REPORT

AkzoNobel Facility

Odour Emissions Assessment

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19130795-037-R-Rev0

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Distribution List

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1.0 INTRODUCTION

1.1 Improvement Notice Requirements

On 5 October 2021, the Victorian Environment Protection Authority (EPA) issued AkzoNobel Pty Ltd (AkzoNobel) an Improvement Notice (IPMN-00001398) for its powder, paint and resin production plant (the Facility) located at 51 McIntyre Rd in Sunshine North, VIC.

The IPMN states the following requirements:

1) *By 31/01/22 you must provide a document which identifies, assesses, and outlines reasonably practicable controls for, odour generated from and within the paint production building at the premises. This must include, but does not need to be limited to:*

   a. *An identification of all potential point sources of odour within the paint production building, including all discharge points.*

   b. *An identification of all potential fugitive sources of odour within the paint production building.*

   c. *An assessment of the level of risk and degree of harm for potential sources of odour within the paint production building, including all discharge points and fugitive sources. This should include, but not be limited to:*

      i. *assessing both the concentration and characterisation of odour discharged through identified discharge points in accordance with AS/NZS 4323.3-2001 Stationary source emissions - Part 3: Determination of odour concentration by dynamic olfactometry, and;*

      ii. *assessing the level of risk and degree of harm for all potential point sources of odour within the paint production building, with regard to the assessment carried out as part of requirement 1(c)(i) of this remedial notice.*

      iii. *assessing the level of risk and degree of harm for all potential fugitive sources of odour within the paint production building.*

   d. *An assessment regarding if the current operating stacks, and any associated emissions control systems, are reasonably practicable controls to treat odour and the associated risk to human health and the environment. This should include, but not be limited to;*

      i. *Outlining the specifications of any operational stacks including the height, diameter, and velocity of air through those stacks.*

      ii. *Outlining the specifications of any emissions control systems used in the paint production building.*

      iii. *Assessing the effectiveness of the existing stacks, and emissions control systems, in minimising the risk of harm to human health and the environment from odour generated from and within the paint production building.*

   e. *Recommendations of reasonably practicable improvements to both odour extraction and treatment systems, and the management of fugitive sources of odour, to minimise the risks of harm to human health and the environment from odour generated from and within the paint production building.*

1.2 Related Requirements

The requirements of IPMN are specific to odour emissions from the AkzoNobel paint plant, which have a characteristic “paint or solvent” type odour. The powder plant at the Facility is not a source of odour emissions. However, the resin plant is a source of odour which has been characterized as having a “sickly sweet” odour.

Odour emissions from the resin plant have been the subject of previous EPA notices issued to AkzoNobel. These include:

- Pollution Abatement Notice (PAN) #90011934, issued on 23/04/2021.
- Clean Up Notice (CUN) #90011654, issued 25/03/2021.

On 30 July, 2021 AkzoNobel provided EPA with details of the Air Emission Monitoring Program in response to requirements set forth in PAN #90011934 (Golder Report # 19130795-016-R-Rev0). This Golder report was subsequently updated to further document odour emissions specific to the paint plant (Golder Report #19130795-016-R-Rev1). This odour assessment report includes information from the earlier Golder report.

Requirements in CUN #90011934 focus on emissions from the resin plant and the proposed installation of a regenerative thermal oxidizer (RTO) to reduce resin plant emissions of volatile organic compounds (VOCs) and odour. Delivery and commissioning of the RTO was delayed due to COVID-related issues. However, on 4 January, 2022, AkzoNobel provided EPA with an RTO stack testing report (Golder Report #19130795-042-R-Rev0) as well as supporting information required to address CUN #90011654 requirement 3.6 (Golder Technical Memorandum #19130795-043-TM-Rev0). This odour assessment report also includes information from this earlier Golder report.

1.3 Contents and Structure of this Report

AkzoNobel retained Golder Associates Pty Ltd. (Golder) to complete an Odour Emissions Assessment (the Assessment) for the Facility to address the requirements of the IPMN. The Assessment considers both “paint/solvent” and “sickly sweet” odour emissions from the paint and resin plants, respectively. Table 1 provides a summary of the IPMN requirements, and the sections of this Assessment that address each requirement. The Assessment includes:

- A quantitative odour emissions inventory for paint and resin plant sources (Section 2.0).
- A summary of results from fence line VOC monitoring, boundary and residential odour surveys (Section 3.0).
- Results of odour dispersion modelling (Section 4.0) used to:
  - assess potential effects of odour emissions from the Facility on nearby residents; and
  - assess the effectiveness of emissions reductions that can be achieved with improved capture and treatment of paint plant odour emissions.
- Recommendations for improved emissions capture and control based on the results of the odour dispersion modelling (Section 5.0).

Table 1: Improvement Notice Requirements Summary

IPMN Requirement	Description	Document Section	Title
1a	Identification of paint plant point sources of odour.	Section 2.1	Odour Emissions Inventory
1b	Identification of paint plant fugitive sources of odour.	Section 2.2	Odour Emissions Inventory
1c(i), (ii), (iii)	Assessment of risk from paint plant odour sources.	Section 3.0	Boundary VOC and odour monitoring.
1d(i), (ii), (iii)	Assessment of existing emissions and risk to human health and environment.	Section 2.3, Section 3.0, & Section 4.0	Odour Emissions Quantification, Boundary VOC and Odour Monitoring, & Odour Dispersion Modelling
1e	Recommendations to reduce odour emissions and minimize risk to human health and environment.	Section 5.0	Conclusions and Recommendations

2.0 ODOUR EMISSIONS INVENTORY

2.1 Point Source Identification

Figure 1 shows a site map including the locations of major site infrastructure including the powder, paint and resin plants, the tank farm and trade waste pits. It also includes the locations of the resin plant AC filter system and the resin plant RTO stack (i.e., RTO1).

APPENDIX A contains an engineering schematic illustrating the "Areas" within the powder, paint and resin plants, and the locations of each discharge point that is considered as part of the site-wide emissions monitoring program (see Golder Report #19130795-016-R-Rev1 for additional details). Table 2 summarizes discharge points for each work area, the type of emissions from that source and the frequency with which the discharge points are tested by a NATA-accredited consultant.

The powder plant at the Facility is not a source of odour and is not considered further in this assessment. Similarly, discharge points DP60, DP65 and DP133 are sources of particulate matter (PM), not odour, and are not considered further in this assessment.

2.2 Fugitive Source Identification

Experienced odour professionals from Golder completed several site visits to the Facility in 2020 and 2021. Boundary odour surveys have also been completed twice every six days since August of 2021. Results of the site visits and odour surveys indicate four potential non-point sources of odour emissions from the Facility. These include the following:

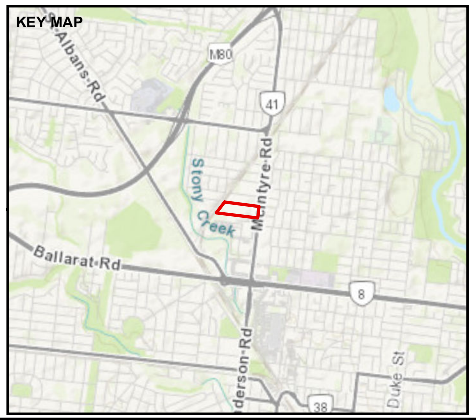
- Fugitive emissions from the resin plant building;
- Fugitive emissions from the paint plant building;
- Fugitive emissions due to working and breathing losses from compounds stored in the tank farm; and
- Fugitive emissions from the trade waste pits.

Odour emissions from these sources are discussed in the following sub-sections.

LEGEND

- Facility Boundary
- Cadastre Boundary
- Site Area

KEY MAP



0 20 40 60 80

1:1,250 METRES

NOTE(S)
1. PROJECTION: GDA 1994 MGA ZONE 55.

REFERENCE(S)
1. KEY MAP SOURCED FROM ESRI ONLINE BASEMAPS.
2. AERIAL IMAGERY SOURCED FROM NEARMAP.COM. DATE OF CAPTURE 02/05/2021.
3. STATE DATA SOURCED FROM DATA.VIC.GOV.AU.

CLIENT
AKZONOBEL PTY LTD

PROJECT
AKZONOBEL ODOUR EMISSIONS ASSESSMENT

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	-
PREPARED	MAH
REVIEWED	CM
APPROVED	CM

TITLE
AKZONOBEL SUNSHINE PLANT LAYOUT

PROJECT NO.	CONTROL	REV.	FIGURE
19130795	037-R	0	1

Table 2: Emissions Monitoring Program Summary

Plant	Area	Discharge Point	Testing Frequency	Sample Types
Powder	101	DP61	bi-annual	PM
		DP62	bi-annual	PM
		DP66	bi-annual	PM
Paint	11	DP101	n/a	
		DP102	bi-annual	VOC, odour
		DP103	n/a	
		DP104	n/a	
		DP105	quarterly	VOC, odour
		DP106 (new)	quarterly	VOC, odour
	12	DP46.10	bi-annual	VOC, odour
		DP46.11	n/a	
		DP46.9	n/a	
		DP46.6 (new)	quarterly	VOC, odour
		DP46.4	n/a	
		DP46.3	n/a	
		DP46.2	n/a	
		DP46.1	n/a	
		DP46.8	bi-annual	VOC, odour
		DP46.7	bi-annual	VOC, odour
		DP23	quarterly	VOC, odour
		DP46.12	n/a	
		DP13 (new)	quarterly	VOC, odour
		DP46.5	n/a	
		DP63	quarterly	PM, VOC, odour
		DP53	quarterly	PM, VOC, odour
		DP133 (new)	bi-annual	PM
Resin	07	DP19	n/a	minor VOCs
		DP65	bi-annual	PM
	08	DP48 (new)	n/a	minor VOCs
		DP32	bi-annual	VOC, odour
		DP60	bi-annual	PM
	RTO system	DP120	quarterly	NPG, odour

2.2.1 Fugitive Emissions from the Paint Plant Building

The paint plant is a potential source of fugitive emissions of a “chemical solvent or paint” type odour. Each area of the paint plant is equipped with ventilation and air handling systems. These systems serve two main purposes.

First, potential fugitive emissions from paint reaction vessels are collected directly using Nederman arms (adjustable extraction vents) either attached directly to the vessels, or manoeuvred over vessels at work stations where odour emissions may be occurring inside the building. This approach appears effective and reduces worker exposure to odour but does not result in 100% capture of odour emissions.

The secondary capture system includes general purpose extraction vents that draw air from the paint plant building, discharging this air from stacks located on the paint plant roof (e.g., some members of the 46-series of discharge points in Table 2). These secondary vents maintain a fresh air environment inside the paint plant building by extracting air containing residual VOCs and odour not captured directly at their source(s). Extracted air is replaced naturally by fresh air entering the building via doors, windows and louvres.

Although the paint plant area contains doors, windows and louvres, the current ventilation system results in a slight negative pressure on the building, which minimizes fugitive odour emissions from escaping the building envelope. For example, at the west side of Area 11 is a roll-up door large enough to allow forklifts to enter this paint production area. Inside the building solvent/paint type odours are distinct and constant, whereas just outside the roll up door these odours are non-detectable to weak in intensity and, when detected, usually only transient; i.e., occurring only briefly when the door is first opened.

Based on the existing engineering controls, and observations while on site, potential fugitive emissions of paint/solvent odour from the paint building are considered very low to negligible and are therefore not considered further in this assessment.

2.2.2 Fugitive Emissions from the Resin Plant Building

Historically the resin plant may have been a source of fugitive emissions of a sickly sweet odour associated with emissions of neopentyl glycol (NPG).

In response to the PAN #90011934, and as part of the RTO installation in spring 2021, AkzoNobel has improved the capture of headspace gases from reaction vessels and other plant infrastructure used to produce resin. New ducting has also been installed from the resin plant to the RTO to eliminate the potential for fugitive leaks at junctions and gaskets in the previous system.

As a result of these improvements, fugitive emission of (sickly sweet) odours from the resin plant building are considered very low to negligible and are not considered further in this assessment.

2.2.3 Trade Waste Pits

During the 2020 odour monitoring assessment the trade waste pits were identified by Golder as a potential source of fugitive odour emissions. Fugitive odour emissions associated with the sickly sweet smell of NPG were confirmed during a subsequent site visit by Golder.

In response to PAN #90011934, AkzoNobel upgraded the trade waste pit infrastructure to include extraction vents and better seals between the sides of the pits and their retractable lids. The seals and extraction vents are designed to maintain a slight negative pressure in the headspace of the trade waste pits. The purpose is to reduce the potential for fugitive emissions of NPG and odour from this source. Captured emissions are routed to the resin plant RTO for treatment.

Occasionally the covers to the trade waste pits must be opened. In these instances, there is the potential for NPG and odour to be released for short periods of time. These occurrences are infrequent but unavoidable because lifting the covers is part of the maintenance and inspection program for the pits. To better manage these fugitive emissions, management controls for the trade waste pits have also been improved. Operating procedures include employees being directed to maintain the covers in the closed position, rather than leaving them open unnecessarily. The purpose of this policy is to reduce the frequency of potential fugitive odour emissions from this source.

During a follow up site visit on 24 June 2021 Golder inspected the upgraded trade waste pits and confirmed a decrease in the magnitude and intensity of the odour at this location. As a result of these improvements, fugitive emissions of the sickly sweet odour from the trade waste pits are considered very low to negligible and are not considered further in this assessment.

2.2.4 Tank Farm

Paint Plant

The tank farm at the facility is used to store reactants used in the paint plant (Figure 1). Tanks with the highest potential to produce fugitive emissions include the following:

- PRIMAX Paint Tanks1
- Shadow Grey tanks

These tanks are fitted with pressure relief valves to reduce fugitive emissions. However, the tanks may be a small source of breathing losses during daytime heating of the tanks.

There is also the potential for these tanks to be a source of working losses while tanks are being refilled. Delivery and transfer of reactants into the storage tanks is via tanker trucks. During filling operations, vapour recovery lines are run from the tanks to the tanker trucks. This approach reduces direct working losses from the tank headspaces during filling operations.

Observations during site visits indicate these engineering and management controls are effective and residual fugitive emissions from the paint plant storage tanks are considered very low to negligible and are not considered further in this assessment.

Resin Plant

The NPG reactant is delivered to AkzoNobel by 20,000 L tanker truck in a 90% water solution. NPG is transferred from the tanker truck to a single on-site storage tank in the tank farm (Figure 1). The NPG storage tank has a capacity of 80,000 L and total annual NPG consumption is 2,400,000 L per year. This results in approximately 125 tanker deliveries per year and a tank turnover rate of approximately 2.5 turnovers per month.

When NPG is transferred from the truck to the tanker there is the potential for fugitive NPG and odour emissions (i.e., working losses). There is also the potential for a small amount of NPG and odour emissions from pressure relief valves during daytime heating of the tanks (i.e., breathing losses).

Fugitive NPG and odour emissions from the tank source area are intermittent and would typically occur for only 90 to 120 minutes approximately every three days. Further characterization or quantification of this source of fugitive emissions has not been carried out at this time.

APPENDIX B lists bulk storage on site.

2.3 Odour Emissions Quantification

Table 2 identifies each discharge point at the Facility, its emissions type(s) and the frequency with which the sources are tested as part of the Facility-wide air emissions monitoring program. In 2018 the ventilation systems servicing the paint plant were upgraded. This included decommissioning of DP54 and installation of a new small batch baghouse (DP106) servicing paint plant Area 11. Because of these changes, only odour emissions data from mid-2018 onward are considered representative of current odour emissions from the Facility.

Table 3 summarizes odour emissions based on NATA-accredited odour stack testing and includes:

- Annually averaged volumetric odour emissions rates in OU/min for years 2018 (partial year for Area 11 and 12 sources), 2019 and 2020.
- Three-year average of odour emissions rate from each discharge point.
- Annually averaged volumetric odour emissions rates for year 2021, which are provided as a check of the conservatism included in the 2018 to 2020 3-year average.
- Stack parameters including:
  - Stack diameter;
  - Stack exhaust temperature; and
  - Stack exhaust velocity.

To quantify facility-wide odour emissions, several assumptions need to be applied to the 2018 to 2020 stack testing results. These assumptions include the following:

1) Point (sickly sweet) odour emissions are assumed to be associated exclusively with DP48 and the resin plant RTO. An odour removal efficiency of 90% is assigned to the RTO based on the commissioning stack tests completed in December, 2021.
2) There are no 2019 or 2021 odour emissions measurements for DP48 so values are calculated from the average of the 2018 and 2020 stack tests. In Table 3 these cells have been shaded green to indicate they are calculated values rather than direct measurements.
3) Discharge points DP101, DP103 and DP104 in Paint Area 11 are assigned the average odour discharge rate measured biannually in DP102. In Table 3 these rows have been shaded green to indicate they are calculated values rather than direct measurements.
4) The 46-series discharge points (except DP46.6) in Paint Area 12 that are not routinely tested are assigned the average odour discharge rates measured in DP46.7, DP46.8 and DP46.10. These rows have also been shaded green in Table 3 to indicate the values have been calculated.

For DP's without historical emissions testing, estimates of contemporary odour emissions needed to be generated (e.g., see Assumption #3 above). These engineering estimates are based on the processes associated with the DP and the available test data for DP's with similar characteristics. Additional assumptions applied to the historical data to form a contemporary emissions estimate include the following:

5) There are no 2018 stack measurements for DP106 so the average is computed from the 2019 and 2020 data only. In Table 3 this cell has been shaded green to indicate it is a calculated value rather than direct measurement. Results from stack testing in 2021 confirm the 3-year average is a conservative estimate.

6) Discharge Points 46.6 and DP13 (N12-STK13) in Paint Area 12 were assigned the average 2018 odour emissions rate (126,400 OU/min) measured in DP23. This is considered a very conservative assumption for the following reasons:

   a. Ducting associated with DP46.6, DP13 and DP23 changed in 2018;

   b. The 3-year, 2018 to 2020 average emissions rate from DP23 is 84,500 OU/min;

   c. The measured odour emissions rate in 2021 was 62,000 OU/min; and

   d. AkzoNobel and Golder consider it likely that total historical and contemporary emissions among DP46.6, DP13 and DP23 are constant; i.e., their total emissions are likely closer to 126,400 OU/min, rather than emissions rate being 126,400 OU/min from each discharge point.

Based on the above assumptions, especially assumption #6, the Facility-wide odour emissions estimates presented in Table 3 are considered a conservative estimate.

Table 3: Odour emissions quantification summary.

Plant	Area	Discharge Point	Drawing ID	2018 Avg Odour Emissions Rate (OU/min)	2019 Avg Odour Emissions Rate (OU/min)	2020 Avg Odour Emissions Rate (OU/min)	3-year Avg Emissions Rate (OU/min)	2021 Avg Odour Emissions Rate (OU/min)	Stack Diameter (m)	Stack Temperature (°C)	Exhaust Velocity (m/s)
Powder	101	DP61	nd	No Odour emissions							
		DP62	nd	No Odour emissions							
		DP66	nd	No Odour emissions							
Paint	11	DP101	P-EXT-N11-STK01	15000	39000	11000	21667	11000	0.7	28	4.2
		DP102	P-EXT-N11-STK02	15000	39000	11000	21667	11000	0.7	28	4.2
		DP103	P-EXT-N11-STK03	15000	39000	11000	21667	11000	0.7	28	4.2
		DP104	P-EXT-N11-STK04	15000	39000	11000	21667	11000	0.7	28	4.2
		DP105	P-EXT-N11-STK05	92200	59000	59000	70067	31000	0.7	24	8.0
		DP106 (new)	"small batch baghouse"	247500	240000	255000	247500	205000	0.61	28	5.4
	12	DP46.10	P-EXT-N12-STK01	73000	14000	17000	34667	20000	0.55	20	8.6
		DP46.11	P-EXT-N12-STK02	41000	24500	20833	28778	37000	0.55	20	7.2
		DP46.9	P-EXT-N12-STK03	41000	24500	20833	28778	37000	0.55	20	7.2
		DP46.6 (new)	P-EXT-N12-STK04	126400	126400	126400	126400	62000	0.62	25	10.1
		DP46.4	P-EXT-N12-STK05	41000	24500	20833	28778	37000	0.55	20	7.2
		DP46.3	P-EXT-N12-STK06	41000	24500	20833	28778	37000	0.55	20	7.2
		DP46.2	P-EXT-N12-STK07	41000	24500	20833	28778	37000	0.55	20	7.2
		DP46.1	P-EXT-N12-STK08	41000	24500	20833	28778	37000	0.55	20	7.2
		DP46.8	P-EXT-N12-STK09	12000	12000	12000	12000	12000	0.55	16	2.2
		DP46.7	P-EXT-N12-STK10	38000	47500	33500	39667	79000	0.55	24	10.9
		DP23	P-EXT-N12-STK11	126400	99000	29333	84911	38500	0.62	25	10.1
		DP46.12	P-EXT-N12-STK12	41000	24500	20833	28778	37000	0.57	22	8.2
		DP13 (new)	P-EXT-N12-STK13	126400	126400	126400	126400	126400	0.62	25	10.1
		DP46.5	P-EXT-N12-STK14	41000	24500	20833	28778	37000	0.55	20	7.2
		DP63	P-EXT-N12-STK15	175000	81000	110000	122000		0.61	30	6.4
		DP54	P-EXT-N12-STK16	Decommissioned							
		DP53	P-EXT-N12-STK17	334800	145000	420000	299933	325000	0.44	26	21.7
		DP46.6-new 2021	nd					62000	0.65	18	
	13	no ID	P-EXT-N13-STK01	No Odour emissions							
		no ID	P-EXT-N13-STK02	No Odour emissions							
		DP133 (new)	P-EXT-N13-STK03	No Odour emissions							

Plant	Area	Discharge Point	Drawing ID	2018 Avg Odour Emissions Rate (OU/min)	2019 Avg Odour Emissions Rate (OU/min)	2020 Avg Odour Emissions Rate (OU/min)	3-year Avg Emissions Rate (OU/min)	2021 Avg Odour Emissions Rate (OU/min)	Stack Diameter (m)	Stack Temperature (ºC)	Exhaust Velocity (m/s)
Resin	07	DP19	R-EXT-N07-STK01	no data - very low to negligible source							
		DP38	R-EXT-N07-STK02	Decommissioned							
		no ID	no ID	No Odour emissions							
		no ID	R-EXT-N07-STK03	No Odour emissions							
		DP65	R-EXT-N07-STK04	No Odour emissions							
	08	DP48 (new)	R-EXT-N08-STK01	11000	9000	7000	9000	9000	0.48	32.5	13.25
		DP32	R-EXT-N08-STK02	No Odour emissions							
		no ID	R-EXT-N08-STK03	Decommissioned							
		no ID	R-EXT-N08-STK04	Decommissioned							
		no ID	R-EXT-N08-STK05	Decommissioned							
		no ID	R-EXT-N08-STK06	Decommissioned							
		DP60	R-EXT-N08-STK07	No Odour emissions							
	Historic Scrubber	DP120	R-FES-ABU-STK01	Decommissioned							
	AC system	DP120-temporary	Update pending	n/a	n/a	n/a	n/a	573,000	0.55	19	9.3
	RTO system	DP120-permanent	Update pending	n/a	n/a	n/a	n/a	160,000	0.55	35	7.9
			Total*	**1750700**	**1311300**	**1406300**	**1489433**	**1247900**			

nd = no data; n/a = not applicable; green shading indicates values are engineering estimates
*excludes emissions from the AC filter and RTO systems

3.0 BOUNDARY VOC AND ODOUR MONITORING

Since March of 2021 AkzoNobel have retained Golder to complete boundary VOC monitoring to assess potential effects of paint and resin plant emissions of VOCs on human health and the environment. Since August 2021 this monitoring has also included boundary odour monitoring to assess potential effects of paint and resin plant emissions of odour on amenity in the community. The subsections that follow summarize these the results of these observations.

3.1 Boundary VOC monitoring

In response to public and EPA concerns about potential health effects of VOC (and odour) emissions, AkzoNobel retained Golder to undertake 1-in-6 day, 24-hr sampling of selected VOCs associated with solvents used in the paint plant.

3.1.1 Methods

The VOC monitoring for toluene, ethyl benzene, and xylene isomers is carried out in accordance with Golder Associates NATA-accredited Test Method No. P13, *"Passive Gas Sampling: In Ambient Air by Radiello Passive Samplers".* Diffusive samplers consist of a diffusive barrier through which gases of interest are allowed to pass, to a separate sorbent section. The sorbent section is then desorbed in a suitable solvent in the laboratory and analysed by gas chromatography with flame ionisation detection (GC-FID).

Eight sampling locations were selected around the site boundary to represent and characterise the off-site emissions (Figure 2).

Figure 2: AkzoNobel property boundary (green) and VOC monitoring locations (labelled pins).

3.1.2 Air Quality Assessment Criteria

As part of the implementation of the *Environment Protection Act 2017* which came into effect on 1 July 2021, the EPA published the draft Guideline for assessing and minimising air pollution in Victoria, Publication 1961, May 2021 (draft guideline). The *National Environmental Protection (Air Toxics) Measure*, (NEPM (Air Toxics)), describes air quality objectives and sampling methodologies at sites where significantly elevated concentrations of one or more air toxics are expected to occur.

For boundary monitoring at AkzoNobel, the concentrations of the contaminants of interest (i.e., toluene, ethylbenzene and total xylenes) are compared directly to their corresponding NEPM (Air Toxics) criteria and EPA's Draft Air Quality Assessment Criteria (AQAC) (Table 4).

Table 4: Ambient Air Quality Criteria for the AkzoNobel Air Quality Monitoring Program

VOC Compound	Averaging Period	NEPM (Air Toxics)	Draft Air Quality Assessment Criteria (AQAC)
		Concentration (µg/m³)	
Toluene	24-hr	3,766	
Ethylbenzene	24-hr		21,712
Xylenes	24-hr	1,085	8,685

Notes: µg/m³ = micrograms per cubic metre of air at 25 °C and 101.3 kPa

3.1.3 Results

From April 2021 to December 2021 (5 rounds/month x 8 locations x 9 months) there have been 360, 24-hr VOC samples collected for analysis. Most of these measurements are below the analytical method's limit of detection for the individual VOCs. These below detection samples are typically upwind or adjacent to the wind direction over the 24-hr sampling period. During each round of 24-hr monitoring, at least one of the target VOCs have been detected at a downwind location. In each case, the measured concentration of the target VOCs were well below their corresponding NEPM or draft AQAC (Table 5).

Based on 9 months of 1-in-6-day, 24-hr monitoring of toluene, ethylbenzene and total xylenes we conclude:

1) **Potential acute or chronic health risks from emissions of toluene, ethylbenzene and total xylenes from the AkzoNobel paint plant are very low to negligible.**

Table 5: Summary of boundary VOC monitoring, April to December, 2021.

VOC Compound	Averaging Period	Observed Maximum	NEPM (Air Toxics)	Draft Air Quality Assessment Criteria (AQAC)
		Concentration (µg/m³)		
Toluene	24-hr	460	3,766	
Ethylbenzene	24-hr	69		21,712
Xylenes	24-hr	190	1,085	8,685

3.2 Odour Monitoring

In response to public and EPA concerns about potential amenity effects related to emissions of odour, AkzoNobel retained Golder to undertake boundary odour monitoring at the Facility.

3.2.1 Methods

Boundary odour monitoring is undertaken while deploying and recovering the 24-hr VOC samples (see previous section). This results in back-to-back surveys that occur twice every six days.

Odour intensity assessments are designed to qualify odour emissions from industry and quantify the odour level as a perceived strength. Field based boundary odour monitoring is undertaken twice every six days to assess the general amenity of the area. Residential odour monitoring is undertaken at downwind locations only, and only when an odour intensity of three or higher was recorded during the fenceline survey.

Odour surveys were undertaken by Golder staff, who are trained and certified as odour assessors. The staff members participate in annual screening sessions that assess their responsiveness to a reference odour (n-butanol). All staff have been screened within the past 12 months and their Individual Threshold Estimates (ITEs) were within the acceptable range.

The odour surveys were undertaken in accordance with EPA "*Guidance for field odour surveillance*", Publication 1881, May 2021. Odours detected at the site during the monitoring period were assessed for the following parameters:

- Location;
- Intensity (see next Section);
- Character (classified as 'paint or solvent', 'sickly sweet', 'acrid or burnt', or 'other');
- Presence (classified as 'Constant', 'Frequent/Repetitive' or 'Transient); and
- Local meteorological conditions.

Boundary odour monitoring is carried out at the same eight sampling locations where 24-hr VOC samples are collected (Figure 2). Since October 2021 the odour surveys have included both boundary monitoring and, when necessary, residential surveys.

Residential odour assessments are undertaken when an odour intensity of three or higher is recorded along the north, east or west boundary of the AkoNobel site; and when the odours have characteristics associated with emissions from the Facility (i.e., when odours are characterized as either sickly sweet or paint/solvent). Residential odour assessments are conducted downwind from the site boundary at four evenly spaced locations (where possible) in the residential area. Example routes for residential odour monitoring are presented in Figure 3. Actual monitoring locations will vary based on wind speed and direction.

Figure 3: Residential odour monitoring locations

Assessment Criteria

As part of the implementation of the *Environment Protection Act 2017,* which came into effect on 1 July 2021, the EPA, published the draft *Guideline for assessing and minimising air pollution in Victoria*, Publication 1961, May 2021 (draft guideline). This draft guideline, when finalised, is intended to replace parts of the *State Environment Protection Policy (Air Quality Management)* (SEPP(AQM)). The draft guideline refers to publication 1883, *Guidance for Assessing Odour*, for assessing the impacts of odour, however, this document has not yet been released.

Golder has previously used the German Standard VDI 3940:2010 for assessing the impact of odour. This standard has a seven-point odour intensity scale ranging from 0 to 6 (Table 6). Based on Golder's experience, odour intensity levels less than three (or 'Distinct' comparable to "Obvious" in the EPA publication 1881) are less likely to cause annoyance and result in complaints. Table 6 compares the German Standard intensity scale to the EPA publication 1881.

Table 6: Comparison of odour intensity scales.

German Standard		EPA pub 1881
Intensity	**Description**	**Description**
0	Not detectable	No Odour
1	Very Weak	Subtle
2	Weak	
3	Distinct	Obvious
4	Strong	

German Standard		EPA pub 1881
5	Very Strong	
6	Extremely Strong	

3.2.2 Results

Table 7 summarizes the monthly odour intensities measured among all eight monitoring locations visited during each round of monitoring. As indicated, odour was not detected 48% of the time due to monitoring locations being upwind or adjacent to the prevailing winds. Thirty-eight (38%) of the time odour is detected but is very weak or weak, intensities not likely to be considered offensive by nearby residents. However, 14% of the time intensities are distinct or stronger indicating the potential for odours to be considered offensive.

Table 8 summarizes the odour frequency, and where detected: the odour's character. Distinct or stronger odours were observed as constant half of the time, with the remaining instances being frequent. This implies that in cases where odour intensities are weak, they can frequently be observed but are not observed to be constant.

Odours were not detected 48% of the time. Therefore, the frequency of occurrence of a given odour type (e.g., sickly sweet versus acrid/burnt) is expressed as a percentage of when odours are detected. Table 8 shows that odours observed as sickly sweet occur 33% of the time, and paint/solvent type odours are observed 30% of the time. These odours are associated with odour emissions from the resin and paint plants respectively. The boundary odour survey data also show that Acrid/Burnt and Other odours occur at a similar frequency and account for 37% of the odour observations.

Burnt/Acrid and Other odours are not associated with AkzoNobel site operations. For example, other odour types include food odours from local restaurants, and petroleum or exhaust type odours likely emitted from traffic on McIntyre Rd. These observations show that odours from the AkzoNobel facility are not the only odours that may be affecting the amenity of nearby residents.

When odour intensities are distinct or greater at the Facility's property boundary, there is potential for them to be considered offensive at nearby residences. Combining odour intensity and odour character data shows that distinct or greater and sickly sweet or paint/solvent odours occur at the Facility boundary only 8% of the time, or approximately 3 days per month. However, distinct or greater odours that are described as either Acrid/Burnt or Other occur 5% of the time; or, approximately 2 days per month.

Since October 2021 residential odour surveys have been undertaken when odour intensities are both distinct and have a character of either sickly sweet or paint/solvent. Residential surveys have been required once in October and November and twice in December 2021. In each of the four cases, the results of the residential surveys showed that intensities had decreased and were either not detectable, very weak or weak; all intensities that are not typically considered offensive. Based on these observations we conclude:

2) **Odour emissions from the Facility reach intensities at the property boundary that are potentially offensive to nearby residences approximately three times per month.**
3) **Odours from other sources (e.g., traffic and restaurants) were also observed at intensities potentially considered offensive to nearby residences approximately two times per month.**
4) **Residential odour surveys during high intensity Facility-derived odour events indicate the spatial extent of potentially offensive odours is limited; and, is attenuated to intensities not considered offensive within approximately 100 to 200 metres from the Facility boundary.**

Table 7: Boundary Odour Monitoring Odour Intensity Summary

Month	Odour Intensity							Offensive	
	Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Total	AkzoNobel	Other
August	42	18	12	7	1	1	81	6	3
September	47	16	11	3	6	1	84	9	1
October	41	25	20	8	2	1	97	8	3
November	42	17	18	11	1	1	90	5	8
December	39	13	17	13	4	0	86	9	8
Total (%)	48%	20%	18%	10%	3%	1%		8%	5%

Table 8: Boundary Odour Monitoring Odour Frequency and Character Summary

Month	Odour Frequency				Odour Character				
	N/A	Transient	Frequent	Constant	N/A	Sickly Sweet	Paint/Solvent	Acrid/Burnt Smell	Other
August	42	7	23	9	42	15	11	11	2
September	47	5	27	5	47	9	20	7	1
October	41	16	35	5	41	23	13	11	9
November	42	34	11	3	42	15	11	8	14
December	39	19	20	8	39	13	14	7	13
Total (%)	48%	18%	26%	7%	48%	33%	30%	19%	17%

4.0 ODOUR DISPERSION MODELLING

Transport of odour emissions off-site occurs under a range of meteorological conditions and it is impractical to undertake odour monitoring continuously on an hourly basis. Here we employ the use of an air quality dispersion model to predict hourly odour intensities for a 5-year period under 'worst case conditions' using conservative Facility-wide odour emissions rates. This modelling serves two purposes:

- To evaluate the potential for Facility odour emissions to affect amenity of nearby residents; and
- To evaluate the effectiveness of new odour emissions controls on reducing potential amenity effects to nearby residents.

The subsections that follow document the odour dispersion modelling methods and results of three modelling scenarios. These modelling scenarios are described as follows:

Base Case: A conservative estimate of contemporary emissions from each discharge point at the paint plant, plus resin plant emissions that include the use of an RTO to reduce NPG and odour emissions.

Scenario 1: All paint plant discharges routed through an RTO (labelled RTO2), with an assumed 100% capture efficiency and 95% removal efficiency. This case represents a treatment option that routes all of the existing paint plant emissions through a single new treatment system.

Scenario 2: Discharges from paint plant stacks accounting for approximately 50% of the emissions (i.e., DPs 106, 105, 46.6, 46.7, 13, 23, and 53) routed through RTO2, assuming 100% capture and 95% removal efficiencies. The remaining discharge points have the same odour emission rates as the Base Case.

Scenario 2 can be considered a case where direct capture of odour emissions at the reactor vessel sources (i.e., captured by Nederman arms) is 100% efficient. Current capture by these systems is less than 100%, as indicated by the appreciable odour emissions from the other 46-series DP's providing general ventilation. Therefore, Scenario 2 represents a conservative estimate of emissions after design and implementation of improved capture and treatment of odours at their source(s) in the paint plant.

4.1 Methods

4.1.1 Model Configuration

Golder has carried out air dispersion modelling of discharges of odour to predict peak ground-level concentrations (GLCs) of odour around the Site. The assessment uses AERMOD[1], which is approved by the EPA for impact assessments in Victoria. This assessment follows modelling guidelines issued by the EPA[2,3].

The key inputs to AERMOD are source characteristics and emission rates, building dimensions, terrain height, site boundary location, receptor grids, and discrete receptors. The model is run with an hourly timestep for a five-year period, based on the local meteorology.

AERMOD produces peak GLCs of the modelled air contaminants at the defined receptors, on a 3-minute time average as defined in the odour assessment criterion. The following sections described the components of the model configuration.

---

[1] Cimorelli A, Perry S, Venkatram A, Weil J, Paine R, Wilson R, Lee RF, Peters W, Brode R & Paumier J (2004). AERMOD: description of model formulation. EPA-454/R-03-004. September 2004, 91pp.

[2] EPA Victoria, 2013. Guidance notes for using the regulatory air pollution model AERMOD in Victoria. Publication 1551, October 2013.

[3] EPA Victoria, 2013. Construction of input meteorological data files for EPA Victoria's regulatory air pollution model (AERMOD). Publication 1550. October 2013.

4.1.2 Meteorology (AERMET modelling)

AERMOD's companion model, AERMET, has been run to provide meteorological inputs for the five-year period, 2009 to 2013 inclusive, following EPA Victoria guidelines on meteorological modelling. The inputs are based on observed meteorology from the Bureau of Meteorology Footscray site. A wind rose derived from the Footscray data is shown in Figure 4.

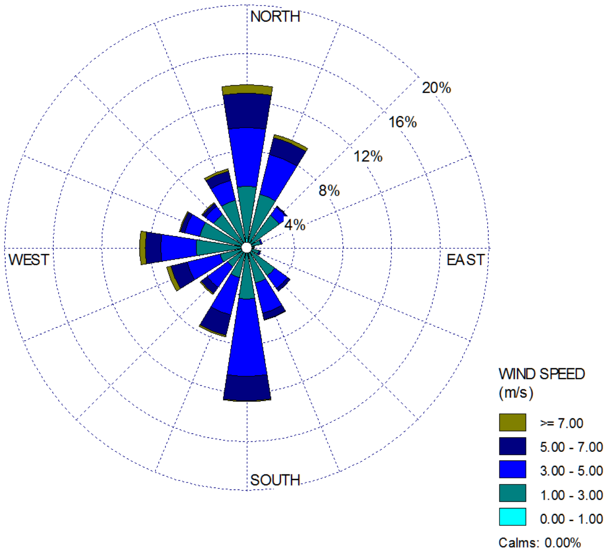


Figure 4: Wind rose from Footscray meteorological site, years 2009-2013.

4.1.3 Buildings (BPIP)

When air flows over buildings or other structures, a wake and a cavity region are generated in which turbulence is enhanced and small-scale re-circulating eddies are produced. The effect of these circulations can be to entrain pollutant plumes from stack sources, bringing them to ground level earlier than would occur in the absence of buildings. This can increase the ground-level concentrations of air pollutants around the building. Several buildings at the AkzoNobel facility have been included in the modelling, including the Paint Plant, Powder Plant, Resin Plant, and Tank Farm. All are assumed to be 10 m tall.

AERMOD runs the building profile input program (BPIP)[4] before the dispersion model is run, to calculate downwash parameters. Then, the hour-by-hour impacts of buildings on the dispersion on air pollutants are modelled using the PRIME algorithm[5]. This algorithm has the effect of bringing the plume trajectory closer to the surface downwind of the building, and of increasing plume impacts at the surface due to enhanced turbulence in the building wake.

The locations of buildings and stacks included in the modelling are shown in Figure 5, superposed on Google Earth aerial imagery. Note the location of DP106, which is located external to the paint plant at the southwest corner of the resin plant. This is also the assumed location for RTO2 in Scenarios 1 and 2.

[4] EPA 1995. User's guide to the building profile input program. Report EPA-454/R-93-038, February 1995.

[5] Schulman L.L., Strimaitis D.G. and Scire J.S. 1998. Development and evaluation of the PRIME plume rise and building downwash model. American Meteorological Society conference paper.

Figure 5: Modelled stacks and buildings at the AkzoNobel facility.

4.1.4 Receptors and terrain

A regular grid of receptors has been set up, centred on the Facility, with 51 x 51 grid points at 100 m resolution. This covers an area 5 km by 5 km around the Facility, at sufficient resolution to observe the general spatial pattern of modelled odour impacts. To model impacts at the Facility boundary in more detail, a set of fence line receptors has been set up at 10 m intervals.

Specific sensitive receptors have not been defined. The closest residences are across Barwon Street from the Facility; their front facades are approximately 20 m from the Facility boundary, and modelled odour concentrations at the boundary are therefore representative of the residential receptors. Elsewhere – for example, residences to the east of the Facility, or the neighbouring industry to the south – modelled concentrations are captured to sufficient precision on the regular grid of points.

AERMAP was run to provide ground elevations for all receptors, sources, and buildings, based on Shuttle Radar Topography Mission (SRTM) data at around 90 m resolution. The area around the facility is flat and approximately 46 m above mean sea level.

4.1.5 Sources

Discharge points have been modelled as point sources, which allows for the effects of buoyancy and upward momentum in the description of initial plume rise. The model requires stack height, stack diameter, plume exit temperature and velocity. The model inputs for these discharge points are summarized in Table 9.

Table 9: Modelled Stack Parameters.

Area	ID	Coordinates (m, UTM zone 55S)	Diameter (m)	Exit Velocity (m/s)	Exit Temperature (°C)
11	DP101	(308703, 5817457)	0.7	4.2	28
	DP102	(308704, 5817467)	0.7	4.2	28
	DP103	(308723, 5817471)	0.7	4.2	28
	DP104	(308721, 5817453)	0.7	4.2	28
	DP105	(308712, 5817458)	0.7	8	24
	DP106	(308743, 5817482)	0.61	5.4	28
	RTO2	(308743, 5817482)	0.55	7.9	35
12	DP46.10	(308724, 5817455)	0.55	8.6	20
	DP46.11	(308724, 5817463)	0.55	7.2	20
	DP46.9	(308733, 5817462)	0.55	7.2	20
	DP46.6	(308731, 5817455)	0.62	10.1	25
	DP46.4	(308730, 5817449)	0.55	7.2	20
	D46.3	(308739, 5817448)	0.55	7.2	20
	DP46.2	(308754, 5817446)	0.55	7.2	20
	DP46.1	(308766, 5817443)	0.55	7.2	20
	DP46.8	(308742, 5817462)	0.55	2.2	16
	DP46.7	(308755, 5817461)	0.55	10.9	25
	DP23	(308741, 5817456)	0.62	10.1	25
	DP46.12	(308726, 5817472)	0.57	8.2	22
	DP13	(308749, 5817455)	0.62	10.1	25
	DP46.5	(308754, 5817454)	0.55	7.2	20
	DP63	(308728, 5817440)	0.61	6.4	30
	DP53	(308748, 5817435)	0.44	21.7	26
08	DP48	(308625, 5817429)	0.48	13.3	33
	RTO1	(308569, 5817445)	0.55	7.9	35

In Table 9, the stack parameters are taken from the odour emissions inventory and are based on available historical stack testing data for the discharge points. Other key assumptions regarding the stack parameters include the following:

- RTO2 is placed in the same location as DP106, the small batch baghouse currently serving Area 11.
- Stack parameters for RTO2 (exit velocity, exit temperature, internal diameter) are taken from the stack testing results for RTO1.
- The AC filter is to be used only as a back-up; i.e., no discharges have been modelled for this source.

- All buildings are assumed to be 10 m tall and all stacks are 14 m tall.

The odour emissions rates for each scenario are summarized in Table 10. Emission rates are based on the three-year averages of the 2018 to 2020 test data. Total Base Case emissions are 1,652,000 OU/min which is the sum of the conservatively estimated 1,490,000 OU/min from the paint and resin plants, plus 162,000 OU/min measured from RTO1 in December 2021 (Table 3).

RTO2 is assumed to reduce odour emissions by 95%. Odour emission rates from RTO2 are lower for Scenario 2 (50,000 OU/min) than in Scenario 1 (74,000 OU/min), but the Scenario 2 total emission rate (706,000 OU/min) is higher than Scenario 1 (245,000 OU/min). This is because Scenario 1 assumes 100% capture of paint plant odour emissions prior to treatment, whereas Scenario 2 captures approximately 50% of paint plant emissions for treatment.

Overall Scenario 1 represents an 85% reduction in Facility-wide odour emissions compared to the Base Case. Scenario 2 represents a 57% reduction compared to the Base Case.

Table 10: Odour emissions rates (OU/min) for each modelling scenario.

Discharge Point	Base Case	Scenario 1	Scenario 2
DP106	248,000	0	0
DP101	22,000	0	22,000
DP102	22,000	0	22,000
DP103	22,000	0	22,000
DP104	22,000	0	22,000
DP105	70,000	0	0
DP46.11	29,000	0	29,000
DP46.10	35,000	0	35,000
DP46.9	29,000	0	29,000
DP46.6	126,000	0	0
DP46.4	29,000	0	29,000
DP46.8	12,000	0	12,000
DP23	85,000	0	0
DP46.3	29,000	0	29,000
DP63	122,000	0	122,000
DP46.7	40,000	0	0
DP46.2	29,000	0	29,000
DP53	300,000	0	0
DP46.5	29,000	0	29,000
DP46.1	29,000	0	29,000
DP13	126,000	0	0
DP46.12	29,000	0	29,000

Discharge Point	Base Case	Scenario 1	Scenario 2
DP48	9,000	9,000	9,000
RTO1 (RESIN)	162,000	162,000	162,000
RTO2 (PAINT)	0	74,000	50,000
TOTAL	1,652,000	245,000	706,000

4.1.6 Model Outputs – Maximum Ground Level Concentrations

AERMOD produces hourly odour concentrations (in OU) at the receptor locations for the 5-year modelling period. Three-minute averages have been calculated from 1-hour averages by multiplying by a constant factor 1.82, following EPA Victoria guidance. Additionally, the criterion is based on the modelled 99.9th percentile concentration, which is the 9th highest in a year. Hence results at higher percentiles have been discarded and the highest 99.9th percentile over the 5-year period is presented below This is in accordance with EPA guidance, and done to model results on hourly time averages (or shorter), to avoid unrealistic model overprediction in extreme meteorological conditions.

5.0 RESULTS

This section presents results of the odour dispersion modelling for each scenario. Note briefly that there is not a 1-to-1 correspondence between in-stack odour concentrations or predicted ground level odour concentrations, in OU, and the intensity of odour observed during field odour surveys. Thus, the results of odour monitoring presented in Section 3.2 are not directly comparable to the model results.

Based on professional experience and guidance from other states[6], modelled ground level odour concentrations of 3 to 5 OU are not typically considered offensive. The offensiveness of predicted odour concentrations of 5 to 10 OU may or may not be offensive, depending on their frequency and hedonic tone, whereas predicted odour concentrations greater than 10 OU would likely be considered offensive.

Although these relationships are operationally defined, they enable a qualitative comparison between model predictions and field observations.

5.1 Base Case

Figure 6 plots 3-minute maximum ground-level odour concentration contours for the Base Case. These contours are a ‘worst case’ scenario based on a conservative estimate of Facility-wide odour emissions.

The results show the potential for odour emissions from the Facility to reach offensive levels at distances of up to 400 metres from the Facility. Odours are most intense within 100 metres of the Facility, particularly north of the paint plant and southeast of the resin plant. These model predictions are consistent with the results of odour monitoring which indicated that odours are frequently most intense at the North-Central, North-East, South and South-East odour survey locations.

Table 11 summarizes the maximum 3-minute ground level odour concentration predicted at the North and South boundaries for each scenario.

The model results for the Base Case indicate that:

[6] *Guideline: Odour Impact Assessment from Developments*, Government of Queensland, Department of Environment and Heritage Protection.

5) **Current odour emissions from the Facility have the potential to cause offensive levels of odour at nearby residences, especially those within approximately 400 metres of the Facility.**

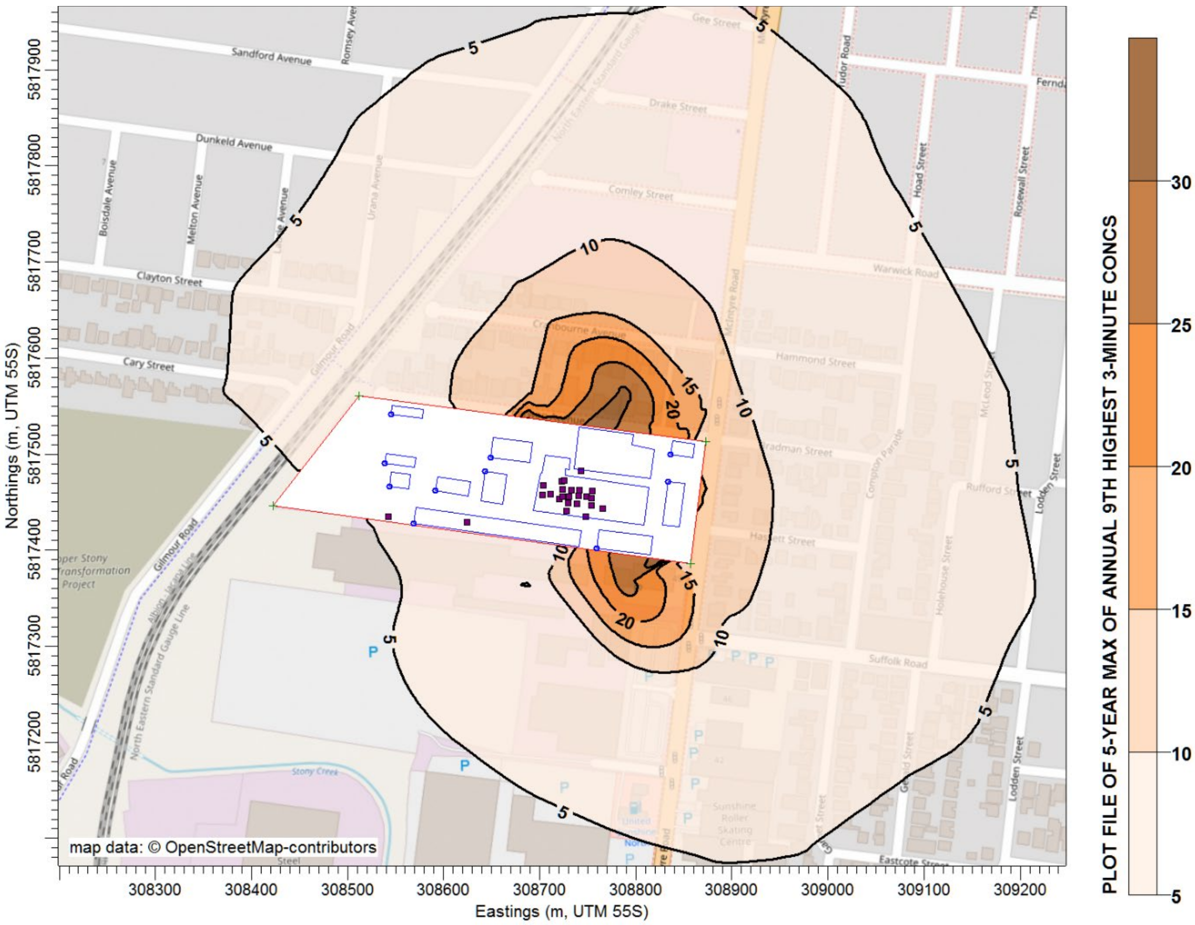


Figure 6: Base Case maximum 3-minute ground level odour concentrations.

Table 11: Predicted maximum 3-minute off-site ground level odour concentrations.

Scenario	Location	Odour Concentration (OU)
0	Northern boundary	33
	Southern boundary	31
1	Northern boundary	1.1
	Southern boundary	0.42
2	Northern boundary	13
	Southern boundary	14

5.2 Scenario 1

Scenario 1 represents a best-case emissions reduction scenario where 100% of the paint plant emissions are captured and treated with 95% efficiency. Scenario 1 also considers the capture and treatment of the resin plant odours (including the trade waste pit) routed through RTO1. Figure 7 plots the maximum 3-minute ground level odour concentrations for Scenario 1. The model results indicate that:

6) An 85% reduction in Facility-wide odour emissions would very likely result in the elimination of offensive odours and associated loss of amenity due to odour at nearby residences, even those within 100 metres of the Facility.

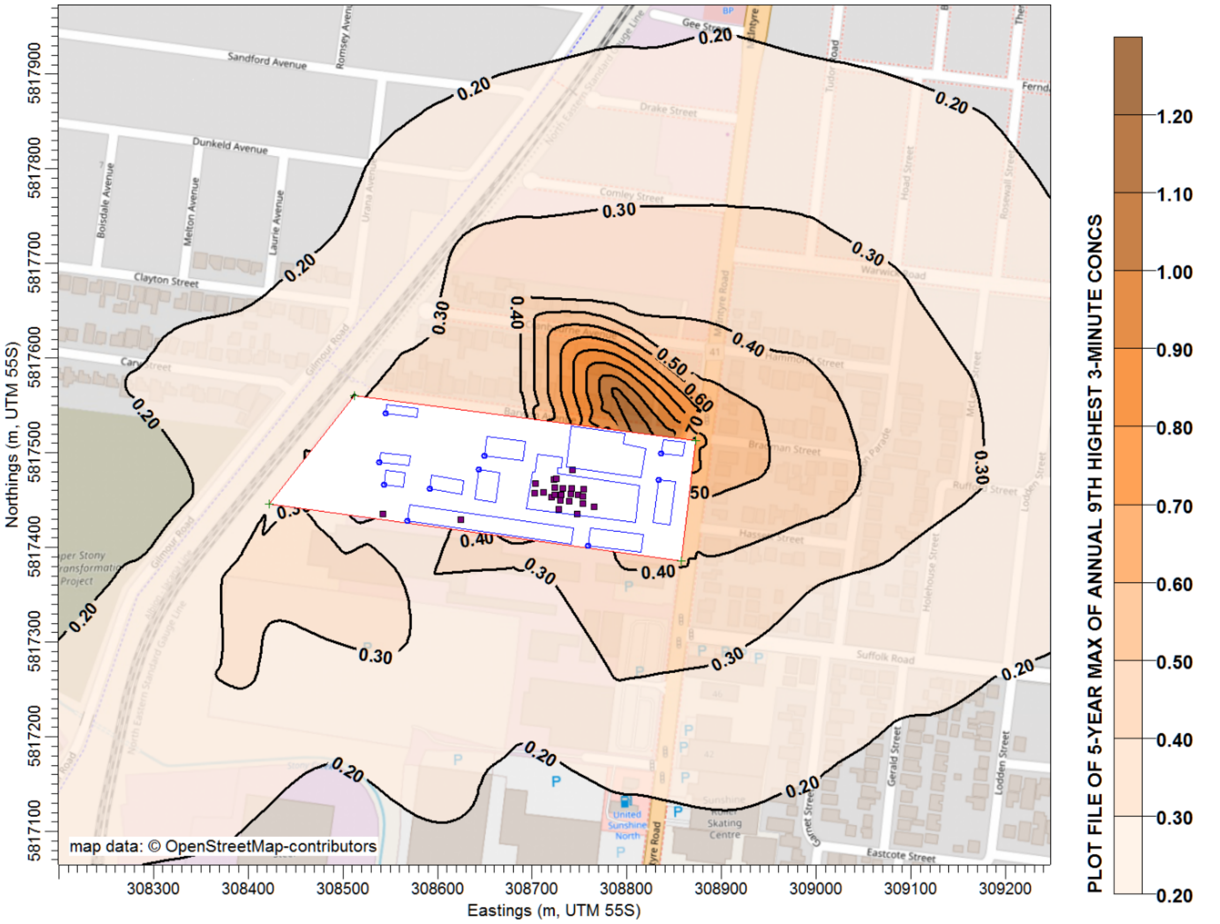


Figure 7: Scenario 1 maximum 3-minute ground level odour concentrations.

5.3 Scenario 2

From an engineering and management perspective, it may not be reasonably practicable to capture 100% of the paint plant emissions prior to treatment. Instead, Scenario 2 considers:

- 100% capture of direct odour emissions at their source within the paint plant (approximately 50% of total paint plant odour emissions); and
- No treatment of discharges points associated with secondary ventilation providing fresh air to the paint plant work areas.

Practically speaking this requires redesign and implementation of a two-tier ventilation and ducting system. The primary system would be responsible for capture of VOCs and odour from reaction vessels directly at their emissions source. In theory this would result in proportionately lower odour emissions from the secondary system's discharge points, which handle general building ventilation (e.g., some members of the current 46-series discharge points).

The increase in odour concentrations in the primary odour capture system, and corresponding reduction in secondary system odour concentrations cannot be modelled accurately without engineering design information. However, by treating the primary odour emissions sources, and assuming the secondary system odour emission rates remain high, Scenario 2 represents a conservative estimate of what could be achieved through an improved two-tier odour emissions capture and treatment system for the entire paint plant.

The maximum 3 minute ground level odour concentrations for Scenario 2 emissions are illustrated in Figure 8. The model results indicate that:

7) A minimum of approximately 60% reduction in (conservatively estimated) Facility-wide odour emissions is likely required to eliminate the potential for offensive odours and loss of amenity at nearby residences.

Note that a two-tier capture and treatment system is more practical than 100% capture and treatment (Scenario 1), since the RTO unit proposed for odour removal will have specific volumetric flow rate and exhaust air energy content (i.e., VOC concentration) requirements.

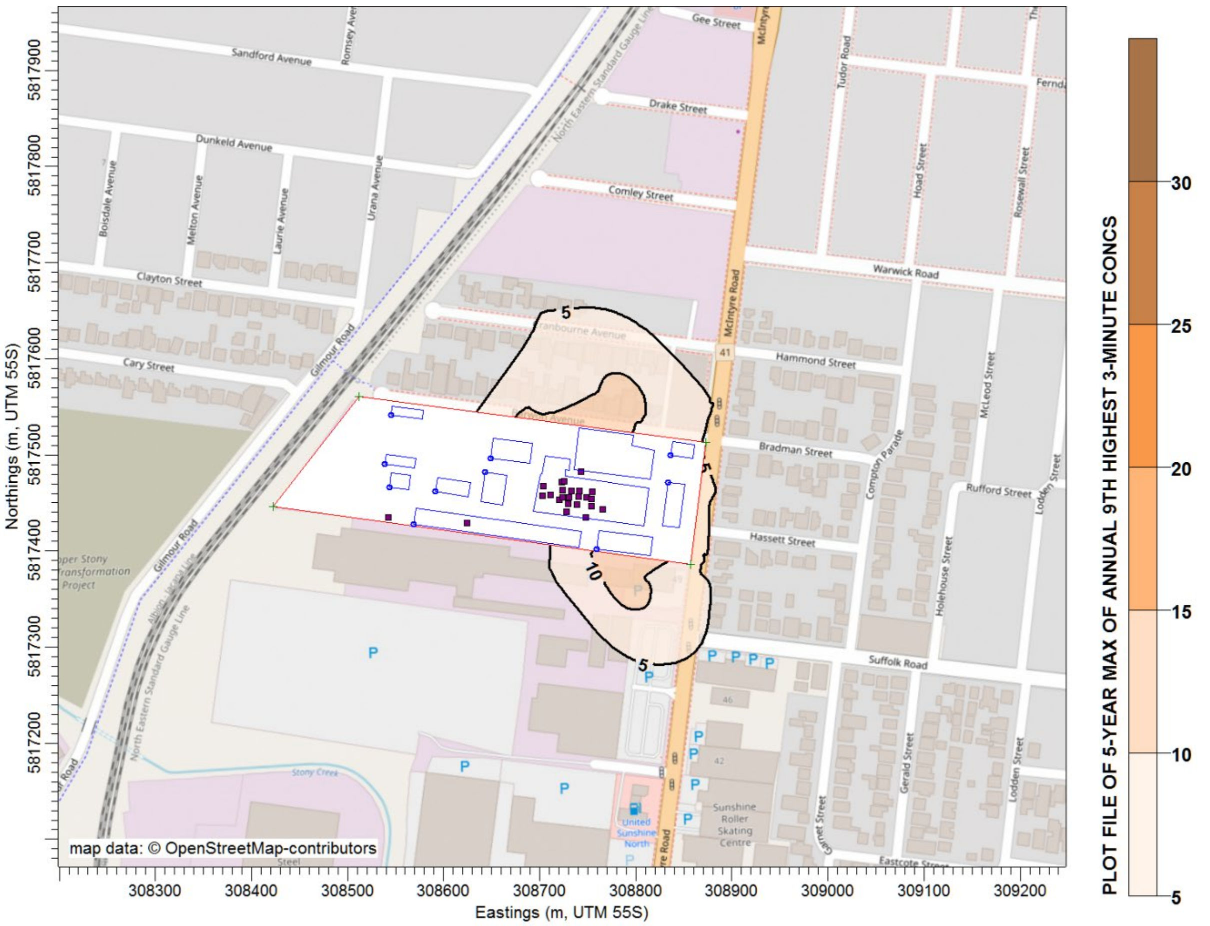


Figure 8: Scenario 2 maximum 3-minute ground level odour concentrations.

6.0 CONCLUSIONS AND RECOMMENDATIONS

In response to IPMN #00001398, PAN #90011934 and CUN #90011654, AkzoNobel have undertaken VOC and odour monitoring as well as odour dispersion modelling to assess potential effects of odour emissions on local residents. Based on the results of odour monitoring and modelling we conclude:

<u>VOC Monitoring</u>

1) Potential acute or chronic health risks from emissions of toluene, ethylbenzene and total xylenes from the AkzoNobel paint plant are very low to negligible.

<u>Odour Monitoring</u>

2) Odour emissions from the Facility reach intensities at the property boundary that are potentially offensive to nearby residences approximately three times per month.

3) Odours from other sources (e.g., traffic and restaurants) were also observed at intensities potentially considered offensive to nearby residences approximately two times per month.

4) Residential odour surveys during high intensity Facility-derived odour events indicate the spatial extent of potentially offensive odours is limited; and, is attenuated to intensities considered non-offensive within approximately 100 to 200 metres from the Facility boundary.

<u>Odour Modelling</u>

5) Current odour emissions from the Facility have the potential to cause offensive levels of odour at nearby residences, especially those within approximately 400 metres of the Facility.

6) An 85% reduction in Facility-wide odour emissions would very likely result in the elimination of offensive odours and associated loss of amenity due to odour at nearby residences, even those within 100 metres of the Facility.

7) A minimum of approximately 60% reduction in (conservatively estimated) Facility-wide odour emissions is likely required to eliminate the potential for offensive odours and loss of amenity at nearby residences.

The results of modelling Scenarios 1 and 2 show that a 60% to 85% reduction in Facility wide odour emissions would likely minimise the risks of harm to human health and the environment from odour generated from and within the paint production building.

The over-arching recommendations based on odour monitoring and modelling is as follows:

- AkzoNobel should undertake an engineering feasibility study to reduce paint plant emissions that focusses on:
  - Improving the capture efficiency of a primary emissions control system designed to capture odour emissions directly at their sources within paint plant areas 11 and 12 (e.g., at the reaction vessels).
  - Targeting a 95% odour removal efficiency for the resin plant RTO and the primary emissions control system implemented in paint plant areas 11 and 12 (e.g., a second RTO for the paint plant).
  - Implementing a redesigned secondary general ventilation system for the paint plant which, in conjunction with improvements in the primary system's capture efficiency, leads to an overall decrease in odour emission rates from discharge points not routed to a treatment system.
- AkzoNobel target a Facility wide reduction in odour emissions of 60% to 85% compared to the current, conservative estimate of a Facility-wide odour emissions rate of 1,652,000 OU/min.

- After completing the feasibility study, odour dispersion modelling be updated to confirm that the proposed capture and treatment system appropriately reduces the risk of offensive odours at nearby residences.

The recommended engineering feasibility study will take time to complete, and the selected odour emissions capture and control system will take time to procure and install. Based on the results of VOC and odour monitoring we have the following additional recommendations:

- Fence line VOC monitoring has demonstrated that risks to human health from emissions of specific VOCs, including toluene, ethylbenzene and xylenes, are well below their relevant AQAC and should therefore be discontinued at the end of February 2022.
- AkzoNobel should maintain the existing boundary odour surveys on a 1-in-3 day schedule and, where intensities at the boundary are distinct, continue to conduct residential odour surveys to assess the potential for temporary health effects on nearby residents. This odour monitoring program should continue until AkzoNobel’s paint plant emissions are being effectively captured and controlled by new emissions control system.

7.0 IMPORTANT INFORMATION

Your attention is drawn to the document titled - “Important Information Relating to this Report”, which is included in Appendix C of this report. The statements presented in that document are intended to inform a reader of the report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Important Information document does not alter the obligations Golder Associates has under the contract between it and its client.

Signature Page

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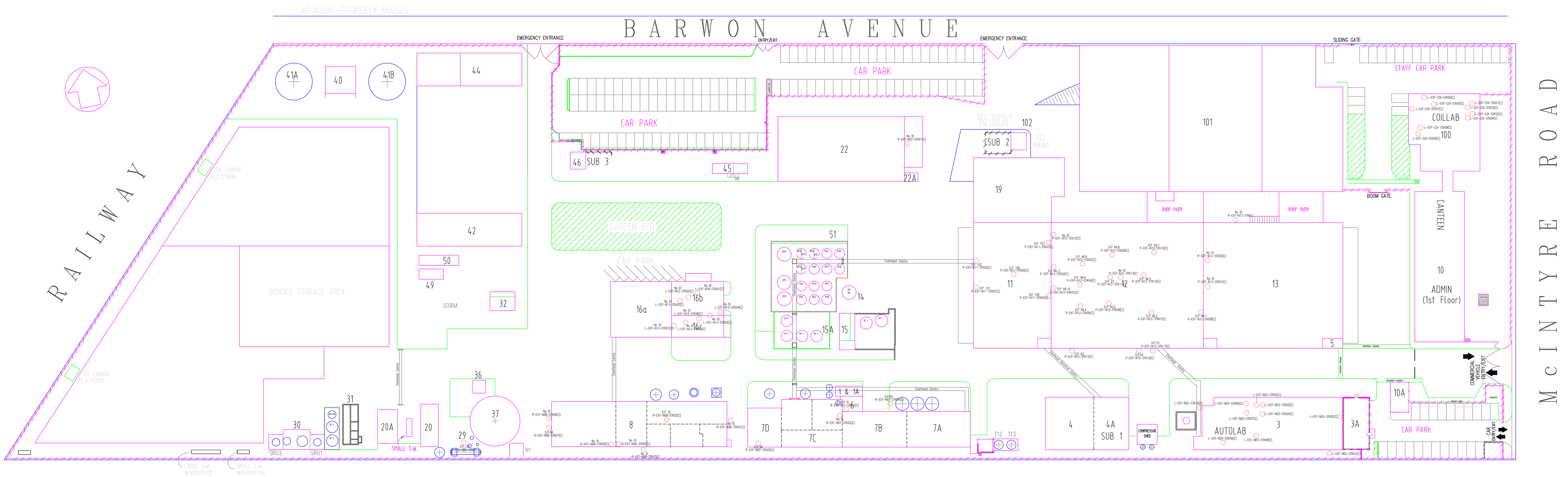
https://golderassociates.sharepoint.com/sites/115853/project files/6 deliverables/037-r - impn 00001398 - odour assessment report/19130795-037-r-rev1 - akzonobel odour assessment.docx

APPENDIX A

Discharge Point Schematic



KEY / LEGEND

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No	DATE	APP'D	AMENDMENT
A			
B			

LOCATION

1	TOILET BLOCK	10	ADMINISTRATION BLOCK	21		44	STORE RAW MATERIAL / FORKLIFTS
1A	CONTROL ROOM	10A	SECURITY BLOCK	22	INDUSTRIAL WAREHOUSE	45	FIELD OFFICE
3	LABORATORY	11	SMALL BATCH PLANT	22A	SWITCH ROOM	46	No.3 SUB-STATION
3A	BASF/AKZO NOBEL	12	MAIN PAINT FACTORY	29	AFTERBURNER	47	
4	STORE	13	RAW MATERIALS STORE	30	SOLVENT RECOVERY TANK	48	
4A	No1 SUB & SWITCHBOARDS	14	DIW TANK	31	TRADE WASTE PIT	49	FIELD OFFICE (BUNDED SITE OFFICE)
4A	QUV & SALT SPRAYS	15	PALLET STORAGE	32	FIRE STATION	50	FIELD OFFICE (BUNDED SITE DESPATCH)
5	GOODS RECEIVING	15A	WATER BASED RESIN TANKS	36	COOLING TOWER	51	TANK FARM
6	SWITCH ROOM	16A	RESIN STORE	37	COOLING WATER STORAGE	100	PACKAGING LABORATORY
7A	RESIN MANUFACTURE	16B	RESIN R & D LABORATORY	38		101	POWDER PLANT
7B	RESIN MANUFACTURE	16C	SPECIALTY FINISH LABORATORY	40	FIRE PUMP HOUSE	102	No.2 SUB-STATION
7C	RESIN MANUFACTURE	19	PRE BATCH AREA	41A	WATER TANK		
7D	RESIN MANUFACTURE	20	BOILER HOUSE	41B	WATER TANK		
8	RESIN MANUFACTURE	20A	AUTO BOILER	42	MAINTENANCE WORKSHOP		

AkzoNobel

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Sunshine, VIC 3020 Australia
Tel: (03) 9313 4555 Fax: (03) 9311 9141

TITLE: STACKS - SITE LAYOUT

AREA: SITE

DRAWING NO: AN - IF - S- EXT- 0001

DEPARTMENT: ENGINEERING		SCALE: NTS
DRAWN: J.TIPPING	DATE: 03-12-15	REVISION: 0
CHECKED: XX.XX	DATE: 15-01-16	SHEET NO: 1 / 1
APPROVED:	DATE:	

APPENDIX B

Bulk Storage Onsite

1. Bulk Storages

Details of dangerous goods kept in bulk or in storage tanks (other than packages)

Area/Tank Identification No. (as shown on site plan)	Name of Dangerous Goods (Correct Product Name)	GRACO Code	Class	UN Number	Packaging	HazChem Code	Tank Design Code	Tank Type	Area/Tank Capacity
BT1	Paint	4C0820	3	1263	III	•3Y	-	Mild Steel	50000
BT2	Resin Solution	RP0940	3	1866	III	•3Y	-	Mild Steel	40000
BT4	Cymel 303 LF Resin	RN0371	N/A	N/A	N/A	N/A	-	Stainless Steel	40000
BT5	Cymel 303 LF Resin	RN0371	N/A	N/A	N/A	N/A	-	Stainless Steel	40000
BT9	Deionised Water (D.I.W)	N/A	N/A	N/A	N/A	N/A	-	Stainless Steel	50000
BT10	Resin Solution	RP4979	3	1866	III	•3Y		Stainless Steel	30000
BT11	Resin Solution	RP6240	3	1866	III	•3Y	AS1940	Stainless Steel	30000
BT12	Resin Solution	RP0940	3	1866	III	•3Y	AS1940	Stainless Steel	30000
BT13	Neo Pentyl Glycol NPG(90%)	KP0573	N/A	N/A	N/A	N/A	AS1940	Stainless Steel	80000
BT14	Resin Solution	RP2242	3	1866	III	•3Y	AS1940	Stainless Steel	30000
BT15	Resin Solution	RX6195	3	1866	III	•3Y	AS1940	Stainless Steel	30000
BT16	Empty						AS1940	Stainless Steel	30000
BT17	Environmentally hazardous substance, liquid, n.o.s. (Epoxy resin)	RE1553	9	3082	III	•3Z	AS1940	Stainless Steel	50000
BT18	Resin Solution	RL2557	N/A	N/A	N/A	N/A	AS1940	Stainless Steel	30000
BT19	Petroleum Distillates, N.O.S. (Petroleum Naphtha)	CB0030	3	1268	III	3Y	AS1940	Stainless Steel	30000
BT20	Solvent Naphtha, Petroleum, Heavy Aromatic	CB0039	9	3082	III	•3Z	AS1940	Stainless Steel	30000
BT21	Diacetone Alcohol	CA0022	3	1148	III	•2Y	AS1940	Stainless Steel	15000
BT22	Paint Related Material	Wash solvent	3	1263	III	•3Y	AS1940	Stainless Steel	15000
BT23	Xylene	CB0004	3	1307	III	3Y	AS1940	Stainless Steel	30000
BT24	C1 - Combustible Liquid	CG0009	N/A	N/A	N/A	N/A	AS1940	Stainless Steel	30000
BT25	Environmentally hazardous substance, liquid, n.o.s . (SOLVENT NAPHTHA (PETROLEUM), HEAVY AROMATIC)	CB0060	9	3082	III	•3Z	AS1940	Stainless Steel	15000
BT26	Petroleum Distillates, N.O.S. (Petroleum Naphtha)	CB0030	3	1268	III	3Y	AS1940	Stainless Steel	30000
BT27	Butanol	CA0005	3	1120	III	•2Y	AS1940	Stainless Steel	15000
BT28	Butanol	CA0005	3	1120	III	•2Y	AS1940	Stainless Steel	15000
BT29	Paint	4B0580	3	1263	III	•3Y	AS1940	Stainless Steel	80000
T12 & T13	Resin Solution	Various	3	1866	III	•3Y	-	Stainless Steel	2 x 35000
S.R.U.1	Paint Related Material	Wash solvent	3	1263	III	•3Y	AS1940	Stainless Steel	8000
S.R.U.2	Paint Related Material	Wash solvent	3	1263	III	•3Y	AS1940	Stainless Steel	6000
N1	Nitrogen	N/A	2.2	1977	-	2T	AS1210	Stainless Steel	15000
N2	Nitrogen	N/A	2.2	1066	-	2T	AS1210	Stainless Steel	15000
???	Diesel Fuel	N/A	3	1202	III	3Y			

APPENDIX C

Important Information

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

This Report is provided for use solely by Golder's Client and persons acting on the Client's behalf, such as its professional advisers. Golder is responsible only to its Client for this Report. Golder has no responsibility to any other person who relies or makes decisions based upon this Report or who makes any other use of this Report. Golder accepts no responsibility for any loss or damage suffered by any person other than its Client as a result of any reliance upon any part of this Report, decisions made based upon this Report or any other use of it.

This Report has been prepared in the context of the circumstances and purposes referred to in, or derived from, the Contract and Golder accepts no responsibility for use of the Report, in whole or in part, in any other context or circumstance or for any other purpose.

The scope of Golder's Services and the period of time they relate to are determined by the Contract and are subject to restrictions and limitations set out in the Contract. If a service or other work is not expressly referred to in this Report, do not assume that it has been provided or performed. If a matter is not addressed in this Report, do not assume that any determination has been made by Golder in regards to it.

At any location relevant to the Services conditions may exist which were not detected by Golder, in particular due to the specific scope of the investigation Golder has been engaged to undertake. Conditions can only be verified at the exact location of any tests undertaken. Variations in conditions may occur between tested locations and there may be conditions which have not been revealed by the investigation and which have not therefore been taken into account in this Report.

Golder accepts no responsibility for and makes no representation as to the accuracy or completeness of the information provided to it by or on behalf of the Client or sourced from any third party. Golder has assumed that such information is correct unless otherwise stated and no responsibility is accepted by Golder for incomplete or inaccurate data supplied by its Client or any other person for whom Golder is not responsible. Golder has not taken account of matters that may have existed when the Report was prepared but which were only later disclosed to Golder.

Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

By date, or revision, the Report supersedes any prior report or other document issued by Golder dealing with any matter that is addressed in the Report.

Any uncertainty as to the extent to which this Report can be used or relied upon in any respect should be referred to Golder for clarification

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