2 Working Paper

Noise and Vibration

SAPPHIRE TO WOOLGOOLGA HIGHWAY UPGRADE

NOISE & VIBRATION IMPACT ASSESSMENT

ACOUSTICS AND AIR

REPORT NO. 00086
VERSION G

WILKINSON MURRAY

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VERSION G

AUGUST 2007

PREPARED FOR

CONNELL WAGNER PTY LTD
116 MILITARY ROAD
NEUTRAL BAY NSW 2089

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1 INTRODUCTION

1.1 Background

It is proposed to upgrade the Pacific Highway between Sapphire and Woolgoolga. The Proposal entails the provision of dual carriageways between the northern end of the existing dual carriageway at Sapphire to Arrawarra Creek, north of Woolgoolga, a distance of approximately 25km. A range of corridor and route options have previously been evaluated and a preferred route option has been selected. This report has been prepared to form part of the Environmental Assessment for the Proposal. It details the extent of potential noise and vibration impacts associated with the construction and operation of the proposed upgrade, including mitigation measures where relevant.

Noise and vibration impacts have been assessed in accordance with the NSW Government's Environmental *Criteria for Road Traffic Noise (ECRTN) and the RTA Environmental Noise Management Manual (ENNM)*. In addition, the Department of Environment & Climate Change (DECC) *Environmental Noise Control Manual (ENCM)* has been employed in the assessment of construction noise impacts.

1.2 Project Description

The Proposal commences from approximately 8km north of Coffs Harbour at Sapphire, extending for approximately 25 km to the vicinity of Arrawarra Beach Road north of Woolgoolga. The Proposal can be further broken down into the southern "upgrade" section (from Sapphire to south Woolgoolga) and the northern "bypass" section (Woolgoolga bypass).

From Sapphire to south Woolgoolga, the Proposal entails the duplication of the existing highway to a dual carriageway, controlled access highway (Figure 1-1). This section of the Proposal includes an access road for local traffic alongside or near the highway. The Proposal ties into the existing dual carriageway highway at Korora, with a left-in/left-out intersection at Campbell Close on the western side and a right-in/left-out intersection with the eastern local access road (the existing highway) opposite Campbell Close. North of Campbell Close, access to and from the highway would be restricted to grade-separated interchanges.

The Woolgoolga bypass section of the Proposal is also a dual carriageway standard upgrade, with the existing highway becoming the local access road. The bypass would deviate from the existing highway just north of Graham Drive, and rejoin the existing highway at the grade-separated interchange at Arrawarra. Two interchanges, one at south Woolgoolga and another at Arrawarra, would provide access to the bypass (Figure 1-2).

Figure 1-1 Southern Section

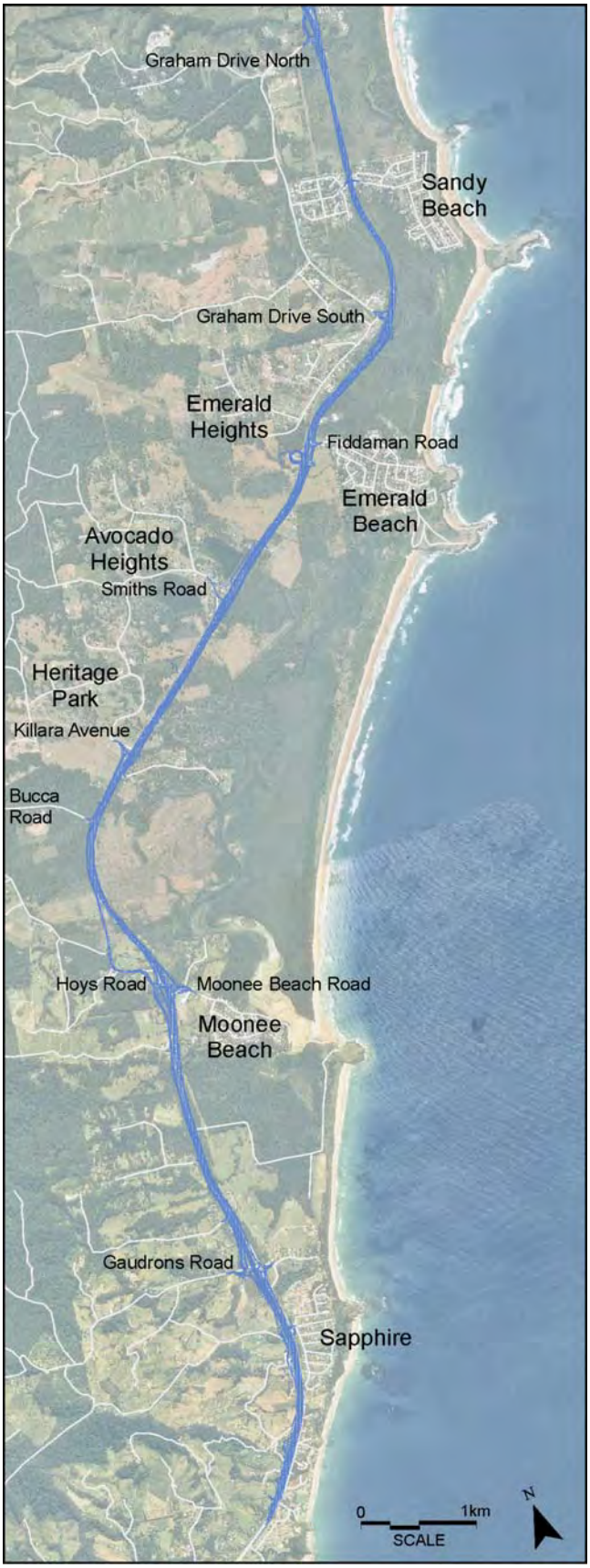


Figure 1-2 Woolgoolga Bypass Section

2 EXISTING AMBIENT NOISE ENVIRONMENT

2.1 Monitoring Locations

To define the existing noise environment in potentially affected areas, ambient noise surveys were undertaken between 19/20 May 2005 and 30/31 May 2005, and between 30/31 May 2005 and 8 June 2005. Fourteen sites were surveyed to assess the level of existing traffic noise. A further three sites were chosen to measure background noise at representative locations potentially affected by long-term construction works. The sites are listed in Table 2-1 and shown in Figure 2-1 to Figure 2-5.

The sites represent locations which may potentially experience noise impacts due to operational or construction noise (or both) associated with the project, and are designed to allow validation of the predictive model as well as derivation of relevant noise criteria.

Table 2-1 Noise Measurement Sites

Site	Location	Shown on Figure
1	2/786 Pacific Highway	2-1
2	817 Pacific Highway, Korora	2-1
3	8 Alpini Place, Sapphire Beach	2-2
4	18 Woodhouse Road, Moonee Beach	2-3
5	20 Hoys Road, Moonee Beach	2-3
6	26 Tiki Road, Moonee Beach	2-4
7	9 Smiths Road, Emerald Beach	2-4
8	9 Bream Close, Emerald Beach	2-5
9	53 Emerald Heights Drive, Emerald Beach	2-5
10	5 Pine Crescent, Sandy Beach	2-6
11	6 Wattle Place, Sandy Beach	2-6
12	11 Hearnes Lake Road, Woolgoolga	2-7
13	5 Ryan Crescent, Woolgoolga	2-8
14	Go Bananas Motel, 53 Clarence Street	2-8
15	127 Woolgoolga Creek Road, Woolgoolga	2-8
16	18 Gresham Drive, Woolgoolga	2-8
17	2921 Pacific Highway, Woolgoolga	2-9

Figure 2-1 Monitoring Sites 1 and 2

Figure 2-2 Monitoring Site 3

Figure 2-3 Monitoring Sites 4 and 5

Figure 2-4 Monitoring Sites 6 and 7

Figure 2-5 Monitoring Sites 8 and 9

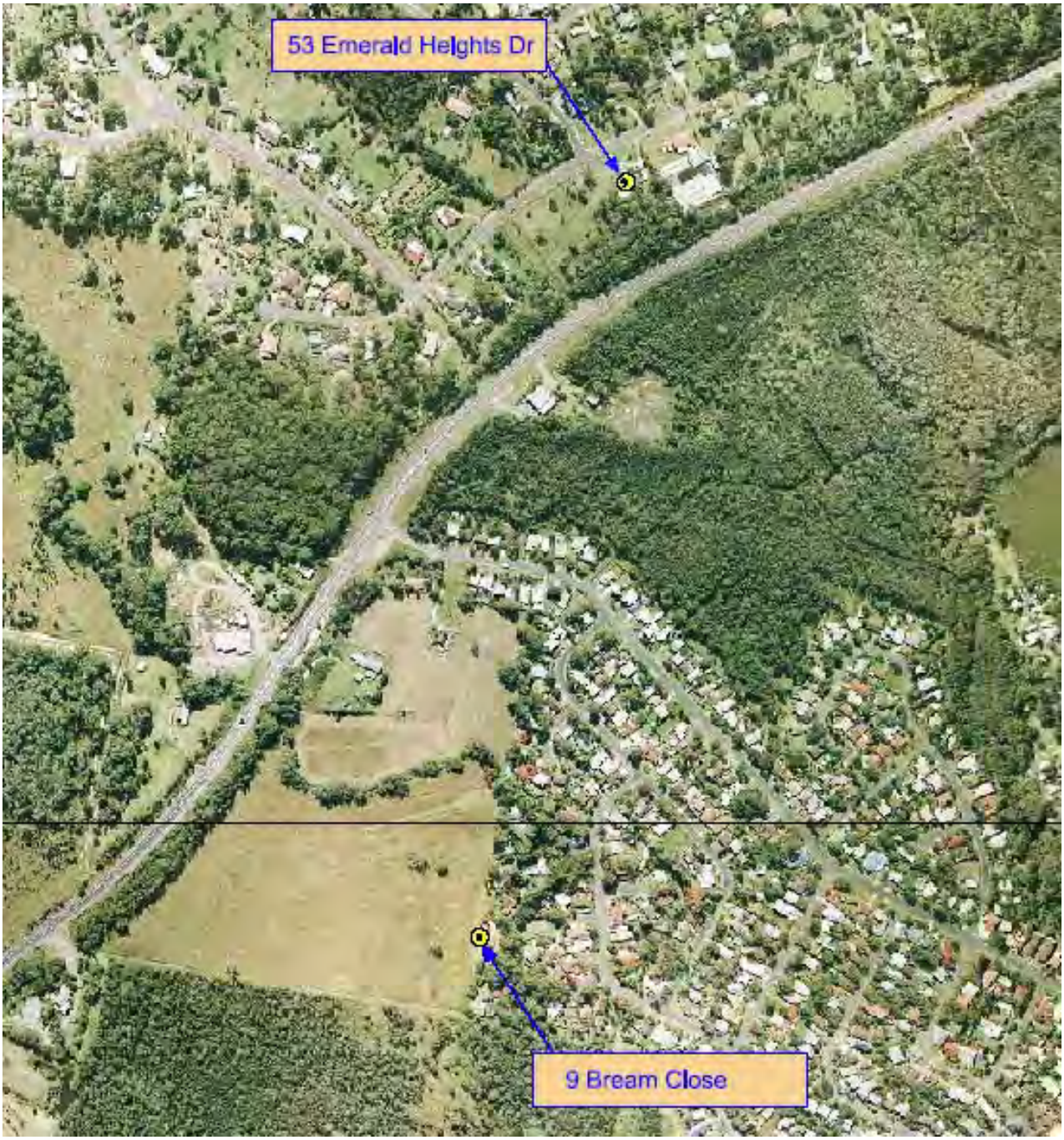


Figure 2-6 Monitoring Sites 10, 11

Figure 2-7 Monitoring Site 12

Figure 2-8 Monitoring Sites 13, 14, 15, 16

Figure 2-9 Monitoring Site 17

2.2 Monitoring & Analysis Procedures

The unattended noise monitoring equipment used for these measurements consisted of an Environmental Noise Logger set to A-Weighted, Fast response, continuously monitoring over 15-minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for later analysis. The equipment calibration was checked before and after the survey and no significant drift occurred.

The logger determines $L_{A1,}$ $L_{A10,}$ L_{A90} and L_{Aeq} levels of the existing noise Environment. The $L_{A1,}$ L_{A10} and L_{A90} levels are the levels exceeded for 1%, 10% and 90% of the sample time respectively. The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional passby of a heavy vehicle. The L_{A90} level is normally taken as the background noise level. The L_{Aeq} level is the Equivalent Continuous Sound Level and has the same sound energy over the sampling period as the actual noise Environment with its fluctuating sound levels. Whilst the L_{A10} has in the past been used as a descriptor for traffic noise, the L_{Aeq} is now the standard descriptor for traffic noise.

To describe background noise levels, the measure currently recommended in NSW is the Rating Background Level (RBL) as defined in the NSW Department of Environment & Climate Change (DECC) *NSW Industrial Noise Policy (INP)*. A glossary of terms is provided in Appendix A.

Meteorological data for the relevant periods was obtained from the nearest weather station at Coffs Harbour. Periods in which it was raining, or when wind speeds exceeded 5m/s at microphone height, were excluded from analysis, in accordance with principles agreed by the NSW DECC.

A second correction to the data was performed to exclude sources of extraneous noise. These sources are not always identifiable; however those 15 minute periods in which the L_{Aeq} level is significantly higher than the L_{A10} level and corresponds to a high maximum level are unlikely to be “normal” traffic noise and have therefore been excluded from statistical analysis of logger data.

The results of the noise survey are shown in graphical form in Appendix D. The results are summarised and discussed in detail in Sections 5 and Section 7 for construction and operational noise respectively.

3 CRITERIA FOR OPERATIONAL NOISE

3.1 Noise Criteria for Residences

Criteria for assessment of road traffic noise are set out in the NSW Government's *Environmental Criteria for Road Traffic Noise (ECRTN)*. The RTA has also published the *Environmental Noise Management Manual (ENMM)* to assist in implementing the Environmental Criteria for Road Traffic Noise.

Under the Environmental Criteria for Road Traffic Noise, road developments are classified as either "new road" or "redevelopment of an existing road". Practice note (i) of the Environmental Noise Management Manual describes the circumstances under which each of these applies. Applying this practice note to the Proposal, in general terms the area to the north (the bypass section) would be classified as a "*new freeway or arterial road corridor*" and the southern section to the south of the bypass a *"redevelopment of existing freeway/arterial road*". The criteria set out in Table 3-1 would therefore apply.

Table 3-1 *Environmental Criteria for Road Traffic Noise* criteria for operational traffic noise - residences

Type of Development	Noise Level Criterion		Where Criteria are already Exceeded
	Day (7.00am-10.00pm)	Night (10.00pm-7.00am)	
New freeway or arterial road corridor	$L_{Aeq,15hr}$ 55dBA	$L_{Aeq,9hr}$ 50dBA	The new road should be designed as not to increase existing noise levels by more than 0.5dB.
Redevelopment of existing freeway/arterial road	$L_{Aeq,15hr}$ 60dBA	$L_{Aeq,9hr}$ 55dBA	In all cases, the redevelopment should be designed so as not to increase existing noise levels by more than 2dB. *Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies …*

In applying Table 3-1, the noise level criterion applies to the predicted noise level at a time 10 years after opening of the project (design year), which in this case is year 2021. The "existing" noise levels are described in the Environmental Noise Management Manual as "future existing" levels – that is, noise levels due to traffic on existing roads as predicted at a time immediately before opening of the project.

Where the "base" criteria in Table 3-1 are already exceeded, Practice Note (iv) of the Environmental Noise Management Manual provides further discussion of situations where provision of additional controls would be considered "feasible and reasonable". In particular, for "new freeways or arterial roads" it is generally *not* considered reasonable to take action to reduce noise levels to the target noise levels if the noise levels with the proposal, ten years after project opening, are predicted to be:

- Within 2dBA of "future existing" noise levels; *and*
- No more than 2dBA above the target noise levels set out in the Table 3-1.

For road "redevelopments" it is generally *not* considered reasonable to apply additional treatments (after opportunities for noise control have been incorporated into the road design) if predicted design year noise levels:

- Do not exceed the Environmental Criteria for Road Traffic Noise allowance of 2dBA over "future existing" noise levels, *and*
- Will not be "acute" (i.e. do not exceed 65dBA $L_{Aeq,15h}$ and 60dBA $L_{Aeq,9h}$).

A further point should be noted in applying this RTA policy. The Environmental Criteria for Road Traffic Noise indicates (technical note ix) that if the existing noise level is below the criterion but within 2dB of the criterion, then the 2dB allowance may also be applied. Hence, the exclusion above is also taken to apply to cases where an existing noise level below the "base" criterion is predicted to increase by 2dBA or less.

3.2 Criteria for Construction / Blasting Noise & Vibration

3.2.1 General Guidelines

Guidelines for assessment of construction noise are specified in the Department of Environment and Climate Change (DECC) Environmental Noise Control Manual *(ENCM)* Chapter 171. These are currently under revision, but these revisions are not expected to substantially alter their application in this project. The guidelines are:

- For periods of 4 weeks or less, the L_{A10} level should not exceed the background (L_{A90}) level by more than 20dBA; and
- For periods greater than 4 weeks and less than 26 weeks, the L_{A10} level should not exceed the background (L_{A90}) level by more than 10dBA.

Although not clearly stated in the Environmental Noise Control Manual, past practice has indicated that for periods greater than 26 weeks, the DECC would expect that the L_{A10} level should not exceed the background (L_{A90}) level by more than 5dBA.

It is accepted that for determining noise criteria, the L_{A90} background noise level should be quantified by the Rating Background Level (RBL) value.

In addition, the DECC specifies the following time restrictions for construction activities:

- Monday to Friday 7.00am to 6.00pm
- Saturday 8.00am to 1.00pm (if noise is audible at residential premises)

No construction work is to take place on Sundays or Public Holidays.

There are cases where it is impossible or impractical to restrict road construction activities to within the above hours. For example activities involving road closures, diversions or traffic disruption are also most appropriately conducted outside normal working hours. In these cases, in the absence of specific criteria supplied by the DECC, the criteria for out-of-hours operations are also assumed to be the RBL background level plus 5dBA. (Of course, the RBL will be significantly lower at night.)

The DECC also recommends generally that all possible steps should be taken to reduce noise levels of construction site equipment so as to minimise the impact of construction noise.

3.2.2 Sleep Disturbance

In addition to the above criteria, where any work is conducted during the night-time period 10.00pm-7.00am, the DECC recommends that to protect against sleep disturbance, the L_{A1} noise levels should not exceed the background level by more than 15dBA at any residence. In practice, the L_{A1} level can be represented by the maximum noise level. While there are no specific criteria relating to sleep disturbance in the Environmental Criteria for Road Traffic Noise, the document advises that maximum internal noise levels below 50-55dBA are unlikely to cause awakening reactions.

3.3 Vibration (Excluding Blasting)

Impacts from vibration can be considered both in terms of effects on building occupants (human comfort) and the effects on the building structure (building damage). Of these considerations, the human comfort limits are the most stringent. Therefore, for occupied buildings, if compliance with human comfort limits is achieved, it will follow that compliance will be achieved with the building damage objectives.

3.3.1 Human Comfort

The DECC's *Assessing Vibration: A Technical Guideline* provides acceptable values for continuous and impulsive vibration in the range 1-80Hz. Both preferred and maximum vibration limits are defined for various locations and are shown in Table 3-2.

Table 3-2 Preferred and Maximum Peak Particle Velocity (PPV) values for Continuous and Impulsive Vibration

Location	Assessment period [1]	Preferred values	Maximum Values
Continuous vibration			
Critical areas [2]	Day or night time	0.14	0.28
Residences	Daytime	0.28	0.56
	Night time	0.20	0.40
Offices, schools, educational institutions and places of worship	Day or night time	0.56	1.1
Workshops	Day or night time	1.1	2.2
Continuous vibration			
Critical areas [2]	Day or night time	0.14	0.28
Residences	Daytime	8.6	17.0
	Night time	2.8	5.6
Offices, schools, educational institutions and places of worship	Day or night time	18.0	36.0
Workshops	Day or night time	18.0	36.0

Note: 1) Daytime is 7.00am to 10.00pm and night time is 10.00pm to 7.00am.
2) Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas. Source BS 6472-1992.

These limits relate to a long-term (16 hours for daytime), continuous exposure to vibration sources. Where vibration is intermittent, a vibration dose is calculated and acceptable values are shown in Table 3-3.

Table 3-3 Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Daytime (1)		Night time (1)	
	Preferred value	Maximum Values	Preferred value	Maximum Value
Critical areas (2)	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Note: 1) Daytime is 7.00am to 10.00pm and night time is 10.00pm to 7.00am.
2) Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas. Source BS 6472-1992.

3.3.2 Building Damage

In regard to potential building damage, the German Standard DIN4150 suggests a limit of 10mm/s PPV within any building and the British Standard BS7385: Part 2 - 1993 sets a limit within buildings which depends upon the vibration frequency, but is as low as 7.5mm/s PPV (at 4.5Hz). For the likely frequency content of vibration resulting from this Proposal, a limit of approximately 10 mm/s PPV would apply.

3.4 Blasting Assessment Criteria

3.4.1 Annoyance & Discomfort

For assessment of annoyance due to blasting, the DECC (and most similar authorities in Australia) has adopted guidelines produced by the Australian and New Zealand Environment and Conservation Council (ANZECC). The fundamental criteria are that at any residence or other sensitive location:

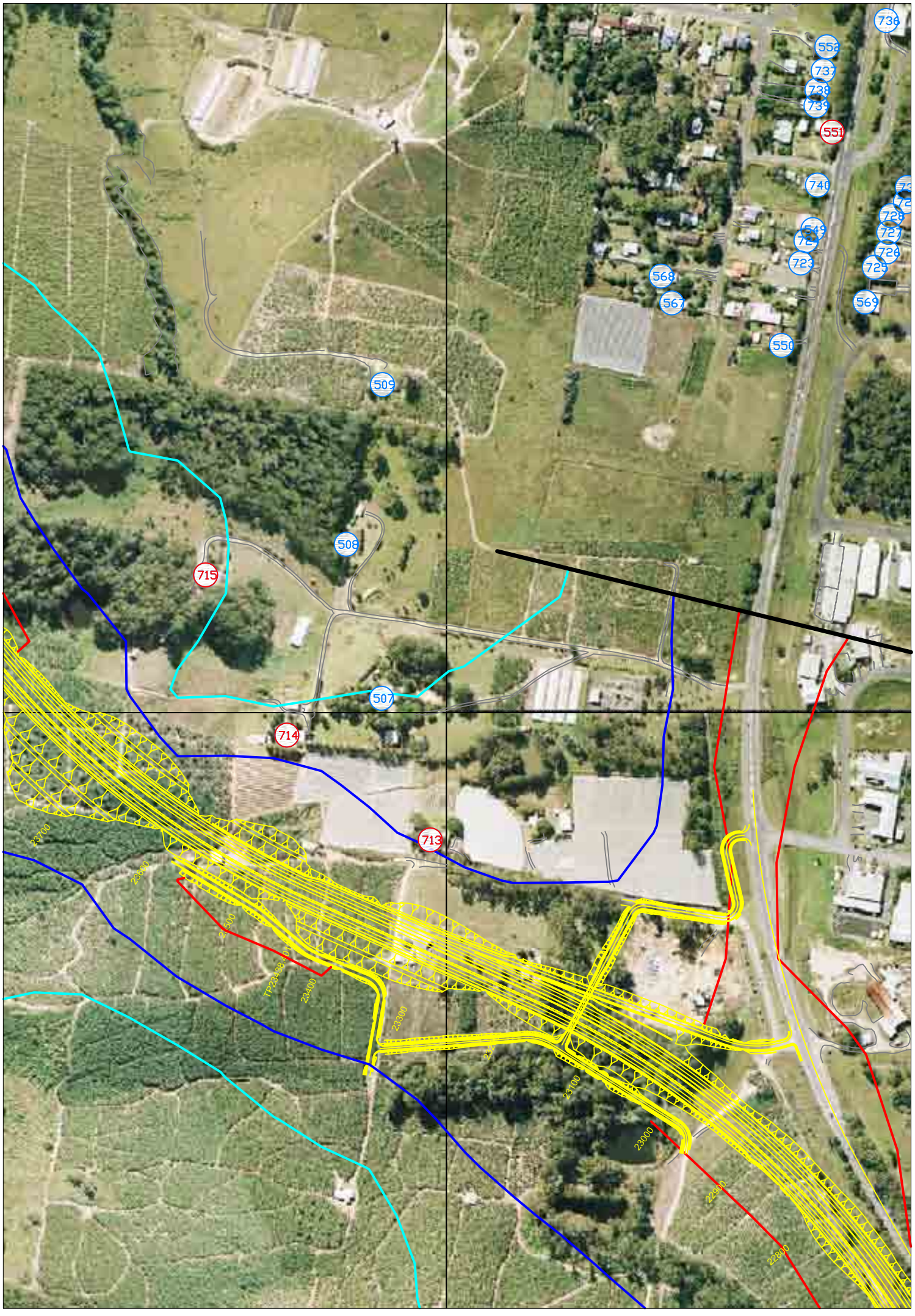
- The maximum overpressure due to blasting should not exceed 115dB for more than 5% of blasts in any year, and should not exceed 120dB for any blast; and
- The maximum peak particle ground velocity should not exceed 5mm/sec for more than 5% of blasts in any year, and should not exceed 10mm/sec for any blast.

3.4.2 Structural Damage

At sufficiently high levels, blast overpressure may in itself cause structural damage to some building elements such as windows. However, this occurs at peak overpressure levels of about 133dB and above, well in excess of criteria for annoyance.

For assessment of damage due to ground vibration, Australian Standard *AS2187.2-1993 Explosives – Storage, Transport and Use* contains an appendix specifying recommended levels for peak particle vibration velocity to protect typical buildings from damage. These are:

- "Structures that may be particularly susceptible to ground vibration" – 5mm/sec
- "Houses and low-rise residential buildings; commercial buildings not included below" – 10mm/sec
- "Commercial and industrial buildings or structures of reinforced concrete or steel construction" – 25mm/sec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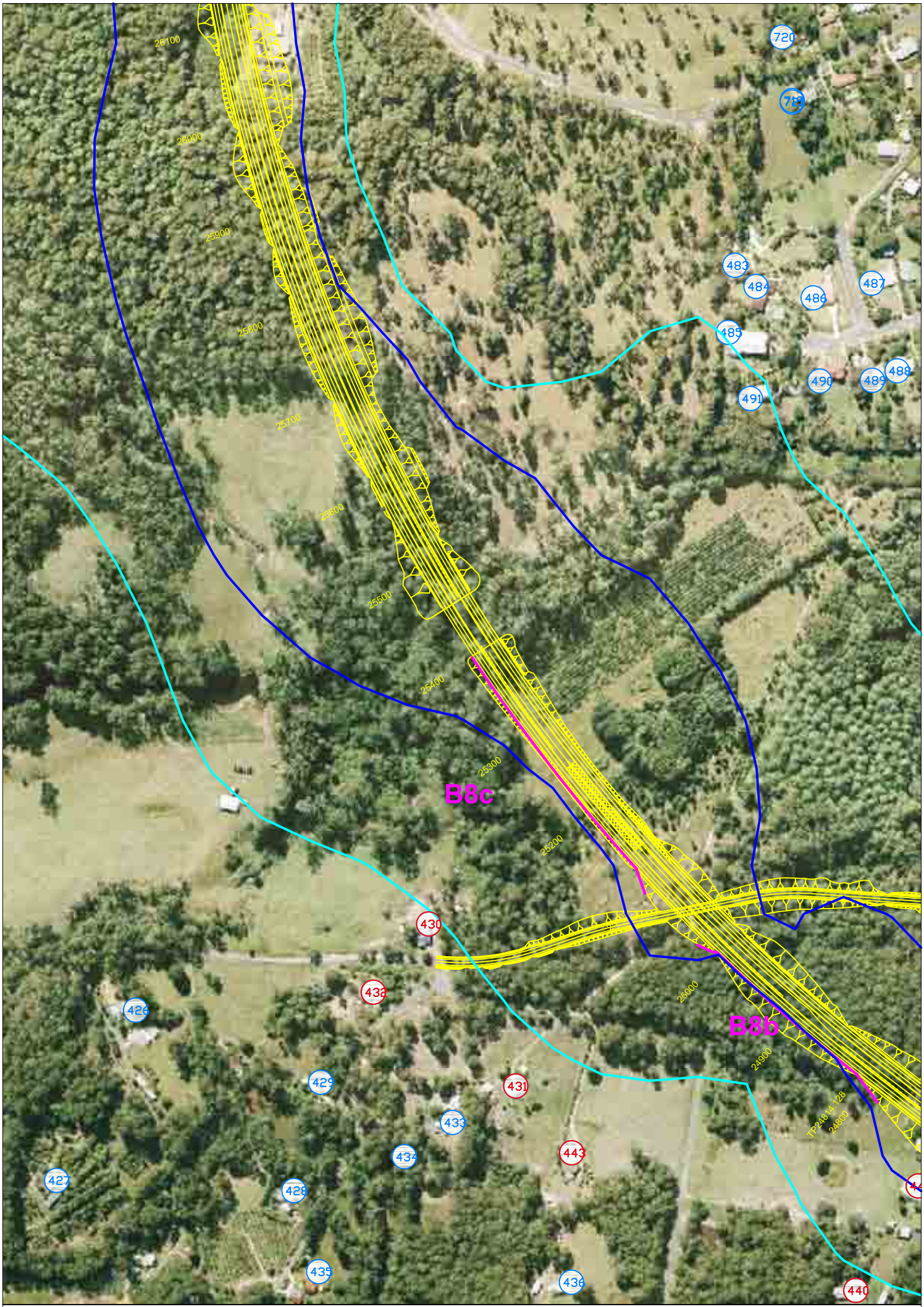
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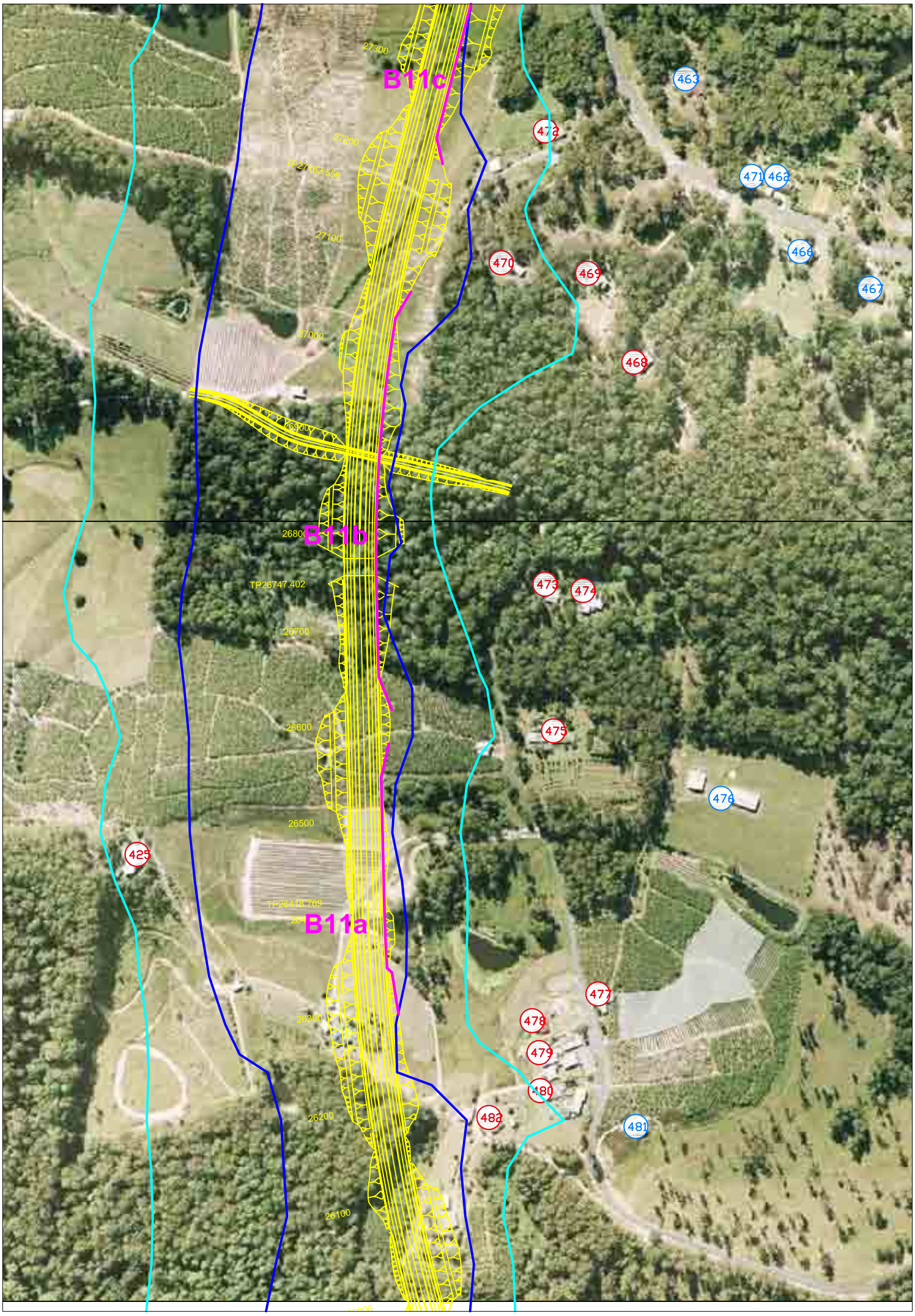
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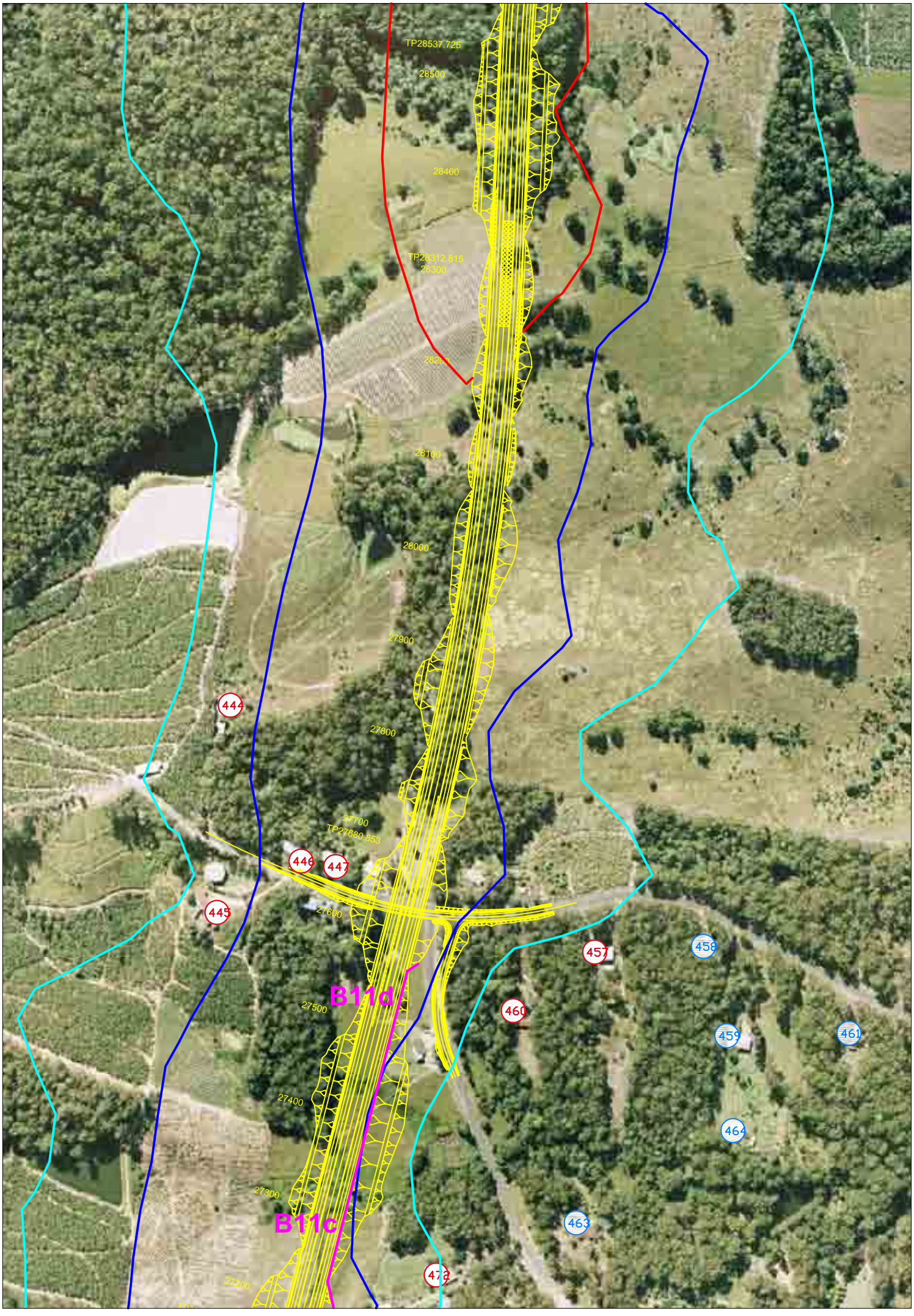
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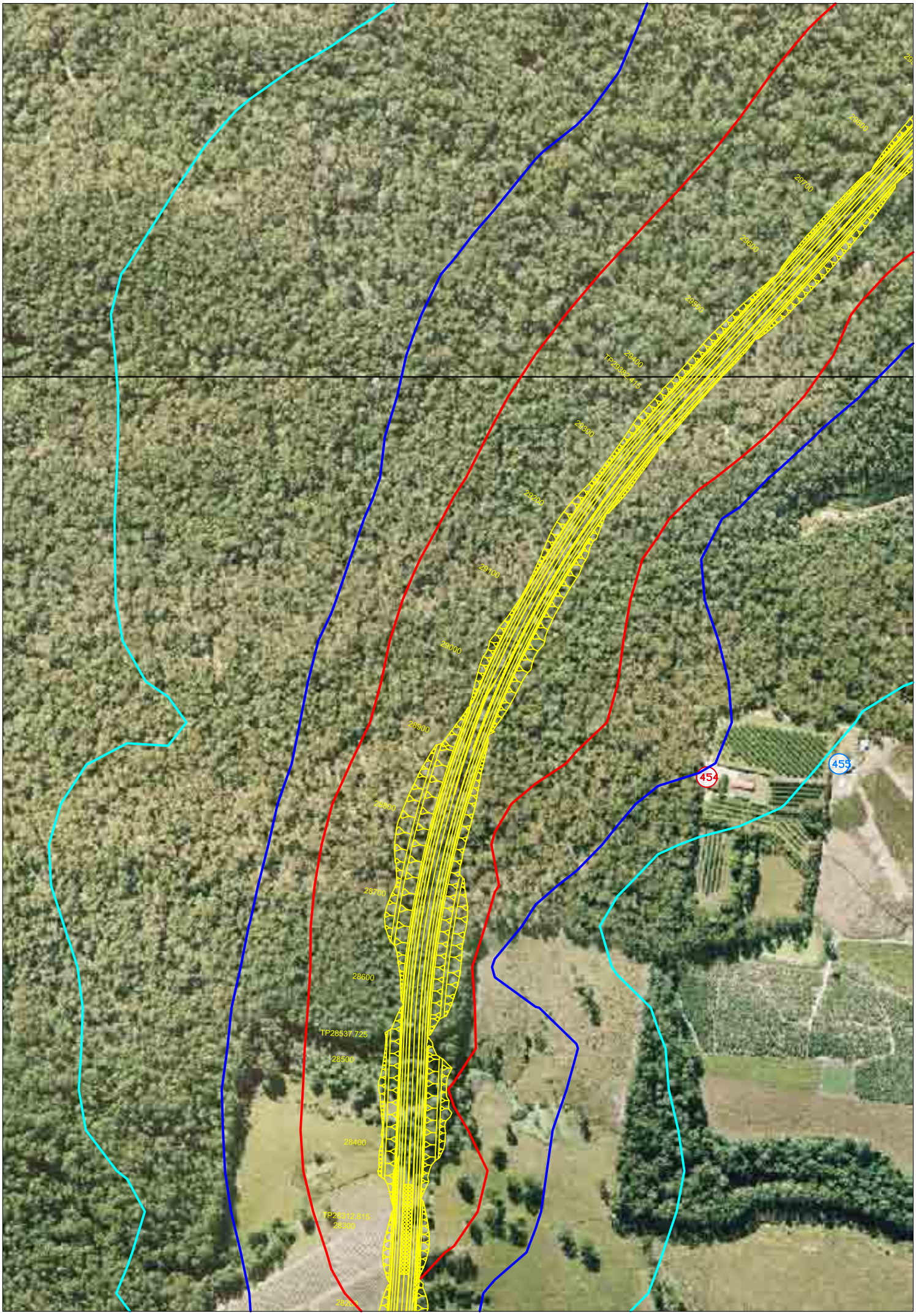
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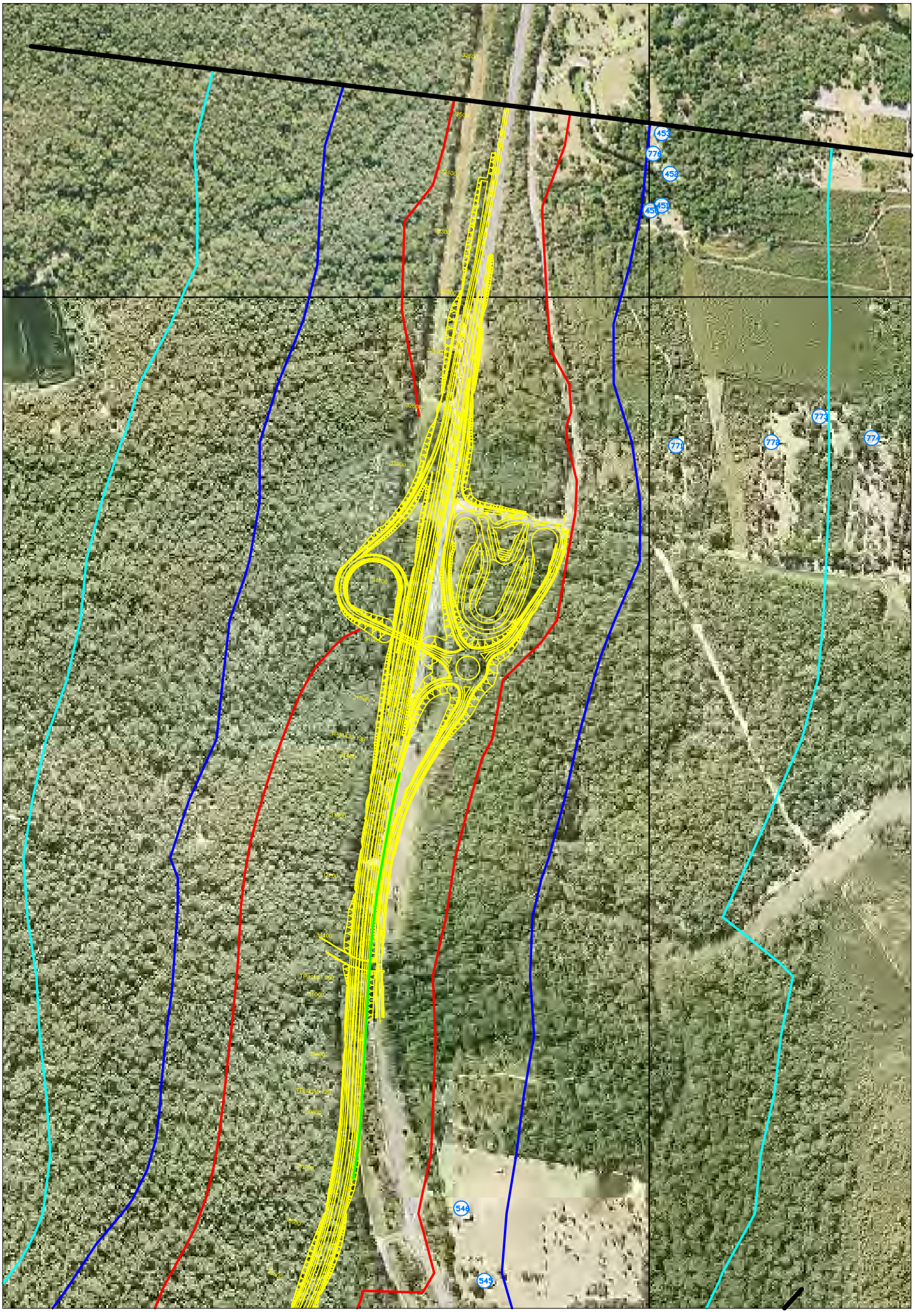
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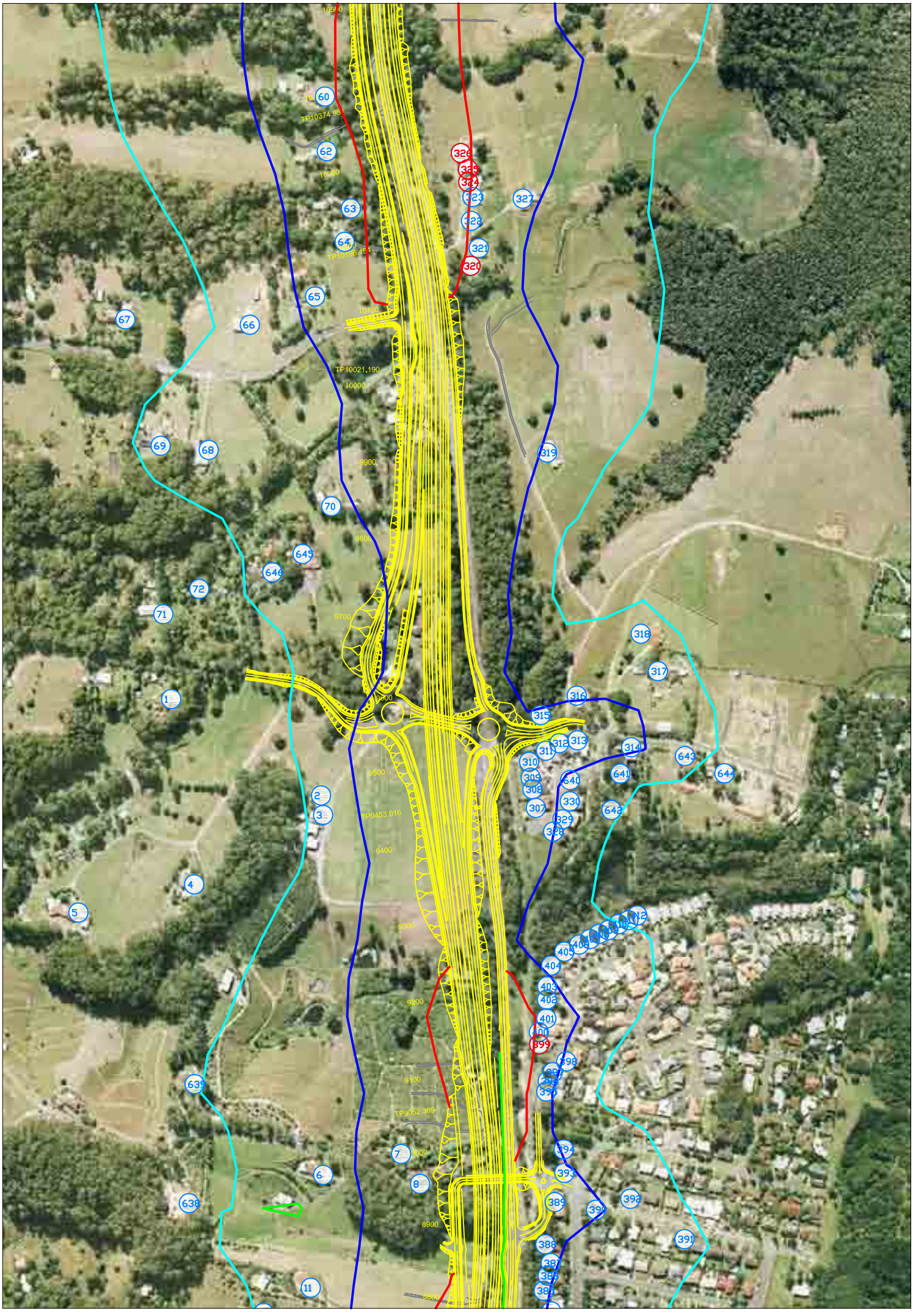
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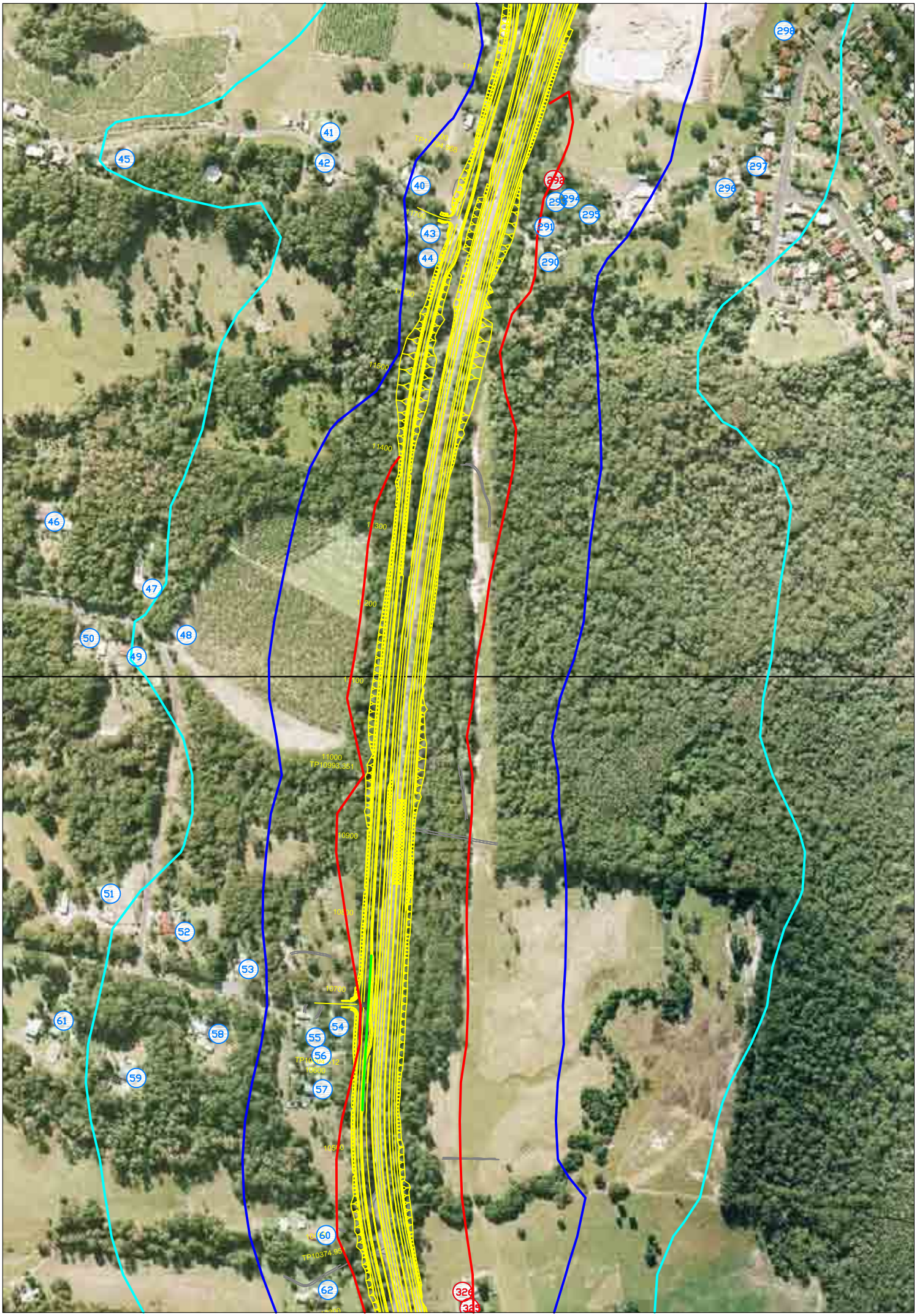
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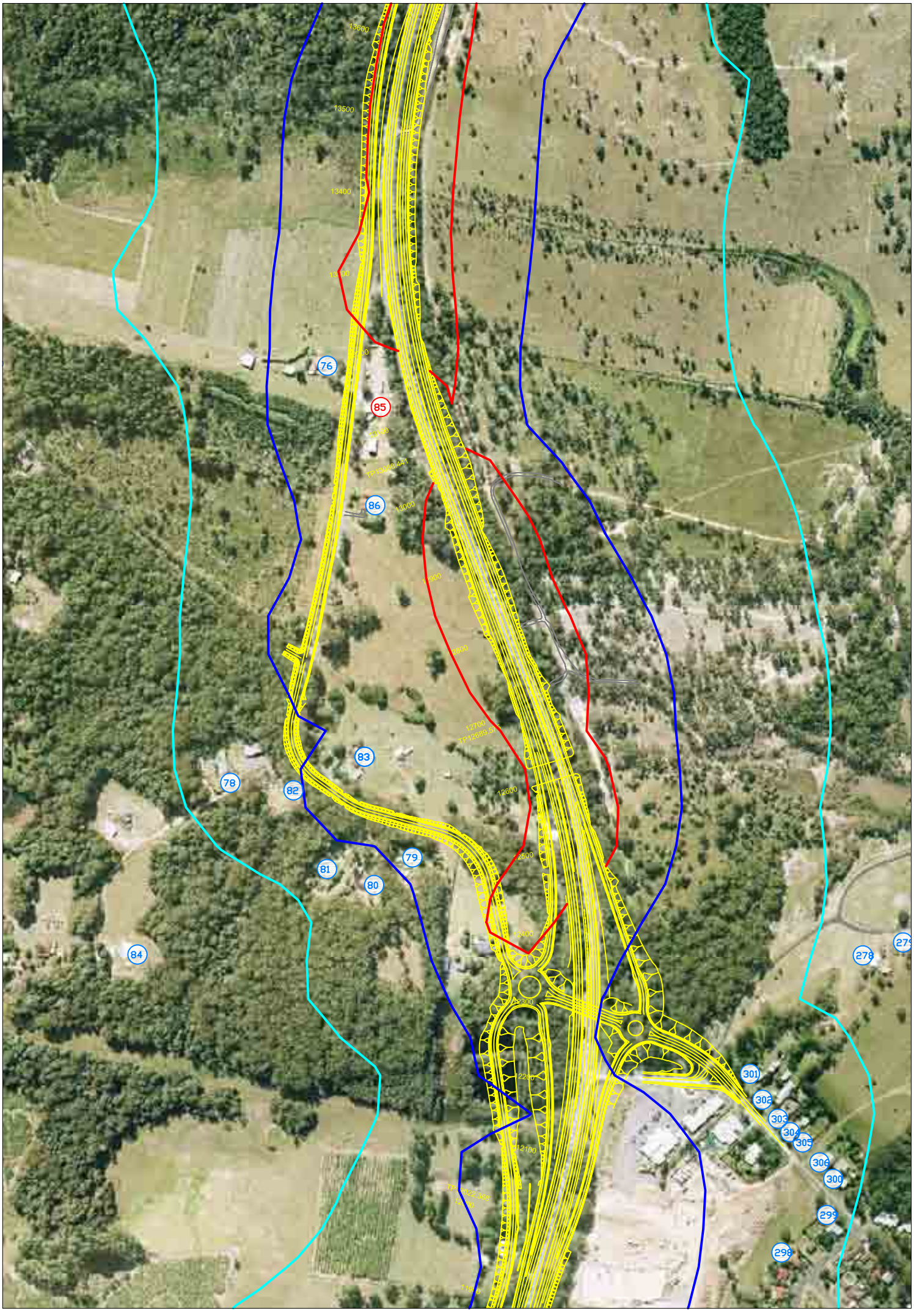
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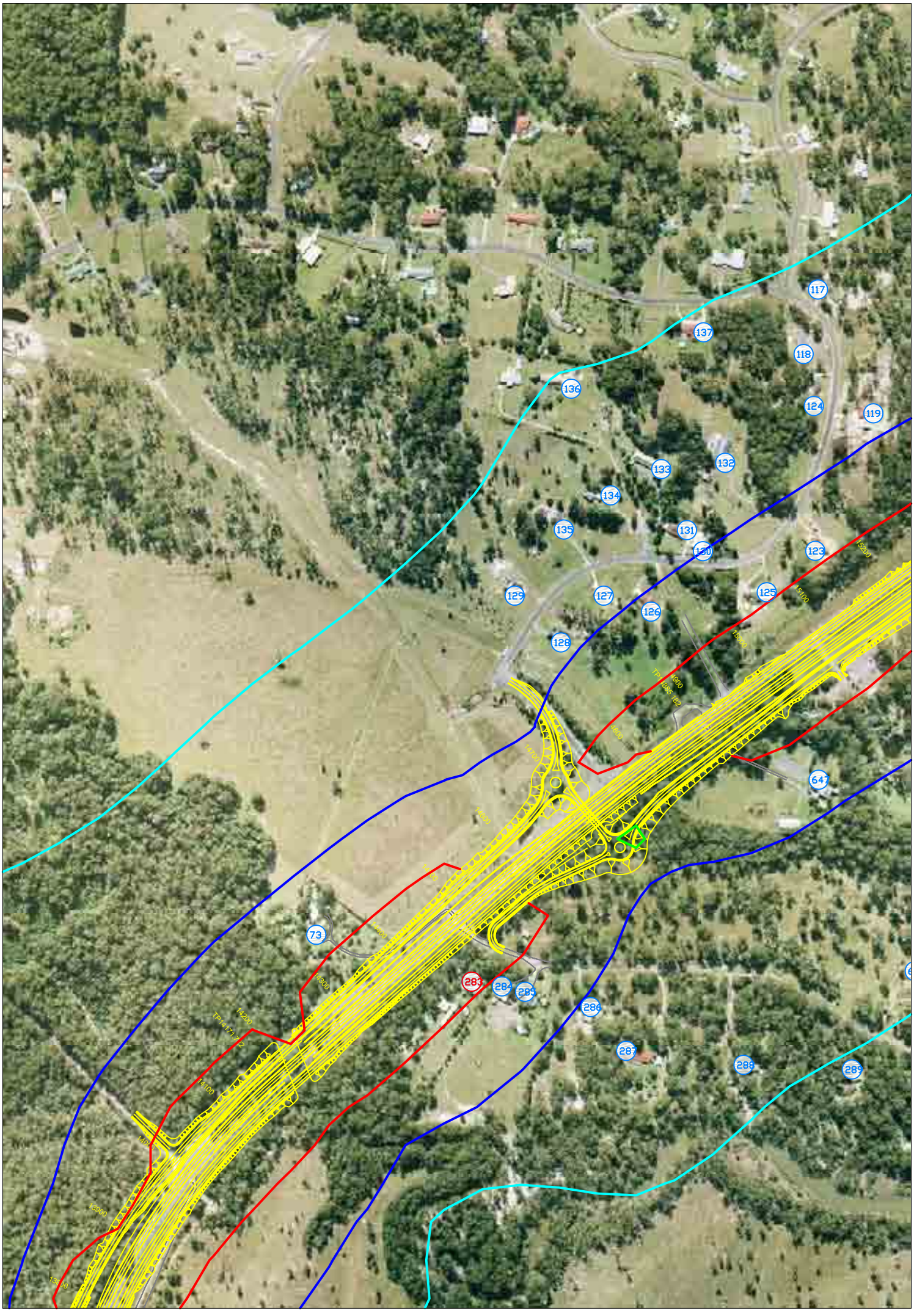
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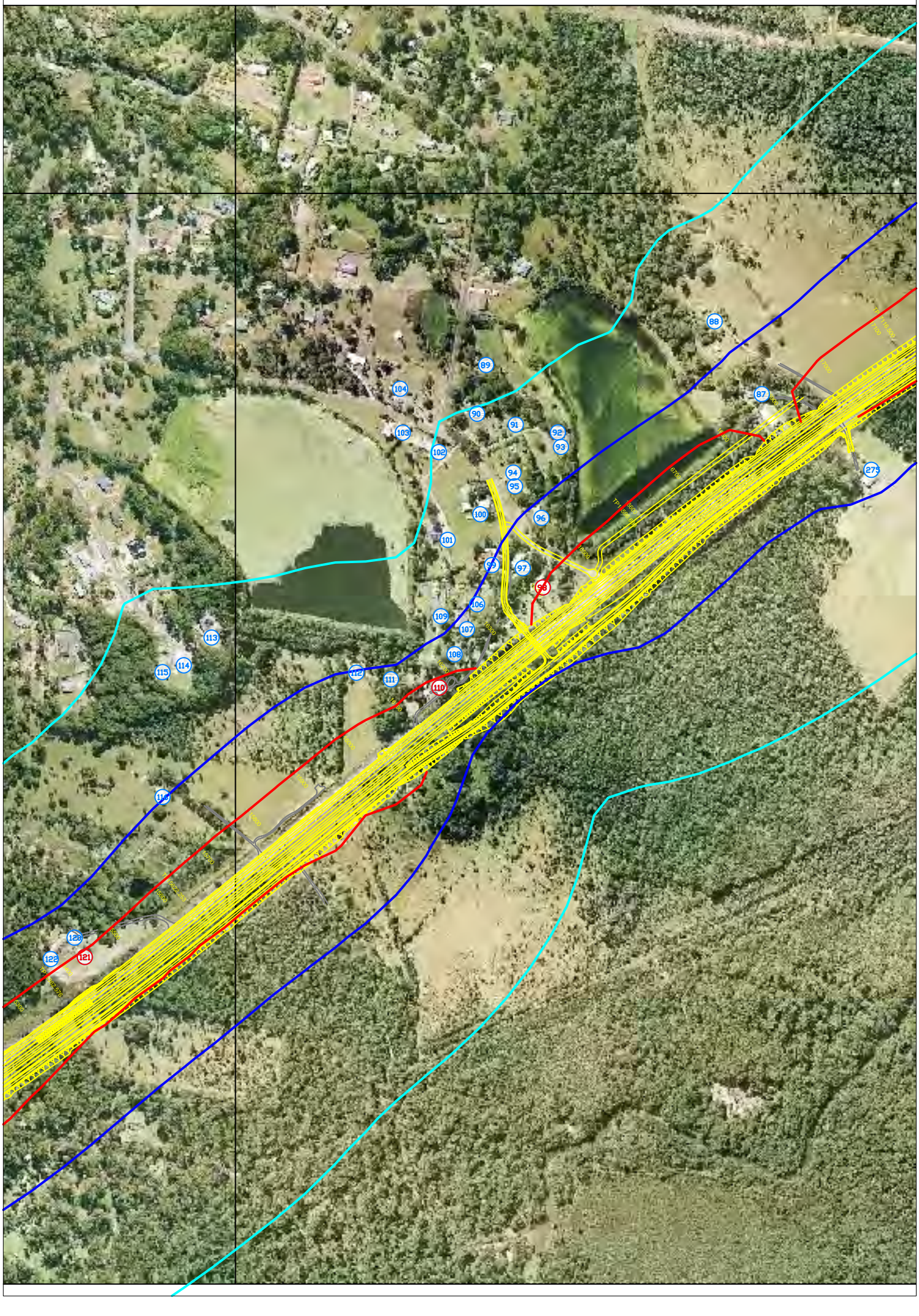
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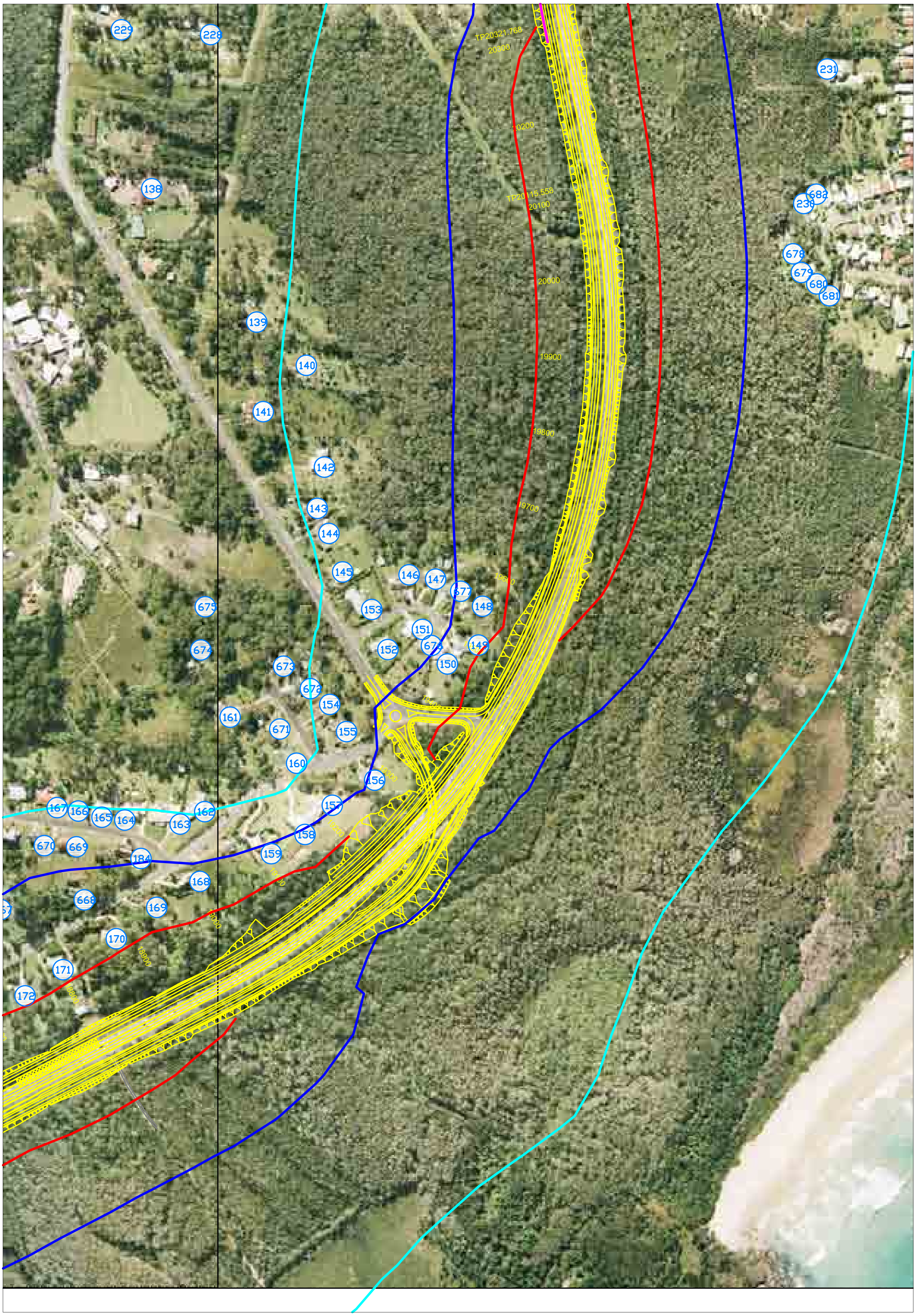

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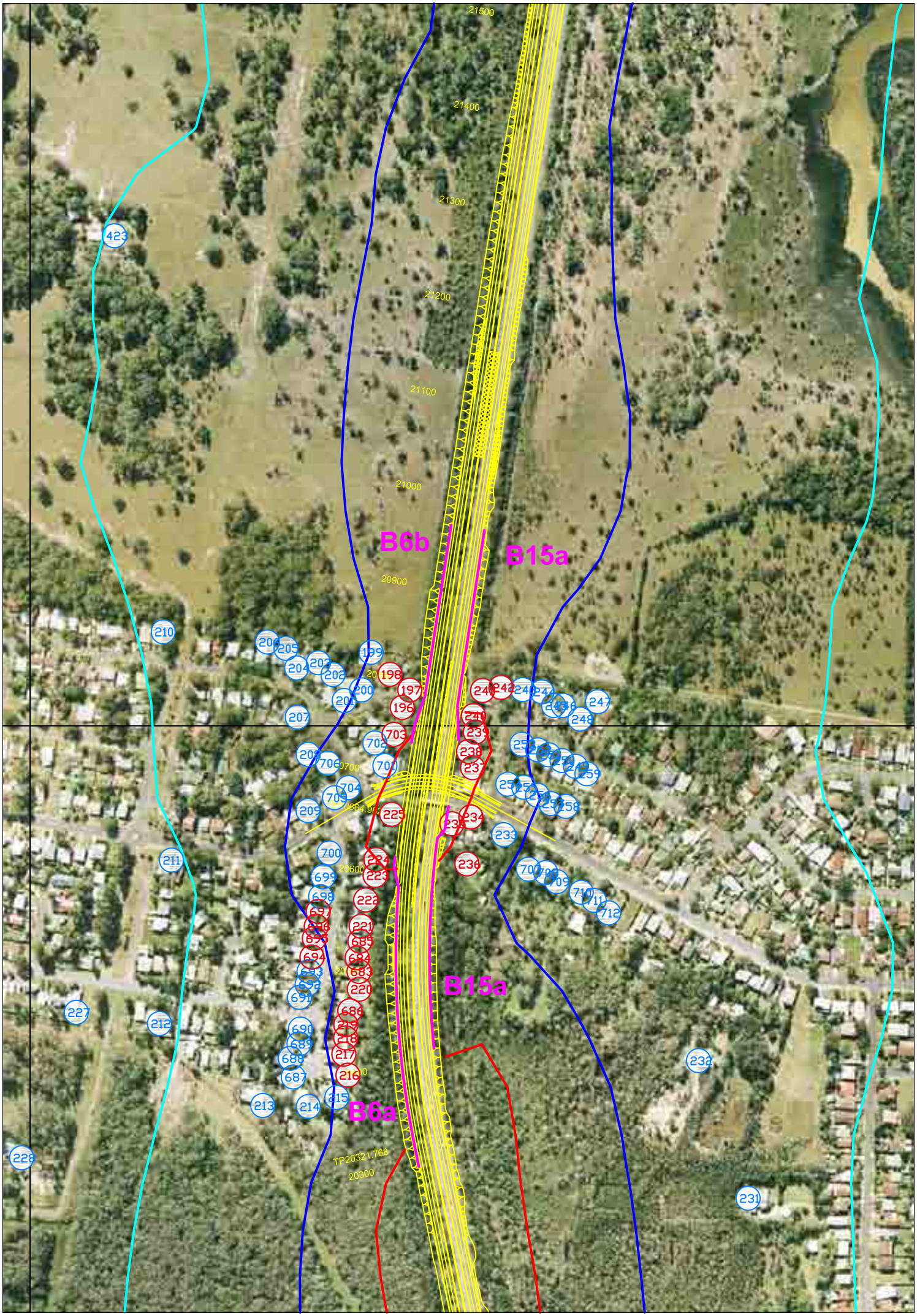
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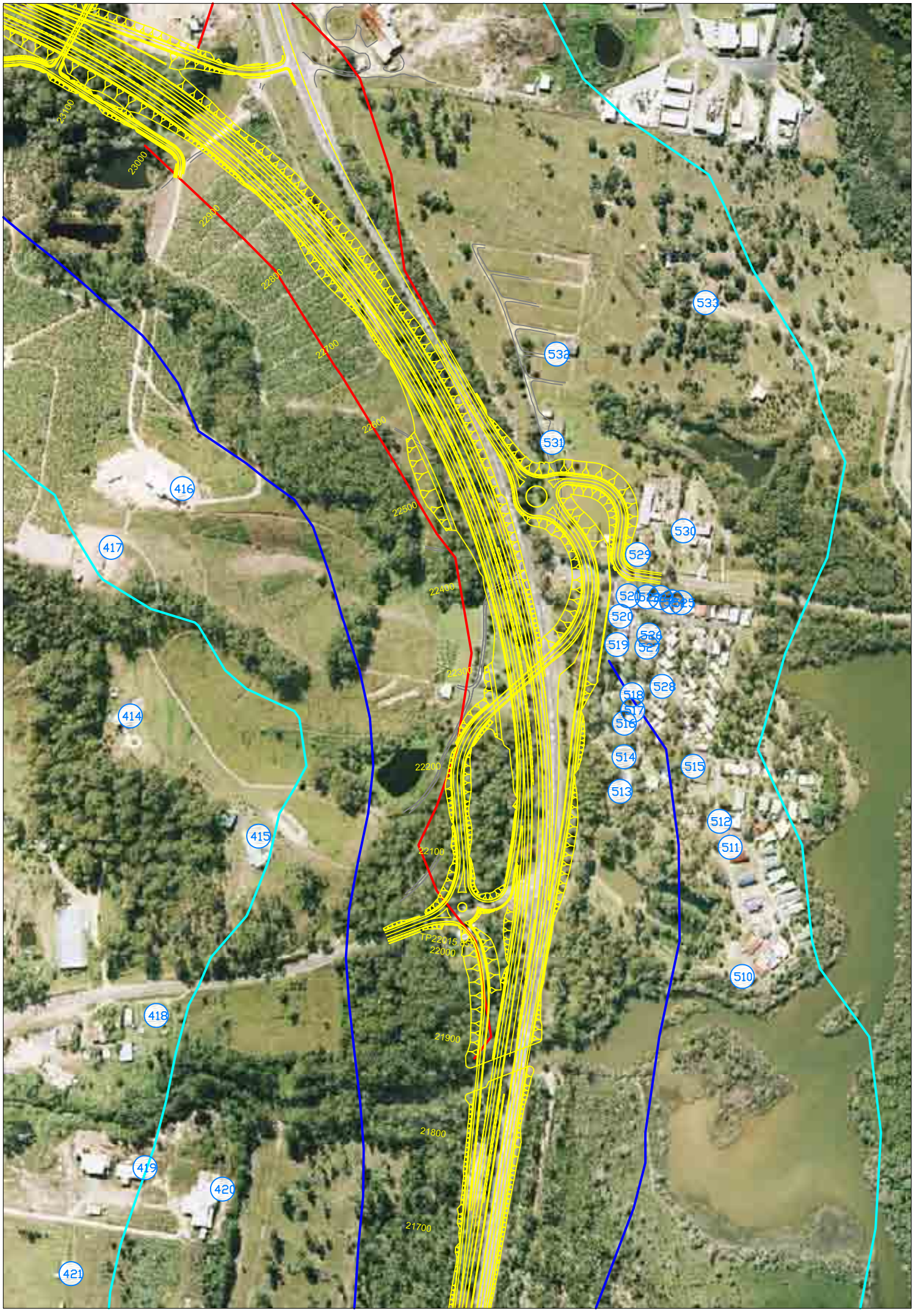
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4 OPERATIONAL NOISE ASSESSMENT

4.1 Modelling Methodology

4.1.1 Modelling Procedures

Noise levels from both the existing and proposed road designs were calculated using procedures based on the CoRTN prediction algorithms. The standard CoRTN prediction procedures were modified in the following ways.

- L_{Aeq} values were calculated from the L_{A10} values predicted by the CoRTN algorithms using the well-validated approximation $L_{Aeq,1hr} = L_{A10,1hr} - 3$.
- Noise source heights were set at 0.5m for cars, 1.5m for heavy vehicle engines and 3.6m for heavy vehicle exhausts, representing typical values for Australian vehicles. Noise from a heavy vehicle exhaust was assessed as 8dBA lower than the noise from the engine.

The models were implemented using *ROADent* software, based on road design points at 10m intervals along both the existing route and proposed design. Inputs to the model are listed in Table 4-1.

Where there are no barriers present, ground was taken to be 50% soft. This has been previously found to give a good correlation with measured noise levels in other Pacific Highway Projects over the last ten years. With barriers, hard ground is assumed, as required under the CoRTN procedures.

Table 4-1 Summary of *ROADent* Modelling Inputs

Input Parameter	Data Source
Road Design	Existing and proposed alignment supplied by Connell Wagner.
Topographical Data	Contours at 2m intervals supplied by Connell Wagner.
Traffic Volumes & Mix	Supplied by Connell Wagner.
Vehicle Speeds	For existing roads, posted speed limit. For new roads, 110kph on freeways, 80kph on ramps and service roads.
Receiver Locations	Based on surveys undertaken by Connell Wagner and Wilkinson Murray.
Height of Receivers	1.5m above floor level. In the case of multi-storey residences, 1.5m above floor level of the two storeys most affected by traffic noise.
Road Surface	Existing roads: Dense graded asphalt (CoRTN correction 0dB), chipseal (CoRTN correction 3dB) and stone mastic asphalt concrete (CoRTN correction -2dB) Upgraded Roads: Hessian-dragged tyned concrete for upgraded roads (CoRTN correction 3dB), with stone mastic asphalt concrete (CoRTN correction -2dB) as a noise control option.

4.1.2 Modelling Scenarios

Two models were created, corresponding to the existing alignment and proposed design. The following scenarios were modelled.

- Existing conditions. Current noise levels were calculated based on 2005 traffic counts. These levels are used to test the integrity of the noise models by comparing the predicted levels with measured levels from noise loggers.
- Year 2011 "Future existing". In this scenario noise levels were calculated for traffic on the existing road network immediately prior to the anticipated opening of the proposed works.
- Year 2021. Noise levels were calculated for the proposal 10 years after anticipated opening.

For each model, exceedances of *ECRTN* criteria at residences were generally highest at night, so that if mitigation measures are designed to meet relevant criteria at night they will also meet them during the daytime. For this reason, when considering protection of residences in the discussion below, only night-time noise levels are considered. A small number of receivers near local roads were found to have higher noise levels during the day due to the contribution from the local road network, but these are discussed separately.

4.2 Noise Catchment Areas

All residential locations potentially affected by the upgrade were included in this analysis, but for ease of reference, specific areas of the project have been grouped together into noise catchment areas (NCAs). Table 4-2 describes the location of each NCA and they are shown graphically in Appendix B.

Table 4-2 Noise Catchment Areas

NCA	Location
	West of Proposed Highway
1	Sth Limit to Gaudrons Rd IC
2	Gaudrons Rd IC to north of Maccues Road
3	South of Moonee Beach IC to Killara Ave Overpass
4	Killara Ave Overpass To North of Smiths Road
5	North of Smiths Road to North of Graham Drive
6	North of Graham Drive to North of Blackbutt Avenue
7	North of Blackbutt Avenue to South of Greys Road (Bypass)
8	South of Greys Road to Newmans Road (Bypass)
9	Newmans Road to Northern Limit
	East of Proposed Highway
10	Northern Limit to Arrawarra Interchange
11	Northern Bypass to South of Newmans Road
12	South of Newmans Road to Greys Road
13	Greys Road to South Woolgoolga Interchange
14	South Woolgoolga Interchange to North of Sandy Beach
15	North of Sandy Beach to north of Emerald Interchange

NCA	Location
16	Emerald Beach
17	South of Emerald Beach to Killara Avenue
18	Killara Avenue to North of Moonee Beach Interchange
19	Moonee Beach Interchange
20	South of Moonee Beach Interchange to Gaudrons Road
21	South of Gaudrons Road to Southern Limit
	Existing Highway
22	North of Newmans Road
23	South of Newmans Road

4.3 Traffic Modelling Parameters

As described in Section 2, a detailed study of existing ambient noise levels was carried out in May 2005 and June 2005. Traffic volumes and Ausroads vehicle classification from various surveys in 2005 are summarised in Table 4-3. Predicted traffic flows for 2011 with the existing alignment and 2021 with the Proposal are shown in Table 4-4 and Table 4-5 respectively. Predicted 2021 flows on ramps and service roads are shown in Table 4-6 and Table 4-7.

Table 4-3 Existing Traffic Flows May 2005

Location	Direction	Daytime (7.00am-10.00pm)			Night (10.00pm-7.00am)			Total
		Light	Heavy	%HV	Light	Heavy	%HV	
South of Headlands Rd	NB	7665	840	9.9%	510	359	41.3%	18721
	SB	7586	828	9.8%	704	229	24.5%	
North of Headlands Road	NB	7209	739	9.3%	475	356	42.8%	17443
	SB	7018	774	9.9%	641	231	26.5%	
North of Gaudrons Road/ Split Solitary Road	NB	7084	716	9.2%	466	354	43.2%	17102
	SB	6867	759	10.0%	624	232	27.1%	
North of Moonee Beach Rd	NB	6331	574	8.3%	410	347	45.8%	15080
	SB	5991	666	10.0%	534	226	29.7%	
North of Bucca Road	NB	6342	570	8.2%	411	343	45.5%	15087
	SB	5990	673	10.1%	530	229	30.2%	
North of Killara Ave	NB	6267	570	8.3%	406	344	45.9%	14930
	SB	5922	673	10.2%	519	229	30.6%	
North of Fiddaman Rd	NB	6108	566	8.5%	397	344	46.4%	14585
	SB	5767	681	10.6%	492	231	32.0%	
North of Graham Dve South	NB	5112	548	9.7%	338	346	50.6%	12459
	SB	4859	670	12.1%	360	227	38.7%	
North of Graham Dve North	NB	6237	563	8.3%	404	339	45.6%	14844
	SB	5876	686	10.5%	505	233	31.6%	
North of River St	NB	3583	509	12.4%	252	342	57.6%	9193
	SB	3430	629	15.5%	231	218	48.6%	
North of Pullen St / Clarence St	NB	5787	554	8.7%	377	340	47.4%	13877
	SB	5452	696	11.3%	435	236	35.2%	

Location	Direction	Daytime (7.00am-10.00pm)			Night (10.00pm-7.00am)			Total
		Light	Heavy	%HV	Light	Heavy	%HV	
North of Newmans Rd	NB	5246	554	9.6%	346	348	50.1%	12756
	SB	4986	670	11.8%	379	227	37.5%	
North of Safety Beach Rd	NB	4417	545	11.0%	301	356	54.2%	11030
	SB	4234	651	13.3%	304	222	42.2%	
North of Mullaway Dve	NB	3566	506	12.4%	250	339	57.6%	9144
	SB	3404	632	15.7%	228	219	49.0%	

Table 4-4 Predicted Traffic Flows 2011 with Existing Alignment

Location	Direction	Daytime (7.00am-10.00pm)			Night (10.00pm-7.00am)			2-way Total
		Light	Heavy	%HV	Light	Heavy	%HV	
South of Headlands Road	NB	10492	1064	9.2%	698	455	39.5%	25427
	SB	10376	1084	9.5%	963	295	23.4%	
North of Headlands Road	NB	10273	964	8.6%	677	453	40.1%	24609
	SB	10003	1029	9.3%	914	296	24.5%	
North of Gaudrons Road / Split Solitary Road	NB	10056	932	8.5%	661	449	40.5%	24039
	SB	9753	1006	9.4%	886	296	25.0%	
North of Moonee Beach Road	NB	9711	782	7.5%	630	439	41.1%	22784
	SB	9211	902	8.9%	821	289	26.0%	
North of Bucca Road	NB	9625	773	7.4%	623	435	41.1%	22569
	SB	9112	904	9.0%	806	290	26.5%	
North of Killara Avenue	NB	9525	774	7.5%	618	436	41.4%	22363
	SB	9023	905	9.1%	791	290	26.8%	
North of Fiddaman Road	NB	9124	764	7.7%	593	434	42.3%	21489
	SB	8640	907	9.5%	736	292	28.4%	
North of Graham Drive South	NB	7778	747	8.8%	514	436	45.9%	18627
	SB	7419	896	10.8%	550	287	34.3%	
North of Graham Drive North	NB	8982	747	7.7%	582	426	42.3%	21138
	SB	8484	897	9.6%	729	291	28.5%	
North of River Street	NB	5487	690	11.2%	385	429	52.7%	13739
	SB	5281	836	13.7%	355	276	43.7%	
North of Pullen St / Clarence St	NB	7888	716	8.3%	514	422	45.1%	18767
	SB	7457	885	10.6%	595	290	32.8%	

Location	Direction	Daytime (7.00am-10.00pm)			Night (10.00pm-7.00am)			2-way Total
		Light	Heavy	%HV	Light	Heavy	%HV	
North of Newmans Road	NB	7345	722	9.0%	485	432	47.1%	17670
	SB	7006	865	11.0%	533	282	34.6%	
North of Safety Beach Road	NB	6254	712	10.2%	425	440	50.9%	15404
	SB	6018	845	12.3%	432	278	39.2%	
North of Mullaway Drive	NB	5345	677	11.2%	375	424	53.1%	13402
	SB	5133	830	13.9%	343	275	44.5%	

Table 4-5 Predicted Traffic Flows 2021 with Proposed Design

Location	Direction	Daytime (7.00am-10.00pm)			Night (10.00pm-7.00am)			2-way Total
		Light	Heavy	%HV	Light	Heavy	%HV	
Upgraded Highway								
South of Headlands Road	NB	14565	1446	9.0%	969	617	38.9%	35264
	SB	14405	1519	9.5%	1336	406	23.3%	
North of Gaudrons Road / Split Solitary Road	NB	13841	1406	9.2%	921	608	39.8%	33461
	SB	13559	1469	9.8%	1260	397	24.0%	
North of Moonee Beach Road	NB	11961	1301	9.8%	799	585	42.3%	29154
	SB	11680	1356	10.4%	1092	379	25.8%	
North of Fiddaman Road	NB	11004	1248	10.2%	737	574	43.8%	25286
	SB	9268	1213	11.6%	887	356	28.6%	
North of Graham Drive South	NB	10570	1224	10.4%	709	568	44.5%	25692
	SB	10046	1259	11.1%	953	363	27.6%	
Woolgoolga Bypass	NB	4265	728	14.6%	299	489	62.1%	11377
	SB	4096	910	18.2%	274	316	53.6%	
Bypassed Section of existing highway								
North of Graham Drive North*	NB	7870	298	3.6%	487	77	13.7%	17190
	SB	7367	312	4.1%	711	68	8.7%	
North of River Street	NB	3008	217	6.7%	211	74	26.0%	6888
	SB	2905	226	7.2%	197	49	19.9%	
North of Pullen Street / Clarence Street	NB	6240	254	3.9%	386	69	15.2%	13653
	SB	5835	286	4.7%	519	65	11.1%	

Location	Direction	Daytime (7.00am-10.00pm)			Night (10.00pm-7.00am)			2-way Total
		Light	Heavy	%HV	Light	Heavy	%HV	
North of Newmans Road	NB	5681	267	4.5%	357	81	18.5%	12556
	SB	5391	273	4.8%	448	59	11.6%	
North of Safety Beach Road	NB	4146	252	5.7%	273	89	24.6%	9365
	SB	3998	247	5.8%	307	53	14.7%	
North of Mullaway Drive	NB	3190	228	6.7%	224	75	25.1%	7281
	SB	3063	244	7.4%	205	52	20.2%	

Table 4-6 Predicted 2021 Flows on Ramps

Location	Daytime (7.00am-10.00pm)			Night (10.00pm-7.00am)			Estimated AADT
	Light	Heavy	%HV	Light	Heavy	%HV	
Gaudrons/Split Solitary Road Interchange							
On Ramp - Northbound	646	36	5.3%	43	8	15.7%	733
Off Ramp - Northbound	1370	76	5.3%	91	17	15.7%	1554
On Ramp - Southbound	1602	96	5.7%	149	16	9.7%	1862
Off Ramp - Southbound	756	45	5.6%	70	7	9.1%	879
Moonee/Hoys Road Interchange							
On Ramp - Northbound	2784	155	5.3%	185	34	15.5%	3159
Off Ramp - Northbound	4664	260	5.3%	307	57	15.7%	5288
On Ramp - Southbound	3930	235	5.6%	357	38	9.6%	4561
Off Ramp - Southbound	2052	123	5.7%	190	20	9.5%	2385
Fiddaman/Graham Drive (South) Interchange							
Entry at Graham Drive (South) - Northbound	923	52	5.3%	61	11	15.3%	1047
Off Ramp - Northbound - South of Fiddaman Road	955	53	5.3%	64	12	15.8%	1084
Exit at Graham Drive (South) - Northbound	1357	76	5.3%	90	17	15.9%	1540
Entry at Fiddaman Road - Southbound	2406	144	5.6%	212	23	9.8%	2785
Graham Drive (North)/Woolgoolga Bypass Interchange							
On Ramp - Northbound	132	7	5.0%	9	2	18.2%	150

Location	Daytime (7.00am-10.00pm)			Night (10.00pm-7.00am)			Estimated AADT
	Light	Heavy	%HV	Light	Heavy	%HV	
Off Ramp - Southbound	124	7	5.3%	11	1	8.3%	144
Off Ramp from Pacific Highway - Northbound	6437	503	7.2%	418	81	16.2%	7438
On Ramp from Service Road - Southbound	6074	356	5.5%	690	49	6.6%	7169
Off Ramp at Graham Drive (South) - Southbound	772	46	5.6%	72	8	10.0%	898
Arrawarra Beach Interchange							
On Ramp - Northbound	2381	133	5.3%	158	29	15.5%	2701
Off Ramp - Northbound	437	24	5.2%	29	5	14.7%	496
On Ramp - Southbound	372	22	5.6%	35	4	10.3%	433
Off Ramp - Southbound	2588	155	5.7%	240	25	9.4%	3009

Table 4-7 Predicted 2021 Flows on Service Roads

Location	Daytime (7.00am-10.00pm)			Night (10.00pm-7.00am)			Estimated AADT
	Light	Heavy	%HV	Light	Heavy	%HV	
Service Road - South of Headlands Road	1044	61	5.5%	83	11	11.7%	1199
Service Road - North of Headlands Road	1717	101	5.6%	137	18	11.6%	1972
Service Road - North of Gaudrons Road	374	22	5.6%	30	4	11.8%	430
Service Road - North of Bucca Road	1581	93	5.6%	126	16	11.3%	1815
Service Road - North of Killara Avenue	935	55	5.6%	74	10	11.9%	1073
Service Road - North of Fiddaman Road	3401	199	5.5%	271	35	11.4%	3906

4.4 Model Validation

Noise levels are calculated using the existing model inputs for locations where noise loggers had been left during the ambient noise survey. The results are shown in Table 4-8 rounded to 0.5dBA. Only those loggers within 300m of the highway are used for the model validation as other non-traffic noise sources can become dominant at greater distances.

Table 4-8 Model Validation Results

Site	Location	$L_{Aeq,15hr}$ (dBA) Daytime (7am–10pm)		$L_{Aeq,15hr}$ (dBA) Night time (10pm-7am)	
		Measured	Predicted	Measured	Predicted
1	2/786 Pacific Highway	60	62	57.5	57.5
2	817 Pacific Highway	63.5	63 (1)	62	58 (1)
3	8 Alpini Place	60	62.5	58.5	58
4	18 Woodhouse Rd	55.5	59.5	54.5	54.5
5	20 Hoys Rd	68	68	65	63.5
6	26 Tiki Rd	53	54.5	49.5	50
7	9 Smiths Rd	58.5	60.5	55	56
8	9 Bream Close	52.5	54	54	49.5
9	53 Emerald Heights Drive	58	59.5	55.5	55.5
10	5 Pine Crescent	59.5	63	57.5	58.5
11	6 Wattle Place	57	58.5	53	54
12	11 Hearnes Lake Rd	56.5	61.5	57	58
14	Go Bananas	67	67.5 (1)	66	63.5 (1)
17	2921 Pacific Highway	58.5	61.5 (2)	57	59 (2)

Notes 1) 1dBA subtracted from measured level to account for effect of reverberant space
2) 2.5dBA subtracted from predicted level as measurement taken in free field

Agreement to within 2dBA is generally considered acceptable given the limitations of standard noise modelling procedures, and also week-to-week variability in traffic volumes and measured noise levels. Predicted noise levels are generally within this range at night, however there is a tendency to over-predict noise levels during the daytime. This is most likely due to traffic travelling at lower speeds than modelled during the day. Nevertheless the design of noise mitigation measures would be governed by predicted night time noise levels which show good agreement with measured levels.

With regard to 9 Bream Close, only four days of logger data are available due to logger failure. Unusually the measured night time levels are higher than those measured during the daytime. Examination of the logger graphs would suggest that there was an extraneous noise source since the receiver is approximately 350 metres from the road and unlikely to be dominated by road traffic noise.

At Go Bananas Motel, the measured levels at night are again very similar to daytime measured levels. At this location there were a number of nearby air-conditioning units that may have affected measured night time levels. Alternatively, results may have been influenced by noise from refrigeration units of trucks parked on the western side of the highway at night.

4.5 Sensitivity Analysis

To ensure the future design will meet requirements a sensitivity analysis has been undertaken so that variations in noise levels due to potentially increased speeds or traffic flows are provided for. It is considered that 1dBA should be added to all predicted noise levels for the 2021 design noise model to allow for this possibility. This would equate to an increase in speeds of 15-20kph or a corresponding increase of 15-20% in heavy vehicle volumes, depending on the specific location along the proposed alignment.

4.6 Predicted Noise Levels

All residential locations potentially affected by the upgrade are included in this analysis, and detail of existing and future noise levels at individual residences is shown in Appendix D of this report. For ease of reference, the following Section groups residences into noise catchment areas (NCAs). Location of NCAs is shown graphically in Appendix B. Noise level contours are shown on the figures in Appendix C.

Preliminary modelling of the proposed alignment indicated that south of the bypass section, residences have existing exposure to traffic noise and that this section of the upgrade would generally be considered a redevelopment of an existing freeway or arterial road as defined in the Environmental Criteria for Road Traffic Noise *(ECRTN)*. Residences near to the proposed bypass section generally have little or no existing exposure to traffic noise, and the *ECRTN* criteria for new freeways or arterial roads would apply.

More than 360 residences would require mitigation if the redeveloped highway were surfaced with a hessian-dragged tyned concrete surface and noise mitigation measures such as noise barriers would be required over most sections of the highway. The majority of these residences are located south of the bypass section.

Further modelling indicated that, with a low-noise pavement surface; less than 140 of the modelled residences would require further noise mitigation measures and that the majority of residences would experience a reduction in noise levels from existing levels. The low-noise surface was therefore adopted as an appropriate noise control measure over the majority of the proposed route. This would extend from the southern end of the project at Sapphire to approximately 700m north of Bark Hut Road on the bypass section where the surface would revert to concrete.

Residences on the bypassed section of the existing Pacific Highway north of the proposed bypass section would experience a reduction in noise levels of typically 3-10dBA as a result of the removal of a substantial proportion of existing traffic.

Table 4-9 outlines the results of noise modelling with a low-noise pavement for each noise catchment area (NCA) with no additional mitigation measures and the number of predicted exceedances of Environmental Criteria for Road Traffic Noise criteria in each NCA.

Table 4-9 Summary of Predicted Noise Levels (Low Noise Pavement Without Barriers)

NCA	Results
1	Eleven residences are predicted to have noise levels that exceed Environmental Criteria for Road Traffic Noise. A noise barrier would be required at one location and is proposed. Architectural treatments of dwellings would be considered at three residences where barriers are not considered appropriate given the separation between dwellings or where houses are situated high above the road. Two residences have already been architecturally treated as a result of Northern Pacific Highway Noise Taskforce investigations.
2	Noise levels are predicted to fall by approximately 2-3dBA and no consideration of noise mitigation measures is required. At sections where a headlight screen has been proposed, noise levels would fall by up to 5dBA.
3	Noise levels are generally predicted to fall by approximately 1-2dBA and no consideration of noise mitigation measures is required with the exception of one residence on Hoys Rd where the noise level is predicted to be acute and mitigation would be required.
4	Three residences are predicted to have acute noise levels, despite a net reduction in noise levels of 2-3dBA from future existing levels. Architectural treatments would be considered for these residences.
5	Three residences are predicted to have acute noise levels and architectural treatments would be considered.
6	Residences closest to the alignment are predicted to have exposure to noise levels that exceed Environmental Criteria for Road Traffic Noise criteria. Noise barriers are proposed.
7	All residences are predicted to have noise levels within Environmental Criteria for Road Traffic Noise criteria, with noise levels 1-4dBA less than future existing levels.
8	Nine residences in total are predicted to have exposure to noise levels that exceed Environmental Criteria for Road Traffic Noise. A noise barrier is proposed. Three residences would also be considered for architectural treatments.
9	Four residences are predicted to have exposure to noise levels that exceed Environmental Criteria for Road Traffic Noise. The residences are located above a section of road which is already in cutting up to 15m deep. A noise barrier would be inefficient at this location and it would not be possible to meet the Environmental Criteria for Road Traffic Noise base criteria at these residences and therefore the residences should be considered for architectural treatments.
10	Noise levels are predicted to increase by 1-2dBA however all levels are within Environmental Criteria for Road Traffic Noise criteria. No mitigation measures would be required.
11	Sixteen residences are predicted to have noise levels that exceed Environmental Criteria for Road Traffic Noise criteria. Two isolated residences would require architectural treatment. Noise barriers would be required south of Bark Hut Road and are proposed.
12	Three residences are predicted to have noise levels that exceed Environmental Criteria for Road Traffic Noise. Nose barriers are not an efficient means of controlling noise at this location due to the local topography. Architectural treatments would be considered at the residences.
13	Residents in this noise catchment area have exposure to noise from a different direction. This new noise source is considered significant, as defined in Practice Note (i) of the Environmental Noise Management Manual, and the “new road” criteria would apply at the western façades of the residences. Noise levels at three residences would exceed Environmental Criteria for Road Traffic Noise and would be considered for architectural treatment.
14	Noise levels are predicted to fall by between 3-6dBA and no noise mitigation would be required.
15	Noise levels in this noise catchment area are predicted to fall as a result of the introduction of low noise pavement and the northbound carriageway moving further to the east. However, six residences to the north and three to the south of Diamond Head Drive overpass are predicted to have acute noise levels and noise barriers would be required and are proposed.
16	There would be very little change in noise levels for residences in this noise catchment area, although one residence is predicted to experience a slight increase in noise to an acute level. Architectural treatment is proposed for this residence.
17	Noise levels are predicted to fall by 2-5dBA. No noise mitigation would be required.

NCA	Results
18	Noise levels are predicted to fall by 2-3dBA although one residence is predicted to experience a slight increase in noise to an acute level. Architectural treatment is proposed for this residence.
19	Residences would experience a net reduction in noise levels of 2-3dBA.
20	Five residences are predicted to retain acute noise levels despite a general reduction of 1-2dBA in this noise catchment area. Architectural treatments are proposed for these residences.
21	Three groups of residences are predicted to have noise levels that either exceed Environmental Criteria for Road Traffic Noise allowance or are acute. Barriers would be required at those locations and are proposed. One residence has already been architecturally treated as a result of Northern Pacific Highway Noise Taskforce investigations.
22, 23	Noise levels on this section of the existing Pacific Highway are predicted to fall by typically 3dBA to 10dBA. No mitigation would be required. However, six residences are predicted to retain acute noise levels, even with the predicted noise level reduction. The RTA would assess the need to implement architectural treatments between six months and one year after opening the project.

4.7 Design of Noise Mitigation Measures

For all locations where noise mitigation would be required, guidance is taken from the RTA's *Environmental Noise Management Manual (ENMM)*, which was published to assist in implementation of the Environmental Criteria for Road Traffic Noise and in particular, provide guidance on the selection of appropriate mitigation measures. It should be noted that this document states that community views should be fully taken into account in following the processes for evaluating and selecting noise treatments.

Where the barrier height required to meet Environmental Criteria for Road Traffic Noise base criteria would have unacceptable visual impacts, a procedure is outlined to undertake a cost-benefit analysis of various barrier configurations. For the purposes this report, it is expected that a noise barrier of up to 4 metres (above pavement level) could be built with acceptable visual impacts and community support. Where noise modelling has indicated that a height of greater than 4 metres would be required to meet criteria, a cost benefit exercise is carried out to determine a suitable "assessed" barrier height.

In 2003 the NSW Government commissioned the Northern Pacific Highway Noise Taskforce to investigate and assist in the identification of road traffic noise issues along the northern part of the Pacific Highway from Coffs Harbour to the Queensland border. As a result of these taskforce investigations, the RTA commissioned acoustic consultants to undertake noise studies in affected areas – including at the southern end of the Proposal. From those studies a number of residences at Sapphire were identified for architectural treatments. No additional architectural treatment is proposed for residences previously treated as a result of the noise taskforce investigations.

Table 4-10 indicates appropriate noise barrier heights that are proposed for each noise catchment area. The number of residences that would require architectural treatments to meet Environmental Criteria for Road Traffic Noise criteria (inclusive of proposed barriers) is also provided for each noise catchment area. All barrier heights are heights above pavement level in metres except where stated.

Table 4-10 Noise Mitigation Design (Low-noise pavement)

NCA	Barrier Ref	Barrier Height (m)	Chainage	Architectural Treatments	Comments
1	B1a	3	7397-7605	9, 10, 21, 24, 36, 37 (6 residences)	9 and 10 are situated above the road and barriers are not and efficient means of controlling noise. 24 and 21 are isolated residences. Residences 36 and 37 south of the extent of works in Sapphire would also be have noise levels exceeding ECRTN, however property access requirements would inhibit construction of a suitable barrier. Residences 616 and 617 have already been architecturally treated as a result of Northern Pacific Highway Noise Taskforce investigations.
2	N/A	N/A	N/A		
3	N/A	N/A	N/A	85 (1 residence)	An isolated residence on Hoys Road is predicted to have an acute noise level and would be considered for architectural treatment.
4	N/A	N/A	N/A	98, 110, 121 (3 residences)	
5	N/A	N/A	N/A	178, 180, 195 (3 residences)	
6	B6a	4	20300-20620	222, 223, 224, 225 (4 residences)	With this barrier configuration noise levels at most residences meet the *ECRTN*. There are 4 residences that would have levels that remain acute. These residences would be considered for architectural treatment. Barriers would merge into roadside cutting.
	B6b	4	20740-20970		
7	N/A	N/A	N/A		
8	B8a	3.5	24490-24625	425, 441, 442 (3 residences)	With the barriers in place 2 residences are predicted to have noise levels above the base *ECRTN*. Both are positioned high above the road where the road is in deep cut & the criterion cannot be reasonably achieved by means of a barrier. A third isolated residence (425) would also require architectural treatment. Barriers would merge into roadside cutting.
	B8b	3.5	24785-25030		
	B8c	4	25105-25400		
9	N/A	N/A	N/A	444, 445, 446, 447 (4 residences)	A barrier is not efficient here as the residences are either isolated or positioned above deep roadside cutting.
10	N/A	N/A	N/A		
11	B11a	3	26300-26585	454, 470, 482 (3 residences)	In addition to the isolated residence 454, 2 other residences remain above the base *ECRTN* with the barrier in place. Again these residences are located in positions where use of noise barriers is not feasible to meet the criterion.
	B11b	3	26600-27075		

NCA	Barrier Ref	Barrier Height (m)	Chainage	Architectural Treatments	Comments
	B11c	4	27205-27430		
	B11d	2.5	27430-27575		
12	N/A	N/A	N/A	495, 496, 498 (3 residences)	*ECRTN* cannot be achieved at these residences by means of a barrier due to their position relative to the highway, where the road is in deep cutting.
13	N/A	N/A	N/A	713, 714, 715 (3 residences)	Treatment would be considered as a result of the bypass section being considered a new source of traffic noise as it is from a different direction and makes a "significant contribution to noise exposure".
14	N/A	N/A	N/A		
15	B15a	4	20420-20680	235, 237, 238, 239, 240 (5 residences)	Noise levels at 5 residences remain acute with the barrier in place. These residences would be considered for architectural treatment. Barriers would merge into roadside cutting.
	B15b	4	20750-20970		
16	N/A	N/A	N/A	267 (1 residence)	
17	N/A	N/A	N/A		
18	N/A	N/A	N/A	283 (1 residence)	
19	N/A	N/A	N/A		
20	N/A	N/A	N/A	292, 320, 324, 325, 326 (5 residences)	A barrier is not appropriate here as property access is required. An isolated residence (292) would also be considered for architectural treatment.
21	B21a	3.5	6915-7225	332, 336, 337, 635 (4 residences)	Noise barriers would be required in three discrete sections, however a 2.5m sight screen of would also be employed from chainage 7395 to 9125, and this would reduce noise levels further. However, noise levels are predicted to remain acute at five residences and architectural treatments would be considered. Residence 333 has already been architecturally treated as a result of Northern Pacific Highway Noise Taskforce investigations.
	B21b	3.5[1]	7740-7980		
	B21c	3.5[1]	8260-8560		
22,23	N/A	N/A	N/A	551, 560, 561, 566, 757, 758 (6 residences)	Noise levels are predicted to remain acute at these residences. Barriers would not be a suitable means of noise mitigation given property access requirements. the RTA would assess the need to implement architectural treatments between six months and one year after opening the project

Note [1] quoted height is height above the service road

There may be minor changes in barrier heights and lengths as the noise mitigation is optimised as part of the detailed design process or following community consultation.

4.8 Summary of Operational Noise Mitigation Design

A total of 742 residences in 23 catchment areas have been identified and noise levels predicted at each location 10 years after opening of the proposed highway upgrade in accordance with guidelines set out in the *Environmental Noise Management Manual (ENMM)*. It is proposed that the main carriageways of the proposed design have a low noise pavement surface from the southern end of the project at Sapphire to a point approximately 700m north of Bark Hut Road on the bypass section. From that point to the northern project limits a concrete surface would be adopted. Barriers would be constructed in six of the catchment areas as a primary means of noise control. In addition to the proposed noise barriers, 49 residences would be considered for architectural treatments. Three residences in Sapphire have already been architecturally treated as a result of Northern Pacific Highway Noise Taskforce investigations. A further six residences near the bypassed section of the existing Pacific Highway have been identified as having noise levels that would remain acute. The RTA would assess the need to implement architectural treatments at those residences between six months and one year after opening the project.

Figure 4-1 to Figure 4-3 outline the number of residences predicted to experience changes in night time noise levels over those NCAs where there is existing traffic noise from 2011 to 2021. The NCAs have been combined into residences west of the proposed upgraded section; east of the proposed upgraded section; and the bypassed section of the existing Pacific Highway. Noise levels are calculated with proposed barriers in place. This type of analysis is not considered appropriate for those residences near the bypassed section, as they have little or no existing exposure to road traffic noise. Traffic noise levels ten years after anticipated opening are predicted to increase substantially at those residences. However noise levels are predicted to be within ECRTN for new roads at the majority of residences. At those residences where ECRTN are exceeded, architectural treatments are proposed.

Figure 4-1 Change in Noise Levels - West of Upgraded Section

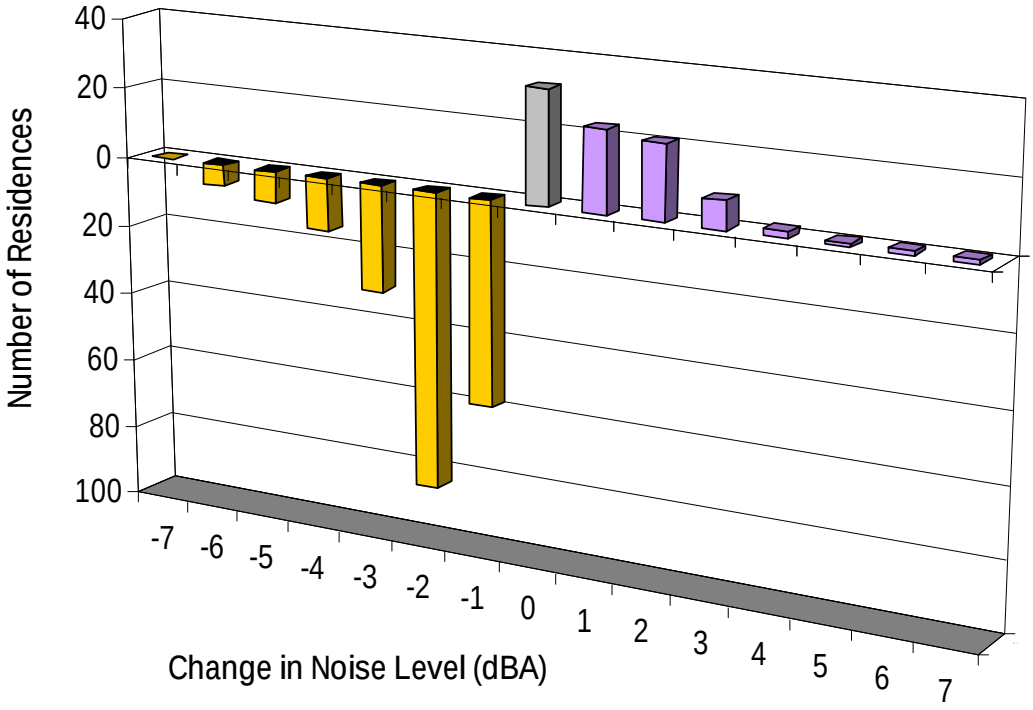


Figure 4-2 Change in Noise Levels - East of Upgraded Section

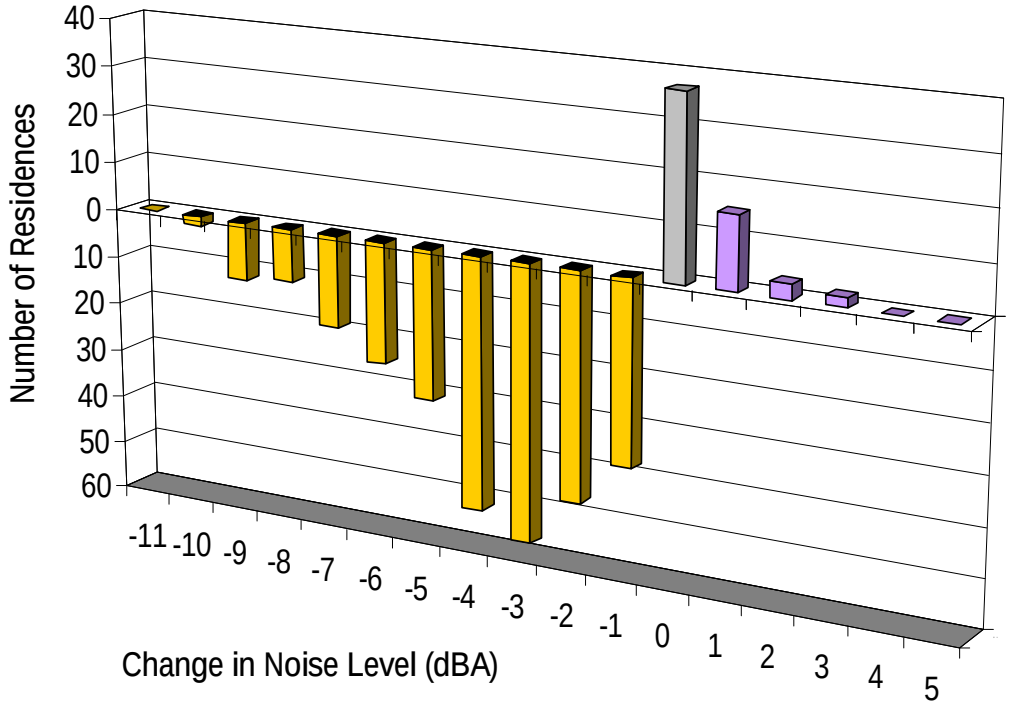
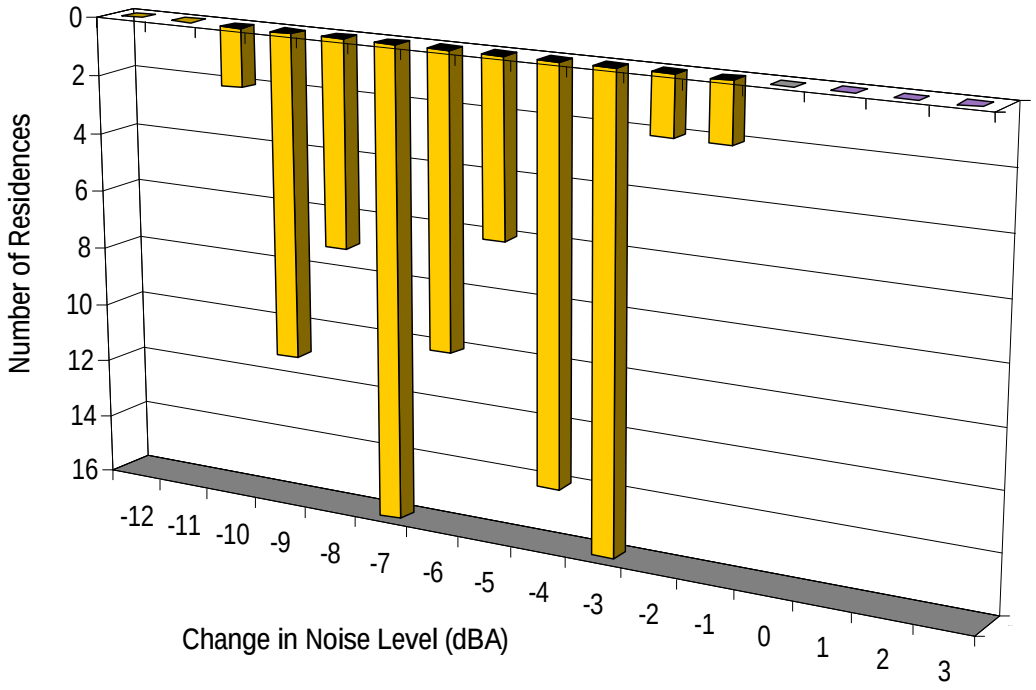


Figure 4-3 Change in Noise Levels – Bypassed section of existing Pacific Highway



5 MAXIMUM NOISE LEVEL ASSESSMENT

Although there are no specific criteria relating to sleep disturbance in the *Environmental Criteria for Road Traffic Noise (ECRTN)*, the document recommends that an assessment of such levels be undertaken where impacts may occur during the night. The only guidance offered in terms of acceptable maximum noise levels are:

- *Maximum internal noise levels below 50-55dBA are unlikely to cause awakening reactions*
- *One or two noise events per night with maximum internal noise levels of 65-70dBA are not likely to significantly affect health and wellbeing*

The RTA's *Environmental Noise Management Manual (ENMM)* puts forward a protocol for assessing maximum traffic noise levels. In Practice Note (iii) the document states:

> *At locations where road traffic is continuous rather than intermittent, the $L_{Aeq,9hr}$ target noise levels should sufficiently account for sleep disturbance impacts.*
>
> *A "maximum noise event" can therefore be defined as any pass=by for which*
>
> L_{Amax}-$L_{Aeq,\ 1hr}$ >= 15dBA

5.1 Measurement of Maximum Noise Levels

Recent technical innovations have enabled the collection of accurate data regarding maximum noise levels, and in particular, frequency of occurrence of "maximum noise events". Traditional environmental noise loggers capture several statistical parameters including maximum noise level over any period greater than one minute and typically fifteen minutes. Whilst this data will indicate the absolute maximum level over the measurement period, there is no way of knowing how frequently such maxima occurred.

During the background noise monitoring survey outlined in Section 2, a MadMax recorder was connected to an ARL environmental noise logger at three of the measurement locations. This device can be programmed to record all maximum levels above a specific sound pressure level. The data can later be downloaded and analysed. The following default parameters were used in setting up the MadMax devices:

- Sample time: Time between readings of the instantaneous SPL from the logger. 250msec is the default, and is adequate for events such as vehicle passbys.
- Min drop between maxima (default 5dBA): If the noise level does not fall by at least this amount between two local maxima, they are treated as being part of the same event.
- Min time between max (default 3 sec): If two local maxima are separated by less than this period, they are treated as being part of the same event.
- Max wait time for drop (default 25 sec): If the noise level does not fall by the minimum drop value within this time period after a local maximum, the maximum is not considered to be an event.
- Min recorded maxima (default 65dBA): Noise events are not recorded in the database if the maximum level is below this value.

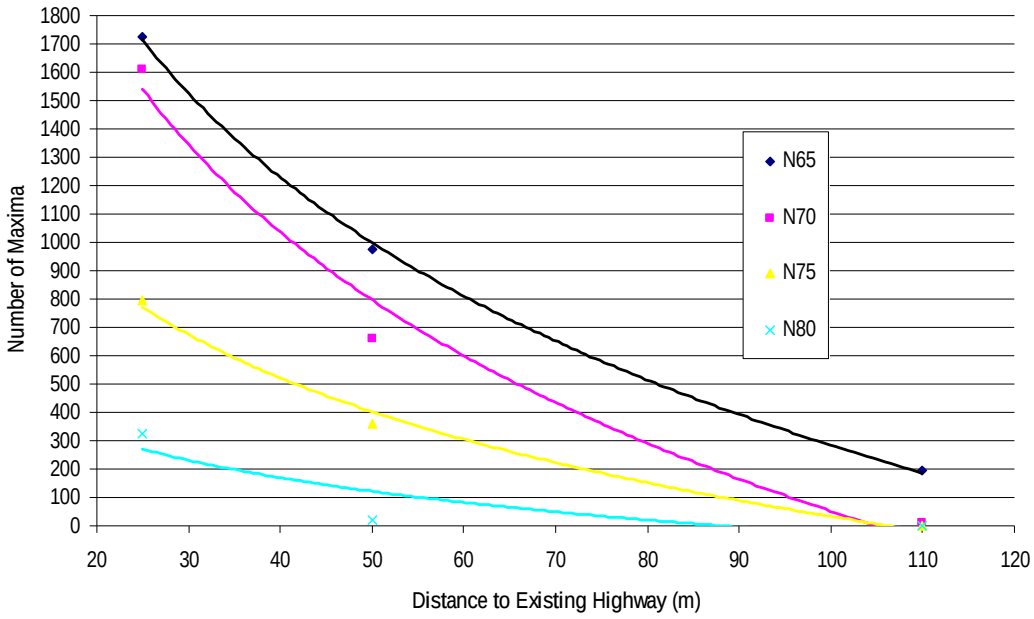
Maximum noise levels were collected over the course of one night at the locations listed in Table 5-1.

Table 5-1 Location of MadMax devices

Location	Date	Distance from Road (m)
20 Hoys Road, Moonee Beach	19/05/05-20/06/05	20
817 Pacific Highway, Korora	08/06/05-09/06/05	50
11 Hearnes Lake Road, Woolgoolga	08/06/05-09/06/05	110

Locations were chosen that were relatively close to the existing Pacific Highway so as to ensure that captured levels were from passing vehicles and not extraneous noise from other sources. The equipment calibration was checked before and after the survey and no significant drift occurred. Data was downloaded and maxima from the night time (10.00pm-7.00am) period analysed. The number of maximum events per night over discrete interval periods of 65dBA, 70dBA, 75dBA and 80dBA is shown in Figure 5-1.

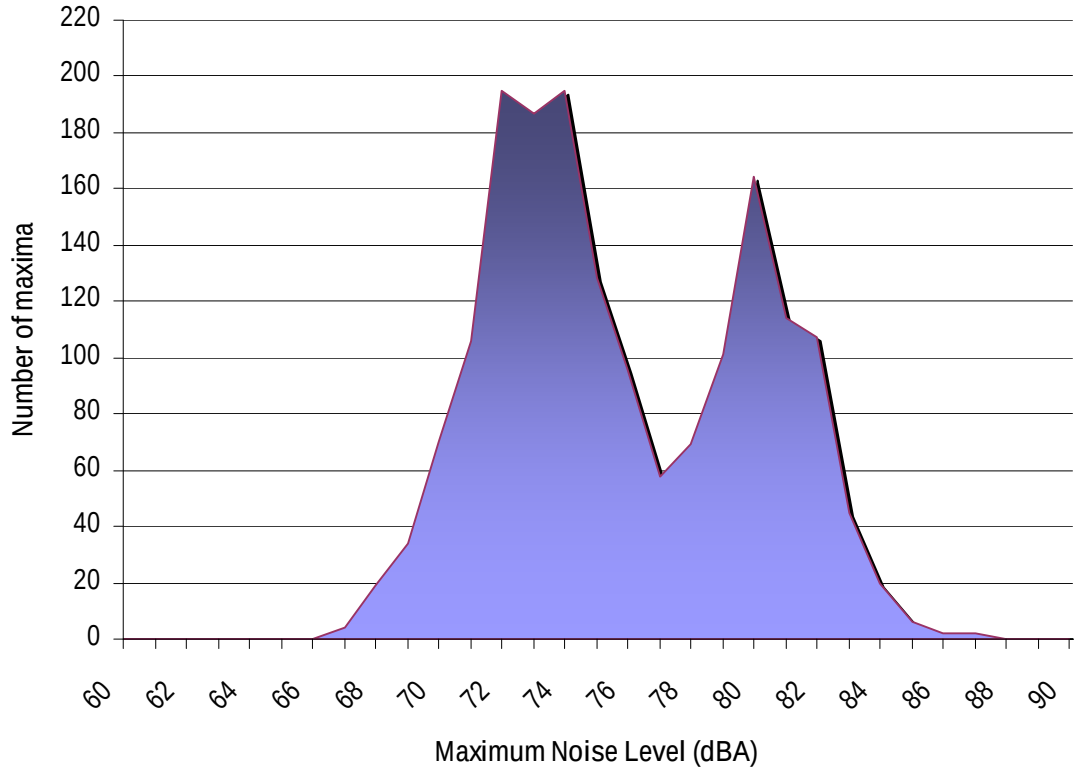
Figure 5-1 Number of Measured Maximum Noise Events (External)



The above data is for external noise levels only. It would be reasonable to subtract 10dBA to conservatively estimate internal noise levels with windows open for ventilation. In addition, the introduction of a low-noise pavement on the upgraded highway would result in a further reduction in typical passby maximum levels of around 5dBA. This reduction would not apply to other maxima associated with heavy vehicles such as compression braking; however the redevelopment of the highway in itself would generally reduce the need for such braking. With this in mind, the internal N65 curve would equate to the external N80 curve in the above figure. Whilst the measured maxima show a clear trend with distance; the derivation of any mathematical relationship using this data would not be acceptable, given the relatively small number of measurement locations. A better predictive method would be to look at the distribution of maxima at the closest location in the study, and from this data then calculate the

attenuation that would be required to achieve the internal noise level goals. Figure 5-2 shows the distribution of recorded maximum noise events at 20 Hoys Road. Given the proximity to the road it is unlikely that any of the measured maxima are caused by anything but the passing of vehicles at night.

Figure 5-2 Distribution of Maximum Noise Levels 20 Hoys Road



There are two clear peaks in the graph resulting from passing cars and trucks respectively. The above graph does not however allow for any assessment of sleep disturbance as it is likely that many of the L_{Amax} events above would not be sufficiently above the general noise level to cause awakening reactions

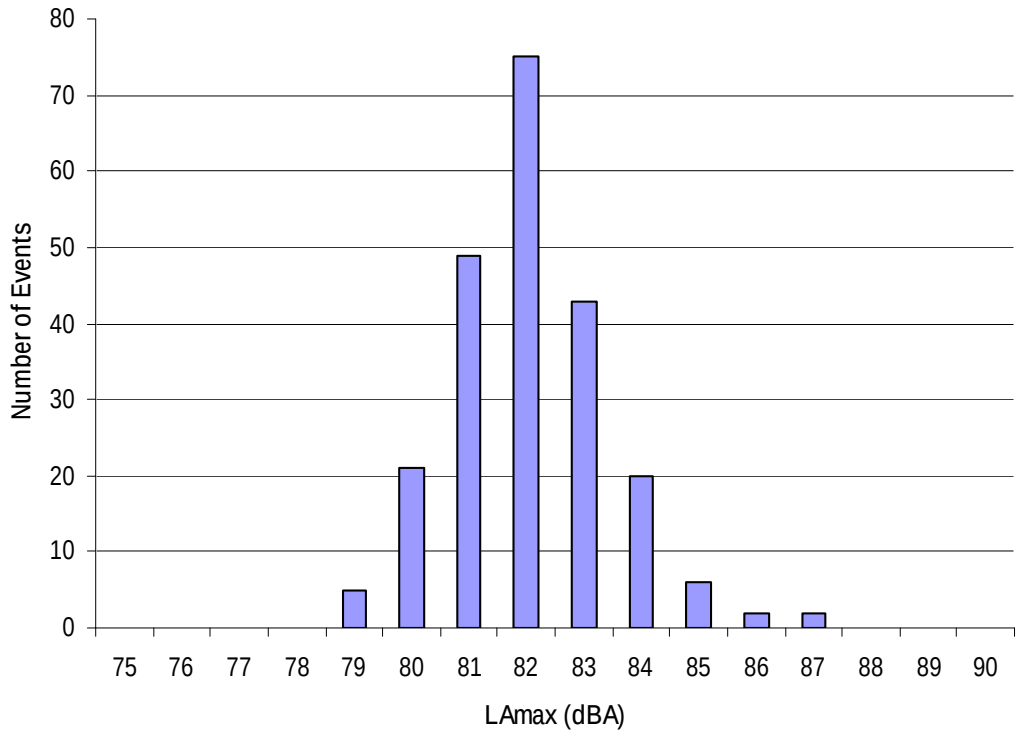
Using the protocol outlined in the Environmental Noise Management Manual which defines a *maximum noise event*, namely $L_{Amax} - L_{Aeq,1hr} >= 15$dBA, the measured $L_{Aeq,\ 1hr}$ traffic noise levels during the measurement period at 20 Hoys Road are shown in Table 5-2 below.

Table 5-2 Measured $L_{Aeq,\ 1hr}$ Traffic Noise Levels

Period	$L_{Aeq,\ 1hr}$
10pm-11pm	67.5
11pm-12am	67
12am-1am	66.5
1am-2am	66.5
2am-3am	65.5
3am-4am	65
4am-5am	65
5am-6am	63.5
6am-7am	67.5

Applying the dataset of L_{Amax} levels illustrated in Figure 5-2 to these ambient L_{Aeq} levels, a graph of Environmental Noise Management Manual maximum noise events is derived and shown in Figure 5-3 below.

Figure 5-3 Distribution of ENMM Maximum Noise Events 20 Hoys Road

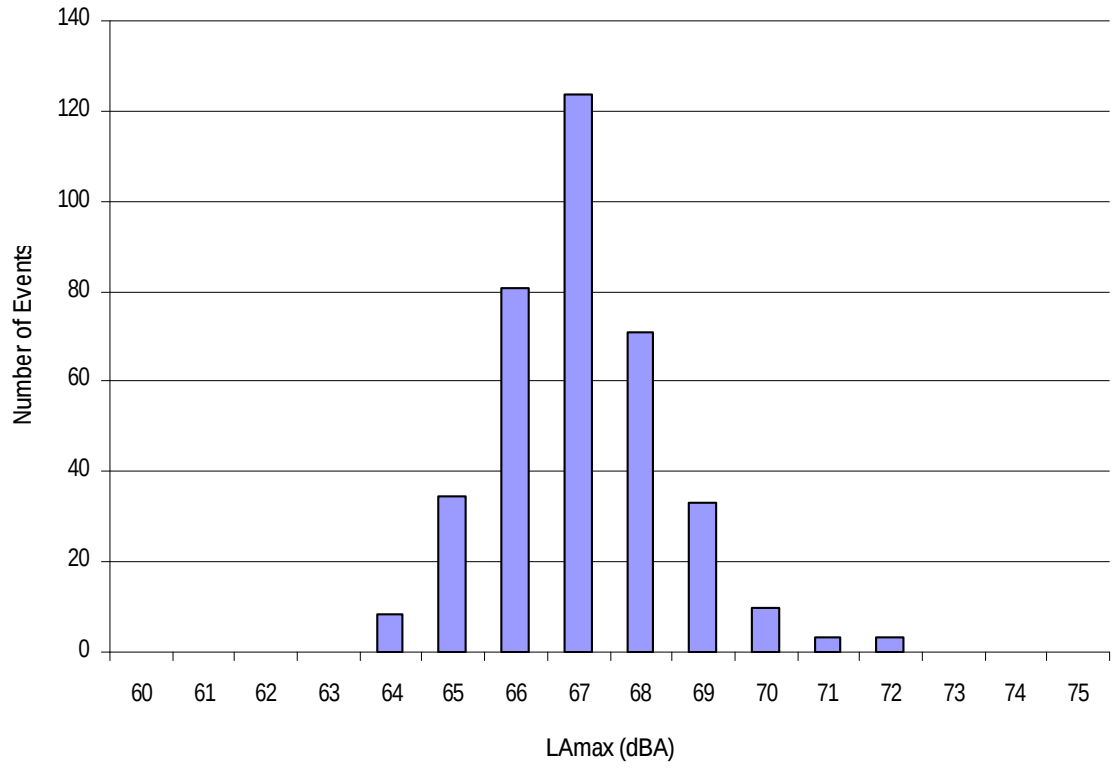


In order to predict the distribution of internal maxima, the following adjustments are made to the curve in Figure 5-3:

- 10dBA is subtracted from the measured maxima to conservatively estimate internal noise levels with windows open for ventilation.
- 5dBA is subtracted from the measured maxima to account for the introduction of a low-noise pavement in the proposed design.
- The number of maxima is increased by 65% to account for the projected maximum increase in current heavy vehicle movements at night from 2006 to 2021. Note that is the worst-case increase for this project and other sections of the proposed highway would have a lower increase in traffic flows.

Figure 5-4 shows the adjusted distribution curve for maximum internal noise events at 20 Hoys Road, which reflects the predicted frequency of internal maximum noise levels for 2021.

Figure 5-4 Adjusted Distribution of Maximum Internal Noise Levels 20 Hoys Road



At the maximum predicted internal level of 72dBA there are three events per night. In order to meet the health and wellbeing goals of two events at 65-70dBA per night, there would need to be a further reduction in noise levels of 7dBA in addition to implementation of a low-noise pavement surface. Taking into account noise attenuation due to geometric spreading, atmospheric absorption and the effect of acoustically soft ground, Table 5-3 outlines the additional distance from the highway at which the internal goal of 65dBA would be met. Note this calculation is conservative as it does not take into account the additional attenuation

provided by roadside noise barriers, or by areas where the road is in cut and topographic shielding would exist.

Table 5-3 Required Distance to meet Maximum Noise Goal

Surface	Distance (m)
Low-noise Pavement	55

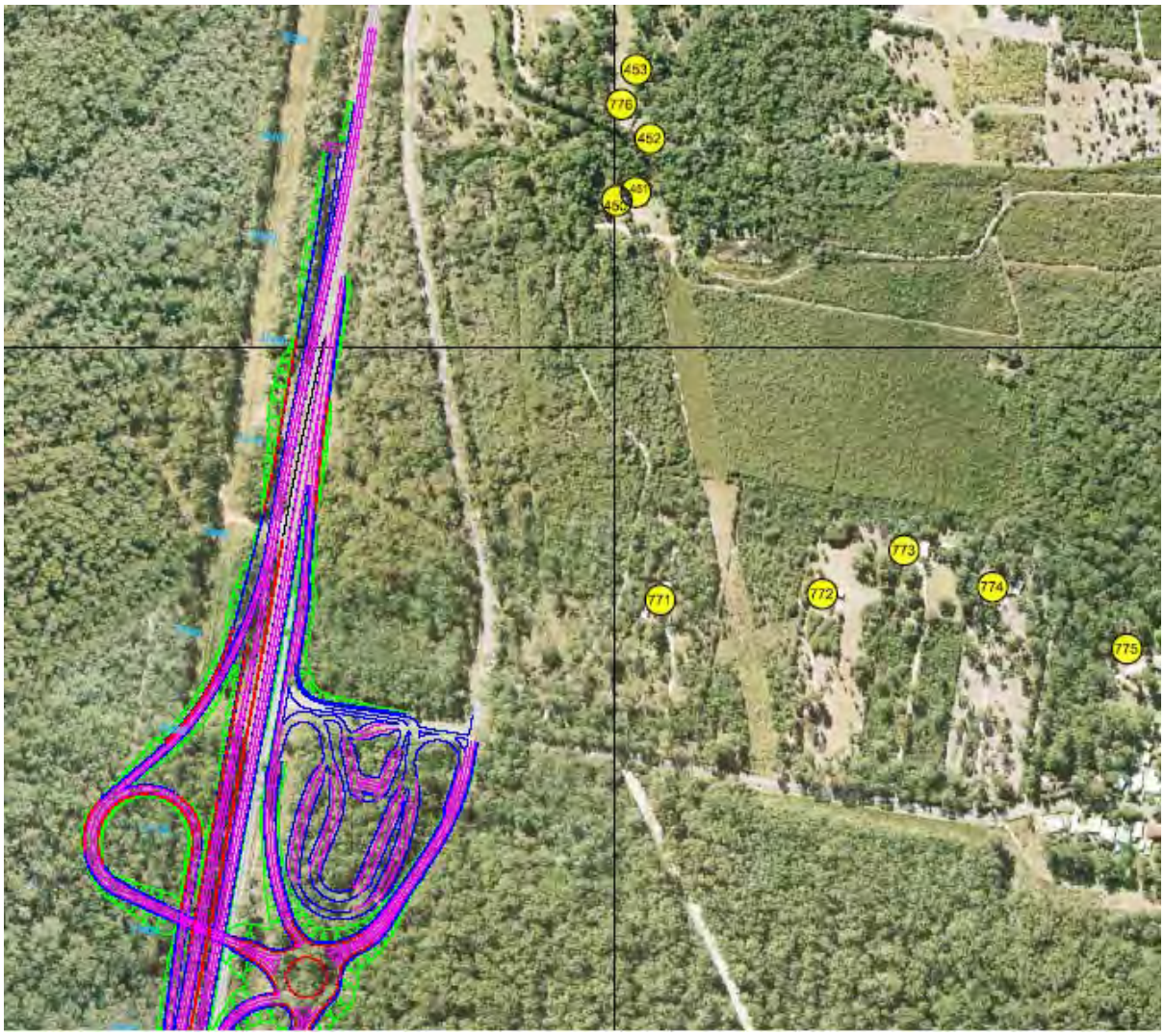
There are three residences located south of the proposed bypass section within 55m of the highway that have not already been assessed under the operational noise section of this report, and where use of noise barriers or architectural treatments would not already have been considered. Residences 17, 18, and 19 on Hunter Close should be reviewed during the detail design stage and further assessment of maximum noise impacts and potential mitigation addressed at that stage. With regard to the bypass section of the proposal, there are two within 55m. Both of these residences have previously been identified and assessed for mitigation of operational noise in Section 4. It should also be noted that with regard to the redeveloped section of highway, although the frequency of maximum events is predicted to increase, the actual internal L_{Amax} noise level would decrease by 3-5dBA from current levels due to the introduction of a low-noise pavement.

Further analysis of maximum noise events at 11 Hearnes Lake Road using the procedure outlined above indicates that over the course of a night, there are 3 maximum noise events as defined in the ENMM protocol. The measured levels were in the range 71-75dBA, which would correspond to an internal level of 56-60dBA with a low noise surface. This shows that as distance from the highway increases to greater than 100m, individual maxima greater than 15dBA above the traffic noise continuum would not occur frequently, and any such maximum events would be below the adopted goal for health and well being.

6 REST AREA AT ARRAWARRA INTERCHANGE

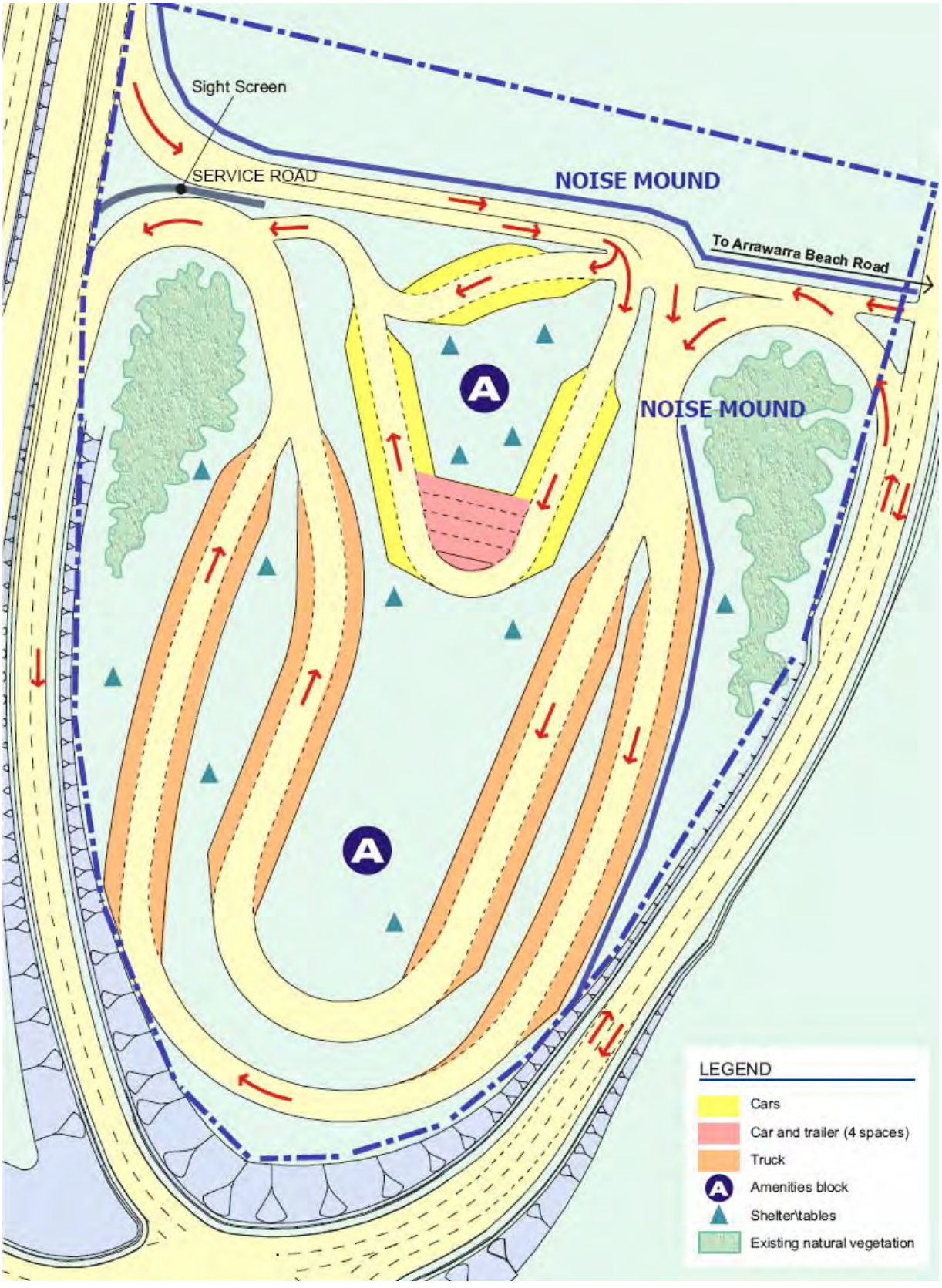
It is proposed that a rest area for cars and heavy vehicles would be located to the east of the upgraded highway near the proposed Arrawarra interchange and immediately south of Arrawarra Beach Road. The rest area would have the capacity to service approximately 25 light and 20 heavy vehicles. A plan of the proposed rest area is shown in Figure 6-1 with the nearest residential receivers also identified.

Figure 6-1 Proposed Truck Stop Location



The closest residential receivers are located in two clusters to the north and east of the proposed rest area. The closest residence in each group is approximately 600 metres away (450) and 275 metres away (771) respectively. A detailed layout of the proposed rest area is shown in Figure 6-2.

Figure 6-2 Proposed Rest Area Detail



Vehicles travelling south on the proposed upgraded highway would use the southbound off ramp to the Arrawarra Interchange, and turn left into the rest area on Arrawarra Beach Road. It is proposed that this section of Arrawarra Beach Road which is an existing public road would become a service road for the rest area. Access to Arrawarra Beach Road would then only be via the Arrawarra Interchange.

Vehicles travelling north would enter the rest area via the Arrawarra Interchange and then onto a section of the old Pacific Highway, turning left onto the proposed service road and into the rest area from the east. All vehicles would depart by rejoining the southbound off ramp of the Arrawarra Interchange.

It is proposed to construct noise mounds approximately 3.5 metres in height along the northern and eastern boundaries of the proposed rest area to minimise noise impacts to the residences shown in the above figure.

6.1 Noise Criteria

There are no specific criteria for addressing noise from rest areas so the most relevant assessment methodologies have been reviewed and a conservative approach adopted.

The Environmental Criteria for Road Traffic Noise is primarily concerned with the assessment of noise from continually flowing traffic and does not specifically address rest areas adjacent to roads or freeways. The Environmental Criteria for Road Traffic Noise requires assessment of L_{Aeq} noise levels over either the daytime or night time periods.

The Environmental Criteria for Road Traffic Noise also recommends consideration of maximum (L_{Amax}) noise levels and suggests levels outside a residence of between 60-65dBA are unlikely to cause annoyance. The document also suggests that if typical maximum noise levels are less than 15dBA above the L_{Aeq} noise level from traffic noise, the L_{Aeq} parameter is sufficient to assess likely annoyance. It is considered that while a truck is slowing to approach the rest area or is accelerating away, the noise is associated with a moving vehicle within the road reserve and should therefore be assessed in accordance with the Environmental Criteria for Road Traffic Noise.

Previous studies of vehicle noise when all vehicles are slowing to stop at tollgates and accelerate away indicate a reduction in L_{Aeq} noise levels, although the character of noise is different, particularly for heavy vehicles accelerating. In comparison, for a rest area adjacent to a highway, where only a relatively small proportion of the heavy vehicle component of traffic is stopping, then L_{Aeq} noise levels would remain unchanged compared with the situation without a rest area.

However, there would be a different character of noise associated with the small number of heavy vehicles which do stop and activities within the rest area. An additional method of assessment has therefore also been considered.

The additional procedure is to consider the rest area as if it were an “industrial” operation and assess the noise levels generated in accordance with the *Industrial Noise Policy* (*INP)*. This policy requires the L_{Aeq} noise level associated with the proposed operation over a typical 15 minute period at any time should not exceed the background L_{A90} noise level by more than 5dBA. The specific approach taken for the proposed Arrawarra rest area is therefore to assess vehicle noise on ramps that are public roads under the Environmental Criteria for Road Traffic

Noise, and noise emanating from vehicles within the rest area that are not considered public roads under the Industrial Noise Policy. This would include the service road linking the southbound off ramp to the rest area.

For night time use of the rest area it is also relevant to consider the Department of Environment and Climate Change sleep arousal guidelines contained in the *Environmental Noise Control Manual (ENCM)*. This requires that the typical maximum noise level (denoted as L_{A1} in the *ENCM*) associated with noise from heavy vehicles at the rest area (engines starting/doors closing) should not exceed the background L_{A90} noise level by more than 15dBA.

During the ambient noise survey described in Section 2 there were no surveys undertaken at either of the two groups of residences identified above. However it is likely that the ambient noise levels at those locations would be similar to levels at residences that are setback at an equivalent distance to the highway. Table 6-1 outlines the derived rating background level (RBL) based on measured ambient noise levels at such locations.

Table 6-1 Derived Rating Background Levels at Residences

Location	Distance from Highway (m)	Rating Background Levels (dBA)		
		Daytime (7.00am-6.00pm)	Evening (6.00pm-10.00pm)	Night (10.00pm-7.00am)
Eastern Residences	250	43	43	33
Northern Residences	350	45	45	35

Based on the above rating background levels, the *Industrial Noise policy* intrusiveness criterion for each period is then shown in Table 6-2 and the *Environmental Noise Control Manual* sleep arousal guideline is shown in Table 6-3.

Table 6-2 Industrial Noise Policy Intrusiveness Criterion

Location	Industrial Noise Policy Intrusiveness Criterion (LAeq, 15 min dBA)		
	Daytime (7.00am-6.00pm)	Evening (6.00pm-10.00pm)	Night (10.00pm-7.00am)
Eastern Residences	48	48	38
Northern Residences	50	50	40

Table 6-3 Sleep Arousal Guideline

Location	Sleep Arousal Guideline (L_{Amax} dBA)
Eastern Residences	48
Northern Residences	50

6.2 Predicted Traffic Volumes

The RTA carried out a survey at a similar facility at Halfway Creek on the Pacific Highway in November 2002. The survey outlined patterns of use for heavy vehicles over a weekend and weekday. It is reasonable to adopt a similar pattern of use to the proposed Arrawarra Creek rest area. Table 6-4 shows the maximum number of arrivals and departures in any 15 minute period identified in the Halfway Creek survey, as well as the maximum number of heavy vehicles using the facility in any 15 minute period.

Table 6-4 Maximum Utilisation of Halfway Creek Rest Area November 2002

Period	Arrive	Leave	At Rest
Day	4	4	7
Evening	5	4	9
Night	5	6	12

Given that heavy vehicle volumes are predicted to increase by 44% in this section of the highway from 2005 to 2021, it is appropriate to apply the same increase to numbers of heavy vehicles using the proposed rest area. Table 6-5 outlines predicted maximum utilisation in 2021 with the corresponding 44% increase in heavy vehicle volumes on the highway.

Table 6-5 Predicted maximum utilisation of Arrawarra Creek rest area 2021

Period	Arrive	Leave	At Rest
Day	6	8	10
Evening	7	8	13
Night	7	9	17

Table 6-5 shows that the most sensitive time would be use at night time by heavy vehicles. The night time period has the highest predicted usage and also the lowest noise criteria. As a worst case it is assumed that arrivals and departures could happen in the same 15 minute period.

6.3 Noise Level Predictions

For noise within the rest area the following source noise levels have been assumed at 7 metres. These are based on previous measurements conducted by Wilkinson Murray of similar items.

- Truck L_{Amax} (high revs) 87dBA
- Truck start 85dBA
- Truck idle 66dBA
- Truck door close 75dBA
- Truck refrigeration unit 73dBA

The most sensitive time is likely to be the use at night time by heavy vehicles, therefore the assessment has focused on the possibility of truck mounted refrigeration units operating continuously while a truck is parked, and the noise level associated with a truck changing up through its gears as it departs. It is not expected that trucks will need to use engine brakes while slowing to stop, although there will be some noise associated with trucks changing down through its gears to enter the site and the air release on stopping. It is assumed that vehicles entering the rest area from the southbound ramp via the Arrawarra service road would travel at no more than 40kph and once within the rest area at no more than 20kph. Calculated $L_{Aeq,\ 15\ min}$ noise levels from both movement and vehicles at rest are outlined in Table 6-6 and levels compared with the Industrial Noise Policy criterion. Calculations are carried out with noise barriers or mounds in place, at least 3.5m high on the northern and eastern site boundaries as shown in Figure 6-2.

Table 6-6 Calculated Rest Area $L_{Aeq,\ 15\ min}$ Noise Levels

Location	L_{Aeq}, 15 min Noise Level (dBA)			
	Movement	At rest	Total	Industrial Noise Policy Criterion
Northern Residences	32	27	33	40
Eastern Residences	36	32	37	38

Noise levels are predicted to be within Industrial Noise Policy criterion at both locations. Calculated L_{Amax} noise levels from both movement and vehicles at rest shown in Table 6-7 and levels compared with the Environmental Noise Control Manual guideline.

Table 6-7 Calculated Rest Area $L_{Aeq,\ 15\ min}$ Noise Levels

Location	LAmax Noise Level (dBA)	
	Max Power	Environmental Noise Control Manual Guideline
Northern Residences	38	50
Eastern Residences	46	48

Maximum noise levels are also within Environmental Noise Control Manual guideline levels at both locations with 3.5 metre high mounding on the eastern and northern boundaries.

6.4 Assessment of traffic noise against Environmental Criteria for Road Traffic Noise

Future existing (2011) noise levels and associated criteria as calculated in Section 4.6 are outlined in Table 6-8 for the closest residences to the east and north of the proposed rest area.

Table 6-8 Environmental Criteria for Road Traffic Noise

Residence	2011 $L_{eq,9hr}$ Noise Level	Environmental Criteria for Road Traffic Noise	
		Base	Allowance
Northern (450)	54	55	56
Eastern (771)	52	55	N/A

Noise levels are then calculated for 2021 for the redeveloped highway. These levels are segregated into noise from the upgraded highway and ramps and shown without the rest area in operation in Table 6-9 below.

Table 6-9 2021 Calculated L_{Aeq} noise level with no rest area

Residence	$L_{eq,9hr}$ Level (dBA)		
	Highway	Ramps	Total
Northern (450)	55.5	36	55.5
Eastern (771)	54	37.5	54

Noise from traffic on the highway is dominant at both locations, to the extent that noise from traffic using the ramps would likely be inaudible. Noise levels are again calculated with the maximum predicted rest area usage added to the ramps and shown in Table 6-10.

Table 6-10 2021 Calculated L_{Aeq} noise level with rest area in operation

Residence	$L_{eq,9hr}$ Noise Level (dBA)		
	Highway	Ramps	Total
Northern (450)	55.5	39	55.5
Eastern (771)	54	40	54

When rest area traffic is added to non-rest area traffic on the ramps, the noise level at residences from traffic on the ramps is predicted to increase by approximately 3dBA. This level is however at least 14dBA below noise from traffic on the proposed upgraded highway and as such would likely have a negligible impact on residences. Further, this would be worst-case and there would be a significantly reduced number of heavy vehicles from the rest areas using the ramps during the majority of other time periods.

6.5 Summary of Rest Area Impacts

In summary, a noise wall or earth mound at least 3.5 metres high would be required on the northern and eastern boundaries of the proposed rest area to ensure compliance with the Industrial Noise Policy intrusiveness criterion and the Environmental Noise Control Manual sleep disturbance guideline. This is based on the proviso that noise from ramps should not be assessed under the Industrial Noise Policy or Environmental Noise Control Manual. Instead it is considered more appropriate to assess vehicle noise on ramps under the Environmental Criteria for Road Traffic Noise as the ramps are part of the public road network. Noise from traffic on the ramps would increase when the rest area is busy, however the proportion of total noise from the ramps at residences would likely be inaudible, given that noise from the redeveloped main carriageways of the highway would be at least 14dBA higher.

7 CONSTRUCTION NOISE & VIBRATION ASSESSMENT

7.1 General Description of Construction Methodology

7.1.1 Hours of Operation

In general, construction hours would be limited to daytime hours, i.e. Monday to Friday 7.00am-6.00pm and Saturday 8.00am-1.00pm. Normally on a project of this scale, there must be some work outside these hours, typically for safety reasons or maintenance of satisfactory traffic flow.

7.1.2 Temporary Infrastructure

The requirements for temporary infrastructure are likely to be substantial with the 25km long project spread over numerous land use, zoning and residential areas. Provision of a number of facilities is necessary to plan and manage construction activities with minimal impact to adjacent land use, traffic flows on existing roads and amenity of adjoining residential areas.

There would be a number of temporary infrastructure facilities as follows:

- Batching Plant sites, primarily concrete production.
- Construction Compounds.
- Stockpile Sites.
- On site Materials Processing Areas.

These facilities are to be provided in a number of areas for construction efficiency and ready access for incoming materials and resources. In this regard, they need to be close enough to the existing road network to provide good transport access but would ideally be remote from residential areas and sensitive land use areas.

7.1.3 Batching Plant Sites

It is expected that batching plants for concrete and/or asphalt would be established on site for the bulk supply of fresh concrete and/or asphalt for major paving operations. This production would be supplemented by routine deliveries for minor works such as drainage structures.

The batching plant sites would take substantial traffic movements of incoming materials, such as cement, bitumen, aggregate and sands. They would also require a regular water supply. Importantly, they should be selectively placed along the project to facilitate cost-effective delivery of paving materials. In considering the 25km length of the project and the desire to limit haulage to a notional 5km length, this would require batch plants at the 5km, 15km and 25km points. These correspond (approximately) to the Moonee Beach, Graham Drive North and Arrawarra Interchange locations, all on the existing highway but in areas of major construction activity. These locations may change as the specific requirements of the project become more discernable but are considered appropriate for assessment at the Environmental Assessment stage.

As such, the following sites near these nodes, but separated from residential areas, have been included for consideration within the acoustic assessment:

- Northern end of Hoys Road, Moonee Beach;
- On the existing highway at Unwins Road or within the adjacent Woolgoolga Industrial area;
- South of Arrawarra Beach Road, at the proposed rest area.

These sites have the potential to be large and should also be considered for major construction compounds as outlined below.

7.1.4 Construction Compounds

Additional construction compounds for site offices and amenities, vehicles and stores provisions, as well as security for plant and equipment would be required in numerous locations. It is expected that at least two major compounds would be required for the project and these would be supplemented with localised smaller compounds in some areas.

Major construction compounds could be co-located with or separated from the batch plant sites nominated above. The minor compounds would be smaller and focus on more specialist areas of construction such as retaining walls and major bridge sites. Potential sites for construction compounds separated from the batch plant sites are as follows:

- Near Campbell Close at start of project;
- Western end of Hunter Close;
- Service road north of Gaudrons Road;
- Service road south of Killara Avenue;
- Suitable sites east of the highway between Tiki Road and Emerald Beach.
- Existing timber mill property to be acquired south of Emerald Beach;
- On Woolgoolga Creek Road for access to Woolgoolga Creek; and
- North of Bark Hut Road.

7.1.5 Stockpile Areas

Stockpile areas are smaller dedicated sites for local or temporary storage of construction materials such as topsoil, sands, aggregates, stormwater drainage pipes and pre-cast drainage pits. The selection and use of these sites would be the domain of the construction contractor. The RTA would establish protocols for conditions of use with respect to access, security, noise and environmental management.

7.1.6 On-site Materials Processing Areas

On-site materials processing is likely to be required if suitable rock materials are identified for processing as select material or for the production of aggregates for concrete batching. If this is the case, it is likely to be in the major cuttings where competent rock may be found in excavated materials. This is most likely to occur on the cuttings within the Woolgoolga bypass section of the project.

Other than initial establishment and removal of processing equipment, all access to these areas would be along the route to be constructed. Access to local roads for processed materials would be precluded.

7.1.7 Casting Yards

Dedicated casting yards for pre-cast concrete structures or bridge components are not expected to be required for the Proposal. Small scale pre-cast components for drainage structures would be transported to the project construction from the various commercial sites and production facilities nominated in Section 5. Bridge planks and girders would be expected to be delivered by special truck consignment from Sydney or Brisbane.

7.2 Background Noise Levels

7.2.1 Description of Rating Background Level

Noise criteria are assessed by comparison of the intrusive noise against the prevailing ambient background noise in the receiver area. The background noise levels in each noise catchment area are described by their Rating Background Level (RBL) for daytime, evening and night. The RBL is a descriptor implemented by the NSW Department of Environment & Climate Change (DECC) and described in their *NSW Industrial Noise Policy (INP).* It is a single number description of background noise levels measured over an extended period.

7.2.2 Assessment Areas

During the course of the assessment of operational noise of the Sapphire to Woolgoolga Upgrade, Wilkinson Murray measured the existing ambient background noise level at many locations along the route of the upgrade. These noise surveys are detailed in Section 2 of this report.

The existing L_{Aeq} noise level was used to determine appropriate noise criteria for operational noise of the highway. The criteria for construction noise, however, are determined from the L_{A90} noise levels. These vary according to the location along the route, however, the variation is not great. Consequently, the route has been divided into two sections where the ambient noise levels are generally similar and the assessment of construction noise can be greatly simplified by setting only two sets of noise criteria. Those sections are the Pacific Highway upgrade section from Sapphire to Woolgoolga and the Woolgoolga Bypass section.

7.2.3 Pacific Highway Upgrade section

The existing ambient background noise levels in this section of the route are generally RBL daytime 45dBA and night time 35dBA.

7.2.4 Woolgoolga Bypass section

In this rural area the existing RBL noise levels are 35dBA during daytime and 32dBA at night time. An exception occurs in the area near the Woolgoolga Creek Road where the daytime noise levels drop to 32dBA.

7.3 Construction Noise Criteria

7.3.1 General Guidelines

Guidelines for assessment of construction noise are specified in the DECC's *Environmental Noise Control Manual (ENCM)* Chapter 171. These are currently under revision but these revisions are not expected to substantially alter their application in this project. The guidelines are:

- for periods of 4 weeks or less, the L_{A10} level should not exceed the background (L_{A90}) level by more than 20dBA; and
- for periods greater than 4 weeks and less than 26 weeks, the L_{A10} level should not exceed the background (L_{A90}) level by more than 10dBA.

Although not clearly stated in the *ENCM*, past practice has indicated that for periods greater than 26 weeks, the DECC would expect that the L_{A10} level should not exceed the background (L_{A90}) level by more than 5dBA.

It is accepted that for determining noise criteria the L_{A90} background noise level should be quantified by the RBL value.

In addition, the DECC guideline specifies the following time restrictions for construction activities:

- Monday to Friday 7.00am to 6.00pm
- Saturday 8.00am to 1.00pm

No construction work is to take place on Sundays or Public Holidays.

During the majority of the upgrade of the Pacific Highway and construction of the bypass section there would be no fixed or constant construction noise within the road corridor for the duration of the project. The centre of activity would move along the highway as work progresses during the different phases. Therefore, the criterion for construction periods longer than 4 weeks, but less than 26 weeks will be used. Thus, for daytime construction the $L_{A10,15min}$ should not exceed RBL L_{A90} (background noise level) + 10dBA.

Noise from the major interchanges or where bridgeworks are required plus the batching plants at the major compounds would occur for more than 6 months and a suitable noise criterion is that the $L_{A10,15min}$ should not exceed RBL L_{A90} (background noise level) by more than 5dBA

Certain works would be required outside the normal working hours for safety and traffic management reasons. These are likely to be short term in nature and a suitable noise criterion is that the $L_{A10,15min}$ should not exceed RBL L_{A90} (background noise level) by more than 5dBA.

7.3.2 Criteria for Construction Road Traffic Noise

There are no specific criteria for assessment of construction road traffic noise. However, the criteria from the *ECRTN* are considered reasonable guidelines for assessment of a development with the potential to increase traffic noise for more than six months. The *ECRTN* criterion is that the new traffic should not increase the existing noise level by more than 2dBA.

In general, because of the high traffic flow on the Pacific Highway, this increase will be insignificant.

Table 7-1 Summary of Project Specific Criteria

Location	RBL Day, (dBA)	RBL Night, (dBA)	Construction Noise Day, L_{A10}	Construction Noise Night, L_{A10}	Concrete Batching Plant L_{A10}	L_{Amax}, Night*
Pacific Highway Upgrade	45	35	55	40	50	50
Woolgoolga Bypass	35	32	45	37	40	47

7.4 Assessment of Noise from Mobile Plant

7.4.1 Mobile Plant Source Noise Levels

Sound levels of typical equipment are listed in Table 7-2. The Table gives both Sound Power Level (SWL) and Sound Pressure Levels (SPL) at 7 metres for the equipment. SWL is independent of measurement position. Verification of plant noise is typically done by measuring the SPL at 7m.

Table 7-2 Typical Construction Plant Sound Levels

Plant	L_{A10} Sound Power Level (dBA)	L_{A10} Sound Pressure Level at 7m (dBA)
Front End Loader	111	86
Grader	107	82
Smooth Drum Roller	107	82
Spoil, Materials or Concrete Truck	109	84
Tower Crane or Mobile Crane	105	80
Truck-mounted Shotcrete Pump	106	81
Excavator or Bobcat	107	82
Concrete Pump	105	80
Concrete Vibrator	103	78
Concrete Cutter	109	84
Large Bored Drilling Rig	112	87
Small Bored Drilling Rig	108	83
Powered Hand Tools	109	84
30t Excavator operating with hydraulic hammer	122	97
Rock Saw	116	91
Water Cart	110	85
Kerbing Machine	99	74
Chainsaw	106	81
Forklift	106	81
Mulcher	106	81
Articulated Dump Truck	113	88

Plant	L_{A10} Sound Power Level (dBA)	L_{A10} Sound Pressure Level at 7m (dBA)
Handheld Jackhammer	113	88
Air Compressor (Power Tools)	98	73
Asphalt Paving Plant	114	89

7.4.2 Typical Activity Noise Levels

Based on the above, noise level predictions have been conducted for each of the construction phases outlined in Section 7.1 above.

Table 7-3 Calculation of Total Sound Power Level (SWL)

Activity	Typical Equipment Used	Total L_{A10} Sound Power Level (SWL) used for calculations
Milling and repaving	Road Trucks, Compactor, multi tyred and vibratory Rollers, Asphalt paving plant, Backhoe, Profiler, Sweeper, Compressors, Generators	113
Site establishment	Excavators, Chainsaws, Mulching plant and Chipper, Cranes, Generators	110
Removal of corridor vegetation	25t Excavator, Mulcher, Chainsaw, Trucks, Grader, Combination Backhoe FEL	111
Earthworks	Road Trucks, Compactor, Grader, Steel, multi tyred and Vibratory Rollers, Concrete pour, including Trucks and Concrete Vibrator, Asphalt paving plant, Backhoe, Sweeper, Compressors, Generators, (Excavator with hammer)	114 (120)
Piling	Bored or driven piling rigs	115 (bored) – 120 (driven)
Bridge works	Piling rigs, cranes	115 – 120 (possible when piling)
Paving	Road Trucks, Compactor, (Jackhammers), Steel, multi tyred and vibratory Rollers, Concrete Pour, including Trucks & Concrete Vibrator, Asphalt paving plant, Backhoe, (Concrete saw), Profiler, Sweeper, Compressors, Generators	113 (116)
Landscaping of exposed areas	Excavator/Bobcat, Powered Hand Tools, Air Compressor, Spoil, Material or Concrete truck, Jackhammer (for concrete embedded parts)	109

Note: The Table shows the typical maximum sound power level predicted for each activity. The figures in brackets are for the occasional use of rock breakers, jackhammers and concrete saws.

7.4.3 Noise to Residences

The noise level experienced at any residence along the route will depend upon many factors, such as distance to the construction site, shielding between the site and the residence, and the activity occurring at the construction site. The quietest activities, such as site preparation, would be up to 20dBA quieter than the noisiest activities if earthworks using rock breakers are used. Further, noise levels would be quieter whenever the construction takes place in cut compared with that undertaken on fill. Table 7-4 shows the range of noise levels that could be expected from the different construction activities.

Table 7-4 Predicted noise levels and duration of construction activities

Activity	Expected duration	Expected noise levels from typical activities L_{A10} dBA
Removal of Corridor Vegetation	3-4 weeks	65-75 (at 30m) 40-50 (at 150m)
Bulk earthworks	2-3 to 6 months	68-78 (at 30m) 43-53 (at 150m)
Drainage works		65-75 (at 30m) 40-50 (at 150m)
Bridges		68-78 (at 30m) 43-53 (at 150m) +5dBA when piling
Paving	2-4 weeks	68-78 (at 30m) 43-53 (at 150m) +3dBA when using concrete saw

As the construction site moves, residences are typically not exposed to line of sight view of paving equipment for an extended period of time (i.e. more than a few days or a week). Noise impact is therefore restricted to a limited time period.

7.5 Assessment of Noise from Concrete Batching Plant

Wilkinson Murray has previously measured noise levels of concrete batching plants. The typical sound power levels of batching plant are as follows:

- Conveyor Drive 97dBA
- Front End Loader 111dBA
- Concrete batching, including concrete truck 109dBA
- Trucks unloading into hopper 115dBA
- Cement Bulk Tanker unloading 109dBA

The typical overall sound power level of the concrete batching plant will be approximately 113dBA.

7.5.1 Noise to Residences

Predicted noise levels from the batching plant and compounds are given in Table 7-5.

Table 7-5 Predicted noise levels from batching plants and compounds

Activity	Expected duration	Expected noise levels from typical activities L_{A10} dBA
Concrete Batching Plants/Major compounds	6 months	67-77 (at 30m) 42-52 (at 150m)
Minor compounds	2-3 to 6 months	At 30m - Up to 75 during traffic movements At 150m - Up to 49 during traffic movements

7.6 Assessment of Vibration

7.6.1 Vibration Criteria

The DECC has recently released their publication *Assessing Vibration: a technical guideline* (February 2006). It considers impacts from vibration in terms of effects on building occupants (human comfort) and the effects on the building structure (building damage). The guideline gives "preferred" and "maximum" vibration levels at buildings exposed to continuous and impulsive vibration. For construction noise the guideline is to apply the criteria for maximum continuous vibration. These levels are summarised in.

In relation to building damage from vibration, suitable levels are determined from:

- German Standard DIN 4150 and BS 7385: Part 2 – 1993
- British Standard BS 6472

The limits interpreted from these Standards are included in Table 7-6.

Table 7-6 Vibration Criteria

Receiver	Vibration Criteria, Maximum Peak Velocity (mm/s)	
	Human Comfort	Building Damage
Residential buildings during daytime	0.28	10
Residential buildings during night time	0.20	10
Offices during day	0.56	10-20

Notes 1) Criterion dependant on structural integrity of building

7.6.2 Source Levels of Vibration

Table 7-7 provides some estimated vibration levels at a range of distances from the various construction activities.

Table 7-7 Typical Vibration Emission Levels from Construction Plant

Activity	PPV Vibration Level (mm/s) at Distance		
	10m	20m	30m
Concrete Sawing	0.5	0.3	0.2
4-Tonne Vibratory Roller (High)	2.0-2.4	0.4-1.2	0.2-0.8
Hydraulic Hammer (30t)	3	1.5	1.0

7.6.3 Vibration Levels at Residences

The vibration levels at this project will not result in levels that cause damage to buildings. It is possible that at some residences close to the upgrade route that there will be vibration levels exceeding the criteria for human comfort, particularly when the hydraulic hammer is used within 30m of any residence. Some impact could also be expected during use of the vibratory roller within approximately 30-40m of any residence. The impacts are expected to be temporary as the construction site moves away the residential areas.

8 BLASTING VIBRATION & OVERPRESSURE ASSESSMENT

8.1 Prediction of Noise & Vibration Levels

Airblast overpressure and ground vibration levels from blasting are related to the "scaled distance" from the blast, which is defined as

Scaled distance = $D/W^{(1/3)}$ for airblast overpressure, and
Scaled distance = $D/W^{(1/2)}$ for ground vibration,

where D is the distance from the blast in metres and W is the maximum instantaneous charge of explosive, in kg Ammonium Nitrate Fuel Oil (ANFO) equivalent.

Standard predictive curves relating scaled distance to overpressure and ground vibration levels have been derived from measurements conducted at numerous sites. Wilkinson Murray has developed predictive algorithms for calculation of blast overpressure and vibration based on measurement of multiple mining blasts. For this assessment, blast measurements performed at the Bayswater No. 3 Mine between 1996 and 1999 were used in predictions. Ground vibration data for 193 blasts, and overpressure data for 171 blasts, were available for analysis.

Figure 8-1 shows the best-fit line and 95% confidence limit derived from the measured vibration levels. The figure also indicates the predicted vibration level using the method outlined in Australian Standard AS2187.2-1993 : *Explosives – Storage, Transport and Use* for both normal and hard rock.

Figure 8-2 shows measured airblast overpressure values. As for most blast measurement data, overpressure levels show much higher variability than vibration levels.

Figure 8-1 Measured Peak Particle Ground Velocity & Scaled Distance

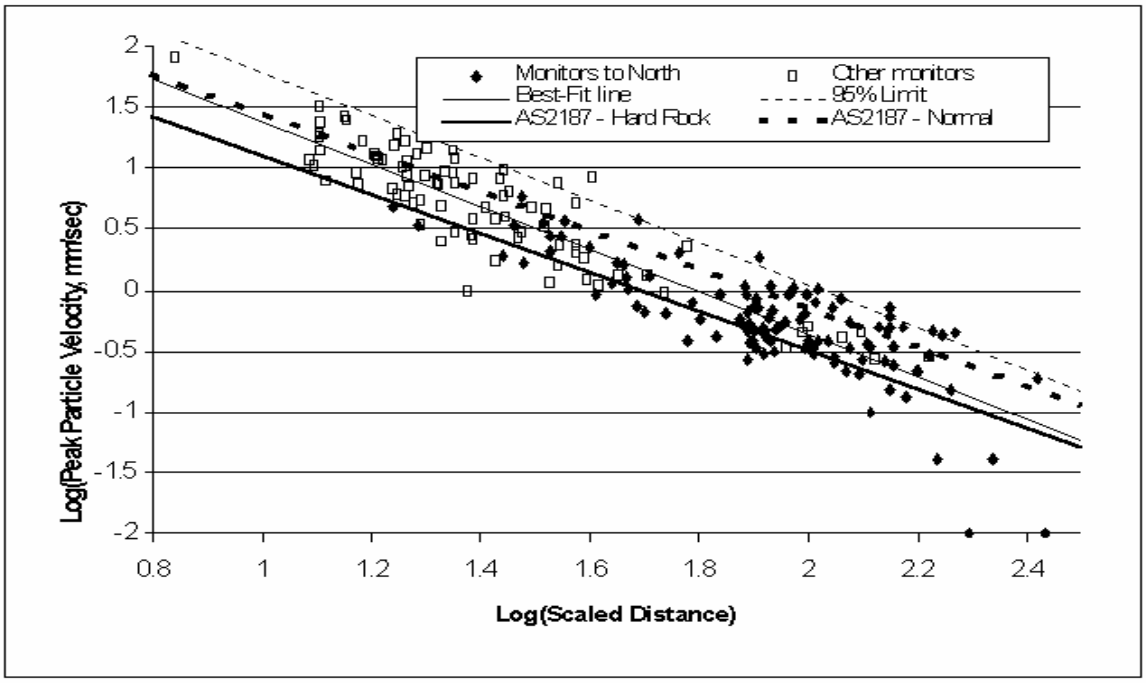
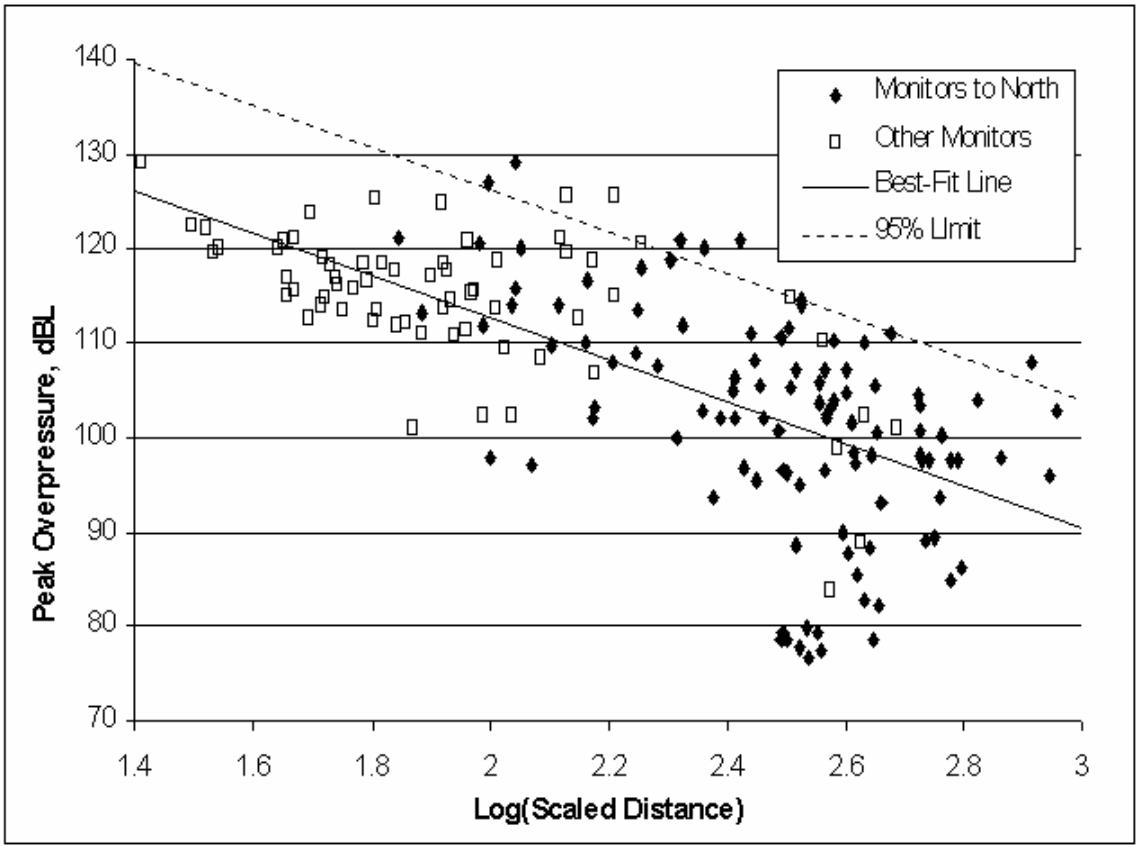


Figure 8-2 Measured Blast Overpressure & Scaled Distance



8.2 Predicted MIC to meet Residential Overpressure & Vibration Criteria

The Maximum Instantaneous Charges (MICs) at which vibration and overpressure levels meet the ANZECC guidelines can be calculated using the closest distance to any residential dwelling and predictive equations derived from the above figures.

Blasting may be required at approximately twelve locations along the alignment.

Table 8-1 shows the blast location, distance to the nearest residential dwelling and MIC to meet the ANZECC guidelines. The MIC is presented as a level to meet both the 95th percentile and "best-fit" lines in Figure 8-1 and Figure 8-2 for annoyance.

In order to meet the "best-fit" lines control measures on blasting would need to be implemented. Necessary best-practice measures would include:

- Strict control of stemming for blast holes;
- Ensuring adequate timing sequences for all blasts; and
- Restriction of blasting under adverse weather conditions.

Monitoring all blasts and reviewing MIC if required.

Table 8-1 MICS to meet Annoyance Goals

Blast Location (Chainage)	Distance to closest Residence (m)	Maximum Instantaneous Charge (kg)	
		95th Percentile	Best Fit
23300	150	0.1	6
23700	240	0.45	24
24400	60	N/A	0.4
25100	230	0.4	21
25800	330	1.2	63
26050	150	0.1	6
26300	100	0.04	1.7
26600	110	0.05	2.35
27150	100	0.04	1.7
27600	90	N/A	0.6
27850	200	0.25	14
28700	275	0.65	36

Table 8-2 MICS to meet Building Damage Goals

Blast Location (Chainage)	Distance to closest Residence (m)	Maximum Instantaneous Charge (kg)	
		95th Percentile	Best Fit
23300	150	27.5	82
23700	240	73	210
24400	60	1.8	13
25100	230	67	192
25800	330	138	398
26050	150	27.5	82
26300	100	8.2	36
26600	110	10.9	44
27150	100	8.2	36
27600	90	2.8	18
27850	200	50	146
28700	275	95	275

With regard to annoyance and discomfort, the calculated MICs in Table 8-1 are unlikely to be cost-effective at those locations close to residences even when best-practice blasting techniques are implemented. Consideration would be given to alternative methods of removing rock in these locations, such as use of rock breaker equipment where appropriate. Where blasting is still considered to be necessary, arrangements would need to be made with residents to facilitate any such blasting.

Table 8-2 indicates that ANZECC guidelines building damage are achievable at all but the closest residences for MICs typical of those required for the construction of previously upgraded areas of the Pacific Highway. Alternative methods of rock removal may be required at those locations that are very close to the proposed blast sites.

In order to meet the "best-fit" lines control measures on blasting would need to be implemented. Necessary best-practice measures would include:

- Strict control of stemming for blast holes;
- Ensuring adequate timing sequences for all blasts; and
- Restriction of blasting under adverse weather conditions.

Development of these procedures will require ongoing refinement of blast design in conjunction with monitoring. With such measures in place it is considered that overpressure and vibration levels equivalent to the best-fit lines in Figure 8-1 and Figure 8-2 are appropriate to use for this assessment.

With regard to annoyance and discomfort, the calculated maximum instantaneous charges in Table 8-1 may not be cost-effective at locations close to residences (within approximately 150 metres) even when best-practice blasting techniques are implemented. Consideration would be given to alternative methods of removing rock in these locations, including the use of rock breaker equipment. However, alternative methods of removing rock, such as rock breaker equipment are likely to take longer than blasting. Residents may accept some form of short-term vibration impacts (exceeding annoyance goals), subject to building damage goals being achieved, rather than having to experience longer periods of noisy rock breaking activity. The maximum instantaneous charge blasting configuration for each blasting location would be determined during the detailed design phase. Any decision regarding the use of blasting or rock breaker equipment would be undertaken in consultation with affected residents and the Department of Environment and Climate Change.

9 CONCLUSION

Noise and vibration impacts from the proposed Sapphire to Woolgoolga highway upgrade have been assessed in accordance with appropriate environmental standards, notably the NSW Department of Environment and Climate Change *Environmental Criteria for Road Traffic Noise (ECRTN)* and Industrial Noise Policy (*INP*). Impacts at relevant residential dwellings have been quantified and where possible, measures have been proposed that would reduce these impacts. The major conclusions of this assessment are as follows.

- Traffic volumes are predicted to grow by up to 40% from anticipated year of opening volumes on the existing alignment to 2021 volumes on the proposed alignment.

- Most residences have exposure to existing traffic noise although those near the proposed bypass section have little or no existing exposure.

- Preliminary noise modelling indicated that the most effective noise control measure for residences, particularly south of the bypass section would be the use of a low-noise pavement. With such a pavement in place the vast majority of residences would experience a reduction from existing noise levels.

- A sensitivity analysis was undertaken to account for possible variations in noise levels at residences as a result of increased speeds or traffic flows. To allow for these possible variations, 1dBA was added to all predicted noise levels from traffic on the proposed design ten years after opening.

- Where reasonable and feasible, noise barriers have been designed to mitigate noise to base ECRTN levels at residences where exceedances of criteria are predicted. For the purposes of this assessment it has been presumed that barriers up to 4m high would be feasible and visually acceptable. Where barriers higher than this are required to meet base ECRTN, a cost benefit analysis has been undertaken in accordance with Practice Note (IVa) of the *Environmental Noise Management Manual (ENMM)* to determine a suitable barrier height.

- Where barriers are not an appropriate noise mitigation solution, individual residences have been identified to be considered for architectural treatments.

- Proposed noise mitigation measures would be reviewed and optimised, where necessary, at the detail design stage.

- Residences on the existing Pacific Highway bypassed by the Proposal (between south Woolgoolga and Arrawarra Creek) would experience a reduction in noise levels typically between 3-10dBA as a result of reduction in both traffic flows and speed limits.

- Noise and vibration impacts during construction and residences that may possibly be impacted have been identified.

- Noise impacts from a proposed rest area near the Arrawarra Interchange have been assessed against appropriate criteria. Appropriate noise mitigation measures in the form of noise walls or mounds have been identified to ensure compliance with the various criteria.

Note
All materials specified by Wilkinson Murray Pty Limited have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose.

Quality Assurance
We are committed to and have implemented AS/NZS ISO 9001:2000 “Quality Management Systems – Requirements”. This management system has been externally certified and Licence No. QEC 13457 has been issued.

AAAC
This firm is a member firm of the Association of Australian Acoustical Consultants and the work here reported has been carried out in accordance with the terms of that membership.

Version	Status	Date	Prepared by	Checked by
A	Draft	24 October 2006	Tim Dean	Neil Gross
B	Draft	23 May 2007	Tim Dean	Neil Gross
C	Draft	7 June 2007	Tim Dean	Neil Gross
D	Draft	27 June 2007	Tim Dean	Neil Gross
E	Draft	8 August 2007	Tim Dean	Neil Gross
F	Draft	15 August 2007	Tim Dean	Neil Gross
G	FINAL	5 September 2007	Tim Dean	Neil Gross

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY

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 overleaf, 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_{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.

L_{A50} – The L_{A50} level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the L_{A50} level for 50% of the time.

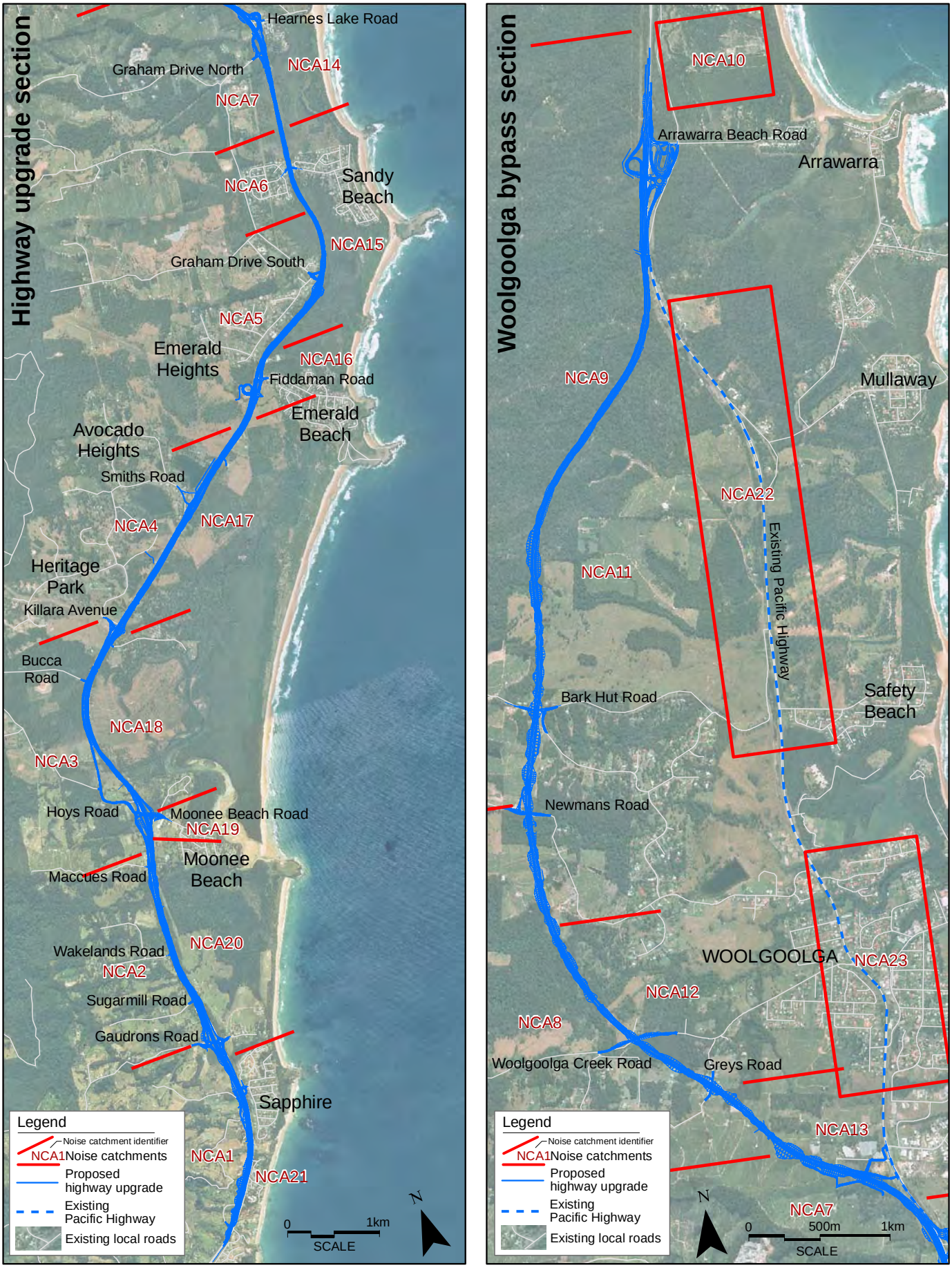
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

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 10^{th} percentile (lowest 10^{th} 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.

APPENDIX B

Noise Catchment Areas



Appendix B

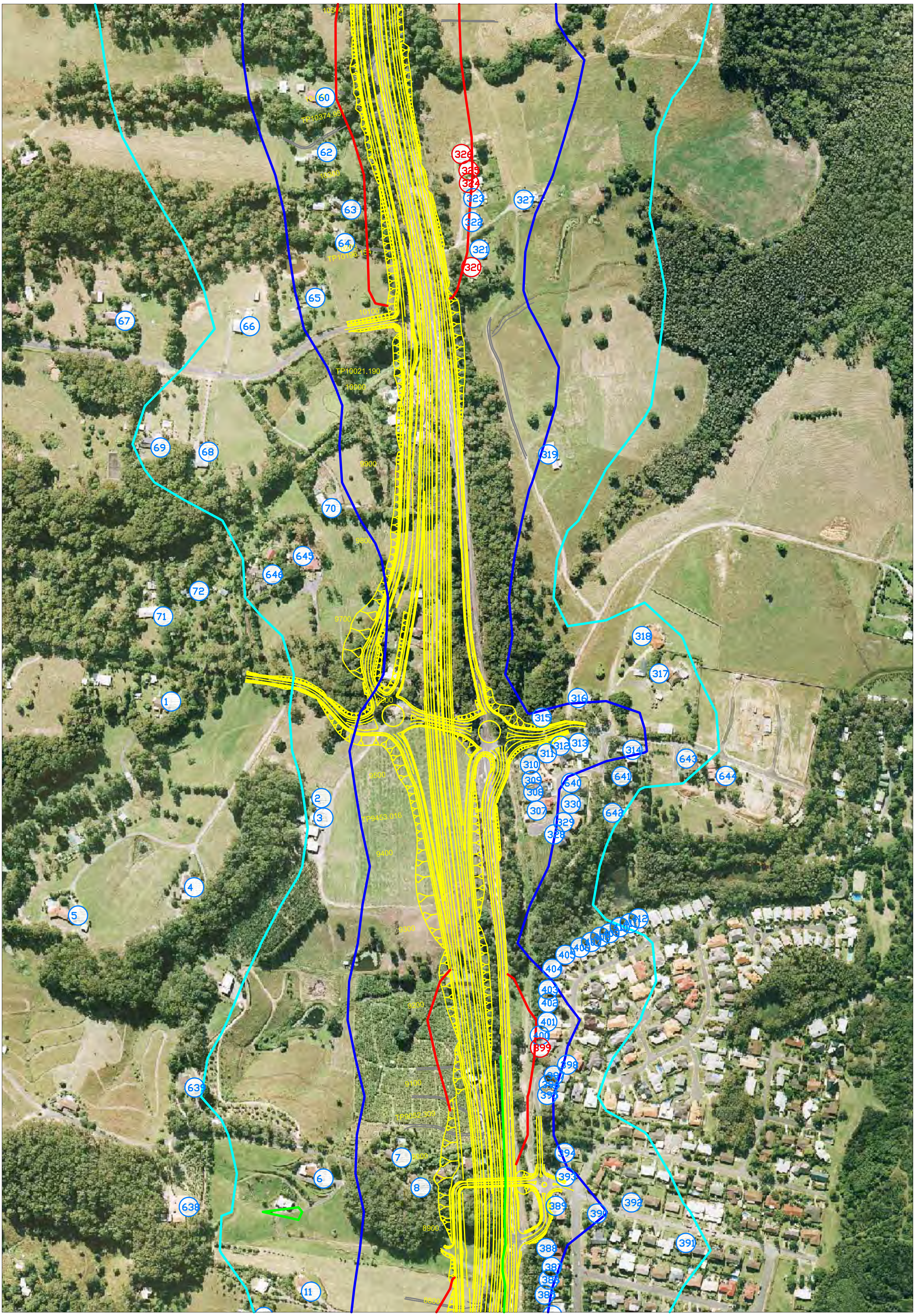
Source: Noise 2007 (Wilkinson Murray P/L)

Noise catchment areas

APPENDIX C

Noise Contours and Residence Locations


LAeq 9hr (NIGHT TIME 10pm-7am)
50dBA
55dBA
60dBA
NOISE WALL
SIGHT SCREEN
B21c
B21b
B1a
B21a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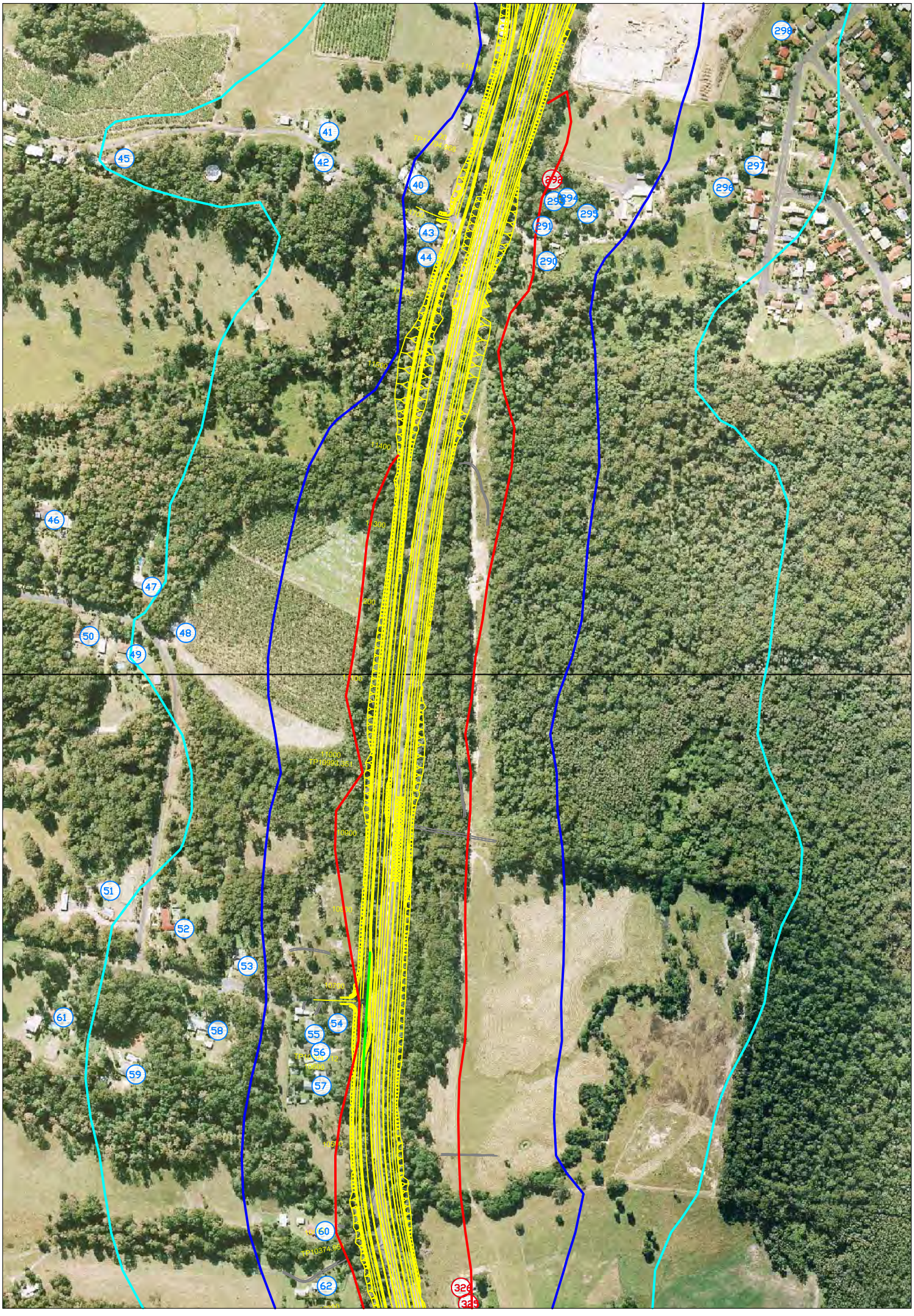
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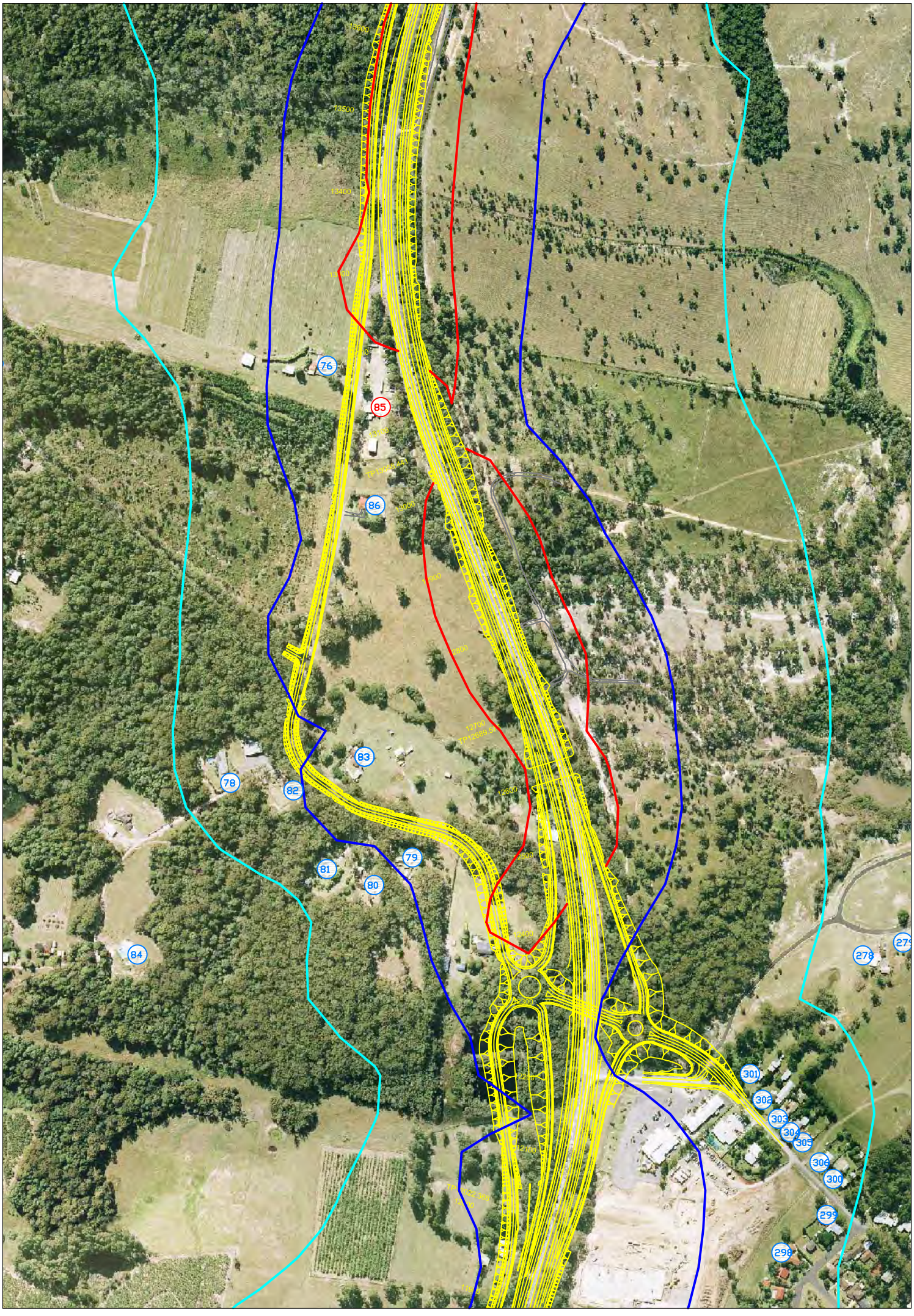
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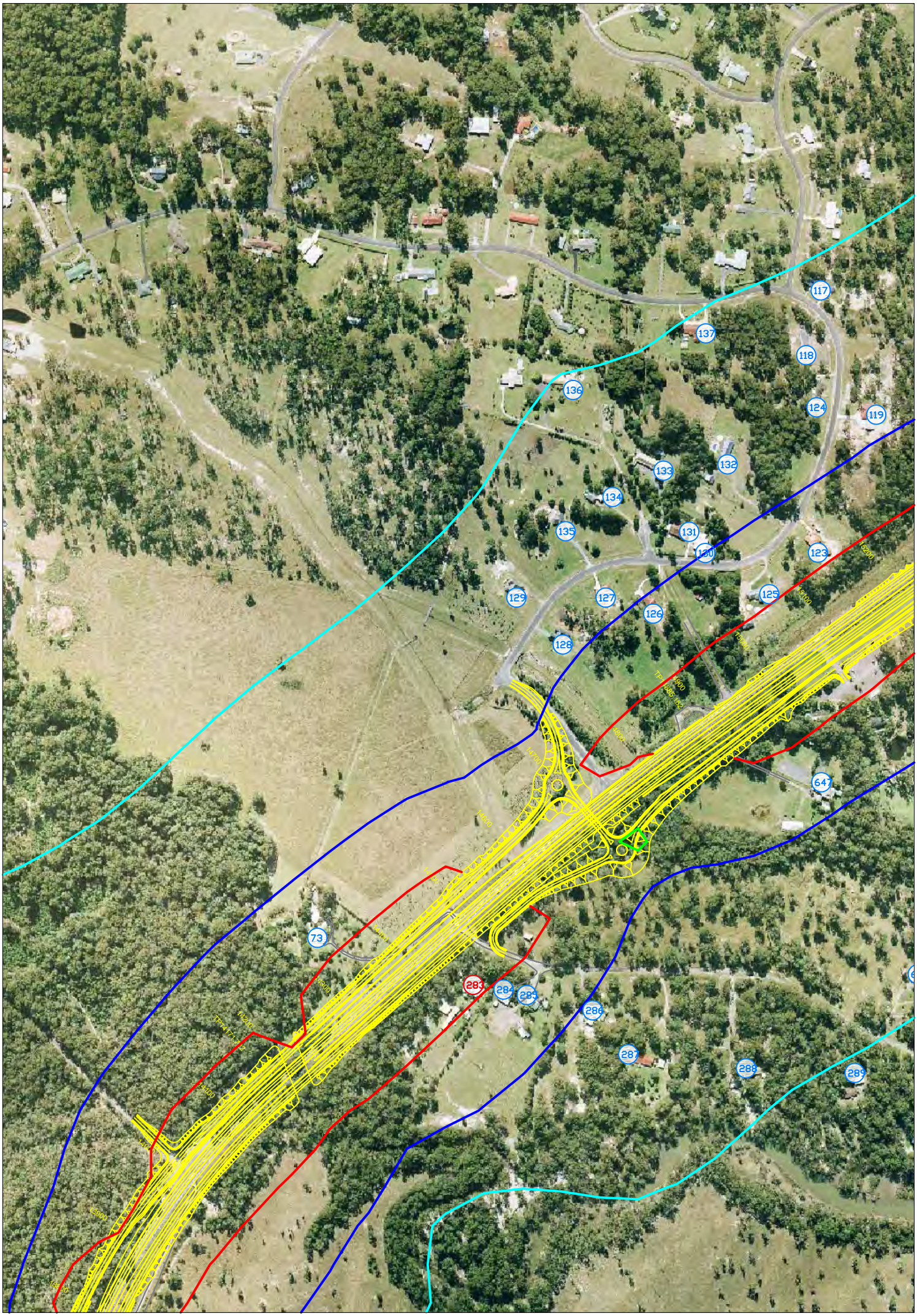
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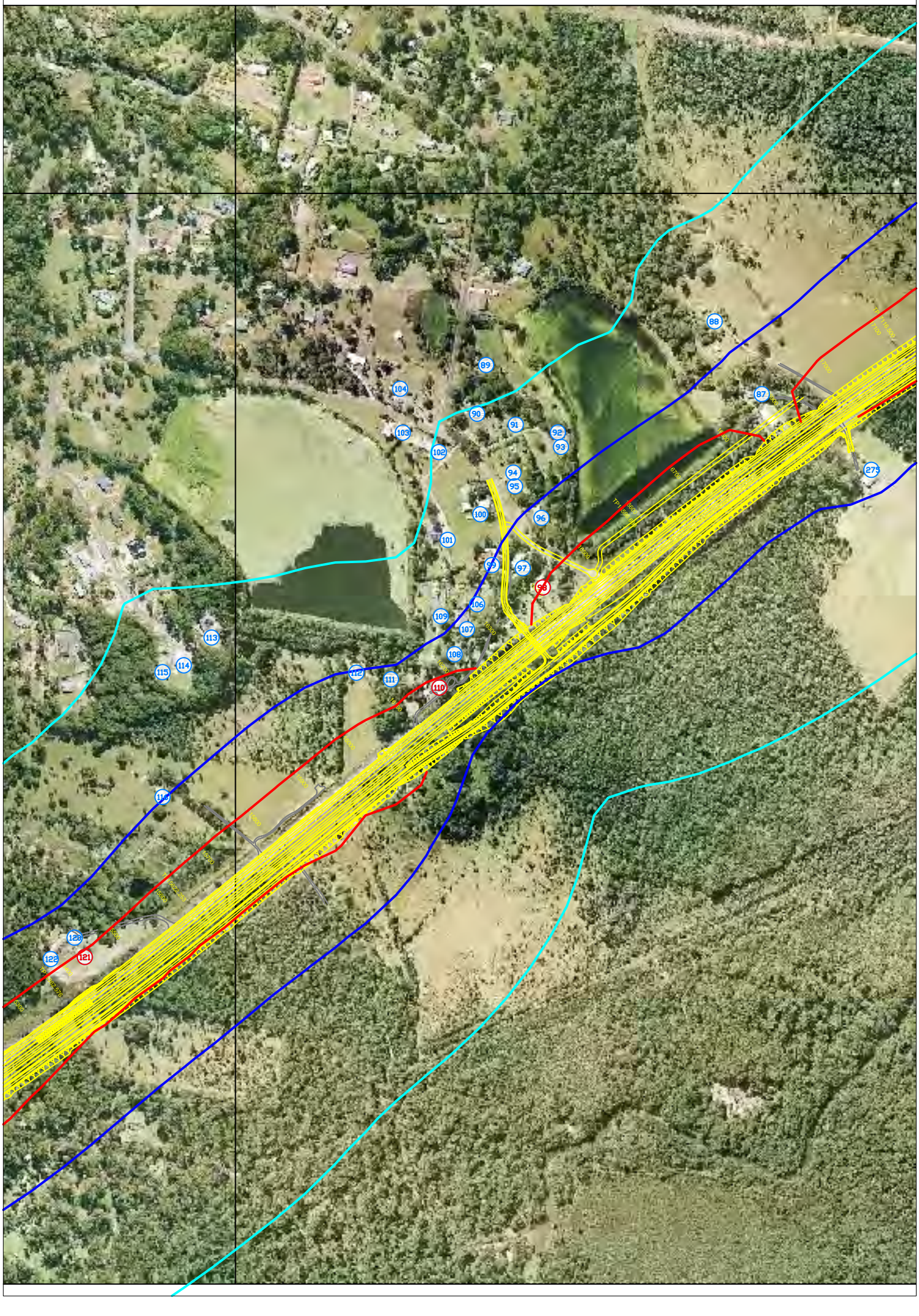
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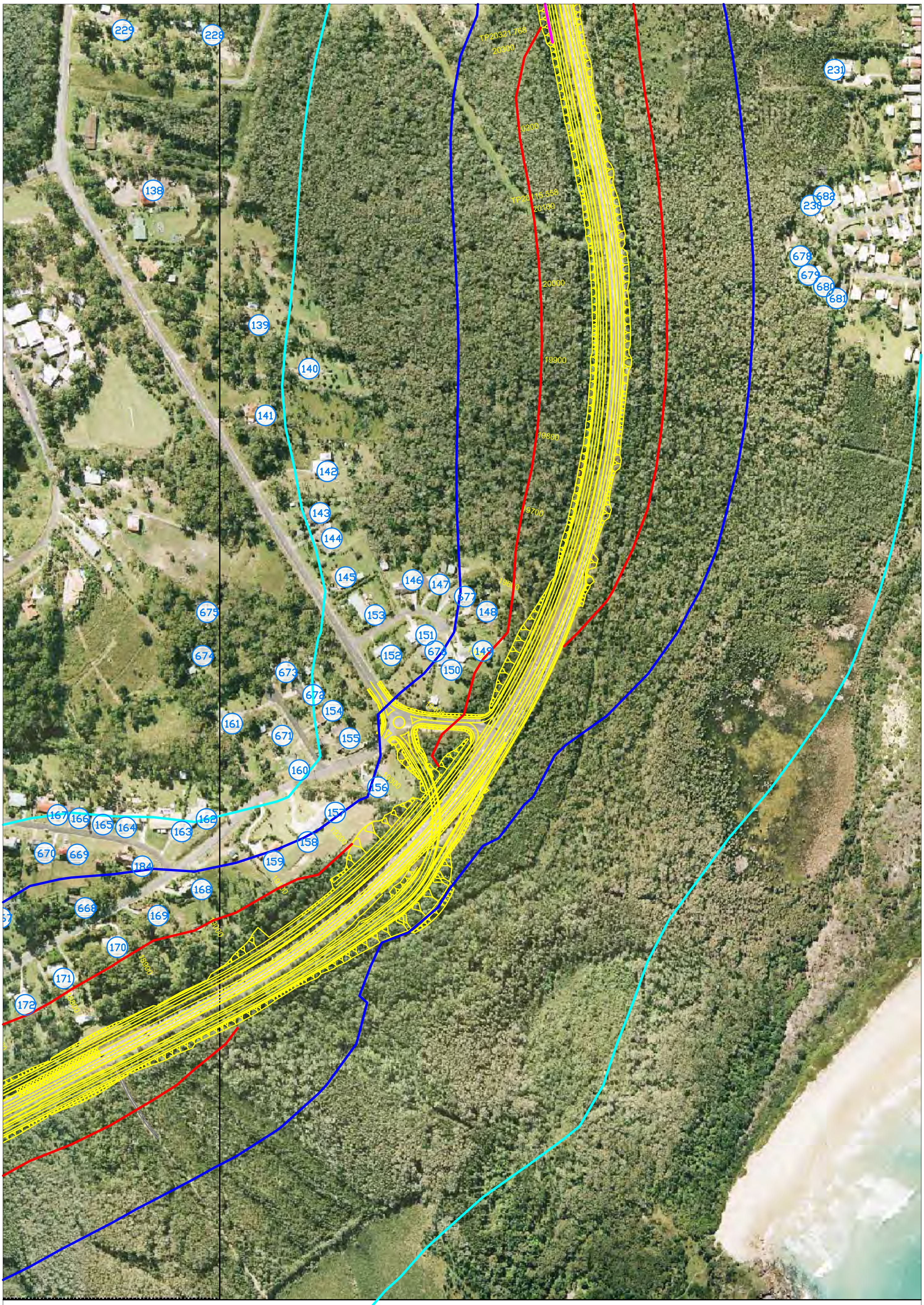
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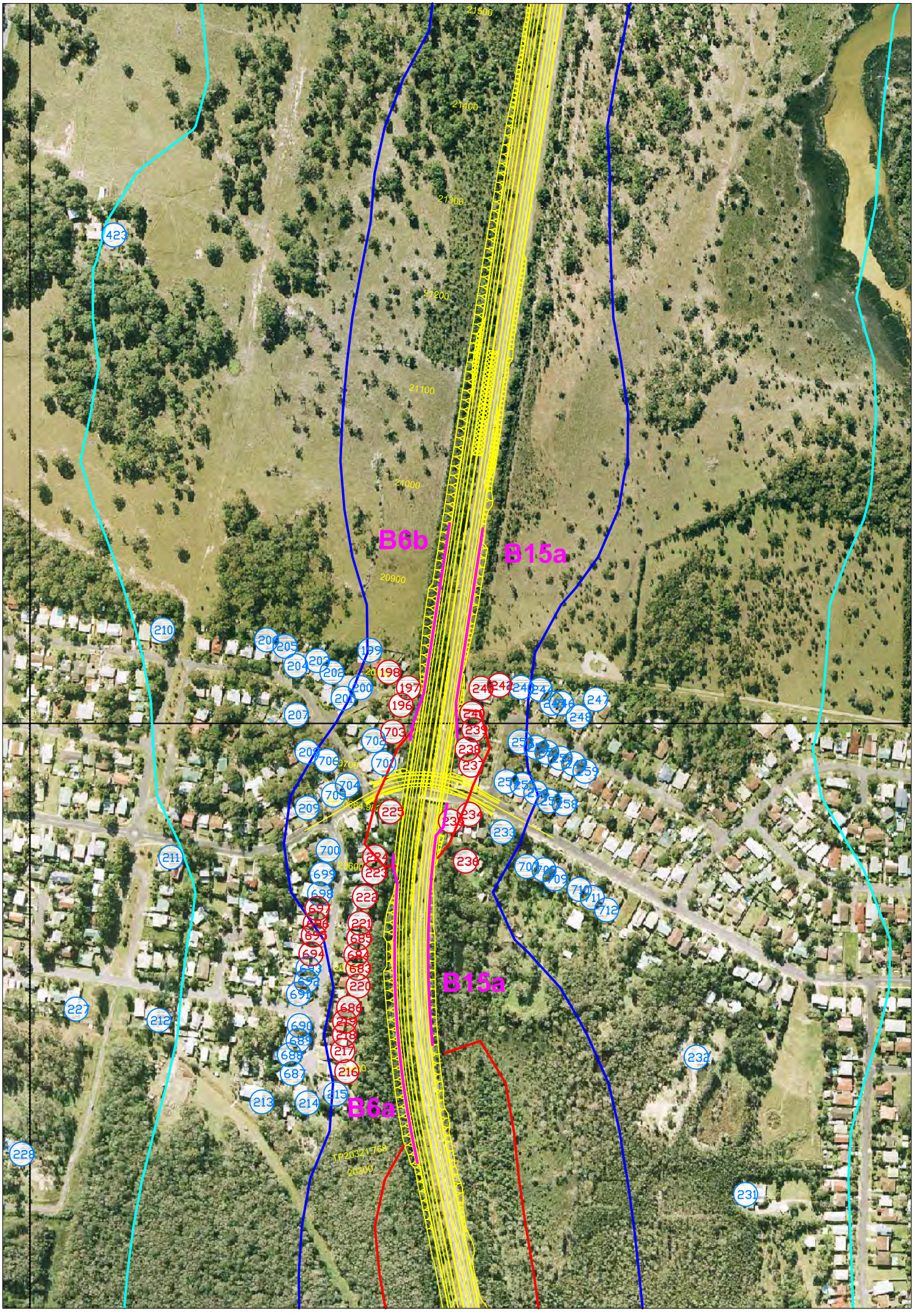
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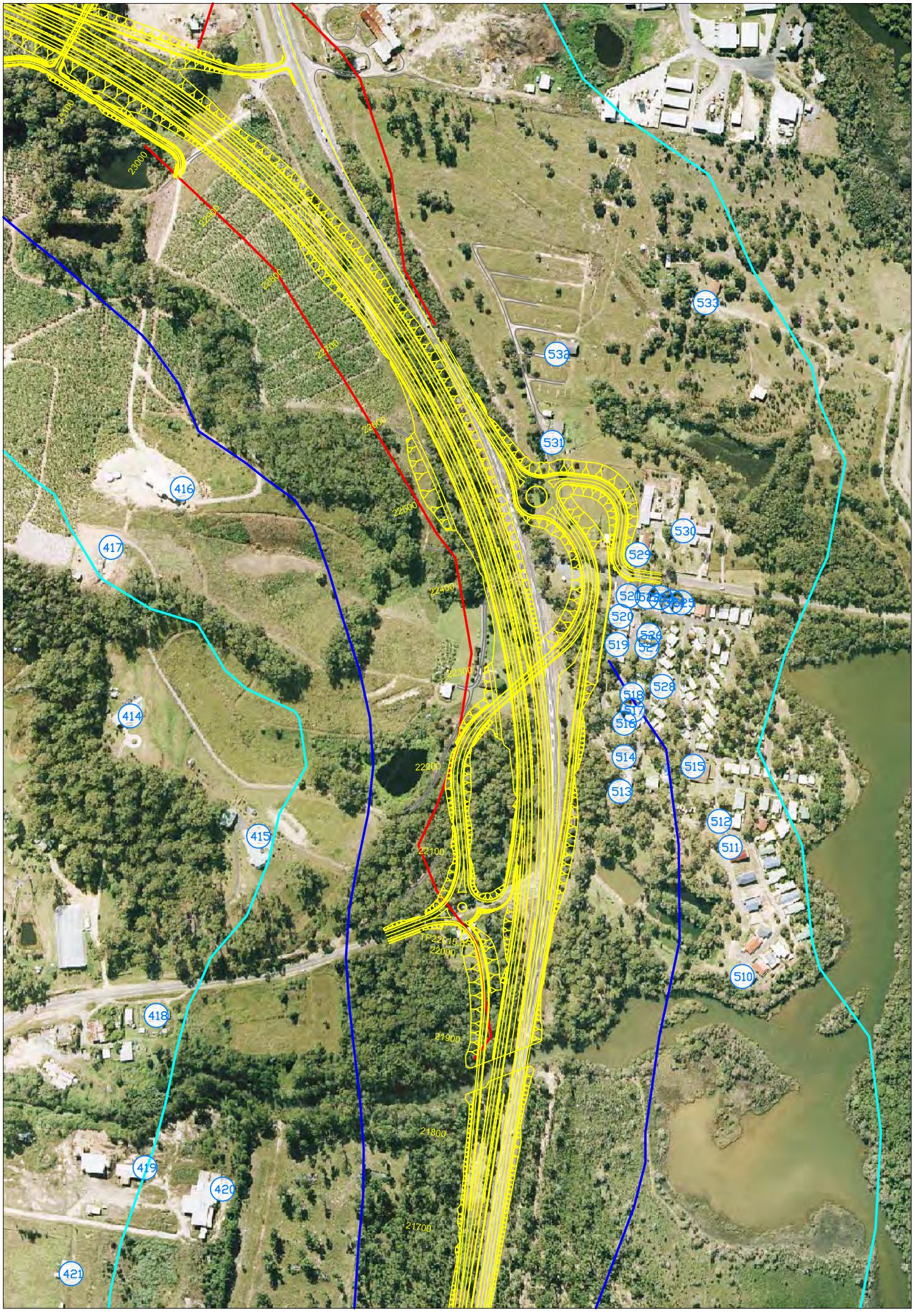
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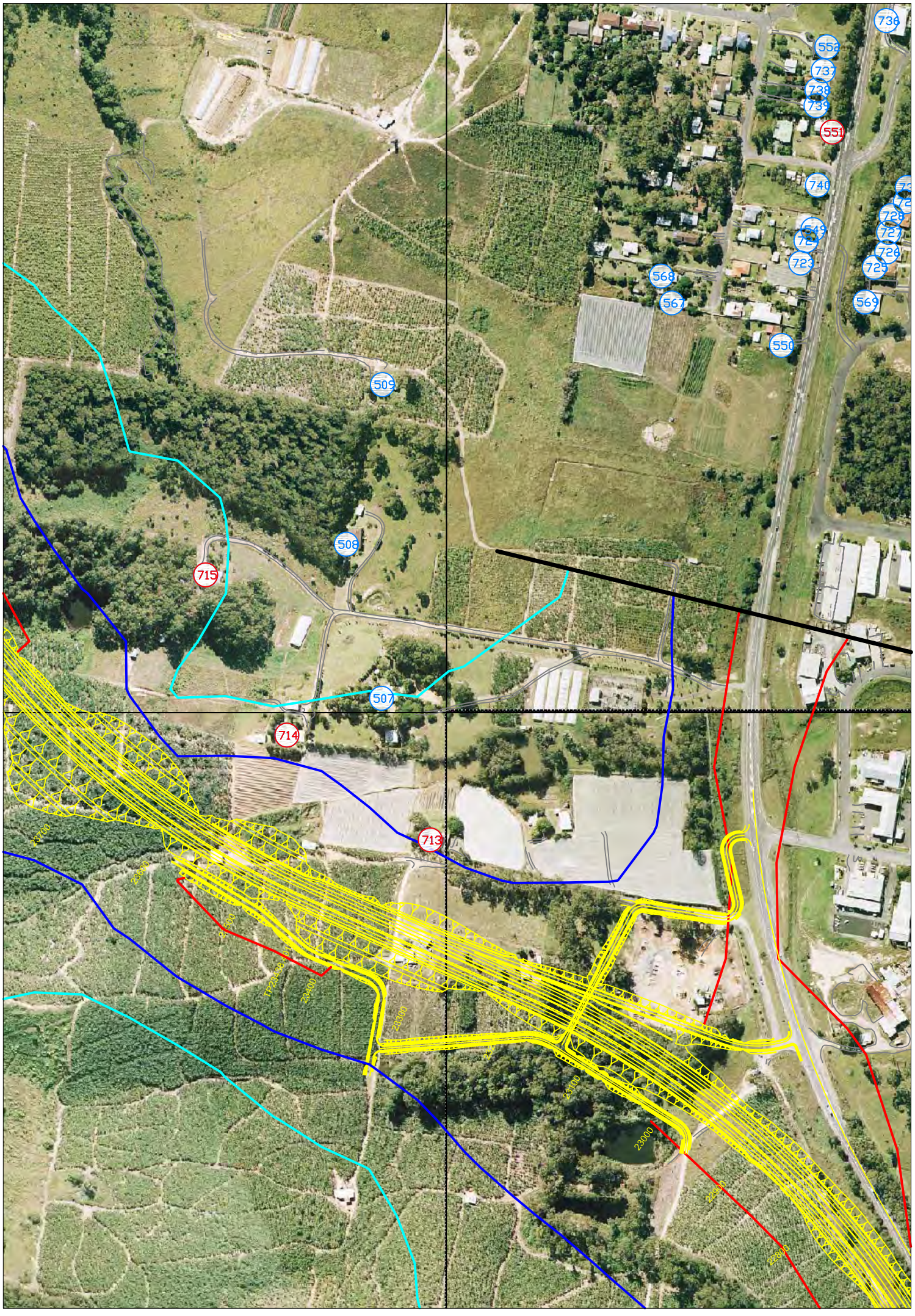
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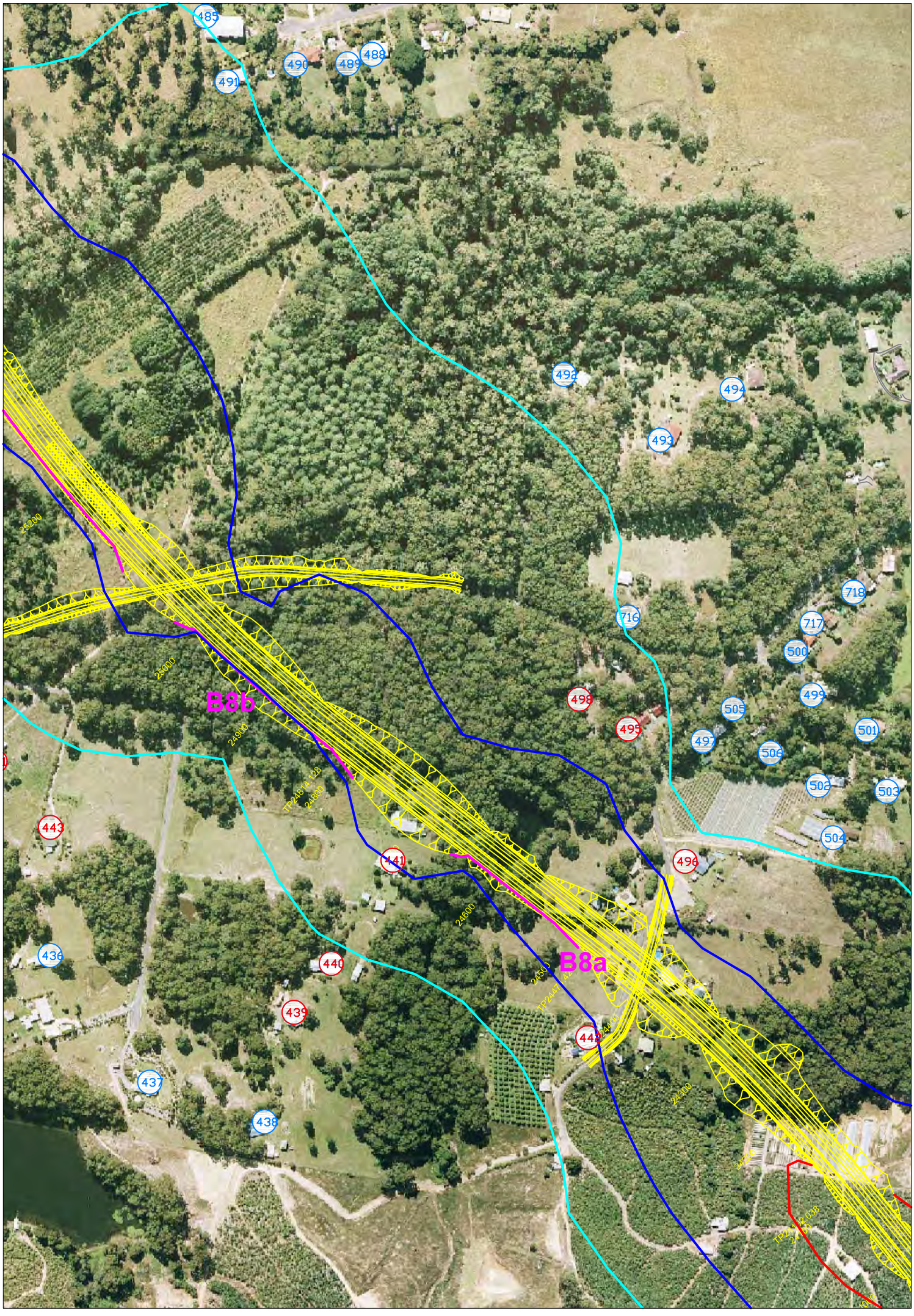
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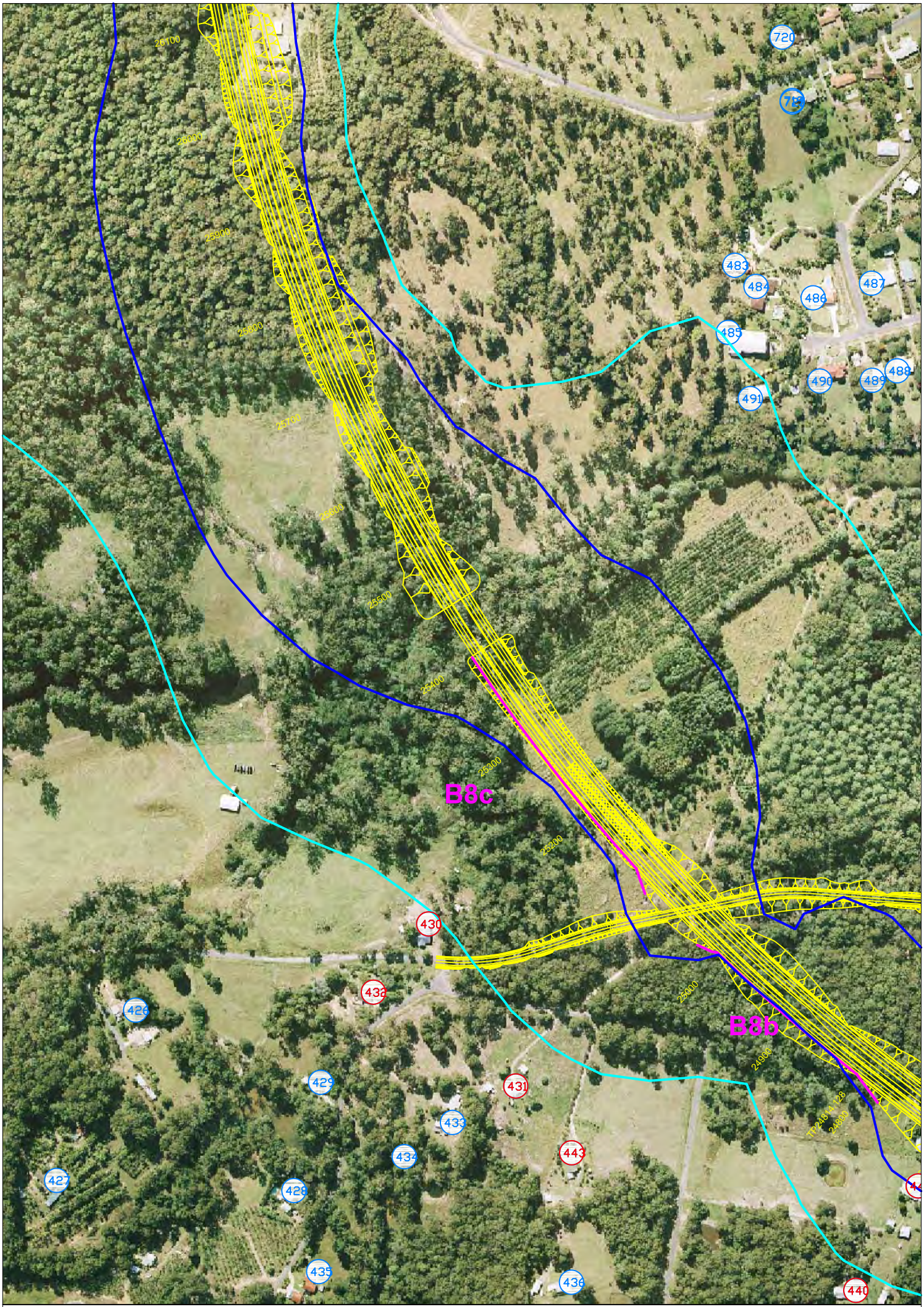
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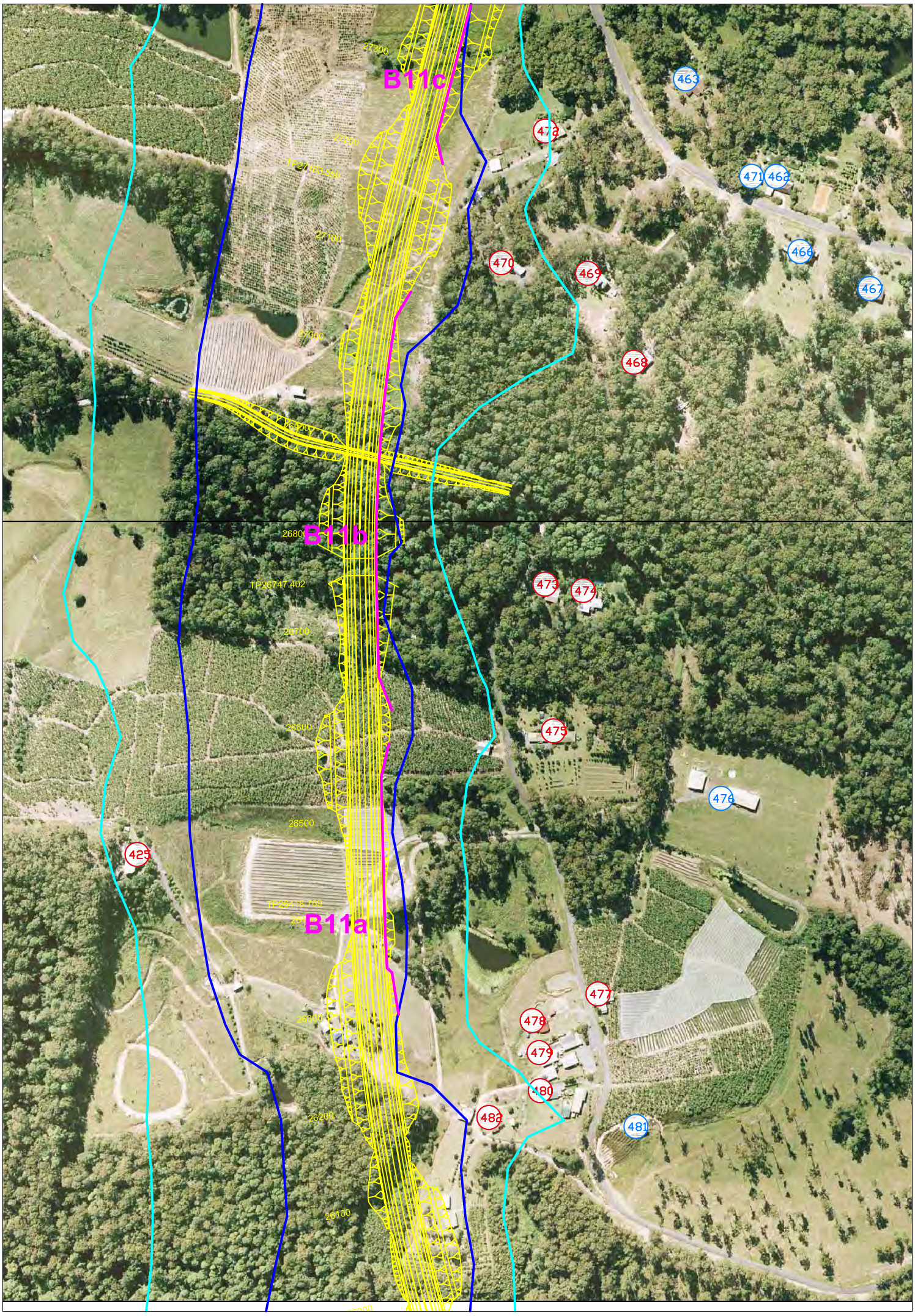
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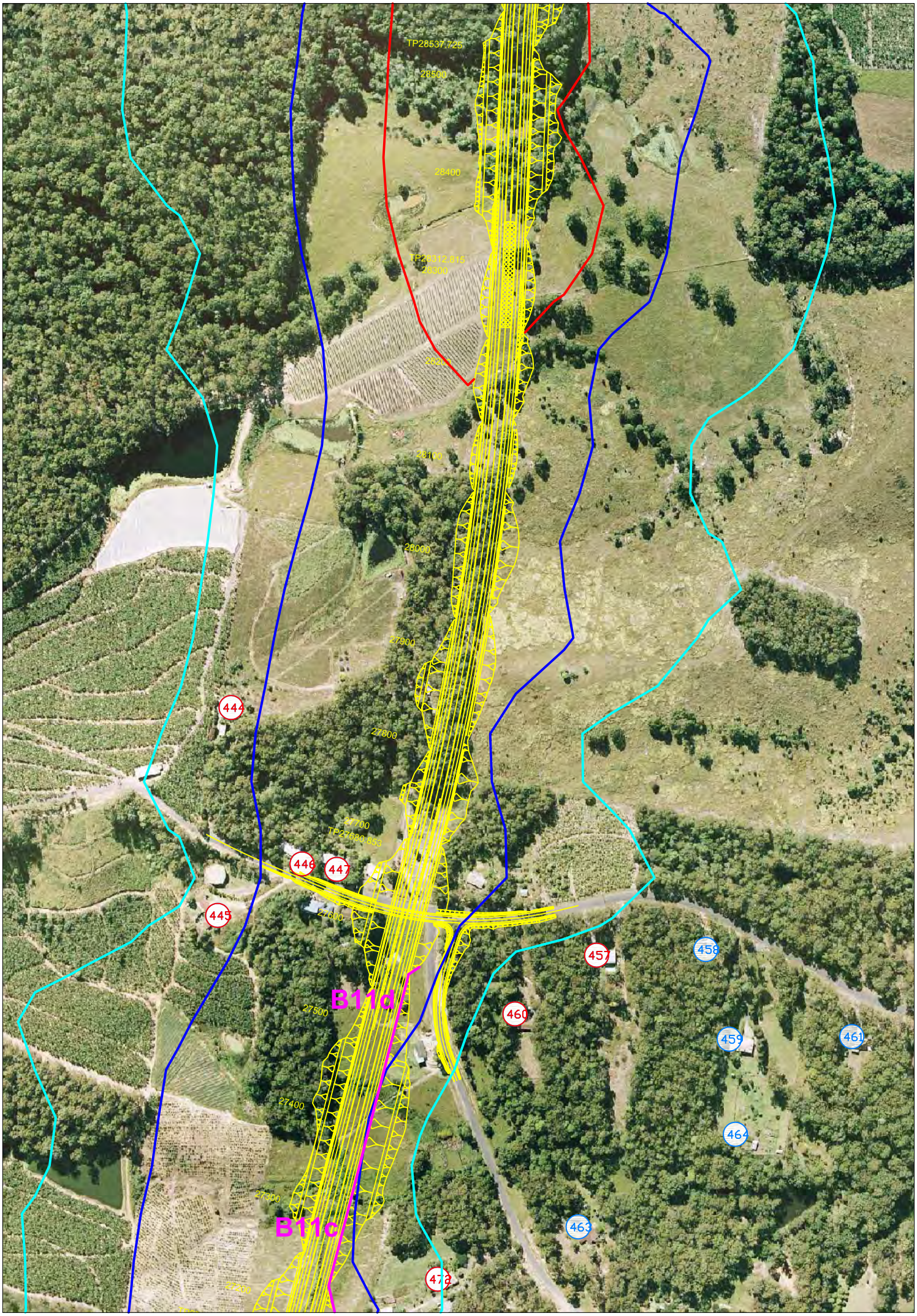
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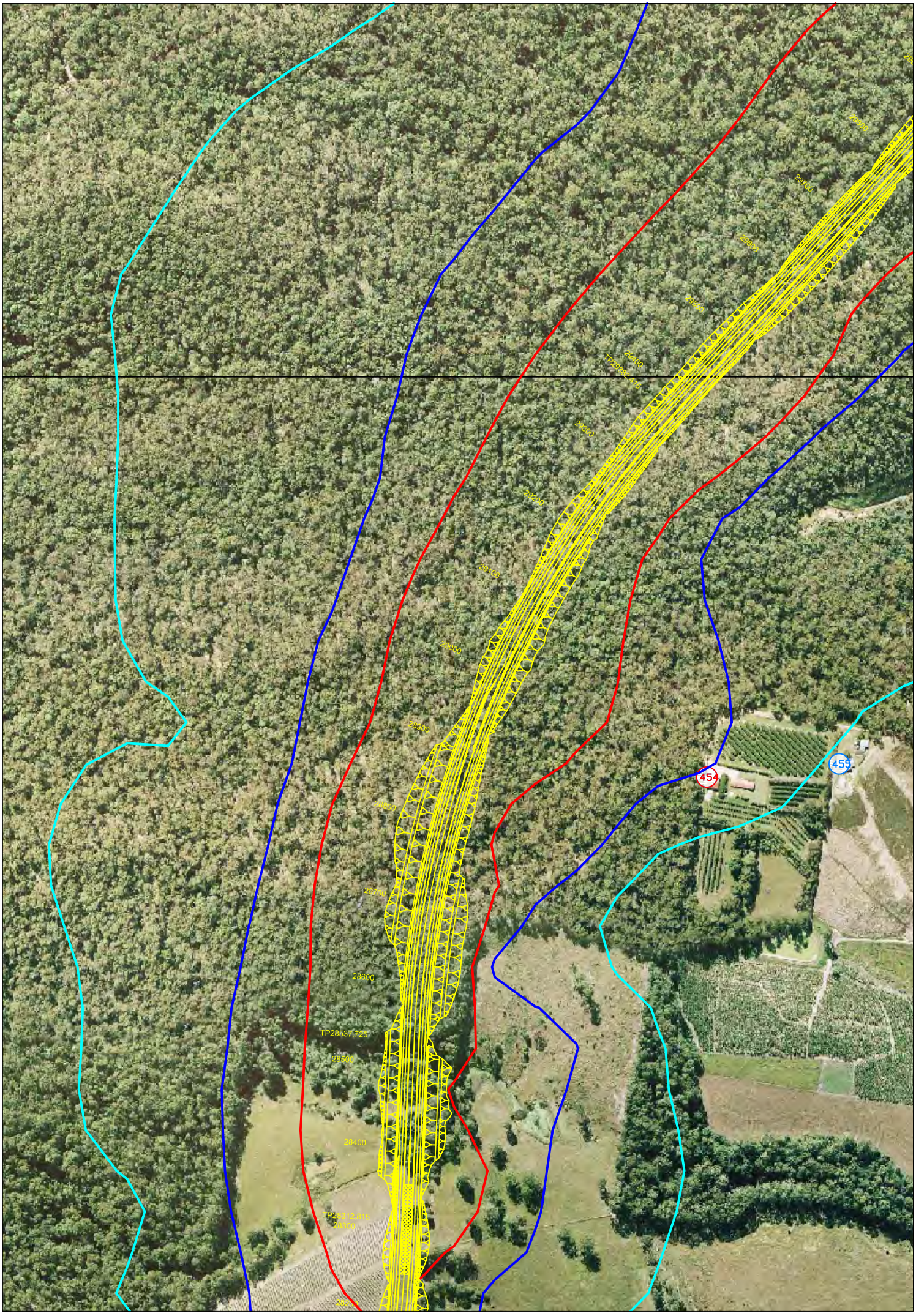
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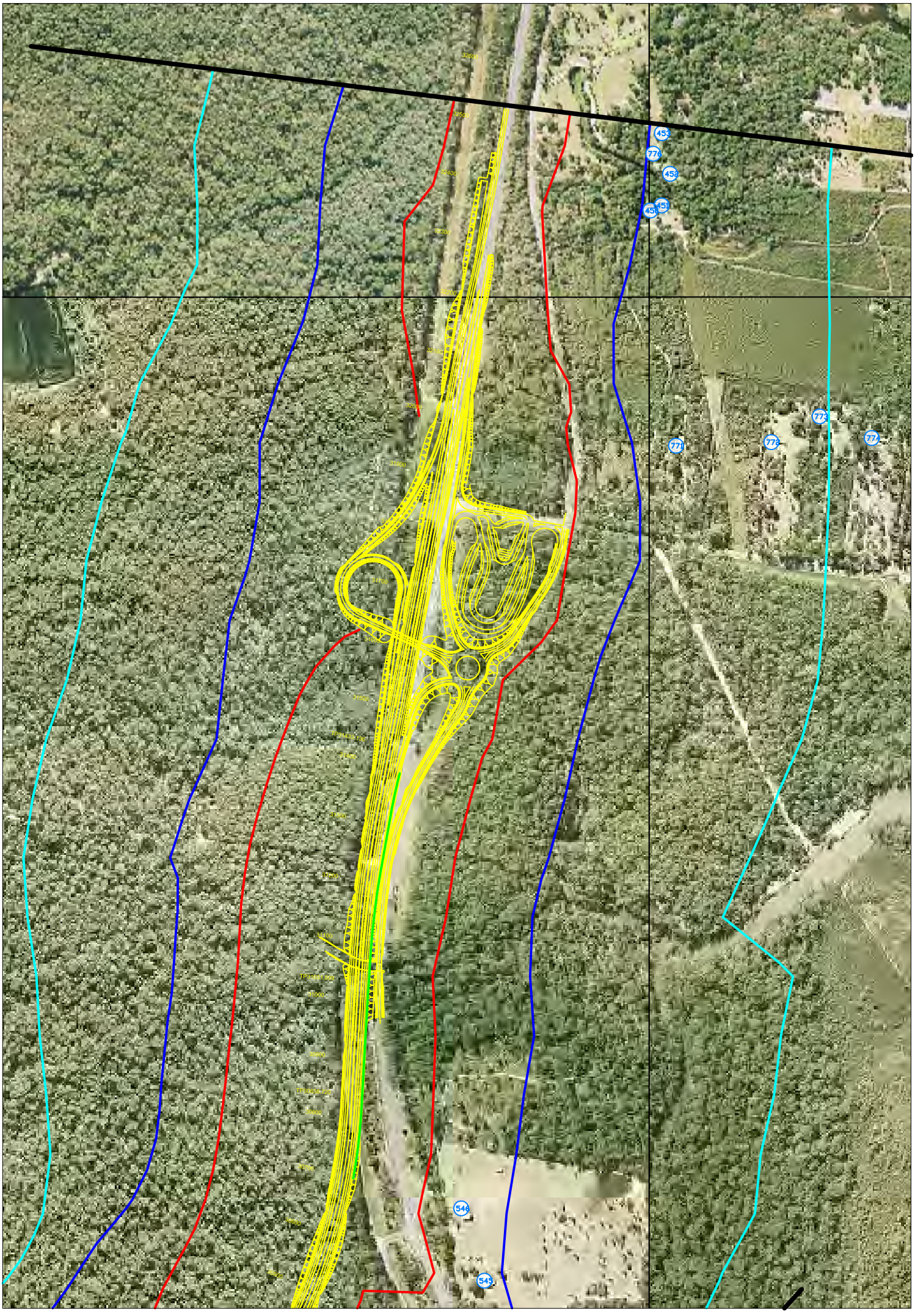
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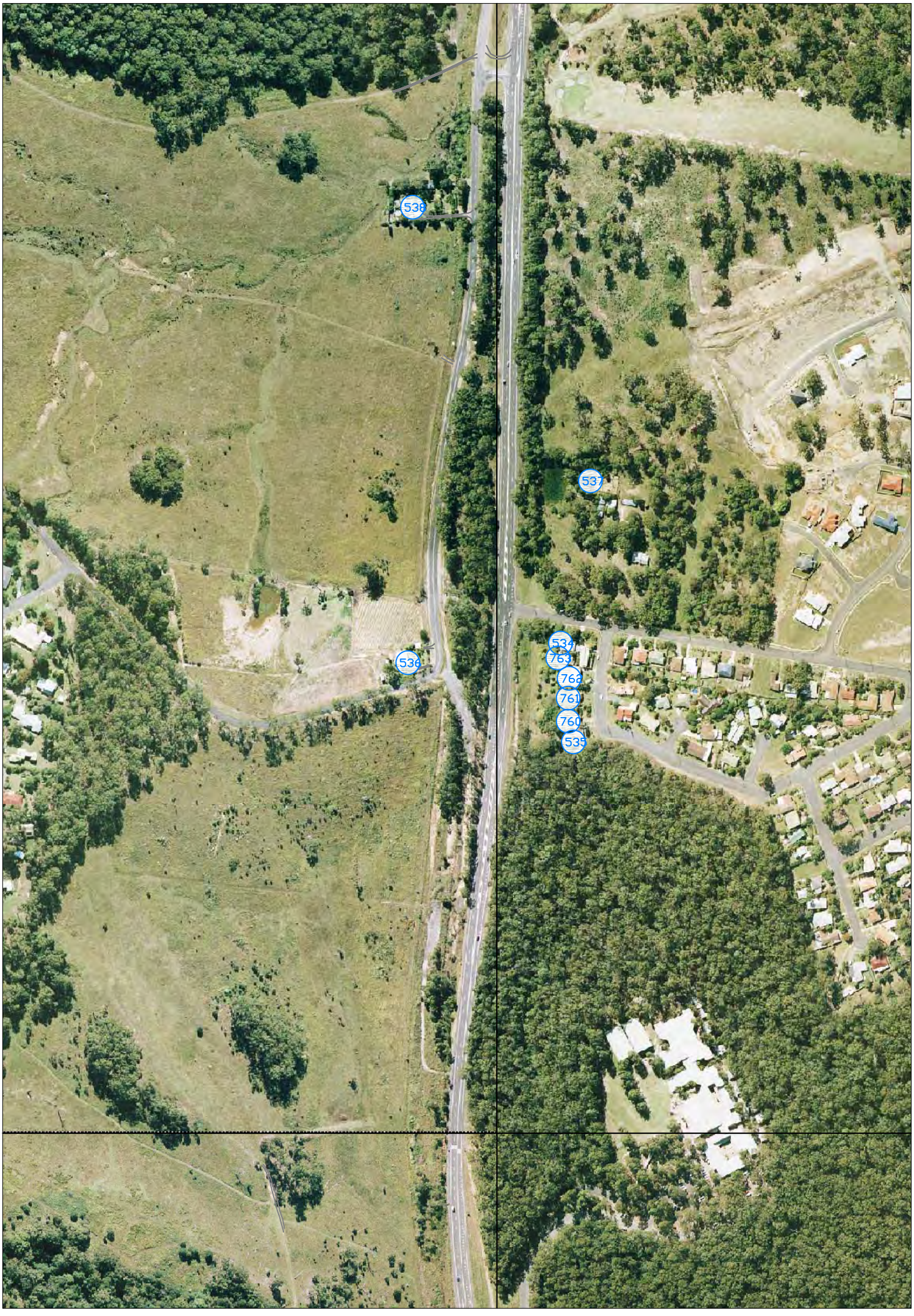
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APPENDIX D

Calculated Noise Levels at Residences

The following table shows the calculated noise levels at each residence under assessment. In the case where residences have more than one floor, the highest predicted noise level is recorded. Residence numbers refer to figures in Appendix C. Levels are calculated first for night time 2011 on the existing alignment. Then criteria are set and an allowance given where criteria are already exceeded. Noise levels are then calculated for 2021 night time with a low noise pavement but with no barriers in place. The next column indicates whether mitigation (either noise barriers or architectural treatments) is "reasonable and feasible" under guidelines from the RTA's *Environmental Noise Management Manual.* Then predicted noise levels are outlined with the proposed barrier configuration outlined in Section 4 in place. Note that for some residences noise levels increase slightly with barriers is position. This occurs where there are barriers proposed on the opposite side and noise is reflected across the highway. The next column indicates if architectural treatments would be required. Finally the change in noise level from 2011 to 2021 (with noise barriers) is shown.

There may be minor changes in barrier heights and lengths as the noise mitigation is optimised as part of the detailed design process or following community consultation.

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
1	1	48.5	50	N/A	47		47.5		-1
1	2	51	55	N/A	51		51.5		0.5
1	3	51	55	N/A	51		51.5		0.5
1	4	48	50	N/A	47.5		47.5		-0.5
1	5	46.5	50	N/A	45.5		46		-0.5
1	6	52.5	55	N/A	53.5		54		1.5
1	7	55	55	57	56		56.5		1.5
1	8	55.5	55	57.5	56		57		1.5
1	9	56	55	58	60	Y	61.5	Y	5.5
1	10	54.5	55	56.5	57	Y	57.5	Y	3
1	11	50	55	N/A	51		52.5		2.5
1	12	48.5	50	N/A	48.5		50		1.5
1	13	46.5	50	N/A	47.5		50		3.5
1	14	54.5	55	56.5	56.5		56.5		2
1	15	54	55	56	54.5		56		2
1	16	54	55	56	55.5		56		2
1	17	57.5	55	59.5	57.5		58.5		1
1	18	56	55	58	56.5		58		2
1	19	57.5	55	59.5	58		59.5		2
1	20	51.5	55	N/A	52.5		54.5		3
1	21	56	55	56.5	58.5	Y	58.5	Y	2.5
1	22	47	50	N/A	48.5		50		3
1	23	47.5	50	N/A	49.5		50		2.5
1	24	58	55	59.5	62	Y	62	Y	4
1	25	47.5	50	N/A	48.5		50		2.5
1	26	52.5	55	N/A	52		53		0.5
1	27	48.5	50	N/A	50.5	Y	50		1.5
1	28	48.5	50	N/A	51	Y	50		1.5
1	29	54.5	55	56.5	54		55		0.5
1	30	51.5	55	N/A	56		52.5		1
1	31	50	55	N/A	53.5		50		0
1	32	48.5	50	N/A	52.5	Y	49		0.5
1	33	53.5	55	55.5	58.5	Y	53		-0.5
1	34	54	55	56	57.5	Y	55.5		1.5
1	35	57	55	59	56		56.5		-0.5

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
1	36	59	55	59.5	58.5		60	Y	1
1	37	56.5	55	58.5	59.5	Y	61	Y	4.5
1	38	52.5	55	N/A	52.5		52.5		0
1	39	47	50	N/A	47.5		49		2
1	616	60.5	55	59.5	61.5	Y	62.5	Treatments already in place	2
1	617	61	55	59.5	61.5	Y	63	Treatments already in place	2
1	638	48.5	50	N/A	49		50		1.5
1	639	49.5	50	N/A	50		50.5		1
2	40	59.5	55	59.5	56		56		-3.5
2	41	56	55	58	53.5		53.5		-2.5
2	42	56	55	58	54		54		-2
2	43	60.5	55	59.5	57		57		-3.5
2	44	60.5	55	59.5	57		57		-3.5
2	45	52.5	55	N/A	50.5		50.5		-2
2	46	50.5	55	N/A	48.5		48.5		-2
2	47	51.5	55	N/A	49.5		49.5		-2
2	48	53.5	55	55.5	51.5		51.5		-2
2	49	52.5	55	N/A	50.5		50.5		-2
2	50	51.5	55	N/A	50		49.5		-2
2	51	52	55	N/A	50		49.5		-2.5
2	52	54.5	55	56.5	52.5		52		-2.5
2	53	57	55	59	54.5		54		-3
2	54	63.5	55	59.5	58		58		-5.5
2	55	61	55	59.5	57.5		57		-4
2	56	62	55	59.5	58		57.5		-4.5
2	57	62	55	59.5	58.5		58		-4
2	58	56	55	58	54		53.5		-2.5
2	59	53.5	55	55.5	52		51.5		-2
2	60	62	55	59.5	59.5		59.5		-2.5
2	61	51.5	55	N/A	50		49.5		-2
2	62	60.5	55	59.5	58		58		-2.5

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
2	63	61.5	55	59.5	59.5		59.5		-2
2	64	60.5	55	59.5	58.5		58.5		-2
2	65	58	55	59.5	56.5		56.5		-1.5
2	66	53.5	55	55.5	51		51		-2.5
2	67	50	55	N/A	48.5		48.5		-1.5
2	68	53	55	N/A	52		52		-1
2	69	52.5	55	N/A	51.5		51.5		-1
2	70	54.5	55	56.5	54		54		-0.5
2	71	49	50	N/A	47.5		47.5		-1.5
2	72	50	55	N/A	49		49		-1
2	645	54.5	55	56.5	54		54		-0.5
2	646	52.5	55	N/A	51.5		52		-0.5
3	73	62	55	59.5	58		58		-4
3	74	52	55	N/A	49		49		-3
3	75	49.5	50	N/A	47		47		-2.5
3	76	58.5	55	59.5	58		58		-0.5
3	77	49	50	N/A	47.5		47.5		-1.5
3	78	52	55	N/A	51.5		51.5		-0.5
3	79	57	55	59	56.5		56.5		-0.5
3	80	54	55	56	53		53		-1
3	81	52	55	N/A	51.5		51.5		-0.5
3	82	53	55	N/A	54.5		54.5		1.5
3	83	55.5	55	57.5	55.5		55.5		0
3	84	51	55	N/A	49.5		49		-2
3	85	56.5	55	58.5	62	Y	62	Y	6.5
3	86	59	55	59.5	58		58		-1
4	87	59.5	55	59.5	58		58		-1.5
4	88	56.5	55	58.5	53.5		53.5		-3
4	89	51	55	N/A	48.5		48.5		-2.5
4	90	53	55	N/A	50		50		-3
4	91	54	55	56	51.5		51.5		-2.5
4	92	55.5	55	57.5	53		53		-2.5
4	93	56	55	58	53.5		53.5		-2.5
4	94	56	55	58	53.5		53.5		-2.5

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
4	95	56.5	55	58.5	53.5		53.5		-3
4	96	58.5	55	59.5	55.5		55.5		-3
4	97	61	55	59.5	58		58		-3
4	98	63	55	59.5	60	Y	60	Y	-3
4	99	58.5	55	59.5	55		55		-3.5
4	100	56.5	55	58.5	54		54		-2.5
4	101	54	55	56	51.5		51.5		-2.5
4	102	53.5	55	55.5	51		51		-2.5
4	103	51.5	55	N/A	49		49		-2.5
4	104	52	55	N/A	49.5		49.5		-2.5
4	106	59.5	55	59.5	55.5		55.5		-4
4	107	60	55	59.5	56		56		-4
4	108	61.5	55	59.5	58		58		-3.5
4	109	56.5	55	58.5	54		54		-2.5
4	110	65.5	55	59.5	63	Y	63	Y	-2.5
4	111	58.5	55	59.5	56		56		-2.5
4	112	58	55	59.5	56		56		-2
4	113	53.5	55	55.5	52		52		-1.5
4	114	54	55	56	52		52		-2
4	115	53.5	55	55.5	51.5		51.5		-2
4	116	56.5	55	58.5	55		55		-1.5
4	117	52.5	55	N/A	50.5		50.5		-2
4	118	53	55	N/A	51.5		51.5		-1.5
4	119	56	55	58	54		54		-2
4	120	60	55	59.5	57.5		57.5		-2.5
4	121	63.5	55	59.5	60	Y	60	Y	-3.5
4	122	60.5	55	59.5	58		58		-2.5
4	123	60.5	55	59.5	58.5		58.5		-2
4	124	54.5	55	56.5	52.5		52.5		-2
4	125	61	55	59.5	59		59		-2
4	126	58	55	59.5	56		56		-2
4	127	56.5	55	58.5	54		54		-2.5
4	128	56.5	55	58.5	54		54		-2.5
4	129	54.5	55	56.5	52		52		-2.5
4	130	57	55	59	55		55		-2

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
4	131	56	55	58	54		54		-2
4	132	54.5	55	56.5	52.5		52.5		-2
4	133	54	55	56	52		52		-2
4	134	54.5	55	56.5	52		52		-2.5
4	135	54	55	56	51.5		51.5		-2.5
4	136	53	55	N/A	50.5		50.5		-2.5
4	137	52.5	55	N/A	50.5		50.5		-2
5	138	48.5	50	N/A	47.5		47		-1.5
5	139	51	55	N/A	50		49.5		-1.5
5	140	52	55	N/A	51		50.5		-1.5
5	141	51.5	55	N/A	50		49.5		-2
5	142	52	55	N/A	51		50.5		-1.5
5	143	51.5	55	N/A	50.5		50.5		-1
5	144	51.5	55	N/A	50.5		50.5		-1
5	145	51.5	55	N/A	50.5		50.5		-1
5	146	53.5	55	55.5	52.5		52.5		-1
5	147	55	55	57	53.5		53.5		-1.5
5	148	59.5	55	59.5	57		57		-2.5
5	149	61.5	55	59.5	59.5		59.5		-2
5	150	59.5	55	59.5	57		57		-2.5
5	151	54	55	56	52.5		52.5		-1.5
5	152	52	55	N/A	51.5		51		-1
5	153	52	55	N/A	51		51		-1
5	154	52.5	55	N/A	51.5		51.5		-1
5	155	53.5	55	55.5	52		52		-1.5
5	156	59.5	55	59.5	53.5		53.5		-6
5	157	58.5	55	59.5	53.5		53.5		-5
5	158	60	55	59.5	55.5		55.5		-4.5
5	159	61	55	59.5	58.5		58.5		-2.5
5	160	51.5	55	N/A	49		49		-2.5
5	161	48.5	50	N/A	46.5		46.5		-2
5	162	51.5	55	N/A	49		49		-2.5
5	163	54	55	56	51		50.5		-3.5
5	164	53.5	55	55.5	51		51		-2.5

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
5	165	53.5	55	55.5	50.5		50.5		-3
5	166	53	55	N/A	50		50		-3
5	167	52	55	N/A	50		49.5		-2.5
5	168	59.5	55	59.5	58		58		-1.5
5	169	59	55	59.5	58		58		-1
5	170	60	55	59.5	59.5		59.5		-0.5
5	171	59	55	59.5	58.5		58.5		-0.5
5	172	59.5	55	59.5	59		59		-0.5
5	173	59	55	59.5	59		59		0
5	174	58	55	59.5	58.5		58.5		0.5
5	175	58	55	59.5	58.5		58.5		0.5
5	176	57.5	55	59.5	58.5		58.5		1
5	177	57.5	55	59.5	59		59		1.5
5	178	57.5	55	59.5	60	Y	60	Y	2.5
5	179	57.5	55	59.5	58.5		58.5		1
5	180	60	55	59.5	61	Y	61	Y	1
5	181	57.5	55	59.5	58		58		0.5
5	182	56.5	55	58.5	56.5		56.5		0
5	183	54.5	55	56.5	55		55		0.5
5	184	56.5	55	58.5	55.5		55.5		-1
5	185	53	55	N/A	54.5		54.5		1.5
5	186	56	55	58	55		55		-1
5	187	55.5	55	57.5	55		55		-0.5
5	188	50.5	55	N/A	50		50		-0.5
5	189	55	55	57	53.5		53.5		-1.5
5	190	55.5	55	57.5	54		54		-1.5
5	191	49.5	50	N/A	50.5		50		0.5
5	192	49	50	N/A	49		49		0
5	193	51	55	N/A	52		52		1
5	194	53	55	N/A	55		55		2
5	195	64.5	55	59.5	61.5	Y	61.5	Y	-3
5	655	55	55	57	54		54		-1
5	656	55	55	57	54.5		54		-1
5	657	51	55	N/A	52.5		52.5		1.5
5	658	53	55	N/A	54		54		1

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
5	659	54	55	56	55		55		1
5	660	55	55	57	55.5		55.5		0.5
5	661	55.5	55	57.5	56		56		0.5
5	662	56.5	55	58.5	56.5		56.5		0
5	663	56	55	58	55.5		55.5		-0.5
5	664	57	55	59	56.5		56.5		-0.5
5	665	56	55	58	55.5		55.5		-0.5
5	666	56	55	58	55		55		-1
5	667	56.5	55	58.5	56		56		-0.5
5	668	56.5	55	58.5	55.5		55.5		-1
5	669	56	55	58	55		55		-1
5	670	55	55	57	54		54		-1
5	671	51	55	N/A	49		49		-2
5	672	52.5	55	N/A	51.5		51		-1.5
5	673	51	55	N/A	49.5		49		-2
5	674	49	50	N/A	47.5		47		-2
5	675	50	55	N/A	48.5		48.5		-1.5
5	676	58	55	59.5	55.5		55.5		-2.5
5	677	58	55	59.5	56		56		-2
6	196	63	55	59.5	62.5	Y	58		-5
6	197	64	55	59.5	64	Y	57.5		-6.5
6	198	61	55	59.5	60.5	Y	56		-5
6	199	59.5	55	59.5	58.5		55		-4.5
6	200	59	55	59.5	58		55		-4
6	201	58	55	59.5	56.5		54.5		-3.5
6	202	57.5	55	59.5	56		54		-3.5
6	203	57	55	59	55.5		53.5		-3.5
6	204	56	55	58	54.5		53		-3
6	205	55.5	55	57.5	54.5		53		-2.5
6	206	55	55	57	54		52.5		-2.5
6	207	56	55	58	54.5		53.5		-2.5
6	208	56.5	55	58.5	54.5		54.5		-2
6	209	58	55	59.5	56		56		-2
6	210	53	55	N/A	51.5		51		-2

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
6	211	50.5	55	N/A	49.5		49		-1.5
6	212	50.5	55	N/A	49.5		49.5		-1
6	213	55	55	57	54		52.5		-2.5
6	214	57	55	59	56.5		54		-3
6	215	60.5	55	59.5	59.5		55.5		-5
6	216	61	55	59.5	60.5	Y	55.5		-5.5
6	217	61.5	55	59.5	61	Y	57		-4.5
6	218	61	55	59.5	60.5	Y	56		-5
6	219	61	55	59.5	60.5	Y	55.5		-5.5
6	220	61.5	55	59.5	61.5	Y	55.5		-6
6	221	62.5	55	59.5	62.5	Y	58		-4.5
6	222	63	55	59.5	62.5	Y	60	Y	-3
6	223	64	55	59.5	63.5	Y	62.5	Y	-1.5
6	224	63.5	55	59.5	63	Y	63	Y	-0.5
6	225	64.5	55	59.5	64	Y	64.5	Y	0
6	227	49	55	N/A	48		48		-1
6	228	49.5	55	N/A	48.5		48		-1.5
6	229	48	55	N/A	46.5		46.5		-1.5
6	683	61.5	55	59.5	61.5	Y	55.5		-6
6	684	61	55	59.5	61	Y	55		-6
6	685	61.5	55	59.5	61.5	Y	55.5		-6
6	686	61	55	59.5	61	Y	55.5		-5.5
6	687	56.5	55	58.5	55.5		53.5		-3
6	688	56.5	55	58.5	56		53.5		-3
6	689	58	55	59.5	57		54		-4
6	690	58.5	55	59.5	57.5		54		-4.5
6	691	58	55	59.5	57		54		-4
6	692	57.5	55	59.5	57.5		54.5		-3
6	693	56.5	55	58.5	58		54.5		-2
6	694	55	55	57	58	Y	54.5		-0.5
6	695	55	55	57	58	Y	55		0
6	696	55.5	55	57.5	58	Y	55.5		0
6	697	55.5	55	57.5	58	Y	56		0.5
6	698	56.5	55	58.5	58		56.5		0
6	699	59	55	59.5	57.5		57		-2

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
6	700	59.5	55	59.5	57.5		57.5		-2
6	701	62	55	59.5	58.5		59.5		-2.5
6	702	61	55	59.5	58		57.5		-3.5
6	703	62.5	55	59.5	60.5	Y	59.5		-3
6	704	59	55	59.5	56.5		57.5		-1.5
6	705	58.5	55	59.5	57		57		-1.5
6	706	57	55	59	55.5		55.5		-1.5
7	413	45	50	N/A	44		44		-1
7	414	52	55	N/A	49.5		49.5		-2.5
7	415	52.5	55	N/A	50.5		50.5		-2
7	416	58	55	59.5	54		54		-4
7	417	56	55	58	52.5		52.5		-3.5
7	418	50.5	55	N/A	49		49		-1.5
7	419	51.5	55	N/A	50		50		-1.5
7	420	53.5	55	55.5	52		52		-1.5
7	421	50.5	55	N/A	49		49		-1.5
7	422	51	55	N/A	49.5		49.5		-1.5
7	423	52.5	55	N/A	51		51		-1.5
8	424	N/A	50	N/A	44		46		N/A
8	425	N/A	50	N/A	53.5	Y	54	Y	N/A
8	426	N/A	50	N/A	47.5		46		N/A
8	427	N/A	50	N/A	45.5		44.5		N/A
8	428	N/A	50	N/A	43.5		43.5		N/A
8	429	N/A	50	N/A	44.5		44.5		N/A
8	430	N/A	50	N/A	53	Y	50		N/A
8	431	N/A	50	N/A	52	Y	49.5		N/A
8	432	N/A	50	N/A	51	Y	49		N/A
8	433	N/A	50	N/A	47		46.5		N/A
8	434	N/A	50	N/A	43		43		N/A
8	435	N/A	50	N/A	43.5		43.5		N/A
8	436	N/A	50	N/A	49.5		47.5		N/A
8	437	N/A	50	N/A	47.5		46		N/A
8	438	N/A	50	N/A	48		46.5		N/A
8	439	N/A	50	N/A	50.5	Y	48		N/A

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
8	440	N/A	50	N/A	52	Y	49.5		N/A
8	441	N/A	50	N/A	56	Y	54.5	Y	N/A
8	442	46.5	50	N/A	56	Y	55.5	Y	9
8	443	N/A	50	N/A	51	Y	48.5		N/A
9	444	N/A	50	N/A	54	Y	54	Y	N/A
9	445	N/A	50	N/A	52.5	Y	53.5	Y	N/A
9	446	N/A	50	N/A	54	Y	54	Y	N/A
9	447	N/A	50	N/A	55.5	Y	55.5	Y	N/A
10	450	54	55	56	55.5		55.5		1.5
10	451	53.5	55	55.5	55		55		1.5
10	452	53.5	55	55.5	55		55		1.5
10	453	54	55	56	55.5		55.5		1.5
10	771	52	55	N/A	54		54		2
10	772	50	55	N/A	51.5		51.5		1.5
10	773	49	50	N/A	50		50		1
10	774	48.5	50	N/A	49		49		0.5
10	775	47.5	50	N/A	48		48		0.5
10	776	54	55	56	55.5		55.5		1.5
11	454	N/A	50	N/A	55.5	Y	55.5	Y	N/A
11	455	N/A	50	N/A	42.5		42.5		N/A
11	457	N/A	50	N/A	50.5	Y	48		N/A
11	458	N/A	50	N/A	47.5		45.5		N/A
11	459	N/A	50	N/A	47		44		N/A
11	460	N/A	50	N/A	52	Y	48		N/A
11	461	N/A	50	N/A	46		44		N/A
11	462	N/A	50	N/A	47.5		44.5		N/A
11	463	N/A	50	N/A	49		44.5		N/A
11	464	N/A	50	N/A	45.5		42		N/A
11	465	N/A	50	N/A	46.5		44		N/A
11	466	N/A	50	N/A	46		44		N/A
11	467	N/A	50	N/A	45.5		44		N/A
11	468	N/A	50	N/A	51.5	Y	49		N/A
11	469	N/A	50	N/A	50.5	Y	49		N/A
11	470	N/A	50	N/A	54	Y	52.5	Y	N/A

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
11	471	N/A	50	N/A	47.5		44.5		N/A
11	472	N/A	50	N/A	55.5	Y	50		N/A
11	473	N/A	50	N/A	52	Y	47.5		N/A
11	474	N/A	50	N/A	51	Y	46.5		N/A
11	475	N/A	50	N/A	52.5	Y	48.5		N/A
11	476	N/A	50	N/A	48.5		45		N/A
11	477	N/A	50	N/A	51	Y	47.5		N/A
11	478	N/A	50	N/A	51.5	Y	48		N/A
11	479	N/A	50	N/A	51.5	Y	49		N/A
11	480	N/A	50	N/A	52	Y	50		N/A
11	481	N/A	50	N/A	45.5		46		N/A
11	482	N/A	50	N/A	54	Y	53	Y	N/A
11	722	N/A	50	N/A	41.5		41.5		N/A
12	483	N/A	50	N/A	47		48		N/A
12	484	N/A	50	N/A	47.5		48.5		N/A
12	485	N/A	50	N/A	49.5		50		N/A
12	486	N/A	50	N/A	46.5		47.5		N/A
12	487	N/A	50	N/A	44		45		N/A
12	488	N/A	50	N/A	47		48.5		N/A
12	489	N/A	50	N/A	47.5		49		N/A
12	490	N/A	50	N/A	48.5		50		N/A
12	491	N/A	50	N/A	49		50		N/A
12	492	44.5	50	N/A	47.5		49		4.5
12	493	45	50	N/A	47.5		48.5		3.5
12	494	45	50	N/A	45		46		1
12	495	45	50	N/A	52	Y	53.5	Y	8.5
12	496	46	50	N/A	53.5	Y	54.5	Y	8.5
12	497	45.5	50	N/A	45.5		46		0.5
12	498	44	50	N/A	51.5	Y	53	Y	9
12	499	45	50	N/A	43		43.5		-1.5
12	500	45.5	50	N/A	45		45.5		0
12	501	45.5	50	N/A	43		43		-2.5
12	502	45.5	50	N/A	44		44.5		-1
12	503	46	50	N/A	46.5		46.5		0.5

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
12	504	46.5	50	N/A	50		50		3.5
12	505	45.5	50	N/A	45.5		46		0.5
12	506	45.5	50	N/A	43.5		44		-1.5
12	716	45	50	N/A	49.5		50		5
12	717	45.5	50	N/A	45.5		46		0.5
12	718	46	50	N/A	46		46.5		0.5
12	719	N/A	50	N/A	45		45.5		N/A
12	720	N/A	50	N/A	44		44		N/A
12	721	N/A	50	N/A	45		45.5		N/A
13	507	49	50	N/A	50		50		1
13	508	49	50	N/A	48		45		-4
13	509	48.5	50	N/A	48.5		48.5		0
13	713	51	50	51.5	53.5	Y	53.5	Y	2.5
13	714	48.5	50	N/A	52.5	Y	53	Y	4.5
13	715	46	50	N/A	50.5	Y	50.5	Y	4.5
14	510	56.5	55	58.5	53.5		53.5		-3
14	511	57	55	59	54		54		-3
14	512	57.5	55	59.5	54		54		-3.5
14	513	62	55	59.5	58.5		58.5		-3.5
14	514	61.5	55	59.5	58		58		-3.5
14	515	56	55	58	52		52		-4
14	516	59.5	55	59.5	56.5		56.5		-3
14	517	58	55	59.5	54.5		54.5		-3.5
14	518	57.5	55	59.5	53		53		-4.5
14	519	59	55	59.5	52.5		52.5		-6.5
14	520	59	55	59.5	52.5		52.5		-6.5
14	521	59	55	59.5	53.5		53.5		-5.5
14	522	58	55	59.5	53.5		53.5		-4.5
14	523	57.5	55	59.5	54		54		-3.5
14	524	57	55	59	53.5		53.5		-3.5
14	525	57	55	59	53.5		53.5		-3.5
14	526	57.5	55	59.5	51.5		51.5		-6
14	527	57.5	55	59.5	51.5		51.5		-6
14	528	57	55	59	52.5		52.5		-4.5

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	No.	2011 $L_{Aeq,9hr}$ (dBA)	ECRTN Base Criterion (dBA)	Allowance Where base criterion already exceeded (dBA)	Without Barriers	Mitigation Required Under ENMM?	With Proposed Barriers in Place	Architectural Treatment Required?	Change from 2011 to 2021 with Proposed Barriers (dBA)
14	529	59	55	59.5	54.5		54.5		-4.5
14	530	57.5	55	59.5	53.5		53.5		-4
14	531	63	55	59.5	58		58		-5
14	532	60.5	55	59.5	55.5		55.5		-5
14	533	56	55	58	52.5		52.5		-3.5
15	230	54.5	55	56.5	53		53		-1.5
15	231	53.5	55	55.5	52		52		-1.5
15	232	54	55	56	52.5		52.5		-1.5
15	233	60	55	59.5	57.5		56		-4
15	234	64.5	55	59.5	60.5	Y	59.5		-5
15	235	69.5	55	59.5	65	Y	65	Y	-4.5
15	236	63	55	59.5	61.5	Y	56		-7
15	237	62.5	55	59.5	61.5	Y	62	Y	-0.5
15	238	61	55	59.5	62.5	Y	63.5	Y	2.5
15	239	60.5	55	59.5	62.5	Y	62.5	Y	2
15	240	63	55	59.5	65	Y	65.5	Y	2.5
15	241	64.5	55	59.5	63	Y	59		-5.5
15	242	62	55	59.5	60.5	Y	57.5		-4.5
15	243	60	55	59.5	58		55.5		-4.5
15	244	58.5	55	59.5	56.5		54.5		-4
15	245	57	55	59	55.5		54		-3
15	246	57	55	59	55		54		-3
15	247	56	55	58	54.5		53		-3
15	248	56	55	58	54.5		53.5		-2.5
15	249	55	55	57	54		53.5		-1.5
15	250	55.5	55	57.5	54		53.5		-2
15	251	55.5	55	57.5	54.5		54		-1.5
15	252	56	55	58	55		54		-2
15	253	56.5	55	58.5	56		55		-1.5
15	254	58.5	55	59.5	57		57		-1.5
15	255	57	55	59	56		56		-1
15	256	56.5	55	58.5	55.5		55		-1.5
15	257	56.5	55	58.5	55		54.5		-2
15	258	56	55	58	54.5		54		-2

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
15	259	55	55	57	53.5		53		-2
15	678	55	55	57	53		53.5		-1.5
15	679	55	55	57	53		53		-2
15	680	54.5	55	56.5	52.5		52.5		-2
15	681	54	55	56	52		52.5		-1.5
15	682	54.5	55	56.5	52.5		52.5		-2
15	707	58.5	55	59.5	56.5		54		-4.5
15	708	57.5	55	59.5	55.5		54		-3.5
15	709	57	55	59	55.5		53.5		-3.5
15	710	56.5	55	58.5	54.5		53.5		-3
15	711	56	55	58	54.5		53.5		-2.5
15	712	56	55	58	54		53		-3
16	260	57.5	55	59.5	56.5		56.5		-1
16	261	57	55	59	56.5		56.5		-0.5
16	262	56.5	55	58.5	56		56		-0.5
16	263	55	55	57	54.5		54.5		-0.5
16	264	54.5	55	56.5	54		54		-0.5
16	265	54	55	56	53.5		53.5		-0.5
16	266	54	55	56	53		53		-1
16	267	60	55	59.5	60.5	Y	60.5	Y	0.5
16	268	58.5	55	59.5	59		59		0.5
16	269	58	55	59.5	58		58		0
16	270	57.5	55	59.5	57		57		-0.5
16	271	56	55	58	55.5		55.5		-0.5
16	272	55.5	55	57.5	55		55		-0.5
16	273	55.5	55	57.5	55		55		-0.5
16	274	55	55	57	54.5		54.5		-0.5
16	650	55.5	55	57.5	55.5		55.5		0
16	651	55.5	55	57.5	55		55		-0.5
16	652	57.5	55	59.5	57		57		-0.5
16	653	55	55	57	54.5		54.5		-0.5
16	654	59.5	55	59.5	58.5		58.5		-1
17	275	61.5	55	59.5	56.5		56.5		-5
17	276	64	55	59.5	58.5		58.5		-5.5

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
17	277	52.5	55	N/A	50		50		-2.5
17	647	58	55	59.5	56.5		56.5		-1.5
18	278	53	55	N/A	50.5		49.5		-3.5
18	279	52.5	55	N/A	50.5		49.5		-3
18	280	52	55	N/A	49.5		49		-3
18	281	51.5	55	N/A	49.5		49		-2.5
18	282	51.5	55	N/A	49		49		-2.5
18	283	63.5	55	59.5	61	Y	61	Y	-2.5
18	284	61.5	55	59.5	59		59		-2.5
18	285	60	55	59.5	57.5		57.5		-2.5
18	286	57.5	55	59.5	54.5		54.5		-3
18	287	55.5	55	56	53		53		-2.5
18	288	53.5	55	55.5	51		51		-2.5
18	289	52	55	N/A	50		50		-2
18	648	52.5	55	N/A	50.5		50.5		-2
19	298	53.5	55	55.5	51		51		-2.5
19	299	53.5	55	55.5	51		51		-2.5
19	300	53.5	55	55.5	51		51		-2.5
19	301	56	55	58	52.5		52.5		-3.5
19	302	55.5	55	57.5	52		52		-3.5
19	303	55	55	57	51.5		51.5		-3.5
19	304	54.5	55	56.5	51.5		51.5		-3
19	305	54.5	55	56.5	51.5		51.5		-3
19	306	54	55	56	51.5		51.5		-2.5
20	290	61	55	59.5	58.5		58.5		-2.5
20	291	62	55	59.5	59		59		-3
20	292	61.5	55	59.5	60.5	Y	60.5	Y	-1
20	293	61	55	59.5	59		59		-2
20	294	60	55	59.5	58.5		58		-2
20	295	59	55	59.5	57		57		-2
20	296	55.5	55	57.5	54		54		-1.5
20	297	55.5	55	57.5	53.5		53.5		-2
20	307	57	55	59	57		57		0
20	308	57.5	55	59.5	57		57		-0.5

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
20	309	58	55	59.5	57		57		-1
20	310	59.5	55	59.5	58		58		-1.5
20	311	58	55	59.5	56.5		56.5		-1.5
20	312	57.5	55	59.5	56.5		57		-0.5
20	313	56.5	55	58.5	56.5		56.5		0
20	314	55	55	57	56.5		56.5		1.5
20	315	58	55	59.5	55.5		55.5		-2.5
20	316	56.5	55	58.5	54		54		-2.5
20	317	53.5	55	55.5	51.5		51.5		-2
20	318	54.5	55	56.5	51		51		-3.5
20	319	58	55	59.5	54.5		54.5		-3.5
20	320	61.5	55	59.5	60.5	Y	60.5	Y	-1
20	321	60.5	55	59.5	59		59		-1.5
20	322	61	55	59.5	59.5		59.5		-1.5
20	323	60.5	55	59.5	59.5		59.5		-1
20	324	61	55	59.5	60	Y	60	Y	-1
20	325	61	55	59.5	60	Y	60	Y	-1
20	326	61	55	59.5	60.5	Y	60.5	Y	-0.5
20	327	58	55	59.5	56.5		56.5		-1.5
20	328	54.5	55	56.5	54.5		54.5		0
20	329	54.5	55	56.5	54.5		54.5		0
20	330	54.5	55	56.5	54		54		-0.5
20	640	55	55	57	54		54		-1
20	641	51.5	55	N/A	52.5		52.5		1
20	642	51.5	55	N/A	52		52		0.5
20	643	50.5	55	N/A	51.5		51.5		1
20	644	49	50	N/A	49.5		49.5		0.5
21	331	58.5	55	59.5	59		53		-5.5
21	332	62.5	55	59.5	64	Y	61.5	Y	-1
21	333	61.5	55	59.5	61	Y	60.5	Treatments already in place	-1
21	334	58	55	59.5	55		55.5		-2.5
21	335	63.5	55	59.5	59		57.5		-6
21	336	65.5	55	59.5	63.5	Y	61.5	Y	-4

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	No.	2011 $L_{Aeq,9hr}$ (dBA)	ECRTN Base Criterion (dBA)	Allowance Where base criterion already exceeded (dBA)	Without Barriers	Mitigation Required Under ENMM?	With Proposed Barriers in Place	Architectural Treatment Required?	Change from 2011 to 2021 with Proposed Barriers (dBA)
21	337	64	55	59.5	62.5	Y	61	Y	-3
21	338	66.5	55	59.5	63	Y	59		-7.5
21	339	67	55	59.5	63	Y	58.5		-8.5
21	340	61	55	59.5	53		52		-9
21	341	60.5	55	59.5	53.5		52.5		-8
21	342	60	55	59.5	55		53.5		-6.5
21	343	59.5	55	59.5	55.5		53.5		-6
21	344	58	55	59.5	55		53		-5
21	345	57.5	55	59.5	55		53		-4.5
21	346	57	55	59	55.5		52.5		-4.5
21	347	55.5	55	57.5	54.5		51.5		-4
21	348	55	55	57	54.5		51		-4
21	349	54.5	55	56.5	54.5		51		-3.5
21	350	55	55	57	54.5		51		-4
21	351	57	55	59	56		53		-4
21	352	57.5	55	59.5	56.5		53		-4.5
21	353	61	55	59.5	60	Y	56		-5
21	354	56	55	58	54		53.5		-2.5
21	355	55	55	57	53.5		52		-3
21	356	57.5	55	59.5	53.5		52		-5.5
21	357	62	55	59.5	56.5		54		-8
21	358	59.5	55	59.5	56.5		53.5		-6
21	359	59.5	55	59.5	57		53.5		-6
21	360	57.5	55	59.5	56.5		53		-4.5
21	361	57.5	55	59.5	56.5		53		-4.5
21	362	61	55	59.5	60.5	Y	57		-4
21	363	56.5	55	58.5	56.5		53		-3.5
21	364	54.5	55	56.5	54.5		52		-2.5
21	365	56.5	55	58.5	58.5		56		-0.5
21	366	55.5	55	57.5	58.5	Y	56.5		1
21	367	55	55	57	58	Y	56		1
21	368	54	55	56	56.5	Y	55		1
21	369	53.5	55	55.5	55.5		54		0.5
21	370	57	55	59	60	Y	58.5		1.5
21	371	57	55	59	59		56.5		-0.5

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
21	372	55.5	55	57.5	55		53		-2.5
21	373	59	55	59.5	59		56		-3
21	374	54	55	56	54.5		52		-2
21	375	58.5	55	59.5	57.5		54.5		-4
21	376	59.5	55	59.5	57		54		-5.5
21	377	58	55	59.5	54		52.5		-5.5
21	378	60	55	59.5	56		54		-6
21	379	60	55	59.5	57.5		54.5		-5.5
21	380	59	55	59.5	54.5		53		-6
21	381	60	55	59.5	56		54		-6
21	382	57.5	55	59.5	53		52		-5.5
21	383	58.5	55	59.5	54		53		-5.5
21	384	58.5	55	59.5	54		53		-5.5
21	385	61.5	55	59.5	58.5		55.5		-6
21	386	59.5	55	59.5	56		54		-5.5
21	387	60.5	55	59.5	59		56		-4.5
21	388	61	55	59.5	59		56		-5
21	389	59.5	55	59.5	59		56.5		-3
21	390	56	55	58	57		55.5		-0.5
21	391	50.5	55	N/A	52		51		0.5
21	392	53	55	N/A	54.5		53.5		0.5
21	393	56.5	55	58.5	57		56		-0.5
21	394	52.5	55	N/A	53		53		0.5
21	395	55	55	57	56		55.5		0.5
21	396	56	55	58	56.5		56		0
21	397	56	55	58	56		56		0
21	398	53.5	55	55.5	54		54		0.5
21	399	60	55	59.5	60	Y	59.5		-0.5
21	400	60	55	59.5	59.5		59.5		-0.5
21	401	59	55	59.5	58.5		58.5		-0.5
21	402	59	55	59.5	57		57		-2
21	403	59.5	55	59.5	57.5		57.5		-2
21	404	58.5	55	59.5	54.5		54.5		-4
21	405	56.5	55	58.5	53		53		-3.5
21	406	55	55	57	52.5		52.5		-2.5

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
21	407	53.5	55	55.5	51		51		-2.5
21	408	53.5	55	55.5	52		52		-1.5
21	409	53	55	N/A	52		52		-1
21	410	52	55	N/A	51.5		51.5		-0.5
21	411	51.5	55	N/A	51		51		-0.5
21	412	51	55	N/A	50.5		50.5		-0.5
21	600	57	55	59	58.5		53.5		-3.5
21	601	58.5	55	59.5	61	Y	55		-3.5
21	602	59	55	59.5	61	Y	54.5		-4.5
21	603	59	55	59.5	61	Y	54		-5
21	604	59	55	59.5	61	Y	53.5		-5.5
21	605	59	55	59.5	60.5	Y	53.5		-5.5
21	606	59.5	55	59.5	61	Y	54		-5.5
21	607	59	55	59.5	60.5	Y	53.5		-5.5
21	608	57	55	59	58.5		51.5		-5.5
21	609	60.5	55	59.5	62	Y	54		-6.5
21	610	60.5	55	59.5	62	Y	54.5		-6
21	611	60	55	59.5	60.5	Y	55.5		-4.5
21	612	60.5	55	59.5	61	Y	56		-4.5
21	613	58.5	55	59.5	58.5		54.5		-4
21	614	57	55	59	56.5		53		-4
21	618	59.5	55	59.5	60	Y	57		-2.5
21	619	60.5	55	59.5	61.5	Y	59		-1.5
21	620	59.5	55	59.5	59.5		57.5		-2
21	621	59	55	59.5	58.5		57		-2
21	622	59.5	55	59.5	59		58		-1.5
21	623	59.5	55	59.5	59		59.5		0
21	624	61.5	55	59.5	59		59.5		-2
21	625	57.5	55	59.5	56		56		-1.5
21	626	54	55	56	50.5		51		-3
21	627	54	55	56	50		50		-4
21	628	54.5	55	56.5	50		50		-4.5
21	629	54	55	56	49		49.5		-4.5
21	630	53	55	N/A	48.5		48.5		-4.5
21	631	52.5	55	N/A	48		48		-4.5

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
21	632	52	55	N/A	47.5		48		-4
21	633	60	55	59.5	59.5		56.5		-3.5
21	634	56.5	55	58.5	57		55		-1.5
21	635	65	55	59.5	62.5	Y	60.5	Y	-4.5
21	636	60.5	55	59.5	54.5		53		-7.5
21	637	61	55	59.5	54		53		-8
22	534	62	55	59.5	54.5		54		-8
22	535	58	55	59.5	52.5		52.5		-5.5
22	536	55.5	55	57.5	50.5		50.5		-5
22	537	60.5	55	59.5	52.5		52.5		-8
22	538	56	55	58	49		49		-7
22	539	62.5	55	59.5	53.5		53.5		-9
22	540	60	55	59.5	51		51		-9
22	541	56	55	58	47		47		-9
22	542	63	55	59.5	53.5		53.5		-9.5
22	543	61	55	59.5	52.5		52.5		-8.5
22	544	61.5	55	59.5	53.5		53.5		-8
22	545	60.5	55	59.5	56		56		-4.5
22	546	58	55	59.5	56.5		56.5		-1.5
22	547	59.5	55	59.5	54.5		54.5		-5
22	764	61	55	59.5	51.5		51.5		-9.5
22	765	60	55	59.5	50.5		50.5		-9.5
22	766	55.5	55	57.5	46.5		46.5		-9
22	767	62.5	55	59.5	53		53		-9.5
22	768	58.5	55	59.5	52		52		-6.5
22	769	64.5	55	59.5	56		56		-8.5
22	770	61.5	55	59.5	54		54		-7.5
23	548	57.5	55	59.5	51		51		-6.5
23	549	67	55	59.5	59.5		59.5		-7.5
23	550	66.5	55	59.5	57.5		57.5		-9
23	551	67.5	55	59.5	60	Y	60	To be determined within 12 months of project opening	-7.5
23	552	62.5	55	59.5	52.5		53		-9.5

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
23	553	58	55	59.5	54		54		-4
23	554	59.5	55	59.5	55.5		55.5		-4
23	555	58.5	55	59.5	54.5		54.5		-4
23	556	59	55	59.5	55.5		55.5		-3.5
23	557	57.5	55	59.5	54		54		-3.5
23	558	57.5	55	59.5	53		53		-4.5
23	559	54.5	55	56.5	49		49		-5.5
23	560	64.5	55	59.5	62	Y	62	To be determined within 12 months of project opening	-2.5
23	561	65	55	59.5	62	Y	62	To be determined within 12 months of project opening	-3
23	562	61.5	55	59.5	58.5		58.5		-3
23	563	60	55	59.5	57		57		-3
23	564	62	55	59.5	57.5		57.5		-4.5
23	565	59.5	55	59.5	56.5		56.5		-3
23	566	65	55	59.5	63.5	Y	63.5	To be determined within 12 months of project opening	-1.5
23	567	59	55	59.5	50.5		50.5		-8.5
23	568	58	55	59.5	50		50		-8
23	569	62.5	55	59.5	56		56		-6.5
23	723	65.5	55	59.5	58.5		58.5		-7
23	724	66	55	59.5	58.5		58.5		-7.5
23	725	63	55	59.5	56.5		56.5		-6.5
23	726	61.5	55	59.5	54.5		54.5		-7
23	727	61.5	55	59.5	54.5		54.5		-7
23	728	61	55	59.5	54.5		54.5		-6.5
23	729	60	55	59.5	53		53		-7
23	730	60	55	59.5	53		53		-7
23	731	59	55	59.5	52		52		-7
23	732	58.5	55	59.5	51.5		51.5		-7

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
23	733	58	55	59.5	51.5		51.5		-6.5
23	734	58	55	59.5	51		51		-7
23	735	57	55	59	50.5		50.5		-6.5
23	736	64.5	55	59.5	59.5		59.5		-5
23	737	63	55	59.5	52.5		52.5		-10.5
23	738	63	55	59.5	53		53		-10
23	739	63.5	55	59.5	54		54		-9.5
23	740	66	55	59.5	59		59		-7
23	741	58	55	59.5	52		52		-6
23	742	58	55	59.5	53.5		53.5		-4.5
23	743	58	55	59.5	53.5		53.5		-4.5
23	744	57.5	55	59.5	53		53		-4.5
23	745	58.5	55	59.5	54.5		54.5		-4
23	746	58.5	55	59.5	54.5		54.5		-4
23	747	58	55	59.5	54.5		54.5		-3.5
23	748	58	55	59.5	54.5		54.5		-3.5
23	749	58.5	55	59.5	55		55		-3.5
23	750	58	55	59.5	54.5		54.5		-3.5
23	751	58	55	59.5	54.5		54.5		-3.5
23	752	58	55	59.5	53		53		-5
23	754	62.5	55	59.5	59.5		59.5		-3
23	755	61	55	59.5	58		58		-3
23	756	61.5	55	59.5	58.5		58.5		-3
23	757	65	55	59.5	62	Y	62	To be determined within 12 months of project opening	-3
23	758	62.5	55	59.5	60	Y	60	To be determined within 12 months of project opening	-2.5
23	759	59.5	55	59.5	56		56.5		-3
23	760	60.5	55	59.5	54		54		-6.5
23	761	60	55	59.5	53.5		53.5		-6.5
23	762	60.5	55	59.5	53.5		53.5		-7

					Design Noise 2021 $L_{Aeq,9hr}$ (dBA)				
NCA	**No.**	**2011 $L_{Aeq,9hr}$ (dBA)**	**ECRTN Base Criterion (dBA)**	**Allowance Where base criterion already exceeded (dBA)**	**Without Barriers**	**Mitigation Required Under ENMM?**	**With Proposed Barriers in Place**	**Architectural Treatment Required?**	**Change from 2011 to 2021 with Proposed Barriers (dBA)**
23	763	62	55	59.5	54.5		54.5		-7.5
23	777	63	55	59.5	59		59		-4
23	778	60.5	55	59.5	56.5		56.5		-4
23	779	59	55	59.5	54.5		54.5		-4.5