APPENDIX G

NOISE IMPACT ASSESSMENT

ACOUSTICS AND AIR

STOCKTON SAND QUARRY DREDGING

NOISE IMPACT ASSESSMENT

REPORT NO. 17220
VERSION C

OCTOBER 2019

PREPARED FOR

BORAL RESOURCES (NSW) PTY LTD

WILKINSON MURRAY

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GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

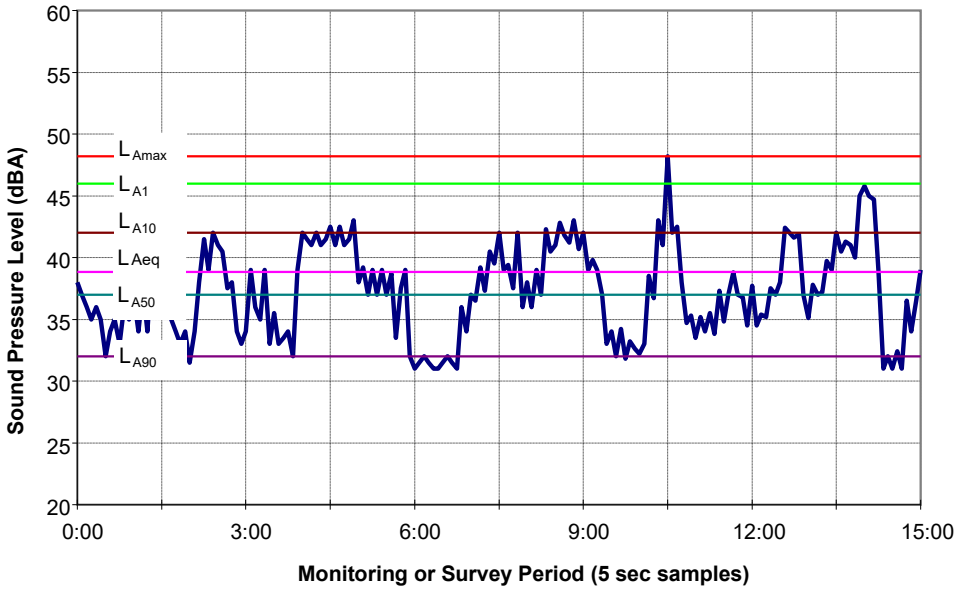
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

Boral Resources (NSW) Pty Ltd (Boral) owns and operates the Stockton Sand Quarry (hereafter referred to as the 'site' or the 'quarry'), a long standing operation that currently extracts sand from the windblown (transgressive) sand dunes of Stockton Bight and transports up to 500,000 tonnes per annum (tpa) of sand product for use in the building, landscaping and construction markets.

Due to current and future demand for sand in the Hunter and Sydney regions, Boral is seeking approval for continued and expanded operations at the site through a State Significant Development (SSD) application. The proposed development (hereafter referred to as the 'Project') involves the extraction of sand from the inland vegetated dunes by front-end loader/excavator to a depth of 4 metres (m) Australian Height Datum (AHD) in Stage 1, and subsequent dredging from 4 m AHD to 15 m below sea level (-15 m AHD) in Stages 2 to 6. The Project would seek to permit a site wide increase on the dispatch limit to 750,000 tpa (i.e. the windblown sand extraction area and the Project operations combined) up until 2028 after which the site wide limit would reduce to no more than 500,000 tpa. The Project would be for a period of up to 25 years, subject to demand of sand resources.

Wilkinson Murray Pty Limited (WMPL) has been engaged by Element Environment (Element) on behalf of Boral to conduct a Noise Impact Assessment for the Project. This report provides a detailed assessment of potential operational noise impacts. The assessment has been conducted in general accordance with the NSW Environmental Protection Authority (EPA) document *Noise Policy for Industry* (NPfI).

The Project will generate heavy vehicle movements along Nelson Bay Road, Cabbage Tree Road and Medowie Road. A detailed assessment of road traffic noise has therefore also been conducted in accordance with the EPA's NSW *Road Noise Policy* (RNP).

It should be noted that no significant sources of vibration have been identified for the Project. Additionally, the distance between the quarry and the closest receivers is over 500m, therefore a detailed assessment of potential vibration impacts is not considered necessary.

1.1 Secretary's Environmental Assessment Requirements

The following table identifies Planning Secretary's Environmental Assessment Requirements (SEAR) that are relevant to this NIA, and which sections of the report they are addressed.

Table 1-1 Secretary's Environmental Assessment Requirements

Key Issue	Description	Section
Noise	A detailed assessment of the likely construction, operational and off-site transport noise impacts of the development in accordance with the Interim Construction Noise Guideline, NSW Noise Policy for Industry and the NSW Road Noise Policy respectively, and having regard to the Voluntary Land Acquisition and Mitigation Policy;	Section 3, Section 4

2 PROJECT DESCRIPTION

2.1 Location and Surrounding Receivers

The Project site is located at the end of Coxs Road to the east of Fullerton Cove from Nelsons Bay Road to Stockton Beach, covering an area of approximately 37 ha. The site is accessed by road from Coxs Lane and Nelson Bay Road. The nearest and most potentially affected receivers comprise:

- Residences along Coxs Lane, George Street and Fullerton Cove Road in Fullerton Cove to the north-west of the site; and
- Residences along Tuckeroo Circuit and Norfolk Street within the Fern Bay Seaside Village, Fern Bay to the south west of the site.

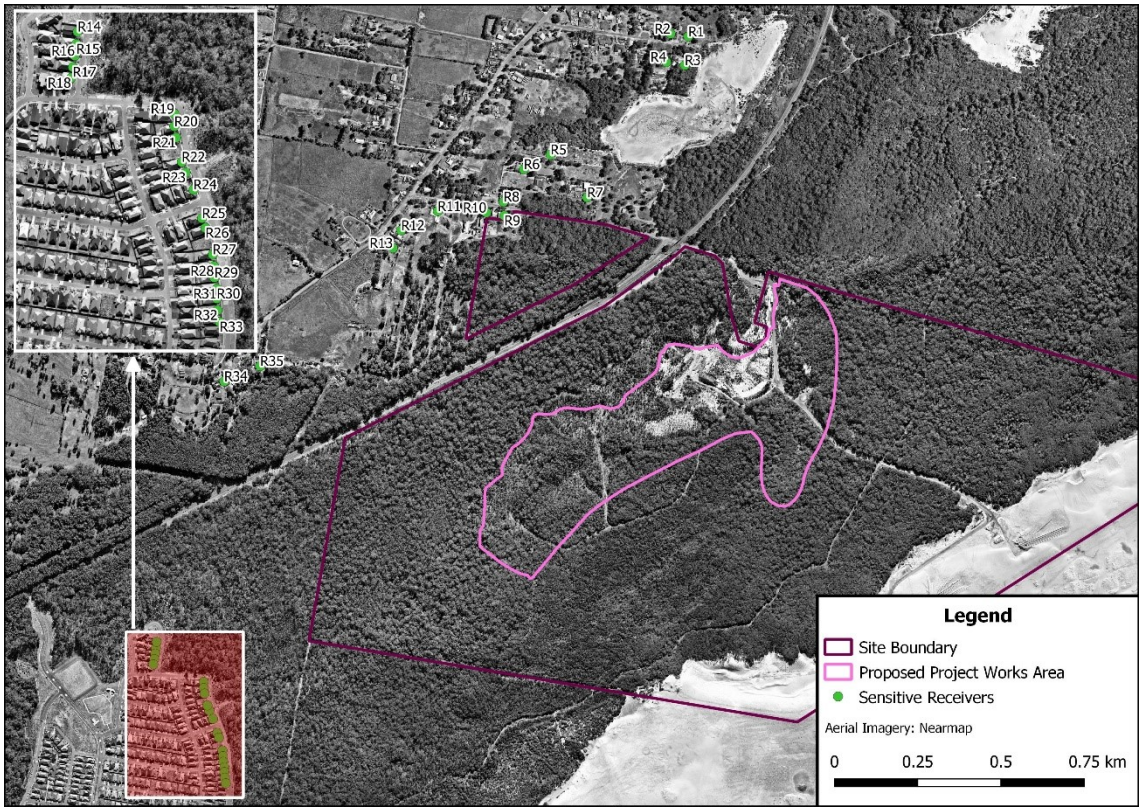
These receivers are all residential. There are no other sensitive receiver types identified in the surrounding area. The nearby sensitive receivers are described in Table 2-1 and shown in Figure 2-1.

Table 2-1 Sensitive receivers

Receiver	Address	Lot/DP Number
R1	11 George Street, Fullerton Cove	Lot 7 DP 255734
R2	9 George Street, Fullerton Cove	Lot 6 DP 255734
R3	14 George Street, Fullerton Cove	Lot 8 DP 255734
R4	12 George Street, Fullerton Cove	Lot 9 DP 255734
R5	Unknown Address, Fullerton Cove	Lot 5 DP 1105459
R6	6 Coxs Lane, Fullerton Cove	Lot 6 DP 998656
R7	1 Zircon Lane, Fullerton Cove	Lot 72 DP 876716
R8	17a Coxs Lane, Fullerton Cove	Lot 8 DP 742586
R9	12 Coxs Lane, Fullerton Cove	Lot 1 DP 120634
R10	10 Coxs Lane, Fullerton Cove	Lot 11 DP 881613
R11	4 Coxs Lane, Fullerton Cove	Lot 1 DP 724265
R12	306 Fullerton Cove Road, Fullerton Cove	Lot 100 DP 819758
R13	304 Fullerton Cove Road, Fullerton Cove	Lot 101 DP 819758
R14	14 Tuckeroo Circuit, Fern Bay	Lot 28 DP 280063
R15	16 Tuckeroo Circuit, Fern Bay	Lot 29 DP 280063
R16	18 Tuckeroo Circuit, Fern Bay	Lot 30 DP 280063
R17	20 Tuckeroo Circuit, Fern Bay	Lot 31 DP 280063
R18	22 Tuckeroo Circuit, Fern Bay	SP98989
R19	101 Norfolk Street, Fern Bay	Lot 49 DP 280063
R20	99 Norfolk Street, Fern Bay	Lot 48 DP 280063
R21	97 Norfolk Street, Fern Bay	Lot 47 DP 280063
R22	93 Norfolk Street, Fern Bay	Lot 45 DP 280063
R23	91 Norfolk Street, Fern Bay	Lot 44 DP 280063

Receiver	Address	Lot/DP Number
R24	2 Uralla Street, Fern Bay	Lot 43 DP 280063
R25	87 Norfolk Street, Fern Bay	Lot 37 DP 280057
R26	85 Norfolk Street, Fern Bay	Lot 38 DP 280057
R27	81 Norfolk Street, Fern Bay	Lot 40 DP 280057
R28	79 Norfolk Street, Fern Bay	Lot 41 DP 280057
R29	77 Norfolk Street, Fern Bay	Lot 42 DP 280057
R30	75 Norfolk Street, Fern Bay	Lot 43 DP 280057
R31	73 Norfolk Street, Fern Bay	Lot 44 DP 280057
R32	71 Norfolk Street, Fern Bay	Lot 45 DP 280057
R33	69 Norfolk Street, Fern Bay	Lot 46 DP 280057
R34	248 Fullerton Cove Road, Fullerton Cove	Lot 3421 DP 1232950
R35	260 Fullerton Cove Road, Fullerton Cove	Lot 1 DP 745337

Figure 2-1 Site and surrounding sensitive receivers



2.2 Project Overview

The site contains an existing operation located approximately 375 m south east of the Project site, referred to as the windblown sand extraction area (or pit 7). The windblown sand extraction area is approved to operate until 2028 and dispatch up to 500,000 tpa from the site (refer to condition 6 of DA 140-6-2005).

Sand from the former inland extraction area was only extracted to 5 m AHD under the original 1996 development consent. The sand resource above 5 m AHD was exhausted in 2008 and in accordance with the conditions of consent the operations have ceased.

The Project involves the extraction of sand from within the former inland extraction area (inclusive of Stages 1 – 6) from the existing ground level to a depth of 15 m below sea level (-15 m AHD). As extraction will intercept the groundwater table (at approximately 1 m AHD) the primary method of sand extraction will involve dredging.

There is an estimated 9 million tonnes of sand resource within the Project extraction area. The Project would seek to permit a site wide increase on the dispatch limit to 750,000 tpa (i.e. the windblown sand extraction area and the Project operations combined) up until 2028 after which the site wide limit would reduce to no more than 500,000 tpa.

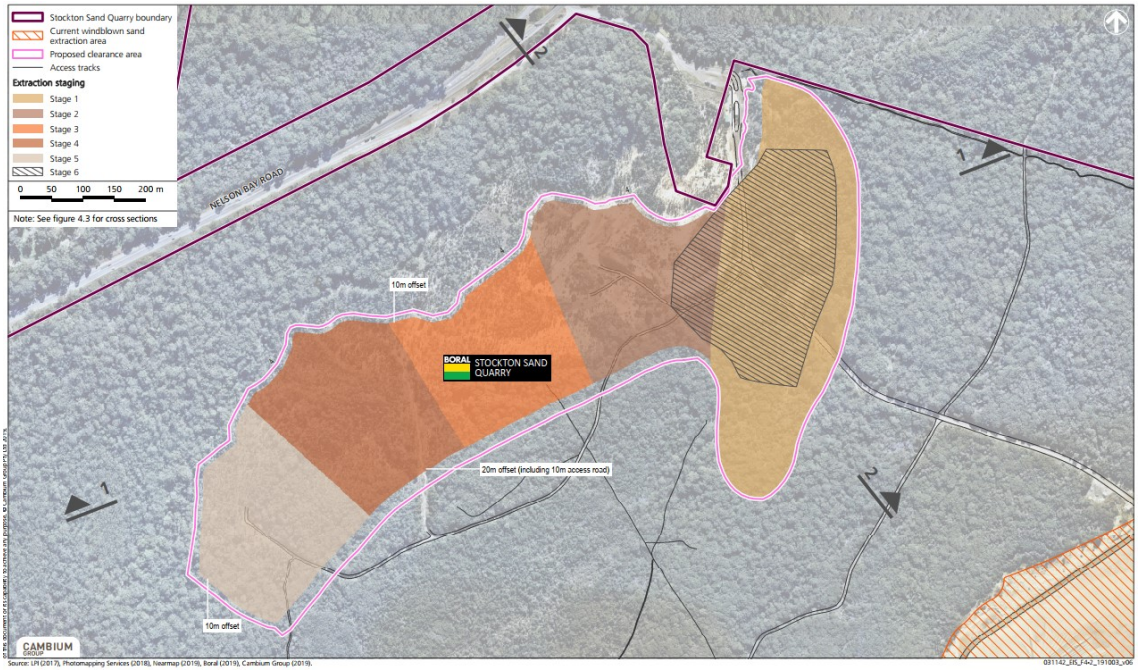
Mobile plant and equipment utilised at the site would operate across both project areas and a docket system at the weighbridge would monitor outgoing product as a site total.

To account for market fluctuations in demand, Boral are seeking a development consent period of 25 years for the SSD approval.

2.3 Sand Extraction & Staging Overview

The Project is to be undertaken progressively in six stages, commencing with Stage 1. An overview of the extraction staging plan for the Project is presented in Figure 2-2**.**

Figure 2-2 Extraction staging plan



Similar to previous operations of the inland extraction area, sand extraction will involve clearing and grubbing of established vegetation from previous rehabilitation and possible screening of accumulated leaf litter and organic matter. Cleared vegetation will either be mulched or stockpiled on-site for later reuse in rehabilitation. Similarly, any stripped topsoil would be retained for use in rehabilitation efforts across the site.

Stage 1 will involve dry extraction to a depth of 4 m AHD. A front-end loader will push into the exposed sand face and as the sand is relatively free-flowing, material will fall towards the front-end loader at the natural angle of repose.

The sand will then be screened and stockpiled before a front-end loader then loads road trucks in-pit with screened raw sand for transport off-site via the weighbridge.

A pond will be created in the area of Stage 2 following initial dry extraction of sand in Stage 1. The pond will be large enough to float a dredge and accommodate fresh water pumping for the proposed wash plant.

The dredge will move progressively through the Stage 2 to 6 extraction area generally following the nominated stages. In most cases, the sand in each extraction stage is fully extracted unless constraints are encountered.

The dredge will move backwards and forwards across the active dredge pond, sucking the underwater sand face. The sand/water mix will be pumped directly from the dredge via a pontoon-mounted pipeline to the wash plant in the processing area. The dredge will manoeuvre around the pond and its position will be stabilised by wire ropes connected to the pond banks.

The dredge will move progressively through the extraction area in a south-westerly direction in a staged process. Extraction will then move to the east and culminate with relocation of the proposed processing and stockpile area to a confined area in Stage 1 and subsequent dredging of the majority of the Stage 1 extraction area (to be known as Stage 6).

Sand will be extracted to a maximum depth of approximately 15 m below the sea level (0 m AHD).

2.3.1 Stage 1

The Stage 1 extraction area is located along the eastern portion of the Project site (refer to Figure 2-2).

Stage 1 of the Project would involve the following activities:

- removal of vegetation from across the whole footprint of the Stage 1 extraction area and a small portion of land to the north-east of the existing depot to allow for the construction of a new haul route that will extend around the north, east and southern perimeter of Stage 1 and link to the existing haul road to the windblown sand extraction area;
- where present, stripping topsoil and store on site within designated stockpile areas;
- extraction of sand in the Stage 1 extraction area via front end loader and excavator to a depth of 4 m AHD;
- screening and stockpiling sand;
- levelling of the Stage 1 extraction area as required;
- establishing a level pad at the north-western boundary of Stage 1 and establishing the wash plant and diesel generators; and
- delivery and installation of a prefabricated office building and commencement of other alterations to the existing site depot.

2.3.2 Stage 2

As Stage 1 is nearing completion, Stage 2 will be commenced. To limit the loss of sand product to wind erosion, a maximum extent of 200 - 300 m of vegetation and ground cover will be cleared at any one time. The general area of Stage 1 will be used for stockpiling of processed sand ready for dispatch.

The typical method for sand extraction in Stage 2 will be:

- progressive stripping of areas in 200-300 m segments across the stage;
- excavation of an initial dredge window to allow for a suitable water to sand ratio to develop, and may involve excavation from 2-6 m AHD;
- once a suitable sand/water ratio has been established the dredge will be floated. The dredge will be fixed to a pontoon which is connected to the wash plant via a pipeline;
- a sand/water mix will be dredged by suction to the wash plant, where sand will be extracted and excess water will be returned via a separate pipeline to dredge pond;
- the wash plant will screen out oversize material in excess of 20 mm in size; and
- dredging will be to a maximum depth of 15 m below sea level.

2.3.3 Stages 3 – 5

The methodology described in Stage 2 would be repeated in each subsequent stage culminating with the completion of Stage 5.

At the completion of Stage 5 progressive rehabilitation of the stages 2-5 dredge pond banks will commence. Initial rehabilitation will not include the Stage 1 extraction area as this will continue to be disturbed for Stage 6 of the project.

2.3.4 Stage 6

Except for the southern portion of Stage 1, containing the wash plant and generator, the Stage 1 extraction area will be excavated to reveal the groundwater table and subsequently dredged in an identical manner to stages 2-5. The stage 2-5 dredge pond will be extended into the Stage 1 extraction area and dredging of the pond will also be to a depth of 15 m below the water table.

2.4 Hours of Operation

The Project will continue to operate in accordance with the following approved hours of operation in the 2006 development consent:

- Monday to Friday – 6:15am to 5:00pm;
- Saturday – 6:15am to 12 noon; and
- no operation on Sundays or Public Holidays.

The site is also approved to operate extended hours during major supply contracts as follows:

- Monday to Friday – 6:15am to 6:00pm;
- Saturday – 6:15am to 3:00pm; and
- no operation on Sundays or Public Holidays.

3 NOISE CRITERIA

3.1 Existing Noise Levels

Unattended noise monitoring was conducted between 3 December and 17 December 2018 to determine the existing ambient and traffic noise levels. The monitoring was undertaken at three locations, as shown and described in Table 3-1. The monitoring at location M1 was redone between 05 July and 15 July 2019 as the original data was unsuitable. The new data was used for the assessment.

Table 3-1 Noise monitoring locations

Location	Purpose	Address
M1	Existing ambient noise levels	4 Coxs Lane, Fullerton Cove (R11)
M2	Existing traffic noise levels	157 Cabbage Tree Road, Williamtown
M3	Existing traffic noise levels	1051 Nelson Bay Road, Fern Bay

Measured ambient noise levels at location M1 are considered representative of the ambient environment for all receivers in the Fullerton Cove region surrounding the site. These measured levels are also used to assess the noise impact on receivers in the Fern Bay Seaside Village. There is a significant amount of construction currently being undertaken within the Fern Bay Seaside Village making the area not suitable for background monitoring. However, due to the proximity of these receivers to the coastline, the levels are considered conservative.

The noise monitoring equipment used for these measurements consisted of an ARL NGARA environmental noise logger set to A-weighted, fast response. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

From the background noise levels (L_{A90}) the Rating Background Levels (RBLs) were determined using the methodology recommended in the NSW *Noise Policy for Industry* (NPfI). The existing windblown sand operation was not audible during deployment or collection of unattended noise monitoring equipment and is unlikely to contribute significantly to background levels in the vicinity of the Project. However, it should be noted that Appendix A1 of the *NPfI* addresses modifications to existing premises. The policy acknowledges that where the premises has been operating for a significant period of time, as is the case here, then it is considered a feature of the acoustic environment and may be included in the background noise assessment.

The existing ambient noise levels are presented in Table 3-2. Due to the operating hours of the site, the results from the morning (AM) shoulder period are also presented. Daily plots of the noise logger data are presented in Appendix A.

Table 3-2 Existing ambient noise levels

Monitoring Location	Time of Day	Noise Levels (dBA)	
		RBL	L_{Aeq}
M1	AM shoulder	38	48
	Day	41	56
	Evening	36	47
	Night	33	46
	15-hour	-	55
	9-hour	-	46
M2	AM shoulder	48	67
	Day	46	66
	Evening	41	62
	Night	33	62
	15-hour	-	65
	9-hour	-	62
M3	AM shoulder	49	71
	Day	55	71
	Evening	47	67
	Night	38	66
	15-hour	-	70
	9-hour	-	66

Day = 7:00am – 6:00pm; Evening = 6:00pm – 10:00pm; Night = 10:00pm – 7:00am; AM Shoulder = 5:00am – 7:00am.

3.2 Operational Noise Trigger Levels

The *Noise Policy for Industry* (NPfI) (EPA, 2017) provides a framework for assessing environmental noise impacts from industrial premises and industrial development proposals in New South Wales.

The *NPfI* recommends the development of project noise trigger levels, which provide a benchmark for assessing a proposal or site. The project noise trigger levels should not be interpreted as mandatory noise criteria but, rather, as noise levels that, if exceeded, would indicate a potential noise impact on the community.

The project noise trigger level is the lower value of the project intrusiveness noise level and the project amenity noise level. The project intrusiveness noise level assesses the likelihood of noise being intrusive above the ambient noise level and is applied to residential receivers only. The project amenity noise level ensures the total industrial noise from all sources in the area does not rise above a maximum acceptable level.

In addition to the requirements above, the site also operates under Environmental Protection License 10132, issued by the EPA.

3.2.1 EPL License Conditions

Section L3 of the EPL states the noise limit conditions. These conditions are described in Table 3-3 below. Compliance with Limit L3.1 is to be assessed in conjunction with operational noise criteria outlined in the *NPfI*.

Table 3-3 EPL noise limits

Limit	Description
L3.1	Noise emissions from the premises must not exceed an Leq(15 minute) noise emission criterion of 35 dB(A) at the nearest residential receiver.
L3.2	Noise from the premises is to be measured at the worst affected point or within the residential boundary, or the most affected point within 30 metres of a dwelling (rural situations) where the dwelling is more than 30 metres from the boundary, to determine compliance with the noise limit in this licence.
L3.2	The noise emission limit identified in this licence applies in the following weather conditions: - wind speed up to 3m/s at 10m above ground level; or - temperature inversion conditions of up to 30C/100m and wind speed up to 2m/s at 10m above ground level.

3.2.2 NPfI Project Intrusiveness Noise Levels

The intrusiveness noise level is the noise level 5 dBA above the background noise level (RBL) for each time period (daytime, evening or night time) of interest at a residential receiver. The RBL is derived from the measured L_{A90} noise levels.

The *NPfI* stipulates that project intrusiveness noise levels should not be set below 40 dBA during the daytime and 35 dBA in the evening and night time. Additionally, the *NPfI* recommends that the project intrusiveness noise level for evening is set at no greater than that for the daytime, and that the project intrusiveness level for night time is set at no greater than that for the evening and daytime.

As the site currently has approval for operation from 6:15am, intrusiveness noise levels have been derived for the morning (AM) shoulder period.

Intrusiveness noise levels for the project are calculated from the RBLs at location M1, given it is the closest monitoring location to the site, and are presented in Table 3-4.

Table 3-4 Project intrusiveness noise levels

Receiver	Time of Day	RBL	Project Intrusiveness Noise Level ($L_{Aeq,15min}$)
All	Morning shoulder	38	43
	Day	41	46
	Evening	36	41
	Night	33	38

Day = 7:00am – 6:00pm; Evening = 6:00pm – 10:00pm; Night = 10:00pm – 7:00am; AM Shoulder = 5:00am – 7:00am.

3.2.3 NPfI Project Amenity Noise Levels

Project amenity noise levels aim to set a limit on continuing increases in noise levels from all industrial noise sources affecting a variety of receiver types; that is, the ambient noise level in an area from all industrial noise sources remains below recommended amenity noise levels.

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include transportation noise (when on public transport corridors), noise from motor sport, construction noise, community noise, blasting, shooting ranges, occupational workplace noise, wind farms, amplified music/patron noise.

The amenity noise level aims to limit continuing increases in noise levels which may occur if the intrusiveness level alone is applied to successive development within an area.

The recommended amenity noise level represents the objective for total industrial noise at a receiver location. The project amenity noise level represents the objective for noise from a single industrial development at a receiver location.

To prevent increases in industrial noise due to the cumulative effect of several developments, the project amenity noise level for each new source of industrial noise is set at 5 dBA below the recommended amenity noise level.

The following exceptions apply to determining the project amenity noise level:

- For high-traffic areas the amenity criterion for industrial noise becomes the $L_{Aeq,period(traffic)}$ minus 15 dBA.
- In proposed developments in major industrial clusters.
- If the resulting project amenity noise level is 10 dB or more lower than the existing industrial noise level, the project amenity noise level can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.
- Where cumulative industrial noise is not a consideration because no other industries are present in, or likely to be introduced into the area, the relevant amenity noise level is assigned as the project amenity noise level for the development.

Amenity noise levels are not used directly as regulatory limits. They are used in combination with the project intrusiveness noise level to assess the potential impact of noise, assess mitigation options and determine achievable noise requirements.

The project amenity noise levels are calculated from the recommended amenity noise levels presented in Table 3-5.

Table 3-5 Recommended amenity noise levels

Receiver	Noise Amenity Area	Time of Day	Recommended Amenity Noise Level (dBA $L_{Aeq,period}$)
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	See column 4	See column 4	5 dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day.
School classroom-internal	All	Noisiest 1-hour period when in use	35
Hospital ward internal external	All	Noisiest 1-hour	35
	All	Noisiest 1-hour	50
Place of worship-internal	All	When in use	40
Area specifically reserved for passive recreation (e.g. national park)	All	When in use	50
Active recreation area (e.g. school playground, golf course)	All	When in use	55
Commercial premises	All	When in use	65
Industrial premises	All	When in use	65
Industrial interface (applicable only to residential noise amenity areas)	All	All	Add 5 dB(A) to recommended noise amenity area

Day = 7:00am – 6:00pm; Evening = 6:00pm – 10:00pm; Night = 10:00pm – 7:00am.

Recommended amenity noise levels presented in Table 3-5 above represent the objective for total industrial noise at a receiver location. In the case of a single new noise source being proposed, the project amenity noise level represents the objective for noise from a single industrial development at the receiver location. This is calculated as the recommended amenity noise level minus 5 dBA.

Due to different averaging periods for the $L_{Aeq,15min}$ and $L_{Aeq,period}$ noise descriptors, the values of project intrusiveness and amenity noise levels cannot be compared directly when identifying noise trigger levels i.e.; the most stringent values of each category. In order to make a comparison between descriptors, the *NPfI* assumes that the $L_{Aeq,15min}$ equivalent of an $L_{Aeq,period}$ noise level is equal to the $L_{Aeq,15min}$ level plus 3 dB.

Based on the methodology for determining residential receiver category in the *NPfI*, the area surrounding the site can be classified as 'Suburban Residential'. These amenity noise levels have been adopted and are presented in Table 3-6.

Table 3-6 Project amenity noise levels

Noise Amenity Area	Time of Day	Recommended Amenity Noise Level ($L_{Aeq,period}$)	Project Amenity Noise Level ($L_{Aeq,15min}$ dBA)
Suburban	Day	55	53
	Evening	45	43
	Night	40	38

Day = 7:00am – 6:00pm; Evening = 6:00pm – 10:00pm; Night = 10:00pm – 7:00am.

3.2.4 NPfI Project Noise Trigger Levels

Table 3-7 below shows the project noise levels for sensitive receivers, with the project noise trigger levels shown in **bold**.

Table 3-7 Project noise trigger levels

Receiver	Time of Day	Project Intrusiveness Noise Levels ($L_{Aeq,15min}$ dBA)	Project Amenity Noise Levels ($L_{Aeq,15min}$ dBA)
All	Morning shoulder	**43**	**43**
	Day	**46**	53
	Evening	**41**	43
	Night	**38**	**38**

Day = 7:00am – 6:00pm; Evening = 6:00pm – 10:00pm; Night = 10:00pm – 7:00am; AM Shoulder = 5:00am – 7:00am.
Project amenity noise levels are not specified for shoulder periods, therefore the day level has been adopted.

3.2.5 NPfI Maximum Noise Trigger Levels

Noise sources at night occurring over a short duration have the potential to cause sleep disturbance despite complying with project noise trigger levels. The site intends to operate from 6:15am, during the morning shoulder period. Therefore, maximum noise level events need to be considered for potential sleep disturbance.

The *NPfI* recommends that, where the night time L_{Amax} receiver noise levels from a development exceeds 52 dBA or the RBL plus 15 dBA, whichever is the greater, then a more detailed assessment of potential sleep disturbance impacts is warranted. Table 3-8 presents the maximum noise trigger levels for the receivers identified in this assessment. These noise levels are typically addressed at the facade of potentially affected dwellings and should consider multiple storey dwellings.

Table 3-8 Maximum noise trigger levels

Receiver	Night RBL (dBA)	RBL + 15 dBA	Maximum Noise Trigger Level (dBA)
All	33	48	52

Additionally, in instances where night time $L_{Aeq,15min}$ noise levels exceed 40 dBA or the prevailing RBL plus 5 dBA, whichever is the greater, then a detailed assessment of potential sleep disturbance impacts is warranted.

3.3 Road Traffic Noise Criteria

The EPA's NSW *Road Noise Policy* (RNP) provides criteria for managing noise levels associated with a development that will increase traffic on a particular road.

Although trucks accessing the site will continue to operate in the same manner as for the current operations, the increase in in total sand dispatched to 750,000 tpa will result in additional trucks on the surrounding road network until 2028.

The *RNP* assessment criteria for residential land uses are presented in Table 3-9.

Table 3-9 Road traffic noise assessment criteria for residential receivers

Road Category	Type of Proposal / Land Use	Noise Criteria (dBA)	
		Day (7am-10pm) (dBA)	Night (10pm-7am) (dBA)
Freeway / arterial / sub-arterial roads	Existing residences affected by additional traffic on existing freeways / arterial / sub-arterial roads generated by land use development	$L_{Aeq,15hr}$ 60 (external)	$L_{Aeq,9hr}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use development	$L_{Aeq,1hr}$ 55 (external)	$L_{Aeq,1hr}$ 50 (external)

The *RNP* also offers the relative increase criteria to manage the permissible increase in road traffic noise from a land use development. This criteria states that:

> "*For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.*"

As the measured $L_{Aeq,15hr}$ and $L_{Aeq,9hr}$ from Table 3-2 are above the *RNP* assessment criteria at both assessment locations, the relative increase criteria is to be adopted.

4 OPERATIONAL NOISE ASSESSMENT

4.1 Operational Noise Modelling Methodology

4.1.1 Computer Noise Model

Operational noise emissions associated with the Project were modelled using the CadnaA acoustic noise prediction software and the CONCAWE noise prediction algorithm. The CONCAWE noise propagation model is used around the world and is widely accepted as an appropriate model for predicting noise over significant distances. Factors addressed in the noise modelling are:

- Equipment noise level emissions and locations;
- Shielding from ground topography and structures;
- Noise attenuation due to geometric spreading;
- Ground absorption; and,
- Atmospheric absorption.

4.1.2 Ground Topography

Topographical data for the site and nearby surrounding area has been sourced from NSW Spatial Services as 1 m contours and has been incorporated in the model.

4.1.3 Ground Absorption

A ground absorption factor of 0.75 has been applied to the entire model. This global ground absorption value conservatively represents the mix of hard ground (absorption = 0) and soft ground (absorption = 1) on and around the site.

4.1.4 Meteorological Effects

At relatively large distances from a source, the resultant noise levels at receivers can be influenced by meteorological conditions, particularly temperature inversions and gradient winds. Where these factors are a feature of an area their effect on resultant noise levels should be taken into account.

'Fact sheet D' of the *NPfI* states that an assessment can incorporate noise-enhancing meteorological conditions into the modelling for all assessment periods without undertaking detailed meteorologic analysis. Stability class D with light winds (3 m/s at 10 m AGL) for day and evening periods and stability class F with winds up to 2 m/s at 10 m AGL for the night period should be adopted as a conservative approach. These conditions have been included in this assessment.

4.2 Operational Noise Sources

4.2.1 Sources of Operational Noise

The major noise sources associated with the operation of the Project are:

- Mobile plant, such as excavator, dozer, front end loader (FEL) and dump trucks;
- The mobile screen (Stage 1);
- The suction dredge (Stage 2 onwards);
- The wash plant (Stage 2 onwards);
- The booster pump; and,
- Road trucks exporting sand and importing virgin excavated natural material (VENM) during rehabilitation.

Source sound power levels for mobile plant items, including road trucks, have been taken from previous measurements of similar equipment conducted by Wilkinson Murray on similar sites. Wilkinson Murray undertook a site visit to Stockton Sand Quarry to measure sound power levels for existing plant. Results of these measurements validated the assumed sound power levels.

The wash plant operating on the site would be similar to those operating on existing Boral sand extraction sites. Accordingly, the sound power level for this item has been taken from the noise impact assessment conducted by Wilkinson Murray for the Boral operated Dunmore Lakes Sand Project (WM Report No. 18156, Version B, March 2019).

Table 4-1 summarises the operational noise sources associated with the Project and their respective SWL. Equipment used in each of the assessment scenarios is detailed in Section 4.3.

Table 4-1 Operational noise sources and sound power levels

Item	Description (typical)	SWL (dBA) per item
Dozer	Caterpillar D7	113
FEL	Volvo 180H	108
Excavator	40 tonne	113
Dump truck	Caterpillar 740	110
Road truck	Truck and dog	104
Water cart	1987 Volvo F86	103
Mobile screen	Powerscreen M90	101
Dredge	-	68
Wash plant	-	93
Diesel generator	-	80

4.3 Modelled Activities and Assessment Scenarios

Two separate scenarios have been chosen for modelling that represent the worst-case scenarios for the nearby receivers.

Receivers to the north-west of the site will be worst impacted during Stage 1 where a significant portion of the plant and activity is located at the northern most area of the site near the site entrance. During Stage 1, extraction will still be taking place in pit 7 (windblown sand extraction area) as well, and therefore plant has also been modelled in this area. Trucks and a water cart moving between pit 7 and the northern end of the site have been included in this scenario.

Site activities between Stages 2-5 will be reasonably similar, therefore the Stage 5 was selected as this is when plant and activities will be closest to the Fern Bay receivers to the south-west of the site. A water cart has been included moving between the Stage 5 area and the entrance to the site in Stage 1.

Table 4-2 presents the list of plant modelled in each scenario.

Table 4-2 Scenario plant list

Scenario (Extraction Stage)	Plant	Number	Area
Scenario 1 (Stage 1)	Dozer	1	Stage 1
	Mobile screen	1	Stage 1
	Excavator	1	Stage 1
	FEL	1	Stage 1
	FEL	1	Pit 7 (windblown)
	Truck	5	Stage 1
	Truck	2	Pit 7 (windblown)
	Truck	1	Haul road – Pit 7 to weighbridge
	Water cart	1	Haul road – Pit 7 to weighbridge
Scenario 2 (Stage 5)	Dozer	1	Stage 5
	Dredge	1	Boundary Stage 4/5
	Excavator	1	Stage 5
	FEL	1	Stage 1
	Generator	1	Boundary Stage 3/4
	Wash plant	1	Stage 1
	Dump truck	2	Stage 5
	Truck	4	Stage 1
	VENM truck (tipping)	1	Stage 5
	Water cart	1	Haul road – Stage 5 to weighbridge

4.3.1 Predicted Daytime $L_{Aeq,15min}$ Operational Noise Levels

The predicted $L_{Aeq,15min}$ noise levels associated with the operation of the Project during the day period are presented in Table 4-3.

Table 4-3 Predicted daytime $L_{Aeq,15min}$ operational noise levels

Receiver	Project Noise Trigger Level ($L_{Aeq,15min}$ dBA)	Predicted Noise Levels – Scenario 1 (dBA)	Predicted Noise Levels – Scenario 2 (dBA)	Compliance
R1	46	28	28	Yes
R2	46	29	28	Yes
R3	46	29	29	Yes
R4	46	30	29	Yes
R5	46	27	31	Yes
R6	46	26	30	Yes
R7	46	27	33	Yes
R8	46	26	31	Yes
R9	46	27	31	Yes
R10	46	26	30	Yes
R11	46	24	29	Yes
R12	46	24	30	Yes
R13	46	24	30	Yes
R14	46	15	23	Yes
R15	46	14	23	Yes
R16	46	13	23	Yes
R17	46	12	23	Yes
R18	46	13	22	Yes
R19	46	16	25	Yes
R20	46	15	24	Yes
R21	46	16	24	Yes
R22	46	18	24	Yes
R23	46	18	24	Yes
R24	46	17	24	Yes
R25	46	16	23	Yes
R26	46	17	23	Yes
R27	46	17	22	Yes
R28	46	17	22	Yes
R29	46	17	21	Yes
R30	46	15	21	Yes
R31	46	14	21	Yes
R32	46	13	21	Yes

Receiver	Project Noise Trigger Level ($L_{Aeq,15min}$ dBA)	Predicted Noise Levels – Scenario 1 (dBA)	Predicted Noise Levels – Scenario 2 (dBA)	Compliance
R33	46	14	21	Yes
R34	46	23	28	Yes
R35	46	23	29	Yes

Based on the results of Table 4-3 there are no exceedances of the project noise trigger level for either scenario during the day period.

4.3.2 Predicted AM Shoulder $L_{Aeq,15min}$ Operational Noise Levels

The predicted $L_{Aeq,15min}$ noise levels associated with the operation of the Project during the AM shoulder period are presented in Table 4-3.

Table 4-4 Predicted AM shoulder $L_{Aeq,15min}$ operational noise levels

Receiver	Project Noise Trigger Level ($L_{Aeq,15min}$ dBA)	Predicted Noise Levels – Scenario 1 (dBA)	Predicted Noise Levels – Scenario 2 (dBA)	Compliance
R1	43	29	29	Yes
R2	43	30	29	Yes
R3	43	30	29	Yes
R4	43	31	30	Yes
R5	43	28	32	Yes
R6	43	27	31	Yes
R7	43	28	33	Yes
R8	43	27	32	Yes
R9	43	27	32	Yes
R10	43	27	31	Yes
R11	43	25	30	Yes
R12	43	24	31	Yes
R13	43	24	31	Yes
R14	43	15	24	Yes
R15	43	14	24	Yes
R16	43	14	24	Yes
R17	43	12	23	Yes
R18	43	13	22	Yes
R19	43	16	26	Yes
R20	43	15	25	Yes
R21	43	16	25	Yes
R22	43	18	25	Yes

Receiver	Project Noise Trigger Level ($L_{Aeq,15min}$ dBA)	Predicted Noise Levels – Scenario 1 (dBA)	Predicted Noise Levels – Scenario 2 (dBA)	Compliance
R23	43	19	25	Yes
R24	43	18	24	Yes
R25	43	17	24	Yes
R26	43	17	24	Yes
R27	43	17	23	Yes
R28	43	17	22	Yes
R29	43	17	22	Yes
R30	43	16	22	Yes
R31	43	15	22	Yes
R32	43	14	21	Yes
R33	43	14	21	Yes
R34	43	23	29	Yes
R35	43	23	30	Yes

Based on the results of Table 4-4 there are no exceedances of the project noise trigger level for either scenario during the AM shoulder period.

4.3.3 Environmental Protection License Noise Limits

EPL Limit L3.1 states that *noise emissions from the premises must not exceed an Leq(15 minute) noise emission criterion of 35 dB(A) at the nearest residential receiver*. This assessment has predicted a maximum $L_{Aeq,15min}$ noise level at any receiver of 33dBA. Compliance with this limit condition is therefore predicted to be achieved at all times.

4.3.4 Cumulative Noise Impacts

The noise assessment methodology recommended by the *NPfI* implicitly considers potential cumulative impacts from multiple industrial activities through the amenity noise levels. Furthermore, all predicted $L_{Aeq,15min}$ noise levels are 10dB or more below the project noise trigger level. It is therefore expected that the quarry will have a negligible contribution to the total $L_{Aeq,15min}$ noise levels at receivers near the site.

4.3.5 L_{Amax} Operational Noise Levels

A typical L_{Amax} sound power level can range from 3-7 dBA above the operational L_{Aeq} sound power level. As detailed above, the predicted $L_{Aeq,15min}$ noise levels during the morning shoulder period are well below the project specific criterion at each receiver. Given this, the Project will also meet the maximum noise trigger levels detailed in Table 3-8. No further assessment of maximum noise levels is therefore warranted.

4.4 Road traffic noise assessment

Based on information sourced from the Traffic Impact Assessment for this Project (Transport & Urban Planning, 2019), the site will be accessed via the following routes:

a) Nelson Bay Road between Cabbage Tree Road and Seaside Boulevard and Cabbage Tree Road/Tomago Road for access to the Central Coast, Sydney and Hunter Valley. This route accounts for 50% of vehicle movements.

b) Nelson Bay Road (south of Coxs Lane) and Tourle Street/Cormorant Road for access to the Newcastle area. This route accounts for 45% of vehicle movements.

c) Nelson Bay Road, north of Cabbage Tree Road and Medowie Road for access to Port Stephens and North Coast. This route accounts for 5% of vehicle movements.

These roads are classified as arterial or sub-arterial based on the classification guidelines in the *RNP*.

Traffic generation for the Project is predicted to result in an increase of 84 heavy vehicle movements on an average weekday and 132 movements on a busy weekday. Traffic movements on Saturdays are predicted to be minimal based on current operations and therefore assessment of Saturday movements has not been conducted.

These movements have been divided evenly across the operating hours of the site and divided between the routes as described above. The breakdown of movements is presented in Table 4-5. As a conservative approach the assessment has been conducted based on the busy day scenario.

Two-way 5-day average traffic volumes for the surrounding road network have also been sourced from the Traffic Impact Assessment. The increase in traffic noise due to the additional heavy traffic from the Project has been assessed using the *CORTN* calculation method.

Table 4-5 Busy weekday movements

Route	% of Project Movements	Increase in Busy Day Heavy Vehicles from Project	Existing Daily (Weekday) Average Traffic Volume		Relative Noise Increase (dBA)
			Total	% of Heavy Vehicles	
a)	50	66	10857	10.5	<0.2
b)	45	59	26264	5.2	<0.1
c)	5	7	7206	6.1	<0.1

Compliance is expected to be achieved on a busy day at all assessment locations, with predicted relative increases of less than 0.2 dB along all routes. Based on compliance during the busy weekday, it is expected that compliance will be comfortably achieved during an average weekday.

5 CONCLUSION

Wilkinson Murray Pty Limited has been engaged by Element Environment on behalf of Boral to conduct a Noise Impact Assessment for the proposed continued and expanded operations at the Stockton Sand Quarry.

This NIA provides a detailed assessment of potential operational noise impacts associated with the Project and will accompany an Environmental Impact Statement for submission to the Department of Planning, Industry and Environment. The assessment has been conducted in general accordance with the *Noise Policy for Industry* (NPfI) and the Quarry's existing Environmental Protection License noise limits.

Unattended noise monitoring was conducted to determine the existing ambient noise levels at the most potentially affected residential receivers in the area surrounding the Project.

Based on information from Boral, operating parameters, equipment and source sound power levels have been developed to describe several noise assessment scenarios for the Project.

$L_{Aeq,15min}$ operational noise levels have been predicted at sensitive receivers for each assessment scenario. The predicted noise levels comply with the established project noise trigger levels. In accordance with the *Noise Policy for Industry* and *Voluntary Land Acquisition and Mitigation Policy*, no further noise mitigation measures or controls are warranted.

Noise impacts due to heavy vehicle movements on the surrounding road network have been assessed. The predicted relative increase in noise levels are within the allowable limits outlined in the *Road Noise Policy* on all designate access routes.

APPENDIX A

NOISE MEASUREMENT RESULTS

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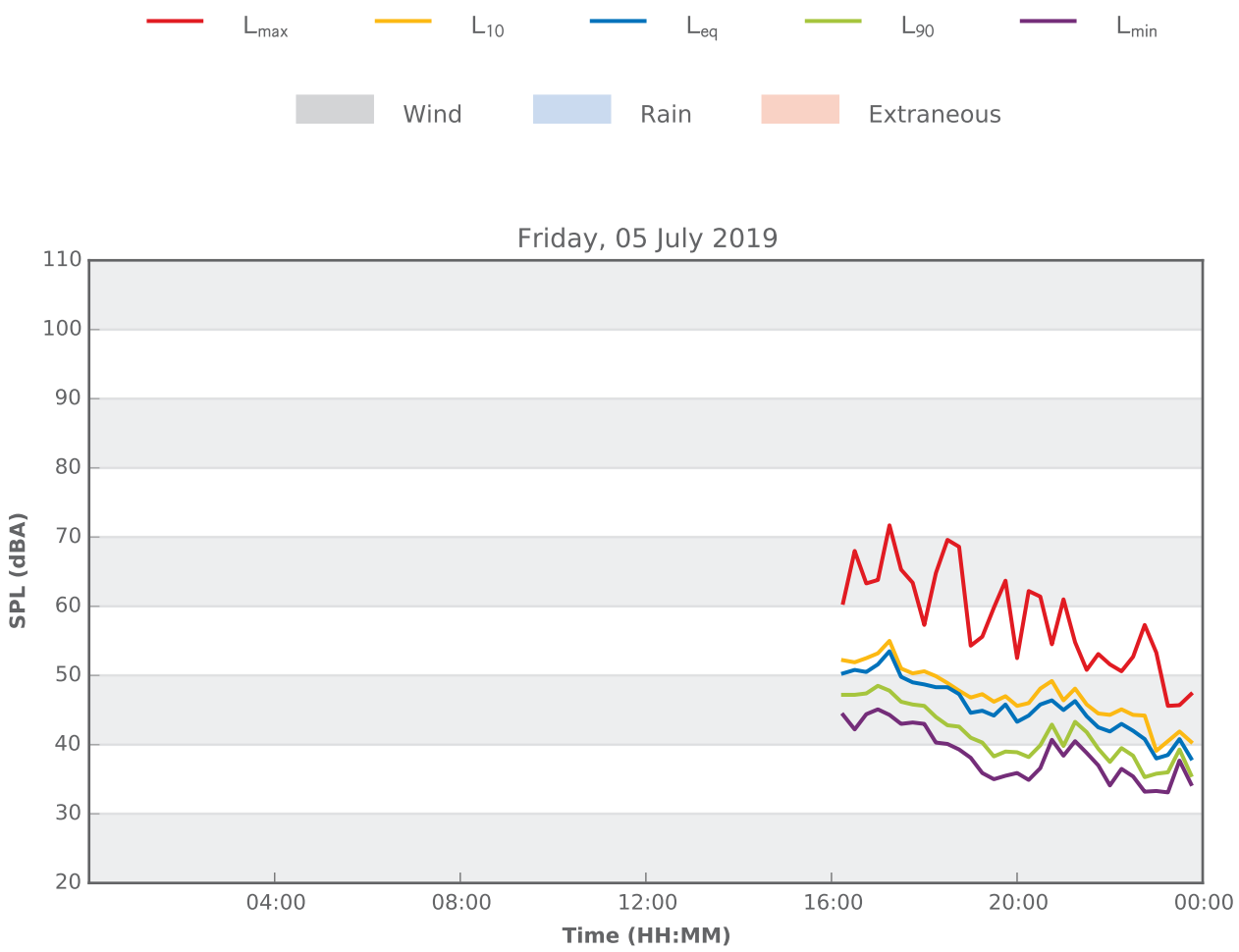

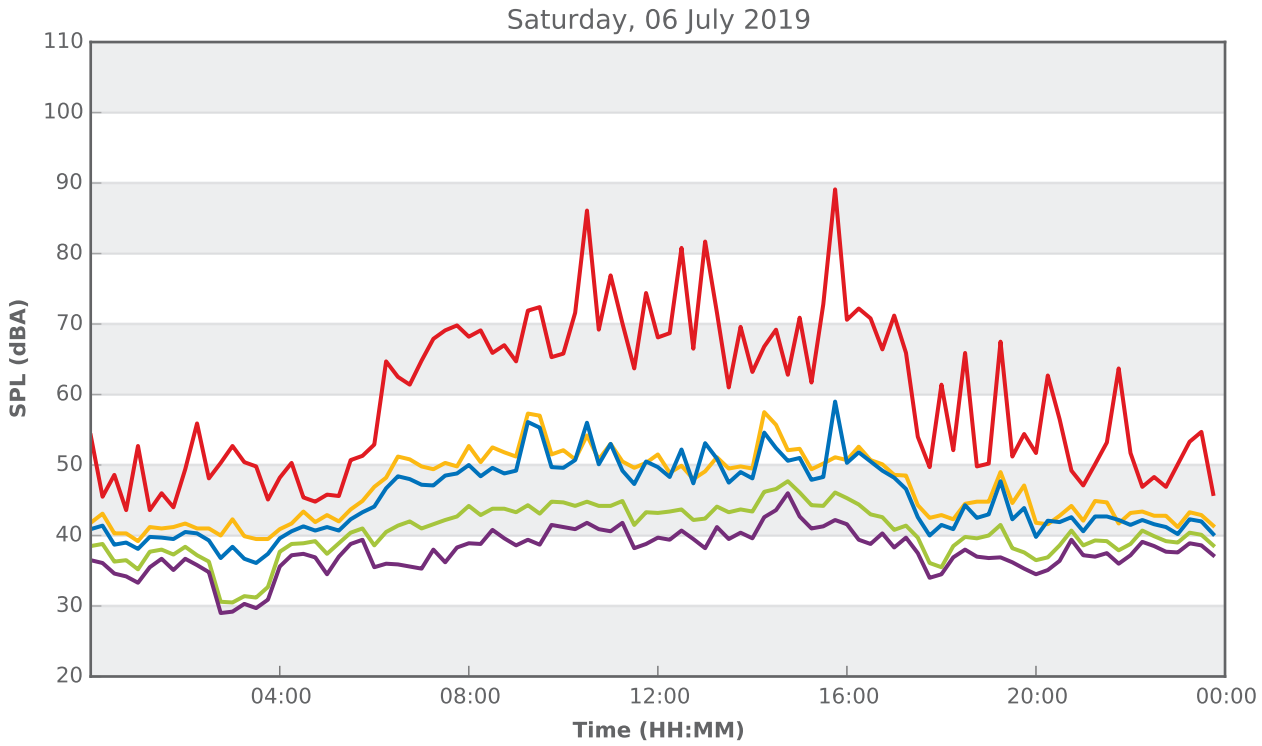

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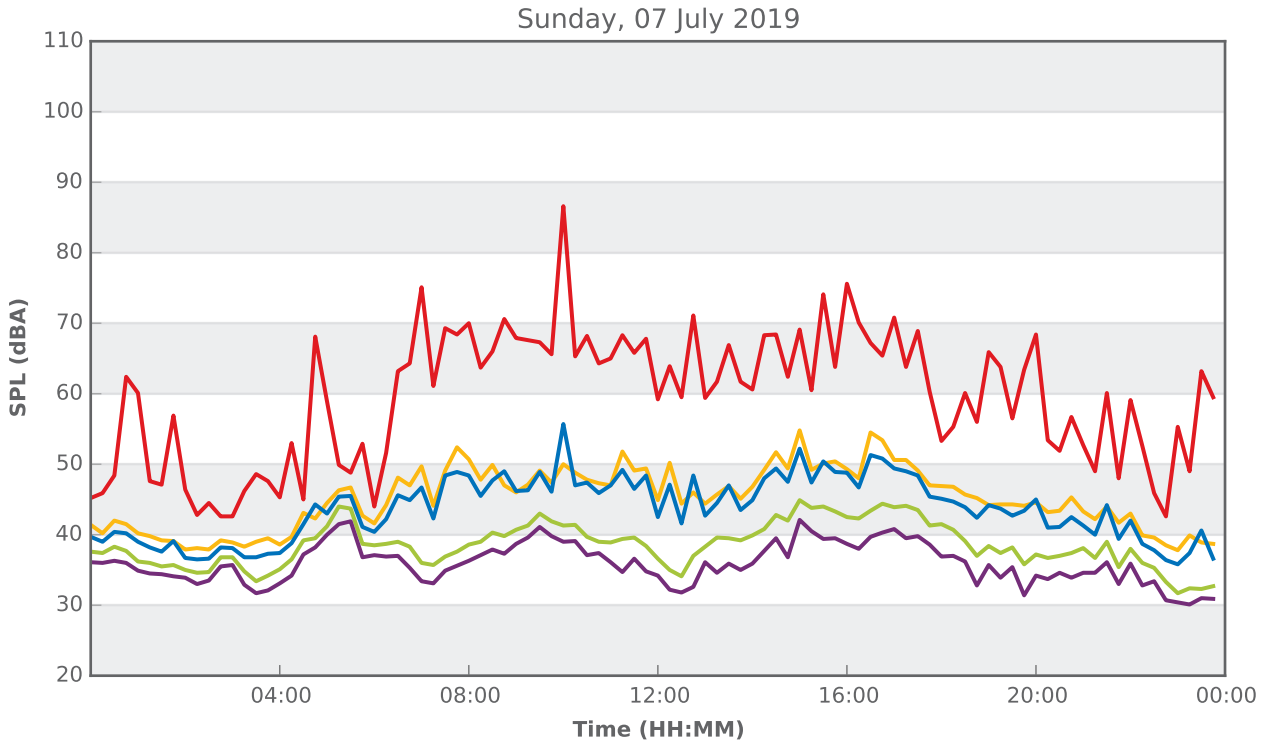

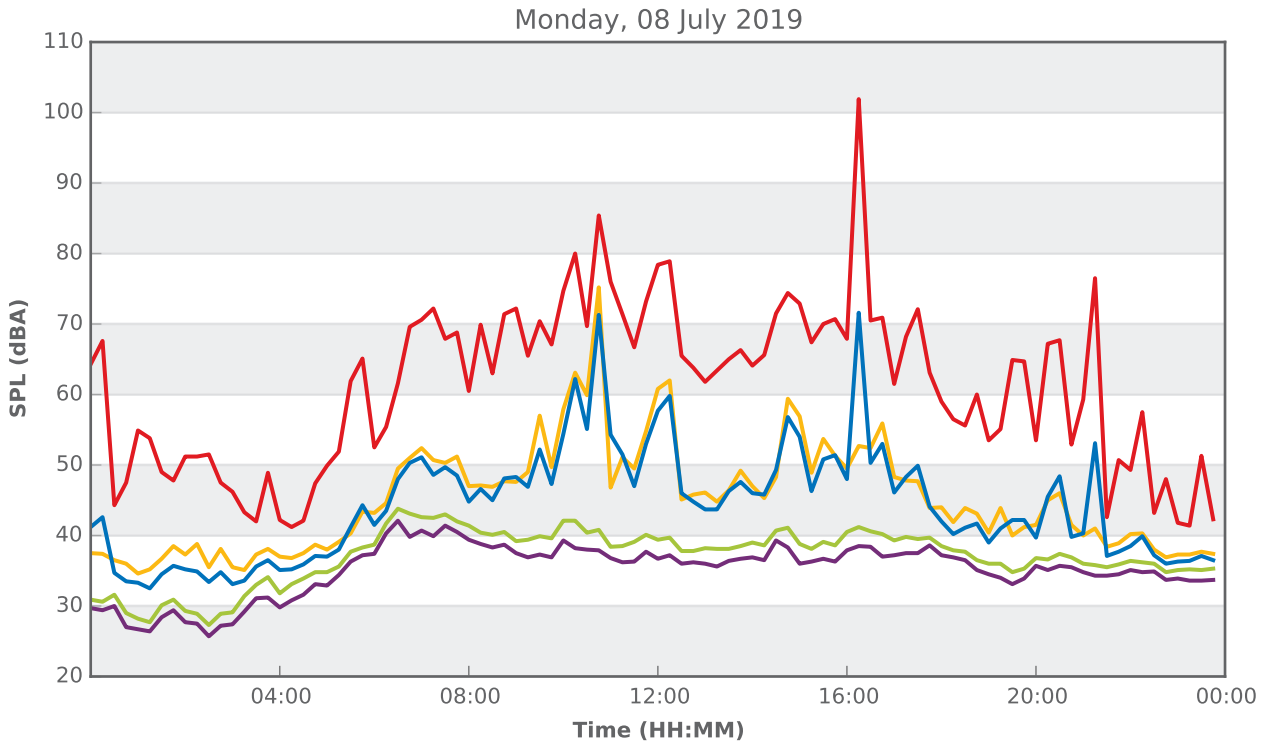

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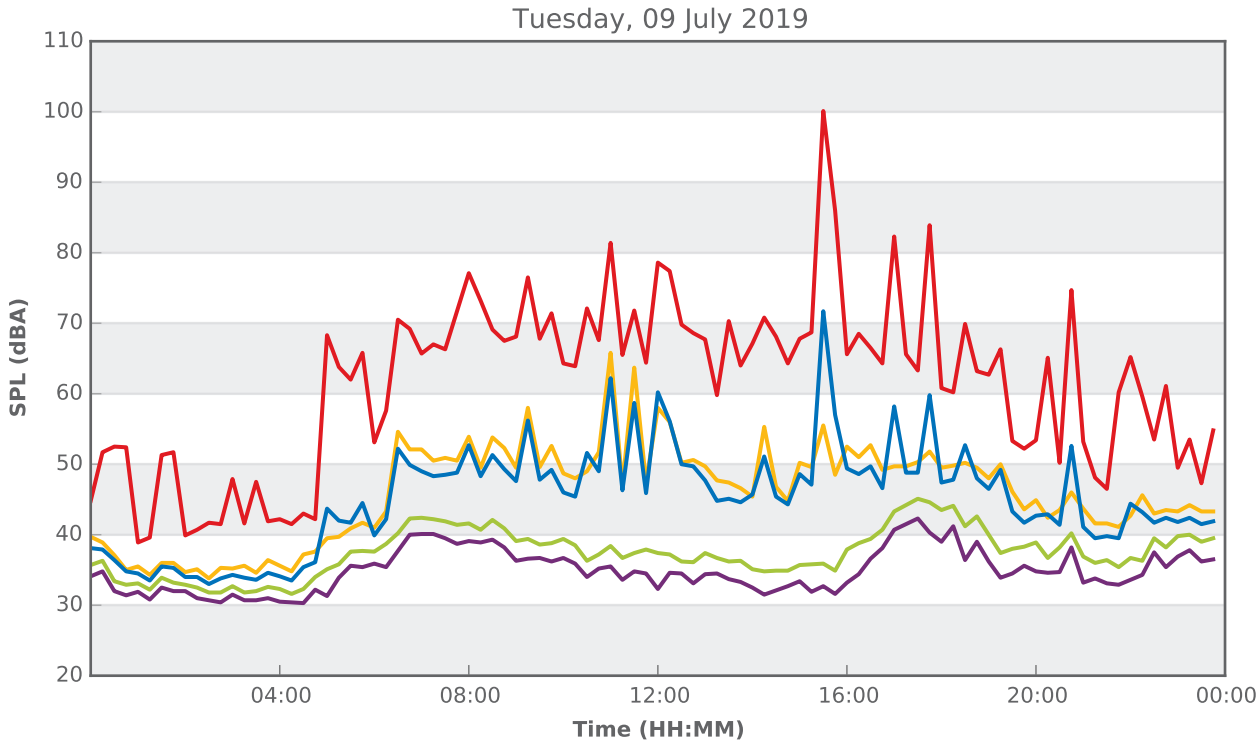

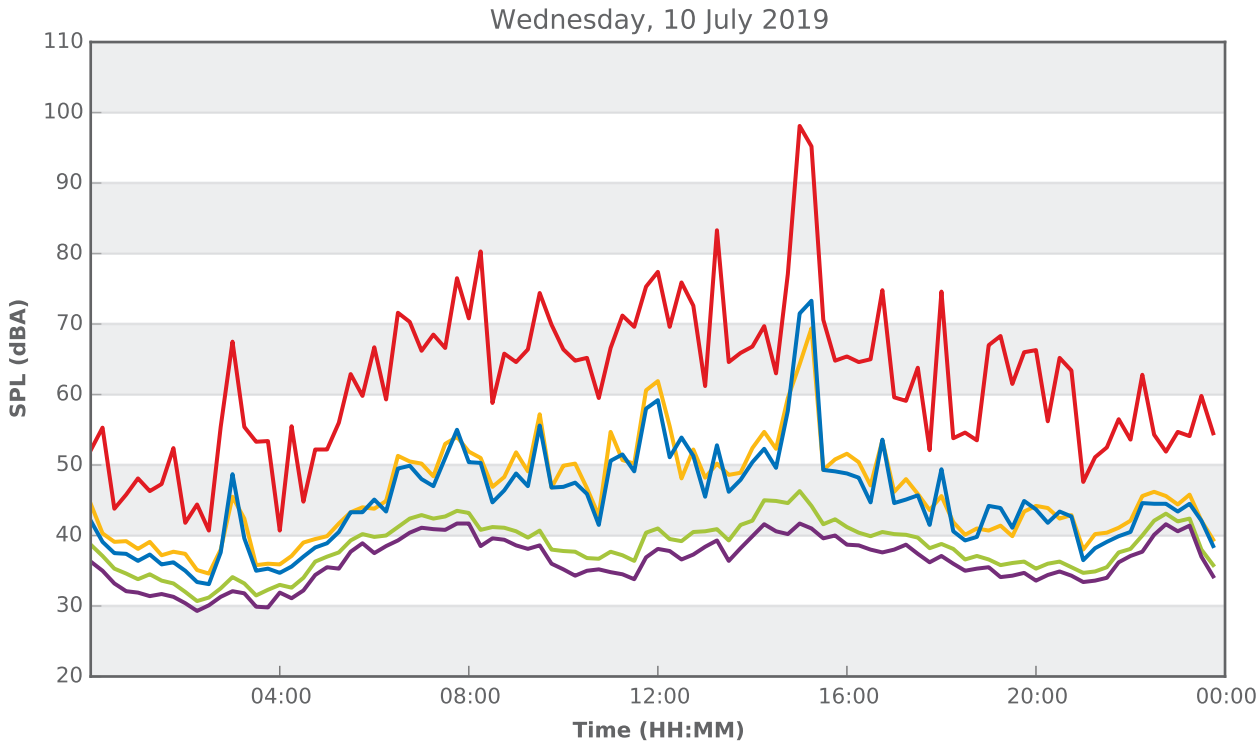

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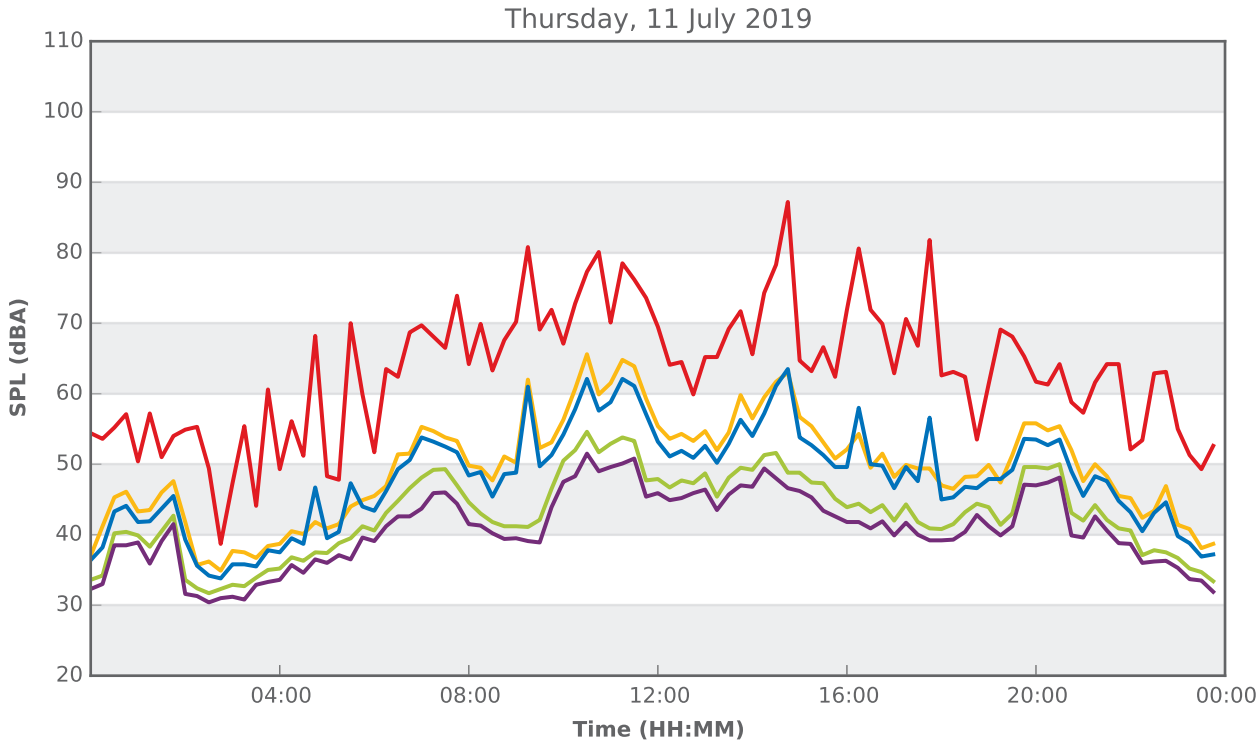

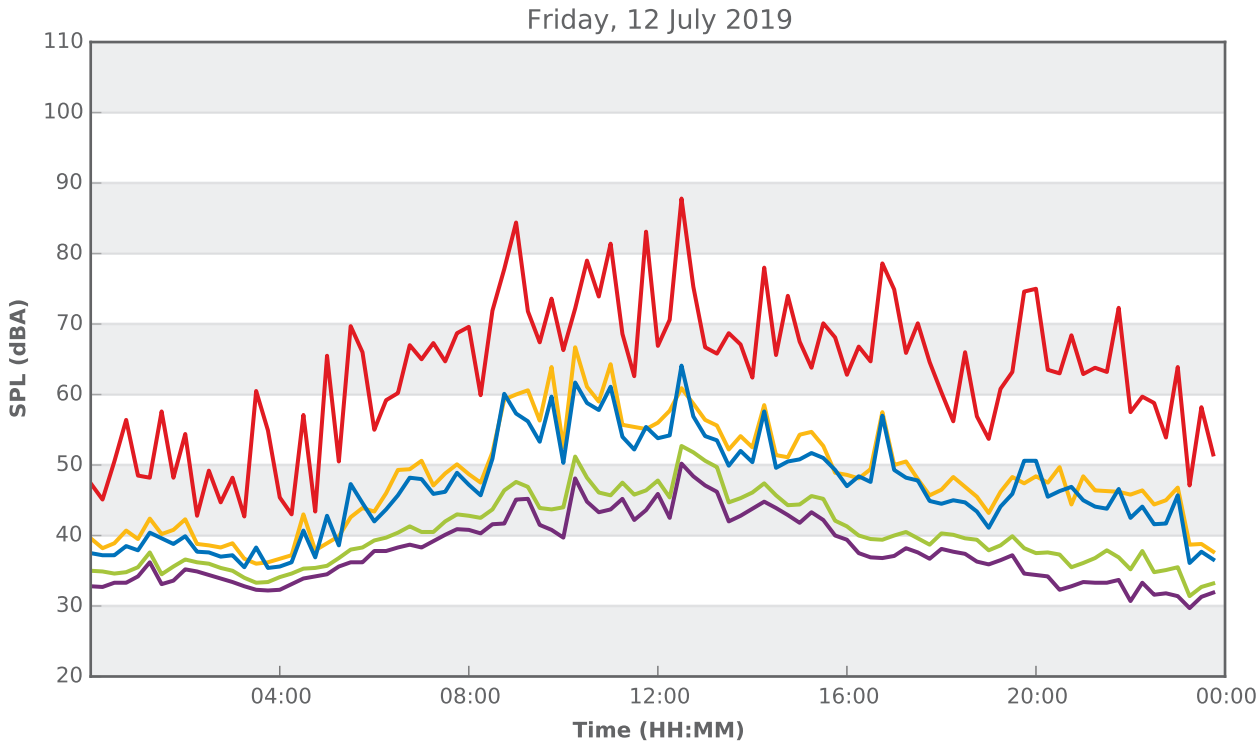

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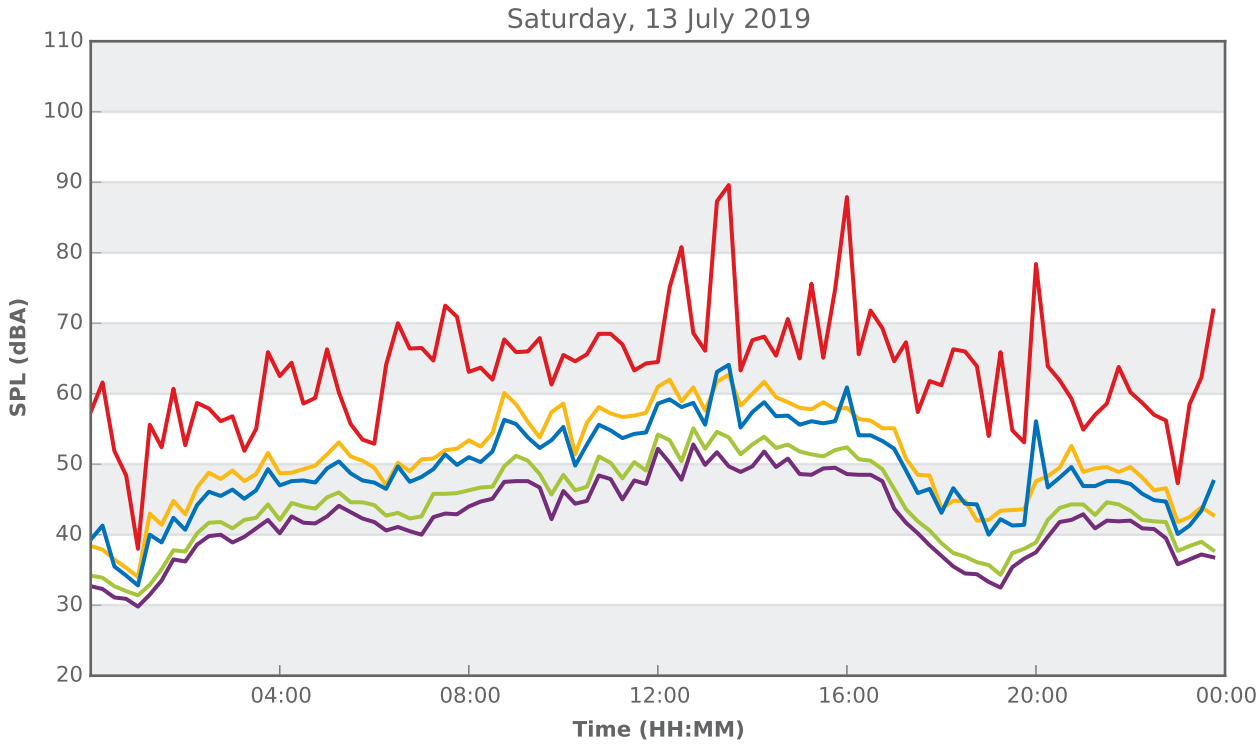

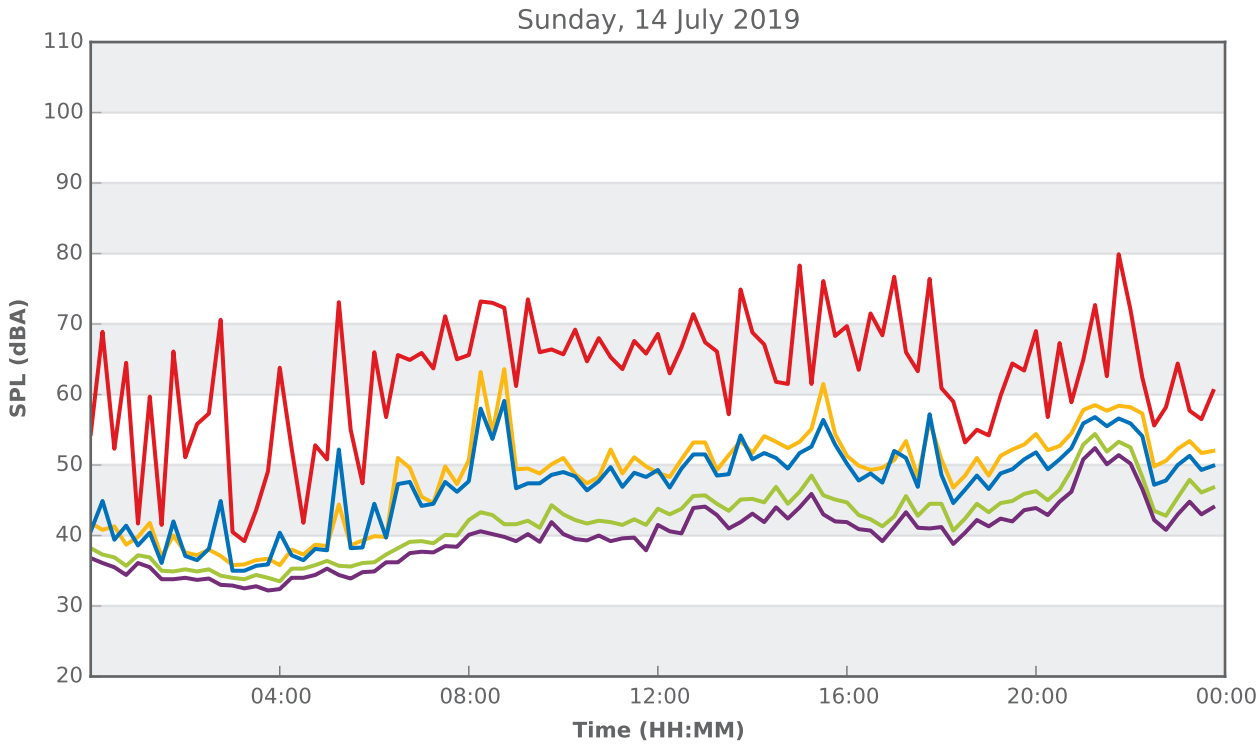

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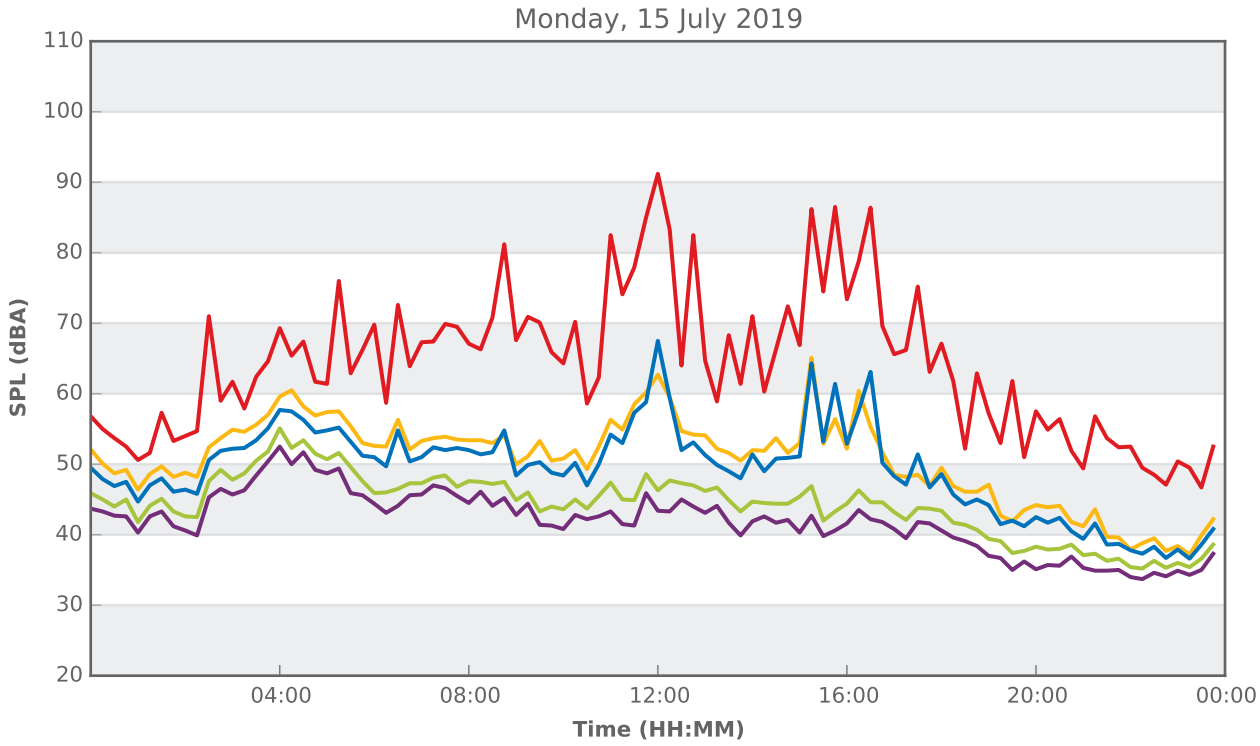

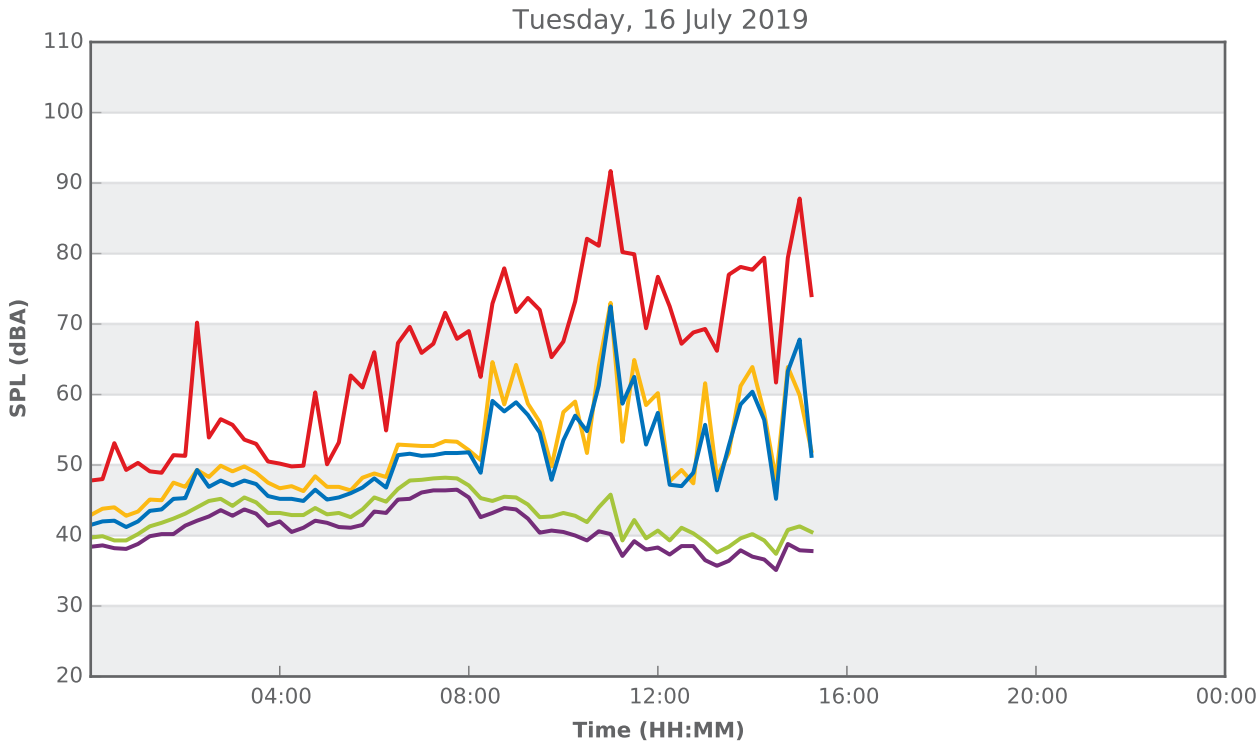

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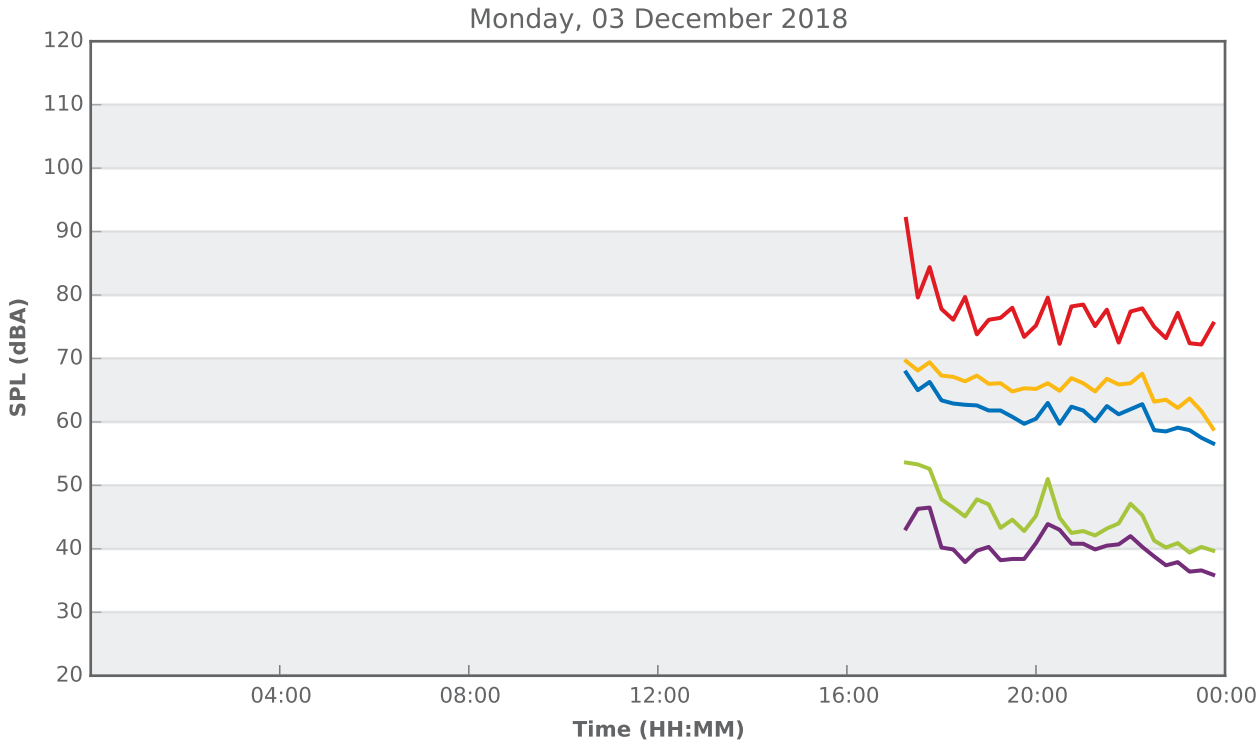

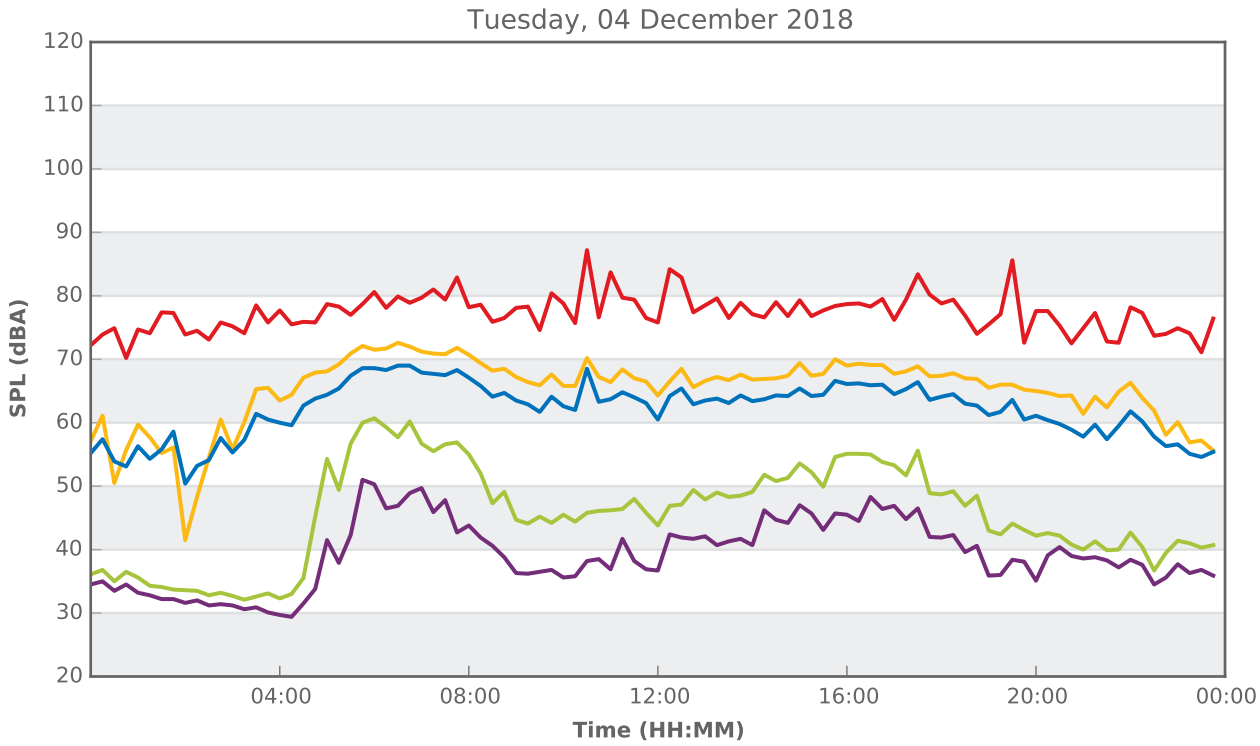

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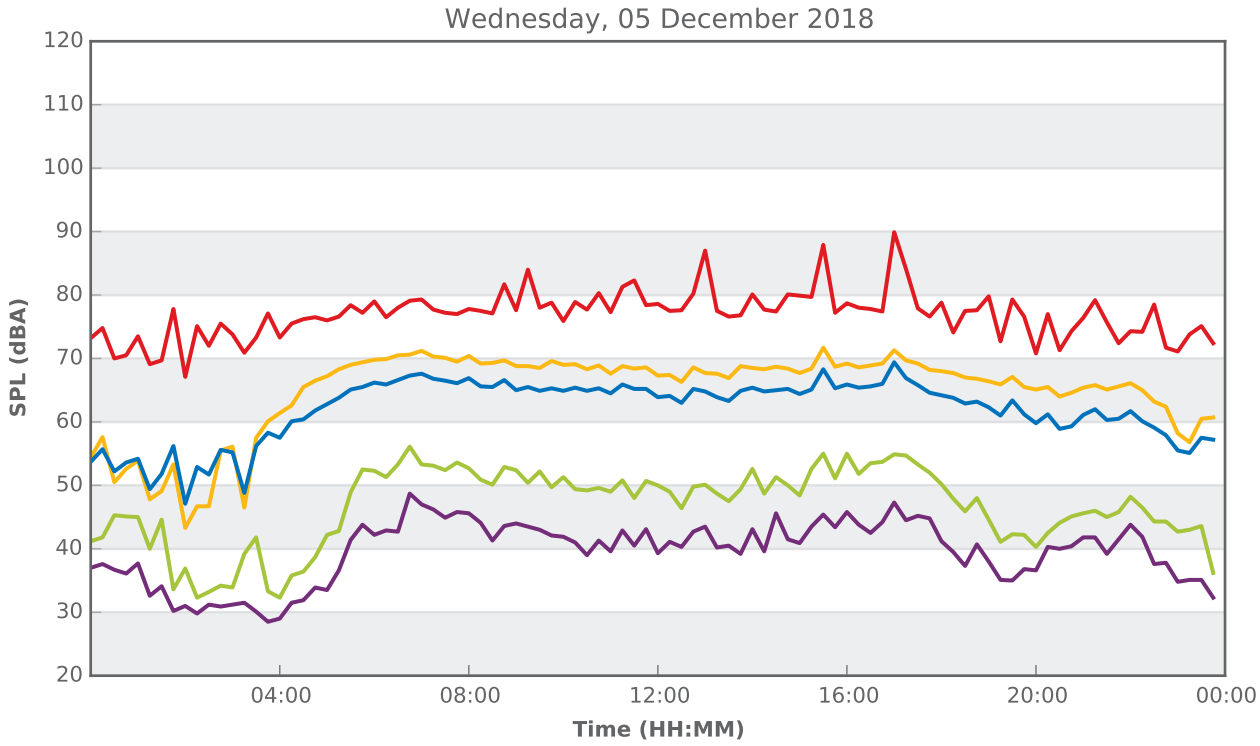

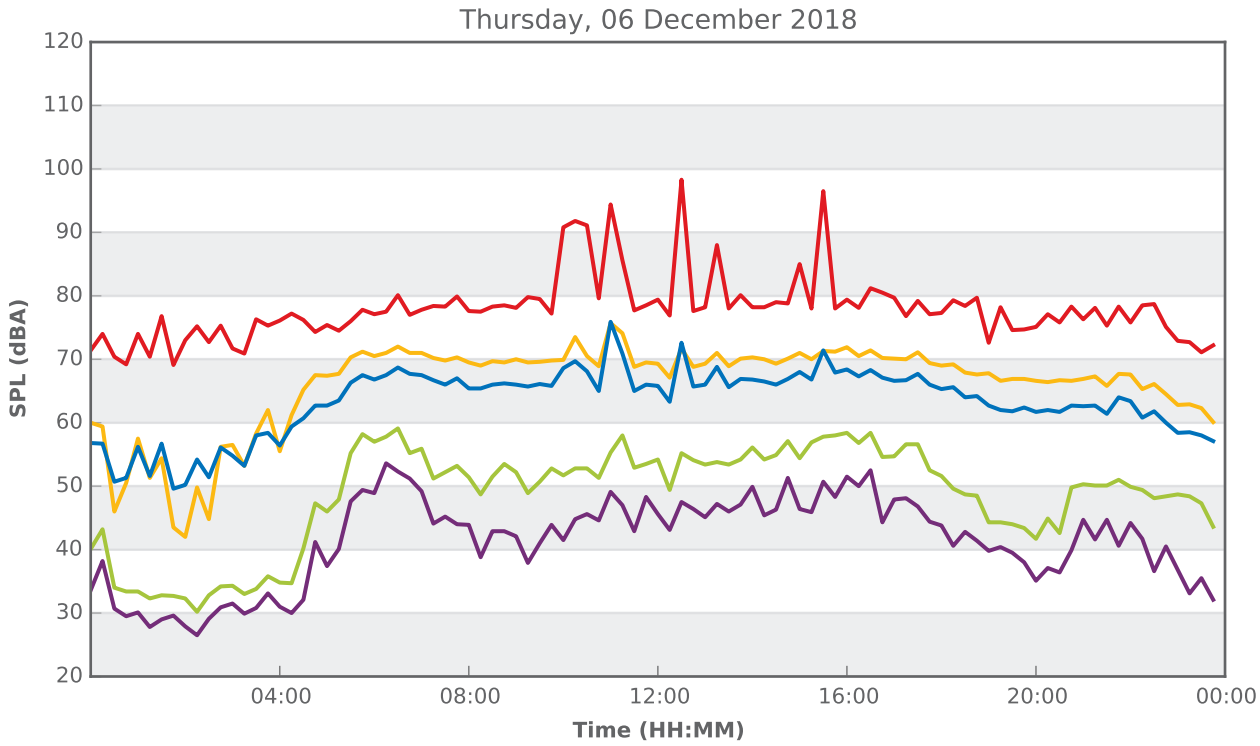

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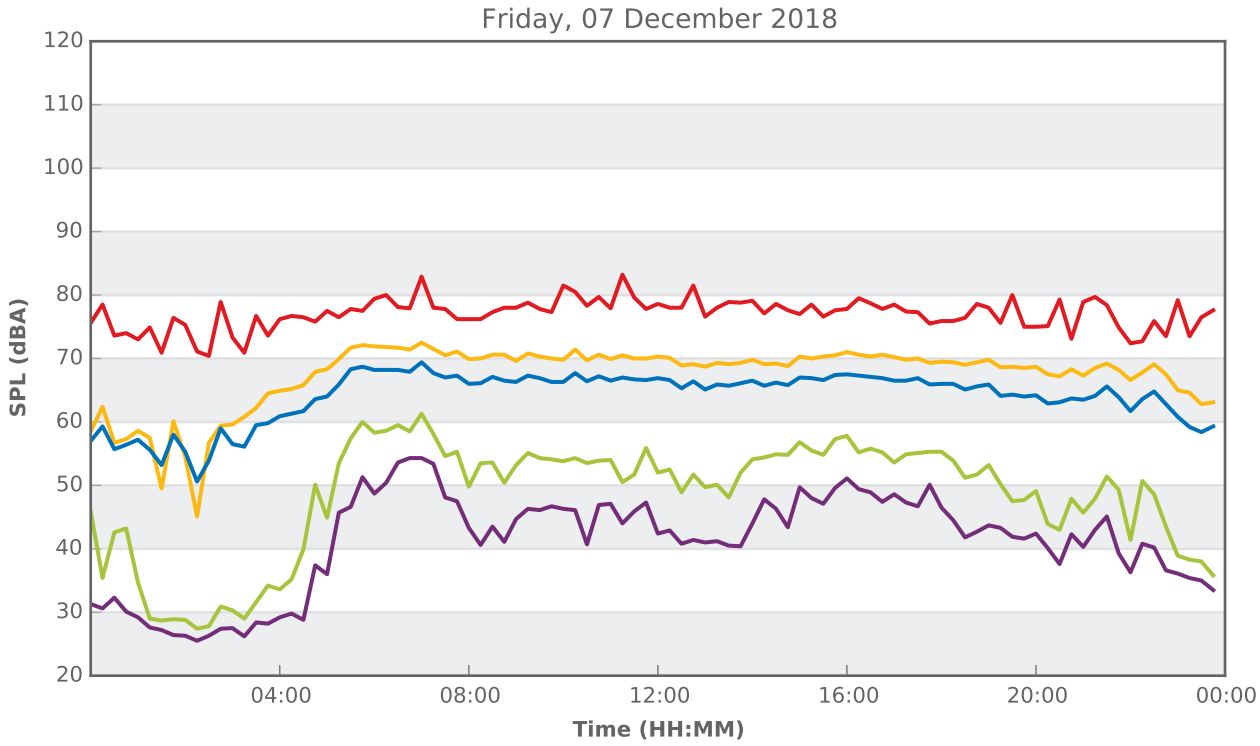

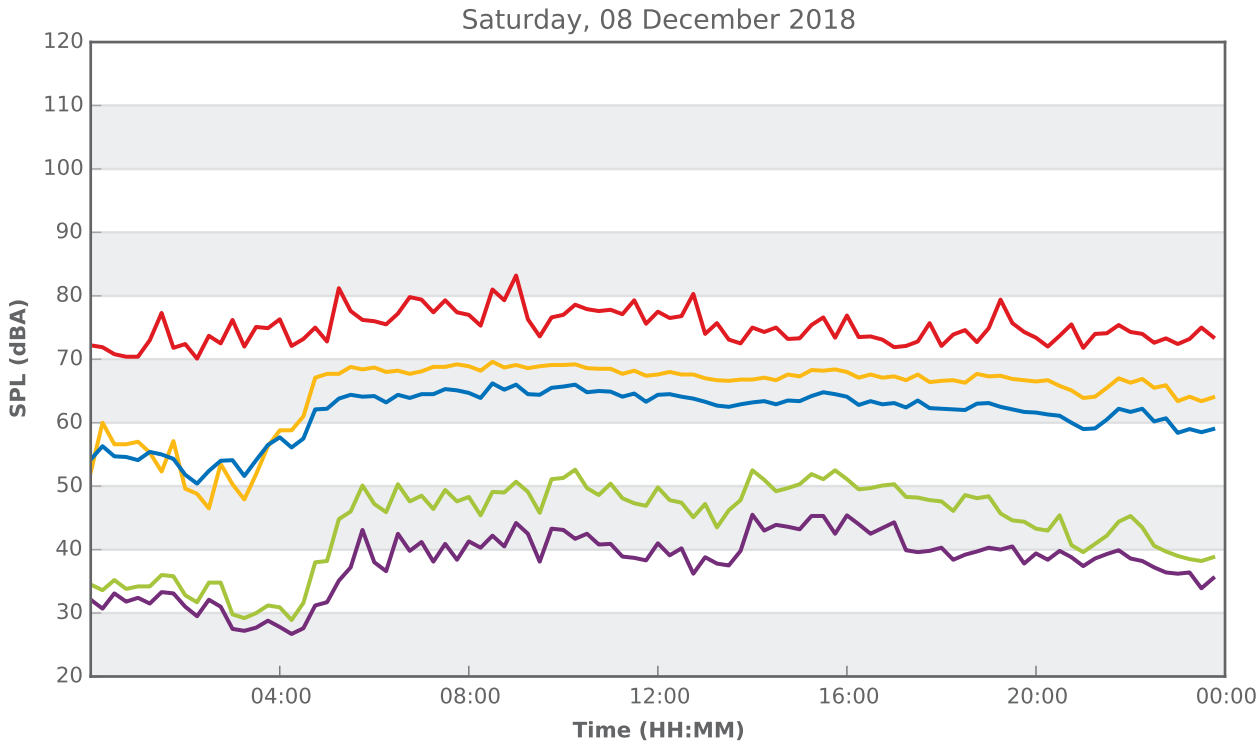

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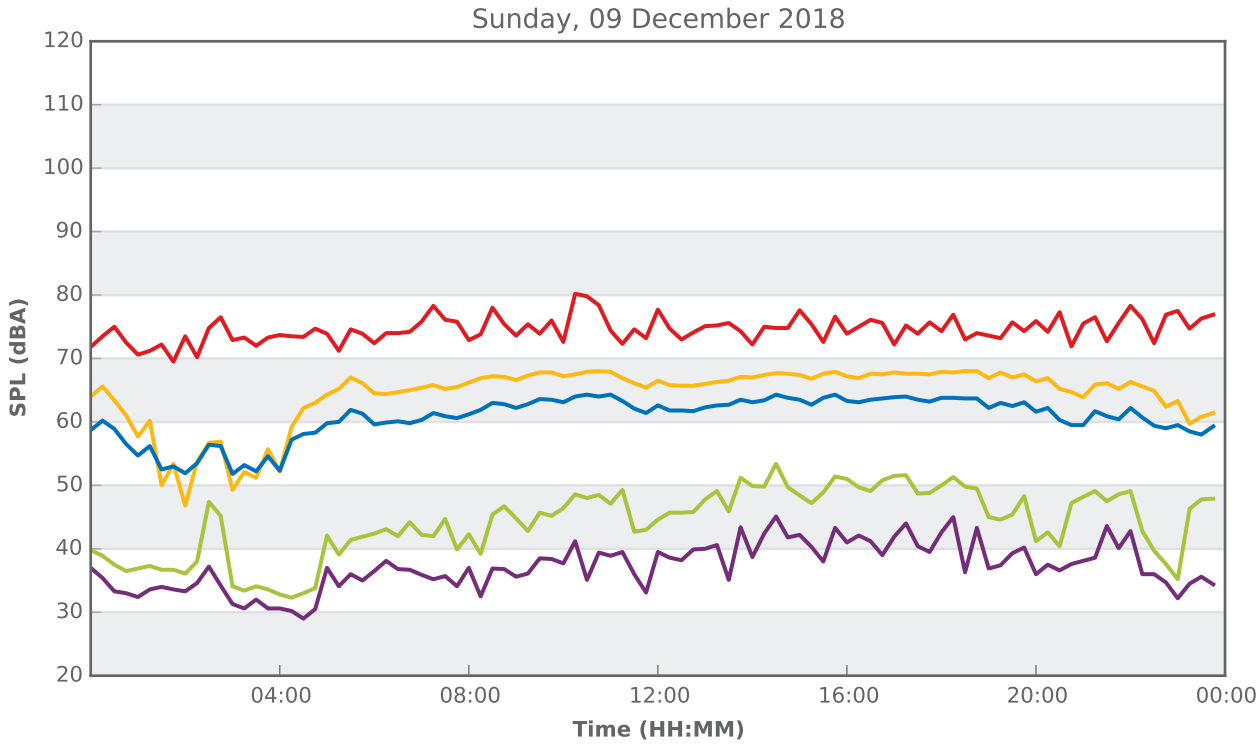

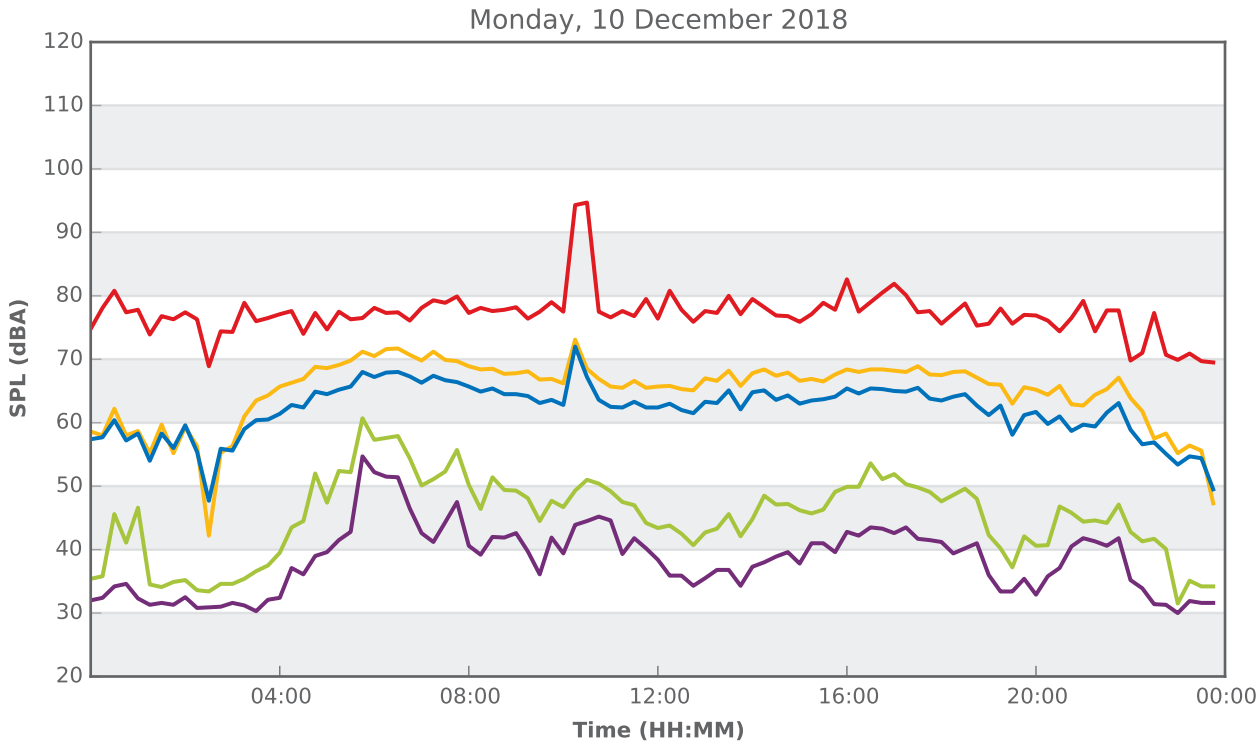

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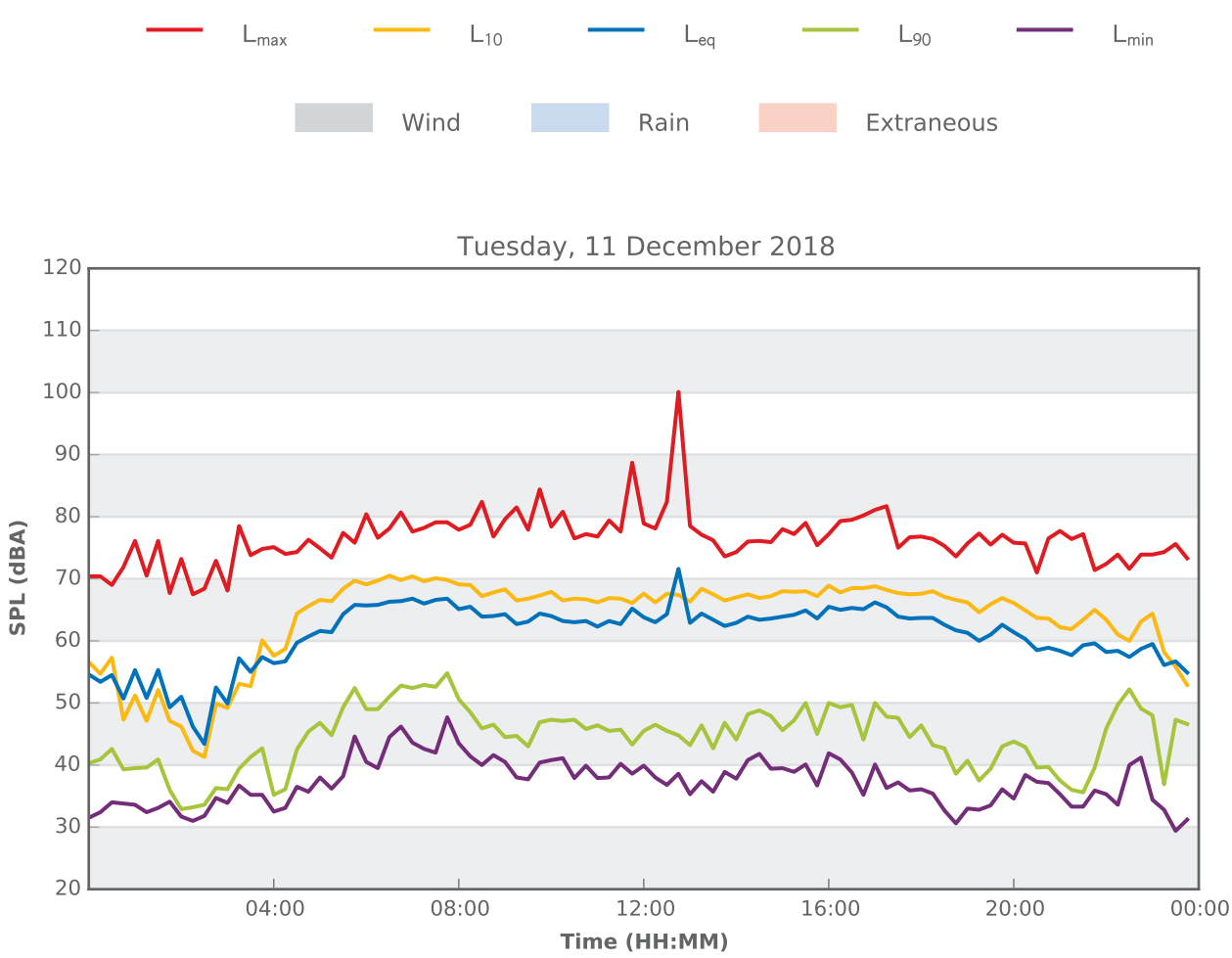

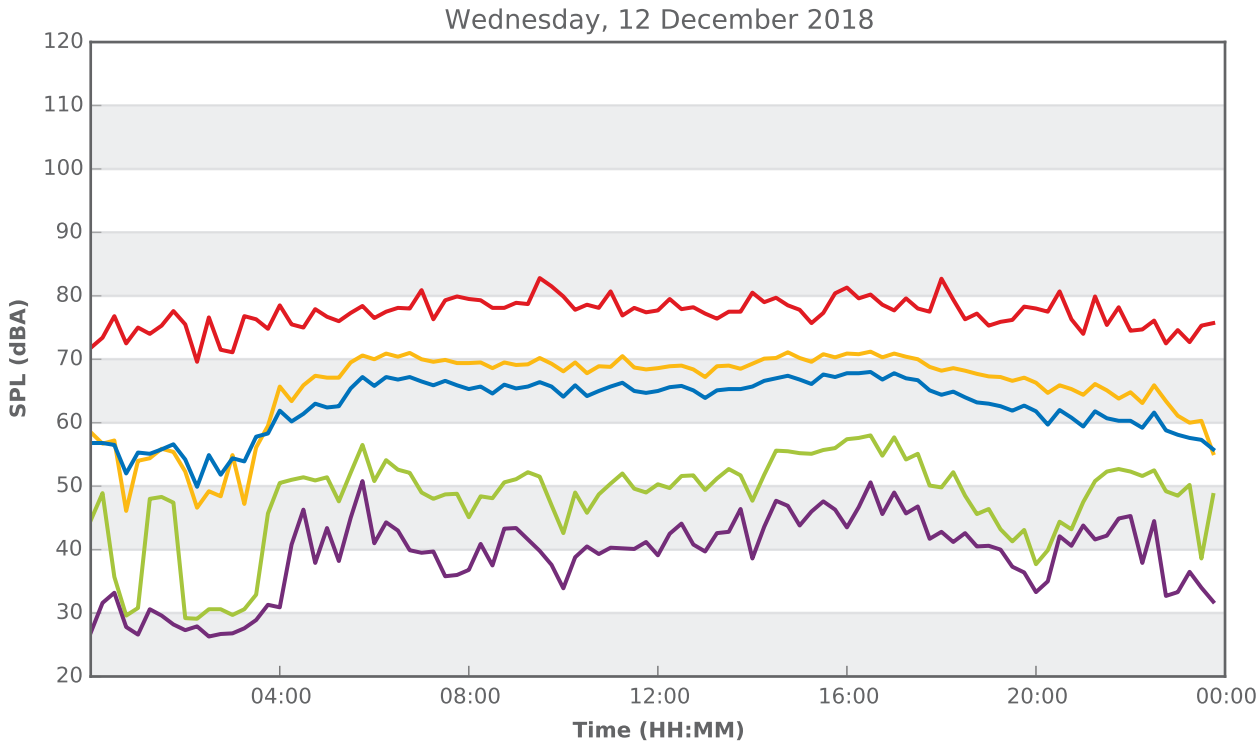

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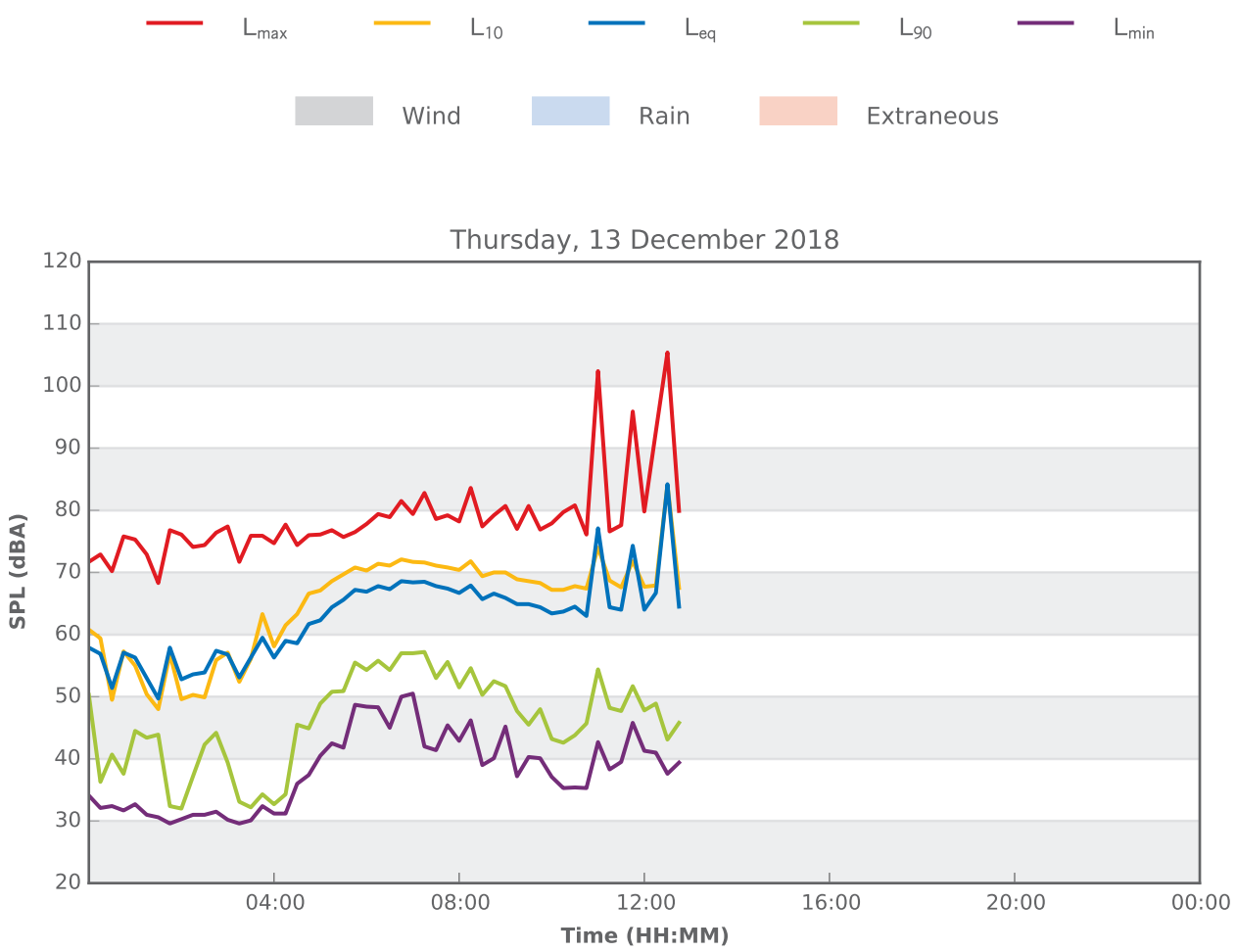

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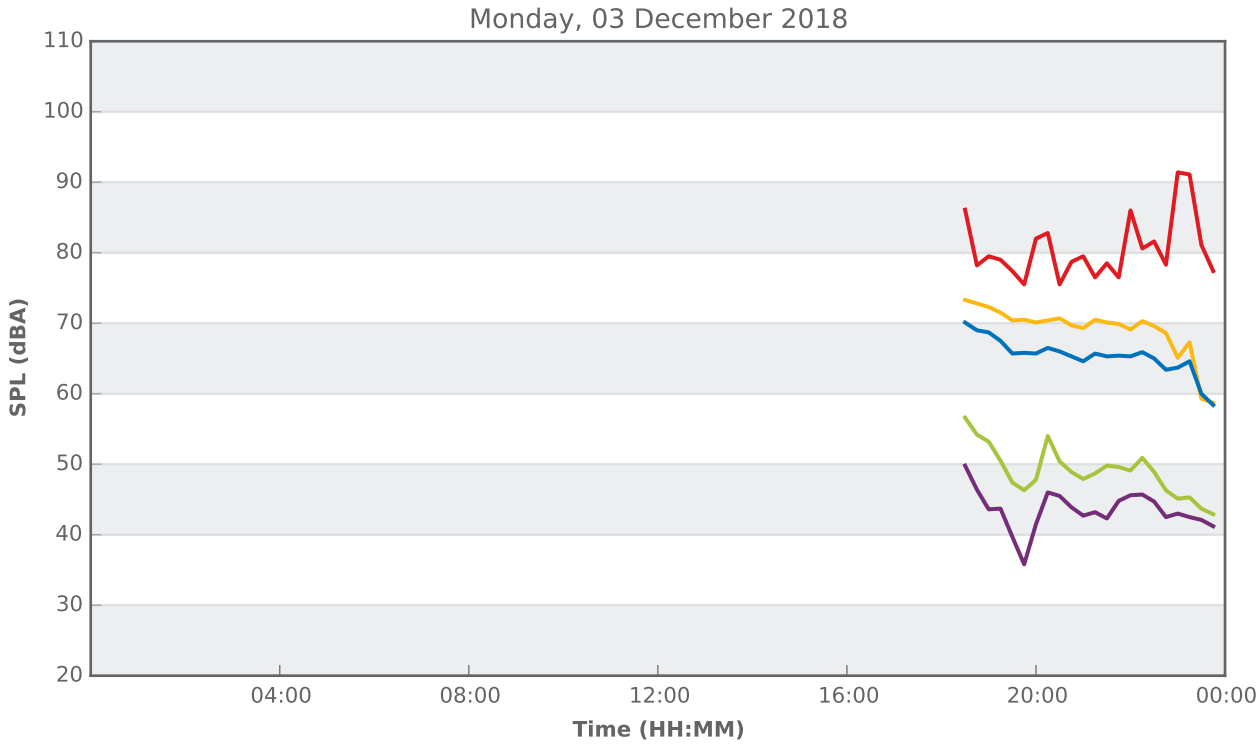

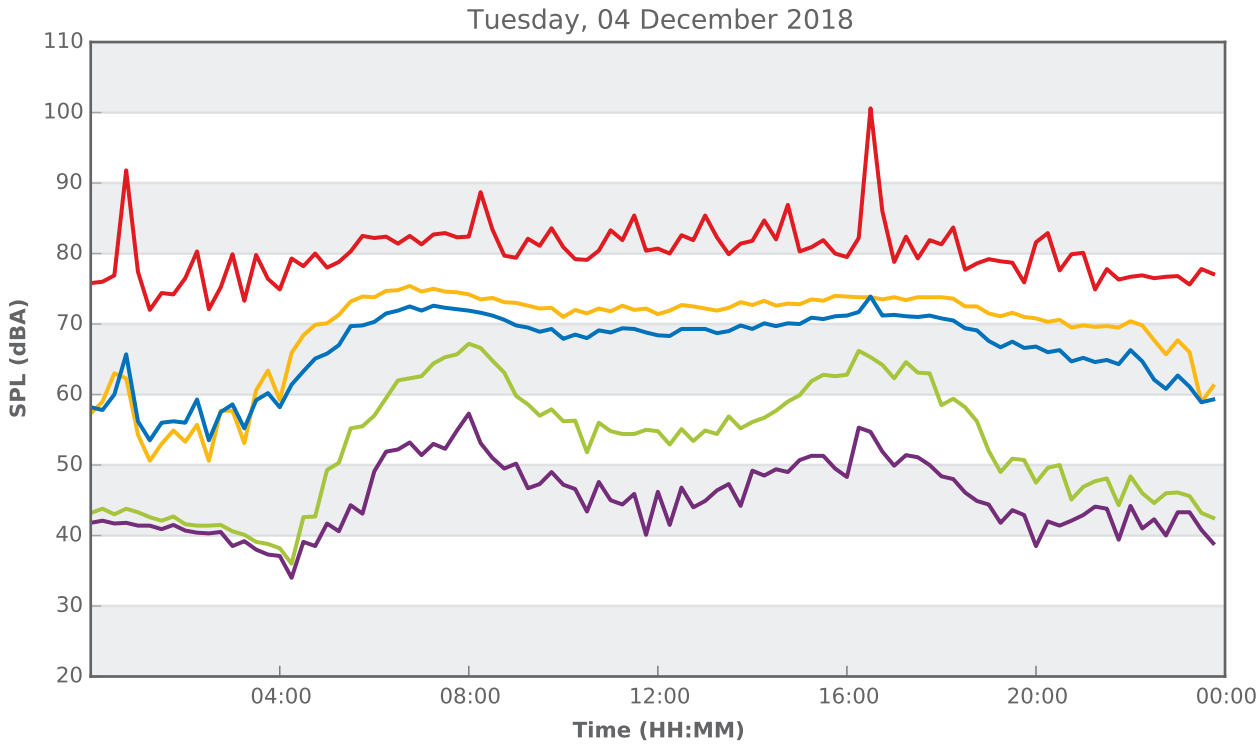

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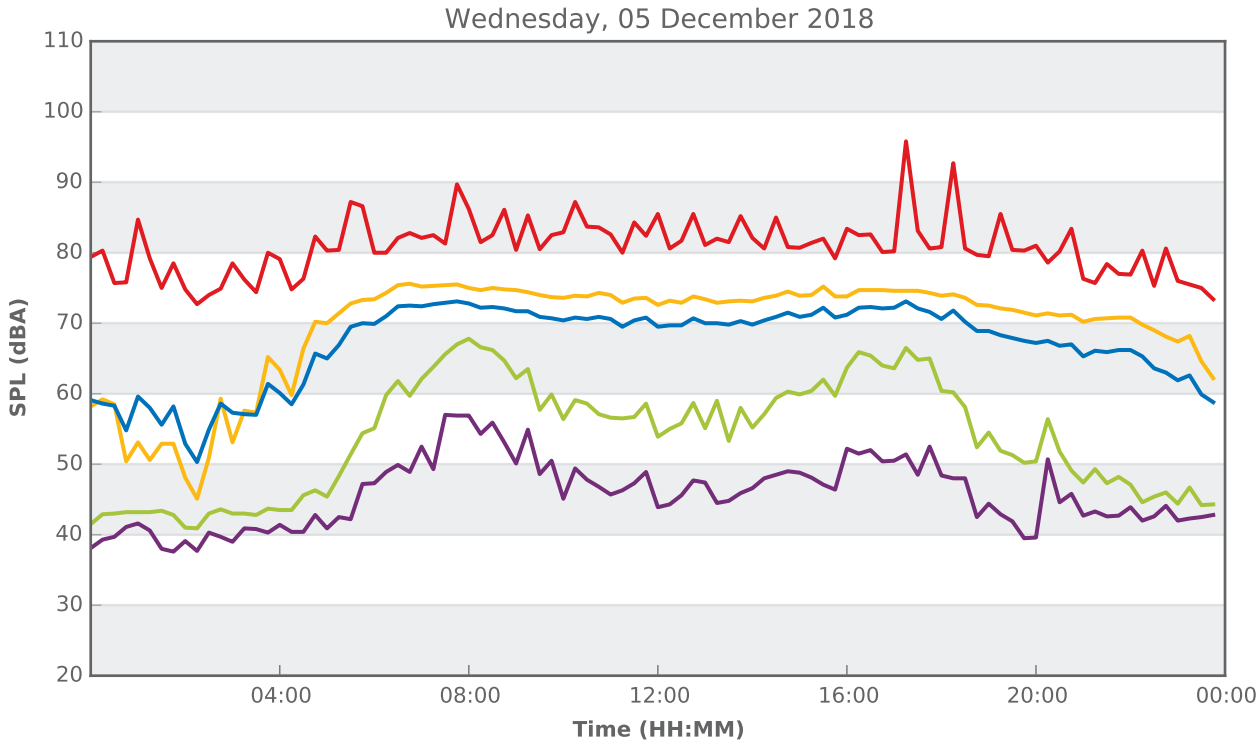

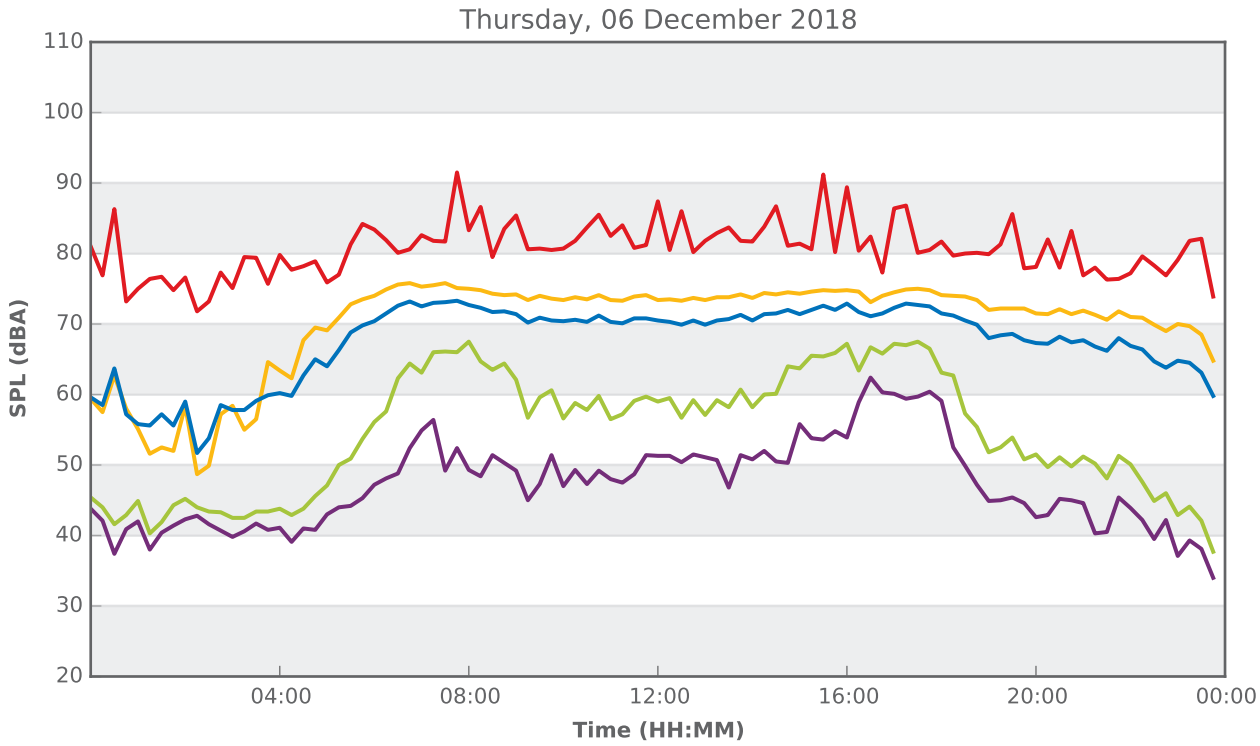

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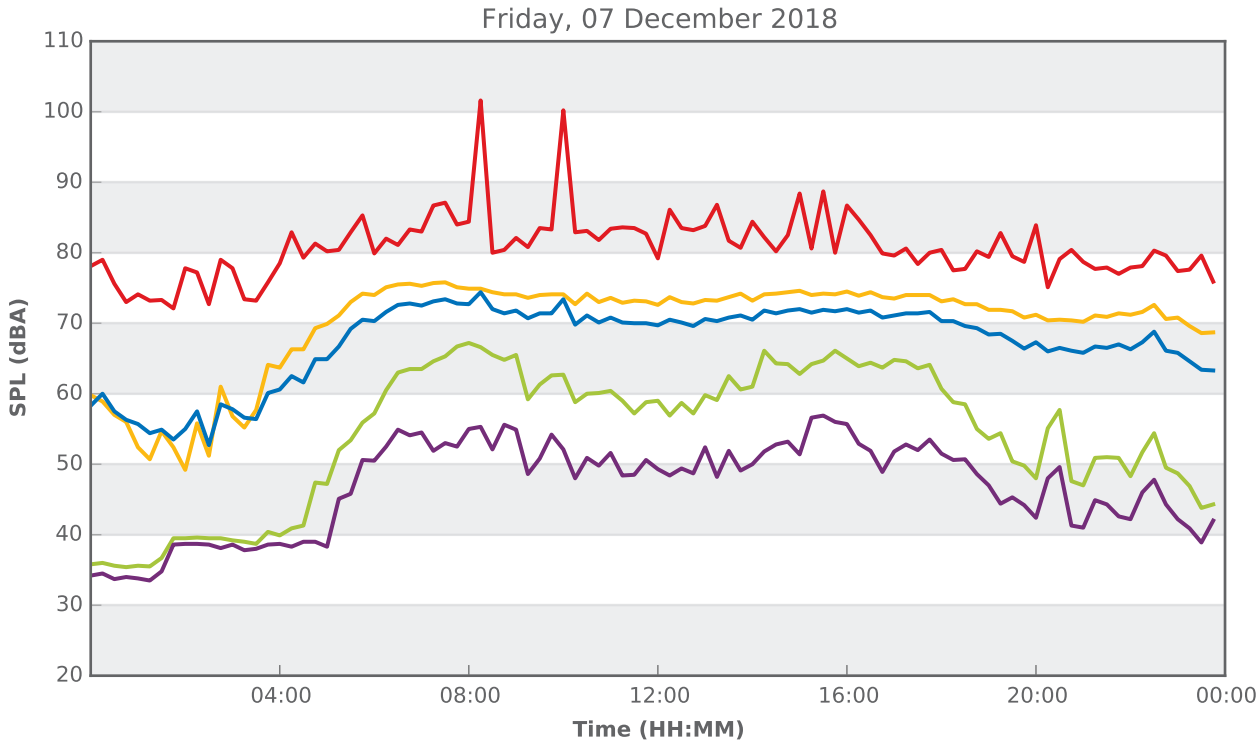

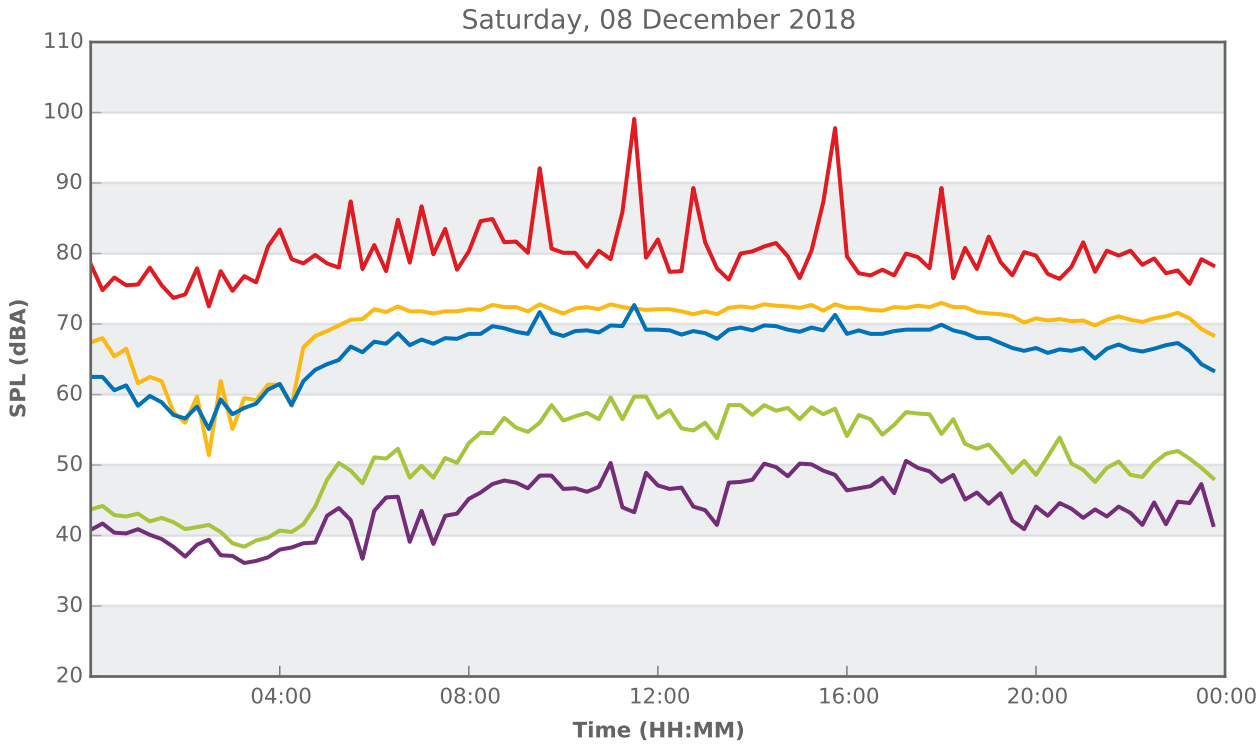

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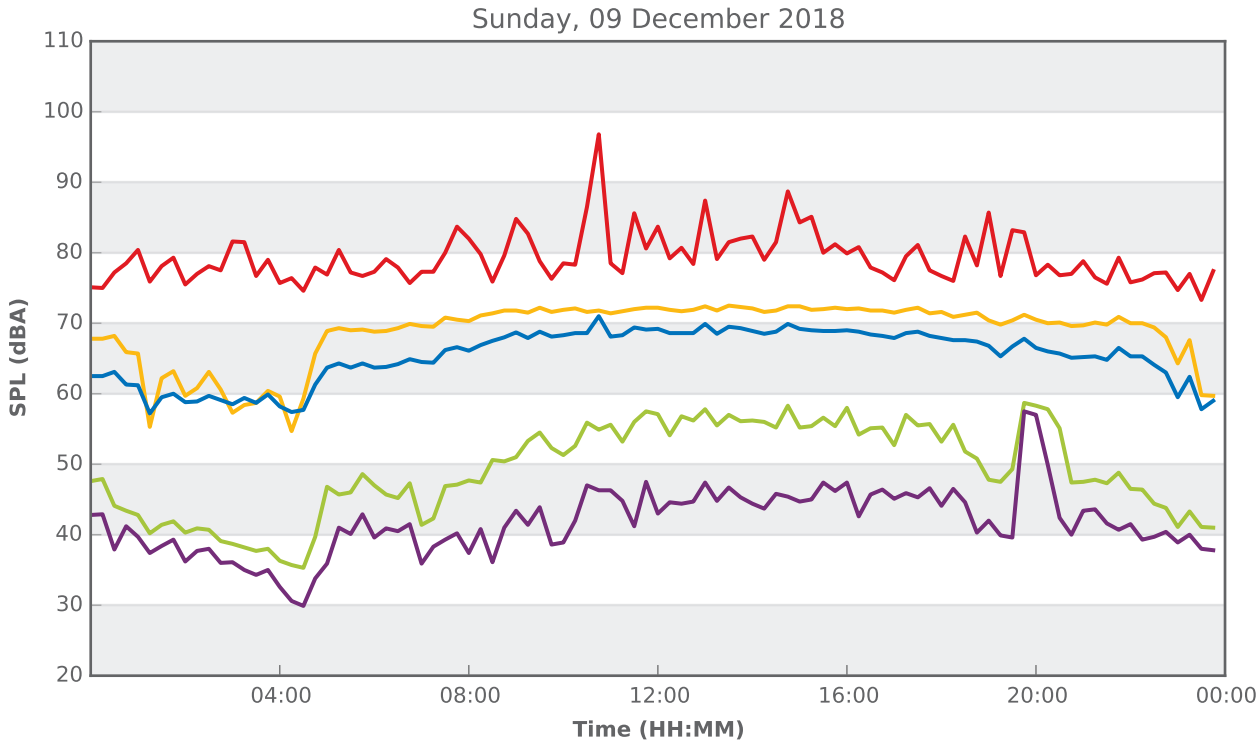

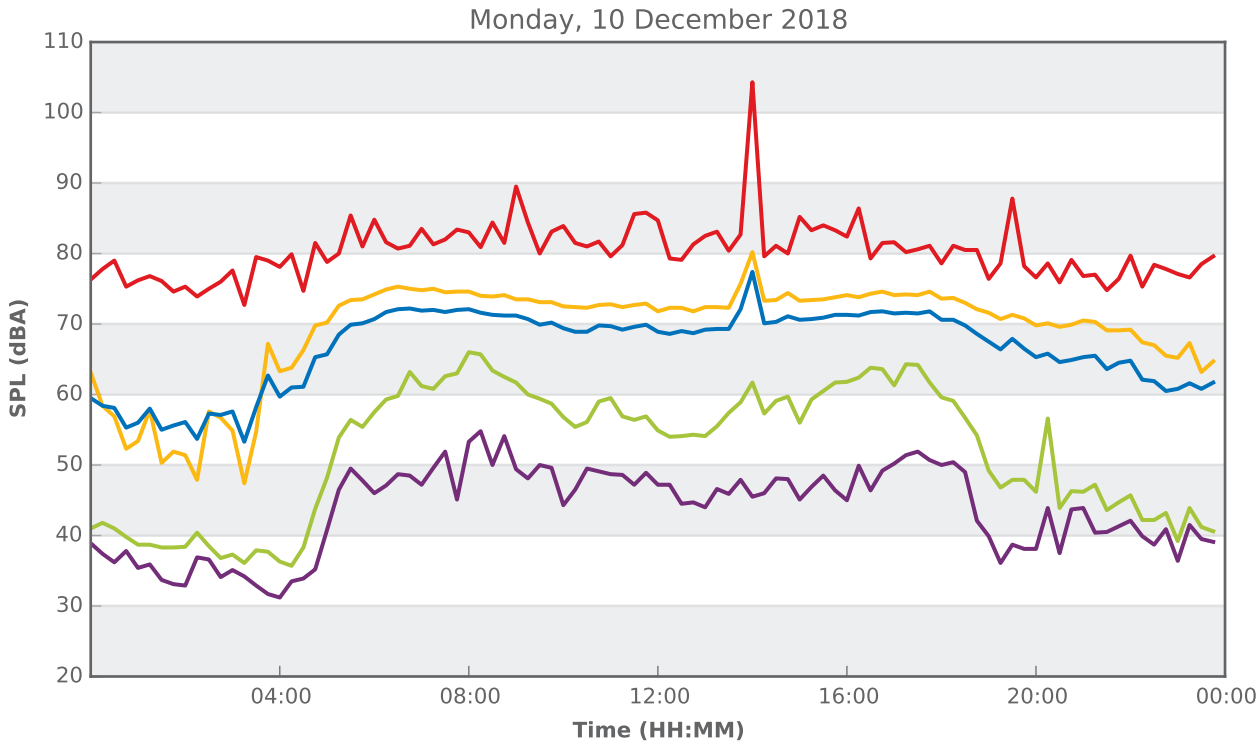

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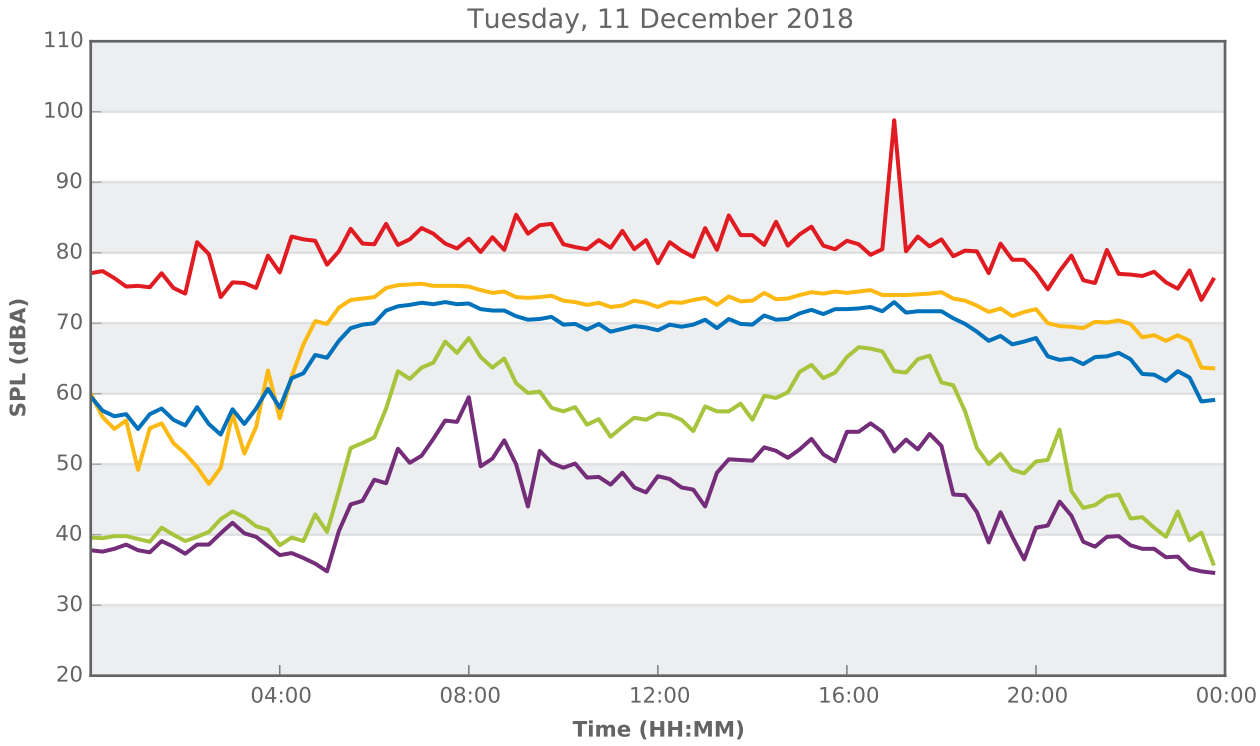

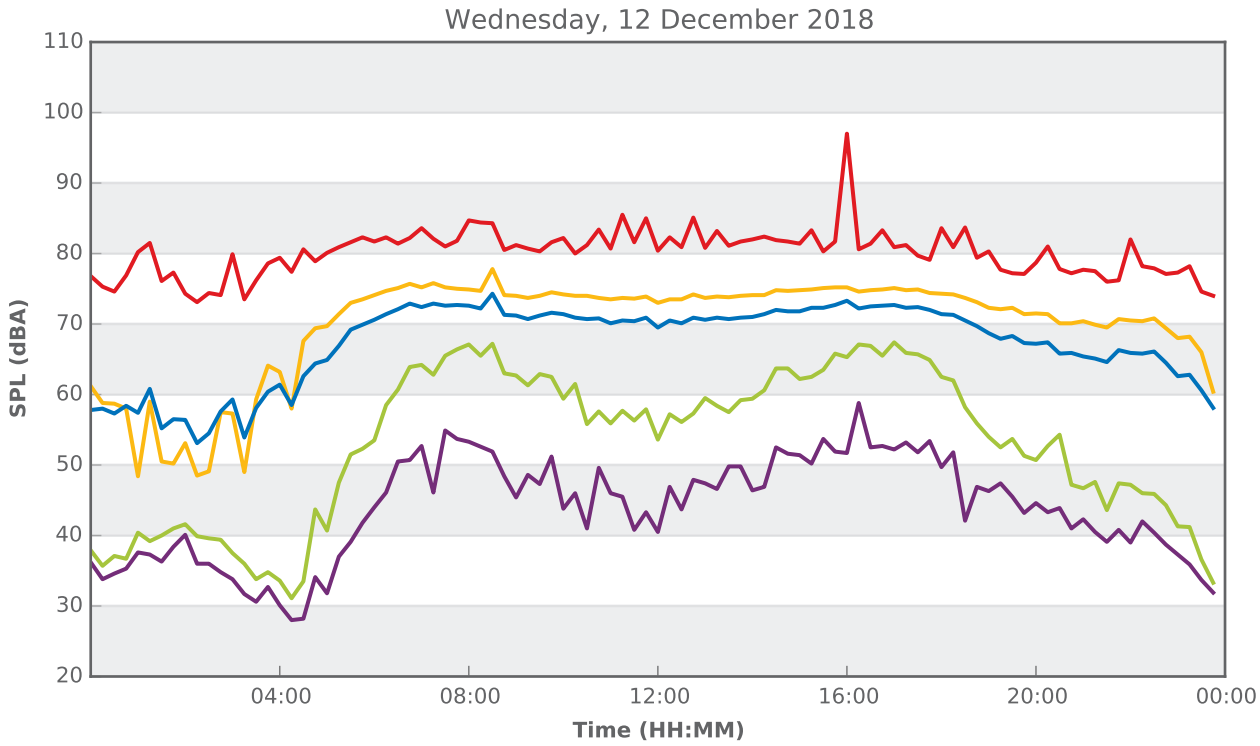

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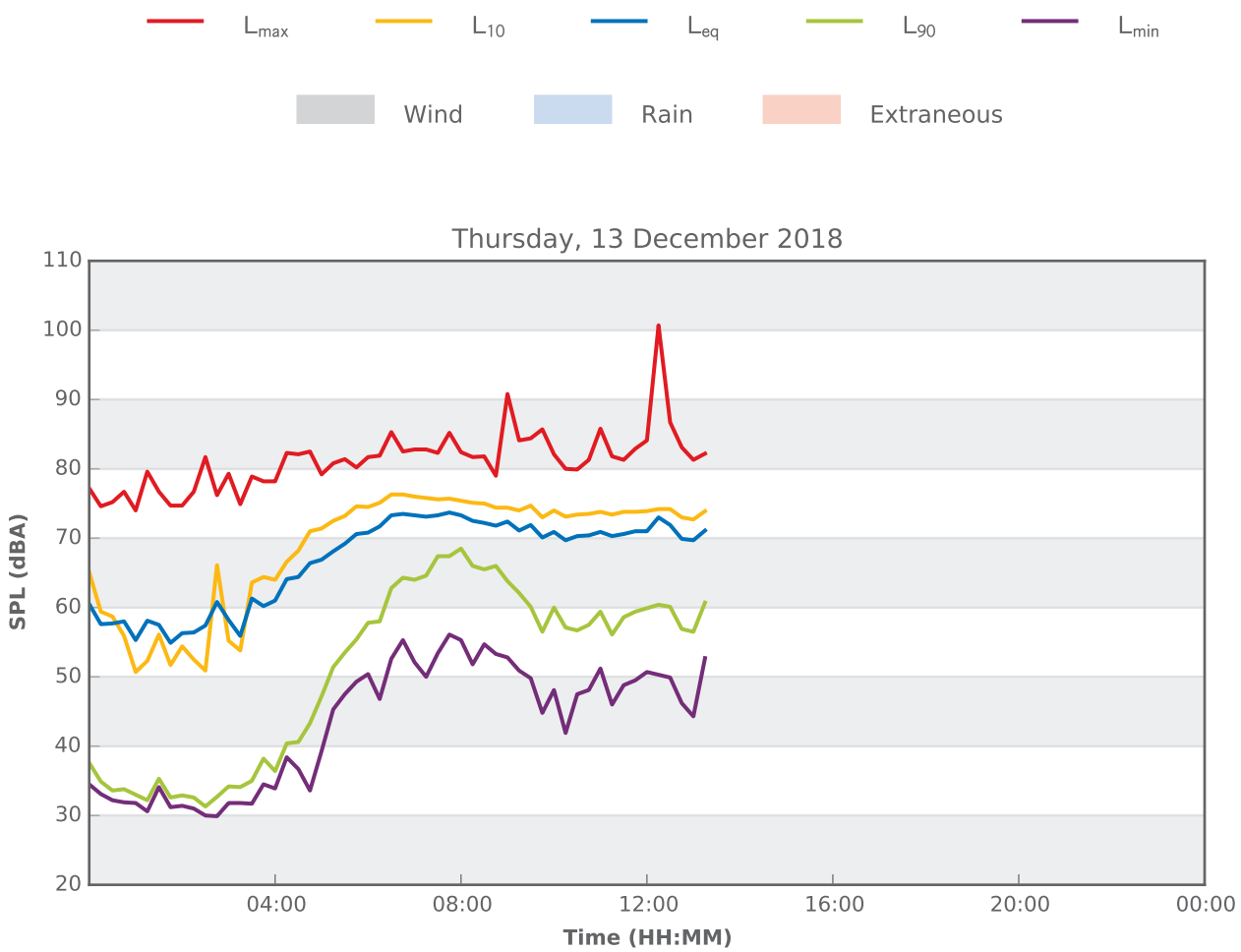
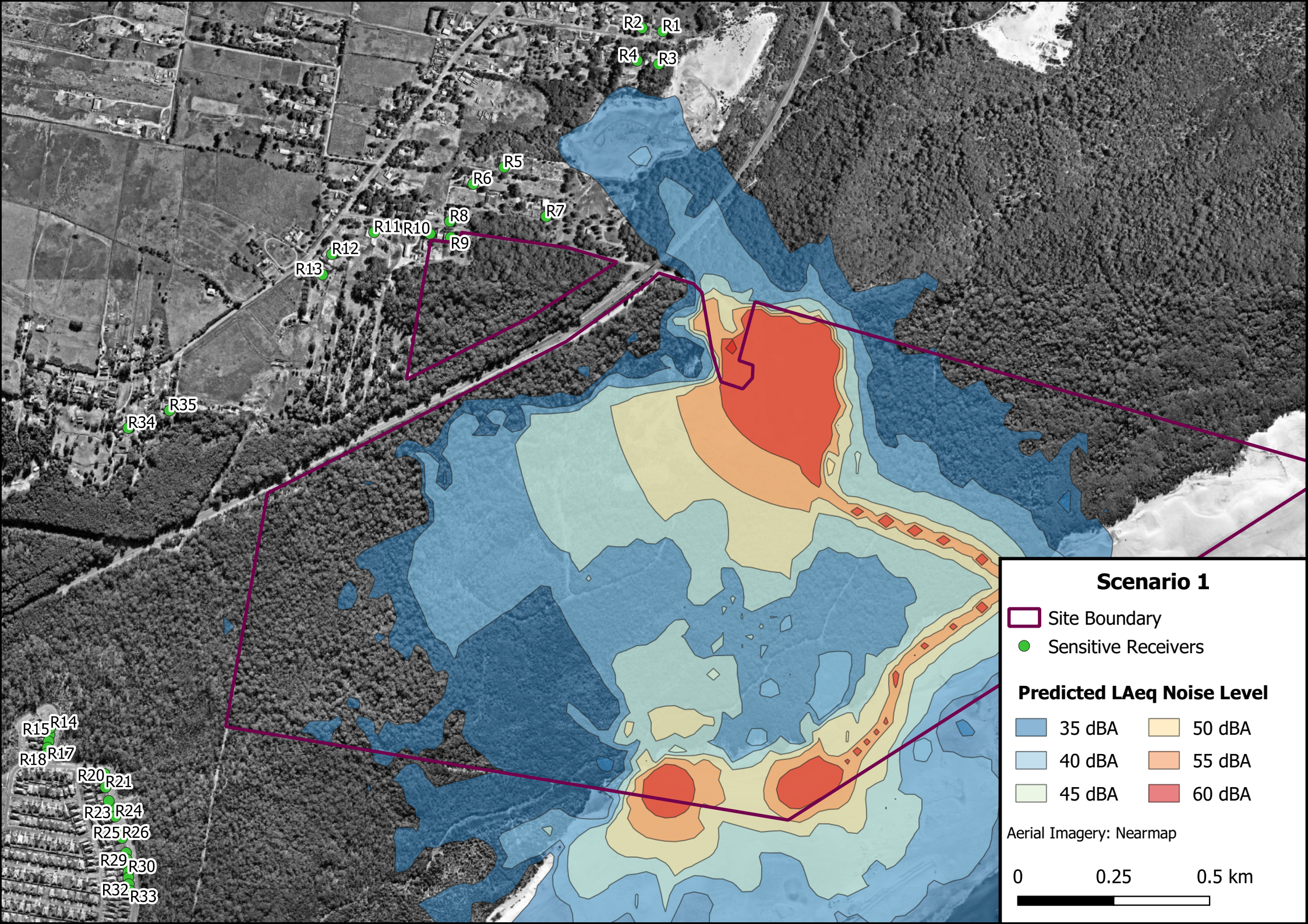
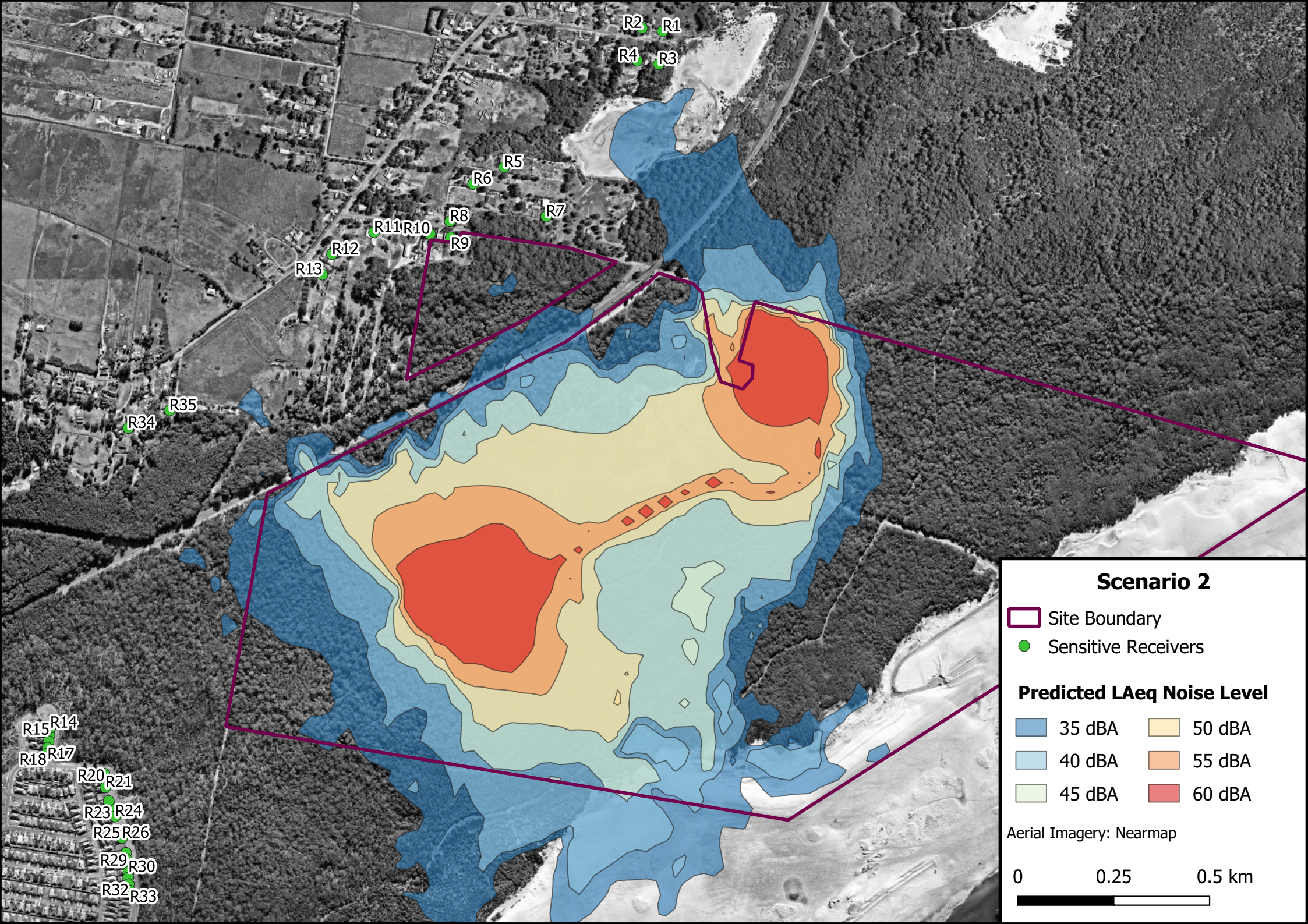


APPENDIX B

SCENARIO NOISE CONTOURS


R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R17
R18
R20
R21
R23
R24
R25
R26
R29
R30
R32
R33
R34
R35
Scenario 1
Site Boundary
Sensitive Receivers
Predicted LAeq Noise Level
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
60 dBA
Aerial Imagery: Nearmap
0
0.25
0.5 km


R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R17
R18
R20
R21
R23
R24
R25
R26
R29
R30
R32
R33
R34
R35
Scenario 2
Site Boundary
Sensitive Receivers
Predicted LAeq Noise Level
35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
60 dBA
Aerial Imagery: Nearmap
0
0.25
0.5 km