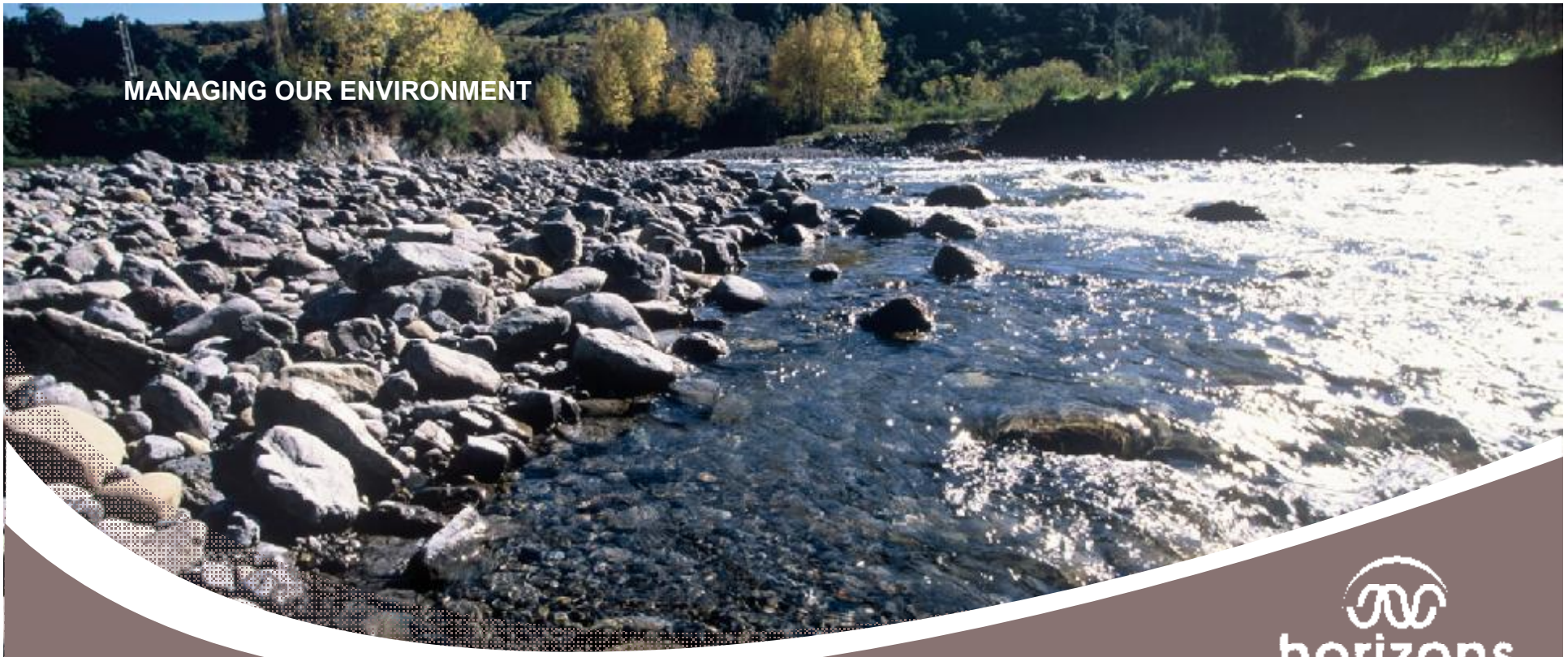

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Statement of evidence

Dr. Jon Roygard

Defining Highly Erodable Land

- Two reports:
  - Page, Sheppard, Dymond and Jessen, 2005 (Page et al., 2005) &
  - Dymond and Sheppard 2006

- "*Page et al. (2005) produced a report defining highly erodable land in the Manawatu-Wanganui Region. Highly erodable land is defined as land with potential for severe erosion if it does not have protective woody vegetation.*" (Dymond and Sheppard et al., 2006 (Page 4)).

- Dymond & Sheppard (2006) provided more detail around the location of HEL via summary information for major catchments.

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2) refer Table 1 Page 9

The definition of HEL is a mixture of LUC and Slope

- **John Dymonds presentation simplified the definition of HEL to Slopes of above 25^{o}**

- **The definition was more complex than that (as outlined in the technical reports).**

- **Section 5.1.3 of this report concludes the report as follows**

  "*The guidelines in the previous section of the report are designed to help the assessment of present erosion severity. The Land Use Capability system of land classification (Soils Conservation and Rivers control Council, 1971) is designed to identify, by considering physical land characteristics, climate and response to land use and management, where the potential for erosion is a limitation to sustainable land use (ie. land that is highly erodible).*
  (Page et al. 2005)

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3) refer page 8

LUC units comprising HEL in Hill Country (Dymond et al. 2006)

NZLRI Region	Taranaki-Manawatu	Southern Hawke's Bay-Wairarapa	Wellington	
Terrain (and main erosion type)	LUC units			Slope threshold (degrees)
Mudstone hill country (landslide)	6e3, 6e4, 6e5, 6e7, 6e8, 6e21, 7e1, 7e2, 7e7, 7e9 7e20, 8e3,	6e2, 6e3, 6e7, 6e8 7e1, 7e2, 7e12		24
Mudstone hill country (earthflow)	6e19, 6e20 7e12, 7e14	6e10, 6e12 7e6, 7e7, 7e8, 7e9, 8e3		24
Consolidated sandstone hill country (landslide)	6e2, 6e3, 6e4, 6e10, 6e12, 6e13, 6e14, 6e15, 6e17, 6e23 7e3, 7e4, 7e5, 7e11, 7e13, 7e17, 7e23, 8e3	6e9 7e4, 8e1, 8e2		28
Moderate to unconsolidated sandstone hill country (landslide, gully)	6e11, 6e13, 6e14 7e6, 7e16, 8e2			22
Greywacke hill country (landslide, scree)	6e16 7e8, 7e10	6e11 7e10	6e6, 6e8, 6e10 7e1, 7e2	32

4) refer Table 1 Page 9

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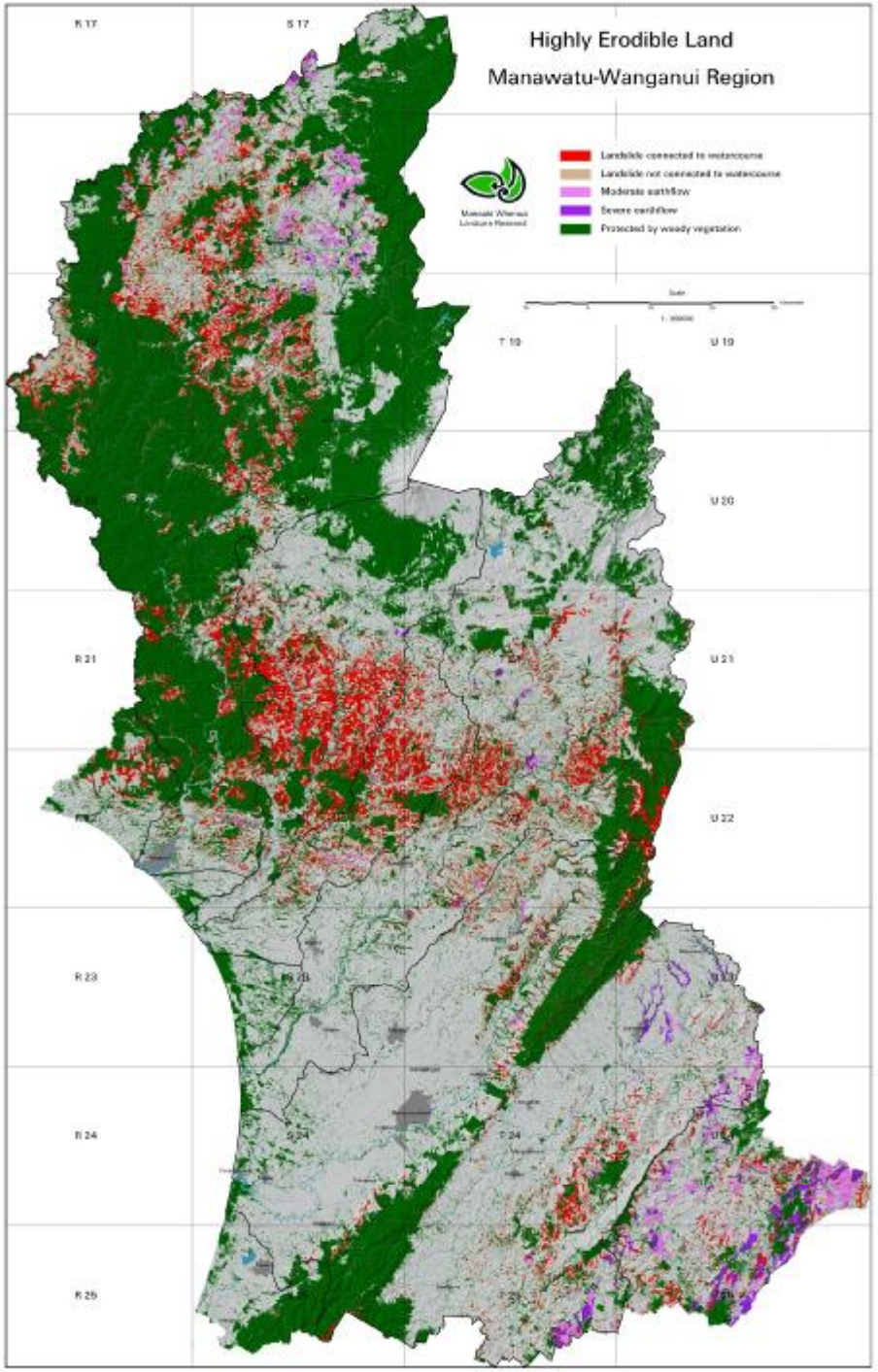
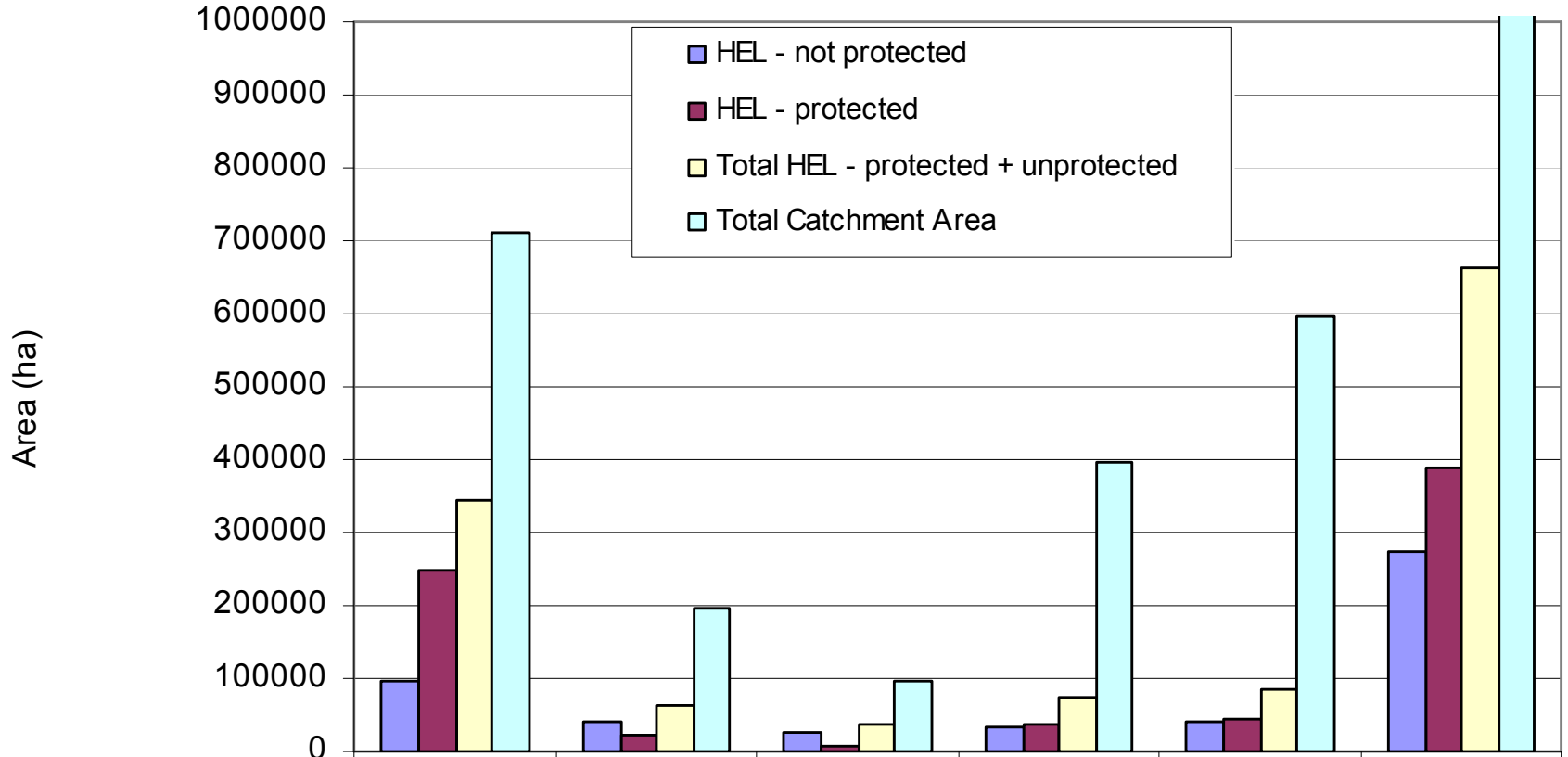
Map from Dymond and Sheppard (2006)

- Landslide connected to watercourse
- Landslide not connected to watercourse
- Moderate earthflow
- Severe earthflow
- Protected by woody vegetation



5) refer Map 1 page 12

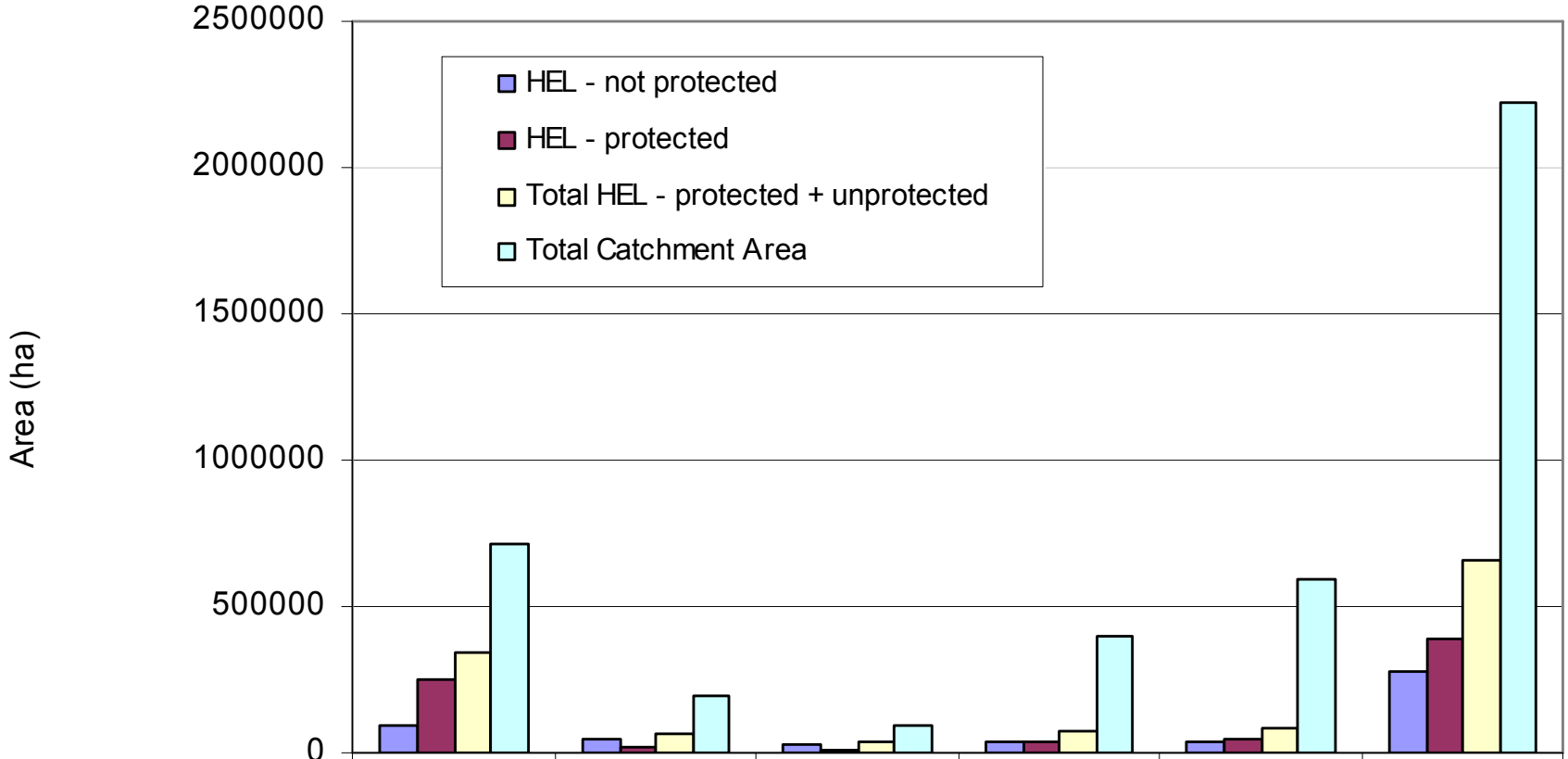
Quantifying HEL – Dymond & Sheppard. 2006



	Wanganui	Whangaehu	Turakina	Rangitikei	Manawatu	Region
HEL - not protected	95201	42073	26808	34633	39356	273527
HEL - protected	248304	21115	9254	38197	44851	387832
Total HEL - protected + unprotected	343505	63188	36062	72830	84207	661359
Total Catchment Area	712185	196561	96606	397931	596861	2220890

6) refer Table 3 Page 10

Quantifying HEL – Dymond & Sheppard. 2006



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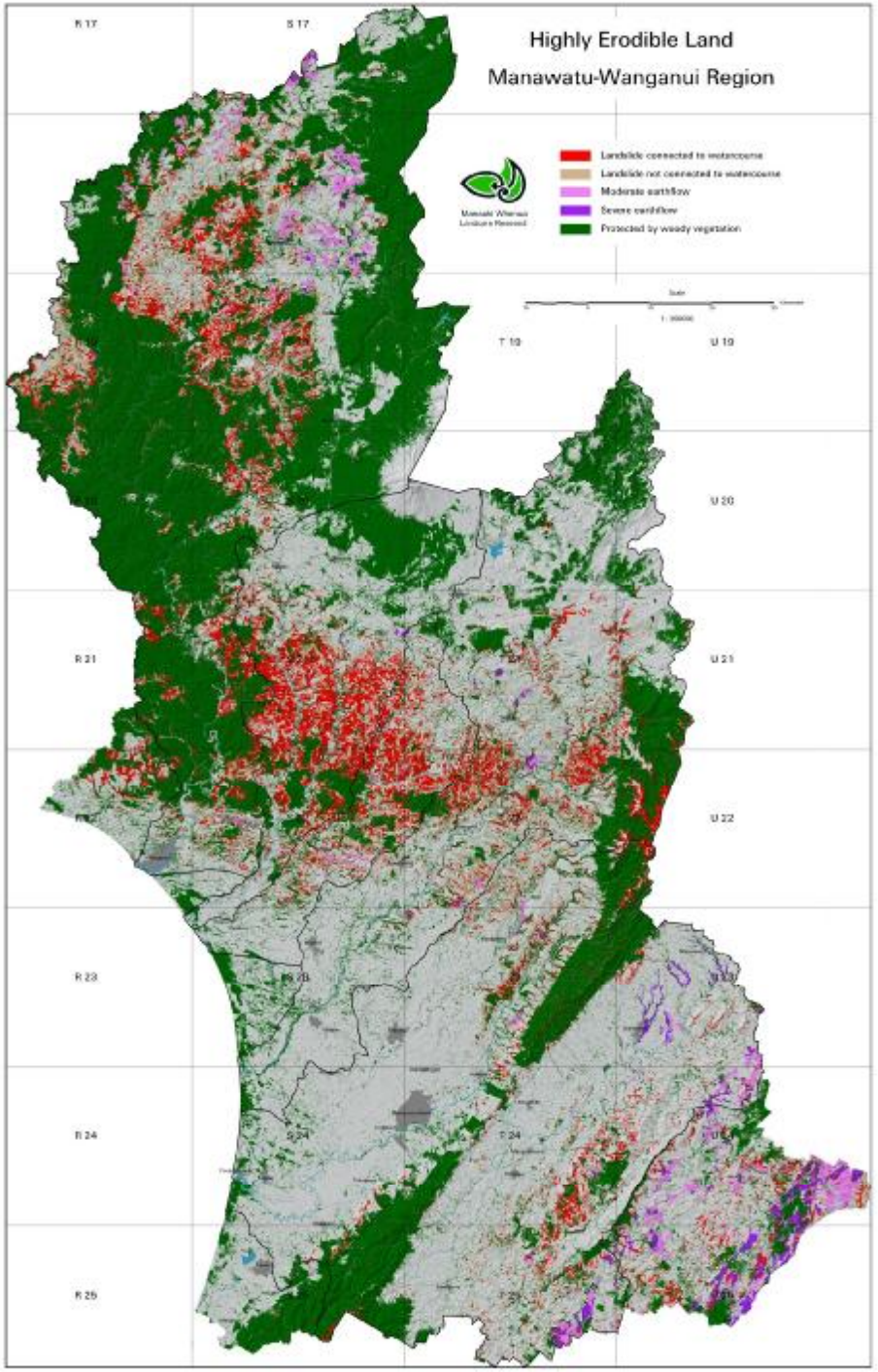
7) refer Table 3 Page 10 and points 29 to 32 Page 11

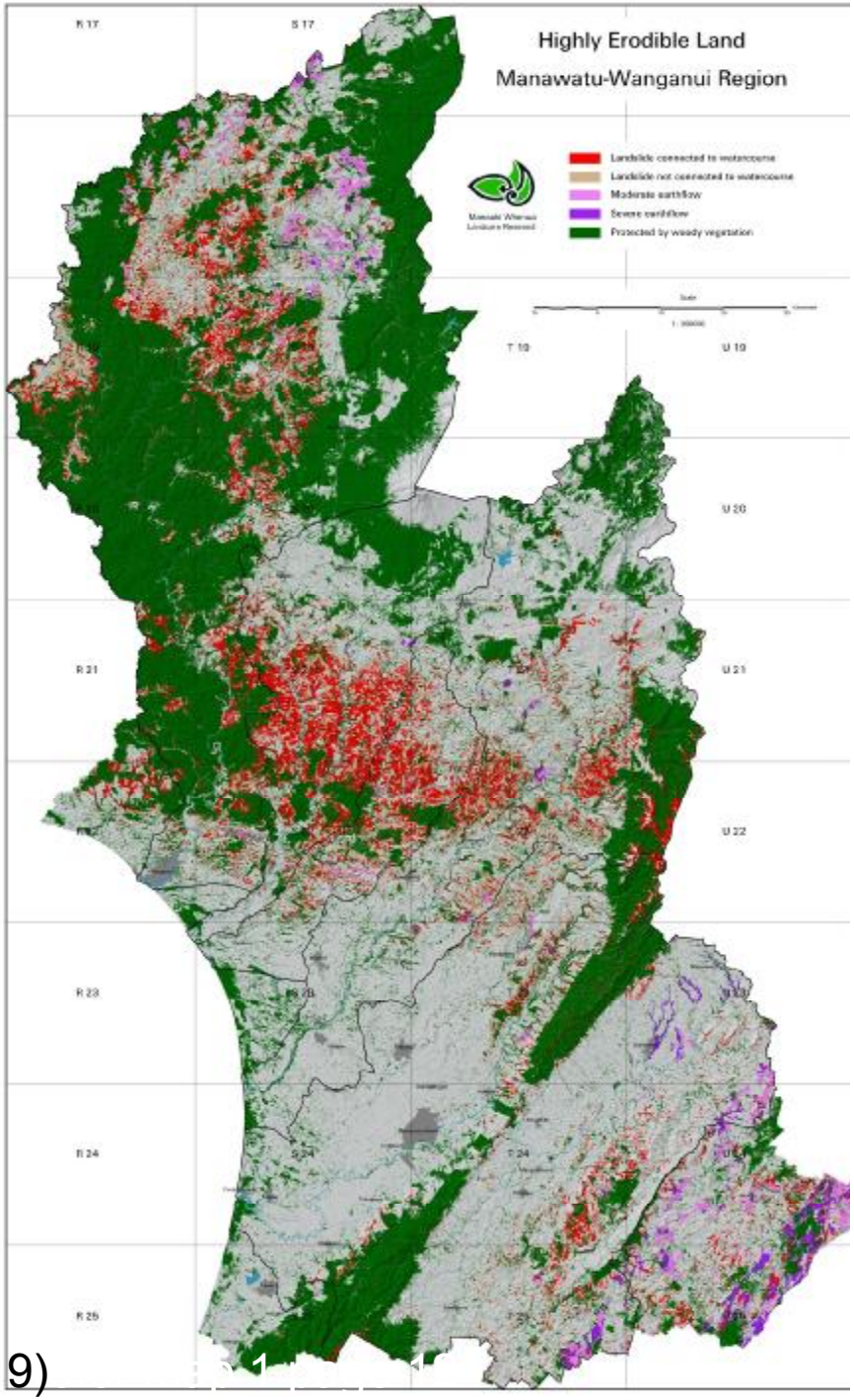
Map from Dymond and Sheppard (2006)

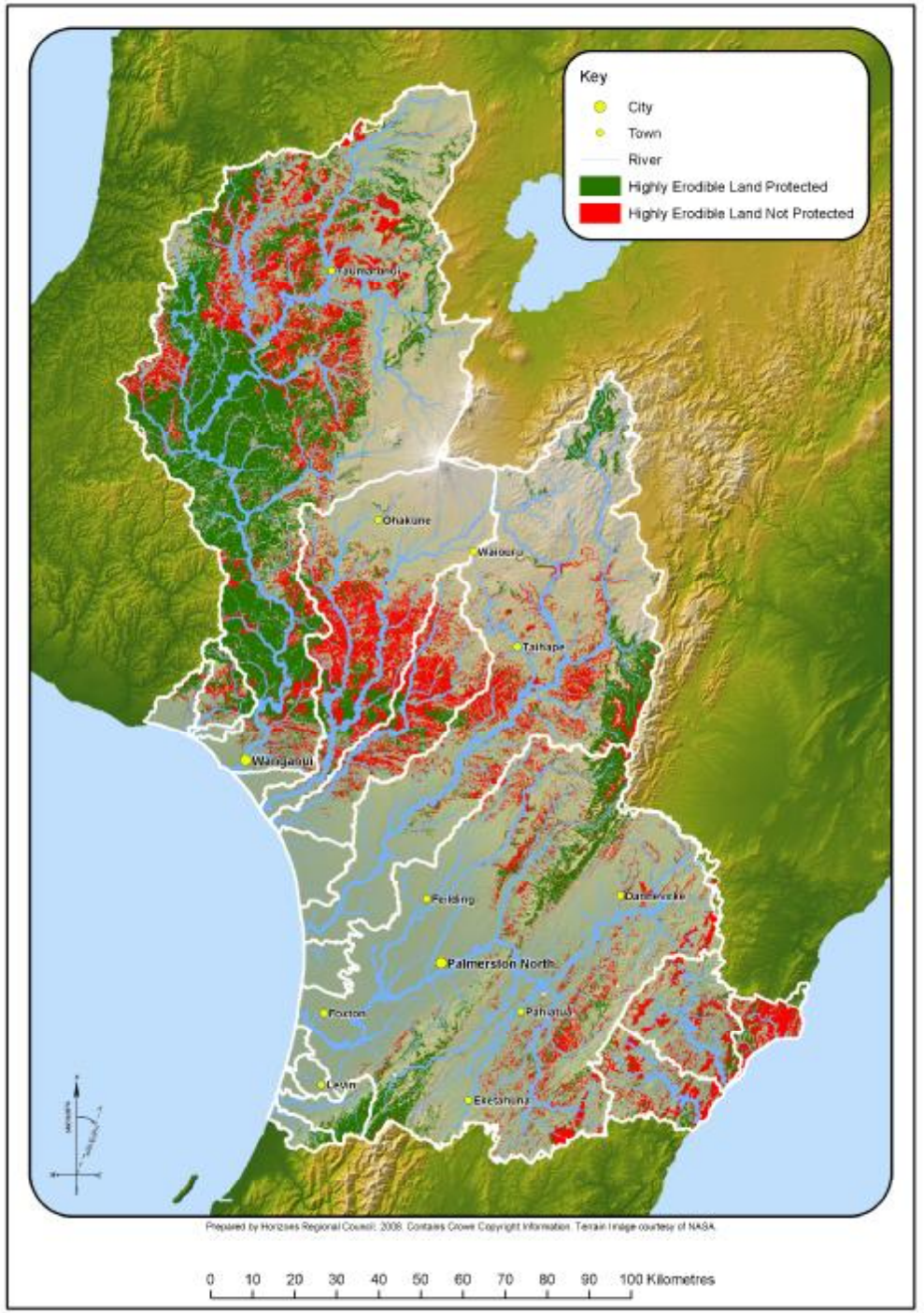
- Landslide connected to watercourse
- Landslide not connected to watercourse
- Moderate earthflow
- Severe earthflow
- Protected by woody vegetation

- The map in Schedule A is essentially this map scaled up to property boundaries (point 33, page 11)
- Coastal HEL is not in the Dymond & Sheppard Map.
- It is noted the green overlay is the woody vegetation layer and does not necessarily imply there is HEL below the green

8) refer Map 1 page 12




Highly Erodible Land
Manawatu-Wanganui Region
Landslide connected to watercourse
Landslide not connected to watercourse
Moderate earthflow
Severe earthflow
Protected by woody vegetation

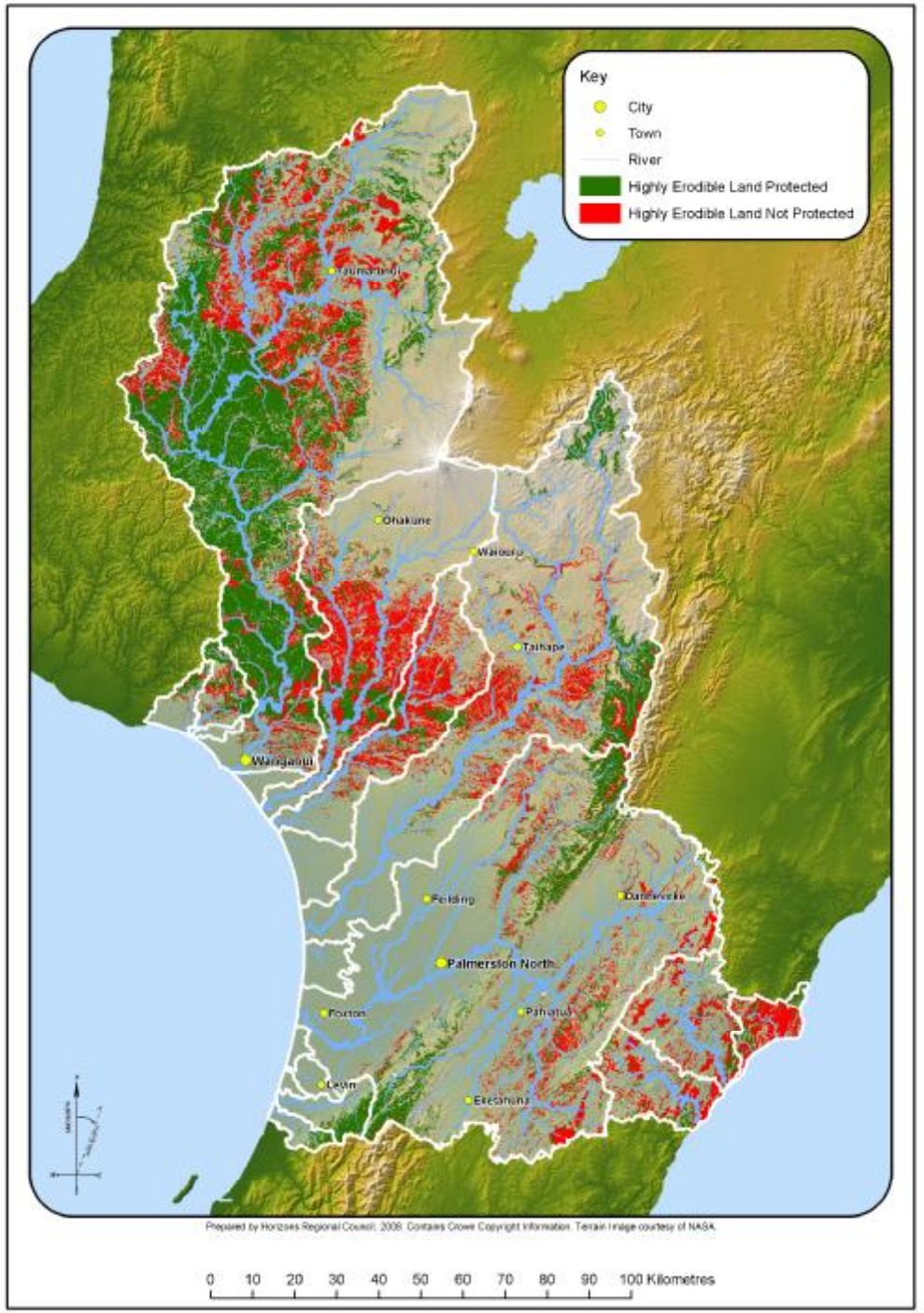

Key
City
Town
River
Highly Erodible Land Protected
Highly Erodible Land Not Protected
Ohakune
Taihape
Wanganui
Feilding
Palmerston North
Foxton
Levin
Eketahuna
Prepared by Horizons Regional Council, 2008. Contains Crown Copyright information. Terrain image courtesy of NASA.
0 10 20 30 40 50 60 70 80 90 100 Kilometres

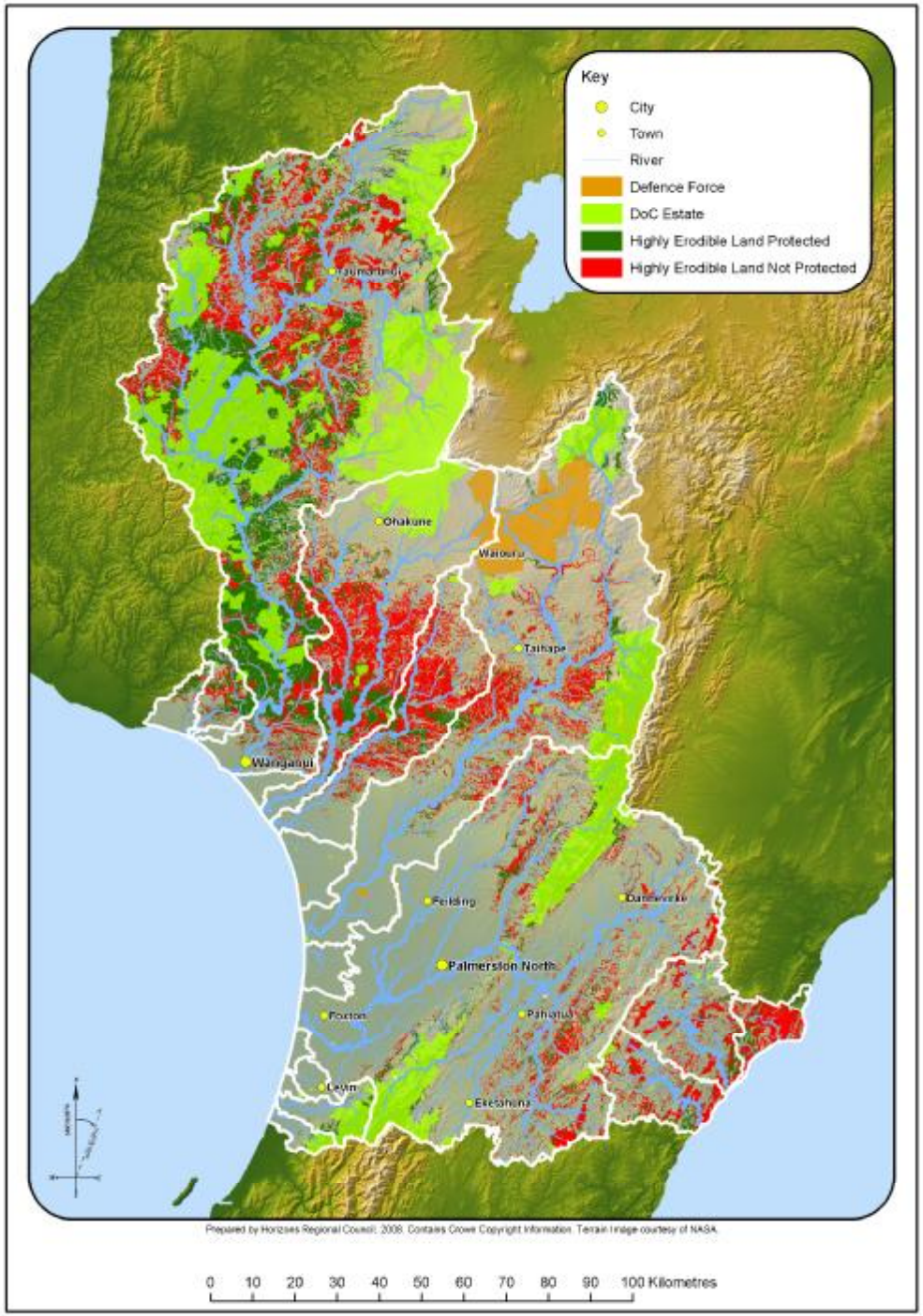
9)

Simplified map version of from Dymond and Sheppard (2006)

Region totals (ha)	Protected	Not protected	Total
Dymond & Sheppard	**387832**	**273527**	**661359**
Simplified	**387901**	**273390**	**661291**
Difference	**-69**	**137**	**68**

10) as requested





Defence force (DF) / DoC land (DoC)

Region totals (ha)	Protected	Not protected	Total
Simplified	387901	273390	661291
DF	635	329	964
DoC	187595	9250	196845
DoC + DF	188229	9580	197809
Region excluding DoC & DF	199672	263810	463482

11) as requested

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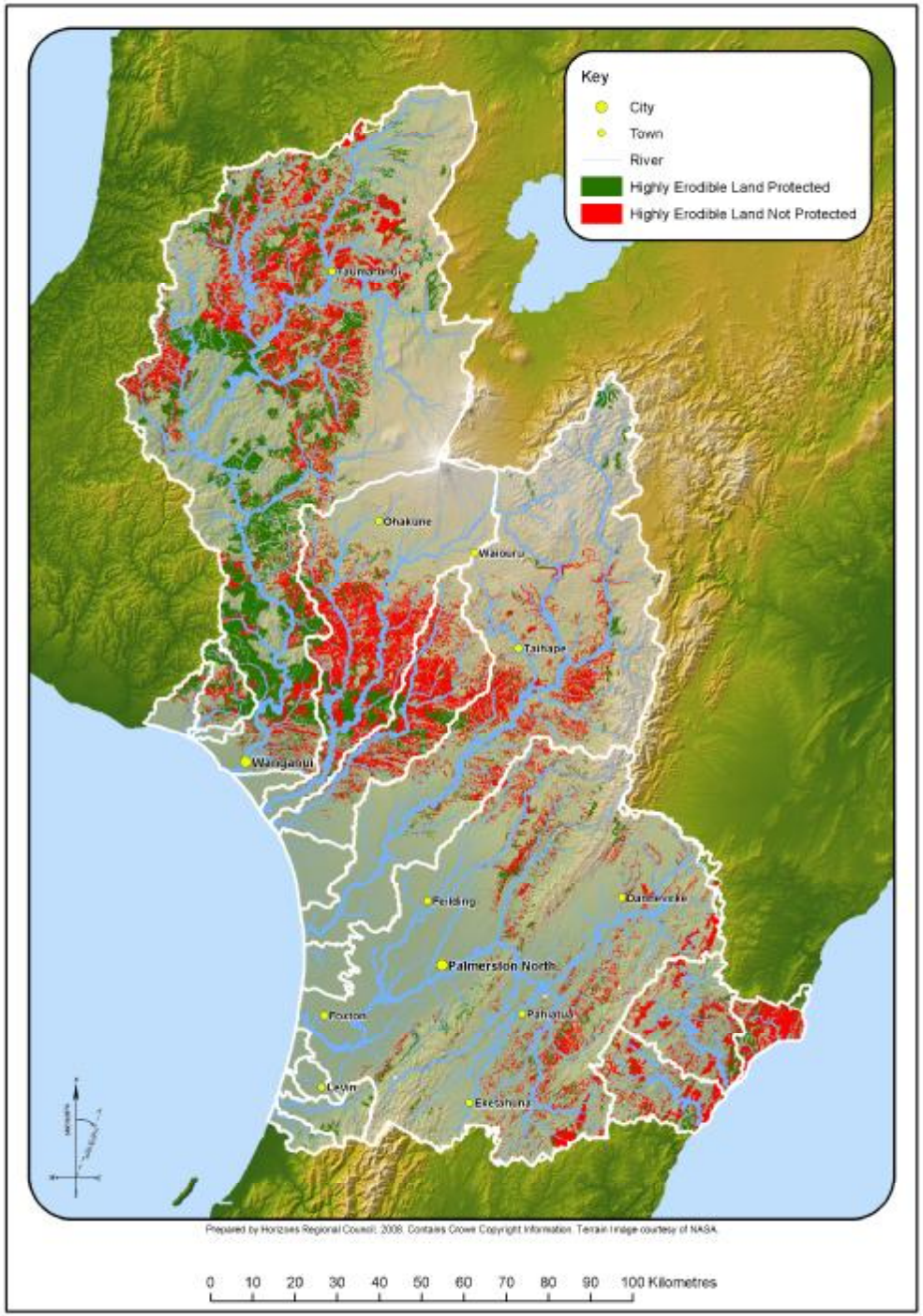

Final Map

- The map is a simplified version of the Dymond and Sheppard map with the DoC and DF land removed
- This map is recommended for inclusion in the RPS.
- The planners will provide further explanation

12) as requested

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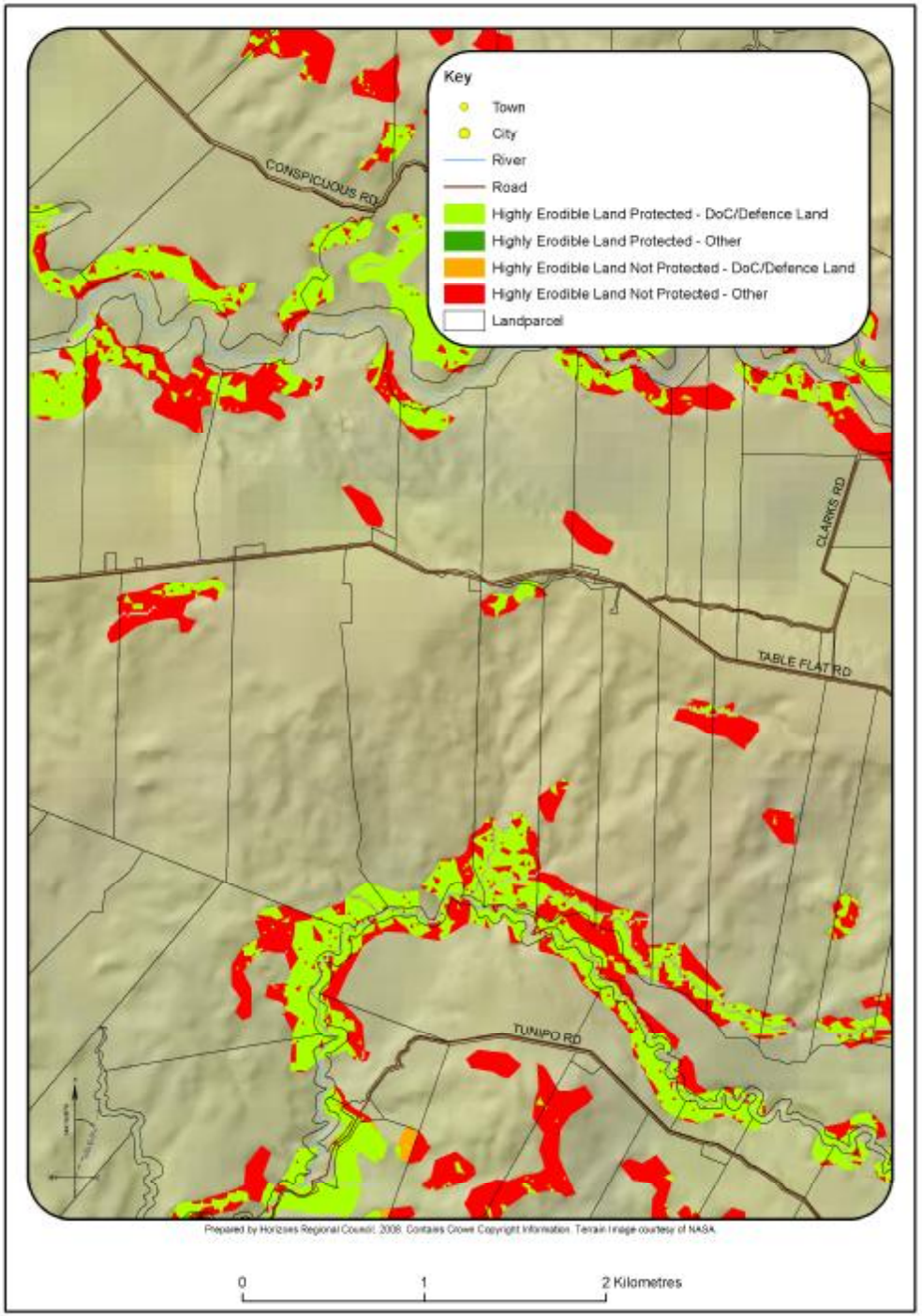
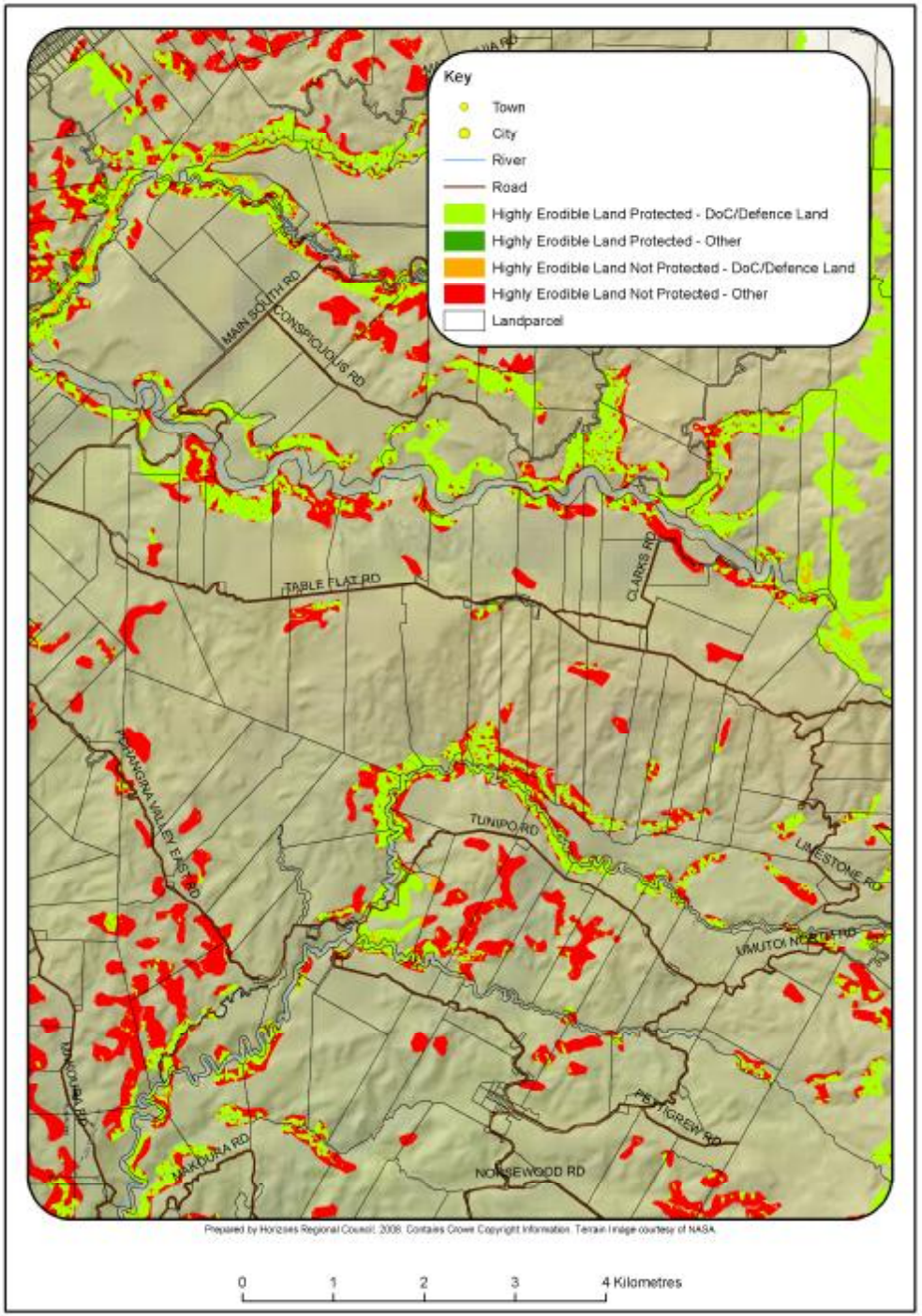
1:25000 maps for the Regional Plan

- At the request of the planners an example map has been produced at 1:25000 scale showing the location of HEL – protected or not protected have been produced with the property boundaries overlaid.
- The intention is for this to replace the maps in the regional plan
- The planner will provide further detail on this.



1:50,000 maps for the Regional Plan

- For context purposes this map is a 1:50,000 version of the previous map



Whole Farm Plan Template

- This project provides consistency
- documents the details for the development of a whole farm plan (WFP) template and includes the critical components in a WFP, the minimum data sets and documentation of the protocol to be used in the development and implementation phases of the WFP with land owners.
- The report also provides comment on land evaluation and planning skill sets, required by a land manager to complete the environmental component of the plan.
- A draft audit and review process is also included in the report for evaluating quality, consistency and effectiveness of delivery of the 40 plans at the end of 2006/07 and in future years.

15) points 16, 41,42,43 page 14

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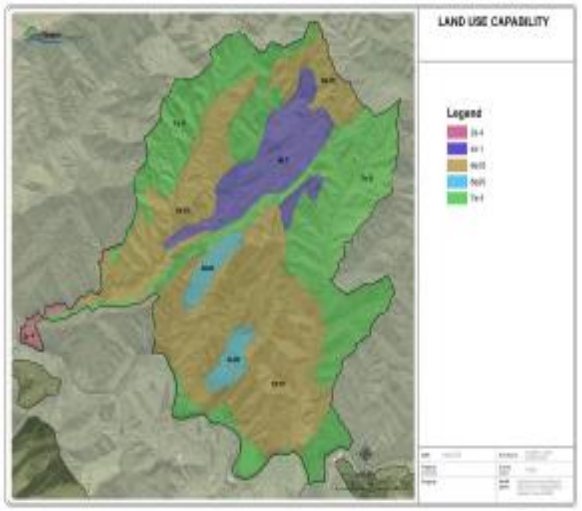
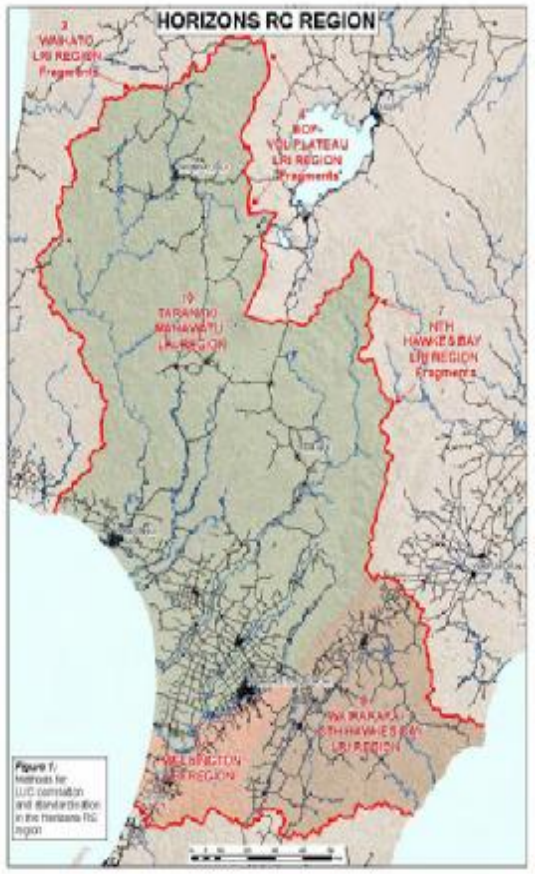
LUC handbook upgrade

- Original Classification is now over 30 years old
- Scoping document for upgrade was completed by Douglas et al. 2006
- *"Published last in 1974, the handbook requires significant updating to address some inconsistencies in allocation of units to land class, incorporate advances in land management research and practices, and ensure consistency of interpretation across the Region. With this update in place, HRC can then revise its Regional land inventory in a consistent and transparent manner."*
- Project commenced in March 07 aiming for completion in December 2008
- There are 3 NZLRI, LUC classifications in the region (see map).

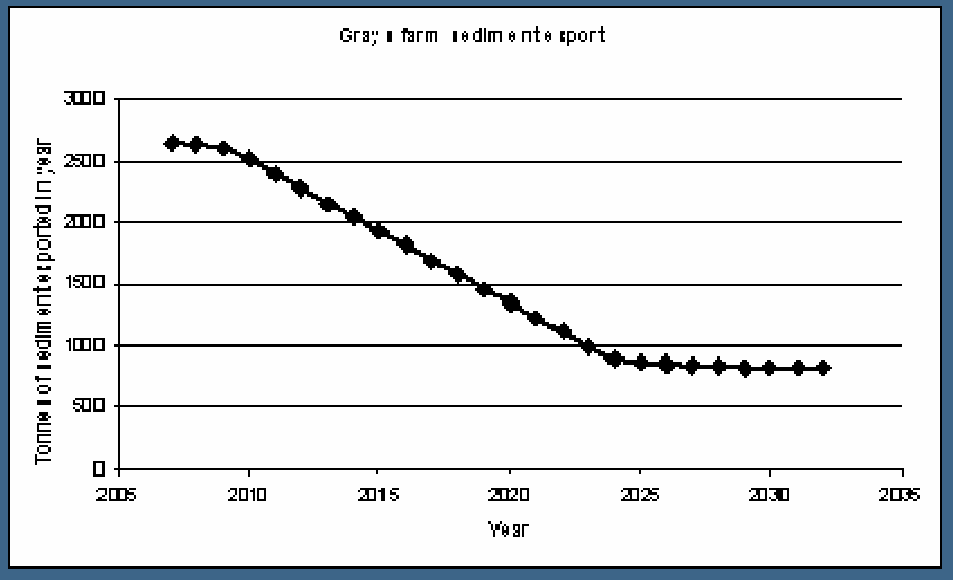
16) points 17, 34-37 page 13





Whole Farm Plan Monitoring

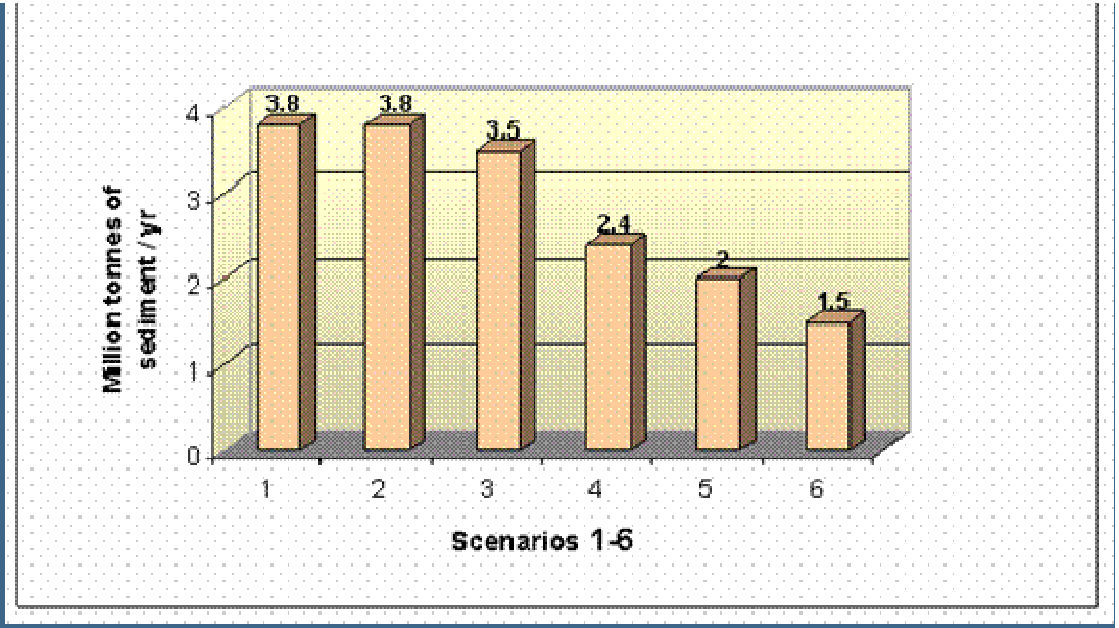
- Revised current practices of Horizons and neighbouring Councils
- Links on farm works programmes with regular monitoring of these to a simple model of sediment export from farms to determine effectiveness of the implementation of the works, and to continue to assess these over time.
- Regular monitoring also keeps the conversation going and provides feedback
- Focus is on outcomes



17) points 18, 44-47 page 14-16

SLUI Outcomes – sediment discharge

- Scherlitz et al. 2006
- Links on farm works to catchment outcomes



Land-use scenario	Predicted mean sediment discharge (10^6 tonnes/yr)	Percentage reduction in mean sediment discharge when compared to the no farms scenario
(1) No farms	3.8	0
(2) Random selection of 50 farms (ie. the present situation approximately)	3.8	0
(3) Random selection of 500 farms	3.5	8
(4) 250 of the highest priority farms (.e. with the most area of “eroding land” connected to streams) and 250 randomly selected	2.4	37
(5) 500 of the highest priority farms (ie. with the most area of “eroding land” connected to streams)	2.0	47
(6) All the farms	1.5	60

18) points 18, 44-47 page 14-16

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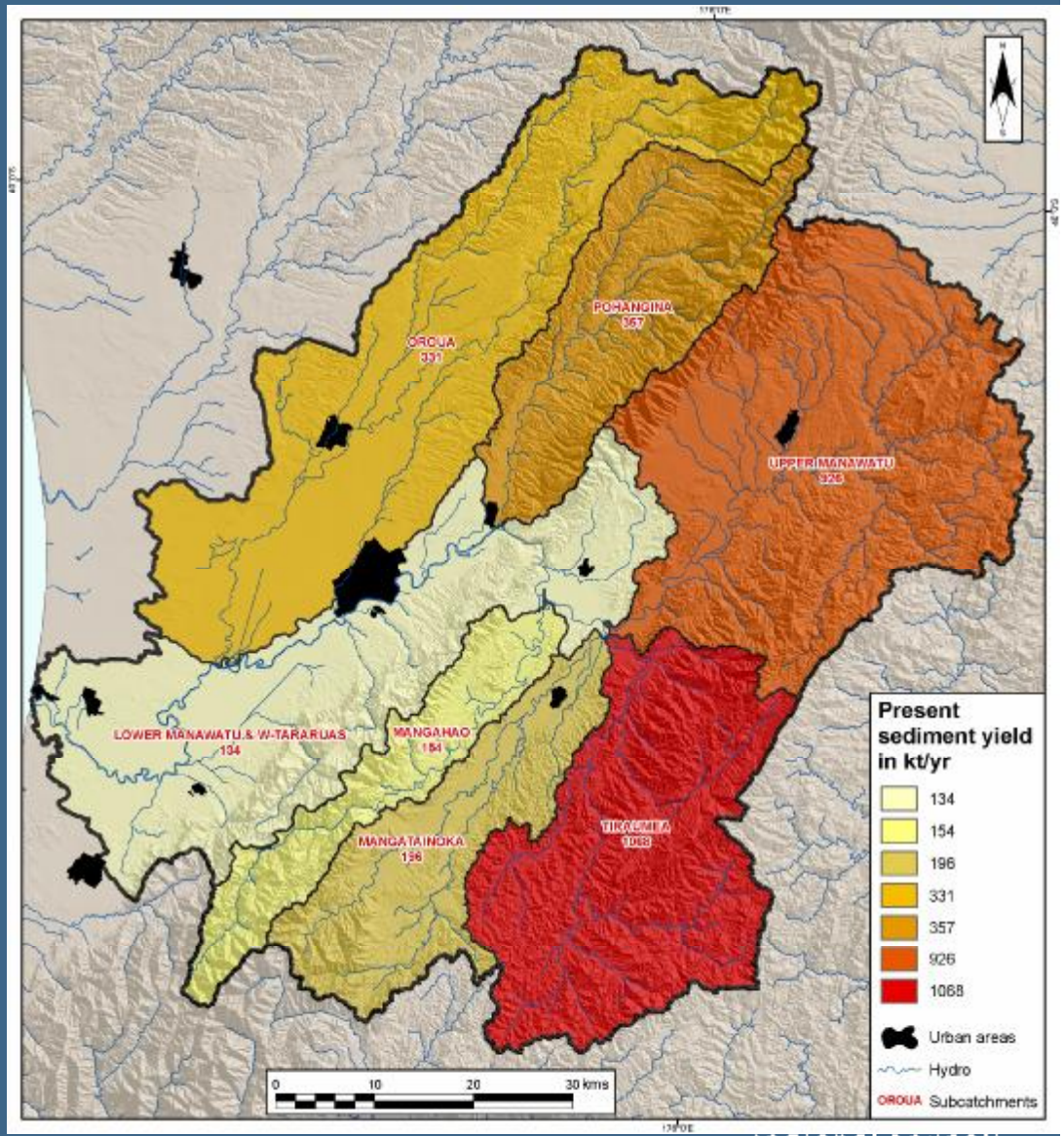
Sediment discharge

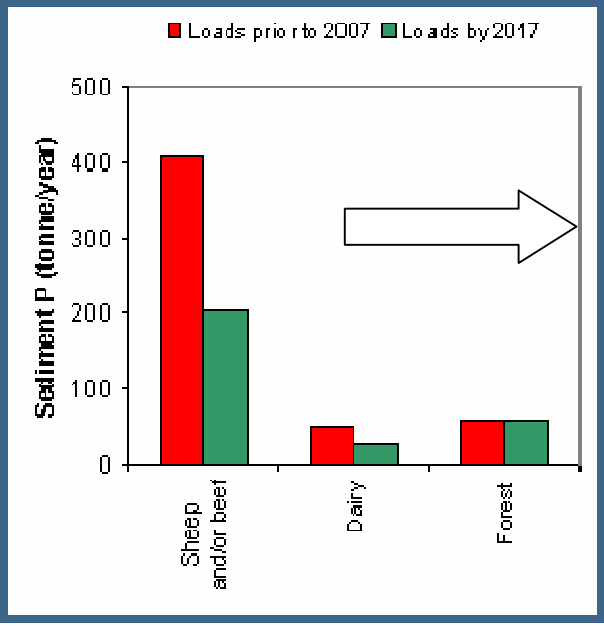
Major sub catchment	Kt/year Present scenario
Tiraumea	1068
Upper Manawatu	926
Pohangina	357
Oroua	331
Managatainoka	196
Mangahao	154
Lower Manawatu & western Tararuas	134
Total	3166

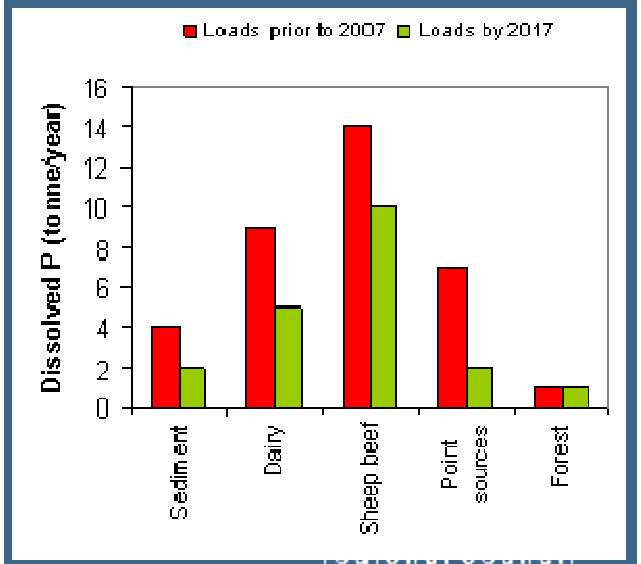


19) points 82 & 83 page 30-32

SLUI Outcomes – Phosphorous (P)

- Implementation of best practice on farm can significantly reduce the amount of phosphorus entering water ways
- This phosphorus balance for the upper Manawatu river (Upstream of Hopelands) concluded
  - Particulate P could be reduced from 511 to 280 tonnes by targeted planting of trees on HEL
  - Sheep and or beef was the largest single contributor of Dissolved Reactive Phosphorous (DRP) to the catchment (14 out of 35 tonnes)
  - 14 tonnes from Sheep and beef could be reduced to 10 with targeted planting of trees in riparian zones

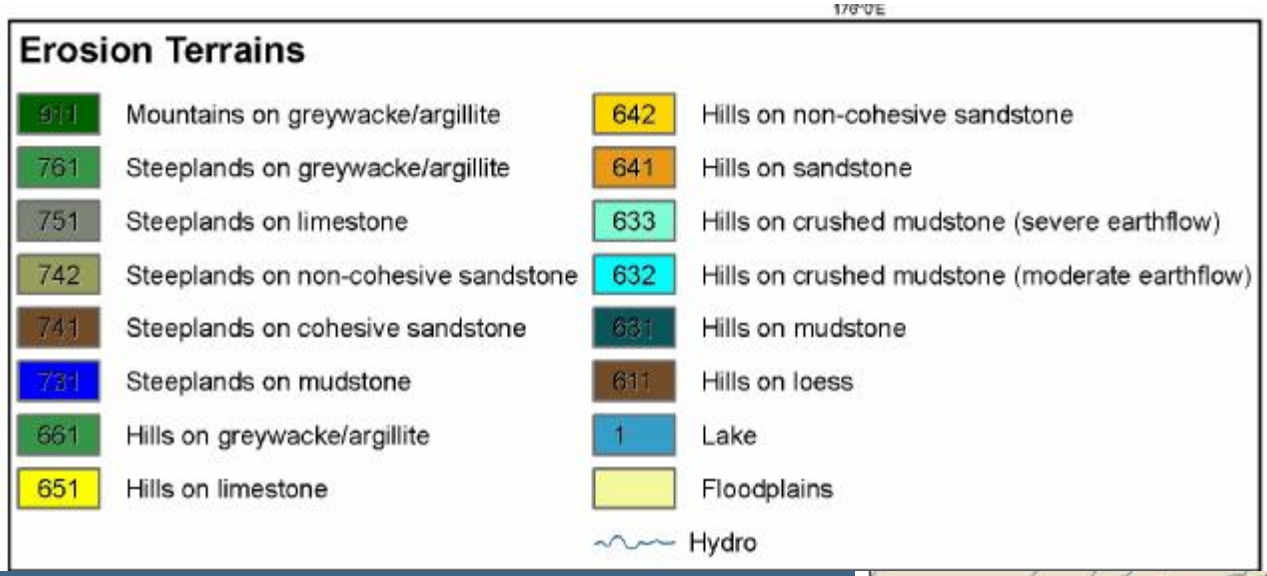


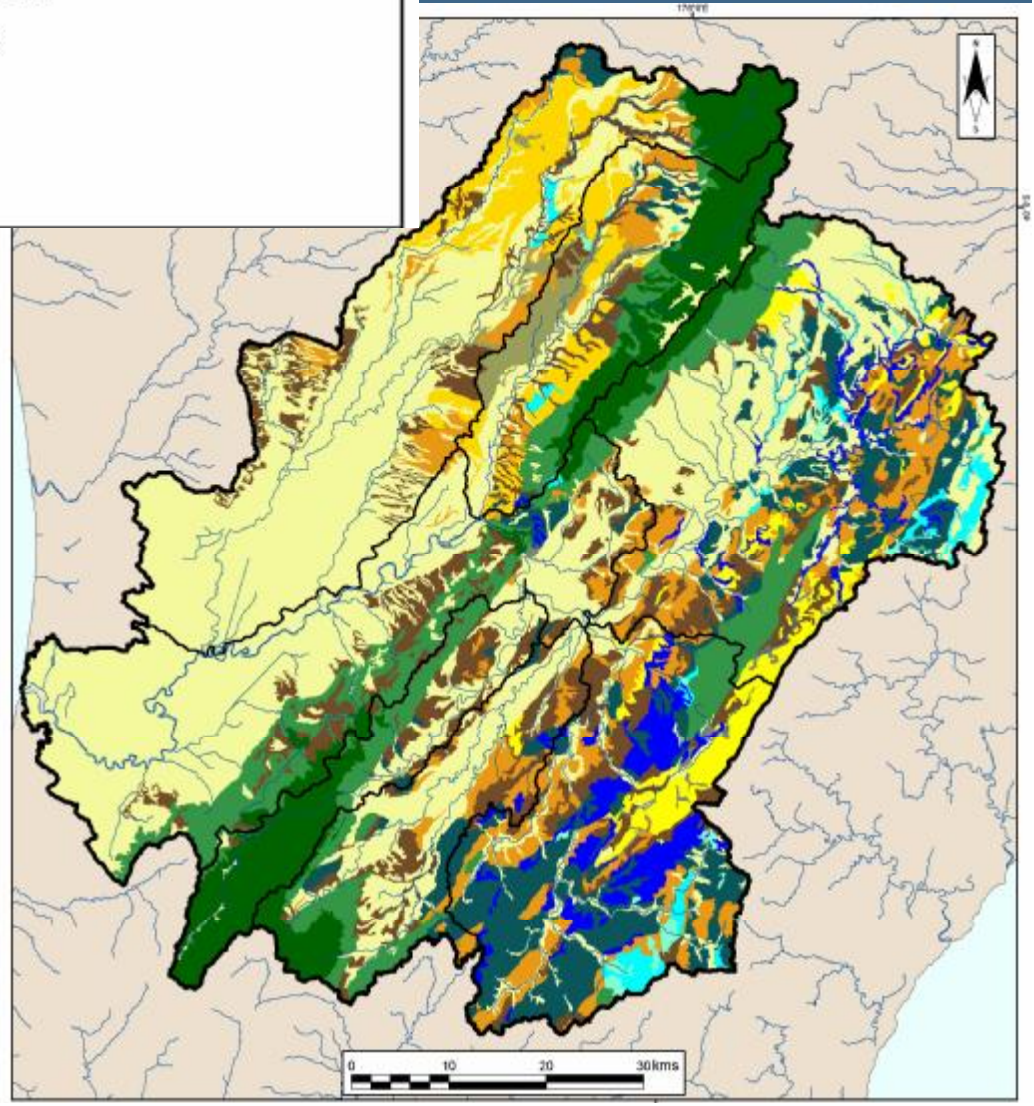


20) points 20, 55-61 pages19-22

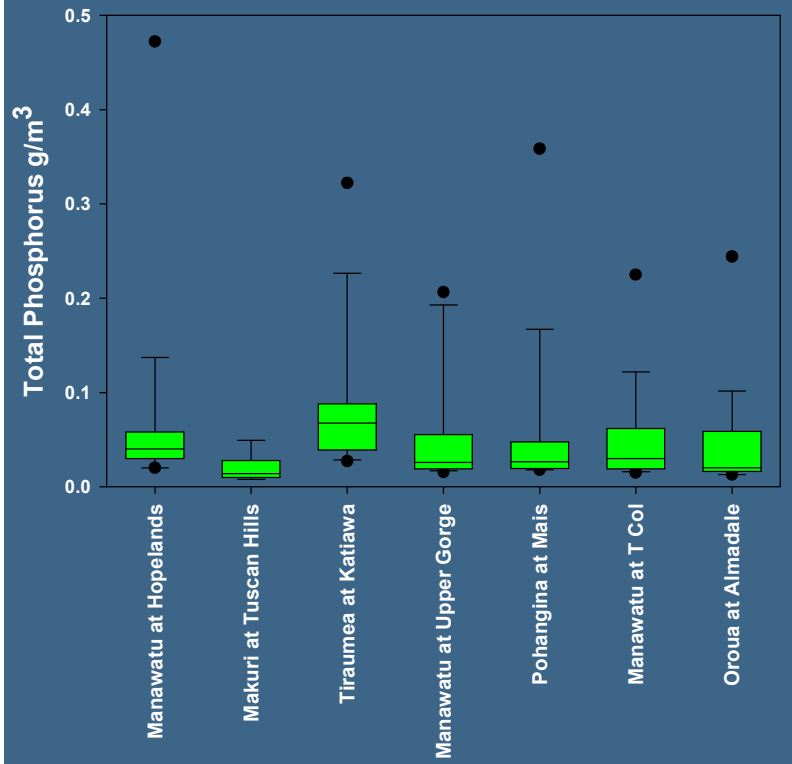
Erosion Terrians of the Manawatu

From Schierlitz 2008

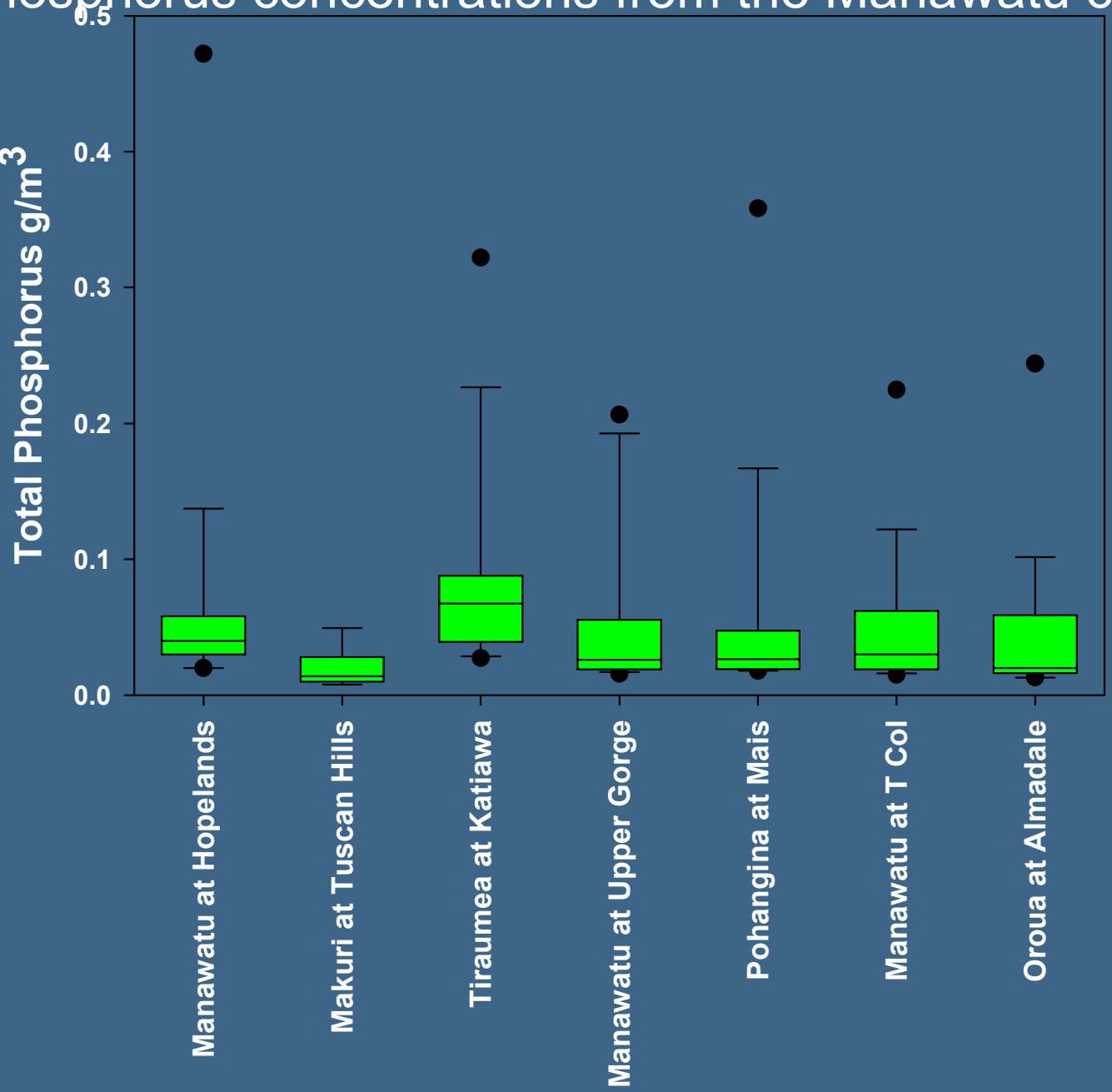




Total Phosphorus



Total Phosphorus concentrations from the Manawatu catchment



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SLUI outcomes – Aggradation in rivers

- As discussed by Allan Cook
- Aggradation requires specific monitoring
- Cross sections provide on method
- Lidar provides a more accurate measure for the future
- Smart 2007 Fluvial review recommendations have been incorporated into the prioritisation

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23) points 20, 55-61 pages19-22

SLUI - Monitoring

- Monitoring of the methods of the One Plan (Land chapter) we be via an integrated monitoring approach
- Some of the benefits at a catchment level will take time to show (e.g. as soil conservation works mature)
- Continuous Turbidity monitoring will provide one key method to monitor outcomes in terms of turbidity and sediment load
- Work is underway to refine the monitoring programmes to align with the SLUI priority areas and to monitor outcomes from WRET

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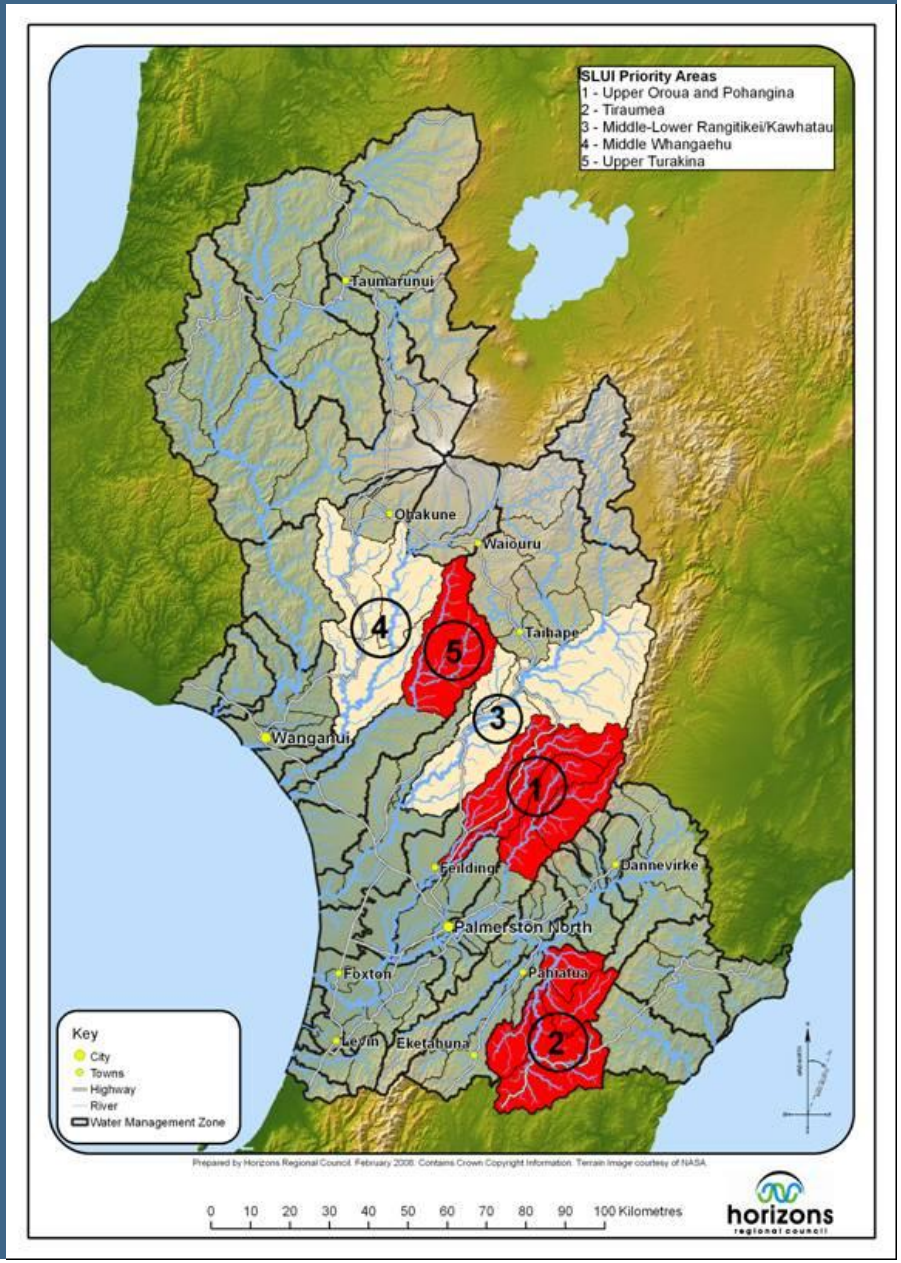
24) points 23, 87-103 pages 33-46

SLUI - Prioritisation

- SLUI prioritisation is not a question of where is the most non protected HEL?
- Rather where would treating the HEL make the biggest difference to outcomes at the farm and catchment level?
- SLUI is an integrated catchment management approach for multiple outcomes



25) points 25, 77-86 pages 26-33

SLUI - Prioritisation

- What are the potential outcomes of SLUI
  - Land Stabilisation
  - Retention of soil on farm
  - Less damage to infrastructure (e.g. from slips)
  - reduced aggradation in waterways/flood plains
  - Reduced sediment loading to waterways
  - Reduced phosphorus loading to waterways

  Secondary outcomes
  - Biodiversity
  - reductions in other nutrients off farm (through use of nutrient budgeting)
  - Identifying yield gaps…

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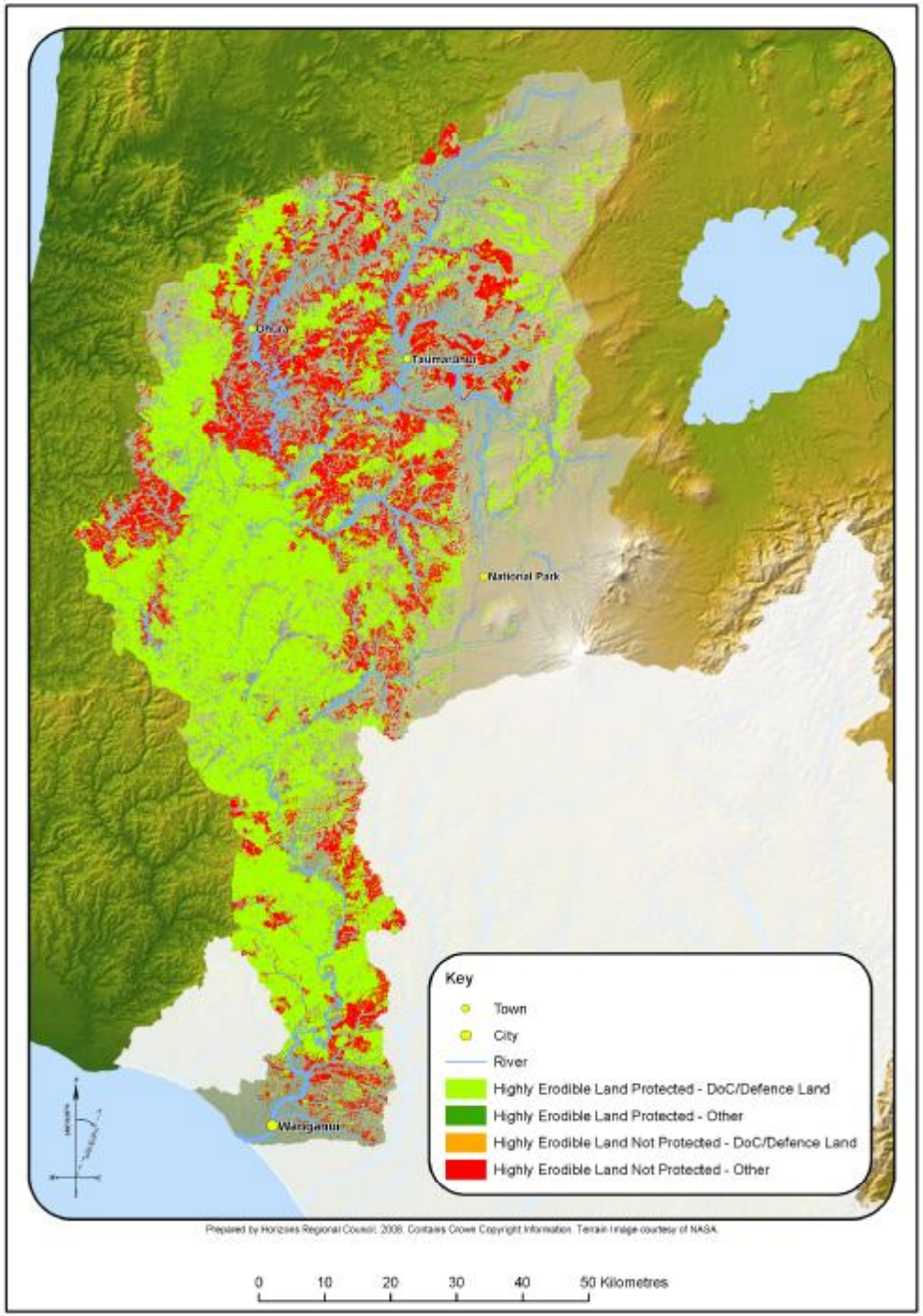
26) points 25, 77-86 pages 26-33



Whanganui Catchment

Total catchment area 712,785 Ha

Totals (Ha)	Protected	Not protected	Total
Simplified	**248848**	**95402**	**344251**
DoC + DF	**125606**	**1799**	**127405**
Excluding DoC & DF	**123243**	**93603**	**216846**
excluding DoC & DF %age of catchment	**17%**	**13%**	**30%**

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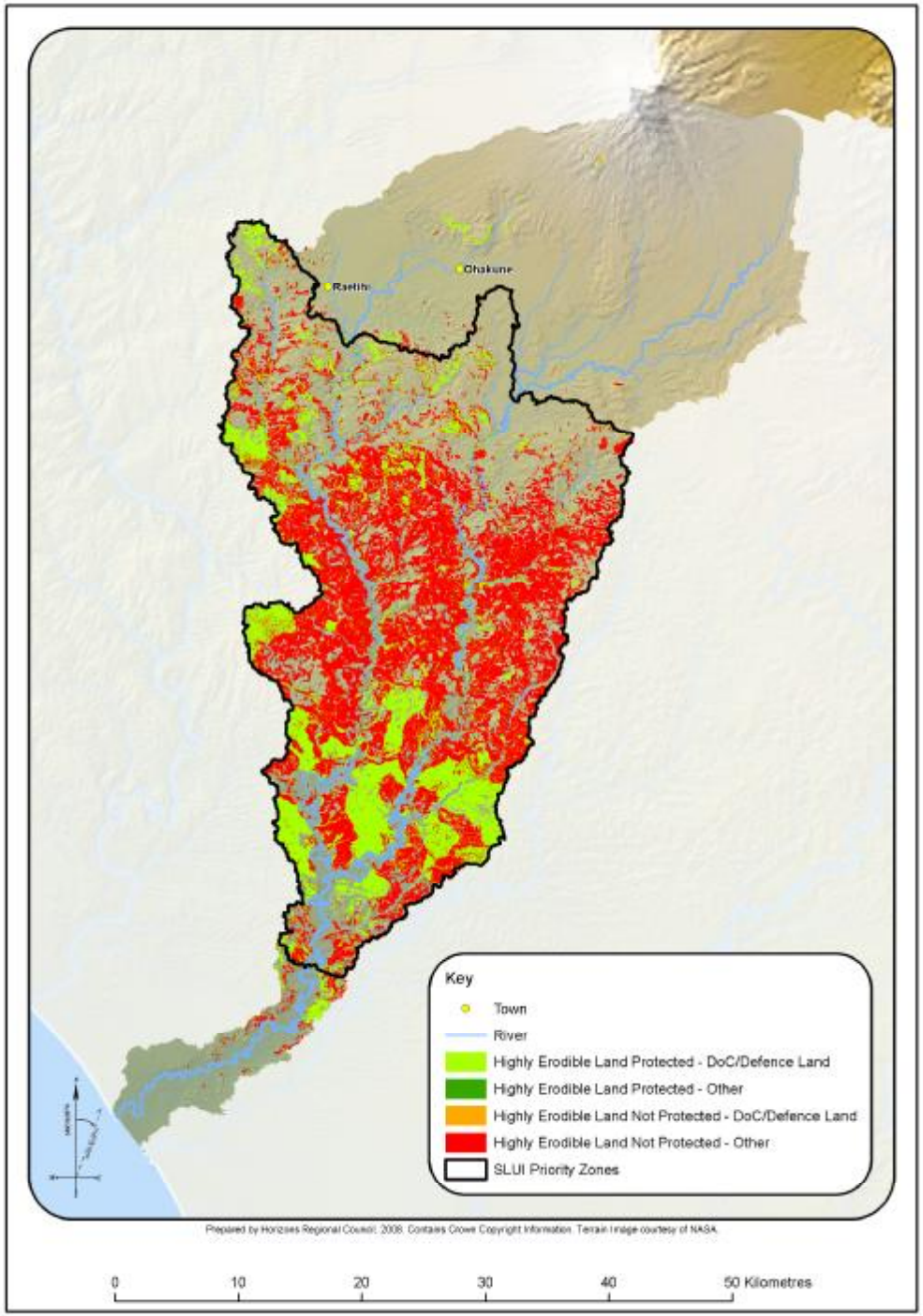

Whangaehu

Total Catchment area 196561(ha).

Region totals	Protected	Not protected	Total
Simplified	**21035**	**42302**	**63336**
DoC + DF	**1054**	**612**	**1666**
Whangaehu excluding DoC & DF	**19980**	**41690**	**61670**
%age of catchment	**10%**	**21%**	**31%**
Priority Zone	**19369**	**41535**	**60904**

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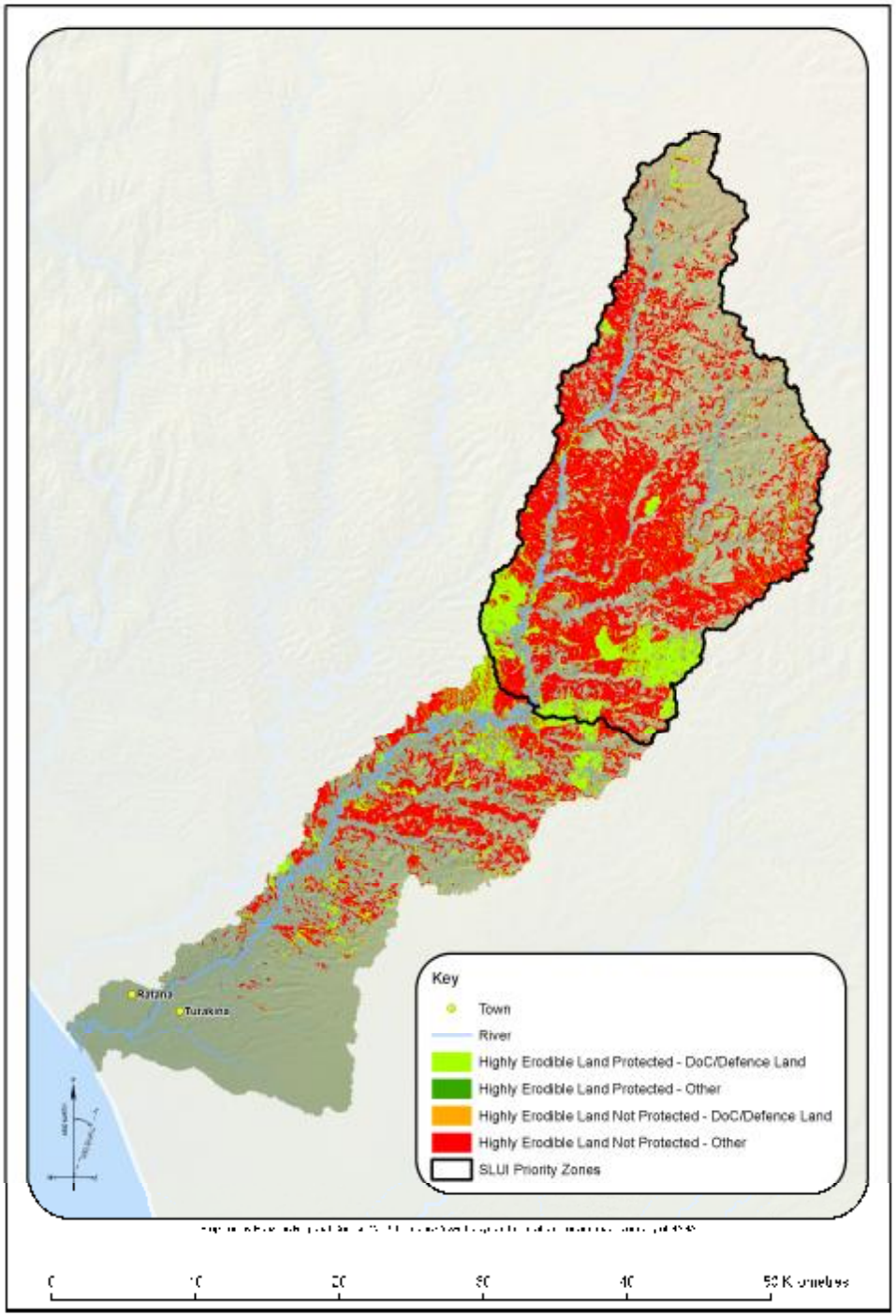

Turakina

Total catchment area 96,606 Ha.

Totals (Ha)	Protected	Not protected	Total
Simplified	**9219**	**26935**	**36154**
DoC + DF	**133**	**75**	**209**
Turakina excluding DoC & DF	**9086**	**26859**	**35945**
%age of catchment	**9%**	**28%**	**37%**
Priority Zone	**5725**	**19595**	**25320**

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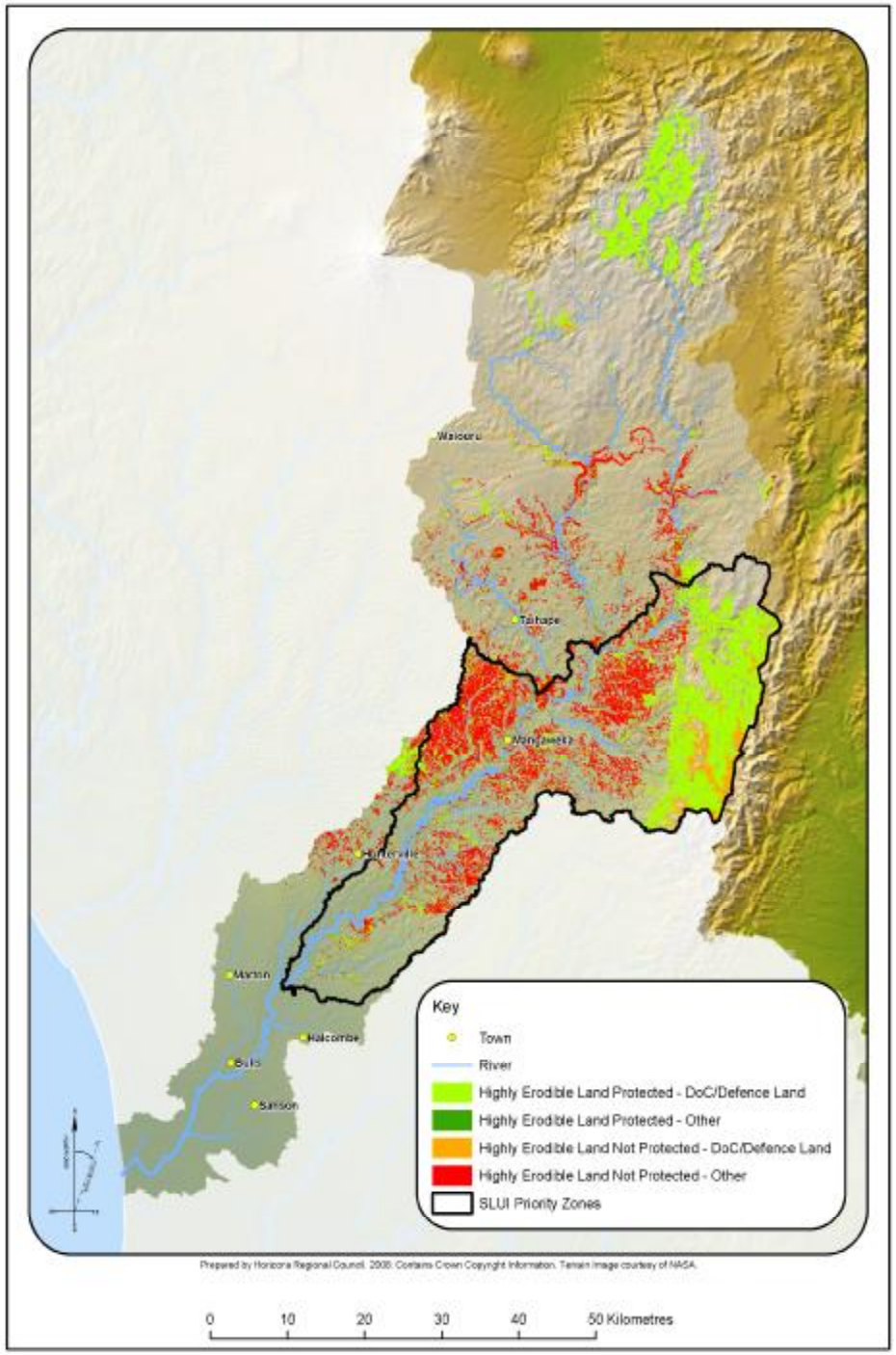

Rangitikei

Total catchment area 397,931Ha.

Totals	Protected	Not protected	Total
Simplified	**38200**	**34779**	**72980**
DoC + DF	**23782**	**4158**	**27940**
Rangitikei excluding DoC & DF	**14418**	**30622**	**45039**
%age of catchment	**3.6**	**7.6**	**11.3**
Priority Zone	**7111**	**21261**	**28372**

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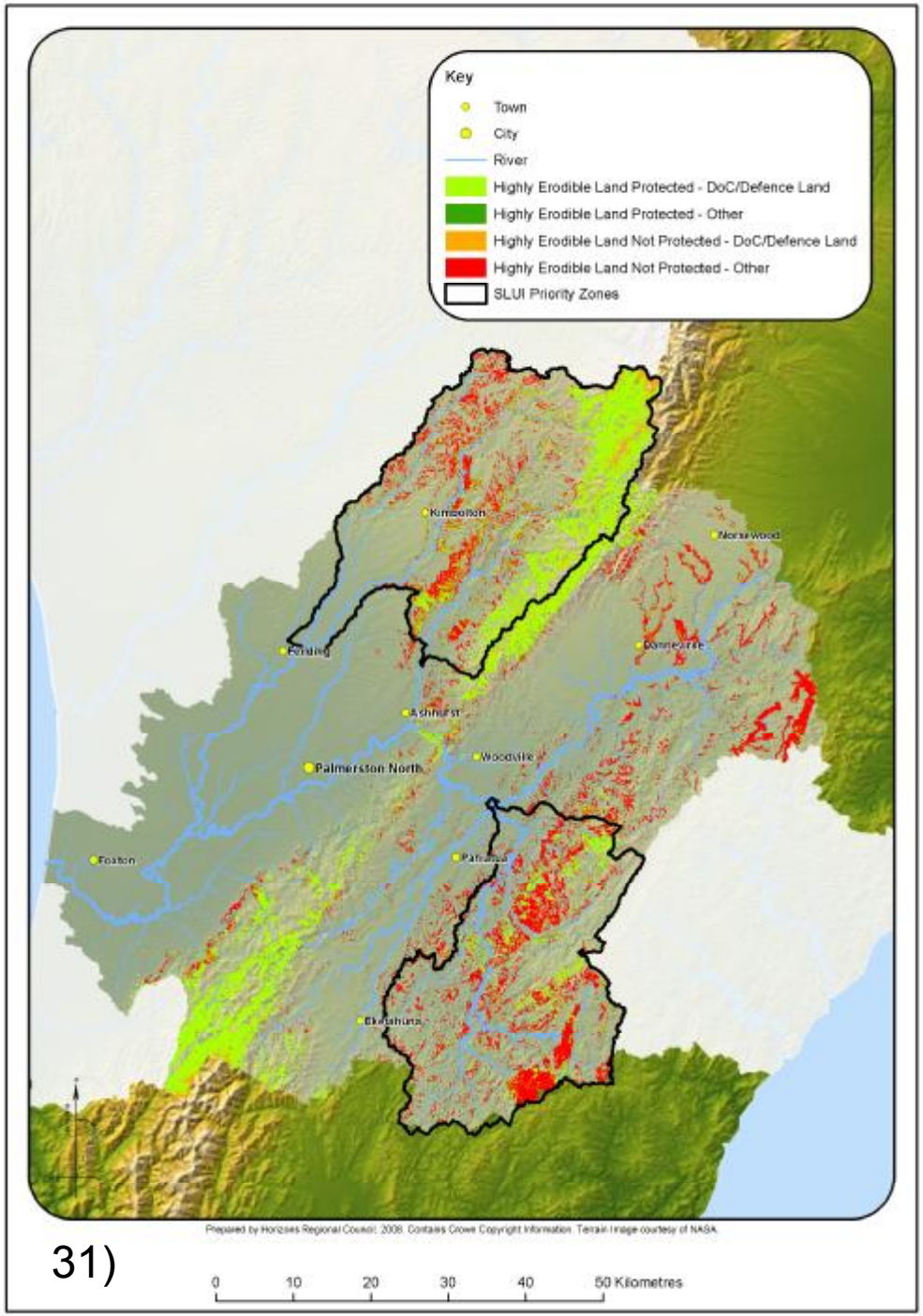


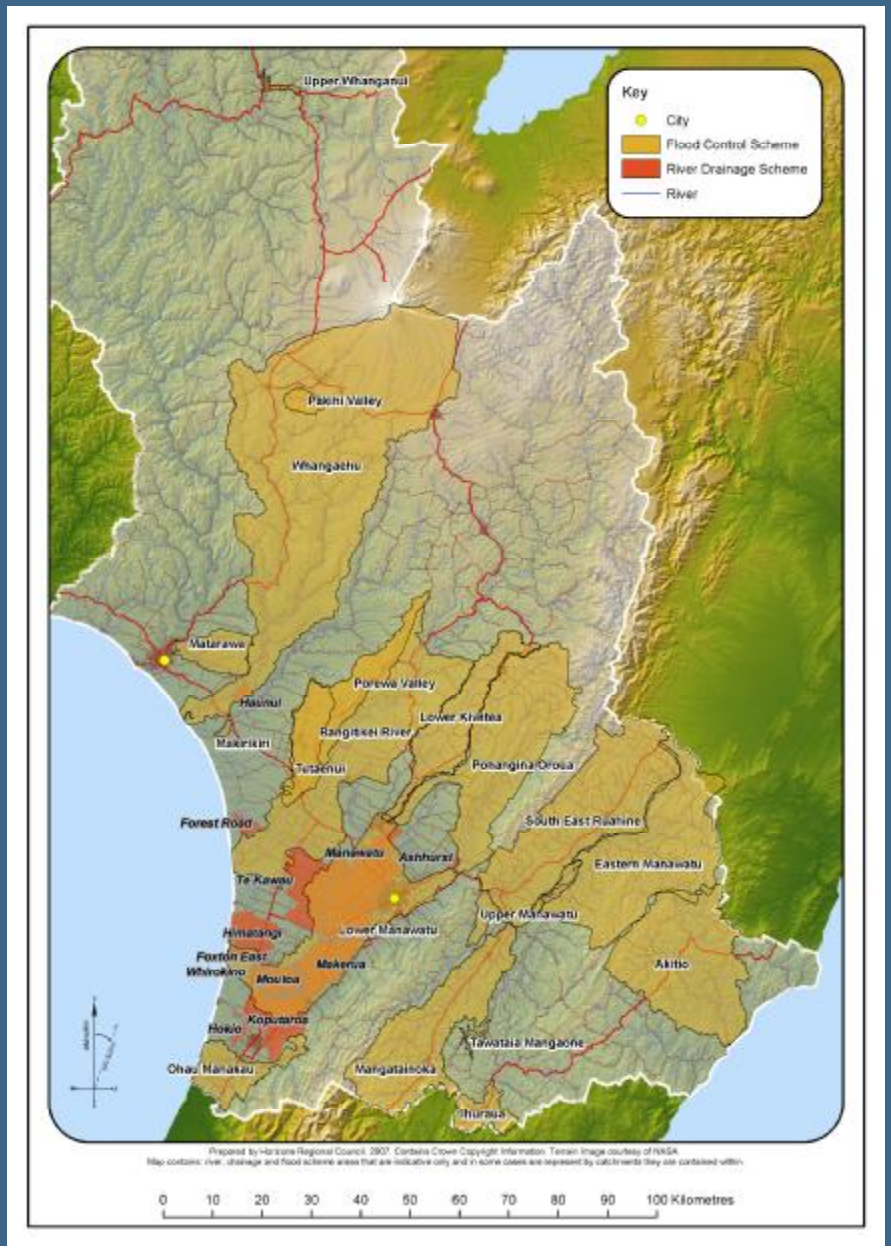
31)

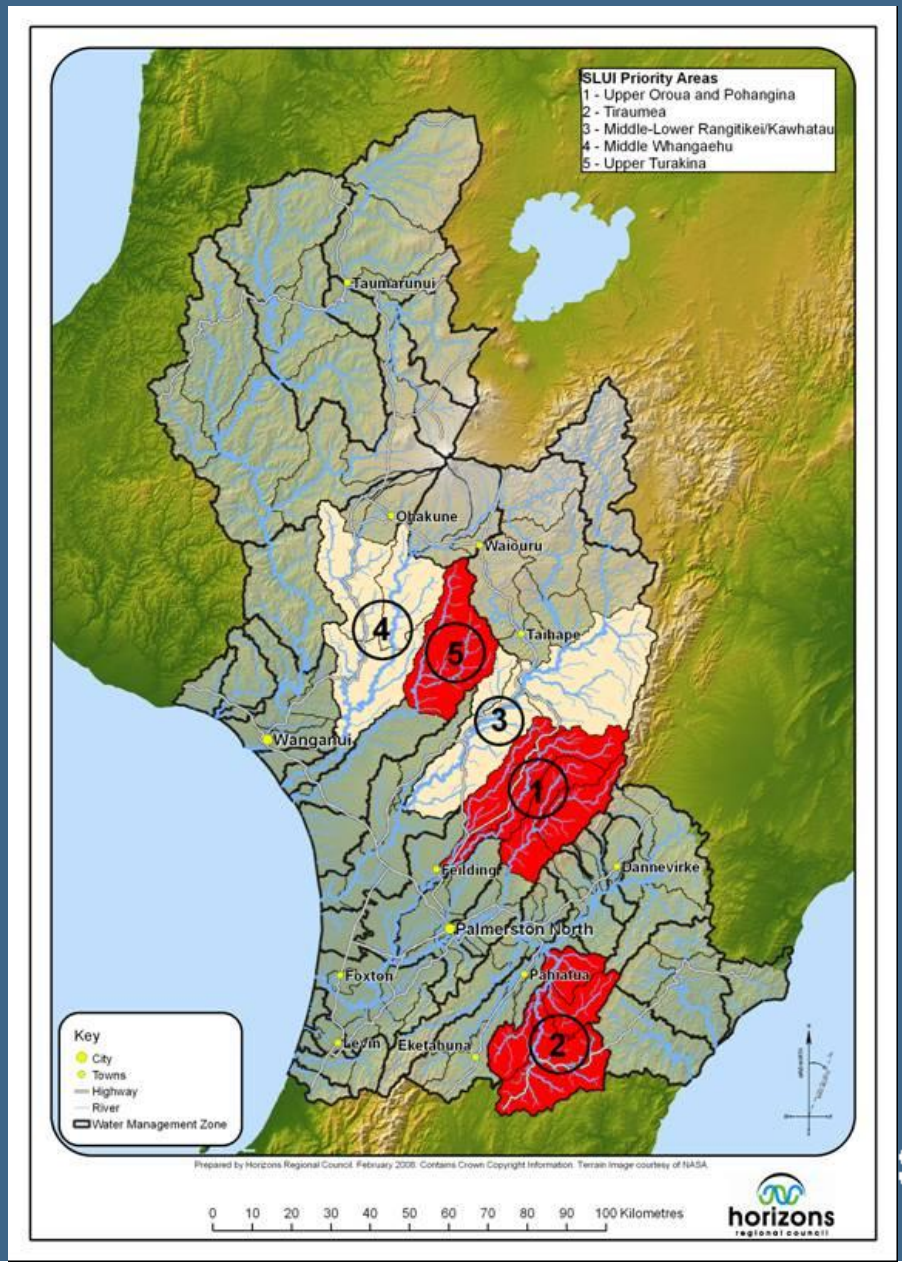
Manawatu

Total catchment area 596,861 Ha.

Totals (ha)	Protected	Not protected	Total
Simplified	45436	39265	84702
DoC + DF	30092	3022	33114
Manawatu excluding DoC & DF	15344	36244	51588
%age of catchment	3	6	9
Priority Zone Oroua / Pohangina	5023	9181	14204
Priority Zone Tiraumea	4117	13570	17687

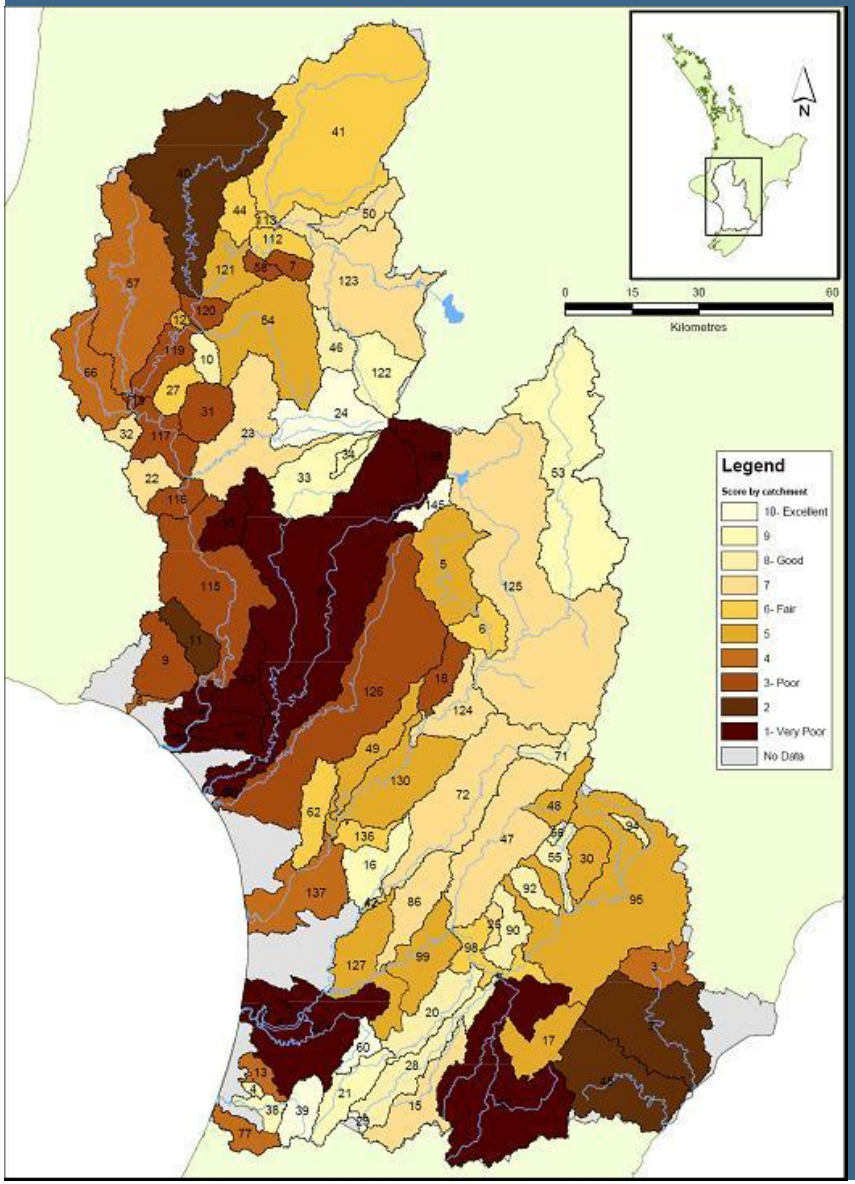
Flood control and Drainage Schemes (From Schedule I)



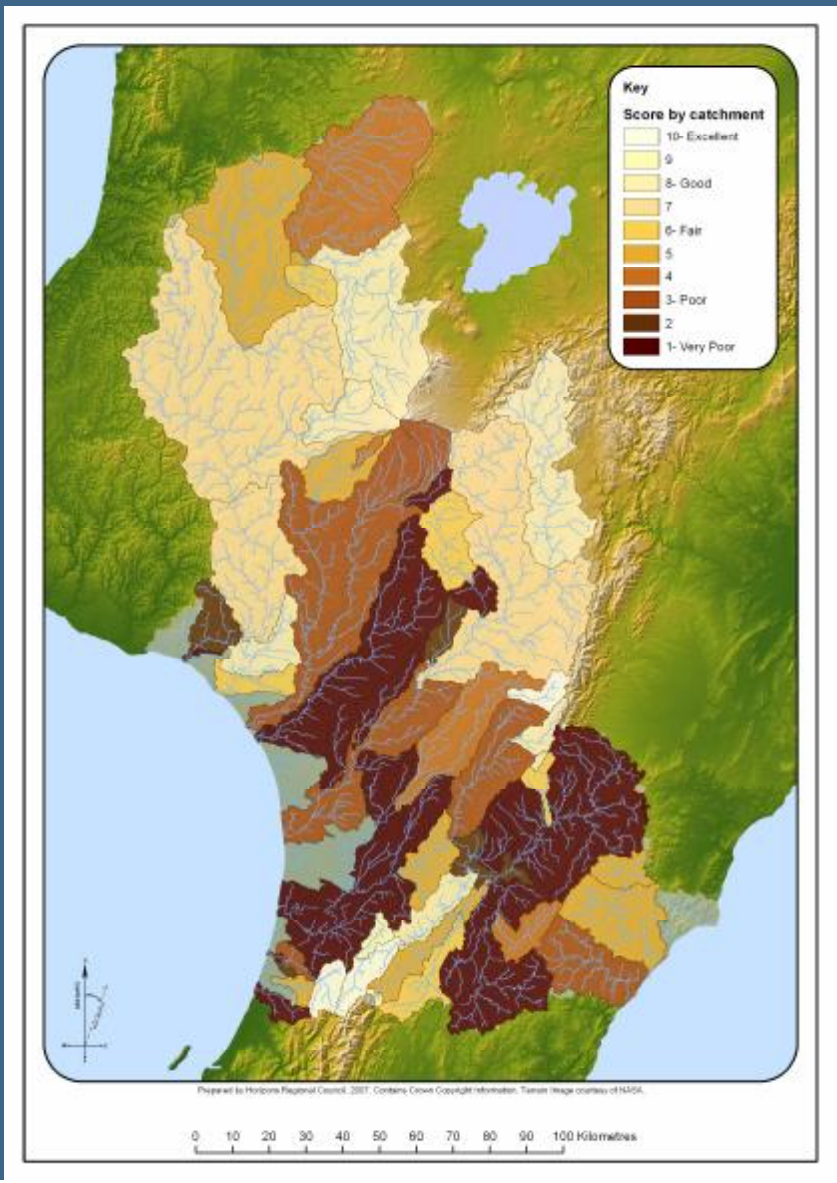


SOE indicator maps

Turbidity



Phosphorus



- Most GIS programmes us two approaches for representation of information in geographic space.
  - Raster (used in the John Dymond Layer)
  - Vector (Polygons)
- Raster is a grid cell format whereby the location of geographic objects are defined by row and column location of the cell or pixel. Each cell or pixel is given a value which indicates the classification or feature it is representing. For example John Dymonds layer the pixels that have a landslide connected to a water course are given the value 4.
- Vector converts feature boundaries to straight sided polygons. Each polygon is located by coordinates of their vertices. Polygons can be given text attributes.

horizons
regional council

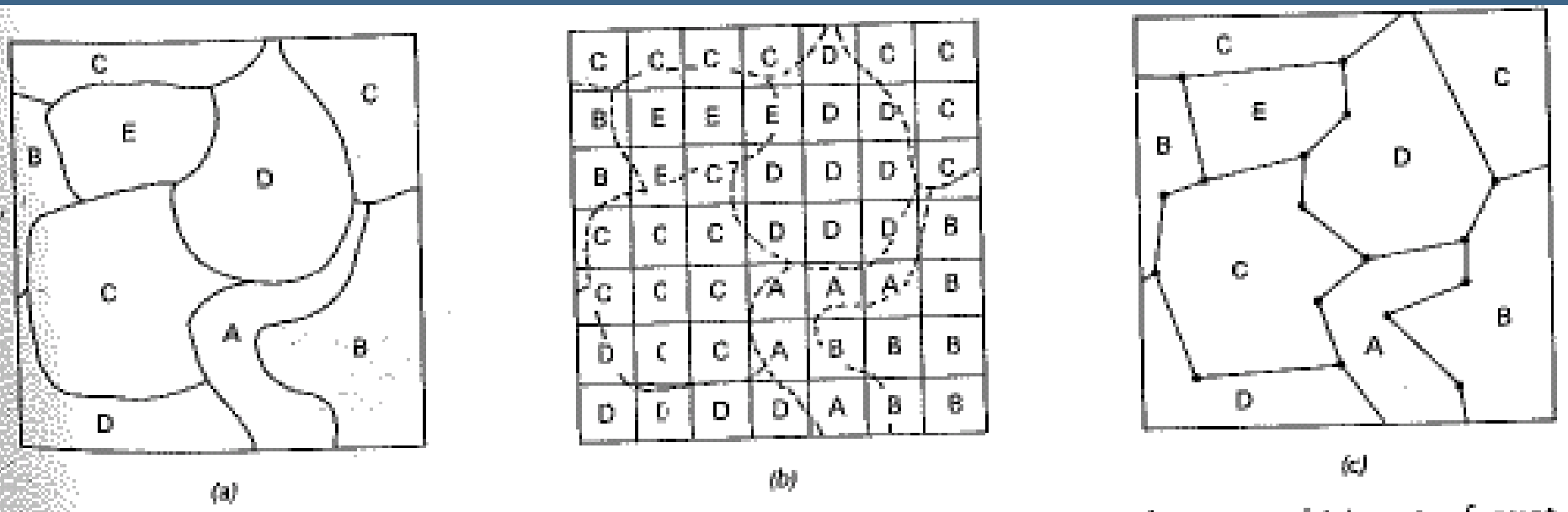


Figure 1.23 Raster versus vector data formats: (*a*) original line map, (*b*) raster format, and (*c*) vector format.