

Harvest regulation

When implementing group selection prescriptions, resource managers risk over-harvesting unless they make a conscious effort to consider and pre-plan the size and number of canopy gaps created, and the residual basal area of the areas between gaps. The amount to be harvested can be regulated by area control, basal area control or volume control. For each method, managers must establish appropriate targets for residual basal area and stand structure (**Tables 6.1.4 to 6.1.7**).

The area method of harvest regulation is recommended where harvesting will occur almost entirely within the created gaps and the total area harvested per cutting cycle is likely to be 10 % or less of the stand area.

However, if the silvicultural prescription specifies that only a few openings will be created or group selection openings are being implemented together with a single-tree selection prescription (on the portions of the stand between openings), harvest regulation should be calculated by basal area control. In this case, the residual basal area of the stand between the gaps must be maintained at a higher level than is recommended in **Tables 6.1.4 to 6.1.7**, to compensate for the openings that will have a basal area of zero following cutting. Tree removal priorities remain the same – culls and near culls, trees with significant cull in the butt log, low grade trees not expected to attain sawlog quality, short-lived species or species with low-vigor (Miller *et al.* 1998).

Managers should consider using volume control to determine the amount of wood to be harvested when group selection openings in one cutting cycle will constitute more than 10 % of the stand area.

It is unlikely that an entire stand would be suited to group selection. Generally there will be portions (e.g., 10 to 90 %) that are left undisturbed, managed on a longer rotation, or treated with single-tree selection or some other silvicultural system.

Area Control

The total area of group openings should be calculated in the following way:

$$\boxed{\begin{array}{l} \% \text{ of stand total area} \\ \text{in group openings in} \\ \text{each cutting cycle} \end{array}} = \boxed{\begin{array}{l} \% \text{ of stand to be} \\ \text{managed by group} \\ \text{selection} \end{array}} \div \boxed{\begin{array}{l} \text{rotation age (years to merchantable size)} \\ \text{cutting cycle (years between periodic} \\ \text{harvests)} \end{array}}$$

For example, assuming

- 80 % of the stand is to be managed by group selection
- the rotation age to merchantable size is 120 years
- the cutting cycle is 15 years, and
- there is no thinning between openings

then a maximum of 10 % (rounded to the nearest 1 %), of the total stand area should be in group openings during each periodic harvest.

Control of the amount of periodic harvest by area involves creating and maintaining age classes within the stand that result in the total area in group selection openings being approximately the same size for each periodic harvest.

The following calculations illustrate how the harvest should be regulated, and how the stand would develop after one rotation, given a 25 ha stand with the same rotation age, cutting cycle, and stand proportion in group openings as presented above:

- 20 % x 25 ha = 5 ha would be left uncut
- a maximum of 2.0 ha of the stand would be in group openings each cutting cycle (i.e., 10 % x 20 ha = 2 ha)
- after 8 successive periodic harvests (i.e., 8 x 15-year cutting cycle = 120 years later), the stand would be comprised of approximately 8 age classes comprising approximately 2 ha each: 0, 1-15, 16-30, 31-45, 46-60, 61-75, 76-90, 91-105, 106-120, plus an additional 5 ha that was left as uncut old growth. In reality, some of the trees in each age class patch might be older if regeneration was present at the time of cutting. Also within each age class patch sizes could range from as high as 1 patch of 2 ha to as many as 20, 0.1ha patches depending on the prescribed patch sizes and stand conditions.

Basal area control

Prior to tree marking, the forest inventory should determine the area of the stand that is suited to group selection openings. This area should be incorporated in the single-tree selection prescription and generally should not exceed 10 % of the total stand area. A residual target basal area should be set based on the stand structure, quality and management objectives. The basal area between openings will need to be higher than this target to accommodate the total loss of basal area in the openings following harvesting.

The higher residual basal area to be left between gaps should be calculated in the following way:

Target residual BA between groups (m ² /ha)	=	Target residual BA for the single-tree selection prescription (m ² /ha)	÷	% of the stand to be treated with single-tree selection prescription only (i.e., proportion not in group openings)
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For example, assuming:

- 90 % of the stand is to be managed by single-tree selection
- the target residual BA for the single-tree selection prescription is 20 m²/ha (for stems 10 cm in DBH and larger)

then the target residual basal area to be left between group openings should be 22 m²/ha.

Tree-marking crews that are marking both single trees and creating some group openings in the same stand, must keep track of the number and size of the group openings they

create and ensure they do not exceed the target total area to be treated by group selection (i.e., 10 % in this example).

Volume control

The total volume to be harvested must be determined by adding the sum of the volume of wood removed throughout the stand by single-tree selection thinning *plus* the volume of wood removed from the group selection openings. Furthermore, this total volume should not exceed the estimated volume of growth that can be expected during a cutting cycle, since sufficient residual stand basal area must be retained to provide a future sustained yield (Miller *et al.* 1995).

Regulating the amount of wood to be harvested by volume control requires good stand growth information that allows managers to be confident of the average annual growth rate of the stand. **Table 7.2.2** shows a considerable range in the annual volume growth among even-aged hardwood stands in Site Regions 6E and 7E. If accurate annual growth rate information for the stand is not known, conservative estimates of growth should be used to determine the volume to be harvested.

Using volume control, the amount to be harvested should be calculated in the following way:

$$\begin{array}{|c|} \hline \text{Volume to be} \\ \text{harvested (m}^3\text{)} \\ \hline \end{array} = \begin{array}{|c|} \hline \text{Annual volume} \\ \text{growth of the} \\ \text{stand (m}^3\text{/ha)} \\ \hline \end{array} \times \begin{array}{|c|} \hline \text{Total stand} \\ \text{size (ha)} \\ \hline \end{array} \times \begin{array}{|c|} \hline \text{Cutting Cycle} \\ \text{(years)} \\ \hline \end{array}$$

For example, assuming:

- a conservative annual growth estimate of 3 m³/ha/yr in a typical upland tolerant hardwood stand in Site Region 6E
- a stand size of 20 ha, and
- a cutting cycle of 15 years

then the volume to be harvested by a combination of single-tree and group harvesting is 900 m³ per cutting cycle. This is roughly equivalent to 204,300 bd.ft. or 4,134 bd. ft./acre.