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PLANS AND DOCUMENTS
referred to in the PDA APPROVAL
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Sonic Healthcare Limited
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Edgecliff
NSW 2027

Attention: Nick Lucas

Dear Nick

Sullivan Nicolaides Pathology - Hurworth Street Laboratory and Offices Air Quality Report

As requested, this letter outlines our findings regarding potential air quality issues associated with Sullivan Nicolaides Pathology's proposed development on Hurworth St, Brisbane, adjacent to the Best St sewer vent. This report has been prepared in response to the request for additional information issued by the Urban Land Development Authority (ULDA) for an Air Quality Report addressing sewer vent issues (ULDA Ref No. DEV2012/393).

1 Background

Sullivan Nicolaides Pathology (SNP) recently lodged a submission with the ULDA for a laboratory on Lot 5, Hurworth St, Bowen Hills. One issue for this site is that it has an easement in the southeastern corner, which contains a sewer vent that connects to a very large trunk sewer line. This sewer vent is the responsibility of Queensland Urban Utilities (QUU) and is currently being upgraded to include a new Odour Control Plant (OCP) to minimise odours from the vent stack and to decrease maintenance requirements.

After performing an assessment of the development application, ULDA determined that further information was required to decide the application, which included:

- *"An air quality report addressing the sewer vent issues"*

SLR Consulting has been commissioned to provide expert advice regarding odour and other air quality issues relevant to the sewer vent for the proposed development and to prepare an air quality report to meet ULDA's requirements.

The information/materials provided to SLR Consulting used to prepare this report were:

- The information request from ULDA dated 20 December 2012
- Drawings of the proposed building showing the external features of the building, and the relative locations of the Best St sewer vent stack and the proposed building;
- *Best St Odour Control System on the S1 Sewer - Supply and Design Technical Package*, compiled by QUU, 30 August 2010; which includes:

- *Technical Specification - Odour Treatment System - Minor Works Specifications for the Design, Fabrication, Supply, Installation, Testing and Commissioning of Odour Treatment Systems for Best St MH on the M1 Sewer* prepared by QUU;
- *Test Report - Odour Monitoring Conducted on the Carbon Filter at Best St, Bowen Hills*, prepared by AirLabs Environmental, June 2010; and
- *S1 Sewage Tunnel Ventilation and Odour Control Issues Investigation – Best St and North Quay,* prepared by Parsons Brinckerhoff Australia Pty Ltd, June 2010.

2 Emissions from the Best Street Sewer Vent

Emissions to air from sewer systems include methane, volatile organic compounds such as toluene and xylene, reduced sulphur compounds such as amines, mercaptans and hydrogen sulfide, and ammonia. Many of these compounds are detectable by humans at low concentrations due their low odour thresholds and these emissions can therefore give rise to nuisance odour issues if inadequately controlled. In addition, air emissions from sewer systems also have the potential to contain bioaerosols if inadequately controlled.

The S1 sewer tunnel was constructed under the Brisbane CBD in 1999-2000, and was intended to provide an interconnecting sewer that would allow overhaul of the existing main sewage carrier under the Brisbane CBD. The S1 tunnel was designed originally to take sewage flows from this interconnection, and to also receive and transport increased sewage flows due to storm flows. In more recent times, the S1 sewer has been used to receive inflows from the Heroes Ave Sewage Pump Station and in 2010 QUU commissioned a number of studies into the performance of the existing odour control systems on the sewer (the Best St site being one of these) for the changed operations. This included emission testing and an odour dispersion modelling study. Subsequent to these studies, QUU have commissioned a new Odour Control Plant (OCP) for the Best St sewer vent which is currently being installed and commissioned.

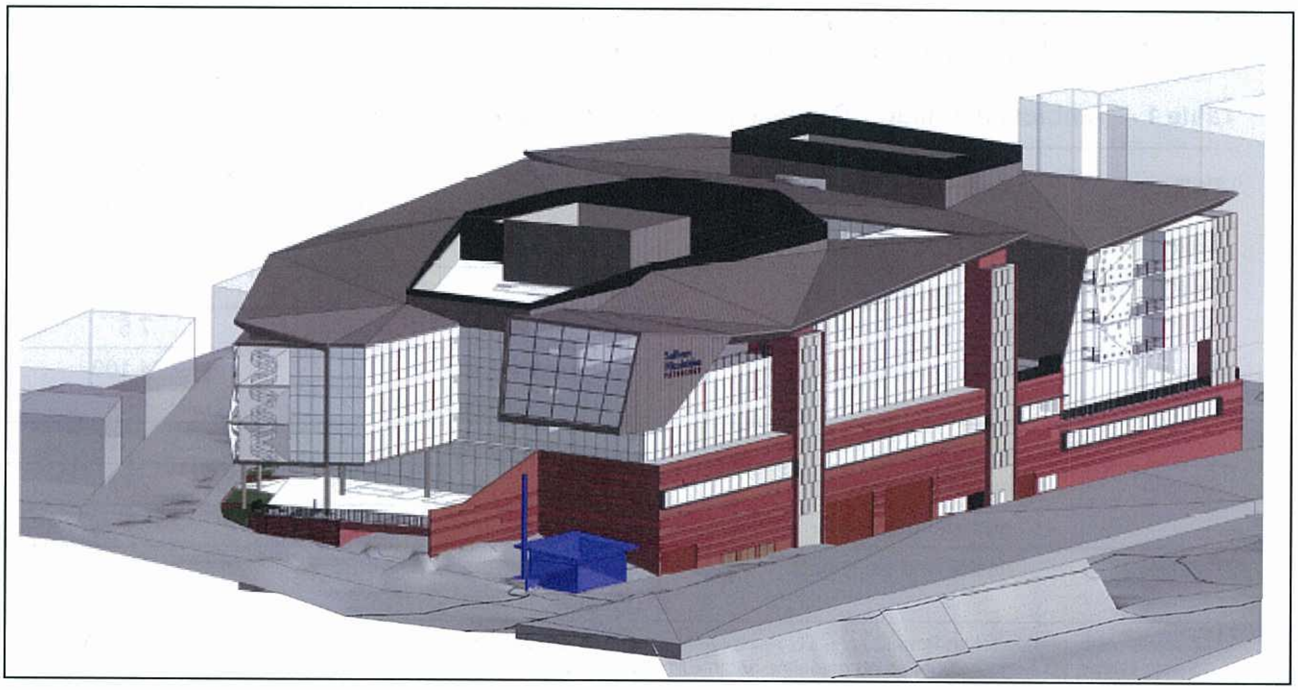
The new OCP comprises a two-stage treatment system consisting of two biotrickling filters in parallel with subsequent activated carbon polishing. Odorous air from the sewer vent is extracted and transported to the biotrickling filters (arranged in parallel to provide full redundancy in the event that one biotrickling filter is off-line). In the biotrickling filter, a film of bacteria growing on reticulated foam packing material breaks down the odorous compounds in the gas as it passes through the filter. The cleaned gases are then passed through an activated carbon filter to absorb any remaining pollutants from the airstream, such as residual hydrogen sulfide and volatile organic compounds, to produce clean air that is then discharged to atmosphere via a 10 m tall stack.

In addition to emissions from the stack, there is also the potential for emissions to occur when the carbon bed is being replaced. Previously this needed to be done approximately every six weeks and during replacement of the carbon, vessels containing the carbon were opened, the old carbon vacuumed out and air blowers were used to load the new carbon into the vessels. This resulted in significant disturbance of the spent carbon media and gave rise to significant odour emissions. These emissions would also occur as ground-level, fugitive emissions from the carbon beds, as opposed to the continuous emissions vented to atmosphere via the stack, and therefore be subject to less dispersion than the continuous emissions from the stack.

With the new OCP, the lifespan of the carbon filter material is expected to be significantly extended, with the carbon only needing to be replaced every six to nine months. This is because the bulk of the odorous gases will be removed by the biotrickling filter prior to the gases being passed through the carbon filter for final polishing. The method to be used to replace the carbon media is also understood to be under review and it is possible that the entire carbon vessel may be removed and replaced rather than the vessel being opened to replace the carbon filter material inside. This would avoid disturbance of the spent media and significantly reduce emissions during this process, however as noted above, it is understood that the feasibility of changing replacement methodology has not been assessed.

The location of the OCP and stack relative to the proposed SNP building is shown in **Figure 1**, with the OCP building and stack highlighted in blue. The proposed SNP building has a balcony area located above the sewer easement which is fully enclosed by glass on the southern façade. A visitors' car park area is located below the stack discharge point to the west of the easement.

Figure 1 View of Proposed SNP Building and Best St Sewer Vent



3 Air Quality Criteria

3.1 Odour

Odour concentration is measured in terms of odour units (OU). 1 OU is the concentration of odour-containing air that can just be detected by 50% of members of an odour panel (persons chosen as representative of the average population sensitivity to odour). This process is defined within Australian Standard AS4323.3: *Stationary Source Emissions – Part 3: Determination of Odour Concentration by Dynamic Olfactometry (Standards Australia 2001).*

An Odour Emission Rate (OER) is the product of the odour concentration (OU) and the volumetric flow rate (e.g. m^3/s or m^3/min), and is often annotated as $OU.m^3/s$, or $OU.m^3/min$.

Impacts from odorous air contaminants are often nuisance-related rather than health-related. Odour performance goals guide decisions on odour management, but are generally not intended to achieve "no odour". For additional background information on the basis of odour assessment criteria, please refer to **Attachment A**.

The Queensland odour impact assessment guidelines (*Ecoaccess Guideline: Odour Impact Assessment from Developments, 2004)* require that the modelled odour concentrations at the "most exposed existing or likely future off-site sensitive receptors" be compared with the following guideline values:

- 0.5 OU, 1-hour average, 99.5th percentile for tall stacks; and
- 2.5 OU, 1-hour average, 99.5th percentile for ground-level sources and down-washed plumes from short stacks.

For the Best St OCP stack, which will be subject to building downwash effects from the proposed SNP building, the appropriate assessment criterion would be a 1-hour average of 2.5 OU, at the 99.5th percentile model prediction.

3.2 Individual Odorous Compounds

Relevant air quality criteria for individual odorous compounds measured in the untreated emissions from the Best St sewer vent (refer to **Attachment B**) have been sourced from the Environmental Protection Policy (EPP (Air)) (2008) and are summarised in **Table 1**.

Table 1 Ambient Air Quality Guidelines for Individual Odorous Compounds (EPP (Air) 2008)

Pollutant	Environmental Value	Averaging Time	Air Quality Objective (ppm)	Air Quality Objective (µg/m^3)
Ammonia [1]		1-Hour	0.46	330
Hydrogen sulfide	health and wellbeing	24-Hours	0.11	160
	protecting aesthetic environment	30-Minutes	0.0049	7.5
Toluene	health and wellbeing	24-Hours	1.0	4,100
		Annual	0.1	410
	protecting aesthetic environment	30-Minutes	0.26	1,100
Styrene	health and wellbeing	7-Days	0.06	280
	protecting aesthetic environment	30-Minutes	0.016	75
Xylenes	health and wellbeing	24-Hours	0.25	1,200
		Annual	0.2	950

[1] Assessment criterion taken from NSW OEH *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, 26 August 2005, as no guideline set in EPP (Air) 2008.

3.3 Bioaerosols

Biological contaminants include viable and non-viable microbiological matter such as viruses, bacteria and fungi. These contaminants are ubiquitous in the air and general environment and there are no ambient air quality criteria set in the EPP (Air) 2008 or other state or national policies, guidelines or legislation for these microorganisms.

4 Performance Specifications for the new Best St OCP

The *Technical Specification - Odour Treatment System - Minor Works Specifications for the Design, Fabrication, Supply, Installation, Testing and Commissioning of Odour Treatment Systems for Best St MH on the M1 Sewer* prepared by QUU and contained within the *Best St Odour Control System on the S1 Sewer - Supply and Design Technical Package* includes the following specifications for the OCP in Section 3.1:

- Hydrogen sulphide (H_2S) concentrations at any source outlet shall be no greater than 0.11 ppm averaged over a 24 hour period and shall perform to a 99.9% reduction in H_2S concentrations.
- Air quality of other gases at any source outlet shall be less than the odour objectives of the EPA as shown in **Table 2** below.

Table 2 Source Outlet Design Specifications for the Best St OCP

Pollutant	Maximum Concentration
Toluene	1.0 ppm
Styrene	0.06 ppm
Xylenes	0.25 ppm
Odour	2.5 OU

Comparison with the ambient air quality guidelines set in the EPP (Air) 2008, as summarised in **Table 1** shows that these stack outlet limits are based on the Queensland health-based ambient air quality criteria and odour nuisance guideline. This means that concentrations in the OCP stack outlet are required to be at or below the ambient air quality guidelines. Thus, while any additional dilution of the contaminants in the plume between the stack discharge point and ground level (or any location where the public may be exposed to emissions from stack, such as the SNP carparking area or balconies) will further reduce those concentrations, but should not be required to meet the ambient air quality criteria.

The specifications for H_2S and odour were adopted in the tender documents (on page 4) supplied by CleanTeQ to supply and install the new OCP (also included in the *Best St Odour Control System on the S1 Sewer - Supply and Design Technical Package)* as summarised in **Table 3**. The stack exit velocity specified in the CleanTeQ technical specification is 15 m/s.

Table 3 CleanTeQ Design Specifications for the New Best St OCP

Parameter	Inlet	Outlet
Flow	6,000 m^3/hr	6,000 m^3/hr
H_2S (peak)	50 ppm	0.11 ppm
H_2S (average)	10 ppm	0.11 ppm
Odour Concentration	-	<2.5 OU

5 Assessment of Potential Impacts

As discussed in **Section 2**, there are two potential sources of odour from the Best St sewer vent:

- Continuous emissions of treated gases from the outlet of the new OCP (once commissioned) which are discharged via a 10 m stack; and
- Intermittent (once every six to nine months) fugitive emissions from the carbon filters during replacement of the carbon media.

Provided the new OCP operates as per the design specifications, the potential for emissions from the OCP exhaust stack to give rise to health-related or nuisance-related impacts is very low. The new OCP has two-stage treatment (first a biological scrubber where bacteria are used to remove the odorous compounds, and then carbon 'polishing' filters). The technical specifications require that the outlet concentrations in the stack discharge comply with State health-based and amenity-based air quality criteria. This means that the contaminant concentrations at any locations where the public may be exposed to emissions from the stack, such as the SNP car parking area or balconies, will be even lower than these criteria due to the plume dilution that will occur between the stack discharge point and ground level.

As the new system is a two-stage process, when the carbon is being replaced, the biological scrubbers will still be operating so there will still be control of odours from the sewer vent and there should be no significant increases in odours from the stack. Conversely, when one of the biological scrubbers is off-line being topped up with fresh bacteria (approximately once every 10 years) the second biological scrubber and the carbon filter will still be on-line and will control the odour.

The process of replacing the spent carbon media, however, has the potential to give rise to significant fugitive odours. Once the new OCP is commissioned, the frequency of replacement of the the carbon media will drop significantly from once every six weeks or so, to around once every six to nine months. The process takes approximately one day to complete and therefore the total number of hours per year when fugitive odours may be emitted as a result of these activities is up to 16 hours per year. The criterion for odour nuisance in Queensland for ground level sources is 2.5 OU based on the 99.5 percentile odour concentration – which means that there can be around 44 hours per year where the guideline of 2.5 OU is exceeded. This is based on reasoning that short-term, infrequent odours do not give rise to nuisance impacts. Hence if the carbon changeovers occur without any control and give rise to odours, then they would likely still comply with the nuisance criterion.

In addition, the SNP building design will minimise any exposure to odours from the OCP, with the balcony on the southern end of the building being fully enclosed by glass on the southern façade. The visitors' car park area is open, however people will spend only short periods of time in this area and as long as the OCP operates as expected, no odours or elevated contaminant concentrations would occur under normal operating conditions and only on very infrequent occasions during replacement of the carbon media.

The only other potential air quality issue relates to failure of the OCP. If the biological scrubber fails for any reason and the carbon filter becomes overloaded, the emissions from the stack would increase significantly. The technical specifications for the OCP include gas analysers on the inlet and outlet streams of the OCP to continuously measure H_2S concentrations which will warn of any performance issues for the OCP (Section 3.2.6). Therefore there should be early warning of any failure and remedial action can be taken.

In summary, based on the discussion above, it is concluded that provided the OCP is designed, installed and operated as per the information contained within the *Best St Odour Control System on the S1 Sewer - Supply and Design Technical Package*, downwind air quality can be expected to comply with the relevant State health-based and amenity-based air quality criteria and no adverse impacts are anticipated.

Yours sincerely

KIRSTEN LAWRENCE
Principal

ATTACHMENT A - BACKGROUND ON ODOUR ASSESSMENT CRITERIA

Impacts from odorous air contaminants are often nuisance-related rather than health-related. Odour performance goals guide decisions on odour management, but are generally not intended to achieve "no odour".

The detectability of an odour is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation. This point is called the *odour threshold* and defines one odour unit (OU). An odour goal of less than 1 OU would theoretically result in no odour impact being experienced.

In practice, the character of a particular odour can only be judged by the receiver's reaction to it, and preferably only compared to another odour under similar social and regional conditions. Based on the literature available, the level at which an odour is perceived to be a nuisance can range significantly depending on a combination of the following factors:

- *Odour Quality*: whether an odour results from a pure compound or from a mixture of compounds. Pure compounds tend to have a higher threshold (lower offensiveness) than a mixture of compounds.
- *Population sensitivity:* any given population contains individuals with a range of sensitivities to odour. The larger a population, the greater the number of sensitive individuals it may contain.
- *Background level:* whether a given odour source, because of its location, is likely to contribute to a cumulative odour impact. In areas with more closely-located sources it may be necessary to apply a lower threshold to prevent offensive odour.
- *Public expectation:* whether a given community is tolerant of a particular type of odour and does not find it offensive, even at relatively high concentrations. For example, background agricultural odours may not be considered offensive until a higher threshold is reached than for odours from a landfill facility.
- *Source characteristics:* whether the odour is emitted from a stack (point source) or from an area (diffuse source). Generally, the components of point source emissions can be identified and treated more easily than diffuse sources. Emissions from point sources can be more easily controlled using control equipment. Point sources tend to be located in urban areas, while diffuse sources are more often located in rural locations.
- *Health Effects:* whether a particular odour is likely to be associated with adverse health effects. In general, odours from agricultural activities are less likely to present a health risk than emissions from industrial facilities.

Odour assessment criteria are generally designed to control odours to ensure offensive odour impacts are effectively managed, but are not intended to achieve 'no odour'. Odour impact assessment guidelines are most often expressed as a modelled average odour concentration level of *XX* OU for more than *XX* percent of the (hourly) meteorological conditions in a year.

Computational dispersion modelling is usually carried out for one-hour time steps as the meteorological data available for use in modelling are generally recorded in one-hour time steps. However, the human perception of odour occurs over much shorter time scales and people can sense concentrations of odorous substances that last only for a few seconds. Within each modelled hour, the odour concentration will fluctuate above and below the predicted average concentration as a result of atmospheric turbulence. The difference in the short-term "nose-response" time and the 1-hour average dispersion modelling output is therefore accommodated by applying a 'peak-to-mean' factor to "scale up" the model predictions to estimate the short-term peak concentrations important for annoyance in humans. However, the variations in 'peak-to-mean' factors for different source types need to be considered when doing this.

The Queensland odour impact assessment guidelines are set on the basis of an assumed general annoyance level of 5 OU as a peak, or "nose response" time, average. The guideline requires that the modelled odour concentrations at the "most exposed existing or likely future off-site sensitive receptors" be compared with the following guideline values.

- 0.5 OU, 1-hour average, 99.5th percentile for tall stacks; and

- 2.5 OU, 1-hour average, 99.5th percentile for ground-level sources and down-washed plumes from short stacks

The guideline also states that for facilities that do not operate continuously, the 99.5th percentile is to be applied to the actual hours of operation. In theory this means a plant that operates only 3,000 hours per year must comply with the guideline at the 99.5th percentile of 3,000 hours, which is the 15th highest 1-hour modelled prediction. This is considerably more stringent than the requirement for a continuously operating source which only has to comply at the 99.5th percentile of 8,760 hours, which is the 44th highest prediction. This unfairly penalises facilities that only operate intermittently and has no sound basis for the prevention of odour nuisance impacts, hence use of the 99.5th percentile is generally used in all applications regardless of operating frequency.

These guideline values are based upon application of default peak to mean ratios of 10:1 for stacks and 2:1 for ground-level or down-washed plumes from short stacks to the default annoyance threshold of 5 OU.

The guidelines note that these criteria should not be used as “pass” or “fail” test as there are a number of limitations in modelling. Sources of uncertainty include odour sources being underestimated or over-looked, short-term peak emissions not being catered for in the guideline, the guideline not being stringent enough for specific substances of greater offensiveness, variability in emission rates, models under-predicting actual concentrations and use of peak to mean ratios too low for actual dispersion. In addition, odorous emissions that are extremely offensive may also cause odour impacts with downwind concentrations lower than the guideline value.

ATTACHMENT B - SUMMARY OF EMISSION DATA FOR THE BEST ST SEWER VENT

Stack testing – June 2010

The untreated emissions from the Best St sewer vented were tested in June 2010 by AirLabs Environmental. The results of the sampling are summarised below:

- Temperature = 24.8 degrees Celsius
- Methane concentration = <0.1%
- Hydrogen sulfide concentration = 2.3 ppm
- Ammonia concentration = 19 ppm
- Toluene concentration = 0.084 ppm
- Xylene concentration = 0.19 ppm
- Styrene concentration = <0.004 ppm
- Odour concentration = 12,900 odour units (OU)

The odour concentration in the gases exiting the old odour control system was measured at 920 OU, giving an odour control efficiency for the old control system of 92.9%.