The Acoustic Group
CONSULTING ACOUSTICAL & VIBRATION ENGINEERING

ACOUSTIC ASSESSMENT
PROPOSED HELIPAD
TRINITY POINT DEVELOPMENT
48.4732.R7C:MSC

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APPENDICES

1.0 INTRODUCTION

An acoustic assessment was undertaken in 2016 and placed on public exhibition. The assessment accompanied a Section 75W application (MOD 3) to Concept Plan approval 06-039 for the addition of a helipad to the Trinity Point Marina and Mixed Use Development. As a result of comments provided as part of that exhibition an update of the October 2016 report has been requested by Council.

The purpose of this updated report is to present the results of an acoustic assessment of helicopter operations from the proposed helipad adjacent to the Trinity Point Marina in Bardens Bay, towards the south western end of Lake Macquarie.

This report has also been prepared to accompany DA 1176/2014 for the construction and operation of the proposed helipad. DA 1176/2014 has been lodged with Lake Macquarie City Council and is supported by an Environmental Impact Statement (EIS) prepared by ADW Johnson (2018). This acoustic assessment forms part of the EIS.

Approval has been granted for residential and commercial premises forming part of the Trinity Point development. The development includes a tourist resort and marina in the southern end of Bardens Bay that is presently under construction.

The proposal involves a helipad installed on a floating pontoon attached to the marina, which will be available for use by guests of Trinity Point via a 'prior permission' protocol.

The operation of helicopters to and from the proposed pontoon is permissible under aviation requirements governed by Air Services Australia.

NSW Planning & Environment, by letter of 6th July 2016, provided revised Secretary's Environmental Assessment Requirements (SEARs) for the Trinity Point Morisset Park Helipad. The SEARS provide, under the heading "Key Issues", the following two subsections titled "Establishment of Helipad and Helicopter Noise Impacts" and "Noise and Vibration":

- *Establishment of Helipad and Helicopter Noise Impacts*
  - *provide a Noise Assessment Report, prepared by a qualified acoustic consultant which investigates potential noise impacts associated with the take-off, approaches and route of helicopters to the helipad. The report shall address potential impacts on residential areas and other*

noise sensitive locations/uses: fauna and fauna habitats in particular threatened species, populations, or ecological communities of fish or marine vegetation and critical habitat.

- *identify all types of helicopters that are proposed to be used and include flight path, hours and frequency of operation, noise contours/levels, routes, noise mitigation measures and/or acoustic treatments and need for such a facility. Best practice in the measurement and prevention/mitigation of noise impacts shall be adopted.*

- *Noise and vibration*
  - *Including construction, operation and aircraft noise in accordance with the relevant Environment Protection Authority guidelines. The assessment must consider any potential impacts on nearby private receptors and the suitability of any noise mitigation measures.*

At the initial planning stage, two (2) possible helipad locations were nominated that used a primary flight path to and from the south south east. A secondary flight path to the north had also been nominated.

To examine the potential impact of helicopter operations, test flights were carried out while noise monitoring was conducted at locations around Bardens Bay and Trinity Point. The test flights were carried out in the presence of Council officers.

Prior to the actual testing of a helicopter, the sites for noise monitoring were established in consultation with Council officers, as was the test procedure necessary to consider different wind directions and the two possible helipad locations.

To identify the actual flight tracks that were flown, GPS instrumentation data from the helicopter was extracted.

Council officers were in attendance (on the ground) to observe the helicopter operations. The Council officers were also given the opportunity to observe the flight tracks from the air (whilst inside the helicopter) with observers on the ground confirming the same flight tracks.

Department of Planning officers were advised of the testing and invited to observe but declined.

The SEARs require the noise report to identify all of the helicopter types that will be used and include intended flight paths for the subject helipad. These selections form part of noise control measures.

A site visit was carried out on the morning of Thursday 24th March 2016. A series of test flights were conducted using an Airbus H125 helicopter (formerly identified as a Eurocopter or Aerospatiale AS 350F helicopter) while monitoring was undertaken at or near various residential locations. The helicopter selected for the testing represents the common class of helicopters that are used in the area for charter work.

Contrary to claims made in some submissions the helicopter type as tested was a Eurocopter/Aerospatiale AS 350F (now identified as an Airbus H125) and not a helicopter type identified as “Firebird 288”. There is no helicopter brand identified as Firebird.

In 2008, The Acoustic Group was retained by Lake Macquarie City Council to review an acoustic assessment that accompanied an application for a Marina/Residential/Tourist Development at Trinity Point and included a proposal for a helipad.

The 2008 review of the acoustic assessment is available on the Council’s website and includes comments concerning a proposal for a helipad.

Prior to undertaking an assessment of this proposal, approval was sought from Council to ensure a conflict would not arise if The Acoustic Group provided advice/assessments for the Johnson Property Group. Council advised that it did not object to The Acoustic Group providing advice to the Johnson Property Group on the Trinity Point Project.

As previously advised to Council (in 2008), the acoustic criteria for helicopter operations has been established by different authorities with confusion often occurring in the public domain about the appropriate limits and responsibilities for compliance. Such confusion as to helicopter criteria was apparent during the exhibition of the preliminary results of the test in May 2016.

Appendix A sets out the location of the proposed helipad and identifies the nominated monitoring locations, helipad locations and flight paths. Locations 1 – 5 were considered appropriate for the testing, but following an initial site inspection with Council, Locations 6 and 7 were added to the program.

Appendix B identifies the proposed order of test flights to address the various combinations of flight tracks and helipads.

Appendix C presents the actual helicopter flight paths that were tested on the day, utilising the two helipad options.

The proponent has advised that as a result of the testing and consideration of the use of the marina, helipad 1 as described in the testing procedure will not be used.

2.0 MEASUREMENT TECHNIQUES

A series of ambient monitoring measurements have been conducted on the site of the Trinity Point Development, in Morisset Point and on the opposite side of Bardens Bay. These measurements were used to set acoustic levels applicable to the entire Trinity Point Development. The measurements were conducted by The Acoustic Group using both attended and unattended measurements (refer to Section 3.0). Council was provided with the ambient measurement results prior to the helicopter testing. Council accepted the ambient measurement results were appropriate for use in the helipad assessment.

Preliminary flight paths were considered, taking into account the prevailing wind and the location of the two nominated helipads. This is because the operational requirement of AirServices Australia anticipates there will be a headwind component onto the helicopter (not a tail wind) and different flight tracks might therefore be required, depending on the wind direction.

A review of the flight paths and the surrounding area indicated a number of monitoring locations that were located around the perimeter of Bardens Bay, which would be needed during the test procedure.

Prior to the testing, a site meeting occurred with Council officers and the pilot, to identify the proposed testing procedure and flight paths.

Council reviewed the proposed locations and flight paths and required two additional locations to be included in the monitoring program.
The procedure for helicopter testing as set out in Australian Standard AS2363 1990 requires the measurement of the various helicopter operations using the A-weighting results obtained using FAST response. SLOW response is used for aircraft measurements under Australian Standard AS2021. The FAST response will automatically give higher maximum levels (than SLOW response) if the acoustic signal contains short term impulsive characteristics.

Appendix A7 identifies the seven attended monitoring locations used during the test flights by way of green circles with three yellow circles identifying the location of unattended logging results used previously.

The helicopter testing utilised a mixture of instruments. A person attended each monitoring location to ensure the security of the sound level meter(s) and record times of the various flight paths and any extraneous noise. All instruments used for monitoring were set up by The Acoustic Group engineers.

SVAN 979 sound level meters were used at locations 3, 4 & 5. The meters were set to record on a continuous basis and to record wave file measurements at the same time.

At locations 1 & 6, measurements were conducted using Bruel & Kjaer 2250 Sound Level Meters providing A-weighted traces and wave file recordings of the measurements.

At locations 2 and 7, measurements were obtained using Bruel & Kjaer 2260 Modular Sound Level Meters with backup by SVAN 957 Sound Level Meters.

All sound level meters are Type 1 meters and suitable for the subject measurements.

The reference calibration level of all meters was checked prior to and after measurements by The Acoustic Group engineers using a Bruel & Kjaer Sound Level Calibrator Type 4230. All meters carry calibration to manufacturers specifications. Certificates for external laboratory testing of the SVAN and B & K 2250 meters are provided in Appendix J.

Observations of the helicopter operations from locations 1 and 6 were required to identify the time at which the helicopter came into the position over the nominated helipad, or on the occasion when the helicopter landed on the Trinity Point site.

3.0 MEASUREMENT RESULTS

3.1 Ambient Noise Levels

Ambient noise levels around Barden's Bay were determined as part of the application for the Trinity Point development and are set out in our acoustic assessment report "Acoustical Criteria, Trinity Point Marina and Mixed Use Development", ref 44.4732.R2 dated 22nd August 2014.

The ambient measurements were conducted using unattended loggers, without any building works occurring on Trinity Point. The 2014 results were consistent with the results from a similar exercise conducted in 2008 by Arup Acoustics.

Council requested a copy of the ambient measurement results prior to the helicopter testing and was satisfied that the 2014 ambient measurement results were suitable for this assessment.

The ambient (logger) measurements when assessed in accordance with the procedures set out in Appendix B of the EPA's *Industrial Noise Policy* were separated into the Rating Background Level, and the ambient LAeq level, for the standard EPA industrial noise time periods of day, evening and night.

Table 1 provides a summary of the logger results from the above report, corresponding to the helicopter monitoring locations.

TABLE 1: Measured Ambient Noise Levels

Location	Noise Descriptor	Time of Day		
		Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)
5	Rating Background Noise Level (dB(A) L_{90})	35	34	33
	Ambient Noise Level dB(A) $L_{eq(Period)}$*	46	42	39
2	Rating Background Noise Level (dB(A) L_{90})	32	32	30
	Ambient Noise Level dB(A) $L_{eq(Period)}$*	49	44	43
1	Rating Background Noise Level (dB(A) L_{90})	37	33	32
	Ambient Noise Level dB(A) $L_{eq(Period)}$*	45	40	42

To place the above results in the context of the ambient measurements, Appendix H provides a copy of the logging data for location 5 previously provided to Council. Location 5 is relevant for the monitoring locations on the eastern side of Barden's Bay.

3.2 Site Conditions

On the morning of the helicopter test, the weather conditions were fine and mild with a light north-westerly wind being identified at the site (10m above ground, utilising an onsite anemometer installed at Council's request) at the beginning of the test. As the testing continued, the wind increased in strength and changed direction so that it was coming from the east north east. This influenced the measurement results when the helicopter was hovering at helipad 2 with a tail wind component, but it was not necessary to adjust any of the results to address this issue (see Section 5.5 of this report).

The operating parameters of the helicopter were:

- Helicopter type Airbus H1254 (formerly identified as a Eurocopter AS350FB2) single engine helicopter.
- Registration number VH ICM
- Landing configuration for the initial landing was three persons on board.
- During test flights two persons were on board - approximately 230 kg with the fuel supply being replenished when transferring passengers to keep the helicopter near 90% maximum weight.
- On site local weather conditions were a temperature of 18 - 25°C during the test with a light wind from the north west of less than 1m/s at the commencement of the testing (10 m elevated wind anemometer). During the test, the wind moved to the north east and then east north east with the wind at the elevated anemometer indicating an average wind of 4 – 5 m/s with gusts of 8 – 10m/s.
- At microphone height on the site, there was a slight wind from the south at the commencement of the testing that swung to the east but did not exceed 5 m/s.

3.3 Test Flight Program

Due to the combination of three designated possible flight paths for each helipad and that each flight path could be flown in different directions, the test program (provided prior to the testing) involved some 64 dedicated movements. This is because Australian Standard AS 2363-1990 requires testing of at least 4 flights per movement, but in this case additional flights were added in case of any extraneous noise.

The test flight program that was distributed to participants prior to testing, including Council, is set out in Appendix B and indicates the testing program commenced with helipad 2, being the location of the helipad that is the subject of the application.

Appendix C provides a diagram of the flight tracks that were used on the day of testing. The actual tracks have been determined from the GPS data of the helicopter after the event.

The first group of flights involved the arrival of the helicopter on flight path 2A, being a direct landing from the south with the take-off in a clockwise direction to the north-east and turning to the south to intercept the southern approach.

After 10 flights using flight path 2A operating in a clockwise direction, the next 10 movements involved flight path 2A operating in an anticlockwise direction.

The next set of test flights involved the northern flight path which is identified as flight path 2B, with the helicopter landing from the north (i.e. heading in a southerly direction) to hover over the helipad then turning around and departing on the reciprocal flight track to the north.

The exercise then involved a landing on the ground to accommodate a test flight with Council officers on board. After bringing the Council officers back to the site, the entire program was repeated for helipad 1.

Because there is no helipad in situ, the test flights used the actual flight profiles that would occur, until the helicopter was over the helipad, where the test helicopter was required to hover elevated above the water. This resulted in the generation of a greater level of noise than would occur if the helicopter had been landing on the actual helipad (see Section 3.4).

Appendix D sets out the actual test flights that occurred on the day. These flights followed the original test plan with tracking between the southern flight path and the northern flight path occurring as an overflight. The Council requested overflights on the day of testing. To be consistent with the original flight plan the overflights are not identified as movement numbers.

The test program involved a significant number of flights, compared to the proposed use. Any subjective observation of frequency of helicopter movements on the test day does not represent the proposed operational context of the helipad.

In terms of helicopter measurements, a take-off and a landing are counted as two separate movements and for an acoustic assessment are not described as a flight. If a helicopter is based at a helipad and takes off and then returns to that helipad, that is described as a flight and contains two movements.

If a helicopter from another site arrives and lands on a helipad and then later departs, then the landing and take-off would be described as two movements.

As part of the helicopter operation, there is usually a start-up or a shutdown operation that, in terms of the acoustic assessment, occurs as part of the movement. For both start up and shutdown the engine must be operating for a period of between 30 and 90 seconds (dependent upon the helicopter) for stabilisation of the engine(s) temperature.

The analysis of the flight profiles that were used during the test program is defined in Appendices A3 to A6 inclusive by way of headings and tracks for the final helipad location (helipad 2).

3.4 Hovering Effects

When a helicopter comes into land on the ground, or in this case a floating pontoon, the helicopter hovers above the termination point where the downward pressure of air from the main rotor is reflected off the ground and supports the helicopter in what may be described as an “air cushion”.

The hover that occurs relatively close to a reflecting plane (land, water o rooftop) is described as a hover in ground effect (HIGE). The downdraft of the rotor blades and reflecting off the ground/water creates an air cushion effect.

The hovering of the helicopter at an elevated height above a reflecting plane (then not subject to the air cushion effect) is described as a hover out of ground effect (HOGE). A helicopter hovering in the air without the benefit of the air cushion requires more engine power to maintain the hover position and in turn gives rise to a higher level of noise emission (than for a hover in ground effect).

The Council officers observed the landing of the helicopter above the proposed helipad for the marina and were made aware of the differences in terms of the two types of hover mode.

The testing involved a HOGE because the pontoon has not yet been constructed. The hover over the proposed location of the helipad (the water) for the test results gives rise to a higher noise level than would occur for the hover over the helipad when in situ (HOGE versus HIGE).

In reality for the proposed pontoon the helicopter will be hovering over the pontoon and will be in the HIGE mode, before landing on the pontoon.

Documentation provided by the US Federal Aviation Administration (FAA) and the US Department of Transport shows the results of extensive testing of six helicopters carried out at Dulles airport in the 1970s (identified as the “Rainbow” test series) to determine the A-weighted and EPLN values for use in the US Federal Aviation Administration’s *Integrated Noise Model* and the development of the *Helicopter Noise Model*.

The FAA Rainbow Series of reports include out of ground effect and in ground effect hovers for various helicopter types.

The FAA/DOT testing included the Aerospatiale AS350D helicopter (*Noise Measurement - Flight Test for Aerospatiale AS 350D Helicopter: Data and Analyses*, Report FAA-EE-84-05 September 1984, US Department of Transportation & Federal Aviation Administration) but did not include the out of ground effect testing results due to limited data.

The FAA/DOT testing used a twin-engine variant of the AS350B described as the AS355F (*Noise Measurement Flight Test for Aerospatiale AS 355F Helicopter: Data/Analyses*, Report FAA-EE-84-04, August 1984, US Department of Transportation & Federal Aviation Administration). The testing revealed that for a distance of 150 m from the test point, there was an average A-weighted difference of 6 dB with the out of ground effect noise being higher than the in ground effect noise, and noise for the ground idle operation being even lower.

Testing of an AS350B at HMAS Albatross for the Australian Department of Defence (carried out by The Acoustic Group) included specifically the HIGE and HOGE and produced a similar result to the FAA/DOT data for the AS355F.

The Australian Department of Defence report for the AS350B helicopter is not in the public domain as it was part of a series of testing for 9 helicopters used by the military. The aim of the testing was to determine Noise Power Distance Curves to permit such helicopters to be included in the Integrated Noise Model, and occupational noise exposure levels for persons on the flight line. The testing of the nine helicopters used by the Australian Defence Forces found the HIGE levels to be about 6 dB lower than the HOGE levels

3.5 Helicopter Noise Analysis

The procedure for analysing the noise of the helicopter is undertaken in accordance with Australian Standard AS2363 – 1990, in view of the use of the recommended noise criteria that does not appear in the 1999 version of AS 2363.

To assess the energy average noise level of the subject helipad, the individual movements/modes of flight are expressed as a sound exposure level. The sound exposure level (SEL) is the total energy average of the noise event or mode when normalised to a time period of one second. The provision of the SEL is required so that equal energy events can be added to determine the resultant helicopter Leq level.

The SEL for each mode of operation for each flight path is the logarithmic average of each relevant SEL for individual flights/modes.

The maximum level of a movement is simply the maximum of the individual movement (landing or take-off), or the hover mode.

The maximum level for each mode of operation for each flight path is the logarithmic average of each relevant individual flights/modes.

Appendix E provides a series of tables that provide the results of the individual flight tests for the various locations, which involved hundreds of calculations to obtain the measurement results for analysis.

AS 2363 (both versions) requires one to undertake an energy (logarithmic) average of the individual movements for each track, which appears as a summary table commencing at Appendix E4. These energy average results are used in the calculation process to derive the A-weighted Leq helicopter contribution for comparison with the assessment against 12 hour criteria in AS 2363-1990 or a 24 hour LAeq level, that in turn can be converted to an ANEF level. Further details about the appropriate acoustic criteria to be applied are set out in Section 4 of this report.

The results in Appendix E cover the test flights for the seven locations. A number of the measurement results for individual flights were masked by extraneous noise.

For the measured test flights there is no separate hover SEL in Appendix E. For the analysis of the Leq, the SEL for take offs and landings includes 15 seconds of the out of ground effect hover, therefore adopting a conservative approach. If the helicopter had been able to land on a pontoon, then the hover (above the pontoon) noise component would be significantly lower than the hover out of ground effect that was observed in the testing over the two helipad locations.

In view of the large number of results, Appendix F sets out graphical results for a number of the test flights. These charts are identified as time splice charts.

The time splice charts show the variation in the A-weighted level over time for the relevant movement that is identified.

In view of the different acoustic criteria that have been used for helicopter assessments (see Section 4), it is necessary to separate the test flights into the different parts of a movement:

- out of ground effect hover
- take off
- landings
- in ground effect hover
- helicopter flat pitch idle
- power up

As discussed below, the upper portions of the time splice charts that are set out in Appendix F have coloured horizontal bars (above the noise level trace) identifying the different parts of the test flights (including onto the ground).

There are hundreds of charts available for the test results. The following discussion is provided to assist in examining the measurement results for the most affected locations.

The upper figure in Appendix F1 shows the measurement results at Location 1 for the first two movements (landing from the south and take off to the south) using flight path 2A in a clockwise direction. The graph shows by, coloured bands in the top of the graph, the relevant components of the test flights.

The lower figure in Appendix F1 provides the results from the same movements recorded at Location 2. Comparison of the test flights for movements 1 & 2 identifies the difference in the noise as a result of the proximity of the helicopter on its fight track to the receiver location.

Test results for movements 1 and 2 at Location 1 (upper time splice in Appendix F1) reveal that the maximum noise level of the helicopter for the landing movement occurs while passing Location 1, before it reaches the helipad location.

The time splice graph shows the build-up of the helicopter noise as the helicopter approaches the site. It shows that the noise has some variations (typical of helicopter operations) with a maximum of around 73 dB(A) occurring at 9:16 AM. This maximum occurs before the helicopter passed the monitoring location and is related to noise from the main rotor. The second peak occurs after passing location 1, which at that point is then subject to noise from the tail rotor and engine of the helicopter.

The noise level in the hover position (being the blue bar) is relatively steady for the required 30 second period (from AS2363) and then slight variations occur as the helicopter positions itself for the take-off.

The take-off operation to the north east then curves around to the south to intersect the southerly flight path. This results in lower noise levels than that on the landing, which is to be expected as the flight tracks to show that the helicopter was further removed from the microphone position (for Location 1).

The lower time splice in Appendix F1 relates to Location 2. The time splice shows the helicopter noise levels at Location 2 are lower than for Location 1.

Appendix F2 provides the time splices for the same two movements recorded at Location 3 and Location 4.

The maximum levels for both locations are higher than the out of grounds effect hover. Examination of the time spice graph for Location 4 shows the higher maximum level for location 4 occurs in the take-off mode, because the flight path has the helicopter closer to the receiver location than for the landing phase.

Appendix F3 provides the time splice graphs for Locations 5 & 6 and shows the same pattern with respect to the maximum levels.

The lower figure in Appendix F3 covers the flight movements 1 & 2 measured from location 6 on the eastern side of Bardens Bay.

That graph shows that the landing from the south produces a maximum noise level slightly before coming into the hover position. That level is less than 70 dB(A). The hover position generates significantly lower levels than that associated with the flight movement.

The noise levels vary as the helicopter is held in the hover position for approximately 30 seconds and then commences a turn to carry out the take off in a clockwise direction to the south which involved the helicopter flying closer to Location 6 than for the landing. The take off for Location 6 produced a maximum noise level in the order of 73 dB(A) and that the sound rapidly drops off as the helicopter moves away from the landing site.

Appendix F4 provides a time splice graph for movements 1 & 2 obtained at Location 7. The vertical hash lines relate to extraneous noise from birds.

The table in Appendix F5 presents a breakup of the movements by reference to the time aligned data from all locations, for the maximum level and the sound exposure level.

Appendix F6 provides the results of movements 11 and 12 for locations 1 & 6 where the helicopter operated in an anticlockwise direction for the southern flight path.

The table provides the data for each movement with and without the hover component.

Appendix F7 provides the time splice graph for movements 21 & 22 at Locations 1 and 6, whilst Appendix F8 present the time splice for the same movements recorded at Location 4.

Movement 33 in Appendix F9 is taken at location 1 for the helicopter coming into land on the actual land, where the termination point was approximately 50 m from the microphone, although the helicopter on landing and take-off was closer than 50 metres due to the oblique angle of the flight track.

Movement 33 involved the helicopter coming in to land, hovering above the ground, then lowering to the ground, followed by the helicopter idling to stabilise the engine temperature before shut down.

The lower time splice graph in Appendix F9 is for movement 34 obtained a Location 1 for the helicopter on start-up and taking off and shows the pattern that occurs is entirely different to that from the measurements recorded for the proposed helipad.

Appendix F10 provides the same two movements measured at location 6 and shows the signature that involves the actual landing on to ground is different to the hover (out of ground effect) above the proposed helipad.

Appendix F11 provides a table of results for the required indices that includes with and without the hover component. The results for movements 11 and 12 over the helipad show the HOGE component makes a negligible/slight difference to the SEL assigned to the landing or take off. For the purpose of evaluating the Leq levels for the airborne components, the conservative approach has been adopted by using the various movements with 15 seconds of out of ground effect hover.

It can be also seen that for the actual helipad the hover will occur in ground effect. On reducing the HOGE to a HIGE by 6 dB, then the hover component over the pontoon will have no impact on the SEL or maximum levels for the airborne results.

Appendix H provides the results of unattended noise logging at Location 5 prior to any building works at Trinity Point, being the basis of the ambient background levels (in accordance with the INP) used for ground component assessment.

Examination of the logger charts for location 5 reveal a variation in the background and ambient LAeq levels throughout the day and reveals the ground borne component is insignificant for that location.

The airborne LAeq levels under maximum capacity worst case scenario are similar to the ambient daytime LAeq level at location 5 shown in the table in Appendix H1 and Table 2. The mix of different flight paths and elimination of the HOGE contribution would realise the helicopter airborne contribution less than the LAeq daytime ambient level in Table 2.

For Location 1 (Trinity Point) the airborne LAeq levels under maximum capacity worst case scenario are slightly greater that the ambient daytime Leq level at location 1 shown in the Table 2. However, the ambient levels at Trinity Point were recorded for a vacant site. With the development of the Trinity Point Development (residential and commercial areas) and the Marina the ambient levels will be greater that obtained for the vacant site.

Appendix I provides the results of attended measurements conducted at the water's edge of Trinity Point in 2014, before any building works on the site, to reveal the variation in ambient noise because of boats on Bardens Bay, birds and fixed wing aircraft overflights. Dependent upon the various noise sources in the area the ambient Leq can, from the measurements shown in Appendix J, be between 3 and 20 dB(A) above the background level.

The ambient measurements provided in Appendices H and I place into context the Leq contribution for the airborne component, under the worst-case scenarios that have been modelled, with the ambient noise that in itself is subject to variations through the day.

4.0 ACOUSTIC CRITERIA

The revised Secretary's Environmental Assessment Requirements (SEARs) for the Trinity Point Morisset Park Helipad requires the noise impact report to consider CASA and EPA guidelines.

The CASA CAAP 92-2 "*Guidelines for the establishment and operation of onshore Helicopter Landing Sites (HLS)*" cited in the SEARs does not provide any acoustic criteria.

There are no current EPA Guidelines specifically for helicopter noise as it has been established the EPA have no authority (noise wise) to control helicopters.

A guideline issued in 1982 by the SPCC (now EPA) and contained in their Environmental Noise Control Manual is redundant (as the Environmental Noise Control Manual has been superseded). The documents replacing the Environmental Noise Control Manual do not specify noise criteria for helicopter operations.

In dealing with an acoustic assessment of helicopters, there is often confusion about the noise criteria that applies to a helipad. This is because different noise criteria have been specified over the years with different interpretations as to what components of helicopter noise are controlled by the EPA or AirServices Australia.

Whilst verbal advice has been provided to The Acoustic Group from the NSW EPA and AirServices Australia that noise from all helicopter operations are the responsibility of AirServices Australia, and are assessed in terms of the ANEF criteria, there is no written advice as to the appropriate acoustic criteria now applied to helicopters.

Matters concerning acoustic criteria raised during the public meeting about the preliminary results of the helicopter testing at Trinity Point, and the following explanation is provided to address this potential confusion. While EPA officers have provided verbal advice as to helicopter noise criteria, the EPA/DECCW has not publicly addressed the changes in helicopter noise assessment procedures.

With the introduction of helicopter operations from television stations in the late 1970s the general acoustic assessment for helicopter operations was conducted using Australian Standard AS 1055 *Noise Assessment in Residential Areas.* After that time various acoustic criteria have been used in NSW for the assessment of helicopters

The Principal of The Acoustic Group has been involved in the measurement, review and assessment of helicopter operations since 1978 and a full CV in relation to helicopter experience is available if required.

The development of various helicopter noise guidelines or Standards used in Australia rely upon the criteria specified for aircraft noise that is set out in Australian Standard AS 2021 Acoustics – Aircraft noise intrusion – Building siting and construction.

AS 2021 utilises a noise exposure system calculated in Australian Noise Exposure Forecast (ANEF) units, that takes into account the following features of aircraft noise:

(a) The intensity, duration, tonal content and spectrum of audible frequencies of the noise of aircraft take offs, approaches to landing, and reverse thrust after landing (for practical reasons, noise generated on the aerodrome from aircraft taxiing and engine running during ground maintenance is not included).

(b) The forecast frequency of aircraft types and movements on the various flight paths, including flight paths used for circuit training.

(c) The average daily distribution of aircraft arrivals and departures in both daytime and night-time (daytime defined as 0700 hours to 1900 hours, and night -time defined as 1900 hours to 0700 hours).

The ANEF was developed in the early 1980's following a major socio-acoustic investigation undertaken by the National Acoustics Laboratories ("NAL") to assess the impact of aircraft noise on residential communities in Australia. The NAL study led to the development of a dose-response curve to identify the response of the community to the ANEF exposure level leading to an acceptable aircraft noise exposure defined in AS 2021 as being less than ANEF 20, and an unacceptable level of aircraft noise exposure above ANEF 25.

The ANEF system utilises the Effective Perceived Noise Level as the measurement parameter of an aircraft flyover. A general approximation between ANEF and dB(A) Leq is a difference of 35 dB.

Australian Standard AS2021 was first published in 1977 (using the American NEF system), then revised in 1985, 1994, 2000 and 2015 using the ANEF system.

4.1 NSW SPCC Helicopter Guideline

In 1982 the NSW State Pollution Control Commission ("SPCC") advised the helicopter industry that, on a noise basis, it legally had control over helicopter operations and introduced noise criteria that covered both operations on the ground and in the air. The SPCC helicopter noise criteria were subsequently set out in a guideline (Chapter 165) contained in the *Environmental Noise Control Manual* ("the EPA Helicopter Noise Guideline").

At that time, the legal position as to responsibility was never placed in the public domain by the SPCC (EPA), despite requests from the helicopter industry for a copy of the "legal position".

In 1982 all helicopter operations were controlled by the SPCC/EPA as helipads were classified as Scheduled Premises under the Noise Control Act. Under the EPA Helicopter Noise Guideline, helipads and heliports were required to satisfy a maximum noise level limit and an energy average noise limit depending upon the time of operation of the helipad.
At the release of the EPA Helicopter Noise Guidelines, the SPCC cited the relationship of ANEF + 35 = Leq dB(A) as previously used (and continued to be used) by the Department of Aviation/Civil Aviation Authority/Air Services Australia.

The EPA Helicopter Noise Guideline were identified as being based upon the aircraft noise acceptability target of 20 ANEF (Australian Noise Exposure Forecast) for a heliport having 50 movements per day, where both the Leq target of 55 dB(A) and the maximum level of 82 dB(A) were mathematically related to the 20 ANEF value.

Due to the mathematical relationship between the maximum level and the Leq level, the consequence of a helipad having a lower number of movements would (for the same Leq level) result in a higher maximum level criterion.

The EPA Helicopter Noise Guideline did not provide the corresponding equivalent maximum level for a helipad with having, for example only 8 movements a day.

Persons experienced with the Leq formula (in the EPA Helicopter Noise Guideline) would be aware the EPA formula is mathematically incorrect. The Leq formulae is a parabola. For high usage helipads the formula provides a point at which the higher the number of helicopters movements, the Leq level would be reduced below the ambient Leq level, which is impossible. Therefore, to be technically correct the Leq must be expressed as a contribution (as confirmed by the Commission of Inquiry into the proposed Sydney CBD Heliport – discussed below), excluding the ambient Leq component in the EPA helicopter Leq formula.

As a result of the heliport criterion set out in the EPA Helicopter Noise Guideline, for helipads in proximity to residential premises the governing limit was the maximum level criterion, not the Leq level.

To the best of our knowledge all Land & Environment Court matters pertaining to helicopter applications (from 1982 up until 1993) were assessed against the EPA Helicopter Noise Guideline.

In 1999 and 2000 the EPA issued the *Environmental Noise Criteria for Road Traffic Noise* and the *Industrial Noise Policy*, which replaced parts of the *Environmental Noise Control Manual*. The EPA confirmed that the *Environmental Noise Control Manual* was not to be used. As noted above there was no replacement for the EPA Helicopter Noise Guideline contained in the *Environmental Noise Control Manual*.

Councils and residents, if relying upon previous Land & Environment Court judgments, would be unaware of the changes to the noise criteria/assessments for helicopter landing sites and may well assume there is a requirement under EPA/DECCW criteria for noise testing/assessment of helicopter flight paths under the EPA Helicopter Noise Guideline – even though the *Environmental Noise Control Manual* was discontinued in 2000.

The EPA has not released a replacement helicopter noise guideline, nor published any technical update or application note about helicopter noise criteria.

The Environmental Noise Control Manual has been superseded and the EPA has not issued any replacement criteria specifically for helicopter noise assessments. The EPA Helicopter Noise Guideline is not therefore applicable to the subject helipad.

4.2 Australian Standard AS 2363

In 1990 Australian Standard AS 2363-1990 *Acoustics – Assessment of noise from helicopter landing sites* was published. The Standard formalised measurement and analysis procedures and excluded ambient noise in the determination of the helicopter noise level to address the technical error in the EPA Helicopter Noise Guideline.

Appendix A of AS 2363-1990 provided acceptability criteria for 12-hour periods. The acceptability criteria were provided by the Civil Aviation Authority (now AirServices Australia) and were based on the ANEF system used for the assessment of aircraft noise in Australia (established under AS2021).

The Standard defined the method of energy averaging the results of the individual flight path movements. The Standard nominated the use of FAST response for helicopter measurements (instead of SLOW response used for the ANEF procedures) to account for the subjective characteristics of helicopter noise.

Joint testing of helicopter operations undertaken by the Principal of The Acoustic Group and the EPA (for the Standards committee) identified a significant difference between the FAST and SLOW response could occur in varying wind conditions for various flight modes. The joint testing also confirmed issues with the SPCC/EPA calculation set out in Chapter 212 of the EPA's Environmental Noise Control Manual.

The ANEF system is based upon aircraft movements over 24 hours for an average day. For ANEF 20 (the threshold of acceptability for aircraft noise exposure) the equivalent Leq level has been taken as 55 dB(A) Leq. The ANEF formulae has a different weighting for the night time period when one aircraft movement at night is taken calculated as equivalent to four daytime movements.

The majority of helipads operate in daylight hours. As a result of normal operations AirServices Australia proposed for the helicopter standard AS2363 different Leq limits in the day versus the night for residential receivers.

Appendix A of the Standard AS 2363-1990 noted that, while acceptability criteria were recommended, the provision of actual noise limits was the responsibility of the relevant statutory authority.

Table A1 of the Standard AS2363-1990 is reproduced below.

RECOMMENDED ACCEPTABLILITYCRITERIA FOR 12-HOUR PERIODS

Usage of premises and zoning	L_{Aeq},T (Hel)		L_{Amax} (Hel) (see Note 3)	
	Daytime	Nightime	Daytime	Nightime
Residential and hospital areas	60 (see Note 2)	50 (see Note 2)	85	80
Commercial areas	65	65	95	90
Other areas (churches, schools, theatres, etc.)	60	60	90	90

NOTES:

1. This Standard makes no recommendation on limits in industrial areas
2. For these area classifications, $L_{Aeq,T}$ (Amb) + 10 dB(A) can be used instead of $L_{Aeq,T}$ (Hel) if the former is lower
3. Special consideration may be given to the operation of aerial ambulances. For this reason, $L_{Aeq,T}$ (Hel) either night or day, must be satisfied, but L_{Amax} (Hel) is not specified for aerial ambulances.
4. In the absence of further information, daytime is understood to be between 0700 hours and 1900 hours and nightime between 1900 hours and 0700 hours.
5. If the existing ambient level exceeds the L_{Aeq} level specified in the table, the introduction of helicopter operations should not raise the level by more than 2 dB(A).

The ANEF index is just aircraft noise and does not include ambient in the formula or consider the aircraft noise relative to the ambient noise level.

Note 2 to the above table was introduced into the Standard by the NSW EPA to account for the use of a 60 dB(A)/50 dB(A) Leq limit for residential locations in quiet areas could create an unacceptable impact.

The use of ambient Leq + 10 dB(A) would in quiet areas provide a lower Leq limit than the base limit set out in Table A1 of AS2363-1990 and is appropriate in quiet areas.

In 1999 the second version of AS2363 was issued. It incorporated minor amendments to the assessment procedure and excluded the recommended acceptability levels in Appendix A.

Section 6 of the second version (1999) of Standard AS 2363 required the assessment to be compared with criteria set by the relevant statutory authority.

In the absence of EPA noise criteria to replace the EPA Helicopter Noise Guideline, the most relevant criteria are the AirServices Australia 20 ANEF criteria (equivalent to an Leq, 24 hr 55 dB(A)), derived from AS2021.

Although the criteria in Table A1 of 2363-1990 are no longer current, the table can be used to supplement an analysis against the ANEF 20 criteria and to confirm the acceptability of noise impacts. In particular, the criteria can be used to identify the relevant target criteria in quieter areas.

4.3 Commission of Inquiry into Sydney CBD Heliport at Pyrmont Pier 8

The EIS for the Sydney CBD Heliport evaluated the proposed operations in terms of the EPA Helicopter Noise Guideline (with corrections) and AS2636-1990.

Following exhibition of the Sydney Heliport EIS and recommendation for approval, a Commission of Inquiry was held into the proposed Pier 8 Heliport.

A submission from the NSW Department of Transport (to the Commission of Inquiry) contained in Appendix C, the following brief statement from the Civil Aviation Authority (Acting General Manager, R & D and ICAO Division):

> *The CAA is represented on the Standards Australia committee AV/11 Acoustics – aircraft and helicopter noise, and supports the use of Australian Standard AS 2363-199*0.

Objector submissions about the heliport cited the use of the EPA Helicopter Noise Guideline.

In the Report from the Commission of Inquiry (1993) into the Sydney CBD Heliport, the Commissioner (with the technical assistance of an acoustical engineer Mr. D. Craig) was critical of the SPCC guideline (because of the problem with the formula described above) and applied an assessment criterion for residential receivers based on a helicopter contribution (in the air) of 20 ANEF (referenced back to the Australian Standard for aircraft noise AS2021). The report from the Commission of Inquiry adopted the general conversion of ANEF + 35 = LAeq 55 dB.

The benefit of the Commission of Inquiry report is an acknowledgment by the EPA that the EPA Helicopter Noise Guideline contained errors, the ANEF was the appropriate noise target, and that AirServices Australia endorsed the use of ANEF 20 (or equivalent in LAeq) for helicopters.

4.4 EPA 2004 Advice

In 2004, the EPA provided verbal advice to The Acoustic Group that it had received further legal opinion confirming the EPA did not have authority to control noise from helicopters, except when the helicopter was on the ground.

The 2004 verbal advice came as a result of completion of an annual acoustic compliance test required for a helipad at Australia's Wonderland (near Blacktown). The compliance testing was conducted in accordance with the conditions M8.2, L6.1 and L6.2 on EPA Environment Protection Licence 11509. Subsequent verbal advice from the EPA was that the Licence had been changed to only require noise assessment for operation of the helicopter on the ground. We conducted the compliance test and were advised by Australia's Wonderland that no notification of the change in compliance testing requirements had been provided to Australia's Wonderland.

The EPA advised The Acoustic Group in 2004 that only the noise component of the helicopter whilst on the ground was to be assessed in accordance with the EPA's *Industrial Noise Policy ("INP").* The EPA advised that the moment the helicopter skids (or wheels) are off the ground then the noise generated by the helicopter falls under the control of AirServices Australia.

The INP presents two acoustic criteria, the intrusive noise target and the amenity noise target.

The "intrusive noise target" which assesses noise from the helicopter as an Leq level over a 15-minute period at any residential boundary, or for large properties at the residential boundary or 30 m envelope from the residence, whichever is closer to that residence.

The amenity noise target is the cumulative ground noise component measured/assessed over the entire daytime period of 7AM to 6PM, the evening period of 6PM to 10PM, and the night time period of 10PM to 7AM.

For the ground component of a helipad the intrusive noise target would be the target of concern.

In 2005, the EPA confirmed its advice about assessing the ground component only. This was one of the requirements of the Department of Environment and Conservation (DEC) for a proposal at Capertee to operate helicopter joy flights over the Capertee Valley.

An acoustic assessment report for the Capertee helipad was prepared by PKA Acoustic Consulting (ref 205 042 R01, dated March 2005). Page 4 sets out the following as one of the DEC requirements:

Noise Assessment for Ground Operations at Aircraft (Helicopter) Facilities

The assessment is for ground operations only. Air Services Australia should be consulted for airborne operational noise requirements. The assessment comprises three components, each of which should be assessed for relevant residential receivers.

- *The measured or predicted L_{Aeq}, 15min from typical worst-case ground operation shall be assessed against criteria derived from the Rating Background Noise Level (RBL) at relevant receiver locations plus 5 dB(A).*

  Notes: RBL is defined in the NSW Government Industrial Noise Policy, Ground operations include the activities outlined in the Protection of the Environment Operations Act 1997, Schedule 1 definition of Aircraft (Helicopter) Facilities. DEC notes that typical worst case ground operations may include engine start-up, warmup, takeoff and landing operations for short duration flights.
- *The measured or predicted L_{Aeq}, period (considering the operating period of the helipad) from ground operation shall be assessed against the acceptable noise levels in Table 2.1 of the NSW Government Industrial Noise Policy at relevant receiver locations. The assessment periods are those defined for day, evening and night (as relevant to the proposed operating hours of operation of the facility) within the NSW Government Industrial Noise Policy. Where operations are proposed for only part of an assessment period, the period of actual operation shall be assessed against the acceptable noise level for the period.*

- *Where exceedance of either component of the assessment criteria is noted, an assessment of feasible and reasonable mitigation options shall be presented.*

The acoustic report from PKA Acoustic Consulting for the Capertee heliport did not provide a copy of the DEC (EPA) correspondence.

The report of Lithgow Council's Group Manager Regional Services for DA 319/06 about the operation of the heliport at Capertee is dated 4 June 2007. An extract of the report is provided in Appendix G. Page 17 of the extract identifies it was a requirement of the development application for the assessment consist of noise emissions resulting from all ground operations of a helicopter operating at the site.

Page 24 of the Officer's report under heading of "Department of Environment and Conservation (Environmental Protection Unit)" states:

> *The General Terms of approval issued by the DEC are attached as part of Schedule 1 of the recommendations.*
>
> *In their correspondence the DEC indicated that in assessing the proposal and reviewing the public submissions, as with the first Development Application (DA 22–05) the EPA again identify the potential impact of noise on the amenity of residents of the Capertee Valley and the surrounding areas as an important issue. Lithgow City Council should consider the issue in its overall assessment of the application. The noise from helicopters in flight is outside the control of the EPA; nevertheless, it is apparent from the public submissions the noise from helicopters in the air is the overwhelming impact of concern for people who made submissions objecting to the proposed development.*

Appendix G includes a copy of Schedule 1 referred to in the officer's report. In condition L6.1 there are noise limits specified by the DEC, being the intrusive noise target of background +5 dB(A) and the amenity noise target derived from the EPA's INP document for three residential receivers.

Condition L6.1 does not specify that the noise limits are restricted to ground operations. Condition L6.6 (still being part of the noise limits), however, clearly refers to ground operations.

Condition L6.6 identifies the requirement for a noise management plan that addresses noise impacts from the heliport ground operations.

The officer's report and the DEC (EPA) conditions provided in Appendix G indicate that the Council and the EPA accepted:

- The EPA did not have control over noise from the helicopter when airborne, and
- It was appropriate to apply the INP for on ground noise.

The Capertee heliport proposal subsequently came before the Land & Environment Court in *Mark Lilley – v- Council for the City of Lithgow* (Proceeding No. 10390 of 2007). The Acoustic Group were retained by the Applicant in those proceedings.

Ground noise from the helicopter operations was not an issue in that case by reason of compliance with the DEC's General Terms of Approval. The acoustic issue before the Senior Commissioner related to the airborne noise component.

4.5 Environment Principles and Procedures for Minimising the Impact of Aircraft Noise

The Acoustic Group raised the issue of the OEH/DECC/DECCW/EPA noise criteria for helicopter noise when it acted for the Applicant in *Mark Lilley – v- Council for the City of Lithgow*.

As a result of the EPA's advice that it was not concerned with noise from the helicopter when airborne, The Acoustic Group presented the following position to the Court:

- AS 2363-1999 did not recommended acoustic criteria (compared to the 1990 version),
- The NSW EPA did not have any airborne noise criteria,
- AirServices used the ANEF system for assessment of aircraft noise, and
- AirServices Australia had issued a planning document "*Environmental Principles and Procedures for Minimising the Impact of Aircraft Noise*" ("ASA Environmental Principles"),
- The proposed helicopter joy flights would occur over the Capertee National Park, being locations removed from the main highway.

In the Lilley matter the proposal was to provide a helipad at Capertee that was for the specific purpose of providing scenic flights over the Capertee National Park. At the time of the proposal there were no such operations.

There is a total of 12 Principles provided in the ASA Environmental Principles for the design of flight paths and operational procedures that may be adopted to minimise noise.

Part A of the document provides a summary of the Principles as follows:

FUNDAMENTAL PRINCIPLES

The following fundamental principles are to be used in environmental assessments (of proposals for new air routes and for changes to existing arrangements) and as a basis for selecting preferred noise abatement procedures.

Total Noise Dose

Principle 1: Noise abatement procedures should be optimised to achieve the lowest possible overall impact on the community.

Spatial Distribution of the Noise Dose

Principle 2: Noise should be concentrated as much as possible over non-residential areas.

Principle 3: Noise exposure should be fairly shared wherever possible.

Principle 4: No suburb, group or individual can demand or expect to be exempt from aircraft noise exposure.

Upper and Lower Limits of Noise Exposure

Principle 5: Noise is not considered significant when selecting noise preferred options if exposure amounts to less than 40 $LAeq_{24}$ and there are less than 50 overflights per day.

Principle 6: No residential area should receive more than 60 $L_{Aeq\ 24}$, i.e., no residential area should receive more noise exposure than that which is considered "unacceptable" for residential housing under Australian Standard AS 2021.

Principle 7: There should be a current agreed aircraft noise exposure level above which no person should be exposed, and agreement that this level should be progressively reduced. The goal should be 95 dB(A).

Timing/ Historical Issues

Principle 8: When comparing options, operations that are conducted at night or on weekends should be treated as being more sensitive than those which occur during the daytime or on weekdays.

Principle 9: Both short-term and long-term noise exposure should be taken into account in deciding between options.

Principle 10: Options which allow for a gradual change from the current plan procedures should be given preference.

Principle 11: In deciding between mutually exclusive, but otherwise equivalent options, involving

(i) the overflight of an area which has previously been exposed to aircraft noise for a considerable period of time (and which a large proportion of residents would therefore have been aware of the noise before moving in); or

(ii) a newly exposed area,

option (i) should be chosen.

Reciprocal Flight Paths

Principle 12: To the extent practicable, residential areas overflown by aircraft arriving on a particular runway should not also be overflown by aircraft departing from the runway in the reciprocal direction.

In the Lilley matter it was agreed between the acoustic experts that airborne helicopter operations giving rise to a contribution not exceeding 40 dB(A) would, for quiet areas in a National Park removed from the highway, not generate a significant disturbance. In the Lilley decision the Senior Commissioner chose a 40 dB(A) $L_{eq,\ 24\ hr}$ criterion to apply for the National Park (Principle 5). It is noted that the ambient Leq levels in the Park were taken to be 30 dB(A) and that the 40 dB(A) criteria applied by the Senior Commissioner conforms to Note 2 in Table A1 of AS2363-1990 (ambient levels plus 10dB(A)).

However, the ambient Leq noise levels in proximity to the subject helipad are not less than 30 dB(A). The acoustic environment of Bardens Bay cannot be equated to Capertee National Park. For this reason alone, Principle 5 of the ASA Environmental Principles is not relevant to and should not be applied in the assessment of the subject helipad.

Further, it is noted that the ASA Environmental Principles could not be found on the AirServices Australia website and there is no indication on the website about the current status of that document. The Acoustic Group has now been advised by AirServices Australia that the ASA Environmental Principles are no longer used by AirServices Australia. For helicopter noise the AirServices Australia website refers to fly neighbourly agreements and not any specific acoustic criteria.

In any event, the assessment and design of the subject helipad complies with Principles 1, 2, 3 and 4 of the ASA Environmental Principles. Principle 5 is expressed as a threshold level, under which noise levels will be deemed not to be significant (provided there are less than 50 movements a day). It does not specify an acceptability target (as per Principle 6). In that sense, it is only relevant where noise levels are less than the 40 $LAeq_{24}$ and where levels are higher than that, a proper assessment of impact would need to be undertaken to determine whether the noise impacts will be acceptable. In this case, Principle 5 is not relevant, but the criteria in Principles 6 and 7 should be considered. Section 5.3 of this report address the compliance of the proposal with the ASA Environmental Principles.

The result of the testing has led to the application having less than 50 overflights per day (Principle 5), and less than the acoustic criteria set out in Principle 5 & 6. These concepts automatically occur from the application of Part C of the ASA Environmental Principles that governs helicopter operations and identifies procedures to be adopted where possible.

For the subject helipad, the proposed flight tracks to the south do not overfly residential areas (procedure 1) below cruise altitude of 1000ft that is permitted by air navigation procedures over the subject area (Part C of the ASA Environmental Principles).

The northerly flight path does overfly residential properties at the northern end of Bardens Bay when in the landing phase. The application nominated a maximum of 8 movements per day if all flights on a day utilised approaches from the north.

The flight tracks that have been nominated for the helipad do not involve circling over residential areas, adopt fly neighbourly procedures, and the use of the nominated flight paths is specified in the management of the operation of the helipad (Part C of the ASA Environmental Principles).

In light of the advice from AirServices Australia that the ASA Environmental Principles are no longer used and in the absence of written clarification as to whether the Principles still apply, The Acoustic Group considers that the most relevant criterion is the ANEF 20. Other current documentation provided by AirServices Australia provides that helicopter operations whilst in the air operate under the Aircraft Noise Exposure system (ANEF- Aircraft Noise Exposure Forecast) which predicts noise levels over a one-year average.

4.6 Current EPA Criteria

Under the *Protection of the Environment Operations Act ("POEO Act")* helicopter-related activities are declared to be Premises-based activities that are identified as "Scheduled Premises".

In Schedule 1 of the POEO Act "helicopters-related activities" are defined as:

> *meaning the landing, taking off or parking of helicopters (including the use of terminals and the use of buildings for the parking, servicing or maintenance of helicopters), being an activity:*
>
> *(a) that has an intended use of more than 30 flight movements per week (where take-off and landing are separate flight movements), and*
>
> *(b) that is conducted within 1 kilometre of a dwelling not associated with the landing, taking-off or parking of helicopters,*
>
> *but not including an activity that is carried out exclusively for the purposes of emergency aeromedical evacuation, retrieval or rescue.*

Schedule 1 does not define what constitutes "landing", "taking off" or "parking" of a helicopter. Hovering is part of the landing and take-off procedure, whilst parking can involve flying the helicopter (in a hover) to a particular parking spot. The operation of a helicopter whilst on the ground prior to or after a flight is not defined in the Schedule.

Chapter 1 of the EPA's *Noise Guide for Local Government* provides a table identifying the responsibility for different types of noise sources that may occur in New South Wales (separately from aircraft operations that may occur on Commonwealth airports). The *Noise Guide for Local Government* states on page 1.18 that for "helicopter premises not covered by the POEO Act Schedule 1 - e.g. aircraft on the ground undergoing excessively noisy engine maintenance" the responsibility for noise from the ground component of helicopters lies with the Council (being the Appropriate Regulatory Authority under the POEO Act). The EPA is the Appropriate Regulatory Authority for such activities covered by the POEO Act Schedule.

We are instructed there will be no engine maintenance or servicing carried out at Trinity Point Marina helipad.

Page 1.18 of the EPA's *Noise Guide for Local Government* under the "Comments" column for all helicopter premises (covered by the POEO Act or otherwise) states:

> *Air Services Australia is responsible for noise from aircraft in flight and aircraft movements (taxiing, taking off and landing). The POEO Act provisions cannot be applied to these activities. This includes conditions specifying, for example:*
>
> - *noise limits that apply to aircraft in flight and aircraft movements*
> - *permitted hours for movements, permitted number of movements*
> - *(except in limited circumstances) permitted aircraft models – e.g. models certified to meet a certain noise level in certain specified test conditions.*

Excluding the above operations that are governed by AirServices Australia, the only helicopter noise component that could fall under the responsibility of Council or the EPA relates to the period of time when the helicopter is stationary on the ground at the final shutdown/start up location. Arguably, the Council or the EPA may not be responsible for that startup / shutdown noise either, because it forms part of the flight movement. Under operational procedures, the starting of the engine of a helicopter in aviation terms becomes part of the flight, as does the time until the engine is shut down, i.e. the pilot in logging their hours total the engine operating hours in their log book.

If that is the case, the Council and the EPA would only have responsibility for noise impacts from engine maintenance or other ground activities ancillary to the helicopter flights, but not helicopter engines. The *Noise Guide for Local Government* indicates that the Industrial Noise Policy will be relevant to an assessment of those impacts. This position is consistent with the most recent verbal advice received by The Acoustic Group from the EPA.

As noted above in *Mark Lilley – v- Council for the City of Lithgow* the (then) DECC confirmed (for the preparation of the acoustic report to accompany the DA) that the ENCM guideline for helicopters did not apply. The DECC specified for the helipad application the standard *intrusive noise* criteria from their *Industrial Noise Policy* document.

Consequently, it would appear that for helicopter operations when on the helipad the relevant criteria are the intrusive goal (for individual movements), and the amenity goal (for the total number of movements in a day whilst on the helipad), derived from the *Industrial Noise Policy*.

However, in 2015 The Acoustic Group sought to resolve some ambiguity about the Schedule to the POEO Act concerning emergency helicopter operations when dealing with an application for the proposed Westpac Rescue Helicopter Operations at Lake Macquarie airport. We were advised by the EPA that it had received further (unpublished) “legal opinion” confirming that if a helicopter was on the ground and had the engine running that was part of the flight component and as such fell under the control of AirServices Australia.

If this is the case, then the INP noise criteria will not apply to on-ground helicopter noise. The noise criteria applying to airborne noise (ANEF 20 based on AS2021 or other as determined by authorities) should then be applied to the helicopter noise from the time the engine starts or shuts down relative to the movement(s) in question.

Consistent with the most recent verbal advice received from the EPA, this assessment proceeds on the basis that noise from helicopters whilst in the air or on the ground is not controlled by the EPA or Council. Any noise emission from helicopters idling or powering up whilst on the ground is part of the airborne component and therefore falls under the control of AirServices Australia.

Based on its significant experience with helicopter and aircraft noise assessments, knowledge of the various criteria that have been applied in the past, and its understanding of aviation operational procedures, The Acoustic Group considers that it is appropriate to follow the EPA's most recent verbal advice. That is, The Acoustic Group agrees that the relevant criteria for the assessment of helicopter noise including any on ground component is ANEF 20 and the *Industrial Noise Policy* does not apply to helicopter engine noise, even when it is on the ground.

After further consultation with the Department concerning the subject proposal it has been suggested that whilst the ASA Environmental Principles are no longer used by AirServices Australia they should be a reference document for assessment purposes and supplemented by the HAI Fly Neighborly Guide, cited by AirServices Australia as a noise abatement concept.

4.7 Orange East Heliport

In the intervening period between the issue of the acoustic assessment report for the proposed helipad at the Trinity Point Development and this amended report the Chief Judge of the Land & Environment Court of NSW has issued a Judgment in relation to the helipad at the Highland Heritage Estate becoming the Orange East Heliport with the capacity for a greater number of movements than nominated for the Trinity Point Development.

The Judgment from the Chief Judge as Nessdee Pty Limited v Orange City Council [2017] NSWLEC 158 addresses the acoustic issues/criteria commencing at paragraph 19 of the Judgment. The judgment confirms the use of ANEF 20 with the nominal conversion of 35 to an LAeq over a 24 hour period was accepted by the tow acoustic experts in that matter.

It is noted that the assessment for the Orange East Heliport followed the same procedure as set out in the original and this amended acoustic report, with the testing being witnessed by Council officers and an acoustic expert retained by the Council.

The analysis and calculations relating to the helicopter testing was view by both experts. Whilst all the test flights were recorded simultaneously at multiple locations by The Acoustic Group, both experts attended each of the monitoring locations during the tests and jointly conducted their own supplementary monitoring.

The monitoring assessed multiple flight paths and the various permutations in the use of those paths, dependent upon the wind direction and strength.

The acoustic assessment report and the joint reports of the acoustic experts identified limitations in flight numbers/paths/helicopters in a similar manner as set out in this report.

In relation to acoustic criteria that were assessed in the original acoustic assessment for the helipad at the Trinity Point Development, some of those criteria would in terms of the Chief judge's decision in the Orange East Heliport matter be redundant. However, for consistency with the previous version of this report that material is still provided.

4.8 Noise Criteria for Helicopters

ASA Environmental Principles

Under the suggestion that reference should be made to the ASA document *Environmental Principles and Procedures for Minimising the Impact of Aircraft Noise* (which was referred to by the Court in the Lilley matter), whilst the design has already addressed Principles 1, 2, 3 and 4, then for acoustic purposes Principles 6 and 7 would apply:

Principle 6: *No residential area should receive more than 60 LAeq $_{24}$, i.e., no residential area should receive more noise exposure than that which is considered "unacceptable" for residential housing under Australian Standard AS 2021.*

Principle 7: *There should be a current agreed aircraft noise exposure level above which no person should be exposed, and agreement that this level should be progressively reduced. The goal should be 95 dB(A).*

Principle 6 provided the direct link to the ANEF system under AS2021 and confirmation of a 35 dB(A) adjustment. The unacceptable limit for residential receivers in AS2021 is ANEF 25, giving rise to ANEF 25 + 35 = LAeq $_{24}$ value of 60dB.

AS2021 provided the upper limit of acceptable aircraft noise at ANEF 20. Therefore, ANEF 20 + 35 = LAeq $_{24}$ value of 55dB.

Given the relevance of AS2021 the following criteria from the ASA Environmental Principles document should apply:

> *Noise emission from the helicopter when taking off or landing, and including operations whilst on the helipad arising from the start up, idle, power up and (in reverse) until shutdown are not to exceed an unacceptable level of aircraft noise impact of 60 dB LAeq$_{24}$, and in the circumstances of the acoustic environment of Bardens Bay, should have a noise objective of less the 55 dB LAeq$_{24}$.*

Reference to the HAI Fly Neigborly Guide provides planning and operational concepts for helicopter operations but no noise criteria. The guide was prepared by the Fly Neighbourly Committee of the Helicopter Association International (with technical assistance of the HAI Acoustics Committee).

In the absence of any specific direction as to noise criteria applicable to the airborne component of the subject helipad, under the due diligence requirement for the project The Acoustic Group are of the opinion there are a number of criteria that have been used in the past and should be identified.

EPA Criteria

There are no longer any EPA criteria for the airborne or ground components of helicopter operations.

Acceptability Criteria (AS 2363-1990)

Australian Standard AS2363 *Acoustics – Measurement of noise from helicopter operations* sets out the methodology for the measurements and analysis of helicopter noise. Whereas the 1990 version of the Standard included noise criteria, the 1999 version of the Standard does not. If the subject helipad is assessed in accordance with AS2363-1990, then from AS2363-1990 the following criteria would apply:

> *Noise emission from the helicopter when taking off or landing, and including operations whilst on the helipad arising from the start up, idle, power up and (in reverse) until shutdown are to comply with the 12 hour Leq levels and corresponding maximum levels identified in Table A1 (including note 2) and assessed in accordance with the procedures set out in AS2363-1990.*

Table A1 of AS2363-1990 provides residential Leq targets of 60 dB(A) and 50 dB(A) over the 12 hour periods of 7AM - 7 PM, and 7PM and 7AM respectively.

Note 2 to Table A1 in AS2363 provides that for residential dwellings in low ambient areas $L_{Aeq,T\ (Amb)}$ + 10 dB(A) can be used instead of $L_{Aeq,T\ (Hel)}$, if the $L_{Aeq,T\ (Amb)}$ + 10 dB(A) is lower that the $L_{Aeq,T\ (Hel)}$ criterion.

From Table 1 (on page 6 of this report) the daytime ambient Leq levels are less than 50 dB(A), whilst the evening ambient Leq levels are over 40 dB(A). The ambient Leq + 10 dB criterion (Note 2 to Table A1 of AS2363-1990) applies for the day, but not for the period of 7 PM to 10 PM).

The existing ambient Leq levels are below the targets provided in AS 2363-1990. Therefore, Note 5 to Table A1 of AS2363-1990 does not apply.

Based on Note 2 to Table A1 of AS2363-1990, the following helicopter noise contribution targets have been allocated for the subject helipad (for the purposes of assessing compliance with the 12 hour Leq levels under AS2363-1990).

For the monitoring locations used in the study the results of the three logger locations have been assigned to the other monitoring locations as shown in Table 2.

TABLE 2: AS2363-1990 Helicopter Noise Targets

Logger/Residential Locations	L_{Aeq},T (Hel)		L_{Amax} (Hel) (see Note 3)	
	Daytime	Nightime	Daytime	Nightime
1, 7	55	50	85	80
2	59	50	85	80
3,4,5, 6	56	50	85	80

ANEF 20 (AS 2021)

AirServices Australia have provided verbal advice to the Acoustic Group that the ANEF is the acoustic index to be used for assessment purposes. Page 17 outlined the basis of the ANEF parameter.

The ANEF is a noise contribution and does not include ambient noise in the assessment process. There is no allowance or consideration of the ANEF value relative to the ambient noise.
The Acoustic Group consider that in assessing the noise impact of helicopter operations that the approach from AS2363-1990 dealing with the low noise acoustic environments should also be applied to the subject application, with consideration also given to ASA Principles 6 & 7.

In dealing with the ANEF 20 criteria, identified by AirServices Australia as their current noise targets, from the previous discussion the following airborne noise criteria is proposed for the subject helipad:

> *Noise emission from the helicopter when taking off or landing, and including operations whilst on the helipad arising from the start up, idle, power up and (in reverse) until shutdown are to comply with an ANEF 20/$L_{(Aeq,24hr)}$ 55 dB(A) when assessed in accordance with the procedures set out in AS2363-1990.*

AS2363 requires measurements recorded using the A-weighted parameter not the Effective Perceived Noise Level (EPNL). The AirServices Australia correction of +35 dB to the ANEF is required to determine the ANEF from the calculated LAeq results.

Conclusion

As a result of the above analysis of the most appropriate criteria for the acoustical assessment should be in terms of the AirServices Australia ANEF 20 criterion ($LAeq_{24}$ 55 dB). This agrees with the Orange East Heliport Judgment.

In addition, as a precautionary measure the helicopter operation can be assessed against the criteria set out in AS2363-1990and ASA Environmental Procedures. This, in our view, results in a more conservative and very comprehensive assessment of the potential noise impacts.

5.0 ACOUSTIC ASSESSMENT

Australian Standard AS2363 defines the various components of helicopter operations for assessment purposes, the method of measurement, and analysis procedures to be adopted.

The Leq acoustic assessment for the airborne component (with or without a ground component) requires separating the various flight modes for each test and analysis of each mode.

The procedure is to extract the relevant time signature applicable to each of the different operations and derive the sound exposure level (SEL). The SEL is the equivalent energy noise level of the event in question if all that sound was to occur in a one second period.

Depending upon which acoustic criteria are used, the assessment involves different mathematical analyses.

With the SEL value (an Leq equivalent for one second) the calculation of the resultant Leq for either the 24-hour contribution under AS 2021/AirServices Australia criteria or the 12 hour Leq criteria is determined.

The methodology of testing (from AS2363) normally has the helicopter on the helipad at flat pitch idle (minimum power) for at least 30 seconds between the landing and a take-off, to allow the landing component to be separated from the take-off component.

As there was no pontoon on the water the helicopter conducted an out of ground effect hover above the proposed helipad locations, where a stationary hover for 30 seconds was requested (after a landing), before orientating the helicopter for the take-off procedure.

Reliance on the timing of the movements was obtained from observations at locations 1 & 6, and logging of times obtained by a person in the helicopter recording such information.

Normalisation of the timing for the individual meters versus the observers at each location was required before analysis using the Bruel and Kjaer Evaluator program, Bruel & Kjaer Reflex Program, or Excel spreadsheets of the SVAN logger file, for extraction of the different flight movement data.

From the individual movement results set out in Appendices E1-E3, the logarithmic (energy) average of the individual landing profiles is used to determine a mean SEL (Appendices E4 & E5) from which the resultant Leq calculations may be derived.

The maximum level of each flight mode for each event is also determined and the logarithmic (energy) average for each flight path/mode is derived.

The number of flights is expected to vary from day to day. On some days there may be no flights. A maximum number of 8 helicopter movements a day has been specified for the subject helipad, and a maximum number of 38 helicopter movements a week.

To address the operational aircraft aviation requirement (by AirServices Australia), to consider different wind directions there have been three flight paths identified for helipad 2.

To provide an insight into the potential noise from such helicopter operations we have assumed a mix of operations on the three flight paths that were used in the testing, on the basis of equal distributions to derive the following scenarios:

- **Scenario 1** – 4 landings using flight path 2a (clockwise) + 4 take offs flight path 2a (clockwise)
- **Scenario 2** – 4 landings using flight path 2a (anticlockwise) + 4 take offs flight path 2a (anticlockwise)
- **Scenario 3** – 4 landings using flight path 2a (clockwise) + 4 take offs flight path 2b to north
- **Scenario 4** – 4 landings using flight path 2b + 4 take offs flight path 2a anticlockwise

The aviation consultant has indicated that whilst scenario 3 is operationally acceptable, in practice the majority of the flights are expected to be to the south and scenario 1 is likely to prevail. However, the procedures in AS2362 require consideration of all flight path scenarios.

As a result of our analysis of the various criteria for the airborne component discussed in the previous section, we are of the opinion the assessment should be in terms of the AirServices Australia ANEF 20 criteria. From the ANEF one can convert to the LAeq24 limit from the ASA Environmental Principles document, for assessment against that document.

Additionally, as a precautionary measure the helicopter operation has also been assessed against the criteria set out in AS2363-1990.

5.1 ANEF (24 hour) Analysis and Consideration of ASA Environmental Principles

In dealing with the ANEF noise target the correct procedure is to utilise the Effective Perceived Noise Level for determining the ANEF value. However, that process involves extensive analysis of the noise data.

The ANEF level is the aircraft noise contribution and does not include ambient noise. The ANEF level is a stand-alone index and is not related to any increment above the ambient background noise. The ANEF does not consider the maximum level.

The ANEF is the aircraft noise contribution as an average day over all operations in a year.

The ANEF is based on the average distribution of flight paths and is not restricted to a single flight path.

The annual average distribution across the three flight paths is unknown at this point in time. For this analysis we have considered a worst-case situation of having all flights applied to each of the four scenarios noted above. Such a situation would never occur and therefore the true ANEF level would be lower than that shown in the nominated scenarios.

AirServices Australia have utilised for the Sydney Airport EIS and the Third Runway assessment report the concept of +35 dB(A) being the difference between the ANEF and the Leq 24-hour value. It is on this basis that 20 ANEF is equivalent to 55 Leq dB(A). This is consistent with the concept provided by the EPA in their original helicopter guidelines, when the ambient noise is excluded from the calculation.

For the above four scenarios the following ANEF contributions have been determined on the basis of all helicopter movements occurring between 8 AM and 7 PM:

TABLE 3: Helicopter Noise Contributions (ANEF) - Daytime flights only

Scenario	Location						
	1	2	3	4	5	6	7
1	10.9	1.7	-3.1	-2.4	8.7	6.4	-5.3
2	9.5	-1.5	-5.2	-3.6	9.7	5.2	-7.8
3	10.5	3.7	7.3	8.0	11.5	5.4	-5.4
4	10.3	0.4	1.6	9.6	10.3	5.8	-10.0

The results in Table 3 reveal the sound level contribution from the four scenarios when assessed at the residential receivers to be well under the 20 ANEF aircraft noise level.

The landing and take-off SEL results includes part of the out of ground effect hover. Extracting the measured hover component and then adjusting that component to obtain an in ground effect hover is a complex task. As the SEL results provided in Appendix E include 15 seconds of the out of ground effect hover, and the in ground effect hover would give rise to lower levels, the ANEF contributions that would occur with the pontoon in place would be lower that identified in Table 3.

The ANEF value is an exposure level of the cumulative noise level from just the helicopter operations (ambient is not included) expressed in ANEF units. The presence of negative values in the calculated ANEF is permitted, just as in special acoustic test rooms one can measure below 0 dB, as 0 dB is a reference level for measurements.

From the results in Table 3 the ANEF values for all flights occurring between 7AM and 7PM can be converted to $LAeq_{24}$ by adding 35 as shown in Table 4.

TABLE 4: Helicopter Noise Contributions ($LAeq_{24}$) - Daytime flights only

Scenario	Location						
	1	2	3	4	5	6	7
1	45.9	36.7	31.9	32.6	43.7	41.4	29.7
2	44.5	33.5	29.8	31.4	44.7	40.2	27.2
3	45.5	38.7	42.3	42.0	46.5	40.4	29.6
4	45.3	35.4	36.6	44.6	45.3	40.8	25.0

The ANEF contributions in Table 3 relate to the operation of the helipad every day throughout the year at the maximum number of 8 movements a day for each scenario. To place the proposed maximum of 8 movements a day into the context of 20 ANEF, the four scenarios described above (of equal distribution of flight paths) have been extended to ascertain the maximum number of flights that could be permitted, noting that such a situation is not proposed by Trinity Point.

TABLE 5: Maximum Number of Helicopter Movements per day (re 20 ANEF)

	Location						
	1	2	3	4	5	6	7
Maximum Number	32	172	74	42	28	90	1324
Scenario	1	3	3	4	3	1	1

The ASA Environmental Principles document is silent on the acoustic correct for operations between 7PM and 7AM. If all flights occur between 7AM and 7PM there is no difference in the ANEF value, and therefore the $L_{Aeq\,24}$ value (as per Table 4).

Under the ANEF system aircraft movements occurring between 7 PM and 7 AM have a 6 dB penalty adjustment (leading to one flight between 7 PM and 7 AM being equivalent to 4 daytime flights) arising from the National Acoustics Laboratories socio-acoustic study.

The following table considers the ANEF result for the four scenarios but on the basis of 3 take offs and 3 landings in the day, and one take off and one landing in the period 7 PM to 10 PM (subject to end of daylight).

TABLE 6: Helicopter Noise Contributions (ANEF) – 6 movements in the day and 2 movements in evening

Scenario	Location						
	1	2	3	4	5	6	7
1	13.3	4.1	-0.6	2.0	11.2	8.8	-2.9
2	11.9	1.1	-2.9	0.9	12.1	7.6	-5.4
3	12.9	6.3	9.7	10.4	13.9	7.8	-3.0
4	12.8	4.9	6.0	12.1	12.7	8.2	-7.5

The ANEF contributions in Table 6 (as a worst-case scenario) are well below the ANEF 20 acceptable limit.

From the results in Table 6 the ANEF values for 6 flights occurring between 7AM and 7PM and 2 flights between 7PM and & 7AM can be converted to $LAeq_{24}$ by adding 35 as shown in Table 7.

TABLE 7: Helicopter Noise Contributions ($LAeq_{24}$) – 6 movements in the day and 2 movements in evening

Scenario	Location						
	1	2	3	4	5	6	7
1	48.3	39.1	34.4	37.0	46.2	43.8	31.1
2	46.9	36.1	31.1	35.9	47.1	42.6	29.6
3	47.9	42.3	44.7	45.4	48.9	42.8	32.0
4	47.8	39.9	41.0	47.1	47.7	43.2	27.5

It is noted that the Principle 6 target relates to the "unacceptable" limit of ANEF 25 set out in Australian Standard AS2021 and that the helicopter contributions set out in Table 7 are significantly below that 60 dB limit. Additionally, the results reveal that no contribution exceeds a 55 dB $LAeq_{24}$ level, which demonstrates the suitability of the noise against the ASA Environmental Principles document.

As the maximum noise levels recorded from the test measurements satisfy the day and night time maximum levels set out in AS2363-1990 (80 to 85dB(A)), then the maximum level set out in Principle 7 (95dB(A)) is also satisfied.

5.2 AS2363 -1990 Assessment

The AS2363-1990 procedure considers the helicopter Leq and maximum level contributions over 12 hour periods.

In considering the Leq targets for AS2363 there are two distinct time periods and different Leq (12 hour) targets as shown in Table 2 (on page 36).

The results in Table 4 consider the four scenarios on the basis of all 8 movements occurring between 7AM and 7 PM, but calculated over a 24 hours period. Restricting all flights in to a 12 hour (day or night) would result in a LAeq 12 level 3 dB higher than the 24 hour level as shown in Table 8.

TABLE 8: 12 Hour Daytime Helicopter Leq Contribution as per AS 2363 for 8 movements

Scenario	Location						
	1	2	3	4	5	6	7
1	48.9	39.7	34.9	35.6	46.7	44.4	32.7
2	47.5	36.6	32.8	34.4	47.7	43.2	30.2
3	48.5	41.7	45.3	46.0	49.5	43.4	32.6
4	48.3	38.4	39.6	47.6	48.3	43.8	28.0
Leq Target (day)	55	59	56	56	56	56	55
Leq target (night)	50	50	50	50	50	50	50

Consistent with the ANEF results in Table 3, Locations 1 & 5 represent monitoring locations that experience the highest Leq helicopter contributions.

As noted above with the hover over the pontoon (rather than out of ground effect hover) the LAeq contributions would be lower than shown in Table 8.

The results in Table 8 also show that if **all** helicopter movements were to occur in the daylight period between 7 PM and 10 PM, but assessed over the 12 hr "Nighttime" period identified in AS 2363, the contributions would be the same as shown for the daytime and all locations would have an Leq (12 hr) contribution less than 50 dB(A). Such a scenario would not occur and therefore the few operations that would occur after 7 PM and before last light would result in an LAeq,night contribution well below the 50 dB(A) criterion.

Examination of the maximum levels for helipad 2 in Appendices F4 and F5 reveal full compliance with both the daytime and night time maximum level limits from AS2363-1990, which factor in the ambient noise environment. These generally also align with criteria and assessment provided against the ASA Environmental Principles.

5.3 Helicopter Hover Component Over Pontoon

The assessment of noise for the helicopter operations using the measurement results included noise from the helicopter conducting a hover out of ground effect (HOGE) over the helipad location, as the site testing did not have the availability of a pontoon for physically landing the helicopter for the test measurements.

Measurements of various helicopters have consistently revealed a higher noise level when the helicopter is hovering out of the ground effect compared to hovering in the ground effect.

As a result of the difference between HOGI and HIGE the resultant noise level with the pontoon in place will be lower than the measured levels from the testing. The following discussion identifies the basis of the reductions.

The approach in undertaking the assessment of the Leq contribution in the tables above has included the measured out of ground effect hover obtained during the tests. In the time splice sample graphs used to show the methodology in the assessment procedure, the contribution with and without the hover component has been identified for a number of locations.

Appendices F 1 – F4 present time splice graphs for movements 1 & 2, being the first landing and take-off over helipad 2. The purpose of the time splice graph is to identify the out of ground effect hover recorded at each of the 7 locations.

The table in Appendix F5 provides a calculation of the SEL for each of the two movements that includes 15 seconds of the out of ground effect hover (to accord with the analysis described earlier and results provided in Appendix E) then followed by the contribution attributed to the hover out of ground effect component with the time period being extended to 30 seconds that typically occurs when the helicopter is over a landing site.

The table in Appendix F5 reveals in all cases (except location 7) the inclusion of the hover increases the SEL of the relevant movement. Reducing the hover SEL component by 5 dB (to account for the in ground effect hover) would result in a lower hover contribution and an insignificant impact on the SEL for the relevant movement.

For identification of the different components of the helicopter tests, the results from the Bruel & Kjaer Evaluator program have included horizontal coloured bars at the top of the graph. The green bar represents the landing phase of the test, the blue bar represents the hover component and the pink bar represents the take-off component. The excel graphs for the Svan results have identification of the different modes in the body of the graphs.

Examination of the results in the table in Appendix F5 reveal Locations 1 & 6 to experience the highest helicopter noise levels.

On the same basis of presentation, Appendix F6 provides a graphical result of the testing for movements 11 & 12 (the southern flight path operating in an anticlockwise direction) for Locations 1 & 6.

Similarly, for operation of the northern flight path Appendix F7 provides a graphical result for movements 21 and 22 with respect to Locations 1 & 6.

As the helicopter using the northern flight path overflies Location 4, the graphical results for the northern flight path over Location 4 is presented in Appendix F8. Appendix F8 includes a table of results with and without the hover component for Locations 1, 4 & 6.

To identify the difference for a landing with a HIGE is to examine the take-offs and landings onto the ground at Trinity Point (movements 33 & 34) set out in Appendices F9 & F10, with the table of results set out in Appendix F11.

As a result of the analysis of the various flight modes it can be seen that correcting the SEL data to account for hovering over the pontoon versus in the air would require a complex explanation, whereas including the as measured out of ground effect hover in the test results provides a simple conservative approach in the analysis of the Leq contribution.

Locations 2, 3, 4 & 7 experience a HOGE more than 10 dB below the maximum level of the helicopter take-off or landing, whereas Locations 1, 5 & 6 had a HOGE at or less than 10 dB below the maximum level.

At the time of the testing no specific comparison of HIGE versus HOGE was included in the program, on the basis of previous verbal advice from the EPA that the INP was not applicable.

From the tables in Appendix F it can be seen reducing the hover SEL component by 5 dB (to account for the in ground effect hover) and increasing the time period for the hover and ground running would not give rise to a higher SEL contribution than obtained from the measurements that included a HOGE.

5.4 Variation in Wind

Just as airports utilise different runways, dependent upon the prevailing wind, the operation of a helipad has a number of flight paths to address different wind directions.

When there is a moderate wind, the preference is to have the helicopter operating with a nose wind component. Different helicopter types have operating restrictions for situations where there is a tail wind component.
To address those operational requirements with respect to wind, the subject helipad has three different flight paths that may be used, as identified in Appendices A3 – A6.

When there is no prevailing wind, or a light wind, occurring at the site the principal flight path in use for the subject helipad is that to the south.

The procedure for compliance testing or evaluation testing of helicopters for a landing site is required under Clause 4.5 of Australian Standard AS2363 - 1999 to occur in calm air or in no more than light wind conditions (5 km/h). The testing for helipad 2, being the location that is to be used for the Trinity Point Marina helipad, occurred under those conditions.
The testing for helipad 2 resulted in some locations being upwind of the flight path/hover point, some locations downwind of the flight path/hover point and some locations being cross wind of the flight path/hover point.

Typically, the matter of adverse weather impacts relates to wind and temperature inversions with respect to noise received at residential premises.

An increase in wind with respect to assessment of industrial premises can cause an increase in noise levels received at positions downwind and a reduction in noise for positions up wind. The primary issue for industrial premises and adverse weather is related to receiver locations removed from the site where the presence of wind and temperature inversions can cause a greater variation in the noise level). In the context of the subject proposal the receiver locations are not significantly removed from the flight paths or helipad locations, when compared to industrial premises where wind and temperature inversions can be an issues.

Temperature inversion over the relatively short distances from the pontoon to the receiver location is not envisaged to be a matter of concern particularly when consideration of the temperature inversion is generally related to night-time operations (which will not occur at the helipad). The INP only requires consideration of this issue if the temperature inversions occur for more than 30% of the time at night in winter. As this does not occur in this case, the requirement for consideration of temperature inversions under the INP does not apply.

For the purpose of obtaining an ambient background level upon the EPA place a limitation of 5 m/s (18 km/h) above which wind conditions are unsuitable for obtaining a background level.

Similarly, for compliance purposes the EPA restrict noise monitoring to avoid strong winds (see condition L6.5 of EPA General Terms of Approval for Lilley Heliport in Appendix G5.
As noted previously, the measurement of helicopters under Australian Standard AS 2363 uses FAST response rather than the SLOW response requirement for the measurement of fixed wing aircraft (under Australian Standard AS 2021). The use of FAST response for helicopters automatically leads to a higher measured noise level and automatically takes account of any fluctuations in the noise generally attributed to variations in the wind.

The individual test flights for each of the different flight paths/mode revealed minor variations in the measured levels, which is to be expected due to slight variations in the flight profile or wind at the time of the individual flight.

The use of an energy average for both the SEL and maximum level components of each flight path/mode automatically provides an average level that is biased towards the higher levels obtained in the dataset for each flight path/mode.

5.5 Impact on Marine Fauna

With respect to fauna located on the land area surrounding Bardens Bay the noise associated with the helicopter would be similar to or greater than that occasioned by existing activities occurring on the waterways.

Studies by the US Department of Interior in conjunction with the U.S. Air Force with respect to the effects of aircraft operations on wildlife (US Air Force Engineering and Services Centre and US Department of the Interior Fish and Wildlife Service, 1988 *Effects of aircraft noise and sonic burns on domestic animals and wildlife: A literary literature synthesis NERC 82/29*) were identified in the ARUP Acoustics assessment for the Trinity Point development.

The noise level cited for impacts on land based wildlife associated with aircraft operations occur at levels significantly higher than that generated by the subject helicopter.

This conclusion is similar to the decision of Mark Lilly v Lithgow City Council matter, where at paragraph 26 Senior Commissioner Roseth discussed the adverse impact of flora and wildlife in national parks and stated:

> *While helicopter flights certainly disturb the peace of those who try to experience nature from the ground, this is not the same thing as having an adverse impact on flora and fauna. Helicopter flights over Capertee Valley and the Blue Mountains National Park are possible from other nearby airports. If helicopter flights over these areas are harmful to the environment or disturbing to bushwalkers, they should be prohibited by more effective and appropriate means and the refusal of this application.*

In relation to aquatic flora and fauna the acoustic assessment involves different parameters to that for an acoustic assessment in the air. Only a small percentage of the acoustic energy generated by the helicopter and the down wash is transferred into the water. Whilst noise in water is also expressed in decibels, the reference level for the evaluation of underwater sound level levels uses a different reference level to sound in the air and cannot be directly compared.

The ARUP Acoustics report of October 2008 for the Trinity Point Development identified that the acoustic impedance of water is approximately 3600 times the acoustic impedance of air, and therefore at the air water interface 99% of the acoustic energy contained in the audible instant sound will be reflected and only 1% transmitted to the water.

From measurements of other helicopters in proximity to the ground effect it is expected for the subject helipad a maximum noise level in the order of 100 – 108 dB(A) would occur at the surface of the water outside the helipad itself, that on conversion to underwater sound metrics would suggest that the noise level in the water would be less than 80 dB. This indicates noise of the helicopter would be audible to fish but under the 90 dB $_{ht\,(Species)}$) criterion expressed in report from Nedwell, Parvin, Edwards, Workman, Brooker and Kynock (2007) *Measurement and interpretation of underwater noise during construction and operation of offshore wind farms in UK waters*, COWRIE, Report NOISE– 03–2003.

The ARUP Acoustics assessment considered the operation of the various helicopter types was considered unlikely to cause adverse noise impact to fish.

Of relevance to the transfer of noise to the aquatic area is the operation of boats in Bardens Bay. The noise from boat propellers is generated in the water itself and therefore represents a significantly greater level of noise in the water than the transfer of the airborne component of the helicopter noise through the air/water interface.

The ARUP Acoustics report identified that measurements of underwater noise levels from boats have resulted in sound pressure levels in excess of 140 dB re 1µPA at a distance of 1m (reference quoted as Erbe, C (2002) *Underwater Noise of Whale-Watching Boats and Potential Effects on Killer Wales (orcinus orca), based on an acoustic impact model*, Marine Mammal Service 18 (2) pp 39 –418).

From our perspective, the various boats that have been observed to operate in Bardens Bay whilst having lower airborne noise components than the helicopter would clearly generate a greater level of underwater noise level because of the propellers associated with those boats. It is therefore suggested that the existing boats would give rise to a significantly higher level of underwater noise than that from the subject helicopter.

The impact on aquatic fauna as a result of the subject helipad is addressed by others.

5.6 Use of the helipad by other helicopter types

The helicopter used for the testing represents the general type of helicopter that would be defined as “charter operations” and covers the medium weight turbine helicopters including the Bell 206 JetRanger/LongRanger, Bell 407, McDonnell Douglas MD500C/D/E and Airbus EC120 & EC130 helicopters. Noise test data (normal operations and certification tests) reveal similar levels and would not alter the matter of acoustic compliance.

The use of larger/greater capacity helicopters (particularly twin engine helicopters) is limited by the size of the helipad. The size of the helipad imposes a limit for an Agusta Westland AW109 or an Airbus EC135, with the AW109 selected as the ‘design helicopter’ for the physical pontoon design.

Typically, reference to noise emission for different helicopter types is based on certification data. However, certification data relates to the helicopter near maximum load and undertaking operations under specific procedures that do not occur in practice. Noise data from actual flight testing using the proposed flight tracks provides realistic noise data.

To overcome the difference between different helicopters, a method of helicopter Leq noise weighting (from actual flight profiles) was developed in 1992 for the proposed Sydney CBD heliport at Pier 8 Pyrmont, as contained in an EIS prepared by Warren & Associates Pty Ltd and Heli-Consultants Pty Limited, in association with James Madden Cooper Atkins Pty Ltd.

Measurements were conducted at Peacock Point, East Balmain, being a reference location R1 used for previous helicopter testing for potential heliport sites at Pier 23 Darling Harbour, Pier 14 Pyrmont and Pier 23 Pyrmont. Other locations were the subject of testing.

From the Pier 8 Pyrmont EIS the monitoring location R1 is identified as 730 metres from the landing site (across water), involved a principal flight track down the eastern side of Darling Harbour and directly into the landing pad, or an alternative track that went past the helipad and turned to the west to land from the south east.

Three helicopter types were tested in the Pier 8 Heliport study, being the Bell 206 JetRanger, a twin engine Aerospatiale AS355F and a twin engine Sirkorsky S76.

The assessment of the helicopter operations was undertaken with respect to AS2363-1990.

From the measurement data the maximum number of helicopter movements were determined for each helicopter. At that time the most common turbine engine helicopter used for charter purposes was the Bell JetRanger. From the most critical receiver (location R1 at Peacock Point) it was established that 52 JetRanger movements a day could occur and satisfy the Leq noise limit.

A similar exercise was conducted for the other two helicopters tested. By reference to the 52 JetRanger movements a Noise Weighting was obtained where the JetRanger was assigned a value of 1.0, the AS355F 1.2, and the S76 2.9.

The NSW EPA were present for the testing and conducted simultaneous monitoring at Peacock Point at a position within 5 metres of the James Madden Cooper Atkins Pty Ltd R1 meter.

The Acoustic Assessment then reviewed the measurements recorded at location R1 for the Piers 22/23 study where a JetRanger 206, a Robinson R22, an Aerospatiale AS350B and an August A109A were the subject of testing. By way of the same methodology the following Noise Weightings for reference location R1 were obtained:

- Robinson R22 0.5
- 206 JetRanger 1.0
- Aerospatiale AS 350B 1.9
- Agusta A101A 2.1
- Aerospatiale AS 355F 1.2
- Sikorsky S76 2.9

The CBD Pier 8 Heliport was the subject of a Commission of Inquiry in 1993 and had the benefit of assistance from Mr D Craig (acoustic engineer) from Challis & Associates.

The Commission of Inquiry supported the use of the helicopter weighting method described above and determination of the helicopter contribution - no inclusion of ambient (so as to accord with AS2363 and AS2021). The Commission of Inquiry report simplified the basis of the helicopter weighting to be equivalent to 50 JetRanger movements per day. This changed the above weightings (set out in the EIS) slightly.

The benefit of the weighting method for different helicopter types is that one can use the maximum number of movements determined in Table 5 for the test helicopter (Airbus/Aerospatiale AS350B) and determine the maximum number of movements that would apply to other types of helicopters using the Trinity Point Marina helipad. Table 10 provides the result of that exercise to maintain a 20 ANEF for all flights occurring in the day.

TABLE 10: Maximum Number of Helicopter Movements per day (re 20 ANEF)

Maximum Number of Movements	Location						
	1	2	3	4	5	6	7
Airbus AS350B	32	172	74	42	28	90	>1000
JetRanger 206	61	326	140	79	53	171	>2000
Airbus AS355F	38	206	88	50	33	108	>1000
AgustaWestland A109A	28	155	66	38	25	81	>1000

This is a highly unlikely situation. The above table identifies that the restriction of 8 helicopter movements a day will clearly satisfy the AirServices Australia noise target for the helicopter types that are likely to use the helipad.

As the results in Table 10 have been assessed in terms of the ASA 20 ANEF target then the maximum number of movements relate to a $LAeq_{24}$ target of 55 dB and clearly satisfies the ASA Environment Principles unacceptable target of 60dB $LAeq_{24}$.

5.7 Future Residential Receivers within Development of MP 06-0309

Location 1 (being Lot 31 DP 1117408) is located on the Trinity Point Marina and Mixed Use Development site, and will include the range of land based uses as identified in the approved concept plan. This includes future residential uses. The approved concept plan provides for up to 157 residential apartments in the central and southern precincts of the site. Of the range of development approvals on this land, DA 496/2015 includes 34 residential apartments (integrated with 93 tourist accommodation apartments) in four x four storey buildings.

The northern most building sits to the south west of the proposed helipad, being north of Location 1. Under the approved concept plan, future residential land uses can also be sought, further south of the approved buildings.

The assessment of Location 1 does not identify any non-compliance against various acoustic criteria arising due to the operation of the helipad under a worst case scenario.

Examination of the flight tracks shown in Appendices A3 – A6 reveals similar horizontal distances to the shoreline of the residential section of the Trinity Point Development to that of Location 1. The elevation of the helicopters with respect to Location 1 and landing on a pontoon will be higher at the southern end of the development and lower at the pontoon than were recorded for Location 1.

With the helicopter landing on the pontoon (rather than the out of ground effect hover that was recorded in the tests) the SEL level at Location 1 will be lower.

With respect to any residential use that sits to the north of Location 1 (the attended measurement location) the maximum level for arrival would be marginally less, whilst on departing, levels would be expected to be similar to Location 1. On an Leq basis, it could be taken that result to be 0-1dB(A) higher.

With respect to any residential use that sits to the south of Location 1 (the attended measurement location) the maximum levels would be similar or lower, and the Leq could be 1-2dB(A) lower. These variances are minor and would not result in impacts to the future residential uses against acoustic considerations.

The arrival and departure of helicopters will be audible to residential receivers of the Trinity Point Development and dependent upon the visual exposure to the helicopter will generate a short term increase in noise similar to or greater than the use of Bardens Bay by various boats. The assessment is compared against the ambient environment for a green field site. With the development of the site, that included residential and tourism accommodation, commercial components and the marina, there will be an automatic increase in the prevailing acoustic environment.

The future residents of the Trinity Point Mixed Use site will be co-existing within a tourist facility, including an operational marina, 300 seat function centre, restaurant and dining area, and tourist accommodation. Condition 34 of DA 496/2015 relates to Social Impact Management, and required a Social Impact Management Plan to be lodged with and approved by Lake Macquarie City Council that addresses, amongst other matters, measures to ensure that conflict between user groups of the development (e.g. tourists and residents) does not occur. One of the mechanisms is to ensure that future residents are well informed on the mix of uses and the nature and scale of those uses.

Any future residential land use established under MP 06_0309 will have disclosure that clearly establishes that they are part of a wider mixed use development project, that highlights the existence of the range of land uses, including function centre, restaurant, tourist accommodation, marina and helipad (as proposed) and associated operations and impacts.

Current titling intentions are that any residential unit will form part of a community title scheme (this is subject to a current application before LMCC), which includes a Community Management Statement (CMS). The CMS is part of the titling system, and the existence of the non-residential uses and disclosure can sit within the bylaw that expresses the 'theme of development'. If necessary, a specific bylaw applying to residential apartments can also be added.

In addition to the titling, JPG in contracts of sales for residential apartments would include similar disclosure of the mix, nature and scale of uses at Trinity Point, including the marina, function centre, dining and helipad (as proposed).

6.0 SUMMARY AGAINST SEARs

NSW Planning & Environment, by letter of 6th July 2016, provided revised Secretary's Environmental Assessment Requirements (SEAR 846) for the Trinity Point Morisset Park Helipad.

With respect to acoustic impacts the SEARs required the investigation of potential noise impacts associated with the take-off, approaches and route of helicopters to the helipad.

This acoustic assessment identifies testing that occurred with a generic helicopter using nominated flight paths for 2 helipads. Testing confirmed that the first helipad is to be used for the subject application.

As required by the SEARs the potential impacts of the helicopter operations on residential areas has been undertaken with the location of assessment (and monitoring) identified by the Council prior to the conduct of the test.

As required by the SEARS the flight paths, hours of operation and flight paths that would apply to the helipad have been identified. The frequency of operation has been assessed as a daily worst-case scenario of eight movements per day for operations restricted to each of the three flight paths and/or flight path combinations that have been identified to accommodate different wind directions.

An overall maximum number of movements per week (being less than that assessed for eight movements every day) will automatically result in a lower cumulative noise from the subject helipad when assessed in accordance with the AirServices Australia ANEF (aircraft noise exposure forecast) method, ASA Environmental Procedures Principle 6 and AS2363-1990.

The consideration of other helicopter types has been conducted to reveal full compliance with the AirServices Australia criteria, ASA Environmental Procedures Principle 6 and AS2363-1990.

The construction of the "helipad" from a noise perspective is one of towing a floating pontoon to the subject site and anchoring that pontoon to the bottom of the bay. The noise impacts associated with construction of the Marina (involving piling) has been addressed under other approvals and that the construction of the "helipad" will fully satisfy the requirements of those approvals.

7.0 SUMMARY

The proposal to include a helipad as part of the approved marina at Trinity Point, Lake Macquarie, has been the subject of acoustic testing using a generic helicopter that represents the typical fleet of turbine helicopters used in charter situations.

Prior to the testing a meeting occurred on site with Council officers to identify the proposed format of testing and locations for monitoring and to seek Council's general approval of the process. The Council officers accepted the monitoring program and the rationale behind the testing to satisfy the requirements set out in Australian Standard AS2363-1990 but subsequently added two additional locations for monitoring purposes.

Monitoring was conducted in March 2016 in the presence of Council officers and involved testing for three different flight paths and two helipad locations.

Seven locations approved by Council were monitored on a continuous basis to record the helicopter operations for subsequent analysis.

A preliminary analysis of the testing was the subject of a public information session in late May 2016. Input from the residents identified the necessity to provide a detailed explanation of the development of acoustic criteria concerning helicopters, as the residents in attendance had incorrect information.

As discussed in this report there have been significant changes to the relevant criteria, including as a consequence of verbal advice from the EPA. Previously, the EPA imposed guidelines and noise limits for helicopter operations. However, the current advice is that the EPA does not have any authority to control helicopter noise (either on the ground or in the air).

Based on The Acoustic Groups significant expertise with helicopter noise assessments, it is our opinion that helicopter operations fall under the jurisdiction of AirServices Australia, and that the use of the Aircraft Noise Exposure Forecast system (ANEF) under AS2021 is the mechanism that applies to helicopter operations (including ground components).

AirServices Australia has, for acoustic assessments concerning the Third Runway at Sydney Airport, used the general conversion factor of 35 dB between the ANEF and the A-weighted Leq level, in that the A-weighted measurement represents a significant simplification and cost saving to the more complex and time consuming Effective Perceived Noise Level (EPNL) procedures used in deriving an ANEF. This adjustment permits the use of a simple conversion from the calculated LAeq levels to derive a 24 hour ANEF value for comparison with the recommended acceptability of 20 ANEF.

Compliance with the acceptability criterion of 20 ANEF automatically results in compliance with the ASA Environmental Principles limit of 60 $LAeq_{24}$. In fact, the results demonstrate that the proposal sits below 55 dB and 50 dB LAeq24, which falls within the range of acceptable noise identified in the ASA Environmental Principles, and also aligns with the criteria from AS2363-1990 which considers the ambient noise environment of Bardens Bay.

The 1990 version of AS2363 included criteria provided directly from AirServices Australia that was based upon the ANEF system for 12 hour periods of operation, and incorporates the technical amendments to the EPA's original assessment criteria as a result of a Commission of Inquiry into a proposed Sydney CBD heliport.

Analysis of the helicopter results with respect to each of the 3 flight paths has considered four scenarios using an equal distribution on the flight paths at the maximum number of proposed movements per day, for the determination of the ANEF (Aircraft Noise Exposure Forecast) values.

That distribution indicates helicopter noise levels to be significantly below the 20 ANEF criteria specified in Australian Standard AS2021.

To place the proposed maximum of 8 movements a day in the context of 20 ANEF a reverse analysis to determine the maximum number of movements that could occur per day under consideration for the 4 scenarios has been conducted. That analysis confirms that the application for 8 movements a day is significantly less than the maximum number of movements that on a noise basis could be permitted.

A suite of noise criteria that have been used for helicopter assessments in NSW have been examined and are all satisfied for 8 movements a day (4 arrivals and 4 take-offs) for the test helicopter.

For completeness the assessment has also considered the different scenarios to cater for different wind directions in terms of the criteria set out in ASA Environmental Principles and in AS2363 – 1990 that finds both the Leq and maximum levels to be significantly lower than the recommended criteria, even when one includes the recommendations for low noise areas to use ambient Leq +10 dB which is the conservative approach used in this assessment from AS 2363-1990.

The assessment has considered the use of different helicopter types (and their derivatives) based upon an energy noise weighting procedure developed for the proposed Sydney CBD Heliport based upon testing of a number of helicopter types.

That assessment reveals use of helicopter types up to the AgustaWestland A109A to maintain compliance with the noise targets applied to helipads.

The assessment of the helipad has identified the following operational procedures to mitigate the noise impacts:

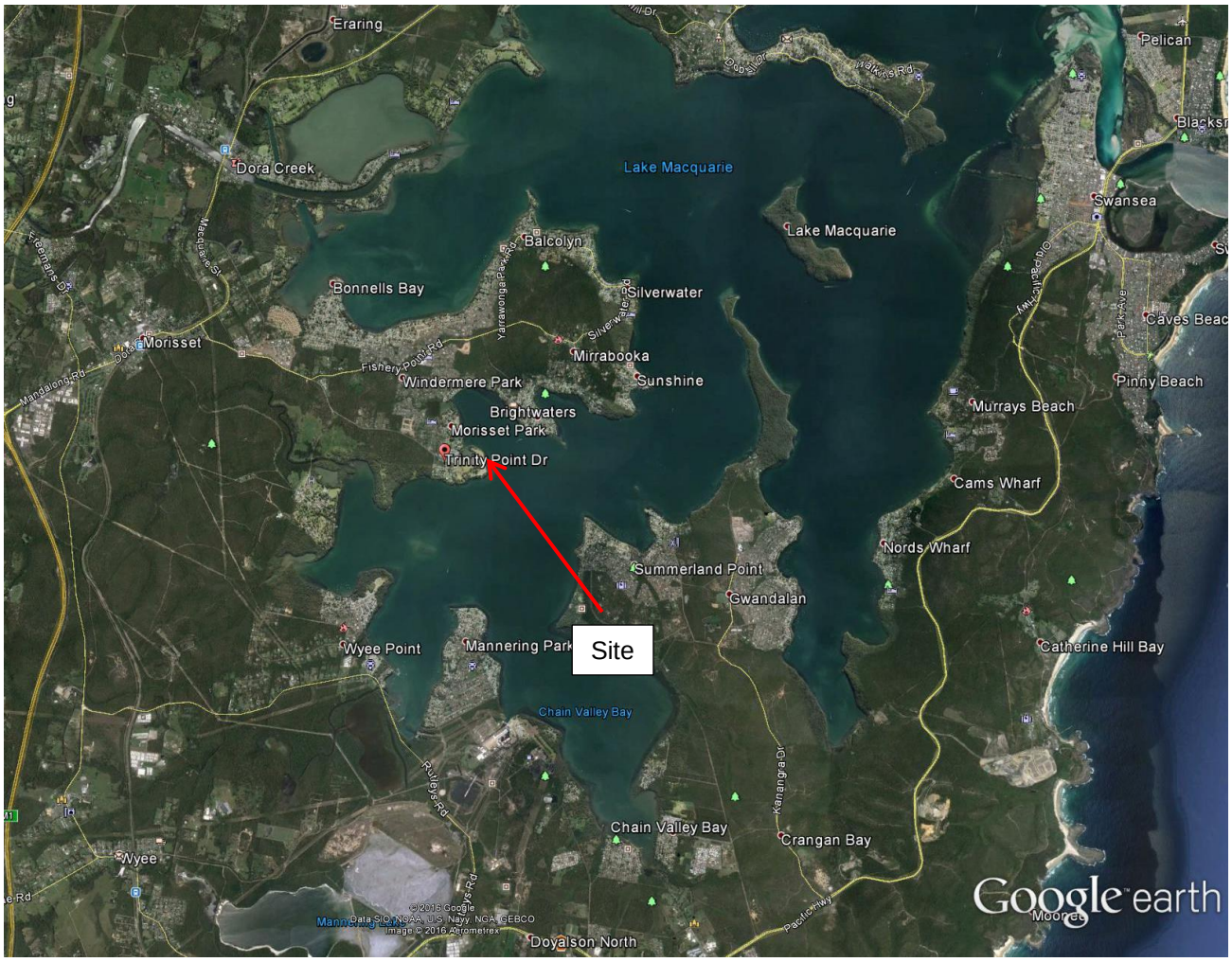
- Use of the helipad is by prior permission only
- Requirement to follow prescribed flight paths
- Operations only in daylight hours and not before 8am
- No joyfilght/joyrides from the helipad

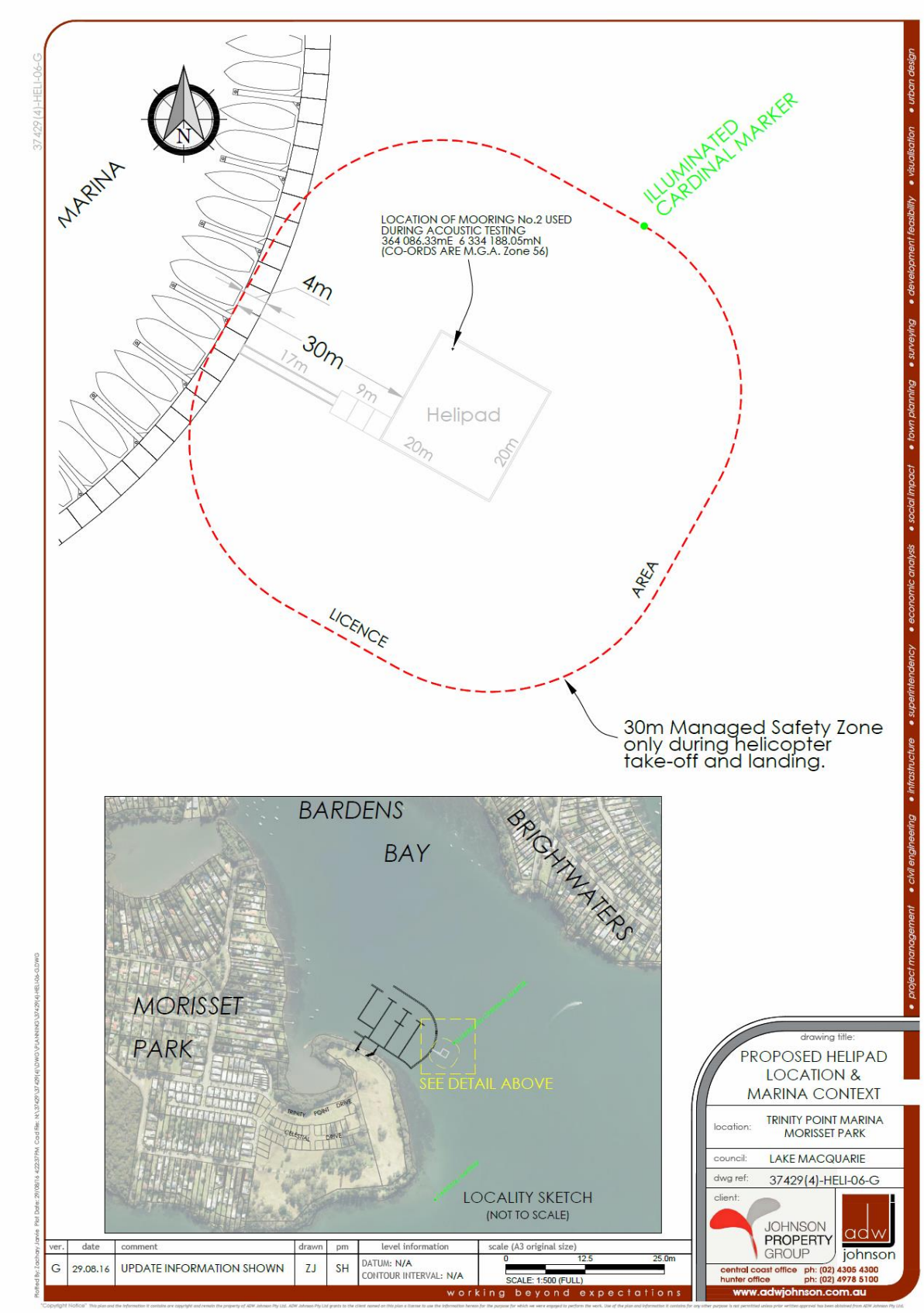
Yours faithfully,

THE ACOUSTIC GROUP PTY LTD

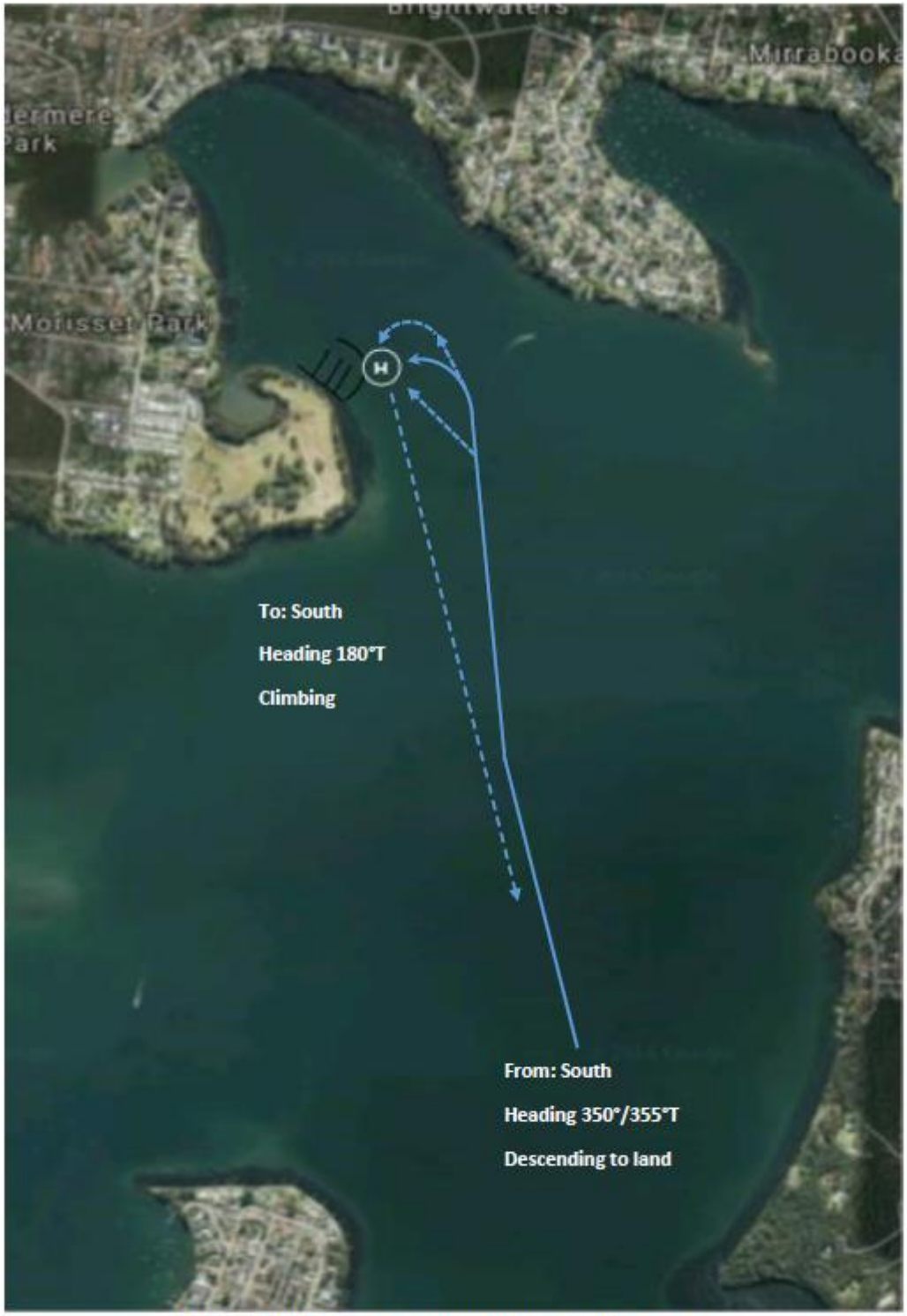
STEVEN E. COOPER

APPENDIX A: Site and Measurement Locations




37429(4)-HELI-06-G
MARINA
N
ILLUMINATED CARDINAL MARKER
LOCATION OF MOORING No.2 USED DURING ACOUSTIC TESTING
364 086.33mE 6 334 188.05mN
(CO-ORDS ARE M.G.A. Zone 56)
4m
30m
17m
9m
Helipad
20m
20m
AREA
LICENCE
30m Managed Safety Zone only during helicopter take-off and landing.
BARDENS BAY
BRIGHTWATERS
MORISSET PARK
SEE DETAIL ABOVE
LOCALITY SKETCH
(NOT TO SCALE)
drawing title:
PROPOSED HELIPAD LOCATION & MARINA CONTEXT
location: TRINITY POINT MARINA MORISSET PARK
council: LAKE MACQUARIE
dwg ref: 37429(4)-HELI-06-G
client:
JOHNSON PROPERTY GROUP
adw johnson
central coast office ph: (02) 4305 4300
hunter office ph: (02) 4978 5100
www.adwjohnson.com.au
ver. | date | comment | drawn | pm | level information | scale (A3 original size)
G | 29.08.16 | UPDATE INFORMATION SHOWN | ZJ | SH | DATUM: N/A CONTOUR INTERVAL: N/A | 0 12.5 25.0m SCALE: 1:500 (FULL)
working beyond expectations
project management • civil engineering • infrastructure • superintendency • economic analysis • social impact • town planning • surveying • development feasibility • visualisation • urban design

Approach Path A to meet Calm conditions, North, North East, North West and East winds.



Approach Path B1 to meet North West, West and South West winds.

Approach Path B2 designed to meet South East, South, South West winds.

Alternate Approach Path C for South West, South, South East winds. This is an Alternate to Path B2.

Attended Measurement Location

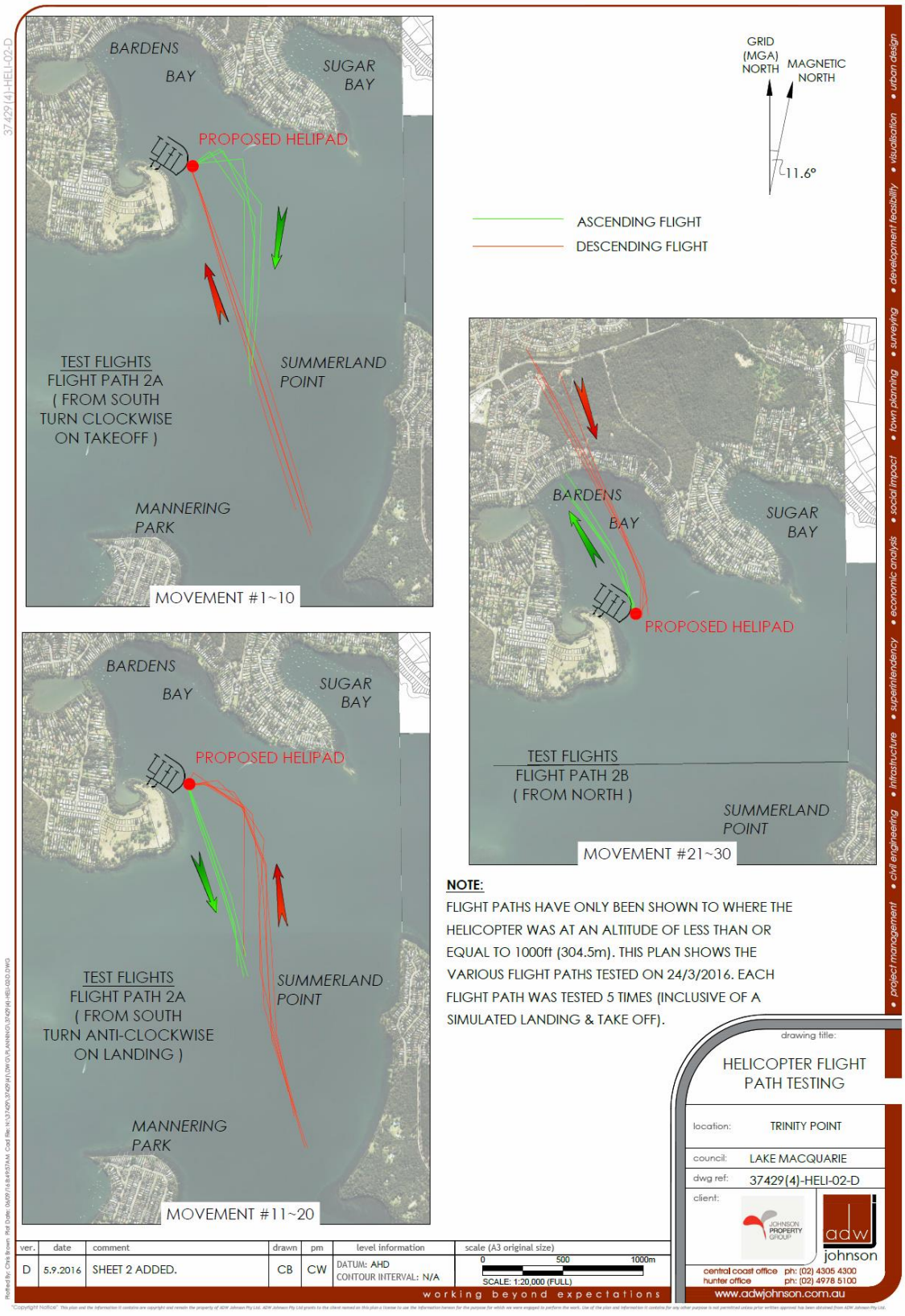
Logger Location

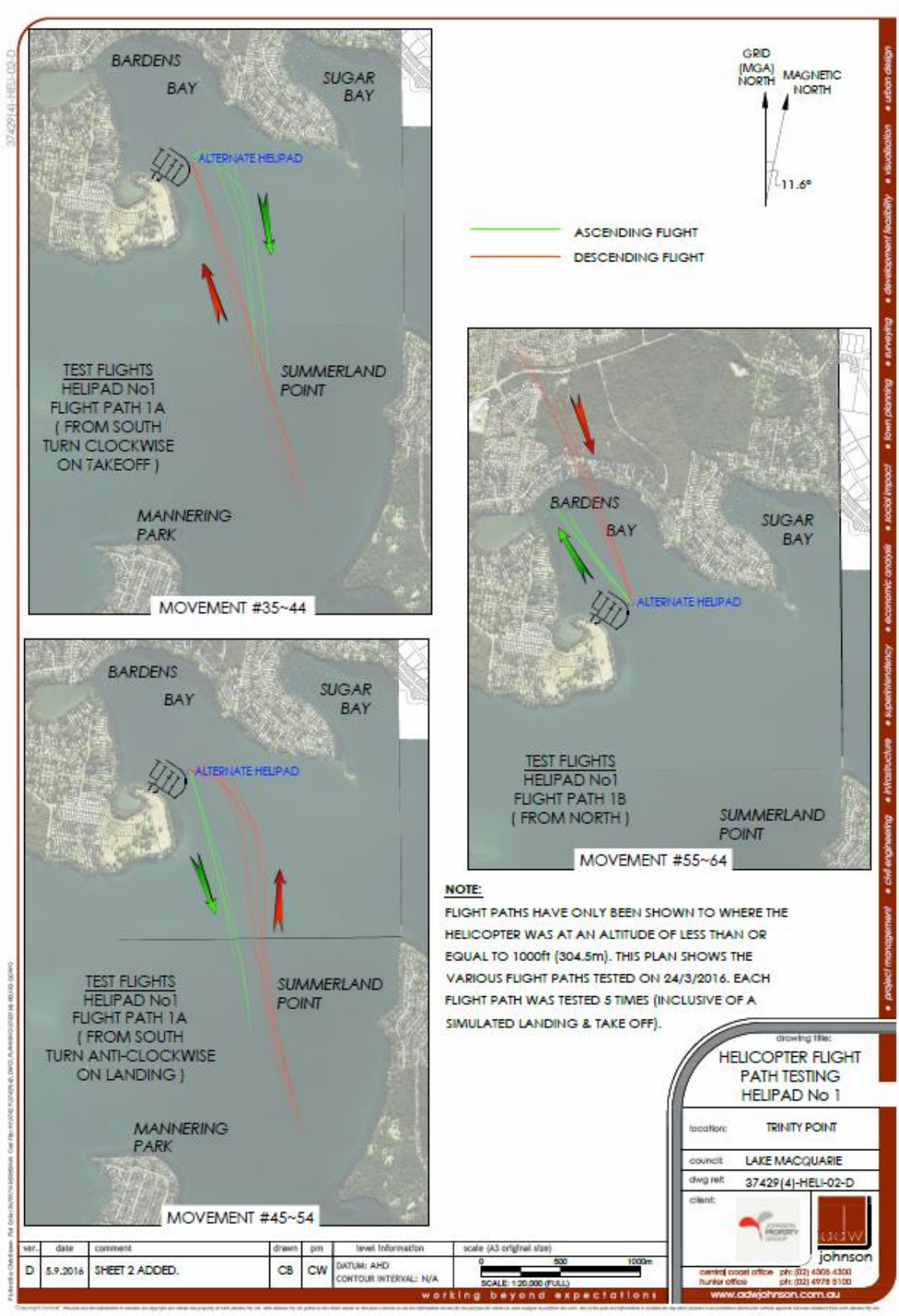
APPENDIX B: Original Test Flight Program

ACOUSTIC TEST DAY ITINERARY- TRINITY POINT HELIPAD PROPOSAL				
Movement Number	**Helipad**	**Flight Path**	**Direction**	**Type**
1	2	2A	Clockwise	Landing
2				Take off
3				Landing
4				Take off
5				Landing
6				Take off
7				Landing
8				Take off
9				Landing
10				Take off
11	2	2A	Anticlockwise	Landing
12				Take off
13				Landing
14				Take off
15				Landing
16				Take off
17				Landing
18				Take off
19				Landing
20				Take off
21	2	2B	South	Landing
22			North	Take off
23			South	Landing
24			North	Take off
25			South	Landing
26			North	Take off
27			South	Landing
28			North	Take off
29			South	Landing
30			North	Take off
31		On land	South	Landing
32	N/A	On land	North	Take off
?? Council flights	N/A	anywhere		

ACOUSTIC TEST DAY ITINERARY- TRINITY POINT HELIPAD PROPOSAL				
Movement Number	**Helipad**	**Flight Path**	**Direction**	**Type**
33		On land	North	**Landing**
34		On Land	South	Take off
35	1	1A	clockwise	Landing
36				Take off
37				Landing
38				Take off
39				Landing
40				Take off
41				Landing
42				Take off
43				Landing
44				Take off
45	1	1A	Anticlockwise	Landing
46				Take off
47				Landing
48				Take off
49				Landing
50				Take off
51				Landing
52				Take off
53				Landing
54				Take off
55	1	1B	South	Landing
56			North	Take off
57			South	Landing
58			North	Take off
59			South	Landing
60			North	Take off
61			South	Landing
62			North	Take off
63			South	Landing
64			North	Take off

APPENDIX C: Flight tracks on the day of testing




BARDENS BAY
SUGAR BAY
ALTERNATE HELIPAD
TEST FLIGHTS
HELIPAD No1
FLIGHT PATH 1A
(FROM SOUTH
TURN CLOCKWISE
ON TAKEOFF)
SUMMERLAND POINT
MANNERING PARK
MOVEMENT #35~44
GRID (MGA) NORTH
MAGNETIC NORTH
11.6°
ASCENDING FLIGHT
DESCENDING FLIGHT
BARDENS BAY
SUGAR BAY
ALTERNATE HELIPAD
TEST FLIGHTS
HELIPAD No1
FLIGHT PATH 1B
(FROM NORTH)
SUMMERLAND POINT
MOVEMENT #55~64
BARDENS BAY
SUGAR BAY
ALTERNATE HELIPAD
TEST FLIGHTS
HELIPAD No1
FLIGHT PATH 1A
(FROM SOUTH
TURN ANTI-CLOCKWISE
ON LANDING)
SUMMERLAND POINT
MANNERING PARK
MOVEMENT #45~54
NOTE:
FLIGHT PATHS HAVE ONLY BEEN SHOWN TO WHERE THE HELICOPTER WAS AT AN ALTITUDE OF LESS THAN OR EQUAL TO 1000ft (304.5m). THIS PLAN SHOWS THE VARIOUS FLIGHT PATHS TESTED ON 24/3/2016. EACH FLIGHT PATH WAS TESTED 5 TIMES (INCLUSIVE OF A SIMULATED LANDING & TAKE OFF).
ver. | date | comment | drawn | pm | level information | scale (A3 original size)
D | 5.9.2016 | SHEET 2 ADDED. | CB | CW | DATUM: AHD CONTOUR INTERVAL: N/A | 0 500 1000m SCALE: 1:20,000 (FULL)
working beyond expectations
drawing title:
HELICOPTER FLIGHT PATH TESTING HELIPAD No 1
location: TRINITY POINT
council: LAKE MACQUARIE
dwg ref: 37429(4)-HELI-02-D
client:
johnson
central coast office ph: (02) 4305 4300
hunter office ph: (02) 4978 5100
www.adwjohnson.com.au

APPENDIX D: Actual Test Flights

Movement Number	Helipad	Flight Path	Direction	Type
1	2	2A	Clockwise	Landing
2				Take off
3				Landing
4				Take off
5				Landing
6				Take off
7				Landing
8				Take off
9				Landing
10				Take off
11	2	2A	Anticlockwise	Landing
12				Take off
13				Landing
14				Take off
15				Landing
16				Take off
17				Landing
18				Take off
19				Landing
20				Take off
Overflight 1			north	Overflight
21	2	2B	South	Landing
22			North	Take off
23			South	Landing
24			North	Take off
25			South	Landing
26			North	Take off
27			South	Landing
28			North	Take off
29			South	Landing
30			North	Take off
31		On land	South	Landing
32	N/A	On land	North	Take off
?? Council flights	N/A	anywhere		

Movement Number	Helipad	Flight Path	Direction	Type
33		On land	North	**Landing**
34		On Land	South	Take off
35	1	1A	clockwise	Landing
36				Take off
37				Landing
38				Take off
39				Landing
40				Take off
41				Landing
42				Take off
43				Landing
44				Take off
45	1	1A	Anticlockwise	Landing
46				Take off
47				Landing
48				Take off
49				Landing
50				Take off
51				Landing
52				Take off
53				Landing
54				Take off
Overflight 2			North	Overflight
55	1	1B	South	Landing
56			North	Take off
57			South	Landing
58			North	Take off
59			South	Landing
60			North	Take off
61			South	Landing
62			North	Take off
63			South	Landing
64			North	Take off

APPENDIX E: Tables of Measurement Results

Helipad 2

Movement Number	Flight Path	Type	Locn 1		Locn 2		Locn 3		Locn 4		Locn 5		Locn 6		Locn 7	
			Max	SEL	Max	SEL	Max	SEL	Max	SEL	Max	SEL	Max	SEL	Max	SEL
1	2A Clockwise	Landing	74	87	63	76	59	73	60	73	73	85	70	82	53	68
2		Take off	71	84	63	75	61	72	66	74	76	86	73	84	56	68
3		Landing	74	87	63	76	58	72	63	74	73	84	69	81	70	74
4		Take off	73	86	62	75	60	73	66	74	76	84	72	83	**	**
5		Landing	74	86	62	76	59	72	61	73	76	84	71	80	56	69
6		Take off	74	87	68	75	61	70	64	72	74	84	72	83	60	72
7		Landing	74	85	71	82	**	**	61	71	71	84	69	81	62	71
8		Take off	79	88	64	79	59	74	62	73	73	84	72	83	58	69
9		Landing	75	87	66	76	**	**	57	72	71	81	66	80	57	68
10		Take off	72	83	62	74	**	**	60	72	73	83	72	80	55	67
11	2A Anti-Clockwise	Landing	71	83	58	72	**	**	**	**	73	86	67	80	57	66
12		Take off	77	86	65	75	53	69	**	**	74	82	63	82	57	68
13		Landing	73	83	60	73	**	**	**	**	72	84	67	80	51	65
14		Take off	78	87	64	75	**	**	**	**	75	84	70	81	57	68
15		Landing	69	83	56	73	**	**	56	72	73	85	66	81	52	65
16		Take off	77	86	67	74	56	69	56	67	75	85	70	81	57	68
17		Landing	70	81	58	71	58	71	60	75	73	84	65	77	55	65
18		Take off	78	87	64	74	57	70	60	71	75	86	70	81	57	66
19		Landing	70	83	59	69	57	70	61	71	71	82	68	77	**	**
20		Take off	77	86	70	77	56	70	61	70	77	87	71	82	56	67
20A	Overflight	To north	66	78	69	77	69	79	66	79	63	76	62	74	63	76

** Interference from extraneous noise

Movement Number	Flight Path	Type	Locn 1		Locn 2		Locn 3		Locn 4		Locn 5		Locn 6		Locn 7	
			Max	SEL	Max	SEL	Max	SEL	Max	SEL	Max	SEL	Max	SEL	Max	SEL
21	2B Landing South Direction, Take Off North Direction	Landing	74	85	64	75	65	76	75	86	73	85	67	80	53	65
22		Take off	70	83	68	79	73	85	74	85	76	88	70	78	57	67
23		Landing	72	87	62	75	65	80	75	88	75	87	70	79	51	61
24		Take off	73	84	69	79	76	86	74	87	76	87	72	79	54	65
25		Landing	71	84	63	75	65	81	77	88	75	85	70	80	48	58
26		Take off	74	85	71	81	73	85	74	87	75	88	68	81	61	70
27		Landing	73	83	64	76	67	80	79	89	75	86	67	81	53	59
28		Take off	73	86	71	80	73	85	73	85	76	89	75	84	60	69
29		Landing	74	85	66	74	64	79	78	88	76	87	71	83	45	56
30		Take off	73	85	69	80	74	86	74	86	75	89	70	81	61	70
31	South	On land	*	*	72	81	60	72	64	72	71	80	67	80	50	62
32	North	On land	87	102	70	79	73	84	74	85	73	83	70	79	55	65
33	North	On land	89	102	73	84	69	82	78	88	77	88	67	78	**	**
34	South	On land	92	105	70	78	55	66	61	69	68	75	68	74	60	68
35	1A Clockwise	Landing	72	85	76	79	60	74	57	65	76	87	70	80	58	67
36		Take off	73	83	67	78	61	72	62	68	75	83	72	81	53	64
37		Landing	76	86	67	79	56	66	61	67	73	82	65	78	59	70
38		Take off	77	86	66	77	62	71	64	70	75	86	73	83	53	66
39		Landing	74	86	66	78	54	60	60	74	73	86	68	81	56	67
40		Take off	76	84	70	80	60	70	62	70	75	85	70	82	55	65
41		Landing	74	86	65	76	55	69	57	67	76	84	69	80	54	67
42		Take off	72	83	65	78	60	72	64	72	75	88	74	83	55	66
43		Landing	74	85	65	77	55	70	61	73	75	89	66	78	51	64
44		Take off	73	84	68	78	59	70	64	73	75	84	73	82	51	64

* Meter reset (no measurement)

** Interference from extraneous noise

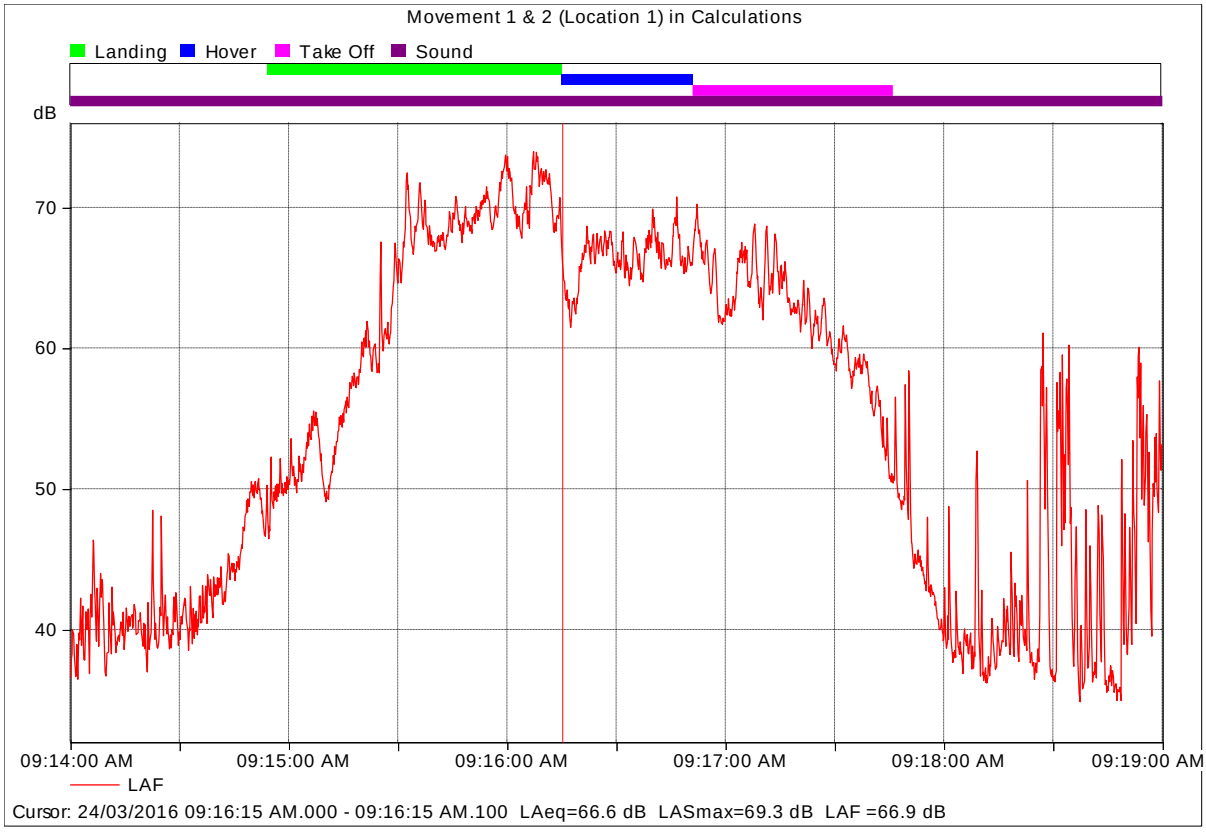
Movement Number	Flight Path	Type	Locn 1		Locn 2		Locn 3		Locn 4		Locn 5		Locn 6		Locn 7	
			Max	SEL	Max	SEL	Max	SEL	Max	SEL	Max	SEL	Max	SEL	Max	SEL
45	1A Anti-clockwise	Landing	67	79	62	75	61	72	62	74	71	84	70	81	51	64
46		Take off	73	84	69	77	57	71	59	72	70	82	69	77	52	64
47		Landing	68	80	66	76	56	69	64	74	73	84	71	81	53	64
48		Take off	72	84	67	76	57	71	60	71	72	82	72	78	53	66
49		Landing	66	80	63	77	57	68	63	72	74	83	72	82	56	65
50		Take off	73	85	71	79	61	73	63	72	72	83	69	78	55	66
51		Landing	69	79	65	78	63	73	63	73	71	82	68	80	52	65
52		Take off	73	84	71	75	59	73	64	74	72	84	68	79	53	66
53		Landing	68	79	70	79	58	71	62	74	74	88	68	81	55	66
54		Take off	74	84	69	77	59	72	58	71	71	80	66	77	56	67
54A	Overflight	To north	72	81	71	80	72	81	72	81	67	79	67	77	61	73
55	1B Landing from South, Take off to North	Landing	71	81	66	79	67	81	76	89	72	81	67	77	43	57
56		Take off	74	82	70	82	74	85	74	85	75	86	71	79	64	72
57		Landing	71	80	69	80	67	81	77	89	76	90	68	77	47	59
58		Take off	77	84	70	81	74	86	73	86	76	87	69	79	58	67
59		Landing	70	80	69	80	67	81	77	88	74	87	69	78	46	58
60		Take off	77	85	73	82	72	84	73	85	75	86	70	79	59	70
61		Landing	70	81	69	81	69	81	77	89	73	87	69	78	46	60
62		Take off	73	83	72	82	71	84	72	85	72	85	70	80	56	68
63		Landing	71	81	72	80	66	80	77	88	76	88	66	77	44	59
64		Take off	73	83	74	82	73	84	72	85	75	87	71	77	58	68

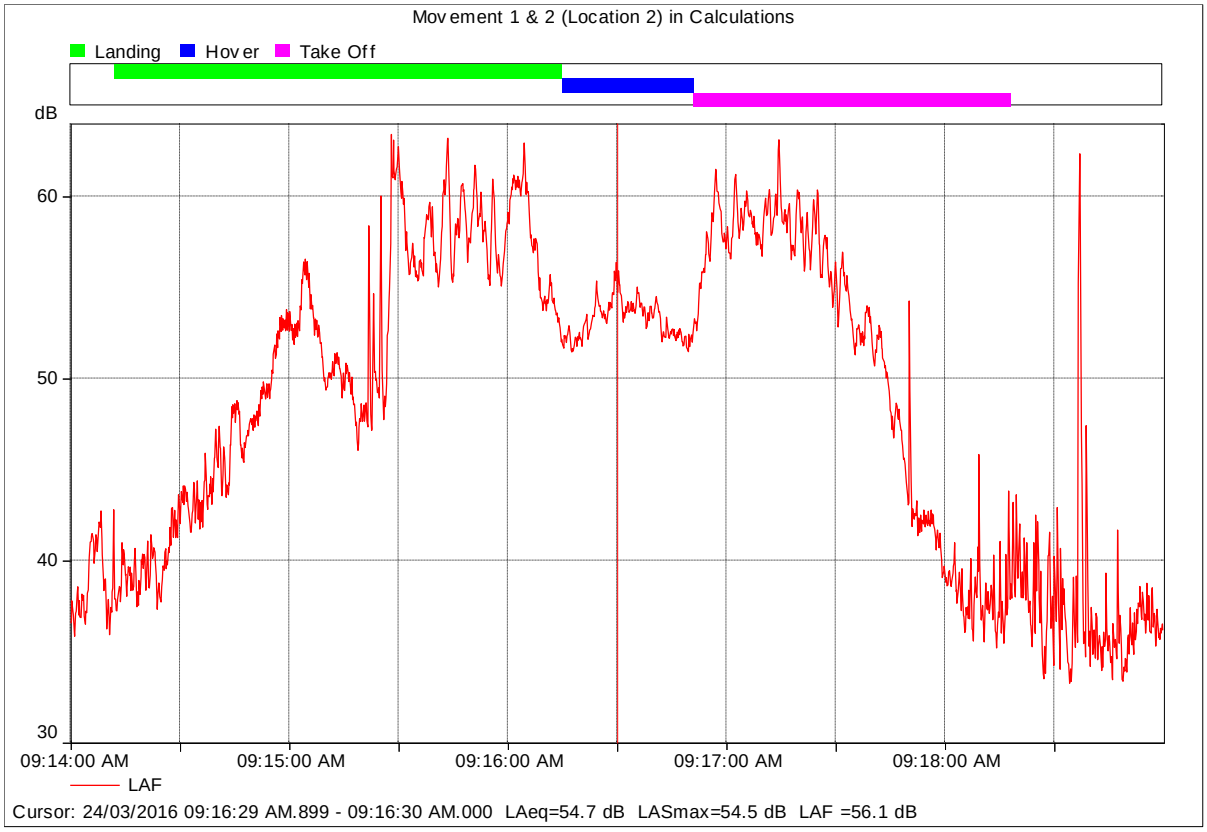
Summary Table - Log average

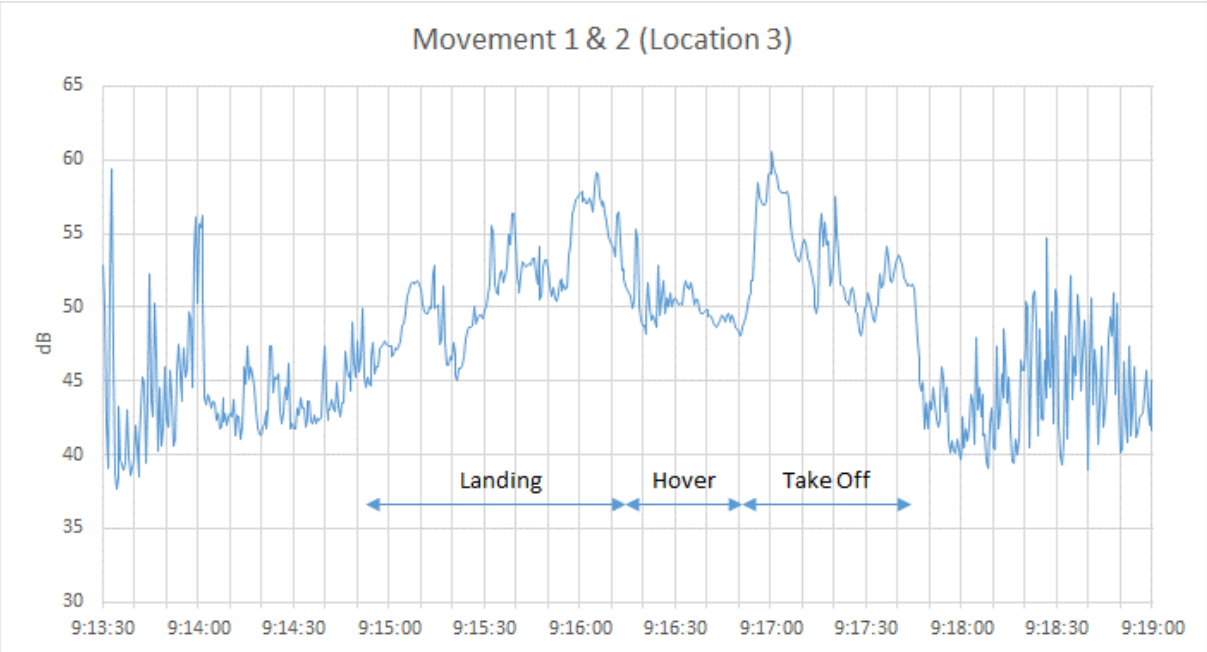
Location	Flight Path	Direction	Take off		Landing		Overflight	
			Max	SEL	Max	SEL	Max	SEL
1	2A	Clockwise	75	85.8	74	86.6	-	-
	2A	Anticlockwise	77	86.3	71	82.5	-	-
	2B	North	73	84.8	-	-	-	-
	2B	South	-	-	73	84.9	-	-
	Overflight 1000 ft	North	-	-	-	-	66	77.6
	1A	Clockwise	75	84.3	74	85.6	-	-
	1A	Anticlockwise	73	84.2	68	79.4	-	-
	1B	North	75	83.5	-	-	-	-
	1B	South	-	-	71	80.7	-	-
	Overflight 500 ft		-	-	-	-	72	81.4
2	2A	Clockwise	65	76.0	67	77.8	-	-
	2A	Anticlockwise	67	75.4	58	71.8	-	-
	2B	North	70	79.9	-	-	-	-
	2B	South	-	-	64	75.1	-	-
	Overflight 1000 ft	North	-	-	-	-	62	74.4
	1A	Clockwise	68	78.0	70	77.9	-	-
	1A	Anticlockwise	70	77.0	66	77.1	-	-
	1B	North	72	81.5	-	-	-	-
	1B	South	-	-	69	80.0	-	-
	Overflight 500 ft		-	-	-	-	71	79.5
3	2A	Clockwise	60	72.4	59	72.0	-	-
	2A	Anticlockwise	57	69.5	58	70.6	-	-
	2B	North	74	85.4	-	-	-	-
	2B	South	-	-	65	79.5	-	-
	Overflight 1000 ft	North	-	-	-	-	69	79
	1A	Clockwise	61	71.1	57	69.8	-	-
	1A	Anticlockwise	59	69.6	60	71.0	-	-
	1B	North	73	84.7	-	-	-	-
	1B	South	-	-	67	80.9	-	-
	Overflight 500 ft		-	-	-	-	72	81
4	2A	Clockwise	64	73.1	61	72.7	-	-
	2A	Anticlockwise	60	70	60	73.0	-	-
	2B	North	74	86.1	-	-	-	-
	2B	South	-	-	77	87.9	-	-
	Overflight 1000 ft	North	-	-	-	-	66	79
	1A	Clockwise	63	70.9	60	70.7	-	-
	1A	Anticlockwise	61	72.2	63	73.5	-	-

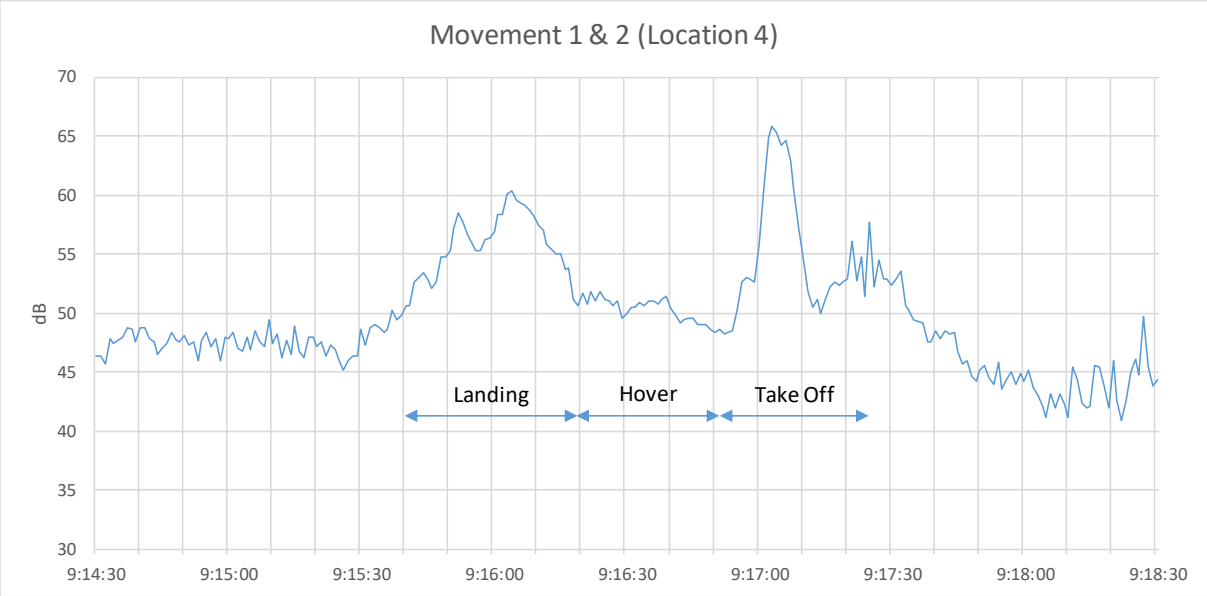
Location	Flight Path	Direction	Take off		Landing		Overflight	
			Max	SEL	Max	SEL	Max	SEL
	1B	North	73	85.2	-	-	-	-
	1B	South	-	-	77	88.6	-	-
	Overflight 500 ft		-	-	-	-	72	81
5	2A	Clockwise	75	84.3	73	83.8	-	-
	2A	Anticlockwise	75	85.1	73	84.4	-	-
	2B	North	76	88.3	-	-	-	-
	2B	South	-	-	75	86.1	-	-
	Overflight 1000 ft	North	-	-	-	-	63	76
	1A	Clockwise	75	85.5	75	86.3	-	-
	1A	Anticlockwise	72	82.4	73	84.8	-	-
	1B	North	75	86.3	-	-	-	-
	1B	South	-	-	75	87.4		
	Overflight 500 ft		-	-	-	-	67	79
6	2A	Clockwise	72	82.7	69	80.5	-	-
	2A	Anticlockwise	70	81.4	67	79.4	-	-
	2B	North	72	80.9	-	-	-	-
	2B	South	-	-	69	80.8	-	-
	Overflight 1000 ft	North	-	-	-	-	62	74.4
	1A	Clockwise	73	82.0	68	79.6	-	-
	1A	Anticlockwise	69	77.9	70	80.8	-	-
	1B	North	70	78.8	-	-	-	-
	1B	South	-	-	68	77.6	-	-
	Overflight 500 ft		-	-	-	-	67	79.5
7	2A	Clockwise	59	69.2	64	70.7	-	-
	2A	Anticlockwise	57	67.5	54	65.3	-	-
	2B	North	59	68.6	-	-		
	2B	South	-	-	51	61.0	-	-
	Overflight 1000 ft	North	-	-	-	-	63	76
	1A	Clockwise	54	65.1	56	67.4	-	-
	1A	Anticlockwise	54	65.9	54	64.9	-	-
	1B	North	60	69.4	-	-	-	-
	1B	South	-	-	45	58.7	-	-
	Overflight 500 Ft		-	-	-	-	61	73

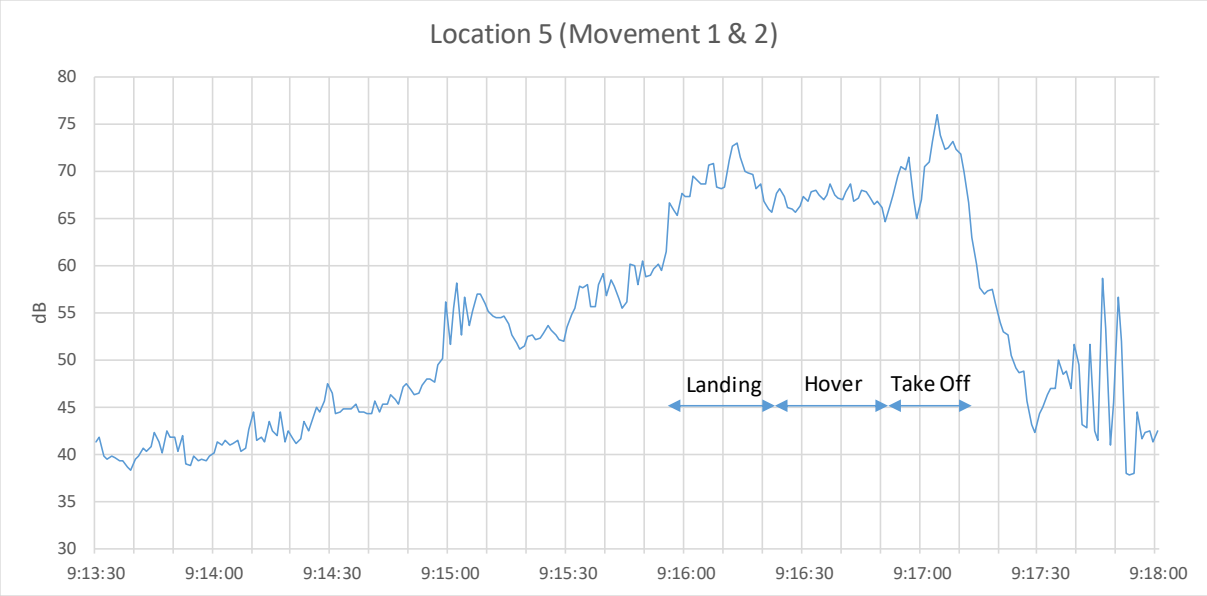
APPENDIX F: Measurement Results
2A Clockwise

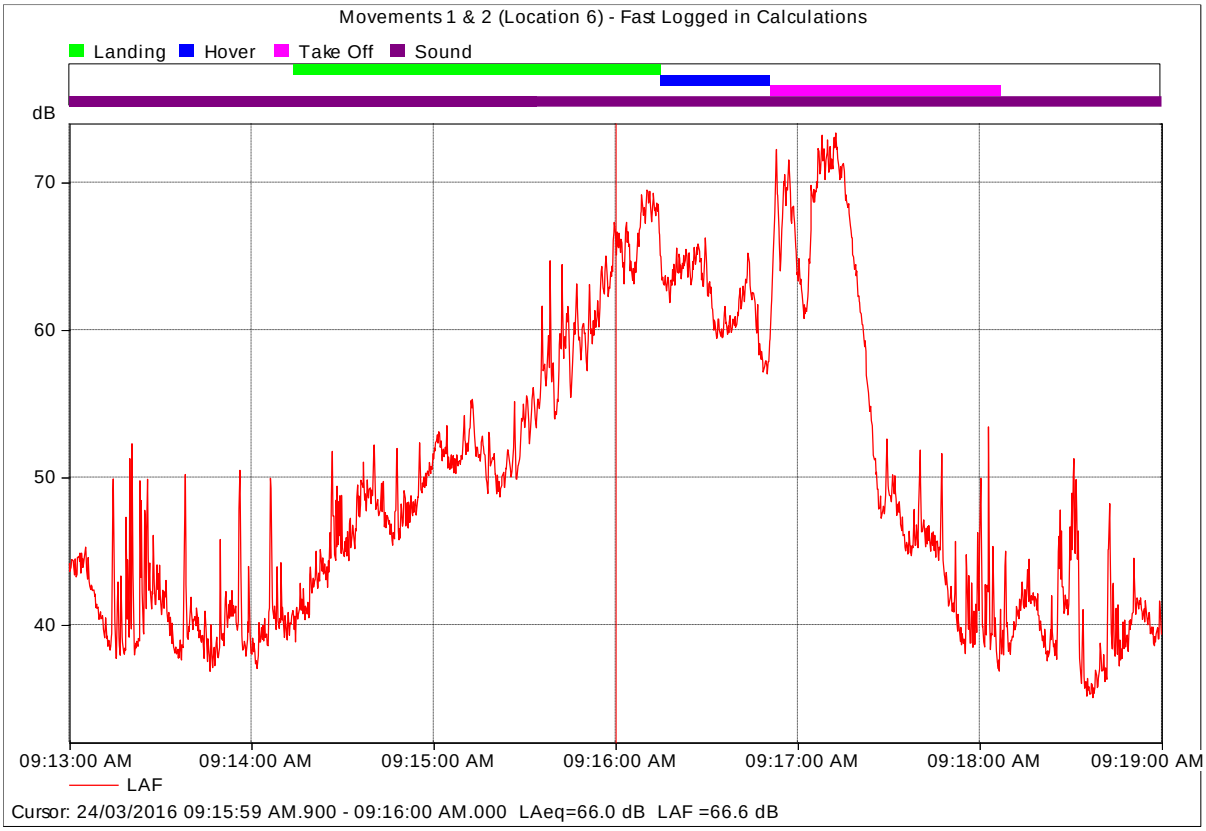


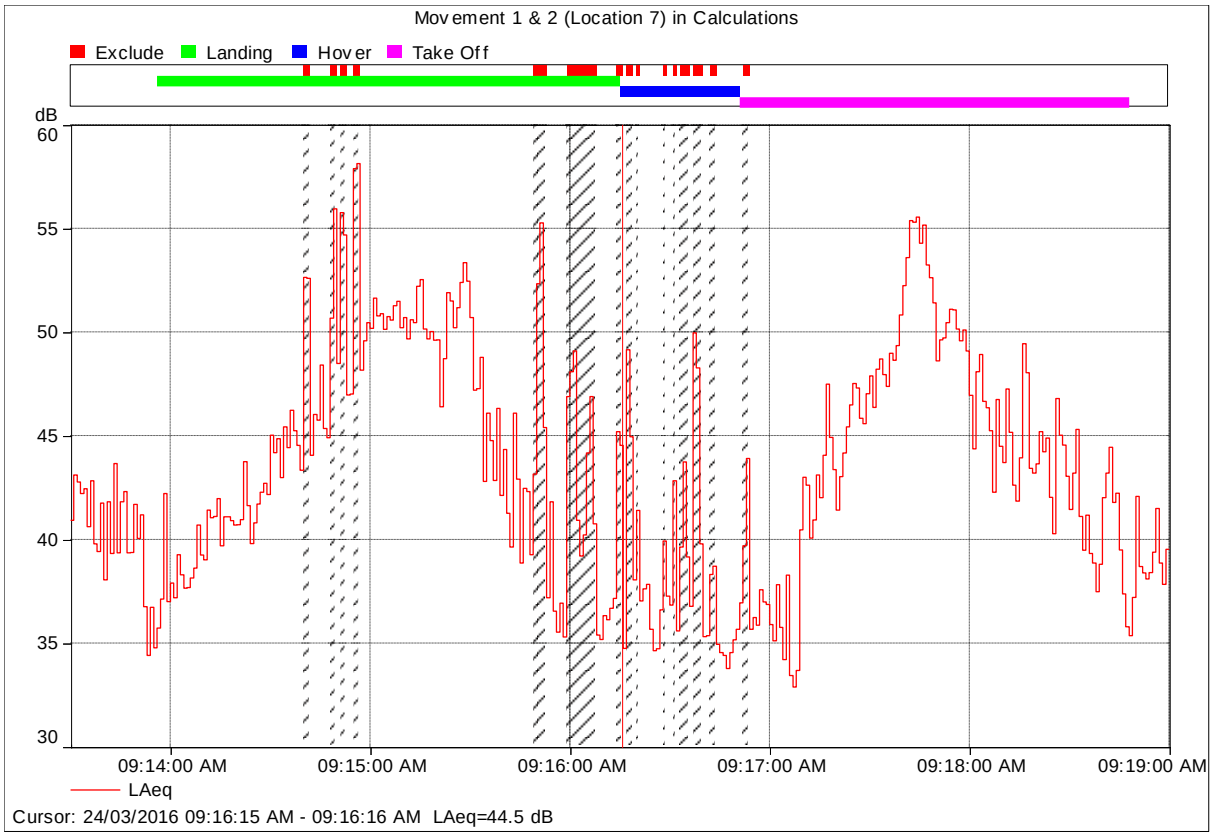



Movement 1 & 2 (Location 3)
dB
65
60
55
50
45
40
35
30
9:13:30
9:14:00
9:14:30
9:15:00
9:15:30
9:16:00
9:16:30
9:17:00
9:17:30
9:18:00
9:18:30
9:19:00
Landing
Hover
Take Off


Movement 1 & 2 (Location 4)
dB
70
65
60
55
50
45
40
35
30
9:14:30
9:15:00
9:15:30
9:16:00
9:16:30
9:17:00
9:17:30
9:18:00
9:18:30
Landing
Hover
Take Off

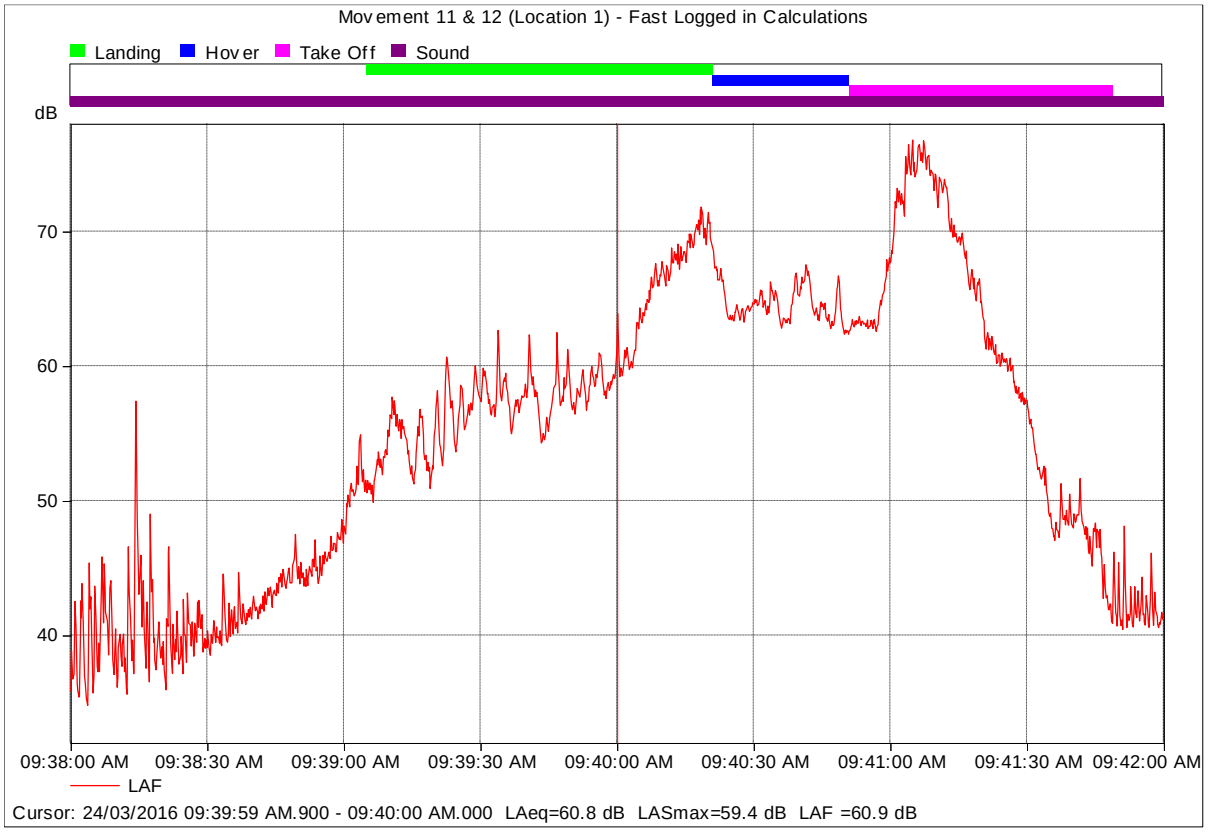

Location 5 (Movement 1 & 2)
dB
80
75
70
65
60
55
50
45
40
35
30
9:13:30
9:14:00
9:14:30
9:15:00
9:15:30
9:16:00
9:16:30
9:17:00
9:17:30
9:18:00
Landing
Hover
Take Off

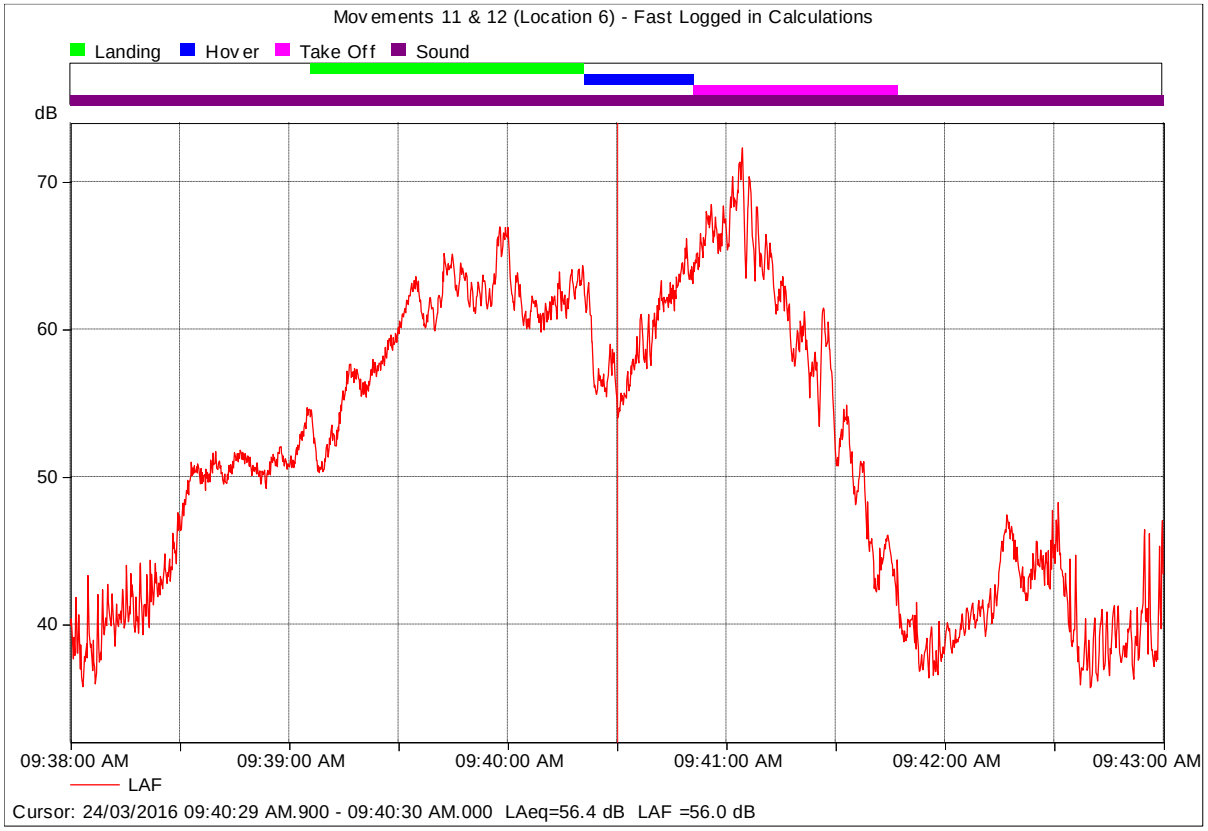

Movements 1 & 2 (Location 6) - Fast Logged in Calculations
Landing
Hover
Take Off
Sound
dB
70
60
50
40
09:13:00 AM
09:14:00 AM
09:15:00 AM
09:16:00 AM
09:17:00 AM
09:18:00 AM
09:19:00 AM
LAF
Cursor: 24/03/2016 09:15:59 AM.900 - 09:16:00 AM.000 LAeq=66.0 dB LAF =66.6 dB


Movement 1 & 2 (Location 7) in Calculations
Exclude
Landing
Hover
Take Off
dB
60
55
50
45
40
35
30
09:14:00 AM
09:15:00 AM
09:16:00 AM
09:17:00 AM
09:18:00 AM
09:19:00 AM
LAeq
Cursor: 24/03/2016 09:16:15 AM - 09:16:16 AM LAeq=44.5 dB

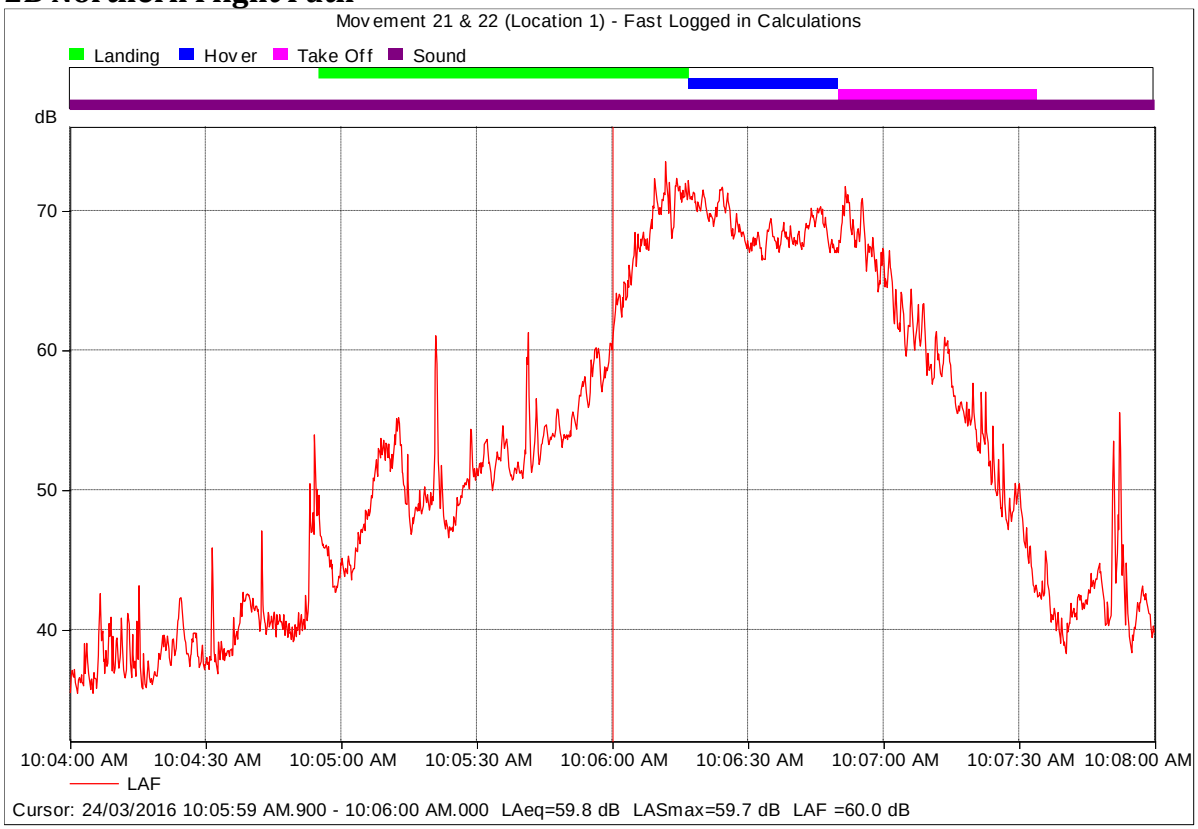
		Movement 1 with hover component	Movement 1 without hover component	Movement 2 with Hover Component	Movement 2 without Hover Component	Hover
Location 1	Max dB(A)	74.0	74.0	70.7	70.2	70.7
	SEL dB(A)	87.4	86.8	84.1	81.1	82.2
Location 2	Max dB(A)	63.4	63.4	63.1	63.1	56.4
	SEL dB(A)	76.3	76.1	75.4	74.8	68.9
Location 3	Max dB(A)	59.2	59.2	60.5	60.5	52.8
	SEL dB(A)	72.5	72.0	72.1	71.7	65.6
Location 4	Max dB(A)	60.4	60.4	65.9	65.9	51.9
	SEL dB(A)	72.9	72.5	74.4	73.8	65.5
Location 5	Max dB(A)	72.9	72.9	76.0	76.0	68.7
	SEL dB(A)	84.7	83.4	85.5	84.4	81.9
Location 6	Max dB(A)	69.5	69.5	73.3	73.3	65.8
	SEL dB(A)	81.7	80.5	84.2	83.9	78.2
Location 7	Max dB(A)	53.3	53.3	55.5	55.5	38.0
	SEL dB(A)	67.6	67.6	68.0	68.0	48.9

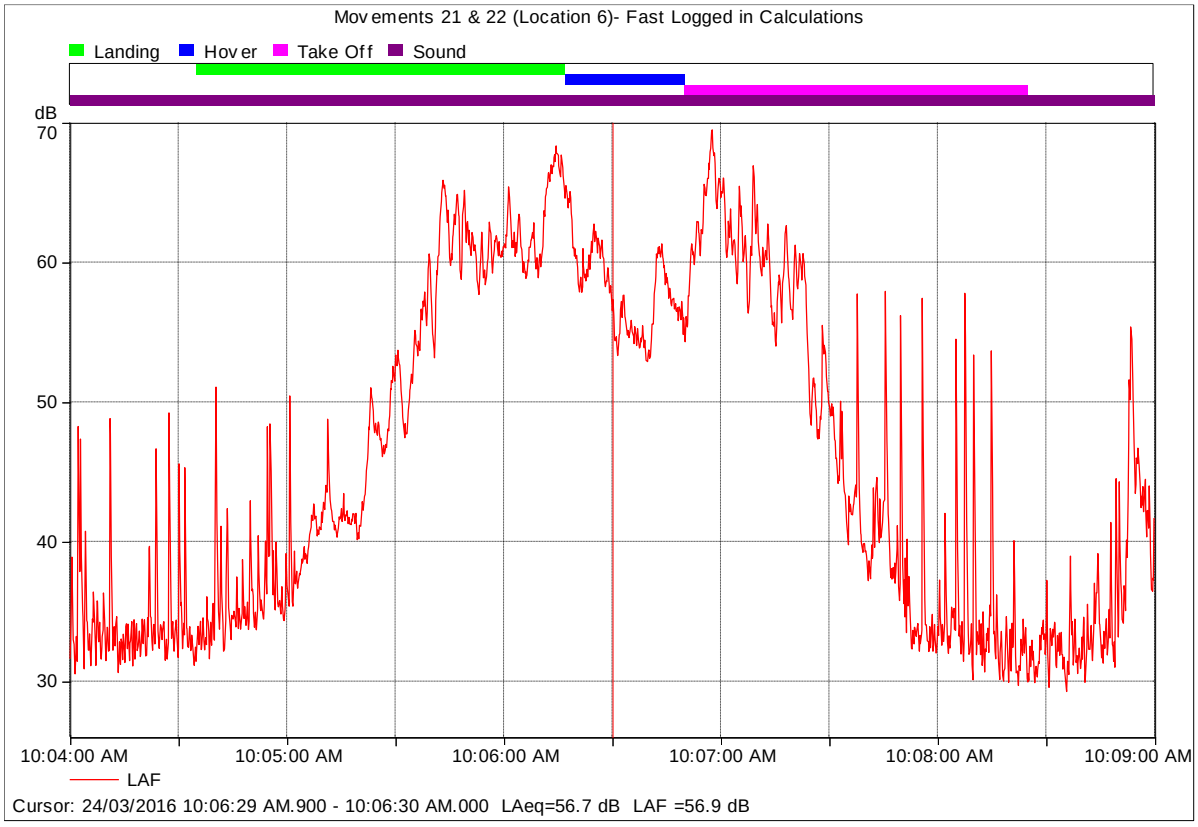
2A Anti-Clockwise

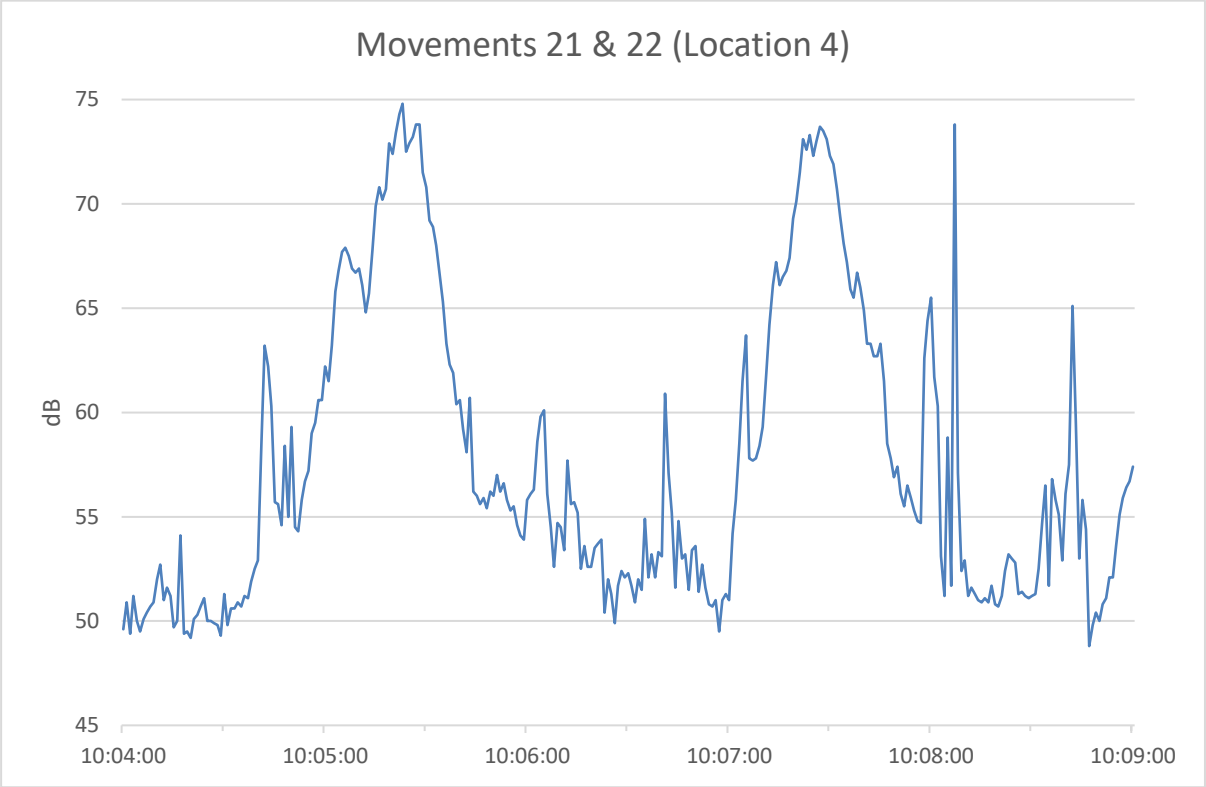




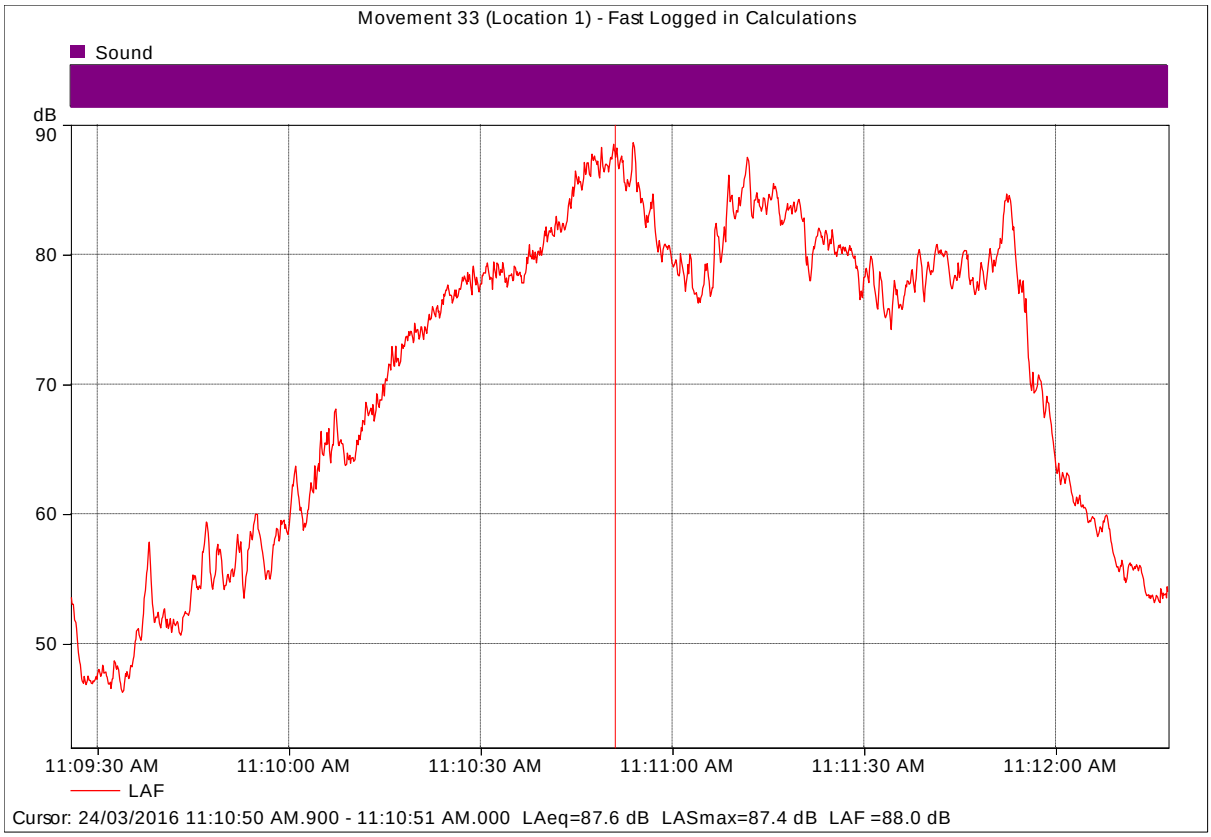
2B Northern Flight Path

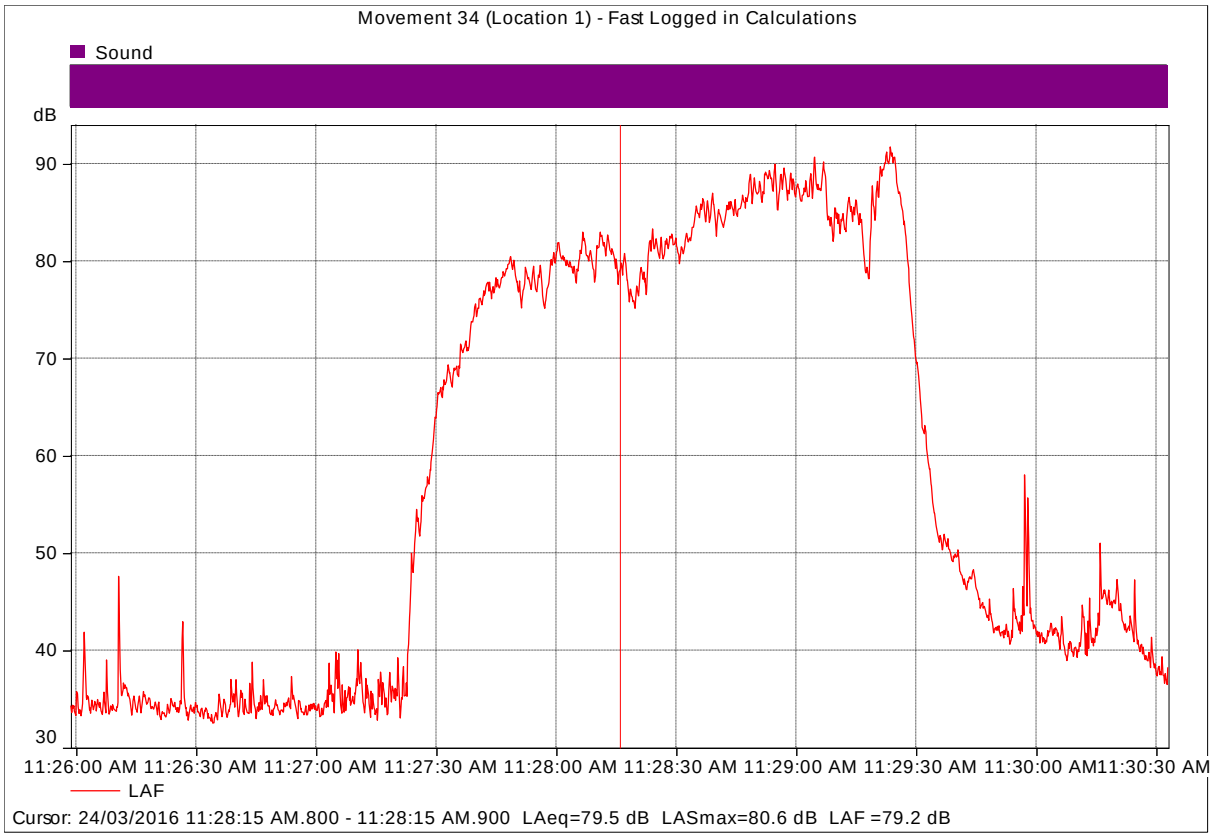


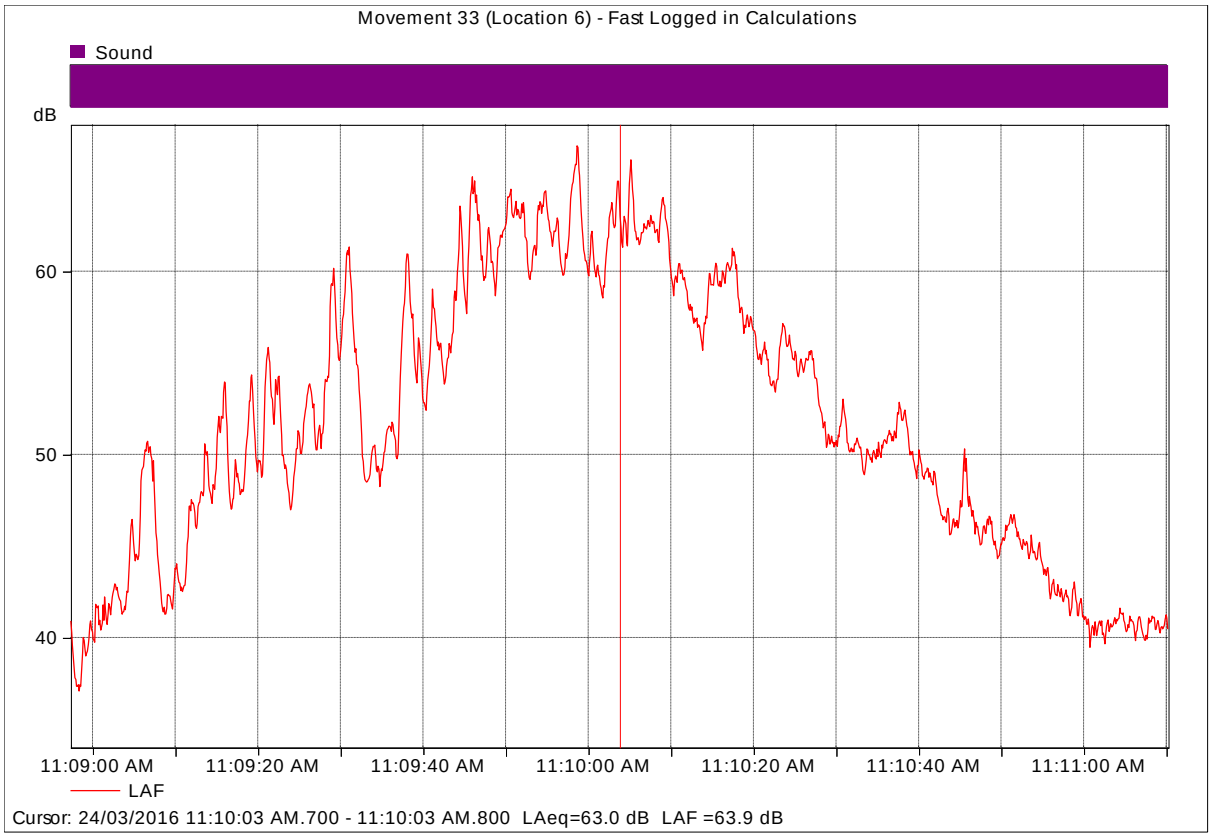


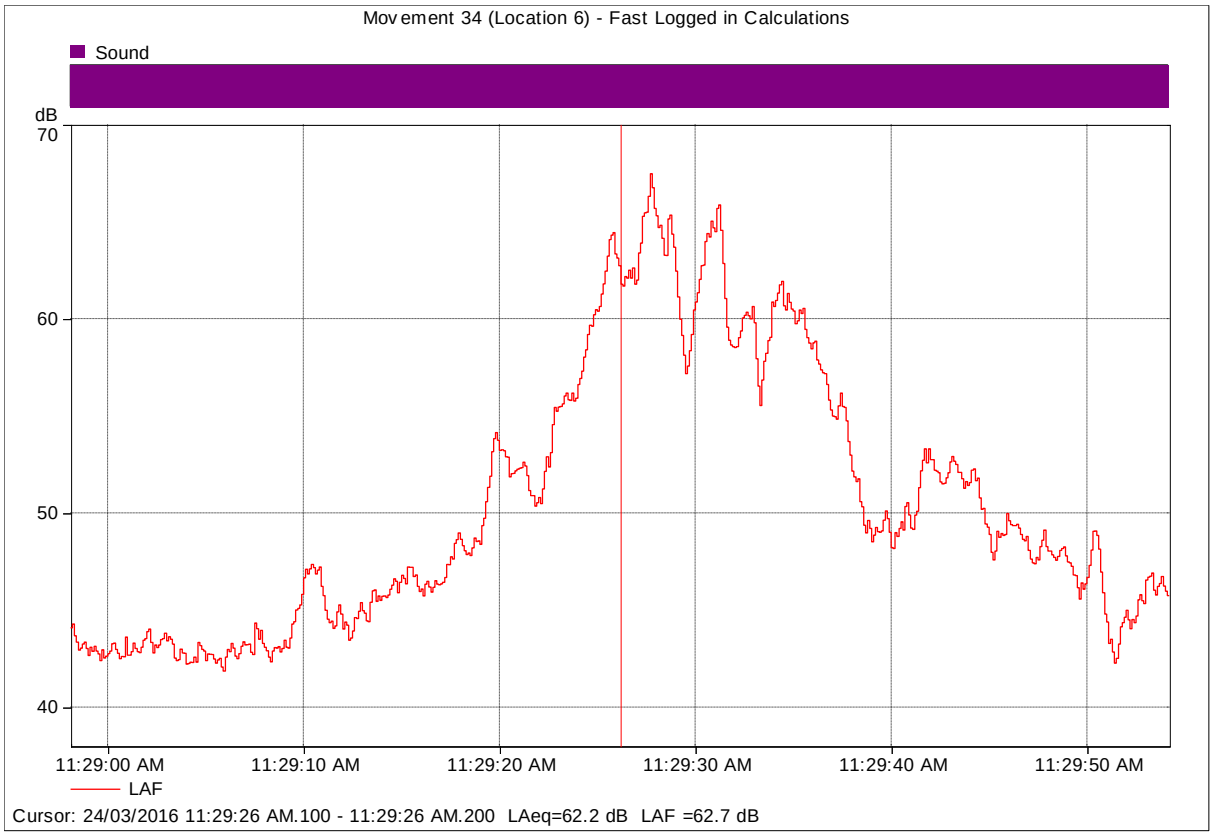


	Location 1		Location 4		Location 6	
	Max dB(A)	SEL dB(A)	Max dB(A)	SEL dB(A)	Max dB(A)	SEL dB(A)
Movement 21	74	81.8	75	86.1	68	78.8
Movement 21 with hover component	-	84.5	-	86.1	-	79.6
Movement 22	72	79.9	74	85.1	66	77.8
Movement 22 with hover component	-	83.2	-	85.1	-	78.4
Hover	72	84.2	61	68.8	70	74.2


Movement 33 (Location 1) - Fast Logged in Calculations
Sound
dB
90
80
70
60
50
11:09:30 AM
11:10:00 AM
11:10:30 AM
11:11:00 AM
11:11:30 AM
11:12:00 AM
LAF
Cursor: 24/03/2016 11:10:50 AM.900 - 11:10:51 AM.000 LAeq=87.6 dB LASmax=87.4 dB LAF =88.0 dB


Movement 34 (Location 1) - Fast Logged in Calculations
Sound
dB
90
80
70
60
50
40
30
11:26:00 AM
11:26:30 AM
11:27:00 AM
11:27:30 AM
11:28:00 AM
11:28:30 AM
11:29:00 AM
11:29:30 AM
11:30:00 AM
11:30:30 AM
LAF
Cursor: 24/03/2016 11:28:15 AM.800 - 11:28:15 AM.900 LAeq=79.5 dB LASmax=80.6 dB LAF =79.2 dB


Movement 33 (Location 6) - Fast Logged in Calculations
Sound
dB
60
50
40
11:09:00 AM
11:09:20 AM
11:09:40 AM
11:10:00 AM
11:10:20 AM
11:10:40 AM
11:11:00 AM
LAF
Cursor: 24/03/2016 11:10:03 AM.700 - 11:10:03 AM.800 LAeq=63.0 dB LAF =63.9 dB


Movement 34 (Location 6) - Fast Logged in Calculations
Sound
dB
70
60
50
40
11:29:00 AM
11:29:10 AM
11:29:20 AM
11:29:30 AM
11:29:40 AM
11:29:50 AM
LAF
Cursor: 24/03/2016 11:29:26 AM.100 - 11:29:26 AM.200 LAeq=62.2 dB LAF =62.7 dB

	Location 1		Location 4		Location 6	
	Max dB(A)	SEL dB(A)	Max dB(A)	SEL dB(A)	Max dB(A)	SEL dB(A)
Movement 11	72	81.5	**	**	67	80.3
Movement 11 with hover component	-	82.9	**	**	-	80.3
Movement 12	77	86.1	**	**	72	81.2
Movement 12 with hover component	-	86.2	**	**	-	82.1
Hover	69	79.6	**	**	66	75.3
Movement 33 (landing onto land)	88	102	-	-	67	78
Movement 34 (take-off from land)	92	105	-	-	68	74

** Means interference by extraneous noise

APPENDIX G: Extract from Lithgow Council Report re: Capertee Heliport

proposed to relocate some of the resort facilities into land that is owned by the Department of Environment and Conservation that forms part of the Wollemi National Park.

Emirates and the Department of Environment and Conservation have negotiated a land swap with an interim lease of the National Park land. The Department of Planning assessed the merits of the project and was satisfied that it would not generate unacceptable impacts on the surrounding area. Subsequently, the modification was approved subject to conditions.

Council has been successful in negotiations with Emirates to process the Construction Certificate for the project. This is a major achievement as these large projects are usually won by private certifiers acting for the owner. A number of meetings have been held with the developer in this regard.

POLICY IMPLICATIONS
Nil

FINANCIAL IMPLICATIONS
The contribution towards the cost of upgrading the Wolgan Road is currently being negotiated between the parties.

LEGAL IMPLICATIONS
Nil

ATTACHMENTS

1. Copy of the Modification Approvals from the Department of Planning.

RECOMMENDATION

THAT the information be noted.

ITEM:7 **REG - 04/06/07 - DA 319/06 CONSTRUCTION AND OPERATION OF HELIPORT - CASTLEREAGH HWY, CAPERTEE**

REPORTED BY: ANDREW MUIR – GROUP MANAGER REGIONAL SERVICES

REFERENCE
Min 07-94: Finance and Services Committee 5 March 2007 (DA 319-06) – calling in the development application.

Noise from the proposed operation of a heliport at the site is considered the major impact of the proposal. The EIS has indicated that several noise abatement procedures will be implemented under the proposal. They include:

- "Blade Slap" will be avoided (in accordance with the Robinson Helicopters noise abatement guidelines).
- Departure from and approach to the landing site is to be direct.
- Prolonged flight over residential dwellings is to be avoided.
- Flight paths are to be varied so that the same buildings are not repeatedly subjected to the impacts of the operations.
- Flight is to be above 500ft AGL, and will be preferably above 1000ft AGL.
- Scenic joyflight operations will occur between the hours of 7.00am and 7.00pm. Bushfire emergencies and other circumstances (eg: check flights, Sydney transit) may mean flights will occur at other times.

The appropriate regulatory authority (in this case the Department of Environment and Conservation) may at any time issue, in writing, a noise control notice prohibiting a specified activity or operation of a specified article (in this case a helicopter) in such a manner as to cause emission from the premises. This notice may specify times or days during which the emission, when measured at any specified point, must not exceed a specified level. In this particular case the operation of a heliport is subject to approval being issued by the Department of Environment and Conservation (DEC). As such, General Terms of Approval (GTA) must be issued by the DEC prior to any final assessment of the proposal by Council. This has occurred.

It was a requirement of the development application that an assessment was made of the noise emission resulting from all the ground borne operations of a helicopter operating at the site. Noise level measurements were undertaken on 7 March 2005 at the critical receiver locations of warm up and initial take off, landing and the staged cool down procedure of the helicopter operation. The report was submitted by PKA Acoustic Consulting using a Robinson R22 helicopter. A supplementary report dated June 2006 by PKA Acoustic Consulting has also been submitted utilising both a Robinson 44 and Bell 47 Helicopter. Results of that report indicate that the ground borne noise output allows for their operation at the proposed site. Thus any conditions of approval will be limited to the type of helicopter proposed.

Natural & Man Made Hazards – running operations such as restocking hangar fuel supplies, helicopter refuelling and maintenance present potential for a chemical (fuel) spill. Appropriate bunding will be installed to cover the possibility of environmental harm via a spillage. Operations at night will be kept to a minimum, however low level light pollution may occur at times. Screening the landing site with vegetation will potentially ameliorate or minimise this impact.

Vibration – although separate to the land use issues relevant to this application, the impact of vibration at very low altitudes (whilst not proposed) may have the potential to cause cliff collapse. It is considered that if approval is given then mechanisms be put in place such as a Fly Neighbourly Policy to help address this concern.

Flora & Fauna – Flora, fauna and habitat values at the site were assessed in the EIS. Given that the proposal will develop lands presently cleared and presenting very poor

(h) the pilot of the aircraft is engaged in an operation which requires the dropping of packages or other articles or substances in accordance with directions issued by CASA.

These stipulations will be encumbrances on the applicant should development consent be considered.

Department of Environment & Conservation (Environmental Protection Unit)

The General Terms of approval issued by the DEC are attached as part of Schedule 1 of the recommendations.

In their correspondence the DEC indicated that in assessing the proposal and reviewing the public submissions, as with the first Development Application (DA 22-05) the EPA again identified the potential impact of noise on the amenity of the residents of the Capertee Valley and the surrounding areas as an important issue. Lithgow City Council should consider the issue in its overall assessment of the application. The noise from helicopters in flight is outside the control of the EPA; nevertheless, it is apparent from the public submissions that noise from helicopters in the air is the overwhelming impact of concern for people who made submissions objecting to the proposed development.

The Department of Environment & Conservation (Threatened Species Unit)
Information received from the Threatened Species Unit of the DEC led to Council forwarding the information to the Commonwealth Department of Environment and Heritage.

The Commonwealth Department of Environment and Heritage
In correspondence received from the Department of Environment and Heritage it was found that after careful examination of the development application information the Department has concluded that the impact the proposal would have on the Regent Honeyeater, in this case, is unlikely to be significant. The Department therefore concluded that they do not propose to take any compliance action

The public interest
The approval of such an application is of particular public interest . Council has received substantial objection pertaining to the application with the predominant objection being related to airborne noise and privacy. Council being a landuse authority has limited compliance authority over airborne activity, however through the applicant's undertakings in the EIS it is proposed to implement conditions to minimise these potential concerns. Having community input into the preparation of a Fly Neighbourly Policy (FNP) can also help minimise these potential concerns.

DISCUSSION AND CONCLUSIONS
The development application has been the subject of much public interest. Issues relating to potential impacts of the helicopter whilst in the air and the relevant controlling authority have led to the conclusion that Council's responsibility lies in the impacts directly related to the landuse. Notwithstanding this, after extensive consultation and assessment it has been concluded that development consent can be granted subject to a number of conditions. These include limiting the number of flights and also placing a sunset condition limiting the operation to 5 years. However, the option is given to the

Environment Protect Licence - Protection of the Environment Operations Act 1997

General Terms of Approval

Notice No: 1070080

ATTACHMENT A

ADMINISTRATIVE CONDITIONS

Note: Mandatory conditions for all general terms of approval

A1. Information supplied to the EPA

A1.1 Except as expressly provided by these general terms of approval, works and activities must be carried out in accordance with the proposal contained in:

- the development application DA No. 319/06 submitted to Lithgow City Council on 2 January 2007
- the Environmental Impact Statement for Proposed Heliport Capertee (December 2006) by Mjadwesch Environmental Service Support relating to the development; and
- all additional documents supplied to the EPA in relation to the development, including: Supplement to Acoustic Report 205 042 R01 Ground Measurements of Various Helicopters (Project 205 04) June 2006.

A2. Fit and Proper Person

A2.1 The applicant must, in the opinion of the EPA, be a fit and proper person to hold a licence under the Protection of the Environment Operations Act 1997, having regard to the matters in s.83 of that Act.

Limit conditions

L1. Pollution of waters

L.1.1 Except as may be expressly provided by a licence under the Protection of the Environment Operations Act 1997 in relation of the development, section 120 of the Protection of the Environment Operations Act 1997 must be complied with in and in connection with the carrying out of the development.

L5. Waste

L5.1 The licensee must not cause, permit or allow any waste generated outside the premises to be received at the premises for storage, treatment, processing, reprocessing or disposal or any waste generated at the premises to be disposed of at the premises, except as expressly permitted by a licence under the Protection of the Environment Operations Act 1997.

L5.2 This condition only applies to the storage, treatment, processing, reprocessing or disposal of waste at the premises if it requires an environment protection licence under the Protection of the Environment Operations Act 1997.

Environment Protection Authority - NSW

Page 1 of 7

Environment Protect Licence - Protection of the Environment Operations Act 1997

General Terms of Approval

Notice No. 1070000

L6. Noise limits

L6.1 Noise generated at the premises must not exceed the noise limits presented in the table below:

Noise Limits (dB(A))

Location	Day	Evening	Night	Night
	$L_{Aeq(15\ minute)}$	$L_{Aeq(evening)}$	$L_{Aeq(15\ minute)}$	$L_{A1,\ 1\ minute}$
Receiver 1 No. 4564	*37 dB(A)*	*37 dB(A)*	*35 dB(A)*	*45 dB(A)*
Receiver 2 "Koora"	*38 dB(A)*	*38 dB(A)*	*35 dB(A)*	*45 dB(A)*
Receiver 3 Capentee "Kraal" and other noise sensitive receiver	*35 dB(A)*	*35 dB(A)*	*35 dB(A)*	*45 dB(A)*

L6.2 For the purpose of Condition 6.1:

- Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm, Sundays and Public Holidays.
- Evening is defined as the period from 6pm to 10pm,
- Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sundays and Public Holidays.

L6.3 Noise from the premises is to be measured within the most affected point on or within the residential boundary or at the most affected point within 30 meters of the dwelling (rural situations) where the dwelling is more than 30 meters form the boundary to determine compliance with the $L_{Aeq(15\ minute)}$ noise limits in condition L6.1.

Where it can be demonstrated that direct measurement of noise from the premises is impractical, the EPA may accept alternative means of determining compliance. See Chapter 11 of the NSW Industrial Noise Policy.

The modification factors presented in Section 4 of the NSW Industrial Noise Policy shall also be applied to the measured noise level where applicable.

L6.4 Noise from the premises is to be measured at 1m from the dwelling façade to determine compliance with the $L_{A1(1\ minute)}$ noise limits in condition L6.1.

L6.5 The noise emissions limits identified in condition **L6.1** apply under meteorological conditions of:

- wind speeds up to 3 m/s at 10 metres above ground level for the day and evening period; and
- temperature inversion conditions of up to 3°C/100m and wind speeds up to 2 m/s at 10 metres above ground level for night time.

Environment Protection Authority - NSW

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Notice No: 1070939

L6.6 The proponent shall develop and implement a Noise Management Plan that addresses noise impacts from the heliport ground operations. The Plan should include, but not necessarily be limited to:

- Licence limits for noise;
- Approved hours of operation;
- Scheduling and locating of ground activities such as helicopter maintenance to comply with licence limits for noise and avoiding impacts;
- A system for recording and responding to complaints;
- A site contact person to follow up complaints; and
- Contingency measures when noise complaints are received.

Definition:

L_{eq} is the equivalent continuous noise level – the level of noise equivalent to the energy-average of noise levels emitted by the premises over the stated measurement period.

Operating conditions.

O3. Stormwater/sediment control - Construction Phase

O3.1 An Erosion and Sediment Control Plan (ESCP) must be prepared and implemented. The plan must describe the measures that will be employed to minimise soil erosion and the discharge of sediment and other pollutants to lands and/or waters during construction activities. The ESCP should be prepared in accordance with the requirements for such plans outlined in *Managing Urban Stormwater: Soils and Construction* (available from the Department of Housing).

Reporting conditions

R1.1 The applicant must provide an annual return to the EPA in relation to the development as required by any licence under the Protection of the Environment Operations Act 1997 in relation to the development. In the return the applicant must report on the annual monitoring undertaken (where the activity results in pollutant discharges), provide a summary of complaints relating to the development, report on compliance with licence conditions and provide a calculation of licence fees (administrative fees and, where relevant, load based fees) that are payable. If load based fees apply to the activity the applicant will be required to submit load-based fee calculation worksheets with the return.

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General Terms of Approval

Notice No: 1070080

ATTACHMENT – MANDATORY CONDITIONS FOR ALL EPA LICENCES

ADMINISTRATIVE CONDITIONS

OPERATING CONDITIONS

Activities must be carried out in a competent manner

Licensed activities must be carried out in a competent manner.

- This includes:

  a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and

  b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

Maintenance of plant and equipment

- All plant and equipment installed at the premises or used in connection with the licensed activity:

  a) must be maintained in a proper and efficient condition; and

  b) must be operated in a proper and efficient manner.

MONITORING AND RECORDING CONDITIONS

Recording of pollution complaints

The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.

- The record must include details of the following:

  a) the date and time of the complaint;

  b) the method by which the complaint was made;

  c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;

  d) the nature of the complaint;

  e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and

  f) if no action was taken by the licensee, the reasons why no action was taken.

The record of a complaint must be kept for at least 4 years after the complaint was made.

The record must be produced to any authorised officer of the EPA who asks to see them.

Telephone complaints line

The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.

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Environment Protect Licence - Protection of the Environment Operations Act 1997

General Terms of Approval

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The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.

This condition does not apply until 3 months after this condition takes effect.

REPORTING CONDITIONS

Annual Return documents

What documents must an Annual Return contain?

- The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:

  a) a Statement of Compliance; and

  b) a Monitoring and Complaints Summary.

A copy of the form in which the Annual Return must be supplied to the EPA accompanies this licence. Before the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.

Period covered by Annual Return

An Annual Return must be prepared in respect of each reporting, except as provided below

Note: The term "reporting period" is defined in the dictionary at the end of this licence. Do not complete the Annual Return until after the end of the reporting period.

- Where this licence is transferred from the licensee to a new licensee,

  a) the transferring licensee must prepare an annual return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and

  b) the new licensee must prepare an annual return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.

Note: An application to transfer a licence must be made in the approved form for this purpose.

- Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an annual return in respect of the period commencing on the first day of the reporting period and ending on

  a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or

  b) in relation to the revocation of the licence – the date from which notice revoking the licence operates.

Deadline for Annual Return

The Annual Return for the reporting period must be supplied to the EPA by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').

Licensee must retain copy of Annual Return

The licensee must retain a copy of the annual return supplied to the EPA for a period of at least 4 years after the annual return was due to be supplied to the EPA.

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Environment Protect Licence - Protection of the Environment Operations Act 1997

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Certifying of Statement of Compliance and Signing of Monitoring and Complaints Summary

Within the Annual Return, the Statement of Compliance must be certified and the Monitoring and Complaints Summary must be signed by:

(a) the licence holder; or

(b) by a person approved in writing by the EPA to sign on behalf of the licence holder.

A person who has been given written approval to certify a Statement of Compliance under a licence issued under the Pollution Control Act 1970 is taken to be approved for the purpose of this condition until the date of first review this licence.

Notification of environmental harm

Note: The licensee or its employees must notify the EPA of incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act

Notifications must be made by telephoning the EPA's Pollution Line service on 131 555.

The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.

Written report

Where an authorised officer of the EPA suspects on reasonable grounds that:

(a) where this licence applies to premises, an event has occurred at the premises; or

(b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence,

and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.

The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.

- The request may require a report which includes any or all of the following information:

  a) the cause, time and duration of the event;

  b) the type, volume and concentration of every pollutant discharged as a result of the event;

  c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event; and

  d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort;

  e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants;

  f) (details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event;

  g) (any other relevant matters.

The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.

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Environment Protect Licence - Protection of the Environment Operations Act 1997

General Terms of Approval

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GENERAL CONDITIONS

Copy of licence kept at the premises or on the vehicle or mobile plant

A copy of this licence must be kept at the premises or on the vehicle or mobile plant to which the licence applies.

The licence must be produced to any authorised officer of the EPA who asks to see it.

The licence must be available for inspection by any employee or agent of the licensee working at the premises or operating the vehicle or mobile plant.

APPENDIX H: Location 5 Logger Results (2014)

Trinity Point Development, Lake Macquarie

Job Number: 44.4732.R7
ARL
Instrumentation: Logger
Logger Location: Location 5
Free Field: yes
Monitoring Period: Wednesday 23 July 2014 to Friday 1 August 2014

BACKGROUND AND AMBIENT NOISE MONITORING RESULTS
NSW EPA's INDUSTRIAL NOISE POLICY , 2000

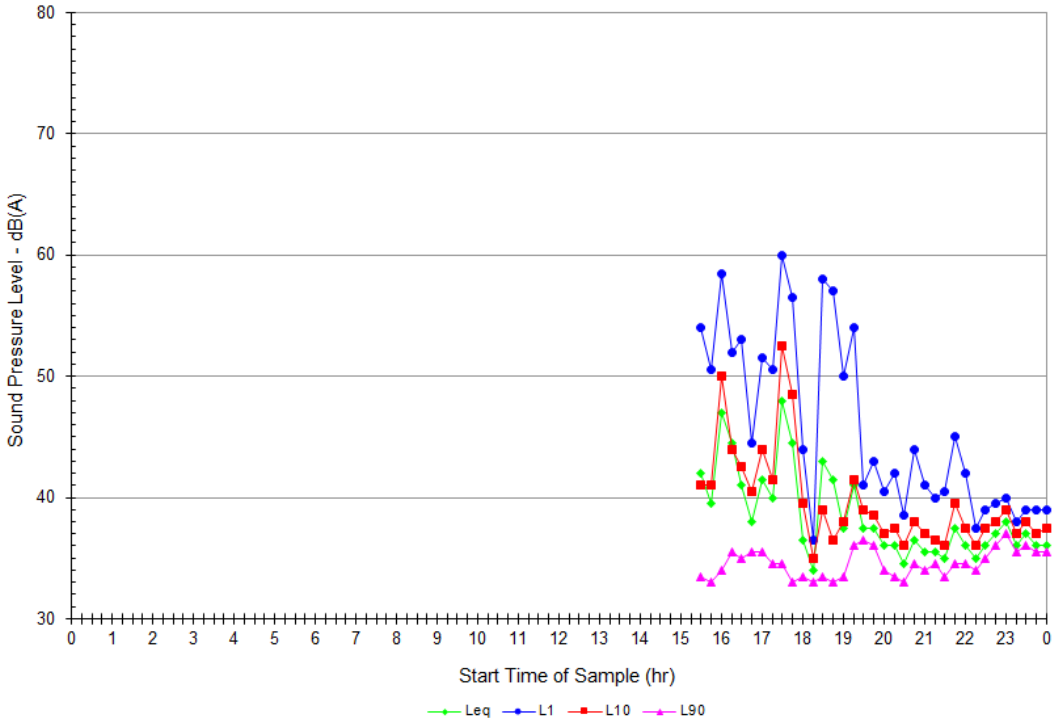
Day	L90 Background Noise Levels			Leq Ambient Noise Levels		
	Day 7am - 6pm	**Evening** 6pm - 10pm	**Night** 10pm - 7am	**Day** 7am - 6pm	**Evening** 6pm - 10pm	**Night** 10pm - 7am
Wednesday 23 July 2014	*	33.0	34.0	*	38.0	39.2
Thursday 24 July 2014	33.5	33.0	33.0	44.0	37.4	38.4
Friday 25 July 2014	37.0	34.0	32.0	46.2	42.2	40.8
Saturday 26 July 2014	35.5	36.5	35.5	44.8	42.0	39.9
Sunday 27 July 2014	33.5	33.5	33.5	45.1	36.7	42.1
Monday 28 July 2014	32.5	34.0	33.0	47.0	39.5	37.6
Tuesday 29 July 2014	35.0	33.5	32.0	46.2	46.8	38.0
Wednesday 30 July 2014	34.5	33.5	33.0	45.2	38.4	37.6
RBL Median	**34.8**	**33.5**	**33.0**	-	-	-
Log Average	**-**	**-**	**-**	**45.7**	**41.9**	**39.4**

TRAFFIC NOISE MONITORING RESULTS
OEH's NSW ROAD TRAFFIC POLICY 2011

Day	Leq Ambient Noise Levels		Leq 1 Hr Noise Levels			
	Day 7am - 10pm	**Night** 10pm - 7am	**Day - Max**	**Day - Min**	**Night - Max**	**Night - Min**
Wednesday 23 July 2014	*	41.7	47.1	*	47.8	37.9
Thursday 24 July 2014	45.4	40.9	50.2	37.0	47.4	36.5
Friday 25 July 2014	48.0	43.3	53.2	42.4	50.3	35.5
Saturday 26 July 2014	46.7	42.4	50.5	41.5	48.4	38.8
Sunday 27 July 2014	46.4	44.6	50.8	38.4	52.8	36.9
Monday 28 July 2014	48.4	40.1	56.8	37.8	46.3	36.3
Tuesday 29 July 2014	48.8	40.5	54.7	37.8	45.8	35.7
Wednesday 30 July 2014	46.7	40.1	54.0	38.1	45.3	36.4
Thursday 31 July 2014	48.5	41.1	51.1	44.6	45.6	35.6
Friday 1 August 2014	*	*	48.1	*	*	*
Log Average	**47.5**	**41.9**	**52.6**	**40.6**	**48.5**	**36.8**

* indicates an incomplete set of data for a given time period
# Nighttime for a given day continues through to the following morning

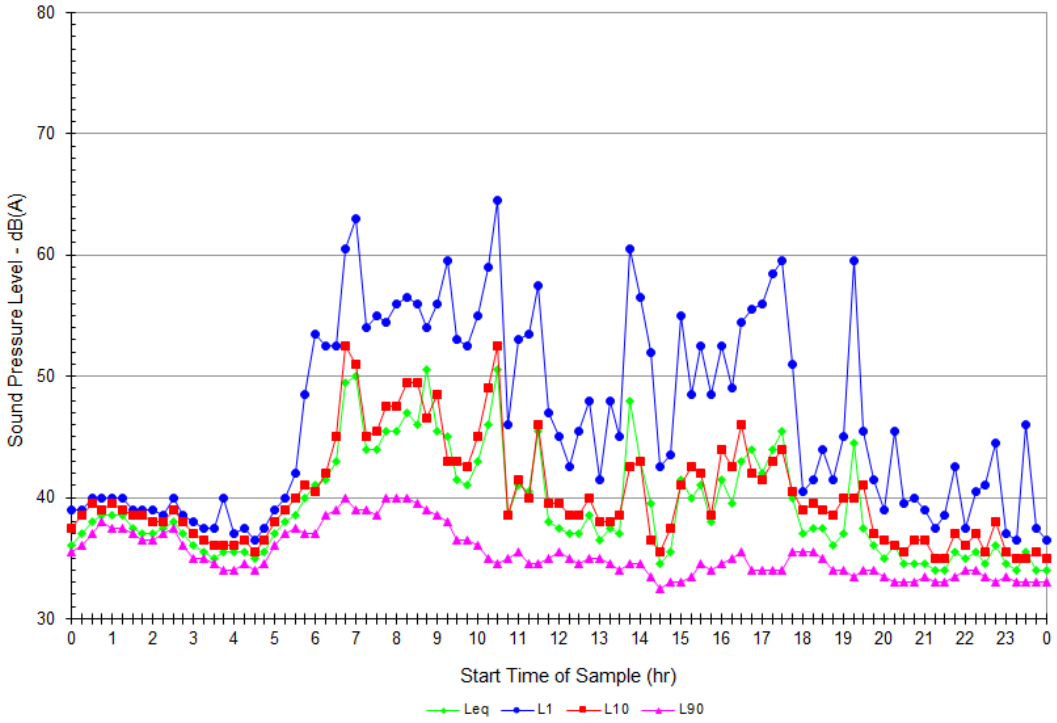
Ambient Measurements
Wednesday, 23 July 2014



Trinity Point Development, Lake Macquarie
ARL Logger

44.4732.R7
Location 5

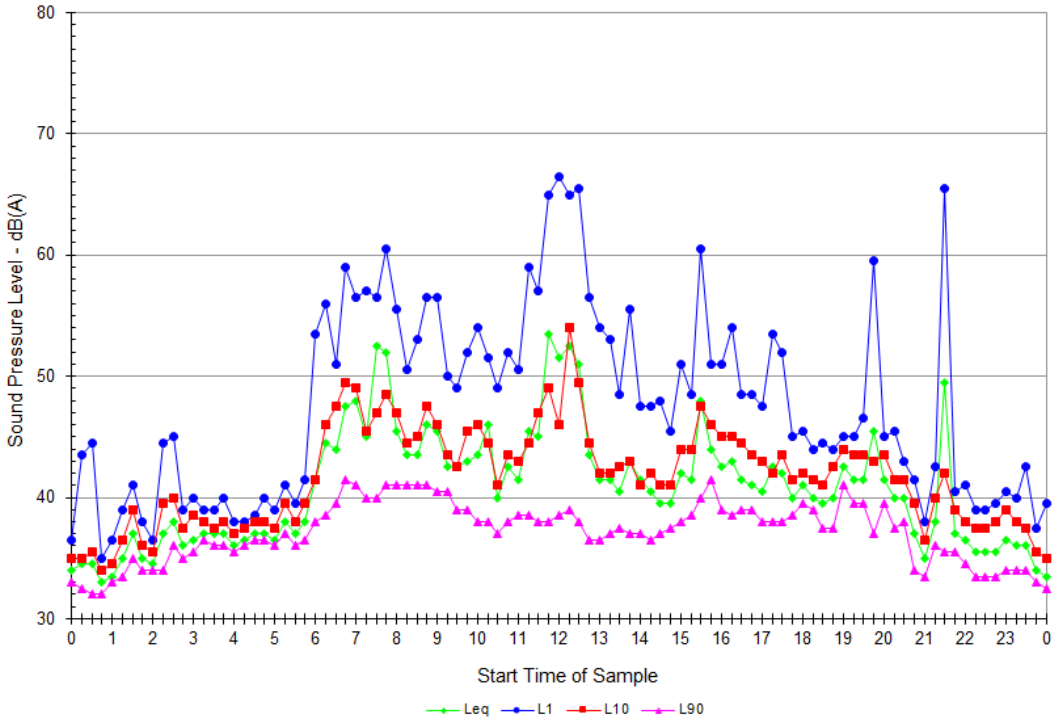
Ambient Measurements
Thursday, 24 July 2014



Trinity Point Development, Lake Macquarie
ARL Logger

44.4732.R7
Location 5

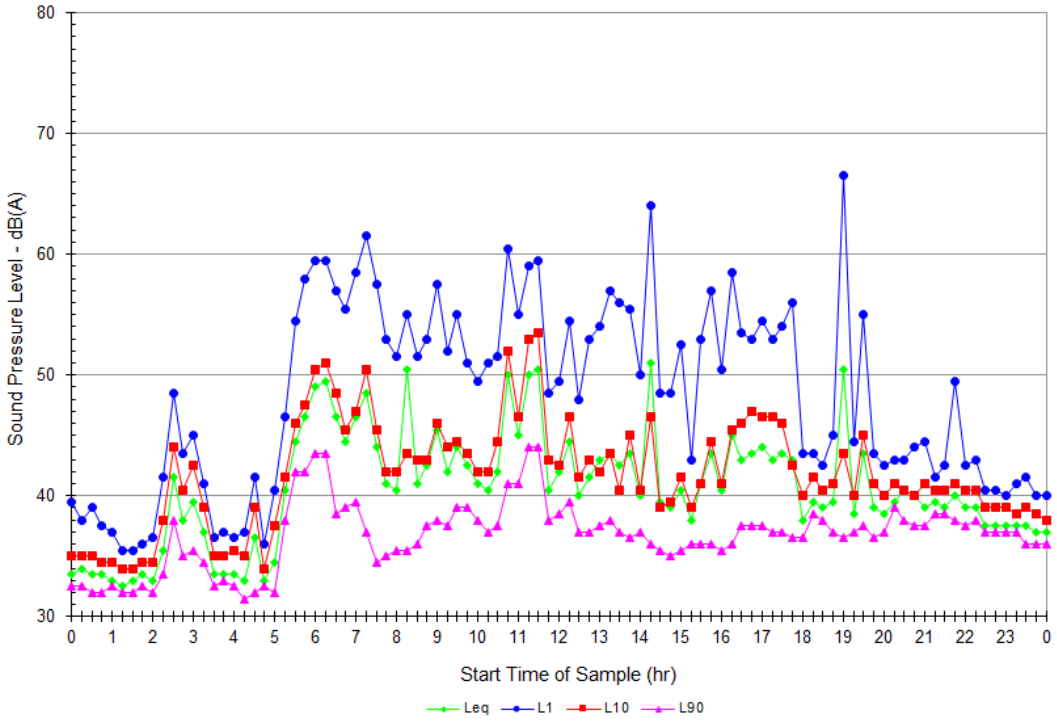
Ambient Measurements
Friday, 25 July 2014



Trinity Point Development, Lake Macquarie
ARL Logger

44.4732.R7
Location 5

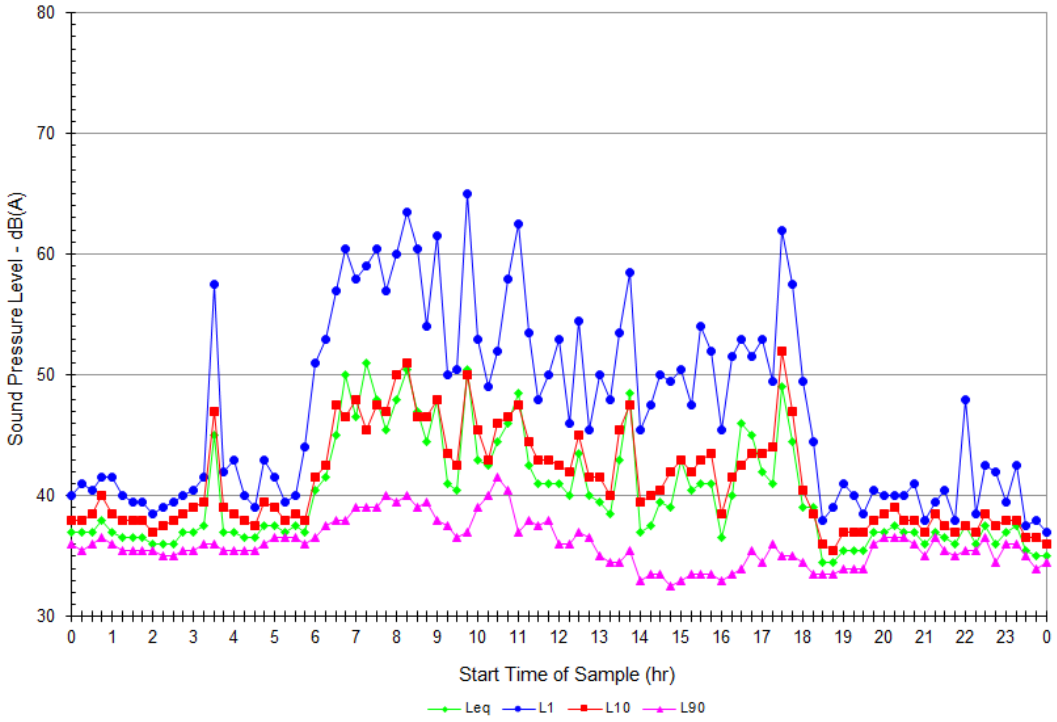
Ambient Measurements
Saturday, 26 July 2014



Trinity Point Development, Lake Macquarie
ARL Logger

44.4732.R7
Location 5

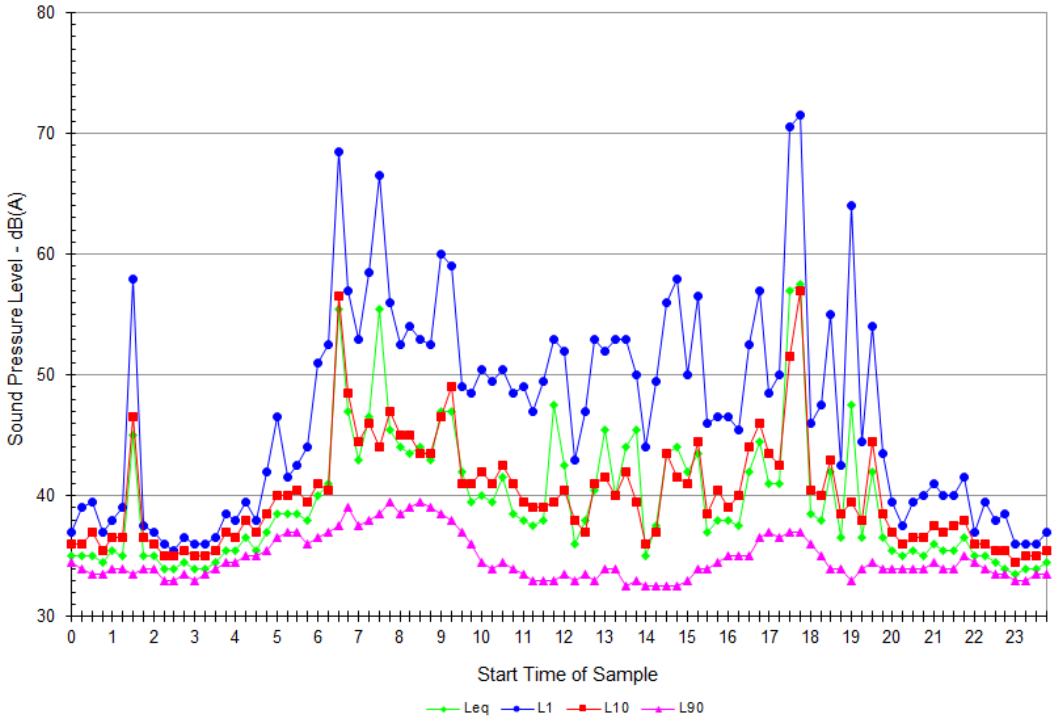
Ambient Measurements
Sunday, 27 July 2014



Trinity Point Development, Lake Macquarie
ARL Logger

44.4732.R7
Location 5

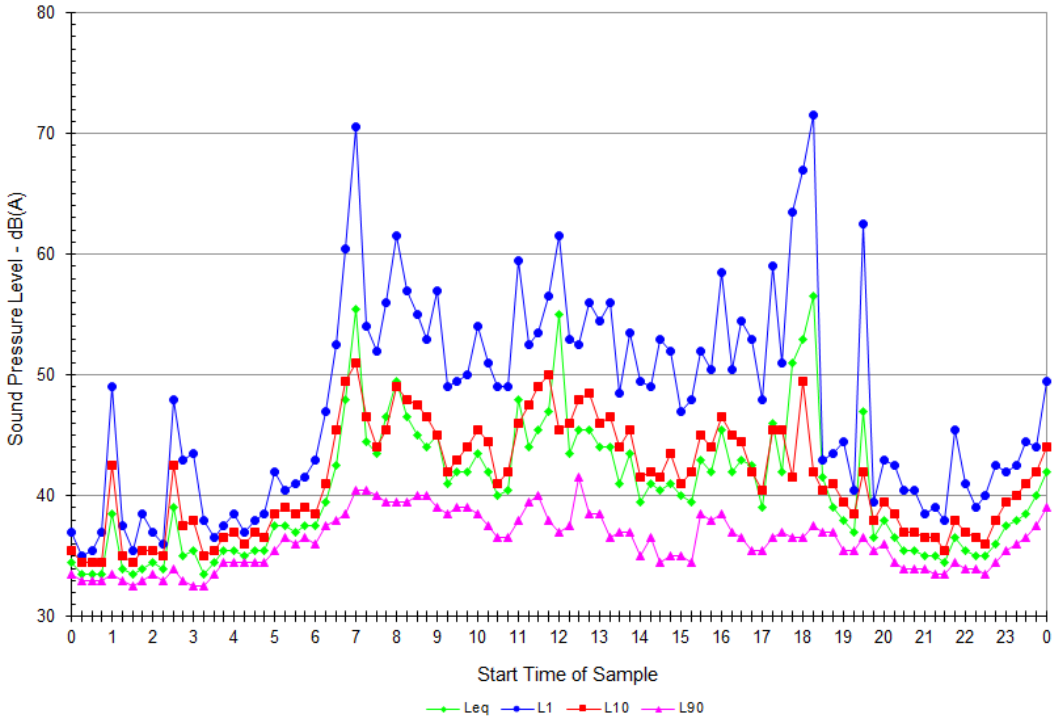
Ambient Measurements
Monday, 28 July 2014



Trinity Point Development, Lake Macquarie
ARL Logger

44.4732.R7
Location 5

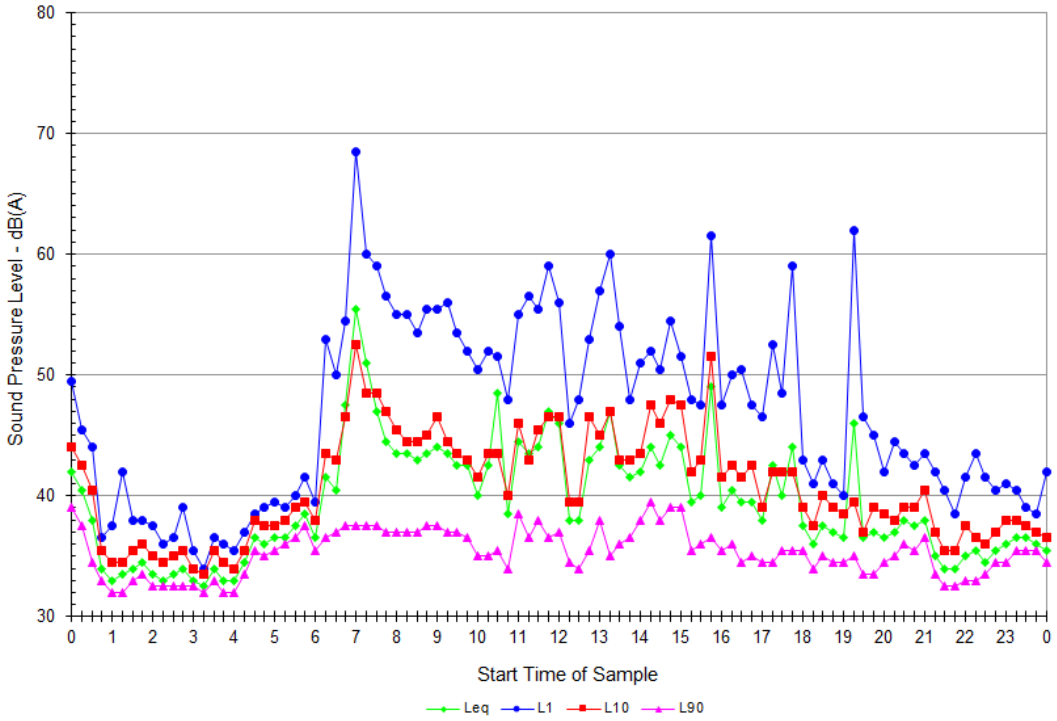
Ambient Measurements
Tuesday, 29 July 2014



Trinity Point Development, Lake Macquarie
ARL Logger

44.4732.R7
Location 5

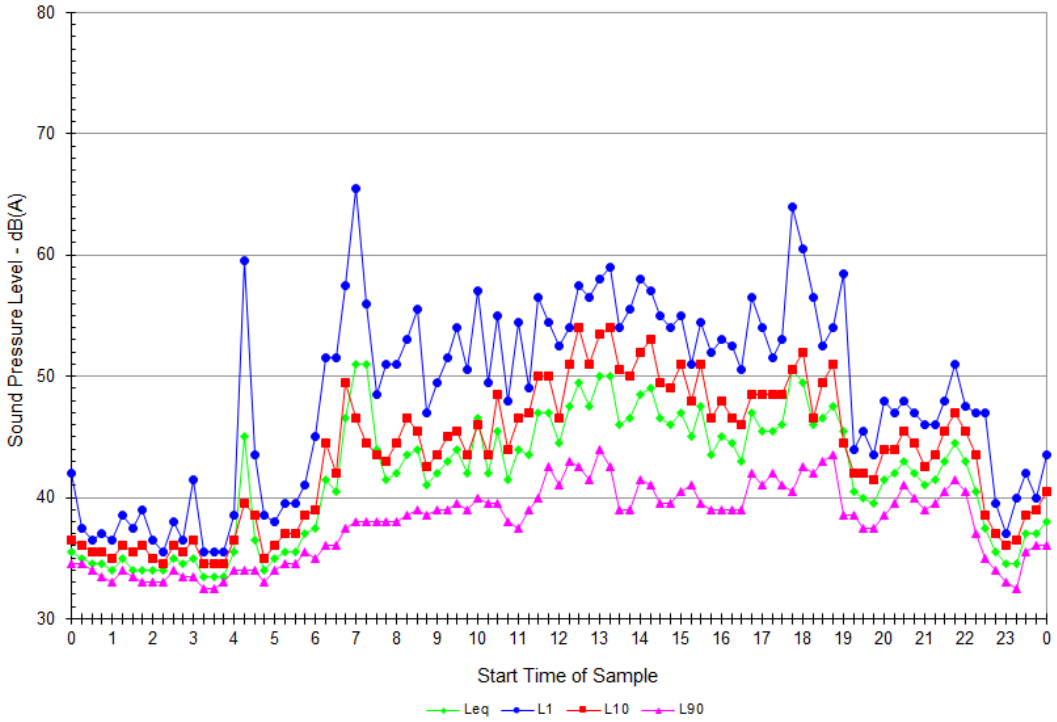
Ambient Measurements
Wednesday, 30 July 2014



Trinity Point Development, Lake Macquarie
ARL Logger

44.4732.R7
Location 5

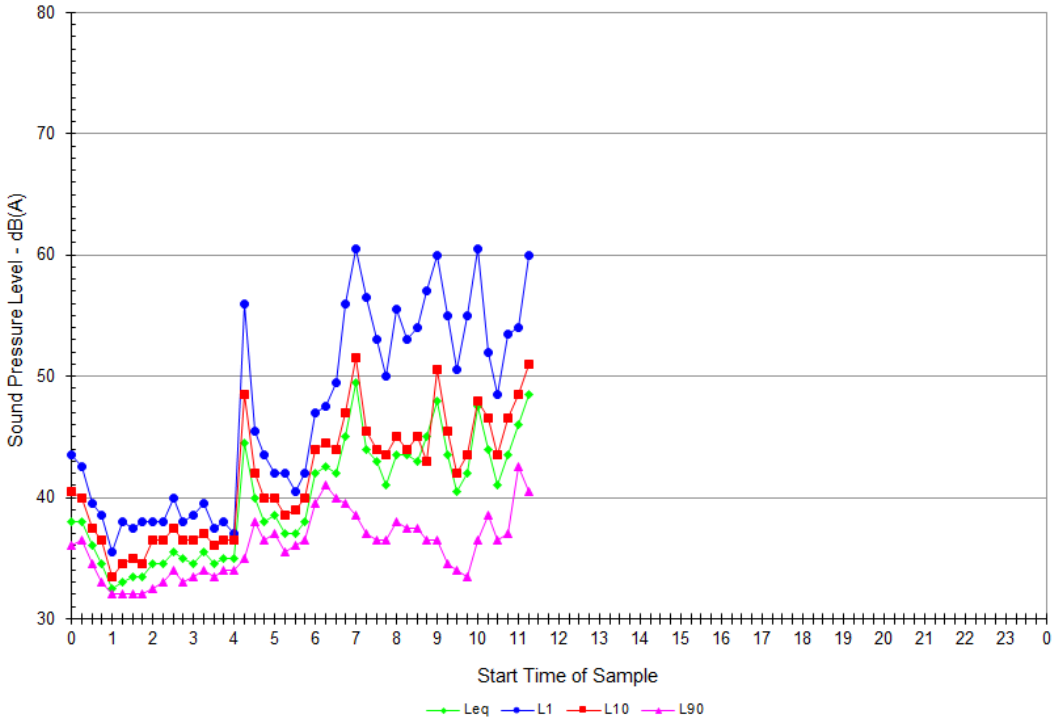
Ambient Measurements
Thursday, 31 July 2014



Trinity Point Development, Lake Macquarie
ARL Logger

44.4732.R7
Location 5

Ambient Measurements
Friday, 1 August 2014

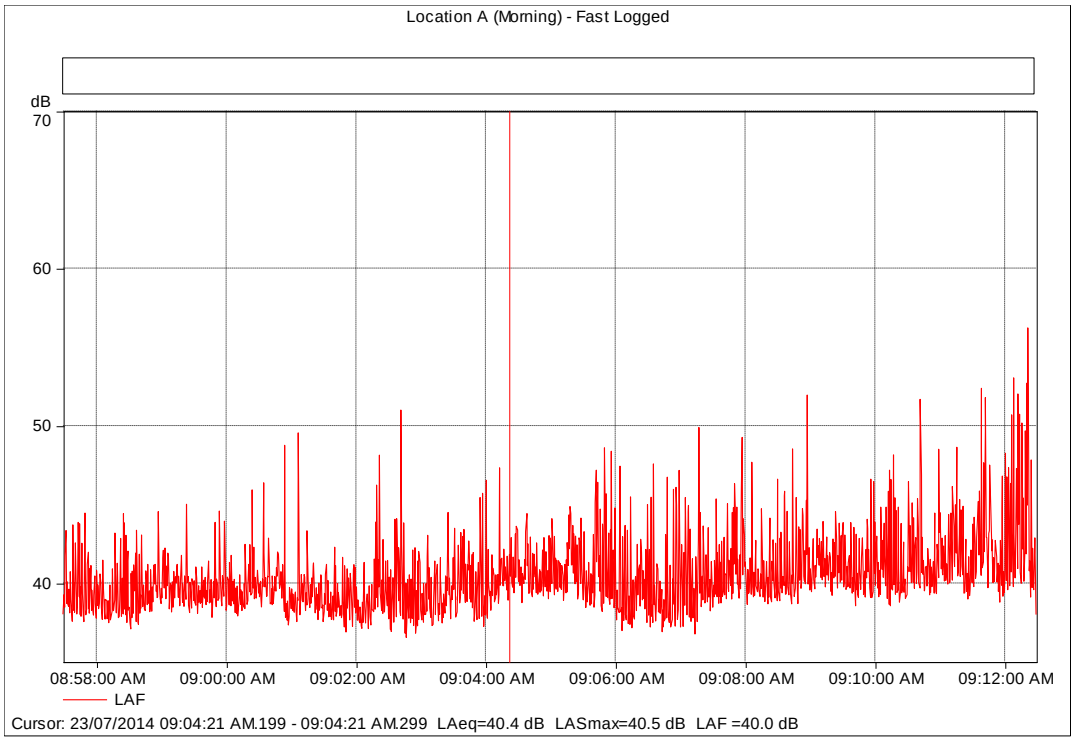


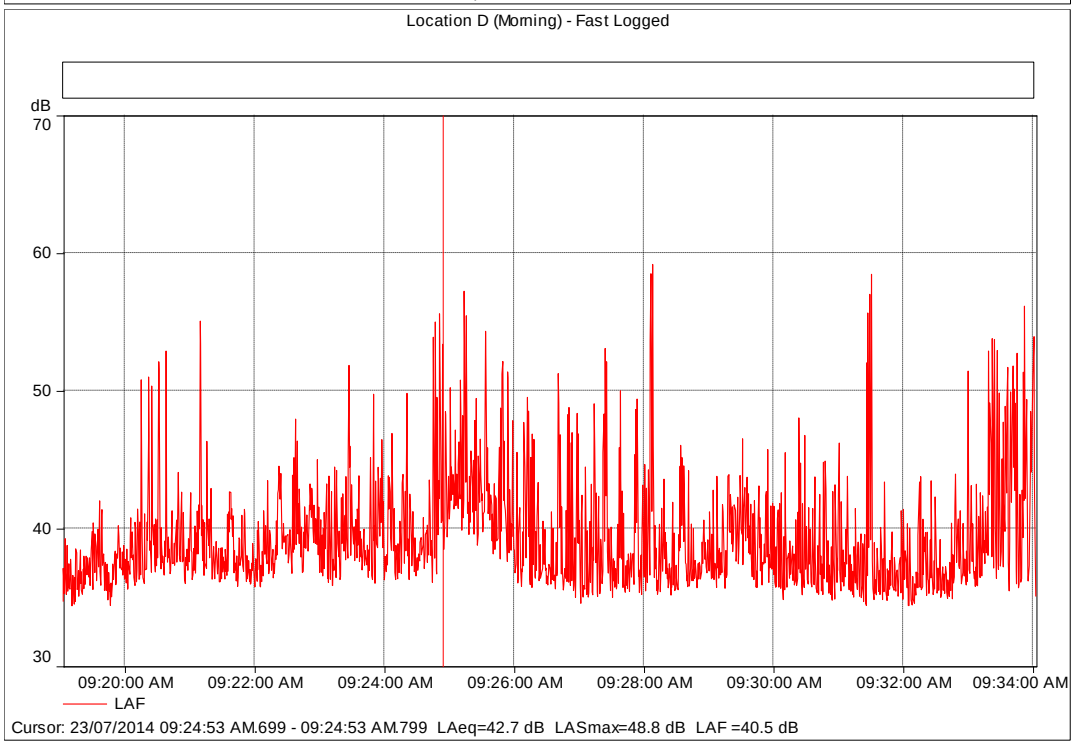
Trinity Point Development, Lake Macquarie
ARL Logger

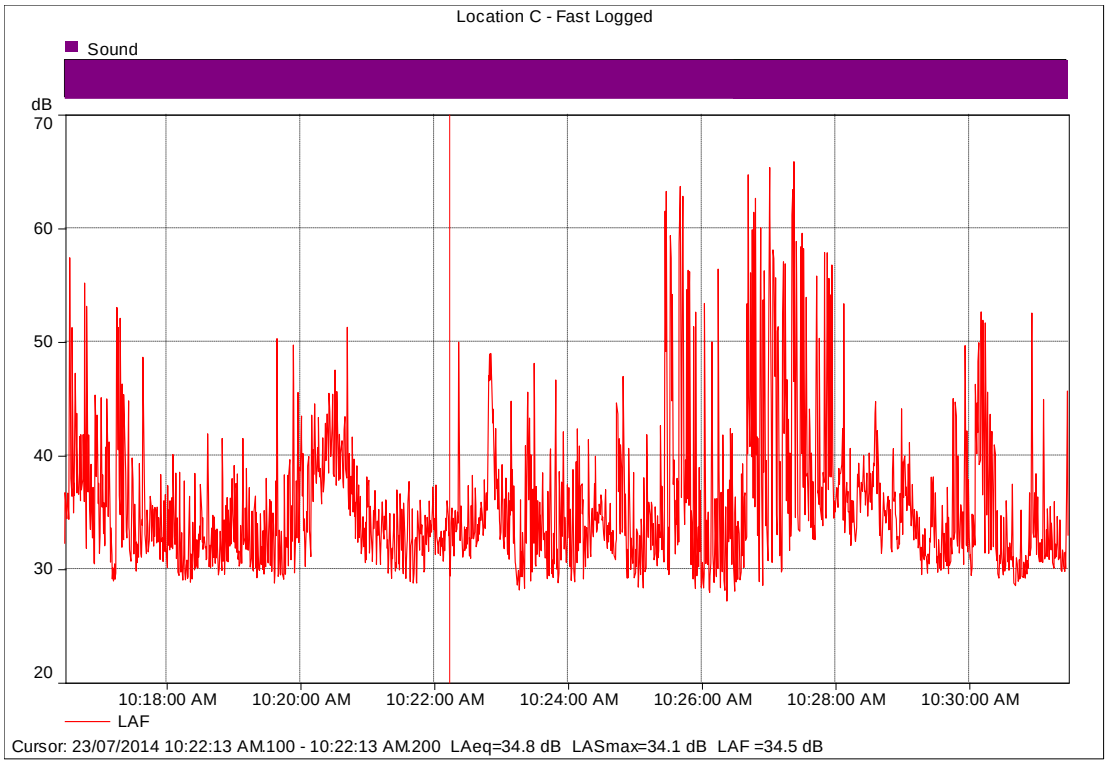
44.4732.R7
Location 5

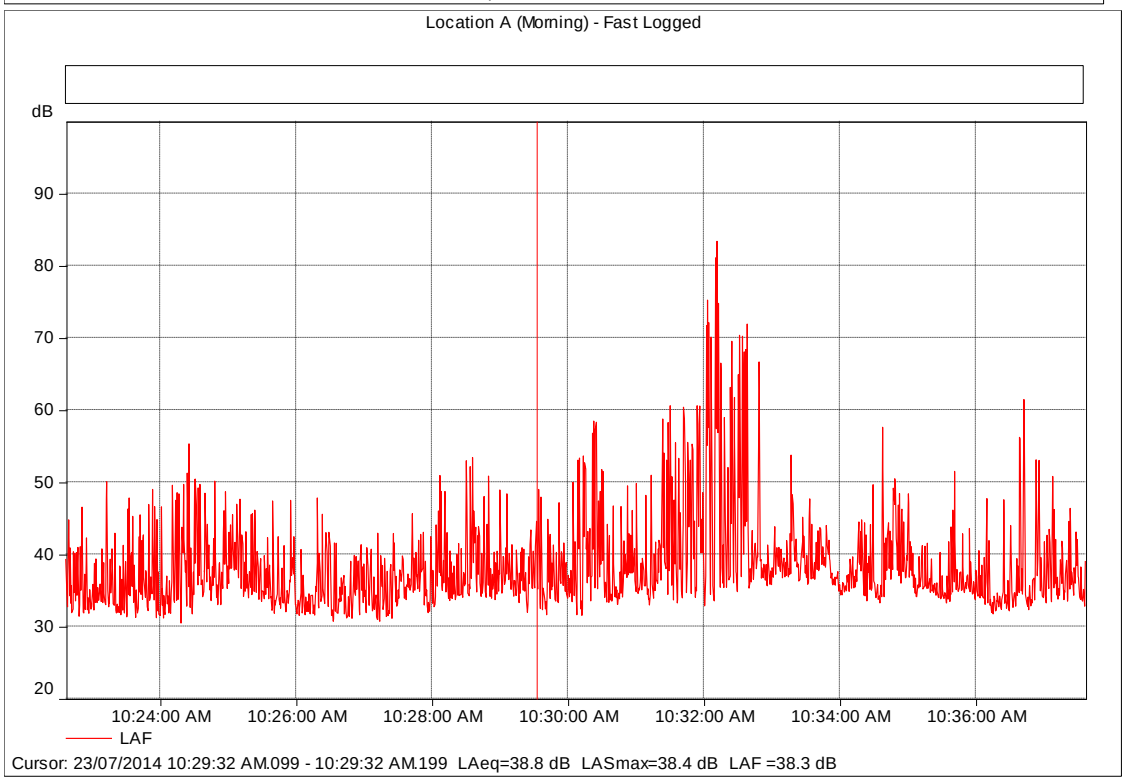
APPENDIX I: Attended Measurement Results (2014)

Attended Measurement Locations


Location A (Morning) - Fast Logged
dB
70
60
50
40
08:58:00 AM
09:00:00 AM
09:02:00 AM
09:04:00 AM
09:06:00 AM
09:08:00 AM
09:10:00 AM
09:12:00 AM
LAF
Cursor: 23/07/2014 09:04:21 AM.199 - 09:04:21 AM.299 LAeq=40.4 dB LASmax=40.5 dB LAF =40.0 dB

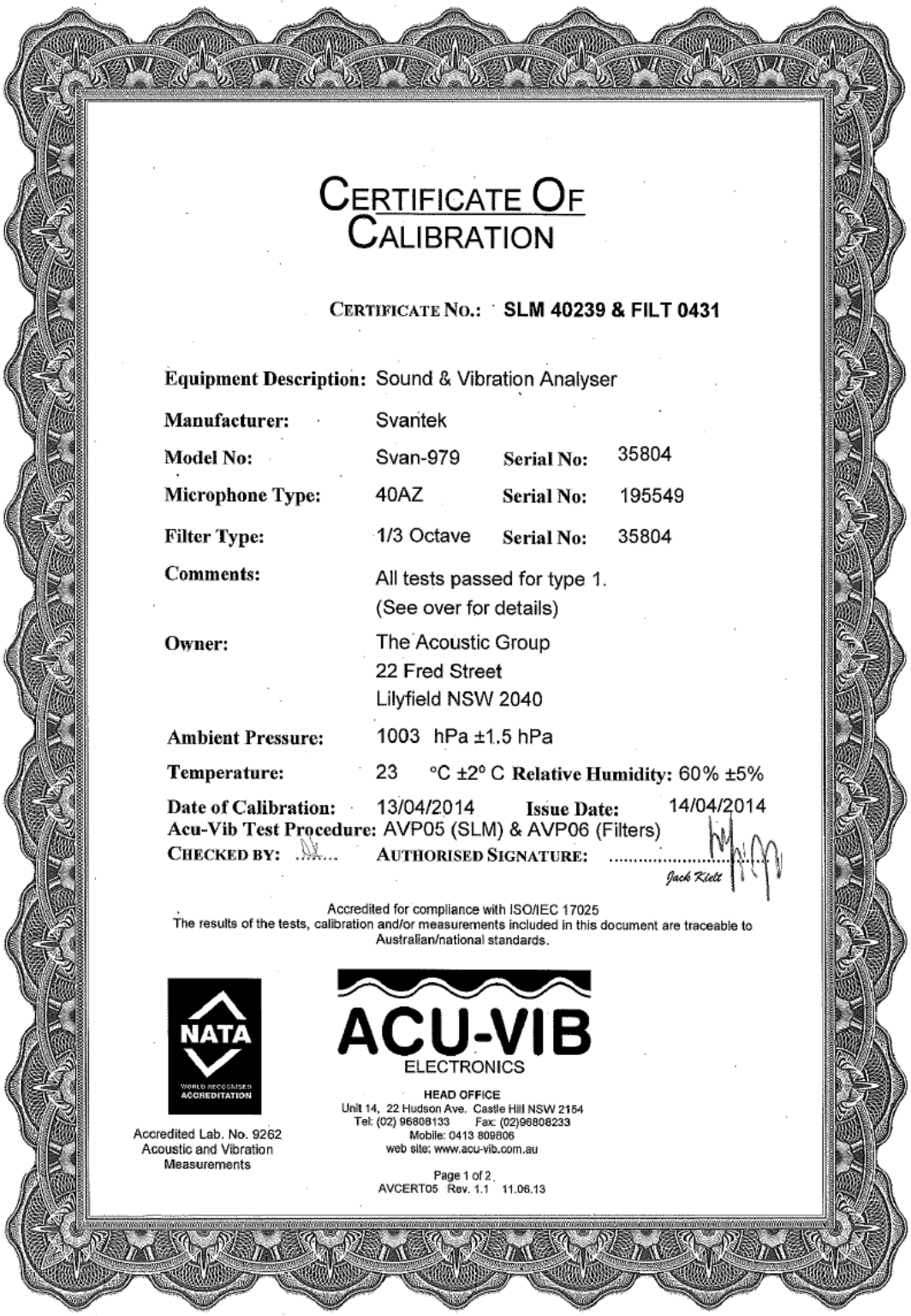

Location D (Morning) - Fast Logged
dB
70
60
50
40
30
09:20:00 AM
09:22:00 AM
09:24:00 AM
09:26:00 AM
09:28:00 AM
09:30:00 AM
09:32:00 AM
09:34:00 AM
LAF
Cursor: 23/07/2014 09:24:53 AM.699 - 09:24:53 AM.799 LAeq=42.7 dB LASmax=48.8 dB LAF =40.5 dB


Location C - Fast Logged
Sound
dB
70
60
50
40
30
20
10:18:00 AM
10:20:00 AM
10:22:00 AM
10:24:00 AM
10:26:00 AM
10:28:00 AM
10:30:00 AM
LAF
Cursor: 23/07/2014 10:22:13 AM.100 - 10:22:13 AM.200 LAeq=34.8 dB LASmax=34.1 dB LAF =34.5 dB


Location A (Morning) - Fast Logged
dB
90
80
70
60
50
40
30
20
10:24:00 AM
10:26:00 AM
10:28:00 AM
10:30:00 AM
10:32:00 AM
10:34:00 AM
10:36:00 AM
LAF
Cursor: 23/07/2014 10:29:32 AM.099 - 10:29:32 AM.199 LAeq=38.8 dB LASmax=38.4 dB LAF =38.3 dB

Location	Start Time		dB(A)	Octave Band Centre Frequency (Hz)								
				31	63	125	250	500	1k	2k	4k	8k
23rd June 2014												
A	08:57	L_{10}	43	58	61	54	44	35	33	34	36	24
		L_{eq}	41	56	59	52	42	34	31	31	32	21
		L_{90}	38	54	55	50	40	32	29	22	<20	<20
D	09:19	L_{10}	43	57	59	50	38	37	35	36	36	25
		L_{eq}	39	56	56	48	35	35	33	36	33	22
		L_{90}	36	53	52	45	33	32	29	22	<20	<20
C	10:16	L_{10}	42	57	53	43	31	32	35	38	35	25.0
		L_{eq}	44	55	52	42	29	31	33	42	40	24
		L_{90}	30	52	47	37	25	23	22	22	19	11
A	10:22	L_{10}	42	58	58	53	44	36	34	32	29	<20
		L_{eq}	53	56	53	45	34	33	38	49	48	37
		L_{90}	33	51	48	41	30	27	25	23	22	<20

APPENDIX J: Calibration Certificates



CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: **SLM 40239 & FILT 0431**

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-979	**Serial No:**	35804
Microphone Type:	40AZ	**Serial No:**	195549
Filter Type:	1/3 Octave	**Serial No:**	35804
Comments:	All tests passed for type 1. (See over for details)		
Owner:	The Acoustic Group 22 Fred Street Lilyfield NSW 2040		
Ambient Pressure:	1003 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	60% ±5%
Date of Calibration:	13/04/2014	**Issue Date:**	14/04/2014

Acu-Vib Test Procedure: AVP05 (SLM) & AVP06 (Filters)

CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....

Jack Kielt

Accredited for compliance with ISO/IEC 17025
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

NATA
WORLD RECOGNISED ACCREDITATION

Accredited Lab. No. 9262
Acoustic and Vibration Measurements

ACU-VIB
ELECTRONICS

HEAD OFFICE
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
Tel: (02) 96808133 Fax: (02)96808233
Mobile: 0413 809806
web site: www.acu-vib.com.au

Page 1 of 2.
AVCERT05 Rev. 1.1 11.06.13

Brüel & Kjær

Certificate of Conformance

The Acoustic Group
20-22 Fred Street
2040 Lilyfield New South Wales

Reference number:	Service request:	Date:
Written approval	1-424394285	24 Apr 2018

We hereby declare that

-2250--D00- 2250-G4 Handheld Analyzer Serial Number: 3004338

has been tested and passed all test.

The instrument has been tested according to published specifications at the date of the test.
All tests have been performed using calibrated equipment, traceable to National or International Standards or by ratio measurements.

Certificate issued
17-Jun-2015

Torben Bjørn

Vice President - Operations
For and behalf of Brüel & Kjær HQ

Recommended date for next check: Jun-2016

Brüel & Kjær is certified under ISO 9001:2008, assuring that all calibration data is retained on file and is available for inspection upon request

Note:
Although this certificate states that your instrument complied with all specifications at the time of the test, this is not a calibration certificate.

Brüel & Kjær Australia
A Division of Spectris Australia Pty Ltd
ACN 001 216 128 • ABN 51 001 216 128
auinfo@bksv.com • www.bksv.com.au

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Queensland •
Tel: 07 3252 5700 • Fax: 07 3257 1370
Western Australia •
PO Box 1141 • West Leederville • WA 6902
Tel: 08 9380 6933 • Fax: 08 9388 2631

NATA
WORLD RECOGNISED ACCREDITATION

CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 20034 & FILT 1562

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-979	**Serial No:**	35804
Microphone Type:	40AZ	**Serial No:**	195549
Filter Type:	1/3 Octave	**Serial No:**	35804
Comments:	All tests passed for class 1. (See over for details)		
Owner:	The Acoustic Group 22 Fred Street Lilyfield NSW 2040		
Ambient Pressure:	1000 hPa ±1.5 hPa		
Temperature:	24 °C ±2° C	**Relative Humidity:**	51% ±5%
Date of Calibration:	23/01/2017	**Issue Date:**	23/01/2017

Acu-Vib Test Procedure: AVP10 (SLM) & AVP06 (Filters)

CHECKED BY: ..... **AUTHORISED SIGNATURE:** ..... Jack Rolt

Accredited for compliance with ISO/IEC 17025
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

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Accredited Lab. No. 9262
Acoustic and Vibration Measurements

ACU-VIB
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CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: **SLM 20033 & FILT 1565**

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-979	**Serial No:**	35808
Microphone Type:	40AZ	**Serial No:**	182254
Filter Type:	1/3 Octave	**Serial No:**	35808
Comments:	All tests passed for class 1. (See over for details)		
Owner:	The Acoustic Group 22 Fred Street Lilyfield NSW 2040		
Ambient Pressure:	1000 hPa ±1.5 hPa		
Temperature:	24 °C ±2° C	**Relative Humidity:**	50% ±5%
Date of Calibration:	23/01/2017	**Issue Date:**	23/01/2017

Acu-Vib Test Procedure: AVP10 (SLM) & AVP06 (Filters)

CHECKED BY: ..... **AUTHORISED SIGNATURE:** ..... Jack Kiely

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 20026 & FILT 1564

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-979	**Serial No:**	27164
Microphone Type:	40AZ	**Serial No:**	133962
Filter Type:	1/3 Octave	**Serial No:**	27164
Comments:	All tests passed for class 1. (See over for details)		
Owner:	The Acoustic Group 20-22 Fred Street Lilyfield NSW 2040		
Ambient Pressure:	1000 hPa ±1.5 hPa		
Temperature:	25 °C ±2° C	**Relative Humidity:**	53% ±5%
Date of Calibration:	17/01/2017	**Issue Date:**	18/01/2017
Acu-Vib Test Procedure:	AVP10 (SLM) & AVP06 (Filters)		

CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....
Jack Kiely

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 20073 & FILT 1575

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-957	**Serial No:**	15364
Microphone Type:	7052H	**Serial No:**	40614
Filter Type:	1/3 Octave	**Serial No:**	15364
Comments:	All tests passed for class 1. (See over for details)		
Owner:	The Acoustic Group 22 Fred Street Lilyfield NSW 2040		
Ambient Pressure:	994 hPa ±1.5 hPa		
Temperature:	25 °C ±2° C	**Relative Humidity:**	45% ±5%
Date of Calibration:	24/01/2017	**Issue Date:**	24/01/2017

Acu-Vib Test Procedure: AVP10 (SLM) & AVP06 (Filters)

CHECKED BY: ..... **AUTHORISED SIGNATURE:** .....

Jack Kelt

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