South Waikato National Grid Connection

Roadside Barrier Design Report

This report was independently prepared by BECA in October 2021.
The design outlined in this report is subject to minor amendments during the construction phase of the project.

POWERco

Revision History

Revision Nº	Prepared By	Description	Date
A	Callum Wilson	Final issue for Client	14/10/2021

Document Acceptance

Action	Name	Signed	Date
Prepared by	Callum Wilson		14/10/2021
Reviewed by	Campbell McKegg		14/10/2021
Approved by	Alex Aramakutu		14/10/2021
on behalf of	Beca Limited		

Contents

Appendices

1. Purpose of Design Report

This Roadside Barrier design report summarises the process and outcomes Beca has completed on behalf of PowerCo for the Arapuni to Putaruru 110kV overhead line Roadside Barrier protection project. The report outlines the design approach, scope, design inputs, roadside treatment types and safety in design. Departures from any standard as well as communications and engagement are also discussed.

2. Project Scope

The scope of the barrier design is to protect all power poles within a 5m offset of the road edge line. This philosophy was set during the previous phase with Beca's Transportation team who agreed this risk-based approach with PowerCo. The initial barrier extents protected 29 power poles. Throughout power pole design changes and amendments, the number of power poles for protection was lowered to 27. As part of the barrier design, shoulder treatment was considered and designed in specific areas, consideration was also made for each individual entrance on the route.

3. Existing Situation

Arapuni Road has a posted speed of 100km an hour, an estimated 1655 average daily traffic (mobile roads), the section of road this design covers is roughly 1.9 kilometres of Arapuni Road. The designed portion of Arapuni Road contains several existing underground services on either side of the road, including Chorus fibre. An overhead power supply and several residential connections, both underground and overhead also span the length of Arapuni Road. It is understood the existing 11kV Power overhead line is to be removed or relocated as part of this project. There are two bridges along the route, both of which have existing roadside barriers protecting the approaches and the bridges themselves.

The PowerCo project is to install a 110kV overhead line which connects the Arapuni Hydro Power Station to the Putaruru substation. This project consists of portions of 110kV cable leading underground and transitioning to an overhead line. The powerline design was largely completed by the time the barrier design was initiated. The portions of cable that are overhead are designed to be held up by power poles of varying foundation type, these poles are typically located within the road corridor. This design protects the required 110kV overhead line power poles.

4. Project Inputs

Prior to the initiation of the barrier design, a site inspection was completed with PowerCo and Beca's barrier designers. Each power pole location was inspected, and offset measurements taken, individual commentary was given on each pole to provide a more accurate and bespoke design. This information fed into the barrier design calculations and end terminal selection, *refer to Appendix A – Barrier Design Calculations.* Final proposed power pole locations have been provided by PowerCo.

Arapuni Road contains several underground and above ground services. The location of these services have been provided by the service owners through BeforeUDig and by PowerCo directly for existing power assets.

5. Barrier Design

Barrier design commenced after services were identified and final 110kV power pole locations were confirmed. Several design factors were considered throughout the project; offset, barrier type, length of need, end terminal selection, and property access.

5.1 Services

Several services have been identified during the design and indicative locations provided within drawings. Prior to construction, the contractor is required to positively identify location of any underground services using hydro excavation, where services are within 1m of any proposed barrier post. Where any potential clashes exist, they are to be raised with the engineer for barrier design confirmation. This includes any changes to barrier offset to avoid clashes, or necessary service relocation. It is assumed that clashes with any existing underground power assets will be relocated by PowerCo prior to the installation of barriers.

Options to avoid barrier service clashes include:

- Barrier offset/ alignment design see section 5.4.
- Omitting up to 2 posts from the barrier section to avoid clash where a service crosses through the barrier alignment.
- Concrete capping ground beam, this has not been detailed in the design drawings as this is preferably not used due to high cost.

5.2 W-Section Barrier

W-Section barrier was selected as the barrier type to be used throughout the project; this provides a TL-3 level of protection, refer to M23 for compliant TL-3 barriers. Where required due to deflection constraints between power poles and barriers, lowered post spacings can be utilised. *Refer to Appendix B: Barrier Post Deflections*. Thrie beam was considered for use at the areas close to the power poles, however this has not been adopted. The increased cost of thrie beam and the transition sections is not preferred, and alternative compliant solutions are available.

Plastic blockouts have been specified for any portions of barrier which are closer than 5m to any new power pole. This philosophy means any barrier posts that are in the ground within a 5m radius of any power pole are to use a plastic blockout for conductive insulation. The purpose of using plastic blockouts is to mitigate the chance of a power fault livening the barrier. As the plastic blockout is non-conductive, in the event of power fault in the line, any current that could potentially travel down the power pole, through the ground and up the barrier post will be stopped at the blockout.

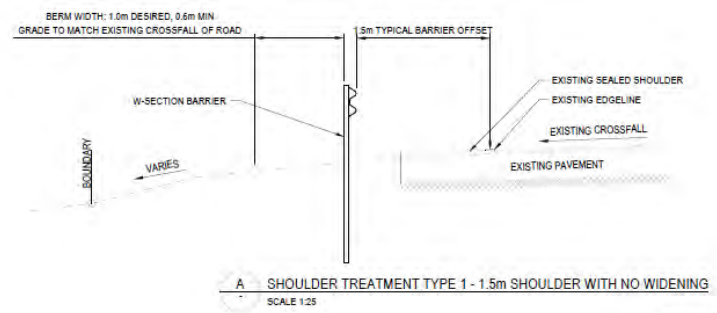
5.3 Length of need

Length of need is the calculated length of barrier required to adequately protect a hazard, in both directions. The Length of Need for each power pole was calculated, *refer to Appendix A: Barrier Design Calculations*. Calculated length of need has been inputted on the drawings. It was shown that some of the pole protection LON were overlapping and within a relatively close distance of each other. The decision was made to connect barriers together when the required length of need was close to overlapping. By connecting continuous barrier lengths along the route, a safer and cheaper outcome is provided.

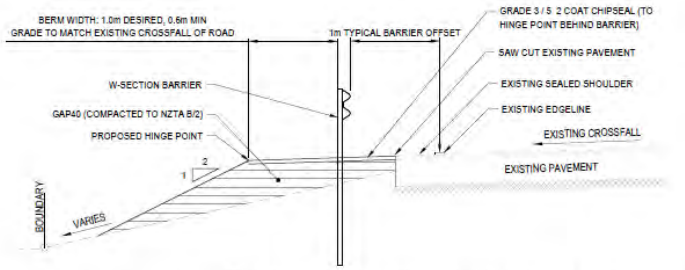
5.4 Offset

Barrier offset requirements were based on site inspection completed by Beca Engineers. The philosophy for barrier offset was to use 1.5m where possible as an optimal offset width. Where 1.5m offset is not possible, 1m offset is used instead, this is for instances such as outside curves and tops of banks. This approach was discussed and agreed with South Waikato District Council (Andrew Diffey, Roading Engineer).

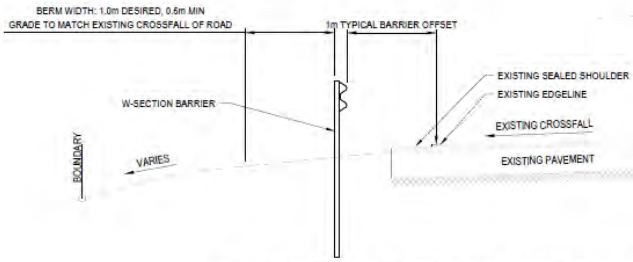
The offsets of barriers have been considered in the context of underground services. If an underground service is identified as clashing with a proposed barrier, flexibility within the design offset is acceptable provided the other design requirements are achieved and a consistent offset at 1m or greater is provided. Revised barrier designs are to be confirmed with the engineer prior to construction.



A SHOULDER TREATMENT TYPE 1 - 1.5m SHOULDER WITH NO WIDENING
SCALE 1:25



B SHOULDER TREATMENT TYPE 2 - 1.0m SHOULDER WITH WIDENING
SCALE 1:25

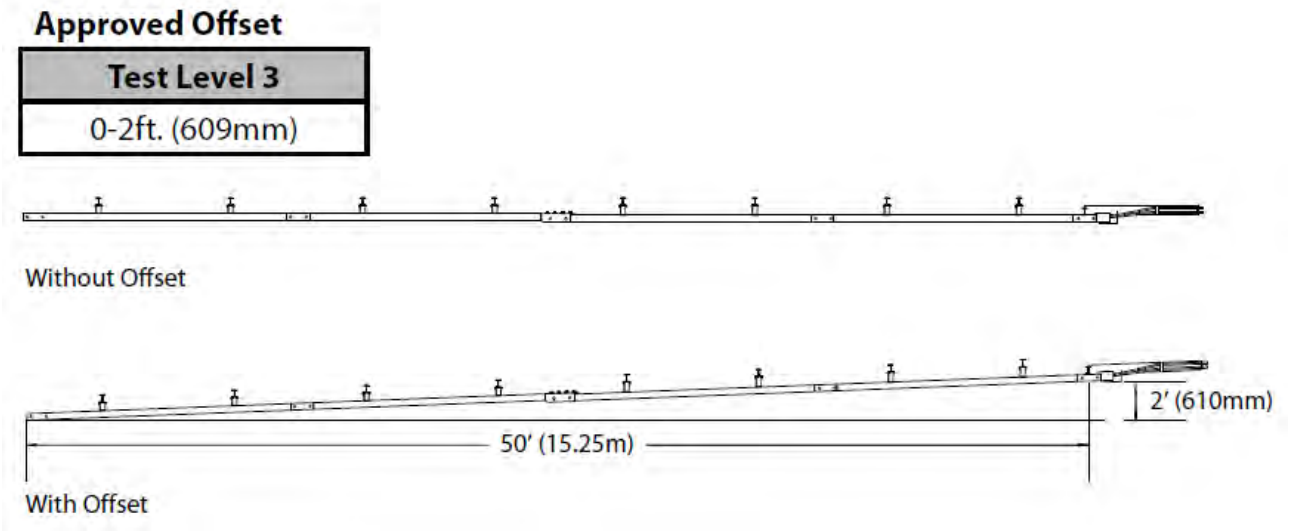


C SHOULDER TREATMENT TYPE 3 - 1.0m SHOULDER WITH NO WIDENING
SCALE 1:25

5.5 End Terminal

The philosophy for selecting end terminal is to preferably utilise a curved end terminal, if possible, with a leading end terminal as the second preferred option. Leading end terminals have only been selected for straight barrier terminations. Leading end terminal length shown on the design plans is 16m, this allows for

all M23 compliant end terminals to be fit into the designed space. Curved end terminals have been used where it is possible to protect against head on crashes to the barrier, and where impact to vehicle entrance operation is minimal. The use and extent of both the leading end terminal and curved end terminal is to be confirmed on site with engineer. This is confirmed only after consultation has been completed between the contractor and the adjacent landowner. Where required, end terminal flaring has been accepted, this is to be agreed with the engineer on site. Flare rates are not to exceed more than 4%, as per manufacturers specifications, unless agreed with engineer on site.



5.6 Property Access

Each property access where curved end terminals are proposed is to be inspected on site prior to any construction commencement. The vehicle entrance is to be assessed for any potential grading (ground slope behind barrier) issues or physical works that may be required at the entranceway. This is to ensure the operation of the vehicle entrance is not impeded. The use of curved end terminals must be discussed and agreed with the contractor and landowner prior to installation. Any required drainage works and behind barrier earthworks are to be agreed with the contractor and engineer on site prior to construction.

6. Pavement and Surfacing

Pavement works are only required for shoulder detail; *Treatment Type 2 - 1m Shoulder with Widening.* The intent of the design is to gain additional shoulder width through minor shoulder top up and shaping to provide a platform for new barrier. The pavement material is expected to be a clean, well graded aggregate (GAP 40 or similar approved).

A grade 3/5 two coat chip seal is proposed to extend from the existing edge of seal to the face of new barrier. The required width behind the barrier is a minimum 0.6m with a desired offset of 1.0m, the slope is to match the existing road crossfall. Prior to constructing shoulder widening, contractor is required to mark out saw cut extents and agree layout with engineer on site.

7. Departures

Where required length of need for power poles is further than barrier can be installed, the barrier is curved into a vehicle entrance or down a side road. The use of a curved terminal provides more protection than terminating barrier prematurely with a leading end terminal. In some instances, this is not compliant with M23, so must be agreed with engineer on site prior to construction.

The use of a plastic blockout is not within M23 specification as standard post material. However plastic block out is specified within end terminal manufacturers guidelines.

8. Safety in Design

Beca attended a joint safety in design workshop led by PowerCo on the 23/09/2021. Risks raised during this forum are discussed below:

	Risk	Mitigation
Barrier Construction	Underground Service Strike	Existing underground power to be relocated / removed, contractor to locate all existing services, hold point for barrier designer to adjust barrier alignment to avoid any clash as necessary.
	Vehicle strike with worker	Contractor to implement appropriate Temporary Traffic Management
Barrier Operation	Vehicle crash into poles	Protect all proposed power poles within 5m of road edge line with roadside barrier
	Electrocution of MOP on or near steel barrier	Plastic block outs between steel barrier post and rail within 5m radius of new poles
	Vehicle crash, new barrier blocking visibility at exiting entrance	Barrier must be positioned not to impede visibility, sight visibility at each vehicle entrance has been checked during design phase and potential risk areas identified. In areas where sight distance is limited, it has been ensured that the barrier installation will have only a minor effect on sight distance. Sight distance is to be checked on site prior to installation of barrier.
	Barrier restricts ability for maintenance vehicles to access new power poles	Barrier rail sections can be removed temporarily to access behind + temporary traffic management

9. Cost Estimate Summary

Our expected construction cost estimate for the work is **$725K** as shown the breakdown below. This is approximately $50k less than the previous estimate, due to a reduction in leading end terminals and overall barrier length;

Item	Unit	Qty	Rate	Amount
Shoulder widening	m	755	$127	$95,885
Barrier	m	2,042	$130	$265,460
Curved terminal	ea.	10	$5,200	$52,000
Leading terminal	ea.	10	$6,000	$60,000
Connect to existing	ea.	2	$400	$800.00
Traffic management	day	38	$2,200	$83,600
P&G	%	12%		$66,929
Subtotal physical works				**$624,674**
Contingency	%	10%		$62,467
Construction monitoring	%	6%		$37,480
Total				**$724,622**

Accuracy of this estimate is not expected to be better than approximately - 10% - +25% **($652K - $906K)**. The cost estimate is developed based on extrapolation of recent similar project pricing, industry unit rates and Beca's general experience. The estimate is based on the current level of design and is not warranted or guaranteed by Beca.

Items specifically excluded within the estimate:

- *We have not included any escalation as have assumed the works will be undertaken within next 6 months.*
- *GST*
- *Admin, legal or financing costs*
- *Procurement risk*
- *Fast tracking or staging of works. We have assumed that the works will be procured and constructed as one contract*
- *Works outside of normal working hours*
- *No allowance has been made for the impacts of extraordinary global events (such as the current COVID-19 outbreak) within the base estimate*

10. Communications and Engagement

Communications and engagement with relevant landowners will be arranged directly through PowerCo and the selected contractor. Communications and Engagement regarding the barrier placement is not currently within Beca's scope.

A

Appendix A – Barrier Design Calculations

TITLE: **ROADSIDE BARRIER DESIGN CALCULATIONS**

REVISION No.: **2**

DATE: **14/10/2021**

														LEADING BARRIER						TRAILING BARRIER							
Barrier Section	**Pole Number**	**Barrier Required**	**Pole Foundation Base Width (If No value, pole is direct buried cement stabilized)**	**Lane Width**	**Side Of Road Pole Is On (When Travelling West)**	**Pole Offset From Edgeline**	**Shoulder Width**	**Pole Location Chainage**	**Barrier Offset From Edgeline**	**Barrier Start Chainage**	**Barrier Finish Chainage**	**Seperation Between Barrier Lengths of Need**	**Barrier Start Terminal Type**	**Barrier Finish Terminal Type**	**La**	**Lr**	**L2**	**b/a**	**L1**	**X**	**La**	**Lr**	**L2**	**b/a**	**L1**	**X**	**Total Barrier Length**	**Structure / Pole Description**
																											Putaruru CTS, Steel, Type = STR, Height = 17-0m, Strength = xxkN, Foundation = Board Pile x.xm x x.xm
1	3	YES		3.5	LEFT	3.2	1.5	949	1.5	*915*	*965*	17.2	Leading End	~	3.2	64.0	1.5	0.0	0.0	**34.0**	6.7	64.0	5.0	0.0	0.0	**16.2**	**53.3**	Pole 3, Type 01, Concrete, Type = SUS, Height = 20-0m, Strength = 16kN, Foundation = Direct Buried Cement Stabilised
	4	YES		3.5	LEFT	3.5	1.5	1019	1.5	*982*	*1037*	50.3	~	Curved End	3.5	64.0	1.5	0.0	0.0	**36.6**	7.0	64.0	5.0	0.0	0.0	**18.3**	**57.2**	Pole 4, Type 08, Concrete, Type = SUS, Height = 20-0m, Strength = 16kN, Foundation = Direct Buried Cement Stabilised
2	5	YES		3.5	LEFT	3.9	1.5	1127	1.5	*1088*	*1148*	31.9	Leading End	Leading End	3.9	64.0	1.5	0.0	0.0	**39.4**	7.4	64.0	5.0	0.0	0.0	**20.8**	**61.0**	Pole 5, Type 08, Concrete, Type = SUS, Height = 20-0m, Strength = 16kN, Foundation = Direct Buried Cement Stabilised
	6	YES	1.2	3.5	LEFT	3.3	1.5	1219	1.5	*1180*	*1240*	27.7	Leading End	~	3.9	64.0	1.5	0.0	0.0	**39.4**	7.4	64.0	5.0	0.0	0.0	**20.8**	**61.0**	Pole 6, Type 09, Steel, Type = SUS, Height = 17-0m, Strength = 40kN, Foundation = Bored Pile 1.2m x 4.8m
3	7	YES	1.2	3.5	LEFT	3.5	1.5	1308	1.5	*1267*	*1330*	17.2	~	~	4.1	64.0	1.5	0.0	0.0	**40.6**	7.6	64.0	5.0	0.0	0.0	**21.9**	**64.8**	Pole 7, Type 09, Steel, Type = SUS, Height = 18-5m, Strength = 40kN, Foundation = Bored Pile 1.2m x 5.7m
	8	YES	1.2	3.5	LEFT	5	1.5	1394	1.5	*1347*	*1423*	48.2	~	~	5.6	64.0	1.5	0.0	0.0	**46.9**	9.1	64.0	5.0	0.0	0.0	**28.8**	**76.2**	Pole 8, Type 09, Steel, Type = SUS, Height = 18-5m, Strength = 40kN, Foundation = Bored Pile 1.2m x 5.8m
	9	YES		3.5	LEFT	2.4	1.5	1495	1.5	1471	1505		~	TBC	2.4	64	1.5	0	0	**24**	5.9	64	5	0	0	**9.8**	**34.3**	Pole 9, Type 08, Concrete, Type = SUS, Height = 20-0m, Strength = 16kN, Foundation = Direct Buried Cement Stabilised
	10	YES		3.5	LEFT	6.1	1.5	1569	1.5	1521	1600	-10.4	Leading End	~	6.1	64	1.5	0	0	**48.3**	9.6	64	5	0	0	**30.7**	**80.0**	Pole 10, Type 08, Concrete, Type = SUS, Height = 20-0m, Strength = 16kN, Foundation = Direct Buried Cement Stabilised
4	11	YES		3.5	LEFT	3.4	1.5	1625	1.5	*1589*	*1643*	-4.3	~	~	3.4	64.0	1.5	0.0	0.0	**35.8**	6.9	64.0	5.0	0.0	0.0	**17.6**	**57.2**	Pole 11, Type 08, Concrete, Type = SUS, Height = 20-0m, Strength = 16kN, Foundation = Direct Buried Cement Stabilised
	12	YES		3.5	LEFT	4.5	1.5	1681	1.5	*1638*	*1705*		~	TBC	4.5	64.0	1.5	0.0	0.0	**42.7**	8.0	64.0	5.0	0.0	0.0	**24.0**	**68.6**	Pole 12, Type 08, Concrete, Type = SUS, Height = 18-5m, Strength = 24kN, Foundation = Direct Buried Cement Stabilised
	13	YES		3.5	LEFT	4.1	1.5	1760	1.5	*1719*	*1782*	45.1	Curved End	~	4.1	64.0	1.5	0.0	0.0	**40.6**	7.6	64.0	5.0	0.0	0.0	**21.9**	**64.8**	Pole 13, Type 08, Concrete, Type = SUS, Height = 20-0m, Strength = 16kN, Foundation = Direct Buried Cement Stabilised
5	14	YES		3.5	LEFT	3.2	1.5	1861	1.5	*1827*	*1877*		~	Leading End	3.2	64.0	1.5	0.0	0.0	**34.0**	6.7	64.0	5.0	0.0	0.0	**16.2**	**53.3**	Pole 14, Type 08, Concrete, Type = SUS, Height = 20-0m, Strength = 16kN, Foundation = Direct Buried Cement Stabilised
	15	YES	1.2	3.1	RIGHT	4.7	1	1959	1	*1926*	*2011*	1.1	Leading End	~	8.4	64.0	4.1	0.0	0.0	**32.8**	5.3	64.0	1.0	0.0	0.0	**51.9**	**87.6**	Pole 15, Type 04, Steel, Type = SUS, Height = 18-5m, Strength = 40kN, Foundation = Bored Pile 1.2m x 4.4m
	16	YES		3.1	RIGHT	5.1	1	2044	1	*2012*	*2095*	18.3	~	~	8.2	64.0	4.1	0.0	0.0	**32.0**	5.1	64.0	1.0	0.0	0.0	**51.5**	**83.8**	Pole 16, Type 08, Concrete, Type = SUS, Height = 20-0m, Strength = 16kN, Foundation = Direct Buried Cement Stabilised
6	17	YES		3.1	RIGHT	4.9	1	2145	1	*2114*	*2196*	7.7	~	~	8.0	64.0	4.1	0.0	0.0	**31.2**	4.9	64.0	1.0	0.0	0.0	**50.9**	**83.8**	Pole 17, Type 08, Concrete, Type = SUS, Height = 18-5m, Strength = 24kN, Foundation = Direct Buried Cement Stabilised
	18	YES		3.1	RIGHT	4.7	1	2234	1	*2204*	*2284*	3.8	~	~	7.8	64.0	4.1	0.0	0.0	**30.4**	4.7	64.0	1.0	0.0	0.0	**50.4**	**83.8**	Pole 18, Type 08, Concrete, Type = SUS, Height = 20-0m, Strength = 16kN, Foundation = Direct Buried Cement Stabilised
	19	YES		3.1	RIGHT	5.6	1	2322	1	*2288*	*2375*		~	Curved End	8.7	64.0	4.1	0.0	0.0	**33.8**	5.6	64.0	1.0	0.0	0.0	**52.6**	**87.6**	Pole 19, Type 08, Concrete, Type = SUS, Height = 21-5m, Strength = 24kN, Foundation = Direct Buried Cement Stabilised
	20	YES		3.1	RIGHT	4.7	1	2451	1	*2421*	*2501*	37.2	Curved End	~	7.8	64.0	4.1	0.0	0.0	**30.4**	4.7	64.0	1.0	0.0	0.0	**50.4**	**83.8**	Pole 20, Type 08, Concrete, Type = SUS, Height = 21-5m, Strength = 24kN, Foundation = Direct Buried Cement Stabilised
7	21	YES		3.1	RIGHT	5.2	1	2571	1	*2539*	*2623*		~	Leading End	8.3	64.0	4.1	0.0	0.0	**32.4**	5.2	64.0	1.0	0.0	0.0	**51.7**	**87.6**	Pole 21, Type 01, Concrete, Type = SUS, Height = 20-0m, Strength = 16kN, Foundation = Direct Buried Cement Stabilised
8	22	YES	1.2	3.1	RIGHT	3.3	1	2643	1	*2616*	*2691*		Leading End	Bridge Connection	7.0	64.0	4.1	0.0	0.0	**26.5**	3.9	64.0	1.0	0.0	0.0	**47.6**	**76.2**	Pole 22, Type 04, Steel, Type = STR, Height = 18-5m, Strength = 40kN, Foundation = Bored Pile 1.2m x 4.5m
9	28	YES		3.1	RIGHT	2.7	1	3308	1	*3289*	*3348*		Leading End	Leading End	5.8	64.0	4.1	0.0	0.0	**18.8**	2.7	64.0	1.0	0.0	0.0	**40.3**	**61.0**	Pole 28, Type 01, Concrete, Type = SUS, Height = 21-5m, Strength = 24kN, Foundation = Direct Buried Cement Stabilised
	30	YES		3.1	LEFT	3.3	1	3482	1	*3437*	*3505*	14.8	Leading End	~	3.3	64.0	1.0	0.0	0.0	**44.6**	6.4	64.0	4.1	0.0	0.0	**23.0**	**68.6**	Pole 30, Type 01, Concrete, Type = SUS, Height = 18-5m, Strength = 24kN, Foundation = Direct Buried Cement Stabilised
10	31	YES	1.2	3.1	LEFT	2.8	1	3565	1	*3520*	*3589*	5.2	~	~	3.4	64.0	1.0	0.0	0.0	**45.2**	6.5	64.0	4.1	0.0	0.0	**23.6**	**72.4**	Pole 31, Type 09, Steel, Type = SUS, Height = 17-0m, Strength = 32kN, Foundation = Bored Pile 1.2m x 5.7m
	32	YES	1.2	3.1	LEFT	5.9	1	3648	1	*3594*	*3685*		~	~	6.5	64.0	1.0	0.0	0.0	**54.2**	9.6	64.0	4.1	0.0	0.0	**36.7**	**91.4**	Pole 32, Type 09, Steel, Type = SUS, Height = 17-0m, Strength = 32kN, Foundation = Bored Pile 1.2m x 4m
	33	YES	1.2	3.1	LEFT	4.1	1	37501	1	*37451*	*37531*		~	Bridge Connection	4.7	64.0	1.0	0.0	0.0	**50.4**	7.8	64.0	4.1	0.0	0.0	**30.4**	**83.8**	Pole 33, Type 09, Steel, Type = SUS, Height = 18-5m, Strength = 40kN, Foundation = Bored Pile 1.2m x 4.8m
12	62	YES		3.1	LEFT	5.4	1	8433	1	*8381*	*8466*		Leading End	Leading End	5.4	64.0	1.0	0.0	0.0	**52.1**	8.5	64.0	4.1	0.0	0.0	**33.1**	**87.6**	Pole 62, Type 02, Concrete, Type = SUS, Height = 18-5m, Strength = 24kN, Foundation = Direct Buried Cement Stabilised
												311.0															**1870.7**	

B

Appendix B – Barrier Post Deflections

Nu-Guard™ 31 Normalised Deflections

Red = Actual Results
Black = Normalised Deflections from Actual 2270P Test (2270kg, 25 degree & 100kph)

25 Degree impacts at 100kph

	Test Vehicle			
Post Spacing (m)	**820C**	**2000P**	**2270P**	**8000S**
1.905	0.68*	0.93**	1.05	1.20
0.953	0.51	0.70	0.78	0.90
0.476	0.38	0.52	0.59	0.68

* 'Median system
**Normalised by weight.
Normalised by post spacing

15 Degree impacts at 100kph

	Test Vehicle		
Post Spacing (m)	**2000P**	**2270P**	
1.905	0.35	0.39	
0.953	0.26	0.29	
0.476	0.20	0.22	

Normalised by post spacing and angle

15 Degree impacts at 80kph

	Test Vehicle		
Post Spacing (m)	**2000P**	**2270P**	
1.905	0.22	0.25	
0.953	0.17	0.19	
0.476	0.12	0.14	

Normalised by post spacing, angle and speed

25 Degree impacts with the pickup truck

Test Level	Vehicle	Angle (˚)	Speed (kph)	Deflection (m)
TL-3 (MASH)	2270P	25	100	1.05
TL-3 (350)	2000P	25	100	0.93
TL-? (350)	2000P	25	80	0.59
TL-2 (350)	2000P	25	70	0.45
TL-1 (350)	2000P	25	50	0.23

Normalised by speed and weight.

Note: standard post spacing.

15 Degree impacts with the pickup truck

Test Level	Vehicle	Angle (˚)	Speed (kph)	Deflection (m)
TL-3 (MASH)	2270P	15	100	0.39*
TL-3 (350)	2000P	15	100	0.35**
TL-? (350)	2000P	15	80	0.22
TL-2 (350)	2000P	15	70	0.17
TL-1 (350)	2000P	15	50	0.09

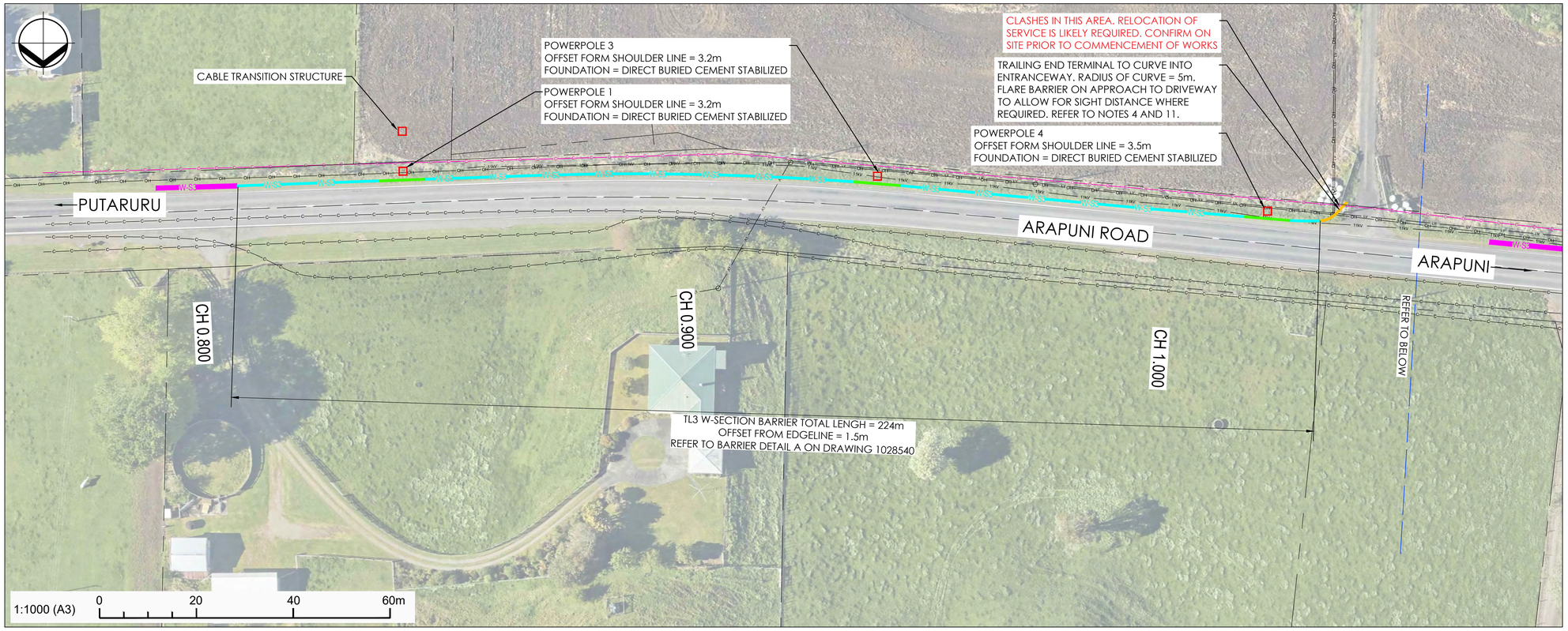
* Normalised by angle.
** Normalised by angle and weight.
Normalised by speed, weight and angle.

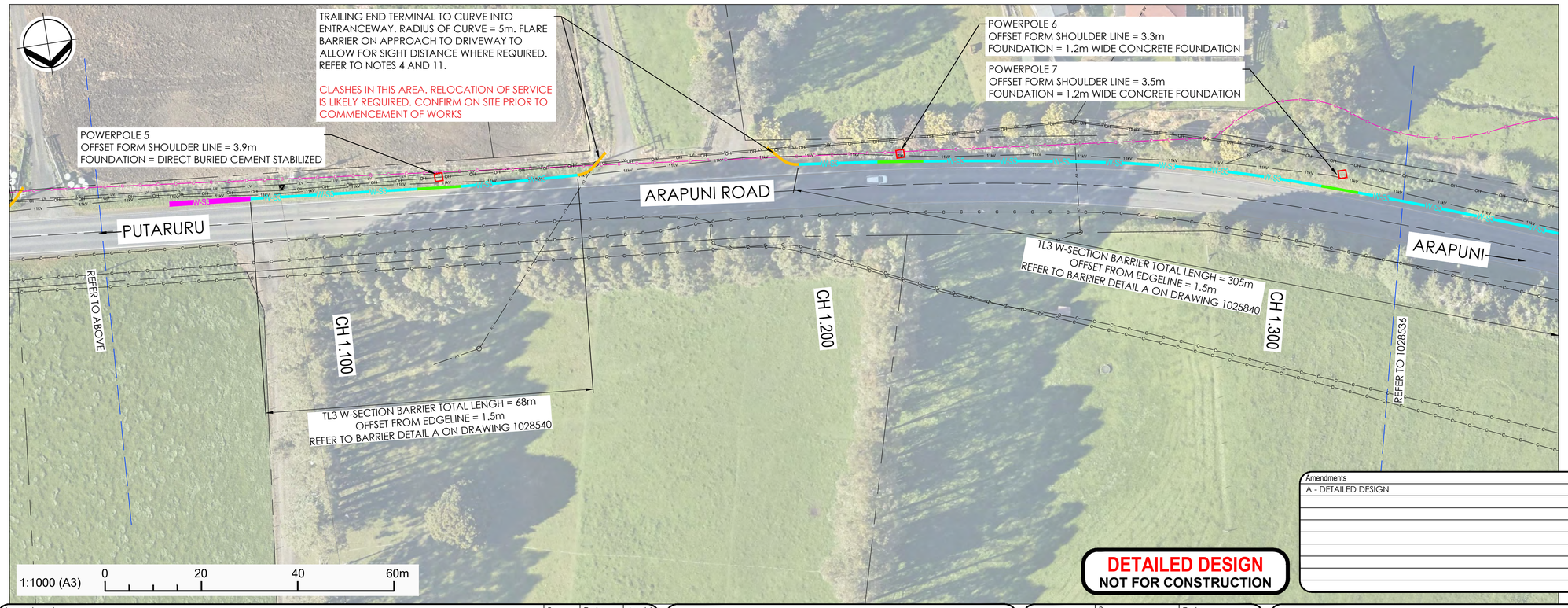
Note: standard post spacing.

NB: All deflections are in metres.
25% ‘assumed’ performance improvement when post spacing is halved.

C

Appendix C – Roadside Barrier Design Drawings





LEGEND:

- PROPERTY BOUNDARIES
- CENTRELINE
- EDGELINE
- EXISTING POWER POLE
- PROPOSED POWER POLE
- W-S3 — PROPOSED TL-3 W-SECTION BARRIER
- W-S3 — PROPOSED LEADING END TERMINAL
- PROPOSED TRAILING END TERMINAL
- PLASTIC BLOCKOUT TO BE USED
- C — CHORUS FIBRE
- LV — EXISTING LOW VOLTAGE POWER
- OH — EXISTING OVERHEAD POWER
- C — CHORUS CABLE
- 11kV — EXISTING 11kV POWER

NOTES:

1. MATCH EXISTING CROSSFALL AT PAVEMENT TIE-IN LOCATION. MATCH EXISTING CROSSFALL TO A MINIMUM OF 0.6m BEHIND BACK OF W-SECTION BARRIER.
2. PRIOR TO CONSTRUCTION OF ADDITIONAL SHOULDER THE PAVEMENT JOIN SHALL BE MARKED OUT INTO SEGMENTS PLEASING TO THE EYE, AND SAWCUT TO A MINIMUM DEPTH OF 50mm.
3. CONTRACTOR IS REQUIRED TO POSITIVELY IDENTIFY LOCATION OF ANY UNDERGROUND SERVICES USING HYDRO EXCAVATION WHERE SERVICES ARE WITHIN 1m OF ANY PROPOSED BARRIER POST. WHERE ANY POTENTIAL CLASHES EXIST, THEY ARE TO BE RAISED WITH THE ENGINEER FOR BARRIER DESIGN CONFIRMATION, INCLUDING ANY CHANGES TO BARRIER OFFSET TO AVOID CLASHES, OR NECESSARY SERVICE RELOCATION.
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Amendments	By	Date	App'd
A - DETAILED DESIGN	CW	11/10/21	CH

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NOT FOR CONSTRUCTION

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Checked	C.MCKEGG	11/10/2021
Approved	C.HICK	11/10/2021
Drawing 1 of 6 Drawings		Revision No. A
Scale: AS SHOWN		
Dwg. Source:		
Source Ref. No.: 1028535		

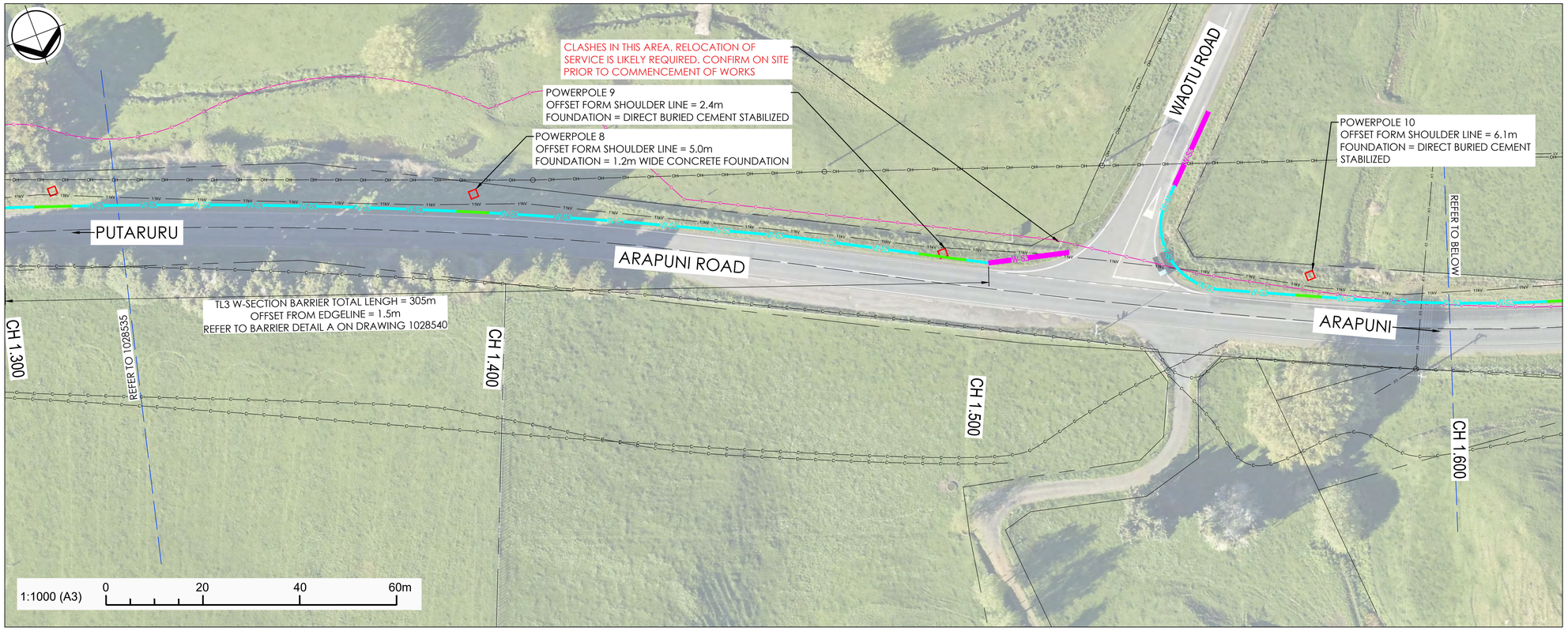
SUBTRANSMISSION

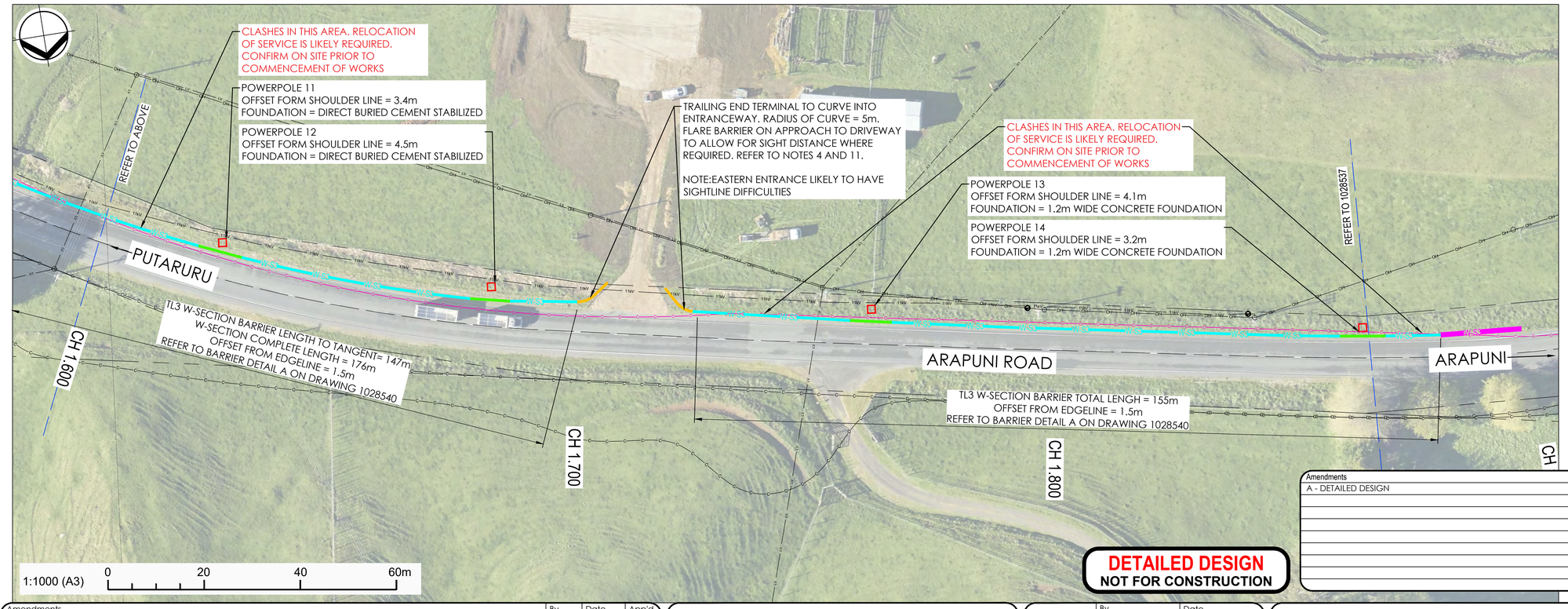
PUTARURU-ARAPUNI 110kV OVERHEAD LINE

BARRIER DESIGN - SHEET ONE

POWERCO
ELECT. DIVISION

Code	CIVIL
A1:	1028535





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- 1kv — EXISTING 11kV POWER

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Approved	C.HICK	11/10/2021
Drawing 2 of 6 Drawings		Revision No. A
Scale: AS SHOWN		
Dwg. Source:		
Source Ref. No.: 1028536		

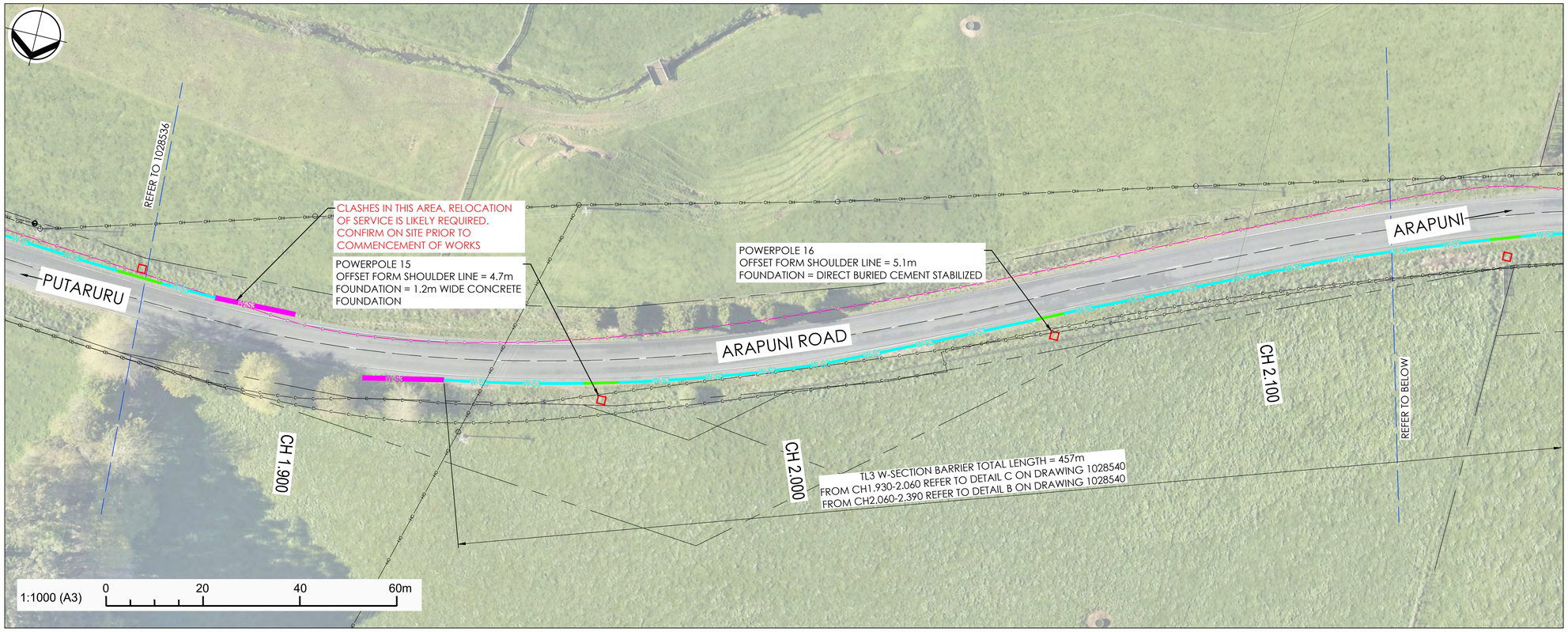
SUBTRANSMISSION

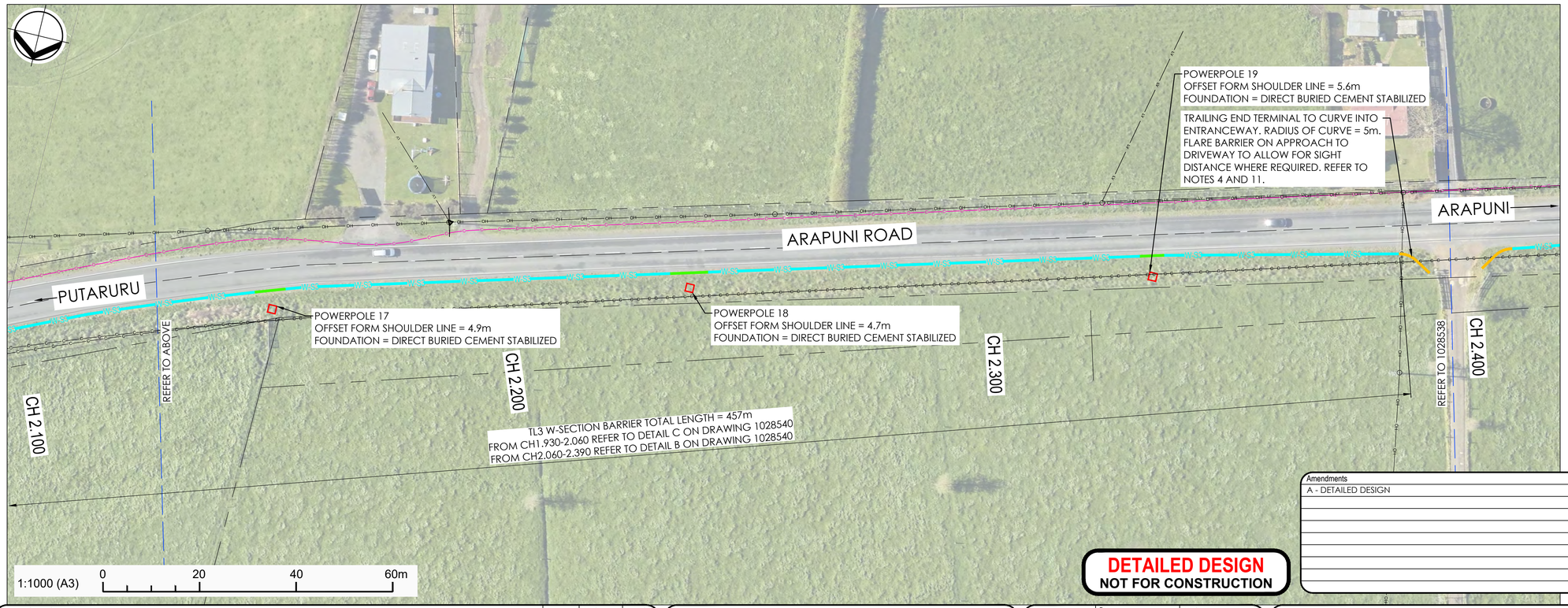
PUTARURU-ARAPUNI 110kV OVERHEAD LINE

BARRIER DESIGN - SHEET TWO

POWERCO
ELECT. DIVISION

Code	CIVIL
A1:	1028536





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NOT FOR CONSTRUCTION

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Approved	C.HICK	11/10/2021
Drawing 3 of 6 Drawings		Revision No. A
Scale: AS SHOWN		
Dwg. Source:		
Source Ref. No.: 1028537		

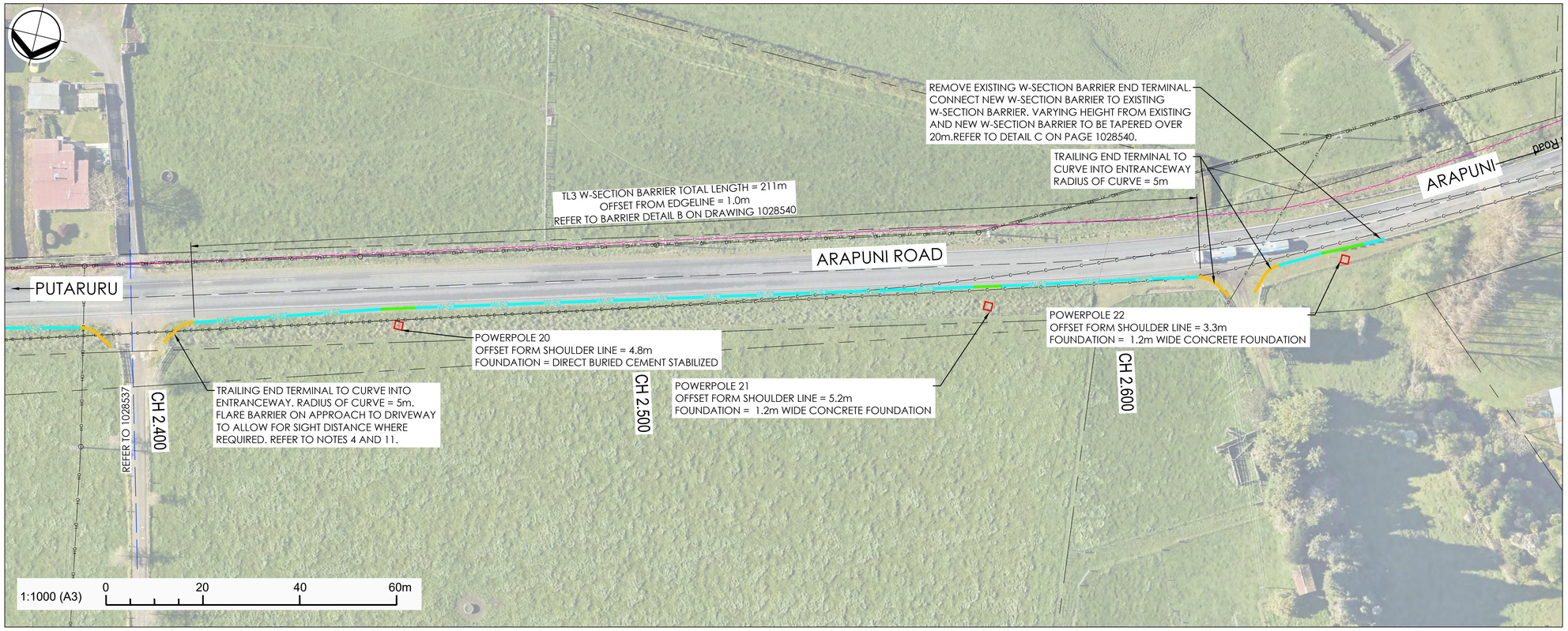
SUBTRANSMISSION

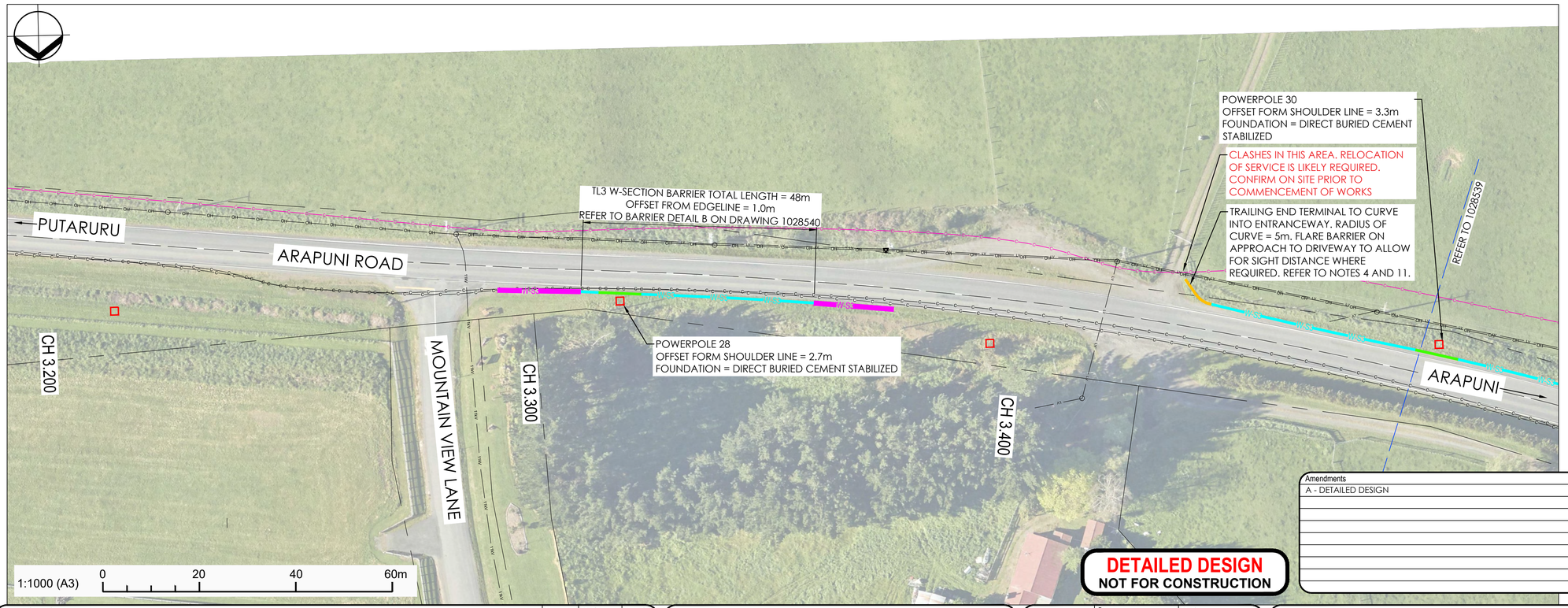
PUTARURU-ARAPUNI 110kV OVERHEAD LINE

BARRIER DESIGN - SHEET THREE

POWERCO
ELECT. DIVISION

Code	CIVIL
A1:	1028537





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Drawing 4 of 6 Drawings		Revision No. A
Scale: AS SHOWN		
Dwg. Source:		
Source Ref. No.: 1028538		

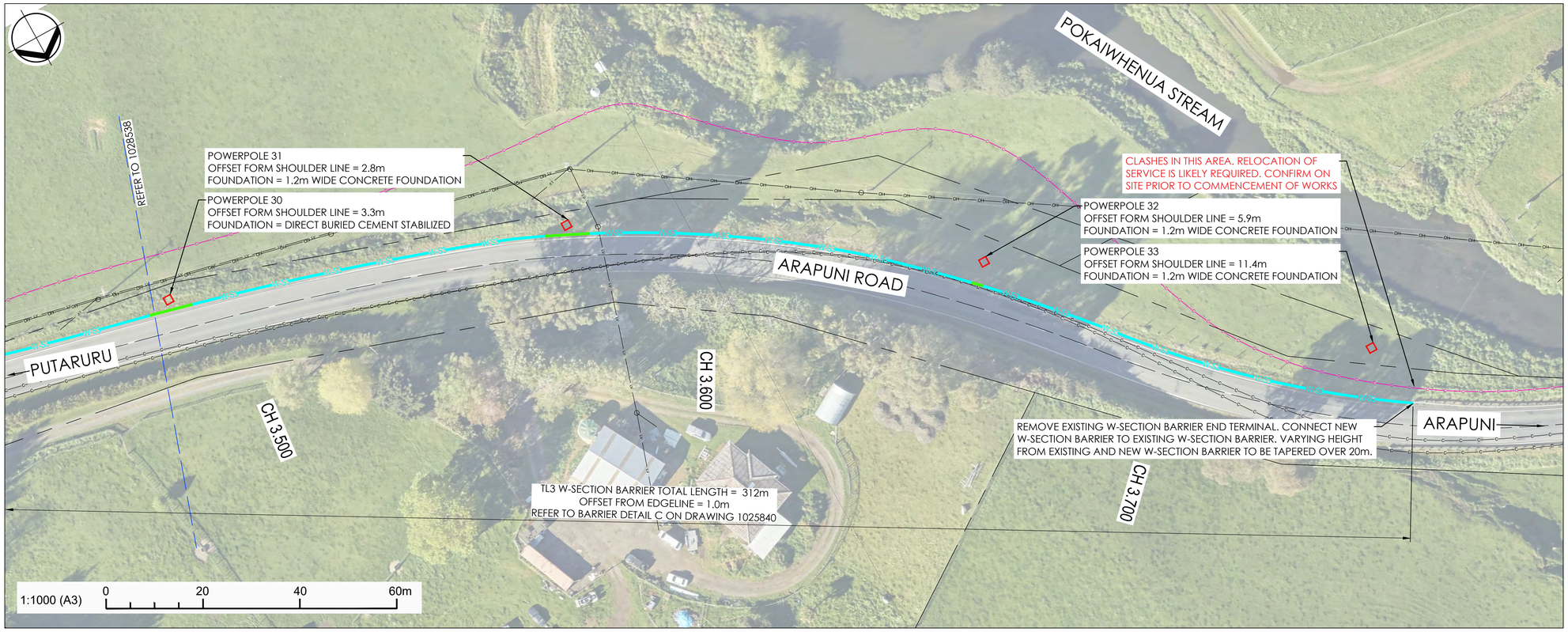
SUBTRANSMISSION

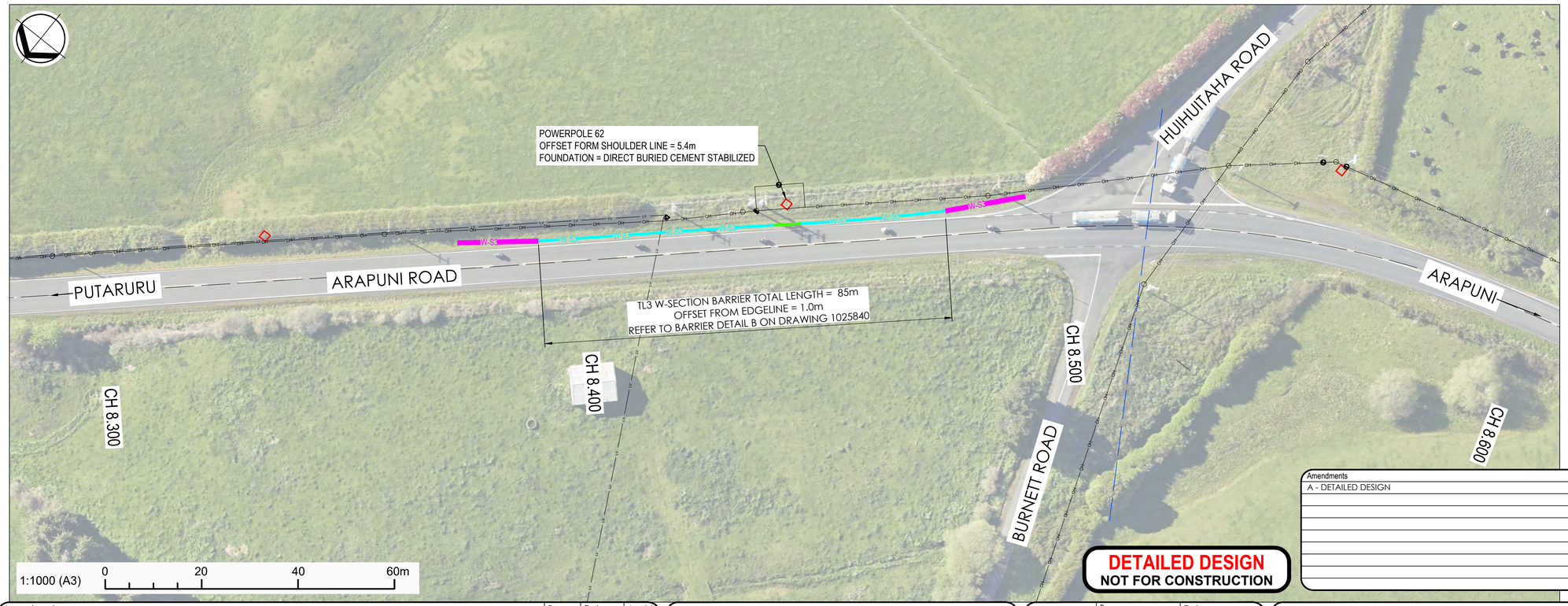
PUTARURU-ARAPUNI 110kV OVERHEAD LINE

BARRIER DESIGN - SHEET FOUR

POWERCO
ELECT. DIVISION

Code	CIVIL
A1:	1028538





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Dwg. Source:		
Source Ref. No.: 1028539		

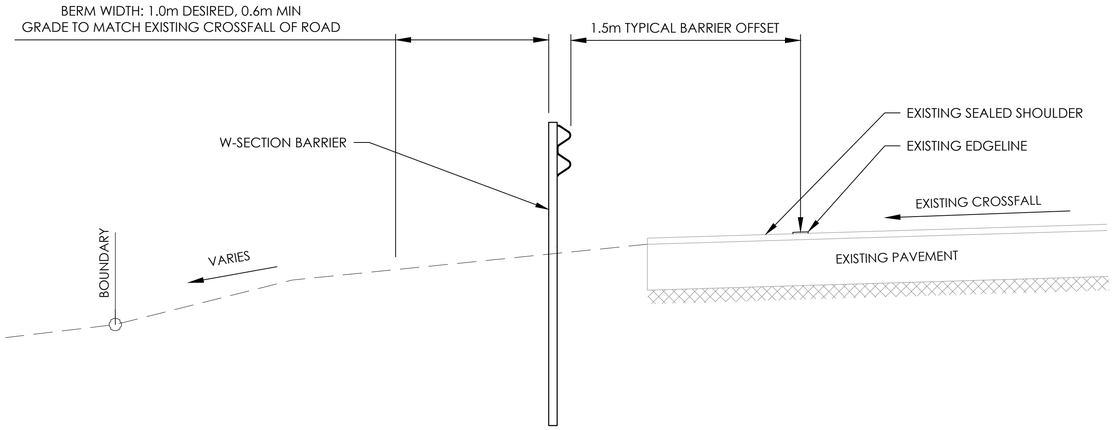
SUBTRANSMISSION

PUTARURU-ARAPUNI 110kV OVERHEAD LINE

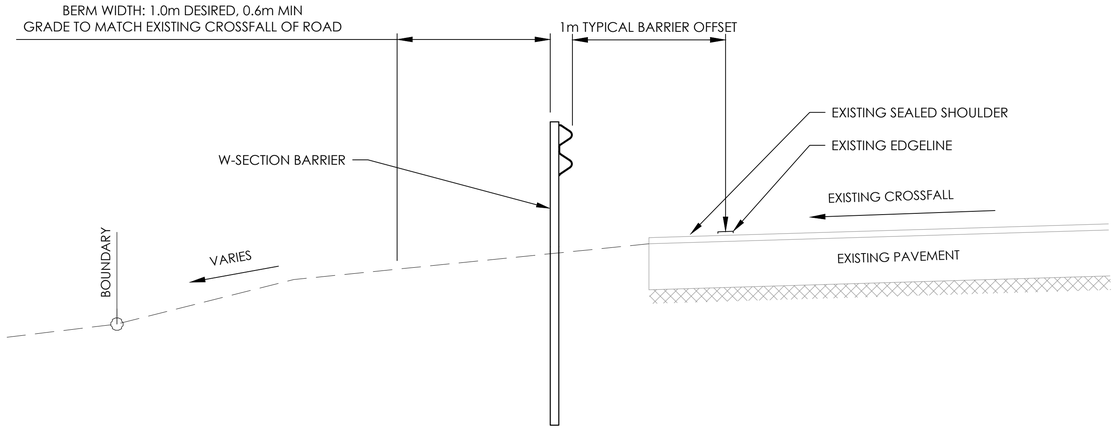
BARRIER DESIGN - SHEET FIVE

POWERCO
ELECT. DIVISION

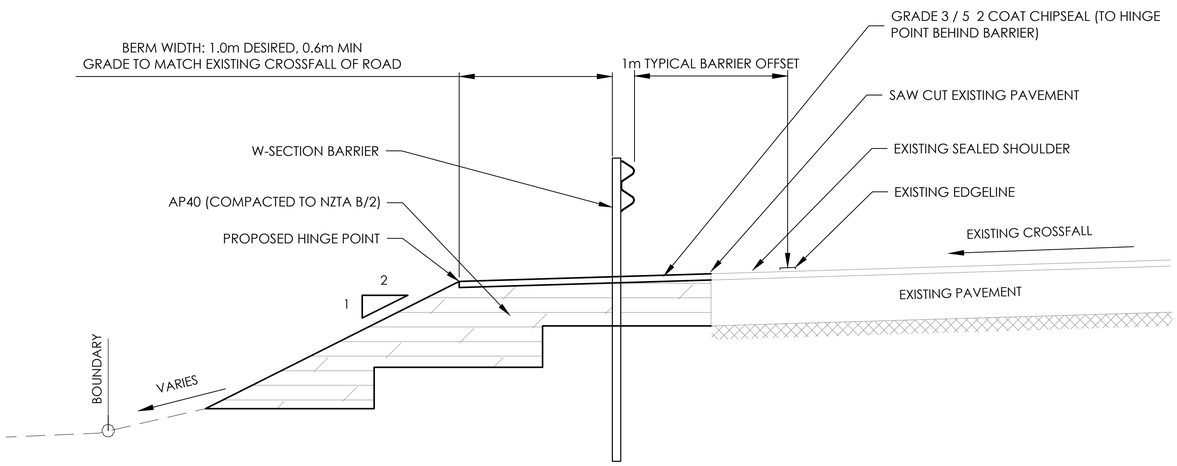
Code	CIVIL
A1:	1028539



A - SHOULDER TREATMENT TYPE 1 - 1.5m SHOULDER WITH NO WIDENING
SCALE 1:25



C - SHOULDER TREATMENT TYPE 3 - 1.0m SHOULDER WITH NO WIDENING
SCALE 1:25



B - SHOULDER TREATMENT TYPE 2 - 1.0m SHOULDER WITH WIDENING
SCALE 1:25

NOTES

1. CONTRACTOR TO REBATE FROM SAWCUT LINE 300mm DEEP WITH REBATED MATERIAL TO BE COMPACTED AS FOUNDATION FOR NEW BASE COURSE.
2. NEW BASE COURSE MATERIAL TO BE COMPACTED IN TWO LAYERS, TOP SURFACE TO MATCH CROSSFALL OF ADJACENT ROAD.
3. FINAL SURFACE TO BE FREE FROM LOOSE MATERIAL, PRE SEAL INSPECTION BY ENGINEER REQUIRED BEFORE SURFACING.
4. PRIOR TO ANY PAVEMENT WIDENING WORKS, CONTRACTOR TO REMOVE ANY ORGANIC MATERIAL AND CART TO WASTE OR STOCKPILE FOR RE USE.

Amendments	By	Date	App'd
A - DETAILED DESIGN	CW	11/10/21	CH

DETAILED DESIGN
NOT FOR CONSTRUCTION

Amendments	By	Date	App'd

Beca

	By	Date
Designed	C.WILSON	11/10/2021
Drawn	C.WILSON	11/10/2021
Checked	C.MCKEGG	11/10/2021
Approved	C.HICK	11/10/2021
Drawing 6 of 6 Drawings		Revision No. A
Scale: AS SHOWN		
Dwg. Source:		
Source Ref. No.: 1028540		

SUBTRANSMISSION

PUTARURU-ARAPUNI 110kV OVERHEAD LINE

BARRIER DESIGN - TYPICAL SHOULDER

POWERCO
ELECT. DIVISION

Code	CIVIL
A1:	1028540