

APPENDIX 7 – CULTURAL ASSESSMENT



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Otaki to Levin Road of National Significance

Otaki - Taylors Road to Ohau/SH57 Roding Alternative – Cultural Assessment

Summary

1. This report will evaluate 5 main potential alternative routes linking the RoNS to just north of Otaki at Taylors Road to Ohau/Arapaepae Road vicinity on SH57. The report will also evaluate a variation to the southern end routes from Taylor Road to around Waikawa Beach Road which would connect all 5 routes. This report will examine the likely effects of each route on Maori cultural matters including the crossing of Maori land, sites of significance to Maori and areas of cultural significance such as rivers, streams and wetlands.
2. It is noted that all the alternatives will cross Maori land to a greater or lesser degree. For this analysis all Maori land is generally regarded as equal, with the exceptions being Maori reservations, Marae, urupa and sites of cultural significance.
3. Particular consideration is given to potential effects on the two main functioning Marae in this area close to these routes. Both Tukorehe Marae and Wehiwehi Marae and currently located adjacent to SH 1.
4. Consideration is also given to potential effects on waterways including the main rivers, streams and some water races, along with any wetlands, along the routes. The indigenous fish in the waterways are of some significance in this region.
5. Consideration is also given to remnant patches of indigenous forest and scrub along the routes. These considerations are not only looking at the flora but also the fauna, and in particular the indigenous birdlife.
6. For the routes see the attached map.
7. The principle differences between the five main routes are as follows.
 - a. Route T01 has the part of the route from Taylors Road to Pukehou in common with T03 and T02. That part of the route avoids the Maori land parcels at Pukehou with one small exception. That part of the route also avoids the wetlands and most cultural sites. The stream crossings are similar for all alternatives.
 - b. Routes T04 and T05 from Pukehou to Manakau do not traverse Maori land in this part of the route and although they cross the same streams as the other three alternatives that is at different points along the streams. However the effects are similar for each crossing.

- c. Therefore all 5 alternatives from Taylors Road to Waikawa Beach Road probably cannot be differentiated, with the cultural effects being the same for each route option.
- d. The key differences between the alternative route from the cultural perspective start as the route alternatives cross Waikawa Beach Road heading north with each route having different potential effects.
- e. T03 is a route well to the west of all others. Generally Maori interest increases to the west as a result of Maori occupation starting from the coast and progressing slowly inland. The route crosses large blocks of Maori land bisecting many of these blocks creating maximum impact both either side of Whakahoro Road and likewise just north of Kuku Beach Road. This route could conflict with waahi tapu and sacred puna/spings and also come close to old Pa sites. However it is well away from the existing marae. This route also proceeds through the block Muhunoa 1B1B administered by Te Tumu Paeroa. This route is likely to be strongly opposed by Maori generally.
- f. Option T01 swings further east than T03. It still crosses significant blocks of Maori land on either side of Whakahoro Road. This alternative will affect nearly as much Maori land as T03 and a similar amount as T04. T01, T04 and T02 go either side of a block of remnant bush near the North Island Main Trunk Railway (NIMTR) north of Wehiwehi Marae. Any effects on that block and the bush near Kuku Beach Road are likely to be similar for T01, T02 and T04. The routes all come together as they near the Ohau River crossing through a block of Maori land to cross just east of the existing SH 1 bridge. New river crossings raise issues for Maori with respect to indigenous fish populations and water quality for swimming.
- g. T03 crosses the Ohau River further to the west than all other options which means it does avoid the Maori land Block close to the existing State Highway 1 (SH 1) but having crossed significant Maori land parcels north of Kuku Beach Road.
- h. T05 from Waikawa Beach Road north has its own route to the east of all alternatives. It would cross the NIMTR just south of Wehiwehi Marae with an elevated section of highway which almost certainly would have adverse noise effects on the marae particularly for powhiri held outside. The route would briefly re-join the existing SH1 alignment but would proceed to the east of Tukorehe Marae crossing several Maori land blocks and then bifurcating, with the SH 1 route being approximately parallel but east of the existing SH1 crossing the Ohau River to join into the existing SH1 route just south of Ohau village. The bifurcation for SH57 will cross the Ohau River well east

avoiding the Maori Land Block Muhunua 1B1B and largely the stands of indigenous trees.

Comparison between the Options

8. The issues that affect the selection of the preferred option in this area are dominated for the tangata whenua by Maori land ownership. What makes this area particularly difficult in this respect is that by and large the land blocks run largely in a west – east direction and were partitioned into ever narrower blocks running in that direction. The roads of course run north south so every road alignment will cross Maori land blocks.
9. All Maori land is regarded as equal with the exception of pieces which generally should be avoided if possible and cannot be mitigated including the two working marae, Wehiwehi and Tukorehe, the urupa including those in current use and the older ones which may no longer be used. Other places to avoid are old historical Pa or kainga sites, waahi tapu and sacred puna/springs. By and large this category of sites have been avoided by most options. However some routes are likely to have effects such as noise on Marae even though they do not physically encroach on the Marae land.
10. In looking at the Maori land much is leased for farming purposes (often to non-Maori farmers) and routes that bisect blocks will often have greater effects than those which may cross the extremities of blocks.
11. Also to be avoided are the remnant stands of indigenous bush which are important both for cultural reasons along with the significant flora and fauna that still exist in the stands. These by and large are avoided by all route alternatives.
12. There are issues associated with waterways from the major rivers, stream, drains and wetlands. These largely run from east to west and are crossed by the north-south route proposals. There are some places where river and stream crossings should be avoided.
13. In summary the following table relates to the scoring system that generally run from ++ for options which have positive effects, “0” where the effects are neutral and - - for options with negative effects an impacts from the Maori cultural matters.

	T01	T02	T03	T04	T05
Impact on Maori Land	--	--	--	-	--
Maori sites of significance	--	--	--	-	--
Rivers, streams and wetlands	--	--	--	--	--

14. This shows all routes having significant effects on Maori land and places with a slight difference in favour of route T04.

Options between Taylors Road and Waikawa Beach Road

15. T01A to T05A all share a common route at the southern end which broadly runs to the west of SH 1 but to the east of the main trunk railway line, which it crosses near Forest Lakes Road. This route crosses several blocks of Maori land bisecting them. The balance of the route would pass through farmland with no known sites of significance to Maori. From the cultural values standpoint this variant has much greater effects than the option further to the east.
16. The alternate route for T04A and T05A between Pukehou and Manakau crosses farmland and does not give rise to any cultural issues.

Variation at Pukehou to Manakau

	T01A	T02A	T03A	T04A	T05A
Impact on Maori Land	- -	--	--	--	--
Maori sites of significance	-	-	-	-	-
Rivers, streams and wetlands	--	--	--	--	--

Conclusions

1. From the Maori cultural perspective the alternative that would be favoured is T04 in that it affects the least amount of Maori land although the differences with three other alternatives are quite small. T04 also has less effects on the two marae in the area by taking the road away from them. As it tracks down the rail corridor then the effects are from the combined situation for road and rail.
2. The next favoured route is T02 as this goes through less of the Maori land than others and is located away from the marae, urupa and most of the sites of significance. It is noted that T01, T02 and T03 will have the interchange that will affect significant parcels of Maori land around Whakahoro Road whereas T04 and T05 do not.
3. Route T03 would be disliked by many of the iwi because of the prospect of it passing through wahi tapu, old Pa sites, possibly old burial sites and sacred puna or spring water sources.
4. With the additional options between Taylors Road and Pukehou the eastern route causes little conflict with Maori land or sites. However the alternate routes T01A, T02A and T03 along with routes T04, and T05 all pass through significant pieces of Maori land essentially bisecting the blocks and through areas of wetlands which also have cultural significance.

APPENDIX 8 – PRODUCTIVE LAND REPORT



Taylor's Road to Ohau Road Realignment Proposals Land Resources Assessment

May 2015
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1 SUMMARY

In evaluating the ten different proposals on soil quality and landuse, the following were highlighted:

- All of the options affect soil quality and elite soils. In general there was slightly less impact on the “a” options but overall it was considered this was not significant.
- The distribution of LUC classes between the options was very similar.
- A potential stocking rate was assigned to each LUC unit to determine if there was any difference in livestock carrying capacity between the options. The results showed there was very little difference between the options.
- Analysis of the land cover database (LCDB3) showed that there was very little difference between the options on land use.
- There was a slight difference on the impact to dairying from the various options. Those “a” options had one less dairy unit affected and this was generally from the severely affected category.

Overall it was concluded that there was not much difference between the 10 options on soil quality and landuse.

In rating the options on soil quality and landuse the scoring system of 2- to 2+ was used. The overall results of this are shown in the following table.

Option	Critical Analysis Scoring
TO1a	1-
OT1	1-
OT2a	1-
OT2	1-
OT3a	1-
OT3	1-
OT4a	1-
OT4	1-
OT5a	1-
OT5	1-

All options were assigned the same classification of 1- as it was considered there was very little difference between them but the options did have a general negative impact on landuse and soil quality.

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3 BACKGROUND INFORMATION

MWH have requested land resource information along the lines of the different road realignment scenarios between Taylors Road and Ohau. In total there are ten options that have been investigated.

The land resources in the region have been described and evaluated according to the Land Resource Inventory (LRI) and Land Use Capability (LUC) Classification system.

The information used for this assessment included the LCDB3, NZLRI, cadastral maps and independent soil and LUC mapping undertaken by LandVision Ltd.

The LRI system involves mapping landscape units according to five inventory factors. These include rock type, soil unit, slope class, erosion type and severity, and vegetation.

From the LRI assessment, the area was then classified into LUC classes according to the level of limitations present for productive use. LUC classes range from class I land (elite land) through to class VIII land (no productive value) The LUC classes are then further broken down according to the most dominant limitation to production. These limitations include erosion, wetness, soil or climate. Finally the LUC unit is derived from a combination of the LUC class and subclass along with the five land resource inventory factors. Hence it groups land with similar productive capability, levels of limitations, and land resource inventory factors.

The LCDB3 (Land cover database 3) is regional scale land cover as of 2008.

4 OPTIONS

The various options considered are shown on the Options Map in Appendix 4.

4.1 Landuse Capability

The impact of the various options on the LUC classes was determined by generating an area for each option (120 m wide along the length of the proposal) and clipping the regional NZLRI shape file. For all the options only LUC classes 1-4 were present and distribution of these is shown in the following table.

Table x. The percentage of LUC classes present for each of the options.

LUC Class	TO1a	TO1	TO2a	TO2	TO3a	TO3	TO4a	TO4	TO5a	TO5
Class 1	33%	36%	34%	37%	33%	36%	35%	38%	27%	31%
Class 2	11%	9%	10%	8%	13%	11%	12%	10%	25%	22%
Class 3	54%	52%	54%	53%	52%	51%	50%	49%	43%	42%
Class 4	2%	2%	2%	2%	2%	2%	2%	2%	5%	5%

This table shows that there is very little difference in the distribution of LUC classes between the options. This is confirmed when each LUC class is given a weighting and multiplied out to give a weighted average.

It is also noted that there are other LUC classes in the vicinity but none of these were within the 120 m swath of the different options.

The distribution of the areas (ha) for the various LUC units within each option is shown in the following table.

	TO1a	TO1	TO2a	TO2	TO3a	TO3	TO4a	TO4	TO5a	TO5
	Area (ha)									
1c 1	38.87	38.87	40.16	40.16	32.32	32.32	37.52	35.73	36.8	34.9
1c 1+6e 1	10.51	18.02	10.51	18.02	10.51	18.02	15.44	24.2	14.59	24.2
1s 1	14.7	14.7	14.56	14.56	21.83	21.83	14.58	14.58	1.89	1.89
1s 1+4s 1	2.05	2.04	2.05	2.04	2.05	2.04	-	2.04	-	2.04
2e 1	4.7	4.7	4.7	4.7	4.69	4.69	4.69	4.69	4.82	4.82
2s 1	8.95	8.95	7.17	7.17	13.86	13.86	7.24	7.24	32.67	32.67
2s 3	2.54	2.54	2.6	2.6	2.76	2.76	7	7.68	6.92	7.67
2w 2	5.21	2.01	5.21	2.01	5.21	2.01	4.48	-	4.81	-
3e 1	4.89	4.89	4.89	4.89	4.93	4.93	8.76	8.81	9.15	9.32
3e 2	13.48	-	13.48	-	13.48	-	13.48	-	13.44	-
3e 3	-	12.85	-	12.85		12.85		13.07	-	13.08
3e 3+6e 1	10.94	9.43	10.94	9.43	10.94	9.43	2.13		2.75	-
3s 2	64.18	64.25	65.92	65.99	61.55	61.62	59.91	61.95	46.98	49.02
3s 4	13.07	14.33	13.07	14.33	13.07	14.33	13.08	14.33	13.07	14.33
3w 3	-	-	-	-	0.07	0.07	-	-	-	-
4s 1	4.68	4.68	4.83	4.83	3.58	3.58	4.76	4.76	9.85	9.85
Grand Total	198.77	202.26	200.09	203.58	200.85	204.34	193.07	199.08	197.74	203.79

This table shows that there are some compound units present that include LUC unit 6e1 land. If the mapping survey was undertaken at a smaller scale (say 1:10,000 rather than 1:50,000) then it would differentiate these poorer quality units.

Again, if each unit was assigned a weighting scale based on its productive potential or carrying capacity to determine a weighted average, there is very little difference between the options. The calculations for this are shown in Appendix 5.

4.2 Elite soils

Elite soils can also be considered using the NZLRI. Generally, elite soils will only occur on LUC class 1 and 2 land and the distribution of these for each option is shown in the following table.

	TO1a	TO1	TO2a	TO2	TO3a	TO3	TO4a	TO4	TO5a	TO5
Area of LUC class 1 and 2 land (ha)	87.5	91.8	87.0	91.3	93.2	97.5	91.0	96.2	102.5	108.2

This table shows us that there is a difference in the area of elite soils affected by the different options. TO1a is the least affected option whilst TO5 is the most affected option. There is less impact on the “a” options with regards to elite soils.

It is also noted that it is these classes of land where the horticulture and market gardening occurs.

Overall it is considered that the variations between options are small.

4.3 Land Cover

The areas of various land uses along the different options were determined using the Land Cover Data Base3. The results are shown in the following table.

Vegetation Type	T01a	T01	T02a	T02	T03a	T03	T04a	T04	T05a	T05
	Area (ha)									
Broadleaved Indigenous Hardwoods	-	0.66	-	0.66	-	0.66	-	0.86	0.47	1.33
Built-up Area (settlement)	0.77	0.77	0.77	0.77	0.77	0.77	0.49	0.49	0.67	0.67
Deciduous Hardwoods	1.45	1.45	1.45	1.45	0.94	0.94	0.9	1.44	1.34	1.88
Exotic Forest	1.97	1.47	4.38	3.88	0.92	0.42	4.5	4	4.01	3.56
Gravel and Rock	0.68	0.68	0.68	0.68	0.36	0.36	0.67	0.67	1.81	1.81
Herbaceous Freshwater Vegetation	1.35	-	1.35	-	1.35	-	1.35	-	1.46	
High Producing Exotic Grassland	183.56	188.96	182.47	187.87	181.42	186.82	173.02	180.33	168.58	176.06
Indigenous Forest	0.98	0.98	0.98	0.98	1.38	1.38	1.44	1.44	1.81	1.79
Low Producing Grassland	0.72	-	0.72	-	0.72	-	0.72	-	0.73	-
Orchard Vineyard & Other Perennial Crops	-	-	-	-	-	-	-	-	0.35	0.35
Short-rotation Cropland	5.49	5.49	5.49	5.49	11.95	11.95	8.1	7.97	15.12	14.95
Surface Mines and Dumps	-	-	-	-	-	-	-	-	0.04	0.04
Transport Infrastructure	0.58	0.58	0.58	0.58	-	-	0.58	0.58	-	-
Urban Parkland/Open Space	1.22	1.22	1.22	1.22	1.04	1.04	1.3	1.3	1.35	1.35
Grand Total	198.77	202.26	200.09	203.58	200.85	204.34	193.07	199.08	197.74	203.79

If only the productive land (2008) was included in the above table it would show the impact to the area of agricultural or horticultural sector. This is shown in the following table.

Vegetation Type	TO1a	TO1	TO2a	TO2	TO3a	TO3	TO4a	TO4	TO5a	TO5
	Area (ha)									
Exotic Forest	1.97	1.47	4.38	3.88	0.92	0.42	4.5	4	4.01	3.56
High Producing Exotic Grassland	183.56	188.96	182.47	187.87	181.42	186.82	173.02	180.33	168.58	176.06
Low Producing Grassland	0.72	-	0.72	-	0.72	-	0.72	-	0.73	-
Orchard Vineyard & Other Perennial Crops	-	-	-	-	-	-	-	-	0.35	0.35
Short-rotation Cropland	5.49	5.49	5.49	5.49	11.95	11.95	8.1	7.97	15.12	14.95
Subtotal (ha)	191.74	195.92	193.06	197.24	195.01	199.19	186.34	192.3	188.79	194.92
Grand Total (ha)	198.77	202.26	200.09	203.58	200.85	204.34	193.07	199.08	197.74	203.79
Percentage of area %	96%	97%	96%	97%	97%	97%	97%	97%	95%	96%

This table shows that the impact on the agricultural or horticultural sector is generally fairly similar for all options. Option 5a may have less high quality pasture but there is more short rotation crops compared with the other options.

4.4 Impacts on dairy farming

The following table outlines the impacts from the various options on dairy farming from a desk top analysis of aerial photography. The small size of property parcels makes classification of dry stock farming difficult.

Option	Possible impacts
TO1a	Dissects eight dairy units of which three would be severely affected.
OT1	Dissects nine dairy units of which four would be severely affected.
OT2a	Dissects eight dairy units of which four would be severely affected.
OT2	Dissects nine dairy units of which five would be severely affected.
OT3a	Dissects eight dairy units of which five would be severely affected.
OT3	Dissects nine dairy units of which six would be severely affected.
OT4a	Dissects eight dairy units of which three would be severely affected.
OT4	Dissects nine dairy units of which four would be severely affected.
OT5a	Dissects seven dairy units of which four would be severely affected.
OT5	Dissects eight dairy units of which five would be severely affected.

This table shows that options with “a” had one less dairy unit affected and this was generally from the severely affected category.

A map of the dairy farms in the area is shown in Appendix 4. This map shows the farms LandVision Ltd has soil mapped and also points of other dairy units in the area.

5 CRITICAL ANALYSIS SCORING

The critical analysis scoring methodology (as shown in Appendix 1) was used to rank all 10 options with respect to landuse.

Option	Critical Analysis Scoring
TO1a	1-
OT1	1-
OT2a	1-
OT2	1-
OT3a	1-
OT3	1-
OT4a	1-
OT4	1-
OT5a	1-
OT5	1-

All options were considered very similar in terms of impact to LUC units, elite soils and production. There were no 'fatal flaws' for any of the options. All options were assigned the same classification of 1- as it was considered there was very little difference between them but the options did have a negative impact on landuse and soil quality.


6 APPENDIX 1 – CRITICAL ANALYSIS SCORING CRITERIA


The following table details the scoring descriptions used in the evaluation.

SCORE	DESCRIPTION
++	Route option is, on average, very good in terms of this attribute
+	Route option is, on average, good in terms of this attribute
0	Route option is neutral, or neither good or problematic, on average, in terms of this attribute
-	Route option includes, on average, minor or intermediate issues or concerns in terms of this attribute
--	Route option includes, on average, major or intermediate issues or concerns in terms of this attribute


7 APPENDIX 2: LAND USE CAPABILITY UNITS


This section details the Land Use Capability units found in the general area of the different scenarios.



LUC description	Parent material	Dominant soil type	Slope (°)	Strengths	Limitations	Landuse suitability	Conditions of use
<p>Ic1 Flat to gently undulating, high and medium-height terraces with a mantle of loess and minor tephra. The soils are deep, fertile and well drained. The terraces typically occur between 10-60 m a.s.l. where rainfall is 1000-1200 mm p.a. Occurs between Shannon and Otaki.</p> 	Loess and minor tephra.	Levin silt loam (L1)	0-3	Contour. Access. Deep, fertile soils. Good natural drainage.	Potential to dry out slightly in the summer.	Intensive pastoral farming.	Maintain soil health and fertility.
<p>Is1 Flat, low river terraces and levees of the floodplains with fine-textured alluvial soils. The soils are deep, fertile and well drained, although they dry out slightly in summer. Typically occurs near Manawatu, Ohau and Otaki Rivers.</p>	Fine-grained alluvium.	M Kt	0-3	Contour. Access. Deep, fertile soils. Good natural drainage.	Potential to dry out slightly in the summer.	Intensive pastoral farming.	Avoid over-cropping. Maintain soil health and fertility.

LUC description	Parent material	Dominant soil type	Slope (°)	Strengths	Limitations	Landuse suitability	Conditions of use
<p>Ile1</p> <p>Undulating high and medium-height terraces with a mantle of loess and minor tephra. The soils are deep, fertile and well drained. There is a potential for slight sheet and rill erosion when cultivated. Occurs in the Levin district.</p> 	Loess and minor tephra.	Levin silt loam (L1)	4-7	<p>Contour.</p> <p>Access.</p> <p>Deep, fertile soils.</p> <p>Good natural drainage.</p>	Potential for slight sheet and rill erosion when cultivated.	Intensive pastoral farming.	Care with cultivation to avoid sheet and rill erosion. Use minimum tillage techniques.
<p>Ils1</p> <p>Flat, low river terraces and levees of the floodplains with alluvial soils. The soils are sandy in texture and moderately deep overlying gravels. They are fertile and well drained although they tend to dry out in summer. Occurs on Manawatu, Ohau and Waikanae floodplains.</p>	Fine-grained alluvium.	Manawatu fine sandy loam (M3).	0-3	<p>Contour.</p> <p>Access.</p> <p>Deep, fertile soils.</p> <p>Good natural drainage.</p>	<p>Potential to dry out slightly in the summer.</p> <p>Potential for slight streambank erosion where adjacent to a stream.</p>	Intensive pastoral farming.	<p>Avoid over-cropping.</p> <p>Maintain soil health and fertility.</p> <p>Plant shrub willows on pressure points of the stream.</p>

LUC description	Parent material	Dominant soil type	Slope (°)	Strengths	Limitations	Landuse suitability	Conditions of use
<p>Ils2</p> <p>Flat to undulating medium-height terraces overlain by slightly consolidated Aeolian sands. Soils are sandy in texture and well drained, tending to dry out in summer. Occurs around Levin and Otaki.</p>	Weakly to unconsolidated sands.	Kp1 Wt1	0-7	Contour. Access. Good natural drainage.	Potential to dry out in the summer. Potential for slight wind erosion when cultivated.	Intensive pastoral farming.	Care with cultivation to avoid soil exposure to wind erosion. Use minimum tillage techniques. Maintain a vegetative cover through grazing management and soil fertility.
<p>Ils3</p> <p>Flat, medium-height alluvial terraces with well drained, moderately deep soils overlying gravel. Soils dry out in summer.</p>	Fine-grained alluvium over gravels.	Te Horo silt loam (TH1)	0-3	Contour. Access. Good natural drainage.	Dries out in the summer.	Intensive pastoral farming.	Care with cultivation to avoid soil exposure to wind erosion. Use minimum tillage techniques. Maintain a vegetative cover through grazing management and soil fertility.
<p>Ilw2</p> <p>Flat, low lying basins within the Manawatu floodplain, consisting of interbedded layers of peat and alluvium. The soils have peaty textures and are poorly drained.</p>	Peat and alluvium. Peat over alluvium.	Op Mk	0-3	Contour. Access. Holds on longer under drought conditions.	Poorly drained soil has high potential for damage from stock and machinery. High water table.	Pastoral farming with drainage.	Avoid over-cropping, compaction and pugging. Use feedpad and/or stand-off pad during extended wet periods. Maintain soil health and fertility. Logs appearing near the surface require removal for arable use.

LUC description	Parent material	Dominant soil type	Slope (°)	Strengths	Limitations	Landuse suitability	Conditions of use
<p>Ille1</p> <p>Dissected terrace land formed from unconsolidated sands and conglomerate. Soils are intergrades between yellow-brown earths and yellow-brown loams developed from loess and minor tephra. Potential for moderate sheet and rill erosion when cultivated.</p> 	Loess and minor tephra.	Waitohu silt loam (W1)	4-15	Contour. Access. Good natural drainage.	Potential for moderate sheet and rill erosion when cultivated.	Intensive pastoral farming.	Contour cultivation to reduce potential for sheet and rill erosion. Use minimum tillage techniques.
<p>Ille2</p> <p>Rolling to undulating downlands of slightly consolidated aeolian sands. Soils are sandy textured and well drained. There is a potential for slight to moderate sheet, rill and wind erosion when cultivated. Occurs around Otaki and Paraparaumu.</p>	Slightly unconsolidated sands.	Kp2	4-15	Contour. Access. Good natural drainage.	Potential for moderate sheet, rill and wind erosion when cultivated. May dry out in the summer.	Intensive pastoral farming.	Contour cultivation to reduce potential for sheet, rill and wind erosion. Use minimum tillage techniques. Establish windbreaks.

LUC description	Parent material	Dominant soil type	Slope (°)	Strengths	Limitations	Landuse suitability	Conditions of use
<p>Ille3</p> <p>Rolling dissected terrace land and fans with a mantle of loess over sands conglomerate and colluvium.</p>	Loess or loess over colluvium	Sh Wu To Ko	4-15	<p>The soil texture and topsoil depth, allow soil to hold on longer under drought conditions than free draining soils.</p> <p>Good natural fertility (unless gleyed).</p> <p>This unit can be used to finish stock.</p>	<p>Often easily pugged with heavy cattle following prolonged wet periods.</p> <p>Cropping versatility is restricted by wetness that can delay planting.</p> <p>Lacking shade and shelter.</p>	Intensive pastoral farming.	<p>Care with cultivation to reduce the incidence of surface erosion. Ensure cultivation is undertaken at the correct moisture levels.</p> <p>Care with grazing with heavy cattle following heavy rain or wet periods to reduce the incidence of pugging and treading.</p>
<p>Illw1</p> <p>Flat, narrow alluvial valley floors with imperfectly to poorly drained soils developed from fine-grained alluvium.</p> 	Fine-grained alluvium over gravels. (Al/Gr)	Parewanui silt loam (P1)).	0-3 (A)	<p>Contour.</p> <p>Access.</p> <p>Fertile soils.</p>	<p>Potential for compaction from machinery when soils are wet.</p> <p>Prone to occasional flooding (every 5 years).</p> <p>Moderately high water table.</p>	Vineyard.	<p>Avoid compaction from machinery.</p> <p>Maintain soil health and fertility.</p>
<p>Illw3</p> <p>Low lying, imperfectly to poorly drained sand plains amongst the inland dunes between Waitarere and Waikanae. Water tables are at or near the surface in winter.</p>	Windblown sands.		0-3	<p>Contour.</p> <p>Access.</p>	High water table in winter.	Intensive pastoral farming.	Care with cattle during winter to avoid pugging and treading damage.

LUC description	Parent material	Dominant soil type	Slope (°)	Strengths	Limitations	Landuse suitability	Conditions of use
<p>Ills2</p> <p>Flat, medium height alluvial terraces with somewhat excessively drained soils developed from stony alluvium.</p> 	<p>Alluvium over gravels. (Al/Gr)</p>	<p>Ashhurst stony silt loam (AH2). Te Horo stony silt loam (TH1)). Paraha stony silt loam (Pa2).</p>	0-3 (A)	<p>Contour. Access. Good drainage.</p>	May dry out in summer.	Vineyard.	Maintain soil health and fertility.
<p>Ills4</p> <p>Flat to gently undulating high terraces with a mantle of loess. The presence of a subsoil pan causes perching of water. Soils are poorly drained in winter but subject to summer soil moisture deficiencies.</p> 	Loess	Tokomaru silt loam.	3-7	<p>Contour. Access.</p>	Poorly drained.	Pastoral farming.	Care with heavy cattle when wet.

LUC description	Parent material	Dominant soil type	Slope (°)	Strengths	Limitations	Landuse suitability	Conditions of use
<p>IVs1</p> <p>Flat low river terraces with shallow, sandy to stony soils. Soils are somewhat excessively drained and subject to seasonal moisture deficiencies.</p>	<p>Gravels</p> <p>Patchy alluvium over gravels.</p>		0-3	Free draining			
<p>Vle1</p> <p>Moderately steep to steep short terrace scarps of the high terrace lands. The scarps have a shallow mantle of loess and tephra over unconsolidated sands and conglomerate.</p>	<p>Loess and colluvium over unconsolidated to moderately consolidated sands and conglomerates.</p>		20-35	<p>Reasonable natural drainage.</p> <p>Reasonable natural fertility.</p>	Potential for moderate soil slip and sheet erosion.	Pastoral farming.	<p>Maintain pasture quality through fertiliser programme.</p> <p>Plant soil conservation trees where susceptible to erosion.</p>

8 APPENDIX 3: POTENTIAL PRODUCTIVITY OF THE LUC UNITS

The following table shows the estimated carrying capacity of the various LUC units found within the different options.

LUC unit	Estimated stocking rate
1c 1	23
1c 1+6e 1	20
1s 1	19
1s 1+4s 1	17
2e 1	18
2s 1	14
2s 3	14
2w 2	17
3e 1	14
3e 2	13
3e 3	15
3e 3+6e 1	13
3s 2	9
3s 4	12
3w 3	11
4s 1	6

The table below shows the distribution of the LUC units for the various options.

	T01	T01a	T02	T02a	T03	T03a	T04	T04a	T05	T05a
	Area (ha)									
1c 1	38.87	38.87	40.16	40.16	32.32	32.32	37.52	35.73	36.8	34.9
1c 1+6e 1	10.51	18.02	10.51	18.02	10.51	18.02	15.44	24.2	14.59	24.2
1s 1	14.7	14.7	14.56	14.56	21.83	21.83	14.58	14.58	1.89	1.89
1s 1+4s 1	2.05	2.04	2.05	2.04	2.05	2.04	0	2.04	0	2.04
2e 1	4.7	4.7	4.7	4.7	4.69	4.69	4.69	4.69	4.82	4.82
2s 1	8.95	8.95	7.17	7.17	13.86	13.86	7.24	7.24	32.67	32.67
2s 3	2.54	2.54	2.6	2.6	2.76	2.76	7	7.68	6.92	7.67
2w 2	5.21	2.01	5.21	2.01	5.21	2.01	4.48	0	4.81	0
3e 1	4.89	4.89	4.89	4.89	4.93	4.93	8.76	8.81	9.15	9.32
3e 2	13.48	0	13.48	0	13.48	0	13.48	0	13.44	0
3e 3	0	12.85	0	12.85		12.85	0	13.07	0	13.08
3e 3+6e 1	10.94	9.43	10.94	9.43	10.94	9.43	2.13		2.75	0
3s 2	64.18	64.25	65.92	65.99	61.55	61.62	59.91	61.95	46.98	49.02
3s 4	13.07	14.33	13.07	14.33	13.07	14.33	13.08	14.33	13.07	14.33
3w 3	0	0	0	0	0.07	0.07	0	0	0	0
4s 1	4.68	4.68	4.83	4.83	3.58	3.58	4.76	4.76	9.85	9.85
Grand Total	198.77	202.26	200.09	203.58	200.85	204.34	193.07	199.08	197.74	203.79

These two tables above were used to determine the weighted average for the various Options. The results are shown in the following table. The total stocking is the summation of the area of each LUC unit within an option multiplied by the potential carrying capacity. The total area within an option has been generated by a 120 m swath (60 m either side) along the line of the option. The average stocking rate per hectare is calculated by dividing the total stock units by the total number of hectares within an option.

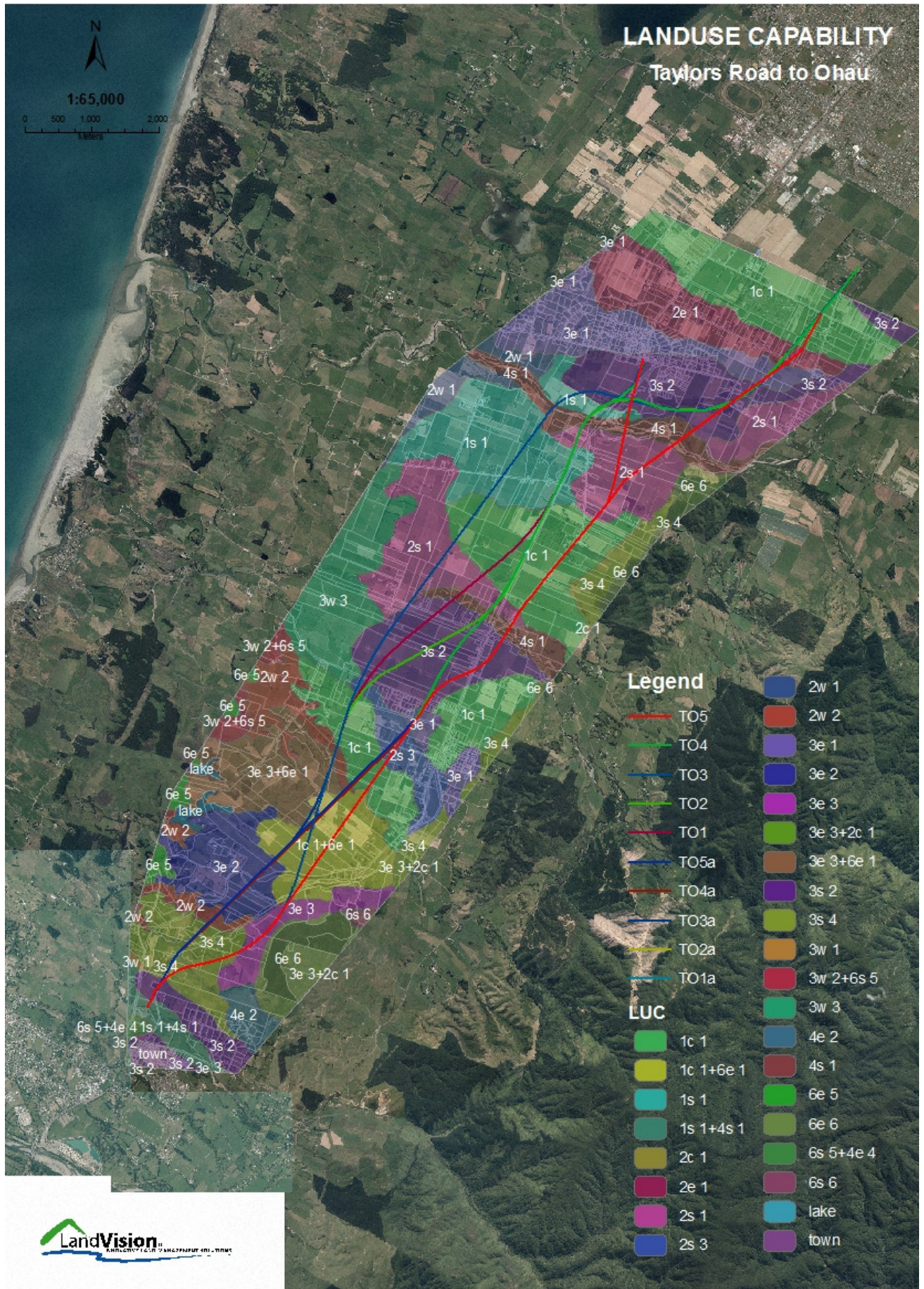
	TO1	TO1a	TO2	TO2a	TO3	TO3a	TO4	TO4a	TO5	TO5a
Total stock units (su)	2,901	3,010	2,920	3,030	2,928	3,038	2,859	2,988	2,874	3,008
Total area (ha)	198.77	202.26	200.09	203.58	200.85	204.34	193.07	199.08	197.74	203.79
Average stocking rate per ha (su/ha)	14.6	14.9	14.6	14.9	14.6	14.9	14.8	15.0	14.5	14.8

9 APPENDIX 4: MAPS FOR THE GENERAL AREA

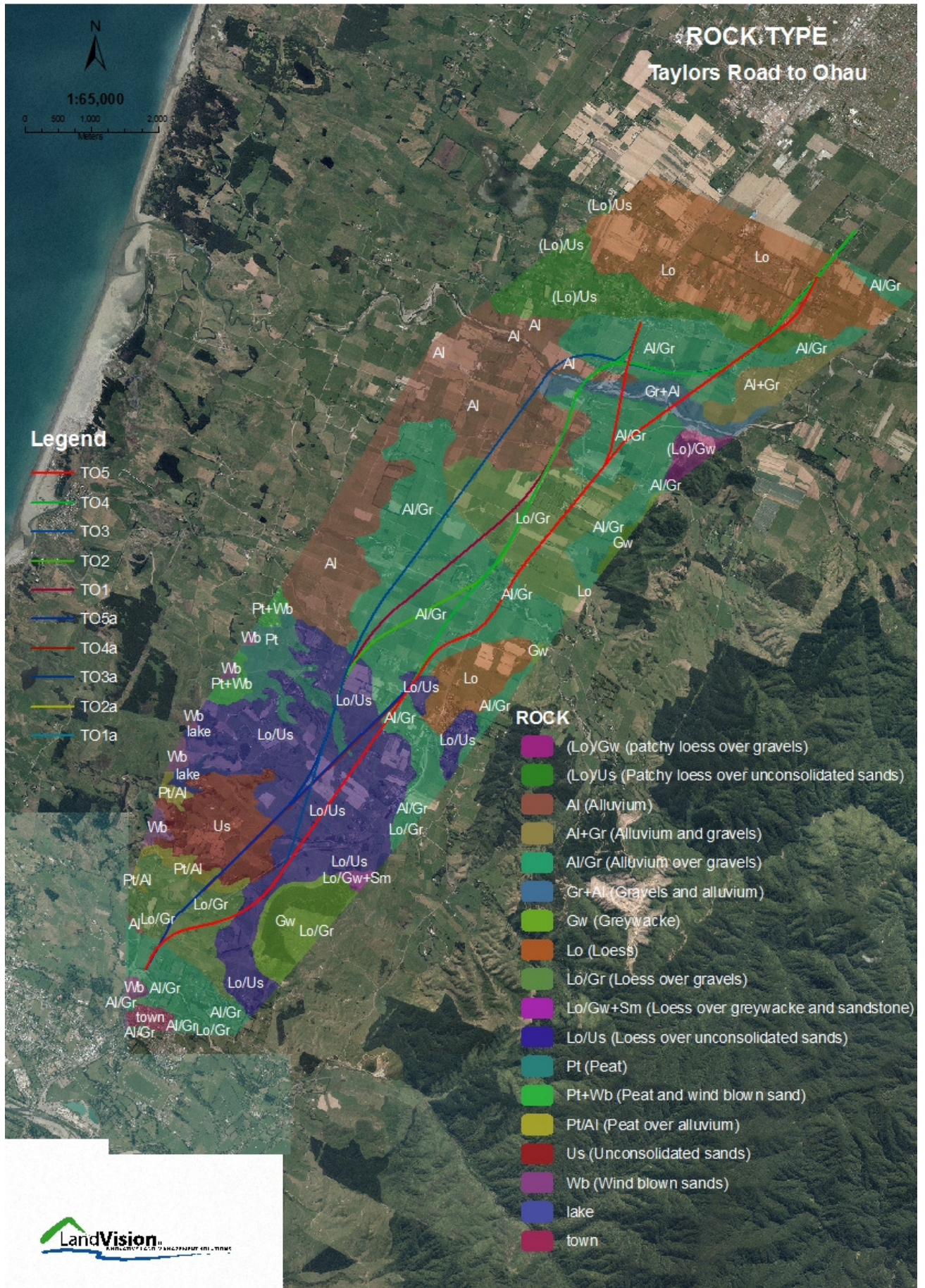
9.1 Proposed Options



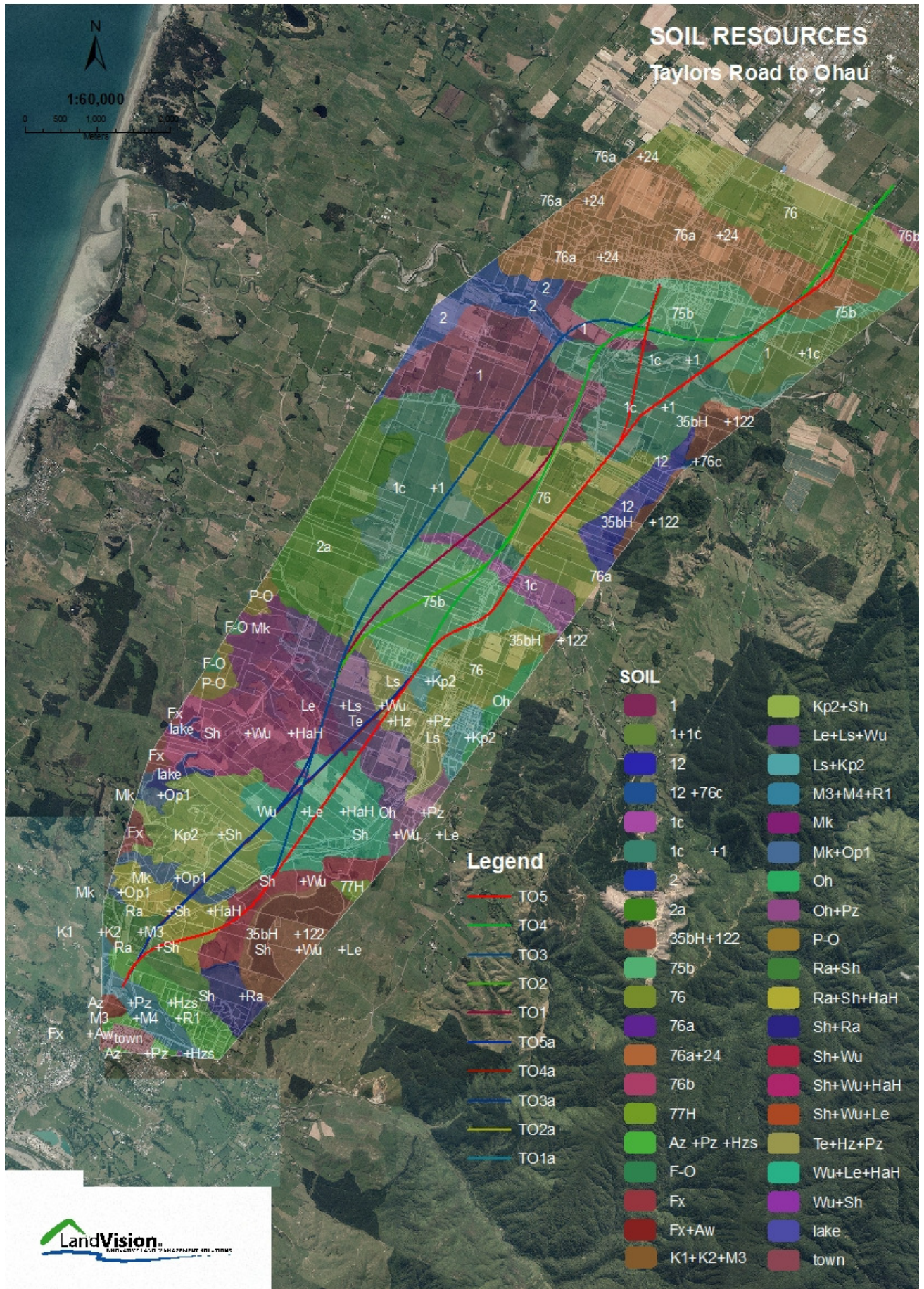
9.2 Landuse Capability



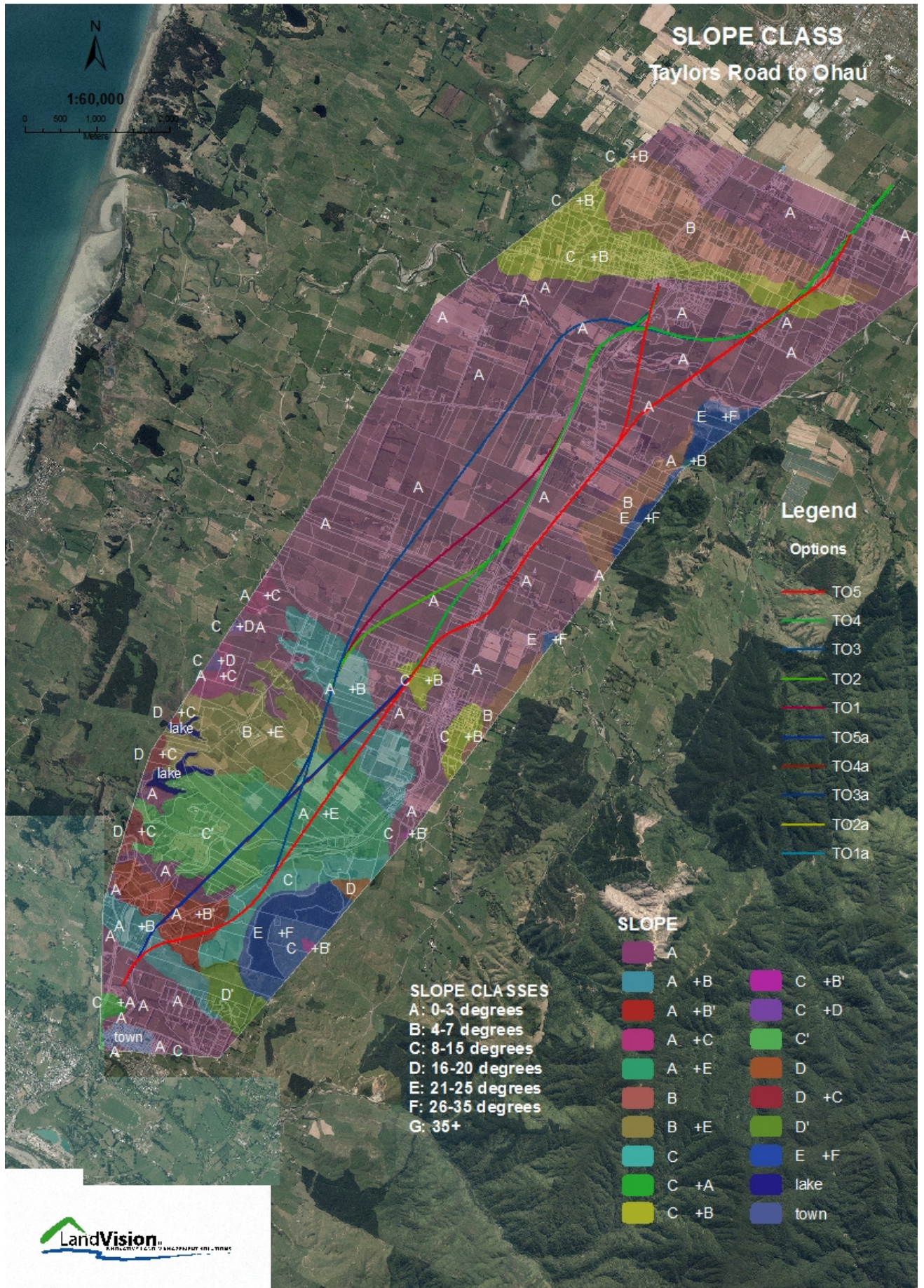
9.3 Geology



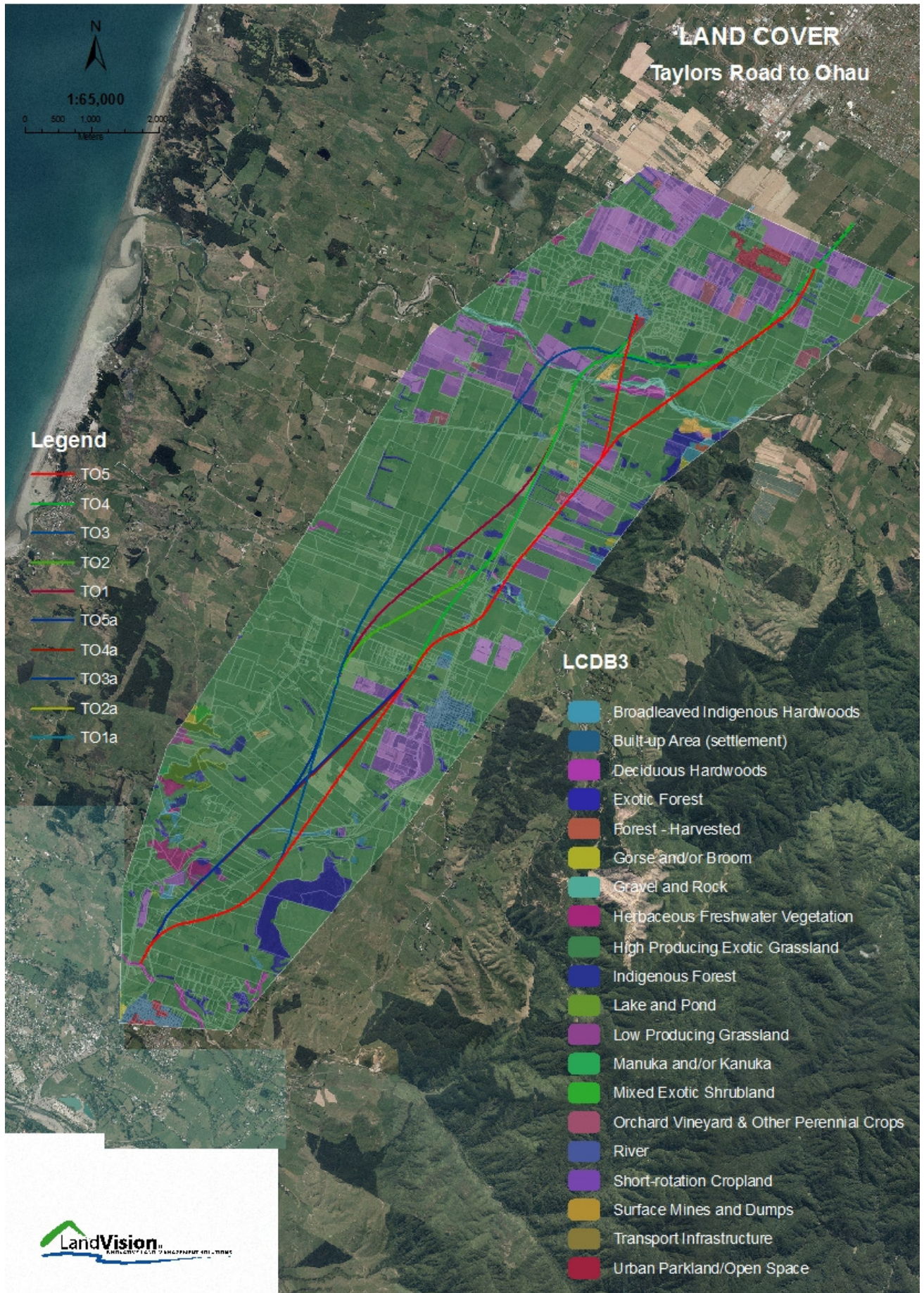
9.4 Soils



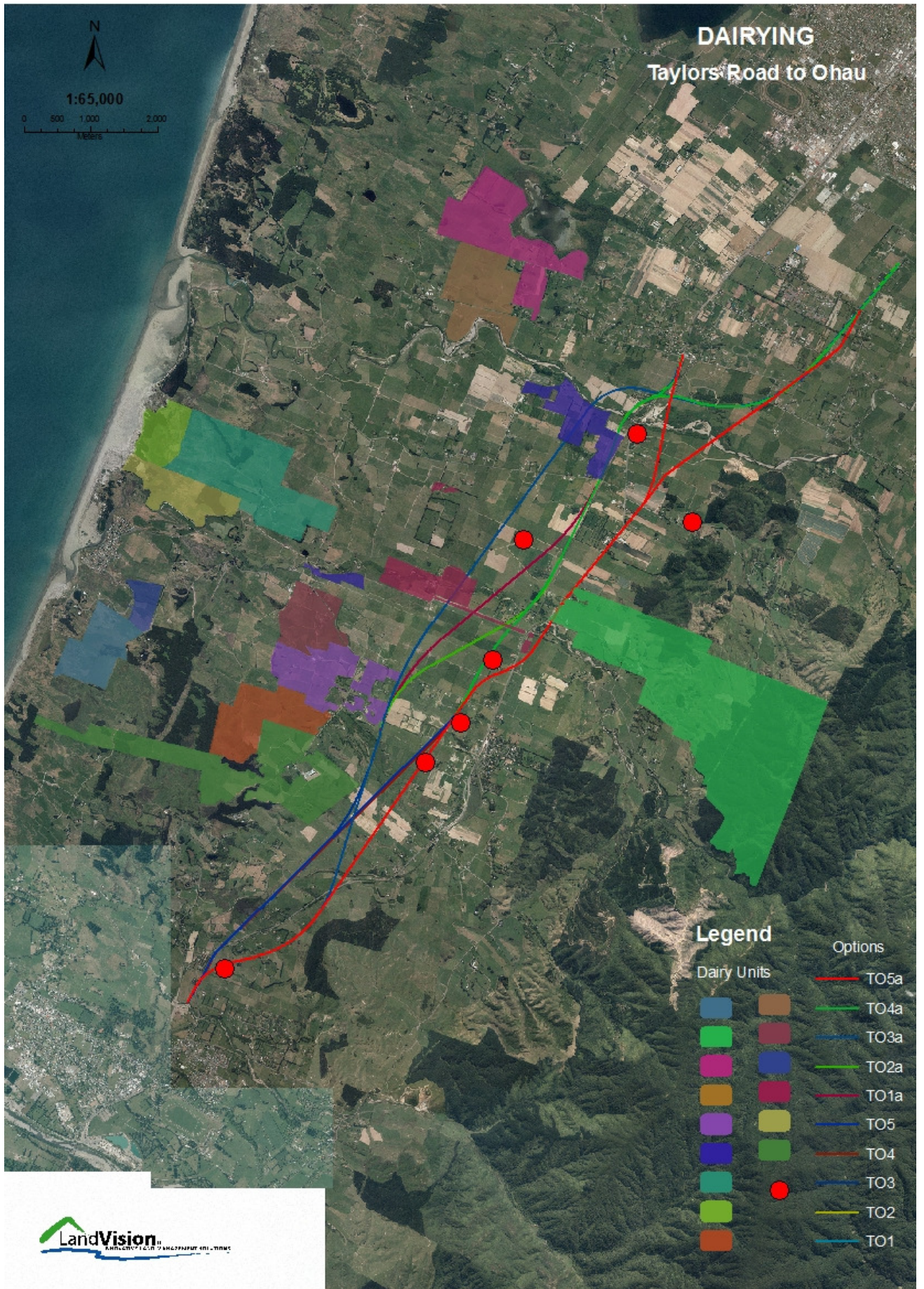
9.5 Slope



9.6 Landcover



9.7 Dairying



APPENDIX 9 – ENGINEERING DEGREE OF DIFFICULTY NOTES

MCA Analysis – Engineering Degree of Difficulty

Otaki to North of Levin: Taylors Road to Ohau (South Levin IBC)

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Rev. No.	Date	Description	Prepared By	Reviewed By	Approved By
-	19/06/15	Draft for Comment	M Oppenhuis / J Povall	P Peet	P Peet

1 Introduction

As part of the Otaki to North of Levin Road of National Significance investigation, an Indicative Business Case is currently being prepared for improvements between Taylors Road to South Levin. As part of this work, a Multi Criteria Analysis (MCA) is being undertaken to help inform a decision on which option(s) to take forward into the Detailed Business Case.

This short report focuses on the Engineering Degree of Difficulty aspect for the MCA. The information below was initially compiled for Options TO1-TO5 (including the 'A' variants) before the MCA workshop on 29 April 2015.

2 Engineering Degree of Difficulty Scores

The scores in the table below reflect the above. These are discussed briefly in the subsequent sections.

Option	Terrain	Structures/ Interchanges	Railway Crossings	Rivers and Streams	Local Network Connectivity/ Traffic Mgmt
TO1	++	0	+	+	0
TO1A	+	0	+	0	0
TO2	++	-	+	+	0
TO2A	+	-	+	0	0
TO3	++	++	+	+	+
TO3A	+	+	+	0	+
TO4	++	--	+	+	-
TO4A	+	--	+	0	-
TO5	++	--	-	0	--
TO5A	+	--	-	-	--

Utilities – leave on existing highway (TBC)

3 Engineering Degree of Difficulty Criteria

The criteria used are listed below along with a brief summary of issues which could create difficulties in constructing the option.

3.1 Terrain:

- TO1-TO5 similar issues, no real difference
- 'A' variants more difficult terrain as west of existing alignment in south (lakes)

3.2 Structures

Option	Taylor's Overbridge	Forest Lakes Rail overpass	Waikawa Stream	Kuku Beach Rd Overpass River	SH1/57 Bifurcation Structures	Ohau River	Nth Manakau Rd Overpass	SH1 Southbound	Bishops rail arch	Total
TO1	1	1	1	1	2	1	0	0	0	7
TO1A	1	1	1	1	2	1	0	0	0	7
TO2	1	1	1	1	2	1	0	0	0	7
TO2A	1	1	1	1	2	1	0	0	0	7
TO3	1	1	1	1	2	1	0	0	0	7
TO3A	1	1	1	1	2	1	0	0	0	7
TO4	1	1	1	1	2	1	0	0	0	7
TO4A	1	1	1	1	2	1	0	0	0	7
TO5	1	1	1	0	0	2	1	1	1	8
TO5A	1	1	1	0	0	2	1	1	1	8

3.3 Railway Crossings

- TO1-TO4 no substantial differences (including A variants)
- TO5 and TO5A required to cross rail at Bishops Road

3.4 Rivers and Streams

- TO1-TO4 no substantial differences – 2 river crossings
- TO1A-TO4A have complications with lakes / watercourses at Forest Lakes
- Option TO5 and TO5A – 3 river crossing (two separate crossings of Ohau River)

3.5 Local Network Connectivity

- TO1 and TO2 (including 'A' variants) limited severance
- TO3 and TO3A, greater separation to existing network
- TO4 and TO4A, longer detour lengths
- TO5 and TO5A, issues between Waikawa Stream and Ohau River