Preliminary site selection guidelines for new *Pinus pinaster* plantations

1. Context

These recommendations apply to broad-scale and block plantations of *Pinus pinaster*, within areas in which:

- mean annual rainfall is a minimum of 600 mm of rainfall, but preferably 700 mm
- generally within 100 km of Kewdale
- a minimum area per farm of 20 hectares

Although these guidelines should be regarded as preliminary, they are based on the best available knowledge for this species.

2. Selection criteria

Guideline 1: *Soils should have >2.5 m of root penetrable material. Soil inspection in backhoe pits is recommended so as to assess likely root penetration. Roots will be impeded by rock (limestone, granite, dolerite etc), continuous hardpans (ferricrete, coffee rock) and poorly structured sub-soils. Some effort should be made to assess the variability of depth across the site.*

Guideline 2: *Poor tree growth is expected on sandy soils, >2 m deep, which are white (Munsell chromas <3) throughout the soil profile. These sites should be avoided. Sands with brighter colours within the profile (Munsell chromas >3) are acceptable.*

Guideline 3: *Sites with waterlogging, within 1 m of the surface for more than 2 months a year should not be planted. Indications of waterlogging include landform, gleyed sub-soil clays and vegetation such as paperbark (Melaleuca spp) and rushes (Juncus spp).*

Guideline 4: *The current expression of salinity should be assessed from surface indicators such as scalds, salt efflorescences and surface plant indicators such as barley grass. Soil samples (1:5 water) should be taken from the soil surface and at depth from the backhoe pit, and assessed with an electrical conductivity meter. Sites with values >60 mS/m should not be planted.*

Guideline 5: *The future risk of salinity developing via rising groundwater tables should be deduced from landscape position. Deep drilling will not occur. Likely quality of groundwaters should be determined from the Geological Survey of WA, WAWA and DAWA.*

Guideline 6: *Soils with extreme alkalinity within the soil profile (pH >8.5) should be avoided. These sites are often associated with shallow limestone, or with incipient salinity.*

Guideline 7: *Soil fertility should be assessed via analysis of surface (0-10 cm) soil samples. Phosphorus fertilizers may be required on sites with <10 ppm bic-P. Potassium fertilizer responses have not been reported for* Pinus pinaster *in WA; those sites with very low levels of bic-K. (<40 ppm) may have other limitations. Nitrogen fertilizer responses are unlikely irrespective of previous pasture condition.*

Guideline 8: *All of the above limiting factors should be assessed in a systematic manner. Soil surveys provide such a framework, should be undertaken by suitably trained staff according to CALM standards. For more details see Section 4.*

3. Safety

Backhoe pits are potentially dangerous. Although observations of soil materials, and sampling, can often be undertaken on spoil brought to the surface, it is sometimes necessary to enter a soil pit.

Field operators should not enter pits:

- with a surface sand horizon >80 cm deep.
- with water seepage in sand horizons
- alone. Always ensure that another person is aware that you have entered the soil pit
- in any situation where their judgement suggests that it is dangerous.

4. Site assessment procedure

4.1. Aims of site surveys

The aims of the soil surveys are to:-

- Identify the major soils, and their areal extent, and present this information on a map.
- Identify those soils where tree performance will be impaired by soil and site conditions, using the above criteria. These will generally be those factors which affect the moisture availability to the trees, and plant stability (i.e. Valentine 1986)
- Provide information so that CALM can produce parametric maps (i.e. hardpan distribution, waterlogging hazard)

4.2. Soil survey criteria

4.2.1. Scale

A mapping scale of 1:10 000 will be used.

4.2.2. Mapping base and photography

An aerial photographic enlargement at a scale of 1:10 000 will be provided, for use as a mapping base. Stereo-contact prints will also be used, both of the most recent aerial photography, and also of historical runs if available, and if required. Where available colour photography will be used.

4.2.3. Field inspections

4.2.3.1. Field inspection strategy

The surveyor has control over the selection of sampling sites. Free survey, using interpretations of both aerial photography and the landscape is acceptable, provided adequate ground observations are made.

4.2.3.2. Intensity of sampling

A mean of one soil observation per hectare is required.

4.2.3.3. Depth of sampling

Soils will be assessed to a depth of at least 2.5 m. In deep sandy terrain some holes should extend beyond this (~4 m).

4.2.3.4. Method of sampling

Soils will be examined in backhoe pits.

4.2.3.5. Attributes recorded

4.2.3.5.1. Location

The location of each sampling site (easting, northing) will be recorded with a GPS.

4.2.3.5.2. Soils

Soils will be described according to McDonald and Isbell (1990). A minimum data set is:-

- Depth of each major soil horizon
- Texture and colour (Munsell or Japanese soil colour charts) of each major horizon. An indication of amount and intensity of mottling.
- Depth, thickness, and nature of any root impenetrable layers.

- Nature of any parent rock and segregations.
- Profile drainage (i.e. waterlogged, or well drained).
- Other hazards (salinity etc)

4.2.3.5.3. Geomorphology

Classification of landscape position (i.e. crest, midslope, lower slope), and geomorphological element (dune, ridge) according to Speight (1990).

4.2.3.5.4. Method of recording field data

Field data will preferably be recorded on the field description sheet (Figure 20) of McDonald *et al.* (1990).

4.2.4. Soil sampling and analysis

Soil sampling and analysis will be undertaken for assessment of salinity, pH and nutrient content. Salinity samples will be taken from the soil surface and at depth in the backhoe pits; nutrients from 0-10 cm bulked samples (CSBP tool).

4.2.5. Soil map and legend

4.2.5.1. Map presentation

A procedure for using a GIS for these maps will need to be developed.

Soil mapping delineations, and location of all sequentially numbered field observation sites will be drawn on a transparent overlay to the aerial photograph enlargement (overlay provided by CALM), and on a separate plain paper copy. The major soil classes will be coloured by pencil.

4.2.5.2. Minimum delineation

A minimum delineation of 1.0 ha is required. Each delineation exceeding this area will require a complete soil profile description.

4.2.5.3. Mapping Units

Soil map to comprise Soil Mapping Units (SMU), each preferably comprised of a single Soil Profile Class (SPC, Isbell, 1988). If complex mapping units have to be used, due to soil complexity, an indication of relative proportions, and nature of interrelationships between soil and landscape is required.

Soil Profile Classes will be analogous to the series and phases of the USDA (Soil Survey Staff 1975, Dent and Young 1981), however both the SMU and SPC will be defined by the surveyor in the field. The mapping units must be composed such that differences in drainage, depth of soil and texture can be recognised.

4.2.5.4. Legend (Field Classification)

The map legend will list each soil mapping unit, with an indication of aerial extent, composition (of SPC), landscape relationships and drainage.

4.2.6. Report

4.2.6.1. Written report

A report is required which will be an extension of the map field legend, and be around 4-5 A4 pages in length. It will include:

- Description of each mapping unit, with an indication of the relationship to the landscape.
- Description of modal Soil Profile Classes, with horizons classified according to McDonald and Isbell (1990), and an indication of the range in individual attributes. A Table will be adequate for this purpose.
- Classification of the SPC according to Northcote (1979), Stace *et al.* (1968) and an estimate made of the Orders and Sub-Orders in Soil Taxonomy (Soil Survey Staff 1975).
- Brief notes to be made, for each soil, of the factors which are likely to limit the growth of plantation trees, and any recommendations for management.

4.3. References

Dent, D. and Young, A. 1981. *Soil Survey and Land Evaluation.* George Allen and Unwin, London. 278 pp.

Isbell, R.F. 1988. Soil classification. In *Australian Soil and Land Survey Handbook – Guidelines for conducting surveys.* R.H. Gunn et al. (eds), pp 20–37, Inkata Press, Melbourne.

McDonald, R.C. and Isbell, R.F. 1990. Soil Profile. In *Australian Soil and Land Survey Handbook – Field Handbook,* 2nd ed. McDonald, R.C., Isbell, R.F., Speight, J.G., Walker, J. and Hopkins, M.S. (eds), pp 103–152, Inkata Press, Melbourne.

Northcote, K.H. 1979. *A Factual Key for the Recognition of Australian Soils.* Rellim, Adelaide. 124 pp.

Soil Survey Staff. 1975. Soil Taxonomy: A Basic System of Soil Classification for Making and Interpreting Soil Surveys. USDA Handbook N° 436. Govt Printer, Washington.

Speight, J.G. 1990. Landform. In *Australian Soil and Land Survey Handbook – Field Handbook,* 2nd ed. McDonald, R.C., Isbell, R.F., Speight, J.G., Walker, J. and Hopkins, M.S. (eds), pp 9–57, Inkata Press, Melbourne.

Stace, H.C.T., Hubble, G.D., Brewer, R., Northcote, K.H., Sleeman, J.R., Mulcahy, M.J. and Hallsworth, E.G. 1968. *A Handbook of Australian Soils.* Rellim, Adelaide.

Valentine, K.W.G. 1986. *Soil Resource Surveys for Forestry. Soil, terrain, and site mapping in boreal and temperate forests.* Monographs on Soil and Resources Survey N° 10, Clarendon Press, Oxford. 147 pp.

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January 19, 1995