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Adelaide Desalination Plant Operational Underwater Noise Monitoring

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Revision Table

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Glossary

dB	Decibel—a unit of measurement used to express sound level. It is based on a logarithmic scale which means a sound that is 3 dB higher has twice as much energy.
dB re 1 μPa	Decibel referenced to 1 μPa – used to quantify sound pressure levels during measurements underwater.
Frequency (Hz)	The number of times a vibrating object oscillates (moves back and forth) in one second. Fast movements produce high frequency sound (high pitch/tone), but slow movements mean the frequency (pitch/tone) is low. 1 Hz is equal to 1 cycle per second.
Power spectral density	Used to describe how the power of a measured sound level is distributed with frequency, independent of the frequency bin width used.
Sound Pressure Level (SPL)	Overall sound level (in dB) at the measurement location, based on a logarithmic measure of the sound pressure relative to the reference pressure value (1 μPa for underwater).

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1 Introduction

The Adelaide Desalination Plant is a seawater desalination plant at Lonsdale, South Australia, with the capacity to deliver up to 100 billion litres of water each year. Construction has been completed, and the complete plant is now operational.

AdelaideAqua Pty Ltd has engaged Resonate Acoustics to assist with an assessment of underwater noise monitoring results gathered during operation of the plant, as required by the EPA licence. An underwater noise logger was located between the outfall diffusers and intake structure for a period of five days, including a short period when the plant was not operating to provide a comparison to ambient underwater noise levels.

2 Assessment criteria

The assessment criteria for the Adelaide Desalination Plant, proposed in the *Technical Report – Underwater Noise & Vibration*[1], are reproduced in Table 1. Note that the continuous criteria are applicable to noise from the operational plant.

Table 1 – Proposed assessment criteria for Adelaide Desalination Plant

Species	Source character	Unit	Organ damage	Hearing damage (PTS or TTS)	Behavioural response
Marine fauna	Continuous	dB re 1 µPa (RMS)	185	140	120
	Impulse		200	170	160
Human	Continuous		185	155	140
	Impulse		200	170	160

In addition to this, the Technical Report also provides the results of ambient underwater noise monitoring conducted at five locations near the current monitoring site (refer Figure 1).

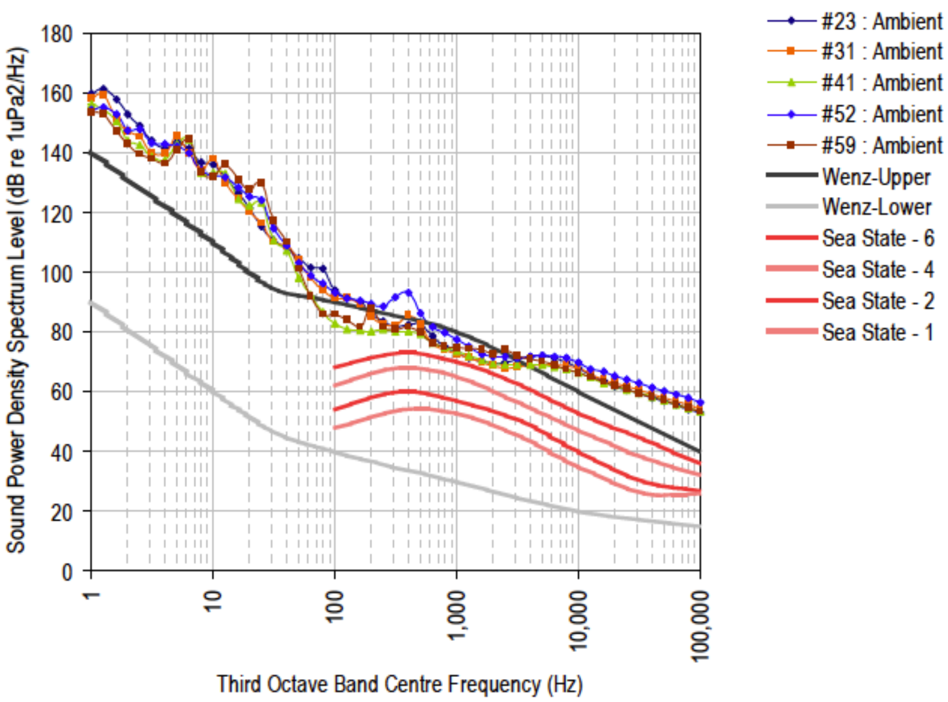

Figure 1 – Ambient noise monitoring results using a hydrophone (*Technical Report – Underwater Noise & Vibration*)

[1] Connell Wagner, Adelaide Desalination Project – Technical Studies & Investigations, *Technical Report – Underwater Noise & Vibration*, 24 October 2008

From Figure 1, it can be seen that the measured SPL at a number of the measurement locations would already exceed the lowest proposed assessment criteria of 120 dB re 1 μPa, when considered over the frequency range of 20 Hz to 100 kHz. This includes measurements at Location 52 and Location 59, both approximately 500 metres from the measurement location used for this assessment.

Therefore, the operational measurement results should also be compared to the ambient monitoring results in considering whether there has been a change in the underwater noise environment.

3 Monitoring procedure

Underwater noise monitoring was undertaken between 19 November and 23 November 2012, with a DSG-Ocean underwater noise logger fitted with a hydrophone with a sensitivity of -180.4 dB re 1V/μPa. The logger was configured to record for 15 seconds during every 15-minute period of the measurements, with a sampling frequency of 80 kHz. A 20 dB gain was applied to the signal during each measurement and the logger was positioned approximately five to six metres below the surface.

AdelaideAqua located the underwater noise logger between the outfall diffusers and intake structure, approximately at Location MP3 shown in Figure 2. The monitoring location is approximately one kilometre offshore.

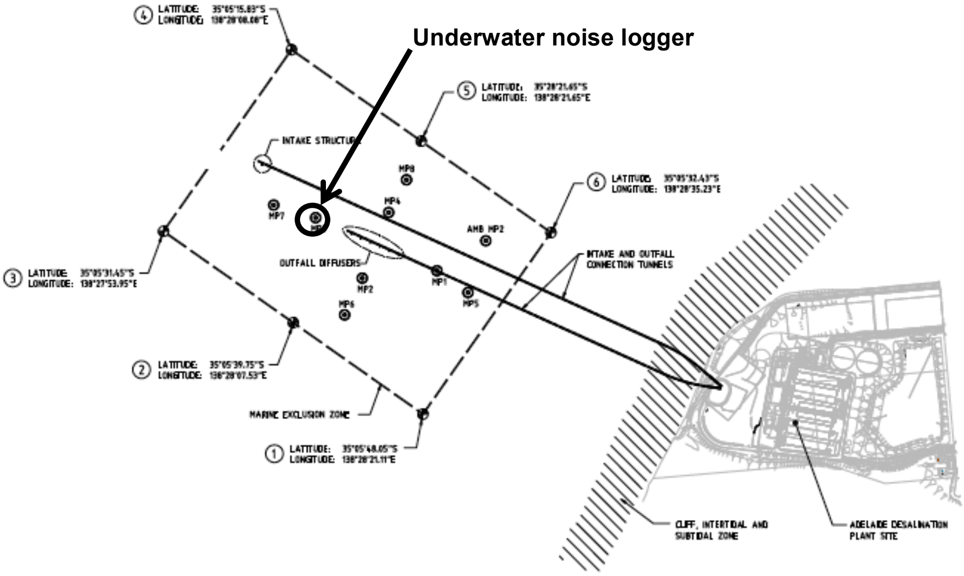

Figure 2 – Underwater noise monitoring location

4 Measurements

4.1 Monitoring results

Figure 3 presents the measured Sound Pressure Levels (SPL) for each 15-minute period during the monitoring. The 120 dB re 1 µPa behavioural response criterion proposed as an assessment criterion is also shown for reference, along with the average flow rates from the intakes and outfall. Note that the SPL has been calculated based on the measured levels between 20 Hz and 30 kHz, in order to remove any short-term noise created by movement of the measurement equipment and flow-generated noise at the hydrophone.

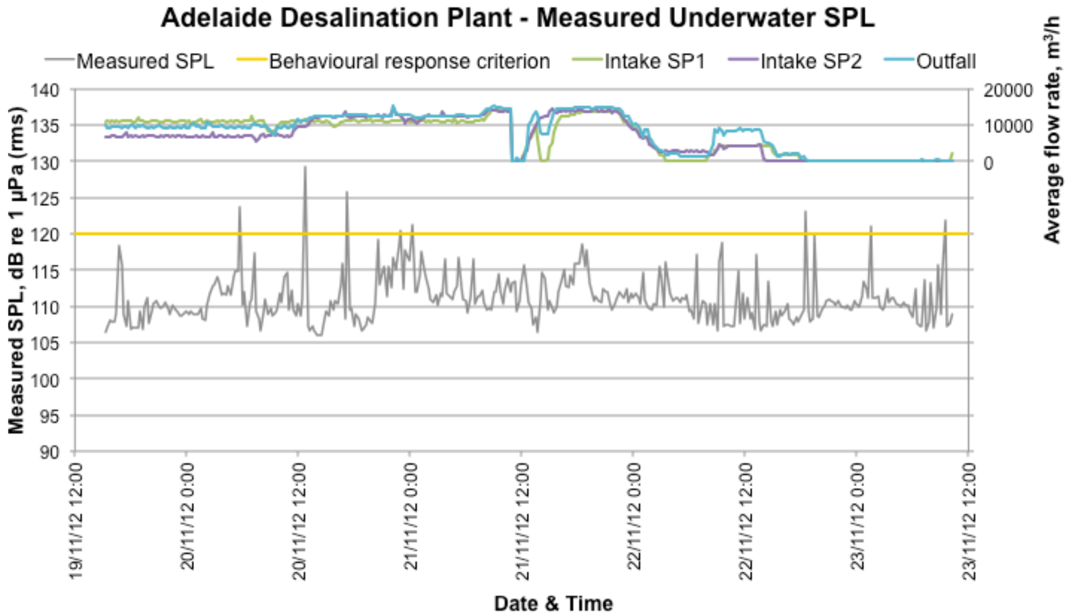

Figure 3 – Measured underwater SPL during monitoring period

It can be seen that the measured SPL typically remained below 120 dB re 1 µPa, with the exception of 7 periods. There also does not appear to be a clear correlation between the measured SPL and the average flow rates, suggesting that flow from the intake and outfall does not control the noise environment.

The measured sound power spectral density for each of the 7 periods exceeding 120 dB re 1 µPa are presented in Figure 4, and the measured overall SPL is summarised in Table 2 along with notes collated based on review of the collected audio data.

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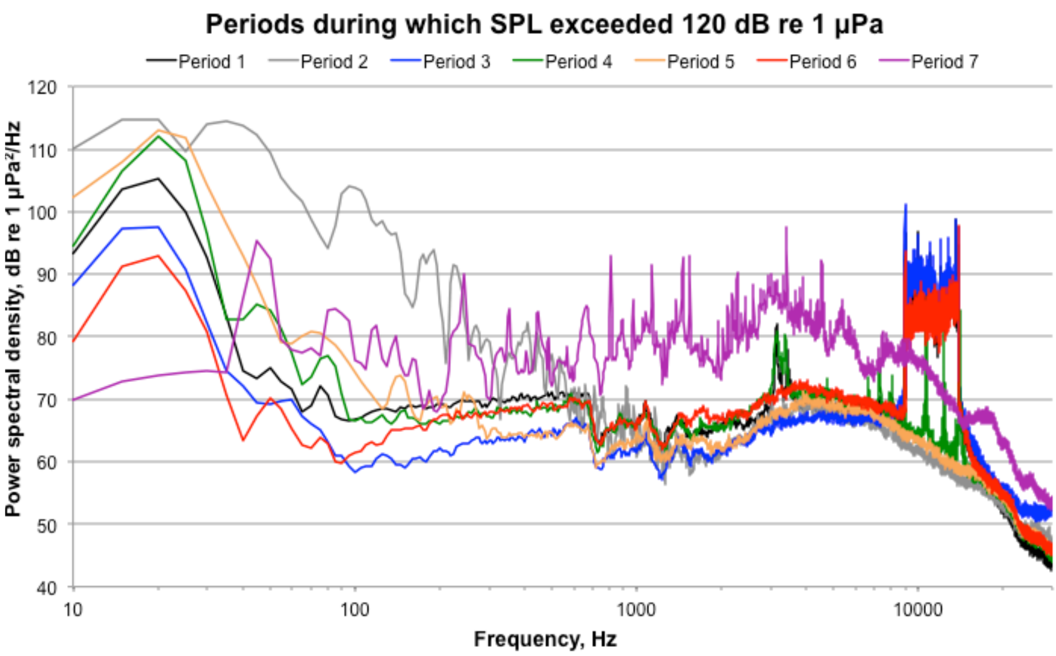

Figure 4 – Power spectral density for periods during which SPL exceeded 120 dB re 1 µPa

Table 2 – Periods where measured SPL exceeded 120 dB re 1 µPa

Period	Date	Time	Measured SPL, dB re 1 µPa (RMS)	Notes, including impression from audio
1	20/11/2012	5:45	124	Acoustic modem operating during measurement
2	20/11/2012	12:45	129	Short-term contact with hydrophone
3	20/11/2012	17:15	126	Acoustic modem operating during measurement
4	21/11/2012	0:15	121	
5	22/11/2012	18:30	123	Appears to be higher flow noise at low frequency
6	23/11/2012	1:30	121	Acoustic modem operating during measurement
7	23/11/2012	9:30	122	Mechanical noise, potentially from pump or engine

Of the 7 periods, only Period 7 was controlled by mechanical noise generated by either a pump or engine. Given that this was only detected at this level for one period out of the five days of measurements and during a period when there was little or no flow through the intakes and outfall, it appears this was a short-term event unrelated to general operation of the outfall diffusers and intake structure.

During periods 1, 3, 4 and 6, a review of the audio data indicated that an acoustic modem used to transmit data on underwater conditions was operating and resulted in higher measured noise levels, typically from 9 to 14 kHz. With noise from the modem excluded, the measured SPL during these periods was 110-115 dB re 1 μPa.

Period 2 was affected by a short-term low frequency noise, which appeared to be caused by something coming into brief contact with the hydrophone.

The cause of the exceedance during Period 5 appears to be related to higher environmental flow noise across the microphone, with the SPL calculated between 30 Hz and 30 kHz being 114 dB re 1 μPa. Note that this was unrelated to flow rates from the intakes and outfall, which were very low during this period.

Overall, the exceedances of the proposed assessment criteria do not appear to relate to operation of the intake and outfall of the Adelaide Desalination Plant.

4.2 Measured levels in context

To provide a comparison between measured levels pre- and post-construction of the Adelaide Desalination Plant, the power spectral densities in Figure 4 can be directly compared to those presented in Figure 1.

It can be seen that noise levels up to 1 kHz are typically lower in the operational measurements than in the ambient measurements taken prior to the operation of the plant. This suggests that operation of the intake and outfall at the Adelaide Desalination Plant is not significantly influencing the ambient noise environment at the measurement location.

At frequencies above 1 kHz, measured levels were similar to those measured previously, with the exception of short-term noise from the acoustic modems used to transmit data. Note that at these frequencies, ambient noise levels are typically controlled by other factors such as snapping shrimp noise.

5 Conclusion

This report presents the results of operational underwater noise monitoring conducted at the Adelaide Desalination Plant from 19 November to 23 November 2012.

The measured underwater noise levels were compared to the assessment criteria proposed as part of the Technical Report during the environmental assessment process. The measured levels were found to comply with the proposed criteria, with the exception of isolated periods, which were not found to correlate with operation of the intake structure and outfall diffusers.

The measured levels could also be compared to ambient measurements taken prior to construction of the plant. It was found that operation of the intake and outfall at the Adelaide Desalination Plant did not appear to significantly influence the measured underwater noise levels.