

Appendix E

## Air quality impact assessment (GHD)





16 January 2013

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Our ref: 22/16065/100498  
Your ref:

Dear Mr John Boyd

## **Macquarie River to Orange Pipeline Project Proposed Project Refinements - MR5a**

### **Air Quality Impact Assessment**

#### **1 Introduction**

Orange City Council proposes to undertake the Macquarie River to Orange pipeline project (referred to in this report as 'the project') for the purposes of drought relief (when needed). This report has been prepared to provide an assessment of the air quality impacts of the project construction as an input to the Environmental Assessment (EA).

The EA addresses the requirements of the Director-General of the NSW Department of Planning and Infrastructure (the Director-General's Requirements) dated 24 March 2011. It is noted that the Director-General's Requirements do not specifically require an assessment of air quality impacts associated with the project. This air quality study has been completed upon request of Orange City Council.

As identified in the Preliminary Environmental Assessment (PEA) for the project<sup>1</sup>, the primary emissions to air are likely to be dust emissions during construction works. Air quality impacts during the operation phase of the project are expected to be minimal and primarily be caused by limited maintenance activities. Subsequent to testing and commissioning, it is not expected that routine maintenance would be required for many years. Maintenance crews may need to traverse unsealed access roads and the easement but this is expected to be so infrequent that it can be discounted for a dust impact assessment.

This report addresses the MR5a alignment of the proposed pipeline and is provided to supplement the Air Quality Impact Assessment report (AQIA) prepared by GHD for a previous alignment of the project (GHD report 96872, dated 23 July 2012). It is noted that the majority of the proposed alignment remains identical to the previous assessment, with only the northern section changing to the MR5a option.

The MR5a pipeline would commence at the offtake point on the bank of the southern bank of the Macquarie River. It would be located within the formation of an existing farm track for a distance of approximately 1,200 metres. This farm track has undergone previous vegetation clearing.

At chainage 1200, the pipeline would leave the farm track and traverse cleared paddocks to chainage 1800. The pipeline would be located within road reserves to chainage 6480 near Long Point Road. From chainage 6480 to the discharge structure, the route is as per the exhibited project.

This section of pipeline is approximately 6.5 km in length.

The methodology and findings of the AQIA (GHD, 2012) are discussed in this report.

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<sup>1</sup> GHD Pty Ltd. Orange City Council, Orange Drought relief Connection preliminary Environmental Assessment, March 2011.

## 2 Existing Environment

The existing air quality environment along the MR5a section of the proposed alignment will be similar to that of the original alignment.

Ambient levels of dust for rural NSW areas were sourced in the AQIA. Based on this data, an estimate of the background levels of fine particulate matter less than 10 microns in equivalent aerodynamic diameter (PM<sub>10</sub>) was made to be 20 µg/m<sup>3</sup> to be representative across the entire project area. As discussed below, this background level is added to project predicted impacts before comparison with the air quality impact assessment criteria.

Local meteorology was also sourced for the Orange area and was used to characterise the transport and dispersion of emissions from the construction area along the entire pipeline corridor. Predominant wind directions are from the north-northwest, west-southwest and east-northeast.

## 3 Predicted Air Quality Impacts

### 3.1 Impact Assessment Criteria

Dust impact assessment criteria for PM<sub>10</sub> and total suspended particles (TSP) are prescribed within the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DECC, August 2005). PM<sub>10</sub> and TSP criteria are provided as cumulative concentration (background plus increment).

Table 3-1 summarises the *Approved Methods* air quality goals.

**Table 3-1 Assessment criteria for PM<sub>10</sub> and TSP**

| Pollutant        | Averaging Period | Criteria                                                   |
|------------------|------------------|------------------------------------------------------------|
| PM <sub>10</sub> | 24 hours         | 50 µg/m <sup>3</sup>                                       |
|                  | Annual           | 30 µg/m <sup>3</sup>                                       |
| TSP              | Annual           | 90 µg/m <sup>3</sup>                                       |
| Dust deposition  | Annual           | 2 g/m <sup>2</sup> /month*<br>4 g/m <sup>2</sup> /month ** |

\*Maximum increase in deposited dust level

\*\*Maximum total deposited dust level (increment plus background)

### 3.2 General Construction Dust Impacts

The AQIA, completed for the project (GHD, 2012) focuses on dust emissions associated with the linear construction phase of the pipeline. Atmospheric dispersion modelling was undertaken for a range of construction activities and was used to predict the area of potential dust impact. The assessment identified the potential for dust impacts at levels of concern for sensitive receptors within 80 metres of normal construction activities. Under worst-case dust generation and meteorological conditions, receptors as far as 240 metres from construction activities could experience short term dust impacts.

### 3.3 MR5a Impacts

The foot print of construction dust impacts predicted during the original assessment would also apply along the MR5a section of the pipeline.

The northern area of the proposed pipeline is located in a rural environment with few residential dwellings and therefore few locations sensitive to air quality impacts.

A comparison of the number and location of sensitive receptors along the two identified pipeline alignments (from chainage 0 to chainage 4000 of the original alignment) has been made and summarised in Table 3-2. Note that the MR5a section is longer than the original section and extends from chainage 0 to chainage 6480.

**Table 3-2 Comparison of Sensitive Receptor Locations**

| Route option       | Number of identified receptors in pipeline vicinity                                                                                                                                                                                                                                         | Number of receptors within 240 metres                                         |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Original alignment | Four residential receptors identified. All 1000 metres or greater from the alignment.                                                                                                                                                                                                       | None                                                                          |
| MR5a               | Three residential receptors identified. Four other receptors such as farm sheds identified. One residential receptor at chainage 5700, approximately 100 metres from alignment. All others are either greater than 300 metres from the alignment or identified as non-residential premises. | One (chainage 5700). Located on Long Point Road at 100 metres from alignment. |

In comparing the two alignment options, it is noted that there are sensitive receptors located closer to the MR5a alignment. Therefore, there is a higher potential for dust impacts from unmitigated construction work along the MR5a alignment. However, only one residential receptor has been identified within 240 metres of the alignment. Dust impacts, if any, at this receptor would be short term as the pipeline construction moves past the property.

## 4 Mitigation Measures

For the pipeline construction, it is recommended that some of the dust control measures outlined below be adopted during construction for sections of the pipeline corridor which fall within close range of sensitive receptors (within 240 metres) or during dry and/or windy conditions when visible dust plumes are moving off-site towards sensitive receptors.

Appropriate dust management and mitigation measures have been identified in the air quality impact assessment with typical control activity applying at all times (for example, watering of access/haul tracks) and additional control (proactive measures to reduce emissions) when a residential dwelling is within 240 metres downwind of dust-generating activity.

Recommendations for measures to minimise air quality impacts are as follows:

- All construction and maintenance equipment/vehicles are to be operated and maintained to manufacturer's specifications in order to minimise exhaust emissions.
- Vehicular speeds are to be limited to 15 km/hr on areas of unconsolidated/ unsealed soil associated with the project.
- Limit cleared areas of land and clear only when necessary to reduce fugitive dust emissions.

- Aim to minimise the size of storage piles where possible.
- Excavating operations conducted in areas of low moisture content material should be suspended during high wind speed events or water sprays should be used.
- All haulage vehicles are to have their loads covered while transporting material to and from work areas.
- Prompt mitigation of visible dust emissions, which may involve a combination of
- Stabilisation of surface silt content through the application of water sprays.
- Control of mechanically induced dust emissions by temporarily suspending activity or reducing the intensity of operations, including speed limits.
- Implementing Level 2 ( $>2$  litres/m<sup>2</sup>/hr) haul road watering when sensitive receptors are located within 240 metres of construction works. Increased watering during haul road activities can reduce the potentially impacted footprint to within 100 - 150 metres of the construction works.
- For the residence on Long Point Road, close consultation with the affected occupants is recommended (for example, bundled with any correspondence concerning cutting any access points). This should occur before construction is due to be within 240 metres.

## 5 Conclusions

An assessment of potential dust impacts during construction of the project has been undertaken.

The assessment identified the potential for dust impacts at sensitive receptors within 80 metres of normal construction activities. Under worst-case dust generation and meteorological conditions, receptors as far as 240 metres from construction activities could experience short term dust impacts.

As discussed in the assessment, it is expected that the generation of dust emissions due to construction of the project can effectively be mitigated by implementation of a dust management plan, incorporating the abovementioned mitigation measures.

Regards



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Appendix F

## Noise and vibration impact assessment (Renzo Tonin & Associates)



MACQUARIE RIVER TO ORANGE PIPELINE PROJECT  
PROPOSED PROJECT REFINEMENTS - MR5A  
NOISE AND VIBRATION IMPACT ASSESSMENT

TF332-02F02 (REV 3) PPR.DOCX

17 JANUARY 2013

Prepared for:

ORANGE CITY COUNCIL

Attention: MR JOHN MARSHALL



## DOCUMENT CONTROL

| Date     | Revision History                 | Non-Issued Revision | Issued Revision | Prepared By (initials) | Instructed By (initials) | Reviewed & Authorised by (initials) |
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| 17/01/13 | Update Project title and figures | -                   | 3               | WC                     | MCH                      | MCH                                 |

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# 1 INTRODUCTION

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Renzo Tonin & Associates was engaged to prepare a Preferred Project Report (PPR) to compare the potential noise and vibration impacts from the proposed Orange Drought Relief Pipeline route presented in the Environmental Assessment (EA) to the proposed alternative MR5A route option.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

## 1.1 Location of the Refined Section

The location of MR5a is shown in Figure 1 and described below. Further information on the location, including figures showing the overall route of the refined project, is provided in volume 1.

### 1.1.1 Offtake Structure and Pump Station

The location of the offtake structure is shown in Figure 1. The offtake structure (which includes a pump station) would be located on the southern bank at Cobbs Hut Hole.

Access to the site is via an unsealed road. The site is surrounded by the river and sparsely wooded banks. Areas in the vicinity of the site are used informally for recreation purposes. There are no structures or residences in the vicinity of the site. Other than landowners there is no real public access to the site except by river craft.

The nearest residence to the offtake structure is 'Fleming's shed' which is a shearing shed located approximately 1.32 km to the south-east. This property has an informal residential component.

### 1.1.2 Pipeline

The pipeline would commence at the offtake point on the bank of the southern bank of the Macquarie River. It would be located within the formation of an existing farm track for a distance of approximately 1,200 metres. This farm track has undergone previous vegetation clearing.

At chainage 1200, the pipeline would leave the farm track and traverse cleared paddocks to chainage 1800. The pipeline would be located within road reserves to chainage 6480 near Long Point Road. From chainage 6480 to the discharge structure, the route is as per the exhibited project.

This section of pipeline is approximately 6.5 km in length.

The width of the construction trench and final easement are as described in sections 6.2.2 and 7.2.2 of the EA.

#### 1.1.3 Access Road

The proposed access road would be located between Long Point Road and Cobs Hut Hole at the Macquarie River. The access road would be approximately 6m wide and 1421.40m long.

#### 1.1.4 Power Supply

Construction of new overhead power supply would be required from approximately chainage 1200 to approximate chainage 4328.274, a further section of underground power would be installed from chainage 00 to 1200. The overhead power line would be installed through open paddocks and broadly parallel to Long Point Road avoiding large trees where possible. The underground power has been proposed to minimise the extent of clearing required and will be common trenched with the pipeline.

## 2 EXISTING ACOUSTIC ENVIRONMENT

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### 2.1 Noise Monitoring Locations

Unattended and attended noise monitoring were conducted at representative locations along the proposed MR5A route. The monitoring locations are as follows and are shown in Figure 1.

- **Location M1 – Macquarie River**

Near the location of the proposed offtake structure of the project and in the 'free field'. Noise environment is dominated by natural sounds and water flow noise from Macquarie River.

- **Location M2 – Long Point Road Location 1**

Representative location along the proposed MR5A route at approximate chainage Ch 2100.00 and in the 'free field'. Noise environment is dominated by natural sounds and occasional traffic noise along Long Point Road. Noise data represents the ambient and background noise levels for residences close to the proposed MR5A route.

- **Location M3 – Long Point Road Location 2**

Representative location along the proposed MR5A route at approximate chainage Ch 3700.00 and in the 'free field'. Noise environment is dominated by natural sounds and occasional traffic noise along Long Point Road. Noise data represents the ambient and background noise levels for residences close to the proposed MR5A route.

- **Location M4 – Long Point Road Location 3**

Representative location along the proposed MR5A route at approximate chainage Ch 5100.00 and in the 'free field'. Noise environment is dominated by natural sounds and occasional traffic noise along Long Point Road. Noise data represents the ambient and background noise levels for residences close to the proposed MR5A route.

To quantify the existing ambient noise environment, long-term (unattended) noise monitoring was conducted between Tuesday 9<sup>th</sup> and Wednesday 17<sup>th</sup> October 2012 at Location M1, while attended noise monitoring was conducted on Tuesday 9<sup>th</sup> October 2012 at Locations M2, M3 and M4.

Appendix A of this report presents a description of acoustic terms. Appendix B details the noise monitoring methodology and the graphical recorded output from long term noise monitoring is included in Appendix C. The graphs in Appendix G were analysed to determine an assessment background level (ABL) for each day, evening and night period in each 24 hour period of noise

monitoring, and based on the median of individual ABLs an overall single Rating Background Level (RBL) for the day, evening and night period is determined over the entire monitoring period in accordance with the NSW INP.

## 2.2 Existing Background and Ambient Noise Levels

Existing background and ambient noise levels are presented in Table 2.1 below.

The long term unattended noise monitor was positioned outdoors in the 'free field' (ie away from building facades). Operational noise from the site should be assessed away from the facade at the potentially most affected residential boundaries and therefore the representative noise levels listed in Table 2.1 are directly applicable.

**Table 2.1 – Unattended Measured L<sub>90</sub> Background & L<sub>eq</sub> Ambient Noise Levels, dB(A)**

| Location    | L <sub>90</sub> Background Noise Levels |         |       | L <sub>eq</sub> Ambient Noise Levels |         |       |
|-------------|-----------------------------------------|---------|-------|--------------------------------------|---------|-------|
|             | Day                                     | Evening | Night | Day                                  | Evening | Night |
| Location M1 | 42                                      | 42      | 43    | 48                                   | 47      | 45    |

The short term attended noise measurements were also undertaken in the free field and results of the L<sub>A90</sub> background noise levels are presented in Table 2.2 below.

**Table 2.2 – Attended Measured L<sub>90</sub> Background & L<sub>eq</sub> Ambient Noise Levels, dB(A)**

| Location    | Survey Period    | L <sub>90</sub> Background Noise Levels | L <sub>eq</sub> Ambient Noise Levels |
|-------------|------------------|-----------------------------------------|--------------------------------------|
| Location M2 | 12:52pm – 1:07pm | 30                                      | 43                                   |
| Location M3 | 2:12pm – 2:27pm  | 30                                      | 37                                   |
| Location M4 | 2:30pm-2:45pm    | 26 <sup>1</sup>                         | 42                                   |

Notes: 1. Where measured L<sub>A90</sub> background noise level is less than 30dB(A), this will be set to 30dB(A) in accordance with p24 of the NSW INP

From the above monitoring results it is noted that the existing noise environment along the proposed MR5A route is similar to the noise environment along the original route proposed in the EA. The background noise levels are representative of residences in a rural environment with day time and night time background noise levels at 30dB(A) or below. The identified receivers in the vicinity of the pipeline route (proposed in EA and MR5A route) are all classified as rural under INP guidelines. Based on page 24 of the INP, where background noise levels are less than 30dB(A), the minimum applicable background noise level is recommended to be 30dB(A). Therefore, this minimum background noise level has been adopted for all receivers, along the pipeline route.

## 2.3 Noise Sensitive Receivers

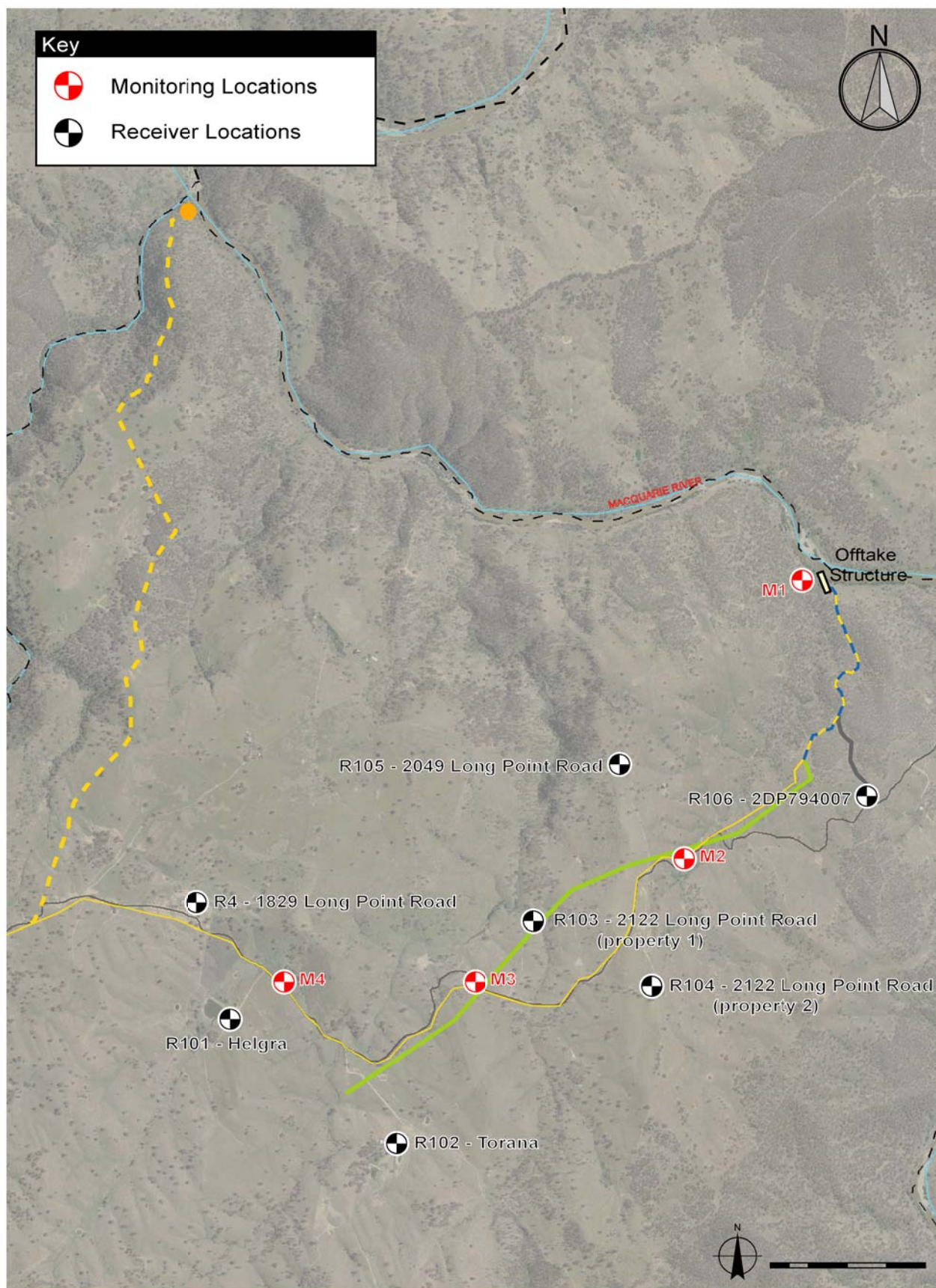
The EA proposed route identified four (4) receivers as potentially affected. With the MR5A route one (1) of these receivers will still be affected (Receiver R3 - 1829 Long Point Road) and an additional six (6) receivers were identified as potentially affected.

The identified noise receivers and their coordinates are presented in the table below.

**Table 2.3 – Property IDs and Coordinates (MGA55)**

| Property ID                                       | Lot No. | DP No. | Easting (m) | Northing (m) | Approx. Distance to Project (m) |
|---------------------------------------------------|---------|--------|-------------|--------------|---------------------------------|
| Receiver R4 – 1829 Long Point Road <sup>1</sup>   | 40      | 756881 | 708621.0    | 6343041      | 47                              |
| Receiver R101 – Helgra                            | 1       | 395059 | 708754.5    | 6342418      | 350                             |
| Receiver R102 – Torana                            | 22      | 852675 | 709590.3    | 6341820      | 420                             |
| Receiver R103 – 2122 Long Point Road (Property 1) | 36      | 756881 | 710345.8    | 6342894      | 335                             |
| Receiver R104 – 2122 Long Point Road (Property 2) | 31      | 756881 | 710945.7    | 6342631      | 210                             |
| Receiver R105 – 2049 Long Point Road              | 20      | 756881 | 710815.6    | 6343751      | 500                             |
| Receiver R106 – 2DP794007                         | 2       | 794007 | 712368.6    | 6343537      | 615                             |

Notes: 1. Also impacted upon by the pipeline route proposed in the EA



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**Title :** Figure 1 – Locality Plan

**Project:** Macquarie River to Orange Pipeline Project –  
Proposed Project Refinements – MR5a

**Date :** 17/12/12

**Scale:** NTS

**Ref :** TF332-02P01 (rev 0)

### 3 CONSTRUCTION NOISE AND VIBRATION IMPACT

#### 3.1 Construction Noise Impact

##### 3.1.1 Construction Noise Management Levels

As presented in the EA, construction noise management levels are based on the 'Interim Construction Noise Guideline' (ICNG), which states construction noise management levels to be as follows:

$$L_{Aeq(15 \text{ min})} \leq L_{A90} \text{ Background Noise Level} + 10\text{dB(A)}$$

In addition to the above management level requirement, any construction noise impact at a receiver location that is 75dB(A) or above is considered highly noise affected and specific noise mitigation measures in terms of respite periods are required in accordance with the ICNG

It is noted that the above criteria is applicable to residential receivers and for construction works occurring during the standard construction hours recommended in the ICNG (Monday to Friday 7am to 6pm, Saturday 8am to 1pm, No work on Sundays or public holidays).

For work outside of the recommended standard construction hours, the applicable management levels are:

$$L_{Aeq(15 \text{ min})} \leq L_{A90} \text{ Background Noise Level} + 5\text{dB(A)}$$

##### 3.1.2 Predicted Construction Noise Levels

The predicted construction noise levels for the six new identified receivers and the previously identified receiver are presented in the table below.

It is noted that the noise levels presented are based on all construction plant and equipment nominated previously in the EA, to be operating concurrently at a location along the pipeline closest to the corresponding receiver.

**Table 3.1 – Predicted  $L_{Aeq}$  Noise Levels During Construction, dB(A)**

| Receiver                                          | Noise Management Level <sup>2</sup> | Predicted $L_{Aeq}$ Noise Level | Predicted Exceedance <sup>2</sup> |
|---------------------------------------------------|-------------------------------------|---------------------------------|-----------------------------------|
| Receiver R4 – 1829 Long Point Road <sup>1</sup>   | 40 / 35                             | 60                              | 20 / 25                           |
| Receiver R101 – Helgra                            | 40 / 35                             | 44                              | 4 / 9                             |
| Receiver R102 – Torana                            | 40 / 35                             | 43                              | 3 / 8                             |
| Receiver R103 – 2122 Long Point Road (Property 1) | 40 / 35                             | 45                              | 5 / 10                            |
| Receiver R104 – 2122 Long Point Road (Property 2) | 40 / 35                             | 56                              | 16 / 21                           |
| Receiver R105 – 2049 Long Point Road              | 40 / 35                             | 47                              | 7 / 12                            |

| Receiver                  | Noise Management Level <sup>2</sup> | Predicted L <sub>Aeq</sub> Noise Level | Predicted Exceedance <sup>2</sup> |
|---------------------------|-------------------------------------|----------------------------------------|-----------------------------------|
| Receiver R106 – 2DP794007 | 40 / 35                             | 38                                     | - / 3                             |

Notes: 1. Receiver previously identified in EA  
2. Noise management levels and exceedances represent standard hours / outside of standard hours

From the table above it can be seen that exceedances of 3 to 20dB(A) are predicted for six out of the seven receivers, while Receiver R106 is predicted to comply with the established noise management level during the recommended standard construction hours.

During the periods outside of the recommended standard construction hours, exceedances of 3 to 25dB(A) are predicted at all receiver locations.

However, it is noted that no receiver locations would experience highly noise affected levels of 75dB(A) or more.

For the EA route, the construction noise level for Receiver R4 was predicted to be 28dB(A). With the MR5A route the construction noise level for Receiver R4 is predicted to be 60dB(A) which is an increase of up to 32dB(A) compared to the EA route.

For the EA route the construction noise level for three (3) out of the four (4) receivers were predicted to comply with the noise management level outside of standard hours. All four (4) receivers were predicted to comply with the noise management levels during standard hours. With the MR5A route the construction noise level for all seven (7) receivers (as presented in Table 3.1 above) were predicted to exceed the noise management level outside of standard hours. Six (6) out of the seven (7) receivers were predicted to exceed the noise management levels during standard hours.

It is noted that the expected construction rate of 1-2km per week for the pipeline works would mean the potential of the noise impacts at each identified receiver is not expected to occur for more than 2 weeks.

### 3.2 Construction Vibration Impact

The nearest potentially affected receiver to the construction works for the MR5A route is Receiver R4 (1829 Long Point Road), which is approximately 47m from the construction works at the closest point. The remaining six (6) identified receivers are located in excess of 200m from the construction works associated with the proposed MR5A route. Based on these separation distances and the type of plant and equipment proposed and presented in the EA, the probability of damage to structures from construction vibration is low.

Similarly for the EA route, the probability of damage to structures from construction vibration was identified as low.

## 4 OPERATIONAL NOISE IMPACT

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In the EA, the operational noise level from the Offtake Structure / Pump Station 1 location were predicted to be less than 20dB(A) at the nearest affected receiver locations and no operational noise impacts were identified.

All identified receivers are located in excess of 1.3km from the proposed M5A route Offtake Structure / Pump Station 1. While for the EA route all receivers were located in excess of 1.6km from the proposed EA route Offtake Structure / Pump Station 1.

Based on the same pump station building construction nominated in the EA, the operational noise levels from the proposed MR5A route Offtake Structure / Pump Station 1 location is predicted to be less than 20dB(A). This is well below both the background noise levels and the nominated criteria. Therefore, it is expected that the operation of the pumping station will be inaudible at all receivers along the proposed M5A pipeline route. This is consistent for the EA route.

## **5 CUMULATIVE NOISE IMPACT**

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### **5.1 Cumulative Construction Noise**

At present there are no known construction activities or projects that would result in cumulative construction noise impacts when combined with the construction works associated with the project. If and when future construction works not associated with the project arise in the surrounding area of the pipeline corridor, the cumulative noise impact from all construction activities would need to be considered.

### **5.2 Cumulative Operational Noise**

Predicted operational noise levels from the offtake structure and ancillary services were found to be well below the background noise levels at residential areas close to the pump stations. This is consistent for both the EA route and MR5A route. Therefore the noise impacts from the operation of the project would not contribute to the existing acoustic environment and no cumulative noise impacts would be experienced at nearby residences.

## **6 ROAD TRAFFIC NOISE IMPACT**

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### **6.1 Construction Traffic**

In the EA, the minimum buffer distance required to comply with the NSW Road Noise Policy (RNP) for receivers on Long Point Road was determined to be 120m. With the proposed EA route, all four (4) potentially affected receivers are located beyond 120m from the construction traffic route along Long Point Road. With the proposed MR5A route, the six (6) new identified receivers will meet this 120m buffer distance. Receiver R4 is located approximately 47m from the construction traffic route along Long Point Road and therefore feasible and reasonable noise mitigation options nominated in the EA should be considered for this receiver.

### **6.2 Operational Traffic**

During the operation of the pipeline system, traffic movements will be mainly from 4WD utilities and 3-tonne trucks for maintenance works. Scheduled maintenance visits will typically occur one to two times a week. As a result, vehicle movements are anticipated to be minimal and would not differ to existing traffic on the roads. This is consistent for the proposed EA route and the proposed MR5A route.

Therefore, road traffic noise due to the operation of the project is not expected to adversely impact residences along the transport routes.

## **7 CONCLUSION**

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Renzo Tonin & Associates have completed a comparison of the potential noise and vibration impacts from the proposed route in the EA to the proposed alternative MR5A route. The alternative MR5A route would potentially impact seven (7) receivers, including six (6) new identified receivers, compared to four (4) receivers for the EA route. Differences in noise and vibration impacts, during construction and operational stages, between the two routes have been discussed.

## APPENDIX A - GLOSSARY OF ACOUSTIC TERMS

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The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Acoustic Barrier</i>    | Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc used to reduce noise, without eliminating it.                                                                                                                                                                                                                                                                                                                                                       |
| <i>Adverse Weather</i>     | Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).                                                                                                                                                                          |
| <i>Air-borne Noise</i>     | This refers to noise which is fundamentally transmitted by way of the air and can be attenuated by the use of barriers and walls placed physically between the noise and receiver.                                                                                                                                                                                                                                                                                                     |
| <i>Ambient Noise</i>       | The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.                                                                                                                                                                                                                                                                                                                                             |
| <i>Assessment Period</i>   | The period in a day over which assessments are made.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <i>Assessment Point</i>    | A point at which noise measurements are taken or estimated.                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <i>Audible Range</i>       | The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.                                                                                                                                                                                                                                        |
| <i>Background Noise</i>    | Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the <b>L<sub>90</sub></b> noise level (see below). |
| <i>Barrier</i>             | See "acoustic barrier", a solid object used to attenuate sound.                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <i>Character, acoustic</i> | The total of the qualities making up the individuality of the noise. The pitch or shape of a sound's frequency content (spectrum) dictate a sound's character.                                                                                                                                                                                                                                                                                                                         |

## *Decibel [dB]*

The level of noise is measured objectively using a Sound Level Meter. This instrument has been specifically developed to mimic the operation of the human ear. The human ear responds to minute pressure variations in the air. These pressure variations can be likened to the ripples on the surface of water but of course cannot be seen. The pressure variations in the air cause the eardrum to vibrate and this is heard as sound in the brain. The stronger the pressure variations, the louder the sound is heard.

The range of pressure variations associated with everyday living may span over a range of a million to one. On the top range may be the sound of a jet engine and on the bottom of the range may be the sound of a pin dropping.

Instead of expressing pressure in units ranging from a million to one, it is found convenient to condense this range to a scale 0 to 120 and give it the units of decibels. The following are examples of the decibel readings of every day steady or quasi-steady sounds;

|       |                                                       |
|-------|-------------------------------------------------------|
| 0dB   | the faintest sound we can hear                        |
| 20dB  | quiet bedroom at night or recording studio            |
| 30dB  | quiet library or quiet location in the country        |
| 40dB  | living room                                           |
| 50dB  | typical office space or ambience in the city at night |
| 60dB  | normal conversational speech                          |
| 70dB  | a car passing by                                      |
| 80dB  | kerbside of a busy road                               |
| 90dB  | truck passing by                                      |
| 100dB | nightclub                                             |
| 110dB | rock band or 2m from a jackhammer                     |
| 120dB | 70m from a jet aircraft                               |
| 130dB | threshold of pain                                     |
| 140dB | 25m from a jet aircraft                               |

## *dB(A): A-weighted decibels*

The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The

sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.

*Diffraction*

The distortion around solid obstacles of waves travelling past.

*Fluctuating Noise*

Noise that varies continuously and to an appreciable extent over the period of observation. It can also include intermittent noise. As a guide, when the level varies noticeably by more than 5 dB over a period of less than one minute, the noise is considered to be fluctuating.

*Free-field*

An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground.

*Frequency*

Frequency is synonymous to *pitch*. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.

*Ground-borne noise*

Ground-borne noise propagating through the ground as vibration and then radiated by vibrating building elements such as wall and floor surfaces. This noise is normally noticeable only in areas that are well protected from airborne noise.

*Impulsive noise*

Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.

*Intermittent noise*

The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.

*Loudness*

A 3dB increase represents a doubling of the sound pressure, however an increase of about 10dB is required before the sound will subjectively appear to be twice as loud. That is, a sound of 85dB is twice as loud as a sound of 75dB which is twice as loud as a sound of 65dB and so on. That is, the sound of 85dB is four times as loud as a sound of 65dB. The smallest change which can be readily heard is approximately 2dB. An increase beyond 5dB is considered to represent the level at which a change in loudness begins to be clearly perceived.

*L<sub>max</sub>*

The maximum sound pressure level measured over a given period.

|                            |                                                                                                                                                                                                                                      |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $L_{min}$                  | The minimum sound pressure level measured over a given period.                                                                                                                                                                       |
| $L_{av. max}$              | The average of the maximum noise levels in a sample.                                                                                                                                                                                 |
| $L_1$                      | The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.                                                                                                                                  |
| $L_{10}$                   | The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.                                                                                                                                 |
| $L_{90}$                   | The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the $L_{90}$ noise level expressed in units of dB(A).                                                                                               |
| $L_{eq}$                   | The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.                                                                                                                         |
| <i>Low-frequency noise</i> | Containing major components within the low frequency range (20Hz – 250Hz) of the frequency spectrum.                                                                                                                                 |
| <i>Microphone</i>          | An electro acoustic transducer which receives an acoustic signal and delivers a corresponding electric signal.                                                                                                                       |
| <i>Nature, acoustic</i>    | The innate or essential quality of the noise. That which makes one noise distinguishable from another (e.g. the spoken voice from the sound of a dog barking, a telephone ringing from the sound of a gun).                          |
| <i>Noise</i>               | Sound which a listener does not wish to hear.                                                                                                                                                                                        |
| <i>Noise Monitor</i>       | See "sound level meter".                                                                                                                                                                                                             |
| <i>NRC</i>                 | The <i>Noise Reduction Coefficient</i> is the arithmetic average, rounded off to the nearest multiple of 0.05 of the sound absorption coefficients at 250, 500, 1kHz and 2kHz for a specific material and mounting condition.        |
| <i>Quality, acoustic</i>   | An attribute, characteristic or property of the noise, its duration, its time-varying characteristics or its frequency content. Examples are the "screech" of screaming, the "rumble" of an airconditioner, the "dripping" of a tap. |
| <i>Reflection</i>          | Sound wave changed in direction of propagation due to a solid object obscuring its path.                                                                                                                                             |
| $R_w$                      | The <i>Weighted Sound Reduction Index</i> or $R_w$ is a measure of the noise reduction property of the partition, a higher rating implying a higher sound reduction performance.                                                     |

|                              |                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>SEL</i>                   | Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.                      |
| <i>Sound</i>                 | A fluctuation of air pressure which is propagated as a wave through air.                                                                                                                                                                                                                                                                                            |
| <i>Sound Absorption</i>      | The ability of a material to absorb sound energy through its conversion into thermal energy.                                                                                                                                                                                                                                                                        |
| <i>Sound Level Meter</i>     | An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.                                                                                                                                                                                                             |
| <i>Sound Pressure Level</i>  | The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.                                                                                                                                                                                                                                                   |
| <i>Sound Power Level</i>     | Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.                                                                                                                                                                                                                                                  |
| <i>STC</i>                   | Sound Transmission Class. This is a measure of the extent of sound reduction of noise going through a building element, presented as a rating or class. It denotes the sound attenuation properties of walls, floors and ceilings used to construct building spaces. The higher the STC the better the sound reducing performance of the construction.              |
| <i>Structure-borne noise</i> | This refers to noise which is generated by vibrations induced in the ground and/or structure. These vibrations excite walls and slabs in buildings and cause them to radiate noise. This type of noise can not be attenuated by barriers or walls but requires the interposition of a resilient (neoprene, springs etc.) break between the source and the receiver. |
| <i>Tonal noise</i>           | Containing a prominent frequency and characterised by a definite pitch.                                                                                                                                                                                                                                                                                             |

## APPENDIX B - NOISE MONITORING METHODOLOGY

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### B.1 Noise Monitoring Equipment

All long term noise monitoring was conducted using RTA Technology noise loggers. The noise monitoring equipment used here complies with Australian Standard 1259.2-1990 "Acoustics - Sound Level Meters" and is designated as a Type 2 instrument suitable for field use.

A noise monitor consists of a sound level meter and a computer housed in a weather resistant enclosure. Ambient noise levels were recorded at a rate of 10 samples per second. Every 15 minutes, the data is processed statistically and stored in memory. The equipment was calibrated prior and subsequent to the measurement period using a Bruel & Kjaer Type 4230 calibrator. No significant drift in calibration was observed.

The equipment used for the short term, attended noise measurements was a Brüel & Kjær Type 2250 precision sound level analyser. Statistical noise levels were acquired in both overall and octave band frequencies. This instrument complies with Australian Standard 1259.2-1990 "Acoustics - Sound Level Meters – Part 2: Integrating - averaging" and is designated as Type 1 instrument having accuracy suitable for field and laboratory use.

The sound level analyser was calibrated prior and subsequent to the measurements using a Bruel & Kjaer Type 4231 calibrator. No significant drift in calibration was observed.

### B.2 Meteorology during Monitoring

Measurements affected by extraneous noise, wind (greater than 5m/s) or rain were excluded from the recorded data in accordance with the INP. The Bureau of Meteorology provided meteorological data, which is considered representative of the site, for the duration of the noise monitoring period.

### B.3 Noise vs Time Graphs

Noise almost always varies with time. Noise environments can be described using various descriptors to show how a noise ranges about a level. In this report, noise values measured or referred to include the  $L_{10}$ ,  $L_{90}$ , and  $L_{eq}$  levels. The statistical descriptors  $L_{10}$  and  $L_{90}$  measure the noise level exceeded for 10% and 90% of the sample measurement time. The  $L_{eq}$  level is the equivalent continuous noise level or the level averaged on an equal energy basis. Measurement sample periods are usually ten to fifteen minutes. The Noise -vs- Time graphs representing measured noise levels at the noise monitoring locations in Appendix G illustrate these concepts.

Noise levels are commonly measured in units of A-weighted decibels or dB(A). The "A-weighting" refers to standardised amplitude versus frequency curve used to "weight" sound measurements to represent the response of the human ear. The human ear is less sensitive to low pitch sound than it is to high pitch sound. Overall A-weighted measurements quantify sound with a single number to represent how people subjectively hear different frequencies at different levels.

Background noise is the term used to describe the noise measured in the absence of the noise under investigation. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample time period. This is represented as the **L<sub>90</sub>** noise level.

## APPENDIX C - NOISE MONITORING RESULTS

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## Intake Station at Macquarie River

## BACKGROUND & AMBIENT NOISE MONITORING RESULTS NSW 'INDUSTRIAL NOISE POLICY', 2000

|                             | L <sub>A90</sub> Background Noise Levels <sup>5</sup> |             |             | L <sub>Aeq</sub> Ambient Noise Levels |             |             |
|-----------------------------|-------------------------------------------------------|-------------|-------------|---------------------------------------|-------------|-------------|
| Day                         | Day                                                   | Evening     | Night       | Day                                   | Evening     | Night       |
| Tuesday-09-October-2012     | 42.4                                                  | 42.5        | 42.8        | 46.9                                  | 50.6        | 45.1        |
| Wednesday-10-October-2012   | 41.9                                                  | 42.0        | 42.5        | 48.3                                  | 46.5        | 42.9        |
| Thursday-11-October-2012    | 43.1                                                  | 42.5        | 42.7        | 50.8                                  | 50.6        | 44.9        |
| Friday-12-October-2012      | 42.7                                                  | 42.2        | 42.8        | 47.7                                  | 45.3        | 45.3        |
| Saturday-13-October-2012    | 42.2                                                  | 42.0        | 42.6        | 48.0                                  | 46.6        | 44.6        |
| Sunday-14-October-2012      | 41.4                                                  | 42.0        | 42.6        | 46.3                                  | 45.9        | 44.8        |
| Monday-15-October-2012      | 42.2                                                  | 42.1        | 42.3        | 54.9                                  | 47.0        | 44.6        |
| Tuesday-16-October-2012     | 41.7                                                  | 41.4        | 42.0        | 48.3                                  | 47.8        | 46.2        |
| Wednesday-17-October-2012   | 42.5                                                  | -           | -           | 47.7                                  | -           | -           |
|                             |                                                       |             |             |                                       |             |             |
|                             |                                                       |             |             |                                       |             |             |
|                             |                                                       |             |             |                                       |             |             |
|                             |                                                       |             |             |                                       |             |             |
|                             |                                                       |             |             |                                       |             |             |
|                             |                                                       |             |             |                                       |             |             |
|                             |                                                       |             |             |                                       |             |             |
| <b>Representative Level</b> | <b>42.2</b>                                           | <b>42.1</b> | <b>42.6</b> | <b>48.0</b>                           | <b>46.8</b> | <b>44.8</b> |

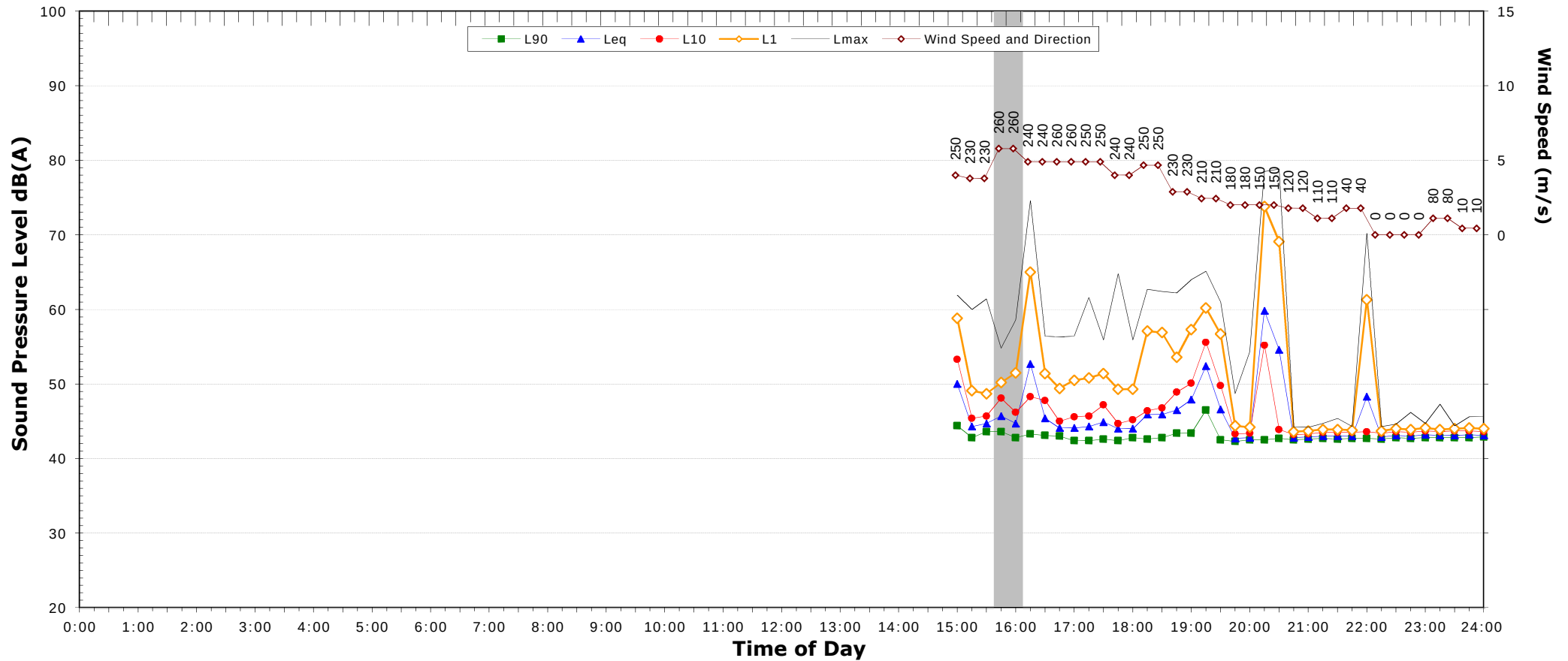
Notes:

1. Day is taken to be 7:00am to 6:00pm
2. Evening is taken to be 6:00pm to 10:00pm.
3. Night is taken to be the remaining periods.
4. Rating Background Level (RBL) for L90 and logarithmic average for Leq
5. Assessment Background Level (ABL)

# EXISTING AMBIENT NOISE LEVELS

## Intake Station at Macquarie River

Tuesday, 9 October 2012



| NSW Industrial Noise Policy (Free Field) |         |          |                    |
|------------------------------------------|---------|----------|--------------------|
| Descriptor                               | Day     | Evening  | Night <sup>2</sup> |
|                                          | 7am-6pm | 6pm-10pm | 10pm-7am           |
| L <sub>90</sub>                          | 42.4    | 42.5     | 42.8               |
| Leq                                      | 46.9    | 50.6     | 45.1               |

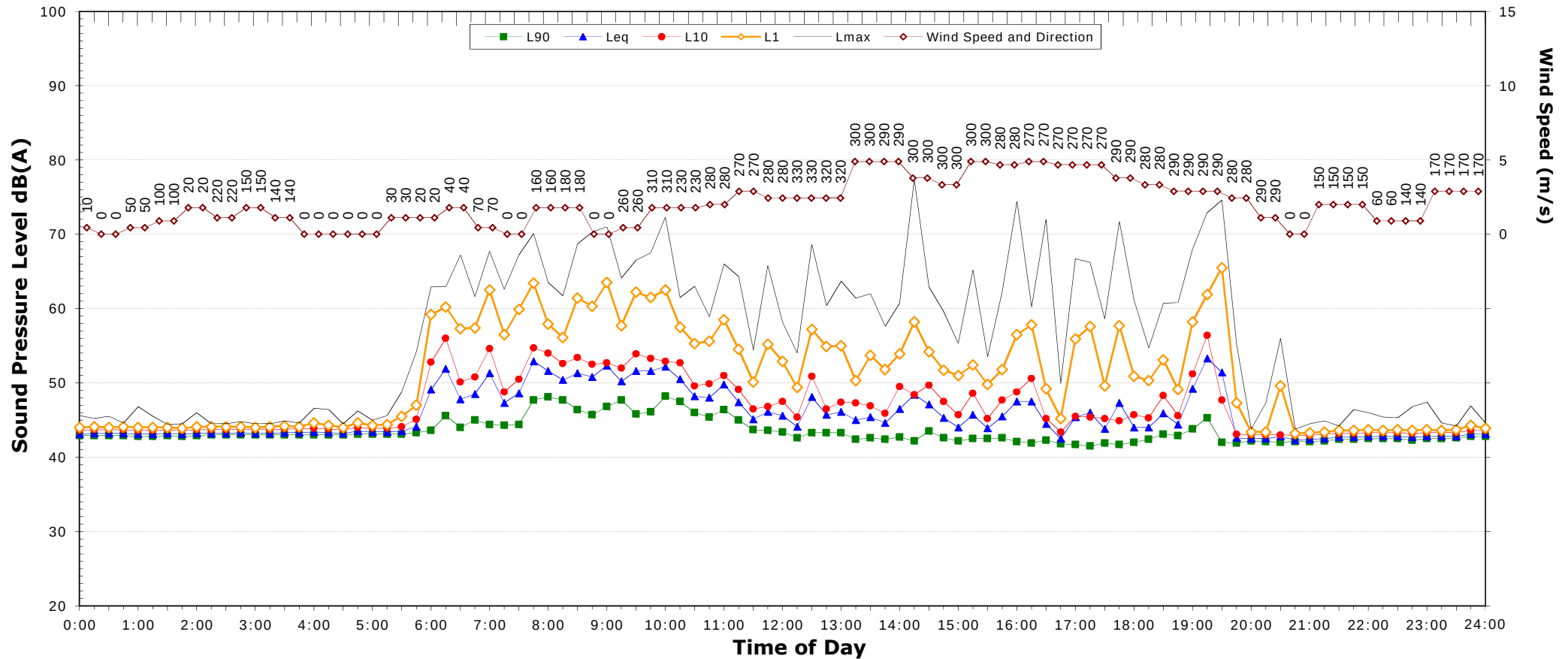
### NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Intake Station at Macquarie River

Wednesday, 10 October 2012



| NSW Industrial Noise Policy (Free Field) |         |          |                    |
|------------------------------------------|---------|----------|--------------------|
| Descriptor                               | Day     | Evening  | Night <sup>2</sup> |
|                                          | 7am-6pm | 6pm-10pm | 10pm-7am           |
| L <sub>90</sub>                          | 41.9    | 42.0     | 42.5               |
| Leq                                      | 48.3    | 46.5     | 42.9               |

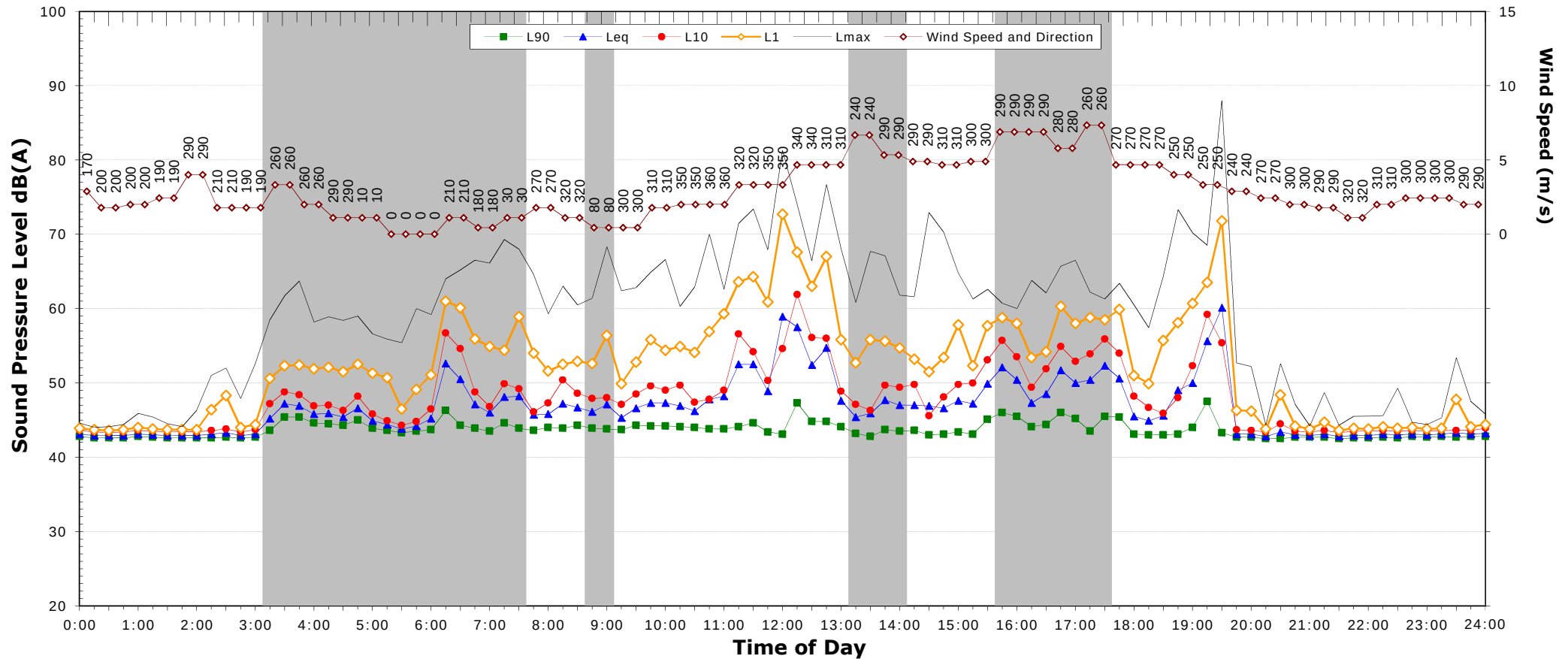
### NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Intake Station at Macquarie River

Thursday, 11 October 2012



| NSW Industrial Noise Policy (Free Field) |         |          |                    |
|------------------------------------------|---------|----------|--------------------|
| Descriptor                               | Day     | Evening  | Night <sup>2</sup> |
|                                          | 7am-6pm | 6pm-10pm | 10pm-7am           |
| L <sub>90</sub>                          | 43.1    | 42.5     | 42.7               |
| Leq                                      | 50.8    | 50.6     | 44.9               |

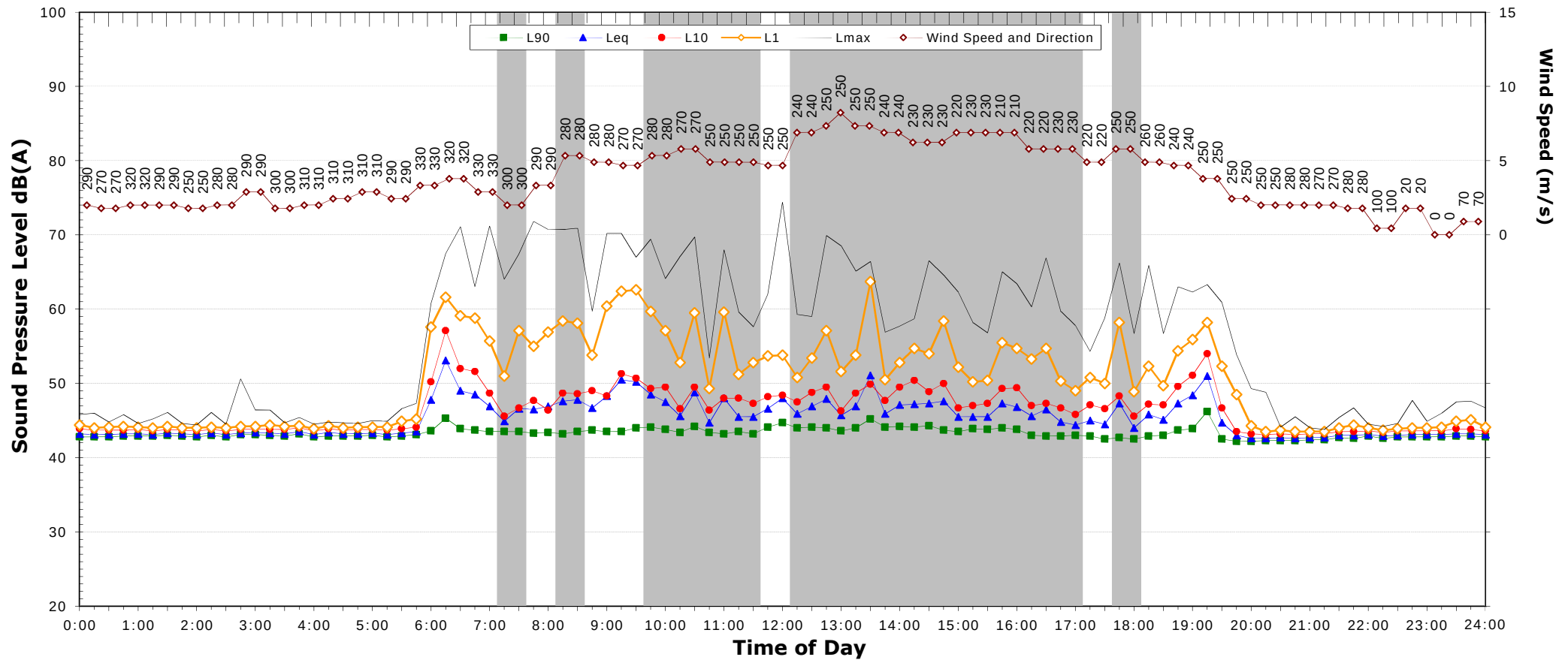
### NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Intake Station at Macquarie River

### Friday, 12 October 2012



| NSW Industrial Noise Policy (Free Field) |         |          |                    |
|------------------------------------------|---------|----------|--------------------|
| Descriptor                               | Day     | Evening  | Night <sup>2</sup> |
|                                          | 7am-6pm | 6pm-10pm | 10pm-7am           |
| L <sub>90</sub>                          | 42.7    | 42.2     | 42.8               |
| Leq                                      | 47.7    | 45.3     | 45.3               |

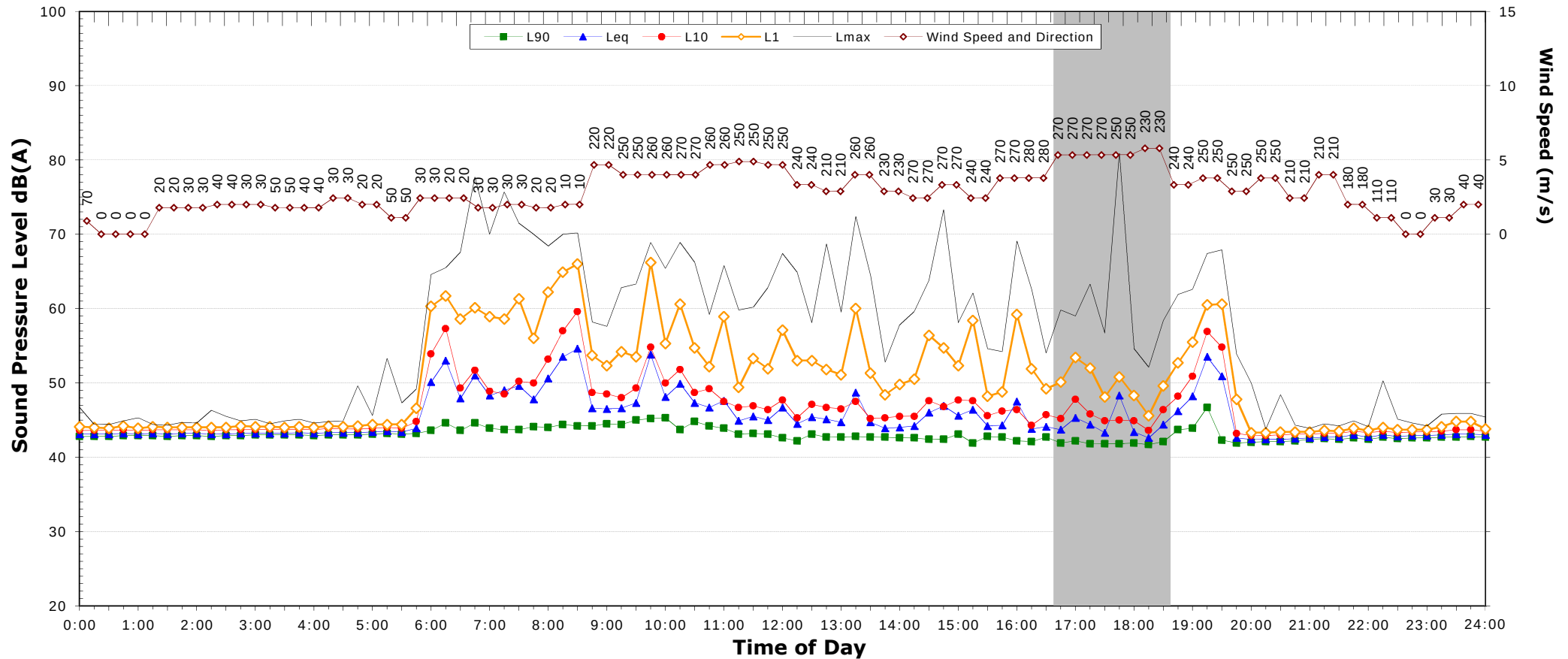
#### NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Intake Station at Macquarie River

### Saturday, 13 October 2012



| NSW Industrial Noise Policy (Free Field) |         |          |                    |
|------------------------------------------|---------|----------|--------------------|
| Descriptor                               | Day     | Evening  | Night <sup>2</sup> |
|                                          | 7am-6pm | 6pm-10pm | 10pm-7am           |
| L <sub>90</sub>                          | 42.2    | 42.0     | 42.6               |
| Leq                                      | 48.0    | 46.6     | 44.6               |

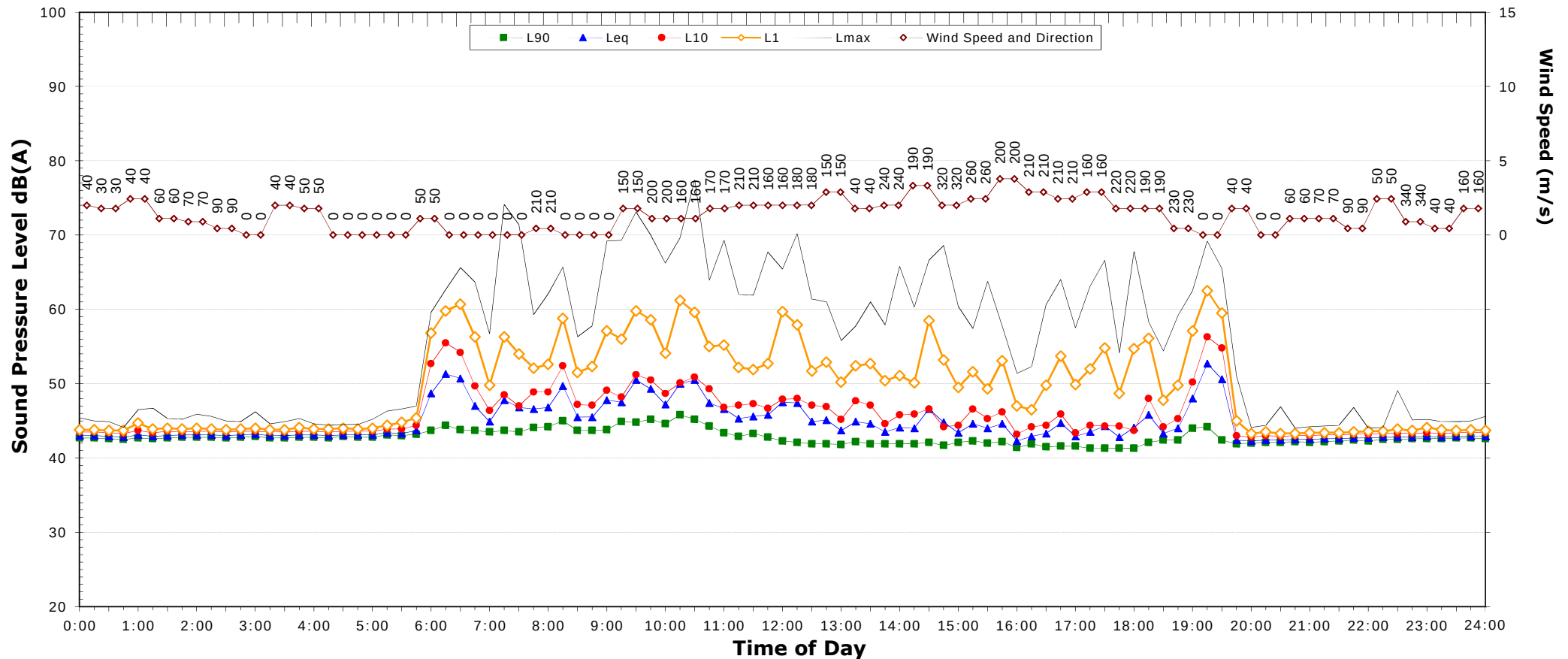
#### NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time L<sub>max</sub> values are shown only where L<sub>max</sub> > 65dB(A) and where L<sub>max</sub>-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Intake Station at Macquarie River

### Sunday, 14 October 2012



| NSW Industrial Noise Policy (Free Field) |         |          |                    |
|------------------------------------------|---------|----------|--------------------|
| Descriptor                               | Day     | Evening  | Night <sup>2</sup> |
|                                          | 7am-6pm | 6pm-10pm | 10pm-7am           |
| L <sub>90</sub>                          | 41.4    | 42.0     | 42.6               |
| Leq                                      | 46.3    | 45.9     | 44.8               |

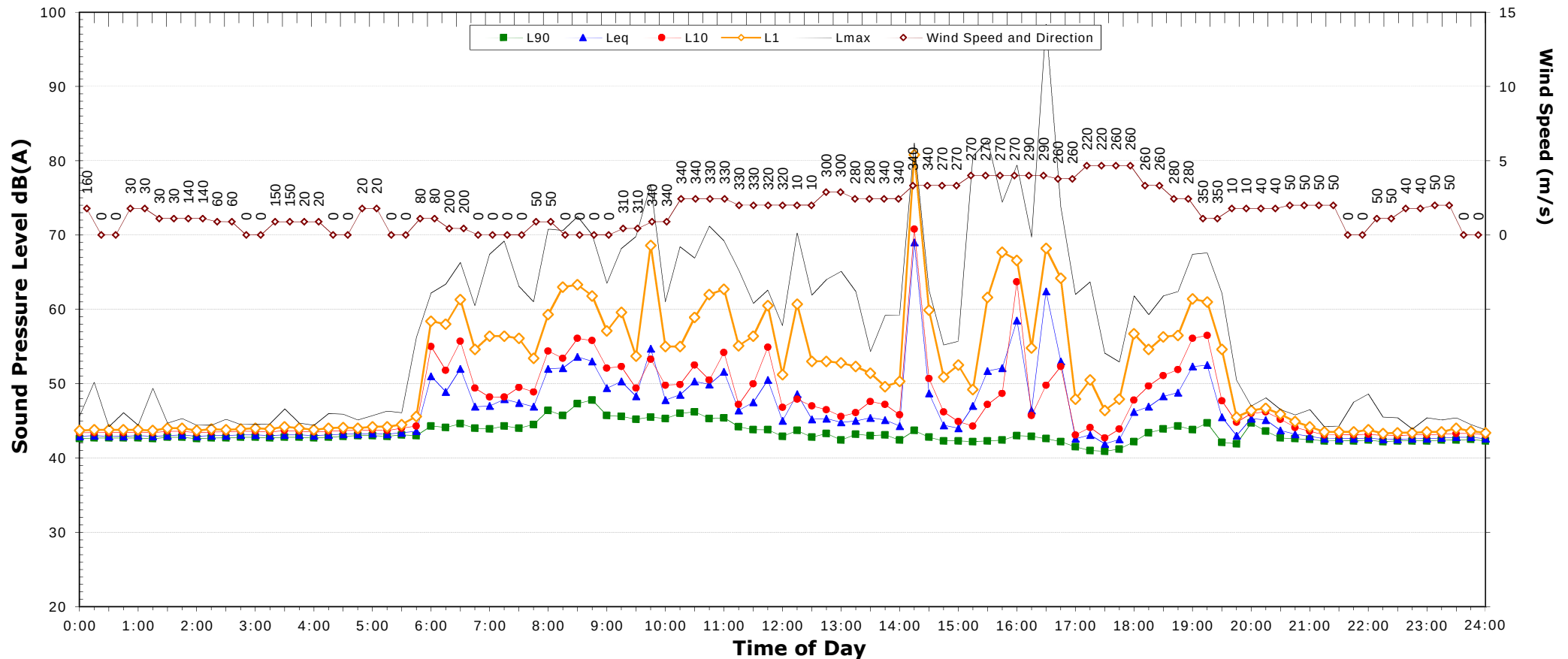
#### NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time L<sub>max</sub> values are shown only where L<sub>max</sub> > 65dB(A) and where L<sub>max</sub>-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Intake Station at Macquarie River

### Monday, 15 October 2012



| NSW Industrial Noise Policy (Free Field) |         |          |                    |
|------------------------------------------|---------|----------|--------------------|
| Descriptor                               | Day     | Evening  | Night <sup>2</sup> |
|                                          | 7am-6pm | 6pm-10pm | 10pm-7am           |
| L <sub>90</sub>                          | 42.2    | 42.1     | 42.3               |
| Leq                                      | 54.9    | 47.0     | 44.6               |

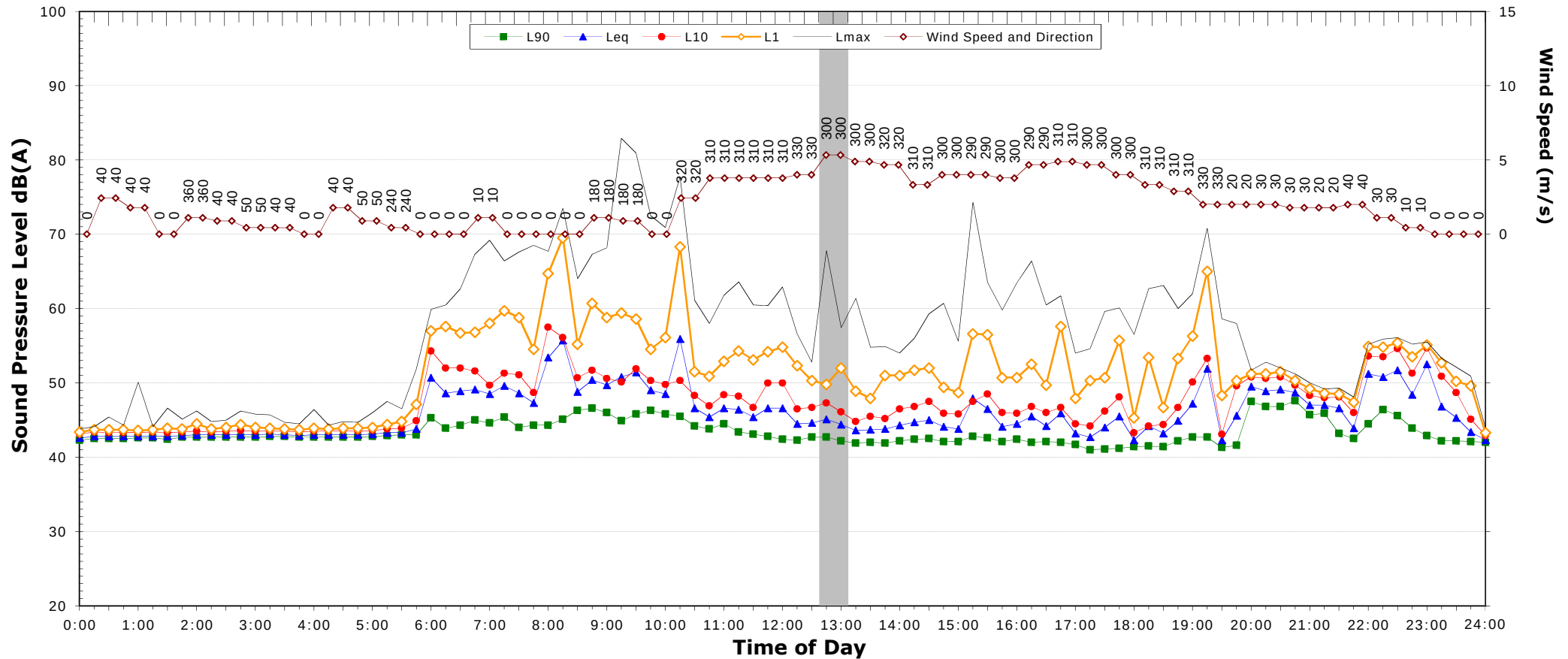
#### NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Intake Station at Macquarie River

### Tuesday, 16 October 2012



| NSW Industrial Noise Policy (Free Field) |         |          |                    |
|------------------------------------------|---------|----------|--------------------|
| Descriptor                               | Day     | Evening  | Night <sup>2</sup> |
|                                          | 7am-6pm | 6pm-10pm | 10pm-7am           |
| L <sub>90</sub>                          | 41.7    | 41.4     | 42.0               |
| Leq                                      | 48.3    | 47.8     | 46.2               |

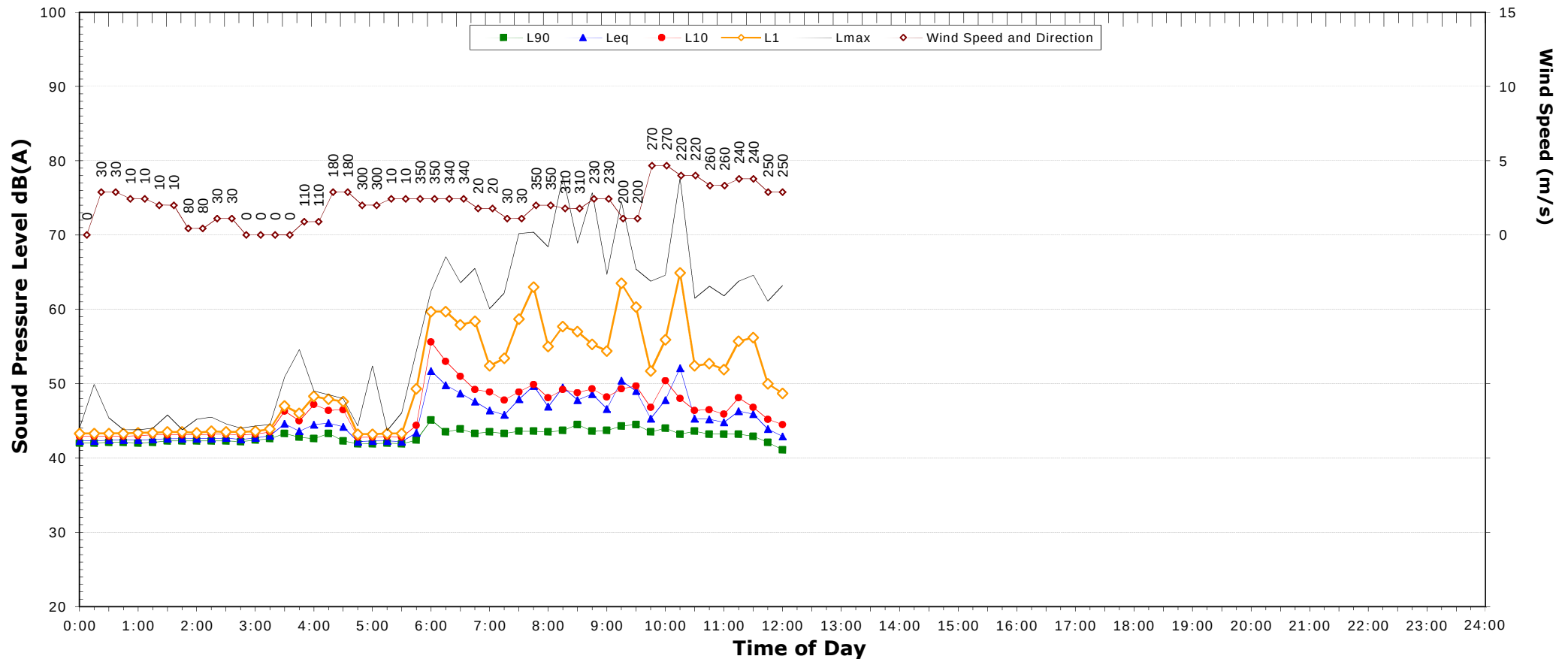
#### NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Intake Station at Macquarie River

Wednesday, 17 October 2012



| NSW Industrial Noise Policy (Free Field) |         |          |                    |
|------------------------------------------|---------|----------|--------------------|
| Descriptor                               | Day     | Evening  | Night <sup>2</sup> |
|                                          | 7am-6pm | 6pm-10pm | 10pm-7am           |
| L <sub>90</sub>                          | 42.5    | -        | -                  |
| Leq                                      | 47.7    | -        | -                  |

### NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

## Appendix G

# Cultural heritage assessment (Navin Officer heritage consultants)





# Cultural Heritage Assessment of Infrastructure Revisions

## Addendum to July 2012 Cultural Heritage Assessment Report Macquarie River to Orange Pipeline Project Proposed Project Refinements – MR5a

Navin Officer Heritage Consultants

21 January 2013

### Addendum Report

This addendum report provides a cultural heritage assessment of an anticipated development impact that was not detailed in the 2012 Culture Heritage Assessment of the Macquarie River to Orange Pipeline Project conducted by Navin Officer Heritage Consultants (NOHC) for GHD Pty Ltd (NOHC 2012). This document acts as an addendum to the July 2012 assessment. For more detailed information regarding previous assessments, the reader is referred to the above report, and other previous reports listed in the References.

### Infrastructure Revision

The location of the new area subject to impact (MR5a) is shown in Figures 1 and 2, and described below. It comprises an alternate northern route for the Orange Water Pipeline.

#### Offtake Structure and Pump Station

The location of the offtake structure is shown in Figure 1. The offtake structure (which includes a pump station) would be located on the southern bank at Cobbs Hut Hole.

Access to the site is via an unsealed road. The site is surrounded by the river and sparsely wooded banks. Areas in the vicinity of the site are used informally for recreation purposes. There are no structures or residences in the vicinity of the site. Other than landowners there is no real public access to the site except by river craft.

The nearest residence to the offtake structure is 'Fleming's shed' which is a shearing shed located approximately 1.32 km to the south-east. This property has an informal residential component.

#### Pipeline

The pipeline would commence at the offtake point on the bank of the southern bank of the Macquarie River. It would be located within the formation of an existing farm track for a distance of approximately 1,200 metres. This farm track has undergone previous vegetation clearing.

At chainage 1200, the pipeline would leave the farm track and traverse cleared paddocks to chainage 1800. The pipeline would be located within road reserves to chainage 6480 near Long Point Road. From chainage 6480 to the discharge structure, the route is as per the exhibited project.

This section of pipeline is approximately 6.5 km in length.

#### Access Road

The proposed access road would be located between Long Point Road and Cobs Hut Hole at the Macquarie River. The access road would be approximately 6 m wide and 1421.40m long.



## **Power Supply**

Construction of new overhead power supply would be required from approximately chainage 1200 to approximate chainage 4328.274 a further section of underground power would be installed from chainage 00 to 1200. The overhead power line would be installed through open paddocks and broadly parallel Long Point Road avoiding large trees where possible. The underground power has been proposed to minimise the extent of clearing required and will be common trenched with the pipeline.

## **Assessment**

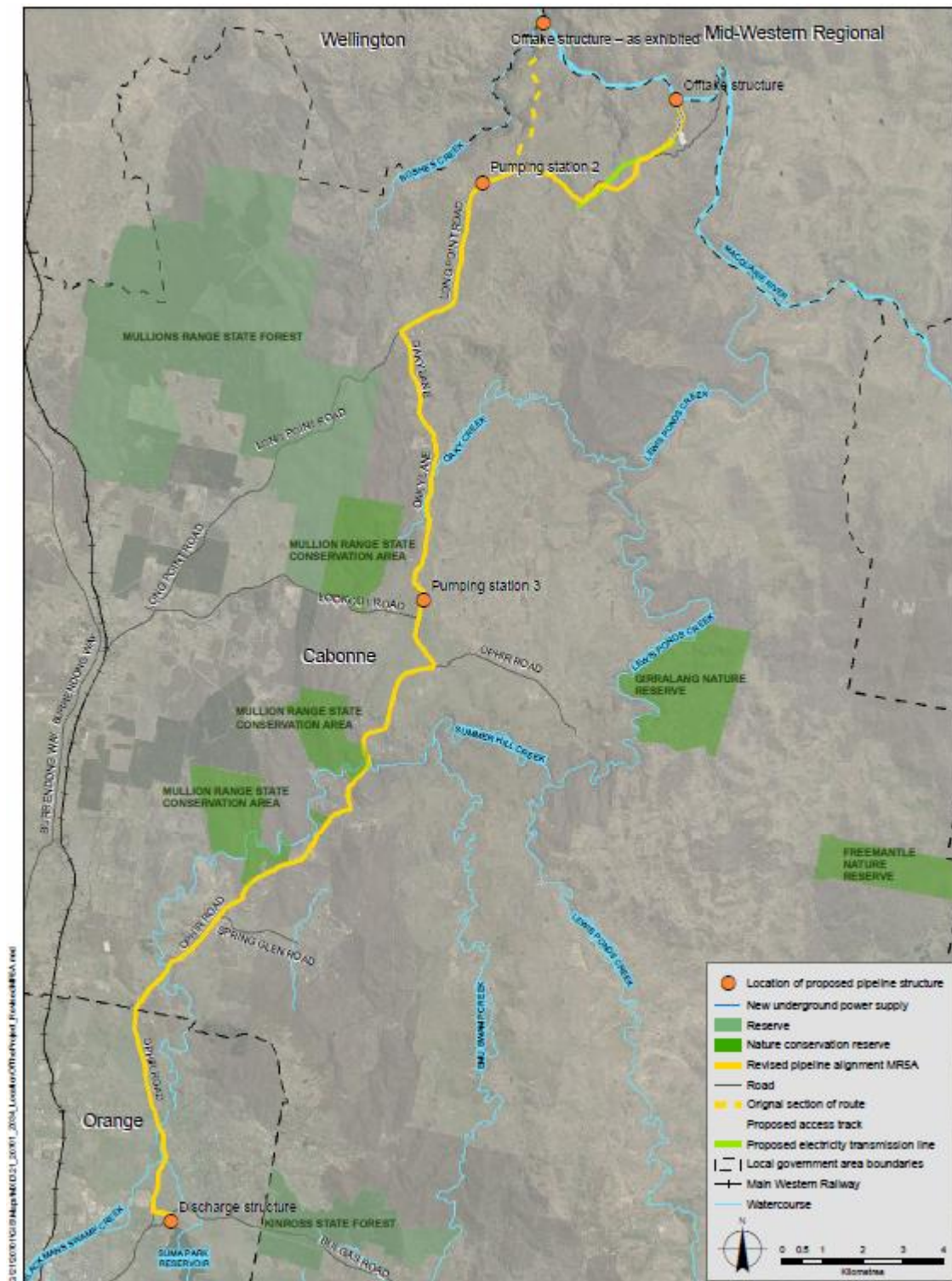
A majority of the study area has been subject to previous archaeological survey and cultural heritage assessment. The archaeological survey area for the original 2012 NOHC assessment of the Orange Water Pipeline project included pumping stations, water pipeline and associated infrastructure to transfer water from the Macquarie River to Suma Park Dam.

Following the original 2012 study an alternate northern route, MR5a, from Long Point Road to Hobbs Hut Hole (Figure 2) required assessment. This route would replace the originally assessed route from Long Point Road to Boshes Creek and the Boshes offtake with a new pipeline route and offtake location.

A survey of route MR5a was done over the course of one day in October 2012 by archaeologists Adrian Cressey and Stuart Hawkins.

This report describes the results of the survey of the alternate route MR5a and includes an assessment of:

- the impacts of the new options in accordance with the Original DGRs;
- the impacts of the current option vs. the proposed MR5a option (difference between both); and
- the quantum of impacts (over all impacts of the project existing route to long point road than the MR5a section).



*Addendum to July 2012 Cultural Heritage Assessment Report  
Macquarie River to Orange Pipeline Project  
Navin Officer Heritage Consultants January 2013*

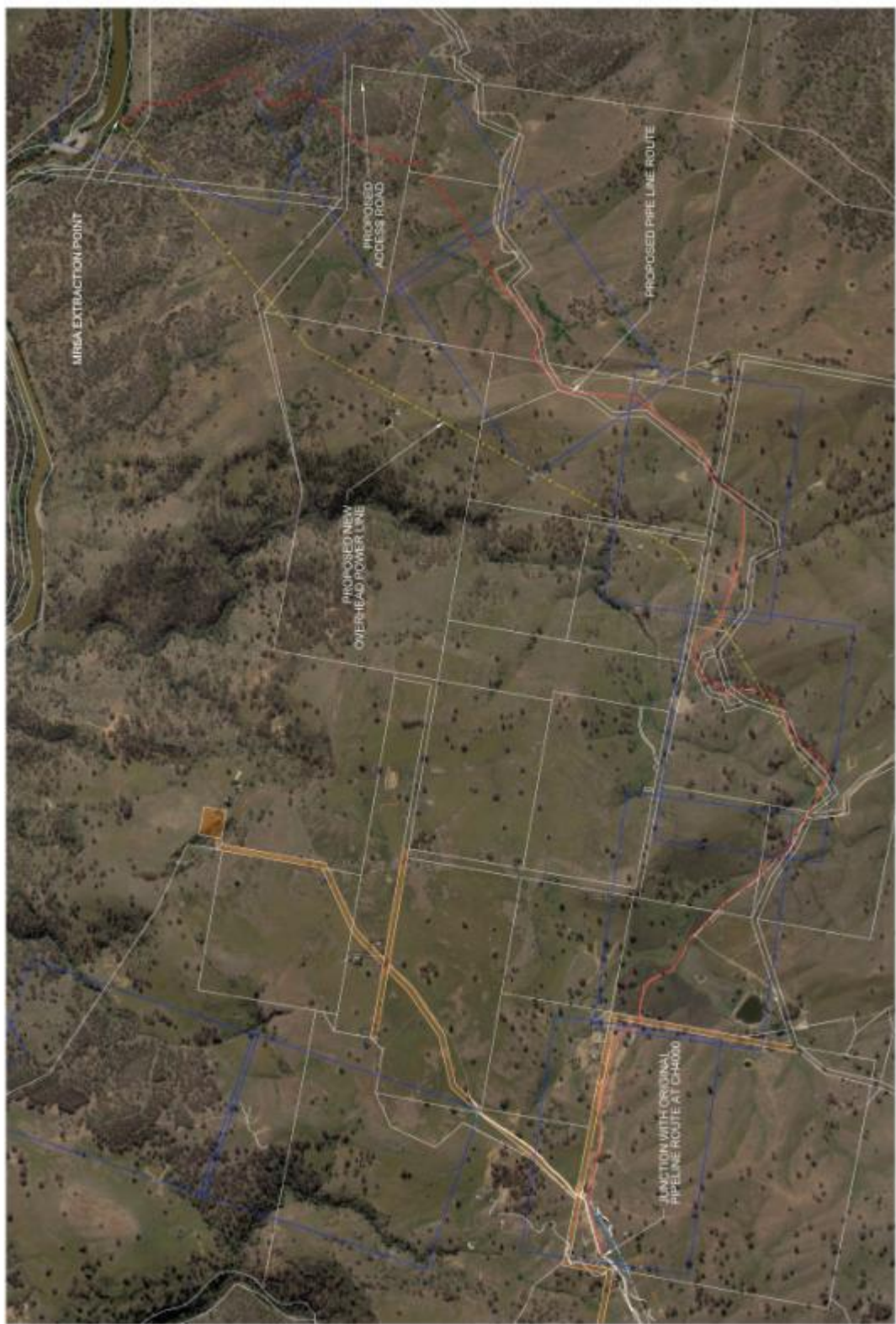


**Figure 2** Location of the proposed alternate route for the Orange Water Pipeline (red line)



## Aboriginal Consultation

Members of the Orange Local Aboriginal Land Council and Group Five [Requested to remain anonymous] were invited to attend the field survey.

As a result, a representative from Group Five attended and participated in the field survey.

A draft copy of this report, accompanied by an invitation to provide comments, was provided via post to each of the registered stakeholders and the OLALC on 19<sup>th</sup> December 2012. The letter accompanying the Aboriginal Cultural Heritage Assessment addendum draft report for the Orange Water Pipeline project requested that any comments be provided by 16<sup>th</sup> January 2013.

One submission was received in relation to this Addendum report from Group Five. Table 1 provides a summary of this submission.

**Table 1** Summary of Stakeholder Submissions

| Organisation                                      | Submission                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Group Five<br><br>[Requested to remain anonymous] | <ul style="list-style-type: none"><li>a. Agrees with the findings of the archaeological site significance assessments in regards to the artefacts and potential Aboriginal Heritage sites identified</li><li>b. Agrees that this alternate survey pipeline route MR5a has far less impact to Aboriginal Heritage sites and would be preferred if this project were to proceed.</li><li>c. Have concerns over the environmental and ecological affects and loss of habitat that removal of trees will have in this area.</li><li>d. Believes survey Area F has sensitive areas which may contain PAD's and it is our recommendation that these <i>not be used</i> for any type of storage/office/worker camps to assist in protecting them.</li><li>e. Request that MPA20 (PAD) have further archaeological investigations especially if the pipeline will impact on it.</li><li>f. Request that isolated finds MPA18 and MPA19 be recovered after an AHIP is obtained.</li><li>g. <i>Objects</i> to the Orange to Macquarie pipeline as it will be directly impacting on natural water flow and absorption which will in turn impact sub terrain water tables in the region. This will have flow on consequences.</li><li>h. Would support Orange City Council in their effort for Storm Water Harvesting <i>only</i>, which has proven to be successful and for which they have been awarded. Storm Water Harvesting within the Orange City Council area has sufficient water capturing capacity once expanded to secure enough water for the City in conjunction with enhancing Suma Park Dam Wall enabling greater water storage capacity and better management and use of Spring Creek Dams.</li></ul> |



## Discussion and Proponent Response – Cultural Heritage Assessment

The following is a discussion of the stakeholder responses, and the actions of the project proponent to address the issues raised above.

### Areas of Agreement

The above stakeholder (Group Five) response to this report, (a) endorses the archaeological site significance assessments in regards to the artefacts and potential Aboriginal Heritage sites identified in this Cultural Heritage Assessment Addendum report, and (b) supports the conclusion that pipeline route MR5a would result in less impacts to Aboriginal heritage sites, suggesting that if the project is to proceed MR5a would be the preferred route.

### Requested Revisions and Actions

Group Five submitted (c) concerns over the environmental and ecological affects and loss of habitat that removal of trees will have in this area.

Response:

*The loss of habitat through the 'clearing of native vegetation' has been identified in the environmental assessment as a process that could harm some species. Such processes have been reduced for MR5a, with the 'clearing of native vegetation' having been reduced by 2.6 hectares, by the change in the location of the section of project between Long Point Road and the offtake point. In addition, the extent of 'loss of hollow-bearing trees' has been reduced by 75%, with only 21 trees likely to be removed in the refined section, compared to 85 trees in the original section.*

Group Five submitted that (d) survey Area F has sensitive areas which may contain PAD's and it is our recommendation that these not be used for any type of storage/office/worker camps to assist in protecting them.

Response:

*Archaeological survey of the MR5a pipeline route was focussed on areas within the planned project footprint. In survey Area F, the pipeline route is planned to be within, or directly adjacent to the current alignment of Long Point Road. While there may be sensitive landforms within the general vicinity of survey Area F, the MR5a pipeline route is not planned in these location, and the route within survey Area F will only be situated in areas of negligible archaeological potential, most of which is already heavily disturbed through its current use as a transport corridor. Any future alterations to the footprint of the MR5a pipeline route and its related ancillary areas will be assessed for archaeological potential if and when the need arises, and any such developments would include the consultation with registered Aboriginal stakeholders.*

Group Five submitted that (e) MPA20 (PAD) have further archaeological investigations especially if the pipeline will impact on it.

Response:

*Navin Officer Heritage Consultants (NOHC) have provided the following recommendations regarding further archaeological investigations and/or mitigation relating to Aboriginal heritage sites within the MR5a pipeline project area:*

- 1. Impacts to sites MPA18, MPA19 and MPA20 should be avoided wherever possible.*
- 3. If sites will not be directly impacted but are in close proximity to construction then sites should be fenced prior to commencement of construction and their locations*



*should be clearly marked on all relevant maps and plans to avoid impacts to these sites. A buffer of 10 m should be applied for fencing of these sites.*

4. *A program of archaeological subsurface testing should be conducted within the affected sections of MPA20. Depending upon the results of that testing, it may be necessary to undertake salvage excavations.*

Group Five submitted that (f) isolated finds MPA18 and MPA19 be recovered after an AHIP is obtained.

Response:

*Navin Officer Heritage Consultants (NOHC) have provided the following recommendations regarding the mitigation of impacts to isolated finds MPA18 and MPA19:*

2. *If impact is unavoidable then salvage of artefacts should be conducted and a Care and Control permit should be prepared for all Aboriginal objects prior to any salvage works.*

### **Objections to, and Suggestions for, the Macquarie River to Orange Pipeline Project**

Group Five submitted that (g) objects to the Orange to Macquarie pipeline as it will be directly impacting on natural water flow and absorption which will in turn impact sub terrain water tables in the region. This will have flow on consequences:

Response:

*In terms of natural water flow and absorption assuming they are referring to river flows through part of the bed that comprise of gravel and may be connected to sub-terranean aquifers etc. It is considered that there has been sufficient consideration of minimum water levels so the gravel bars were not excessively exposed by draw off of water during extended dry periods.*

Group Five submitted that (g) they would support Orange City Council in their effort for Storm Water Harvesting only, which has proven to be successful and for which they have been awarded. Storm Water Harvesting within the Orange City Council area has sufficient water capturing capacity once expanded to secure enough water for the City in conjunction with enhancing Suma Park Dam Wall enabling greater water storage capacity and better management and use of Spring Creek Dams.

Response:

*Orange City Council's existing water supply system includes the currently approved stormwater harvesting scheme components. Approval of two additional stages of the Blackmans Swamp Creek stormwater harvesting scheme could increase the system secure yield by 1,100 ML/year. While significant, expansion of the stormwater harvesting scheme alone is not sufficient to provide water security over the 50 year strategic planning period. Further details relating to remaining issues that need to be resolved before stormwater harvesting can be considered to be a permanent part of the long term water solution are provided in Section 3.4.4 of PPR Volume 1.*



## Landscape Assessment

A majority of the study area is in an already formed vehicle track (Long Point Road) that has been subject to considerable ground surface disturbance. The revised proposal of the Orange Water Pipeline has been divided in eight areas for the survey (see Figure 8).

In Area A, the survey was along the existing access track. The majority of the track is on very steep mid-slopes and on some spur crests descending towards the river. Visibility on track is 70% and exposure is 80%. There is a lot of shale on the road and some natural outcropping. There is no stone suitable for knapping in this area.

In Area B, the survey was in cross country, with grasslands and intermittent trees. The proposed pipeline alignment traverses a number of moderate gradient spurlines, which increase in gradient closer to the river. Visibility was 40% and exposure was 25%. There was a lot of shale but no stone suitable for knapping in this area.

In Area C, the proposed pipeline follows the road alignment. Visibility was 80% on road and 50% on road verges, and exposure was 90% on road and 30% on road verges. The road traverses moderate to steep gradient mid-slopes. There were some introduced stones and gravels on and adjacent to the road. The disturbance on road and road verges was high, with low potential for artefacts. There were very few areas of flat or near level ground.

In Area D, the survey was on low gradient mid-slopes and basal slopes approaching a small drainage line. Visibility was 80% on road and 50% on road verges, and exposure was 90% on road and 30% on road verges. There was heavy disturbance on road and road verges, with a low potential for artefacts.

In Area E, the survey was on moderate gradient mid-slopes and spur crests. Visibility was 80% on road and 50% on road verges, and exposure was 90% on road and 30% on road verges. There was heavy disturbance on road and road verges, with a low potential for artefacts.

In Area F, the survey was on low to moderate gradient mid-slopes and basal slopes, leading to flats adjacent to the creek. Visibility was 80% on road and 30% on road verges, and exposure was 90% on road and 20% on road verges. There was heavy disturbance on road and road verges, with a low potential for artefacts. The proposed pipeline route doesn't cut through the more sensitive landforms in the area (e.g. the flats).

In Area G, one site has been recorded during the survey: MAP20 (PAD). The road verges were less disturbed in this area than in other areas of the survey. The most sensitive part of the area is downslope from the road. Visibility was 80% on road and 80% on road verges, and exposure was 90% on road and 40% on road verges. Disturbance in the area includes the road, stock and pasture.

In Area H, two sites have been recorded during the survey: MPA18 and MPA19. The survey was on mid-slopes, basal slopes and low to moderate gradient spurlines descending towards the creek flats. There was high disturbance on road and road verges, with a low potential for artefacts.



## Results

Two isolated finds and one PAD have been recorded during the survey of the alternate northern route for the Orange Water Pipeline.

### MPA18

GDA 708540.6343000

This site is an isolated find located on the edge of a road adjacent to two farm sheds (Figure 3). The site is located on the shoulder of a low to moderate gradient spur, descending east to an alluvial flat and a creek terrace.

Visibility on the track was 90% and exposure was 80%. There is low to moderate potential for additional artefacts and low potential for subsurface archaeological deposit, because of the disturbed nature of the site and the presence of the road and spur drains.

Artefact (Figure 4):

1. Grey/green sedimentary core (medium to fine grained) 62 x 45 x 31 mm.



**Figure 3** MPA18 location



**Figure 4** MPA18



## MPA19

GDA 708252.6343042

This site is an isolated find located on a saddle between a knoll and a spur line (Figure 5). The site has been found on the road, in a highly disturbed context.

Visibility on the track was 90% and exposure was 80%. There is low potential for additional artefacts and low potential for subsurface archaeological deposit.

Artefact (Figure 6):

1. Dark grey fine to medium grained core 66 x 48 x 18 mm



**Figure 5** MPA19 location



**Figure 6** MPA19



## MPA20 (PAD)

GDA 709022.6342659

This site is a PAD located on a low gradient flat adjacent to the creek. There were small exposures of quartz along the edge of the road which were not present in many other exposures of the survey (Figure 7).

Visibility on the track was 90% and exposure was 80%. There is moderate to high potential for additional artefacts, moderate potential for subsurface archaeological deposit and moderate potential for *in-situ* below 20 cm.



Figure 7 MPA20 (PAD)

## Conclusions

This report describes the results of a survey along the alternate northern route MR5a for the Orange Water Pipeline (Figure 8).

During the survey of the original northern route for the pipeline, six sites were recorded: two artefact scatters, two isolated finds and two historic sites.

It is assessed that the original proposed route for the Orange Water Pipeline has a moderate to high archaeological potential.

During the survey of the alternate northern route for the pipeline, three sites have been recorded: two isolated finds and one PAD.

It is assessed that the alternate northern route for the Orange Water Pipeline has a moderate to low archaeological potential.

As a conclusion, the number of the sites impacted on the alternate route for the pipeline would be less than on the original route, with a low potential for more archaeological sites.



## Quantum of Impacts

The overall impacts of the project on the existing route to Long Point Road are:

- MPA1 – water rising main corridor;
- MPA2 – water rising main corridor;
- MPA3 – water rising main corridor;
- MPA4 – water rising main corridor;
- MPA6 – water rising main corridor;
- MPA7 – water rising main corridor;
- MPA8 – water rising main corridor;
- MPA10 – water rising main corridor;
- MPA11 – water rising main corridor;
- MPA14 – water rising main corridor;
- MPA15 – water rising main corridor;
- Oakey Creek 1 – water rising main corridor;
- Oakey Creek 2 – water rising main corridor;
- PASA1 – water rising main corridor;
- PASA2 – water rising main corridor;
- PASA3 – water rising main corridor;
- PASA4 – water rising main corridor;
- PASA5 – water rising main corridor;
- MPH2 – water rising main corridor;
- MPH6 – water rising main corridor.

Inadvertent impacts may occur to:

- MPA5 – vegetation clearance and vehicle/plant movements;
- MPA9 – vehicle/plant movements; and
- MPH1 – vegetation clearance and vehicle/plant movements.

Impacts from the MR5a may occur to sites:

- MPA18 – water rising main corridor;
- MPA19 – water rising main corridor; and
- MPA20 – water rising main corridor.



## Recommendations

The alternate northern route for the Orange Water Pipeline is considered to have low archaeological potential.

Three previously un-recorded Aboriginal sites were located during the current field survey. The following recommendations are made following on-site consultation with the Aboriginal representatives:

1. Impacts to sites MPA18, MPA19 and MPA20 should be avoided wherever possible.
2. If impact is unavoidable then salvage of artefacts should be conducted and a Care and Control permit should be prepared for all Aboriginal objects prior to any salvage works.
3. If sites will not be directly impacted but are in close proximity to construction then sites should be fenced prior to commencement of construction and their locations should be clearly marked on all relevant maps and plans to avoid impacts to these sites. A buffer of 10 m should be applied for fencing of these sites.
4. A program of archaeological subsurface testing should be conducted within the affected sections of MPA20 depending upon the results of that testing, it may be necessary to undertake salvage excavations.
5. A final copy of this report should be forwarded to NSW OEH.

## References

Navin Officer Heritage Consultants (NOHC) 2012 Macquarie River to Orange Pipeline Project, Cultural Heritage Assessment. Report to GHD Pty Ltd.

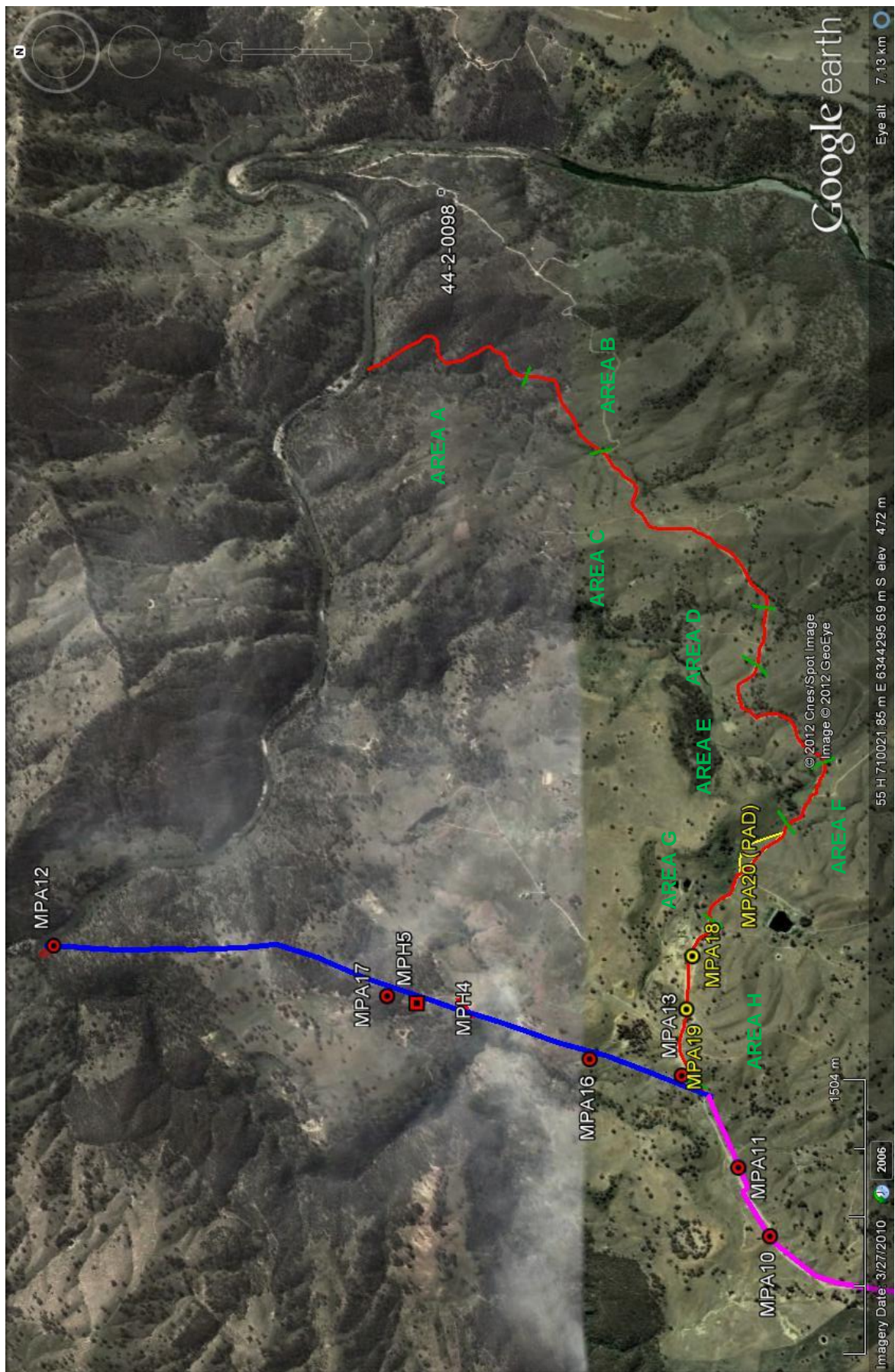


**Figure 8** Location sites (yellow) recorded along the alternate northern route MR5a (red) compared to original route (blue) for the Orange Water Pipeline. Survey areas marked in green.  
(Base map: Google Earth Pro 2012)



**Figure 9** Location of Aboriginal sites MPA 18 and MPA 19 (Yellow) relative to chainages along the alternate northern route MR5a.



**Figure 10** Location of MPA 20 (PAD) (Yellow outline) relative to chainages along the alternate northern route MR5a.