

C5 FOREST MANAGEMENT PLAN 2006–2026

APPENDIX 7. WILDLIFE STATUS, SUPPORTIVE
TABLES FOR OBJECTIVE 1/ECOLOGICAL
STRUCTURE RETENTION

National and Provincial Wildlife Listings

Common Name	Scientific Name	National (SARA)	Alberta (Wildlife Act)	Alberta General Status 2000	C5 FMU
Fish					
Shortjaw Cisco	<i>Coregonus zenithicus</i>	Threatened	Threatened	May Be At Risk	NR
Western Silvery Minnow	<i>Hybognathus argyritus</i>	Threatened	Threatened	May Be At Risk	NR
St. Mary Sculpin	<i>Cottus bairdi punctulatus</i>	Under Review	Threatened	May Be At Risk	NR
Stonecat	<i>Noturus flavus</i>	Not Reviewed	Threatened	Undetermined	NR
Lake Sturgeon	<i>Acipenser fulvescens</i>	Under Review	Threatened	Undetermined	NR
Bull Trout	<i>Salvelinus confluentus</i>	Not Reviewed	Special Concern	Sensitive	R
Amphibians					
Northern Leopard Frog (Alberta)	<i>Rana pipiens</i>	Special Concern	Threatened	At Risk	P
Great Plains Toad	<i>Bufo cognatus</i>	Special Concern	Data Deficient	May be at Risk	NR
Western Toad	<i>Bufo boreas</i>	Special Concern	Not Reviewed	Sensitive	R
Long-toed Salamander	<i>Ambystoma macrodactylum</i>		Special Concern	Sensitive	R
Reptiles					
Eastern Short-horned Lizard	<i>Phrynosoma hernandesi</i>	Special Concern	Status report update in progress	May be at Risk	NR
Birds					
Greater Prairie Chicken	<i>Tympanuchus cupido</i>	Extirpated			NR
Eskimo Curlew	<i>Numenius borealis</i>	Endangered			NR
Whooping Crane	<i>Grus americana</i>	Endangered	Endangered	At Risk	NR
Barred Owl	<i>Strix varia</i>		Special Concern	Sensitive	R
Burrowing Owl	<i>Athene cunicularia</i>	Endangered	Threatened	At Risk	NR
Piping Plover	<i>Charadrius melodus</i>	Endangered	Endangered	At Risk	NR
Sage Grouse	<i>Centrocercus urophasianus</i>	Endangered	Endangered	At Risk	NR
Mountain Plover	<i>Charadrius montanus</i>	Endangered	Endangered	Sensitive	NR
Sage Thrasher	<i>Oreoscoptes montanus</i>	Endangered	Status report in progress	Undetermined	NR
Anatum Peregrine Falcon	<i>Falco peregrinus</i>	Threatened	Threatened	At Risk	NR
Prairie Falcon	<i>Falco mexicanus</i>		Special Concern	Sensitive	R
Sprague's Pipit	<i>Anthus spragueii</i>	Threatened	Special Concern	Sensitive	P
Loggerhead Shrike	<i>Lanius ludovicianus</i>	Threatened	Special Concern	Sensitive	P
Trumpeter Swan	<i>Cygnus buccinator</i>		Threatened	At Risk	P
Harlequin Duck	<i>Histrionicus histrionicus</i>		Special Concern	Sensitive	R
Ferruginous Hawk	<i>Buteo regalis</i>	Special Concern	Threatened	At Risk	P
Short-eared Owl	<i>Asio flammeus</i>	Special Concern	Status report completed	May be at Risk	R
Long-billed Curlew	<i>Numenius americanus</i>	Special Concern	Special Concern	May be at Risk	P
Black-throated Green Warbler	<i>Dendroica virens</i>		Special Concern	Sensitive	NR
Cape May Warbler	<i>Dendroica tigrina</i>		Special Concern	Sensitive	NR
Bay-breasted Warbler	<i>Dendroica castanea</i>		Special Concern	Sensitive	NR

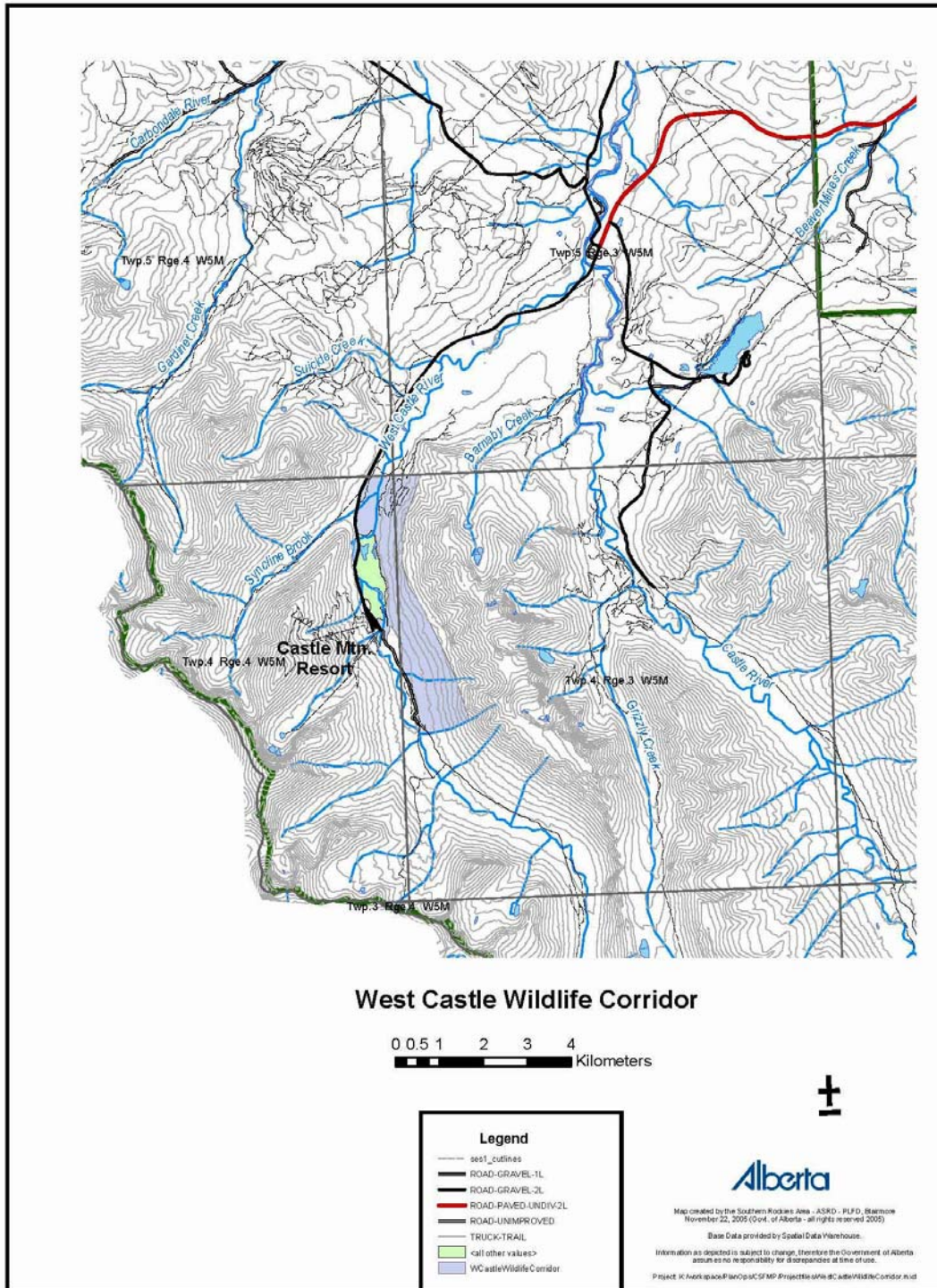
Common Name	Scientific Name	National (SARA)	Alberta (Wildlife Act)	Alberta General Status 2000	C5 FMU
Yellow Rail	<i>Coturnicops noveboracensis</i>	Special Concern		Undetermined	NR
White-winged Scoter	<i>Melanitta fusca</i>		Special Concern	Sensitive	NR
Mammals					
Swift Fox	<i>Vulpes velox</i>	Endangered	Endangered	At Risk	NR
Black-footed Ferret	<i>Mustela nigripes</i>	Extirpated			NR
Wood Bison	<i>Bison bison</i>	Threatened	Endangered	At Risk	NR
Plains Bison	<i>Bison bison</i>		Endangered		
Woodland Caribou	<i>Rangifer tarandus</i>	Threatened	Threatened	At Risk	NR
Wolverine	<i>Gulo gulo</i>	Special Concern	Data Deficient	Maybe at Risk	R
Grizzly Bear (Mountain and Boreal)	<i>Ursus arctos</i>	Special Concern	Status recommendation - Threatened	May be at Risk	R
Grizzly Bear (Prairie)	<i>Ursus arctos</i>	Extirpated			
Ord's Kangaroo Rat	<i>Dipodomys ordii</i>	Special Concern	Endangered	May be at Risk	NR
Gastropods					
Banff Springs Snail	<i>Physella johnsoni</i>	Endangered	Under Review		NR
Lepidopterans					
Monarch Butterfly	<i>Danaus plexippus</i>	Special Concern			NR
Weidemeyer's Admiral	<i>Limenitis weidemeyerii</i>	Special Concern	Under Review		NR
Yucca Moth	<i>Tegeticula yuccasella</i>	Endangered	Endangered		NR
Plants					
Tiny Cryptanthe	<i>Cryptantha minima</i>	Endangered	Under Review		NR
Small-flowered Sand Verbena	<i>Tripterocalyx micanthus</i>	Endangered	Threatened		NR
Slender Mouse-ear-cress	<i>Halimolobos virgata</i>	Threatened	Under Review		NR
Western Blue Flag	<i>Iris missouriensis</i>	Threatened	Threatened		NR
Western Spiderwort	<i>Transcantia occidentalis</i>	Threatened	Endangered		NR
Soapweed	<i>Yucca glauca</i>	Threatened	Endangered		NR
Smooth Goosefoot	<i>Chenopodium subglabrum</i>	Special Concern	Not Reviewed		?
Hare-footed Locoweed	<i>Oxytropis lagopus</i>	Special Concern	Not Reviewed		?
Bolander's Quillwort	<i>Isoetes bolanderi</i>	Special Concern	Not Reviewed		R
Tall Woolly-heads	<i>Psilocarphus elatior</i>	Special Concern	Not Reviewed		?
Mosses					
Haller's Apple Moss	<i>Bartramia hallerana</i>	Threatened	Not Reviewed		?
Porsild's Bryum	<i>Mielichhoferia macrocarpa</i>	Threatened	Not Reviewed		?

R: Resident

NR: Non-resident

P: Peripheral

?: Not Sure



Map showing the West Castle Wildlife Corridor.

STAND LEVEL RETENTION GUIDELINES

The retention of trees, snags and woody debris in harvest areas is a key component of ecologically based forest management. The retention of structure within harvest sites is intended to provide stand conditions more analogous to those created by natural disturbance events. Single tree retention, tree clumps and snags increase the structural diversity of the regenerating stand, retain some late seral conditions such as a multi-layered canopy, provide a future supply of large snags and downed logs, and increase microsite variability for a more diverse plant understory. This structural diversity provides habitat opportunities for wildlife species that would not otherwise be available. In addition, retention of structure in a harvest block provides ecological sites from which plant and animal species can disperse onto the surrounding harvest block.

The purpose of these guidelines is to provide strategies and targets on how to create ecological diversity across the landscape and within the harvest blocks. Implementation of these procedures will help to provide many values and ensure ecological diversity and habitat opportunities for all plants and wildlife species.

Principles

The following principles will guide implementation of stand level procedures:

- Some form of vertical and horizontal structure will be retained in most harvested areas.
- It is acknowledged that amounts will vary within individual blocks with larger retentions as harvest block size increases.
- Sensitive sites shall be protected.
- Opportunities for both current and short-term wildlife habitat purposes shall be enhanced.
- Loss of nutrients from the forest ecosystem shall be minimized.
- Safety of harvested areas must be maintained.

Components of Stand Level Retention

There are five component areas for which Stand Level Retention Guidelines will be developed. These guidelines contain procedures and responsibility of implementing retention requirements for the following:

- snag retention;
- single-tree, small clump (less than 0.01 ha) retention;
- large clump (0.01 or greater up to 15 ha) retention;
- coarse woody debris retention (slash piles and individual pieces greater than 7.5 cm in diameter);
- unique site retention.

Values

Values provided by maintaining stand structure diversity are as follows:

- Snag, green trees, small clumps and large clumps:
 - Habitat opportunities for many species of invertebrates, birds and mammals;
 - Retention of late seral conditions (e.g., multi-layer canopy);
 - Increase micro-site variability for a more diverse plant understory;
 - Provide habitat for a variety of species;
 - Function as travel routes for species that find harvest areas difficult to cross;
 - Provide ecological sites (refugia) from which unaffected plant and animal species can disperse onto the surrounding cutover.
- Coarse woody debris (includes slash piles):
 - Hiding and nesting cover for small mammals and furbearers, and habitat for invertebrates;
 - Nutrient cycling.
- Unique site retention:
 - May host rare plant communities;
 - May provide habitat opportunities for small mammals, amphibians, reptiles and invertebrate species.

GENERAL STRATEGIES FOR STRUCTURE RETENTION

Stand retention will comprise merchantable stems representing all diameter classes found in the proposed harvest block, as well as non-merchantable standing and downed trees. Merchantable trees will be left based on site-specific objectives and general stand strata.

Retention clumps will vary in size and shape, generally ranging from individual trees to clumps that are several hectares in size. The distribution patterns and size will depend on conditions in each block. The harvest block size will influence the amount of structure and must meet requirements in the C5 Regional Operating Ground Rules.

Pure, even-aged, conifer stands present fewer opportunities for leaving structure; however, retentions will be designed such that some will be available for harvest in future passes during the rotation period. Such retentions will remain on the landscape within a range of 30-90 years. Upon final removal of these retentions, the target is still to retain 3% of the standing merchantable trees over the rotation.

STRATEGIES FOR SNAG RETENTION

Snags are defined as a standing dead tree within the harvested area. The objective is to leave all snags standing recognizing safety considerations (see safety considerations below). Retention of full height snags within protected clumps is preferred; however, where safety is an issue, and snags are desired, live trees may be “topped off” around 6 m to create snags, bird perches and

potential cavity nests. The primary target size for topped off trees is in tree diameter classes greater than 35 cm when measured at breast height.

Safety Considerations

Safety is the first priority in determining whether a dead or dying snag should remain standing within a block. Site-specific judgment will be required for the final decision.

- Dead trees less than 6 m in height, or firm trees less than 15 cm dbh, can normally be considered acceptable.
- Dead trees greater than 6 m in height and/or greater than 15 cm dbh are considered acceptable if they have been tested to ensure they are firm (i.e., bumped with machine), and are not near roads or landings.
- Unsafe trees such as leaners, non-firm, unsound or decayed standing trees greater than 6 m in height, and all dead or dying trees within 2 tree lengths of roads, landings or other designated work areas, must be removed (see next bullet).
- Dead or dying trees contained within clumps and buffered by live trees will be considered acceptable.
- In all cases, the operator will have flexibility and responsibility to remove any snag or tree deemed unsafe for workers on site.
- Reforestation activities are post-operation treatment and will be allowed providing a reasonable amount of time (at least 30 days) has elapsed since operations. Operations will have removed unsafe trees and the time period will allow any other unsafe trees to fall. In addition, reforestation workers must have flexibility to avoid trees they feel are dangerous. This may include entire blocks on very windy days where hazards exist. Note: the exception to this is that scarification activities conducted with safety-equipped forestry equipment (e.g., cab guarding) may commence treatment of a cutover immediately following harvest operations.

STRATEGIES FOR SINGLE GREEN TREE AND SMALL CLUMP RETENTION

Single green tree retention is defined as single trees or groupings of up to five trees left standing in a harvest area. Small clump retention is defined as small groups of trees covering an area less than 0.01 ha in size, growing together, that are left standing undisturbed in the harvest area.

Trees to be considered for retention include:

- Understory trees
- Non-merchantable trees
- Merchantable trees
- Rub trees.

Good choices for tree retention include:

- Dying trees that are safe to leave.
- Subalpine fir and larch, Douglas fir and all deciduous species.
- Wolf trees or trees with heavy branching or poor form.

- Wildlife trees (e.g., with nests, cavities).
- Single trees located in sensitive sites.
- All limber pine and whitebark pine encountered.

When leaving single trees select trees that are more windfirm, consider:

- Exposure to wind (proximity to edge, etc.).
- Rooting — soil resistance.
- Tree form (branching and taper).
- The number of trees to leave will depend on the type of forest and harvest patch size proposed in the Spatial Harvest Sequence/Final Harvest Plan. Large clumps >0.01 ha are the preferred stand structure targets for the C5 FMU; however, the following should be considered for single or small clump placements:
 - Both live single conifer and deciduous trees, and merchantable and non-merchantable trees, can be retained in small clumps (<0.01 ha).
 - Spruce trees greater than 8 m in height should be left only if protection from wind is provided by natural barriers, deciduous or pine/Douglas fir species.
 - Retention of clumps (small and large) are preferable to single trees. (Forest and Prairie Protection Regulations Part 2.)
 - It is advantageous to leave small clumps within 30-50 m from edge of the harvest block. Fire regulations prevent the leaving of clumps within the 0-25 m range of the harvest edge.)
 - No small clumps or single trees should be left within the 5-m slash-free zone of the harvest block.
 - Small clump distribution will consider the total SHS patch size. A rule of thumb for an average block in the 5 to 20 ha range could be 1 small clump/ha, and this should be widely distributed throughout the harvest block.
 - During the harvest phase, focus should be placed on leaving and/or creating more snags within the harvest block (i.e., consider “topping-off” trees at 6 m height when safety is at risk).
 - It is important to leave examples of all represented diameter classes found in the proposed harvested block.

STRATEGIES FOR LARGE CLUMP RETENTION

Large clump retention is defined as a group of trees that are left standing in the harvest block, and which take up greater than 0.01 ha (100 m²) of the area of a harvest block. The shape of clump retentions may vary widely.

Trees to consider for retention in clumps include:

- Understory trees that also contain mature merchantable and/or non-merchantable trees.
- Large conifer that are windfirm.

Best choices for tree retention are to take advantage of natural features, such as:

- Areas containing shrubs, understory or unique sites.

- Located around groupings of snags, wolf trees or wildlife trees.
- Wet areas (i.e., ephemeral creeks, water source areas, etc.) within the harvest block.
- Inoperable areas within the harvest block (e.g., steep slopes pitches, sensitive soils).

Note: these areas should be included in the harvest design.

The presence of retention clumps is very important and is affected by the spatial harvest sequence or final harvest plan design and OGRs. Points to consider in placing a large retention clump include:

- Retention clumps shall include merchantable trees and can also include non-merchantable trees, buffers around unique sites, wildlife trees, snags, etc.
- Consider feathering the edges of larger clumps and positioning all clumps in wind-protected areas when possible.
- In large, pure pine blocks with little natural biodiversity, vertical diversity must be planned (i.e., small and large clumps).
- Try to locate some larger retention clumps within 30-50 m from the edge of the harvest block to allow ease of access for wildlife.
- Clump placements should represent the variety of topography found in harvest blocks; i.e., clumps need to be placed on flat ground as well as steep terrain.

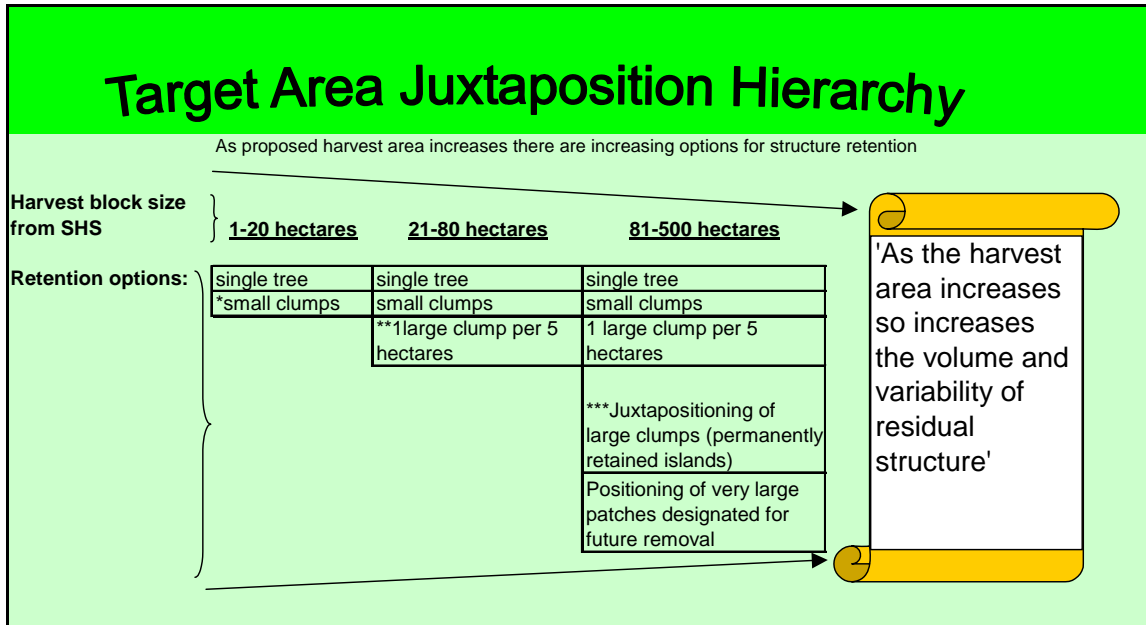
Clump Size

Clump size will vary depending on site conditions and size of harvest block. The following suggestions apply:

- For harvest blocks over 20 ha in size, on average there should be 1 small clump per hectare and at least 1 additional large retention clump of trees for every 5 hectares harvested.
- Large clump size should increase as total block size increases, and can be joined to create islands of permanently retained structure. This juxtaposition of large clumps is at the discretion of the forestry practitioner recognizing the need for variability over the landscape.
- The larger the harvest block, the larger the size of retention clump that could be retained—keeping in mind the range of retention is 0-5%, with a compartment average of 3% by volume.
- Where retentions are proposed that will exceed 5% of the area of a proposed harvest block, it would be appropriate to identify the large clumps to be considered for future removal. In very large harvest blocks (80-500 ha), these retention clumps should be pre-identified for removal in the future (i.e., 30-90 years). Alternatively, the large clumps may be used to meet the percentages required for old seral stages at a landscape level if they are not harvested.

The placement of stand structure in a harvest block is an art and a science, and it is of primary importance that a wide range of structure remains on the landscape. Uniformity is not desired, and the forest practitioner designing residual structure retention areas must use professional judgment in applying stand structural guidelines.

Based on the concept that “As the harvest area increases so increases the range of area/volume and variability of residual structure,” the following diagram is provided to summarize the above bullets and intended approach:



- * Small clumps are groups of trees taking up an area of less than 0.01 hectares (i.e., 100 m²) and large clumps are groups of trees taking up an area of greater than 0.01 hectares.
- ** Large clumps can be located in blocks smaller than 21 hectares recognizing that variability within a range is desired.
- *** Large clumps can be positioned together to form permanently retained islands. This combining of clumps process also can apply to harvest blocks smaller than 80 hectares based on local circumstance and the discretion of the forestry practitioner.

STRATEGIES FOR RETENTION OF UNIQUE ECOLOGICAL SITES

Unique ecological sites are defined as sites that contain natural features of special value for wildlife and plant species. Unique sites may include:

- Small clumps of old forest remnants from previous fires or old logging.
- Clusters of large-diameter downed logs
- Small bogs and wetlands
- Wildlife trees
- Treed rocky outcrops
- Sites immediately surrounding dens, hibernacula, mineral licks, etc.
- Whitebark or limber pine.

Every effort should be made to identify all unique sites during planning and layout. All the unique sites identified during planning and harvesting must be left undisturbed during harvesting. Protection of these sites may include buffering.

STRATEGIES FOR RETENTION IN PINE FOCUS BLOCKS ASSOCIATED WITH MOUNTAIN PINE BEETLE

In recognition of other values where large (20 ha or greater), pure pine blocks are encountered that contain little natural biodiversity, vertical diversity must be planned (i.e., small and large clumps) regardless of mountain pine beetle (MPB) susceptibility rating. These pine retentions are to be monitored for MPB. Single trees attacked by MPB will be treated by burning or bark removal to kill beetle larvae.

In pine leading types throughout the C5 FMU, and particularly in the Crowsnest Pass corridor where excessive wind is a concern, forest companies are required to apply the following stand retention guidelines when harvesting:

- Retain all Douglas fir, whitebark pine, limber pine, subalpine fir, alpine larch or any other species found as single trees or as clumps.
- Retain spruce where sheltered or protected in clumps by other species. Remove those merchantable spruce stems standing greater than 9 m in height that are not found within protected clumps
- Retain all deciduous species.

Note: these are guidelines only, and it is recognized that road location and harvest activity in difficult terrain may require removal of species named above.

STRATEGIES FOR COARSE WOODY DEBRIS

Coarse woody debris (CWD) is defined as wood (logs or pieces) lying at an angle of less than 45 degrees from the ground and with a diameter greater than 7.5 cm. It includes the following:

- Clusters of large-diameter downed logs
- Naturally occurring, non-merchantable downed logs scattered through the cutblock harvest block
- Small unburned brush piles
- Single green trees that are dying and/or snags subject to blowdown (ultimately becoming CWD)
- Other slash.

The amount of dispersed CWD will vary in each harvested area (compartment); however, the ASRD policy document *Debris Management Standards for Timber Harvesting Operations*, dated July 2, 2004 (or its predecessors) and the *Forest Prairie and Protection Act and Regulations* must be followed.

Strategies for retention/recruitment for CWD outside the 10 km FireSmart zones that should be considered, include:

- Windthrown trees contribute to CWD; therefore, not all windthrow areas have to be salvaged.
- Single tree retention for future recruitment of large piece sizes.
- Stump-side processing, tree tops and breakage.
- Hazard trees that have to be cut down, should be retained on site.
- Rub-trees should be felled and retained on site.
- No permanent debris piles are allowed within the 10 km zone of FireSmart plans, Crowsnest Community Zone plan, and Castle Mountain Resort Zone Plan.
- If constructing debris piles identified for long-term retention, consider the following:
 - Utilize the unusable pieces of timber (e.g., tops and branches).
 - The size of the piles should be no larger than 3 m in diameter and 2 m high.
 - To meet Forest Protection policy, no piles are to be located within 25 m of the harvest block edge; however, locating some piles a distance of 30 m from the harvest edge is encouraged.
 - Piles should contain coarse wood (log diameter greater than 7.5 cm) and limbs.
 - Leave no more than 6 piles for every 10 ha logged.
 - No CWD or slash piles should be left within the 5 m slash-free zone of the cutblock harvest block.
- Leave naturally occurring, non-merchantable wood scattered throughout the cutblock harvest block.
- For fire protection, no piles scheduled for burning should be left located within 8 m of the cutblock harvest block edge.

CWD MONITORING

Monitoring will consist of the quota holder (or SRD staff for the CTP program) visually assessing the coarse woody debris of stems greater than 7.5 cm of the stand during pre-harvest conditions, and making an assessment after the harvest and initial silviculture treatments are completed on the percentage of the total harvest area (expressed as hectares) that contain CWD greater than 7.5 cm. CWD greater than the pre-harvest levels can be accepted as “equivalent”, provided slash and debris levels meet pertinent regulations.

The CWD hectares for each block following site scarification can be noted in the post harvest assessment expressed as hectares of the block meeting pre-harvest equivalent conditions, and shall be included as a summary in the following year’s annual operating plan. This procedure is recognized as imperfect; therefore, during implementation of this FMP, consideration will be given to incorporating a survey process in ASRD’s Permanent Sample Plot program to develop a database in which to determine the natural ranges of CWD in each yield group within the C5 FMU. This information will be used to set definitive targets in the next FMP.

STAND LEVEL RETENTION MONITORING

The objective of this section is to outline a stand structure monitoring approach, and to document stand structure retention in the C5 FMU.

Sample Design

The amount of stand structure retained in harvest blocks can be assessed through a number of different approaches:

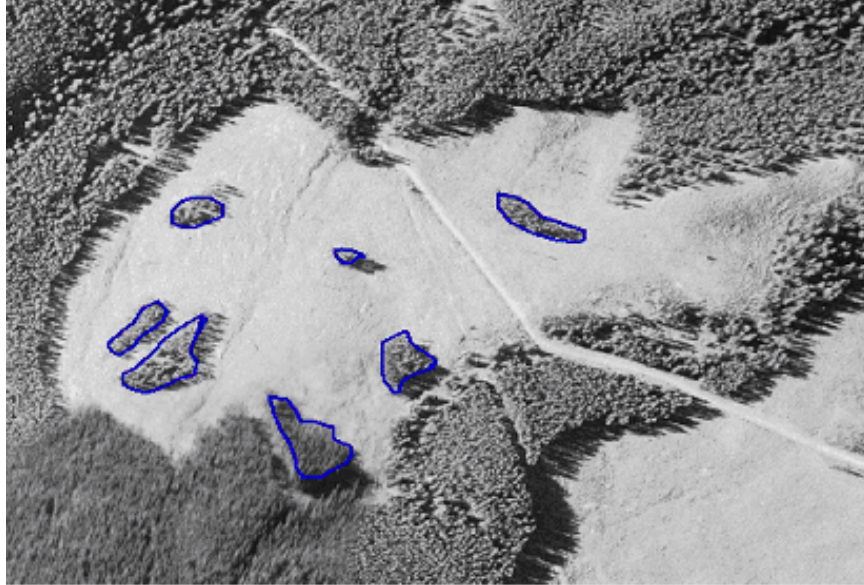
- Leaving naturally occurring, non-merchantable wood scattered throughout the cutblock harvest block;
- The use of aerial photography for the harvest blocks harvested during the previous year; or
- The use of ground surveys applied randomly to 20% of those harvest blocks where small clumps are not easily recognizable on aerial photography, and to account for individual tree retention; and
- The use of applied volume per hectare generated from the 20% random sample to the remaining 80% of harvest blocks that could or were not assessed via the aerial photography method.

Aerial Photography

Aerial photography will be used to assess the percentage ground cover attributable to vertical retention. Each year the department will fly aerial photography to update the disturbance layer for the FMU. This photography will be interpreted to identify the percentage of the area of a harvest block still covered by standing forest. This method may be used to measure retention of all clumps; however, measurement of clump sizes below 0.01 ha will depend on photo scale and other technology. For practical purposes, the cutoff will be 0.01 unless SRD achieves otherwise. This procedure will be the responsibility of the department and will be performed by staff in the Southern Rockies Forest Area. For those blocks where no measurable clumps are found through the photo method, quota holders, or SRD in the case of commercial timber program, will undertake ground surveys as discussed in the next section (Ground Surveys).

The general method will be to simply calculate the percent area retained in clumps in relation to the total block area, and to calculate the relative merchantable volume based on the average volume/ha from the harvest block obtained from standard sample scale information. A simple example is illustrated below:

Block Area (ha)	Retention Clump (ha)	% Area Retained	Block Volume (M ³)	Block Volume (m ³ /ha)	Retention Volume (m ³)	% Volume Retained
100	4	4	22,000	220	880	4



Aerial photo of delineated patches as an example of air photo extrapolation.

Ground Surveys

For harvest blocks that contain structure retention where aerial photography cannot be used or is not preferred (i.e., the quota holder chooses to complete a survey rather than rely on the air photo method) for assessing merchantable volume retained, each quota holder will be responsible for conducting ground surveys. Department staff will be responsible for the Community Timber Permit Program harvested blocks and auditing blocks measured by quota holders.

Two methods are presented and will be tested in unison on a series of harvest blocks during the first years of the first quadrant period to establish the preferred field survey method. These two methods are referred to as the Two Meter Lineal Transect and the Four Meter Survey Grid. These methods are described below.

The Two Meter Lineal Transect

The two meter lineal transect method will be carried out on all harvest blocks that cannot be assessed using the air photo method. The method consists of using a linear transect sample strip to survey both individual merchantable trees and merchantable trees within small clumps.

- A single straight line linear transect, 2 m wide, will be plotted along the long axis of a cutblock.
- All merchantable trees within the 2-m wide linear transect will be tallied. The line location may be recorded on GPS and temporarily marked in the field for auditing purposes. Where a GPS is not available, line length can be established by a topofil. For intersected clumps, entry and exit waypoints will be recorded if GPS is used, and field marked if a topofil is used.

- The tree tally within clumps suspected of being 2 ha or larger will be kept separate pending determination of the patch size.
- To determine clump size, the segregated tallies can be used as a check with the aerial photography method, and included into the main tally or excluded depending on the result of the comparison. If GPS is used, the waypoints will then be compared with the aerial photography interpretation of the clumps. The tally information will be kept separate from the main tally if the clump is 2 ha or greater. Tally information will be included in the main tally if the clump is less than 2 ha.

In determining the percent area of small clumps and percent merchantable volume represented by small clumps and individual stems, the following procedure will be used:

To determine the percent area of small clumps and individual trees:

Given:

- Block area = 28 ha
- Total Transect length = 1010 m
- Clump transect length = 70 m
- Determine the total linear transect area in hectares; square meters of linear transect/10000. ($1010 \text{ m} \times 2 \text{ m}/10000 = 0.202 \text{ ha}$)
- Determine the percent area of small clumps:
 - Record the total area of linear transect within clumps less than 2 ha in size ($70 \text{ m} \times 2 \text{ m}/10000 = 0.014 \text{ ha}$)
 - Determine as a percentage of the total linear transect area. ($0.014 \text{ ha}/0.202 \text{ ha} \times 100 = 6.9\%$)

Note: This percentage should be representative of the small clump area per block.

To determine the percent volume of small clumps and individual trees:

Given:

- Block volume = 6180
- Trees/m³ = 3.64
- Trees tallied = 8
- Determine m³ per transect:
 - Divide the total merchantable stems tallied by the average trees per cubic meter for the block. ($8 \text{ trees}/3.64 \text{ trees}/\text{m}^3 = 2.20 \text{ m}^3$)
- Determine m³/ha retained:
 - Divide the m³ per transect by the area per transect in hectares ($2.20 \text{ m}^3/0.202 \text{ ha} = 10.9 \text{ m}^3/\text{ha}$)
- Determine % of merchantable volume retained:
 - Retained m³/ha x block area/harvested block volume x 100

$$(10.9 \text{ m}^3/\text{ha} \times 28 \text{ ha}/6180 \text{ m}^3) \times 100 = 4.95\%$$

The area figures derived from the aerial photo of clumps and from the linear transect are additive for blocks where both procedures were employed.

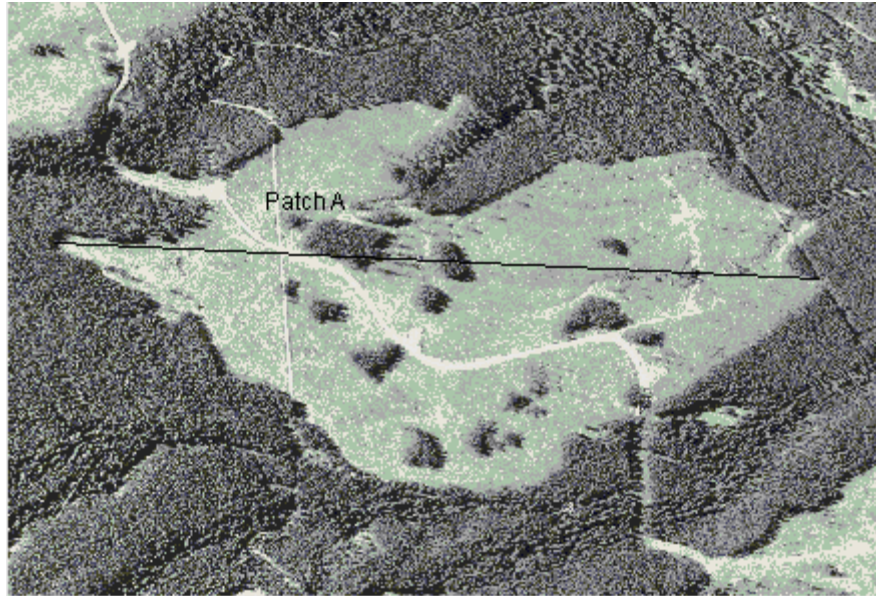


Photo example of the Two Meter Lineal Transect Method.

Four Meter Wide Survey Grid

This method will be carried out on a random selection of 20% of the candidate blocks requiring or desired for field survey. This ground survey methodology will follow the control line, and survey line pattern identified in the Alberta Regeneration Survey Manual to survey both individual merchantable trees and merchantable trees found along the transect that are within clumps inside the 4-m wide continuous plot.

- The survey line pattern will provide a continuous plot measuring 4 m wide. All coniferous stems >7.5 cm dbh found within the lineal plot will be tallied.
- A ground survey will take precedence over the photo method of volume estimation if both are completed on a harvest block.

The following information is required on the tally card used for standing structure field measurements:

- Compartment name, License #, Blk number, GPS or Legal address.
- *Subregion—Subalpine or Montane—Total survey line length and plot area. (4 m *total length) = m²
- Tree species
- Stump diameter at 30 cm.
- Stem height (m) to the top.

- Estimated volume per tree*(m³) (*Ecologically Based Individual Tree Volume Estimation for Major Alberta Tree Species for Subalpine (8) and Montane (9) subregions will be provided by SRD and used to arrive at the estimated coniferous volume.)
- Total coniferous volume (m³) in plot.
- Coniferous volume per hectare (individual coniferous tree volumes totaled/area of lineal plot).
- Healthy regeneration stem count and expressed as stems per hectare. (Note: subalpine fir understory cannot be counted as healthy until it has survived for two summers post harvest, and should therefore not be included in understory dot counts).
- Stem count on all deciduous trees and expressed as stems per hectare.

Example of coniferous stand retention volume calculation from the Four Meter Wide Survey Grid Method

a) Transect length (m)	b) Transect area length*4 m (a*4) (m ²)	c) Transect coniferous volume totaled (m ³)	d) Average retention volume/hectare (c/b)*10000 (m ³ /ha)	e) Total block area (ha)	f) Total block coniferous retention volume est. (d*e) (m ³)	g) Total delivered (scaled) volume (m ³)	h) Total block volume f+g (m ³)	i) Volume retained f/h*100 (%)
2345	9380	1.324	1.412	17	24.004	3400	3424.004	0.7

Ground Survey Extrapolation by Compartment

The ground survey methods can be applied to every harvest block if the quota holder so desires. However, the ground survey method need only be applied randomly to 20% of the harvest blocks (that only contained small clump or single tree retention where aerial photography cannot be used to assess merchantable volume retained). The average volume per hectare identified will be applied to the remaining harvest blocks (which contained only small or single tree retention where aerial photography cannot be used or is not desired to assess merchantable volume retained). Item “d” in the table above is applied to the total harvest area in hectares.

Compartment Volume Assessment

The total volume of retention for a compartment will be composed of the following:

- Air photo assessed blocks (area converted to volume as stated above).
- Actual measured stand structure based on the best survey results of the two survey methods to be tested on blocks not assessed through the air photo method.
- Where the Four Meter Wide Survey Grid Method is accepted as a preferred survey method, the average volume/hectare based on the 20% sample will be applied to the remaining 80% of those blocks that could not be assessed by the air photo method.

The total volume retention from the three above methods above will be compared to the forecasted volume through the Spatial Harvest Sequence and to the total delivered volume by block for the compartment. To ensure inclusion of this information in the five year stewardship report, the reporting period will include only the first four years of harvest activity. The second

stewardship reporting period will include summary information for years 1-4, 5-9 and 1-9. On the basis of the years 1-9 summary, decisions regarding stand structure will be include in the 10 year timber supply analysis.

CONCLUSION RATIONAL

The intent of this monitoring program is to track the amount of merchantable coniferous structure left on harvest blocks to ensure the timber supply assumption in the C5 Forest Management Plan is followed. A target of 0 to 5% structure retention is desired, with an average of 3% retained by compartment over the life of this plan. Where the five year stewardship report identifies stand structure as varying above or below the 3% average harvest, companies will be required to adjust their stand structure practices for the next five years to ensure the target is met by the end of the second stewardship reporting period (2nd quadrant end), in preparation for completion of a rerun of the timber supply analysis.

Supportive Tables for Objective 1 in the C5 FMP

Table 1. Occurrence of early and late old growth (EL) on the C5 landscape based on the PFMS TSA run 90022 for the 200 year planning horizon — net landbase.

C5 Subregion	Early and Late Old Growth Percent Occurrence over 200 year planning horizon (minimum)	Early and late old growth percent occurrence over 200 year planning stage (average)	Early and late old growth percent occurrence over 200 year planning stage (maximum)	Ecological benchmark ¹	Old growth trend (first 20 years)	Old growth trend (first 100 years)	Old growth trend (second 100 years)
Porcupine Hills	0%	3%	8%	9%	Stable	Increase	Decrease-Stable
Continental Divide North	7%	12%	20%	15%	Increase	Stable	Decrease-Stable
Continental Divide South	5%	9%	15%	13%	Stable	Stable	Decrease
Castle	2%	5%	10%	9%	Stable	Increase	Stable
Livingstone	4%	7%	12%	9%	Stable	Increase	Decrease

Table 2. Occurrence of early and late old growth (EL) on the C5 landscape based on the PFMS TSA run 90022 for the 200 year planning horizon — gross landbase.

C5 Subregion	Early and Late Old Growth Percent Occurrence over 200 year planning horizon (minimum)	Early and late old growth percent occurrence over 200 year planning stage (average)	Early and late old growth percent occurrence over 200 year planning stage (maximum)	Ecological benchmark ¹	Old growth trend (first 20 years)	Old growth trend (first 100 years)	Old growth trend (second 100 years)
Porcupine Hills	0%	15%	39%	13%	Stable	Increasing	Decrease-Stable
Continental Divide North	22%	34%	45%	23%	Stable	Increasing	Decreasing
Continental Divide South	14%	33%	47%	20%	Stable	Increasing	Stable
Castle	6%	29%	48%	13%	Stable	Increasing	Decreasing
Livingstone	7%	33%	54%	13%	Stable	Increasing	Decreasing

Table 3. Occurrence of early and late old growth (MEL) on the C5 landscape based on the PFMS TSA run 90022 for the 200 year planning horizon — net landbase.

C5 Subregion	MEL % Occurrence Over 200 Year Planning Horizon	MEL % Occurrence Over 200 Year Planning Horizon	MEL % Occurrence Over 200 Year Planning Horizon	Ecological Benchmark ¹	Old growth trend (first 20 years)	Old growth trend (first 100 years)	Old growth trend (second 100 years)
	MINIMUM	AVERAGE	MAXIMUM				
Porcupine Hills	13%	35%	75%	30%	Increase	Decrease	Increase-Stable
Continental Divide North	22%	39%	53%	35%	Stable	Decrease-Increase	Stable
Continental Divide South	17%	35%	59%	30%	Stable	Increase-Decrease	Stable
Castle	12%	34%	66%	35%	Increase	Stable-Decrease	Stable
Livingstone	15%	70%	70%	35%	Increase	Decrease-Increase	Decrease-Stable

¹Ecological benchmarks were developed in an exercise that incorporated an analysis of natural disturbance on the C5 landscape, expert knowledge and appropriate literature review. These benchmarks represent one estimate of seral stage cover within the range of natural variation required for maintaining biodiversity values in the C5 Forest Management Unit.

Table 4. Occurrence of early and late old growth (MEL) on the C5 landscape based on the PFMS TSA run 90022 for the 200 year planning horizon — gross landbase.

C5 Subregion	MEL % Occurrence Over 200 Year Planning Horizon	MEL % Occurrence Over 200 Year Planning Horizon	MEL % Occurrence Over 200 Year Planning Horizon	Ecological Benchmark ¹	Old growth trend (first 20 years)	Old growth trend (first 100 years)	Old growth trend (second 100 years)
	MINIMUM	AVERAGE	MAXIMUM				
Porcupine Hills	30%	51%	81%	30%	Increase	Increase-Decrease	Stable-Increase
Continental Divide North	45%	59%	71%	35%	Increase	Stable	Decrease-Stable
Continental Divide South	37%	58%	78%	35%	Increase	Increase-Decrease	Stable
Castle	43%	59%	79%	35%	Increase	Increase-Decrease	Decrease-Stable
Livingstone	34%	62%	81%	35%	Increase	Decrease-Stable	Decrease

¹Ecological benchmarks were developed in an exercise that incorporated an analysis of natural disturbance on the C5 landscape, expert knowledge and appropriate literature review. These benchmarks represent one estimate of seral stage cover within the range of natural variation required for maintaining biodiversity values in the C5 Forest Management Unit.

Table 5. Occurrence of regeneration on the C5 landscape based on the PFMS TSA run 90022 for the 200 year planning horizon — net landbase.

C5 Subregion	Regen % Occurrence Over 200 Year Planning Horizon MINIMUM	Regen % Occurrence Over 200 Year Planning Horizon AVERAGE	Regen % Occurrence Over 200 Year Planning Horizon MAXIMUM	Ecological benchmark ¹
Porcupine Hills	8%	37%	66%	40%
Continental Divide North	15%	58%	38%	30%
Continental Divide South	21%	40%	64%	30%
Castle	6%	38%	57%	40%
Livingstone	5%	40%	65%	40%

¹Ecological benchmarks were developed in an exercise that incorporated an analysis of natural disturbance on the C5 landscape, expert knowledge and appropriate literature review. These benchmarks represent one estimate of seral stage cover within the range of natural variation required for maintaining biodiversity values in the C5 Forest Management Unit.

Table 6. Occurrence of regeneration on the C5 landscape based on the PFMS TSA run 90022 for the 200 year planning horizon — gross landbase.

C5 Subregion	Regen % Occurrence Over 200 Year Planning Horizon MINIMUM	Regen % Occurrence Over 200 Year Planning Horizon AVERAGE	Regen % Occurrence Over 200 Year Planning Horizon MAXIMUM	Ecological benchmark ¹
Porcupine Hills	8%	29%	48%	N/A
Continental Divide North	13%	25%	35%	N/A
Continental Divide South	12%	26%	55%	N/A
Castle	7%	47%	47%	N/A
Livingstone	3%	22%	36%	N/A

¹Ecological benchmarks were developed in an exercise that incorporated an analysis of natural disturbance on the C5 landscape, expert knowledge and appropriate literature review. These benchmarks represent one estimate of seral stage cover within the range of natural variation required for maintaining biodiversity values in the C5 Forest Management Unit.