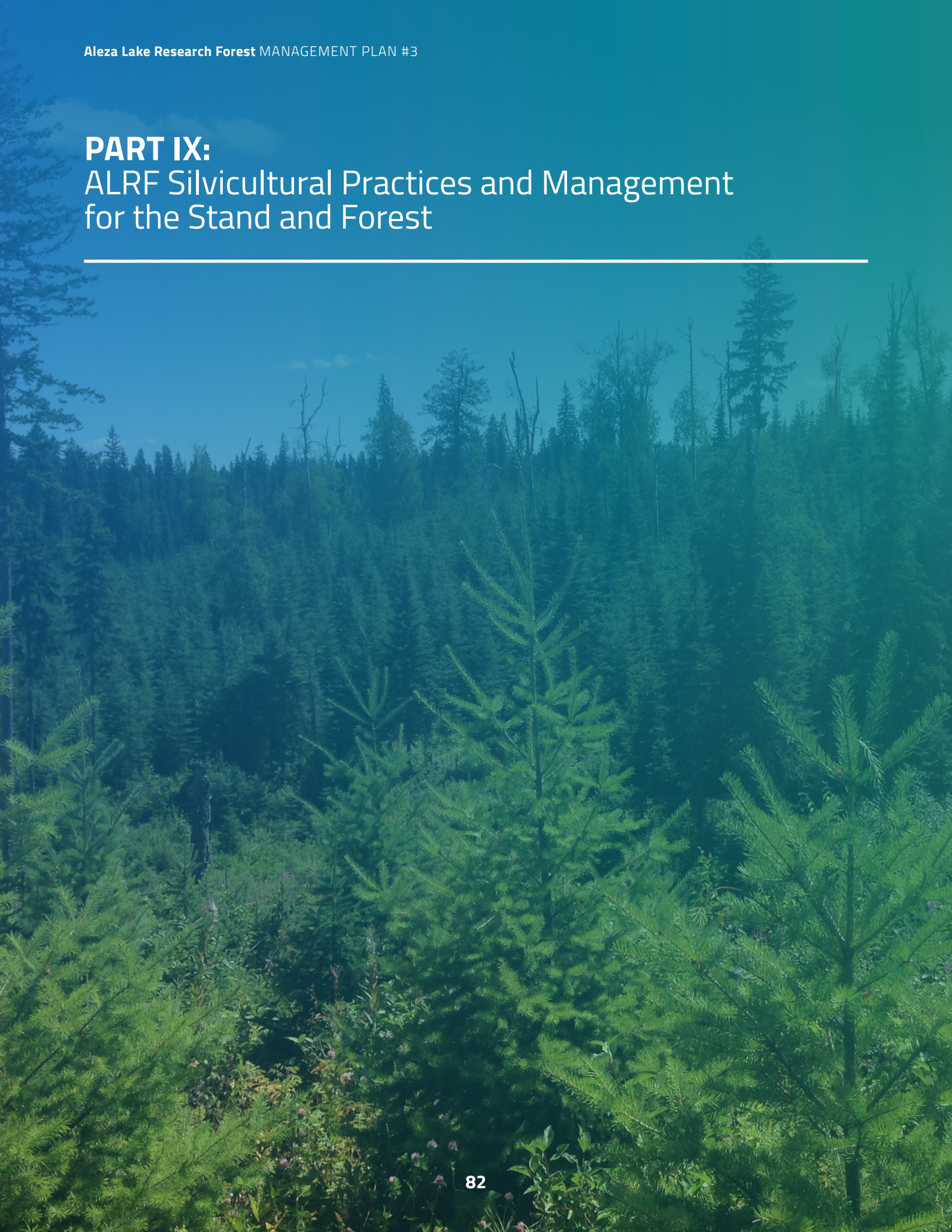
PART IX:
ALRF Silvicultural Practices and Management for the Stand and Forest



13. SILVICULTURAL PRACTICES AND MANAGEMENT FOR THE STAND AND FOREST

"The competent practice of silviculture, whether it be crude or elaborate, demands as much knowledge of such fields as ecology, plant physiology, entomology, and soil science as a forester can acquire. It is through silviculture that the growing store of knowledge about trees and forests is applied.

Skillful practice itself is a continuing informal kind of research in which understanding is sought, new ideas are applied, and old ideas are tested for validity. The observant forester, who is wise to seek to explain what is observed, will find answers to many silvicultural questions in the woods by examining the results of accidents of nature and earlier treatments of the forest."

Excerpted from: *The Practice of Silviculture: Applied Forest Ecology* (Chapter 1)
David M. Smith, Bruce C. Larson, M. Kelty, and PM Ashton (1997)

Mature ALRF spruce-subalpine fir stand, originally logged in 1927

13.1 Key ALRF Silvicultural Goals

ALRF silvicultural practices from stand establishment through to maturity will consider the overall management intent and objectives for the Aleza Lake Research Forest landbase, including forest education and demonstration, and facilitation of scientific enquiry and research across a wide range of ecosystems and forest practices.

The 6 key goals of ALRF silvicultural planning and practice are to:

1. Grow, manage, and utilize diverse, productive, resilient, high-quality forests on a sustainable basis within the identified ALRF timber-management land base, in a manner compatible with other forest land management goals and statutory requirements, and mindful of present and future climatic variability.
2. Foster diverse teaching and learning opportunities, innovation, and research opportunities relating to silvicultural strategies and practices.
3. Manage and maintain timber values amongst a diverse array of non-timber forest values on the ALRF landscape.
4. Use and demonstrate on the landbase, a wide range of tree species, silvicultural systems, harvest patterns and systems, reforestation methods, and stand-structure retention strategies.
5. Undertake scientific studies and well-monitored operational practices that differ from currently accepted methods and standards, for the purposes of teaching and demonstration, advancing scientific understanding, and testing the outcomes of contrasting management techniques. And,
6. Provide revenues from sustainable forest harvest operations to provide sufficient financial resources for supporting ALRF management goals on a long-term basis.

13.2 Chief Forester's Standards for Seed Use

Seed use for reforestation by tree-planting on the ALRF will be consistent with the Chief Forester's Standards for Seed Use, (or "CF standards") as amended and updated from time to time.

For greater clarity, the CF standards apply to planted trees, and do not apply to tree seedlings that naturally establish or regenerate on ALRF sites from locally-occurring seed sources, sprouts, or suckers.

As per the intent of these standards, the ALRF Society as tenure holder will ensure that at least 95% of the trees planted on the tenure area over a specified time period are consistent with the transfer limits for registered seedlots and vegetative material under the standards.

The ALRF will vary from the CF standard regarding the time period over which compliance with this provision is measured. For the ALRF, compliance with transfer limits will be measured based on all trees planted over 36 months (3 years) prior to the end of the most recently-completed calendar year (for the ALRF, Dec. 31st of a given year). The rationale for this variance is due to potentially high year-to-year variability in harvest activity and reforestation scheduling at the ALRF.

Douglas-fir is an increasing component of ALRF regeneration on drier sites

As allowed for in the CF standards, the ALRF Society as tenure holder may vary from the standards and transfer limits (as above) for up to a cumulative total 5% of trees planted over the above time period. The ALRF's reasons for varying from the CF transfer limits will include:

- **a)** Establishment of controlled research and experimental trials.
- **b)** Tree species "facilitated migration" trials.
- **c)** Operational reforestation trials of specific seedlots and/or tree species mixes not compliant with Chief Forester standards. And/or,
- **d)** Arboretum or special plantation establishment for teaching and demonstration purposes.

ALRF strategies for mitigating silvicultural risk in such applications will include one or more of the following: (a) keeping trials within a relatively limited proportion of the ALRF net area to be reforested in a given time period, (b) potentially establishing 'higher-risk' seed sources as fill-plantings or minor admixtures among local natural regeneration and approved planted seedlots, and/or (c) rigorous documentation, monitoring and GPS / GIS mapping and recording of the locations of of test plantings and trials.

An ALRF summer student brush-saws cottonwood saplings to reduce brush competition in a 7-year-old western larch trial (East Branch Road area, ALRF)

13.3 Climate Change Adaptation

Because British Columbia's current and future climate will tend to change and vary over time due to natural factors and anthropogenic forcing (IPCC 2013, Foord, 2016), ALRF reforestation and silvicultural strategies must consider the productivity and forest health implications of both current climatic conditions and historical variability, and potential future climatic potential conditions. This presents an ongoing challenge for silviculturists in setting reforestation and silvicultural strategies that consider forest resilience in a range of potential future climatic possibilities for the ALRF area.

Provincially, considerations for climate change adaptation for reforestation and stand establishment are incorporated into the Chief Forester's standards for tree use, and the standards are periodically updated by MFLNRORD (or applicable agencies) to reflect new understandings and scientific knowledge. This includes a Climate Based Seed Transfer strategy developed by the Ministry (O'Neill et al, 2017).

Provincial strategies and action plans for climate change adaptation in the forest sector are evolving, and will likely continue to do so over the term of this ALRF management plan. ALRF management will continuously consider such provincial guidance and evolving scientific and local knowledge, while also providing management flexibility to periodically test ALRF climate-adaptation strategies suited to local conditions.

Based on local and regional silvicultural experience, the ALRF will incorporate the following reforestation and stand management strategies in locally-based climate change adaptation (CCA) on the ALRF landbase under this management plan, as detailed in Table 8.

Table 8: Current climate change adaptation strategies for ALRF reforestation and silvicultural practices.

Strategy #	Management issue	Concerns	Applicable ecosystems / site series	Adaptive Strategies
1	Management of droughty sites	Summer drought stress on subalpine fir (and to less extent spruce) on SBSwk1 mesic and drier sites	SBSwk1-01, 02, 03, 04	• Replace or reduce Spruce-subalpine fir stand composition as these sites are harvested or otherwise treated silviculturally. • Enhance Douglas-fir and lodgepole pine as preferred species, • Spruce as acceptable or preferred on 01 sites, • Subalpine fir not preferred or acceptable on these sites
2	Douglas-fir (Fd) range expansion and retention	Maintain and enhance regeneration opportunities for Douglas-fir (Fd), and retain fire-resistant large stems for ecological resilience and local Fd seed sources within the ALRF.	SBSwk1-01, 04, 05, 07	• Post-harvest retention of > 75% of Douglas-fir stems > 40 cm dbh especially on these site series. • Promote natural regeneration of Fd through retention of adjacent seed sources. • Promote planting of Fd on frost-shedding mesic and drier sites.
3	Red-band needle blights (*Dothistroma septosporum*) on pines on humid sites	Elevated risks of Dothistroma needle blights on pines in humid rich subhygric and hygric sites, and along watercourses given high sensitivity of needle blight risks to warmer, wetter climatic trends (McCulloch and Woods, 2009)	SBSwk1-06, 08, 09, 10	• Emphasize hybrid white spruce (Sx) as preferred species on these site series, with subalpine fir and deciduous tree species as acceptable species for admixtures. • Downgrade lodgepole pine to Acceptable species only on these sites. • Minimize or eliminate future planting of pine on these site series except on degraded sites (roads and landings). Proportion of regenerated pine outside rehabilitation sites will be ≤ 20% in high hazard areas (as per McCulloch & Woods, 2009). • Upgrade black spruce (Sb) to acceptable species on 09 and 10 site series, especially on sites prone to growing-season frosts.
4	Mixed stands and stand - and landscape level diversity	Ensure enhanced / adequate diversity of tree species across the landscape for climate-change adaptation and resilience.	All	• Strategies per this Mgmt Plan: • Landscape-level tree species composition objectives. • Deciduous strategies

13.4 Forest Health Strategies

At the ALRF, forest health management at the landscape- and stand-level will consider natural forest ecosystem dynamics and function, climate change impacts, and the developing health and condition of individual stands and trees on the managed forest landbase.

Prescription and application of forest health strategies will provide opportunities for a wide diversity of operational and experimental approaches, rather than a narrowly-defined set of methods focused on optimizing timber management alone. Forest health strategies will consider and balance:

1. Education and research opportunities for the rigorous testing, comparison, and demonstration of different forest health management methods and approaches.
2. Existing mortality or declines in tree vigor, and relative risk or consequences of loss of adjacent trees or stands, recognizing that not all tree mortality has negative ecological consequences.
3. Potential beneficial as well as detrimental aspects of forest health agents for forest habitat, stand structure, and ecosystem function (e.g., creation of canopy gaps, wildlife trees, and coarse woody debris).
4. Potential for economic salvage of existing or incipient mortality in a cost-effective manner that minimizes impacts to, or conserves other forest resources.

General ALRF strategies for monitoring and management of forest health issues in natural and managed stands are outlined in Table 9.

ALRF forest health management practices will be consistent with the *Forest and Range Practices Act* and the *Forest Planning and Practices Regulation*, as amended from time to time. If the ALRF uses trap trees or pheromones to concentrate insect populations, the ALRF will ensure that the insect brood is destroyed before the insects emerge.

Spruce-beetle Kill of mature spruce trees at the ALRF, summer 2017

Table 9: ALRF management strategies with respect to different forest health and damage agents

Damage Agent	Strategy
Bark Beetles	• Prompt detection • Prompt salvage of infested stems where risk of loss or further infestation would have an unacceptably adverse effect on other forest resources • Retention of non-susceptible crop trees and vigorous pole-sized trees ≤ 40 cm dbh where operationally practical • Thorough ground reconnaissance • Thorough cleanup • Deployment of traps and trap trees as necessary • Adherence to district transportation restrictions
Tomentosus Root Rot	• Identification of disease centres • Encouraging mixed species stands
Spruce Terminal Weevil (*Pissodes strobi*)	• Plant "weevil resistant" rated seedlots for spruce. • Consider establishing spruce in mixed stands or under partial canopy on high hazard sites. • Consider modified strategies for juvenile spacing/brushing of spruce stands to reduce but not eliminate deciduous overstory. • Considerate moderate over-topping or admixtures of conifers with deciduous species for first two decades of rotation.
Stem Rust (*Endocronartium* spp.) [lodgepole pine]	• Plant Pli at high densities ≥ 2,000 sph • Remove infected pine stems during spacing or intermediate cuts. • Avoid pure stands of pine.
Growing Season Frost	• Identify frost-prone sites before and after harvest, for identification of suitable planting species. • Consider deciduous nurse crops (including willow) for frost prone sites. • Pine establishment is to be limited or avoided in low-lying, humid locations (such as near wetlands or creek draws) where Dothistroma / needle blight risk is a moderate to high risk after the age of free-growing, and/or through to rotation age. • Plant frost sensitive species such as Douglas-fir on upland sites and avoid frost-shedding or exposed positions
Rodents	• Regenerate sites promptly • Avoid peak population cycles for stand tending • Regenerate mixed species
Wind Damage	• Consider direction of dominant damaging winds (especially southerly to westerly winds) in design of cutblock and reserve boundaries and partial-cut silvicultural systems. • Maintain existing stable stand edges and stand structures and incorporate into operational management strategies and harvest / retention planning. • Conduct windthrow hazard and risk ratings for operational plans and silvicultural prescriptions • Target conservative harvest removals and opening sizes in partial cuts to minimize damage risk. • Use detailed pre-harvested ecological and soils mapping to avoid implementing partial cuts on areas of poor rooting and / or high wind exposure
Dothistroma Red band needle blight [lodgepole pine] (*Dothistroma septosporum*)	• Plant less susceptible (non-pine) tree species in areas of cold air ponding and high humidity, including sub-hygric or hygric / hydric sites, and areas along watercourses. • Regeneration with a non-pine-leading tree species mix. The proportion of regenerated pine should not exceed 20% in high hazard areas (McCulloch & Woods, 2009).

25-year old lodgepole pine and spruce plantations in the southwest of the ALRF

13.5 Forest-level Tree Species Composition Targets

This management plan sets ecologically-based forest-level tree species targets for biodiversity of second-growth (regenerating) managed forests within the ALRF. These species targets follow the preliminary framework established in MFLNRORD Technical Report #82 (Mah and Astridge, 2014). These MFLNRORD species benchmarks for the SBSwk1 in the Prince George area have been adapted and modified in this plan to reflect the tenure-area-specific climatic, soil, and ecological conditions found within the ALRF, based on local knowledge and management experience (as per Table 10 below).

Table 10: Forest-level Tree Species Composition Targets

*For the ALRF for (a) overall all-tree-species composition in managed stands, and (b) preferred and acceptable "crop-tree" species composition in managed stands. Benchmark values for the SBSwk1 subzone as a whole in the Prince George District (Mah and Astridge, 2014) are provided for reference *.*

Tree Species	Species Code	SBSwk1 Benchmarks* (MFLNRORD Tech Rep 82)	ALRF Target % Range of All Tree Species[a] (in managed regenerating stands)
		% and range	% and range
Hybrid white spruce	Sx	40 – 60%	50 – 60%
Subalpine fir	Bl	10 – 20%	15 – 20%
Aspen / Cottonwood	At/Ac	10 – 15%	10 - 12%
Lodgepole pine	Pl	10 – 20%	8 - 10%
Douglas-fir	Fd	5 – 10%	5 – 7%
Paper birch	Ep	5 – 6%	5 - 8%
Black spruce	Sb	No target	1 – 2%
Western larch	Lw	No target	0 to 1%
Western hemlock	Hw	0 – 5%	1 – 2%
Western redcedar	Cw	0 – 5%	0 to 1%

The forest-level species target (or "benchmark") represents the desired proportion of tree species for managed stands at the landcape level that would maintain or increase tree species diversity in ecosystems, and promote resilient landscapes. The intended use of the benchmark or target is to provide higher-level management direction for forest-level species composition from an ecological perspective within a specific ecological landscape (in this case, the ALRF), for the next 10 to 20 years, with a review about every 5 years against actual tree species proportions for managed stands.

Comparison of actual forest-level tree species composition against the target or desired species composition will allow potential imbalances to be identified, and corrective management measures (if needed) to be implemented. Desired species compositions will be compared against actual species proportions for managed stands in Age Class 1 (< 20 years) at time of regeneration delay / surveys, at time of free growing achievement, and post-free growing (20 years +).

13.6 Regeneration Methods to Achieve ALRF Reforestation Objectives

The ALRF landbase contains 10 native tree species, of which 9 have widespread distribution, within specific site and seral-stage adaptations, and 1 (western redcedar) has localized natural occurrences. Hybrid white spruce and subalpine fir are the dominant naturally-occurring conifers, with Douglas-fir, lodgepole pine, black spruce, and western hemlock also occurring, in order of decreasing abundance. Typical of sub-boreal forest types, paper birch, black cottonwood, and trembling aspen are the three broad-leaved (or "hardwood" species) that naturally occur at the ALRF, often in seral situations. Paper birch is also a recurring minor element of some mature and old-growth stands.

Three other tree species native to British Columbia, but not the ALRF, that have been planted in ALRF research and demonstration trials in the past decade include western larch, tamarack, and western white pine. Western larch and western white pine are native to moister areas of the southern BC Interior, while tamarack does naturally occur in both boreal and sub-boreal BC ecosystems.

Although planting (artificial regeneration) is standard practice after logging at the ALRF, natural regeneration and "seeding in" from surrounding stands adds significantly to the diversity of the regenerating stand

Planting methods

Hybrid white spruce, lodgepole pine, Douglas-fir, and to a lesser extent. subalpine fir, have been the traditionally-preferred merchantable tree species for sawlog-oriented harvesting in ALRF forests. Over the last 3 decades, planting has tended to be been the dominant ALRF regeneration strategy for reforestation. Correspondingly, hybrid white spruce (86%), lodgepole pine (7%), and Douglas-fir (5%) have been the most-planted tree species at the ALRF over the last 14 years (2003-2016), with their proportions being generally reflective of the relative ecological suitability of planting sites for these three species. The remaining 2% of ALRF plantings have been made up of black spruce, western larch, western white pine, and tamarack.

However, understanding of the composition of regenerating stands on previously-havested sites must consider not just planting trends, but also:

a) the contributions of natural and advance regeneration influencing the composition of the regenerating sites. And,

b) the mix of regeneration strategies (including planted, natural, and advance regeneration) that may be prescribed or occur to meet tree species composition goals.

Several different native ALRF species may be regenerated by two or more regeneration strategies. Table 11 provides a summary of recommended ALRF regeneration strategies by tree species for timber-oriented stand management and silvicultural systems.

Natural regeneration methods

In addition to artificial regeneration (planting) methods, all 10 native tree species can naturally regenerate from local seed sources (or in the case of aspen, vegetatively from root suckers as well) on appropriate seedbeds in harvested and disturbed ALRF sites. The preferred regeneration strategy for subalpine fir at the ALRF has historically been, and will continue to be natural and advance regeneration, not planting, due to abundant seed sources and advance regeneration in surrounding stands. Aspen, cottonwood, and birch typically provide considerable natural regeneration establishment on harvested ALRF areas, especially areas with naturally or mechanically disturbed microsites, with more abundant mineral soil exposure.

Advance regeneration methods

Advance regeneration (including seedlings, saplings, or poles) of subalpine fir and spruce that develop or are present in the understory prior to harvest disturbance) can be an important source of regeneration stocking in second-growth stands at the ALRF where suitable harvest practices have been used. This is especially true in partial-cut stands where understory seedlings or saplings have been protected during harvest extraction of individual merchantable trees. For Douglas-fir and black spruce, advance regeneration protection is rare, with much more limited application.

Cumulative regeneration outcomes (all methods)

Although historical plantings of spruce, pine, and Douglas-fir have made up 98% of total trees planted on the ALRF to date, landscape level species composition goals aim for these tree species to make up about 73% of the resultant total stems-per-hectare within the managed forest at a landscape scale. Recommended regeneration strategies for the tree species making up the remaining approx. 27% difference in the tree-species composition for the ALRF will be met by incorporating natural regeneration strategies (for subalpine fir, paper birch, black cottonwood, trembling aspen, black spruce, and western hemlock) and advance regeneration strategies (for subalpine fir and spruce) into ALRF forest practices.

ALRF reforestation practices on the managed forest landbase as a whole will frequently include blended strategies for regeneration of harvested areas, using planted, natural, and advance regeneration (in descending order of priority for implementation), to meet both stand-level reforestation requirements, and landscape-level tree-species composition goals. Regeneration prescriptions and strategies will vary on a site-to-site basis, and individual site plans may also consider site-specific regeneration opportunities in addition to (or complementing) planting, that can contribute significantly to landscape level goals.

For example, mature Douglas-fir leave-tree retention may provide Douglas-fir seed sources for natural regeneration. Likewise, mature or second-growth stands with well-developed thrifty subalpine fir and/or spruce regeneration can provide opportunities for modified harvest procedures for advance regeneration retention, with planting needed only in larger harvest openings or unstocked pockets.

Table 11: Recommended ALRF regeneration strategies by tree species for timber-oriented stand management and silvicultural systems

(Note that tree-species suitability and acceptability will vary by BEC site series and site-specific objectives)

	Occurrence / abundance on ALRF landscape	Current timber management significance	Anticipated future timber management significance	Planted Regeneration	Natural Regeneration	Advance Regeneration and Poles *	Ecologically Suitable for Clearcuts and Patch Cuts > 1 ha?	Ecologically Suitable for Selection, Shelterwood systems, & Openings < 1 ha?
Hybrid white spruce	Yes (H)	High	High	✔	✔	✔	Yes	Yes
Subalpine fir	Yes (H)	High	High		✔	✔	Yes	Yes
Douglas-fir	Yes (M)	Moderate	High	✔	✔	✔	Yes	In openings > 0.25 ha**
Lodgepole pine	Yes (M)	Moderate	Moderate	✔	✔		Yes	No
Aspen / Cottonwood	Yes (M)	Low	Moderate		✔		Yes	No
Black spruce	Yes (M)	Low	Moderate	✔	✔	✔	Yes	Yes
Paper birch	Yes (M)	Low	Moderate		✔		Yes	In openings > 0.25 ha**
Western hemlock	Yes (M)	Low	Low		✔		Yes	Yes
Western redcedar	Yes (L)	Nil	Unknown	✔***	✔		No***	Yes***
Western larch	Planting trials	Nil	Low	✔***			Yes***	No
Tamarack (*Larix laricina*)	Planting trials	Nil	Unknown	✔***			Yes***	No

* Subject to stem damage acceptability criteria.

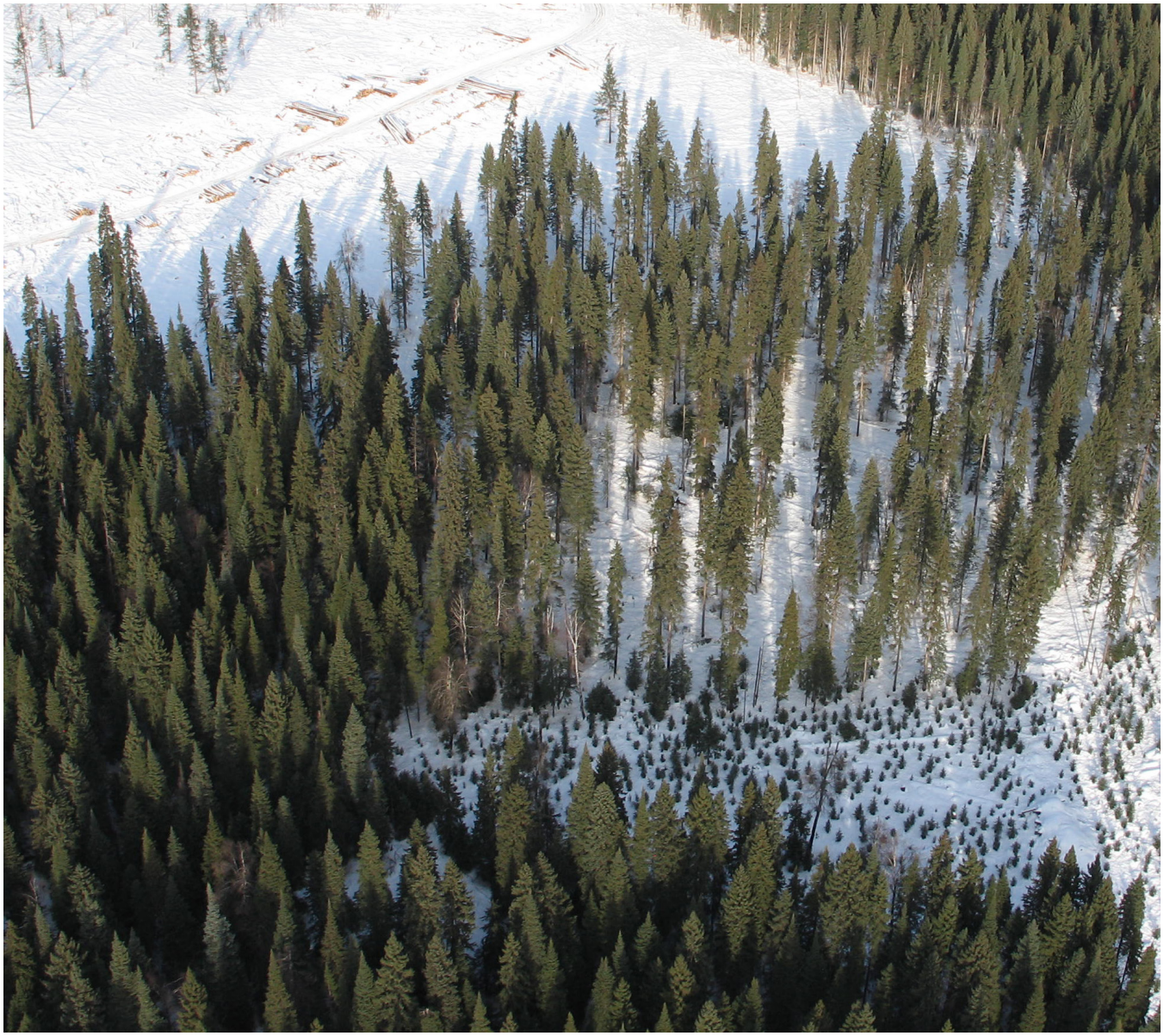
** Partial shade tolerance. Warmer brighter locations in openings and frost-shedding sites preferred for better performance.

*** Generally, currently in localized ALRF research trials only, due to current seed transfer limitations for the SBSwk1 subzone.

H = Species is frequently to highly abundant on many to most ALRF sites.

M = Species is of medium abundance on suitable sites.

L = Species is of low to scattered occurrence across ALRF sites.



Aerial view south of the West Branch Road at the ALRF, illustrating a variety of silvicultural systems, including clearcut (upper photo), uniform shelterwood (centre of photo), and group / strip selection (lower photo)

13.7 Silvicultural systems

Consistent with the educational and research mandate of the Aleza Lake Research Forest, ALRF silvicultural management will provide opportunities for:

1. A wide spectrum of examples of silvicultural systems and post-harvest levels of structural retention at the ALRF, to provide teaching and demonstration, to meet a range of ALRF land-use objectives, and to provide comparisons and information for research and educational purposes. And,
2. Incorporation of innovative and unconventional stand management techniques into routine year-to-year forest land management at the ALRF.

Single-tree selection-cut stand at ALRF in 2018, 23 years after a partial-cut stand entry to remove spruce-beetle-attacked trees.

Silvicultural systems that have been historically used at the ALRF generally include clearcut and patch cut systems, group (or strip) selection, irregular single-tree selection, uniform (and irregular) shelterwoods.

General considerations for, and definitions of ALRF silvicultural systems for the purposes of this management plan are summarized in Table 12 and 13.

The ALRF guidance matrix for reporting retention openings and partial-cut silvicultural systems into the RESULTS provincial silviculture reporting system is summarized in Appendix D.

Site-specific considerations for applying different silvicultural systems

In general, ALRF silvicultural systems prescribed for a given stand, site, and management situation will be the best or most feasible combination of harvest and silvicultural treatments to meet all of the following basic goals:

1. Consistency with the goals and objectives of the management unit or land-use zoning.
2. Site-specific research, demonstration, and/or educational goals.
3. Consistency with the ecology and silvics of the desired tree species and stand structure, including regeneration ecology.
4. Efficient use of growing space, timber growing stock, and site productivity, in the context of specific land use goals.
5. Minimizing damage from biotic and abiotic damage agents, including wind, insects, pathogens, and logging damage / stem decays and defect.
6. Logging equipment, treatment feasibility, and economics, both in current and future cutting cycles. And
7. Efficient spatial arrangement and organization of forest operations.

Various site and stand factors, and land-use objectives must be evaluated when considering the options for, and final choice of silvicultural systems for a particular area. Table 12 provides a summary of different site and stand factors common to the ALRF landbase that may influence the choice of partial-cut vs clearcut systems:

Table 12: Factors influencing choice of silvicultural systems and/or harvest patterns at the ALRF.

This table is designed as a general reference guide for management, and is not a comprehensive decision key.

Type of factor	Favorable for partial-cut silvicultural systems	Consider clearcut or similar even-aged systems
Stand structure and tree vigor	• Greater proportion of vigorous and healthy ("thrifty") trees vs poorer quality or declining trees. And/or • Well-developed thrifty advance regeneration layer. Or • Well-developed cohort of target leave trees	• Unfavorable stand structures or tree pathology, or advanced stand age, with much higher proportion of low-vigor, declining, or poor-quality trees (such as at stand "breakup"). And/or • Heavy damage or mortality to the majority of stems (or basal area) in the stand.
Natural disturbance characteristics	Stand - or habitat management objectives that include smaller-gap regeneration, retention of mature stand characteristics, or creation of multi-layered or - aged stand structures (e.g. - gap / patch dynamics).	Stand or habitat management objectives that include emulation of larger-scale natural disturbance characteristics (e.g. large patch sizes) and extensive even-aged stand management (e.g. - fire).
Soil drainage and texture	Moderately- to well-drained soils with (for example) > 40 cm rooting depth and lower windthrow hazard.	Relatively poorly-drained soils (e.g. heavy clay soils) with < 30 cm rooting depth and moderate to high windthrow hazard.
Past stand wind damage history or clear future wind damage potential	Stands or soils with apparently relatively little evidence of historic stand-damaging wind events.	Sites with widespread shallow tree rooting, extensive butt- or root-rots, and high wind-snap or windthrow potential (e.g. - pit-and-mound micro-topography).
Regeneration (if applicable)	Desired tree species for regeneration are ecologically suited to shaded /overstory conditions.	Desired tree species for regeneration are ecologically suited to open conditions.
Terrain and potential timber access routes	Terrain and good access routes and/or treatment-unit boundaries that facilitate efficient removal and adjacent decking of trees to be harvested, while minimizing logging damage or future wind damage to the residual stand.	Terrain and potential access routes and/or treatment unit boundaries that: • are severely constrained to difficult physical boundaries, • prevent efficient removal of trees to be harvested. And/or • Incur high risk of harvesting or wind damage to residual stand.
Ecological stratification and treatment unit size	Site has clearly-defined and consistent ecological strata (including soil types and site series), to form effective operational unit.	Highly variable ecological strata (including soil types and site series), and poor site continuity and area for effective operational standards units.
Relative ease of access for teaching and demonstration	Sites of favorable existing or future road access, or visibility, and which provide above-average opportunities and access for education and demonstration.	More remote sites limited by access and/or terrain, which few opportunities and access for effective education and demonstration.

Table 13: Guiding definitions for ALRF silvicultural systems

These definitions are provided to clearly categorize ALRF silvicultural systems based on current or potential practices at the Research Forest, and are not intended for prescriptive purposes.

Stand Structural Objective	Spatial arrangement of harvest and regeneration within stand	Spatial and temporal pattern of Leave-tree or Patch Retention	Applicable Silvicultural System
Even-aged	Clear-felled large openings, > 3 ha.	Low or no long-term retention of unharvested areas. Dominantly open conditions.	Clearcut (may include deciduous-coniferous "mixedwoods"), or, Clearcut with reserves (low retention)
	Uniform removal of most or all mature overstory, with retention of advance regeneration of adequate stocking, quantity, and suitability as crop trees.	Retention of adequate stocking and quality of advance regeneration for timber crop trees.	Natural shelterwood
Even-aged with reserves	Clear-felled large openings, generally > 3 ha.	Less than 50% of cutblock is within 60 metres (i.e. - approx 2 tree heights) from either a harvest boundary or edge of a long-term retention patch.	Clearcut with reserves
		Greater than 50% of cutblock is within 60 metres (i.e., approx 2 tree heights) from either a harvest boundary or edge of a long-term retention patch.	Variable Retention
Generally Even-aged to Two-aged	Clear-felling of small openings generally > 0.5 ha but < 3 ha. A maximum of 40% of the stand will be harvested over the whole stand prior to 3 m green-up of these harvested openings.	No point within the harvested area is > 60 metres (i.e. - approx 2 tree heights) from either a harvest boundary or edge of a long-term retention patch (or WTP).	Patch cut
	Clear-felled small or large groups with retention of seed trees (e.g. Douglas-fir or paper birch) with adequate seedbed for natural regeneration.	Dispersed mature live seed trees for crop tree regeneration objectives (plus reserves).	Seed tree
Two-aged	Dispersed partial harvest that retains > 40% of pre-harvest basal area, and creates adequate seedbed, to promote natural regeneration, under well distributed healthy mature overstory.	One or more stand entries for harvest of mature overstory within +/- 25 years of initial stand entry.	Uniform shelterwood (Seed Cut) Uniform shelterwood (Regeneration Cut)
		Long-term retention of mature overstory for > 25 years after initial stand entry, up to one rotation (80 years) or more.	Irregular shelterwood
		One or more stand entries for harvest of mature overstory within +/- 25 years of initial stand entry.	Group shelterwood
Unevenaged (Multi-aged)	Small groups, generally < 0.5 ha. (up to 1 ha.), removing < 40% of stand by area per +/- 25-40 yr cutting cycle.	Selection systems can be applied with or without reserves.	Group selection Strip selection
	Dispersed, uniform harvest and regeneration pattern, removing < 40% of stand basal area per +/- 25-40 yr cutting cycle.	Selection systems can be applied with or without reserves.	Single-tree selection

Heavier establishment of aspen, birch, and black cottonwood resulting from heavier soil disturbance in early 1980's logging at the ALRF. Conifer release treatments between 2008 and 2012 reduced deciduous competition in this area to more moderate levels.

13.8 Strategies for Management of Competing Vegetation

The ALRF has legal obligations under its tenure to adequately reforest areas within the ALRF that are denuded by forest harvesting, and these legal obligations include reforestation to required standards that incorporate criteria such preferred and acceptable tree species, required densities, and health criteria to be attained.

The ALRF will promote reforestation management strategies that are proactive and preventative in terms of anticipating vegetation management issues. To improve the likelihood of successful reforestation outcomes, the ALRF will ensure that harvested areas are planted within 18 months after harvesting, and are planted or otherwise regenerated with healthy, robust, and vigorous

stock of trees ecologically adapted to the planting site to Chief Forester standards. Standards and practices for regenerating stands at the ALRF will incorporate and accept biodiversity elements like deciduous tree species, and post-harvest mature leave trees. The ALRF will monitor and survey the progress of its regenerating stands in a timely manner.

Despite best efforts and practices, from time to time, the ALRF will need to address excessive "competing" non-crop-tree vegetation within areas to be reforested, including native brush species that unduly negatively affect the survival and growth of crop trees, and substantially constrain the likelihood of a sufficient density of crop trees in the area achieving a free growing stand.

For the purpose and context of this management plan, "vegetation management" refers to the cutting, girdling, removal, or other treatment (such as by registered permitted chemical herbicides) of specific competing vegetation species in the vicinity of crop trees within an area to be reforested. To be effective, this treatment must be in a manner sufficient to reduce competing vegetation, enhance crop tree survival and growth, and achieve reforestation objectives in a timely way.

The guiding principles of ALRF vegetation management are to choose and implement appropriate vegetation control strategies that:

1. Are biologically effective at targeting and reducing specific non-crop vegetation competition to crop trees, while minimizing the impact of vegetation management in plantations to non-target vegetation, high value browse species for wildlife, or other forest resource values,
2. In general, include monitoring and assessment of identified areas (strata) of impeded trees first for at least one year, then, prescribe vegetation management treatments only if needed as demonstrated by monitoring. And,
3. Minimize the use of chemical herbicides (including but not limited to glyphosate) to the following general situations and conditions: (a) specifically targeted localized areas of high-risk vegetation complexes that also clearly demonstrate impeded seedling growth within an area being reforested, as above, (b) research purposes, and/or (c) demonstration trials.

Overall ALRF silvicultural treatment history and performance over the 15-year period from 2003 to 2017 indicate that herbicides (i.e. - glyphosate) have been used for control of competing vegetation on an average of 6 % of the net area to be reforested (or NAR). The rate over the last 10 years (2008-2017) has been 3.0 to 3.5% of NAR. All applications to date have been backpack herbicide applications. Average size of herbicide application area has historically averaged 5 to 6 hectares, and range from 1 to 10 hectares.

Specified results and strategies for vegetation management at the ALRF are summarized in Table 14.

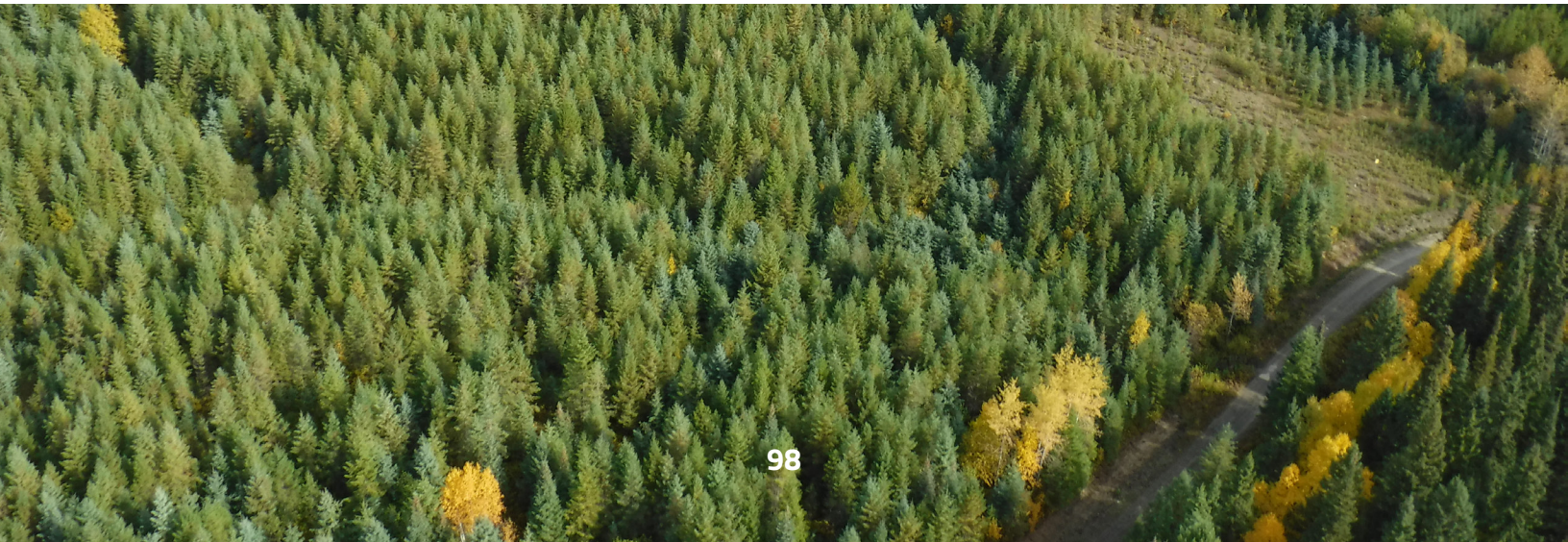


Table 14: ALRF vegetation management strategies for different complexes of competing vegetation commonly occurring in the SBSwk1 subzone.

Competing vegetation	Treatment strategy	Conditions / qualifications
Willow (*Salix* spp.) Alder (*Alnus* spp.)	Manual cutting (brush saw)	Willow sprouting from cut stumps is highly desirable for moose browse.
Trembling aspen (*Populus tremloides*) Black cottonwood (*Populus trichocarpa*)	• Manual cutting * (brush or chainsaw) • Girdling (stems > 15 cm dbh)*	* Only where removal is consistent with Site Plan, stocking standards, and ALRF landscape-level tree species objectives. Limit tree removal to stems directly impeding crop trees.
Paper birch (*Betula papyrifera*)	Avoid treatment if not directly impeding achievement of required minimum stocking standards. Manually brush if necessary.	High value moose browse species and potential significance for birch bark uses.
Thimbleberry (*Rubus parviflorus*) and/or Raspberry (*Rubus idaeus*) and/or Twinberry (*Lonicera involucrata*)	Foliar-spraying backpack herbicide* (glyphosphate or other approved herbicide) within identified high-competition / impeded plantations.	Applications must be consistent with the provincial *Integrated Pest Management Act* as amended from time to time, and other statutory requirements.

13.9 Rotation Length

Rotation lengths for even-aged stands and species will vary from stand to stand depending on tree species or mixes, site productivity (site index), stand management objectives, desired forest product objectives, and stand density managements regime.

However, for general guidance and timber-supply project purpose, median, minimum, and maximum rotation lengths for different tree species are indicated in this plan in Table 15 below:

Table 15: General rotation lengths for different tree species at the ALRF

Leading species	Rotation Length (minimum harvest age*)	Rotation Length (median range)	Rotation Length (late)
	Years	Years	Years
Hybrid white spruce	60	70 to 90	120
Subalpine fir	60	70 to 90	100
Lodgepole pine	40	50 to 70	80
Douglas-fir	80	80 to 100	120
Deciduous species (birch, aspen, cottonwood)	40	50 to 70	80

* Commercial thinning and intermediate (partial) cuts excepted

13.10 Reforestation Standards

Preamble

Stocking standards define the legal requirements and obligation of the tenure holder for reforestation following the harvest of a forest stand. These standards are a required element of this ALRF Management Plan.

For reforestation in British Columbia under the *Forest and Range Practices Act* and its regulations, "stocking standards" are the tree stocking requirements that apply when (a) establishing a free growing stand in general (after clearcut harvesting or similar methods), or (b) meeting the requirements for tree retention and regeneration after partial harvest methods including commercial thinning, partial cut silvicultural systems, intermediate cuts, and partial harvesting for special forest products.

As per the Act and its regulations, stocking standards mandate the achievement one or both of the following requirements on harvested areas, depending on the silvicultural system used:

1. Regeneration requirements for each defined ecological site type, including identified ecologically suitable tree species, stand density (target number and minimum number per hectare), minimum inter-tree distance, free growing height, and height to brush (competition) ratio. And/or,
2. For partial-cut and retention systems, requirements for retention of remaining (or "residual") post-harvest overstory trees left for future crop trees and structural biodiversity / wildlife habitat. Specified requirements include a description of residual live leave-tree density (either stems-per-hectare or basal area), identified ecologically suitable species for leave trees, and descriptive physical criteria (i.e. – the "characteristics, quantity and distribution of retained trees of a species") for appropriate leave trees.

Stocking standards also describe the specific situations and circumstances under which a standard will be applied.

The Forest Planning and Practices Regulation (as amended from time to time) provides the legal basis for the Province to consider and/or approve stocking standards based on the following criteria:

a) Factors relating to stocking specifications, as defined by the Province.
b) Whether the proposed stocking standards will result in harvest areas being successfully regenerated with ecologically suitable species adapted to site conditions, forest health factors, and current and future climates on the area.
c) Whether the free growing criteria are suitable to reliably demonstrate that trees of a given species adapted to the site, are growing well and can reasonably be expected to continue to do so in the future. And,
d) Whether regenerated stands will be reforested to a suitable density or basal area that will maintain or enhance an economically valuable supply of commercial timber from the area in future, and in a manner consistent with the timber supply analysis and forest management assumptions that apply to the area covered by the plan.

Linkage of ALRF Reforestation Standards and Reporting of Provincial Silviculture Obligations

Under Special Use Permit 23615, the ALRF Society as tenure holder reports on its land management activities, including reforestation, to the District Manager in a manner acceptable to the Province. The form of this reporting is not specifically defined in the Permit.

To facilitate consistent reporting and tracking of forest harvesting and related ALRF reforestation obligations, and related updates to the Provincial forest inventory, the ALRF as tenure holder commits to ensuring the timely electronic submission

Commercial thinning of 30- to 45-year-old second-growth spruce stands at the ALRF will increase in potential in coming years, due to regional mid-term timber supply constraints (Example of treatment from West Fraser Ltd.'s tree farm license area south of Hixon, BC).

of reforestation obligations in the Provincial silvicultural database (currently known as RESULTS or the *"Reporting Silviculture Updates and Land Status Tracking System"*) as amended from time to time. This system is also linked to tracking of forest harvest areas in the provincial Forest Tenures Administration System (or FTAS).

It is recognized in this Plan that provincial silviculture reporting specifications require consistency in data submission requirements to maintain the integrity and quality of provincial silviculture data. It is also recognized that both stocking standards and related provincial reporting requirements may evolve over time, based on changing forest management goals and legal requirements of the Province.

This Plan includes ALRF stocking standards that have foundations in regional knowledge from past Ministry guidance documents, are guided by provincial and standards and legal requirements, and also incorporate by new scientific information and local professional experience and knowledge of ALRF ecosystems, including adaptation to climate change.

Finally, this ALRF Management Plan presents these ALRF standards in well-established stocking-standard formats and terminology intended to aid in the clear integration of ALRF standards into provincial silviculture survey protocols, and silvicultural reporting systems such as the Province's RESULTS database.

13.10.1 Stocking Standards For clearcut and patch cut silvicultural systems

ALRF even-aged stocking standards (Table 16) are applicable to clearcut or patch cut harvest openings. These are defined in this Plan as openings that are > 1 hectare in size and greater than 3 mature tree heights wide, and have less than or equal to 6 square metres per hectare of retained leave-tree basal area of live trees.

For the purposes of silviculture surveys and provincial silviculture reporting in RESULTS, please refer to Appendix D for greater detail on criteria distinguishing such clearcut and light-retention openings and silvicultural management regimes from Retention Openings and partial-cut silvicultural systems,

Table 16: ALRF Even-aged Regeneration Standards for Tree Species Selection, Stocking, and Free Growing Status.

BGC Classification (SBSwk1)		Regeneration Tree Species				Stocking (i) Well spaced / ha.					Max Regen Delay (years)	Free Growing Assessment	Free Growing Assessment
Site Series	Site Series Name	PRIMARY	Preferred (P)	Acceptable Conifers (Acon)	Acceptable Broadleaf Species (Adec)	Target	MIN P+A	MIN P	MAX Adec Broad-leave Stems	MINI Inter-tree Dist. (m)		Earliest	Latest (years)
1	Sxw - Oak Fern	Fd_{32} Pl Sx	Fd_{32} Pl Sx	$Bl_{29,32}$	At_a Ep_a	1400	700	600	300	1.6	4	9	15
2	Pl - Huckleberry – Cladina	Fd Pl	Fd Pl	Sx		1000	500	400	0	1.6	7	12	15
3	Pl - Huckleberry - Velvet leaved Blueberry	Fd Pl	Fd Pl	Sx_{28}	At_b	1000	700	600	200	1.6	7	12	15
4	SxwFd - Knight Plume	Fd Pl	Fd Pl	Sx_{28}	At_b	1000	700	600	200	1.6	7	12	15
5	Sxw - Huckleberry - Highbush Cranberry	Fd Sx	Fd Sx Pl	Pl	At_a Ep_a	1200	700	600	300	1.6	7	9	15
6	Sx - Pink Spirea - Oak Fern	Sx_{32}	Sx_{32}	Sb, Pl, $Bl_{29,32}$	At_a Ep_a	1000	700	600	300	1.0	4	9	15
7	Sxw - Twinberry - Oak Fern	Sx_{32}	Sx_{32} (Pl)	$Fd_{9,32}$ $Bl_{29,32}$ Pl	Act_b At_a Ep_a	1400	700	600	300	1.6	4	9	15
8	Sxw - Devil's Club	Sx	Sx	Pl Bl_{29} $Fd_{3,9,53}$	Act_b At_a Ep_a	1400	700	600	300	1.6	4	9	15
9	Sxw -Horsetail	$Sx_{1,32}$ Pl_1	$Sx_{1,32}$ Pl_1	Sb, $Bl_{29,32}$	At_b Ep_a	1000	500	400	200	1.0	4	9	15
10	Sxw - Devil's Club - Lady Fern	$Sx_{1,32}$	$Sx_{1,32}$	Sb $Bl_{29,32}$	Act_a, At_a, Ep_a	1000	500	400	200	1.0	4	9	15
11*	SbSxw - Scrub birch – Sedge	Pl_1 Sb $Sx_{1,32}$	Pl_1 Sb $Sx_{1,32}$	Bl		400	200	200	0	1.0	4	12	15
12	SbPl – Feathermoss	Pl	Pl, Sb	Sx_{32}		1200	700	600	0	1.6	7	12	15

Conifer Tree Species Codes for Table 16

Act – Black Cottonwood	Fd – Douglas-fir
At – Trembling Aspen	Hw – Western hemlock
Bl – Subalpine fir	Pl – Lodgepole pine
Cw – Western redcedar	Sx – Hybrid white spruce or interior spruce
Ep – Paper birch	
Sb – Black spruce	

Cautionary and Restrictive Codes for Table 16

1	elevated microsites are preferred	29	risk of heavy browsing by moose
3	restricted to sandy or coarse-textured soils	32	limited by growing-season frosts
9	restricted to crest, southerly, or westerly slopes	53	minor component
12	suitable on cold air drainage sites	a	productive, reliable, and feasible regeneration option
23	restricted to trial use	b	limited in productivity, reliability and/or feasibility
28	limited by moisture deficit		

13.10.2 Acceptability and Management of Deciduous (Broadleaf) Tree Species

Deciduous or "broadleaf" tree species are explicitly incorporated into ALRF stocking standards to specified limits on identified BEC site types (as per Table 16 of this Plan), in a manner consistent with prior provincial Chief Forester direction (Sheldan and Snetsinger, 2008) and other provincial science-based guidance and recommendations (Harper and Roach, 2014).

Mixed coniferous-deciduous 30-year old ALRF stand resulting from spruce planting, and natural regeneration of deciduous trees, and 2012 selective brushing of willows and deciduous trees.

While recognizing that current ALRF timber management objectives and market opportunities for stand management are still – at time of plan preparation – dominantly oriented towards coniferous species, broad-leaf tree species are important to incorporate into ALRF stocking standards as a recognized secondary component of managed stands, for the following reasons:

1. Maintenance and enhancement of broadleaf tree species (including paper birch, trembling aspen, and black cottonwood) on the ALRF landscape are important landscape-level and stand-level goals in this Plan.
2. Broadleaf tree species may contribute to the diversity, productivity, and value of future timber species in the ALRF and the region.
3. Broadleaf trees in ALRF ecosystems are naturally abundant, especially on disturbed sites, and are ecologically important in a variety of soil and successional processes including nutrient cycling, and for the maintenance of species diversity and structural / habitat biodiversity in managed stands.
4. Maintaining broadleaf tree species in managed stands is one stand-level strategy contributing to reducing catastrophic fire risk in the ALRF landscape. And
5. The diversity of tree species in managed stands, especially including broadleaf trees as well as conifers, may provide additional ecological resilience in the face of future climate change and forest health factors.

Management Intent and Constraints for Broadleaf Trees within Stocking Standards

As per the even-aged stocking standards in Table 16, broadleaf tree species are considered "Acceptable" as crop trees to specified densities on several ecological site types within the ALRF, and are considered to be especially productive on moist, well-drained rich sites. At this time, no broadleaf species are listed as Preferred species for regeneration, due to limitations in commercial market acceptability.

Where broadleaf trees of suitable species are acceptable on a given ALRF site type, the density of Acceptable" broad-leaf trees is currently limited to 200 or 300 sph depending on the site type. **In general, the intent of these current stocking standards is that broadleaf trees at the ALRF are limited to:**

a) Acceptable trees only (not Preferred).
b) For silviculture reporting, to be acceptable only in the absence of preferred or acceptable conifer species,
c) No greater than 25% of all Preferred + Acceptable trees in aggregate, on average, across a Standards Unit.

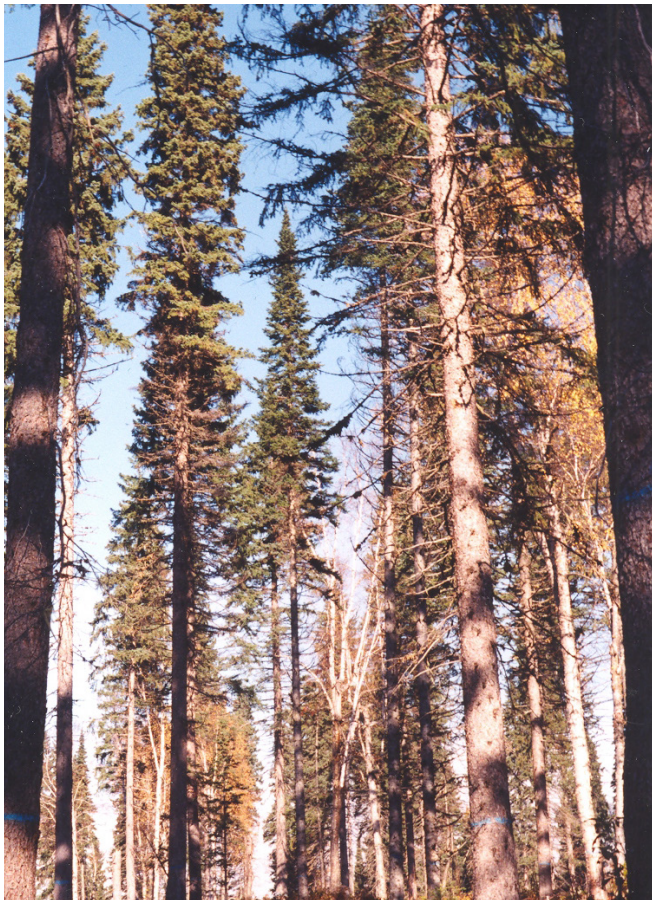
Silviculture Surveys and Assessment of Interactions between Coniferous and Broadleaf Crop Trees

For silvicultural surveys, and the Free Growing milestone declaration in particular, the Quadrant Method (as per Appendix 9 of the Establishment to Free Growing Guidebook, Prince George Forest Region, Ver. 2.3, 2000, and revised 2007) will be used to determine whether a coniferous crop tree in the immediate vicinity of competing vegetation or broadleaf trees, is potentially Free Growing. Note that any individual broadleaf tree designated as an acceptable well-spaced tree cannot also be a a competing tree.

Management of Broadleaf Tree Density within Mixed Conifer-Broadleaf Stands

Treatments for control of broadleaf tree density (such as motor-manual cutting or girdling) within managed stands over and above broadleaf densities permitted in the ALRF stocking standards will be limited to:

- For general forest operations: Removal of only a suitable amount or distribution of broadleaf trees in a stand, sufficient to attain Free Growing status for a Silvicultural Opening or Standards Unit, while maintaining as many broadleaf trees in the stand as within these requirements, for other objectives.
- Exemption for research and demonstration trials: Broadleaf retention and/or removal as required to meet relevant research and educational objectives.



Uniform shelterwood silvicultural system, 3 years after initial stand entry. Location: East Branch Road, ALRF

13.10.3 Stocking Standards for Partial-Cut and Retention Silvicultural Systems

Overview

The following standards have adapted and integrated elements from the Partial Cutting Stocking Standards for the Quesnel Forest District (BC Forest Service, 2007), the Rocky Mountain Forest District (BC Forest Service, 2010), and the provincial Silviculture Surveys Procedures Manual (MFLNRORD Resources Practices Branch, 2016). In addition, the stocking standards for partial-cut and retention silvicultural systems presented here incorporate past ALRF management experience with a harvesting and regeneration within a range of clearcut and partial-cut systems, and local knowledge of ALRF stand types, silvicultural histories, and soils.

Key ALRF management principles guiding these silvicultural systems and related standards are:

1. To achieve stand stocking levels and growth rates that will promote optimal timber production and quality.
2. To manage for stand-level biodiversity. And,
3. To create and maintain appropriate stand structures for site-specific management objectives.

Of special note for the ALRF are subalpine fir ("balsam") management strategies within ALRF partial cut or retention systems. The will take into account opportunities for subalpine fir regeneration in mixed-species stands, the high wildlife value for subalpine fir as a browse species for large ungulates including moose, timber objectives, and the generally shorter pathological rotation and sensitivity to stem damage of this species relative to spruce.

Application of ALRF Partial Cut Stocking Standards Preface

Silvicultural survey and field assessments will follow general standards and protocols as defined in the provincial Silvicultural Survey Procedures Manual. For ALRF managed stands with complex or variable stand structures, the choice of Complex Vertical Structure Survey Methodologies (detailed in the manual) to be used on any given stand and site will be specified in this management plan or in a site-specific Site Plan.

However, it is recognized that the ALRF's research and education mandate, history of a range of silvicultural systems and long-term monitoring thereof, and prevalence of different silvicultural approaches on this landbase means that the ALRF as tenure-holder will also pioneer or pilot innovative approaches to stocking standards. Therefore, ALRF stocking standards can and will evolve and improve during the term of this plan.

As such, the following stocking standards are to be considered as default standards only, unless otherwise specified in professionally-prepared Site Plans. Site-specific variances from the default standards are permitted as a matter of due course, as per professionally-prepared Site Plans with accompanying written rationales for such variances.

For greater detail on ALRF silviculture survey procedures:

- **a)** Retained leave trees are assumed to contribute to retention basal area when live, not dead.
- **b)** Dead trees are assumed to have no competitive or inhibitory effect on tree regeneration.
- **c)** Basal area is defined as the cumulative cross sectional area, represented in m^2, of the live trees, that are greater than or equal to 12.5 centimeters in diameter, measured at breast height. Basal area must be collected by species where the silviculture plan or prescription specifies basal area by species and by diameter class.
- **d)** Mappable clumps of retained leave trees > 0.25 ha and averaging > 20 m^2/ha of live trees within larger openings will be stratified out and treated separately from the surrounding more open stratum. Qualified silviculture surveyors and forest professionals may map out (stratify) retained-tree clumps of > 6 and < 20 m^2/ha at their discretion.
- **e)** To be acceptable as a crop tree for future timber production, leave trees must be consistent with attributes described in Table 4 of the Tree Wounding and Decay Guidebook (Ministry of Forests, 1997).

A. Stands with Light (< 6 m^2) Dispersed Basal Area Retention

Even-aged stocking standards (Table 16) and standard even-aged silvicultural survey methodologies (as per the Silviculture Surveys Procedures Manual) will apply to stands or mappable harvest openings > 0.25 hectares with an average basal area retention of dispersed leave trees that is less than 6 m^2/ha. For greater clarity, this standard will apply to clearcuts, patch cuts, and group selection systems where harvest openings are larger than 0.25 ha.

B. Moderate-Retention Partial Cut Stands (> 6 and < 20 m^2/ha Dispersed Basal Area Retention)

Even-aged stocking standards (Table 16) and Layered Survey methodologies (as per the Silviculture Surveys Procedures Manual) will apply to stands with an average basal area retention of dispersed leave trees that is between 6 and 20 m^2/ha.

Stocking decisions and appropriate standards for these types of partial-cuts will assume management objectives focused towards the production of sawlog timber, except in areas identified in ALRF Site Plans and strategic plans recognizing the management of non-timber values.

The timing of silvicultural survey and stocking assessments in residual stands that include prescribed retention of advance regeneration, pole-size trees, and larger trees, must be no earlier than 4 years following the harvest stand entry, in order to take into account:

1. Tree release and rates of growth.
2. Potential for mechanical damage to trees during harvest, post-release 'shock' or 'sunscald of regeneration, and/or wind or snow/ice damage or post-harvest sunscald). And
3. Planted and natural supplemental regeneration strategies establishment, and growth rates.

C. Higher-Retention Partial-cut Stands with > 20m² Dispersed Basal Area Retention

Partial Cuts in Even-aged to Two-aged Stands:
Survey methodologies for Intermediate Cuts and Commercial Thinning (as per the Silviculture Surveys Procedures Manual) will apply to even-aged to two-aged stands with an average basal area retention of dispersed leave trees that is 20 m²/ha or greater.

Partial Cuts for Unevenaged Management (single-tree selection systems):
For managed uneven-aged stands managed under single-tree selection with average basal area retention of dispersed leave trees that is 20 m²/ha or greater, silviculture survey procedures will be specified and included in professionally-prepared Site Plans with accompanying written rationales. For greater clarity, provincial standards will not apply to ALRF stands managed under single-tree selection, due to the lack of suitable provincial stocking standards for unevenaged management of spruce-subalpine fir forest types.

The timing of silvicultural survey and stocking assessments in such residual stands at the ALRF, which include retention of advance regeneration, pole-size trees, and larger trees must be no earlier than 4 years following the harvest stand entry, in order to take into account:

1) Potential for mechanical damage or stress to trees during or after harvest, and/or
2) Wind damage.

As per standard stratification requirements, contiguous mappable areas of areas of less than this basal area retention that are greater than 0.25 hectare will be identified, surveyed, and managed as a separate stratum or to even-aged stocking standards.

General Site Planning Provisions:
While stands with an average basal area retention of greater than 20m²/ha are managed as a class of stands distinct from Low and Moderate Retention stand types, the 20m²/ha basal area classification limit is not considered a preferred or optimum level for ALRF stands.

Rather, the qualified professional determination of an appropriate basal area retention level for a given stand and site (including potentially, prescribed variation in the spatial distribution of leave trees and canopy gaps for regeneration) will depend on site-specific factors and constraints, timber management objectives, measures to minimize windthrow (including consideration of soil and stand factors), forest health objectives, and the anticipated future silvicultural regime for the stand.

Site Plans for higher-retention partial-cut harvests will include, but are not limited to the following stand information:

1. Pre-harvest and prescribed post-harvest basal area (m²/ha.).
2. Target post-harvest stand structure (stems per hectare per diameter class).
3. Target post-harvest species composition (by basal area).
4. Prescribed stocking of suitable regeneration (by stems per hectare). And,
5. The anticipated cutting cycle or stand re-entry period.

ALRF single-tree selection cut, harvested 1995, 40% volume removal