WISE SCENARIO MODELLING – WRC SOILS STRATEGY

EXPLORING THE IMPLICATIONS OF FUTURE GROWTH AND LAND USE CHANGE ON SOILS RESOURCES

Assessment of Potential Impacts on Valuable and Vulnerable Soils in Region - Final Report – July 2018

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SUMMARY

Analysis Undertaken:

- The WISE Reference scenario was compared with a scenario that would stop further development of urban land uses and lifestyle residential on high class soils
- The WISE Reference scenario was compared with a scenario that would push all vegetable cropping and horticulture onto elite soils.
- The WISE Reference scenario was compared with a scenario that would retire all peat soils from productive (pastoral) land uses by 2040.
- The Peat retirement scenario was then adjusted to retire only peat soils within drainage assisted (pumped) areas
- The implication of coastal inundation from projected sea level rise on peat soils in Hauraki basin was assessed.

Key Findings:

- Restricting future urban development on high class soils would have impacts on the current planned zoning for future development in Hamilton, Cambridge, Te Awamutu, Tuakau and Pokeno. Applying this restriction would mean a 'shortfall' in available zoned areas for residential growth from about early 2030's. Approximately 2000ha of alternate area would need to be zoned low density residential in Region to meet demand out to 2060 if current undeveloped high class soils are to be maintained.
- Hamilton particularly has large area of high class soils within its current boundary as well as in planned expansion areas to the north and north-east of city. Significant areas of high class soils also exist in areas planned for industrial/manufacturing growth at Te Rapa/Rotokauri, Ruakura and Horotiu. Approximately 700ha of alternate area would need to be zoned manufacturing in the Region to meet demand out to 2060 if high class soils are to be maintained.
- In a scenario to optimise the use of elite soils for only vegetable cropping and horticulture this would replace existing or future growth of ~1000 ha of dairying, ~300 ha of Lifestyle blocks, ~40 ha of low density residential and 180 ha of manufacturing. The benefit would be ~1400 ha more of the elite soils being used for vegetable cropping and horticulture.
- Retiring all 'Peat'[1] soils from productive pastoral land uses would be a major change in land use across the Hauraki/Hamilton basins. It could potential affect ~100,000 of productive land use. The largest impact would be on dairying (~71,000 ha which represent ~11% of regional dairy land use) and sheep and beef (~14,000 ha which represent ~2% of regional sheep and beef land use). The scenario modelling shows that for Sheep and Beef it is relocated to other parts of Region (although not all

[1] There is uncertainty about the currency of using the "organic" layer from FSL as representation of peat soils in the region. However no consistent alternate spatial layer exists for use in this type of analysis.

sheep and beef was pushed of peat in these initial scenarios. For Dairying however, most of the displaced land use could not be relocated to other parts of region due to lack of land suitability or policy restrictions.

- Under the initial scenario analysis the transition is mainly into forestry or indigenous, further scenarios analysis restricted forestry onto these soils so that the outcome of complete retirement was achieved. Further scenarios could be used to test alternate land use and transition options.
- The majority of the 'Peat' soils are within managed drainage schemes (74% of by area) with 24% of all peat soils being in 'pumped' schemes (~27% of the impacted dairying is in pumped schemes).
- A scenario that looked at removing agricultural land uses from just the pumped drainage areas represented a smaller impact (~25,000 ha total area) but the relocation outcomes for land uses such as sheep and beef and forestry were similar.
- Significant areas of peat occur within the low lying part of the Hauraki Plains and this area is most vulnerable to potential coastal inundation from projected sea level rise.
- The greatest area of peat that could be impacted occurs within existing pumped drainage schemes and behind existing flood protection. Therefore the potential effects of coastal inundation will be determined by the management decision made for the wider areas under these flood protection and drainage schemes.

Next Steps:

- The power of scenario analysis is in undertaking iterations to refine testing of policy options and explore specifics of plausible land use change outcomes. In this study only one or two iterations were undertaken for the initial management question.
- These management questions have focused on the extent and risks to particular soil types/attributes. The 'follow-on' questions that have emerged from looking at this analysis tend to be more focused on alternate land management /use scenarios that are often wider than specific soils management and are more about sustainable/best use options for land management.
- The natural extension of this initial work is therefore to use WISE and the scenario planning approach to investigate and inform some of the wider land use/best use questions that would come with the development of broader land management strategy.

BACKGROUND

WISE can provide plausible projections of future land use across the Waikato region based on a wide range of scenarios. These scenarios can range from continuation of 'status quo' with respect to current zoning and projected growth, to possible futures such as high population growth, demand for different land uses, possible restrictions on land development and use.

Analysis of WISE scenario outputs and further spatial analysis with other data can provide useful information on resource management and support robust analysis, debate and decision making.

The aim of this project is to understand some of the possible implications of future projected growth on the management of the Regions valuable and vulnerable soils. This work is to assist the development of a Soil Resource Strategy for the Waikato. WISE is used to explore the consequences of 'status quo' or doing nothing new and then exploring what factors could be changed to create different outcomes for the soils resource.

This report presents outcomes from several scenarios that were developed in consultation with WRC Soils Staff. These scenarios look at both high class soils[2] and versatile soils[2], and vulnerable soils (peat soils).

After undertaking some initial scenarios looking at high class soils it was then considered important to include possible land use change restrictions that might occur under the proposed Healthy Rivers Policy for the Waikato River Catchment. This policy area was added into the WISE model and after discussions with WRC policy staff 'suitable' restrictions were set up in WISE model to best represent the plausible outcomes of this proposed policy. This setup was then used to run the scenarios presented below.

SCENARIOS ASSESSED

For this report five scenarios were assessed using projected land use outcomes from the WISE model. These scenarios were develop through progressive discussions with WRC Soils staff with initial scenario results informing the discussion and leading to further policy questions and scenario ideas.

The scenarios presented here are:

1. High Class soils – Assess implications for stopping further urban development on high class soils
2. Elite Soils - Assess outcomes if push all vegetable cropping and horticulture onto elite soils (LUC Class 1)
3. Peat Soils - Retire all peat soils from productive land use by 2040 – to represent impact of carbon tax/sequestration needs

[2] High Class soils are classed in Waikato RPS as those soils in Land Use Capability Classes I and II (excluding peat soils) and soils in Land Use Capability Class IIIe1 and IIIe5, classified as Allophanic Soils, using the New Zealand Soil Classification. Versatile soils are defined as LUC class 1-2 = High, LUC class 3-4 = Moderate, LUC class 5-6 Limited, LUC class 7-8 Low. Elite soils are defined as LUC class 1 units.

4. Peat Soils - Retire all peat soils in areas with assisted drainage from productive land use by 2040 – remaining peat soils area into horticulture.
5. Peat Soils – Understand the impact of modelled Hauraki coastal inundation on peat soils.

1. RESTRICTED URBAN DEVELOPMENT ON HIGH CLASS SOILS

Prior to restricting any future urban development on high class soils, the projected future land use outcomes from the WISE Reference scenario were used to assess the extent of possible future impacts on the high class soils based on 'status quo' policy and growth projections for the Waikato Region.

This analysis involved an assessment of how much high class soils currently used for agricultural purposes would be potentially converted to urban land uses[3] at different time steps into the future (2020, 2030, 2040, 2050 and 2060). The analysis shows that a further 3500 ha of high class soils could be loss by 2030, and up to 6,500 ha by 2060 (Figure 1).

Most of this land use change is the result of expansion in residential lifestyle and residential low density land use (Figure 2). This tends to occur with the loss of sheep and beef, and dairying land uses. There is also a modest increase in manufacturing land use on high class soils (480 ha by 2040, 740 ha by 2060).

The first new scenario assessed was to look at the implications of 'policy/zoning' restrictions that would stop further urban development on high class soils (i.e. control urban land uses and lifestyle residential). This is done by creating a 'zone' for high class soils in WISE and setting any future growth of urban land uses in this zone as 'Prohibited'. The outcomes of this scenario are then compared with the Reference ('status quo' policies) to explore potential implications.

The implications of such a policy restriction are discussed by urban land use type:

RESIDENTIAL - LIFESTYLE

Applying the high class soils restriction makes no real difference to the total extent of Residential Lifestyle land use in future as there are enough zoned areas available for lifestyle demand to accommodate restriction on high class soils especially in Waikato District (Figure 3). The result is a relocation of lifestyle residential growth out and further away from Hamilton and Cambridge with growth occurring mainly to the north and west. Difference in net outcomes by 2063 no different 42,101 ha in References vs 42,108 ha under high class soils restriction applied.

[3] For this study urban land use / growth represents the sum of the following land use types – Residential – lifestyle, low density and med-high density; commercial; manufacturing; and community services.

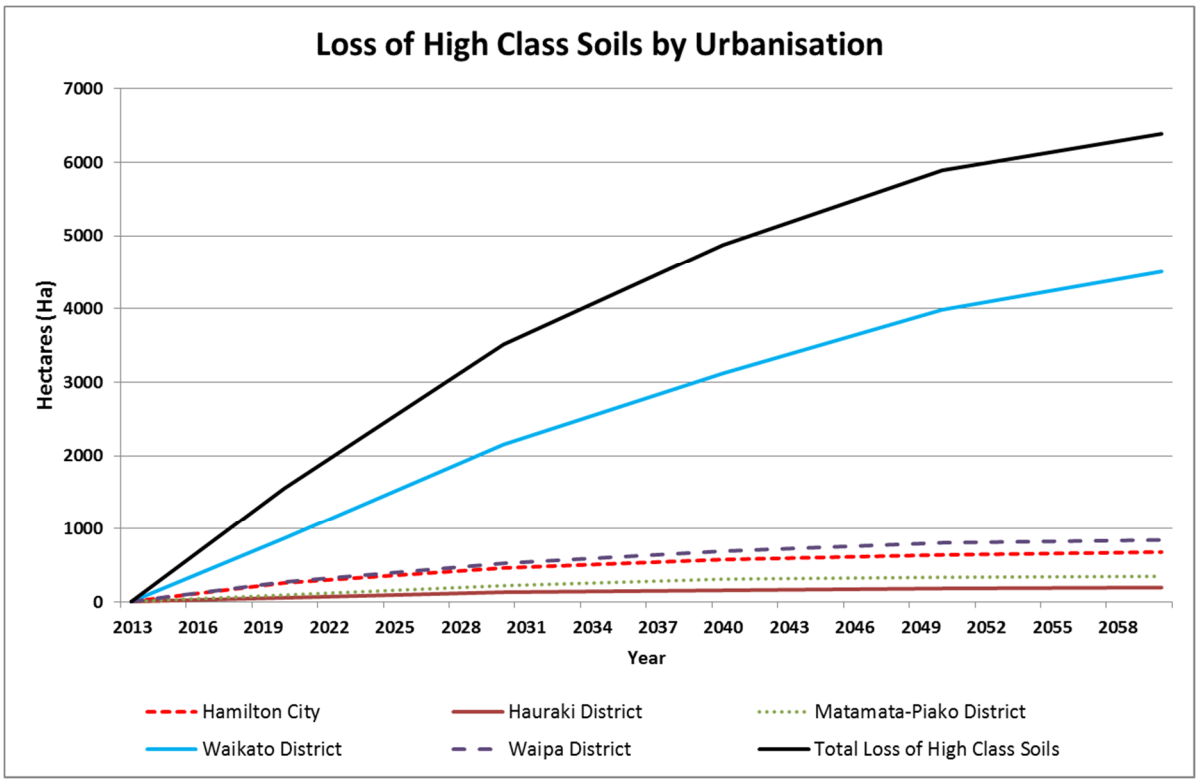

Figure 1: Projected Future Loss of High Class soils to further urban growth (Reference scenario)

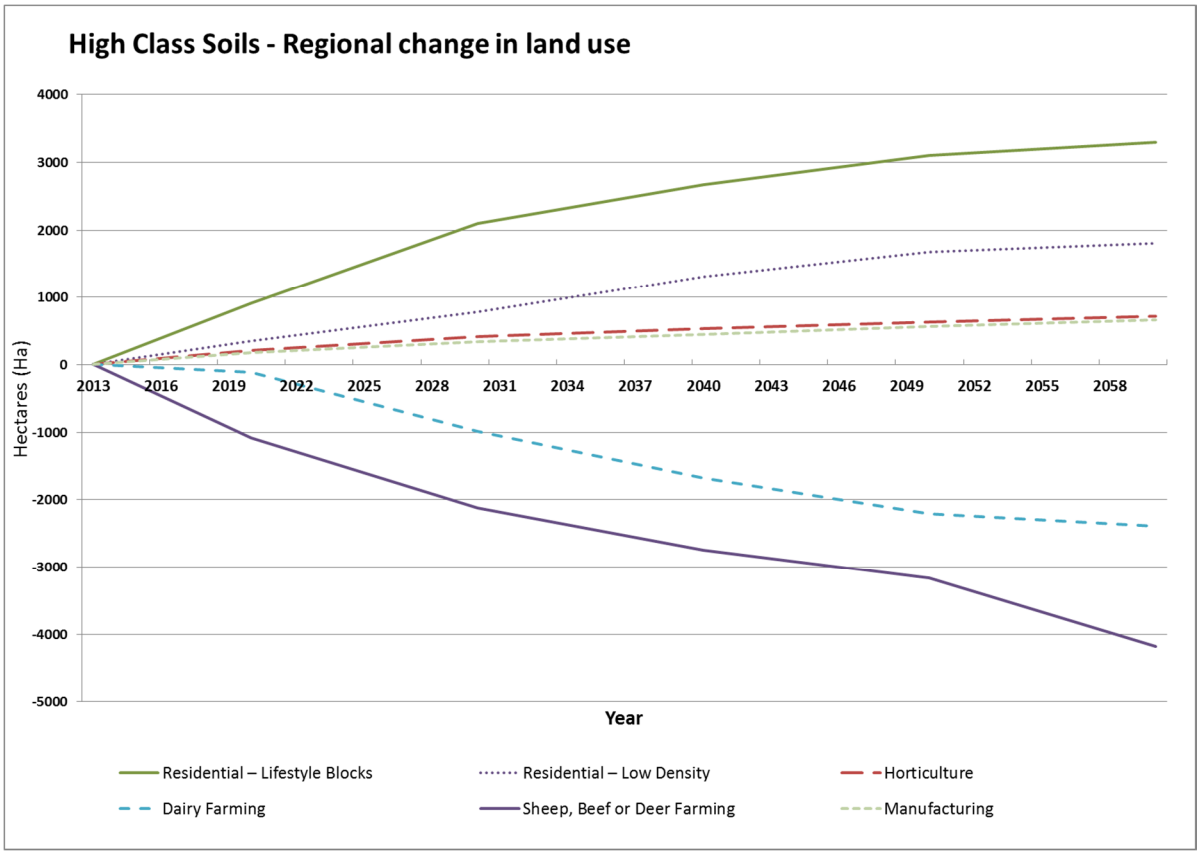

Figure 2: Projected Future Loss of High Class soils – key changes by land use (Reference scenario)

The impact of this change might be to make lifestyle land use less attractive to people as they would need to be located further away from main urban centres. So if a high class soils restriction was applied this may reduce the future demand for this land use type – this potential drop in attractiveness is not considered in this WISE scenario.

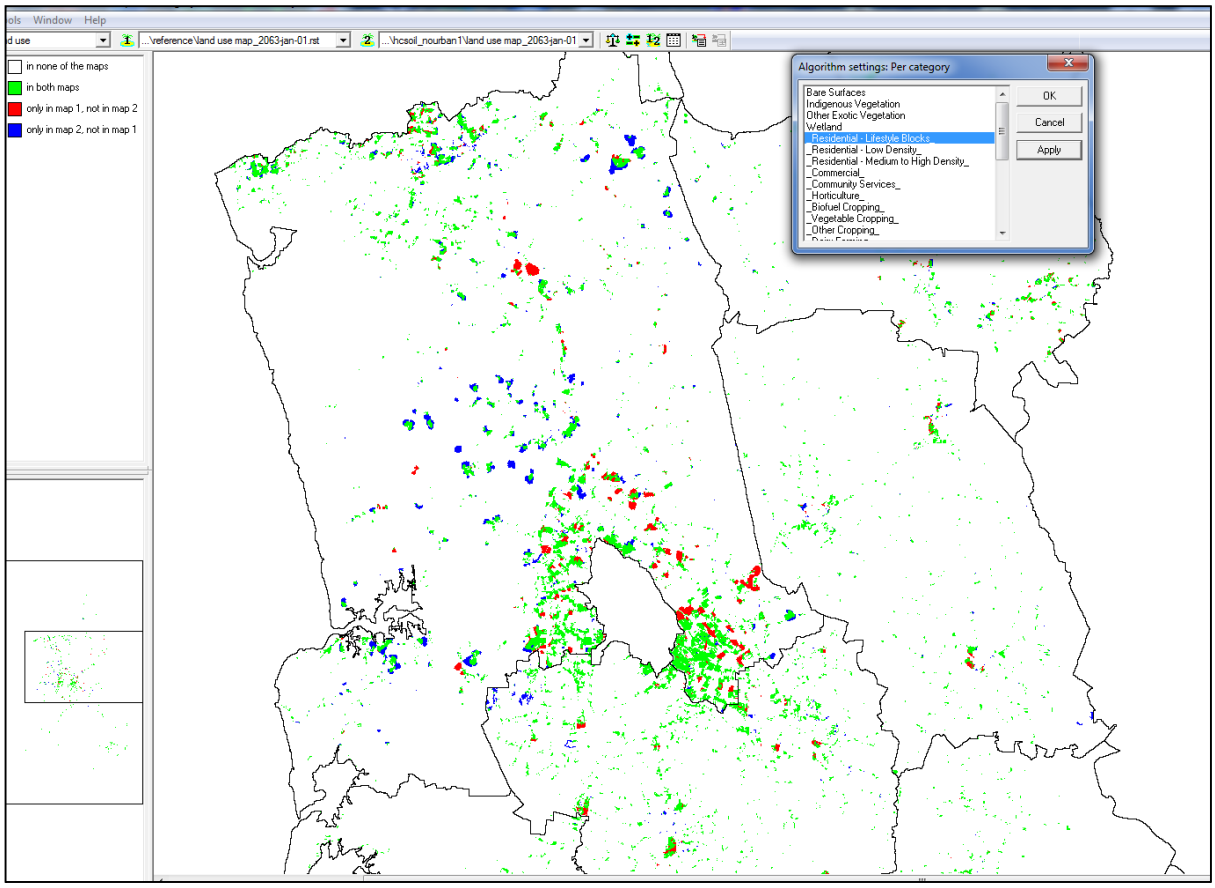

Figure 3 – Changes to location of Lifestyle Residential land use in 2064 with 'prohibited' restriction on High Class soils (Red areas represent where land use occurs under the Reference scenario, Blue areas represent where land use occurs under HC soils restriction scenario, Green areas – where land use occurs under both scenarios)

The other benefit from this relocation of future lifestyle land use is that about 1130 ha of dairying land use on high class soils is not converted to lifestyle land use by 2063. To off-set this there is additional conversion of sheep and beef and forestry land uses to lifestyle under the "Restriction Scenario".

RESIDENTIAL – LOW DENSITY

For Low Density (LD) Residential protecting high class soils would have significant impacts for main centres – especially Hamilton City but also Cambridge, Te Awamutu, Tuakau and Pokeno (Figure 4).

By 2063 under the Reference scenario 18,003 ha of LD Residential exists, on all soil types, but under the high class soils restriction only 16,200 ha exists. This 1800 ha 'shortfall' is a function of not enough non-high class soils areas being zone for residential development during the scenario resulting in demand for LD residential land not being met in the modelling.

In reality more land would be zoned in other areas for residential land development. The largest impact is in Hamilton City where ~900ha of 'shortfall' occurs due to the large areas of high class soils in the current northern and eastern residential zoned growth areas. Waikato District has a ~480 ha 'shortfall' this occurs mainly in Tuakau and Pokeno areas. Waipa District has a ~400 ha 'shortfall' this occurs mainly in southern Cambridge and around the NW and SE parts of Te Awamutu. The high class soils restriction on LD Residential does not appear to affect projected growth in any of the other districts in the Waikato.

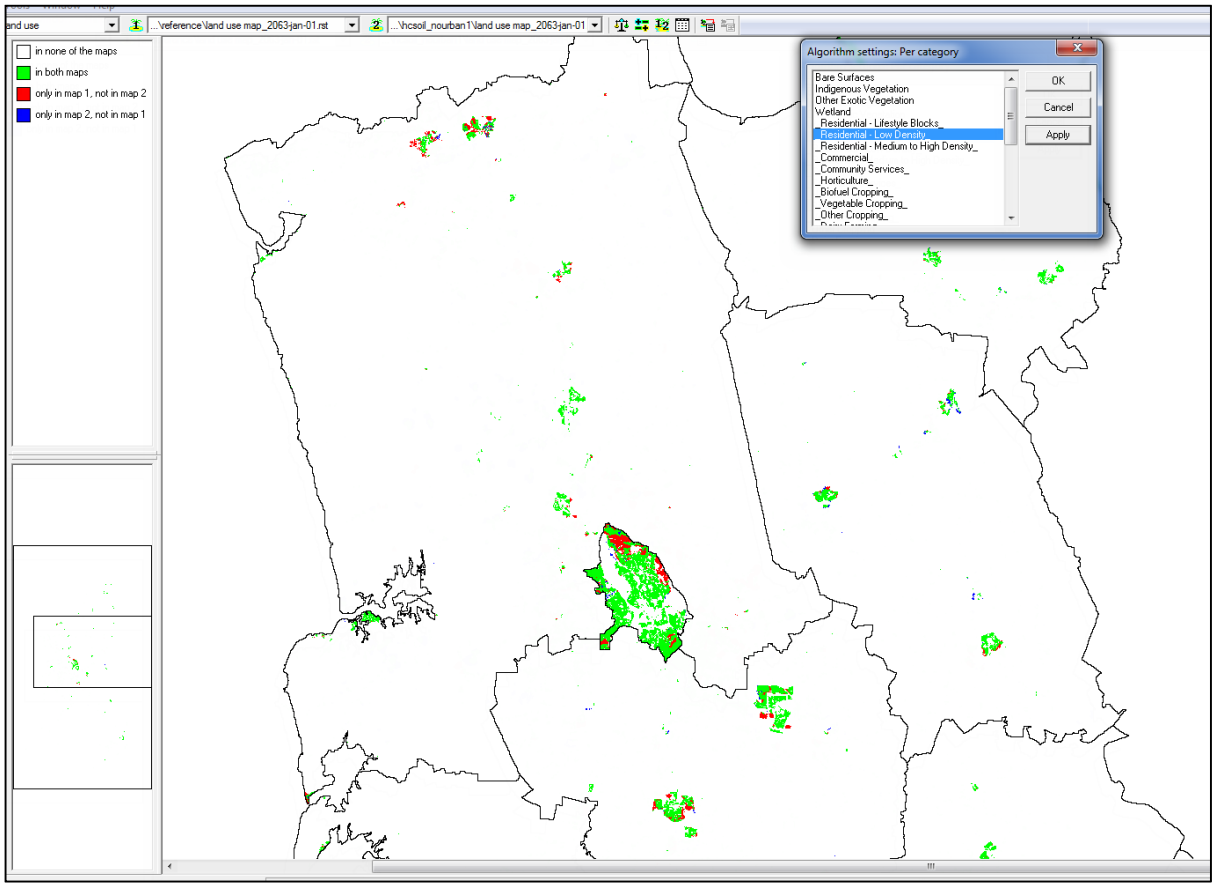

Figure 4 – Changes to location of Low Density Residential land use in 2064 with prohibited restriction on High Class soils (Red areas represent where land use occurs under the Reference scenario, Blue areas represent where land use occurs under HC soils restriction scenario, Green areas – where land use occurs under both scenarios)

The lack of enough zoned non-high class soil land creates an unrealistic outcome for this scenario as the demand for residential land is not being meet in some TA's and this creates an implausible outcome as population growth needs to go somewhere. This disconnect begins from early 2030's (Figure 5) and demand (Red line) is not meet by supply (Green line) for the remainder of the scenario.

To correct this, alternative areas of non-high class soils adjacent to the urban areas could be 'zoned' in the WISE model to provide the required land for LD residential development. This could be discussed further to determine what criteria would be used to select these alternate areas. Then implications of high class soils restriction on other land uses could be more plausibly assessed.

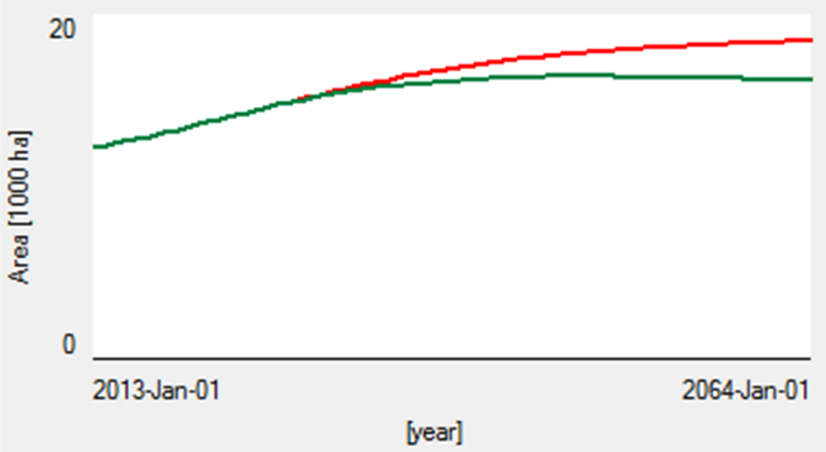

Figure 5 – Low Density Residential Demand (Red) vs Supply (Green) with prohibited restriction on High Class soils

RESIDENTIAL – MEDIUM-HIGH DENSITY

For medium-high density residential land use the application of a restriction on high class soils primarily affects potential development in Hamilton City. This results in ~160 ha 'shortfall' (Figure 6). The cause and solutions for these outcomes are the same as those discussed above for LD Residential land use above.

Like the LD Residential outcomes a lack of zoned non-high class soil land for MH Density Residential also creates an unrealistic outcome for the scenario. This disconnect begins from early 2040's (Figure 7) and demand (Red line) is not meet by supply (Green line) for the remainder of the scenario.

COMMERCIAL AND MANUFACTURING LAND USE

The projected growth and allocation of productive urban land uses (commercial and manufacturing) are also impacted by the application of a development restriction on high class soils. For manufacturing there is a large (220 ha) reduction in Hamilton city and a smaller reduction in Waikato District (35ha). Most of this occurs around Te Rapa and the planned Ruakura hub. For WDC the reduction is primarily around Horotiu. There is some loss from around Morrinsville but this is made up largely in other parts of District (Figure 8).

Because these land use types (manufacturing, commercial) are allocated regionally in WISE model the demand and allocation are 'matched' so there is not a regional 'shortfall' as is seen in residential land uses, which are allocated at a TA level based on population growth. This results in more manufacturing being allocated into other districts with Waipa District gaining about 50% of the loss from HCC and WDC, and most other districts also gain some additional manufacturing.

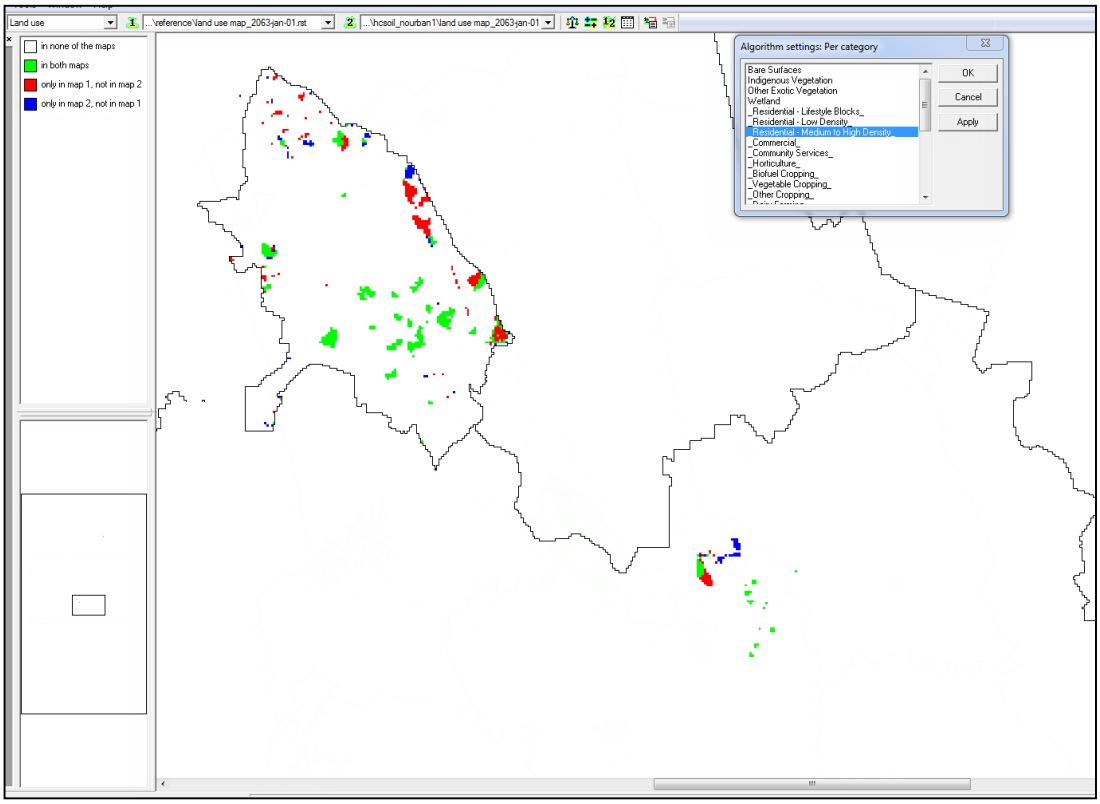

Figure 6 – Changes to location of Med-High Density Residential land use in 2064 with prohibited restriction on High Class soils (Red areas represent where land use occurs under the Reference scenario, Blue areas represent where land use occurs under high class soils restriction scenario, Green areas – where land use occurs under both scenarios)

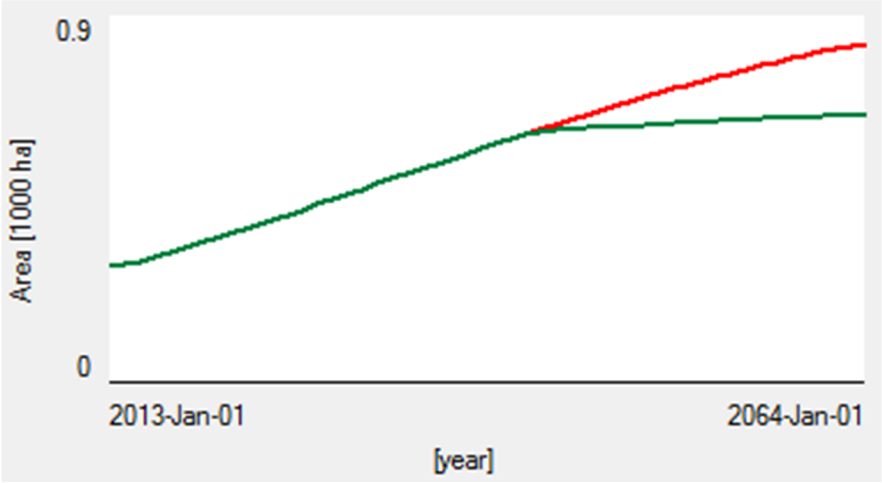

Figure 7 – Medium-High Density Residential Demand (Red) vs Supply (Green) with prohibited restriction on High Class soils

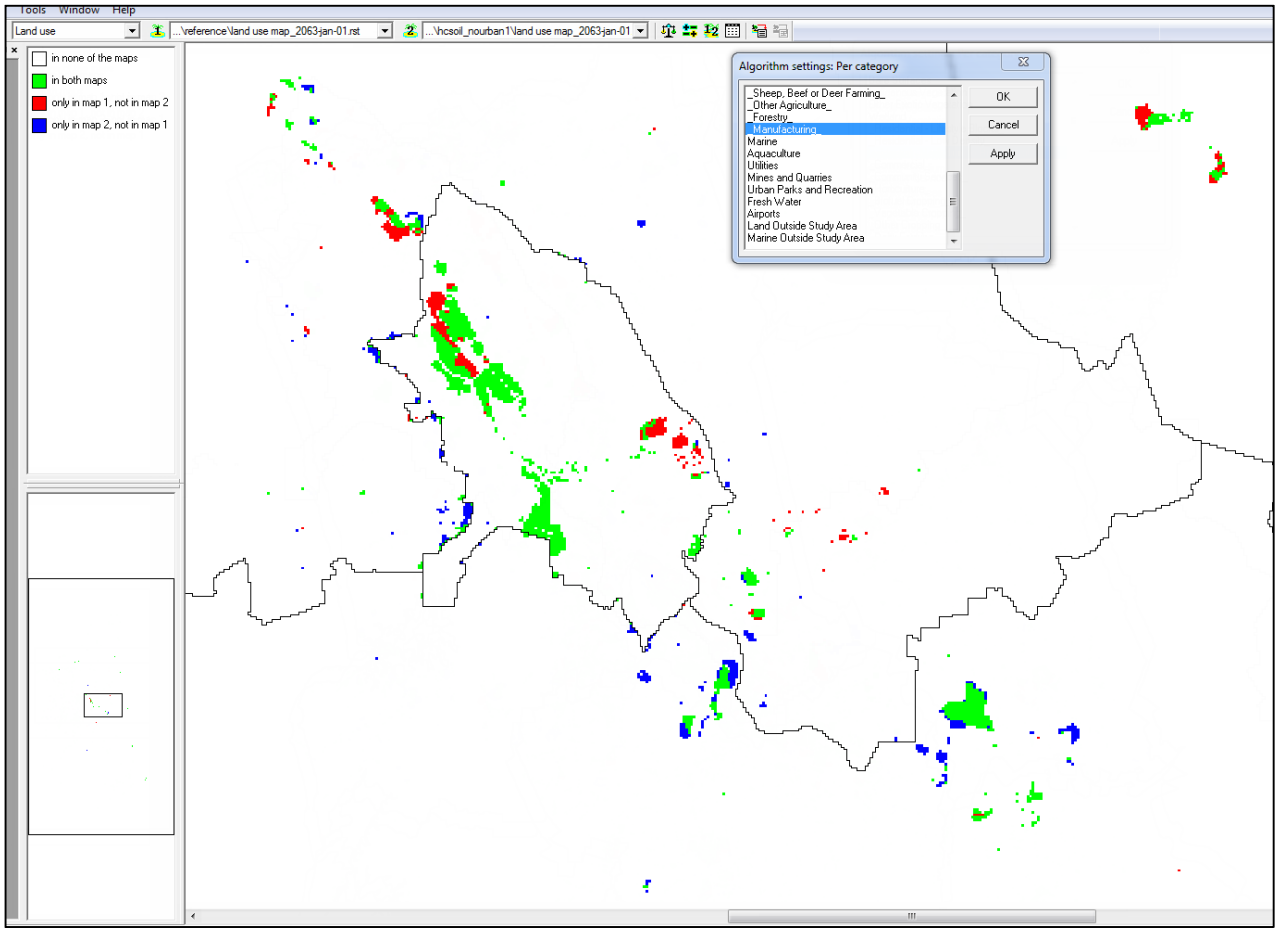

Figure 8 – Changes to location of Manufacturing land use in 2064 with prohibited restriction on High Class soils (Red areas represent where land use occurs under the Reference scenario, Blue areas represent where land use occurs under high class soils restriction scenario, Green areas – where land use occurs under both scenarios)

This outcome, as shown in Figure 8, may not be very plausible, as the high class soil restriction 'removes' key zoned areas from being used and the WISE model then used the next least restrictive area (even though this might be zoned as non-complying or some distance from urban areas).

The value in scenario planning is to assess the outcomes from a scenario and then develop further scenarios to improve outcomes to be more plausible or to test other assumptions. In this case further discussions on alternate areas to zone for manufacturing and commercial land uses could be used improve the set up in WISE and test possible outcomes from these new zoned areas.

For commercial land use again HCC (-78 ha) and WDC (-22 ha) are the losers under current zoning and application of a high class soils restriction (Figure 9) (to lesser extent MPDC -8 ha). This growth is reallocated under this scenario to Waipa DC (29 ha more) and Hauraki DC (74 ha more).

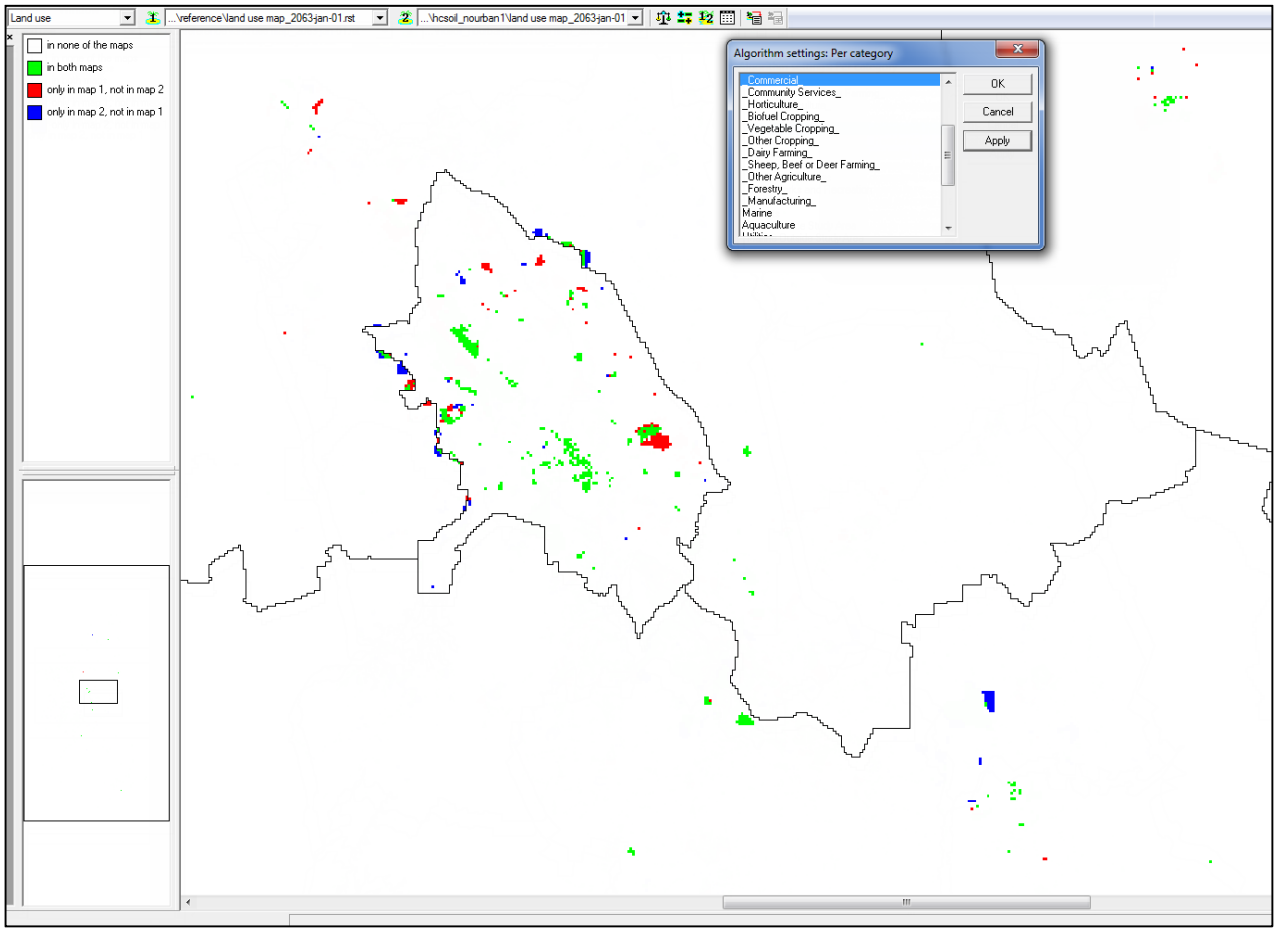

Figure 9 – Changes to location of Commercial land use in 2064 with prohibited restriction on High Class soils (Red areas represent where land use occurs under the Reference scenario, Blue areas represent where land use occurs under high class soils restriction scenario, Green areas – where land use occurs under both scenarios)

SUMMARY OF IMPLICATIONS

In summary the implications of applying a restriction on future urban land use growth on high class soils would mean that significant changes to the current zoning for these land uses would be required. To protect the high class soils large areas of lower quality soils would need to be zoned for future urban growth. The biggest impact is around Hamilton city and northern Waikato where significant areas of urban growth are projected and large tracts of high class soils exist.

Table 1 shows the implications for the extent of high class soils under the two scenarios: 1. Status quo under current zoning and planning policies; and 2. Applying restrictions to protect productive use of high class soils.

The total area of high class soil potentially protected for productive land uses by applying a restriction on use of high class soils is approximately 7000 ha (~3% of 260,000 ha of HC Soils in Region) by 2060.

Land Use in 2063	Land Use on HC soils 2013	Reference scenario – land use on HC soils in 2060	HC Soils scenario – land use on HC soils in 2060	Impact of restriction by 2060
Indigenous	5680	5455	5458	3
Lifestyle Block	11138	14431	10655	-3776
L Den Residential	2011	3814	1970	-1844
MH Den Residential	15	226	15	-211
Commercial	139	289	139	-150
Community Services	420	692	420	-272
Horticulture	997	1710	1655	-55
Veg cropping	3286	3316	3527	211
Other cropping	1740	1527	1551	24
Dairying	170478	168082	171752	3670
Sheep and Beef	54662	50485	53356	2871
Other Agriculture	3165	2664	2778	114
Forestry	1632	2240	2313	73
Manufacturing	497	1156	497	-659

Table 1: Differences in spatial extent of land use types on high class soils under two WISE modelled scenarios

2. PROMOTE USE OF ELITE SOILS FOR HORTICULTURE AND VEGETABLE CROPPING

This scenario was set up to assess the outcomes if all future growth of vegetable cropping and horticulture was to occur only on onto elite soils (defined as Land Use Classification [LUC] Class 1 soils). This would represent an outcome that makes the most of the elite soils by using them only for intensive high value crops.

To set the scenario up a layer for elite soils was created using LUC Class 1 unit. This layer was then used to create a scenario where all future land use change except to horticulture and vegetable cropping are prohibited.

The outcomes of the scenario show that most of the land use change on elite soils under this scenario is into horticulture with an estimated 1300 ha of additional horticulture on elite soils by 2063 (Table 2). The level of increase in vegetable cropping between scenarios is relative small with only an additional 87 ha of growth onto elite soils.

The main land uses to be replaced on elite soils or restricted from expansion onto elite soils are Dairying (1042 ha less), lifestyle blocks (287 ha less) and manufacturing (182 ha less) (Table 2).

The spatial implications of the changes for horticulture land use can be seen in Figure 8. This shows that the major areas of dairying that would become horticulture under this scenario are mainly in the Hauraki plains (north of Morrinsville).

Land Use in 2063	Land Use on Elite soils 2013 (ha)	Reference scenario – land use on Elite soils in 2063	Elite Soils scenario – land use on Elite soils in 2063	Impact of restriction by 2063
Indigenous	104	105	133	28
Other exotic veg	8	0	0	0
Lifestyle Block	1160	1433	1146	-287
L Den Residential	204	244	204	-40
MH Den Residential	0	0	0	0
Commercial	56	60	56	-4
Community Services	34	35	34	-1
Horticulture	42	84	1384	1300
Veg cropping	568	583	670	87
Other cropping	219	219	219	0
Dairying	4633	4338	3296	-1042
Sheep and Beef	1456	1178	1347	169
Other Agriculture	103	92	98	6
Forestry	25	59	25	-34
Manufacturing	164	346	164	-182

Table 2: Differences in spatial extent of land use types on elite class soils under two WISE modelled scenarios (Reference scenario and elite soils restriction)

The key changes for restricting further lifestyle residential development onto elite soils would occurring in the area between Hamilton and Cambridge.

The major differences for manufacturing would occur primarily along a tongue of elite soils that occurs through north eastern Hamilton (Te Rapa) out to Horotiu industrial area.

In summary apply such a restriction would increase the total area of horticulture and vegetable cropping on elite soils by about 1400 ha from the Reference scenario, this represents about 16% of 9020 ha of elite soils that occurs in the Waikato.

3. RETIREMENT OF PEAT SOILS FROM PRODUCTIVE LAND USES FOR CARBON BENEFITS

Peat soils are one of the vulnerable soil types in the Waikato Region, others include erodible and fragile soils. The initial discussions with WRC staff have focused around assessing some of the key peat management/threat issues separately from other vulnerable soils.

As one option to maintain or protect these soils this scenario investigates the potential implications of retiring all peat soils from productive land use (pastoral, cropping or urban land uses) by 2040. This scenario is seen to represent potential changes that might be required under a carbon taxation system that would include soil carbon loss and that might also rewarded the benefit of carbon sequestration of peat systems.

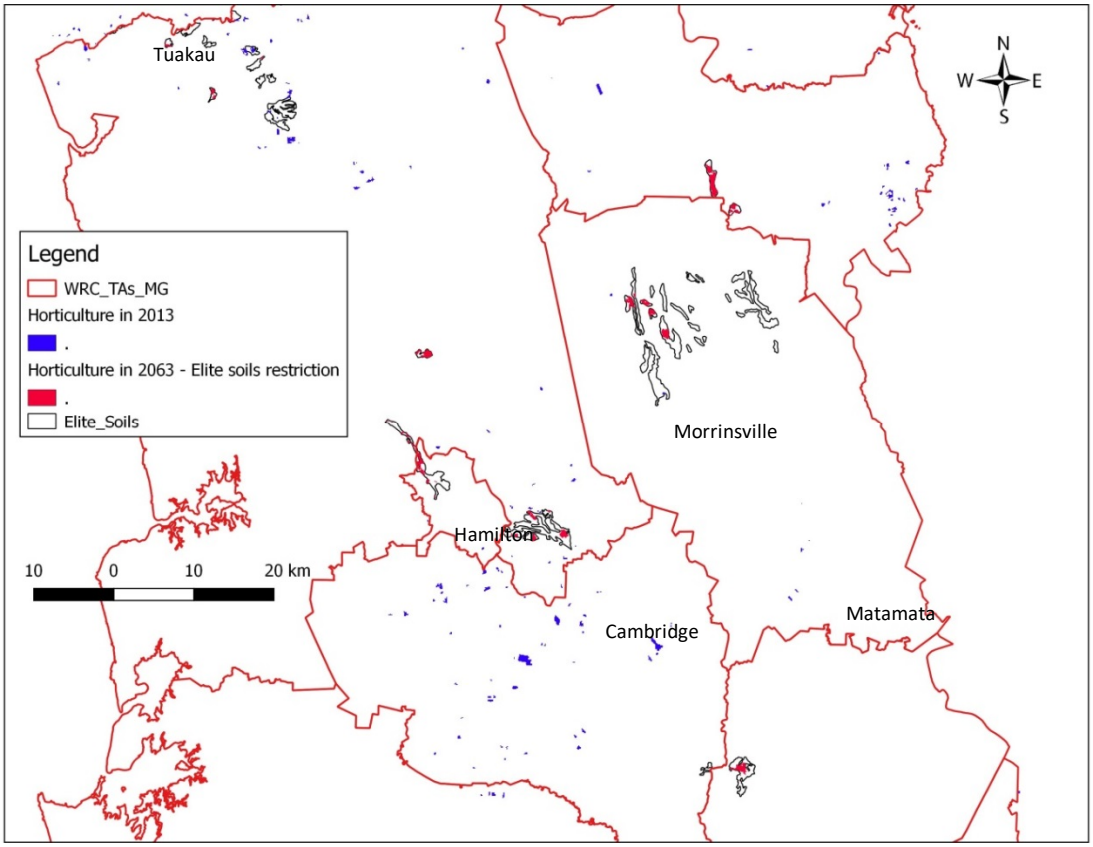

Figure 8 – Changes to location of horticulture land use in 2063 with restriction on elite soils

Peat soils are defined here as 'organic' soils in the Fundamental Soils Layer (FSL) GIS data set. However, there is some uncertainty about the currency of using the "organic" layer from FSL as a valid representation of peat soils in the region. This data set was established some time ago and some areas of peat soils have reduced/disappeared since. More recent data on peat extent and depth has been collected in a couple of areas (around Huntly and Mangatawhiri/Aka Aka) and this was compared to FSL organic layer. At these sites it was found that the FSL data overestimated the extent of peat soils.

There is however, no consistent alternate spatial layer to the FSL that covers the whole region, so it is used here for this analysis. Given current uncertainties around this data it is likely to over-estimate the extent of peat soils for this analysis.

Initial work was undertaken to define the implications for the current land uses on peat soils and how these are likely to change under the WISE "Reference" scenario (Table 3). This shows that most rural land uses on peat soils are relative 'stable', with the exception of 'Other exotic vegetation' which declines and is offset by increases in 'Forestry' and the expansion of urban growth (residential, commercial, manufacturing) onto areas of peat soils. A lot of the residential expansion occurs in Hamilton around Temple View and Rotokauri areas, and manufacturing around Rotokarui to Horotiu area.

It was recognised that the areas of peat have different management issues based on their drainage status. WRC staff sourced spatial layers that define the types and extent of drainage schemes of which peat soils are a part. This drainage status of peat soils in the Waikato is shown in Figure 9.

This layer was used to cross tabulate 'peat by drainage type' against future projected land uses in the scenarios being assessed here.

Land Use Type	Area on peat soils in 2013 (ha)	Area on peat soils in 2040 (ha)	Difference (ha)
Indigenous	13091	13046	-45
Other exotic veg	1678	1051	-627
Lifestyle Blk	1246	1239	-7
LD Residential	152	445	293
HMD Residential	0	17	17
Commercial	1	26	25
Community Services	38	63	25
Horticulture	276	281	5
Veg cropping	213	212	-1
Other cropping	99	88	-11
Dairying	71755	71803	48
Sheep and Beef	14660	14620	-40
Other Agriculture	191	183	-8
Forestry	359	547	188
Manufacturing	147	275	128
Utilities	490	489	-1
Urban Parks, Rec.	197	197	0

Table 3: Land use types on peat soils under WISE References scenario for 2013 and 2040.

Table 4 represent the extent of projected land uses under the WISE Reference scenario that occur on peats soils and the different drainage types. These results represent the potential 'loss' or change in productive land use required to meet the objective of "Retiring all peat soils from productive land use by 2040". The biggest impact would be on dairying land use with about 72,000 ha affected (~11% of dairy land in Region). The second largest land use change required would be for Sheep and Beef with 14600 ha affected (~2.3% of regional sheep and beef).

Although not large in spatial area 10% of the Regions horticulture occurs on the peat and could be affected by such a restriction.

The next step in the scenario development was to consider the spatially dynamic outcomes of moving these land uses out of these peat areas on other land use patterns in the region. The WISE model was set up to replace the current land uses on peat soils with indigenous vegetation. The spatial differences in land use from the starting 2013 land use to projected land use outcomes after all the peat has been retired are shown in figure 10 and 11 respectively.

Spatially the extent of land use change under this "restriction on all peat soils" scenario (Figure 11) is extensive and represent about 87,000 ha of land use change to indigenous vegetation from existing land uses.

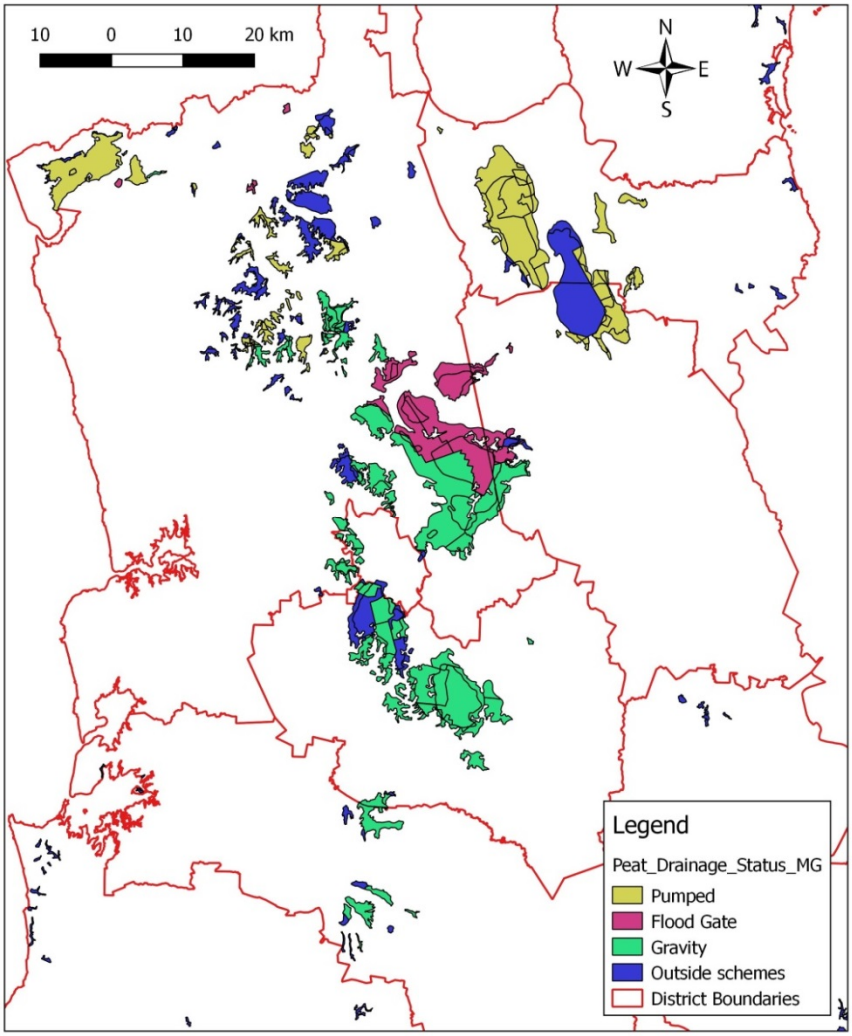

Figure 9 - Drainage Status of Peat soils in Waikato

Land Use in 2040	**Scheme – drainage method**					
(area in ha)	Pumped	Flood Gate	Gravity	Outside Schemes	Totals	% of Regional land use
Indigenous	1833	44	178	10991	13046	
Other exotic veg	470	0	5	576	1050	
Lifestyle Block	181	157	638	263	1239	3.0
LD Residential	6	3	330	106	445	2.6
Horticulture	48	1	185	47	281	9.4
Veg cropping	51	0	34	127	212	3.4
Other cropping	12	0	58	18	88	2.5
Dairying	19392	11780	32032	8599	71803	11.1
Sheep and Beef	3419	2050	3791	5360	14620	2.3
Other Agriculture	49	0	83	51	183	2.8
Forestry	13	10	11	513	547	
Utilities	54	10	115	310	489	
Urban Parks, Rec.	29	42	9	117	197	
Totals	25569	14110	37977	27625	104200	

Table 4: Projected 2040 land use on peat soils under different drainage methods in Waikato Region

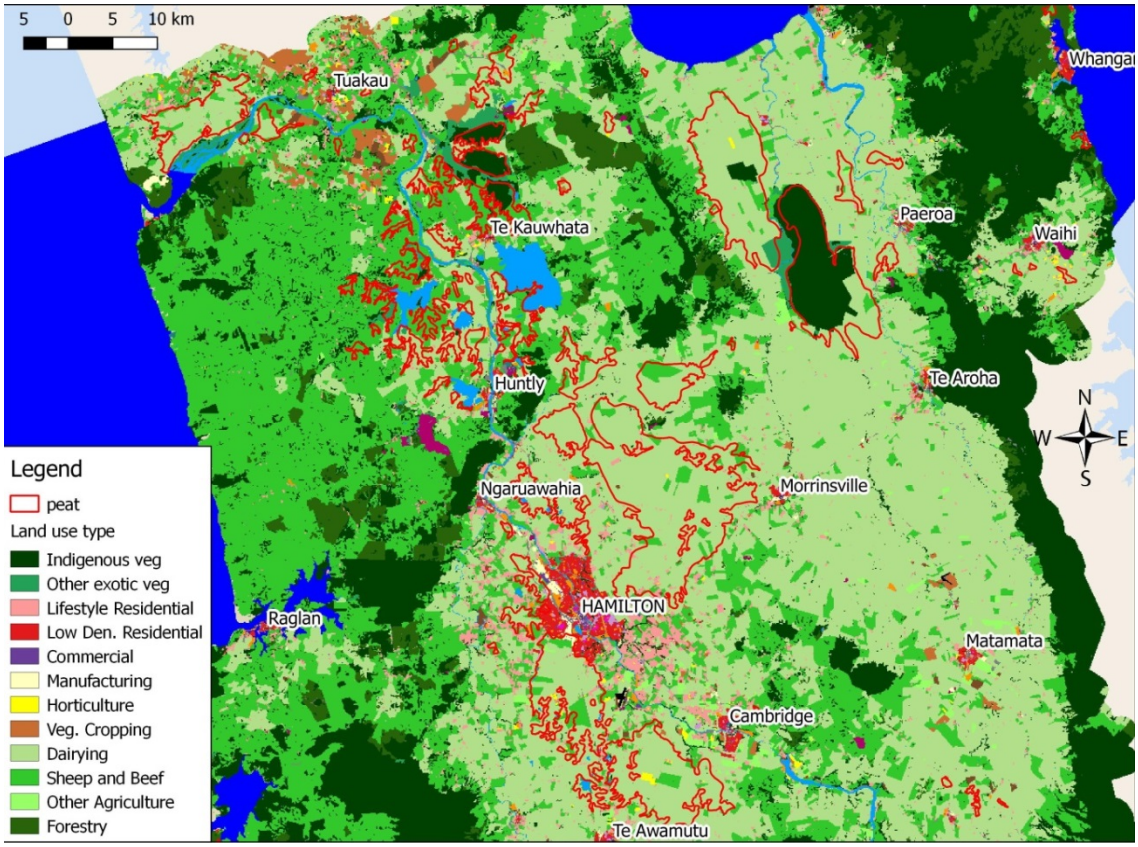

Figure 10: 2013 land use and extent of peat soils in Waikato

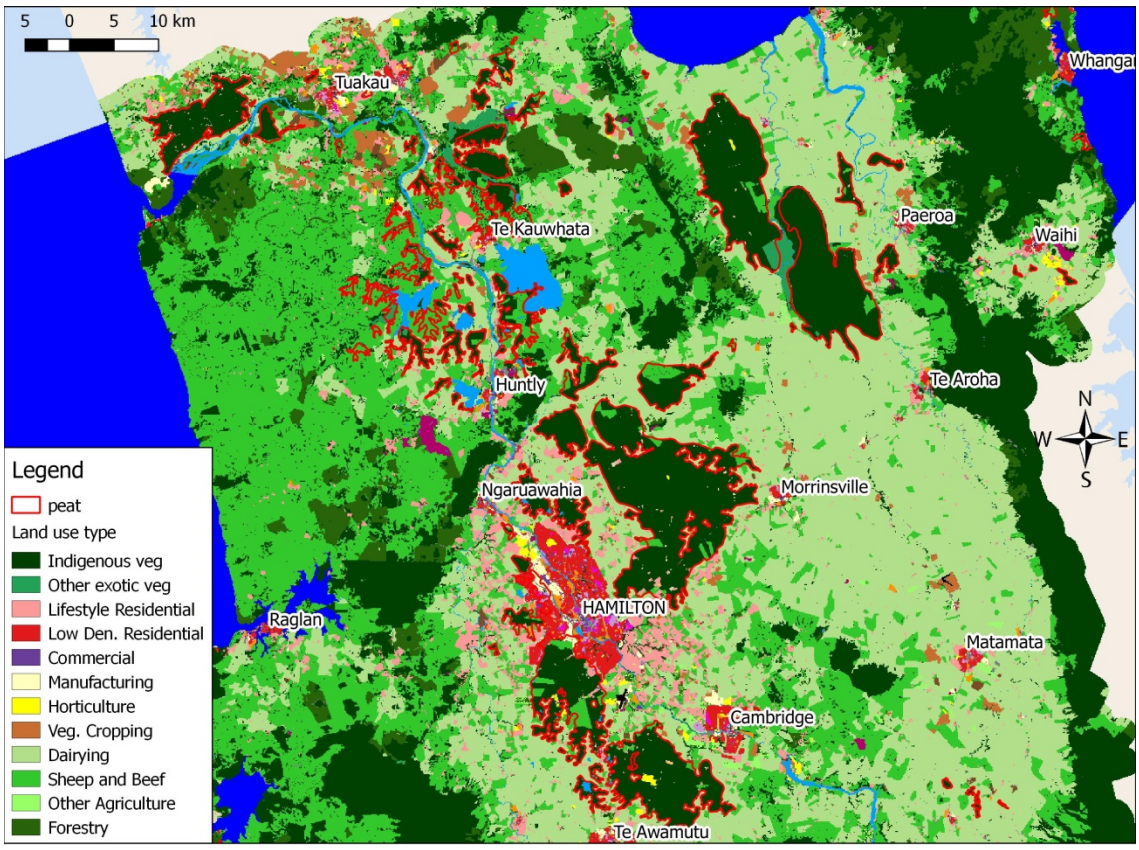

Figure 11: Land use outcomes from removing productive land uses from Peat soils

The main land use changes to make way for this change on peat soils occur between dairying, sheep and beef, and forestry. Under this scenario ~79,000 ha of dairying is displaced from peat soils (Table 4) there are some small areas of new dairying in west coast and Hauraki catchments (~3,000ha in total) to off-set but the net effect is a 76,000 ha reduction in the areas of dairying in the Region.

For sheep and beef there is about 5,000 ha of this land use removed from on peat soils, but under this scenario most of this land use is relocated into areas of forestry mainly adjacent to current sheep and beef land use down the west coast and Mokau catchments. The net result is no change in the extent of this land use on a regional basis. However, under this scenario not all the sheep and beef were removed from peat areas (Figure 11). Adjusting parameters to remove the last of this land use caused some unexpected outcomes which would require further investigation.

The net outcome for forestry is a small increase in area (~2300 ha) for this land use in the region. This increase occur in scattered small clusters around the region at the agricultural land uses and other exotic vegetation. About 1000 ha of the increase is on bare land use on the West coast 'sands' areas. This may not be entirely plausible for these locations – but this outcome does reflect the 'pressure' such a big land use change can put on demand for some land use transitions.

The scale and shift in land use under this scenario is significant and would 'test' the calibration of the WISE model. It is recommended that further work be undertaken around this scenario if policy investigations are developed further to look at this management option.

	Reference	All Peat Protected	Difference		Only Pumped Peat Protected	Difference
Land use type	(ha in 2064)	(ha in 2064)			(ha in 2064)	
Low Density Residential	17950	17958	8		17945	-5
Dairy Farming	646900	571000	-75900		625160	-21740
Sheep and Beef	603560	603560	0		603560	0
Forestry	340200	342500	2300		341200	960
Indigenous/ Wetlands	658700	734200	75500		679400	20700

Table 5: Change in extent of land uses in Region with different restrictions on peats soils

4. RETIREMENT OF PEAT SOILS UNDER ASSISTED DRAINAGE

A follow-on scenario to the previous scenario this scenario looks at implications of only removing productive land uses from those peat areas the received 'active' pumped drainage to maintain their current land use. To do this the pumped areas in Figure 9 were used to set up WISE to prohibit future productive land uses in these areas.

The outcome of this scenario can be seen in Figure 12 and the extent of this change on major land uses is outlined in Table 5. In this scenario the extent of change required is much less than the previous scenario with only about 22,000 ha peat soils being affected.

In this case about 21,700 ha of dairying land use is lost from the Region, with only ~500 ha being relocated to other areas. For sheep and beef there is only about 1,000 ha of this land use removed from on peat soils and under this scenario most of this land use is relocated into areas of forestry mainly adjacent to current sheep and beef land use down the west coast and north Waikato catchments.

In this scenario as in the full peat retirement scenario the largest land use being displaced is Dairying and the outcome that large areas of new dairying do not appears is seen as an indication that most of the land that is suitable for dairying is already in that land use and also that the demand for other land uses (Sheep and Beef, horticulture etc) is enough to minimise any 'dairy expansion'.

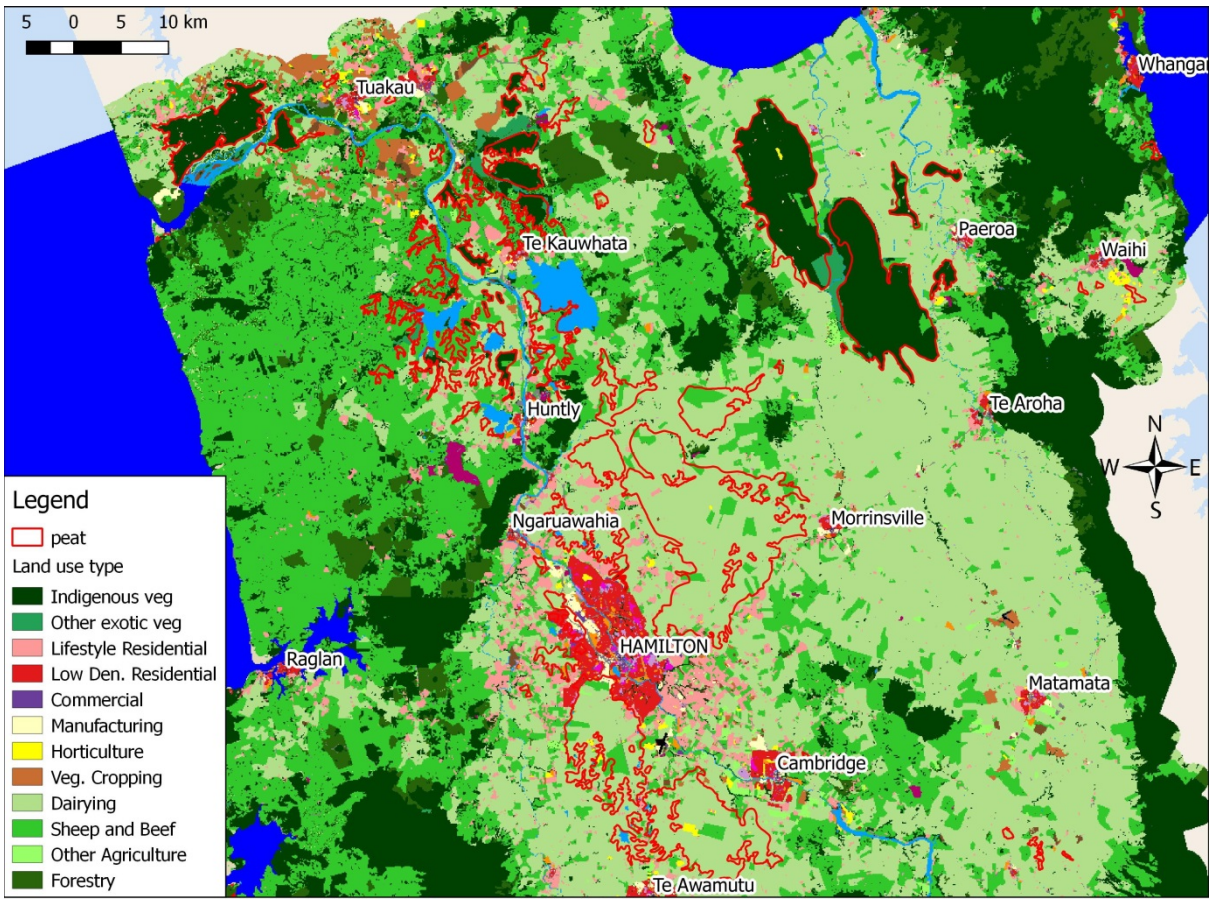

Figure 12: Land use outputs from removing productive land uses from pumped Peat soils

5. IMPACT OF COASTAL INUNDATION ON PEAT SOILS IN HAURAKI

The projected future changes in sea level under climate change scenarios and storm surge have been used to model potential coastal inundation for the Hauraki plains area. The implications of different level of potential future inundation on land use types has been undertaken in a separate report using WISE projections of future land use (Doc# 1346990- Hauraki_Coastal Inundation_WISE_LandUse_Scenario-Initial _Analysis_July18.doc)

Although not a specific WISE based scenario the two data sets (Peat soils and their drainage type, and coastal inundation extent at increasing sea levels [Relative Level - mm above datum]) were analysed in GIS to provide an indication of the extent and spatial distribution of affected areas at different inundation levels.

The results of coastal inundation modelling provided specific depths of inundation (mm) for areas that would be directly connected to sea. The areas that were not connected to sea but were at or below the specific RL water level were given a value of 99. For this analysis of the inundation raster layers the data was simplified into two groups – inundated depths connected to the sea are classed as 'inundated' and areas at or below water level but not connected to sea are classed as 'saturated'.

The results of cross-tabulating peat soils by drainage type (as used in section 3 above) against modelled inundation from increasing sea levels (RL's from 1800 – 4800mm above Moturiki datum) are summarised in Figure 11.

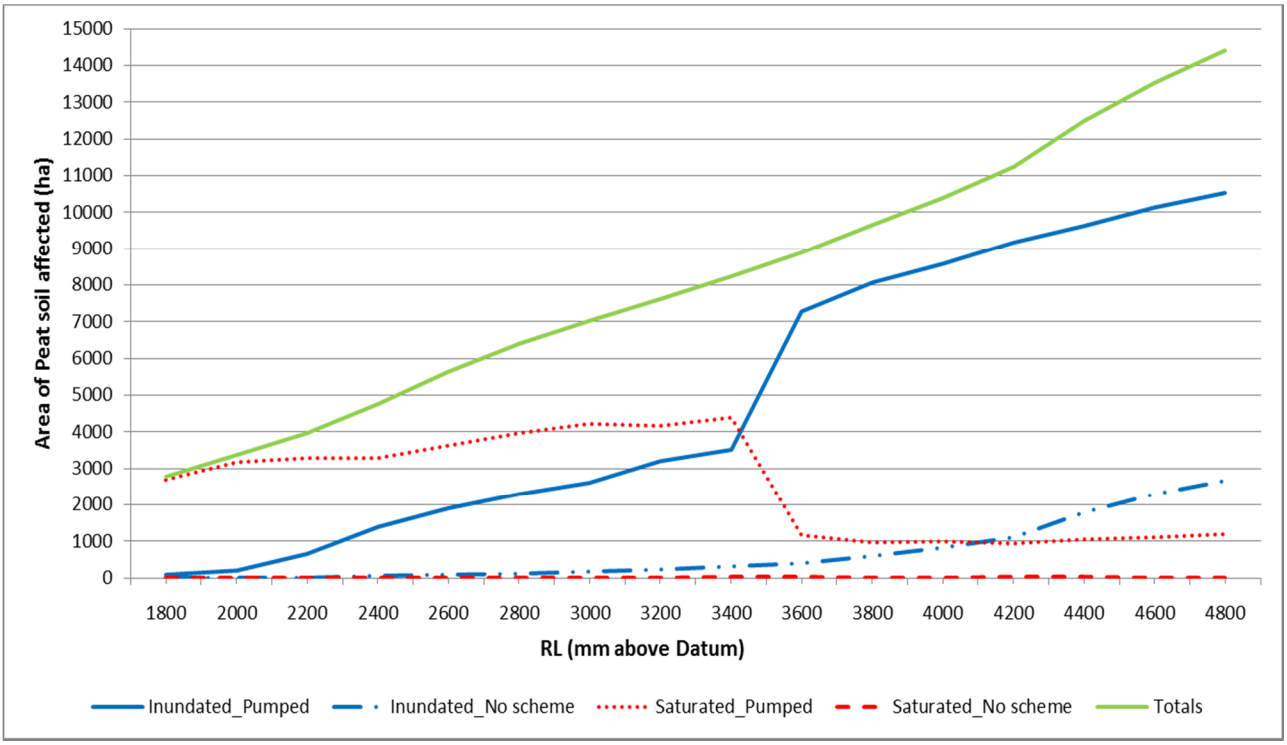

Figure 11 – Projected impact of increasing seal levels on potential inundation of peat soils in Hauraki Plains

This shows that total impacts on peat soils would be about 3000ha at 1800mm RL to around 14,000ha at 4800mm RL.[4] Most of the 'pump' drained peat soils occur around the Ngatea-Torepae-Patetonga area to the north west of Kopuatai peat dome, and to south west of the dome around

[4] RL's for the different risk scenarios are: Current state 1% Annual Exceedance Probability = 3100 mm Reduced Level [RL], Climate change scenario 1 (1 % AEP + 0.5 m Sea Level Rise) = 3600 mm RL, Climate change scenario 1 (1 % AEP + 1.0 m Sea Level Rise) = 4100 m RL.

Otway-Tirohia area. These pumped peat soil areas get progressively inundated as RL's increase to the point at 3600mm, at which point the existing flood protections fails and there is a significant jump in the area of pump drained peat soils that would potentially be inundated.

The peat soils outside the existing drainage schemes are not significantly impacted by effects of increased sea level until around 3400 RL (~340ha) with a greater increase in area impacted after about 4200mm RL (~1100 ha, increasing to ~2700 ha at 4800 RL). However, most of this inundation at high RL's occurs around the lower central part of the Kopuatai peat dome.

In summary the majority of the impact on peat soils from increase sea level rise would occur in areas that are within current drainage schemes. Therefore the changes in future management of these schemes in the face of projected increases in sea level will significantly affect the maintenance and sustainability of these vulnerable soils.

DISCUSSIONS – IMPLICATIONS FOR SOILS MANAGEMENT

HIGH QUALITY SOILS

The current zonings for future urban growth in the Waikato has provided little consideration to use and protection of high class soils. Therefore, there is little to stop most of these soils around existing large urban centres being converted either low productive uses (lifestyle residential) or lost entirely under urban development.

Under current plans and zoning restrictions it is likely that 3500 ha will be lost by 2030 and 6500ha lost by 2060. Unless planning considerations are changed then these versatile soils will continue to be lost for future use. To protect these high class soils would mean that significant changes to the current zoning for these land uses would be required. To protect the high class soils large areas of lower quality soils would need to be zoned for future urban growth.

Any changes to restrict future urban development on high class soils would have impacts on the current planned zoning for future development in Hamilton, Cambridge, Te Awamutu, Tuakau and Pokeno. Applying the scenario tested here (no further urban growth on HC soils) would mean a 'shortfall' in available zoned areas for residential growth from about early 2030's. Approximately 2000ha of alternate area would need to be zoned low density residential in Region to meet demand out to 2060 if current undeveloped high class soils are to be maintained.

Hamilton particularly has large area of high class soils within its current boundary as well as in planned expansion areas to the north and north-east of city. Significant areas of high class soils also exist in areas planned for industrial/manufacturing growth at Te Rapa/Rotokauri, Ruakura and Horotiu. Approximately 700ha of alternate area would need to be zoned manufacturing in the Region to meet demand out to 2060 if high class soils are to be maintained.

In a scenario to optimise the use of elite soils for only vegetable cropping and horticulture this would replace existing or future growth of ~1000 ha of dairying, ~300 ha of Lifestyle blocks, ~40 ha of low

density residential and 180 ha of manufacturing. The benefit would be ~1400 ha more of the elite soils being used for vegetable cropping and horticulture.

Further scenarios analysis could be used to investigate alternative growth areas and develop a longer term strategy for planning growth and mitigating the losses of limited high value soils resources.

VULNERABLE SOILS

Peat soils are one of the key vulnerable soils in the Waikato. By their very nature they are not sustainable for most agricultural uses as the degree of drainage required causes oxidation and loss of the peat. Long term management of the peat is one of the land management challenges for the Waikato community.

The most extreme option is to retire all peat soils from drainage and productive agricultural use. This would represent a major change in land use across the Hauraki/Hamilton basins. It could potential affect ~100,000 of productive land use. The largest impact would be on dairying (~71,000 ha which represent ~11% of regional dairy land use) and sheep and beef (~14,000 ha which represent ~2% of regional sheep and beef land use). The scenario modelling shows that for Sheep and Beef it is relocated to other parts of Region (although not all sheep and beef land use was pushed off peat in these initial scenarios. For Dairying however, most of the displaced land use could not be relocated to other parts of region due to lack of land suitability or policy restrictions.

Under the initial scenario analysis the transition is mainly into forestry or indigenous, further scenarios analysis restricted forestry onto these soils so that the outcome of complete retirement was achieved. Further scenarios could be used to test alternate land use and transition options.

The majority of the 'Peat' soils areas are within managed drainage schemes (74% of by area) with 24% of all peat soils being in 'pumped' schemes (~27% of the impacted dairying is in pumped schemes). The scenario of removing agricultural land uses from just the pumped drainage areas represented a smaller impact (~25,000 ha total area) but the relocation outcomes for land uses such as sheep and beef and forestry were similar.

Significant areas of peat occur within the low lying part of the Hauraki Plains and this area is most vulnerable to potential coastal inundation from projected sea level rise. Other existing modelling work undertaken by WRC of coastal inundation was used to assess potential impacts on peat soils. The greatest area of peat that could be impacted occurs within existing pumped drainage schemes and behind existing flood protection. Therefore the potential effects of coastal inundation will be determined by the management decision made for the wider areas under these flood protection and drainage schemes.

IMPLICATIONS AND OPPORTUNITIES FOR LAND MANAGEMENT

This report presents a small number of scenarios looking at some relatively simple policy questions for valuable and vulnerable soils in the Waikato. The issues tested here are part of the larger challenge of sustainable land management which not only maintains or enhances the stability and quality of the soils but also support the other part of the environment and provides best economic and social outcomes for the Region.

The power of scenario analysis is in undertaking iterations to refine testing of policy options and explore specifics of plausible land use change outcomes. In this study only one or two iterations were undertaken for the initial management question.

These management questions have focused on the extent and risks to particular soil types/attributes. The 'follow-on' questions that have emerged from looking at this analysis have also tended to focus more on alternate land management /use scenarios that are often wider than specific soils management and are more about sustainable/best use options for land management.

The natural extension of this initial work is therefore to use WISE and the scenario planning approach to investigate and inform some of the wider land use/best use questions that would come with the development of broader land management strategy.