SUPPLEMENTARY ACOUSTIC ASSESSMENT
PROPOSED HELIPAD
TRINITY POINT DEVELOPMENT
49.4732.R9:MSC

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CONTENTS

APPENDICES

1.0 INTRODUCTION

The purpose of this report is to present the results of amended 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 been prepared as a supplementary report to address proposed changes to the application made during proceedings in the Land and Environment Court. Generally the changes involve:

(a) Flights being restricted over residential areas of Bardens Bay, identified as an "exclusion area" for all helicopters using the helipad.

(b) Specific flight paths being removed and a take-off and landing area provided to the south and east of the helipad.

(c) A reduction in the number of flight movements to a maximum of six movements per day and 38 movements per week.

Figure 1 shows the revised proposal.

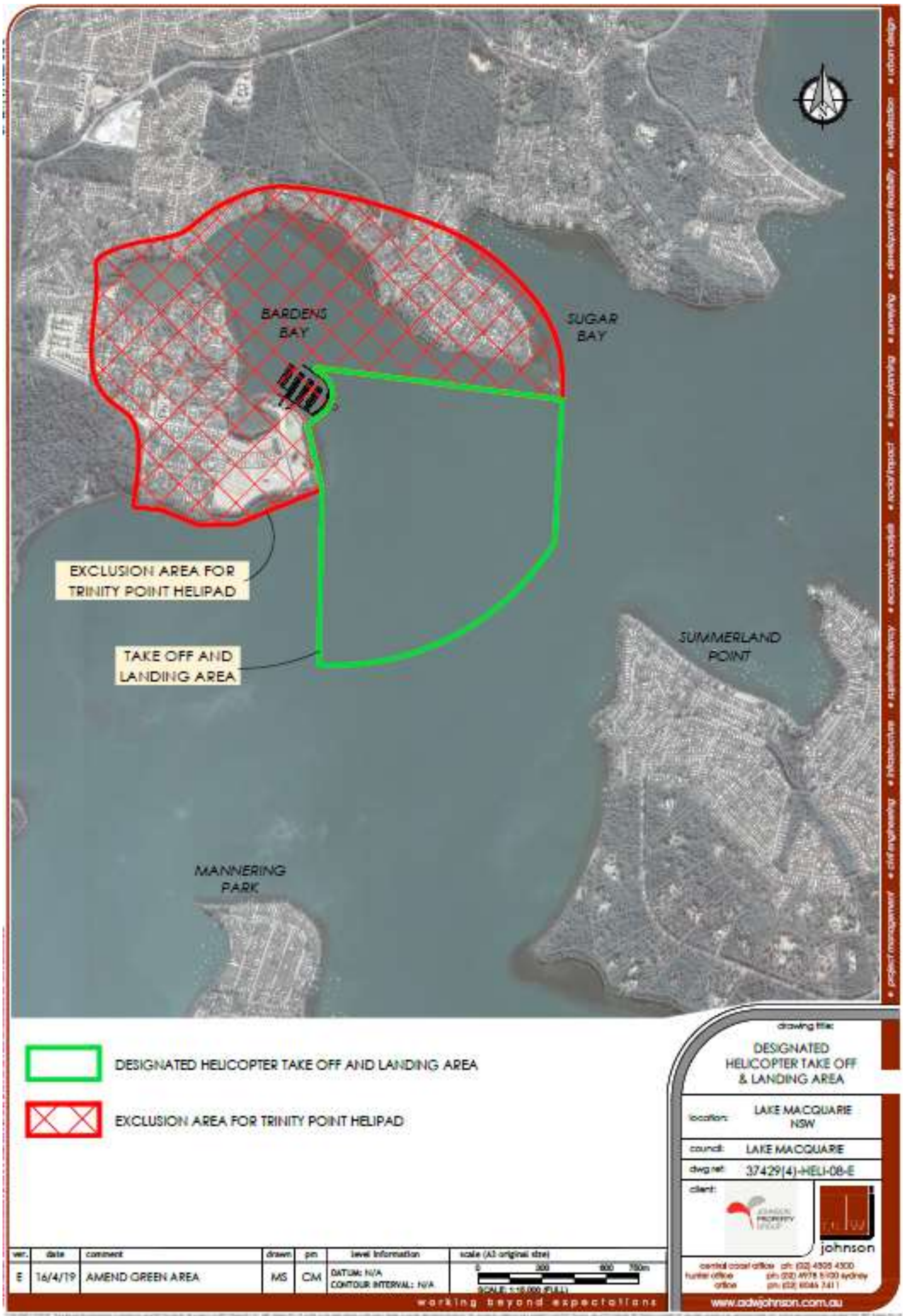


FIGURE 1: Revised Take Off and Landing Area

To place in context the amended proposal, the following figure depicts in yellow the area associated with landing and take-offs set out in the acoustic assessment report (our reference 48.4732.R7C) prepared in May 2018 versus the proposed landing and take-off area shown in green.

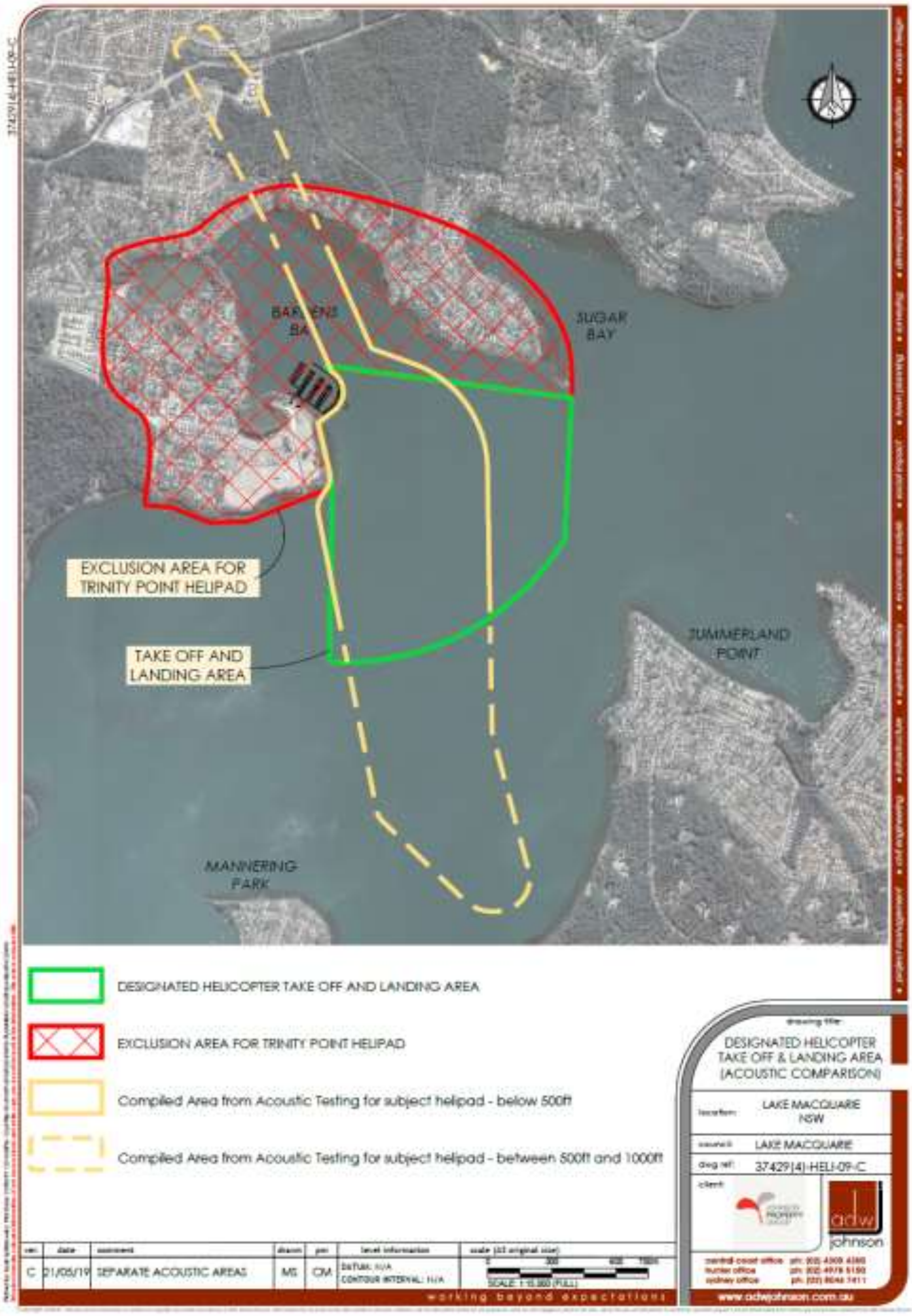


FIGURE 2: Comparison of Previous and Amended Take-off and Landing Areas

Figure 2 identifies the revised take-off and landing area removes helicopter operation within Bardens Bay and consequently would not give rise to any increase in noise from that obtained at the relevant monitoring locations used for the acoustic testing conducted in May 2016 set out in the acoustic report that accompanied the documentation prepared by ADW Johnson submitted with the Application for the helipad.

As a result of the removal of flight tracks north of the green line delineating the landing and take-off area, there is a requirement to review the predicted helicopter noise levels from the May 2018 report. Figure 2 reveals the proposed helicopter land and take off area does not come closer to any of the dwellings in Bardens Bay when compared with the original test flights, thereby not requiring the conduct of additional testing.

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.

As a result of the helicopter noise testing the application has utilised the helipad on the southern side of the marina, that was described in the acoustic testing as helipad 2.

For this revised acoustic assessment, the relevant material for the proposed helipad has been extracted from the acoustic assessment report (our reference 48.4732.R7C) prepared in May 2018 and assessed against the ANEF noise criterion identified in the acoustic report. The discussion on the development of noise criteria in NSW for helicopters is set out in the May 2018 report and is no longer relevant for this revised acoustic assessment.

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.

To examine the potential impact of helicopter operations, test flights were carried out in March 2016 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.

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.

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 for the nominated helipad.

Appendix C presents the actual helicopter flight paths that were tested on the day for the nominated helipad.

2.0 MEASUREMENT TECHNIQUES

The measurement techniques and procedure for helicopter testing used in March 2016 were set out in Section 2 of the May 2018 report.

The procedure for helicopter testing as set out in Australian Standard AS2363 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 A9 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.

3.0 MEASUREMENT RESULTS

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 the May 2018 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 (except for the overflights with Council officers on board)
- Taking into account the maximum weight specified for the helicopter (being an internal load not an external slung load) and the empty weight for the subject helicopter (with operating equipment and additional gear on board) the fuel supply was 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.

3.1 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 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 relative to 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 (not forming part of the Application).

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.

Appendix D sets out the actual test flights that occurred on the day for helipad 2. 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 A5 to A8 inclusive by way of headings and tracks for the final helipad location (helipad 2).

3.2 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 35oD 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 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

3.3 Helicopter Noise Analysis

The procedure for analysing the noise of the helicopter is undertaken in accordance with Australian Standard AS2363.

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 requires one to undertake an energy (logarithmic) average of the individual movements for each track, which appears as a summary table commencing at Appendix E3. 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 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 shutting 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.

4.0 ACOUSTIC CRITERIA

Section 4 of the May 2018 acoustic assessment report presented details of the development of noise criteria for helicopter operations in NSW, leading to the current situation that with respect to noise helicopters fall under the responsibility of AirServices Australian and utilised the ANEF (Australian Noise Exposure Forecast) system.

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.

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.

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

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.*

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 (a 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 & E2, the logarithmic (energy) average of the individual landing profiles is used to determine a mean SEL (Appendix E3) 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.

5.1 Previous Application

The number of flights is expected to vary from day to day. On some days there may be no flights. In the previous application, a maximum number of 8 helicopter movements a day had 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 were three flight paths identified for helipad 2.

To provide an insight into the potential noise from such helicopter operations an assumed mix of operations on the three flight paths that were used in the testing, were considered 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 were 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.

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 was unknown at the time of the assessment. For the previous 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 were determined on the basis of all helicopter movements occurring between 8 AM and 7 PM:

TABLE 1: 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	9.6	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	10.2	5.8	-10.0

The results in Table 1 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 1 the ANEF values for all flights occurring between 7AM and 7PM can be converted to $LAeq_{24}$ by adding 35 as shown in Table 2. This permits comparison in terms of the general dB(A) level and the equivalent target of 55 dB(A).

TABLE 2: 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	44.6	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	45.2	40.8	25.0

The ANEF contributions in Table 1 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 3: 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

If all flights occur between 7AM and 7PM there is no difference in the ANEF value, and therefore the $LAeq_{24}$ value (as per Table 1).

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).

<u>TABLE 4</u>: 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	12.0	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 4 (as a worst-case scenario) are well below the ANEF 20 acceptable limit.

From the results in Table 4 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.

<u>TABLE 5</u>: 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	47.0	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

5.2 Revised Application

As a result of the reduction of the maximum number of movements per day it follows that there will be a reduction in the ANEF results.

Furthermore, by examination of Figure 2 it can be seen that due to the additional distance to the amended take-off and landing area that locations 3 & 4 would experience a significant reduction in the helicopter noise levels, locations 2 and 5 could experience a slight reduction. Location 6 would experience similar levels, whilst location 7 would not be expected to experience any difference for operations to and from the south.

Utilising the previous assessment for 8 movements a day the results from Table 1 have been corrected for a maximum of 6 movements a day to reveal the following ANEF levels on the basis of all helicopter movements occurring between 8 AM and 7 PM, noting that Scenario 3 & 4 no longer apply.

TABLE 6: Revised Helicopter Noise Contributions (ANEF) - Daytime flights only

Scenario	Location						
	1	2	3	4	5	6	7
1	9.6	0.4	-4.3	-3.7	7.5	5.2	-6.6
2	8.2	-2.6	-6.5	-4.8	8.4	3.9	-9.1
3	NA	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA	NA	NA

The results in Table 6 reveal the sound level contribution from the amended application (based upon the original landing and take-off profiles from/to the south) when assessed at the residential receivers to be well under the 20 ANEF aircraft noise level.

From the results in Table 6 the ANEF values for all flights occurring between 7AM and 7PM can be converted to $LAeq_{24}$ by adding 35 as shown in Table 2. This permits comparison in terms of the general dB(A) level and the equivalent target of 55 dB(A).

TABLE 7: Revised Helicopter Noise Contributions ($LAeq_{24}$) - Daytime flights only

Scenario	Location						
	1	2	3	4	5	6	7
1	44.6	35.4	30.7	31.3	42.5	40.2	28.4
2	43.2	32.4	28.5	30.2	43.4	38.9	25.9
3	NA	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA	NA	NA

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 2 take offs and 2 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 8: Revised Helicopter Noise Contributions (ANEF) – 4 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	12.0	7.6	-5.4
3	NA	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA	NA	NA

The ANEF contributions in Table 8 (as a worst-case scenario) are well below the ANEF 20 acceptable limit.

From the results in Table 8 the ANEF values for 4 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 9.

TABLE 9: Revised Helicopter Noise Contributions ($LAeq_{24}$) – 4 movements in the day and 2 movements in evening

Scenario	Location						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1	47.7	38.4	33.7	34.3	45.5	43.2	31.5
2	46.2	35.4	31.5	33.2	46.4	42.0	28.9
3	NA	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA	NA	NA

The GPS flight tracks set out in Appendix C1 identify the take-off operation for Movements 1 -10 went above the proposed take and landing zone set out in Figure 2. On that basis one would expect the resultant ANEF/LAeq24 levels to be slightly lower than set out in the tables above.

The GPS flight tracks set out in Appendix C1 reveal no flight tracks (other than for the north) flew over residential receivers. Utilising the scale at the bottom of each figure in Appendix C1 provides a distance (in plan view) of the helicopter from the various residential receivers.

Due to the vertical profile of the helicopter operations the actual distance from the helicopter to the residential receivers (called the slant distance) will be greater than the distance in plan when the helicopter is more than 200 feet above the water.

Appendix G1 provides an expanded view of a landing and take-off for the May testing obtained from the GPS tracking system used in the test flights. Superimposed on the track are horizontal distances from the commencement of the movement. The flight track selected was for the alternative helipad but relates to the flight track that was closest to the eastern shore of Bardens Bay, i.e. adopting a conservative approach.

Appendix G2 provided a cross sectional elevation of the tracks from Appendix G1 to show the height of the helicopter at the same reference distances. The sectional elevations also include the plan distance to reference location 5.

Appendices G3 & G4 provide the relevant detail for the test flights in the opposite direction.

For the reference locations identified in the plan and section one can determine for those points (with the plan distance to a residential receiver) the slant distance to the helicopter, i.e. the slant distance to the residential receivers must be greater than the distance in plan view.

Furthermore the material in Appendix G identifies the distances at which cruise altitude of 1000ft above ground level was achieved.

For use of the designated landing and take-off area south of Bardens Bay and east of the May 2016 testing the closest distance to residential boundaries to the east of reference location 6 (from Appendix G1) is approximately 150 – 160m (in plan view). At the distance along the take off track identified as 791m the elevation of the helicopter was 202m (662 ft) above the reference level of ground level.

The overflight test results at 500 ft above ground level for the direct overflight at location 4 (northern end of Bardens Bay) gave an SEL of 81 dB(A) which is similar to the SEL values obtained at location 6 for the test flights. This indicates the resultant ANEF/Leq level for locations to the east of reference location 6 would be similar to or lower than the results determined for reference location 6.

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.

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 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, 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.

International Civil Aviation Organization (ICAO) specifications for new aircraft (including helicopters) require new models to be quieter. Accordingly, newer helicopters (for the same maximum take-off weight) are automatically quieter.

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 A109A 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 3 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 using the four scenarios modelled in the previous application and excluding the Sikorsky S76 helicopter that would not be permitted to use the helipad.

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 situation that would never occur at the subject helipad. The above table is used to identify that the restriction of 6 helicopter movements a day will clearly satisfy the AirServices Australia noise target for the helicopter types that are likely to use the helipad.

6.0 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 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.

An acoustic assessment report (May 2018) identified there have been significant changes to the relevant criteria, including as a consequence of verbal advice from the EPA. As discussed in the May 2018 report the control of noise from helicopters rest with AirServices Australia with the ANEF system being the acoustic parameter.

The Application of the ANEF assessment procedure was confirmed in the Judgment from the Chief Judge as Nessdee Pty Limited v Orange City Council [2017] NSWLEC 158 with respect to the Orange East Heliport.

This report has been prepared as a supplementary report to address proposed changes to the application made during proceedings in the Land and Environment Court. Generally, the changes involve:

(a) Flights being restricted over residential areas of Bardens Bay, identified as an “exclusion area” for all helicopters using the helipad.

(b) Specific flight paths being removed and a take-off and landing area provided to the south and east of the helipad.

(c) A reduction in the number of flight movements to a maximum of six movements per day and 38 movements per week.

It has been proposed for the amended application that helicopters associated with the subject helipad will be prohibited from overflying Bardens Bay by the imposition of an exclusion zone shown in Figures 1 & 2.

This supplementary acoustic assessment has considered the amended take-off and landing area and the exclusion zone by removing scenarios 3 & 4 (from the previous assessment) and reducing the number of movements per day from eight to six.

Whilst the northern line of the proposed take-off and landing area (see Figures 1 & 2) restricts helicopter take-off and landing movements further to the south than tested in May 2016, this assessment has adopted the conservative approach by using the measured data without any adjustments for the revised application (other than described above).

As expected the revised application will result in lower ANEF levels at all reference locations nominated by the Council, and achieve ANEF levels significantly less than the ANEF 20 residential limit.

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:

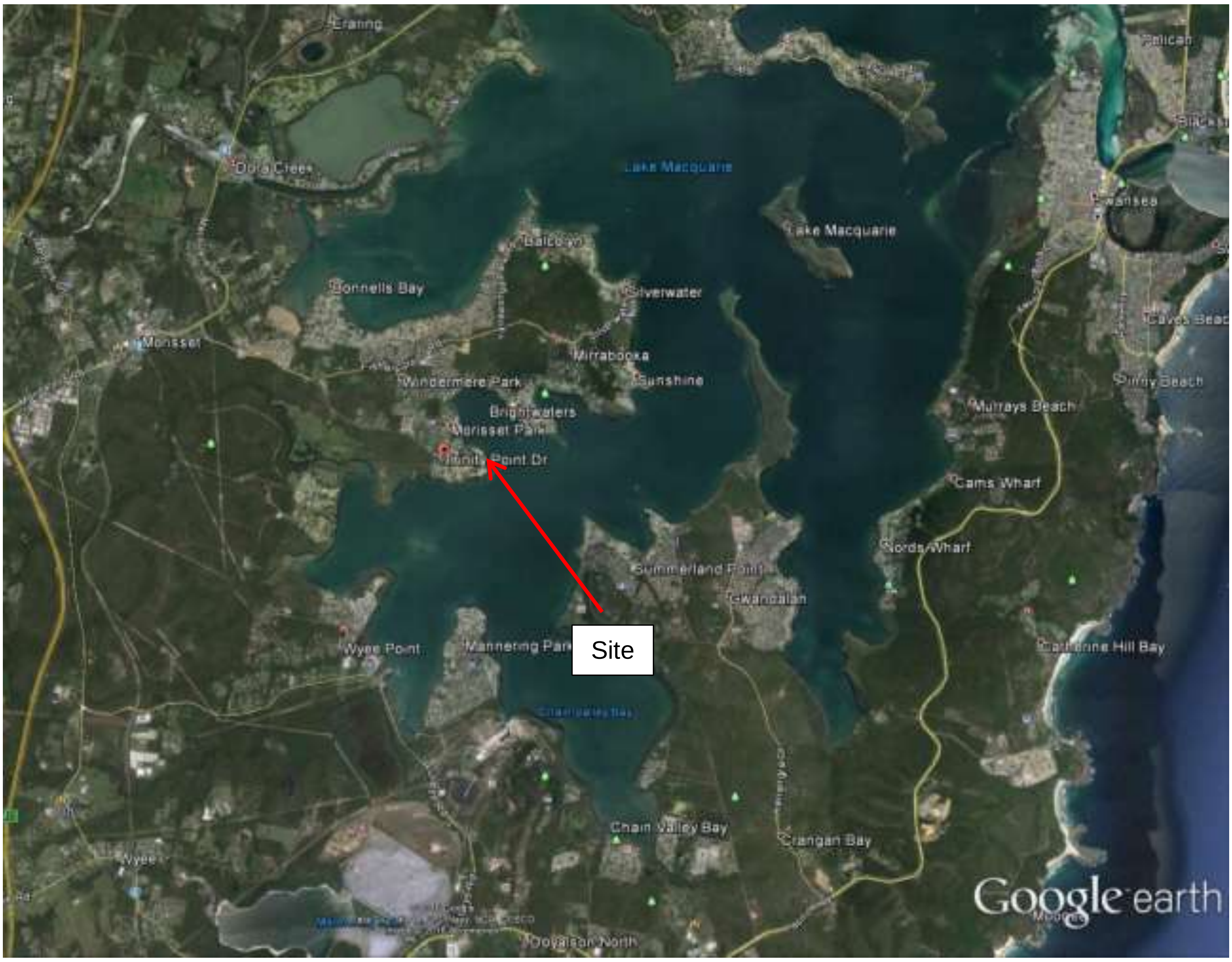
- Use of the helipad is by prior permission only
- Requirement to land and take off within the designated area and for helicopter arriving or departing the helipad to not fly over Bardens Bay (identified as an exclusion zone)
- Operations only in daylight hours and not before 8am
- No joyfilght/joyrides from the helipad

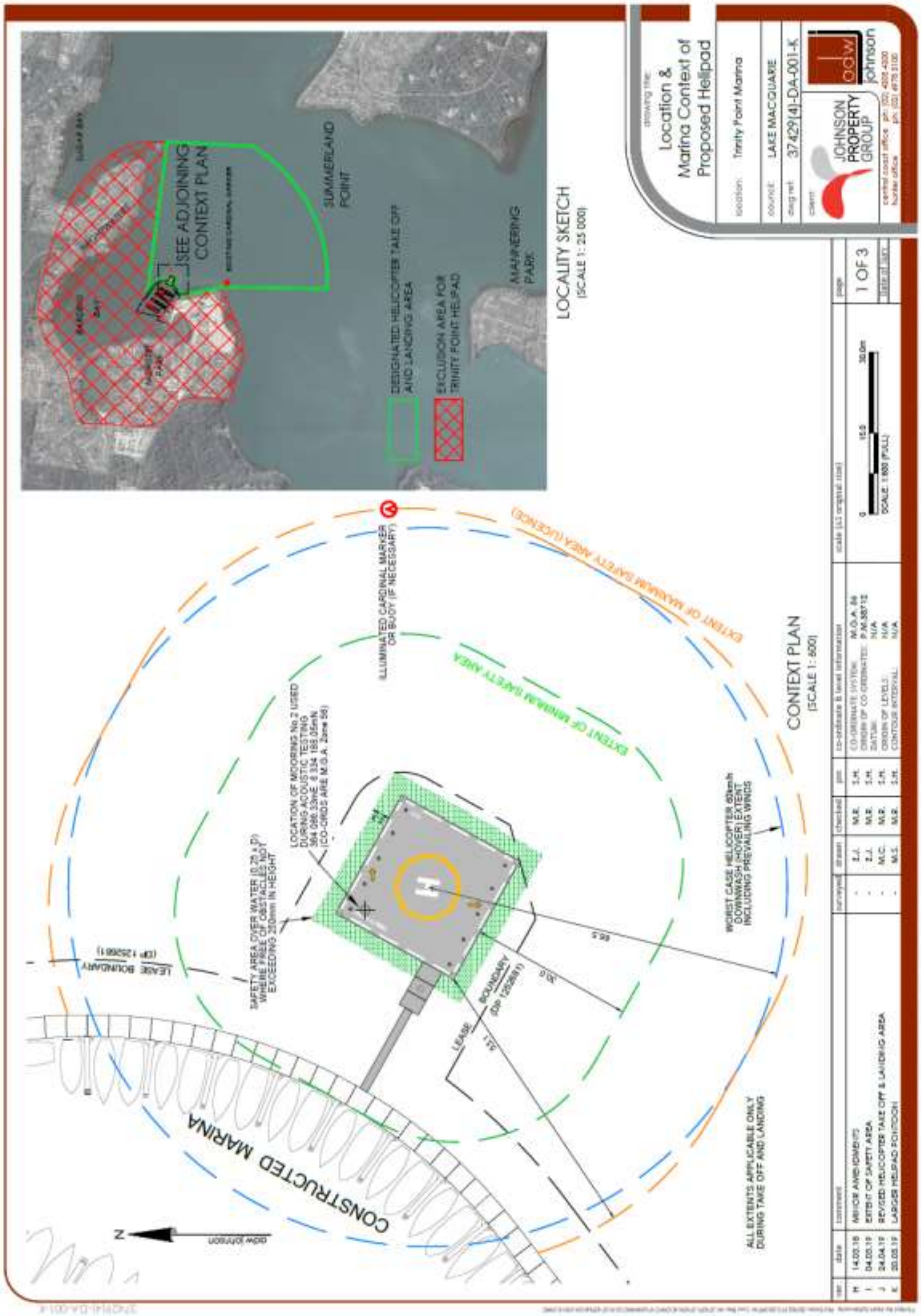
Yours faithfully,

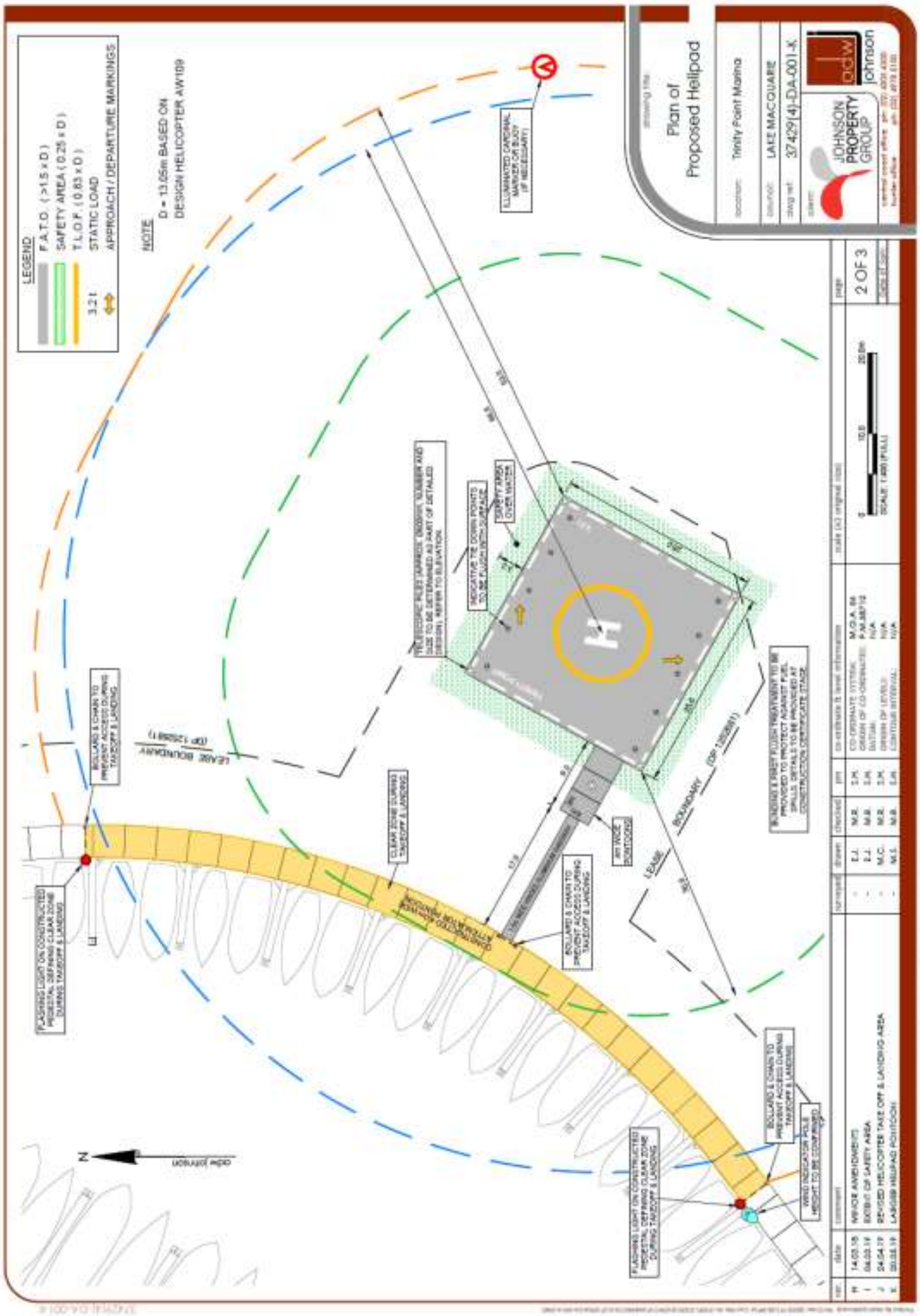
THE ACOUSTIC GROUP PTY LTD

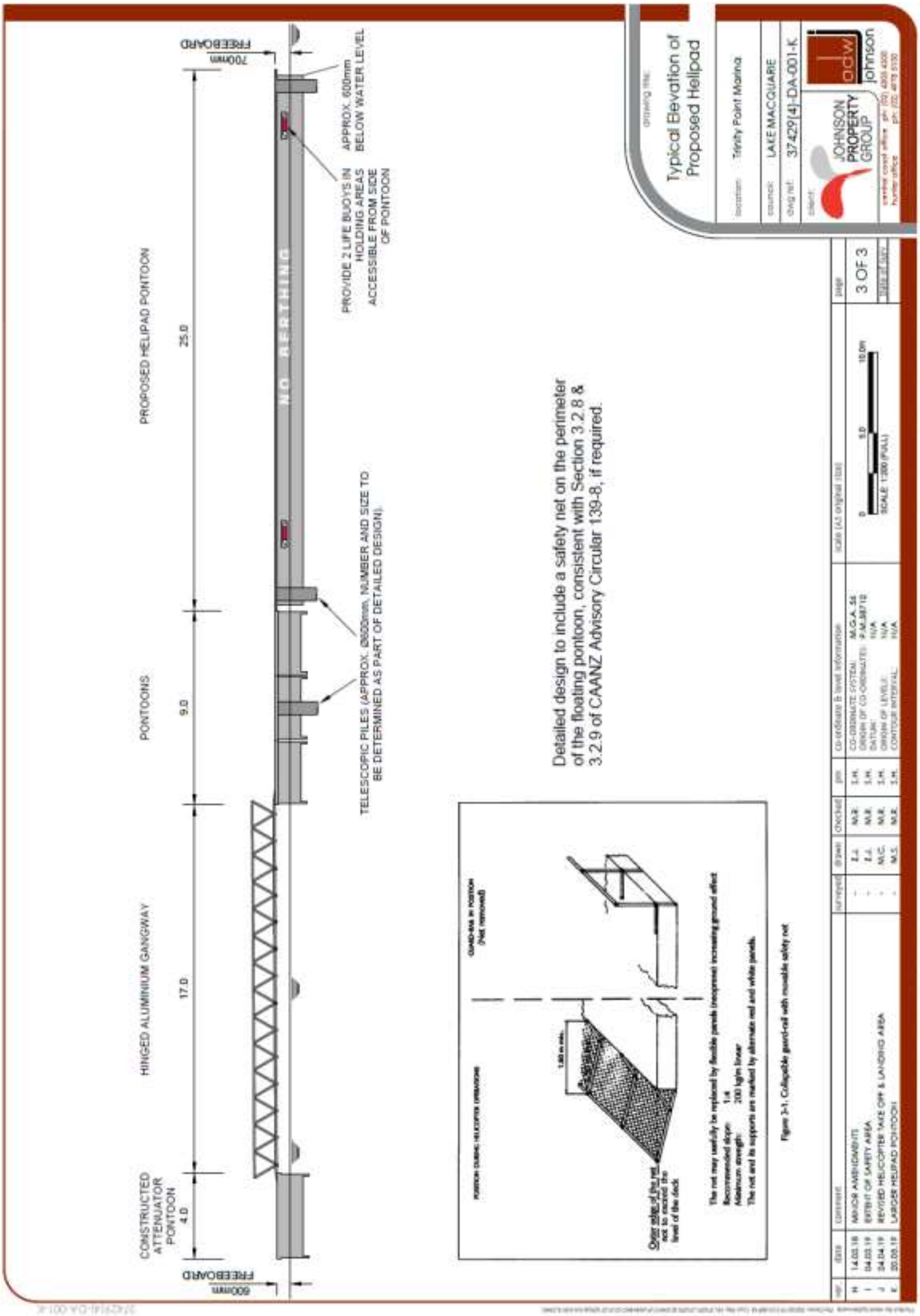
STEVEN E. COOPER

APPENDIX A: Site and Measurement Locations

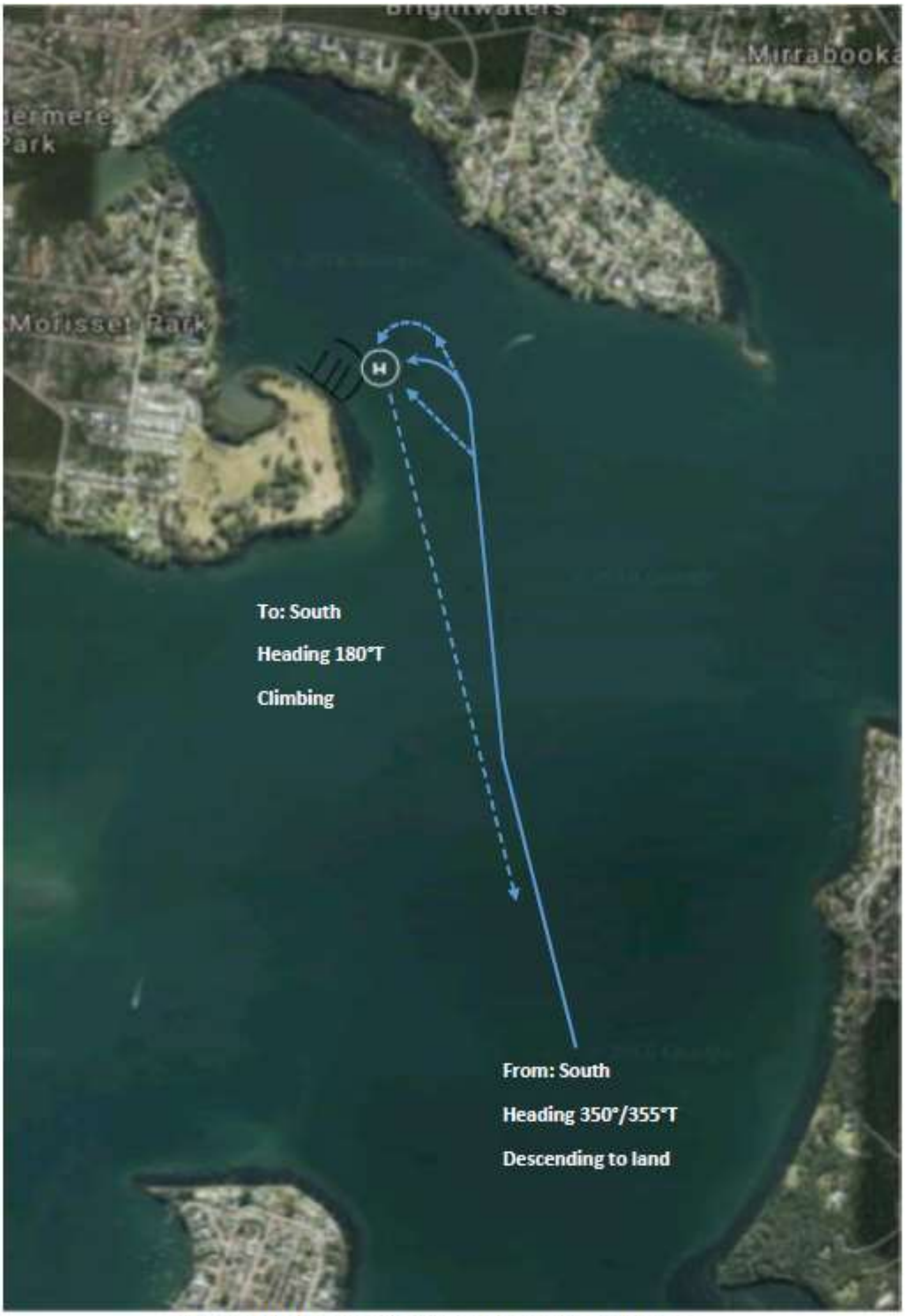



LOCALITY SKETCH
(SCALE 1: 25 000)
SEE ADJOINING CONTEXT PLAN
SUMMERLAND POINT
MANNERING PARK
DESIGNATED HELICOPTER TAKE OFF AND LANDING AREA
EXCLUSION AREA FOR TRINITY POINT HELIPAD
CONTEXT PLAN
(SCALE 1: 600)
CONSTRUCTED MARINA
EXTENT OF MINIMUM SAFETY AREA
EXTENT OF MAXIMUM SAFETY AREA (LICENCE)
ILLUMINATED CARDINAL MARKER OR BUOY (IF NECESSARY)
ALL EXTENTS APPLICABLE ONLY DURING TAKE OFF AND LANDING
Location &
Marina Context of
Proposed Helipad
Trinity Point Marina
LAKE MACQUARIE
37429(4)-DA-001-K
JOHNSON PROPERTY GROUP
1 OF 3


LEGEND
F.A.T.O. (>1.5 x D)
SAFETY AREA (0.25 x D)
T.L.O.F. (0.83 x D)
STATIC LOAD
APPROACH / DEPARTURE MARKINGS
NOTE
D = 13.05m BASED ON DESIGN HELICOPTER AW109
Plan of Proposed Helipad
Trinity Point Marina
LAKE MACQUARIE
37429(4)-DA-001-K
JOHNSON PROPERTY GROUP
johnson
2 OF 3


PROPOSED HELIPAD PONTOON
25.0
PONTOONS
9.0
HINGED ALUMINIUM GANGWAY
17.0
CONSTRUCTED ATTENUATOR PONTOON
4.0
FREEBOARD
700mm
600mm
NO BERTHING
PROVIDE 2 LIFE BUOYS IN HOLDING AREAS ACCESSIBLE FROM SIDE OF PONTOON
APPROX. 600mm BELOW WATER LEVEL
TELESCOPIC PILES (APPROX. Ø600mm, NUMBER AND SIZE TO BE DETERMINED AS PART OF DETAILED DESIGN).
Detailed design to include a safety net on the perimeter of the floating pontoon, consistent with Section 3.2.8 & 3.2.9 of CAANZ Advisory Circular 139-8, if required.
Typical Elevation of Proposed Helipad
Trinity Point Marina
LAKE MACQUARIE
37429(4)-DA-001-K
JOHNSON PROPERTY GROUP
3 OF 3

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.

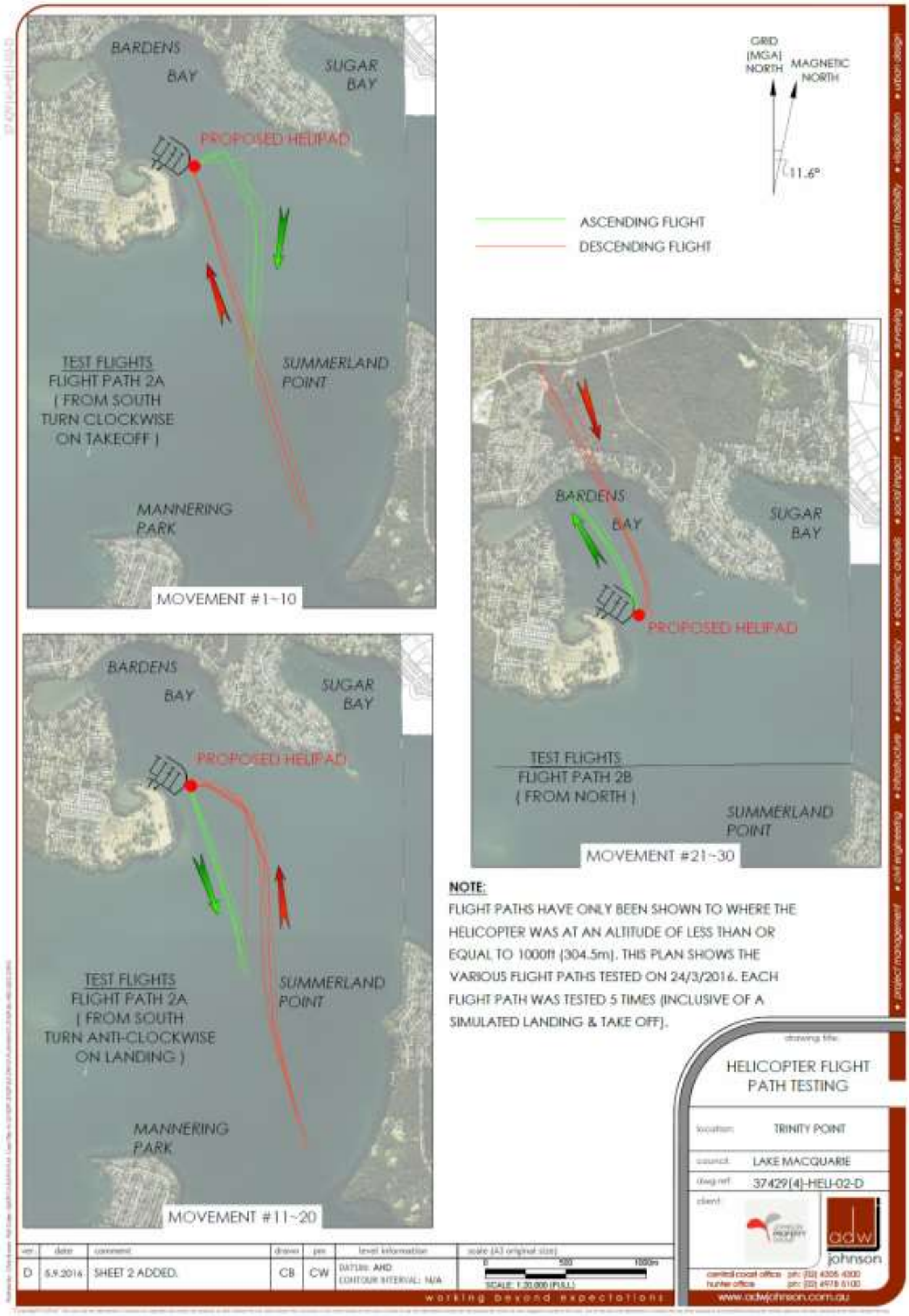
Attended Measurement Location

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		
33		On land	North	**Landing**
34		On Land	South	Take off

APPENDIX C: Flight tracks on the day of testing



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		
33		On land	North	**Landing**
34		On Land	South	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	**	**	69	78	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

* Meter reset (no measurement)
** Interference from extraneous noise

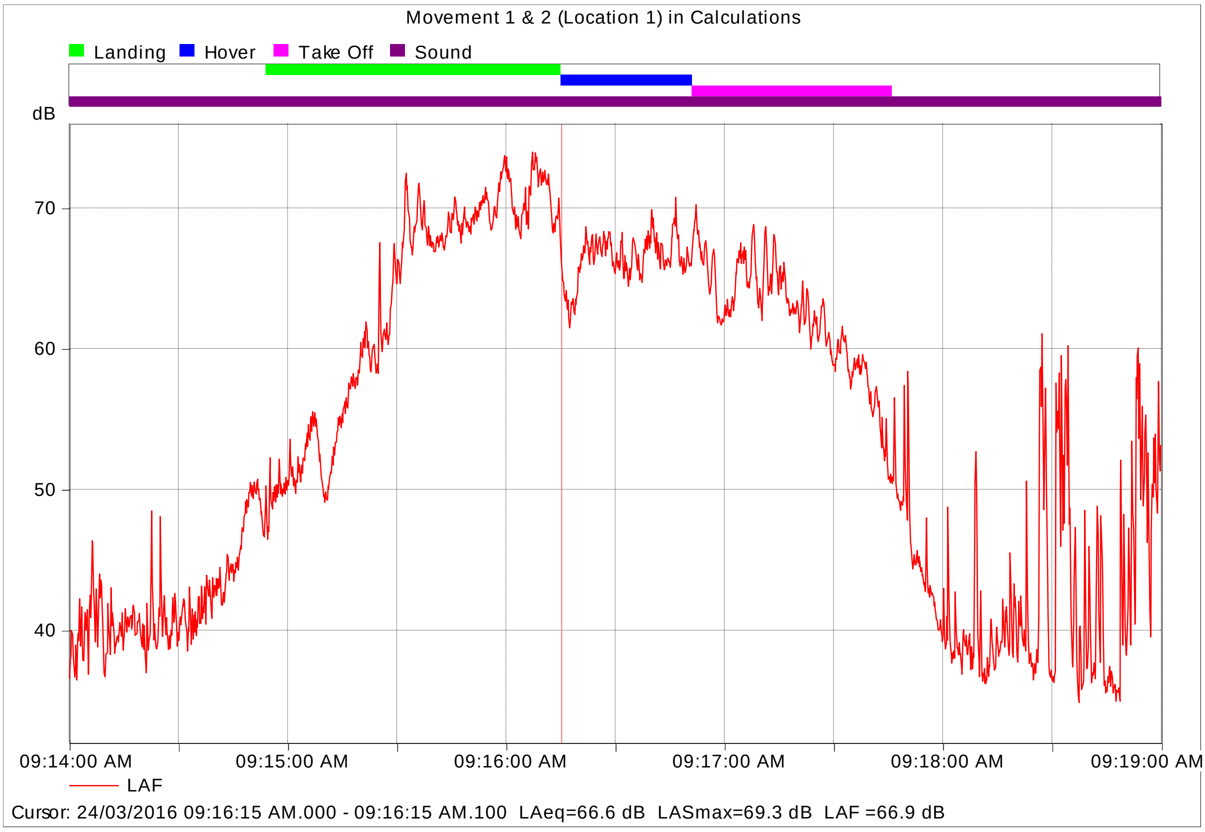
Summary Table - Log average

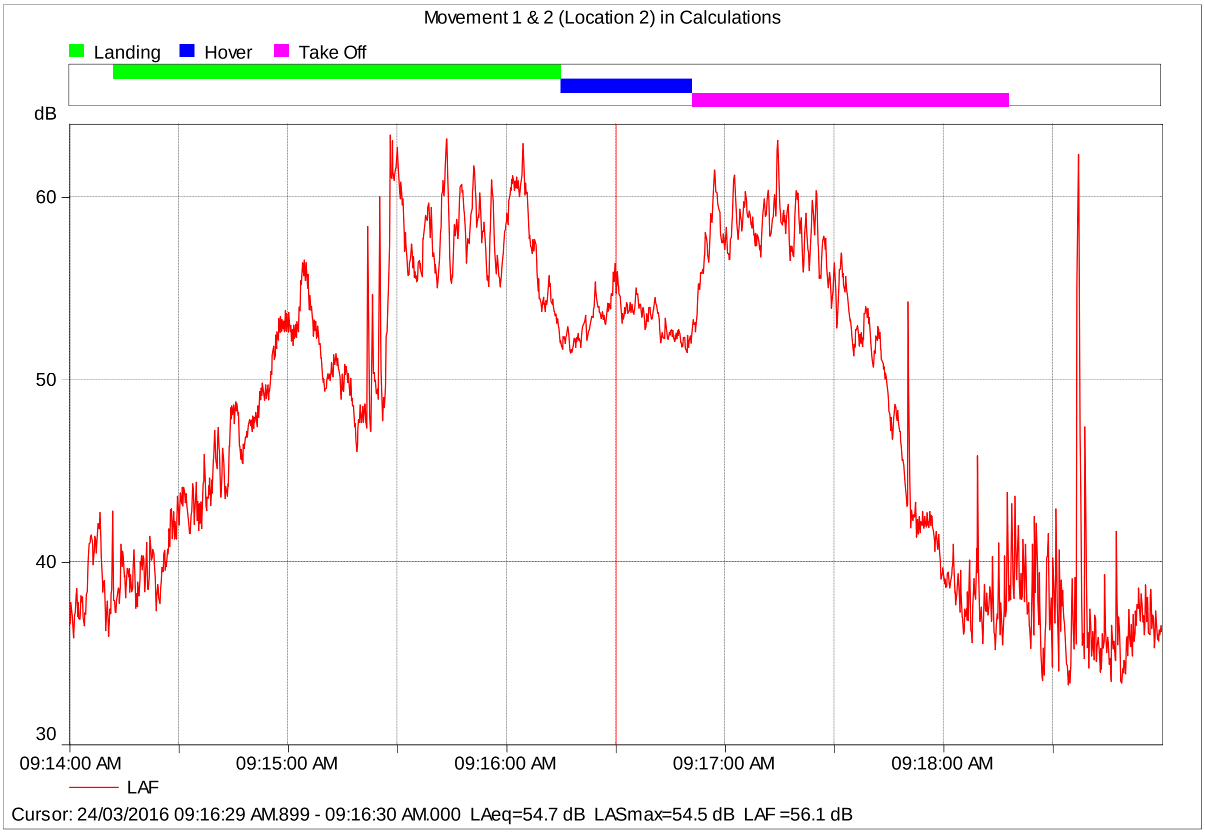
Location	Flight Path	Direction	Take off		Landing		Overflight	
			Max	SEL	Max	SEL	Max	SEL
1	2A	Clockwise	75	85.8	74	86.6	-	-
	2A	Anticlockwise	77	86.3	71	82.5	-	-
	2B	North	73	84.8	-	-	-	-
	2B	South	-	-	73	84.9	-	-
	Overflight 1000 ft	North	-	-	-	-	66	77.6
	Overflight 500 ft		-	-	-	-	72	81.4
2	2A	Clockwise	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
	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
	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
	Overflight 500 ft		-	-	-	-	72	81
5	2A	Clockwise	75	84.3	73	83.8	-	-
	2A	Anticlockwise	75	84.9	73	84.4	-	-
	2B	North	76	88.3	-	-	-	-
	2B	South	-	-	75	86.1	-	-
	Overflight 1000 ft	North	-	-	-	-	63	76
	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	-	-	-	-

Location	Flight Path	Direction	Take off		Landing		Overflight	
			Max	SEL	Max	SEL	Max	SEL
	2B	South	-	-	69	80.8	-	-
	Overflight 1000 ft	North	-	-	-	-	62	74.4
	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
	Overflight 500 Ft		-	-	-	-	61	73

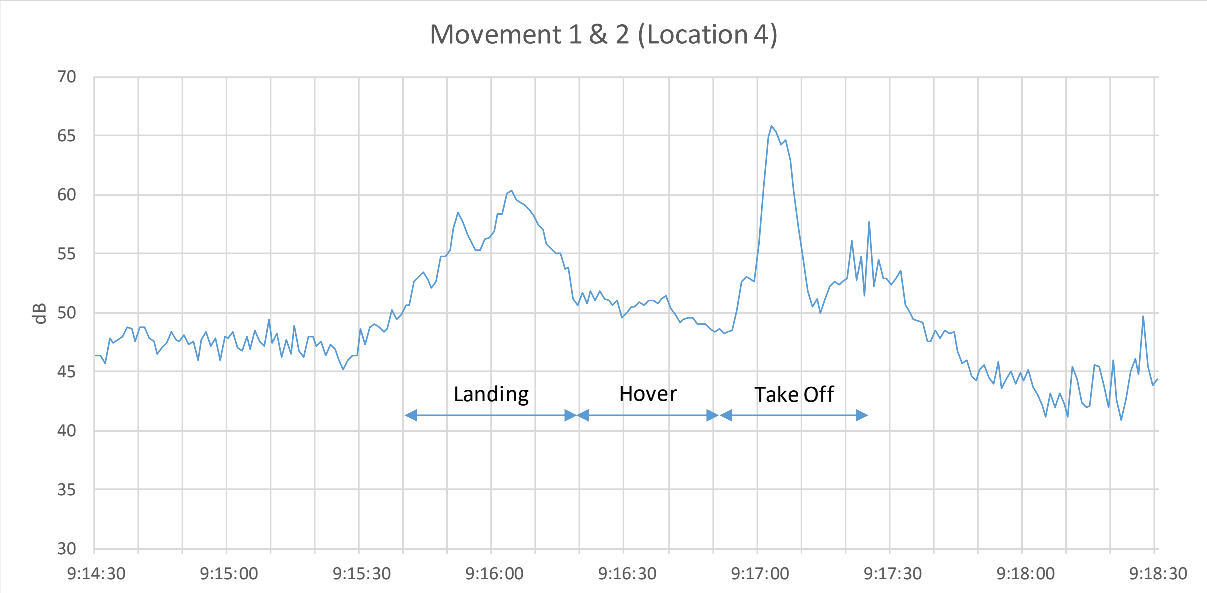
APPENDIX F: Measurement Results

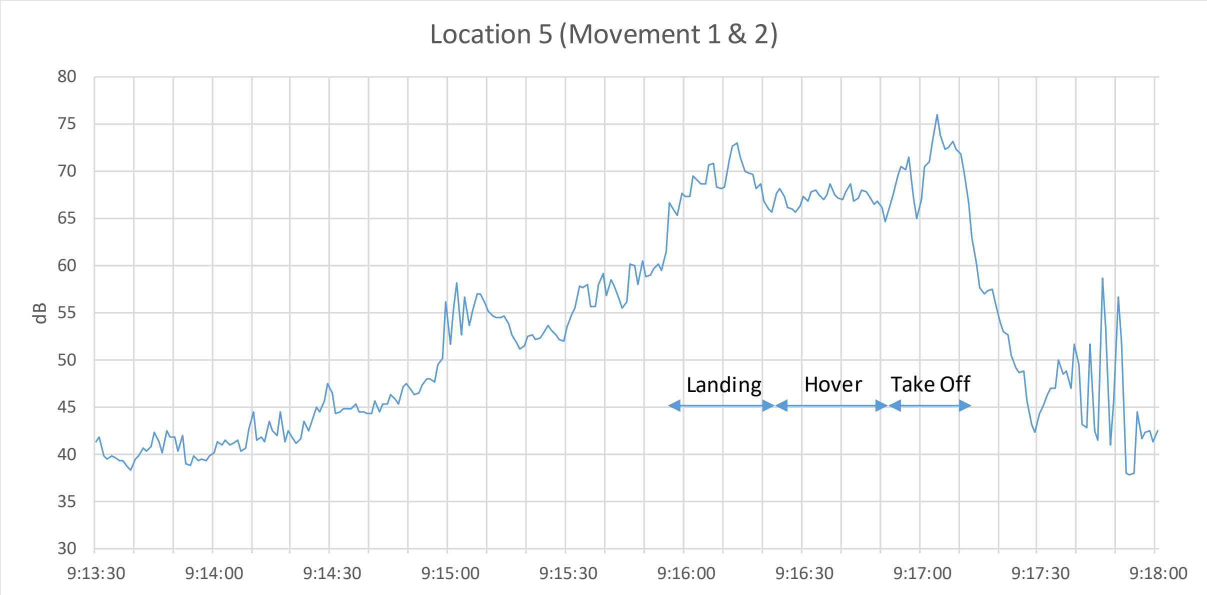
2A Clockwise

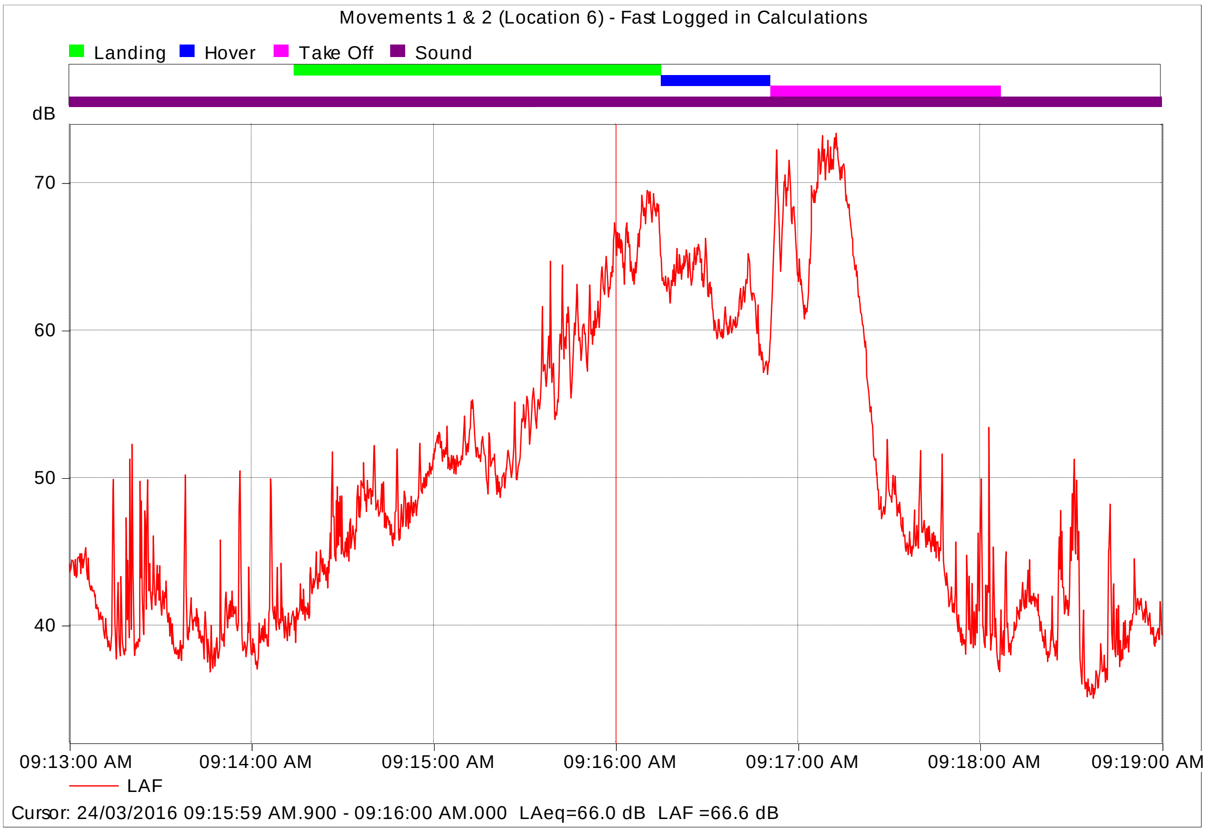


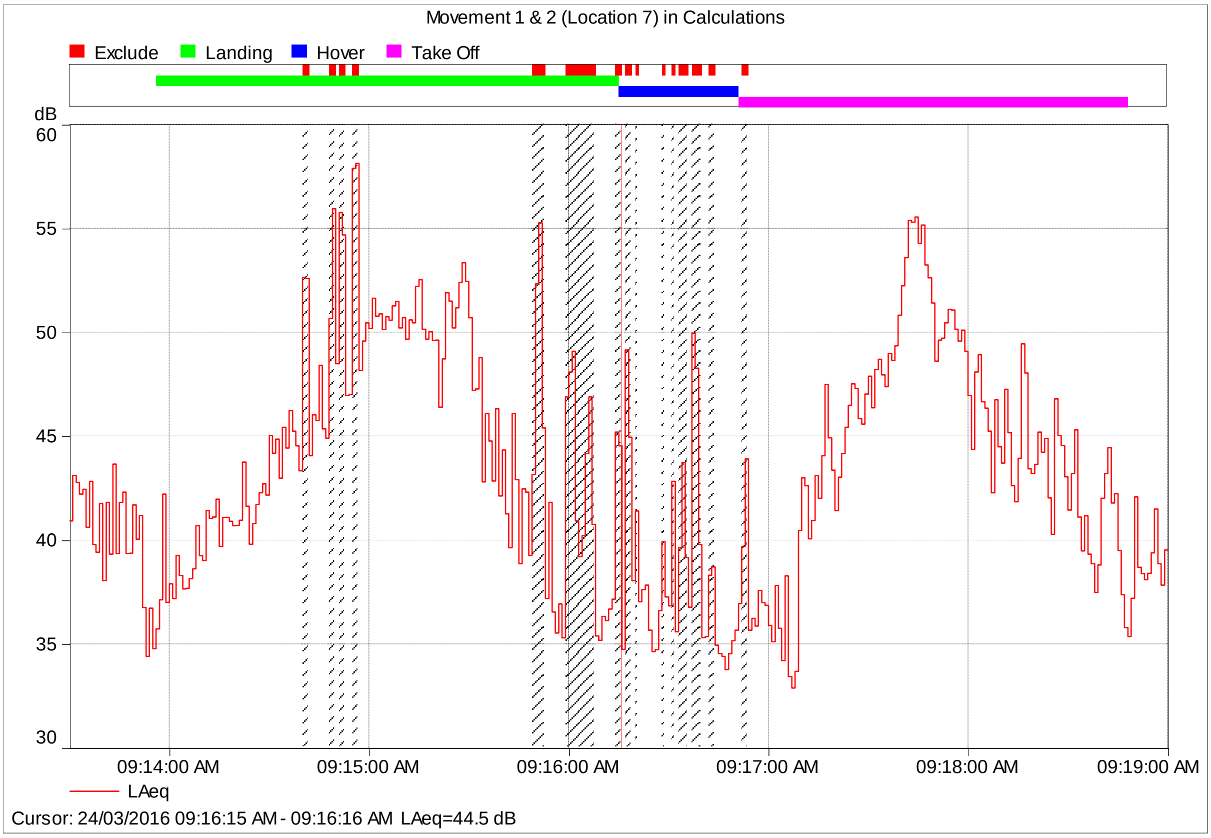



Movement 1 & 2 (Location 3)
dB
65
60
55
50
45
40
35
30
Landing
Hover
Take Off
9:13:30
9:14:00
9:14:30
9:15:00
9:15:30
9:16:00
9:16:30
9:17:00
9:17:30
9:18:00
9:18:30
9:19:00


Movement 1 & 2 (Location 4)
dB
70
65
60
55
50
45
40
35
30
Landing
Hover
Take Off
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

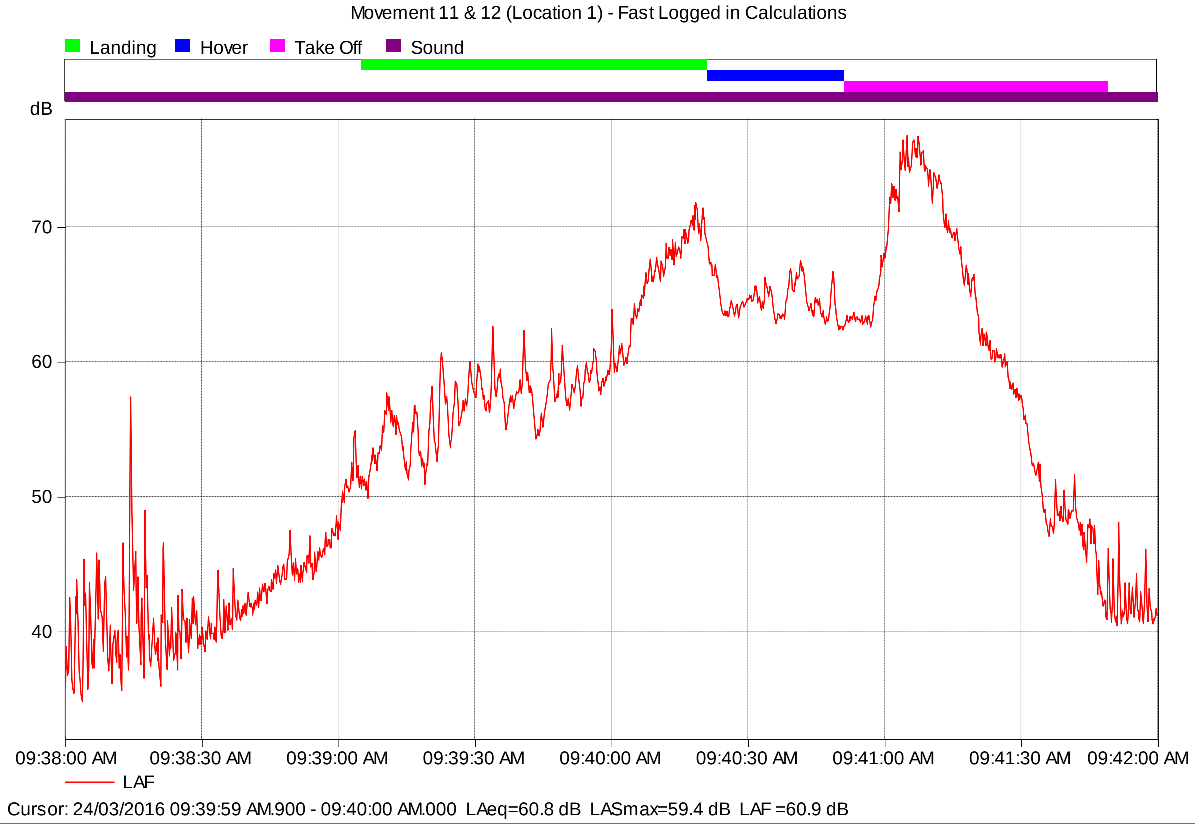

Location 5 (Movement 1 & 2)
dB
80
75
70
65
60
55
50
45
40
35
30
Landing
Hover
Take Off
9:13:30
9:14:00
9:14:30
9:15:00
9:15:30
9:16:00
9:16:30
9:17:00
9:17:30
9:18:00

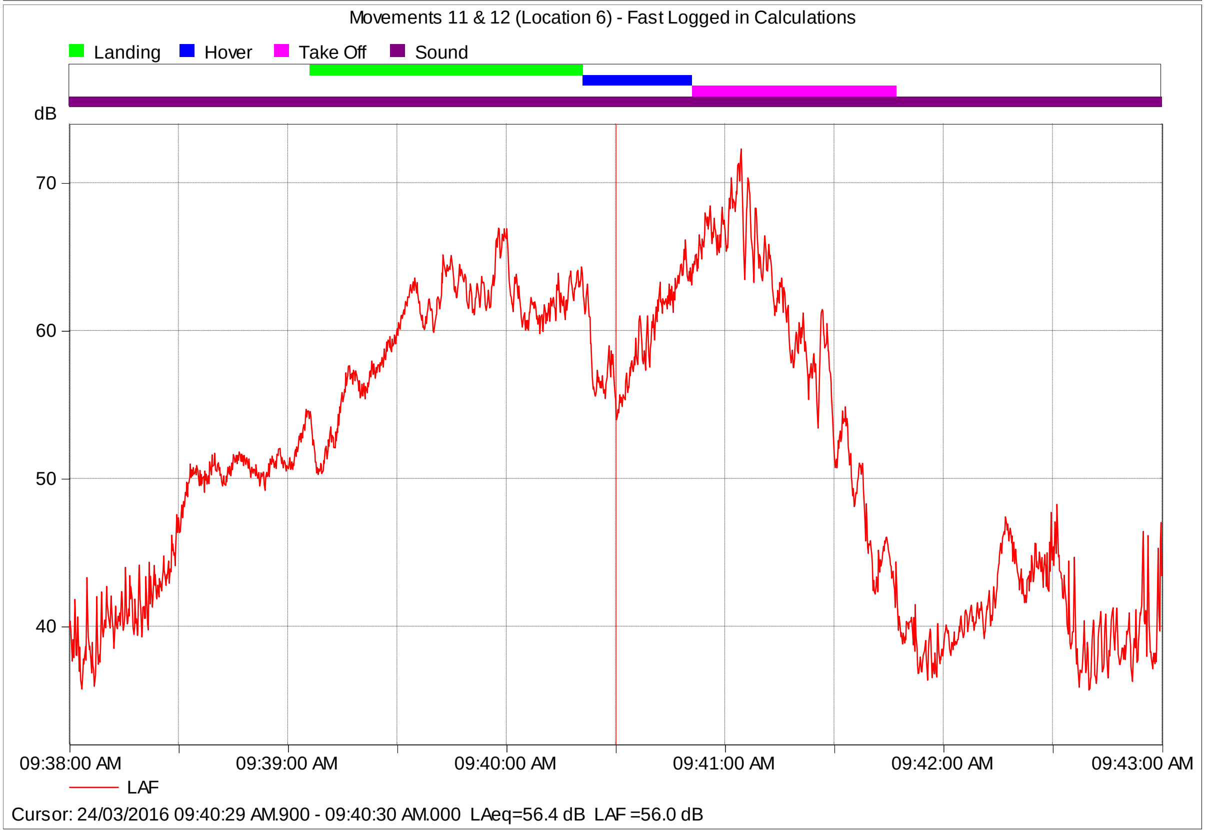

Movements 1 & 2 (Location 6) - Fast Logged in Calculations
Landing
Hover
Take Off
Sound
dB
70
60
50
40
09:13:00 AM
09:14:00 AM
09:15:00 AM
09:16:00 AM
09:17:00 AM
09:18:00 AM
09:19:00 AM
LAF
Cursor: 24/03/2016 09:15:59 AM.900 - 09:16:00 AM.000 LAeq=66.0 dB LAF =66.6 dB


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

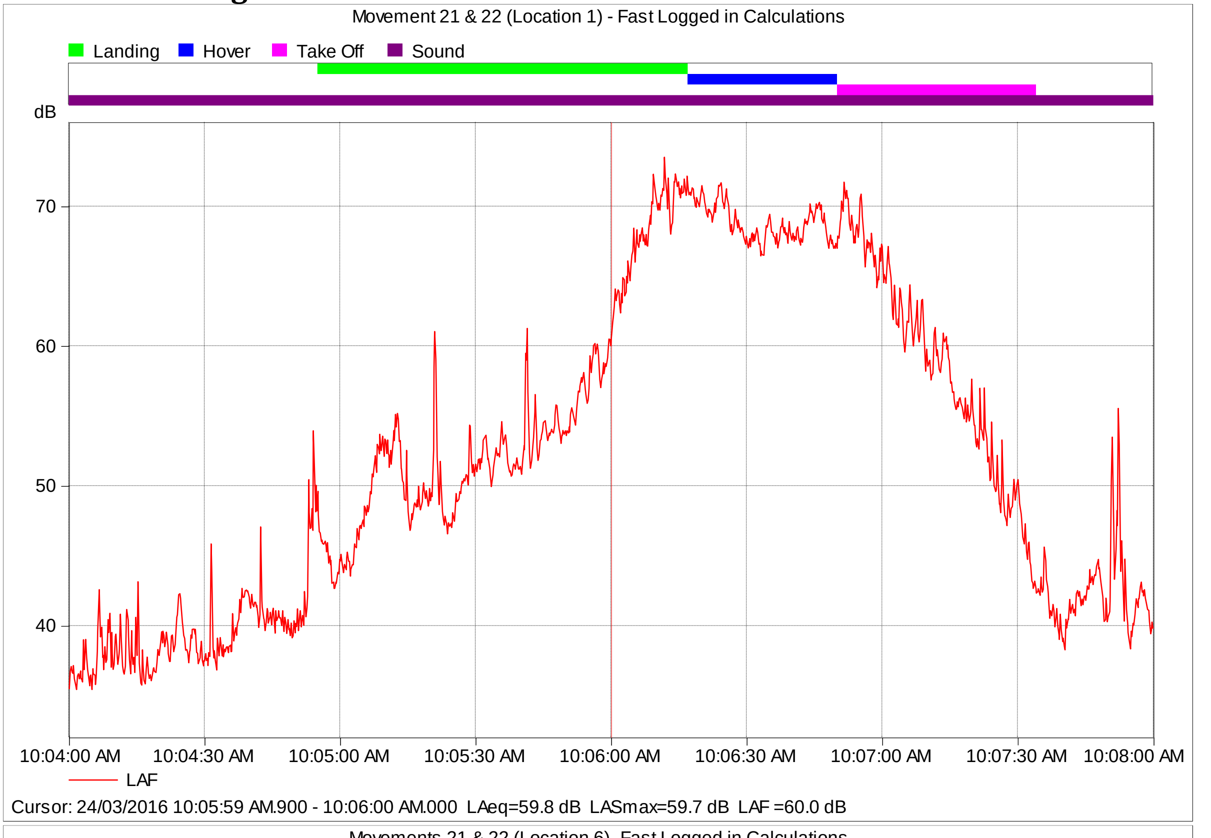
		Movement 1 with hover component	**Movement 1 without hover component**	**Movement 2 with Hover Component**	**Movement 2 without Hover Component**	**Hover**
Location 1	Max dB(A)	74.0	74.0	70.7	70.2	70.7
	SEL dB(A)	87.4	86.8	84.1	81.1	82.2
Location 2	Max dB(A)	63.4	63.4	63.1	63.1	56.4
	SEL dB(A)	76.3	76.1	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

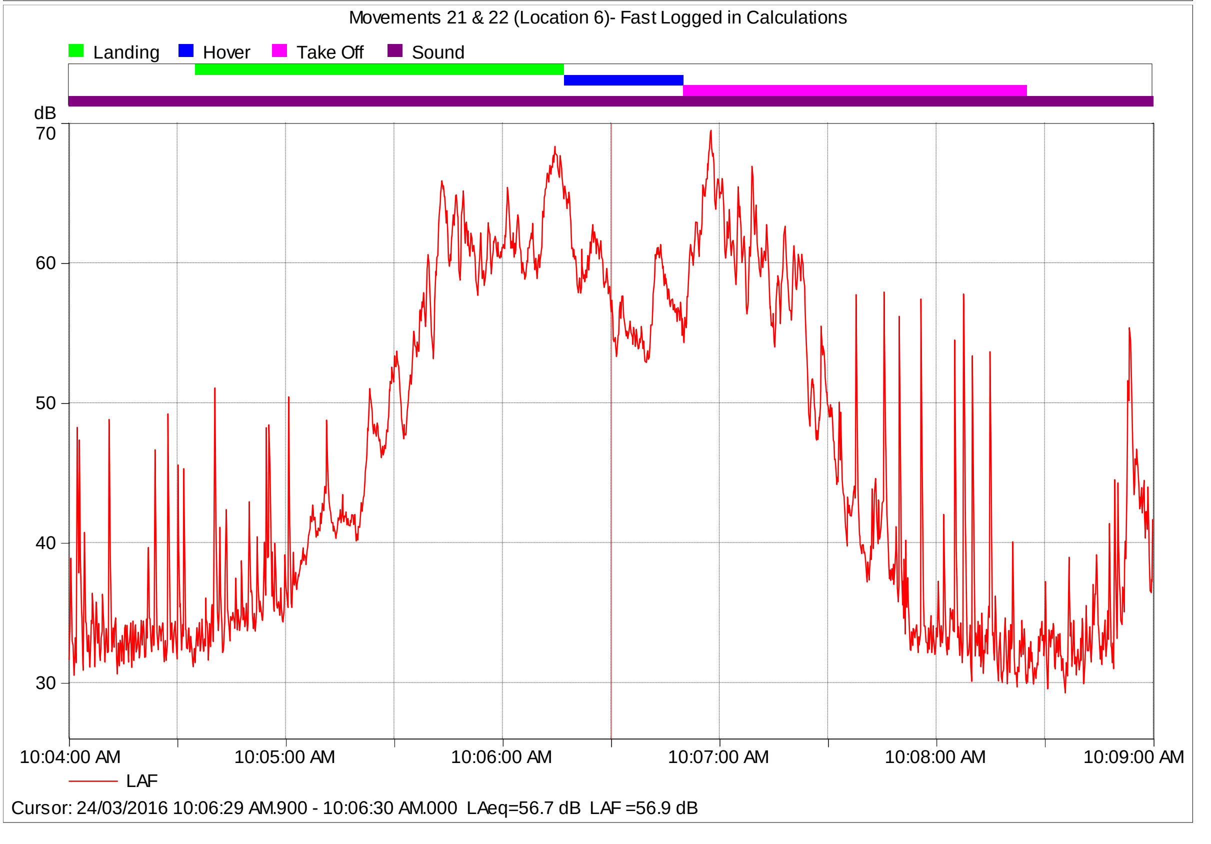
2A Anti-Clockwise

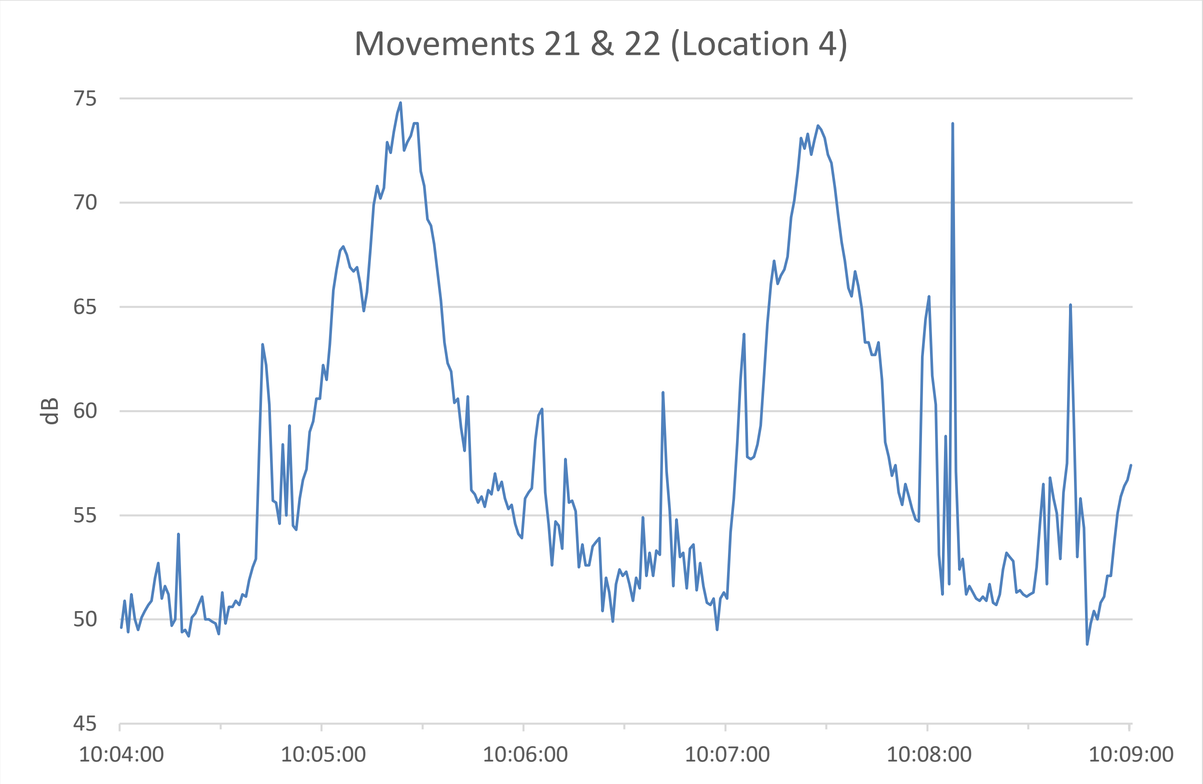




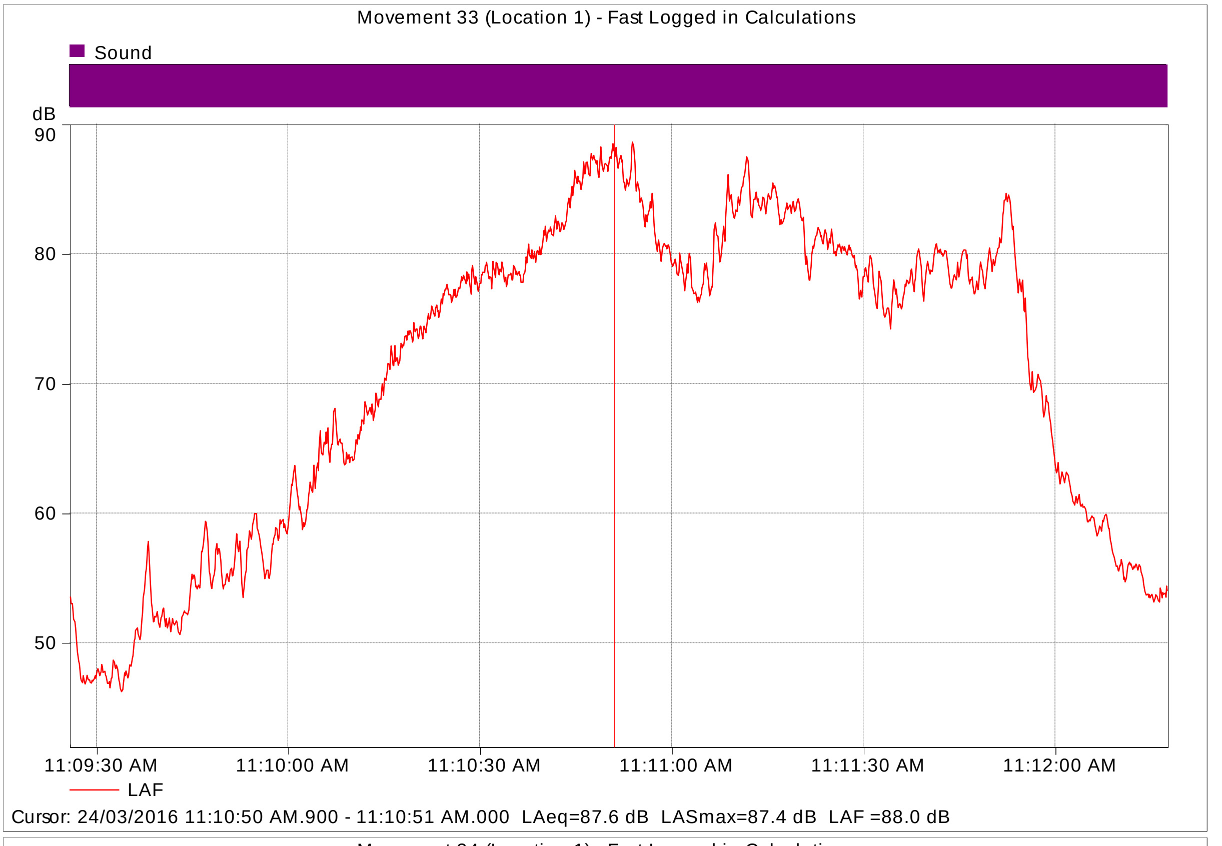
2B Northern Flight Path

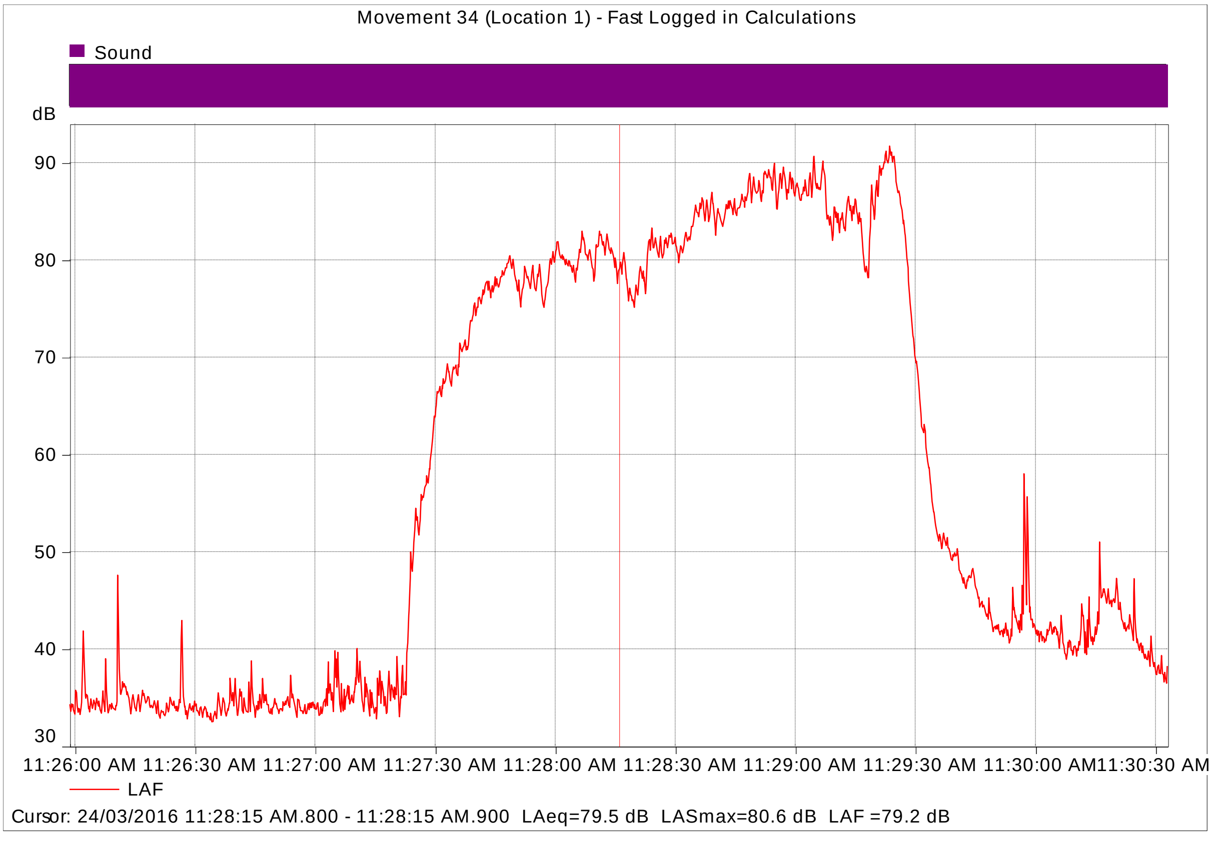


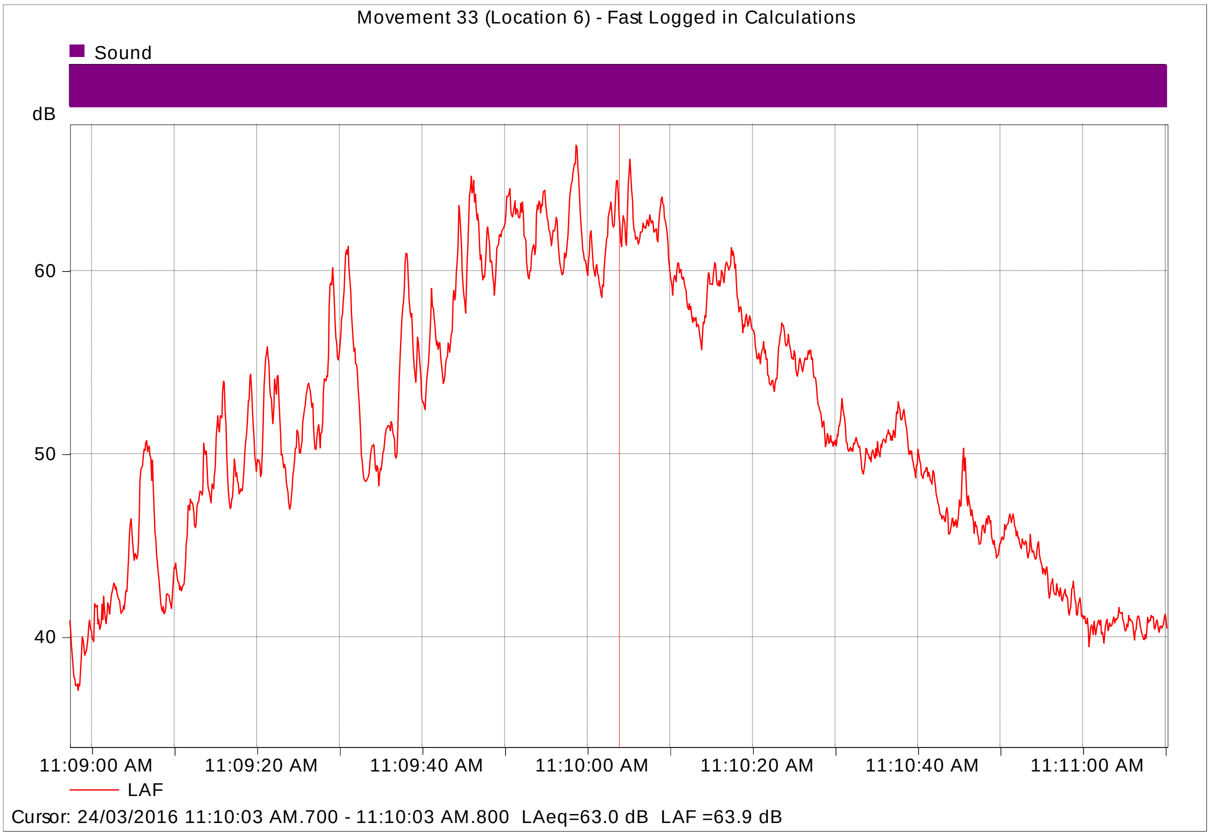


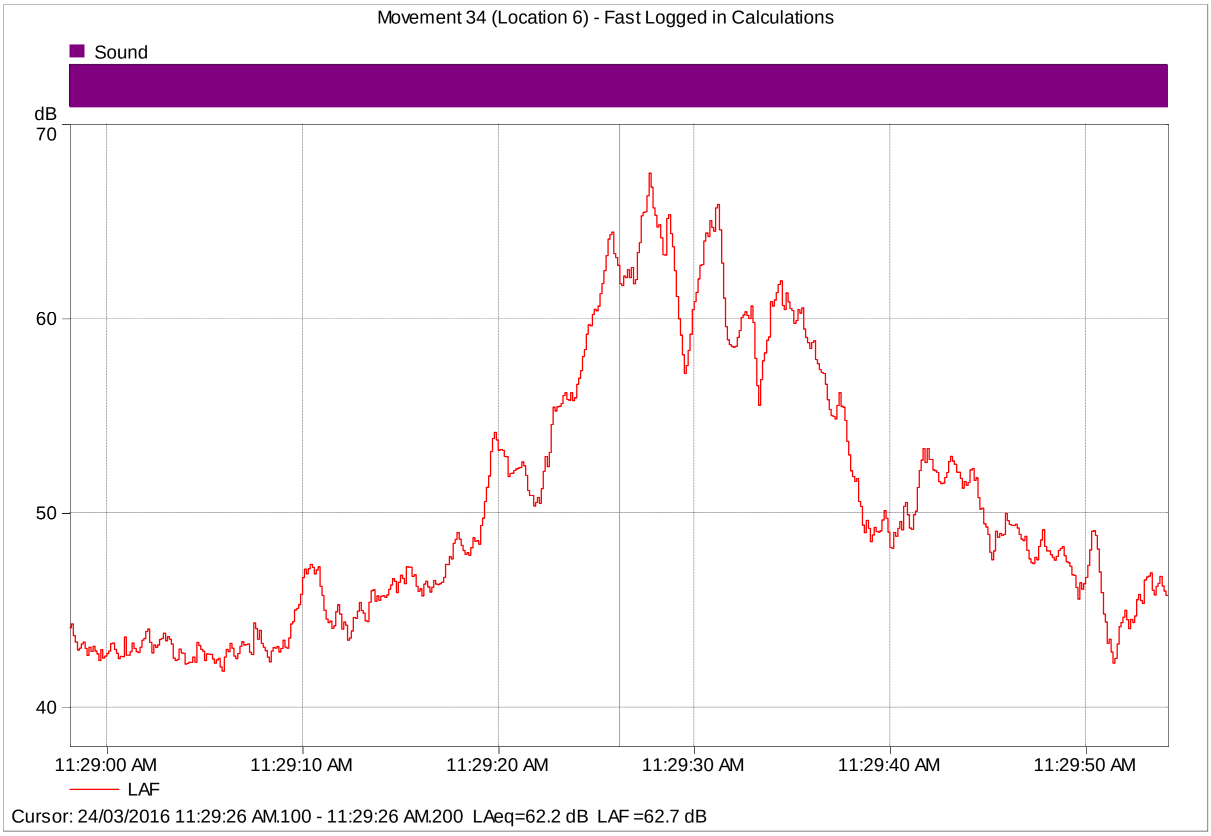


	Location 1		Location 4		Location 6	
	Max dB(A)	SEL dB(A)	Max dB(A)	SEL dB(A)	Max dB(A)	SEL dB(A)
Movement 21	74	81.8	75	86.1	68	78.8
Movement 21 with hover component	-	84.5	-	86.1	-	79.6
Movement 22	72	79.9	74	85.1	66	77.8
Movement 22 with hover component	-	83.2	-	85.1	-	78.4
Hover	72	84.2	61	68.8	70	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 AM11:30:30 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

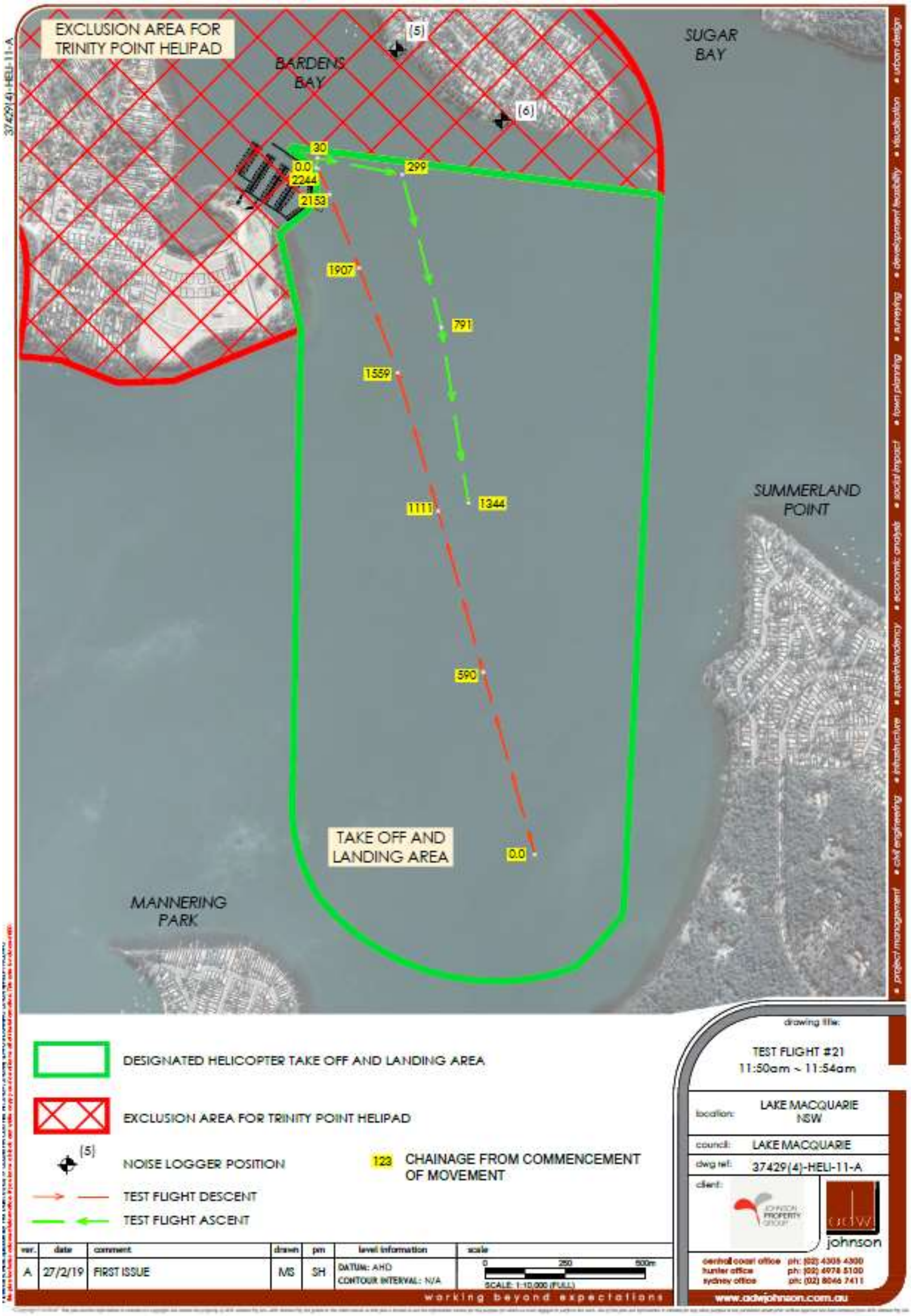

Movement 33 (Location 6) - Fast Logged in Calculations
Sound
dB
60
50
40
11:09:00 AM
11:09:20 AM
11:09:40 AM
11:10:00 AM
11:10:20 AM
11:10:40 AM
11:11:00 AM
LAF
Cursor: 24/03/2016 11:10:03 AM.700 - 11:10:03 AM.800 LAeq=63.0 dB LAF =63.9 dB

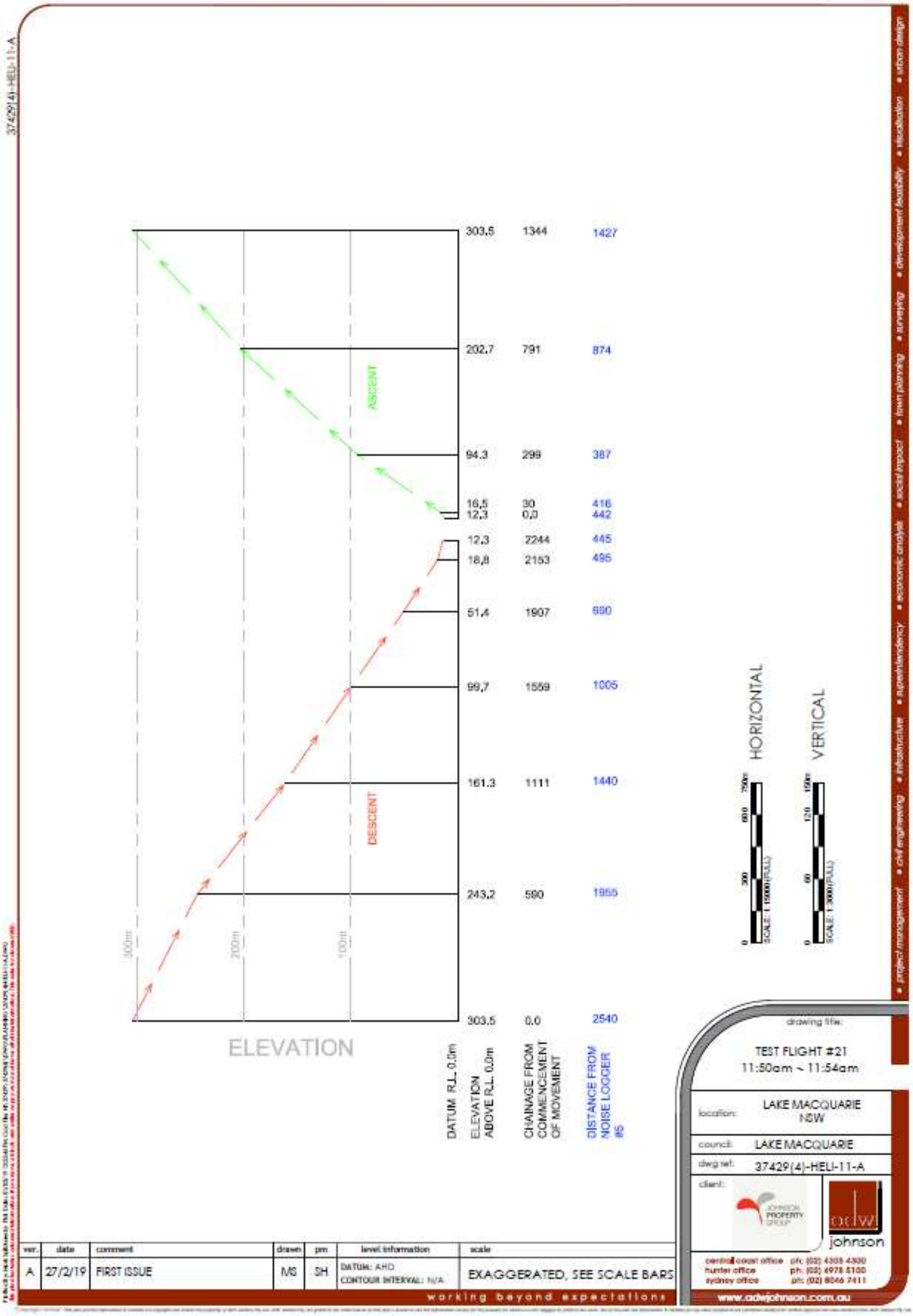

Movement 34 (Location 6) - Fast Logged in Calculations
Sound
dB
70
60
50
40
11:29:00 AM
11:29:10 AM
11:29:20 AM
11:29:30 AM
11:29:40 AM
11:29:50 AM
LAF
Cursor: 24/03/2016 11:29:26 AM.100 - 11:29:26 AM.200 LAeq=62.2 dB LAF =62.7 dB

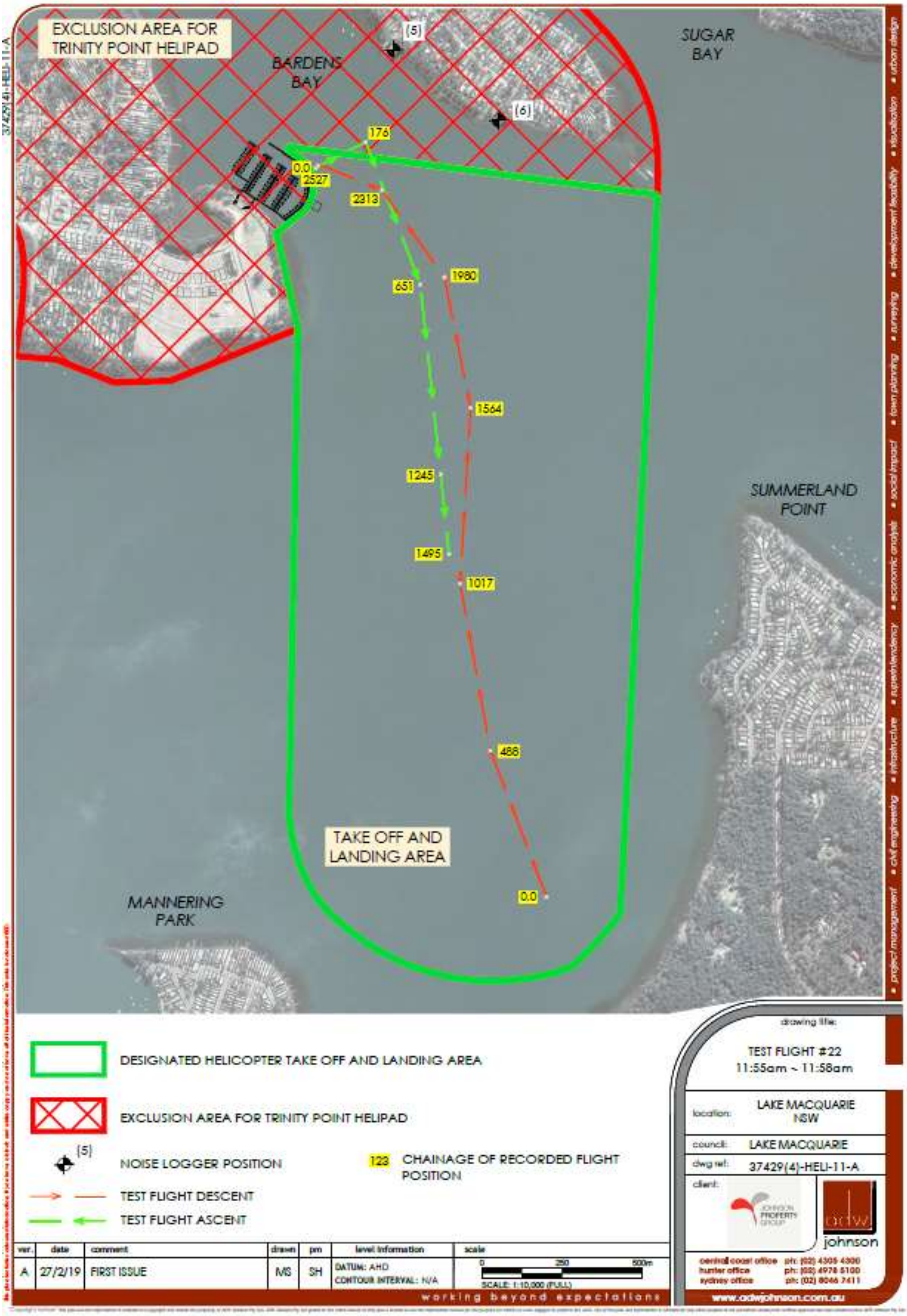
	Location 1		Location 4		Location 6	
	Max dB(A)	SEL dB(A)	Max dB(A)	SEL dB(A)	Max dB(A)	SEL dB(A)
Movement 11	72	81.5	**	**	67	80.3
Movement 11 with hover component	-	82.9	**	**	-	80.3
Movement 12	77	86.1	**	**	72	81.2
Movement 12 with hover component	-	86.2	**	**	-	82.1
Hover	69	79.6	**	**	66	75.3
Movement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

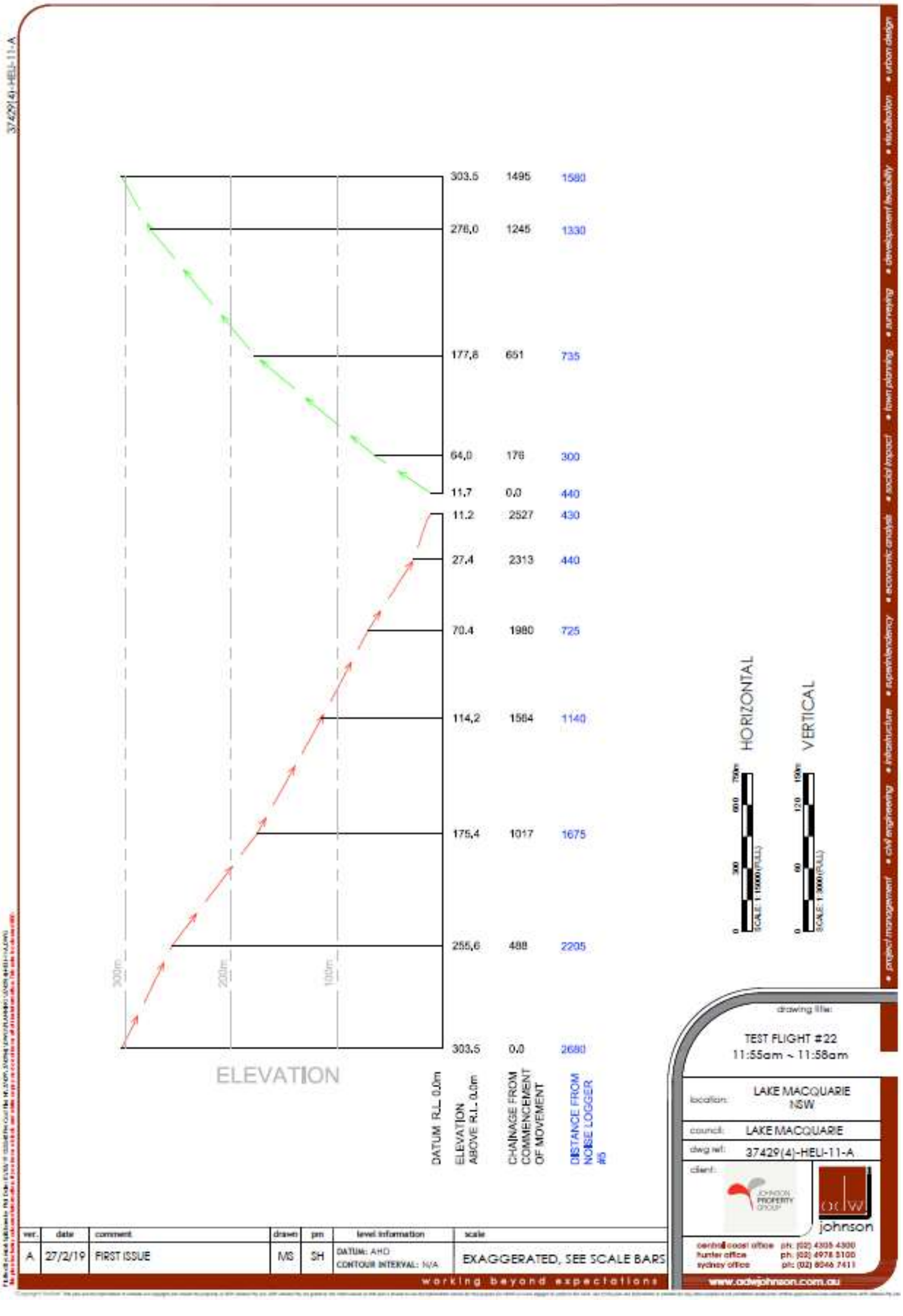
** Means interference by extraneous noise

APPENDIX G: GPS Track for Test Flights




37429(4)-HELI-11-A
ELEVATION
ASCENT
DESCENT
DATUM R.L. 0.0m
ELEVATION ABOVE R.L. 0.0m
CHAINAGE FROM COMMENCEMENT OF MOVEMENT
DISTANCE FROM NOISE LOGGER #5
303.5 1344 1427
202.7 791 874
94.3 299 387
16.5 30 416
12.3 0.0 442
12.3 2244 445
18.8 2153 495
51.4 1907 690
99.7 1559 1005
161.3 1111 1440
243.2 590 1955
303.5 0.0 2540
HORIZONTAL
VERTICAL
drawing title:
TEST FLIGHT #21
11:50am ~ 11:54am
location: LAKE MACQUARIE NSW
council: LAKE MACQUARIE
dwg ref: 37429(4)-HELI-11-A
client:
ver. date comment drawn pm level information scale
A 27/2/19 FIRST ISSUE MS SH DATUM: AHD CONTOUR INTERVAL: N/A EXAGGERATED, SEE SCALE BARS
working beyond expectations
www.adwjohnson.com.au


EXCLUSION AREA FOR TRINITY POINT HELIPAD
BARDENS BAY
SUGAR BAY
(5)
(6)
176
0.0
2527
2313
1980
651
1564
1245
1495
1017
488
0.0
SUMMERLAND POINT
TAKE OFF AND LANDING AREA
MANNERING PARK
DESIGNATED HELICOPTER TAKE OFF AND LANDING AREA
EXCLUSION AREA FOR TRINITY POINT HELIPAD
NOISE LOGGER POSITION
123 CHAINAGE OF RECORDED FLIGHT POSITION
TEST FLIGHT DESCENT
TEST FLIGHT ASCENT
drawing title:
TEST FLIGHT #22
11:55am ~ 11:58am
location: LAKE MACQUARIE NSW
council: LAKE MACQUARIE
dwg ref: 37429(4)-HELI-11-A
client:
ver. date comment drawn pm level information scale
A 27/2/19 FIRST ISSUE MS SH DATUM: AHD CONTOUR INTERVAL: N/A
SCALE 1:10,000 (FULL)
working beyond expectations
www.adwjohnson.com.au


37429(4)-HELI-11-A
303.5 1495 1580
276.0 1245 1330
177.8 651 735
64.0 176 300
11.7 0.0 440
11.2 2527 430
27.4 2313 440
70.4 1980 725
114.2 1564 1140
175.4 1017 1675
255.6 488 2205
303.5 0.0 2680
300m
200m
100m
ELEVATION
DATUM R.L. 0.0m
ELEVATION ABOVE R.L. 0.0m
CHAINAGE FROM COMMENCEMENT OF MOVEMENT
DISTANCE FROM NOISE LOGGER #5
HORIZONTAL
VERTICAL
drawing title:
TEST FLIGHT #22
11:55am ~ 11:58am
location: LAKE MACQUARIE NSW
council: LAKE MACQUARIE
dwg ref: 37429(4)-HELI-11-A
client:
JOHNSON PROPERTY GROUP
adw johnson
ver. date comment drawn prm level information scale
A 27/2/19 FIRST ISSUE MS SH DATUM: AHD CONTOUR INTERVAL: N/A EXAGGERATED, SEE SCALE BARS
central coast office ph: (02) 4305 4300
hunter office ph: (02) 4978 5100
sydney office ph: (02) 8046 7411
working beyond expectations
www.adwjohnson.com.au
project management • civil engineering • infrastructure • superintendency • economic analysis • social impact • town planning • surveying • development feasibility • visualisation • urban design