder, coinciding with a similar report from the previous night for the same address. However, unlike the E winds of the previous night, the wind was from a S/SSW direction. Upon arrival, no odour was detected at the address or during the patrol of surrounding streets.

OUTCOME 1

The recycled water used at the Admin area, Rasmussen Park, and Hefron Park does not produce an odour intensity or character likely to trigger complaints for the majority of the population. However, it cannot be ruled out that individuals with a higher odour sensitivity may be annoyed by this odour if residing near the edges of these parks.

OUTCOME 2

The source(s) of the reported odour at Hopkins Street and Clancy Street could not be identified during either OP #1 or OP #2.

OUTCOME 3

No specific odours or odour-emitting activities were identified during nighttime in the industrial area located south of South Boulder.



Figure 20: Odour map 3 (OP #2)

5.5 OP #3 – Wednesday 23 October. 2024

Wind data for OP #3 is presented in **Figure 21**.

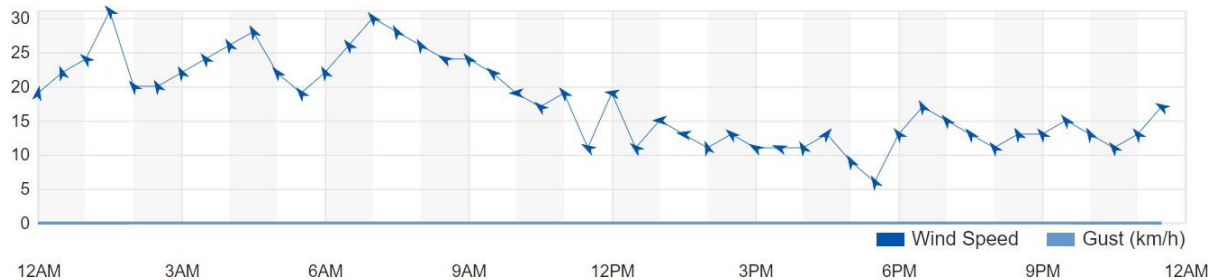


Figure 21: Wind data for OP #3

The SE wind was gentle to moderate up to 9.00 before shifting to a gentle to light SSE/E wind up to 16.00. From 17.00 onwards, the wind was from SE from 5 to 15 kph.

Four odour maps were generated for OP #3, each corresponding to a specific time period:

- Map 1: 6.50 to 11.00, shown in **Figure 22**
- Map 2: 14.10 to 15.20, shown in **Figure 23**
- Map 3: 18.42 to 19.23, shown in **Figure 24**
- Map 4: 21.08 to 22.46 shown in **Figure 25**

5.5.1 ODOUR MAP 1 (6.50 – 11.00)

Odour map 1 is presented in **Figure 22**.

At 6.50, the odour from the SBWWTP was recognised at obvious level at point A3 on Anzac Dr. and a concentration of 3 to 6 ppb of H₂S was measured by the Jerome equipment. The same odour was also recognised at obvious level at points A4 and A5 on Anzac Dr. (500 m wide plume).

No odour could be recognised at points C2, C3, C31 and C32 between 700 m and 1,300m downwind of points A3, A4 and A5.

As it coincided with the timing of flights between Kalgoorlie-Boulder and Perth, OPAM Consulting conducted an odour assessment downwind of the airport tarmac. At 07.40, two planes were taxiing. No odour was detected at Point B on Greenhill Road at 07.40, nor at Point C4 in Broadwood at 07.48. However, as the aircraft moved to the runway for take-off, the same hydrocarbon (HC) burnt odour experienced on Monday, 21 October, was recognised at a subtle level between 08.05 and 08.10.

On Goldfields Highway, obvious HC odour from WRR was recognised at 09.16 and 09.19. Further south, obvious odour from the SBWWTP was detected at 09.21 and 09.25, with a recorded H₂S concentration of 8.16 ppb. Odour assessments were carried out between Goldfields Highway and Anzac Drive from 09.31 to 10:12. During this time, both obvious and subtle odours from the SBWWTP and subtle HC odours from WRR were recognised at various points..

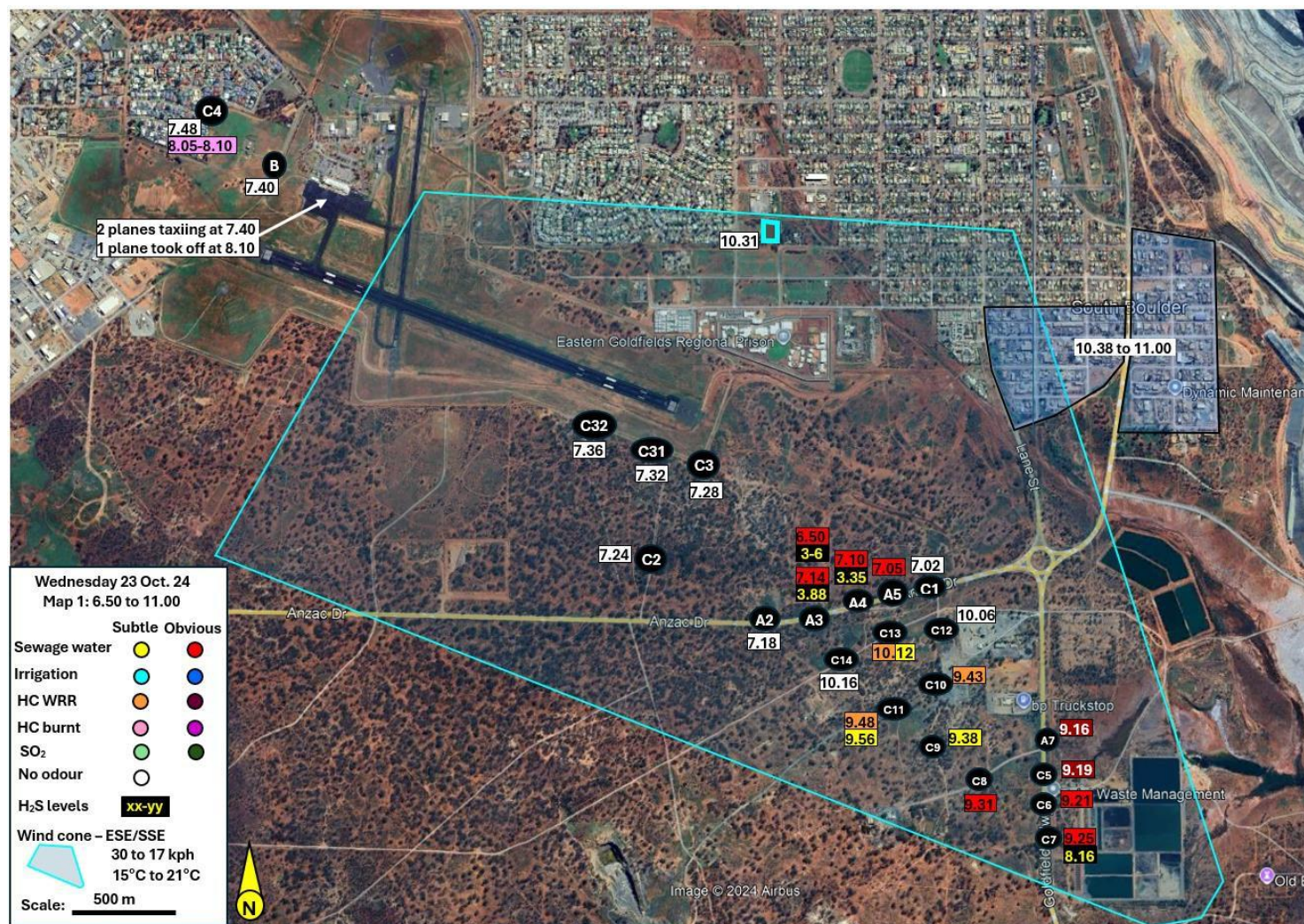


Figure 22: Odour map 1 (OP #3)

An assessment of the pond at Dwyer Park at 10.30 shown that no odour was recognised downwind of the pond. Therefore, this pond was discarded as a possible source of odour.

Additionally, a patrol within the industrial area south of South Boulder during daytime (10.38 and 11.00) has returned no odour and no activities as potential odour emitters.

5.5.2 ODOUR MAP 2 (14.10 – 15.20)

Odour map 2 is presented in **Figure 23**.

A text message was received at 14.05 reporting a strong odour near the BP petrol station. OPAM Consulting conducted a patrol starting from the north of the prison, moving along its eastern and southern boundaries, following the track at the end of the runway to Anzac Dr.. The path crossed Anzac Dr., continued south and stopped on the east of a former pit, straight west of the SBWWTP.

Under a SE/SSE wind, if any odorous plume from WRR or the SBWWTP was present at ground level, OPAM Consulting would have encountered it along this path. However, no odour was detected at any point where assessments were conducted.

This suggests that during the early afternoon, the heat and unstable atmospheric conditions likely caused convective conditions, resulting in a more elevated plume dispersing and/or diluting to levels that could not be detected at downwind and ground level locations between 1.800 m and 3.000 m.

5.5.3 ODOUR MAP 3 (18.42 – 19.23)

Odour map 3 is presented in **Figure 24**.

OPAM Consulting followed a similar path than earlier in the afternoon, as the wind was from a comparable ESE/SSE direction. However, by the end of the day, more stable atmospheric conditions were anticipated, which could result in odour plumes staying closer to the ground and extending over longer distances.

At point C16 (1,200 m from the WRR ponds and 1.400 m from SBWWTP Lagoons 1A and 1B), obvious odours from both sources were detected at significant levels, with H₂S concentrations measured between 4 and 6 ppb using the Jerome.

The same odours (a mix of SBWWTP and WRR odours) were detected at obvious levels at point C19 and at subtle levels at points C17 and C18 between 18.48 and 19.05. These points are located approximately 2.500 m from the WRR ponds and 2.700 m from SBWWTP Lagoons 1A and 1B.

Further downwind at points C21, C22, and C23 (between 19.15 and 19.23), these odours were no longer recognisable. This indicates that the maximum extent of the plume was around 3.000 m.

The investigation was concluded as a smoke odour from a bushfire or similar event began to dominate the atmosphere, obscuring the recognition of any other potential odours.

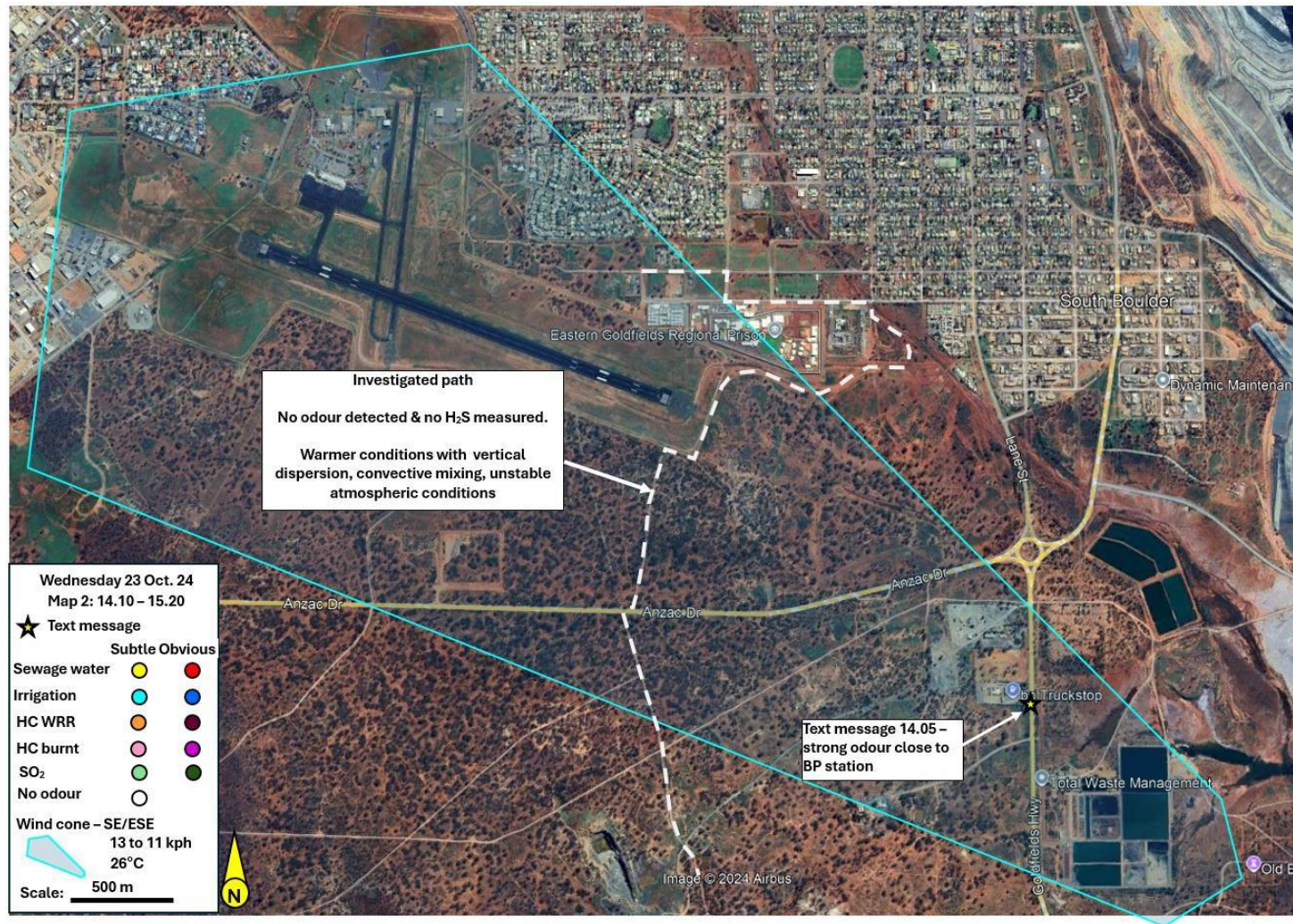


Figure 23: Odour map 2 (OP #3)

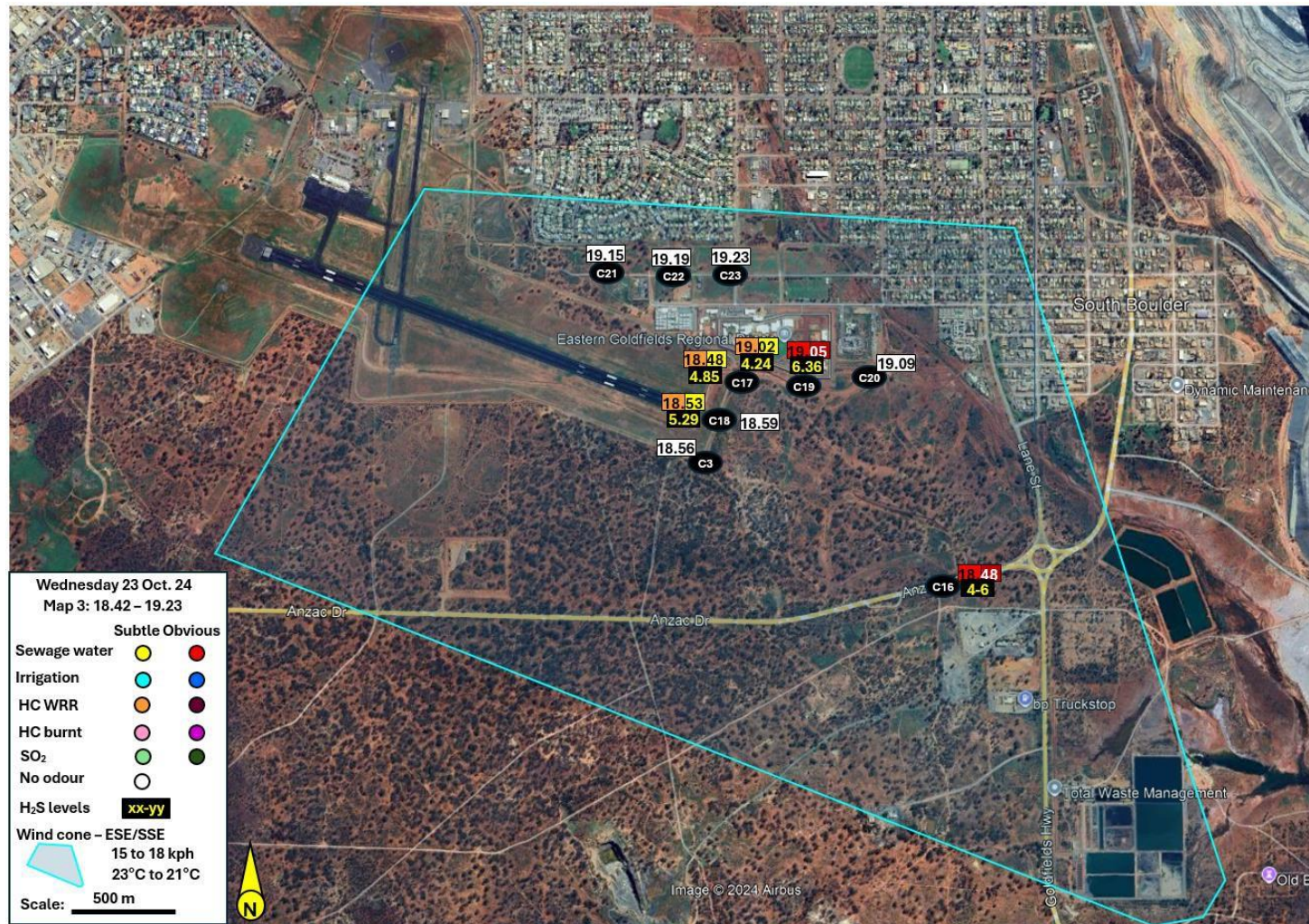


Figure 24: Odour map 3 (OP #3)

5.5.4 ODOUR MAP 4 (18.42 – 19.23)

Odour map 4 is presented in **Figure 25**.

Two text messages were received at 21.02 and 21.05 from Smythe Rd and Longmore Parade, indicating a chemical odour present since 20.50.

OPAM Consulting drove to Broadwood and identified a rotten egg odour characteristic of the SBWWTP at an obvious level. The Jerome equipment returned some H₂S concentrations between 4 and 6 ppb. The same odour was recognised at a subtle level at point B (H₂S: 3.39 ppb) at 21.20 and at an obvious level at point C25 (H₂S: 7.17 ppb) at 21.28.

Following the path from the prison to Anzac Dr. along the track at the end of the runway, the same odour was detected at a subtle level at points C17 and C3 and at an obvious level at point C26 between 21.37 and 21.46. H₂S concentrations between 3.6 and 8.3 ppb were recorded. Additionally, HC odour from the WRR ponds was recognised at points C3 and C26 at subtle and obvious levels, respectively.

Both odours from the SBWWTP and WRR were subsequently recognised on Anzac Dr., where H₂S levels between 9 and 12 ppb were measured. On Goldfields Hwy, obvious odours from WRR and SBWWTP were recognised at obvious levels, with H₂S levels peaking at 60 ppb.

OPAM Consulting then returned to the Broadwood area to determine whether the odour was still present and whether H₂S levels could be measured using the Jerome equipment.

At 21.30, at point C24, a subtle odour from the SBWWTP was recognised, along with a hydrocarbon odour similar to the WRR odour, although it could not be confirmed with certainty.

The SBWWTP odour was intermittently recognised at subtle levels at five points from the southern area of Somerville to Great Eastern Hwy, with H₂S concentrations of 3 to 5 ppb recorded at these locations.

The SBWWTP odour was recognised up to 6.5 km away during this evening, while the WRR HC odour was confirmed up to 2.5 km.

It was not possible to conclusively confirmed the WRR odour at point C24 at 21.30 (5.4 km from WRR). However, with this odour recognised at obvious level at point C19 at 19.05 (2.3 km from WRR), this odour can be recognised beyond 2.5 km.

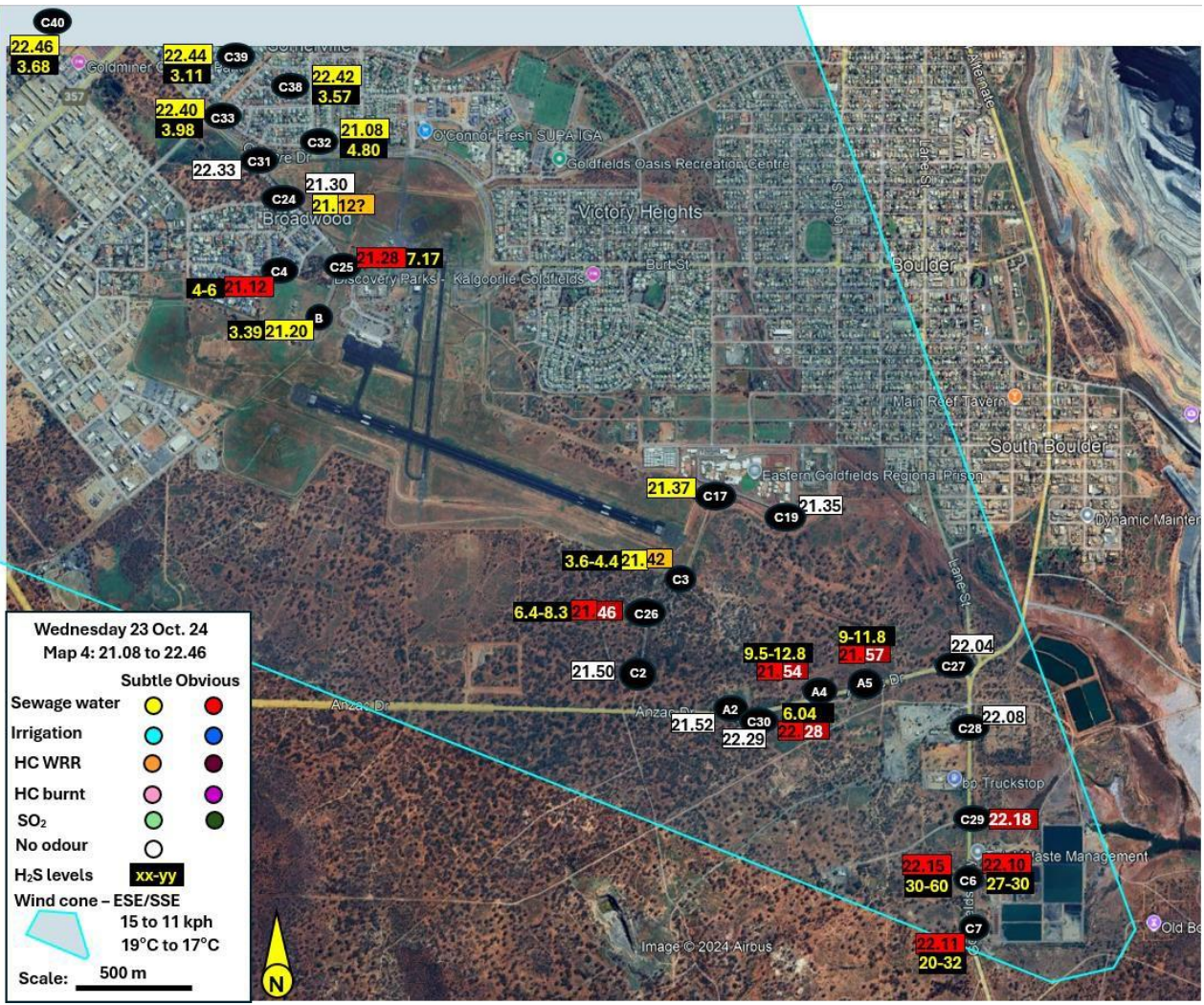


Figure 25: Odour map 4 (OP #3)

OUTCOME 1

The SBWWTP odour was detectable up to 6.5 km from the facility under light to gentle SE winds during the evening. H₂S concentrations ranged from a maximum of 60 ppb at the SBWWTP boundary to 3–5 ppb at a distance of 6.5 km.

The flat terrain, stable atmospheric conditions, and likely lower pH levels during nighttime (refer to section 4.1) create favourable conditions for increased odour and H₂S emissions. These emissions can be transported over long distances with limited dilution.

OUTCOME 2

The WRR hydrocarbon odour was detectable at subtle level up to 2,500 m and at obvious level up to 2,300 m from the facility. It is likely recognisable at subtle levels at greater distances beyond 2,500 m. Additional assessments would be required to better ascertain the distance

OUTCOME 3

It appears that the industrial area south of South Boulder does not have any activity that would emit odour and be a local source to impacts in the area. However, it should be noted that this assessment was limited in time and may not have covered every possible conditions that can exist for all industrial sites.

6. Role of the Super Pit rock walls

The three photos (source: City of Kalgoorlie Boulder) presented in **Figure 26** shows the elevation of the rock wall on the south-western side of the Super Pit. The photos were taken at the corner of Goldfields Highway and Mount Monger Road.

June 2015



September 2022



January 2025



Figure 26: Increased elevation of the Super Pit rock walls (2015 – 2025)

The high rock walls play likely a role in the plume movements under SW/SSW winds. Under such winds, a plume from the CBWWTP or the WRR facility will be transported towards the south-western edge of the Super Pit rock wall and will likely be diverted

from its NE/NNE path to follow the rock wall in a northern or even NNW path towards or close to the eastern edge of South Boulder and Boulder. When this happens, an odorous plume from these facilities may impacts residents on the eastern edge of these suburbs.

Figure 27 shows a simplistic representation of the variation of the plume movements from 2004 to 2024/2025 (Aerial views: Google Earth).

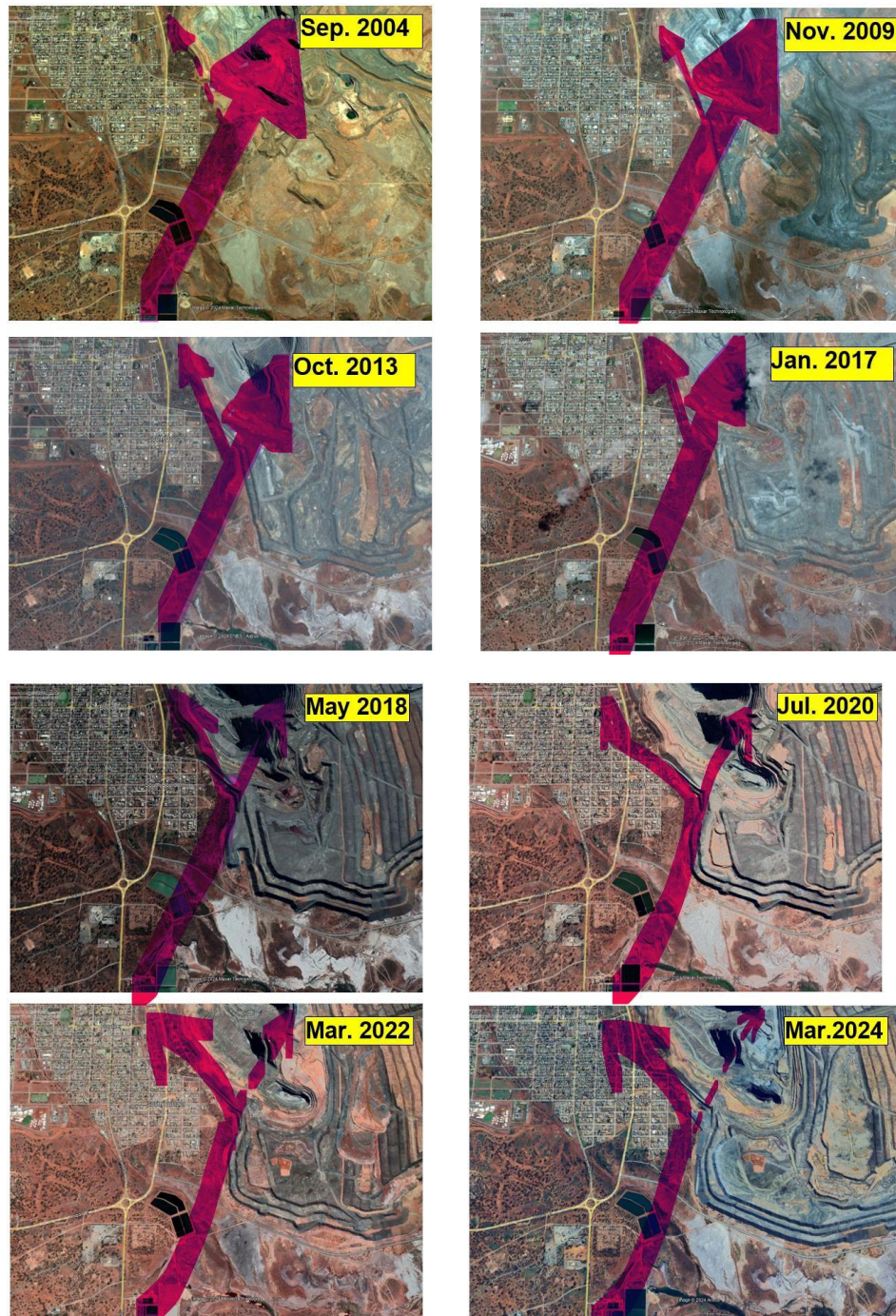


Figure 27: Western rock wall elevation variations (2004 – 2024)

In 2004, there were no walls or walls of limited elevations while in 2024/2025, the western side of the Super Pit shows very high rock walls.

The thickness of the arrows is related to the volumes of the plumes likely travelling in a given direction. With time, the volumes of the plume travelling more N and NNW along the Super Pit rock wall are larger and larger with the increasing height of the wall.

7. Conclusion

Residents in the southern suburbs of Kalgoorlie-Boulder have been reporting odour impacts over the past 18–24 months. Despite reviewing these reports and conducting some investigations, the City was unable to conclusively identify the source(s) of the odour. To address this issue, OPAM Consulting was engaged to improve the likelihood of identifying the odour source(s).

After conducting preliminary research on potential odour emitters in the area, both local and distant, OPAM Consulting spent five days in Kalgoorlie-Boulder from 20 to 25 October 2024. Following a meeting with City representatives to review and discuss planned actions, OPAM Consulting engaged with the community, encouraging residents to support the investigation by sending quick text message notifications when they experienced odour events.

A total of 22 text messages were received by OPAM Consulting during this period from 11 active volunteers. The timely, consistent, and genuine support from these community members was essential in helping OPAM Consulting meet the project objectives within the limited timeframe.

All reported odour impacts occurred under S/SE winds ranging from 5 to 20 kph. The sources, or some of the sources, responsible for the odour impacts are located to the south of the reported impact areas. It is also possible that some local sources are a contributor of odour.

The work conducted during OPAM Consulting's time in Kalgoorlie-Boulder involved attending locations where odour impacts were reported, conducting site visits, and performing odour patrols (OPs).

Among the far sources responsible for some of the odour reports are the South Boulder Wastewater Treatment Plant (SBWWTP) and the Western Resource Recovery Pty Ltd (WRR) facility. These two facilities are situated side-by-side along the Goldfields Hwy, approximately 1,800 m from the southern end of South Boulder.

For the SBWWTP, OPAM Consulting reviewed data from the City regarding modifications to the plant design since 2022, including the shift from mechanical treatment to a pond system and monitoring data from the past four years. OPAM Consulting also conducted observations and monitoring on Monday 21 October 2024, along with odour patrols. The results indicated that a combination of factors contributed to low pH levels and potentially low ORP levels (though not measured),

which have likely played a role in facilitating odour emissions. Key contributing factors included:

- The absence of mechanical aeration
- Low winter temperatures during the transition period
- Significant intake volumes of K210 liquid waste

The most recent assessment of pH and ORP conducted on Monday, 2024, indicates that the performance of the pond treatment system has likely improved over the past two years with expected lower emission rate of odour and H₂S compared to the initial year of the pond system (April 2023 to mid-2024).

However, under the current conditions, odour from the SBWWTP, primarily from Lagoons 1A and 1B, can still be recognised up to 6.5 km from the facility under specific wind and atmospheric conditions. During these conditions, H₂S concentrations were measured at 60 ppb at the boundary, decreasing to 3–5 ppb at 6.5 km.

The reduced volume of K210 liquid waste received since July 2024 has likely contributed to the improvement in treatment performance at the lagoons.

The ongoing construction and planned installation of a preliminary screening system at the facility (due to be completed by early 2025) is expected to significantly reduce the volume of solids sent to Lagoons 1A and 1B, which should further enhance the treatment performance. It is also recommended to conduct bathymetric surveys to assess the thickness of the bottom layer in Lagoons 1A and 1B.

It is recommended that monitoring of at least pH and ORP be conducted twice daily using a consistent method to establish and track trends, which will provide insights into the performance of the system.

The quality of treated water was higher when mechanical aeration (IDEA) treatment was in use. Refurbishment of the IDEA system has been discussed as a potential option. If implemented, OPAM Consulting was informed that 70% of the inflow would be treated through the pond system, with 30% treated via one IDEA train.

Upgrades and improvements at the SBWWTP would also likely have a beneficial impact on the recycled water used to water parks.

Following the installation of the preliminary screening and potential other upgrades or improvements, and pending the level of odour reports received in the following weeks and months, it is suggested that OPAM Consulting conduct another independent assessment during the winter period. This assessment should evaluate impacts from the SBWWTP, as well as other potential sources.

WRR receives large volumes of emulsified water, which undergoes two stages of gravity separation, with the second stage occurring in large ponds (total surface area of 5,200 m²). During the site visit on Monday, 21 October, a strong hydrocarbon (HC) odour was noted on the side of the ponds.

OPs have shown that odours from WRR can be recognised beyond 2,500 m. The odour from this site can be recognised as far as Boulder, Victory Heights, and possibly, though not confirmed, Broadwood.

Gravity separation over a large surface area is straightforward to operate and energy efficient. However, it is a slow process with limited effectiveness. The light oil floats on top of the water column in the pond, exposed to the atmosphere, likely preventing efficient evaporation of the aqueous phase. Dissolved Air Flotation (DAF) and possibly stripping are more effective solutions with a significantly reduced footprint, resulting in lower odour emission rates.

During OPAM Consulting's limited time in Kalgoorlie-Boulder, it was also identified that recycled water used for irrigation at certain parks could be a source of odours for local residents, particularly at Wingate and Dwyer Parks. While most of the reservoirs do not seem to be a source of odour themselves, further assessments should be carried out to confirm this over a longer period.

The airport, specifically taxiing aircraft with idling engines, can contribute to odour impacts in the Broadwood area under SE winds.

It appears that the BHP Nickel Smelter was not operational during OPAM Consulting's time in Kalgoorlie-Boulder. Lynas has been commissioning their operations for several months and while initial production has commenced, it is not yet at full production capacity.

Stack emissions from Fimiston may also be a potential source of odour (SO₂), with the plume possibly travelling over the Super Pit and impacting Boulder. OPAM Consulting identified this source once, and further assessments would be required to verify its role.

Finally, although significant work was completed within a limited timeframe, some uncertainties remain regarding the role of certain sources, which would require further investigation. However, this work has confirmed that the SBWWTP and WRR are two major odour emitters that have likely contributed to numerous odour reports received by the City over the past two years.

REFERENCES

AS 4323

Stationary Source Emissions Part 3: Determination of Odour Concentration by Dynamic Olfactometry, ANZ 4323.3:2001, Standards Australia, Sydney

DWER, 2019

Guideline: Odour Emissions, DWER WA, Department of Water and Environmental Regulation, June 2019

EN, 2016: *Ambient Air – Determination of odour in ambient air by using field inspection, Part 2: Plume method – European Standard EN 16841-2:2016*, Commission Européenne de Normalisation (CEN)

VEPA, 2022: *Guidance for assessing odour* – Publication 1882, Victoria Environmental Protection Authority, June 2022

ATTACHMENTS

