Highly erodible land in the Manawatu-Wanganui region

John Dymond and James Shepherd

Landcare Research NZ Ltd
Private Bag 11 052
Palmerston North
New Zealand

Landcare Research Contract Report: 0607/027

Prepared for:
Horizons Regional Council
Private Bag 11025
Palmerston North
New Zealand

Date: September 2006

Contents

1. Summary

Highly erodible land is defined as land with the potential for severe erosion if it does not have protective woody vegetation. The 2 220 000 hectares of the Manawatu-Wanganui region contains 273 000 hectares of such highly erodible land, i.e. 12.3% of the region. The areas of highly erodible land without protective vegetation in each of the main river catchments are: Wanganui 95 000 ha; Whangaehu 42 000 ha; Turakina 27 000 ha; Rangitikei 35 000; and the Manawatu 39 000 ha.

2. Introduction

The February 2004 storm that struck the Manawatu, Rangitikei, Wanganui, and Tararua Districts, caused erosion in the hill country, and flooding, sedimentation and stream course changes in the lowlands. Damage is estimated to have cost over $300 M. Unsustainable land use of hill country was a major factor contributing to this damage, and is now one of four major issues identified by Horizons Regional Council in their draft Horizons One Plan. The Council is currently examining options to reduce hill country erosion risk.

Page et al. (2005) produced a report defining highly erodible land in the Manawatu-Wanganui region. Highly erodible land is defined as land with potential for severe erosion if it does not have protective woody vegetation. In this report we map the distribution of highly erodible land (as defined by Page et al. (2005)) in the Manawatu-Wanganui region, and to better focus soil conservation efforts, we present summary statistics of highly erodible land in the major catchments of the region.

3. Methods

Definitions of types of erosion, criteria for deciding erosion severity, and the selection of highly erodible LUC units were derived by reference to Page et al. (2005). See Table 1.

Table 1. LUC units comprising highly erodible land in hill country

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, 6^{e}10, 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

A 1:50 000 scale map of highly erodible land was derived as follows:

1. A slope threshold was defined for each LUC unit (Table 1).
2. All pixels in a 15 m pixel DEM above the threshold defined by the pixel's LUC were assigned to highly erodible land.
3. The pixel-based map was converted to a hillslope basis by using an aspect-based filter with a 25% risk rule (2 ha minimum mapping unit).
4. All pixels in moderate or severe earthflow land were assigned to highly erodible land.
5. All highly erodible land was examined to see if it could deliver sediment to a water course or not. Land was considered capable of delivering sediment if it was possible to traverse down DEM streamlines until a watercourse was reached without encountering two consecutive pixels of low slope (i.e. 5 degrees). All moderate and severe earthflow land was considered capable of delivering sediment. If land can deliver sediment to a water course then it is labelled as "connected".
6. All highly erodible land was examined to see if it had protective woody vegetation on it according to the EcoSat woody layer (http://www.landcareresearch.co.nz/services/ecosat/). If it did not, the land was labelled as "not protected".

4. Results

Table 2 shows the area statistics of highly erodible land in the Manawatu-Wanganui region. The classes of highly erodible land summarised are as follows:

Landslide connected	highly erodible land, due to high landslide risk, that can deliver sediment to a watercourse
Landslide disconnected	highly erodible land, due to high landslide risk, that can *not* deliver sediment to a watercourse
Landslide connected - not protected	highly erodible land, due to high landslide risk, that is not protected by woody vegetation and can deliver sediment to a watercourse
Landslide disconnected – not protected	highly erodible land, due to high landslide risk, that is not protected by woody vegetation and can *not* deliver sediment to a watercourse
Moderate earthflow	highly erodible land, due to moderate earthflow risk
Moderate earthflow – not protected	highly erodible land, due to moderate earthflow risk, that is not protected by woody vegetation
Severe earthflow	highly erodible land, due to severe earthflow risk
Severe earthflow – not protected	highly erodible land, due to severe earthflow risk, that is not protected by woody vegetation

Table 2. Summary statistics of highly erodible land in the Manawatu-Wanganui region according to the region and major catchments.

Land Areas (hectares)	Wanganui catchment	Whangaehu catchment	Turakina catchment	Rangitikei catchment	Manawatu catchment	Region
Total	712185	196561	96606	397931	596861	2220890
Lowland	111089	61703	24842	127547	248878	652785
Hill Country	550465	106131	71642	131290	291196	1295235
Mountain Land	45758	27818	98	138336	51532	272871
Land Proportions (%)	**Wanganui**	**Whangaehu**	**Turakina**	**Rangitikei**	**Manawatu**	**Region**
Lowland	15.6%	31.4%	25.7%	32.1%	41.7%	29.4%
Hill Country	77.3%	54.0%	74.2%	33.0%	48.8%	58.3%
Mountain Land	6.4%	14.2%	0.1%	34.8%	8.6%	12.3%
Highly erodible land areas (hectares)	**Wanganui**	**Whangaehu**	**Turakina**	**Rangitikei**	**Manawatu**	**Region**
Landslide Connected	230370	44493	21853	56092	57919	440353
Landslide Connected – Not Protected	48248	29628	15795	22410	18779	146532
Landslide Disconnected	93156	17992	12544	14757	15871	162945
Landslide Disconnected – Not Protected	33428	11867	9581	10691	11693	81672
Moderate Earthflow	19273	555	1659	1082	5515	40283
Moderate Earthflow – Not Protected	12964	445	1426	917	4834	31591
Severe Earthflow	706	147	6	899	4902	17778
Severe Earthflow – Not Protected	560	133	6	615	4050	13733
Highly erodible land proportions (%)	**Wanganui**	**Whangaehu**	**Turakina**	**Rangitikei**	**Manawatu**	**Region**
Landslide Connected	32.35%	22.64%	22.62%	14.10%	9.70%	19.83%
Landslide Connected – not Protected	6.77%	15.07%	16.35%	5.63%	3.15%	6.60%
Landslide Disconnected	13.08%	9.15%	12.99%	3.71%	2.66%	7.34%
Landslide Disconnected – not Protected	4.69%	6.04%	9.92%	2.69%	1.96%	3.68%
Moderate Earthflow	2.71%	0.28%	1.72%	0.27%	0.92%	1.81%
Moderate Earthflow – not Protected	1.82%	0.23%	1.48%	0.23%	0.81%	1.42%
Severe Earthflow	0.10%	0.07%	0.01%	0.23%	0.82%	0.80%
Severe Earthflow – not Protected	0.08%	0.07%	0.01%	0.15%	0.68%	0.62%
Total highly erodible land	**Wanganui**	**Whangaehu**	**Turakina**	**Rangitikei**	**Manawatu**	**Region**
Area (hectares)	343505	63188	36062	72830	84207	661359
Proportion (%)	48.2%	32.1%	37.3%	18.3%	14.1%	29.8%
Total highly erodible land – not protected	**Wanganui**	**Whangaehu**	**Turakina**	**Rangitikei**	**Manawatu**	**Region**
Area (hectares)	95201	42073	26808	34633	39356	273527
Proportion (%)	13.4%	21.4%	27.7%	8.7%	6.6%	12.3%
Total highly erodible land connected	**Wanganui**	**Whangaehu**	**Turakina**	**Rangitikei**	**Manawatu**	**Region**
Area (hectares)	250349	45195	23517	58073	68336	498414
Proportion (%)	35.2%	23.0%	24.3%	14.6%	11.4%	22.4%
Total highly erodible land connected – not protected	**Wanganui**	**Whangaehu**	**Turakina**	**Rangitikei**	**Manawatu**	**Region**
Area (hectares)	61772	30206	17228	23942	27663	191855
Proportion (%)	8.7%	15.4%	17.8%	6.0%	4.6%	8.6%

5. Bibliography

DeRose R 1995. Slope limitations to sustainable land use in hill country prone to landslide erosion. Unpublished Report, Landcare Research, Palmerston North, New Zealand.

Dymond JR, Ausseil A, Shepherd JD (Submitted). Validation of a region-wide model of landslide risk in the Manawatu/Wanganui region of New Zealand. Geomorphology.

Eyles GO 1985. The New Zealand Land Resource Inventory Erosion Classification. Water and Soil Miscellaneous Publication 85. 61 p.

Fletcher JR 1987. Land use capability classification of the Taranaki-Manawatu Region: a bulletin to accompany the New Zealand Land Resource Inventory Worksheets. Water and Soil Miscellaneous Publication 110. 228 p.

Fletcher JR, Jessen MR, Hunter GG, Lynn IH 1994. Definitions and guidelines for land use capability surveys in New Zealand: a discussion document. Unpublished progress report for the Foundation for Science, Research and Technology, FRST Contract No. LC 9293. 39 p.

Glade T 2003. Landslide occurrence as a response to land use change: a review of evidence from New Zealand. Catena 51: 297–314.

Glade T 1998. Establishing the frequency and magnitude of landslide-triggering rainstorm events in New Zealand. Environmental Geology 35(2–3): 160–174.

Glade T, Crozier M 1996. Towards a national landslide information base for New Zealand. New Zealand Geographer 52(1): 29–40.

Hancox GT, Wright K 2005. Analysis of landsliding caused by the 15–17 February 2004 rainstorm in the Wanganui-Manawatu hill country, southern North Island, New Zealand. Institute of Geological and Nuclear Sciences Science Report 2005/11. 64 p.

Hancox GT, Wright K 2005. Landslides caused by the February 2004 rainstorms and floods in southern North Island, New Zealand. Institute of Geological and Nuclear Sciences Science Report 2005/10. 32 p.

Hicks DL, Fletcher JR, Eyles GO, McPhail CR, Watson M 1993. Erosion of hill country in the Manawatu-Wanganui Region 1992. Impacts and options for sustainable land use. Landcare Research Contract Report LC9394/51 (unpublished) for Federated Farmers. 90 p.

Jessen MR, Crippen TF, Page MJ, Rijkse WC, Harmsworth GR, McLeod M 1999. Land use capability classification of the Gisborne-East Coast region: a report to accompany the second edition New Zealand Land Resource Inventory. Landcare Research Science Series No. 21. Lincoln, Manaaki Whenua Press. 213 p.

Lough CJ 1993. Effect of soil conservation measures on 1992 erosion of hill country farmland in the Pohangina District. Research report for Bachelor of Horticulture (Technology). 19.441 Research project and seminar, Department of Soil Science, Massey University, New Zealand.

Lynn IH, Eyles GO 1984. Distribution and severity of tunnel gully erosion in New Zealand. New Zealand Journal of Science 27: 175-186.

Noble KE 1985. Land use capability classification of the Southern Hawke's Bay-Wairarapa Region: a bulletin to accompany New Zealand Land Resource Inventory Worksheets. Water and Soil Miscellaneous Publication 74. Wellington, Ministry of Works. 128 p.

Page MJ 1995. Land use capability classification of the Wellington Region: a report to accompany the second edition New Zealand Land Resource Inventory. Landcare Research Science Series No. 6. Lincoln, Manaaki Whenua Press. 127 p

Page MJ, Shepherd J, Dymond J, Jessen M 2005. Defining highly erodible land for Horizons Regional Council. Landcare Research Contract Report LC0506/050 (unpublished) for Horizons Regional Council. 18 p.

Reid LM, Page MJ 2002. Magnitude and frequency of landsliding in a large New Zealand catchment. Geomorphology 49(1–2): 71–88.

Soil Conservation and Rivers Control Council 1971. Land use capability survey handbook. 2nd ed. Wellington, Water and Soil Division, Ministry of Works and Development. 138 p.

Stephens PR, Harmsworth GR, Dymond JR 1999. Developing environmental performance indicators for hill country erosion. Part 3. Proposed indicators for erosion-prone hill country in New Zealand. Landcare Research Contract Report LC9899/54 (unpublished) for the Ministry for the Environment. 45 p.