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# Vipac Engineers & Scientists

Planit Consulting Pty Ltd

# Kings Forest WWTP

# Noise Assessment

70Q-17-0005-TRP-541306-0

13 April 2017

| **Report Title: Noise Assessment**<br>**Job Title: Kings Forest WWTP** | |
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## EXECUTIVE SUMMARY

Vipac Engineers and Scientists Ltd (Vipac) was commissioned by Planit Consulting Pty Ltd to carry out a noise impact assessment of the proposed Waste Water Treatment Plant (WWTP) for the Kings Forest Development in the Tweed Shire.

The purpose of this assessment is to determine the potential noise impacts associated with the proposed WWTP, on Noise Sensitive Receptors (NSR's) located in the surrounding area. Noise impacts have been assessed in accordance with the NSW Industrial Noise Policy (INP) (Environment Protection Authority, 2000).

The likely noise impacts have been predicted (during both construction and operational phases) using the CONCAWE methodology in SoundPLAN. The resultant noise impacts have been assessed for the construction stage and operation stage of the WWTP.

During the construction phase two future NSR's (Future Residence and Future Neighbourhood Centre) are predicted to exceed the construction noise criteria. Where the Future NSR's are already constructed prior to the WWTP construction activities, a Construction Noise Management Plan would be required to consider managing noise levels at these NSR's to minimise potential for noise impacts.

Predicted noise levels for the operational phase of the WWTP are predicted to comply with the noise criteria at all NSR's.

## TABLE OF CONTENTS

# 1 INTRODUCTION

Vipac Engineers and Scientists Ltd (Vipac) was commissioned by Planit Consulting Pty Ltd to carry out a noise impact assessment of the proposed Waste Water Treatment Plant (WWTP) for the Kings Forest Development in the Tweed Shire, Northern New South Wales.

The purpose of this assessment is to determine the potential noise impacts associated with the proposed WWTP, on Noise Sensitive Receptors (NSR's) located in the surrounding area. Noise impacts have been assessed in accordance with the NSW Industrial Noise Policy (INP) (Environment Protection Authority, 2000).

Noise impacts have been assessed for the construction stage and operation stage of the WWTP.

# 2 PROJECT DESCRIPTION

## 2.1 SITE LOCATION AND DESCRIPTION OF THE WWTP

The proposed WWTP is to be located approximately 700m to the west of Tweed Coast Road, at the end of what is currently Depot Road/Pine Ridge Road, Kings Forest (Lot Section 1//781633), in the vicinity of the proposed Kings Forest Development.

The existing land use in the vicinity of the proposed WWTP is predominantly agricultural with some forested areas. There are existing scattered residential and farm buildings.

The location of the proposed WWTP is illustrated in Figure 2-1.


*Figure 2-1: Proposed WWTP Location [Google Earth, 2016]*

The proposed WWTP will incorporate 3 stages of Membrane Bio Reactor with UV disinfection, a 2ML Permeate Storage Tank for Class A treated effluent to provide feed water to an advanced water treatment plant (AWTP). The 2ML Storage Tank is for storage of excess permeates during wet weather events.

The AWTP incorporates an Ultra Filtration Membrane system, UV disinfection and Chlorine contact tank with transfer pumps to transfer the Class A+ treated effluent to the storage reservoirs. There are also three 2ML tanks for Drinking Water to provide for four days of storage.

The proposed configuration of the WWTP is shown in Figure 2-2.

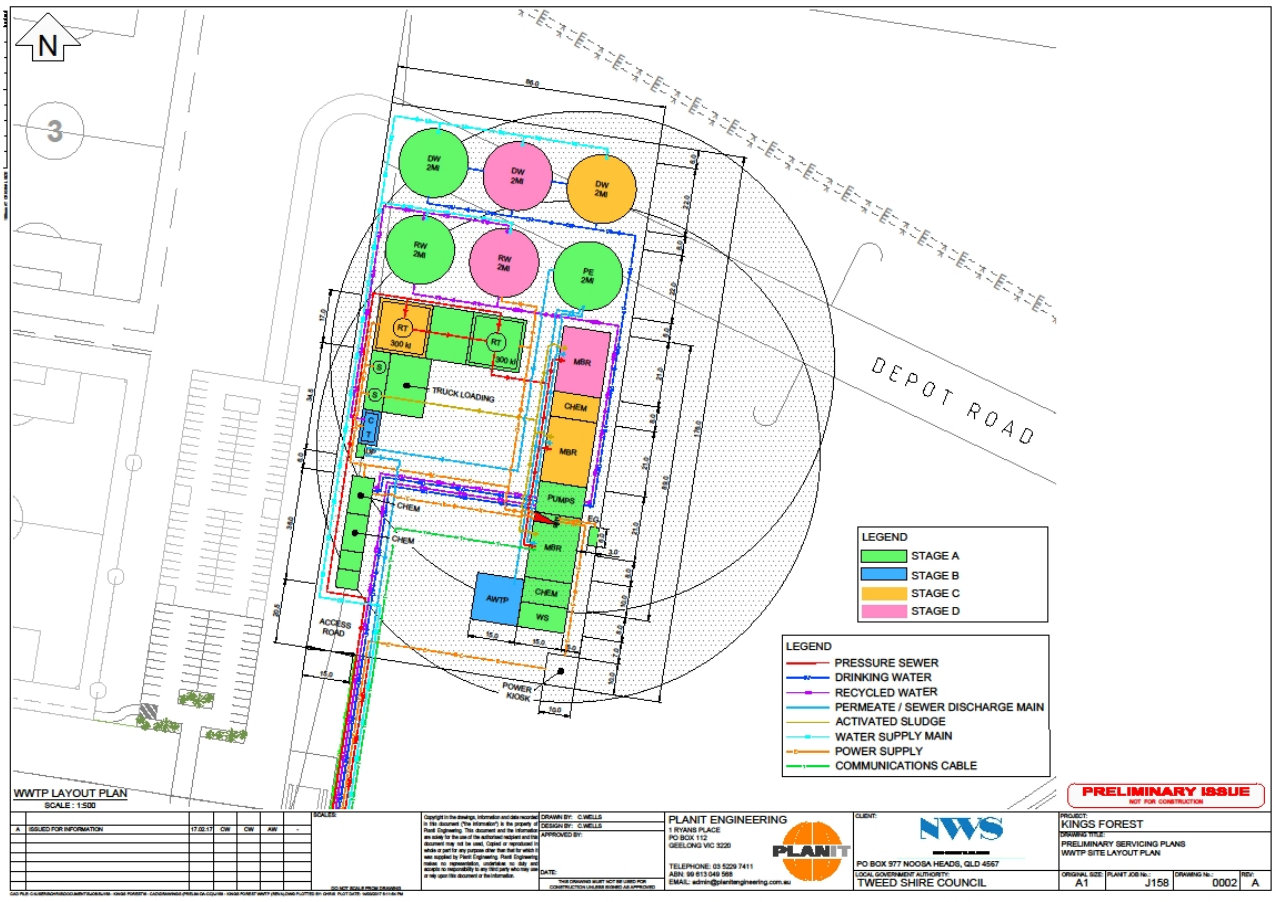



*Figure 2-2: Proposed WWTP Configuration*

## 2.2 NOISE SENSITIVE RECEPTORS

The nearest existing NSR's were identified from a review of aerial imagery and during a site visit undertaken by Vipac staff on 8/03/17. Existing NSR's surrounding the WWTP site consist of residential dwellings and farming properties. A total of 19 NSR's in the area that are within approximately 1km from the site boundaries were considered for the purposes of this assessment.

Future NSR's consist of residential dwelling and a neighbourhood centre that are part of a proposed Kings Forest development (from the development plan), located to the south of the WWTP site. Sports fields are proposed to be located immediately west of the WWTP site. Sports fields have not been considered as noise-sensitive land use, however, potential noise levels have been discussed for the sports field in relation to potential impacts to amenity.

NSR's are shown in Figure 2-2 in relation to the WWTP site. A list of the nearest potentially affected NSR's to the proposed WWTP site is provided in Appendix A. Note that for future receptors, the locations shown in

Figure 2-2 and Appendix A represent a conservative worst case scenario of receptors located closest to the WWTP.

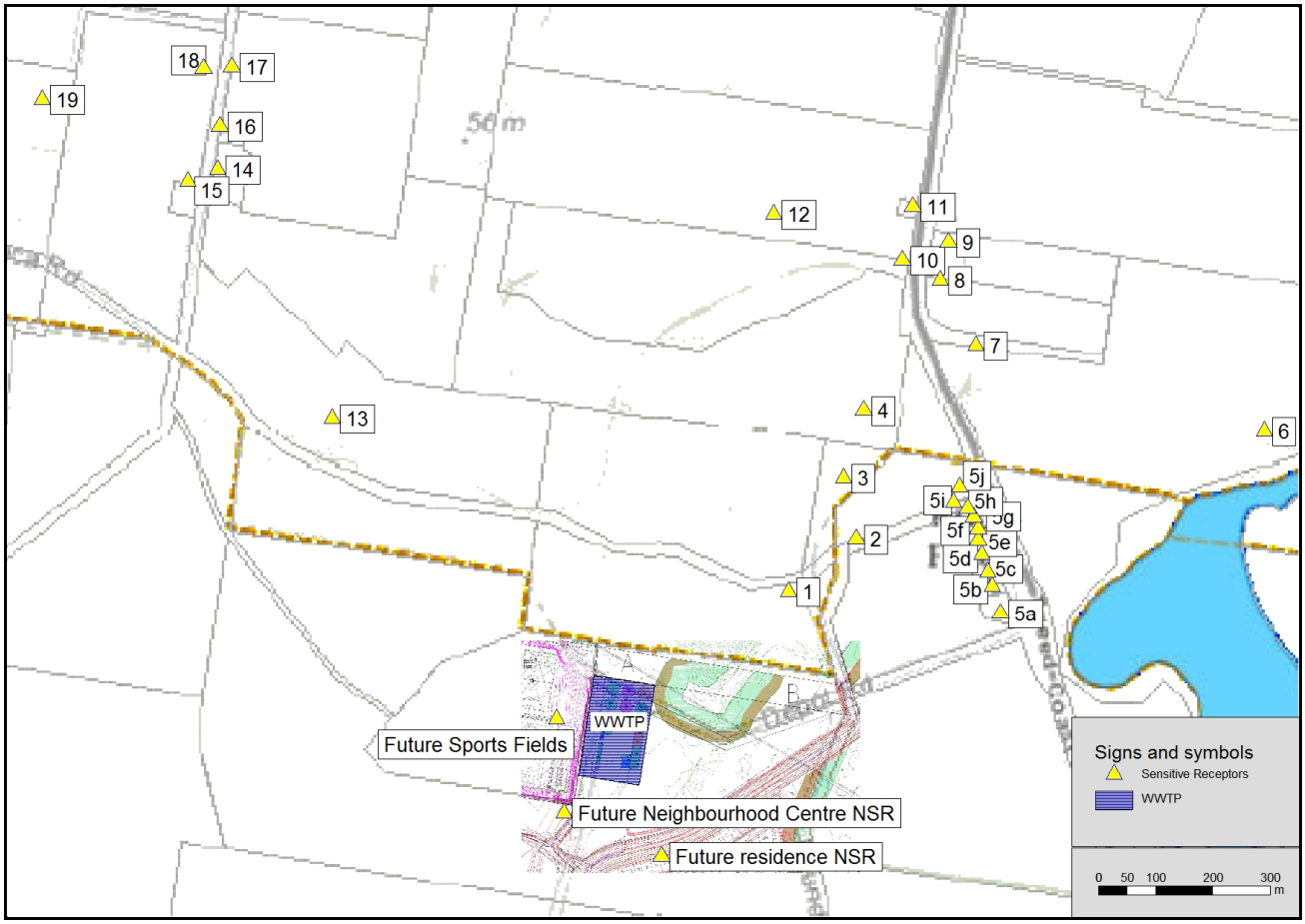



*Figure 2-3: Sensitive Receptor Locations and the WWTP Boundary*

Note that NSR's 1 to 12 and future NSR's are located closer to Tweed-Coast Road, while NSR's 13 to 19 are located further away. Noise monitoring was conducted at NSR's 1 and 14 to provided representative noise levels of the two areas. Noise monitoring results are discussed in Section 5.

# 3 REGULATORY FRAMEWORK AND NOISE CRITERIA

The regulatory framework and project noise criteria have been discussed below for the construction stage and operation stage of the WWTP.

## 3.1 CONSTRUCTION STAGE

The *NSW Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009) and contains detailed procedures for the assessment and management of construction noise impacts.

The Guideline presents two ways of assessing construction noise impacts:

- Quantitative method, which is generally suited to longer-term construction works; and
- Qualitative method, which is generally suited to short-term works (usually not more than three weeks) such as infrastructure maintenance.

It is expected that the length of the construction works associated with the proposed WWTP would be more than three weeks and therefore, a quantitative method has been used for this assessment.

Table 3-1 sets out the management levels for noise at residences and sensitive land uses, respectively. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level. Noise management levels associated with the construction phase are presented in

Table 3-2, based on noise measurements taken at NSR's.

*Table 3-1: Noise at Residence using Quantitative Assessment*

| Time of Day | Management Level $L_{Aeq(15min)}$ [1] |
|---|---|
| Monday to Friday - 7 am to 6pm<br>Saturday - 8am to 1 pm<br>No Work on Sundays or Public Holidays | Noise affected = RBL [2] + 10 dB |
| | Highly noise affected [3] = 75 dB |
| Outside recommended standard hours | Noise affected = RBL [2] + 5 dB |

*Table 3-2: Project Specific Construction Noise Levels at NSR's*

| Location | Period | RBL* dB(A) | Noise Management Levels |
|---|---|---|---|
| NSR 1<br>(at Secret Lane) | Day | 35 | 45 |
| | Evening | 37 | 42 |
| | Night | 34 | 41 |
| NSR 14<br>(at Reardons Road) | Day | 32 | 43 |
| | Evening | 37 | 42 |
| | Night | 33 | 41 |

* Note: Assessment background noise levels for 9, 10, and 11 April were used to calculate RBL levels. Background noise levels for 6, 7, 8 April were not included in the RBL calculation as background noise levels were higher with higher wind speeds. Although the background noise levels for 6, 7, 8 April are representative of the periods where wind speeds are higher, these noise levels have not been included to provide conservative noise criteria and assessment.

1 Noise levels apply at the boundary that is most exposed to construction noise and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise-affected residence.

2 RBL is the Rating Background Level as defined in the EPA Industrial Noise Policy.

3 $L_{Aeq\ 15\text{-}minute} \geq 75$ dB is highly likely to generate strong community reactions and should be avoided.

The Noise Management Levels for NSR 1 has been applied to NSR's 1 to 12 and Future NSR's, while Noise Management Levels for NSR 14 has been applied to NSR's 13 to 19.

For the operational noise assessment, evening noise criteria have not been used as night time criteria are more stringent and compliance with the night criteria will also result in compliance with the evening criteria.

As outlined above, the recommended standard hours for construction works are limited to day time hours (Monday to Friday 7am to 6pm, Saturday 8am to 1pm, with no work on Sundays or Public Holidays). Therefore the day time Noise Management Levels presented in

Table 3-2 would be applicable to assess the Construction Noise Management Levels associated with "recommended standard hours".

Where works are required to take place out of hours, Noise Management Levels should be calculated for the relevant time periods when works are proposed.

### 3.2 OPERATIONAL STAGE

The Industrial Noise Policy (NSW Environmental Protection Authority, 2000) sets limits on the noise that may be generated by the proposed WWTP during the operational stage. These limits are dependent upon the existing noise levels at the site and are designed to ensure changes to the existing noise environment are minimised and deal with the intrusiveness of the noise and the amenity of the environment. The most stringent of the limits is taken as the limiting criterion for the noise source.

The intrusiveness noise criterion requires that the $L_{Aeq,15minutes}$ for the noise source, measured at the most sensitive receiver under worst-case conditions, should not exceed the Rated Background Level (RBL) by more than 5 dB, represented as $L_{Aeq,15minutes}$ < RBL+ 5 dB.

Noise levels at nearby NSR's associated with proposed WWTP should not exceed the Project Specific Noise Levels detailed in Table 3-3.

*Table 3-3: Project Specific Operational Noise Levels at NSR's*

| Location | Period | dB(A) | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Existing $L_{Aeq}$** | **Existing RBL** | **Recommended Acceptable $L_{Aeq}$ [1]** | **Amenity Criteria Level** | **Intrusive-ness Criteria Level** | **Project Specific Noise Level** |
| NSR 1 (at Secret Lane) | Day | 49 | 35 | 50 | 44 | 40 | **40** |
| | Evening | 54 | 37 | 45 | 45 | 42 | **42** |
| | Night | 44 | 34 | 40 | 40 | 39 | **39** |
| NSR 14 (at Reardons Road) | Day | 47 | 32 | 50 | 47 | 37 | **37** |
| | Evening | 56 | 37 | 45 | 45 | 42 | **42** |
| | Night | 40 | 33 | 40 | 40 | 38 | **38** |

The Project Specific Noise Levels for NSR 1 has been applied to NSR's 1 to 12 and Future NSR's, while Project Specific Noise Levels for NSR 14 has been applied to NSR's 13 to 19.

For the operational noise assessment, evening noise criteria have not been used as night time criteria are more stringent and compliance with the night criteria will also result in compliance with the evening criteria. NSR Neighbourhood Centre would not be occupied during the night time and night time criteria would not be applicable for this NSR.

[1] Recommended Acceptable $L_{Aeq}$ noise level for residences in rural area from Table 2.1 in OEH Industrial Noise Policy.

# 4 METHODOLOGY

This section outlines the methodologies for the fieldwork, noise monitoring data analysis and noise prediction used for this assessment.

## 4.1 FIELDWORK METHODOLOGY

The fieldwork has been carried out in compliance with the following standards and guidance documents:

- *Australian Standard AS 1055-1997 Acoustics — Description and Measurement of Environmental Noise. Parts 1-3. Standards Australia; NSW.*
- Environmental Protection Authority (EPA) Office of Environmental and Heritage (OEH) NSW *Industrial Noise Policy* (INP); Sydney.

## 4.2 NOISE PREDICTION METHODOLOGY

### 4.2.1 NOISE MODEL

Noise level predictions have been assessed using the SoundPLAN noise modelling software using the CONCAWE (Manning, 1981) noise prediction methodology. The CONCAWE method was originally developed for predicting the long-distance propagation of noise from petrochemical complexes in the United Kingdom. It is especially suited to predicting noise propagation over large distances as it accounts for a range of atmospheric conditions that can significantly influence the propagation of noise over large distances.

The prediction of noise in the environment requires the definition of the noise sources and NSR's. A number of environmental parameters affect noise propagation, including geometric spreading, obstacles such as enclosures, barriers, and buildings, meteorological conditions and ground effects.

The SoundPLAN software and calculation methodology allows the environmental parameters identified above to be modelled.

### 4.2.2 METEOROLOGICAL CONDITIONS

Two modelling scenarios were run for the WWTP under neutral weather conditions for the day and worst case weather conditions during evening/night periods. It should be noted that noise will propagate further through the atmosphere under certain weather conditions. Adverse weather conditions chosen were those highly conducive to the propagation of sound (includes the consideration of the effects of a temperature inversion). As operations occur during 24 hours 7-days a week, this situation has been considered in the noise predictions. Table 4-1 presents the weather parameters used in the CONCAWE calculations based on annual data from the Bureau of Meteorology (BoM) Weather Station at nearby Coolangatta Airport.

*Table 4-1: Weather Conditions for Modelling Scenarios*

| Parameter | Day | Night Time |
|---|---|---|
| | Neutral | Adverse |
| Pasquill Stability Category | D | F |
| Wind Speed (m/s) | 4 | 3 |
| Wind Direction | Source to Receptor | |
| Humidity (%) | 66 | 66 |
| Temperature (˚C) | 24 | 16 |

### 4.2.3 MODELLING SCENARIOS

The following worst-case scenario has been modelled:

- Construction phase: All equipment running simultaneously during normal construction hours as detailed in Table 3-1. Four truck movements which are expected per day; and
- Operational phase: All equipment running simultaneously 24 hours per day, seven days per week except for truck movements which are expected to be four movements during the day period only.

### 4.2.4 SOUND POWER LEVELS

The significant construction noise sources used for this assessment are identified in Table 4-2 and Table 4-3. The following sources have been referred to in establishing associated sound power levels (SWL) of the noise sources:

- Vipac's database, which includes noise measurements of plant measured at existing mine sites; and
- Australian Standard AS 2436 (2010) '*Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Site'* which includes the database of construction and open sites as provided in British Standard BS 5228:1 (2009) '*Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise'*.

The sound power levels detailed in Table 4-2 have been adjusted for estimated percentage of time per 15 minute period as not all of the equipment will be operating at 100% at the same time.

*Table 4-2: Modelled Sound Power Levels (SWL) for Construction Stage*

| Equipment Description | No of unit | SWL / Unit dB(A) | Percentage of Time per 15 minutes |
|---|---|---|---|
| Backhoe | 1 | 104 | 50% |
| Trucks | 4/day | 112 | 4/day |
| Angle Grinder | 1 | 108 | 5% |
| Vibration Roller | 1 | 119 | 5% |
| Vibration Roller (Smooth) | 1 | 108 | 10% |
| Dump Truck | 1 | 115 | 25% |
| Concrete Pumping | 1 | 109 | 105 |
| Mobile Crane | 1 | 101 | 5% |
| Tracked Excavator | 1 | 105 | 50% |
| Dozer D6 | 1 | 112 | 50% |
| Water Cart | 1 | 111 | 10% |

NWS provided details and locations for the pumps associated with the WWTP. Whilst no noise levels were provided, the noise levels were calculated from the kilowatt data from NWS and RPM data from the manufacturers.

An equation to calculate the sound pressure levels of pumps at 1m based on kilowatt data and RPM is presented in *Engineering Noise Control* (Bies & Hansen, 2009). The sound power levels are presented in Table 4-3.

*Table 4-3: Modelled Sound Power Levels (SWL) for Operational Stage*

| Location | Tag No | Equipment Description | No of units | kW | RPM | SWL / Unit dB(A) |
|---|---|---|---|---|---|---|
| Pump Room | PMP-4004 | Drinking Water Pump Station Jockey Pump | 1 | 2.2 | 2853 | 89 |
| | PMP-4003 | Drinking Water Pump Station Duty Pump | 3 | 5.5 | 2917 | 98 |
| | PMP-5002/3 | Irrigation Transfer Duty Pump | 2 | 37 | 2957 | 104 |
| AWTP | UF-001&2 | UF Filtration Pump | 2 | 31 | 400 | 96 |
| Recycled Water Pump Room | PMP-3004 | Recycled Water Jockey Pump | 1 | 2.2 | 2853 | 89 |
| | PMP-3003/2/1 | Recycled Water Duty Pump | 3 | 5.5 | 2917 | 98 |
| Chemical Dosing Area | PMP-3316 | Chemical Dosing Water Pump | 1 | 3 | 2902 | 90 |
| | PMP-3311 | Chlorine Dosing Recycled Water Pump | 1 | 0.024 | 3000 | 69 |
| | PMP-3314 | Chlorine Dosing MBR Pump | 1 | 0.37 | 3000 | 81 |
| Redundancy Tanks | TRP-1001 & 1002 | Redundancy Tank Transfer Pump | 2 | 2.4 | 3000 | 92 |
| | JM-001 -004 | Redundancy Tank Jet Mixers | 4 | 5.5 | 3000 | 99 |
| MBR | PMP-3211 | Caustic Dosing Pump | 1 | 0.024 | 3000 | 69 |
| | PMP-3215 | Caustic Dosing Pump | 1 | 0.37 | 3000 | 81 |
| | PMP-3111 | PACL Dosing Pump | 1 | 0.024 | 3000 | 69 |
| | PMP-3011 | Acetic Acid Dosing Pump | 1 | 0.024 | 3000 | 69 |
| | PMP-2009 | Permeate Pump | 2 | 1.5 | 3000 | 90 |
| | PMP-2010 | MBR/CIP Pump | 3 | 0.18 | 3000 | 83 |
| | SCR-2000 | Screen | 1 | 1.1 | 3000 | 86 |
| Trucks | - | Off-site waste disposal | 4/day | - | - | 112 |

The majority of the pumps are to be located within a building. The sound transmission loss of the building has been determined based on typical single panel Colorbond construction of 0.42 mm thickness steel, and this has been applied in the noise model.

# 5 EXISTING ENVIRONMENT

The existing noise environment has been determined through continuous ambient noise monitoring from 6th April 2017 to 12th April 2017 at two locations (NSR's 1 and 14) in the vicinity of the Project site. The noise monitoring locations are shown in Figure 5-1. Attended noise measurements at the sites were also performed.


*Figure 5-1: Noise Monitoring Locations [Google Earth, 2016]*

The weather observations during the monitoring period were obtained from the Bureau of Meteorology for the Coolangatta Airport (station number 040717), and supplemented by local rainfall observations. A wind shear correction was applied to the wind speed data to account for the difference in the weather station anemometer height and noise monitoring microphone height.

The noise monitoring details, measurement data and weather observations during the monitoring period are presented in Appendix B. The criterion determined from the noise measurements is detailed in

Table 3-2 and Table 3-3.

# 6 RESULTS

## 6.1 CONSTRUCTION PHASE

Noise prediction modelling has been carried out to assess the potential impact associated with the construction of the proposed WWTP on the noise environment at the nearest NSR's located in proximity to the site. The predicted noise levels representative of the construction phase during the day are presented in Table 6-1.

*Table 6-1: Construction Phase Predicted Noise Impact*

| Receptor | Day time | | |
|---|---|---|---|
| | Noise Level dB(A) | Criteria dB(A) | Compliant |
| 1 | 44 | 45 | Yes |
| 2 | 45 | 45 | Yes |
| 3 | 43 | 45 | Yes |
| 4 | 41 | 45 | Yes |
| 5a | 42 | 45 | Yes |
| 5b | 43 | 45 | Yes |
| 5c | 42 | 45 | Yes |
| 5d | 42 | 45 | Yes |
| 5e | 42 | 45 | Yes |
| 5f | 42 | 45 | Yes |
| 5g | 42 | 45 | Yes |
| 5h | 42 | 45 | Yes |
| 5i | 42 | 45 | Yes |
| 5j | 42 | 45 | Yes |
| 6 | 35 | 45 | Yes |
| 7 | 39 | 45 | Yes |
| 8 | 39 | 45 | Yes |
| 9 | 38 | 45 | Yes |
| 10 | 38 | 45 | Yes |
| 11 | 38 | 45 | Yes |
| 12 | 38 | 45 | Yes |
| 13 | 42 | 43 | Yes |
| 14 | 35 | 43 | Yes |
| 15 | 35 | 43 | Yes |
| 16 | 35 | 43 | Yes |
| 17 | 34 | 43 | Yes |
| 18 | 34 | 43 | Yes |
| 19 | 33 | 43 | Yes |
| Future Neighbourhood Centre | 57 | 45 | No |
| Future Residence NSR | 54 | 45 | No |

It can be seen from Table 6-1 that noise levels from construction activities are predicted to comply with the relevant criteria with the exception of Future NSR's where noise levels may exceed by up to 12 dB(A). Where the Future NSR's are already constructed prior to the WWTP construction activities, a Construction Noise Management Plan would be required to consider managing noise levels at these NSR's to minimise potential for noise impacts.

Noise levels at the sports field are predicted to be 61 dB(A) which is not expected to impact its use for sporting purposes.

## 6.2 OPERATIONAL PHASE

The predicted noise levels representative of the completed operational phase during the day and night time for worst case meteorological conditions are presented in Table 6-2.

*Table 6-2: Operational Phase Predicted Noise Impact*

| Receptor | Day time | | | Night time | | |
|---|---|---|---|---|---|---|
| | Noise Level dB(A) | Criteria | Compliant | Noise Level dB(A) | Criteria | Compliant |
| 1 | 24 | 40 | Yes | 25 | 39 | Yes |
| 2 | 23 | 40 | Yes | 23 | 39 | Yes |
| 3 | 21 | 40 | Yes | 21 | 39 | Yes |
| 4 | 19 | 40 | Yes | 20 | 39 | Yes |
| 5a | 20 | 40 | Yes | 20 | 39 | Yes |
| 5b | 20 | 40 | Yes | 20 | 39 | Yes |
| 5c | 20 | 40 | Yes | 20 | 39 | Yes |
| 5d | 20 | 40 | Yes | 20 | 39 | Yes |
| 5e | 20 | 40 | Yes | 20 | 39 | Yes |
| 5f | 19 | 40 | Yes | 20 | 39 | Yes |
| 5g | 19 | 40 | Yes | 20 | 39 | Yes |
| 5h | 19 | 40 | Yes | 20 | 39 | Yes |
| 5i | 20 | 40 | Yes | 20 | 39 | Yes |
| 5j | 19 | 40 | Yes | 19 | 39 | Yes |
| 6 | 13 | 40 | Yes | 13 | 39 | Yes |
| 7 | 16 | 40 | Yes | 17 | 39 | Yes |
| 8 | 16 | 40 | Yes | 16 | 39 | Yes |
| 9 | 15 | 40 | Yes | 15 | 39 | Yes |
| 10 | 16 | 40 | Yes | 16 | 39 | Yes |
| 11 | 15 | 40 | Yes | 15 | 39 | Yes |
| 12 | 15 | 40 | Yes | 15 | 39 | Yes |
| 13 | 19 | 37 | Yes | 19 | 38 | Yes |
| 14 | 13 | 37 | Yes | 14 | 38 | Yes |
| 15 | 13 | 37 | Yes | 13 | 38 | Yes |
| 16 | 13 | 37 | Yes | 13 | 38 | Yes |
| 17 | 12 | 37 | Yes | 12 | 38 | Yes |
| 18 | 12 | 37 | Yes | 12 | 38 | Yes |
| 19 | 11 | 37 | Yes | 11 | 38 | Yes |
| Future Neighbourhood Centre | 39 | 40 | Yes | NA* | NA* | NA* |
| Future residence NSR | 35 | 40 | Yes | 35 | 38 | Yes |

* NSR Neighbourhood Centre would not be occupied during the night time.

It can be seen from Table 6-2 that noise levels from operational activities are predicted to comply with the relevant noise criteria at all NSR's.

The noise level from the WWTP at the sports field during the day is predicted to be 40 dB(A) which is not expected to impact the use of the sports fields.

# 7 RECOMMENDATIONS

The proposed WWTP has been assessed using a number of assumptions, including:

- Sound Power Levels that were calculated from the kilowatt data provided by NWS, and RPM data provided by manufacturers;
- Most of the equipment will be located within a building constructed of Colorbond panels of 0.42 mm thickness steel, which will attenuate noise to nearby NSR's.

For the detailed design stage of the WWTP, it is recommended that assumptions around sound power levels of equipment be verified using manufacturer or supplier noise data, or noise measurements of similar operations. The design of the building proposed to house equipment should ensure adequate noise attenuation is achieved.

Where the Future NSR's are already constructed prior to the WWTP construction activities, a Construction Noise Management Plan would be required to consider managing noise levels at these NSR's to minimise potential for noise impacts.

# 8 CONCLUSION

Vipac Engineers and Scientists Ltd (Vipac) was commissioned by Planit Consulting Pty Ltd to carry out a noise impact assessment of the proposed Waste Water Treatment Plant (WWTP) for the Kings Forest Development in the Tweed Shire.

The purpose of this assessment is to determine the potential noise impacts associated with the proposed WWTP, on NSR's located in the surrounding area. Noise impacts have been assessed in accordance with the NSW Industrial Noise Policy (INP) (Environment Protection Authority, 2000).

The likely noise impacts have been predicted (during both construction and operational phases) using the CONCAWE methodology in SoundPLAN. The resultant noise impacts have been assessed for the construction stage and operation stage of the WWTP.

During the construction phase two future NSR's (Future Residence and Future Neighbourhood Centre) are predicted to exceed the construction noise criteria. Where the Future NSR's are already constructed prior to the WWTP construction activities, a Construction Noise Management Plan would be required to consider managing noise levels at these NSR's to minimise potential for noise impacts.

Predicted noise levels for the operational phase of the WWTP are predicted to comply with the noise criteria at all NSR's.

# Appendix A NOISE SENSITIVE RECEPTOR LOCATIONS

*Table A-1 Sensitive Receptor Details*

| ID | Description | Universal Transverse Mercator Location (m) | |
|---|---|---|---|
| | | X | Y |
| 1 | Residential Dwelling | 554831.45 | 6870819.85 |
| 2 | Residential Dwelling | 554949.54 | 6870911.32 |
| 3 | Residential Dwelling | 554927.34 | 6871018.41 |
| 4 | Residential Dwelling | 554962.13 | 6871135.72 |
| 6 | Residential Dwelling | 555661.22 | 6871099.61 |
| 7 | Residential Dwelling | 555157.47 | 6871249.22 |
| 8 | Residential Dwelling | 555095.58 | 6871363.3 |
| 9 | Residential Dwelling | 555109.53 | 6871428.87 |
| 5a | Residential Dwelling | 555200.67 | 6870780.81 |
| 5b | Residential Dwelling | 555186.96 | 6870828.55 |
| 5c | Residential Dwelling | 555179.49 | 6870853.68 |
| 5d | Residential Dwelling | 555168.26 | 6870885.09 |
| 5e | Residential Dwelling | 555162.03 | 6870908.96 |
| 5f | Residential Dwelling | 555162.08 | 6870929.05 |
| 5g | Residential Dwelling | 555154.59 | 6870949.15 |
| 5h | Residential Dwelling | 555143.33 | 6870965.5 |
| 5i | Residential Dwelling | 555119.5 | 6870975.6 |
| 5j | Residential Dwelling | 555129.6 | 6871003.2 |
| 10 | Residential Dwelling | 555030.05 | 6871397.97 |
| 11 | Residential Dwelling | 555047.53 | 6871491.16 |
| 12 | Residential Dwelling | 554805.81 | 6871477.89 |
| 13 | Residential Dwelling | 554035.05 | 6871121.93 |
| 14 | Residential Dwelling | 553835.77 | 6871556.04 |
| 15 | Residential Dwelling | 553783.94 | 6871535.44 |
| 16 | Residential Dwelling | 553839.4 | 6871631.99 |
| 17 | Residential Dwelling | 553860.35 | 6871735.53 |
| 18 | Residential Dwelling | 553812 | 6871732.18 |
| 19 | Residential Dwelling | 553529.91 | 6871678.73 |
| Future Neighbourhood Centre | Neighbourhood Centre | 554439.52 | 6870434.03 |
| Future residence NSR | Residential Dwelling | 554609.93 | 6870358.04 |
| Future Sports Fields* | Sports Fields | 554426.6 | 6870596.44 |

* Included in the assessment but not considered a noise sensitive land use.

# Appendix B NOISE MONITORING RESULTS

## Monitoring Location 1: 11 Secret Lane, Kings Forest

### Monitoring Details

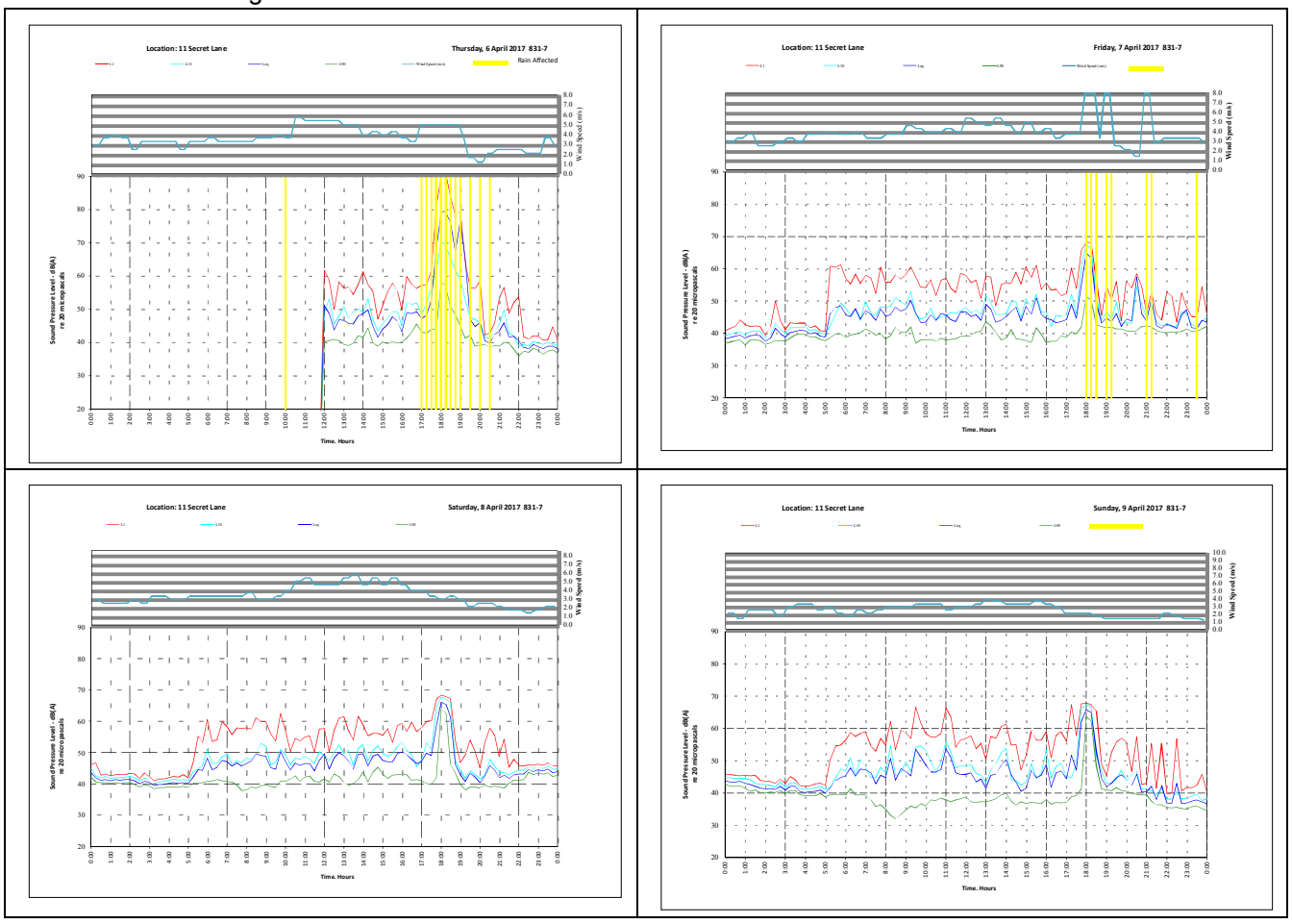
Coordinates: 153°33.54 E, 28°17.27 S
SLM Time/Frequency weighting: Fast/A
Instrument: Larson Davis 831-7
Instrument calibration due date: 12th August 2018
Microphone Height: 1.5 m free field
Measurement Period: 15 minutes
Serial Number: 2163
Calibration level: 94 dB pre and post measurement

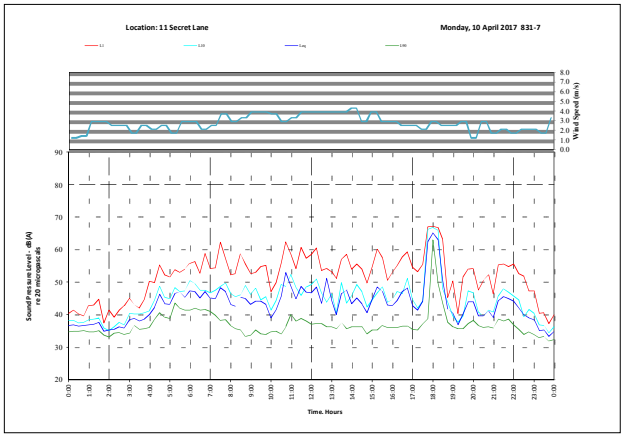
### Site Comments

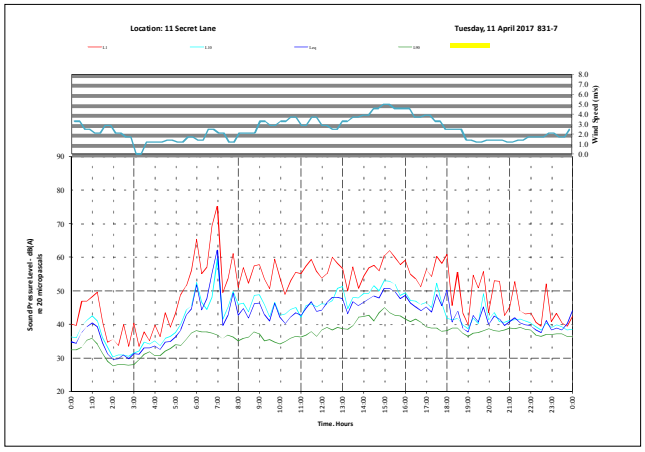
During the site visit on 6 April the day time noise environment consisted of noise from traffic on Tweed Coast Road (dominant), rustling of leaves, and bird and insect noise. During the site visit on 11 April the night time noise environment consisted of distant ocean noise, occasional traffic on Tweed Coast Road, occasional bird and insect noises, and aircraft flyover.

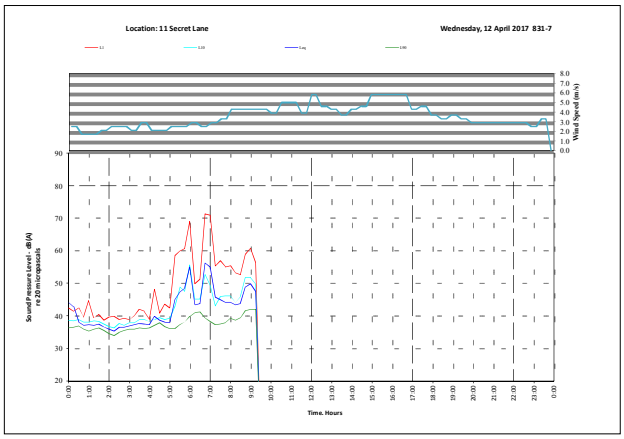
### Data

Rain periods have been highlighted in yellow in the graphs below. Periods with rain fall and wind speeds greater than 5m/s have been excluded from data analysis. High noise levels due to extraneous local events such as lawn mowing do not affect RBL levels.




Location: 11 Secret Lane
Monday, 10 April 2017 831-7
Wind Speed (m/s)
Time. Hours


Location: 11 Secret Lane
Tuesday, 11 April 2017 831-7
Wind Speed (m/s)
Time. Hours


Location: 11 Secret Lane
Wednesday, 12 April 2017 831-7
Wind Speed (m/s)
Time. Hours

## Monitoring Location 2: 79 Reardons Road, Cudgen

### Monitoring Details

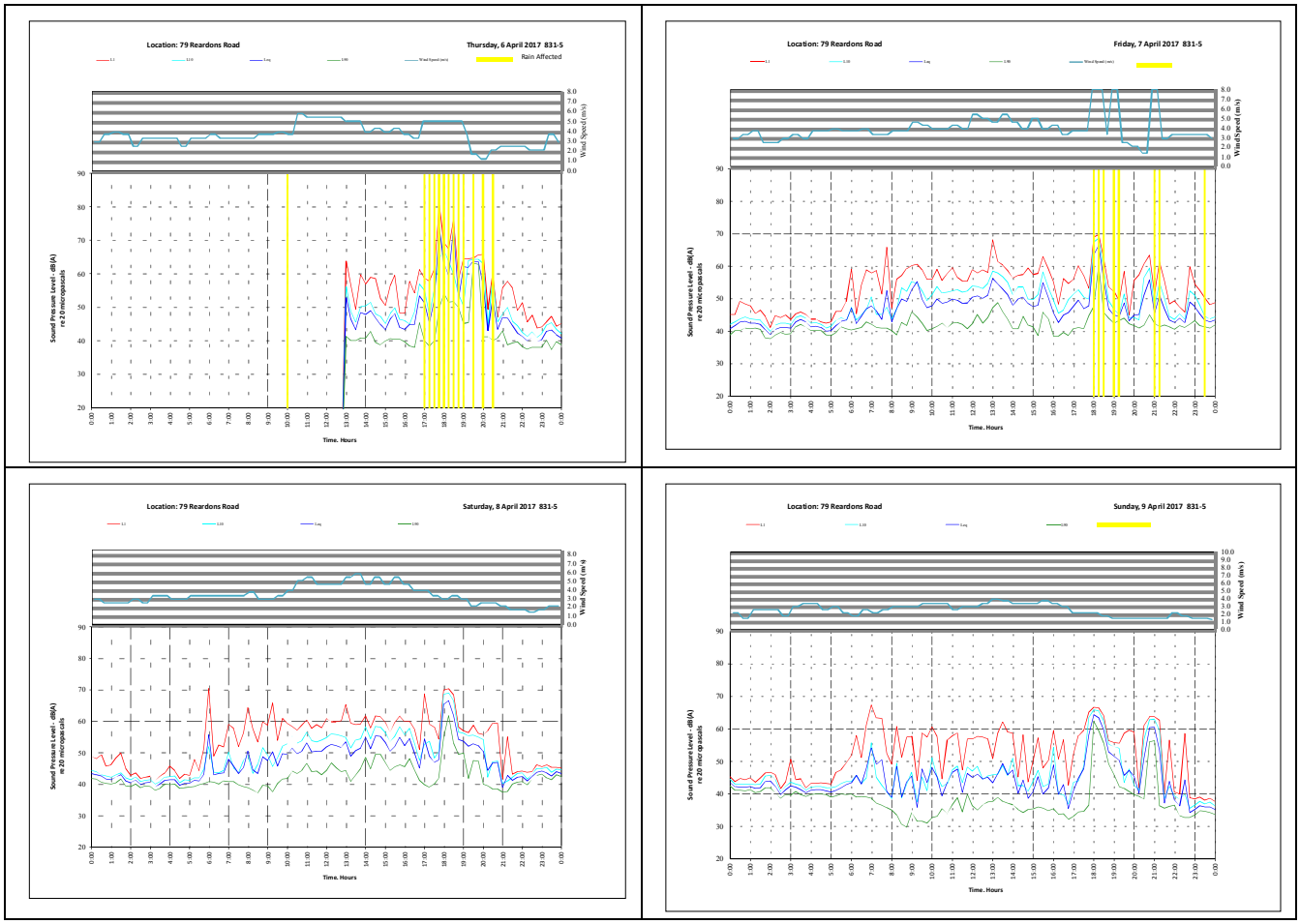
Coordinates: 153°32.96 E, 28°16.88 S
SLM Time/Frequency weighting: Fast/A
Instrument: Larson Davis 831-5
Instrument calibration due date: 1st March 2019
Microphone Height: 1.5 m free field
Measurement Period: 15 minutes
Serial Number: 2160
Calibration level: 94 dB pre and post measurement

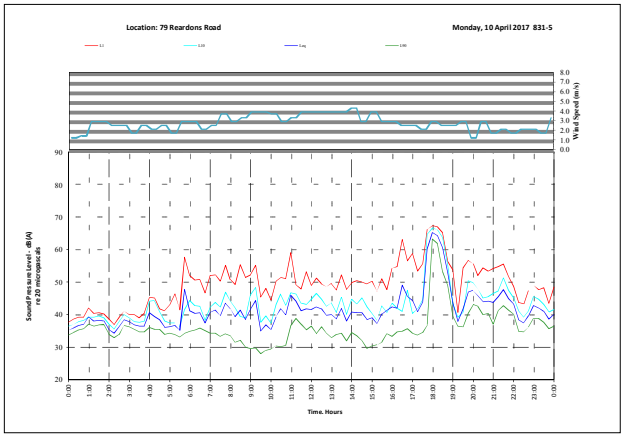
### Site Comments

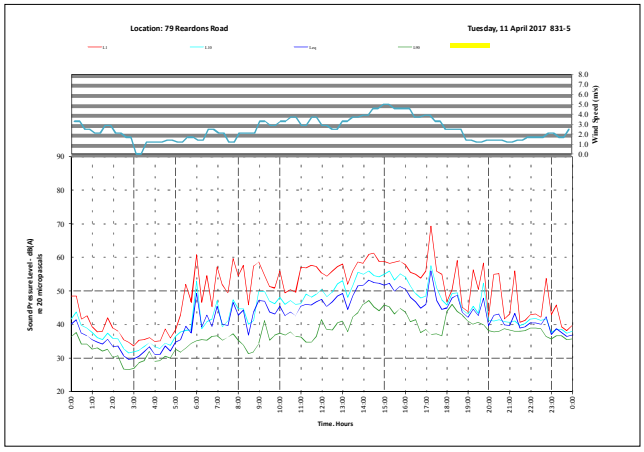
During the site visit on 6 April the day time noise environment consisted of rustling of leaves, bird and insect noises, occasional aircraft flyovers, and distant traffic (barely audible). During the site visit on 11 April the night time noise environment consisted of distant ocean noise, occasional bird and insect noises, and some distant traffic noise.

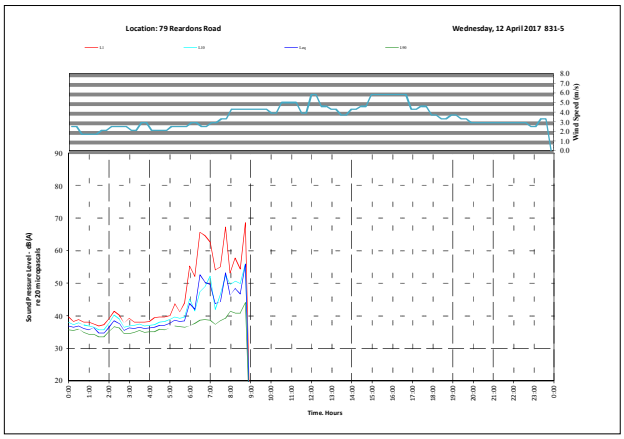
### Data

Rain periods have been highlighted in yellow in the graphs below. Periods with rain fall and wind speeds greater than 5m/s have been excluded from data analysis. High noise levels due to extraneous local events such as lawn mowing do not affect RBL levels.




Location: 79 Reardons Road
Monday, 10 April 2017 831-5
Wind Speed (m/s)
Time. Hours


Location: 79 Reardons Road
Tuesday, 11 April 2017 831-5
Wind Speed (m/s)
Time. Hours


Location: 79 Reardons Road
Wednesday, 12 April 2017 831-5
Wind Speed (m/s)
Time. Hours

# Appendix C NOISE MAPS FOR OPERATIONAL PHASE

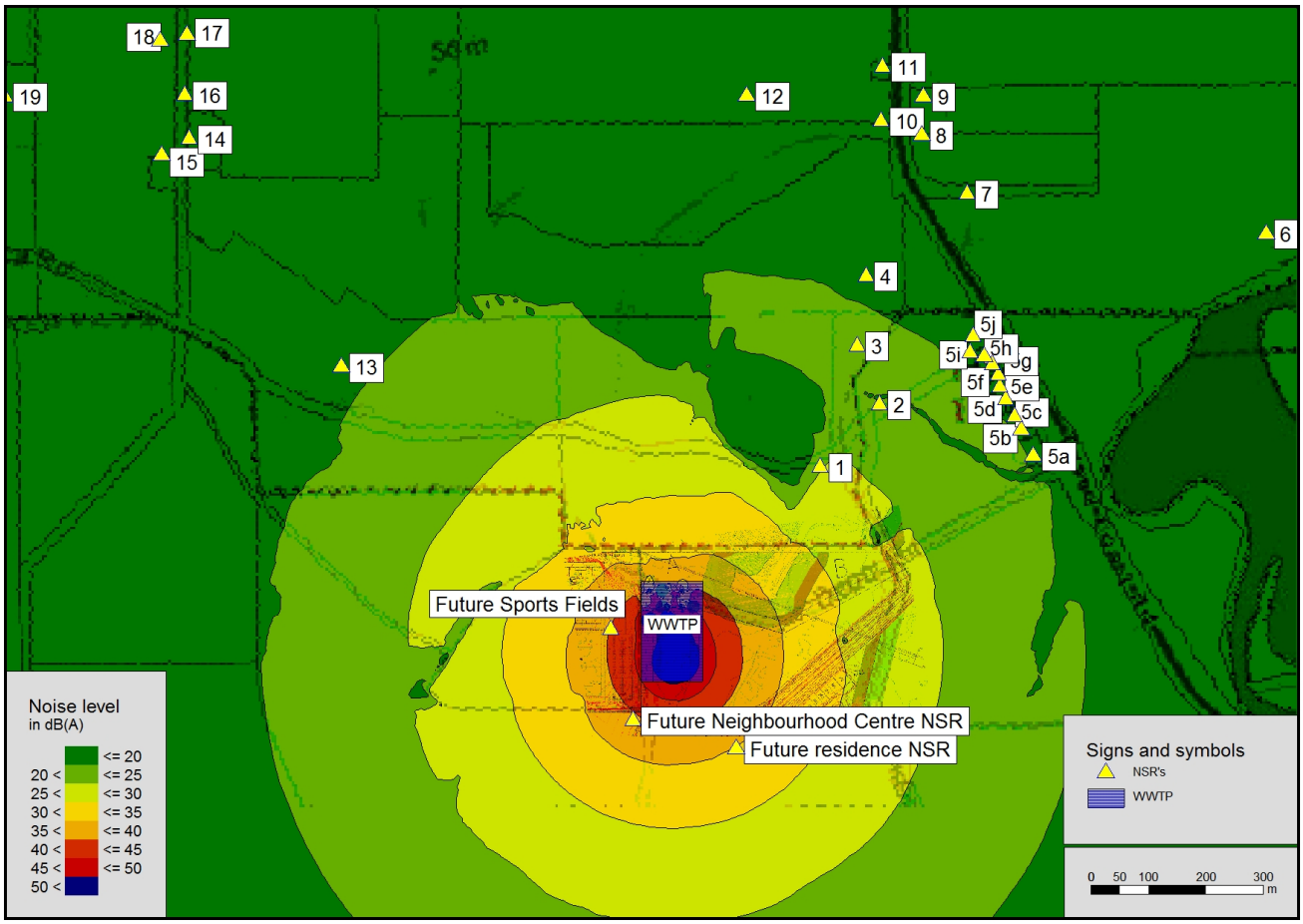



*Figure C-1 Noise Map for Day Time Operational Phase*

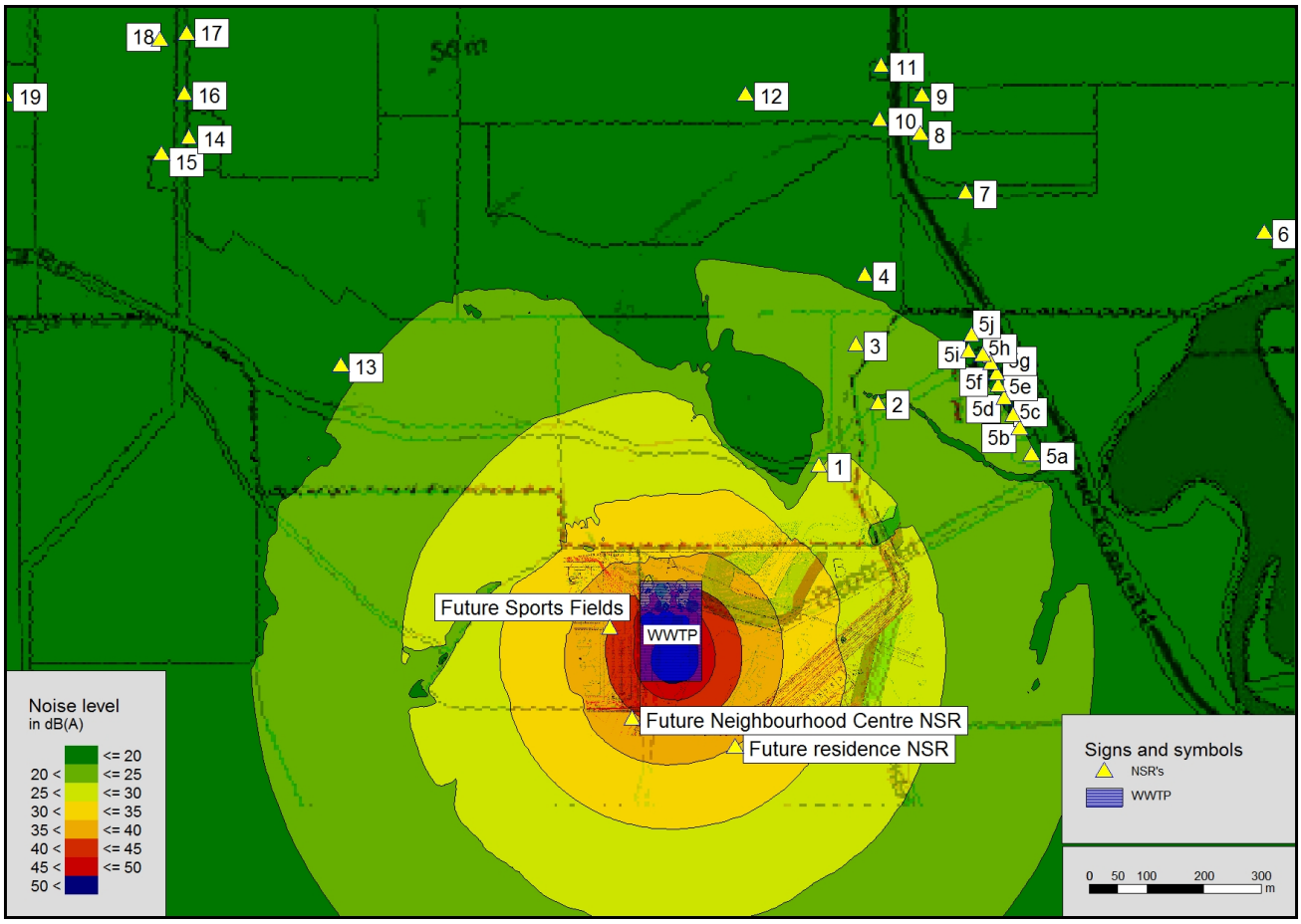



*Figure C-2 Noise Map for Evening and Night Time Operational Phase*