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Cronulla Sharks Redevelopment Master Plan

Past 3A - Noise Impact Assessment

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1 EXECUTIVE SUMMARY

This report details the noise and vibration assessment for impacts impacting on the proposed Cronulla Sharks Redevelopment Master Plan development as well as potential for noise impacts generated on the site impacting on surrounding areas (including built and natural environments).

The report has been developed to assess noise and vibration as required by Condition 8 of the Director Generals Requirements which follows:

> ***8. Noise and Vibration Assessment***
>
> *The EPA should address the issue of noise and vibration impacts and provide details of how these will be managed and ameliorated through the design of the building, in compliance with the relevant Australian Standards and the Departments Interim Guidelines for Development near Rail Corridors and Busy Roads.*

The report details the assessment conducted into existing noise impacts which will potentially affect future residence and includes:

1. Traffic noise from surrounding road ways.

2. Noise Impact from the neighbouring Toyota Stadium.

The report also details the potential of noise impact from the proposed development to surrounding receivers including the built and natural environment (including neighbouring wet lands and Towra Point). The assessment includes noise generated on the site during the construction phase of the project as well as noise impact one the project is completed.

This report provides the results of Environmental Noise Study for the proposed Cronulla Sharks Redevelopment. Noise at the site has been measured and noise goals have been set in accordance with the requirements of the relevant statutory/regulatory authorities including Local Council and the Department of Environment and Climate Change.

Determination of noise assessment criteria based on the DECCW's Industrial Noise Policy and ECRTN have been determined based on both unattended and attended noise monitoring conducted at the proposed site.

Potential noise impacts generated from the proposed retail area of the development will be required to comply with the environmental noise level criteria detailed in this report (such as loading docks, carpark, plant and equipment etc).

Additionally in principal treatments have been provided to ensure internal noise levels from surrounding noise sources (namely Captain Cook Drive) comply with the relevant Australian Standards.

Based on the assessment detailed in this report the proposed development (residential and retail) will comply with all relevant noise and vibration criteria.

2 INTRODUCTION

Acoustic Logic Consultancy Pty Ltd has been engaged to conduct an acoustic assessment for the purpose of assessing the potential impacts on the acoustic amenity of the proposed Cronulla Sharks Redevelopment for both external and internal noise sources as part of the Planning Application Part 3A submission. The noise sources investigated are as follows:

- Environmental noise impact on the future site, including surrounding traffic noise from surrounding roadways.
- Noise emissions associated with the neighbouring sports ground.
- Noise emissions associated with traffic generated from the site.
- Noise emissions from the site including mechanical plant noise to surrounding receivers.

Environmental noise will be covered first as it will potentially impact the future residential development. Unattended and attended noise monitoring was conducted in order to determine the existing traffic noise levels around the perimeter of the site.

The final part of the report will address noise generated from the retail and residential elements of the development to surrounding properties. At this early stage no detailed design has been conducted for mechanical plant as is standard at DA/PA stage. This cursory study will set the goal assessment criteria applicable to the project based on the Department of the Environment and Climate Change (DECC) requirements, other council and relevant statutory/regulatory requirements.

2.1 SITE DESCRIPTION

Figure 1 below illustrates the location of the Cronulla Sharks Redevelopment site, and the location of noise monitoring and measurements.

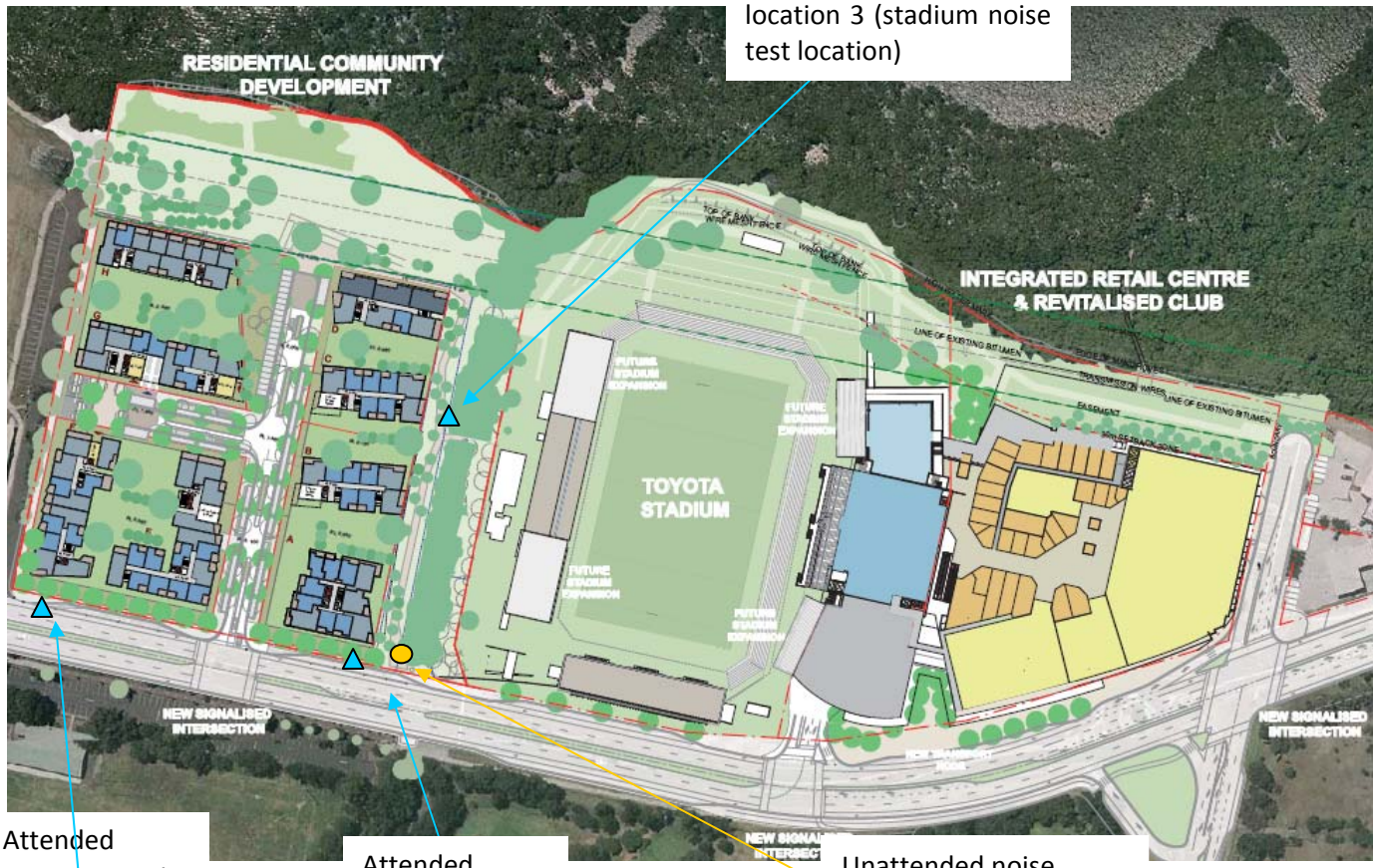


Figure 1 – Site Location and Measurement Positions

The existing environmental noise sources affecting the site are as follows:

- The residential development is affected by environmental noise predominantly from traffic noise from Captain Cook Drive to the south of the site which carries high volumes of traffic.
- Toyota Stadium to the east of the site. Games are typically conducted on sporting field every second weekend during the winter seasons of approximately March to September.
- Other surrounding boundaries are neighboured by existing parklands.

The environmental noise source outlined above has varying degrees of impact upon the proposed residential development which will be outlined in this report.

3 EXISTING ACOUSTIC ENVIRONMENT

Environmental noise impacting the site is a result of traffic noise from the surrounding perimeter roadways.

3.1 TOPOGRAPHY

The topography of the site and surrounding land of the proposed residential development is generally flat, the acoustic assessment has taken this topography into account.

4 ACOUSTIC SURVEY

As part of this assessment an acoustic survey of the proposed Cronulla Sharks Redevelopment site has been conducted.

The acoustic survey included attended and unattended noise logging which is detailed in this section of the report.

4.1 ENVIRONMENTAL NOISE LEVELS

Environmental noise constantly varies in level, due to fluctuations in local noise sources including road traffic. Accordingly, a 15 minute measurement interval is normally utilised. Over this period, noise levels are monitored on a continuous basis and statistical and integrating techniques are used to determine noise description parameters.

In the case of environmental noise three principle measurement parameters are used, namely L_{10}, L_{90} and L_{eq}.

The L_{10} and L_{90} measurement parameters are statistical levels that represent the average maximum and average minimum noise levels respectively, over the measurement intervals.

The L_{10} parameter is commonly used to measure noise produced by a particular intrusive noise source since it represents the average of the loudest noise levels produced by the source.

Conversely, the L_{90} level (which is commonly referred to as the background noise level) represents the noise level heard in the quieter periods during a measurement interval. The L_{90} parameter is used to set the allowable noise level for new, potentially intrusive noise sources since the disturbance caused by the new source depends on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the L_{90} level.

The L_{eq} parameter represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the measurement period. L_{eq} is important in the assessment of traffic noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of industrial noise.

4.2 ATTENDED NOISE MEASUREMENTS

Attended noise level measurements conducted as part of this assessment are detailed in this section of the report.

4.2.1 Measurement Equipment

Attended noise measurements were obtained using a CEL-593 Type 1 Sound Level Analyser, set to A-weighted fast response. The sound level meter was calibrated before and after the measurements using a RION NC-73 Sound Level Calibrator. No significant drift was recorded.

4.2.2 Measurement Period

Noise monitoring was conducted at the locations detailed in Figure 1 in Section 2 above during the following period:

1. Peak afternoon conditions between 4.30pm and 6pm on the 10th of June, 2011.

2. Additional attended measurements were conducted on the evening of the Friday 3rd June, 2011 during a period when a Cronulla home game was being conducted home game was being conducted with a Crowd of over 15,000 people.

4.3 UNATTENDED NOISE MONITORING

Unattended noise monitoring conducted as part of this assessment is detailed in this section of the report. The results of unattended noise logging are included in Appendix A.

4.3.1 Unattended Monitoring Period

Unattended noise monitoring was conducted at the site during the period of 10th to 20th June 2011 in order to measure the existing background and traffic noise levels at the site.

The noise level monitors were located at the following locations:

1. Location 1 – To the south east of the site facing Captain Cook Drive. This logger will be used for traffic noise levels and background noise levels at the site.

4.3.2 Monitoring Equipment

Unattended noise measurements were obtained using an Acoustic Research Laboratories Pty Ltd noise logger. The logger was programmed to store 15-minute statistical noise levels throughout the monitoring period. The noise monitors were calibrated at the beginning and the end of the measurement using a Rion NC-73 calibrator. No significant drift was detected. All measurements were taken on A-weighted fast response mode. Periods of adverse weather conditions during the during the measurement period have not be used in this assessment.

4.4 RESULTS OF THE ACOUSTIC SURVEY

An acoustic survey was undertaken at the proposed Cronulla Sharks Redevelopment site in order to determine the existing acoustic environment. The unattended monitor results will be used to determine the variation between day, evening and night time noise levels. Attended measurements will be compared with the unattended monitoring data during the same measurement period so that relative differences between the attended and unattended locations can be formed thereby providing a comprehensive study of existing noise levels around the proposed site.

4.4.1 Existing Background Noise Levels

Background noise levels during day time are dominated by general vehicular traffic movements. The NSW Department of Environment and Climate Change (DECC) Industrial Noise Policy (INP) details specific steps in determining the background noise level for assessment of the day, evening and night time periods. Table 1 summarises the background determined at the monitoring location, based on the guidelines set out in the INP and the results of unattended noise monitoring.

Table 1 – Measured Ambient Noise Levels

Location	Description	Day Noise Level 7am to 6pm (dB(A))	Evening Noise Level 6pm to 10pm (dB(A))	Night Noise Level 10pm to 7am (dB(A))
Location 1 – Noise Monitoring Location	Background $L_{90,15min}$	44	42	34

In addition to the background levels obtained at the unattended monitoring position presented above, attended noise monitoring was conducted at 2 locations around the perimeter of the subject site as detailed in Figure 1 of Section 1 above. The results of the attended noise measurements are presented in Table 2 below.

Table 2 – Measured Attended Environmental Noise Levels

Location	Time Period	Measured Noise level dB(A) $L_{eq\ (15\ min)}$
Location 1 – Captain Cook Drive Location 1	Peak Afternoon Period 3.30pm to 6pm	67
Location 2 – Captain Cook Drive Location 2	Peak Afternoon Period 3.30pm to 6pm	64
Location 3 – Stadium Noise level measurement location	7.45pm-8.30pm During game time	65

5 NOISE EMISSION LIMITS – NOISE GENERATED ON THE SITE

The Department of Environment and Climate Change (DECC) Industrial Noise Policy provides guidelines for assessing noise impacts from development sites. The recommended assessment objectives vary depending on the potentially affected receivers, the time of day, and the type of noise source. The DECC's Industrial Noise Policy has two requirements which both have to be complied with, namely an amenity criterion and an intrusiveness criterion. In addition, the DECC in its Environmental Noise Control Manual states that noise controls should be applied with the general intent to protect residences from sleep arousal.

For land use developments with the potential to create additional traffic on local roads the development should comply with the requirements detailed in the Environmental Criteria for Road Traffic Noise (ECRTN).

Noise level criterion detailed in this section of the report includes noise levels generated from both the retail and residential elements of the proposed redevelopment.

5.1 DECC INTRUSIVENESS CRITERION

The DECC guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the L_{eq} descriptor not exceed the background noise level by more than 5 dB(A). Where applicable, the intrusive noise level should be penalised (increased) to account for any annoying characteristics such as tonality.

5.2 DECC AMENITY CRITERION

The DECC guideline is intended to limit the absolute noise level from all industrial noise sources to a level that is consistent with the general environment.

The DECC's Industrial noise policy sets out acceptable noise levels for various localities. Table 2.1 on page 16 of the policy indicates 4 categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface.

Table 5 of the INP provides the recommended ambient noise levels for the suburban residential receivers for the day, evening and night periods. For the purposes of this condition:

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

Table 3 – EPA Recommended Amenity Noise Levels

Type of Receiver	Time of day	Recommended Acceptable Noise Level dB(A) L_{eq}
Residential	Day	55
	Evening	45
	Night	40

5.3 SLEEP AROUSAL

To minimise the potential for sleep arousal the $L_{1\ (1\ minute)}$ noise level of any specific noise source does not exceed the background noise level (L_{90}) by more than 15 dB(A) outside a resident's bedroom window between the hours of 10pm and 7am. The L_1 noise level is the level exceeded for 1 per cent of the time and approximates the typical maximum noise level from a particular source. Where the typical repeatable existing L_1 levels exceed the above requirement then the existing L_1 levels form the basis for, sleep disturbance criteria.

5.4 SUMMARY OF ASSESSMENT CRITERIA FOR PROPOSED SITE

The DECC INP intrusiveness, amenity and sleep arousal criteria for this project have been determined using these guidelines and the noise monitoring results. These are summarised below. We note that the formulation of the assessment criteria has been based on the lowest ambient levels determined from all monitoring data.

5.4.1 Day Time Period

The following table sets out the measured L_{eq} amenity and L_{90} background noise levels, and the assessment criteria based on the suburban criteria. The day period applies between 7am and 6pm Monday to Saturday; and 8am to 6pm Sundays and public holidays.

Table 4 – Measured L_{eq} & L_{90} Noise Levels and Criteria - Daytime

Location	Measured L_{eq} Noise Level dB(A)	Measured L_{90} Noise Level dB(A)	Amenity Criterion dB(A) L_{eq}	Intrusiveness Criterion dB(A) L_{eq}
Surrounding Residential Receivers	48	44	55	49

5.4.2 Evening Period

The following table sets out the measured L_{Aeq} and L_{90} background noise levels, and the assessment criteria based on the suburban criteria. The evening period applies between 6pm and 10pm.

Table 5 –Measured L_{eq} & L_{90} Noise Levels and Criteria - Evening Period

Location	Measured L_{eq} Noise Level dB(A)	Measured L_{90} Noise Level dB(A)	Amenity Criterion dB(A) L_{eq}	Intrusiveness Criterion dB(A) L_{eq}
Surrounding Residential Receivers	45	42	45	47

5.4.3 Night Time Period

The night period (that is, between 10pm and 7am) is the period where noise emissions can have the most significant effect on residential amenity. In addition to the quasi-steady state criteria the L_1 noise emission level should not exceed the background noise level by more than 15 dB(A) to prevent sleep arousal from intermittent events. The night time period applies between 10pm and 7am.

Table 6 –Measured L_{eq} & L_{90} Noise Levels and Criteria - Night Time Period

Location	Measured L_{eq} Noise Level dB(A)	Measured L_{90} Noise Level dB(A)	Amenity Criterion dB(A) L_{eq}	Intrusiveness Criterion dB(A) L_{eq}	Night time Sleep Disturbance dB(A) $L_{1\ (1\ Min)}$
Surrounding Residential Receivers	40	34	40	39	49

5.5 RESULTING NOISE LEVEL CRITERIA

The criteria for the various monitoring locations have been considered and assessed for the surrounding receivers. Table 7 below details the noise level criterion for properties surrounding the proposed development. In all cases, if a discrepancy in attended and unattended noise levels were obtained at two nearby locations within a residential grouping the more conservative noise level criterion has been adopted.

Table 7 – Noise Objectives for Surrounding Receivers

Location	Day time Noise Objective dB(A) L_{eq}	Evening Noise Objective dB(A) L_{eq}	Night time Noise Objective dB(A) L_{eq}	Noise Objective for Intermittent Activities dB(A) $L_{1\ (1\ Min)}$ (Background + 15 dB(A))
Surrounding Residential Receivers	53	45	40	55

Noise level criteria are to be applied to commercial traffic levels generated from vehicle movements on the site only, as presented by the Industrial Noise Policy. Noise levels generated from the movement of vehicles entering and exiting the site on ramps are generally required to comply with levels presented in the presented tables for surrounding receivers.

5.6 ASSESSMENT CRITERIA – ADDITIONAL TRAFFIC GENERATION

For land use developments with the potential to create additional traffic on local roads the development should comply with the requirements detailed in the DECC ECRTN. Criteria applicable to the development are detailed below. If existing noise levels exceed those in Table 8 a 2 dB increase in noise is allowed.

The proposed development includes the use of a carpark and future roadways to the north east and northwest of the site which will be assessed against the criteria detailed in the table below.

Table 8 - Criteria for Traffic Noise for New Developments

Time of day	Criteria for Acceptable Traffic Noise Level dB(A)
Day (7am to 10pm)	60 $L_{Aeq(1hr)}$ – Collector Road 55 $L_{Aeq(1hr)}$ – Local Road
Night (10pm to 7am)	55 $L_{Aeq(1hr)}$ – Collector Road 50 $L_{Aeq(1hr)}$ – Local Road

Note: the criteria above includes noise levels generated from both the residential and retail areas of the proposed redevelopment.

Attended and unattended traffic noise levels measurements were conducted at a number of locations surrounding the development including locations as detailed in the table below. The resulting noise levels have been used to generate the resulting noise level criterion for additional traffic movements which been used in this assessment.

Table 9 - Criteria for Traffic Generation

Location	Criteria for Acceptable Traffic Noise Level dB(A) $L_{eq\ (1hr)}$	
	Day (7am to 10pm)	Night (10pm to 7am)
Captain Cook Drive	66*	63

*Based on evening noise levels obtained at the site.
Note: Noise levels calculated to potentially worst affected residential facades from results of on site testing.

6 ADDITIONAL TRAFFIC NOISE GENERATION ASSESSMENT

The proposed development includes carpark a below ground carpark within the site which will potentially provide for upto 750 cars (residential parking) and above ground car parking associated with the retail area of the project. Potential noise impacts from traffic movements generated by the development on public roads have been assessed for residents surrounding the site and future tenancies within the development, including the potential for noise impact generated from the proposed additional roadways on the perimeter of the site. The assessment is based on the maximum traffic flow periods using FHWA and CORTN traffic noise prediction models and noise level measurements conducted at the site and presented in this report.

6.1 ADDITIONAL TRAFFIC NOISE ON LOCAL STREETS

Traffic noise generated by the proposed development was assessed using current and predicted traffic numbers provided by Scott Carver to this office for both the retail and residential areas of the project.

The predicted worst case noise increases on each of the streets surrounding the development are summarised in the following table. The assessment was conducted assuming up to a 75% renewal of car spaces during a worst case 1 hour during a peak morning or evening period within the future basement carpark area.

The calculated potential noise from additional traffic movements from the site are displayed in the table below at the potentially worst affected residential receivers located at 1 Carabella Road to the west of the site.

Table 10 – Calculated Noise Associated with Traffic Generation

Roadway	Time Period	Current Traffic Noise Levels	Criteria for Acceptable Traffic Noise Level dB(A) $L_{eq\ (1hr)}$	Calculated Future Traffic Noise $L_{eq\ (1\ hr)}$	Compliance
Carabella Road	Day (7am to 10pm)	64	66	Approximately 0.1 dB(A) increase on existing noise levels	Yes
	Night (10pm to 7am)	61	63	Approximately 0.1 dB(A) increase on existing noise levels	Yes

Note: All calculations were conducted using FHWA and CORTN traffic modelling.

The investigation into noise associated with additional traffic movements revealed that any increased traffic flows will cause either no noise increase to existing roadways or compliance with INP criteria for increased traffic volumes on surrounding roadways and would not adversely impact on the acoustic amenity of surrounding residential receivers.

7 INTERNAL ENVIRONMENTAL ACOUSTIC OBJECTIVES

This section of the report details the assessment of potential environmental noise impact within the future residential areas of the development.

7.1 INTERNAL TRAFFIC NOISE OBJECTIVES

As the development is located adjacent to Captain Cook Drive internal noise levels from traffic noise will be assessed in conjunction with recommended maximum noise levels within the Australian Standard AS2107:2000 'Acoustics - Recommended design sound levels and reverberation times for building interiors' for developments nears major roads. AS/NZS 2107:2000 nominates the L_{eq} descriptor as the noise descriptor. The L_{eq} descriptor is commonly used and recognised as the most appropriate descriptor to assess external noise intrusion as it more closely corresponds with human perception of a changing noise environment; such as character of traffic noise. Based on the above, the following criteria will be applied for external noise intrusion.

Table 11 – Internal Traffic Noise Assessment Criteria

LOCATION	Required Internal Noise Levels / Time of Day	
	Day Time dB(A) $L_{eq\ (1hr)}$ (7am – 10pm)	Night Time dB(A) $L_{eq\ (1hr)}$ (10pm – 7am)
Bedrooms	45	40
Living rooms	45	N/A

7.2 COMPLIANCE WITH INTERNAL NOISE LEVELS

Experience with similar projects indicates that compliance with internal noise level criteria detailed in this section of the report is both possible and practical. The external façade of the future development will be acoustically treated where necessary to ensure internal noise levels comply with specified noise levels.

Acoustic treatment will include the upgrading of glazing and other façade elements based on noise level measurements conducted at the site. Typically the required upgraded glazing for acoustics will include 6.38mm laminated or 10.38mm laminated glazing.

Masonry and other high mass elements of the façade will not require additional acoustic treatments. Light weight wall constructions will include acoustic insulation and the like to ensure internal noise level criteria are achieved.

7.3 INTERNAL SPORTS GROUND NOISE LEVELS

Internal noise levels within the future residential development as a result of sporting events conducted within Toyota Stadium to the east of the site will be assessed in conjunction within the recommended maximum noise levels within the Australian Standard AS2107:2000 'Acoustics - Recommended design sound levels and reverberation times for building interiors' for developments near minor roads. AS/NZS 2107:2000 nominates the L_{eq} descriptor as the noise descriptor. The L_{eq} descriptor is commonly used and recognised as the most appropriate descriptor to assess external noise intrusion as it more closely corresponds with human perception of a changing noise environment; such as character of traffic noise. Based on the above, the following criteria will be applied for external noise intrusion.

Table 12 – Internal Sports Ground Noise Assessment Criteria

LOCATION	Required Internal Noise Levels / Time of Day	
	Day Time dB(A) $L_{eq\ (1hr)}$ (7am – 10pm)	Night Time dB(A) $L_{eq\ (1hr)}$ (10pm – 7am)
Bedrooms	40	35
Living rooms	40	N/A

7.4 COMPLIANCE WITH INTERNAL NOISE LEVELS

Experience with similar projects indicates that compliance with internal noise level criteria detailed in this section of the report is both possible and practical. The external façade of the future development will be acoustically treated where necessary to ensure internal noise levels comply with specified noise levels.

Acoustic treatment will include the upgrading of glazing and other façade elements based on noise level measurements conducted at the site. Typically the required upgraded glazing for acoustics will include 6.38mm laminated or 10.38mm laminated glazing.

Masonry and other high mass elements of the façade will not require additional acoustic treatments. Light weight wall constructions will include acoustic insulation and the like to ensure internal noise level criteria are achieved.

7.5 TYPICAL EXTERNAL GLASS SELECTIONS

As part of this assessment an assessment of internal noise levels within future apartments has been conducted and typical façade constructions selected which would be required to comply with criteria detailed in this report for both traffic and sports ground noise levels.

The following constructions are typical constrictions only, details of window to be used will be provided as part of the Constriction Certificate.

Table 13 – Typical Glazing Requirements

Location	Room	Glazing Requirements	Acoustic Seals
Captain Cook Drive Façade	Bedrooms	10.38mm laminated	Yes
	Living rooms	6.38mm laminated	Yes
Northern Façade	Bedrooms	4mm Float	Yes
	Living rooms	4mm Float	Yes
Western Façade	Bedrooms	4mm Float	Yes
	Living rooms	4mm Float	Yes
Eastern Façade facing neighbouring sports Ground	Bedrooms	6.38mm laminated	Yes
	Living rooms	6.38mm laminated	Yes
All other facades	Bedrooms	4mm Float	Yes
	Living rooms	4mm Float	Yes

Thicker glazing may be required for structural, safety or other purposes. Where it is required to use thicker glazing than scheduled, this will also be acoustically acceptable. Glazing to all units not listed in the table may be 6mm thick, float or toughened glass for windows and doors.

In addition to complying with the minimum scheduled glazing thickness, the STC rating of the glazing fitted into openable frames and fixed into the building opening should not be lower than the values listed in Table 13 for all rooms.

Table 14 - Minimum STC of Glazing

Glazing Assembly	Acoustic Seals	Minimum STC of Installed Window
4mm Float	Yes	28
6.38mm laminated	Yes	30
10.38mm laminated	Yes	35

7.6 INTERIM GUIDELINES FOR DEVELOPMENT NEAR RAIL CORRIDORS

As the development is not located with 60m of a railway corridor no additional acoustic assessment of noise or vibration impact from train passbys is required.

8 MECHANICAL PLANT TREATMENTS

As detailed plant selections have not been conducted at this time a detailed acoustic assessment of noise impact can not be conducted which is typically of DA/PA stage.

A detailed mechanical noise assessment will be conducted once plant selections and services drawings have been finalised as part of the construction documentation to ensure noise levels comply with the criteria detailed in this report. Details will be provided as part of the CC submission of the project.

Based on experience with similar development acoustic treatments are both possible and practical using acoustic treatments such as lining of ductwork, acoustic silences, variable speed controllers, time switches, acoustic screens etc. General requirements for a number of potential plant items on the site are expanded on below.

8.1 CHILLERS / AIR HANDLING UNITS

Units can be located on roof tops with an acoustic screen or in basement areas, with acoustic treatment to intake and exhaust as necessary.

These units would predominantly operate during the day, with the potential to operate with extended hours. Acoustic treatment to these units may be required to ameliorate noise impact to the surrounding residents and to comply with the criteria specified in this report and verified at CC stage.

8.2 SUPPLY / EXHAUST FANS

Supply and exhaust fans may be located within the underground plant rooms or in rooftop plant areas. These units typically emit high noise levels and require acoustic treatment such as silencers and internal lined ductwork. Silencer requirements would be determined once fan selections have been completed at CC stage.

8.3 CONDENSER UNITS

Condensing units typically emit relatively low noise levels and with careful selection, it is possible that no further acoustic treatment would be necessary.

8.4 MINOR PLANT

Other minor plant items, such as bathroom or kitchen exhaust fans, will be required. These items typically emit relatively low noise levels and may require minimal acoustic treatment of a standard nature., such as internally lining of ductwork.

9 TOWRA POINT NATURE RESERVE

An acoustic (including noise and vibration) investigation into the potential impacts from the proposed development on the Towra Point nature reserve has been conducted. Based on the proximity of the reserve to the development site, approximately 2km, there will be no additional noise and vibration impact above those already experiences from the existing environment (including Captain Cook Drive and Toyota Stadium).

10 FUTURE RETAIL/COMMERICIAL AREA

Design of any the proposed retail centre and commercial areas within the Cronulla Sharks Redevelopment Master Plan including the integrated retail centre and revitalised club will be developed to minimise the acoustic impact to existing and future residential properties. Noise level will be designed to comply with criteria detailed in this report as required by the DECCW's INP and council criteria.

The acoustic treatments and controls will be developed once final layouts and activities to be conducted are know and may include the following:

- Acoustic treatment of loading docks and delivery areas.
- Acoustic treatment of the required building services including mechanical plant.
- Locating seating below awnings and overhangs to limit noise impact to residence above.
- Limit deliveries and waste removal to day time hours
- Incorporate acoustic treatments and controls to external areas as appropriate. It is noted that noise associated with future areas will be assessed once tenancy uses are finalised.
- No playing of recorded music externally to tenancies.

It is noted that management of these uses are located within Stage 2 of the development which will be subject to detailed design and a DA to Sutherland Council at a later time. Therefore, detailed assessment will be conducted at this time.

A review of the proposed retail/commercial areas indicates that acoustic treatments to ensure noise levels comply with all relevant criteria will be both possible and practical.

11 CONSTRUCTION NOISE AND VIBRATION

A construction noise and vibration plan will be prepared for the site once construction activities are finalised. The noise and vibration plan has been developed in conjunction with the following:

- Australian Standard AS2436:1981 "Guide to noise control on construction, maintenance and demolition sites
- Department of Environment Climate Change and Water - Construction Noise Guideline

The detailed construction noise and vibration management plan will be provided as part of the CC submission once a construction (including demolition, excavation and construction) programs and required activities methodologies have been developed.

12 NOISE IMPACT TO SURROUNIDNG AREAS

An acoustic (including noise and vibration) investigation into the potential impacts from the constructions of the proposed development on the Towra Point nature reserve has been conducted. Based on the proximity of the reserve to the development site, approximately 2km, there will be no additional noise and vibration impact above those already experiences from the existing environment (including Captain Cook Drive and the Toyota Stadium).

This section of the report details the predicted noise impact to surrounding natural areas to the site during the construction stage of the project as well as on completion during normal operating hours.

12.1 EXISTING NOISE LEVELS

Existing noise levels at the site have been recorded at between 50-64 dB(A) at the site and at the Towra Point. Based on the noise levels detailed in the table above noise levels at the Towra Point reserve will not be greater than current noise level impacting the site. Examples of exiting noise levels which impact the surrounding wet lands and Towra Point reserve are approximated in the table below. The existing noise level impacting areas surrounding the site will mark noise from the construction and operation of the development.

Table 15 – Examples of Existing Noise Levels

Location	Noise Source	Approximate Noise level
Towra Point	Boats	65-70 dB(A) L_{10}
	Traffic Noise	50-55 dB(A) L_{10}
	Sporting Events	55-60 dB(A) L_1
	Aircraft Noise	65-70 dB(A) L_{10}
Adjacent Wet Lands	Boats	65-70 dB(A) L_{10}
	Traffic Noise	55-60 dB(A) L_{10}
	Sporting Events	65-70 dB(A) L_1
	Aircraft Noise	65-70 dB(A) L_{10}

12.2 CONSTRUCTION NOISE LEVEL

The predicted noise levels from a number of activities on the site during construction and completion on the surrounding nature areas, including the wet lands directly to the north and Towra Point are presented in the tables below. An assessment of noise impact from a number of construction activities are included which represents the potentially worst case impacts. Calculated noise level are represented as maximum noise levels and as such levels will not be accumulative.

Table 16 – Construction Noise Levels at Surrounding Locations (Maximum Noise Levels)

Equipment Type	Sound Power Level (SWL)	Location					Discussion
		Wet Land directly adjacent to the site	20m from the site	40m from the site	60m From the Site	Towra point 500m from the site	
Hydraulic Hammers*	115	87 dB(A)	81 dB(A)	75 dB(A)	71 dB(A)	50 dB(A)	Intermittent noise level as equipment can not run continuously
Concrete Saw Cutting*	114	86 dB(A)	80 dB(A)	74 dB(A)	70 dB(A)	49 dB(A)	Only when in operation
Excavator (without hammer)	98	70 dB(A)	64 dB(A)	58 dB(A)	54 dB(A)	33 dB(A)	Detailed noise levels based on worst case levels (ie operating at boundary of the site with the wetlands)
Drill Pilling equipment	105	77 dB(A)	71 dB(A)	65 dB(A)	61 dB(A)	40 dB(A)	Detailed noise levels based on worst case levels (ie operating at boundary of the site with the wetlands)

*Note: Operations will be limited as site is predominantly sand.

All noise levels detailed in the table above are presented as the typical maximum dB(A) L_{10} noise levels associated with the presented equipment. Noise levels will only result during periods when the equipment is in operation. All calculated noise levels presented assume no screening and will reduce by 5-8 dB(A) is screening from other structures occurs.

12.3 FUTURE NOISE LEVELS

Future noise levels from the operation of the development will be designed to comply with the DECCW noise level criteria which are detailed in the table below. This includes all building services noise including mechanical equipment, loading docks, car parking, etc.

Table 17 - Noise Objectives for Surrounding Receivers (Including Wetlands)

Location	Day time Noise Objective dB(A) L_{eq}	Evening Noise Objective dB(A) L_{eq}	Night time Noise Objective dB(A) L_{eq}
Surrounding Receivers	53	45	40

Compliance with the noise levels detailed in the table below will result in levels being inaudible at Towra Point Reserve.

Some additional noise from activities such as the cycle track and play ground will result in noise levels of up to 65 dB(A) in the adjacent wet lands, these noise level represent a level which is no greater than that currently experienced on the site (including the existing sports ground). All play areas and cycle ways on the site will be inaudible at the Towra Point Reserve.

13 CONCLUSION

This report provides the results of Environmental Noise Study for the proposed Cronulla Sharks Redevelopment. Noise at the site has been measured and noise goals have been set in accordance with the requirements of the relevant statutory/regulatory authorities including Local Council and the Department of Environment and Climate Change.

Determination of noise assessment criteria based on the DECCW's Industrial Noise Policy and ECRTN have been determined based on both unattended and attended noise monitoring conducted at the proposed development.

Additionally in principal treatments have been provided to ensure internal noise levels from surrounding noise sources (namely Captain Cook Drive) comply with the relevant Australian Standards.

Based on the assessment detailed in this report the proposed development will comply with all relevant noise and vibration criteria.

We trust this information is satisfactory. Please contact us should you have any further queries.

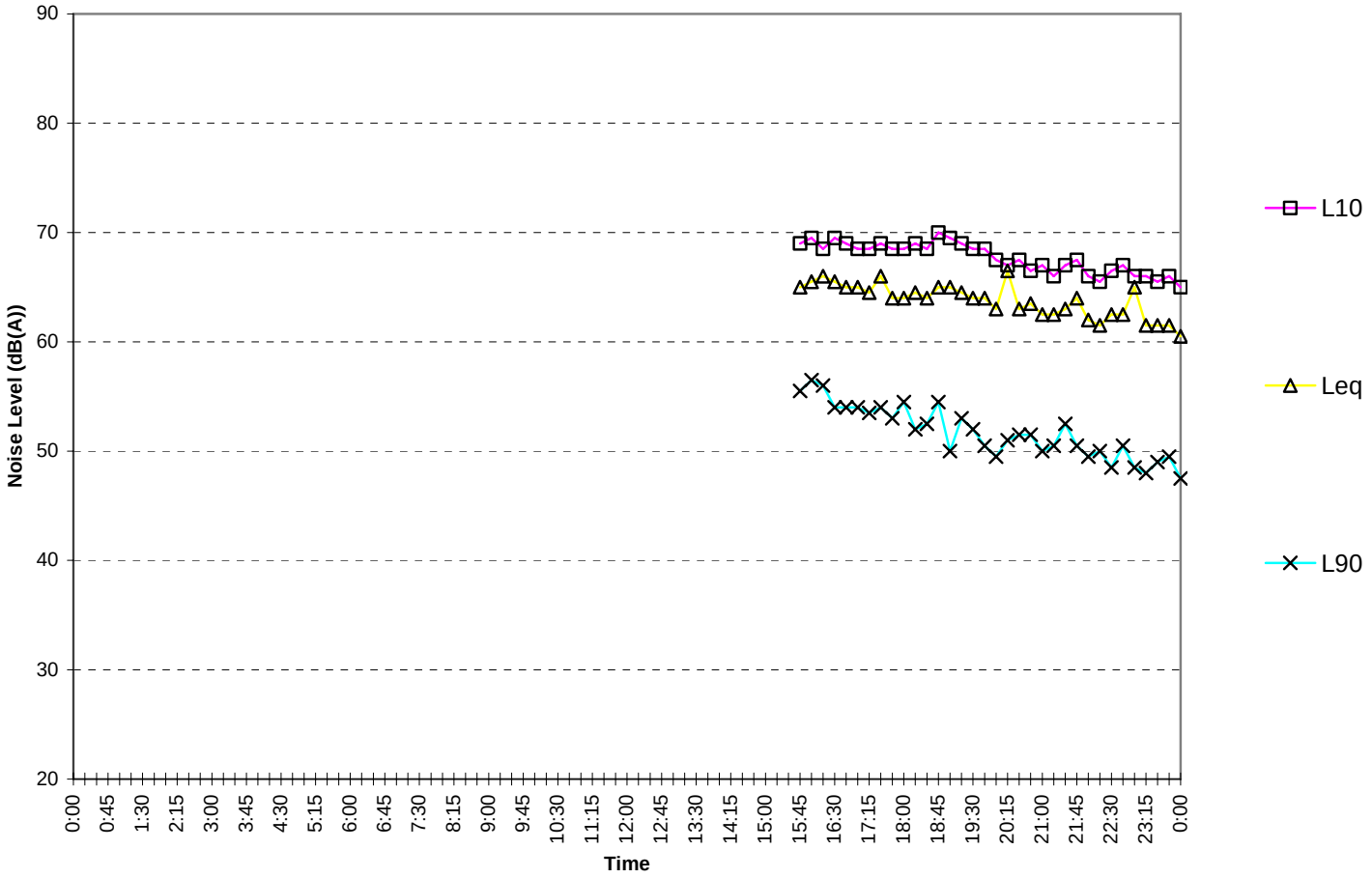
Report prepared by,

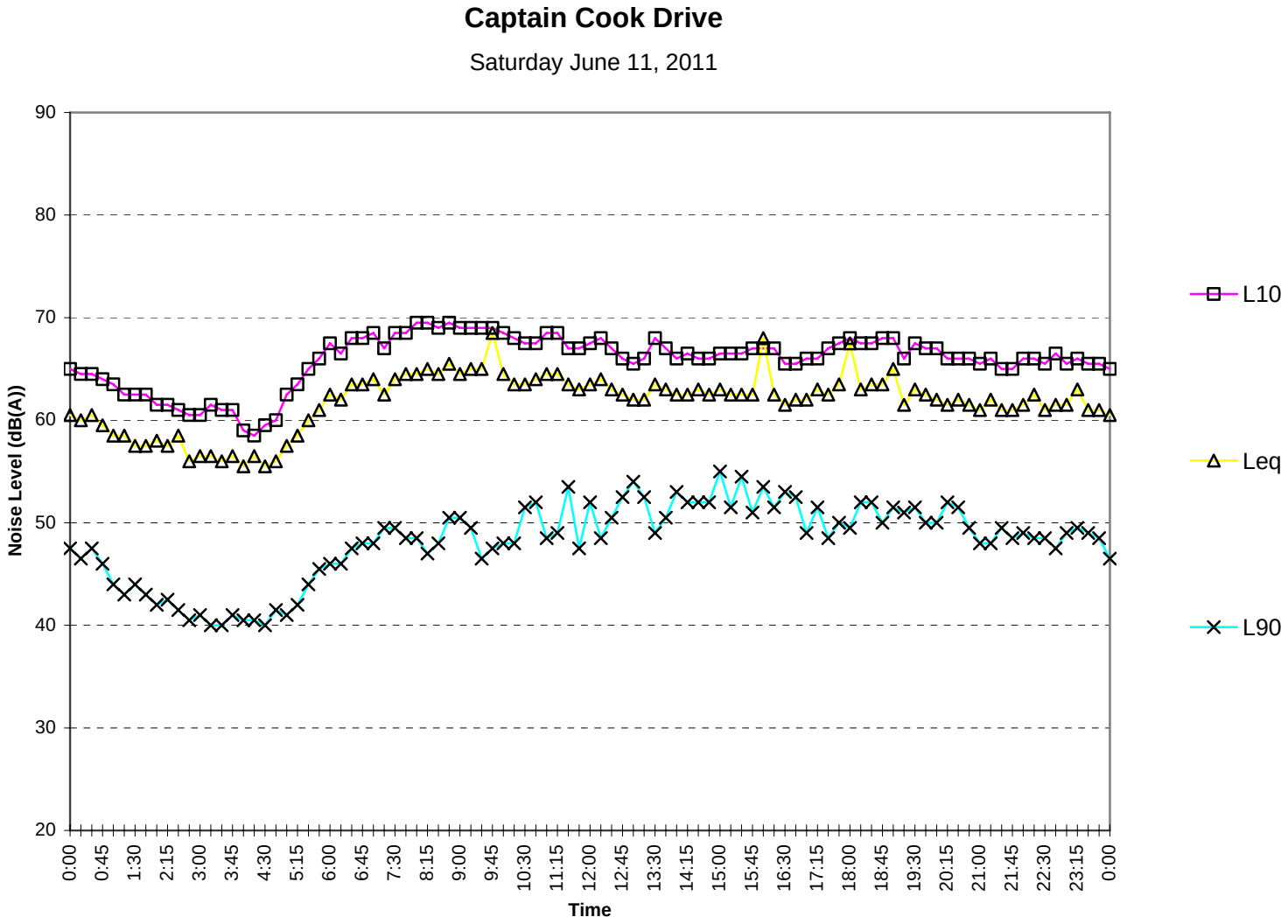
ACOUSTIC LOGIC CONSULTANCY PTY LTD
Ben White

APPENDIX A
UNATTENDED NOISE MONITORING RESULTS

Captain Cook Drive

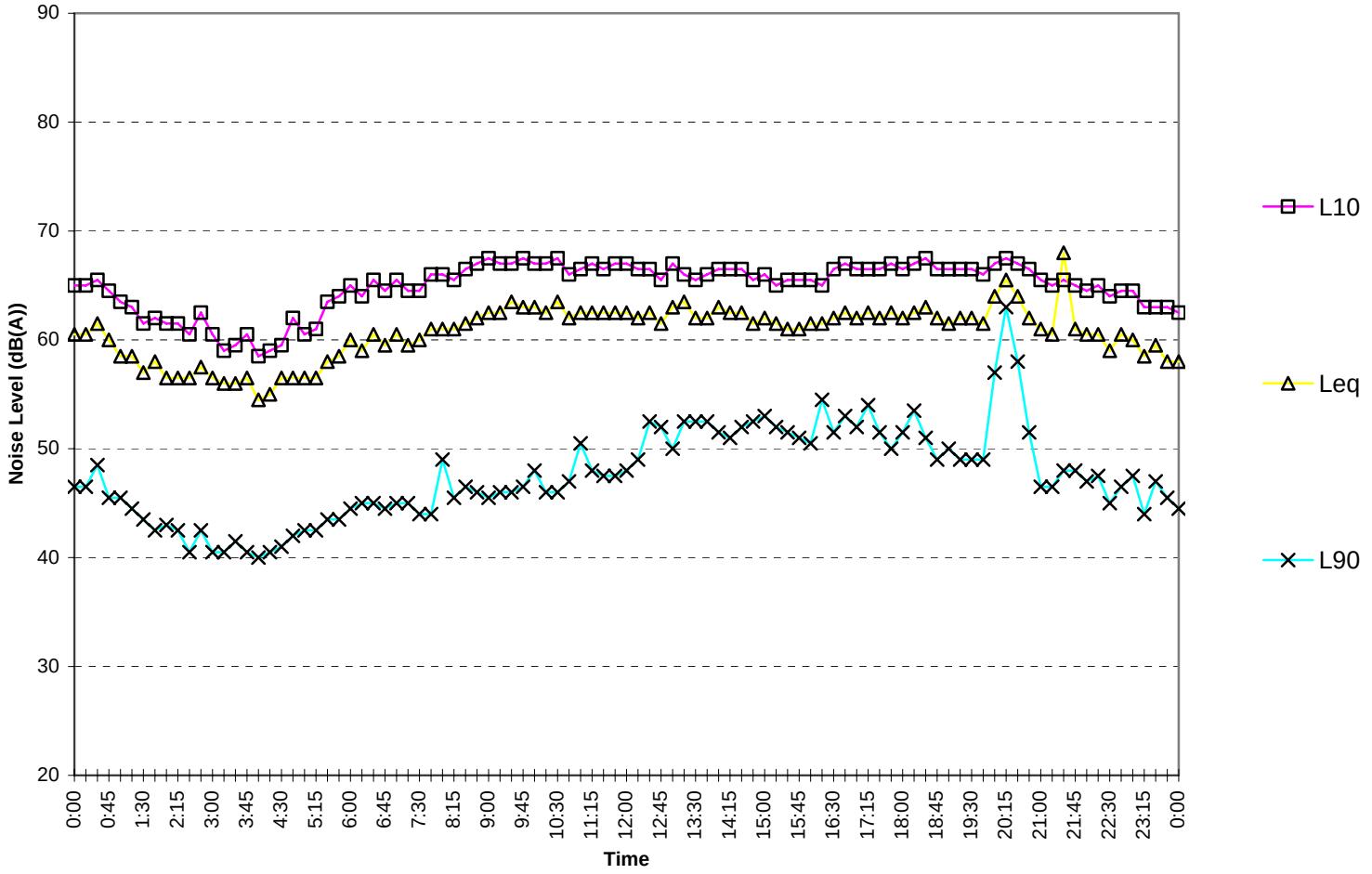
Friday June 10, 2011

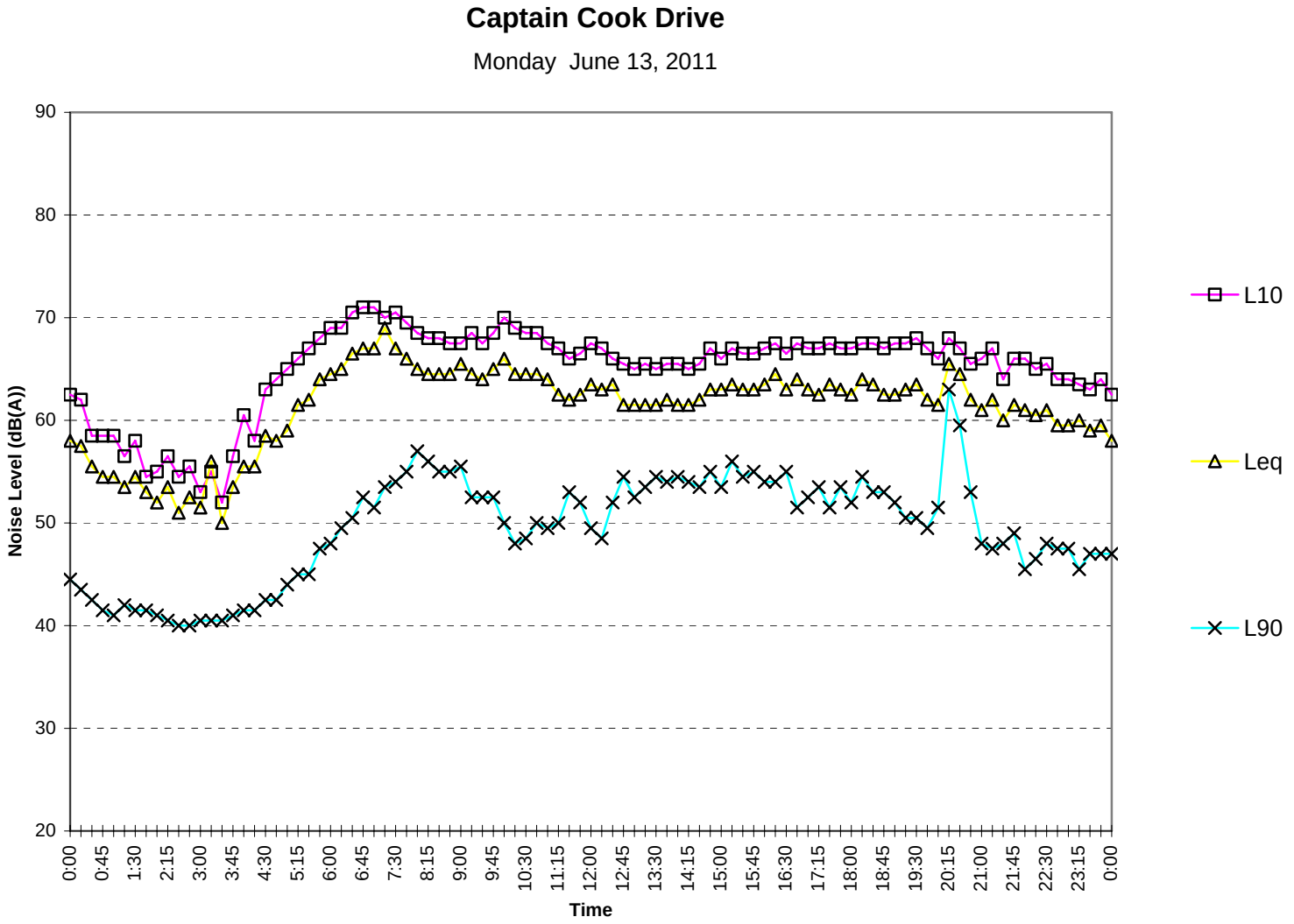



Captain Cook Drive
Saturday June 11, 2011
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
L10
Leq
L90

Captain Cook Drive

Sunday June 12, 2011




Captain Cook Drive
Monday June 13, 2011
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
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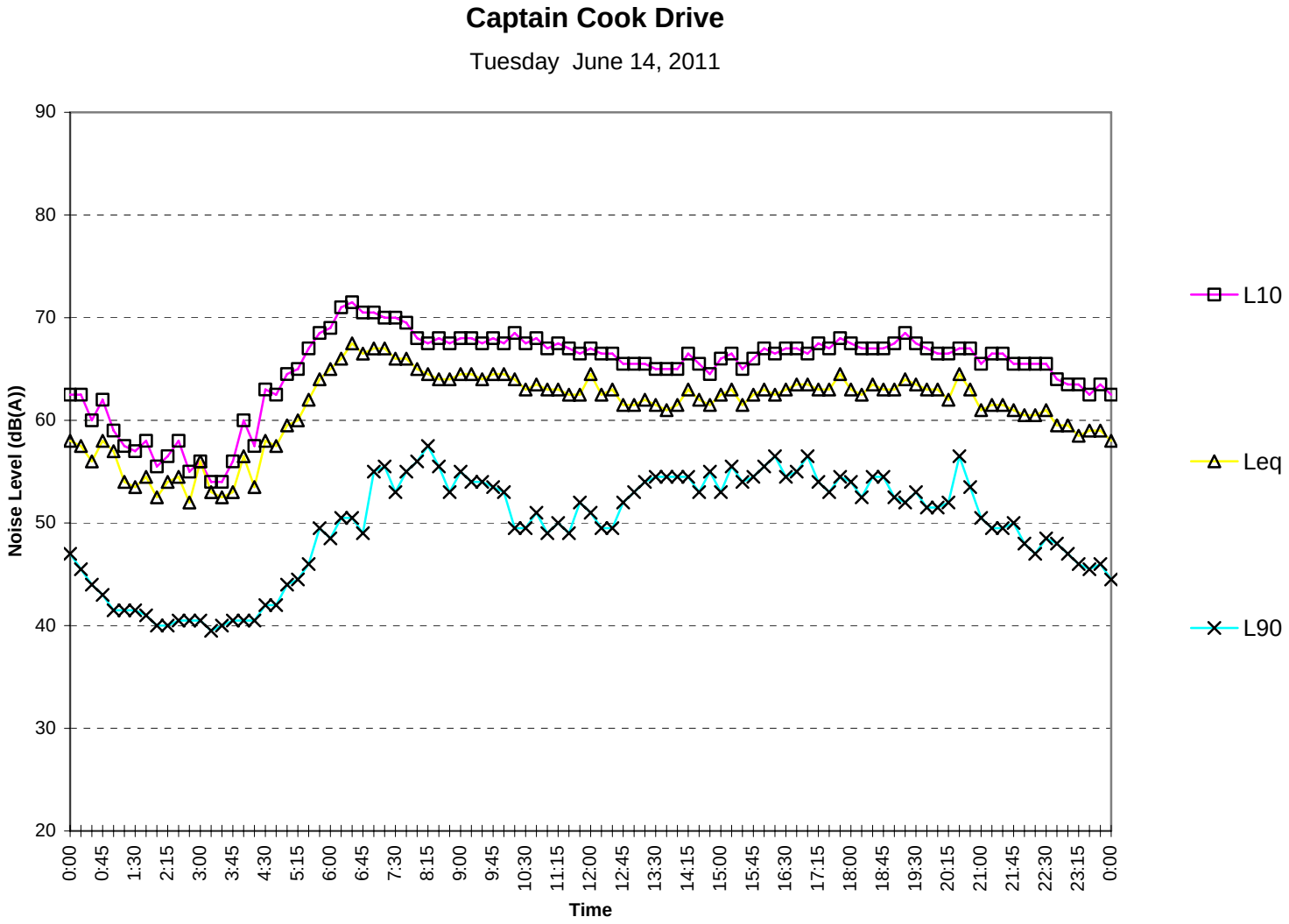
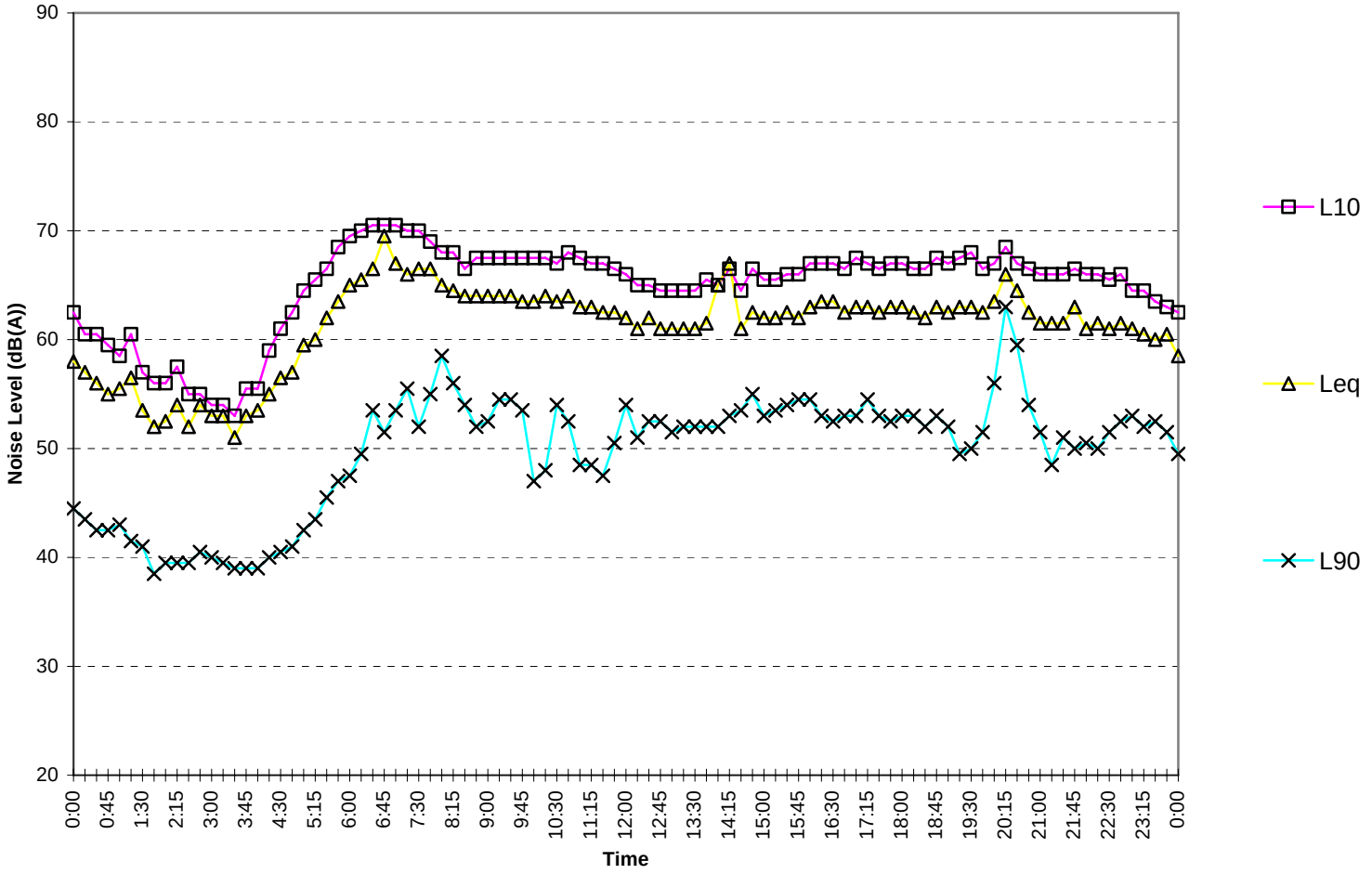
21:00
21:45
22:30
23:15
0:00
Time
L10
Leq
L90


Captain Cook Drive
Tuesday June 14, 2011
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
L10
Leq
L90

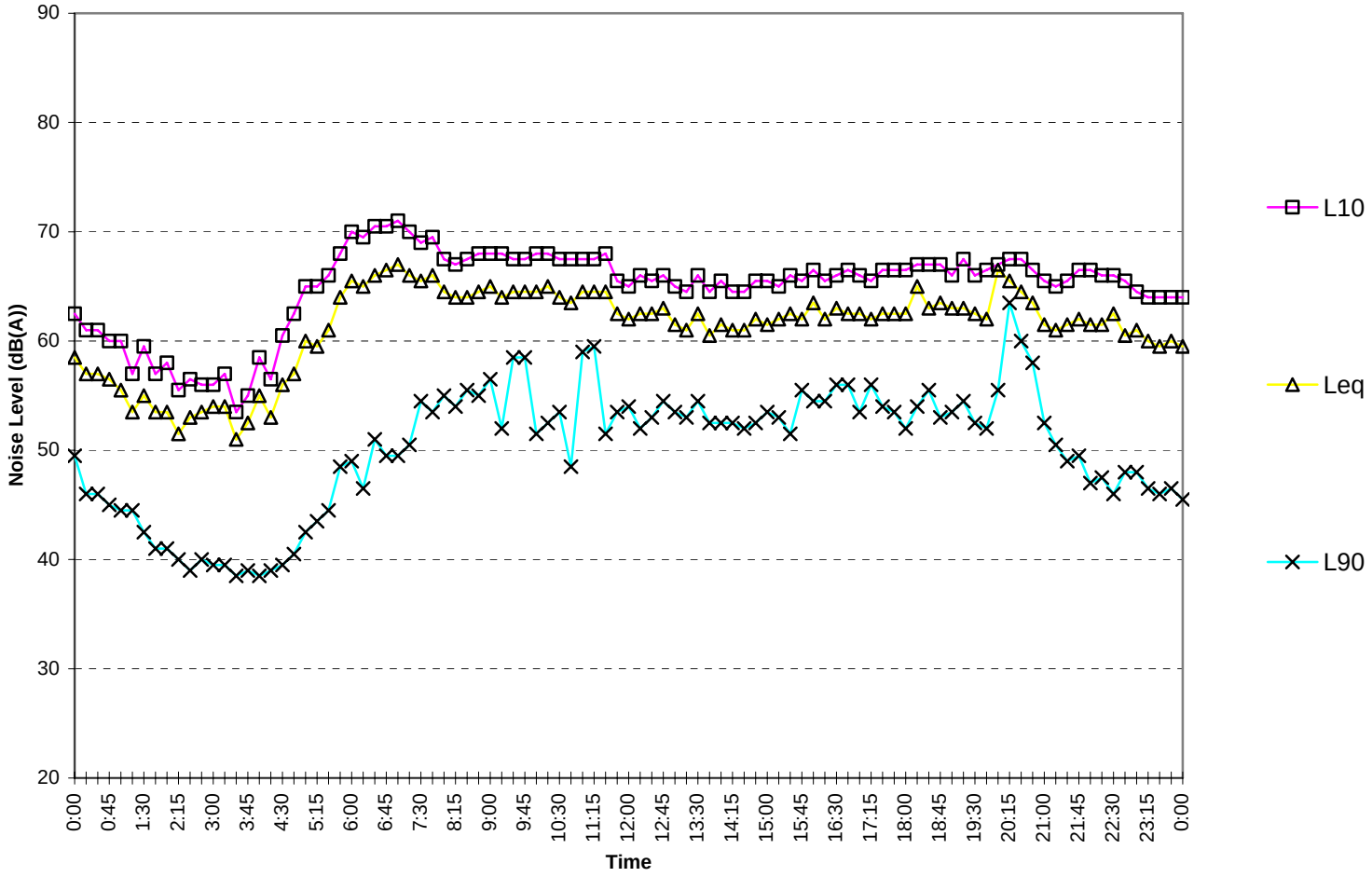
Captain Cook Drive

Wednesday June 15, 2011



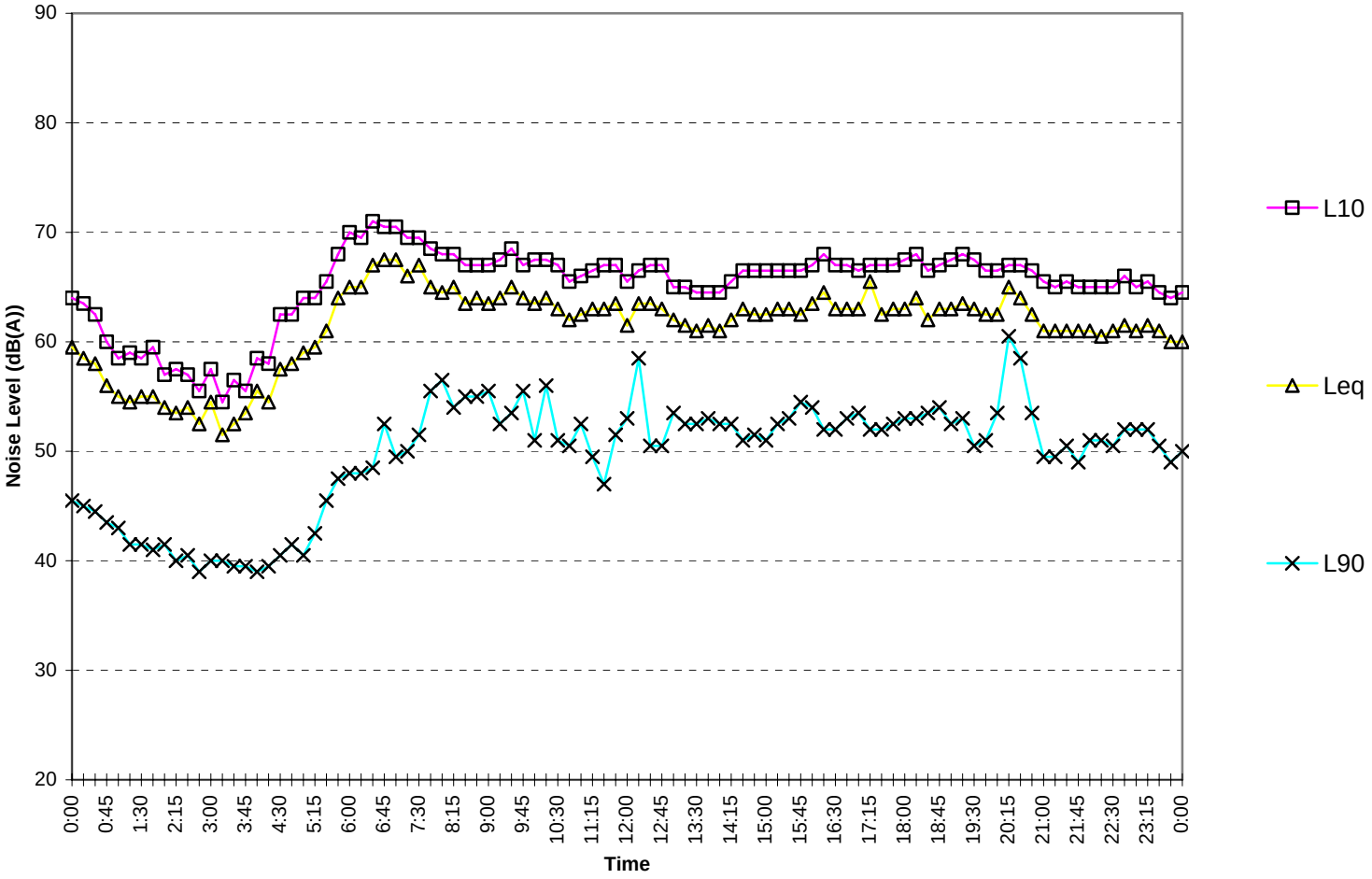
Captain Cook Drive

Thursday June 16, 2011



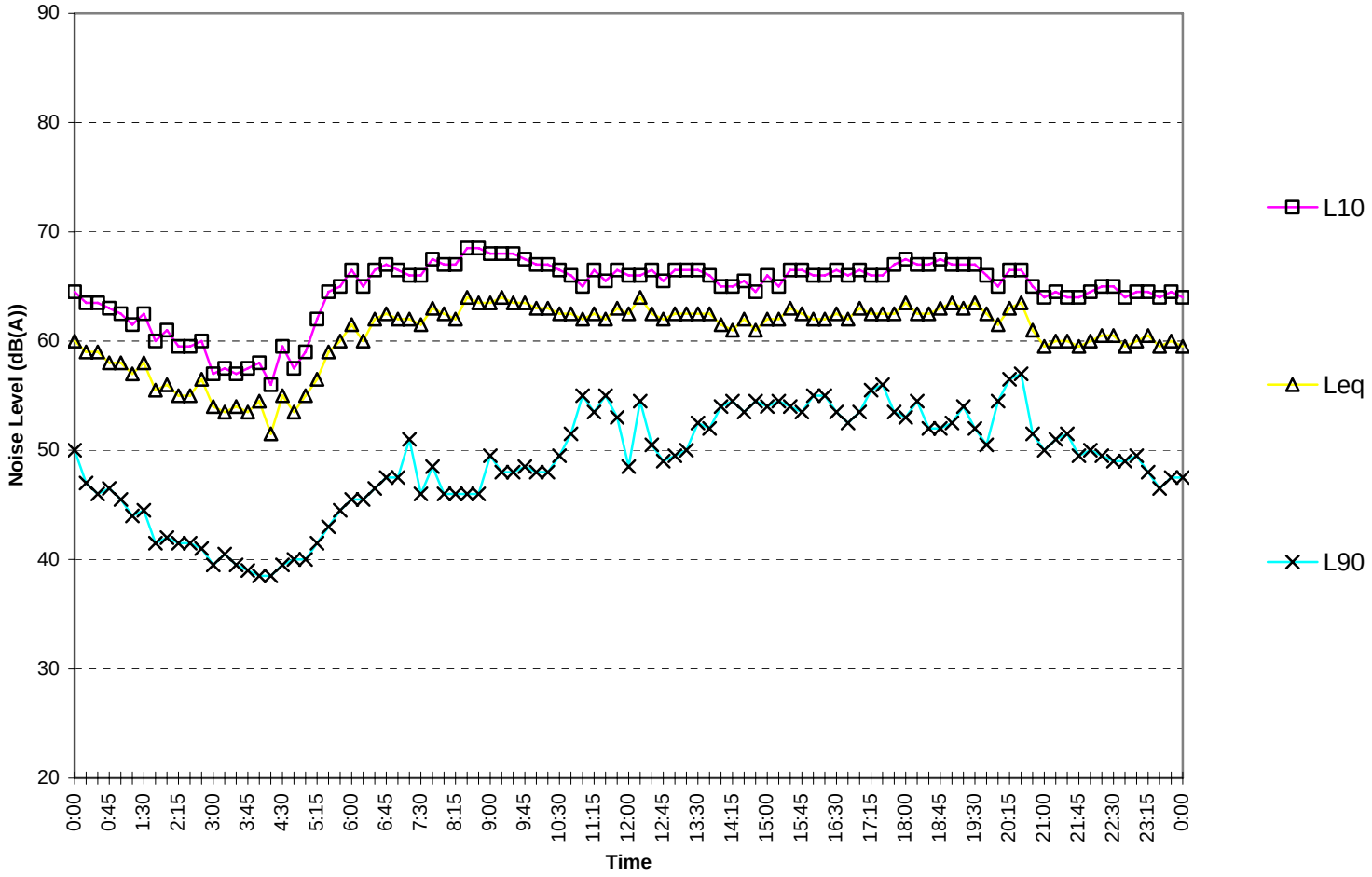
Captain Cook Drive

Friday June 17, 2011



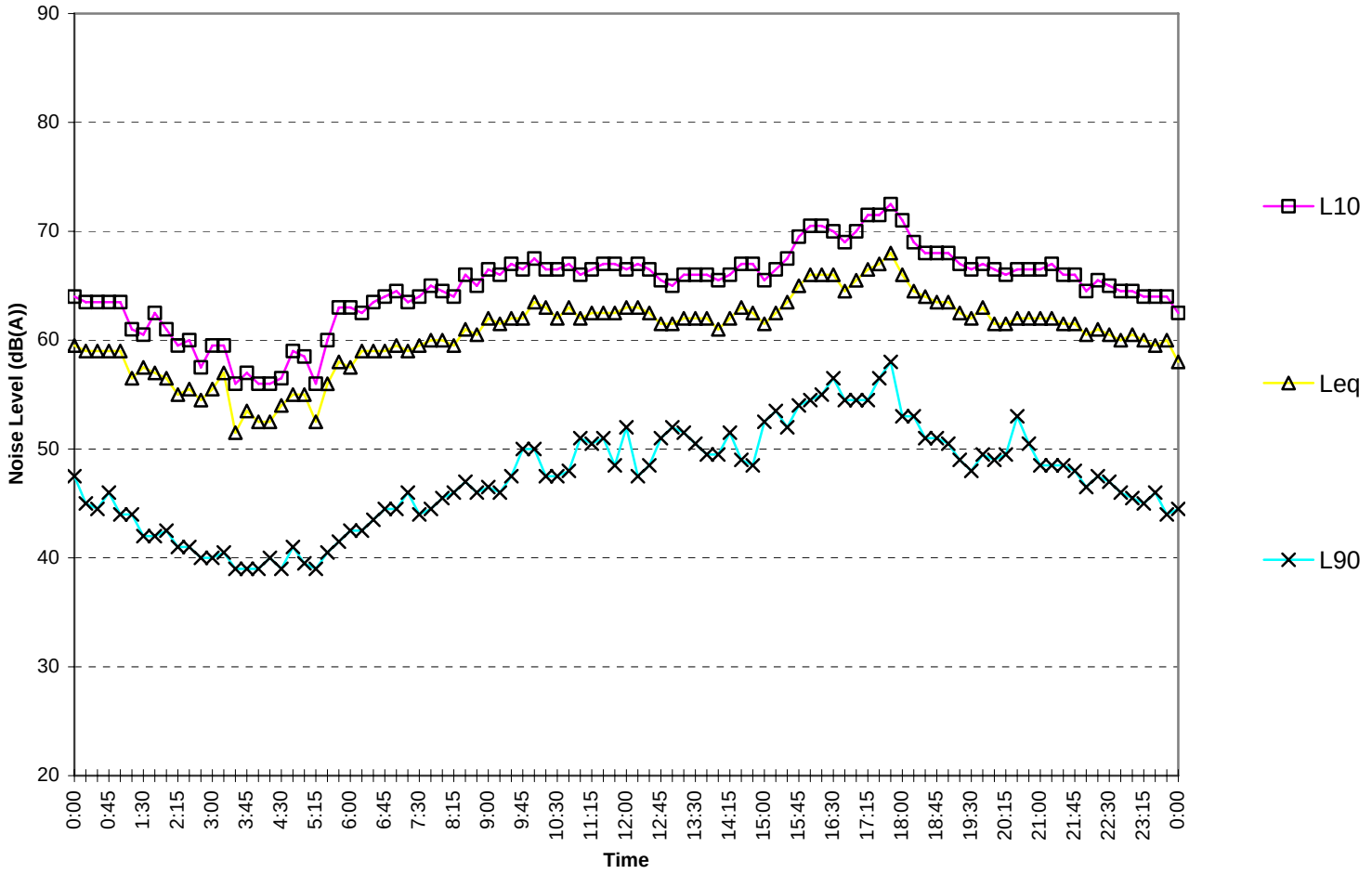
Captain Cook Drive

Saturday June 18, 2011



Captain Cook Drive

Sunday June 19, 2011



Captain Cook Drive

Monday June 20, 2011