A Review of Erosion and Water Pollution Hazard Assessment Systems within Selected Australian and Overseas Forestry Agencies

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Summary: Erosion hazard and water pollution hazard assessment are becoming common features of forest codes of practice implemented by forest agencies in Australia and overseas. Very few of these systems cover all forms of erosion (sheet, rill, gully and mass movement) or consider sediment delivery to streams separate from erosion. A comparison between selected Australian and North American forest agencies is presented below. Structure and implementation of the various erosion hazard assessment systems is dependent on the legislative environment and Forest Code of Practice that the forest agency is working within.

1. INTRODUCTION

This review concentrates primarily on the erosion hazard and water pollution hazard assessment systems that have been implemented by Australian state forest agencies as part of their environmental management systems. Selected overseas systems are also covered. It is important to understand what sort of environmental management system the agency is working under and how the hazard assessment techniques are related to the regulatory environment of the respective agency. It is also necessary to understand some terminology related to Forest Codes of Practice.

2 FOREST CODES OF PRACTICE

A Code of Forest Practice is ideally a compilation of principles and goals for forest management for that State. These principles are presented as a series of Rules and/or Standards. These are sometimes elaborated with Guidelines, Rules and Standards typically have statements with the word "must" included while Guidelines use the word "should".

Implementation of these Rules/Standards at the forest management unit level require their translation into Prescriptions which may be facilitated by having sets of upon:

1. Local geology classes
2. Vegetation classes
3. Gravel content
4. Specific soil types
5. Local experience

While the use of a high level, categorical soil erodibility class has many benefits, such as use of geological information and in making prescriptions site specific, there is a disadvantage in ignoring other factors such as rainfall erosivity and landsurface geometry and soil variation. There has been a recent development of a soil erodibility test procedure based upon wet sieving of a whole soil sample to 80 cm (Laffan et al. 1997) which covers the soil variation problem.

There is no direct assessment of sediment delivery to streams and therefore no water pollution hazard assessment. While there are prescriptions for drainage specific Guidelines. Prescriptions can be considered as work instructions while Guidelines can be considered advice. Prescriptions and Guidelines are used to support preparation of Forest Operational Plan, eg. a Timber Harvesting Plan.

Erosion hazard and water pollution hazard assessment system are usually present as Rules/Standards and often elaborated as Guidelines.

3 TASMANIA

Tasmania has a legislated Forest Practices Code (Forestry Commission of Tasmania 1993) that combines Standards, Prescriptions and Guidelines. Forestry Tasmania is one of two forest agencies in Australia that uses an erosion hazard assessment in its Code of Forest Practice. Soil erodibility class is one of the key inputs that is used to produce various hazard assessments. Forest Practices Board employs Forest Practices Officers which include a specialist in forest soils. Forest Practices Board also has produced various guidebooks and manuals to assist foresters in preparing operational plans.

The Soil Erodibility Classification is outlined in the Code and further expanded in the Soil Conservation Manual (Brown and Laffan 1993). This classification is based and construction of forest road crossing which are related to Soil Erodibility Class, there no consideration roads as a source of stream sediment.

The Tasmania code also assesses hazard due to mass movement and specific geomorphology such as karst (limestone/dolomite landscapes). Soil and geomorphological expertise is developed at the operational level and within the Forest Practices Board which also carries out an auditing function. The consideration of karst geomorphology as a high hazard environment from heritage value and water quality value is unique in Australia and overseas.

4 SOUTH AUSTRALIA

Primary Industries of South Australia (PISA) has an Internal Code of Forest Practice for *Pinus radiata* plantations (Anon 1995a) which are the dominant managed forests in SA. PISA has been providing large-scale soils and land evaluation map/reports to local Soils Boards in South Australia so there is a tradition of

relatively large scale soils mapping across most of the high rainfall zone of SA.

PISA has developed a Land Capability Classification for pine plantation which has guidelines for erosion control and water quality protection. These guidelines are not prescriptive and are based on site and soil properties which can collected in the field or from soil survey data. Land capability classifications require a foundation of soil survey and site data. While the soil erodibility classes developed by PISA are interesting in that they use field data, they only address sheet/rill erosion (there is a separate classification for wind erosion that only SA addresses). There is no consideration of gully or mass movement hazard. Nor is there any direct consideration of water pollution as in sediment delivery by harvesting operations and road crossing.

5 BRITISH COLUMBIA, CANADA

British Columbia, Canada is similar to Tasmania in having a legislative Code of Forest Practice. Forest Practices Code of British Columbia Act established the code, established mandatory requirements for planning and forest practices, sets enforcement and penalty provisions, and specifies administrative arrangements.

BC Forests have developed a detailed series of hazard assessment systems that cover mass movement (terrain stability), gully erosion, and soil degradation (surface disturbance, compaction, surface erosion and mass wasting). These assessment are categorical, field based, point-scored systems. Guidebooks (Anon 1995b, c, d) have been produced that provide qualitative classification procedures to assess each of these hazards. There has been one Guidebook which shows how these hazard assessments can be combined to affect Prescriptions for forest operations (Anon 1995e)

Water pollution hazard assessment is also catered for as "Potential for sediment delivery from surface erosion sources". This categorical table emphasises stream permanency, probability of point source (road crossings) and non-point source (harvest area) sediment delivery. This table can be utilised in reference to gully erosion and mass movement.

This hazard assessment system is one of the most comprehensive and detailed found during the review. It addresses all forms of erosion and soil degradation within a forest environment. The system is categorical, field based, and hazard is determined by accumulating points over multiple attributes. There is also an acknowledgment that different scales are required for different hazards.

The point score system does have inherent difficulties in that it does not emphasise the most limiting attribute and actual point scales and weighting are very arbitrary.

6 WASHINGTON STATE, USA

The Pacific north-west states of Washington, Oregon and California have forest legislation and structures similar to British Columbia. In Washington State the legislative Forest Practices Code covers public and private forestry. The Watershed Analysis Manual (Washington Forest Practice Board 1992) has been produced by the Washington Forest Practice Board. The public forest manager is the Department of Natural Resources. This manual performs the same role as the guidebooks in British Columbia; a means of helping forest managers in drawing up prescriptions for specific operational plans.

There is an explicit division on scale of assessment from reconnaissance down to local. There is also an important recognition of the difference between hazard potential and its probability of occurrence (vulnerability or risk). Washington watershed analysis distinguishes two main categories of hazard:

1. Mass wasting which includes landslides and slope instability
2. Surface erosion from hillslopes and from roads

This erosion and water pollution hazard assessment is one of the few reviewed that covers roads as a major source of potential sediments to streams. It also used a lot of the summary research from the USFS Pacific NW and Rocky Mountain Research Stations on forest road erosion.

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