Appendix 7

Existing TransGrid 500kV Transmission Line Realignment Option Study

prepared by

GHD Pty Ltd

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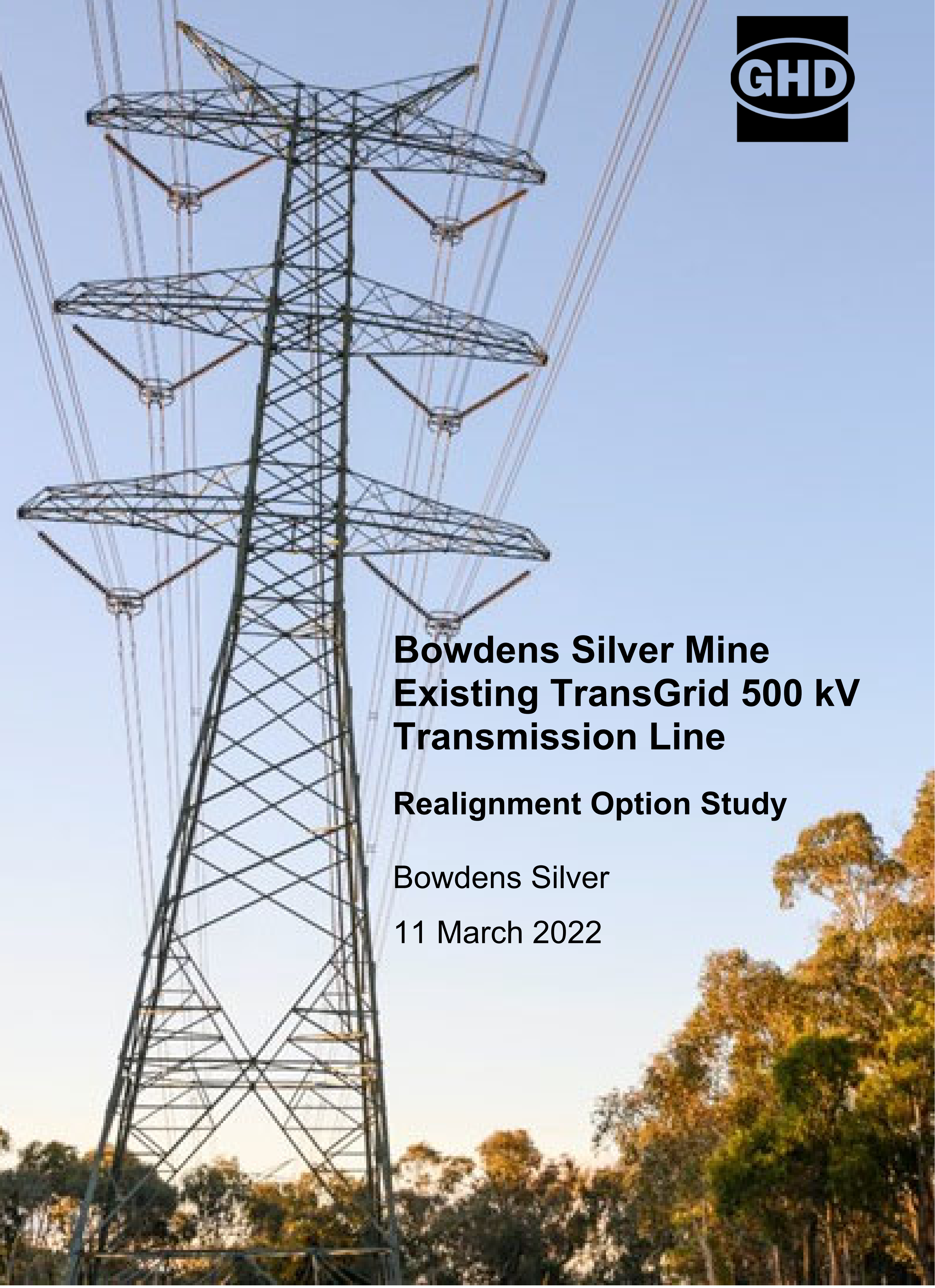

Bowdens Silver Mine Existing TransGrid 500 kV Transmission Line

Realignment Option Study

Bowdens Silver

11 March 2022

GHD | ABN 39 008 488 373
Level 15, 133 Castlereagh Street
Sydney, NSW 2000, Australia
T 02 9239 7100 | **ghd.com**

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Author	Airaf Afzal, Brent Mitchley
Project manager	Jason Clegg
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Executive summary

The existing 500kV TransGrid feeders 5A5 and 5A3 run between Mt Piper Power Station and Bayswater Power Station, NSW. A section of these existing 500kV transmission feeders traverses the proposed main open cut pit and other mining infrastructure proposed for the Bowdens Silver Mine at Lue, NSW (the Project), and therefore requires an assessment of line relocation options.

A feasibility study was carried out in 2018 for the Project and considered opportunities for the 500kV alignment. Following that review a preferred alignment was selected and presented in the EIS. The purpose of this realignment option assessment aims at optimising the preferred option in the EIS, and providing an alternative realignment option that will reduce the visual impact of the preferred option proposed in the feasibility study. The alternative re-alignment option considered in this report is approximately 300m from the existing alignment. This review refers to the EIS Alignment and the Proposed Alignment to compare the alignment proposed in the EIS and that now proposed following this study.

The table below provides the findings of the line relocation assessment:

Item	Assessment Criteria	Proposed Alignment	EIS Alignment	Comments
1	Re-alignment route length	The proposed alignment deviation route length is approximately 2.7km.	The EIS alignment deviation route length is approximately 3.5km.	The EIS alignment length is greater than the proposed alignment length and therefore would result in two (2) additional structures along the route.
2	Proximity to properties outside mine site boundary	The proposed alignments shortest distance to a property is approximately 1.5km to property 35.	The EIS alignments shortest distance to a property is approximately 1.4km to property 35.	The EIS alignment would be located closer to properties outside the mine site boundary, such as properties 36A and 35, compared to the proposed alignment.
3	Terrain profile as seen from properties towards re-alignment structures	Some structures will be visible when viewed from private residences though the views are mitigated by distance.	Structure views are visible when viewed from private residences.	Some structures appear hidden behind terrain peaks on the EIS alignment route in southern sections, especially from property 35. However, in these locations the proposed alignment would not change from existing tower locations and therefore existing impacts would not change or towers would remain obscured. In general, the EIS Alignment is more visually prominent than the Proposed Alignment.
4	Proximity to mining layout area	Shortest distance to mining layout area is approximately 300m.	Shortest distance to mining layout area is approximately 350m.	The proposed alignment is located closer to the mining area compared to the EIS alignment. Both options satisfy the required safety clearance of 201m[1].
5	Impact on existing structure duty	Compared to the existing alignment, the proposed alignment will reduce the deviation angle at the structure where deviation will begin (northern end). However, a deviation angle will be created as the line joins back at the existing structure on the southern side.	Similar to the proposed alignment, the deviation angle is reduced at the starting structure of the deviation (north) and is created at the last structure where the deviation joins back to existing structure (south).	Both options would reduce the existing deviation angle at the existing structure located to the north. Where the re-located line joins with existing alignment to the south, new deviation angles would be created and the existing structure duty is to be assessed for the new deviation angles. The adjacent span lengths in both options are similar at the existing structure located north.
6	Terrain profile	The shortest and longest span length is approximately 310m and 490m respectively.	The shortest and longest span length is approximately 227m and 475m.	The terrain profile is similar for both options. There are shorter span lengths in the EIS alignment as a result of two (2) deviation angles located on the line route.

Based on the above considerations, the proposed alignment is the preferred option as the number of structures to be relocated has been reduced; the re-alignment route is located further away from properties outside the mine site boundary compared with the EIS alignment; therefore the proposed alignment has less visual impact to the surrounding properties.

[1] 42925_Vol 1_Part 1 Noise and Vibration - May 2020.pdf prepared by SLR Consulting Australia Pty Ltd.

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1. Introduction

1.1 Purpose of this report

GHD has been engaged by Bowdens Silver to provide a high level assessment of realignment options for a section of the existing TransGrid 500 kV transmission feeders 5A5 and 5A3 running between Mt Piper Power Station and Bayswater Power Station, NSW.

The two feeders share the same towers in a double circuit configuration. As shown in Figure 1, a section of the 500 kV overhead line is located within the boundary of the proposed Bowdens Silver Mine (the Project). The section traverses the proposed main open cut pit and other mining infrastructure proposed for the Project, therefore a realignment is proposed. A feasibility study was carried out in 2018 and three (3) realignment options were proposed. The preferred realignment option at that time was selected following this review and is shown in pink line, with the existing 500 kV overhead line alignment shown in blue line in Figure 1.

The purpose of this realignment option assessment aims at optimising the option presented in the EIS, and providing an alternative realignment option that will reduce the visual impact of the option presented in the EIS.

GHD's assessment takes the following factors into consideration:

– the impact on structural loading at proposed structure locations.
– conductor clearances.
– structural loading impact at existing tower locations.
– the clearance required to the proposed mining infrastructure.
– the visual impact from properties located outside the mine site boundary (see Figure 1).

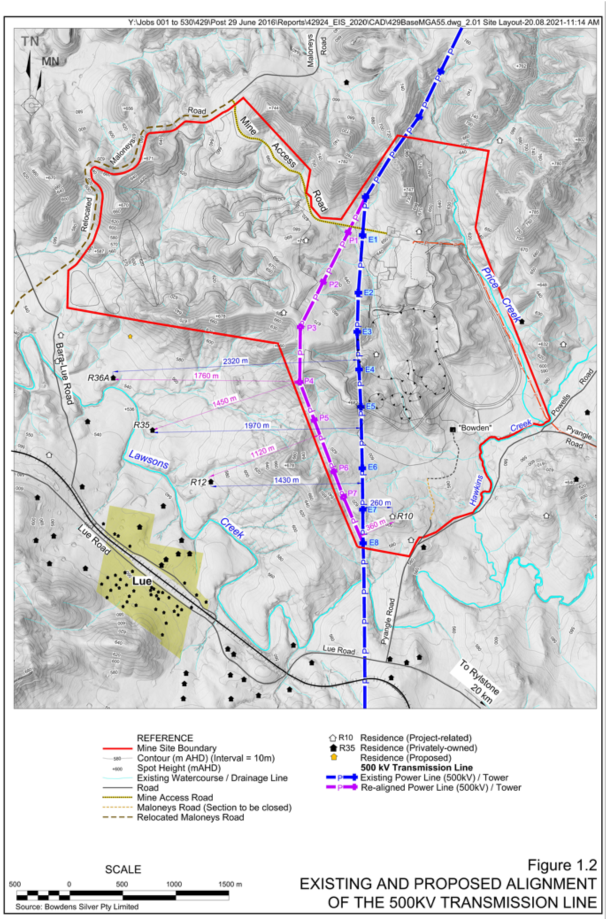

Figure 1: Existing and the original proposed alignment of 500 kV transmission line.

1.2 Scope and limitations

As part of this assessment, GHD created an overhead line model using PLS-CADD software, and presented multiple alternative options located between 200m to 500m on the western side of the existing alignment. In GHDs' meeting with Bowdens on 29 Oct 2021, Bowdens stated that the new preferred alignment is 300 m from the existing alignment, as the 300m provided mitigation of potential visual impacts for private landowners while retaining a suitable offset distance from mining.

As a result, this report provides an assessment of the following line route options:

- Proposed Alignment: Re-alignment located approximately 300m west of the existing 500kV transmission line.
- EIS Alignment: Re-alignment located near the mine site boundary. This is the original preferred realignment option represented by the pink colour re-alignment in Figure 1.

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The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1.3 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

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1.3 Assumptions

The re-alignment models have been created using the following assumptions:

– 500kV double circuit structure geometry, as per TransGrid drawings TL-158091 and TL-169979. Structure dimensions have been based on similar 500kV arrangements such as Figure 13.3-8 EPRI AC Transmission Line Reference Book - 200kV and Above. See Appendix A for structure outline drawings.
– 54/3.25 7/3.25 ACSR/GZ used to model phase conductors, as per Section 10.2 TLDM-MNB. See Appendix B for conductor details.
– 30/3.00 7/3.00 ACSR/GZ used to model earth wires, as per Section 10.2 TLDM-MNB. See Appendix B for conductor details.
– No structure model has been created in PLS-CADD for detailed tower strength assessment.
– Existing TransGrid towers have not been modelled for detailed tower strength assessment.
– Existing transmission line survey has not been made available for the re-alignment options assessment.

2. Reference Standards

The following standards have been utilized in the assessment of the 500kV re-alignment options:

– TransGrid Transmission Line Design Manual for 220kV, 330kV and 500kV – Major New Build TLDM-MNB.
– AS/NZS 7000:2016.

3. Input Files

The following files provided by Bowdens have been imported into modelling software PLS-CADD to assess the re-alignment options:

– Lidar_contour_2m.dxf
– Land_Ownership.dxf
– Existing Powerline.shp
– Mine Site Layout.shp
– Mine_Site_Boundary.shp
– Easements_LPI_2017_GDA94_MGA55.dxf
– PowerlineOptions.dxf
– Cadastre_LPI_DCDB_2017.dxf

Terrain LIDAR points have been imported from open source, Elevation and Depth – Foundation Spatial Data.

4. Existing line route - Plan & Profile View

Figure 2 is a plan view of existing 500kV transmission line route. The Mine site boundary is displayed in red line.

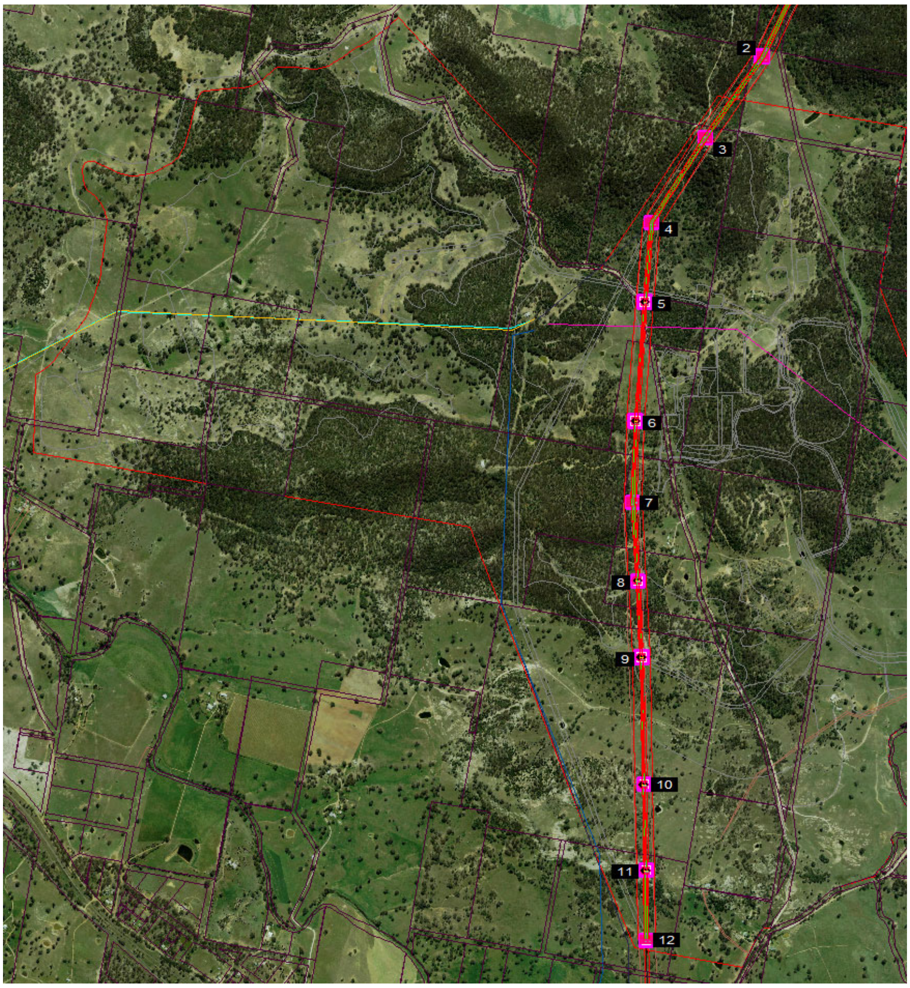


Figure 2: Existing line route plan view.

Figure 3 below is profile of the existing line route.

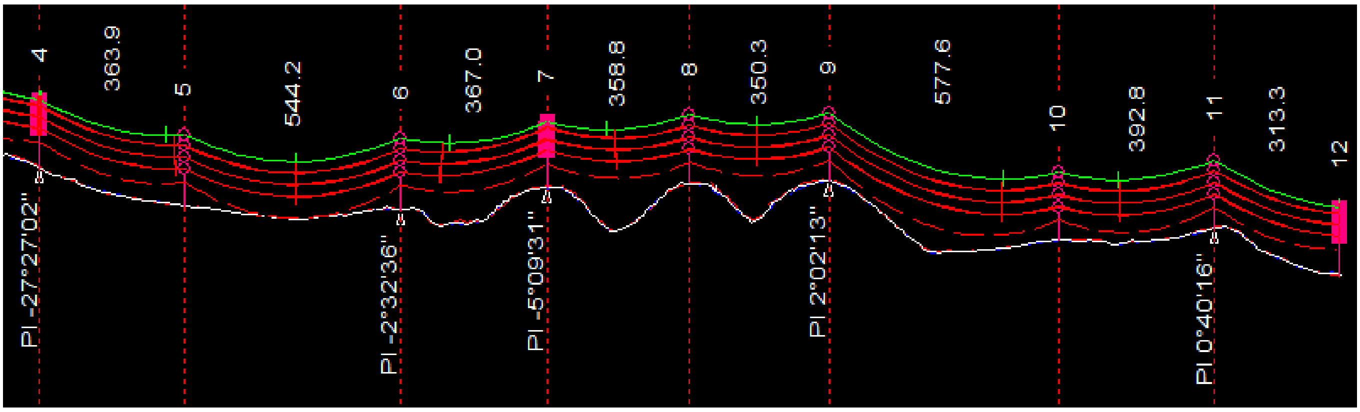


Figure 3 : Existing line route profile view.

5. Proposed Alignment - Plan & Profile View

The alignment is to be relocated 300 m west of the existing 500 kV overhead line.

Figure 4 below is a plan view of the proposed alignment of the 500kV transmission line. The existing structures labelled 4 and 11 represent the start and finish locations of the line route deviation.

Distance is displayed between the existing alignment and the re-alignment.

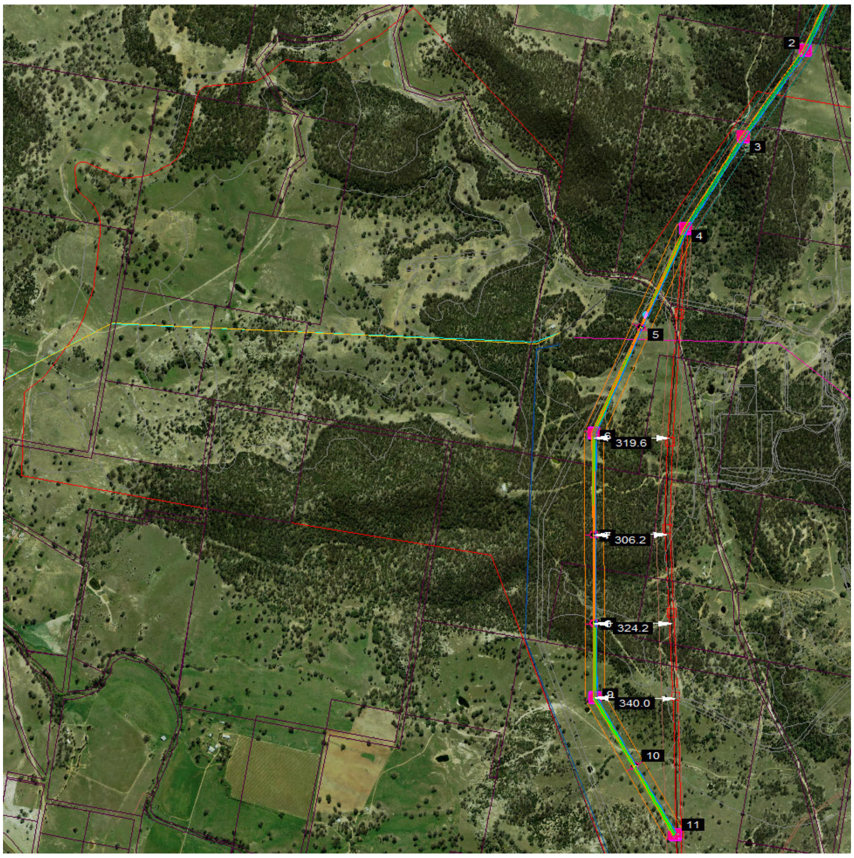


Figure 4 : Proposed alignment plan view.

Figure 5 below is the proposed alignment profile. The structures 4 and 11 represent the start and finish locations of the re-alignment.

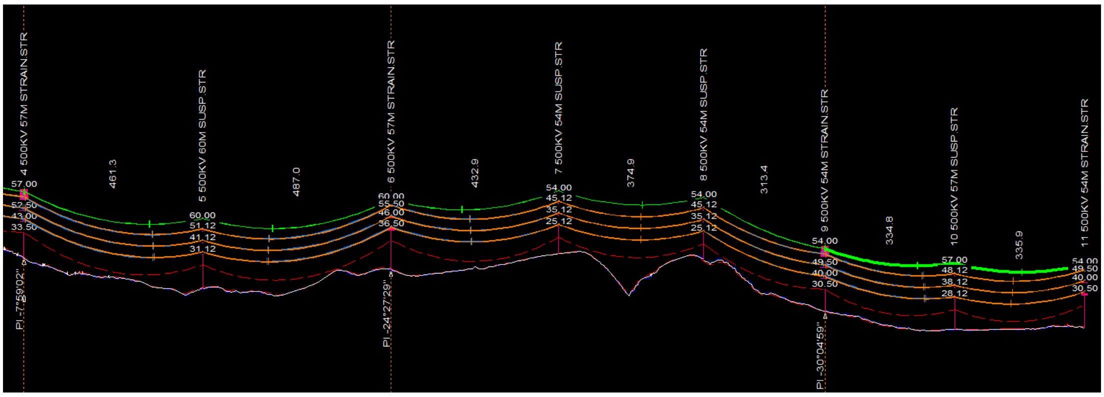


Figure 5 : Proposed alignment profile.

6. EIS Alignment – Plan & Profile View

Figure 6 below is a plan view of the EIS alignment of the 500kV transmission line. Existing structures labelled 4 and 13 represent the start and finish locations of the line route deviation.

Distance is displayed between the existing alignment and the re-alignment.

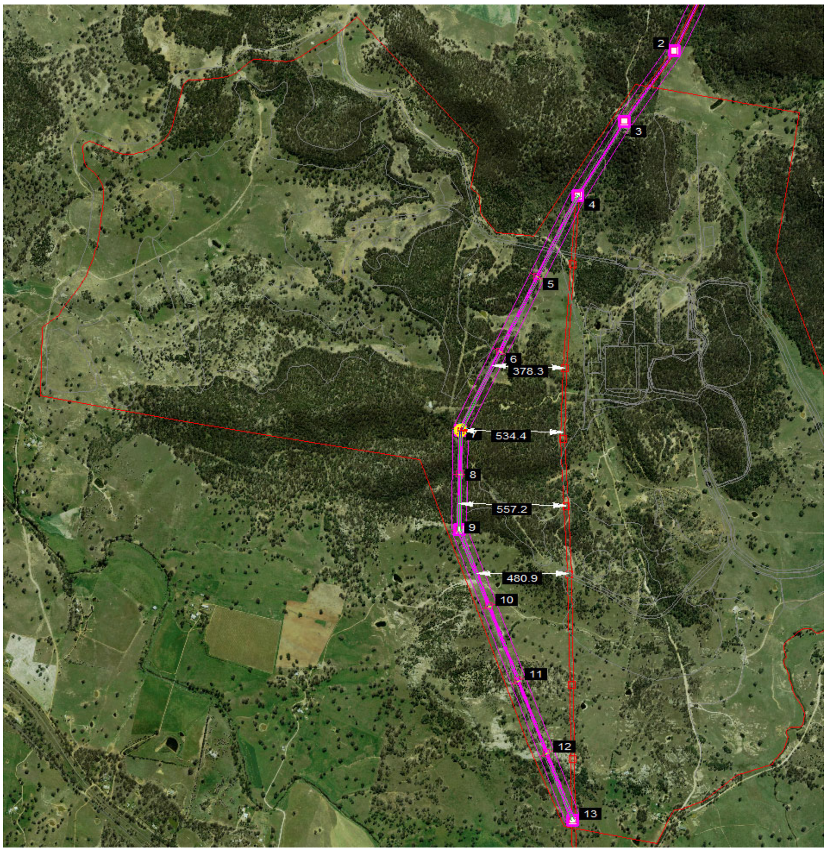


Figure 6 : EIS alignment plan view.

Figure 7 below is the EIS alignment profile. The structures 4 and 13 represent the start and finish locations of the re-alignment.

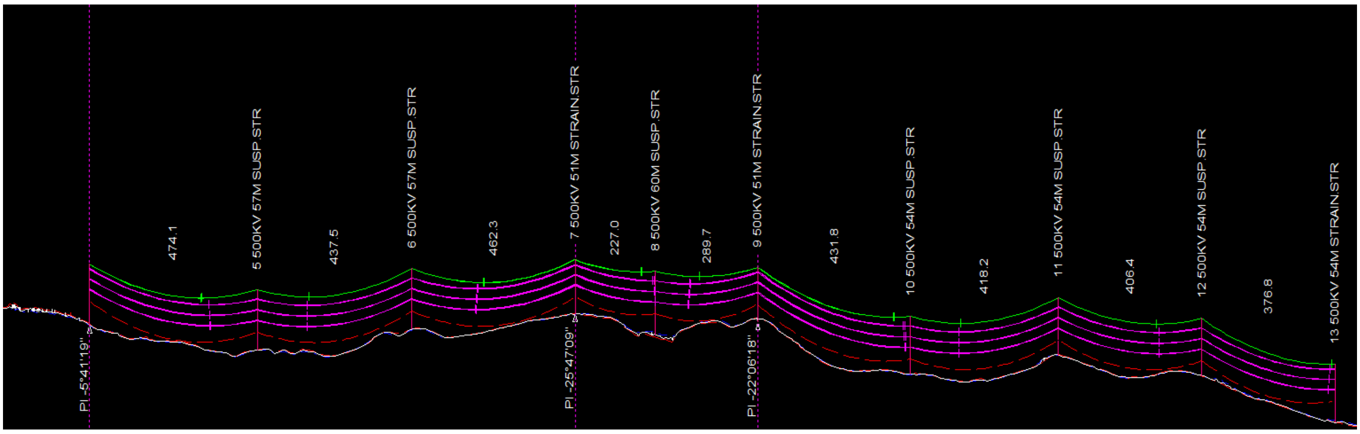


Figure 7 : EIS alignment profile view.

7. Visual impact assessment – plan view

This section indicates distances from the re-alignment options to properties 36A and 35 located outside the mine site boundary.

7.1 Property 36A proximity

Figure 8 below is a plan view from property 36A to the proposed alignment. Distances are shown from property 36A to the proposed re-alignment.

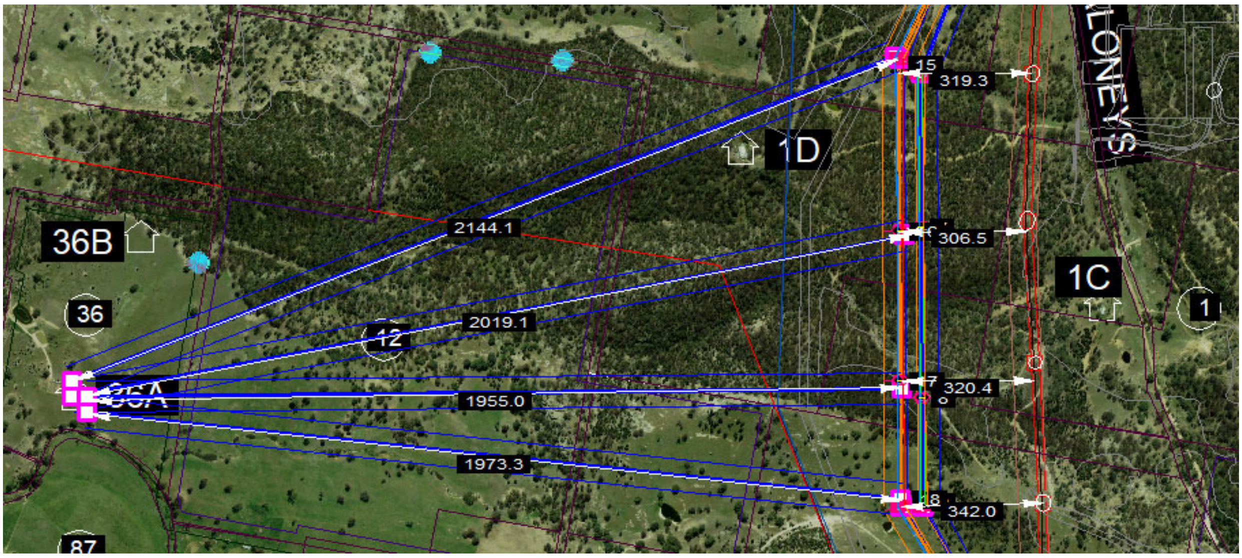


Figure 8 : Distance from property 36A to the proposed alignment.

Figure 9 below is a plan view from property 36A to the EIS alignment. Distances are shown from property 36A to structures on the proposed re-alignment.

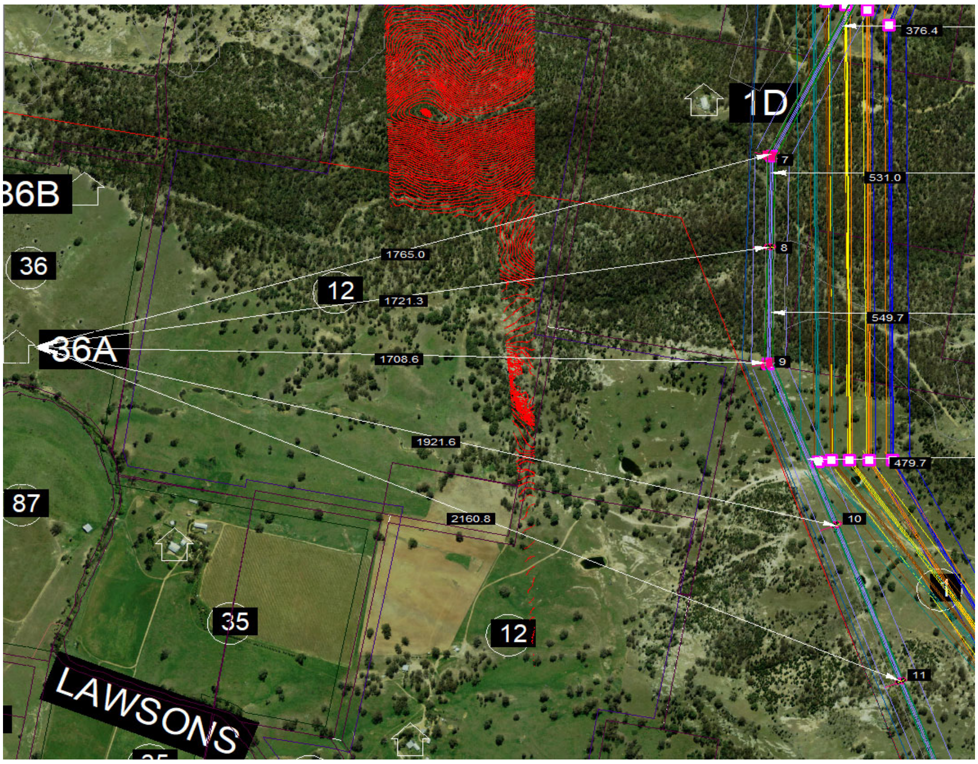


Figure 9 : Distance from property 36A to the EIS alignment.

7.2 Property 35 proximity

Figure 10 below is a plan view from property 35 to the proposed alignment. Distances are shown from property 35 to structures on the proposed re-alignment.

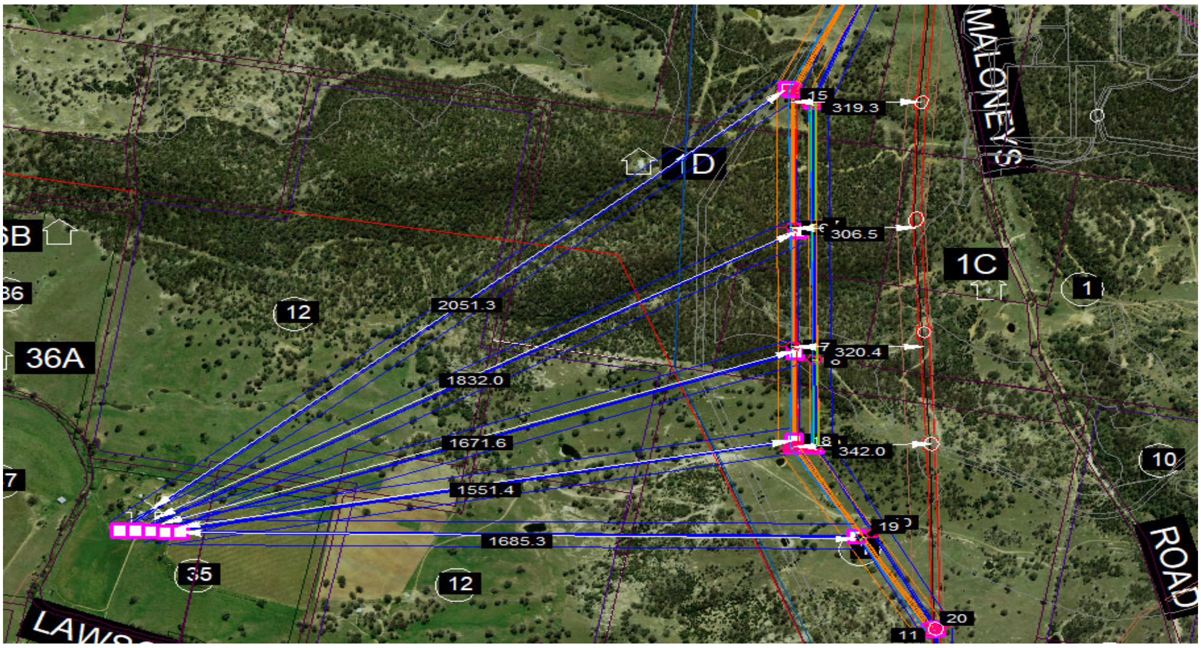


Figure 10 : Distance from property 35 to the proposed alignment.

Figure 11 below is a plan view from property 35 to the EIS alignment. Distances are shown from property 35 to structures on the proposed re-alignment.

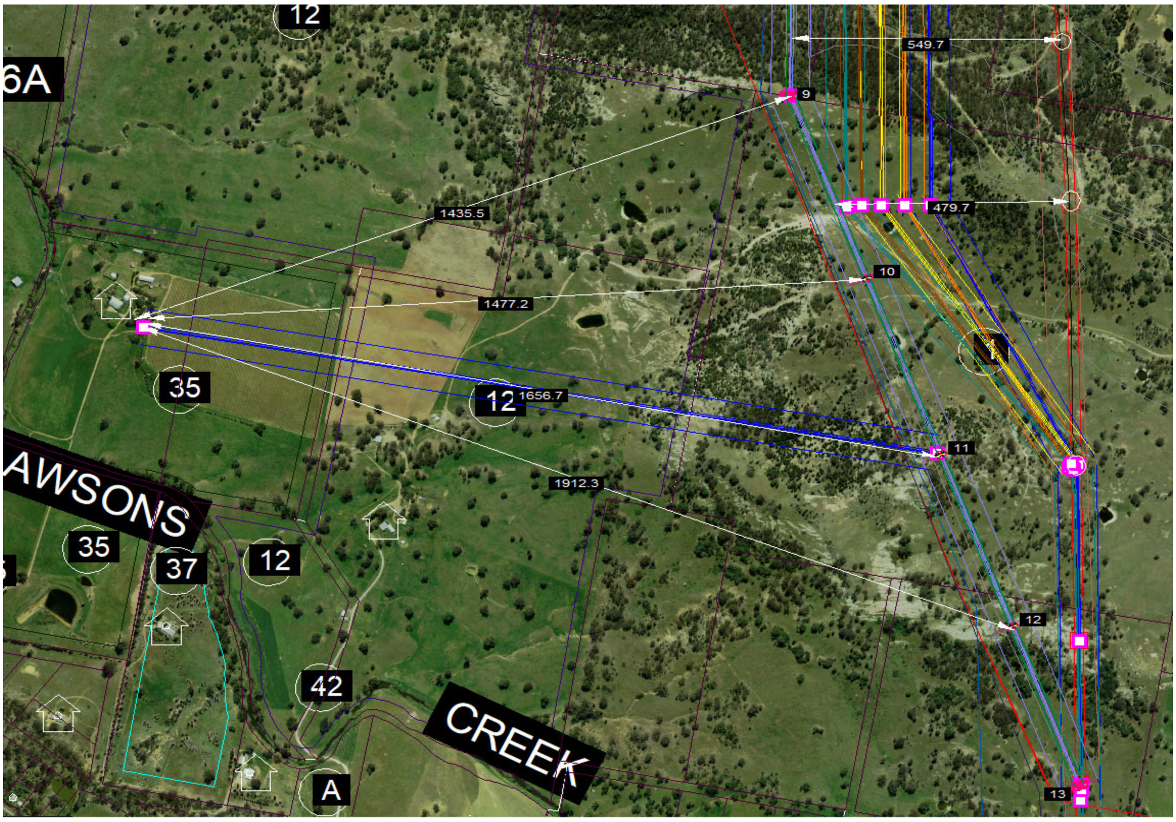


Figure 11 : Distance from property 35 to the EIS alignment.

7.3 Summary of re-alignment proximity to properties

Based on above plan view assessment of re-alignment distances to properties 36A and 35, the following is observed:

- The closest distance to property 36A from the proposed alignment is approximately 1.9km and from the EIS alignment it is approximately 1.7km.
- The closest distance to property 35 from the proposed alignment is approximately 1.5km and from the EIS alignment it is approximately 1.4km.

8. Visual impact assessment - profiles

8.1 Terrain Profile from property 36A

Figure 12 below are terrain profiles as seen from property 36A to the proposed alignment. Property 36A is located at the far left of the terrain profiles. The four (4) profiles below are to four (4) different structure locations on the re-aligned route.

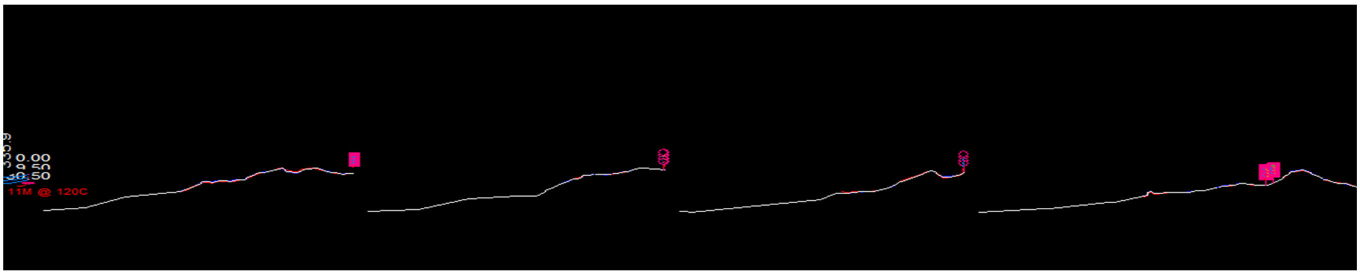


Figure 12 : Terrain profiles from property 36A to the proposed alignment.

Terrain profiles are shown below as seen from property 36A to the EIS alignment. Property 36A is located at the far left of the terrain profile. The five (5) profiles below are to five (5) different structure locations on the re-aligned route.

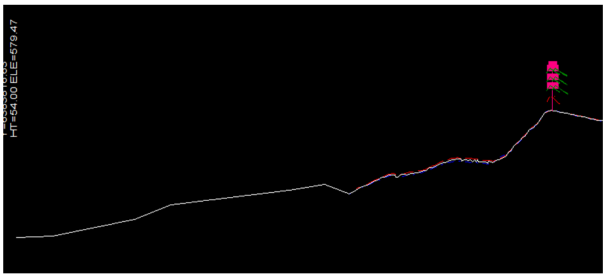


Figure 13 : Terrain profile 1 from property 36A to the EIS alignment.

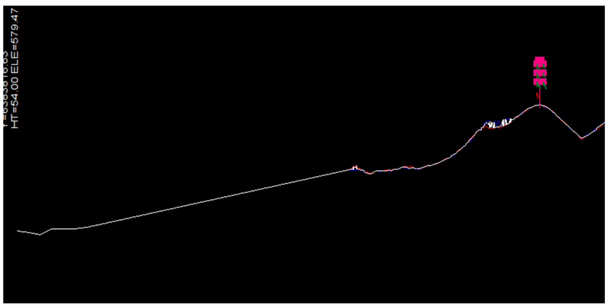


Figure 14 : Terrain profile 2 from property 36A to the EIS alignment.

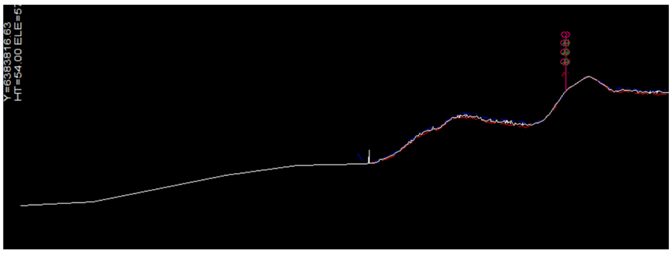


Figure 15 : Terrain profile 3 from property 36A to the EIS alignment.

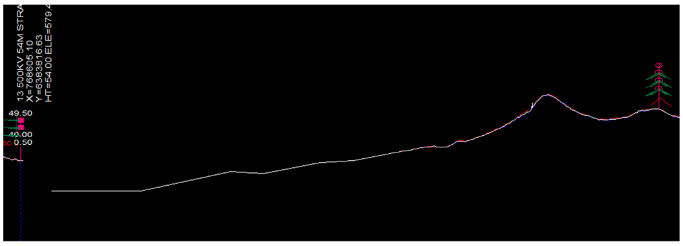


Figure 16 : Terrain profile 4 from property 36A to the EIS alignment.

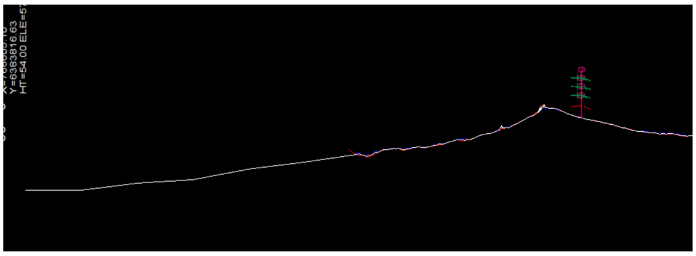


Figure 17 : Terrain profile 5 from property 36A to the EIS alignment.

8.2 Terrain Profile from property 35

Figure 18 below provides terrain profiles as seen from property 35 to the proposed alignment. Property 35 is located at the far left of the terrain profiles. The five (5) profiles below are to five (5) different structure locations on the re-aligned route.

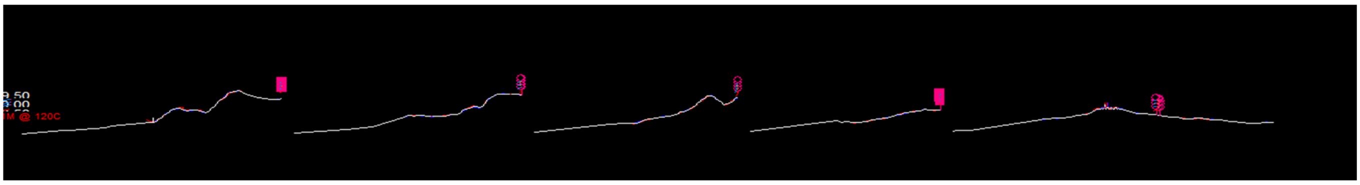


Figure 18 : Terrain profiles from property 35 to the proposed alignment.

Terrain profiles are shown below as seen from property 35 to the EIS alignment. Property 35 is located at the far left of the terrain profile. The four (4) profiles below are to four (4) different structure locations on the re-alignment.

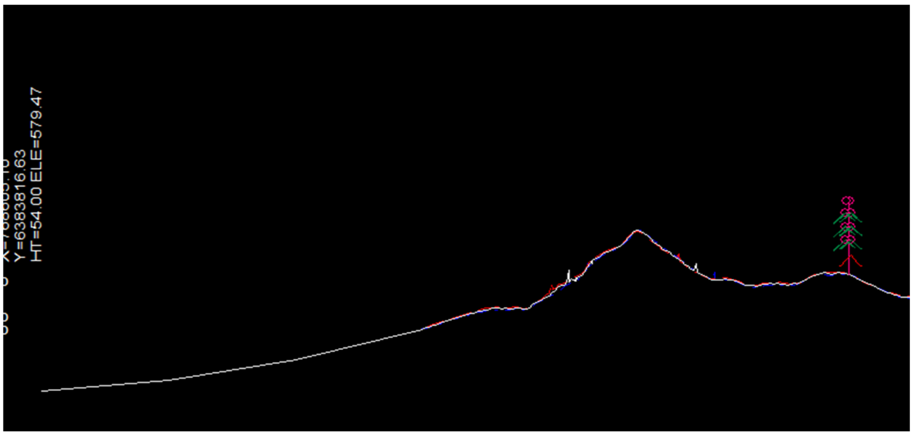


Figure 19 : Terrain profile 1 from property 35 to the EIS alignment.

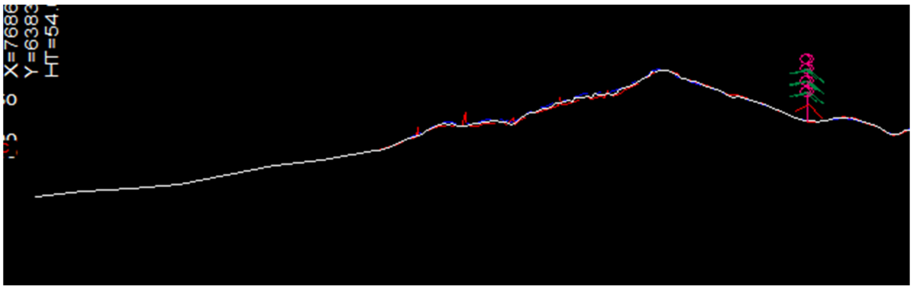


Figure 20 : Terrain profile 2 from property 35 to the EIS alignment.

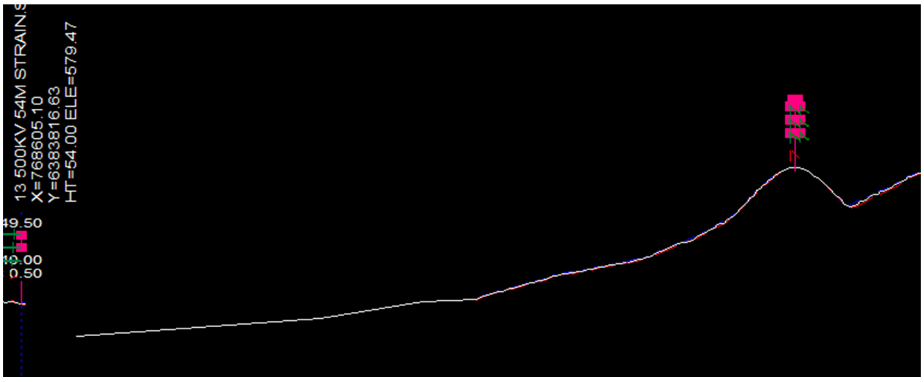


Figure 21 : Terrain profile 3 from property 35 to the EIS alignment.

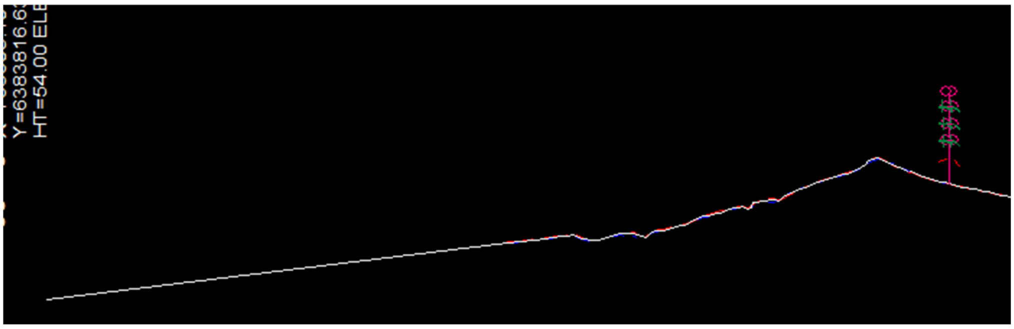


Figure 22 : Terrain profile 4 from property 35 to the EIS alignment.

8.3 Summary of terrain profiles from properties

Based on the above profile views as seen from properties 36A and 35 towards the re-alignment options, the following is observed:

- Structure views from property 36A will be visible on both the proposed and EIS alignments at different locations along the re-alignment route.
- Structure views are visible from property 35 to the proposed alignment at different locations on the re-alignment route to the EIS alignment. Some structures appear hidden behind terrain peaks for the EIS alignment route in southern sections, however towers in this location would not be changed under the proposed alignment (that is, they would remain in existing locations).

9. 3-D Terrain Profiles

The below 3-D terrain profiles indicate the land topography, location of new structures along the re-alignment options and location of properties outside the mine site boundary.

Figure 23 below shows the 3-D terrain view of the existing line and the proposed and EIS alignments, looking south.

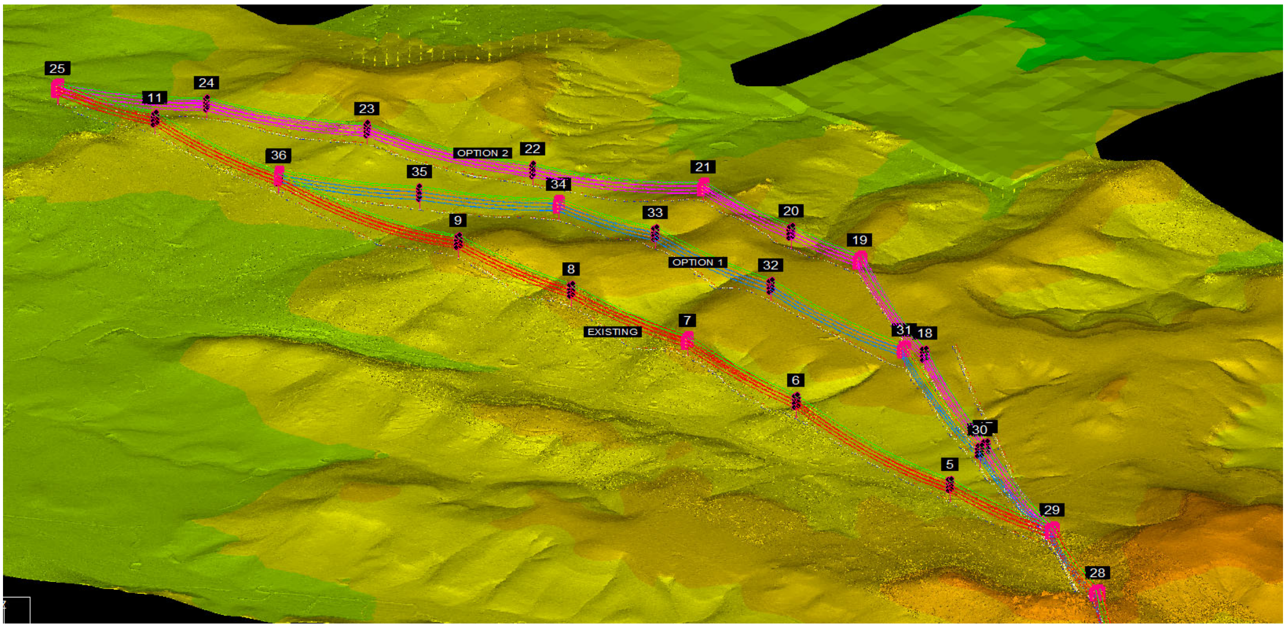


Figure 23 : 3D terrain view of re-alignment options looking south.

Figure 24 below is a close-up of the 3-D terrain view of the existing line and the proposed and EIS alignments, looking south.

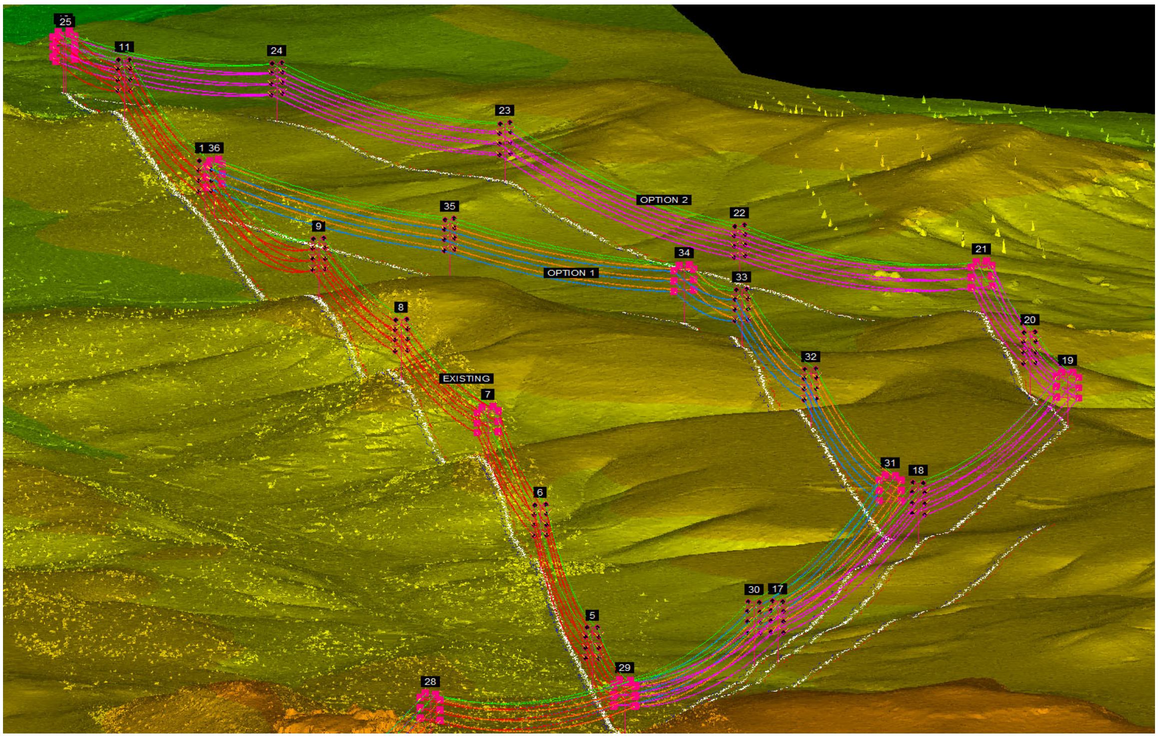


Figure 24 : 3D terrain view close-up of re-alignment options looking south.

Figure 25 below shows the 3-D terrain view of the existing line and the proposed and EIS alignments, looking north.

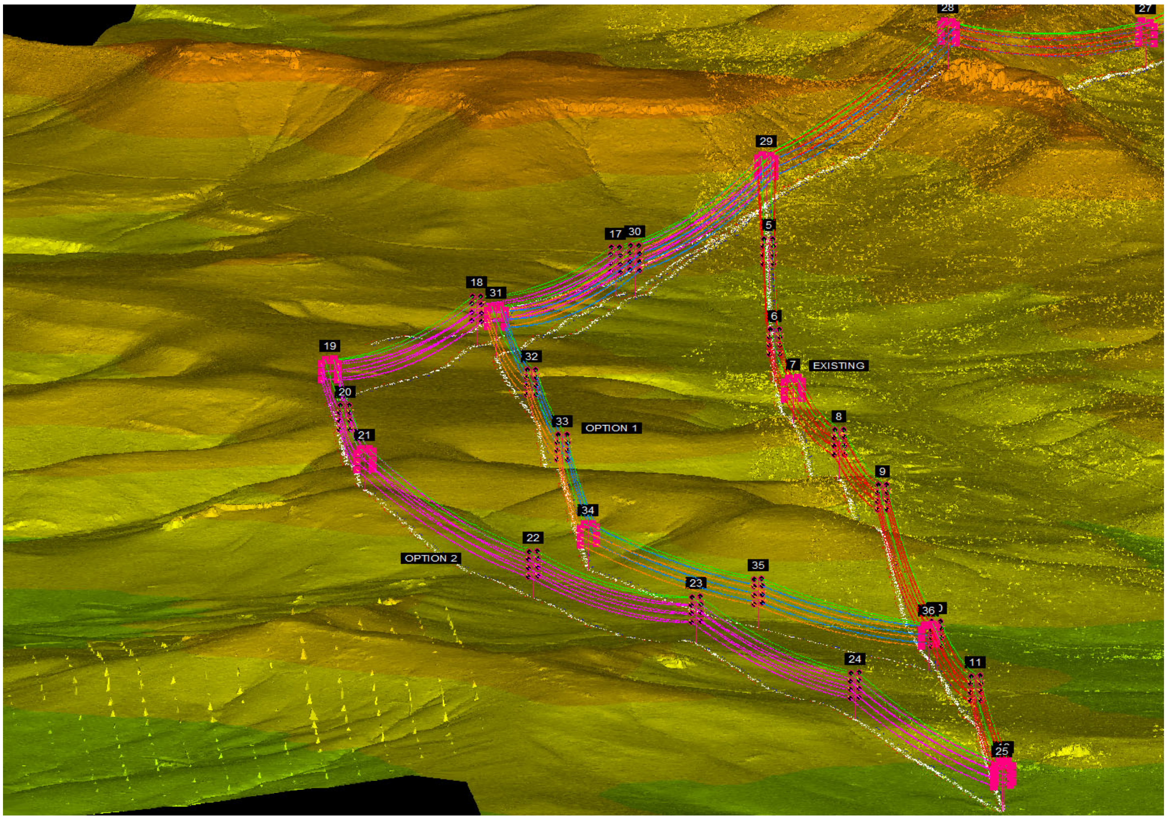


Figure 25 : 3D terrain view of re-alignment options looking north.

Figure 26 below shows the 3-D terrain view with properties shown in the background. Labels 37 and 38 represent properties 36A and 35 respectively. Label 39 is property 12 which is Project-related.

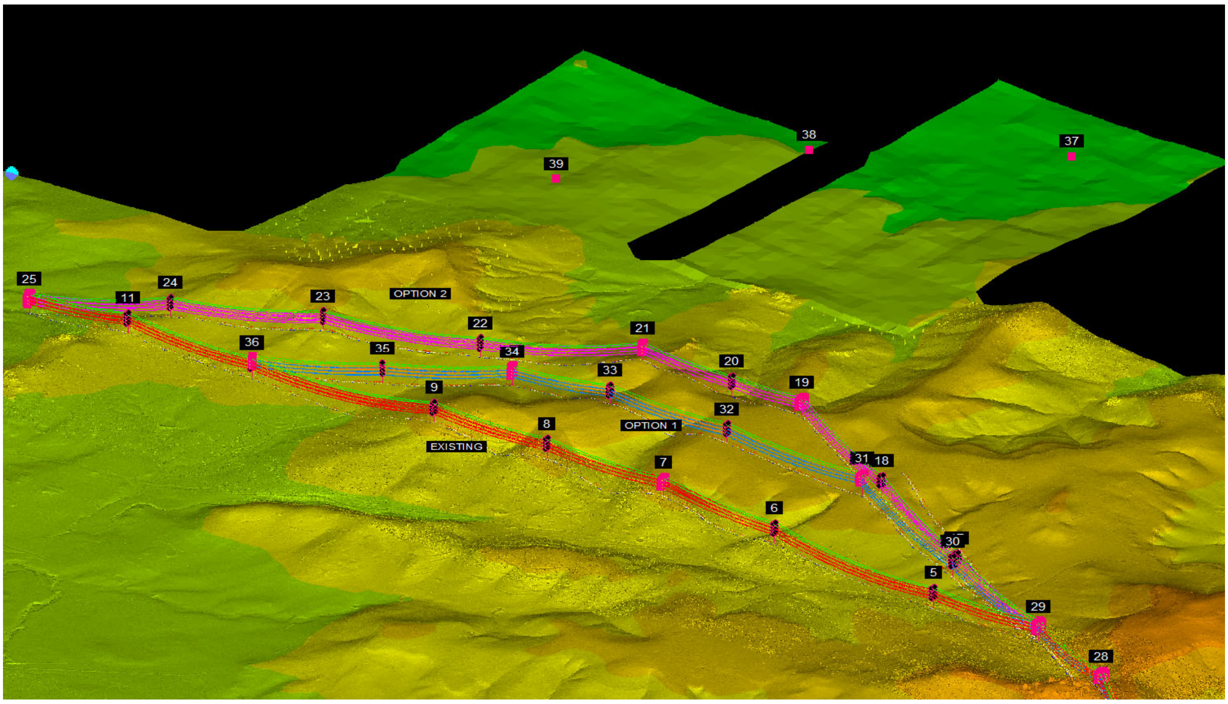


Figure 26 : 3D terrain view of re-alignment options. 37 and 38 represent properties 36A and 35 respectively.

Figure 27 below shows the 3-D terrain view with properties shown in the foreground. Labels 37and 38 represent properties 36A and 35 respectively.

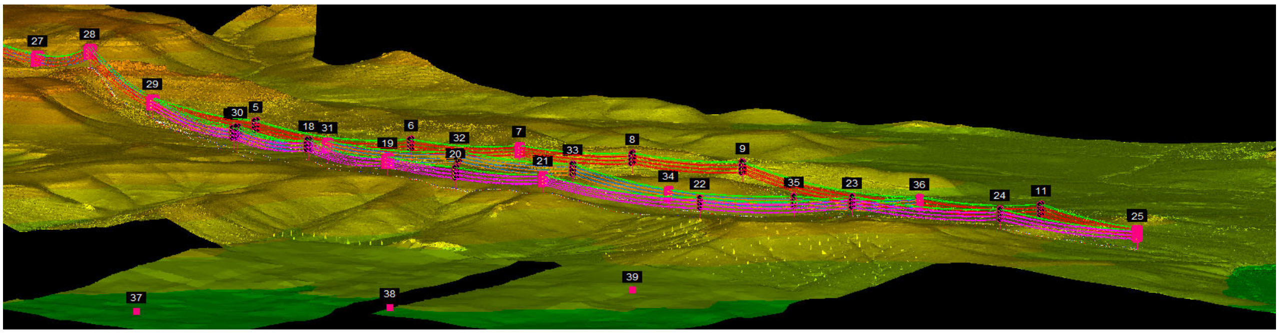


Figure 27 : 3D terrain view looking from properties 36A and 35.

Figure 28 below shows the 3-D terrain view with properties shown in the foreground. Vegetation points are displayed along the existing and re-alignment line routes.

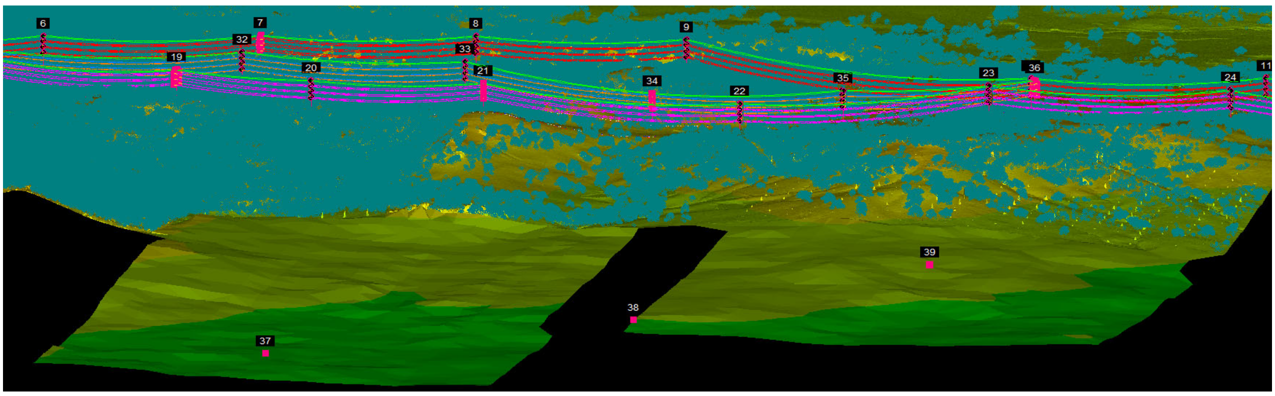


Figure 28 : 3D terrain view looking from properties 36A and 35 with tall vegetation points displayed.

10. Options Comparison Summary

The Table below provides a comparison summary between the proposed and EIS alignments for different criteria requirements.

Item	Assessment Criteria	Proposed Alignment	EIS Alignment	Comments
1	Re-alignment route length	The proposed alignment deviation route length is approximately 2.7km.	The EIS alignment deviation route length is approximately 3.5km.	The EIS alignment length is greater than the proposed alignment length and therefore would result in two (2) additional structures along the route.
2	Proximity to properties outside mine site boundary	The proposed alignments shortest distance to a property is approximately 1.5km to property 35.	The EIS alignments shortest distance to a property is approximately 1.4km to property 35.	The EIS alignment would be located closer to properties outside the mine site boundary, such as properties 36A and 35, compared to the proposed alignment.
3	Terrain profile as seen from properties towards re-alignment structures	Some structures will be visible when viewed from private residences though the views are mitigated by distance.	Structure views are visible when viewed from private residences.	Some structures appear hidden behind terrain peaks on the EIS alignment route in southern sections, especially from property 35. However, in these locations the proposed alignment would not change from existing tower locations and therefore existing impacts would not change or towers would remain obscured. In general, the EIS Alignment is more visually prominent than the Proposed Alignment.
4	Proximity to mining layout area	Shortest distance to mining layout area is approximately 300m.	Shortest distance to mining layout area is approximately 350m.	The proposed alignment is located closer to the mining area compared to the EIS alignment. Both options satisfy the required safety clearance of 201m[2].
5	Impact on existing structure duty	Compared to existing alignment, the proposed alignment will reduce the deviation angle at the structure where deviation will begin (northern end). However, a deviation angle will be created as the line joins back at the existing structure on the southern side.	Similar to the proposed alignment, the deviation angle is reduced at the starting structure of the deviation (north) and is created at the last structure where the deviation joins back to existing structure (south).	Both options would reduce the existing deviation angle at the existing structure located to the north. Where the re-located line joins with existing alignment to the south, new deviation angles would be created and the existing structure duty is to be assessed for the new deviation angles. The adjacent span lengths in both options are similar at the existing structure located north.
6	Terrain profile	The shortest and longest span length is approximately 310m and 490m respectively.	The shortest and longest span length is approximately 227m and 475m.	The terrain profile is similar for both options. There are shorter span lengths in the EIS alignment as a result of two (2) deviation angles located on the line route.

Based on the above considerations, the proposed alignment is the preferred option as the number of structures to be relocated has been reduced; the re-alignment route is located further away from properties outside the mine site boundary compared with the EIS alignment; therefore the proposed alignment has less visual impact to the surrounding properties.

[2] 42925_Vol 1_Part 1 Noise and Vibration - May 2020.pdf prepared by SLR Consulting Australia Pty Ltd.

Appendices

Appendix A

Structure Outline Drawings

The drawings below have been used to develop 500kV structure outline models in PLS-CADD.

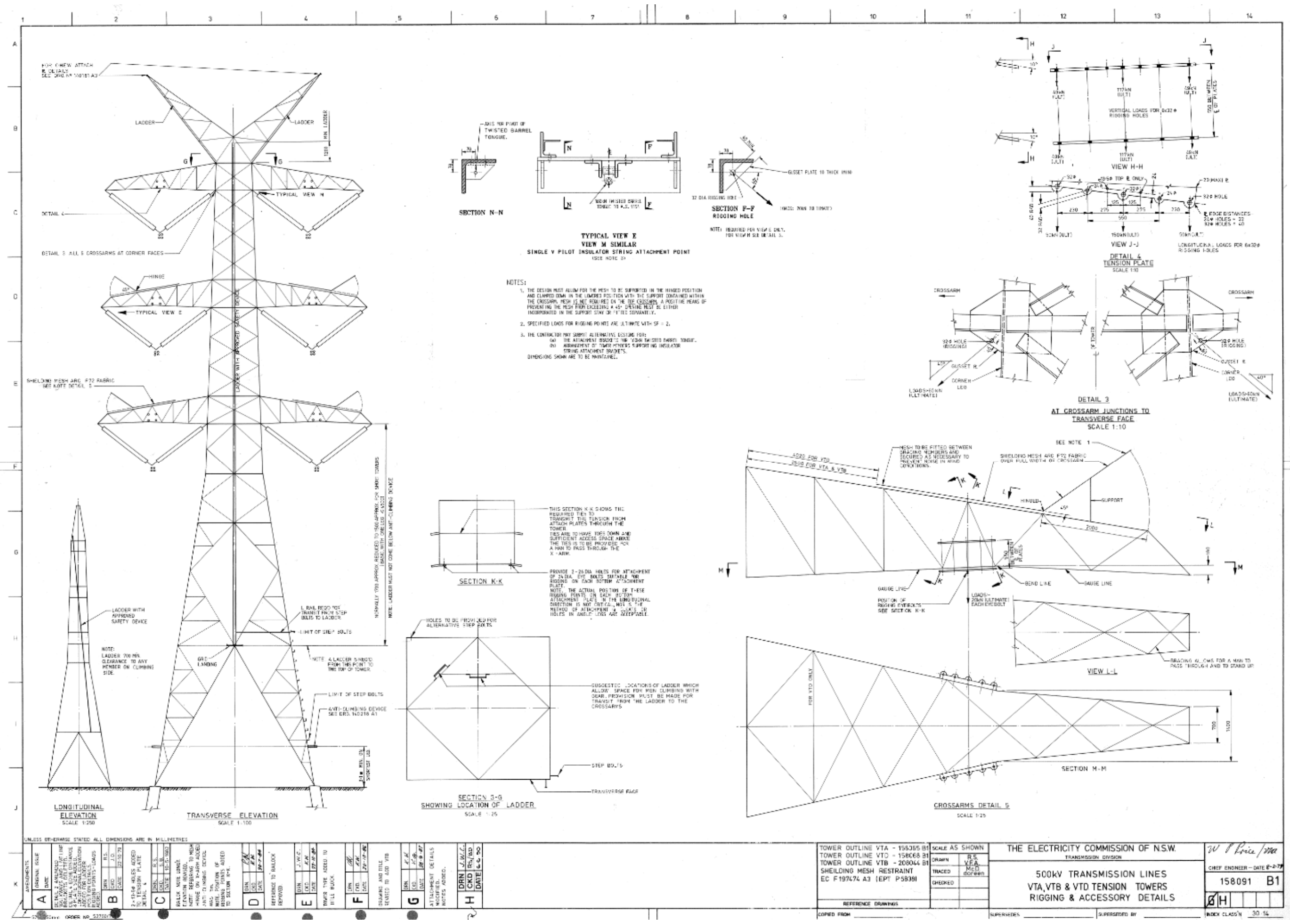


Figure 29 : TransGrid drawing TL-158091 – 500kV Transmission Lines – VTA,VTB & VTD Tension Towers – Rigging & Accessory Details

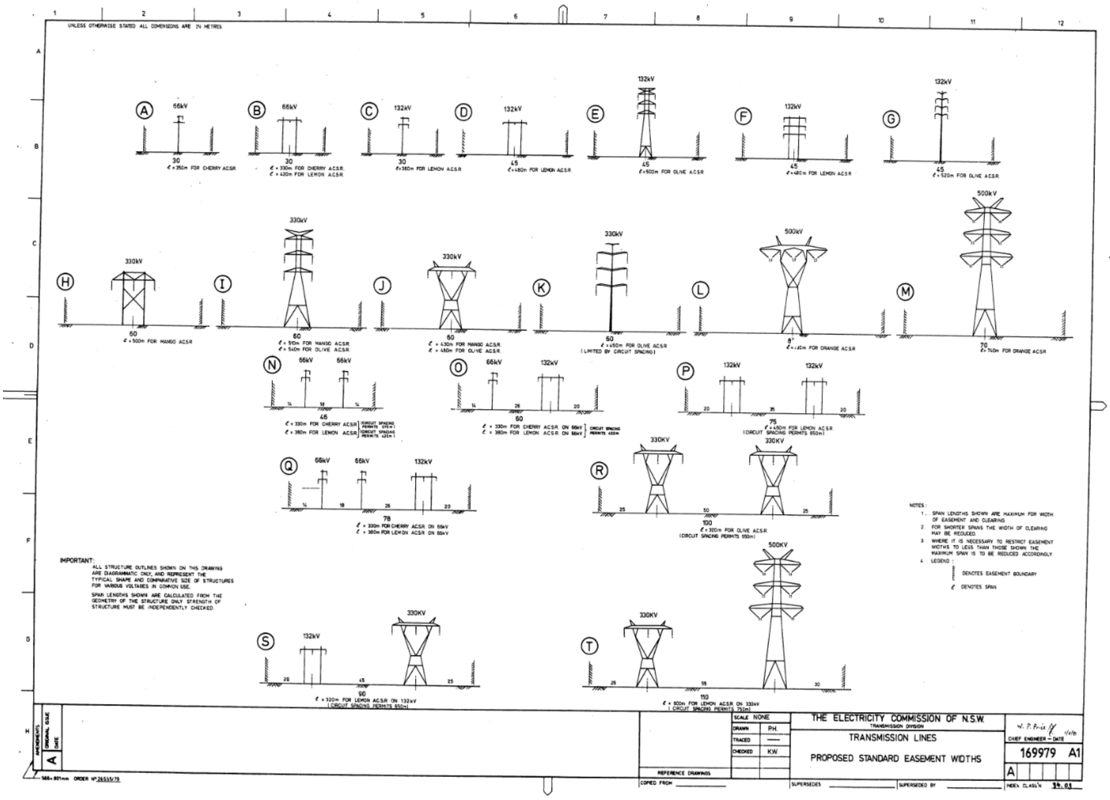


Figure 30 : TransGrid TL-169979 – Transmission Lines – Proposed Standard Easement Widths

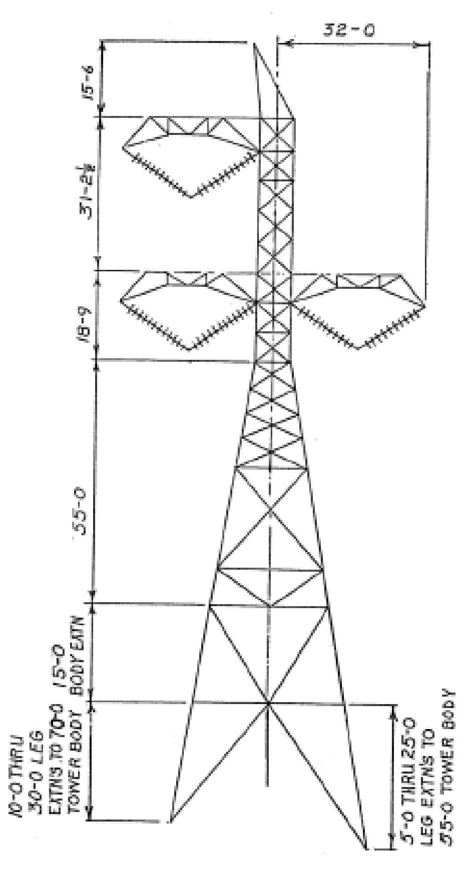


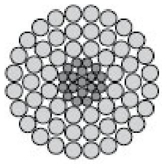
Figure 31 : Extract of Figure 13.3-8, Chapter 13 – EPRI AC Transmission Line Reference Book

Appendix B

Conductor Details

Phase conductor and earth wire have been modelled as per the physical and electrical details shown below.

Bare Conductors
Type ACSR/GZ



Aluminium conductors, galvanised steel reinforced manufactured to AS 3607.

Physical and Mechanical Performance Data

Conductor codename	Stranding and wire diameter no/mm Aluminium	Steel	Nominal overall diameter mm	Cross-sectional area mm^2	Approximate mass kg/km	Breaking load kN	Modulus of elasticity GPa	Coefficient of linear expansion $\times 10^{-6}/°C$	Product code
Almond	6/2.50	1/2.50	7.5	34.4	119	10.5	83	19.3	Almond
Apricot	6/2.75	1/2.75	8.3	41.6	144	12.6	83	19.3	Apricot
Apple	6/3.00	1/3.00	9.0	49.5	171	14.9	83	19.3	Apple
Banana	6/3.75	1/3.75	11.3	77.3	268	22.7	83	19.3	Banana
Cherry	6/4.75	7/1.60	14.3	120	402	33.4	80	19.9	Cherry
Grape	30/2.50	7/2.50	17.5	182	677	63.5	88	18.4	Grape
Lemon	30/3.00	7/3.00	21.0	262	973	90.4	88	18.4	Lemon
Lychee	30/3.25	7/3.25	22.8	307	1140	105	88	18.4	Lychee
Lime	30/3.50	7/3.50	24.5	356	1320	122	88	18.4	Lime
Mango	54/3.00	7/3.00	27.0	431	1440	119	78	19.9	Mango
Orange	54/3.25	7/3.25	29.3	506	1690	137	78	19.9	Orange
Olive	54/3.50	7/3.50	31.5	587	1960	159	78	19.9	Olive
Pawpaw	54/3.75	19/2.25	33.8	672	2240	178	77	20.0	Pawpaw
Quince	3/1.75	4/1.75	5.3	16.8	95	12.7	136	13.9	Quince
Raisin	3/2.50	4/2.50	7.5	34.4	195	24.4	136	13.9	Raisin
Sultana	4/3.00	3/3.00	9.0	49.5	243	28.3	119	15.2	Sultana
Walnut	4/3.75	3/3.75	11.3	77.3	380	43.9	119	15.2	Walnut

Electrical Performance Data

Cond. code name	DC resist. at 20°C Ω/km	AC resist. at 50Hz 75°C Ω/km	Inductive reactance to 0.3m at 50Hz Ω/km	Continuous current carrying capacity, A — Rural weathered — Winter night — Still air	1m/s wind	2m/s wind	Summer noon — Still air	1m/s wind	2m/s wind	Industrial weathered — Winter night — Still air	1m/s wind	2m/s wind	Summer noon — Still air	1m/s wind	2m/s wind
Almond	0.975	1.31	0.296	108	186	216	84	167	198	116	190	220	79	164	196
Apricot	0.805	1.08	0.290	123	209	244	95	188	223	131	215	248	89	184	220
Apple	0.677	0.910	0.285	138	233	272	107	209	248	148	240	277	98	205	244
Banana	0.433	0.582	0.271	187	309	359	141	274	326	201	318	367	129	268	321
Cherry	0.271	0.367	0.256	259	416	483	191	364	434	280	430	495	171	354	426
Grape	0.196	0.263	0.240	330	513	598	238	449	531	361	532	614	211	436	520
Lemon	0.136	0.167	0.228	441	680	787	307	586	698	482	707	811	269	567	682
Lychee	0.116	0.142	0.223	493	752	879	341	645	769	540	783	906	298	623	751
Lime	0.100	0.123	0.219	548	826	976	377	706	843	601	862	1007	328	681	823
Mango	0.0758	0.0955	0.212	648	960	1147	443	816	991	711	1003	1183	383	786	966
Orange	0.0646	0.0816	0.207	724	1061	1282	492	898	1106	796	1110	1323	424	863	1078
Olive	0.0557	0.0705	0.202	804	1165	1421	543	981	1225	884	1220	1466	466	941	1194
Pawpaw	0.0485	0.0615	0.198	885	1270	1563	595	1065	1347	974	1333	1614	508	1020	1312
Quince	3.25	4.37	0.346	53	93	108	42	85	100	56	95	110	40	83	99
Raisin	1.59	2.14	0.324	85	145	169	66	131	155	91	149	172	61	129	153
Sultana	0.897	1.21	0.302	120	203	236	91	181	215	129	208	241	84	178	212
Walnut	0.573	0.770	0.288	161	269	312	121	238	283	175	277	319	111	233	279

Note Current ratings are based on the following conditions:

- Conductor temperature rise above ambient of 40°C
- Ambient air temp. of 35°C for summer noon or 10°C for winter night
- Direct solar radiation intensity of 1000W/m^2 for summer noon or zero for winter night
- Diffuse solar radiation intensity of 100W/m^2 for summer noon or zero for winter night
- Ground reflectance of 0.2
- Emissivity of 0.5 for rural weathered conductor or 0.85 for industrial weathered conductor
- Solar absorption coefficient of 0.5 for rural weathered conductor or 0.85 for industrial weathered conductor

Cross sections not to scale

Nexans Olex

7

Figure 32 : Conductor details

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