PLANNING FOR RE-ESTABLISHMENT

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Until recently most forest planting activity in New Zealand has involved the conversion of native bush, reverted scrub land or, in the more recent years, the conversion of farmland predominantly to Radiata pine. This is commonly referred to as newland planting.

Re-establishment is the set of operations that link consecutive crops of trees. Re-establishment begins sometimes prior to the removal of one crop of trees and is completed when the next crop of trees is growing relatively unhindered by competing weeds.

The challenges and considerations in re-establishing plantation cutover can be quite different to those involved with planting newland.

Last year was the first year in recent times that the area being re-established in New Zealand exceeded the area of new planting with approximately 25,000 ha of cutover being re-established compared to approximately 15,500 ha of newland (Lindsay Vaughan, MOF Rotorua pers comms). Forest re-establishment areas are likely to gradually increase as the maturity of the national plantation resource increases. The area of new land planting is likely to vary according to forestry taxation regimes in place and investor's perceptions about forestry. It is anticipated that in 1992 new planting will again exceed re-establishment areas with the bulk of this activity occurring outside of the larger forestry companies.

The theme of this Seminar is harvesting and re-establishment of difficult terrain. This paper will not be restricted to re-establishment of difficult terrain as the distinction between difficult terrain and easier terrain is not as clearly definable for re-establishment as it is for harvesting.

Forestry as a Continuum

Re-establishment activities bring together two groups - the loggers and the foresters. It would be fair to say that there has traditionally been a degree of separation between these two parties in most forestry organisations in New Zealand - both in forestry companies and in the research and support organisations. However by standing back and taking an overall perspective harvesting and re-establishment can be viewed as just parts of a continuum of management activities directed primarily at producing wood. Any split between harvesting and re-establishment is basically an administrative split, albeit a logical split. This split must not be allowed to hinder co-operation between these groups in achieving the common long term objective.

Much is made about the impact of harvesting activities on re-establishment activities and there have been recent examples of

re-establishment activities impacting on harvesting activities. How harvesting and re-establishment impact on each other will be elaborated on later on in this paper. What is probably more important is to first put a focus on how both of these sets of activities can impact on a site.

On-Site Impacts of Harvesting and Re-establishment Activities

The key elements of a forest site as far as tree growth is concerned are the soil, the sun and climate. The forest manager has little control over the latter two but can have a major impact on the first of these - the soil.

The duff layer on the top of the soil profile is vitally important to tree growth as much of the nutrient reserves on a site can be held in this layer. This organic layer can protect the soil from surface erosion and reduce moisture loss caused by evaporation.

Harvesting and re-establishment activities have the greatest potential for negative impact on the soil during a rotation of trees. Dyck and Kimmins (1990) noted studies of whole tree harvesting, slash burning and mechanical site preparation in Sweden where declines in tree growth were attributed to loss of organic matter and associated nutrients. These two authors note New Zealand studies that also relate nutrient loss to harvesting and re-establishment activities, with site preparation activities such as windrowing having the most detrimental effect.

It is important to make the distinction between site quality and site productivity. Site quality is a measure of the potential of a site to support net primary production. Site productivity in a forestry sense is commonly a measure of the wood produced on the site. It is possible in the short term, through more intensive management practices and through tree breeding, to improve site productivity while site quality is declining. However over the longer term declining site quality will result in a reduction in site productivity. An important lesson can be learnt from the Swedish studies referred to above where scarification and slash burning resulted in accelerated growth through to age 15 and yet a reduction in growth by mid-rotation. Similar effects have been reported from studies by John Balneaves in Canterbury. Faster growing more uniform second rotation Radiata pine stands in New Zealand probably owe their performance more to intensive weed control and tree improvement programmes then to any improvement in basic site quality.

As well as improving site productivity, improvement, or at least maintenance, of site quality must be an overriding concern when planning harvesting and re-establishment operations if plantation forestry is to be a sustainable land use.

There is a need for continued, and increased, support from the forest industry for research into the long term impacts of harvesting and site preparation activities on site quality. Good data in this area is important to ensure that forests are managed in a sustainable manner. Appropriate structures are required which facilitate research projects drawing expertise from the harvesting, soils and site management and other forest management research fields.

Harvesting Impacts on Re-establishment

Harvesting residue, planting block size and boundaries, stage of weed development and **soil disturbance/compaction** are the four main factors directly influenced by harvesting which impact on re-establishment. Each of these will be dealt with as planning for re-establishment and re-establishment operations are described below.

Planning for Re-establishment

In planning for re-establishment there are a number of sometimes conflicting pressures. There is pressure to minimise the regeneration interval - i.e. the period of time that land is unproductive between rotations. Conversely, the success and sometimes the cost of re-establishment operations, particularly those concerning weed control, can be dependent on the period of time available over which to conduct those operations and the season in which those operations are carried out. Achieving a good establishment result at minimal cost is particularly important as establishment costs need to be carried for about thirty years. The forest manager needs to balance these considerations and many others in planning re-establishment operations.

- **Prior to Clearfall**

Planning for re-establishment will usually begin prior to clearfall. Budgetting for dollars and resources will rely on scheduled clearfall area. Tree stock requirements for example need to be estimated one year prior to planting to ensure security of supply - some forest managers will probably be scratching around the country now trying to secure tree stocks for this winter's planting, without much success.

- **During Clearfall**

During clearfelling re-establishment staff need to regularly inspect cleared cutover to be able to effectively plan for weed control, slash treatment, cultivation treatments and planting block boundaries and size.

With logging activity increasingly being driven by log market demands, logging crews tend to shift from one area to another as logging managers chase a particular log grade. This logging pattern complicates site preparation and weed control activities in that it is more difficult to achieve logical planting boundaries. Logical planting boundaries usually relate to logical logging boundaries - i.e. gully bottoms, ridges, roads, streams, etc. Problems arise when, for example, a logging crew moves out of an area when they have logged half way up a hill and don't get back to the area prior to planting. Logging crew shifts due to weather conditions and log demands are inevitable, however disruptions to re-establishment can be minimised by good communications between logging and re-establishment staff. A basis to good communications is an understanding of each other's respective constraints.

- **Cutover Clean up**

Cutover clean up is often a source of conflict between logging and re-establishment staff. Cutting scrub and knocking over unmerchantable spars adds to the dollars per tonne cost of a logging operation. Leaving them standing hinders

re-establishment operations and poses particular hazards to aerial spraying operations. Whether such clean up should be the responsibility of logging or re-establishment staff will probably depend on which party can deal with the problem most efficiently. In most cases the costs will eventually end up on the same desk. Merchantable timber left on a cutover is a concern from two points of view - firstly it means a reduction in harvested volume, and hence revenue, and secondly it adds to a slash problem, and hence costs.

- **Slash Treatment**

The amount of slash left on a site after harvesting will depend on the species, age and silvicultural history of the previous crop, the harvesting system used - ie. whole tree harvesting or trimming in the bush, the terrain of the site as it affects breakage during felling and extraction method (ground based or hauler), whether a pulp/chip market exists and on cutover clean up standards. In some cases it is concentrations of slash rather then slash over the whole site that is the major concern - this is often the case in hauler whole tree extraction situations where slash builds up in "birds nests" around a skid site.

The negative impacts of heavy slash from a re-establishment point of view are:

(i) hindrance to access for planting and weed control operations
(ii) increased risk of frost damage to seedlings
(iii) increased risk of insect damage to seedlings
(iv) increased fire risk
(v) hindrance of access for mechanical cultivation such as ripping.

The positive impacts of slash retention from a re-establishment point of view are:

(i) improved soil moisture retention
(ii) improved nutrient retention on the site
(iii) minimising costs.

In the past fire was a commonly used tool for dealing with slash, particularly in the conversion of indigenous cover to plantation species. The impact of fire on a cutover site can be difficult to predict as negative impacts are related to the intensity and duration of the fire - these are not always easily controlled. Many forest managers are limiting or avoiding the use of controlled burning due to risks to surrounding crops, concerns about nutrient retention, cost considerations and off-site impacts from smoke. As utilisation standards increase there is less need to burn.

Where slash is a concern there is a range of mechanical treatment options available to the forest manager:

(i) Windrowing - blading and raking slash into windrows was a common method of dealing with slash in the past. The operation usually resulted in considerable disturbance and removal of duff layers and topsoil with resultant productivity losses. Windrowing with a crawler tractor is rarely done today. A recent development for windrowing involves using a hydraulic excavator fitted with a rake. This technique, described by P Hall (LIRO -

paper in prep.) results in minimal soil disturbance and can be applied to steeper slopes and in heavier slash then is practical with a crawler tractor. This technique is being applied in several South Island forests.

(ii) Line blading - blading slash from planting lines to allow access for planting can be an effective treatment but if the blade is too deep it can also result in disturbance and removal of the duff layer and topsoil. This is particularly so where line blading is down slopes where the operator is using the blade to control the downhill speed.

(iii) V-Blading - this operation, where topsoil is mounded to either side of a V-blade mounted on the front of a crawler tractor, is applied to effect cultivation, reduce the risk of mortality due to Armillaria root rot, provide frost protection through elevation, improve drainage, or as a means of dealing with heavy slash. The impacts on site quality from this operation are not well understood. Some researchers and practitioners have attributed stability problems to V-blading and there have been recent examples of V-blade mounds impacting on production thinning operations.

(iv) Roller Crushing - either with a towed roller or a gravity roller. This technique is finding favour as a means of breaking down slash to improve access whilst maintaining the benefits of slash retention.

Typically cutover burning costs are in the range $150-200/ha and mechanical slash treatments are in the range $200-$300/ha (FRI Bulletin 169 - 1991). For most forest managers facing light to moderate levels of slash and not needing to mechanically cultivate a site the decision will usually be to leave the slash untreated. This is usually the least cost option and maintains the benefits of slash retention. On steeper country the options for dealing with slash are likely to be limited irrespective of the levels of slash.

- **Cultivation**

Cultivation may be necessary to ameliorate compaction resulting from harvesting activity, or to deal with specific soil characteristics such as the presence of a pan in the soil profile which will restrict root growth or impede drainage. Mechanical cultivation on cutover sites usually takes the form of ripping or ripping/mounding. Even moderate levels of slash will generally restrict these operations. If mechanical cultivation is necessary slash usually needs to be cleared for access by blading, roller crushing or burning. Mechanical cultivation of cutover is restricted to relatively flat areas.

The bulk of cutover establishment, including flatter areas, usually proceeds without mechanical cultivation.

Logging skids are areas of severe compaction and topsoil removal. Where these are re-planted they need to be ripped and usually fertilised. Tree growth on ex-skid sites is

generally much reduced compared to that on the surrounding cutover.

- **Pre-Plant Weed Control**

Within the forest industry there is little dispute about the benefits of weed control for ensuring acceptable tree growth and survival. In most instances herbicides have been the most cost-effective weed control tool available to the forest manager for dealing with problem weeds. Despite advances in biological weed control herbicides are likely to continue to play a vital role in weed control/management strategies. This will depend on forest managers being seen to be policy makers continuing to consider technical arguments in the herbicides debates.

On removing a forest crop the cutover is opened up to invasion by a host of weeds. These weeds are likely to include residual weeds from the previous crop but more importantly there is likely to be a host of pioneer weed species. Significant examples of these include buddleia, pampas, broom and gorse, all of which can prove particularly troublesome to forest managers in various parts of the country. Blackberry can prove to be a major problem both as regrowth from existing crowns and from new seedlings. The weeds mentioned here are just a few examples - there are many others.

Generally the forest manager has more weed control options and a better chance of successfully controlling problem weeds if weeds are treated prior to planting. After planting weed control operations are generally restricted to selective herbicides. Selective herbicides tend to be more expensive than non-selective herbicides.

Successful herbicide control of weeds will often rely on sufficient development of the weeds to provide for sufficient foliar absorption. The stage of development of weeds will depend on the time since clearfall and the season - for example, if a logged area is released in early spring there would be ample time for weed development through the spring and summer allowing for spraying at the end of summer, with the weed residues breaking down during the autumn leaving a clean weed free site for planting in the winter - an ideal situation. However if a logged area comes free in late autumn there is little time for weed development and spraying prior to the winter. Residual weeds such as blackberry or gorse may not pose problems at the time of planting in this situation but can cause major releasing problems as they resprout in the next growing season.

Several forestry companies in New Zealand have elected to work to cut-off dates for preparing land for planting - e.g. land freed up from logging prior to December 31st is scheduled for planting in the following winter but land coming available from logging after this date is not scheduled for planting until the winter 12-18 months away. This allows a better opportunity to achieve optimal weed control and site preparation, often at a lower operational cost than working with a shorter time frame. However these moves have to be balanced against the fact that this will increase the regeneration interval - i.e. the average period of time land is out of production.

- **Planting**

There has been a trend over the past ten to fifteen years for initial planting stockings to be reduced. The forest manager will plant as many trees as are thought necessary to ensure an adequate final crop selection. Between planting and final crop selection trees are lost through mortality, in some cases trees are removed in intermediate waste or production thinnings, and some trees are not acceptable due to poor form or growth.

Final crop stockings (ie. target stockings after the final thinning operation) are currently typically in the range 250-400 stems per hectare. Whilst it was usual to plant 1500-2000 stems per hectare ten to fifteen years ago initial stockings are typically in the range 600-1000 stems per hectare nowadays. These reductions in initial stocking have been as a result of improved management practices resulting in better survival and, more recently, through the planting of genetically improved stock from which a higher proportion of trees will have acceptable form. As stockings have been reduced the attractiveness of spot treatments rather then broadcast treatments of slash and weeds has increased.

- **Post Plant Weed Control**

Provided sufficient time has been available for effective pre-plant treatment of weeds post-plant weed control will generally be restricted to targetted hand spraying of grass and weeds which are restricting tree growth and survival. This releasing of the trees occurs in the first and, sometimes, second growing seasons. If no pre-plant treatment of weeds has been possible it is sometimes necessary to broadcast spray with a selective herbicide. Selective herbicides are generally expensive and usually its a situation of trying to apply enough chemical to control the weeds whilst at the same time not damaging the trees - the selectivity is usually only relative.

- **Regeneration Treatment**

An increasing problem for most forest managers is controlling natural regeneration of radiata pine in planted cutover. Most planting today is with genetically improved stock whilst most harvesting is being done in stands of unimproved stock. Regeneration is a problem in that it dilutes the benefits from planting the improved stock. As the age of clearfall comes down the viability of the seed from the felled crop increases. Burning reduces regeneration problems significantly but burning as a site preparation tool is being less frequently applied for reasons already outlined. Currently most forest managers are dealing with regeneration problems by manually removing the regeneration.

- **Oversowing**

Oversowing cutover with grasses and legumes is finding favour as a means of suppressing problem weeds and providing tree nutrition benefits from nitrogen fixation by the legumes. The basic principle involved is putting an easily managed vegetation cover over a bare site to prevent, or reduce, the invasion of problem weeds. This technique is generally applied in conjunction with a herbicide regime but will usually result in savings in herbicide costs. Slash levels have an impact on the oversown cover but sites with moderate levels of slash are being

successfully oversown.

Summary

- Harvesting and re-establishment activities are parts of a forest management continuum - they are usually split within forestry companies and within research organisations for logical administrative purposes. The administrative split between harvesting and re-establishment should not hinder co-operation between staff involved in these activities at the operational level nor between staff in research organisations.

- Harvesting and re-establishment activities have the greatest potential for negative site impacts in a rotation. Both of these activities should be conducted in such a way which minimises the negative impacts on site quality.

- Impacts of harvesting on re-establishment, and vice-versa, can be minimised by good communication between staff involved in these two activities and an understanding of each others constraints.

References

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