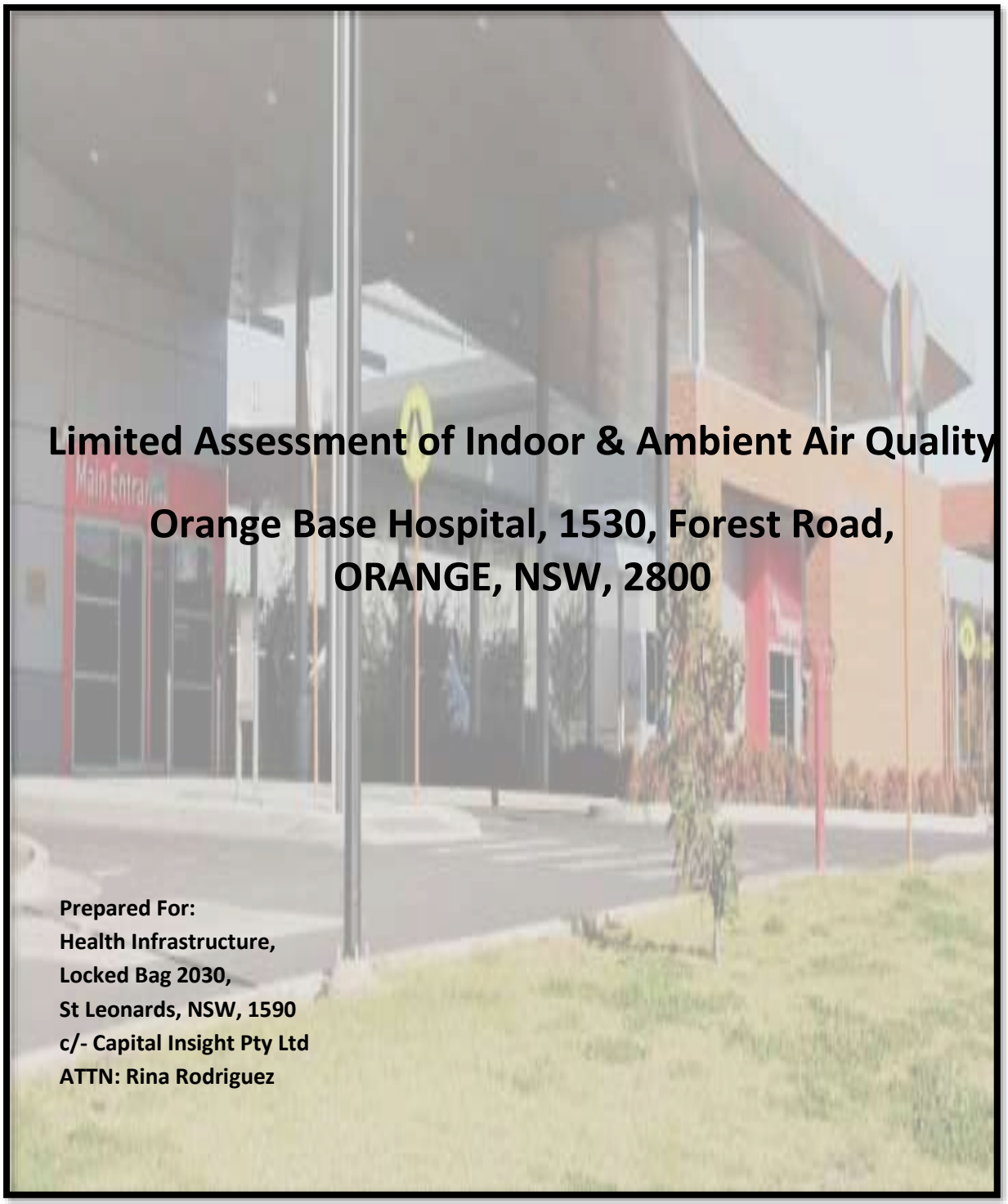

Limited Assessment of Indoor & Ambient Air Quality

Orange Base Hospital, 1530, Forest Road, ORANGE, NSW, 2800

Prepared For:
Health Infrastructure,
Locked Bag 2030,
St Leonards, NSW, 1590
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1 Executive Summary

On Tuesday 7th May 2024 EnviroScience Solutions was requested by Health Infrastructure c/-Rina Rodriguez of Capital Insight Pty Ltd to conduct a limited indoor air quality assessment at predetermined locations at Orange Hospital, 1530, Forest Road, ORANGE, NSW, 2800. The sampling also included five (5) ambient dust sample, also from predetermined locations. It should be noted that only four (4) samples could be taken due to the Courtyard location being inaccessible.

The sampling program comprised of the following parameters;

- Temperature
- Relative Humidity
- Ambient Dust ($PM^{2.5}$ & PM^{10})
- Carbon Dioxide
- Carbon Monoxide
- Visual Assessment of Mould

The sampling areas provided by Health Infrastructure c/- Capital Insight to EnviroScience Solutions indicated a limited scope of works. The works requested sampling at internal and external locations to provide results and the indication was the sampling results would provide input to a *"Review of Environmental Factors".*

The survey plans showed existing rooms, bedrooms on the first-floor level of the hospital however, the rooms were inaccessible and were sealed since original construction in approximately 2011. The indoor air quality assessment was conducted in the first-floor corridor at locations approximate to the door openings indicated on the floor plans.

The samples taken, all recorded results that were acceptable or below concentrations when compared to the recommended exposure limits for indoor air quality and ambient dusts. Similarly, there was no evidence of visual microbial mould growths within the assessment areas on the day of sampling.

Therefore, the results indicated that indoor air quality and ambient dust concentrations were adequate when compared to recognised guidance materials, and therefore safe for use.

The Way Forward

It is suggested that once the bedrooms are opened, that an indoor air quality assessment is conducted for each room to ensure indoor air quality is satisfactory following many years of being sealed. This approach would assist with addressing the health districts work health and safety and other legislative requirements.

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2 Revisions

Table 1 – Table of Report Revisions

Status	Date	Prepared	Reviewed	Approved	Updates
Draft 0	09/05/2024	J Bartholomew	M Williamson	J Duffy	Issued Internally for QA
V1	10/05/2024	J Bartholomew	G Murphy	J Duffy	Sent to Client for Review & Comment
V2	13/05/2023	G Murphy	J Bartholomew	J Duffy	Sent to Client

3 Glossary

Table 2 - ***Glossary & Key Terminology***

Term	Meaning
PM	Particulate Matter
CO	Carbon Monoxide
CO_2	Carbon Dioxide
RH	Relative Humidity
Airborne Contaminant	Means a contaminant in the form of a fume, mist, gas vapour or dust, and includes microorganisms.
TWA	Time Weighted Average (8-hour time weighted averag The average airborne concentration of a substance wh calculated over a normal eight-hour working day.
NATA	National Association of Testing Authorities
PCBU	Person Conducting a Business or Undertaking

4 Scope

EnviroScience Solutions Pty Ltd were engaged by Health Infrastructure C/- Rina Rodriguez, of Capital Insight Pty Ltd, to conduct limited sampling to determine the quality of the atmosphere at predetermined locations at selected perimeter locations and on the first-floor level of Orange Hospital, 1530, Forest Road, ORANGE, NSW, 2800.

The parameters selected to conduct the assessment were consistent with industry practices for testing the quality of indoor & ambient air environments, for the purposes of this study the following parameters were selected;

Temperature	Relative humidity
Carbon monoxide	Carbon dioxide
Visual Mould	Ambient Particulate Matter as $PM^{2.5}$ & PM^{10}

The limited indoor air quality assessment at Orange Hospital was essentially a 'snap-shot' taken on Tuesday 7th May 2024 and the results are reflecting the environment on that day only. The locations sampled were not considered to be current active work areas of the hospital with the exception of the ambient dust samples.

The sampling results are to provide input into the *"Review of Environmental Factors"* planning pathway in regards to Indoor and Outdoor Air Quality.

5 Introduction

Orange Hospital was opened in March 2011 and covers approximately 32,000m^{2}. Anecdotal evidence indicated that future plans highlighted the need to keep part of the north-east wing on the first-floor level separate with bedrooms build but not commissioned. The rooms were sealed behind a plasterboard wall and corridor, adjacent the rooms, and have been sealed since the Hospital opening and it is believed that the rooms are part of a development to commission the area.

Figure 1 – Location Map of Orange Hospital Showing Approximate Locations for the Ambient Dust Sampling

Figure 2 – Level 1 Floor Plan Showing Approximate Sample Locations

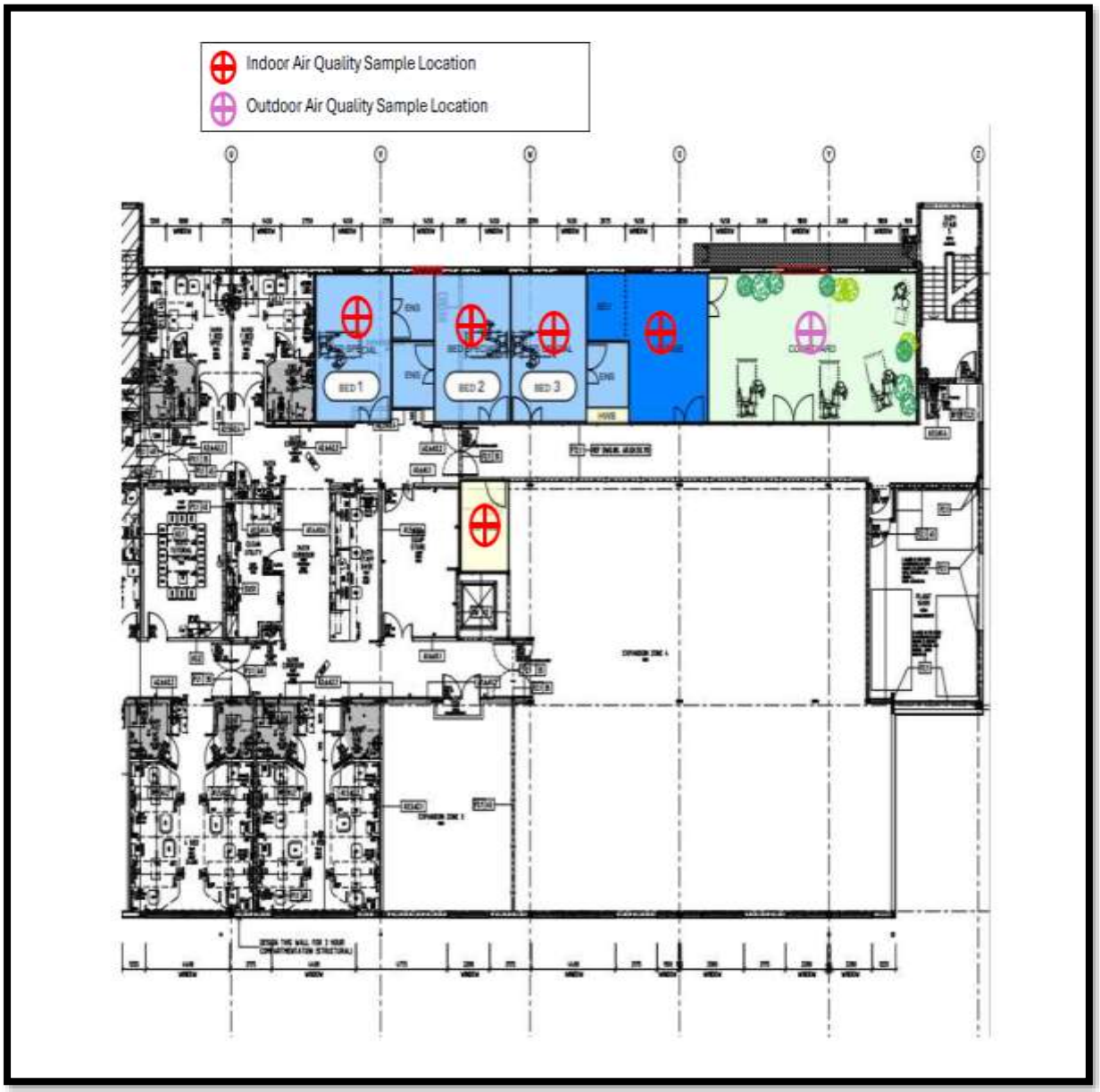

Figure 3 – Outdoor Perimeter Ambient Air Sample Locations

6 Indoor Air Quality Background Information

6.1 Indoor Air

The National Health and Medical Research Council (NHMRC) defines indoor air as “air within a building occupied for at least one hour by people of varying states of health”.

Poor indoor air quality can result in significant adverse impacts on health and the indoor environment and the impacts can carry a significant cost to the economy. As buildings become better sealed from the external environment, pollutants released from indoor sources are progressively found at higher concentrations. Indoor air quality can be adversely affected by other pollutants such as fungi, microbial contamination, particulates and air toxics such as formaldehyde.

Some common indoor air quality symptoms and health problems that result from exposure to poor indoor air are presented in the table below.

Table 3 – Common Symptoms & Health Effects

Rhinitis / Nasal Congestion (inflammation of the nose, runny nose)	Dyspnea (Laboured or Difficult Breathing	Pharyngitis (Sore Throat)
Wheezing / Asthma	Conjunctivitis (Watery Eyes)	Skin Rashes
Fever / Chills	Headaches / Dizziness	Lethargy / Fatigue

6.2 Carbon Monoxide (CO)

Carbon Monoxide is a gaseous asphyxiant, CO is known as the 'silent killer' as it is colourless and odourless. When it is breathed in CO binds to red blood cells preventing them from carrying oxygen and essentially suffocating the victim. Methylene Chloride may also breakdown to form Carbon Monoxide as well. Methylene Chloride is a common toxic solvent used in many products such as paint and paint strippers.

6.3 Carbon Dioxide (CO_2)

Carbon dioxide is a natural gaseous component of air and is colourless, odourless and tasteless, it is also a respiratory by-product and the concentration of carbon dioxide in an indoor space is often used an indicator of the effectiveness of ventilation. Excessive carbon dioxide in an enclosed space has the potential for asphyxiation due to displacement of oxygen however more common and less dramatic effects tend to be fatigue related.

6.4 Microbial Growth (Bacteria and Fungi)

Bacteria and fungi can grow at a rapid rate in ideal conditions on building materials where moisture is present and available. The background levels can change frequently due to human occupation and activity within a building especially the operation of a mechanical air handling system. The Institute of Medicine (IOM) made a clear link between the growth of *Filamentous fungi* commonly known as *'mould'* and damp indoor environments that have potential to impact on the health of occupants within a building. Excessive water / moisture can act as a precursor for the growth of bacteria and fungi (moulds) that can manifest as an obnoxious odour in an indoor environment.

6.5 Particulate Matter

Indoor Particulate Matter (PM) tend to be associated with human activities typically, smoking, cooking, heating systems, cleaning and resuspension due to the presences of human occupancy movements. Particulates manifest in range of sizes which are expressed in the unit micrometres and are usually measured from $PM_{2.5}$, PM_{10} and Total Suspended Particulate (TSP) but can be more sensitive if required.

The size fraction of the particulate matter depends on the site of deposition within the human body and the potential health effects. Typically, PM_{10} is small enough to pass through the throat and nose areas of the human respiratory system and deposit in the lungs and have potential to affect the heart and lungs and lead to adverse health effects (eye / nose / throat irritation, Bronchitis / Asthma), PM_{10} has a diameter of 10 micrometres or less.

6.6 Temperature & Relative Humidity

Temperature and Relative Humidity within an indoor environment tends to affect the thermal comfort of the occupant/s within the space. Temperature relates to how hot or cold the environment is and relative humidity is a marker for how much moisture vapour is present in the air and temperature and humidity are directly related. There are recommended seasonal settings for temperature and relative humidity for workplaces typically for summer and winter comfort.

7 Methodology

The methodology presented was consistent with recognised guidelines and standards and was conducted using the following electronic real-time scientific devices.

TSI 7575 Q-TRAK Indoor Air Quality Monitor, this device was used to sample:

- Carbon Dioxide;
- Carbon Monoxide;
- Temperature; and
- Relative Humidity.

An Aeroqual Ranger 2326 with a dust sampling head was used to sample ambient dust fractions:

- $PM_{2.5}$ and
- PM_{10}.

A visual microbial assessment to identify the presence or mould.

Both real-time sampling devices provide real time analysis with the capability to log results for sample periods, both devices were calibrated and set to run for 15-minute periods at the designated locations.

The *Safe Work Australia Guidance on the Interpretation of Workplace Exposure Standards for Airborne Contaminants, 2013* was used as reference material to compare the results.

8 Monitoring Locations and Results

Five locations were sampled on the first-floor level of Orange Hospital, the measurement were obtained from the corridor adjacent to where the doorways to the rooms were indicated on the map.

Table 4- Level 1 Atmospheric Results from Corridor Adjacent Designated Sample Locations

	Sample Locations					
Parameter	**South Side of Corridor Opposite Bedroom 2**	**Adjacent Bedroom 1**	**Adjacent Bedroom 2**	**Adjacent Bedroom 3**	**Room Between Bedroom 3 & Courtyard**	**Recommended Level**
Carbon Dioxide (Ambient 380ppm)	495 ppm	640 ppm	630 ppm	612 ppm	542 ppm	**< 800 ppm**
Carbon Monoxide	1.0 ppm	0.8 ppm	0.9 ppm	0.9 ppm	0.7 ppm	**9 ppm**
Temperature (C)	21.2	21.9	20.9	21.0	21.0	**20° – 23° Winter 23° – 26° Summer**
Relative Humidity %	44.0	41.5	40.3	40.0	38.3	**35%-65%**
Visual Mould	None Present	None Present	None Present	None Present	None Present	**Visual Presence of Mould**

The following table is based on the NSW EPA & National Environment Protection (Ambient Air Quality) Measure Standards and would not normally refer to a workplace.
Table 5 presents the locations and a summary of the ambient dust monitoring findings;

Table 5 – Ambient Dust Results

Ambient Dust Location (See Map)	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)
1	1.3	2.7
2	2.1	4.4
3	1.8	8.2
4	1.3	4.6
National Environmental Protection Measure (Ambient Air Quality)	**25 µg/m³ - 24 Hour Average**	**50 µg/m³ - 24 Hour Average**

9 Recommendations

Based on the scope of work for the initial indoor air quality and ambient dust assessment it is suggested that Health Infrastructure consider conducting additional indoor air quality assessment once the rooms and the general area are unsealed and prepared for construction works.

10 Conclusion

Based on the indoor air quality, ambient air monitoring results and the visual mould inspection conducted at the Orange Hospital, located at 1530, Forest Road, ORANGE, NSW, 2800, the indoor and ambient air sampled suggests that the locations are safe for human occupancy.

11 References

NSW Work Health & Safety Act, 2011, Government Printers, Sydney.

NSW Work Health & Safety Regulation, 2017, Government Printers, Sydney.

Safe Work Australia, 2024, Guidance on the interpretation of workplace exposure standards for airborne contaminants.

Code of Practice Managing the Work Environment and Facilities, 2019, SafeWork NSW, Gosford & Safe Work Australia, Canberra.

AS 2365.2-1993 (R2014) – Methods for the sampling of indoor air – determination of carbon monoxide – direct reading portable instrument method.

AS 3580.7.1-2023 – Methods for sampling and analysis of ambient air – Determination of carbon monoxide – Direct reading instrumental method.

National Health and Medical Research Council, 1996, Ambient and Interim National Indoor Air Quality Goals Recommended by NHMRC.

12 Appendices

Appendix 1: Work Health & Safety Legislative Requirements

Presented below are the legislative and other requirements incumbent on the person/s with a duty of care in relation to work health and safety requirements.

Table 6 – Legislative and Other Requirements

Legislative Instrument	Requirement
NSW Work Health & Safety Act, 2011 19 Primary Duty of Care	(1) A person conducting a business or undertaking must ensure, so far as is reasonably practicable, the health and safety of: (a) workers engaged, or caused to be engaged by the person, and (b) workers whose activities in carrying out work are influenced or directed by the person, while the workers are at work in the business or undertaking. (2) A person conducting a business or undertaking must ensure, so far as is reasonably practicable, that the health and safety of other persons is not put at risk from work carried out as part of the conduct of the business or undertaking. (3) Without limiting subsections (1) and (2), a person conducting a business or undertaking must ensure, so far as is reasonably practicable: (a) the provision and maintenance of a work environment without risks to health and safety, and (b) the provision and maintenance of safe plant and structures, and (c) the provision and maintenance of safe systems of work, and (d) the safe use, handling, and storage of plant, structures and substances, and (e) the provision of adequate facilities for the welfare at work of workers in carrying out work for the business or undertaking, including ensuring access to those facilities, and (f) the provision of any information, training, instruction or supervision that is necessary to protect all persons from risks to their health and safety arising from work carried out as part of the conduct of the business or undertaking, and (g) that the health of workers and the conditions at the workplace are monitored for the purpose of preventing illness or injury of workers arising from the conduct of the business or undertaking.
NSW Work Health & Safety Act, 2011 274 Approved Codes of Practice	(1) The Minister may approve a code of practice for the purposes of this Act and may vary or revoke an approved code of practice.

Legislative Instrument	Requirement
NSW Work Health & Safety Regulation, 2017 40 Duty in Relation to General Workplace Facilities	A person conducting a business or undertaking at a workplace must ensure, so far as is reasonably practicable, the following: (e) ventilation enables workers to carry out work without risk to health and safety, (f) workers carrying out work in extremes of heat or cold are able to carry out work without risk to health and safety,
NSW Work Health & Safety Regulation, 2017 49 Ensuring Exposure Standards for Substances and Mixtures Not Exceeded	A person conducting a business or undertaking at a workplace must ensure that no person at the workplace is exposed to a substance or mixture in an airborne concentration that exceeds the exposure standard for the substance or mixture.
NSW Work Health & Safety Regulation, 2017 50 Monitoring Airborne Contaminant Levels	(1) A person conducting a business or undertaking at a workplace must ensure that air monitoring is carried out to determine the airborne concentration of a substance or mixture at the workplace to which an exposure standard applies if: (a) the person is not certain on reasonable grounds whether or not the airborne concentration of the substance or mixture at the workplace exceeds the relevant exposure standard, or (b) monitoring is necessary to determine whether there is a risk to health.
NSW Government Code of Practice Managing the Work Environment & Facilities 2.7 Air Quality	Workplaces should be adequately ventilated. Fresh, clean air should be drawn from outside the workplace, uncontaminated by discharges from flues or other outlets, and be circulated through the workplace. Workplaces inside buildings may have natural ventilation, mechanical ventilation (fans or extraction units) or air-conditioning. An air conditioning system should: • Provide a comfortable environment in relation to air temperature, humidity and air movement. • Prevent the excessive accumulation of odours. • Reduce the levels of respiratory by-products, especially carbon dioxide, and other indoor contaminants that may arise from work activities. • Supply an amount of fresh air to the workplace, exhaust some of the stale air as well as filter and recirculate some for the indoor air Enclosed workplaces should be supplied with comfortable rates of air movement (usually between 0.1m and 0.2m per second). Air conditioning and other ventilation systems should be regularly serviced and maintained in accordance with manufacturer's instructions.
NSW Government Code of Practice Managing the Work Environment & Facilities 2.8 Heat and Cold	Thermal Comfort Work should be carried out in an environment where a temperature range is comfortable for workers and suits the work they carry out. Air temperature that is too high or too low can contribute to fatigue and heat or cold related illness. Thermal comfort is affected by many factors, including air temperature air movement, floor temperature, humidity, clothing, the amount of physical exertion, average temperature of the surroundings and sun penetration.

Appendix 2: Calibration Certification

TRtechrentals

Certificate of Calibration Conformance

Certificate Number : 37504
Reference : 616844
Model : TSI,7575
Asset Number : 202031
Description : TSI Q-TRAK IAQ Monitor CO2, CO Temperature & Humidity Logger

Date Calibrated : 10/05/2023
Technician : Hamish McDonald
Serial No. : 7575X1429010/90061
Calibration valid for : 365 days.

The performance of the above listed equipment has been verified for measurement accuracy to the manufacturers relevant published specification, in accordance with our Quality Assurance Procedures, using the appropriate calibrated equipment, traceable to nationally recognised standards.

SOURCE ASSET 125545 CAL.SUB-CONTRACTED REPORT 614351 DUE 20/02/2024

Mark Benesovsky
Quality Assurance Manager

QSF 326-1/C

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