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Erosion and environmental degradation issues associated with the proposed Turitea Windfarm.

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1. The proposed site for the windfarm has been classified as Highly Erodible Land (Todd 2005), rendering it highly susceptible to erosion, which is likely to be exacerbated by disturbance associated with windfarm construction.

2. Removal of any vegetation is likely to have a detrimental impact on erosion at disturbed sites. The presence of scrub and more mature vegetation dramatically reduces erosion risk. This has been demonstrated in this region by peer reviewed research published by Dymond *et al.* (2006).

3. Construction of access roads either in conjunction with vegetation removal, or across existing pasture, will alter catchment hydrology and have a follow-on impact on erosion processes. This has been highlighted by recent research by the National Academy of Sciences (USA) Committee on Hydrological effects of forest management[1]:

3.1 Roads modify surface and subsurface flowpaths of water:

3.1.1 Overland flow is generated by compacted surfaces with very low infiltration rates (e.g. Luce & Cundy, 1994).

3.1.2 Cutslopes above roads and hillslopes below roads also have lower infiltration rates than undisturbed soils, thus also generating overland flow.

3.1.3 Roads constructed on steep slopes can also intercept shallow subsurface flow, further increasing overland flow (Wemple & Jones, 2003).

3.1.4 During rainfall, water flows on road surfaces and/or in ditches that are connected to streams, thus the road network efficiently conveys water directly to the surface channel network in the catchment.

3.2 Roads contribute to increased size of peak flows by increasing surface runoff from impervious surfaces, intercepting subsurface storm flow and speeding the delivery of this runoff to the stream network. This increases catchment susceptibility to erosion and flooding:

3.2.1 Overland flow has higher surface velocities than subsurface flow and thus greater potential for erosion from higher shear stresses exerted by the flowing water over surfaces, be they natural or made ground.

3.2.2 Increased discharge from raised runoff levels renders stream channels in the catchment (both ephemeral and perennial) susceptible to degradation by erosion of the channel boundary by higher peak flows.

3.2.2.1 Stream channels adjust to accommodate discharge supplied to them. This is a well established principle of hydraulic geometry (e.g. Knighton 1998).

3.2.2.2 The adjustment mechanism is via bed and bank erosion, contributing additional sediment to the catchment system.

3.2.3 High rates of overland flow along unpaved road surfaces entrain sediment, erode road surfaces and contribute sediment to streams (Reid & Dunne, 1984).

3.2.4 Increased frequency of higher peak flows increases flood risk in the catchment, particularly in the light of predicted climate change impacts, forecsting increasing intensity of rainfall events in New Zealand (Hennessy *et al.* 2007).

3.2.5 Increased flood magnitude and frequency may severely degrade river channels (Fuller, 2007; 2008).

3.3 Compacted road surfaces, cutslopes, fillslopes, ditches and areas below culverts are exposed to chronic surface erosion due to generation and concentration of overland flow, increasing suspended sediment loads in streams.

3.3.1 Suspended sediment can degrade water clarity, reduce interstitial flow and dissolved oxygen levels, as well as alter stream channel morphology (Swanson *et al.* 2000).

3.3.2 Sediment laden water will increase water treatment costs, reduces water storage capacity over time and sediment particles can bind with and become a transportation vehicle for contaminant particles such as nutrients, metals, organic compounds and pesticides.[1]

3.4 Estimates suggest such roads may increase landslide erosion rate by 30-300 times relative to undisturbed areas (Sidle & Ochiai, 2006).

3.4.1 Road fills and cutslope areas are subject to landsliding during storm events (Wemple *et al.* 2001).

3.4.2 Landsliding contributes potentially large volumes of sediment to stream channels, often of a fine nature (Hancox & Wright, 2005).

3.4.2.1. Excess fine sediment contributed to the stream network is detrimental to stream water quality and aquatic habitat (3.3.1, 3.3.2).

3.4.2.2 Coarse material (gravel, cobbles, boulders) contributed from mass movements can exacerbate flood hazard and channel erosion.

4. The risks of environmental degradation posed to such a vulnerable landscape by the proposed windfarm construction renders the development environmentally unsound.

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[1] *Hydrological Effects of a Changing Forest Landscape*, National Research Council, National Academies Press, Washington DC, 2008.

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