APPENDIX 2 - LAND FEATURES DETERMINING CAPABILITY

The land features used in capability rating systems can impose limitations to the use of land through effects o the production, the management or the hazards. This section explains why these land features are important in determining capability.

1. Slope

As slope increases, erosion hazard increases because the erosivity of the runoff water increases. Lack of adequate ground cover, such as occurs during construction activities, on tracks and intensive use areas, under cropping uses where cultivation is required, or as a result of overgrazing, accentuates the erosion hazard.

A main influence of slope on rating for capability for urban and similar uses is related to the increasing cost of providing engineering services as slope increases. The slope categories used in urban ratings have been chosen on the basis of per block costs of building and providing services, as described by Neil, R.C. and Scales, P. J. (1).

In agricultural activities, steeper slopes are more difficult and costly to work and may impose limitations on the type of machinery which can be used.

Seepage problems increase with slope on certain soil types, and may increase the risk of mass movement such as slumping of batters of excavations and road cuts. Problems with the absorption and retention of septic effluent below the soil surface increases as the slopes become steeper.

In general, the cost of developing and managing land increase as slope increases.

2. Land slip Hazard

Landslips are an important factor to consider with respect to human safety, damage to property and access. High landslip hazard can be a permanent limitation to some land uses because even where it may be technically possible to prevent landslips, to cost would be generally prohibitive.

3. Percentage of Outcropping Boulders

Boulders are a physical barrier to excavation, cultivation and plant growth, and so inhibit land uses involving these activities. These limitations may be overcome to a certain extent by blasting which involves additional costs. For extensive uses, such as grazing, boulders can be regarded as a permanent limitation, as it is not economical to remove them and there may be additional costs involved in the increased management required as compared with boulder free land.

4. Availability of Dam Sites

For agricultural uses dams may be required for irrigation or for stock water. In areas where reticulated water is not available dams may also be needed for domestic uses.

5. Site drainage

Site drainage is influenced by rainfall, soil permeability, the steepness of slope, slope shape and the position on the slope. It is important for most land uses that water flows freely from the site. Poor site drainage may result in the land becoming waterlogged and boggy, plant growth may be inhibited, roads and buildings may be damaged through subsidence and efficient effluent disposal will not be possible.

6. Soil Profile Permeability

Soil of low permeability do not readily drain vertically through the profile, although when on sloping land lateral flow above a horizon of low permeability may occur. Areas with such soils may become waterlogged and plant growth could be inhibited. Soils with poor permeability may

become too boggy for the use of agricultural machinery at certain times of the year. They cause problems when used for effluent disposal.

Poor soil permeability may result in loss of production (reduced plant growth) and increased management restrictions, and increased costs in overcoming the problems of effluent disposal. Conversely, an extremely permeable soil may suffer from excessive leaching of plant nutrients or an inability to retain moisture for plant growth. Such a soil may also drain too rapidly to perform the purification function required for septic effluent disposal.

7. Infiltration

The ability of soil to absorb applied water (rain or irrigation water) has an important effect on the production of surface runoff and may also affect the ability of soil to provide moisture for plant growth because of limitations to the amount of water entering the soil.

Raindrop splash and, in some instances, wash of surface soil, may cause “surface sealing” which results in the blocking of surface pores and a reduction in the amount of water penetrating the soil. Soils differ in their resistance to surface vents raindrop splash or surface wash in an appropriate means of retaining soil infiltration capability.

8. Gravel and Stones

Excavation of soils with large amounts of stones and gravel require special machinery. The sides of construction trenches and holes in these soils are less stable.

Because stones occupy soil volume and do not contribute to the availability of plant nutrients or moisture they reduce the productive potential of soils. Soils with stones and gravel are difficult to cultivate and they are far less suited to intensive cropping and gardens than are stone-free soils. Stones cause problems with mechanical harvesting of root crops (notably potatoes).

Soil micro-organisms are essential to the purification of septic effluent, but stoney or gravelly soils provide a less suitable environment for these organisms than stone and gravel-free soils. Thus populations of micro-organisms in very stoney soils are small. Furthermore, the effluent flows quickly through stoney soils which reduces the time available for purifying processes which take place in the soil. For some land use activities, limitations imposed by stones and gravel can be overcome by special management or technology (e.g. engineering problems of excavating in stoney soils). These usually increase the costs of the operation.

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The limitations to plant growth can be overcome by importing topsoil which in effect is changing the nature of the land. Stones and gravel soils intended for intensive cropping can be regarded as a permanent limitation, causing lower plant yields and increased management problems unless the importation of topsoil can be justified. The problems of septic effluent disposal by absorption in these soils are difficult to overcome and may be regarded as a permanent limitation to the commonly used tiledrain disposal system.

9. Depth to Rock

If bedrock is close to the surface, excavation will be costly and cultivation may be difficult or impossible. Plant growth and water penetration are adversely affected by shallow soils.

These limitations to engineering activities may be overcome by blasting. In low intensity uses bedrock at shallow depth is regarded as a permanent limitation and will result in increased costs of agricultural production through the difficulty or constructing farm dams and reduced plant yield.

10. Depth to Winter Water Table

This factor is dependent on the soil profile permeability and site drainage. If the water table is too close to the surface the topsoil will become boggy and problems similar to those as described for site drainage and profile permeability may arise. Special management requirements, such as drainage, may be required to enable efficient disposal and to present damage to roads and buildings, both during and after construction.

11. Depth of Cultivable Soil

For intensive cropping it is necessary to cultivate soils deep enough to provide a good soil structure for root and water penetration. Plant growth will be limited if this depth is less than 0.5 metres.

12. Limiting Soil Depth for Pasture Roots

The depth of rooting pasture plants may be restricted by much soil features as heavy clay subsoil or a gravel bed. If this feature is close to the surface, root development, and therefore plant growth, will be restricted. Reduction in pasture production results in reduced economic returns and increase costs would be incurred in overcoming the problem by methods such as deep ripping the clayey subsoil.

13. Moist Consistence and Dry Consistence

Consistence determination provides an indication of the coherence of soil. If soil becomes boggy when moist or hard and powdery when dry, then time of cultivation, and thus management for intensive cropping, will be restricted.

14. A Horizon pH

The pH of the soil is a measure of the acidity or alkalinity. Most plants have a limited pH range for optimum for high plant fields and will result in reduced crop production or may require costly treatment to bring the pH closer to the optimum.

15. A horizon Soil Texture

The A horizon or topsoil texture provides an indication of the likely physical performance of the soil or whether the topsoil will become sticky when wet (clay) unstable when dry (sand) which are important considerations for some recreation pursuits.

The texture of the A horizon is one of the soil features which influences whether water can easily penetrate the topsoil. It also affects the ability of the soil to retain moisture available for plant use and the nutrient supplying ability of the soil. This factor may limit the growth of lawns and gardens in the urban use and plant yield in agricultural uses.

Some of the limitations imposed by soil texture can be reduced or overcome by special treatments such as addition of stabilizing chemicals or organic matter or simply by importing better quality topsoil.

16. A Horizon % Organic Matter

Generally the higher the level of organic matter in the topsoil, or A horizon, the better the structure and chemical fertility of the soil. Such soils are good usually for intensive cropping.

Low organic matter content may be overcome by management techniques such as the growing of green manure crops or the addition of fertilizers.

17. B horizon Emerson Dispersion and Slaking Class

Dispersion and sling are important for their influences on the erodibility of a soil. This is particularly important in construction activities where the B horizon, or sub-soil, is exposed in cut batters or where the material is used in earth embankments. It can also be important in other uses, such as paths and tracks, where the area as been denuded of vegetation and possibly some topsoil. A high degree of slaking or dispersibility of soils will lead to soil erosion in these land uses.

In a highly dispersible soil, soil pores may become blocked thus reducing water infiltration and adversely affecting land use requiring good drainage such as effluent disposal.

18. B Horizon Unified Soil Group

The Unified soil Classification is used by engineers to group soils with similar engineering properties. Such properties include, bearing capability, drainage characteristics and the amount of shrinking and swelling a soil undergoes as the moisture content changes.

The soils of the area have been grouped according to these engineering properties. Soils having inherent engineering problems increase construction costs.

19. B Horizon Shrink-Swell

Shrink-swell is a percentage measurement of how much a soil increases and decreases in volume when wet and dry respectively. These measurements are made on soil from the B horizon.

Shrink-swell influences the capability for land uses which require a stable subsurface such as roads or building. Buildings and roads may shift or crack I soils which undergo large changes in volume, when wetting or drying.

A high shrink-swell value requires special construction techniques such as laying a deeper than usual road paving or using a concrete slab rather than strip footing for dwelling construction.

20. Slumping of Batters

Batters are man-made earthen slopes. A knowledge of the stable angle (angle or repose) for the material involved is necessary for good management.

21. Flood Hazard

Flood hazard is an important factor in terms of human safety, damage to property and general inconvenience. Thus flood prone land should not be used for capital intensive uses, but may be capable of supporting extensive land uses such as grazing.

In some areas the problem may be overcome by the building of levee banks or retarding basins. Some change in flooding characteristics may be possible by special negative management aimed at delaying surface runoff. However, when dealing with large catchments, the problem can be regarded as a long term hazard and a permanent limitation.