SP AusNet
PowerCor Region Terrain comparison Project

Project Report

Version 1.0

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1 Introduction

We-do-IT were engaged by SP AusNet to provide a comparative analysis of the variation in terrain roughness with PowerCor. The scope of the project is to assist with the future planning of SP AusNet's wireless telecommunication network (WIMAX).

This initial investigation focuses on the variation in topography (terrain roughness) and property density throughout the landscape. Both parameters are used as an indication of the "serviceability" of the properties throughout the State. Both SP AusNet and We-do-IT are aware that additional parameters would factor in the Serviceability Index but these will not be covered at this stage.

2 GIS Methodology

2.1 Terrain Roughness

Although elevation information may provide an indication of the area where wireless communication may be affected, We-do-IT believe it is insufficient to identify the variation in landscape which directly impacts wireless communications.

In this document, terrain roughness will be defined as the expression of the variability of a topographic surface. A variety of calculation methods can be found in literature depending on the objective, scale and field of study.

Based on Grohmann et al. (2011), the most suitable methodology for roughness calculation is the standard deviation of the slope as it offers the best performance at a variety of scales (regional in this case).

The slope and its standard deviation were calculated for the State of Victoria using Vicmap DTM 10-20m raster dataset, ESRI ArcGIS 10.1 and the Spatial Analyst extension at a 1 km resolution. The result of a standard deviation classification of the roughness for the State of Victoria can be seen in Figure 2.1 below.

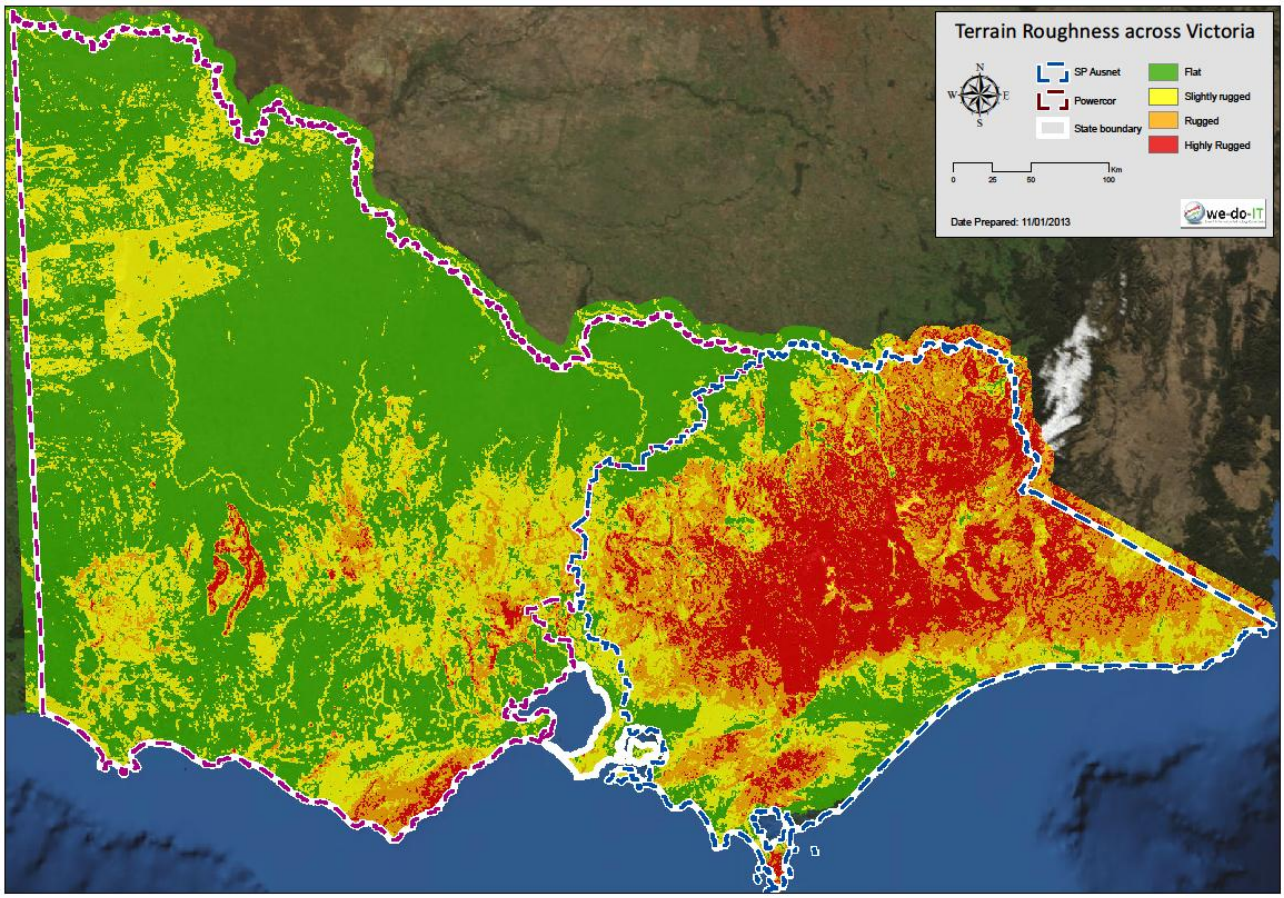

Figure 2.1 Terrain Roughness across Victoria.

When the ability to locate and map atypical values is more important than mapping the values themselves, then a standard deviation classification should be used. Therefore it was choosen because it creates classes that represent the dispersion of the individual values from the mean more effectively.

Within the State of Victoria the standard deviation of the slope over a square kilometer varies between 0 degrees (Flat) and 19 degrees (Highly Rugged). In other words, the variation between the average slope value within a square kilometre may vary greatly in some areas.

2.2 Property Density

Based on SP AusNet's requirements, the property density per square kilometre across the State of Victoria was calculated using the centroids of the VICMAP property dataset and classified required by SP AusNet. The result of the analysis at a Statewide level can be seen in Figure 2.2 below.

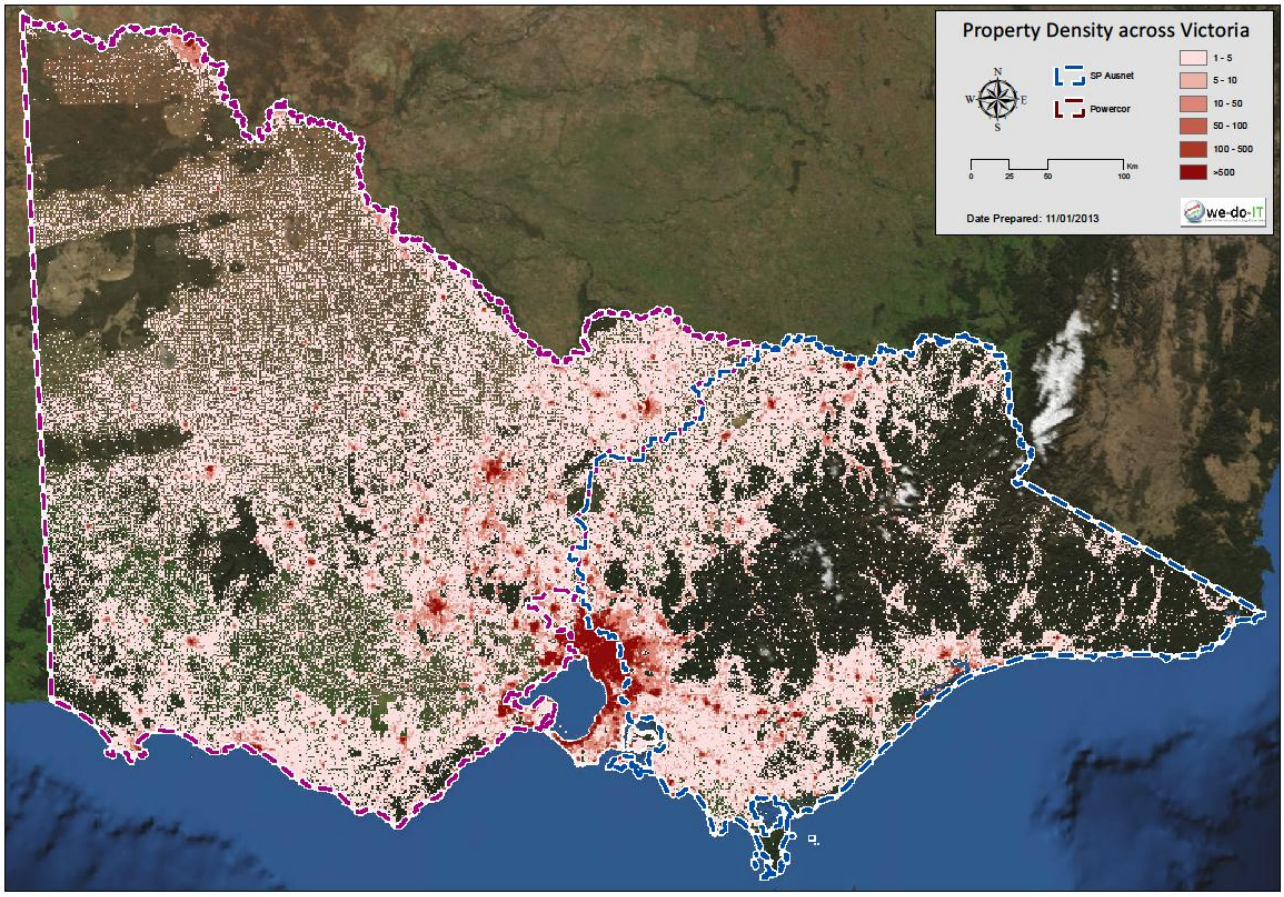

Figure 2.2 Property Density across Victoria.

Figure 2.2 above clearly identifies the Melbourne metropolitan area and the denser regional centres such as the city of Bendigo, Ballarat, etc.

It also outlines that both regions contain large "empty areas" where no properties are found.

2.3 Serviceability Index

In order to better compare the two regions considering both the terrain roughness and property density, a Serviceability Index matrix was developed (See table 2.3 below) for interpretation of the combination of both dataset. The serviceability matrix addresses the challenges of wireless network connection in a given area and therefore the associated costs.

	Property Density (sq Km^2)					
Terrain	1 - 5	6 - 10	11 - 50	51 - 100	100 - 500	> 500
Flat						
Slightly rugged						
Rugged						
Highly Rugged						

Easy
Moderate
Difficult

Table 2.3 Serviceability Index matrix (Source: SP AusNet).

Based on that Serviceability Index matrix, a serviceability layer was plotted (see Figure 2.3 below).

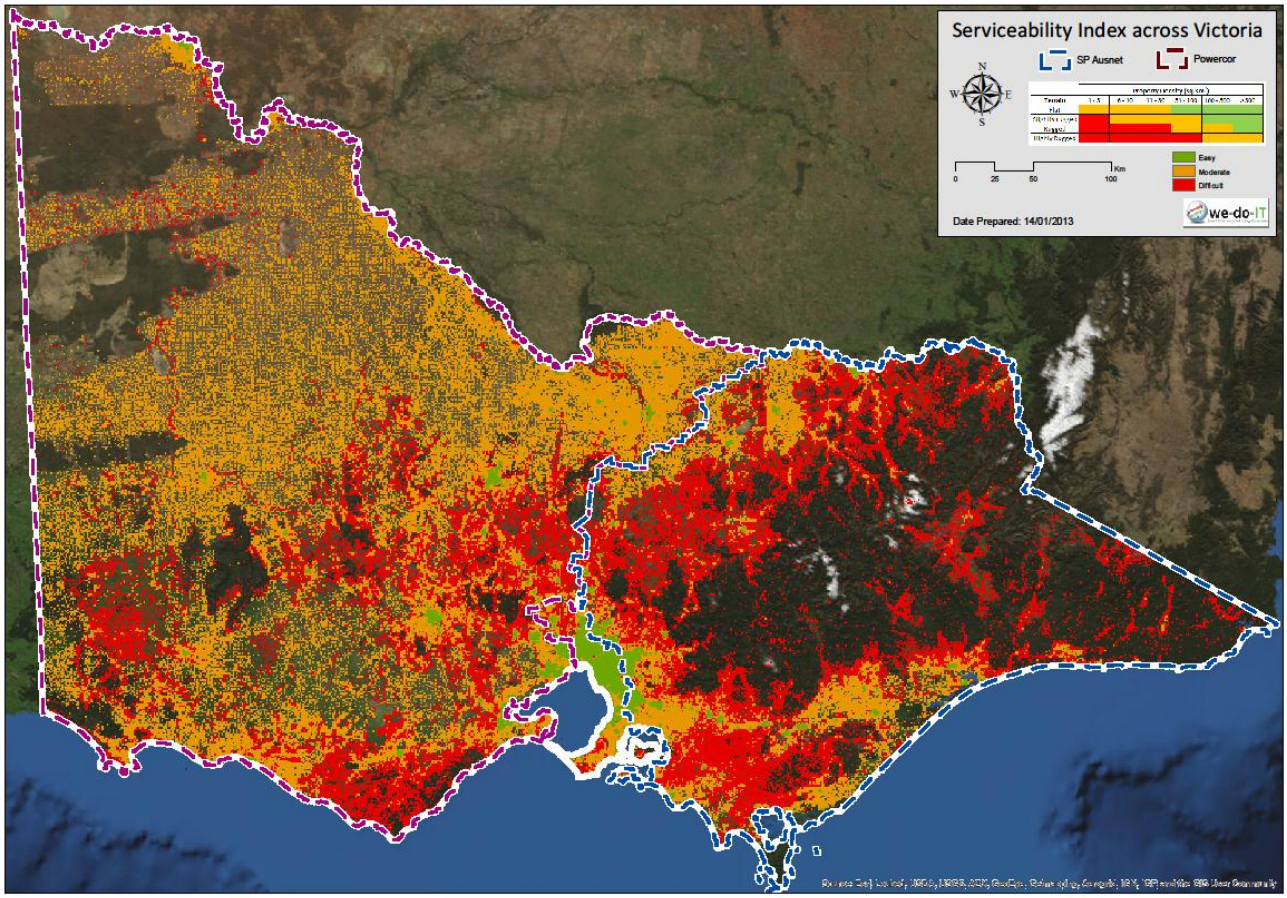

Figure 2.3 Serviceability Index across Vicoria.

The figure above shows that a large portion of the land within SP AusNet's area has a Serviceability Index set to hard. The dispersion / isolation for many of these areas makes it additionally challenging.

3 Region analysis

Based on the property density, terrain roughness and serviceability layers created in Section 2, the number of properties were extracted and analysed within and between each region.

The tables below gather the number of properties found for each Property Density class / Terrain Roughness case.

	SP AUSNET							
	Property Density (sq Km^2)							
Terrain Roughness	1 - 5	6 - 10	11 - 50	51 - 100	100 - 500	> 500	**Total**	**%**
Flat	15161	5177	10863	7853	41783	126646	**207483**	26.7
Slightly rugged	20822	10432	28288	19278	111584	260560	**450964**	57.9
Rugged	18001	6855	12693	6724	35459	18474	**98206**	12.6
Highly Rugged	6769	1708	3052	2083	5949	2079	**21640**	2.8
Total	**60753**	**24172**	**54896**	**35938**	**194775**	**407759**	**778293**	
%	7.8	3.1	7.1	4.6	25.0	52.4		

Table 3.1 Serviceability matrix for SP AusNet Region.

	POWERCOR							
	Property Density (sq Km^2)							
Terrain	**1 - 5**	**6 - 10**	**11 - 50**	**51 - 100**	**100 - 500**	**> 500**	**Total**	**%**
Flat	57294	13251	38611	15504	99289	240223	**464172**	54.1
Slightly rugged	30246	12040	34260	17764	89785	167113	**351208**	40.9
Rugged	7028	2994	4927	3563	10324	8790	**37626**	4.4
Highly Rugged	1291	400	898	322	2112	0	**5023**	0.6
Total	**95859**	**28685**	**78696**	**37153**	**201510**	**416126**	**858029**	
%	11.2	3.3	9.2	4.3	23.5	48.5		

Table 3.2 Serviceability matrix for Powercor Region.

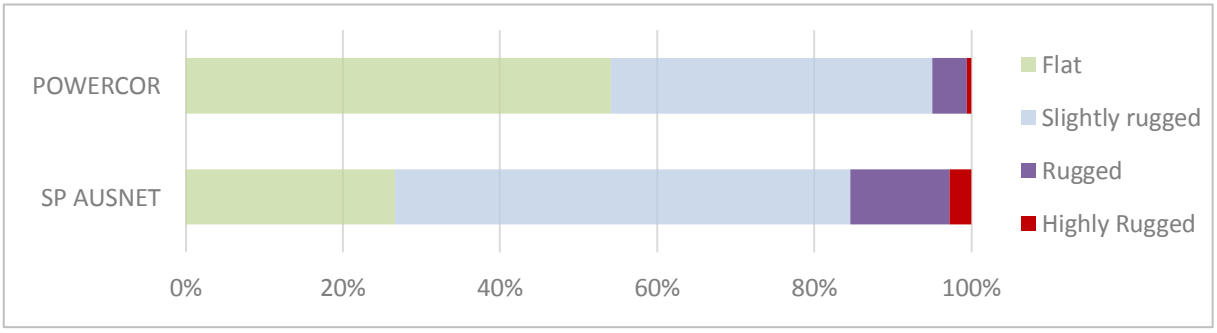

Figure 3.1 Proportion of Properties by Terrain categories.

The proportion of rugged to highly rugged properties is approximately 16% for the SP AusNet region (120,000 properties) whereas it is only 5% across the Powercor region (43,000 properties).

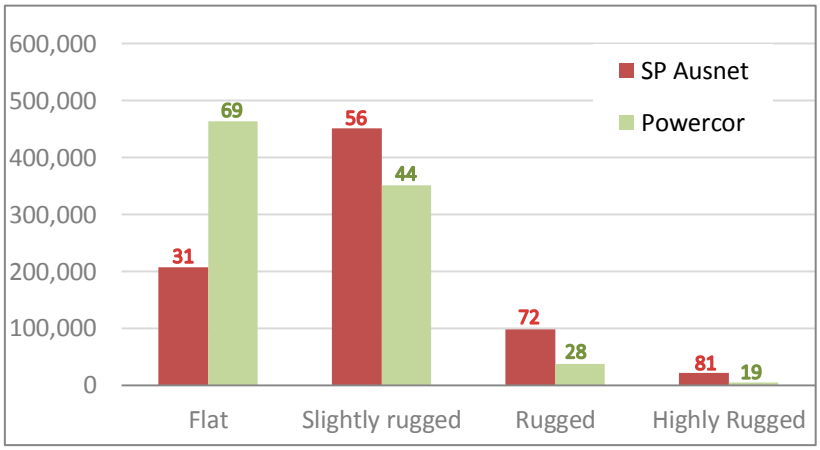

Figure 3.2 Number of Properties by Terrain Roughess category.

As seen in Figure 3.1 above, SP AusNet is responsible for a greater portion of the properties in rougher terrain (**74%** of the rugged to highly rugged properties belong to SP AusNet).

Table 3.3 below gathers the information from table 3.1 and 3.2 by Serviceability Index (Easy, Moderate, Difficult).

	SP AusNet	PowerCor	TOTAL	%
Easy	566900	620704	**1187604**	73
Moderate	139410	189219	**328629**	20
Difficult	71983	48106	**120089**	7

Table 3.3 Serviceability rating comparison.

The proportion of properties with difficult serviceability is greater for SP AusNet (10%) compared to PowerCor (5%).

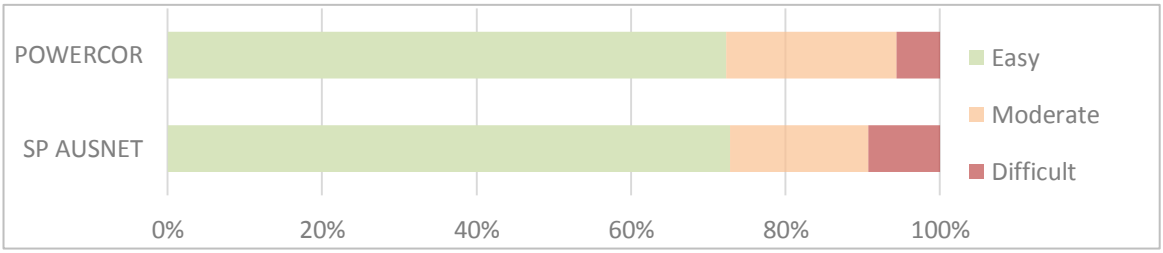

Figure 3.3 Properties by Serviceability.

4 Conclusion

This report demonstrates that terrain roughness varies between regions. SP AusNet has three times more properties in a “rugged” or “highly rugged” environment than PowerCor.

Moreover, SP AusNet is responsible for a much greater total number of properties in difficult serviceability area (72,000 compared to 48,000 for PowerCor). Properties with a difficult serviceability represent about 10% of SP AusNet’s properties, twice the proportion than it is for PowerCor (5%).