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Environmental Noise Assessment

Marayong Zone Substation
2 Raymond Street, Marayong, NSW

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6260-1.1R

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1.0 CONSULTING BRIEF

Day Design Pty Ltd was engaged by Endeavour Energy Pty Ltd to assess the environmental noise impact of their existing Marayong Zone Substation and proposed options for refurbishment . This commission involves the following:

Scope of Work:

- Inspect the site and environs
- Measure background noise levels at critical locations and times
- Establish acceptable noise level criterion
- Quantify noise emissions from the Zone Substation
- Calculate the level of noise emission, taking into account building envelope transmission loss, screen walls and distance attenuation
- Prepare a site plan identifying the development and nearby noise sensitive locations
- Provide reasonable and feasible recommendations for noise control (if necessary)
- Prepare an Environmental Noise Assessment Report.

2.0 PROJECT DESCRIPTION

Endeavour Energy supplies electricity to the greater part of Sydney's west, the Blue Mountains, The Illawarra and the Southern Highlands regions. To sustain this service they have a number of Zone Substations to convert high voltage electricity to standard 240 volt supply. The transformers used for the conversion typically generate a low frequency 'hum' at 100 Hz.

The Marayong Zone Substation has three existing 33 / 11 kV, 25 MVA transformers and one capacitor bank.

The closest residences to the Zone Substation are across Raymond Street to the north, across Frederick Street to the south and across Charles Street to the west. Refer to Figure 1 for a map of the area with these residences marked and Table 1 below.

Table 1 Noise Sensitive Receptors

Receptor and Type	Address	Direction from site
B – Residence	18 Charles Street	West
C – Residence	17 Charles Street	North
D – Residence	9 Frederick Street	East
E – Residence	2 Frederick Street	South
F – Residences	15 Charles Street	South

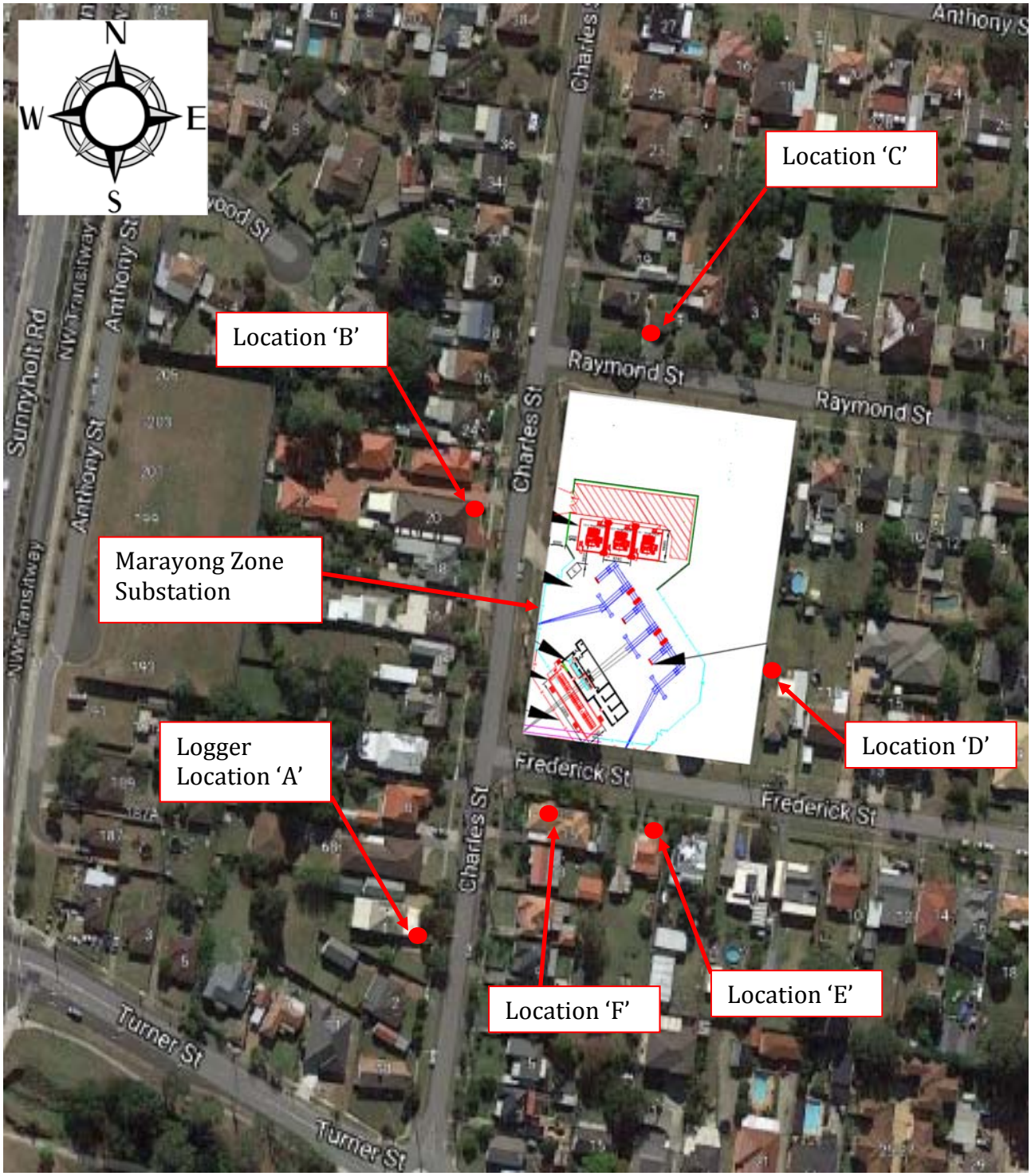


Figure 1 – Location Plan, Marayong Zone Substation

3.0 NOISE SURVEY INSTRUMENTATION

Noise level measurements and analysis were made with instrumentation as follows in Table 2 below:

Table 2 Noise Instrumentation

Description	Model No.	Serial No.
Modular Precision Sound Analyser	B&K 2250	2690243
Condenser Microphone 0.5" diameter	B&K 4189	3022960
Acoustical Calibrator	B&K 4231	1095415
Infobyte Noise Logger	iM4	116
Condenser Microphone 0.5" diameter	MK 250	116

An environmental noise logger is used to continuously monitor ambient noise levels and provide information on the statistical distribution of noise during an extended period of time. The Infobyte Noise Monitor iM4 #116 is a Type 2 precision environmental noise monitor meeting all the applicable requirements of AS1259 for an integrating-averaging sound level meter.

The B&K 2250 Sound Analyser is a real-time precision integrating sound level meter with octave and third octave filters, that sample noise at a rate of 10 samples per second and provides L_{eq}, L_{10} and L_{90} noise levels using both Fast and Slow response and L_{peak} noise levels on Impulse response time settings. The meter is frequency weighted to provide dBA, dBC or Linear sound pressure level readings as required.

All instrument systems had been laboratory calibrated using instrumentation traceable to Australian National Standards and certified within the last two years thus conforming to Australian Standards. The measurement system was also field calibrated prior to and after noise surveys. Calibration drift was found to be less than 1 dB during unattended measurements. No adjustments for instrument drift during the measurement period were warranted.

4.0 MEASURED AMBIENT NOISE LEVELS

4.1 Background Noise Level

In order to assess the severity of a possible environmental noise problem in a residential area it is necessary to measure the ambient background noise level at the times and locations of worst possible annoyance. The lower the background noise level, the more perceptible the intrusive noise becomes and the more potentially annoying.

The ambient L_{90} background noise level is a statistical measure of the sound pressure level that is exceeded for 90% of the measuring period (typically 15 minutes).

The Rating Background Level (RBL) is defined by the NSW EPA as the median value of the (lower) tenth percentile of L_{90} ambient background noise levels for day, evening or night periods, measured over a number of days during the proposed days and times of operation.

Ambient L_{90} background noise levels were measured at Location "A" shown on the Location Plan over seven days from Thursday 15 June 2017 to Wednesday 21 June 2017. The measured levels are presented in the attached Appendix A and also in Table 3 below.

Table 3 Rating Background Level

Noise Measurement Location	Time Period	Rating Background Level	Ambient Noise Level
Location 'A' – 4 Charles Street, Blacktown	Day (7 am to 6 pm)	**42 dBA**	**54 dBA**
	Evening (6 pm to 10 pm)	**42 dBA**	**52 dBA**
	Night (10 pm to 7 am)	**37 dBA**	**49 dBA**

Meteorological conditions during the testing typically consisted of clear skies with temperatures of 9 to 19˚C. Atmospheric conditions were ideal for noise monitoring. Noise measurements were therefore considered reliable and typical for the receptor area.

5.0 ACCEPTABLE NOISE LEVELS

5.1 NSW Industrial Noise Policy

The Environment Protection Authority (EPA) published their NSW Industrial Noise Policy in January 2000. The Industrial Noise Policy is specifically aimed at assessing noise from industrial noise sources scheduled under the Protection of the Environment Operations Act 1997 (POEO, 1997).

The Marayong Zone Substation is not a 'scheduled premises' under the Protection of the Environment Operations Act 1997 as Endeavour Energy Pty Ltd is not required to hold a license under that Act for operations at the site.

The appropriate regulatory authority (EPA) may, by notice in writing given to such a person, prohibit the person from causing, permitting or allowing:

(a) any specified activity to be carried on at the premises, or

(b) any specified article to be used or operated at the premises,

or both, in such a manner as to cause the emission from the premises, at all times or on specified days, or between specified times on all days or on specified days, of noise that, when measured at any specified point (whether within or outside the premises,) is in excess of a specified level.

It is an offence to contravene a noise control notice. Prior to being issued with a noise control notice, no offence has been committed.

While the Industrial Noise Policy is not strictly applicable to this site, as the site is not scheduled, in the absence of other relevant standards the limits set out in the NSW Industrial Noise Policy will be used as a guide in determining whether the level of noise is considered intrusive or not.

5.2 Residential Receptor Intrusiveness Criteria

The EPA states in Section 2.1 of its NSW Industrial Noise Policy (January 2000) that the L_{eq} level of noise intrusion from broad-band industrial noise sources may be up to 5 dB above the L_{90} background noise level at the receptor without being considered intrusive (EPA, 2000, Section 2.1).

The Rating Background Level at Blacktown was 42 dBA during the day, 42 dBA in the evening and 37 dBA at night. Therefore the acceptable L_{eq} noise intrusiveness criteria for **broadband noise** in this area is:

- (42 + 5 =) 47 dBA during the day,
- (42 + 5 =) 47 dBA in the evening and
- (37 + 5 =) 42 dBA at night.

5.3 Amenity Criteria

Depending on the type of area in which the noise is being made, there is a certain reasonable expectancy for noise amenity. The NSW Industrial Noise Policy provides a schedule of recommended L_{eq} industrial noise levels that under normal circumstances should not be exceeded. If successive developments occur near a residential area, each one allowing a criterion of background noise level plus 5 dB, the ambient noise level will gradually creep higher.

The recommended L_{eq} noise levels in Table 4 below are taken from Section 2.2 of the INP.

Table 4 Amenity Criteria

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{eq} Noise Level, dBA	
			Acceptable	Recommended Maximum
Residential	Suburban	Day	55	60
		Evening	45	50
		Night	40	45

Compliance with the amenity criteria will limit ambient noise creep. Wherever the existing L_{eq} noise level from industrial noise sources approaches or exceeds the amenity criteria at a critical receptor location, the intrusive L_{eq} noise from the noise source in question must be reduced to a level that may be as much as 10 dB below the existing L_{eq} industrial noise level.

The existing L_{eq} noise level at Blacktown was 54 dBA during the day, 52 dBA in the evening and 49 dBA at night, dominated by road traffic noise on Sunnyholt Road. Therefore the acceptable L_{eq} amenity criteria for in this area is:

- 55 dBA during the day;
- 45 dBA in the evening; and
- 40 dBA at night.

5.4 Modifying Factors

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. Correction factors are to be applied to the noise from the source measured or predicted at the receiver before comparison with the criteria. AC500-9, in the Appendices is extracted from Table 4.1 of the INP.

5.5 Project Specific Noise Criteria

When all the above factors are considered, we find that the most stringent noise criterion is:

- **47 dBA for broadband noise sources** during the day,
- **45 dBA for broadband noise sources** in the evening, and
- **40 dBA for broadband noise sources** at night.

These criteria apply at the most-affected point on or within the residential property boundary – or, if that is more than 30 metres from the residence, at the most-affected point within 30 metres of the residence. For upper floors, the noise is assessed outside the nearest window.

6.0 ZONE SUBSTATION NOISE EMISSION

The main sources of noise from the Marayong Zone Substation are the transformers that operate continually throughout the day and night. The noise level does not change appreciably from the day to the night and therefore the predicted noise level at night will be the worst-case scenario.

6.1 Measured Sound Power Levels

Sound power levels of the three existing transformers were previously taken on Thursday 10th November 2005 and presented in a previous Report 3462-R1 dated 13th December 2005. More recent sound power levels were measured during a site visit on 15 June 2017.

A schedule of the sound power levels of the existing transformers in 2005 and in 2017 is given in Table 5 below.

Table 5 Transformer L_{eq} Sound Power Levels

Description	Sound Power Levels (dB) at Third Octave Band Centre Frequencies (Hz)							
	dBA	50 63 80	100 125 160	200 250 315	400 500 630	800 1k 1k25	1k6 2k 2k5	3k15 4k 5k
November 2005								
No 1 Transformer, 33/11kV, 25 MVA (existing)	**75**	64 66 66	76 76 62	**73** 64 76	71 64 66	69 64 60	59 57 54	54 55 53
No 2 Transformer 33/11kV, 25 MVA (existing)	**75**	65 67 67	73 70 62	**75** 63 73	74 68 70	68 64 57	56 54 52	48 47 44
No 3 Transformer 33/11kV, 25 MVA (existing)	**76**	65 65 65	75 75 62	**76** 66 77	72 72 68	67 64 60	60 59 56	57 56 53
No 1 Capacitor Bank 12kV, 5 MVAr (existing)	**69**	69 72 71	73 67 63	62 59 65	64 62 60	60 60 59	57 54 53	49 47 46
Typical Cooling Fan	**70***	65	60	64	65	66	63	61
June 2017								
Transformer No.1 33/11kV, 25 MVA (Existing)	**85**	72 72 72	85 76 67	**86** 75 **87**	77 74 72	**79** 70 63	60 58 54	54 49 49
Transformer No.2 33/11kV, 25 MVA (Existing)	**82**	72 71 70	76 68 68	**81** 72 84	79 74 71	70 69 60	63 57 56	51 53 56
Transformer No.3 33/11kV, 25 MVA (Existing)	**85**	71 70 70	77 69 80	84 76 **89**	77 77 75	75 68 61	58 56 54	48 47 47

*Cooling fan noise level data have been taken from a typical fan manufacturer's data.

It is clear from Table 5 that the transformer noise levels have increased by up to 10 dB in the last 12 years.

6.2 Proposed Sound Power Levels

As part of the Zone Substation refurbishment, the existing transformers are likely to be replaced by new transformers with a lower sound power level. Various options look at either replacing Transformer No. 3 only or all three transformers.

The possible new transformers have been identified as 33/11kV, 25 MVA transformers with a sound power level of 62 dBA at no load. This equates to sound power level of 67 dBA at 66% capacity. Day Design has previously measured such a transformer, with the measured sound power levels in octave bands shown in Table 6 below.

Table 6 Proposed Transformer L_{eq} Sound Power Levels

Description	Sound Power Levels (dB) at Third Octave Band Centre Frequencies (Hz)							
	dBA	**50 63 80**	**100 125 160**	**200 250 315**	**400 500 630**	**800 1k 1k25**	**1k6 2k 2k5**	**3k15 4k 5k**
New Transformer, 33/11kV, 25 MVA (proposed, 62 dBA at no load)	**67**	65 66 67	76 61 59	**76** 61 56	58 53 52	51 51 49	47 44 43	43 44 42

Knowing the sound power level of a noise source (see above Tables 5 and 6), the sound pressure level (as measured with a sound level meter) can be calculated at a remote location using suitable formulae to account for distance losses, sound barriers, etc.

6.3 Calculated Noise Emission (Option 1A)

Endeavour Energy are considering a range of options for the renewal of Marayong Zone Substation. These are attached as Appendix B.

Option 1A retains the existing Transformer No. 1 and Transformer No. 2, with Transformer No. 3 to be replaced by a new low noise transformer at a new location.

The calculated noise levels at the various receptors during typical peak loads with 3 transformers operating at night is shown below in Table 7.

Table 7 Calculated L_{eq} Sound Pressure Levels (Option 1A)

Residential Receptor Location	Calculated L_{eq} Noise Level	Tonal	Modified L_{eq} Noise Level	Acceptable L_{eq} Noise Level	Compliance
Location 'B' 18 Charles Street, Marayong	45 dBA	Yes	50 dBA	40 dBA	**No (+ 10 dB)**
Location 'C' 17 Charles Street, Marayong	40 dBA	No	40 dBA	40 dBA	**Yes**
Location 'D' 9 Frederick Street, Marayong	37 dBA	No	37 dBA	40 dBA	**Yes**
Location 'E' 2 Frederick Street, Marayong	41 dBA	No	41 dBA	40 dBA	**Yes***
Location 'F' 15 Charles Street, Marayong	37 dBA	No	37 dBA	40 dBA	**Yes**

*An exceedance of up to 2 dB is allowed by the NSW Industrial Noise Policy before a development is considered non-compliant.

The noise levels from the Marayong Zone Substation calculated at the nearby receptor locations will exceed the acceptable noise level at Location 'B' as detailed in Section 5.5 of this report.

6.4 Calculated Noise Emission (Option 1B)

Options 1B proposes replacing all transformers with new low noise transformers at a new location. No additional buildings are proposed and the existing buildings are retained.

The calculated noise levels at the various receptors during typical peak loads with 3 transformers operating at night is shown below in Table 8.

Table 8 Calculated L_{eq} Sound Pressure Levels (Option 1B)

Residential Receptor Location	Calculated L_{eq} Noise Level	Tonal	Acceptable L_{eq} Noise Level	Compliance
Location 'B' 18 Charles Street, Marayong	36 dBA	No	40 dBA	**Yes**
Location 'C' 17 Charles Street, Marayong	36 dBA	No	40 dBA	**Yes**
Location 'D' 9 Frederick Street, Marayong	31 dBA	No	40 dBA	**Yes**
Location 'E' 2 Frederick Street, Marayong	28 dBA	No	40 dBA	**Yes**
Location 'F' 15 Charles Street, Marayong	24 dBA	No	40 dBA	**Yes**

The noise levels from the Marayong Zone Substation calculated at the nearby receptor locations, when at typical peak loads, with new low noise transformers will meet the acceptable noise level criteria as detailed in Section 5.5 of this report and require no additional noise controls.

6.5 Calculated Noise Emission (Option 2A)

Option 2A retains the existing Transformer No. 1 and Transformer No. 2, with Transformer No. 3 to be replaced by a new low noise transformer at a new location with construction of a new 11kV switchroom.

The calculated noise levels at the various receptors during typical peak loads with 3 transformers operating at night is shown below in Table 9.

Table 9 Calculated L_{eq} Sound Pressure Levels (Option 2A)

Residential Receptor Location	Calculated L_{eq} Noise Level	Tonal	Modified L_{eq} Noise Level	Acceptable L_{eq} Noise Level	Compliance
Location 'B' 18 Charles Street, Marayong	45 dBA	Yes	50 dBA	40 dBA	**No (+ 10 dB)**
Location 'C' 17 Charles Street, Marayong	34 dBA	No	34 dBA	40 dBA	**Yes**
Location 'D' 9 Frederick Street, Marayong	37 dBA	No	37 dBA	40 dBA	**Yes**
Location 'E' 2 Frederick Street, Marayong	41 dBA	No	41 dBA	40 dBA	**Yes***
Location 'F' 15 Charles Street, Marayong	37 dBA	No	37 dBA	40 dBA	**Yes**

*An exceedance of up to 2 dB is allowed by the NSW Industrial Noise Policy before a development is considered non-compliant.

The noise levels from the Marayong Zone Substation calculated at the nearby receptor locations will exceed the acceptable noise level at Location 'B' as detailed in Section 5.5 of this report.

6.6 Calculated Noise Emission (Option 2B)

Option 2B, proposes replacing all transformers with new low noise transformer at a new location, with construction of a new 11kV switchroom.

The calculated noise levels at the various receptors during typical peak loads with 3 transformers operating at night is shown below in Table 10.

Table 10 Calculated L_{eq} Sound Pressure Levels (Option 2B)

Residential Receptor Location	Calculated L_{eq} Noise Level	Tonal	Acceptable L_{eq} Noise Level	Compliance
Location 'B' 18 Charles Street, Marayong	36 dBA	No	40 dBA	**Yes**
Location 'C' 17 Charles Street, Marayong	31 dBA	No	40 dBA	**Yes**
Location 'D' 9 Frederick Street, Marayong	31 dBA	No	40 dBA	**Yes**
Location 'E' 2 Frederick Street, Marayong	28 dBA	No	40 dBA	**Yes**
Location 'F' 15 Charles Street, Marayong	24 dBA	No	40 dBA	**Yes**

The noise levels from the Marayong Zone Substation calculated at the nearby receptor locations, when at typical peak loads, with new low noise transformers will meet the acceptable noise level criteria as detailed in Section 5.5 of this report and require no additional noise controls.

6.7 Calculated Noise Emission (Option 3A)

Option 3A retains the existing Transformer No. 1 and Transformer No. 2, with Transformer No. 3 to be replaced by a new low noise transformer at a new location and construction of a new 33/11 kV switchroom and demolition of the existing switchroom building.

The calculated noise levels at the various receptors during typical peak loads with 3 transformers operating at night is shown below in Table 11.

Table 11 Calculated L_{eq} Sound Pressure Levels (Option 3A)

Residential Receptor Location	Calculated L_{eq} Noise Level	Tonal	Modified L_{eq} Noise Level	Acceptable L_{eq} Noise Level	Compliance
Location 'B' 18 Charles Street, Marayong	45 dBA	Yes	50 dBA	40 dBA	**No (+ 10 dB)**
Location 'C' 17 Charles Street, Marayong	34 dBA	No	34 dBA	40 dBA	**Yes**
Location 'D' 9 Frederick Street, Marayong	37 dBA	No	37 dBA	40 dBA	**Yes**
Location 'E' 2 Frederick Street, Marayong	41 dBA	No	41 dBA	40 dBA	**Yes***
Location 'F' 15 Charles Street, Marayong	42 dBA	No	42 dBA	40 dBA	**Yes***

*An exceedance of up to 2 dB is allowed by the NSW Industrial Noise Policy before a development is considered non-compliant.

The noise levels from the Marayong Zone Substation calculated at the nearby receptor locations will exceed the acceptable noise level at Location 'B' as detailed in Section 5.5 of this report.

6.8 Calculated Noise Emission (Option 3B)

Option 3B proposes replacing all transformers with new low noise transformers at a new location with construction of a new 33 / 11 kV switchroom and demolition of the existing switchroom building.

The calculated noise levels at the various receptors during typical peak loads with 3 transformers operating at night is shown below in Table 12.

Table 12 Calculated L_{eq} Sound Pressure Levels (Option 3B)

Residential Receptor Location	Calculated L_{eq} Noise Level	Tonal	Acceptable L_{eq} Noise Level	Compliance
Location 'B' 18 Charles Street, Marayong	36 dBA	No	40 dBA	**Yes**
Location 'C' 17 Charles Street, Marayong	31 dBA	No	40 dBA	**Yes**
Location 'D' 9 Frederick Street, Marayong	31 dBA	No	40 dBA	**Yes**
Location 'E' 2 Frederick Street, Marayong	28 dBA	No	40 dBA	**Yes**
Location 'F' 15 Charles Street, Marayong	29 dBA	No	40 dBA	**Yes**

The noise levels from the Marayong Zone Substation calculated at the nearby receptor locations, when at typical peak loads, with new low noise transformers will meet the acceptable noise level criteria as detailed in Section 5.5 of this report and require no additional noise controls.

6.9 Calculated Noise Emission (Option 4A)

Endeavour Energy are considering a range of options for the renewal of Marayong Zone Substation. These are attached as Appendix B.

Option 4A proposes retaining the existing Transformer No. 1 and Transformer No. 2, with Transformer No. 3 to be replaced by a new low noise transformer at a new location and construction of a new control building and demolition of the existing switchroom.

The calculated noise levels at the various receptors during typical peak loads with 3 transformers operating at night is shown below in Table 13.

Table 13 Calculated L_{eq} Sound Pressure Levels (Option 4A)

Residential Receptor Location	Calculated L_{eq} Noise Level	Tonal	Modified L_{eq} Noise Level	Acceptable L_{eq} Noise Level	Compliance
Location 'B' 18 Charles Street, Marayong	45 dBA	Yes	50 dBA	40 dBA	**No (+ 10 dB)**
Location 'C' 17 Charles Street, Marayong	34 dBA	No	34 dBA	40 dBA	**Yes**
Location 'D' 9 Frederick Street, Marayong	37 dBA	No	37 dBA	40 dBA	**Yes**
Location 'E' 2 Frederick Street, Marayong	41 dBA	No	41 dBA	40 dBA	**Yes***
Location 'F' 15 Charles Street, Marayong	42 dBA	No	42 dBA	40 dBA	**Yes***

*An exceedance of up to 2 dB is allowed by the NSW Industrial Noise Policy before a development is considered non-compliant.

The noise levels from the Marayong Zone Substation calculated at the nearby receptor locations will exceed the acceptable noise level at Location 'B' as detailed in Section 5.5 of this report.

6.10 Calculated Noise Emission (Option 4B)

Endeavour Energy are considering a range of options for the renewal of Marayong Zone Substation. These are attached as Appendix B.

Option 4B proposes replacing all transformers with new low noise transformer at a new location with construction of a new control building and demolition of the existing switchroom.

The calculated noise levels at the various receptors during typical peak loads with 3 transformers operating at night is shown below in Table 14.

Table 14 Calculated L_{eq} Sound Pressure Levels (Option 4B)

Residential Receptor Location	Calculated L_{eq} Noise Level	Tonal	Acceptable L_{eq} Noise Level	Compliance
Location 'B' 18 Charles Street, Marayong	36 dBA	No	40 dBA	**Yes**
Location 'C' 17 Charles Street, Marayong	31 dBA	No	40 dBA	**Yes**
Location 'D' 9 Frederick Street, Marayong	31 dBA	No	40 dBA	**Yes**
Location 'E' 2 Frederick Street, Marayong	28 dBA	No	40 dBA	**Yes**
Location 'F' 15 Charles Street, Marayong	29 dBA	No	40 dBA	**Yes**

The noise levels from the Marayong Zone Substation calculated at the nearby receptor locations, when at typical peak loads, with new low noise transformers will meet the acceptable noise level criteria as detailed in Section 5.5 of this report and require no additional noise controls.

7.0 NOISE CONTROL RECOMMENDATIONS

The calculated level of noise emission from the Marayong Zone Substation under Option 1A, 2A, 3A and 4A are above the recommended noise limits established in Section 5.0 of this report. Therefore engineering noise control will be required. We recommend the following acoustical treatment.

7.1 Option 1 - Boundary Barrier Wall

A steel framed barrier with a sound absorptive lining should be constructed along a portion of the boundary of the Zone Substation site, as shown in Appendix C. The barrier should extend from the control building north along the perimeter fencing up to the proposed new transformer location. The barrier should be constructed to a minimum height of 3 metres above ground level.

The barrier may be constructed from 1.2 mm galvanised steel or 6 mm thick fibre cement sheets fixed to one side of 92 mm galvanised steel girts. Insulation should consist of 75 mm thick CSR Martini Polymax "Absorb HD 75" polyester insulation (www.csrmartini.com.au). The insulation should be installed between 92 mm galvanised steel girts. Perforated zincalume steel with minimum 20% open area should be screwed to the steel girts facing the transformer, to protect the insulation.

Care must be taken to ensure that there are no gaps in the sound barrier walls through which sound may penetrate. Access doors to the transformer bays will need to be acoustically designed to reduce any noise transmission through these penetrations of the transformer barrier.

7.2 Option2 - Transformer Barrier Wall

A steel framed barrier with a sound absorptive lining should be constructed around 3 sides of Transformer No. 1 and Transformer No. 2, with the open side facing north for access and ventilation. The barrier should be constructed to a minimum height of 5 metres above ground level.

The barrier may be constructed from 1.2 mm galvanised steel or 6 mm thick fibre cement sheets fixed to one side of 92 mm galvanised steel girts. Insulation should consist of 75 mm thick CSR Martini Polymax "Absorb HD 75" polyester insulation (www.csrmartini.com.au). The insulation should be installed between 92 mm galvanised steel girts. Perforated zincalume steel with minimum 20% open area should be screwed to the steel girts facing the transformer, to protect the insulation.

Care must be taken to ensure that there are no gaps in the sound barrier walls through which sound may penetrate. Access doors to the transformer bays will need to be acoustically designed to reduce any noise transmission through these penetrations of the transformer barrier.

7.3 Construction Disclaimer

Recommendations made in this report are intended to resolve acoustical problems only. We make no claim of expertise in other areas and draw your attention to the possibility that our recommendations may not meet the structural, fire, thermal or other aspects of building construction. The integrity of acoustic structures is very dependent on installation techniques. Therefore the use of contractors that are experienced in acoustic construction is encouraged.

We encourage clients to check with us before using materials or equipment that are alternative to those specified in our Acoustical Report.

7.4 Calculated Noise Levels – Option 1A, 2A, 3A and 4A

With the recommended boundary barrier above constructed, the following noise levels are calculated at the nearby residential locations.

Table 15 Calculated L_{eq} Sound Pressure Levels after Noise Controls (Option 1A, 2A, 3A and 4A)

Residential Receptor Location	Calculated L_{eq} Noise Level	Tonal	Modified L_{eq} Noise Level	Acceptable L_{eq} Noise Level	Compliance
Location 'B' 18 Charles Street, Marayong	37 dBA	No	40 dBA	40 dBA	**Yes**
Location 'C' 17 Charles Street, Marayong	40 dBA	No	40 dBA	40 dBA	**Yes**
Location 'D' 9 Frederick Street, Marayong	27 dBA	No	27 dBA	40 dBA	**Yes**
Location 'E' 2 Frederick Street, Marayong	36 dBA	No	36 dBA	40 dBA	**Yes**
Location 'F' 15 Charles Street, Marayong	36 dBA	No	36 dBA	40 dBA	**Yes**

8.0 NOISE IMPACT STATEMENT

Day Design has been engaged by Endeavour Energy Pty Ltd to assess the environmental noise impact of the Marayong Zone Substation located at 2 Raymond Street, Marayong, NSW.

Measurements and calculations show that, provided the noise control recommendations detailed in Section 7 are satisfactorily implemented, or alternatively all transformers are replaced with low noise transformers, the level of noise emitted by the Marayong Zone Substation will be able to meet the Environment Protection Authority's acceptable noise level requirements as detailed in Section 5.0 of this report.

William Wang, BE (Mechatronics), MIEAust, MAAS
Senior Acoustical Engineer
for and on behalf of Day Design Pty Ltd

AAAC MEMBERSHIP

Day Design Pty Ltd is a member company of the Association of Australian Acoustical Consultants, and the work herein reported has been performed in accordance with the terms of membership.

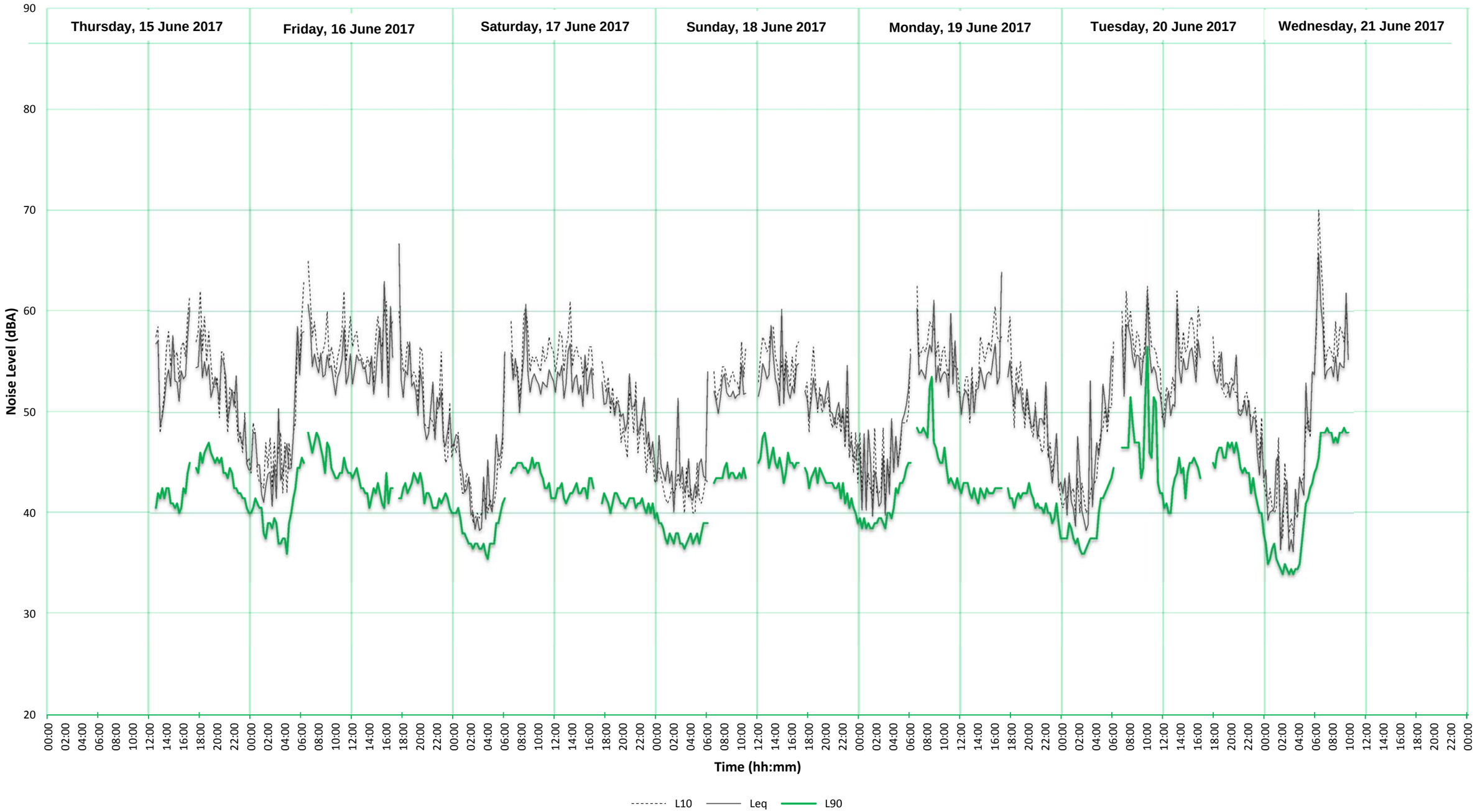
Attachments:

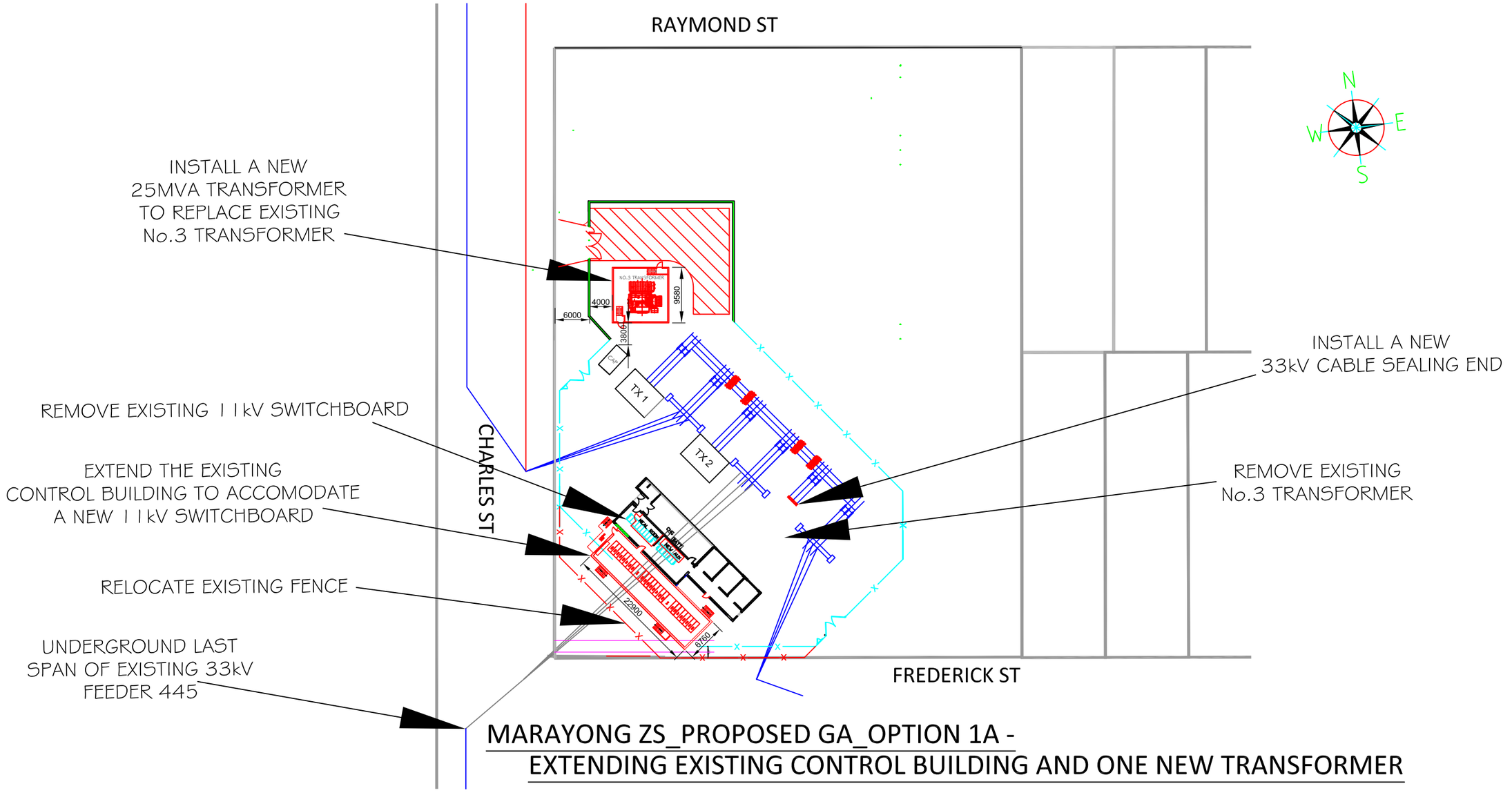
- Appendix A – Ambient Noise Survey
- Appendix B – Proposed ZS Layout Options
- Appendix C – Sound Barrier Wall Location (Typical for Options 1A, 2A, 3A and 4A)
- AC500-9 – Modifying Factor Correction

AMBIENT NOISE SURVEY

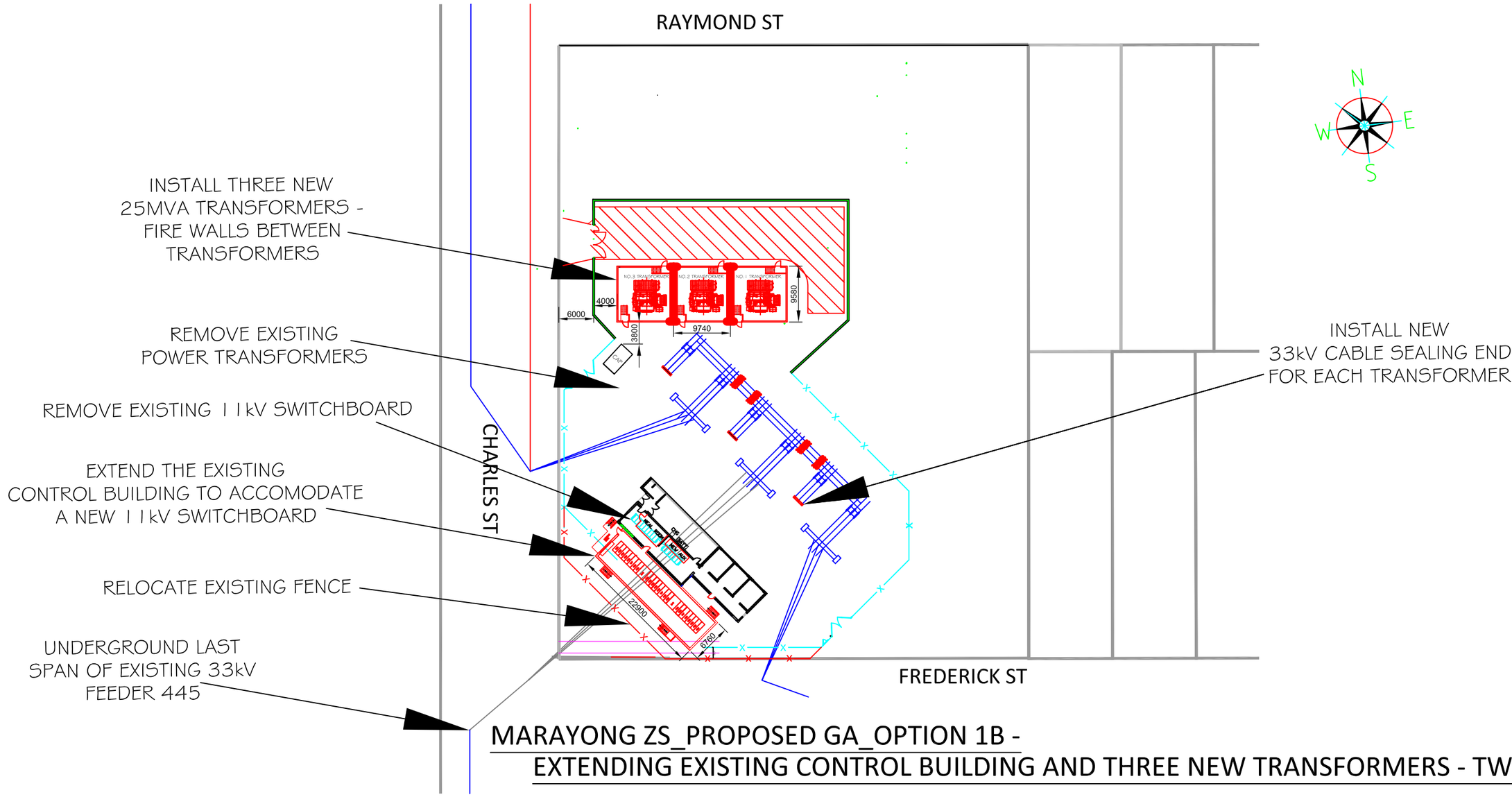
6260-1
Appendix A

Located at 4 Charles Street, Blacktown, NSW

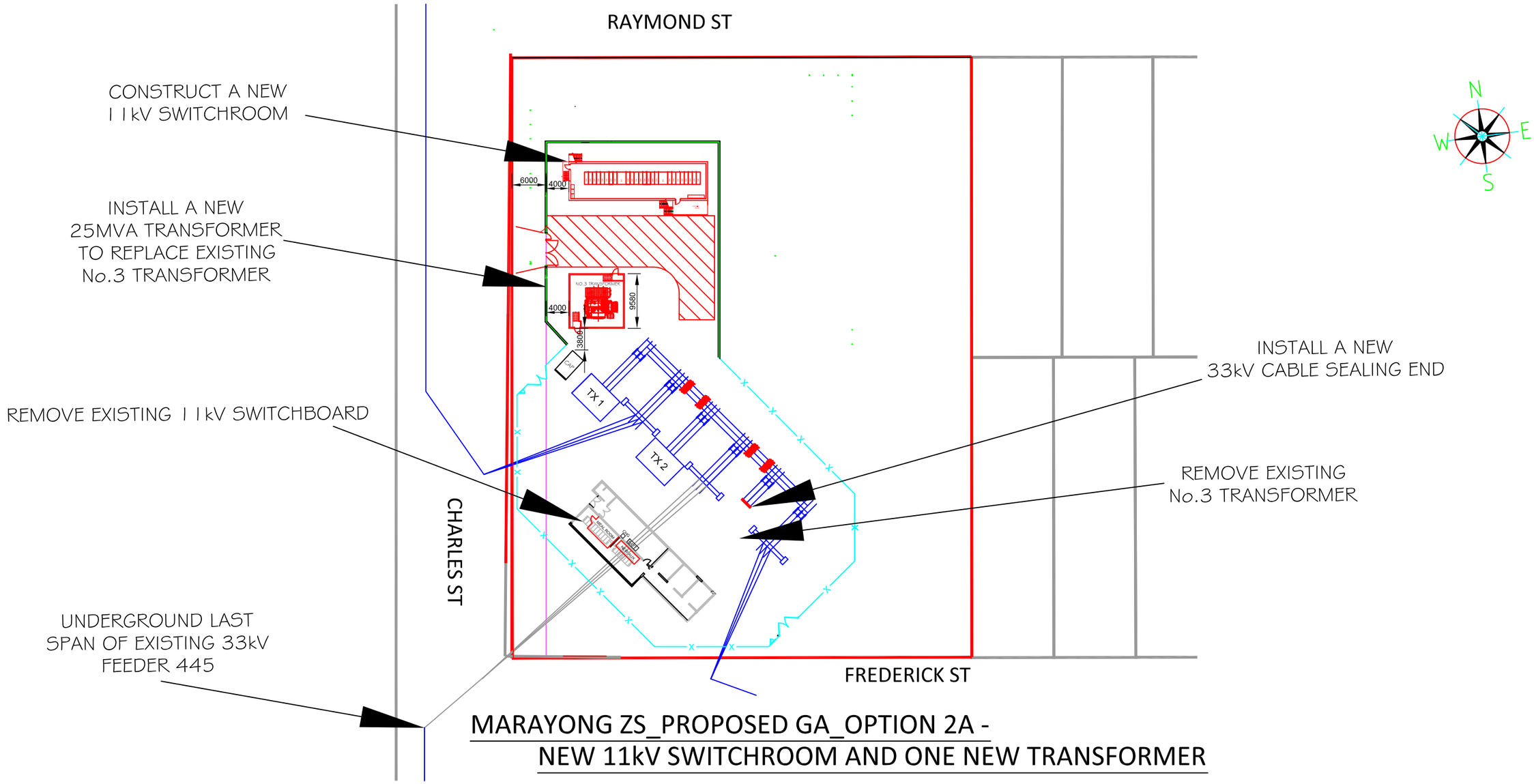




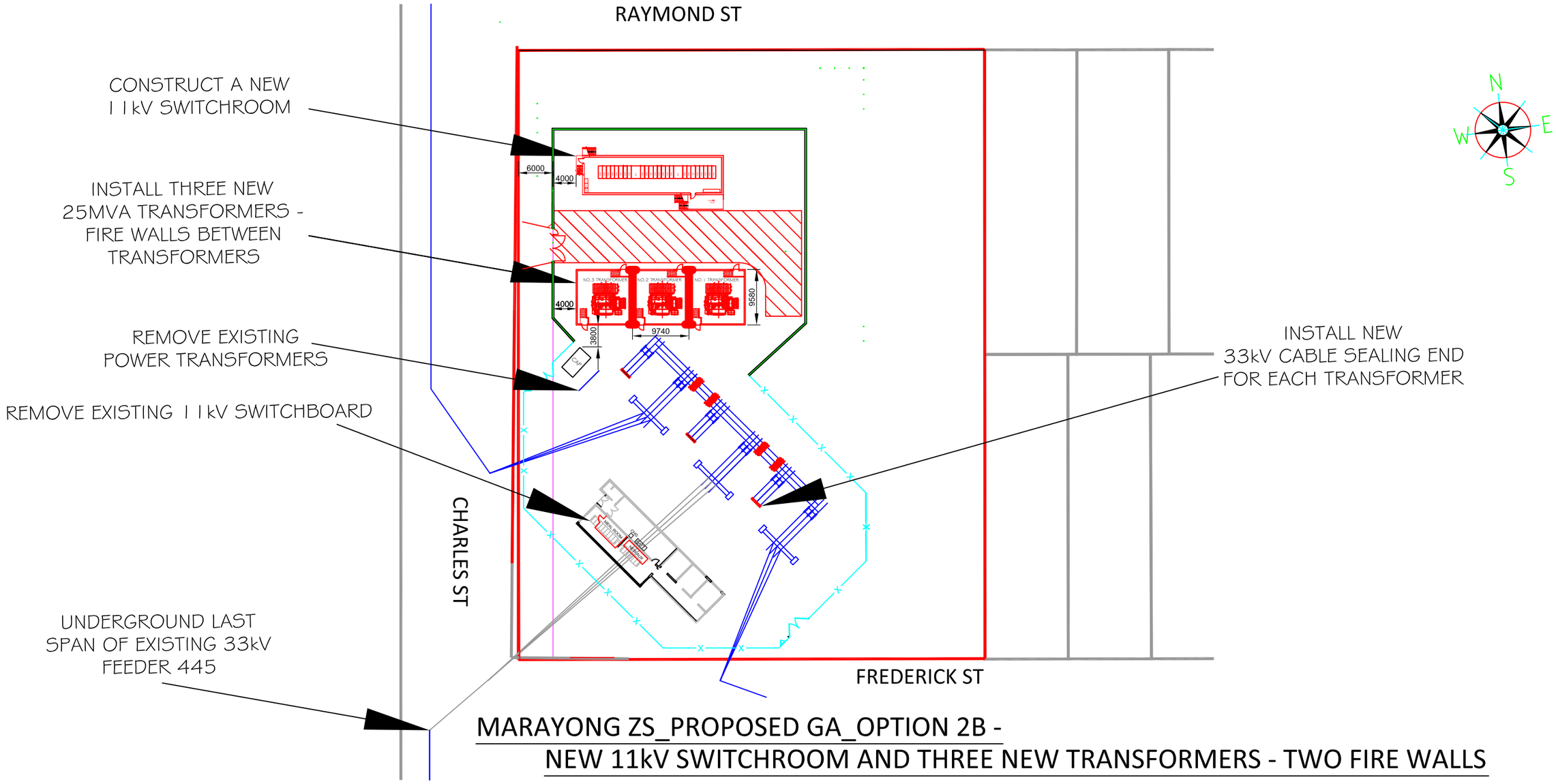
MARAYONG ZS_PROPOSED GA_OPTION 1A -
EXTENDING EXISTING CONTROL BUILDING AND ONE NEW TRANSFORMER



MARAYONG ZS_PROPOSED GA_OPTION 1B -
EXTENDING EXISTING CONTROL BUILDING AND THREE NEW TRANSFORMERS - TWO FIRE WALLS



MARAYONG ZS_PROPOSED GA_OPTION 2A -
NEW 11kV SWITCHROOM AND ONE NEW TRANSFORMER



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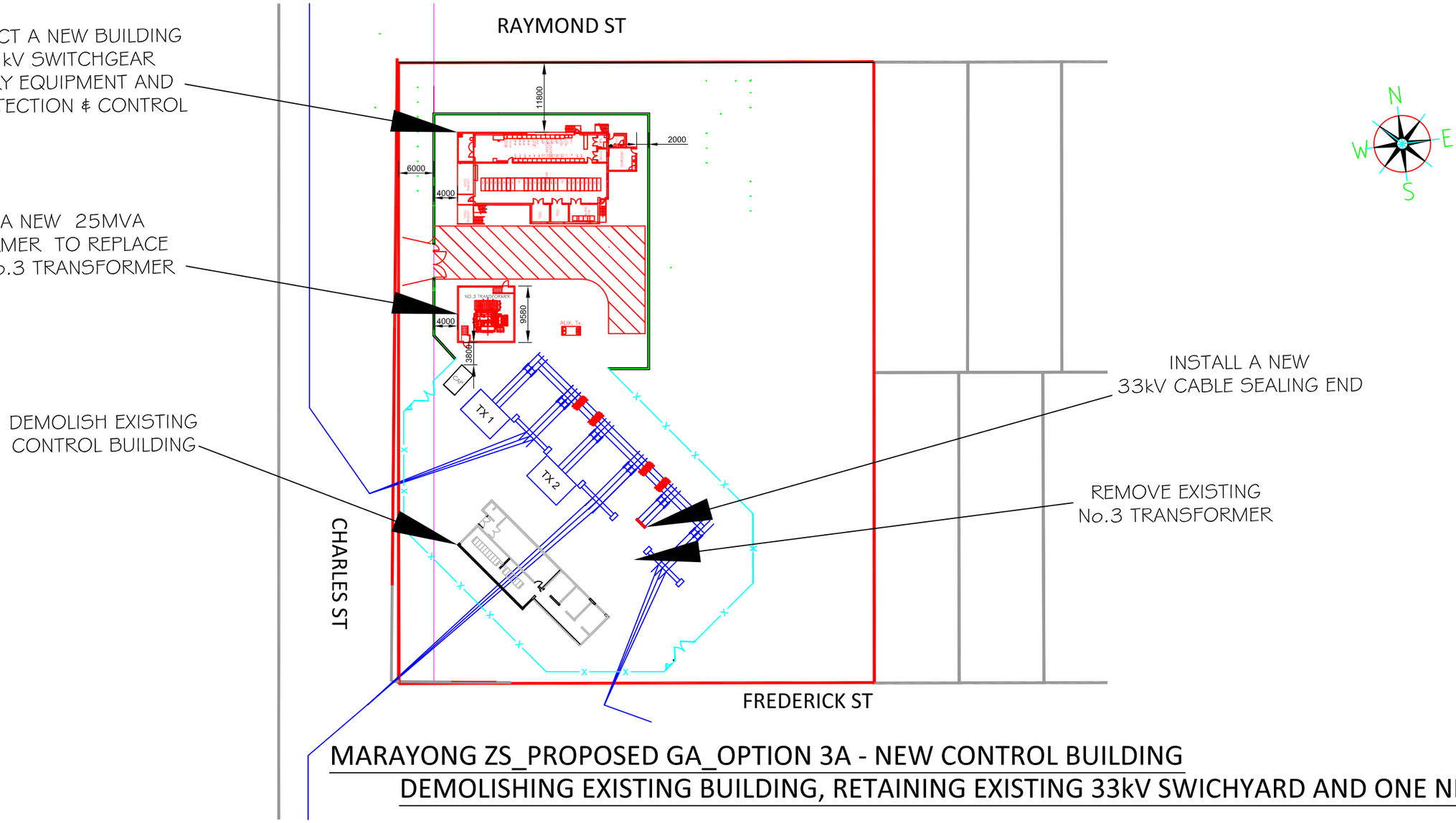
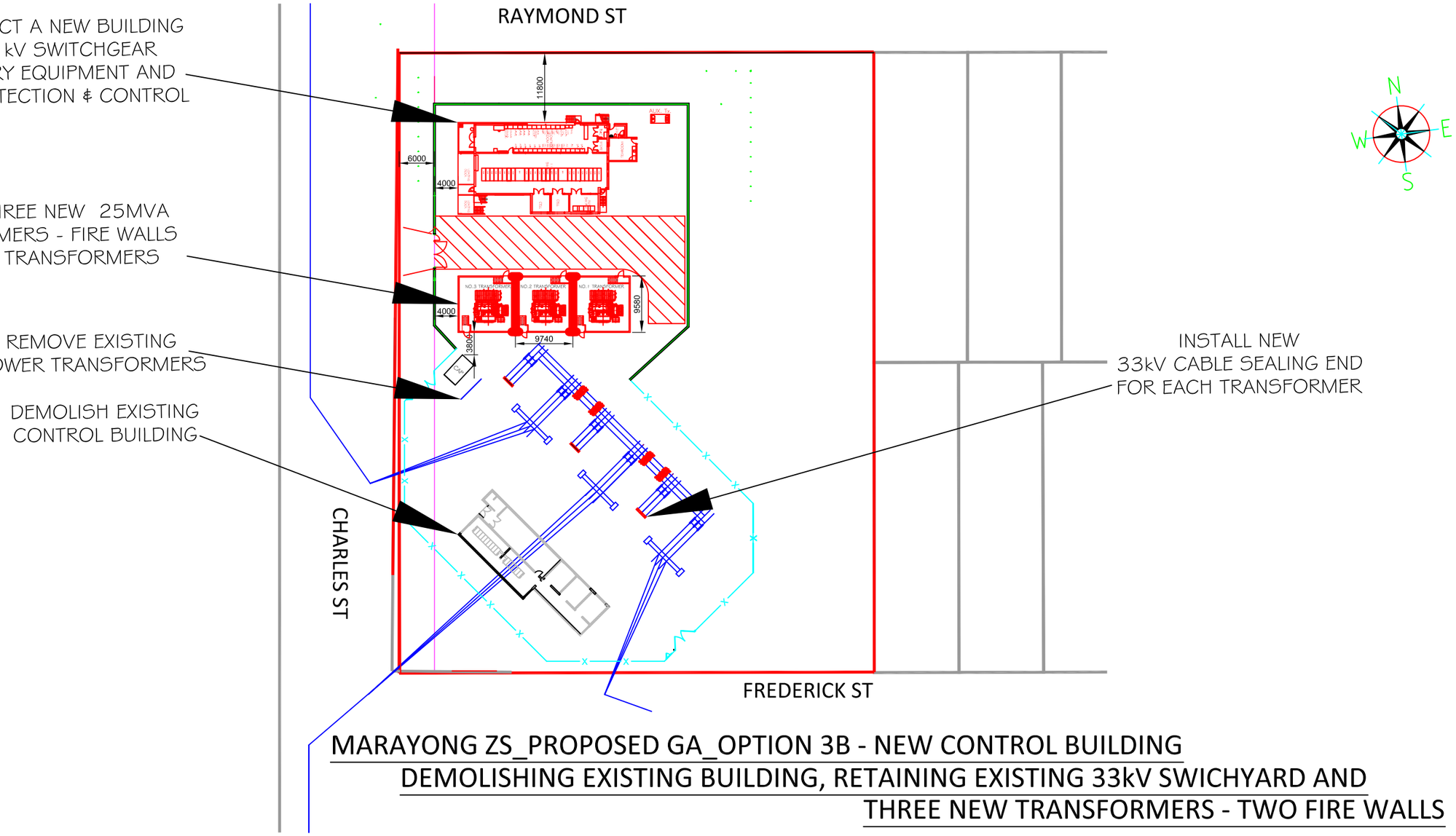
NEW 11kV SWITCHROOM AND THREE NEW TRANSFORMERS - TWO FIRE WALLS

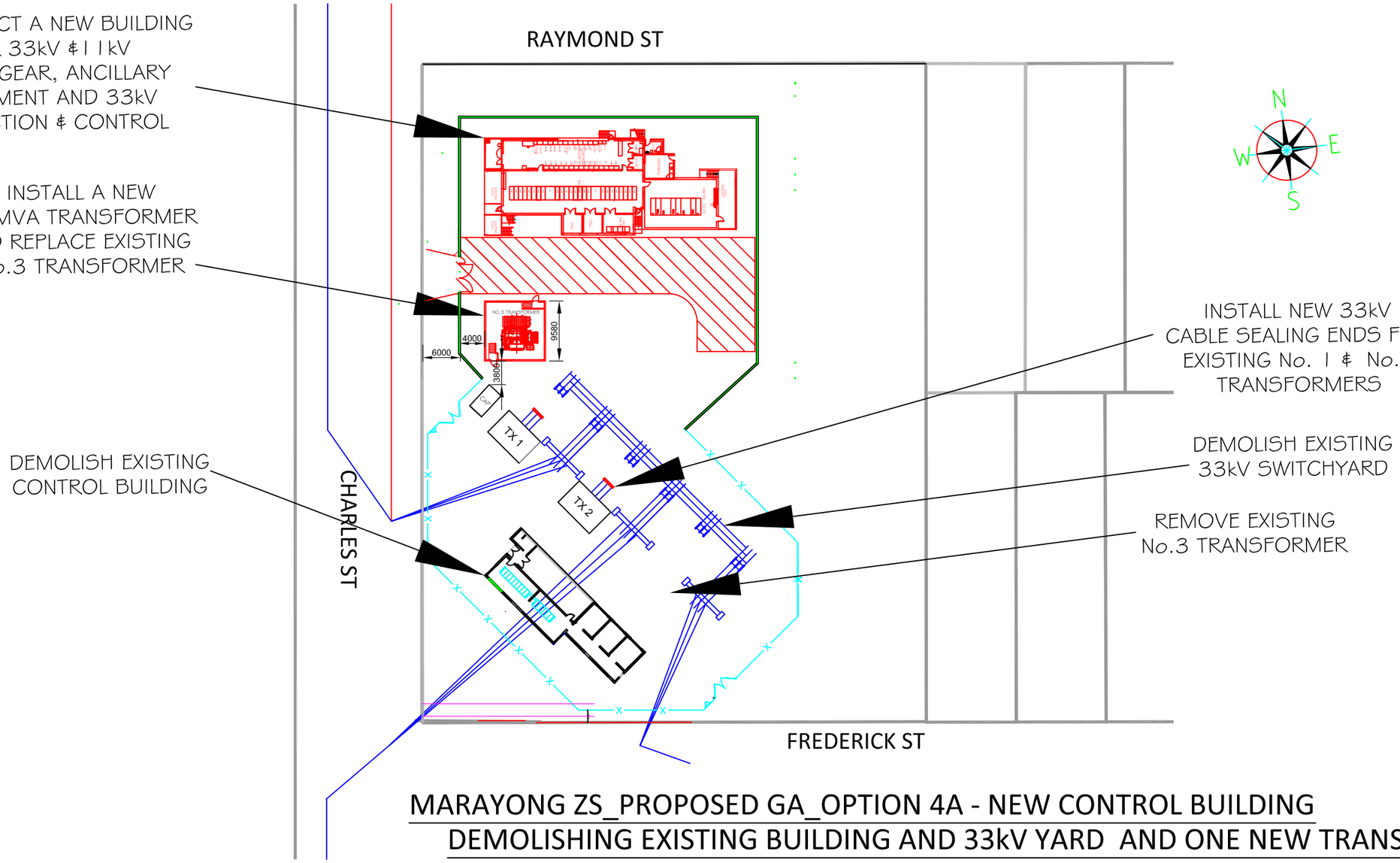


MARAYONG ZS_PROPOSED GA_OPTION 3A - NEW CONTROL BUILDING

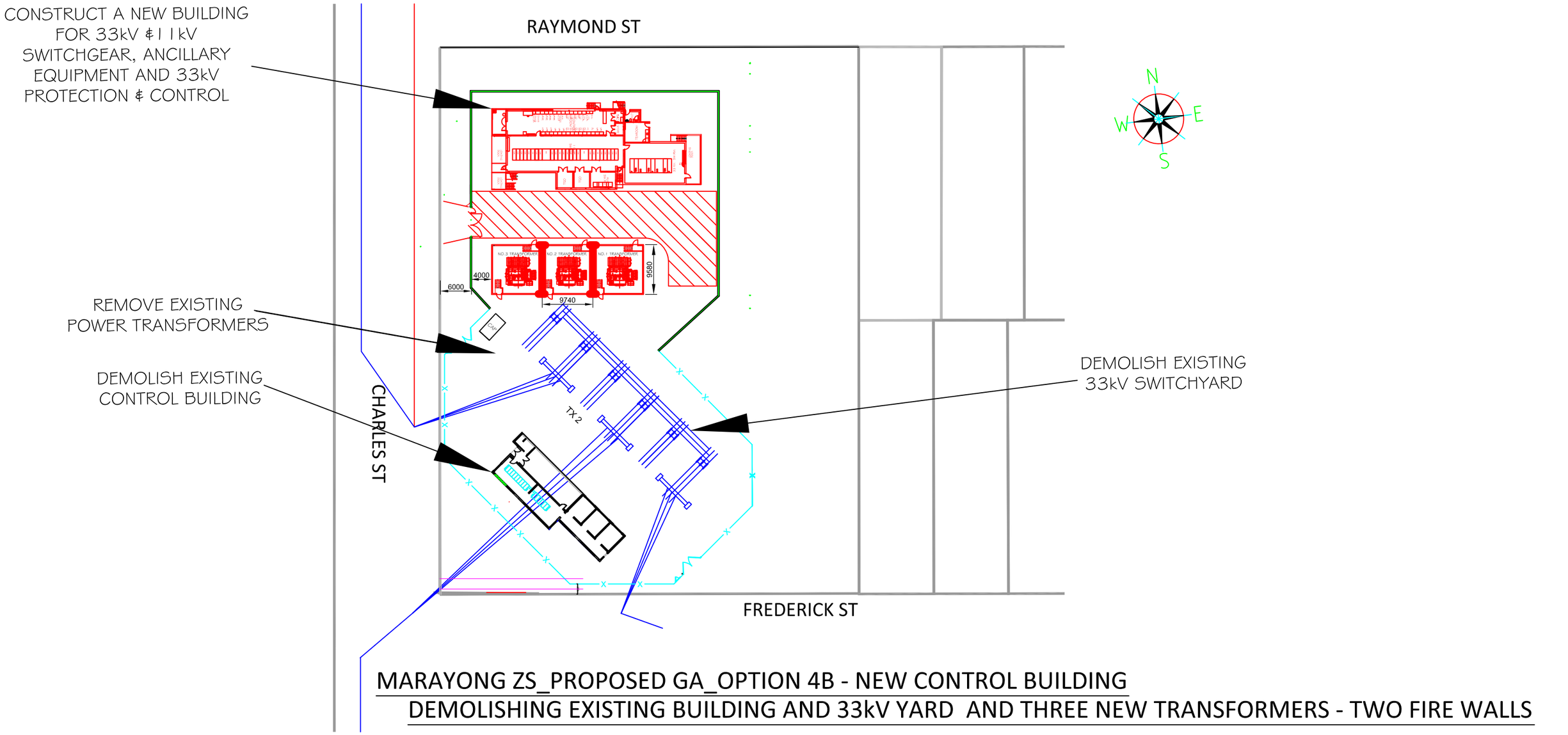
DEMOLISHING EXISTING BUILDING, RETAINING EXISTING 33kV SWICHYARD AND ONE NEW TRANSFORMER



MARAYONG ZS_PROPOSED GA_OPTION 3B - NEW CONTROL BUILDING
DEMOLISHING EXISTING BUILDING, RETAINING EXISTING 33kV SWICHYARD AND
THREE NEW TRANSFORMERS - TWO FIRE WALLS

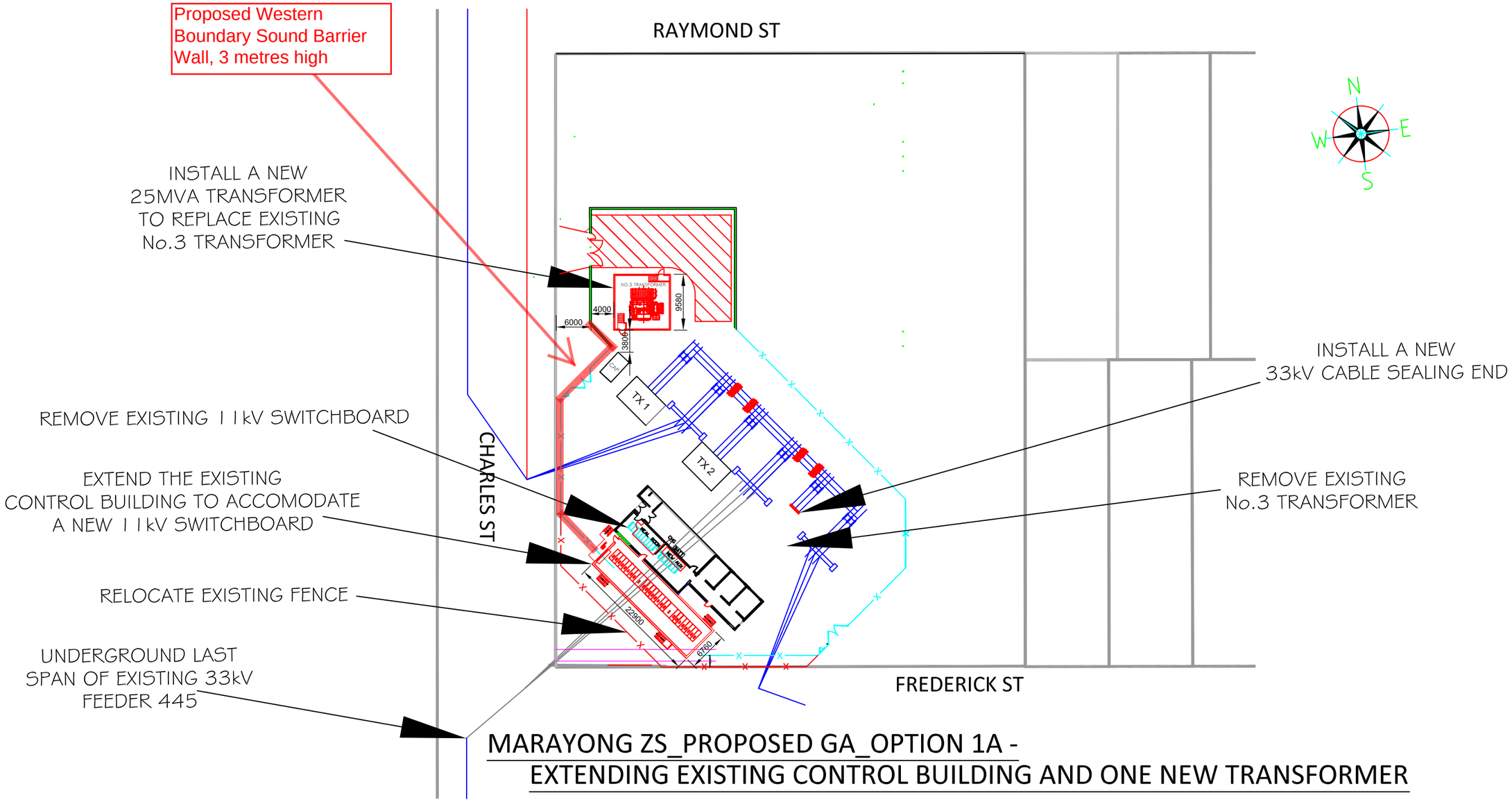


MARAYONG ZS_PROPOSED GA_OPTION 4A - NEW CONTROL BUILDING
DEMOLISHING EXISTING BUILDING AND 33kV YARD AND ONE NEW TRANSFORMER



MARAYONG ZS_PROPOSED GA_OPTION 4B - NEW CONTROL BUILDING

DEMOLISHING EXISTING BUILDING AND 33kV YARD AND THREE NEW TRANSFORMERS - TWO FIRE WALLS



MARAYONG ZS_PROPOSED GA_OPTION 1A -
EXTENDING EXISTING CONTROL BUILDING AND ONE NEW TRANSFORMER

Table 4.1 Modifying factor corrections
(See definitions in Section 4.2)

Factor	Assessment/ Measurement	When to apply	Correction[1]	Comments
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: **- 5 dB** or more if the centre frequency of the band containing the tone is above 400 Hz **- 8 dB** or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive - **15 dB** or more if the centre frequency of the band containing the tone is below 160 Hz	5 dB[2]	Narrow-band frequency analysis may be required to precisely detect occurrence
Low frequency noise	Measurement of C-weighted and A-weighted level	Measure/assess C- and A-weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more	5 dB[2]	C-weighting is designed to be more responsive to low-frequency noise
Impulsive noise	A-weighted fast response and impulse response	If difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB	Apply difference in measured levels as the correction, up to a maximum of 5 dB.	Characterised by a short rise time of 35 milliseconds (ms) and decay time of 1.5s
Intermittent noise	Subjectively assessed	Level varies by more than 5 dB	5 dB	Adjustment to be applied for **night-time only.**
Duration	Single-event noise duration may range from 1.5 min to 2.5 h	One event in any 24-hour period	0 to –20 dB(A)	The acceptable noise level may be increased by an adjustment depending on duration of noise. *(See Table 4.2)*
Maximum Adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated	Maximum correction of 10 dB(A)[2] (excluding duration correction)	

Notes:
1. *Corrections to be added to the measured or predicted levels.*
2. *Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range.*